

Ian J. McColm

Dictionary of Ceramic Science and Engineering

Third Edition

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 Springer

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*To Thomas, Lara, Joseph, Ewan and Aidan
who are following the family tradition as wordsmiths*

Preface

The collection of words and terms for a science as large as ceramics and its related technology, industry and applications has been an on-going large task. When Head of the Department of Industrial Technology, more than 15 years ago, I became aware of the exponentially growing vocabulary needed by the students to understand and answer the examination questions passing across my desk at times throughout the year. This was particularly true for the burgeoning science of advanced ceramics and composites, magnetic, electrical and electronic ceramics and the new areas involving nanomaterials. A determined search of the sources these students were asked to consider involved many more text books, journals and information technology outlets than the large number involved in the second edition of this Dictionary.

The pace of change has been amazing with, for example, the discovery of all the new allotropes of carbon and their suggested applications as well as their actual applications. The methods of forming, shaping and consolidating ceramics expand all the time, and the science and use of composites containing ceramics has accelerated. Science has continued to precipitate ceramics into new areas of application as well as give explanations through concepts, such as **plasmons**, to the fascinating art of ceramics throughout millennia as exemplified by the **Lycurgus cup**. This is an example of the use made of bold text in this edition.

It has been an enormous effort to bring information from so many sources to a single collection. There is more science and a wider range of definitions in this greatly expanded text which the student communities I tried them out on found useful and many said “sped them on their way to a faster understanding”.

The proven basis of the first two editions has been retained but a greater emphasis has now been given to guiding the reader to related information by emboldening words and concepts in the text that have their own entries. Double entries occur when a series of adjectives are used attached to the same word or concept and there has been a gathering together of items scattered throughout the text, such as equations. The wide use of acronyms and abbreviations has continued to grow and an effort has been made to keep pace in this edition. Further progress has been made to consolidate SI units, but some of the “beloved” older systems continue through many of the Appendix Tables and in definitions in the text.

The text has become somewhat more hybrid between straight dictionary and science encyclopaedia as trial users asked more about the range of sciences and techniques encompassed by ceramics. Striking a balance has been as hard as many ceramics are. I earnestly hope that this edition continues in the development of the ideals and concepts of the first edition and that this will be used as a first port of call by those puzzled by some of what they read or are just curious or perhaps crossword addicts.

I have learned so much doing the work and preparing the manuscript that it has enriched me greatly notwithstanding what may be forthcoming.

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Aa

A. *Symbol.* Stands for: (1) old chemical symbol for argon but superseded by Ar; (2) the symbol in **cement notation** for Al_2O_3 .

Å. *Symbol.* Used for **angstrom unit** this is a convenient size for discussing crystal structure and lattices. $1 \text{ Å} = 10^{-8} \text{ m}$.

@. *Symbol.* Used to indicate that a metal is incorporated into a **fullerene** cage e.g. Mn@C_{60} .

aa. *Noun.* A volcanic rock found in angular blocks with a very rough surface formed from molten lava.

abacus. *Noun.* The flat upper part of the capital of a column.

abampere. *Noun.* The **cgs unit** of current; equivalent to 10 A. It is the constant current that, when flowing through two parallel straight infinitely long conductors 1 cm apart, will produce a force between them of 2 dyn cm^{-1} .

Abbé value. v. *Noun.* A number designating the dispersion of light waves by an optical glass, expressed as the reciprocal dispersive power of the glass by the equation $v = (n_D - 1) / (n_F - n_C)$, in which n_D is the **index of refraction** of the glass for the sodium line at 589.3 nm, and n_F and n_C are the indices for the hydrogen lines at 486.1 and 656.3 nm, respectively. Also known as **Abbé number**, **nu value** and **constringence**.

abcoulomb. *Noun.* A **cgs unit** of charge given as the charge per second passing any cross section of a conductor through which a steady current of 1 **abampere** is flowing. It is equivalent to 10 **coulombs**.

abfarad. *Noun.* The **cgs unit** of capacitance; the capacitance of a capacitor having a charge of 1 **abcoulomb** and a potential difference of 1 **abvolt** between its conductors. Equivalent to 10^9 **farads**.

abhenry. *Noun.* The **cgs unit** of inductance. Defined as the inductance that occurs when a rate of change of current of 1 **abampere** per second generates an induced emf of 1 **abvolt**. Equivalent to 10^{-9} **henry**.

abherent. *Noun.* A coating that prevents surfaces from adhering to each other. Such materials are also known as **release agents** or **abhesives**.

abhesive. *Noun.* See **abherent** and **release agent**.

ab initio. *Latin.* From the start. Calculations, often of molecular structure, made from first principles without empirical data. For solid-state calculations this usually involves the **Schrödinger equation** and the method of self-consistent fields.

ablate. *Verb trans.* To remove something by **ablation**.

ablation. *Noun.* The process of wearing or wasting away of the surface of an object by erosion, melting, evaporation, or vaporisation. See **laser ablation**.

ablative generation. *Noun.* The production of acoustic emission by the recoil force of rapid vaporisation of surface material caused by laser pulses impinging on the surface.

ablative material. *Noun.* A body or a coating of low thermal conductivity, such as a ceramic or a glass-reinforced plastic, which a pyrolytic process removes resulting in the absorption or dissipation of heat from a substrate.

ablator. *Noun.* A material that dissipates heat by eroding, such as silicone resin containing cork used to insulate the space shuttle external fuel tanks.

abopon. *Noun.* Sodium borophosphate complex; a viscous liquid used in porcelain enamels and glazes as a suspension agent and binder.

ABR. *Abbreviation.* Standing for **abrasive**.

abrade. *Verb trans.* To roughen or wear away a surface especially by friction.

Abrams' law. *Noun.* The strength of a concrete or mortar is governed by the quantity of mixing water employed, so long as the mix is of workable plasticity; it may be calculated by the equation: $S = A/B^r$, in which S is the strength, A and B are constants, and r is the **water to-cement ratio** of the compacted mortar or concrete.

abrasion. *Noun.* The wearing, grinding, or rubbing away of the surface of a solid by friction induced by moving solids, liquids, or gases.

abrasion hardness. *Noun.* The relative hardness of a solid substance in terms of its capacity to scratch or abrade another solid material or itself be scratched or abraded. See also **Brinell test**, **Knoop hardness**, **Mohs hardness**, **Rockwell hardness**, and **Vickers hardness**.

abrasion resistance. *Noun.* Measures of the ability of a material to resist wear by friction. Samples may be evaluated on the basis of loss in weight, loss of gloss, or by the degree of permanence of discolouration when a lead pencil, dye, or fine powder of contrasting colour is drawn or rubbed across the abraded area.

abrasion tester. *Noun.* A laboratory device, usually provided with a scouring, cascading, or jet-propelled abrasive acting on the surface of a solid, employed in the evaluation of the abrasion-resistant properties of surfaces. See **Kessler abrasion tester**, **Tabor abrader**.

abrasion-wear index. *Noun.* The comparative degree of wear on the surface of a solid material produced by constant test conditions.

abrasive. *Noun.* Any substance, which, by virtue of its hardness and wear-resistance, is used for grinding, cutting, or polishing. Ceramics, such as **diamond**, **silicon carbide**, **alumina**, **sand**, **ceria**, **rouge**, etc., are the most commonly used abrasives.

abrasive belt. *Noun.* A band or endless loop of cloth, paper, leather, or sheet of other flexible substance to which an abrasive product has been bonded for use in grinding and polishing operations.

abrasive cloth. *Noun.* A strong, usually pliable fabric or cloth to which an abrasive has been bonded, and which is used in manual or mechanical grinding and polishing operations.

abrasive cone. *Noun.* A solid, cone-shaped, bonded abrasive product mounted on a spindle for use in high-speed grinding and machining operations.

abrasive disk, bonded. *Noun.* See **bonded abrasive disk**.

abrasive disk, coated. *Noun.* See **coated abrasive disk**.

abrasive-jet cleaning. *Noun.* The process of removing dirt and soil from a solid surface by the impingement of an abrasive-bearing stream of liquid or gas on the surface of the solid.

abrasive, levigated. *Noun.* See **levigated abrasive**.

abrasive machining. *Noun.* The technique of forming or shaping a solid item by grinding, drilling, or some similar mechanical process.

abrasive, mild. *Noun.* See **mild abrasive**.

abrasive paper. *Noun.* A paper sheet of high **tearing strength** to which an abrasive has been glued; used in

grinding and polishing operations; sandpaper and emery paper are examples.

abrasive sand. *Noun.* Sharp-grained sand, usually graded to a **mesh size**, used as an abrasive.

abrasive tumbling. *Noun.* A process used to improve the surface finish or to deburr solid materials by tumbling in a rotating cylinder containing abrasive particles.

abrasive wheel. *Noun.* A grinding wheel or disk composed of an abrasive grit and an appropriate bonding material used for the grinding, polishing, shaping, or cutting of a solid surface.

absolute density. *Noun.* The weight of a unit volume of a pore free substance under specified conditions of pressure and temperature. See also **X-ray density** and **theoretical density**.

absolute electric constant. ϵ_0 . *Noun.* A constant in Coulomb's Law when it is expressed in SI units; value $8.854 \times 10^{-12} \text{ Fm}^{-1}$. Also known as the **absolute permittivity of free space**.

absolute humidity. *Noun.* The weight of water vapour contained in a unit volume of air. Several units used but gram per cubic metre is common.

absolute permittivity of free space. ϵ_0 . *Noun.* See **absolute permittivity of free space**.

absolute specific gravity. *Noun.* The ratio of the weight of a given volume of a substance in a vacuum at a given temperature to the weight of an equal volume of water in a vacuum at the given temperature.

absolute temperature. *Noun.* Thermodynamic temperature. Temperature measured from absolute zero on an accepted scale of temperature measurement, such as the Celsius (Kelvin) or the Fahrenheit (Rankine) scale. Also called **Kelvin temperature**, **thermodynamic temperature**.

absolute unit. *Noun.* (1) A unit of measurement forming part of the **cgs system** of electromagnetic units, such as the **abampere**. (2) A unit of measurement in a system that does not have its unit of force defined by the acceleration of free fall.

absolute viscosity. *Noun.* The complete name for **viscosity** that differentiates it from **specific viscosity** and **kinematic viscosity**.

absolute zero. *Noun.* Temperature characterised by the complete absence of heat, or at which all particles whose motions constitute heat cease to move; believed to be equivalent to -273.16°C .

absorb. *Verb trans.* (1) To soak or suck up liquids. (2) To take in incident radiated energy and retain it without reflection or transmission. (3) To undergo or cause a process in which a gas or liquid permeates and is dissolved in a solid.

absorbance. *Noun.* A measure of the light-absorbing ability of a material or object expressed as \log_{10} of the reciprocal of the **internal transmittance**.

absorbent. *Adjective.* (1) Able to **absorb**. (2) *Noun.* A material that absorbs.

absorbency. *Noun.* The ability of a fluid material to penetrate into another material; specified as the weight of fluid absorbed to the weight or volume of the dry specimen.

absorber. *Noun.* (1) A material or structure that **absorbs**. (2) A material that absorbs radiation or causes the radiation to lose energy.

absorption. *Noun.* (1) The process in which fluid molecules are taken up by, and distributed through, a solid or another liquid. (2) The reduction of the intensity of any radiation as a result of energy conversion in the material such as sound to heat. (3) An optical effect whereby the energy of a photon of light is taken into a substance by electronic polarisation or electron excitation.

absorption centres. *Plural noun.* Dye molecules, transition metal ions or small particles of metal that cause attenuation of light of certain wavelengths to be more heavily attenuated and so giving a transparent body a resultant colour.

absorption characteristics. *Noun.* A combination of factors affecting the ability of a ceramic to absorb infrared radiation, e.g., crystal structure, reflectivity, and transmissivity.

absorption coefficient. *Noun.* A parameter, characteristic of the interaction of a beam of radiation with the material under investigation. It is μ in the equation $I = I_0 e^{-\mu x}$, where I is the beam intensity measured at a distance x inside the material.

absorption-dye, test. *Noun.* See **dye-absorption test**.

absorption factor or absorptance. *Noun.* A measure of a materials ability to absorb radiation. It is equal to the ratio of the absorbed radiant flux to the incident flux. For a layer of material the ratio of the flux absorbed between the entrance and exit surfaces to the flux leaving the entry surface is the **internal absorptance**.

absorption rate. *Noun.* The amount of water absorbed by a brick or other body during partial or complete immersion for a specified period, usually 1 min; expressed in grams per unit of time for a sample of specified size.

absorption ratio. *Noun.* The ratio of the weight of water absorbed by a masonry unit during immersion in cold water to the weight absorbed during immersion in boiling water for an equivalent period of time. See **absorption test** (2).

absorption test. *Noun.* (1) See **dye-absorption test**. (2) A test in which a body is immersed in a selected or specified solution for a designated time and temperature, and the ratio of the weight of solution absorbed to the weight or the volume of the dry specimen is reported as the **absorbency** of the body.

absorption, x-ray. *Noun.* See **x-ray absorption**.

absorptivity. *Noun.* The fraction of the incident radiant energy, at a given wavelength, absorbed by a unit area of surface. A **black body** has absorptivity of unity. If the absorptivity varies with wavelength, the surface is termed coloured.

abutment. *Noun.* The portion of a structure that receives the thrust or pressure of the **arch** in a furnace or kiln, and which generally consists of a **skewback brick** and steel support.

abvolt. *Noun.* The **cgs system** of potential difference in the electromagnetic system. The potential difference between two points when 1 **erg** of work must be done to transfer 1 **abcoulomb** between them. It is equivalent to 10^{-8} V.

abwatt. *Noun.* The **cgs system** of power in the electromagnetic system. Equals the power dissipated when 1 **abampere** flows across a potential difference of 1 **abvolt**. It is equivalent to 10^{-7} W.

A/C. *Abbreviation.* Used to denote **asbestos cement**.

ac. *Abbreviation.* Standing for alternating current.

acacia gum. *Noun.* A water-soluble gum derived from various acacia plants; used as a binder in porcelain-enamel and glaze slips; also known as **gum Arabic**, **gum Senegal**, and **gum Kordofan**.

acanthite. *Noun.* The primary mineral source of silver; usually occurs as **blebs** within **galena**.

accelerated-service life. *Noun.* The elapsed time required to reach the end point in a service test conducted under conditions more severe than those that will be encountered during the normal use of a product.

accelerated test. *Noun.* Any test of a property which is conducted under conditions more severe than will be encountered during the normal life of a product or material.

accelerator. *Noun.* (1) A chemical admixture introduced into a batch of concrete, **stucco**, mortar, plaster, or similar material as a catalyst to hasten hydration or other setting reaction, thereby causing the batch to develop strength more rapidly than normally would be attained; examples are the **alkali carbonates**, **potash alum**, and powdered **gypsum**. (2) A device that increases the speed and thus the energy of charged particles.

acceptability. *Noun.* The quality of a product in terms of its ability to meet minimum standards specified for its use.

acceptance level. *Noun.* The maximum and minimum limits of quality standards between which a product is considered to be acceptable for its intended use.

acceptance limits. *Noun.* The test levels used in the sorting of specimens that establish the rating group into which a material or product under test should be assigned.

acceptance number. *Noun.* The maximum number of defective pieces allowable in a sample of specified size.

acceptance standard. *Noun.* A specimen of a material or product selected to be used as a reference standard to indicate the acceptable measure of quantity, weight, extent, value, or quality of a material or product.

acceptance test. *Noun.* A test to determine the conformance of a product to a purchase order or contract, or to determine the degree of uniformity of the product, as a basis for its acceptance by the purchaser.

acceptor. *Noun.* (1) Impurity atoms added to a semiconductor. An acceptor is in a lower periodic group e.g. boron when added to a group IV semiconductor. Called acceptors because they have energy levels in the **forbidden zone** just above the **valence band**, thus creating **holes** in the electronic structure when electrons from the valence band rise into them. It is common for thermal energy to raise electrons from the valence band into them. (2) The atom or group that accepts electrons in a coordinate bond.

acceptor level. *Noun.* An energy level lying within a forbidden zone but close to the top of the valence band in an insulator or semiconductor. The existence of such levels is responsible for **holes** in energy bands and the properties associated with semiconductors. Also called **acceptor state**.

acceptor state. *Noun.* See **acceptor level**.

accessory mineral. *Noun.* A mineral found in a subordinate quantity in another mineral, but which is not essential and which does not affect the character or the properties of the parent mineral.

accuracy. *Noun.* The degree of precision existing between an experimentally determined value and an accepted reference value.

ACE. *Acronym.* Standing for amethyst contrast enhancer. See **amethyst contrast enhancer**.

A. Cer. S. *Abbreviation.* The official abbreviation for The American Ceramic Society.

acetylene black. *Noun.* A very pure form of graphitic carbon powder; made by controlled combustion of acetylene in air under pressure.

ACF. *Abbreviation.* Cement notation for a product of composition $\text{Al}_2\text{O}_3 + \text{CaO} + \text{Fe}_2\text{O}_3$ or $\text{CaAl}_2\text{Fe}_2\text{O}_7$. See **ferrite (3)**.

Acheson process. *Noun.* An industrial process for the manufacture of **graphite** and/or **silicon carbide** by heating coke and clay mixtures in an arc furnace. First SiC is prepared which loses silicon at 4,150 °C to yield graphite. Patented in 1896.

Acheson SiC. *Noun.* Silicon carbide lump and powder made by the **Acheson process**.

achondrite. *Noun.* A rare form of meteorite consisting mainly of silicate minerals but containing no **chondrules**.

achromatic. *Adjective.* (1) Without colour. (2) Capable of reflecting or refracting light without chromatic aberration.

achromatic colour. *Noun.* Colour, such as white, black and grey, which is devoid of **hue**.

achromatic glass. *Noun.* Glass that will transmit light without dispersing it into its constituent colours.

achromatic lens. *Noun.* A combination of two or more lenses of different focal powers that will transmit light free of undesired colours.

achromic or achromous. *Adjective.* Colourless.

acierate. *Verb trans.* To change iron into steel by removal of free carbon and development of **cementite**, iron carbide.

acicula. *Noun.* Needle-shaped component, such as a crystal in a microstructure.

acicular. *Adjective.* Needle-like.

acicular interlocking. *Adjective.* A microstructural description of some glass-ceramics where interlocking rod- or bladelike crystals serve as a toughening and strengthening system.

acid. *Noun.* In the ceramic context, an oxide, R_xO_y , in which R represents an element with a high charge and small size such as silicon, titanium, zirconium, tin, or boron that will react chemically as an acid.

acid annealing. *Noun.* A process for preparing metal shapes for **porcelain-enamelling** in which the metal is coated with acid followed by annealing to remove oils, rust, and other soil from the surface by scaling, and to relieve stresses in the metal prior to application of the enamel coating.

acid bottom and lining. *Noun.* The exposed bottom and lining of a steel-making furnace composed of materials such as silica brick, sand, siliceous rock, or other refractories, which will react as an acid with the molten metal and slag at operating temperatures. See **acid open-hearth furnace**, **acid refractories**, **acid slag**, and **acid steel**.

acid clay. *Noun.* Clay that releases hydrogen ions on contact with water.

acid embossing. *Noun.* The process in which the surface of glass is obscured by treatment with hydrofluoric acid or its compounds. See **frosted**.

acid etching. *Noun.* A technique used to obtain translucent surfaces on glassware by immersing it, or an area of it, in solutions containing hydrofluoric acid. Patterns are obtained by covering some glass areas with **wax resist**.

acid-extractable material. *Noun.* Substances, which may be dissolved and removed from a material by treatment with an acid, usually under specified conditions.

acid frosting. *Verb int.* To etch glass, particularly glass tableware, by treatment with hydrofluoric acid or its compounds.

acid gold. *Noun.* A decoration of gold applied to the surface of a glaze, which previously was etched with hydrofluoric acid or other fluoride to improve adherence.

acidic. *Adjective.* Of an oxide: yielding an acid in water.

acidic oxide. *Noun.* Any oxide that will display acidic properties, such as SiO_2 , TiO_2 , ZrO_2 , SnO_2 , CeO_2 , GeO_2 , PrO_2 , Sb_2O_3 , As_2O_3 , B_2O_3 , and P_2O_5 .

acid lava. *Noun.* Magma that has an acidic content and flows very slowly, often cooling in volcano vents leading to plugs that trap gases that can later explode producing **pyroclastic rocks**. Rocks and minerals formed from acid lava often have distinctive bands due to the very slow flow prior to solidification.

acid open-hearth furnace. *Noun.* An **open-hearth furnace** lined with a highly siliceous refractory brick, the lining sometimes being coated with a fritted layer of silica sand.

acid polishing. *Verb int.* The process of polishing glass surfaces by means of an acid treatment to minimize roughness.

acid refractories. *Noun.* Refractories containing substantial amounts of silica which may react with basic refractories, slag, or fluxes at high temperatures.

acid-refractory furnace. *Noun.* A furnace or **cupola** lined with an acid-type refractory, such as silica brick.

acid resistance. *Noun.* The degree to which porcelain enamels, glazes, glasses, and other ceramic surfaces are resistant to attack by acids.

acid-resisting brick. *Noun.* A fired clay brick with high resistance to corrosion by acids. This situation is achieved by use of raw materials with low alkaline content and by firing to high **vitrification** such that low-water absorption is achieved.

acid-resisting enamel. *Noun.* A porcelain enamel exhibiting high resistance to attack by acids, particularly household cleaners, fruit, and cooking acids.

acid scaling. *Verb int.* The process of dipping or spraying raw metal with acid followed by annealing at a red heat as a means of removing oils, rust, and other soils prior to the application of a porcelain-enamel to the metal.

acid slag. *Noun.* Slag in which the silica content is greater than the content of basic ingredients, such as lime and magnesia.

acid spar. *Noun.* A fluor spar containing 98 % or more of calcium fluoride and 1 % or less of silica.

acid steel. *Noun.* A grade of steel produced in furnaces lined with silicate refractories.

acid, white. *Noun.* See **white acid**.

ACL kiln. *Noun.* A type of traveling-grate preheater employed to preheat a Portland cement batch before it is charged into the rotary cement kiln as a means of minimising the length of the kiln required for the clinkering operation.

acmite. *Noun.* $\text{NaFe}(\text{SiO}_3)_2$. An iron containing fibrous silicate.

acoustic atom. *Noun.* A concept proposed for **phononic crystals**, which are **artificially structured materials** with a periodicity of structural changes where each different repeat structure has a characteristic but different elastic moduli and mass densities. If the wavelength of an acoustic wave in the material is very much smaller than the modulations in the structure and the structure can be made to contain a layer of different material in some of the modulating blocks of structure these layers act like single acoustic centres and carry the name acoustic atom. These “atoms” change the excitation and propagation of acoustic waves leading to unexpected properties such as, negative refraction, negative mass and negative elastic constants. For example two interpenetrating spherical lattices of a polaritonic material such as LiTaO_3 , or SiC plus a plasmonic material like MgB_2 give negative refractive index effects for acoustic waves in the composite. These new structures are called **acoustic metamaterials**.

acoustic emission testing. *Noun.* A non-destructive test method that monitors energy released when cracks nucleate and move or when phase changes occur; wave frequency and amplitude are monitored.

acoustic impedance. **Za.** *Noun.* the ratio of the sound pressure in a medium to the rate of alternating flow of the medium through a specified surface due to the sound wave.

acoustic insulation. *Noun.* Foamed or highly porous plaster, tile, or other product of very low density employed to diminish the intensity of sound.

acoustic metamaterial. *Noun.* An artificially structured solid that shows some novel and counterintuitive effects for sound wavelengths much greater than the periodicity of the engineered structure. See **acoustic atom**.

acoustic microimaging. *Noun.* A non-destructive examination technique that uses sound waves in the 5–200 MHz range to analyse internal features and defects in ceramics. Echoes of sound pulses from air gaps and grain boundaries are captured and presented as a relative intensity picture after computer processing.

acoustic microscope. *Noun.* A microscope in which sound is used to scan a sample. See **acoustic microscopy**.

acoustic microscopy. *Noun.* A technique used to study features beneath the surface of light-opaque materials. Sound waves, generated by a **piezoelectric transducer**, are focused by a **sapphire** crystal, through water onto a reflecting object. The reflected sound wave is used to electronically build up a picture of the structure on a video screen.

acoustic mobility. *Noun.* See **acoustophoretic measurement**.

acoustic phonic crystal. *APC.* *Noun.* See **phonic crystals**.

acoustic phonon. *Noun.* See **phonon**.

acoustic plaster. *Noun.* A plaster with a chemically or mechanically textured or roughened surface that absorbs or prevents the transfer of sound.

acoustic solid. *Noun.* A three-dimensional image formed from **C-SAM** scans. A solid is treated as a sequence of planar acoustic images.

acoustic spectroscopy. *Noun.* Measurement of the attenuation and velocity of ultrasonic pulses as they pass through concentrated suspensions and slurries. Measurements are made over a large range of frequencies to generate spectra from which particle size distributions in the range 5 nm to 100 μ m can be measured. The rate of change of signal level as an acoustic pulse travels a distance in a colloidal suspension over a series of distances corresponds to the attenuation due to losses in the colloid. The attenuation is normalised by frequency and the particle size distribution is obtained by computing an expected attenuation against that observed.

acoustic streaming. *Verb.* Stimulated displacement in liquid particles caused by ultrahigh-frequency agitation that leads to production of ultrasound.

acoustic tile. *Noun.* A thin, decorative tile of plaster, ceramic, fibre or other material having sound-absorbing properties, which is used as a covering for walls, ceilings, and other surfaces.

acoustic waves. *Noun.* This is an **elastic wave** passing through a solid as **phonons** passing through the solid.

acoustoelectronic. *Adjective.* Describing a device in which electronic signals are converted into acoustic waves.

acousto-optic. *Adjective.* Relating to the use of **ultrasound** to modulate or change the direction of light in glasses and transparent ceramics.

acoustophoresis. *Noun.* An extension of **acoustophoretic measurement**. A ceramic powder suspension is subjected to a high frequency alternating electric field. The movement of charged particles generates an acoustic wave that is sensed by transducers. A dynamic mobility spectrum is generated as a function of the ac field frequency and this allows **zeta potentials** and particle sizes to be calculated. The method works for much higher volume fractions than traditional **electrophoresis**.

acoustophoretic measurement. *Noun.* An ultrasonic technique used to study acoustic mobility, AM, and **zeta potential**, ζ , through the expression $\zeta = (AM) \eta / \epsilon$, where η and ϵ are the viscosity and dielectric constant, respectively, of water. The ceramic powder is suspended in water and subjected to a compressive ultrasonic wave of 200 kHz which induces periodic polarisation of the **Stern layer** and this alternating potential is measured and used to derive AM.

acousto-ultrasonics. *AU.* *Noun.* A non-destructive examination method using a combination of the principles of acoustic emission and conventional ultrasonics. Stress waves are stimulated in a material by a sending transducer, but unlike normal ultrasonics, these are detected by a receiving transducer and analysed using **acoustic emission** methods. It aims to give an overall assessment of the state of the material between the transducers but does not locate or size defects.

acrylic polymer. *Noun.* A thermosetting resin used as a binder in laminated products; made by polymerisation of acrylic acids, acrylates, etc.

actinic. *Adjective.* Of or concerned with radiation producing a photochemical effect.

ACTFELD. *Acronym.* Stands for alternating current thin film electroluminescent device. See **alternating current thin film electroluminescent device**.

actinic glass. *Noun.* A glass that transmits more of the visible components of light and less of the infrared and ultraviolet components.

actinide series. *Noun.* Chemical elements of atomic number 89–103.

actinolite. *Noun.* $\text{CaFe}_3(\text{Si}_4\text{O}_{11})_2(\text{OH},\text{F})_2$. A natural mineral with a fibrous habit. One of the amphibole silicates, useful as a reinforcing fibre in plastic matrices. See **jade**.

activated alumina. *Noun.* A highly porous, granular form of Al_2O_3 made by thermal decomposition of **gibbsite**, $\text{Al}(\text{OH})_3$, at 350–400 °C. Used as an absorbent, a catalyst itself, and as a catalyst carrier. It is chemically inert to most gases, will not swell, soften, or disintegrate in water, exhibits high resistance to thermal and mechanical shock, to abrasion, and will hold moisture without change in form or properties.

activated carbon. *Noun.* See **activated charcoal**.

activated charcoal. *Noun.* A family of highly porous carbonaceous substances of high surface area per unit of volume; manufactured in powdered, granular, or pelletised form by processes that develop high absorptive properties. Exposing it to superheated steam markedly enhances its adsorbing power. Used chiefly for removing impurities from alcohols, occluding gases, etc. Also known as **activated carbon**.

activated carbon, granular. *Noun.* See **granular activated carbon**.

activated clay. *Noun.* Clay, such as **bentonite**, that has been treated with acid to improve its bleaching and adsorptive properties.

activated diffusion bonding. *Noun.* See **diffusion bonding**.

activation. *Noun.* Any process, such as chemical treatment, heat or radiation, which is employed to improve the reactivity or absorptive properties of a material.

activation analysis. *Noun.* A sensitive technique for the identification of trace elements based on the induced radiation characteristics of a specimen exposed to neutrons in a nuclear reactor. The energy of the emitted x-rays identifies the elements and their flux gives the composition.

activation energy. Q. *Noun.* (1) The minimum energy required for a chemical reaction to take place. It is the energy barrier that has to be overcome for reaction to proceed. It determines the way in which the reaction rate varies with temperature. (2) The energy required for initiating a physical process such as diffusion.

activation polarisation. *Noun.* A state reached in an electrochemical reaction when the rate is controlled by the slowest step in a sequence of steps that the reaction proceeds by.

activator. *Noun.* (1) An ion or group within a host lattice that can absorb photons and readmit at a slightly changed wavelength. (2) A chemical used to initiate a polymerisation process.

active current. *Noun.* The component of an electric current in a branch of an alternating current circuit that is in phase with the voltage. Also known as **watt current**.

active material. *Noun.* The electrode material in a dry cell that takes part in the electrochemical reaction that stores or delivers electrical energy.

active material utilisation. *Noun.* The fraction of the **active material** that reacts during the discharge before the **cell** can no longer deliver the required current at a useful voltage.

active site. *Noun.* A position on the surface of a solid catalyst at which chemical activity occurs.

active substrate. *Noun.* Semiconductor or ferrite materials in which active elements are formed that also acts as a mechanical support for the other elements of a semiconductor device or integrated circuit.

activity. a. *Noun.* (1) A general term describing the ability or capacity of a material to absorb or to react in a desired manner. (2) The effective concentration of an aqueous electrolyte solution or **solid solution**, which empirically accounts for the interactions between molecules that interfere with the behaviour of the solutes. (3) It is defined mathematically in terms of either the partial molar free energy of mixing, G_i , or in terms of chemical potential, μ_i , by the equations: $RT\ln a_i = \Delta G_i$

and $RT\ln a_i = \mu_i - \mu_i^\circ$, where a_i is the activity of the i -th component in a solution. Activity is determined by measuring a property that changes with concentration, for example by measuring the vapour pressure above a solution containing the element of interest: $a_i = p_i/p_i^\circ$, where p_i is the partial pressure of the element of interest above a solution containing the element of interest and another element and p_i° is the partial pressure above the pure element at the same temperature. See **chemical potential**.

activity coefficient. γ_i . *Noun.* The factor that relates the **activity** of a component in a solution to the concentration of the component: $a_i = x_i \gamma_i$, where x_i is the **mole fraction** of component i and a_i is the **activity** of component i . It indicates the degree of deviation of the solution from ideal behaviour

actuator. *Noun.* A ceramic crystal with **piezoelectric** or electrostrictive properties, such as **PZT**, in which strains can be very accurately generated by using controlled electric fields. Such strains are used in devices to position semiconductor chips to tolerances of $0.1 \mu\text{m}$ for surface treatment.

actuator materials. *Plural noun.* These include many materials that change their dimensions when subjected to stimuli, such as heat, a voltage or light. the result is a mechanical response much greater than the original input.

adamantine. *Adjective.* (1) Very hard; unbreakable. (2) An appearance and texture description of fracture surfaces of **glass ceramics**. It is rougher than a **glassy fracture** but smoother than a **waxy fracture** and appears as a function of crystal size and content; no crystals give the glassy fracture surface, nanosized crystals give the adamantine surface and micron sized crystals produce the waxy texture. (3) Having the lustre of **diamond**.

adamantine lustre. *Adjective.* A surface showing a brilliant appearance like a diamond.

Adams and Walrath test. *Noun.* A mechanical test used on composites involving double cantilever beam loading.

Adams chromatic value system. *Noun.* A colour measurement method based on lightness, the amount of red or green, and the amount of yellow or blue in the colour being measured.

adapter. *Noun.* (1) A type of flange used to mount a grinding wheel on a shaft of smaller diameter than the centre hole in the wheel. (2) A device or attachment designed to connect or attach two dissimilar sized parts in an apparatus.

adaptive structure. *Noun.* A load bearing structure whose geometrical configuration and inherent structural characteristics can be changed in order to adapt to environmental changes.

ADC. *Abbreviation.* Standing for analogue-to-digital converter. See **analogue-to-digital converter**.

addition. *Noun.* A material added in relatively small quantities to a ceramic coating, body, or other composition to influence the manufacturing, working, or performance properties of the composition.

additive. *Noun.* A substance added in relatively small quantities to bring about a change in, or to enhance, the properties of another substance.

adherence. *Noun.* (1) In general ceramic usage, the bond or union developed at the interface between two substances by fusion or by chemical or physical reaction during fusion. (2) The degree to which a porcelain enamel, glaze, or other ceramic coating adheres to its substrate. (3) A measure of the stress necessary to cause one material to separate from another at their interface.

adherence failure. *Noun.* The separation of a porcelain enamel from its base metal, usually exposing bright metal in the fractured area; the traditional measure of the degree of failure is the ratio of bright metal to adherent enamel fragments remaining in an indented area which was deformed by a plunger in a specified manner to a specified size.

adherence promoter. *Noun.* Oxides added to glass enamelling frits to ensure the correct conditions at the iron or steel-glass interface. They provide available oxygen by a reduction process; they lower the saturation concentration value for the substrate metal oxide in the glass and speed up dissolution of substrate oxide; CoO and TiO₂ are common examples.

adhesion. *Noun.* (1) The degree or strength of attachment of a material in contact with another. (2) Any mutually attractive force holding together two magnetic bodies.

adhesion-type ceramic veneer. *Noun.* Thin sections of a ceramic held in place by the adhesion of a mortar to the unit and to the backing without the use of metal or other fasteners.

adhesive. *Noun.* A mucilaginous or cementitious substance placed or spread between two solid surfaces to bind the surfaces together; usually a colloidal solution that gels.

adhesive strength. *Noun.* The stress required to separate two bonded surfaces.

adhesive-bonded nonwoven fabric. *Noun.* Ceramic textile material made of a **web** or **batt** of fibres; bonded by applying adhesive.

adiabatic. *Adjective.* (1) A process in which the change is associated with a change in the temperature of the system since the system is surrounded by a barrier that does not permit heat to pass. (2) An occurrence which takes place without the loss or gain of heat, such as the expansion or contraction of bodies during drying at constant temperature. (3) *Noun.* A curve or surface on a graph representing the change in two or more

characteristics, such as the volume and pressure of a system undergoing an adiabatic process.

adiabatic compression. *Noun.* A reduction in volume of a substance without heat flows, in or out.

adiabatic cooling. *Noun.* A process in which the temperature of a system is reduced without any heat being exchanged between the system and its surroundings.

adiabatic demagnetisation. *Noun.* Also known as magnetic cooling; a method for producing very low temperatures, below 10⁻² K, whereby a cooled salt such as ferric ammonium alum is first magnetised isothermally and then demagnetised adiabatically.

adiabatic envelope. *Noun.* A surface enclosing a thermodynamic system in an equilibrium which can be disturbed only by long-range forces or by motion of part of the envelope; intuitively, this means that no heat can flow through the surface.

adiabatic process. *Noun.* Any thermodynamic procedure that takes place in a system without the exchange of heat with the surroundings.

adiabatic vaporisation. *Noun.* Vaporisation of a liquid with virtually no heat exchange between it and its surroundings.

adion. *Noun.* A cation or anion in solution that is adsorbed on to a solid surface, such as an oxide in suspension. See **adsorbate**.

additive colouration. *Verb.* To produce colour by combining different intensities or amounts of three primary colours, red, green and blue.

adlattice. *Noun.* Structure formed in two dimensions by adsorbed atoms or molecules on the surface of an adsorbing solid.

admicelle. *Noun.* A bilayer of adsorbed surfactant molecules on the surface of a solid adsorbent formed by interaction of the non-polar parts of sorbed molecules.

admix. *Verb trans.* To mix or blend.

admixture. *Noun.* A material added in small quantities to a batch to alter the working or performance characteristics of the batch in a desired manner.

adobe. *Noun.* (1) A structure made of unfired brick or clay. (2) Clay from which unfired brick is made. (3) Large, roughly moulded, sun-dried brick of varying dimensions which sometimes are reinforced by the incorporation of straw in the batch.

adsorb. *Verb.* To undergo or cause to undergo a process in which a substance accumulates on the surface of a solid. In the air this is usually a monolayer of gas molecules.

adsorbant. *Noun.* The solid phase involved in a **sorption** process.

adsorbate. *Noun.* (1) A substance, which, in molecular, atomic, or ionic form, will condense on, penetrate into, and be retained by another liquid or solid. (2) The cation or anion partitioned from an aqueous solution to a solid surface in the process of **sorption**. Sometimes called an **adion**.

adsorbed water. *Noun.* A water layer, one or more molecules thick, held on the surface of a solid by molecular forces.

adsorbent. *Adjective.* (1) Capable of adsorption. (2) *Noun.* Any solid or liquid, such as **activated charcoal**, **activated alumina**, **silica**, water, and mercury, having the ability to attract and concentrate significant quantities of another substance on its surface and to be penetrated by this substance.

adsorption. *Noun.* The attraction and adhesion, in extremely thin layers, of molecules, atoms, or ions of gases, liquids, or dissolved substances to the surface of solid or liquid materials in which they come in contact.

adsorption, anion. *Noun.* See **anion adsorption**.

adsorption, cation. *Noun.* See **cation adsorption**.

adsorption, chemical. *Noun.* See **chemical adsorption**.

adsorption coefficient. *Noun.* This is the C term in the **BET equation** (see **nitrogen surface area**) which relates the difference between the energy of adsorption of a vapour onto a pristine surface, E_1 and the energy of liquefaction E_L as the equation: $E_L \cdot C = \exp(E_1 - E_L)$.

adsorption, countercurrent. *Noun.* See **countercurrent adsorption**.

adsorption, heat of. *Noun.* See **heat of adsorption**.

adsorption, hydraulic. *Noun.* See **hydraulic adsorption**.

adsorption, integral heat of. *Noun.* See **integral heat of adsorption**.

adsorption, irreversible. *Noun.* See **irreversible adsorption**.

adsorption isotherm, Freundlich. *Noun.* See **Freundlich isotherm**.

adsorption isotherm, Langmuir. *Noun.* See **Langmuir isotherm**.

adsorption, preferential. *Noun.* See **preferential adsorption**.

adsorption, reversible. *Noun.* See **reversible adsorption**.

adsorption theory, Langmuir. *Noun.* See **Langmuir adsorption theory**.

adsorption, Van der Waals. *Noun.* See **Van der Waals adsorption**.

adsorption zone. *Noun.* The area on an adsorbent in which the concentration of an adsorbate in a fluid

decreases from the influent concentration to the lowest detectable concentration.

adsorptive capacity, dynamic. *Noun.* See **dynamic adsorptive capacity**.

adsorptive capacity, equilibrium. *Noun.* See **equilibrium adsorptive capacity**.

adularescent. *Adjective.* Describing minerals, such as **moonstone** that emit a bluish **iridescence**.

adularia. *Noun.* KAlSi_3O_8 . A white, glassy variety of **orthoclase** with a prismatic habit occurring in metamorphic rocks that is used as a gemstone.

adulterate. *Verb.* To debase by adding inferior material.

advanced composite. (A/C). *Noun.* A combination of stiff strong, usually ceramic, fibres, with a compatible resin or metal **matrix**.

advanced local oxidation. LOCOS. *Noun.* The effect caused in very local areas of a silicon semiconductor wafer when it is ion bombarded with O^+ ions to produce localised insulating **mesas**.

AEA. *Abbreviation.* Stands for air-entraining agent. See **air-entraining agent**.

aeolian rock. *Noun.* Rock formed from wind-deposited dusts.

aerate. *Verb.* To introduce air into a slurry by stirring or other means of agitation.

aerated concrete. *Noun.* Concrete containing a substantial amount of entrapped air, which was introduced into the mass by foaming or other process.

aeration of concrete. *Noun.* The process by which air or other gas is introduced into concrete to produce a product having a density substantially less than that of normal concrete, and to reduce **bleeding** and segregation in the concrete; the gas-forming ingredients usually are introduced into the **cement clinker** during grinding or into the concrete batch during mixing.

aerator. *Noun.* A machine for breaking down lumps in a sand mixture.

aerogel. *Noun.* The porous product obtained when **alcogel** is dried under **supercritical** conditions. It is a **colloid** that has a continuous solid phase containing dispersed gas.

aerate. *Verb.* To expose to the action of the air.

aerosol. *Noun.* A colloidal dispersion of solid or liquid particles in a gas to form a smoke or fog.

aerolite. *Noun.* A stony meteorite consisting of **silicate** minerals.

aerugo. *Noun.* Synonym for verdigris. See **verdigris**.

AES. *Abbreviation.* Stands for Auger electron spectroscopy. See **Auger effect**.

AFA rammer. *Noun.* A device consisting of a 6.35 kg weight falling from a height of 5.1 cm onto a plunger of a 5.1 cm mould to form test specimens of particulate refractory compositions, foundry sands, and similar materials or products.

affinity. *Noun.* A measure of the tendency of a chemical reaction to take place measured in terms of the **free energy** change.

AFM. *Abbreviation.* Standing for atomic force microscopy. See **atomic force microscopy**.

African wonderstone. *Noun.* See **sculpture stones**.

after-expansion or after-contraction. *Noun.* The permanent linear change measured on a refractory material reheated to a specified temperature for a prescribed time; reported as a percentage of the original length.

afterglow. *Noun.* (1) The glow in a material after removal from an external ignition source. (2) A cause of shadow images on electronic display screens arising when **cathodoluminescence** decays at an expected rate until a threshold value is reached after which it decays much more slowly. Usually arises from impurities present in the ceramic **phosphor**.

A g⁻¹. *Abbreviation.* Stands for amps per gram of platinum; a unit used in the field of **fuel cells** to denote current density instead of the normal A cm⁻².

agalmatolite. *Noun.* Al₂(Si₂O₃)₂(OH)₂(H₂O)_x. A natural hydrous aluminium silicate of the **pyrophyllite** family. Density 2,800–2,900 kg m⁻³; hardness (Mohs) 1–2.

agar. *Noun.* A complex gelatinous carbohydrate obtained from seaweed.

agarose. *Noun.* A purified derivative of **agar**; used as a gelation agent in **gel casting**.

agate. *Noun.* A variegated **chalcodony**, SiO₂, with its colours arranged in stripes, blended in clouds, or displaying moss like forms. Used in the production of **agate mortars and pestles**, as grinding balls in ball mills, and as a burnisher or polisher of gold in ceramic-ware decorations. Density 2,650 kg m⁻³; hardness (Mohs) 6.5–7.0.

agate glass. *Noun.* A multicoloured glass resembling natural agate in appearance; made by blending glasses of two or more colours while in the molten or highly viscous state, or by rolling a transparent glass into other glasses of various colours.

agate mortar and pestle. *Noun.* A highly polished, blemishfree, abrasion-resistant mortar and pestle made of natural quartz; resistant to all acids and alkalis except HF and NaOH; used to pulverise materials when minimal contamination is required.

agateware. *Noun.* Ceramic and porcelain-enamelled ware characterised by veins of colour distributed through the body or coating in a pattern resembling the appearance of natural agate or marble..

age hardening. *Noun.* See **precipitation hardening**.

agglomerate. *Noun.* (1) An association of individual crystallites in a powder within which the interfacial area is small and the total binding forces are weak so that they can be dispersed in suspension by chemical or physical means. (2) A rock consisting of angular fragments of lava and **volcanic bombs**. (3) A confused mass. (4) *Adjective.* Formed into a mass. (5) *Verb.* To be formed or to form a cluster or mass.

aggregate. *Noun.* (1) An inert material, such as sand, gravel, slag, shell, or broken stone, which is to be mixed with cement to form concrete or mortar. (2) In powder making it is an association of individual powder crystallites with either a large interfacial boundary area or very strong bonding forces across the crystallite boundaries that are difficult to separate as opposed to agglomerate. (3) A rock composed of closely packed mineral crystals of a single type or various kinds of mineral rock fragments. (4) *Adjective.* Formed of separate units bound into a whole.

aggregate, coarse. *Noun.* See **coarse aggregate**.

aggregate, expanded. *Noun.* See **expanded aggregate**.

aggregate, exposed. *Noun.* See **exposed aggregate**.

aggregate, fine. *Noun.* See **fine aggregate**.

aggregate, heavy. *Noun.* See **heavy aggregate**.

aggregate, lightweight. *Noun.* See **lightweight aggregate**.

aggregate, reactive. *Noun.* See **reactive aggregate**.

aggregate, separated. *Noun.* See **separated aggregate**.

aggregation. *Noun.* (1) An irreversible physical process in which initially dispersed basic units, such as particles, stick together to form characteristic structures with relatively strong bonds whose size increases with time. (2) The basis of **colour centre** lasers where **F-centres** are converted into F_L(II) centres. X-ray irradiated, lithium doped KCl crystals are cooled to –10 °C and then exposed to white light. Trapped electrons are released from F-centres leaving behind normal **anion vacancies**, which diffuse through the lattice before recombining with e⁻ to reform F-centres next to a Li⁺ and recombination with e⁻ forms the F_L(II)-centre required for the laser process. This scheme is **aggregation** and it is permanent as long as the temperature remains below –10 °C.

aging. *Verb.* (1) To store porcelain-enamels, glazes, slips, slurries, or frit powders before use. (2) To cure prepared ceramic materials by storage for a definite period under controlled conditions. (3) To cure mortars and

cements for periods of sufficient duration to develop necessary strength before exposure to severe conditions of use. (4) *Noun*. The change occurring in slips, slurries, or frit powders with the passage of time. Also known as **maturing**, **souring**.

agitated media mill. *Noun*. A continuously operated mill for both **wet** and **dry grinding**. A rotating grinding pan has an eccentrically positioned grinding tool by which material is fed into the pan, creating a zone for high energy input. Several sources of energy are applied simultaneously and the material being ground rises continuously from bottom to top of the pan.

agitator. *Noun*. An instrument or apparatus employed to stir, shake, or mix.

A-glass. *Trademark, noun*. High-alkali glass used to make single-filament glass fibres; a general-purpose reinforcing glass cheaper than E-glass, used mainly with plastic matrices; composition (wt. %): SiO_2 (72.7), Al_2O_3 (1.5), CaO (5.3), MgO (3.5), $\text{Na}_2\text{O} + \text{K}_2\text{O}$ (14.0).

agonic. *Adjective*. Having or making no angle, having no inclination as in agonic line, the irregular line connecting the magnetic north and south poles of the earth.

AGR cores. *Noun*. **Graphite bricks** formed into annular shapes 1 m long with internal and external diameters of 240 and 380 mm, respectively, together with smaller interstitial bricks, held together by keys. The whole is the centre core of advanced gas-cooled nuclear reactors.

agricultural pipe. *Noun*. A conduit, usually made from fired clay, used to drain water from agricultural land.

agricultural tile. *Noun*. An unglazed porous tile of tubular shape designed for burial in the ground to form a piping system to drain excess water from agricultural lands.

Ah. *Symbol*. Stands for ampere-hours. See **capacity**.

AIM. *Acronym*. Stands for aqueous injection moulding. See **aqueous injection moulding**.

air. *Noun*. The mixture of gases that forms the earth's atmosphere; sea level density 1.226 kg m^{-3} ; consists of 78.08 % nitrogen, 20.95 % oxygen, 0.93 % argon, 0.03 % carbon dioxide, water vapour varies between 0 and 4 %, and very small quantities of ozone and other inert gases.

air bells. *Noun*. A defect in optical glass consisting of irregularly shaped bubbles formed during pressing and moulding operations.

airborne seal. *Noun*. A repair in which a refractory powder is blown and collected in a defective or leaking area of a hot retort to stop the leak.

air brick. *Noun*. A fired brick essentially of standard size in which holes are formed through its length, as

opposed to its depth, to permit the circulation of air in structures.

air brush. *Noun*. An atomiser for spraying solutions through flames to make ultrafine powders.

air chain. *Noun*. A chain or string of air bubbles or inclusions contained in glass, glaze, porcelain-enamel, a vitreous or near-vitreous body, or similar product, usually as a defect.

air classification. *Noun*. The separation and grading of solid particles of a material by density or size by a technique of progressive suspension or settling as in a rising stream of air at a controlled velocity, each grading being reported as a percentage of the original sample.

air content. *Noun*. The volume of voids in a cement paste, mortar, or concrete, excluding the pore space in the aggregate particles; expressed as a percentage of the total volume of the paste, mortar, or concrete.

air conveyor. *Noun*. A device that transports powdered or granular material through a pipe by means of high-velocity air or by vacuum.

air-cooled blast-furnace slag. *Noun*. Molten blast-furnace slag cooled under normal atmospheric conditions or cooled in an accelerated manner by the application of water to the solidified slag surface.

air drying. *Verb*. To remove moisture from a material, glaze, porcelain-enamel, or body by exposure to air.

aired ware. *Plural noun*. Defective ceramic ware on which the glaze has become partially devitrified or some volatilisation of glaze ingredients has occurred.

air elutriator. *Noun*. A device designed to remove impurities from the air, as by washing or filtering.

air-entrained concrete. *Noun*. A concrete containing purposefully introduced air bubbles of minute sizes as a means of improving its **durability** and other properties. See **aeration of concrete**.

air-entraining agent. *Noun*. A material or admixture, such as a soap, resin, or grease-like substance, which reduces the surface tension of water in concrete to facilitate the entrapment of minute bubbles of air in the batch as a means of improving the durability or other properties of the concrete; the agent sometimes may be added to the cement during grinding.

air-entraining hydraulic cement. *Noun*. Hydraulic cement containing a sufficient amount of **air-entraining agent** to cause air to be entrained in the **mortar**.

air-floated. *Adjective*. Clays and other materials that are finely milled and separated or graded by density or size by the use of an air classifier. See **air classification**.

air-fuel ratio. *Noun*. The ratio of the air supply to the fuel supply during combustion, expressed in terms of volume or weight.

air-hardening refractory cement. *Noun.* A finely ground, refractory cement containing admixtures to promote setting of mortars and cements at temperatures at or above room temperature but below **vitrification** temperature.

air inclusions. *Noun.* (1) Small bubbles of air or other gas enclosed in glass, glazes, porcelain-enamels, or bodies which become evident after firing; usually a defect but sometimes intentional as a form of decoration. (2) Gaseous inclusions in **mica** that appear as greyish areas in transmitted light and as silvery areas in reflected light.

air jet loom. *Noun.* A loom using a jet of air to move the **yarn** through the process.

air jet spinning. *Noun.* A system of spinning that uses air to apply the twisting forces to the yarn while at the same time moving the yarn through the process.

air laying. *Noun.* A method used to form a **web** or **batt** of staple fibres whereby fibres are subjected to an air stream and then condensed downstream on to a permeable conveyor.

airless drying. *Noun.* A drying method in which the air in the drier is re-circulated and raised in temperature so that it is progressively replaced as the heat transfer medium by superheated steam produced from the moist product. No air is permitted to enter the drier during the drying process. The main advantages lie in the reduction of heating costs, and in heat recovery from the steam produced by the ware.

air line. *Noun.* (1) A fine, elongated **cord** or bubble having the appearance of a **hairline**, which is considered a fault in glassware, particularly in glass tubing where it arises from the drawing process. (2) A system of pipes and tubing moving compressed air from one point to another.

air permeability. *Noun.* The measure of the rate of flow or diffusion of air through a porous ceramic; expressed as a unit of volume or pressure gradient per unit of area.

air pocket. *Noun.* A sizable bubble of air found in clay bodies during **wedging** or **throwing**.

air, primary. *Noun.* See **primary air**.

air ramming. *Verb.* To shape refractory or other ceramic products by means of pneumatic hammers.

air-relief valve. *Noun.* A small automatic or manually operated valve placed at a high point in a pipeline to exhaust air or other gases from the line.

air, saturated. *Noun.* See **saturated air**.

air seal. *Noun.* A moving curtain of air across the entrance or exit of a furnace or other enclosed area as a means of minimising heat loss or to minimise the movement of air in or out of the area.

air, secondary. *Noun.* See **secondary air**.

air separator. *Noun.* A device in which a stream of air at a controlled velocity is used as a means of separating particles of solid material as they remain suspended in the stream or settle from the stream.

air set. *Adjective.* The property by which a material develops strength during the process of losing moisture by evaporation.

air-setting binder. *Noun.* A term used to describe any binder that will harden when exposed to the air at room temperature; however, it is commonly used to describe oil-oxygen binders that require baking to complete the hardening.

air-setting cement. *Noun.* A cement or mortar that develops high strength in air during the loss of moisture by evaporation.

air-setting refractories. *Plural noun.* Refractory mortars, **ramming mixes**, **gunning mixes**, cements, and similar compositions which are **tempered** with water for placement; the mixtures develop a strong bond and strength on drying which is retained during subsequent service at elevated furnace and kiln temperatures.

air surface devitrification. *Noun.* Devitrification at the surface of glass caused by the volatilisation of oxides at the molten surface with resultant silica enrichment.

air-swept ball mill. *Noun.* A continuous ball mill in which the finely milled particles of the mill charge are removed by a current of air as the coarser particles continue to be ground.

air, tertiary. *Noun.* See **tertiary air**.

air twist. *Noun.* A process in which twisted capillaries are incorporated in the stems of glass tableware to produce a pleasing decorative effect.

air void. *Noun.* An air-filled space of irregular shape sometimes occurring in freshly mixed concrete; the voids are larger in size than intentionally entrained air bubbles, and are considered to be defects.

akaganéite. *Noun.* β -FeOOH. A brown to yellow coloured, rare natural product. Iron ions occupy positions in an anionic close packed structure. Usually contains some Cl^- ions. It is also a product of the hydrolysis of ferric chloride solution in the presence of urea.

akermanite. *Noun.* $\text{Ca}_2\text{MgSi}_2\text{O}_7$. A discrete ionic pyrosilicate.

alabandite. *Noun.* MnS . Naturally occurring manganese sulphide; a special ceramic with the **rock-salt** structure.

alabaster. *Noun.* (1) Compact, fine-grained white or delicately shaded **gypsum**, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$; used to make statues and vases. (2) A form of hard semi-translucent **calcite**; used in early windows.

alabaster glass. *Noun.* A glass containing inclusions of materials having different indices of refraction, and which shows no colour reaction to light; resembles **alabaster** or **onyx** in appearance.

Albany slip. *Noun.* Clay of high flux content and fine particle size found in the vicinity of Albany, New York; the clay fires in the temperature range of cones 6–9; it is used as a glaze for **electrical porcelain** and **stone-ware** bodies, and as a bond in the manufacture of **vitrified grinding wheels**.

albedo. *Noun.* (1) The fraction of incident electromagnetic radiation reflected by a surface. Most commonly refers to light. (2) The probability that a neutron passing through a surface will return through that surface.

albertite. *Noun.* A black solid form of **bitumen** that exhibits conchoidal fracture.

albite. *Noun.* $\text{Na}(\text{Al}_{0.25}\text{Si}_{0.75}\text{O}_2)_4$. Triclinic crystalline soda feldspar used as an ingredient in ceramic bodies and glazes, and as a substitute for **Cornish stone**. It is colourless through a range of colours to black depending on the impurities present in the crystal structure. It occurs in sedimentary, igneous and metamorphic rocks. Weathers in basic conditions to form **kaolinite clay**. Sometimes known as **white feldspar**, **soda spar**, **white schorl**, and **sodaclase**.

albolite. *Noun.* A plastic cementitious material composed essentially of **silica** and **magnesia**.

Alborex. *Trademark, noun.* $\text{Al}_{1.63}\text{B}_{0.36}\text{O}_3$. An alumina-based, boron-containing, reinforcing **whisker** material 0.5–1.0 μm in diameter and 10–30 μm in length.

alcogel. *Noun.* The rigid product obtained in **sol-gel** processing when **metal alkoxide**-organic solvent solutions are hydrolysed.

alcoholate. *Noun.* A salt formed by replacing the H in OH-groups of organic alcohols by metal cations, for example $\text{Ti}(\text{OC}_2\text{H}_5)_4$; usually soluble in organic solvents and as a result are used extensively in **sol-gel** powder manufacture and processing. See **alkoxide**.

Alcorit. *Tradename, noun.* Porous commercial refractory, designed to have high thermal shock resistance for kiln furniture construction. Consists of **mullite** plus **cordierite**; working temperature 1,350 °C.

alcove. *Noun.* The narrow channel through which molten glass flows from the **fining chamber** to the **forehearth**, or to a revolving pot, for gathering by an Owens machine. See **Owens process**.

alcoxolation. *Noun.* A condensation polymerisation reaction in which a bridging oxo-group is formed by the elimination of an alcohol molecule.

alembic. *Noun.* A type of retort used for distillation.

alexandrite. *Noun.* $\text{BeAl}_2\text{O}_4:\text{Cr}^{3+}$. **Chrysoberyl** doped with chromium to generate **photoluminescent** properties and is used as a gemstone.

algal limestone. *Noun.* A sedimentary limestone that has included algae in the formation and when crystallised this produces microstructural features resembling trees etc. Also called **muddy limestone** and **landscape marble**.

alginates. *Plural noun.* Hydrophilic, colloidal salts of the alginic acids, chiefly sodium or ammonium alginate; used as **binders** and **suspension agents** in ceramic bodies, glazes, porcelain-enamels, and similar slurries, and as a waterproofing agent in concretes.

alginic acid. *Noun.* A polysaccharide isolated from brown kelp. It is a block copolymer of D-mannuronic acid and L-gluconic acid. The monovalent salts are called alginates and are used in ceramic processing. See **alginates**.

algorithm. *Noun.* A set of numerical operations designed to undertake a specific mathematical task.

aliquot. *Noun.* A representative sample of a large quantity of a material.

ALISO-B. *Trademark, noun.* $\text{Al}(\text{OC}_3\text{H}_7)_x \cdot (\text{OC}_4\text{H}_9)_y$, where x approx is equal to y and $x+y=3$. A commercially available aluminium **alkoxide** that is used as a **thixotropic** reagent for slips and the **sol-gel** processing of ceramic powders.

alite. *Noun.* $\text{Ca}_3(\text{SiO}_4)\text{O}$; in cement notation C_3S . A constituent of **Portland-cement clinker**. An ionic **orthosilicate** where regions of Ca^{2+} and O^{2-} packing can be seen reminiscent of the CaO structure. Several **polymorphs** exist depending on the degree of **isomorphous replacement** of Ca^{2+} by Mg^{2+} . Develops compressive strength rapidly when hydrated, i.e., 70 % of final value in 28 days.

alk. *Abbreviation.* Standing for **alkali**.

alkali. *Noun.* A general term applied to the oxides, hydroxides, and carbonates of sodium and potassium, the alkaline earth metals, and other alkaline metals; used primarily as **fluxing agents** in ceramic compositions.

alkali-aggregate reaction. *Noun.* A deleterious reaction between the siliceous parts of aggregates and the alkalis contained in **Portland cement**, the reaction usually occurring in concrete after it has hardened. See **alkali-silica reaction**, **concrete cancer**.

alkalic. *Adjective.* Igneous rocks that contain large amounts of sodium and potassium.

alkali carbonates. *Plural noun.* The carbonate salts of periodic groups 1 and 2. All are extensively used as **fluxing agents**, **accelerators** and in glass batch compositions.

alkali fullerides. *Noun.* M_3C_{60} . The product of the reaction of **buckminsterfullerene** with hot vaporised alkali metals. Chains of three alkali metal atoms are sequestered into the cage of carbon atoms. The proximity of a metallic to insulator transition makes them **high temperature superconductors**, for example Cs_3C_{60} has a T_c value of 38 K.

alkalimeter. *Noun.* (1) An apparatus for measuring the amount of carbon dioxide in carbonates. (2) An apparatus for determining the concentration of alkalis in solution.

alkaline. *Adjective.* Containing an alkali or having the properties of an alkali.

alkaline earths. *Plural noun.* The oxides of barium, calcium, magnesium, strontium, radium, and beryllium; the oxides of barium and calcium are used primarily as fluxes in porcelain-enamels and glazes, and magnesium oxide is used extensively in refractories. Barium oxide is an essential component in oxide superconductors. See **superconductor**.

alkaline glaze. *Noun.* Glaze containing high percentages of alkaline materials, such as Na_2O , K_2O , Li_2O , CaO , MgO , BaO , etc.

alkalinity. *Noun.* (1) The amount of alkali in solution; it relates to the **pH** of the solution. (2) The state of being alkaline.

alkali resistance. *Noun.* The relative degree to which porcelain-enamels, glazes, and other ceramic surfaces will resist attack by aqueous alkaline solutions, the term most frequently referring to the resistance of these products to alkaline materials used in the home, e.g., **alkaline-resisting enamel**.

alkali-resisting enamel. *Noun.* An enamel with overall composition close to a typical porcelain which requires a high application temperature; shows a high resistance to dulling from frequent applications of detergents, soaps, and general alkaline cleaning products.

alkali-silica reaction. *Noun.* A major cause of concrete deterioration caused by volume expansion when ordinary Portland cement, **OPC**, reacts with **acidic aggregate**. The cause of concrete cancer. See **concrete cancer** and **alkali-aggregate reaction**.

alkali zinc phosphate glasses. *Plural noun.* Chemically durable, low temperature glasses with formulae in the range: $xM_2O + yZnO + zP_2O_5$, where, in mole fractions, $x < 0.25$, $y < 0.5$ and $0.29 < z < 0.5$. M is Li, Na or K.

alkoxide-forming. *Noun.* A way to process ceramic fibre-ceramic matrix composites by infiltrating the matrix as an alcoholate (alkoxide) powder into the fibre preform and then the whole is hot pressed.

alkoxysilanes. *Plural noun.* Materials, such as $CH_3CHCH_2Si(OCH_3)_3$, which can be **gelled** by adding water and then heated to prepare silicon carbide, SiC , powders.

alkyd. *Plural noun.* Any of a group of thermoplastic resins prepared by the reaction of some polybasic alcohols, such as glycol or glycerine, with dibasic acids or anhydrides, such as phthalic anhydride; used extensively as adhesives for glass fibres.

allanite. *Noun.* $(Ca,Ce,La,Y)_2(Al,Fe,Be,Mn,Mg)_3(SiO_4)_3(OH)$. A brown-black mineral silicate occurring in **igneous** rocks and is a source of yttrium and beryllium.

allemontite. *Noun.* AsSb. A rare natural alloy of variable composition with all properties intermediate between arsenic and antimony; found in lithium-rich **pegmatites**.

allergens. *Plural noun.* Chemicals that produce allergies in a significant percentage of workers exposed to them.

alligator hide. *Noun.* A defect characterised by an extreme roughness of a porcelain-enamel surface that resembles the hide of an alligator in appearance; it is somewhat analogous to a severe case of **orange peel**.

allochromatic. *Adjective.* A material, usually a mineral, which can occur in a variety of colours.

allochthonous. *Adjective.* Describes rocks or mineral deposits found in a place other than where they or their constituents were produced.

allomerism. *Noun.* Similarity of crystalline structure in substances of different chemical composition.

allomorph. *Noun.* Any of two or more different crystalline forms of a mineral.

allomorphism. *Noun.* Variation in the crystalline form of a chemical compound.

allophe. *Noun.* $Al_2O_3 \cdot SiO_2 \cdot nH_2O$. A gel-like, naturally occurring amorphous hydrous **aluminosilicate clay mineral** sometimes containing appreciable amounts of Fe_2O_3 . When the iron oxide content is 30–40 % it is called **hisingerite**, and **iron allophe** when it contains 15–20 %. Density 1,800–1,900 $kg\ m^{-3}$; hardness (Mohs) 3.

allotrope. *Noun.* Different physical forms in which an element can exist; diamond and graphite are allotropes of carbon.

allotropy. *Noun.* The existence of two or more crystal structures for a substance. Usually the term is reserved for chemical elements; see **polymorphism**.

allowed direction. *Noun.* See **polars**.

allowed energy bands. *Noun.* The restricted regions of possible electron energy levels in a solid.

allowed transition. *Noun.* A transition between two **atomic energy states** which is permitted by the selection rules and which consequently has a relatively high priority.

alloy. *Noun.* A fused combination of two or more materials most commonly encountered in metallurgy but some ceramic composites are alloys of oxides. Not a mixture because the components cannot be physically separated.

alloyed junction. *Noun.* A semiconductor junction formed by alloying metal contacts, which act as **emitter** and **collector** regions, to a semiconductor base **wafer**.

alluvial clay. *Noun.* Brickmaking clay deposited in or near river beds by flowing; water more plastic, less refractory, and darker in colour than **residual clays**.

alluvial fan. *Noun.* A fan-shaped accumulation of **silt**, **sand**, **gravels**, and **boulders** deposited by fast-flowing mountain rivers when they reach flatter land.

alluvial mining. *Noun.* The dredging of alluvial deposits, such as an **alluvial fan**.

alluvium. *Noun.* Fine-grained sand and silt deposited by flowing water.

almandine. *Noun.* The most common iron aluminium silicate **garnet** found as the mineral. **Almandite** is used in a variety of industrial applications mainly in the abrasives area because fracture is by lamella parting to give constant sharp edges. Naturally occurring large purple crystals of gem quality are found and can be cut or carved for decorations. Hardness (Mohs) 7.5–8.

almandite. *Noun.* A mineral in the **garnet** family, which fractures to give very sharp edges, and is therefore used as a coated abrasive. See **almandine**.

alpha activity. *Noun.* The spontaneous emission of doubly charged helium ions from the nucleus.

alpha alumina. *Noun.* α - Al_2O_3 . Occurs naturally as **corundum** and is obtained by heating **alumina hydrates** to temperatures in excess of 900 °C but never to the melting point, 2,050 °C; the hardest, most chemically stable form of alumina. See **alumina**.

alpha case. *Noun.* A brittle ceramic alpha phase, similar to **case hardening**, which forms on surfaces during heating metals, such as titanium, in oxygen containing atmospheres. It can act as a crack initiator.

alpha phase. *Noun.* A rhombohedral **quartz polymorph**; stable below 573 °C.

alpha particle. *Noun.* A positively charged helium-4 nucleus emitted by several radioactive materials.

ALPO. *Acronym.* Stands for aluminophosphate. See **aluminophosphate**.

alternating current loss. *Noun.* Conventional superconductors exhibit losses in alternating current applications, such as in 60-Hz power transmission or in microwave devices. Although little is known about the alternating current characteristics of the new **high-temperature superconductors**, there is no reason to expect that the new materials will exhibit lower alternating current

losses than other types of superconductor materials. Recent measurements on thin films in parallel, applied fields show the presence of a large surface barrier for the entry of flux, which indicates that **hysteresis losses** would be small.

Alternating current thin film electroluminescent device. ACTFELD. *Noun.* A device built-up of thin layers of ceramic phosphor and electrodes on a glass substrate. Used to provide strong, robust visual displays.

alum. *Noun.* (1) $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. Potash alum, a sulphate of potassium and aluminium with astringent and acidic properties. Used as an **accelerator**. (2) Any of various double salts with similar chemical formulae and crystal structure to potash alum. See **alum minerals**. (3) Colloquial name for **alumnite** and **alunogen**.

alumina. *Noun.* Al_2O_3 . The old ceramic name for **aluminium oxide**. An **amphoteric** material second only to **silica** in importance to the ceramic industry; acts as a refractory in low-temperature products and as a **flux** in high-temperature compositions; used extensively in the manufacture of **abrasives**, **refractories**, **whiteware**, refractory coatings, protective surfaces for transistors, glass, and **cermets**; examples of specific products include thread guides, clutch and brake linings, spark plugs, mill linings, blasting nozzles, welding-rod coatings, colour modifiers, jewel bearings for watches and scientific instruments, electron tubes, infrared windows, resistors, **semiconductors**, **lasers**, gas-turbine parts, **radomes**, rocket equipment, and prosthetics, such as artificial teeth and bones. When pure and unhydrated only one **polymorph**, α -**alumina**, exists. It has a hexagonal crystal structure. Other important forms are ternary phases, see **alumina-beta** and **alumina-gamma**. Technical forms of alumina, described as A-1 to A-16 dependent on particle size and Na_2O content (up to 0.4 %), contain α , β and γ -forms. Mp 2,030 °C; density 3,400–4,000 kg m^{-3} ; hardness (Mohs) 9; 22 GN m^{-2} Vickers hardness.

alumina, activated. *Noun.* See **activated alumina**.

alumina-alumina composite. *Noun.* Ceramic alumina fibre preforms are infiltrated from the vapour phase by AlCl_3 , which is then oxidised into an alumina matrix.

alumina balls. *Noun.* (1) High-density, abrasion-resistant balls used as grinding media in ball mills where contamination by iron or other metallic grinding media is to be avoided. (2) Spheres ranging from 6.25 to 18.75 mm in diameter that exhibit high heat and chemical resistance when used in chemical reactors or catalytic beds.

alumina-based fibre. *Noun.* Fibres with >60 wt.% Al_2O_3 usually prepared by extruding an aqueous **gel** through spinnerets, drying and then firing to 1,200 °C; high strength $\sim 2.3 \text{ GN m}^{-2}$ that is preserved to temperatures up to 1,000 °C.

alumina-beta. *Noun.* β - Al_2O_3 . An ionically conducting ceramic of overall hexagonal structure in which each unit cell has, perpendicular to the c-axis, two mirror planes of O^{2-} and M^{n+} ions separated by a **spinel**-like block formed by four layers of close-packed O^{2-} ions with Al^{3+} in octahedral and tetrahedral sites. In β - Al_2O_3 the M^{n+} ions are Na^+ with an idealised formula of $\text{Na}_2\text{O} \cdot 11\text{Al}_2\text{O}_3$. Many variations exist by changing the M^{n+} ions and by varying the size of the spinel blocks along the c-axis. Nomenclature is β' , β'' , β''' , etc., depending on x in $\text{M}_2\text{O} \cdot x\text{Al}_2\text{O}_3$. Conductivity is 2-D in the mirror planes and not along the c-axis direction. Applications are in high temperature, high-energy-density electrochemical cells such as the sodium-sulphur battery.

alumina brick. *Noun.* Refractory brick containing 50 % or more of α - Al_2O_3 ; used in high-temperature applications, such as liners for kilns and furnaces, particularly in areas where the service conditions are severe.

alumina bubble brick. *Noun.* A lightweight, insulating refractory product made by pressing the brick or other shapes from Al_2O_3 into which air bubbles have been introduced by passing a stream of air through a molten Al_2O_3 batch.

alumina, calcined. *Noun.* See **calcined alumina**.

alumina cement. *Noun.* A **hydraulic cementitious** product formed by sintering mixtures of **bauxite** with **limestone**; the main constituent is CaAl_2O_4 , **CA** in **cement notation**, which hydrates to CAH_{10} . Transformations of the hydrate can lead to very porous structures based on C_3A . This cement will set to maximum strength in about 24 h; used where cement resistant to elevated temperatures is required. Consists of Al_2O_3 (40 %), CaO (40 %), SiO_2 (10 %) plus 10 % impurities; density $3,000 \text{ kg m}^{-3}$.

alumina, exploded. *Noun.* See **exploded alumina**.

alumina fibre. *Noun.* A strong, usually short thread or fibre of Al_2O_3 used in the production of plastic-bonded insulating products and **dielectrics**. Most alumina fibre is in fact a form of **aluminosilicate**.

alumina, friable. *Noun.* See **friable alumina**.

alumina, fused. *Noun.* See **fused alumina**.

alumina-gamma. *Noun.* The name given to a number of phases that arise during the decomposition of hydrated, gelatinous $\text{Al}(\text{OH})_3$ and $\text{AlO}(\text{OH})$. Structures are **spinel**-like stabilised by protons; occurs as an intermediate in the **kaolin-to-mullite** transformation.

alumina, hydrated. *Noun.* See **hydrated alumina**.

alumina, microcrystalline. *Noun.* See **microcrystalline alumina**.

alumina, natural abrasive. *Noun.* See **natural alumina**.

alumina porcelain. *Noun.* High-grade, dense, strong porcelain made of bodies in which Al_2O_3 is a major component; used in manufacture of spark plugs and electric insulators.

alumina, reaction-bonded. *Noun.* See **reaction-bonded alumina**.

alumina, regular. *Noun.* See **regular alumina**.

alumina, ruby. *Noun.* See **ruby alumina**.

alumina, semi-friable. *Noun.* See **semi-friable alumina**.

alumina-silica refractories. *Noun.* A class of refractories consisting essentially of alumina and silica, including the **high-alumina**, **fireclay**, and **kaolin refractories**.

alumina, single-crystal. *Noun.* See **corundum**.

alumina, sintered. *Noun.* See **sintered alumina**.

alumina substrate. *Noun.* A sheet of sintered Al_2O_3 made from powder with particle sizes in the range $1\text{--}4 \mu\text{m}$ and usually made by the **doctor blade** method from suspension. Alumina substrates have advantages, such as high insulation resistance, stability in the presence of moisture, good thermal diffusivity.

alumina, tabular. *Noun.* See **tabular alumina**.

aluminates. *Plural noun.* (1) Salts containing $[\text{AlO}_2]^-$ or $[\text{AlO}_3]^{3-}$ ions that are formed when $\text{Al}(\text{OH})_3$ or γ - Al_2O_3 are dissolved in solutions of strong bases. (2) Compounds of various metal oxides with **alumina**, and having the general formula $\text{M}_x\text{O}_y \cdot x\text{Al}_2\text{O}_3$ in the old notation but more usefully as $(\text{M}^{n+})_{5/n}[\text{AlO}_4]^{5-}$ or $(\text{M}^{n+})_{9/n}[\text{AlO}_6]^{9-}$ to indicate the anions present. These compounds are characterised by high-strength and oxidation resistance; melting points ranging from approximately $1,400\text{--}2,140^\circ\text{C}$; employed most widely in structural applications.

alumina trihydrate. *Noun.* In old notation this was prefixed with β - and signified aluminium trihydroxide. See **bayerite**.

alumina, white. *Noun.* See **white alumina**.

alumina whiteware. *Noun.* Any ceramic product with an essentially white body, such as **artware**, **dinnerware**, wall tile, **sanitary ware**, spark plugs, and other products in which Al_2O_3 constitutes a major phase.

alumina-zirconia-silica refractory. **AZS.** *Noun.* A bonded brick consisting of alumina (68 %), zirconia (20 %) and silica (11.5 %); used as a refractory to build furnace superstructures.

aluminiferous. *Adjective.* Containing or yielding **alumina** or aluminium.

aluminite. *Noun.* $\text{Al}_2(\text{SO}_4)_3$. A white pigment often found as a deposit in stream beds as a result of mining pollution. Colloquially known as **alum**.

aluminium antimonide. *Noun.* AlSb . A special ceramic with the **zinc blende** structure; used in the production of semiconductors, transistors, rectifiers, and similar electronic products. One of the III-V compound semiconductors, energy band gap 1.52 eV; significant **hole conductivity**. Mp 1,080 °C.

aluminium borate. *Noun.* (1) $\text{Al}_4\text{O}_3(\text{BO}_3)_2 \cdot 3\text{H}_2\text{O}$. Employed as an ingredient in glass and other vitreous and semi-vitreous products. Dissociates at approximately 1,035 °C. (2) $\text{Al}_{18}\text{O}_{25}(\text{BO}_2)_4$. Employed in bodies requiring good thermal-shock resistance and refractoriness under load. Mp about 1,950 °C.

aluminium boride. *Noun.* Covers several special hard ceramics (1) AlB_2 . Mp 1,654 °C; **Knoop hardness** 9.75 GN m⁻²; dissociates at about 980 °C; density 3,160 kg m⁻³. (2) AlB_{10} . Mp about 2,421 °C; density 2,540 kg m⁻³; Knoop hardness 26.5 GN m⁻² (3) AlB_{12} . Mp 2,163–2,213 °C; density 2,560–2,660 kg m⁻³; Knoop hardness 22.5–24.5 GN m⁻². These borides have different degrees of covalent bonding between the boron atoms in the structure, e.g., AlB_{12} contains B_{12} icosahedral units connected at their corners to form a **cubic close-packed** arrangement; the Al^{3+} occupy interstices in this structure. These, like most borides, have covalent+ionic+metallic components in their bonding and so have metallic appearance.

aluminium carbide. *Noun.* Al_4C_3 . Ionic carbide in which the carbon ions are isolated and so is known as a methanide because hydrolysis yields methane gas. Mp about 2,704 °C; density 2,994 kg m⁻³.

aluminium chlorhydrate. *Noun.* $\text{Al}_2(\text{OH})_5\text{Cl} \cdot x\text{H}_2\text{O}$, where $x=2\text{--}2.5$. Used in ceramic applications where high purity **alumina** is required, such as in ceramic fibre and catalyst support systems. Sold as a 50-wt% solution in water and called **chlorthydrol**.

aluminium enamel. *Noun.* A relatively low-melting porcelain enamel formulated specifically for application to aluminium and aluminium alloys.

aluminium fluoride. *Noun.* AlF_3 . A source of **alumina** and fluorine and used for its fluxing and opacifying properties. Sublimes at about 1,260 °C; density 2,889 kg m⁻³.

aluminium fluoride hydrate. *Noun.* $\text{AlF}_3 \cdot 3\frac{1}{2}\text{H}_2\text{O}$. Sometimes used in the production of white porcelain-enamels.

aluminium fluosilicate. *Noun.* $\text{Al}_2(\text{SiO}_4)(\text{OH},\text{F})_2$. Known as **topaz** and used as a gemstone. It is brittle with perfect cleavage in one direction; sometimes used in porcelain-enamels and glass manufacture. Density 3,490–3,570 kg m⁻³; hardness (Mohs) 8.

aluminium hydroxide. *Noun.* (1) $\text{Al}(\text{OH})_3 \cdot x\text{H}_2\text{O}$. A white gelatinous precipitate from solutions containing Al^{3+} ions. Used in the manufacture of glassware and glazes.

Loses water at 300 °C; density about 2,400 kg m⁻³. (2) $\text{Al}(\text{OH})_3$. A white powder derived from **bauxite**; used in the manufacture of ceramics and glass.

aluminium metaphosphate. *Noun.* $\text{Al}(\text{PO}_3)_3$. Used in porcelain-enamels, glazes, and glasses and as a high-temperature insulating cement. Mp about 1,537 °C.

aluminium monohydrate. *Noun.* AlOOH . Used as an inorganic thickener and suspension agent, coating material, binder, high temperature adhesive, and as a source of **alpha-alumina** or **corundum** in bodies formed by hot pressing. Also called **diaspore**. Density 2,400 kg m⁻³.

aluminium nitride. *Noun.* AlN . Special ceramic with a low coefficient of friction; used as a component in the manufacture of crucibles for the melting of aluminium. Mp 2,000 °C; density 3,260 kg m⁻³; hardness (Mohs) 6–7.

aluminium orthophosphate. *Noun.* AlPO_4 . A phase with several polymorphs isostructural with **tridymite** and **crystalite**. They are used as binders in refractories and dental cements, and as partial replacement for SiO_2 to reduce liquidus temperatures and batch costs. Because they are analogous to the silica phases they are used to form a series of silicophosphate phases. See **aluminium phosphates**.

aluminium oxide. *Noun.* Al_2O_3 . Used in the natural form, or as a prepared compound, as a component in abrasives, refractories, electrical insulators, electronic products, crucibles, laboratory ware, whiteware, and a wide variety of other ceramic products in which strength, toughness, thermal durability, chemical resistance, and similar properties are of primary importance. Mp 2,030 °C; density 3,400–4,000 kg m⁻³; hardness (Mohs) 9. See also **alumina**, **bauxite**, **corundum**.

aluminium oxide, hydrous. *Noun.* See **hydrous aluminium oxide**.

aluminium phosphates. *Plural noun.* A general name used to describe phases occurring in **phosphate-bonding agents** that arise from the reaction of **phosphoric acid** with oxides and **siliceous** materials at elevated temperature. The main phases present up to 400 °C are: $\text{AlH}_3(\text{PO}_4)_2 \cdot 3\text{H}_2\text{O}$, $\text{Al}(\text{H}_2\text{PO}_4)_3$ and $\text{Al}(\text{HPO}_4)_2$ all of which are acid phosphates but above 400 °C **aluminium orthophosphate** is the main phase along with lesser amounts of $\text{Al}(\text{PO}_3)_3$ and $\text{Al}_4(\text{P}_2\text{O}_7)_3$.

aluminium phosphide. *Noun.* AlP . A fairly wide band gap, 2.5 eV, type semiconductor with the **zinc blende** structure; bulk modulus 86 GN m⁻²; mp 1,500 °C.

aluminium silicate refractories. *Plural noun.* Two crystalline phases found in the Al-Si-O system of variable composition and structure: (1) **mullite** $\text{Al}[\text{Si}_2\text{Al}_x\text{O}_{5.5-0.5x}]$, where x varies from 1.25 to 1.40; long **acicular** crystals which give strength to pottery and

fireclay refractories; used in the manufacture of various refractory products and laboratory ware. Stable at high temperatures; mp 1,810 °C but softens at 1,650 °C; density 3,150 kg m⁻³. (2) **Sillimanite**, **kyanite** and **andalusite** all have the same nominal composition, Al₂OSiO₄, and are stable up to 1,810 °C when they decompose into mullite needles and silica. Porcelain made from these minerals has high mp, low thermal expansion and low electrical conductivity and therefore find use as spark plugs. (3) A more general term used to describe ceramic material composed essentially of aluminium, silicon and oxygen; prepared from such materials as **bauxite**, **andalusite**, **diaspore**, **gibbsite**, **kyanite**, **sillimanite** and blends of Al₂O₃ and SiO₂.

aluminium sodium sulphate. *Noun.* AlNa(SO₄)₂·12H₂O. Called **soda alum**; occurs in clay bearing rocks. See **alum minerals**.

aluminium titanate. *Noun.* Al₂TiO₅. Used in the production of special ceramics resistant to thermal shock. Mp 1,860 °C; stable from 1,150 to 1,865 °C, density 3,680 kg m⁻³. See **tialite**.

aluminophosphate. **ALPO.** *Noun.* A catalyst with a **zeolite** structure made by heating **aluminium hydroxide gel**, **phosphoric acid**, cobalt acetate and a template molecule, 2-methoxycyclo hexamine, at 200 °C.

aluminosilicate. *Noun.* A compound in which some of the silicon in [SiO₄]⁴⁻ tetrahedra have been **isomorphously** replaced by Al³⁺; the resultant negative charge increase in the solid is compensated usually by intercalating other metal ions into the structure or occasionally by **oxygen vacancies**. The most refractory aluminosilicate is mullite. See **mullite**.

aluminothermic process. *Noun.* A method developed to make carbides using the aluminothermic reaction where mixtures of oxides, carbon and aluminium powder are ignited under inert gas pressure and after a violent **exothermic reaction** the molten **alumina** slag is removed from the carbide. Also called the **thermite process**.

aluminous cement. *Noun.* (1) See **alumina cement**. (2) Another name for **ciment fondu**.

aluminous porcelain. *Noun.* An alumina-glass composite used in dentistry containing as much as 50 % Al₂O₃.

alum minerals. *Plural noun.* A large and diverse group of ionic chemical salts having the general formula MⁿM³⁺(SO₄)₂·12H₂O. Some have industrial use, e.g., NaAl(SO₄)₂·12H₂O and medical use as styptic pencil KAl(SO₄)₂·12H₂O.

alumoxanes. *Plural noun.* See **carboxylate-alumoxanes**.

Alundum. *Trademark, noun.* Commercial **fused alumina** used as an abrasive or refractory material.

alunite. *Noun.* KA1₃(SO₄)₂(OH)₆. A naturally occurring white or reddish mineral with the hexagonal **tungsten**

bronze structure formed from sheets of AlO₆ octahedra. The source of commercial alums and a calcined material employed in the production of **high-alumina refractories**. Density 2,600–2,800 kg m⁻³; hardness (Mohs) 3.5–4.0.

alunogen. *Noun.* Al(OH)SO₄. Aluminium hydroxy sulphate; used as a white pigment and colloquially known as **alum**.

alunogenite. *Noun.* Al₂(SO₄)₃·18H₂O. A mineral used in the paper industry which when heated produces **alumina**.

amazonite. *Noun.* A mineral rock suitable for **tumbling**, which produces attractive patterned decorative stones.

amber glass. *Noun.* A tinted glass with colours ranging from pale yellow to brown or reddish brown by the addition of iron oxide and sulphur compounds to the **batch**.

amber mica. *Noun.* Another name for the magnesium bearing mica, **phlogopite**.

ambetti. *Noun.* A translucent antique glass containing minute opaque specks of crystallised particles from the molten batch.

ambient. *Adjective.* Surrounding; a term describing the conditions or character of an encompassing environment, such as the atmosphere or fluid, in terms of its temperature, composition, pressure etc.

ambipolar. *Adjective.* A description of a material in which both electrons and holes can carry current; **graphene** is an example.

amblygonite. *Noun.* LiAl(PO₃)₄(F,OH). Lithium aluminium fluophosphate; a mineral with obtuse angle crystals, hence its name from Greek amblys=blunt plus gonia=angle. A grey-white mineral source for lithium and used as a flux in low-temperature porcelain-enamels and to promote opacity in glass dinnerware. In ceramic bodies the F and Li decrease expansion and increase their strength; normally grey-white with a pearly lustre but can be pink, blue or pale green. Mp 1,170 °C; density 3,100 kg m⁻³; hardness (Mohs) 6.

Amer. Ceram. Soc. *Abbreviation.* Stands for the American Ceramic Society.

American bond. *Noun.* The bond in which a **header** course of brick is used every fifth, sixth, or seventh course, with **stretcher** courses being used between the header courses. Also known as **common bond**.

American hotel china. *Noun.* A heavy, moderately translucent dinnerware of high strength and a water-absorption value of less than 0.3 %; the ware is coated with a glaze highly resistant to commercial soaps and detergents, food chemicals, and physical damage.

amethyst. *Noun.* (1) A purple or violet transparent variety of **quartz** and because the colour is rarely distributed evenly, tumble-polished stones have a pleasing mottled

appearance. The colours are caused by iron and titanium impurities. (2) A purple variety of **sapphire** known as **oriental amethyst**.

amethyst contrast enhancer. ACE. *Noun.* A type of optical glass filter used to improve colour discrimination. Normal spectacle glass compositions to which a mixture of **rare earth oxides** are added. Works by selectively positioning transmission in the blue, green, and red spectral region.

AMLCD. *Abbreviation.* Stands for active matrix liquid crystal display. See **liquid crystal display**.

ammonia. *Noun.* NH_3 . Important base used to precipitate hydroxides; when added to iron oxide bodies of the **sgraffito-decorated** type it **deflocculates** and controls the segregation of iron oxide and stabilises the red colour over a firing range wider than normal.

ammonite. *Noun.* The shell of an extinct marine cephalopod occurring in fossils as a form of calcium carbonate.

ammonium alum. *Noun.* $\text{NH}_4\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. Used to increase the set of porcelain-enamel ground coats and acid-resisting cover coats.

ammonium bicarbonate. *Noun.* $(\text{NH}_4)\text{HCO}_3$. Used with fluorine compounds in an etching bath to produce frosted surfaces on glass, such as obtained on electric light bulbs.

ammonium bifluoride. *Noun.* NH_4HF . Used in combination with hydrofluoric acid to produce frosted surfaces on glassware.

ammonium dawsonite. *Noun.* $\text{NH}_4\text{Al}(\text{OH})_2\text{CO}_3$. A source of **alumina** powder because thermal decomposition yields mono-sized, highly dispersed Al_2O_3 powder that is good for **slip casting** in a porous plastic mould before low-temperature, $<1,200^\circ\text{C}$, sintering to high density.

ammonium diuranate. *Noun.* $(\text{NH}_4)_2\text{U}_4\text{O}_{13}$. A precipitate made by adding ammonia to **uranyl nitrate** solution. Heating to 450°C turns it into U_3O_8 , which is the precursor for UO_2 or uranium metal.

ammonium metavanadate. *Noun.* NH_4VO_3 . Used as a colorant to produce yellow, green and turquoise glazes and porcelain-enamels, frequently used in conjunction with the oxides of tungsten, molybdenum, and zirconium. Density $2,300\text{ kg m}^{-3}$.

ammonium molybdate. *Noun.* $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$. Sometimes used as an **adherence-promoting agent** in clear and white porcelain-enamel ground coats. Decomposes on heating; density $2,380\text{--}2,950\text{ kg m}^{-3}$.

ammonium paratungstate. *Noun.* $(\text{NH}_4)_{10}\text{W}_{12}\text{O}_{41} \cdot 11\text{H}_2\text{O}$. Very insoluble; used in the production of tungsten trioxide, WO_3 , by calcination at 600°C . Density $2,300\text{ kg m}^{-3}$.

ammonium polymethylmethacrylate. APMA. *Noun.* Aqueous solutions act as a dispersing agent for very

fine powders of **alumina** enabling them to be more easily cast.

ammonium stearate. *Noun.* $\text{C}_{17}\text{H}_{35}\text{COO}(\text{NH}_4)$. Employed as a waterproofing additive in hydraulic cements.

amorphatisation. *Noun.* The loss of order and crystalline structure. See **void swelling**.

amorphous diamond. The name is short for amorphous ceramic; a class of diamond prepared in vacuum by **laser ablation** of **graphite** at intensities in excess of 10^{11} W cm^{-2} . When condensed onto substrates nodules of amorphous diamond are formed as both the cubic and hexagonal modification of diamond intergrow in a random way. It consists of sp^3 -bonded carbon in a matrix of sp^2 -bonded carbons. Now used as a protective coating material.

amorphous. *Adjective.* Having only short-range order leading to no discernible crystalline structure.

amorphous carbon. *Noun.* Another **allotrope** of **carbon** manifest in a number of forms one of which is **carbon black**.

amorphous carbon nitride. *Noun.* C_3N_4 . A semiconductor material made by reacting CO_2 with **lithium nitride** at 330°C . The **exothermic** reaction also produces lithium cyanamide, Li_2CN_2 , and so maybe an energy efficient way to fix atmospheric carbon dioxide.

amorphous graphite. *Noun.* A form of natural graphite formed by metamorphosis of coal seams exposed to high pressure and moderate temperatures. Not accurately described as amorphous but rather as **cryptocrystalline**; soft and black in appearance.

amorphous iron hydroxide. *Noun.* See **ferrihydrate**.

amorphous limit. *Noun.* An assumed limit to the high temperature **thermal conductivity** of materials culminating in the measured values found for **silica glass** at high temperatures.

amosite. *Noun.* $\text{Fe}_{5.5}\text{Mg}_{1.5}(\text{Si}_4\text{O}_{11})_2(\text{OH})_2$. Also known as **grunerite**, an **amphibole** type fibrous silicate consisting of harsh, spikey brittle fibres grey in colour and diameters less than $0.1\text{ }\mu\text{m}$. Used at 35 % level in calcined calcium silicate matrix as tiles for thermal insulation; also mixed with magnesia or sodium silicate as thermal tiles. Density $3,430\text{ kg m}^{-3}$; hardness (Mohs) 5–6; has a high tensile strength at 2.5 GN m^{-2} .

amount of substance. n. *Noun.* A measure of the number of entities present in a substance. The entity may be an atom, molecule, ion, electron, photon etc., or any combination of these. The amount of substance of an element, for example, is proportional to the number of atoms present and the constant of proportionality is the **Avogadro constant**. The **SI** unit of amount of substance is the **mole**.

amp. *Abbreviation.* Stands for **ampere** or **amperage**. See **ampere**.

ampelite. *Noun.* Carbonaceous **schist** containing alumina, silica, and sulphur; sometimes used as a refractory.

amperage. *Noun.* (1) The strength of an electric current measured in amperes. (2) The rated current of an electrical component or device.

ampere. A. *Noun.* The basic **SI unit** of electric current; defined as the constant current that, when maintained in two parallel conductors of infinite length and negligible cross section placed 1 m apart in a vacuum, produce a force of attraction between them of $2 \times 10^{-7} \text{ N m}^{-1}$. 1 A is equivalent to 1 C s^{-1} . Abbreviated a; A; amp.

Ampere currents. *Noun.* A postulated “molecular-ring” current used to explain the phenomenon of magnetism, as well as the apparent nonexistence of isolated magnetic poles.

Ampere law. *Noun.* A law giving the magnetic induction at a point due to given currents in terms of the current elements and their positions relative to the point. Also known as the Laplace law. A law giving the line integral over a closed path of the magnetic induction due to given currents in terms of the total current linking the path.

ampere metre squared. *Noun.* The **SI unit** of electromagnetic moment. Abbreviated A m^2 .

ampere-minute. A min. *Noun.* A unit of electrical charge, equal to the charge transported in 1 min by a current of 1 A, or to 60 C.

ampere per square inch. *Noun.* A unit of current density, equal to the uniform current density of a current of 1 A flowing through an area of 1 square inch. Abbreviated A in^{-2} .

Ampere rule. *Noun.* The rule stating that the direction of the magnetic field surrounding a conductor will be clockwise when viewed from the conductor if the direction of current flow is away from the observer

ampere square metre per joule second. *Noun.* The **SI unit** of gyromagnetic ratio. Abbreviated $\text{A m}^2 \text{ J}^{-1} \text{ s}^{-1}$.

Ampere theorem. *Noun.* The theorem which states that an electric current flowing in a circuit produces a magnetic field at external points equivalent to that due to a magnetic shell whose bounding edge is the conductor and whose strength is equal to the strength of the current.

ampere-turn. *Noun.* A unit of magnetomotive force in the **SI system**. It is produced by a current of 1 A passing through one full turn of a coil. Measured as an ampere-turn it is equivalent to 1.257 **gilberts**. Abbreviated to amp-turn.

amphibole. *Noun.* Any member of a large group of **mineral silicates** containing calcium, iron, magnesium, sodium and aluminium often with **acicular crystal habit**, dark in colour. From the Greek *amphibolos* meaning uncertain. See **amphiboles**.

amphiboles. *Plural noun.* Widely found in **igneous** and **metamorphic rocks**. Double-chain silicate minerals formed from SiO_4 tetrahedra sharing corners in 2-D chains. Silicon can be partially replaced by Al. They commonly contain OH^- , F^- or O^{2-} ions. Examples are **asbestos**, **hornblende** and **tremolite**. The basic structural unit consists of infinite chains formed from two single $[(\text{SiO}_3)^{2-}]_n$ chains that share oxygen ions to form $[(\text{Si}_4\text{O}_{11}\text{OH})^{7-}]_n$.

amphibolite. *Noun.* A **metamorphic** rock containing mainly **amphibole** and **plagioclase**.

amphichroic. *Adjective.* A system producing two colours, one in an acid environment and the other in an alkaline medium.

amphiphilic. *Adjective.* Having a hydrophobic and a hydrophilic end.

amphora. *Noun.* A large ceramic jar with a narrow neck and with two handles that rise almost to the level of the mouth.

amphoteric. *Adjective.* Capable of reacting as an acid or as a base; for example, Al_2O_3 , Fe_2O_3 and Cr_2O_3 .

amplifier. *Noun.* A device that increases the amplitude of a signal at its input to give a larger signal at its output.

amplitude. *Noun.* The maximum displacement above or below the zero point of a wave or **wave function**. The energy of a wave is proportional to the square of the amplitude.

amplitude modulation. *Noun.* One of the main methods of transmitting audio or visual information; the amplitude of a radio frequency carrier wave is modulated by the information that is to be transmitted while the frequency of the carrier wave remains unchanged.

ampoule. *Noun.* A small bulbous glass container that may be filled and then sealed by fusion of the neck.

amu. *Abbreviation.* Stands for atomic mass unit. See **atomic mass unit**.

amygdale. *Noun.* An oval shaped pore in a solid, formed by escaping gas on cooling, that has subsequently become filled with another phase of lighter colour, such as **quartz** or **calcite**.

amygdaloidal. *Noun.* (1) A volcanic igneous rock containing **amygdales**. (2) Having a shape like that of an almond.

amygdaloidal basalt. *Noun.* A rock that arises from **vesicular basalt** when the large pores are filled with another mineral, such as **calcite**.

anacoustic. *Adjective.* Unable to support the propagation of sound.

analcite. *Noun.* $\text{NaAlSi}_3\text{O}_6 \cdot \text{H}_2\text{O}$. A white or grey coloured cubic **zeolite** mineral also called **zedite**.

analogue. *Noun.* Something similar to something else, particularly in terms of features or properties on which comparisons may be made.

analogue signal processor. *Noun.* High-speed analogue signal processors performing such functions as filtering, convolution, correlation, Fourier transformation, and analogue-to-digital (A-to-D) conversion are important for many applications. Various high-speed A-to-D converters have been tested successfully at 4.2 K. If high-quality **Josephson junctions** can be fabricated from the new superconductors, these devices should perform comparably at 77 K. At this temperature, integration of the superconducting devices with some semiconducting devices (for example, **complementary metal oxide semiconductors**) becomes feasible, and new hybrid systems may well result in the fastest A-to-D converters available.

analogue-to-digital converter. ADC. *Noun.* A device for presenting data to a digital computer from an input varying directly with the property being monitored.

analyser. *Noun.* See **polariser**.

analysis. *Noun.* The separation and measurement of the constituents of a substance, and the interpretation of these results. Also identified as chemical content, mineral content, and physical properties.

analysis, gravimetric. *Noun.* See **gravimetric analysis**.

analysis, mechanical. *Noun.* See **mechanical analysis**.

analysis, optical. *Noun.* See **optical analysis**.

analysis, proximate. *Noun.* See **proximate analysis**.

analysis, qualitative. *Noun.* See **qualitative analysis**.

analysis, quantitative. *Noun.* See **quantitative analysis**.

analysis, screen. *Noun.* See **screen analysis**.

analysis, size. *Noun.* See **size analysis**.

analysis, statistical. *Noun.* See **statistical analysis**.

analysis, ultimate. *Noun.* See **ultimate analysis**.

analysis, volumetric. *Noun.* See **volumetric analysis**.

analysis, x-ray. *Noun.* See **x-ray analysis**.

analytical-reagent grade. *Noun.* A classification adopted by the American Chemical Society to designate the quality of a chemical or chemical reagent in terms of its composition and degree of purity.

anamorphism. *Noun.* Metamorphism in rocks in which complex minerals are formed from simpler ones. See **metamorphic**.

anatase. *Noun.* TiO_2 . A blue or black mineral that is the tetragonal form of TiO_2 ; used as an **opacifier** and pigment in porcelain-enamels, glazes, and glass; the first polymorph to crystallise in enamels containing TiO_2 but on annealing it changes to rutile. Mp about $1,885^\circ\text{C}$; density $3,900\text{--}4,200\text{ kg m}^{-3}$; hardness (Mohs)

$5.5\text{--}6$ and Vickers 9.5 GN m^{-2} . See **titanium dioxide**, **rutile**, and **brookite**.

anchor. *Noun.* An L-shaped supporting device used to mount glass, masonry, concrete, or other panels or units to a wall or other surface.

anchored-type ceramic veneer. *Noun.* Any ceramic panel or sheet laid superficially over a permanent backing and then anchored in place.

anchor, storm. *Noun.* See **storm anchor**.

andalusite. *Noun.* Al_2OSiO_4 . A **subsaturate** mineral which dissociates to yield principally **mullite** on firing at $1,350^\circ\text{C}$; used as a component in refractories, spark plugs, insulators, and **whiteware** bodies. See also **kyanite** and **sillimanite**. Density $3,000\text{--}3,500\text{ kg m}^{-3}$; hardness (Mohs) $7\text{--}7.5$.

andesine. *Noun.* A soda-lime **feldspar** in which the principal constituents are **albite**, $\text{NaAlSi}_3\text{O}_8$ and **anorthite**, $\text{CaAl}_2\text{Si}_2\text{O}_8$.

andesite. *Noun.* An **amphoteric igneous** rock of intermediate **silica** content and small grain size formed by volcanic extrusion. It contains **andesine**, **amphibole**, **pyroxene** and **plagioclase feldspar**.

Andrades creep law. *Noun.* Flow under constant stress when the strain is characterised by $\varepsilon = \beta t^{1/3}$, where t is the elapsed time and β is a constant. It occurs at the beginning of creep tests where transient flow predominates.

Andreasen similarity condition. *Noun.* An equation that uses the **cumulative percent finer than** concept: $\text{CPFT}/100 = [D/D_L]^n$, where D is the particle diameter, D_L is the largest particle size and n is the distribution modulus.

andradite. *Noun.* $\text{Ca}_3\text{Fe}_2(\text{SiO}_4)_3$. A **garnet** whose colour varies from yellow-green to brownish-black; used as a gemstone. Different coloured varieties have different names, such as **topazolite**. Used as a gemstone.

Andreasen sedimentation pipette. *Noun.* An instrument in which differences in settling rate are employed as a means of determining the particle size distribution in clays and materials of similar character.

Andrews's elutriator. *Noun.* A device consisting of a sequence of classifiers and a graduated cylinder for use in making particle-size analyses. See **classifier**.

Andrieux-Weiss process. *Noun.* An electrochemical method involving the electrolysis of fused masses of carbonates to produce **carbide** and **oxide** mixtures from which the oxide can be chemically removed to leave behind refractory carbide material.

anechoic. *Adjective.* Having a low degree of reverberation.

anelasticity. *Noun.* Time-dependent elastic i.e., non-permanent, strain in response to stress in some materials.

aneroïd. *Adjective.* Not containing a liquid.

aneroïd barometer. *Noun.* A barometer in which variations in atmospheric pressure are measured by fluctuations of a thin elastic metal covering a partially evacuated chamber and indicated by a pointer on a calibrated dial.

anfractuös. *Adjective.* Convoluted; characterised by twists and turns.

angle bead. *Noun.* A slender, curved item of ceramic tile designed to finish the internal or external corners of a wall tile installation.

angle brick. *Noun.* A brick shaped to fit a corner.

angle of deviation. *Noun.* The angle between the **refracted ray** and the **incident ray** when a ray of light passes from one medium to another.

angle of drain. *Noun.* After dipping ware in a porcelain-enamel slip, the angle at which ware is placed on a rack to drain to obtain a desired coating thickness.

angle of incidence. *Noun.* The angle between a ray of light at a surface and a line perpendicular to that surface.

angle of nip. *Noun.* The maximum angle of the jaws, rolls, mantle, or ring of a **jaw crusher** which will accept and grip a solid mass for crushing.

angle of reflection. *Noun.* The angle a beam of reflected radiation makes with the normal to a surface at the point of reflection.

angle of refraction. *Noun.* The angle made by the refracted part of a light ray with a line perpendicular to the surface of the refracting medium through the point of incidence of the refracted ray.

angle of repose. *Noun.* The maximum angle to the horizontal that heaps of powders, aggregates, etc., will make before becoming unstable and sliding.

angle of wind. *Noun.* The angle of the **roving band** with respect to the **mandrel**. It is also described as the angle contained between a **warp of yarn** on the surface of a **package** and the diametrical plane of the package.

anglesite. *Noun.* PbSO_4 . Oxidised layer of **galena** deposits; a source of lead oxide in ceramics.

angle tile. *Noun.* A tile designed or cut for placement in an angular space.

angstrom unit. \AA . *Noun.* A length equal to 10^{-10} m; used primarily to express wavelengths in the x-ray region and to denote the size of x-ray unit cell dimensions of crystal structures.

angular acceleration. *Noun.* The rate of change of **angular velocity**.

angular frequency. ω . *Noun.* $\omega = 2\pi\nu$ or $2\pi c/\lambda$, where λ is the wavelength, c is the velocity of propagation of the electromagnetic wave, and ω is the angular

frequency; used in mathematical treatments of electromagnetic waves.

angular momentum. *Noun.* A vector quantity. The product of the momentum of a rotating body and its distance from the axis of rotation.

angular velocity. *Noun.* The velocity of a body rotating about a fixed point measured as the rate of change of the angle subtended at that fixed point by the path of the body.

angulate. *Adjective.* Having angles; being angular shaped.

anharmonicity, electrical. *Noun.* See **electrical anharmonicity**.

anharmonicity, mechanical. *Noun.* See **mechanical anharmonicity**.

anhedral. *Adjective.* A solid having no planar surfaces.

anhydride. *Noun.* (1) An oxide which on addition of water produces an acid or a base. (2) A material formed from another by removal of water.

anhydrite. *Noun.* CaSO_4 . Natural deposits in sedimentary rocks formed by evaporation of sea water above 25°C . Used as a drying agent, as a substitute for **gypsum** in cement, and in the manufacture of ammonium sulphate fertiliser. Mp $1,450^\circ\text{C}$; density $2,963\text{ kg m}^{-3}$; hardness (Mohs) 3–3.5.

anhydrous. *Adjective.* Without water, both free water and water of crystallisation.

anhydrous borax. *Noun.* $\text{Na}_2\text{B}_4\text{O}_7$. A refined borate used in ceramics, glass frits and glass manufacture. See **borates**.

anhydrous boric acid. *Noun.* B_2O_3 . See **boric oxide**.

anion. *Noun.* A negatively charged ion that is attracted to the anode during electrolysis.

anion adsorption. *Verb.* The adsorption of anions from solution on to free solid surfaces.

anionic dispersant. *Noun.* Polymeric materials used to generate steric hindrance at the surface of nanoparticles to prevent aggregation or agglomeration. Polyacrylic acid is a common dispersant used to disperse TiO_2 and BaTiO_3 . The amount used depends on the molecular weight of the polymer, pH, and volume fraction of solid. See **aggregate** and **agglomerate**.

anionic exchange. *Noun.* A type of ionic exchange in which the negative ions in a solution are exchanged with the negative ions in a solid, the superficial physical structure of the solid being unaffected. This process is preceded by **anion adsorption**.

anionic exchange capacity. *Noun.* A measure of the ability of a solid substance, such as clay, to exchange or adsorb ions; usually expressed in milliequivalents of ion per 100 g of solid.

anisometric. *Adjective.* Describes a crystal or artefact having unequal measurements.

anisotropic. *Adjective.* Physical properties that depend on the crystallographic direction in which they are measured. Even materials with the cubic crystal structure can have some anisotropic properties.

ankerite. *Noun.* A variety of **dolomite** in which considerable **isomorphous replacement** of Mg^{2+} and Ca^{2+} by Fe^{2+} has occurred.

annabergite. *Noun.* $\text{Ni}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$. A green, monoclinic mineral that is a source of arsenic and nickel. Also called **nickel bloom**.

anneal. *Verb.* (1) The process of heating and cooling glass on a prescribed schedule to prevent or release stresses which contribute to brittleness. (2) The heating of metal shapes to a red heat or above as a means of removing scale, rust, and other surface contaminants prior to cleaning and pickling the ware prior to **porcelain-enamelling**. (3) Quenched or cold-worked solids in general will contain a considerable amount of **strain energy** stored in the crystals arising from an array of **dislocations**. If the material is heated to a temperature near the melting point, re-crystallisation can take place. This treatment, known as **annealing**, allows the grains to re-form themselves in strain-free distributions.

annealed glass. *Noun.* See **anneal**. Such glass breaks into **shards**.

annealing. *Noun.* A generic term used to denote a heat treatment designed to alter the microstructure and hence the properties of a material. See **anneal**.

annealing, abrasive. *Noun.* See **abrasive annealing**.

annealing, acid. *Noun.* See **acid annealing**.

annealing, bright. *Noun.* See **bright annealing**.

annealing, fine. *Noun.* See **fine annealing**.

annealing fire. *Verb.* (1) To heat treat glass and metals to remove internal stresses. (2) To heat treat metal shapes prior to cleaning for porcelain-enamelling to burn off scale, dirt, grease, and other contaminants, and sometimes to temper the metal.

annealing furnace. *Noun.* The furnace or oven in which the temperature, and sometimes the atmosphere, is controlled for the annealing of glass or metal.

annealing, glass. *Noun.* See **glass annealing**.

annealing point. *Noun.* The temperature, or the temperature-time relationship, at which internal stresses in a glass are substantially reduced or relieved in a time of about 15 min. The viscosity of the glass at this temperature is about 10^{12} Pa·s or 10^{13} P.

annealing, porcelain-enamelling. *Verb.* See **annealing fire** (2).

annealing range. *Noun.* The range of temperatures in which the inherent internal stresses in glass can be reduced or relieved and which generally is at a rate considered feasible for commercial production.

annealing temperature. *Noun.* Any temperature within a temperature range at which internal stress in a glass can be substantially reduced or relieved, usually for commercially practical purposes, within a matter of minutes. In order to achieve this, the viscosity of the glass must be close to 10^{12} N s m^{-2} .

annealing twin. *Noun.* See **twinned crystal**.

annular coil. *Noun.* An electromagnetic coil of the encircling type.

annular kiln. *Noun.* A kiln of the type in which ware is placed in stationary compartments, and the firing zone is moved through each compartment in a successive manner by adjustment of the fuel input.

annular nozzle. *Noun.* A nozzle equipped with a ring-shaped orifice.

anode. *Noun.* The positive, electron-deficient electrode from which electrons flow in an electrochemical circuit. Oxidation occurs at the anode.

anodic cleaning. *Verb.* See **anodic pickling**.

anodic pickling. *Noun.* An electrolytic process for cleaning and pickling metal to be used for porcelain enamelling, or any other finishing treatment, in which the metal is used as the anode in a cleaning and pickling bath. Also known as **anodic cleaning**.

anomalous. *Adjective.* Deviating from the normal or the expected value.

anomalous dispersion. *Noun.* The existence of a large discontinuity in the dispersion curve of a material because at longer wavelengths the material has higher values of **refractive index**.

anorthic. *Adjective.* Synonym for **triclinic**.

anorthite. *Noun.* $\text{CaAl}_2\text{Si}_2\text{O}_8$. Low-thermal-expansion aluminosilicate of the **feldspar** group found mainly in igneous rocks; a calcium **feldspar** used in concretes, porcelain-enamels, glazes, abrasives, abrasive bonds, artificial teeth, glass, insulating compounds, and conventional ceramic bodies. Also known as **calcium feldspar**. Density 2,740–2,760 kg m^{-3} ; hardness (Mohs) 6.0–6.5.

anorthoclase. *Noun.* A **feldspar** of a composition between **albite** and **orthoclase** formed by rapid cooling to yield a **perthite**, therefore metastable, but persists indefinitely at normal temperatures; occurs only in lavas. Also known as **soda orthoclase**, **soda microcline** and **anorthose**.

anorthose. *Noun.* See **anorthoclase**.

anorthosite. *Noun.* A coarse grained igneous rock consisting mainly of **plagioclase feldspar**.

anta. *Noun.* A **pilaster** attached to the end of a side wall.

antenna. *Noun.* A device to transform electromagnetic energy from a conducted mode to a radiated mode or vice versa.

anthophyllite. *Noun.* $\text{Mg}_7[\text{Si}_4\text{O}_{11}](\text{OH},\text{F})_2$. A natural fibrous mineral of the **amphibole** class used as a reinforcing fibre.

anthracite. *Noun.* The hardest and highest quality coal; shiny in appearance and clean to touch it gives out most heat with little smoke. The carbon content ranges from 86 to 98 % carbon with a calorific value about $3.4 \times 10^7 \text{ J kg}^{-1}$. Also called **hard coal**. See **coal rank**.

anthracite-coal-based refractory. *Noun.* A refractory composition containing appreciable amounts of calcined anthracite coal as a source of carbon.

anthracite duff. *Noun.* Briquettes composed of mixtures of powdered **anthracite** and **bituminous** coals sometimes used in chain-grate stokers for cement kilns.

anthracitic. *Adjective.* Materials containing **anthracite** as a major ceramic constituent.

anthracoid. *Adjective.* Having the appearance of carbon, coal or charcoal.

anti bonding orbital. *Noun.* An **orbital** which when occupied tends to induce dissociation; viewed as being formed by electrons when electron waves of positive and negative amplitudes overlap.

anticatalyst. *Noun.* See **inhibitor**.

antifatigue. *Noun.* The occurrence of increased strength observed for glass objects that have been immersed in water with the absence of applied stress and then dried before testing.

antiferroelectric. *Adjective.* A **polar ceramic** with equal numbers of **dipoles** aligned in opposite directions.

antiferromagnetic material. *Noun.* A weakly magnetic material resulting from nearly equal magnetic moments in the structure being ordered antiparallel to each other. MnO is an example. Unless the moments completely cancel there is a significantly higher magnetic moment than paramagnetic materials possess.

antiferromagnetism. *Noun.* See **antiferromagnetic material**.

antimonate of lead. *Noun.* See **lead antimonate**.

antimony oxide. *Noun.* Sb_2O_3 . Colloquially called **antimony**; used as an opacifier in porcelain-enamels and as a minor **adherence-promoting agent** in white porcelain-enamel ground coats, as a constituent in **Naples yellow pigments**, as a decolouriser and **fining agent** in glass manufacture, and as a component in

glass which is transparent to infrared radiation. Density 5,200–5,700 kg m^{-3} . Also called **stibium oxide** and **valentinite**.

antimony spot. *Noun.* A type of dermatitis caused by exposure to **antimony oxide**.

antimony sulphide. *Noun.* Sb_2S_3 . Used as an aid in the production of **ruby** and **amber glasses**, to promote **opacity** in **opal glass**, and occasionally as a minor adherence promoting agent in porcelain-enamels. Mp 546 °C; density 4,600 kg m^{-3} . Also known as **stibnite**, **antimony orange**, **antimony black**, **antimony needles** and **antimonous sulphide**.

antimony tin oxide. **ATO.** *Noun.* A ternary oxide with useful semiconducting properties. It can be deposited from solution to make thin films that are transparent for use in **LCD** displays and photovoltaics.

antimony yellow. *Noun.* See **lead antimonate**.

Antioch process. *Noun.* A technique for the production of plaster casting moulds in which an aqueous slurry of **plaster of Paris** is poured over a mould, following which the mould is steam-treated, allowed to set in air, oven-dried, and then cooled for use.

antique glass. *Noun.* A type of glass similar in appearance and character to the medieval glasses used in **stained-glass** windows, which usually is produced in the form of hand-blown cylinders that are cut in the soft or plastic state and allowed to sag to flatness on a suitable, smooth or textured surface.

antiscalse compound. *Noun.* A preparation applied to alloy burning tools to protect them from oxidising and scaling during the firing of porcelain-enamels.

antiskid finish. *Noun.* A textured or intentionally roughened surface on porcelain-enamel, tile, concrete, or other facing area to prevent or minimise the possibility of accidental slipping or skidding.

antistatic agent. *Noun.* A substance applied to a **substrate** to prevent the accumulation of an electric charge.

antistatic tile. *Noun.* Floor tile containing a material, usually carbon, which will dissipate or disperse charges of static electricity, particularly for use in areas where sparking may be hazardous.

anti-Stokes bands. *Noun.* See **Raman effect**.

anti-Stokes fluorescence. *Noun.* See **frequency up-conversion**.

antlarite. *Noun.* $\text{Cu}_3\text{SO}_4(\text{OH})_4$. A corrosion product of copper forming a green protective patina. Can be used as a green pigment.

Antonoff's rule. *Noun.* A statement that the surface tension at the interface between two saturated liquid layers at equilibrium is equal to the difference between the individual surface tensions of similar layers when exposed to air.

antozonite. *Noun.* An example of a fetid fluorite mineral. See **fetid fluorite**.

anvil. *Noun.* A piece of wood, a pebble, or other hard substance used to prevent the distortion of a pot during forming by pressing the anvil against the inside wall at the point opposite the point where the forming or shaping pressure is applied.

AP. *Abbreviation.* Stands for **annealing point**.

apache tears. *Noun.* A colloquial name for a stone that polishes easily to provide a shiny purple colour with some variegation.

apatite. *Noun.* $\text{Ca}_5(\text{F,Cl,OH})(\text{PO}_4)_3$. A naturally occurring mineral consisting of either **calcium fluorophosphate** or calcium chlorophosphate in a hexagonal crystal. Used as an opacifier in the manufacture of **opal glass** and as a substitute for **bone ash** in whiteware bodies; the major constituent of teeth and bones in mammals. A source of phosphorus and is used as a fertiliser. Density 3,100–3,002 kg m⁻³; hardness (Mohs) 5.

APC. *Abbreviation.* Stands for acoustic phonic crystal. See **phonic crystals**.

aperture. *Noun.* (1) A slit, gap, hole or other opening. (2) A circular variable opening in an optical instrument that controls the radiation entering the instrument.

apthitalite. *Noun.* A very colourful rock with large well-formed crystals produced in the hot springs associated with dormant and dying volcanos.

aplasia. *Noun.* Failure to develop, to show growth, or to change.

aplastic. *Adjective.* (1) Showing **aplasia**. (2) A noncommittal term describing a mineral or similar substance difficult to identify, or appearing to be essentially fine gravel.

APF. *Abbreviation.* Standing for atomic packing factor. See **atomic packing factor**.

aplite. *Noun.* A light-coloured, fine-grained granitic mineral consisting mainly of **quartz** and **feldspar**; used as a source of alumina in glass, porcelain and whiteware, pottery, and porcelain-enamel. Also called **haplite**.

APMA. *Abbreviation.* Stands for ammonium polymethylmethacrylate. See **ammonium polymethylmethacrylate**.

apochromat. *Noun.* Objective lenses in microscopes and cameras which have been carefully colour corrected by making the lens of three or more elements of different types of glass designed to bring light of three different colours to the same focal point.

apochromatic. *Adjective.* A lens almost free from spherical and chromatic aberration.

apophyllite. *Noun.* $\text{KCa}_4(\text{Si}_2\text{O}_7)_4(\text{F,OH}) \cdot 8\text{H}_2\text{O}$. A white, colourless, pink, or green, **sheet silicate mineral** of

rare tetragonal structure in which the SiO_4 tetrahedra form 4- and 8-membered rings as opposed to the usual hexagonal sheet structure of 6-membered SiO_4 rings.

apparent dc resistance. *Noun.* The reciprocal of **dc conductance**.

apparent dc surface resistance. *Noun.* The reciprocal of apparent dc surface conductance.

apparent dc volume resistance. *Noun.* The reciprocal of apparent dc volume conductance.

apparent density. *Noun.* The mass per unit volume of a material, including voids present in the material. See **apparent specific gravity**.

apparent initial softening point. *Noun.* The initial or lowest temperature at which softening or viscous flow of a body, such as glass, glaze, porcelain-enamel, etc., begins, and the physical rigidity of the body is overcome.

apparent porosity. *Noun.* The ratio of the open pore space of a body to its bulk volume, expressed in percent; calculated by the formula: $P = [(W_s - W_f)/V] \times 100$, where P is the apparent porosity, W_s is the weight of the water saturated specimen in kilograms, W_f is the weight of the original fired specimen in kilograms, and V is the volume of the specimen in cubic meters.

apparent solid volume. *Noun.* The total volume occupied by a body, including open and sealed pores.

apparent specific gravity. *Noun.* The ratio of the mass of a unit volume of a body to the mass of an equal volume of water at the same temperature as determined by the formula: $G = W_f/V (W_s - W_f)$, where G is the apparent specific gravity, W_f is the mass of the fired specimen in kilograms, V is the volume of the fired specimen in cubic metres, and W_s is the mass of the water-saturated specimen in kilograms. Also known as **apparent density**.

apparent volume. V_a . *Noun.* The volume of a body, including its sealed pores, as indicated by the equation $V_a = V_T + V_s = D/d_a$, where V_a is the apparent volume, V_T is the true volume, V_s is the volume of the sealed pores, D is the dry weight, and d_a is the apparent density or **apparent specific gravity**.

application specific integrated circuit. asic. *Noun.* A methodology used to implement **system on a chip**.

application weight. *Noun.* The weight of an application of a porcelain-enamel coating per unit of area covered, usually expressed in grams per square metre for **cover coats** (one side of test panel) or grams per square metre (both sides of test panel) for **ground coats**; normally, the term refers to dry weight unless specifically indicated to be wet weight.

applicator. *Noun.* That part of a microwave or radio frequency heating installation in which the product is heated. It consists of an electrode system, which with the sample, constitutes a tuned circuit coupled inductively with the generator output.

applied stress intensity factor. K_I . *Noun.* A function of applied load and pre-existing crack size that denotes stress at the tip of a crack. K_I increases with load and when it attains the critical value, K_{Ic} , which has a value equal to $(2E\gamma_i)^{1/2}$, where E is **Young's modulus** and γ_i is the effective **surface energy**, the crack will progress abruptly and rapidly.

approval. *Noun.* A material is evaluated in order to achieve this state (approval) for a given application.

apron. *Noun.* (1) A protective refractory shielding arrangement designed to protect the undercarriage of kiln cars from hot gases emanating from the firing chamber of a tunnel kiln situated immediately above the cars; the system consists of vertical metal plates attached to the sides of the kiln car which slide through sand contained in troughs along the bottom of the inside walls of the kiln. (2) A slab of concrete, metal, wood, or other material over the opening to a cistern, barrel, drum, or similar vessel. (3) A platform of concrete, metal, wood, or other material protecting an item of machinery. (4) A ground covering of concrete laid to protect soil from water erosion. (5) A sheet of sand or gravel deposited in front of a moraine.

apron conveyor. *Noun.* A conveyor consisting of a series of metal or wood plates mounted at right angles on an endless chain to transfer materials or products from one location to another.

apron feeder. *Noun.* A modification of an apron conveyor designed to feed pulverised materials to a process or packaging unit at a controlled rate.

AQL. *Abbreviation.* Stands for acceptable quality level. See **acceptability**.

aquamarine. *Noun.* A gem variety of beryl. See **beryl**.

aqua regia. *Noun.* A powerful oxidising solution, which is a mixture of three parts by volume of, concentrated nitric acid, one part of concentrated hydrochloric acid, and one part water.

aqueous injection moulding. AIM. *Noun.* A process developed to use water in place of expensive organic binders in moulding compositions, that is, ceramic powder plus binder. Removal of environmentally unfriendly organic liquids is avoided. Gel cellulose additives need to be added to facilitate removal from the mould.

aqueous pressure casting. *Noun.* The application of pressure to an aqueous **slip** in a die with a porous bed. Developed to improve casting speed and produce thicker walled samples. **Filter cake** thickness develops with time as: $d^2 = 2k\Delta P/\eta[V_o/V_c - V_o]t$, where d is the filter cake thickness, k is the permeability of the porous bed, ΔP is the pressure difference, η is the slip viscosity, V_o is the solids volume content of the slip, V_c is the solid volume content of the cake and t is the time. this is an application of **Darcy's equation**.

aqueous solution. *Noun.* A solution in which water is the solvent.

aquifer. *Noun.* Water-bearing rock; **sandstone** is an example.

aquo. *Noun.* $[M-H_2O]^{n+}$. A water molecule acting as a ligand when a metal salt is hydrolysed. See **hydroxo** and **oxo**.

arabesque. *Noun.* An ornate type or style of decoration consisting of flowers, foliage, animals, and figures applied to pottery and artware by painting, low-relief carving, etc., so as to produce intricate patterns of interlaced lines.

Arabian lustre. *Noun.* A pottery **overglaze** containing carbonates or sulphides of copper or silver which are reduced during firing to produce a metallic appearance.

Arabic, gum. *Noun.* See **gum Arabic**.

aragonite. *Noun.* A rare metastable polymorph of calcium carbonate, $CaCO_3$. Used in refractories, whiteware, glass, electronic bodies, and similar products. Sometimes has a **coralloid habit**. Decomposes at 825 °C; density 2,930 kg m⁻³; hardness (Mohs) 3.5–4.

Araldite. *Trademark, noun.* An epoxy resin used to repair china and glass.

arbor. *Noun.* A spindle or shaft on which a grinding wheel, cutting tool, or other rotating part is mounted.

arbor hole. *Noun.* The hole in the centre of a grinding wheel, cutting tool, or other rotating part by which the part is mounted on the spindle or shaft of a machine.

arc. *Noun.* (1) The luminous discharge of electricity between two electrodes separated by a small gap and a high potential difference. (2) Something curved in shape.

arcade. *Noun.* A set of arches and their supporting columns. (2) A part of a building with an arched roof.

arcanite. *Noun.* K_2SO_4 . A phase present in the white **efflorescence** on the surface of fired-clay bricks after laying. It arises from **mortar**-brick interactions.

arcature. *Noun.* (1) A set of blind arches attached to a wall as decoration. (2) A small **arcade**.

arc furnace. *Noun.* A furnace in which the heat is generated by means of an **electric arc**.

arc furnace, direct. *Noun.* See **direct arc furnace**.

arc furnace, indirect. *Noun.* See **indirect arc furnace**.

arch. *Noun.* (1) A curved structure spanning an open space such as the working zone in a furnace or kiln, thereby forming the roof of the furnace or kiln. (2) *Verb.* To heat a crucible or glass-melting pot in a **pot furnace**.

Archaeon. *Adjective.* Of or relating to the highly metamorphosed rock formed in the Precambrian era.

archaeomagnetism. *Noun.* A technique used to date clay objects by measuring the extent to which they have been magnetised by the earth's magnetic field after firing destroyed the original magnetisation.

Archard's coefficient. *Noun.* A value for the constant, C, in the **sliding wear equation**: $V_w = C.P.s/H$, where P is the load, s is the distance travelled and H is the material hardness. Archard showed C to equal $K/3$, where K is the probability that two asperities coming into contact will form a fragment during sliding.

arch, bearer. *Noun.* See **bearer arch**.

arch brick. *Noun.* (1) A wedge-shaped brick designed for use in an arch. (2) An extremely hard-fired or over-burned brick from an arch of a kiln.

arch, catenary. *Noun.* See **catenary arch**.

arch, chimney. *Noun.* See **chimney arch**.

arch, cooling. *Noun.* See **cooling arch**.

arch, curtain. *Noun.* See **curtain arch**.

arch, drop. *Noun.* See **drop arch**.

arch, flat. *Noun.* See **flat arch**.

arch furnace. *Noun.* A furnace or kiln having a curved roof which spans and is supported by two walls.

arch, ignition. *Noun.* See **ignition arch**.

arch, jack. *Noun.* See **jack arch**.

arch, main. *Noun.* See **main arch**.

arch, pot. *Noun.* See **pot arch**.

arch, relieving. *Noun.* See **relieving arch**.

arch, rider. *Noun.* See **rider arch**.

arch rise. *Noun.* The vertical distance between the spring line and the highest point of the under surface of the arch.

arch, rowlock. *Noun.* See **rowlock arch**.

arch, saddle. *Noun.* See **saddle arch**.

arch, segmental. *Noun.* See **segmental arch**.

arch, sprung. *Noun.* See **sprung arch**.

arch, suspended. *Noun.* See **suspended arch**.

archetype. *Noun.* (1) The original pattern or model. (2) A perfect example or model of a structure.

Archimedes principle. *Noun.* A body immersed in a liquid undergoes an apparent loss in mass equal to the mass of the fluid it has displaced.

Archimedes screw. *Noun.* (1) A spiral tube around an inclined axis or an inclined tube containing a tight-fitting broad-threaded screw originally designed to raise water from one level to another. (2) Part of **extruder** equipment.

architectonics. *Noun.* The science of architecture.

architectural concrete. *Noun.* A concrete of particularly high quality and free from blemishes; used as the exposed surface on the interior or exterior faces of buildings and other structures.

architectural glass. *Noun.* Glass used in the building industry.

architectural terra cotta. *Noun.* Hard-fired, glazed or unglazed clay building units generally larger than brick or conventional facing tile; the units may be **machine-extruded** or hand-moulded, and they may be plain or ornamental.

architrave. *Noun.* (1) A moulding around a doorway, window, or other opening. (2) The lowest part of an entablature that bears on the columns.

archive sample. *Noun.* A sample retained for purposes of record.

archivolt. *Noun.* (1) A decorated moulding round an arch. (2) The under surface of an arch.

archless kiln. *Noun.* An **updraft kiln** having no permanent parts and is constructed with walls of either burned or unburned brick; after loading, the kiln is covered with brick, earth, or ashes and fired with solid, liquid, or gaseous fuels.

arc-image furnace. *Noun.* A furnace that produces very high temperatures by focusing the rays of an electric arc into a relatively small area by means of lenses and mirrors.

arc light. *Noun.* An intense light source produced by striking an arc between two carbon electrodes.

arc material transfer. *Noun.* The movement of contact material by the action of an electric arc.

arc melting. *Verb.* To melt a substance in or by means of an electric arc.

arc of contact. *Noun.* The portion of a grinding wheel in contact with the material or object being ground.

arc plasma spraying. *Noun.* Fine ceramic powder is injected into a **plasma** jet that heats and accelerates it onto a surface. Not all particles are melted since conventional **spray guns** inject the powder orthogonally and some particles remain in the cooler outer layers of the plasma flame.

arc spraying. *Noun.* The deposition of molten refractory materials, such as oxides, carbides, nitrides, and silicides, on ceramic or metal surfaces by blowing them in an atomised state at supersonic speeds by the use of a plasma jet.

arcuate. *Adjective.* Bent or shaped like an arch or bow.

arcuation. *Noun.* An arrangement of arches.

area, nitrogen surface. *Noun.* See **nitrogen surface area**.

area, surface. *Noun.* See **surface area**.

arenaceous. *Adjective.* Composed of sand or sandstone; of or concerning sedimentary rocks.

arenaceous clay. *Noun.* Sandy clay; sometimes known as **arenite** or **sandstone**.

arenite. *Noun.* Any **arenaceous** rock; sandstone.

Argand diagram. *Noun.* Two perpendicular axes, the x-axis, called the real axis, and the y-axis, called the imaginary axis, on which a complex number $z = (x - iy)$ can be represented as a point.

argentiferous. *Adjective.* Containing silver.

argentite. *Noun.* Ag_2S . A dark grey mineral with a cubic crystal structure; source of silver.

argil. *Noun.* Clay, especially **potters' clay**.

argillaceous. *Adjective.* Meaning composed of very fine material such as clay; being derived from **sedimentary rocks**.

argilliferous. *Adjective.* Containing or yielding clay.

argillite. *Noun.* Hardened **mudstone** or any sedimentary argillaceous rock.

argon. *Noun.* An inert gas used as a protective atmosphere surrounding materials that are sensitive to atmospheric gases during firing; used in plasma-jet torches during the application of highly refractory materials to metals and in arc furnaces.

aridised plaster. *Noun.* Plaster treated with **calcium chloride** during hydration as a means of increasing its strength and the uniformity of its properties.

aristotype. *Noun.* The classic named example of a structure type shared by several materials, for example **rock salt**, **zinc blende**. It is the parent structure from which other related structures can be derived by combinations of distortion, substitution of ions and intergrowth with other structures. See **hettotype**.

Arita. *Toponym.* A type of Japanese porcelain decorated with asymmetric designs. Made in the town of Arita.

ark. *Noun.* A large container or vat used for the mixing and storage of **clay slips**.

arkose. *Noun.* Sedimentary, coarse-grained **sandstone** composed of fragments containing a high ratio of **feldspar** and **quartz** cemented by **clay minerals**. Derived from rapid disintegration of granite. Also known as **feldspathic sandstone**.

armchair CNT. *Noun.* See **carbon nanotubes**.

Armco iron. *Trade name, noun.* A relatively pure grade of iron made by the open-hearth process; used in **porcelain-enamelling**.

armour ceramics. *Plural noun.* Ceramic materials used to neutralise and absorb kinetic energy threats to personnel and vehicles; **boron carbide**, and siliceous core materials are examples.

armouring. *Noun.* A metal encasement for refractory brick that is used to protect brick exposed to corrosive atmospheres at the top of the stack of a blast furnace.

arsenopyrite. *Noun.* FeAsS . A grey-white ore of arsenic consisting of monoclinic crystals of iron arsenide sulphide. Also called **mispickel**.

Arrentine ware. *Noun.* See **Samian ware**.

arris. *Noun.* The short edge or angle at the junction of a building brick and a **ridge tile** at the hip or ridge of a roof moulding, or raised edge.

arsenic. *Noun.* In the ceramic context, a term for arsenic oxide As_2O_3 . See **arsenic oxide**.

arsenic acid. *Noun.* $\text{H}_3\text{AsO}_4 \cdot 0.5\text{H}_2\text{O}$. Sometimes used as a source of arsenic in glass. See **arsenic oxide**.

arsenic oxide. *Noun.* As_2O_3 . Used as a fritting agent and as a decoloriser in glass and as an opacifier in glazes. Sublimes at 193 °C. Also known as **arsenious oxide**, **arsenic trioxide**, and **white arsenic**. See **white arsenic**.

arsenic trioxide. *Noun.* Another name for arsenic oxide. See **arsenic trioxide**.

arsenious oxide. *Noun.* See **arsenic oxide** and **white arsenic**.

arsenide. *Noun.* A compound of arsenic and a metal. One of the **pnictides**.

arsenious. *Adjective.* Containing arsenic in the trivalent state.

arsenopyrite. *Noun.* FeAsS . A monoclinic mineral with a metallic appearance that is a sulphide of iron and arsenic. Also called **mispickel**.

Artex. *Trademark, noun.* A coating for walls and ceilings that gives a textured finish.

artifact. *Noun.* Alternative spelling of **artefact**.

artificial aging. *Verb.* In a precipitation hardening process it is aging above room temperature. That is heating to achieve an improvement in hardness.

artificial discontinuity. *Noun.* Discontinuities such as, grooves, notches, or holes that are introduced into bodies intended to be used as reference standards to provide accurately reproducible sensitivity levels for electromagnetic test equipment.

artificially structured materials. *Noun.* Crystals fabricated with layers of inter-grown material that give a periodic modification in refractive index, mass, elastic moduli etc., with the wavelength of the modulation

able to interact with acoustic waves, light waves and elastic waves passing through the **composite crystal**. See **photonic crystals** and **phononic crystals**.

artificial weathering. *Noun.* A test, frequently accelerated, to estimate the resistance of a material or product to weathering in which specimens are subjected to infrared radiation, water, salt water, ultraviolet radiation, another conditions simulating those encountered in nature.

art-to-part. *Colloquial.* An expression for **solid free form fabrication** or **mouldless manufacturing**, where material is added to, rather than taken away from a component during fabrication. Usually involves **computer aided design**.

Artuff. *Trademark, noun.* A family of advanced ceramic composite materials made from **alumina**, Al_2O_3 matrices reinforced with **silicon carbide**, **SiC whiskers**.

artware. *Noun.* Porcelain-enamelled articles and ceramic pieces made for decorative and artistic reasons only.

asbestine. *Noun.* A fibrous variety of **talc** exhibiting properties similar to asbestos. See **asbestos**.

asbestos. *Plural noun.* A group of impure minerals mainly **amphibole**: which occur in fibrous form, such as **amosite**, **tremolite**, **actinolite**, **crocidolite**, etc.; used for fireproofing, heat and electrical insulations, building materials, and similar applications. **Chrysotile** is a rolled sheet silicate variation.

asbestos board. *Noun.* A fire-resistant board made of a mixture of **asbestos**, **Portland cement**, and water.

asbestos cement. *Noun.* A mixture of asbestos and Portland cement used in the production of fire-resistant flat and corrugated sheets, **shingles**, tile, piping, **siding**, wallboard, and similar products.

asbestos cement pipe. *Noun.* A pipe manufactured from **asbestos cement** for use in drainage applications and in corrosive environments.

asbestos felt. *Noun.* **Asphalt**-impregnated asbestos; used as a vapour barrier for concrete.

asbestos fibre. *Noun.* Milled and screened asbestos in fibre form.

asbestos insulation. *Noun.* A fibrous asbestos used as thermal insulation at temperatures above 815 °C; frequently bonded with clay and **sodium silicate**.

asbestosis. *Noun.* A lung disease associated with use of fibrous ceramic material; characterised by deposition of scar tissue from build-up of collagen in the lungs.

asbestos shingle. *Noun.* A shingle resistant to weather, fire, and general deterioration which is formed by compressing mixtures of asbestos fibre and Portland cement; used as roofing, siding, and similar applications in building construction.

asbolane. *Noun.* See **asbolite**.

asbolite. *Noun.* $(\text{Co,Mn})\text{O}\cdot 2\text{MnO}_2\cdot 4\text{H}_2\text{O}$. An impure earthy mixture of cobalt and manganese oxides used in the production of **underglaze** blue colours when fired under reducing conditions. Also known as **asbolane**, **black cobalt**, **cobalt**, **ochre**, **earthy cobalt**.

A-scans. *Plural noun.* A display of the variation of the magnitude of the reflected echoes of **ultrasound** with time. Amplitude is decreased by material discontinuities and so ceramic defects can be studied.

ash. *Noun.* The non-combustible solid residue remaining from the burning of a fuel or other organic material.

ashes. *Plural noun.* The residue of burned trees, land plants, bones, seaweed, and marsh plants; sometimes used as a flux in high-temperature bodies and glazes.

ashet. *Noun.* A ceramic dish or large plate.

ash furnace. *Noun.* A fritting furnace used in the production of materials for the production of glass. See **frit**.

ashlar. *Noun.* (1) A block of hewn stone with straight edges for use in building work. (2) Masonry made of ashlar.

ashlar brick. *Noun.* A brick produced with a rough-hackled face resembling the appearance of stone.

ashlar masonry. *Noun.* A type of masonry construction of **fired-clay** blocks of a size larger than conventional brick, and with the exposed faces of square or rectangular shape, laid in mortar in a uniform pattern; sometimes sawed, dressed, tooled, or quarry-faced stone is used in place of the ceramic block.

ashler. *Noun.* Alternative spelling for ashlar. See **ashlar**.

asic. *Acronym.* Stands for application specific integrated circuit. See **application specific integrated circuit**.

as-is basis. *Adjective.* A material or product offered and accepted in the condition or shape in which it exists at the time without making changes.

aspect. *Noun.* A surface that faces in a particular direction.

aspect ratio. *Noun.* A term used to define **chopped strand fibres** by dividing the fibre length by its diameter. See **critical fibre aspect ratio**, **Halpin-Kardos equation**.

asperity. *Noun.* Roughness of a surface.

asphalt. *Noun.* Any of several black semisolid mixtures containing bitumen and inert mineral material; occurs naturally or is the residue from petroleum distillation; used as a waterproofing material, in paints and dielectrics, and, mixed with gravel, is a road surfacing material. (2) *Verb trans.* To cover with asphalt.

asphalt felt. *Noun.* A sheet of feltlike material impregnated with **asphalt** for use in roofing and waterproofing application, frequently in conjunction with asbestos-cement products.

asphaltite. *Noun.* Any naturally occurring hydrocarbon that resembles asphalt but has a higher melting point.

asphalt rock. *Noun.* A porous rock such as sandstone or dolomite, which has become impregnated with asphalt in its natural location.

aspirating screen. *Noun.* A sieve through which particles are drawn by a combination of vibration and suction.

ASR. *Abbreviation.* Standing for the alkali-silica reaction. See **alkali-silica reaction**.

assay. *Noun.* A qualitative or quantitative measurement of the components of a material.

assay, chemical. *Noun.* See **chemical assay**.

assay, physical. *Noun.* See **physical assay**.

assembler. *Noun.* A nanorobot that assembles nanomachines by precisely positioning components.

assembly, joint. *Noun.* See **joint assembly**.

assurance, quality. *Noun.* See **quality assurance**.

asteriated. *Adjective.* A star-like effect produced when light is dispersed about a six-fold axis in a transparent crystal.

asterism. *Noun.* The appearance of star-like figures in a transparent mineral when viewed in transmitted or reflected light; **phlogopite** shows this effect well.

ASTM. *Abbreviation.* Stands for the American Society for Testing and Materials.

astragal. *Noun.* (1) A small convex moulding with a semicircular cross-section. (2) A moulding in the form of a string of beads.

astringent clay. *Noun.* Clay containing an astringent salt such as **alum**.

Astroquartz. *Trademark, noun.* Commercial continuous quartz fibre. Density $2,200 \text{ kg m}^{-3}$; Young's modulus 69 GN m^{-2} ; strength 3.45 GN m^{-2} .

atactic. *Adjective.* A random arrangement.

ATB. *Abbreviation.* Stands for aluminium tertiary butoxide. See **aluminium tertiary butoxide**.

ATH. *Abbreviation.* Stands for aluminium trihydrate. See **alumina trihydrate**.

athermal transformation. *Noun.* A reaction that is not thermally activated, and usually diffusionless. See **martensitic transformation**. Such reactions are usually extremely fast and the extent of reaction depends on holding temperature.

atm. *Abbreviation.* Stands for **atmosphere**; a unit of pressure.

atmolysis. *Noun.* A method of separating gases based on their different diffusion rates through porous ceramics.

atmometer. *Noun.* An instrument for measuring the rate of evaporation of water into the atmosphere.

atmosphere. *Noun.* (1) The gaseous mass surrounding the earth that is composed of 21 parts of oxygen and 78 parts of nitrogen by volume (23 parts of oxygen and 77 parts of nitrogen by weight), 1 % of argon, 0.02 % of carbon dioxide, and some aqueous vapour. (2) The gaseous environment existing in a furnace or kiln, particularly in the zone in which ware is being fired. (3) A unit of pressure equal to $1.013259 \times 10^5 \text{ N m}^{-2}$, the air pressure at mean sea level.

atmosphere, controlled. *Noun.* See **controlled atmosphere**.

atmosphere, neutral. *Noun.* See **neutral atmosphere**.

atmosphere, oxidising. *Noun.* See **oxidising atmosphere**.

atmosphere, reducing. *Noun.* See **reducing atmosphere**.

ATO. *Acronym, noun.* Stands for antimony tin oxide. See **antimony tin oxide**.

atom. *Noun.* The smallest particle of an element that will enter into the composition of a molecule.

atom fraction. x_i . *Noun.* A basic way of expressing the concentration of a species in a solution in terms of the number of moles of each chemical species present. For a solution containing k components it is: $n_i / \sum_1^k n_j$.

atom percent. *Noun.* The **atom fraction** expressed as a percentage and so is $100 x_i$.

atom, super. *Noun.* See **super atom**.

atomic absorption spectrometry. *Noun.* The measurement of light absorbed by the unexcited atoms of an element as a means of identifying the composition and properties of a substance.

atomic force microscopy. **AFM.** *Noun.* A mechanical profiling method that generates three-dimensional maps of surfaces by scanning an atomically sharp probe attached to a cantilever over a surface. The attractive forces that act between the tip of the cantilever and the surface are used to control the height of the probe above the surface. Unlike **STM** it can be used on insulating as well as conductive surfaces. The technique uses sharp tips to "feel" the shape and not light to see it. A scanning technique capable of imaging crystal surfaces as they grow with a resolution of about 0.3 nm . See **trolling atomic force microscopy**.

atomic heat. *Noun.* The product of an element's **atomic mass number** and its **specific heat capacity**.

atomic mass. *Noun.* The mass of an isotope of an element in **atomic mass units**.

atomic mass unit. **amu.** *Noun.* A measure used to define relative atomic mass; one twelfth of the mass of a ^{12}C atom.

atomic number. **Z.** *Noun.* The number of protons in the nucleus of an atom; locates an atom in the periodic table.

atomic orbital. *Noun.* The **wave function** for an electron in an atom that describes the distribution of electron density in an atom.

atomic packing factor. APF. *Noun.* The fraction of the volume of a **unit cell** that is occupied by the **hard sphere** atoms or ions.

atomic units. *Noun.* Scales of measurement, introduced to simplify the constants in the **Schrödinger equation**, in which the mass of the electron is 1.0, charge is a multiple of the proton's charge, length is a multiple of the **Bohr radius**, energy is in multiples of twice the ionisation potential of the hydrogen atom, and velocity is in multiples of the velocity of light.

atomic vibration. *Noun.* The vibration of an atom about its normal position in a material.

atomic volume. *Noun.* The **relative atomic mass** of an element divided by its density.

atomic weight. A. *Noun.* The weighted average of the atomic masses of an atom's naturally occurring isotopes. Can be expressed on an atomic basis in terms of **atomic mass units**, or the mass per **mole** of atoms.

atomise or atomize. *Verb.* (1) To convert liquids and solids to a fine spray, minute particles, or a fine dust. (2) To separate into free atoms.

atomised oil. *Noun.* Fuel oil combined with air under pressure to facilitate its combustion.

atomiser. *Noun.* A device fitted to a liquid supply that reduces the liquid to a fine spray.

atomising air. *Noun.* A stream of fast-moving air employed to convert liquids or solids to fine sprays or dusts.

atom percent. at%. *Noun.* A way of expressing the concentration of the components of a compound on the basis of the number of moles, or atoms, of a particular element relative to the total number of moles, or atoms, of all elements within the compound.

ATP. *Abbreviation.* Stands for acceptance test procedure. See **acceptance test**.

attapulgite. *Noun. Toponym.* $\text{Mg}_5\text{Si}_8\text{O}_{20}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$. A white fibrous clay mineral. Large deposits at Attapulgus in America. Used as a suspension agent in various ceramic slips. Also known as **palygorskite**.

attenuate. *Verb trans.* (1) To reduce in size, strength, density, or other value. (2) To cause an object to lessen in width or taper. (3) *Adjective.* (1) Attenuated. (2) Tapering gradually.

attenuation. *Noun.* (1) The loss of energy of radiation as it passes through matter as a result of scattering or absorption. (2) In fibre optics it is the loss of light intensity as a light pulse is transmitted along the fibre. It is measured in db km^{-1} . The attenuation equation is: $\text{Att} = -10 \log_{10} [P_x/P_0]/x$, where P_0 is the power at $x=0$ and P_x is the power at x kilometres.

attenuation duct. *Noun.* Short tunnels, of small aperture, sited at inlet and outlets of continuous radio-frequency and microwave ovens and furnaces to prevent excessive leakage of radio-frequency and microwave energy.

attenuator. *Noun.* Any device that is designed to reduce the power of a wave without distorting it.

attic order. *Noun.* A low **pilaster** of any order set into the cornice of a building.

attribute. *Noun.* (1) An inherent property; a characteristic or quality of a material. (2) *Verb trans.* To regard something as the cause or influence of something.

attribute sampling. *Verb.* A method of quality-control inspection in which sampled ware is classified only as passable or defective.

attribute testing. *Verb.* A reliability test procedure in which specimens are evaluated and classified on the basis of qualitative properties or characteristics.

attrition. *Noun.* Wear and disintegration of a surface by rubbing or friction. Also known as **scouring**, **scoring**.

attrition mill. *Noun.* A machine in which materials are pulverised between toothed metal disks rotating in opposite directions.

atritus. *Noun.* Powder produced by **attrition**.

at. wt. *Abbreviation.* Stands for **atomic weight**.

AU. *Abbreviation.* Stands for acousto-ultrasonics. See **acousto-ultrasonics**.

a. u. *Abbreviation.* Standing for **atomic unit**.

aubergine purple. *Noun.* See **Bishops purple**.

aubrite. *Noun.* An **achondrite** containing **enstatite**.

audibility. *Noun.* The minimum effective pressure of sound waves capable of producing a sensation in the ear.

audit. *Noun.* A way of checking at any given time whether the **quality assurance** system is operating in the way it has been designed.

augelite. *Noun.* $\text{Al}_2(\text{OH})_3\text{PO}_4$. A colourless to white phosphate mineral.

auger. *Noun.* A machine which forces or extrudes moist clay and similar bodies through a die by means of a revolving screw contained in a closed cylinder or barrel.

Auger effect. *Noun.* A radiationless transition from an excited state to a dissociative state which diminishes the intensities of x rays by removing electrons from solids. If the energy of the Auger electron is measured information about the energy levels of electrons in solids can be obtained; See **Auger electron spectroscopy**.

Auger electron spectroscopy. AES. *Noun.* a surface analysis method used to identify elements and their oxidation state by measurement of excited low-energy secondary electrons.

augite. *Noun.* $(\text{Ca},\text{Na})(\text{Mg},\text{Fe},\text{Al})(\text{Si},\text{Al})_2\text{O}_6$. A series of solid solutions formed between the **pyroxenes**, **diopside** and **hedenbergite**. Black or dark green. Found in **basalt** rocks.

aurene glass. *Noun.* An art effect produced in glass by adding metal oxides, such as silver oxide, to the glass batch. When these oxides are pulled to the surface of the hot formed glass object they create a mirror-like finish that becomes iridescent when sprayed with stannous oxide.

aurichalcite. *Noun.* $\text{Cu}_{3-x}\text{Zn}_x(\text{OH})_6(\text{CO}_3)_2$. A basic copper-zinc carbonate mineral that when heated to 450 °C converts to a copper-covered ZnO catalyst material able to convert CO_2 to CO in the water-gas shift reaction.

auric chloride. *Noun.* See **gold chloride**.

Aurivillius phases. *Plural noun.* A group of layered perovskite materials characterised by Bi_2O_2 layers in their structures, which separate blocks of the perovskite structure $(\text{A}_{n-1}\text{B}_n\text{O}_{3n+1})^{2-}$, in antiphase relationship with each other. In the general formula, n is the width of the perovskite block in octahedra, A is Bi^{3+} , Ba^{2+} , Pb^{2+} , La^{3+} , Ca^{2+} , K^+ , Na^+ , and B is Nb^{5+} , Mo^{6+} , W^{6+} ; many are **ferroelectrics** and may have high-temperature superconducting properties.

austenite. *Noun.* Face centred cubic iron.

autoclave. *Noun.* (1) An airtight vessel in which materials are subjected to high pressure. One variant uses high-pressure steam. (2) A vessel in which freshly made concrete bricks or sand-lime bricks are cured very rapidly by subjection to high pressure steam. (3) *Verb.* To heat a material in a pressure vessel.

autoclave cure. *Verb.* A means of accelerating the curing reactions of concrete, asbestos cement, and similar products at elevated temperatures and pressures in saturated steam, particularly when siliceous materials have been incorporated in a cementitious matrix such that a hydrothermal reaction takes place between the silica and the cement.

autocombustion. *Noun.* An automatic system designed to improve the efficiency of oil combustion by means of electric or electronically controlled impulses.

autogenous grinding. *Verb.* Grinding in a rotating cylindrical mill without the use of balls or rods, the grinding media being incoming additions of the coarse material to be ground.

autogenous healing. *Noun.* (1) A self-healing of cracks in concrete under favourable conditions of temperature, moisture, and lack of movement. (2) The self-healing

of cracks, **pinholes**, etc., in porcelain-enamels and glazes under the influence of heat.

autogenous mill. *Noun.* A closed, rotating cylinder or mill in which the grinding medium is the coarse feed of incoming material to be ground.

automatic drier. *Noun.* A drier in which the temperature and atmosphere are controlled by means of an appropriate control device.

automatic snagging. *Verb.* The removal of surface defects and excess metal from a product by the use of automatic or semiautomatic grinding machines, where the pressure between the grinding surface and the work, as well as the traverse wheel over the work, is controlled mechanically or hydraulically from a control station away from the grinding wheel.

automaton. *Noun.* A mechanical device operating under its own power system; a robot.

autoradiograph. *Noun.* A photograph showing the distribution of radioactive substances in a specimen.

autotransformer. *Noun.* A transformer in which all or part of the winding is common to both primary and secondary circuits.

autunite. *Noun.* $\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 11\text{H}_2\text{O}$. A yellowish, fluorescent, tetragonal mineral with radioactive properties.

auxetic ceramics. *Plural noun.* Materials, such as **bismuth cuprate superconductors**, **α -cristobalite** and some composites, which have negative value for **Poisson's ratio** and so when stretched in tension, become wider because they have a positive lateral strain. Such behaviour often results from a nodule-fibril microstructure where the fibrils act as hinges. Negative ν -values lead to enhanced properties, such as **elastic moduli**, for example **shear modulus** is inversely proportional to $(1 - \nu^2)$.

available energy. *Noun.* Energy existing in bodies or systems under conditions in which work may theoretically be obtained from them.

available heat. *Noun.* The amount of heat per unit mass of a substance that may be transformed into some form of work, such as in an engine or other system, under ideal conditions.

avalanche. *Noun.* A group of ions arising from the collision of a single ion with some other form of matter.

avalite. *Toponym.* A soft, green mineral that contains **chromium oxide** and is an ore of chromium concentrated around mount Avala in Serbia.

avanturine. *Noun.* See **aventurine**.

aventurine, aventurin or avanturine. *Noun.* (1) A dark-coloured glass or glaze usually green or black, containing coloured, opaque spangles of other materi-

als such as copper, gold, chrome, or **haematite** which give the glaze a shimmering appearance. (2) A variety of **quartz** containing red or green particles of iron oxide or **mica**; used as a gemstone. (3) A translucent form of **orthoclase feldspar** containing red-gold particles of iron compounds; also known as **sunstone**.

average coefficient of cubical expansion. *Noun.* The average change in the unit volume of a body or substance per unit change in temperature over a prescribed temperature range.

average coefficient of linear expansion. *Noun.* The average change in the unit length of a body per unit change in temperature over a prescribed temperature range.

average particle size. *Noun.* The average of the dimensions of particles of a material or a mixture of materials.

Avogadro's constant or number. N_A . *Noun.* The number of atoms in 12 g of ^{12}C . More generally it is number of atoms or molecules in a **mole** of a substance, equal to $6.02252 \times 10^{23} \text{ mol}^{-1}$. Now used to define the mole by fixing its value at exactly 6.0221415×10^{23} . See **mole**.

axial-flow compressor. *Noun.* A machine for compressing a gas by accelerating it tangentially by means of bladed rotors, and then diffusing it through static vanes to increase its pressure.

axonometry. *Noun.* Part of **crystallography** concerned with measuring the axes of crystals.

azafullerene. *Noun.* **Buckyball**-type molecules containing nitrogen atoms in place of some carbon atoms in the structure.

azide. *Noun.* A compound containing the $[\text{N}_3]^-$ ion or $-\text{N}_3$ group.

azonal soil. *Noun.* A soil whose profile of texture, particle sizes and mineral composition is determined by non-local climatic conditions, such as glacial soil and volcanic soil.

azote. *Noun.* Obsolete name for nitrogen.

AZP glasses. *Abbreviation, plural noun.* Stands for alkali zinc phosphate glasses. See **alkali zinc phosphate glasses**.

AZS refractories. *Abbreviation.* Stands for alumina-zirconia-silicate refractories. See **alumina-zirconia-silicate refractories**.

azurite. *Noun.* $\text{Cu}_3(\text{OH})_2(\text{CO}_3)_2$. Hydrous copper carbonate; a basic carbonate of copper used as a blue pigment with greenish overtones and as a gemstone. Density $3,770\text{--}3,830 \text{ kg m}^{-3}$; hardness (Mohs) 3.5–4.0. Also known as **blue copper**, **blue malachite**, **chessylite**.

Bb

b. *Symbol.* Standing for: (1) **barn**; (2) **bel**.

B. *Symbol.* Represents: (1) The chemical element **boron**; (2) **magnetic flux density**; (3) on pencils to signify the degree of softness of the lead, B, 2B, etc.

Babinet compensator. *Noun.* A crystal plate of variable thickness with faces cut parallel to the optic axis used to produce or analyse elliptically polarised light. **Quartz** crystal is commonly used.

Babo's law. *Noun.* The statement that the vapour pressure of a solution is reduced in proportion to the mass of solute added.

bacile. *Noun.* A deep ceramic dish or basin.

back bond. *Noun.* A chemical bond between an atom in the surface layer of a solid and an atom in the second layer.

back draft. *Noun.* A slight undercut in a mould that makes removal of the moulded part difficult.

back emf. *Noun.* An electromagnetic force appearing in an inductive circuit in an opposing direction to any change of current in the circuit.

back emission. *Noun.* The secondary emission of electrons from an anode.

backer strip. *Noun.* An asphalt-coated felt strip employed as a water-repellent backing for the vertical joint between asbestos-cement **shingles**.

background. *Noun.* In the detection of nuclear radiation, that part of the signal which arises from natural radioactivity or cosmic rays.

background fluorescence. *Noun.* The fluorescent residues observed on the surface of a test specimen during fluorescent-penetrant inspection.

backing. *Noun.* (1) The portion of a wall or structure installed behind a facing course to attain a particular property in the structure, such as strength, insulation, or economy. (2) A backing material such as cloth,

paper, fibre, etc., used as the backing for coated abrasives. (3) The flexible carrier for the magnetic oxide coatings employed on magnetic tapes.

backing plate. *Noun.* A plate used to support the cavity blocks and guide pins in injection moulding.

backing sand. *Noun.* In moulding it is any sand mixture used to fill the flask after the facing sand mixture is in place.

back-off. *Verb trans.* To remove a cutting tool or grinding wheel from contact with an item being processed.

back pressure. *Noun.* (1) The resistance to forward flow of plastic material in an extruder. (2) In moulding the viscous resistance encountered when the mould is closing.

back scatter. *Noun.* The scattering of particles or waves, such as x-rays, sound waves, α -particles and electrons, by the structure through which they pass, in the backward direction. (2) The radiation or particles so scattered.

back stamp. *Noun.* A mark made on the back or bottom of a product to identify its origin or manufacturer; a hallmark.

back wall. *Noun.* The wall at the charging end of a glass-melting furnace.

backwear. *Noun.* A worn condition on the back of an abrasive belt caused by high speed, high pressure, or both that results in friction between the belt and its backup at the point of contact with a work piece.

baddeleyite. *Noun.* ZrO_2 . Naturally occurring monoclinic form of **zirconia**; used in refractory and corrosion-resistant applications such as furnace linings and muffles and as an ingredient in low-expansion ceramic bodies but such use is limited to temperatures below 1,450 °C because of the monoclinic to tetragonal phase change that causes severe mechanical stress. Mp 2,850 °C; density 5,765 kg m⁻³.

badging. *Noun.* The marking of glassware and other ceramic products to identify the manufacturer, ownership, capacity, composition, or other information.

baffle. *Noun.* (1) A partition consisting of a panel, plate, screen, wall, or other device designed to check, regulate, or deflect the flow of something, such as a shield placed in a position to protect ware from combustion gases in a furnace or kiln during firing. (2) The part of a glass-forming mould designed to shut off the delivery of molten glass into the mould.

baffle mark. *Noun.* A mark or seam line visible on a bottle or other glass product caused by the joint between the mould and the **baffle**.

baffle wall. *Noun.* A wall constructed in a furnace or kiln to protect items being fired from flames and combustion gases.

bagasse. *Noun.* The crushed fibrous material remaining after the juice is extracted from sugar cane employed as a reinforcement and filler in plaster products, such as acoustic tile.

bag filter. *Noun.* An apparatus containing porous cloth, paper, or felt bags designed to collect dust from dust-laden gases passed through the apparatus.

baghouse. *Noun.* A chamber containing an arrangement of bag filters for the removal of airborne particles from air or gas streams emanating from furnaces, dry mixers, or other dust-producing equipment or operations.

baghouse dust. *BHD. Noun.* The fine particulate matter collected in the **baghouse**. It contains a mixture of starting materials in a form suitable for use in the manufacture of **cement clinker**.

Bagley plot. *Noun.* **Extrusion die** pressure plotted against length of die capillary divided by capillary diameter for a series of pre-set **extrudate** velocities. The lines this produces are used to compensate for die entry and exit effects.

bag moulding. *Verb trans.* A process whereby a flexible bag is used to apply uniform pressure over the surface of a ceramic fibre laminate during matrix impregnation.

bag wall. *Noun.* A refractory wall in a furnace or kiln designed and placed to deflect a flame to prevent it from striking ware being fired.

baidunzi. *Noun.* Small white bricks formed by dry pressing **porcelain stone**.

Bailey meter. *Noun.* A flow meter of helical vane construction used to measure the weight of powdered or granular materials passing through an essentially vertical shaft or other enclosed passage.

bainite. *Noun.* A composite of iron carbide, Fe_3C , and iron present in incompletely hardened steels annealed at temperatures between the **pearlite** and **martensite**

range, 250–550 °C. An austenitic transformation product found in some steels and cast irons. The microstructure consists of α -**ferrite** and a fine dispersion of **cementite**.

bait. *Noun.* A tool dipped into a bath of molten glass to start a drawing operation.

baked core. *Noun.* A moulded mass of a sand mixture that has been baked to be used as a core in a sand moulding operation.

baking. *Noun.* Heat processing sufficient to promote bond formation of binder constituents.

balance. *Noun.* A weighing device consisting essentially of a horizontal beam having a fulcrum at the centre with a pan suspended from each end, one holding the object being weighed and the other holding equivalent weights.

balanced design. *Noun.* In a filament wound composite it is a winding pattern for the ceramic fibre so designed that all filaments have equal stresses.

balanced-in-plane contour. *Noun.* The contour of the head in a filament wound composite in which filament orientation within a plane and the radii of curvature are adjusted to balance the stresses along the filaments with loading pressure.

balanced laminate. *Noun.* A composite laminate in which all lamina angles except 0° and 90° occur only in + or – pairs symmetrically about a centre plane.

balanced runner. *Noun.* A runner system from an injection moulders made to place all cavities at the same distance from the **sprue**.

balance, dynamic. *Noun.* See **dynamic balance**.

balance, material. *Noun.* See **material balance**.

balance, static. *Noun.* See **static balance**.

balancing. *Noun.* Testing for balance by adding or subtracting weight to put a grinding wheel or other rotating part into either static or dynamic balance. See **static balance**, **dynamic balance**.

balas. *Noun.* A red variety of **spinel** often called **balas ruby**.

balas ruby. *Noun.* A mixed oxide of aluminium, iron, and manganese with the **spinel** structure having a pale red or orange colour. Found in Afghanistan; prized as a gemstone.

ballas. *Noun.* Diamond with a morphology of ball-shaped aggregates with a radial structure. It is formed when grains grow simultaneously and impinge while growing to produce grain boundaries that are disordered variants of the cubic diamond structure.

ball charge. *Noun.* Volume of balls loaded in a ball mill. Commonly one-third the total mill volume.

ball clay. *Noun.* Clay that has been transported by water from where it was formed to give secondary deposits in sedimentary **lenses**. Mainly **kaolinite** contaminated with organic matter but not with iron during deposition. Formed by superheated steam passing through granite fissures, which caused **feldspar** to become kaolinite. This process is known as **hydrothermal alteration**. Ball clay is characterised by high plasticity, fine-grained particles, high dry strength, long vitrification range, and a white to cream colour after firing; employed in ceramic bodies to provide plasticity during forming and to induce vitrification during firing, as a suspension agent in porcelain-enamels and glazes, and as a bonding agent in non-plastic refractories. The colloquial name is believed to come from the fact that plastic clay was mined by hand spade in Devon in lumps or balls weighing 14 kg.

ball, grinding. *Noun.* See **grinding ball**.

balling. *Noun.* The tendency of a material to agglomerate or cluster, particularly during mixing.

ballistic limit. *Noun.* The maximum velocity of a projectile that a given amount of **ceramic armour** will defeat.

ball mill. *Noun.* A closed-end rotating cylinder, usually consisting of a steel jacket with an abrasion-resistant porcelain or porcelain-like lining and containing pebbles or porcelain balls as the grinding media, in which materials are wet or dry ground as a means of mixing or reducing the particle size. The mill and grinding media may be of steel or alloy compositions if contamination is not a factor.

ball mill, air-swept. *Noun.* See **air-swept ball mill**.

ball milling. *Verb trans.* Using a ball mill to prepare materials.

ball mill, Krupp. *Noun.* See **Krupp ball mill**.

ball mill, vibrating. *Noun.* See **vibrating ball mill**.

ballotini. *Noun.* Minute glass spheres, 1–60 μm diameter, made to reflect light by flame-drawing and then allowing the molten glass to fall in an air jet. Used in the composition of reflective paints.

ball test. *Noun.* (1) A test in which a ball of specified size and weight is dropped or forced onto the surface of a body, glaze, porcelain-enamel, or other material under prescribed conditions as a means of evaluating a property such as resistance to impact, degree of adherence, etc. (2) An on-site test of the consistency of concrete.

Balmer series. *Noun.* The series of lines in the visible part of the spectrum of hydrogen which can be represented by the equation: $J_n = R(0.25 - 1/n^2)$, where $n=3, 4, 5$, etc., J_n is the wave number, and R is the Rydberg constant for hydrogen.

bamboo ware. *Noun.* A type of brownish or cane-coloured **stoneware**.

Banbury mixer. *Noun.* A heavy-duty mixer consisting of two rotors, the faces of which turn in opposite directions; used in mixing viscous compositions and pastes.

band. *Noun.* A restricted range in which the energies of electrons in solids lie, or from which they are excluded, as understood in **quantum-mechanical** terms.

band gap. *Noun.* The energy difference from the top of the valence band to the bottom of the conduction band in semiconductor electron energy level diagrams. It is typically in the range 0.2–4.0 eV. The wider the gap, the more colourless the material, e.g., diamond 5.6 eV, SiC 3.1 eV is blue-green and Si 1.1 eV is opaque. Intrinsic materials electrons are forbidden to have energies within the energy range of the band gap.

banding. *Verb.* The application of a decorative line or band of colour to the edges, sides, and facial surfaces of chinaware, pottery, and similar products.

band-pass filter. *Noun.* (1) A filter passing only those currents having a frequency within specified limits. (2) An optical device consisting of absorbing filters, for transmitting electromagnetic waves of selected wavelength.

bandwidth. *Noun.* (1) The range of frequencies within a given wave band used for a particular radio frequency transmission. (2) The range of frequencies over which a receiver or amplifier should not differ significantly from its maximum value. (3) The width of a filament-wound band.

bank kiln. *Noun.* A kiln constructed on a slope or bank of earth, the incline serving in place of a flue for the removal of combustion gases.

bank run. *Noun.* Concrete aggregate in the condition as excavated from banks or pits.

banks. *Noun.* The sloping refractory section of an open-hearth furnace located between the hearth and the front and back walls.

bank sand. *Noun.* A sand of low clay content used in making casting cores.

bannering. *Verb.* The levelling of **saggers** in a kiln to facilitate stacking.

bar. *Noun.* A **cgs unit** of pressure equal to 10^6 dyn cm^{-2} or in the SI system 10^5 N m^{-2} ; approx. 0.987 atm.

barbertonite. *Noun.* See **stichite**.

Bardeen-Cooper-Schrieffer theory. *Noun.* A theoretical explanation of the theory of superconductivity formulated by Bardeen, Cooper and Schrieffer in 1976. An electron moving through a crystal creates a small distortion in a nearby atom position by coulombic interaction. The distortion persists long enough for a second electron to have its passage helped. Thus bound pairs carry the current; they are called

Cooper pairs. Pair formation involves creation of an energy gap in what would normally be a continuum of electron energy states in a partly filled band. The electrons in the pairs have opposite spin and momentum. Once excited above the energy gap, single electrons cannot decay to their normal states and they become free to move through the structure without scattering by ion cores.

bare glass. *Noun.* Glass fibre yarns, rovings, etc. from which the **sizing** or other surface finish has been removed.

bar graph. *Noun.* A graph consisting of vertical or horizontal bars whose lengths are proportional to amounts.

baria. *Noun.* Ceramic name for barium oxide. Not used much in ceramics because it is unstable and reacts with water. See **barium oxide**.

barilla. *Noun.* An impure mixture of **sodium carbonate** and **sodium sulphate** obtained from the ash of plants, such as kelp.

barite. *Noun.* BaSO_4 . The American name for **barytes**. An orthorhombic mineral employed in glasses as a flux to reduce **seeds**, increase toughness, improve brilliance, and reduce annealing time. Mp 1,580 °C; density 4,300–4,600 kg m^{-3} ; hardness (Mohs) 2.5–3.5. Also known as **blanc fixe**.

barium aluminate. *Noun.* (1) $\text{Ba}_3\text{Al}_2\text{O}_6$; employed as a source of barium oxide in glass compositions to decrease the solubility and increase the brilliance of the glass; also used in cathode coatings for vacuum tubes. (2) BaAl_2O_4 barium aluminium **spinel**; mp 1,998 °C; density 3,990 kg m^{-3} . (3) $\text{BaAl}_{12}\text{O}_{19}$; mp 1,860 °C density; 3,640 kg m^{-3} .

barium aluminium silicate. *Noun.* $\text{BaAl}_2\text{Si}_2\text{O}_8$. Mp 1,716 °C; density 3,210–3,300 kg m^{-3} .

barium borate. **BBO.** *Noun.* BaB_2O_4 or $\text{Ba}(\text{BO}_2)_2$. A non-linear optical ceramic capable of second harmonic generation and so is used as an optical parametric oscillator.

barium boride. *Noun.* BaB_6 . Mp 2,270 °C; density 4,320 kg m^{-3} ; hardness (Vickers) approx. 30 GN m^{-3} .

barium calcium silicate. *Noun.* $\text{BaCa}_2(\text{SiO}_3)_3$. A chain **pyroxene**.

barium carbide. *Noun.* BaC_2 . An acetylide containing $(\text{C}-\text{C})^{2-}$ ionic units; source of acetylene. Mp > 1,760 °C; density 3,570 kg m^{-3} .

barium carbonate. *Noun.* BaCO_3 . Employed as a flux in porcelain-enamels and glazes to improve elasticity, brilliance, mechanical strength, acid resistance and to prevent scumming; used as an ingredient in flint glass, pressed tableware, television tubes, and laboratory glassware to lower the melting point, improve workability, improve brilliance and hardness, and to improve dielectric constants and resistivity; used to obtain

maximum flux density in hard core permanent magnets; used in structural clay products to prevent **scum** and **efflorescence**; and employed in **steatite**, **forsterite**, **zircon porcelain**, and titanate electronic components to reduce **dielectric loss**. Mp 1,360 °C; density 4,400 kg m^{-3} . See **witherite** which is a ceramic name for this material.

barium cerium oxide. *Noun.* BaCeO_3 . A **perovskite** oxide developed as a proton-conductor in the 200–900 °C range; used as a hydrogen sensor device.

barium chloride. *Noun.* BaCl_2 . Used as a **set-up agent** and **scum** preventative in porcelain enamels by precipitating soluble sulphates as insoluble barium sulphate. Mp 960 °C; density 3,097 kg m^{-3} .

barium chromate. *Noun.* BaCrO_4 . Used in the production of yellow and pale green overglaze colours. Density 4,500 kg m^{-3} . Also known as **chrome yellow**.

barium crown glass. *Noun.* An optical crown glass containing barium oxide as a major component. See **optical crown glass**.

barium diuranate. BaU_2O_7 . An orange-yellow powder used as a ceramic colourant, particularly for porcelain.

barium ferrite. *Noun.* $\text{BaFe}_{12}\text{O}_{19}$. A magnetic ceramic with the hexagonal **magnetoplumbite** structure; it has a high value of uniaxial anisotropy field and high coercive force which makes it stable in strong demagnetising fields; a high resistivity $10^6 \Omega \text{ m}$. Used as magnets in TV tubes. Several trade names: **Feroba**, **Magnadur**, **M-compounds**.

barium flint glass. *Noun.* An optical flint glass containing barium oxide as a major component. See **crown glass**, **optical**.

barium fluoride. *Noun.* BaF_2 . Used as an opacifier and flux in porcelain-enamels. Mp 1,280 °C; density 4,832 kg m^{-3} .

barium fluosilicate. *Noun.* BaSiF_6 . Used as a flux and an opacifier in porcelain-enamels and glazes. Decomposes at 300 °C; density 4,300 kg m^{-3} . Also known as **barium silicofluoride**.

barium glass. *Noun.* A glass in which part of the calcium oxide component is replaced by barium oxide.

barium hydroxide. *Noun.* $\text{Ba}(\text{OH})_2$. Used in some ceramic formulation as the source of barium oxide. Also known as **baryta**. See **barium octahydrate**.

barium iron arsenide. *Noun.* BaFe_2As_2 . The **archetype** of a series of high temperature superconductors that do not contain CuO_2 layers in the structure. $\text{Sr}_{0.6}\text{K}_{0.4}\text{Fe}_2\text{As}_2$, for example has a T_c value of 32 K.

barium metaphosphate. *Noun.* $\text{Ba}(\text{PO}_3)_2$. Used as a precoating treatment for metals to prevent primary **boiling** in sheet steel enamels, and as an ingredient in certain types of **bright** glass. Mp 849 °C.

barium molybdate. *Noun.* BaMoO_4 . Used as an opacifier and adherence-promoting agent in porcelain-enamel compositions. Mp $> 1,300^\circ\text{C}$; density $4,652\text{ kg m}^{-3}$.

barium monohydrate. *Noun.* Precipitated barium hydroxide used in the manufacture of **barium ferrite** magnets.

barium niobate. *Noun.* $\text{Ba}_6\text{Nb}_2\text{O}_{11}$. An electroceramic with various applications. Mp $1,927^\circ\text{C}$; density $5,982\text{ kg m}^{-3}$.

barium nitrate. *Noun.* $\text{Ba}(\text{NO}_3)_2$. Used to improve homogeneity and opacity in porcelain-enamels and as an ingredient in optical glasses. Mp 575°C ; density $3,244\text{ kg m}^{-3}$. Also known as **nitrobarite**.

barium octahydrate. *Noun.* $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$. Used in ceramics as a source of high purity BaO . Loses water of crystallisation at 78°C ; mp of anhydrous $\text{Ba}(\text{OH})_2$ 408°C ; density $1,656\text{ kg m}^{-3}$. Also known as **barium hydroxide**.

barium osumilite. *Noun.* $\text{BaMg}_2\text{Al}_6\text{Si}_9\text{O}_{20}$. A refractory aluminosilicate **glass ceramic** with potential use in gas turbines for power generation.

barium oxide. *Noun.* BaO . A yellowish-white solid. Used as a fluxing ingredient in glass and in the Brin process to fix oxygen because when heated in air it goes reversibly to BaO_2 . Mp $1,923^\circ\text{C}$; density $5,722\text{ kg m}^{-3}$; hardness (Mohs) 3.5. Also called **baryta** and **baria**.

barium peroxide. *Noun.* BaO_2 . Has limited use in glass manufacture; strong oxidising agent; source of hydrogen peroxide when added to sulphuric acid. Mp 450°C ; decomposes at 800°C ; density $4,580\text{ kg m}^{-3}$.

barium phosphate. *Noun.* $\text{Ba}_3(\text{PO}_4)_2$. An orthophosphate that is sometimes used as a gunnable refractory to repair furnace linings. Mp $1,727^\circ\text{C}$; density $4,100\text{ kg m}^{-3}$.

barium phosphide. *Noun.* Ba_3P . Source of phosphine when treated with acid. Density. $3,180\text{ kg m}^{-3}$; hardness Vickers 3 GN m^{-2} .

barium propoxide. *Noun.* $\text{Ba}(\text{OC}_3\text{H}_7)_2$. An alkoxide soluble in propanol that is used to prepare ceramic precursor sols and gels.

barium silicate. *Noun.* Several ionic and sheet structured silicates (1) BaSiO_3 . A **pyroxene** chain silicate containing two dimensional chains of $[\text{SiO}_4]^{2-}$ tetrahedra sharing two corners; mp $1,640^\circ\text{C}$; density $4,400\text{ kg m}^{-3}$. (2) Ba_2SiO_4 . A discrete ionic **orthosilicate** containing $[\text{SiO}_4]^{4-}$ tetrahedral anions; mp approximately $1,755^\circ\text{C}$; density $5,200\text{ kg m}^{-3}$. (3) BaSi_2O_5 . A two dimensional sheet silicate structure; mp $1,640^\circ\text{C}$; density $4,405\text{ kg m}^{-3}$. (4) $\text{Ba}_2\text{Si}_3\text{O}_8$. A fibrous silicate; mp $1,449^\circ\text{C}$; density $3,930\text{ kg m}^{-3}$.

barium sodium niobate. *BNN. Noun.* $\text{Ba}_2\text{NaNb}_3\text{O}_{15}$. A piezoelectric material used to detect infrared radiation.

barium stannate. *Noun.* $\text{BaSnO}_3 \cdot 3\text{H}_2\text{O}$. Used as an additive to barium titanate bodies to decrease the **Curie temperature** when they are needed for use as capacitors of high **dielectric constant**. Also used in glass-enamels to improve alkali resistance. Loses H_2O at 280°C .

barium sulphate. *Noun.* See **blanc fixe**.

barium sulphide. *Noun.* BaS . Used to manufacture crucibles for melting cerium and uranium. Mp $1,660^\circ\text{C}$ and may be fired in bodies that it will vaporise at $1,600^\circ\text{C}$; density $4,250\text{ kg m}^{-3}$.

barium tantalum oxynitride. *Noun.* BaTaO_2N . A deep brown coloured **perovskite** dielectric capable of being sintered in a reducing atmosphere, which allows the use of metals other than Pt for electrodes to be sintered in place during processing.

barium thorate. *Noun.* BaThO_3 . A perovskite phase; mp $2,299^\circ\text{C}$; density $7,660\text{ kg m}^{-3}$.

barium tin borate. *Noun.* $\text{BaSn}(\text{BO}_3)_2$. A low-sintering-temperature metaborate used as a multilayer substrate.

barium titanate. *Noun.* A general name for several barium titanium oxides used in devices involving **piezoelectric** effects and magnetic properties such as guided missiles, ultrasonic generators, electronic filters, accelerometers etc. Compositions are: (1) BaTiO_3 ; a **perovskite**; **ferroelectric** ceramic with **polymorphic** phase transition enhancement of piezoelectric performance; $d_{33} = 190\text{ pC N}^{-1}$ but low Currie temperature, $T_c = 120^\circ\text{C}$ limits use to sonar and record player needles; mp $1,618^\circ\text{C}$. (2) BaTi_2O_5 ; mp $1,320^\circ\text{C}$. (3) BaTi_3O_7 ; mp $1,356^\circ\text{C}$. (4) BaTi_4O_9 ; mp $1,420^\circ\text{C}$; density $4,600\text{ kg m}^{-3}$; a dielectric resonator ceramic with frequency 4 GHz . (5) $\text{Ba}_2\text{Ti}_9\text{O}_{20}$; a dielectric resonator ceramic.

barium titanium silicate. *Noun.* (1) BaTiSiO_5 ; mp $1,398^\circ\text{C}$. (2) $\text{BaTiSi}_2\text{O}_7$; mp $1,248^\circ\text{C}$; discrete ionic silicate containing the double tetrahedral $(\text{Si}_2\text{O}_7)^{6-}$ anion.

barium tungstate. *Noun.* BaWO_4 . Used as a white pigment and as a phosphor in ultraviolet radiation. Density $5,040\text{ kg m}^{-3}$.

barium zirconate. *Noun.* BaZrO_3 . Another **perovskite** used as an addition to barium titanate bodies to improve their dielectric properties. Mp $2,620^\circ\text{C}$; density $2,630\text{ kg m}^{-3}$.

Barker-Truog clay treatment. *Noun.* An alkali treatment for clay to obtain pH values ranging from 7 to 10, depending on the original acidity of the clay; such clays exhibit improved plasticity, which aids the shaping of brick.

Barkhausen effect. *Noun.* The succession of abrupt changes in magnetisation occurring when the magnetising force acting on a magnetic material is varied.

Barlow's formula. *Noun.* Used to calculate wall thickness in composite laminate pipes $t = P \cdot r \cdot d / 2a$, where t is the wall thickness, P the working pressure, d the pipe inside diameter, and a is the design stress.

bar mat. *Noun.* A mat of preassembled steel bars for installation as reinforcement in a concrete slab, usually a paving slab.

bar mould. *Noun.* A mould in which the inlets are arranged in rows on separate bars, each of which may be removed individually.

barn. b. *Noun.* A unit of area equal 10^{-28} m^2 . Used as a convenient scale to measure the cross-sectional area of atomic nuclei. Colloquially derived from "as wide as a barn door" as far as nuclear bombardment is concerned.

barometer. *Noun.* An instrument designed to measure the pressure of the atmosphere.

barophoresis. *Noun.* The diffusion of suspended particles at a rate dependent on external forces.

baroque. *Noun.* (1) A style of decoration and architecture characterised by excessive ornamentation. Flourished from sixteenth to eighteenth centuries in Europe. (2) *Adjective.* Of pearls: irregularly shaped.

barrel. *Noun.* (1) A unit of measure of cement equal to 170.9 kg or four sacks. (2) The cylindrical portion of an extruder or injection-moulding machine containing the screw plunger.

barrel finishing. *Verb.* Improving the surface or removing burrs from the edges of work by tumbling the work in a rotating cylinder containing suitable particles or grains of abrasives.

barrel vault. *Noun.* An arch roof having the form of a half cylinder unbroken by joins.

barrier. *Noun.* A panel, wall, or other structure designed to bar or deflect the passage of something, such as a baffle placed to deflect combustion gases in a furnace from impinging on ware being fired.

barrier voltage. V_{gb} . *Noun.* The voltage drop across the grain boundary caused by the application of an extended voltage to a **varistor**; typically 2–4 V/grain boundary.

barrier, moisture. *Noun.* See **moisture barrier**.

bar, runner. *Noun.* See **runner bar**.

bars, Holdcroft. *Noun.* See **Holdcroft bars**.

barye. *Noun.* A unit of pressure in the cgs system equal to 1 dyn cm^{-2} . It is equivalent to 1 microbar.

baryon. *Noun.* Elementary particle with a spin of $1/2$ involved in strong interactions. Baryons include protons and neutrons.

baryta. *Noun.* (1) $\text{Ba}(\text{OH})_2$. A white solid mp 408°C . See **barium octahydrate**. (2) Common name for **barium oxide**, BaO . See **barium hydroxide**.

barytes. *Noun.* BaSO_4 . A colourless or white mineral of barium sulphate in its rhombic crystal form occurring in **sedimentary rocks**. Used as a flux in glasses to reduce **seeds**, increase toughness, improve brilliance, and reduce annealing time; also used in ceramic bodies, glazes, and porcelain-enamels to minimise or prevent scumming. Mp $1,580^\circ \text{C}$; density $4,300\text{--}4,600 \text{ kg m}^{-3}$; hardness (Mohs) 2.5–3.5. Also known as **barite**, **blanc fixe**, and **heavy spar**.

basal plane. *Noun.* The plane perpendicular to the c -axis in a hexagonal or tetragonal structure. In the hexagonal system denoted as (0001), packing such planes in the sequence ... ABABAB ... generates an ideal close-packed hexagonal structure such that the c/a ratio is 1.633.

basalt. *Noun.* (1) A crystalline basic high-silica-content volcanic rock composed essentially of soda-lime **feldspar**, **pyroxene**, **magnetite**, **olivine**, **magnesite**, and **ilmenite**, all with very small grain sizes. (2) A black unglazed form of pottery resembling **basalt**.

basalt, fusion-cast. *Noun.* See **fusion-cast basalt**.

basalt lava. *Noun.* Ground volcanic lava that melts into a dark brown glass at **stoneware** temperatures; used as a basis for coloured and **tenmoku** glazes. See **Pele's hair**.

basaltware. *Noun.* A hard, black, fine grained, unglazed vitreous **stoneware** having an appearance similar to that of **basalt** rock.

basanite. *Noun.* A black basaltic rock containing **plagioclase**, **augite**, **olivine** and **nepheline**. Formerly used as a **touchstone**.

base. *Noun.* (1) An alkaline substance, either ionic or molecular, that accepts protons from another substance or which will react with an acidic material. (2) The bottom of a container, bottle, or other item. (3) The compacted earth or granular material upon which a paving slab is placed. (4) The foundation that supports a printed circuit or the pins, leads, or other terminals of a bulb or tube to which an external electrical or electronic connection is to be made. (5) The middle region of a **transistor** between the **emitter** and the **collector**.

base coat. *Noun.* A fired coating over which another coating is applied.

base course. *Noun.* The concrete foundation over which a wall, pavement, or other structure is to be erected or placed.

base exchange. *Noun.* A surface property exhibited by colloidal inorganic materials, such as clays, whereby certain anions are replaced by other ions from a surrounding medium.

base metal. *Noun.* The metal to which porcelain-enamel is applied.

base unit. *Noun.* Any of the fundamental units in measurement system. The SI base units are: **metre, kilogram, second, ampere, kelvin, candela, and mole.**

basic. *Adjective.* (1) Of, denoting, or containing a base; alkaline. (2) Of a salt containing hydroxide or oxide groups all of which have not been replaced by an acid radical. (3) Of, concerned with, or made by a process in which the furnace or converter equipment is made from a basic material, such as **magnesia**. (4) Of **igneous rocks**, such as **basalt** containing less than 50 % silica.

basic brick, direct-bonded. *Noun.* See **direct-bonded basic brick.**

basic brick, pitch-bonded. *Noun.* See **pitch-bonded basic brick.**

basic brick, pitch-impregnated. *Noun.* See **pitch-impregnated refractories.**

basic fibre. *Noun.* Untreated glass fibre as it is obtained from the forming equipment.

basicity. *Noun.* The extent to which a substance is basic.

basic lava. *Noun.* Magma with a high alkaline content, which results in rapid smooth flow. The surface solidifies but the centre still flows and wrinkled rocks arise. Such wrinkled rocks are called **ropy lavas**. See **acid lava**.

basic lead carbonate. *Noun.* $\text{Pb}_3(\text{CO}_3)_2(\text{OH})_2$. A white pigment. See **white lead** and **hydrocerussite**.

basic-lined. *Adjective.* A furnace, kiln, converter, or similar structure lined with basic refractory shapes made of materials such as lime, magnesite, chrome ore, etc.

basic open-hearth furnace. *Noun.* An open-hearth furnace constructed of basic refractories covered with **magnesite** or **burned dolomite**, and which is employed in the production of basic pig iron.

basic oxide. *Noun.* A metallic oxide that will react chemically with acidic materials.

basic refractory. *Noun.* A refractory composed of basic refractory materials, such as lime, magnesite, chrome magnesite, etc., and which will react with acidic slags or fluxes at elevated temperatures.

basic slag. *Noun.* A slag rich in basic ingredients produced as a by-product in the steel-making process; used in fertiliser formulations because it contains large amounts of calcium phosphate.

basic structural unit. *BSU. Noun.* A term now being used in the new polymorphs of carbon area where a BSU is an isolated polyaromatic entity less than 1 nm diameter.

basket, pickle. *Noun.* See **pickle basket**.

basket weave. *Noun.* One of the weaving formats where two more warp yarns are threaded through two or more yarns. Fabrics with these weaves are more pliable and easily formed to curved shapes.

basket-weave chequer work. *Noun.* An arrangement of corrosion-resistant refractory brick serving as flues in **regenerators** and other structures in which the ends of each brick are placed at right angles to the centre of each adjacent brick to form a pattern resembling the weave of the splints in a basket.

bas-relief. *Noun.* A type of **artware** in which the figures project slightly above the background surface.

basse taille. *Noun.* A process in which transparent or translucent porcelain-enamels are applied and fired over a metal background that has been carved in low relief.

bastard ganister. *Noun.* A mineral that has the appearance of **ganister** but having substantially different properties.

bastnäsite. *Noun.* LnFCO_3 . A yellow-brown fluorocarbonate mineral containing amounts of **lanthanides** up to 70 % rare earth oxides by weight. A particular source of dysprosium oxide.

bat. *Noun.* (1) A plaster slab or disk upon which clay is worked, or upon which ware is formed and dried. (2) A fireclay slab upon which ware is placed and fired in a kiln. (3) A fragment of hardened clay or brick. (4) A slab of moist clay. (5) A brick cut transversely so as to leave one end whole. (6) A sheet of gelatine used in bat printing. A tangled mass of single filament fibres. Also called **batt** or **web**.

batch. *Noun.* A quantity of raw materials blended together for subsequent processing, such as a glass batch or furnace charge.

batch blanket. *Noun.* The solid layer of new ingredients added to a glass making furnace. The first part in the first stage in a modular melting industrial glassmelting process. It is where the batch materials enter and are heated to about 1,200 °C. This is achieved in part by a strong return flow of hot glassmelt and from the top by burning gas. See **modular glass making**.

batch blending. *Noun.* Stepwise changes in the composition of a batch to arrive at a desired composition of a final product.

batch charger. *Noun.* A mechanical device employed to introduce a batch into a smelter or melting tank.

batch drier. *Noun.* A periodic drier, in which the ware being dried remains stationary in a circulating stream of usually warm or hot air, until dry.

batcher. *Noun.* A type of equipment in which the ingredients of a batch are measured and collected before discharging into a process operation, such as a ball mill or concrete mixer.

batch feeder. *Noun.* A mechanical device, such as an **auger**, employed to charge a glass or porcelain enamel batch into a melting tank or smelter.

batch-free time. *Noun.* The time needed to complete the melting reactions in a glass melt. Consists of the time to heat the batch to reaction plus the time to complete the vigorous initial melt, plus the time to dissolve the residual sand grains.

batch furnace. *Noun.* A furnace into which ware is charged, fired, and removed before the introduction of another charge.

batch house. *Noun.* The area in a factory in which materials are received, stored, handled, weighed, and mixed preparatory for movement to a subsequent manufacturing operation.

batching sequence. *Noun.* The process of introducing raw materials into a batch mixer or process in an ordered, stepwise sequence.

batch operation, contact. *Noun.* See **contact batch operation**.

batch process. *Noun.* A manufacturing operation or process that is carried to completion before the same operation or process is repeated; that is, the process is not continuous.

batch, raw. *Noun.* See **raw batch**.

batch smelter. *Noun.* A periodic smelter or glass-melting tank into which a charge is introduced, melted, and discharged as a unit process in accordance with a prescribed time and temperature cycle.

batch truck. *Noun.* A dump truck in which the body is partitioned into compartments for the transport of weighed batches of cement and aggregate from the weighing areas to the mixer.

batch-type mixer. *Noun.* A machine into which all ingredients of a batch are weighed, mixed, and discharged as a unit operation before introduction of a subsequent charge.

bath. *Noun.* (1) A liquid preparation, such as water, cleaner, acid, neutraliser, or other solution, in which something is immersed for treatment. (2) Liquid penetrants into which parts are immersed for inspection.

batholith. *Noun.* Enormous igneous masses in the central core of major folded mountain ranges. During the cooling of these bodies major sulphide ore deposits are made.

Bath stone. *Noun.* A type of **limestone** found near Bath and used as a building stone.

bat. *Noun.* An alternative spelling of bat. See **bat**.

batten. *Noun.* A thin strip of material employed to seal, conceal, or reinforce a joint as, for example, a strip of flat or corrugated asbestos cement used to conceal butt joints of flat or corrugated asbestos-cement sheets.

batter. *Noun.* The upward slope or the angle at which the outer face of a wall slopes from the vertical.

batteries. *Plural noun.* Devices containing two or more primary **cells** usually connected in series. See **cell**.

battery management. *Noun.* The control of charging and discharging conditions by temperature, cut-off voltage and current.

batt printing. *Noun.* A process for printing on ceramic ware in which a design is transferred from an engraving plate to ware by means of a **bat** of solid glue or gelatine.

bat wash. *Noun.* A slurry of refractory materials applied to **kiln setters** to prevent the sticking of ware during firing.

Baumé. *Noun.* Either of two calibrated hydrometer scales to estimate the specific gravity of liquids. For liquids less dense than water, the specific gravity equals $140/(130 + ^\circ\text{Be})$ at 15.6°C ; for liquids more dense than water, the specific gravity equals $145/(145 - ^\circ\text{Be})$ at 15.6°C .

Bauschinger effect. *Noun.* The observation that if a specimen is lightly deformed in one direction and then immediately reloaded in the opposite direction it begins to flow in this direction at a reduced yield stress.

bauxite. *Noun.* $\text{Al}_2\text{O}_3 \cdot n\text{H}_2\text{O}$. Aluminium ore, found as clay-like rocks consisting largely of hydrates of **alumina**, together with varying amounts of iron and titanium oxides, silica, and other impurities. Bauxites fuse at $1,800^\circ\text{C}$ and above, and have densities varying from $2,450$ to $3,250 \text{ kg m}^{-3}$. As a major source of alumina, bauxites are employed extensively in the manufacture of grinding wheels, abrasive stones, abrasive cloth and paper, polishing and grinding powders, refractories for **kilns** and **glass tanks**, **electroceramics**, and quick-setting alumina cements.

bauxite clay. *Noun.* A natural mixture of bauxite and clay containing not less than 47 % or more than 65 % of alumina on a **calcined** basis.

bayerite. *Noun.* $\alpha\text{-Al}(\text{OH})_3$. α -Aluminium trihydroxide which in old notation was called beta **alumina trihydrate**. The structure contains $\text{Al}(\text{OH})_6$ octahedra in layers, stacked in the hexagonal sequence with the layers linked together by hydrogen bonds; rarely found in nature but made by several commercial methods.

Bayer process. *Noun.* A process in which aluminium ores are digested in hot solutions of caustic soda and the aluminium is removed as soluble **aluminates**. Further treatments can either lead to pure **alumina** or aluminium metal.

Bayer red mud. *Noun.* A complex mixture of waste products arising in large amounts from the **Bayer process**. It typically contains silica, alumina, iron oxide, titania, sodium compounds and has an alkaline pH. For every tonne of alumina powder produced in the **Bayer process** there is 1 tonne of red mud.

B-basis. *Noun.* Any stated mechanical property value above which 90 % of all test values should fall within a confidence limit of 95 %.

BBO. *Abbreviation.* Stands for barium borate. See **barium borate**.

BCS theory. *Noun.* See **Bardeen-Cooper-Schrieffer theory**.

***Be.** *Symbol.* Stands for Baumé. See **Baumé**.

bead. *Noun.* (1) An enlarged, rounded edge of a glass tumbler or other glass article. (2) An excess of porcelain-enamel slip or powder along the edge of a coated ware. (3) An application of porcelain enamel, usually of a contrasting colour to the edge or rim of a porcelain-enamelled article. (4) A small piece of glass tubing used to enclose a lead wire. (5) A ceramic insulator through which passes the inner conductor of a coaxial transmission line and by means of which the inner conductor is supported in a position coaxial with the outer conductor. (6) A spherical glass or pottery sample through the centre of which a hole has been drilled to allow it to be strung for decorative use.

beader. *Noun.* An operator who applies a beading enamel to a porcelain-enamelled article.

beader-off. *Noun.* An operator who removes a bead of excess porcelain-enamel or smooths the edges of the coating on porcelain-enamelled ware.

beading. *Verb.* (1) To apply porcelain-enamel, usually of a contrasting colour, to the edges of rims of porcelain-enamelled articles. (2) To remove excess slip from the edge of dipped ware.

beading enamel. *Noun.* Any of the special porcelain-enamels applied as a beading on ware for purposes of decoration and protection of exposed edges of the ware.

bead test. *Noun.* A test of the softening and flow characteristics of glaze, glass, and porcelain-enamel compositions in which a bead or button-like specimen of specified size and shape is compared with standard compositions at elevated temperatures.

bead thermistor. *Noun.* A **thermistor** consisting of two wire leads cemented together by a molten droplet of a semiconducting material, such as **nickel oxide**, NiO.

beam, reinforced. *Noun.* See **reinforced beam**.

bearer arch. *Noun.* One of a series of arches that supports the **checkerwork** in a **regenerator** or heat exchanger that heats air or gas before combustion.

bearing zone. *Noun.* The middle region of a fibre or wire drawing die where the final diameter and surface finish of the wire or fibre are determined. See **die zones**.

Becke lines. *Plural noun.* Lines that appear at the edges of a microscope image of a fibre caused by refraction at the fibre edge.

beckelite. *Noun.* $\text{Ca}_3(\text{Ce}, \text{La}, \text{Y})_4(\text{Si}, \text{Zr})_3\text{O}_{15}$. A yellow coloured mineral used as a source of cerium.

Becquerel. B_q . *Noun.* The **SI unit** of radioactive decay; one B_q is equal to one radioactive decay per second. Usually quoted as $\text{B}_q \text{ g}^{-1}$ or $\text{B}_q \text{ cm}^2$ to define the mass or area of contamination.

becquerelite. *Noun.* $\text{UO}_2 \cdot 2\text{H}_2\text{O}$. Small yellow crystals of hydrated **uranium dioxide** occurring on the surface of **pitchblende**.

bed. *Noun.* (1) The layer of mortar upon which brick and stone are laid. (2) The prepared base or foundation upon which ware is placed for processing, such as the floor of a kiln.

bedded tuff. *Noun.* A layered rock formed from volcanic ash. See **tuff**.

bed depth, critical. *Noun.* See **critical bed depth**.

bedder. *Noun.* A plaster-of-Paris shape for forming a bed of powdered **alumina** on which **bone china** is fired.

bedding. *Verb.* To place ceramic ware in a suitable refractory grain or powder as a support to prevent warpage during firing.

bedding course sand. *Noun.* Well-graded, free-draining, mechanically resistant sand placed below **clay pavers** in flexible pavements to provide a uniform support for the pavers and prevent stress concentrations that could cause damage.

bed, expanded. *Noun.* See **expanded bed**.

bed, fluidised. *Noun.* See **fluidised bed**.

bed, intermittent-moving. *Noun.* See **intermittent-moving bed**.

bedrock. *Noun.* The solid, unweathered rock that lies beneath the soil etc.

beehive kiln. *Noun.* A circular beehive-shaped kiln characterised by a domed roof and fired through chambers stationed around the circumference.

Beer-Lambert law. *Noun.* Layers of equal thickness of a homogeneous material absorb equal proportions of light. This is expressed as $I = I_0 \exp(-ad)$, where I is the intensity of the transmitted light, d is the layer thickness, and a is a constant known as the absorption coefficient; a is dependent on the wavelength of light used and the structure and composition of the material.

Beevers-Ross site. *Noun.* Positions formed by hexagonally close-packed O^{2-} ions on the mirror planes of $\beta\text{-Al}_2\text{O}_3$; two types of site exist and are occupied by the M^{n+} ions, one is directly above an O^{2-} in the **spinel** layer and one above an **interstitial site** in the spinel layer. Movement of M^{n+} within these sites is responsible for fast ion conduction in $\beta\text{-Al}_2\text{O}_3$.

beidellite. *Noun.* $(\text{Al}_{1.53}\text{Fe}_{0.2}\text{Mg}_{0.25})(\text{Si}_{3.88}\text{Al}_{0.12})\text{O}_{10}(\text{OH})_2$. A **montmorillonite** three-sheet 2:1 layer-lattice clay mineral in which magnesium substitutes for aluminium in octahedral sites and some silicon is substituted by aluminium in tetrahedral sites.

bel, b or B. *Noun.* A unit for comparing two power levels. If two power levels to be compared are P_1 and P_2 the power ratio is $\log_{10}(P_1/P_2)$ bel. Since the bel is particularly large it is more common to use a subunit, the **decibel**, which is one tenth of a bel.

belemnite. *Noun.* A fossil found in the Pee Dee formation in South Carolina that is used as the main standard for carbon isotope determination. See **mille**.

Belgian kiln. *Noun.* A longitudinal-arch, side-fired kiln in which the fire is directed to grates stationed at regular intervals along the bottom of the structure.

belite. *Noun.* One of the main constituents of **Portland cement** and is the colloquial name used to describe one of the four known **polymorphs** of the **orthosilicate** Ca_2SiO_4 . It reacts with water to form a paste able to develop compressive strength. In **cement notation** it is C_2S .

bell. *Noun.* (1) The enlarged end of a concrete or other pipe that overlaps the end of an adjoining pipe. (2) A refractory funnel placed to receive molten steel from the nozzle of a ladle.

bellarmine. *Noun.* A fat, narrow-necked, **salt-glazed** bottle or jug usually having a bearded face stamped or engraved on the neck as a decoration.

bell damper. *Noun.* A bell-shaped, sand-seal type of damper frequently used in **annular kilns**.

bell dresser. *Noun.* A tool consisting of rotating metal cutters employed in the truing, shaping, and dressing of grinding wheels.

Belleek china. *Noun.* Thin, highly translucent chinaware having zero water absorption, which is composed of a body containing substantial amounts of frit, and which normally, is coated with a soft lustre glaze. Named after the town in Ireland where it was first made.

bell glass. *Noun.* See **bell jar**.

bell jar. *Noun.* A bell-shaped glass cover used to prevent gases escaping in experiments and to cover apparatus. Also called **bell glass**.

belly. *Noun.* (1) The side of a clay pot. (2) The section of a converter in which steel is collected before it is poured. (3) The widest section of a blast furnace.

Belshazzar. *Noun.* A wine bottle of approximately 16-quart capacity or 15.1 litres.

belt. *Noun.* An endless flexible band passing around two or more pulleys; used to convey materials or objects, or to transmit motion from one pulley to one or more other pulleys.

belt conveyer. *Noun.* An endless belt running between head and tail pulleys used to transport loose materials or products from one point to another.

belt drive. *Noun.* A mechanism actuating a **ball mill** or other item of equipment by means of a friction belt rotating around a pulley mounted on a rotating shaft.

belt feeder. *Noun.* A mechanical device that delivers raw materials from one point to a processing station by means of a moving belt.

belt grinding. *Verb.* To grind the surface of a material or product by means of a continuous abrasive-coated belt.

belting. *Verb.* A finishing operation for concrete pavement in which a wide belt is dragged back and forth across a fresh slab of concrete and advanced along the slab.

belt kiln. *Noun.* A kiln through which ware being fired is transported by means of an endless, high-temperature-resistant alloy belt.

belt marks. *Noun.* Marks made on the bottom of glass articles as they ride through the **lehr** on a slightly overheated chain belt.

belt, segmented. *Noun.* See **segmented belt**.

bench. *Noun.* The floor of a **pot furnace**, often called **siege**.

bench grinder. *Noun.* An offhand grinding machine supported on a bench, the grinding mechanism consisting of one or two grinding wheels mounted on a horizontal spindle.

bench marks. *Noun.* Striations on a fatigue fracture surface showing where the crack front was held between moves forward.

bench moulding. *Verb.* The hand tool production of small moulds at a bench.

bench scale. *Adjective.* A process, test, or other procedure carried out on a small scale as on a laboratory bench or worktable.

bend. *Noun.* A pane of glass that has been bent to fit an opening. See **bending**.

bending. *Verb.* To manipulate glass in a kiln, particularly flat glass, to form curved shapes or bends.

bend test. *Noun.* (1) A measure of the transverse or cross-bending strength. (2) A test in which **bisque** or fired porcelain-enamelled panels are distorted by bending to determine the resistance of the coating to cracking or fracture.

benefication, beneficiation. *Noun.* Any process of upgrading or improving the physical or chemical properties of a mineral to enhance its use, such as washing, **flotation**, etc.

benitoite. *Noun.* $\text{BaTiSi}_3\text{O}_9$. A **ring silicate** containing $[\text{Si}_3\text{O}_9]^{6-}$ discrete ions formed from three corner-sharing $[\text{SiO}_4]^{4-}$ tetrahedra.

ben glass. *Noun.* Flat glass that has been shaped into cylindrical, curved, or other shapes while hot.

beptonite. *Noun.* Clay derived from volcanic ash and characterised by an extremely fine grain size. Its main constituent is **montmorillonite**, plus 5–10 % of alkalis or alkaline earth oxides. One type, which absorbs large quantities of water, swells enormously. It is used to increase dry and fired strengths and reduce absorption in whiteware bodies; also used as a **suspension agent** in porcelain-enamel slips. See **montmorillonite**.

berlinite. *Noun.* AlPO_4 . A phosphate with the quartz structure.

bernalite. *Noun.* $\text{Fe}(\text{OH})_3$. A rare greenish coloured iron oxide with a **perovskite** structure.

Bernal-stacking. *Noun.* Carbon atoms in the second layer of **graphene** sheets are positioned above the centres of hexagons in the first layer. This is the structure of **bilayer graphene**. Also known as AB-stacking.

bertrandite. *Noun.* $\text{BeSi}_2\text{O}_5 \cdot \text{H}_2\text{O}$. A major ore of beryllium in the form of hydrated beryllium disilicate.

beryl. *Noun.* $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$. A **ring silicate** inert to most reagents except hydrofluoric acid; employed as a **dielectric**, to reduce firing shrinkage, and to improve transverse strength, resistance to thermal shock, and improve electrical resistance in spark plug bodies; used in mat glazes for **talc** bodies, as a green colorant in other glazes, and in the production of glass windows for x-ray tubes. Gem varieties are **aquamarine** and **emerald**. Mp 1,410 °C; density 2,640–2,800 kg m^{-3} ; hardness (Mohs) 7.5–8.

beryl-ceramics. *Plural noun.* Refractory compositions containing **beryllium oxide**.

beryllia. *Noun.* Ceramic nomenclature for beryllium oxide. See **beryllium oxide**.

beryllides. *Plural noun.* Refractory hard compounds in which one element is beryllium, the general formula being Me_xBe_y ; characterised by high melting temperatures ranging from approximately 1,427 to 2,080 °C; excellent resistances to oxidation up to 1,260 °C and some to as high as 1,540 °C; high strength with strength retention at elevated temperatures, and excellent thermal-shock resistance; reported **specific heats** range from 796 to 1,600 $\text{J kg}^{-1} \text{K}^{-1}$; **thermal conductivities** range from 0.44 to 1.41 $\text{J s}^{-1} \text{K}^{-1}$ between 371 and 1,483 °C; linear thermal expansions of about 2 % at 1,371 °C; bend strengths of about 173 MN m^{-2} between 21 and 1,231 °C; **Vickers hardness** values between 5 and 13 GN m^{-2} and Young's modulus around 258 GN m^{-2} at 21 °C; potential materials for use in structural applications and spark-resistant tools.

berylliosis. *Noun.* An incapacitating lung disease caused by the inhalation of beryllium containing dusts.

beryllium. *Noun.* Be. A metalloid ceramic with toxic properties. A component in a number of special ceramics. Density 1,848 kg m^{-3} ; mp 1,289 °C.

beryllium aluminate. *Noun.* BeAl_2O_4 . An **olivine** even though formula suggests a **spinel**; mp 1,870 °C; density 3,500–3,840 kg m^{-3} ; hardness (Mohs) 8.5. Also known as **chrysoberyl**.

beryllium boride. *Noun.* Be_2B ; BeB_2 ; BeB_6 . See **borides**.

beryllium carbide. *Noun.* Be_2C . Employed as a neutron **moderator** in nuclear applications and in applications where hardness, toughness, elasticity, and corrosion resistance at moderately high temperatures are important. Decomposes above 2,950 °C; unstable in oxygen above 982 °C; density 1,900 kg m^{-3} ; hardness (Mohs) approximately 9; modulus of rupture 0.11 GN m^{-2} ; compressive strength 72.4 GN m^{-2} .

beryllium nitride. *Noun.* Be_3N_2 . Used in incandescent mantles and in applications where hardness, elasticity, corrosion resistance and toughness at temperatures in the range 600–1,400 °C are required. Mp 2,200 °C; density 2,710 kg m^{-3} ; oxidises in air above 600 °C.

beryllium oxide. *Noun.* BeO . A lightweight and rigid ceramic that exhibits excellent dielectric properties, good physical strength, resistance to wetting by metals and non-metals, and high thermal conductivity (ten times greater than **alumina**). Employed in rocket nozzles, crucibles, insulators, **radomes**, thermocouple protection tubes, microwave parts, solid-state devices, gyroscopes, as a **moderator**, reflector material, in some porcelain glazes and as a matrix for fuel elements in nuclear applications. Poisonous vapour. Mp 2,570 °C; density 3,016 kg m^{-3} ; hardness (Mohs) 9. Also known as **beryllia**.

beryllium silicate. *Noun.* Be_2SiO_4 . Mp 1,560 °C; density 2,990 kg m^{-3} . Also known as **phenacite**.

beryllosilicates. *Plural noun.* Ceramics with three-dimensional structures made from corner sharing oxygen atoms in SiO_4 and BeO_4 tetrahedra. See **chkalovite**.

Bessemer converter. *Noun.* A refractory-lined vessel, in which, steel is produced by the **Bessemer process**.

Bessemer process. *Noun.* A process for making steel by blowing air through molten pig iron, whereby most of the carbon and impurities are removed by oxidation.

BET. *Acronym.* Stands for Brunauer-Emmett-Teller equation. See **Brunauer-Emmett-Teller equation**.

beta activity. *Noun.* A form of radioactivity in which the atomic nucleus emits an electron or positron accompanied by an uncharged anti-neutrino, or neutrino respectively.

beta-alumina. *Noun.* See **alumina-beta**.

beta-eucryptite. *Noun.* β -LiAlSiO₄. The stable hexagonal solid solution of **β -quartz** present in some glass-ceramic compositions.

beta particle. *Noun.* An electron, of either positive or negative charge, which has been emitted by an atomic nucleus or neutron in the process of transformation.

beta phase. *Noun.* A **polymorph** of a material. See **quartz inversion**, **cristobalite**, **tridymite**.

beta-plane. *Noun.* Terminology used in the **electrical double layer model**. It is the outer surface of the first layer of water molecules adsorbed on an oxide surface. It is often disrupted by the presence of large-sized anions. The estimated **dielectric constant** of this water layer is 32. Also called the **outer Helmholtz plane**. See **d-plane** and **o-plane**.

betatron. *Noun.* Machine consisting of an evacuated circular tube used to accelerate electrons to energies around 100 MeV.

betavoltaic. *Noun.* A three-dimensional **p-n diode** formed in **porous silicon**. It is used to capture energetic electrons (**β -particles**) released in the radioactive decay of **tritium** absorbed within the pores and turn the **beta particle** energy directly to electric current.

BeV. *Acronym.* American term for GeV, which is an energy of 10⁹ eV or 1.602 × 10⁻¹⁰ J.

bevel brick. *Noun.* A brick with one edge or surface sloping to another surface at an angle that is not a right angle.

bevelled pipe. *Noun.* A pipe with an end angled to mate with a complementary pipe end.

beveling. *Verb.* To edge-finish flat glass to a desired bevel angle.

beaverite. *Noun.* Pb(Cu,Fe,Al)₃SO₄(OH)₆. An hydrous mineral consisting of lead, copper, iron and aluminium sulphates existing as canary-yellow plates.

BFRA. *Abbreviation.* Standing for boron fibre-reinforced aluminium.

BFRP. *Abbreviation.* Standing for boron fibre-reinforced plastic.

bias. *Noun.* A constant or systematic error as opposed to random error, manifested as a persistent positive or negative deviation of the method average from the accepted reference value.

B-H curve. *Noun.* See **magnetisation curve**.

BHD. *Abbreviation.* Stands for baghouse dust. See **baghouse dust**.

bias, statistical. *Noun.* See **statistical bias**.

biaxial crystal. *Noun.* A crystal with two axes or directions in which light vibrating in any plane will travel

with the same velocity. Most naturally occurring crystals are of this type. See **optic axis**.

biaxial winding. *Noun.* A type of winding used to make reinforced composites in which the helical band of fibre is laid in sequence, side by side, with no fibre crossover.

biberon. *Noun.* A ceramic cup with a spout for feeding invalids.

bicarbonate. *Noun.* An acid carbonate, [HCO₃]⁻; systematic name is acid carbonate.

bicchulite. *Noun.* Ca₈[Al₂SiO₆]₄(OH)₈. A framework **aluminosilicate** mineral used as a **zeolitic** catalyst. It has an unusual structure consisting of Ca₄(OH)₄ cubes in a **fcc** packing arrangement linked by Al₂SiO₆ double tetrahedra.

Bicheroux process. *Noun.* An intermittent process employed in the fabrication of **plate glass** of high quality in which molten glass is cast between driven conveyor rolls or a flat moving table which delivers the strip to a **lehr** where the glass is slowly cooled while passing between a series of asbestos-covered rollers.

bichromate of potash. *Noun.* K₂Cr₂O₇. Employed with **whiting** and **zinc oxide** to make **carnation pink** or red ceramic colours. Mp 396 °C; decomposes at 500 °C; density 2,692 kg m⁻³.

biconical cheese. *Noun.* See **cheese**.

bidet. *Noun.* A low, basin-like item of ceramic sanitary ware designed for personal hygiene.

Bierbaum scratch hardness. *H_s. Noun.* A measure of the hardness of a solid material based on the width of a scratch made by drawing a diamond point across the surface under preset pressure conditions, the measurement being made by use of a microscope. The calculation of the hardness value depends on the shape of the diamond, e.g., for a square-based pyramid with edge leading $H_B = 4P/W$, where P is the load and W is the track width, and for a conical diamond $H_B = 2.55P/W$.

bifilar. *Adjective.* Relating to a resistor where the wire is wound in a loop around a coil, this gives two parallel leads, which reduces inductance.

bifurcate. *Verb.* To divide into two branches, as cracks do in brittle ceramics and glass when they reach a **terminal propagation velocity**.

bilayer graphene. *Noun.* A polymorph of carbon consisting of two hexagonal layers with **Bernal-stacking**. See **low dimensional materials**.

bilayer manganates. *Plural noun.* A crystal structure resulting from blocks of MnO₆ octahedra corner sharing oxygens in 3-D but separated in to two-dimensional double layers by inserting a thin **rock-salt** layer to form the bilayer structure. This structure type often leads to **colossal magnetoresistance**.

billet. *Noun.* A cylinder-shaped specimen.

bi-metal. *Noun.* A bonded laminate of two dissimilar metals having different expansion properties; employed in thermocouples to measure differences in temperature.

bi-morph element. *Noun.* A device consisting of two **piezoceramic** strips **poled** in opposite directions and bonded together. Any strain caused by bending produces a voltage; used in record player pickup heads.

BIMOS. *Acronym.* Stands for bipolar metal-oxide semiconductor. See **bipolar metal oxide semiconductor**.

bin. *Noun.* A relatively large enclosed area in which raw materials are stored prior to use.

binary diagram. *Noun.* A **phase diagram** of a two-component system.

binary phase. *Noun.* A material with two **components**.

binder. *Noun.* A cementing medium, or a substance, often organic, added to a powder or granular material, to give formed items workability and green or dry strength sufficient for handling and machining in all stages prior to firing, and which usually is expelled during sintering or firing; normally a material of relatively low melting point added to a powder mixture for the specific purpose of cementing together powder particles which alone could not be handled without danger of breakage or which would not sinter or fire into a strong body.

binder course. *Noun.* A **bituminous** layer serving as a **bonding agent** between the **foundation layer** and the **wearing course** of a concrete installation.

binder tape. *Noun.* A paper or other material employed to wrap groups of insulated wire into cable configuration prior to sheathing.

binding energy. *Noun.* Used to denote the energy required to just remove an electron from an atom or molecule.

binding energy of nuclei. *Noun.* Atomic nuclei have a mass less than their constituent neutrons and protons; the mass difference is the **mass defect**. In order to break up a nucleus, energy equal to mc^2 must be supplied, where c is the velocity of light and m is the mass defect.

bing. *Noun.* A heap or pile of minerals or mine spoil.

Bingham plasticity. *Noun.* Flow associated with a minimum **shear stress** value. The minimum shear stress needed to cause flow is known as the **yield value**. Once flow is established shear stress is almost proportional to **shear rate**.

Bingham plastometer. *Noun.* An instrument designed to assess the deformation and flow of materials in which slurry is forced through a capillary under various pressures.

biocers. *Abbreviation.* Stands for bioceramics, which are biological-inorganic materials created from proteins,

peptides, and DNA or biological cells. For example, protein molecules **intercalated** between the aluminosilicate layers in clay or the unstable **vaterite** form of **calcium carbonate** that is stabilised when protein secreted from verticillium acts as a catalyst when Ca^{2+} ions are added to a solution of the fungus spores. See **biomimetics**.

biodegradation. *Noun.* See **biodeterioration**.

biodeterioration. *Noun.* Any undesirable change in the properties of ceramics and glasses caused by the vital activities of living organisms. Not to be confused with **biodegradation** which is often a useful process in pollution control.

Bioglass. Trademark. *Noun.* A **soda-lime silica glass** containing 6 wt.% phosphoric oxide, P_2O_5 , which can bond to living tissue. The composition has about double the soda and lime and reduced amounts of silica compared to normal **soda-lime glass**. When implanted a **silica-gel** surface is formed by ion exchange between body fluids and the Na^+ , K^+ and Ca^{2+} in the glass. The glass ions are replaced by H_3O^+ ions which then react with $-Si-O-Si-$ bonds to form silol groups, $Si-OH$. This leads to a surface layer with a high concentration of Ca^{2+} and P_2O_5 from which **hydroxycarbonate apatite (HCA)** crystallises and this resembles bone and so becomes the layer on which new bone grows.

biognosis. *Noun.* See **biomimetics**.

biomimetics. *Plural noun.* The abstraction of materials design from nature. Sometimes called **bionics**, **biognosis**.

bionics. *Noun.* See **biomimetics**.

biopersistence. *Noun.* The dwell time of **man-made vitreous fibres** in lungs as estimated by one of three tests: **vitro dissolution test**, K_{diss} , **long term animal test**, $T_{1/2}$ or for fibres longer than 20 μm , the **short term animal test**.

bipolaron. *Noun.* A mobile pair of electrons arising from strong electron-lattice interactions in a mixed-valent system, such as Ti_4O_7 . Unlike **Cooper pairs** the bipolaron moves by a diffusion process.

biotite. *Noun.* $K(Mg,Fe)_3(Al,Fe)Si_3O_{10}(OH)_2$. A common mineral of the **mica** family with a monoclinic crystal structure derived from **talc**. A frequent impurity in **feldspar** and **nepheline syenite**; usually black or dark green in colour and therefore often called **black mica**. It is a **true mica**. Density 2,800–3,200 $kg\ m^{-3}$; hardness (Mohs) 2.5–3.

biotite granite. *Noun.* A coarse grained **intrusive rock** in which the grains are **quartz** and **feldspar** is commonly called **granite** and this can contain finer grains of **mica**, such as **biotite**.

Biot modulus. *Noun.* See **Biot number**.

Biot number. β . *Noun.* A numerical evaluation to estimate the **thermal-shock resistance** of a material from its heat-transfer properties by the formula: $\beta = rh/k$, in which h is the **heat-transfer coefficient**, r is the distance between a specific plane and the surface of a specimen, and k is the **thermal conductivity** of the material. It is used to apply a correction to the **thermal shock fracture parameter, R**. It has values in the range 0.5–20 for real cooling situations and high values of β are equivalent to more severe conditions. Its use explains why the maximum stress occurs sometime after the initial **thermal shock** and hence to delayed fracture.

biphasic. *Adjective.* Having two phases.

bipolar. *Adjective.* (1) Having or involving the use of two poles, such as positive and negative electrical poles. (2) A transistor using both majority and minority charge carriers.

bipolar field. *Noun.* The longitudinal magnetic field within a part or object having two magnetic poles.

bipolar metal oxide semiconductor. BIMOS. *Noun.* A semiconductor **transistor** with two poles and one **gate**.

bipolaron. *Noun.* A state where two **holes** or two electrons are bound together by their lattice distortion and move as an entity together with their distortion through the lattice.

biprism. *Noun.* A prism with a very obtuse angle to facilitate beam splitting.

birdsmouth. *Noun.* A notch cut on the face of one material in order to join another piece.

birefringence. *Noun.* (1) The double bending of light rays as observed in an **anisotropic** crystal viewed under cross Nicols when characteristic and measurable colours are produced to indicate the difference in the minimum and maximum **indices of refraction** of the crystal. It is the property of certain crystals, like **calcite** and **mica**, of forming two **refracted rays** from a single incident ray. The **ordinary ray** obeys the normal laws of refraction, the other, called the **extraordinary ray**, follows different laws. The two refracted rays are **polarised** at 90° to each other. Along an **optic axis** both rays travel at the same velocity. (2) The difference between the refractive index of a fibre measured parallel to its axis, $n_{||}$, and that measured perpendicular to the axis, n_{\perp} ; $\Delta n = n_{||} - n_{\perp}$.

birefringent. *Adjective.* Light transmitting.

birnessite. *Noun.* A polymorph of manganese dioxide, MnO_2 . See **manganese dioxide**.

biscrolling. *Verb.* A technique for making ceramic yarns that contain 95 % of the ceramic powder so that the yarn has effectively the properties of the powdered material. The powder is placed on top of a host nanotube sheet, which is then twisted to form a **yarn**. Carbon, silica and Si_3N_4 nanotubes can be used. Using carbon nanotubes and $LiFePO_4$ powders a flexible Li-ion battery cathode can be spun or knitted.

biscuit. *Noun.* (1) Unglazed **clayware** hardened by the effect of heat producing dehydration and **vitrification**. (2) A term employed in some industries having the same meaning as **bisque**. (3) A small setter composed of refractory clays on which pots are placed for firing.

biscuit fire. *Noun.* The firing that converts ceramic **greenware** to **biscuit**. Also called **bisque fire**.

biscuiting. *Verb.* A first firing of ceramic **greenware** that converts it to **biscuit**.

bishofite. *Noun.* $MgCl_2 \cdot 6H_2O$. Hydrous magnesium chloride. A mineral occasionally used in formulations to adjust magnesium content in ware, frits and cements.

bishop's purple. *Noun.* A violet coloured glaze in some oriental porcelains. Also called **aubergine purple**.

bisilicate. *Noun.* Another name for the ionic metasilicates. A silicate containing $[SiO_3]^{2-}$ ions or chains of $[SiO_3]_n^{2n-}$ ions.

bismuth. *Noun.* Bi. Used as organic complexes to make **lustre glazes** as the organic components burn away to leave shiny bismuth metal. often used as a carrier of other lustre colours and can give a **mother-of-pearl** effect.

bismuth chromate. *Noun.* $Bi_2(CrO_3)_2$. Used as an orange-to yellow pigment in porcelain-enamels and glazes.

bismuth cuprate. BISCCO. *Noun.* A high-temperature superconductor oxide involving bismuth, strontium, calcium, copper, and oxygen. The material can be fabricated into tapes and wires capable of carrying currents of $5,000 \text{ A cm}^{-2}$. Zero resistance of $Bi_2Sr_2Ca_2Cu_3O_x$ occurs at 70 K. See **2212-bismuth oxides**.

bismuth ferrite. *Noun.* $BiFe_2O_4$. A **spinel** phase that can be doped to make a useful lead-free **actuator**. See **samarium doped bismuth ferrite**.

bismuthinite. *Noun.* Bi_2S_3 . Bismuth trisulphide; an ore of bismuth found in fibrous masses; hardness (Mohs) 2; density $6,810 \text{ kg m}^{-3}$.

bismuth oxide. *Noun.* Bi_2O_3 . Employed as a fluxing component in optical glasses, as a flux and bonding agent for metallic components in ceramic glazes, as a flux in cast-iron porcelain-enamels, and in ceramic colours; its ceramic properties are similar to those of **lead oxide**, but it is more fusible. Mp $820\text{--}860^\circ\text{C}$; density $8,200\text{--}8,900 \text{ kg m}^{-3}$.

2212-bismuth oxides. *Noun.* $Bi_2Sr_2CaCu_2O_{8+x}$. High temperature superconducting compounds whose structure consists of intergrowths of **perovskite** and **rock salt** layers: $(AO)_m(A'CuO_{3-y})_n$; $T_c = 100 \text{ K}$. See **bismuth cuprate**.

bismuth potassium titanate. *Noun.* **BKT**; $Bi_{0.5}K_{0.5}O_3$; a lead-free **ferroelectric ceramic** with the tetragonal **perovskite** structure that allows **compositional engineering** around the tetragonal to cubic phase transition to improve the **ferroelectric** properties. Hot pressing needed to achieve 97 % density in devices; d_{33} value of 70 pC N^{-1} .

bismuth pyrochlore. *Noun.* $\text{Bi}_2(\text{Zn}_{1.33}\text{Sb}_{0.67})\text{O}_6$. A resistive grain boundary phase which limits grain growth in ZnO varistor manufacture.

bismuth selenide. *Noun.* Bi_2Se_3 . Used in some thermoelectric applications. Mp 706°C ; density $6,820\text{ kg m}^{-3}$.

bismuth sodium titanate. BNT. *Noun.* $\text{Bi}_{0.5}\text{Na}_{0.5}\text{TiO}_3$. A lead-free ferroelectric. See **BKT**.

bismuth stannate. *Noun.* $\text{Bi}_2(\text{SnO}_3)_3 \cdot 5\text{H}_2\text{O}$. Used as an additive in barium titanate capacitors to produce bodies of intermediate dielectric constant. Dehydrates at 200°C and above to form $\text{Bi}_2(\text{SnO}_3)_3$.

bismuth subcarbonate. *Noun.* $(\text{BiO})_2\text{CO}_3$. Used as a flux and opacifier in glass and porcelain-enamels. Density $6,860\text{ kg m}^{-3}$.

bismuth subnitrate. *Noun.* $\text{Bi}_5\text{O}(\text{NO}_3)_4(\text{OH})_9$. Used to give pearly lustre to glasses and glazes, as a constituent in high-refractive index glass, and in low-temperature porcelain-enamels and colorants. Decomposes at 260°C ; density $4,928\text{ kg m}^{-3}$.

bismuth telluride. *Noun.* Bi_2Te_3 . Thermoelectric material employed in cooling devices. Mp 585°C ; density $7,300\text{ kg m}^{-3}$; hardness (Mohs) 1.5–2.

bismuth titanate. BIT. *Noun.* $\text{Bi}_4\text{Ti}_3\text{O}_{12}$. A ferroelectric Aurivillius phase consisting of perovskite blocks sandwiched between fluorite-like $[\text{Bi}_2\text{O}_2]^{2+}$ sheets. A dielectric used in the fabrication of multilayer ceramic capacitors and as information storage material in random access memories.

bismuth trioxide. *Noun.* BiO_3 . See **bismuth oxide**.

bisque, bisque ware. *Noun.* (1) Unglazed ceramic ware that has been subjected to a single fire. (2) A coating of wet-process porcelain-enamel that has been dried but not fired.

bisque fire. *Noun.* (1) A low temperature, about $1,000^\circ\text{C}$, firing of porcelain where glaze has been added to the body for a one stage process. After the bisque fire the temperature is raised to $1,200$ – $1,400^\circ\text{C}$. (2) The kiln firing of ceramic ware before application of a glaze. See **biscuit fire** and **high biscuit-low glost**.

BISCCO. *Acronym.* Standing for bismuth strontium calcium copper oxide. See **bismuth cuprate**.

bistability. *Noun.* The ability of a molecular system to occur in two different electronic states.

BIT. *Acronym.* Standing for bismuth titanate. See **bismuth titanate**.

bit gatherer. *Noun.* An operator who gathers small quantities of glass on an appropriate tool for use in the decoration of hand-blown glassware.

bit stone. *Noun.* Refractory particles, such as flint fragments or sand, placed in saggars to prevent ware from sticking to the sagger bottoms during firing.

bitumen. *Noun.* (1) A transparent brown pigment or glaze made from asphalt. (2) Various impure mixtures of hydrocarbons that occur naturally in asphalt, tar, and mineral waxes. Used in road surfacing and roofing. (3) The part of coal that can be extracted using an organic solvent.

bituminise. *Verb trans.* To treat with bitumen.

bituminous. *Adjective.* See **bitumen**.

bituminous coal. *Noun.* A soft, black coal rich in volatile hydrocarbons. Carbon content 46–86 %. Calorific value 1.93 – $3.96 \times 10^7\text{ J kg}^{-1}$. Also called **soft coal**. See **coal rank**.

bituminous concrete. *Noun.* Concrete in which a bituminous material has been incorporated as a binder.

bixbyite. *Noun.* A family of cubic oxides with the $\alpha\text{-Mn}_2\text{O}_3$ structure. The structure contains two types of linked polyhedra, one a distorted octahedron containing two longer M-O distances as a result of the Jahn-Teller effect.

Bizen ware. *Toponym, noun.* Made in Japan in the Bizen area from about 1180 AD. A robust development of Sue ware. Made in large, 50 m, tunnel kilns fired by pine wood and reaching temperatures of $1,250^\circ\text{C}$ for up to 20 days, which develops a partial natural glaze from the pine ash, over dark-bronze coloured stoneware.

BKT. *Abbreviation.* Stands for bismuth potassium titanate. See **bismuth potassium titanate**.

blackband ironstone. *Noun.* FeCO_3 . Carbonate iron ore containing coal-type deposits sufficient for the iron to be smelted without additional fuel.

blackboard enamel. *Noun.* A special, slightly roughened porcelain-enamel that will provide a suitable writing surface for blackboard chalk.

black body. *Noun.* A hypothetical body that will absorb all radiation and which will emit radiant energy at a maximum rate for a given temperature; used to determine the temperature of a closed furnace when viewed through a relatively small hole with an optical pyrometer. Also called a **full radiator**.

black body radiation. *Noun.* Radiation characterised by a spectral energy distribution according to Planck's law, such as would be radiated by a black body measured as a function of wavelength. The shape of such a curve is only dependent on the absolute temperature of the body and as the temperature increases the peak in the curve moves towards higher energies. The energy spectrum emerging from a small hole in the wall of a high temperature furnace resembles a black body spectrum quite closely.

black box. *Noun.* An individual, self-contained unit in an electronic system whose circuitry need not be known in order to use it.

black cobalt. *Noun.* See **asbolite**.

black cobalt oxide. *Noun.* A coverall term used to describe mixed **cobalt oxides**, such as Co_3O_4 , Co_2O_3 and CoO . Used as a **flux** and powerful blue colorant in glazes where small changes in content give pale blue to blue-black glazes. Small amounts are used to whiten the appearance of **porcelain** bodies.

black copper oxide. *Noun.* CuO . A **basic oxide** used to produce blue and green colours in glass, **faience**, **porcelain**, **stoneware**, and other ceramics when fired in an oxidising atmosphere, and red colours when fired in a reducing atmosphere. Enhances lead release from lead glazes. Strongly absorbs microwaves and so powders can be used to heat other ceramics in microwave ovens. Mp 1,064 °C; density 6,320 kg m⁻³.

black core, black heart. *Noun.* A defect occurring in fireclay and other refractory brick when **vitrification** of the surface takes place before oxidation of carbonaceous matter in the interior is complete.

black coring. *Noun.* See **coring**.

black cotton soils. *Noun.* The name for swelling clays, dark in colour, low in organic matter, with alkaline or near-neutral suspension; found in northeast Nigeria.

black diamond. *Noun.* See **carbonado**.

black earth. *Noun.* Black soil rich in humous and carbonates.

black edge, black edging. *Noun.* A black porcelain-enamel applied and fired over the ground coat at the exposed edges of ware for both protective and decorative purposes; subsequent coatings of cover-coat enamels are brushed from the areas prior to firing.

black glass. *Noun.* Carbon-modified silica.

black hot-pressed ceramic. *Noun.* A metal carboxide that is a dispersion of **titanium carbide** particles in **alumina** containing more than 40 % titanium carbide. Used as a hard cutting tool.

blackening. *Noun.* Graphite applied to the working surface of moulds as a parting material to prevent a casting from sticking, and to improve the surface of ware cast in the moulds.

black iron oxide. *Noun.* FeO . A widely **nonstoichiometric** ceramic oxide. Mp 1,420 °C; density 5,700 kg m⁻³. Also known as **wüstite**.

blackjack. *Noun.* The colloquial name for sphalerite the most important zinc ore. See **sphalerite**.

black lead. *Noun.* A synonym for **graphite**.

black light. *Noun.* Light in the near-ultraviolet and infrared range of wavelengths just below and above the visible range, from 320 to 400 nm.

black-light filter. *Noun.* A filter that will suppress transmission of visible light but will permit passage of ultraviolet radiation having wavelengths in the range of 320–400 nm.

black mica. *Noun.* Sometimes called **brown mica**, which is the **ferromagnesian** variety of mica, known as biotite. See **biotite**.

black raku. *Noun.* A rough, thick-walled, very soft, and porous **earthenware** coated with a **lead borate** glaze; used in the tea ceremony in Japan.

black sands. *Plural noun.* Found in volcanic areas they are beach sands rich in dark minerals with very little **quartz** content. Dark **olivine** sands are found in Scotland and **magnetite** sands in the Canary islands.

black shape. *Noun.* Fabricated ware or shapes prior to porcelain-enamelling.

black silicon carbide. *Noun.* A black, impure silicon carbide manufactured from coke and **silica** in an electric furnace, and employed as an abrasive; contains free carbon.

black speck. *Noun.* A defect in fired porcelain-enamels or glassware appearing as visible black specks, usually caused by dirt or scale, but which also may be **glass-eye blisters** or **boiling** from the ground coat.

black titania. *Noun.* Titanium dioxide, TiO_2 , nanocrystals that have been hydrogenated to introduce vacancies and disorder in the crystal structure. The process turns the white oxide black in the surface layers so that it will absorb infrared and visible radiation while the inner white material absorbs ultraviolet radiation making the material more efficient at photocatalysis and improving the breakdown of water to produce hydrogen for fuel.

black top. *Noun.* A bituminous mixture.

blaes. *Plural noun.* A hardened **clay** or **shale** reddish or blue-grey in colour usually used in small broken pieces to make paths and drives.

blanc de chine. *Noun.* A white, glazed Chinese porcelain.

blanc fixe. *Noun.* See **barite**.

blank. *Noun.* (1) A **parison** or preliminary shape from which a finished article is further formed, or a mould for producing such a shape. (2) Any article of glass on which subsequent forming or finishing is required. (3) A piece cut from a metal sheet from which a finished article for porcelain-enamelling is to be fabricated.

blanket. *Noun.* A layer of radioactive material placed around the core of a nuclear reactor as a reflector and to breed new fissionable fuel.

blanket feed. *Noun.* A technique for charging a glass batch into a furnace to produce a broad, thin layer of even distribution across the width of the furnace.

blanking. *Verb.* To cut and form metal shapes for porcelain-enamelling by means of a mechanically operated die and plunger press.

blank mould. *Noun.* A metal mould employed in the manufacture of glass holloware to give the item its initial shape or form.

blank, optical. *Noun.* See **optical blank**.

blank, pressing. *Noun.* See **pressing blank**.

blast. *Noun.* (1) Air blown into a furnace or kiln under pressure. (2) An explosion, as of dynamite, in a quarry or mine to break up the mineral.

blast-furnace cement. *Noun.* A mixture of ordinary Portland cement and crushed slag from a steel furnace. It has lower setting properties than **OPC** alone.

blast-furnace slag. *Noun.* The non-metallic product, consisting essentially of **silicates** and **aluminosilicates** of calcium and other base materials that is developed in a molten condition simultaneously with iron in a blast furnace.

blast-furnace slag, expanded. *Noun.* See **expanded blast-furnace slag**.

blast-furnace slag, granulated. *Noun.* See **granulated blast-furnace slag**.

blasting. *Noun.* The process of cleaning metal, especially cast iron, for porcelain-enamelling in which the surface of the metal is subjected to the abrasive action of sharp abrasive particles carried in a fast-moving stream of air.

blaze. *Noun.* A ridge that occurs on the sloping sides of crystals.

bleaching powder. *Noun.* $\text{CaCl}(\text{OCl})\cdot 4\text{H}_2\text{O}$. Chlorinated calcium hydroxide; used in solution as a bleaching agent and disinfectant. Also called **chloride of lime**, **chlorinated lime**.

bleb. *Noun.* (1) A small blister. (2) An air bubble. (3) A small blister or bubble defect on the surface of pottery.

bleed. *Verb intrans.* To exude a liquid, usually water, during compaction of cement, mortar etc.

bleed back. *Noun.* The ability of a penetrant to bleed out of a discontinuity after it has been cleaned from the surface of a specimen.

bleeder resistor. *Noun.* A resistor connected across the output terminals of a power supply in order to improve voltage regulation and to discharge filter capacitors.

bleeding. *Noun.* The autogenous flow of mixing water within, or its emergence from, newly placed concrete or mortar, caused by the settlement of the solid materials or drainage of the mixing water.

bleed out. *Noun.* The action of an entrapped penetrant in emerging from surface discontinuities.

bleed valve. *Noun.* A valve for allowing gas accumulation in a liquid to blow off.

blemish. *Noun.* (1) A defect or flaw in a product consisting of a stain, disfigurement, or strained area attributable to the normal composition, forming, or extraneous factors encountered in the production of the item. (2) An insignificant imperfection in a dry-process porcelain-enamel.

blend. *Noun.* A combination of materials that are thoroughly mixed.

blende. *Noun.* ZnS . (1) Synonym for **sphalerite** or abbreviation for **zinc blende**. (2) Any naturally occurring metal sulphide.

blender brush. *Noun.* A china decorating paintbrush of which the soft squirrel hair is formed into a dome shape about 40 mm long and 20 mm across the end.

blending. *Verb.* (1) To mix materials. (2) To even the rougher part of a surface with the smoother part so that the entire surface is of the same plane or surface texture, or both.

blending, batch. *Verb.* See **batch blending**.

blending sand. *Noun.* Sand that is added to the normal available sand in concrete to improve **gradation**.

blibe. *Noun.* A defect in glass in the form of a gas-filled cavity, between a **seed** and **blister** in size.

blind hole. *Noun.* A hole not completely drilled through.

blinding. *Noun.* (1) A surface defect in glazes due to devitrification, resulting in a dull or crystalline appearance. (2) The clogging of a sieve. Corrected by paying attention to the amount of powder used in the sieve analysis.

blind spit. *Noun.* A colloquial term for broken bubbles on the surface of porcelain as opposed to bone china.

blister. *Noun.* (1) A bubble or gaseous inclusion of relatively large size in a body or at the surface of a glaze or porcelain-enamel after firing. (2) Large bubbles remaining in finished glass. Also known as **bubbles**.

blister copper. *Noun.* The product when **matte** is reduced. It is 99 % pure copper.

blistering. *Noun.* (1) The development of enclosed or broken macroscopic bubbles or a **vesicular** structure in a body, glaze, porcelain-enamel, or other coating during firing. (2) Non-adherence of colour in firing.

blister, metal. *Noun.* See **metal blister**.

blister, pipe. *Noun.* See **pipe blister**.

blister, weld. *Noun.* See **weld blister**.

bloach. *Noun.* An imperfection resulting from the incomplete grinding of plate glass caused by a low point in the glass, which retains a part of the original rough surface.

bloat. *Verb trans.* To cause solid particles, such as clays and slags, to puff or swell due to sudden expansion of air or moisture contained in the material or a chemical release of a gas, such as carbon dioxide, when subjected to a blast of a superheated air, hot flame, or other high-temperature source.

bloated clay. *Noun.* See **expanded clay**.

bloating. *Noun.* The permanent expansion or swelling of a ceramic material or body during heating which produces a **vesicular structure** in the substance being heated.

Bloch wall. *Noun.* The transition layer, with finite thickness of a few hundred lattice constants, between adjacent **ferromagnetic domains** magnetised in different directions. It allows the spin directions to change gradually from one orientation to another, rather than abruptly.

block. *Noun.* (1) A master mould made from an original pattern from which case moulds are produced. (2) Hollow, translucent glass units having various patterns moulded on their interior or exterior surfaces, or both, and usually made in two halves that are sealed together.

block brick. *Noun.* A brick, larger than standard or jumbo in size, used to bond adjoining or intersecting walls.

block density. *Noun.* The mass of a unit volume of a substance, including its pore volume but excluding inter-particle voids; determined under specified conditions.

block diagram. *Noun.* (1) A three-dimensional drawing showing geological structure. (2) A diagram showing the interconnections between parts of an industrial process, such as ceramic manufacture.

block filter. *Noun.* A hollow, rectangular, vitrified clay masonry unit, sometimes **salt glazed**, used in trickle-type floors in sewage disposal plants. The block is designed with apertures connecting with drainage channels through the upper surface, which are arranged to form aeration and drainage grilles to pass air into, and liquids from, overlying filter media; the drainage channels convey liquid away from the filter bed.

block handle. *Noun.* A particular type or style of handle attached to a cup, vase, or other item by means of a clay bar.

blocking. *Verb.* (1) To shape a **gather** of glass in a metal or wood cavity called a **block mould**. (2) To stir a glass batch by immersing a wooden block or other source of gaseous bubbles in the molten mass. (3) To reprocess glass in order to remove surface imperfections. (4) To mount **optical glass** blanks in a holder for grinding and polishing operations. (5) To idle a furnace at a reduced temperature. (6) To set refractory blocks in a furnace.

block model. *Noun.* A way to analyse electrical properties of ceramic solid-state devices which assumes that the device contains cubes of conducting oxide of side length d , separated by insulating barriers of thickness t , within an electrode separation distance, D .

block mould. *Noun.* A one-piece mould used in glass-making; often consists of wood or iron.

block out. *Noun.* An opening or cavity formed in concrete to facilitate subsequent construction operations, such as an opening in a wall for the installation of a pipe or other item; the opening frequently is sealed with mortar or concrete when the installation has been completed.

block press. *Noun.* A press used to bind **laminate** squares while heating them. Each square is superimposed in a perpendicular way to minimise **anisotropy** caused by first forming a laminate.

block, quarl. *Noun.* See **quarl block**.

block rake. *Noun.* A scratch or **cullet cut** imperfection in glass caused by a particle of cullet lodged in the polishing felt during the polishing operation on flat glass. Also called **block reek**.

block reek. *Noun.* See **block rake**.

block, rotary kiln. *Noun.* See **rotary kiln block**.

block, scotch. *Noun.* See **scotch block**.

block, scouring. *Noun.* See **scouring block**.

block, skimmer. *Noun.* See **skimmer block**.

block, sleeper. *Noun.* See **sleeper block**.

block, soldier. *Noun.* See **soldier block**.

block, spreader. *Noun.* See **spreader block**.

block structure. *Noun.* A slab-like assembly of corner sharing $[\text{MO}_6]$ octahedra. M is usually a metal like Mo, W, Ti, Re and some other transition block element.

block, tank. *Noun.* See **tank block**.

block, trimmed. *Noun.* See **trimmed block**.

block, tweel or tuille. *Noun.* See **tweel block**.

blomstrandine. *Noun.* A mineral with useful **rare earth** content.

bloom. *Noun.* (1) A non-reflecting coating on glass. (2) A surface film on glass resulting from attack by constituents in the atmosphere, or by the deposition of smoke or other vapours. (3) Formation of powdery or crystalline salt on the surface of concrete or masonry due to diffusion and precipitation of salt solutions from the interior. See **efflorescence**.

blotter. *Noun.* A disk of compressive material, usually of blotting paper stock, used between an abrasive grinding or polishing wheel and its mounting flange.

blotting. *Noun.* In liquid penetrant inspections, particularly of electromagnetic and magnetic particles and products, it is the action of a developer in soaking up a penetrant from the surface of a fault in order to obtain increased contrast.

blow-and-blow process. *Noun.* The process of forming hollow glassware in which the preliminary and final shapes are formed by air pressure.

blow-blow. *Noun.* A process or machine using compressed gas blown into the mouth of an artefact to form both **parison** and final object.

blower. *Noun.* (1) An operator who forms glass by blowing. (2) A machine employed to move or supply air to a particular area for a particular use.

blow head. *Noun.* Part of a glass-forming machine serving to introduce air under pressure to blow a hollow glass article.

blowhole. *Noun.* (1) A large blister such as is formed when contaminants are vaporised along a weld seam during the firing of porcelain-enamels. (2) A device placed in the top of a kiln to facilitate the escape of steam and other gases, particularly during the early stages of the firing operation.

blowing. *Verb.* (1) To shape hot glass by air pressure, either by machine or by mouth. (2) *Noun.* The bursting of pots and crucibles when heated too rapidly.

blowing iron. *Noun.* The pipe used by a glassmaker for gathering and blowing glassware by mouth.

blow mould. *Noun.* The metal mould in which a blown glass article is finally shaped.

blow moulding. *Verb.* To shape glass in the viscous or molten state by placing a **parison** in a mould and completing the shaping operation by blowing air into the parison.

blown away. *Noun.* A fault in the neck of a glass bottle that occurs when an insufficient quantity of molten glass is employed during fabrication.

blown enamel. *Noun.* Ridges produced on the surface of ware during the spraying of wet porcelain-enamels, usually the result of the coating being too thick or too fluid or of excessive atomising air pressure at the spray gun.

blown glass. *Noun.* Glassware formed by air pressure, as by mouth blowing or by the use of compressed air.

blow off. *Verb.* To remove dust and dirt from the surface of dry, or **bisque**, porcelain-enamels just prior to firing.

blowout. *Verb.* To displace and lengthen an electrical arc to cause its extinction, as by an air blast, magnetic field, or raising one electrode.

blow-over. *Noun.* The thin-walled bubble of glass formed above a **blow mould** in a handshop operation to facilitate **bursting off**.

blow pipe. *Noun.* (1) An apparatus employed to produce a hot localised flame by using a mixture of compressed air and coal gas also called **blow torch**. (2) A long metal pipe used for the working and forming of glass at the bench.

blow torch. *Noun.* See **blow pipe**.

blue asbestos. *Noun.* See **crocidolite**.

blue aventurine. *Noun.* A mineral rock suitable for **tumbling** to reveal a pale-blue and white mottling that is a pleasant decoration to wear.

blue azurite. *Noun.* See **copper carbonate**.

blue copper. *Noun.* See **azurite**.

blue enamel. *Noun.* Wet or dry process enamel applied so thinly that it appears bluish in colour as the base metal ground coat shows through.

blue ground coat. *Noun.* A porcelain-enamel composition usually containing additions of cobalt, manganese, and nickel oxides as adherence-promoting agents; the coating, which fires to a dark blue colour, is used as a ground coat on sheet iron and steel.

blueing-off. *Verb.* A term used in mould making when a coating of **Prussian blue** is applied to one of a pair of mating faces in order to check the efficiency of mating by observing how the blue colour is transferred.

blue john. *Noun.* A corruption of the term “bleu-jeune” which was used to describe the blue form of the normally yellowish form of the naturally occurring **fluorite** crystals. The blue colour is caused by electron excess **F-centres** formed by radiation from uranium compounds in nearby deposits. See **Derbyshire spar**.

blue lead. *Noun.* Alternative name for **lead sulphide** or **galena**.

blue lias. *Noun.* A type of rock consisting of alternate layers of bluish clay and grey **argillaceous limestone**.

blue malachite. *Noun.* See **azurite**.

blue, mazarine. *Noun.* See **mazarine blue**.

blue spinel. *Noun.* A naturally occurring **spinel** that has large crystals that can be cut and used as jewellery.

bluestone. *Noun.* (1) A blue-grey sandstone containing high proportions of clay. Used as a building stone and for **pavers**. (2) A blue variety of **basalt** found in Australia. (3) Blue crystals of copper sulphate.

blue topaz. *Noun.* A natural silicate found in granites and pegmatites as very large crystals that are valued for their use as gems. See **topaz**.

blue tourmaline. *Noun.* A gem quality form of the mineral **tourmaline** that occurs as large crystals in some **pegmatites**.

blue zircon. *Noun.* A naturally occurring form of **zirconium silicate** coloured blue from partial cation substitution. It can be cut and polished when it displays a **lustre** and fire close to that of **diamond**.

blunge or blunging. *Verb trans.* To agitate or blend ceramic materials in a mechanical or hand-operated mixer, usually to suspend the materials in water or other liquid.

blunger. *Noun.* A large vat used as a mixer with revolving paddles or other mixing device employed to produce slurries or slips.

blurring highlight test. *Noun.* A test, usually visual, to evaluate the resistance or the degree to which porcelain-enamels are attacked by acids.

blushing. *Adjective.* The discoloration or clouding of a glaze on porcelain-enamel during firing.

BMC. *Abbreviation.* Stands for **bulk moulding compound**.

BNN. *Abbreviation.* Stands for barium sodium niobate. See **barium sodium niobate**.

BNT. *Abbreviation.* Stands for bismuth niobium titanate. See **bismuth niobium titanate**.

boart. *Noun.* See **bort**.

boat. *Noun.* A ceramic artefact used to hold a substance for combustion analysis.

BoB. *Abbreviation.* Stands for bobbin. See **bobbin**.

bobbin coil. *Noun.* A coil, or coil assembly, used for electromagnetic testing by insertion into a test specimen as, for example, an inside probe for tubing.

Boccaro ware. *Toponym.* Red, unglazed **stoneware** with relief decorations.

body. *Noun.* (1) A mixture of clays and non-plastic material that is workable and has suitable firing properties from which ceramic products are made. (2) The structural portion of a ceramic article, as distinct from the glaze, or the material or mixture from which the item is made. (3) The attribute of molten glass associated with homogeneity and viscosity that contributes to its workability. (4) An object or substance that has three dimensions, a mass, and is distinguishable from surrounding objects.

body centred. *Noun.* Having a lattice point at the centre of each crystallographic unit cell as well as at the corners. A common cubic crystal structure.

body colour. *Noun.* Colour arising from selective absorption of some parts of the visible spectrum because light penetrates a certain distance into the material before reflection and selective absorption occurs in this volume of material.

body mould. *Noun.* The portion of a glass mould that shapes the outer surface of ware during pressing.

boehmite. *Noun.* γ : $\text{AlO}(\text{OH})$. Grey, red, or brown mineral; a natural hydrated aluminium oxide occurring as a major constituent in **bauxite** and **bauxitic clays**. Contains $\text{AlO}(\text{OH})$ double layers that are cubic close packed. Decomposes at 360°C ; density $3,014\text{ kg m}^{-3}$.

BOF. *Acronym.* for basic oxygen furnace used in steel-making for which refractories are specially designed.

bogie. *Noun.* A small wagon of short wheelbase running on a railway track.

bog manganese. *Noun.* See **manganite**.

bogie kiln. *Noun.* An intermittent box-type kiln in which ware, placed on a **bogie** or **kiln car**, is charged, fired, and discharged before a subsequent charge is placed in the kiln.

Bohemian glass. *Noun.* A hard, brilliant glass employed in table and chemical ware, usually a lime-potash glass with high silica content.

Bohr atomic model. *Noun.* An early model of the atom in which electrons are assumed to move in orbits around the nucleus that are discrete and have **stationary state** properties.

bohr magneton. μ_B . *Noun.* Fundamental unit of measurement of magnetic dipole moment of an atom equal to $9.274 \times 10^{-24}\text{ T}^{-1}$.

Bohr theory. *Noun.* A theory of atomic structure developed to explain the spectrum of the hydrogen atom. It assumes that electrons orbiting the nucleus can only exist in certain energy states, **stationary states**, and change from one state to another is accompanied by the absorption or emission of a **quantum** of radiation.

boil. *Noun.* (1) A defect occurring in fired porcelain-enamels that consists of bubbles, pinholes, black specks, dimples, or spongy surfaces. (2) An imperfection in glass that consists of gaseous inclusions or small bubbles; bubbles larger than seeds. (3) The turbulence caused by the evolution of gases from melting glass, porcelain-enamels, or other batches. Also called **boiling**.

boiling. *Noun.* See **boil**.

boiling through. *Adjective.* A term sometimes used to describe the boiling of porcelain-enamels, particularly in instances of severity when defects occur in cover coats.

boiling water reactor. BWR. *Noun.* A nuclear reactor that surrounds the **uranium dioxide** fuel elements with water which acts as **moderator** and coolant. Hence the steam is produced within the reactor.

boil, primary. *Noun.* See **primary boiling**.

bole. *Noun.* Any of a variety of soft unctuous clays used to produce colour in whiter-firing clays, or a reddish-brown body made from such clays. Used as a pigment. Also known as **bolus**.

bolelection. *Noun.* A stepped moulding projecting beyond the joint of two members with surfaces at different levels.

boligong. *Noun, colloquial.* Expression for glass fibre-reinforced plastic; of Chinese origin meaning "glass-steel."

bolometer. *Noun.* A device for measuring the energy of an **electromagnetic wave** by absorbing the wave and registering an increase in temperature as measured by a change in its electrical resistance.

bolt-hole. *Noun.* A hole made in a component during the manufacture of an item to facilitate final assembly of the item by means of inserted bolts, screws, or other fasteners.

bolt-hole brush. *Noun.* A special round brush, usually equipped with a centred metallic guide pin, employed to remove bisque porcelain-enamel from the inside and edges of small openings in the ware, particularly to prevent chipping during subsequent assembly of the porcelain-enamelled product. See **bisque** (2).

Boltzmann constant. k. *Noun.* The ratio of the **gas constant** to the **Avogadro constant**. A thermal energy constant; also known as the **gas constant** when considering 1 molecule only; has a value equal to $1.3806 \times 10^{-23} \text{ J atom}^{-1} \text{ K}^{-1}$.

Boltzmann distribution. *Noun.* An expression concerning the statistical distribution of large numbers of particles subject to thermal agitation and acted upon by a field, such as magnetic, electric or gravitational. The number of particles per unit volume in any region of the field when in equilibrium is given by $N = N_0 \exp\{-E/kT\}$, where N_0 is the number of particles per unit volume in a region in which the energy E of a particle is zero.

Boltzmann factor. *Noun.* The term $\exp(-E/kT)$ in the **Boltzmann distribution**.

bolus. *Noun.* See **bole**.

bolus alba. *Noun.* See **kaolin**.

bonce. *Noun.* A large playing marble.

bond. *Noun.* (1) The degree of adhesion of a porcelain-enamel or other coating to the metal to which it is applied and fired. (2) The forces holding one material to another at the interface. (3) The material in a grinding wheel that holds the grains together and supports them while in use. (4) The intergranular material that provides strength in ceramic bodies. (5) The adhesion of cement paste to aggregate particles, or of concrete or mortar to reinforcing steel, or of concrete to previously hardened concrete on a construction joint or in a patch.

Bond and Wang crushing theory. *Noun.* The energy required to pulverise or crush a solid may be calculated by the equation: $h = 0.001748 C^2 (n+2)(n-1)/SEn$, where h is the energy required, C is the **compressive strength**, S is the **specific gravity**, E is **Young's modulus** of elasticity, and n is the approximate **reduction ratio**.

bond, chemical. *Noun.* See **chemical bond**.

bond clay. *Noun.* A plastic clay of high dry strength employed as a binder in ceramic bodies containing substantial amounts of non-plastic components.

bonded abrasive disk. *Noun.* A disk-shaped bonded abrasive product fitted onto a faceplate for use on grinding and milling machines; work for polishing and grinding is presented to the side of the abrasive disk opposite to the faceplate.

bonded brickwork. *Noun.* Any regular arrangement of bricks in a structure designed to increase the strength and to enhance the appearance of the structure.

bonded fabric. *Noun.* A fibre web held by a matrix that is not continuous itself.

bonded products. *Plural noun.* Products in which an abrasive and a bonding agent have been intermixed and processed to produce a relatively inflexible abrasive product, such as a grinding wheel or rubbing stone.

bonded restoration. *Noun.* A combination of **porcelain** and a metal alloy, usually nickel-chromium, used in restorative dentistry. The alloy is cast to fit a prepared space and then coated in porcelain making it a form of enamelling.

bonded roof. *Noun.* The roof of a furnace or kiln in which the transverse joints are staggered.

bonder. *Noun.* (1) A brick of special size and shape employed to begin or finish a course of bonded brickwork. (2) See **bondstone**.

bond fireclay. *Noun.* A fireclay exhibiting sufficient natural plasticity to bond nonplastic materials in the manufacture of refractory products.

bond, in-and-out. *Noun.* See **in-and-out bond**.

bonding agent. *Noun.* (1) An admixture for improving the bond of mortar and concrete in a patch. (2) A paint or coating applied to hardened concrete to facilitate the bonding of a new application of concrete or mortar. (3) Any material in a sand or ceramic powder mixture that by means of adhesion and cohesion holds the grains to a degree suitable for further processing.

bonding energy. *Noun.* The energy required to separate two atoms that are chemically bonded to each other. It is most commonly expressed on a per mole of atoms basis. See **bond strength**.

bonding force. *Noun.* The force that holds two atoms together; it results from a decrease in total electron wave energy as two atoms are brought closer to each other.

bonding materials. *Plural noun.* Organic materials employed in conjunction with glass and ceramic fibres, sheets, moulded shapes, and other products to impart strength, adherence, chemical resistance, weather resistance, electrical properties, and similar properties for use in the production of cloth, laminates, electrical and electronic components, insulating materials, and the like.

bonding pattern. *Noun.* When bricks are laid they form patterns between courses and these are called bonding patterns. The most common is called stretcher bond. See **stretcher**.

Bondley process. *Noun.* A metalising process in which titanium or zirconium is bonded to the surface of a ceramic body to facilitate soldering or joining of components in the production of electrical and electronic products.

bond line. *Noun.* A line along which two surfaces are joined together.

bond, organic. *Noun.* See **organic bond**.

bond, shellac. *Noun.* See **shellac bond**.

Bond's hypothesis. *Noun.* The grinding rate of a solid material is proportional to the rate at which a crack will progress through the material.

bondstone. *Noun.* A long stone or brick laid in a wall as a **header**. Also called **bonder**.

bond strength. *Noun.* (1) The degree of adherence of a porcelain-enamel to the metal to which it is applied and fired. (2) The strength of a mortar joint or wall in construction applications. (3) The energy measured in kJ mol^{-1} needed to overcome the forces holding atoms in solids and molecules. (4) The ability of a heterogeneous product to resist stress loading. (5) The binding forces produced by electron interactions between atoms.

bond, vitrified. *Noun.* See **vitrified bond**.

bone ash. *Noun.* A white porous residue of high temperature calcined bones consisting of 67–85 % **calcium phosphates** but mainly **hydroxyapatite**, $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$. Employed in the manufacture of porcelain, where at high temperature it reacts with silica and alumina to produce a liquid binding phase. The final product is known as **bone china**.

bone china. *Noun.* A soft, highly translucent chinaware of relatively low firing temperature made from a whiteware body containing a minimum of 25 % **bone ash** as a mineraliser and having a water absorption ranging from 0.3 to 2 %; a typical composition is 50 % bone ash, 25 % **china clay**, and 25 % **Cornish stone**. Fired under oxidizing conditions, melting range 1,350–1,500 °C; contains **apatite** crystals and $\text{Ca}_3(\text{PO}_4)_2$ crystals.

bone-dry. *Adjective.* Thoroughly dried and free of uncombined water.

bone turquoise. *Noun.* Fossilised bone stained blue with ferrous phosphate and used as a gemstone. Also called **odontolite**.

bonnet hip. *Noun.* A roofing tile of special angular shape employed as a junction between two faces of a roof.

bookform splittings. *Noun.* Consecutive splittings of **mica** from the same block, each usually dusted with

mica powder to reduce cohesion, arranged in individual books or bunches for use as an electrical insulating material.

boojom. *Noun.* Chiral supramolecular nanoparticle based on C_{60} **fullerene**-type carbon. It has been functionalised with six optically active liquid crystalline components called **mesogens**. On slow cooling the fullerene adduct exhibits a helical liquid crystalline phase.

book mica. *Noun.* Large irregular crystals of mica having cleavage plates resembling the pages of a book.

boost melting. *Noun.* An auxiliary method of adding heat to molten glass in a fuel-fired tank by passing an electric current through the glass.

boot. *Noun.* A suspended or floating refractory shape in the nose of a glass-melting tank to protect the glass from fuel gases and floating scum and to serve as an opening for the **gathering** of the glass.

BOP. *Acronym.* Standing for basic oxygen process for steelmaking. See **basic oxygen process**.

boracic acid. *Noun.* H_3BO_3 . Alternative name for boric acid. See **boric acid**.

boracite. *Noun.* $\text{Mg}_3\text{B}_7\text{O}_{13}\text{Cl}$. Magnesium borate; a natural **borate** mineral occurring as fibrous masses in salt domes. The structure contains BO_4 tetrahedra and BO_3 planar units linked to form tunnels in which Mg^{2+} and Cl^- ions reside. Overall the structure is pseudocubic. Hardness (Mohs) 7–7.5; density $2,970 \text{ kg m}^{-3}$.

borate glass. *Noun.* A glass in which **boric oxide** in combination with **silica** is employed as the major glass-forming ingredient.

borates. *Plural noun.* Salts of the family of boric acids. The borate anions $(\text{B}_x\text{O}_y)^{n-}$ are not as easy to classify as silicates because boron has both 3 and 4 coordination by oxygen. The simple ions are orthoborate, $(\text{BO}_3)^{3-}$, discrete ions; pyroborate, $(\text{B}_2\text{O}_5)^{4-}$, also discrete ions; metaborate chains, $(\text{BO}_2)^{n-}$; amphibole-type double chains, $(\text{B}_4\text{O}_7)^{2n-}$ and sheets of $(\text{BO}_4)^{5-}$. All are used in glass-forming reactions, in detergent formulations and as fluxing agents.

borax. *Noun.* $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$. A refined borate employed as a powerful flux in analysis and as a glass-forming agent in glass, glazes, porcelain-enamels, etc. Mp (anhydrous) 741 °C; density $1,700 \text{ kg m}^{-3}$; hardness (Mohs) 2–2.5.

borax decahydrate. *Noun.* See **borax**.

borax glass. *Noun.* Vitreous, anhydrous borax used as a glass former and flux in glass, glazes, and porcelain-enamels.

Borazon. *Trademark, noun.* The cubic polymorph of **boron nitride**, BN. See **boron nitride**.

borescope. *Noun.* A stand-alone video probe used to inspect inaccessible areas within turbines.

boric. *Adjective.* Containing **boron**.

boric acid. *Noun.* H_3BO_3 . Correctly known as trioxoboric III acid and polydioxoboric II acid but technically as orthoboric, HBO_3 , and metaboric acid, $(HBO_2)_n$. Orthoboric acid is a white solid soluble in water, mp 169 °C. Both are used in glass making, borosilicate glass, low temperature glazes and enamels. Has the colloquial name **sassoline**.

boric oxide. *Noun.* B_2O_3 . Used principally in the manufacture of glass and porcelain-enamels as a flux, and in nuclear applications as a thermal-neutron absorber. Unexpectedly low mp at 450 °C; density 1,830–1,880 kg m⁻³.

borides. *Plural noun.* Special ceramics in which one element is boron and the other a metal or **metalloid**, and having composition ranging from M_3B to MB_{12} and occasionally MB_{60} . They are characterised by the degree of self-bond formation by the boron atoms, for example, MB_{12} phases contain covalently bonded B_{12} icosahedra packed closely in a cubic stacking sequence with metal atoms occupying octahedral interstitial sites. MB_6 phases contain discrete B_6 octahedra joined at each apex to another such unit, metal atoms occupying octahedral sites between six such units. Other units are isolated B atoms, B_2 pairs, and sheets of 2-dimensional hexagonal rings. In the high-metal content borides the structures are viewed as being formed from the filling of M_6 trigonal prisms with boron atoms. No single metal will form all 12 known types of boride phases and molybdenum forms the most with six known borides. Because of the extensive, covalent+metallic+ionic bonding they are harder, higher melting, chemically less reactive, and electrically more resistive than the constituent metallic elements. They are characterised by high oxidation resistance and strength retention at elevated temperatures; melting points can be as high as 3,260 °C; densities range from 2,500 to 16,000 kg m⁻³; specific heats of less than 5.8 J kg⁻¹ K⁻¹ up to 2,205 °C; linear thermal expansions of 2 % or less between 21 and 1,649 °C; elastic moduli ranging between 200 and 400 GN m⁻² at room temperature; microhardness values range between 13 and 33 GN m⁻². All these properties make them potential materials for use as structural materials, particularly in aerospace applications. Used in composites.

bornite. *Noun.* A mineral sulphide that is a major copper ore; named after the mineralogist Born. See **peacock ore**.

borocalcite. *Noun.* $CaB_4O_7 \cdot 4H_2O$. A natural **borate** mineral.

boron. B. *Noun.* A reactive non-metallic element; when formed as fibre, on a very hot tungsten core by vapour deposition, it is used in metal-matrix composites. A **moderator** material in nuclear reactors. Mp 2,300 °C; density 2,450 kg m⁻³.

boronatrocalcite. *Noun.* $Na_2B_4O_7 \cdot Ca_2B_6O_{11} \cdot 16H_2O$. A natural **borate** mineral.

boron carbide. *Noun.* B_4C . Third only to diamond in hardness; produced by reduction of boric oxide by carbon in an electric furnace; employed as an abrasive in grinding wheels, belts, papers, and powders; in articles of high resistance to abrasion, in nozzles for high-temperature applications, in control rods for nuclear reactors, and electrical-resistance heating elements for high-temperature furnaces. 6-mm thick hot-pressed tiles are used in aircraft and body armour. B_4C is the idealised composition since the structure of B_{12} icosahedra bonded to each other and to C_3 carbon chains does have some composition variation as some of the C_3 chains can contain boron. Mp 2,350 °C; density 2,505 kg m⁻³.

boron content, equivalent. *Noun.* See **equivalent boron content**.

boron-content, equivalent factor. *Noun.* See **equivalent boron-content factor**.

boron content, total equivalent. *Noun.* See **total equivalent boron content**.

boron-epoxy. *Noun.* A ceramic composite in which the matrix is a thermosetting plastic and boron fibres provide strength.

boron equivalent. *Noun.* The absorptive capacity for thermal neutrons of weights of various elements expressed in terms of the weight of natural boron. Also called **boron value**.

boron nitride. *Noun.* BN. Two ceramics of this composition exist: (1) hexagonal BN, also known as **white graphite**, in which both B and N are sp²-hybridised and so form infinite 2-D sheets of B-N-B-hexagonal rings only held by weak van der Waals forces to other sheets; a structure which imparts solid lubricating properties. Unlike **graphite** it is an electrical insulator. Refractory crucible material mp about 3,000 °C; used to form seals, gaskets, furnace insulation and in pump parts where aggressive chemicals are to be moved; a neutron absorbing material. (2) **Borazon**, the cubic modification derived by subjecting the hexagonal form to 2,000 °C and pressures in excess of 100 GN m⁻². Atom hybridization is now sp³ to give a material nearly as hard as diamond; used as an abrasive and in some cutting tools. Density 2,250 kg m⁻³.

boron oxide. *Noun.* See **boric oxide**.

boron phosphate. *Noun.* BPO_4 . Used in ceramic bodies and special glasses; isomorphous with **high cristobalite**. Vaporises at 1,400 °C; density 1,873 kg m⁻³.

boron phosphate glass-ceramics. *Plural noun.* Glasses in the molar composition range 1:1:1 to 1:1:3 of B_2O_3 - P_2O_5 - SiO_2 can be heat-treated to yield ultrafine-grained transparent glass-ceramics containing **boron phosphate** as the crystalline phase. They have dc resistivities around 1,016 Ω-cm at 250 °C, which is higher than Al_2O_3 .

boron phosphide. *Noun.* BP. A material with the **zinc blende** structure; **electroluminescent** material; bulk modulus 166 GN m⁻²; mp above 2,000 °C; density 2,970 kg m⁻³.

boron silicide. *Noun.* (1) B₆Si; mp 1,946 °C; density 2,430 kg m⁻³. (2) B₄Si; decomposes at 1,093 °C; density 2,460 kg m⁻³. (3) B₃Si; mp 1,927 °C; sp. gr. 2,640 kg m⁻³. Also known as **silicon boride**.

boron, soluble. *Noun.* See **soluble boron in boron carbide**.

boron value. *Noun.* See **boron equivalent**.

borosilicate. *Noun.* Any of a large number of substances in which BO₃-planar triangles and SiO₄-tetrahedra are linked to form networks. When fused they produce glasses with lower fusion temperatures and a longer working viscous range that makes them useful; **Pyrex glass** is an example.

borosilicate crown glass. *Noun.* An **optical crown glass** containing substantial quantities of **silica** and **boric oxide**. See **optical crown glass**.

borosilicate glass. *Noun.* A **silicate glass** containing not less than 5 % of **boric oxide**.

boroxol group. *Noun.* A structural unit present in the range 12–75 % in **boric oxide** glass. It consists of 3 BO₃ planar triangles bonded into a planar hexagonal B₃O₃ ring with B-O-B angles of 120°.

borsic. *Acronym, noun.* A composite of **silicon carbide** reinforced by **boron fibres**.

bort. *Noun.* An imperfect **diamond** or diamond fragments employed principally as an abrasive or as a bonded tip on a cutting tool. Also called **boart** or **bortz**.

bortz. *Noun.* See **bort**.

Bose-Einstein statistics. *Noun.* The part of quantum statistics developed to deal with systems of particles of zero or integral spin, such as bosons like pions that do not obey the exclusion principle. See **Pauli exclusion principle**.

bosh. *Noun.* (1) The lower tapering part of a blast furnace between the hearth and stack in which iron ore is reduced to metallic iron. (2) Siliceous deposits occurring on metal refining vessels, particularly copper. (3) A water tank used for cooling glass-making tools.

boson. *Noun.* A particle (e.g., **photon**) that does not obey the **Pauli exclusion principle** but obeys **Bose-Einstein statistics**.

bossing. *Verb.* To remove brush marks from painted pottery by patting or striking the design with a silk bag stuffed with soft cotton or wool, particularly used for designs that are first painted in oil and then dusted with powdered pigments.

botryoidal. *Adjective.* Resembling a bunch of grapes.

botryoidal aggregate. *Noun.* Prismatic crystals radiating from a common centre to form spherical surfaces with groups larger than 13 mm in size; **haematite kidney ore** is an example.

Bottger ware. *Noun.* Dark red **stoneware**.

botting clay. *Noun.* A refractory clay of high plasticity used to plug the tapping spouts of cupolas and furnaces containing molten materials.

bottle. *Noun.* A glass or ceramic vessel of cylindrical shape that can be closed-off with a cork or cap that is used to store liquids.

bottle glass. *Noun.* Glass with an **aluminosilicate** composition used to make bottles.

bottle green. *Adjective.* A dark-green colour so named because many wine bottles are made to be this colour.

bottle kiln, bottle oven. *Noun.* An **updraft kiln** in the shape of a tapered bottle, the tapered neck serving as the flue.

bottle, vacuum. *Noun.* See **vacuum bottle**.

bottom clay. *Noun.* The layer next to the sand at the base of a **ball clay lens**.

bottoming. *Noun.* The lowest level of rocks, stones or concrete used as part of a foundation for a road or building.

bottom pouring. *Verb.* To discharge the contents of a smelter, melting tank, ladle, or other container from the bottom.

bottom, slugged. *Noun.* See **slugged bottom**.

bottom tap. *Noun.* A hole for the drainage of molten compositions and slags from the bottom of a furnace, smelter, or melting tank.

bottom teeming. *Verb.* To fill ingots or moulds in which the molten batch enters the moulds from the bottom.

bottom up nanotechnology. *Noun.* See **top down nanotechnology**.

boulder. *Noun.* Sedimentary rock rounded in shape and bigger than 256 mm in diameter.

boulder clay. *Noun.* A glacial deposit of fine clay mixed with **boulders** and **pebbles**.

boule. *Noun.* A pure crystal, such as silicon or **sapphire**, frequently a pear-shaped mass consisting of a single crystal, formed in a special furnace by rotating a small seed crystal while slowly pulling it out of the molten bath; used as bearings, thread guides, record player needles, etc.

boundary. *Noun.* (1) A thermodynamic boundary that separates a thermodynamic system from its surroundings. (2) Something that denotes the farthest limit of an area.

boundary, large-angle. *Noun.* See **large-angle grain boundary**.

boundary layer. *Noun.* The layer of a fluid closest to the surface of a solid over which the fluid is flowing. Because of adhesion it flows more slowly than the bulk of the liquid.

boundary lubrication region. *Noun.* See **Stribeck curve**.

boundary, small-angle. *Noun.* See **small-angle grain boundary**.

bound state. *Noun.* The function describing an electron in an atom, in which the energy is discrete and the **wave function** localised.

bournonite. *Noun.* PbCuSbS_3 . One of the most abundant sulphosalts. A major ore of lead and copper; grey to black, orthorhombic crystals; hardness (Mohs) 2.5–3; density 5.933 kg m^{-3} .

Bowen's reaction series. *Noun.* The sequence in which minerals are formed during the cooling of a **batholith**.

bowing. *Noun.* The tendency of a length of coated abrasive or other material to curve or bend; caused by excess moisture (expansion) or lack of moisture (shrinkage) on one side of the abrasive strip

bowl. *Noun.* The portion of a feeder that delivers molten glass to the **forming unit**, and which consists of the orifice, revolving tube, needle, etc.

bow-off. *Verb.* To remove excess clay from a moulded artefact prior to removing it from the mould.

boxcar roof. *Noun.* The roof of an **open-hearth furnace** in which the transverse and horizontal ribs form box-like shapes along the top.

box furnace, box kiln. *Noun.* An intermittent box-shaped furnace in which ware is placed, fired, and removed on a scheduled basis before the introduction of a subsequent charge.

boxing. *Noun.* To arrange cups rim-to-rim in a kiln to prevent distortion during firing.

box section. *Noun.* A concrete pipe of rectangular cross section.

boy. *Noun.* Apprentice glassblower who takes hand-blown **lead crystal glass** to the **annealing lehr**.

boy, mechanical. *Noun.* See **mechanical boy**.

bp. *Abbreviation.* Stands for boiling point. Also **b.pt.**

b.pt. *Abbreviation.* Stands for boiling point. Also **bp.**

Bradford. *Toponym.* Used attributively for a type of **clay** found near the town of Bradford-on-Avon. It is a grey **marl** clay with thin layers of tough **limestone** and **calcareous sandstone**.

Bragg equation. *Noun.* See **x-ray diffraction**.

Bragg's law. *Noun.* A relationship that sets out the conditions for a set of crystallographic planes to diffract a beam of x-rays. See **Bragg equation**.

Bragg stack. *Noun.* An acoustic mirror composed of multiple layers each with a different acoustic impedance.

braid. *Noun.* (1) A shield from strong electrostatic fields for insulated cables and conductors consisting of woven metallic wire. (2) A woven, fibrous, protective covering over an insulated conductor or cable.

brain coral. *Noun.* A stony coral with a structure resembling the convoluted surface of a brain.

brake lining. *Noun.* A covering of **asbestos**, **cermet**, **carbon fibre** or other ceramic material moulded to the brake shoe or brake band which presses against the rotating drum to apply resistance to the motion of a body.

brale. *Noun.* A diamond indenter of sphero-conical shape used in **Rockwell hardness** testing.

branch. *Noun.* (1) An arm of a dendritic crystal. (2) A section of a curve separated from the rest of the curve by discontinuities or special points. (3) In computer technology it is a departure from the normal sequence of programmed instructions into a sub-routine.

brannerite. *Noun.* ThTi_2O_6 . The **archetype** of the AB_2O_6 family of ceramics, some of which are used as **electroceramics**.

brash. *Noun.* Loose, broken rock.

brass wire. *Noun.* Wire of selected diameters employed to cut clay and unfired ceramic products.

braunite. *Noun.* $\text{Mn}_7\text{SiO}_{12}$ or $3\text{Mn}_2\text{O}_3 \cdot \text{MnSiO}_3$. A brownish-black mineral consisting of both **manganese oxide** and **manganese silicate**. A source of manganese.

Bravais lattice. *Noun.* The 14 regular arrangements of points in 3-D space. Every crystal structure belongs to one of these lattices.

Brazilian test. *Noun.* A diametral splitting test performed on ceramic disks in which a disk is compressed until it fails in tension along the vertical diameter. See **splitting tensile test**.

brazilite. *Noun.* The name given to naturally occurring **baddeleyite**, ZrO_2 , when it is found with a fibrous or columnar habit.

brazing. *Noun.* To join two or more metal parts by fusing a solder between the adjoining surfaces to form a vacuum-tight bond; in ceramic technology, the braze is made between a metallised ceramic and a mating metal.

breadboard. *Noun.* An experimental model of an item being considered for production, particularly a proposed electronic product, to establish the feasibility of the item and to detect areas for its improvement.

breakdown field. *Noun.* The local field at grain boundaries in a ceramic **varistor** at which the grains change from insulators to large current conductors.

breakdown field strength. *Noun.* The electric field strength at which excessive ionisation in the ceramic occurs. Any conductive paths may carbonise or cause arcs and consequential damage.

breakdown voltage. *Noun.* The potential difference at which electrical failure occurs in an electrical insulating material located between two electrodes under specified conditions. Also termed **dielectric** and **electric breakdown voltage**.

breaking extension. *Noun.* See **extension at break**.

breaking length. L_B . *Noun.* The length of a specimen whose weight is equal to the breaking load $L_B = P_B \rho$, where ρ is density kg m^{-3} and P_B is the breaking load in kg m^{-2} .

breaking stress. *Noun.* The stress required to fracture a material, by tension, compression, or shear.

breakout. *Noun.* A defect in dry-process porcelain-enamels characterised by an area of blisters with well-defined boundaries.

break point. *Noun.* (1) The first appearance in the effluent of an adsorbate on activated carbon under prescribed conditions. (2) A change in the shape of a plot of density against log of the compacting pressure in a uniaxial compaction of dry powder. It becomes obvious when the powder contains granules of homogeneous size and strength. The break point represents the stress needed to break the **agglomerate** bonds in the granules.

breasts. *Noun.* The sloping refractory components below the ports and adjoining brickwork of an **open-hearth furnace** that serves to join the hearth with the furnace ends.

breast wall. *Noun.* (1) The entire side wall of a furnace between the **flux block** and **crown**, excluding the ends. (2) The refractory wall between pillars of a **pot furnace** and in front of or surrounding the front of a pot.

breccia. *Noun.* A rock consisting of angular fragments embedded in a finer matrix.

breccia violetto. *Noun.* An Italian marble with a very distinctive polished microstructure that is typical of a **breccia** and as a result is used to decorate buildings etc.

breche sanguine. *Noun.* An attractive red **marble breccia**. Also called **red African**.

breeze. *Noun.* Ashes of coal used to make **breeze block**.

breeze block. *Noun.* A low density building brick used for non-load bearing walls made from **breeze** bonded by cement. Also called **cinder block**, **clinker block**.

breeze coal. *Noun.* The residue from coke and charcoal making; used in concrete and bricks.

breezing. *Noun.* A thin layer of buckwheat, anthracite coal, or coarse sand spread on the refractory floor of a glass furnace before the setting of pots.

bremssstrahlung. *Noun.* Electromagnetic radiation emitted when the velocity of a charged particle changes.

Brenner gauge. *Noun.* A device calibrated to estimate the thickness of porcelain-enamels as a function of the force required to lift a metal pin from contact with the coating surface against a known magnetic force acting beneath the under-surface of the base metal.

breunnerite. *Noun.* A **solid solution** of iron magnesium carbonate that occurs naturally with an iron content in the 4–8 wt.% Fe_2O_3 , which when **dead burned** makes a good refractory for steel production.

Brewster. *Noun.* A unit of photoelasticity equivalent to a retardation of $10^{-12} \text{ m}^2 \text{ N}^{-1}$.

Brewster angle. θ_i . *Noun.* The angle of incidence of a light beam at an air-reflecting medium interface at which it is polarised to its maximum extent, which is the maximum divergence in reflectivity between the **p-wave** and **s-wave** of the light. The reflectivity of the p-wave becomes zero at the angle: $\tan \theta_i = n_2/n_1$, where n_1 and n_2 are the medium and air refractive indices.

Brewster's law. *Noun.* The tangent of the polarising angle, α , for a material is equal to the index of refraction n : $n = \tan \alpha$; the polarising angle is defined as the angle of incidence for which the reflected polarised ray is perpendicular to the refracted ray.

Brewster's window. *Noun.* A glass window of special composition used in each end of some gas **lasers** to transmit one polarisation of the laser output beam without loss.

brianchone lustre. *Noun.* A lustre in which a reducing agent is incorporated as a component of a ceramic glaze.

brick. *Noun.* A block of clay or shale formed into a rectangular prism while in a plastic condition, and hardened by firing in a kiln or by sun baking (**adobe**) for use as a masonry unit in building and other construction. Manufactured brick now contains up to 10 % of recycled material and they can be recycled after use. Burnt brick has the resilience of stone but can also be shaped and fired with glazes to produce a range of bright colours. The mineral content of the original clay, the firing temperature and the kiln atmosphere affects the colour of the brick.

brick acid. *Noun.* A solution used to clean cement mortar stains from concrete blocks, pavers and bricks. Commonly contains hydrochloric acid.

brick, acid resisting. *Noun.* See **acid resisting brick**.

brick, air. *Noun.* See **air brick**.

brick, alumina. *Noun.* See **alumina brick**.

brick, angle. *Noun.* See **angle brick**.

brick, arch. *Noun.* See **arch brick**.

brick, ashlar. *Noun.* See **ashlar brick**.

- brick, basic.** *Noun.* See **basic brick**.
- brickbat.** *Noun.* A piece of brick.
- brick, bauxite.** *Noun.* See **alumina brick**.
- brick, block.** *Noun.* See **block brick**.
- brick brindled.** *Noun.* See **brindled brick**.
- brick, building.** *Noun.* See **building brick**.
- brick, calcium silicate.** *Noun.* See **calcium silicate brick**.
- brick, centre.** *Noun.* See **centre brick**.
- brick, chequer.** *Noun.* See **chequer brick** or **checkers**.
- brick, chemically bonded.** *Noun.* See **chemically bonded brick**.
- brick, chrome.** *Noun.* See **chrome brick**.
- brick, chrome-magnesia.** *Noun.* See **chrome-magnesia brick**.
- brick, chrome-magnesite.** *Noun.* See **chrome-magnesite brick**.
- brick, chuff.** *Noun.* See **chuff brick**.
- brick, circle.** *Noun.* See **circle brick**.
- brick classification.** *Noun.* A naming system indicating the potential use of the brick. There are three classes: **common**, **face** or **facing**, and **engineered** or **engineering brick**.
- brick clays.** *Plural noun.* Clays possessing properties suitable for the production of brick. Such clays, which usually fire to a red colour, are somewhat impure, containing considerable amounts of fluxing ingredients, will mould readily, fire to an appropriate degree of hardness at a relatively low temperature, and will be resistant to warping and cracking during firing. Grades that contain lesser amounts of impurities and soluble salts, and which fire to greater hardness, lower porosity, greater strength, and more uniform colours are used in the manufacture of face brick.
- brick, clinker.** *Noun.* See **clinker brick**.
- brick, concrete.** *Noun.* See **concrete brick**.
- brick, cored.** *Noun.* See **cored brick**.
- brick, critical diameter.** *Noun.* See **critical diameter**.
- brick, crown.** *Noun.* See **crown brick**.
- brick, dc/dc.** *Noun.* See **dc/dc brick**.
- brick, deaired.** *Noun.* See **deaired brick**.
- brick, dolomite.** *Noun.* See **dolomite brick**.
- brick, dolomite-magnesite.** *Noun.* See **dolomite-magnesite brick**.
- brick, dome.** *Noun.* See **dome brick**.
- brick, double.** *Noun.* See **double brick**.
- brick, drop-machine silica.** *Noun.* See **drop-machine silica brick**.
- brick, dry-pressed.** *Noun.* See **dry-pressed brick**.
- brick earth.** *Noun.* A loamy, relatively impure clay used in making some types of common brick.
- brick, economy.** *Noun.* See **economy brick**.
- brick, electrocast.** *Noun.* See **electrocast brick**.
- brick, end-cut.** *Noun.* See **end-cut brick**.
- brick, end skew.** *Noun.* See **end skew brick**.
- brick, engineered.** *Noun.* See **engineered brick**.
- brick, engineering A brick.** *Noun.* See **engineering A brick**.
- brick, engineering B brick.** *Noun.* See **engineering B brick**.
- brick, facing.** *Noun.* See **face brick**.
- brick, feather.** *Noun.* See **feather brick**.
- brick, fire.** *Noun.* See **firebrick**.
- brick, flashed.** *Noun.* See **flushed brick**.
- brick, floor.** *Noun.* See **floor brick**.
- brick, furring.** *Noun.* See **furring brick**.
- brick, glass.** *Noun.* See **glass brick**.
- brick, graphite.** *Noun.* See **graphite brick**.
- brick, green.** *Noun.* See **green brick**.
- brick, hard-burned.** *Noun.* See **hard-burned brick**.
- brick, hand-made.** *Noun.* See **hand-made brick**.
- brick, high-alumina.** *Noun.* See **alumina brick**.
- brick, high-duty fireclay.** *Noun.* See **high-duty fireclay brick**.
- brick, industrial floor.** *Noun.* See **industrial floor brick**.
- brick, inwall.** *Noun.* See **inwall brick**.
- brick, ipre.** *Noun.* See **ipre brick**.
- brick, jack.** *Noun.* See **jack brick**.
- brick, jamb.** *Noun.* See **jamb brick**.
- brick, jumbo.** *Noun.* See **jumbo brick**.
- brick, key.** *Noun.* See **key brick**.
- brick, ladle.** *Noun.* See **ladle brick**.
- brick, lattice.** *Noun.* See **lattice brick**.
- bricklayer.** *Noun.* A skilled person trained to lay bricks.
- bricklaying.** *Noun.* The art and skill of laying bricks.

- brick, low-duty fireclay.** *Noun.* See **low-duty fireclay brick**.
- brick, lug.** *Noun.* See **lug brick**.
- brick, magnesia.** *Noun.* See **magnesia brick**.
- brick, magnesite.** *Noun.* See **magnesia brick**.
- brick, medium-duty fireclay.** *Noun.* See **medium-duty fireclay brick**.
- brick, merch.** *Noun.* See **merch brick**.
- brick, metalkase.** *Noun.* See **metalkase brick**.
- brick, modular.** *Noun.* See **modular brick**.
- brick, mould.** *Noun.* See **mould brick**.
- brick, neck.** *Noun.* See **neck brick**.
- brick, nine-inch.** *Noun.* See **nine-inch brick**.
- brick, Norman.** *Noun.* See **Norman brick**.
- brick, nozzle.** *Noun.* See **nozzle brick**.
- brick, packaged.** *Noun.* See **packaged brick**.
- brick, panel.** *Noun.* See **panel brick**.
- brick, paving.** *Noun.* See **paving brick**.
- brick, perforated.** *Noun.* See **perforated brick**.
- brick, pitch-bonded basic.** *Noun.* See **pitch-bonded basic brick**.
- brick, pitch-impregnated.** *Noun.* See **pitch-impregnated refractories**.
- brick, place.** *Noun.* See **place brick**.
- brick, pressed.** *Noun.* See **pressed brick**.
- brick, radial.** *Noun.* See **radial brick**.
- brick red.** *Adjective.* A reddish-brown colour.
- brick, refractory.** *Noun.* See **refractory brick**.
- brick, repressed.** *Noun.* See **repressed brick**.
- brick, Roman.** *Noun.* See **Roman brick**.
- brick, rubbing.** *Noun.* See **rubbing brick**.
- brick, runner.** *Noun.* See **runner brick**.
- brick, salmon.** *Noun.* See **salmon brick**.
- brick, sand-creased.** *Noun.* See **sand-creased brick**.
- brick, sand-lime.** *Noun.* See **sand-lime brick**.
- brick, sand-struck.** *Noun.* See **sand-struck brick**.
- brick saw.** *Noun.* A mechanically operated abrasive disk used to cut brick.
- brick, scove.** *Noun.* See **scove brick**.
- brick, SCR.** *Noun.* See **SCR brick**.
- brick scratchers.** *Noun.* A wire comb employed to texture the surface of brick following the extrusion operation.
- brick, semi-silica fireclay.** *Noun.* See **semi-silica fireclay brick**.
- brick, sewer.** *Noun.* See **sewer brick**.
- brick, sidearch.** *Noun.* See **sidearch brick**.
- brick, side-cut.** *Noun.* See **side-cut brick**.
- brick, silica.** *Noun.* See **silica brick**.
- brick, siliceous fireclay.** *Noun.* See **siliceous fireclay brick**.
- brick, skewback.** *Noun.* See **skewback brick**.
- brick, sleeve.** *Noun.* See **sleeve brick**.
- brick, soap.** *Noun.* See **soap brick**.
- brick, soft-mud.** *Noun.* See **soft-mud brick**.
- brick, standard.** *Noun.* See **standard brick**.
- brick, stiff-mud.** *Noun.* See **stiff-mud brick**.
- brick, straight.** *Noun.* See **straight brick**.
- brick, sun-dried.** *Noun.* See **sun-dried brick**.
- brick, superduty fireclay.** *Noun.* See **superduty fireclay brick**.
- brick, superduty silica.** *Noun.* See **superduty silica brick**.
- brick, tapestry.** *Noun.* See **tapestry brick**.
- brick, textured.** *Noun.* See **textured brick**.
- brick, triple.** *Noun.* See **triple brick**.
- brick, tuyere.** *Noun.* See **tuyere brick**.
- brick, unburned.** *Noun.* See **unburned brick**.
- brick, water-struck.** *Noun.* See **water-struck brick**.
- brick, wedge.** *Noun.* See **wedge brick**.
- brick, wire-cut.** *Noun.* See **wire-cut brick**.
- brickwork.** *Noun.* Any masonry structure or pavement made of brick.
- brickwork, reinforced.** *Noun.* See **reinforced brickwork**.
- brickyards.** *Noun.* A commercial unit where bricks are made, stored and sold.
- brick, zirconia.** *Noun.* See **zirconia brick**.
- bridge.** *Noun.* The structure formed by the end walls of the adjacent **melter** and **refiner** compartments of a **glass tank**.
- bridge cover.** *Noun.* A refractory block spanning the space between the end walls of a glass-melting tank and the adjacent **refiner tank**.

bridge-material transfer. *Noun.* Material transfer that occurs in an electric arc furnace without the presence of a gaseous electric discharge. The filament of molten contact material that connects the two separating electrodes does not rupture in the middle and there is a gain of material on one contact and a loss of material from the other from this molten bridge.

bridge wall. *Noun.* The part of a **glass-melting tank** that separates the **melting** and **refining sections**.

bridging oxygen. *Noun.* An atom of oxygen situated between and covalently bonded to two **network-forming atoms**, such as silicon, in a glass structure.

bright. *Adjective.* Emitting or reflecting considerable light.

bright annealing. *Verb.* To heat steel or iron to a red heat or above in an inert or reducing atmosphere which inhibits or prevents oxidation, the surface of the metal remaining bright for subsequent enamelling.

bright glaze. *Noun.* A white, coloured, or clear ceramic glaze having a high gloss.

bright gold. *Noun.* An inexpensive **lustre of gold** resinate combined with other metal resins and a flux; used as a decoration when fired on glass, porcelain-enamel, glaze, or other surfaces. See **lustre**.

brightness. *Noun.* (1) A term for the flux emitted per unit emissive area as projected on a plane normal to the line of sight. The unit is that of a perfectly diffusing surface emitting 10^4 lm m^{-2} of projected surface, called a **lambert**; millilambert is more convenient. The **SI unit** is the **candela** per steradian. (2) A measure of total light present in a colour.

brights. *Noun.* Any portion of decorated glass forming a part of a design, but which has not been acid-treated.

brilliance. *Noun.* The property of being very bright in appearance. In glasses or glassy compositions, the **index of refraction**, the transparency, and the surface polish of the item being observed influence the property.

brilliant cutting. *Verb.* To decorate flat glass by cutting designs in the glass by abrasives and polishing wheels.

brimstone. *Noun.* An old name for sulphur.

brindled brick. *Noun.* A brick of high crushing strength made of iron-bearing **sedimentary clays** in which the iron oxides are partially reduced during firing.

Brinell hardness. *Noun.* See **Brinell test**.

Brinell hardness number. *Noun.* See **Brinell test**.

brinelling. *Noun.* Surface corrosion at very localised places.

Brinell test. *Noun.* A measurement of the hardness of a material obtained by pressing a steel ball 1 cm in diameter into a polished surface of the material being tested under a prescribed load; the applied load is divided by the spherical-surface arc area of the resulting indentation; the results are reported as the **Brinell number** with

units of kg mm^{-2} . Sometimes called the **Brinell hardness number**.

briquette or briquet. *Noun.* (1) A mass of fine granular material compressed into some desired shape and held together with a bonding agent. (2) A small brick of any substance. (3) A small brick made by compressing coal dust and used for fuel. (4) *Verb trans.* To make into a brick form.

briquetting. *Verb trans.* To form powdered or granular materials into cubes, blocks, or other shapes in dies under pressure.

bristle. *Noun.* A generic term for short stiff fibres.

Bristol glaze. *Noun.* An unfritted zinc-bearing glaze for **stoneware**, **terra cotta**, and similar bodies. It has the following composition in wt. %: SiO_2 (67.09), Al_2O_3 (13.01), Na_2O (1.98), K_2O (3.01), MgO (2.57), CaO (7.16) and ZnO (5.19).

britholite. *Noun.* $\text{Ca}_4\text{Ln}_6(\text{SiO}_4)_6\text{O}_2$. A mineral with a structure and composition that make it a possible containment phase for plutonium by **isomorphous replacement** of the lanthanide ions in the structure.

British thermal unit. Btu. *Noun.* The unit of heat required to raise the temperature of 1 lb of water at maximum density (air-free) 1°F under a constant pressure of 1 atm; the equivalent of 252 cal.

brittle. *Noun, adjective.* The property of being broken or fractured without prior deformation. Unable to support slow crack growth. Having a low value for the **fracture toughness parameter**, K_{Ic} , which is usually $<1.0 \text{ MN m}^{-3/2}$.

brittle-ductile transition. BDT. *Noun.* Most brittle materials when tested at constant strain rate as a function of temperature show a change from characteristic brittle fracture to one showing some ductile characteristics. The BDT is associated with a reduction in the localised force on an existing critical crack due to plastic flow during loading. The change in behaviour has a characteristic temperature, T_c .

brittle fracture. *Noun.* A fracture occurring in a metallic or ceramic body exhibiting the characteristics of very rapid crack propagation. In this mode cracks propagate rapidly with little obvious plastic deformation.

brittle mica. *Noun.* A **divalent mica**, that is one containing divalent cations between the Si-O sheets for charge balancing, showing perfect basal cleavage but the greater **ionic bond strength** makes the resultant sheets brittle in character.

brittleness index. *Noun.* A measure of ceramic grindability defined as H_v/K_{Ic} , where H_v is the **Vickers hardness** measured in GN m^{-2} and K_{Ic} is the **fracture toughness parameter**, which has the units $\text{MN m}^{-3/2}$. Hence, brittleness index is measured in units of $\text{m}^{-1/2}$ and the larger the value the less energy required grinding to a given particle size.

- brittle-ring test.** *Noun.* A **tensile strength** test in which maximum stress is applied to the inner periphery of a ring-shaped specimen by application of a compressive load to the outer periphery of the ring. Failure should occur through the vertical diameter of the annular specimen.
- brochantite.** *Noun.* $\text{Cu}_4\text{SO}_4(\text{OH})_6$. A basic copper sulphate formed by atmospheric corrosion of copper. A characteristic green colour.
- broken-joint tile.** *Noun.* A roofing tile laid over the centre of the head of a tile immediately below.
- broken seed.** *Noun.* A fractured bubble on the surface of plate glass after polishing.
- Brongniart's formula.** *Noun.* A formula used to calculate the solid content of a suspension: $W = (P - 20)S / (S - 1)$, in which W is the weight of solid in 1 pint of the slurry in ounces, P is the weight of 1 pint of the slurry, and S is the **specific gravity** of the dry solid material.
- bronzing.** *Noun.* A mixture of pigments of a metallic lustre or powdered metal, and a binding agent, such as gold size, that is applied to a ceramic surface.
- bronzite.** *Noun.* An **orthopyroxene** silicate having a metallic or pearly lustre.
- bromellite.** *Noun.* BeO . A somewhat rare ore; synthetic bromellite, **beryllium oxide**, has some specialised refractory uses.
- Brookfield viscometer.** *Noun.* An instrument to measure the viscosity of a porcelain-enamel or glaze slip in which the resistance of an electrically operated cylinder to rotation in the slip is determined.
- brookite.** *Noun.* TiO_2 . A black, brown, or reddish, orthorhombic mineral of titania, which is **trimorphous** with **anatase** and **rutile**, having a density of 3,870–4,080 kg m^{-3} and a **Knoop hardness** of 8.53 GN m^{-2} .
- brown asbestos.** *Noun.* Colloquial expression for the fibrous **amphibole** mineral amosite. See **amosite**.
- brown coal.** *Noun.* See **lignite**.
- brown coat.** *Noun.* A mortar or plaster that has been strengthened by the addition of hair or other fibrous material and over which a finish coat is applied.
- Brownian motion.** *Noun.* The incessant motion of small particles suspended in a fluid. It is an important factor in causing nanoparticles in suspension to **aggregate**. This is seen in the controlling equation: $\Delta x = [6kT\Delta t / 3\pi\mu d_p]^{1/2}$, where Δx is the mean displacement, Δt is the diffusion time, k the **Boltzmann constant**, T the temperature, μ the viscosity of the suspension fluid, and d_p is the particle diameter. This shows that particles approach each other more often as their size decreases, which enhances aggregation.
- brownies.** *Noun.* A synonym for copperheads in porcelain-enamel. See **copperheads**.
- brown mica.** *Noun.* See **black mica**.
- brownmillerite.** *Noun.* $\text{Ca}_2\text{AlFeO}_5$. A phase formed in **cement clinker**.
- brownstone.** *Noun.* An iron-rich **sandstone** with an attractive reddish-brown colour; used for building.
- brown tourmaline.** *Noun.* A gem quality form of the mineral **tourmaline** that occurs as large crystals in some **pegmatites**.
- brucite.** *Noun.* $\text{Mg}(\text{OH})_2$. Magnesium hydroxide. Used in refractories as a source of **dead-burned magnesite**, and as a component in welding-rod coatings. Density 2,380–2,400 kg m^{-3} ; hardness (Mohs) 2.5.
- bruise.** *Noun.* An area of small cracks in glassware resulting from impact.
- Brunauer-Emmett-Teller equation. BET.** *Noun.* A function for the determination of the surface area of a powder or porous solid by computing the monolayer area from the volume of a gas adsorbed on the surface of a sample of known mass; an extension of **Langmuir's isotherm equation**. An expression of the equation is: $1/[(p/p_o) - 1] = c - 1/v_m c [p/p_o] + 1/v_m c$, where p is the equilibrium pressure, p_o is the saturation pressure of adsorbate, v is the adsorbed gas volume, v_m is the monolayer adsorbed gas volume, and c is the BET constant; c is obtained from $c = \exp(E - E_L/RT)$, where E is the heat of adsorption and E_L is the heat of liquefaction of the adsorbent.
- brush.** *Noun.* A conductor arranged to make electrical contact between a stationary and one or more moving components.
- brush, blender.** *Noun.* See **blender brush**.
- brush, bolt-hole.** *Noun.* See **bolt-hole brush**.
- brush, edging.** *Noun.* See **edging brush**.
- brush force.** *Noun.* The force required to close, maintain, and open electrical contacts.
- brush, fan blender.** *Noun.* See **fan blender brush**.
- brushing.** *Verb.* (1) To remove bisque porcelain-enamel from ware before firing by brushing through a stencil or along an edge to produce a design or edging. (2) To remove bedding material from ceramic ware after the **bisque fire**.
- brush, Japanese.** *Noun.* See **Japanese brush**.
- brush, lawn.** *Noun.* See **lawn brush**.
- brush mark.** *Noun.* A defect or blemish in glassware consisting of fine lines having the appearance of brush marks.
- brush, sable detail.** *Noun.* See **sable detail brush**.
- brush, scroller.** *Noun.* See **scroller brush**.
- brush, stain.** *Noun.* See **stain brush**.

brush, tinter. *Noun.* See **tinter brush**.

BSI. *Abbreviation.* Stands for British Standards Institute: the UK's national standards body.

BSU. *Abbreviation.* Stands for basic structural unit. See **basic structural unit**.

Btu. *Abbreviation.* Stands for British thermal unit. See **British thermal unit**.

bubble. *Noun.* See **blister**.

bubble cap. *Noun.* A ceramic cap, serrated along the bottom to permit the passage of vapours; for use in distillation and de-acidifying towers in chemical processes.

bubble glass. *Noun.* A decorative product containing bubbles of prescribed size and arrangement.

bubble-pressure pore-size determination. *Noun.* A method of estimating the maximum pore size of a material by calculating the pressure required to force a bubble of air through the material wetted by a liquid of known surface tension.

bubble raft. *Noun.* A two-dimensional frame where bubbles are produced on the surface of a liquid. The bubble morphology can be studied as a model of grain size, grain boundaries, and grain structures.

bubble structure. *Noun.* The size and distribution of voids in a fired porcelain-enamel coating.

bubbly clay. *Noun.* Clay containing organic impurities that cause bubbles in porcelain-enamels and glazes during firing.

Buchner funnel. *Noun.* A laboratory filter funnel used under reduced pressure, made from **porcelain** consisting of a shallow cylinder with a perforated base

buck. *Noun.* A special support employed in the firing of heavy porcelain-enamelled ware.

bucket conveyor. *Noun.* A conveyor of bulk material consisting of a series of scoops or bucket-like containers mounted on an endless belt or chain.

bucking coil. *Noun.* A coil connected and positioned in such a way that its electric or magnetic field opposes the electric or magnetic field of one or more other coils so that an imbalance is produced in the system to yield an indication.

buckling. *Adjective.* A mode of failure found in **fibre-reinforced composites** where an unstable lateral deflection is produced by a compressive stress. In advanced composites not only general buckling is observed but also micro-instability at individual fibres can be a problem.

buckling, local. *Noun.* See **local buckling**.

buckminster fullerene. *Noun.* An allotrope of carbon consisting of C_{60} molecular units that are football-shaped cage molecules. The cage contains 6- and

5-membered rings as the carbon atoms are arranged at the vertices of a polyhedron with hexagonal and pentagonal faces to produce the spherical shape. Each C_{60} unit packs to form a face-centred cubic solid that is a new allotrope of carbon. It is produced in carbon arcs where it condenses on the cool hearth and can occasionally be found in some minerals. Also called **fullerene** or **buckyballs**. Interstitial sites in the solid structure can be occupied by K or Cs to give M_3C_{60} superconducting carbides; $T_c = 18$ K. See **fullerene**.

buckstave, buckstay. *Noun.* A steel bracing employed to take the thrust of the refractory structure, such as the roof, in the construction of a furnace.

buckyballs. *Noun.* See **buckminsterfullerene, fullerene**.

buckytubes. *Noun. Colloquial.* Name for a form of carbon consisting of cylindrical carbon molecules. The cylinders are helically wrapped sheets of hexagonal carbon rings. Tubes have outer diameters of 4–30 nm and therefore may form electron guides. The tubes can be multi-walled i.e. several sheets are rolled-up or single-walled i.e. **graphene** rolled into a tube.

buddie. *Noun.* A sloping trough used to wash minerals as part of their **beneficiation**.

buff. *Adjective.* A dull yellow colour.

buffer. *Noun.* (1) A flexible disk or wheel impregnated with a fine abrasive for polishing. (2) A cloth or pad used for polishing. (3) The salt of a weak acid or base added to a solution to stabilise its pH.

buffing wheel. *Noun.* A flexible disk coated with a very fine abrasive that is used in buffing or polishing surfaces.

bugholes. *Noun.* Small pits, bubbles, or voids in the surface of formed concrete.

buhr mill. *Noun.* A pulverising machine in which materials are ground between a siliceous rock rotating against a stationary surface of the same material.

buhrstone. *Noun.* See **burstone**.

builder. *Noun.* A scrap refractory used as a filler in the construction of **kiln bottoms** and similar items.

building block. *Noun.* Hollow concrete or fired-clay blocks used in the construction of walls that usually are to be covered with a finishing material such as stone.

building brick. *Noun.* A brick formed and fired to a stable unit from clay, but not especially produced for colour or texture, for use in the general construction industry.

building clay. *Noun.* Clay suitable for the production of brick for use in the construction industry.

bulb edge. *Noun.* The heavy rounded edge or bead on sheetdrawn glass.

bulb trailer. *Noun.* An instrument for squeezing out the flow lines of slip on a clay surface.

bulged finish. *Noun.* A distended top section of a glass bottle.

bulk density. *Noun.* The ratio of the mass of an object or material to its total volume, including pore space; units are kg m^{-3} .

bulkhead. *Noun.* A panel of brick built into a wall for easy replacement.

bulking. *Noun.* The tendency of fine particles of a material to occupy a greater volume when moist.

bulk modulus of elasticity, K. *Noun.* The ratio of the compressive forces applied to a material per unit of surface area to the change in the volume of the material per unit of volume. $K = -V \, dp/dv$.

bulk nanostructured materials. *Plural noun.* Solid samples with **nanoscale** or partly nanoscale microstructures after sintering, within them.

bulk sample. *Noun.* A portion of a sample designed to represent the whole.

bulk specific gravity. *Noun.* The ratio of the mass of a material to that of a quantity of water which has a volume equal to the bulk volume of the material at the temperature of measurement.

bulk volume, V_b . *Noun.* The volume of a solid material, including the volume of open and sealed pores. Calculated by the equation: $V_b = P_o + P_s + V_T = D_w/\rho$, in which V_b is the bulk volume, P_o is the volume of open pores, P_s is the volume of sealed pores, V_T is the true volume of the solid, D_w is the dry weight of the specimen, and ρ is the bulk density of the specimen.

Buller rings. *Plural noun.* Unfired ceramic rings, 6.35 cm in diameter with a hole 2.22 cm in diameter in the centre, of prescribed compositions, which by their respective shrinkages are used as an indication of the thermal history to which accompanying ware has been exposed during firing.

bulletproof glass. *Noun.* See **bullet-resisting glass**.

bullet-resisting glass. *Noun.* A special laminated safety glass composed of three sections: (1) impact striking section, (2) transition section, (3) impact absorbing section; total thickness 1.9–7.6 cm. Also known as **bulletproof glass**.

bull float. *Noun.* A finishing tool with a handle several feet long which will permit a worker, standing at a distance, to finish a slab of concrete from the interior to the edge.

bull header. *Noun.* A bull-nosed or **jamb brick** laid on its face so that the normal bedding area is visible in the wall face.

bullion. *Noun.* The central portion of a disk of crown glass to which the blowing iron was attached.

bullnose. *Noun.* A brick having the corner of one end and side rounded to a radius approximately equal to the width of the brick.

bull's eye. *Noun.* A circular window.

Bull's kiln. *Noun.* A clamp kiln in which bricks are placed and fired in trenches.

bunch. *Noun.* A fibre yarn defect where a length <6 mm shows an abrupt increase in diameter where the fibres are matted.

bundle strength. *Noun.* Filament strength as determined from a tensile test of a bundle of parallel fibres rather than from monofilament tests, which are more difficult to perform.

bundle, fibre. *Noun.* See **fibre bundle**.

bung. *Noun.* (1) A group of **saggers** or pots stacked in a kiln. (2) A removable roof section built in a kiln.

bunker fuel oil. *Noun.* A heavy fuel oil formed by the stabilisation of the residual oil remaining after the cracking of crude petroleum, and used in large-scale heating and power-production applications. A graded product and grade 6 is commonly used in industry.

bunsenite. *Noun.* NiO. The mineralogical name for cubic **nickel oxide**. It has a glassy dark green colour. Density $6,790 \text{ kg m}^{-3}$; hardness 5.5 (Mohs).

burette. *Noun.* A graduated glass tube used in analysis for transferring known volumes of liquids.

Burgers vector, b. *Noun.* A vector that specifies the direction and distance by which atoms in a slipped area of crystal have moved with respect to those on the plane below, over which they have moved. This vector is the most characteristic feature of a **dislocation**.

burin. *Noun.* A hardened steel chisel used to carve marble.

burley clay, burley flint clay. *Noun.* A rock containing nodules of **aluminous** or **ferruginous** materials, or both, bonded by **fireclay**.

burley flint. *Noun.* See **burley clay**.

burn. *Noun.* (1) The controlled heat treatment of ceramic ware and coatings in a furnace or kiln. (2) *Synonym* for firing.

burned sand. *Noun.* A sand mixture in which the bonding agent has been **calcined** by the heat of the cast.

burned sienna. *Noun.* See **sienna**.

burner. *Noun.* (1) The mechanism by which air and fuel are mixed and directed into a combustion chamber. (2) The operator whose duty it is to tend a ceramic kiln.

burner block. *Noun.* A refractory block with one or more orifices through which fuel is introduced into a furnace or kiln.

burner, premix. *Noun.* See **premix burner**.

burning. *Verb.* (1) To fire ceramic bodies, glazes, porcelain-enamels and other coatings and products in a furnace or kiln for the purpose of developing a bond or other necessary or desired physical and chemical properties. (2) The heat treatment, vitrification, or curing of a grinding wheel to produce desired bond properties. (3) Over pickling of metal for porcelain-enamelling, often producing pits in the metal surface. (4) *Noun.* The change in a material being ground or polished caused by heat generation during the grinding operation, frequently accompanied by discoloration of the material.

burning bar, point, or tool. *Noun.* A heat-resistant metal alloy used to support porcelain-enamelled ware during the firing operation.

burning glass. *Noun.* A convex glass lens used to concentrate sun rays and raise temperatures locally.

burning off. *Verb.* Over firing of porcelain-enamels resulting in a rough, dark surface saturated with undissolved iron oxide.

burning shrinkage. *Noun.* See **firing shrinkage**.

burning-tool marks. *Noun.* A defect in porcelain-enamels occurring on the sheet-metal surface opposite the point of contact with the supporting burning tool.

burning zone. *Noun.* The volume in a continuous furnace where the major amount of heat is supplied to ware during the firing operation.

burnish. *Noun.* A shine or lustre.

burnished gold. *Noun.* A durable type of gold applied to glazed ware as a suspension in oil, fired, and rubbed with **agate** or other polishing material to a bright finish.

burnishing. *Verb trans.* Polishing of overglaze gold, **leather-hard clay**, or other material with **agate**, stone, sand, or steel wool to produce a bright surface.

burnishing, pattern. *Noun.* See **pattern burnishing**.

burn-off. *Verb.* (1) The process of severing an unwanted portion of a glass article by fusing the glass. (2) *Noun.* Slag-like area resulting from an insufficient coating of porcelain-enamel that occurs during firing.

burn-out. *Verb.* The removal of organic binders from unfired shapes by the application of heat

burnt lime. *Noun.* Calcined **dolomitic limestone** or **calcite**, or a mixture of these.

burnt shale. *Noun.* Carbonaceous **shale** formed by distillation of oil shale. Can be used in road making.

burnt sienna. *Adjective.* Of a reddish-brown or deep reddish orange colour. (2) *Noun.* The natural raw material of a brownish-yellow colour heated to give the reddish-orange coloured material used a pigment.

burnt umber. *Noun.* A brown pigment made by heating **umber**.

burn-up. *Noun.* Nuclear transformations induced during nuclear operations. The term may be applied to fuel or to other materials or to the amount of depletion due to nuclear transformation.

burr. *Noun.* (1) A thin, ragged edge of metal resulting from punching, cutting, or grinding of a metal sheet. (2) A fragment of excess material, or of a foreign material, adhering to the surface of a body. (3) A mass of hard siliceous rock enclosed by soft rock.

burring. *Verb.* The removal of sharp edges or fins from punched, cut, or ground metal items.

burr mill. *Noun.* A mill consisting of two ribbed disks of stone or metal rotating against each other. Used in the grinding of solid materials and in homogenising mixtures of pigments in a suitable liquid medium to produce pastes for the decoration of ware.

burrstone. *Noun.* See **burstone**.

bursting. *Noun.* The disintegration of refractories containing **chrome ore** when exposed to **iron oxide** at high temperatures; characterised by having the exposed face swell and grow until it breaks away from the brick mass following a permanent increase in volume.

bursting expansion. *Noun.* A term sometimes used as a synonym for bursting.

bursting off. *Verb.* The breaking of the thin-walled bubble of glass formed above a blow mould.

bursting strength. *Noun.* The rupture strength of a material as determined by applying internal gas pressures.

burstone. *Noun.* (1) A high silica content, tough rock used as a grindstone. (2) A grindstone or **millstone** made of this rock. Also called **buhrstone** or **burrstone**.

burst phenomenon. *Noun.* A rapid rise in temperature shown by some ultrafine amorphous powders as they are heated to a temperature at which they crystallise. The transformation from amorphous to **tetragonal zirconia** is a good example.

burst pressure. *Noun.* The maximum inside pressure a material or object can withstand without rupture.

bushing. *Noun.* (1) The liner of an orifice that delivers molten glass to a forming machine, or the liner of the unit through which molten glass is drawn in the production of glass fibres. (2) A bearing that lines the supporting structure for a rotating shaft.

bushing, reducing. *Noun.* See **reducing bushing**.

busting strength. *Noun.* The ability of woven fabric to resist rupture by pressure.

bustle pipe. *Noun.* A large refractory-lined pipe that encircles and delivers a hot-air blast to a blast furnace.

butter of zinc. *Noun.* Archaic name for **zinc chloride**; sometimes used as a **flashing** agent.

buttes. *Plural noun.* Very large protruding rocks produced by wind erosion.

butting contact. *Noun.* Electrical contact in which the motion of the moving contact is perpendicular to the contact faces, and which opens and closes with no appreciable sliding or rolling action.

button. *Noun.* A section in pressed glassware so designed that it may be knocked out to form a hole of specified dimensions in the parent glass.

button test. *Noun.* A test in which button-like specimens of prescribed form and sometimes density, are employed to evaluate the fusion and flow characteristics of frits, glasses, and powders.

buttress. *Noun.* A projection designed to increase the resistance of a wall in a structure to lateral forces.

butt joint. *Noun.* Geometry for joining two pieces of composite or ceramic with adhesive. The two pieces meet end on with the adhesive between them. It gives a continuous section profile but is a poor design for joining thin sheets.

butt seal. *Noun.* Straight end-to-end joining of ceramic to metal or glass to metal seals which will withstand high temperatures and a high vacuum without leakage. Often achieved by having a thin sheet of metal between the components when heat is applied to form the seal.

BWR. *Abbreviation.* Stands for boiling water reactor. See **boiling water reactor**.

bytownite. *Noun.* Soda-lime **feldspar**.

c. *Symbol.* Stands for: (1) cubic; (2) **cycle**; (3) **specific heat capacity**; (4) the velocity of light in a vacuum; (5) **carat**.

C. *Symbol.* Standing for: (1) **carbon**; (2) **lime**, CaO, in **cement notation**; (3) the derived SI unit of electric charge; see **coulomb**; (4) **capacitance**; (5) **heat capacity**; (6) Roman numeral for 100.

°C. *Symbol.* Degrees Centigrade or Celsius.

cabal-12 glass. *Noun.* A corrosion-resistant glass of extremely low thermal expansivity developed for glass-metal seal formation, contains (in mole %) B₂O₃ (40), CaO (20), Al₂O₃ (20) and MgO (20).

cabochon. *Noun.* A smooth polished gem, unfaceted but domed. One of the first ways used to cut gemstones.

CAC. *Acronym.* Standing for carbon arc cutting. See **carbon arc cutting**.

CA cement. *Abbreviation, noun.* Standing for calcium aluminate cements. See **calcium aluminate**.

CAD. *Acronym.* Standing for computer-aided design. See **computer aided design**.

CADCAM. *Acronym.* Standing for computer-aided design and manufacture. See **computer aided design**.

cadmium acetate. *Noun.* Cd(CH₃COO)₂·3H₂O. Used in the production of iridescent glazes. Loses water at 130 °C; Mp of hydrate 256 °C; density 2,010–2,345 kg m⁻³.

cadmium antimonide. *Noun.* CdSb. A ceramic semiconductor with a narrow band gap of 0.48 eV; equal electron and **hole** mobility; Mp 452 °C.

cadmium carbonate. *Noun.* CdCO₃. Used to improve the stability of **cadmium selenide** red colours; decomposes below 500 °C; density 4,258 kg m⁻³.

cadmium fluoride. *Noun.* CdF₂. Used in electronic and optical applications and as the basis crystal for several **laser** compositions. Mp. 1,000 °C; density 6,640 kg m⁻³.

cadmium-free quantum dot. CFQD. *Noun.* Quantum dots that can be tuned to produce wavelengths of light from uv to near infrared for use in biological applications because they were developed to contain no cadmium. They now have general electronic applications.

cadmium niobate. *Noun.* Cd₂Nb₂O₇. A **pyrochlore** structure oxide with useful antiferroelectric properties because of its low-loss properties at high frequencies.

cadmium nitrate. *Noun.* Cd(NO₃)₂·4H₂O. Used as a reddish-yellow colourant in porcelain-enamels and glass. Mp 59.5 °C; bp 32 °C; density 2,455 kg m⁻³.

cadmium orange. *Noun.* (1) An impure form of cadmium sulphide used as a ceramic colorant. (2) CdS_{0.25}Se_{0.75}; a particular **solid solution** of the two wurtzite semiconductors CdS and CdSe, which has a **band gap** such that all incident light except the yellow wavelengths is absorbed.

cadmium selenide. *Noun.* CdSe. A **zinc blende** structure semiconductor used in the production of red ceramic colours or, in combination with **cadmium sulphide**, orange to bright red colours in low temperature glazes, **lustres** and **enamels**. Mp above 1,350 °C; density 5,810 kg m⁻³.

cadmium silicate. *Noun.* CdSiO₃. A chain **pyroxene**; Mp 1,242 °C; density 4,932 kg m⁻³.

cadmium sulphide. *Noun.* CdS; **zinc blende** structure; employed as a component in the production of red, orange, and yellow ceramic colours. A II-VI semiconductor; sublimates at 980 °C; density 3,900–4,800 kg m⁻³. Also known as **cadmium yellow**.

cadmium telluride. *Noun.* CdTe. A **zinc blende** structure semiconductor; employed in rectifiers, solar batteries, and optical systems; Mp 1,090 °C; density 6,200 kg m⁻³.

cadmium tin oxide. *Noun.* Cd₂SnO₄. A conductive **spinel** phase applied as a transparent coating to substrates.

cadmium titanate. *Noun.* CdTiO₃. A **perovskite** structure oxide with **ferroelectric** properties.

cadmium yellow. *Noun.* A series of coloured compounds, usually **cadmium sulphide** coprecipitated with **barium sulphate**, ranging from golden yellow to a greenish or reddish yellow. Used as pigments and glaze additives. See **Pigment Yellow 37**.

cadmium zirconate. *Noun.* CdZrO_3 . A cubic perovskite used to depress the **dielectric constant** of **barium titanate** capacitors at the Curie temperature.

caesium carbonate. *Noun.* Cs_2CO_3 . Used in speciality glasses. Decomposes at 610 °C.

caesium perchlorate. *Noun.* CsClO_4 . Used in optical and speciality glasses. Mp 250 °C; density 3,330 kg m⁻³.

cage. *Noun.* A preassembled unit of reinforcements for concrete pipe or piling consisting of circumferential and longitudinal steel bars or wire mesh.

cage-mill disintegrator. *Noun.* A machine consisting of high speed rotating vanes employed to disintegrate soft particles in the beneficiation of coarse concrete aggregate.

cairn gorm. *Noun.* A smoky yellow, grey or brown variety of **quartz**. Used as a gemstone. Also called **smoky quartz**.

cake. *Noun.* (1) A slab of damp clay or ceramic body as removed from a filter press or a slip casting mould. (2) A package of glass fibre strands made by collet winding. (3) The product from a filter press with 8–12 wt.% water content that can be stacked as dry solid. (4) A crust or slab of solidified or compressed material.

cake filtration. *Noun.* One of the two principal processes for the separation of solids from liquids. A solid filter cake is formed usually on large differential pressure belt filters operating typically with a differential pressure of 8–16 bar but can be as high as 150 bar for difficult systems, such as **clay** filtration, with or without in-situ cake washing to remove solute. 8–12 wt.% cake moisture is the goal that determines the differential pressure used.

calamine. *Noun.* (1) A naturally occurring pink coloured mixture of **smithsonite**, ZnCO_3 , **ferric oxide**, and the **pyrosilicate** mineral, **hemimorphite**, $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$. (2) The name sometimes used for smithsonite.

calandria. *Noun.* A cylindrical vessel through which tubes pass to form a heat exchanger, evaporator, or nuclear reactor.

calaverite. *Noun.* AuTe_2 . Gold telluride occurring naturally as striated crystals. Has semiconducting properties and is a source of gold metal.

calcareous. *Adjective.* Any material containing **calcium carbonate**; chalky.

calcareous clay. *Noun.* Clay containing calcium-bearing minerals, usually sulphate or carbonate.

calcareous tufa. *Noun.* A very porous **evaporate** rock formed by the evaporation of spring water.

calcia. *Noun.* CaO. Old ceramic name for calcium oxide.

calcic. *Adjective.* Of, containing, or concerned with **lime** or calcium.

calciferous. *Adjective.* Forming salts of calcium, which in nature is often **calcium carbonate**.

calcific. *Adjective.* Forming **lime** or **chalk**.

calcification. *Noun.* The process of becoming calcified.

calcify. *Verb trans.* (1) To convert or be converted into lime. (2) To become hardened by impregnation with calcium salts.

calcimine. *Noun.* A white wash for walls; can be slightly tinted. (2) *Verb trans.* To cover with calcimine. See **kalsomine**.

calcination. *Noun.* A high-temperature reaction whereby one solid material is dissociated to form a gas and at least one new solid phase.

calcine. *Verb trans.* (1) To heat a material or mixture to high temperature without fusion and so eliminate volatile constituents and to produce desired physical changes. (2) *Noun.* A solid mixture of oxides, sulphides and sulphates obtained from copper ore heated between 500–700 °C.

calcined alumina. *Noun.* Al_2O_3 . Available in several grades based on heat treatment; contains traces of residual water; contains less of the alpha phase than the **tabular** grades, and is easier to mill. Characterised by high purity, high hardness, high density, good thermal conductivity, good mechanical and thermal shock resistance, and good electrical resistivity at high temperatures; used in abrasives, glass, porcelains, spark plugs, and electrical insulators. mp 2,040 °C; density 3,500–4,000 kg m⁻³; index of refraction 1.765; hardness is about 24 GN m⁻².

calcined clay. *Noun.* **Ball** or **china clay** that has been heated until the combined water is removed, and the plastic character is destroyed.

calcined gypsum. *Noun.* $\text{CaSO}_4 \cdot 0.5\text{H}_2\text{O}$; known commercially as **plaster of Paris**.

calcined kaolin. *Noun.* A mixture of **mullite** crystals and a glassy phase that is the final high temperature decomposition product of kaolin clay; Mp 1,770 °C; deformation temperature 1,750–1,770 °C; used in refractories, kiln furniture, castables, investment moulds, low-expansion and insulating bodies, and other high-temperature products to improve refractoriness, mechanical strength, thermal-shock resistance, load-bearing properties, and resistance to corrosion by molten glasses, fritted glazes, porcelain-enamel frits, and slags.

calcined limestone. *Noun.* Limestone converted by heat to **quicklime**, CaO.

calcined refractory dolomite. *Noun.* Refractory dolomite, which has been heated for a sufficient time and temperature to remove volatile matter and to decompose the carbonate structure to leave a mixture of **magnesia** and **lime**.

calcined soda. *Noun.* The commercial grade of **sodium carbonate** used in the manufacture of glass.

calcite. *Noun.* CaCO_3 . Small crystalline phase in limestone that has perfect cleavage in three directions but not at right angles. Employed as a major component in **Portland cement** manufacture, in soda lime glassware, in pottery bodies, and for insulating coatings for capacitors and printed circuits. Density $2,720 \text{ kg m}^{-3}$; hardness (Mohs) 2. Also known as **calcspars**.

calcite dolomite. *Noun.* A carbonate rock consisting of 10–50 % **calcite** and the balance **dolomite**.

calcium acrylate. *Noun.* $(\text{CH}_2\text{CHCOO})_2\text{Ca}$. Used as a binder for clay products and foundry moulds.

calcium aluminate. *Noun.* (1) CaAl_2O_4 . A **spinel** phase; Mp $1,600^\circ\text{C}$; density $3,670 \text{ kg m}^{-3}$. (2) CaAl_4O_7 ; melts incongruently at $1,760^\circ\text{C}$; density $2,900 \text{ kg m}^{-3}$. (3) $\text{Ca}_3\text{Al}_{10}\text{O}_{18}$; Mp $2,230^\circ\text{C}$. (4) $\text{Ca}_3\text{Al}_2\text{O}_6$; Mp $1,538^\circ\text{C}$; density $3,000 \text{ kg m}^{-3}$. (5) $\text{CaAl}_{12}\text{O}_{19}$; decomposes peritectically to **corundum** plus a liquid phase at $1,850^\circ\text{C}$. All five phases are present in **high alumina cement**.

calcium aluminate fibre. *Noun.* An amorphous fibre made by melt spinning of low-viscosity melts by jet stabilisation; overall composition is $\text{Ca}_3\text{Al}_4\text{O}_9$.

calcium aluminium silicate. *Noun.* (1) A slag-like product consisting essentially of CaO, Al_2O_3 , MgO, and SiO_2 . Used in amber, green, and other glasses. (2) $\text{Ca}(\text{Al,Si})\text{O}_2$; Mp $1,549^\circ\text{C}$; density $2,771 \text{ kg m}^{-3}$. (3) $\text{Ca}_2\text{Al}(\text{Si,Al})\text{O}_7$; Mp $1,596^\circ\text{C}$; density $3,040 \text{ kg m}^{-3}$.

calcium antimonate. *Noun.* $\text{Ca}(\text{SbO}_4)_2$. Limited use as an opacifier in porcelain-enamels and glazes.

calcium boride. *Noun.* CaB_6 . An ionic **boride** containing $[\text{B}_6]^{2-}$ units; Mp $2,235^\circ\text{C}$; density $2,450 \text{ kg m}^{-3}$; hardness (Vickers) 26.89 GN m^{-2} .

calcium carbide. *Noun.* CaC_2 . An **acetylide** containing $[\text{C}_2]^{2-}$ units. Generates acetylene when added to water. Density $2,040 \text{ kg m}^{-3}$; Mp $2,160^\circ\text{C}$.

calcium carbonate. *Noun.* CaCO_3 . Decomposes at 825°C to give calcium oxide and therefore is a major component in the manufacture of Portland cement, soda-lime glassware and pottery bodies, and as an insulating coating for printed circuits and capacitors, and as a filler in plastics and paper; density $2,700\text{--}2,950 \text{ kg m}^{-3}$. Also known as **calcite**, **aragonite** and **limestone**.

calcium chloride. *Noun.* CaCl_2 . A white deliquescent salt. Used as a mill addition in porcelain-enamel slips,

as a **flocculant** to hold glazes in suspension and as a drying agent. Mp 772°C ; density $2,150 \text{ kg m}^{-3}$.

calcium chromate. *Noun.* $\text{CaCrO}_4 \cdot 2\text{H}_2\text{O}$. Loses water at 200°C ; used as a yellow colorant.

calcium copper silicate. *Noun.* A pale-blue pigment. See **Egyptian blue**.

calcium cyanamide. *Noun.* CaCN_2 . Important raw material in the plastics industry. Mp $1,200^\circ\text{C}$; density $1,083 \text{ kg m}^{-3}$.

calcium dialuminate. *Noun.* CaAl_4O_7 . A component of **high-alumina cement**. Mp $1,705^\circ\text{C}$.

calcium ferrite. *Noun.* (1) $\text{Ca}_2\text{Fe}_2\text{O}_7$; Mp $1,438^\circ\text{C}$; density $3,980 \text{ kg m}^{-3}$. (2) CaFe_2O_4 ; a **spinel**-type **ferrite**. Mp $1,215^\circ\text{C}$; density $5,080 \text{ kg m}^{-3}$.

calcium fluophosphate. *Noun.* See **apatite**.

calcium fluoride. *Noun.* CaF_2 . Used as an **opacifier** and flux in porcelain-enamels, glass, and glazes, as a flux in whiteware bodies, as a glass etchant, and as a component in crucibles for melting uranium. Mp $1,360^\circ\text{C}$; density $3,181 \text{ kg m}^{-3}$; hardness (Mohs) 4.

calcium fluorophosphate. *Noun.* $\text{Ca}_5\text{F}(\text{PO}_4)_3$. A **phosphor** used to coat the inside of mercury vapour lamps, but to produce photoluminescence, Sb^{3+} and Mn^{2+} **activators** have to be incorporated.

calcium fluosilicate. *Noun.* CaSiF_6 . Source of **fluosilicic acid** when added to sulphuric acid. Density $2,662 \text{ kg m}^{-3}$.

calcium hafnate. *Noun.* CaHfO_3 . A **perovskite** with a very low coefficient of thermal expansion, around 7×10^{-6} . Mp $2,470^\circ\text{C}$; density $5,730 \text{ kg m}^{-3}$.

calcium hydrate. *Noun.* See **calcium hydroxide**.

calcium hydroxide. *Noun.* $\text{Ca}(\text{OH})_2$. A white, slightly soluble alkali. Present in mortars, plasters, and cements after hydration. Also known as **hydrated lime**, **slaked lime**, **calcium hydrate** and **caustic lime**. Loses combined water at 580°C ; density $2,340 \text{ kg m}^{-3}$.

calcium iron arsenide. *Noun.* $\text{Ca}_{0.6}\text{Na}_{0.4}\text{Fe}_2\text{As}_2$. An high temperature superconductor, $T_c = 21 \text{ K}$, that does not contain CuO_2 layers.

calcium light. *Noun.* Another name for **limelight**.

calcium lignosulfonate. *Noun.* An inexpensive clay conditioner that lubricates and binds the mix increasing **green strength** and plasticity.

calcium magnesium silicate. *Noun.* (1) $(\text{Ca,Mg})\text{SiO}_4$. A discrete ion orthosilicate. Mp $1,499^\circ\text{C}$, but melts incongruently; density $3,200 \text{ kg m}^{-3}$. (2) $(\text{Ca,Mg})\text{SiO}_3$. A chain silicate mineral **diopside**. Mp $1,390^\circ\text{C}$; density $3,280 \text{ kg m}^{-3}$. (3) $(\text{Ca,Mg})\text{Si}_2\text{O}_7$. Mp $1,460^\circ\text{C}$; density $2,940 \text{ kg m}^{-3}$. (4) $\text{Ca}_3\text{Mg}(\text{SiO}_3)_4$. All the above are formed by isomorphous substitution of Ca^{2+} in calcium silicate by Mg^{2+} .

calcium magnesium zirconium phosphate. CMZP. *Noun.* $\text{Ca}_{1-x}\text{Mg}_x\text{Zr}_4(\text{PO}_4)_6$, x is in the range 0–0.5. An interstitially filled form of magnesium zirconium phosphate, **MZP**. Octahedral interstices in MZP are filled with Mg^{2+} and Ca^{2+} ions giving a compound of the above composition. This has the effect of reducing the thermal expansion to almost zero up to 1,250 °C. The hexagonal structure shows an anisotropic effect to be responsible for this with the a -axis expanding and the c -axis contracting. It has excellent thermal shock resistance. Used as a **thermal barrier material** and has potential for heat engine development.

calcium metaborate. *Noun.* $\text{Ca}(\text{BO}_2)_2$. Contains $(\text{BO}_4)^{5-}$ and $(\text{BO}_3)^{3-}$ anions in the crystal. Mp 1,100 °C.

calcium metasilicate. *Noun.* CaSiO_3 . A chain **pyroxene**; used in pottery bodies, wall tiles, cements, wallboard, mineral wool, and special low-loss electroceramics. Occurs naturally as **wollastonite**. Mp 1,544 °C; density 2,800–2,900 kg m^{-3} ; hardness (Mohs) 4.5–5.

calcium molybdate. *Noun.* CaMoO_4 . Used as an **adherence-promoting agent** in some antimony-bearing porcelain-enamel ground coats.

calcium monoaluminate. *Noun.* CaAl_2O_4 . See **calcium aluminate**.

calcium niobate. *Noun.* (1) $\text{Ca}_3(\text{NbO}_4)_2$. Mp 1,560 °C, but melts incongruently; density 4,230 kg m^{-3} . (2) $\text{Ca}_2\text{Nb}_2\text{O}_7$. Mp 1,565 °C; density 4,390 kg m^{-3} . (3) $\text{Ca}(\text{NbO}_3)_2$. Mp 1,560 °C; density 4,722 kg m^{-3} . All three materials have useful dielectric properties.

calcium nitrate. *Noun.* (1) $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$. Used as an oxidizing agent in zirconia and titania opacified porcelain-enamels. Mp 42 °C; decomposes at 132 °C; density 1,820 kg m^{-3} . (2) $\text{Ca}(\text{NO}_3)_2$. Mp 561 °C.

calcium nitride. *Noun.* Ca_3N_2 . Formed when calcium burns in air. Reacts with water to give ammonia. Density 2,060 kg m^{-3} .

calcium orthosilicate. *Noun.* Ca_2SiO_4 . A constituent in **Portland cement** and some **dolomite refractories**. Mp 2,130 °C; density 3,270 kg m^{-3} .

calcium oxide. *Noun.* CaO . A white alkaline salt. A fluxing ingredient used extensively in a wide variety of ceramic products: glass, pottery, glazes, porcelain-enamels, Portland cement, mortar, and plaster. Also known as **lime** or **calcia**. Mp 2,570 °C; density 3,400 kg m^{-3} .

calcium phosphate. *Noun.* Ca_3PO_4 . A very insoluble salt of orthophosphoric acid that is the main constituent of **bone ash** and is a constituent part of animal bone.

calcium phosphate, dibasic. *Noun.* See **dibasic calcium phosphate**.

calcium phosphate, tribasic. *Noun.* See **tribasic calcium phosphate**.

calcium plumbate. *Noun.* Ca_2PbO_4 . Used in glass manufacture as a flux. Density 5,715 kg m^{-3} .

calcium potassium silicate. *Noun.* CaK_2SiO_4 . An ionic **orthosilicate**. Mp 1,631 °C.

calcium pyrophosphate. *Noun.* $\text{Ca}_2\text{P}_2\text{O}_7$. A component in **castable** repair compositions. Mp 1,230 °C; density 3,090 kg m^{-3} .

calcium scumming. *Noun.* See **scumming**.

calcium silicate. *Noun.* (1) CaSiO_3 . Often referred to as **wollastonite**; a **pyroxene**. A phase found in cement and has the **cement notation** CS. Mp 1,544 °C; density 2,800–2,900 kg m^{-3} ; hardness (Mohs) 4.5–5. (2) $\text{Ca}_3\text{Si}_2\text{O}_7$. A **pyrosilicate**; decomposes at 1,899 °C. (3) Ca_2SiO_4 . An **orthosilicate** phase commonly found in cement with the cement notation C_2S ; Mp 2,130 °C; density 280 kg m^{-3} . (4) Ca_3OSiO_4 . Decomposes at 1,465 °C.

calcium silicate brick. *Noun.* Brick made by bonding **quartz sand** with **calcium orthosilicate** and water. Used as a refractory and in some engineering applications.

calcium soap. *Noun.* Calcium resinate used as a binder in ceramic inks and pastes.

calcium stannate. *Noun.* CaSnO_3 . A **perovskite** employed in **barium titanate** bodies to lower the **Curie temperature**, and as a base for **phosphors**. Mp >1,200 °C.

calcium sulphate. *Noun.* CaSO_4 . As **plaster of Paris**, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$, it is known as **gypsum**. Used extensively in models and moulds, as a bedding agent in the grinding and polishing of plate and optical glasses, as an occasional batch ingredient in glass and glazes, as a binder in low-density insulation, and as a flocculant in glazes and other slips to prevent settling. Mp 1,450 °C; density 2,964 kg m^{-3} .

calcium titanate. *Noun.* CaTiO_3 . Known as **perovskite**; a mineral with a high dielectric constant. Used with barium and other rare earth titanates and zirconates for **piezoelectric** applications. Mp 1,915 °C; density 3,170–4,020 kg m^{-3} ; hardness (Mohs) 5.5.

calcium titanium silicate. *Noun.* CaTiOSiO_4 . Mp 1,382 °C; density 3,500 kg m^{-3} .

calcium triphosphate. *Noun.* $\text{Ca}_3(\text{PO}_4)_3$. A biologically active ceramic that is used in bone repair. See **osteo ceramic**.

calcium tungstate. *Noun.* CaWO_4 . Good mechanical strength and chemical stability. Mp 1,535 °C; density 5,900–6,100 kg m^{-3} ; hardness (Mohs) 4.5–5; index of refraction 1.93 approx.

calcium uranate. *Noun.* CaUO_4 . Mp 1,799 °C; density 7,450 kg m^{-3} .

calcium zinc silicate. *Noun.* $\text{Ca}_2\text{ZnSi}_2\text{O}_7$. An ionic silicate containing $(\text{Si}_2\text{O}_7)^{6-}$ units. Mp 1,427 °C

calcium zirconate. *Noun.* CaZrO_3 . A low firing shrinkage ceramic that is used in titanate dielectrics as an additive to improve performance. Mp 2,350 °C; density 4,740 kg m⁻³.

calcrete. *Noun.* A bed of gravel and sand or clay cemented by calcium carbonate, sodium chloride, Chile saltpetre and other soluble minerals. Common in arid regions. Also called **caliche**.

calcsinter. *Noun.* See **travertine**.

calcspar. *Synonym.* Stands for **calcite** or **limestone**.

calc-tuff. *Noun.* Another name for **tufa**.

calculus. *Noun.* A ceramic deposit found on teeth consisting mainly of $\text{Ca}_3(\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}$. Also called **tartar**.

Calgon. *Trademark, noun.* The water-softening product, sodium metaphosphate.

calibration. *Noun.* (1) Determination of the values of the significant parameters by comparison with values indicated by a reference instrument or by a set of reference standards. (2) The process of fixing, checking, or correcting an arbitrary or inaccurate scale of a measuring instrument to absolute values.

calibration, chemical. *Noun.* See **chemical calibration**.

calibration curve. *Noun.* The graphical representation of a relationship between a measured parameter and a concentration or mass of the standard for the substance under consideration.

calibration factor. *Noun.* The slope of the calibration curve, or its inverse, usually in terms of the measured unit per concentration or mass of the element.

calibration standard. *Noun.* Material or stimulus of known parameters and size that are used to adjust the sensitivity of test instruments.

caliche. *Noun.* See **calcrete**.

calk. *Verb trans.* To transfer a design by tracing it with a blunt tool from one sheet, backed with loosely adhering colourant onto another placed underneath.

callipers. *Plural noun.* An instrument consisting of a pair of hinged legs that may be used to measure internal and external dimensions.

calomel. *Noun.* HgCl_2 . An ore occurring as **drusy** masses of tetragonal crystals. Used in pharmaceutical preparations and with mercury metal as a standard EMF cell. Hardness (Mohs) 1.5; density 7,230 kg m⁻³.

calorescence. *Noun.* The absorption of radiation by a material or a body and re-emission at a longer wavelength.

calorie. *Noun.* The quantity of heat required to raise the temperature of 1 g of water by 1 °C, from 3.5 to 4.5 °C.

calorie, large. *Noun.* See **large calorie**.

calorific. *Adjective.* Concerning or generating heat.

calorific value. *Noun.* A measure of the quality of fuels; usually expressed as available **Btu** per unit of weight or volume for complete combustion.

calorimeter. *Noun.* A piece of equipment for measuring quantities of heat. Used to find **specific heat capacities** and **calorific values**.

calx. *Noun.* (1) A metal oxide formed by heating an ore in air. (2) Alternative name for **calcium oxide**.

CAM. *Acronym.* Standing for computer aided manufacturing. See **computer aided manufacture**.

camber. *Noun.* A surface imperfection consisting of a single arch of curvature as opposed to waviness.

camber arch. *Noun.* An arch with a horizontal exterior and a slightly curved interior.

came. *Noun.* Lead strips used for setting glass panes.

cameo. *Noun.* A decoration that is carved out in relief on ceramic ware and decorative stones.

cameo glass. *Noun.* (1) A glass object with a relief surface. Made by etching a plate of glass or metal, filling the pattern with an ink made from asphaltum, beeswax, gum mastic and turpentine, then transferring the pattern to paper, printing this pattern on the glass surface, coating the plain areas with wax and immersing the object in acid. Also known as **sculptured glass**. (2) An ancient technique lost after Roman times where two glass compositions, usually coloured, were fused together during manufacture without mixing and then cut by hand to show relief patterns. The **Portland vase** was the best surviving example before being broken by a drunken man.

campaign. *Noun.* The working life of a furnace, glass tank, or other melting unit between major cold repairs.

Canada balsam. *Noun.* Exudates of the balsam fir tree having an index of refraction similar to that of glass; used in cementing optical lenses and other optical elements.

canal. *Noun.* The section of a **glass tank** through which molten glass flows from the relatively wide **fining area** to the **drawing chamber** or machine.

canasite. *Noun.* $\text{Ca}_5\text{Na}_4\text{K}_2\text{Si}_{12}\text{O}_{30}\text{F}_4$. A rare quadruple chain silicate developed in some **glass-ceramics** to induce toughness. The structure contains four silicate chains running parallel to the b-axis cross-linked to form a tubular unit and a basic structural unit $\text{Si}_{12}\text{O}_{30}$. The sodium and potassium ions are located centrally in the tubes. Density 2,710 kg m⁻³.

cancrinite. *Noun.* (1) $\text{Ca}_2\text{Na}_6[\text{Al}_6\text{Si}_6\text{O}_{24}](\text{CO}_3)_2 \cdot 2\text{H}_2\text{O}$. An aluminosilicate present in **Bayer red mud**. It is formed when lime is added at the digestion stage of the **Bayer process** and the waste product reacts with carbon dioxide on standing. (2) A mineral family with the general formula: $3\text{Na}[\text{AlSiO}_4] \cdot \text{R} \cdot (\text{CO}_3, \text{SO}_4, \text{Cl}, \text{OH}) \cdot x\text{H}_2\text{O}$, where R is Na, K, or Ca.

cancrinite hydrate. *Noun.* $\text{Na}_6[\text{Al}_6\text{Si}_6\text{O}_{24}] \cdot 6\text{H}_2\text{O}$. A **faujasite** structure **zeolite** containing some linked $(\text{AlO}_4)^{5-}$ tetrahedra.

candela. cd. *Noun.* The luminous intensity at 90° to a blackbody surface of $1/600,000 \text{ m}^2$ at a temperature of the melting point of platinum at $101,325 \text{ Nm}^{-2}$ (1 atm) pressure. Alternatively it is the **luminous intensity** of a source that emits monochromatic radiation of $540 \times 10^{12} \text{ Hz}$ and has a radiant intensity of 11,683 W per **steradian**.

candle. *Noun.* One-sixtieth the **luminous intensity** of 1 cm^2 of the surface of a blackbody radiator at the melting point of platinum, 2,042 K.

cane. *Noun.* Solid glass rods of small to medium diameter. Also called **rod**.

cane clay. *Noun.* A **fireclay**, sometimes sandy, but less refractory than normal fireclay.

canning. *Noun.* A dish shaped distortion on a flat surface.

cannon pot. *Noun.* A small glass-melting pot or crucible.

cantilever arch. *Noun.* An arch supported by flat projections on opposite walls.

cant strip. *Noun.* A strip placed under the edge of the lowest row of tiles on a roof to give them the same slope as the other tiles.

cap. *Noun.* (1) A type of bottle closure. (2) *Verb.* To cut off the end of a glass cylinder. (3) *Verb.* The act of preparing a strength specimen for testing in which a fluid or mastic material is applied to the ends of the specimen that will be in contact with the testing machine. (4) *Synonym.* Standing for **crown**.

capability. *Noun.* the values of **accuracy**, **repeatability**, **reproducibility** and **stability** combined into a single value for a material or property measurement.

capacitance. C. *Noun.* (1) The property of a system of conductors and **dielectrics** that permits the storage of electrically separated charges when potential differences exist between the conductors. The value is a function of the geometry and the electrical properties of the dielectric and often the operating voltage and frequency. (2) A measure of electric charge storing capability equal to the charge that must be added to raise its electrical potential by one unit. It is simply defined as the charge stored on either plate divided by the applied voltage.

capacitance unbalance. *Noun.* The difference in capacitance of two insulated conductors to the shield, expressed as a percentage of the capacitance between the conductors or in percent unbalance.

capacitor. *Noun.* A device consisting of conductive or semi conductive plates separated by a dielectric, and which stores electric charge to give capacitance. Formerly called **condenser**. They charge very rapidly but have low power densities. New oxide systems have fast charge and high power densities, see **psuedocapacitors**.

capacitor code. *Noun.* A way of specifying size and temperature standards for capacitors as defined by the Electronic Industries Association. The size is given as "llww" where ll is length and ww is width in thousands of an inch, e.g., 0607 means $0.06 \times 0.07 \text{ in}$. Temperature characteristics are defined by a temperature range code, for example X7 and Y5, which means -55 to $+25^\circ\text{C}$ and -30 to $+85^\circ\text{C}$ respectively. There is also a temperature tolerance code: R means $\pm 15\%$ and V means $+22, -88\%$. Hence X7R means ceramic capacitors stable to $\pm 15\%$ in the temperature range -55 to $+25^\circ\text{C}$.

capacitor colour code. *Noun.* A series of coloured rings on ceramic capacitors that record the **temperature coefficient**, **capacitance**, and **tolerance** of the device. Black is the lowest value and white the highest on a scale 1–9. The ring nearest the left-hand side gives the temperature coefficient, the next two rings give the first and second significant figure of capacitance in picofarads, the fourth ring gives the multiplier, and the fifth ring gives the tolerance. See **Table A.8**.

capacity. *Noun.* (1) The cubic content or volume that can be contained by a receptacle or a porous substance. (2) The ability of a material to yield, withstand, or perform. (3) For a dry cell it is the amount of charge, expressed as ampere-hours, Ah, that can be withdrawn from a fully charged battery under standard conditions.

capacity, electrode material. *Noun.* See **electrode material capacity**.

capacity, insulation. *Noun.* See **insulation capacity**.

capillarity. *Noun.* The ability of a brick or other fired ceramic product to conduct liquids through its pore structure by the force of surface tension.

capillary. *Noun.* A tube having a very small internal diameter and thick wall.

capillary drying. *Verb.* The progressive removal of moisture from a porous solid by surface evaporation followed by the capillary movement of more moisture to the drying surface until the core and surface of the solid are of the same moisture concentration.

capillary tube. *Noun.* A glass tube with thick walls and a very fine bore; used in thermometers.

capillary viscometer. *Noun.* A long narrow tube used to measure the laminar flow of liquids.

capital expenditure. *Noun.* Money spent for long-term improvements, additions, or equipment, and charged to a capital assets account.

capped. *Adjective.* A description of a pellet that **delaminates** during its uniaxial pressing from powder.

cap seat. *Noun.* The ledge inside the mouth of a milk bottle.

capstone. *Noun.* A slab shaped stone on the top of a wall.

carafe. *Noun.* A glass bottle for table use.

carat. c. *Noun.* (1) A measure of the weight of precious stones, 1 carat equals 0.2 g. (2) A measure of gold quality, 24 carat gold is pure gold.

carbell kiln. *Noun.* A furnace built with no doors to reduce heat loss; it is lifted vertically, having no bottom, and placed over loaded kiln cars.

carbides. *Noun.* (1) A binary compound of carbon with other elements. Classified according to the predominant atomic bonding present: ionic, e.g., CaC_2 ; covalent, e.g., SiC ; mixed ionic + covalent + metallic, e.g., WC , TiC . Carbides are characterised by high melting points. Mohs hardness values of 8–9, low impact strength, high electrical and thermal conductivities, and high moduli of elasticity. They are used in grinding wheels, grinding belts and papers, electrical-resistance heating elements for kilns and furnaces, drill bits, sawteeth, wire-drawing dies, balls for the tips of ballpoint pens, and similar applications where thermal and wear resistance are important, and as fibres in high-strength composites. (2) A cemented or compacted mixture of carbides used for metal-cutting and machining tools

carbide fuel. *Noun.* An oxidation-resistant, high-strength, refractory composition prepared from a fissile fuel metal such as uranium, thorium, plutonium, combined with carbon e.g., UC .

carbide tool. *Noun.* A high-heat and wear-resistant cutting and machining tool made from the carbides of tantalum, titanium, or tungsten bonded by cobalt metal. Also called **refractory hard metals**.

Carbofrax. *Trade name, noun.* A commercial refractory **silicon carbide** used in refractory cements, refractory brick, and shapes for furnace walls, domes, **checkers**, radiant tubes, hearths etc., where temperatures are severe.

carbon. C. *Noun.* A polymorphic element whose properties vary widely with form. Sublimes above $3,500^\circ\text{C}$; density (**amorphous**) about $2,000\text{ kg m}^{-3}$, (**graphite**) $2,250\text{ kg m}^{-3}$, (**diamond**) $3,500\text{ kg m}^{-3}$. See **buckyballs**, **graphene**, **carbon nanotubes**, and **fullerene**.

carbonaceous deposits. *Noun.* Particles of carbon or a material with substantial carbon content usually occurring as a contaminant in or on the surface of a body or other substance from **pyrolysis** of carbonaceous materials.

carbon, activated. *Noun.* See **activated carbon**.

carbonado. *Noun.* (1) An inferior dark variety of diamond used for polishing and drilling. It is a mechanically bonded form of diamond arising from severe physical conditions causing pre-formed crystals to become joined and full of mechanical twins. Impurities causing colour are often trapped within the mechanically formed boundaries. (2) Polycrystalline **CVD** grown diamond films that are deposited rapidly so that they contain small amounts of **graphite** at grain boundaries. Used in heat dissipation applications where use is made of the high thermal conductivity of the diamond. Also called **black diamond**.

carbon arc. *Noun.* An electric discharge produced between two carbon electrodes.

carbon arc cutting. CAC. *Noun.* The use of an intensely hot plasma maintained between two carbon electrodes to cut and shape hard materials, such as ceramics, by melting and ablation.

carbonate. *Noun.* (1) Salt or ester of carbonic acid. (2) In ceramic usage, a salt consisting of a metallic element in combination with a $[\text{CO}_3]^{2-}$ radical, e.g., BaCO_3 , CaCO_3 , K_2CO_3 , and Na_2CO_3 , used as a convenient source of metal oxides in ceramic bodies as they decompose to release carbon dioxide.

carbonation. *Noun.* The attack by carbon dioxide gas on cement and concrete structures which leads to their loss of strength and coherence. It leads to a lowering of pH as Ca(OH)_2 is turned to CaCO_3 and so is sometimes called **neutralisation**.

carbonatites. *Plural noun.* Igneous rocks that are more than 50 % carbonate minerals, such as **calcite**, crystallised from mantle melts that provide minable niobium ore and a source of the **rare earths**.

carbon black. *Noun.* Any of various colloidal black substances consisting essentially of elemental carbon prepared by partial combustion or thermal decomposition of hydrocarbons.

carbon black structure. *Noun.* The degree or state of **agglomeration** of particles in **carbon black**.

carbon brush. *Noun.* A small block of carbon used to make electrical connection between the stationary and moving parts of an electric motor, dynamo etc.

carbon-carbon composite. *Noun.* A composite consisting of **continuous strand** carbon fibres embedded in a carbon matrix. The matrix is most commonly derived

from a polymer resin that has been subsequently **pyrolysed**. Another common structure consists of woven carbon fibre preform infiltrated with **graphitic carbon** to produce the carbon fibre-carbon matrix composite. Retains useful properties up to 2,760 °C.

carbon-ceramic refractory. *Noun.* A refractory product composed of a mixture of carbon or **graphite** and one or more refractory ceramic materials, such as **fireclay** or **silicon carbide**.

carbon cloth reinforced plastic. *Noun.* Shapes are cut from a fabric made from woven carbon fibres and they are then impregnated with a two component thermosetting compound and then compressed and heated.

carbon-14 dating. *Verb.* Dating artefacts by means of radioactivity.

carbon deposition. *Verb.* (1) When firing traditional ceramics the deposition of **amorphous carbon**, resulting from the decomposition of carbon monoxide into carbon dioxide and carbon within a critical temperature range. When deposited within the pores of a refractory brick, the carbon may provide subsequent local oxidation resistance. (2) The use of hydrocarbon gases, heat, and plasmas to provide hard protective layers on a substrate.

carbon dioxide. *Noun.* CO₂. A heavy colourless, odourless gas; a source of defects when formed by the thermal decomposition of carbonaceous impurities in bodies and coatings.

carbon dioxide bonding. *Noun.* A bonding process for foundry sands and **cores** in which formed mixtures of a refractory and **sodium silicate** are exposed to carbon dioxide.

carbonette. *Noun.* A ball of compressed coal dust used as fuel.

carbon fibre. *Noun.* Pyrolysed organic fibres of originally 93–95 % carbon by elemental analysis, which produces fibres that are 99+ % carbon. Fibre differences arise from heat treatment temperatures: carbon fibre is **polyacrylonitrile** pyrolysed to 1,350 °C whereas graphite fibre is **pyrolysed** to 2,450 °C.

carbon fibre paper. *Noun.* A paper produced by draining a slurry of carbon fibres through a moving mesh. The resulting web is pressed and heated to tissues and felts, 20 or 250 g⁻², suitable for composite formation.

carbon-film resistor. *Noun.* A resistor consisting of a film of carbon deposited on a ceramic form.

carbon, granular activated. *Noun.* See **granular activated carbon**.

carbon, graphitic. *Noun.* See **graphitic carbon**.

carbon, green. *Noun.* See **green carbon**.

carbonic. *Adjective.* Containing tetravalent carbon or carbon in general.

carboniferous. *Adjective.* Yielding carbon.

carbonific. *Adjective.* A chemical compound that on decomposition produces a carbon mass occupying a volume greater than the original un-**pyrolysed** material.

carbonise. *Verb.* (1) To convert to carbon by heating in the absence of air. (2) See **carburise**.

carbon, manufactured. *Noun.* See **manufactured carbon**.

carbon microphone. *Noun.* A microphone that uses a diaphragm that picks up sound waves and oscillates against a pack of carbon granules or a block of carbon through which an electric current is flowing. The changes in pressure change the resistance of the carbon which modulates the current at the frequency of the applied sound waves.

carbon nanoposts. *Noun.* Carbon structures projecting from the pores of anodic **aluminium oxide**. Depositing **pyrolytic carbon** in the porous nano-channels of an anodic aluminium oxide substrate makes an array of such posts. The posts stand proud of the channels by some 60 nm and are 50 nm in cross-section. When inverted the arrays can be used to stamp a nanodot array onto a substrate.

carbon nanotubes. *Plural noun.* Forms of carbon that are nanoscale **graphene** cylinders closed at each end by half a **fullerene**. Structures with one cylinder are called **single-walled nanotubes** (SWNT's) and **multi-wall nanotubes** (MWNT's) contain two or more concentric graphene cylinders.

carbon nitride. *Noun.* C₃N. A **graphitic** material made by reacting chlorine with pyridine at 700 °C. It is thought that pressure and temperature may transform it to β-C₃N₄, a potential super-hard material.

carbon nitride, amorphous. *Noun.* See **amorphous carbon nitride**.

carbon onions. *Noun.* **Hyperfullerenes** composed of concentric fullerene shells.

carbon refractory. *Noun.* A refractory product composed substantially or entirely of carbon or graphite, or both; used in crucibles, stopper nozzles in steel-making furnaces, etc.

carbon, retort. *Noun.* See **retort carbon**.

carbon steel. *Noun.* Steel whose properties are largely determined by the amount of carbon it contains.

Carborundum. *Trade name, noun.* Various abrasives, refractories, and similar products of **silicon carbide**, **fused alumina**, and other materials; employed as abrasive grains and powders for cutting, grinding, and polishing, grinding wheels and stones, rubbing bricks, coated abrasives, tiles, antiskid tiles and treads, refractory grains, and as a semiconductor.

- carborundum stone.** *Noun.* A **silicon carbide** whetstone used to remove pinpoints, and other imperfections from ware. Also used to sharpen knives and tools.
- carboxides.** *Noun.* A category of composite **cutting tools** formed from carbides dispersed in oxide matrices; see **black hot-pressed ceramic**.
- carboxylate-alumoxanes.** *Plural noun.* Solubilised aluminium oxide nanoparticles made by reacting **boehmite** with organic carboxylic acids in water. They are chemically functionalised nanoparticles in the range 5–150 nm depending on the organic component.
- carboxymethylcellulose. CMC.** *Noun.* Employed as a binder, thickener, and suspension agent in porcelain-enamel and glaze slips.
- carboy.** *Noun.* A large, specially cushioned glass container of 18.9–56.8 l capacity for liquids, especially acids.
- carbuncle.** *Noun.* (1) A rounded gemstone, usually a grey garnet, cut without facets. (2) *Adjective.* A dark-reddy-brown colour.
- carburet.** *Verb trans.* To mix a gas with carbon or carbon compounds.
- carburettor.** *Noun.* A refractory-lined apparatus or chamber in which oils are vaporised, cracked, and enriched in the manufacture of carburetted water gas.
- carburiise.** *Verb.* Synonym for **carbonise** sense (2); to increase the carbon content of the surface layers of metals or alloys, especially iron and steel, usually by diffusion from the surrounding environment. See **pack carburising**.
- carcinogen.** *Noun.* An agent that can incite cancerous growth.
- card.** *Verb.* To untangle and straighten fibres by passing them between closely spaced surfaces, moving at different speeds, one of which is covered in sharp points.
- car drier.** *Noun.* A drier in or through which ware is transported on cars.
- CARE.** *Acronym.* Stands for ceramic application in reciprocating engines.
- car, kiln.** *Noun.* See **kiln car**.
- Carman-Kozeny equation.** *Noun.* An expression relating the **slip casting** rate and **permeability** of the cast body: $L^3/t = kp$, where L is the cast thickness, t is the cast time, p is the permeability and k is a constant.
- carallite.** *Noun.* A mineral of ideal composition $KMgCl_3 \cdot 6H_2O$; occurs as granular masses; bitter taste, soluble in water. Density $1,600 \text{ kg m}^{-3}$; hardness (Mohs) 2.5.
- carnegieite.** *Noun.* $NaAlSiO_4$. An artificial mineral similar to **feldspar**; Mp $1,526^\circ\text{C}$.
- carnotite.** *Noun.* $K_2(UO_2)_2(VO_4)_2 \cdot nH_2O$. A radioactive vanadate mineral that is a source of uranium and vanadium.
- Caro's acid.** *Noun.* A colloquial name for **peroxysulphuric acid**.
- carpuncle.** *Noun.* An **earthenware** vessel.
- carrageen.** *Noun.* An **Irish moss** from which a syrup is made for use as a siccative or suspension agent for glazes and other slips.
- Carrara marble.** *Noun.* The marble made famous by Michelangelo. Quarried in Tuscany it has few coloured impurities and is very white.
- carrier.** *Noun.* (1) A substance to which a trace element has been added and which will carry the trace element through a desired chemical or physical process for a particular purpose. (2) Electrons, **holes**, or ions capable of mobility in a potential gradient.
- carrier fluid.** *Noun.* The fluid in which fluorescent and nonfluorescent magnetic particles or other active materials are suspended to facilitate their application for testing purposes.
- carrier gas.** *Noun.* (1) An inert gas that is used to sweep gaseous products through an analysis system, but not included in the analysis. (2) The gas that transmits powder from one point to another, as from a **spray gun**. (3) An inert gas transporting reactants in **CVD** processes.
- carry-in.** *Verb.* To manually load a **lehr**.
- cartoon.** *Noun.* A drawing or sketch used as a model for a product.
- car top.** *Noun.* The refractory surface of a tunnel-kiln car.
- cartouch.** *Noun.* A carved or cast ornamental panel in the form of a scroll.
- cartridge.** *Noun.* An electromechanical transducer, usually containing a **piezoelectric ceramic**, in the head of a gramophone. Also called **crystal cartridge**.
- cartridge heater.** *Noun.* Electrical heater for **injection moulds** and **injection nozzles**.
- car tunnel kiln.** *Noun.* A long kiln, with the firing zone located near the centre, through which ware is transported by means of **kiln cars**.
- caryatid.** *Noun.* A column in the form of a draped female figure.
- cascade.** *Noun.* (1) The downward flow of particles over one another in a manner resembling a waterfall. (2) Slip cast moulds stacked above each other. (3) A consecutive sequence of physical or chemical processes. (4) A set of electrical components connected in series.

cascade pulveriser. *Noun.* An apparatus in which crushing and grinding are accomplished by the tumbling action of large lumps of a material on other particles of the same material.

case. *Noun.* The outer layer of a substance that is substantially harder than its core.

cased glass. *Noun.* (1) Glassware having a surface composition different from the glass body. (2) Glass composed of two or more layers of different colours.

case hardening. *Verb.* A process of hardening a substance so that the surface layer or **case** is made substantially harder than the interior or core. For steel a carburising or nitriding process in order to improve wear and fatigue resistance usually achieves this.

casein. *Noun.* Precipitated milk protein used as a bonding agent in sand moulding.

casement wall. *Noun.* (1) The entire sidewall of a furnace between the flux block and the **crown**, excluding the ends. (2) A refractory wall between pillars of a **pot furnace** situated in front of or surrounding the front of a pot.

case mould. *Noun.* A mould replica of an original model used to make a working mould.

casserole. *Noun.* A lidded cooking dish of glass, pottery, etc.

casiterite. *Noun.* SnO_2 . Tin dioxide or tin ore. Crystal structure tetragonal. A mineral associated with silica rich rocks like **pegmatite**; yellow, black, or brown in colour. Density 6,800–8,100 kg m^{-3} ; hardness (Mohs) 6–7. Also called **tinestone**.

Cassius purple. *Noun.* A precipitated pigment, obtained by mixing the chlorides of gold and tin; used in glazes at low and medium firing temperatures.

cast. *Verb.* (1) To form a liquid or plastic mass into a specific shape by setting or by cooling in a mould. (2) *Noun.* An object formed by casting.

castable. *Noun.* A combination of refractory grains and a suitable bonding agent, usually an **acid phosphate**, which, after the addition of a proper liquid, is usually poured or sprayed into place to form a refractory shape or structure which becomes rigid by chemical action; used in the construction and repair of furnaces, **cupolas**, and similar applications.

castable refractory. *Noun.* A hydraulic-setting refractory suitable for casting into shapes and usually bonded with aluminous cement or **aluminium phosphates**.

caster. *Noun.* A bottle with a perforated top for spreading granules and powders.

cast glass. *Noun.* Glass developed for use in large castings such as telescopes, architectural features and art pieces.

casting. *Noun.* (1) A process of shaping glass by pouring the molten material into or onto moulds, tables, or rolls. (2) The process of pouring a molten substance into a suitable mould and allowing it to solidify. (3) An item produced by a casting process. (4) *Verb.* To form ceramic ware by pouring a body **slip** into a porous mould which absorbs sufficient water from the slip to produce a semi-rigid article.

casting, drain. *Noun.* See **drain casting**.

casting, fusion. *Noun.* See **fusion casting**.

casting, hollow. *Noun.* See **drain casting**.

casting, investment. *Noun.* See **investment casting**.

casting ladle. *Noun.* A refractory-lined steel ladle used to transport molten steel from one location to another, and from which molten steel is poured into moulds.

casting plaster. *Noun.* A white **gypsum** product used in making castings and carvings.

casting, pressure. *Noun.* See **pressure casting**.

casting, refractory. *Noun.* See **refractory casting**.

casting refractories. *Noun.* Refractories of special shapes in which molten metals are cast.

casting shrinkage. *Noun.* Reduction of the volume of the cast material from beginning to end of the solidification.

casting slip. *Noun.* A slurry of properly formulated ceramic bodies that are shaped by pouring into appropriate moulds.

casting, slip. *Noun.* See **slip casting**.

casting, solid. *Noun.* See **solid casting**.

casting spot. *Noun.* A surface defect appearing as a discoloured, vitrified spot on the surface of cast pottery, the defect frequently being formed when improperly **deflocculated** clay makes contact with the mould.

casting strain. *Noun.* Strains that are developed in a cast body during cooling.

casting stress. *Noun.* Stresses, which develop in a casting as a result of **casting strain**, that is, shrinkage.

casting, wet-ground hollow. *Noun.* See **drain casting**.

cast iron. *Noun.* Any iron-carbon alloy, the carbon content of which is greater than the maximum solubility in **austenite** at the **eutectic temperature**. Commercial cast irons contain between 3.0 and 4.5 wt.% carbon and between 1 and 3 wt.% silicon. Too brittle to shape by processes other than melting and casting into moulds.

cast-iron enamel. *Noun.* A porcelain-enamel compounded specifically for use on cast iron.

cast-iron enamelling. *Verb.* See **dry process enamelling**; **wetprocess porcelain-enamelling**.

castor. *Noun.* A glass or ceramic bottle with a perforated top for sprinkling powder.

cast stone. *Noun.* A moulded concrete building block shaped to resemble natural stone and usually faced with material resembling natural stone.

cataclasis. *Noun.* Deformation by crushing and shearing.

catalysis. *Noun.* The change in the rate of a chemical reaction brought about by the presence of a substance which itself is unchanged at the completion of the reaction.

catalyst. *Noun.* A substance which, by its presence, will change the rate of a chemical reaction but which itself will be unchanged in composition or quantity after the reaction is completed.

cataphoresis. *Noun.* The movement of suspended particles through a fluid by an electromotive force. Another name for **electrophoresis**.

catch basin. *Noun.* A reservoir in to which water from a process is drained to permit solids to settle for subsequent recovery or disposal.

catch-scan acoustic microscopy. *Noun.* A reflection-mode acoustic microimaging technique used to scan areas of planar section in a ceramic. A 2–200 MHz transducer scans the solid switching thousands of times per second between pulsing ultrasound in and collecting the return echoes from which the acoustic image is generated in a linked computer.

CATE. *Acronym.* Standing for ceramic applications in turbine engines.

catenary. *Noun.* (1) The difference in lengths of the **filaments** in a given **tow** as a result of uneven tension. (2) A curve with the shape of a suspended chain from two points of equal height.

catenary arch. *Noun.* A sprung-type arch in the form of an inverted **catenary**, the curve formed by a chain suspended from two points of equal height, the resultant arch exhibiting minimal stresses.

cat eye. *Noun.* An imperfection in glass consisting of an elongated bubble containing a particle of foreign matter.

cathedral glass. *Noun.* An unpolished, translucent sheet glass, usually formed by rolling, with one surface sometimes textured.

Catherine wheel. *Noun.* A circular window with ribs radiating from the centre.

cathode. *Noun.* (1) The negative terminal of an electrical system and so is the electrode that receives electrons from an external circuit and is the electrode at which

reduction reactions occur. (2) The negative terminal of a **diode** biased in the forward direction. (3) The primary source of electrons in an electron tube. (4) The positively charged pole of a storage battery or **primary cell**.

cathode arc. *Noun.* An arc occurring when the contact spacing exceeds a certain critical value, depending on the contact material and current. Material transfer is from cathode to anode.

cathode drop. *Noun.* The potential difference between the cathode and the electric discharge plasma. Also called **cathode fall**.

cathode fall. *Noun.* See **cathode drop**.

cathode material transfer. *Noun.* The movement of contact metal from the cathode by means of a cathode arc.

cathodoluminescence. *Noun.* The emission of light from material under electron beam irradiation. The beam causes electron-hole pairs to form in numbers given by $E/3E_g$, where E is the electron beam energy and E_g is the width of the energy band gap. When the electrons and holes recombine, photons are emitted that give light containing information on the impurities in the material. See **oxide phosphors**.

cation. *Noun.* A positively charged atom; the ion in an electrolyte that migrates to the cathode.

cation adsorption. *Noun.* In clays, the adsorption of cations either on basal surfaces where negative charges occur, possibly as a result of **isomorphous replacements** within the crystal, or adsorption on prism surfaces where unsatisfied negative bonds may occur, or both; basal surface adsorption predominates in **three-layer clays**, while edge adsorption predominates in **kaolin clays**.

cation exchange. *Noun.* A surface property exhibited by **colloidal** inorganic materials, such as clays, whereby surface ions are replaced by other ions present in the surrounding medium.

cation exchange capacity. *Noun.* A measure of the ability of a substance, such as clay, to adsorb or exchange cations, usually expressed in terms of milliequivalents of cations per 100 g of dry substance.

cationic. *Adjective.* Having a positive charge and will move toward a cathode in an electrolysed solution.

catolyte. *Noun.* The part of the **electrolyte** that surrounds the cathode.

cat scratch. *Noun.* A surface imperfection on glassware consisting of marks resembling a scratch by the claws of a cat.

cat's-eye. *Noun.* A greenish-yellow variety of **chrysoberyl**, which reflects a streak as in the **cabochon** cut.

Catseye. *Trade name, noun.* A spherical glass bead approximately 1 cm diameter set in a protective rubber coat and laid into roads, which by a process of total internal reflection acts as a road-marker at night.

Cauchy equation. *Noun.* See **dispersion curve**, **Cauchy light-dispersion formula**.

Cauchy light-dispersion formula. *Noun.* The index of refraction of a medium, n , as a function of wavelength, λ , is expressed by the equation: $n = A + (B/\lambda^2)$, in which A and B are constant.

cauliflower structure. *Noun.* See **high burn-up structure**.

cauliflower ware. *Noun.* Cream-coloured ware moulded to resemble the appearance and surface configuration of a cauliflower.

caulking. *Noun.* A material used to make a seam or joint airtight, watertight, or steam-tight. (2) *Verb.* To force a suitably pliable material or compound into a seam or joint.

caustic. *Adjective.* (1) Capable of corroding by chemical action. (2) A caustic substance which is now usually taken to be an **alkali**.

caustic lime. *Noun.* **Calcium hydroxide**, $\text{Ca}(\text{OH})_2$. Used in mortars, plasters, and cements where it is a vital component in the setting process. Loses water at 580°C ; density $2,340\text{ kg m}^{-3}$.

caustic potash. *Noun.* See **potassium hydroxide**.

caustic soda. *Noun.* See **sodium hydroxide**.

cave. *Noun.* A pit under a glass furnace where the fire is located.

cavetto. *Noun.* A concave moulding.

cavitation. *Noun.* (1) Pitting or erosion of concrete, as when exposed to high-velocity turbulent flow of water. (2) The collapse of ultrasonically induced bubbles on surfaces leading to localised very high pressures and temperatures; See **cavity**. (3) The formation of cavities in a structure.

cavity. *Noun.* (1) Small bubble which grows and contracts at the surface of a solid; caused by ultrasound in a liquid. Growth rate always exceeds contraction rate and so a critical size is reached after which it implodes. Implosion causes very high, highly localised, temperatures, up to $5,500^\circ\text{C}$, with cooling rates of the order of $10^9^\circ\text{C s}^{-1}$. This produces physical effects, such as cleaning and hardening, on surfaces and is known as **cavitation**. (2) In extrusion processes it is the mould into which the clay, glass or other extrudates is forced.

cavity block. *Noun.* A precast concrete block that contains central cavities.

cavity oscillator. *Noun.* A type of radio-frequency generator construction in which all elements including the valve are densely packed inside a conducting surface in

which an oscillating electromagnetic field can be maintained; the dimensions of the cavity determine the resonant frequency of the oscillations and can be used to obtain frequencies in excess of 300 MHz and so it is used in microwave devices. Also called **cavity resonator**.

cavity quantum electrodynamics. QED. *Noun.* The study of the optical properties of emitters, such as isolated atoms confined in structures in which light of certain frequencies is allowed. Such an isolated atom is called a **quantum dot** and the confining structure is often a semiconducting ceramic.

cavity resonator. *Noun.* See **cavity oscillator**.

cavity wall. *Noun.* A wall constructed in two adjacent sections with an air space between to provide thermal insulation.

cavo-relievo. *Noun.* A relief sculpture in which the highest point on the carving is below the original surface level of the clay, ceramic, or stone.

cay. *Noun.* A small bank or low-lying island composed of **sand** and **coral**.

CB. *Abbreviation.* Stands for conduction band. See **conduction band**.

c-BN. *Symbol.* Stands for the diamond-type cubic structure modification of **boron nitride**.

CCB's. *Abbreviation.* Stands for coal combustion by-products.

C-C composite. *Abbreviation.* Stands for carbon-carbon composite. See **carbon-carbon composite**.

CCIM. *Abbreviation.* Standing for cold-crucible induction melter. See **cold-crucible induction melter**.

ccp. *Abbreviation.* Stands for cubic close-packed. See **cubic close packed**.

CCPA. *Abbreviation.* Stands for Cemented Carbide Producers Association.

CCRP. *Abbreviation.* Stands for carbon cloth-reinforced plastic. See **carbon cloth-reinforced plastic**.

cd. *Abbreviation.* Stands for candela. See **candela**.

CDW. *Abbreviation.* Stands for charge density wave. See **charge density wave**.

CED. *Abbreviation.* Stands for cohesive energy density. See **cohesive energy density**.

celadon or celadon glaze. *Noun.* A greyish-green, semi-opaque glaze fired in a reducing atmosphere in which reduced iron is the colorant. Sometimes the name of a blue-grey coloured Chinese **porcelain**.

celeste blue. *Noun.* (1) Any of a number of iron-blue pigments, usually containing a considerable quantity of extender, such as **barytes**. (2) A cobalt-blue pigment softened by additions.

celestite. *Noun.* SrSO_4 . An orthorhombic **mineral** ranging in colour from white to red. Used to impart **iridescence** on pottery glazes and glass, and as a **fining** agent in crystal glass. Decomposes at 1,580 °C; density 3,953 kg m⁻³; hardness (Mohs) 3–3.5. Also known as **celestine**.

ceil. *Verb trans.* (1) To cover a ceiling with **plaster**. (2) To make a ceiling for a structure.

celestine. *Noun.* See **celestite**.

celite. *Noun.* (1) **Diatomaceous earth** and products of similar composition composed essentially of (wt.%): **silica** (92.7), **alumina** (3.8), **ferric oxide** (1.4), lime and magnesia (1.0), and potash and soda (0.9 %), and which is used as an ingredient in cements and as an abrasive in glass and metal polishing. (2) A **solid-solution** constituent in **Portland cement clinker** composed of $\text{Ca}_4\text{Al}_2\text{Fe}_2\text{O}_{10}$ and $\text{Ca}_6\text{Al}_4\text{Fe}_2\text{O}_{15}$. These phases help to control the development of $\text{Ca}_3\text{Al}_2\text{O}_6$, which is a deleterious component.

cell. *Noun.* (1) A hollow space enclosed in a **hollow-clay building block** or similar structure having a minimum dimension of not less than 1.25 cm and a cross-sectional area of not less than 6.25 cm². (2) A device for converting chemical energy into electrical energy, usually consisting of two electrodes and an electrolyte enclosed in a container. (3) A dense tangle of **dislocations** in a crystal structure arranged in walls that enclose nearly dislocation free regions of crystal structure.

cell density. *N.* *Noun.* The number of cells per unit area in a **cellular ceramic** catalyst support system; $N = 1/L^2$, where L is the cell repeat distance.

cell furnace. *Noun.* A **glass-tank furnace** in which the glass in the **melting** and **auxiliary zones** is heated electrically.

cellular concrete. *Noun.* A concrete of reduced density and increased insulating properties prepared by the addition of substances, which by chemical reaction, cause the concrete to foam, entrapping gases in the concrete mass.

cellular glass. *Noun.* A foamed glass block or sheet made from a mixture of powdered glass and a gas-forming material heated to the flow temperature of the glass. Also known as **foamed glass**.

cellular membrane. *Noun.* A type of microstructure found in **glass-ceramics** when the developing crystal phase is slightly lower in SiO_2 than the bulk composition so that an SiO_2 glassy film envelops the impinging grains during crystallisation.

cellular solid. *Noun.* A material with a structure of inter-connecting struts or plates that form edges and faces of cells and the cells are packed closely to fill space.

cellular structure strength. *Noun.* See **mechanical integrity factor**.

cellulose gum. *Noun.* Sodium carboxymethylcellulose (CMC); a synthetic gum used in whiteware bodies and glazes as a thickener and binder to improve the **green strength**.

cellulose nitrate. *Noun.* $\text{C}_6\text{H}_5(\text{NO}_2)_3$. Sometimes employed as a binder in conductive and other coatings.

cellulose xanthate. *Noun.* See **viscose**.

celsian. *Noun.* $\text{BaAl}_2\text{Si}_2\text{O}_5$ or $\text{Ba}(\text{Al}_{0.5}\text{Si}_{0.5}\text{O}_2)_4$. Barium **feldspar** sometimes used in refractories for electric furnaces and kilns. Mp 1,780 °C.

Celsius. *Noun.* A temperature scale in which 0° is the freezing point and 100° is the boiling point of water; a synonym for the **centigrade scale** of temperature measurement.

CELSOR. *Trademark, noun.* A **cordierite**-type commercial square cell, **cellular catalyst support** exhibiting linear elastic behaviour up to 1,200 °C; composition in wt.% is MgO (14), Al_2O_3 (35), SiO_2 (51); open porosity 35 %; density 1,680 kg m⁻³; **cell density** 400.

cement. *Noun.* (1) Anhydrous **Portland cement** powder. (2) A generic term for plastic materials having adhesive and cohesive properties and which will harden in place. (3) A fine, grey powder produced from a calcined mixture of **clay** and **limestone** which, when mixed with water, forms a paste that hardens via water reactions into a stone-like mass, and which is the bonding medium in **mortar** and **concrete**. (4) Something that unites or bonds, such as **silica** and **calcite** that bind particles of rock etc.

cement aeration. *Noun.* The effect of the atmosphere, particularly moist air and carbon dioxide, on the storage characteristics and subsequent setting properties of **Portland cement**.

cementation. *Noun.* (1) The process by which individual particles are bonded together by hardening of a binder phase. (2) The process of heating a solid with a powdered ceramic material to modify the properties of the solid as in **case hardening**.

cement, air-setting. *Noun.* See **air-setting cement**.

cement, alumina. *Noun.* See **alumina cement**.

cement brick. *Noun.* A moulded brick of cement and sand formed under pressure and steam cured at 93 °C; used as backing brick.

cemented carbide. *Noun.* A **metal matrix-ceramic composite** of the carbides of the heavy metals, such as tantalum and tungsten, bound together by a low-melting metal, such as cobalt; used in abrasive products, machining and cutting tools, drills, sandblast nozzles, wear-resistant machine parts, tyre studs, hard-facing welding rods, etc., because of toughness, shock resistance, compressive strength, and good thermal conductivity.

cement factor. *Noun.* The cement content of concrete.

cement, fireclay. *Noun.* See **fireclay cement**.

cement, gaize. *Noun.* See **gaize cement**.

cement, grappier. *Noun.* See **grappier cement**.

cement, gravel. *Noun.* See **gravel cement**.

cement gun. *Noun.* (1) A mechanical device employed to place mortar or cement in selected areas. (2) A machine designed to mix, wet, and apply refractory mortars in the walls of hot furnaces and kilns.

cement, high-alumina. *Noun.* See **high-alumina cement**.

cement, high early strength. *Noun.* See **high-early-strength concrete**.

cement, high-temperature. *Noun.* See **high-temperature cement**.

cement, hydraulic. *Noun.* See **hydraulic cement**.

cement, insulating. *Noun.* See **insulating cement**.

cement, iron-ore. *Noun.* See **iron-ore cement**.

cementite. *Noun.* Fe_3C . A hard, brittle iron carbide which will scratch **feldspar** and glass, but not **quartz**; found in certain steels, **cast iron**, and iron-carbon alloys. Forms a microstructure with **ferrite** that is known as **pearlite**. Has an orthorhombic structure and is widely nonstoichiometric.

cementitious. *Adjective.* Possessing cementing properties.

cementitious material. *Noun.* Any material to which a liquid may be added to form a paste having adhesive and cohesive properties and which subsequently will harden into a solid mass.

cement, Keene's. *Noun.* See **Keene's cement**.

cement kiln. *Noun.* A rotary kiln in which **limestone** and **clay** are calcined at $1,550^\circ\text{C}$ to produce **Portland cement** and which is fired from the discharge end at the bottom.

cement-kiln head. *Noun.* The head of the burner and the discharge end of a rotary cement kiln.

cement, Kuhl. *Noun.* See **Kuhl cement**.

cement, lap. *Noun.* See **lap cement**.

cement, lime-slag. *Noun.* See **lime-slag cement**.

cement, low-heat. *Noun.* See **low-heat cement**.

cement, magnesia. *Noun.* See **magnesia cement**.

cement, masonry. *Noun.* See **masonry cement**.

cement mill. *Noun.* A mill in which rock is pulverised to powder form for use primarily in the production of cement.

cement mortar. *Noun.* A plastic mixture consisting of one part of **Portland cement**, three parts of sand, and a small amount of **lime**, all blended in water.

cement, natural. *Noun.* See **natural cement**.

cement, neat. *Noun.* See **neat cement**.

cement notation. *Noun.* Oxides present in cement compositions are given simple one-letter symbols, e.g., $\text{C}=\text{CaO}$, $\text{A}=\text{Al}_2\text{O}_3$, $\text{S}=\text{SiO}_2$, so that Ca_2SiO_4 is C_2S .

cement paint. *Noun.* A mixture of **Portland cement**, filler, **accelerator**, water repellent, and water, employed as a waterproof coating for concrete, brickwork, and other masonry surfaces.

cement, Parian. *Noun.* See **Parian cement**.

cement paste. *Noun.* A plastic mixture of **Portland cement** and water only.

cement, patching. *Noun.* See **patching cement**.

cement plaster. *Noun.* A **gypsum** plaster used in mortar for plastering interior surfaces.

cement, polymeric. *Noun.* See **polymeric cement**.

cement, Portland. *Noun.* See **Portland cement**.

cement, Portland blast-furnace slag. *Noun.* See **Portland blast-furnace slag cement**.

cement, Portland-pozzolan. *Noun.* See **Portland-pozzolan cement**.

cement, Potter's red. *Noun.* See **Potter's red cement**.

cement pump. *Noun.* A device designed to move plastic concrete from one location to another.

cement, reaction. *Noun.* See **reaction cement**.

cement, refractory. *Noun.* See **refractory cement**.

cement, refractory patching. *Noun.* See **refractory patching cement**.

cement rock. *Noun.* An **argillaceous limestone** containing lime, silica, alumina, and magnesia used in the manufacture of **Portland cement**.

cement sand. *Noun.* A sand well suited for mixing with **Portland cement**.

cement, silica. *Noun.* See **silica cement**.

cement silo. *Noun.* A large structure or silo in which dry, bulk powdered cement is stored for subsequent use.

cement, slag. *Noun.* See **slag cement**.

cement, Slater's. *Noun.* See **Slater's cement**.

cement, soil. *Noun.* See **soil cement**.

cement, Sorel. *Noun.* See **Sorel cement**.

cement, sulphoaluminate. *Noun.* See **sulphoaluminate cement**.

cement, tarras. *Noun.* See **tarras cement**.

cement, waterproof. *Noun.* See **waterproof concrete**.

cement, white. *Noun.* See **white cement**.

cem-fil. *Trademark, noun.* A glass fibre of high, 20 wt.% ZrO_2 content, developed to withstand the alkaline environment in hydrated **ordinary Portland cement** in order to use it as a fibre reinforcement for **mortar** and concrete.

CEMFIL. *Trade name, acronym.* Stands for a composite consisting of **ordinary Portland cement** and **cem-fil** glass fibres.

cenosphere. *Noun.* A hollow sphere; derived from *kenos* (hollow) and *sphaira* (sphere) and used to describe a lightweight, inert hollow sphere of **silica** and/or **alumina** formed as a firing product in coal fired furnaces. With a density less than $1,000 \text{ kg m}^{-3}$ cenospheres are separated from other by-products by water floatation. Used to make lightweight concretes, insulating materials, expanded clays and as an extender for plastics.

centigrade. $^{\circ}\text{C}$. *Noun.* A temperature scale in which 0° is the freezing point and 100° is the boiling point of water; a synonym for the **Celsius** scale of temperature measurement.

centipoise. **cP.** *Noun.* 10^{-2} of a **poise**, the old **cgs** unit of viscosity, which equals 10^{-3} Nsm^{-2} .

centistoke. **cSt.** 10^{-2} of a **stoke** which is the unit of kinematic viscosity. It equals the viscosity in **poise** divided by the density, in grams cm^{-3} , times 10^2 .

centre. *Verb.* To force a ball of clay into a centred position on a **potter's wheel**.

centre brick. *Noun.* A special, hollow, refractory shape with opening at the top and along the sides through which bottom-poured molten steel is directed from guide tubes to **ingot moulds**.

centre-hole lapping. *Verb.* To clean and finish centre holes by **lapping** with abrasive grains.

centreless grinding. *Verb.* To grind the inside or outside diameter of a cylindrical piece which is supported on a work blade instead of being held between centres and which is rotated by a so-called regulating wheel.

centre line average. **CLA.** *Noun.* An indication of surface roughness.

centre of gravity. *Noun.* The point through which the gravitational forces on a body always acts.

centre of mass. *Noun.* The point at which the mass of a system could be concentrated without affecting its behaviour under external linear forces.

centre of pressure. *Noun.* The point on a plane surface, immersed in a fluid, at which the resultant pressure on the surface may be taken to act. If the surface is horizontal the centre of pressure coincides with the centre of gravity; otherwise it is below the centre of gravity but gets nearer to it as the liquid depth increases.

centre-reinforced grinding wheel. *Noun.* A grinding wheel in to which steel rings have been incorporated near the centre to provide additional strength.

centres. *Noun.* Conical steel pins of a grinding machine on which a work piece is centred and rotated during grinding.

centring. *Noun.* The operation on lens elements wherein the element is optically lined up with the axis of rotation and the edges are ground concentric with the **optical axis**.

central-field approximation. *Noun.* In this approximation, each electron in an atom moves under the action of a spherically symmetric electric field caused by the nucleus and all the other electrons. In this approximation, the **quantum state** of each electron is identified by the four quantum numbers n , l , m , and s .

central-mixed concrete. *Noun.* Concrete that is mixed in a stationary mixer in a central plant and then delivered in agitators to the job site.

centrifugal casting. *Verb.* To cast bodies in rapidly spinning moulds as a means of producing bodies and shapes of high density.

centrifugal pipe. *Noun.* Concrete pipe manufactured by spinning the concrete mix in a horizontal **form** and so forcing the concrete to the interior rim of the form by centrifugal force.

centrifugal refiner. *Noun.* The third stage of the **RAMAR** modular glass melting process where the residual gaseous inclusions are removed by centripetal force.

centrifuge. *Noun.* A mechanical device rotating at very high speed employed to separate particles of varying density

Ceraborex. *Trademark, noun.* A composite of zirconium boride, ZrB_2 , in an iron or steel matrix.

ceramagnet. *Abbreviation.* Stands for ceramic magnet. A **ferrimagnet** composed of $\text{BaFe}_{12}\text{O}_{19}$.

ceramal. *Acronym.* Comes from (Ceram)ic and (al)loy and is another name for **cermet**. A term sometimes used to identify mixtures or composites of ceramics and metals.

ceramicist. *Noun.* See **ceramics**.

ceramic. *Noun.* (1) Any of a class of inorganic, nonmetallic products which are subjected to a temperature of 540°C

or above during manufacture or use, including metallic **oxides, borides, carbides, or nitrides**, and mixtures or compounds of such materials. Until recent times the term was mostly concerned with hard, brittle materials made by firing clay. (2) An object made from such materials. (3) *Adjective*. Pertaining to ceramics or to the manufacture or use of ceramic processes, articles, materials, technology, and science. from the Greek *keramos* meaning pottery clay.

ceramic aggregate. *Noun*. Concrete containing porous clay or lumps of ceramic material.

ceramic amplifier. *Noun*. An amplifier using **piezoelectric semiconductors** of ceramic compositions.

ceramic armour. *Noun*. An armour system designed to defeat specific threats and which contains ceramic elements.

ceramic article. *Noun*. An article having a glazed or unglazed body of crystalline or partly crystalline structure, or of glass, which body is produced essentially from inorganic, non-metallic materials and either is formed from a molten mass that solidifies on cooling, or is formed and simultaneously or subsequently matured by the action of heat.

ceramic bond. *Noun*. The mechanical and physical strength developed in a ceramic body by a heat treatment that causes the adhesion of adjacent particles.

ceramic capacitor. *Noun*. A capacitor whose **dielectric** is a ceramic material.

ceramic-carbon refractory. *Noun*. A manufactured refractory composed of carbon, including graphite, and one or more ceramic materials, such as **fireclay** and **silicon carbide**.

ceramic cartridge. *Noun*. A **piezoelectric ceramic** used in microphones, record player cartridges, and similar elements.

ceramic coating. *Noun*. An inorganic, non-metallic coating bonded to a substrate by firing, e.g., a glaze.

ceramic coating on metal. *Noun*. An inorganic, protective coating bonded to a metallic substrate and suitable for use at or above a red heat.

ceramic colorant. *Noun*. An inorganic material employed to impart colour to a porcelain-enamel, glaze, glass, or ceramic body.

ceramic colour glaze. *Noun*. An opaque coloured glass of satiny or glossy finish obtained by spraying a clay body with a compound or mixture of metallic oxides, chemicals, and clays, which is fired at a sufficiently high temperature to form a fused coating inseparable from the body.

ceramic corridor. *Noun*. An area of New York State containing a high density of high-technology ceramic producers and research centres.

ceramic fibre. *Noun*. A filament formed from a ceramic material for use in lightweight units for electrical, thermal, and sound insulation, high-temperature filtration, reinforcement, and packing. High-strength and high-modulus materials, e.g., SiC, Al₂O₃ are used.

ceramic filter. *Noun*. (1) A fired ceramic of selected porosity through which a fluid is passed to separate out matter in suspension. (2) A ceramic or glass composition employed to suppress waves or oscillations of certain frequencies.

ceramics, fine. *Noun*. See **fine ceramics**.

ceramic foams. *Plural noun*. A class of materials with pores that form open or closed cells within a solid ceramic phase. Characterised by low relative density, high **permeability** for open cell forms, high surface area and limited mechanical strength. The relationship between foam strength and relative density is given by the Gibson-Asbby equation: $\sigma/\sigma_0 = c(\rho/\rho_0)^{3/2}$, where σ is the strength of the foam, σ_0 is the strength of the ceramic struts that make-up the foam lattice, c is a constant, ρ is the **bulk density** of the foam and ρ_0 is the density of the ceramic struts.

ceramic fuel elements. *Noun*. Uranium oxide, plutonium oxide, actinide carbides and oxides, etc., employed to form fuel rods for nuclear reactors.

ceramic, glass. *Noun*. See **glass ceramic**.

ceramic glaze. *Noun*. (1) A ceramic coating, glossy or **matte**, matured to a glassy state on a formed ceramic article. (2) The material or composition from which the coating is made.

ceramic hob. *Noun*. A flat cooking surface on an electric cooker made from ceramic or **glass-ceramic** material with an electric heating element fitted to the underneath.

ceramic ink. *Noun*. An ink consisting of a ceramic pigment suspended in a liquid medium, the pigment developing its colour on firing, a dispersant and a resin to provide green strength to the deposit. Used in general ceramic decoration and in the **direct ceramic jet printing** process.

ceramic magnet. *Noun*. A permanent magnet made from pressed and sintered magnetic ceramic powders, such as **barium ferrite, lead ferrite, strontium ferrite, magnesium ferrite**, etc. See **magnetic ceramics**.

ceramic-matrix composite. CMC. *Noun*. A composite where both the matrix and the dispersed phase are ceramic materials. The dispersed phase is added to improve the fracture toughness as well as increase the strength.

ceramic-metal coating. *Noun*. A mixture of one or more ceramic materials in combination with a metallic phase which may be applied to a metal or non-metallic substrate; the coating may or may not require heat treatment prior to service.

ceramic, metallised. *Noun.* See **metallised ceramic**.

ceramic-metal reaction welding. *Noun.* Thin foils of metal are inserted between two ceramics, e.g., MgO/Pt/MgO and the contact zone is heated to below the melting point of the least refractory component while a small load around 100 kN m^{-2} is applied. This action forms vacuum-tight joints.

ceramic microphone. *Noun.* A microphone in which a **piezoelectric cartridge** is employed.

ceramic-mould casting. *Noun.* A precision casting process in which carbon, low-alloy, and stainless steels are formed in a ceramic mould and fired at a high temperature.

ceramic mosaic tile. *Noun.* An unglazed clay or porcelain tile formed either by **dust pressing** or by plastic forming to 6.35–9.52 mm in thickness having a facial area of less than 38.7 cm^2 ; the tiles are usually mounted on paper sheets approximately $61 \times 30.5 \text{ cm}$ to facilitate setting.

ceramic nuclear fuel. *Noun.* See **ceramic fuel elements**.

ceramic oxide. *Noun.* Any compound of an element or elements with oxygen that has ceramic properties. See **ceramics**, **oxide ceramics**.

ceramic paste. *Noun.* A synonym for **ceramic body**.

ceramic pick-up. *Noun.* A record player pickup employing a **ceramic cartridge**.

ceramic, polarised. *Noun.* See **polarised ceramic**.

ceramic process. *Noun.* The production of articles or coatings from ceramic materials, the article or coating being made permanent and suitable for its intended use by the action of heat at temperatures sufficient to cause sintering, solid-state reactions, bonding, or by whole or partial conversion to the glassy state.

ceramic, rainbow. *Noun.* See **rainbow ceramic**.

ceramic-rod flame spraying. *Noun.* A process in which a ceramic coating is applied to a surface by means of a high-temperature gun that atomises a ceramic rod, delivering and bonding the ceramic to the substrate by an air blast.

ceramics. *Plural noun.* A general term applied to the art or technique of producing articles by a ceramic process, or to articles so produced. A person so employed is a **ceramicist** or **ceramist**.

ceramics, oxide. *Noun.* See **oxide ceramics**.

ceramics, reticulated. *Plural noun.* See **reticulated ceramics**.

ceramics, solution. *Noun.* See **solution ceramics**.

ceramic steel. *Noun.* Ceramic alloys containing metastable **tetragonal zirconia** in which, when stress is applied at the front of a crack tip, the t-ZrO_2 becomes monoclinic with a localised volume increase to absorb

energy at the crack front. Since the tetragonal to monoclinic ZrO_2 transformation is **martensitic** there is an analogy with steels that contain iron martensite.

ceramic tile. *Noun.* A ceramic surfacing unit, usually relatively thin, composed of a clay body or a body composed of a mixture of ceramic materials, and having a glazed and unglazed face, which is fired at a temperature sufficiently high to produce desired physical properties and other characteristics; used principally for decorative effects and sanitary purposes.

ceramic-to-metal seal. *Noun.* An airtight seal between a ceramic composition and a metal such as that providing lead-through contacts for electrical and electronic components for use in high-temperature and nuclear environments.

ceramic tools. *Plural noun.* Cutting tools made from sintered or hotpressed metal oxides, carbides, borides, nitrides, etc., often containing additives to promote sintering.

ceramic transducer. *Noun.* A transducer of ceramic composition which depends on the production of an elastic strain in certain asymmetric crystals when an electric field is applied, or which produces a voltage when the crystal is deformed. See **piezoelectricity**.

ceramic tube. *Noun.* An electron tube having a ceramic envelope capable of withstanding operating temperatures in excess of 500°C .

ceramic veneer. *Noun.* Thin sections of ceramic on a surface held in place by the adhesion of a mortar to the unit and backing, or thick sections of ceramic held in place by grout and wire anchors connected to the backing wall.

ceramic whiteware. *Noun.* A fired ware consisting of a glazed or unglazed body which is usually white and of fine texture, such as china, porcelain, semivitreous ware, earthenware, spark plugs, sanitary ware, and the like.

ceraming. *Noun.* The two stage process of nucleating at a moderate temperature and then crystallising at a higher temperature to produce the desired crystals and crystal sizes in the manufacture of **glass ceramics**.

ceramography. *Noun.* The application of optical and electronoptical methods to produce micrographs of polished ceramic surfaces and then the use of standard statistical methods to interpret the structural features observed.

ceramist. *Noun.* See **ceramics**.

ceramoplastic. *Noun.* A ceramic insulating material made by bonding **synthetic mica** and glass.

Cerapear crown. *Noun. Tradename.* A commercial Japanese glass-ceramic used to make crowns for dental restoration. The overall composition is: 45:5:15:35, $\text{CaO}:\text{MgO}:\text{Al}_2\text{O}_3:\text{P}_2\text{O}_5$ and initially crystallises as

oxyapatite, $\text{Ca}_{10}(\text{PO}_4)_6\text{O}$. This phase hydrolyses to **hydroxyapatite** in the mouth fluids.

ceraplast. *Noun*. Reinforced thermoplastic containing ceramic or mineral particles dispersed in the liquid plastic before cooling, each particle first being immersed in a resin to assist bonding to the matrix plastic.

cerargyrite. *Noun*. AgCl . A soft, greyish-yellow ore occurring in arid areas containing cubic crystalline silver chloride as waxy masses of cubic crystals. A source of silver. Density $5,550 \text{ kg m}^{-3}$; hardness (Mohs) 2.5. Also called **horn silver**.

cereal binder. *Noun*. A finely milled flour used as a binder for core mixtures in a casting process. Also called **cereal flour**. See **corn polenta**.

cereal flour. *Noun*. See **cereal binder**.

Cerenkov radiation. *Noun*. Light emitted when a charged particle travels through a transparent material at a velocity greater than light in that medium.

ceria. *Noun*. Alternative ceramic name for **cerium dioxide**.

ceric. *Adjective*. Containing cerium in the tetravalent state.

ceric oxide. *Noun*. See **cerium dioxide**.

cerium boride. *Noun*. (1) CeB_4 . A **network boride**; density $5,740 \text{ kg m}^{-3}$. (2) CeB_6 . Contains B_6 octahedra; Mp $2,190^\circ\text{C}$; density $4,820 \text{ kg m}^{-3}$; hardness (Vickers) 30.82 GN m^{-2} ; low work function material used as an electron source.

cerium carbide. *Noun*. (1) Ce_2C_3 . Ionic carbide containing C_2^{2-} ions; density $6,970 \text{ kg m}^{-3}$. (2) CeC_2 . Mp $2,538^\circ\text{C}$; density $5,560 \text{ kg m}^{-3}$ also an ionic carbide. Both have elements of metallic bonding and react with water to give hydrocarbons. Present in spent UC fuel elements.

cerium dioxide. *Noun*. See **cerium oxide**.

cerium fluoride. *Noun*. CeF_3 . Used in arc carbons to increase the **brilliance** of the arc light. Mp $1,460^\circ\text{C}$; density $6,160 \text{ kg m}^{-3}$.

cerium hydroxide. *Noun*. $\text{Ce}(\text{OH})_3$. Used as an opacifier in porcelain-enamels and glazes, and as a yellow colorant in glass.

cerium nitrate. *Noun*. $\text{Ce}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$. Used in gas mantles where it becomes **ceria**, CeO_2 . Loses $3\text{H}_2\text{O}$ at 150°C ; decomposes at 200°C .

cerium nitride. *Noun*. CeN . Golden with a metallic **lustre** arising from mixed bonding, ionic, covalent and metallic. The Ce is present in Ce III and Ce IV oxidation states plus some N^{3-} defects. Density $8,090 \text{ kg m}^{-3}$.

cerium oxide. *Noun*. (1) CeO_2 . Used as an opacifier in low temperature porcelain-enamels, as a decolouriser and brightener in glass, and as a polishing agent for glass, marble, and optical surfaces; produces a yellow colour in glass when used with **titania**. Mp $1,950^\circ\text{C}$; density $7,650 \text{ kg m}^{-3}$. Also known as **ceria**. (2) Ce_2O_3 . Blue coloured with the **bixbyite** structure.

cerium sulphide. *Noun*. (1) CeS . A rock salt structured non-stoichiometric material with a metallic lustre. Mp $2,540^\circ\text{C}$. (2) Ce_2S_3 . Mp $1,890^\circ\text{C}$. (3) Ce_3S_4 . Mp $2,050^\circ\text{C}$. All three are used for metallurgical melting crucibles for their chemical and thermal resistance properties.

cermet. *Noun*. A composite material composed of two or more intimately mixed but separable phases, of which at least one is ceramic and the other metallic, combining the toughness of metal with the thermal resistance and hardness of the ceramic; formed by mixing, pressing, and sintering. Used in rocket motors, gas turbines, turbojet engines, nuclear reactors, brake linings, etc., and other products requiring high oxidation resistance at elevated temperatures. The most common examples are the **cemented carbides**, which are composed of very hard WC, TiC etc. and cobalt or nickel.

cermet coating. *Noun*. A mixture of one or more ceramic materials with a metallic phase applied to a metallic or non-metallic (for example graphite) substrate, and which may or may not require heat treatment prior to service.

cermet resistor. *Noun*. A resistor consisting of a metal and insulating materials fired on to a ceramic substrate.

cerous. *Adjective*. Containing cerium in the trivalent state.

certificate of test. *Noun*. A written, printed, or signed document attesting to the validity of a performed test.

certification. *Noun*. A written statement of a materials compliance with set criteria.

cerulean blue. *Noun*. A light blue pigment composed of **cobalt stannate**, $\text{CoO} \cdot n(\text{SnO}_2)$.

ceruse. *Noun*. Another name for white lead. See **white lead**.

cerussite, cerusite. *Noun*. PbCO_3 . A white mineral consisting of orthorhombic **lead carbonate** in the upper layers of a **galena** deposit that has been oxidised. Also known as **white lead ore**.

CF. *Abbreviation*. Stands for: (1) Continuous filament when describing ceramic fibre. See **continuous filament**. (2) Carbon fibre. See **carbon fibre**.

CF glass. *Noun*. **Continuous filament glass yarn** used to make glass fabric.

CFRP. *Abbreviation.* Stands for carbon fibre reinforced plastic. See **carbon fibre reinforced plastic**.

CFQD. *Abbreviation.* Stands for cadmium-free quantum dot. See **cadmium-free quantum dot**.

C-glass. *Noun.* A glass composition chosen for fibre manufacture where the fibre has to be chemically resistant: SiO_2 (64.6 %), Al_2O_3 (4.1), CaO (13.4), MgO (3.3), $\text{Na}_2\text{O} + \text{K}_2\text{O}$ (9.6), B_2O_3 (4.7), and BaO (0.9).

egs units. *Noun.* A system of units based on the centimetre, gram and second. Now replaced for technical and scientific purposes by **SI units**.

chabazite. *Noun.* $\text{CaAl}_2\text{Si}_4\text{O}_{12} \cdot 6\text{H}_2\text{O}$. An aluminosilicate zeolite commonly found in crevices in basaltic lavas as **drusy crystal** aggregates; hexagonal crystal system; pink, white or colourless.

chaffing fatigue. *Noun.* Surface fatigue initiated by rubbing against another material.

chain, air. *Noun.* See **air chain**.

chain conveyor. *Noun.* A conveyor consisting of one or two endless chains, equipped with appropriate hooks or crossbars for the movement of materials from one location to another.

chain grate. *Noun.* A mechanical furnace stoker in which the grate, in the form of an endless chain, draws the solid fuel into the furnace as it rotates.

chain marks. *Noun.* Marks made on the bottom of glass articles as they ride through a **lehr** on a slightly overheated chain belt.

chair. *Noun.* A team of glassblowers consisting of: gatherer, **servitor**, footmaker, **maker** or **gaffer**, and **boy**.

chalcantinite. *Noun.* A naturally occurring form of **copper sulphate**.

chalcedony. *Noun.* SiO_2 . A **cryptocrystalline** form of silica, often grey in colour with crystals arranged in parallel fibres. **Cornelian**, **onyx**, **agate** and **chrysoprase** are all forms of chalcedony. Density 2,600–2,650 kg m^{-3} ; hardness (Mohs) 6.5–7.0.

chalcocite. *Noun.* Cu_2S . Copper sulphide, a major ore of copper of orthorhombic crystal type below 105 °C; a precursor of **malachite** and **azurite**. Hardness (Mohs) 2.5–3; density 5,770 kg m^{-3} .

chalcogenide glass. *Noun.* A glass containing sulphur, selenium, polonium, or tellurium, and which is used in glass switches; usually very dark coloured but transmits infrared radiation.

chalcopyrites. *Noun.* CuFeS_2 . Copper ore. A widely distributed yellow-red mineral of tetragonal crystal structure. Also called **copper pyrites**.

chalk. *Noun.* CaCO_3 . Employed as a source of **lime** or substitute for **limestone** in ceramic bodies, glazes, porcelain-enamels, glass, cements, and polishing powders, and as a medium- and high-temperature flux. Decomposes at 825 °C; density 2,700–2,950 kg m^{-3} .

chalkboard enamel. *Noun.* A porcelain-enamel having a matte, slightly roughened surface on which writing with **chalk** may be done; sometimes called **blackboard enamel**.

chalked. *Adjective.* A condition occurring on porcelain-enamelled surfaces and glazes wherein the coating has lost its natural gloss and has become powdery; the powder may or may not be strongly bonded to the surface. Also known as **chalky**.

chalk pit. *Noun.* A quarry for chalk. Another name for **limestone quarry**.

chalky. *Adjective.* See **chalked**.

chalybeate. *Adjective.* Containing or impregnated with iron ions.

chalybite. *Noun.* See **siderite**.

chamber, combustion. *Noun.* See **combustion chamber**.

chamber, drawing. *Noun.* See **drawing chamber**.

chamber drier. *Noun.* A drier of one or more compartments into which freshly formed ware is placed and dried under reasonably controlled conditions of time, temperature, humidity, and air flow.

chamber kiln. *Noun.* A kiln consisting of one or more compartments into which ware is set on appropriate refractory shapes and fired.

chamber oven. *Noun.* A refractory-lined structure in which gas is produced primarily from coal.

chambersite. *Noun.* An iron containing phase of the natural **boracite**, $\text{Mg}_3\text{B}_7\text{O}_{13}\text{Cl}$.

chamfer. *Noun.* (1) A narrow flat surface at the corner of a **paver**, etc., especially one at an angle of 45. (2) A bevelled surface cut onto a sharp edge.

chamosite. *Noun.* $(\text{Fe}_{10}\text{Al}_2)(\text{Si}_3\text{Al}_2)\text{O}_{20}(\text{OH})_{16}$. **Chlorite**-type clay with good vitrifying properties. Used in brick making. It is a common constituent of carboniferous shales and glacial clays.

chamotte. *Noun.* A **grog** produced by firing refractory clay for use as a non-plastic component in refractory compositions.

champlevé. *Noun.* French for raised field. A form of porcelain-enamelled ware in which a design is engraved or carved into the surface of the base metal, frequently copper, gold, or other soft metal; thin, raised divider strips are carved or tacked in place to outline various features of the design; porcelain-enamels of selected

colours are placed in the various compartments and fired to produce artistic effects.

channel. *Noun.* The section of a **forehearth** that carries molten glass from the **tank** to the **flow spout**, and in which adjustments in temperature are made. Also known as **feeder channel**.

channel, feeder. *Noun.* See **channel**.

channelling. *Noun.* The greater flow of fluid through passages of lower resistance as may occur in fixed beds or columns of **activated carbon** or other granular materials due to non-uniform packing, irregular sizes and shapes of the particles, gas pockets, wall effects, or other causes.

chaplet. *Noun.* (1) The metal support holding a ceramic core in place in a moulding. (2) A narrow convex moulding in the form of a string of beads.

char. *Noun.* Carbonaceous material formed by incomplete combustion.

charcoal. *Noun.* A porous solid produced by burning carbonaceous materials such as wood, peat, coal, and cellulosic materials in an absence of air to produce a product containing 85–90 % of carbon. Used as an absorbent, in reducing ores and as a fuel.

charge. Q. *Noun.* (1) A glass-forming mixture or batch ready for injection into a smelter or glass-melting tank. (2) A load of ware placed in a furnace or kiln to be fired. (3) A property of some elementary particles that causes them to exert forces on each other. The natural unit of negative charge is that possessed by the electron while the proton has an equal amount of positive charge; unlike charges attract each other.

charge carrier. *Noun.* A mobile conduction electron or mobile **hole** in a **semiconductor** or ion in a conducting oxide etc.

charge density. *Noun.* The electric charge per unit volume of a body or per unit area of a surface.

charge density wave. CDW. *Noun.* The phenomenon of electron-lattice interaction in a cooperative way to change crystal symmetry. Electrons or holes are trapped in clusters, which prevents e^- to e^- interactions to form **Cooper pairs** that are necessary for **superconductivity**.

charger, batch. *Noun.* See **batch charger**.

charging. *Verb.* (1) To place ware in a furnace or kiln. (2) To introduce a batch in a smelter or **glass-melting tank**.

Charlton photoceramic process. *Noun.* A photographic process in which a photosensitive emulsion is applied to a ceramic surface and exposed to a negative in such a manner as to produce a positive image which subsequently is fired on the item.

Charpy impact test. *Noun.* An impact test used to measure the impact energy or notch toughness of a standard

notched specimen. A freely swinging pendulum is permitted to strike and break a notched specimen laid loosely on a support; the position of the pendulum before release is compared with the position to which it swings after breaking the specimen.

chase. *Noun.* The part of the mould that contains the cavity.

chassis. *Noun.* In electronics it is the mounting for the circuit components of an electrical or electronic device.

chatoyancy. *Noun.* A blue glow in reflected light caused by compositional planes in **plagioclase feldspars** giving interference bands. **Labradorite** is particularly prized for its chatoyancy.

chatoyant. *Adjective.* (1) Twinkling, having changeable **lustre**. (2) In some crystals and gems, showing a band of light reflected off inclusions, such as another mineral.

chatter. *Noun.* An undesirable repetitive pattern created on the surface of a work-piece, usually at regularly spaced intervals, due to an out-of-round or out-of-balance condition in the abrasive machine. Also called **chatter mark**.

chatter mark. *Noun.* (1) Surface imperfections on work being ground, usually caused by vibrations transferred from the wheel-work interface during grinding. (2) Grooves on the surface of a rock made by glacial movement.

check. *Verb trans.* (1) To crack or cause to crack. (2) To mark with a pattern of squares or crossed lines. (3) *Noun.* An imperfection consisting of a fracture in the surface of a glass article penetrating into the body; normally more than 6 mm long.

checker. *Noun, verb trans.* (1) Open lattice refractory brickwork in furnace flues to extract the heat from effluent flue gases and then to heat incoming gases on the next cycle. See **regeneration**. (2) American spelling of chequer. See **chequer** and **chequerboard**.

checking. *Noun.* See **chequing**.

check, pressure. *Noun.* See **pressure check**.

cheeks. *Noun.* The refractory sidewalls of the ports of a fuel-fired furnace.

cheese. *Noun.* A cylindrical block of **ceramic fibre**, particularly **glass fibre**, ready for use with a **rove** depositor or for delivering **strand** for chopping. During winding to make a cheese the traverse length may be progressively reduced to produce tapered or rounded ends; such packages are called **tapered** or **biconical cheeses**.

cheese hard. *Adjective.* The degree of hardness of a freshly formed ceramic body at which the plastic shape may be handled without deformation.

cheese, biconical. *Noun.* See **cheese**.

cheese, tapered. *Noun.* See **cheese**.

chemical adsorption. *Noun.* The process by which an **adsorbate** is bound to the surface of a solid by forces approximating those of a chemical bond. Also called **chemisorption**.

chemical assay. *Noun.* A chemical measurement of the quantity of one or more components in a material.

chemical bond. *Noun.* A model describing the interaction of electron waves (**orbitals**), centred on individual atoms, which result in a mutual decrease in energy and so maintain atoms in groups as molecules and solids. Four extremes of the model are described: **covalent**, **ionic**, **metallic**, and **van der Waals**.

chemical brick. *Noun.* See **chemical stoneware**.

chemical calibration. *Noun.* The use of a standard chemical analysis, such as gravimetric or titrimetric analysis, to check and calibrate an instrumental method of analysis.

chemical durability. *Noun.* The physical and chemical lasting quality of a product in terms of chemical and physical changes in the product surface or changes in the total composition of the body.

chemical etching. *Verb.* (1) To form a characteristic surface texture when a polished glass surface is immersed in corrosive reagents. (2) To use reactive solutions to reveal grain boundaries and other microstructural features in polished ceramic specimens.

chemical glass. *Noun.* A **chemically durable** glass suitable for use in laboratory and production equipment subjected to hostile materials or environments. Usually contains a high **boric oxide**, B_2O_3 , content.

chemical jet stabilisation. *Noun.* A technique to enable very low viscosity molten jets to become stable fibres by extruding them into atmospheres containing hydrocarbon gases that decompose on the fibre surface to give a layer of carbon that encapsulate the fibre.

chemically bonded brick. *Noun.* Brick manufactured by processes in which mechanical strength is developed by chemical bonding agents instead of by firing.

chemically bound mat. *Noun.* **Chopped strand fibres** covered with powdered resin and heated to consolidate the shape. Such mats are used in **hand lay-up** composite manufacture.

chemically combined water. *Noun.* Water that is chemically a part of a **clay mineral** as hydroxyl ions and can be released only upon dissociation of the clay at or about red heat.

chemically strengthened glass. *Noun.* Glass treated by an ion exchange process to produce a surface layer of high compressive stress.

chemical polishing. *Verb.* To clean a surface to a **lustre** by means of a chemical treatment.

chemical porcelain. *Noun.* Vitreous ceramic whiteware containers of high chemical and physical durability in which chemicals are contained, reacted, or transported.

chemical potential. μ_i . *Noun.* A thermodynamic state function measuring the change in the **Gibbs free energy** for a system where the chemical composition or amount of material in the system changes: $\mu_i = (\partial G / \partial n_i)_{T,P,n_j}$, where the subscripts, T, P, n_j represent constant temperature, pressure and concentration of the other components in the solution. **Standard chemical potentials**, μ_i° , are given in terms of the pure element in its most stable form and values at other concentrations are given by equations of the form: $\mu_i = \mu_i^\circ + RT \ln(a_i)$, where a_i is the **activity** or concentration of the element. Hence chemical potential represents the reactivity of the species in the solution of interest.

chemical reprocessing. *Verb.* (1) To separate and recover unused source and newly formed nuclear material contained in irradiated reactor fuel elements. (2) To recover valuable components from used materials, wastes, and materials of low concentration by chemical processing.

chemical resistance. *Noun.* The ability of a product to resist chemical attack, decomposition, solution, or other chemical change when in contact with gaseous, liquid, or solid substances encountered in service environments.

chemical-resistant concrete. *Noun.* A type of **Portland cement** of high tetracalcium aluminoferrite and low tricalcium aluminate content plus additions such as calcium soaps, **water glass** and other materials that render the product resistant to chemicals.

chemical separation. *Noun.* The removal, isolation, or separation of a desired substance from the remainder of a sample by chemical techniques as opposed to physical or mechanical separations.

chemical stoneware. *Noun.* A ceramic product highly resistant to acids, alkalies, and other chemicals made essentially from **lime-** and iron-free clays, and of relatively low sand content, such bodies exhibit low firing shrinkage, low water absorption (0.4 %); density 2,200 kg m⁻³; ultimate tensile strength of 13.8 MN m⁻², ultimate compressive strength of 552 MN m⁻², and a modulus of rupture of 34.5 MN m⁻², the values being approximate.

chemical toughening. *Noun.* A method of making **toughened glass** by immersing it in a molten salt at a temperature below the transformation range so that ion exchange between glass and melt produces compressive surface stresses.

chemical vapour deposition. CVD. *Noun.* A manufacturing technique much used in the electroceramic, semiconductor and superconductor industries in which

reactive gases are caused to react at low pressure on a heated substrate surface. An alternative is to condense the reaction products from the dilute reactant gases onto the substrate. Fabrication speed is in the range 10^{-8} to 10^{-5} m min⁻¹ of product thickness. Only thin films can realistically be formed, from 10^{-6} to 10^{-3} m thick.

chemical vapour infiltration. *Noun.* A technique used to prepare **ceramic matrix composites** when a chemical vapour process is used to deposit a matrix ceramic onto and into voids and pores of ceramic fibre preforms.

chemical vapour transport. *CVT. Noun.* The use of volatile molecules to transport metal atoms to sites where they can react to form a ceramic layer etc.

chemiluminescence. *Noun.* The emission of non-incandescent light during a chemical reaction.

chemisorption. *Noun.* The binding of an adsorbate to the surface of a solid by forces exhibiting energy levels approximating those of a chemical bond.

chequer. *Noun.* (1) A pattern consisting of squares of different colours, textures or materials. (2) *Verb trans.* To make irregular in colour, texture or material. American spelling **checker**.

chequerboard. *Noun.* Open brickwork in a chequerboard regenerator allowing passage of hot spent gases. See **chequerboard regenerator**. American spelling is **checkerboard**

chequerboard regenerator, chequer work. *Noun.* An open chequerboard arrangement of firebrick in a high-temperature chamber that absorbs heat during a processing cycle and releases it to preheat fresh combustion air during the down cycle.

chequer-brick, chequers. *Noun.* Refractory brick of special design to permit the passage of hot gases through a **chequerboard regenerator**.

chequers. *Plural noun.* (1) The firebrick, alternating with openings, in the chambers of a regenerative furnace to permit the flow of hot air to the combustion chamber. (2) Regenerators constructed in such a fashion. (3) The refractory pieces used in such a manner. American spelling is **checkers**.

chequer work, basket weave. *Noun.* See **basket-weave chequer work**.

chequing, checking. *Noun.* (1) Cracking or crazing of ceramic bodies or glazes. (2) Crazing or cracking of cast-iron porcelain-enamels resulting from cracks in the ground coat. (3) Tearing on the surface of an extruded shape.

chert. *Noun.* A broad group of sedimentary rocks containing a fine-grained variety of silica or quartz. Varieties include **flint**, **lyddite** and **hornstone** by which name chert is also known.

chessylite. *Noun.* See **azurite**.

chest knife. *Noun.* A tool for removing the **moil** from hand-blown glassware.

cheval glass. *Noun.* A full length swivelling mirror.

Cheverel phases. *Plural noun.* Ternary molybdenum sulphide and selenide compounds containing metal clusters of Mo-Mo bonded groups: $M_x MoS_8$, $M_x Mo_6 Se_8$, $Mo_9 Se_{11}$ and $MMoS_3$ are some examples.

Chevron notch test. *Noun.* Used to measure the **fracture toughness** of fibres.

chiastolite. *Noun.* A type of inclusion found in some minerals where the included phase is non-crystalline but is oriented along certain directions, such as carbon along $\langle 110 \rangle$ in **andalusite**. Also called **macle**.

chilling. *Verb.* To rapidly remove heat from a body or product after firing by means of a cold-air blast, water spray, immersion in water or other liquid, etc. See **quenching**.

chill mark. *Noun.* A wrinkled surface on glassware as a result of uneven cooling during the forming operation.

chimie douce. *Noun.* Literally soft or gentle chemistry; a series of powder synthesis methods starting from solid precursors or molecular precursors, such as **sol-gel**. It uses **topochemical reactions** in which the final product retains a memory of the precursor structure.

chimney. *Noun.* (1) A vertical structure, frequently made from bricks, enclosing a flue for carrying off smoke and exhaust gases. (2) A narrow glass tube placed around a flame to shield it from draughts.

chimney arch. *Noun.* An arch in the base of a chimney used to admit a flue.

chimney breast. *Noun.* The walls that surround the base of a chimney.

chimney pot. *Noun.* A pipe, usually made from **earthenware**, at the top of a **chimney**.

chimney stack. *Noun.* (1) A brickwork or masonry chimney rising above a roof and containing several **flues**. (2) A very tall chimney serving a factory.

china. *Noun.* A vitreous ceramic whiteware, glazed or unglazed, such as **dinnerware**, **sanitary ware**, **art-ware**, and other products of nontechnical use.

china, Belleek. *Noun.* See **Belleek china**.

china, bone. *Noun.* See **bone china**.

china clay. *Noun.* Refractory clay consisting of minerals of the **kaolin** family which fires to a white or nearly white colour.

china, frit. *Noun.* See **frit china**.

chinagraph. *Noun.* A pencil that will write on glass and **china**.

China ink. *Noun.* See **India ink**.

china, ironstone. *Noun.* See **ironstone china**.

china process. *Noun.* A process of manufacturing glazed dinnerware, sanitary ware, artware, and the like by which a ceramic body is fired to maturity, following which a glaze is usually applied and fired at a lower temperature.

china sanitary ware. *Noun.* Glazed, vitrified **whiteware** designed for sanitary functions.

china, semivitreous. *Noun.* See **semivitreous china**.

china stone. *Noun.* (1) A weathered kaolinised granitic-type stone containing **plagioclase** sometimes used as a **flux** in pottery and **earthenware** bodies. See **petuntse**. (2) Types of **limestone** having a very fine grain and smooth texture.

china, vitreous. *Noun.* See **vitreous china**.

chinaware. *Noun.* Objects made of **china**.

Chinese blue. *Noun.* A black mineral aggregate containing hydrated oxides of manganese and cobalt used for underglaze porcelain blue colours. Also known as **Chinese cobalt**.

Chinese cobalt. *Noun.* See **Chinese blue**.

Chinese red. *Noun.* Various red and orange colours produced by mixtures of **lead chromate**, PbCrO_4 , and **lead oxide**, in different proportions. Also known as **chrome red**.

Chinese white. *Noun.* White **zinc oxide**; used in paints. Also called **zinc white**. See **zincite**.

chinoiserie. *Noun.* A decoration that copies Chinese features or motifs.

chip. *Verb.* (1) To break-off a fragment from an otherwise regular surface, particularly along an edge or corner. (2) *Noun.* A tiny semiconductor mounted on an appropriate substrate to form a **diode**, **transistor**, or similar device.

chipped glass. *Noun.* An intentionally chipped surface on a glass article.

chipping. *Verb.* (1) To remove thin sections or fins of extra glass from glass articles prior to grinding. (2) A defect in porcelain-enamelled ware in which fragments of the fired coating are broken away from the surface. (3) Fragments unintentionally broken from a body, glaze, or glass.

chipping, spontaneous. *Noun.* See **spontaneous spalling**.

chiral CNT. *Noun.* See **carbon nanotubes**.

chirality vector. C. *Noun.* The method used to relate the circumference of a **SWNT** to its structure and properties. $C = [n.a_1 + m.a_2]$, where a_1 and a_2 are unit vectors of

the **graphene** lattice. The two integers, n and m , represent the structure. If $n-m=3i$, where i is an integer, the **SWNT** is a metallic conductor; if $n-m$ does not equal $3i$ it is a semiconductor.

chi square test. *Noun.* A statistical test used to compare the goodness of fit of theoretical and observed frequency distributions and to test hypotheses.

chittering. *Noun.* Small ruptures occurring along the edges or rims of ceramic ware as a result of improper **fettling**.

chkalovite. *Noun.* $\text{Na}_2\text{BeSi}_2\text{O}_6$. A naturally occurring silicate with a three-dimensional structure similar to **α -cristobalite** stuffed with Na^+ ions to compensate for the inclusion of BeO_4 tetrahedra for some SiO_4 tetrahedra to form the **beryllosilicate** framework.

chloanthite. *Noun.* NiAs . A nickel ore mined mostly for its nickel content but can be used in developing coloured glazes.

chlorapatite. *Noun.* Mineral **apatite** in which Cl^- predominates as the balancing anion.

chlorhydrol. *Noun.* See **aluminium chlorhydrate**.

chloride of lime. *Noun.* See **bleaching powder**.

chlorite. *Noun.* $(\text{Mg,Fe,Al})_6(\text{Si,Al})_4\text{O}_{10}(\text{OH})_8$. A three-sheet non-expandable **clay mineral** produced by weathering of **pyroxenes** and **amphiboles**. The extra **brucite**, $\text{Mg}(\text{OH})_2$, layer in the structure attracts water to ensure plasticity.

chloroargyrite. *Noun.* AgCl . A secondary mineral greyish-yellow in colour. Also called **horn silver**.

chloroplatinic acid. *Noun.* $\text{H}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$. Employed to produce pleasing grey colour effects in the decoration of high-quality porcelains.

chocolate gauge. *Noun.* See **grinding gauge**.

choke. *Noun.* (1) An imperfection consisting of an insufficient opening in the neck of a glass container. (2) A device designed to prevent the passage of high-frequency current.

choke crushing. *Verb.* To grind materials in a **roll crusher** with the space between the rolls being completely filled with the material to gain the added effect of the particles grinding and wearing on each other.

chondre. *Noun.* One of the small rounded grains that enter into the composition of stony meteorites.

chondrite. *Noun.* A stony meteorite consisting of silicate minerals as aggregated **chondrules**.

chondrodite. *Noun.* $\text{Mg}_5(\text{SiO}_4)\text{F}_2$. The first crystalline phase occurring in **Macor**, a machinable glass-ceramic. It subsequently transforms to **norbergite**, which then reacts with residual glass to produce **fluorophlogopite mica**.

chondrules. *Noun.* One of the small spherical masses of silicate minerals found in **chondrites**.

chondrus. *Noun.* See **Irish moss**.

chopped roving. *Noun.* Strands of **glass filaments** cut to desired length.

chopped strand fibre. *Noun.* Ceramic fibre used to form composites usually >0.5 mm in length.

chroma. *Noun.* The purity of colour, that is **hue**, determined by its degree of freedom from white or grey; colour intensity. See **Munsell colour classification**.

chromate. *Noun.* A salt of chromic acid containing the CrO_4^{2-} ion; chromates have an orange colour.

chromate red. *Noun.* See **chrome red**.

chromatic. *Adjective.* Of or relating to colour.

chromatic aberration. *Noun.* Production of coloured images produced at the edges of lenses because there the shape gives them the properties of prisms.

chromaticity. *Noun.* The quality of a colour or light with reference to its dominant wavelength and purity.

chromatic value system, Adams. *Noun.* See **Adams chromatic value system**.

chromating. *Verb.* To apply a very thin layer of ceramic magnesium chromate, Mg_2CrO_4 , to magnesium alloy surfaces to make them hard as well as protect them from corrosion. It gives a chocolate-brown finish that is hard to paint over and offers a barrier to galvanic corrosion.

chromatography. *Noun.* The separation of complex solutions or gaseous mixtures into chemically distinct layers by seepage or by percolating through a selectively adsorbing medium.

chrome. *Noun.* A general term for chrome-bearing pigments.

chrome alum. *Noun.* See **chromium potassium sulphate**.

chrome-alumina pink. *Plural noun.* A family of pink ceramic colours consisting of combinations of Cr_2O_3 , Al_2O_3 , and ZnO .

chrome brick. *Noun.* A refractory brick produced substantially or entirely of chrome ore; frequently used as a substitute or replacement for **magnesia brick** in furnaces and kilns because of lower cost, and also, because of their high resistance to chemical reaction with both basic and acidic oxides at elevated temperatures; also used as a spacer between the silica-brick roofs and magnesia brick walls of **open-hearth** and similar furnaces.

chrome cake. *Noun.* A green form of **salt cake**, sodium sulphate, Na_2SO_4 , which contains small amounts of chromium.

chrome glue. *Noun.* Glass cement or a waterproofing agent made by mixing glue with ammonium or **potassium dichromate** or with **chrome alum**.

chrome green. *Noun.* (1) Any of various brilliant green ceramic colorants containing or consisting of **chromic oxide**. (2) A green pigment made by mixing **lead chromate** with **Prussian blue**.

chromel. *Noun.* A series of nickel-chromium alloys, sometimes with additions of iron, used as thermocouples and load-bearing accessories in kilns and furnaces.

chrome-magnesia brick. *Noun.* Two combinations predominate, 70:30 and 60:40 **chrome ore** to **magnesia**. Used in process with variable basicity slags and in particular the acid end ($\text{CaO/SiO}_2 \leq 1$). These bricks were extensively used in **cement kiln** linings prior to anxieties about Cr (IV) materials and health.

chrome-magnesite brick. *Noun.* A burned or unburned refractory brick consisting substantially of **refractory chrome ore** and **dead-burned magnesite** in which the chrome ore is the predominant ingredient by weight.

chrome orange. *Noun.* See **chrome red**.

chrome ore. *Noun.* A refractory ore consisting essentially of chrome-bearing **spinel**s with only minor amounts of accessory minerals, and with properties suitable for making refractory products. Also called **refractory chrome ore**.

chrome oxide. *Noun.* Cr_2O_3 . Produces a range of green colours in glazes and is used to stain clay bodies, porcelains and slips. Also called **chromic oxide**, **chromium sesquioxide** and **chrome green**.

chrome oxide green. *Noun.* A pigment consisting essentially of **chromic oxide**; made by burning **sodium dichromate** with a reducing agent; used in finishes for concrete surfaces; not to be confused with **chrome green**.

chrome red. *Noun.* Pigments containing varying proportions of **lead chromate**, PbCrO_4 and **lead oxide**, PbO to produce colours ranging from light orange to red. Also known as **China red**.

chrome refractory. *Noun.* A refractory product made entirely of chrome ore.

chrome spinel. *Noun.* MgCrO_4 . A natural or synthetic oxide of magnesium, aluminium, and chromium used as a refractory.

chrome tape. *Noun.* Thin plastic tape coated with **chromium dioxide** for use in magnetic recording.

chrome-tin pink. *Noun.* A glaze colorant consisting of **chromic oxide** and **tin oxide** mixed with **lime**.

chrome yellow. *Noun.* A series of yellow pigments composed essentially of **lead chromate** and **lead sulphate**.

chrome-zircon pink. *Noun.* A glaze colorant similar to **chrome-tin pink** but with a substantial portion of the tin oxide replaced by **zircon**.

chromic. *Adjective.* Of or containing chromium in the trivalent state.

chromic acid. *Noun.* (1) Alternative name for chromium trioxide. See **chromium trioxide**. (2) H_2CrO_4 . An unstable oxidising acid only existing in solution from which chromates are made.

chromic oxide. *Noun.* Cr_2O_3 . Chromium sesquioxide; a green coloured basic oxide obtained by heating chromic hydroxide, which is itself obtained by the action of alkalis on chromic salts, such as CrCl_3 . Used as a stable pigment in and on ceramics and as a green, pink, and red colorant in glass, glazes, and porcelain-enamels, and as an ingredient in some refractory bricks. When added to magnesia brick it is called esolite. This oxide is responsible for the non-corrosive behaviour of stainless steel on which it forms a transparent adhesive layer in oxidising environments. Mp 1,990 °C; density 5,040 kg m^{-3} ; hardness (Mohs) 9. Also known as **chrome oxide green** and **chromium oxide**. See **esolite**.

chromite. *Noun.* (1) A mineral composed of the oxides of chromium, iron, aluminium, and magnesium; used in refractories and pigments. (2) FeCr_2O_4 . The only ore of chromium; a **spinel** phase, and the only one used essentially as a refractory; weakly magnetic; used as a grey colorant; density 5,090 kg m^{-3} ; black metallic lustre; hardness (Mohs) 5.5. Also known as **chromite ore**. (3) A salt of chromous acid.

chromite ore. *Noun.* See **chromite**.

chromium anhydride. *Noun.* Alternative name for chromium trioxide. See **chromium trioxide**.

chromium boride. *Noun.* (1) CrB_2 . Poor resistance to oxidation and thermal shock at high temperatures. Mp 2,760 °C; density 5,600 kg m^{-3} ; tensile strength 731 MN m^{-2} ; thermal expansion 4.6×10^{-6} . (2) Cr_2B ; Mp 1,649 °C; density 6,240 kg m^{-3} . (3) Cr_2B ; Mp 1,832 °C; density 6,530 kg m^{-3} . (4) Cr_3B_3 ; Mp 1,899 °C; density 6,120 kg m^{-3} . (5) CrB ; Mp 1,999 °C; density 6,110 kg m^{-3} . (6) Cr_3B_4 ; Mp 1,927 °C; density 5,760 kg m^{-3} . (7) Cr_2B_3 ; Mp 1,999 °C.

chromium carbide. *Noun.* (1) Cr_3C_2 . Employed in bearings, seals, valve seats, jet nozzles and chemical equipment. Mp 1,890 °C; density 6,880 kg m^{-3} . (2) Cr_4C ; Mp 1,521 °C; density 6,990 kg m^{-3} . (3) Cr_7C_3 . An important component in stainless steels. Mp 1,779 °C.

chromium dioxide. *Noun.* CrO_2 . A black oxide with the **rutile** structure and hard-magnetic properties; used as a coating on magnetic tapes.

chromium nitride. *Noun.* CrN . Important in some steels. Decomposes at 1,500 °C; density 6,100 kg m^{-3} ; Vickers hardness 10.8 GN m^{-2} .

chromium oxide. *Noun.* Cr_2O_3 . See **chromic oxide**.

chromium phosphide. *Noun.* (1) CrP_2 ; density 4,500 kg m^{-3} . (2) CrP ; Mp 1,359 °C; density 5,490 kg m^{-3} ; hardness (Vickers) 6.2 GN m^{-2} . (3) Cr_2P . (4) Cr_3P ; density 6,510 kg m^{-3} .

chromium potassium sulphate. *Noun.* $\text{CrK}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$. An **alum** employed as a red or green ceramic colourant.

chromium sesquioxide. *Noun.* See **chromium oxide**.

chromium silicide. *Noun.* (1) Cr_3Si . Mp 1,710 °C; density 6,450 kg m^{-3} ; hardness (Vickers) 9.8 GN m^{-2} . (2) Cr_3Si_2 ; Mp 1,560 °C; density 5,600 kg m^{-3} ; hardness (Vickers) 12.6 GN m^{-2} . (3) CrSi ; Mp 1,543 °C; density 5,430 kg m^{-3} ; hardness (Vickers) 9.8 GN m^{-2} . (4) Cr_2Si_3 . (5) CrSi_2 ; Mp 1,538 °C; density 5,000 kg m^{-3} ; hardness (Vickers) 9.8–15.7 GN m^{-2} . (6) Cr_2Si_7 . Artefacts made from these special ceramics exhibit moderate strength, excellent oxidation resistance, good resistance to thermal shock, poor resistance to impact loading. Used in wear-resistant components for high temperature applications and furnace heating elements.

chromium sulphate. *Noun.* $\text{Cr}_2(\text{SO}_4)_3$. A pigment used in ceramic glazes as a green colorant. Density 3,010 kg m^{-3} .

chromium trioxide. *Noun.* CrO_3 . A low melting point volatile, corrosive source of chromium. Also known as **chromium anhydride**, **chromic acid**.

chromogenic materials. *Noun.* Materials that undergo photochemically induced changes in structure, which causes a significant alteration in their absorption characteristics. They are used in applications such as, optical filters and optical data storage.

chromophore. *Noun.* A group of atoms or ions that cause colour when present in a material.

chryso-. *Combining form.* Indicating the colour of gold.

chrysoberyl. *Noun.* BeAl_2O_4 . A minor spinel structure gemstone but non-gem quality material is used as source of BeO and Al_2O_3 in bodies. Density 3,500–3,800 kg m^{-3} ; hardness (Mohs) 8.5.

chrysocolla. *Noun.* A hydrous copper silicate mineral that is amenable to in-situ leaching with a solution of pH 2 to provide a leachate from which copper can be economically extracted.

chrysolite. *Noun.* Another name for **olivine**.

chrysoprase. *Noun.* A form of **chalcedony**. See **chalcedony**.

chrysotile. *Noun.* $\text{Mg}_3(\text{Si}_2\text{O}_5)(\text{OH})_4$. Known as **white asbestos** it is the principal mineral in commercial asbestos. A silicate in which the sheets have rolled to form tubes.

chuck. *Noun.* A device for holding grinding wheels or special shapes, or the work being ground or shaped.

- chuck-a-muck.** *Noun.* An old device that used the silica in **flint** to cause steel to spark and light a gas stream.
- chuff brick.** *Noun.* A relatively soft, under-fired brick of salmon colour.
- chün glaze.** *Noun.* A thick, high-temperature opalescent glaze often decorated with a splash of red or purple.
- chunk glass.** *Noun.* Optical glass obtained by breaking open the pot in which it has been melted and cooled.
- chunks.** *Plural noun.* Random sized glass sheet that is smaller than standard sizes of work sheets.
- churchwarden.** *Noun.* A long-stemmed tobacco pipe made from clay.
- chute.** *Noun.* A passage or conduit, often inclined, through which objects and free-flowing substances may be conveyed at high velocity.
- chute conveyor.** *Noun.* A channel or series of channels through which the movement of materials is expedited by vigorous vibration.
- chute, grizzly.** *Noun.* See **grizzly chute**.
- CIB ratio.** *Noun.* The ratio of the weight of water absorbed by a masonry unit during immersion in cold water to the weight absorbed during immersion in boiling water; an indication of the probable resistance of brick and similar fireclay products to freezing and thawing.
- CIE.** *Abbreviation.* Stands for Commission Internationale de l'Eclairage. See **colour-order system**.
- CIELAB.** *Acronym, noun.* The most commonly used system of surface colour definition in the ceramics whiteware industry. See **colour-order system**.
- CIGS.** *Acronym.* Stands for copper indium gallium selenide. See **copper indium gallium selenide**.
- CIM.** *Abbreviation.* Stands for computer-integrated manufacture. See **computer-aided manufacture**.
- Ciment Fondu.** *Trademark, noun.* Rapid-hardening refractory cement having a high alumina content composed of 40 % **lime**, 40 % **alumina**, 10 % **silica**, and 10 % impurities. Also called **aluminous cement**.
- cinder.** *Noun.* See **slag**.
- cinder block.** *Noun.* A low density concrete block made of a mixture of cement and **breeze**. See **breeze block**.
- cinder concrete.** *Noun.* A concrete in which **breeze** is employed as the **aggregate**.
- cinder notch.** *Noun.* An opening in the bottom of the wall of a blast furnace to permit the flow of slag from the furnace.
- cinereous.** *Adjective.* (1) resembling or containing ashes. (2) A grey colour.
- cinnabar.** *Noun.* HgS. Mercury ore. A form of mercuric sulphide; red in colour; the principal ore of mercury, which when heated decomposes to give mercury metal. Density 8,050 kg m⁻³; hardness (Mohs) 2–2.5.
- cinnamon stone.** *Noun.* See **hessonite**.
- CIP.** *Abbreviation.* Stands for cold isostatic pressing. See **cold isostatic pressing**.
- Cipollino marble.** *Noun.* A marble showing grey-blue streaks when polished that make it an attractive monumental building material.
- circle brick.** *Noun.* A brick formed as a segment of a circle used in the construction of cylindrical structures.
- circuit breaker.** *Noun.* Device for interrupting a circuit between separable contacts under normal or abnormal conditions; they are ordinarily required to operate only infrequently, although some classes of breakers are suitable for frequent operation.
- circuitry.** *Noun.* (1) The design of an electric circuit. (2) The system of circuits used in an electronic device.
- circular braiding machine.** *Noun.* The most commonly used braiding machine for composite forming, ranging in size from 16 to 144 carriers to produce fabrics from 1 cm to 1 m in diameter.
- circular kiln.** *Noun.* A tunnel kiln constructed in the form of a circle with loading and unloading stations side by side; that is, the entrance and exit of the kiln are in the same location.
- circular magnetic field.** *Noun.* A magnetic field surrounding any electrical conductor or part as a current passes through the conductor, or part, from one end to the other.
- circular measure.** *Noun.* The measurement of an angle in radians.
- circular mil.** *Noun.* A unit of area of cross-section of a fibre, equal to the area of a circle whose diameter is one thousandth of an inch; 1 circular mil = 0.2×10^{-9} m².
- circular polarisation.** *Noun.* A transformation of electromagnetic radiation to a form in which the vector representing the instantaneous intensity of the electric field describes a circle about the direction of propagation at any point in the path of the radiation.
- circular reinforcement.** *Noun.* A circular-shaped line of reinforcement for concrete pipe.
- circulating pump.** *Noun.* A pump employed to move slurries and liquids, which have been processed, back into the process system.
- circulator.** *Noun.* A three part **ferrite** device allowing transmission of energy in only one direction.
- circumferential coil.** *Noun.* An encircling coil used in electromagnetic testing.

circumferential reinforcement. *Noun.* Reinforcing material that is approximately perpendicular to the longitudinal axis of a concrete pipe.

circumfuse. *Verb.* (1) To pour or spread a powder or liquid around. (2) To surround with another substance.

circumvolution. *Noun.* The act of turning, winding, or folding about a central axis.

circ winding. *Noun.* In filament wound-reinforced composites, a winding with filaments perpendicular to the axis.

cire. *Adjective.* A description of a fibre or fabric that has been heat-treated or wax-treated to make it smooth.

cire perdue. *Noun.* An expression for the lost wax process. See **lost wax process**.

CIS. *Acronym.* Stands for copper indium selenide. See **copper indium selenide**.

citrate gel method. *Noun.* A method used to make sub-micron sized, atomically mixed powders of ceramic oxides for processing. Selected nitrates are dissolved in water and the solutions mixed to obtain the desired stoichiometry after which citric acid is added. Concentration of the solution turns it to a gel that is dried under vacuum before heating in the range 300–700 °C to get the oxides.

citrine. *Noun.* A yellow coloured **quartz** crystal that occurs naturally as gem-quality crystals. The colour arises from iron and titanium impurities in the quartz. Also called **yellow quartz**.

cl. *Symbol.* Stands for centilitre.

CLA. *Abbreviation.* Stands for centre line average. See **centre line average**.

clad. *Verb.* (1) To coat, encapsulate, or contain nuclear fuel elements. (2) To enclose or encapsulate a substance or item as a protection against a hostile condition or environment.

cladding. *Noun.* (1) Material used to face the outside of a building. (2) The second component of an **optical fibre**. It is the outer layer of the fibre and must have a **refractive index** slightly less than the core material.

cladding glass. *Noun.* Special glasses used for curtain walls, either coloured or with a coloured coating fused on to the surface during manufacture.

clam. *Noun.* (1) A mixture of clay, sand, and water, or similar composition used to seal the door of a kiln to prevent heat loss during firing. (2) *Verb.* To apply an insulating coating to a kiln door.

clamp. *Noun.* A pile of bricks ready for firing.

clamped relative permittivity. ϵ_{33}/ϵ_0 . *Noun.* The **impedance** transverse to the field direction at frequencies away from the electromechanical resonance in a **piezoelectric ceramic**.

clamping efficiency. *Noun.* See **clamping voltage**.

clamping voltage. *Noun.* A measure of the protective characteristics of a **varistor** defined as the voltage, V_2 , at a given discharge current, I_d ; the protective level, P_L , is defined as V_2/V_1 , where V_1 is the steady operating voltage, and is known as the **clamping efficiency**.

clamp kiln. *Noun.* A periodic, updraft, open-top kiln of semi-permanent construction; similar to a **scove kiln** except that it has walls containing fire arches which are laid up with **scove brick**.

Clapeyron-Clausius equations. *Noun.* A set of equations that define the change with pressure, in the temperature, or vice-versa, at which a material can exist in two forms at equilibrium, for example SiO_2 as α - and β -**quartz**. The basic equation is: $dP/dT = \Delta H^\circ / T \Delta V$, where H , V and T are enthalpy, volume and temperature of the transition; it is applicable to all materials in all states and to all transitions, recrystallisation, melting or evaporation, which gives rise to a family of equations, such as: $\ln(P_2/P_1) = \Delta H^\circ_{\text{vap}} / R [1/T_2 - 1/T_1]$. Hence the set of equations provide a method of predicting changes in **transition temperatures**, vapour pressures etc. and provide a method for finding molecular weights.

clart. *Noun.* A lump of mud and clay.

class A amplifier. *Plural noun.* Electronic amplifiers in which an output current flows for all of the input signal cycle.

class B amplifier. *Plural noun.* Electronic amplifiers in which an output current flows for half of the input signal cycle.

class C amplifier. *Plural noun.* Electronic amplifiers in which an output current flows for less than half of the input signal cycle.

class 1 capacitor. *Plural noun.* A capacitor made from **linear polar dielectric** ceramics, which has a predictable change in capacitance with temperature. Used when good stability and low loss are required; usually Ba, Ca, Mg, Sr and **lanthanide titanates** with **dielectric constants** in the range 5–600. Also known as **temperature compensated capacitors**, TCC.

class 2 capacitor. *Plural noun.* A ceramic capacitor that has a high dielectric constant, in the range 600–6,000, the value of which varies strongly in a non-linear way with temperature; CaZrO_3 , **calcium zirconate** is an example.

class C fly ash. *Noun.* Produced in **lignite**-burning power plants; high **lime** content $\geq 10\%$; has **pozzolanic** properties and is also **cementitious**.

class F fly ash. *Noun.* Produced in power stations burning **anthracite** or bituminous coal; low lime content $\geq 10\%$; high $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ content; unlike **class C fly ash**, it has **pozzolanic** properties only.

classification. *Noun.* The process of improving or changing the gradation of **aggregate** or other substance by screening or other sorting equipment.

classifier. *Noun.* A device for separating mixtures into the constituents according to particle size, density, or other property.

clastic. *Adjective.* Composed of fragments of pre-existing sedimentary rock previously transported from their place of origin before compaction.

clathrate. *Noun.* A solid in which ions and molecules of a substance are physically trapped in the crystal lattice of a host material such as **zeolites**.

Clausius-Mosotti law. *Noun.* The relationship between dielectric constant k , polarisation P , molecular weight M , and density ρ : $P = (k - 1)/(k + 2)[M/\rho]$.

clay. *Noun.* Any of a group of natural mineral aggregates consisting essentially of hydrous aluminium silicates with layered structures which become plastic when sufficiently wetted, rigid when dried en masse, and vitrified when heated to a sufficiently high temperature; used in many ceramics, including **whiteware**, **pottery**, **brick**, **tile**, **stoneware**, **drain tile**, **mortars**, **moulds**, **firebrick**, **cement**, etc.

clay, adsorption anion. *Noun.* See **anion adsorption**.

clay, adsorption cation. *Noun.* See **cation adsorption**.

clay, alluvial. *Noun.* See **alluvial clay**.

clay, arenaceous. *Noun.* See **arenaceous clay**.

clay, ball. *Noun.* See **ball clay**.

clay bank. *Adjective.* A dull brownish-orange colour.

clay, bottling. *Noun.* See **bottling clay**.

clay, Bradford. *Noun.* See **Bradford**.

clay, brick. *Noun.* See **brick clays**.

clay, burley or burley flint. *Noun.* See **burley clay**.

clay, calcareous. *Noun.* See **calcareous clay**.

clay, cation adsorption. *Noun.* See **cation adsorption**.

clay, china. *Noun.* See **china clay**.

clay, clear. *Noun.* See **clear clay**.

clay, crank. *Noun.* See **crank clay**.

clay, diaspore. *Noun.* See **diaspore clay**.

clay, enamel. *Noun.* See **enamel clay**.

clay, expanded. *Noun.* See **expanded clay**.

clay, fat. *Noun.* See **fat clay**.

clay, ferruginous. *Noun.* See **ferruginous clay**.

clay, fire. *Noun.* See **fireclay**.

clay, flint. *Noun.* See **flint clay**.

clay, foamed. *Noun.* See **foamed clay**.

clay, fusible. *Noun.* See **fusible clay**.

clay, glacial. *Noun.* See **sedimentary clays**.

clay, glaze. *Noun.* See **glaze clay**.

clay inclusions. *Noun.* (1) Unreacted clay or other solid material remaining in a porcelain-enamel or glaze after firing; a defect. (2) Earthy inclusions in **mica** that appear in various colours when observed in any type of light.

clay, ironstone. *Noun.* See **ironstone clay**.

clay, lamella. *Noun.* See **lamella clay**.

clay, lean. *Noun.* See **lean clay**.

clay, long. *Noun.* See **long clay**.

clay, marl. *Noun.* See **marl clay**.

claymation. *Noun.* The application of animation techniques to clay models.

clay mineral. *Plural noun.* Any of a large group of minerals containing hydrated **aluminium silicates**.

clay mineral classification. *Noun.* A classification of clay types based on their geological origin. Within the classification are: **ball clay**, usually formed in swamps; **glacial clay**, formed when silt is finely ground by glacial movement; **coal formation clay**, derived from silts in ancient swamps where vegetation has become coalified; **sedimentary clay**; **secondary clay**; **residual clay**; **primary clay**.

clay, mortar-mix. *Noun.* See **mortar-mix clay**.

clay, open. *Noun.* See **open clay**.

clay pan. *Noun.* A layer of impervious clay sited just below the soil level that holds water after heavy rain.

clay, paving brick. *Noun.* See **paving-brick clay**.

clay, pipe. *Noun.* See **pipe clay**.

clay, plastic. *Noun.* See **plastic clay**.

clay, plug. *Noun.* See **plug clay**.

clay, pneumatic. *Noun.* See **pneumatic clay**.

clay, pot. *Noun.* See **pot clay**.

clay, potter's. *Noun.* See **potter's clay**.

clay press. *Noun.* A device that removes water from clay/water slurries by filtering under pressure.

clay, primary. *Noun.* See **primary clay**.

clay, pure. *Noun.* See **pure clay**.

clay, red. *Noun.* See **red clay**.

clay, refractory. *Noun.* See **refractory clay**.

clay, residual. *Noun.* See **residual clay**.

clay, rich. *Noun.* See **rich clay**.

clay, saddle. *Noun.* See **saddle clay**.

clay, sagger. *Noun.* See **sagger clay**.

clay, secondary. *Noun.* See **secondary clay**.

clay, sedimentary. *Noun.* See **sedimentary clay**.

clay, short. *Noun.* See **short clay**.

clay shredder. *Noun.* Equipment designed to chop and fragment plastic clays preparatory to further processing.

clay, slip. *Noun.* See **slip clay**.

claystone. *Noun.* A very fine-grained rock consisting of compacted clay particles.

clay, stove. *Noun.* See **fireclay**.

clay substance. *Noun.* In **foundry sand** mixtures it is the part that fails to settle in a water suspension at a rate of 2.5 cm min^{-1} . It includes **silt** and **clay minerals**.

clay, surface. *Noun.* See **surface clay**.

clay, swelling. *Noun.* See **swelling clay**.

clay, tap-hole. *Noun.* See **tap-hole clay**.

clay tile, natural. *Noun.* See **natural clay tile**.

clay tile, structural. *Noun.* See **structural clay tile**.

clay, treading. *Noun.* See **treading clay**.

clay, top. *Noun.* See **top clay**.

clay, vacuumed. *Noun.* See **vacuumed clay**.

clay, varved. *Noun.* See **varved clay**.

clay, vitrification. *Noun.* See **vitrification clay**.

clay, ware. *Noun.* See **ball clay**.

clay wash. *Noun.* A slurry containing **bentonite** or **fireclay**.

clay, washed. *Noun.* See **washed clay**.

clay-water pastes, yield point. *Noun.* See **yield point**.

clay, white. *Noun.* See **white clay**.

clay, white-hard. *Noun.* See **white-hard clay**.

clay winning. *Noun.* The mining and processing of clay raw materials to make them suitable for subsequent use.

clean. *Adjective.* Free of interfering contamination.

cleanability. *Noun.* The relative ease that soils can be removed from a material, particularly from the surface of the material.

cleaner. *Noun.* A solution, usually alkaline, but sometimes an organic solvent, used to remove oil, grease, drawing compounds, dirt, etc., from a metal surface being prepared for porcelain-enamelling.

cleaning, immersion. *Verb.* See **immersion cleaning**.

clean room processing. *Noun.* Using ultraclean conditions to make and process ceramics in order to achieve trace levels only of impurities; involves air filtering, double skinned room design, and personnel wearing special clothing and gloves.

cleaning, post. *Noun.* See **post cleaning**.

clean-up. *Verb.* To prepare a construction joint or rock foundation to receive concrete in which the surface is scrubbed or sandblasted to remove dirt, laitance oil, and other foreign matter.

clear. *Adjective.* Free of visible defects.

clearance. *Noun.* The gap between two flush surfaces.

clear ceramic glaze. *Noun.* An inseparable, fire-bonded, translucent or tinted glaze having a lustrous finish.

clear ceramic glazed tile. *Noun.* Facing tile having facing surfaces covered by a tinted or translucent glaze with a glossy finish.

clear clay. *Noun.* A **kaolin** clay free of organic and other deleterious impurities.

clear frit. *Noun.* A frit that remains essentially transparent when processed into a porcelain-enamel.

clear glaze. *Noun.* A colourless or tinted transparent ceramic glaze.

clearcole. *Noun.* A form of **whiting** containing **size**.

cleat. *Noun.* (1) A small triangular-shaped nail used in glazing. (2) A main cleavage plane in a coal seam.

cleavage. *Noun.* (1) The tendency of some crystals to break along definite planes when sharply hit. It is described as perfect, good, fair, or poor depending on the regularity of the break. (2) Failure of a composite laminate along a line or plane between layers.

cleavage fracture. *Noun.* A fracture in a polycrystalline material involving transgranular failure by cleavage and not just crack propagation along grain boundaries.

cleavage plane. *Noun.* The surface revealed in a crystal exhibiting cleavage; it is usually a **close-packed plane** of strongly bonded atoms. These planes usually lie parallel to possible crystal faces.

cleave. *Verb.* To split an object along a natural weakness.

cleveite. *Noun.* A crystalline variety of **uraninite**.

climb. *Noun.* A process whereby **edge dislocations** move vertically from their slip planes by interaction with **lattice vacancies**.

clinker. *Noun.* (1) A fused or partly fused by-product of the combustion of coal. (2) Synonym for lava. (3) Synonym for Portland cement clinker. (4) Partially vitrified slag. (5) A type of brick. (6) *Verb.* To shrink or shrivel.

clinker block. *Noun.* See **breeze block**.

clinker brick. *Noun.* A very hard-fired brick of a pale colour whose shape is often distorted or **bloated** due to overfiring to nearly complete **vittrification**. Used originally for pavements in Holland.

clinkering. *Noun.* A process involving **calcining** and **sintering**.

clinkering zone. *Noun.* The high-temperature section of a **cement kiln** where the **clinker** is formed.

clinkstone. *Noun.* A type of **phonolite** that makes a metallic sound when struck.

clino-. *Prefix.* Meaning combining form, slope or inclination.

clinoclore. *Noun.* $(\text{Mg}_{10}\text{Al}_2)(\text{Si}_6\text{Al}_2)\text{O}_{20}(\text{OH})_{16}$. **Chlorite clay** that is a mixed class of **layer silicates** derived from the **talc**, **pyrophyllite** and **brittle mica** group of layer silicates, hence the prefix **clino**. The basic structure is the three-layer talc unit but instead of K^+ ions binding the units there is an intermediate $\text{Mg}(\text{OH})_2$ layer. Large compositional variation as Al^{3+} and Cr^{3+} replace Mg^{2+} in the **brucite** layer. Thermal decomposition occurs in a step-wise **topotactic** fashion in the brucite layers to form **forsterite**, then **spinel** and finally **enstatite**. Excess H_2O associated with the brucite layer means that clinoclore is soft and plastic. Has some use in enamelling frit compositions and as a welding-rod coating. Hardness (Mohs) 2.0–2.5, density 2,600–3,100 kg m^{-3} .

clinoenstatite. *Noun.* One of the three polymorphic forms of **enstatite**, MgSiO_3 . Most commonly found in **glass ceramics** where it is formed from the high-temperature **protoenstatite** by a **martensitic** transformation and the ultrafine lamellae so formed impart considerable **toughness**.

clinoptilolite. *Noun.* $(\text{Na},\text{K})_6(\text{Si},\text{Al})_{36}\text{O}_{72} \cdot 20\text{H}_2\text{O}$. A naturally occurring **zeolite** silicate mineral which selectively binds Cs^+ and so is used in effluent treatment from nuclear fuel processing plants.

clinopyroxene. *Noun.* A member of the **pyroxene** family of minerals with a monoclinic structure; **diopside** is an example.

clinozoisite. *Noun.* $\text{Ca}_2\text{Al}(\text{AlO})\text{OH}(\text{Si}_2\text{O}_7)(\text{SiO}_4)$. An **epidote** silicate with no iron, or only a limited amount, up to an Al/Fe ratio of 9/1.

clinquant. *Noun.* Imitation gold leaf used in some on-glaze decoration.

clintonite. *Noun.* $\text{Ca}(\text{Mg},\text{Al})_3(\text{Al}_3\text{Si})\text{O}_{10}(\text{OH})_2$. A brittle **divalent mica** mineral used in general mica applications.

clip. *Noun.* The portion of a brick cut to a desired or specified length.

clip tile. *Noun.* Tile designed as a base fitting around the flanges of an I-beam.

clobber. *Verb trans.* (1) To paint over existing decoration on pottery. (2) To decorate the ware of another artist or producer without permission.

cloisonné. *Noun.* An art form of porcelain-enamel, pottery, and tile in which differently coloured enamels or glazes are separated by fillets applied along the outlines of a design; for porcelain-enamel, the fillets are wire or thin strips of metal secured to the base metal, while for pottery and tile the fillets consist of a ceramic paste squeezed on the base-body surface through a small-diameter tube.

closed chip. *Noun.* A fractured area on the surface, edge or corner of a piece where the material or coating has not actually broken away from the item.

closed-circuit grinding. *Noun.* A continuous grinding or milling process in which particles of acceptable fineness are removed from the grinding system by a screen or cyclone classifier, while oversized particles are returned to the pulveriser for further processing

closed cycle. *Noun.* A thermodynamic cycle in which the thermodynamic fluid does not enter or leave the system, but is used over and over again.

closed-edge nanoribbon. *Noun.* **Graphene nanotube** thermally treated so that it collapses and becomes a squashed tube i.e. a ribbon but this one has regular smooth edges that allow better control of electronic and chemical properties.

closed mould process. *Noun.* Composite fabrication involving a two-piece mould.

closed pore volume. *Noun.* See **sealed pores**.

closed pot. *Noun.* A glass-melting pot having a **crown** to protect the batch from the combustion gases.

closed system. *Noun.* A system, which is isolated so that it cannot exchange matter or energy with its surroundings and can therefore, attain a state of thermodynamic equilibrium.

closer, king. *Noun.* See **king closer**.

closure strip. *Noun.* A preformed filler strip of **asphalt** or rubber having the same shape and pitch as the **corrugated asbestos-cement product**, and which is used to close openings or joints in the corrugated sheets at window beads, eaves, lower edges of siding, and similar places.

clot. *Noun.* An approximately hand-sized piece of clay used in the **soft mud moulding** brick making process. The clot is coated with sand as a **mould release agent** and thrown into a mould for shaping.

cloth. *Noun.* A firm-textured woven fabric of cotton or linen which is dampened and placed over filter-press cakes, **pugged** clays, and the like to prevent loss of moisture before use.

cloth, wire. *Noun.* See **wire cloth**.

cloverite. *Noun.* A cubic gallophosphate **zeolite** material with a gallium-phosphorus-oxygen network structure containing tunnels with unusual cross-sectional shape, mainly like a cloverleaf, of some 3 nm cross-sectional dimension. The tunnels run in three dimensions and this may confer useful catalytic behaviour.

clustomesogens. *Noun.* A class of compounds that are a class of liquid crystals involving ceramic materials and metal clusters. They have an intense glow when irradiated with red light or infrared radiation.

cm. *Symbol.* Stands for **centimetre**.

CMC. *Abbreviation.* Standing for: (1) ceramic-matrix composite. See **ceramic-matrix composite**. (2) Critical moisture content. See **critical moisture content**. (3) Carboxymethylcellulose. See **carboxymethylcellulose**.

cm Hg. *Abbreviation.* Stands for the pressure unit centimetres of mercury, 76 cm Hg is equivalent to 1 atm pressure.

CMOS. *Acronym.* Stands for complementary metal oxide semiconductor. See **complementary metal oxide semiconductor**.

CMR. *Abbreviation.* Stands for colossal magnetoresistance. See **colossal magnetoresistance**.

CMZP. *Abbreviation.* Stands for calcium magnesium zirconium phosphate. See **calcium magnesium zirconium phosphate**.

CNT. *Abbreviation.* Standing for carbon nanotube. See **carbon nanotubes**.

coacervate. *Noun.* A small domain in a **colloidal suspension** in which the solid particles do not have an ordered arrangement. The opposite of **tactoid**.

co-adsorption. *Verb.* To adsorb two or more components on to activated carbon or similar substance, each component affecting the adsorption of the other.

coagulant. *Noun.* A substance that produces or assists **coagulation**.

coagulate. *Noun.* (1) The product of particles in a **sol** combining as the solvent is removed in such a way that the process is irreversible on addition of extra solvent. (2) *Verb.* To cause a sol or colloid to **agglomerate** or **aggregate** by change in pH, addition of salts or removal of solvent.

coal. *Noun.* A sedimentary black or brown rock formed from the fossilised remains of plants. A fuel and a source of **coke**, **coal tar** and **coal gas**. See **vitritine**.

coal brasses. *Noun.* Inclusions of **iron pyrites** found in some **coal** deposits.

coal, breeze. *Noun.* See **breeze coal**.

coalescence. *Noun.* The physical attraction and merging of particles to form larger particles.

coal formation clay. *Noun.* See **clay mineral classification**.

coal gas. *Noun.* A gaseous mixture produced by the destructive distillation of **coal** consisting mainly of methane, hydrogen and carbon monoxide; used as a commercial fuel.

coal oil. *Noun.* A crude oil produced when **bituminous coal** is distilled to make **coal gas**.

Coalport. *Noun.* A **translucent** white **bone china** with a richly moulded and patterned decoration. Made in the nineteenth century near Shrewsbury.

coal rank. *Noun.* The amount of carbon and moisture in the **vitritine** component of whole coal. High carbon, low moisture is **hard coal** of which there are two types: **bituminous** and **anthracite**. High rank coal has a high 6-membered ring or aromatic content, around 10 rings per molecule. Low carbon, high moisture content is low rank, **lignite** and sub-bituminous coal.

coal tar. *Noun.* A black tar made by distilling **bituminous coal**. Contains several valuable chemical compounds.

coal tar pitch. *Noun.* The final residue consisting of high hydrocarbons and **carbon** in the distillation of **bituminous coal**. Used as a binder in **briquette** making, carbon electrodes and in road making.

coal, white. *Noun.* See **white coal**.

coarse aggregate. *Noun.* (1) The mineral materials, such as sand and stone, in their natural condition. (2) That portion of concrete aggregate that is retained on a 4.75-mm sieve.

coarse-grained. *Adjective.* A macrostructure consisting of large-sized grains.

coarse pearlite. *Noun.* A **pearlite** microstructure in which the alternating layers of **ferrite** and **cementite** are relatively thick.

coast-and-island. *Noun.* A type of microstructure produced as an equilibrium crystal develops from a metastable crystal. The stable phase grows from grain boundaries as an interlocking structure surrounding small areas, islands, of randomly nucleated and growing stable phase.

coated abrasive. *Noun.* An abrasive product in which the abrasive particles are bonded to paper, cloth, fibre, or other backing material by a resin or glue.

coated abrasive disk. *Noun.* A paper, cloth, fibre, or other disk, coated on one side with a mixture of abrasive and binder; used in mechanical grinding

coated sand. *Noun.* Sand covered with resin.

coating. *Noun.* A film of a substance applied over the surface of another solid.

coating, ceramic. *Noun.* See **ceramic coating**.

coating, flow. *Noun.* See **flow coating**.

coating, HVOF. *Noun.* See **HVOF-coating**.

coating, immersion. *Noun.* See **immersion coating**.

coating, pyrolytic. *Noun.* See **pyrolytic coating**.

coating, refractory. *Noun.* See **refractory coating**.

coating, roller. *Noun.* See **roller coating**.

coating, slip. *Noun.* See **slip coating**.

coating, vacuum. *Noun.* See **vacuum coating**.

coaxial. *Adjective.* Having a common axis.

coaxing. *Noun.* Increasing the **fatigue strength** value of a material by applying a gradually increasing stress cycle but starting well below the **fatigue limit**.

cob. *Noun.* (1) A building material consisting of chopped straw mixed with **clay**. (2) A small rounded heap of ore or coal.

cobalt aluminate. *Noun.* CoAl_2O_4 . A **spinel** pigment ranging from blue to blue-green. Its colour is most intense when there is a deficiency in cobalt. Mp 1,960 °C; density $\sim 3,700 \text{ kg m}^{-3}$.

cobalt arsenate. *Noun.* $\text{Co}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$. Used as a blue colourant in glass and ceramic inks. Density $2,950 \text{ kg m}^{-3}$. See **skutterudites**.

cobalt bloom. *Noun.* See **erythrite**.

cobalt blue. *Noun.* A blue to blue-green pigment composed of **cobalt aluminate** and aluminium oxides. Made by heating a mixture of **cobalt sulphate**, **aluminium oxide** and **phosphoric acid**. Also called **Thénard's blue**.

cobalt carbonate. *Noun.* CoCO_3 . Used in the production of blue and black ceramic colorants. Decomposes on heating; density $4,130 \text{ kg m}^{-3}$.

cobalt chloride. *Noun.* (1) CoCl_2 . Sublimes when heated; density $3,348 \text{ kg m}^{-3}$. (2) $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$. Employed as a decolouriser in iron-tinted glass. Mp 86.8 °C; density $1,924 \text{ kg m}^{-3}$.

cobalt chromate. *Noun.* Used with aluminium and zinc oxides to produce light-blue and light-green colours in porcelain-enamel and glazes.

cobalt ferrate. *Noun.* CoFe_2O_4 . A **soft magnetic spinel**. Mp 1,571 °C; density $5,305 \text{ kg m}^{-3}$.

cobalt fluoride. *Noun.* CoF_3 . An **antiferromagnetic** material with a Néel temperature 460 K.

cobalt green. *Noun.* A synthetic **spinel** developed as a pigment with composition, $(\text{Co}, \text{Ni}, \text{Zn})(\text{Ti}, \text{Al})\text{O}_4$.

cobaltine. *Noun.* See **cobaltite**.

cobaltite. *Noun.* CoAsS . A silvery white mineral containing cobalt, arsenic, and sulphur in a cubic crystalline form; used in ceramic formulations. Also called **cobaltine**.

cobalt molybdate. *Noun.* CoMoO_3 . A **perovskite** that is **antiferromagnetic**; Néel temperature 391 K.

cobalt nitrate. *Noun.* $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. A soluble salt used as a metal treatment to promote adherence of porcelain-enamels to iron and steel. mp 56 °C; density $1,880 \text{ kg m}^{-3}$

cobalt ochre. *Noun.* See **asbolite**.

cobalt oxide. *Noun.* (1) CoO ; decomposes at 180 °C; density $5,700\text{--}6,700 \text{ kg m}^{-3}$. (2) Co_2O_3 ; decomposes at red heat; density $4,810\text{--}5,600 \text{ kg m}^{-3}$. (3) Co_3O_4 ; density $6,075 \text{ kg m}^{-3}$. All employed as colorants and sometimes as decolourisers or masking agents in glass, under-glazes, over-glazes, porcelain-enamels, **decals**, and similar decorative applications. Important adherence-promoting ingredients in porcelain-enamel ground coats, particularly CoO .

cobalt oxide, black. *Noun.* See **black cobalt oxide**.

cobalt silicate. *Noun.* Co_2SiO_4 . An **orthosilicate**; See **smalt**. Mp 1,253 °C; density $4,680 \text{ kg m}^{-3}$; hardness (Mohs) 5–7.

cobalt silicide. *Noun.* (1) Co_2Si . A refractory hard metal. (2) CoSi . A harder more stable silicide. Both silicides are present in Si_3N_4 matrices when **silicon nitride** is sintered with cobalt powder. The resultant composite contains 5 mm-sized islands of silicide in the cobalt matrix, which is a good cutting material with a density around $3,500 \text{ kg m}^{-3}$ and a **fracture toughness** $10 \text{ MN m}^{-3/2}$.

cobalt stannate. *Noun.* A blue compound of uncertain composition. Also known as cerulean blue. See **cerulean blue**.

cobalt sulphate. *Noun.* (1) CoSO_4 . Mp 989 °C; density $3,470 \text{ kg m}^{-3}$. (2) $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$. Mp 96.8 °C; density $1,920 \text{ kg m}^{-3}$. Used to impart blue and blue-white colours in **whiteware** bodies.

cobalt tungsten. *Noun.* Co_2W . A phase encountered in Co-WC cutting tool formulations.

cobble mix. *Noun.* Concrete containing aggregate up to 15.25 cm in diameter.

cobbles. *Plural noun.* (1) Sedimentary rocks with particle sizes in the range 64–256 mm. (2) Coal in small rounded lumps. (3) **Cobblestones**.

cobblestone. *Noun.* Rounded stone lumps used as paving stones.

cock spur. *Noun.* A triangular item of kiln furniture with a single sharp point on which plates and similar ware are placed for firing.

cocolith. *Noun.* Micron-sized scales of **calcite** that coat one-celled marine plants. Crystal growth on these scales leads to deposits of crystalline calcite.

cocotte. *Noun.* A small fireproof dish.

coconut shell activated carbon. *Noun.* A tough and abrasion resistant form of carbon containing micropores of less than 2 nm diameter formed by carbonising coconut shell in the presence of steam or carbon dioxide. The best form of **activated carbon** for gas masks and solvent recovery.

code. *Noun.* A computer programme.

coefficient of confidence. *Noun.* In statistics it is a stated proportion of the times the confidence interval is expected to include the population parameter.

coefficient of expansion. *Noun.* The amount of expansion or contraction per unit length of a material arising from a temperature change of 1°.

coefficient of friction. μ . *Noun.* The coefficient that equates friction force, F , due to the roughness of the surface, to applied load, W , acting vertically: $F = \mu W$.

coefficient of reflection. r . *Noun.* A constant needed to determine the amplitude of reflected light; r is defined by the equation: $r = (n_0 - n_1) / (n_0 + n_1)$, where n_0 and n_1 are the indices of refraction across a boundary in the direction in which the light is travelling; rE_0 defines the amplitude of the reflected wave when a wave of amplitude E_0 falls on a surface.

coefficient of saturation. *Noun.* The ratio of the weight of water absorbed by masonry or other unit during immersion in cold water to weight absorbed during immersion in boiling water, the ratio to be taken as an indication of the resistance of brick to freezing or thawing.

coefficient of scatter. *Noun.* The ratio of the increase in reflectance with thickness of a porcelain-enamel or other coating applied over an ideally black backing.

coefficient of thermal expansion. *Noun.* The fractional change in the length or volume of a body per degree of temperature change.

coercive field. E_c or ϵ_c . *Noun.* The negative electrical or magnetic field needed to make remnant polarisation or magnetisation vanish in a **ferroelectric** or **ferromagnetic** material. It is a magnetic field value equal to twice the width of a magnetic hysteresis loop. Also called **coercivity**.

coercive force. *Noun.* A way of quantifying the magnetisation of a ferromagnetic ceramic. The external magnetic field strength to demagnetise a magnetically saturated sample is used and expressed in amperes per metre.

coercivity. *Noun.* See **coercive field**.

coesite. *Eponym, noun.* SiO_2 . A high-pressure form of silica. Named after L Coes who first synthesised the polymorph at pressures $> 2 \times 10^4$ atm.

coextrusion. *Noun.* A process designed to produce welded laminates by extruding two or more materials through a single die with two or more orifices arranged so that the extrudates merge.

coffinite. *Noun.* A uranium-bearing ore found in Colorado.

Coffin-Manson relation. *Noun.* The fatigue life of a device consisting of silicon and a package is inversely proportional to the square of the thermal coefficient of expansion difference between these two components of the device.

coherence. *Noun.* The property of substances being held physically together by mutual attraction of the particles of the substances.

coherence length. *Noun.* The correlation distance of the superconducting electrons in a superconducting material.

coherency strain. δ . *Noun.* the lattice distortion needed on either side of a semi-coherent phase boundary to adjust the atom or ion distances on either side to meet coherently. Coherency strain has a critical value to produce misfit dislocations in one of the phases forming the boundary.

coherent. *Adjective.* A situation where all the waves in a beam of light are in phase and all wave peaks coincide.

coherent light. *Noun.* Radiation composed of wave trains vibrating in phase with each other.

cohesion, cohesiveness. *Noun.* The tendency of substances of like composition to hold together as a result of intermolecular attractive forces.

cohesionless soil. *Noun.* A free-running soil, such as sand, whose strength depends on friction between particles.

cohesive energy density. CED. *Noun.* The atomic binding forces per unit of volume.

cohesive failure. *Noun.* The failure of an adhesive bond joint by failure of the adhesive not the adhesive-material interface.

cohesive soil. *Noun.* Soil that adheres, such as clayey soil, whose strength depends on the surface tension and capillary forces of water in capillaries and pores.

coil. *Noun.* The process of making speciality or art items by forming the object from ropes or coils of plastic clay.

coil, annular. *Noun.* See **annular coil**.

coil, bobbin. *Noun.* See **bobbin coil**.

coil, bucking. *Noun.* See **bucking coil**.

coil, circumferential. *Noun.* See **circumferential coil**.

coil, comparator. *Noun.* See **comparator coil**.

coil, differential. *Noun.* See **differential coil**.

coil, encircling. *Noun.* See **encircling coil**.

coil, feed-through. *Noun.* See **feed-through coil**.

coil gun. *Noun.* See **coil/rail gun**.

coil, ID. *Noun.* See **ID coil**.

coil, inserted. *Noun.* See **inserted coil**.

coil method of magnetisation. *Noun.* A method of magnetisation in which part or all of a component is encircled by a current-carrying coil.

coil, probe. *Noun.* See **probe coil**.

coil/rail gun. *Noun.* A device that uses a rapidly changing magnetic field in a spiral coil (coil gun) or a linear conductor (rail gun) to accelerate a projectile via magnetic forces. Much greater velocities can be reached than are possible with gas expansion (as in a conventional gun).

coil, reference. *Noun.* See **reference coil**.

coil size. *Noun.* The geometry or dimensions of a coil such as length or diameter.

coil spacing. *Noun.* The axial distance between two encircling coils in a differential system of electromagnetic testing.

coil, test. *Noun.* See **test coil**.

coir. *Noun.* An important natural fibre produced from coconut husk.

coke. *Noun.* The solid product resulting from the incomplete combustion of coal, consisting principally of carbon; used chiefly as a fuel in metallurgy to reduce metal oxides to metal.

coke oven. *Noun.* A refractory-lined oven in which coal is fired in an essentially oxygen-free atmosphere to produce coke.

coking. *Verb.* To produce carbon from hydrocarbon gas streams in **solid-state fuel cells**. The carbon can clog-up the cell anode. See **reforming**.

cockscorn habit. *Adjective.* A description of the crystal formation found for some minerals, such as **marcasite**, that exist as a broad spike of crystals resembling the comb of a cock.

Colburn process. *Noun.* A method of forming **flat glass** in which a ribbon of molten glass is drawn upward from the **glass tank**, rolled flat, annealed, and then cut into desired sizes and shapes.

colcothar. *Noun.* Fe_2O_3 , a finely powdered form of **red iron oxide** made by heating ferric sulphate. Used as a pigment and as a polishing agent called **jewellers' rouge**. Also called **crocus**.

cold cracking. *Verb.* To develop flaws due to cycling from sub-ambient to ambient temperatures.

cold-crucible induction melter. **CCIM.** *Noun.* A glass-making furnace in which the charge is heated in a crucible formed from metal tubing, such as copper, held inside the inductor coil of an induction heater. The crucible coils are water-cooled.

cold-curing. *Verb.* To cure fibre reinforced plastics at normal ambient temperature in dry air.

cold-end coating. *Noun.* The process of adding a thin layer polymeric material to a glass bottle outer surface as it leaves the **annealing lehr** to increase its lubricity and improve the scratch resistance. Water based polyethylene emulsions are commonly used because they can be applied by spraying.

cold gas dynamic spray technology. *Noun.* A technique similar to **thermal spraying** but the powder feed stock is not heated to melting point which means that ceramic powders must be mixed with ductile binder powder. The kinetic energy of the powder particles is converted into localised heat and interfacial deformation to produce mechanical bonding with the substrate. Gas and powder heating up to 1,000 °C and nitrogen gas pressures between 20 and 55 bar, applied through a **de Laval** nozzle, are used.

cold isostatic pressing. *Noun.* See **isostatic pressing**.

cold joint. *Noun.* The surface between two successive pourings of concrete in which the first pouring has set and can no longer be blended into the second pouring.

cold light. *Noun.* Light, such as **fluorescence**, **phosphorescence** or **triboluminescence**, that is emitted at low temperatures and does not depend on an incandescent source.

cold moulding. *Noun.* The production of artefacts using resins that polymerise and a suitable mould.

cold pressing. *Noun.* A bonding operation in which a powder or fibre-matrix mixture, is pressurised without heat to attain sufficient **green strength** for handling.

cold-rolled steel. *Noun.* A low-carbon, cold-reduced sheet steel used in porcelain-enamelling.

cold setting binders. *Plural noun.* Any binder that will harden a casting core so that it can be removed without distortion.

cold spray. *Noun.* The common name for cold gas dynamic spray technology. See **cold gas dynamic spray technology**.

colemanite. *Noun.* $\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$ or more correctly $\text{CaB}_3\text{O}_4(\text{OH})_3 \cdot \text{H}_2\text{O}$. Hydrated calcium borate found in Turkey. An important borate mineral, used as source of CaO and B_2O_3 in pink and maroon raw-lead glazes, and as a flux in glazes. Density 2,420 kg m⁻³; hardness (Mohs) 4.0–4.5.

collapse. *Noun.* The accidental densification of a ceramic composite with a cellular microstructure during manufacture as the network of cells is damaged.

collar in, collaring. *Verb.* To reduce the diameter of a pot, particularly the opening, by pressure from the outside while turning it on a wheel.

collet. *Noun.* (1) A split sleeve used to hold work or tool during machining or grinding. (2) The neck of a glass bottle after removal from the blowing iron. (3) The drive wheel that pulls glass fibre from the bushing.

collier. *Noun.* (1) A coal miner. (2) A ship designed to carry coal.

colliery. *Noun.* A coal mine.

colligative. *Adjective.* A physical property dependent on amount of material, that is concentration of atoms, ions etc.

colloid. *Noun.* (1) A substance in the form of sub-microscopic particles in the range 10^{-7} to 10^{-9} m, which do not settle out when in suspension. The mixture has intermediate properties between a solution and a fine suspension. (2) Such a substance together with gaseous, liquid, or solid medium in which it is dispersed.

colloidal. *Adjective.* Having the characteristics of a colloid.

colloidal clay. *Noun.* A very fine natural clay, which usually swells when it takes up water, and which is used as a binder for non-plastic materials.

colloidal formation. *Noun.* To make an emulsion of very fine particles and suspending fluid, usually by mechanical means, such that the solid does not settle out with time.

colloidal notation. @MO. *Noun.* A system of denoting the components of sol-gel prepared colloidal nanopowders. For example, Eu,Ti@ZnO represents a zinc oxide colloidal suspension containing Eu^{3+} and Ti^{4+} ions from which a doped oxide can be obtained as powder or thin film.

colloid mill. *Noun.* A high-speed grinding device capable of making very fine dispersions of liquids or solids by breaking down particles in an emulsion or paste.

colloid probe atomic force microscope. (CP-AFM). *Noun.* A technique used to investigate the dispersion state of nanoparticles when suspended.

colloidal quantum dots. *Plural noun.* Nanosized pyramidal shaped semiconductor particles. They have a core of cadmium selenium alloy coated with zinc cadmium sulphur alloy. Different core sizes in the range 2.5–4.2 nm changes the colour of their laser emission from blue to red.

colloid vibration current. CVD. *Noun.* See **electroacoustic spectroscopy**.

collophane. *Noun.* $\text{Ca}_3(\text{PO}_4)_2 \cdot \text{H}_2\text{O}$; the most important constituent of **phosphate rock**.

colly. *Noun.* (1) Coal dust. (2) Soot.

colonnade. *Noun.* An arrangement of evenly spaced columns.

Colorado ruby. *Noun.* A fiery-red garnet mined in Colorado.

Colorado topaz. *Noun.* (1) A golden-brown form of topaz mined in Colorado. (2) Any quartz with the colour of Colorado topaz.

colorant. *Noun.* Any pigment that bestows colour.

colorific. *Adjective.* Imparting colour or relating to colour.

colorimeter. *Noun.* An instrument that measures colour by determining the intensities of the three primary colours that comprise a particular colour.

colossal magnetoresistance. CMR. *Noun.* A property of some cubic perovskites, particularly manganites, such as $\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$, LCMO, that show a dramatic increase in resistance in the presence of a magnetic field. They need fields of several tesla to effect a significant resistance.

colour. *Noun.* The wavelength composition of light, particularly with reference to its visual appearance; a colour other than white, black, or grey. The colour of a non-self-luminous object is dependent on the spectral composition of the incident light, the spectral reflectance or transmission of the object and the spectral response of the observer. It is described qualitatively in terms of hue, saturation and lightness. Numerically it is specified by chromaticity coordinates. It can also be specified by reference to visual standards.

colourant or colorant. *Noun.* Any substance that imparts colour, such as a pigment or dye.

colourant, ceramic. *Noun.* See **ceramic colourant**.

colouration depth. *Noun.* A colour quality associated with an increase in the amount of colourant present, all other conditions, such as light and viewing angle remaining the same.

colour centre. *Noun.* This is a lattice defect, such as, vacancy, interstitial, or substituent, which absorbs visible light. See **F-centre**.

colour code. *Noun.* A system of easily distinguishable colours, as for the identification of resistors. See **Table A.8**.

colour constancy. *Noun.* The ability of a coloured object to give the same general colour impression when viewed under different illuminants.

colour contrast. *Noun.* A physiological effect whereby the appearance of a colour changes when surrounded by another colour. For example grey appears bluish when surrounded by yellow.

- coloured frit.** *Noun.* A frit containing a colorant to produce a strong colour in porcelain-enamel or other ceramic coating.
- colour filter.** *Noun.* A transparent material, such as glass, with selective properties with respect to the absorption of light waves according to wavelength.
- colour index.** *Noun.* (1) A systematic arrangement of colours with respect to their **hue**, saturation, and **brightness**. (2) In a rock it is the total of the dark or coloured minerals, expressed as a percentage of the total minerals.
- colouring.** *Noun.* The art of applying decorative colours.
- colouring agent.** *Noun.* Any substance that will impart colour to another substance or product.
- colourless.** *Adjective.* Without colour.
- colour, metallic.** *Noun.* See **metallic colour**.
- colour, metameretic.** *Noun.* See **metameretic colour**.
- colour-order system. CIE.** *Noun.* A colour matching system from the Commission Internationale de l'Eclairage. The system matches colours by mixing coloured lights from standard sources observed by a standard observer. A set of standard coordinates, called tristimulus values, are used to classify.
- colour oxide.** *Noun.* An oxide of a metal that is used to colour glass, glazes, porcelain-enamels, ceramic bodies, and other products.
- colour quality.** *Noun.* Specification of colour in terms of **hue** and **saturation**.
- colour stability.** *Noun.* The resistance of a product to a change in colour.
- colour, structural.** *Noun.* See **structural colour**.
- colour temperature.** *Noun.* The temperature of a **black-body** that would emit radiation of the same **chromaticity** as a light of interest.
- colour variation.** *Noun.* The property of non-uniform colour exhibited by a product during some stage of the manufacturing operation or before or after some condition of service, such as **weathering**.
- colourwash.** *Noun.* (1) **Whitewash** with an added pigment and **size** to make **distemper**. (2) *Verb trans.* To apply colourwash.
- coltan.** *Noun.* A generic name for the metallic ores consisting of **columbite** and **tantalite**; used as a source of tantalum.
- columbic.** *Adjective.* Another name for **niobic**.
- columbite.** *Noun.* $(\text{Fe}, \text{Mn})(\text{Nb}, \text{Ta})_2\text{O}_6$. A black mineral occurring in coarse granites that is an ore of both niobium and tantalum. An orthorhombic material. Also called **niobite**. See **coltan**.
- columbium.** *Noun.* An earlier name for niobium.
- columbous.** *Adjective.* Another word for niobous.
- column, reinforced.** *Noun.* See **reinforced column**.
- combed finish.** *Adjective.* Articles, such as tile or brick, having face surfaces intentionally altered by scratches or **scarves** during manufacture to give increased bond with mortar, plaster, **stucco**, or other **mastic** used in installations.
- combed ware.** *Noun.* Ware that has been finished either by combing or by flowing several wet slips or glazes together.
- combinatorial materials library.** *Noun.* A large series of compounds synthesised by sequentially depositing thin-film precursors at different sites on a substrate using a series of precisely positioned shadow masks. After deposition a low temperature anneal at 400 °C precedes a high temperature firing. Rotation by 90° of a series of 5 masks produces 4ⁿ different compositions and the final product is a tile-like array of different materials all able to be screened for a given property.
- combined sewer.** *Noun.* A pipeline intended to convey sewage and storm water.
- combined suspension-solution freeze drying.** *Noun.* A modification of the **freeze-drying method** of powder preparation developed for production of ternary ceramics, such as **spinel**s where no soluble salt of one component can be found. A suspension of oxide in the appropriate salt solution is freeze-dried to produce the intimately mixed, ultrafine particles of the pre-firing mixture.
- combined water.** *Noun.* Water that is combined chemically with clays and minerals and which can be expelled only by heating to relatively high temperatures. Also known as **water of crystallisation**, **water of hydration**, **water of constitution**.
- combing, feather.** *Noun.* See **feather combing**.
- comb rack.** *Noun.* (1) A comb-shaped burning tool used to support ware during firing. (2) A comb-like tool used to support metal ware during the cleaning and pickling stage of porcelain-enamelling.
- combustible.** *Adjective.* Easily ignited and burned.
- combustion.** *Noun.* The process of burning.
- combustion air.** *Noun.* Air introduced into a firing chamber or zone to support the combustion of fuel.
- combustion chamber.** *Noun.* The area in a furnace or kiln in which fuel is burned.
- combustion efficiency.** *Noun.* The ratio of the heat actually developed during combustion to the heat theoretically possible under ideal conditions.
- combustion, glowing.** *Noun.* See **glowing combustion**.

combustion, incomplete. *Noun.* See **incomplete combustion**.

combustion, surface. *Noun.* See **surface combustion**.

combustion synthesis. *SHS. Noun.* See **self-propagating high-temperature synthesis**.

comeback. *Noun.* The time required for a porcelain-enamelling or other furnace to return to temperature after introduction of a load of ware.

commensurate phase. *Noun.* A magnetic material in which the repeat unit of the ordered **magnetic moments** is an integral number of crystal lattice spacings.

comminute. *Verb trans.* To reduce the particle size of a material by any of several process.

common brick. *Noun.* In the **brick classification** scheme it is the lowest class. It is a block of clay material usually fired to form a stable mass and used for general building purposes. There is no guarantee of a consistent face.

commute. *Verb trans.* To transform, to change.

compact. *Verb.* (1) To treat glass in a manner, such as by heat treatment, to approach maximum density. (2) To densify by any means.

compacts. *Noun.* A cylinder of particle fuel elements used in high temperature gas cooled reactors. See **TRISCO coated particle fuel**.

compacted graphite iron. *Noun.* A cast iron alloyed with silicon and a metal, such as cerium, in which the graphite has a worm-like morphology.

compaction. *Noun.* (1) A technique for reducing space requirements for a material. (2) Increasing the dry density of a material. (3) The preparation of a compact or object produced by the compression of a powder, generally while confined in a die, with or without the inclusion of lubricants, binders, etc., and with or without the concurrent application of heat.

comparative measurements. *Plural noun.* Experiments conducted to determine if one product, procedure, or system is better than another.

comparative standard. *Noun.* A reference material used as a basis for comparison or calibration to detect any property or condition that is not common to the test subject and the standard.

comparator coil. *Noun.* An electromagnetic test involving two coils connected in series opposition such that there is no mutual induction. A standard in one coil and a test specimen in the second will give an indication of imbalance if they do not have the same magnetic or dielectric properties.

compass window. *Noun.* A bay window with a semicircular shape.

compatibility. *Noun.* Capable of existing in a homogeneous mixture with another substance without separation or chemical reaction.

compatibility triangle. *Noun.* A subset of compatible phases in a ternary system.

compensating defect. *Noun.* Any oppositely charged **defect** in a crystal that is required by the electroneutrality principle. For example, V_o requires M_m or e^- , where the defects are described by the Kroger-Vink notation. See **Kroger-Vink notation**.

complementary colour. *Noun.* One of any pair of colours, such as yellow and blue that give white or grey when mixed in the correct proportions. See **subtractive colouration**.

complementary wavelength. *Noun.* The wavelength of monochromatic light that could be mixed in calculated proportions with a given coloured light to produce some specified **achromatic** light.

complete fusion. *Adjective.* Complete liquefaction under the influence of heat.

complex. *Adjective.* (1) Made up of various interconnecting parts. (2) *Noun.* A chemical compound in which molecules or ions are bonded to a central metal ion by coordinate bonds. Also called **coordination compounds**.

complex number. *Noun.* Any number of the form $a + bi$, where a and b are real numbers and $i = -1^{1/2}$.

complex salt. *Noun.* A salt that contains one or more complex ions.

compliance. *J. Noun.* The measurement of softness expressed as the reciprocal of **Young's modulus**, or **shear modulus**, or the inverse of the stiffness matrix.

complicated silicosis. *Noun.* See **silicosis**.

compo. *Noun.* A mixture of materials such as mortar, plaster, etc.

component. *Noun.* (1) A constituent part of a mixture. (2) The smallest number of independently variable substances able to form all the constituents of a system in what ever proportion they may be present, and from which the composition of each phase can be quantitatively expressed.

Composite. *Adjective.* Concerned with or referring to one of the five orders of classical architecture characterised by a combination of the **Corinthian** and **Doric** styles.

composite. *Noun.* A material composed of two distinct parts, such as a mixture of ceramic materials and metallic phase, intended to produce a material with specific properties; for example, glass-fibre-reinforced plastics and metals used in the production of boats, cars, radomes, nose cones, aircraft parts, etc. A composite

differs from a simple mixture in that it contains a well-bonded interface that bestows unusual and desirable properties, such as **toughness**. It consists of a protective matrix phase and a strengthening phase that is usually fibres.

composite, 3-3. *Noun.* A ceramic and either metal or polymer composite. The numbers refer to the number of dimension in which each phase is continuous. Their open porous structure allows them to be infiltrated. See **interpenetrating composite**.

composite coating. *Noun.* A mixture of one or more ceramic materials in combination with a metal phase applied to a metallic substrate, or a non-metallic substrate, such as graphite, which may or may not require heat treatment prior to service.

composite coating, refractory. *Noun.* See **refractory composite coating**.

composite column. *Noun.* A concrete column reinforced with a metal core, usually steel.

composite compact. *Noun.* A compact composed of one or more layers of different substances with each substance retaining its own identity.

composite crystal. *Noun.* Another name for **artificially structured materials**. See **phononic crystals**, **photonic crystals**.

composite, interpenetrating. *Noun.* See **interpenetrating composite**.

composite laminate. *Noun.* Plastic joined to a ceramic or other material in such a way that distinct alternating sheets of each distinct material occur in the structure.

composite lot sample. *Noun.* A single sample prepared from several containers or lots by combining them in the same ratio as the net weight of the materials sampled.

composite moulding. *Noun.* The process of moulding two or more materials in the same cavity at the same time.

composite, structural energy storage. *Noun.* See **structural energy storage composite**.

composite tape laying. **CTL.** *Verb.* An operation performed by automated equipment to lay **prepreg epoxy graphite** composites over contoured surfaces.

composite wheel. *Noun.* A bonded abrasive product in which two or more specifications are bonded together into one wheel.

composition. **C_p.** *Noun.* The combination of elements or compounds comprising the whole of a material or product. Usually expressed as weight percent or atom percent.

compositional engineering. *Noun.* An approach to property improvement and optimisation where the

composition of a ceramic is adjusted to bring it into the proximity of a polymorphic phase boundary (PPT) or into a **morphotropic phase boundary region (MBP)**.

composition plane. *Noun.* The twin plane separating two twins within a single crystal. It is not like the boundary between two separate crystals where atomic mismatching is extremely severe.

compound. *Noun.* (1) A material resulting from the chemical bonding of two or more elements. (2) A mixture of two or more materials. (3) *Verb.* To mix together the ingredients for a **frit**, **glass batch**, **body** etc.

compound microscope. *Noun.* A microscope with a short focal length lens to form a magnified image that is further magnified by a longer focal length lens.

compound rolls. *Noun.* A pulverising system consisting of two or more pairs of rolls arranged vertically, one pair above the other, with the spacing between the rolls being decreased in descending order so that the particle size of a material is reduced as it passes from the upper set of rolls to the next.

compressed air. *Noun.* Air under pressure greater than the surrounding atmosphere.

compressed air ejection. *Verb.* To remove a moulding by means of a jet of compressed air.

compressibility. **β.** *Noun.* The change in volume per unit volume produced by changing the pressure. Related to the **bulk modulus**, **K**, by the relationship: $\beta = -(V)^{-1}(dV/dP)_T = 1/K$.

compression. *Noun.* Reduction in volume of a substance under pressure.

compression after impact. **CAI.** *Noun.* A test used to assess the damage tolerance of composites.

compression failure. *Noun.* The breaking or disintegration of a solid under some form of pressure.

compression set. *Noun.* Percentage of original dimensions by which a material is deformed after a compressive stress is released.

compression test. *Noun.* A test made on a specimen of a material placed under load to determine its compressive strength.

compressive strength. *Noun.* The maximum resistance of a material to compressive loading, or the specified resistance used in design calculations, based on the original area of the specimen cross section.

compressive stress. *Noun.* A stress developing in a solid under the influence of some form of pressure that involves a decrease in atomic bond distances.

Compton effect. *Noun.* See **Compton scattering**.

Compton scattering. *Noun.* The effect discovered by Compton that the wavelength of scattered x-rays was

greater than that of the incident radiation and was dependent on the scattering angle.

computer-aided design. CAD. *Noun.* using computers to develop the design of a product to be manufactured. It works by creating a mathematical description of the shape of an object that can be viewed and manipulated by the user.

computer-aided manufacture. CAM. The use of computers and related technology to control, manage, operate, and monitor manufacturing.

concentrate. *Verb.* (1) To increase the amount of a substance in a mixture, solution, or ore. (2) *Verb trans.* To remove rock and earthy material from an ore to make it purer. (3) *Noun.* A solution from which much of the solvent has been removed, usually by evaporation.

concentration gradient. dc/dx . *Noun.* The slope of the **concentration profile** of a sample at a specific position.

concentration polarisation. *Noun.* The situation whereby the rate of an electrochemical reaction is limited by the rate of diffusion of an ion in the electrolyte.

concentration profile. *Noun.* The curve that results when the concentration of a chemical species is plotted against the position in a material.

concentration, threshold. *Noun.* See **threshold concentration**.

concentric wheel. *Noun.* A bonded abrasive product containing two or more concentric sections of different abrasive specifications.

conchoidal fracture. *Adjective.* Shell-like fracture pattern characteristic of amorphous materials. It contains **mirror, mist, and hackle zones** spreading out from the point of initial failure.

concrete. *Noun.* A homogeneous mixture of **Portland cement, aggregate**, and water, which may also contain selected **admixtures**, and sets to a hard solid mass over several days. The ratio of aggregate to cement is usually 3:1.

concrete, aerated. *Noun.* See **aerated concrete**.

concrete aggregate. *Plural noun.* Sand, gravel, crushed rock, slag, and similar materials blended with Portland cement to form concrete.

concrete, air-entrained. *Noun.* See **air-entrained concrete**.

concrete, architectural. *Noun.* See **architectural concrete**.

concrete beam. *Noun.* A structural beam of reinforced concrete designed for load-bearing functions.

concrete block. *Noun.* Concrete fashioned in the form of hollow and solid blocks of various sizes, frequently $20.3 \times 20.3 \times 40.6$ cm, for use in construction and other applications.

concrete brick. *Noun.* Concrete formed in the sizes and shapes of conventional brick, and having high compressive strength and resistance to the conditions of weathering; for use in construction and other applications. Hydrated to a water/cement ratio of 0.3 and set for several weeks.

concrete buggy. *Noun.* A cart designed to carry concrete from a mixer or hopper to pouring forms.

concrete cancer. *Noun.* The term applied to a mechanism by which concrete spontaneously breaks up; apparently caused by localised expansion as the alkali and silica react. The silica source is the **aggregate**.

concrete canvas. *Noun.* A concrete disaster shelter in a bag. The bag is filled with water, which controls the **water-to-cement ratio**. After 15 min the structure is inflated using a small chemical pack prior to setting in a tent-like form. The cement is reinforced by the canvas of the bag.

concrete, cellular. *Noun.* See **cellular concrete**.

concrete, centrally mixed. *Noun.* See **central-mixed concrete**.

concrete chute. *Noun.* A round-bottomed trough to convey concrete to a lower level.

concrete column. *Noun.* A vertical structure of reinforced concrete designed to carry loads.

concrete finish. *Noun.* The surface texture or smoothness of hardened concrete.

concrete, foamed. *Noun.* See **foamed concrete**.

concrete form. *Noun.* A mould, usually made from wood, in to which concrete is poured and cast into a shaped object.

concrete form oil. *Noun.* Oil, which is employed to coat the forms into which concrete is cast, to facilitate the removal of the concrete from the forms after it has set.

concrete, fresh. *Noun.* See **fresh concrete**.

concrete, green. *Noun.* See **green concrete**.

concrete hardener. *Noun.* An additive to a concrete mix, such as sodium hydroxide, sodium chloride, or calcium chloride, to hasten the set of the concrete.

concrete, heavy. *Noun.* See **heavy concrete**.

concrete, insulating. *Noun.* See **insulating cement**.

concrete, lightweight. *Noun.* See **lightweight concrete**.

concrete masonry. *Noun.* Any form of construction composed essentially of concrete block, brick, or tile laid by masons.

concrete, mass. *Noun.* See **mass concrete**.

concrete mixer. *Noun.* A rotating cylinder or drum in which concrete is mixed.

concrete, nailing. *Noun.* See **sawdust concrete**.

concrete, no-fines. *Noun.* See **no-fines concrete**.

concrete pile. *Noun.* A pile or column of reinforced concrete, either cast in place or precast, which is driven into the ground as a support for subsequent construction.

concrete pipe. *Noun.* A porous pipe or conduit made of concrete that generally is used in some type of drainage application.

concrete, plain. See **plain concrete**.

concrete, post-tensioned. *Noun.* See **post-tensioned concrete**.

concrete, precast. *Noun.* See **precast concrete**.

concrete, prestressed. *Noun.* See **prestressed concrete**.

concrete products. *Plural noun.* **Precast concrete** such as brick, block, pipe, sills, garden objects, and similar items produced at a central manufacturing plant.

concrete pump. *Noun.* A machine that drives or forces concrete into placing position.

concrete, ready-mixed. *Noun.* See **ready-mixed concrete**.

concrete, reinforced. *Noun.* See **reinforced concrete**.

concrete retarder. *Noun.* A material added in small quantities to a concrete mix to increase or lengthen the setting time and decrease the rate at which strength is developed; the retarder should have no effect on the concrete after it has set.

concrete, roller compacted. *Noun.* See **roller compacted concrete**.

concrete, sawdust. *Noun.* See **sawdust concrete**.

concrete, shrink-mixed. *Noun.* See **shrink-mixed concrete**.

concrete slab. *Noun.* (1) A flat, relatively thick plate of concrete of various shapes used as stepping stones, well and pit covers, floors, roofing sections, bridge decks and the like. (2) A concrete pavement.

concrete special design. *Noun.* A concrete pipe design for sizes, loads, and service conditions which are not covered by pipe of standard design.

concrete, transit-mixed. *Noun.* See **transit-mixed concrete**.

concrete, truck-mixed. *Noun.* See **truck-mixed concrete**.

concrete, ultra-high performance. UHPC. *Noun.* See **ultra-high performance concrete**.

concrete, vacuum. *Noun.* See **vacuum concrete**.

concrete vibrator. *Noun.* A vibrating device used to consolidate concrete by encouraging flow and removing air bubbles.

concrete, waterproof. *Noun.* See **waterproof concrete**.

concrete workability. *Noun.* The ease with which the ingredients of a concrete batch can be mixed and subsequently can be handled, transported, and placed without loss of homogeneity.

concretion. *Noun.* See **nodule**.

concurrent engineering. *Noun.* A method of designing new products in which the development stages are run in parallel rather than in series.

concurrent processing. *Noun.* One or more operations taking place at the same time.

condensate. *Noun.* The liquid product from a condenser.

condensation. *Noun.* The process of reducing a gas or vapour to a liquid or solid form.

condenser. *Noun.* (1) Any enclosed vessel in which a vapour is changed or condensed to its liquid state. (2) Another name for capacitor; see **capacitor**.

condensed matter. *Noun.* Crystalline and amorphous solids including **liquid crystals**, **glasses**, **polymers** and **gels**.

conditional glass formers. *Plural noun.* Oxides that are not themselves glass formers but can enter the glass network when mixed with network formers, e.g., Al_2O_3 and PbO .

conditioning. *Verb.* To prepare a material for subsequent processing or use.

conditioning zone. *Noun.* The section of a glass-melting tank in which temperatures of the molten batch are adjusted for subsequent operations.

conductance. *Noun.* The property of transmitting electricity, expressed as the reciprocal of resistance, i.e., the ratio of current to voltage. Old unit **mho** has been replaced by **siemens**.

conducting material. *Noun.* Any material through which heat, electricity, or sound will flow.

conduction. *Noun.* Transfer of energy through a material without bulk transport of the material. Another name for **conductivity**.

conduction band. *Noun.* For semiconductors and insulators it is the lowest-lying energy band that contains no electrons at 0 °K.

conductive ceramic tile. *Noun.* A tile made from a body composition designed to give a specified electrical conductivity but retaining other normal properties associated with ceramic tile.

conductive coating. *Noun.* A porcelain-enamel, glaze, metallic, or other coating capable of conducting electricity.

conductive composite. *Noun.* Composite materials with a volume resistivity equal to or less than 500 Ω -cm.

conductivity. *Noun.* The property and rate of conducting heat, electricity, and sound.

conductor. *Noun.* Any substance that will conduct heat, electricity and sound.

conductor, insulated. *Noun.* See **insulated conductor**.

conduit. *Noun.* (1) A pipe for the conveyance of water or other fluid. (2) A pipe for protecting electric wiring against damage from external causes.

cone. *Noun.* A conical package of ceramic yarn wound on to a conical support.

cone and quartering method. *Noun.* A sampling method whereby a powder is piled into a conical heap, pressed down to a circular cake, and divided into quarters. Diagonally opposite quarters are taken for the sample. The procedure can be repeated until the desired size of sample is obtained.

cone classifier. *Noun.* A device consisting of an inverted cone in which solid particles are separated according to size or density by settling in a rising stream of air or water.

cone core. *Noun.* A yarn holder of conical shape.

cone crusher. *Noun.* A machine for crushing that consists of a cone gyrating within a conical cavity with tapered clearances such that a material is reduced several times during passage.

cone, pyrometric. *Noun.* See **pyrometric cone**.

cone screen test. *Noun.* A technique for measuring the fineness of porcelain-enamels in which a cone-shaped sieve is used.

cone wheel. *Noun.* A relatively small abrasive grinding wheel in the shape of a cone which may be mounted in a stationary or portable tool

confidence. *Noun.* The degree of assurance that a specified rate of failure is not exceeded.

confidence interval. *Noun.* The frequency that a sample or product will meet or exceed specified requirements.

confidence level (coefficient). *Noun.* The stated proportion of the times the confidence interval is expected to be attained.

configuration. *Noun.* The shape or structure of a body or product.

confocal microscope. *Noun.* A microscope with an optical system arranged to reject background from material outside the focal plane, which allows images from different sections of a sample to be obtained.

conge. *Noun.* A concave moulding.

conglomerate. *Noun.* (1) A heterogeneous mixture of solids, usually with no, or only minor, chemical interaction. (2) A type of rock consisting of very rounded, large flint pebbles cemented by pressure.

congruent melting. *Noun.* The change of a substance, when heated, from a single phase solid form to a single phase liquid of the same composition, such as, for example, ice to water.

congruent transformation. *Noun.* A change of one phase to another of the same composition.

conical crusher. *Noun.* A clay comminutor in which the material passes through a moving set of conical rollers.

conical roll. *Noun.* A crushing device in which clay or other substances pass vertically between a set of inverted cone-shaped rolls.

conjugate fibre. *Noun.* The extrusion of two different polymers through the same orifice to eventually yield a bi-component fibre.

connected porosity. *Noun.* The volume fraction of all voids and channels within a solid mass that are interconnected and also are reached via the external surface so that they can be detected by fluid penetration.

connection, feeder. *Noun.* See **feeder connection**.

connectivity. *Noun.* (1) A concept introduced by Newnham to consider theoretically the **piezoelectric constants** of ceramic-polymer composites. (2) The way in which a solid is contiguous in space; defined and measured in **fractal analysis** by the **spreading dimension**. (3) The manner in which individual phases are self-connected in a composite. In a diphasic system there are ten types of connectivity in which each phase is continuous in zero, one, two, or three dimensions; denoted as 0-0, 0-1, 2-3, etc.

conode. *Noun.* An isothermal construction line between two phases in equilibrium.

consanguinity. *Noun.* The similarity of origin of igneous rocks as demonstrated by their common mineral and chemical composition and texture.

consistency. *Noun.* (1) The properties of a slip that influence its draining, flowing, and spraying behaviour. (2) A measure of the fluidity, softness, or wetness of fresh concrete, determined by the number of centimetres. a sample slumps or subsides when a conical form is removed from the sample; the greater the subsidence, the higher the slump and the wetter or softer the concrete.

consistometer. *Noun.* Any of a variety of instruments designed to measure the fluidity, including the draining, flowing, spraying, and slumping properties, of slips and slurries.

console. *Noun.* A panel consisting of meters, dials, switches, and other instruments by which a manufacturing operation is controlled.

consolidate. *Verb.* To form into a compact mass or to unite as a whole, such as concrete or powder pressing.

- consolute temperature.** *Noun.* The temperature above or below which a separated phase mixture becomes a single phase.
- constant.** *Noun.* A fixed value that does not change during a particular test or process.
- constant rate of loading. CRL.** *Noun.* A machine setting used in the mechanical testing of materials in which the rate of increase of the force being applied to the specimen is uniform with time.
- constant-weight feeder.** *Noun.* A mechanical device for the delivery of a designated weight of raw material from one process to another per unit of time.
- constituent.** *Noun.* An essential component of a substance or product.
- constitutive.** *Adjective.* Of a physical property, being determined by the arrangement of atoms in a molecule rather than by their properties.
- constriction.** *Noun.* The reduction or narrowing of a channel or opening.
- constringence.** *Noun.* The reciprocal of the **dispersive power** of a medium such as glass. See **nu value** or **Abbé value**.
- construction joint.** *Noun.* A plane surface between two pourings of concrete, the second pouring being placed on or against the first after the first was hardened and so does not form any strong bonds.
- contact adhesive.** *Noun.* A liquid adhesive that dries to a tack free film to all materials but itself so that if two surfaces to be joined have a coating, when they are pressed together, they will bond.
- contact angle.** *Noun.* The angle between the tangent at the point of contact between a liquid drop and a surface; used to quantify the wetting of solids by liquids and the bonding between substrates and thin films.
- contact arc.** *Noun.* That portion of the circumference of a grinding wheel in contact with the work being ground.
- contact area.** *Noun.* The total area of the surface of a grinding wheel in contact with the work being ground.
- contact batch operation.** *Noun.* An adsorption process onto **activated charcoal** dispersed in a liquid being treated whereby the charcoal is removed after equilibrium.
- contact fatigue.** *Noun.* Cracking on surfaces subjected to alternating stress such as those encountered during rolling or sliding.
- contact pressure.** *Noun.* The force of contact between two surfaces per unit of area.
- contact twins.** *Noun.* Twinned crystals exhibiting growth in two directions from a composition plane.
- container.** *Noun.* Any receptacle used to hold something.
- container, glass.** *Noun.* See **glass container**.
- container sample.** *Noun.* Samples obtained from individual containers by use of a sample thief or other approved means.
- contaminate.** *Verb trans.* (1) To soil or change the composition by the introduction of impurities. (2) To make radioactive.
- contiguity.** *Noun.* Fraction of interface area shared by particles of the same phase in a microstructure of two or more phases. A more full definition is the area of bonding between grains per unit of bulk volume of the sample. Many physical and mechanical properties, such as electrical **resistivity**, **fracture toughness**, **Vickers hardness** and **tensile properties** are related to the **contiguity parameter**. In an α - β phase mixture it is expressed as: $C_\alpha = 2S_v^{\alpha\alpha}/[2S_v^{\alpha\alpha} + S_v^{\alpha\beta}]$ and $C_\beta = 2S_v^{\beta\beta}/[2S_v^{\beta\beta} + S_v^{\alpha\beta}]$, where C_α and C_β denote contiguities of α and β , $S_v^{\alpha\alpha}$ and $S_v^{\beta\beta}$ are the interface areas of the α and β particles per unit volume and $S_v^{\alpha\beta}$ is the area of interface between α and β particles per unit volume. The contiguities can be found from intercept measurements on a random plane of polish: $C_\alpha = 2N_L^{\alpha\alpha}/[2N_L^{\alpha\alpha} + N_L^{\alpha\beta}]$ and $C_\beta = 2N_L^{\beta\beta}/[2N_L^{\beta\beta} + N_L^{\alpha\beta}]$, where N_L is the number of intercepts of the three types.
- contiguity parameter.** *Noun.* See **contiguity**.
- contiguous.** *Adjective.* In contact. Touching along an edge or boundary. (2) Neighbouring; physically adjacent.
- continuity of coating.** *Noun.* The degree to which a porcelain-enamel or other ceramic coating is impervious; that is, free from **pinholes**, blisters, bare spots, **boiling**, **copperheads**, or other defects that would reduce its protective properties.
- continuous-chamber kiln.** *Noun.* A chamber kiln in which the arched roof is constructed in a position transverse to the length of the kiln.
- continuous cleaning.** *Adjective.* A term describing a particular type of porcelain-enamel that will oxidise and remove food soils accumulated on the interior surfaces of cooking ovens at normal temperatures and conditions of use.
- continuous control.** *Noun.* An automatic system designed to control a manufacturing process or operation.
- continuous distribution.** *Noun.* Concerning powders this is a description of a powder in which all possible particle sizes within a range are present. For example a particle size given as passing a 150 μm **screen** means that all sizes below 150 μm are present.
- continuous drier.** *Noun.* A drier in which the ware moves through the drying cycle in an uninterrupted flow pattern as opposed to a batch-type drier.

continuous filament. CF. *Noun.* A glass or other ceramic fibre of great and indefinite length. This type of fibre is made by pulling coarse filaments, themselves formed by feeding material into a heated zone at a slower rate than the fibre is pulled away.

continuous filament yarn. *Noun.* Yarn formed by twisting two or more **continuous filaments** into a continuous strand. One filament yarn is called **monofilament**; other numbers of filaments are called **multifilament**.

continuous furnace. *Noun.* A furnace or kiln into which ware is fed continuously without interruption and through which the ware progresses until the firing operation is complete.

continuous glass tank. *Noun.* A glass furnace in which the molten glass is maintained at a constant level by continuously charging new batch into the furnace in an amount equal to the amount of molten glass withdrawn.

continuous kiln. *Noun.* See **continuous furnace**.

continuous laminating. *Verb.* Chopped strand and continuous reinforcing mat are automatically and continuously passed through resin and combined between flexible covering sheets.

continuous mixer. *Noun.* A mixer in which materials are charged, mixed, and discharged in a continuous pattern of flow.

continuous moving bed. *Noun.* An adsorption process characterised by the flow of a fluid through a continuously moving bed of granular material, such as **activated carbon**, with the continuous withdrawal of the spent granular material from the bottom of the bed being replaced by new or reprocessed material at the top.

continuous particle distribution. *Noun.* A powder containing all possible particle sizes within a given range. If a ceramic body has a particle size distribution given as 100 % passing 150 μm , all particle sizes below 150 μm will be present.

continuous production. *Noun.* A sequence of production operations involving the continuous flow of material from one station to the next without interruption. Often controlled by a computer.

continuous retort. *Noun.* A refractory- or glass-lined vessel in which substances are distilled or disintegrated by heat on a continuous basis.

continuous smelter. *Noun.* Any smelter into which a batch is charged, melted, and discharged continuously.

continuous spectrum. *Noun.* The emission spectrum of incandescent ceramics is continuous because it contains all wavelengths over the majority of its range.

continuum states. *Plural noun.* States where the **wave function** of the system extends throughout space and the allowed energy values are continuous.

contraction. *Noun.* The process of diminishing in size, for example, the reduction in the size of concrete during setting or the shrinkage of a ceramic body during drying or firing.

contraction crack. *Noun.* A crack developing in a body due to the stresses induced by excessive shrinkage.

contraction joint. *Noun.* An intentionally placed crack or groove in concrete or a masonry unit to create a plane of weakness so that the unit will crack at the weakened groove and minimise the development of random cracks during setting and during the service life of the unit.

contrast. *Verb.* To compare materials and products in such a way to show differences.

contrast ratio. *Noun.* The ratio of the **reflectance** of a coating over a black substrate to its reflectance over a substrate having a reflectance value of 80 %.

control. *Verb.* To direct, check, test and verify the performance of a process or the quality of a product during a manufacturing operation.

control board. *Noun.* See **console**.

control, criticality. *Noun.* See **criticality controls**.

controlled atmosphere. *Noun.* A specified concentration of gas or mixture of gases at a specified temperature and pressure and sometimes at a specified humidity, in which selected processes take place.

controlled cooling. *Noun.* The cooling of an object from an elevated temperature in a predetermined manner or under specified conditions.

controlled fission. *Noun.* Fission under conditions of continuous adjustment of control rods and of other control devices in a reactor that compensates for the changes in excess reactivity, which result from high-power operation and from nuclear reactor temperature fluctuations.

controlled fusion. *Noun.* The generation of power under controlled thermonuclear fusion reactions.

control panel. *Noun.* See **console**.

control, process. *Noun.* See **process control**.

control, quality. *Noun.* See **quality control**.

control rod. *Noun.* A device, usually a neutron-absorbing material, such as boron, used to control chain reactions, particularly in nuclear reactors. Control is exercised by lowering or raising the rod within the reactor core.

control specimens. *Plural noun.* A set or sets of samples taken from a **batch**, kept under specified conditions and tested as needed to allow changes in physical properties of material from the same batch and now in use in the specified conditions, to be evaluated.

- control standard.** *Noun.* Any of the standards of various types having known parameters which are used for the evaluation of materials and products, or which may be used to adjust the sensitivity setting of test instruments, or for periodic adjustment to sensitivity.
- control tests, quality.** *Noun.* See **quality control tests**.
- convection.** *Noun.* The transfer of heat by the circulatory motions in air or fluids due to warmer portions rising and cooler portions sinking.
- conventional hardness.** *Noun.* The indentation hardness defined as applied load over contact area: $H = F/A_c$.
- convergence.** *Noun.* The approach to a common centre or point.
- conversion.** *Noun.* The change of a compound from one isomorphous form to another as in the high-temperature conversion of **quartz** to **crystalite** and **tridymite**.
- convective heat flux.** J_Q . *Noun.* The heat removed from a hot solid by surface convection. See **surface convection**.
- conversion factor.** *Noun.* The numerical factor by which a quantity must be multiplied or divided in order to convert the quantity from one unit of terminology to another.
- converter.** *Noun.* A refractory-lined furnace in which air is blown through or across molten metal to remove impurities by oxidation.
- converter, Bessemer.** *Noun.* See **Bessemer converter**.
- converter reactor.** *Noun.* A nuclear reactor for converting one fuel into another.
- conveyor.** *Noun.* A machine designed for the continuous transport of items from one location to another.
- conveyor, air.** *Noun.* See **air conveyor**.
- conveyor, apron.** *Noun.* See **apron conveyor**.
- conveyor belt.** *Noun.* An endless belt, running between head and tail pulleys, used to transfer loose material or objects from one location to another.
- conveyor, chain.** *Noun.* See **chain conveyor**.
- conveyor, roller.** *Noun.* See **roller conveyor**.
- conveyor, screw.** *Noun.* See **screw conveyor**.
- conveyor, slide.** *Noun.* See **slide conveyor**.
- conveyor, spiral.** *Noun.* See **spiral conveyor**.
- coolant.** *Noun.* A liquid applied to the work or grinding wheel during grinding to keep the work from overheating and oxidising, which keeps the tool cool to prevent reduction in hardness and resistance to abrasion, and which washes away chips and grits, and aids in obtaining a finer finish.
- cooler.** *Noun.* An auxiliary section in a cement kiln in which the **clinker** is cooled before grinding.
- cooler nail.** *Noun.* A cement-coated nail.
- cooling arch.** *Noun.* A stationary **lehr** in which glass is annealed.
- cooling curve.** *Noun.* A time-temperature curve denoting the rate at which a fired or heated product is cooled, usually to room temperature.
- cooling-down period.** *Noun.* (1) The elapsed time between the opening of a covered glass-melting pot and the time the glass is sufficiently cool to work. (2) The period between the **fining** stage and the removal of glass from a furnace.
- cooling process.** *Noun.* The removal of heat from a substance.
- cooling rate.** *Noun.* The time required for a glass or fired ceramic to cool between the limits of the working range.
- cooling stress.** *Noun.* Stress resulting from uneven contraction during the cooling period because of uneven temperature distribution in a body or because of anisotropic thermal expansion of the crystalline phases.
- cooling zone.** *Noun.* The section in a continuous furnace or kiln in which ware is permitted to cool following the firing operation.
- cool pigments.** *Plural noun.* Coloured oxides that are designed to retain strong absorbance in the visible region but have low absorbance in the infrared and so not get hot in sunlight; **yttrium indium manganese oxide** is a good example.
- cooperative luminescence.** *Noun.* See **frequency up-conversion**.
- Cooper pair.** *Noun.* The concept that in a superconducting material the **wave function** for electron energy calculation is based on pairs of electrons weakly bound together and not individuals.
- coordination number.** *Noun.* The number of nearest-neighbour atoms or ions for any specific atom or ion in a structure.
- cope.** *Noun.* (1) The upper portion of a flask, mould, or pattern. (2) Another name for **coping**.
- copestone.** *Noun.* A stone used to form a **coping**. Also called **coping stone**.
- coping.** *Verb.* (1) To shape stone or other hard ceramic material by the use of a grinding wheel. (2) *Noun.* The sloping top course of a wall made of **brick** or **masonry**.
- coping stone.** *Noun.* See **cope stone**.
- copita.** *Noun.* A tulip-shaped glass used for drinking sherry.

Coplan's construction. *Noun.* See **yield point**.

copper acetate. *Noun.* See **verdigris**.

copperas, green copperas. *Noun.* $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$. Ferrous sulphate; used as a red ceramic colorant. Also called **green vitriol**.

copper carbonate. *Noun.* $\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$. A basic salt used as red, blue, and green colourant in glazes. Also known as **mineral green**. **Malachite green**, $\text{Cu}(\text{OH}) \cdot \text{CuCO}_3$ and **blue azurite**, $\text{Cu}(\text{OH})_2 \cdot 2\text{CuCO}_3$ are natural variants. Also known as **verditer**.

copper enamels. *Plural noun.* Porcelain-enamels formulated specifically for use as a decorative and protective coating on copper; usually of high thermal expansion.

copper fluoride. *Noun.* $\text{CuF}_2 \cdot 2\text{H}_2\text{O}$. Used in porcelain-enamels and glazes, both as a flux and colourant. Mp 785°C ; density $4,230\text{ kg m}^{-3}$.

copperhead. *Noun.* A defect occurring in porcelain-enamel ground coats that appear as small freckle-like, reddish-brown spots consisting essentially of iron oxide.

copper indium gallium selenide. CIGS. *Noun.* $\text{CuIn}_{0.75}\text{Ga}_{0.25}\text{Se}_2$. A semiconductor thin film material used in solar cell applications.

copper indium selenide. CIS. *Noun.* CuInSe_2 . A material with high absorbance of solar radiation.

copper metaborate. *Noun.* $\text{Cu}(\text{BO}_2)_2$. Used as pigment in ink for painting on porcelain and other ceramics. Density $3,860\text{ kg m}^{-3}$.

copper oxide, black. *Noun.* See **black copper oxide**.

copper oxide, red. *Noun.* See **red copper oxide**.

copper pyrites. *Noun.* Another name for **chalcopyrite**.

copper-red glaze. *Noun.* A traditional glaze used in China; its **hue** varies with firing atmosphere as Cu-CuS-bubble defects become clustered from $2\text{ }\mu\text{m}$ in size downwards. Analysis is typically: (wt. %) CuO (2.4), CaO (17), $\text{K}_2\text{O}/\text{Na}_2\text{O}$ (3.8), Al_2O_3 (13.9), Fe_2O_3 (1.2), SiO_2 (60.5), TiO_2 (0.05).

copper sulphate. *Noun.* $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$. Used as the colorant in the production of **copper-ruby glass**. Used to kill moulds and fungi in reusable moulds. Found naturally as **chalcanthite**. Dehydrated at 200°C ; decomposes at 340°C ; density $2,284\text{ kg m}^{-3}$.

copper titanate. *Noun.* CuTiO_3 . A **perovskite** that is an additive to promote high fired density in perovskite bodies.

copper wheel engraving. *Verb.* To use a copper wheel, onto which abrasive is fed, to grind a pictorial decoration on **lead crystal** and domestic glassware.

coprolite. *Noun.* Rounded stony nodules believed to be fossilised faeces of Mesozoic reptiles.

coquille. *Noun.* A ceramic dish resembling a shell.

coquimbite. *Noun.* Hydrated **ferric sulphate** found in volcanic fumaroles and in some rocks.

coquina. *Noun.* A soft **limestone** containing shells, etc.

coral. *Noun.* (1) A **calcareous** material coming from the skeletons of small sea creatures forming rock-like aggregates. (2) A deep-pink to yellowish-pink colour.

coralline. *Adjective.* Resembling or of the colour of **coral**.

corallite. *Noun.* The skeleton of a **coral** polyp.

coralloid. *Adjective.* A description of a mineral crystal habit whose shape resembles corals.

coral red. *Adjective.* Low-temperature colour produced in porcelain-enamel and glazes by **lead chromate**.

coral reef. *Noun.* An undersea limestone ridge consolidating **corals** and **organic matter**.

corals. *Plural noun.* Inorganic **stains** for use as glaze colorants that get their colour from small crystals of **iron oxide** being completely surrounded by larger crystals of silicate. See **zircon iron corals**.

corbeil. *Noun.* Carved ornaments on ceramics or buildings in the form of baskets of fruit, flowers, etc.

corbel. *Noun.* (1) A bracket usually made from brick or stone. (2) *Verb trans.* To lay bricks or stone so that it forms a corbel.

corbelling. *Noun.* A set of **corbels** stepped outwards one above another.

corbel out. *Verb.* To support on **corbels**.

cord. *Noun.* An attenuated glassy inclusion possessing optical and other properties differing from those of the surrounding glass. Arises from such occurrences as a glassy drip from the ceiling of the furnace, or unmelted SiO_2 causing volumes of off-composition glass.

cordierite. *Noun.* $\text{Mg}_2\text{Al}_4\text{Si}_5\text{O}_{18}$. A low-thermal-expansion, orthorhombic silicate; formed or used in electronic-ceramic, **stoneware**, **porcelain**, and vitreous-china bodies to improve the thermal-shock resistance of the articles. When found as the grey or violet mineral in which Fe^{2+} replaces some of the magnesium it is called **dichroite** or **iolite**. Density $2,600\text{--}2,660\text{ kg m}^{-3}$; hardness (Mohs) $7.0\text{--}7.5$.

cordierite porcelain. *Noun.* A vitreous ceramic white-ware for technical applications in which cordierite is the essential crystalline phase.

cordierite whiteware. *Noun.* Any ceramic whiteware in which cordierite is the essential crystalline phase.

core. *Noun.* (1) One or more members supported within an extrusion die to form holes in extruded brick or tile.

(2) A cylinder of concrete taken from concrete by means of a core drill for testing or archival purposes. (3) The central part of a sand mould used in foundries. (4) The central part of a plaster mould used in solid casting. (5) A one-piece, heat-insulating shape used at the top of ingot moulds. (6) The central part of a laminate. (7) The part of a magnetic circuit that is situated within the winding.

core buster. *Noun.* A **reticulated ceramic** sleeve inserted at specified locations along the inside of radiant tubes to modify the heat transfer mechanism from the flames in a furnace. Often made by ceramic slurry infiltration of a polymeric foam followed by a heat treatment.

cored brick. *Noun.* A brick that is at least 75 % solid in any plane parallel to the load-bearing surface.

core loss. *Noun.* Total power loss in the core of a magnetic circuit when subjected to cycles of magnetisation. It is due to **magnetic hysteresis** and eddy currents. Expressed as **watts** at a given frequency and maximum flux density.

core making. *Verb.* The compacting of a **core sand** mixture into a desired shape.

core-shell hybrid composite. *Noun.* See **hybrid composite**.

core-shell nomenclature. *Noun. Convention.* A naming system developed to describe reactive thin-film deposits on spherical ceramic substrate particles. The substrate spheres are named, then the @ sign, then the host crystal, colon, and then the embedded **phosphor** ion etc. For example, $\text{SiO}_2\text{:SrAl}_2\text{Si}_2\text{O}_8\text{:Eu}^{2+}$.

core-shell structure. *Noun.* A microstructure consisting of well-dispersed, submicron, spherical substrate particles with a narrow size distribution on which a thin layer of coating is deposited that has desirable functional properties. Typically the layer is 20–50 nm thick and can be laid down by several techniques, such as **coprecipitation**, **sol-gel**, surface reaction, vapour phase epitaxy etc.

core store. *Noun.* Synonym for a memory device in computer technology.

core, strainer. *Noun.* See **strainer core**.

core wash. *Noun.* Refractory materials in suspension and then applied to a **casting core** surface and dried.

coring. *Noun.* (1) A phenomenon in solid solutions when too rapid cooling results in a non-equilibrium distribution of composition in the grains. (2) A black or grey course in the interior of a brick, usually associated with carbonaceous clays and other organic matter that have had insufficient oxidation before vitrification of the surface.

Corinthian. *Adjective.* Relating to one of the five classical **orders** of architecture: characterised by bell-shaped capitals with carved ornaments based on acanthus leaves.

cork. *Noun.* The outer bark of a species of oak growing in Mediterranean countries. Used to protect ceramic test pieces in the jaws of a **tensiometer**.

cornelian. *Noun.* A form of **chalcledony**. See **chalcledony**.

corner joint. *Noun.* An L-shaped joint formed by two members perpendicular to each other as used in construction.

corner rolls. *Noun.* A half-round unit of asbestos cement used to trim and flash corners in asbestos-cement installations.

cornerstone. *Noun.* A stone at a corner uniting two intersecting walls. Also called **quoin**.

corner wear. *Noun.* The wear of abrasive wheels on the edges of the outer rims.

cornice. *Noun.* A continuous horizontal projecting course or moulding at the top of a wall or building.

corniculate. *Adjective.* Having hornlike projections.

Corning code. CC. *Noun.* A numerical list of glass compositions, for example **borosilicate glass** is CC 8870 and **vykor-R** is CC 7930.

Cornish stone. *Noun.* Partially decomposed **granite** in which **quartz**, **feldspar**, and fluorine minerals are the major constituents: used as a flux in the production of ceramic whiteware. Also known as **china stone**, **Cornish clay**.

corn polenta. *Noun.* A main source of starch used as a green body binder.

cornstone. *Noun.* A mottled red and green limestone.

cornu prism. *Noun.* A 60° prism made by joining two 30° prisms at a face. One prism is made from right-handed and one from left-handed **quartz**. The **optic axis** of the quartz is parallel to the base of the composite prism. This arrangement prevents double refraction of circularly **polarised light** from occurring and so is used in spectrometers.

corona. *Noun.* A pale violet glow observed around a high-field electrode usually in excess of 5,000 V; caused by ionisation of the surrounding gas.

corrasion. *Verb.* Erosion of rock surfaces by particles carried across it by water or wind.

correlation. *Noun.* (1) A reciprocal relationship between two or more things. (2) In statistics it is the degree of quantitative association between two variables. It is positive or direct when two variables move in the same direction and negative or inverse when they move in opposite directions.

correlation coefficient. *Noun.* A statistical value measuring the degree of **correlation** between two variables obtained by dividing their **covariance** by the square root of the product of their **variances**.

correlation factor. *Noun.* See **resolved shear stress**.

correlation time. τ_c . *Noun.* A period of time used to describe relaxation processes; for example, it is the average time for a molecule to rotate by one radian.

Corrodokote test. *Noun.* An accelerated corrosion test applied to electrodeposits.

corrosion. *Noun.* The destruction or wearing away of a material by chemical action.

corrosion fatigue. *Noun.* Failure of a material or a structure that results from the simultaneous action of a cyclic stress and chemical attack.

corrosion of refractories. *Noun.* The destruction and wearing away of refractories by the chemical action of external agents such as fluxes.

corrosion penetration rate. CPR. *Noun.* The thickness loss per unit of time as a result of corrosion. Usually expressed as mils per year or millimetres per year.

corrosives. *Plural noun.* Chemicals capable of destroying living tissue, such as skin, eyes, mucosa, by chemical action.

corrosive sublimate. *Noun.* Another name for **mercuric chloride**.

corrugated. *Adjective.* Sheets of materials formed into alternating ridges and grooves.

corrugated asbestos board. *Noun.* Sheets of asbestos cement formed to produce a wavy or corrugated contour.

corrugated glass. *Noun.* Sheets of glass rolled into a wavy, furrowed, or corrugated form.

corrugations. *Noun.* Sometimes called sinuous variations; a general class of defect that can occur in glass made by the float process. It is a regular waviness of the top and bottom surfaces of the glass sheet.

corundum. *Noun.* α - Al_2O_3 . (1) Single crystal aluminium oxide; artificially made by pulling a seed crystal from molten alumina; tough, abrasion resistant; employed in instrument bearings, fibre-pulling dies, lasers, and other products where resistance to high temperatures and mechanical damage is needed. Often used as gemstones. (2) A variously coloured mineral found in **metamorphosed** shales and limestone, in veins and in some **igneous rocks**. The red variety is **ruby** and the blue variety is **sapphire**. Mp 2,040 °C; density 3,980 kg m⁻³; hardness (Vickers) 26 GN m⁻².

coruscate. *Verb.* To sparkle or emit light flashes.

costrel. *Noun.* Old name for an **earthenware** flask.

cost, unit. *Noun.* See **unit cost**.

cotectic. *Noun.* The simultaneous crystallisation of two or more phases from a single liquid.

Cotterell precipitator. *Noun.* An electrostatic device used to remove dust particles from industrial waste gases, by attracting them to charged grids or wires.

cottle. *Noun.* The frame placed around a model to hold a plaster slurry until the plaster has set to form a mould.

cotton balls. *Noun.* Aggregates of radiating needle-like crystals that form white silky masses in mineral borates, such as **ulexite**, $\text{NaCaB}_5\text{O}_9 \cdot 8\text{H}_2\text{O}$.

coulomb. C. *Noun.* The derived **SI unit** of electric charge; the quantity of electric charge transported in 1 s by a current of 1 A.

coulomb field. *Noun.* The electrostatic field around an electrically charged body or particle.

coulombic force. *Noun.* A force between charged particles such as ions, it is a repulsive force when the particles have the same sign of charge.

Coulomb's law. *Noun.* The rule that the force, attractive or repulsive, between two point electrical charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them. The law extends to magnetic poles also.

count. *Noun.* A measure of yarn, made from ceramic fibre, per unit weight. The higher the count the finer the yarn. Each type of fibre has its own count system; for fibre glass yarn it is the number of 100 yard lengths per lb; e.g., 450 is 450, 100 yard strands per lb.

counter blow. *Verb.* To blow the **parison** from **blown glassware** after the initial shaping operation.

countercurrent adsorption. *Noun.* An adsorption process in which the fluid flow is directly opposite to the movement of the adsorbent.

coupler. *Noun.* (1) A rod transmitting power between two rotating, or a rotating and a reciprocating, parts. (2) A device such as a transformer, used to couple two or more electrical circuits.

coupling. *Noun.* (1) A device or substance for linking together two parts or things. (2) An interaction between different properties of a system. (3) *Verb.* To transfer energy from one part of a circuit to another.

coupling agents. *Plural noun.* Molecules of a substance oriented so that selected ions will react and bond with silicon ions on the surface of glass fibres, while the remainder of the molecule will react with resin during the curing operation, thereby coupling or bonding the glass fibre and resin together.

coupon. *Noun.* A small area cut from a production run which is used to establish quality.

course. *Noun.* A horizontal layer or row of brick, block, or other substance in a structure.

course, rowlock. *Noun.* See **rowlock course**.

coursing joint. *Noun.* A mortar joint between two masonry courses.

court plaster. *Noun.* A plaster made by spreading isin-glass onto silk.

covalent bond. *Noun.* A type of chemical bond described as the pairing of **electron wave orbitals** between adjacent atoms with a resultant energy loss to the system. Very directional in character, very strong leading to the highest values of **Young's modulus**.

covariance. *Noun.* A measure of the association between two variables found by dividing the product of the mean deviation of corresponding observed values of the two variables by the number of pairs of observed values.

cove. *Noun.* A concave tile or other moulding forming the junction between floor or ceiling of a room and the wall.

cover. *Noun.* (1) A refractory slab placed over a pot or other container to protect the contents from contamination, heat loss, etc. (2) An item of kiln furniture supporting the posts and top of a firing assembly, and protecting the ware being fired from damage from ware placed above.

coverage. *Noun.* The surface area to be continuously covered by a specific quantity of material.

cover coat. *Noun.* (1) A coating of porcelain-enamel applied and fused over a previously fired **ground coat**. (2) A finish-coat porcelain-enamel applied and fired on metal without benefit of a ground or intermediate coat.

covered pot. *Noun.* A refractory crucible or glass-melting pot covered with a refractory roof or slab during firing of its contents.

covering power. *Noun.* The degree to which a porcelain-enamel, glaze, or other coating obscures the underlying surface.

cove tile. *Noun.* Flanged tile used to complete floor and corner joints in walls.

CP. *Abbreviation.* Stands for chemically pure.

CP-AFM. *Abbreviation.* Stands for colloid probe atomic force microscope. See **colloid force atomic probe microscope**.

cP. *Abbreviation.* Stands for centipoise. See **poise**.

CPFT. *Abbreviation.* Stands for cumulative percent finer than. See **cumulative percent finer than**.

CQD. *Abbreviation.* Stands for colloidal quantum dots. See **colloidal quantum dots**.

CPR. *Abbreviation.* Standing for corrosion penetration rate. See **corrosion penetration rate**.

crack, cracking. *Noun.* (1) A fracture in a wet-process porcelain-enamel coating that has been dried but not

fired. (2) A break in a ceramic body or glaze. (3) The initial opening of a kiln after firing.

crack, grinding. *Noun.* See **grinding cracks**.

crack growth parameters. *Noun.* The constant B and the exponent n in the **static fatigue equation**. See **power law crack velocity relation**.

cracking, map. *Noun.* See **pattern cracking**.

cracking, pattern. *Noun.* See **pattern cracking**.

cracking, random. *Noun.* See **random cracking**.

crackle. *Noun.* (1) A textured effect obtained in wet-process porcelain-enamels characterised by a mottled or wrinkled finish. (2) Glassware, the surface of which has been cracked intentionally by immersion in water and then partially healed by reheating before the final shaping operation. (3) Decorative, intentional fissures netting the surface of a glaze. (4) *Verb trans.* To decorate pottery or porcelain by causing a fine network of cracks to appear in the glaze.

crackledama. *Adjective.* Textured finish in a wet-process porcelain-enamel resembling a wrinkled surface.

crackleware. *Noun.* Porcelain or pottery decorated by **crackle**.

crack off. *Verb.* To separate a glass article from the **moil** by breaking, first by scratching and then sharply heating.

crack pinning. *Plural noun.* Techniques, such as solid-state precipitation, developed to improve strength and hardness by hindering dislocation movement in crystalline solids and slowing crack front movement in both crystalline and non-crystalline solids.

crack, settlement. *Noun.* See **settlement crack**.

cracks, green. *Noun.* See **green cracks**.

crack, shrinkage. *Noun.* See **shrinkage crack**.

cracks, plastic. *Noun.* See **plastic cracks**.

crack stopper. *Noun.* A part of a design, such as a drilled hole used to delay crack propagation.

cranberry glass. *Noun.* A glass artefact decorated by producing a pale-red coloration from gold chloride introduced into the kiln atmosphere. Difficult to control the depth of colour.

crank. *Noun.* (1) A refractory support for the firing of glazed flatware. (2) A low **sagger** holding one porcelain plate. (3) A coarse-textured modelling clay usually containing about 20 % **grog** that fires well between 1,100–1,300 °C.

craquele. *Noun.* An alternate spelling of **crackle**.

crawling. *Noun.* (1) A porcelain-enamelling defect in which the fired coating has pulled away or rolled up at the edge of a panel or over dirt or grease, giving the

ridged appearance of agglomerates or of irregularly shaped islands. (2) A parting and contraction of glaze on the surface of ceramic ware during drying or firing, resulting in unglazed areas by the coalesced glaze. Also known as **tearing**.

craze, crazing. *Noun.* (1) To develop or cause to develop a fine network of cracks. (2) The cracking that occurs in fired glazes, porcelain-enamels, and other ceramic coatings due to critical tensile stresses in the coatings. Usually caused by a mismatch of the thermal expansion coefficient of the glaze and the body. (3) Hair-line cracks in concrete caused by tensile stresses created when the surface shrinks more rapidly than the interior

crazed. *Adjective.* Having a fine network of cracks in the glaze.

crazing resistance. *Noun.* The resistance of glazes, porcelain-enamels, and other ceramic coatings to cracking. See **craze**.

crazy lace agate. *Noun.* A form of **agate** that has an attractive patterning when polished by **tumbling**.

creased, sand. *Noun.* See **sand creased**.

credenite. *Noun.* See **silver copper oxide**.

creep. *Noun.* Deformation of a body as a function of a sustained stress at a value less than the yield stress, the temperature, and the time. Several mechanisms are responsible, e.g., vacancy diffusion, grain boundary diffusion, viscous flow.

creep compliance. *Noun.* The degree to which a fluid shears with time in response to a small applied stress.

creep modulus. *Noun.* The ratio of initial applied stress to creep strain.

crenel. *Noun.* An opening at the top of a wall or parapet having slanting sides, as in a battlement.

crenellate. *Verb.* To form square indentations in a moulding.

crenulate or crenulated. *Adjective.* Having a margin very finely notched with rounded projections.

crenulation. *Noun.* A tooth or notch in a crenulated structure.

crenulations. *Plural noun.* Multiple kinks in a fibre.

crepitate. *Verb.* To make a rattling or cracking sound.

cretaceous. *Adjective.* Consisting of or resembling chalk.

crevice corrosion. *Noun.* Corrosion occurring within or close to a boundary between materials.

cribiform. *Adjective.* Sieve-like; pierced with holes.

cricondenbar. *Noun.* The maximum pressure at which two phases can coexist.

cricondentherm. *Noun.* The maximum temperature at which two phases can coexist.

crimp. *Verb.* To cause to become wrinkled, wavy, or bent as a means of strengthening the edges of metal shapes prior porcelain-enamelling.

crinkled. *Adjective.* A textured porcelain-enamelled surface characterised by a fine wrinkled or rippled appearance.

crispate. *Adjective.* Having a curled or wavy appearance.

crystalite. *Noun.* A crystalline polymorph of **silica** formed by the inversion of **quartz** at 1,470 °C. A major component of **silica refractories**; also used in investment casting of metals; sometimes present in siliceous ceramic bodies. Mp 1,713 °C.

critical angle. α_c . *Noun.* An angle of incidence given by the formula $\alpha = \sin^{-1}(n_2/n_1)$, where n_2 and n_1 are refractive indices of two dielectric materials making an interface with each other. The light ray is in the medium with $n_2 > n_1$. At angles greater than α_c **total internal reflection** occurs and no refracted beam into the n_2 medium is produced.

critical bed depth. *Noun.* The minimum depth of an adsorbent bed required to maintain the **mass-transfer zone**.

critical constants. *Plural noun.* Physical constants that define the properties of a substance in its **critical state**.

critical current density. J_c . *Noun.* The current density in a **superconductor** that destroys the superconducting effect. It is a function of temperature and applied magnetic field, approaching zero as either the **magnetic induction** approaches B_c or the sample temperature approaches T_c . For practical applications $J_c > 10^3$ A mm⁻² are needed; so far YBa₂Cu₃O₇ has achieved 10² A mm⁻².

critical diameter. *Noun.* A parameter for bricks that specifies the size below which 90 % of the porosity exists. Frost resistance is related to this parameter and a brick is frost resistant if the critical diameter is ≥ 1.8 μ m. See also **Maage durability factor**.

critical fibre aspect ratio. *Noun.* The ratio of fibre length to fibre diameter that will guarantee fibre fracture in a chopped strand composite. See **Halpin-Kardos equation**.

critical field. *Noun.* The maximum magnetic field strength that a superconductor can produce without damaging its superconductivity.

critical humidity. *Noun.* The humidity value, above which a solid salt will always become damp and below which it will always remain dry.

criticality. *Noun.* The condition whereby a chain reaction is allowed or accidentally occurs; sustaining a chain reaction is not necessary in the definition of criticality.

criticality controls. *Plural noun.* Mechanisms ensuring that criticality cannot occur. See **criticality**.

criticality incident. *Noun.* An accident caused by the accumulation of a critical mass fissile of material.

critical length. l_c . *Noun.* The minimum length of a **chopped strand fibre** that will guarantee that it can reach its failure stress; below l_c the fibre will **pull-out** and so contribute to composite toughness.

critical longitudinal fibre stress. *Noun.* The stress applied longitudinally that causes separation of fibres in a spun yarn by overcoming the inter-fibre friction.

critical magnetic field. *Noun.* The value of an externally applied magnetic field at which a **superconductor** becomes non-superconducting (normal). The two types of superconductors approach the change differently: **Type I superconductor**-material with perfect electrical conductivity for direct current that also possesses perfect **diamagnetism** (i.e., magnetic flux is totally excluded from the material), most metal element superconductors are Type I and the transition from superconducting to normal state is sharp. **Type II superconductor**-material with perfect electrical conductivity for direct current but does not possess perfect diamagnetism (i.e., flux penetration of the material is possible), most oxide superconductors are this type; metal alloys and compounds go through a broad "mixed state" region before becoming non-superconducting.

critical mass. *Noun.* The minimum mass of fissile material that can attain **criticality** with a specified geometrical arrangement and material composition.

critical moisture content. CMC. *Noun.* The water content of a clay brick after which no further volume contraction occurs on drying. All the water is in void space not between the particle faces. It marks the end of the constant drying rate period when there is an unbroken water film on the surface of the body.

critical path analysis. *Noun.* The sequence of stages requiring the longest time in a complex project is the **critical path**; critical path analysis is the study of alternative systems with reference to this time.

critical point. *Noun.* A point on a phase diagram that represents the critical state of a substance. See **critical state**.

critical pressure. *Noun.* The pressure of a gas or the saturated vapour pressure of a liquid or solid in its **critical state**.

critical radius. r^* . *Noun.* The radius of a solid particle in a liquid, above which, an increase in size will bring about a decrease in **free energy** of the system. Particles equal in size to r^* are called **nuclei**. $r^* = -2\gamma/\Delta G_v$ where γ is the **interfacial free energy** for solid-liquid, and ΔG_v is the free energy change per unit volume which occurs when a liquid solidifies.

critical resolved shear stress. τ_{crss} . *Noun.* The shear stress necessary to cause slip to take place along a given **slip plane** and direction. Defined as Schmid's law. See **Schmid's law**.

critical speed. *Noun.* The speed of rotation, above which, the vibration of a spindle carrying an abrasive wheel or point would be hazardous.

critical state. *Noun.* The state of a substance in which two of its phases have identical temperature, pressure, and volume.

critical stress intensity factor. K_{Ic} . *Noun.* A material parameter equal to $(2E\gamma_i)^{1/2}$, where E is **Young's modulus**, and γ_i is the effective **surface energy**. When the crack tip stress intensity reaches the K_{Ic} value the crack becomes unstable and propagates at high speed in brittle ceramics and glass.

critical supersaturation. *Noun.* The concentration of a **sol-gel** forming solution at which the **activation energy barrier** is low enough for the rate of production of **critical sized nuclei** to be dramatically increased so that sufficient will grow to produce a sol.

critical temperature. T_c . *Noun.* (1) A characteristic temperature for each superconducting material below which it has zero resistivity. For device applications superconductors should operate at $0.75 T_c$ and so for liquid nitrogen operation T_c around 100 K is needed. (2) The temperature of a substance in its critical state; to liquefy a gas by pressure alone it must be below its critical temperature.

critical volume. *Noun.* The volume occupied by 1 mol of a substance in its critical state.

critical volume fraction. *Noun.* The volume of brittle ceramic fibres in a ductile matrix, such as a metal, that must be exceeded before the strength of the composite exceeds the strength of the matrix material alone.

crizzle. *Noun.* (1) An imperfection in glass consisting of a multitude of fine surface fractures which do not penetrate into the glass to any appreciable distance. (2) A crack produced over a long period of time on the surface of glass when alkali metal ions are ion exchanged by hydrogen ions from atmospheric moisture. The evolved alkali is **hygroscopic** and attracts moisture making the surface slippery, this is described as **weeping**. (3) *Verb.* To become rough on the surface, as some kinds of stone or glass by scaling.

crocidolite. *Noun.* $\text{Na}_2\text{Fe}_3[\text{Si}_4\text{O}_{11}]_2(\text{OH})_2$. A blue **amphibole** fibrous silicate used in cement reinforcements and insulations but recently found to be a health hazard. Also known as **riebeckite** or **blue asbestos**.

crook. *Noun.* (1) An **earthenware** pot. (2) A **shard** of earthenware.

crockery. *Noun.* (1) A collective noun for china dishes, earthenware pots, etc. (2) A thick form of porous opaque pottery often fired at low temperatures.

crocoite. *Noun.* PbCrO_4 . Naturally occurring, monoclinic **lead chromate**. Also called **red lead ore**.

crocus abrasive. *Noun.* A mixture of iron oxide with a small amount of silica with a hardness approx. 6 Mohs, used in very fine polishing operations. See **colcothar**.

crocus cloth. *Noun.* A fabric impregnated with iron oxide; used as a fine polishing agent.

crocus martis. *Noun.* A purple or brownish red **iron oxide** used as a pigment in **decalcomanias** and glazes. A name used in the pigment industry for **iron oxides**.

Cromlech. *Noun.* A structure consisting of a large flat unhewn stone resting horizontally on three or more stones set upright. Originally the work of prehistoric peoples.

Crooke's glass. *Noun.* A glass of low ultraviolet transmission containing **cerium oxide** and other **rare earths**.

crossbar architecture. *Noun.* A microchip design where one set of parallel nanowires run perpendicular to another set forming a switch at each intersection. Easier and less expensive to manufacture than other sorts of silicon arrangements.

cross-bend test. *Noun.* A test in which **bisque** and fired porcelain-enamelled panels are progressively distorted by bending to determine the resistance of the coating to cracking.

cross-breaking strength. *Noun.* A measure of the resistance of a material to breakage under transverse stress.

crossed polars. *Noun.* A situation where a sequential pair of polars have their vibration direction perpendicular to each other and so no light is transmitted.

cross-feed grinding. *Noun.* The controlled movement of a grinding wheel over a horizontal workpiece resting on a worktable, the grinding being done at a prescribed rate or depth.

cross-fired furnace. *Noun.* A furnace in which fuel is supplied from side ports and flames cross the width of the furnace, hence at least 6 m wide.

cross grains. *Plural noun.* Tangled laminations in a body causing irregular or imperfect cleavage patterns.

cross section. *Noun.* (1) A cut through a substance, especially at right angles to a dimension. (2) Probability of a neutron-atom interaction; expressed as an area.

cross slip. *Noun.* Crossing of slip bands from one parallel **slip plane** to another when they approach closely to each other. Thus, the slip surface is two planes joined by parallel bands.

crown. *Noun.* (1) The top or dome of a furnace or kiln. (2) The top or highest point of the internal surface of the transverse cross-section of a concrete pipe. (3) The solid material gathered from the surface of a cooled condenser in a process involving vapours or gaseous products that condense to a solid.

crown blast. *Noun.* A stream of air introduced at the top of the exit of a tunnel kiln.

crown brick. *Noun.* A wedge-shaped brick at the crown of an arch that locks other bricks in place.

crown flint glass. *Noun.* An optical **crown glass** containing a substantial addition of **lead oxide** to produce a higher **dispersion** of light than the usual **optical crown glass**.

crown glass. *Noun.* (1) A hard, easily polished, highly transparent optical glass with high **refraction** and low **dispersion**, typically containing 72 % SiO_2 , 15 % Na_2O , and 13 % CaO . See **optical crown glass**. (2) A type of window glass shaped by whirling a glass bubble to form a flat circular disk with a lump in the centre formed on the glassblower's rod.

crown glass, barium. *Noun.* See **barium crown glass**.

crown glass, borosilicate. *Noun.* See **borosilicate crown glass**.

crown glass, lead-barium. *Noun.* See **lead-barium crown glass**.

crown glass, optical. *Noun.* See **optical crown glass**.

crown process. *Noun.* Obsolete way of making flat glass whereby a sphere is blown and a **punty** stuck on opposite the **blowpipe**; after cutting away, the cut sphere is spun to a disk.

crucible. *Noun.* A refractory vessel or pot in which a material may be melted or **calcined** at a high temperature.

crucible clay. *Noun.* Refractory ball clay used in the production of high-temperature crucibles or pots. See **ball clay**.

CRUD. *Colloquial noun.* A tenacious iron, nickel, chromium oxide deposit that forms on nuclear fuel element surfaces from stainless steel corrosion products. It reduces the heat transfer ability of the fuel rod.

crude-dressed mica. *Noun.* Crude mica from which dirt, rock and other contaminants have been removed.

crude mica. *Noun.* Mica in the state as mined, with dirt, rock and other contaminants still present.

cruse. *Noun.* A small **earthenware** container used for liquids.

crush. *Verb.* (1) To grind or break solid substance into small bits or fragments. (2) *Noun.* A defect consisting of lightly pitted, dull-grey areas on flat glass sheets.

crush dressing. *Verb.* To use steel rolls to form or dress the face of grinding wheels to a desired contour.

crushed bort. *Noun.* See **bort**.

crushed gravel. *Noun.* The product resulting from the artificial crushing of gravel with substantially all fragments having at least one face resulting from fracture; used as aggregate in concrete

crushed stone. *Noun.* The product resulting from the artificial crushing of rocks, **boulders**, or **cobblestones**, substantially all faces of which have resulted from the crushing operation.

crusher. *Noun.* A device that breaks or grinds substances into smaller particles.

crusher cone. *Noun.* A crushing device consisting of a gyrating cone in a conical cavity with tapered clearances such that material is reduced in size several times during passage.

crusher, conical. *Noun.* See **conical crusher**.

crusher, disintegrator. *Noun.* See **disintegrator crusher**.

crusher, gyratory. *Noun.* See **gyratory crusher**.

crusher, impact. *Noun.* See **impact crusher**.

crusher, intermediate. *Noun.* See **intermediate crusher**.

crusher, jar. *Noun.* See **jar mill**.

crusher, jaw. *Noun.* See **jaw crusher**.

crusher, muller. *Noun.* See **muller**.

crusher, primary. *Noun.* See **primary crusher**.

crusher, ring. *Noun.* See **ring crusher**.

crusher, rod. *Noun.* See **rod mill**.

crusher, roll. *Noun.* See **roll crusher**.

crusher, rotary. *Noun.* See **rotary crusher**.

crusher, sawtooth. *Noun.* See **sawtooth crusher**.

crusher, secondary. *Noun.* See **secondary crusher**.

crusher, single-roll. *Noun.* See **single-roll crusher**.

crusher, vibratory. *Noun.* See **vibratory crusher**.

crushing. *Verb.* To reduce the size of lump material by mechanical means.

crushing, choke. *Noun.* See **choke crushing**.

crushing strength. *Noun.* The property of a material to resist breakdown under externally applied compressive loads, calculated as the load in newtons per square metre required to fracture the specimen.

crustal. *Adjective.* Of or relating to the earth's crust.

cryocable. *Noun.* A cable cooled by liquid nitrogen to make it more conducting.

cryogenic grinding. *Verb.* To apply low temperatures in ball milling in order to powder material that is ductile or plastic at ambient temperatures. Also known as **freeze grinding**.

cryogenics. *Noun.* The study of the production of extremely low temperatures and their effects on materials.

cryohydrate. *Noun.* A crystalline substance containing water and a salt in definite proportions; a **eutectic** crystallising below the freezing point of water.

cryolite. *Noun.* Na_3AlF_6 . An aluminofluoride mineral used in **opal glass** and porcelain-enamels as a flux and **opacifier**, as a filler in grinding wheels, as a flux in whiteware bodies, and as a constituent in dental cements, light bulbs, and welding-rod fluxes. Also used in aluminium extraction. Mp 1,000 °C; density 2,950–3,000 kg m⁻³; hardness (Mohs) 2.5.

cryostat. *Noun.* A vessel that can be maintained at a specified low temperature; a low-temperature thermostat.

cryotron. *Noun.* A type of switch that depends on superconductivity. It consists of a wire surrounded by a coil in a liquid helium bath. Both the wire and the coil are superconducting and a low voltage can produce a current in the wire. If a current is also passed through the coil its magnetic field alters the superconducting properties of the wire and switches off the current, thus the presence or absence of a current in the coil determines the ability of the wire to conduct.

crypt or crypto. *Combining form.* Forming words with the meaning hidden or obscure.

cryptoclastic. *Adjective.* A description of rocks and minerals composed of microscopic fragments.

cryptocrystalline. *Adjective.* A crystalline structure in which the individual crystals are so small that they are not visible under a **petrographic microscope** using **polarised light**.

cryptoefflorescence. *Adjective.* The state where **magnesium sulphate** does not **effloresce** to the surface of brick but crystallises just below the surface where it can cause deterioration.

cryptometer. *Noun.* An instrument for measuring the opacity of pigments.

cryst. *Abbreviation.* Stands for crystalline or crystal.

crystal. *Noun.* A chemically homogeneous solid having a defined internal structure and, if developed under favourable conditions, having a characteristic external form bounded by plane surfaces.

crystal carbonate. *Noun.* $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$. Naturally occurring **sodium carbonate** hydrate.

crystal cartridge. *Noun.* See **cartridge**.

crystal class. *Noun.* Any of 32 possible types of crystals, classified according to their rotational symmetry about a point. Also called **point group**.

crystal counter. *Noun.* An instrument used to detect and measure high-energy radiation intensity by the momentary increase in conductivity of a crystal caused by the radiation.

crystal field theory. *Noun.* A theory relating the symmetry of the anions around d-transition cations in solids to electrical, magnetic, and chemical properties. It provides simple rules for predicting these properties by analysing how the d-orbital degeneracy is lifted in electrostatic fields of given symmetry as a function of field strength.

crystal glass. *Noun.* A colourless, highly transparent glass used for art and tableware, contains **lead oxide**, PbO, in its composition and is frequently deeply cut to emphasize its brilliance.

crystal habit. *Noun.* The size and shape of a crystal.

crystal laser. *Noun.* A solid laser of high-purity crystalline or doped crystalline material, such as pure or doped **ruby**; used for generating a coherent beam of output light. See **laser**.

crystal lattice. *Noun.* A regular array of points in space, on or about which the atoms or ions of a crystal are centred. Each lattice point must have the same orientation in space.

crystalline. (1) *Noun.* The state of a solid material characterised by a periodic and repeating three-dimensional array of atoms, ions or molecules. (2) *Adjective.* Composed essentially of crystals.

crystalline discoloration. *Adjective.* Discoloration appearing as lighter or darker shades of the basic colour of **mica**.

crystalline glaze. *Noun.* A glaze containing macroscopic crystals that have grown during the cooling period following a firing operation.

crystallite. *Noun.* A crystal with at least one microscopic or sub-microscopic dimension occurring in a microstructure.

crystallisation, water of. *Noun.* See **combined water**.

crystallographic shear plane. CSP. *Noun.* A concept and a mechanism for materials to accommodate large degrees of **nonstoichiometry** whereby **vacancies** are concentrated in selected crystallographic planes and so change the octahedral linkage pattern in those planes. In order to achieve new linkage patterns a mechanism of **shear** is envisaged. CSP are found to be regularly spaced giving a microstructure of unperturbed blocks of original structure of equal thickness separated by narrow CSPs of changed composition.

crystallographic slip. *Noun.* Dislocation movement on planes within a crystal when the **critical resolved shear stress is exceeded**.

crystal pick-up. *Noun.* A gramophone pick-up employing a **piezoelectric ceramic** to turn the movements of the stylus into electrical signals.

crystal, polar. *Noun.* See **polar crystal**.

crystal, quartz. *Noun.* See **quartz crystal**.

crystal, rock. *Noun.* See **rock crystal**.

crystal, semiconducting. *Noun.* See **semiconducting crystal**.

crystal structure. *Noun.* The arrangement of atoms or molecules in a crystal. The geometry of the unit cell, the number of atoms in the cell, and the coordinates of each atom within that cell define it.

crystal system. *Noun.* A set of axes; one of seven classifications of crystals defined by their symmetry. The classes are cubic, tetragonal, hexagonal, orthorhombic, monoclinic, and triclinic.

Crystolon. *Trademark, noun.* Stands for an abrasive form of **silicon carbide**.

C-SAM. *Acronym.* Stands for catch-scan acoustic microscopy. See **catch-scan acoustic microscopy**.

c-scans. *Plural noun.* Systems used to map defects in ceramics and other solids by scanning a **piezoelectric** transducer over the surface of a specimen and then detect the decline in the magnitude of the reflected echoes. A computer controls a two- or three-axis scanning frame and also analyses the echoes to produce a visual image.

CSP. *Abbreviation.* Stands for crystallographic shear plane. See **crystallographic shear plane**.

CSZ. *Abbreviation.* Stands for calcia stabilised zirconia. See **calcia stabilised zirconia**.

CTL. *Abbreviation.* Stands for composite tape laying. See **composite tape laying**.

cubic. *Adjective.* Relating to the crystal system that has 3 equal length axes that intersect at right angles. **Diamond**, **fluorspar** and **garnet** are examples of ceramics in this crystal system. Sometimes called **isometric**.

cubical expansion. *Noun.* The increase in volume of a material with increase in temperature and decrease in pressure.

Cubitron 321. *Trademark, noun.* A composite of cellular sub-micron **α -alumina** with cell sizes in the range 2–5 μm with platelets of **rare earth magnetoplumbite**, $\text{Mg(RE)Al}_{11}\text{O}_{19}$, within and between the cells. The grains of the composite are harder than **fused alumina** but less hard than **diamond**. Hardness (Vickers) 19 GN m^{-2} ; toughness k_{IC} equal to 4 $\text{MN}^{-3/2}$.

- cuenca.** *Adjective.* A pattern style on tiles where a sunken pattern is surrounded by a raised outline.
- culet.** *Noun.* The flat face at the bottom of a gemstone.
- cull.** *Noun.* Material rejected as being below standard and therefore unacceptable.
- cullet.** *Noun.* Waste or broken glass recycled as an addition to **raw batch** to facilitate melting in the manufacture of glass.
- cullet cut.** *Noun.* A scratch imperfection in glass caused by a particle of **cullet** lodged in the polishing felt during the polishing operation.
- cullet, raw.** *Noun.* See **raw cullet**.
- culm.** *Noun.* (1) Coal mine waste. (2) Inferior **anthracite**.
- culvert.** *Noun.* A covered channel or pipeline under a highway, railroad, canal, or similar construction for the conveyance of water.
- cumulative percent finer than. CPFT.** *Noun.* A way used to describe quantitatively the composition of a **continuous distribution** powder. It is used in conjunction with the Andreasen formula. See **Andreasen equation**.
- cumulative weighing.** *Verb.* The weighing of materials successively on the same scales, the weights being added to the previous weights of the batch.
- cupel.** *Noun.* A small crucible made of **bone ash** used in assay work.
- cup gun.** *Noun.* A spray gun with a fluid container or cup attached as an integral part so as to feed the fluid into the atomising nozzle or air stream.
- cupola.** *Noun.* A circular, vertical furnace, for the melting of iron.
- cupping.** *Verb.* (1) The pouring of porcelain-enamel slip over an item or part during draining to obtain a smoother and more uniform coating. (2) *Noun.* A concave or convex arcing of a coated abrasive caused by either an excess or lack of moisture in the backing and the bond.
- cuprate superconductors.** *Plural noun.* See **high temperature superconductors**.
- cuprite.** *Noun.* Cu_2O . A colloquial name for **cuprous oxide**.
- cuprous oxide.** *Noun.* See **cuprite**.
- cup wheel.** *Noun.* A cup-shaped or dish-shaped grinding wheel.
- cure.** *Noun.* (1) The reaction mechanism in which the physical chemical, and mechanical properties of a hydraulic cement change through the phases of slurry-paste-solid with time, with or without heat, in the presence of water. (2) The heat treatment given to thermosetting polymer matrices to bring about bonding.
- cure, autoclave.** *Noun.* See **autoclave cure**.
- cure, normal.** *Noun.* See **normal cure**.
- cure, normal-cure.** *Noun.* See **normal-cure cure**.
- cure stress.** *Noun.* An internal stress caused by resin shrinkage during the curing process of ceramic-polymer composite and also because a composite contains dissimilar materials, e.g., ceramic fibre and thermosetting polymer.
- curie. Ci.** *Noun.* A unit of radioactivity equal to 3.7×10^{10} disintegrations per second. Named after Pierre Curie.
- Curie point or Curie temperature. θ .** *Noun.* The temperature marking the transition between ferromagnetism and paramagnetism in a material or between the ferroelectric state and the paraelectric state.
- Curie's law.** *Noun.* The observation that the magnetic susceptibility of a paramagnetic material is inversely proportional to its **thermodynamic temperature**.
- Curie-Weiss law.** *Noun.* The principle that the magnetic susceptibility of a paramagnetic substance is inversely proportional to the difference between its temperature and its **Curie temperature, θ** .
- curing.** *Verb.* To protect concrete for a specified period of time after placement by providing moisture for hydration of the cement, the proper temperature, and protection from damage by loading or mechanical disturbance.
- curing agent.** *Noun.* An additive for cement and asbestos-cement products used to increase the chemical activity between the cementitious components with an increase or decrease in the rate of setting.
- curing blanket, curing mat.** *Noun.* (1) A dampened mat laid over fresh concrete to provide curing moisture. (2) A dry mat laid over green cement as insulation during cold weather.
- curing compound.** *Noun.* A liquid sealant sprayed on the surface of fresh concrete to prevent loss of moisture.
- curing cycle.** *Noun.* The time required for curing fresh concrete.
- curing, membrane.** *Verb.* See **membrane curing**.
- curling.** *Noun.* A defect in porcelain-enamel similar to crawling. See **crawling**.
- current collector.** *Noun.* In a dry cell it is the metallic part of an electrode that conducts electrons to and from the **active material**.
- current crowding.** *Noun.* A heating effect found at the interface between two dissimilar materials, such as **graphene** and a metal. It is an inhomogeneous distribution of charge carriers with some areas having large numbers of electrons, which causes the localised heating.

current density. J. *Noun.* The ratio of the electric current flowing at a given point in a conductor to the cross-sectional area of the conductor taken perpendicular to the current flow at that point; units are Am^{-2} .

current, eddy. *Noun.* See **eddy current**.

current-flow magnetisation. *Noun.* A method of magnetising by passing a current through a component by means of prods or contact heads; the current may be alternating, rectified alternating, or direct.

current-induction magnetisation. *Noun.* A method of magnetising in which a circulating current is induced in a ring component by the influence of a fluctuating magnetic field.

current, inrush. *Noun.* See **inrush current**.

current leakage. *Noun.* Current leaking through the gate dielectric, which is the insulating layer underneath the gate that turns the **transistor** on and off. This is a limitation for **silicon transistors** less than 90 nm in size when the insulator is **silica**.

current, magnetising. *Noun.* See **magnetising current**.

current, steady state. *Noun.* See **steady state current**.

current, voltaic. *Noun.* See **voltaic current**.

curtain arch. *Noun.* An arch of refractory brickwork supporting the wall and the upper part of a gas producer and the gas uptake.

curtains. *Noun.* A defect, which may occur in porcelain-enamel ground and cover coats, characterised by a sagged or draped appearance.

curtain wall. *Noun.* An exterior or interior wall of a building that is neither an integral part of the structure nor load bearing.

curve, calibration. *Noun.* See **calibration curve**.

curvilinear. *Adjective.* Consisting of, bounded by, or characterised by a curved line.

Cusil. *Tradename, noun* An alloy developed to wet ceramics and be used in the **moly-manganese** ceramic to metal brazing process; in weight percent it contains Ag (27), Ti (71), Cu (2).

cuspidine. *Noun.* $\text{Ca}_4\text{Si}_2\text{O}_7\text{F}_2$. A low melting discrete ion pyrosilicate that contains layers of fluoride ions. Usually found in slags discarded from low to medium carbon steel production.

cut. *Noun.* A powder sample taken from a separation procedure such that its particle size lies between two stated sizes.

cut glass. *Noun.* Glassware that has been decorated by grinding figures or patterns on the surface of the ware by means of an abrasive, followed by polishing.

cut glaze. *Noun.* A glazed area in which the coating is of insufficient thickness for good coverage.

cutlery mark. *Noun.* A metallic line or smear on a dinnerware glaze caused by the abrasion of a knife or other instrument on the surface.

cut-off level. *Noun.* The value established above or below which a product is rejectable or distinguished from other items of the same origin.

cut-off scar. *Noun.* A machine-made scar on the base of a glass bottle.

cut-off wheel. *Noun.* A thin, usually organic-bonded, abrasive wheel used for cutting, slicing, or slotting a material.

cut sizes. *Plural noun.* Flat glass sheets cut to specific dimensions.

cutter. *Noun.* (1) A workman engaged in grinding figures or designs on glass. (2) A workman who cuts flat glass. (3) A tool used in cutting glass.

cutter, guillotine. *Noun.* See **guillotine cutter**.

cutter, reel. *Noun.* See **reel cutter**.

cutting. *Verb.* (1) Scoring a glass sheet with a diamond or steel wheel and then breaking it along the scratch. (2) Producing cut glass.

cutting, brilliant. *Noun.* See **brilliant cutting**.

cutting fluid. *Noun.* See **coolant**.

cutting off. *Verb.* Removing a pot from the potter's wheel by cutting with a wire or string.

cutting over. *Verb.* Turning over moulding and core mixtures by shovel to obtain a more uniform mixture.

cutting rate. *Noun.* The amount of material removed by a grinding wheel per unit of time.

cutting table. *Noun.* A mechanical or stationary table upon which a clay column is severed or sliced.

cutting tool. *Noun.* The portion of the grinding or machining device that contacts and removes material from a work piece.

CVD. *Abbreviation.* Standing for chemical vapour deposition. See **chemical vapour deposition**.

CVI. *Abbreviation.* Stands for (1) chemical vapour infiltration. See **chemical vapour infiltration**. (2) Colloid vibration current. See **electroacoustic spectroscopy**.

CVT. *Abbreviation.* Standing for chemical vapour transport. See **chemical vapour transport**.

cyanide metal treatment. *Noun.* A cleaning and neutralising treatment of metals using a dilute aqueous bath of sodium cyanide prior to porcelain-enamelling.

cyanide neutraliser. *Noun.* An aqueous bath employed in the treatment of metals for porcelain-enamelling which contains a small addition of sodium cyanide to reduce the hardness of water, to assist in further cleaning of the metal, and to aid in the complete neutralisation of acids remaining on the pickled ware.

cyanite. *Noun.* An alternative spelling of kyanite. See **kyanite**.

cycle. *Noun.* (1) A complete set of operations that is repeated as a unit. (2) The time between the first fill of batch and the casting of glass in **open-pot** practice.

cyclic contact twins. *Noun.* Single crystals, like **chrysoberyl**, which show repeated twinning at regular intervals so that crystal growth occurs along a circular path.

cyclone separator. *Noun.* A device for removing particles from air, water, or other fluids, or for separating substances according to size or density, by centrifugal means.

cyclopean. *Noun.* Mass concrete, such as used in dams and thick structures, containing aggregate larger than 15 cm.

cylinder. *Noun.* A large steel pipe filled with concrete and used as a pile foundation.

cylinder process. *Noun.* A process for the manufacture of window glass in which molten glass is blown and drawn into the form of a cylinder which subsequently is split or cracked open, reheated, and flattened.

cylinder, test. *Noun.* See **test cylinder**.

cylinder wheel. *Noun.* A grinding wheel with a comparatively large hole, typically several inches in diameter, used in surface grinding where the work is done by the side rather than by the peripheral surface of the wheel.

cylindrical grinding. *Verb.* To grind the outer surface of a part, which is either rotated on centres, or is centred in a chuck.

cylindrical-screen feeder. *Noun.* An apparatus in which plastic clay is forced through a cylindrical screen by a bladed shaft rotating on the same axis as the centre of the screen; the shredded clay is then delivered to a processing unit.

cylindrical weave. *Noun.* Ceramic or glass fibres are woven dry to form a shape in which the fibres are oriented in the radial, circumferential, and axial directions and the matrix material is then infiltrated into the shape.

Czochralski process. *Noun.* A technique for growing single crystals by pulling a rotating seed crystal from a bath of molten material of the same composition.

Dd

- d.** *Abbreviation.* Standing for: (1) diameter; (2) day(s).
- d.** *Symbol.* Standing for: (1) **density**; (2) a small increment commonly used to indicate a derivative of one variable with respect to another, such as dx/dy .
- D.** *Abbreviation.* Standing for dimensional when used after a number.
- D.** *Symbol.* Chemical notation for deuterium.
- dabber.** *Noun.* A pad used by engravers for applying pigment by hand.
- dacite.** *Noun.* A fine-grained volcanic rock containing quartz.
- dacitic.** *Adjective.* Of or concerning **dacite**.
- dado.** *Noun.* (1) The part of a pedestal between the base and the cornice. (2) The lower part of an interior wall decorated differently from the upper part.
- dado rail.** *Noun.* A decorative moulding on an interior wall, usually about windowsill height.
- dalton.** *Noun.* Another name for the **atomic mass unit**.
- damage.** *Noun.* Harm to a product, facility, equipment, or other item of value, usually short of complete destruction.
- damage index. D.** *Noun.* A defined quantity used in **P-I curve determination** to assess the blast resisting properties of concrete structures. $D = 1 - (P_{res}/P_{des})$, where P_{res} is the residual axial load-carrying capacity of the damaged reinforced concrete column and P_{des} is the maximum load-carrying capacity of the undamaged column. When is in the range D 0–0.2 damage is low, 0.5–0.8 damage is high and 0.8–1.0 collapse will occur.
- damp.** *Adjective.* (1) Slightly wet. (2) *Noun.* Moisture or humidity. (3) *Verb trans.* To reduce the air supply to a fire to make it less intense. (4) *Verb trans.* To reduce the amplitude of an oscillation.
- damp air.** *Noun.* Air having a high **relative humidity**.
- damp course.** *Noun.* A layer or sheet of any impervious material, such as a plastic, placed over or around an area such as a wall to prevent the seepage of water into the area.
- damper.** *Noun.* A movable panel or valve designed and placed to regulate the flow or draft of air into a furnace or kiln.
- damping.** *Noun.* (1) Moistening or wetting. (2) The introduction of a resistance into a resonant circuit. (3) Any method of dissipating energy in a vibrating system.
- damping capacity.** *Noun.* The ability of a material to absorb vibrations by internal friction and convert the mechanical energy into heat.
- damp proof.** *Adjective.* (1) Impervious to damp. (2) *Verb trans.* To make a structure impervious to damp by means of a **damp course**.
- damp-proof course-1 brick.** *Noun.* A clay brick fired to a compressive strength $\geq 5 \text{ MN m}^{-2}$ and water absorption $\leq 4.5 \text{ wt.}\%$.
- damp-proofer.** *Noun.* A substance, such as sodium silicate or a fluosilicate of aluminium or zinc, which is added to a batch of concrete or applied as a coating to the surface of hardened concrete to decrease the capillarity of the concrete.
- Danner process.** *Noun.* A continuous process for producing glass rod or tubing in which molten glass is drawn from tank and formed by means of a rotating mandrel.
- daraf.** *Noun.* Reverse spelling of farad, the unit of elastance; equal to a reciprocal **farad**.
- darby.** *Noun.* A flat-surfaced metal or wood tool used for smoothing freshly applied plaster.
- darcy. D.** *Noun.* A unit used in permeability studies of porous ceramics. See **Darcy's law**.

Darcian permeability. k_f . *Noun.* The rate at which a fluid will flow through a porous substance as calculated using Darcy's law. See **Darcy's law**.

Darcy's law. *Noun.* The permeability of a substance is the rate at which a fluid will flow through the substance times the pressure drop per unit of length of flow divided by the viscosity of the fluid. It is expressed in two equations, the first dealing with incompressible fluids and liquids: $\Delta P/L = (P_i - P_o)/L = \mu V/k_f$. The second deals with compressible fluids and gases: $(P_i^2 - P_o^2)/2PL = \mu V/k_f$. In these equations ΔP is the pressure drop along the thickness L of the porous medium, μ is the fluid viscosity, V is the dynamic fluid velocity, P is the pressure at which the values of μ and V are taken, k_f is the **Darcian permeability coefficient** or **intrinsic permeability**. The units of k_f are m^2 , or **perm** = $10^{-4} m^2$, or **darcy** ($10^{-12} m^2$).

dark current. *Noun.* The residual current produced by a photoelectric ceramic when not illuminated.

dark-field illumination. *Noun.* Illumination of the field of view of a microscope from the side so that the specimen is viewed against a dark background.

dark-field microscope. *Noun.* See **ultramicroscope**.

dark mica. *Noun.* See **mica**.

dark plaster. *Noun.* A plaster made from calcined, but unground, **gypsum**.

dash number. *Noun.* Numerical identification of materials or parts on a product drawing.

dashpot. *Noun.* A device for damping-down vibrations consisting of a fluid-filled chamber in which a piston is sited and then attached to the equipment to be damped.

data. *Plural noun.* Experimental information organized for analysis or used as the basis for a decision, discussion, or calculation.

data analysis. *Noun.* The evaluation and interpretation of data.

dataglove. *Noun.* A glove fitted with sensors that transmit the hand movements of the wearer to a virtual reality system.

data, raw. *Noun.* See **raw data**.

datolite. *Noun.* $\text{CaBSiO}_4(\text{OH})$. A colourless, monoclinic mineral sometimes used as a flux in glazes. Occurs in cavities in **igneous rocks**. Density 2,900–3,000 kg m^{-3} ; hardness (Mohs) 5–5.5.

daub. *Verb trans.* (1) To cover or coat a substance crudely with a soft thick material. (2) To apply a coating with crude strokes. (3) *Noun.* A mixture of clay or plaster and straw with wattle (sticks, twigs, etc.) used to form a wall.

daughter. *Noun.* The product of radioactive decay of a nuclide; the product may or may not be radioactive.

Dawson anions. *Noun.* $[\text{W}_{18}\text{P}_{2}\text{O}_{62}]^{8-}$. A structural building unit found in microporous solids synthesised by hydrothermal methods.

daylight glass. *Noun.* A glass that absorbs red light so that the transmitted light resembles daylight; used in incandescent light bulbs and similar products.

day tank. *Noun.* A periodic glass-melting tank consisting of a single compartment designed to be charged, fired, and emptied during each day of hand gathering.

dB. *Abbreviation.* Standing for decibel. See **decibel**.

dc. *Abbreviation.* Standing for direct current.

DCCA. *Abbreviation.* Standing for drying control chemical additives. See **drying control chemical additives**.

dc/dc brick. *Noun.* A three-dimensional energy converter in an electronic device. The term brick refers to the size of dc/dc power modules used to convert power in electronic packages. Originally $4.6 \times 2.4 \times 0.5$ in. but now, due to the use of solid state ceramics, about 1/16 this size as more space is needed on electronic boards for core applications, such as **processors**.

dc insulation resistance. *Noun.* The reciprocal of conductance.

DCJP. *Abbreviation.* Stands for direct ceramic jet printing. See **direct ceramic jet printing**.

DDTA. *Abbreviation.* Standing for derivative differential thermal analysis. See **derivative differential thermal analysis**.

dead-air space. *Noun.* Sealed air space, such as between the inside and outside panels in a wall.

dead burn. *Verb.* To heat-treat a material, such as a basic refractory, to produce a dense refractory product resistant to atmospheric hydration or recombination with carbon dioxide; usually the treatment is at a higher temperature, above 1,900 °C for a longer period of time than a normal calcining treatment. Surface area is reduced and grain density is increased.

dead-burned magnesia. *Noun.* See **dead-burned magnesite**.

dead-burned magnesite. *Noun.* Magnesite, MgCO_3 , or other magnesium-bearing substance convertible to magnesia, MgO , which has been heat-treated to temperatures above 1,450 °C to produce a stable material suitable for use as an ingredient in refractory products.

dead-burned refractory dolomite. *Noun.* Raw dolomite, $\text{CaMg}(\text{CO}_3)_2$, heated to form CaO and MgO , in a matrix resistant to hydration and recombination with carbon dioxide. See **dead-burned magnesite**.

dead flat. *Adjective.* A lustreless coating.

dead load. *Noun.* A load permanently acting on a structure.

dead plaster. *Noun.* **Plaster of Paris** that has been over fired during manufacture.

dead plate. *Noun.* A stationary plate in a glass-making machine on which a glass article rests to await transfer to a subsequent operation during an automatic production process.

dead time. *Noun.* An electronics term meaning the time interval immediately following a stimulus during which a component is insensitive to further signals.

deaired brick. *Noun.* A densified brick from which air has been removed during the forming process by the application of a vacuum.

deairing. *Verb.* The process of removing entrapped or absorbed air from a mass or slurry, usually by application of a vacuum.

dealumination. *Noun.* The replacement of aluminium atoms by silicon atoms in a three-dimensional network aluminosilicate by heating in a nitrogen atmosphere containing SiCl_4 vapour.

debased. *Adjective.* A description of a material to which another has been added to dilute it.

debiteuse. *Noun.* A vertically slotted, floating clay block on the surface of molten glass through which glass is drawn upward in the **Fourcault process**.

debris. *Noun.* The particles that have become detached in wear and erosion processes.

debug. *Verb.* To locate and remove sources of defects and causes of failure in a process or system.

debulk. *Verb.* Compacting and squeezing out air from between plies in laminates under vacuum or heat to promote adhesion.

debur. *Verb trans.* To remove burrs, sharp edges, and fins from a product, either by grinding or tumbling in a drum containing loose abrasive particles.

de Broglie wavelength. *Noun.* See **de Broglie waves**.

de Broglie waves. *Noun.* A set of waves that represent the nature and behaviour of an elementary particle. A collection of these waves can represent an atom or molecule and be used to predict the properties of such species. The wave is given by the equation: $\lambda = h/mv$, where λ is the **de Broglie wavelength**, v is the velocity of the particle, m is the mass of the particle and h is **Planck's constant**. Also called **matter waves**.

debye. *Noun.* A unit of electric **dipole moment**. It is the dipole moment produced by two charges of opposite sign, each of 1 **statcoulomb** placed 10^{-20} m apart. The value is 3.33564×10^{-30} C meter.

Debye-Hückel layer. *Noun.* A region beneath a surface of an ionic ceramic, such as a grain boundary, which contains an excess of oppositely charged defects to those causing the surface charge.

Debye parameter. κ . *Noun.* A property of the diffuse double layer resulting from the surface potential of a solid suspended in an aqueous solution of ionic strength I ; $\kappa = 8\pi e^2 N_0 I / 10^3 \epsilon k T$, where N_0 is **Avogadro's constant**, e is the dielectric constant for water. κ^{-1} is often called the **double layer thickness**.

decal. *Verb.* To transfer a design by **decalcomania**.

decalcomania. *Noun.* Coloured designs printed on specially prepared paper for transfer as decorations on to glass, glazed and unglazed ceramic ware, porcelain-enamels, and other surfaces. See **slide-off transfer**.

decalescence. *Noun.* The absorption of heat when a solid is heated through a particular temperature range, caused by a thermally activated crystal structure change.

decant. *Verb.* Pour off liquid from sediment or off a heavier liquid without disturbing the sediment etc.

decanter. *Noun.* A stoppered glass bottle into which a drink, such as wine, is poured for later serving by decanting from any lees.

decarbonate. *Verb trans.* To remove carbon dioxide from a substance as for example in the heating of **limestone**.

decarburised steel. *Noun.* Steel of extremely low carbon content suitable for porcelain-enamelling, particularly in the production of one-coat (no ground coat) ware.

decastyle. *Noun.* A portico consisting of ten columns.

decay. *Verb.* (1) The spontaneous transformation of a nuclide into one or more nuclides having measurable lifetimes. (2) A gradual decrease of a current, magnetic flux, stored charge, etc., when the source of energy has been removed.

deci. *Prefix.* denotes one tenth; 10^{-1} .

decibel. *Noun.* (1) One tenth of a **bel**. (2) For sound measurement, $10 \log_{10} (I_m / I_0)$, where I_m is the measured sound and I_0 is the lowest audible note of the same frequency.

decile. *Noun.* In statistics it is one of nine actual or notional values assumed by a variable dividing its distribution into ten equal frequency groups.

decitex. dtex. *Noun.* See **tex**.

deck. *Noun.* The refractory top of a kiln car.

decking. *Verb.* The loading of ware in multiple layers on kiln cars preparatory to firing.

decoloriser. *Noun.* A material, such as a selenium compound, which is added to glass batches to remove or mask colour in finished products.

decolorising. *Verb.* The process of producing a colourless appearance in glass.

decompose. *Verb.* To separate into constituent parts.

decomposition. *Noun.* Chemical breakdown of a substance into one or more simpler substances.

decomposition temperature. *Noun.* The temperature at which the first indications of decomposition are noted.

decorate. *Verb trans.* To evaporate a metal film onto a crystal in order to show dislocations in the structure.

decorated. *Verb trans.* An item made attractive and pleasing to the eye by the use of designs and colours.

decorating fire. *Noun.* The firing process in which decorations are fixed to glazed and porcelain-enamelled surfaces.

decorating kiln. *Noun.* The kiln used for the **decorating fire**. Usually a smaller more closely controlled kiln with respect to temperature and atmosphere.

decoration, impressed. *Noun.* See **impressed decoration**.

decoration, inglaze. *Noun.* See **inglaze decoration**.

decoration, monochrome. *Noun.* See **monochrome decoration**.

decoration, overglaze. *Noun.* See **overglaze decoration**.

decoration, underglaze. *Noun.* See **underglaze decoration**.

decrepitate. *Verb trans.* To heat a solid until it emits a crackling sound.

deenameling. *Verb.* The chemical or mechanical removal of a porcelain-enamel coating from its base metal; for example, by immersion of the enamelled item in a hot bath of sodium hydroxide or by sandblasting.

deencapsulation. *Noun.* Removal of the impervious coating on a ceramic after it has been hot isostatically pressed. Sandblasting is usually employed.

deep cutting. *Verb.* The use of a large abrasive wheel to grind a geometrical pattern on **lead crystal glass** and domestic glassware.

deep drawing. *Verb.* The die pressing of sheet-metal shapes to relatively large depth-to-diameter ratios, the shapes subsequently to be porcelain-enamelled.

deep draw mould. *Noun.* A mould where the core is long relative to the wall thickness.

deep level transient spectroscopy. DLTS. *Noun.* A technique used to characterise electronic defects in the **depletion regions of grain boundaries** by monitoring capacitance transients at a **p-n junction**.

defect. *Noun.* (1) An imperfection or discontinuity in a product that interferes with the usefulness or the aesthetic value of the product. (2) All crystalline solids consist of a regular periodic array of atoms or molecules and departures from regularity are defects. See **defect structure**.

defect conduction. *Noun.* Electrical conduction arising from the presence of **holes** in the **valence band** of a semiconductor.

defect structure. *Noun.* A description of the types and concentrations of **vacancies**, **interstitials**, and **dislocations** in a ceramic material.

deflagrate. *Verb.* To cause to burn intensely as in the **thermite** reaction.

deflecting wedge. *Noun.* A wedge-shaped refractory placed so as to split and distribute a cascading stream of material such as, for example, a stream of coal onto the floor of a coke oven.

deflection. (1) *Verb.* To alter the direction of flow of a stream of gas or liquid by means of a baffle or other designed obstruction. (2) *Noun.* The linear measurement of bend when a specimen or beam is loaded at midspan. (3) *Noun.* The change in direction of a light beam as it crosses a boundary between media of different refractive index. (4) *Noun.* A deviation of the indicator of a measuring instrument from its zero position. (5) *Noun.* The movement of a structure or component when subjected to a load.

deflection temperature. *Noun.* Formerly called the heat distortion temperature, it is the temperature at which a simple beam, in many places dimensioned according to ASTM D468, deflects 0.25 mm under a load of $0.464 \times 10^6 \text{ kg m}^{-2}$ or $1.856 \times 10^6 \text{ kg m}^{-2}$.

deflocculant. *Noun.* A substance, such as water glass or sodium carbonate, or organic salt, which will disperse the agglomerates in a slurry to form a colloidal or near-colloidal suspension to produce a more fluid slurry or slip.

deflocculate. *Verb.* To disintegrate and disperse **agglomerates** in a slurry in order to form a colloidal or near-colloidal suspension of greater fluidity.

deflocculating. *Verb.* Reducing the viscosity of a slip or slurry by the addition of a deflocculant such as water glass, sodium silicate, or polymeric organic salts.

defoamer. *Noun.* Any substance, such as the sulphonated oils and silicones, which will reduce or eliminate foam from glaze or porcelain-enamel slips, cleaning and pickling solutions, etc.

deformation. *Noun.* An alteration in the shape or dimensions of a solid when subjected to stress.

deformation bands. *Plural noun.* Lines of slip within a crystal of varied orientation determined by the slip systems that can operate when a solid is deformed.

deformation, elastic. *Noun.* See **elastic deformation**.

deformation, plastic. *Noun.* See **plastic deformation**.

deformation point. *Noun.* The temperature at which viscous flow of a glass exactly counteracts the thermal expansion of the glass.

deformation, pyroplastic. *Noun.* See **pyroplasticity**.

deformation temperature. *Noun.* The minimum temperature at which a solid substance begins to deform under the stress of its own mass.

deformation twin. *Noun.* Parallel-sided areas in a single crystal grain caused by the stacking arrangement of the atoms inverting into a mirror image across an interface under the influence of a stress greater in value than the material's yield stress.

deformed bar. *Noun.* A steel rod or bar covered with ribs or indentations to improve or enhance its bond with concrete.

deg. *Abbreviation.* Stands for degree of temperature.

degassing. *Verb.* To remove gases from liquid and solids, such as by heating or by the application of a vacuum.

degauss. *Verb.* Another word for **demagnetise**.

degeneracy. *Noun.* The number of **degenerate quantum states** of a given **orbital, energy level, degree of freedom** etc.

degenerate. *Adjective.* (1) Having the same energy but different **wave functions**. (2) A resonator having two or more modes of equal frequency.

degrade. *Verb trans.* (1) To reduce in quality, intensity, strength etc. (2) To be decomposed or decompose into atoms. (3) To be reduced or to reduce by erosion.

degreasing fluid. *Noun.* A solvent or detergent solution employed to remove oil and grease from a surface.

degree of freedom. *Noun.* (1) One of a number of variables (temperature, pressure, volume, composition, concentration, etc.) which must be specified to define the state of a material or system. (2) One of the independent components of motion (translation, vibration, rotation) of an atom or molecule. (3) One of a number of intensive properties that can be varied independently without changing the number of phases in a system.

dehumidify. *Verb.* To lower the concentration of water vapour within a given volume.

dehydrate. *Verb.* (1) To cause to lose water or to lose water. (2) To cause to lose oxygen and hydrogen atoms in the ratio 1:2 from a compound.

dehydration. *Noun.* The removal of free or combined water from a substance or compound, usually by heating or by evaporation in a vacuum.

deionise. *Verb.* To remove ions from water usually by passing over an ion exchange resin.

deionised water. *Noun.* Water that has been purified of salts by passage through an ion-exchange resin.

delaminate. *Verb.* To divide into very thin layers.

delaminated nanocomposite. *Noun.* A hybrid material containing regions of intercalated composite but these are not well ordered within the polymer matrix. See **intercalated composite**.

delamination. *Noun.* The separation of a laminate into its constituent parts.

delayed failure. *Noun.* Fracture of glass when stressed below its known failure stress for a period of time in a moist environment; caused by subcritical crack growth arising from chemical reactions between strained Si-O bonds and water.

delayed fish scale. *Noun.* Half-moon or fish-scale-shaped fractures occurring spontaneously in porcelain-enamel coatings at some time after the completion of the porcelain-enamelling process.

delft, delftware. *Noun, toponym.* A soft, buff-coloured **majolica** body covered with an opaque white tin-glaze; decorations are painted over the unfired glaze, often using a characteristic blue, and fired with the glaze. Originated from the Dutch town of Delft.

deliquescent. *Adjective.* The property of some solids to absorb water vapour from the atmosphere and dissolve to form a solution.

delivery. *Noun.* (1) The process or the equipment delivering charges or gobs of glass to a forming machine. (2) The final act of any glass-forming unit or process, including the removal of an article from its mould. (3) The act of delivery or conveying.

Della Robbia ware. *Noun.* A hard, durable item of **terra-cotta** artware covered with white and brilliantly coloured glazes.

de Laval nozzle. *Noun.* A converging and then diverging spray gun nozzle that accelerates heated powder and gases to supersonic velocities for use in **thermal spraying** and **cold gas dynamic spray technology**.

demagnetisation. *Verb.* The reduction of magnetism from a ferromagnetic material such as hitting a bar magnet with a hammer to disorient the previously oriented **magnetic domains**.

demantoid garnet. *Noun.* A green form of **garnet** found as large gem-sized crystals that can be faceted and polished. It has a colour rivalling that of **emerald** and a better fire than **diamond**.

demijohn. *Noun.* A narrow-necked glass or **stoneware** bottle of 4.56- to 45.6-L capacity; the bottle usually has one or two handles and is enclosed in a wickerwork basket.

demineralise. *Verb trans.* To remove dissolved salts from a liquid.

demitasse. *Noun.* A small ceramic cup used to serve coffee.

dendrite. *Noun.* A crystal that has branched while growing into two parts. Crystals that have grown this way, **dendritic growth**, are tree-like in appearance.

dendritic growth. *Noun.* Growth of a solid nucleus in a solidifying liquid in a branching or spike-like fashion. See **dendrite**.

dendron. *Noun.* Another name for a **dendrite**.

denier. D. *Noun.* A measure of **fibre, filament** or **yarn**, linear density expressed as the weight in grams of 9,000 m of fibre. Assuming a circular cross-section, the fibre diameter, d , can be calculated in metres from: $d = (4D/9,000\pi\rho)^{1/2}$, where D is the denier and ρ is the fibre density in kg m^{-3} .

dense. *Adjective.* (1) Compressed closely together into a compact mass. (2) A subclass of optical glass having a higher than normal index of refraction. (3) Having a high density.

dense medium. *Noun.* A state achieved when a solid powder is subjected to a **mach-disk** front in shock-wave reactions. Passage of the mach-disk causes pressure release and **adiabatic** heating. This causes vaporisation into the cavity produced by forming the dense medium in about 10^{-6} ct is. This effect is post-shock vaporisation and causes ultrafine quenched powder to be formed.

densimeter. *Noun.* Any instrument used to measure density.

densitometer. *Noun.* An instrument used to measure the light transmittance or reflecting properties of a material.

density. *Noun.* (1) The mass of a substance per unit of volume, expressed as kilograms per cubic meter. (2) The degree of opacity of a **translucent** material.

density, absolute. *Noun.* See **absolute density**.

density, apparent. *Noun.* See **apparent density**.

density, block. *Noun.* See **block density**.

density, bulk. *Noun.* See **bulk density**.

density gradient ultracentrifugation. *Noun.* A technique used to separate components in a mixed powder suspension using an aqueous solution with a controlled density gradient in an ultracentrifuge. Under the influence of the centripetal force, the species separate towards their respective **isopycnic points** and can be separated by fractionation.

density, magnetic flux. *Noun.* See **magnetic flux density**.

density of states. $Z(E)$. *Noun.* A concept of some importance in the quantum theory of the electronic properties and bonding of solids. The number of quantum states,

those having four distinct quantum numbers, whose energy lies between E and $E + dE$ for a volume V is given by: $Z(E)dE = 2\pi/h^3(2m_e)^{3/2}VE^{1/2}dE$, where $Z(E)$ is the density of states, m_e is the mass of the electron, and h is **Planck's constant**.

density, packing. *Noun.* See **packing density**.

density, particle. *Noun.* See **particle density**.

density, pour. *Noun.* See **pour density**.

density, powder. *Noun.* See **powder density**.

density, pressure. *Noun.* See **pressure density**.

density, tap. *Noun.* See **tap density**.

density, theoretical. *Noun.* See **theoretical density**.

density, true. *Noun.* See **true density**.

dental composite. *Noun.* A paste containing dimethacrylate monomer, a cross-linking agent and 80 wt.% silane-coated ceramic particles of size range 0.04–4.0 μm . When exposed to a blue laser addition polymerisation of the vinyl groups occurs and the paste becomes a durable filling.

dental glass. *Noun.* A complex **aluminosilicate** that can be heat treated to form a **glass-ceramic** containing **β -quartz** solid solution. Other components, such as ZnO , ZrO_2 increase its x-ray **opacity**, CeO_2 acts as a colour control agent and TiO_2 and P_2O_5 act as **nucleating agents**.

dental porcelain. *Noun.* A bubble-free porcelain of exceptionally high strength and density that is shaped and tinted for oral prosthetic use.

dentil. *Noun.* One of asset of small square or rectangular blocks evenly spaced to form an ornamental row.

deoxidiser. *Noun.* A material that will reduce the oxygen content of another material.

dependability. *Noun.* The probability of satisfactory component performance; a function of reliability, maintainability and component life.

depleted uranium. *Noun.* Uranium containing less than 0.71 wt.% ^{235}U .

depletion layer. *Noun.* A region in a semiconductor in which the mobile charge carrier density is not sufficient to neutralise the net fixed charge density of **donors** and **acceptors**.

depletion region. *Noun.* An electrically insulating boundary region of about 100 nm thickness at the outside of a **ZnO varistor** grain which contains higher concentrations of dopant oxide cations. It is wholly inside the grain and is not a grain boundary deposit.

depoling. *Verb.* To apply a uniaxial stress to a **poled** piezoelectric ceramic which forces the aligned **domains** to switch to the transverse direction to the applied stress in order to relax internal stresses.

depolarise. *Verb.* To cause to undergo a loss of polarisation.

depolarisation temperature. T_d . *Noun.* The temperature at which a poled **ferroelectric ceramic** partially or completely depolarises as determined by **pyroelectric** measurements.

depolarising factor. L . *Noun.* an electric field induces polarisation in a dielectric and the dipole moments per unit volume so induced set up an electric field opposite to the applied field; this is known as depolarisation. The polarising field, E_{dep} , is equal to $[(k - 1)/(k + 2)] \cdot E_0$, where k is the dielectric coefficient; the depolarising factor, L , is the ratio of E_{dep} to polarisation: $L = \epsilon_0 (E_{dep}/P)$. Because of ϵ_0 , L is dimensionless.

deposition, vacuum. *Noun.* See **vacuum deposition**.

deposits, carbonaceous. *Noun.* See **carbonaceous deposits**.

depth of cut. *Noun.* The thickness of material removed when machining a material.

depth of discharge. *Noun.* In a dry cell or battery it is the ratio of the **ampere hours** discharged to the available capacity measured at the same discharge rate.

depth of fusion. *Noun.* The distance to which fusion extends in to a body from its original surface following exposure of the body to its fusion temperature.

depth of penetration. *Noun.* (1) The distance a penetrant has entered into a solid material as measured from the surface of the material. (2) The maximum depth at which a magnetic or ultrasonic indication can be measured in a test specimen.

Derbyshire spar. *Noun.* A dark-blue to purple fibrous form of **fluorspar**, CaF_2 . Used to make **opalescent**, **opaque**, and coloured decorative glass. Also called blue john. See **blue john**.

derivative differential thermal analysis. *Noun.* A technique where the heat content in a sample is compared to that of a standard, such as Al_2O_3 , while both are subjected to a linearly increasing or decreasing temperature. The slope of the difference between the sample and standard are plotted. It allows precise determinations of slight temperature changes.

derived unit. *Noun.* A unit of measurement obtained by division or multiplication of the base units of a system such as the **SI units**.

Deryaguin, Landau, Verwey, and Overbeck theory. **DVLO.** *Noun.* A theory of **agglomeration** forces and agglomeration energy in powder-liquid **colloids** and suspensions.

desaturation. *Noun.* The addition of white to a colour to produce a paler, less saturated colour.

descale. *Verb trans.* (1) To remove scale from iron and steel surfaces which are to be porcelain-enamelled by

treatment in an acid bath or by heating the metals in a furnace to red heat, or both. (2) More generally to remove deposits mechanically from pipes and tanks.

desiccant. *Noun.* A drying agent or substance that will absorb moisture from the atmosphere; for example, **calcium oxide**.

desiccate. *Verb trans.* To remove most of the water from a material. To dehydrate.

desiccated. *Adjective.* Dehydrated and powdered.

desiccator. *Noun.* A container, usually made of glass, containing a **desiccant** and in which a material can be stored in a dry atmosphere.

design for the environment. **DFE.** *Noun.* The science of making products and processes as benign as possible.

design life. *Noun.* The duration of intended function of a component or system.

design, standard. *Noun.* See **standard design**.

design stress. σ_d . *Noun.* Product of the calculated stress level, on the basis of stated maximum load, and a design factor, which has a value less than unity. Used to protect against unanticipated failure.

design wavelength. *Noun.* The wavelength for which calculations are made with respect to thin films on substrates and their reflectivity. See **dielectric mirror**.

desorb. *Verb.* To change from being adsorbed on a surface to the gaseous or liquid state.

desorption. *Noun.* The removal of **adsorbate** from a surface; the inverse of **absorption** or **adsorption**.

desuatselite. *Noun.* $\text{Mg}_6\text{Mn}_2(\text{OH})_{16}(\text{CO}_3)_4 \cdot 4\text{H}_2\text{O}$. A rhombohedral layered double hydroxide. See **layered double hydroxide**.

detection limit. *Noun.* The lowest concentration of an impurity in a ceramic that can be determined with confidence.

detector. *Noun.* In fibre optic technology it is a device that receives light from the fibre and converts it into an electrical signal.

detector efficiency. *Noun.* The fraction of particles or photons striking a detector which give rise to a detected response in the measurement of radioactivity.

detector geometry. *Noun.* The fraction of emissions from a source (particles or photons levels) that impinge on a detector in the measurement of radioactivity.

detector, germanium. *Noun.* See **lithium drifted germanium detector**.

detent. *Noun.* A bump-like defect on the surface of a laminate.

detergent. *Noun.* A substance or mixture having a cleaning action due to a combination of factors such as the

reduction of surface tension and improved wetting, emulsification, dispersion, and foam-forming properties of washing solutions; a detergent may be anionic (such as the alkylaryl sulphonates), cationic (such as the quaternary ammonium halides), or non-ionic (such as the alkylamides) in their cleansing actions.

detergent remover. *Noun.* An aqueous solution of a detergent employed to remove penetrants from test specimens.

determinate. *Adjective.* Able to be defined; definitely limited.

determinate structure. *Noun.* Any structure that can be analysed mechanically such that all internal stresses are determined by the use of the six equations of equilibrium.

determination. *Noun.* The ascertainment of the quantity or concentration of a substance in a sample.

detritus. *Noun.* Debris from forming processes, particularly where wear has occurred.

detrusion. *Noun.* Synonym for **shear strain**.

developer. *Noun.* A material applied to the surface of a test specimen, after the removal of a penetrant solution, to intensify the marking of a discontinuity in the specimen surface.

developer, soluble. *Noun.* See **soluble developer**.

deviation of strain. *Noun.* The strain tensor obtained by subtracting the mean normal strain component of a strain tensor from each normal strain component.

deviation of stress. *Noun.* The stress tensor obtained as described in **deviation of strain**.

deviation, relative standard. *Noun.* See **relative standard deviation**.

devitrify. *Verb.* To change from a glassy or vitreous state to a crystalline state.

devitrification. *Noun.* The formation of crystals in a glassy matrix, such as may occur in a glass, glaze, or porcelain-enamel during the slow cooling of a vitreous mass or due to prolonged exposure to sub-liquidus temperatures.

devitrified glass. *Noun.* A glassy product containing a crystalline phase produced by incorporating a **nucleating agent** in the molten glass batch, followed by a predetermined heat-treatment process; such products exhibit high resistance to breakage, thermal shock, and chemical attack, and are particularly useful in high-temperature applications.

devitrify. *Verb.* To change from a glass or vitreous state to a crystalline state.

devitrite. *Noun.* $\text{Na}_2\text{Ca}_3\text{Si}_6\text{O}_{16}$. A common crystalline phase in devitrified soda-lime-silica glass.

Dewar flask. *Noun.* A type of vacuum flask used in experiments to keep liquid nitrogen, etc.

dewatering. *Verb.* To remove water from a slurry or slip by **filter pressing**, centrifuging, evaporation, or other process.

dew point. *Noun.* The temperature at which water vapour in the air becomes saturated. Condensation begins at this temperature when air is cooled at constant pressure.

Dexil. *Trade name, noun.* Commercial carborane-siloxane polymer that is **pyrolysed** to an amorphous $\text{SiC-B}_4\text{C}$ powder mixture.

dextrin. *Noun.* A polymer of glucose having a composition between that of starch and maltose; used as a **finer** in glazes and as a carrier or binder for **ceramic inks** and decorating colours.

DFE. *Abbreviation.* Stands for design for the environment. See **design for the environment**.

DF stone. *Trade name, noun.* A type of **granite** found in some **china clay** areas which, after treatment to remove iron-bearing mica and fluorites, hence DF prefix, is used as a flux in ceramic bodies.

D-glass. *Trade name, noun.* A high-boron-content glass often used in laminates.

diabase. *Noun.* An alternative name for **dolerite**.

diadochy. *Noun.* Mineralogical term describing the variation in composition of most minerals brought about by **solid solution formation** or substitutional replacement of cations and anions in crystals.

diagenesis, reaction. *Noun.* See **reaction diagenesis**.

diagenesis, thermal. *Noun.* See **thermal diagenesis**.

diagonal. *Noun.* Refers in hardness testing to the line between opposite corners of a **pyramid indentation**.

diagonal bond. *Adjective.* A type of masonry construction in which the **header** bricks are laid in a diagonal pattern.

diagonal tensile stress. *Noun.* The cause of diagonal cracks in brittle materials such as ceramics; it is one of the principal stresses, being a combination of horizontal and vertical shear stresses, in a slab-shaped specimen.

diagram, equilibrium. *Noun.* See **equilibrium diagram**.

diagram, phase. *Noun.* See **phase diagram**.

diamagnet. *Noun.* A material that shows diamagnetic behaviour.

diamagnetic. *Adjective.* Concerned with or exhibiting **diamagnetism**.

diamagnetic material. *Noun.* A material where the susceptibility is negative, i.e., the magnetisation opposes the magnetising force and so is repelled by a magnet.

It will position itself at right angles to the magnetic lines of force; the permeability is less than unity.

diamagnetism. *Noun.* A weak form of induced or nonpermanent magnetism for which the magnetic susceptibility is negative. It arises from the orbital motion of electrons and is unaffected by temperature.

diametral compression test. *Noun.* A tensile test carried out on disc-shaped samples compressed along a diameter. The samples are protected from the **patens** by soft material and the anvil patens are contoured to match the circumference of the sample. Fracture strength is given by $\sigma = 2P/\pi Dt$, where P is the applied load, D the disc diameter, and t the disc thickness.

diamantiferous. *Adjective.* Diamond yielding.

diamantine. *Adjective.* Of or resembling **diamond**.

diamond. *Noun.* A mineral or synthetic product consisting essentially of carbon crystallised in the cubic system, usually in octahedral shape; used in polishing powders, abrasive wheels, glass cutters, drill bits, and similar products; very high thermal conductivity makes it useful as a semiconductor device substrate. Density 3,510–3,530 kg m⁻³; hardness (Mohs) 10.

diamond, black. *Noun.* See **carbonado**.

diamond defects. *Plural noun.* See **N-V centre**, **H3 centre**, **H4 centre**, **N3 centre**.

diamond fire. *Noun.* See **dispersion**.

diamond indenter. *Noun.* An instrument equipped with a diamond point, which is pressed into the surface of a solid, the depth of penetration under a given load being taken as a measure of the hardness of the material being tested. See **Vickers hardness**.

diamond-like carbon. *Noun.* An amorphous form of carbon with a large fraction of diamond-like sp³ bonds. Film can be prepared by bombarding a substrate with a C⁺ ion beam to produce a smooth hard film with properties intermediate between polycrystalline diamond and graphite films. The films are transparent and can be deposited at room temperature and so used to protect optical surfaces, engine parts, and magnetic hard disks. See **DLC**.

diamond paste. *Noun.* Diamond dust dispersed in a paste or slurry for use as a grinding or polishing compound.

diamond point. *Noun.* A cutting tool equipped with a diamond point.

diamond point engraving. *Verb.* Scratching on the surface of glass to produce pictorial decoration.

diamond powder. *Noun.* See **diamond paste**.

diamond-pyramid test. *Noun.* A measurement of the hardness of a solid material in which a diamond point having fixed angle between opposite faces is pressed into the surface of the material under variable loads,

the depth or width of the indentation being taken as a measurement of the hardness of the material. See **Knoop hardness**, **Vickers hardness**.

diamond saw. *Noun.* A saw with diamonds or **diamond dust** inset on the cutting edge of the saw blade.

diamond, synthetic. *Noun.* See **synthetic diamond**.

diamond tool. *Noun.* Any tool in which the working area is inset with diamonds or diamond dust.

diamond wheel. *Noun.* A bonded grinding wheel in which the abrasive grains are crushed and sized natural or synthetic diamonds.

diamond, white. *Noun.* See **white diamond**.

diaspore. *Noun.* α -AlO(OH). A white, yellowish or grey mineral used in refractories or as an abrasive. Found in **bauxite** and corundum. Density 3,350–3,450 kg m⁻³; hardness (Mohs) 6.5–7.

diaspore clay. *Noun.* A mineral consisting essentially of **diaspore** bonded by clay.

diathermic. *Adjective.* The ability to transmit radiant heat.

diatom. *Noun.* Any of a class of minute planktonic unicellular organisms with silicified skeletons.

diatomaceous earth. *Noun.* A light friable highly siliceous material derived from the skeletons of **diatoms**; used as a thermal insulator in the form of aggregate, brick, blocks, and cement, and sometimes as a mild abrasive. Mp 1,715 °C; density 1,900–2,350 kg m⁻³.

diatomite. *Noun.* Dense, **chert**-like diatomaceous earth formed from the skeletons of microscopic animals deposited at the bottom of bogs and swamps; used as an absorbent, insulator, filter medium, filler, etc. See **diatomaceous earth**.

dibase. *Noun.* A basic **igneous rock** used as aggregate in concrete.

dibasic calcium phosphate. *Noun.* CaHPO₄·2H₂O. Used in the manufacture of glass, principally as a fluxing and glass-forming ingredient. Decomposes at 25 °C; density 2,306 kg m⁻³.

DIC. *Abbreviation.* See **Digital Image Correlation**.

dice. *Plural noun.* Cubical fragments of tempered glass.

dice block. *Noun.* The refractory shapes that line the submerged passage between the melting and the **refining zones** of a **glass tank**.

dichlorodimethylsilane. **DCDMS.** *Noun.* (CH₃)₂SiCl₂. The precursor, which when heated with lithium metal, forms a polycarbosilane polymer capable of being pulled and pyrolysed to SiC fibre.

dichroic. *Adjective.* Of a **uniaxial crystal** showing **dichroism**.

dichroic filter. *Noun.* An optical colour filter operating on the principle of interference rather than by colour absorption.

dichroic glass. *Noun.* A glass, which will transmit some colours and reflect other colours, or which will display certain colours when viewed from one angle and different colours when viewed from a different angle.

dichroism. *Noun.* The property of some **uniaxial** crystals, such as **tourmaline**, to selectively absorb light vibrations in the plane while allowing light vibrations at 90° to this plane to pass through. Thus, perceptible differences in colour can be seen in such materials when viewed in different directions. Two colours are seen when the crystal is rotated in **plane polarised** white light with the plane of vibration parallel to the **optic axis** (c-axis).

dichroite. *Noun.* Another name for **cordierite**.

dichromate. *Noun.* $[\text{Cr}_2\text{O}_7]^{2-}$. Salts of dichromic acid. Also called **bichromate**.

dichromatic. *Adjective.* Having or consisting of only two colours.

dichromic. *Adjective.* Another word for **dichromatic**.

dichromic acid. *Noun.* $\text{H}_2\text{Cr}_2\text{O}_7$. An unstable powerful oxidising acid existing only in solution. Used as a surface cleaner in some ceramic operations.

dicing. *Noun.* The fragmentation of **tempered glass** by the release of stored **strain energy** at fracture and the fact that travelling cracks must meet at 90° this leads to uniformly sized cubes of glass as new surfaces are generated by the energy release.

dickite. *Noun.* $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$. A mineral of the **kaolin** family; very like **kaolinite** but monoclinic with a c-axis spacing twice as long as kaolinite.

DICOR. *Trademark, noun.* A commercial glass-ceramic based on the crystalline **tetrasilic mica** phase $\text{KMg}_{2.5}\text{Si}_4\text{O}_{10}\text{F}_2$. Used in dentistry because of its good durability and **translucency**; **ceria** is added to simulate natural teeth.

didymium salts. *Plural noun.* A mixture of **rare earth** salts sometimes used in substantial amounts as a glass colorant, the colour varying with the particular rare earths present; sometimes used in small amounts as a glass decoloriser; also added as a component in temperature-compensating capacitors.

die. *Noun.* (1) A mould in which ware is shaped by pressing, casting, or by extrusion. In extrusion processes the word **cavity** is also used. (2) A perforated plate through which ware is shaped by extrusion. (3) An individual integrated circuit chip approximately 0.4 mm thick and about 6 mm square.

die drawing. *Verb.* To pull filaments or tubing of molten glass through a die to obtain a desired cross-sectional shape and dimension.

Diehls rule. *Noun.* A method used to derive the relevant combination of **slip** direction and **slip plane** relevant to **plastic deformation**.

die land. *Noun.* A delivery pipe connected to the upper of two parallel plates in an extrusion die system.

dielectric. *Noun.* (1) An electric insulator in which an electric field can be sustained with a minimum dissipation of power. (2) Two classes of material, polar and nonpolar, with a nonpolar material being one which contains no dipoles when there is no applied electric field. A polar material contains dipoles with a permanent moment, for example, a water molecule has a dipole moment that is the vector sum of the moments of the two O-H bonds. When a field is applied these moments tend to line up with the field, producing an **orientation polarisation** P_o . (3) In radiofrequency heating it is the material being heated.

dielectric breakdown voltage. *Noun.* The potential difference at which electrical failure occurs, under prescribed conditions, in an electrical insulating material between two electrodes.

dielectric coefficient. k. *Noun.* For a **dielectric** material this is defined by the equation $k = (1 + \chi)$, where χ is the **electric susceptibility**.

dielectric constant. ϵ_r . *Noun.* The ratio of the capacitance of a capacitor filled with a given dielectric to that of the same capacitor with a vacuum as the dielectric. Also known as the **specific inductive capacity, k**, since the capacity of a condenser is increased k times when air is replaced by a dielectric material. The value serves as an index of the ability of a substance to resist the transmission of an electrostatic force from one charged body to another.

dielectric displacement. D. *Noun.* The magnitude of charge per unit area of capacitor plate.

dielectric heating. *Noun.* A technique in which an insulator is heated by application of a high-frequency electric field.

dielectric lens. *Noun.* A lens made from a material that diverges or converges a beam of radio frequency electromagnetic radiation.

dielectric loss. *Noun.* An energy loss sustained by a dielectric sited in an alternating electric field that appears as heat at low frequencies. At higher frequencies vibrating ions couple energy out of the lattice together with resonance effects, electron energy level transfers and heat are the mechanisms of energy loss.

dielectric loss factor. $\text{ktan}\delta$. *Noun.* The inherent ability to be heated in an oscillating electric field. A measure of the amount of energy dissipated in the dielectric medium; it equals the product of the **dielectric constant** and the **dielectric loss tangent**.

dielectric loss tangent. δ . *Noun.* The degree of difficulty with which molecular or **dipole** ordering occurs.

dielectric mirror. *Noun.* A thin film of transparent material, such as silica glass, ceramic oxides and fluorides, which can act as perfect mirrors. The film must be thin and have a larger **refractive index** than the substrate, which then exhibits maximum reflectivity.

dielectric phase angle. δ . *Noun.* The difference in phase, expressed as an angle, between a sinusoidal alternating potential applied to a dielectric, and the induced alternating current.

dielectric polarisation. *Noun.* The dipole moment per unit volume of a dielectric.

dielectric power factor. *Noun.* The cosine of the **dielectric phase angle**.

dielectric resonator. *Noun.* An unmetallised polar ionic ceramic that functions as a resonant cavity by means of reflections at the ceramic-air interface. Used as a microwave filter and oscillator. Examples are: $\text{BaTi}_3\text{O}_{20}$ and $\text{Zr}_{1-x}\text{Sn}_x\text{TiO}_4$.

dielectric strength. *Noun.* The maximum electrical field a dielectric can withstand without allowing a significant current to pass when tested under specified conditions. It is often expressed as breakdown voltage per mil, where a mil = 0.001 in. and is the sample thickness expressed in these units. More modern units are kV mm^{-1} .

dielectric susceptibility. χ . *Noun.* For piezoelectric ceramics this is the electrical analogue of **Young's modulus**. It is defined as electric strain/electric stress: $P/\epsilon_0 E$, where P is the polarisation of the ceramic, E is the applied field and ϵ_0 is the dimension-changing constant and equals $8.85 \times 10^{-12} \text{ Fm}^{-1}$ which leads to χ being dimensionless.

dielectric test. *Noun.* A higher than rated voltage is applied to an insulating ceramic for a specified time so that its ability to withstand breakdown is tested.

die lubricant. *Noun.* A material applied to the work surface of a die or added to the substance or product being formed to facilitate movement of the material to minimise die wear and to ease the removal of the formed product from the die; examples of such lubricants are **graphite** and **molybdenum disulfide**.

die pressing. *Verb.* To form or shape an item in a die or mould under pressure.

die stock. *Noun.* The device used to hold dies needed to cut an external screw thread.

die zones. *Plural noun.* Distinct geometrical regions that have to be machined into ceramic dies used in wire and fibre pulling operations: **entrance zone**, **reduction zone**, **bearing zone**, **relief zone**, and **exit zone**.

difference frequency generation. *Noun.* A non-linear interaction of **laser** light and matter where light is generated at a frequency of the difference of two laser frequencies $\omega_1 - \omega_2$.

differential coil. *Noun.* Similar to the comparator coil but the two coils are arranged around two parts of the same sample to test for local inhomogeneities in samples.

differential hardness. H_d . *Noun.* A modulus that represents the resistance to deformation more explicitly than **conventional hardness**, $H_d = dF/dA_c$.

differential heating. *Noun.* The thermal gradient occurring in a body during heating, causing stress to develop in a body.

differential heat of adsorption. *Noun.* The measure of the heat evolved during the adsorption of an incremental quantity of an adsorbate at a given level of adsorption.

differential measurements. *Noun.* The measurement of any imbalance in a body or system.

differential pressure. *Noun.* The difference in pressure occurring in a system.

differential scanning calorimeter. DSC. *Noun.* a way of determining the rate of heat evolution or absorption of a sample subjected to a programmed linear temperature change. The data are presented as increase in heat per increase in temperature against temperature.

differential thermal analysis. DTA. *Noun.* The determination of the temperature at which thermal reactions occur in a material during heating or cooling by comparing the temperature of a standard, usually Al_2O_3 , to that of the sample as both are subjected to a linear change in temperature.

differential thermogravimetric analysis. DTG. *Noun.* The measurement of the weight change taking place in a material during heating and plotting the gradient of the weight change.

differentiated signal. *Noun.* An output signal that is proportional to the rate of change of the input signal.

diffraction. *Noun.* (1) Deviation in the direction of a wave at the edge of an obstacle in its path. (2) Bending of light as it passes through narrow slits or past the edges of opaque bodies. The overall effect is to produce fringes of dark and bright bands through interference.

diffraction grating. *Noun.* (1) A glass plate or mirror with a large number of equidistant parallel lines or grooves on its surface separated by distances on the order of one wavelength of radiation to be diffracted. It causes diffraction of transmitted or reflected radiation. (2) Any arrangement that is equivalent, in its action toward light, to a number of parallel equidistant slits of equal width.

diffraction pattern. *Noun.* The pattern of dark and light fringes formed by **diffraction**.

diffraction, x-ray. *Noun.* See **x-ray diffraction**.

diffractometer. *Noun.* An instrument used to study diffraction and derive data on molecular and crystal structure.

diffuse. *Verb.* To spread or cause to spread in all directions.

diffused junction. *Noun.* A semiconductor junction formed by diffusing dopant atoms to act as donors or acceptors into the chip to form regions of n-type or p-type conductivity.

diffuse indication. *Noun.* The detection of the presence of some imperfection in a specimen that has not been clearly defined.

diffuse light. *Noun.* Non-directional light.

diffuse reflectance. *Noun.* An infrared examination method well suited to composites and some ceramic powders whereby radiation penetrates the sample and re-emerges after being scattered several times. Because of the multiple scattering several wavelengths are selectively absorbed and the diffuse remainder contains information relevant to the structure of the sample.

diffusion. *Noun.* Several processes that are responsible for the movement of matter through matter, some of which are responsible for material transfer and densification in sintering processes; see **volume diffusion**, **self-diffusion**, **surface diffusion**, and **grain boundary diffusion**.

diffusion bonding. *Noun.* Localised heat applied to the boundary area between two extremely clean surfaces subjected to a compressive force in order to encourage atom or ion diffusion to bond the parts together; a wholly solid state process. High temperatures are needed but little macroscopic deformation occurs. There are two alternatives: **diffusion welding** and **diffusion brazing**. Welding is when two materials are joined by temperature and pressure without melting. An interlayer foil may be used. this is also known as **solid state diffusion bonding** and **hot press bonding**. Brazing is when two surfaces are joined by heating to make a liquid at the interface via a foil or a coating on one or both surfaces. Pressure may or may not be applied. This is also known as **transient liquid phase diffusion bonding**, **activated diffusion bonding**, **eutectic diffusion bonding** or **liquid phase diffusion bonding**.

diffusion brazing. *Noun.* See **diffusion bonding**.

diffusion coefficient. D. *Noun.* The flux of substance moving across unit area in unit time under the influence of a unit concentration gradient; generally accepted as a measure of the amount of atomic diffusion. It is the proportionality constant between the diffusion flux and the concentration gradient in **Fick's first law**.

diffusion couple. *Noun.* Two materials in such close contact that atoms from each diffuse into the other.

diffusion flux. J. *Noun.* The quantity of mass of material diffusing through a perpendicular plane of unit cross-sectional area of material per unit of time.

diffusion, vacuum. *Noun.* See **vacuum diffusion**.

diffusion welding. *Noun.* See **diffusion bonding**.

diffusivity. D. *Noun.* Flow of fluid through a solid that is controlled by areas of different concentration; flow is from high to low concentration.

diffusivity, thermal. *Noun.* See **thermal diffusivity**.

digest. *Verb.* To soften or disintegrate by the action of heat, moisture or chemicals.

digester. *Noun.* An autoclave or other vessel in which the process of digestion is carried-out.

digital. *Noun.* (1) In electronics it is a system, such as a logic circuit, which responds to discrete input voltages producing discrete output voltage levels. (2) Displaying information as numbers rather than by a pointer moving over a dial.

digital image correlation. DIC. *Noun.* A non-contact optical technique for measuring displacement and strain in structures and materials. Digital photographs are compared at different stages of deformation. Blocks of pixels are tracked to build-up two and three-dimensional deformation fields and strain maps.

digitron. *Noun.* A tube with a common anode and several cathodes shaped as characters that can be lit by a glow discharge.

diglycol stearate. *Noun.* $C_{17}H_{35}(COOC_2H_4)_2O$. A white waxlike solid used as a temporary binder in the manufacture of grinding wheels and other abrasive products.

digs. *Noun.* Deep, short scratches on the surface of glass.

dihedral. *Adjective.* Formed by two intersecting planes.

dihedral angle. *Noun.* The equilibrium angle at which grains of the same material form a boundary. Achievement of the dihedral angle dictates the curvature of grain boundaries and hence the direction of their movement in sintering processes.

dilatancy. *Noun.* (1) A phenomenon encountered in ceramic processing involving powder suspensions at high shear rates. The high rate causes too many violent collisions between particles so that instead of flowing smoothly past each other they pile-up. This leads to an increase in viscosity. In extreme cases the build-up will bridge across pipes and block flow completely causing a **dilatant blockage**. It is detected using a rotational viscometer at different shear rates over several orders of magnitude when a dilatant system shows decreasing viscosity, reaching a minimum, before rising viscosity with shear rate. The shear rate at the minimum is known as the **onset of dilatancy**. (2) For some **sols** it describes their solidification under pressure. (3) The **thixotropy** of certain gels.

dilatant. *Adjective.* (1) Tending to dilate. (2) *Noun.* A material that increases in volume when its shape changes. See **flow curves**. (3) Non-Newtonian fluid where the shear rate response to shear stress is non-linear.

dilatant blockage. *Noun.* See **dilatancy**.

dilate. *Verb.* To expand or cause to expand.

dilatometer. *Noun.* Any of several instruments used to measure the volume change of a material, usually as a function of temperature.

diluent. *Noun.* A substance used to cause dilution.

dilute. *Verb.* (1) The reduction of the concentration of a substance by the addition of another substance. (2) *Adjective.* Of a solution, suspension or mixture; having a low concentration or a concentration that has been reduced by admixture.

dilution. *Noun.* The act of diluting.

dilution factor. *Noun.* The ratio of the volume of a diluted substance to the volume of the original substance before dilution.

dimension. *Noun.* (1) The measurement of the size of an object in a particular direction. (2) The number of coordinates needed to locate a point in space in the general physics sense.

dimensional coordination. *Noun.* The selection of components by materials size and shape in a relationship with other units to facilitate assembly or construction.

dimensional deviations. *Noun.* Expressed as a square root multiple of the work size, d , it is the allowance any one brick, tile, or paver can be allowed: $t_1 = 0.4 d^{1/2}$ and $t_2 = 0.25 d^{1/2}$, where t_1 and t_2 are the thickness of specimen at centre and **nib**.

dimensionality. *Noun.* Size characteristics that define the physical and chemical properties of a material. See **low dimensional materials**.

dimensional stability. *Noun.* Ability of a ceramic or artefact to retain its shape when heated, stressed, or kept in changing gaseous environments.

dimension, nominal. *Noun.* See **nominal dimension**.

dimorph. *Noun.* Either of two forms of a material that exhibits dimorphism. See **dimorphism**.

dimorphism. *Noun.* A property of certain ceramics that can exist in two crystalline forms with distinct melting points.

dimorphous. *Adjective.* Exhibiting dimorphism.

Dimox process. *Trade name, noun.* A process developed to make ceramic-metal composite shapes. It involves directed oxidation of a molten alloy by air or oxygen to form a porous oxide into which molten metal is **wicked** to form the matrix.

dimple. *Noun.* (1) A shallow conical depression in a fired porcelain-enamel or glaze surface. (2) A bubble or dent in glass.

Dinas refractories. *Noun.* Traditional European naturally occurring refractory material containing 92–98 % **silica**.

Dinger-Fink particle size distribution. *Noun.* An equation developed to find the **distribution modulus**, n ,

which in turn enables powder size ratios to be adjusted to obtain minimum porosity. When $n = 0.37$ perfect packing is achieved and minimum porosity results. The equation is: $(CPFT)/100 = (D^n - D_s^n)/(D_L^n - D_s^n)$, where n is the distribution modulus, D is the particle diameter, D_s is the smallest particle diameter, D_L is the largest particle diameter and CPFT is the cumulative percent finer than.

dinner service. *Noun.* A set of matching dishes and plates suitable for serving a meal to a certain number of people.

dinnerware. *Noun.* Ceramic and glass articles employed in table service.

diocahedral. *Adjective.* A crystal structure where atoms fill 66 % of the 6-fold interstices.

diode. *Noun.* (1) A rectifier consisting of a semiconducting crystal with two terminals that allows electric current to flow in one direction only. (2) An electron tube containing an anode and a cathode.

diode laser. *Noun.* A **semiconductor laser** consisting of a **p-n junction** with an applied forward bias voltage making it a **LED**. Population inversion in the junction region is achieved by having a highly doped n-type segment so that $[e^-] > [p]$ in the interface. The crystal is highly polished so that emitted photons reflect to cause a stimulated avalanche. They are very small in size, approx. 1 mm, and **GaAs** or **InP** are commonly used.

diopside. *Noun.* $\text{CaMg}(\text{SiO}_3)_2$. A **pyroxene** mineral; used as a component in whiteware bodies, glazes, and glass, and as a refractory in welding-rod coatings. Mp 1,392 °C; density 3,280 kg m⁻³.

diopase. *Noun.* $\text{CuSiO}_4 \cdot \text{H}_2\text{O}$. Hydrated copper silicate mineral; green with glassy lustre; hexagonal crystal system.

diopre. *Noun.* The unit used to define the refracting power of a lens expressed as the reciprocal of the focal length in metres.

dioptric. *Adjective.* Refractive; causing the divergence or convergence of a beam of light.

dioptrics. *Noun.* The branch of science concerned with the refraction of light.

diorite. *Noun.* A coarse-grained, dark coloured igneous rock usually a mixture of **plagioclase feldspar** and ferromagnesian minerals but richer in plagioclase.

dioritic. *Adjective.* See **diorite**.

dioxide. *Noun.* An oxide compound containing a ratio of two atoms of oxygen in combination with another element.

dip coatings. *Plural noun.* Coatings applied to ceramic bodies or to steel to be porcelain-enamelled by dipping the item in a solution, slip, or other bath and then allowing it to drain to the desired thickness before firing.

- dip encapsulation.** *Verb.* To enclose or encase an item by immersion in an insulating material.
- dip mould.** *Noun.* A glass-forming mould constructed in one piece having an opening at the top for the entry of the molten glass and for the removal of the finished piece.
- dipole.** *Noun.* A pair of equal but opposite charges, $+/-q$, at a separation a , where a is arbitrarily small.
- dipole moment.** μ . *Noun.* The product of the charge q and the separation distance of the two q charges that constitute the dipole.
- dipole potential.** V . *Noun.* The potential at a point x due to a dipole in a solid; it has a value given by $V = q/4\pi\epsilon_0 \cdot [1/r_1 + 1/r_2]$, where r_1 is the distance of x from $+q$ and r_2 is the distance of x from $-q$ and ϵ_0 is the **absolute permittivity of free space**. When r is large $r_1 = r_2$ then $V = q\cos\theta/4\pi\epsilon_0(r)^2$, where θ is the angle between a and r .
- dipped joint.** *Noun.* A masonry joint in which the masonry first is wetted by a mortar slurry before it is set or placed in the mortar joint, or by pouring the slurry over a course of masonry before laying the next course.
- dipper.** *Noun.* An operator who applies porcelain-enamel or glaze slips to ware by dipping.
- dipping.** *Verb.* (1) To apply porcelain-enamel or glaze to an item by dipping it in a slip or slurry; a smooth uniform coating is obtained by allowing the item to drain naturally or by swinging, shaking, and gently spinning the article. (2) To immerse a heated cast iron article in dry powdered **frit** to obtain an adherent coating which may or may not be subjected to further heating to obtain complete fusion.
- dipping weight.** *Noun.* The weight of a coating retained on dipped ware per unit of area, reported either as wet or dry weight, the dry weight being the more accurate.
- dip rinse.** *Verb.* To remove excess penetrant from an inspection specimen by dipping the specimen in water or a penetrant remover.
- dip tank.** *Noun.* A receptacle or tank containing a solution or slurry in which ware is dipped.
- dip tank, recirculating.** *Noun.* See **recirculating dip tank**.
- diptral.** *Adjective.* A structure having a double row of columns.
- Dirac constant.** h . *Noun.* a constant used in **quantum mechanics** equal to the **Planck constant** divided by 2π .
- direct arc furnace.** *Noun.* A melting furnace in which an electric arc extends directly from electrodes to the batch in the furnace.
- direct-bonded basic brick.** *Noun.* A fired refractory in which the grains are bonded by solid-state diffusion.
- direct ceramic jet printing.** **DCJP.** *Noun.* A process whereby a ceramic powder is placed layer by layer and fixed with a binder solution delivered through a desk jet printer nozzle. The ceramic powder is part of an ink that can pass through a nozzle of diameter 60–100 μm . See **ceramic ink**.
- direct current.** *Noun.* A continuous electric current flowing in one direction.
- direct fire.** *Noun.* The firing of ware in direct contact with the products of combustion in the furnace or kiln.
- direct-fired furnace.** *Noun.* A furnace having neither recuperator nor regenerator; that is, the furnace is fired without preheating the fuel or air of the fuel mixture. See **recuperator, regenerator**.
- directional solidification.** *Noun.* Solidification of a ceramic melt so that liquid is continually available to the growing solid face.
- direct-on enamel.** *Noun.* A porcelain-enamel finish coat applied directly to a steel base without benefit of a **ground coat**.
- director.** *Noun.* The preferred direction along which molecules align in the **mesophase** of a **nematic** crystal.
- direct random access memory.** **DRAM.** *Noun.* A dielectric ceramic used for memory storage in computer technology. See **volatile memory**.
- dirt.** *Noun.* Undesirable foreign matter in a body or coating; a cause for rejection.
- dirty metal.** *Noun.* Terminology for a fault in glass consisting of a ribbon of blisters in the glass body running down one side of the object, usually a bottle.
- disaccommodation.** *Noun.* The change in a **ferrite** magnetic **permeability** with time.
- disappearing filament pyrometer.** *Noun.* An instrument for measuring high temperatures in which a heated filament of calibrated temperature, enclosed in a telescope, disappears when focused on an incandescent background or surface at the same temperature.
- disappearing highlight test.** *Noun.* A test to evaluate the deterioration of a glaze, porcelain-enamel, or glass surface, or damage done by chemical or physical action, by observing the loss of **gloss** or change in surface texture.
- disc or disk.** *Noun.* A flat circular plate.
- discharge tube.** *Noun.* A **fluorescent** light or neon tube where light is produced by electrons flowing in an ionised gas.
- disclination.** *Noun.* A linear defect found in **liquid crystals**.
- discontinuity.** *Noun.* A pinhole, fracture, or other break in a coating that impairs or destroys the usefulness, purpose, or value of a coating.

discontinuity, artificial. *Noun.* See **artificial discontinuity**.

discontinuity, subsurface. *Noun.* See **subsurface discontinuity**.

discontinuous grain growth. *Noun.* The rapid increase in volume of a grain in a sinter specimen in the final stages of the process. Such a grain begins larger than the average and has more than six sides so that triple points of 120° mean that the grain boundaries are curved in a concave fashion.

discrete particle distribution. *Noun.* In a powder all particle sizes within the range of a discrete distribution are not represented. It contains only a small number of tightly defined, discrete particle sizes.

dish. *Noun.* A shallow pottery or glass container for serving food.

dish grinder. *Noun.* A grinding machine equipped with a **dish wheel** as a grinding mechanism.

dishing. *Verb.* To form a concave surface.

dish wheel. *Noun.* A dish-shaped abrasive grinding wheel.

disintegration. *Verb.* To come apart or to separate into components.

disintegrations per minute. *Noun.* The number of spontaneous nuclear transformations occurring in a radioactive material per minute.

disintegrator. *Noun.* A device for grinding and pulverising materials.

disintegrator crusher. *Noun.* A two-roll crusher consisting of a low-speed, smooth, and a high-speed, serrated roller between which solids are crushed and passed.

disk feeder. *Noun.* A rotating disk beneath the opening of a bin, which delivers material from the bin at a specified rate by controlling the rate of rotation of the disk and the size of the gate opening of the bin.

disk grinder. *Noun.* A grinding machine equipped with a large abrasive disc as the work mechanism.

disk sander. *Noun.* A machine that employs an abrasive coated disk as the grinding and polishing surface.

disk, strain. *Noun.* See **strain disk**.

disk wheel. *Noun.* A bonded abrasive wheel mounted on a plate so that grinding may be done on the side of the wheel.

dislocation. *Noun.* A linear crystalline defect around which there is atomic misalignment. The boundary between slipped and unslipped areas in a crystal. Severe processes may form it, e.g., diffusional transport, but the same configuration can always be obtained by pure slip. The slip vector and the **dislocation line** define a dislocation. Dislocation theory allows great rationalisation

of mechanical properties of solids, particularly metals, and in particular, their failure to achieve theoretical strengths. Plastic deformation occurs as dislocations move in response to an applied **shear stress**. The two main types are **edge dislocation** and **screw dislocation**.

dislocation climb. *Noun.* Migration of vacancies to or from the edges of the half-planes that constitute dislocations at temperatures where self-diffusion is rapid. This results in dislocations changing from horizontal groupings to vertical groupings as they move out of their slip planes.

dislocation decomposition. *Noun.* See **dislocation strength**.

dislocation density. *Noun.* The total dislocation length per unit volume of material or the number of dislocations that intersect a unit area of a random surface section.

dislocation line. *Noun.* The line that extends along the extra half plane of atoms for an edge dislocation, and along the centre of the spiral of a screw dislocation.

dislocation loop. *Noun.* See **Frank-Read source**.

dislocation, partial. *Noun.* See **partial dislocation**.

dislocation strength. *Noun.* The distance of the **Burgers vector**, b , relative to the lattice spacing. When b equals one lattice spacing the configuration in the slipped area is the same as the initial one and the dislocation is said to have unit strength. Strengths greater than one are unstable and decompose into two or more dislocations of strength less than unity.

disorder. *Noun.* The occupation of crystal sites by atoms or ions in a random way to form a solid solution.

dispersant. *Noun.* A liquid used to separate and mix small particles.

disperse phase. *Noun.* (1) The discontinuous phase in composites and some two-phase ceramic alloys that is surrounded by the matrix phase. (2) Sol particles in suspension.

dispersion. *Noun.* (1) The variation of the relative **dielectric constant** or the variation of the square of the **refractive index** at infrared or optical frequencies. (2) The ability of a glass prism or a **grating** to separate any two colours of wavelength λ_1 and λ_2 . (3) A change in the refractive index of a substance that occurs with change in wavelength or frequency. It is the property that gives rise to **fire** in diamond. $v = (n_y - 1)/(n_i - n_c)$, where v is the dispersion, n_y is the refractive index for yellow light at 587 nm, n_i is the refractive index for blue light at 484 nm, n_c is the refractive index for red light. The reciprocal of v is the **dispersive power**. (4) Widely distributed or scattered particles in a medium. (5) Of an **optical fibre** it is the delay between the arrival time of the start of a light pulse and its finish time.

dispersion curve. *Noun.* A plot of **refractive index**, n , against wavelength of the radiation being **refracted**. The curve usually follows the **Cauchy equation**: $n = A + B/\lambda^2 + C/\lambda^4$, where A , B , and C are material constants and λ is the wavelength.

dispersion medium. *Noun.* The liquid phase that contains the solid particles in a **sol**.

dispersion strengthening. *Verb.* To increase the strength of a load bearing phase by uniformly dispersing hard, inert particles $< 0.1 \mu\text{m}$ in size within it.

dispersive power. *Noun.* See **dispersion (3)**.

dispersoid. *Noun.* A system such as a colloid with one phase dispersed in another.

displacement angle. *Noun.* The distance advanced by the winding ribbon along the equator after one circuit in a filament winding operation.

displacement per atom. dpa. *Noun.* A way to quantify the amount of radiation damage in structural materials used in fission and fusion reactors. One dpa corresponds to stable displacement of every atom from its lattice site.

displacive transformation. *Noun.* A change in the long-range order of a structure as the crystal symmetry is changed; caused by changes in bond lengths or bond angles without altering the local coordination number. Whole rows of atoms shear or displace together with each atom moving in the same fashion as its neighbours. The change is instantaneous producing a viable volume of the new phase. **Martensitic** transformations are a sub-class of this type of transformation.

dissipation factor. $\tan\delta$. *Noun.* The tangent of the loss angle. See **loss tangent**.

dissociated zircon. *Noun.* A mixed oxide of ZrO_2 and SiO_2 produced by heating **zircon**, ZrSiO_4 , above $1,750^\circ\text{C}$, used as a starting material in the production of **zirconia**.

dissociation. *Noun.* The breakdown of a compound or substance due to a change in physical conditions, such as pressure or temperature.

dissolver residue. *Noun.* The undissolved solid left when spent ceramic nuclear fuel is leached with nitric acid.

dissolver solution. *Noun.* The solution obtained on dissolving spent ceramic nuclear fuels in nitric acid.

distemper. *Noun.* (1) Various water based paints including **whitewash**. (2) *Verb trans.* To mix pigments with water and **size**. (3) To paint masonry etc. with distemper.

distensibility. *Adjective.* Ability to be stretched.

distinguishing stain. *Noun.* An organic colorant added to a body, glaze, or porcelain-enamel slip as a means of identification of the slip before use, particularly when slips of different compositions are of the same colour; the colorant or dye burns out during firing.

distortion. *Noun.* (1) A change in the shape of an item due to improper processing, such as uneven pressures, uneven or too rapid heating, etc. (2) An optical effect due to variations in the thickness of plate glass. (3) A fault or aberration in an optical system in which the magnification varies with the lateral distance from the axis. (4) An undesired change in the shape of an electrical wave. (5) In crystallography a slight deviation from a recognised **aristotype** structure.

distributed feedback laser. DFB. *Noun.* A single lasing wavelength produced by placing a grating into the **laser cavity**.

distributed impact test. *Noun.* The way that an **erosion test** is often described to emphasise the fact that the eroding medium is distributed over an area of the surface as opposed to a single point impact.

distribution. *Noun.* (1) The degree of dispersion of a substance in another substance. (2) The range of wall thicknesses in a glass article.

distribution coefficient. K . *Noun.* In phase diagrams it is the ratio of the slopes of the **liquidus** and **solidus** lines where they intersect at T_m . In general K is less than 0.5.

distribution, continuous. *Noun.* See **continuous distribution**.

distribution, discrete. *Noun.* See **discrete particle distribution**.

distribution modulus. n . *Noun.* The steepness of the slope of the particle size histogram and it relates to particle size distribution through the Dinger-Fink equation. See **Dinger-Fink particle size distribution**.

dithionite. *Noun.* See **hyposulphite**.

dititanates. *Plural noun.* Ceramic phases of general composition MTi_2O_5 , where M is a divalent metal cation.

divalent. *Adjective.* Possessing a valency of two.

divalent mica. *Noun.* A form of **mica** containing divalent cations between the Si-O sheets for charge balancing.

divorced eutectic. *Noun.* A micrographic description of a **eutectic** in which each phase appears as very large crystals instead of the characteristic finely dispersed intimate mixture of very small crystallites.

DLC. *Abbreviation.* Stands for diamond-like carbon. See **diamond-like carbon**.

D-load. *Noun.* The supporting strength of a concrete pipe loaded under three-edge bearing test conditions; expressed in kilograms per linear metre per metre of inside diameter or horizontal span, or expressed in newtons per linear meter per millimeter of inside diameter or horizontal span.

D-load, 0.025-mm crack. *Noun.* The maximum three-edge bearing test load supported by a concrete pipe before a crack 0.025-mm wide occurs throughout a length of at least 310 mm of the pipe.

D-load ultimate. *Noun.* The maximum three-edge bearing load that will be supported by a concrete pipe.

DLTS. *Abbreviation.* Stands for deep level transient spectroscopy. See **deep level transient spectroscopy**.

DLVO. *Abbreviation.* Stands for the Deryaguin, Landau, Verwey, and Overbeck. See **Deryaguin, Landau, Verwey, and Overbeck theory**.

DMC. *Noun.* See **dough-moulding compound**.

dobbin. *Noun.* A turntable type of drier upon which ceramic **tableware** is dried in the mould in which it was formed.

dobie. *Noun.* A hand-shaped, crudely formed, building or refractory brick, either fired or unfired.

docking. *Verb.* The remove **lime** deposits from the surface of building brick and roofing tile by immersion in, or washing with, water.

doctor. *Verb.* (1) To spread a surface coating in a uniform layer on a substrate. (2) *Noun.* Shortened form of doctor blade. See **doctor blade**.

doctor blade. *Noun.* A flat metal knife or blade mounted in a device so as to spread a uniform thickness of a material on a surface and to remove excess material from the surface, such as, the scraping of excess colouring pastes from roller coaters, etc.

doctor mark. *Noun.* A defect on a surface coating which looks like a ridge, caused by a damaged **doctor blade**.

doctor roll. *Noun.* A type of roller device employed to remove **filter cake** from rotary filter drums.

documented. *Noun.* Correctly recorded ware.

document glass. *Noun.* An ultraviolet-absorbing glass used as a cover to protect documents and valuable papers against deterioration from strong light.

dodecanoic acid. *Noun.* $\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$. A crystalline fatty acid found in vegetable glycerides and used in die lubrication and cold pressing. Also called **lauric acid**.

Dodge crusher. *Noun.* A type of jaw crusher with a stationary jaw and a movable jaw hinged at the bottom of the crushing unit.

dog. *Noun.* (1) A device for holding a workpiece so as to permit the piece to be rotated during machining. (2) A type of drag for a wheel or traversing table.

dog bone. *Noun.* The description sometimes applied to a tensile test specimen.

dog ear. *Noun.* A torn surface on a column of clay emerging from a **pug mill** showing as edge cracks

along the extrusion direction. It is caused by clay moving irregularly at the corners of the extruder die due to insufficient plasticity of the clay column or to damaged or dirty extrusion nozzles. It is remedied by improving the lubrication at the die corners usually by increasing the water content of the clay. Also called **dog teeth**.

doghouse. *Noun.* A small boxlike vestibule on a glass furnace into which raw materials are fed to form the **batch blanket** or which facilitates the introduction and removal of **floaters**.

dog teeth. *Noun.* See **dog ear**.

dolerite. *Noun.* (1) A dark basic igneous rock consisting of **plagioclase feldspar** and a **pyroxene**; coarse-grained **basalt**. (2) Any dark igneous rock whose composition cannot be determined by the unaided eye.

dolime. *Noun.* The product of **calcined dolomite**.

dolly. *Noun.* (1) A hand-operated, low-platform truck mounted on casters used for the movement of materials and ware. (2) A type of tool used for mixing glazes and other slips. (3) A refractory-tipped, glass-gathering iron used in semi-automatic forming machines.

doloma. *Noun.* The **calcined** product of the mineral **dolomite**. It is a mixture of lime, CaO, and periclase, MgO.

dolomite. *Noun.* $\text{CaMg}(\text{CO}_3)_2$. Used in refractories, glass, tile, and pottery bodies and also in glazes, primarily as a fluxing ingredient. Carbon dioxide is expelled at about 900 °C and **doloma** is formed; density 2,900 kg m⁻³; hardness (Mohs) 3.5–4.0.

dolomite brick. *Noun.* A refractory brick made substantially or entirely of **dead-burned dolomite**.

dolomite, calcined refractory. *Noun.* See **calcined refractory dolomite**.

dolomite, dead-burned refractory. *Noun.* See **dead-burned refractory dolomite**.

dolomite, double-burned. *Noun.* See **double-burned dolomite**.

dolomite magnesite brick. *Noun.* A refractory brick made of **dead-burned dolomite** and **dead-burned magnesite** and in which the dead-burned dolomite predominates.

dolomite matte. *Noun.* A **matte** glaze finish produced by the formation of calcium and magnesium silicates in the glaze during firing.

dolomite, raw refractory. *Noun.* See **raw refractory dolomite**.

dolomitic limestone. *Noun.* A mineral composed of more than 80 % **calcium magnesium carbonate**; used as a source of calcium in glazes, as a component in cement, as a refractory, and refractory ingredient.

domain. *Noun.* A volume region of a **ferromagnetic**, **ferrimagnetic** or **ferroelectric** material within which all atomic or ionic magnetic moments are aligned in the same direction. The domains have dipole vectors randomly distributed. Application of an electric or magnetic field causes domains in the crystallite parallel to the field to grow and those at right angles to shrink and this gives rise to a nonlinear polarisation or magnetisation response to the field strength. When all crystallites have only one domain the material acts like a normal dielectric.

domain wall. *Noun.* The transition region in which the direction of polarisation or magnetisation changes from one domain to the next.

dome. *Noun.* The end of a filament-wound container.

dome brick. *Noun.* A brick of a curved pattern or shape suitable for use in the construction of a dome.

dominant wavelength. *Noun.* The wavelength at which the peak energy is emitted from an infrared source; used to characterise industrial emitters.

donor. *Noun.* An impurity that adds electrons at energy levels above the **valence band** but below the **conduction band** in a semiconductor, e.g., phosphorus added to a group IV element.

donor level, donor state. *Noun.* For a semiconductor or an insulator it is an energy level lying within, but near the top, of the **energy band gap** from which electrons may be promoted into the conduction band. It is normally associated with an impurity atom in the material.

dopant. *Noun.* An element used to dope a semiconductor. See **doping agent**.

dope. *Noun.* (1) A lubricant, such as graphite, which is applied to glass moulds to reduce friction and prevent sticking during the forming of glass articles. (2) *Verb trans.* In electronics it is to add impurities to a semiconductor in order to develop the property of semiconduction or to modify its properties. See **doping agent**.

doping. *Verb.* The intentional addition of controlled levels of **donor** or **acceptor** impurities in semiconductors.

doping agent. *Noun.* A measured element or impurity added to a semiconductor composition to promote the development of a desired property or characteristic. Sometimes called **dope**, **dopant**.

Doppler effect. *Noun.* When a source of waves is in motion through a stationary medium, the wavelength is changed. The waves sent out in the direction that the source is moving are shorter, those in the opposite direction are longer, than the waves from the source at rest. Also called the Doppler shift. Named after C. J. Doppler.

dop-stick. *Noun.* A device for holding a stone and presenting it to a **lap**. It is a length of wood or metal about 15 cm long to which the stone is fixed at the end by **dop wax**. If the dop-stick is hand held only simple cuts can be achieved. More sophisticated cuts can be achieved with the dop-stick fitted into a graduated holder called an **index head**.

dop wax. *Noun.* See **dop-stick**.

Doric. *Adjective.* Of, denoting, or relating to one of the five classical orders of architecture: a column no base, a heavy fluted shaft, and an **ovolo** capital beneath a square **abacus**.

dornick. *Noun.* A small stone or pebble.

dose. *Noun.* The total energy of ionising radiation absorbed by unit mass of material. It is measured in **grays**.

dosimeter. *Noun.* An instrument for measuring doses of x ray or radioactivity.

dot. *Noun.* A refractory spacer used with kiln furniture.

dotting. *Verb.* To place flatware horizontally on refractory pins in bins prior to firing.

double brick. *Noun.* A brick 13.5 × 10.2 × 20.3 cm in size.

double burned. *Adjective.* A refractory or brick that has been subjected to two separate firings.

double-burned dolomite. *Noun.* Mixture of dolomite and iron oxide that has been subjected to a single **calcination** treatment.

double-cavity mould. *Noun.* A two-compartment mould for the concurrent fabrication of two articles of glass.

double-cavity process. *Noun.* Any glass-forming process in which two items of glass are formed at the same time in a **double-cavity mould**.

double chain silicates. *Plural noun.* Silicate structures containing $[\text{SiO}_4]^{4-}$ tetrahedra half of which share three oxygen atoms and half share only two, to produce giant negative ions of $n[\text{Si}_4\text{O}_{11}]^{6-}$ units, as 2-D chains. The chains are aligned in the crystal structure and held together by cations.

double decomposition. *Noun.* A reaction between two compounds that results in the exchange of one part of each to form two new compounds.

double dipping. *Verb.* The process of applying a glaze to a pottery item by dipping the item into a glaze slip twice before firing; the purpose is to obtain contrasting colours on ware which may be fired at the same time.

double drain. *Noun.* The undesired draining of a once-dipped porcelain-enamel coating a second time after the initial drain has appeared to be complete, resulting in a coating of non-uniform thickness.

double embossing. *Noun.* The treatment of a glass surface with acid to produce a design, followed by two additional acid treatments, so that three different shades are produced on the glass surface.

double-faced ware. *Noun.* Porcelain-enamelled ware with a finish coat applied to both surfaces of the metal base.

double-frit glaze. *Noun.* A glaze in which frits of two different compositions are incorporated to obtain a coating with a longer firing range and having improved physical and chemical properties.

double glazing. *Noun.* (1) The application of a glaze over a previously applied and dried glaze on ceramic ware, both coatings being fired concurrently. (2) The placement of two parallel panes of glass in a window. The panes being separated by a thickness, or cell, of stationary air as a means of sound and thermal insulation.

double-glazing unit. *Noun.* A window assembly consisting of two panes of glass separated by a permanently sealed cavity, compartment, or cell.

double glide. *Noun.* Crystals slipping simultaneously on two **slip systems** caused when deformation on one set of planes causes the **resolved shear stress** on a second set to increase and start slip on a second set; it occurs commonly in **rock salt structure** crystals.

double-gob process. *Noun.* The process of forming two glass items simultaneously.

double hetero-structure. *Noun.* Two epitaxial layers of different composition.

double layer thickness. *Noun.* Defined as the reciprocal **Debye parameter** and is the distance from a particle surface at which the surface potential has fallen to 1/e of the value at the surface.

double strap joint. *Noun.* A **butt joint** supported top and bottom by **lap joints** formed by an extra piece of material. It has very good performance characteristics.

doubler. *Noun.* An area in a fibre composite that contains extra reinforcement fibre.

double perovskite. *Noun.* Ceramics with the general formula $A_2B_2O_6$. They are metallic **ferrimagnets** with half the lattice having a delocalised electronic structure and reasonably high magnetic transition temperatures. Some, such as Sr_2FeMoO_6 , have applications in magnetotransport devices.

double refraction. *Noun.* A phenomenon exhibited by some crystals, **calcite** and **quartz** are two examples, whereby a beam of ordinary unpolarised light is refracted into two beams. **Snell's law** of refraction holds for one beam, the **ordinary ray**, but not for the other, known as the **extraordinary ray**. See **birefringence**.

double-roll crusher. *Noun.* A pulverising machine for minerals consisting of two toothed rolls rotating in opposite directions on parallel axes.

double salt. *Noun.* A **solid solution** of two simple salts made by crystallising a solution containing both salts.

double-screened ground refractory materials. *Noun.* A once-graded refractory material that has been screened to remove particles that are both coarser and finer than specified sizes.

double-shelled tile. *Noun.* A tile with two faces separated by short webs.

double-strength glass. *Noun.* Sheet of thicknesses between 2.9 and 3.6 mm.

double tetrahedral silicates. *Plural noun.* Formed when each $[SiO_4]^{4-}$ tetrahedron in a structure shares one oxygen with an adjacent tetrahedron to produce $[Si_2O_7]^{6-}$ groups, known as **pyrosilicate ions**, which are packed into a structure stabilised by cations.

double-wing auger. *Noun.* An **auger** equipped with two screws at the discharge end.

doubling. *Verb.* Combining two or more fibre strands without twisting.

dough moulding compound. DMC. *Noun.* A mixture of partially cured epoxy resin, glass or ceramic fibre, $CaCO_3$, lubricants and catalysts, with a clay-like mouldable consistency from which **hand-lay composite** artefacts can be formed.

dovetail. *Noun.* A joint designed to interlock two or more parts.

dowel. *Noun.* (1) A metal bar extending across a concrete joint to aid in vertical alignment and to equalise the transfer of applied loads. (2) A pin used to ensure alignment of two parts of a mould.

dowel assembly. *Noun.* A reinforcing network or alignment of dowels around which concrete is poured in construction projects. Also called **dowel basket**.

dowel basket. *Noun.* See **dowel assembly**.

downdraught kiln. *Noun.* Kilns in which the hot gases from the firebox are passed to the **crown**, then directed through the ware being fired, and finally are exhausted into a flue or stack.

downdraw. *Noun.* The process of continuously drawing glass downward from an orifice.

downfeed. *Noun.* In surface grinding to shape a ceramic it is the rate at which the grinding wheel is fed into the work.

down time. *Noun.* The production time lost when an item of equipment is not operating due to malfunction, maintenance, power failure, or other cause.

dpa. *Noun.* See **displacement per atom**.

d-plane. *Noun.* Terminology used to identify the structure of the double layer surrounding a metal oxide in water. It is about two layers thick growing out from the **inner Helmholtz plane**. The thickness is determined as that needed to completely cover the anions in the inner Helmholtz plane with water molecules. It also contains solution cations. Also called the **outer Helmholtz layer**.

draught. *Noun.* (1) The difference in pressure that causes air and combustion gases to flow from one area to another, such as from a furnace, kiln, or drier to a flue. (2) The taper given to a die or mould so that work can easily be removed.

draught gauge. *Noun.* A manometer or instrument employed to measure pressure differences between two areas, such as between a furnace, kiln, or drier and a flue.

draught, induced. *Noun.* See **induced draught**.

drag. *Noun.* (1) The resistance of the foot or base of a ceramic article to shrinkage during firing due to friction with the **slab** or **sagger** on which it rests. (2) The bottom section of a mould.

dragade. *Noun.* **Cullet** produced by ladling molten glass from the melting chamber and quenching in water. Also called **drag ladle**.

drag ladle. *Noun.* See **dragade**.

dragon kiln. *Noun.* A long low kiln built to follow the contours of a hillside, heated by a single wood burning firebox at the lower end. Large in size it allows thousands of items to be fired simultaneously.

drag-out. *Noun.* The solution removed from a bath by the ware and equipment, as in the cleaning and **pickling** of metal for porcelain-enamelling.

drain. *Noun.* (1) The flow of a porcelain-enamel or glaze slip on the surface of a piece to form a smooth, even coating. (2) The layer in a **semiconductor device** to which the current carriers in the active layer are moving. Typically the drain is about 4 μm from the source layer.

drain angle. *Noun.* The angle at which an item to be porcelain-enamelled or glazed is positioned after dipping to permit the excess slip to drain from the item, and that portion of the coating retained on the item to flow to a smooth uniform thickness.

drain casting. *Verb.* To form a ceramic body by pouring slip into a porous mould and then draining the slip from the mould after the cast body has attained the desired thickness.

draining. *Verb.* To remove excess **slip** from dipped items by gravity flow.

drain line. *Noun.* A line or streak appearing in dipped or flow coated ware as the result of uneven coating thickness.

drain pipe. *Noun.* A pipe for collecting and carrying surface and subsurface water.

drain, storm. *Noun.* See **storm sewer**.

drain tile. *Noun.* Tile of circular cross section designed to collect and convey surface and subsurface water away from an area.

drain time. *Noun.* The time required for a porcelain-enamel or glaze slip applied by dipping, slushing, or flow coating to cover the ware uniformly and for drainage to cease.

DRAM. *Acronym.* Stands for dynamic random access memory as used in computer storage systems. See **volatile memory**.

draw. *Noun.* (1) The quantity of glass delivered by a glass-melting tank per unit of time; usually 24 h. (2) The draft in a flue. (3) *Verb.* To remove a charge of fired ware from a kiln.

drawability. *Noun.* The property of fibre-forming materials to undergo several hundred percent of deformation under load at the working temperature.

draw bar. *Noun.* A submerged, refractory block in a **glass tank** defining the point at which sheet glass is drawn.

draw-down. *Noun.* See **spin-stretch ratio**.

draw firing. *Verb.* To remove a load from a porcelain-enamelling furnace prior to completion of the firing operation to permit equalisation of the heat in the ware, particularly in areas of greater thickness; the load may, or may not, be returned to the furnace, depending on the degree of maturity of the coating.

draw gang. *Plural noun.* A group of workmen employed to cut and handle glass coming from the **lehr**.

drawing. *Verb.* (1) To unload of kiln. (2) To extend a synthetic fibre to orient the structure, to reduce the cross-sectional area and improve its properties. (3) To continuously form sheets, tubes, or fibre from molten glass. (4) To plastically deform metals in order to shape them.

drawing chamber. *Noun.* The section of a glass-melting tank from which molten glass is drawn.

drawing compound. *Noun.* A composition, such as **graphite**, **talc**, greases and oils, applied to the surface of metal to serve as a lubricant to prevent **draw marks** and **tearing** during **drawing** and **stamping** operations.

drawing die. *Noun.* A die in which sheet metal and some composites are shaped by drawing and stamping.

drawing dock. *Noun.* See **setting dock**.

drawing tractors. *Plural noun.* Two rollers counter rotating; used to pull glass-fibre through the **size** material and onto the winding drum.

draw mark. *Noun.* An imperfection in a material shape caused by friction with, or a defect in, a **die**.

drawn glass. *Noun.* Glass made automatically and continuously by drawing from the melting tank, and then rolling or shaping.

drawn stem. *Adjective.* Glass **tableware** in which the stem or base is pulled or drawn from the bowl while in the plastic state.

draw off. *Verb.* To cause a liquid to flow from something.

draw ratio. *Noun.* The ratio of the cross-sectional area of a drawn fibre to that of the undrawn material; a measure of the stretching achieved.

dredging. *Verb.* The application of powdered, porcelain-enamel frit to a hot metal shape, usually cast iron, by sifting the powder over the surface of the metal.

dreikanter. *Noun.* A faceted **pebble** formed by wind driven sand erosion in desert areas.

Dresden china. *Noun.* Porcelain ware of high quality made at Meissen near Dresden since 1710.

dress. *Verb.* To shape or return a tool to its original shape and sharpness.

dressed crude mica. *Noun.* Mica from which dirt and rock have been removed.

dresser. *Noun.* An apparatus employed to shape, true, and dress grinding wheels by the use of rotating cutters.

dresser, Huntington. *Noun.* See **Huntington dresser**.

dresser, star. *Noun.* See **Huntington dresser**.

dressings. *Verb.* (1) To restore the efficiency of an abrasive grinding wheel by removal of dulled grains. See **dulling**. (2) To reshape the faces of grinding wheels to special contours.

dressings, crush. *Noun.* See **crush dressing**.

dried sand. *Noun.* Sand with less than 0.5 % moisture.

drier or dryer. *Noun.* (1) A heated chamber, frequently with circulating air, in which ware is placed for the removal of water or moisture by evaporation. (2) A person or apparatus that dries. (3) One of a number of chemicals that when added to oil in paint help it to dry.

drier, automatic. *Noun.* See **automatic drier**.

drier, batch. *Noun.* See **batch drier**.

drier car. *Noun.* A drier through which ware is transported by means of cars.

drier, chamber. *Noun.* See **chamber drier**.

drier, continuous. *Noun.* See **continuous drier**.

drier, hot-floor. *Noun.* See **hot-floor drier**.

drier, humidity. *Noun.* See **humidity drier**.

drier, infrared. *Noun.* See **infrared drier**.

Drierite. *Trademark, noun.* A commercial drying agent consisting essentially of anhydrous calcium sulphate.

drier, jet. *Noun.* See **jet drier**.

drier, pallet. *Noun.* See **pallet drier**.

drier, periodic. *Noun.* See **periodic drier**.

drier, pipe-rack. *Noun.* See **pipe-rack drier**.

drier, Proctor. *Noun.* See **Proctor drier**.

drier room. *Noun.* A heated room in which ware is placed, dried, and sometimes stored prior to firing

drier, rotary. *Noun.* See **rotary drier**.

drier, spray. *Noun.* See **spray drier**.

drier, steam-rack. *Noun.* See **steam-rack drier**.

drier, string. *Noun.* See **string drier**.

drier, tunnel. *Noun.* See **tunnel drier**.

drier, waste-heat. *Noun.* See **waste-heat drier**.

drier white. *Noun.* Discoloration of clayware due to the presence of soluble salts at the surface, usually due to the migration of the salts dissolved in the water moving from the interior of the body to the surface during the drying cycle.

drift transistor. *Noun.* A transistor manufactured to have an impurity gradient from the collector–base junction to the emitter–base junction and so have a graded resistance to increase its high-frequency response.

drigauge. *Noun.* Material quenched to a glass by pouring a melt into cold water.

drip. *Noun.* **Vitrification** followed by flow of superstructure refractory brick hot surfaces caused by the corrosive action of **sodium borate** and water vapour in the **glass tank** atmosphere.

drip feed. *Noun.* A technique for supplying oil or paraffin as lubricants for moving parts.

drippings, smelter. *Noun.* See **smelter drippings**.

dripstone. *Noun.* The form of limestone found in stalactites and stalagmites.

driving force. *Noun.* The impetus behind a reaction, such as **grain growth**, phase transformation etc. It is associated with a decrease in **free energy** in the system.

drop arch. *Noun.* An auxiliary arch projecting below the inner surface of the arched roof of a furnace.

drop chute. *Noun.* Flexible sheet metal tubes forming downspouts to control the flow of concrete during a vertical or downward fall as it is being placed.

- drop-machine silica brick.** *Noun.* Silica brick formed by dropping the prepared mix into a mould from varying heights, the force of the drop being sufficient to force the mix into all corners to fill the mould.
- droppers.** *Noun.* A form of ceramic glaze defect consisting of brownish discoloured spots on top of it. The cause is drips from the refractory glass phase in the kiln ceiling falling during firing.
- dropping.** *Verb.* To shape a glass article by sagging heat-softened glass into a mould without the application of mechanical pressure.
- drop test.** *Noun.* A durability test performed by dropping the article a predetermined height onto a standard hard surface.
- drop throat.** *Noun.* The throat of a **glass tank** situated below the level of the bottom or floor of the melting tank.
- drop weight test.** *Noun.* A fracture test similar to the **Izod test** except that the height from which the weight is launched at the specimen is varied.
- dross.** *Noun.* (1) Waste and impurities collected on the surface of a molten **glass tank**. (2) Scum formed by oxidation on the surface of molten metal.
- drum drier.** *Noun.* A heated, rotating drum in which tumbling or cascading raw materials are dried.
- drusy crystals.** *Adjective.* Aggregates of small well-formed crystals that grow on the surface or along cleavage fractures in rocks; **chabazite** is a common example.
- dry.** *Adjective.* Free from, or deficient in, water or moisture.
- dry bag isostatic pressing.** *Verb.* A forming method in which the sealing envelope is permanently sealed into a pressure vessel to facilitate loading, pressing, and product removal.
- dry basis.** *Noun.* The weight or volume of a substance exclusive of any moisture that may be present.
- dry body.** *Noun.* (1) An unglazed body, usually of the **stoneware** type. (2) A body from which all moisture has been removed.
- dry-bone ore.** *Noun.* A colloquialism for smithsonite. See **smithsonite**.
- dry bulb temperature.** *Noun.* Actual atmospheric temperature as measured by an ordinary dry-bulb thermometer.
- dry bulb thermometer.** *Noun.* An ordinary thermometer used alongside a **wet bulb thermometer** in order to obtain air humidity values.
- dry cell.** *Noun.* An electric cell in which the electrolyte is thick paste to stop it from spilling.
- dry disk.** *Noun.* An apparatus for finishing the face of an abrasive grinding wheel.
- dry edging.** *Noun.* An imperfection consisting of rough edges and corners on glazed ceramic ware due to insufficient application of glaze to the area.
- dryer.** *Noun.* Alternative spelling of **drier**.
- dry-film lubricant.** *Noun.* See **die lubricant**.
- dry foot.** *Noun.* An unglazed base or foot on the underside of fired ceramic ware.
- dry gauge.** *Noun.* **Cullet** produced by ladling molten glass from a melting unit into water. See **drigauge**.
- dry grinding.** *Verb.* Milling of materials without a liquid medium.
- dry ice.** *Noun.* Solid carbon dioxide. Used as a coolant and refrigerant. Sublimes at -78.5°C .
- drying.** *Verb.* To remove of water and moisture from a body.
- drying control chemical additives.** **DCCA.** *Plural noun.* Chemicals added to gels that speed up the drying process. The mechanism is unclear but it may be concerned with the fact that they make the capillary stress uniform by narrowing the distribution of pore sizes.
- drying crack.** *Noun.* A fissure in an unfired body, glazes, or porcelain-enamel due to stresses incurred during handling or drying.
- drying oven.** *Noun.* A closed unit in which specimens are dried by gentle heating.
- drying rate.** *Noun.* The speed at which a moisture-bearing material, body, or coating will dry under specific heating or atmospheric conditions, or both.
- drying shrinkage.** *Noun.* The contraction of a moist body during the drying process, expressed as linear percent of the original length or volume percent of the original volume.
- drying shrinkage, linear.** *Noun.* See **linear drying shrinkage**.
- drying shrinkage, volume.** *Noun.* See **volume drying shrinkage**.
- drying time.** *Noun.* The time required for a moist body, material, or coating to dry under given heating and atmospheric conditions.
- drying, vacuum.** *Noun.* See **vacuum drying**.
- dry kiln.** *Noun.* A kiln designed to dry ceramic **greenware** at the lowest possible heat before it enters the firing zone.
- dry milling.** *Verb.* To reduce the particle size of a substance by milling without the use of a liquid medium.

dry mix. *Verb.* To blend a batch of ingredients in the dry state, liquids being added at the time when subsequent processing is required.

dry modulus of rupture. *Noun.* The transverse strength of a standard specimen in the dry, but unfired, state. See **modulus of rupture**.

dry pack. *Noun.* A moist mixture of cement and sand used in the repair of deep cracks and cavities in concrete.

dry pan. *Noun.* A muller-type mixer in which materials are ground or blended with a minimum amount of moisture. See **muller**.

dry powder. *Noun.* A finely pulverised substance or mixture free from or deficient in moisture.

dry press. *Noun.* A mechanically or hydraulically actuated press used in the shaping of moistened ceramic bodies in a mould under pressure.

dry-pressed brick. *Noun.* Brick formed in a mould under high pressure from a relatively dry body containing 5–7 % moisture.

dry pressing. *Verb.* To form or shape ceramic bodies of low moisture content (5–10 % water) by compression in moulds.

dry process. *Noun.* (1) A process for manufacturing **Portland cement** in which the batch is charged into the cement kiln in the dry state. (2) To process concrete aggregate without the use of water.

dry-process enamelling. *Noun.* A process of porcelain-enamelling in which the base metal, usually cast iron, is heated to a temperature slightly above the fusion temperature of the enamel, followed by sifting finely powdered enamel frit on to the metal surface or by dipping the hot metal into a dry batch of powdered frit, and then firing the coating to maturity; the process may be repeated with minimal cooling of the ware until the desired coating thickness is attained.

dry-rubbing test. *Noun.* (1) A test to evaluate the resistance of a glaze, porcelain-enamel, or other surface to abrasion by rubbing the surface with a dry abrasive powder under standardised test conditions. (2) A test to evaluate the degree to which a chemical attacks a glaze, porcelain-enamel, or other surface by rubbing a finely divided powder of a contrasting colour across the test area and observing the degree of colour retained by the chemically treated surface.

dry sand mould. *Noun.* A mould from which the moisture content has been removed by heating prior to filling the mould cavity.

dry screening. *Verb.* To separate small sizes of granular or powdered solids from coarser particles by passing them through a screen of desired mesh size while in the dry state. See **screen analysis**.

dry shake. *Noun.* A dry mixture of cement and special fine aggregate broadcast over a concrete floor before final finishing in order to provide a wear-resistant surface.

dry spinning. *Verb.* To make a polymer fibre or fibre composite by forcing a polymer solution or ceramic-polymer suspension through a small orifice and solidified by solvent evaporation.

dry spot. *Noun.* A type of composite defect; a volume in a fibre-epoxy composite that has not had sufficient resin during the forming stage.

dry spray. *Noun.* An imperfection having the appearance of a rough sandy surface on porcelain-enamelled ware due to improper spraying.

dry stone. *Noun. Adjective.* Describes stonewalls constructed without **mortar**.

dry strength. *Noun.* (1) The resistance of a dried but unfired ceramic body to physical or mechanical damage. (2) Strength of a laminate as established immediately after drying under specified conditions.

dry tack. *Adjective.* Property of certain adhesives to adhere on contact even though they seem dry to the touch.

dry wall. *Noun.* A type of construction characterised by having an interior finish that is not plaster.

dry weight. *Noun.* The weight of a porcelain-enamel or other coating applied per unit of area to an item after the wet coating has been thoroughly dried.

DSP cements. *Noun.* Cementitious bodies formed by compaction, up to 30 MN m⁻² pressure, using dense packing particles of cement and silica fume.

dual-drum mixer. *Noun.* A mixer consisting of a long drum containing two compartments separated by a bulkhead with a swinging chute extending through the unit.

duct. *Noun.* A channel through which a fluid can be transported.

ductile. *Adjective.* (1) Capable of being deformed by elongation without fracture. (2) Capable of being moulded into a new form.

ductile fracture. *Noun.* A type of failure where the crack propagates slowly along a zigzag path following planes on which maximum resolved shear stress occurs. This leads to gross plastic deformation.

ductile-to-brittle transition. *Noun.* The transition from ductile to brittle behaviour with a decrease in temperature.

ductility. *Noun.* The amount of plastic strain a material can show before fracture. It may be expressed as percentage elongation, %EL, or percentage reduction in area, %RA, as obtained from a tensile test.

Dufton's column. *Noun.* A glass column containing a glass rod with a metal wire wrapped around it in a spiral fashion so that it was a close fit in the column. This is used for fractional distillation and is very efficient because the rising vapour is made to stay in contact with descending liquid for longer.

dull. *Adjective.* (1) Lacking brilliance, brightness, **lustre** or intensity. (2) Not resonant or ringing.

dulling. *Noun.* (1) The wearing of the sharp edges of cutting tools or abrasive grains resulting in inefficient or ineffective performance of the tools or grains. (2) The effect observed when bright enamel surfaces lose their brilliance due to corrosion as ions are leached-out of the glass by aqueous solutions.

dullness. *Noun.* The opposite of **brightness**. Lacking in **brilliance** or **lustre**, as evidenced in porcelain-enamel and glaze surfaces. An increase in dullness is the comparable effect of adding a small quantity of neutral grey colourant.

dumbbells. *Noun.* A type of defect in the structure of wet-lay non-woven fabrics consisting of paired clumps of fibre connected by one or more long fibres. They are caused when the **chopped strand** used has some over long pieces that encounter a snag in the delivery pipe-work, form the clumps while held, then break away to enter the fabric.

dummy. *Noun.* A foot-operated device employed for the wetting, raising, opening, and closing of **paste moulds** used in blowing glassware by mouth.

dummy joint. *Noun.* A preformed contraction joint in concrete designed to form a line along which a crack can form in the slab with minimum damage to the adjacent sections of the slab.

Dumont's blue. *Noun.* A sintered mixture of cobalt oxide, sand, and potash; employed as a colorant in glass, glazes, and porcelain-enamels.

dumortierite. *Noun.* $\text{Al}_{16}\text{O}_7(\text{BO}_4)_2(\text{SiO}_4)_6 \cdot \text{H}_2\text{O}$. A **sillimanite** mineral employed in the manufacture of high-grade porcelains to improve their resistance to **thermal shock** and physical damage by including boron in the glassy phase. Density 3,200–3,300 kg m^{-3} ; hardness (Mohs) 7.

dump hopper. *Noun.* A large hopper that can be tipped mechanically to remove its contents.

dunite. *Noun.* The name given to rock rich in **olivine**; used in the manufacture of **forsterite refractories** as a source of chromium.

dunk. *Verb.* To plunge hot glazed ware into a cold liquid, usually water, to produce decorative crazing in the glaze.

dunt. *Noun.* A crack formed in too rapidly heated or cooled ware which does not allow time for the various silica phase transformations to occur.

dunting. *Noun.* The cracking of fired ware that has been cooled too rapidly.

dunting point. *Noun.* The temperature at, which the inversion of crystalline silica from the alpha form to the beta form occurs, and vice versa.

durability. *Noun.* The property of a material of being resistant to physical and chemical damage under the usual conditions of service, and of being useful over extended periods of time and use.

durain. *Noun.* A **lithotype** of whole coal. It has a granular, dull-black appearance. See **exinite** and **vitrinite**.

Durital. *Trademark, noun.* A commercially available superstructure refractory containing 75 % **alumina** and 24 % **silica**.

durometer. *Noun.* Group name for hardness testers.

dust. *Noun.* Fine dry particles of matter which essentially are larger than colloidal in size, less than 67.5 μm in maximum cross section, and which are capable of being suspended in air or other gases.

dust coat. *Noun.* (1) A thin dusty-appearing coating of porcelain-enamel or glaze applied by spraying. (2) A mixture of concrete and fine aggregate distributed over a concrete slab before finishing, and while the concrete is still plastic to improve the resistance of the concrete to wear.

dusting. *Verb.* (1) The sifting of finely powdered porcelain-enamel frit over preheated metal articles the powdered coating subsequently being fired. (2) The removal of dust and loose dirt from dried porcelain-enamel and glaze surfaces before firing. (3) The application of a thin dust-like coating on an item of ware by spraying. (4) *Noun.* An imperfection on glaze and porcelain-enamel surfaces consisting of an inordinate build-up of dry slip during spraying. (5) *Noun.* The disintegration of refractories by the inversion of one crystal form to another during cooling. (6) *Noun.* The erosion of concrete surfaces under traffic.

dusting powder. *Noun.* Fine powder, such as **talc**, used to absorb moisture.

dust pressing. *Verb.* The process of forming ceramic bodies of 1.5 % or less water content by pressing in a mould.

dusty spray. *Verb.* The application of porcelain-enamel and glaze slips to ware in a manner that a wet film is not produced.

dwel mark. *Noun.* A feature observed on some fracture surfaces, which looks like a ripple on the surface, caused by the crack front stopping momentarily at that place.

dwel time. *Noun.* (1) The time a penetrant is in contact with a surface during an absorption or penetration test, including the application and drain times. (2) Time a composite laminate is held at temperature before pressure is applied in the forming process.

dyad. *Noun.* An atom or group that has a valency of two.

dye-absorption test. *Noun.* A test of the porosity of a fired specimen in which the specimen is immersed in a dye solution under specified conditions of time, pressure, and temperature; the depth of penetration of the dye into the specimen is then observed or measured.

dyes. *Plural noun.* (1) Soluble, combustible organic colorants added to glazes, porcelain-enamels, and other coatings to assist sprayers in controlling the uniformity and thicknesses of coatings that are difficult to see. (2) Soluble, combustible organic colorants added to bulk porcelain-enamel and glaze slips in storage to assist workers in identifying materials of different composition but of similar outward appearance. (3) Colorants in solution used to aid in the detection of cracks, pinholes, and other surface and body imperfections in fired ware; the solutions are brushed over and then wiped from areas of potential defects to reveal the imperfections.

dye-sensitised solar cell. *Noun.* A device based on a dense array of oriented, single-crystal **zinc oxide** nanowires in which photogenerated electrons are transported by trap-limited diffusion. To achieve this each nanowire is coated in a light sensitive dye.

dynamic. *Adjective.* Of or concerned with forces or energy that produces motion.

dynamic adsorptive capacity. *Noun.* The mass of material adsorbed per unit mass of powder from a fluid moving through a bed of the powder at **breakpoint**.

dynamic balance. *Noun.* The condition under which a grinding wheel or other rotating part, rotating at a high speed, will exhibit no vibration or whip due to uneven distribution of mass in its volume.

dynamic creep. *Noun.* **Creep** caused by a periodically changing load or temperature.

dynamic light scattering. *Noun.* A method developed to measure the mean hydrodynamic diameter, $d(H)$, of nanosized crystals in **sols**. The method detects the **Brownian motion** and relates it to particle size using the **Stokes-Einstein equation**: $d(H) = kT/3\pi\eta D$, where D is the translational diffusion coefficient, η is the viscosity, k is the **Boltzmann constant** and T is the absolute temperature. The diameter so determined is from diffusion through a fluid and is therefore called the **hydrodynamic diameter**.

dynamic modulus. *Noun.* The stress-to-strain ratio under vibratory excitation.

dynamometer. *Noun.* A calibration device using electric impulses to check the loads applied in a fatigue test.

dyne. *Noun.* The **cgs unit** of force; the force needed to accelerate a 1 g mass by 1 cm s^{-2} . It equals 10^{-5} N in the **SI system**.

dynode. *Noun.* An electrode on to which a beam of electrons can impinge to cause the emission of a greater number of electrons by secondary emission; used in photomultipliers for amplification.

dysprosium oxide. *Noun.* Dy_2O_3 . A **rare earth** or lanthanide oxide. Used as a component in control rods for nuclear reactors, as a **phosphor** activator, and in dielectric compositions. Density $7,810 \text{ kg m}^{-3}$.

dysprosium titanate. *Noun.* $\text{Dy}_2\text{Ti}_2\text{O}_7$. An example of a **spin ice** material that has been shown to have isolated magnetic charges, **magnetic monopoles**, capable of sharply defined excitations.

DZ. *Abbreviation.* Stands for dissociated zircon. See **dissociated zircon**.

- e.** *Symbol.* Standing for: (1) electron; (2) a number fundamental to mathematics that is the limit of $(1 + 1/n)^n$ as n increases to infinity. Approximate value 2.718282. Used as the base for natural logarithms. Has an important relationship to π : $e^{i\pi} = -1$, where $i = (-1)^{1/2}$.
- E.** *Symbol.* Commonly used symbol for: (1) **Young's modulus** of elasticity; (2) energy; (3) electromotive force; (4) electric field strength.
- $E_{0.5}$** *Symbol.* An arbitrarily selected parameter used to characterise the efficiency of a ZnO **varistor** by defining the breakdown voltage needed to produce a current of 0.5 mA cm⁻² in the device. $E_{0.5} = Vd^{-1}$, where V is the nonlinear voltage and d is the varistor thickness measured in cm.
- EACCVDe.** *Abbreviation.* Stands for electrostatic assisted combustion chemical vapour deposition. See **electrostatic assisted combustion chemical vapour deposition**.
- eaglestone.** *Noun.* Hollow oval nodules of **clay ironstone**.
- earth.** *Noun.* (1) The loose, soft mixture of disintegrated rock, clay and organic matter that constitutes a large part of the ground. Also called soil. (2) A connection between an electrical circuit or device and the earth, which is at zero potential.
- earth, alkaline.** *Noun.* See **alkaline earth**.
- earth colour.** *Noun.* A variety of brown pigments containing mainly iron oxides.
- earthen.** *Adjective.* Made of baked clay.
- earthenware.** *Noun.* A glazed or unglazed, non-vitreous, opaque, ceramic whiteware having water absorption greater than 3 %.
- earth, rare.** *Noun.* See **rare earths**.
- earth wax.** *Noun.* See **ozocerite**.
- earthy cobalt.** *Noun.* See **asbolite**.
- earthy lustre.** *Adjective.* A dull matte appearance of the surface of a mineral or ceramic.
- EBC.** *Abbreviation.* Standing for electron beam cutting. See **electron beam cutting**.
- EBM.** *Abbreviation.* Standing for electron beam machining. See **electron beam machining**.
- EBSD.** *Abbreviation.* Stands for electron back scatter diffraction. See **electron back scatter diffraction**.
- ebullioscopy.** *Noun.* A technique for measuring **molecular weights** of materials by measuring the extent to which they change the boiling point of a solvent.
- EBW.** *Abbreviation.* Standing for electron beam welding. See **electron beam welding**.
- eccentric axis.** *Noun.* An axis located elsewhere than at the geometrical centre of a body.
- eccentricity.** *Noun.* (1) The distance of a misalignment from the centre. (2) The percentage difference between maximum and minimum wall thickness. (3) The distance of the line of action of a load from the centroid.
- eccentric load.** *Noun.* Any load which does not act through the centroid of the cross section.
- ECD.** *Abbreviation.* Standing for electrochromic display. See **electrochromic display**.
- ECDL.** *Abbreviation.* Stands for external cavity diode laser. See **external cavity diode laser**.
- ECG.** *Abbreviation.* Standing for electrochemical grinding. See **electrochemical grinding**.
- echinus.** *Noun.* An **ovolo** between the shaft and the **abacus** of a Doric column. See **Doric column**.
- eclogite.** *Noun.* Coarse-grained, very dense basic rock, neither **igneous** nor **metamorphic**, containing small red **garnet** and green **pyroxene crystals**. Originating from high-pressure **metamorphism**.

ECM. *Abbreviation.* Standing for electrochemical machining. See **electrochemical grinding**.

economic mineral. *Noun.* A mineral of commercial interest or value.

economy brick. *Noun.* Brick nominally 10.2×10.2×20.3 cm in size.

ECOPAVE. *Trade name, noun.* A multi-purpose road pavement construction system intended for major road building. It has three components: a special concrete base layer 200–250 mm thick containing coarse but graded aggregate and **thixotropic** mortar placed by vibration; **asphalt** paving layer; a system of controlled cracks to accommodate shrinkage and thermal movement. It is essentially a composite construction of concrete and asphalt.

ECT. *Abbreviation.* Standing for eddy current testing. See **eddy current testing**.

edaphic. *Adjective.* Relating to the physical and chemical conditions of soil.

EDAX. *Acronym.* Standing for energy dispersive analyser x ray.

eddy. *Noun.* A place in a fluid at which the direction of flow doubles back on itself.

eddy current. *Noun.* An electric current induced in a conductor moving through a magnetic field or in an area where there is a change in magnetic flux. Troublesome in electromagnets and transformers. Also called **Foucault current**.

eddy-current testing. *Verb.* A **non-destructive test** in which eddy-current flow is induced in a specimen, and changes in flow are measured. The changes indicate the presence of defects such as **bubbles**, inclusions, and fractures.

EDFA. *Abbreviation.* Stands for erbium-doped fibre amplifier.

edge. *Noun.* (1) A line along which two faces or surfaces meet. (2) The sharp cutting side of a blade.

edge angle. *Noun.* The angle formed by two opposite edges of an **indentation hardness tester** tip.

edge bowl. *Noun.* The hollow bowl-like protrusion containing a slot through which sheet glass is drawn in the **Pittsburgh sheet-glass process**.

edgecoat. *Noun.* A dense layer of ceramic material on the surface of a **reticulated ceramic** that is the same composition as the reticulate and bonded to it. Used as a strengthener and to channel the flow through the network.

edge dislocation. *Noun.* A linear crystalline defect associated with the lattice distortion produced in the volume around the end of an extra half-plane of atoms within a crystal. The **Burgers vector** is perpendicular to the dislocation line. See **dislocation**.

edge distance. *Noun.* The distance from the centre of a hole in a material to the nearest free edge of that material.

edge distance ratio. *Noun.* The distance from the centre of the bearing hole to the edge of a sample in the direction of the principal stress, divided by the hole diameter.

edge effect. *Noun.* (1) An outward-curving distortion of the lines of electrical force near the edge of two parallel plates forming a capacitor. (2) The disturbance of a magnetic field and eddy current due to the proximity of an abrupt change in geometry, such as an edge.

edge lining. *Verb.* The application of a decorative line around the rim of ceramic ware such as plates, saucers, dishes, and other shapes of dinnerware.

edge polishing. *Verb.* The polishing of the edges of plate glass after it has been cut.

edge, rough and burred. *Noun.* See **rough and burred edge**.

edge-runner mill. *Noun.* A pulverising or crushing mill equipped with vertical rollers rotating in a circular enclosure of metal, ceramic, or stone.

edge skew brick. *Noun.* A brick with one side sloped at an angle, the ends and faces each being parallel.

edge, thick. *Noun.* See **thick edge**.

edge tool. *Noun.* A tool with one or more cutting edges.

edgework. *Verb.* The grinding, smoothing, or polishing of the edge of a glass object

edging. *Verb.* (1) The removal of unfired porcelain-enamel from the edges of a piece of ware prior to firing. (2) The spraying of porcelain-enamel over the edge of ware as a decoration or reinforcement. (3) The grinding of the edge of a piece of glassware to a prescribed size or shape.

edging brush. *Noun.* A stiff-bristled brush with a metal guide used to remove dry, but unfired porcelain-enamel from the edge of ware before firing to prevent chipping and so improve the appearance of the final product.

EDFA. *Abbreviation.* Stands for erbium-doped fibre amplifier.

EDL. *Abbreviation.* Stands for electrical double layer. See **electrical double layer**, and **o-plane**.

EDM. *Abbreviation.* Standing for electrical discharge machining. See **electrical discharge machining**.

EDU. *Abbreviation.* Standing for electronic display unit. See **electronic display unit**.

educt. *Noun.* A substance separated from others without chemical change.

edulcorate. *Verb trans.* To remove soluble impurities by washing.

effective depth of penetration. *Noun.* The minimum depth beyond which a test no longer indicates an increase in the thickness of the penetrated layer.

effective depth of reinforced concrete. *Noun.* The distance of the centroid of the reinforcement from the compression face of a concrete beam.

effective full power years. *Plural noun.* The total time when a nuclear reactor is running at full power. Abbreviated to **EFPY**.

effective loss factor. *Noun.* The total loss in a ceramic medium at radio and microwave frequencies. It consists of three terms: dc conductivity, dipolar, and Maxwell-Wagner mechanisms.

effective modulus of elasticity of concrete. *Noun.* The modulus calculated from a stress-strain diagram that ignores the always present time-dependent **creep** of the material.

effective modulus of rupture. M_c . *Noun.* The average modulus of rupture obtained for a number of samples taken from the same specimen; from this average, each value less than the average is subtracted and the difference squared; the average is taken away from values greater than itself and the difference squared. All the square terms are summed and divided by the number of samples examined minus one. The square root of this is M_c .

effective nuclear charge. Z_e . *Noun.* The charge due to the protons of the nucleus of an atom less a screening factor arising from the electrons present.

effective permeability. *Noun.* A hypothetical quantity describing the permeability experienced by a specimen under a given set of physical conditions, such as a cylindrical specimen in an encircling coil at a specific test frequency.

effective porosity. *Noun.* The porosity of a material containing interconnected pores, expressed as a percentage of the bulk volume occupied by the pores.

effective resolved shear stress. **ERSS.** *Noun.* A theory developed to consider the stress acting beneath the faces of a pyramidal hardness indenter and so explain the phenomenon of hardness anisotropy.

effenbergite. *Noun.* $\text{BaCuSi}_4\text{O}_{10}$. A discrete ionic type silicate mineral used as a pigment.

effervesce. *Verb intrans.* To give off bubbles of gas.

effervescence. *Noun.* The evolution of a gas that accompanies some chemical reactions.

effervescent. *Adjective.* Bubbling.

efficiency. *Noun.* A widely used term generally taken to be measure of the performance of a device as given by ratio of the output to the input of power or energy.

efficiency, detector. *Noun.* See **detector efficiency**.

efficiency of reinforcement. η . *Noun.* The factor by which the contribution of the ceramic fibres in a fibre composite must be multiplied if the load is not parallel to the fibre direction. $\eta = \cos^4\theta$, where θ is the mean angle between fibre directions and the applied stress direction.

efficiency, relative. *Noun.* See **relative efficiency**.

efficiency, relative detector. *Noun.* See **relative detector efficiency**.

efficiency, thermal. *Noun.* See **thermal efficiency**.

effloresce. *Verb intrans.* To become powdery due to the loss of **water of crystallisation**, or to become encrusted with crystals of salt from a solution due to evaporation or chemical change.

efflorescence. *Noun.* A formation of powdery salt on the surface of concrete or masonry due to the diffusion and precipitation of soluble salts from the interior of the body. Also known as bloom. See **bloom**.

efflorwick test. *Noun.* A test to estimate the tendency of a building brick to **effloresce** in which a fired cylinder of brick clay is immersed in a solution of soluble salt in distilled water, dried, crushed, and analysed for the presence of the selected salt. See **efflorescence**.

effluent. *Noun.* A liquid discharged or flowing from a process or place.

effuse. *Verb intrans.* To flow out or through; to emanate.

effusimeter. *Noun.* An apparatus for determining the rates of effusion of gases.

effusion. *Noun.* The escape of a fluid from a container, or the fluid that escapes.

EFPI. *Abbreviation.* Standing for extrinsic Faby-Perot interferometric sensor. See **Faby-Perot interferometric sensor**.

EFPY. *Abbreviation.* Standing for effective full power years. See **effective full power years**.

egg and dart. *Noun.* A moulding or ornamentation consisting of alternate egg-shaped figures and arrowheads.

eggshell. *Adjective.* (1) A fired porcelain-enamel or glaze having a semi matte, eggshell-like texture. (2) A type of very thin, highly translucent porcelain originally made in China.

eggshell china. *Noun.* Very thin **translucent** porcelain originally made in China. Also called **eggshell porcelain**.

eggshell glazed tile. *Noun.* A tile coated with a glaze having a semi matte, eggshell-like texture.

eggshell porcelain. *Noun.* See **eggshell china**.

egg tempera. *Noun.* A mixture of egg yolk and water used as a binder for oil-based pigments in ceramic decoration.

E-glass. *Abbreviation, noun.* Stands for electrical-grade glass; developed for low electrical conductivity applications, such as printed circuit boards. It is also used to make fibre of low alkali content. A calcium aluminoborate glass with a typical composition in wt. %: SiO_2 (57.0), Al_2O_3 (9.5), CaO (19.0), MgO (4.5), B_2O_3 (8.5), $\text{Na}_2\text{O} + \text{K}_2\text{O}$ (0.5), F (0.3), Fe_2O_3 (0.3), TiO_2 (0.5).

Egyptian blue. *Noun.* A pale-blue frit or a powdered calcium copper silicate pigment of the general composition CuO-CaO-4SiO_2 contained in a glassy matrix.

Egyptianised clay. *Noun.* Clay to which tannin has been added to make it more plastic.

Egyptian jasper. *Noun.* A form of **jasper** with zones of colour throughout; found in Egyptian deserts.

eigen-. *Combining form.* Characteristic, proper.

eigentone. *Noun.* A resonance acoustic frequency of a system.

eigenvalue. *Noun.* In wave mechanics it is equivalent to the energy of a quantum state of a system.

Einstein temperature. *Noun.* See **Einstein theory of specific heat**.

Einstein theory of specific heat. *Noun.* A theory to account for the **specific heat** of a solid. It assumes that each atom within the solid acts as an independent harmonic oscillator, the energy of which is **quantised**, and all atoms have the same frequency. This gives rise to the equation: $C_v = 3R[\hbar\nu/kT]^2 [\exp(\hbar\nu/kT)/\{\exp(\hbar\nu/kT) - 1\}^2]$, where C_v is the molar heat capacity at constant volume, ν is the frequency of oscillation, T is the absolute temperature. The ratio $\hbar\nu/k$ is called the **Einstein temperature**, which is a material specific constant.

Einstein Brownian diffusion coefficient. D_B . *Noun.* The proportionality constant relating the three-dimensional mean displacement of suspended particles and Δt , the diffusion time. D_B equals $\kappa T/3\pi\mu d_p$, where κ is the **Boltzmann constant**, T is the thermodynamic temperature, μ is the viscosity of the dispersion fluid, and d_p is the particle diameter.

EIS. *Abbreviation.* Stands for electrochemical impedance spectroscopy. See **electrochemical impedance spectroscopy**.

elastance. *Noun.* The reciprocal of capacitance; measured in reciprocal farads or **darafs**.

elastic. *Adjective.* Of a material: capable of returning to its original shape after compression, expansion, or any other deformation.

elastic after effect. *Noun.* The ratio of deformation remaining in a specimen, after a given period of tensile stress, to the degree of deformation immediately after the stress has been relaxed.

elastic deformation. *Noun.* The degree of deformation of a ceramic or other body under load, which disappears when the load is removed or relaxed.

elastic fractionation. *Noun.* A process in which soft aggregate particles are separated from harder particles by throwing the mixture against a steel plate; the harder particles will rebound farther on impact and hence be separated.

elasticity. *Noun.* A property of a material that enables it to immediately regain its original dimensions after the distorting stress is removed

elastic limit. *Noun.* The greatest stress a material can sustain without permanent strain remaining when the stress is completely removed.

elastic modulus. *Noun.* The ratio of stress to strain within the **elastic range** of a substance.

elastic phonic crystal. **EPC.** *Noun.* See **phononic crystals**.

elastic range. *Noun.* The range of stress for a ceramic from zero up to and including the elastic limit.

elastic recovery. *Noun.* The fraction of an obtained deformation on application of a load that behaves elastically. Hence, a perfectly elastic material has an elastic recovery of one, while a perfectly plastic material has an elastic recovery equal to zero.

elastic strain. *Noun.* Strain that is instantly and fully recovered when the applied stress is removed.

elastic strain energy. *Noun.* The potential energy stored in a strained solid. It equals the area under a stress-strain diagram up to the **yield point**.

elastic wave. *Noun.* See **acoustic wave**, **phononic crystal**.

elastohydrodynamic lubrication. *Noun.* See **Stribeck curve**.

elaterite. *Noun.* Rubber-like, brown, naturally occurring **bitumen**.

electret. *Noun.* A dielectric material that possesses a permanent or semi-permanent polarity in a manner analogous to a permanent magnet.

electrical anharmonicity. *Noun.* A state where the **dipole moment** of a solid depends non-linearly on the ion displacement.

electrical conductivity. σ . *Noun.* The measure of the ability, of a material to conduct electric current. It is defined as the number of charge carriers per unit volume times the charge carrier mobility and carrier charge value; for electrons, $\sigma = Ne\mu$, where $N = 10^{29} \text{ m}^{-3}$, $e = 1.6 \times 10^{-19} \text{ C}$, and μ is defined under **electronic mobility**.

electrical conductivity of a particulate substance. *Noun.* A measure of the current flowing through a unit cross-section of a particle for an imposed unit gradient under specified conditions of packing.

electrical dipole. *Noun.* A pair of equal but opposite charges that are separated by a small distance.

electrical discharge machining. EDM. *Noun.* A thermoelectrical material removal process. Sparks are generated between a workpiece ceramic, which must be conducting ($>0.3\text{--}1\text{ Sm}^{-1}$) and a tungsten electrode so that melting, **spalling** and evaporation of the workpiece occurs without direct contact. The workpiece and electrode are often submerged in a dielectric liquid. Suitable for ceramic composites containing conducting ceramics, such as TiN, TiC, ZrB_2 , etc. Also known as **electrodischarge machining**.

electrical dissipation factor. *Noun.* The ratio of the power loss in a dielectric to the total power transmitted through the material; equal to the tangent of the **loss angle**, δ .

electrical double layer. EDL. *Noun.* An interface region between a ceramic oxide surface and an aqueous solution. It has an **inner Helmholtz** or **β -plane** defined by the centres of specifically adsorbed anions, and an **outer Helmholtz plane** defined by the centres of the adsorbed balancing cations in the solution.

electrical energy storage. *Noun.* The use of **batteries**, **electric capacitors** and **supercapacitors** to store electrical energy. Two parameters are fundamental to the success, namely **energy density** and **power density**.

electrical erosion. *Noun.* The erosion of an electrical insulator due to the influence of an electrical discharge. Also known as **spark erosion**.

electrical erosion resistance. *Noun.* A quantitative measure of the amount of erosion of an insulator by an electric discharge under specified test conditions.

electrical grade glass. *Noun.* See **E-glass**.

electrical porcelain. *Noun.* A porcelain body formulated and designed for use as an electrical insulator. Usually involves high percentages of **alumina** in the body.

electrical quadrupole. *Noun.* See **quadrupole**.

electric boosting. *Verb.* See **boost melting**.

electric breakdown voltage. *Noun.* See **breakdown voltage**.

electric capacitor. *Noun.* An electrical non-conductor that permits the storage of energy as the result of **electric dipole** alignment when opposite faces are maintained at a different potential.

electric ceramic bonding. *Noun.* A method of joining ceramics whereby a thin electrode is placed between two flat ceramic faces and the sandwich is then heated locally in the region of the join while applying a voltage to the electrode.

electric conductor. *Noun.* A body that transmits electrical energy.

electric constant, absolute. ϵ_0 . *Noun.* See **absolute electric constant**.

electric contact. *Noun.* Any physical contact between two or more parts, which will permit the flow of electricity between the parts.

electric discharge machining. *Verb.* See **electrodischarge machining**.

electric displacement. *Noun.* The electric flux density when an electric field exists in free space into which a **dielectric** is placed. Also known as **electric flux density**.

electric field strength. E. *Noun.* The strength or intensity of an electric field at any point. Expressed as V m^{-1} .

electric flux density. *Noun.* A vector, D , arising from the addition of polarisation, P , and the Gaussian field, E , through: $D = \epsilon_0 E + P$, where ϵ_0 is the **absolute electric constant**.

electric furnace. *Noun.* A furnace or kiln in which the main source of heat is provided by electrical means.

electric, seignette. *Noun.* See **seignette-electric**.

electric strength. *Noun.* The voltage gradient at which dielectric breakdown occurs in an insulating material.

electric susceptibility. χ . *Noun.* Defines a material's **dielectric coefficient**; it is the **polarisability** divided by the **permittivity** times the internal electric field: $\chi = P/\epsilon_0 E_i$.

electrides. *Plural noun.* Crystalline salts that have **vacancies** at the anion sites but electrons trapped at these sites take on the role of anions.

electroacoustics. *Noun.* The technology of the interconversion of electrical and acoustic energy by ceramic transducers.

electroacousticspectroscopy. EAS. *Noun.* Measurement of the interaction of electric and acoustic fields, from which the **zeta-potential** can be determined. The technique is restricted to charged particles. A pulse of ultrasound excites colloidal slurry. This causes displacements of the electrical double-layer around each charged particle, which then causes an electric field change. An antenna immersed in the slurry monitors the electric field. The output is called the short circuit colloid vibration current, **CVI**. Thus the process is sound in, electrical signal out.

electrocast brick. *Noun.* A dense refractory brick or other shape formed by melting the components in an electric furnace followed by casting into a mould.

electrocasting. *Noun.* See **fusion casting**.

electrocast refractories. *Plural noun.* Materials such as **mullite**, **aluminium silicate**, and binary oxides, etc., melted and cast into blocks or other shapes; usually non-porous, hard, and with low expansion coefficients.

electroceraamics. *Plural noun.* Ceramic products that are formulated and designed for use as components in electric circuits, as insulators, or to exploit a physical property activated by electrical potential.

electrochemical grinding. ECG. *Verb.* Using the combined action of electrochemical attack and abrasion for rapid surface removal of ceramic materials.

electrochemical impedance spectroscopy. EIS. *Noun.* An instrument that records the response of a ceramic or composite to an applied alternating signal over a pre-defined frequency range. The impedance is calculated by measuring the applied voltage and the resulting ac current. The complex impedance is separated into real and imaginary parts from which conductance and capacitance are found and it is these properties that are sensitive to physical and chemical changes in the sample. It is a non-destructive technique but small electrodes must be attached to the sample.

electrochemical manganese dioxide. EMD. *Noun.* The **nsutite**, γ -form of MnO_2 ; used as electrode material.

electrochemical reaction. *Noun.* (1) A reaction caused by the passage of an electric current through an ionic solid or liquid. (2) A spontaneous reaction that causes current to flow in a conductor, i.e., the classical **dry cell**.

electrochromic display. EDC. *Noun.* A system where colours are developed in **nonstoichiometric** oxides by applying an electrical potential to change the oxide ion defect concentration; WO_{3-x} oxides are examples.

electrochromic device. *Noun.* A layered composite that becomes coloured when a potential is applied across the layers, e.g., ITO/ WO_3 /IrOx layers some 10–500 nm thick. See **ITO**.

electro consolidation. *Noun.* A preformed part to be densified is surrounded by a pressure-transmitting powder that is electrically conductive so that heating to the consolidation temperature is done by direct resistive heating while a densification pressure is applied simultaneously. Short forming time, around 4 min, is the advantage of this process.

electrode. *Noun.* (1) A conductor on whose surface reactions occur and between any two of which the ions in an electrolyte flow. (2) In radio frequency heating the plates between which is created the alternating electric field needed to heat the material placed between them. (3) An element in a semiconducting device that emits collects or controls the movement of electrons or **holes**.

electrode material capacity. *Noun.* A measure of a materials ability to store charge. See **specific capacity of electrode material**.

electrode material, specific capacity. *Noun.* See **specific capacity of electrode material**.

electrodeposit. *Verb trans.* A way to apply a surface coating on to a conducting ceramic by making it one electrode connected to a copper electrode in a plating solution. (2) *Noun.* The deposit so formed.

electrodischarge machining. EDM. *Verb.* A shaping process used on ceramics and composites to make

complex shapes using electrical energy to erode and vaporise the surface. Used on ceramics with low electrical resistivity, typically less than $100\Omega\text{ cm}$, and so able to support sparking. Fine surface finishes of high integrity are achieved. Also known as **electric discharge machining**.

electrofusion. *Verb.* Melting by electrical means, usually in electric furnace but in some cases the process is augmented by the use of electrodes submerged in the molten bath; also covers inert gas arc melting.

electrokinetic sonic amplitude. ESA. *Noun.* Ultrasonic pulses produced in colloid slurry when an electric field pulse disturbs the **electrical double-layer** around charged colloidal particles.

electroless plating. *Noun.* Deposition of metals such as nickel, copper, cobalt, and iron onto a ceramic surface that acts as a catalyst when a reducing agent is added to an appropriate salt solution in which the ceramic is immersed.

electroluminescence. *Noun.* The emission of light activated by electrical potential. The visible light emitted by a **p-n junction** when a forward-biased voltage is applied, is an example. It arises from the recombination of electrons and **holes** in a doped semiconductor system; **GaAs** is an example.

electrolysis. *Noun.* A pair of electrochemical reactions, i.e., two half-cell reactions, occurring at the anode and cathode electrodes of a cell when a current passes between the electrodes.

electrolyse. *Verb trans.* To subject a material or system to **electrolysis**.

electrolyte. *Noun.* (1) A chemical, usually an inorganic salt added to porcelain-enamel and to ceramic slips to control the suspension and flow properties by controlling particle agglomeration. (2) A solution containing ions or an ionic solid capable of passing a current by the transport of **ions** between electrodes. (3) The ions of an electrolyte. (4) A substance that becomes an electrolyte when dissolved in a suitable solvent or is melted.

electrolytic pickling. *Noun.* A process in which the **pickling** of metal for porcelain-enamelling is enhanced by passing an electric current through the pickling bath in which the metal serves as an electrode.

electromagnet. *Noun.* A core of magnetic material that is magnetised when surrounded by a coil of insulated wire through which a current is flowing.

electromagnetic. *Adjective.* A term describing the inevitable way in which electrical and magnetic fields are related.

electromagnetic acoustic transducer. EMAT. *Noun.* A device consisting of a source of magnetic bias and a conductor in the shape of a coil. A transient current in the conductor induces **eddy currents** in the surface of

the material. The eddy currents interact with the magnetic bias to produce a **Lorentz force**, which produces a dynamic stress in the material. This effect has been built into non-contact, **non-destructive test** systems using **ultrasound** either as the generator of the **elastic wave** or as a detector of **laser**-generated acoustic waves in solids.

electromagnetic field. *Noun.* Electric charges and currents have a specific property of influencing other charges and currents in their environment; the space in which such effects occur is called an electromagnetic field.

electromagnetic frequencies. *Noun.* Mutually perpendicular electric and magnetic fields that are time dependent. The frequency spectrum spans from γ -rays through light and heat rays to audio.

electromagnetic moment. m. *Noun.* A measure of the magnetic strength of a magnet. It is the torque produced when the magnet's axis is perpendicular to 1 unit of magnetic flux density and is measured as $A\ m^2$. Also called **magnetic moment**.

electromagnetic test. *Noun.* A non-destructive measure of some property, such as thickness of an enamelled coating by the use of electromagnetic energy.

electromagnetic unit. e.m.u. *Noun.* Any unit that belongs to a system of electrical **cgs units** in which the magnetic constant is given the value of unity.

electromagnetic waves. *Noun.* A generic term covering such waves as **optical** and **microwaves**. See **electromagnetic frequencies**.

electromechanical coupling factors. k_{xy} . *Noun.* Used to indicate the ability of a **piezoelectric ceramic** to convert electrical to mechanical energy, or vice versa, in the planar, transverse, parallel, and shear modes.

electromigration. *Noun.* The directed diffusion of atoms in a solid by the application of an electric field. The charge on the mobile atoms can be deduced from the material flow.

electromotive force. *Noun.* (1) A source of energy that can cause current to flow in an electrical circuit. (2) The rate at which energy is drawn from this source when unit current flows through a circuit; measured in volts.

electron. *Noun.* A stable fundamental sub-atomic particle present in all atoms considered to be described with both wave and particulate properties. It carries a negative charge of $1.6021765 \times 10^{-19}$ C, a rest mass of 9.109382×10^{-31} kg, a radius of $2.8179403 \times 10^{-15}$ m and a spin equal to $\frac{1}{2}$.

electron affinity. *Noun.* For an isolated atom it is the energy evolved when an electron is brought up from infinity and an anion is formed.

electron back scatter diffraction. *Noun.* A technique that can be achieved in a **scanning electron microscope**.

A stationary electron probe impinges on a tilted crystalline sample and a diffraction pattern, the **electron back scattering pattern**, is formed on a phosphor screen positioned close to the sample. Electrons hitting the sample are scattered in all directions and so some will be incident at the **Bragg angle** on near surface planes, which will be diffracted into shallow cones that will intersect the plane of the phosphor to give a pattern of intersected bands. Each band corresponds to a particular (hkl) and the band width is proportional to $1/d_{(hkl)}$. The band intensity depends on numbers of atoms and their position in the **unit cell**. Thus considerable textural information is stored in the pattern. For example, if the calculated angles between $(h_1k_1l_1)$ and $(h_2k_2l_2)$ etc., are compared to measured values then the grain orientation can be determined.

electron back scattering pattern. EBSD. *Noun.* See **electron back scatter diffraction**.

electron beam. *Noun.* A stream of electrons in an evacuated tube.

electron beam cutting. EBC. *Noun.* highly focused electron beams of high intensity that vaporise material encountered.

electron beam machining. EBM. *Noun.* the equipment used for **EBC** adapted to drill small holes or cut narrow slots.

electron beam processing. *Noun.* The use of a focused high-energy electron beam to locally heat and chemically change micron sized areas on semiconductor wafer devices.

electron beam welding. EBW. *Noun.* the fusion and joining thereby of two pieces of material by directing a high intensity electron beam into the join.

electron configuration. *Noun.* For an atom it is the manner in which possible electron states are filled with electrons.

electronegative. *Noun.* (1) A term used to describe non-metals. (2) A tendency to accept valence electrons. See **electronegativity** for approaches to quantification.

electronegativity. *Noun.* A measure of the power of an atom in a solid, or a molecule, to attract electrons. Two definitions, Pauling's and Milliken's, allow quantification: the Milliken value is one half the sum of the **ionisation potential** plus the **electron affinity** both expressed in electron volts.

electroneutrality principle. *Noun.* Concerns lattice defect formation in crystals; states that in a crystal the sum of all positive charges must equal the sum of all negative charges before, during, and after the formation of defects.

electron hole. *Noun.* An electron-deficient site that provides acceptor energy levels. A **hole** acts as a positive charge carrier.

electron excess centre. *Noun.* See **F-centre**.

electronic. *Adjective.* (1) Of or concerned with, using, or operated by devices, such as **transistors** in which electrons are conducted through a **semiconductor**, vacuum or gas. (2) Of or concerned with electronics. (3) Of or concerned with electrons.

electronic ceramics. *Noun.* (1) Ceramic products that display dielectric, semiconductor, magnetic, or other similar properties that are useful in the production of electronic devices, such as transistors, solid-state devices, electron tubes, magnetic amplifiers, etc. (2) Ceramic materials which amplify or control voltages or currents without mechanical or other non-electrical direction.

electronic configuration. *Noun.* The arrangement of electrons in the **orbitals** of atoms, molecules and crystals.

electronic display unit. *Noun.* Devices containing screens activated by electrons or **liquid crystals** etc. that show the contents of a computer, a television tube or fibre optic probes etc.

electronic filter. *Noun.* Electronic devices based on **inductors**, **capacitors**, **diodes**, **transistors**, and parallel and series tuned circuits, used to remove undesirable frequencies or to pass on required ones.

electronic polarisability. α_e . *Noun.* The factor $4\pi_0 R^3$ by which the displacement of electrons in an atom caused by the application of an external electric field is measured, where R is the radius of the outer **orbital** shell.

electronic polarisation. *Noun.* The response of the electrons in a solid to an applied alternating electric field. This response leads to changes in the **refractive index** of a material, for example when **lead oxide**, **PbO**, is added to glass the highly polarisable Pb^{2+} ions that have a lone pair of electron, replace some Na^+ and the refractive index of the glass is increased considerably. See **polarisation** (1).

electronics. *Noun.* The science and technology behind the behaviour and development of electronic devices and circuits.

electron lens. *Noun.* An arrangement of magnets and electrodes for producing fields to focus a beam of electrons.

electron microscope. *Noun.* An electron-optical instrument in which a beam of electrons is focused on very thin sections of a specimen by means of an **electron lens** to produce a magnified image of a submicron-sized area of the specimen on a fluorescent screen or photographic film. Images many times more magnified than a light microscope are produced.

electron microscope, scanning. *Noun.* See **scanning electron microscope**.

electron mobility. μ . *Noun.* The drift velocity of electrons per unit of electric field: $\mu = e\tau/m_e$, where e is the electron

charge, 1.6×10^{-19} C, τ is the mean free time between collisions, 10^{-14} s, and m_e is the electron mass, 9.1×10^{-31} kg.

electroneutrality. *Noun.* A state where there exists the exact same number of positive and negative charges.

electron probability function. $\Psi^2 dv$. *Noun.* The probability of finding an electron, defined by the wave function Ψ , in a volume element, dv .

electron probe microanalyser. EPMA. *Noun.* a surface elemental analyser device usually attached to a **scanning electron microscope**. Interaction of atoms in the sample surface with the electron beam produces characteristic x-ray emissions, which can be analysed for wavelength and intensity.

electron probe microanalysis. *Noun.* A method for analysing a very tiny amount of material by bombarding it with a finely focussed beam of electrons and then recording the resultant x-ray emission spectrum which is analysed for type and amount of elements present.

electron shell. *Noun.* A group of electrons having the same **principal quantum number**, n.

electron spin resonance. ESR. *Noun.* a technique for examining **paramagnetic** materials by subjecting them to high frequency radiation in a strong magnetic field. Changes in the spin of unpaired electrons cause radiation to be absorbed at definite, characteristic frequencies.

electron volt. eV. *Noun.* The kinetic energy gained by an electron on being accelerated through a potential difference of 1.0 V in a vacuum. It is equivalent to 1.602×10^{-19} J.

electro-optic. *Adjective.* Change in optical properties on application of an electric field.

electro-optic ceramics. *Plural noun.* Ceramics possessing reversible **birefringence** on application of an electric potential, e.g., **PLZT**.

electro-optic effect. *Noun.* See **Kerr electro-optic effect** and **Kerr constant**.

electrophilic. *Adjective.* Having or involving the affinity for negative charge.

electrophoresis. *Noun.* The movement of colloidal particles or macromolecules through a solution under the action of an electromotive force applied through electrodes in contact with the suspension.

electrophoretic deposition. EPD. *Noun.* A surface coating technique from aqueous suspensions. An external dc field is applied and this causes the migration of particles and their subsequent deposition on an oppositely charged surface.

electropolishing. *Noun.* A surface smoothing and finishing technique utilising an electrochemical bath

and making the article the anode, therefore only used with conducting ceramics.

electropositive. *Adjective.* Having a tendency to release electrons and form positive ions or polarised chemical bonds.

electrorheology. *Noun.* The study of the flow of fluids under the influence of electric fields.

electrorheological fluid. **Erf.** *Noun.* A suspension which when subjected to an electric field changes in milliseconds to a solid and when the field is removed it returns to a fluid. Clay suspended in mineral oil plus alcohol is an example.

electrospinning. *Verb.* A versatile method for producing long continuous fibres with diameters ranging from a few microns to a few nanometres. A polymer melt or solution is needed so ceramic precursors soluble in these media are needed and the process needs a pyrolysis step. A strong electric field is applied to a spherical drop suspended from a fine capillary. The drop distorts to a conical shape, which is then attracted to a negative plate. As long as the drop viscosity is high the cone becomes a fast moving filament. The solvent evaporates and an ultra thin fibre is formed that is then pyrolysed. Ceramic fibres made this way include: TiO_2 , SnO_2 , ZnO , In_2O_3 , and WO_3 as thin as 20 nm.

electrostatic assisted combustion chemical vapour deposition. **EACCVDe.** *Noun.* A process that involves spraying atomised droplets across an electric field where they undergo thermal and chemical reactions in the vapour phase close to a heated substrate. The film coating so produced has good adhesion properties. The precursors are water or organic solvent soluble materials. It is a one-step, non-line of sight process and so the substrate can have a complicated shape. Fast build-up rates are possible using inexpensive equipment.

electrostatic precipitation. *Verb.* To remove solid particles in a gas stream by giving them an electric charge and attracting them to charged plates.

electrostatic spray assisted vapour deposition. **ESAVD.** *Noun.* A process where atomised precursor droplets are sprayed across an electric field where they decompose and then undergo vapour phase reaction before depositing on a heated substrate. Yttria-stabilised zirconia for thermal barrier coatings is frequently made this way.

electrostatic spraying. *Noun.* A coating process in which the coating particles are given an electrostatic charge opposite to that of the item being coated, causing the particles to be attracted to the surface of the item with a minimum of overspray as in the electrostatic spraying of porcelain-enamels on metal.

electrostatic surface charge. *Noun.* Particles when dispersed in water become charged as a result of the type and concentration of ions at their surface, the pH of the

fluid, and the concentration of ions in the fluid. The charge is quantified by the **zeta potential** of the suspended particles.

electrostatic unit. **ESU.** *Noun.* Any unit in a **cgs system** that gives the electric constant a value 1.0.

electrostriction. *Noun.* The change in dimensions of a dielectric occurring as an **elastic strain** when an electric field is applied.

electrostrictive material. **ϵ .** *Noun.* Ceramic crystals showing a second-order effect called **electrostriction** in which strain induced in the crystal is proportional to the square of the applied field: $\epsilon = kE^2$, where E is the applied field; the effect is used in actuator devices. **PMN** is such a ceramic material.

electrothermal. *Adjective.* Concerned with the production of electricity by heat.

electrovalent bond. *Noun.* A bond formed by electrostatic attraction between ions of opposite charge in a solid. Also called **ionic bond**.

elephant ear. *Noun.* A type of flat, fine-grained sponge used in finishing pottery surfaces before firing.

elephant trunk. *Noun.* A series of conical sections of steel pipe forming a flexible downspout to control and confine the vertical flow of concrete during pouring.

elevator. *Noun.* A mechanical device used to move material from one level to another.

elevator kiln. *Noun.* A kiln in which ware is placed on a refractory platform to be raised by an **elevator** into the firing chamber directly above.

Ellingham diagrams. *Plural noun.* Graphical representations of the change of **free energy of formation** with respect to temperature per mole of the common element. They were originally constructed for oxides but are now available for sulphides, carbides, nitrides, and several other special ceramics. In the case of oxides the diagrams plot the free energy change per mole of oxygen for the reaction: $(2x/y)\text{M} + \text{O}_2 \leftrightarrow (2/y)\text{M}_x\text{O}_y$, which usually takes the form: $\Delta G_f^\circ = a + bT$, where a and b are constants. The diagrams relate to the relative stabilities of oxides since a metal, whose line lies low in the diagram has a very negative ΔG_f° value and the oxide is very stable, will **reduce** an oxide lying high on the diagram. Use of the **activity** relationship allows conversion of the ΔG_f° term to the equilibrium oxygen partial pressure above the element and so the Ellingham diagram is used to calculate oxygen pressures, which with data from the CO/CO_2 and $\text{CO}/\text{H}_2\text{O}$ systems allows construction of **nomograms** that give direct reading of the CO/CO_2 or $\text{CO}/\text{H}_2\text{O}$ ratios that will reduce a particular ceramic oxide at a given temperature.

ellipsometry. *Noun.* A technique that measures the intensity and **polarisation** of reflected light to give information on the thickness and **refractive index** of surface layers.

Ellis plasticity. *Noun.* A type flow encountered in some powder-loaded fluids which, like **pseudoplasticity**, needs a **shear stress** above a minimum value to induce flow. Once flowing increased shear stress reduces the apparent viscosity.

elongation. *Noun.* The increase in length of a specimen during a tensile test; units in metres.

eluant or eluent. *Noun.* Any solvent used to **elute**.

elute. *Verb trans.* To wash a substance out by means of a solvent suitable for that substance.

eluent. *Verb trans.* See **eluent**.

elutriate. *Verb.* To separate solid particles by washing, decanting, and settling.

eluvium. *Noun.* A mass of sand, salt, gravel, or boulders that is the product of erosion of rocks and has remained at its place of origin.

email. *Noun.* From the French for **enamel**.

email ink. *Noun.* A liquid developed for use on glass and porcelain and to develop decorations on their surface.

email ombrant. *Noun.* A process in which the impressions of the design appear as shadows.

EMAT. *Acronym.* Stands for electromagnetic acoustic transducer. See **electromagnetic acoustic transducer**.

embed. *Verb.* (1) To enclose in a surrounding matrix. (2) To fix firmly and deeply in a surrounding solid.

embedding. *Verb.* Surrounding components with layers of powder or foam to provide insulation or a locally protective environment in a firing process.

emboss. *Verb.* To ornament or decorate with a raised pattern in low relief on the surface of ware.

embossing, double. *Noun.* See **double embossing**.

embossing, single. *Noun.* See **single embossing**.

embossing, white acid. *Noun.* See **white acid embossed**.

embossment. *Noun.* A raised pattern decoration on the surface of an item of ware.

embryo. *Noun.* A particle in a liquid whose radius is less than the critical radius and so will become more stable as its size decreases. An **entropy** effect makes it possible for some embryos to become **nuclei** on which crystallisation can begin.

EMD. *Abbreviation.* Stands for electrochemical manganese dioxide. See **electrochemical manganese dioxide**.

emerald. *Noun.* The most important gem variety of the mineral **beryl**. It occurs as large green-coloured hexagonal crystals in **pegmatites** with **calcite** and **pyrite** and although beryl is colourless, various transition ion impurities impart colour to form the gem varieties. See **beryl**, **aquamarine** and **heliodor**.

emerald cut. *Adjective.* A type of cut to enhance gemstones, particularly coloured stones, after polishing. Also called **step cut**.

emery. *Noun.* Al_2O_3 . An impure, natural **corundum**, powdered for use in grinding and polishing.

emery obscured. *Noun.* A glass surface obscured by grinding with a fine grade of **emery**.

emery paper. *Noun.* An abrasive paper or cloth with a tightly bonded coating of **emery** for use in cleaning and polishing operations.

emery stone. *Noun.* A sharpening device or grinding stone made of bonded **emery**.

emery wheel. *Noun.* A grinding wheel made of tightly bonded **emery** used on mechanical grinding and polishing machines.

emf or EMF. *Abbreviation.* Standing for electromotive force. See **electromotive force**.

emission. *Noun.* (1) Waste gases and vapours discharged into the air. (2) Energy in the form of heat, light, radio waves etc., emitted from a source. (3) The number of electrons emitted by a cathode mostly quoted in mA.

emissivity. *Noun.* (1) The ratio of the radiation given off by the surface of a body to the radiation given off by a perfect **blackbody** at the same temperature. (2) The capacity of a body to radiate heat.

emitter. *Noun.* (1) A source of infrared emission, usually achieved by resistive heating to about 700 °C for long waves, 950 °C for medium waves, and 2,200 °C for short waves. (2) The region in a **transistor** where the charge carrying **holes** or **electrons** originate. (3) A **radioactive** substance.

empirical. *Noun.* Based on experience, observation, and measurement rather than theory.

empirical formula. *Noun.* A statement of the number and kind of atoms in a compound without indicating their grouping.

e.m.u. *Abbreviation.* Standing for electromagnetic unit. See **electromagnetic unit**.

emulsification. *Noun.* The process of dispersing immiscible liquids, such as oil and water, by the application of mechanical energy or the addition of chemical dispersants.

emulsifier. *Noun.* A surface-active chemical that will promote the dispersion of immiscible liquids.

emulsify. *Verb.* To make an **emulsion**.

emulsion. *Noun.* A stable mixture of two immiscible liquids in which one is dispersed as droplets throughout the other.

emulsion, wax. *Noun.* See **wax emulsion**.

emulsoid. *Noun.* A sol with a liquid disperse phase.

EN. *Abbreviation.* Stands for Pan-European design codes.

enamel. *Noun.* (1) A coloured glassy or vitreous coating, translucent or opaque, applied and fired on to metal, glass, or other ceramic ware for decoration or protection; the coating on metal is usually called porcelain-enamel. (2) An article ornamented with enamel. (3) The hard, white calcified substance covering the crown of teeth. (4) *Modifier.* As in enamel broach. (5) *Verb.* To inlay, decorate or coat with enamel.

enamel, acid-resisting. *Noun.* See **acid-resisting enamel**.

enamel, alkali-resisting. *Noun.* See **alkali-resisting enamel**.

enamel, aluminium. *Noun.* See **aluminium enamel**.

enamel-backed glass tubing. *Noun.* Glass tubing with a black or coloured coating on the back segment of the perimeter to facilitate the observation and reading of liquid levels in the tubing, such as used in thermometers, etc.

enamel beading. *Noun.* (1) Porcelain-enamel, usually of a different colour, applied as a decoration or reinforcement to the edge or rim of porcelain-enamelled articles. (2) The process of removing excess slip from the edge of freshly dipped or coated porcelain-enamel ware. (3) A heavy bead of porcelain-enamel along the edge of porcelain-enamelled cast-iron ware.

enamel, blackboard. *Noun.* See **blackboard enamel**.

enamel, blown. *Noun.* See **blown enamel**.

enamel, blue. *Noun.* See **blue enamel**.

enamel brick clay. *Noun.* Clay similar to that used to make buff-coloured **face brick** applied as a coating and fired to **vitrification**.

enamel, cast-iron. *Noun.* See **cast-iron enamel**.

enamel, chalkboard. *Noun.* See **chalkboard enamel**.

enamel clay. *Noun.* **Ball clay** used to promote the suspension of porcelain-enamels and glazes in aqueous slips. See **ball clay**.

enamel colours. *Noun.* Inorganic compositions employed to impart a full spectral range of colours to porcelain-enamel as well as to glazes, glass, and ceramic bodies.

enamel, copper. *Noun.* See **copper enamels**.

enamelled brick. *Noun.* A hard smooth-surfaced brick with a fired wash-type coating, the coating frequently being coloured.

enamel fineness. *Noun.* The degree to which the particle size in an enamel frit has been reduced by milling, usually expressed as grams residue retained on a sieve of specified mesh size from a 50- or 100-g sample.

enamel firing. *Noun.* The process of fusing porcelain-enamel coatings to a metal base.

enamel, glass. *Noun.* See **glass enamel**.

enamelling. *Verb.* See **enamel** (5).

enamelling, cast-iron. *Noun.* See **cast-iron enamelling**.

enamelling, dry-process. *Noun.* See **dry-process enamelling**.

enamelling iron. *Noun.* A low-carbon, low-equivalent-carbon, steel designed for use as a base for porcelain-enamelling.

enamelling kiln. *Noun.* Any furnace in which porcelain-enamels are fired.

enamelling, wet-process. *Noun.* See **wet-process enamelling**.

enamel, jewellers. *Noun.* See **jewellery enamel**.

enamel, matte. *Noun.* See **matte enamel**.

enamel, molybdenum. *Noun.* See **molybdenum enamel**.

enamel, nitty. *Noun.* See **nits**.

enamel oxides. *Plural noun.* A large number of inorganic, usually transition metal, oxides used as colorants in porcelain-enamel.

enamel, porcelain. *Noun.* See **porcelain-enamel**.

enamel, reclaim. *Noun.* See **reclaimed enamel**.

enamel, refractory. *Noun.* See **refractory enamel**.

enamel, retouch. *Noun.* See **retouch enamel**.

enamel scrapings. *Noun.* Porcelain-enamel recovered from spray booths, dip tanks, settling tanks, and other sources, which are suitable for re-use after minimal treatment.

enamel, self-cleaning. *Noun.* See **self-cleaning enamel**.

enamel, sheet-steel. *Noun.* See **sheet-steel enamel**.

enamel, spongy. *Noun.* See **spongy enamel**.

enamel, tin. *Noun.* See **tin enamel**.

enamel, vitreous. *Noun.* See **vitreous enamel**.

enantiomorph. *Noun.* Either of the two crystal forms of a material that are mirror images of each other.

enantiotropy. *Noun.* The relationships between **polymorphs** existing at different temperatures.

enargite. *Noun.* Cu_3AsS_4 . Copper arsenic sulphide, an important copper ore; brittle, opaque with a metallic lustre and black **streak**; hardness (Mohs) 3; density 4400 kg m^{-3} .

encapsulate. *Verb trans.* To an object in or as if in a capsule. *Verb intrans.* To become encapsulated.

encapsulated pigments. *Plural noun.* A glaze colouring agent where the pigment phase is coated or contained inside another protecting, transparent phase, such as **haematite** precipitates inside **zircon**.

encapsulated HIP. *Noun.* A process where material is contained within a gastight envelope while still in the **green state** and then **HIPed**. The envelope must be deformable at the sintering temperature in order to transmit pressure to aid sintering.

encapsulation. *Noun.* (1) A process in which a substance is enclosed, encased, or encapsulated in a protective medium or film. (2) The technique of covering a porous ceramic with a pressure-transmitting medium prior to **HIP treatment**; glass is the commonest material used because preformed glass tube can be heated onto the ceramic form under vacuum.

encaustic. *Noun.* (1) Paint made from pigment mixed with melted beeswax and resin and fixed by heat after decorating ceramic ware. (2) A method of decoration in which the pigment to be applied to the surface of the item is carried in hot wax, or coloured clays are inlaid in the clay forming the body and burned in. (3) A work produced by (2).

encaustic. *Adjective.* Decorated with **encaustic**.

encaustic tile. *Noun.* Ceramic tile in which a design is inlaid and fired with clays of a colour different from that of the body.

encircling coil. *Noun.* An electromagnetic coil surrounding a specimen or part to be tested.

encrinite. *Noun.* A sedimentary rock formed from the skeletal plates of crinoids.

encrust. *Verb trans.* To cover, line or overlay a surface with a hard or decorative layer. *Verb intrans.* To form a crust

encrustation. *Noun.* The accumulated slag or other substance on the inside of a kiln or furnace.

end. *Noun.* (1) In ceramic fibre spinning and braiding it is an individual **strand**. (2) In weaving ceramic cloth it is an individual **warp** thread. (3) With respect to a fabric it is a length of finished fabric less than a customary unit or piece in length.

end-arch brick. *Noun.* A brick with the faces sloped toward each other so as to provide wedge-shaped ends of the same dimensions for use in the construction of the crown of an arch.

end capping. *Noun.* The breaking off at an acute angle the top volume of a **dry-pressed** powder rod when the pressure is released due to stress inhomogeneities present. A sign that the applied pressure is too high.

end construction. *Noun.* A type of construction in which structural tile and block are laid with the hollow cells of tile or block placed in a vertical position.

end-construction tile. *Noun.* A load-bearing, hollow concrete or fired ceramic tile designed to receive its principal stress parallel to the axis of the cell in construction applications.

end-cut brick. *Noun.* Brick made from extruded clay with wire cut sections forming the ends of the brick.

end-feather. *Noun.* The sharp edge of the end of a brick cut lengthwise from one corner to the other corner diagonally opposite to make a brick of triangular cross section.

end-feed centreless grinding. *Noun.* A grinding process in which the item being ground is fed through the grinding and regulating wheels of a **centreless grinder** to an end stop.

end-fired furnace. *Noun.* See **end-port furnace**.

endobon. *Noun.* A material, used as a substitute for **bone** in some **batches**, made by **calcining** natural bone. It consists of highly crystalline, organic-free, carbonate-free **hydroxyapatite**.

end-of-life. EOL. *Noun.* The design lifetime measured in years.

end-of-range defects. EOR. *Plural noun.* Interstitial type **dislocation** loops that nucleate just beneath the crystalline-amorphous interface formed by **ion implantation** in silicon.

endofullerene. *Noun.* A **fullerene**, such as C_{60} , with a metal atom inside the cage molecule.

endohedral. *Adjective.* Describes a cage structure compound, such as a **metallofullerene** in which the metal atom is inside the cage. See **exohedral**.

endohedral doping. @. *Verb.* To incorporate a metal atom inside a cage-structure molecule, such as $M@C_{60}$.

endothermic reaction. *Noun.* A reaction characterised by the absorption of heat.

end point. *Noun.* The stage in a chemical analysis when an observed parameter shows a sharp change in value.

end-port furnace. *Noun.* A furnace in which the ports for the introduction of fuel and air are in the end wall.

end runner. *Noun.* A refractory shape designed to channel and transport molten metal from a feeder head to an ingot mould.

end-skew brick. *Noun.* A brick with one end inclined at an angle other than 90° to the two largest, parallel faces.

endurance limit. *Noun.* The stress level below which a specimen will withstand cyclic stress without eventually showing **fatigue failure**.

endurance, thermal. *Noun.* See **thermal endurance**.

energetic hardness. *Noun.* A measure of the purely plastic properties of a material when defined as the

quotient between plastic work, W_p , the area contained within the loading and unloading curves in a $F(h)$ -plot and the irreversibly displaced material. V_p .

energetics. *Plural noun.* The branch of science that deals with energy and its transformations.

energise or energize. *Verb trans.* To apply an electric current or emf to a circuit.

energy bands. *Noun.* The states and properties of electrons can be interpreted using this concept. They are the ranges of allowed electron energies separated by ranges of forbidden energies. There is no significant conduction if a band is full.

energy density. *Noun.* (1) One of the two parameters fundamental to energy storage; it is the amount of energy stored for a given weight that is the **gravimetric energy density** expressed as Whrk^{-1} . See **power density**. (2) Alternatively it is the energy output from a battery per unit volume which is the **volumetric energy density** expressed as Whrl^{-1} . (3) The density of the energy distribution in an electromagnetic wave in Jm^{-3} .

energy efficiency. *Noun.* For a dry cell it is the energy used to charge the cell divided by the watt-hours available on discharge.

energy gap. *Noun.* (1) Gap in the low-energy excitations of a superconductor. (2) Forbidden zone in the energy spectrum of valency orbitals. If the lower energy band is filled electrons must be excited across the gap for electronic conduction to occur.

energy, internal. *Noun.* See **internal energy**.

energy, kinetic. *Noun.* See **kinetic energy**.

energy level. *Noun.* The energy of a **quantum state** of a system.

energy product. *Noun.* A figure of merit for a permanent magnet comprising the magnetic strength and the **coercivity**; units are kJ m^{-3} . It is the area of the largest rectangle that can be drawn in the second quadrant of a **B-H hysteresis** curve.

Engels salt. *Noun.* $\text{MgCO}_3 \cdot \text{KHCO}_3 \cdot 4\text{H}_2\text{O}$. A precursor to **potash** or **pearl ash** for **batch** preparation made by the reaction of **magnesia** and potassium chloride with carbon dioxide.

engineered brick. *Noun.* The highest classification of brick; used for bricks with nominal dimensions $8 \times 10.3 \times 20.3$ cm that are more dense and harder than ordinary brick. Used for load bearing applications, for water resistant applications and water frost resistance is needed.

engineered nanomaterial. **ENM.** *Noun.* A man-made powdered material where each grain has dimensions less than 100 nm (**nanoparticle**) or with at least one dimension less than 100 nm (**nanomaterial**).

engineering A brick. *Noun.* A clay brick fired to a compressive strength $\geq 70 \text{ MN}^{-2}$ and a **water absorption** $\leq 4.5 \text{ wt\%}$.

engineering B brick. *Noun.* A clay brick fired to a compressive strength $\geq 50 \text{ MN}^{-2}$ and a **water absorption** $\leq 7.0 \text{ wt\%}$.

engineering constants. *Plural noun.* Mechanical moduli obtained directly from uniaxial tensile or compressive tests and pure shear tests.

engineering strain. **ϵ .** *Noun.* The change in gauge length of a specimen, in the direction of the applied stress, divided by its original gauge length.

engineering stress. **σ .** *Noun.* The instantaneous load applied to a specimen divided by its cross-sectional area before deformation.

engine-turned ware. *Noun.* **Bisque ware** lined or fluted in a special lathe.

E. N. glass-ceramic. *Noun.* Ceramics derived via glass crystallisation from nuclei on the surface of glass powders as they viscously sinter to shape.

Engler degree. *Noun.* A unit on a scale of viscosity based on the ratio of the time taken by a liquid to flow through a standard orifice to the time taken by water to flow through the same orifice.

English bond. *Noun.* Alternate courses of **headers** and **stretchers**, the mortar joints in alternate courses being lined up vertically.

English Delftware. *Noun.* Manufactured in London from about 1590. A **slipware** using **tin oxide** opacified glaze, which is later over-painted with scenes and patterns.

engobe. *Noun.* A slip coating applied to ceramic bodies to mask the colour and texture of the body, and to impart colour or opacity, and which may, or may not, be subsequently covered with glaze.

engrave. *Verb.* To carve or grind designs on glass or other ceramic products.

engrave. *Noun.* The result of carving designs on ceramics and glass.

ENM. *Abbreviation.* Stands for engineered nanomaterials. See **engineered nanomaterial**.

enrich. *Verb.* To increase the concentration or abundance one component or isotope in a mixture.

enriched uranium. *Noun.* Uranium produced to contain more ^{235}U than the normal concentration of 0.711 wt. %.

ensemble. *Noun.* (1) A set of systems that are identical in all respects except for the motion of their constituents. (2) a single system in which the properties are determined by the statistical behaviour of its constituents.

engraving. *Noun.* MgSiO_3 . A **single chain silicate**, the magnesium end member of the **pyroxene** family. A green to brown, **orthorhombic** mineral; used in electronic ceramics as a replacement for **talc** to minimise shrinkage. It occurs in three polymorphic forms, **orthoestatite**, which is the ambient form, **protoenstatite**, and **clinoenstatite**. Density $3,200\text{--}3,500\text{ kg m}^{-3}$; hardness (Mohs) 5–6.

entablature. *Noun.* (1) A construction consisting of an **architrave**, a **frieze**, and a **cornice**. (2) The part of a classical temple above the columns.

entablement. *Noun.* The platform of a pedestal above the **dado** that often supports a statue.

entasis. *Noun.* A slight convex curve given to the shaft of a column to correct the illusion of concavity produced by a straight shaft.

enthalpic stabilisation. *Noun.* The situation where the enthalpy change on the close approach of solid particles in suspensions opposes **agglomerate** formation but the **entropy** decrease promotes it. Increasing the suspension temperature can cause agglomeration through the $T\Delta S$ term. Commonly applies in aqueous suspensions.

enthalpy. **H.** *Noun.* A thermodynamic property of a system equal to the sum of the **internal energy** of a body plus the product of its volume multiplied by the pressure exerted on the body by its surroundings. Also known as **sensible heat**, **total heat**, and **heat content**. A state function measured in joules per mole, J mol^{-1} .

enthalpy of mixing. *Noun.* See **heat of mixing**.

entrain. *Verb.* To introduce air or a gas into a **slurry** by vigorous stirring or agitation.

entrained air. *Noun.* Minute bubbles of air formed in concrete by the introduction of an air-entraining agent to the batch.

entrainment. *Noun.* The process of introducing air or other gaseous bubbles into a body by physical means, such as by mechanical agitation, or by chemical means that will generate bubbles capable of being retained by the body.

entrance zone. *Noun.* See **die zones**.

entrapped air. *Noun.* Air voids in concrete generally larger than 1 mm in diameter, which are mechanically formed and trapped in the batch.

entropic stabilisation. *Noun.* The situation where a negative **enthalpy** change works toward particle agglomeration in suspensions but the **entropy** change is also negative and so opposes agglomeration. Cooling reduces the $T\Delta S$ term and causes the solid to agglomerate. Commonly occurs in organic liquid–solid suspensions.

entropy. **S.** *Noun.* A thermodynamic state function. It is a measure of the extent to which the energy of a system

is not available for conversion to mechanical work. Some times associated with the degree of order in a system with more disorder implying greater entropy. It is defined as: $S = q_{\text{rev}}/T$, where q_{rev} is the quantity of heat involved when the change is carried out under thermodynamic reversible conditions, hence it has the units of $\text{J K}^{-1} \text{ mol}^{-1}$.

entropy of mixing. *Noun.* The change of entropy that occurs when x_a , x_b , x_c , etc. mole fractions of A, B, C, etc., are combined to give one mole of solution. For an ideal solution this is the configurational entropy change occurring when the relevant numbers of A, B, etc., atoms are distributed randomly over all N sites available in one mole of the solution.

envelope kiln. *Noun.* (1) Kiln in which the firing zone is positioned above a loaded refractory platform and lowered to surround it. (2) A box-type kiln in which ware placed on a **kiln car** is pushed into the entrance end of the kiln, thereby displacing a car of fired ware at the other end.

enzyme. *Noun.* (1) A natural molecular **nanomachine** made of protein. (2) A catalyst that can speed-up chemical reactions.

oolith. *Noun.* Crudely broken stone, usually flint, used as a tool.

EPA. *Abbreviation.* Stands for US Environmental Protection agency standards.

EPC. *Abbreviation.* Stands for elastic phonic crystals. See **phononic crystals**.

EPD. *Abbreviation.* Standing for electrophoretic deposition. See **electrophoretic deposition**.

epidote. *Noun.* $\text{Ca}_2\text{Fe}(\text{Al}_2\text{O})(\text{OH})(\text{Si}_2\text{O}_7)(\text{SiO}_4)$. A green mineral common in metamorphic rocks. See **epidote silicates**.

epidote silicates. *Plural noun.* A group of silicate minerals containing both $[\text{SiO}_4]^{4-}$ and $[\text{Si}_2\text{O}_7]^{6-}$ anions; **epidote** is: $\text{Ca}_2\text{Fe}(\text{Al}_2\text{O})(\text{OH})(\text{Si}_2\text{O}_7)(\text{SiO}_4)$.

epigene. *Adjective.* Of or concerning rocks formed on the earth's surface.

epitaxial. *Adjective.* Of or concerning crystal growth on a template crystal substrate.

epitaxial transistor. *Noun.* A **transistor** made by a process of depositing a thin layer of pure semiconductor material onto a crystalline substrate by **epitaxy**. The deposited layer acts as the **collector** electrode.

epitaxy. *Noun.* The growth of a crystal on the surface of another crystal such that the unit cell type and dimensions of the substrate crystal orient the growth of the deposited crystal. An important concept in thin film deposition.

EPMA. *Abbreviation.* Stands for electron probe microanalyser. See **electron probe microanalyser**.

epoxy resin. *Plural noun.* A family of thermosetting plastics of high strength, low shrinkage. Usually poly-ether resin employed as a bonding agent in glass-fibre strands and cloth because of its excellent resistance to acids and alkalis and for its excellent electrical properties. They have good adhesion to glass fibres and their thermal expansion can be matched to metals to which they may be joined. **Filament winding, hand lay-up, centrifugal casting, or compression moulding** can form **glass-fibre-reinforced epoxy resin**.

Epsom salts. *Noun.* $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$. Employed as a set-up agent to adjust the viscosity and improve the application and flow properties of slips. See **set**.

equant. *Adjective.* A description of crystals and grains in a microstructure that have the principal dimensions approximately equal.

equation, Abrams' concrete strength. *Noun.* See **Abrams' law**.

equation, absorption. *Noun.* See **absorption coefficient**.

equation, allowable dimensional deviations. *Noun.* See **dimensional deviations**.

equation, Andrade's creep. *Noun.* See **Andrade's creep**.

equation, Andraesen similarity. *Noun.* See **Andraesen similarity condition**.

equation, angular frequency. *Noun.* See **angular frequency**.

equation, apparent volume. *Noun.* See **apparent volume**.

equation, attenuation. *Noun.* See **attenuation**.

equation, Balmer series. *Noun.* See **Balmer series**.

equation, Beer-Lambert. *Noun.* See **Beer-Lambert law**.

equation, BET. *Noun.* See **nitrogen surface area**.

equation, Bond and Wang crushing. *Noun.* See **Bond and Wang crushing theory**.

equation, Bragg. *Noun.* See **x-ray diffraction**.

equation, breaking length. *Noun.* See **breaking length**.

equation, Brewster. *Noun.* See **Brewster angle**.

equation, Brongniart. *Noun.* See **Brongniart's formula**.

equation, Brownian motion. *Noun.* See **Brownian motion**.

equation, Brunauer-Emmett-Teller. *Noun.* See **Brunauer-Emmett-Teller equation**.

equation, bulk volume. *Noun.* See **bulk volume**.

equation, Carman-Kozeny. *Noun.* See **Carman-Kozeny equation**.

equation, Cauchy's. *Noun.* See **dispersion curve and Cauchy light-dispersion formula**.

equation, chemical potential. *Noun.* See **activity**.

equation, Clapeyron-Clausius. *Noun.* See **Clapeyron-Clausius equations**.

equation, Clausius-Mosotti. *Noun.* See **Clausius-Mosotti law**.

equation, coefficient of reflection. *Noun.* See **coefficient of reflection**.

equation, composite toughness. *Noun.* See **pullout work**.

equation, convective heat flux. *Noun.* See **surface convection**.

equation, critical radius. *Noun.* See **critical radius**.

equation, Darcy permeability. *Noun.* See **Darcy's law**.

equation, Debye parameter. *Noun.* See **Debye parameter**.

equation, density of states. *Noun.* See **density of states**.

equation, Dinger-Fink. *Noun.* See **Dinger-Fink particle size distribution**.

equation, dipole potential. *Noun.* See **dipole potential**.

equation, Einstein specific heat. *Noun.* See **Einstein theory of specific heat**.

equation, emissive power. *Noun.* See **Stefan's law**.

equation, figure of merit. *Noun.* See **Seebeck effect**.

equation, firing shrinkage. *Noun.* See **firing shrinkage**.

equation, Forchheimer. *Noun.* See **Forchheimer equation**.

equation, Fourier's heat conduction. *Noun.* See **Fourier equation**.

equation, fractal dimension. *Noun.* See **fractal dimension**.

equation, Fresnel. *Noun.* See **Fresnel's law**.

equation, Fulcher. *Noun.* See **Fulcher equation**.

equation, Gaudin-Schuhmann milling. *Noun.* See **Gaudin-Schuhmann milling equation**.

equation, Gauss-Bonnet theorem. *Noun.* See **genus number**.

equation, geometric surface area. *Noun.* See **geometric surface area**.

equation, Gibson-Asbby. *Noun.* See **ceramic foams**.

equation, Gladstone-Dale. *Noun.* See **Gladstone-Dale equation**.

equation, grams per denier conversion. *Noun.* See **grams per denier**.

equation, grating. *Noun.* See **grating equation**.

equation, Griffith. *Noun.* See **Griffith equation**.

- equation, Hall effect.** *Noun.* See **Hall effect**.
- equation, Hall-Petch.** *Noun.* See **Hall-Petch relationship**.
- equation, Halpin-Kardos.** *Noun.* See **Halpin-Kardos equation**.
- equation, Halpin-Tsai.** *Noun.* See **Halpin-Tsai equation**.
- equation, indentation crack-length toughness.** *Noun.* See **indentation crack-length toughness**.
- equation, Kettler-Helmholtz.** *Noun.* See **Kettler-Helmholtz equation**.
- equation, kinetic crack propagation resistance.** *Noun.* See **kinetic crack propagation resistance parameter**.
- equation, Kirchhoff's.** *Noun.* See **Kirchhoff's law**.
- equation, Kohlrausch.** *Noun.* See **Kohlrausch relaxation**.
- equation, Kozeny-Carmen.** *Noun.* See **Kozeny-Carmen equation**.
- equation, Langmuir's isotherm.** *Noun.* See **Brunauer-Emmett-Teller equation**.
- equation, lens maker's.** *Noun.* See **lens maker's formula**.
- equation, lifetime factor for concrete.** *Noun.* See **lifetime factor method**.
- equation, light dispersion.** *Noun.* See **Cauchy light-dispersion formula** and **R-value**.
- equation, Lorentz.** *Noun.* See **local field**.
- equation, Mie.** *Noun.* See **Mie equation**.
- equation, Meyer's indentation size effect.** *Noun.* See **Meyer's law**.
- equation, Mooney.** *Noun.* See **Mooney equation**.
- equation of state.** *Noun.* An equation that demonstrates the relationship between temperature, pressure and volume of a substance.
- equation, partial free energy of mixing.** *Noun.* See **activity**.
- equation, phase rule.** *Noun.* See **phase rule**.
- equation, pigment strength.** *Noun.* See **pigment strength**.
- equation, quasistatic crack resistance.** *Noun.* See **quasistatic crack propagation resistance parameter**.
- equation, Reynolds number.** *Noun.* See **Reynolds number**.
- equation, Ryshkewitch-Duckworth.** *Noun.* See **Ryshkewitch-Duckworth equation**.
- equation, Schrödinger.** *Noun.* See **Schrödinger equation**.
- equation, sealed porosity.** *Noun.* See **sealed porosity**.
- equations, Kubelka-Munk.** *Noun.* See **Kubelka-Munk equations**.
- equation, sliding wear.** *Noun.* See **Archard's coefficient** and **specific wear rate**.
- equation, Smoluchowski.** *Noun.* See **Smoluchowski equation**.
- equation, specific wear rate.** *Noun.* See **specific wear rate**.
- equation, static fatigue.** *Noun.* See **power law crack velocity relation**.
- equation, Stokes-Einstein.** *Noun.* See **dynamic light scattering**.
- equation, stress concentration.** *Noun.* See **stress concentration**.
- equation, surface enthalpy.** *Noun.* See **surface enthalpy**.
- equation, terminal velocity.** *Noun.* See **terminal fracture velocity**.
- equation, thermal diffusivity.** *Noun.* See **thermal diffusivity**.
- equation, thermal integrity factor.** *Noun.* See **thermal integrity factor**.
- equation, thermal resistance.** *Noun.* See **fracture initiation parameter**.
- equation, Thompson.** *Noun.* See **Thompson effect**.
- equation, van der Waals.** *Noun.* See **van der Waals equation**.
- equation, van t' Hoff.** *Noun.* See **van t' Hoff equations**.
- equation, wave.** *Noun.* See **wave equation**.
- equation, Weber.** *Noun.* See **Weber equation**.
- equation, Wiedermann-Franz.** *Noun.* See **thermal conductivity**.
- equation, zirconia toughening.** *Noun.* See **zirconia toughening**.
- equiaxed.** *Adjective.* A term used to describe ceramic microstructures in which all grains tend to a rounded shape of equal size.
- equiaxed grains.** *Noun.* A microstructure consisting of grains approximately equal in all dimensions.
- equilibrium.** *Noun.* A state in which no change occurs in a system if no change occurs in the surrounding environment. At equilibrium the **free energy** is a minimum.
- equilibrium adsorptive capacity.** *Noun.* The quantity of a component adsorbed per unit of an adsorbing substance at equilibrium temperature, concentration, and pressure.

equilibrium constant. K. *Noun.* A term related to the concentration of reactants and products that coexist in a system that has come to equilibrium. The symbol has different subscripts depending on how the concentrations are specified. For example for a reaction: $aA + bB \leftrightarrow cC + dD$, $K_c = [C]^c[D]^d/[A]^a[B]^b$ where $[A]$ etc. refer to concentrations of the reactant or product or it can be written as $K_p = p_c^c \cdot p_d^d / p_a^a \cdot p_b^b$ when partial pressures are used. The equilibrium constant is related to **free energy** change for a reaction by: $\Delta G^\circ_T = -RT \ln K_T$.

equilibrium diagram. *Noun.* A phase diagram of the equilibrium relationships that exist between composition, temperature, and pressure of a system. See **phase diagram**.

equilibrium distance. *Noun.* The interatomic distance at which the force of attraction equals the force of repulsion between two atoms.

equilibrium eutectic. *Noun.* The composition within which any system of two or more crystalline phases will melt completely at a minimum temperature or at which the composition, per se, will melt.

equilibrium state. *Noun.* That state of lowest **free energy** for the system.

equimolecular. *Adjective.* Description of substances that contain equal numbers of molecules.

equipotential. *Adjective.* Having a uniform electrical potential.

equivalent. *Noun.* See **equivalent weight**.

equivalent, boron. *Noun.* See **boron equivalent**.

equivalent boron content. *Noun.* The concentration of natural boron that will provide a **thermal neutron cross section** equivalent to that of a specific impurity element.

equivalent boron-content factor. *Noun.* A factor employed to convert the concentration of an impurity element to a **neutron cross section** equivalent to that of natural boron.

equivalent circuit. *Noun.* Simple electrical components arranged to be electrically equivalent to a complex electrical circuit and are a device therefore to simplify the analysis of such circuits.

equivalent diameter. *Noun.* The diameter that a spherical particle would have to have in order to yield results in a physical test of fineness the same as those observed for the given solid whatever the shape of its particles.

equivalent focal length. *Noun.* The ratio of the size of an image of a small distant object close to the optical axis to the angular distance of the object in radians.

equivalent spherical diameter. *Noun.* The diameter of a spherical particle having the same density and **sedimentation rate** as clay particles under test.

equivalent, uranium content. *Noun.* See **uranium content equivalent**.

equivalent weight. *Noun.* The weight of an element which will replace or combine with 1.008 parts of hydrogen by weight, 8.00 parts of oxygen, or the equivalent weight of any other element or compound.

erase. *Verb.* (1) To remove a recording from a magnetic tape. (2) In computing it is to replace data on a storage device with characters representing an absence of data.

erbium oxide. *Noun.* Er_2O_3 . A **rare earth** oxide used as an **actuator** for **phosphors**, as a nuclear poison, and as an ingredient in infrared absorbing glasses; gives a pink colour to glass. Density $8,640 \text{ kg m}^{-3}$.

erbium silicate. *Noun.* (1) Er_2OSiO_4 . Mp $1,979^\circ\text{C}$; density $6,800 \text{ kg m}^{-3}$; hardness (Mohs) 5–7. (2) $\text{Er}_4(\text{SiO}_4)_3$. Mp $1,899^\circ\text{C}$; density $6,220 \text{ kg m}^{-3}$; hardness (Mohs) 5–7. (3) $\text{Er}_2\text{Si}_2\text{O}_7$. Mp $1,799^\circ\text{C}$; hardness (Mohs) 5–7.

Erf. *Abbreviation.* Stands for electrorheological fluid. See **electrorheological fluid**.

erg. *Noun.* A **cgs unit** of energy or work equal to the work done by a force of 1 dyn acting over a distance of 1 cm.

ericaite. *Noun.* A mineral consisting mainly of manganese containing **boracite**.

erionite. *Noun.* A naturally occurring **zeolite** mineral with a fibrous habit used as an asbestos alternative. Found to be highly carcinogenic.

Erlanger blue. *Noun.* A general term for a variety of iron-blue pigments.

erode. *Verb.* To grind or wear down or become worn down or ground.

erosion. *Verb.* To wear away the surface of a material, usually by physical action rather than chemical reaction.

erosion-corrosion. *Noun.* A form of deterioration that arises from the combined action of chemical attack and mechanical wear.

erosion of refractories. *Noun.* The wearing away of refractory surfaces by the flowing action of a molten batch at high temperatures.

erosion resistance, electrical. *Noun.* See **electrical erosion resistance**.

error. *Noun.* The deviation of an observed value from the expected or true value.

erythrite. *Noun.* $\text{Co}_3(\text{AsO}_4)_2 \cdot 8\text{H}_2\text{O}$. A pink to purple monoclinic mineral of cobalt arsenate. The name is also given to the red-pink oxidation product of the cobalt nickel arsenide ore **smaltite**. Also known as **cobalt bloom**.

- ESA.** *Abbreviation.* Stands for electrokinetic sonic amplitude. See **electrokinetic sonic amplitude**.
- Esaki diode.** *Noun.* Alternative name for tunnel diode. Named after L. Esaki a Japanese designer. See **tunnel diode**.
- ESAVD.** *Abbreviation.* Stands for electrostatic spray assisted vapour deposition. See **electrostatic spray assisted vapour deposition**.
- ESCA.** *Acronym.* Stands for electron spectroscopy for chemical analysis. See **x-ray photoelectron spectroscopy**.
- escolaite.** *Noun.* The name given to **chromium oxide**, Cr_2O_3 , when it is used for making **chromia** additions to **magnesia bricks** to enhance their slag resistance by lowering slag wetting and increase MgO-MgO bonding across grain boundaries.
- esker or eskar.** *Noun.* A geological feature used as a source of sand and gravel. Formed as linear ridges by streams under glacier ice.
- esteril.** *Noun.* An ester of an organic alcohol ROH with $-\text{SiOH}$ groups. The result is a hydrophobic silica powder used as filler.
- ESU or esu.** *Abbreviation.* Stands for electrostatic unit; a measure of potential difference; $1 \text{ esu} = 300 \text{ V}$.
- etch.** *Verb.* (1) To produce a marking, decoration, or degree of obscuration on glass or other ceramic surface by chemical action, such as by hydrofluoric acid or other agent. (2) To become weathered so that the surface texture of a body, glaze, porcelain-enamel, or other coating is changed or roughened.
- etchant.** *Noun.* An acid or corrosive material used for etching.
- etched.** *Adjective.* (1) Treated by etching. (2) Weathered so that the surface is roughened.
- ethoxide.** *Noun.* MOC_2H_5 . A class of salt-like compounds where M is a metal atom that can be significant for ceramic preparations. Now much used in solution in organic solvents to prepare nanopowders, **sols** and **gels** for ceramics manufacture.
- ethyl cellulose.** *Noun.* An ethyl ester of cellulose used as a binder for technical ceramics and pigments, and as a parting agent for thin sheet ceramics made by the **doctor blade process**.
- ethyl silicate.** *Noun.* $(\text{C}_2\text{H}_5)_4\text{SiO}_4$. A liquid organic silicate used as a binder and as a preservative for brick, concrete, mortar, plaster, refractories, etc.
- Etruscan ware.** *Noun.* A type of basaltic ceramic decorated by the **encaustic process**.
- ettringite.** *Noun.* $\text{C}_3\text{A}_2 \cdot \text{CS} \cdot 32\text{H}$, in **cement notation**. Formed when the C_3A and **gypsum** in **OPC** are **hydrated**.
- eucryptite.** *Noun.* LiAlSiO_4 . A mineral silicate used as a source of lithium in bodies of low thermal expansion. Occurs as a **β -quartz** solid solution in **glass ceramics**. Density $2,670 \text{ kg m}^{-3}$.
- eudiometer.** *Noun.* A calibrated and marked glass tube used to study gas reactions by recording volume changes.
- euhebral.** *Adjective.* External planar outlines which reveal the crystal **symmetry**.
- Euler buckling.** *Noun.* A type of failure mode that results from applying compression to a long thin object, such as a thin sheet of composite, a **nanotube**, or **mica**. It is an elastic phenomenon not dependent on the materials compressive strength and above a critical force the object is unstable with respect to elastic deflections perpendicular to the applied force.
- Euler formula.** *Noun.* Concerns the buckling of slender columns or single fibres in a composite under compressive; load stated as: $P = EI/L^2$, where P is the buckling load. E is the **modulus of elasticity**, I is the second moment of area, and L is the effective length.
- Euler theorem.** *Noun.* A mathematical relationship between the number of individual features present in a geometrical array, such as a polished section of a sintered microstructure, which involves the number of corners, C, number of edges, E, and number of polygonal grains, P. The equation is: $C - E + P = 1$. Applying this theorem gives a prediction for the morphology of a sintered microstructure.
- eulytite.** *Noun.* $\text{Bi}_4(\text{SiO}_4)_3$. A cubic **orthosilicate** that is a mineral source of bismuth.
- European porcelain.** *Noun.* High-grade porcelain of good physical strength, white colour, low absorption, and high **translucency**; usually coated with a hard glaze.
- europium activated yttrium oxysulphide.** *Noun.* $[\text{Eu}^{3+}:\text{Y}_2\text{O}_2\text{S}]$. A **phosphor** used to produce red colours CRO displays.
- europium oxide.** *Noun.* (1) Eu_2O_3 . Used in nuclear control rods, phosphorescent glasses, and as a red **phosphor** in colour television tubes. Density $7,280\text{--}7,992 \text{ kg m}^{-3}$; Knoop hardness 4.27 GN m^{-2} . (2) EuO . **interstitial** oxide with a metallic appearance and properties. Density $8,160 \text{ kg m}^{-3}$. (3) Eu_3O_4 . Density $8,073 \text{ kg m}^{-3}$. (4) $\text{Eu}_{16}\text{O}_{21}$; used in **phosphors** sensitive to red and infrared radiation. density $6,740 \text{ kg m}^{-3}$.
- eutectic.** *Noun.* A mixture of two or more phases having a melting point lower than the melting points of the individual phases and usually a very fine microstructure.
- eutectic alloy.** *Noun.* An alloy with an identical composition to that found at the **eutectic point**.
- eutectic composite.** *Plural noun.* Alloys of ceramic oxides with carbides or borides having the composition

characteristic of the **eutectic point** which, because of their fine eutectic microstructure, have extra hardness, toughness, and strength.

eutectic composition. *Noun.* The composition at the intersection of two or more **liquidus** surfaces or lines on a phase diagram.

eutectic deformation. *Noun.* The composition within a system of two or more phases which when heated reaches a temperature where sufficient liquid develops such that the structure distorts.

eutectic diffusion bonding. *Noun.* See **diffusion bonding**.

eutectic, equilibrium. *Noun.* See **equilibrium eutectic**.

eutectic phase. *Noun.* One of the two phases found in a **eutectic structure**.

eutectic point. *Noun.* The point in a phase diagram indicating both the composition and minimum melting temperature of a mixture of two or more phases.

eutectic reaction. *Noun.* The process whereby liquid remaining at the eutectic temperature is transformed isothermally and reversibly into two different solid phases.

eutectic structure. *Noun.* A two-phase microstructure resulting from cooling through the eutectic point. It is usually characterised by finely dispersed lamellae that alternate with each other.

eutectic temperature. *Noun.* The minimum temperature at which a mixture of two or more phases will melt completely

eutectoid reaction. *Noun.* A process in the solid state where two or more intimately mixed solid phases form isothermally from a single solid phase on cooling. The single phase is reformed if the mixture is cooled slowly enough or slowly re-heated. The reverse reaction is termed **peritectoid**.

eutectoid temperature. *Noun.* The temperature at which the **eutectoid reaction** in a solid occurs.

euxenite. *Noun.* A brownish-black mineral with useful **rare earth** content and a source of niobium.

eV. *Abbreviation.* Stands for electron volt. See **electron volt**.

evacuate. *Verb trans.* To create a vacuum in a reaction vessel etc.

evacuator. *Noun.* A mechanical device that produces a vacuum for the removal of moisture from a ware body or system.

evaluation. *Noun.* A combination of tests, analyses and audits that lead to a pronouncement of **approval**, **validation** or **qualification**.

evanescent. *Adjective.* (1) Transitory. (2) Fading away.

evanescent field. *Noun.* The effect caused when the internal reflection is not 100 % in the core of an **optical fibre** and some energy escapes into the **cladding**.

evanescent wave. *Noun.* A non-propagating electromagnetic wave produced at the interface between two dielectrics of refractive index n_1 and n_2 , with $n_1 > n_2$. When the incident light ray in the n_1 medium makes an angle of incidence at the interface greater than the **critical angle** it is totally internally reflected.

evanescent wave sensor. *Noun.* A device built to use an optical fibre where the electromagnetic field of the **evanescent wave** in the surrounding medium excites **fluorescence** that can be detected and used to study the surrounding material.

evaporator. *Noun.* A shallow pan, container, or other device in which the liquid in a slurry or solution is converted to the vapour state by applying heat, sometimes aided by the use of a vacuum.

evaporite. *Noun.* Any sedimentary rock formed by the evaporation of former lakes and seas. Examples are **gypsum** and **rock salt**.

ewer. *Noun.* A large jug made with a wide mouth.

Ewing theory of magnetisation. *Noun.* Each atom is considered to be a permanent magnet that can rotate about its centre when placed in a magnetic field.

exaggerated grain growth. *Noun.* A phenomenon encountered in the final stage of **sintering** when a grain of more than six sides in one plane expands rapidly outwards consuming small surrounding grains. It is not a desirable phenomenon when high-strength products are required.

excess air. *Noun.* The amount of air introduced into a combustion process that is greater than that theoretically required to obtain complete combustion.

exchange capacity, anion. *Noun.* See **anion exchange capacity**.

exchange capacity, cation. *Noun.* See **cation exchange capacity**.

exchange force. *Noun.* The force that aligns the magnetic **dipole moments** in a **ferromagnetic** ceramic.

exchanger, heat. *Noun.* See **heat exchanger**.

excitation. *Noun.* (1) The production of magnetic flux in an electromagnet by passing a current through a winding. (2) The raising of electrons from the ground state to higher energy levels in an atom.

excitation energy. *Noun.* The quantum of energy needed to change the energy level of an atom or molecule from the ground state to a higher energy level. It is equal to the difference in energy of the two levels.

excite. *Verb trans.* (1) To an atom, electron, etc., from the ground state to a higher energy level. (2) To supply a current to a coil to create a magnetic field.

- excited state.** *Noun.* An energy level of the electrons of an atom, group, or molecule above the ground state that results from absorption of photons in quantised packets from a source of radiation. When the energy source is removed, the atoms return to their ground state either by emitting the absorbed photons or by transferring the energy to other atoms or molecules. In the excited state there is increased vibrational activity.
- exciter.** *Noun.* A small generator that provides current for the field structure of a large generator.
- exciton.** *Noun.* A bound **hole**–electron pair created when a semiconductor absorbs energy, nearly equal to the band gap. The complex defect is free to move through a crystal transporting energy but not charge. If it recombines to form a band–electron state it may give up its energy of formation.
- exclusion principle.** *Noun.* See **Pauli exclusion principle**.
- exergoeconomics.** *Noun.* The branch of ceramic engineering that combines energy analysis and economics to provide plant designers with data not available through conventional energy analysis. Also known as **exergy-aided cost minimisation**.
- exergy.** *Noun.* A measure of the true thermodynamic value of entering and exit streams, heat and work interactions with the surroundings in an operating plant.
- exergy-aided cost minimisation.** *Noun.* See **exergoeconomics**.
- exfoliate.** *Verb intrans.* (1) To shed the thin outermost layer of rocks and minerals because of heating or weathering. (2) For some minerals, such as mica, to expand and separate into parallel layers or sheets under the influence of heat. (3) In general to flake or peel from a surface.
- exfoliated graphite.** *Noun.* A filler compound made by heating a bromine-graphite intercalation compound. This process causes a 20–100-fold volume expansion producing a wormlike morphology from the original graphite flakes; very low density 3–30 kg m⁻³.
- exfoliated perlite.** *Noun.* See **perlite**.
- exfoliation.** *Noun.* A process where layered host materials, such as **clay**, **molybdenum disulphide**, **molybdenum trioxide**, can be made to absorb elements or compounds and so swell and expand infinitely until they separate completely into single layers.
- exhaust.** *Noun.* (1) A duct, flue, chimney, or opening designed for the escape or removal of gases, fumes, vapours, or odours from a room or enclosure, sometimes aided by the use of a fan. (2) The waste material exiting from an **exhaust system**. (3) *Verb.* To remove gases from a container.
- exhaust system.** *Noun.* Any system by which gases are removed from a **drier**, **kiln**, furnace, or other confined area.
- exhaust velocity.** *Noun.* The velocity with which the gas acting as a propellant leaves a rocket motor.
- exinite.** *Noun.* A **coal maceral** formed from sap and waxes present in plants. With time it **transmutes** into durain. See **durain**.
- exitance.** *Noun.* A measure of the ability of a surface to emit radiation.
- exit zone.** *Noun.* See **die zones**.
- exohedral.** *Adjective.* Describes a cage structure compound in which the metal atom or ion is located outside the cage; CaB₆ is an example.
- exothermic burst phenomenon.** *Noun.* The sudden increase in temperature experienced in some ultrafine amorphous powders when they reach a temperature at which they crystallise. The classic example is **zirconia**.
- exothermic reaction.** *Noun.* A chemical reaction characterised by the evolution of heat.
- expanded aggregate.** *Noun.* A lightweight cellular material formed by heating to a specified temperature at a rate that will cause **bloating**; used in the production of lightweight cement and in other products to be used as thermal insulation.
- expanded bed.** *Noun.* A bed of **activated carbon** or other granulated material through which a fluid flows upwards at a rate sufficient to raise and separate the particles in the bed without changing their relative positions.
- expanded blast-furnace slag.** *Noun.* A lightweight highly porous material made by treating molten slag with water, high-pressure steam, air, or a combination of these; used to produce lightweight concrete blocks, etc.
- expanded clay.** *Noun.* Lightweight cellular clay produced by flash heating to a temperature sufficient to cause bubbles to be formed which are retained in the clay particles; bloated **clay**. Usually common brick clay is used in a finely screened form, heated to 1,480 °C as rapidly as possible in order to reduce Fe₂O₃ to FeO and so cause oxygen bubbling to bloat the clay body.
- expansion.** *Noun.* The process of increasing the volume of a constant mass of a material, such as by heating, water absorption, etc.
- expansion coefficient, thermal.** *Noun.* See **thermal expansion coefficient**.
- expansion joint.** *Noun.* A joint or gap in a concrete or masonry structure that permits them to expand and contract without damage or without the introduction of excess stress.
- expansion, moisture.** *Noun.* See **moisture expansion**.
- expansion, secondary.** *Noun.* See **secondary expansion**.
- expansion, thermal.** *Noun.* See **thermal expansion**.

expansion, water. *Noun.* See **water expansion**.

expansive cement. *Noun.* A type of high-sulphate and alumina containing cement which expands after hardening to compensate for shrinkage during drying.

expansivity. *Noun.* Another expression for coefficient of thermal expansion.

exploded alumina. *Noun.* Extremely fine platy, about 5.0 nm thick, form of Al_2O_3 that readily forms even layers on a ceramic surface. So called because it is made by filling the pores in alumina with molten lithium metal and dumping it into water where the violent reaction between water and lithium causes small local explosions that break up the Al_2O_3 into platelets.

explosive forming. *Verb.* The shaping of ware in dies in which the forming pressure is generated by an explosive charge. A reaction wave of high temperature and pressure passes through the powder in the die causing **sintering** to occur in seconds.

exposed aggregate. *Noun.* A type of concrete construction in which the upper surfaces of the aggregate particles are exposed for special architectural effects.

exposed finish tile. *Noun.* A combed, roughened, or smoothed faced building block, the exposed surfaces of which may be painted or left exposed.

expression. *Noun.* A process in which plastic clay bodies are extruded through an aperture to form symmetrical shapes, such as brick, hollow tile, pipe, and the like, which are cut into desired lengths as they emerge from the die.

exsolution. *Noun.* A process whereby oriented solid inclusions are formed in crystals due to the migration of atoms along certain crystallographic planes when they separate out at high temperatures.

extended dislocation. *Noun.* A unit of two half **dislocations** bound together, moving across a **slip plane**.

extender. *Noun.* An inactive or inert material added to another material or body composition to serve as filler, diluent, modifier or adulterant.

extensimeter. *Noun.* See **extensometer**.

extension at break. *Noun.* The **extension percentage** of a test specimen at breaking point.

extension percentage. *Noun.* The increase in length of a specimen during a tensile test, expressed as a percentage of the **gauge length** or the nominal gauge length.

extensive. *Adjective.* Of or relating to a property measurement that is dependent on mass; heat is an extensive property.

extensometer. *Noun.* Apparatus for studying small changes in length, as in thermal expansion or tensile testing. Sometimes called **extensimeter**.

external cavity diode laser. ECDL. *Noun.* A device where the grating is external to the semiconductor diode and feeds back a single lasing wavelength.

external grinding. *Verb.* The process of grinding or polishing the exterior of a rotating item.

external load. *Noun.* An outside load applied to a structure as opposed to the load generated in the structure by virtue of its own mass.

external load-crushing strength. *Noun.* The ability of a concrete pipe to resist crushing forces that are applied externally in specified locations and directions on a specified length of pipe.

external seal. *Noun.* A metal collar or flange sweated around a ceramic shape, the metal having a slightly greater coefficient of expansion to produce a hermetic or near-hermetic seal. See **sweat**.

extinction coefficient. ϵ . *Noun.* See **transmittance**.

extractor. *Noun.* (1) A device for extracting liquid from a solid, especially a centrifugal drier. (2) An instrument for removing tight-fitting components.

extrados. *Noun.* The outer curved surface of an arch or vault.

extra duty glazed tile. *Noun.* A ceramic floor or wall tile suitable for use in light-duty floors and similar applications where impact, wear, and abrasive forces are not excessive.

extralibral. *Noun.* A composite of tin and **barium titanate** that has high stiffness. At 58 °C it has an extreme stiffness because the tin prevents the phase change in barium titanate on cooling and the stored energy makes the diamond-type tin lattice stiffer.

extraordinary ray. *Noun.* The refracted ray of light in a double refracting crystal such as **calcite** that does not obey **Snell's law**.

extrinsic. *Adjective.* (1) Originating or acting from outside. (2) A parameter whose value depends not only on the state of the system but also on the amount of material present.

extrinsic Faby-Perot interferometric sensor. EFPI. *Noun.* See **Faby-Perot interferometer**.

extrinsic point defect. *Noun.* A crystal imperfection created by the addition of an impurity atom.

extrinsic semiconductor. *Noun.* A semiconductor whose electrical characteristics are due to added impurities. For example, replacing some germanium atoms with arsenic atoms leads to mobile surplus electrons and hence to an **n-type** extrinsic semiconductor. If indium is used instead of arsenic, **holes** are produced and a **p-type** extrinsic semiconductor results.

extrudate. *Noun.* The product from an **extrusion** process.

extrude. *Verb trans.* (1) To squeeze or force out. (2) To produce a continuous body of a plastic material by forcing it through a shaping orifice.

extruder. *Noun.* A machine, such as a **pug mill**, which forces plastic bodies through a die in a continuous column.

extrusion. *Noun.* (1) The process of shaping a plastic body or molten glass by forcing it through a die. (2) Igneous rocks formed by magma being forced through cracks in the earth's crust. (3) The process of forming manufactured fibres by forcing a material through an orifice.

extrusion die. *Noun.* An orifice at the delivery end of an extruder barrel.

extrusive. *Adjective.* Formed from magma issuing from volcanoes or cracks in the earth's crust.

extrusive igneous rock. *Noun.* Rock formed from molten magma that erupts as lava and cools on reaching the surface. The most common type is **basalt**.

exude. *Verb.* To release or be released through pores and surfaces.

ex works. *Adverb or adjective.* Of a price or value excluding the cost of delivery and any commission for agents etc. from the factory.

eye. *Noun.* The opening through which the flame enters the bottom of a glass-melting pot.

eyeballs. *Noun.* See **thomsonite**.

eye glass. *Noun.* A monocle or any lens for aiding or correcting defective vision.

eykometer. *Noun.* An apparatus to measure the yield point of clay suspensions.

Ff

f. *Symbol.* Standing for: (1) frequency; (2) function of in maths.

F. *Symbol.* Standing for: (1) Fe_2O_3 in **cement notation**; (2) **farad**; (3) force; (4) **Helmholtz function**.

°F. *Symbol.* Standing for degrees Fahrenheit.

fabrication. *Verb.* The production or assembly of components into a unit or structure.

Faby-Perot interferometer. *Noun.* An instrument that uses the interference patterns developed by multiple reflections in an optical cavity formed between two highly reflecting parallel plates. It can be used in conjunction with a cleaved optical fibre to measure strain and **temperature** changes in a ceramic or glass **fibre composite**; in this application it is known as an **extrinsic Faby-Perot interferometric sensor, EFPI**.

facade. *Noun.* The front or face of a structure.

face. *Noun.* (1) The work face of a grinding wheel. (2) The exterior surface of a structure or wall. (3) Outside ply of a laminate structure.

face brick. *Noun.* The intermediate class in the brick classification scheme where the brick is designed for use on the exterior or facing of a structure or wall; the exposed area of the brick sometimes may be textured. Nominally $6.8 \times 10.2 \times 20.3$ cm but the size varies from manufacturer, geographical area, and architects preference.

face centred cubic, fcc. *Noun.* A crystal structure or a **lattice** type where atoms or **lattice points** are located at all corners and face centres of the **unit cell**.

faced wall. *Noun.* A wall to which an aesthetic facing has been bonded or attached; the facing may or may not be load bearing.

face milling. *Verb.* Machining of surfaces to a desired finish by means of a cutting or milling tool.

facet. *Noun.* (1) The surface plane of a crystal. (2) A surface on a cut gemstone. Sometimes called a **flat**.

facies. *Noun.* The characteristics of rocks involving their composition, appearance and the way they were formed.

facing. *Noun.* (1) Fine sand applied as a facing to a casting mould. (2) The outermost layer of composite of sandwich construction, has a high density of fibre to resist loads.

facing brick. *Noun.* See **face brick**.

facing tile. *Noun.* Tile designed for use on interior or exterior walls for aesthetic or functional purposes.

facing wall. *Noun.* A concrete wall serving as a barrier to prevent movement of earth in embankments and excavations.

façonné or faconne. *Noun.* From the French meaning figured, it describes a type of ceramic decoration where a pattern of small figures is used.

factory. *Noun.* A building or group of buildings in which materials or products are manufactured.

fade. *Noun.* The attack on glass surfaces by substances that produce an oily or whitish appearance.

fading. *Verb.* The loss of colour or brilliance due to deleterious conditions of surface exposure during processing or service.

fahlband. *Noun.* A thin bed of **schist** containing metal sulphides.

Fahrenheit. *Noun.* A temperature scale in which water freezes at 32° and boils at 212° under 1 atm pressure

faience. *Noun.* A body of crushed quartz grains with almost no adhesive remaining, therefore soft and porous, which may be coated with transparent or opaque glaze typical products, are figurines, pottery, tile, beads, and mosaics.

faïence. *Toponym.* Strictly **earthenware** pottery from Faenza in Italy but now more generally tin glazed earthenware usually from Western Europe.

- faience mosaics.** *Noun.* **Faience tiles** usually 8×9 mm and 5 mm thick; usually mounted on a cement plate to facilitate fitting.
- faience tile.** *Noun.* Moulded tiles with variations evident on face, edges and glaze giving a handcrafted appearance; can be glazed or unglazed.
- faience ware.** *Noun.* (1) Old earthenware with opaque glaze. (2) Modern application is to decorate earthenware with a transparent glaze. See **faïence**.
- failure.** *Noun.* A condition in which a product can no longer fulfil its intended purpose.
- failure mode, effects and criticality analysis. FMECA.** *Noun.* A method of assessing quantitatively which parts of a production plant should be maintained to prevent breakdown and which to just replace at breakdown. The analysis involves considering each separate component and quantifying the results of a failure.
- failure probability.** *Noun.* A term needed to determine the **Weibull parameters** for failure prediction. Given by several functions, for example, $P = (k - 0.5)/N$, where P is the failure probability, k is the rank in ascending order, and N is the total number of samples tested.
- falling slag.** *Noun.* A high-calcium blast-furnace slag sometimes used as an aggregate in concrete.
- falling-sphere viscometer.** *Noun.* An instrument used to determine the viscosity of a liquid by measuring the rate of fall of a standardised sphere through the liquid under standardised conditions.
- fallout.** *Noun.* The descent of solids present in the atmosphere, especially of radioactive material following a nuclear explosion, onto the earth.
- false header.** *Noun.* A half brick used to complete a row of brick in a facing wall.
- false indication.** *Noun.* An erroneous test result; usually due to improper sample preparation.
- false set.** *Noun.* The premature and erratic hardening of freshly mixed concrete, mortar, or cement paste usually due to the presence of unstable **gypsum** in the cement; the plasticity may be restored by mixing without the addition of more water.
- Falter apparatus.** *Noun.* An instrument to determine the softening point of glass in which the elongation of glass fibres is measured under specified conditions of temperature and tensile stress
- famille.** *Noun.* A type of Chinese porcelain characterised by a design on a background of a particular colour; see **famille rose**.
- famille jaune.** *Noun.* Chinese porcelain with a design produced on a yellow background.
- famille noir.** *Noun.* Chinese porcelain with a design produced on a black background.
- famille rose.** *Noun.* (1) A series of red colours for porcelain and chinaware produced from mixtures of gold and tin salts. (2) Chinese porcelain with a design produced on a pink background.
- famille verte.** *Noun.* (1) A series of green colours for porcelain and chinaware produced by blends of chromic oxide. (2) Chinese porcelain with a design produced on a green background.
- family.** *Noun.* (1) A group of materials of similar chemical or physical properties. (2) A complete series of materials necessary to perform a specific process or to produce a specific product.
- FAMOS.** *Acronym.* Standing for floating gate avalanche injection metal oxide semiconductor.
- FAMOST.** *Acronym.* Stands for floating gate avalanche injection metal oxide silicon transistor.
- fan.** *Noun.* A mechanical device designed to produce a current of air, gas, or vapour in a furnace, kiln, drier, or other area as a means of delivery, circulation, or exhaust within the area.
- fan blender brush.** *Noun.* A type of brush used for decorating china in which the bristles are stiff with multiple tips arranged in a fanlike shape; it is good for blending and feathering colour.
- fan deposit.** *Noun.* Poorly sorted interbedded sand and gravel in cone-shaped deposits formed by alluvial rivers.
- fantail.** *Noun.* (1) The flue joining the slag pocket to a **regenerator** in an **open-hearth surface**. (2) A burner that ejects fuel to make a wide flat flame in a furnace.
- fan tracery.** *Noun.* Carved ornamentation on **fan vaulting**.
- fan vaulting.** *Noun.* Vaulting with ribs that radiate like those of a fan and come from the top of a **capital** or **corbel**.
- farad.** *Noun.* A derived **SI unit** of electrical **capacitance**. It is the capacitance of a **capacitor** that has plates with a potential of 1 V between them created by a charge of 1 **coulomb**.
- faraday. F.** *Noun.* An electrical quantity used in electrochemical calculations. It is equal to **Avogadro's number** times the charge on the electron and so has the value 96,487 coulombs per mole.
- Faraday effect.** *Noun.* A phenomenon that occurs on the passage of light through materials in a strong magnetic field. When **plane-polarised** light is sent through a specimen in a direction parallel to the applied magnetic field, the plane of vibration is rotated. The rotation, θ , is given by $\theta = VH/l$, where l is the thickness in cm, H the field strength, and V the **Verdet constant**.
- farren wall.** *Noun.* A hollow wall, 10 cm in thickness; common in houses.

fast dislocation. *Noun.* Dislocations moving through a lattice, under the influence of an applied stress, with a velocity sufficient to produce a kinetic energy comparable to the dislocation rest energy. For example, when moving at the velocity of sound in the solid dislocation energy is doubled.

fast ion conductor. *Noun.* An ionic ceramic having a rigid, open network structure, with large tunnels, through which the cations can easily pass under the influence of a potential gradient.

fast neutron. *Noun.* A neutron produced by nuclear fission with a kinetic energy in excess of 1.5 MeV.

fat. *Adjective.* A rich, plastic, cohesive mix.

fat clay. *Noun.* Highly plastic clay of high green strength. Also known as **plastic clay**, **ball clay**, or **long clay**. See **ball clay**.

fatigue. *Noun.* (1) The tendency of a material to fail under cyclic stress, usually by cracking. (2) *Verb.* The process involved in making a material eventually to break by either repeated application or removal of stress, or long continued application of a steady stress. In either case, failure stress is lower than that needed to cause fracture initially.

fatigue crack growth rate. *Noun.* Crack extension per cycle of **fatigue** observed in a constant-amplitude **fatigue test**.

fatigue life. N_f *Noun.* The total number of stress cycles that will cause a fatigue failure at a given stress amplitude.

fatigue limit. *Noun.* The maximum stress amplitude level below which a material can endure stress cycles indefinitely without failure.

fatigue strength. *Noun.* The maximum stress a specimen of a material can withstand over a specific number of specified test conditions, such as number of cycles, without failure.

fatigue test. *Noun.* A test to determine the ability of a material to withstand conditions of alternating stress without failure.

fat mortar. *Noun.* Mortar containing a high proportion of **cementitious** material and which adheres to a trowel.

faujasite. *Noun.* A framework structured silicate that is the basis of many **zeolite** structures. Individual cubooctahedra composed of either $[\text{SiO}_4]^{4-}$ or $[\text{AlO}_4]^{5-}$ tetrahedra at each vertex, are linked by hexagonal prisms to four other cubooctahedra, producing an open network structure containing large tunnels and cages.

fault. *Noun.* (1) An imperfection or defect. (2) In a wire or cable a partial or total local failure in the insulation or continuity of a conductor.

Favrite glass. *Noun.* A type of iridescent glass. Also known as **Tiffany glass**.

fayalite. *Noun.* Fe_2SiO_4 . A mineral in the **olivine** group. It is formed in aluminosilicate refractories when they are fired with iron-bearing slags under reducing conditions.

faying surface. *Noun.* The surface in contact with another material to which it is to be joined.

Fazackerly colours. *Noun.* Bright colours used to decorate **Delft-type ware** manufactured in Liverpool in the nineteenth century. Named after a famous plate held in the Liverpool museum.

FBG. *Abbreviation.* Stands for fibre Bragg grating. See **fibre Bragg grating**.

fcc. *Abbreviation.* Stands for face-centred cubic in crystal nomenclature. See **face centred cubic**.

F-centre. *Noun.* Farbzentrum; the simplest **colour centre** in an ionic crystal, consisting of an electron trapped at an anion vacancy. This can be caused by ionising radiation or quenching the hot crystal in the presence of metal vapour that constitutes the cation in the crystal. The electron absorbs wavelengths in the visible spectrum leaving the subtraction colour to be seen.

FCVI. *Abbreviation.* Standing for forced chemical vapour infiltration. See **forced chemical vapour infiltration**.

feather. *Noun.* (1) An imperfection of feather-like appearance in glass caused by **seeds** arising from dirt and foreign matter introduced during the casting or shaping process. (2) A defect in wire glass caused by deformation of transverse wires. (3) A projecting strip, flange, rib, or fin.

feather brick. *Noun.* A brick cut diagonally from one end or side to the opposite end or side, to form a shape of triangular cross section. The thin edge is approximately 3.2 mm thick. Also called **featheredge brick**.

feather combing. *Verb.* A decorative technique in which a tool containing many sharp points is drawn across superimposed layers of damp slips of various colours for artistic effect.

featheredge. *Noun.* (1) A thin sharp edge. (2) A sharp edge such as is produced when a brick is cut to form a brick of triangular cross section. (3) A level-edged tool used to straighten angles in finish-coat plaster.

featheredge brick. *Noun.* See **feather brick**.

feathering. *Noun.* An imperfection consisting of a devitrified area; usually occurs in lime-rich glazes.

FED. *Acronym.* Stands for: (1) field effect diode. See **field effect transistor**. (2) Field emission display.

feed. *Noun.* (1) the material supplied to a processing unit for treatment. (2) *Verb.* The process of supplying material to a treatment unit.

feed, drip. *Verb.* See **drip feed**.

- feeder.** *Noun.* A device designed to deliver materials to a processing unit, such as raw batch to a melting unit, or to deliver gobs of molten glass to a forming machine.
- feeder, apron.** *Noun.* See **apron feeder**.
- feeder, batch.** *Noun.* See **batch feeder**.
- feeder, channel.** *Noun.* See **channel feeder**.
- feeder connection.** *Noun.* The opening in a furnace wall through which the feeder channel is placed to convey molten glass from the melting tank to the feeder.
- feeder, constant-weight.** *Noun.* See **constant-weight feeder**.
- feeder, cylindrical-screen.** *Noun.* See **cylindrical-screen feeder**.
- feeder, disk.** *Noun.* See **disk feeder**.
- feeder gate.** *Noun.* (1) A device, such as a sliding plate or valve, which controls the passage of a material from one location to another such as from a bin to a truck. (2) The refractory shape which controls the rate of flow of molten glass in or through a **feeder channel**.
- feeder nose.** *Noun.* The end of the forehearth of a glass-melting tank containing the **orifice ring** of the feeder.
- feeder opening.** *Noun.* The feeder connection of a glass tank.
- feeder plate.** *Noun.* A type of conveyor consisting of overlapping plates between the roller chains which delivers materials to a process or packaging unit.
- feeder plug.** *Noun.* A shaped refractory that controls the rate of glass flow in the feeder channel of a glass tank.
- feeder process.** *Noun.* A process in which a gob of glass is delivered to the forming unit.
- feeder, reciprocating.** *Noun.* See **reciprocating feeder**.
- feeder, screw.** *Noun.* See **screw feeder**.
- feeder sleeve, feeder tube.** *Noun.* A cylindrical tube containing the plunger in a glass-forming machine.
- feeder, vane.** *Noun.* See **screw feeder**.
- feeder, vibrating.** *Noun.* See **vibrating feeder**.
- feed, gravity.** *Noun.* See **gravity feed**.
- feed, grinding.** *Noun.* See **grinding feed**.
- feed index.** *Noun.* The rate at which a work piece is being fed to a grinding wheel as indicated by a dial mounted on the grinding equipment.
- feed lines.** *Plural noun.* The pattern formed on a work piece during machining or grinding.
- feed rate.** *Noun.* (1) The amount of material delivered to a process per unit of time. (2) The cutting or grinding speed of a grinding or machining operation.
- feed, ribbon.** *Noun.* See **ribbon feed**.
- feed shaft.** *Noun.* Vertical shafts under the fire holes in topfired kilns for the combustion of fuel and dispersion of heat through the setting.
- feedstock.** *Noun.* The principal raw material used in the manufacture of a product.
- feed-through coil.** *Noun.* A conducting coil, usually copper, surrounds a specimen in electromagnetic testing.
- feedwater.** *Noun.* Water, purified to prevent scale deposit or corrosion that is fed to boilers for steam generation.
- feed wheel.** *Noun.* A wheel on a centreless grinder that regulates the speed and pressure on work during grinding.
- FEEL.** *Acronym.* Stands for ferroelectric electroluminescent. See **electroluminescence**.
- feel.** *Verb.* An empirical practice, whereby raw material properties are determined by the sensation of touch.
- FEFET.** *Acronym.* Stands for ferroelectric dielectric field effect transistor. See **field effect transistor**.
- Feine filter.** *Trademark, noun.* A type of filter in which parallel strings are employed, instead of a filter cloth, to remove a filter cake from the drum.
- FEL.** *Acronym.* Stands for free electron laser. See **free electron laser**.
- feldspar or felspar.** *Noun.* A group of aluminosilicate minerals of potassium, sodium, and calcium, the principal types being **orthoclase**, **microcline**, **albite**, and **anorthite** of the general formula $KAlSi_3O_8$ or its equivalent. The most abundant mineral group making up about 25 % of the earth's crust. Used widely in all types of porcelain, tile, dinnerware, and other whiteware bodies, glass, glazes, porcelain-enamel, and similar ceramic products, generally as a flux. Framework silicates of three-dimensional linked SiO_4 and AlO_4 tetrahedra. Mp 1,100–1,532 °C; density 2,560–2,630 kg m⁻³; hardness (Mohs) 6–6.5.
- feldspar, white.** *Noun.* See **white feldspar**.
- feldspathic.** *Adjective.* Containing **feldspar**, such as a body or glaze.
- feldspathoid.** *Noun.* Framework **aluminosilicate** minerals containing less silicon than **feldspar**. Associated with silica poor rocks rich in sodium.
- felsite.** *Noun.* A fine-grained igneous rock consisting essentially of **quartz** and **feldspar**.
- felspar.** *Noun.* Alternative spelling of feldspar. See **feldspar**.
- felstone.** *Noun.* Alternative name for felsite. See **felsite**.
- felt, asbestos.** *Noun.* See **asbestos felt**.
- FEM.** *Acronym.* Standing for field effect modified transistor. See **field effect modified transistor**.

female end of pipe. *Noun.* The end of a ceramic pipe that overlaps a portion of the end of an adjoining pipe.

FeRAM. *Acronym.* Stands for ferro electric random access memory. See **ferroelectric random access memory**.

ferberite. *Noun.* FeWO_4 . An orthotungstate mineral with a rich brown colour.

Feret's law. *Noun.* A statement that says, the strength of cement mortar or concrete is related to the mixing ratio of the volume of the cement, water, and air contained in the mix.

fergusonite. *Noun.* A general structure-type for MXO_4 compounds where X is a pentavalent cation, tetrahedrally or octahedrally coordinated by oxygen and M is yttrium or a lanthanide ion also in eight- or ninefold coordination by oxygen. Examples are NdVO_4 , LaNbO_4 . It occurs as a natural mineral with a useful **rare earth content**.

Fermat's principle. *Noun.* The statement that a ray of light moves from one place to another in such a way that the time taken is a minimum.

fermi. *Noun.* A length unit used in nuclear science equal to 10^{-15} m.

Fermi contact parameter. *Noun.* A measure of the hyperfine interaction due to the magnetic interaction when an electron and a nucleus with spin are in contact.

Fermi-Dirac statistics. *Noun.* The branch of quantum statistics used to calculate the possible energies of the particles in a system constrained by the **Pauli exclusion principle**.

Fermi energy. E_F *Noun.* The level in the distribution of electron energies in a solid that has a fifty-fifty chance of being occupied or empty.

Fermi level. *Noun.* In the band structure model of bonding this is the energy of electron wave functions at the highest filled level in the structure.

fermion. *Noun.* Particles possessing an intrinsic spin angular momentum of one-half an integral spin quantum number and obey **Fermi-Dirac statistics**.

fermion compounds. *Plural noun.* Materials containing lanthanide elements in which the 4f-electron shell does not keep its local moment characteristic but instead becomes band-like. $\text{NdFe}_2\text{Zn}_{20}$ is an example.

fernico. *Acronym.* An alloy composed of iron, cobalt, and nickel employed in the production of glass-to-metal seals.

feroxyhyte. *Noun.* δ -FeOOH. A reddish-brown coloured, poorly crystalline, mineral form of synthetic δ -FeOOH. Hexagonal close packed anions form the structure. A polymorph of **goethite**.

ferrate. *Noun.* A ceramic containing the divalent ion $[\text{FeO}_4]^{2-}$.

ferric. *Adjective.* Fe(III). Containing iron in the trivalent state.

ferric chloride. *Noun.* FeCl_3 . Used in the development of gold lustres in glass, glazes, and porcelain-enamel. Mp 300°C .

ferric fluoride. *Noun.* FeF_3 . Employed in porcelain and pottery, primarily as a flux and slight opacifier. Density $3,180\text{ kg m}^{-3}$.

ferric hydroxide. *Noun.* $\text{Fe}(\text{OH})_3 \cdot n\text{H}_2\text{O}$. A red pigment known as **red ochre** or **ferrihydrite**.

ferric oxide. *Noun.* Fe_2O_3 . Used in the manufacture of **ferrites** and as a pigment to produce various colours in glazes and glass; also employed as a polishing material for glass and other substances. Also known as **rouge**, **red iron oxide**, and **red earth**. Mp $1,565^\circ\text{C}$; density $5,120\text{--}5,240\text{ kg m}^{-3}$.

ferric oxyhydroxide. *Noun.* See **orange ochre**, and **goethite**.

ferrielectric. *Adjective.* A ceramic with an unbalanced orientation of electric dipoles. It has properties intermediate between **ferroelectric** and **antiferroelectric** materials.

ferriferous. *Adjective.* Iron bearing.

ferrihydrate. *Noun.* (1) A reddish-brown mineral widespread in surface deposits. It is poorly ordered and transforms to more stable iron oxides. Often called **amorphous iron oxide**, **amorphous iron hydroxide** or **hydrous ferric oxide**. Neither the structure nor composition is fully established but is like **haematite** with some OH^- and cation vacancies. (2) $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$. A gel-like precipitate obtained when solutions containing Fe^{3+} and or Fe^{2+} are made basic.

ferrihydrite. *Noun.* A reddish-brown mineral often called **amorphous iron oxide** or hydroxide or hydrous ferric oxide (**HFO**). Its structure is uncertain. Also called **red ochre**.

ferrimagnetic materials. *Plural noun.* Materials with magnetic characteristics similar to those of **ferromagnetic materials** but usually in the lower range of values because the structure consists of unequal magnetic moments lined up anti parallel to each other and so producing a degree of cancellation.

ferrimagnetism. *Noun.* Large and permanent magnetisations occurring in some ceramic materials resulting from antiparallel spin coupling and incomplete magnetic moment cancellation.

ferrite. *Noun.* (1) Any ferrimagnetic material having high electrical resistivity of the general formula MFe_2O_4 , in which M is a divalent metal, such as cobalt, copper, magnesium, manganese, nickel, and zinc or containing both divalent and trivalent cations, such as Fe^{2+} , Fe^{3+} . (2) Body centred cubic iron. (3) The calcium aluminoferrite phase in **cement clinker**.

- ferrite rod aerial.** *Noun.* A small coil of wire around a **ferrite** core; used in radio reception as the coil provides a tuning method.
- ferro.** *Combining form.* Indicating the presence of iron or properties of iron.
- ferroconcrete.** *Noun.* A concrete in which some form of iron or steel is employed as a strengthening agent.
- ferroelectric.** *Noun.* A crystalline ceramic, such as the titanates and zirconates of barium, calcium, magnesium, and the like, which is used in ceramic capacitors, transducers, amplifiers, and other similar applications, and which exhibits spontaneous **electric polarisation**, electric hysteresis, and **piezoelectricity**. The state of permanent electric polarisation can be induced by an electric field and the material is referred to as **poled**.
- ferroelectric crystal.** *Noun.* See **ferroelectric**.
- ferroelectric domain.** *Noun.* A region in a crystal in which the direction of **polarisation** is uniform.
- ferroelectricity.** *Noun.* The phenomenon where the **polarisability**, P , of a ceramic does not depend linearly on the applied electric field strength, E . Characterised by hysteresis in a P versus E plot; is believed to arise from the existence of **domains** in crystallites of the material.
- ferroelectric random access memory.** *Noun.* A device in which the polarisation of a ferroelectric material is reversed. Ferroelectric thin films, such as $\text{Pb}(\text{Zr,Ti})\text{O}_3$, that are used as capacitors in data handling and storage in computers. Abbreviated to **FeRAM** or **FRAM**.
- ferromagnesian.** *Adjective.* Of or concerning minerals that have high percentages of iron and magnesium.
- ferromagnesite.** *Noun.* An iron-bearing **magnesite** employed in refractories for its strong bonding properties at elevated temperatures.
- ferromagnesian.** *Adjective.* Of minerals containing a high proportion of iron and magnesium.
- ferromagnetic material.** *Noun.* Any material displaying **ferromagnetism**.
- ferromagnetism.** *Noun.* A property, exhibited by certain ceramics, metals, alloys, and compounds of the transition (iron group), rare-earth, and actinide elements, in which the internal magnetic moments spontaneously organize in a common direction. The effect gives rise to permeability considerably greater than that of vacuum, and to magnetic hysteresis. The effect is caused by the alignment of electron spins in regions called **domains**.
- ferrous.** *Adjective.* $\text{Fe}(\text{II})$. Of or containing iron in the divalent state.
- ferrosilite.** *Noun.* FeSiO_3 . Iron silicate; a **pyroxene** chain silicate; forms complete solid solutions with **enstatite**.
- ferrospinel.** *Noun.* Any spinel of the general formula MFe_2O_4 in which M may be barium, calcium, cobalt, copper, magnesium, manganese, nickel, strontium, or zinc; used as a refractory because of its high resistance to attack by molten glass and slags.
- ferrous carbonate.** *Noun.* FeCO_3 . Occurs in nature as **spathic iron ore**. See **spathic iron ore**.
- ferrous oxide.** *Noun.* FeO . A useful magnetic ceramic. Mp $1,420^\circ\text{C}$; density $5,700\text{ kg m}^{-3}$.
- ferrous sulphate.** *Noun.* $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$. Used as a red ceramic colorant. Also known as **iron sulphate**, **copperas**, **green copperas**, **green vitriol**, and **iron vitriol**. Occurs as the ore **melanterite**. Mp 64°C ; density $1,890\text{ kg m}^{-3}$.
- ferrous titanate.** *Noun.* FeTiO_3 . Generally identified as a titanium ore; has the **corundum** structure with the metal positions occupied by Fe^{2+} and Ti^{4+} . Also known as **ilmenite**.
- Ferroxcube.** *Trademark, noun.* $\text{Ba}_2\text{M}_2\text{Fe}_{12}\text{O}_{22}$ and $\text{Ba}_3\text{M}_2\text{Fe}_{24}\text{O}_{41}$, where M is a divalent ion Zn , Mg or from the first transition series. Commercial name for **soft ferrites** used in transformer cores where high permeability, low coercive force, and low eddy current loss are essential. More complex hexagonal structures than **barium ferrite**; easy direction of magnetisation is in the basal plane. Also known as **Y- or Z-compounds**. See **ferroplanas**.
- Ferroxdur.** *Trademark, noun.* Commercially available **barium ferrite**, $\text{BaFe}_{12}\text{O}_{19}$, **ferromagnets**.
- ferroplanas.** *Trademark, plural noun.* A commercial name for magnetically soft **ferrites** used in line output transformers for very high frequencies, 200–1,000 MHz. Called **Y-compounds**, or **Z-compounds**. See **Ferroxcube**.
- ferruginous.** *Adjective.* (1) Of or concerning minerals containing iron. (2) Rust coloured.
- ferruginous clay.** *Noun.* A deep red-brown coloured clay containing a high percentage of iron.
- festoon.** *Noun.* A decorative chain of flowers, loops, etc., applied as a decoration on pottery, plaster etc.
- FET.** *Acronym.* Stands for field effect transistor. See **field effect transistor**.
- fetid fluorite.** *Plural noun.* The name given to some **fluorite minerals** because they give a characteristic smell when crushed. It is thought to be due to release of minute amounts of fluorine gas that is produced when the mineral contains uranium. **Antozonite** is an example.
- fettle.** *Verb.* (1) To remove rough edges, mould marks, fins, and other irregularities from dry or nearly dry ceramic ware, usually by cutting, scraping, or abrasion. (2) To repair or line the walls of a kiln or furnace.

fettling. *Noun.* A refractory material used to line the repair kilns.

fettling knife. *Noun.* A sharp knife or instrument used to fettle or trim ceramic green ware. See **fettle**.

FFC-Cambridge process. *Trademark, noun.* Direct reduction of ceramic oxides to metal and carbon **nano-particles** in molten calcium chloride, which has a high solubility for oxide anions. The oxide is sintered into a cathode rod and an inert calcium titanate, CaTiO_3 , doped with CaRuO_3 , anode is used to discharge liberated oxide ion as oxygen gas. Graphite is used as the cathode to generate carbon and metal filled **carbon nanotubes**. Sometimes called an **oxygen ionisation process**.

FFM. *Abbreviation.* Stands for friction force microscopy. See **friction force microscopy**.

FGD-gypsum. *Noun.* Synthetic **gypsum** made by flue gas desulphurisation at coal-fired power stations.

Fiberfax. *Trademark, noun.* A commercially available form of **alumina ceramic fibre**.

fibre. *Noun.* A long, pliable filament made by drawing melts of highly plastic material, or by thermal decomposition of polymer fibres.

fibre, asbestos. *Noun.* See **asbestos fibre**.

fibre axis. *Noun.* The preferred direction of a fibre texture in crystalline fibres.

fibre, basic. *Noun.* See **basic fibre**.

fibre Bragg grating. FBG. *Noun.* Two **coherent** ultraviolet beams intersect on a length of **optical fibre core**, which sets-up a grating consisting of a periodic variation in the **refractive index** within the core. At this **Bragg grating** light with a wavelength twice the periodic variation will be reflected. Since the period of the refractive index variation changes as the fibre is strained the FBG can be used as a strain detector.

fibre bundle. *Noun.* A bundle or package of parallel, long, thin, flexible glass fibres; used to transmit images from one end to the other in fibre optics.

fibre, ceramic. *Noun.* See **ceramic fibre**.

fibre flexural rigidity. *Noun.* (1) The force moment needed to bend a specimen to unit radius of curvature. Units are dyne-centimetre or newton-metre. (2) A measure of individual fibre rigidity.

fibre fineness. *Noun.* The average diameter of expressed in terms of average linear density.

fibre, glass. *Noun.* See **glass fibre**.

fibre, graphite. *Noun.* See **graphite fibre**.

fibre, optical. *Noun.* See **optical fibre**.

fibre optic-coupler. *Noun.* A device used to split the optical signal among multiple paths to multiplex two

wavelengths on to a single fibre. It is usually based on two fibres lying close together; when straight they are **coherently** coupled, but when bent they become decoupled.

fibre optics. *Noun.* Use of glass fibres to transmit light (produced by **lasers**) for telecommunications and computer networking. Optical fibres can carry much more information than electrical wires.

fibre, organic. *Noun.* See **organic fibre**.

fibre orientation. *Noun.* Fibre alignment in a composite where most fibres are lying in the same direction.

fibre-reinforced composite. *Noun.* A composite in which the non-matrix phase is in the form of a **fibre**.

fibre reinforcement. *Verb.* To strengthen a relatively weak material by embedding strong ceramic fibres within the weak matrix phase.

fibre show. *Noun.* In ceramic composites it is the situation where the ceramic fibre strands appear on or above the surface.

fibre torsional rigidity. C. *Noun.* (1) The resistance of a fibre to twisting. (2) The couple needed to put a fibre in unit twist; units are $\text{kg m}^2 \text{s}^{-2}$.

fibre tow infiltration. *Noun.* Shapes made from fibre tow, roving, or bundles are consolidated by impregnation with molten matrix material.

fibre volume. f. *Noun.* The volume of a composite occupied by the reinforcing fibre; calculated from knowledge of weights and densities or from a count on a given area of polished cross section.

fibriform. *Adjective.* Having a fibrous habit.

fibril. *Noun.* (1) A single crystal in the form of a fibre. Also known as **whisker**. (2) A small fibre or part of a fibre.

fibro. *Noun.* Shortened form of **fibrocement**.

fibrocement. *Noun.* A cement-asbestos fibre composite used to make sheet material for building. The asbestos component is now being replaced with other types of fibre for health reasons.

Fibrolite. *Trademark, noun.* A building board made of **fibrocement**.

fibrosis. *Noun.* A disease characterised by scarring of the pleural lining of the lung covering caused by exposure to fibrous dust produced by some ceramics and composites.

fibrous. *Adjective.* Consisting of, containing, or resembling fibres.

Fick's first law of diffusion. *Noun.* An expression of the relationship between the flux of a diffusing species and the concentration gradient: $J = -D \text{dc}/\text{dx}$, where J is the flux of the diffusing species, D is the diffusivity or diffusion coefficient, and dc/dx is the concentration gradient. This relationship is applied for steady state diffusion situations.

Fick's second law of diffusion. *Noun.* A statement that the rate of concentration change is proportional to the second derivative of the concentration gradient: $\partial c_x / \partial t = D \partial^2 c_x / \partial x^2$, where c_x is the concentration at a distance x from the point of reference, t is the time, and ∂ symbolises partial derivative. This relationship is applied in non-steady state diffusion situations.

ficile. *Adjective.* (1) Capable of being moulded from clay. (2) Made by a potter from clay. (3) Relating to the potter's craft.

ficile clay. *Noun.* Mouldable clay suitable for the making of **pottery** and **earthenware**.

fictive temperature. *Noun.* Synonym for the **glass transition temperature**.

fiducial. *Adjective.* Used as a standard of reference or measurement.

field assisted bonding. *Noun.* A technique for making glass to metal joins well below the softening point of the glass by applying a dc voltage in the range 20–50 V across the metal-glass couple using the metal as the anode and the glass as the cathode while heating the whole assembly to 500 °C.

field, bipolar. *Noun.* See **bipolar field**.

field, circular magnetic. *Noun.* See **circular magnetic field**.

field-cured specimen. *Noun.* A test sample of concrete cured at the pouring site under conditions supposedly the same as those of the concrete employed in the structure being built.

field drain. *Noun.* An earthenware pipe used to drain surface and subsurface water from fields. Also called **field tile**.

field effect. *Noun.* The change in the properties and characteristics of a material or a part when subjected to the influence of an electric or magnetic field.

field effect transistor. FET. *Noun.* a semiconductor device based on silicon, GaAs, etc., that has three or more electrode regions, the **source**, a **gate**, and the **drain**. A current flowing in a channel between the highly doped source and drain is controlled by the electric field developed by a voltage applied between source and gate. Also called **field effect diode**. See also **JUGET**, **IGFET**.

field emission. *Noun.* The ejection of electrons from a solid subjected to a large electric field.

field, longitudinal magnetic. *Noun.* See **longitudinal magnetism**.

field magnet. *Noun.* A magnet that produces the **magnetic field** in a generator or electric motor.

field, magnetic. *Noun.* See **magnetic field**.

field, magnetic leakage. *Noun.* See **magnetic flux leakage**.

field meter, magnetic. *Noun.* See **magnetic field meter**.

field of force. *Noun.* The space around a body, such as a magnet or charged particle, within which it can exert a force on a similar body not in contact with it.

field, residual magnetic. *Noun.* See **residual magnetic field**.

fieldstone. *Noun.* Building stone found in fields.

field strength, magnetic. *Noun.* See **magnetic field strength**.

field structure. *Noun.* The device that creates the magnetic field through which an electrical generator armature moves.

field tile. *Noun.* See **field drain**.

figuline. *Adjective.* (1) Of or resembling clay. (2) *Noun.* An article made of clay.

figured glass. *Noun.* Flat glass having a pattern etched or ground on one or both surfaces.

figured rolled glass. *Noun.* A **translucent**, rolled glass, one surface of which has a pattern in consequence of which vision is not clear and, in some instances, is almost completely obscured.

figurine. *Noun.* A **bone china** or **porcelain** sculpture; an example of ceramic **artwork**.

FIL. *Abbreviation.* Standing for filament. See **filament**.

filagree. *Noun, adjective, verb.* A less common spelling of filigree. See **filigree**.

filament. *Noun.* A long, flexible thread of indefinite length and of small cross section, extruded or drawn, such as glass or polymer, or vapour deposited, such as boron; used in filament winding processes and in fibre composites.

filament catenary. *Noun.* The difference in length of the filaments in a given length of **fibre tow** leading to curvature when suspended.

filament number. *Noun.* Density of fibre filament expressed in **denier** or **tex** units.

filament winding. *Noun.* An automated process used to manufacture **ceramic-composite** pipes and cylindrical containers. **Rove** is wound onto a **mandrel** after passing through a resin matrix bath. Fibre **volume fractions** up to 80 % can be achieved. The pattern of winding can be varied so as to achieve stress resistance in particular places and directions.

filamentary composites. *Noun.* The best of the advanced **engineering composites** in which the reinforcing ceramic fibres consist of continuous filaments not

woven but in continuous parallel arrays. Often called **continuous strand composites**.

filamentary superconductor. *Noun.* Superconducting wires embedded in a matrix.

filament yarn. *Noun.* See **continuous filament yarn**.

filar. *Adjective.* (1) Of thread. (2) Describing an optical instrument having fine threads across the eyepiece forming a reticle or cross wires.

field capacity. *Noun.* See **pF**.

filigree. *Noun.* Any delicate fanciful ornamentation. (2) *Adjective.* Made of or as if made of filigree. (3) *Verb trans.* To decorate as if with filigree.

fill. *Noun.* (1) The unit charge of batch introduced into a melting tank, pot, or other processing unit. (2) Yarn oriented at right angles to the **warp** in a woven fabric.

filler. *Noun.* (1) A chemically inert material used to fill holes in a surface prior to the application of a subsequent coating. (2) An inert extender to a composition, which does not add or detract from the intended properties of the composition.

filler, joint. *Noun.* See **joint filler**.

fillet. *Noun.* A concave transition surface between two surfaces, which otherwise would meet at an angle, as a means of lessening the danger of cracking.

filling. *Noun.* The clogging of an abrasive product, such as **emery cloth** or a grinding wheel, by chips, shavings, and fine particles that have been removed from a piece during grinding.

filigree. *Noun, adjective, verb.* Uncommon alternative spelling of filigree. See **filigree**.

filling point. *Noun.* The point of normal capacity of a glass bottle.

film. *Noun.* A thin coating or layer of a substance over the surface of another material.

film conductance, h. *Noun.* The rate of heat flow from unit area of a surface to its surroundings; h has units $\text{W m}^{-2} \text{K}^{-1}$.

film permeability. *Noun.* The rate at which chemical reagents penetrate a film.

films. *Plural noun.* Trimmed **mica** split to specific ranges or thickness under 0.15 mm.

film strength. *Noun.* The resistance of films and coatings, such as glazes and porcelain-enamels in the unfired state, to disruption and mechanical damage.

filter. *Noun.* (1) A porous material through which a fluid is passed to remove matter in suspension. (2) Any device containing a porous medium used to separate suspensions from fluids. (3) Any acoustic, electronic or

optical device that blocks signals or radiation of certain frequencies while allowing others to pass. (4) Any transparent material used to reduce or eliminate the light from a lamp etc. (4) *Verb.* To remove or separate unwanted material or signals etc. by the action of a filter.

filterable. *Adjective.* Capable of being filtered.

filterability. *Noun.* The adaptability of a material in suspension as slurry to separation from the slurry by means of a semi-permeable medium or filter.

filter bed. *Noun.* Any layer of material through which a fluid is passed so as to filter it.

filter, black-light. *Noun.* See **black-light filter**.

filter block. *Noun.* A hollow, rectangular, vitrified **clay masonry unit**, sometimes **salt glazed**, used in trickle-type floors in sewage disposal plants; the block is designed with apertures connecting with drainage channels through the upper surface, and are arranged to form aeration and drainage grilles to pass air into, and liquids from, overlying filter media; the drainage channels convey liquid away from the **filter bed**.

filter cake. *Noun.* The solid or semi-solid residue remaining on a filter after filtration, particularly the products from a filter press.

filter candle. *Noun.* A porous ceramic tube employed as a filter medium.

filter cloth. *Noun.* A cloth employed as a filtering medium in a filter press for the removal of water from clay slips and slurries.

filter, infrared. *Noun.* See **infrared filter**.

filter medium. *Noun.* Closely woven textile or metal cloth; used as **filter cloth**.

filter paper. *Noun.* A porous paper, resistant to decomposition by liquids, used to filter liquids.

filter press. *Noun.* A device consisting of iron frames or plates suspended on a metal rack with a filter cloth stretched between each frame, the entire assembly then being pressed together and tightened by means of a screw mechanism; the slurry to be filtered is pumped through the assembly to remove excess water; the resultant **filter cake** collected on each filter cloth is then removed for further processing.

filter pump. *Noun.* A type of vacuum pump used to assist filtrations in which a jet of water passes at speed through a glass tube and drags air molecules from the system.

filter, quartz-crystal. *Noun.* See **quartz-crystal filter**.

filtrate. *Noun.* A fluid that has been filtered.

filtration. *Verb.* (1) To process a gas or liquid through a porous article or mass to separate out matter in suspension. (2) The act or process of suppressing or minimising

waves or oscillations of certain frequencies of light, electricity, or sound, by passing them through a suitable material or device.

fin. *Noun.* A thin, **featheredge** protrusion or projection from a surface such as a casting, on flat glass after cutting, or on pressed or blown ware at the seam formed between two parts of a mould.

final set. *Noun.* The time required for cement or concrete to harden to the point beyond which plastic deformation will not occur.

findings. *Plural noun.* The many small fittings used in setting ceramics and polished stones for use as jewellery.

fine. *Adjective.* (1) Excellent in quality. (2) Careful workmanship. (3) Very small or thin.

fine aggregate. *Noun.* The portion of the aggregate in concrete or sand in mortar passing a 4.75-mm sieve.

fine annealing. *Verb.* (1) The heat treatment of glassware to an extremely low internal stress to improve its resistance to breakage, and to obtain a uniform **index of refraction** to improve its brilliance. (2) The maintenance of steady temperature at the end of a firing to ensure that all parts of the object reach the same temperature.

fine ceramics. *Noun.* Japanese definition of high-technology ceramics fabricated from ultra-fine, < 0.1 µm diameter powders.

fine grinding. *Noun.* The milling of materials to particle sizes less than 100 mesh.

fineness. *Noun.* A measurement number designating the particle size of a material, usually reported as passing through a screen of a particular standard size.

fineness modulus. *Noun.* An empirical factor designating the fineness of an aggregate as a percentage of the total sample retained on each of a series of screens of decreasing sizes.

fineness-of-grind gauge. *Noun.* See **grinding gauge**.

fineness, porcelain-enamel. *Noun.* See **porcelain-enamel fineness**.

fine pearlite. *Noun.* Pearlite microstructure in which the alternating layers of **ferrite** and **cementite** are very thin.

finer. *Noun.* The portions of a powder composed of particles smaller than 74–20 µm.

fine sand. *Noun.* Sand grains having a diameter between 0.25 and 0.125 mm.

fine structure. *Noun.* The splitting of spectral lines into several components as a result of interactions between spin and orbital angular momenta of electrons in atomic energy levels.

finial. *Noun.* An ornamental projection or end of fired clayware such as is used on spires or the ends of roof ridges.

fining. *Noun.* (1) The process or period in glassmaking during which glass becomes essentially free from bubbles. Often a **fining agent**, such as **arsenic oxide** is added to assist the process. (2) The third stage in a **modular glass melting process** where the temperature is held 100–150 °C above the **sand dissolution stage** i.e. 1,400–1,450 °C. The fining time is 2–3 h. to allow the gas bubbles to reach the surface.

fining agent. *Noun.* Relatively low melting or sublimable oxides added to glass melting tanks in small amounts to assist gas bubble cohesion, growth and subsequent removal from the molten glass. sodium sulphate or sodium antimonate are used for TV tube glass and sodium chloride is used for other compositions. See **fining**.

fining, primary. *Noun.* See **primary fining**.

fining, secondary. *Noun.* See **secondary fining**.

finish. *Noun.* (1) The quality, appearance, or condition of a surface. (2) A material applied to a surface for decorative, protective, or other functional purposes. (3) The stage in the processing of molten glass when the glass appears to be free of **seeds**. (4) The portion of a bottle designed to receive a cap or other closure. (5) *Verb trans.* To provide a product with a finish, especially to put a final coat or surface on the article.

finish, combed. *Noun.* See **combed finish**.

finisher. *Noun.* (1) A workman who completes or perfects the final operation of a manufacturing operation. (2) A workman supervising the melting and **fining** of glass. (3) A person or machine that prepares the bed or finishes the surface of freshly poured concrete.

finish, fire. *Noun.* See **fire finish**.

finish grinding. *Noun.* The completion of a grinding operation to obtain a desired surface appearance or accurate dimensions.

finishing. *Noun.* (1) The completion of an operation or process. (2) Completion of a grinding operation or surface treatment.

finishing lime. *Noun.* Any white, plastic, hydrated **lime** suitable for use in finish-coat plaster.

finish mould. *Noun.* The neck mould of a bottle.

finish, natural. *Noun.* See **natural finish**.

finish, offset. *Noun.* See **offset finish**.

finish, sand. *Noun.* See **sand finish**.

finish, scored. *Noun.* See **scored finish**.

finish screen. *Noun.* A screen for the removal of dirt and undersized particles from coarse aggregate before it enters the bins at a concrete batching plant.

finish, short. *Noun.* See **short finish**.

finish, stippled. *Noun.* See **stippled finish**.

finish tile. *Noun.* Tile employed in construction with the glazed face exposed to finish a wall.

finish, velvet. *Noun.* See **velvet finish**.

finite element. *Noun.* A separate self-contained element of a structure that can be combined with many others to produce an idealised structure and so can form the basis of mathematical modelling of real continuous structures.

fire. *Verb trans.* (1) To consolidate, fix the glaze, and densify ceramic bodies by the application of heat. (2) *Noun.* Flashes of colour produced in **diamond** by its high **dispersion** and very high **refractive index**.

fire, annealing. *Noun.* See **annealing fire**.

fire, bisque. *Noun.* See **bisque fire**.

firebox. *Noun.* The section of a furnace or kiln in which combustion of fuel takes place.

firebrick. *Noun.* Any refractory brick capable of withstanding high temperatures without fusion; used to line furnaces, fireplaces, chimneys, etc.; usually made from **fireclay** and contains not less than 50 % **alumina**.

firebrick, insulating. *Noun.* See **insulating firebrick**.

fire bridge. *Noun.* A low wall separating the hearth and grate of a **reverberatory furnace**.

fire check. *Noun.* A crack resulting from thermal stress developed in ware during firing.

fireclay. *Noun.* Clay containing only small amounts of fluxing ingredients, but high in **alumina** and **silica**, capable of withstanding high temperatures without becoming glassy; used in the production of refractory brick, kiln and furnace linings, glass-melting pots and tanks, crucibles, etc.; variable composition around that of **kaolinite**.

fireclay brick, high-duty. *Noun.* See **high-duty fireclay brick**.

fireclay brick, low-duty. *Noun.* See **low-duty fireclay brick**.

fireclay brick, medium-duty. *Noun.* See **medium-duty fireclay brick**.

fireclay brick, semi-silica. *Noun.* See **semi-silica fireclay brick**.

fireclay brick, siliceous. *Noun.* See **siliceous fireclay brick**.

fireclay brick, super duty. *Noun.* See **super duty fireclay brick**.

fireclay cement. *Noun.* Cement composed of dry **fireclay** and **sodium silicate**; used in the repair of **saggers**, refractories, kiln cracks, etc.

fireclay, flint. *Noun.* See **flint fireclay**.

fireclay, ground. *Noun.* See **ground fireclay**.

fireclay mortar. *Noun.* A mortar composed of finely ground **fireclay** and water.

fireclay, nodular. *Noun.* See **nodular fireclay**.

fireclay, plastic. *Noun.* See **plastic fireclay**.

fireclay, plastic refractory. *Noun.* See **plastic refractory fireclay**.

fireclay, silica. *Noun.* See **silica cement**.

fire crack. *Noun.* A crack resulting from thermal stresses developed in ware during firing.

fire, decorating. *Noun.* See **decorating fire**.

fire, diamond. *Noun.* See **dispersion**.

fire finish. *Noun.* A surface finish or polish on glassware produced by heat treatment, such as in a flame.

fire, glost. *Noun.* See **glost firing**.

firemark. *Noun.* (1) A surface imperfection resulting from contact with a flame. (2) A shallow pinhole-like indentation on the surface of porcelain-enamel.

fire opal. *Noun.* An orange to red coloured variety of **opal** used mainly as a gemstone.

fire over. *Noun.* The idling of a glass-melting tank at operating temperature.

fire polish. *Verb.* To produce a smooth, glossy, or rounded glass surface by heating in a fire.

fireproofing. *Verb.* (1) To render incombustible. (2) *Noun.* Any material used to protect against fire.

fireproofing tile. *Noun.* Tile, usually hollow, employed to protect members of a structure against fire.

fire resistant. *Adjective.* Resistant to combustion for a specified time under standard conditions of heat intensity without burning or structural failure.

fire sand. *Noun.* Highly refractory sand consisting of coarse **quartz** grains in combination with **alumina** and clay bearing sand; used primarily in foundries.

fire, sharp. *Noun.* See **sharp fire**.

fire, short. *Noun.* See **short fire**.

fire, single. *Noun.* See **single fire**.

fire, soft. *Noun.* See **soft fire**.

fireskin. *Noun.* A glassy layer formed on the surface of **terracotta** because of the higher temperature of the surface in firing. It gives enhanced durability on the artefact.

firestone. *Noun.* **Sandstone** capable of withstanding high temperatures and so is used for lining kilns etc.

- firing.** *Noun.* (1) The process of igniting a mixture of fuel and air in a kiln or furnace. (2) The heat treatment of ceramic ware or products in a kiln or furnace to develop desired physical and chemical properties. (3) The fusion of a porcelain-enamel or ceramic coating by heat.
- firing behaviour.** *Noun.* The changes in the appearance and properties of ceramic products during firing or thermal treatment.
- firing chamber.** *Noun.* Any chamber or enclosure in which fuel is burned to provide heat.
- firing curve.** *Noun.* A chart recording the time and temperature conditions during a firing operation.
- firing cycle.** *Noun.* The time required for one complete firing operation.
- firing, direct.** *Noun.* See **direct fire**.
- firing, draw.** *Noun.* See **draw firing**.
- firing expansion.** *Noun.* The increase in the dimensions of a substance or product during thermal treatment.
- firing fork.** *Noun.* A long-handled, two-pronged tool used to charge and remove ware in furnaces.
- firing, glost.** *Noun.* See **glost firing**.
- firing, open.** *Noun.* See **open firing**.
- firing range.** *Noun.* The time-temperature intervals in which bodies and coatings attain the respective desired firing maturities or properties.
- firing shrinkage.** *Noun.* The contraction or decrease in the dimensions of a substance or product during thermal treatment, calculated by the equations: Linear firing shrinkage $\% = [(L_d - L_f)/L_d] \times 100$ where L_d is the length of the dry, but unfired, specimen, and L_f is the length of the fired specimen. Volume firing shrinkage $\% = [(V_d - V_f)/V_d] \times 100$, in which V_d is the volume of the dry, but unfired, specimen, and V_f is the volume of the specimen after firing. Also known as **linear burning shrinkage** and **volume burning shrinkage**.
- firing, sky.** *Noun.* See **sky firing**.
- firing temperature.** *Noun.* (1) The peak temperature reached during the firing of a porcelain-enamel or ceramic ware. (2) The degree of sensible heat attained by the porcelain-enamel ware during the maturing firing of the coating.
- firing time.** *Noun.* The time porcelain-enamelled ware remains in the **firing zone** of a furnace to attain coating maturity.
- firing, vacuum.** *Noun.* See **vacuum firing**.
- firing zone.** *Noun.* The section of a furnace or kiln in which ware is subjected directly to the major influences of heat, as in a **continuous furnace** or kiln.
- first-quality ware.** *Noun.* Products that meet specified standards and are free of imperfections or defects.
- first side.** *Noun.* The surface of plate glass that is first ground and polished.
- first water.** *Noun.* (1) The finest quality of diamond or other precious stone. (2) The best quality of product or material.
- fish bone.** *Noun.* A striation on a fracture surface that does not cross it completely.
- fisheye.** *Noun.* A glass bubble on the fired surface of a glaze or porcelain-enamel.
- fish-eye lens.** *Noun.* A glass lens of small focal length having a highly curved protruding front element that covers an angle of view of almost 180°. It produces a circular image with large linear distortions.
- fish scale.** *Noun.* A half-moon fracture, resembling the scale of a fish, on the surface of porcelain-enamel caused by the presence of small pockets of hydrogen or other substance at the interface between the coating and the steel.
- fish scale, delayed.** *Noun.* See **delayed fish scale**.
- fish scale process.** *Noun.* Fishscale occurring on porcelain-enamelled surfaces during the drying or firing operation.
- fissile.** *Adjective.* (1) Capable of undergoing nuclear fission. (2) Tending to split.
- fission.** *Noun.* The division of an atomic nucleus into parts of comparable mass, usually with the release of energy and one or more neutrons.
- fissionable material.** *Noun.* A material whose nuclei are capable of undergoing **fission**, such as the heavier isotopes of uranium, plutonium, or thorium, with the emission of large amounts of energy.
- fission, controlled.** *Noun.* See **controlled fission**.
- fission products.** *Plural noun.* Nuclides produced by **fission** or by radioactive decay of the fission products.
- fission-track dating.** *Noun.* A method of dating minerals and ancient ceramics by comparing fission tracks of uranium nuclei decay products before and after neutron irradiation.
- fissure.** *Noun.* Surface defect consisting of a narrow opening or crack.
- fit.** *Noun.* The stress or dimensional relationship between a coating and its substrate.
- filch fan.** *Noun.* A brush made from very soft hair used to apply glaze and **underglaze**.
- fitting.** *Noun.* An accessory part used in the assembly of a system, such as T- and Y-joints, elbows, and adaptors.

fixed bed. *Noun.* A bed of powdered or granular material through which a fluid may flow without substantial movement of the bed.

fixed-feed grinding. *Verb.* To feed a material to be ground to a grinding wheel at a given rate or in specific increments. **flacon.**

flacon. *Noun.* A small bottle or flask with a stopper.

flag. *Noun.* See **flagstone**.

flagon. *Noun.* (1) A ceramic or glass vessel with a handle, spout and narrow neck. (2) A large bottle containing alcoholic drink.

flagstone. *Noun.* (1) A hard fine textured rock, such as shale, that can be split up into paving slabs. Also called **flag**. (2) A slab of suitable stone for paving.

flake. *Noun.* (1) A small piece. (2) A small thin **shard** chipped off ceramic, glass or rock.

flake enamel. *Noun.* Porcelain-enamel **frit** available in eggshell-thin fragments or flakes.

flake graphite. *Noun.* Flat plate-like particles found widely dispersed in silica-rich **quartzites**.

flaking. *Noun.* The breaking of small chips or thin fragments from the surface of a refractory, glaze, or porcelain-enamel.

flake white. *Noun.* A pigment consisting of suspended small pieces of **white lead**.

flambé glaze. *Noun.* A red **flow coating** glaze containing reduced copper that produces a variegated appearance on pottery products.

flame. *Noun.* The hot gaseous part of a fire.

flame annealing. *Verb.* To heat a glass or metal part in a flame to remove stresses and to make the glass or metal less brittle.

flame cleaning. *Verb.* To remove scale, rust, and dirt from metal surfaces with a broad flame.

flameproof ware. *Noun.* Ware capable of withstanding extreme **thermal shock**.

flame, reducing. *Noun.* See **reducing flame**.

flame spraying. *Verb.* To deposit a coating on the surface of a product or material by feeding the coating material through a **spray gun** into a gas flame to impinge and fuse molten particles on the work.

flange. *Noun.* (1) A rim designed to strengthen a metal part or to facilitate assembly to another part. (2) The circular metal plates that drive a grinding wheel.

flanged bottom. *Noun.* An imperfection consisting of an offset on the bottom of a bottle.

flange, safety. *Noun.* See **safety flange**.

flaring cup. *Noun.* A cup wheel with the rim extended from the back at an angle.

flash. *Noun.* (1) A thin film of another glass, frequently coloured or opaque, applied and fused to the surface of sheet or other clear glass. (2) A film of different colour or texture on clayware.

flushed brick. *Noun.* Brick subjected to reducing conditions near the end of the firing cycle to produce a desired colour.

flashing. *Verb.* (1) To apply a flash of glass. (2) A firing process used in brick making to control the external colour of bricks. The bricks are fired in a reducing atmosphere with a low partial pressure of oxygen and then cooled using **flash tubes** blowing air over the surface to produce an oxidised layer. The colour is affected by the temperature at which oxidation takes place and the time taken for the temperature to fall below reaction temperature. With red clays colours from black through to orange are achieved. (3) *Noun.* A thin sheet of material placed at the junction of exterior building surfaces to make the joint watertight. (4) *Noun.* The material extruded out of the joint of a dust or plastic clay press. (5) *Verb.* To add metallic zinc to hot brick or ceramic ware in kilns to produce a grey or mossy green surface on the ware. The process can cause zinc shakes. See **zinc shakes**.

flash magnetisation. *Verb.* Magnetisation by a current flow of brief duration.

flash mark. *Noun.* (1) The discoloration of a brick surface due to the presence of **fly ash** during firing. (2) Cross-set marks in sections of brick due to **flashing** reduction; that is, the sections were subjected to reducing conditions during firing, causing colour differences in the brick.

flashover. *Noun.* An electric discharge over or around the surface of an insulator.

flash point. *Noun.* The lowest temperature at which vapours from a volatile liquid will ignite, at least momentarily, on contact with a small flame.

flash set. *Noun.* Rapid and permanent hardening of fresh mortar, concrete, or cement paste with the evolution of heat.

flash smelting. *Noun.* A smelting process for sulphur-containing ores designed to reduce atmospheric pollution. The ore is mixed with oxygen and ignited at the exit from a nozzle where it melts and releases sulphur mainly in the solid form as it drips down to a pan catcher.

flash tubes. *Plural noun.* Air inlets directing an oxidising atmosphere at the surface of cooling brickware. See **flashing** (2).

flash wall. *Noun.* A refractory wall in a kiln placed so as to prevent impingement of flames on the ware being fired.

flask. *Noun.* A glass or ceramic bottle with a narrow neck.

flasket. *Noun.* A small **flask**.

flat. *Noun.* See **facet**.

flat arch. *Noun.* An arch in a furnace or kiln in which both outer and inner surfaces are horizontal; the inner arch may be arched with a large radius. Also known as **jack arch**.

flat-drawn process. *Noun.* A process in which sheet glass drawn vertically from the molten bath is passed between rollers to solidify the sheet to a prescribed thickness.

flat glass. *Noun.* Sheet glass. See **sheet glass**.

flat sheets, type F (flexible). *Noun.* See **type F flat sheet**.

flat sheets, type U (utility). *Noun.* See **type U flat sheet**.

flat slab. *Noun.* A reinforced concrete plate or slab designed to span in two directions, such as in flooring.

flatware. *Noun.* A generic term for flat items of **dinnerware** such as plates, meat platters, saucers, side plates, and the like.

flatwork. *Noun.* Concrete items such as sidewalks, floor, and flat slabs.

flaw. *Noun.* An imperfection or defect.

flaw indication, magnetic-particle. *Noun.* See **magnetic-particle inspection**.

fleck. *Noun.* A small marking or streak.

Fleming's rules. *Noun.* Mnemonics for the relationship between the direction of current flow, motion, and magnetic field in electromagnetic induction. The hand is held with the thumb, first, and second fingers at right angles, respectively, indicating the direction of motion, field, and electric current. The left hand is used for electric motors and the right hand for dynamos.

Flemish bond. *Noun.* Courses of brick consisting of alternate **headers** and **stretchers**, the headers being centred on the stretchers above and below.

fleurette. *Noun.* An ornament or motif on decorated ware resembling a flower.

flexibility. *Noun.* An intrinsic material property that allows it to be bowed repeatedly without fracture.

flexible brick pavement. *Noun.* A designed structure made to resist pedestrian and vehicular loadings, consisting essentially of a top surface of close-fitting **clay pavers**, a layer of bedding sand, and a road base, and sand between the pavers which produces the phenomenon of **interlock** or lock-up.

flexible thin film transistors. *Noun.* Semiconductor ceramic materials, such as **zinc oxide** and silicon, made by vacuum deposition, high temperature curing and then transfer to a flexible substrate, usually polythene.

flexural modulus. *Noun.* The ratio of applied stress causing flexure in a test specimen, to the strain in the outermost fibres of the specimen, at values that remains within the elastic limit.

flexural rigidity. *D. Noun.* A material property that depends on the shape of a specimen and is a measure of its rigidity. For a plate-shaped specimen, $D = Eh^3/12(1 - \nu)$, where E is Young's modulus, h is the plate thickness and ν is **Poisson's ratio**.

flexural ring test. *Noun.* A strength test for glass and ceramic samples in which a sample disk is pressed between two concentric rings of different diameters.

flexural strength. *Noun.* The stress on a material, which in a bending or a transverse load test, will just cause fracture. Conventional tests are evaluated from the relationship $3LP/2bd^2$, where P is the applied load, L is the sample length, b is the width, and d is the thickness.

flexural test. *Noun.* A test used for quality control in fibre composite manufacture in which tensile, compressive, and shear stresses act simultaneously.

flinders. *Plural noun.* Small fragments or splinters.

flint. *Noun.* SiO_2 . (1) A finely crystalline, impure, opaque greyish-black form of natural silica or quartz. Usually found in **chalk**. Used as an abrasive, as balls and liners for ball mills, as a component in glass and pottery manufacture, and as a road construction material. Exhibits **conchoidal** fracture. Produces sparks when struck with steel. (2) The term applied to silica-rich bands and nodules that occur in chalk. A subset of a broader group of rocks called **chert**. A common aggregate for concrete. (3) A colourless glass other than **plate** glass. Density 2,600–2,650 kg m^{-3} ; hardness (Mohs) 6.5–7.

flint clay. *Noun.* A hard, smooth, non-plastic **fireclay**.

flint-enamelled ware. *Noun.* A semi vitreous or **earth-ware** type of pottery flecked in yellow, brown, and blue colours.

flint fireclay. *Noun.* A hard, smooth, non-plastic fireclay.

flint glass. *Noun.* (1) A heavy, colourless, brilliant lead containing glass; often used as an optical glass. (2) A clear, colourless bottle glass. (3) Any glass of high quality. See **optical flint glass**.

flint knapper. *Noun.* A worker who chips flint into shape for wall building etc.

flint mill. *Noun.* A **ball mill** in which flint pebbles are used as the grinding medium; sometimes the mill lining also may be constructed of flint blocks.

flint optical glass. *Noun.* See **optical flint glass**.

flint shot. *Noun.* Hard, coarse, sharp-edged sand used in sandblasting.

flint, white. *Noun.* See **white flint glass**.

flinty. *Adjective.* Of or relating to or resembling **flint**.

flip chip. *Noun.* A **semiconductor package** often used in small appliances, such as mobile phones, because of its low profile and high I/O count.

flip-flop. *Noun.* An electric circuit or device that can assume either of two stable states on receipt of a suitable pulse.

FLO. *Abbreviation.* A micro scale engineering technique used to construct **semiconductor packages**. It uses **lamina flow** of reactive solutions or liquids in capillary structures. The fluid streams run along capillary channels moulded in the surface of a polydimethylsiloxane membrane sealed against a substrate block.

float. *Noun.* (1) A flat wood or metal finishing tool for cement that is used after **screeding** and before **troweling**. (2) A rectangular piece of wood with a handle attached to the underside used to apply and smooth coats of plaster.

float bath. *Noun.* A long shallow bath of molten tin kept under a reducing atmosphere to prevent oxidation on which **float glass** forms from molten glass under the influence of **surface tension** and gravity.

floaters. *Noun.* A floating clay or refractory shape, usually a ring, to skim foreign materials from the surface of molten glass in a **glass tank**, and to control their passage from one section of the tank to the next.

floaters hole. *Noun.* An opening in a glass-melting tank through which **floaters** are placed into a tank.

float finish. *Adjective.* A rough concrete surface produced and smoothed by the use of a wooden float during the finishing operation.

float glass. *Noun.* A type of flat polished glass made by allowing molten glass to be carried along on the surface of a flowing stream of molten tin as it hardens. It is a continuous process.

floating punch. *Noun.* A male mould member free to adjust its position in the female part of the mould when it is closed under pressure.

float mould. *Noun.* A mould having a large central cavity into which many small cavities lead. Used to make many small parts simultaneously, usually under pressure.

floc. *Noun.* (1) A loosely **agglomerated** particle formed from a **colloidal suspension**, capable of being redispersed. (2) Another word for **flocculate**.

flock. *Noun.* Fibres in entangled small masses or beads of irregular broken fibres.

flocculant. *Noun.* A reagent or electrolyte added to a colloidal suspension to cause the particles to **aggregate** or coalesce and settle.

flocculation. *Noun.* The addition of an electrolyte to thicken porcelain-enamel slip by **agglomeration** that causes particles to settle out.

flocculate. *Verb.* To form or be formed into an agglomerated flocculant mass.

floccule. *Noun.* A small **agglomerate** of flocculated particles.

flocculent. *Adjective.* Aggregated in woolly-like masses.

floc test. *Noun.* A test of the **durability** of hydraulic cement in which 1 g of cement is shaken in a test tube containing 100 ml of water and allowed to stand for 7 days and then if the amount of **floc**, or suspended particles, is small the cement is considered to be durable.

flood basalt. *Noun.* A plateau formed by a very extensive lava flow of basaltic composition.

flooding. *Verb.* To flow water over an unfired porcelain-enamel surface in order to produce a coating having a water-streaked appearance when fired.

floor brick. *Noun.* Smooth, dense, abrasion-resistant brick used in floors. Sometimes called **paver**.

floor brick, industrial. *Noun.* See **industrial floor brick**.

floor, hot. *Noun.* See **hot floor**.

floor moulding. *Verb.* To make moulds on a sand covered floor in a specially designated area.

floor-stand grinder. *Noun.* A grinding machine mounted on a stand or base attached to the floor.

floor tile. *Noun.* An abrasion-resistant ceramic tile used in floor construction or decoration of an existing floor.

floor topping. *Noun.* A thin layer of high-quality high-strength concrete applied to a concrete slab as a finished floor.

Florence flask. *Noun.* A round flat-bottomed glass flask with a long neck used in chemistry laboratories.

Florida kaolin. *Noun.* Very clean **ball-type kaolin** of high purity, fine particle size, and **white burning**. Employed to promote refractoriness, plasticity, bonding strength and improve suspension behaviour in many types of ceramics.

flos ferri. *Noun.* A form of **aragonite** deposited as white branching masses from hot springs.

floss. *Noun.* Molten or solid slag floating on the surface of molten metals and glasses.

flotation. *Noun.* A process employed to separate particles in a tank of liquid whereby one group of particles is caused to float and other groups to settle by control of the liquid's density, the use of air streams that agitate the fluid and chemically-induced attachment of gas bubbles to the minerals surface to float it to the top of the slurry.

flour. *Noun.* Any finely powdered substance.

flowage. *Noun.* A gradual deformation of solids, such as **asphalt**, which flow without fracture.

flow-button. *Noun.* A pellet of **frit** or dried slip of porcelain-enamel or glaze employed to evaluate the flow characteristics of the materials at fusion temperatures by comparison with standardised pellets.

flow coating. *Verb.* To apply a coating to an object by pouring a slip over the surface of the object and allowing it to drain.

flow curves. *Plural noun.* Graphical plots of **shear stress** against **shear rate** that are used to define the rheological behaviour of suspensions, such as clay slips. If the curves are convex to the shear rate axis the slip is **dilatant** and the viscosity increases with an increase in the shear rate.

flow, fusion. *Noun.* See **fusion flow**.

flowers of sulphur. *Plural noun.* Tiny crystals of sulphur made by condensing sulphur vapour on a cold surface.

flowers of zinc. *Noun.* See **zinc oxide** and **zincite**.

flow hole. *Noun.* The submerged passage between the **melter** and **refiner** of a **glass-melting tank**.

flow line. *Noun.* A line formed on a moulded item at the point where two input-flow fronts meet during the moulding process.

flow, plastic. *Noun.* See **plastic flow**.

flow process. *Noun.* (1) A process in which a **gob** of glass is delivered to the forming unit. (2) The mechanism of **dislocation movement** in a solid leading to deformation.

flow resistance factor. RTF. *Noun.* A performance feature of **cellular ceramic catalyst** support systems that relates to the back pressure as gas flows through the cellular structure. $RTF = L^2 / (L - t)^4$, where L is the cell repeat distance and t the cell wall thickness.

flow test. *Noun.* A test to determine the flow characteristics of concrete or other plastic mass in which a measured volume is vibrated or jolted on a flat surface and its tendency to flow is observed.

flow, uniform. *Noun.* See **uniform flow**.

flue. *Noun.* A passage to exhaust combustion gases and dust from a kiln, furnace, or other combustion chamber.

flue dust. *Noun.* Particles of dust exhausted from a furnace, kiln, or other combustion chamber.

flue gas. *Noun.* The gaseous products of combustion from a furnace, kiln, or other combustion chamber.

flue-gas analyser. *Noun.* An instrument, such as an **Orsat analyser**, which analyses and sometimes monitors the composition of flue gases and the air-fuel ratio in the combustion chamber of a furnace or kiln.

flue lining. *Noun.* The refractory shapes used to line the flues and exhaust passages of furnaces and kilns.

fluence. *Noun.* The **energy density** of a **laser** beam on a surface. Units are $J\ cm^{-2}$.

fluid. *Noun.* A substance such as a liquid or gas having low resistance to flow and a tendency to assume the shape of its container. A technical definition is a substance at a temperature above its **critical temperature** and its **critical pressure**, where it cannot be made to either liquefy by temperature reduction at constant pressure or to vaporise by pressure reduction at constant temperature. See **critical point**. (2) *Adjective.* Capable of easily changing shape and flowing.

fluid bed. *Noun.* A bed composed of fine particles or granules that behave in a fluid-like manner when moved by a rising stream of gas or air.

fluid carrier. *Noun.* Fluid in which particles are suspended to facilitate their movement or application, for example, water in which glaze and porcelain-enamel compositions are suspended.

fluid-energy mill. *Noun.* A size-reduction machine in which grinding is achieved by the collision of the particles being ground in a high-velocity stream of air, steam, or other fluid.

fluidise or fluidize. *Verb trans.* To make solids fluid by pulverising them so that they can be transported in a stream of gas as if they were liquids.

fluidised bed. *Noun.* An apparatus in which powdered or granular material is contained and suspended in a rising stream of hot air or gases as a means of drying, heating, calcining, coating, or quenching. The powdered or granular material in the suspended state behaves much like a liquid. See **fluid bed**.

fluidised-bed coating. *Verb.* To apply a coating to an article while it is immersed in a **fluid bed** of the coating material or while the article is suspended in a flowing gas stream of the coating material.

fluidised-bed combustion. *Verb.* To burn particulate matter in a **fluid bed** that has an excess of air passing through the bed.

fluidity. *Noun.* (1) The property of a substance to flow like a liquid or gas, when subjected to a shearing force. It is the reciprocal of viscosity with units of reciprocal Pascal second, $Pa^{-1}\ s^{-1}$. (2) The workability or consistency of a material or mixture to flow, such as wet concrete, a glaze, or a porcelain-enamel.

fluid pressure. *Noun.* The pressure that a fluid can exert at any point within it. The difference in pressure between any two points in a fluid is given as $\Delta h \times \rho \times g$, where Δh is the height difference, ρ is the fluid density and g is the acceleration of free fall.

fluobarite. *Noun.* A mixture of **fluorspar**, CaF_2 , and **barite**, $BaSO_4$; used as a flux in glass manufacture.

fluor. *Noun.* (1) A synonym for **fluorspar**, CaF_2 . (2) An atom or ion in a crystal that can **fluoresce**.

fluorapatite. *Noun.* The most common mineral form of **apatite**; the **calcium fluophosphate** phase in which F^- ions predominate as the charge-balancing anion.

fluor crown glass. *Noun.* An optical **crown glass** of low **index of refraction** and **dispersion** containing substantial amounts of fluorine to serve as a flux.

fluoresce. *Verb intrans.* To have the property of **fluorescence**.

fluorescence. *Noun.* Radiation, when absorbed by a system containing electrons may be changed into thermal motion or be re-irradiated. When **luminescence** is emitted from the excited state such light is called fluorescence and the emission is at a lower energy, i.e. a longer wavelength. The difference in energy is taken up by the lattice vibrations so raising the temperature of the fluorescent material. Fluorescent materials are often called **phosphors**.

fluorescence resonance energy transfer. FRET. *Noun.* The process by which the emission wavelength of a **fluorescent** system is changed to a longer wavelength by the proximity of two **fluors**. When long-lived **lanthanide** ions are used as acceptors the process is known as **homogeneous time-resolved fluorescence**.

fluorescent. *Adjective.* Having the property of **fluorescence**.

fluorescent lamp. *Noun.* (1) A lamp where the glass envelope is coated with a **phosphor** on the inside and this is excited by uv-light from a low pressure of mercury vapour that is discharged by the electric voltage. (2) A lamp where an electrical discharge is maintained in a glass tube containing neon, sodium etc., at low pressure. The gas atoms are hit by electrons in the discharge and **fluoresce**.

fluorescent magnetic inspection. *Noun.* The use of a finely divided **ferromagnetic** fluorescent medium as an inspection technique.

fluorescent penetrant. *Noun.* An inspection penetrant that fluoresces or glows in uv light.

fluorescent pigment. *Noun.* A pigment that will give off light (glow) during exposure to radiant energy such as ultraviolet light.

fluorescent screen. *Noun.* A glass screen coated with a **phosphor on one side** that fluoresces when exposed to x-rays or electrons.

fluorhectorite. *Noun.* $LiMg_2LiSi_4O_{10}F_2$. A phase occurring in some **fluormica glass-ceramics** with a water swelling capacity. Glass-ceramics containing this phase swell and delaminate in contact with water to produce a **sol-gel** of fine mica-type platelets that can be **flocculated**, by addition of KF, into a 25 μm thick continuous film of oriented crystals of $KMg_2LiSi_4O_{10}F_2$, **fluortaenolite**. This film has paper-like properties and can withstand temperatures over 500 $^{\circ}C$; it has high dielectric strength.

fluoric. *Adjective.* Concerned with or made from fluorine or **fluorspar**.

fluoride. *Noun.* Any salt of hydrofluoric acid, containing F^- ions.

fluoride glass. *Noun.* Melts of lanthanide fluorides and mixtures of these fluorides that become elastic solids without crystallising; finding use in fibre optics, electrooptics, and lasers. See **fluorozirconate glass**.

fluorimeter. *Noun.* See **fluorometer**.

fluorination. *Noun.* A chemical reaction occurring when fluorine is introduced or comes in contact with a receptive product.

fluorine. F. *Noun.* Introduced in ceramic compositions in the form of various fluorides as a flux or opacifying ingredient.

fluorite. *Noun.* (1) North American synonym for **fluorspar**, CaF_2 . (2) An oxide structure type with formula MO_2 ; typical examples are CeO_2 , HfO_2 .

fluorite oxide. *Noun.* See **fluorite** (2).

fluormica glass ceramics. *Noun.* Glass ceramics formed from batches containing substantial quantities of calcium fluoride and nucleated by zirconia. The main crystalline phases after devitrification contain crystals with the **mica** structure but where some oxygen ions have been replaced by fluoride.

fluoro- or before a vowel fluor-. *Combining form.* (1) Indicating the presence of **fluorine**. (2) Indicating **fluorescence**.

fluorocanasite. *Noun.* $Ca_5K_{2-3}Na_{3-4}Si_{12}O_{30}F_4$. A crystal produced in some fluorine-based glass-ceramics with a structure similar to the rare mineral **canasite** which has four silicate chains parallel to the b-axis, cross-linked to form tubular ionic units of $[Si_{12}O_{30}]^{12-}$ composition; high toughness, around 5.0 $MNm^{-3/2}$, and high strength.

fluorochrome. *Noun.* A chemical entity that possess the property of **fluorescence**.

fluorometer. *Noun.* (1) A device for measuring the intensity of ultraviolet light by determining the amount of **fluorescence** it induces in a **phosphor**. (2) An instrument made to produce **fluorescence** in a sample and then to analyse the emission spectrum of the fluorescent light.

fluorophore. *Noun.* A chemical grouping in a crystal responsible for **fluorescence**.

fluoroscope. *Noun.* A device containing an x-ray source and a fluorescent-glass screen for carrying-out **fluoroscopy**.

fluoroscopy. *Noun.* The projection of an x-ray radiograph onto a fluorescent screen to obtain an inspection image of low density ceramic materials.

fluorozirconate glass. *Plural noun.* A low-loss, fibre-forming glass developed to provide optical fibres with a longer wavelength absorption band. Since **Rayleigh scattering** loss is inversely proportional to λ^4 this greatly reduces loss at 2.5 μm . **ZBLAN** is a commercial example with composition ZrF_4 (55 %), BaF_2 (18 %), LaF_3 (6 %), AlF_3 (4 %), and NaF (17 %). Applications include remote spectroscopy, remote sensing, and lasing and it is used to fabricate waveguides.

fluorphlogopite mica. *Noun.* $\text{KMg}_3\text{AlSi}_3\text{O}_{10}\text{F}_2$. The crystalline phase developed in the machinable glass-ceramic **Macor** and responsible for its machinability.

fluorspar. *Noun.* CaF_2 . Calcium fluoride mineral. Used as a flux and opacifier in ceramic glazes, porcelain-enamels, and glass; as a flux in emery-wheel binders; as a component in certain cements; and as a major component in crucibles used for the melting of uranium for nuclear applications. Exhibits **fluorescence**, from which its name comes. Also called **fluor**, **blue John** and in North America, **fluorite**. Mp 1,350 °C; density 3,200 kg m^{-3} ; hardness (Mohs) 4.

fluortaelinite. *Noun.* See **fluorhectorite**.

fluosilicate. *Plural noun.* Any salt of **fluosilicic acid**. Used as a source of silica and fluorine; barium and **zinc fluosilicate** are used as cement hardeners.

fluosilicic acid. *Noun.* H_2SiF_6 . A colourless liquid used to **etch** glass.

flush tank. *Noun.* A ceramic container designed to supply water to a sanitary water closet.

flushwork. *Noun.* A decorative technique used on outside walls whereby split **flints** showing their black surface are combined with dressed stone to develop tracery etc.

flute. *Noun.* (1) A tall narrow wine glass. (2) A rounded, shallow concave groove on a **pilaster** or **column**.

fluted. *Adjective.* Having flutes, particularly applies to a column.

fluter. *Noun.* (1) A tool used to make **flutes**. (2) A craftsman who makes **fluting**.

fluting. *Verb.* (1) To use a fluting machine to form grooves parallel to the axis of taps and drills. (2) *Noun.* A form of surface decoration consisting of **flutes**.

flux. *Noun.* (1) Any substance such as **borax**, which promotes the fusion and flow of a ceramic or glass mixture when subjected to heat. (2) A clear porcelain-enamel containing no colouring oxide; used in **artware**. Also known as **fondant**. (3) The rate of flow or emanation of radiation from a given source passing through an area of 1 m^2 .

flux block. *Noun.* Refractory shapes used in glass-melting tanks in areas of contact with molten glass.

flux density, magnetic. *Noun.* See **magnetic flux density**.

flux factor. *Noun.* A factor evaluating the quality of silica refractories used in steel manufacture; calculated as the percentage of **alumina** in the brick plus twice the percentage of alkalis. The flux factor of first quality, type-A, brick must not exceed 0.50.

fluxing. *Verb.* The fusion or melting of a substance resulting from the combined influence of chemical reaction and heat.

fluxing agent. *Noun.* Any substance, such as **lead oxide**, **borax** and **lime**, which will promote fusion of ceramic materials.

flux jumping. *Noun.* If a superconductor is present in a transverse magnetic field, currents are generated in the conductor, which then act to shield the bulk of the conductor from the external magnetic field. These currents run a short way along one side of the conductor and then return on the opposite side of the conductor. Hence, the current being carried by the superconductor is increased in one direction and decreased in the other. Because of this the conductor can become resistive and dissipate heat in a transverse direction which results in the magnet being discharged into the resistive portion of the conductor, hence magnetic flux appears to jump.

flux line. *Noun.* (1) The line at the surface of molten glass in a **glass tank** or pot where attack on the refractory lining is most severe. (2) Imaginary magnetic lines indicating the behaviour of a magnetic field.

flux, magnetic leakage. *Noun.* See **magnetic flux leakage**.

flux meter. *Noun.* Any of several types of instrument used to measure magnetic flux with the most common being one that measures current developed in a coil when the flux changes.

fluxoid. *Noun.* A quantum of circulating vortices of current and hence magnetism; one fluxoid = 2×10^{-11} T. Large numbers can exist in superconductors.

flux penetration, magnetic. *Noun.* See **magnetic flux penetration**.

flux pinning. *Noun.* The presence of grain boundaries, impurities, and crystal defects alter the properties of superconducting materials by inhibiting magnetic **domain wall** movement through the material; this is flux pinning and it causes a field gradient which gives rise to a current in the material.

fly. *Noun.* Small fibres released accidentally into the air during processing and forming operations.

fly ash. *Noun.* Fine particles of matter in flue gases, usually resulting from the combustion of fossil fuels; sometimes used as a **pozzolan** or as a filler in some cements. Classified according to its cementitious properties, which arise from its metastable aluminosilicate glass content.

fly ash, class F. *Noun.* See **class F fly ash**.

flying buttress. *Noun.* An arch or part of an arch that supports a masonry wall by transmitting the thrust outwards and downwards.

FMECA. *Abbreviation.* Stands for failure mode, effects and criticality analysis. See **failure mode, effects and criticality analysis**.

foam. *Noun.* (1) A froth or layer of bubbles on the surface of molten glass. (2) A light cellular solid made by developing bubbles in a liquid and cooling it.

foamed clay. *Noun.* Lightweight cellular clay formed by the rapid heating of selected clays to form a bubbled internal structure; used as thermal and acoustic insulation.

foamed concrete. *Noun.* Concrete containing purposefully entrained air or gas bubbles that have been introduced either mechanically or chemically.

foamed glass. *Noun.* Cellular glass of high insulating value, non-combustible, moisture-proof, buoyant, and odourless, produced by adding powdered carbon or other gas forming material to crushed glass and fired in a manner to entrap the evolving gas bubbles; used as insulation for walls, floors, roofing, industrial and domestic equipment and appliances, piping, low-temperature apparatus, etc.

foam line. *Noun.* The line dividing the foam-covered area of a glass-melting tank from the clear area of the tank.

fold. *Noun.* (1) An imperfection on the surface of glassware caused by incorrect glass flow during forming. (2) An abrasive or a tool used for lapping and polishing.

foliate. *Adjective.* (1) Leaf-like. (2) *Verb.* To decorate with flower-like patterns. (3) *Verb trans.* To coat one side of glass with metal foil.

foliated. *Adjective.* Composed of thin, easily separable layers as in **schist**.

foliated crystal. *Noun.* Crystals of **lamella** habit that can be folded, distorted, and contain easily separated layers. **Talc** crystals are an example.

fondant. *Noun.* A clear porcelain-enamel containing no colorants; used in **artware**.

fool's gold. *Noun.* See **orpiment**.

foot. *Noun.* The base of an article.

footboard. *Noun.* A foot-operated lever on the base of a machine, such as a **potter's wheel**.

foot-candle. *Noun.* A former unit of illumination defined as 1 **lumen** per square foot which equals 10.764 **lux**.

foot-lambert, ft-L. *Noun.* An old unit of **luminance** of a surface. A perfectly reflecting surface when illuminated by 1 **foot-candle** has a luminance of 1 foot-lambert.

foot valve. *Noun.* A non-return valve at the inlet end of a pipe.

foraminifera. *Plural noun.* Minutely small marine organisms that secrete **lime**. When they die their shells drop to the bottom of the sea and build-up into **limestone** deposits.

forbidden band. *Noun.* A range of electron energy levels between the top of the **valence band** and the bottom of the **conduction band**. Sometimes called the **band gap**, which in silicon, a semiconductor, is 1.15 eV wide and in diamond, an insulator, is 5.4 eV.

forbidden transition. *Noun.* An energy level transition in an atom that is not allowed by the selection rules in terms of the change of **quantum number** involved.

force. *Noun.* (1) An influence which tends to cause motion or a change in motion. (2) A load applied in a mechanical test. (3) *Verb.* To apply an influence that changes motion etc.

force, coercive. *Noun.* See **coercive force**.

forced chemical vapour infiltration. *Noun.* A method for preparing ceramic-matrix-ceramic fibre-reinforced composites where a thermal and pressure gradient is used to force the reaction. Greatly enhanced production rates can be achieved, e.g., 2.5 cm wall thickness in 24 h.

forced draft. *Noun.* Air under positive pressure produced by fans at the entrance to a furnace or combustion chamber.

Forchheimer equation. *Noun.* See **Forchheimer number**.

Forchheimer number, F_o . *Noun.* A dimensionless parameter used in quantifying the permeability of porous systems. It is defined as: $F_o = \rho V / [\mu (k_1/k_2)]$, where ρ is the fluid density, V is the fluid velocity, μ is the fluid viscosity, k_1 is the **Darcian permeability**, and k_2 is a constant in the Forchheimer equation: $\Delta P/L = \mu V/k_1 + \rho V^2/k_2$. This equation is a development of **Darcy's Law** to deal with higher flow velocities through porous media.

Ford cup. *Noun.* A **viscometer** in which the time required for a measured quantity of liquid or slurry to flow through an orifice of specified size is taken as an indication of the flow characteristics of the material.

forehearth. *Noun.* The section of a furnace from which molten glass is taken for forming.

forest glass. *Noun.* A glass with poor weather resistance; more soluble than **soda glass**. Made from **potash** from the LeBlanc process or the impure residues from that process.

forgeability. *Noun.* The ability of a material to flow under a compressive load without failure.

forging. *Verb.* To plastically deforming materials into shape with compressive force. For ceramics it is accomplished at high temperature with samples of uniform very small grain size.

fork. *Noun.* An apparatus consisting of two or more prongs which may be raised or lowered, and which is employed to charge and to remove ware from a **box furnace**.

forklift truck. *Noun.* A machine equipped with two or more parallel prongs which can be raised or lowered, and which may be inserted under stacked materials for transport.

form grinding. *Verb.* To shape a product by use of an abrasive wheel contoured to the reverse shape of the desired form.

forming. *Verb.* To shape or mould molten glass, plastic ceramics, or powders by the application of pressure, by casting, by hand shaping, or by other means.

forming, explosive. *Noun.* See **explosive forming**.

forming hood. *Noun.* The chamber of the forming equipment in which glass fibres are formed and collected.

forming rolls. *Noun.* Rolls employed in the forming of flat glass.

form oil. *Noun.* A material applied to the surface of moulds and forms to prevent concrete from sticking.

formula. *Noun.* A recipe of ingredients used in the preparation of a desired composition expressed in fixed proportions.

forsterite. *Noun.* Mg_2SiO_4 . A **discrete ionic silicate**. A white to green coloured mineral of the **olivine** group. Used in electronic ceramics, ceramic-metal seals, refractories, and cements because of its high thermal expansion and low-loss dielectric properties. Density $3,210 \text{ kg m}^{-3}$.

forsterite porcelain. *Noun.* A vitreous ceramic in which **forsterite**, Mg_2SiO_4 , is the major crystalline phase.

forsterite whiteware. *Noun.* Any ceramic whiteware in which **forsterite**, Mg_2SiO_4 , is the major crystalline phase.

forward bias. *Noun.* The conducting bias for a **p-n junction rectifier** whereby the electron movement is to the n-side of the junction.

fossil fuel. *Noun.* Any natural hydrocarbon, such as coal, petroleum, or gas, which may be used for fuel.

fotoceram. *Trade name, noun.* A photosensitive glass-ceramic in which metallic Au or Ag particles are nucleated via an optical sensitizer, Ce^{3+} , and then on which **lithium metasilicate** nucleates when heated. This metastable crystalline phase is much more easily etched by HF than the parent glass allowing an irradiated pattern to be selectively etched. A final heat

treatment after flood uv exposure results in stable Li_2SiO_3 crystals being produced to give the object strength. Resolution of $5 \mu\text{m}$ is possible.

Foucault current. *Noun.* See **eddy current**.

fouling. *Verb.* An undesirable process in which the surface of a material or structure becomes encrusted with material from the surrounding environment.

foundation layer. *Noun.* The bottom level of concrete added to act as foundation for other layers culminating in the **wearing layer**. See **foundation seal**.

foundation seal. *Noun.* A sand slab, or a slab of concrete, placed at the bottom of a wet excavation to serve as a seal to facilitate subsequent work.

founder's ague. *Noun.* See **zinc shakes**.

foundry. *Noun.* A building or structure in which glass and metal castings are produced.

foundry clay. *Noun.* A **refractory fireclay**.

foundry engineering. *Noun.* The science and practice of melting and casting glass and metal.

foundry gravel. *Noun.* A term applied to coarser grades of moulding sand.

foundry sand. *Noun.* Sand used to make moulds for metal castings; characterised by refractoriness, cohesiveness, and durability.

Fourcault process. *Noun.* A procedure for making flat glass in which the molten glass is drawn upward from a melting tank in ribbon form through a slotted refractory block, rolled flat, annealed, and then cut to the desired size and shape.

Fourier analysis. *Noun.* The mathematical method in which a complex wave is decomposed into several simple ones by representing it as a sum of a number of sine and cosine functions.

Fourier equation. *Noun.* An experimentally based equation dealing with heat conduction. It has the form: $J_Q = -\kappa dT/dz$, where J_Q = two direction heat flux in W m^{-2} , dT/dz = the temperature gradient, K m^{-1} , and κ is the thermal conductivity, $\text{W m}^{-1} \text{K}^{-1}$. The thermal conductivity is a second order tensor and so it may be directionally dependent. This relation defines the thermal conductivity and is determined by using the **Guarded Hot Plate Method** of measurement as described in ASTM C177.

Fourier transform infrared spectroscopy. FTIS. *Noun.* A technique where all infrared wavelengths simultaneously irradiate the sample for a short time and the absorption spectrum is found by **Fourier analysis**.

four level laser. *Noun.* Ceramics where two intermediate energy levels between the ground state, E_0 , and the pumped state, E_2 , are responsible for laser action. Efficient and capable of continuous operation; **YAG**,

CaWO_4 or glass with Nd^{3+} being the common dopant are good examples.

fractal. *Noun.* (1) A mathematical concept permitting a quantitative description of **aggregate** structures. Introduced in 1970 by Mandelbrot. A fractal is a **rugose** object whose rugosities show up at all scales of observation so that its surface, or outline, cannot be defined by tangent planes or tangents to a smooth curve. (2) A figure or surface generated by successive subdivisions of a simple polyhedron or polygon by a pre-defined iterative process.

fractal dimension. D. *Noun.* A number, not necessarily an integer, which quantitatively measures the **rugosity** of an object. It is obtained by trying to cover all the material of the object with the minimum number of overlapping spheres of a given diameter, l . This operation is repeated using smaller spheres and noting how the minimum number, N , varies with their diameter when l tends to zero. The equation is $N_l = l^{-D}$, where D is the fractal dimension. For a straight line $D=1$ while a smoothly curved surface has $D=2$. Sometimes called the similarity exponent since it shows how the mass of an **aggregate** or body changes after a change of scale; if all lengths are multiplied by λ , then masses are multiplied by λ^D . For a **rugose** structure, like a particle aggregate, D is about 1.25. Another definition is given in terms of the number of parts of the object generated, N , and the similarity ratio, $1/r$, used to divide the initiator: $D = -\log N / \log (1/r)$.

fraction. *Noun.* A sample of powder in which the grains lie between two stated particle sizes.

fractionation, elastic. *Noun.* See **elastic fractionation**.

fractography. *Noun.* The study of fracture surfaces by microscopic methods.

fracture. *Noun.* (1) A crack caused by mechanical failure due to stress. (2) Irregular breakage of a mineral to give no observable cleavage planes. (3) To stress an object or material until it breaks.

fracture, conchoidal. *Noun.* See **conchoidal fracture**.

fracture ductility. *Noun.* True plastic strain at the point of fracture.

fracture initiation parameter. R. *Noun.* One of the **thermal resistance parameters** determined experimentally from the equation: $R = \sigma / E\alpha$, where σ is the tensile fracture strength, E is **Young's modulus** and α is the **thermal expansion coefficient**. The MOR is often used instead of σ .

fracture mechanics. *Noun.* The science of the interaction of defects, strength, and toughness.

fracture, spontaneous. *Noun.* See **spontaneous spalling**.

fracture strength. *Noun.* Tensile load at the start of fracture divided by the original cross-sectional area of the specimen. Also called the **fracture stress**.

fracture stress. *Noun.* See **fracture strength**.

fracture, thermal-shock. *Noun.* See **thermal-shock failure**.

fracture toughness. K_{Ic} . *Noun.* The resistance materials show to the extension of cracks in their body; quantified through the **stress intensity parameter K_{Ic}** . See **plane strain fracture toughness**.

fracture wear. *Noun.* The wear of the grains of a grinding wheel due to fracture.

fragile. *Adjective.* (1) Able to be broken easily. (2) In a weakened physical state. (3) A tendency for a glass to crystallise on being processed.

fragility. *Noun.* (1) The property of being easily broken. (2) A term used to differentiate rapid glass formers, such as polymers, from slow glass formers like silica and window glass. Glass transitions occur over long time scales and how rapidly the time scale increases as the material is cooled determines the fragility. It correlates with the number of possible structural arrangements that can occur on cooling through the **glass transition temperature** and so correlates with a ceramics **heat capacity**.

fragility parameter. *Noun.* An index developed to predict the tendency of a glass to **devitrify** while being worked. It is defined as **glass transition temperature** divided by the **Kauzmann temperature**, T_g/T_k .

fragmental. *Adjective.* Having a structure made-up of fragments of pre-formed rocks or minerals.

fragmented bort. *Noun.* See **bort**.

FRAM. *Acronym.* Stands for ferroelectric random access memory. See **ferroelectric random access memory**.

framoboidal. *Adjective.* Raspberry-shaped spheres; characteristic mineralogical morphology of **pyrite**, FeS_2 .

framework silicate. *Noun.* Ceramics that contain $[\text{SiO}_4]^{4-}$ tetrahedra sharing all four oxygen atoms with adjacent tetrahedra. The result is a framework extending in three-dimension. When some Si atoms are substituted by Al, other metals have to enter the structure as charge-balancing cation; these ceramics are the **aluminosilicates**.

frangible. *Adjective.* Breakable or fragile.

frangibility. *Noun.* The density of fracture fragments when **tempered glass** is fractured by application of a central tension.

Frank-Condon principle. *Noun.* A statement that an electronic transition takes place so fast that a vibrating bond does not change its length appreciably during the transition.

franklinite. *Noun.* $(\text{Fe}, \text{Mn}, \text{Zn})(\text{Fe}, \text{Mn})_2\text{O}_4$. A black, **inverse spinel** mineral containing iron, manganese, and zinc; used as a source of iron and zinc.

Frank partial. *Noun.* A stacking fault in a crystal produced by the condensation of vacancies or interstitial atoms.

Frank-Read source. *Noun.* A theoretical rationalisation of the observation that **dislocation** densities increase when a crystal is heavily deformed. Dislocation lines bow out as they are pinned at two or more points in the **slip plane** and eventually they wrap themselves around the pinning obstacles to form a dislocation loop in the slip plane. The process is then repeated. A critical stress is needed because the initially straight dislocation line has to be bent to a semicircle before it can expand outward.

Fraunhofer diffraction. *Noun.* Diffraction of parallel light beams by parallel slits.

freak. *Noun.* A bottle so badly deformed it will not pass through a filling line.

free blown. *Noun.* Blown glassware formed by hand without the use of a mould.

free body. *Noun.* A device used for theoretical consideration of the stresses in a material, it is an element of structure removed from contact with all others for the purposes of calculation.

free carbon. *Noun.* Elemental carbon present in an uncombined state in a composition or body.

free crushing. *Noun.* The process of crushing friable materials in a manner that the fines separate from the coarse particles and thereby avoid further grinding.

free electron. *Noun.* An electron that has been given sufficient energy to excite it in to the conduction band for semiconductors and insulators, or otherwise above the **Fermi level** energy, which can then be involved in conduction processes.

free electron laser. FEL. *Noun.* A device halfway between a laser and particle accelerator that is capable of producing tuneable high-energy infrared radiation. It consists of a focused beam of electrons of high energy in a vacuum chamber that is stimulated to emit photons by interaction with a static magnetic field arranged to make the electron beam wiggle in the plane perpendicular to the magnetic field.

free energy. *Noun.* A thermodynamic property that expresses the capacity of a system to do work under specified conditions. It is a function of both the **internal energy** and **entropy** of the system. At equilibrium, the free energy is at a minimum. See **Gibbs function**, **Helmholtz function**.

free energy of mixing. *Noun.* The change in the **free energy** that occurs when x moles of A, y moles of B etc., are combined to form one mole of solution.

free enthalpy. *Noun.* See **Gibbs function**.

freehand grinding. *Noun.* The process of grinding an item to shape by hand without the use of guides.

free magnetism. *Noun.* An imaginary magnetic fluid to which the magnetic effects of a magnet are ascribed.

free moisture. *Noun.* The quantity of uncombined water in a body or composition that can be removed by conventional drying.

free relative permittivity. E_{33}/E_0 . *Noun.* The **impedance** parallel to the field direction at frequencies away from the **electromechanical resonance** in a **piezoelectric ceramic**.

free silica. *Noun.* (1) SiO_2 present in natural deposits of clay-type minerals as one of the several **polymorphic** forms of silica. (2) Silica in clay or glazes that remains chemically uncombined with other elements of the composition.

freestone. *Noun.* Fine-grained stone, particularly **limestone** and **sandstone** that can be cut in any direction without breaking.

free water. *Noun.* See **mechanical water**.

freeze. *Noun.* The premature setting of a concrete in a pump, drill rod, etc., before it can be placed in its intended site.

freeze-drying. *Noun.* A method used to separate solids from suspension, or salts from solution, which minimises **agglomeration** of the powder. The suspension is rapidly frozen and then ice or solid solvent is removed by sublimation pumping.

freeze-thaw test. *Noun.* An accelerated test to indicate the resistance of brick, concrete, and similar products used in construction to cycles of freezing and thawing such as may be encountered in service.

freezing mixture. *Noun.* A mixture of two or more substances that absorbs heat when they mix and so causes a temperature drop.

freezing point. *Noun.* The temperature at which a liquid becomes a solid.

French chalk. *Noun.* A very compact form of **talc** used in graphics.

French (hexagonal) roofing. *Noun.* Asbestos-cement roofing chipped at three corners and laid with the diagonals perpendicular to the eaves to form an hexagonal pattern.

Frenkel defect. *Noun.* See **Frenkel pair**.

Frenkel pair. *Noun.* A type of defect found in the solid state consisting of a vacant atom or ion site and the displaced atom or ion in an interstitial site nearby. Often found in ion-bombarded materials.

frequency. *Noun.* The velocity of light divided by the wavelength; thus it is the number of vibrations per second; units are hertz per second, Hz s⁻¹.

frequency band. *Noun.* A continuous range of frequencies between two set limits; particularly significant in the radio spectrum.

frequency doubling. *Noun.* See **non-linear optical materials**. Also called **second harmonic generation**.

frequency mixing. *Noun.* A phenomenon encountered when laser light passes through crystals lacking a centre of symmetry. **Polarisation** gives rise to two output waves of frequency $\omega_1 \pm \omega_2$.

frequency up-conversion. *Noun.* A method of absorbing infrared frequencies and re-emitting them via a **phosphor** as visible light. For example a Y₂O₃/Eu³⁺ phosphor in a host glass where a long wavelength photon is absorbed by the Yb³⁺ and this is immediately transferred to a nearby Eu³⁺ but before it can emit the process repeats. The doubly excited ion returns to the ground state by releasing a photon in the green region, 0.55 µm. Also known as **anti-Stokes fluorescence** or **cooperative luminescence**.

fresco. *Noun.* (1) The process of decoration in which slurries of pigment and a suitable binder are applied on a previously dried but wetted plaster wall. (2) A durable method of wall decoration where watercolours are applied to wet plaster. (3) Painting done in the way described in (2).

fresh concrete. *Noun.* Concrete that has not reached its initial set.

fresnel. *noun.* A unit of **frequency** equal to 10¹² hertz.

Fresnel biprism. *Noun.* A thin double prism used to produce interference and diffraction fringes.

Fresnel diffraction. *Noun.* Diffraction of divergent wave fronts by apertures. Theoretically more complex to interpret than **Fraunhofer diffraction**.

Fresnel's law. *Noun.* The law governing reflection at an interface between materials with different refractive indices: $R_r/I_o = (m-1)^2/(m+1)^2$, where R_r is the intensity of reflected light, I_o the intensity of the incident light and m is the relative refractive index of the materials on either side of the interface which is given by n_1/n_2 .

fresnoite. *Noun.* Ba₂TiSi₂O₈. A mineral silicate in which the titanium enters the silica network forming Ti-O-Si linkages.

FRET. *Acronym.* Stands for fluorescence resonance energy transfer. See **fluorescence resonance energy transfer**.

fret. *Verb trans.* (1) To decorate a ceiling with embossed or carved patterns. (2) To rub or wear away. (3) To make

by wearing away. (4) To remove by chemical action. *Noun.* (5) A groove or hole caused by fretting. (6) A repetitive geometrical figure on an ornamental border, especially one in relief.

fretted. *Adjective.* Ornamented with angular designs.

fretting. *Verb trans.* Wear occurring because of surfaces oscillating against each other.

fretwork. *Noun.* A decoration of geometrical carving or added relief.

Freundlich isotherm. *Noun.* An equation that relates the volume of gas adsorbed on a surface at a given temperature to the pressure of the gas: $x/M = kp^{1/n}$, where x is the quantity adsorbed, M is the amount of adsorbent, p is the partial pressure of the gas, and k and n are constants.

friability. *Adjective.* The ease with which a material may be broken or pulverised.

friable alumina. *Noun.* **Alumina** that is more easily fractured than normal alumina and less friable than white alumina. Medium purity.

friction. *Noun.* The resistance produced when one body moves against another body.

friction constraint. *Noun.* A force-resisting deformation in a fibre composite arising from the multitude of fibre-fibre contacts.

friction force microscopy. *Noun.* A variation of the **atomic force** or **scanning probe microscope**. It measures friction in the smallest sliding contacts between a cantilever with an atomically sharp tip made of Si, Si₃N₄ or tungsten, typically 400 µm long and 2 µm thick. A light spot detects bending or twisting of the cantilever. Frictional resistance to the sliding from atom to atom is detected and used to develop a picture.

friction spinning. *Verb.* To spin a **yarn** by using the external surface of two rotating rollers to collect and twist individual fibres. The rollers are usually perforated so that air can be drawn through for fibre collection. The **nip** of the rollers causes the twist.

Friedel salt. *Noun.* Ca₂Al(OH)₆Cl·2H₂O. Calcium chloroaluminate hydrate formed when **OPC** is hydrated in the presence of chloride ions but it also occurs when normally hydrated OPC in set concrete is corroded by brine.

frieze. *Noun.* (1) An ornamental strip or band on a wall. (2) The horizontal band between the **architrave** and **cornice** of a classical **entablature**.

fringe. *Noun.* (1) The exterior rim of secondary crystallisation that forms on some **stones** in glass manufacture. (2) Any of the black, white or coloured bands produced by the interference or diffraction of light.

frisket. *Noun.* A mask or stencil used to protect an area of ware from a subsequent application of glaze or slip.

frit or fritt. *Noun.* (1) A glass that has been melted and quenched in water or air to form small friable particles, which are then processed by milling for use as a major constituent of porcelain-enamels, **fritted glazes**, and **frit chinaware**. (2) A glassy substance used in making soft paste porcelain. Occasionally spelled as **fritt**.

frit china. *Noun.* A thin, highly translucent whiteware of zero **water absorption** composed of a body containing substantial amounts of **frit**, and coated with a soft glaze.

frit, clear. *Noun.* See **clear frit**.

frit, coloured. *Noun.* See **coloured frit**.

frit seal. *Noun.* A hermetic seal for ceramic packages of integrated circuits produced by fusing metal and glass powders.

fritted glass. *Noun.* Glass of controlled porosity formed by sintering powdered glass.

fritted glaze. *Noun.* A glaze in which part or all of the fluxing ingredients have been fused or quenched to form small friable particles before incorporation into the glaze slip.

fritting. *Noun.* The process of melting and quenching glassy or molten materials to form small, friable particles.

fritting voltage. *Noun.* The voltage at which an electric breakdown occurs between two mating contacts separated by an insulating film.

FRM. *Abbreviation.* Stands for fibre reinforced metals.

frog. *Noun.* A depression on one or both larger faces of a brick or block; so designed to reduce weight and to facilitate the keying in of mortar. It also helps the brick to dry before firing.

front-end coating. *Verb.* The application of a metal oxide surface layer to glass bottle exteriors immediately after forming but before annealing. Volatile materials such as SnCl_4 are used, and the SnO_2 this produces increases the bottle's strength.

frosted. *Adjective.* The surface treatment of glass to produce a frosty appearance or a degree of obscuration, usually by chemical action or light sandblasting.

frost glass, frosted glass. *Noun.* Very thin crushed glass used as a decorative material of tinsel-like appearance when distributed and fused over the surface of a glass article.

frosting. *Noun.* A rough or matte-finish on glass.

frost resistance. *Noun.* See **critical diameter** and **Maage durability factor**.

froth flotation. *Noun.* A materials beneficiation process for finely divided materials in which slurry is caused to foam by the addition of a foaming agent; select particles adhere to the resultant bubbles and are removed with the froth and thus they are separated from the materials remaining in the slurry.

frozen strain. *Noun.* Also known as **residual strain**. Caused when materials are cooled at rates unable to allow stresses from forming operations to be relieved.

FRP. *Abbreviation.* Stands for fibre-reinforced plastics. See **fibre reinforced plastic**.

frustules. *Noun.* Complex three-dimension **silica** nano-materials assembled in nature by single-cell aquatic algae.

FTIR. *Abbreviation.* Stand for Fourier transform infrared spectroscopy. See **Fourier transform infrared spectroscopy**.

fuchsine dye. *Noun.* An aniline dye soluble in alcohol and the solution is used to test the porosity of electrical porcelains and other ceramic bodies.

fuel. *Noun.* A material that is burned to produce useful heat.

fuel-air ratio. *Noun.* The proportions of air and fuel employed in the combustion process.

fuel assembly. *Noun.* Any device containing control materials and special nuclear materials that occupy individually controlled positions in the core of a nuclear reactor, plus structural materials which facilitate assembly of the reactor.

fuel bed. *Noun.* The layer of burning fuel on the floor of a **cupola** or other furnace.

fuel cell. *Noun.* An electrochemical device that directly converts chemical energy into electrical energy with very high efficiencies by removing Carnot cycle limitations. They produce almost no pollutants and vary in scale from mW to hundreds of kW. The different types are classified according to the electrolyte material used in the construction: Proton Exchange Membrane (PEMFC), Molten Carbonate (MCFC), Solid Oxide (SOFC), and Phosphoric Acid (PAFC).

fuel cell module. *Noun.* See **fuel cell stack**.

fuel cell stack. *Noun.* Several **fuel cells** connected in series to provide sufficient voltage to power devices.

fuel element. *Noun.* Cylinders, rods, plates, tubes, or other shapes into which nuclear materials are formed for use in a fission reactor.

fuel gas. *Noun.* Any gaseous material employed to provide heat or power by combustion.

fuel oil. *Noun.* Any oil employed to provide heat or power by combustion.

fuel pin. *Noun.* A nuclear **fuel rod**.

fuel rod. *Noun.* Nuclear fuel pellets, for example uranium dioxide, arranged in long cylinders in excess of 1 m often made from zirconium or niobium with surrounding flowing water channels.

fuel, spent. *Noun.* See **spent fuel**.

fugacity. *Noun.* A thermodynamic expression used to describe the tendency of a gas to expand. It is stated as $d(\ln f) = d\mu/RT$, where μ is the **chemical potential**, R is the **gas constant**, and T is the **thermodynamic temperature**.

fugitive material. *Noun.* A material, usually organic, added to a composition to aid **green forming**, weaving, or sewing, that is later burned out in the air or pyrolysed in vacuum in a carefully programmed way prior to the final high temperature forming process.

Fulcher equation. *Noun.* Empirical in derivation, it relates glass viscosity to temperature: $\log \eta = -A + B/(T - T_0)$, where the temperature T is in $^{\circ}\text{C}$, and A , B , and T_0 are material-specific constants.

fulgurite. *Noun.* A glassy mineral found in sand and rock formed by lightning strikes, hence the name from Latin for lightning, fulgur.

fuliginous. *Adjective.* Sooty, smokey, of the colour of soot. Dull greyish-black soot colour.

fullerene. *Abbreviation, noun.* The abbreviation is for Buckminster Fullerene. A third form of carbon, in addition to diamond and graphite, with a polyhedral molecular structure consisting of closed cages; C_{60} or C_{70} were the first to be discovered and investigated. C_{60} is a mustard-coloured solid dissolving in hydrocarbons to give a magenta coloured solution. C_{70} is a red-brown solid giving a deep red coloured solution. The C_{60} or C_{70} units are packed in the solid about 1.04 nm apart and in the case of C_{60} form an **fcc lattice**. See **buckminster fullerene**, **buckyballs**, and **buckytubes**.

fulleride. *Noun.* A compound formed when atoms or ions are trapped in the **fullerene** cage molecules.

fuller's earth. *Noun.* A non-plastic clay-like material, composed largely of **attapulgit** with some **montmorillonite**, having high natural absorptive power and used after heating to decolourise oils and fats.

fullerite. *Noun.* Crystalline form of **fullerene**.

full lead crystal glass. *Noun.* A form of domestic tableware of carefully controlled composition as specified in BS 3828: PbO (33.0 %), SiO_2 (55.5), K_2O (11.0), and Fe_2O_3 (0.05). Made principally by mouth blowing involving a **chair** of glassmakers.

full radiator. *Noun.* See **black body**.

full-trimmed mica. *Noun.* **Mica** with all cracks and cross grains or reeves removed from all sides by trimming.

fulminating powder. *Noun.* Powder that detonates by percussion.

fumed silica. *Noun.* Ultrafine, ultrapure SiO_2 made by passing silicon tetrachloride through an oxy-hydrogen flame. Particle sizes, before aggregation, are in the range 7–50 nm.

funk. *Noun.* A form of pottery with lively or odd design adhering to no rules of design.

furcate. *Verb.* To fork; divide into two parts.

furcated. *Adjective.* forked, branched.

furnace. *Noun.* An enclosed structure in which elevated temperatures are produced for the firing of ware to obtain desired physical and chemical changes in the ware.

furnace, acid-refractory. *Noun.* See **acid-refractory furnace**.

furnace, arc-image. *Noun.* See **arc-image furnace**.

furnace, basic open-hearth. *Noun.* See **basic open-hearth furnace**.

furnace, box. *Noun.* See **box furnace**.

furnace comeback. *Noun.* The time taken for a furnace or kiln to return to its set temperature after a charge of cold ware has been placed in it.

furnace, continuous. *Noun.* See **continuous furnace**.

furnace, cross-fired. *Noun.* See **cross-fired furnace**.

furnace, direct-fired. *Noun.* See **direct-fired furnace**.

furnace, end-fired. *Noun.* See **end-fired furnace**.

furnace, end-port. *Noun.* See **end-port furnace**.

furnace, hairpin. *Noun.* See **hairpin furnace**.

furnace, Hermansen. *Noun.* See **Hermansen furnace**.

furnace, Herreshoff. *Noun.* See **Herreshoff furnace**.

furnace, high-frequency induction. *Noun.* See **high-frequency induction furnace**.

furnace, image. *Noun.* See **image furnace**.

furnace inclusions. *Plural noun.* A defect in glass arising from foreign bodies in the furnace other than **stone** or **black speck**.

furnace, indirect arc. *Noun.* See **indirect arc furnace**.

furnace, induction. *Noun.* See **induction furnace**.

furnace, Kryptol. *Noun.* See **Kryptol furnace**.

furnace lining. *Noun.* The exposed interior of a furnace, kiln, or smelter that is constructed of high-temperature-resistant, chemical-resistant, and abrasion-resistant refractory materials.

furnace, low-frequency induction. *Noun.* See **low-frequency induction furnace**.

furnace, low-shaft. *Noun.* See **low-shaft furnace**.

furnace, luminous-wall. *Noun.* See **luminous-wall firing**.

furnace, open-arc. *Noun.* See **open-arc furnace**.

furnace, periodic. *Noun.* See **periodic furnace**.

furnace, pot. *Noun.* See **pot furnace**.

furnace, radiant-tube. *Noun.* See **radiant-tube furnace**.

furnace, recuperative. *Noun.* See **recuperative furnace**.

furnace, regenerative. *Noun.* See **regenerative furnace**.

furnace, resistance. *Noun.* See **resistance furnace**.

furnace, reverberatory. *Noun.* See **reverberatory furnace**.

furnace, rocking. *Noun.* See **rocking furnace**.

furnace sand. *Noun.* A relatively pure, coarse type of sand used as a refractory material for hearths and for foundry moulds.

furnace, semi-muffle. *Noun.* See **semi-muffle furnace**.

furnace, side-fired. *Noun.* See **side-fired furnace**.

furnace, side-port. *Noun.* See **side-port furnace**.

furnace, solar. *Noun.* See **solar furnace**.

furnace, tank. *Noun.* See **tank furnace**.

furnace, thermal gradient. *Noun.* See **thermal gradient furnace**.

furnace, U-type. *Noun.* See **hairpin furnace**.

furnace, vacuum. *Noun.* See **vacuum furnace**.

furniture, kiln. *Noun.* See **kiln furniture**.

furring. *Noun.* (1) Wood or metal strips applied to the wall or ceiling of a building to level the surface, to provide a means of attaching plasterboard to the wall, and to permit an air space between the plasterboard and the wall structure. (2) The bristling of magnetic particles due to excessive magnetisation, resulting in a fuzzy appearance. (3) Wall deposits in boilers using hard water.

furring brick. *Noun.* A type of hollow brick that has been grooved to receive and retain a coating of plaster in the construction of walls.

furring tile. *Noun.* A non-load-bearing tile used as an unexposed lining in interior walls, sometimes made with a furrowed or grooved face to receive and retain a coating of plaster.

fusain. *Noun.* A dull black brittle form of carbon resembling **charcoal** found in some **coals**. See **inertinite**.

fuse. *Verb.* To melt or join by the use of heat.

fused alumina. *Noun.* A form of alumina produced by heating a mixture of **calcined bauxite** or Al_2O_3 and iron borings to a temperature in excess of $3,600^\circ\text{C}$ in an electric arc furnace; used in applications where high resistance to abrasion is required, such as in bearings, spindles, etc. Addition of TiO_2 increases the toughness.

fused-grain refractories. *Plural noun.* Refractories made predominantly from refractory substances that have solidified from a fused or molten condition.

fused quartz. *Noun.* A pure silica glass made by melting crushed crystals of natural quartz or silica sand; used in apparatus and equipment requiring materials having low thermal expansion, high melting point, high chemical resistance, and high transparency. Also known as **silica glass**.

fused refractories. *Plural noun.* Cast or moulded refractory shapes which have been formed from molten refractory compositions. Also known as **fusion-formed** or **fusion-cast refractories**.

fused silica. *Noun.* A transparent or translucent glass consisting almost entirely of silica formed by the flame hydrolysis of silicon tetrachloride.

fused-silica refractory. *Noun.* A refractory product composed essentially or entirely of fused, noncrystalline silica.

fusible, fusibility. *Adjective, adverb.* Capable of being softened or melted by heat.

fusible clay. *Noun.* Clay that will vitrify and lose its shape at temperatures of $1,200^\circ\text{C}$ or lower.

fusion. *Verb.* (1) The process of melting, frequently with interaction of two or more materials, to form a more or less homogeneous mass. (2) Joining by the use of heat.

fusion-cast basalt. *Noun.* A hard, crush-resistant, and abrasion-resistant product made by casting molten **basalt** into the desired shape; used as flooring and lining material in areas subjected to severe abrasion.

fusion casting. *Verb.* To form items by casting molten material in a mould followed by controlled cooling to improve their crystallinity.

fusion-cast refractory. *Noun.* A refractory product made by casting molten refractory ingredients in a mould.

fusion flow. *Noun.* The property of a material, such as a glass, frit, or metal, to flow while in the molten state.

fusion-flow test. *Noun.* Any test which will measure or compare the flow characteristics of a material or materials under the influence of heat, such as by heating uniform pellets of a glass or frit on a panel for a period sufficient to cause softening, and then raising the panel to a vertical position to permit the molten pellets to flow down the vertical surface.

fusion, heat of. *Noun.* See **heat of fusion**.

fusion joint. *Noun.* The line at which the surfaces between two solids are joined together by the use of heat.

fusion point. *Noun.* The temperature or range of temperatures at which melting or softening of a composition will occur.

fusion test. *Noun.* Any test to determine the temperature or range of temperatures at which fusion takes place, or to determine the flow or other properties of a material at fusion temperatures.

fustule. *Noun.* The siliceous shell of a **diatom**.

fuzz. *Noun.* Short broken fibre filaments aggregated together and formed when fibres, yarns, etc., are pulled over contact points. The mass of the fuzz is an indication of the ceramic fibre **abrasion resistance**.

fuzz balls. *Plural noun.* A defect consisting of agglomerates of whisker crystals formed during the mixing of matrix powder, whiskers, and suspension agents, in whisker-reinforced ceramic composites.

fuzzy texture. *Noun.* An indistinct or fuzzy-appearing imperfection occurring on porcelain-enamelled ware due to the presence of minute closed and broken bubbles, dimples, and the like, at the surface.

- g.** *Symbol.* Standing for: (1) gallon(s); (2) gram(s); free fall acceleration due to gravity; (4) **grav**.
- G.** *Symbol.* Used to denote: (1) **shear modulus**; (2) **Gibbs free energy**; (3) **gravitational constant**; (4) **gauss**; (5) **conductance**.
- G-II glass.** *Noun.* A high- K_2O -content borosilicate glass that also contains zinc oxide; composition in wt. % is: SiO_2 (58.5), B_2O_3 (22.0), Al_2O_3 (2.0), ZnO (2.7), and K_2O (14.7).
- GAASP.** *Acronym.* Standing for the semiconductor phase **gallium arsenide phosphide**.
- gab.** *Noun.* A prong or toothed part designed to engage periodically with a slotted link or rod in a mechanical train.
- gabbro.** *Noun.* A dark coloured coarse-grained basic plutonic igneous rock containing **plagioclase feldspar**, **pyroxene**, and **olivine**.
- gable.** *Noun.* (1) The triangular wall section at the ends of a pitched roof, bounded by two roof slopes and the ridgepole. (2) The triangular wall on both ends of a **gambrel roof**. (3) A triangular ornamental feature.
- gable end.** *Noun.* The end wall of a building on the side that is topped by a **gable**.
- gable roof.** *Noun.* A pitched roof that ends in a **gable**.
- gabled.** *Noun.* A small **gable**.
- gable tile.** *Noun.* A roofing tile having the same length, but 1.5 times the width of the tile used elsewhere on the roof, used to complete the alternate courses of the gable of a tiled roof.
- gable wall.** *Noun.* (1) The wall of the charging end of a glass-melting furnace. (2) A wall crowned by a **gable**.
- gable window.** *Noun.* A window in a **gable** or having a **gable** over it.
- gadget.** *Noun.* An instrument to hold the foot of a glass during hand finishing of the bowl.
- gaddinite.** *Noun.* A mineral with useful **rare earth** content.
- gadolinia.** *Noun.* See **gadolinium oxide**.
- gadolinite.** *Noun.* See **ytterbite**.
- gadolinium aluminium perovskite. GAP.** *Noun.* $GdAlO_3$. A high temperature ceramic that is able to form a directionally solidified **eutectic** with **alumina** and produce a **composite** of high strength and ductility at high temperature.
- gadolinium ferrate.** *Noun.* $Gd_3Fe_5O_{12}$. A **ferromagnetic** ceramic with the **bixbyite**-type structure; **Curie temperature** 564 K.
- gadolinium gallium garnet. GGG.** *Noun.* $Gd_3Ga_3O_{12}$. A magnetic ceramic capable of having a microstructure containing **magnetic bubble** domains to provide memory chips for computer hardware. See **garnet**.
- gadolinium oxide.** *Noun.* Gd_2O_3 . A **rare earth** or lanthanide oxide. Used in special glasses, ceramic dielectrics, neutron shields, and **phosphor activators**. Mp 2,330 °C; density 7,410 kg m⁻³; hardness (**Knoop**) 4.77 GN m⁻². Old name is **gadolinia**.
- gadolinium zirconate.** *Noun.* (1) Gd_2ZrO_4 . A recently developed **thermal barrier coating** able to protect metal in very hot parts of jet engines from the effects of ingested ash, such as that emitted by volcanoes. (2) $Gd_2Zr_2O_7$. A **pyrochlore** structure material. Resistant to amorphisation by internal damage from α -particles and so it is a potential host ceramic to store plutonium waste by partial replacement of Gd and Zr by Pu.
- gaffer.** *Noun.* The head workman, foreman, or blower in a hand glass factory.
- gahnite.** *Noun.* $ZnAl_2O_4$. A **spinel**-type oxide sometimes used in refractories. Mp 1,950 °C.

gain. *Noun.* Another word for amplification in electronics. It is the ratio of the output signal to the input signal of an amplifier, usually measured in **decibels**.

gaize cement. *Noun.* A cement consisting of a finely ground mixture of a **pozzolanic** material and hydrated lime or a mixture of finely ground pozzolanic material and **Portland cement**.

gal. *Noun.* A unit of acceleration equal to 1 cm s^{-2} .

gal. *Abbreviation.* Stands for gallon.

galaxite. *Noun.* MnAl_2O_4 . A **spinel** that plays an important part in bonding molybdenum metallised layers to alumina prior to making metal- Al_2O_3 seals.

galena. *Noun.* PbS . Lead ore. A soft lead sulphide ore used in the glazing of pottery as a flux substitute for **lead oxide**. Density $7,400\text{--}7,600 \text{ kg m}^{-3}$; hardness (Mohs) 2.5.

gall. *Noun.* (1) Molten sulphate floating on the surface of molten glass in a pot or tank. (2) *Verb.* To fret or wear away by friction.

galleting. *Verb.* To fill in fresh mortar joints and to level roofing tile with chips of stone, chips of roofing tile, etc.

galleyware. *Noun.* A synonym for **delftware**, a type of tinglazed ware.

gallipot. *Noun.* A small **earthenware** pot used to store ointments.

gallium. *Noun.* Ga. A metal used in high-temperature thermometers, as a metallic coating for ceramics and backing for optical mirrors, and as a heat exchange medium for nuclear reactors. Mp 30°C ; bp $1,983^\circ\text{C}$; density $5,910 \text{ kg m}^{-3}$.

gallium antimonide. *Noun.* A semiconductor possessing the **zinc blende** structure. Mp 706°C .

gallium arsenide. *Noun.* GaAs . A mainly n-type **semiconductor** with a 1.3 eV band gap within the **zinc blende** structure. Used as a microwave diode, high-temperature resistor, and rectifier. Mp $1,240^\circ\text{C}$.

gallium ferric oxide. *Noun.* GaFe_2O_4 . A **spinel** structured magnetic ceramic below -13°C and **piezoelectric** from room temperature to -195°C . Mp $1,240^\circ\text{C}$.

gallium manganese arsenide. *Noun.* This is a semiconductor made by replacing a proportion of gallium in **gallium arsenide** with manganese that has the unusual property of converting heat into the quantum mechanical property of spin. Hence it is a **thermo-spintronic material**.

gallium nitride. *Noun.* GaN . An alternative semiconductor to silicon with better electron mobility, higher breakdown voltages and good thermal conductivity leads to higher switching efficiencies than **silicon**. Mp 800°C .

gallium phosphate. *Noun.* GaPO_4 . A compound with a **zeolite**-like cage structure that is the basis, when combined with gallium fluoride, GaF_3 , of a range of catalysts.

gallium phosphide. *Noun.* GaP . Used as a wide band-gap, 2.25 eV, semiconductor with significant n and p-type characteristics. Mp $1,350^\circ\text{C}$.

galmei ore. *Noun.* Zinc-containing ore used in an ultrasonic flow leaching process with ammonium salts to extract the zinc.

galvanic. *Adjective.* Of, producing, or concerning an electric current especially a direct current produced chemically.

galvanic action. *Verb.* The generation of direct current electricity by chemical action.

GAMBIT. *Acronym.* Standing for gate-modulated bipolar transistor. See **gate**.

gamma. *Noun.* (1) A unit of magnetic field strength 10^{-5} oersted, which makes 1 gamma equal to 0.7958×10^{-3} amps m^{-1} . (2) Third letter in the Greek alphabet. (3) *Modifier.* (a) relating to one of two or more **allotropes** of crystal structure, for example $\gamma\text{-Fe}$. (b) Of or relating to photons of very high energy.

gamma activity. *Noun.* The spontaneous emission from a nucleus of high-energy, short-wavelength electromagnetic radiation.

gamma-alumina. *Noun.* $\gamma\text{-Al}_2\text{O}_3$. The name given to a number of phases that arise during the thermal decomposition of gelatinous $\text{Al}(\text{OH})_3$ and **boehmite**, $\text{AlO}(\text{OH})$. Believed to be a defect **spinel** stabilised by protons but its fine particle size makes it almost amorphous toward x-rays. Sintering effects a transition to porous $\alpha\text{-Al}_2\text{O}_3$ grains.

gamma radiation. *Noun.* Electromagnetic radiation emitted by some atomic nuclei; wavelength in the range 10^{-10} to 10^{-13} m .

gamma rays. *Noun.* See **gamma radiation**.

gang, draw. *Plural noun.* See **draw gang**.

gangue or gang. *Noun.* A secondary and valueless mineral associated with relatively valuable minerals.

ganister or gannister. *Noun.* (1) Highly refractory siliceous rock found below coal seams; used in the manufacture of refractory brick, particularly for use in metallurgical furnaces. (2) A refractory synthesised from quartz and **fireclay**.

ganister, bastard. *Noun.* See **bastard ganister**

Gannt chart. *Noun.* A chart showing along horizontal lines planned activity in specific times, which are indicated in vertical bands. Named after H Gannt an American management consultant.

GAP. *Acronym.* Stands for gadolinium aluminium perovskite. See **gadolinium aluminium perovskite**.

gap. *Noun.* An unintentional space between two windings in a filament-wound fibre composite.

gap-sized grading. *Verb.* The removal of particles of intermediate size from brick clay to produce bricks of high bulk density.

garden tile. *Noun.* Moulded tile used as stepping stones in gardens or patios.

Gardner mobilometer. *Noun.* An instrument to measure the flow characteristics of porcelain-enamel slips in which the time required for a solid or perforated disk mounted on the bottom end of a weighted plunger to move a specified distance through a cylinder of slip is taken as a measure of the mobility of the slip.

gargoyle. *Noun.* Any grotesque ornament carved in stone and fitted to a building. Often a feature of a waterspout on a gutter.

garnet. *Noun.* $M_3^{2+}M_2^{3+}X_3O_{12}$. Minerals used as abrasives. The commonest X is silicon and so they are mainly a group of mineral silicates in the cubic crystal system. X can also be Al, Fe, or Ti. The M^{2+} ions occupy 8-coordinate dodecahedral sites, M^{3+} ions occupy distorted octahedral sites surrounded by six oxygen atoms, and X has tetrahedral coordination by four oxygen atoms. All oxygen atoms in the structure are shared by four polyhedra, one tetrahedron, one octahedron, and two dodecahedra. Garnet is also a group name for a diverse set of gems, such as the orange or green **grossular garnet** Mohs hardness 6.5–7.5.

garnet abrasive. *Noun.* Fractured grains of **almandite**.

garnet paper. *Noun.* A **sandpaper** having powdered **garnet** as the abrasive.

garnierite. *Noun.* Not a single mineral but a generic name for a green nickel silicate ore formed by **weathering** of **dunite**, **peridotite**, etc. A mixture of nickel, magnesium layer-silicates. A source of nickel.

garspar. *Noun.* A **feldspar** substitute consisting of finely ground quartz and glass produced as a by-product in the grinding and polishing of plate glass.

gas black. *Noun.* A form of finely powdered **pyrolytic carbon** made from burning petroleum gas. Used as a pigment.

gas ceramics. *Plural noun.* Foam glass ceramics generated when B_2O_3 – $(NH_4)_2HPO_4$ – SiO_2 glasses are melted under reducing conditions, cooled, and then re-fired at about 900 °C. The microstructure contains BPO_4 crystals and isolated bubbles of hydrogen gas about 1.0 μm in diameter, which substantially lower the dielectric constant of the product.

gas constant. R. *Noun.* The proportionality constant, R, in the equation of state for an ideal gas: $PV = RT$, where P is the pressure, V is the volume and T is the temperature of 1 mol of gas. $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$. It is the **Boltzmann constant** per mole of atoms. Sometimes called the **universal gas constant**.

gas cooled reactor. *Noun.* A nuclear reactor in which the coolant is a gas. The early models used carbon dioxide as the coolant, graphite as the moderator and uranium as the fuel.

gas discharge tube. *Noun.* A tube in which an electrical discharge takes place through a gas.

gas equation. *Noun.* An equation of state that relates the product of the pressure and volume of 1 mol of a gas to the product of its **thermodynamic temperature** and the **gas constant**. It is only exact for an ideal gas but is a good approximation for a normal gas at low pressure.

gaseous inclusion. *Noun.* A round or elongated bubble, blister or seed in glass, porcelain-enamels, and glazes.

gaseous inclusion, open. *Noun.* See **open gaseous inclusion**.

gasify. *Verb.* (1) Conversion of a substance to a gas by burning or by reaction with oxygen and superheated steam. (2) To subject coal to destructive distillation to provide fuel gas.

gasket. *Noun.* A compressible piece of **asbestos**, rubber, paper etc., sandwiched between the faces of a ceramic and, or, metal joint to provide a seal.

gasless combustion casting. *Noun.* An adaptation of the **aluminothermic** reaction where mixtures of oxides, carbon and aluminium powder are ignited under inert gas pressure while subjected to centrifugal forces. Al_2O_3 slag is removed to leave a dense carbide product.

gas laws. *Plural noun.* The physical laws obeyed by gases, especially **Boyle's law** and **Charles law**. See **gas constant**.

gas light. *Noun.* A lamp in which illumination is produced by an incandescent ceramic mantle, usually containing **ceria**, and **thoria**, heated by a stream of gas. (2) The light produced by the system described in (1).

gas lighter. *Noun.* A device, usually containing a **piezo-electric ceramic**, for igniting a gas stream.

gas mantle. *Noun.* A dome-shaped mesh of **ceria**, **lanthanum oxide** and **thoria** for use in a **gaslight**.

gas mask. *Noun.* A mask fitted with a chemically impregnated carbon block to enable the wearer to breathe air containing poisonous or corrosive gases.

gas mixer. *Noun.* A fan, aspirator, or injector used to mix gas and air.

gas permeability coefficient. *Noun.* The volume of gas passing between two surfaces of unit area separated by unit distance when a steady-state flow has been established.

gas pickling. *Verb.* Pickling of metal shapes for porcelain-enamelling in a gaseous atmosphere of hydrochloric acid.

gas pressure sintering, GPS. *Noun.* A sintering process where the gas pressure over the compact is increased once a densification temperature is reached. A pressure in the range 1–10 MN m⁻² is used. No special sample container is needed.

gas sensor. *Noun.* A ceramic oxide semiconductor such as SnO₂, Fe₂O₃, ZnO, which when heated has its electrical resistance lowered when in contact with a combustible gas and so can be used to detect and quantify such gases in a gas stream.

gassing. *Noun.* (1) The formation of gas bubbles in porcelain-enamel slips. (2) The act of supplying or treating with gas.

gassy surface. *Noun.* An imperfection characterised by poor gloss and fuzzy texture on a porcelain-enamel surface.

gas thermometer. *Noun.* A device for measuring temperature by observing the pressure of gas at constant volume or the volume of gas kept at constant pressure.

gastropod limestone. *Noun.* Sedimentary limestone in which the fossils of gastropods are clearly seen.

gas turbine. *Noun.* An air-burning combustion engine consisting of an air compressor, combustion chamber, and turbine wheel in which the gaseous products of combustion are used as a means of generating power through a rotating shaft; used more for propulsion than for generating power.

gas-turbine nozzle. *Noun.* The component of a gas turbine in which hot, high-pressure gas expands and accelerates to high velocity. Often constructed from or lined with ceramic.

gate. *Noun.* (1) A movable refractory barrier for shutting off the flow of molten glass in the fore hearth channel of a glass tank. (2) The opening in a casting mould through which molten metal is poured (3). The hole that leads from the injection moulder into the die. (4) An electronic circuit having an output and two or more inputs arranged so that the output is energised only when the two input wires receive pulses.

gate electrode. *Noun.* An area, typically 0.3 µm diameter that controls the electrons flowing through a semiconductor layer to the **drain layer** by creating an electric field in the semiconductor layer.

gate level. *Noun.* The value established for a test signal above or below which electromagnetic test specimens may be rejected or distinguished from other test specimens.

gate oxide. *Noun.* A thin layer of ceramic oxide covering the surface of a semiconductor **chip**. The thinner the layer the faster the interaction speed and lower the power requirement. However the thinner the layer the higher is the leakage current which has the opposite effects and so an optimum thickness is required.

gate valve. *Noun.* A restrictor in a pipe or channel that consists of a sliding plate to control the flow of a fluid.

gather. *Noun.* (1) The mass of glass picked up on a punty or blowing iron by a hand-blowing operator. (2) *Verb.* To collect molten glass on a **punty** or **blowing iron** from a pot or tank.

gathering hole. *Noun.* The opening in a glass pot or tank through which molten glass is gathered on a **punty** or **blowing iron**.

gathering iron. *Noun.* A hollow iron tube on which molten glass is collected at one end for blowing.

gathering ring. *Noun.* A refractory clay ring placed on a bath of molten glass to collect scum and surface impurities; glass of high purity is drawn from the centre of the ring.

Gaudin-Schuhmann milling equation. *Noun.* An equation that quantifies the breaking of grains by using the **cumulative percent finer than** principle: **CPFT** = 100(D/D_L)ⁿ, where D is the particle size, D_L is the largest particle size and n is the **distribution modulus**.

gauge. *Noun.* (1) A measure of thickness of sheet metal, rod, or wire. (2) The minimum screen size through which an aggregate will pass. (3) The exposed length of roofing tile as laid.

gauged brick. *Noun.* (1) A tapered arch brick. (2) A brick produced to accurate dimensions by grinding or other procedure.

gauge capability study. *Noun.* A method of analysis designed to determine components of variation associated with a measurement system.

gauge, dry. *Noun.* See **dry gauge**.

gauge glass. *Noun.* A glass tube attached to the outside of a container to measure the liquid level in the container.

gauge length. *Noun.* The length over which deformation is measured in a test specimen.

gault. *Noun.* Any stiff heavy clay or clayey soil. See **gault clay**.

gault clay. *Noun.* **Marl** containing up to 30 % **calcium carbonate**; used to produce yellow to buff brick and pottery.

gauss, G. *Noun.* In the **cgs system** of units it is the unit of **magnetic flux density**. 1 G = 10⁻⁴ T.

gaussmeter. *Noun.* An instrument for measuring the intensity of a magnetic field.

GAYIG. *Acronym.* Stands for gallium-substituted **yttrium iron garnet**.

GC. *Abbreviation.* Stands for general ceramics.

GCC. *Abbreviation.* Stands for gelated calcium carbonate.

gedrite. *Noun.* $(\text{Mg,Fe})_{5-6}\text{Al}_{1-2}(\text{Si,Al})_8\text{O}_{22}(\text{OH,F})_2$. A fibrous mineral from the **amphibole** group used in commercial asbestos.

gehlenite. *Noun.* $\text{Ca}_2\text{Al}(\text{AlSiO}_4)_2$. A double-tetrahedral, **discrete-ion aluminosilicate**; It has a glassy or resinous lustre. Mp 1,593 °C; density 3,040 kg m⁻³; hardness (Mohs) 5.

gehlenite hydrate. *Noun.* See **stratlingite**.

Geiger counter. *Noun.* A machine for detecting and measuring ionising radiation. It consists of a gas-filled tube with a wire anode along the axis of the tube surrounded by cathode at several hundred volt potential difference. Radiation entering the tube ionises gas molecules, which causes a discharge that is measured and related to the intensity of the radiation.

geikielite. *Noun.* MgTiO_3 . A titanium-magnesium mineral with the **ilmenite** structure.

Geisler tube. *Noun.* A glass or **quartz** vessel usually consisting of two bulbs, each containing an electrode, separated by a capillary tube. Used to produce an electric discharge in a low pressure gas as a source of visible and uv-light.

gel. *Noun.* (1) A colloidal mixture of solid and liquid of jelly-like consistency. The product of a **sol** losing its dispersion medium while undergoing **hydrolysis** and **condensation polymerisation**. The source of ultra fine powders, of fibres, and of monolithic castings. (2) An amorphous material formed during the hardening of cement or an exudation resulting from alkali-aggregate reaction in concrete or mortar.

gelatin or gelatine. *Noun.* A glutinous substance obtained by boiling animal tissues; sometimes used as a sizing agent for glass fibres.

gelation. *Noun.* The conversion of a liquid to the **gel** state; usually accompanied by a sharp increase in viscosity as the solid begins to agglomerate or form a network structure.

gel casting. *Noun.* A **green state** forming process based on in-situ polymerisation of organic monomer binder, such as **agarose**. The process uses <4 % binder and so the green bodies can be directly sintered without special burn-out procedures.

gel cement. *Noun.* Cement containing small additions of **bentonite** to increase homogeneity, increase **water-to-cement ratio**, and reduce water loss of the gel-like cement mix.

gel coating. *Noun.* A method of forming a protective layer on the surface of **glass-fibre-reinforced plastic**

(**GFRP**) products. Usually consists of a resin-only layer about 0.5 mm thick.

gel point. *Noun.* The point at which a solution or slurry begins to increase in viscosity and develop elastic properties.

Gem. *Trademark, noun.* A commercially available superstructure refractory containing 73 % **alumina** and 26 % **silica**.

gemology or gemmology. *Noun.* The branch of mineralogy concerned with **gemstones**.

generated heat. *Noun.* Heat produced by friction or grinding.

generator. *Noun.* (1) A crystal structure or a device that is able to produce a potential difference across two opposite faces sufficiently large to make a spark jump across a gap. **Piezoceramic** generators are used as igniters. (2) A machine that converts mechanical energy to electrical energy. (3) In **dielectric heating** it is a piece of equipment used to convert the mains frequency to the desired operating frequency. (4) The chamber in which solid fuel is converted to producer gas by burning with steam and air. (5) In **fractal analysis** it is the feature which introduces irregularity into the initiator: for example, if the initiator line is divided into three equal segments and the centre part is displaced along two sides of an equilateral triangle, the line is increased in length 4/3 times and becomes kinked. The generator can then be applied to the four straight segments of this kinked line and so on to produce an irregular shape.

genus number. g. *Noun.* The number of holes or handles in or on a surface as defined by the Gauss-Bonnet theorem: $\oint \kappa ds = 2\pi\chi = 4\pi(1 - g)$, where χ is the Euler characteristic.

geo-. *Combining form.* Indicating earth.

geode. *Noun.* (1) Groups of crystals, banded or radiating, that grow inside a cavity in a rock. (2) A stone or rock having a crystal-filled cavity.

geodesic. *Noun.* (1) Specification of exact points or arcs on a surface. They define the shortest line on a given surface. (2) *Adjective.* Made of light, straight structural elements mostly in tension.

geogrid. *Noun.* A network of integrally connected tensile elements used to reinforce and stabilise civil engineering structures.

geology. *Noun.* The scientific study of the structure and composition of the earth.

geometric surface area. GSA. *Noun.* A physical feature of **cellular ceramic catalyst** supports which relates to conversion efficiency in a chemical process: $\text{GSA} = 4(L - t)/L^2$, where L is the cell repeat distance and t is the cell wall thickness.

geometry, detector. *Noun.* See **detector geometry**.

geomimetics. *Noun.* The science that uses preparative techniques to control composition and structure to copy minerals and improve their properties.

geopolymers. *Plural noun.* Mineral polymers formed in geochemical systems or by geosynthesis. They are a family of ceramics used as matrices in composite manufacture formed by condensation polymerisation of hydrated **aluminosilicates** below about 200 °C. For example a 50/50 weight ratio of **kaolinite** and **quartz** mixed with solid NaOH and a little water can be **hot pressed** at 200 °C to form a **sialate**. They consist of Al-O-Si networks throughout the matrix. See **sialate**, **polysilates**.

Georgian-wired glass. *Noun.* Cast or polished glass of which wire mesh of a square pattern is incorporated as reinforcement.

germinate anomaly. *Noun.* When a **modifier oxide** is added to **germanium dioxide** glass there is a composition where thermophysical properties all show a sharp change in behaviour. For example a density maximum at 21 mol% Cs₂O. Thought to be caused by conversion of GeO₄ tetrahedra to GeO₆ octahedra.

germania. *Noun.* See **germanium dioxide**.

germanite. *Noun.* A complex mineral containing copper arsenic sulphide and gallium zinc and lead. An ore of germanium and gallium.

germanium. **Ge.** *Noun.* A semiconducting element used as a resistor element in valves and other electronic devices such as transistors and diode rectifiers. Mp 959 °C; density 5,320 kg m⁻³.

germanium detector, lithium-drifted. *Noun.* See **lithium-drifted germanium detector**.

germanium dioxide. *Noun.* GeO₂. Used as replacement for silica as a **glass former** in glazes and bodies and in glass of high **refractive index**; a semiconductor. Mp 1,115 °C; density 4,250 kg m⁻³. Also called **germania**.

germanium nitride. *Noun.* Ge₃N₄. A covalently bonded insulator. Decomposes at 1,000 °C. See **g-Ge₃N₄**.

germanium oxide. *Noun.* See **germanium dioxide**. Also called **germania**.

g-Ge₃N₄. *Noun.* A high pressure **polymorph** of **germanium nitride** with the **spinel** structure.

getter. *Noun.* (1) A reactive substance usually a metal employed as a coating in vacuum systems to remove last traces of gases from the system. (2) *Verb.* To remove a gas by using a getter.

GeV. *Abbreviation.* Stands for giga-electronvolts, which is 10⁹ electronvolts.

geyserite. *Noun.* A hydrated silica mineral resembling **opal**. Found at hot springs.

GFRP. *Abbreviation.* Standing for glass-fibre-reinforced plastic. See **glass-fibre-reinforced plastic**.

GGBS. *Abbreviation.* Stands for ground granulated blast-furnace slag. See **ground granulated blast-furnace slag**.

GGG. *Abbreviation.* Standing for gadolinium gallium garnet. See **gadolinium gallium garnet**.

Gi. *Abbreviation.* Stands for **gilbert**.

giant magnetoresistance. *Noun.* See **giant magnetoresistive effect**.

giant magnetoresistive effect. GMR. *Noun.* The large change in electrical resistance caused by spin dependent scattering in stacked thin layers of alternating magnetic and non-magnetic materials when an external magnetic field is changed. The effect makes it possible to read tiny **magnetic domains** of densely packed magnetic data and so materials exhibiting the effect are used in read heads in hard disk drives to reduce the size of magnetic **bits** on the drive and so increase data storage. See **manganites**.

Gibbs free energy, free enthalpy. *Noun.* See **Gibbs function**.

Gibbs function. G. *Noun.* A thermodynamic property of a system equal to the difference between its enthalpy and the product of its thermodynamic temperature and its entropy. Measured in Joules. In the USA the symbol is F. Also called **Gibbs free energy, free enthalpy**.

Gibbs phase rule. *Noun.* See **phase rule**.

gibbsite. *Noun.* γ-Al(OH)₃. Aluminium trihydroxide; the major component of **bauxite**; used as a refractory binder for china clays and also as a **bat wash**. The structure consists of cubic close-packed Al(OH)₆ octahedra. Old name was alpha alumina trihydrate.

Gibson-Asbby equation. *Noun.* See **ceramic foam**.

GIC. *Abbreviation.* Stands for graphite intercalation compound. See **graphite intercalation compound**.

gilbert. Gb or Gi. *Noun.* the magnetomotive force resulting from the passage of 4π **abamperes** through one turn of a coil. 1 Gb is 10/4π **ampere-turn**.

Gilsonite. *Trademark, noun.* A naturally hardened, very pure form of **asphalt** from the western USA; used as a bonding material in **casting sand** mixes.

Giorgi system. *Noun.* A system of units that evolved into the SI system. It used m, kg, s, amperes and a magnetic constant equal to 4π × 10⁻⁷ henries m⁻¹.

girasol. *Noun.* A **fire opal** that has a bright pink or red glow in bright light.

gismondine. *Noun.* Ca₄(Al₈Si₈O₃₂)·16H₂O. A naturally occurring **zeolite** mineral used in ion exchange applications.

GIXU. *Acronym.* Stands for grain inspection x-ray unit.

glacial clay. *Noun.* See **sedimentary clays**.

Gladstone-Dale equation. *Noun.* A method used to estimate the **refractive index** of complex ceramic oxides. It has the form: $n = 1 + \rho \sum p_i k_i$, where ρ is the density of the ceramic and $p_i k_i$ refer to the sum of simple oxides that can be considered to make-up the complex formula, k_i is the **refractive coefficient** which is a tabulated empirically determined constant for this procedure and p_i is the weight fraction of the simple oxide in the complex ceramic. See **Table A.21**.

glance. *Noun.* Any mineral with a metallic lustre.

GLARE. *Acronym.* Stands for glass fibre reinforced aluminium composite. A **laminar** developed for the aerospace industry. It consists of alternate layers of glass fibre **pregreg** tape and the appropriate aluminium alloy for the aeroplane part.

glarimeter. *Noun.* An instrument designed to measure the loss of **gloss** of an abraded porcelain-enamel or glaze surface as an indication of the resistance of the surface to abrasive wear.

glarney. *Noun.* A colloquial expression for a glass marble.

glass. *Noun.* (1) Any of a large class of **amorphous**, rigid, inorganic, non-metallic materials of widely variable compositions that solidify from the melt or from the **gel** state without crystallising. Defined, less comprehensively, in ASTM C 162–89 as an inorganic product of fusion that has cooled to a rigid condition without crystallising. Typical glasses include **silica**, **boric oxide**, and **phosphorus oxide** and often contain alumina and basic oxides such as sodium oxide and calcium oxide. They may be transparent or opaque, colourless, or when containing transition metal oxides be coloured, and are often regarded as supercooled liquids that have not maintained an equilibrium structure rather than true solids. (2) A term used for porcelain-enamel frit or fired coatings. (3) A noncrystalline, elastic, solid with 2 nm maximum order and a viscosity $>10^{12.5}$ Nm s⁻². (4) A drinking vessel made of glass.

glass annealing. *Noun.* The heat treatment of glassware in accordance with a prescribed schedule to reduce residual thermal stresses to a specified level and in some cases to substantially modify the structure. A slow rate of cooling is the most important component of the process.

glass, antique. *Noun.* See **antique glass**.

glass armour. *Noun.* Protective barriers composed of, or containing, glass of high strength and polymers in a laminar structure.

glass, barium crown. *Noun.* See **barium crown glass**.

glass, barium-flint. *Noun.* See **barium-flint glass**, **optical flint glass**.

glass-blower. *Noun.* A craftsman engaged in the blowing and shaping of glass by blowing air into a mass of softened glass through a tube.

glass-blowing. *Noun.* The shaping of **viscid** glass by blowing air into it through a tube.

glass, blown. *Noun.* See **blown glass**.

glass, Bohemian. *Noun.* See **Bohemian glass**.

glass-bonded mica. *Noun.* An insulating material consisting mixtures of powdered glass and powdered **mica** formed under pressure at elevated temperatures.

glass, borate. *Noun.* See **borate glass**.

glass, borax. *Noun.* See **borax glass**.

glass, borosilicate. *Noun.* See **borosilicate glass**.

glass, borosilicate crown. *Noun.* See **borosilicate crown glass**.

glass brick. *Noun.* A hollow glass block with plain or patterned surfaces used in the construction of walls, partitions, and windows.

glass brush. *Noun.* A bunch of glass fibres bound together with cord used to polish exposed metal on porcelain-enamelled **artware**.

glass, bulletproof. *Noun.* See **bullet-resisting glass** and **glass armour**.

glass capacitor. *Noun.* A **capacitor** in which glass is employed as the **dielectric material**.

glass, cased. *Noun.* See **cased glass**.

glass, cast. *Noun.* See **cast glass**.

glass ceramic. *Noun.* A predominantly crystalline product made by the controlled crystallisation of glass; can be designed to have thermal expansion coefficients in a range from very low to high and as a result materials with excellent **thermal shock resistance** can be made used in the production of high capacitance, magnetic and **machinable ceramics**. In general materials of high strength and high toughness.

glass, chemical. *Noun.* See **chemical glass**.

glass, chemically strengthened. *Noun.* See **chemically strengthened glass**.

glass, chipped. *Noun.* See **chipped glass**.

glass, chunk. *Noun.* See **chunk glass**.

glass, cladding. *Noun.* See **cladding glass**.

glass-coated steel. *Noun.* Steel containers, tanks, and other equipment coated with a special type of porcelain-enamel having high resistance to chemicals at high temperatures and pressures; for example, chemical reactors and hot-water tanks.

glass container. *Noun.* A generic term for glass bottles, jars, etc.

glass, corrugated. *Noun.* See **corrugated glass**.

glass, cracked. *Noun.* See **crackle**.

glass, Crooke's. *Noun.* See **Crooke's glass**.

glass, crown. *Noun.* See **crown glass**.

glass, crown flint. *Noun.* See **crown flint glass**.

glass, crystal. *Noun.* See **crystal glass**.

glass, cut. *Noun.* See **cut glass**.

glass cutter. *Noun.* (1) A glass-cutting instrument in which the cutting member is a hard steel wheel, a diamond point, or similar hard ceramic; used to cut glass to desired sizes and shapes or to inscribe designs on glass surfaces. (2) A workman who cuts glass to specified sizes and shapes or who inscribes designs on glass surfaces.

glass, devitrified. *Noun.* See **devitrified glass**.

glass, document. *Noun.* See **document glass**.

glass dosimeter. *Noun.* A **dosimeter** in which a fluorescent glass is the radiation-sensitive component.

glass, double-strength. *Noun.* See **double-strength glass**.

glass, drawn. *Noun.* See **drawn glass**.

glassed steel. *Noun.* A synonym for glass-coated steel.

glass enamel. *Noun.* A finely powdered mixture of a low-melting **flux**, calcined ceramic pigment, and a suitable vehicle, which may be applied and fired to a smooth, hard coating on glass at a temperature below the softening point of the glass.

glass eye. *Noun.* A large unbroken bubble or blister occurring beneath the surface of a fired porcelain-enamel coating. (2) An artificial eye made from glass.

glass fibre. *Noun.* A thread of glass used in bulk or woven form; used as acoustic, thermal, or electrical insulation, as a reinforcement in plastic and other matrices, fireproof curtains and drapes, filter cloth, surgical sutures, as well as numerous other applications.

glass fibre reinforced plastic. **GFRP.** *Noun.* One of the earliest man-made composites made by mixing **chopped strand glass fibre** with condensation polymer and shaping before the setting process takes place. A later variation uses woven glass fibre mat impregnated with the resin.

glass, figured. *Noun.* See **figured glass**.

glass filament. *Noun.* An extremely long finely drawn form of glass; diameter is usually <0.125 mm.

glass filament bushing. *Noun.* A manufacturing unit fitted to a small **glass tank** through which the molten glass is drawn to make **glass filaments**.

glass flake. *Noun.* The product from hammer-milling very thin walled glass tube, usually **E-glass**; used as a filler in polymer matrices to increase strength and inhibit moisture up-take.

glass flashing. *Verb.* To apply a thin layer of coloured or opaque glass or **glass enamel**, by vitrification or surface fusion, to the surface of clear glass.

glass, flat. *Noun.* See **sheet glass**.

glass, float. *Noun.* See **float glass**.

glass, fluor crown. *Noun.* See **fluor crown glass**.

glass, foamed. *Noun.* See **foamed glass**.

glass, forest. *Noun.* See **forest glass**.

glass former. *Noun.* (1) Any oxide or other compound which retains an amorphous state on solidification without the presence of another compound. (2) An oxide that conforms to **Zachariason's rules for glass formation** and produces a distorted **network** structure.

glass frost. *Verb.* To chemically or mechanically treat a glass surface, or apply crushed glass particles to a glass surface, to obscure the glass by scattering the light and to simulate the appearance of frost.

glass furnace. *Noun.* Any enclosed or covered furnace, tank, or pot usually of the **reverberatory** type, in which glasses are melted; sometimes electric boosters immersed in the molten glass batch are employed to expedite the process.

glass, Georgian-wired. *Noun.* See **Georgian-wired glass**.

glass, green. *Noun.* See **green glass**.

glass, heat-absorbing. *Noun.* See **heat-absorbing glass**.

glass heat exchanger. *Noun.* A device, which transfers heat from one fluid to another in which the heat transfer medium, is glass.

glass, heat-resisting. *Noun.* See **heat-resistant glass**.

glass, heat-strengthened. *Noun.* See **heat-strengthened glass**.

glass, heavy metal fluoride. *Noun.* See **fluorozirconate glass**.

glass, heavy metal oxide. *Noun.* See **heavy metal oxide glass**.

glass, high-transmission. *Noun.* See **high-transmission glass**.

glasshouse. *Noun.* An American word for a glassworks.

glass ionomer cement. *Noun.* Invented in 1969 these are two-part cements consisting of an ionic polymer liquid, usually a polycarboxylic acid, which is the **ionomer** and a finely powdered glass. The glass particles are about 40 µm and they have a threefold role: as a filler to reduce shrinkage; to improve wear resistance; to act as a setting catalyst by ion-exchange with the polyacid solution.

glass insulator. *Noun.* A tempered or annealed glass shape used as an insulator for electric-power transmission lines.

glassivation. *Verb.* To passivate a **transistor** by encapsulating the semiconductor device, complete with metal contacts, in glass.

glass, laminated. *Noun.* See **laminated glass**.

glass, lampworking. *Noun.* See **lampworking**.

glass laser. *Noun.* A solid state laser in which a fluorescent glass serves to amplify electromagnetic radiation by stimulated emission processes.

glass, lead. *Noun.* See **lead glass**.

glass, lead crown. *Noun.* See **lead crown glass**.

glass, leaded. *Noun.* See **leaded glass**.

glass, light-reducing. *Noun.* See **light-reducing glass**.

glass, lime. *Noun.* See **lime glass**.

glass, lime crown. *Noun.* See **lime crown glass**.

glass-lined steel. *Noun.* See **glass-coated steel**.

glass, liquid. *Noun.* See **sodium silicate**.

glass, low-melting. *Noun.* See **low-melting glass**.

glassmaker. *Noun.* A person who makes glass or glass objects.

glassmaker's soap. *Noun.* A material such as **selenium** or **manganese dioxide** added to a glass batch to remove the green colour arising from the presence of iron salts.

glassman. *Noun.* A person whose occupation is making or selling glassware.

glass mat. *Noun.* A thin mat of chopped glass filaments.

glass matrix composites. *Plural noun.* Articles made by dipping ceramic fibres, such as **SiC**, in a paste of glass powder and binder, then shaping, heating to remove the binder, and then **hot pressing** in vacuum or inert atmosphere.

glass, milk. *Noun.* See **milk glass**.

glass, moulded. *Noun.* See **moulded glass**.

glass, moonstone. *Noun.* See **moonstone glass**.

glass, murrhine. *Noun.* See **murrhine glass**.

glass, neophane. *Noun.* See **neophane glass**.

glass, neutron-absorbing. *Noun.* See **neutron-absorbing glass**.

glass, offhand. *Noun.* See **offhand glass**.

glass, opal. *Noun.* See **opal glass**.

glass, ophthalmic. *Noun.* See **ophthalmic glass**.

glass, optical crown. *Noun.* See **optical crown glass**.

glass, optical flint. *Noun.* See **optical flint glass**.

glass, oven. *Noun.* See **oven glass**.

glass paper. *Noun.* (1) A heat- and environment-resistant paper made of glass fibres; used for permanent documents. (2) A Strong paper coated with powdered glass or other abrasive for polishing and smoothing. (3) *Verb.* To polish with a glass paper.

glass, phosphate. *Noun.* See **phosphate glass**.

glass, phosphate crown. *Noun.* See **phosphate crown glass**.

glass, photochemical. *Noun.* See **photochemical glass**.

glass, photochromic. *Noun.* See **photochromic glass**.

glass, photosensitive. *Noun.* See **photosensitive glass**.

glass, plate. *Noun.* See **plate glass**.

glass-plate capacitor. *Noun.* A capacitor in which glass sheets separate the metallic plates and serves as the dipole.

glass, polished plate. *Noun.* See **polished plate glass**.

glass, polished wire. *Noun.* See **polished wire glass**.

glass pot. *Noun.* A one-piece, crucible-shaped refractory container, open or closed, in which glass is melted.

glass, pressed. *Noun.* See **pressed glassware**.

glass, prismatic. *Noun.* See **prismatic glass**.

glass, quartz. *Noun.* See **quartz glass**.

glass resistor. *Noun.* Tubular glass with a helical electric resistor element of carbon painted on the surface.

glass, rolled. *Noun.* See **rolled glass**.

glass, rough. *Noun.* See **rough glass**.

glass, rough-cast. *Noun.* See **rough-cast glass**.

glass, safety. *Noun.* See **safety glass**.

glass sand. *Noun.* A nearly pure **quartz** with minor amounts the oxides of aluminium, calcium, iron, and magnesium; used in glass making. Contains <1 % iron; mp 171 °C; density 2,200–2,600 kg m⁻³.

glass seal. *Noun.* An airtight seal in which molten glass cooled to form the sealant; for example, the glass-to-metal seals used in electric and electronic components.

glass, sealing. *Noun.* See **sealing glass**.

glass, seedy. *Noun.* See **seedy glass**.

glass, shatterproof. *Noun.* See **shatterproof glass**, **safety glass**.

glass, sheet. *Noun.* See **sheet glass**.

glass, shielding. *Noun.* See **shielding glass**.

glass, silica. *Noun.* See **silica glass**.

glass, single-strength. *Noun.* See **single-strength glass**.

glass, sintered. *Noun.* See **sintered glass**.

glass, skylight. *Noun.* See **skylight glass**.

glass, slab. *Noun.* See **slab glass**.

glass, smoked. *Noun.* See **smoked glass**.

glass, soft. *Noun.* See **soft glass**.

glass softening point. *Noun.* The temperature at which a glass fibre of uniform diameter elongates under its own mass at a specified rate.

glass, solder-sealing. *Noun.* See **solder-sealing glass**.

glass, spandrel. *Noun.* See **spandrel glass**.

glass spheres. *Noun.* Solid glass spheres ranging from 5 to 500 μm in diameter, coated in **size** or **polysilane coupling agent**; used to fill and provide reinforcement to polymer matrices.

glass, spun. *Noun.* See **spun glass**.

glass, square-cut. *Noun.* See **square-cut glass**.

glass, stained. *Noun.* See **stained glass**.

glass stress. *Noun.* In **glass-fibre composites** it is the stress, calculated by dividing the applied load by the cross-sectional area of glass fibres only.

glass, structural. *Noun.* See **structural glass**.

glass switch. *Noun.* A glassy amorphous solid-state device formulated and designed to control the flow of an electric current in electronic components.

glass tank. *Noun.* A large covered refractory container in which glass is melted and from which molten glass is withdrawn for working into artefacts.

glass, tempered. *Noun.* See **tempered glass**.

glass, tempered safety. *Noun.* See **tempered safety glass**.

glass textile. *Noun.* Glass fibres woven into fabrics for use in plastic laminates, thermal insulation, filter cloth, fireproof drapes, etc.

glass, thermal. *Noun.* See **thermal glass**.

glass-to-metal seals. *Noun.* Airtight seals formed by fusing glass onto metals for purposes of insulation in electrical and electronic components, the glass serving as insulation.

glass, toughened. *Noun.* See **toughened glass**.

glass, transfer. *Noun.* See **transfer glass**.

glass transformation. *Noun.* See **glass transition**.

glass transition. *Noun.* A second-order change indicating the temperature point at which a supercooled liquid on further cooling ceases to be in thermodynamic equilibrium and the material enters the glassy state. Often identified with a viscosity of $10^{12.5} \text{ N s m}^{-2}$.

glass transition temperature. *Noun.* See **glass transition**.

glass, translucent. *Noun.* See **translucent glass**.

glass, ultraviolet-absorbing. *Noun.* See **ultraviolet-absorbing glass**.

glass, ultraviolet-transmitting. *Noun.* See **ultraviolet-transmitting glass**.

glassware. *Noun.* Any product made of glass for use in domestic or a laboratory; the term usually refers to **tableware**.

glassware, graduated. *Noun.* See **graduated glassware**.

glassware, pressed. *Noun.* See **pressed glassware**.

glassware, volumetric. *Noun.* See **volumetric glassware**.

glass welding. *Noun.* Joining two or more glass components by fusion at their points of contact.

glass, window. *Noun.* See **window glass**.

glass, wired. *Noun.* See **wired safety glass**.

glass, wired safety. *Noun.* See **wired safety glass**.

glass, Wood's. *Noun.* See **Wood's glass**.

glass wool. *Noun.* A randomly oriented, fleecy mass of glass fibres used for acoustic and thermal insulation, air filters, and similar applications. Made by blowing air at coarse molten glass filaments.

glasswork. *Noun.* (1) The production of glassware. (2) The fitting of glass. (3) Articles of glass.

glassworks. *Noun.* A factory for the moulding of glass.

glassy. *Adjective.* Resembling glass especially in smoothness and transparency.

glassy fracture. *Adjective.* See **adamantine**.

glassy phosphate polymers. GPP. *Noun.* Binary and ternary phosphate compositions that have failed to crystallise on cooling and have formed glasses composed of chain-like or cross-linked structures analogous to organic polymers. The chains are composed of phosphate anion tetrahedra and are short in length compared to organic polymers.

glassy state. *Noun.* A vitreous state in which the atoms or molecules are not oriented in a regular order or pattern. Materials in this state exhibit a second-order change known as the **glass transition** on cooling.

glass, zinc crown. *Noun.* See **zinc crown glass**.

Glauber's salt. *Noun.* $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$. Sodium sulphate decahydrate; a naturally occurring sulphate. Used as a **fining agent**.

glauconite. *Noun.* $\text{K}_2(\text{Mg,Fe})_2\text{Al}_6(\text{Si}_4\text{O}_{10})_3(\text{OH})_{12}$. A green coloured mineral found in **green sands**.

glaze. *Noun.* (1) A glassy coating fired on a ceramic article. (2) The mixture of ingredients from which the

coating is made. (3) *Verb trans.* To coat with a vitreous layer making the object impervious to liquids and smooth to the touch. (4) *Verb trans.* To fit or cover with **sheet glass**.

glaze, aventurine. *Noun.* See **aventurine**.

glaze, bright. *Noun.* See **bright glaze**.

glaze, Bristol. *Noun.* See **Bristol glaze**.

glaze burn-out. *Noun.* A situation where a glaze composition has been fired at too high a temperature and one or more components has been completely volatilised in to the kiln atmosphere.

glaze, celadon. *Noun.* See **celadon glaze**.

glaze claws. *Noun.* A double-handled, two-prong device used to grip ware for glaze slip dipping.

glaze clay. *Noun.* Fine-grained clay containing considerable amounts of colloidal organic matter, which is added to glaze batches as a suspension and binding agent, and which becomes an integral part of the glaze during firing.

glaze, crystalline. *Noun.* See **crystalline glaze**.

glaze, cut. *Noun.* See **cut glaze**.

glazed ceramic mosaic tile. *Noun.* Ceramic mosaic tile that has been glazed on the face to be exposed when assembled.

glazed interior tile. *Noun.* A non-vitreous tile body that has been glazed to make it suitable for mild conditions of use indoors.

glazed pot. *Noun.* A glass-melting pot coated with a hard glaze as a protection against reactive batch ingredients present in some glass melts.

glazed, short. *Noun.* See **cut glaze**.

glazed tile. *Noun.* A tile of any body type coated with an impervious, coloured or uncoloured, ceramic glaze.

glazed tile, eggshell. *Noun.* See **eggshell glazed tile**.

glazed tile, extra-duty. *Noun.* See **extra-duty glazed tile**.

glaze fit. *Noun.* The stress relationship between the glaze and body of a fired ceramic, that is, the degree to which the coefficients of expansion of the two components are matched.

glaze flow. *Noun.* (1) The property of a glaze slip to flow over the surface of a ceramic body to form a smooth, uniform coating. (2) The property of glaze ingredients to flow together to form a smooth, impervious coating during firing.

glaze, fritted. *Noun.* See **fritted glaze**.

glaze, jardinière. *Noun.* See **jardinière glaze**.

glaze, lead. *Noun.* See **lead glaze**.

glaze, leadless. *Noun.* See **leadless glaze**.

glaze, low-solubility. *Noun.* See **low-solubility glaze**.

glaze, majolica. *Noun.* See **majolica glaze**.

glaze mop. *Noun.* A goat hair brush used to paint glaze slip on to pieces.

glaze, opalescent. *Noun.* See **opalescent glaze**.

glaze, opaque. *Noun.* See **opaque glaze**.

glaze, raw. *Noun.* See **raw glaze**.

glaze, salt. *Noun.* See **salt glaze**.

glaze, semiconducting. *Noun.* See **semiconducting glaze**.

glaze, semi-matte. *Noun.* See **semi-matte glaze**.

glaze, short. *Noun.* See **short glaze**.

glaze, slip. *Noun.* See **slip glaze**.

glaze, slop. *Noun.* See **slop**.

glaze, snakeskin. *Noun.* See **snakeskin glaze**.

glaze stains. *Plural noun.* Calcined ceramic pigments, usually metal oxides, incorporated in a glaze slip to produce a coating of uniform colour; some serve essentially as pigments, some as precipitates, and some go into solid solution in the fired glaze.

glaze, starred. *Noun.* See **starred glaze**.

glaze, starved. *Noun.* See **starved glaze**.

glaze, tea-dust. *Noun.* See **tea-dust glaze**.

glaze, transmutation. *Noun.* See **transmutation glaze**.

glaze, vapour. *Noun.* See **vapour glaze**.

glaze, vellum. *Noun.* See **vellum glaze**.

glazing. *Verb.* (1) To apply a glaze to ceramic ware. (2) To cut and fit glass panes into frames and the application of a caulking compound, such as **putty**, to seal the panes in place. (3) *Noun.* The surface of a glazed object. (4) *Noun.* Sheet glass fitted in a frame, such as a door etc.

glazing bar. *Noun.* A strengthening bar for glass windows and doors. Also called **muntin**.

glazing size. *Noun.* The dimensions of a glass pane cut for glazing.

gley. *Noun.* A sticky clay formed under the surface of some waterlogged soils.

glide. *Noun.* A smooth easy movement facilitated in solids by the presence of **dislocations**.

glissile. *Adjective.* Able to glide but cannot climb; a description of a **partial dislocation**.

glob. *Noun.* A rounded mass of high-viscosity fluid.

globate. *Adjective.* Shaped like a globe.

globular. *Adjective.* (1) Consisting of globules. (2) Shaped like a globe.

globule. *Noun.* Small drop of liquid.

glomerate. *Adjective.* (1) Gathered into a compact rounded mass. (2) Fibres wound up like a ball.

glory hole. *Noun.* (1) A furnace for the reheating and fire-polishing of hand-made glassware. (2) The opening exposing the hot interior of a furnace in which glass is reheated for hand-working.

gloss. *Noun.* The polish, **lustre**, or **brilliance** of a fired porcelain-enamel or glaze coating. (2) The ratio of specularly reflected light to the total light reflected by a surface. See **specular gloss**.

gloss, low. *Noun.* See **low gloss**.

glossmeter. *Noun.* An instrument to measure the degree of gloss that works by shining light from a standard source at 45° onto the surface and the reflected light is measured by its effect on a photoelectric cell.

gloss, specular. *Noun.* See **specular gloss**.

glost. *Noun.* A synonym for glazed. See **glost firing**.

glost firing. *Noun.* A kiln firing process, usually carried out at moderate to low temperatures, to which **bisque ware** covered in unfired **glaze frit**, is subjected.

glow. *Noun.* Visible light emitted by a hot body.

glowing combustion. *Noun.* Combustion of a material in the solid state without flame but with emission of light from the combustion zone.

glucinium oxide. *Noun.* Colloquial name for **beryllium oxide**; **beryllia**.

glucose. *Noun.* $C_6H_{12}O_6$. A monosaccharide used as a binder.

glue, chrome. *Noun.* See **chrome glue**.

GMR. *Abbreviation.* Stands for giant magnetoresistance. See **giant magnetoresistance**.

gneiss. *Noun.* **Metamorphic** rocks usually composed of **quartz**, **feldspar**, and other light-coloured silicate minerals arranged in bands with dark minerals, such as **mica** or **hornblende**. They are formed at the highest temperatures and pressures and have coarser grains than **schist**.

gneissic. *Adjective.* Having a dark and light banded structure.

gob. *Noun.* (1) A mass of molten glass gathered on a **punt** or blowpipe for hand-making of glassware. (2) A mass of molten glass delivered by a **feeder** to a forming process. (3) Waste material, such as clay and shale, from mining.

goblet. *Noun.* A ceramic or glass drinking cup having a stem and base, but usually without handles.

gob process. *Noun.* The process by which a **gob** or mass of molten glass is delivered to a forming operation.

godet wheel. *Noun.* A driven roller, which may be heated, around which ceramic fibre in the process of manufacture is passed to regulate its speed during **extrusion**. Godets mostly have a single flange and are mounted on an axle from the flange side. Sometimes they have serrations at a small angle to the roller axis, sometimes stepped and occasionally tapered. The tapered geometry is probably responsible for the name since a godet is a triangular insert of material to give flare to a skirt.

godet, serrated. *Noun.* See **godet wheel**.

godet, stepped. *Noun.* See **godet wheel**.

godet, tapered. *Noun.* See **godet wheel**.

goethite. *Noun.* $\alpha\text{-FeO(OH)}$. Iron oxyhydroxide, an orthorhombic, brown to yellowish mineral with a distinctive yellow streak. Hexagonal close packing of anions with Fe^{3+} ions in octahedral sites. One of the precipitated phases when solutions containing Fe^{2+} or Fe^{3+} ions are neutralised by a base. Used extensively as a pigment. Hardness (Mohs) 5–5.5; density 3,300–3,500 kg m^{-3} . See **green rust**.

goglet. *Noun.* A long-necked porous earthenware vessel designed to hold and cool water by evaporation. Also called **gurglet**.

Golay detector. *Noun.* A pneumatic cell used to detect heat radiation by gas expansion.

gold. *Noun.* Au. A brilliant glass and ceramic decoration applied as a powder suspended in oil and burnished after firing. Mp 1,063 °C; density 19,130 kg m^{-3} .

gold, acid. *Noun.* See **acid gold**.

gold, bright. *Noun.* See **bright gold**.

gold, burnished. *Noun.* See **burnished gold**.

gold chloride. *Noun.* AuCl_3 . Used in gilding and lustre glazes. Used with a mixture of **stannous** and **stannic chlorides** to produce **purple of Cassius** for the colouring or decoration of glass or ceramic ware; also used to produce **ruby reds** as colloidal gold metal particles are formed in glasses, glazes, and porcelain-enamels. Mp 354 °C; density 3,900 kg m^{-3} .

gold eraser. *Noun.* A stick eraser used to remove defects on fired gold without damaging the artefacts.

gold essence. *Noun.* Oil mixtures used to aid the workability of gold while brushing or banding.

gold hydroxide. *Noun.* Au(OH)_3 . Used to decorate ceramics.

gold, liquid. *Noun.* See **liquid gold**.

gold lustre. *Noun.* A mixture used to add gold coloured decoration to ware consisting of either powdered gold suspended in oil or resin or a soluble salt, such as **gold chloride** or oxide in an organic solvent that is subsequently fired in a reducing atmosphere. It is used under glaze.

gold oxide. *Noun.* Au_2O_3 . Used in the form of a **lustre** or **resinate** to decorate ceramics.

gold ruby glass. *Noun.* See **ruby glass**.

gold silvering. *Noun.* A process in which gold is deposited on a glass surface and coated with a protective medium.

goldstone. *Noun.* Another name for **aventurine**.

goldstone glaze. *Noun.* An **aventurine** glaze composed of basic **lead carbonate**, $\text{Pb}(\text{OH})_2\text{CO}_3$, **feldspar**, **silica**, **ferric oxide** and **whiting**.

gold-tin purple. *Noun.* A mixture of **gold chloride** and **brown tin oxide** used in colouring porcelain-enamels, making **ruby glass**, and painting porcelain.

goniometer. *Noun.* An instrument for measuring the angles between the faces of a crystal.

goniophotometer. *Noun.* An instrument used to measure light reflected from a surface as a function of angle.

gooseberry stone. *Noun.* A synonym for grossularite. See **grossularite**.

gore. *Noun.* A piece of material with a curved segmented appearance like a grapefruit segment. Encountered in ceramic decoration.

gouache. *Noun.* A decorating technique using opaque watercolours in which pigments are bound with glue and an inert white pigment, such as **chalk**, is added to make the paint opaque and the ratio of pigment to binder is higher than in watercolours.

gouge. *Noun.* A fine deposit of rock fragments, especially **clay**, occurring between the walls of a fault or mineral vein.

gouge test. *Noun.* A test to evaluate the **wear** resistance of porcelain-enamel in which a small steel ball is rolled across the enamel surface under increasing loads, the degree of wear being determined by the loss of **gloss**.

goulac. *Noun.* By-product from wood pulp manufacture; used as a **binder** in mould forming.

gpd. *Abbreviation.* Stands for grams per **denier**. See **grams per denier**.

GPP. *Abbreviation.* Stands for glassy phosphate polymers. See **glassy phosphate polymers**.

GPS. *Abbreviation.* Standing for gas pressure sintering. See **gas pressure sintering**.

grab sample. *Noun.* A sample taken at random from a large mass, or a large number of items being examined.

gradation. *Noun.* (1) A code or designation of the quality, composition, properties, or type attached to a product by a manufacturer such that the manufacturer may reproduce the product. (2) To sort or classify in steps or degrees by established criteria such as by particle size,

colour, or other property. (3) The strength of bond or **hardness** of a **grinding wheel**, particularly in terms of the resistance of the grains to being torn or split from the wheel during use.

grade. *Noun.* (1) An index of **friability** of bonded abrasives. (2) *Verb.* To sort materials or items to some specified category.

graded index. *Noun.* An **optical fibre** where the **refractive index** varies linearly from the centre to the outside to limit **pulse broadening**.

grading. *Noun.* The process of sorting to some specified category of classification.

grading, gap-sized. *Noun.* See **gap-sized grading**.

Gradium. *Trademark, noun.* A patented trade name for glass manufactured to have a **refractive index** gradient through the thickness that can be adjusted to customer specification by an internal diffusion process.

graduated glassware. *Noun.* Glassware marked with divisions or units for volumetric measurements.

graffito work. *Noun.* Decoration on pottery made by scratching the surface.

grain. *Noun.* (1) Any small hard particle such as an abrasive grain or a grain of sand. (2) A single crystal in a polycrystalline structure.

grain boundary. *Noun.* On crystallisation grains grow from crystallite nuclei and continue to grow until they meet a neighbouring crystallite. The narrow region between the two crystals or grains where the atoms redistribute to minimise growth misfit is a grain boundary. Grain boundaries obstruct **dislocation** movement and so hinder **slip**. Compared with the order within the crystals forming the boundary it is a disordered volume essentially composed of numerous **edge dislocations**.

grain boundary diffusion. *Noun.* The movement of atoms or ions in the volume of disordered structure that constitutes the interface of two crystals or grains in a solid compact. A densification mechanism in **sintering**.

grain boundary migration. *Noun.* A sideways movement of the grain, i.e., **grain growth**.

grain boundary sliding. *Noun.* Relative motion of two grains parallel to the **grain boundary**.

grain boundary squeezing. *Noun.* Relative grain movement perpendicular to the **grain boundary**.

grain corner. *Noun.* A place in a polycrystalline ceramic where four grains meet at a point.

grain edge. *Noun.* The place in a polycrystalline ceramic where three grains meet in a line.

grain fineness. *Noun.* (1) The average particle size of a granular material. (2) The maximum particle size of a granular material passing through a sieve of specified mesh size.

grain growth. *Noun.* A phenomenon occurring in the final stages of sintering when too few pores remain to pin the **grain boundaries**. Curved boundaries move toward their centre of curvature and so large grains with more than six sides grow outwards while grains with less than six sides shrink in size.

grain growth rate. *Noun.* The average increase in grain size experienced during the final stage of **sintering**; follows the function $d_g^2 - d_o^2 = kt$, where d_g is the average grain diameter, d_o is the starting average grain diameter, k is a constant, and t is the elapsed time. The grain growth rate increases with temperature increase in an exponential way.

graining. *Verb.* To produce a decorative finish imitating the grained appearance of wood or marble on porcelain-enamels and glazes, usually by means of a rubber-roll transfer process.

graining oxides. *Plural noun.* Mixtures of ceramic pigments containing small amounts of fluxing ingredients used in **graining pastes** which are used to transfer a decorative finish to porcelain-enamel and glaze surfaces by means of rolls.

graining pastes. *Plural noun.* Oil suspensions of coloured ceramic oxides and suitable fluxes used in the rubber-roll process of decorating porcelain-enamel and glaze surfaces.

graining roll. *Noun.* A special type of rubber roll used to transfer **grain pastes** from a pattern surface to the surface of a porcelain-enamel or glaze.

grain magnesite. *Noun.* **Dead-burned magnesia** in granular form suitable for refractory purposes.

grain size. *Noun.* The average size of particulate materials used in the production of ceramic ware, often simply determined by **screen analysis** or from a number of random cross sections on a micrograph.

grain spacing. *Noun.* The ratio of abrasive grains to binder in a grinding wheel.

gram. *Noun.* A metric unit of weight equal to 10^{-3} of a kilogram, or to 1/28 of an ounce, and nearly equal to the weight of 1 cm³ of water at its maximum density.

gram-atomic weight. *Noun.* The mass in grams corresponding to the **atomic weight** of an element.

gram-molecular weight. *Noun.* The mass in grams corresponding to the formula weight of a compound.

grams per denier. *Noun.* A measure of fibre strength. Converted to **SI units** of N m⁻² by the equation: σ (N m⁻²) = 0.08826 ρ [stress in gpd], where ρ is the fibre density in g cm⁻³. See **tenacity**.

grani-*Combining form.* Indicates grain.

graniglie. *Adjective.* A texture effect obtained on a tile surface from the use of a **frit** that has been crushed on

a **hammer mill** or in a **ball mill** to a size range 0.2–2.0 mm.

granite. *Noun.* A light-coloured, coarse-grained, acid plutonic **igneous rock** composed of **orthoclase** or **albite feldspar** and **mica**. It is a very common **intrusive rock** and as a result of the slow cooling of **magma** deep within the earth has large easily seen crystals. Used as **hard core**, in concrete, and when finely powdered has many of the filling applications that **china clay** is used for.

granite, biotite. *Noun.* See **biotite granite**.

granite, graphic. *Noun.* See **graphic granite**

granite, pink. *Noun.* See **pink granite**.

graniteware. *Noun.* (1) A one-coat porcelain-enamelled article having a mottled **granite**-like appearance produced by controlled corrosion of the metal base prior to firing. (2) A type of **semivitreous**, white pottery with a speckled glaze. (3) A type of white semivitreous pottery of high durability. (4) Iron vessels coated with enamel of granite-like appearance.

graniteware, white. *Noun.* See **white graniteware**.

granitite. *Noun.* Granite with high **biotite** content.

granitisation. *Noun.* The **metamorphic** transformation of rock into granite.

grano-. *Combining form.* Of or having the appearance of granite.

granodiorite. *Noun.* A coarse-grained rock containing twice as much **plagioclase** as **orthoclase** and intermediate in composition between **granite** and **diorite**.

granolith. *Noun.* A paving material made from crushed granite bonded by **cement**.

granophyre. *Noun.* A fine-grained granitic rock with a characteristic microstructure of irregular intergrowths of **quartz** and **feldspar**.

granular. *Adjective.* Consisting of granules.

granular activated carbon. *Noun.* Activated carbon with particle sizes mostly greater than 80 mesh.

granular habit. *Adjective.* A description of **aggregates** composed of mineral crystals cemented together regardless of the habit of the crystals. Descriptive names are added such as: coarse granular, fine granular, and powdery granular.

granulate. *Verb.* (1) To form larger free-flowing particles from powdered materials; usually by adding water or other suitable binder and tumbling in a rotary mixer. (2) *Noun.* The product of a granulation procedure.

granulated blast-furnace slag. *Noun.* Glassy, granular structured material made when molten **blast furnace slag** is quenched in water.

granulation dry pressing. *Noun.* A method of preparing and forming tableware that requires little drying before firing. Powdered clay, **stone**, and calcined bone are mixed as a spray-dried powder that is then granulated to a 2 % moisture **agglomerate**. The agglomerate is then dry-pressed against a steel die by an oil-filled membrane.

granulator. *Noun.* A machine, usually a rotating drum, used to transform fine powders mixed with binder to **agglomerates** of granular size.

granule. *Noun.* (1) Small grain or pellet. (2) Small ceramic grain or pellet applied to asbestos cement to add colour to the surface. (3) **Sedimentary rock** with a particle size in the range 2–4 mm.

granules, roofing. *Noun.* See **roofing granules**.

granulite. *Noun.* A **granular** foliated metamorphic rock with a microstructure that is a mosaic of equal-sized grains.

graphene. *Noun.* Carbon sheets 1 atom thick; the strongest and thinnest material measured with strength 200 times that of steel and conductivity 10^6 times that of copper. Every carbon atom in the sheet is in the sp^2 -hybridised bonding state. Combinations of 6 and 5-membered rings allow the sheets to be curved and rolled into new forms of carbon, see **SWNT**. Made by **CVD** of hydrocarbons on to iridium substrates in the range 20–1,000 °C. Carbon domes are formed as the hydrocarbon loses hydrogen and the peripheral atoms bond to the iridium. The geodesic domes reorganise to graphene sheets. Rolled-up graphene forms **nanotubes**.

graphene oxide. TRGO. *Noun.* A chemically modified form of **graphene** that is easier to manufacture than graphene itself.

graphene, trilayer. *Noun.* See **trilayer graphene**.

graphene, white. *Noun.* See **white graphene**.

graphic granite. *Noun.* A form of **granite** in which the **quartz** crystals were formed as particularly long, angular crystals that resemble ancient script against the even larger pink coloured **feldspar** crystals.

graphite. *Noun.* A carbon polymorph with an hexagonal structure containing strongly bonded 2-D sheets of carbon atoms and very weak inter-sheet bonding. Used in crucibles and other refractories, in arc furnaces, heat shields in rockets, as a solid lubricant in both high- and low-temperature applications, and as a **moderator** in nuclear applications. Soft with an hardness (Mohs) 1–2: mp > 3,500 °C; density 2,090–2,300 kg m⁻³.

graphite, amorphous. *Noun.* See **amorphous graphite**.

graphite-base carbon refractory. *Noun.* A manufactured refractory composed essentially of graphite.

graphite brick. *Noun.* A refractory ceramic brick formed from **coke** and **pitch**, heat-treated above 2,500 °C in an inert atmosphere to form crystallites of graphite.

graphite, exfoliated. *Noun.* See **exfoliated graphite**.

graphite fabric. *Noun.* Cloth woven from graphite fibres.

graphite fibre. *Noun.* Graphite in an ultrathin filament form, frequently made by the **pyrolysis** of **polyacrylonitrile** fibres.

graphite, flake. *Noun.* See **flake graphite**.

graphite intercalation compound. GIC. *Noun.* A form of 2-D solid in which elements such as Na and K, or compounds like CoCl₂, form 2-D arrays between carbon sheets perpendicular to the c-axis direction of the graphite crystal.

graphite, manufactured. *Noun.* See **manufactured graphite**.

graphite-PGA. *Noun.* See **PGA-graphite**.

graphite, pyrolytic. *Noun.* See **pyrolytic graphite**.

graphite refractory. *Noun.* Any refractory product made essentially from graphite.

graphite, synthetic. *Noun.* See **synthetic graphite**.

graphite, vein. *Noun.* See **vein graphite**.

graphite, white. *Noun.* See **white graphite**.

graphitic carbon. *Noun.* Tiny flakes of pure carbon that form in pig iron during cooling and which weaken the product; will cause blistering in porcelain-enamels.

graphitic oxide. *Noun.* C₈O₂(OH)₂. A beige coloured **intercalation compound** of graphite used as an anode material in lithium-carbon cells.

graphitise or graphitize. *Verb trans.* (1) To convert a substance into graphite by heating. (2) To impregnate or coat with graphite.

graphitiser furnace. *Noun.* Vacuum or inert atmosphere furnace designed to purify carbon fibres at temperatures around 1,800 °C by heating for 12–24 h. This reduces alkaline metal impurities to <50 ppm.

graphyne. *Noun.* A carbon allotrope made by synthesising dehydrobenzoannulene precursors that form the sub-units of the graphyne layers. This allotrope has a 2-D lattice of sp - sp^2 hybridised carbon atoms.

grappier cement. *Noun.* Cement made by using under-burned or over-burned **slaked lime** that has been finely ground.

grating equation. *Noun.* For monochromatic light, incident on a grating at angle i , the angle θ at which diffraction lines are formed is given by this equation: $d(\sin i + \sin \theta) = n\lambda$, where d is the grating slit width and n is an integer called the order number

grav. g. *Noun.* A unit of acceleration equal to that experienced in free fall. 1 grav is equivalent to 9.80665 m s⁻².

grave. *Verb.* To carve, sculpt, cut or engrave.

gravel. *Noun.* Loose rounded rock, coarser than sand, and in the size range 4–76 mm. Much used as aggregate in concrete.

gravel cement. *Noun.* Gravel consolidated by **clay**, **calcite**, **silica**, or other material.

gravel, crushed. *Noun.* See **crushed gravel**.

gravel, foundry. *Noun.* See **foundry gravel**.

grave sandblast. *Noun.* A sandblasted decorative design of varying depths on glass surfaces.

gravimeter. *Noun.* An apparatus for measuring **relative density**.

gravimetric. *Adjective.* Of or concerned with or using measurement by weight.

gravimetric analysis. *Noun.* A quantitative chemical analysis based on reactions that produce a material to be weighed.

gravimetric energy density. *Noun.* See **energy density**.

gravimetric factor. *Noun.* The ratio of the atomic or molecular weight of an element or compound to the molecular weight of the compound in which it is a component.

gravitate. *Verb intrans.* To settle or sink.

gravitation. *Noun.* The force of attraction that bodies exert on one another as a result of their mass.

gravitational constant. G. *Noun.* The proportionality constant that relates force to mass and distance. A universal constant with a value of $6.673 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$.

gravitational mass. *Noun.* The mass of a body determined by its response to the force of gravity.

gravity. *Noun.* (1) A term used in the porcelain-enamelling industry for the **specific gravity** of a milled porcelain-enamel slip in which water is equal to one. (2) The force of gravity.

gravity bed. *Noun.* A technique in which solid particles being processed move downward through a liquid, or conversely the molten phase of the material moves upwards.

gravity feed. *Noun.* The movement of materials from one location to another by force of gravity.

gravity separation. *Noun.* The separation of mixtures into layers of equal density in a stream of air or liquid by means of a vibrated sloping **shaker-table** or similar mechanism.

gravity, specific. *Noun.* See **specific gravity**.

gray. Gy. *Noun.* (1) The **S I unit** of absorbed ionising radiation dose or **kerma**; an absorption per unit mass of 1.0 J kg^{-1} of irradiated material. One gray is equivalent to 100 **rads**. (2) *Adjective.* Variant spelling of **grey**.

greasy lustre. *Adjective.* The surface appearance of a material, such as **talc**, which appears to be smeared with a thin layer of colourless grease.

green. *Adjective.* (1) Unfired as of pottery. (2) Concrete that has set but not yet reached design strength. (3) Of the colour green.

green brick. *Noun.* Formed but unfired brick.

green carbon. *Noun.* A formed but unfired carbon body.

green ceramic body. *Noun.* A ceramic shape formed by one of the normal methods that has been dried but not fired.

green concrete. *Noun.* A concrete which has set, but which has not had time to develop noticeable strength.

green copperas. *Noun.* See **ferrous sulphate**.

green cracks. *Noun.* Shrinkage cracks appearing in concrete while in the **green state**.

green density. *Noun.* The mass per unit volume of an unsintered compact.

green glass. *Noun.* (1) Glass in its natural colour; usually greenish from metallic impurities. (2) Glass made green by adding copper oxide, CuO , to a clear glass batch.

green machining. *Noun.* A technique developed to minimise the final grinding to shape and size of sintered ware, whereby the powder is cold **isostatically pressed** to a density which enables a shape to be ground from the blank before sintering.

green, malachite. *Noun.* See **malachite green**.

greenockite. *Noun.* A naturally occurring yellow mineral of cadmium sulphide, CdS . See **Pigment Yellow 37**.

green pellet. *Noun.* A pellet that has been pressed but not fired.

green rust. *Noun.* $\text{Fe}_x^{2+}\text{Fe}_y^{3+}[\text{O}_y^{2-}(\text{OH})_{2-x+y}^-]$, where x is 1.95–3.6 and y is 0.9–2.55; the OH^- ions are sometimes replaced by CO_3^{2-} or Cl^- . Colloquial expression for the precursor used to obtain the transparent yellow iron oxide pigment **goethite** of **acicular** habit 80–100 nm long and 10–20 nm diameter. These nanometre dimensions prevent light scatter and so remove **opacity**.

green sand. *Noun.* Moulding sand in the moist, as-mixed condition.

greensand. *Noun.* (1) Olive-green **sandstone** consisting mainly of **quartz** and **glauconite**. Coloured by the dull green silicates of iron and potassium. (2) A variety of **jade** found in New Zealand.

greensheet. *Noun.* The building unit for thick-film processing in device manufacture; it consists of a sheet of mixed ceramic powders some 200 μm thick capable of being handled and machined, etc., prior to sintering.

green silicon carbide. *Noun.* A finely powdered form of **silicon carbide** that contains little free carbon and as a result has an olive green colour.

green spot. *Noun.* An imperfection in ceramic bodies consisting of a prominent green spot caused by copper or copper-containing impurities in the raw materials.

green state. *Adjective.* Referring to shaped ceramic ware prior to firing.

greenstone. *Noun.* (1) Any of numerous dark green compact rocks, for example **diorite**.

green strength. *Noun.* The stress needed to deform and/or fracture unfired but formed ceramic ware that is **green state** ware.

green tourmaline. *Noun.* A gem quality form of the mineral **tourmaline** that occurs as large crystals in some **pegmatites**.

green verdite. *Noun.* A very green coloured **marble**. The colour comes from the copper it contains.

green vitriol. *Noun.* FeSO_4 . Ferrous sulphate. See **ferrous sulphate**.

greenware. *Noun.* A formed but unfired ceramic body. Ware in the **green state**.

greenware storage. *Noun.* An area or room in which **greenware** is stored while drying prior to firing.

green zircon. *Noun.* A naturally occurring form of **zirconium silicate** coloured blue from partial cation substitution. It can be cut and polished when it displays a **lustre** and fire close to that of **diamond**.

greigite. *Noun.* Fe_3S_4 . A sulphide ore of iron.

greisen. *Noun.* A **metamorphic** rock consisting mainly of **quartz** and **white mica**, formed by the pneumatolysis of **granite**.

Gr/Ep. *Abbreviation.* Stands for the advanced composite, graphite-reinforced epoxy resin matrix.

Grès de Thiviers. GT. *Noun.* A natural raw material from South West France; used as a red bulk pigment for traditional fast firing of **stoneware**. 5 wt.% GT imparts an intense red colour regardless of composition or firing cycle. A unique microstructure of **quartz** grains cemented by **goethite** enables a change from yellow goethite to red **haematite** to be protected from reactive phases, such as **feldspar**, in the mixture.

grex. *Noun.* The weight in grams of 10 km of fibre and so is used as a measure of fibre diameter.

grey. *Adjective.* A neutral tone between black and white, which has no **hue** and reflects and transmits only a little light. Alternative American spelling is **gray**.

grey body. *Noun.* A body with the same spectral emittance at all wavelengths.

grey cast iron. *Noun.* Cast iron alloyed with silicon in which the graphite has a flake-like habit so that a fracture surface appears to be grey.

greywacke. *Noun.* Coarse dark-grey **sandstone** with a matrix of clay minerals.

grid. *Noun.* (1) A network of horizontal and vertical lines superimposed over a micrograph for the purposes of quantitative microscopy. (2) An electrode situated between the anode and cathode of a valve that controls the flow of electrons between them.

grid bias. *Noun.* A fixed voltage applied between the control grid and cathode of a valve.

griffe. *Noun.* A carved ornament at the base of a ceramic column.

Griffith equation. *Noun.* A seminal equation focusing attention on the relationship between **strain energy**, **surface energy**, **flaws**, and strength of brittle solids: $\sigma = (2E\gamma/\pi c)^{1/2}$, where σ is the breaking stress, E is **Young's modulus**, γ is the **specific surface energy**, and c is one-half the length of the **critical flaw** which propagates to cause failure.

Griffith flaw. *Noun.* A microscopically small crack believed to exist on the surface of glass and ceramics, which is responsible for the reduced strengths as well as such effects as **fatigue** and **antifatigue**.

grind. *Verb.* To reduce to small particles by abrading.

grindability. *Noun.* The degree of difficulty encountered in milling or grinding a material to a smaller particle size.

grindability index. *Noun.* A numerical scale indicating the ease with which a material can be ground; parameters include the material hardness.

grinder. *Noun.* (1) A machine that pulverises and reduces the particle size of materials by impact and erosion. (2) A machine fitted with an attachment such as a grinding wheel, abrasive disk or belt, used in mechanical shaping, grinding, sharpening, cutting, polishing, honing, buffing, or lapping operations.

grinder, bench. *Noun.* See **bench grinder**.

grinder, dish. *Noun.* See **dish grinder**.

grinder, disk. *Noun.* See **disk grinder**.

grinder, impact. *Noun.* See **impact grinder**.

grinder, swing-frame. *Noun.* See **swing-frame grinder**.

grinding. *Verb.* (1) To reduce the particle size of a material by mechanical means. (2) To remove excess material from a workpiece by means of an abrasive wheel.

grinding aids. *Plural noun.* Materials added to a **ball mill**, usually a liquid, to accelerate the grinding process by changing the **zeta potential** of the solid.

grinding ball. *Noun.* A hard, dense, abrasion-resistant sphere used as a crushing body in a ball mill; usually shaped from alumina, steel, porcelain, tungsten, or flint.

grinding burn. *Noun.* The localised overheating of work during abrasive grinding.

grinding, centreless. *Noun.* See **centreless grinding**.

grinding, closed-circuit. *Noun.* See **closed-circuit grinding**.

grinding cracks. *Noun.* Cracks appearing on the surface of a workpiece during grinding due to overheating or overgrinding.

grinding, cross-feed. *Noun.* See **cross-feed grinding**.

grinding, cryogenic. *Noun.* See **cryogenic grinding**.

grinding, cylindrical. *Noun.* See **cylindrical grinding**.

grinding, dry. *Noun.* See **dry grinding**.

grinding feed. *Noun.* (1) The rate at which a material is fed automatically to a **cylindrical grinder**. (2) The rate at which solid material is introduced into a continuous pulverising mill.

grinding fluid. *Noun.* A cutting and cooling liquid, such as water or high heat-conducting oil, used in the abrasive grinding of solid surfaces to prevent grinding burns and to assist material removal through alteration of **surface potentials**.

grinding, form. *Noun.* See **form grinding**.

grinding, freehand. *Noun.* See **freehand grinding**.

grinding gauge. *Noun.* A device working to ASTM test method D1210-64 to give information about the coarse end of a suspension being milled. It consists of a heavy block with a sloping channel, from deep at one end to zero at the other, milled into the top surface. A flat scraper blade pulls a sample of the suspension across the face of the gauge from the deep channel end to the top. Where the suspension is disrupted and no longer fills the channel is a guide to the size of the largest particles. Also known as a **Hegman gauge**, **fineness-of-grind gauge** or a **chocolate gauge**.

grinding machine. *Noun.* Any machine equipped with an abrasive grinding wheel.

grinding machine, universal. *Noun.* See **universal grinding machine**.

grinding marks. *Noun.* A pattern of fine striations or score marks, usually directional, resulting from machining and grinding operations.

grinding media. *Plural noun.* The **porcelain**, **flint**, or steel balls, rods, rolls, and other materials used in grinding mills.

grinding mill. *Noun.* (1) Any machine, such as **ball**, **tube**, and **rod mills**, employed to reduce the particle size of minerals, ceramic materials, cement clinker, and other solid substance for commercial and domestic use. (2) A lapidary lathe or wheel.

grinding, offhand. *Verb.* See **offhand grinding**.

grinding pebbles. *Noun.* **Flint** and small porcelain balls employed as grinding media in ball mills, particularly in

the grinding of materials in which iron contamination should be avoided.

grinding, plunge. *Noun.* See **plunge grinding**.

grinding, precision. *Noun.* See **precision grinding**.

grinding ratio. *Noun.* The ratio of the volume of material removed from a workpiece to the volume removed from the grinding wheel.

grinding relief. *Noun.* The groove at the edge of a workpiece that overhangs the corner of the grinding wheel.

grinding, rough. *Noun.* See **rough grinding**.

grinding sensitivity. *Noun.* The susceptibility of a material to damage during grinding.

grinding, side. *Noun.* See **side-grinding**.

grinding stress. *Noun.* The residual stress, tensile or compressive, or a combination of both, generated in a workpiece during a grinding operation.

grinding, surface. *Verb.* See **surface grinding**.

grinding, thread. *Verb.* See **thread grinding**.

grinding, wet. *Verb.* See **wet-grinding**.

grinding wheel. *Noun.* A bonded abrasive wheel or disk mounted on a mechanically actuated axis for use in grinding and polishing operations.

grinding wheel, reinforced. *Noun.* See **reinforced wheel**.

grinding wheel, resinoid bonded. *Noun.* See **resinoid wheel**.

grindstone. *Noun.* A grinding wheel cut from natural **sandstone**; used for grinding, sharpening, smoothing, and shaping.

grip. *Noun.* In tensile testing it is the jaws or other device that holds the specimen.

grisaille. *Noun.* A type of porcelain-enamel artware made by firing various thicknesses of **white enamel** over a black background to produce a monochromatic decoration in shades of grey.

grit. *Noun.* (1) Coarse-grained, sharp angular granules of sand, **garnet**, **alumina**, or other substances of synthetic origin; used mainly as an abrasive. (2) A form of sandstone. See **sandstone**.

grit blasting. *Verb.* A surface treatment in which grit is impinged on the surface of an item to clean and roughen or polish it. The action depends on the size of the grit.

grit number. *Noun.* A number designating the particle size of the grit grains based on sieve analysis.

grit size. *Noun.* The particle size of **grit** and abrasive grains based on a **sieve analysis**.

gritstone. *Noun.* Any coarse sandstone that can be used as a grindstone or millstone.

grizzly. *Noun.* A screening device, consisting of parallel iron or steel bars, for the separation of coarse lumps of raw materials from smaller sizes.

grizzly chute. *Noun.* A chute made with grizzlies of decreasing size, each **grizzly** separating coarse lumps of raw materials from smaller lumps in decreasing size classification.

grizzly crusher. *Noun.* A type of crusher consisting of moving rods or bars that simultaneously crush and separate lumps of raw materials according to size.

grog. *Noun.* A ground mixture of refractory materials such as **firebrick**, **clinker**, **pottery**, **sand**, **saggers**, **crucibles**, and the like added as raw material to refractories, **saggers**, **acid-proof ware**, **terra cotta**, high-temperature porcelain, **stoneware**, **vitreous china** **sanitary ware**, **sewer pipe**, and similar products to improve working and service properties and to reduce shrinkage during drying and firing.

grog-fireclay mortar. *Noun.* A refractory mixture consisting of raw **fireclay**, **calcined fireclay** or broken **fireclay brick**, or all three, milled to a workable fineness.

grooved pipe. *Noun.* The grooved portion at the end of a pipe, regardless of its shape or dimensions, which overlaps a portion of the end of an adjoining pipe.

grooved ware. *Noun.* Pottery made in Orkney approximately 5,000 years ago; hand fashioned with a grooved decoration.

grossular garnet. *Noun.* See **garnet**.

grossularite. *Noun.* $\text{Ca}_3\text{Al}_2(\text{SiO}_4)_3$. A cubic **garnet** encountered in some calcium aluminosilicate glass cements.

gross weight. *Noun.* The total weight of a material and its container.

ground. *Noun.* A conducting connection between an electric circuit and the earth or some conductor that serves as the earth. (2) *Adjective.* Reduced to fine particles by grinding

ground coat. *Noun.* The first coat of porcelain-enamel applied to metal when subsequent coats are to be applied.

ground coat boiling. *Noun.* The undesirable evolution of gas during the firing of porcelain-enamel ground coat resulting in a variety of imperfections such as **blisters**, **pinholes**, **black speck**, **dimples**, or **spongy enamel**.

ground fireclay. *Noun.* Milled fireclay or mixtures of fireclays subjected to no treatment other than weathering.

ground fireclay mortar. *Noun.* A mortar of workable consistency composed of finely ground fireclay and water.

ground glass. *Noun.* (1) Glass with a roughened surface produced by grinding so that it can be used to diffuse light. (2) Particulate glass made by crushing and grinding.

ground granulated blast-furnace slag. *Noun.* A **pozzolanic** component added as filler to **OPC mortars**.

groundhog kiln. *Noun.* A type of art-potter's kiln constructed partly in a hillside.

ground laying. *Verb.* The application of a uniform colour, usually by dusting a powdered ceramic colour over ware or on an area of ware previously painted with adherent oil.

groundmass. *Noun.* The matrix of **igneous** rock in which larger crystals are embedded.

ground state. *Noun.* The lowest energy quantum state of an atom, molecule, or crystalline aggregate of atoms. Systems exist in the ground state until excited by whole quanta of energy.

grout. *Noun.* A mixture of **Portland cement**, **lime**, aggregate, and water blended to a troweling or pouring consistency, which is flowed into open joints or troweled into open spaces on horizontal courses of masonry. (2) *Verb.* To apply grout.

grouting, intrusion. *Verb.* See **intrusion grouting**.

groutite. *Noun.* $\alpha\text{-MnOOH}$. A rhombic modification of **manganite**.

grunerite. *Noun.* An asbestiform mineral. See **amosite**.

g-Si₃N₄. *Noun.* A high pressure **polymorph** of silicon nitride with the **spinel** structure. See **silicon nitride**.

GST. *Abbreviation.* Stands for a group of alloys based on germanium-antimony-tellurium that can change phase between crystalline and amorphous in response to **laser** or electrical stimulus and have been used as **optical storage devices** exploiting the fact that the change is reversible with short intense bursts collapsing the crystal and long weaker burst restoring the crystal

guard. *Noun.* (1) A shield around a grinding wheel to protect a workman from injury. (2) Any attachment or cover placed on a machine to protect an operator or other person in the vicinity.

Guarded Hot Plate Method. *Noun.* An **ASTM** method of measuring thermal conductivity. See **Fourier equation**.

guard ring. *Noun.* A ring-shaped device surrounding a test specimen to ensure an even distribution of heat in heat-flow experiments.

guide eye. *Noun.* A ceramic loop through which fibre passes when transferring from the creel to the mandrel in a filament winding process.

guilloche. *Noun.* A form of decoration consisting of interlaced wavy bands.

guillotine cutter. *Noun.* A mechanically or manually operated heavy steel knife used to cut through and trim material.

gum arabic. *Noun.* A water-soluble gum from acacia trees used as a binder in bodies, and in glaze and porcelain-enamel slips. Also known as **acacia gum**, **gum Senegal**, **gum Kordofan**.

gumbotil. *Noun.* Sticky clay formed by the weathering of glacial drift.

gum Kordofan. *Noun.* See **gum arabic**.

gummite. *Noun.* A naturally occurring mixture of materials, mostly amorphous, containing much lead, uranium, and thorium hydrated oxides; yellow-brown to black with **greasy** or **glassy lustre**.

gum Senegal. *Noun.* See **gum arabic**.

gum set. *Verb.* The abnormal, erratic, quick setting of cement in concrete.

gum tragacanth. *Noun.* Mucilaginous exudate, part soluble, of Asian shrubs; used as a binder in glaze and porcelain-enamel slips, and as an adhesive to bond dry-process enamels to metals.

gunflint. *Noun.* A small piece of **flint** used to strike a hammer and cause a spark.

gunite. *Noun.* A mixture of sand or crushed slag, cement, and water applied pneumatically or sprayed to give a very dense, strong concrete layer. Used to repair shafts and tunnels etc.

Gunn diode. *Noun.* A device based on thin crystals of GaAs, InP, or GdTe where a rapid repetitive fluctuation of current in the crystal sustained by a low voltage, 6 V, has a very high frequency. It is caused by the repeated motion of dipole domains along the specimen toward the anode. Signal frequency is around 109 Hz, which means that compact, low power, microwave sources can be built.

gurglet. *Noun.* See **goglet**.

gutta. *Noun.* One of a set of small drop-like ornaments in stone or ceramic used to decorate some architectural features.

gutta percha. *Noun.* A whitish latex with rubber-like properties obtained from several types of tropical tree; used as electrical insulation and a waterproof material.

GWd/tHM. *Abbreviation.* It is the way the amount of energy extracted from nuclear fuel is expressed. It stands for gigawatt day per tonne of heavy metal

present in the fuel at the start of irradiation. 1 GWd is equivalent to 8.64×10^{13} J.

gypsum. *Noun.* See **calcium sulphate**.

gypsum board. *Noun.* A flat paper-covered board of set **calcium sulphate** such as is used in the construction of walls.

gypsum cement. *Noun.* A group of cements and plasters made principally from **calcium sulphate**; produced by mixing it with selected additions, such as sand, **alum**, **borax**, and **potassium carbonate** with sufficient water to make a trowelable consistency.

gypsum lath. *Noun.* Flat, paper-covered plasterboard that has been treated to receive a plaster coating for use in the construction of walls.

gypsum plank. *Noun.* A precast, wire-mesh-reinforced gypsum product made with tongue and groove steel edgings for use as roofing, ceiling, and flooring in buildings.

gypsum plaster. *Noun.* A plaster composed essentially of **gypsum** mixed with water to a troweling consistency.

gypsum wallboard. *Noun.* **Plasterboard** covered with paper or other fibrous material suitable for painting or papering.

gyratory crusher. *Noun.* A large primary crusher consisting of a rounded crushing head mounted on a vertical shaft in a conical shell, the unit rotating on an eccentric axis.

gyratory screen. *Noun.* A vertical nest of horizontal screens of decreasing mesh size rotating on an eccentric axis employed to determine the particle size distribution of powdered or granular materials, or to separate and collect quantities of a material of specified maximum and minimum sizes.

gyromagnetic. *Adjective.* Concerning magnetic properties arising from the spin of a charged particle.

gyromagnetic ratio. *Noun.* The ratio of the **magnetic moment** of a spinning charged particle to its angular momentum.

gyrophora-esculenta-like. *Adjective.* Platelet shaped **carbon** particles arising from some production methods involving extremely rapid and cooling under pressure that have the appearance of curved ridges and of being formed from aggregates of complex lamellae.

Hh

h. *Symbol.* Stands for **Planck constant**.

H. *Symbol.* Standing for: (1) **enthalpy**; (2) hydrogen; (3) magnetic field strength; (4) henry or henries; (5) In **cement notation** it stands for water, H_2O .

h or H. *Abbreviation.* Standing for: (1) hour; (2) hardness, with a subscript to denote the method, e.g., H_v is the **Vickers hardness**.

H3 centre. *Noun.* A defect in **diamond** where a carbon atom vacancy is adjacent to a cluster of three nitrogen substituent atoms. This defect induces an orange-brown hue in the crystal. The H notation signifies that heating has been used to bring about vacancy diffusion to the nitrogen cluster.

H4 centre. *Noun.* A colour forming defect in **diamond** caused by a carbon vacancy being adjacent to a cluster of four nitrogen atoms substituted for carbon. Heat has been used to cause the vacancy to diffuse.

habit. *Noun.* Short for **crystal habit**; the characteristic crystalline shape or aggregate structure exhibited by a mineral.

habit plane. *Noun.* The plane, identified by its **Miller indices**, that commonly forms the external surfaces of a crystal of a given material.

hack. *Noun.* A more or less orderly stack of newly formed brick set on boards to dry.

hack hammer. *Noun.* A tool shaped like an adze; used for dressing stone.

hacking. *Verb.* (1) The replacement of a single course of masonry with two or more lower courses. (2) The laying of brick with the bottom edge set in from the plane surface of a wall. (3) The process of stacking brick in a kiln or on a kiln car for firing. (4) Dressing stone.

hackle marks. *Noun.* Fine ridges on a glass surface parallel to the direction a fracture propagates. They occur after the **mirror zone**, radiating from the circumference of the **fracture mirror** surface.

haematite. *Noun.* $\alpha\text{-Fe}_2\text{O}_3$. Red iron ore composed essentially of Fe_2O_3 . The most important source of iron and an important red pigment. The stable iron oxide, which is the end member of transformations of other iron oxides. Density 4,900–5,300 kg m^{-3} ; hardness (Mohs) about 6.

haematite (black). *Noun.* $\text{BaMn}_9\text{O}_{16}(\text{OH})_4$. A mineral source of manganese; density 3,700–4,700 kg m^{-3} ; hardness (Mohs) 5–6.

haematite (brown). *Noun.* $\text{FeO}(\text{OH})\cdot n(\text{H}_2\text{O})$. A minor ore of iron sometimes used as a yellow ceramic pigment. Density 3,600–4,000 kg m^{-3} ; hardness (Mohs) 5–5.5. Also called **kidney ore** because of the appearance of lumps of the ore.

hafnia. *Noun.* Colloquial name for hafnium oxide. See **hafnium oxide**.

hafnium boride. *Noun.* (1) HfB_2 . Used for high-temperature-resistant products for nuclear applications. Mp 3,000 °C; density 11,200 kg m^{-3} . (2) HfB ; used in control rods for nuclear reactors. Mp 2,899 °C; density 12,800 kg m^{-3} ; hardness (Knoop) 27.2 GN m^{-2}

hafnium nitride. *Noun.* HfN . A refractory hard metal. Mp 3,300 °C; density 14,000 kg m^{-3} ; hardness (Mohs) 8–9. See **refractory hard metal**.

hafnium oxide. *Noun.* HfO_2 . Used in refractories to lower thermal expansion. Mp 2,790 °C; density 9,700 kg m^{-3} .

hafnium silicate. *Noun.* HfSiO_4 . A discrete ionic tetrahedral silicate.

hafnium silicide. *Noun.* (1) Hf_3Si_3 . Mp 2,299 °C. (2) HfSi . Mp 2,099 °C. (3) HfSi_2 . Mp 1,699 °C; density 8,030 kg m^{-3} ; hardness (Vickers) 8.49 GN m^{-2} . All have refractory uses.

hafnium titanate. *Noun.* HfTiO_4 . **Nonstoichiometric** forms have semiconducting properties. Mp approx. 2,200 °C; density 7,200 kg m^{-3} .

hair cracks. *Noun.* A pattern of hair-like cracks in concrete that occur when the surface layer of concrete dries more rapidly than the interior.

hairline. *Noun.* A faint single line on the surface of a glass container.

hairlines. *Plural noun.* A porcelain-enamel imperfection consisting of a series of small hair-like cracks which appear to follow the strain pattern in the metal and which are visible after the coating has been fired.

hair pin furnace. *Noun.* A continuous porcelain-enamelling furnace constructed in the shape of a hairpin, the firing zone being located in the turn.

hairweight. H. *Noun.* The mass per unit length of a fibre expressed as $\text{g cm}^{-1} \times 10^{-8}$.

half-bat. *Noun.* Building bricks one-half the length of a conventional brick, approximately 10.2 cm.

half-finish. *Noun.* The first cover coat of a two-coat porcelain-enamel system.

half-Heusler alloy. *Noun.* AlLiSi . A **thermoelectric** material. All the atoms are located on a **bcc lattice** within which the Si and Al form a **rock salt structure** and the Li atoms with either the Si or Al form the **zinc blende** structure.

half-life. *Noun.* The period of time in which one-half of the radioactive atoms of a given radionuclide will decay.

half-timbered. *Noun.* A type of building construction in which **stucco**, brick, plaster, or other masonry is applied between exposed load-bearing timbers.

halftone. *Noun.* A screen print where dark and light tones are represented by dots of sizes proportional to the shades they must portray; small dots produce light tones.

half-trimmed mica. *Noun.* Mica trimmed on two sides, two-thirds of which are trimmed adjacent sides and the balance on parallel sides, all of which are crack-free.

halide. *Noun.* A binary compound of a halogen element or ion and a more electropositive element.

halite. *Noun.* NaCl . The mineralogical name for sodium chloride found as masses of interlocking crystals, commonly of cubic habit. Normally grey because of included clay but can occur in many coloured forms; hardness (Mohs) 2; density $2,170 \text{ kg m}^{-3}$.

Hall coefficient. *Noun.* See **Hall effect**.

Hall effect. *Noun.* The electromotive force generated when a current-carrying material is placed in a magnetic field, which usually is perpendicular to the direction of current flow, and the electric field, which usually is perpendicular to both. $E_H = iRB$, where E_H is the **electric field** strength, R is the **Hall coefficient**, i is the current, and B is the **magnetic field strength**.

Hall-Petch relationship. *Noun.* A statement that the yield stress, σ_y , increases inversely as a function of grain size: $\sigma_y = \sigma_0 + Kd^{-1/2}$, where d is the average grain diameter and K is a materials constant. The relationship occurs because **dislocations** moving across any grain must form pile-ups at the **grain boundary** in order to generate sufficient stress to punch new dislocations in the next grain.

halo. *Noun.* (1) A hazy area emanating from a fire decoration. (2) *Plural*; halos; channel-like pores surrounding grains of one phase in some two-phase refractory ceramics, caused by thermal expansion mismatch. It limits crack propagation in the grain boundary region and so gives increased toughness and **spalling** resistance.

halloysite. *Noun.* $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4 \cdot x\text{H}_2\text{O}$. A kaolin-like mineral used in the production of dinnerware and refractories. **Kaolinite** composition plus extra inter layer-water, which causes the sheets to become cylindrical. $\text{Mp} > 1,500^\circ\text{C}$.

Halpin-Kardos equation. *Noun.* This expresses the relationship between **critical fibre aspect ratio**, the tensile strength of the fibre, and the matrix shear strength in a composite: $[l/d]_c = \sigma_{fu}/2\tau_m$, where l and d are the fibre length and diameter respectively, σ_{fu} is the ultimate tensile strength of the fibre, and τ_m is the matrix shear strength.

Halpin-Tsai equations. *Plural noun.* A series of expressions of the **simple law of mixtures** applying to the properties of fibre composites dependent on the fibre shape, size, and distribution. For example, very long fibres lying parallel to the direction of applied stress produce a composite **Young's modulus**: $E_u = fE_f + E_m(1 - f)$, where f is the fibre volume fraction and the subscripts f and m relate to fibre and matrix, respectively.

Hamaker constants. *Plural noun.* Systems constants, whose values depend on the atomic constituents of powders and the liquids they are dispersed in, which are used in the equations relating electronic energies to solid particle attractions and their separation distances.

Hamburg blue. *Noun.* A general term for a variety of iron containing pigments.

Hamiltonian. H. *Noun.* A mathematical function of the coordinates and momenta of a system of particles used to express their equations of motion. (2) A mathematical operator that generates such a function.

hammer, klebe. *Noun.* See **klebe hammer**.

hammer mill. *Noun.* An impact mill or crusher consisting of rotating hammers in a rigid metal casing; used to crush ores and other large solid masses, usually preparatory for further milling.

hammer test. *Noun.* Any of a series of tests in which weights are dropped on specimens until fracture or deformation occurs in the specimens.

hand-blown. *Adjective.* Glassware formed at the end of a blowpipe with air supplied by mouth, the ware being shaped by hand manipulation.

hand-feed. *Verb.* To introduce or advance a material into a process by hand, such as a grinding or machining operation.

hand glass. *Noun.* (1) A magnifying lens with a handle. (2) A small mirror with a handle.

hand jig. *Noun.* A moving-screen **jig** operated by hand that is used to treat small batches of ore; the jig is attached to a rocking-type beam moving in a tank of water.

hand lay-up. *Noun.* A manufacturing process whereby individual pieces of chemically bound fibre mat are cut and pressed into shape by hand before heating to consolidate the shape. A mould of wood or plaster is first made and covered with release agent. Successive layers of mat and resin are used to build-up the dimensions.

handmade brick. *Noun.* Brick shaped in a mould by hand manipulation; the shape may or may not be subject to subsequent mechanical pressing after partial drying. They have a highly textured creased face. Also known as **sort-mud process** brick.

hanging rack. *Noun.* A heat-resistant metal frame suspended in a conveyor system on which porcelain-enamelled ware is hung and transported during processing and firing operations.

hank. *Noun.* A looped bundle of fibres or yarn.

haplite. *Noun.* See **aplite**.

Harcourt test. *Noun.* A method to assess the thermal and strength properties of glazes on tiles. It is a variation of the Harkort crazing test. Tiles with a **water absorption value** $\leq 10\%$ are immersed in water for 5 min at $15 \pm 5^\circ\text{C}$ before heating to 105°C for 20 min. This procedure is repeated 10 times. The surface cracks are revealed with methylene blue and then counted. See **Harkort crazing test**.

hard. *Adjective.* (1) Resistant to abrasion, scratching, cutting, etc. This property is not synonymous with strength. (2) Having a higher than conventional softening or fusion temperature.

hard-burned brick. *Noun.* Any brick, usually a **refractory brick**, fired at a high temperature, sometimes higher than normal.

hard coal. *Noun.* Another name for anthracite. See **anthracite**. See **coal rank**.

hard core. *Noun.* Material, such as broken bricks, stones etc., used to form a foundation of a building etc.

hard disk. *Noun.* A rigid magnetisable material used to store data for computers.

hardener. *Noun.* A chemical compound added to a plastic composition to promote curing and produce a solid matrix with elastic properties and no yield point.

hardening. *Noun.* (1) The process of increasing the hardness by heating or cooling. (2) The process of adding another substance to a material to make it harder.

hardening on. *Verb.* To volatilise oils from decorating liquids and pastes applied to **bisque** ceramic ware and then fusing or hardening the decoration just enough to permit the application of a glaze or other treatment without damage to the decoration.

hard-finished plaster. *Noun.* Over burned gypsum treated with a solution of alum or other material and then re-calcined; used in special cements. See **Parian** and **Keene's** cements.

hard-fired ware. *Noun.* Ceramic ware fired to a high temperature, usually to produce a product of high physical strength and low water-absorption properties.

hard flame. *Noun.* A dark-blue steady flame resulting from combustion of the perfect gas-air mixture. The most efficient for heating.

hard glass. *Noun.* A glass having a high-temperature softening point, high viscosity at elevated temperatures, or high resistance to abrasion, scratching, or other mechanical damage, or any combination of these properties

hard glass enamel. *Noun.* A specially formulated enamel frit to obtain high hardness and acid or alkali resistance. The result is a high firing temperature.

Hardinge mill. *Noun.* A continuous-type **ball mill** of tri-cone construction in which each successive cone has a steeper wall from the feed to the discharge end; the mill sometimes is equipped with a cyclone separator to return oversized particles for additional grinding.

hard magnetic material. *Noun.* A **ferri-** or **ferro-magnetic** material that has large **coercive field** and **remanence** values. They usually find use in permanent magnet applications.

hard metal. *Noun.* See **refractory hard metal**.

hard mica. *Noun.* **Mica** that does not laminate when bent.

hardness. *Noun.* (1) The relative resistance of a body surface to **wear**, abrasion, or similar physical damage. (2) The relative refractoriness of a glaze, glass, or porcelain-enamel. (3) When applied to atoms it defines how easily the number of electrons can be changed. The expression $(I-A)/2$ defines it, where I is the **ionisation potential** and A is the **electron affinity** of the atom or molecule measured in **electron volts**. Hard atoms are least chemically reactive.

hardness, Brinell. *Noun.* See **Brinell test**.

hardness, Knoop. *Noun.* See **Knoop hardness**.

hardness, Mohs. *Noun.* See **Mohs hardness**.

hardness, Rockwell. *Noun.* See **Rockwell hardness**.

hardness scale. *Noun.* A measure of the relative hardness of materials dependent on the way the hardness is measured; thus there are several: **Mohs**, **Vickers**, **Knoop**, **Brinell**, etc.

hardpan. *Noun.* A hard impervious layer of clay beneath the soil that is resistant to drainage and root growth.

hard paste. *Noun.* (1) A **high-fired** china body containing substantial amounts of **feldspar**. (2) See **pâté dure**.

hard porcelain. *Noun.* A porcelain body highly resistant to thermal shock.

hardrock. *Adjective.* Mining that is concerned with rock and excludes coal mining.

hard solder. *Noun.* A solder that melts at temperatures above 370 °C; used in brazing metallised ceramics in the production of glass-to-metal seals.

hard sphere model. *Noun.* A structural model for solids in which atoms or ions are considered to be undeformable hard spheres that pack together as close as possible.

hard-tip, soft spring lithography. *Noun.* An inexpensive device for rapid prototyping of nanoscale devices and structures. A soft polymer backing that supports sharp silicon tips is used as the print head. This arrangement allows all the tips to come into contact with the surface in a uniform manner and produces a pattern with high resolution and density.

Harkort crazing test. *Noun.* A crazing test for glazes in which a specimen is heated to 120 °C and plunged into cold water, the test is then repeated by increasing the specimen temperature in increments of 10 °C until visible crazing occurs.

harl. *Verb.* To cover a wall with **lime** and **gravel**.

harmotome. *Noun.* $\text{Ba}(\text{Al}_2\text{Si}_6\text{O}_{16}) \cdot 6\text{H}_2\text{O}$. A **zeolitic** mineral usually found as monoclinic **twinned** crystals.

harsh. *Adjective.* An unworkable, non-plastic, non-cohesive mix that tends to segregate during working, particularly a concrete mix.

Hartman dispersion formula. *Noun.* The relationship of the index of refraction and the wavelengths of incident light of a glass expressed as: $n = n_0 a(\lambda - \lambda_0)$, in which n is the index of refraction, λ is the wavelength, and n_0 , a , and λ_0 are empirical constants.

Hashin-Rosen model. *Noun.* A first-order approach to calculating the mechanical properties of particulate composites based on the following assumptions: all phases are homogeneous and perfectly elastic; the reinforcement is perfectly spherical; perfect matrix-reinforcement bonding exists; low-particle-volume fractions only occur so that a **simple law of mixtures** can apply.

Hastelloy. *Trade name, noun.* A proprietary nickel-base alloy of high chemical resistance, heat resistance, and mechanical strength used in agitators, autoclaves, heat exchangers, driers, burners, blowers, pickling equipment, furnace parts, and similar applications where resistance to corrosion and physical strength at elevated temperatures are required.

haul-off roller. *Noun.* The first driven roller around which an extruded fibre passes after leaving the fibre preparation area. This roller's surface speed determines the spin: stretch ratio.

haunch. *Noun.* The section of the arch of a furnace or kiln located between the **crown** and **skewback**.

hausmannite. *Noun.* MnMn_2O_4 . **Manganese oxide**; a naturally occurring **spinel** with **ferromagnetic** properties and a tetragonal crystal structure.

hawk. *Noun.* A small square board with a handle underneath used for carrying wet mortar or plaster. Also called **mortar board**.

haydite. *Noun.* Expanded clay, shale, slate, or similar material employed as an aggregate in the production of lightweight concrete and concrete products.

haze. *Adjective.* A cloudy appearance of transparent material caused by light scattering from internal and external surfaces.

HBT. *Abbreviation.* Stands for heterojunction bipolar transistor. See **bipolar metal oxide semiconductor**.

HCA. *Abbreviation.* Stands for hydroxycarbonate apatite. See **hydroxycarbonate apatite**.

hcp. *Abbreviation.* Stands for hexagonal close packed with reference to crystal structure. See **hexagonal close-packed**.

HDDR processing. *Abbreviation.* Stands for hydrogen decomposition-desorption recombination processing. See **hydrogen decomposition-desorption recombination processing**.

HDT. *Abbreviation.* Stands for heat deflection temperature. See **heat deflection temperature**.

header. *Noun.* (1) A brick or stone laid with an end exposed and its length perpendicular to the face of a wall. (2) A tank or hopper that maintains a gravity feed or static fluid pressure in a piece of equipment.

header course. *Noun.* A type of construction in which an entire row, or **course**, of brick is laid as **headers**.

header, false. *Noun.* See **false header**.

header high. *Noun.* Vertical height to the top of a brick course immediately under a **header course**.

header, snap. *Noun.* See **snap header**.

header tile. *Noun.* A tile designed to provide recesses for **header** units in masonry walls.

head lap. *Noun.* The distance between the lower edge of an overlapping **asbestos-cement shingle** or sheet and the upper edge of the lapped shingle in the second course below.

head space. *Noun.* The unfilled space in closed bottles or other containers. See **ullage**.

headstock. *Noun.* The part of a machine, such as a lathe, that supports and transmits the drive to the **chuck**.

headstone. *Noun.* (1) Alternative name for **keystone**. (2) An inscribed stone at the head of a grave.

head, wheel. *Noun.* See **wheel head**.

healing. *Noun.* The process or the ability of a porcelain-enamel, glaze, or other ceramic coating to flow and cover surface imperfections during the firing. Also called **healing power**.

healing power. *Noun.* See **healing**.

hearth. *Noun.* The refractory floor of a furnace, kiln, or **cupola** upon which a charge is placed for melting, sintering, or other heat treatment.

hearth furnace. *Noun.* A type of furnace in which a charge is heat-treated while resting on the furnace floor, or hearth.

hearth roasting. *Noun.* A process for the heat treatment or roasting of ores and other materials on the hearth of a furnace with an excess of air, without fusion, to bring about useful changes in the physical properties of the materials.

hearthstone. *Noun.* (1) A stone that forms a **hearth**. (2) A soft stone used to clean and colour or whiten floors and steps.

heat, q. *Noun.* (1) Any form of energy causing a rise in temperature or which may be translated into some form of work involving mechanical energy, fusion, evaporation, expansion, etc. It is measured in **Joules** and it is an **extrinsic** quantity and so it depends on the size of the system undergoing change, hence associated with moles, for example **heat of formation** is measured in kJ mol^{-1} . (2) The random kinetic energy of atoms and molecules in a solid.

heat-absorbing glass. *Noun.* Any glass capable of absorbing radiant energy in the near-infrared range of the spectrum.

heat affected zone. *Noun.* The volume of material not melted in a brazing or welding operation but whose microstructure the process changes.

heat, available. *Noun.* See **available heat**.

heat balance. *Noun.* The equilibrium existing in a body when the heat gain and the heat loss from all sources are equal.

heat barrier. *Noun.* Any material of low thermal conductivity used to prevent the transfer or movement of heat from a source to another part or substance.

heat capacity. C_p, C_v . *Noun.* The amount of heat required to raise the temperature of a unit mass of a substance one degree, usually under some constant condition such as volume or pressure; the units are $\text{J kg}^{-1} \text{K}^{-1}$. See **specific heat capacity** and **molar heat capacity**.

heat checking. *Noun.* Development of fine cracks due to cyclical heating and cooling.

heat conduction. *Noun.* The transfer or movement of heat between two parts of a system that does not require movement of the system or any of its parts.

heat content. *Noun.* Another name for **enthalpy**. The sum of the **internal energy** contained in a body or system and the product of its volume multiplied by the pressure.

heat convection. *Noun.* The movement or transfer of heat by means of a circulating liquid or gas.

heat deflection temperature. *Noun.* The temperature at which sensible structural deflection first occurs when a shape is heated.

heater. *Noun.* Any device designed to produce and transfer heat.

heat exchanger. *Noun.* A device used to transfer heat from a fluid flowing on one side of a barrier to a fluid flowing on the other side of the barrier; for example, steam driers, muffle furnaces, water-cooled furnaces, nuclear reactors, etc.

heat flow. *Noun.* The movement of heat through a substance or the transfer of heat from one substance to another, usually reported as the quantity of heat moved per unit of time.

heating chamber. *Noun.* The section of a furnace or kiln in which ware is subjected to heat during a firing operation.

heating element. *Noun.* (1) A coil or other arrangement of in which heat is produced by an electric current. (2) A rod or spiral of semiconducting ceramic, such as **silicon carbide** or **molybdenum silicide**.

heating, induction. *Noun.* See **induction heating**.

heating, radiant. *Noun.* See **radiant heating**.

heating, radio-frequency. *Noun.* See **radio-frequency heating**.

heat insulator. *Noun.* A material of low thermal conductivity for example, foamed clays and concrete, glassy mineral wool, foamed glass, etc.

heat, latent. *Noun.* See **latent heat**.

heat of adsorption. *Noun.* The quantity of heat evolved when 1 mol of a material is absorbed by another at constant pressure.

heat of adsorption, differential. *Noun.* See **differential heat adsorption**.

heat of adsorption, integral. *Noun.* See **integral heat of adsorption**.

heat of combustion. *Noun.* The amount of heat evolved when 1 g mole of a substance is completely burned.

heat exchanger. *Noun.* An arrangement for transferring heat from one fluid to another without allowing them to mix.

heat of formation. *Noun.* The heat evolved or absorbed when 1 mol of a compound is formed from its elements.

heat of fusion. *Noun.* The quantity of heat required to convert 1 g mole of a solid to the liquid state at the melting point.

heat of fusion, latent. *Noun.* See **latent heat of fusion**.

heat of hydration. *Noun.* The amount of heat evolved during the **hydration** of a substance such as occurs during the hardening or curing of cements and concrete.

heat of mixing. *Noun.* The heat change that occurs when x_a moles of A, x_b moles of B etc., are mixed to give 1 mol of solution. It is zero for an ideal solution, negative for a solution showing compound formation and positive for immiscibility. If the value lies in the range -16 to $+16$ kJ mol⁻¹ it is taken to be a regular solution.

heat of reaction. *Noun.* The change in **enthalpy** occurring when reactants at temperature T and pressure p are transformed to products at the same temperature and pressure. Since temperature is a variable, published values are quoted for 298.1 K and 1 atm pressure.

heat of segregation. *Noun.* A calculated parameter that is a measure of the energy change when impurity ions segregate to a free surface. The energy required to substitute an impurity ion in the bulk ceramic is calculated and then the calculation is repeated for a surface site and the difference is the heat of segregation.

heat of solution. *Noun.* The heat evolved or absorbed when 1 mol of a substance dissolves completely in a large volume of solvent.

heat shield. *Noun.* A coating with poor thermal conductivity used for shielding from excessive heat.

heat sink. *Noun.* A material, usually a good conductor specially designed to take heat away from electrical and other sensitive components.

heat of transition. *Noun.* The heat evolved or absorbed when a unit mass of a substance is converted from one **polymorph** to another; units are kJ mol⁻¹ or kJ (g atom)⁻¹.

heat of vaporisation, latent. *Noun.* See **latent heat of vaporisation**.

heat pattern. *Plural noun.* Graduated heating zones produced by spacing active **emitters** on a module.

heat pump. *Noun.* Any device that uses mechanical work to transfer heat from a low temperature source to one at a higher temperature.

heat-resistant glass. *Noun.* A glass of low thermal expansion and high resistance to thermal shock such as occurs when the glass is cooled suddenly from an elevated temperature. This inevitably involves high concentrations of **silica** in the composition.

heat, sensible. *Noun.* See **sensible heat**.

heat-setting mortar. *Noun.* A finely ground **refractory mortar** which develops its strength at elevated temperatures.

heat-setting refractory. *Noun.* Finely ground refractory material that develops a ceramic-type bond at elevated temperatures.

heat shield. *Noun.* A layer of substance that provides protection from heat.

heat sink. *Noun.* A device for the transfer of heat away from a sensitive component.

heat, specific. *Noun.* See **specific heat**.

heat-strengthened glass. *Noun.* Glass subjected to a programmed heat treatment to improve its physical strength.

heat transfer. *Noun.* The movement of heat within a body or from one body to another body. Three different processes transfer heat: **thermal conduction**, where heat diffuses through a material; **thermal convection**, where a circulating current in a fluid carries heat; and **thermal radiation**, where heat is transferred by **electromagnetic waves**.

heat transfer coefficient, h. *Noun.* A measure of the heat energy transferred from the surface of a material to a sink. Its value depends on the variables: initial temperature, gas flow rate, atmosphere composition and force of contact; the units are Wm⁻² K⁻¹. Typically, air moving at 120 kg m⁻² s⁻¹ past a ceramic cylinder has a value for h of 500 Wm⁻² K⁻¹.

heat treatment. *Noun.* The process of subjecting a material or body to controlled conditions of heating and cooling to develop specific properties in the material or body such as strength, thermal-shock resistance, etc.

heat work. *Noun.* A concept arising from time-temperature profiles used to fire ceramic ware. It is the integrated area under the time-temperature curve and is related to the work or energy required to achieve densification.

heavy aggregate. *Noun.* Aggregate having a high **specific gravity**, such as steel punching, **magnetite**, barium compounds, etc., used in the production of heavy concrete for special applications.

heavy concrete. *Noun.* A concrete in which part or all of the conventional aggregate is replaced by metal punching, **magnetite**, barium compounds, and similar materials to produce a concrete of high density for use in the production of counterweights, **nuclear shielding**, and other specialised applications.

heavy duty. *Adjective.* Made so as to withstand hard wear, severe conditions, etc.

heavy earth. *Noun.* Another name for **barium oxide**.

heavy fermion. *Noun.* Highly correlated electron behaviour. See **Kondo fermion**.

heavy fermion materials. *Noun.* Some **borides** and **silicides**, such as UB_{13} , CeCuSi_{22} , and some metal alloys, that contain heavy electrons with an effective mass some 10^3 greater than the free electron mass, in open 4f or 5f shells and light electrons in broad spd-bands. See **Kondo fermion**.

heavy media. *Plural noun.* Any fluid of high density used in flotation processes for the removal of low-density aggregate particles from mineral raw materials.

heavy metal fluoride glass. *Noun.* Glasses made from lanthanide fluorides, zirconium fluoride and lead fluoride etc. Used to make optical fibres and low-loss infrared fibres. See **fluorozirconate glass**.

heavy metal oxide glasses. *Noun.* Glasses that contain heavy metal oxides and none of the traditional glass-forming oxides. They are found in the systems: $\text{PbO-Ga}_2\text{O}_3$ and $\text{PbOBi}_2\text{O}_3\text{-Ga}_2\text{O}_3$. Typical composition is 40 cation % PbO , 35 % Bi_2O_3 , 25 % Ga_2O_3 ; all possess high optical nonlinearity.

heavy oil. *Noun.* A mixture of hydrocarbons distilled from coal tar, heavier than water.

heavy spar. *Noun.* Barium sulphate, BaSO_4 ; sometimes used as flux in **stoneware** bodies and glazes; employed in glass as a flux to reduce **seeds**, increase toughness, increase brilliance, reduce annealing time, and prevent **devitrification**.

heavy water. *Noun.* Water containing substantial amounts of deuterium, an isotope of hydrogen having an atomic weight of 2.014; used as a moderator in some nuclear reactors.

heavy water reactor. *Noun.* A nuclear reactor in which **heavy water** is used as a **moderator**.

hectorite. *Noun.* $(\text{Ca}, \text{Li})_{0.315-2.07}(\text{Al}, \text{Mg}, \text{Fe})_2(\text{Si}, \text{Al})_4\text{O}_{10}(\text{OH})_2 \cdot n\text{H}_2\text{O}$. A **phyllosilicate** of the **montmorillonite** clay mineral class, composed of a hydrous silicate of lithium and magnesium.

hedenbergite. *Noun.* $\text{CaFe}(\text{SiO}_3)_2$. Calcium iron **pyroxene**; forms the **augite** solid solution series with **diopside**.

heel tap. *Noun.* An imperfection in glass bottles characterised by a bottom of uneven thickness.

Hegman gauge. *Noun.* See **grinding gauge**.

Heisenberg antiferromagnet. *Noun.* See **rare earth nickelates**.

helical. *Adjective.* A cylindrical spiral, such as a thread on a bolt.

helical dislocation. *Noun.* See **screw dislocation**.

helical reinforcement. *Noun.* Used in concrete technology to restrain lateral movement of a beam under compression; it consists of thin reinforcement wound around the main vertical reinforcement of a column.

helical screw feeder. *Noun.* A tube enclosing a screw that conveys and meters dry powders from a supply bin.

helical winding. *Noun.* A winding in which the filament advances at an angle in a helical path.

helicoid. *Adjective.* Having the shape of a flattened coil.

Helmholtz function. A or F. *Noun.* A thermodynamic property of a system equal to the difference between its **internal energy** and the product of its temperature and its **entropy**. Also called **Helmholtz free energy**.

Helmholtz free energy. *Noun.* See **Helmholtz function**.

Helmholtz inner layer. *Noun.* See **electrical double layer**.

Helmholtz outer layer. *Noun.* See **electrical double layer**.

Helmholtz planes. *Noun.* See **β -plane** and **d-plane**.

hematite. *Noun.* Alternative, American spelling of haematite. See **haematite**.

hemicrystalline. *Adjective.* An earlier name for hypocrystalline. See **hypocrystalline**.

hemihedral. *Adjective.* Referring to crystals that exhibit only half the number of planes needed for complete symmetry.

hemihydrate. *Noun.* A hydrated crystal in which there are two molecules of substance for every one molecule of water.

hemimicelles. *Noun.* Clusters of surfactant molecules on the surface of a solid adsorbent formed by interaction of the non-polar parts of sorbed molecules.

hemimorphic. *Adjective.* Having different forms at each end of an axis in a crystal.

hemimorphite. *Noun.* $\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$. A white **pyrosilicate** zinc ore in the orthorhombic crystal system. Part of a mixture known as **calamine** when found with **smithsonite**, ZnCO_3 .

hemming machine. *Noun.* (1) A device employed to form an edge on a metal sheet by bending the edge of the metal back onto itself for increased edge strength. (2) A machine designed for the grinding of flat surfaces such as knife blades, skate runners, etc.

HEMT. *Abbreviation.* Standing for high-electron-mobility transistor. See **high-electron-mobility transistor**.

henry. H. *Noun.* The **SI unit** of electric inductance; it is the inductance of a closed circuit in which an emf of 1 V is produced when a current varies uniformly at a rate of 1 A s^{-1} .

Henry's law. *Noun.* The principle that the mass of a gas dissolved in a given quantity of liquid is proportional to the pressure of the gas. More generally it relates to dilute solutions in which changes in the concentration of a solute component generate linearly proportional changes in its thermodynamic properties.

hercynite. *Noun.* FeAl_2O_4 . Commonly found **spinel** phase present in **emery** deposits; mp $1,780^\circ\text{C}$; hardness (Mohs) 7.5–8; density $4,390 \text{ kg m}^{-3}$. Also known as **iron spinel**.

Herdan mean diameter. D[4,3]. *Noun.* A particle size average derived from particle size volume distribution via: $D[4,3] = \frac{\int_{D_1}^{D_2} D_n^4(D) dD}{\int_{D_1}^{D_2} D_n^3(D) dD}$, where D_1 and D_2 are the limits of integration and $n(D)$ is the diameter distribution function, which is the number fraction of particles with diameter D . Also called the **volume-moment mean diameter**.

Hermansen furnace. *Noun.* A glass-melting pot furnace of a **recuperative** design.

hermetic. *Adjective.* (1) Sealed so as to be airtight. (2) Of or relating to ancient science.

Herreshoff furnace. *Noun.* A mechanical, multiple-deck muffle furnace cylindrical in shape.

hertz. Hz. *Noun.* The derived **SI unit** of frequency. The frequency of a periodic phenomenon that has a periodic time of 1 s; 1 cycle s^{-1} .

Hertz fracture. *Noun.* A conical fracture spreading outwards as it progresses into glass; usually produced by pressing a ball against the surface.

Hess's law. *Noun.* The statement that the change in enthalpy accompanying a change in the state of a system from a fixed initial to the same final state is a constant, irrespective of whether the change occurs in a single step or as a multi-stage process.

hessite. *Noun.* Ag_2Te . Silver telluride; a grey metallic mineral in cubic crystal form.

hessonite. *Noun.* An orange-brown variety of **grossularite garnet**. Also called **cinnamon stone**.

heterodyne. *Verb.* To mix two alternating signals in order to get two signals with frequencies corresponding to the sum and the difference of the original frequencies.

hetero-epitaxy. *Noun.* Oriented single crystalline growth of a different material on a substrate.

heterogeneous. *Adjective.* Consisting of a mixture of dissimilar ingredients.

heteromorphic pigments. *Plural noun.* Coloured phases coated with a transparent protecting layer, such as red $\text{Cd}(\text{Se}_{1-x}\text{S}_x)$ encapsulated in **zircon**.

hettotype. *Noun.* A tilted and distorted version of an ideal fully-expanded structure of shared polyhedra, such as SiO_4 . The ideal structure is an **aristotype**.

heulandite. *Noun.* $(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_7\text{O}_{18} \cdot 6\text{H}_2\text{O}$. A natural **zeolite** occurring in large deposits in New Zealand as a grey-white to red-brown ore. A product of devitrification and hydration of volcanic glass.

Hexaloy-ST. *Trademark, noun.* A commercially available composite of sintered SiC with no extra silicon but containing from 5 to 20 % TiB_2 as a toughening agent; Knoop hardness 27.5 GN m^{-2} and 50 % tougher than SiC alone.

hexagonal. *Adjective.* Relating to the crystal system that has 4, axes, the 3 horizontals are of equal length and intersect at 60° while the fourth vertical axis is shorter or longer. **Apatite**, and **beryl** are examples of ceramics in this crystal system.

hexagonal close-packed. hcp. *Noun.* A type of crystal structure where the **unit cell** of hexagonal symmetry is generated by close packing of layers of atoms or ions to a repeating ABAB... pattern.

hexamethyldisilazone. *Noun.* $(\text{CH}_3)_3\text{Si-O-Si}(\text{CH}_3)_3$. A gaseous compound which when heated at $1,000^\circ\text{C}$ with ammonia gives a submicron mixed powder of SiC + Si_3N_4 . This powder can be sintered at $1,800^\circ\text{C}$ to a submicron grain size composite.

Heyn method. *Noun.* A micrographic intercept method to find grain size.

HFO. *Abbreviation.* Stands for hydrous ferric oxide. See **ferrihydrite**.

H-harps. *Noun.* A metal frame with cutting wires used to produce clay slabs of even thickness.

hibonite. *Noun.* $\text{CaAl}_2\text{O}_{19}$. A calcium aluminate phase found in a hydrated form in some cements.

HIC. *Abbreviation.* Stands for high index compressive defects.

HID. *Acronym.* Stands for high intensity dispersion. See **high intensity dispersion**.

HIF. *Acronym.* Stands for hot isostatic forging. See **hot isostatic forging**.

high-alumina brick. *Noun.* A **refractory brick** containing substantial amounts of alumina that reacts with silica to form **mullite** when fired to high temperature; used in applications where unusually severe temperature and load conditions exist.

high-alumina cement. *Noun.* (1) Refractory hydraulic cement made by sintering mixtures of **bauxite** and **limestone**; will set to high strength in 24 h. (2) Hydraulic

cement of high alumina content. The main constituent is **CA** in **cement notation**.

high-alumina refractories. *Plural noun.* Aluminium silicate refractory compositions in which the alumina content is 45 % or more.

high angle boundaries. *Noun.* **Grain boundaries**, either **tilt** or **twist**, which require rotations in excess of 15° to gain grain coincidence. They contain large areas of poor fit and so have open structures with almost constant energy: $\gamma_{gb} = 1/3\gamma_{\pi}$, where γ_{gb} is the grain boundary energy and γ_{π} is the **specific surface energy** of the solid.

high biscuit-low glost. *Noun.* A **tableware** manufacturing system involving two firings. Glaze firing is typically done in the range 1,060–1,100 °C on a prefired **biscuit ware**. The alternative is to mature glaze and body together between 1,200 and 1,400 °C after a lower temperature 1,000 °C **bisque fire**.

high-carbon steel. *Noun.* Steel containing more than 1.5 % of carbon. The carbon tends to cause blistering in porcelain-enamelling.

high-duty fireclay brick. *Noun.* Fireclay brick compositions with a **pyrometric cone equivalent** not less than 31½ nor more than cone 33.

high-early-strength concrete. *Noun.* Concrete which will develop a crushing strength greater than 12 MN m⁻² when aged in moist air for 24 h, and greater than 21 MN m⁻² when aged for 24 h in moist air followed by immersion in water for 48 h. The cement used has a high CaO:SiO₂ ratio.

high-electron-mobility transistor. **HEMT.** *Noun.* A device formed by layers of GaAs and (Al,Ga)As in which current flows through the 2-D electron gas formed at the layer interface and is modulated by an applied **gate voltage**. The dilution of the electron gas makes for high velocity.

high-energy fuel. *Noun.* Any fuel which produces greater energy than conventional carbonaceous fuels during combustion.

high fire. *Verb.* To use maximum output from a kiln firing system.

high frequency. **HF.** *Noun.* A radiofrequency lying between 3 and 30 MHz.

high-frequency heating. *Verb.* To develop heat in a body by means of an induced electric current when the body is moved through a non-uniform magnetic field or is subjected to a change in magnetic flux.

high-frequency induction furnace. *Noun.* An **induction furnace** in which heat is generated in a substance or container, or both, by currents induced by a high frequency magnetic flux produced by a surrounding electric coil.

high gloss. *Noun.* A surface of extreme smoothness and therefore excellent light reflecting behaviour.

high-heat cement. *Noun.* Cement that liberates a large amount of heat during curing.

high-heat duty refractory. *Noun.* Fireclay brick with **PCE** > 32½.

high intensity dispersion. **HID.** *Noun.* A method whereby slip suspensions are mixed very rapidly to achieve homogeneity. The process conditions are defined with respect to agitator tip speeds and suspensions solids content. The minimum tip speed is 1,525 m min⁻¹ and solids contents to produce crowding are needed, which is 40–50 vol.% solids. After **HID** any applied shear force during subsequent processing has little effect on the constancy of slip properties.

high-level waste. *Noun.* Radioactive waste material having a high activity and so needing constant cooling for several decades before it can be reprocessed. This type of waste experiences a temperature rise and this fact has to be taken into account when storage methods are designed.

highlight test. *Noun.* A method of evaluating the resistance of a glaze, porcelain-enamel, glass, or other surface to acids, alkalies, and other corrosive and erosive conditions as indicated by a decrease in the sharpness or integrity of an image observed in a direct beam of light.

highly oriented pyrolytic graphite. **HOPG.** *Noun.* Carbon deposited at very high temperatures so that the graphite crystallites are mostly lying with the a-c plane, which is the graphite basal plane, parallel to the substrate surface.

high-pressure gas firing system. *Noun.* A kiln firing system using fuel gas at pressures above 14 kN m⁻² that draws in air by the Venturi principle.

high quartz. *Noun.* The high-temperature form of **silica** crystallising with a cubic structure, known as **cristobalite**.

high-silica glass fibre. *Noun.* Ordinary **A-** or **E-glass fibre** treated with hot acid to remove components other than SiO₂; compositions around 97 % SiO₂ are achieved.

high-speed cement. *Noun.* A fast-setting cement.

high-temperature cement. *Noun.* A refractory cement that will not soften, fuse, or **spall** at elevated temperatures.

high-temperature glaze. *Noun.* A glaze that matures at temperatures above 1,200 °C.

high temperature insulating refractory. **HTI.** *Noun.* A high melting point, low thermal conductivity ceramic composition used to provide heat insulation around high temperature furnaces.

high-temperature material. *Noun.* Any material that can be used in high-temperature environments, such as furnaces, kilns, roasters, smelters, etc., working at temperatures above 1,000 °C.

high-temperature superconductor. HTS. *Plural noun.* Several classes of materials discovered since 1986 with much higher transition temperatures than previously known superconductors; can become superconducting around 100 K. See **YBCO**.

high-transmission glass. *Noun.* A glass that transmits an exceptionally high percentage of visible light.

high-velocity burner. *Noun.* A burner that introduces combustible mixtures into the firing chamber of a furnace or kiln at a very high speed.

high-velocity thermocouple. *Noun.* A thermocouple device that will measure the temperatures of flowing gases in an area where the surroundings are of a different temperature.

hilegardite. *Noun.* $M_3B_7O_{13}Cl$. A **boracite**-type mineral with a structure containing BO_4 tetrahedra and BO_3 planar triangles linked to form channels in which the M cations and Cl^- ions reside. Over all the structure is pseudo cubic and had **piezoelectric** properties.

hindered settlement. *Noun.* A classifying process in which fine aggregate is separated from coarse particles in a water suspension in which a rising current of water hinders the fall of the fine particles while the coarse particles settle to the bottom of the apparatus.

hinge joint. *Noun.* A joint in a pavement or other concrete structure that will permit adjacent sections or slabs to expand, shrink, and move independently of each other and thereby reduce the possibility of uncontrolled breakage of the structure in use.

hip and rib shingles. *Noun.* Rectangular roofing shingles cut and installed with a side lap so as to conceal the joint of the shingles meeting at the hip and ridge of a roof.

HIPing. *Acronym.* Standing for the forming process called hot isostatic pressing where an **isostatic pressure** is applied to an imperviously coated object by a fluid while heating the pressing die. See **hot isostatic pressing**.

HIP map. *Noun.* The output of a computer program in graphical form that calculates the density as a function of applied pressure, temperature, particle size, and internal pressure, in isolated pores, given as a set of **hot isostatic pressing** parameters.

hip roof. *Noun.* A roof having four sloping sections, the shorter slopes being triangular in shape.

hip tile. *Noun.* Specially shaped roofing tile used to form the junction of two faces of a roof.

hisingerite. *Noun.* See **allopheane**.

Hispano-Moresque ware. *Noun.* A type of lustre or tin-enamelled pottery.

HIT. *Abbreviation.* Stands for high index tensile defects.

hitchhiker element. *Noun.* An element that is distributed as a contaminant or trace element within a mineral ore. They are proving to be increasingly important in modern technology and do not have a known ore. They are used in catalysts, electrical storage materials in batteries and as additives in glass and ceramics. Recovery of gallium, tantalum, indium etc., from recycled electronic equipment is now being developed.

HMFG. *Abbreviation.* Stands for heavy metal fluoride glass. See **heavy metal fluoride glass**.

HMO glasses. *Abbreviation.* Stands for heavy metal oxide glass. See **heavy metal oxide glasses**.

hobmouth oven. *Noun.* A bottle- or cone-shaped kiln that is fired from the top.

hod. *Noun.* A V-shaped trough mounted on a pole handle for carrying mortar, bricks etc.

Hoffman kiln. *Noun.* A multichambered, periodic kiln in which the chambers are connected so as to permit the use of combustion gases to dry and preheat ware in the adjacent sections before firing.

Hoffmeister series. *Noun.* An arrangement of anions and cations in the order of decreasing ability to produce **flocculation** when introduced into clay slips.

hog-back tile. *Noun.* A particular type of roofing tile that is not quite half-round; used along the edges of a pitched roof.

holystone. *Noun.* A piece of **sandstone** originally used to scrub the deck of a ship.

hoist, skip. *Noun.* See **skip hoist**.

Holdcroft bars. *Noun.* Bars of selected mineral compositions designed to soften at different temperatures for use as **pyroscopes**.

holding current. *Noun.* See **Ovonic threshold switch**.

holding room. *Noun.* An area in which ware is stored prior to subsequent processing or shipment.

hole. *Noun.* (1) In the energy band model of bonding, removal of an electron from the valence band creates an unoccupied level; this is a hole. Sometimes called a positive hole since electrons in the valence band can accept energy from an applied electric field to move up to the hole; hence, holes drift to the negative plate and appear to be charge carriers. (2) A depression or void in a body, the bottom of which is not visible under normal vision under 200 foot-candles illumination.

hole excess centre. *Noun.* A colour-producing defect in a crystal that is an electron-deficient group, such as $[AlO_4]^+$, associated with a trapped **hole**.

holes, sand. *Noun.* See **sand holes**.

hollow block. *Noun.* A relatively large, hollow, structural clay or concrete building block which is used in the construction of walls, floors, and roofs, sometimes with metal reinforcements.

hollow casting. *Noun.* A synonym for **drain casting**.

hollow-clay blocks. *Noun.* Fired, hollow, structural-clay building blocks used in the construction of walls, partitions, floors, and roofs of buildings.

hollow dislocation. *Noun.* A configuration that has to be assumed by a **dislocation** in an elastic continuum because of the need to avoid infinite energies. In a real crystal this is not necessarily the case and we do not encounter them in simple metallic and ionic crystals. Dislocations in crystals with large unit cells, such as SiC are hollow.

hollow fibre. *Noun.* A tube-like **man-made fibre**. Also called **hollow filament**.

hollow filament. *Noun.* See **hollow fibre**.

hollowing. *Noun.* The process of forming a cavity in a ball of **plastic clay** on a **potter's wheel**.

hollow tile. *Noun.* A hollow building unit formed of concrete or fired structural clay; used in building and other construction.

hollow wall. *Noun.* A masonry wall in building construction with a substantial air space between the wall faces; the dead air space provides improved thermal and sound insulation.

hollowware. *Noun.* Ceramic and porcelain-enamelled ware of significant depth and volume such as bowls, cups, pots, pans, and kettles.

holmium oxide. *Noun.* Ho_2O_3 . Used in the production of special high-temperature refractories. Mp 2,360 °C; density 8,350 kg m⁻³.

holocrystalline. *Adjective.* Describes igneous rocks that have only crystalline phases and no glassy material.

hologram. *Noun.* A three dimensional picture or image produced by reflected laser light on a photographic plate or film illuminated from behind.

holohedral. *Adjective.* Describes a crystal having all the faces needed for complete symmetry.

holon. *Noun.* A manufacturing unit that is completely autonomous.

holystone. *Noun.* A soft **sandstone** used for cleaning floors. (2) *Verb trans.* To clean using holystone.

homeomorphism. *Noun.* A close similarity of crystalline forms between different chemical compounds.

homogeneous. *Adjective.* Consisting of a uniform composition or structure.

homogeneous time-resolved fluorescence. HTRF. *Noun.* See **fluorescence resonance energy transfer**.

homogenise. *Verb.* To allow diffusion to even out compositional differences and hence properties between different regions of a glass melt.

homologous temperature. T_H . *Noun.* A way of standardising comparisons by expressing the sample temperature in degrees Kelvin as a fraction of the absolute melting temperature: $T_H = T/T_m$.

hone. *Noun.* (1) A fine-**gritstone** or block of abrasive used for sharpening and fine grinding. (2) A rotating tool with an abrasive tip used for enlarging and polishing holes and internal cylindrical surfaces to precise dimensions. (3) *Verb.* To sharpen or polish.

honeycomb. *Noun.* (1) A body with a cellular internal structure resembling a honeycomb, and which is used as a lightweight structural material of high strength. (2) A poorly filled, insufficiently compacted, or porous concrete mass.

honoring. *Verb.* To smooth and polish a surface with a fine-grained stone or abrasive.

hood. *Noun.* (1) A guard around a grinding wheel serving as protection against breakage, sparks, released and flying particles and dust. (2) A metal cowl covering a hearth or other work area in an exhaust system for the removal of dust and fumes. (3) A refractory form partially immersed in a molten glass batch to protect the gathering area from furnace gases and floating scum.

hooded pot. *Noun.* A glass-melting pot in which the interior and its contents are protected from combustion gases by a refractory cover or by careful design of the pot, and also provided with an opening for the charging and gathering operations.

hood mould. *Noun.* See **dripstone**.

hook. *Noun.* A curved, heat-resistant alloy upon which porcelain-enamelled ware is suspended for transport through a furnace.

Hookean elasticity. *Noun.* **Strain** is linearly proportional to the **stress**.

Hooke's law. *Noun.* The ratio of the stress to the strain in a body is constant for small values of strain.

hooped column. *Noun.* A reinforced concrete column in which the steel-rod reinforcements, placed vertically in the shaft, are enclosed in steel hoops to tie the rods together.

hoop stress. *Noun.* The circumferential stress in a cylinder subjected to internal or external pressure.

hoop tension. *Noun.* Stress that occurs in the bottom section of a hemispherical dome.

HOPG. *Abbreviation.* Stands for highly oriented pyrolytic graphite. See **highly oriented pyrolytic graphite**.

hopper. *Noun.* A large container in which bulk materials are stored prior to use.

horizontal-cell tile. *Noun.* A hollow building unit of fired structural clay in which the axis of the interior cell is in a horizontal position when placed in a wall.

horizontal crusher. *Noun.* A type of crushing or milling device in which the crushing stone is mounted on a horizontal shaft to minimise headroom requirements.

horizontal retort. *Noun.* A vessel of highly siliceous composition employed in the production of zinc metal and in the gasification of coal.

hornblende. *Noun.* $(\text{Ca}, \text{Na})_2(\text{Mg}, \text{Fe}, \text{Al})_5(\text{Al}, \text{Si})_8\text{O}_{22}(\text{OH}, \text{F})_2$. A common, green- to black-coloured mineral present in clay and feldspathic materials; a **double-chain silicate** of the **amphibole** family. Density 3,000–3,470 kg m⁻³; hardness (Mohs) 5–6.

hornfels. *Noun.* A hard, tough fine-grained, **metamorphic rock** formed by the action of heat on clay rocks. Also called **hornstone**.

horn silver. *Noun.* See **cerargyrite** and **chloroargyrite**.

hornstone. *Noun.* Another name for chert. See **hornfels** and **chert**.

horse. *Noun.* A slightly convex rack on which drying roofing tiles are placed and permitted to sag to a slightly curved shape.

horseshoe flame. *Noun.* The heating pattern obtained when both the entry and exit ports for gases are on the same end wall in a furnace.

hospital. *Noun.* An area in a factory where defective ware is repaired.

hot-blast circulating duct. *Noun.* Large-diameter, refractory-lined pipes that surround and deliver hot air to the **tuyeres** of a blast furnace.

hot-blast main. *Noun.* A refractory-lined pipe that delivers hot air from a hot-blast stove to the hot-blast circulating duct of a blast furnace.

hot-blast stove. *Noun.* A refractory-lined apparatus in which hot air is produced for delivery to the **tuyeres** of a blast furnace.

hot box binder. *Noun.* A liquid resin sand binder used to mould cores from a heated metal box.

hot draw. *Verb.* To remove a material from a furnace or kiln while hot.

hotel china. *Noun.* A hard-glazed, vitreous dinnerware of high strength, usually thicker than **household china**; used by commercial institutions.

hot end. *Noun.* The finishing end of a glass manufacturing operation, including the forming of the molten glass and the annealing of the formed ware.

hot end coating. *Noun.* A coating, usually an organotin compound, sprayed onto glass containers while they are hot and before they pass through the annealing **lehr**.

Such coatings strengthen the surface by imparting a compressive layer.

hot floor. *Noun.* A floor, particularly the floor of a drier, heated by steam pipes or other source of heat.

hot-floor drier. *Noun.* An enclosed chamber or room for the drying of ware in which heat is supplied by steam pipes or other heat source embedded in the floor.

hot isostatic forging. **HIF.** *Noun.* A development of **hot isostatic pressing** made to reduce the process time from hours to minutes. Instead of constant pressure being applied throughout the process a sudden isostatic pressure is applied when the sample just reaches a sinter temperature.

hot-metal ladle. *Noun.* A large, refractory-lined ladle employed to convey molten metal from a blast furnace to a subsequent processing operation.

hot-metal mixer. *Noun.* A refractory-lined holding furnace for molten pig iron.

hot mould. *Noun.* A hot (coated or uncoated) mould in which glass or other ceramic ware is formed.

hot patch. *Verb.* To apply a refractory slurry by spraying to repair a damaged, hot refractory lining of a furnace.

hot press bonding. *Noun.* See **diffusion bonding**.

hot-pressed abrasives. *Plural noun.* Bonded abrasive products formed in a mould by pressing at appropriate high temperatures.

hot pressing. *Verb.* (1) A **jigging** process employing a heated profile tool or plunger. (2) To form ware by pressing in a mould at an elevated temperature. (3) Sintering while simultaneously applying a pressure to the sample.

hot spot. *Noun.* The area of highest temperature in a furnace.

hot top. *Noun.* A special refractory shape placed on the top of an ingot or casting mould so that the **riser** and **sinkhead** will form above the casting.

hot zone. *Noun.* The area in a **continuous furnace** or kiln where the most intense heat is supplied to the ware being fired.

Hough transform. *Noun.* An image processing technique for transforming lines into points so that crystallite orientations can be found **electron back scattering diffraction**.

household china. *Noun.* Vitreous ceramic dinnerware, usually thin and of high **translucency**.

house-of-cards. *Adjective.* A microstructure in which randomly oriented flexible flakes are interlocked.

H-phase. *Noun.* A grain boundary phase in the $\text{Si}_3\text{N}_4\text{-Y}_2\text{O}_3\text{-Ho}_2\text{O}_3$ system that is a nitrogen-containing **discrete ion silicate**.

H-polaroid. *Noun.* Polaroid film prepared by stretching polyvinyl alcohol films to line up the molecules, which are then impregnated by iodine. The iodine atoms form long strings parallel to the fibre axis and are capable of completely absorbing one component of polarisation while transmitting the other.

HTI. *Abbreviation.* Stands for high-temperature insulating refractory. See **high temperature insulating refractory**.

HTRF. *Abbreviation.* Stands for homogeneous time-resolved fluorescence. See **fluorescence resonance energy transfer**.

hue. *Noun.* The position of a colour in relation to the central wavelength of the visible spectrum and it is the attribute of colour that enables an observer to classify it as red, yellow etc. It excludes white, black and grey. See **Munsell colour classification**.

huebnerite. *Noun.* MnWO_4 . An orthotungstate mineral.

hull. *Noun.* (1) A defect in a fabric reinforced composite that consists of dark specks of foreign matter embedded in the fabric fibres. (2) The outer coat around a rice grain that when heated in the absence of air produces **silicon carbide powder**.

humectant. *Noun.* In mould forming it is the name given to a material used for dilution or moistening; **glycol** is an example.

humic acid. *Noun.* A constituent of **lignite** found in samples of **ball clay**. It consists of a heterogeneous mixture of many compounds. Some molecules within the mixture have large numbers of electrically charged sites that interact with the surface charges of **clay minerals** to form weakly bonded organo-clay compounds. This has a marked effect on the casting behaviour of clay slips as well as a marked effect on the **green strength** of clay products with those having a high humic acid content being stronger. See **lignite**.

humidifier. *Noun.* An apparatus designed to introduce water vapour into the atmosphere of an area, such as a **controlled-humidity drier**.

humidity. *Noun.* The degree of dampness or the amount of water vapour contained in the atmosphere.

humidity, absolute. *Noun.* See **absolute humidity**.

humidity drier. *Noun.* A drier in which the humidity of the atmosphere is controlled.

humidity drying. *Noun.* A procedure whereby ware is heated in a moisture-saturated atmosphere and drying is allowed later while the product is hot and the pore water viscosity is lower.

humidity, relative. *Noun.* See **relative humidity**.

hump. *Noun.* A large ball of clay centred on a potter's wheel from which several small pots are thrown.

Huntington dresser. *Noun.* A star-shaped rotating cutting tool employed to **dress** and true abrasive grinding wheels.

huntite. *Noun.* $\text{CaMg}_3(\text{CO}_3)_4$. A **trigonal** mineral with no **centre of symmetry** and so it has **non-linear optical properties**. The induced **dipole moment**, P , is not linear in the strong electric field, E , of a high intensity **laser**. $P = \chi_1 E + \chi_2 E^2 + \dots$ χ_2 is a susceptibility coefficient that relates to the possibility that two photons, frequencies ω_1 and ω_2 will mix to give a new frequency $\omega_1 \pm \omega_2$. One application is to pass a laser beam through the crystal to double its frequency.

huntite borates. *Plural noun.* $\text{LnM}_3(\text{BO}_3)_4$. A large number of ceramics with the **huntite** structure some of which have useful **laser** abilities, e.g. $\text{Nd:LaSc}_3(\text{BO}_3)_4$.

HVOF-coatings. *Plural noun.* High velocity oxy-fuel coatings; composites, such as $\text{Cr}_3\text{C}_2/\text{Ni-Cr}$ and $\text{WC}/\text{Ni-Cr}$, applied as a coating to prevent **wear** and **erosion** in nuclear reactor pipe work where cobalt alloys are to be avoided.

hyalite. *Noun.* A colourless and clear form of **opal** with a globular habit.

hybrid composite. *Noun.* Several types have been defined depending on how the fibres are mixed but all contain more than one type of reinforcing fibre. The different types are: (1) **interply**, where tows are mixed; (2) **core-shell** where sandwiches are made; (3) **laminated**, alternate layers stacked regularly; (4) **intimately mixed**. (5) Combinations of the other four.

hybridisation. *Noun.* A rearrangement of **orbitals**, often obtained from a linear combination of **atomic orbitals**.

hybrid rock. *Noun.* The result of molten magma incorporating pre-existing rock through which it passes.

hydrargillite. *Noun.* $\text{Al}(\text{OH})_3$. Crystalline aluminium hydroxide mineral loses water when heated to give $\gamma\text{-Al}_2\text{O}_3$ at 600 °C.

hydrate. *Noun.* A compound containing water in a definite ratio, the water being retained in its molecular state as H_2O at definite sites in the crystal structure.

hydrated. *Adjective.* Chemically bonded to water molecules.

hydrated alumina. *Noun.* $\text{Al}(\text{OH})_3$. **Gibbsite** or **hydrargillite**. Used as a component in glass and sintered ceramic bodies, and as a coating for **refractory setters** to prevent ware being fired from sticking to the **setters** during the firing operation. Density 2,424 kg m^{-3} .

hydrated borate of sodium. *Noun.* An old name for borax. See **borax**.

hydrated lime. *Noun.* **Quicklime** to which sufficient water has been added to convert the oxides to hydrates.

hydration. *Noun.* (1) The reaction between a hydraulic cement and water during which new compounds are being formed, most of which have strength-producing properties arising from their fibrous **habit**. (2) The chemical process by which cement paste is hardened. (3) The incorporation of water molecules into a compound to form a hydrate.

hydration, heat of. *Noun.* See **heat of hydration**.

hydration resistance. *Noun.* The degree to which a material, particularly a refractory material, resists chemical combination with water.

hydration, water of. *Noun.* See **water of hydration**.

hydraulic adsorption. *Noun.* The adsorption of a weakly ionised acid or base formed by the hydrolysis of some types of salts in aqueous solutions.

hydraulic bond. *Noun.* The mechanical bond formed in a structure that reacts with water to form fibrous crystals that become entangled and also forms **amorphous gel** materials to help the binding process.

hydraulic cement. *Noun.* A cement that sets and hardens by chemical interaction under water; some types will set under water.

hydraulic cement, air-entraining. *Noun.* See **air-entraining hydraulic cement**.

hydraulic lime. *Noun.* Calcined **limestone** which absorbs water without swelling or heating and which produces cement that hardens under water.

hydraulic press. *Noun.* A press actuated by a liquid under pressure.

hydraulic pusher. *Noun.* A hydraulically actuated mechanism designed to push loaded **cars** through a **tunnel kiln**.

hydraulic ram. *Noun.* The working piston of a **hydraulic press**.

hydraulic refractory cement. *Noun.* A composition of ground refractory materials, some of which react chemically to form a strong **hydraulic bond** at room temperature.

hydraulic structure. *Noun.* (1) Any structure, including concrete, used to convey water from one location to another, or which may be exposed to water for substantial periods of time as in canals, sea walls, etc. (2) A shape obtained by using water to hydrate materials like **OPC** in a mould.

hydric. *Adjective.* (1) Containing hydrogen. (2) Containing or using moisture.

hydride. *Noun.* Any compound of hydrogen with another element.

hydroabietyl alcohol. *Noun.* $C_{19}H_{31}CH_2OH$. Used to control the drying, flow-out, and viscosity of screen-process inks. Mp 32 °C; density 1,007 kg m⁻³.

hydroboracite. *Noun.* $CaMgB_6O_{11} \cdot 4H_2O$. A borate mineral from Argentina; used to make fluxes and boron based ceramics.

hydrocalumite. *Noun.* $Ca_2Al(OH)_6(Cl)_{1-x}(OH)_x \cdot 3H_2O$. Formed from contact metamorphism of **limestone**. White to light green in colour with a **pearly lustre**. A phase found in the rutile-calcium phosphate glaze system and used to impart opacity and whiteness to ceramic ware. Hardness (Mohs) 3; density 2,150 kg m⁻³.

hydrocerussite. *Noun.* $Pb_3(CO_3)_2(OH)_2$. A form of **basic lead carbonate** that is the initial corrosion product on lead exposed to the air. Over time it changes to **cerussite**, then lead sulphite and finally to **lead sulphate**. Also called **white lead**.

hydrochloric acid. *Noun.* HCl. Hydrogen chloride gas in aqueous solution. Widely used in the **pickling** of metal for porcelain-enameling. Density 1,190 kg m⁻³.

hydrodynamic abrasive machining. *Noun.* The use of a high velocity, high-pressure jet of abrasive-water slurry in a fine stream at pressures around 420 MN m⁻² to remove material from ceramic and composite surfaces.

hydrodynamic diameter. *Noun.* See **dynamic light scattering**.

hydrodynamic lubrication. *Noun.* See **Stribeck curve**.

hydrodynamics. *Noun.* The study dealing with the motion of fluids and the forces acting on bodies immersed in fluids.

hydroentangled fabric. *Noun.* A nonwoven ceramic fabric made from a fibre **web** or **batt** in which entanglement is provided by high-pressure water jets. Also known as **spinlaced fabric**.

hydrofluoric acid. *Noun.* HF. A solution of hydrogen fluoride in water. Used in the polishing, frosting, and etching of glass surfaces and sometimes used to clean brick.

hydrogarnet. *Noun.* In **cement notation**: $C_3AS_xH_{6-2x}$. It is the only thermodynamically stable aluminate hydrate, which in cement notation is C_3AH_6 , however some silicon atoms in SiO_4 tetrahedra are substituted by $4H^+$ ions so that the general formula is as given above. It is the final hydration reaction product of **calcium monoaluminate**. Also known as **hydrogrossular**.

hydrogel. *Noun.* A **gel** in which the liquid part is water.

hydrogen bond. *Noun.* A form of chemical bond arising from dipole attractions where hydrogen is the positive end of the dipole.

hydrogen decomposition-desorption recombination processing. *Noun.* The use of hydrogen to break down alloys, such as Nd_2Fe_{17} , to mixed hydride plus metal powders in ultrafine particle sizes for reprocessing into permanent magnets.

hydrogen defect. *Noun.* An imperfection in porcelain-enamels due to the presence of hydrogen. Atomic hydrogen is converted to molecular hydrogen in voids causing pressure to develop at the interface between the metal and the solidified coating after firing. This leads to areas where the glass is not bonded to the metal.

hydrogrossular. *Noun.* See **hydrogarnet**.

hydrolyse. *Verb.* To subject a material to **hydrolysis**.

hydrolysis. *Noun.* The chemical reaction of a substance with water to produce another compound.

hydrolyte. *Noun.* A material subjected to **hydrolysis**.

hydrometer. *Noun.* A direct-reading, floating instrument employed to measure the specific gravity or similar properties of liquids and slurries.

hydrophane. *Noun.* A white partially opaque form of **opal** that becomes translucent in water.

hydrophilic. *Adjective.* Having an affinity for water.

hydrophobic. *Adjective.* Having an aversion to water.

hydrophone. *Noun.* An electroacoustic transducer that converts sound and ultrasonic waves to electrical signals usually by using a ceramic **piezomaterial**.

hydroplastic forming. *Noun.* The moulding or shaping of clay-based ceramics that have been made plastic by the addition of water.

hydrosol. *Noun.* A **sol** that has water as its liquid phase.

hydrostatic balance. *Noun.* A chemical balance adapted so that the weight of an object submerged in water can be found to determine the up thrust on it. This then leads to a determination of **specific gravity**.

hydrostatic press. *Noun.* A press actuated by water, oil, or other liquid under pressure.

hydrostatic pressing. *Verb.* To form and compact ceramic bodies contained in a thin rubber or plastic envelope which is placed in a die and surrounded by a fluid and then subjected to high pressures, the pressures being equal in all directions on the specimen.

hydrostatic pressure. *Noun.* The pressure exerted by a liquid that is not flowing, or pressure transferred to a body immersed in a liquid that is subjected to an external pressure.

hydrostatics. *Adjective.* The study of the effects of pressure in a liquid or exerted by a liquid on an immersed body.

hydrostatic strength. *Noun.* The property of a pipe or other shape to withstand the internal pressures of liquids of specific pressure magnitudes.

hydrotalcite. *Noun.* $\text{Mg}_6\text{Al}_2(\text{OH})_{16}(\text{CO}_3)_4\cdot 4\text{H}_2\text{O}$. A rhombohedral **double layered hydroxide**. The hexagonal polymorph is called **manasseite**.

hydrothermal. *Adjective.* Relating to the action of water at high temperature.

hydrothermal alteration. *Noun.* See **ball clay**.

hydrothermal homogeneous precipitation. *Noun.* A method used to make **core-shell materials**. Nanosized spheres of silica or other substrate material are sonically dispersed in nitrate solutions of chosen ions and then **TEOS** and **urea** are added. The dispersions are heated in an **autoclave** at 160 °C for several hours. The precipitates are filtered, washed and then calcined at a temperature sufficient to cause reaction but not **agglomeration** of the spheres.

hydrotalcite. *Noun.* $\text{Mg}_6\text{Al}_2(\text{OH})_{16}\text{CO}_3\cdot 4\text{H}_2\text{O}$. A naturally occurring mineral with a characteristic structure where the **brucite** sheets contain substituted Al^{3+} compensating $[\text{CO}_3]^{2-}$ ions occupy intersheet positions. See **layered double hydroxides**.

hydrothermal synthesis. *Noun.* A process used in the ceramic industry to make, for example, single-crystal **quartz**, and synthetic **feldspars**. The principle is to seal powders with water in an **autoclave** and heat to temperatures in the range 120–700 °C for 1–24 h. This develops pressures up to 100 MN m⁻².

hydrous. *Adjective.* Containing or combined with water.

hydrous aluminium oxide. *Noun.* A mixture of hydrates arising from the different stages of hydration of Al_2O_3 when solutions containing Al^{3+} are neutralised. The main constituents are **gibbsite**, $\text{Al}(\text{OH})_3$, **bauxite**, $\text{Al}_2\text{O}(\text{OH})_4$ and **diaspore**; used as such a mixture in the manufacture of glass, glazes, and vitreous or near vitreous ware.

hydrous copper carbonate. *Noun.* See **azurite**.

hydrous ferric oxide. *Noun.* See **ferrihydrate**.

hydroxide. *Noun.* Any compound containing OH^- ions or -OH groups.

hydroxo. *Noun.* $[\text{M}-\text{OH}]^{(z-1)+}$. A species found in hydrolysing solutions of metal cations. See **aquo** and **oxo**.

hydroxyapatite. *Noun.* $\text{Ca}_5(\text{PO}_4)_3\text{OH}$. Mineral **apatite** in which hydroxyl ion predominates as the balancing anion; used in dentistry. Present in tooth enamel as rod-like crystals. See **apatite**.

hydroxycarbonate apatite. **HCA.** *Noun.* A hydrated and carbonated calcium phosphate resembling living bone. It is the template layer in **Bioglass** applications that allows transfer from ionic bonding in glass inserts to organically bonded bone.

hydrozincite. *Noun.* $\text{Zn}_3(\text{CO}_3)_2(\text{OH})_6$. Basic **zinc carbonate** mineral formed by the action of carbonated water on zinc ores.

hygistor. *Noun.* An electronic component whose resistance varies with humidity.

hygrometer. *Noun.* Any of several instruments that measure the humidity of an atmosphere.

hygroscopic. *Adjective.* Pertaining to the property of a substance to take up and retain water, particularly moisture from the atmosphere.

hygroscopic water. *Noun.* Water taken from the atmosphere by a body, and which can be removed by simple drying.

hypercritical drying. *Verb.* To remove the liquid phase from a drying **gel** above the **critical point** of the liquid so that the developing solid is not subjected to capillary stresses. This process leads to zero shrinkage, which means that shapes made from the gel are extremely fragile.

hypereutectoid. *Adjective.* In alloys and mixture of two components this indicates that it contains more of the solute component than a **eutectoid** mixture.

hyperfullerene. *Noun.* See **carbon onions**.

hypersthene. *Noun.* **Solid solutions** formed between **enstatite**, MgSiO_3 , and **ferrosillite**, FeSiO_3 , carry this name. The colours vary from green to black and the natural **pyroxene** mineral has high strength from which comes the name as sthenos means strength in Greek.

hypoeutectoid. *Adjective.* For a system displaying a eutectoid, an alloy containing less solute than the eutectoid composition.

hypophosphorus acid. *Noun.* H_3PO_2 . The oily monobasic acid that is the source of hypophosphites, MH_2PO_2 .

hypostyle. *Noun.* A building style where the roof is supported by columns.

hyposulphite. *Noun.* $\text{Na}_2\text{S}_2\text{O}_3$. Alternative name for **sodium thiosulphate**; abbreviated to hypo. Another name for **dithionate**.

hysteresis. *Noun.* The name given to the phenomenon whereby a depolarising or demagnetising cycle applied to a **ferroelectric** or **ferromagnetic** material produces two different values of the induced polarisation, P_{ind} , or magnetisation, H_{ind} depending on whether the field applied is going from a positive maximum to a negative one or vice versa. In general the lag or failure of a property that has been changed by an external agent, such as mechanical, magnetic, or electrical stress or to some influence occurring during the history of the material, to return to its original value when the cause of the change is removed.

hysteresis loop. *Noun.* The area between the paths traced by first increasing the external agent and then decreasing it on a hysteresis plot. The area represents energy loss.

hysteresis loss, incremental. *Noun.* See **incremental hysteresis loss**.

hysteresis, magnetic. *Noun.* See **magnetic hysteresis**.

hysteresis, mechanical. *Noun.* See **mechanical hysteresis**.

Hz. *Abbreviation.* Standing for hertz. See **hertz**.

I. *Noun.* The Roman numeral for one.

I. *Abbreviation.* (1) Standing for **inductance**.

I. *Symbol.* Standing for: (1) electrical current; (2) iodine.

i. *Symbol.* In mathematics it is the symbol used to represent the imaginary number equal to the square root of minus one, which is represented in electronics and electric engineering as **J**.

IBLC. *Abbreviation.* Stands for internal boundary layer capacitor. See **internal boundary layer capacitor**.

ic. *Abbreviation.* Standing for **integrated circuit**. These operate by controlling the flow of carriers through a semiconductor by applied electric fields.

ICB. *Abbreviation.* Standing for ionised cluster beam vaporisation process. Clusters of metal atoms are ionised and accelerated by an electric field onto a substrate prior to oxidation to ceramic compositions.

ice. *Noun.* Coarse-grained, clear, white, or coloured compositions of high fluxing characteristics that are applied and fired on glassware to produce a variety of frosted or pebbled effects on the ware. (2) The solid form of water formed at 273 K and 1 atm pressure.

Iceland agate. *Noun.* See **obsidian**.

Iceland spar. *Noun.* Pure, transparent, colourless variety of **calcite**, CaCO_3 , so flawless it can be used as a **polariser** in microscopes; basis of the **Nicol prism**. Easily cleaved in to rhombohedra that show double refraction.

ice point. *Noun.* The temperature at which a mixture of ice and water are in equilibrium at 1 atm pressure. It is 0° on the **Celsius scale**.

IC silicon carbide. *Noun.* **Silicon carbide** impregnated with carbon.

ID coil. *Noun.* An electromagnetic coil inserted inside a hollow test specimen.

ideal crystal. *Noun.* A crystal in which there are only intrinsic thermodynamic defects and no impurities.

ideal gas. *Noun.* A hypothetical gas that obeys **Boyle's law** exactly at all temperatures and pressures, and which has an **internal energy** that depends only on the temperature.

ideal solution. *Noun.* A solution whose behaviour can be expressed by **Raoult's law**. It is a solution in which the interaction between solvent and solute molecules are identical to those between solvent and solvent or solute and solute molecules, which results in zero **heat of mixing**.

ideochromatic. *Adjective.* Possessing the same colour throughout a specimen.

ID grinding. *Noun.* Internal grinding of a hollow body, such as a pipe, cylinder, or similar structure.

idiomorphic. *Adjective.* Naturally occurring minerals in the form of well-developed crystals.

idle. *Noun.* To run without load.

idler wave. *Noun.* See **optical parametric oscillator**.

idle time. *Noun.* The elapsed time equipment is left unused.

idocrase. *Noun.* Another name for vesuvianite. See **vesuvianite**.

IEP. *Abbreviation.* Standing for isoelectric point. See **isoelectric point**.

IGFET. *Acronym, noun.* Stands for insulated-gate-field-effect transistor. See **insulated-gate-field-effect transistor**.

igneous. *Adjective.* Rocks solidified in nature from the molten state.

igneous rocks. *Noun.* The most common type of rocks having formed from molten magma. There are two types: intrusive and extrusive. See **intrusive igneous rock** and **extrusive igneous rock**.

ignescant. *Adjective.* Giving off sparks when struck; **flint** is a good example.

ignimbrite. *Noun.* A rock that is a complicated mixture of volcanic ash welded together by hot gases, heat and pressure.

ignition. *Noun.* The process of starting a fuel to burn.

ignition arch. *Noun.* The section of a kiln in which fuel mixtures are preheated to expedite ignition.

ignition coil. *Noun.* A type of coil employed in ignition systems to ignite a fuel mixture. In practice, the coil stores energy in a magnetic field, which is released suddenly by signal, to ignite the fuel.

ignition, loss on. *Noun.* See **loss on ignition**.

ignition temperature. *Noun.* The lowest temperature at which combustion of a material will occur and continue burning when heated in air.

illite. *Plural noun.* $K_{1-1.5}Al_4(Si_{6.5-7}Al_{1-1.5}O_{20})(OH)_4$. A group of micaceous clay minerals ranging to between **montmorillonite** and **muscovite** in composition and structure. Found in **shales** and **mudstones**. Sometimes used as a clay addition to ceramic bodies.

illuminance. *Noun.* The luminous flux incident on unit area of a surface. It is measured in **lux**. Sometimes called **illumination**.

illuminant. *Noun.* Something that gives off light.

illumination. *Noun.* The luminous flux incident on a unit area of a surface; sometimes-called **illuminance**.

illuvial. *Adjective.* Concerning deposits formed by **illuviation**.

illuviation. *Noun.* The process by which colloids and mineral salts are washed down from one layer of soil to another lower layer.

ilmeneite. *Noun.* $FeTiO_3$. Titanium ore. A component of **mineral sands** used as a source of **titanium** in special glasses, as an **opacifier** in glazes and enamels, as a black colouring agent in brick coatings, as a speckling agent on ceramic tile, and as a component in some ceramic dielectrics. It has the **corundum** structure with half the Al^{3+} sites occupied by Ti^{4+} and half by Fe^{3+} ions. Mp 1,470 °C; density 4,300–5,300 kg m⁻³; hardness (Mohs) 5.5–6.

image charge model. *Noun.* Ionic materials **polarise** substrate metal to create an attractive interaction whereby the ions interact with their image or opposite charges.

image converter. *Noun.* A device for producing a visual image formed by electromagnetic radiation such as x-rays and infrared.

image force. *Noun.* The force exerted on a **dislocation** by a free surface per unit length of dislocation, given as $Gb^2/(1-\nu)r$, where G is the **shear modulus**, b is the

Burgers vector, ν is **Poisson's ratio**, and r is the distance the dislocation is below the surface.

image furnace. *Noun.* A way of producing high temperature in concentrated areas by focusing rays from the sun or electric arcs by means of lenses or mirrors.

image gloss. *Noun.* The distinctness of an image on reflection in the surface.

image intensifier. *Noun.* Screens from which electrons are released by an x-ray beam and are then focused onto a second screen to form a smaller, brighter image.

image orthicon. *Noun.* A TV camera tube in which electrons emitted from a photo emissive surface in proportion to the intensity of the incident light are focused onto a target causing secondary emission of light.

imbibition. *Verb.* The absorption of a liquid by a solid or **gel**, frequently accompanied by an increase in the volume of the absorbent solid; for example, porous **clays**, **graphite** and **silica gel**.

imbricate. *Verb trans.* (1) To place tiles so that they overlap. (2) To decorate with a repeating pattern resembling overlapping tiles.

imide precipitation. *Noun.* A method to make **nitride** powders in which liquid chlorides such as $TiCl_4$, $SiCl_4$, are added to liquid ammonia and so precipitate solid imides such as $Si(NH_2)_2$, which thermally decompose at low temperatures to ultrafine particle size Si_3N_4 , etc.

immersion cleaning. *Verb.* The removal of surface contamination on an object by dipping below the surface of a liquid cleaner.

immersion coating. *Verb.* Applying a coating to an object by dipping it into a coating solution or suspension.

immiscibility. *Noun.* The property of some liquids that will not mix with each other, e.g., oil and water. Encountered in the solid state when two glassy phases form on heat treatment of one glass.

imogolite. *Noun.* $(OH)_3Al_2O_3 \cdot Si(OH)$. An **allophane**-like mineral in which the chains of AlO_6 octahedra are linked by $[Si_2O_7]^{6-}$ complex ions. A tubiform structure having an $Al(OH)$ outer surface to the tube and a $Si(OH)$ inner surface. Formed when solutions containing Al^{3+} ions and silicic acid at a pH > 5 are heated. Believed to restrict the harmful effects of Al^{3+} cations on aquatic life.

impact. *Noun.* The collision of bodies with sufficient force to cause appreciable change in the momentum or condition of the colliding bodies, such as breakage, a change in speed, or a change in direction.

impact analysis. *Noun.* One of the three stages of life cycle analysis. See **life cycle analysis**.

impact crusher. *Noun.* A crushing device which breaks down solid materials by shattering blows imposed by

rotating hammers, bars, or steel plates. A **ball mill** is an example.

impact energy. *Noun.* The energy absorbed during the fracture of a specimen of standard shape and dimensions when subject to very rapid loading. Also called **notch toughness**. See **Charpy impact test**, **Izod impact test**.

impact grinder. *Noun.* A machine for reducing the size of minerals and rocks in which the material is thrown against steel plates by rapidly rotating blades.

impactor. *Noun.* Colloquial name for **impact mill** or **hammer mill**.

impact pressing. *Verb.* A forming process for refractory shapes whereby refractory powder is closely packed by rapid vibration in a mould.

impact resistance. *Noun.* The resistance of a body or coating to breakage, deformation, or other damage when subjected to sharp blows or shock loading.

impact strength. *Noun.* The maximum stress applied at fast loading rates that a test specimen can absorb before fracture.

impact stress. *Noun.* The stress imposed on a body by a suddenly applied force acting on a measured area.

impact test. *Noun.* A procedure designed to evaluate the resistance of a material to physical damage when subjected to a rapidly moving load.

impair. *Verb trans.* To reduce or weaken in strength.

impedance. **Z.** *Noun.* (1) a measure of the opposition to the flow of an a c electric current, quantified as the square root of the sum of the squares of the resistance and the **reactance** measured in ohms. (2) For a material it is the product of the density and the velocity of sound in the material, or the square root of the product of density and **Young's modulus**. It is a measure of the ceramic's ability to withstand impact loading.

impedor. *Noun.* A ceramic resistor or inductor that offers **impedance**.

impeller or impellor. *Noun.* The vaned rotating disk central to a compressor.

imperfect dislocation. *Noun.* A **dislocation** with a **Burgers vector** that produces a new atom configuration in adjacent areas of crystal.

imperfection. *Noun.* A fault or defect. In the case of ceramics it often means a defect in the crystal, such as a **vacancy**.

imperiale. *Noun.* A glass or ceramic bottle of 6-L capacity for table wine, or 4.5-L capacity for sparkling wine.

imperial red. *Noun.* A pigment family of red colours based on **ferric oxide**.

imperial topaz. *Noun.* See **topaz**.

impermiability. *Noun.* The property of a body, glaze, porcelain-enamel, or other material to resist the entry or passage of liquids and gases.

impervious. *Adjective.* A term denoting the degree of **vitrification** of a ceramic or ceramic coating as determined by its resistance to dye penetration as noted by visual observation.

impervious carbon. *Noun.* A dense, impervious, **bitumen**-bonded **carbon** body formed by pressing followed by sintering to an essentially pore-free brick. Used to line chemical process and storage vessels.

implant isolation. *Noun.* The technique of using ion implantation to create highly resistive layers on a microchip semiconductor. A major processing step in device manufacture.

implode. *Verb.* To cause to collapse inwards in a violent manner. See **implosion**.

implosion. *Noun.* A sudden reduction of pressure that causes the surrounding medium to be drawn in rapidly.

impregnate. *Verb trans.* To infuse a porous solid with a fluid.

impregnation. *Noun.* The process of forcing a liquid substance into the pores of a solid.

impress. *Verb trans.* (1) To exert pressure on. (2) To apply a voltage to a circuit or device.

impressed decoration. *Noun.* A decoration stamped under pressure into a plastic clay body.

improvement analysis. *Noun.* The third stage of life cycle analysis. See **life cycle analysis**.

impulse. *Noun.* (1) A surge of unidirectional polarity. (2) Thrust, impetus. (3) The product of the average magnitude of a force acting on a body and the time for which it acts. (4) The change in the momentum of a body as a result of a force acting on it.

impurity. *Noun.* (1) An undesired foreign material in or on a substance. (2) A material introduced in controlled small amounts into a semiconductor to develop the desired type of conductivity and resistance. See **dopant**.

in-and-out bond. *Noun.* A type of masonry construction consisting of alternate courses of **headers** and **stretchers** of brick, stone, concrete block, etc.

incalescent. *Adjective.* Increasing in temperature.

incandesce. *Verb intrans.* To show **incandescence**.

incandescence. *Noun.* Light emission from hot bodies.

incandescent. *Adjective.* Emitting visible light as a result of heat; for example, the filament in an electric light bulb, the walls of a kiln in use, or other object heated to visible radiation temperatures.

incise. *Verb trans.* To decorate ware by cutting, carving, or indenting the ware with a sharp tool. See **pargeting**.

inclusion. *Noun.* (1) A particle of foreign material embedded or trapped in a body or coating other than materials comprising the normal composition. (2) A solid, liquid globule or pocket of gas enclosed in a mineral or rock.

inclusion, gaseous. *Noun.* See **gaseous inclusion**.

inclusion, non-metallic. *Noun.* See **non-metallic inclusion**.

inclusion, open gaseous. *Noun.* See **open gaseous inclusion**.

inclusions, air. *Noun.* See **air inclusions**.

inclusions, clay. *Noun.* See **clay inclusions**.

inclusions, oriented. *Noun.* See **oriented inclusions**.

inclusions, mineral. *Noun.* See **mineral inclusions**.

inclusions, smoky. *Noun.* See **smoky inclusions**.

inclusions, vegetable. *Noun.* See **vegetable inclusions**.

incoherent. *Adjective.* (1) Of two or more waves having the same frequency but not the same phase. (2) Disordered, showing no organisation across an interface.

incoherent growth. *Noun.* The appearance of new crystals from nuclei within a work-hardened crystal with no correlation between the orientation of the original crystal grain and the new one growing in.

incombustible. *Adjective.* Any material that will not burn or support combustion when exposed to flames in air at 648 °C.

incommensurate layer structures. *Noun.* See **misfit layer structures**, also **incommensurate phase**.

incommensurate phase. *Noun.* Relating to magnetic ceramics it is one in which the **unit cell** of ordered magnetic moments is not an integral number of the crystallographic unit cell. (2) See **misfit layer structures**.

incompatibility. *Noun.* Failure to produce a homogeneous mixture; characterised by separation, cloudiness, precipitation, etc.

incompatibility, thermal. *Noun.* See **thermal incompatibility**.

incomplete combustion. *Noun.* A burning process in which oxidation of the fuel is incomplete, sometimes resulting in reducing atmospheres in direct-fired furnaces and kilns.

incongruent. *Adjective.* Containing disparate parts.

incongruent melting. *Noun.* Dissociation at the melting point to form a liquid plus another phase of different composition from the original compound.

incremental hysteresis loss. *Noun.* Loss in hysteresis when a magnetic material is subjected to a pulsating magnetising field.

incremental permeability. *Noun.* The ratio of a change in magnetic induction to the corresponding change in magnetising force when the mean induction differs from zero.

indent. *Noun.* (1) The surface depression left on a polished surface by one of the several **indentation hardness** test procedures. (2) *Verb.* To place an order for materials. (3) *Verb trans.* To make a permanent depression on a surface.

indentation crack-length toughness. *Noun.* Overloaded microindenters on a polished ceramic surface produce **radial** cracks of length, $2c$, which can be measured and used to determine the fracture toughness, k_{Ic} , from one of several equations of the type: $k_{Ic} = 0.16H_v a^{1/2} (c/a)^{-3/2}$, where H_v is the **Vickers hardness** and a is one-half of the indent diagonal.

indentation hardness. *Noun.* A quantitative way of finding the hardness of an optically polished flat surface by either measuring the area of an indent made by a faceted diamond subjected to a fixed load or noting the load needed to produce penetration to a fixed depth. Depending on the method and on the shape of the indenter there are several scales of indentation hardness: see **Vickers**, **Knoop**, **Rockwell**, **Shore**, **Meyer hardness**.

indentation size effect. ISE. *Noun.* The load effect observed in **indentation hardness** measurements when the hardness is found to increase as the applied load is decreased. This is because the **yielding** mechanism becomes influenced by the surface as the volume under going yielding decreases. The exponent n in the **Meyer equation** is a measure of the effect. See **Meyer's law**.

indentation-strength-in-bending. k_{ISB} . *Noun.* A method developed to examine **R-curve** behaviour. Three **Vickers indentations** are made on the tensile surface of a three point bend test polished beam-shaped specimen using a load sufficient to generate **radial** and **lateral cracks** around the indent. As the load is increased the crack size increment is determined up to failure to obtain k_{ISB} and realistic strength-performance data.

indenting. *Verb.* (1) The omission of brick from a masonry construction at such a spacing that the brick may inserted later. (2) See **incise**. (3) The process of making an indent on a polished surface to determine the specimen's **indentation hardness**.

independent variable. *Noun.* A variable in a mathematical equation whose value determines that of the dependent variable.

indeterminate. *Adjective.* Forces in a framework or structure that cannot be fully analysed especially by vector analysis

index grinding feed. *Noun.* A mechanical procedure for feeding internal and other grinding devices in which the rate or amount of feed is indicated by means of a dial similar gauge.

index head. *Noun.* See **dop-stick**.

index of refraction. n. *Noun.* The ratio of the velocity of light or the sine of the angle of incidence, in a material to the velocity of light in a vacuum, or the sine of the angle of refraction. A complex quantity with real and imaginary components connected by the **Kramers-Kronig relationship**. It is usually only the real component that is referred to as the **refractive index**. Often determined by immersing particles of the material in liquids of known refractive index.

index of workability. *Noun.* A measure of the consistency and forming characteristics, particularly mouldability of plastic materials.

Indiana measure of air entrainment. *Noun.* A procedure for estimating the quantity of air entrained in concrete in which the difference in unit weight of samples with and without air is reported.

Indian ink. *Noun.* A black pigment made from **lamp-black** and **gelatin**. Also called **China ink**.

Indian red. *Noun.* (1) A red **ferric oxide** pigment prepared by calcining ferrous sulphate. (2) A type of soil found in South Asia used as a pigment and metal polish.

indication. *Noun.* (1) In magnetic testing, a discontinuity identified as a magnetic-particle build-up resulting from interruption of the magnetic field. (2) In ultrasonic testing, determination of the presence of a flaw by detection of a reflected ultrasonic beam. (3) In general, that which indicates the presence of a flaw or discontinuity in a substance.

indication, diffuse. *Noun.* See **diffuse indication**.

indication, false. *Noun.* See **false indication**.

indication, non-relevant. *Noun.* See **non-relevant indication**.

indicator. *Noun.* A substance used in titrations to indicate the completion of a chemical reaction usually by a change of colour.

indicolite. *Noun.* A form of **tourmaline** with a pale blue to blue-black colour. Also called **indigolite**.

indigolite. *Noun.* See **indicolite**.

indirect arc furnace. *Noun.* A refractory-lined furnace in which ware is heated indirectly by an electric arc struck between electrodes.

indirect band gap. *Noun.* Typically that present in semiconductor silicon where any electron moving between the two energy states, above and below the gap, must

change its momentum. This makes it less likely to occur and so normal bulk silicon does not emit light at 1 μm , which would make it a useful **laser**.

indium. *Noun.* In. A ductile metal used in glass sealing alloys. Mp 156 °C.

indium antimonide. *Noun.* InSb. A **semiconductor** having a small energy gap and very high electron mobility; used in **photodetector** devices as well as in **magnetoresistive** and **Hall effect** devices. Mp 535 °C.

indium arsenide. *Noun.* InAs. A **zinc blende** structure semiconductor used in infrared photoconductor, **magnetoresistive**, and **Hall effect** devices. Mp 943 °C.

indium brazes. *Plural noun.* Various alloys of indium and other elements used in ceramic-metal seals to produce vacuum tight bonds; various solidus temperatures up to 315 °C.

indium gallium nitride. *Noun.* $\text{In}_{1-x}\text{Ga}_x\text{N}$. Semiconductor material that can be grown on **gallium nitride** substrate layers. The **band gap** varies with x and so the layers can be tuned to a wider solar energy wavelength band to allow more efficient solar energy conversion.

indium nitride. *Noun.* InN. A semiconductor with a resistivity of $4.0 \times 10^3 \Omega\text{-cm}$.

indium oxide. *Noun.* In_2O_3 . An n-type semiconductor useful as a resistance element in integrated circuitry. Mp 1,910 °C; density 7,179 kg m^{-3} .

indium oxide, tin-doped. *Noun.* See **indium tin oxide**.

indium phosphide. *Noun.* InP. A **zinc blende** structure semiconductor used to make **rectifiers** and **transistors** stable at temperatures above 400 °C. Mp 1,070 °C

indium tin oxide. ITO. *Noun.* $\text{In}_{2-x}\text{Sn}_x\text{O}_3$. A transparent semiconducting ceramic widely used in solar cells and flat panel displays.

induce. *Verb trans.* (1) To produce an electromotive force or electric current by induction. (2) To transmit magnetism by induction.

induced draught. *Noun.* A current of air produced by suction fans or stream jets in the flues of industrial kilns.

inductance. L. *Noun.* (1) The property of a circuit which, when carrying current, forms a magnetic field. (2) The property of an electric circuit as a result of which an electromotive force is created by a change of current in the same circuit or in a nearby circuit; measured in henries.

induction coil. *Noun.* A transformer for producing a high voltage from a low voltage. It consists of a coil of a few turns, a concentric coil of many turns and a common soft iron core.

induction furnace. *Noun.* An electric furnace consisting of an external water-cooled copper coil surrounding an

electrically conducting sample which is heated by electromagnetically induced eddy currents.

induction heating. *Verb.* To raise the temperature of an electrically conducting material by induced electric currents of high frequency.

induction method of magnetisation. *Noun.* Magnetisation of a material by a circulating current induced in a ring component by an oscillating magnetic field.

industrial diamond. *Noun.* A small, often synthetic diamond, with no value as a **gemstone**. Used as in cutting tools and abrasives.

industrial floor brick. *Noun.* A brick having extremely high resistance to **wear**, mechanical damage, chemicals, and temperature, which may be encountered in a factory.

industrial robot. *Noun.* A programmable, multi-function, manipulator designed to perform repetitive tasks on a production line.

inelastic. *Adjective.* Not having elastic behaviour.

inert. *Adjective.* Unreactiveness in a given set of conditions; a relative term.

inertinite. *Noun.* A **coal maceral** formed from the cellulose, glucose and fatty parts of plants. It has a layered structure that **transmutes** into **fusain** and has a **charcoal-like** appearance.

infiltrate. *Verb.* To undergo or cause to undergo the process by which a fluid passes into the pores of a solid. (2) *Noun.* A fluid that infiltrates.

infrared drier. *Noun.* A drier in which heat is supplied by infrared radiation, such as from infrared lamps.

infrared filter. *Noun.* A material that is transparent to infrared radiation but opaque to other wavelengths.

infrared laser. *Noun.* A **laser** that emits energy in the infrared wavelength band.

infrared spectrum. *Noun.* The part of the electromagnetic spectrum from 0.7 to 400 μm .

infrasizer. *Noun.* An instrument for the fractionation of powders by air classification according to their density and size; the powder is carried in an airstream and collected in a series of tapered cylinders of the same length but of decreasing diameters, the fines being collected in a bag at the end of the system.

infuse. *Verb trans.* To soak or be soaked in.

infusible. *Adjective.* (1) Not capable of melting when heated. (2) Having a high melting point. (3) Capable of being infused.

infusorial earth. *Noun.* An incorrect term for the siliceous remains of **diatoms**.

I.N. glass-ceramic. *Noun.* The commonest way to make ceramics derived from glass by adding a **nucleating agent** to the bulk glass and inducing **internal nucleation**, (**I.N.**), after using normal glass-shaping techniques. Most commercial glass-ceramics are in this category.

inglaze. *Noun.* Decoration applied to the fired glaze of porcelain and reheated to 1,030 °C where it sinks below the glaze surface. See **in-glaze decoration**.

in-glaze decoration. *Noun.* A ceramic decoration applied to the surface of an unfired glaze and fired simultaneously with the glaze. Often confused with **inglaze**. See **inglaze**.

ingot. *Noun.* A metal shape, obtained from a mould, suitable for storage or transportation.

ingot mould. *Noun.* A mould in which **ingots** are cast.

inhibitor. *Noun.* A substance, which when used in small amounts, retards or stops a chemical reaction. Also known as an **anticatalyst**.

initial modulus. *Noun.* The slope of the initial straight-line part of a **stress-strain curve**.

initial permeability. *Noun.* The slope of an induction curve at zero force of magnetisation as a specimen is magnetised.

initial rate of absorption. *Noun.* The weight of water absorbed by a brick when partially immersed in water for 1 min; expressed as grams per minute.

initial set. *Noun.* The period of elapsed time between the adding of water to make **mortar** or concrete and the moment it starts to lose plasticity; determined by the **Vicat needle test**.

initial softening. *Noun.* The time and temperature at which a ceramic or ceramic coating begins to show evidence of flow.

initial strain. *Noun.* The strain present in a specimen when the starting load is achieved in a **creep** test.

initial tangent modulus. *Noun.* The slope of a stress-strain curve at the origin.

initiator. *Noun.* (1) In **fractal** analysis it is the straight line of fixed length to which a **generator** is applied to introduce an irregularity and produce the **fractal dimension**. (2) In polymerisation it is the name given to the catalyst needed to bring about the reaction. (3) An explosive used in detonators.

injection. *Adjective.* A pressure process of forcing a filler material into cracks, cavities, and pores.

injection moulding. *Noun.* The forming of ceramics by the injection of a measured quantity of a body containing plasticising agents into a mould where it is densified by pressing.

ink, ceramic. *Noun.* See **ceramic ink**.

ink, India. *Noun.* See **India ink**.

ink, stamping. *Noun.* See **stamping ink**.

inlay, rolled. *Noun.* See **rolled inlay**.

inner Helmholtz plane. *Noun.* See **β -plane**.

inner plies. *Noun.* In a composite panel construction all plies of reinforcement other than the face or back plies.

inner-sphere adsorption complex. *Noun.* See **specific adsorption**.

inorganic dielectric paper. *Noun.* See **fluorhectorite**.

inorganic pigment. *Noun.* A colouring agent derived from mineral sources.

inorganic polymer. *Noun.* A macro molecular substance linked in two or three dimensions with covalent bonds between identical structural units, e.g., the SiO_4 tetrahedra in **silica**, the SiN_4 and NSi_3 units linked repeatedly throughout Si_3N_4 . Silicates and clays are classical examples.

inorganic spray coating. *Verb.* To colour a ceramic surface by passing the ware through a spray machine, which jets a slurry onto the surface and colour, is then developed by firing and annealing.

inorganic vesicles. *Plural noun.* The cavities occurring in micro- and meso-porous framework structures, such as **fullerenes** and **zeolites**.

IPS. *Abbreviation.* Stands for inter particle spacing. See **inter particle spacing**.

inrush current. *Noun.* A transient current that exists at the instant an electrical contact is closed, and which continues briefly.

inserted coil. *Noun.* A coil or coil assembly that is inserted into a test specimen for purposes such as in magnetic testing.

insertion and deletion of fibres. IDF. *Noun.* A filament winding method designed to save money by varying the density of expensive reinforcing fibres, and the type and cross-section of fibre to suit a design shape.

inside coil. *Noun.* See **inserted coil**.

inside colour. *Noun.* The reverse side of **fired gold**, the colour of which is an indication of firing conditions.

in situ composite. *Noun.* A directionally solidified poly-phase system.

in situ fibre. *Noun.* Fibrous microstructure generated by directional solidification; usually occurs in **eutectic** compositions.

in situ vitrification. ISV. *Noun.* A thermal treatment process that converts contaminated soils into durable,

leach-resistant material, similar to **obsidian** or **basalt**. Electrodes are inserted into the ground and a layer of **frit** plus **graphite** is put between them on the surface. As a current is passed the frit melts causing soil to melt and the molten zone spreads deeper until the power is switched off.

inspection. *Verb.* To examine a product or specimen by visual, mechanical, electrical, or other means to determine its quality in terms of prescribed standards or specifications.

inspection, magnetic-particle. *Verb.* See **magnetic particle inspection**.

inspection, spark-gap. *Noun.* See **spark-gap inspection**.

instantaneous recovery. *Noun.* The immediate strain decrease when a specimen is unloaded.

insulated conductor. *Noun.* A conductor that is coated or surrounded by a non-conducting material to prevent or retard the transfer of electric current, heat, sound, or other phenomenon of concern.

insulated-gate-field-effect transistor. IGFET. *Noun.* A type of **field effect transistor** having one or more semiconductor gate electrodes. Compare **junction field-effect transistor, JFET**.

insulating cement. *Noun.* A cement or concrete product in which a substantial quantity of an insulating material has been incorporated, or a lightweight concrete of relatively low density; used as thermal insulation and fire protection in structures.

insulating concrete. *Noun.* See **insulating cement**.

insulating firebrick. *Noun.* A high-alumina-content refractory brick of low thermal conductivity and low heat capacity and usually of high and obvious porosity.

insulating material. *Noun.* Any material which will prevent or retard the transfer of electric current, sound, heat, or other form of energy.

insulating refractory. *Noun.* See **insulating firebrick**.

insulation capacity. *Noun.* The property of masonry to store heat as a result of its mass, **specific heat**, and density.

insulator. *Noun.* (1) A substance that has a filled **valency band** at 0 K and a wide **energy band gap** resulting in sufficiently low electrical conductivity that the flow of current through it can be ignored. (2) A material of low thermal conductivity.

insweep. *Noun.* The lower part of a glass container which tapers inwards toward the base.

intaglio. *Noun.* A depressed surface decoration in which the design is engraved on the ware.

integral heat of adsorption. *Noun.* The sum of the differential heats of adsorption of an adsorbate from zero to a given level of adsorption.

integral throat entrance. ITE. *Noun.* A ring -shaped ceramic structure used to line the inside of rocket nozzles where hot gases at around 2,800 °C exit.

integral waterproofer. *Noun.* A material or mixture of materials added to concrete to reduce the capillarity or flow of water through the concrete.

integrated circuit. ic. *Noun.* A very small complete circuit manufactured in a single package. All the components, **transistors**, **capacitors**, **resistors**, etc., are manufactured into or onto a **semiconductor chip** by selective diffusion of dopants and **interconnects** are made by metallisation, both using masking techniques.

intelligent processing. *Noun.* A computer-based approach to producing advanced ceramics and composites with the necessary microstructure to fulfil chosen roles.

intensity. *Noun.* A measure of field strength or of the energy transmitted by radiation. For infrared heating also called **power density**; it is the input power in kilowatts per square metre of superficial frontal area of an infrared module.

intensity of magnetisation. *Noun.* The ratio of the **magnetic moment** to the volume of any piece of material, the piece being sufficiently small for its magnetisation to be considered uniform.

intensive. *Adjective.* Of or relating to a property measurement that is independent of mass. See **extensive**.

interaction. *Noun.* The transfer of energy between elementary particles, between a particle and a field, or between fields.

interaction parameter. e_i^1 . *Noun.* This measures the effect that the presence of a chemical species in solution has on the activity of another species in solution as a function of concentration. They permit calculation of the activity coefficient of any solute species present in a multi-component solution.

interactive. *Noun.* Continuous two-way transfer of information between a computer and its user.

interatomic. *Adjective.* Existing or occurring between or among atoms.

intercalary decoration. *Noun.* Bits of gold foil, coloured glass, or enamel applied to the surface of a glass object that is then encased in another layer of hot glass, trapping the design between the layers.

intercalate. *Verb trans.* To insert.

intercalated composite. *Noun.* A material consisting of either single or double polymer layers inserted between layers of the host sheet-like structure to make a well ordered, stacked multilayer structure with a repeat interlayer distance of 0.4–2.0 nm.

intercalation. *Verb.* A reaction that inserts guest species, either organic or inorganic, into the interlayer regions of materials with layered crystal structures. Defined as a reversible **topotactic reaction** in which the guest ions, atoms or molecules occupy empty sites in a solid structure. A charge transfer is always observed between host and guest. Originally observed in **graphite**.

intercalation compound. *Noun.* The product of an **intercalation** reaction. For example, **ornithine** in **vermiculite**, sodium in **graphite**. See **intercalation**.

interconnects. *Plural noun.* The material that joins horizontally and vertically the different parts of an **integrated circuit**. Horizontal interconnects are called **vias**.

intercostals. *Noun.* Short structural members fitted between basic frameworks to support secondary loads.

interface. *Noun.* The surface forming a common boundary between two substances in contact with each other, such as solid-solid, liquid-solid, vapour-solid, etc., defined by an **interfacial energy**. (2) A place where interaction occurs between two **components** or processes.

interfacial energy. *Noun.* Since an interface constitutes a surface between two components it has a positive energy relative to the bulk material. Because the energy is always positive systems work to reduce surface area. More commonly called **surface energy**. See **surface enthalpy**.

interfacial tension. *Noun.* The force of molecular, atomic or ionic attraction, across an interface; measured in newtons per meter, N m^{-1} .

interferometer. *Noun.* An optical instrument that will split a beam of light into two or more beams and then reunite the beams travelling over different routes to produce interference effects. The band pattern is a means of determining the expansion, contraction, strain, and other properties of materials.

intergranular corrosion. *Verb.* Preferential reaction at grain boundaries emergent at a surface; used to produce good micrographic contrast; when this is done by high-temperature heating in the air it is known as **thermal etching**.

intergranular fracture. *Noun.* Fracture of polycrystalline materials by crack propagation along **grain boundaries**.

interior field. E_i . *Noun.* The electric field inside a **dielectric material**. It is equal to the applied electric field, E_o , divided by the **dielectric coefficient**, k .

interior tile, glazed. *Noun.* See **glazed interior tile**.

interlamina shear. *Noun.* Force that produces a relative displacement between two laminae along the plane of the interface.

interlamina stress. *Noun.* A significant stress mode found in plates if the thickness is greater than 10 % of the width or length of the plate; it is the three stress components associated with the thickness dimension.

interlayer. *Noun.* The plastic reinforcing material used in the production of **laminated glasses** and plastic-bonded glass fibres.

interlayer water. *Noun.* Water that enters between the crystallographic layers in some structures and sometimes results in swelling; such water may be removed by heating.

interlock. *Noun.* (1) An electrical or mechanical device designed to prevent certain actions unless the necessary safety conditions are met. (2) A phenomenon observed in flexible brick pavements resulting from the interaction of the paving units and the sand between them which makes the pavement act as a composite whole and not just individual units.

interlocking tile. *Noun.* Roofing tile designed to interlock with adjacent tiles.

interlock, mechanical. *Noun.* See **mechanical interlock**.

intermediate crusher. *Noun.* A crushing or milling device that will reduce materials to intermediate sizes, that is, around 1–5 mm. in cross section, usually before the materials are subjected to additional grinding or processing.

intermediate-duty fireclay brick. *Noun.* A **fireclay** brick having a **pyrometric cone equivalent** not lower than **cone 29**, or more than 3 % deformation at 1,350 °C.

intermediate frequency. *Noun.* The frequency to which the signal carrier frequency is changed in a superheterodyne receiver at which most amplification occurs.

intermediate phase. *Noun.* A phase in a system whose composition does not extend to any of the **components** of the system.

intermediate piece. *Noun.* The refractory channel between the spouts of a **glass tank** and a **pot**.

intermediates. *Plural noun.* Oxides in glass compositions whose behaviour falls between **network modifier** and **network former**.

intermediate solid solution. *Noun.* A phase or solid solution having a composition range that does not extend to any of the pure components.

intermittent kiln. *Noun.* Any kiln in which a batch of ware is placed, fired, cooled, and removed before a subsequent batch is placed in the kiln.

intermittent moving bed. *Noun.* An adsorbent bed of **activated carbon** in which spent carbon periodically is replaced by virgin carbon, the spent carbon being removed from the bottom of the bed and virgin or reprocessed carbon being introduced at the top.

internal boundary layer capacitor. **IBLC.** *Noun.* Ceramic phases containing **semiconducting** grains and insulating grain boundaries. **Perovskites**, such as SrTiO_3 , are made semiconducting by doping with oxides, such as Nb_2O_5 , and firing in a reducing atmosphere at

around 1,450 °C. The grain boundaries are made insulating by painting low melting insulating oxides on the sintered perovskite and re-firing at 1,200 °C. Diffusion down the boundaries gives an insulating layer 10–100 nm thick. The resultant device has a high **dielectric constant** and a low **loss factor**.

internal energy. **U or E.** *Noun.* The sum of the potential and kinetic energies of atoms and molecules. A thermodynamic property of a system that changes by the work done on the system in an **adiabatic** change.

internal friction. *Noun.* Heat generated in a system due to ions being subjected to a fluctuating stress.

internal grinding. *Verb.* To grind and polish the surfaces on the inside of holes, cylinders, and tubular products.

internal seal. *Noun.* A ceramic-to-metal seal in which a ceramic surrounds the metal portion or pin in a cylindrical or similar unit.

internal stress. *Noun.* The stress existing in a solid body which is independent of external forces; for example, the stresses remaining in a glass induced by a particular heat treatment.

internal vibrator. *Noun.* A vibrating apparatus put into freshly placed concrete to render the mixture into a quasi-liquid state to attain maximum consolidation of the concrete in the forms.

International zero of enthalpy. *Noun.* The enthalpy of a pure element in its most stable state is by definition zero at 298 K and 1 atm pressure. See **standard enthalpies**.

inter particle spacing. **IPS.** *Noun.* The average separation distance between all particles in a suspension. It is a fundamental piece of data for predicting **rheological** behaviour.

interpenetrating composite. *Noun.* A new kind of composite structure in which there is an interpenetrating matrix of the two different phases, such as ceramic and metal. They are also known as **3–3 composites**, where the numbers refer to the number of dimensions in which each phase is continuous. Usually made by infiltrating a **foamed-porous ceramic**.

interply hybrid composite. *Noun.* See **hybrid composite**.

interpretation. *Verb.* To clarify and explain the meaning and significance of data and related observations, particularly from the standpoint of their relevance to a situation.

interstice. *Noun.* An empty space between atoms, or groups of atoms, in a solid structure; an empty space in a **lattice structure**.

interstitial. *Adjective.* (1) Related to or occurring in interstices. (2) *Noun.* An atom or ion that is not occupying a lattice point in a crystal but is occupying a

space defined by the nearest neighbour atoms, e.g., tetrahedral or octahedral interstitial site.

interstitial diffusion. *Noun.* A diffusion mechanism in ceramics whereby atom or ion movement is from **interstitial site** to interstitial site.

interstitial site. *Noun.* The empty space in a structure of spherical ions or atoms in contact with each other. Two common sites are generated, tetrahedral when formed by four atoms or ions, and octahedral when formed by six atomic units in contact.

interstitial solid solution. *Noun.* A type of alloy formed when the solute atoms are so much smaller than the solvent atoms that they can fit into the **interstitial sites** in the solvent crystal structure.

intimately mixed hybrid composite. *Noun.* See **hybrid composite**.

intracavity absorption. *Noun.* Occurs when an absorption medium is placed inside a **laser cavity** to increase the effective absorption path length.

intractable. *Adjective.* Difficult to shape or mould.

intrados. *Noun.* The inner curve or surface of an arch or vault, such as a concrete or fired-clay sewer pipe. See **extrados**.

intratelluric. *Adjective.* Formed or occurring below the surface of the earth.

intrinsic. *Adjective.* Inherent; relating to the essential nature of a thing.

intrinsic permeability. k_i . *Noun.* Another phrase for Darcian permeability coefficient. See **Darcy's law**.

intrinsic point defect. *Noun.* A crystal imperfection created when an atom position within the crystal is altered.

intrinsic semiconductor. *Noun.* Semiconductors with an equal number of electrons and **holes** produced thermally by breaking of interatomic bonds. An almost pure material to which no **dopants** have been added and the in which the electrical conductivity depends only on temperature and **band gap** energy. Sometimes called **i-type semiconductor**.

intrusion grouting. *Noun.* The technique of placing the grouting components in position in an area and subsequently converting the mixture to concrete by the addition of water.

intrusive igneous rock. *Noun.* Rocks formed when **magma** solidifies in the earth's crust. the slow cooling produces relatively large mineral crystals. The rock only appears at the surface when the overlying rocks have been eroded away.

intumescency. *Noun.* The property of some materials that causes them to bloat or swell to a permanent vesicular structure on heating, often with the evolution of

water. Used as a technique to induce sound and thermal insulation, as well as fire resistance.

intumescent. *Adjective.* Swelling.

inundate. *Verb.* To cover completely with water.

Invar. *Trademark, noun.* A 36 % nickel-iron alloy with a very small thermal expansion coefficient, $\alpha < 1.3 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$ from 15 to 250 $^\circ\text{C}$, which makes it very suitable for use in making ceramic-to-metal and glass-to-metal seals.

invariant equilibrium. *Noun.* A state of a system in which neither pressure nor temperature, nor composition can be altered without causing a decrease in the number of phases present.

invariant match. *Noun.* A colour match that does not vary with a change in illumination.

invariant point. *Noun.* The locus of pressure, temperature, and composition in a system that allows the maximum number of phases to coexist in equilibrium, as defined by the **phase rule**.

inventory analysis. *Noun.* A component of life cycle analysis. See **life cycle analysis**.

inverse spinel. *Noun.* Ceramics with the **spinel** composition AB_2O_4 , and structure, but which show disorder in the B cation distribution; up to one-half of the B cations leave the octahedral sites and share the tetrahedral sites. while a mixture of A and B cations occupy the octahedral sites. One hundred percent inversion leads to $\text{B}(\text{AB})\text{O}_4$.

inversion. *Noun.* (1) The change in the crystal structure of a material, as between two or more forms of **polymorphic** crystals, without change in chemical composition, such as the **quartz inversion** by thermal treatment. (2) In the **spinel structure** it describes the situation where the same cation is present on both tetrahedral and octahedral sites.

inversion parameter. λ . *Noun.* The fraction of B cations in tetrahedral sites in the **inverse spinel** structure. The value of λ depends on the temperature. When $\lambda = 1/4$ the formula is $(\text{A}_{0.5})_{\text{tet}}[\text{A}_{0.5}\text{B}_{1.5}]_{\text{oct}}\text{O}_4$.

inversion point. *Noun.* The temperature at which an inversion will occur as, for example, the change of α to β -quartz at 575 $^\circ\text{C}$, and vice versa.

inversion, quartz. *Noun.* See **quartz inversion**.

invert. *Noun.* (1) The bottom, or floor, or the lowest point of the internal surface of the transverse cross section of a channel or pipe in which water or other fluid is conducted. (2) *Verb.* To reverse an order, position, or condition, such as to turn upside down or inside out, or to revert from one form to another.

inverter or inverter. *Noun.* A device for changing a direct current to an alternating one.

investment casting. *Noun.* A technique for the production of small or relatively small items of high dimensional precision by casting in a refractory mould which itself was formed by slip casting a refractory body around a wax replica of the item of manufacture. After the mould has set, the wax is melted out, and the body is fired to produce a mould without joints.

investment compound. *Noun.* A mixture of refractory powder, binder, and liquid employed in the production of moulds for **investment castings**.

inviscid. *Adjective.* Term meaning low viscosity when applied to molten salts.

inwall. *Noun.* The refractory lining of the stack of a blast furnace.

inwall brick. *Noun.* Fireclay brick used in the lining of the inwall section of a blast furnace.

iolite. *Noun.* Another name for **cordierite**.

ion. *Noun.* An atom, group of atoms, or molecule which carries a positive or negative charge as a result of having lost or gained one or more electrons.

ion activity coefficient. f_{\pm} . *Noun.* The parameter needed to find the effective concentration of an electrolyte in a processing solution. Defined by Hückel as $\log_{10} f_{\pm} = -A z_+ z_- I^{1/2}$, where A is a composited physical constant, z is the ionic charge, and I is the **ionic strength**.

ion beam sputtering. *Verb.* High-ion-current beams incident on a target generate a flux of vapour atoms; used to coat ceramic fibres.

ion core. *Noun.* An atom without its electrons.

ion exchange. *Noun.* A reversible chemical reaction between a solid and a solution in which ions on the surface of the solid are replaced by other ions from the solution. Clay particles in suspension exhibit this property.

ionic. *Adjective.* Occurring in the form of ions or relating to ions.

Ionic. *Adjective.* Relating to a classical form of architecture characterised by fluted stone columns and capitals with scroll-like ornamentation.

ionic bond. *Noun.* A chemical bond, also called **electrostatic bond**, where the atoms involved decrease their energy by electrostatic attraction after electrons are transferred from some atoms to form **cations** and **anions**. These bonds are generally weaker than **covalent bonds**.

ionic conduction. *Noun.* Electrical charge movement in an ionic solid that occurs when a potential is applied causing the ions to be displaced.

ionic polarisation. *Noun.* The displacement of positive and negative ions in opposite directions in an ionic crystal in response to an applied electric field.

ionic semiconductor. *Noun.* Ceramic in which ion flow is mainly responsible for conductivity instead of electron or **hole** movement.

ionic strength. I. *Noun.* A defined term enabling the **ionic activity** of a solution to be found. Lewis and Randal's definition is: $I = 1/2 \sum m_i z_i^2$, where m is the molarity and z is the ionic charge. It is a measure of the intensity of the electric field due to solute ions in polar solutions.

ion implantation. *Noun.* A technique used in the electro- and electronic-ceramics industry to modify the structure and properties of semiconductors by bombarding their surface with high-velocity O^+ , Si^+ , and N^+ ions in a high-vacuum chamber. The implanted ions cause damage and create a range of localised defects. For example, implanting Si^+ in **gallium arsenide**, GaAs, produces an **n-type semiconductor**. Also used to produce thin, hard, wear- and corrosion-resistant surfaces. Depth of penetration is typically 0.5 μm .

ionisation or ionization. *Noun.* (1) The formation of **ions** as a result of electric discharge, chemical reaction, radiation etc. (2) *Modifier.* Ionisation temperature etc.

ionisation potential. *Noun.* The energy needed to remove to infinity an electron from an **orbital** it occupies in an atom; measured in **electron volts**.

ionising radiation. *Noun.* Electromagnetic frequencies of wavelength less than 100 nm.

ion, network-forming. *Noun.* See **network-forming ion**.

ion, network-modifying. *Noun.* See **network-modifying ion**.

ionomer. *Noun.* See **glass ionomer cement**.

ion vapour deposition. IVD. *Noun.* Evaporated material in an evacuated chamber is subjected to a dc glow discharge causing it to ionise and the ions then attach strongly to surfaces of ceramics to form protective coatings.

IPCS. *Abbreviation.* Stands for International Programme on Chemical Safety.

IPM. *Abbreviation.* Standing for intelligent processing of materials; see **intelligent processing**.

ipre brick. *Noun.* An I-shaped paving brick.

IPS. *Abbreviation.* Stands for inter particle spacing. See **inter particle spacing**.

IRA. *Acronym.* Used in the American brick industry to describe the capillary behaviour of bricks. It is the mass of water picked-up per brick in grams in 1 min. Since a **standard brick** has 30 in.² of surface area, the IRA is measured in g (30 in.²)⁻¹. The equivalent **SI units** are kg m⁻² min⁻¹ and 1 kg m⁻² min⁻¹ equals 20 g (30 in.²)⁻¹ min⁻¹.

iridescence. *Noun.* The interference of light reflected from a surface to produce a rainbow colour effect that changes depending on the observers viewing position.

iridescent. *Adjective.* Displaying a spectrum of colours that change due to scattering and interference as the observer changes position.

iridic. *Adjective.* Containing or concerning iridium.

iridising compound. *Noun.* A strongly adherent film or coating of a metal oxide or other compound on glass or vitreous surfaces as a decoration or to impart a desired surface property, such as electrical conductivity, or scratch resistance. Tin oxide is often used.

iridium oxide. *Noun.* (1) $\text{Ir}_2\text{O}_3 \cdot n\text{H}_2\text{O}$. The anhydrous oxide is not known; on heating it decomposes into metal plus IrO_2 . Used as an underglaze black pigment. Also known as iridium sesquioxide. (2) IrO_2 . A black pigment with the rutile structure; stable to red heat above which it loses oxygen.

iridium potassium chloride. *Noun.* K_2IrCl_6 . Used as a black pigment in the decoration of porcelains.

iridium sesquioxide. *Noun.* See **iridium oxide**.

iris. *Noun.* A type of **quartz** that reflects light from internal fractures and appears to be variously coloured. Also called **rainbow quartz**.

Irish moss. *Noun.* A gelatinous or mucilaginous seaweed sometimes used as a suspending agent for solids in aqueous slurries. Also known as **chondrus**, **carrageen**, **kileen**, **rock-salt moss**, **pearl moss**, and **pig-wrack**.

iron. *Noun.* (1) The various iron, steel, and cast iron structures of products on which porcelain-enamels are employed as decorative and protective coatings, such as household appliances, architectural panels, signs, kitchenware, sanitary ware, some glass-to-metal seals, glass-forming moulds, and the like. The sheet metals usually are of the low-carbon cold-rolled steels, low metalloid enamelling irons, and the decarburised steels. The cast products usually are grey iron castings. (2) Compounds of iron are the most useful and versatile of all metals as colouring agents in clays, pigments, and glazes.

iron allophane. *Noun.* See **allophane**.

iron aluminate. *Noun.* FeAl_2O_4 . A **spinel** with soft magnetic properties used in several devices.

iron arc process. *Noun.* An extremely high-temperature smelting process used in the production of **zirconia** and other refractory materials.

iron, blowing. *Noun.* See **blowing iron**.

iron boride. *Noun.* (1) Fe_2B . Mp 1,371 °C. (2) FeB . Mp 1,538 °C; density 7,150 kg m^{-3} . Both have potential use as ceramic magnets.

iron chalcogenides. *Plural noun.* Fe_{1+x}R . In this group of ceramic materials R is a group 6 element. Recently

discovered to have superconducting properties similar to iron pnictides. See **iron pnictides**.

iron chromate. *Noun.* (1) FeCr_2O_4 . Employed as a black pigment in **engobe**, and porcelain-enamels. Also used in electroceramic applications because it is weakly ferromagnetic. Mp > 1,770 °C; density 5,080 kg m^{-3} . The oxidised form of **chromite** ore.

iron crosses. *Noun.* A form of crystal twinning found in iron **pyrites** that produces a morphology resembling a cross.

iron, enamelling. *Noun.* See **enamelling iron**.

iron germanium sulphide. *Noun.* Fe_3GeS_4 . Special ceramics synthesised to have strong Ge-S covalent bonds to ensure a stable material with a wide **band gap** (1.4–1.5 eV) and so to be an efficient solar energy absorber.

iron glance. *Noun.* Another name for **haematite**.

ironing. *Noun.* A discoloration due to the crystallisation of **cobalt silicate** in glazes.

iron modulus. *Noun.* The ratio $\text{Al}_2\text{O}_3:\text{Fe}_2\text{O}_3$ in a **hydraulic cement**.

iron-ore cement. *Noun.* A cement in which iron ore is employed as a replacement for clay, shale, or alumina. More resistant to some corrosive environments, particularly seawater, than **Portland cement**. Density about 3,310 kg m^{-3} .

iron oxide. *Noun.* (1) Fe_2O_3 . Used in the production of **ferrites** and magnetic ceramics, **ferrospinel**s, ceramic glazes, and body stains. Also known as **jewellers' rouge**, a polishing material. Mp 1,565 °C; density 5,120–5,240 kg m^{-3} . (2) FeO . An important phase in the bonding of glass to metal in enamels. Mp 1,420 °C; density 5,705 kg m^{-3} . (3) Fe_3O_4 . One of the **spinel minerals** with useful magnetic and semiconducting properties arising from **inversion** on the tetrahedral-octahedral sites; used as a black ceramic pigment and a polishing compound. Also known as **black iron oxide**. Mp 1,587 °C; density 4,800–5,100 kg m^{-3} ; hardness (Mohs) 5.5–6.5.

iron pnictides. *Plural noun.* MFe_2R_2 . A group of ceramics where M is a group 2 element and R a group 5 element. The parent compound is CaFe_2As_2 , which was recently discovered to have high temperature superconducting properties.

iron propoxide. *Noun.* $\text{Fe}(\text{OC}_3\text{H}_7)_3$. An **alcoholate** salt used in propanol solution to make **gels** with barium alkoxides, from which **ferrites**, BaFe_2O_4 , $\text{BaFe}_{12}\text{O}_{19}$, can be obtained on mixing with water.

iron pyrite. *Noun.* FeS_2 . A natural mineral containing S_2^{2-} anions with an unrealised potential as a **photovoltaic** material. Failure in this respect is due to amorphous sulphur deficient sulphides being present in the microstructure with lower **band gaps**.

iron pyrites. *Noun.* See **iron sulphide**.

iron red. *Plural noun.* Any of the family of red pigments made from the red varieties of **iron oxide**.

iron saffron. *Noun.* See **Indian red**.

iron scale. *Noun.* Another name used by the pigment industry for **iron oxides**.

iron scurf. *Noun.* A mixture of ground stone and iron particles used as a blue pigment to colour brick. Obtained by polishing gun barrels with siliceous abrasives and grindstones.

iron silicate. *Noun.* Fe_2SiO_4 . Known as **fayalite**, a discrete iron silicate. Mp 1,198 °C; density 4,242 kg m⁻³; hardness (Mohs) 5–7;

iron silicon sulphide. *Noun.* A material developed at the same time as iron germanium sulphide. See **iron germanium sulphide**.

iron spangle. *Noun.* Magnetic iron oxide, Fe_2O_3 . Used in the production of **aventurine-type glazes**.

iron, spathic. *Noun.* See **spathic iron**.

iron spinel. *Noun.* $(\text{Fe,Mg})\text{Al}_2\text{O}_4$. Employed as a refractory. Density 4,390 kg m⁻³.

iron spot. *Noun.* A discoloration in refractory brick resulting from a concentration of iron-bearing impurities.

ironstone. *Noun.* (1) Any rock consisting mainly of an iron-bearing ore. (2) Short for ironstone china. See **ironstone china**.

ironstone china. *Noun.* A generic term for a fine, hard earthenware of high strength and durability.

ironstone clay. *Noun.* (1) Brown; a natural iron oxide or brown ironstone clay of variable composition but usually reported as $\text{FeO}(\text{OH})\cdot n\text{H}_2\text{O}$, mixed with clay. (2) Red; a mineral composed of **ferric oxide** and clay or sand.

iron sulphate. *Noun.* $\text{FeSO}_4\cdot 7\text{H}_2\text{O}$. Also called **copperas**. See **ferrous sulphate**.

iron sulphide. *Noun.* FeS . Also called iron pyrites, fool's gold or coal brasses because of its golden metallic colour; weathers to **copperas**. Mp 1,749 °C; density 4,840 kg m⁻³.

iron tramp. *Noun.* Pieces of unwanted iron, such as a nail, bolt, or iron trimming, which finds its way into a bulk material or batch.

iron vitriol. *Noun.* $\text{FeSO}_4\cdot 7\text{H}_2\text{O}$. See **ferrous sulphate**.

irradiance. E_e . *Noun.* Common term in **laser** applications; the radiant flux incident on unit area of a surface. Power per unit area; measured in W m⁻².

irregular edge dislocation. *Noun.* Any line in a plane that has a **Burgers vector** for its normal satisfies the requirement for an **edge dislocation**, hence dislocations in such a plane can be totally irregular.

irreversible adsorption. *Noun.* An adsorption-desorption cycle showing hysteresis.

irrigation pipe. *Noun.* A conduit of concrete, tile, or other material employed in the transport of water for agricultural irrigation.

irritants. *Plural noun.* Dusts and chemicals capable of inducing a local inflammatory reaction with living tissue.

ISE. *Abbreviation.* Stands for the indentation size effect. See **indentation size effect** and **Meyer's law**.

isinglass. *Noun.* Synonym for **mica**.

IS machine. *Noun.* A glass container-making machine on which the moulds do not rotate on tables.

ISM bands. *Plural noun.* Frequency bands for **dielectric heating** processes allocated for industrial, scientific, and medical use.

ISO. *Abbreviation.* Standing for International Organisation for Standardisation. The world's largest developer and publisher of international standards.

isobar. *Noun.* (1) A graphic indication of the quantity of a substance adsorbed by a material, such as activated carbon, plotted against temperature at a constant pressure or concentration. (2) Any of two nuclides having the same mass number, but different atomic numbers.

isochor. *Noun.* A line on a graph showing the variation of the temperature of a fluid with the pressure, at constant volume.

isochroous. *Adjective.* Having uniform colour.

isoelectric. *Adjective.* Having the same electric potential.

isoelectric point. IEP. *Noun.* The pH of an aqueous suspension at which the **zeta potential** of a colloid suspension goes to zero and the net surface charge on the solid particles is zero. At pH values > IEP the electrostatic surface charge is negative and at pH < IEP the surface charge is positive. Also called **isoelectronic point**.

isoelectronic. *Adjective.* Having the same electronic configuration. See **super atoms**.

isoelectronic point. IEP. *Noun.* A way of characterising powdered materials by quoting the pH value at which the **zeta potential** of a powder in a liquid equals zero. At all pH values lower than the powder's IEP, the electrostatic surface charge will be positive. The opposite applies for pH values higher than the IEP. Also called **isoelectric point**.

isolate. *Verb.* To prevent interaction between circuits; insulate.

isomer. *Noun.* A compound of the same composition and molecular weight as another, but having different physical or chemical properties.

- isometric.** *Adjective.* (1) Relating to minerals that crystallise in the **cubic** system having three equal axes at right angles and having isotropic properties with respect to these axes. (2) Having equal dimensions or measurements.
- isomorphic.** *Adjective.* Having identical crystalline structures but different chemical compositions.
- isomorphic coprecipitates.** *Plural noun.* Precipitates in which the cations form **solid solutions**; this is usually determined by ionic size differences and control of the pH. Most coprecipitates are produced sequentially and so are mixtures where one solid coats the first to precipitate.
- isomorphous.** *Adjective.* Having the same crystal structure type but different composition.
- isomorphous mixture.** *Noun.* A type of solid solution in which minerals of analogous chemical composition and closely related crystal habit crystallise together in various proportions.
- isophorone.** *Noun.* A ketone solvent with moderate power to dissolve common thermosetting resin matrix materials encountered in ceramic-polymer composites.
- isopleth.** *Noun.* A graphical presentation of equilibrium pressure-temperature data in a solid-gas system that is presented as $\ln p$ versus $1/T$, where p is the equilibrium pressure and T is the isothermal temperature.
- isopycnic point.** *Noun.* The position in an aqueous solution with a known density gradient where a component in a suspension has a density equal to that of the gradient. Isopycnic points are used in density gradient ultracentrifugation to separate components in a mixed solid.
- isostatic forging.** *Noun.* See **rapid omnidirectional compaction**.
- isostatic pressing.** *Verb.* A technique for compacting powders into shapes of high, uniform density in which a flexible mould containing the powder is sealed in an impermeable envelope and subjected to high pressure via a surrounding fluid from all sides.
- isostere.** *Noun.* A graphical presentation of equilibrium concentration or pressure against temperature when the quantity adsorbed per unit of a material, such as activated carbon, is held constant.
- isotherm.** *Noun.* (1) A line on a chart representing the relationship or changes in volume or pressure at constant temperature. (2) A plot of the quantity of material adsorbed per unit of another material, such as activated carbon, against equilibrium concentration or pressure at constant temperature.
- isothermal.** *Adjective.* (2) Taking place at constant temperature. (2) Of or relating to an **isotherm**.
- isothermal forging.** *Noun.* The use of hot isostatic pressing methods to shape and join.
- isothermal transformation.** *Noun.* A phase change occurring at constant temperature.
- isotherm, Freundlich.** *Noun.* See **Freundlich isotherm**.
- isotherm, Langmuir.** *Noun.* See **Langmuir isotherm**.
- isotope.** *Noun.* Nuclides having the same **atomic number** but a different **mass number**.
- isotopic assay.** *Noun.* The determination of the percentage, by weight or by atoms, of isotopic components in source or special nuclear materials.
- isotopic composition.** *Noun.* The relative amounts of the various isotopes of an element in a sample of material, expressed as a ratio.
- isotron.** *Noun.* A machine for separating small quantities of isotopes by ionising them and separating the ions in an electric field.
- isotropic.** *Adjective.* (1) Having identical values for a given property in all crystallographic directions. (2) sometimes used to describe **electro-optic** perovskites when in a non-transmitting mode. Application of large electric fields can convert the material to **birefringent**.
- isotropic dielectric.** *Noun.* A dielectric polarised in the direction parallel to an applied electric field, and a magnitude that does not depend on the direction of the electric field.
- isotypic.** *Adjective.* Structures having the same arrangement of polyhedral structural units; zeolites are an example.
- ISV.** *Abbreviation.* Stands for in situ vitrification. See **in situ vitrification**.
- Italian asbestos.** *Noun.* See **tremolite**.
- Italian red.** *Noun.* One of the several shades of **ferric oxide** red pigments.
- ITE.** *Abbreviation.* Stands for integral throat entrance. See **integral throat entrance**.
- iteration.** *Noun.* A process using successive approximations, each one improved by the result of the previous value, to converge on a correct answer.
- itinerant ferromagnet.** *Noun.* Conducting ceramics and alloys that order ferromagnetically in the **ground state** with the conduction electrons also contributing to the overall **magnetic moment**.
- ITO.** *Acronym.* Stands for tin-doped indium oxide. See **indium tin oxide**.
- i-type semiconductor.** *Noun.* See **intrinsic semiconductor**.
- Izod impact test.** *Noun.* A measure of the impact strength of a material in which the height of a pendulum swing after striking a specimen, usually notched, is reported as the energy required to fracture the specimen.

j. *Symbol.* Standing for: (1) Unit vector along the y-axis. (2) The imaginary number $\sqrt{-1}$; see **i**.

J. *Symbol.* Standing for (1) current density. (2) **joule(s)**.

jack. *Noun.* The model from which working moulds are made. Also known as a **case mould**.

jack arch. *Noun.* A sprung arch in which the outer and inner surfaces are constructed along horizontal planes, or in which the inner surface is constructed with a relatively large radius.

jack brick. *Noun.* A type of refractory brick employed as the base on which glass-melting pots are placed, and which is designed with openings or holes to accommodate the fork of a fork-lift truck or similar device for easy transport of the pots from one location to another.

jacket. *Noun.* A reinforced covering providing environmental and mechanical protection for the insulation, core, shield, or armour of a cable.

jacket, primary. *Noun.* See **primary jacket**.

jackhammer. *Noun.* A compressed air-driven, hand-held hammer drill used for drilling ceramics and rocks.

jade. *Noun.* Spanish for kidney stone. One of either of the minerals **jadeite**, $\text{NaAl}(\text{SiO}_3)_2$, or the double-chain silicate **actinolite**, $\text{CaFe}_3(\text{Si}_8\text{O}_{22})(\text{OH},\text{F})_2$. The actinolite form is known as **nephrite** jade. All forms are shaded from white to black but mostly green with a **glassy lustre**. Tough; hardness Mohs 6.5–7.0; density 3,000–3,500 kg m^{-3} ; both of these high values are a consequence of its high-pressure formation. Can be cleaved and carved into jewellery and art objects. The most valuable is **imperial jade** a transparent green variety.

jadeite. *Noun.* A monoclinic structured mineral of the **clinopyroxene** group, found in **igneous** and **metamorphic** rocks. Used as a gemstone. See **jade**.

Jahn-Teller effect. *Noun.* Certain ceramic crystals containing d-transition metal ions possess a distortion from their expected symmetry because an electric field of lower symmetry caused by distorting the oxide anion polyhedra around the cation is able to produce an overall lower energy state of the transition metal cation; this is the Jahn-Teller effect.

jamb. *Noun.* The vertical structural member forming the sidewall of the opening or port of a furnace superstructure carrying the port crown load.

jamb brick. *Noun.* A brick modified so that the corner of one end and side is rounded to provide a radius approximately equal to the width of the brick; used to construct curved walls and other curved structures.

jamb wall. *Noun.* (1) The sidewall of a furnace or kiln between the flux block and crown, but not including the ends. (2) The refractory wall between the pillars of a glass-melting pot furnace and in front of or surrounding the front of a pit.

jam-socket machine. *Noun.* A machine designed to shape the sockets of clay sewer pipes.

JANAF tables. *Noun.* A set of thermodynamic data tables for a range of materials, including ceramics, as a function of temperature. Produced by the National Bureau of Standards.

Janus material. *Noun.* A material that can be induced to have both **ferroelectric** and **ferromagnetic** properties, a combination not commonly encountered. A thin film of europium titanate, EuTi_2O_4 , stretched across a substrate of dysprosium scandate, DyScO_3 , is the strongest simultaneous ferroelectric and ferromagnetic so far produced. See **multiferroics**.

Japanese brush. *Noun.* A chinaware decorating brush fashioned so that the bristles come to an extremely fine point; used for brush stroke decoration.

Japanese porcelain. *Noun.* A porcelain similar to Chinese porcelain, but fired at a lower temperature to provide a softer appearance.

jar. *Noun.* A wide-mouthed cylindrical container with no handles made from glass or **earthenware**.

jar crusher. *Noun.* See **jar mill**.

jardinière glaze. *Noun.* A type of unfritted glaze, either hard or soft, containing the oxides of lead, aluminium, calcium, potassium, silicon, and zinc; used as a decorative glaze on products such as flowerpots.

jargon. *Noun.* (1) Colourless, yellowish, or smoky varieties of **zircon**, ZrSiO_4 , produced by heating the sample. (2) Language evolved in specialized areas of study such as ceramic science.

jar mill. *Noun.* A small rotating closed cylinder of porcelain or porcelain-lined steel containing pebbles or porcelain balls, and in which materials are ground or blended; a laboratory-sized mill.

jarosite. *Noun.* $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$. A yellow-brownish secondary mineral; hexagonal crystals of basic hydrated sulphate of iron and potassium. It has an hexagonal **tungsten bronze** structure formed by sheets of AlO_6 octahedra.

jasper. *Noun.* An opaque, microcrystalline form of **quartz** that is coloured red, brown, green and yellow from a number of impurities. Used as a gemstone.

jasperware. *Noun.* A vitreous, opaque, coloured, unglazed **stoneware** developed by Josiah Wedgwood and which is characterised by relief decoration of white or contrasting colours and containing a substantial amount, approximately 50 %, of **barite**, BaSO_4 .

jawbreaker. *Noun.* See **jaw crusher**.

jaw crusher. *Noun.* A crushing or fragmenting machine consisting of a moving jaw, hinged at one end, which swings toward and away from a stationary jaw in a regular oscillatory cycle; in some designs, both jaws may be actuated.

jaw face. *Noun.* The surface of a tensile tester jaw that holds the specimen.

jaws. *Noun.* The parts of a clamp that hold the specimen in a tensile test.

Jena glass. *Noun.* An early variety of chemically, and sometimes thermally, resistant optical glass having good resistance to thermal and mechanical shock.

jeroboam. *Noun.* A wine bottle having a capacity of about four-fifths of a gallon or 3.03 l.

jet. *Noun.* (1) A strong well-defined stream of gas or fluid emanating from an orifice or moving in a contracted duct. (2) A hard black form of **lignite** that takes a brilliant polish and is used for jewellery.

jet abrader. *Noun.* A device for providing a very fine jet of abrasive powder and monitoring the time to break through a coat to the substrate.

jet drier. *Noun.* A drier in which ware is dried by jets of warm air, steam, or both, injected into the drying chamber.

jet mill. *Noun.* An efficient and effective milling device, producing solids of extremely small and frequently controlled sizes, in which the particles are actuated by high-pressure air, steam or other medium and are fragmented by mutual collisions at high speeds.

jet nozzle. *Noun.* A specially shaped refractory nozzle employed in the production and exhaust of extremely high-temperature jet streams.

jet spinning. *Noun.* The use of a directed blast of hot gas to extend molten a drop into a fine fibre.

jetting. *Adjective.* A thin stream of material emerging from an injection moulder gate that does not spread out to fill the mould. Usually caused by a too small gate diameter.

jetware. *Noun.* A pottery-type ware fabricated from a red-clay body and coated with a black, manganese-containing glaze.

jewel. *Noun.* (1) In the ceramic context, a synthetic alumina bearing gem, such as a ruby or sapphire, which is used as a bearing material in watches and delicate instruments. (2) In general a precious or semi-precious stone. (3) An ornamental glass boss, often faceted, used in stained glass work. (4) *Verb trans.* To fit or decorate with jewels.

jeweller's rouge. *Noun.* A finely powdered form of ferric oxide, Fe_2O_3 used to polish metal. Also called **crocus**.

jewellery enamel. *Noun.* A specially formulated porcelain-enamel, frequently melting at temperatures lower than those of conventional porcelain-enamels, employed on gold, silver, iron, etc., in the manufacture of jewellery, art objects, insignia, and similar products.

JFET. *Acronym noun.* Standing for junction field-effect transistor. See **junction field-effect transistor**.

jig. *Noun.* A device employed to hold and position work during manufacture or assembly.

jigger. *Noun.* (1) A mechanically operated device similar to a potter's wheel on which ceramic ware is formed from a plastic body by the differential rotation of a profile tool and mould, the mould having the contour of one surface, and the profile tool having the contour of the other surface of the ware. (2) A small glass especially for whiskey. (3) *Verb.* To operate a **jigger**.

jigger man. *Noun.* (1) The operator of a **jigger**. (2) The workman who returns the glass residue from a ladle to the charging end of a glass-melting furnace.

jigging. *Verb.* A process for the separation and beneficiation of concrete aggregates and other particulate materials on the principle of hindered settlement, and in which the aggregate is passed over a perforated plate in a tank of water and subjected to vertical pulsations by air jets or by vibrating diaphragms; lightweight materials are floated off and discarded.

jig, hand. *Noun.* See **hand jig**.

jigsaw. *Noun.* A mechanical saw with a very fine steel blade for cutting intricate shapes in sheets of material.

J-integral. *Noun.* Mathematical device to analyse the local stress-strain field around a crack; e.g., for a 2-D crack with a front parallel to the z-axis in the x-z plane the integral is $J = \int_{\gamma} (Wdy - T[\delta\mu/\delta x]ds)$, where W is the strain energy density, γ is the path required to enclose the crack tip, ds is an increment of contour path, T is the outward force vector on ds, and μ is the displacement vector at ds.

JJ. *Abbreviation.* Standing for Josephson junction. See **Josephson junction**.

JM process. *Trade name, noun.* A manufacturing route to **rock wools**; a thin stream of silicate melt falls onto a train of rotating spinning wheels.

jnd. *Abbreviation.* Standing for just noticeable difference.

job-cured specimen. *Noun.* A specimen of concrete cured at the site of use and under the presumed same conditions to which the commercial concrete installation is, or will be, exposed; such specimens may be tested or retained for future reference.

job shop. *Noun.* A factory that produces parts or ware for use or for sale by another organization, frequently under the purchasing organization's trade name.

jockey pot. *Noun.* A glass-melting pot of such size and shape that it may be supported in a furnace by two other pots.

joggle. *Noun.* A plaster or brass insert serving as a key to ensure the correct alignment and adjustment of two halves of a plaster mould. Also known as a **natch**.

jogs. *Plural noun.* (1) The junctions between portions of a **dislocation** lying in parallel **slip planes**; for a jog to move, material must be transferred by the creation or destruction of vacancies and so movement is diffusion controlled. (2) Points of electrical charge on an edge dislocation equal to $\pm e$ where extra atoms add to the bottom of the incomplete plane that forms the edge dislocation. Compensation occurs by formation of vacancies in the crystal lattice.

joint. *Noun.* (1) The point, position, or surface at which two or more things, such as mechanical or structural components, are joined. (2) The interstice between masonry units. (3) A connection between two pipe sections, made either with or without the use of additional parts.

joint assembly. *Noun.* An assembly of dowels and supporting framework for holding the dowels in place during the placing of concrete, particularly in the construction of pavements.

joint, cold. *Noun.* See **cold joint**.

joint, construction. *Noun.* See **construction joint**.

joint, contraction. *Noun.* See **contraction joint**.

joint, control. *Noun.* See either **expansion** or **contraction joint**.

joint, dipped. *Noun.* See **dipped joint**.

joint, dummy. *Noun.* See **dummy joint**.

jointer. *Noun.* (1) A tool for pointing mortar joints in brickwork. (2) A person who makes joints.

joint, expansion. *Noun.* See **expansion joint**.

joint filler. *Noun.* Pre-moulded strips of a bituminous material or asphalt cement containing a filler such as, self-expanding cork, fibrous material, sawdust, felt, or similar material saturated with a bituminous substance, which are manufactured in suitable dimensions and inserted in concrete or other joints to permit movement of the joint without damage to the structure.

joint, hinge. *Noun.* See **hinge joint**.

jointing. *Verb.* (1) The filling or caulking of masonry joints. (2) The process of striking, slicking, or raking the joints between masonry units to provide a desired surface appearance and to improve the tightness and strength of the joint.

jointing yard. *Noun.* An area situated between the grinding and polishing operations in the continuous manufacture of plate glass in which plaster joints holding the glass are remade. Also known as a **laying yard**.

joint, lap. *Noun.* See **lap joint**.

joint line. *Noun.* The seam, mould mark, or line reproduced on glass and cast ceramic ware by the joint between two mould parts.

joint, warping. *Noun.* See **warping joint**.

joint, weakened-plane. *Noun.* See **weakened-plane joint**.

joist. *Noun.* A beam made of reinforced concrete or some other non-ceramic materials used in floor and roof constructions.

jolly, jollyng. *Verb.* The process of forming or shaping ceramic hollowware by means of a machine in which a rotating plaster mould has the contour of the bottom surface and a profile tool, lowered on the body from an otherwise stationary position, forms the other surface of the body.

jolt moulding. *Noun.* A process for the shaping of refractory forms in which the plastic body is subjected to mechanical or manual jolting or jerky movements; a mould plate actuated under pressure sometimes may be employed to shape the top of the body.

jorum. *Noun.* A large drinking bowl.

Josephson effect. *Noun.* An effect arising from the presence a sufficiently thin layer of insulating material in a **superconductor**; a superconducting current can flow across the junction in the absence of an applied voltage. This is the direct-current Josephson effect. Used to precisely standardise the volt.

Josephson junction. *Noun.* A device made from two superconductors separated by a very thin insulating barrier. A simple Josephson junction is a switch, which can be switched from the superconducting to the resistive state either by the application of a voltage or by exceeding the critical junction current. Switching speed is extremely fast, 10^{-12} s. Control is a simple wire generating a magnetic field near the junction and the field will activate the resistive state. Josephson junctions can be used in **SQUIDS** that are capable of measuring voltages as small as 10^{-18} V, currents as small as 10^{-18} A and magnetic fields of 10^{-14} T.

Josephson tunnelling. *Noun.* The phenomenon of charge carriers from a superconductor moving through a non-superconducting, thin barrier material, into a second superconductor.

joule. J. *Noun.* The **SI unit** of energy or work; it is the work done when the point of application of a force of 1 **Newton** is displaced through a distance of 1 m in the direction of the force. One joule is equivalent to 0.239 cal, 10^7 ergs, or 1 W-s.

Joule-Kelvin effect. *Noun.* See **Joule-Thompson effect**.

Joule effect. *Noun.* (1) The production of heat as a result of a current flowing through a conductor. (2) An increase in length of some ferromagnetic materials when longitudinally magnetised.

Joule-Thomson effect. *Noun.* A change in temperature in a thermally insulated gas when it is forced through a porous material or a single small aperture. Each gas has

an inversion temperature above and below which it is a cooling or a heating effect. Also called **Joule-Kelvin effect**.

journal. *Noun.* The part of a shaft or axle in contact with or enclosed by a bearing.

J-phase. *Noun.* $Y_4Si_2O_7N_2$. One of the **oxynitrides** occurring when silicon powder is heated in N_2 gas in the presence of **yttria**, Y_2O_3 .

jug. *Noun.* An **earthenware**, **glass**, or metal container for fluids, usually having a short neck and small mouth, stopper, and handle.

jumbo brick, jumbo block. *Noun.* A generic term indicating a brick or building block larger than standard in size; sometimes produced to specifications. See **standard brick** for normal sizes.

jumper, jumping. *Noun.* A defect occurring in porcelain-enamel ground coats characterised by the spontaneous popping of relatively small circular-shaped flakes of ground coat from the ware. The defect usually appears in random areas, and may appear in the ground coat or the first cover-coat of porcelain-enamel on sheet steel particularly on a radius or edge.

junction. *Noun.* An interface between semiconductor regions.

junction field-effect transistor. *Noun.* A device in which the semiconductor **gate** region or regions form one or more **p-n junctions** with the conduction **channel**. See **junction transistor**.

junction transistor. *Noun.* A bipolar transistor consisting of two p-n junctions combined to form either an n-p-n or a p-n-p transistor. This type of transistor has three electrodes, the emitter base and collector and is used to amplify an electrical signal.

Jun ware. *Noun.* Bright-red or ruby-red ware coloured by **copper red glaze**; first made during the Sung dynasty. Extremely difficult to fire to a uniform colour.

just-in-time. *Noun.* A method of inventory management that ties industrial production to demand rather than holding large stocks in advance of orders.

Kk

- k.** *Symbol.* Standing for: (1) kilo meaning one thousand; (2) **karat**; (3) the unit vector along the z-axis.
- K.** *Symbol.* Standing for: (1) **Kelvin**; a temperature scale; (2) in computing, 1,024 words, bytes, or bits; (3) potassium.
- Kagome nets.** *Noun.* A way of describing crystal structures in terms of layers of atoms present in the structure. An example of the notation is: $^{\infty}(\text{B}_6\text{C}_2)^3$, which indicates that there are infinite 2-D layers of boron and carbon atoms forming 8-membered rings in three orientations related by a threefold rotation axis.
- kainite.** *Noun.* $\text{KCl}\cdot\text{MgSO}_4\cdot 3\text{H}_2\text{O}$. A white mineral containing **magnesium sulphate** and **potassium chloride**. Used as a source of potassium salts in ceramic compositions and as a fertiliser.
- Kaiser effect.** *Noun.* A relationship for ceramic and glass tensile test samples between the applied stress and the measured cumulative number of **acoustic emission** events detected as the applied stress is increased linearly. The cumulative number increases sharply only when the applied stress exceeds the maximum value to which the sample has already been subjected to. Used as a way to determine stored stress levels in ceramics.
- kaki.** *Noun.* A reddish-brown, opaque **stoneware** glaze resembling the colour of persimmon; produced when a layer of iron oxide crystals spreads over the surface of the glaze.
- kaliium carbonate.** *Noun.* Colloquial name for **potassium carbonate**.
- kalsilite.** *Noun.* $\text{K}[(\text{Al},\text{Si})\text{O}_2]_2$. A **nepheline** mineral that contains no sodium ions and so the formula is simplified to the one shown.
- kalsomine.** *Noun.* (1) White or pale-tinted wash for brick walls containing **zinc oxide**, glue and a colorant. Also called **calcimine**. (2) *Verb trans.* To apply a kalsomine wash to walls or ceilings.
- kame.** *Noun.* A ridge of sand and gravel deposited by water. Often a source of materials for ceramic batches.
- Kanthal.** *Trademark, noun.* Sintered rods of MoSi_2 ; used as furnace heating elements. When first heated in the air a protective glassy layer is formed and the elements can then be used up to 1,900 °C giving furnace temperatures up to 1,750 °C.
- kaolin or kaoline.** *Noun.* A group of refractory white or nearly white-burning clays having the approximate composition $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$ plus small amounts of alkali metals and iron cations. Employed in ceramic bodies to impart high strength, plasticity, and workability during forming. Used extensively as a body and glaze ingredient in a wide variety of products, including pottery and cements. Density 1,280–2,600 kg m⁻³; **pyrometric cone equivalent** 34–35. Also called **china clay**, **china stone**.
- kaolin, calcined.** *Noun.* See **calcined kaolin**.
- kaolin, Florida.** *Noun.* See **Florida kaolin**.
- kaolinisation.** *Verb.* Conversion of aluminosilicate rocks into **kaolin** by weathering.
- kaolinite.** *Noun.* $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$. Hydrated aluminium disilicate a white to grey clay mineral with the monoclinic crystal structure. The most common constituent of **kaolin** and a constituent in most clays.
- kaolinosi.** *Noun.* A lung scarring and clogging disease caused by inhaling large amounts of clay dust.
- kaowool.** *Trade name, noun.* Discontinuous fibre formed from Al_2O_3 and SiO_2 . Available commercially as aluminosilicate insulating and strengthening fibre. Density 2,560 kg m⁻³; Young's modulus 84 GN m⁻².
- karat.** *Noun.* Alternative spelling of carat. See **carat**.
- katoite.** *Noun.* $\text{Ca}_3\text{Al}_2(\text{SiO}_4)(\text{OH})_8$. A silicate phase present in **red mud**; formed by the addition of **lime** to the **Bayer process** in order to restrict sodium titanate production.

Kauzmann temperature. *Noun.* The temperature at which the **entropy** of a **supercooled liquid** would drop below that of the crystalline solid. Used to measure glass **fragility**. See **fragility parameter**.

Kavalier glass. *Noun.* A high-potash-content, chemical-resistant glass.

KC. *Abbreviation.* Standing for **kilocycle**.

kcal. *Abbreviation.* Stands for **kilocalorie**.

KDP. *Abbreviation.* Stands for potassium dihydrogen phosphate. See **potassium dihydrogen phosphate**.

KE. *Abbreviation.* Standing for **kinetic energy**.

keatite. *Noun.* A rare form of **silicon dioxide** formed at high pressure; it has an almost zero thermal expansion coefficient.

keel. *Noun.* A stain made from **red ochre**.

Keene's cement. *Noun.* Anhydrous, calcined **gypsum**; a hard, white, finishing plaster containing additions of materials, such as **potassium sulphate** or **potash alum**, to accelerate the set.

Keggin clusters. *Noun.* See **Keggin ions**.

Keggin ions. *Noun.* Large discrete anions like $[\text{H}_2\text{W}_{12}\text{O}_{40}]^{6-}$. Sometimes called **Keggin clusters**.

Kelley consistency test. *Noun.* A test used on concrete samples in which a metal ball of prescribed dimensions and weight is placed on the surface of freshly prepared concrete and the depth of penetration is taken as a measure of the consistency of the mix.

Kelley tables. *Noun.* Thermodynamic data for a wide range of compounds of interest to ceramicists; assembled by the US Bureau of Mines, it has data for thermodynamic functions up to 2,000 °C.

kelvin. K. *Noun.* (1) The basic **S I unit** of thermodynamic temperature. The fraction 1/273.16 of the thermodynamic temperature of the triple point of water. Zero degrees K is the equivalent of -273.16 °C , or **absolute zero**. (2) To get away from the uncertainties of water, purity etc., a new definition in terms of an exact value being ascribed to the **Boltzmann constant** is to be adopted. See **kilogram** and **mole** where other constants are being used to make definitions.

Kelvin scale. *Noun.* A thermodynamic temperature scale based on the efficiencies of ideal heat engines. The zero of the scale is absolute zero. The degree is now defined so that the triple point of water is exactly 273.16 K but was originally equal to the degree on the Celsius scale; it was redefined in 1990.

kelyphitic rim. *Noun.* A mineral shell surrounding another mineral in an **igneous rock**.

kenyaite. *Noun.* $\text{Na}_2\text{Si}_{20}\text{O}_{40}(\text{OH})_2 \cdot 9\text{H}_2\text{O}$. A synthetic hydrated sodium silicate with a layered structure and **zeolite**-like properties.

ken materials. *Plural noun.* Smart materials, particularly engineering materials, which respond to their environment. Ken is the Chinese character meaning structure, integration, wisdom and benignity.

keramics. *Noun.* A rarely used variant of the word ceramics.

keratin. *Noun.* A protein extract from hair and horny substances; used as an addition to retard the set of plaster.

kerbstone. *Noun.* A block of stone or concrete forming a kerb.

kerf. *Noun.* (1) The cut made by a tool. (2) The name given to hand hewn clay blocks to be used in the manufacture of hand5.65 made clay roofing tiles.

kerma. *Noun, acronym.* Arises from: kinetic energy released per unit mass. It is the quotient of the sum of the initial kinetic energies of all the charged particles liberated by ionising radiation in a volume element of material and the mass of the volume element. Measured in **grays**.

kern. *Noun.* The central area of a column or wall through which all compressive forces act.

kernite. *Noun.* $\text{Na}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$. A soft, colourless mineral of monoclinic hydrated **sodium borate**. A source of **borax** and other boron compounds.

kerogen. *Noun.* Solid organic matter found in some rocks, such as oil **shale**.

Kerr cell. *Noun.* The basis of the **electro-optic shutter**. Two parallel electrically charged plates in a glass cell containing a liquid are sandwiched between crossed polariser and analyser. No light will pass when the electric field is off but when the field is on the liquid phase becomes doubly refracting and light passes. If the cell is at 45° to the polarizer the wave has parallel and perpendicular vibrations with respect to the electric field and since these travel at different speeds a phase difference develops which leads to elliptically polarised light.

Kerr component. *Noun.* See **Kerr magneto-optic effect**.

Kerr constant. j. *Noun.* This defines the magnitude of the change of phase of two vibrations produced in a **Kerr cell** by the **electro-optic effect**: $j = \Delta d^2 / l E^2 \lambda$, where Δ is the optical path difference for the two components, d is the plate separation, l is the plate length, E is the potential difference across the plates, and λ is the wavelength in the medium. E is measured in esu, where $1\text{ esu} = 300\text{ V}$, and d and l are in centimetres.

Kerr electro-optic effect. *Noun.* The double refraction of light in glass and other substances produced by an applied electric field. Caused by anisotropic molecules being aligned by the field. Also called **electro-optical effect**.

Kerr magneto-optic effect. *Noun.* The phenomenon of plane polarised light, reflected at normal incidence from a polished face of an electromagnet, becoming elliptically polarised. The magnetic field produces a vibration component called the **Kerr component**, perpendicular to the incident light vibration. Also called **magneto-optical effect**.

Kessler abrasion tester. *Noun.* A device designed to evaluate the resistance of surfaces to abrasion in which corundum of specified size is fed at a specified rate between the surface of an inclined specimen and a notched revolving steel wheel suspended so as to provide a constant, specified weight on the specimen.

Ketteler-Helmholtz equation. *Noun.* A formula used to calculate the optical **dispersion** of glass: $n_{\lambda} = n_a^2 + \frac{\sum M_m (\lambda^2 - \lambda_m^2)}{\lambda^2 - \lambda_m^2} - 1$, where n_{λ} is the refractive index for a wavelength λ , n_a is the index for an infinitely long wavelength, and $\sum \lambda_m$ are the wavelengths of the absorption bands for each of which there is an empirical constant, M_m .

kettle. *Noun.* (1) A container for molten glass. (2) A metallic container in which **gypsum** is converted to **plaster of Paris**.

keV. *Abbreviation.* Stands for **kilo-electron volt**.

key. *Noun.* (1) An elevation or depression formed in a concrete joint surface to provide shear strength across the joint. (2) A device designed to lock mechanical or structural parts together.

key brick. *Noun.* A wedge-shaped brick placed at the crown of an arch to close and tighten the arch.

keystone. *Noun.* The wedge-shaped brick or stone at the highest part of an arch or vault that locks the other parts in place. Also called **headstone**, **quoin**.

Kevlar. *Trademark, noun.* An aromatic polyamide fibre produced by Du Pont that is used in reinforcing ceramics and metals; it has strength values about 25 % greater than **glass fibre**, E value twice as great, and has approximately one-third the density of glass fibre.

K-factor. *Noun.* A relative measure of thermal insulation efficiency.

K feldspar. *Noun.* KAISi_3O_8 . Potassium-bearing feldspar.

KHN. *Abbreviation.* Standing for **Knoop hardness number**. See **Knoop hardness**.

kibble. *Verb.* (1) To grind or divide materials into relatively large particles or pellets. (2) A bucket used in mining for hoisting.

K-glass. *Trademark, noun.* See **Pilkington K-glass**.

kibbler rolls. *Noun.* Toothed rolls used in roll-crushing machines to reduce clays and other minerals to sizes and shapes more amenable to further grinding and use.

K_{1c}. *Symbol.* Stands for fracture toughness parameter; units are $\text{MN m}^{-3/2}$. See **fracture toughness parameter**.

Kick's law. *Noun.* A statement that the energy required to crush a solid substance to a specified fraction of its original size is the same regardless of the original size of the feed material.

kick wheel. *Noun.* A potter's wheel operated by a foot pedal.

kidney. *Noun.* A kidney-shaped instrument made of rubber, plastic, polished wood, or leather used to smooth the surface of pressed, unfired ceramic bodies.

kidney ore. *Noun.* Kidney-shaped masses of the ore **haematite**, Fe_2O_3 , occurring in red-brownish deposits.

kidney stone. *Noun.* Translation of the Spanish word **jade**. It is also another name for **nephrite**. See **jade**.

kieselguhr. *Noun.* **Diatomaceous earth**; a finely powdered sedimentary siliceous material composed essentially of the skeletal walls of **diatoms**. Used as a filtration medium, abrasive, as a component in brick and an aggregate for **lightweight concrete**.

kieserite. *Noun.* $\text{MgSO}_4 \cdot \text{H}_2\text{O}$. A white mineral deposit of **magnesium sulphate**.

kileen. *Noun.* See **Irish moss**.

kiln. *Noun.* (1) A structure in which a material or product is fired, calcined, sintered, or otherwise subjected to elevated temperatures. (2) *Verb trans.* To process in a kiln or to fire.

kiln, ACL. *Noun.* See **ACL kiln**.

kiln, annular. *Noun.* See **annular kiln**.

kiln, archless. *Noun.* See **archless kiln**.

kiln, bank. *Noun.* See **bank kiln**.

kiln, Belgian. *Noun.* See **Belgian kiln**.

kiln block, rotary. *Noun.* See **rotary kiln block**.

kiln, bottle. *Noun.* See **bottle kiln**.

kiln, Bull's. *Noun.* See **Bull's kiln**.

kiln car. *Noun.* A movable truck with one or more platforms on which ware is placed for transport through a kiln.

kiln, cement. *Noun.* See **cement kiln**.

kiln, chamber. *Noun.* See **chamber kiln**.

kiln, clamp. *Noun.* See **clamp kiln**.

kiln, continuous. *Noun.* See **continuous furnace**.

kiln, continuous-chamber. *Noun.* See **continuous-chamber kiln**.

kiln cycle. *Noun.* The time and temperature condition employed in a firing operation.

kiln, decorating. *Noun.* See **decorating kiln**.

kiln, direct-fired. *Noun.* See **direct-fired furnace**.

kiln, downdraught. *Noun.* See **downdraught kiln**.

kiln, dragon. *Noun.* See **dragon kiln**.

kiln, dry. *Noun.* See **dry kiln**.

kiln, elevator. *Noun.* See **elevator kiln**.

kiln, envelope. *Noun.* See **envelope kiln**.

kiln furniture. *Noun.* Small refractory shapes, such as **stilts**, **pins**, **spurs**, cranks, **saddles**, etc., and **slabs**, **posts**, and **setters** of various sizes and shapes upon which ware is placed for firing.

kiln, groundhog. *Noun.* See **groundhog kiln**.

kiln, Hoffman. *Noun.* See **Hoffman kiln**.

kiln, intermittent. *Noun.* See **intermittent kiln**.

kiln, lime. *Noun.* See **lime kiln**.

kiln, longitudinal-arch. *Noun.* See **longitudinal-arch kiln**.

kiln marks. *Noun.* Deformation of a brick caused by **slumping** under load during firing.

kiln, muffle. *Noun.* See **muffle kiln**.

kiln multipassage. *Noun.* See **multipassage kiln**.

kiln, periodic. *Noun.* See **periodic furnace**.

kiln, pusher. *Noun.* See **pusher kiln**.

kiln, roller-hearth. *Noun.* See **roller-hearth kiln**.

kiln, rotary. *Noun.* See **rotary kiln**.

kiln, rotating drum. *Noun.* See **rotating drum kiln**.

kiln, round. *Noun.* See **round kiln**.

kiln run. *Noun.* Brick, tile, or other product from a kiln that has not been sorted or graded for size, uniformity, colour variation, or other property.

kiln, sandwich. *Noun.* See **sandwich kiln**.

kiln, scove. *Noun.* See **scove kiln**.

kiln scum. *Noun.* Discoloration of the surface of a body, such as brick or roofing tile, caused by the diffusion of soluble salts from the interior to the surface or by the reaction of kiln gases with surface constituents during drying and firing.

kiln, shaft. *Noun.* See **shaft kiln**.

kiln, shuttle. *Noun.* See **shuttle kiln**.

kiln, sliding-bat. *Noun.* See **sliding-bat kiln**.

kiln, slip. *Noun.* See **slip kiln**.

kiln, smother. *Noun.* See **smother kiln**.

kiln, top-fired. *Noun.* See **top-fired kiln**.

kiln, top-hat. *Noun.* See **top-hat kiln**.

kiln, transverse arch. *Noun.* See **transverse arch kiln**.

kiln, truck chamber. *Noun.* See **truck chamber kiln**.

kiln, tunnel. *Noun.* See **tunnel kiln**.

kiln, tunnel updraught. *Noun.* See **tunnel updraught kiln**.

kiln wash. *Noun.* A coating, usually consisting of refractory clay and silica, applied to the surfaces of kilns and kiln furniture to protect them from volatile glazes or glaze drops from ware being fired.

kiln white. *Noun.* A white scum that forms on the surfaces of brick and roofing tile during firing as a result of **drier scum** or kiln atmosphere.

kiln, Williamson. *Noun.* See **Williamson kiln**.

kiln, zigzag. *Noun.* See **zigzag kiln**.

kilo. k. *Abbreviation, noun.* (1) Short for kilogram or kilometre. (2) *Prefix.* Denoting 10^3 .

kilocycle. *Noun.* Short for kilocycle per second; a former unit of frequency equal to 1 kHz.

kilogram. kg. *Noun.* (1) One thousand grams. (2) The basic S I unit of mass equal to the mass of the international standard held in Paris. Equivalent to 2.20462 pounds. (3) Since the international standard has been found to change the kilogram has been redefined in terms of **Planck's constant**. Now the kilogram is such that Planck's constant is exactly $6.6260693 \times 10^{-34}$ J s. This arises from Js being $\text{kg m}^2 \text{s}^{-1}$ and both second and metre are fixed by their definition relating them to caesium hyperfine splitting frequency and the speed of light in a vacuum.

kilohertz. kHz. *Noun.* One thousand **Hertz**; one thousand cycles per second.

kilotex. ktex. *Noun.* See **tex**.

kilovolt. kV. *Noun.* One thousand volts.

kilowatt. kW. *Noun.* A unit of power equal to a thousand watts.

kilowatt-hour. kWh. *Noun.* Energy unit equal to the work done by a power of 10^3 W in 1 h.

kimberlite. *Noun.* A type of **peridotite** that often contains diamonds; found in South Africa. An igneous rock formed at great depths in the mantle and consists mainly of **phlogopite** and **olivine**.

kindling point. *Noun.* The lowest temperature at which a material will ignite and continue to burn. Also called **ignition temperature**.

kinematic. *Adjective.* Abstract motion without reference to mass or force.

kinematic viscosity. *Noun.* A measure of the resistance to flow of a fluid, equal to its absolute viscosity divided by its density at the temperature of measurement. It is also known as the **specific viscosity**.

kinetic crack propagation resistance parameter. R. *Noun.* An experimentally determined **thermal shock resistance** modulus defined by the equation: $R = E\gamma_{\text{wof}}/\sigma^2$, where E is **Young's modulus**, γ_{wof} is the **surface energy** as found from the **work of fracture** and σ is the **tensile strength**.

kinetic energy. *Noun.* The energy possessed by a body as a result of its motion equal to one-half of its mass times the square of its velocity.

kinetics. *Noun.* The study of reaction rates and the parameters that affect them.

king closer. *Noun.* A brick cut diagonally, having one 5-cm end and one full-width end.

King's blue. *Noun.* A blue ceramic colorant composed essentially of cobalt and aluminium oxides.

King's yellow. *Noun.* A pigment consisting of powdered **orpiment**.

kink. *Noun.* (1) A type of waviness occurring from the interior surface to the edge of the surface of a coating. (2) Connections between the sections of crystal **dislocations** in adjoining low-energy directions known as **Peierls valleys**. (3) In a fabric it is the short length of **yarn** that has doubled back on itself to form a loop. (4) An atomic scale deviation from a perfect hexagonal lattice shown by carbon **nanotubes** at the interface of tube portions of different diameters. Such kinks are thought to be responsible for **superplasticity** at high temperatures.

kip. *Abbreviation.* Stands for a unit of force used in concrete mechanical tests equal to 1,000 lb. One kip equals 4,448 N.

Kirchhoff's law. *Noun.* An extension of **Hess's law** that permits calculations of **enthalpy** changes at temperatures other than that for which tabulated data are available. The basic equation modifies the enthalpy change calculated at 298 K by including the effects of the **heat capacities** of the reactants and the products on the overall enthalpy change: $\Delta H_o^T = \Delta_o^{298} + \int_{298}^T \Delta C_p dT$

kish. *Noun.* **Graphite** formed on the surface of molten, carbon rich iron.

kiss. *Noun.* Accidental contact between two glazed ceramics in a kiln during firing, resulting in glaze damage at the points of contact.

kissing bonds. *Plural noun.* A range of defects in adhesively bonded structures, such as fibreglass laminates, where the two surfaces touch but do not bond. They are in fact not bonds but disbands with the two surfaces just touching in some way. Another type is a liquid layer, <1 μm , trapped at the adhesive-adherend interface. They are difficult to detect by **NDE** methods. Compressive forces in the system can limit their effect.

kite mark. *Noun.* In Britain, the official mark of quality and reliability in the form of a kite emblem on articles, such as ceramic ware.

klebe hammer. *Noun.* An instrument for preparing standardised compacts of mortars and cements for use in mechanical strength determinations in which a standard weight is dropped on the material to be tested from a specified height to produce uniform compaction to a specified density.

Klein turbidimeter. *Noun.* An apparatus for determining the specific surface area of **Portland cement** in which the turbidity of a sample suspended in castor oil is measured photoelectrically and the results are compared with a calibrated curve.

klystron. *Noun.* An electron tube for generating and/or amplifying microwave energy by velocity modulation.

km. *Abbreviation.* Stands for **kilometre**.

knapping hammer. *Noun.* A hammer for breaking and shaping stones.

kneading. *Verb.* The manual or treading process of mixing and working plastic clay and similar materials and masses to a homogeneous texture.

knit line. *Noun.* The area where two flow fronts meet in a mould. It is often a forming defect because the two flows do not rejoin properly.

knives. *Noun.* (1) Sharp metal blades or specially shaped knives used to advance and blend clay and water in a **pug mill**. (2) Sliding blades or bars, positioned a specified height above and parallel to the surfaces to be coated, used to spread coatings of uniform thickness on the items.

knocking. *Noun.* The accidental chipping of glaze from a body before firing.

knockout. *Noun.* A piece of pressed glass or other material designed so that it may be knocked out of an item to form a hole, usually of a specified dimension.

knock-up. *Noun.* The oversize residue remaining on a screen after a ceramic slip has been **screened**.

Knoop hardness. *Noun.* One of the several hardness scales based on the depth of the indentation made in the polished surface of a material by the diamond point of a **Knoop indenter**. The hardness in N m^{-2} is the load divided by the projected area of the indentation.

Knoop indenter. *Noun.* A hardness-testing instrument containing a diamond with a rhombic base, so that the diagonals have a 1:7 size ratio, and included angles at the diamond edge of 130° and 172° 30'. This geometry produces shallow indentations and is useful in revealing hardness anisotropy.

knop. *Noun.* An ornamental knob included in some glass and porcelain designs for drinking vessels.

knorringite. *Noun.* $\text{Mg}_3\text{Cr}_2(\text{SiO}_4)_3$. A naturally occurring garnet.

knosp. *Noun.* A decoration or ornamentation in the form of a bud or bunch-like protuberance.

knot. *Noun.* An imperfection in glass resulting from an inhomogeneity in the form of a vitreous lump of a composition different from that of the surrounding glass. Thicker, larger pieces of off-composition glass than cords.

know-how. *Colloquial noun.* Experience, often of a technical kind.

knuckle. *Verb.* To **throw** on a potter's wheel, using the knuckles of the hand on the outer surface of the body being shaped.

Knudsen flow. *Noun.* A mechanism that controls gas flow through porous membranes when the pores are in the size range 1–5 nm. Permeability is independent of the pressure gradient in this process. Separation of a gas mixture is related to the inverse square root of the gas molecular weight. Hence, separation of close mixtures such as nitrogen and oxygen is not efficient.

knurl. *Noun.* A small ridge. Several together provide a roughened surface for gripping.

kohl. *Noun.* Powdered **antimony sulphide**.

Kohlrausch relaxation. *Noun.* A phenomenon that originally referred to the decay of residual charge on a glass Leyden jar which followed a stretched exponential law: $Q_{(t)} = \exp[-(\omega t)^\beta]$. Since then this form of relaxation has been found to describe a wide range of physical processes.

komatites. *Plural noun.* High magnesium content lavas found in **greenstone** belts.

Kondo fermion. *Noun.* States formed by hybridisation between itinerant 5d-electrons and localised 4f(5f) electrons that are close to the **Fermi level**. Also called heavy fermion. See **heavy fermion** and **heavy fermion materials**.

Kondo insulators. *Plural noun.* A class of materials that act like small gap semiconductors at low temperatures, with local magnetic moment behaviour disappearing below a temperature close to the gap temperature. Samarium boride, SmB_6 , is a ceramic example.

Kondo lattice. *Noun.* A system in which local magnetic moments are screened by conduction electron spins.

konimeter. *Noun.* An air-sampling device for measuring dust in the atmosphere of cement plants and other industrial areas in which a measured volume of air is drawn through a jet and collected on a glycerine jelly-coated glass, and the particles are counted with the aid of a microscope.

koniology. *Noun.* The study of atmospheric dust and its effects.

Kordofan gum. *Noun.* See **gum arabic**.

kosnarite. *Noun.* $\text{Na}(\text{Zr,Hf})_2(\text{PO}_4)_3$. A mineral with a structure and composition that make it a possible containment phase for plutonium by **isomorphous replacement** of zirconium and hafnium.

kotoite. *Noun.* $\text{Mg}_3(\text{BO}_3)_2$. A mineral form of magnesium orthoborate. It has a structure closely related to **forsterite**.

kovar. *Trade name, noun.* An iron-nickel-cobalt alloy used in glass-to-metal seals.

Kozeny-Carmen equation. *Noun.* An equation developed to model the flow of fluids through powder beds containing capillary pores: $f = K(\text{AV}^3/\mu\text{S}^2)(\Delta\text{P}/\text{L})$, where f is the rate of fluid flow, μ is the fluid viscosity, L is the depth of the packed powder bed, A is the area of the bed, ΔP is the pressure difference, S is the specific surface area of the particles, V is the unit of voids per unit mass of the bed particles and K is a particle shape constant.

K-phase. *Noun.* See **yttrium silicon oxynitride**.

K-polaroid. *Noun.* Polaroid film made by treating a stretched, oriented film of polyvinyl alcohol with hydrogen chloride to make it strongly **dichroic**.

Kramers-Kronig relation. *Noun.* A relation between the real and imaginary parts of the **index of refraction** of a substance, based on the causality principle and **Cauchy's equation**.

Kreüger's ratio. *Noun.* A measure of the frost resistance of building bricks based on the ratio of the 4-day cold water absorption of the brick to its calculated total water absorption.

Kröger and Vink notation. *Noun.* A description of crystal structure defects using a series of symbols involving dot and dash superscripts, and letter subscripts; for example, O_i = interstitial oxygen atom, V_m' = singly negatively charged vacancy, M_i = doubly positively charged interstitial atom, i.e., a cation.

Kronig-Penny model. *Noun.* An idealised one-dimensional model of a crystal in which the potential energy of an electron is an infinite sequence of periodically spaced square wells.

Kruetzer roof. *Noun.* A furnace roof characterised by an arrangement of transverse and longitudinal ribs which gives the appearance of box-like compartments.

Krupp ball mill. *Noun.* A grinding device consisting of chilled iron or steel balls grinding against each other in a die ring of perforated spiral plates, each overlapping the next; the ground material is discharged through a cylindrical screen.

kryptol furnace. *Noun.* A furnace in which heat is generated by passing an electric current through a **rammed refractory** consisting of a mixture of **graphite**, **silicon carbide**, and clay, of high electrical resistance.

ksi. *Abbreviation.* Stands for $1,000 \text{ lb in.}^{-2}$, a commonly encountered unit of stress, particularly in concrete testing. $1 \text{ ksi} = 6.895 \text{ MN m}^{-2}$.

KTP. *Abbreviation.* Stands for the ceramic phosphate, potassium titanium phosphate. See **potassium titanium phosphate**.

Kubelka-Munk equations. *Noun.* Two equations, one for the coefficient of absorption and the other for the coefficient of scatter, that relate these parameters to concentration of pigmenting material in a ceramic glaze. They can be used predict the colour of a glaze containing more than one pigment from a knowledge of the colour properties of a **masstone**, a **white** and a **letdown**.

Kuhl cement. *Trademark, noun.* **Portland cement** in which 7 % each of **alumina** and **ferric oxide** replace part of the **silica**.

kunzite. *Noun.* A pink variety of **spodumene**.

kV. *Abbreviation.* Stands for **kilovolt**.

kW. *Abbreviation.* Stands for **kilowatt**.

kWh. *Abbreviation.* Stands for **kilowatt-hour**.

kX unit. *Noun.* The kilo X unit is a relative scale of distance based on the (200) plane spacing of **calcite**. One kX unit is equal to the (200) plane spacing of calcite divided by 3.02945. It is related to the more common **angstrom unit** by: $1 \text{ kX} = 1.00202 \text{ \AA}$.

kyanite. *Noun.* Al_2OSiO_4 . A member of the **subsaturate silicate** group with a structure containing oxygen ions independent of those contained in the discrete $[\text{SiO}_4]^{4-}$ tetrahedra. A naturally occurring silicate of aluminium that has the same composition as **sillimanite** and **andalusite**, but differs in crystal structure and physical properties. Decomposes to **mullite** and **crystalite** at about $1,300^\circ\text{C}$ with a decrease in density to about $3,000 \text{ kg m}^{-3}$ and a volume expansion of about 10 %. Because of its mechanical strength and refractoriness, it is employed in sanitary porcelains, refractories, precision-casting moulds, brake disks, wall tiles, electrical porcelains, filters, and similar products. Density $3,560\text{--}3,660 \text{ kg m}^{-3}$; hardness (Mohs) 5 along the long axis of the crystal and 7 perpendicular to this direction.

kylix. *Noun.* A shallow, ceramic drinking bowl with two handles originating from Greece.

L. *Symbol.* Standing for: (1) Roman numeral for 50; (2) **lambert** (s); (3) length; (4) **latent heat**; (5) **inductance**; (6) alternative to N for **Avogadro constant**.

l. *Abbreviation.* Standing for: (1) liquid; (2) litre(s).

labradorescent. *Adjective.* Describing minerals that show a bright display of colours like **labradorite**.

labradorite. *Noun.* A composition range in the **plagioclase feldspar** solid solution series, $(\text{Na,Ca})(\text{Al,Si})_4\text{O}_8$. The end members of the series are **albite**, $\text{NaAlSi}_3\text{O}_8$, and **anorthite**, $\text{CaAl}_2\text{Si}_2\text{O}_8$, with labradorite representing about midrange in the series; heavily twinned so that the crystals look like a series of layers and as a result interference of reflected light causes **chatoyancy**; some samples are prized for this property.

lac. *Noun.* A resin of insect origin used to make shellac for decoration compositions.

laccolite. *Noun.* A mass of igneous rock forced up while melting to form a dome with the overlying strata.

lacing. *Noun.* A course of upright brick forming a bond between two or more arch rings.

lacquer. *Noun.* A glossy and quick-drying surface coating composed of natural or synthetic cellulose esters or ethers that dry by solvent evaporation.

lacuna. *Noun.* (1) A cavity or depression in a pitted surface. (2) The low points in planes formed by close-packed spheres.

lacunar. *Noun.* (1) A sunken panel or **coffer** in a ceiling or a **soffit**. (2) A ceiling containing coffers. (3) In crystals it is planes made-up of close-packed spherical atoms which must contain peaks and depressions.

ladder, rock. *Noun.* See **rock ladder**.

ladle. *Noun.* A deep-bowled, long-handled, spoon-like tool used to dip up, transport, and pour molten liquids, such as glass or metal; also used to fill open pots with materials to be melted.

ladle brick. *Noun.* A refractory brick of appropriate shape, uniform size, low porosity, and relatively permanent expansion for use in ladles for the containment of molten metal.

ladle, teapot. *Noun.* See **teapot ladle**.

ladocrase. *Noun.* See **vesuvianite**.

Lafarge cement. *Noun.* A non-staining, white or near white, cement containing **lime**, **plaster of Paris**, and **marble** powder. Used as a mortar and grout in the setting of marble, granite, and limestone. Also called **grappier cement**.

lagna. *Noun.* A bottle with a narrow neck.

lagging. *Noun.* Materials, such as **asbestos** and **kieselguhr**, used to insulate kilns.

laitance. *Noun.* A weak, light-grey coloured material, consisting essentially of cement, water, and clay or silt, formed on the surface of concrete during and immediately after consolidation, particularly when an excess of water is mixed with the cement. A form of **bleeding**. See **bleeding**.

lake sand. *Noun.* Sand from lakes edges and surrounding land.

lambda parameter. *Noun.* See **inversion parameter**.

lambert. L. *Noun.* The **cgs system** unit of brightness; equivalent to 1 lm cm^{-2} . See **brightness**, **lumen**.

Lambert's law. *Noun.* Concerns translucent porcelain and glass ceramics. The ratio of the intensity of emergent light to incident light is an exponential function of the thickness of the ware and a constant, depending on the nature of the ware.

lambrequin. *Noun.* A border pattern giving a draped effect used on ceramics.

lamella. *Noun.* Thin sheet of material or a thin layer in a fluid.

lamella clay. *Noun.* Clay exhibiting microscopic disk-like formations; a characteristic of plastic clays.

lamella habit. *Adjective.* Description of crystals with one appreciably shorter direction than the other two. There are various types depending on dimensions, e.g., **tabular crystals** are thick.

lamelliform. *Adjective.* Plate-like; shaped like a **lamella**.

lamina. *Noun.* Arranged in, or consisting of, thin plates or scales.

lamina composite. *Noun.* A series of two-dimensional sheets of ceramic fibres, each having a preferred high-strength direction, bonded by matrix material on top of the other at changed orientations. This produces a composite of high strength that is quite isotropic in the plane of the sheets.

laminar flow. *Noun.* Non-turbulent movement in a fluid in which parallel layers have different relative velocities.

lamine. *Verb trans* (1) The product or process in which thin plates or sheets, such as glass or other material, are bonded together to form a panel of greater thickness for a particular use, for example, safety glass, laminated electrical contacts, laminated transformer cores, etc. (2) To split into thin sheets. (3) To press materials into thin sheets. (4) *Noun.* A material made by bonding together two or more sheets.

laminated. *Adjective.* Composed of thin sheets.

laminated glass. *Noun.* (1) A transparent safety glass in which two or more glass sheets are bonded together with intervening layers of plastic materials so that, when broken, the glass will tend to adhere to the plastic rather than scatter in pieces. (2) A diffusing glass formed by sandwiching a plastic-bonded glass fibre between sheets of ordinary glass. See **safety glass**.

laminated hybrid composite. *Noun.* See **hybrid composite**.

laminated object manufacturing, LOM. *Noun.* Laser cut layers of ceramic tape, made by the **tape casting process**, are stacked and glued to provide the components shape prior to sintering.

lamine, orthotropic. *Noun.* See **orthotropic laminate**.

laminations. *Plural noun.* Planes or contours of weakness that may develop in a structural shape during forming.

laminato. *Noun.* A texture effect obtained on wall and floor tiles by using dry glaze flakes as the frit. **Roller-quenched frit** must be used.

LAMMS. *Acronym.* Stands for laser microprobe mass spectrometry. See **laser microprobe mass spectrometry**.

Lamotte comparator. *Noun.* An instrument employed to determine the relative acidity or alkalinity of pickling solutions used in preparing sheet metals for porcelain-enamelling by comparing the pH of the solutions with appropriate standard solutions.

lampblack. *Noun.* A black pigment of almost pure carbon made by burning carbonaceous materials with insufficient air; used in cements, ceramic ware, mortar, and thermal insulating compositions.

lamproite. *Noun.* A volcanic rock that is diamond-bearing.

lamprophyre. *Noun.* A group of basic igneous rocks consisting of **feldspathoids** and **ferromagnesian** minerals occurring as dykes in which **biotite** is a major feature.

lamp standard. *Noun.* A tall concrete post topped by a street light.

lamp working. *Verb.* Forming of glass articles from glass tubing or cane by manipulation in a gas flame; used mostly for creating small pieces such as vases, sailing ships, glass eyes, radio and television parts, laboratory equipment, etc.

Lancaster mixer. *Noun.* A counter current, pan-type mixer, which may be designed with various combinations of **mullers**, **ploughs**, **doctor blades**, and **scrapers**.

landscape marble. *Noun.* See **algal limestone**.

Langevin function, L(a). *Noun.* A probability factor used to obtain the magnitude of orientational polarisation in a permanently polarised material in an applied electric field.

Langmuir adsorption theory. *Noun.* A statement that the surface of an adsorbent has only uniform energy sites, and adsorption is limited to a monomolecular layer.

Langmuir isotherm. *Noun.* For gaseous systems it is a plot of isothermal adsorption expressed as: $f = ap / (1 + ap)$, in which f is the fraction of surface covered, p is the pressure, and a is a constant.

lanthanide element. *Noun.* Any of 15 chemically related elements beginning with lanthanum, atomic number 57, to lutetium, atomic number 71. Formed by the filling of the f-orbitals.

lanthanum aluminate. *Noun.* LaAlO_3 . A **perovskite** with a distorted cubic structure; used as a substrate for thin film **1-2-3 superconductors** because the pseudo cubic a-axis parameter of 0.755 nm nearly matches the a-axis of superconductors. Density 6,500 kg m⁻³; mp 2,100 °C.

lanthanum boride. *Noun.* (1) LaB_4 ; density 5,440 kg m⁻³. (2) LaB_6 . A **semiconductor** with a low **work function** and as a result it is used in TV and CRO tubes; when illuminated by light from a **Nd:YAG laser** it emits an extremely bright beam of electrons. Mp 2,149 °C; density 4,722 kg m⁻³; hardness (Vickers) 27.18 GN m⁻².

lanthanum calcium manganate. *Noun.* $\text{La}_{0.3}\text{Ca}_{0.7}\text{MnO}_3$. A perovskite with **colossal magnetoresistive behaviour**.

lanthanum chromate. *Noun.* (1) LaCrO_3 . A **perovskite**-type oxide capable of acting as an oxygen-sensing electrode in a circuit containing LaF_3 . It is **ferromagnetic** with a **Curie temperature** of 300 K.

lanthanum chromite. *Noun.* LaCrO_2 . A special ceramic with semiconducting properties sufficient for its use as a furnace heating element. It has high resistance to oxidation and reduction and so is used to connect **solid oxide fuel cells** and to separate the oxidising air side from the reducing hydrogen side. See **Pyrox**.

lanthanum ferrite. *Noun.* $\text{La}_2\text{Fe}_2\text{O}_6$. It has a double **perovskite** structure with **ferromagnetic** properties; mp 1,871 °C.

lanthanum gallate. *Noun.* LaGaO_3 . An orthorhombic **perovskite** used as substrate material for high-temperature semiconductor film deposition from which microwave circuits are constructed. Mp 1,717 °C.

lanthanum hexaluminate. *Noun.* See **lanthanum magnesium hexaluminate**.

lanthanum magnesium aluminate. *Noun.* $\text{LaMgAl}_{11}\text{O}_{19}$. A complex oxide with the **magnetoplumbite** structure. It has a low thermal conductivity, below $3 \text{ W m}^{-1} \text{ K}^{-1}$. Single crystals doped with neodymium are used in lasers. Mp 1,900 °C. Also known as **lanthanum hexaluminate**.

lanthanum manganite. *Noun.* $\text{LaSr}_8\text{Mn}_2\text{O}_{15}$. An electrically conducting ceramic coating applied to metal electrodes as a thin layer to protect them from oxidation.

lanthanum molybdate. *Noun.* La_2MoO_4 . An **electro-optic material** when **poled**. Mp 1,717 °C.

lanthanum nitrate. *Noun.* $\text{La}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$. Used in the production of **gas mantles**. Mp 40 °C; bp. 126 °C.

lanthanum oxide. *Noun.* La_2O_3 . Used in optical glass and incandescent **gas mantles** and to give high **refractive index** values to optical fibres.

lanthanum phosphate. *Noun.* LaPO_4 . A host matrix material for Tb^{3+} and Ce^{3+} where the Ce^{3+} is a **sensitiser** for the Tb^{3+} which then becomes a green coloured **phosphor**.

lanthanum silicate. *Noun.* (1) La_2OSiO_4 . A **subsaturate silicate**. Mp 1,929 °C; density $5,720 \text{ kg m}^{-3}$; hardness (Mohs) 5–7. (2) $\text{La}_4(\text{SiO}_4)_3$. Discrete ionic silicate; mp 1,749 °C; density $4,850 \text{ kg m}^{-3}$.

lanthanum strontium calcium copper oxide. **LSCCO.** *Noun.* A variant on the cuprate superconductors.

lanthanum strontium manganese oxide. **LSM.** *Noun.* A popular cathode material for **SOFC** stacks manufacture.

lanthanum titanate. *Noun.* (1) LaTiO_3 . A **perovskite** semiconducting phase. (2) $\text{La}_2\text{Ti}_3\text{O}_9$. Possesses semiconducting properties.

lanthanum trifluoride. *Noun.* LaF_3 . Used with **neodymium oxide** in **laser** systems.

lanxide. *Trademark, noun.* A commercially available ceramic-metal composite formed by infiltrating aluminium metal into a porous Al_2O_3 body.

lap. *Noun.* (1) An imperfection in glass consisting of a fold in the surface of an article caused by improper flow during forming. (2) A rotating abrasive wheel or disk used for polishing glass, metal, stone, and other surfaces. (3) Any device to hold a fine ceramic abrasive for polishing. (4) An overlay of an item over the edge of another.

lap cement. *Noun.* A cementitious material used to seal the side and end laps of corrugated roofing.

lap, head. *Noun.* See **head lap**.

lapidary. *Noun.* (1) A person engaged in the art of polishing the surfaces of solid substances, such as gems or ceramics and metals for observation and visual examinations. (2) *Adjective.* Of or relating to gemstones.

lapillus. *Noun.* A small piece of lava thrown from a volcano.

lapis lazuli. *Noun.* See **lazurite**.

lap joint. *Noun.* A simple joint between two items or sheets at the point where one sheet overlaps the edge of the other, as in roofing tile.

Laplace capillary force. *Noun.* Liquids in a capillary, such as those formed by interconnected porosity in a ceramic, have a meniscus that generates a force equal to $2\phi/r$, where γ is the surface tension of the liquid and r is the radius of curvature of the meniscus.

laponite. *Noun.* $\text{Si}_8\text{Mg}_{5.45}\text{Li}_{0.4}\text{H}_4\text{Na}_{0.7}\text{O}_{24}$. An artificial **clay** containing a suspension of $30 \times 1 \text{ nm}$ disk shaped nanoparticles in an hydrous **gel**.

lapping. *Verb trans.* (1) To perform the finish-grinding or polishing operation on the surface of a solid by the use of abrasive grains usually contained in a liquid carrier or medium. (2) To cut stones using a flat wheel charged with abrasive in a horizontal plane.

lap, side. *Noun.* See **side lap**.

lap, top. *Noun.* See **top lap**.

large-angle grain boundary. *Noun.* A boundary between adjacent grains where the disordered region extends over several atomic diameters. A more open boundary and more susceptible to boundary corrosion.

large calorie. *Noun.* An energy unit of heat equivalent to 1,000 cal. See **calorie**.

large-core multimode fibres. *Plural noun.* Fibre-optic communication system with fibres in which the core diameter is 200 μm or greater and whose **numerical aperture** is greater than 0.37. They usually have a **silica** core coated with a hard polymer optical cladding.

large, 9-inch (22.9 cm), brick. *Noun.* A rectangular brick having a length 2.6 cm longer and a width 50 % greater than a standard brick; that is, a width of approximately 15.6 cm. See **standard brick**.

large-particle composite. *Noun.* A particle reinforced composite in which particle-matrix interactions cannot be modelled on an atomic level.

larnax. *Noun.* A coffin made from **terracotta**.

larnite. *Noun.* $\beta\text{-Ca}_2\text{SiO}_4$. A metastable, monoclinic phase of **calcium orthosilicate**. Stable from 520 to 670 $^\circ\text{C}$.

lase. *Verb intr.* To be capable of acting as a **laser**.

laser. *Acronym, noun.* Stands for light amplification by stimulated emission. By definition it is a material that amplifies light by means of a stimulated emission of radiation built into a device that produces an intense monochromatic beam of light. The most striking feature of a laser is that it produces a very intense, very narrow, **coherent** beam of electromagnetic radiation at a precisely defined frequency. See **ruby laser**, **maser**.

laser ablation. *Noun.* (1) The process of vaporising a solid surface with a pulsed laser. (2) A surface engineering and coating process in which a laser pulse enters a vacuum chamber through a laser window and hits a target material. This causes evaporation forming a plume containing a complex mixture of ions and radicals that coat a substrate with a thin film at a rate of about $1.5\text{-}\mu\text{m cm}^{-2}\text{ s}^{-1}$.

laser beam cutting. LBC. *Noun.* The use of a highly focused, high-energy laser beam to drill and cut ceramics and other materials; works by melting and vaporising material.

laser beam machining. LBM. *Noun.* An extension of laser beam cutting. See **laser beam cutting**.

laser cavity. *Noun.* The part of a laser device where light is amplified as it passes back and forth between the end resonators or mirrors of the cavity, so stimulating more light emission.

laser, four level. *Noun.* See **four level laser**.

laser glass. *Noun.* A fluorescent glass that can amplify electromagnetic radiation by the stimulated emission of radiation.

laser-induced breakdown spectroscopy. LIBS. *Noun.* An analytical technique needing no sample preparation. It is an optical spectroscopic method that uses a focussed laser pulse to generate microplasma at the surface in which a small amount of sample is vaporised and a dispersive spectrometer allied with a detector is

used to collect the plasma light and resolve the spectra of the excited species for identification.

laser isotope enrichment. *Noun.* An emerging technology for separating ^{235}U from ^{238}U that involves irradiating a vapour containing these isotopes with laser radiation tuned to excite the energy spectrum of ^{235}U so that it becomes ionised while ^{238}U does not. The ions are collected on charged plates.

laser materials. *Plural noun.* Doped single crystals, **ruby**, rare earth glasses, **p-n junction laser semiconductors**, etc., used in lasers for drilling, machining, surgery, and many similar applications. See **laser**.

laser microprobe mass spectrometry. LAMMS. *Noun.* A technique for surface analysis of ceramics and other solids. A laser is used to excite very small areas on a surface and to generate ions. The ions are separated according to their mass-to-charge ratio in a time-of-flight mass spectrometer. All the ions from a pulsed single event are collected which makes the technique both sensitive and specific.

laser semiconductor. *Noun.* A diode laser in which stimulated emission of coherent light occurs at the p-n junction when electrons are driven into the junction by carrier injection, electron-beam excitation, impact ionisation, optical excitation, and other such means.

laser shock peening. *Noun.* A method used to develop a toughened outer layer on components. A black coloured sacrificial layer is put on the surface and water added to it before a powerful laser is aimed at the object. The sacrificial layer is vaporised and partially ionised to a plasma. The plasma expands but is confined by the water, which causes a mechanical shock wave to be driven into the component. The pressure of the wave exceeds the yield stress and so the material is plastically deformed until the shock wave is less than the yield stress the undeformed material then attempts to restore the original shape and so a compressive layer is produced in a surface layer that enhances the toughness.

laser, sun-pumped. *Noun.* See **sun-pumped laser**.

latent heat. *Noun.* The amount of heat absorbed or evolved per unit of mass of a substance during a change of state at constant temperature; for example, the change of a solid to a liquid or a liquid to a gas or vapour, and vice versa.

latent heat of fusion. *Noun.* The increase in enthalpy accompanying the conversion of a unit mass of a solid to a liquid at its melting point at constant pressure and temperature.

latent heat of vaporisation. *Noun.* The quantity of energy required to evaporate a unit mass of a liquid to a vapour at its boiling point at constant pressure and temperature.

lateral. *Adjective.* Transverse or sideward motion.

lateral force coefficient. *Noun.* The ratio of lateral force to the vertical load.

lateral struggle. *Noun.* Penetration by implanted ions sideways beneath a mask put on to protect an area of device surface during microchip manufacture.

lateral vent. *Noun.* A visible surface crack formed on the surface of a polished ceramic when subjected to an over-loaded Vickers diamond indenter. See **median vent**.

laterite. *Noun.* A weathered material composed of the oxides of aluminium, iron, titanium, and manganese such as or similar to, **bauxite**; sometimes used as a glaze colouration producing reds, yellows, browns, blacks, and grey, depending on the glaze composition and firing atmosphere.

lath. *Noun.* A material in sheet form employed as a base for plaster or tile on walls and ceilings in buildings.

lath brick. *Noun.* A long, slender brick.

lathe. *Noun.* A machine in which a work piece is held in a holding device and turned while being shaped by an appropriate tool.

lattice. *Noun.* A regular periodically repeated 3-D array of points with each point having the same surroundings. These points can be used to specify atom or ion positions in a crystalline solid. See **lattice structure**.

lattice brick. *Noun.* A hollow, perforated type of building brick used as thermal insulation.

lattice constants. *Plural noun.* The edge lengths and the angles between them of the **unit cell** of lattice.

lattice energy. *Noun.* The energy needed to separate the ions in a crystal from their lattice positions to an infinite distance apart. Given in J mol^{-1} .

lattice matching. *Verb.* To enhance active semiconductor growth by using a substrate of similar interatomic spacing.

lattice parameters. *Noun.* The combination of **unit cell** edge lengths and interaxial angles that defines the unit cell geometry.

lattice strains. *Plural noun.* Slight displacement of atoms relative to their normal lattice positions. They are often caused by the existence of crystalline defects, such as **dislocations**, **interstitials**, and impurity atoms.

lattice structure. *Noun.* (1) The regular periodic 3-D arrangement of points in space. There are 14 such structures known as the **Bravais lattices**. (2) A term sometimes used to describe the 3-D covalent linkage of structural units such as SiO_4 tetrahedra that occur in the structure of glasses.

lattice water. *Noun.* Water that is an integral part of a clay structure, as opposed to **interlayer water**, and

which may be removed by heating in the range of about 450–600 °C.

launder. *Noun.* An inclined, refractory-lined channel or trough for the conveyance of molten metal, as from the tap hole of a furnace to a ladle.

lauric acid. *Noun.* See **dodecanoic acid**.

laurionite. *Noun.* Pb(OH)Cl . A lead mineral oxidation product formed in the presence of chlorinated water. Used as a powder in cosmetic bases.

lava. *Noun.* (1) Magma emitted by a volcano. (2) Any **igneous** rock formed by solidification of molten lava.

Lavolain. *Trade name, noun.* Indicates that the product incorporates **lava** or **talc**.

lawn. *Noun.* A fine sheer mesh of metal, natural, or synthetic fibres for use in **silk-screen printing** and sieves.

lawn brush. *Noun.* A decorating brush with a large head of bristles of varying lengths and open cone aspect.

lawsonite. *Noun.* $\text{CaAl}_2\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$. A polymorphic **pyroxene silicate** used by geologists to detect high pressure, low temperature **metamorphism** from the **polymorph** present at a given depth.

layer. *Noun.* (1) A thickness of a homogeneous substance, such as a surface coating or stratum in rock. (2) The workman who lays plate or sheet glass in plaster on grinding and polishing tables for finishing.

layered double hydroxides. LDH'S. *Noun.* A group of porous materials, such as **hydrotalcite**. The general structure is that of magnesium hydroxide, Mg(OH)_2 , but the Mg^{2+} ions are substituted by M^{3+} ions of similar size. Anion charge balancing cations, such as Cl^- , $[\text{CO}_3]^{2-}$, $[\text{ClO}_3]^-$, are situated between the $\text{Mg}_x\text{M}_{1-x}(\text{OH})_6$ layers. The general class name is **hydrotalcites**. The reactive interlayers make them useful catalysts, ion exchange materials, molecular sieves, flame retardants and protonic conductors. Thermally stable up to 1,000 °C. Each naturally occurring LDH is polymorphic having a rhombohedral and an hexagonal form. A typical formula is **takovite**, $\text{Ni}_6\text{Al}_2(\text{OH})_{16}(\text{CO}_3)_4 \cdot 4\text{H}_2\text{O}$ in which the carbonate ions form the reactive layer and have the water attached.

layering. *Noun.* The banded macrostructure of some **igneous** and **metamorphic rocks**. Each band is a different mineral composition and therefore different colour.

layer, reinforcement. *Noun.* See **reinforcement layer**.

laying yard. *Noun.* The site where rough plate or sheet glass is laid in plaster to hold it firmly on grinding and polishing tables for finishing.

layout. *Noun.* A large-scale drawing of all the components needed to make a single device.

lay-up. *Noun.* The way in which fibre-composite sheets are placed relative to each other in the manufacture of a laminate. Has a square bracket notation: e.g., [0/90/0] to signify that layer 2 has the fibre direction at 90° to layer 1 and then layer 3 is parallel to 1. Subscripts are used to denote incorporations such as adhesives into a layer, e.g., [0/0_a/A/90/90_a/90₃/A/0] which indicates a second layer containing adhesive parallel to the first, then a wholly adhesive layer, then a 90° layer, then another 90° layer but containing adhesive strips, then three consecutive 90° layers, etc.

lazuli. *Abbreviation.* Stands for **lapis lazuli**.

lazulite. *Noun.* (Mg,Fe)Al₂(PO₄)₂(OH)₂. A blue coloured mineral occurring in some metamorphic rocks.

lazurite. *Noun.* (Na,Ca)₄₋₈(Al₆Si₆O₂₄)(SO₄,S)₁₋₂. A **soda-lite** mineral also known as **lapis lazuli**; deep blue colour; an aluminosilicate containing sulphate and sulphide ions. Used as a decorative stone. Also known as **haunynite**.

lazy flame. *Noun.* A slow-burning, yellow-coloured flame resulting from a gas-rich mixture that deposits soot. Not usually hot enough for industrial process firing.

lazy tongs. *Noun.* Tongs attached to a framework of hinged, crossed rods to allow objects to be gripped at a distance.

LC₅₀. *Noun.* The concentration in parts per million of a dangerous substance in the atmosphere that is lethal to 50 % of the test animals exposed to it.

LCA. *Abbreviation.* Stands for life cycle analysis. See **life cycle analysis**.

LCD. *Abbreviation.* Stands for liquid crystal display. See **liquid crystal display**.

LD₅₀. *Noun.* A materials toxicity test whereby 50 % of a set of test animals die from a given dosage.

L-D converter. *Noun.* A ceramic lined vessel in which the L-D process is carried-out. See **L-D process**.

LDH's. *Abbreviation.* Stands for layered double hydroxides. See **layered double hydroxides**.

L-D process. *Noun.* A process for making steel by blowing oxygen upon or through molten iron to remove most of the carbon and other impurities by oxidation.

LCMO. *Abbreviation.* Stands for lanthanum calcium manganate. See **lanthanum calcium manganate**.

Lea and Nurse permeability apparatus. *Noun.* A device for the measurement of the specific surface area of a powder in which the air permeability of a prepared bed of the powder is determined by the equation $S = 14[p^3/KV(1 - p^2)]$, in which S is the specific surface area, p is the porosity of the powder bed, V is the **kinematic viscosity** of the flowing air, and K is a constant.

leach. *Verb.* To dissolve and wash soluble components from a material by passing a liquid, usually water, through the material.

leachate. *Noun.* Water with salts in solution dissolved out of materials it has percolated through.

lead. *Verb.* To begin the batching of concrete by introducing a material into the mixer ahead of another material.

lead acetate. *Noun.* Pb(CH₃COO)₂. A white crystalline, toxic solid used in some enamel formulations. Also called **sugar of lead**.

lead antimonate. *Noun.* Pb₃(SbO₄)₂. An orange-yellow powder used as yellow colorant in glass and overglazes. Also known as **Naples yellow**, **antimony yellow**.

lead arsenate. *Noun.* Pb₃(AsO₄)₂. A white, toxic, insoluble powder used as a fungicide in some formulations.

lead-barium crown glass. *Noun.* An optical **flint glass** containing a substantial quantity of **barium oxide**.

lead bisilicate. *Noun.* PbOSi₂O₅. A low-melting stable **frit** used in lead-bearing glazes to minimise lead solubility.

lead borate. *Noun.* Pb(BO₂)₂. Used as a flux in low-temperature frits, vitrified colours, conducting coatings, and bonded **mica**. Density 5,600 kg m⁻³.

lead borosilicate. *Noun.* (1) A mixture of **lead borate** and **lead silicate** used in the manufacture of **optical glass**. (2) Used also in glazes to produce coatings of low lead solubility.

lead carbonate. *Noun.* PbCO₃. Used in glass, porcelain-enamels, and glazes as a flux and **fining agent**. Decomposes at 315 °C; density 6,430 kg m⁻³.

lead carbonate, basic. *Noun.* 2PbCO₃·Pb(OH)₂. A **raw lead** glaze ingredient. See **hydrocerussite** and **basic lead carbonate**.

lead chromate. *Noun.* PbCrO₄. Used as a flux and colorant as in **chrome yellow**. Mp 844 °C; density 6,100 kg m⁻³. Sometimes called **lead chromite**, but **chromite** is usually PbCrO₃ and **crocoite**.

lead chromite. *Noun.* See **lead chromate**.

lead crown glass. *Noun.* An **optical flint glass** containing a substantial proportion of **lead oxide**, PbO, to improve light dispersion and brilliance.

lead crystal glass, full. *Noun.* See **full lead crystal glass**.

lead fume. *Noun.* The product of kiln air and volatilised lead products. It is essentially **lead oxide** of extremely fine particle size, such that it can remain in the air for a long time.

lead glass. *Noun.* Windows made from pieces of coloured or clear glass held in position by strips of lead having an "H" or "U" cross section.

lead germanate. *PG.* *Noun.* $\text{Pb}_5\text{Ge}_3\text{O}_{11}$. A dielectric ceramic used in the fabrication of **multilayer ceramic capacitors**.

lead glass. *Noun.* Glass containing a substantial quantity of **lead oxide** as a flux and to give a high index of refraction, **optical dispersion**, and surface brilliance for use as **optical glass**.

lead glaze. *Noun.* A glaze containing **lead oxide** in a substantial amount as a flux to lower the fusion temperature and viscosity, to improve the flow properties during firing, and to increase the brilliance, **lustre**, smoothness, resistance to water solubility, and resistance to chipping.

lead hydroxide. *Noun.* $\text{Pb}(\text{OH})_2$. See **white lead**.

lead hydroxide chloride. *Noun.* See **laurionite**.

lead indium pyrophosphate. *Noun.* A **glassy phosphate polymer** developed as the host glass for the promethium doped phosphate glass laser at 933 and 1,098 nm because of its resistance to radiation damage.

lead iron niobium oxide. *PFN.* *Noun.* $\text{PbFe}_x\text{Nb}_{1-x}\text{O}_3$. **Perovskite** phases based on lead, iron and niobium; prepared to exploit their **ferromagnetic** and electrical properties.

lead lanthanum zirconate titanate. *PLZT.* *Noun.* $(\text{Pb}_{1-x}\text{La}_x)(\text{Ti}_{1-y}\text{Zr}_y)\text{O}_3$. **Ferroelectric** ceramic possessing electro-optical properties. When **poled** it is a useful **piezoelectric ceramic**. The general formula assumes that all the perovskite A sites are filled by Pb and La and charge compensation occurs with vacancies in the B sites. More than 8 % La leads to transparency in a highly coercive, tetragonal material; a 0.25-cm plate is 100 % transparent. Two polymorphs exist: a cubic form that is **paraelectric** and optically **isotropic** and a ferroelectric, tetragonal polymorph, made by **poling**, which is **birefringent** and so can be used as an optical shutter by varying the applied field.

leadless glaze. *Noun.* A glaze containing only an imperceptible amount of lead in any form.

lead magnesium niobates. *PMN.* *Plural noun.* Mixed **perovskite** and **pyrochlore** phases in the series $\text{PbMg}_x\text{Nb}_{1-x}\text{O}_3$; used as **capacitor** materials. One composition, $\text{PbMg}_{0.33}\text{Nb}_{0.67}\text{O}_3$, which is a **perovskite oxide**, is an **electrostrictive** material able to elongate up to 0.1 % on the application of an electric field without hysteresis on reducing the field strength. Used in actuators and as a **relaxor** material.

lead metaniobate. *Noun.* PbNb_2O_6 . Used in defence electronics, thickness gauges, flaw detectors, accelerometers, air-blast gauges, and other instruments requiring **dielectric**, **piezoelectric**, or **ferroelectric** properties.

lead metatantalate. *Noun.* PbTa_2O_6 . A **ferroelectric** ceramic.

lead molybdate. *Noun.* PbMoO_4 . Employed with antimony compounds as an **adherence-promoting agent** in porcelain-enamels. Mp 1,062 °C.

lead monoxide. *Noun.* A poisonous, insoluble oxide existing in red and yellow polymorphs that is used as a pigment, in making glass, glazes and cements. Also called **litharge**, **plumbous oxide**.

lead oxide. *Noun.* PbO . A **raw lead** glaze ingredient. Also called **litharge**. See **yellow lead oxide**. Also called colloquially **silver foam**. See **lead monoxide**.

lead oxide, red. *Noun.* See **red lead**.

lead oxide, yellow. *Noun.* See **yellow lead oxide**.

lead poisoning. *Noun.* The prolonged ingestion or absorption of lead into the human body, primarily the lungs, resulting in anaemia, colic, inflammation of the peripheral nerves, and brain impairment.

lead release. *Noun.* The mass of lead dissolved from a glass enamel by soaking in acetic acid.

lead scandium niobate. *PSN.* *Noun.* $\text{PbSc}_{0.5}\text{Nb}_{0.5}\text{O}_3$. A **ferroelectric** ceramic with a high **dielectric constant** and a large electromechanical coupling constant. Used in **transducers**.

lead scandium tantalate. *PST.* *Noun.* $\text{PbSc}_{0.5}\text{Ta}_{0.5}\text{O}_3$. A **ferroelectric** ceramic with a reversible **pyroelectric** effect. Used in thermal detectors.

lead selenide. *Noun.* PbSe . Used in semiconductor applications. Mp 1,088 °C.

lead sesquioxide. *Noun.* Pb_2O_3 . Used in glass, glazes, porcelain-enamels, and ceramic cements.

lead silicate. *Noun.* (1) PbSiO_3 . A **pyroxene** employed in lead-fluxed bodies of high dielectric strength and in lead-fluxed **steatite** bodies of a wide firing range. Mp 725–775 °C. (2) Pb_2SiO_4 . Used as a substitute for **lead carbonate** to minimise evolution of carbon dioxide; used as a mill addition because of good dispersion, suspension and freedom from gassing. Density 5,800–6,500 kg m⁻³.

lead soap. *Plural noun.* The product of a lead pigment, such as **lead-tin yellow** and a fatty acid, such as **stearic**. they are soft, white materials that produce **white-specking** in decorations.

lead stannate. *Noun.* PbSnO_3 . Forms a limited solid solution with BaTiO_3 and reduces the **Curie peak** in **barium titanate capacitors** and the tendency to **depolarise** when used in **piezoelectrics**.

lead strontium copper oxide. *PSYCCO.* *Noun.* A high-temperature superconducting oxide of composition $\text{Pb}_2\text{Sr}_2(\text{Y,Ca})\text{Cu}_3\text{O}_{7+x}$.

lead sulphate. *Noun.* PbSO_4 . A white pigment. See **white lead**.

lead sulphide. *Noun.* PbS. Used in semiconductors and in the glazing of clay ware. Mp 1,170 °C; density 7,130–7,700 kg m⁻³. Also called **galena**.

lead tantalate. *Noun.* PbTa₂O₆. **Curie temperature** 260 °C; a possible **electroc ceramic** and **ferroelectric**.

lead telluride. *Noun.* PbTe. Used as a semiconductor and photoconductor in the form of single crystals. Mp 902 °C.

lead tetroxide. *Noun.* Pb₃O₄. A **raw lead** glaze ingredient. Also called **red lead**.

lead-tin yellow. *Noun.* Pb₂SnO₄. A yellow pigment used in decoration.

lead titanate. *Noun.* PbTiO₃. A **perovskite** ceramic employed as an additive to **barium titanate** to improve **piezoelectric** properties.

lead, white. *Noun.* See **white lead**.

lead zirconate. *Noun.* PbZrO₃. A **perovskite** used as a component in piezoelectric bodies.

lead zirconate titanate. PZT. *Noun.* Pb(Ti_{1-x}Zr_x)O₃. A **ferroelectric**, **electro-optic** material having use in piezoelectric bodies. The structure contains non-centrosymmetric Ti⁴⁺, Zr⁴⁺ ions within O₆ octahedra that are attracted to the negative electrode producing an applied field to give rise to a crystal deformation. This is the **piezoelectric effect** in which the induced strain is proportional to the applied electric field. An excellent **piezoceramic** with **morphotropic phase boundaries** between tetragonal and rhombic phases at 48 mol%, PbZr_{0.52}Ti_{0.48}O₃, which assists in the achievement of *d_{ij}* values as high as 79 pC N⁻¹. It also has a high **ferroelectric Currie temperature**, 300–400 °C, that allow for uses up to 200 °C. Widely used in **piezoelectric transducers**.

leakage current. I_R. *Noun.* Watt loss per operating voltage in a ZnO **varistor** device: $I_R = V_{ss}/R_{gb}$, where *V_{ss}* is the steady-state voltage at which the device works and *R_{gb}* is the grain boundary resistance.

leakage, magnetic field. *Noun.* See **magnetic field leakage**.

leakage, magnetic flux. *Noun.* See **magnetic flux leakage**.

leak detector. *Noun.* A device for locating holes or cracks in coating or walls of a vessel, either by electric spark discharge or by fine jets of helium.

leak testing. *Noun.* A technique to determine the presence of void, fracture, or other discontinuity in a coating or body structure in which a penetrant is applied to one surface, and the opposite surface is observed for indications of penetration by the testing solution.

lean. *Adjective.* (1) A weakness in behaviour or a given property. (2) *Noun.* Colorant plus oil mixtures of such composition that they do not flow smoothly onto ware

being decorated. (3) A fuel-air mixture containing insufficient fuel. (4) An ore not having a high mineral content. (5) Concrete made with a small amount of cement.

lean cement. *Noun.* A concrete with insufficient cement.

lean clay. *Noun.* Clay of low **plasticity** and poor green strength.

leaner. *Noun.* A bottle grossly out of vertical.

lean fuel. *Noun.* Fuel low in combustibles, for example, a fuel air mixture with a low percentage of fuel and a high percentage of air.

lean gas. *Noun.* Fuel gas low in butane and heavier fuel gases with an excess of air at the burner.

lean lime. *Noun.* A lime containing an inordinate amount of impurities and which will not **slake** readily with water.

lean manufacturing. *Noun.* A system that cuts lead time and aims to eliminate stock and work in progress. uses production cells and fast set-up changes to manufacture to customer demand rather than make stock to a forecast.

lean mix. *Noun.* (1) A concrete of low cement content. (2) See **lean fuel**.

lean mortar. *Noun.* A mortar deficient in cementitious components and which is usually harsh and difficult to spread.

least count. *Noun.* The smallest change in indicated load on a tensile test machine that can be determined.

least squares. *Noun.* A statistical method that obtains best-fit solutions by minimising the sum of the squared differences between the mean and individual values.

leather hard. *Noun.* Clay that is sufficiently dry and stiff enough to be handled without deformation, but sufficiently damp to be joined to other pieces with **slip**.

leathery texture. *Adjective.* A rough texture on the surface of porcelain-enamel which is similar to, but of larger and coarser pattern, than **eggshell**.

Le Chatelierite. *Noun.* A glassy form of **silica**, SiO₂.

lecithin. *Noun.* Waxy phosphorus-containing substances that have emulsifying and wetting properties, and which are used to lower surface tension in **silk-screen** media.

LED. *Noun. Acronym.* See **light-emitting diode**.

ledeburite eutectic. *Noun.* A microstructure associated with carbides in iron matrices. For example a M₆C-Fe eutectic has a feathery, herring bone appearance. Its presence in cutting tools leads to easy fracture and is avoided by encouraging the development of M₂C carbides.

LeFarge cement. *Trademark, noun.* See **grappier cement**.

lehr. *Noun.* A long tunnel-shaped oven in which glassware is annealed to reduce residual thermal stresses. From the German word for pattern because the glassware is spaced and forms a pattern.

lehr loader. *Noun.* A machine which places and spaces glassware on a continuous lehr belt.

length. *Noun.* (1) The horizontal dimension of a unit in the face of a wall. (2) The longest dimension of an item. (3) The extent of a period of time.

length weighting. *Noun.* A concept developed to overcome the differences in preparing samples of **man-made vitreous fibres** for dimensional characterisation. Because breakage is always across the fibres the length of fibres is summed rather than record the number of fibres in any chosen fibre diameter interval. The accumulated length-diameter distribution is the independent of sample preparation method.

lengthwise direction. *Noun.* In load application it is the direction of the long axis of a rod or tube, but in other shapes it is the direction of the strongest axis. When neither of these is present it is along the grain direction.

lens. *Noun.* (1) A highly polished, highly transparent, defect free, and appropriately shaped flat piece of glass (or a substance like a plastic) either or both sides of which may be flat or curved as required so as to cause transmitted light rays to converge or diverge to form an image; used in optical instruments such as eyeglasses, microscopes, telescopes, and other such devices. (2) An architectural term for a **translucent** or transparent pressed glass unit, which may be square, round, or specially shaped, for use in construction.

lens-fronted tubing. *Noun.* Graduated glass tubing designed for the containment of liquids for use in temperature, pressure, and similar instruments of measurement, but modified so as to magnify the liquid column for easy reading.

lenslet. *Noun.* Very small lenses, typically measuring $700 \times 400 \mu\text{m}$, hot **embossed** onto a glass sheet to form a projector lens.

lens maker's formula. *Noun.* An equation involving the **refractive index** for the yellow sodium line, n , and the required focal length, f , which allows lens radii of curvature to be chosen: $1/f = (n - 1)(1/r_1 + 1/r_2)$.

lenticle. *Noun.* A lens-shaped layer of mineral or rock embedded in a matrix of another composition.

lenticular. *Adjective.* Shaped like a biconvex lens.

Leoxit. *Trademark, noun.* A porous refractory containing **mullite** and **corundum** manufactured for **kiln furniture** use because it can withstand large thermal shocks; maximum working temperature $1,450^\circ\text{C}$.

lepid- or lepid-. *Combining form.* Forms words denoting flake.

lepidocrocite. *Noun.* $\gamma\text{-FeOOH}$. Orange coloured and a component of **rust**. Cubic close packed anions with Fe^{3+} in octahedral sites. Made by air oxidation of **green rust**.

lepidolite. *Noun.* $\text{K}_2(\text{Li,Al})_{5-6}(\text{Si}_{6-7}\text{Al}_{2-1})_8\text{O}_{20}(\text{OH,F})_4$. A **mica** group mineral with the **muscovite** structure and pink colour; employed essentially as a flux in **opal** and **flint** glasses, porcelain-enamels, glazes, and ceramic bodies to reduce the coefficient of expansion, brittleness, and devitrification tendency, and to increase the firing or working range, index of refraction, brightness, and surface hardness. Mp $1,170^\circ\text{C}$; density $2,900 \text{ kg m}^{-3}$; hardness (Mohs) 2.5–4. Also known as **lithia mica** and **amblygonite**.

LET. *Abbreviation.* Stands for linear energy transfer. See **linear energy transfer**.

letdown. *Noun.* A pastel shade of colour in a ceramic glaze that is obtained by mixing a single pigment with an **opacifier** in the proportions needed to obtain the pastel shade.

let-go. *Noun.* An area where there is no longer adhesion between glass and other layer in a **laminated glass**.

leucite. *Noun.* KAlSi_3O_8 . A grey or white mineral **framework silicate** of the **feldspathoid** group closely related to **nepheline**, an essential mineral in **nepheline syenite**. Density $2,500 \text{ kg m}^{-3}$; hardness (Mohs) 5.5–6.

leuco-. *Combining form.* White or lacking colour.

level, acceptance. *Noun.* See **acceptance level**.

level, confidence. *Noun.* See **confidence level**.

level, cut-off. *Noun.* See **cut-off level**.

level, gate. *Noun.* See **gate level**.

levelling step. *Noun.* The first part of a **tile polishing train** where the grinding tool surface contains large grain polishing media with few sharp edges making high pressure contact. This results in severe wear caused by brittle fracture mechanisms and the topography of the surface shows sharp differences in height. All subsequent polishing steps try to correct this deterioration. See **polishing step**.

level, rejection. *Noun.* See **rejection level**.

level, test quality. *Noun.* See **rejection level**.

level, threshold. *Noun.* See **threshold level**.

levigate. *Verb trans.* (1) To grind into a fine powder. (2) To form a homogeneous mixture. To suspend fine particles by grinding in a liquid. Used as a method of separating fine and coarse particles.

levigated abrasive. *Noun.* A fine, chemically neutral, abrasive powder used as a burnishing medium.

levigation. *Noun.* The method of refining clay and other powdered materials by carrying them in a stream of water that deposits the particles at different stages in terms of relative particle size.

lever rule. *Noun.* A scheme to find the relative quantities of phases present at any temperature from a **phase diagram**. $f_s = (a-l)/(s-l)$, where f_s is the fraction of solid, l, a, and s, represent the component of interest's concentration in liquid, alloy, and solid, respectively.

levyne. *Noun.* A natural **zeolite** from the Faröe Islands.

Lewisian gneiss. *Noun.* The oldest rock in Scotland having a colourful pink to green appearance.

Leyden jar. *Noun.* An early capacitor based on a glass jar with the lower half coated on both the inside and outside with tin foil.

herzolite. *Noun.* A **peridotite** rock containing **olivine** and orthorhombic **pyroxenes**.

herzolithe. *Noun.* Ultrabasic rock composed of **olivine**, **orthopyroxene**, **clinopyroxene**, and **spinel**.

LHG-8. *Trademark, symbol.* A phosphate glass formulation used throughout the world for the production of neodymium ultra-high power glass lasers.

LIB. *Acronym.* Stands for lithium ion battery. See **lithium ion battery**.

Libbey-Owens-Ford sheet process. *Noun.* A method of making sheet glass by bending a vertically drawn sheet over a roll that is then used to establish the definition of the draw.

LIBS. *Acronym.* Stands for laser-induced ablation spectroscopy. See **laser-induced ablation spectroscopy**.

LIC. *Abbreviation.* Stands for low index compressive defects.

lid. *Noun.* A movable cover or top of a container such as a dish, crucible, or other receptacle.

Liebig condenser. *Noun.* A glass tube surrounded by a wider bore glass tube through which cooling water flows and condenses vapours in the inner tube.

life cycle analysis. LCA. *Noun.* Methodology to evaluate the environmental effects of a material, product or activity holistically by analysing the entire life cycle of a material, process, product, technology, service or activity. It has three components: inventory analysis, impact analysis and improvement analysis.

lifetime factor method. *Noun.* A modelling system that allows probability analysis to be applied to **concrete durability** towards carbon dioxide attack in an analogous way to mechanical resistance to loading predictions. It is based on two relationships: $R(t_d) - S(t_d) > 0$ and $t_d = \gamma t_g$, where $R(t_d)$ is the performance capacity of the structure over its service life; $S(t_d)$ is the chemical or physical load over the service life; t_d is

the design service life; γ is the lifetime safety factor and t_g is the target service life.

life test. *Noun.* A test, frequently accelerated, to estimate the normal service life of a product.

lift, lifting. *Noun.* (1) A defect characterised by the spontaneous separation of sheet-like pieces of porcelain-enamel or glaze from the surface to which it has been applied. (2) A layer or depth of concrete placed at one time.

lift-off effect. *Noun.* The effect observed in a magnetic test system output due to a change in magnetic coupling between a test system and a probe coil whenever the distance between them is varied.

lift-slab construction. *Noun.* A method in which reinforced concrete floor or roof slabs are cast on the ground floor of a building under construction and raised to final position by means of jacks on top of the building columns.

lift truck. *Noun.* A small truck for lifting and transporting loads.

ligands. *Plural noun.* Molecules that bind to other species. They donate or accept electron pairs to form a coordinate covalent bond with the central metal atom of a coordination complex. Such complexes are often the source of **nanopowders** after controlled precipitation and thermal decomposition.

light. *Noun.* (1) Electromagnetic radiation capable of inducing visual sensation through the eye; that is, the product of the visibility and the radiant power. (2) The subclass of a lower index of refraction in optical glass.

light, black. *Noun.* See **black light**.

light density. *Noun.* The quantitative measure of film blackening as calculated by the formula $D = \log I_0/I$, in which D is the density, I_0 is the light intensity incident on the film, and I is the light intensity transmitted.

light-emitting diode. LED. *Noun.* A diode of semiconductor material, such as GaAs, that is **p-type** on one side and **n-type** on the other side. When a forward potential bias is applied across the junction between the two sides, recombination of electrons and **holes** occurs, which results in the emission of light radiation. The colour of the light depends on the semiconductor being used. Often used as an on/off indicator and for flat panel displays.

light-extinction method of particle suspension measurement. *Noun.* A technique for measuring the concentration of particles in a suspension by determining the amount of light absorbed from a transmitted beam.

light, monochromatic. *Noun.* See **monochromatic light**.

light oil. *Noun.* Oil having a boiling range of 110–210 °C; used as a lubricant to reduce friction between moving solids in contact with each other.

light polarisation. *Noun.* Light waves have dissymmetry of vibration about the direction of propagation, and separation of the wave in terms of this dissymmetry is called polarisation. It can be brought about by reflection, transmission through a pile of plates, **dichroism**, **double refraction**, and scattering.

light-reducing glass. *Plural noun.* A general term describing flat glass having reduced light **transmittance**.

lightweight aggregate. *Noun.* A low density, $\approx 800 \text{ kg m}^{-3}$, inert material such as **bloated clay**, foamed slag, **vermiculite**, **perlite**, and **clinker** used in reinforced concrete and similar products as an aggregate to reduce weight and improve the thermal and sound insulating values of the product.

lightweight concrete. *Noun.* Any concrete made with **lightweight aggregate**.

lignin. *Noun.* A substance that forms the woody cell walls of plants in conjunction with cellulose. It has cementing properties.

lignin extract. *Noun.* A substance extracted from the wood wall cells of plants; used as a **binder** in ceramic bodies and glazes. Also known as **lignone**.

lignin sulphonate. *Noun.* A salt made from **lignin**; used as a binder in ceramic bodies and glazes. No melting point, but decomposes above 200°C .

lignite. *Noun.* A brown carbonaceous sedimentary rock consisting of layers of partially decomposed vegetation. It has a woody appearance. The main constituents are resins, tannins, fats, waxes, **lignin**, cellulose and **humic acid**. Carbon content 46–60 %; calorific value $1.28\text{--}1.93 \times 10^7 \text{ J kg}^{-1}$. Used as a fuel. It occurs in some **ball clays** either as lumps $>50 \mu\text{m}$ or as a colloidal coating on the clay crystallites. The presence of either form in clays imparts a dark colouration to the clay. Also called **brown coal**. See **coal rank**.

lignone. *Noun.* See **lignin extract**.

Ligurian marble. *Noun.* A spectacularly coloured, gold and black form of marble quarried in Liguria in Italy.

lime. *Noun.* CaO. A fluxing agent used in glass, pottery, glazes, and porcelain-enamels, and as a component in Portland cement, mortar, and plaster. Mp $2,750^\circ\text{C}$; density $3,400 \text{ kg m}^{-3}$. The name is also an abbreviation for quicklime, bird lime, and slaked lime. (2) *Verb trans.* To cover a wall or ceiling with a mixture of lime and water. (3) *Verb trans.* To spread a calcium compound on land to control its acidity.

lime burner. *Noun.* A person employed to burn **limestone** to make lime.

lime blowing. *Noun.* Chipping or popping of small circular fragments from the face of building brick due to carbonation of lime, by CaO rehydrating, freezing and thawing of absorbed water or other chemical stress. Also called **lime popping**.

lime, burnt. *Noun.* See **burnt lime**.

lime cement. *Noun.* Originally just **clay** and **limestone** fired together and ground to a powder. Used extensively by the ancient Egyptians, Greeks and Romans as a building **mortar**.

lime-cement mortar. *Noun.* A masonry mortar composed normally of one part of masonry cement, one or two parts of **lime putty** or **hydrated lime**, and five or six parts of **sand** by volume.

lime crown glass. *Noun.* An **optical crown glass** containing a substantial quantity of **calcium oxide** as a fluxing ingredient.

lime, finishing. *Noun.* See **finishing lime**.

lime glass. *Noun.* A glass containing a high percentage of **lime**, usually in association with **soda** and **silica**; widely used in glass products, such as bottles and containers.

lime, hydrated. *Noun.* See **hydrated lime**.

lime, hydraulic. *Noun.* See **hydraulic lime**.

limekiln. *Noun.* A furnace, frequently a long, tilted, rotating cylinder, in which **calcium carbonate** is heated to temperatures above 900°C to produce **lime**.

limelight. *Noun.* (1) A type of lamp where light is produced by heating **lime** to white heat. (2) Brilliant white light produced in a limelight. Also called **calcium light**.

lime matte. *Noun.* A matte glaze caused by the crystallisation of **calcium silicate** during firing and cooling.

lime mortar. *Noun.* A mixture of **hydrated lime**, **sand**, and water used in the construction of non-load-bearing interior walls in building construction. It is much softer than **Portland cement mortar** and as a result protects clay bricks from erosion and corrosion more effectively. Used in the restoration of old brickwork.

lime popping. *Noun.* See **lime blowing**.

lime pops. *Noun.* The product of the **spalling** of brick due to the hydration and carbonation of lime particles at or near the surface the brick.

lime putty. *Noun.* Hydrated lime in plastic form used as an addition to mortar.

limescale. *Noun.* A flaky deposit left on the walls of boilers. Formed by the action of heat on soluble calcium salts. Often shortened to **scale**.

lime-slag cement. *Noun.* Cement produced from a mixture **lime** and granulated blast-furnace slag.

limestone. *Noun.* A **sedimentary rock** composed of more than 80 % calcium and/or magnesium carbonate; used as a source of calcium in glazes; also used as a building stone, in the production of cement, and in the smelting of iron ore etc.

limestone, algal. *Noun.* See **algal limestone**.

limestone, gastropod. *Noun.* See **gastropod limestone**.

limestone, muddy. *Noun.* See **algal limestone**.

limestone, nummulitic. *Noun.* See **nummulitic limestone**.

limestone, oolitic. *Noun.* See **oolitic limestone**.

limestone, shelly. *Noun.* See **shelly limestone**.

limewater. *Noun.* A clear colourless solution of **calcium hydroxide**. Used to test for the presence of carbon dioxide in gases.

limits, acceptance. *Noun.* See **acceptance limits**.

Limoges porcelain clay. *Noun.* A body renowned for its delicate **translucency** and excellent workability; formulated in potteries around the French town of the same name.

limonite. *Noun.* $\text{FeO}(\text{OH}) \cdot n\text{H}_2\text{O}$. A mineral mixture widely found arising from **siderite**; used as a yellow to brown ceramic colorant. Density $3,600\text{--}4,000 \text{ kg m}^{-3}$; hardness (Mohs) 5.0–5.5.

Lindemann glass. *Noun.* A lithium borate-beryllia glass containing no element having an atomic number greater than 8; used in applications requiring high transmission of x rays.

lineage structure. *Noun.* Deviations noted in the alignment of what should be parallel arms of **dendrite** in a microstructure.

Linear A. *Noun.* A form of writing found on clay tablets and pots dating from the fifteenth century BC in Crete.

Linear B. *Noun.* A form of writing found on clay tablets and pots dating from the fourteenth century BC in Crete; a development of **Linear A**.

linear burning shrinkage. *Noun.* See **firing shrinkage**.

linear change, permanent. *Noun.* See **permanent linear change**.

linear coefficient of thermal expansion. *Noun.* See **thermal expansion coefficient, linear**.

linear density, tex. *Noun.* The mass per unit length of single filament fibre.

linear drying shrinkage. *Noun.* The percentage linear contraction shown by a moist body during drying. Calculated from $100(\text{Lp} - \text{Ld})/\text{Lp}$ where Lp is the wet specimen length and Ld is the length of the dry specimen.

linear elastic fracture mechanics. *Noun.* See **fracture mechanics**.

linear energy transfer, LET. *Noun.* This determines the biological effect of radioactive decay particles, α -particles have high LET and so deposit most of their energy in a single cell with large resultant damage.

linear equation. *Noun.* A first-order equation where no terms are exponential.

linear motor. *Noun.* An electric motor in which the stator and rotor are linear and parallel. If used to drive a train, one part of the motor is in the locomotive, the other part is in the track.

linear shrinkage. *Noun.* The reduction in the length of a specimen during drying and firing. See **drying shrinkage** and **firing shrinkage**.

linear thermal expansion. *Noun.* The expansion of a body in one direction when subjected to heat.

lineate. *Adjective.* Decorated or marked with lines; streaked.

lineation. *Noun.* (1) The act of decorating or marking with lines. (2) Parallel arrangement of **acicular** mineral grains.

line, flux. *Noun.* See **flux line**.

line, metal. *Noun.* See **metal line**.

line of flux. *Noun.* A hypothetical line whose direction at all points along its length is that of the electric or magnetic field.

line of reinforcement. *Noun.* The circumferential reinforcement of concrete pipe, it being comprised of one or more layers.

liner. *Noun.* (1) A coating or layer adhering to or in contact with the interior surface and ends of asbestos-cement pipe and related couplings, the coating or layer being more chemically resistant than the pipe and related couplings. (2) The material or coating on the interior of an item for decorative or protective purposes, such as the lining of a container, tank, or kiln.

lines. *Noun.* Fine **cords** or strings of molten glass, molten refractory, or partially molten sand; usually occurring on the surface of flat glass as an imperfection.

line scan. *Noun.* See **wipe test**.

lines of force, magnetic. *Noun.* See **magnetic lines of force**.

line tension, T. *Noun.* The force that produces the tendency for a **dislocation** line to become straight; it is analogous to **surface tension**. Line tension is defined as: $T = \Delta U / \Delta L$, where ΔU is the extra energy due to forming a zigzag per unit length and ΔL is the increase in length per unit length of the line when a zigzag is formed.

lining, monolithic. *Noun.* See **monolithic lining**.

linish. *Verb.* To polish using abrasive powders.

linisher. *Noun.* A polishing machine adapted to use abrasive powders for polishing.

Linseis plastometer. *Trade name, noun.* An instrument employing the tensile strength as a measure of cohesion and the capacity for the relative movement of clay particles without rupture as a measurement of the plasticity of clay.

lintel. *Noun.* A horizontal piece across an opening, such as a window or door, which carries the weight of the structure above it.

lip. *Noun.* The edge or rim of a pot or other hollowware article, or the part that encircles an orifice.

liquate. *Verb.* To separate one phase of a mixture by heating so that the more fusible part melts.

liquation. *Noun.* A **beneficiation** process applied to lean ores that involves melting the component of interest and letting it drain from the **gangue**.

liquefaction. *Noun.* The conversion of a gas or gaseous mixture to the liquid state by cooling or compression, or both.

liquefied petroleum gas. *Noun.* Any gas derived from petroleum, such as propane and butane, which has been liquefied and stored under pressure in suitable containers for easy transport and future use as fuel.

liquid blast cleaning. *Verb.* To clean surfaces by means of a high-velocity jet of abrasive suspended in water or other liquid.

liquid bright platinum. *Noun.* Liquid organic mixtures containing platinum with additions of palladium, gold, or bismuth, which fire to a silvery finish on pottery, glass or tile.

liquid crystal. *Noun.* A substance in a **mesomorphic** state and so appears to be a liquid with some crystalline characteristics, such as different optical properties in different directions. See **smectic** and **nematic**.

liquid crystal display. *Noun.* A display such as numbers in an electronic calculator obtained by applying an electric field to **liquid crystal** cells that change their reflectivity in such a field. Images can be generated on a flat screen and so they are used in laptop computers etc.

liquid gold. *Noun.* An inexpensive gold resinate used in the decoration of ceramic ware.

liquid immersion microscopy. *Noun.* An analytical technique used to examine **green state** microstructure and the optical properties of powders. The powder compact is made transparent using an immersion liquid and an optical microscope in the transmission mode. High transparency is achieved when there is a good match between the refractive indices of the powder and the immersion liquid. The upper limit for the method is an n value about 2.05.

liquid phase diffusion bonding. *Noun.* See **diffusion bonding**.

liquid phase epitaxy. **Lpe.** *Noun.* Growth from melt or solution.

liquid phase sintering. *Noun.* The sintering process, which, by control of composition and temperature, maintains a small volume of liquid around the powder particles and brings about material transfer by a solution-precipitation procedure. The commonest form of ceramic sintering.

liquidus. *Noun.* (1) A line on a phase diagram that represents the boundary of a liquid phase field; a curve on a graph showing temperature versus composition of a material or mixture of materials that connects with temperatures at which fusion is completed as the temperature is raised. (2) For a ceramic alloy, the **liquidus temperature** is the temperature at which a solid phase first forms under equilibrium cooling conditions. (3) In glass technology it is the highest temperature at which devitrification crystals can exist in a given glass.

liquidus temperature. *Noun.* The maximum temperature at which equilibrium exists between a molten substance and its primary crystalline phase.

-lite. *Combining form.* Forms nouns denoting minerals, rocks and fossils.

liter. *Noun.* American spelling of litre. See **litre**.

-lith. *Combining form, noun.* Indicates stone or rock.

litharge. *Noun.* See **red lead** and **lead oxide**.

litharge glass. *Noun.* A soda-lime glass in which part of the **calcium oxide** is replaced by **litharge**.

lithia. *Noun.* Li_2O . The old name for **lithium oxide**. A powerful flux; used in glasses having high electrical resistivity to improve fluidity, working properties, and ultraviolet light transmission; used in dinnerware, **electrical porcelain**, and sanitary ware to improve strength and **gloss**; used in ceramic bodies and refractory specialties to reduce thermal expansion and improve **thermal-shock resistance**; used in porcelain-enamels to improve workability and reduce firing temperatures. $\text{Mp} > 1,700\text{ }^\circ\text{C}$; density $2,012\text{ kg m}^{-3}$.

lithiation. *Verb.* To increase the lithium content of ternary oxide crystals such as LiNbO_3 by reaction with melts containing Li^+ cations.

lithia, mica. *Noun.* See **lepidolite**.

lithic. *Adjective.* Relating to or composed of stone.

lithium aluminate. *Noun.* LiAlO_2 . Used as a flux in refractory porcelain-enamels. $\text{Mp} > 1625\text{ }^\circ\text{C}$; density $2,500\text{ kg m}^{-3}$.

lithium aluminium silicate. *Noun.* (1) $\text{Li}_2\text{Al}_2(\text{SiO}_4)_2$. $\text{Mp } 1,398\text{ }^\circ\text{C}$; density $2,360\text{ kg m}^{-3}$; hardness (Mohs) 5–7. (2) $\text{Li}_2\text{Al}_2(\text{SiO}_3)_4$. $\text{Mp } 1,427\text{ }^\circ\text{C}$; hardness (Mohs) 5–7. (3) $\text{Li}_2(\text{Al}_2\text{Si}_6\text{O}_{16})$. $\text{Mp } 1,183\text{ }^\circ\text{C}$; density $2,410\text{ kg m}^{-3}$; hardness (Mohs) 5–7.

lithium borosilicate. *Noun.* Used extensively in high-temperature, corrosion-resistant coatings.

lithium carbonate. *Noun.* Li_2CO_3 . Used as a source of **lithium oxide**, this then serves as a flux in ceramic bodies, glazes, and porcelain-enamels. Mp 735 °C; density 2,110 kg m^{-3} .

lithium cobaltite. *Noun.* LiCoO_2 . (1) Used in porcelain-enamel ground coats to combine the fluxing power of lithium and the adherence promoting properties of **cobalt oxide**. (2) A ceramic with good Li^+ ion transport properties used in high **energy density** storage dry cells. See **lithium ion battery**. Mp > 1,000 °C

lithium drifted germanium detector. *Noun.* Semiconductor grade germanium crystal doped with lithium atoms to produce a chip capable of x-ray energy determination with good resolution

lithium feldspathoids. *Plural noun.* A group of minerals including **lepidolite**, **spodumene**, and **petalite**, used in bodies, glazes, and porcelain-enamels to reduce thermal expansion and improve thermal-shock resistance.

lithium fluophosphate. *Noun.* $\text{Li}_4\text{PO}_4(\text{F})\cdot\text{H}_2\text{O}$. An **apatite**-like phase found in some fluorine containing **glass ceramic** phases.

lithium fluoride. *Noun.* LiF . Used as a flux and minor opacifier in porcelain-enamels and glazes, and as crystals in infrared instruments. Mp 870 °C; density 2,295 kg m^{-3} .

lithium ion battery. *Noun.* A dry cell containing a lithium cobalt oxide, LiCoO_2 , cathode that allows Li^+ -ion transport to a carbon anode to produce a high **energy density** storage system. See **lithium cobaltite**.

lithium magnetite. *Noun.* Li_2MnO_3 . Used as a flux in porcelain-enamels and in the production of ceramic-bonded grinding wheels.

lithium manganate. *Noun.* LiMn_2O_4 . A **spinel**-type oxide that can be fabricated as nanorods and used as the cathode in a **lithium ion battery**.

lithium metaborate dihydrate. *Noun.* $\text{LiBO}_2\cdot 2\text{H}_2\text{O}$. Used as a flux in porcelain-enamels; also increases tensile strength via the B-O network. Mp 840 °C.

lithium molybdate. *Noun.* Li_2MoO_4 . Used as an **adherence promoter** for white enamels applied directly to steel. Mp 705 °C.

lithium niobate. *Noun.* LiNbO_3 . A **perovskite** with an hexagonal structure and **ferroelectric** properties. It has a large **birefringence** coupled with small **dispersion** and so is used to make **acoustic transducers** and photo-optic devices, such as **optical waveguides**. Incongruent mp 1,253 °C

lithium nitrate. *Noun.* LiNO_3 . Used as an oxidising flux in porcelain-enamels, glazes, and glasses. Mp 261 °C.

lithium nitride. *Noun.* Li_3N . A nitride with a two-dimensional sheet-like structure similar to **graphite**. It can store up to 6 % by weight of hydrogen.

lithium oxide. *Noun.* See **lithia**.

lithium silicate. *Noun.* (1) Li_2SiO_3 . Mp 1,215 °C; density 2,480 kg m^{-3} ; hardness (Mohs) 5–7. (2) Li_4SiO_4 . Mp 1,253 °C; hardness (Mohs) 5–7. Both used in porcelain-enamels as a flux to improve surface texture and as a minor opacifier.

lithium stearate. *Noun.* $\text{Li}(\text{OOC}(\text{CH}_2)_{16}\text{CH}_3)$. A solid-state lubricant used in ceramic powder **dust pressing** as a **die lubricant** and binder phase.

lithium tantalate. *Noun.* LiTaO_3 . A **perovskite** used as a **pyroelectric** sensor in the optical wavelength range 1–15 μm .

lithium tetraborate. *Noun.* $\text{Li}_2\text{B}_4\text{O}_7\cdot x\text{H}_2\text{O}$. Used as a flux in glazes and porcelain-enamels. Loses water at 200 °C.

lithium titanate. *Noun.* Li_2TiO_3 . Used as a flux in porcelain-enamels and as a mill addition in glazes.

lithium titanium oxide. *Noun.* $\text{Li}_4\text{Ti}_5\text{O}_{12}$. A nanopowder made to be the anode for a **lithium ion battery** containing **lithium manganate** as the cathode.

lithium zirconate. *Noun.* Li_2ZrO_3 . Used as a flux and opacifier in porcelain-enamels.

lithium zirconium silicate. *Noun* (1) $\text{Li}_2\text{ZrOSiO}_4$. A strong flux used in porcelain bodies, porcelain-enamels, and glazes. (2) $\text{Li}_8\text{Zr}_3(\text{SiO}_4)_5$. Mp 1,154 °C; density 4,020 kg m^{-3} ; hardness (Mohs) 5–7.

litho- or lith-. *Combining form.* Makes words with the meaning stone.

lithograph. *Noun.* A print made by lithography.

lithography. *Noun.* A technique for making ceramic **decalcomanias** in which a design is printed on special paper from a plane surface, such as a smooth stone or metal plate, on which the image to be printed is ink-receptive and the blank area is ink-repellent.

lithography, hard-tip, soft spring. *Noun.* See **hard-tip, soft spring lithography**.

lithoid or lithoidal. *Adjective.* Resembling stone or rock.

lithology. *Noun.* (1) The physical characteristics of a rock, such as composition, texture, and colour. (2) The study of rocks.

lithomarge. *Noun.* A smooth compacted **kaolin** with a mottled reddish-white colour.

lithopone. *Noun.* A white pigment consisting of a mixture of ZnS , ZnO , and BaSO_4 .

- lithosphere.** *Noun.* The solid rock that constitutes the outer crust of the earth. It is divided into the land masses or Continental crust and the ocean floor or oceanic crust.
- litre.** *Noun.* The volume of a kilogram of water at 1 atm pressure and 4 °C. In USA spelt as **liter**.
- Littleton softening point.** *Noun.* The temperature at which a glass fibre 235 mm long and 0.65 ± 0.1 mm wide extends at a rate of 1.0 mm min^{-1} under its own weight when hanging in a furnace.
- liver, livering.** *Noun.* A defect in glazes and dry-process enamels characterised by a wavelike form of abnormally thick coating.
- liver opal.** *Noun.* A red-brown coloured **opal**. Also called **menilite**.
- liver spotting.** *Noun.* Stains of irregular shape occurring in **silica brick** as the result of the precipitation of **ferric oxide** from solution.
- lizard skin.** *Noun.* A decorative mottled glaze having matte or shiny and sometimes coloured spots on the surface giving the appearance of lizard or snake skin. See **snake skin glaze**.
- llww.** *Abbreviation.* See **capacitor code**.
- load.** *Noun.* (1) The quantity of glass delivered by a furnace during a given period of time, usually 24 h. (2) The charge in a furnace or kiln. (3) The mechanical force applied to a body.
- load axis.** *Noun.* An arbitrary reference axis along which, and about which, forces and moments for the system are calculated.
- load-bearing tile.** *Noun.* A tile used in masonry upon which loads are superimposed during construction and during the life of the completed structure.
- load-crushing strength, external.** *Noun.* See **external loadcrushing strength**.
- load-crushing strength test.** *Noun.* A test of concrete pipe in which external crushing forces are applied in specified directions and locations on a specified length of pipe.
- load deflection curve.** *Noun.* A plot where flexural loads are shown on the ordinate and deflections are shown on the abscissa.
- loaded concrete.** *Noun.* Concrete containing elements of high atomic number and of high neutron capture cross section; used as a radiation shield in nuclear reactors.
- loaded wheel.** *Noun.* A grinding wheel which has been dulled by becoming filled with particles of materials being ground.
- load factor.** *Noun.* Average load over a given period divided by peak load in the time interval.
- loading.** *Verb.* (1) To place a charge in a furnace or kiln. (2) To fill or clog the pores of a grinding wheel face with the material being ground.
- loading station.** *Noun.* A site where materials or products are loaded on a truck or other device for movement to some other location.
- load ratio.** *Noun.* Minimum applied load over maximum applied load in a **fatigue test**.
- loadstone.** *Noun.* Deposits of **magnetite**, FeFe_2O_4 , that are permanently magnetised; black colour, black streak; hardness (Mohs) 5.5–6.5; density $5,209 \text{ kg m}^{-3}$.
- load-transfer device.** *Noun.* Any device, such as a dowel or key, for improving the load transference across a concrete joint; that is, to improve the **shear strength** of the joint, and minimise **wear**.
- loaf.** *Noun.* A raised decoration in the centre of a plate or bowl that resembles a boss. Sometimes called **loaf dish form**.
- loaf dish form.** *Noun.* See **loaf**.
- loam.** *Noun.* (1) A creamy mixture of naturally bonded sand and clay used as a facing over brickwork to complete a mould or core. (2) A soil that is a mixture of clay and sand containing vegetable matter; used in brick manufacture.
- lobster eye.** *Noun.* A colloquial expression for square-channel capillary optic devices. It is so named because it operates on the principle of the eyes of macruran crustaceans where focus is achieved by glancing angle reflection rather than refraction. This fact gives it the possibility of focussing x-rays.
- local buckling.** *Noun.* A type of failure mode experienced by hollow cylindrical structures, such as **single** and **multiwall nanotubes**. Excess pressure on the ends of a hollow cylinder cause it to suddenly give in some local regions to form wrinkles in the surface.
- local field.** *Noun.* The total electric field acting upon a **dipole** in a **dielectric** material which takes account of the applied electric field and the total effect of the permanent and induced dipole fields in a solid. The **Lorentz equation** of the local field is given as: $E_{\text{loc}} = E_A + P/3\epsilon_0$, where E_A is the applied field, P is the **polarisability**, and ϵ , the **dielectric constant**.
- local oxidation of silicon. LOCOS.** *Noun.* This is done by O^+ ion implantation to produce highly resistive layers or localised areas of silicon substrate in **chip** manufacture.
- lock-up.** *Noun.* A phenomenon observed in flexible brick pavements; see **interlock (2)**.
- LOCOS.** *Acronym.* Stands for local oxidation of silicon. See **local oxidation of silicon**.
- lode.** *Noun.* An ore deposit contained in well-defined limits in surrounding rock.

- lodestone or loadstone.** *Noun.* A naturally magnetic rock because it consists of almost pure **magnetite**. See **loadstone**.
- loess.** *Noun.* A fine clay-like material, such as brick clay, which is largely **siliceous** in composition but contains **calcareous** matter, is characterised by the absence of stratification, and contains sharply angular grains of **quartz**. Aeolian or wind deposited. Sometimes spelled **löss**.
- loessial.** *Adjective.* A deposit of fine grained light-coloured, wind-blown clay and silt.
- logarithmic creep.** *Noun.* Deformation by **plastic flow** under constant stress where the **strain**, γ , is given by $\gamma = \alpha \log t$, where α is a constant and t is the time under load.
- logarithmic decrement.** Δ . *Noun.* Used to measure the mechanical damping in a torsion or vibration experiment, which is undertaken to measure **internal friction** and **dynamic shear modulus**: $\Delta = 1/n [\ln A_{(i+n)} / A_i]$, where A_i is the amplitude of the i th oscillation and $A_{(i+n)}$ is the amplitude n vibrations later.
- logic chips.** *Noun.* Integrated circuits consisting of arrays of **gates** made to carry out a Boolean function. Computers are a collection of such chips.
- logic gate.** *Noun.* A single **transistor** or group of transistors that performs some logic function.
- LOI.** *Abbreviation.* Stands for loss on ignition. See **loss on ignition**.
- LOM.** *Abbreviation.* Stands for laminated object manufacturing. See **laminated object manufacturing**.
- long.** *Adjective.* A comparative term denoting a slow-setting glass.
- long clay.** *Noun.* A plastic clay of high **green strength**.
- long glass.** *Adjective.* A slow-to-solidify glass.
- longitudinal-arch kiln.** *Noun.* A kiln in which the arch extends parallel to the length of the kiln.
- longitudinal direction.** *Noun.* The length-wise direction and for a rod or fibre the direction of the long axis.
- longitudinal magnetic field.** *Noun.* A field of magnetism in which the flux lines travel in a direction essentially parallel to the longitudinal axis of the component.
- longitudinal modulus.** *Noun.* Elastic moduli such as **Young's**, E , or shear, G , along the fibre direction in a unidirectional composite.
- longitudinal wave.** *Noun.* A wave that is transmitted in the same direction as the displacement causing the wave.
- longos.** *Noun.* Helical windings of fibre with a low angle.
- long-range order.** *Noun.* Identical coordination over many atomic distances resulting in a crystalline structure.
- long-term animal test.** $T_{1/2}$. *Noun.* The remaining rats used in the **short-term animal test** are sampled up to 6 months and lung burden as a function of time is found and compared to the result of the short-term animal test. This gives the $T_{1/2}$. A $T_{1/2}$ of 10 days is considered safe.
- lonsdaleite.** *Noun.* A rare **polytype** of **diamond** with hexagonal symmetry that occurs naturally.
- looking glass.** *Noun.* A mirror.
- loom.** *Noun.* A machine for interlacing **warp** and **fill** yarns.
- loom fly.** *Noun.* Types of weaving defect in fibre composites where broken fibres are woven into the reinforcing fabric.
- loop break strength.** *Noun.* The strength of two **filaments** of fibre arranged as one loop.
- loop, hysteresis.** *Noun.* See **hysteresis loop**.
- loop knot.** *Noun.* A snag and tangle of filling fibre caused by it coiling upon itself.
- loops, looping.** *Noun.* Defects occurring in porcelain-enamel ground and cover coats characterised by a sagged or draped appearance.
- loop test.** *Noun.* Analogous to the bend test; fibres are drawn into a loop of decreasing radius until failure just occurs and the bending stress is calculated from $\sigma = Ex/\rho$, where x is the distance from the neutral axis to outer fibre, which is the fibre radius for cylindrical fibres, ρ is the radius of curvature of the tightest circle before failure and E is **Young's modulus of the fibre**.
- loose splittings.** *Plural noun.* Heterogeneous shapes of **mica** packed loosely in bulk form, but arranged in no particular order.
- loose splittings with powder.** *Noun.* **Loose splittings** of mica dusted with mica powder; used as electrical insulation.
- loparite.** *Noun.* A **rare earth ore** with a complex composition within the **perovskite**, ABO_3 , structure, with $A = \text{Ce, Na, Sr, Ca}$ and $B = \text{Ti, Nb, Ta, Fe}$. It is a black mineral with cubic or pseudo-cubic **twin** crystals. With time it becomes amorphous due to α -particle bombardment. It is a major source of the light rare earths.
- lopolith.** *Noun.* A lens-shaped body of intrusive igneous rock formed by the penetration of magma between layers of existing rock followed by subsidence beneath the intrusion.
- Lorentz equation.** *Noun.* See **local field**.
- Lorentz-Lorentz law.** *Noun.* States the relationship between **refractive index** of a solid, n , **molecular refractivity**, R , the molecular weight, M , and density, ρ : $R = n^2 - 1/n^2 + 2(M/\rho)$. A similar relationship exists for **polarisability** of dielectrics, see **Clausius-Mosotti law**.

Lorentz number. L_0 . *Noun.* A constant in the **Wiedermann-Franz Law** concerning electronic thermal conductivity in solids. It has a value of $2.44 \times 10^{-8} \text{ W}\Omega \text{ K}^{-1}$.

Los Angeles abrasion test. *Noun.* A test of the hardness and abrasion resistance of concrete aggregates in which a standard sample is tumbled in a standard ball mill for a certain number of revolutions.

löss. *Noun.* See **loess**.

loss angle. *Noun.* The angle whose tangent is the **dissipation factor**.

loss factor. *Noun.* A materials **loss tangent** divided by its **permeability**. See **dielectric loss factor**, also **loss index**.

loss index. *Noun.* The value of the imaginary part of the relative complex permittivity; the product of the **relative permittivity** and **dissipation factor** and is a measure of the alternating current dielectric loss.

loss on ignition (LOI). *Noun.* The loss in weight that results from heating a sample of material to a high temperature after preliminary drying at a temperature just above the boiling point of water; the loss in weight upon drying is identified as free moisture, and the loss in weight occurring above the boiling point of water as loss on ignition, and is reported as a percentage of the weight of the original dry sample.

loss tangent. $\tan \delta_{\text{eff}}$. *Noun.* The ratio of the **relative effective loss factor** to the **relative dielectric constant**. The charge oscillations in a dielectric ceramic subjected to an a.c. voltage dissipate energy which is associated with a dielectric loss and $\tan \delta$ is a measure of the loss. It express the ratio of energy lost per cycle to 2π times the maximum energy stored and the smaller the number the less the charge oscillation dissipates energy as heat. The energy loss equals $1/\omega cR$, where ω is the phase difference in the a.c. circuit, c is the capacitance and R is the resistance. Glass and ceramics have values in the range 0.001–0.02 at low frequencies and room temperature with a few notable exceptions.

lossy. *Adjective.* Colloquial expression for the energy dissipated in a dielectric ceramic as charge displacement oscillates in an alternating voltage.

lost-wax process. *Noun.* The process of preparing an investment casting mould by encasing a wax replica in a bonded refractory powder, removing the wax from the refractory by melting, and then sintering the resultant mould prior to use.

lot. *Noun.* A quantity of material that is uniform in isotopic, chemical, and physical characteristics, and which may be composed of one or more batches, provided that the same starting material is used for all batches.

lot sample, composite. *Noun.* See **composite lot sample**.

low-angle boundaries. *Noun.* Grain boundaries, either tilt or twist, that require rotations of less than 15° to gain coincidence of the grains forming the boundary. The boundary consists of **dislocation** arrays.

low dimensional materials. *Plural noun.* A new class of material with reduced dimensionality, that is, one or more dimensions is constrained to nanometre scale and the **quantum confinement** confers new properties compared to the bulk 3-D material. Hence **dimensionality** defines the chemical and physical properties of the material. 1-D are **nanotubes**, 2-D are nanosheets and pseudo-0-D are **fullerenes**.

low-duty fireclay brick. *Noun.* A **fireclay** brick having a **pyrometric cone equivalent** of not less than cone 15 or higher than cones 28–29.

lower blades. *Noun.* An asbestos-cement product shaped so as to allow the flow and control of air in the ventilation of a building.

low emissivity windows. *Plural noun.* Glass plates on which a sequence of thin films of tin oxide, SnO_2 , and tin fluoride, SnF_2 , are deposited. This produces a strong absorption of thermal energy but a low emissivity and so the windows do not re-radiate the energy.

Lowestoft. *Toponym.* A **soft-paste porcelain** made in the town of Lowestoft since 1757.

low-frequency induction furnace. *Noun.* A refractory-lined furnace in which the charge is heated by **eddy currents**.

low gloss. *Adjective.* Dullness or lack of gloss on a porcelain-enamel or glaze surface.

low-heat cement. *Noun.* **Portland cement** containing a relatively high percentage of **dicalcium silicate** and **tetracalcium aluminoferrite**, and a low percentage of **tricalcium silicate** and **tricalcium aluminate**, and having a considerably lower heat of hydration than Portland cement.

low-level waste. **LLW.** Material emanating from a nuclear facility with measured activity of 12 Bq g^{-1} for β and γ radiation and 4 Bq g^{-1} for α -radiation. It does not need significant shielding or high quality containment during normal handling.

low-load hardness. *Noun.* **Indentation hardness** determined by using a load in the range 1.96–98.1 N where the observed hardness is moderately load-dependent.

low-melting glass. *Noun.* Glass containing selenium, arsenic, thallium, or sulphur having a melting point of 127–349 $^\circ\text{C}$.

low-shaft furnace. *Noun.* A short-shafted, refractory-lined blast furnace used to produce low-grade products by using low-grade fuels.

low-soda alumina. *Noun.* **Aluminium oxide** with less than 0.15 % sodium oxide, and which is used in high-grade electrical insulators and other ceramic bodies.

low-solubility glaze. *Noun.* A lead-bearing glaze in which no more than 5 % of the **lead oxide** is soluble.

low-temperature glaze. *Noun.* A glaze that fires at a temperature of 1,050 °C or below.

low temperature superconductor. *LTS. Plural noun.* Pre-1985 materials that only become superconducting when cooled to a few degrees above the absolute zero of temperature.

LPE. *Abbreviation.* Standing for liquid phase epitaxy. See **liquid phase epitaxy**.

LPG. *Abbreviation.* Stands for liquefied petroleum gas. See **liquefied petroleum gas**.

LSCCO. *Abbreviation.* Standing for lanthanum strontium calcium copper oxide superconductor. See **lanthanum strontium calcium copper oxide superconductor**.

LSD-5 % level. *Abbreviation.* Stands for least significant difference; it is the difference between two measurements, or two simple averages, that would be exceeded only 1 in 20 times under random sampling conditions, when population differences have been specified.

LSM. *Abbreviation.* Standing for lanthanum strontium manganese oxide. See **lanthanum strontium manganese oxide**.

LTS. *Abbreviation.* Stands for low temperature superconductor. See **low temperature superconductor**.

Lubbers' process. *Noun.* The first mass production method for making flat glass. It involved vertically drawing a 14 m long, 1 m diameter tube and then splitting it along its length.

lubricant. *Noun.* (1) A material such as graphite used to lubricate the die-punch interface and/or the green pellet-die interface and/or the particle interfaces within the green pellet during a pressing operation. (2) Substances that facilitate the flow of non-plastic or poorly plastic materials in the formation of dense compacts under pressure. (3) A solution which, when applied to glass fibres, facilitates their handling by reducing mutual abrasion. (4) The liquid used to lubricate the work face, promote a more efficient action, and retard loading of the face of an abrasive wheel. (5) A substance such as lubricating oil employed to reduce friction between moving parts.

lubricant, mould. *Noun.* See **mould lubricant**.

lubricity. *Noun.* (1) Smoothness or slipperiness. (2) The capacity to lubricate. (3) The beneficial effect a binder has in allowing **green** shapes to be released from moulds. The **relative lubricity** can be estimated by measuring the load required to eject a cylindrical pellet from a cylindrical mould using the relationship: $P_e/\pi Dt$, where D is the pellet diameter, t its thickness, and P_e is

the ejection load. Low values for relative lubricity are desirable.

lubricostratic. *Adjective.* Describing structures where two-dimensional layers are intercalated into already layered materials, such as **graphite** that is well ordered. The intercalated layers are separated from each other by exact translations up the c -axis but have no defined separations in the ab -planes.

Lucalox alumina. *Trademark, noun.* A commercially available sintered **alumina** of such high density and small uniform grain size as to be transparent, ZrO_2 , is added as a sintering aid in order to achieve this state by acting as a grain growth inhibitor.

lucent. *Adjective.* Shining, brilliant or translucent.

lucy tool. *Noun.* A tool for removing **slip** from moulds; made from soft plastic so as not to damage the mould.

Lüders bands. *Plural noun.* Also known as **stretcher strains**; they are surface markings appearing at places of stress concentrations, such as shoulders in specimens, when the upper yield point is reached. Their boundaries are surfaces that divide those over strained parts of the crystal from those still un-yielded.

lug. *Noun.* A protuberance or knob on an item or tool used as a handle.

lug brick. *Noun.* A brick formed with **lugs** to facilitate spacing with adjacent brick.

lumen, lm. *Noun.* The derived **SI unit** of **luminous flux** equal to the amount of light emitted in a solid angle of 1 steradian by a point source of light with an intensity of 1 **candela**.

luminance, L. *Noun.* (1) The state or quality of radiated or reflected light. (2) The **luminous intensity** of a surface in a given direction per unit of projected area. (3) For a light source it is a measure of **brightness**. Measured in **candelas** m^{-2} .

luminesce. *Verb int.* To exhibit **luminescence**.

luminescence. *Noun.* The production of light without generating high temperatures or **incandescence**, usually resulting from electron decay from an excited state after exposure to electromagnetic radiation, electron bombardment, electric fields, and chemical reactions at room or ambient temperatures.

luminescent. *Adjective.* Describing materials that show **luminescence**.

luminosity. *Noun.* The factor that enables an object or colour emitting light to be observed. Formerly just called brightness.

luminous. *Adjective.* Radiating or reflecting light.

luminous factor, M_v . *Noun.* The reflectance that a perfectly diffusing surface must possess to appear as bright as a test specimen under identical conditions.

luminous exitance. *Noun.* The ability of a surface to emit light. It is given as the **luminous flux** per unit area at a specified point on the surface.

luminous flux. Φ_v . *Noun.* **Radiant flux** in the visible-wavelength range. For a monochromatic source it is the radiant flux multiplied by the spectral luminous efficiency of the light. It is measured in **lumens**.

luminous intensity. I_v . *Noun.* A measure of the amount of light that a point source radiates in a given direction. It is the **luminous flux** leaving the source in that direction per unit of solid angle.

luminous-wall firing. *Verb.* To fire a furnace or kiln by projecting the fuel onto an incandescent refractory surface.

lump. *Noun.* A raised area or projection, usually rounded, on a porcelain-enamel, glaze, or other solid surface.

lump hammer. *Noun.* A heavy hammer used for breaking stone.

lumped circuit. *Noun.* A radio-frequency circuit with inductance and capacitance in the same physical component.

lumping up. *Verb.* The weekly inspection of moulds for uneven wear.

lunar caustic. *Noun.* Fused silver nitrate. See **silver nitrate**.

lunar glass. *Noun.* Small spherical glass beads frequently found in samples of moon dust; assumed to be formed when meteorites impact the surface basalt rocks of the moon.

Lunden conducting tile. *Trademark, noun.* Tile, particularly floor tile, in which an electrically conducting material such as carbon or metal has been incorporated as a means of dissipating electrostatic charges.

Lüer syringe. *Noun.* A calibrated all glass syringe with a direct action plunger and a conical ground glass nozzle for detachable push-fit needles with the whole able to be sterilised.

Lurgi cement. *Noun.* Hydraulic cement produced by sintering the charge on a grate.

lustre. *Noun.* (1) An iridescent decorative surface appearance on porcelain-enamels, glass, and glazes; usually produced by the application of a very thin film of metal such as gold, silver, platinum, copper, bismuth, and tin over the coating surface; the lustre is applied as an oxide or resinate and fired in a reducing atmosphere. (2) Sheen from reflected light. (3) A mineral property defined by the amount and quality of the surface reflected light. (4) A prismatically cut glass pendant used to decorate a chandelier. (5) A cut glass chandelier.

(6) The way the intensity of light, simultaneously reflected specularly and diffusely, from different parts of a surface differs when exposed to the same incident light. Measurement depends on the ratio of intensities of reflected light for specified angles of incidence and viewing.

lustre, adamantine. *Noun.* See **adamantine lustre**.

lustre colours. *Plural noun.* Clear solutions of mineral pigments in organic solvents.

lustre combination. *Verb.* The effects obtained by sequentially applying and firing a sequence of lustre colours on top of each other.

lustre, earthy. *Noun.* See **earthy lustre**.

lustre, greasy. *Noun.* See **greasy lustre**.

lustre of gold. *Noun.* See **gold lustre**.

lustre, pearly. *Noun.* See **pearly lustre**.

lustre, resinous. *Noun.* See **resinous lustre**.

lustre, silky. *Noun.* See **silky lustre**.

lustre, vitreous. *Noun.* See **vitreous lustre**.

lustreware. *Noun.* Ceramic ware covered with an **iridescent** glaze.

lustrous. *Adjective.* An even, soft shine from a surface.

lute. *Noun.* A clay or cement packed into a joint or applied as a coating over a porous surface to render the joint or surface impervious to gases and liquids.

luting. *Verb.* The joining of two **leather-hard**, unfired ceramic surfaces with slip; for example, the joining of handles to cups, vases, etc., to form a monolithic structure.

luting cement. *Noun.* An adhesive mixture, such as **silica**, trialkoxysilyl compounds and polymethacrylate; used to veneer teeth.

lutite. *Noun.* Synonym for **pelite**.

lux. l_x . *Noun.* The derived **S I unit** of illumination equal to a luminous flux of 1 lm m^{-2} . One lux is equivalent to 0.0929 foot-candle.

Lycurgus cup. *Noun.* An early example of the **plasmonic** colour effect produced by adding tiny particles of copper and gold to glass. The Roman goblet is green but when illuminated from inside it turns to a red colour

lyddite. *Noun.* See **chert**.

lye. *Noun.* Concentrated solution of potassium or sodium hydroxide.

lynn sand. *Noun.* A pure form of **quartzose sand**.

lyo-. *Combining form.* A dispersion or dissolution.

lyophilic. *Adjective.* Description of a colloid dispersed phase that has high affinity for the continuous phase. A lyophilic **sol**.

lyophobic. *Adjective.* Description of a colloid dispersed phase that has little or no affinity for the continuous phase. A lyophobic **sol**.

lysimeter. *Noun.* An instrument for determining the amount of water soluble matter in minerals and soils.

Lytag. *Trademark, noun.* Commercial material, which is an aggregate of sintered, pulverised fuel ash used to make concrete.

Mm

M. *Noun.* The Roman numeral for 1,000.

M. *Symbol.* Standing for: (1) **modulus**; (2) **mutual inductance**; (3) **molar**.

M. *Abbreviation.* Indicating mega, that is 10^6 .

m. *Abbreviation.* Standing for: (1) mass; (2) metre; (3) mile; (4) milli.

macadam. *Noun.* Small broken stones bound together by tar or **asphalt**. Used in road surfacing.

macaulayite. *Noun.* A secondary mineral formed in deeply weathered granite in the presence of water. It has a characteristic deep-red colour.

macchiavectoria. *Noun.* A **limestone breccia marble** with a pale brown matrix to the large breccia crystals that make it an attractive building material.

maceral. *Noun.* Any of the organic units that constitute coal.

macerate. *Verb.* To chop fibre, yarn, or fabric.

mach-disk. *Noun.* A heated, high-pressure wave that sweeps along the axis of a charge in a converging shock-wave apparatus. It is a disk-shaped front moving with the detonation velocity of the explosive charge (between 6 and 7 km s⁻¹). Pressures around 400 GN m⁻² are achieved.

machinability. *Adjective.* The ease with which a material can be machined.

machine moulding. *Noun.* The process of making casting moulds and cores by mechanical means, usually by vibration to compact the **moulding sand**.

machine tool. *Noun.* (1) A power driven machine, such as a grinder or lathe, for cutting, shaping, and finishing materials. (2) A hard, fracture-resistant attachment to a machining apparatus used to cut, drill, shape, grind, or polish a solid product.

machining. *Verb.* The process of cutting, grinding, or shaping a piece of work.

machining stress. *Noun.* Residual stress in a body following a machining operation.

mackinawite. *Noun.* FeS. A non-cubic form of **iron sulphide**, stable in strongly anaerobic conditions; the first product of iron corrosion in aqueous solutions containing S²⁻ ions.

Mack's cement. *Trade name, noun.* Quick-setting cement composed of **plaster of Paris** with additions of calcined **sodium sulphate**, Na₂SO₄, and **potassium sulphate**, K₂SO₄.

macle. *Noun.* (1) See **chiastolite**. (2) Another name for **twin**.

Macor. *Trademark, noun.* A commercial machinable glass-ceramic based on internally nucleated fluormica crystals in glass. Main machinable phase is fluorine-phlogopite, KMg₃AlSi₃O₁₀F₂. It has a continuous use temperature of 800 °C and a coefficient of thermal expansion that matches many metals and sealing glasses. It is non-porous and non-wetting.

macro. *Combining form.* (1) A prefix meaning large. (2) Structure that can be seen without the aid of a microscope.

macrodefect-free cement. *Noun.* A composite involving inorganic hydraulic cement such as **OPC**, and a water-soluble polymer, such as PVA (polyvinyl acetate) mixed with water at a low water-to-cement ratio, 0.10–0.15, and mixed by mechanical shearing to remove the macro-sized pores as the mixture sets. Also called **MDF cement**.

macropore. *Noun.* A pore of sufficient size that it will not retain water by capillary action.

macropore volume. *Noun.* The volume fraction of a porous solid comprising all interconnected pores. The size of the pore opening is sometimes specified, e.g., 35–70 nm in some types of alumina.

macroscopic. *Adjective.* (1) Visible to the unaided eye. (2) Concerned with large units.

Madelung constant. *Noun.* A crystal structure-dependent number which is used to determine the attractive energy of ions in a solid; it is the sum of a geometrical progression obtained by considering the attraction of nearest neighbours and repulsion of next nearest neighbours.

mafic minerals. *Noun.* A group of magnesium, iron, and calcium silicates sometimes used as inexpensive substitutes for **feldspar**; mp approximately 1,250 °C.

magadiite. *Toponym, noun.* $\text{NaSi}_7\text{O}_{13}(\text{OH})_3 \cdot 4\text{H}_2\text{O}$. Hydrated **sodium silicate** named from the original source at lake Magadi in Kenya. A white, soft mineral with an interesting structure consisting of clay-like sheets of linked SiO_4 tetrahedra with some alternation of the apical oxygen atoms above and below the layer and zeolite-like elements. Hardness (Mohs) 2; density 2,230 kg m^{-3} . A synthetic **zeolite**, $\text{Na}_2\text{Si}_{12}\text{O}_{24}(\text{OH})_2 \cdot 9\text{H}_2\text{O}$, also has this name.

maghemite. *Noun.* $\gamma\text{-Fe}_2\text{O}_3$. Isostructural with **magnetite** and so is a cation deficient **inverse spinel**. It occurs due to weathering of magnetite or heating other iron oxides in the presence of organic matter. An important magnetic pigment.

magic angle NMR. *Noun.* A technique developed to produce narrow-line-width spectra from solid-state samples. The sample is spun rapidly around an axis aligned at 54.7° to the direction of the applied magnetic field; used to examine ^{27}Al and ^{29}Si sites in aluminosilicates and so obtain structural data concerning tetrahedral linkage patterns. A non-destructive test.

magic numbers. *Plural noun.* Numbers of neutrons or protons that reside in atomic nuclei and result in very stable atoms. For both protons and neutrons 2, 8, 20, 28, 50 and 82 are magic numbers. For neutrons 126 and 184 are also magic numbers, while 114 is a proton magic number.

maglev. *Abbreviation.* Stands for magnetic levitation; a process whereby strong permanent magnets, such as **neodymium iron boride**, attached to the body of a vehicle running on magnetised rails provide a lifting force.

Magnatherm reaction. *Trade name, noun.* A commercial process to get magnesium from **dolomite** using a **ferrosilicon** reductant and a **bauxite** flux.

Magneli oxides. *Plural noun.* A series of oxides obtained from a particular family structure by ordered omission of chains of oxygen atoms and a process of **crystallographic shear**. For example the rutile structured oxide, VO_2 , gives rise to a series $\text{V}_n\text{O}_{2n-1}$ for $3 < n < 10$, where the new oxides may be viewed as a string of n , VO_2 rutile blocks, separated by a distorted V_2O_3 unit of structure. At the shear planes the MO_6 octahedra that form the structure change their sharing pattern from corner to edge etc.

magnesia. *Noun.* MgO . See **magnesium oxide**.

magnesia brick. *Noun.* A refractory brick composed of approximately 85 % **magnesium oxide**, MgO , and 15 % other oxides; used where corrosion by basic slags may be severe.

magnesia cement. *Noun.* **Magnesium oxychloride cement** produced by adding magnesium chloride solution to **magnesia**.

magnesia-chrome brick. *Noun.* Chromium oxide is present at <50 %. See **chrome-magnesia brick**.

magnesia, dead-burned. *Noun.* See **dead-burned magnesite**.

magnesia-dolomite brick. *Noun.* A refractory brick produced from a mixture of **dead-burned magnesite** and **magnesia-rich dead-burned dolomite**, the **magnesite** being the predominant phase.

magnesian matte. *Noun.* A matte glaze containing an excess of magnesium oxide.

magnesia, refractory. *Noun.* See **refractory magnesia**.

magnesia, seawater. *Noun.* See **seawater magnesia**.

magnesia-spinel brick. *Noun.* A refractory brick made by sintering a mixture of **dead burned magnesia** with synthetic **spinel**, MgAl_2O_4 . This type of brick often replaces **magnesia-chrome** formulations. The two phase brick has **halos** round the spinel grains which introduce greater spalling resistance than that found in pure **magnesia bricks**.

magnesiochromite. *Noun.* MgCr_2O_4 . A **spinel** component of **chrome magnesite refractories**. When doped with Ti^{4+} ions it is turned into a p-type semiconductor that is used in humidity-sensing devices. Mp 2,250 °C; density 4,410 kg m^{-3} .

magnesioferrite. *Noun.* MgFe_2O_4 . A **spinel** phase sometimes present in basic refractories.

magnesiothermic reduction. *Noun.* Powdered mixtures of magnesium metal and carbon are used to reduce oxides at temperatures around 1,750 °C to produce fine powders of carbide. For example, $\text{B}_2\text{O}_3 + \text{Mg} + \text{C}$ yield a composite of B_4C and MgO .

magnesite. *Noun.* MgCO_3 . Used as an ingredient in basic refractories and glazes as a source of magnesium oxide, MgO . Decomposes at about 350 °C; density 3,050 kg m^{-3} ; hardness (Mohs) 3.5–4.5.

magnesite brick. *Noun.* See **magnesia brick**.

magnesite-chrome brick. *Noun.* A refractory produced from a mixture of **dead-burned magnesite** and **chrome ore**, **magnesite** being the predominant ingredient.

magnesite, dead-burned. *Noun.* See **dead-burned magnesite**.

magnesite, grain. *Noun.* See **grain magnesite**.

magnesite refractory. *Noun.* A refractory product in which **magnesite** is the essential starting raw material.

magnesite wheel. *Noun.* A grinding wheel in which **magnesium oxychloride** is the bonding agent.

magnesium aluminate. *Noun.* MgAl_2O_4 . See **spinel**.

magnesium aluminium silicate. *Noun.* (1) $\text{Mg}_2\text{Al}_4\text{Si}_5\text{O}_{18}$. Mp 1,471 °C; density 2,510 kg m^{-3} ; hardness (Mohs) 5–7. (2) $\text{Mg}_4\text{Al}_{10}\text{Si}_2\text{O}_{23}$. Employed as a ceramic binder. Mp 1,454 °C; hardness (Mohs) 5–7.

magnesium carbonate. *Noun.* MgCO_3 . Used both as a low-temperature refractory and high-temperature flux in glass, porcelain, insulator-bodies, vitreous and semi-vitreous ware, glazes, and porcelain-enamels where it produces a satin-matte surface when used in amounts up to 10 % but above this it can cause **crawling** or **pinhole** formation. It improves **craze** resistance. Also used as a setting-up agent in porcelain-enamels and other slips. Decomposes at 350 °C; density 3,040 kg m^{-3} .

magnesium chromite. *Noun.* MgCr_2O_4 . See **magnesiochromite**.

magnesium dititanate. *Noun.* MgTi_2O_5 . The nucleating phase that is the first to appear in high TiO_2 content (>10 wt.%) glass ceramic compositions containing Al_2O_3 , MgO , SiO_2 and ZnO .

magnesium ferrite. *Noun.* MgFe_2O_4 . See **magnesioferrite**.

magnesium fluoride. *Noun.* MgF_2 . Used as a flux in various ceramic and glass compositions, particularly for infrared components; used in severe conditions and as a host for Ni^+ ions to produce a **laser** with a wavelength of 1.93 μm and a power of 1.0 W. Mp 1,396 °C; density 3,000 kg m^{-3} .

magnesium fluosilicate. *Noun.* $\text{MgSiF}_6 \cdot 6\text{H}_2\text{O}$. Used in ceramic coatings and as a concrete hardener where its waterproofing properties are also exploited.

magnesium flux. *Noun.* **Magnesium fluoride**, MgF_2 .

magnesium lime. *Noun.* Lime containing more than 20 % magnesium oxide; slakes more slowly and evolves less heat, but sets more rapidly with less expansion, to produce mortars of higher strength than high-calcium limes.

magnesium mica. *Noun.* $\text{KMg}_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$. Used as thermal and electrical insulation. Has the double-sheet silicate structure. Density 2,860 kg m^{-3} ; hardness (Mohs) 2.5–3.

magnesium nitride. *Noun.* Mg_3N_2 . An ionic nitride that hydrolyses to give ammonia; used to make metal-melting crucibles. Decomposes at 1,500 °C; density 2,710 kg m^{-3} .

magnesium oxide. *Noun.* MgO . **Magnesia** in ceramic terminology. A basic oxide unstable in acidic media;

used in refractories, crucibles, thermocouple tubing, thermal insulation, infrared windows, etc., as a viscous flux and an opacifier; also used in the production of **Sorel cement** and some electronic components. Mp 2,800 °C; density 3,222 kg m^{-3} ; hardness (Mohs) 5–7.

magnesium oxychloride cement. *Noun.* A mixture of magnesium oxide and an aqueous solution of magnesium chloride; used for interior flooring. Also known as **Sorel cement**.

magnesium phosphate. *Noun.* $\text{Mg}_3(\text{PO}_4)_2$. Used in glazes for sanitary ware as a replacement for tin oxide to obtain improved colour, opacity, brilliance, and texture. Mp 1,383 °C; density 2,610 kg m^{-3} .

magnesium scum. *Noun.* See **scumming**.

magnesium silicate. *Noun.* (1) MgSiO_3 . A **pyroxene** mineral used as a component in glass, refractories, and other ceramic bodies. Density 2,600–2,800 kg m^{-3} . (2) Mg_2SiO_4 . An ionic **orthosilicate** commonly known as **forsterite**; mp 1,910 °C; density 3,220 kg m^{-3} ; hardness (Mohs) 5–7.

magnesium silicofluoride. *Noun.* See **magnesium fluosilicate**.

magnesium soaps. *Plural noun.* The product of the reaction between magnesium hydroxide and organic fatty acids; used as die pressing lubricants.

magnesium stannate. *Noun.* (1) MgSnO_3 . Used in dielectric compositions and as a **phosphor** base. (2) Mg_2SnO_4 . A spinel-type phase; mp 1,950 °C; density 4,740 kg m^{-3} .

magnesium stearate. *Noun.* $\text{Mg}[\text{OOC}(\text{CH}_2)_{16}\text{CH}_3]_2$. A soft white powder, one of the **magnesium soaps**, used as a die lubricant and plastic stabiliser.

magnesium sulphate. *Noun.* MgSO_4 . Used as a suspension-promoting agent in slips and as a flux when used at the 1 % level in glaze compositions. May be a source of scum formation. Mp 1,950 °C; density 4,740 kg m^{-3} .

magnesium titanate. *Noun.* (1) MgTiO_3 . A **perovskite** phase, which, because of its low dielectric constant it is used in dielectric manufacture. Mp 1,690 °C; density 4,000 kg m^{-3} . (2) MgTi_2O_4 . A **spinel** phase which, when prepared slightly Ti-rich, has superconducting properties. Mp 1,732 °C; density 3,520 kg m^{-3} . (3) MgTi_2O_3 ; mp 1,649 °C; density 3,663 kg m^{-3} .

magnesium tungstate. *Noun.* MgWO_4 . An orthotungstate sometimes used as a fluorescent pigment.

magnesium uranate. *Noun.* MgU_2O_4 . A **spinel**, mp 1,749 °C.

magnesium wolframate. *Noun.* MgWO_4 . See **magnesium tungstate**.

magnesium zirconate. *Noun.* MgZrO_3 . Used in dielectric compositions and as a setter for firing titanates, ferrites, etc. Mp 2,150 °C

magnet. *Noun.* A material that produces a magnetic field external to itself and which attracts iron; a piece of ferro- or ferrimagnetic material.

magnetic. *Adjective.* Exhibiting the property of a magnet.

magnetically modulated microwave reflection spectroscopy. MMR. *Noun.* Used to estimate T_c for superconductors and to assess grain size effects.

magnetic analysis inspection. *Noun.* A non-destructive test to identify variations in magnetic flux in ferromagnetic materials of constant cross-section, which may be caused by defects, discontinuities, irregularities, variations in magnetic hardness, etc.

magnetic anisotropy. *Noun.* The difference in the energy needed to magnetise a material with the applied field along different directions.

magnetic bottle. *Noun.* A set of magnetic fields in a particular relationship to each other designed to contain the plasma in controlled thermonuclear reactions.

magnetic bubbles. *Plural noun.* Ferrimagnetic domains in ceramics, such as rare earth orthoferrites and garnets, whose shape can be changed to a set of individual cylindrical domains by the application of an externally applied field; used to store information in computer memories.

magnetic ceramics. *Plural noun.* Fired mixtures of some transition metal oxides that interact to produce perovskite, spinel, and related phases, among themselves, or with divalent metal such as barium, cobalt, copper, lead, magnesium, manganese, nickel, strontium, or zinc, which exhibit ferromagnetic and antiferromagnetic, magneto-optical, and magnetostrictive effects; used in antennae, computer memory cores, TV yokes, telecommunication systems, etc.

magnetic circuit. *Noun.* A closed path described by magnetic flux.

magnetic constant. M_0 . *Noun.* The permeability of free space; it has a value of $4 \times 10^{-7} \text{ H m}^{-1}$. Also called the absolute permeability.

magnetic dipole moment. *Noun.* A measure of magnetic strength of a magnet or current-carrying coil. It is the torque produced when the magnet has its axis perpendicular to a unit magnetic field.

magnetic domain. *Noun.* Distinct microscopic regions in a crystal each magnetically saturated in a different direction. This occurs because the local atomic magnetic moments are all aligned in the same direction but this is different to other nearby regions.

magnetic field. *Noun.* A field of force surrounding a permanent magnet or a moving charged particle in

which another permanent magnet or moving charge experience force.

magnetic field dependence. *Noun.* A term used to denote the fact that a slight magnetic field will reduce the critical current of the Josephson junction. Used to make ultrafast switches and memory cells.

magnetic field leakage. *Noun.* The magnetic field that leaves or enters the surface of a component at a discontinuity or change in section configuration of a magnetic part.

magnetic field, longitudinal. *Noun.* See longitudinal magnetic field.

magnetic field meter. *Noun.* An instrument that measures the strength of a magnetic field.

magnetic field, residual. *Noun.* See residual magnetic field.

magnetic field, resultant. *Noun.* See resultant magnetic field.

magnetic field strength. H. *Noun.* The measured intensity of a magnetic field expressed in tesla per metre.

magnetic filter. *Noun.* A magnetic field through which powders and slurries can be passed in order to remove magnetic impurities such as iron.

magnetic flaw detector. *Noun.* See magnetic-particle inspection.

magnetic flux. M_x . *Noun.* (1) A magnetic field. (2) The product of the area and the magnetic flux density through it; a measure of the strength of a magnetic field. Measured as Maxell or Weber.

magnetic flux density. B. *Noun.* (1) The strength of a magnetic field at a given point expressed as flux lines per unit area. The vector product of magnetic flux density and current in a conductor gives force per unit length. (2) The magnetic field produced in a material by an external magnetic field. Also called magnetic induction.

magnetic flux leakage. *Noun.* The excursion of magnetic lines of force from the surface of a specimen, particularly at discontinuities and shape changes.

magnetic flux penetration. *Noun.* The depth to which magnetic flux is generated in a specimen.

magnetic hysteresis. *Noun.* The non-correspondence in the magnetisation of a specimen when coming to the same value of magnetising force from an increasing or a decreasing direction.

magnetic induction. B. *Noun.* Another name for magnetic flux density. See magnetic flux density.

magnetic ink. *Noun.* An ink containing magnetic-ceramic particles; used for printing characters for magnetic character recognition.

magnetic lens. *Noun.* A set of magnets used to focus or defocus a beam of charged particles such as electrons in an electron microscope.

magnetic levitation. *Noun.* A superconducting ring mounted over a magnetised rail will cause a lifting force as a current is induced in the ring.

magnetic lines of force. *Noun.* Lines used to represent the magnetic induction in a magnetic field, such as are produced when iron filings are sprinkled over a non-magnetic sheet placed over a magnet.

magnetic memory. *Noun.* The storage of data on computer chips using **ferromagnetic ceramics**. They are non-volatile (see **volatile memory**) since ferromagnetic materials have **remanence**.

magnetic moment. *Noun.* Short for magnetic dipole moment. The magnetic field localised on an atom due to the **spin** and **orbital** moment of its electrons. See **magnetic dipole moment**.

magnetic-particle inspection. *Noun.* A non-destructive test procedure whereby discontinuities in ferromagnetic materials are revealed as magnetic particles sprinkled over the surface collect at the site of the defects.

magnetic permeability. μ . *Noun.* The proportionality constant between B and H fields. Vacuum has a permeability μ_0 that is equal to $1.257 \times 10^{-6} \text{ H m}^{-1}$.

magnetic pick-up. *Noun.* A form of gramophone pick-up where the stylus moves a ferromagnet core in a coil causing a change in the magnetic field that produces the current.

magnetic pulley. *Noun.* A magnetised pulley at the discharge end of a conveyor that attracts and removes magnetic impurities from a material cascading over the end of the conveyor.

magnetic purification. *Noun.* The removal of magnetic particles from a slip or slurry by means of magnets.

magnetic resonance imaging. MRI. *Noun.* A diagnostic imaging method utilising interactions between a magnetic field, radio-frequency radiation, and hydrogen atoms. Differences in the magnetic properties of tissues give rise to clear images. In ceramic manufacture it is used to examine green state ware for flaws. The system must contain nuclei with odd numbers of protons or neutrons; most suitable for water-containing systems and so can be used to monitor wall build-up in slip casting.

magnetic saturation. *Noun.* The point at which the field strength of a magnetised material will not increase by application of additional magnetising force.

magnetic separator. *Noun.* An apparatus in which fluid suspensions are passed over a series of magnets to remove magnetic substances and separate minerals and powders according to their density and magnetic properties.

magnetic shielding. *Noun.* The use of superconducting wires and sheets to create regions free from all magnetic fields or to shape magnetic fields.

magnetic susceptibility. χ_m . *Noun.* The proportionality constant between the **magnetisation**, **M**, and the **magnetic field strength**, **H**. It can be viewed as the amount by which the relative permeability of a material differs from unity; positive for a **paramagnetic** medium, negative for a **diamagnetic** material; $\chi_m = M/H$, where **M** is the **intensity of magnetisation** at any point within the body and **H** is the **magnetic flux** producing **M**.

magnetic tape. *Noun.* A long narrow plastic strip coated with **iron oxide** or other **ferroc ceramic**; used to record sound or video signals, or to store information in computers.

magnetic thickness gauge. *Noun.* An instrument used to measure the thickness of porcelain enamel in which the magnetic force needed to lift a magnet from the coating is calibrated to indicate the distance between the coating surface and the coating-metal interface.

magnetic writing. *Noun.* A non-relevant indication caused when a magnetic part comes in contact with another ferromagnet.

magnetisation. **M.** *Noun.* (1) The total **magnetic moment** per unit volume of material. (2) A measure of the degree of orientation of the electronic spins along the direction of an external magnetic field. (3) The contribution to the magnetic flux made by a material within a field, **H**.

magnetisation curve. *Noun.* A plot showing the relation between **magnetic induction**, **B**, and **magnetising force**, **H**, for a magnetic material; also known as a **B-H curve**.

magnetisation, flash. *Noun.* See **flash magnetisation**.

magnetisation, swing-field. *Noun.* See **swing-field magnetisation**.

magnetisation, yoke. *Noun.* See **yoke magnetisation**.

magnetising current. *Noun.* The flow of electric current inducing magnetism into a substance.

magnetism. *Noun.* (1) The property of attraction as exhibited by a magnet. (2) A field of force caused by a moving electric charge.

magnetism, free. *Noun.* See **free magnetism**.

magnetism, residual. *Noun.* See **residual magnetism**.

magnetite. *Noun.* Fe_3O_4 or FeFe_2O_4 . An inverse **iron oxide spinel**; a **ferromagnetic ceramic** responsible for the magnetic properties of rocks; used as a colorant in the production of pale green, **celadon greens**, and pale blues, and black glazes, and as a permanent magnet. Also known as **lodestone**. Mp $1,594^\circ\text{C}$; density $5,200 \text{ kg m}^{-3}$; hardness (Mohs) 6.

magneto-. *Combining form.* (1) Indicating magnetism or having magnetic properties. (2) *Noun.* A small electric generator in which the magnetic field is produced by a permanent magnet; often used to produce sparks.

magnetocaloric ceramic. *Noun.* A material, such as $\text{Gd}_3\text{Si}_2\text{Ge}_2$, that heat-up and cool-down when moved in and out of a magnetic field. Attempts to build a magnetic refrigerator have been based on such ceramics in conjunction with **neodymium iron boride** permanent magnets.

magnetochemistry. *Noun.* Branch of chemistry concerned with the relationship between magnetic, structural, and chemical properties.

magnetohydrodynamics. **MHD.** *Noun.* (1) The generation of electricity by subjecting a **plasma** to a magnetic field and collecting the deflected, free electrons. (2) The study of conducting fluids in magnetic fields.

magnetohydrodynamic electrodes. *Plural noun.* Conducting ceramic electrodes made from **ceria**, CeO_2 , doped **zirconia**, ZrO_2 and **tin oxide**, able to function at 1,800 °C in a **magnetohydrodynamic generator**. In such a generator an electrically charged gas is moved at high velocity through a magnetic field thereby generating a d.c. current, which is collected by these electrodes.

magnetometer. *Noun.* Sensor designed to measure magnetic field strength.

magneton. *Noun.* (1) A unit of magnetic moment equal to $eh/4\pi m$, where e and m are the charge and mass of an electron, and h is the **Planck constant**; it has a value of $9.274096 \times 10^{-24} \text{ J T}^{-1}$. Also called **Bohr magneton**. (2) A thermionic device for generating microwave power; widely used in industrial applications of **micro-wave heating**.

magnetoplumbites. *Plural noun.* See **Cubitron 321**.

magnetosome. *Noun.* Micron sized colloidal crystals of **magnetite** enveloped in a thin lipid film. Biological source of **iron oxide**.

magnetopolariton. *Noun.* A spin and mechanical mode that is a combination of magnetic excitation and lattice deformation that enables energy to be exchanged coherently in a nanomechanical resonator.

magnetoresistance. *Noun.* The change in the electrical resistance in the presence of a magnetic field. An effect used to determine the **magnetisation** of a ceramic. Multi-layered mixed valency **manganites** are an example. Some **manganese perovskites** show such a large effect that it is called colossal magnetoresistance. See **colossal magnetoresistance**.

magnetoresistance, giant. *Noun.* See **giant magnetoresistive effect**.

magnetoresistive effect. *Noun.* See **giant magnetoresistive effect**.

magnetoresistive random access memory. *Noun.* A system where magnetic tunnel junctions are used as the basis of an information storage device.

magnetostriction. *Noun.* A positive or negative reversible strain along the axis of magnetisation caused by the magnetic dipoles in the solid being rotated into alignment. Conversely, pressure applied to a magnetic ceramic changes its magnetic properties.

magnet, permanent. *Noun.* See **permanent magnet**.

magnon. *Noun.* A spin wave caused when rotational inertia prevents the spin on one iron atom, which is at an angle to the overall direction of magnetisation being brought immediately into line by the neighbouring aligned spins. Neutron or phonon scattering can only detect them.

magnon drag. *Noun.* A thermoelectric effect caused by the flow of **magnons** dragging electrons in a solid.

magnum. *Noun.* A 1.5-l glass or ceramic bottle.

mag tape. *Abbreviation.* Stands for **magnetic tape**.

main arch. *Noun.* The crown or central part of a furnace, kiln, or glass tank.

maiolica. *Noun.* A variant spelling of **majolica**. See **majolica**.

majolica. *Noun.* Earthenware of relatively high absorption and low mechanical strength, usually coated with a glossy, **tin oxide-opacified** white glaze, with coloured overglaze decoration fired at relatively low temperatures. See **Delft ware**.

majolica glaze. *Noun.* A glossy, **tin oxide-opacified** white or coloured, overglaze decoration fired at a relatively low temperature.

majority carrier. *Noun.* The type of carrier, for example, a **hole**, in a **semiconductor** that constitutes more than 50 % of the charge carrier concentration.

maker. *Noun.* The chief man in a glassblowing team or **chair**.

malachite. *Noun.* $\text{Cu}_2\text{CO}_3(\text{OH})_2$. Basic copper carbonate. A source of copper and ornamental stones. Used as a green colourant in **stoneware** and as a green dye to indicate the absorption characteristics of ceramic bodies. See **copper carbonate**.

malachite green. *Noun.* Powdered malachite used as a ceramic pigment. See **malachite**.

malayaite. *Noun.* CaSnSiO_5 . A ceramic phase with the **sphene** crystal structure into which Cr^{3+} ions can be substituted to a concentration of 0.02 mol of Cr_2O_3 per mol of malayaite in order to produce a pink colour I glazes. Sometimes called **tin sphene**.

male end of pipe. *Noun.* The end part of a pipe that is overlapped by the end of an adjacent pipe.

malfunction. *Noun.* Failure to perform in the normal or intended manner.

malleable. *Adjective.* Able to be shaped or worked by blows or pressure without breaking.

mallet. *Noun.* A hammer with a head of wood, rubber, or raw hide, used to shape metal to be used in making porcelain-enamel artware.

malms. *Noun.* An easily crumbled **limestone**; used in the manufacture of brick, and as an anti-crazing ingredient in **stoneware**.

malmsone. *Noun.* **Chert** used as a foundation material in building and paving.

manasseite. *Noun.* See **hydrotalcite**.

mandrel. *Noun.* (1) A steel shaft on which bonded abrasives are attached in the production of grinding wheels. (2) A shaft inserted through a hole in a component to serve as a support during machining. (3) A refractory tube used in the production of glass rod and tubing. (4) A core around which filament wound composite structures are formed.

manganese-alumina pink. *Noun.* A ceramic colorant consisting of a **calcined** mixture of **manganese carbonate**, **aluminium hydrate**, and **borax**.

manganese aluminate. *Noun.* MnAl_2O_4 . A partially **inverse spinel** with magneto-ceramic properties. Mp 1,560 °C; density 4,120 kg m⁻³.

manganese aluminium silicate. *Noun.* (1) $\text{Mn}_2\text{Al}_2\text{Si}_5\text{O}_{17}$. Mp 129 °C; hardness (Mohs) 5–7. (2) $\text{Mn}_3\text{Al}_2\text{Si}_3\text{O}_{10}$. Mp 1,198 °C; density 4,180 kg m⁻³; hardness (Mohs) 5–7.

manganese carbonate. *Noun.* MnCO_3 . Used as a black, brown, and purple colorant in glazes. Decomposes on heating; density 3,125 kg m⁻³.

manganese dioxide. *Noun.* MnO_2 . A **polymorphic** oxide converted to Mn_2O_3 at 535 °C; used in glass as both a colorant and decolouriser depending on the furnace atmosphere, as a **mineraliser** in **white-ware** bodies, as a **die lubricant** and surface colour adjuster in hand-made tile manufacture, and electrical porcelain, as a black, brown, and purple colorant in glazes, and as an oxidising agent, colour and **adherence-promoting agent** in porcelain-enamelling. As the γ -polymorph it is a promising cathode material for high-energy-density lithium batteries. Density 5,000 kg m⁻³.

manganese ferrate. *Noun.* MnFe_2O_4 . Disordered **spinel** with electrical and magnetic uses. Mp 1,571 °C; density 4,750 kg m⁻³.

manganese fluoride. *Noun.* MnF_2 . Large crystals can be made easily with the **fluorite structure** in which Ni^{2+} ions can be substituted to make a laser with a wavelength of 1.93 μm .

manganese pyrophosphate. *Noun.* $\text{Mn}_2\text{P}_2\text{O}_7$. Used as a binder phase in **castables**. Mp 1,196 °C; density 3,700 kg m⁻³.

manganese silicate. *Noun.* (1) MnSiO_3 . Mp 1,323 °C; density 3,700 kg m⁻³. (2) Mn_2SiO_4 . A discrete ion silicate; mp 1,340 °C; density 4,050 kg m⁻³.

manganese titanate. *Noun.* (1) MnTiO_3 . A **perovskite** with magnetic properties; mp 1,359 °C; density 4,540 kg m⁻³. (2) TiMn_2O_4 . A **spinel** with varying degrees of **disorder**; a **ferromagnetic ceramic** with a **Curie temperature** of 77 K. Mp 1,454 °C; density 4,540 kg m⁻³.

manganese vanadate. *Noun.* Mn_2VO_4 . A **ferromagnetic spinel** phase with a **Curie temperature** of 62 K.

manganic. *Adjective.* Of or containing manganese in the trivalent state.

manganic oxide. *Noun.* Mn_2O_3 . A dark brown oxide that loses oxygen at 1,080 °C. Density 4,320–4,820 kg m⁻³

manganite. *Noun.* $\text{MnO}(\text{OH})$. A brown or black, monoclinic ore consisting of basic manganese oxide. Sometimes called bog manganese. A source of **manganese dioxide** and manganese metal. Density 4,200–4,400 kg m⁻³; hardness (Mohs) 4.

manganites. *Plural noun.* (1) AMnO_3 . **Perovskite** phases in which, when A is a mixture of lanthanum and Ca, Sr, and Ba, the material exhibits **giant magnetoresistance**. (2) $\text{Mn}_{3-x}\text{T}_x\text{O}_4$. Ceramics where T is a transition metal and x is in the range 0–1. They are used as negative temperature coefficient **thermistors**.

manganosite. *Noun.* MnO . A cubic **rock-salt** structure oxide; often widely **nonstoichiometric**.

manganous. *Adjective.* Of or containing divalent manganese.

manganous-manganic oxide. *Noun.* Mn_3O_4 . A **spinel** phase often expressed as MnMn_2O_4 . Used for its semiconductor properties; occurs naturally as the mineral **hausmannite**. Mp 1,565 °C; density 4,820 kg m⁻³; hardness (Mohs) 5–5.5.

manganous oxide. *Noun.* MnO . Used in glass compositions, in **ferromagnetic materials** and computer memory cores. Mp 1,650 °C; density 5,090–5,180 kg m⁻³.

mangle. *Noun.* (1) A vertical-type drier in which ware is dried in the moulds in which it was formed. (2) A machine with two or more rollers running in contact to form a nip. Used to express liquid from solids, such as clays and gels that are passed through it.

manhole. *Noun.* A concrete structure serving as an access to underground areas.

manhole base. *Noun.* Concrete slab foundation of the bottom manhole riser section with or without an integrally cast concrete floor over which a **manhole** is constructed.

manhole reducer. *Noun.* A concrete pipe serving as the transition joint between **manhole risers** of different diameter.

manhole riser. *Noun.* The section of concrete pipe used in the construction of a **manhole**, but excluding the base, reducers, and top sections.

manhole top. *Noun.* The concrete slab or conical top employed to reduce the diameter of the **manhole riser** to that of the desired access hole.

manifold. *Noun.* An arrangement in which a pipe or tube with at least one inlet provides two or more outlets to other pipes, such as in the delivery of fuel from a single line to several burners in a furnace or kiln.

man-made mineral fibres. MMMF. *Plural noun.* Ceramic compositions formed by a number of processes into substitutes for natural asbestos fibres; the bulk of such production is glassy forms of **carbon**, **silicon carbide**, **boron nitride**, **calcium sulphate**, **alumina**, and glass itself.

man-made vitreous fibres. MMVF. *Plural noun.* A name from a classification scheme introduced to help distinguish between commercial products. It is the class made-up of: amorphous fibrous insulation materials, **fibreglass**, **mineral wools** and refractory ceramic fibres.

manometer. *Noun.* An instrument to measure the difference between two fluid pressures.

mantel. *Noun.* A horizontal structure over a space in a blast furnace to carry the weight of the refractories and the casing of the exhaust stack.

manufactured alumina. *Noun.* Alumina, and mixtures containing alumina, subjected to thermal treatments sufficient to produce crystalline products for use as abrasives.

manufactured carbon. *Noun.* A family of materials that are essentially a bonded granular form of carbon subjected to temperatures between 900 and 2,400 °C. Each member varies in such characteristics as pore density, pore size, degree of crystallisation, and grain orientation. The material treated at the higher temperatures is more graphite-like and is called **manufactured graphite**.

manufactured graphite. *Noun.* See **manufactured carbon**.

map, cracking. *Noun.* See **pattern cracking**.

mar. *Verb.* To mutilate a surface.

marble. *Noun.* (1) A hard crystalline **metamorphic rock** of large grain size grown from **limestone** or **dolomite**, which may be easily cut and polished. Used for buildings and sculpture and marble dust is used as a source of **calcium oxide**, CaO, in glazes. There are a variety of specially named marbles depending on the colour and the types of inclusions, for example the black and gold variety called **Ligurian marble** named

from the Italian region it comes from. (2) A small round glass or stone ball used in playing the game of marbles. (3) A glass sphere used to load heated bushings from which **CF glass fibres** are pulled. One marble weighing 13.3 g will produce 234 km of single-filament fibre.

marble, saccharoidal. *Noun.* See **saccharoidal marble**.

marbled ware. *Noun.* A surface finish on ceramic and porcelain-enamel ware produced by the irregular blending of **slips** of different colours, resulting in the appearance of variegated marble.

marbling. *Noun.* A pattern or mottled effect resembling **marble**.

marcasite. *Noun.* FeS₂. An polymorph of iron sulphide commonly formed in a **cockscomb habit** of orthorhombic crystals with a metallic lustre; pale bronze colour. Used in jewellery. Density 4,880 kg m⁻³; hardness (Mohs) 6–6.5.

margaric. *Adjective.* Resembling **pearl**.

margarite. *Noun.* (1) CaAl₂(Al₂Si₂O₁₀)(OH)₂. A pink and pearly **micaceous** mineral. It is a brittle **divalent mica** mineral. (2) An aggregate of microscopic bead-like masses occurring in glassy **igneous rocks**.

margaritic. *Adjective.* Resembling **pearl**.

marl. *Noun.* A fine-grain sedimentary rock made-up of **clay minerals**, calcium carbonate as **aragonite** or **calcite**, and **silt**. Used as a fertiliser as well as a ceramic raw material.

marl clay. *Noun.* Crumbly clay containing magnesium and calcium; used in the production of building bricks, and as an anti-crazing ingredient in **stoneware**.

marlite. *Noun.* A type of **marl** containing **clay** and **limestone** that is resistant to decomposition in the atmosphere. Also called **marlstone**.

marlstone. *Noun.* See **marlite**.

marmoreal. *Adjective.* Of, related to, or resembling **marble**.

mar resistance. *Noun.* Another measure of abrasive resistance where a surface is abraided and then the gloss of the abraided areas are compared with unabraided areas using a **glossmeter**.

Mars pigments. *Plural noun.* A series of pigments (yellow, orange, brown, red, and violet) made by calcining precipitates from solutions of calcium hydroxide and ferrous sulphate at different temperatures.

Martens hardness. *Noun.* The slope of the square root of applied force to **indentation depth** in an **indentation hardness test** that monitors indentation depth as the applied force increases.

martensite. *Noun.* If the iron-carbon solid-solution phase **austenite** is quenched rapidly it cannot transform by

carbon diffusion to **ferrite** or ferrite-cementite eutectic, but does transform by a diffusionless mechanism to a distorted tetragonal structure, which is **martensite**.

Marteu's heat deflection temperature. *Noun.* The temperature at which a bar of rigid material is deflected by a specified amount in a four-point bend test.

Martin's cement. *Trade name, noun.* A quick-setting **gypsum cement** in which **potassium carbonate** is used instead of **alum**.

marver. *Noun.* A flat plate of metal or stone on which hand gathered glass is rolled, shaped, and cooled.

maser. *Acronym.* Stands for microwave amplification by stimulated emission of radiation; a device for amplifying microwaves dependent on the same principles as the **laser**.

maser, optical. *Noun.* See **optical maser**.

masing. *Noun.* The technique of amplifying microwaves using crystals, such as **ruby**. It needs extreme conditions, such as temperatures near **absolute zero**, ultra-high vacuum and powerful magnetic fields.

mask. *Noun.* A protective covering placed over portions of a surface to prevent subsequent treatments of coatings from affecting those areas. Particularly used now in preparing microcircuits on **ceramic chips**.

masking power. *Noun.* The ability of a coating, such as a glaze or porcelain-enamel, to obscure the surface to which it is applied.

MASNMR. *Abbreviation.* Stands for magic angle spinning nuclear magnetic resonance spectroscopy. See **magic angle spinning NMR**.

mason. *Noun.* A worker engaged in the building of stone structures.

mason jar. *Noun.* An airtight glass jar for preserving food.

masonry. *Noun.* A construction of brick, tile, concrete, and stone, used separately or in various combinations: usually bonded with mortar.

masonry cement. *Noun.* A hydraulic cement composed of a mixture of natural or **Portland cement**, **hydrated lime**, and **sand** for use in mortars for masonry construction.

masonry, prefabricated. *Noun.* See **prefabricated masonry**.

masonry, reinforced. *Noun.* See **reinforced masonry**.

masonry unit. *Noun.* Natural or manufactured building units of fired clay, stone, glass, gypsum, or concrete.

masonry unit, modular. *Noun.* See **modular masonry unit**.

mass, kg. *Noun.* The amount of material present in a system.

mass action law. *Noun.* A statement to the effect that in a system at constant temperature the rate of a chemical reaction is proportional to the concentration of the reactants.

mass balance. *Noun.* (1) A comparison of the masses of reactants used and the products obtained in a chemical process. (2) A structural counterpoise.

mass concrete. *Noun.* Concrete placed in large masses, such as in dams or large footings, frequently containing **pozzolans** and **large aggregate**, and set without structural reinforcement.

mass, critical. *Noun.* See **critical mass**.

mass defect. *Noun.* See **binding energy of nuclei**.

mass driver. *Noun.* A track surrounded by a series of electromagnetic rings used to accelerate magnetic materials.

massicot. *Noun.* (1) A yellow earthy mineral containing lead monoxide. Occasionally used as a ceramic colour. (2) The form of lead monoxide, PbO, prepared below the fusion temperature.

massive talc. *Noun.* See **soapstone**.

mass number. *Noun.* The total number of neutrons and protons in an atomic nucleus.

mass resistivity. *Noun.* See **resistivity**.

mass spectrometer. *Noun.* A sensitive method of analysis in which the vapour species above a solid are ionised and passed through a magnetic field to separate them by their momentum and mass/charge ratio.

mass stress. *Noun.* The force per unit mass per unit length in fibre loading. for example, grams per **denier**.

masstone. *Noun.* The colour of a ceramic glaze that is obtained by adding the pigment to the **glaze frit** with no **opacifier** in the formulation.

mass transfer zone. *Noun.* The region in which the concentration of **adsorbate** in a fluid decreases from influent concentration to the lowest detectable concentration.

master cylinder. *Noun.* A large cylinder in a hydraulic system in which the working fluid is compressed by a piston.

master mould. *Noun.* A **plaster mould** cast around a model, in which a **case mould** or replica of the model may be cast.

mastic. *Noun.* A paste-like material used as an adhesive in the setting of tile or similar product.

mat, matt, or matte. *Noun.* (1) A felt-like product made from glass fibres. (2) A concrete footing under a post. (3) Mesh reinforcement in a concrete slab. (4) A surface texture of **low gloss**. (5) *Adjective.* Having a dull, lustreless or roughened surface. (6) *Verb.* To give a surface a dull finish.

mat, chemically bound. *Noun.* See **chemically bound mat**.

matching. *Verb.* To adjust the amount of each colouring additive present in a batch to make the final colour as close to a given sample as possible.

matchmark. *Noun.* A mark made on mating components to ensure that they are assembled in the correct relative positions.

material. *Noun.* The substance of which a thing is composed or made; component or constituent matter.

material balance. *Noun.* The comparison of input and output of material quantities for a particular process. Generally, the comparison of inventory plus receipts at the beginning of a process with the inventory plus shipments at the end of the process.

material balance area. *Noun.* An area within a factory where material records are maintained in a manner that a balance may be taken from records to show the amount of material for which the area is responsible.

material, conducting. *Noun.* See **conducting material**.

material, diamagnetic. *Noun.* See **diamagnetic material**.

material, ferromagnetic. *Noun.* See **ferromagnetic material**.

material, insulating. *Noun.* See **insulating material**.

material, nonferromagnetic. *Noun.* See **nonferromagnetic material**.

material, paramagnetic. *Noun.* See **paramagnetic material**.

material test. *Noun.* Any test designed to measure or evaluate the chemical, physical, or mechanical properties of a substance or product.

material transfer, arc. *Noun.* See **arc material transfer**.

mat reinforcement. *Noun.* Tension-zone circumferential reinforcement secured to a cage in a concrete-pipe wall

matrix phase. *Noun.* (1) The solid matter in which **aggregates** or crystal phases are embedded or bonded. (2) The bonding protective material part of a fibre composite.

matt. *Adjective, noun or verb.* See **mat**.

matte. (1) *Noun.* A liquid with a high freezing temperature consisting mainly of molten sulphides. (2) The product of **calcine** in copper production when heated to 1,200 °C with flux. (3) *Adjective, noun, or verb.* See **mat**.

matte enamel. *Noun.* A porcelain-enamel, which after firing, has no gloss.

matte glaze. *Noun.* A fired glaze having little or no gloss, differs from gloss transparent glaze in the large quantity of small crystals distributed throughout the

glaze as well as on its surface. Typical crystals are **wollastonite**, **diopside**, and **willemite**. Typical glaze composition in molecular presentation is: 0.545 Na₂O, 0.044 K₂O, 0.335 CaO, 0.076 ZnO, 0.307 Al₂O₃, 0.006 Fe₂O₃, 5.420 SiO₂, 0.893 B₂O₃, and 0.408 ZrO₂.

matte, lime. *Noun.* See **lime matte**.

matte porcelain-enamel. *Noun.* A fired porcelain-enamel with little or no gloss.

matter waves. *Noun.* See **de Broglie waves**.

Matthiessen's rule. *Noun.* Vacancies quenched into both sub-lattices of a binary compound contribute to the **resistivity** in equal proportions at all temperatures.

maturation. *Noun.* The extent of reaction of the clay decomposition reaction and transformation in traditional ceramic ware after the firing cycle.

maturing. *Noun.* The final stages of processing during which ceramic bodies and coatings develop desired chemical, physical and mechanical properties.

maturing range. *Noun.* The combination of time and temperature required to develop desired chemical and physical properties in a ceramic body, coating, or related material.

maturing temperature. *Noun.* The temperature at which ceramic bodies and coatings develop desired chemical and physical properties over a reasonable time interval.

mat, vacuum. *Noun.* See **vacuum mat**.

mauve spinel. *Noun.* A naturally occurring **spinel** that has large crystals that can be cut and used as jewellery.

mauve-grey tourmaline. *Noun.* A gem quality form of the mineral **tourmaline** that occurs as large crystals in some **pegmatites**.

maximum size. *Noun.* The smallest sieve opening through which the entire amount of a material, such as aggregate, is permitted to pass.

maximum thermometer. *Noun.* A thermometer that gives a permanent indication of the maximum temperature attained during a period of time and has to be reset for subsequent tests.

maxwell, M_x. *Noun.* The **cgs unit** of **magnetic flux** equal to the flux through 1 cm² normal to a field of 1 G. Equivalent to 10⁻⁶ **weber**.

Maxwell's relationships. *Plural noun.* Relationships between several of the thermodynamic state parameters that are used to develop mathematical equations used in thermodynamics. Their extreme usefulness is that they equate immeasurable quantities, to measurable quantities, for example the rate of change of **entropy** with volume at constant temperature to the rate of change of pressure with temperature at constant volume: $(\partial S/\partial V)_T = (\partial P/\partial T)_V$.

mayenite. *Noun.* $\text{Ca}_{12}\text{Al}_{14}\text{O}_{33}$. A phase developed in **calcium aluminate cement**, which in **cement notation** is C_{12}A_7 .

mazarine blue. *Noun.* A rich, dark-blue ceramic colour containing approximately 50 % **cobalt oxide**; used as under- or over-glaze colorant.

MBE. *Abbreviation.* Standing for molecular beam epitaxy. See **molecular beam epitaxy**.

MBI. *Abbreviation.* Standing for the methylene blue index. See **methylene blue index**.

MBP. *Abbreviation.* Stands for morphotropic phase boundary. See **morphotropic phase boundary region**.

MCF. *Abbreviation.* Standing for metal coated fibre

MCFC. *Abbreviation.* Stands for molten carbonate fuel cell. See **fuel cell**.

MCP. *Abbreviation.* Stands for microchannel plate. See **microchannel plate**.

MCT. *Abbreviation.* Stands for mercury cadmium telluride. See **mercury cadmium telluride**.

MDF cement. *Noun.* See **macrodefect free cement**.

mean free path. *Noun.* The average distance travelled by a particle between collisions.

mean life. *Noun.* In radioactivity it is the average lifetime of a particular nuclei; the half-life divided by 0.693.

mean stress. $\bar{\sigma}$. *Noun.* The simple mean of the maximum and minimum stress in one cycle of a dynamic loading **fatigue test**.

mean surface distance. h. *Noun.* An important parameter in the prediction of aggregation behaviour of sub-micron and nanoparticles suspensions. It is related to particles through: $h = d_p (1/3\pi F + 5/6)^{1/2} - 1$, where d_p is the particle diameter and F is the volume fraction. This predicts difficulties with aggregation of nanoparticles at much smaller volume fractions than sub-micron powders.

mechanical analysis. *Noun.* Mechanical separation of particles, such as aggregate, on a nest of sieves of graded sizes to determine particle-size distribution in the parent material.

mechanical anharmonicity. *Noun.* The effect a non-parabolic restoring potential has on an oscillator when the restoring force is not proportional to the displacement.

mechanical boy. *Noun.* A mechanism to manipulate the mould in the hand-forming of glass.

mechanical damping. *Noun.* Mechanical resistance to the movement of solids in a structure.

mechanical dissipation factor. *Noun.* The **loss modulus** divided by **Young's modulus** of elasticity.

mechanical equation of state. *Plural noun.* Various relationships between stress, strain, strain rate, and temperature, where one variable is expressed as a linear equation of the others.

mechanical hysteresis. *Noun.* A situation where an elastic unloading stress-strain curve does not follow the loading curve. The area contained by the two curves is equal to the heat generated by the system.

mechanical impedance. Z_m . *Noun.* the ratio of the mechanical force along the direction of motion to the velocity of the resulting vibration.

mechanical integrity factor. MIF. *Noun.* The mechanical strength of square-cell, **cellular-ceramic catalyst** support systems: $\text{MIF} = t^2/L(L-t)$, where t is the cell wall thickness and L is the cell repeat length. MIF times the ceramic material strength gives the **cellular structure strength**.

mechanical interlock. *Noun.* (1) Failure of electrical contacts to separate due to surface asperities formed by oxidation. (2) The joining of two components by means of hooks, dowels, keys, dovetails, etc.

mechanical press. *Noun.* A press in which ware is formed in a **die** under a mechanically applied pressure.

mechanical properties. *Plural noun.* Properties of materials associated with elastic and inelastic reactions in response to an applied force; they are related via relationships involving **stress** and **strain**.

mechanical separation. *Verb.* To separate materials into fractional components by settling, filtration, or centrifugal action.

mechanical shovel. *Noun.* A machine controlling a large scoop that can be manipulated to transfer solid materials into containers or trucks.

mechanical slip. *Adjective.* A fine surface layer produced by smoothing a wet clay surface.

mechanical spalling. *Noun.* Breaking away of chip-like pieces of a ceramic or glass under the influence of impact or pressure.

mechanical water. *Noun.* Uncombined water, usually added to a body or slip to produce plasticity or workability, and which is removed by evaporation during drying or the early stages of firing; calculated as the difference in weight of a sample of the plastic body and its weight after drying to constant weight at 110 °C; may be reported as a percentage of the plastic or the dry weight of the sample, the latter being preferred. Also called **free water**, or **uncombined water**.

mechanical wear. *Noun.* Removal of surface material due to mechanical action such as **abrasion**.

media. *Plural noun.* The **aggregate** used in **ball mills**.

median vent. *Noun.* The crack initiated below the contact point of a **Vickers pyramid indenter** when a critical load is exceeded. On removal of the indenter this crack extends, driven by the **residual stress**, to become part of the surface cracks known as **lateral vents** and from which **fracture toughness** parameters can be calculated.

medina quartzite. *Noun.* A variety of quartz containing 97.8 % **silica**; mp 1,900 °C.

medium. *Noun.* A surrounding substance in which bodies exist and move, and through which a force acts, or an effect is produced: for example, water is the medium in which glazes and porcelain-enamel frits are milled.

medium-duty fireclay brick. *Noun.* A refractory **fireclay** brick with a **PCE** value of at least 29 and no greater than 31.5.

meerschaum. *Noun.* $\text{Mg}_2\text{Si}_3\text{O}_6(\text{OH})_4$. (1) Also called sepiolite. A white to yellow or pink coloured mineral that is easily carved. (2) A tobacco pipe having a bowl carved from this mineral. See **sepiolite**.

megalith. *Noun.* A stone of great size.

Meissen. *Noun.* The first **hard-paste** porcelain to be made in Europe in 1710, following the discovery by Böttger in Saxony.

Meissner effect. *Noun.* The expulsion of magnetic flux from a **superconductor**. If a superconductor is taken toward a magnetic field it sets up screening currents on its surface, which create an equal but opposite magnetic field to cancel the original field, and allow none into its interior. The reverse process causes a superconductor to lift above a magnetic field when it is cooled down to its critical temperature. If the magnetic field becomes too great the Meissner effect is overcome, magnetic field penetration occurs, and the material loses its superconductivity.

melamine formaldehyde. *Noun.* An amino resin made from formaldehyde and melamine; used as a **matrix** for some glass-fibre composites and as a bonding agent for glass fibre insulation.

melanite. *Noun.* A form of **andradite garnet**.

melanterite. *Noun.* A natural ore containing **ferrous sulphate**, $\text{FeSO}_4 \cdot \text{H}_2\text{O}$.

melilites. *Plural noun.* Silicates that contain discrete $[\text{Si}_2\text{O}_7]^{6-}$ ions, such as **akermanite**, $\text{Ca}_2\text{Mg}(\text{Si}_2\text{O}_7)$.

melt. *Noun.* (1) A change of state from solid to liquid effected by raising the temperature of the solid. (2) A molten substance. (3) A specific quantity of glass melted at one time.

melt blowing. *Noun.* A ceramic fibre manufacturing method in which a melt is extruded through a **die** into a high velocity stream of hot gas. Short fibres are formed and collected as a sheet on a moving screen.

melter. *Noun.* (1) The chamber of a **glass tank** in which a glass batch is melted. (2) A person supervising a glass tank during the filling and melting operation.

melt fracture. *Noun.* An irregularity in a **melt spinning** process that leads to the extrudate surface becoming rough.

melting. *Noun.* Fusion; the thermal process of converting a solid to a liquid.

melting, boost. *Noun.* See **boost melting**.

melting, congruent. *Noun.* See **congruent melting**.

melting end. *Noun.* The main chamber of a **tank furnace** into which the batch is charged and melted.

melting furnace. *Noun.* Any of the several types of furnace in which raw batches of glass and porcelain-enamel are melted.

melting, incongruent. *Noun.* See **incongruent melting**.

melting point. *Noun.* The temperature at which crystalline and liquid phases of the same composition coexist in equilibrium.

melting point, glass. *Noun.* The temperature at which point the viscosity of a glass is 10 Ns m^{-2} or 100 **poise**.

melting pot. *Noun.* A pot in which materials are melted and mixed.

melting temperature. *Noun.* The temperature range at which heterogeneous mixtures, such as a glass batch, glazes, and porcelain-enamels, become molten or softened.

melting zone. *Noun.* The section of a glass tank or smelter in which batches of glass or glass-forming mixtures melt.

melt phase epitaxy. *Noun.* A surface layer growth technique in which a substrate of higher melting point and with a small lattice mismatch is chosen for device manufacture. A fine powder of the device material is sprinkled on the surface and the temperature is raised until it just melts; slow cooling then produces the epitaxial layer. LiNbO_3 layers about $6 \mu\text{m}$ thick on top of LiTaO_3 are made this way.

melt spinning. *Noun.* The process in which a melt, such as molten glass, is extruded through a **spinneret** and cooled into fibres.

melt spun. *Adjective.* Describing fibres and filaments made by **melt spinning**.

membrane. *Noun.* Any thin pliable sheet of material.

membrane curing. *Verb.* To cure concrete by spraying a liquid, such as a bituminous compound onto the surface to form a solid impervious layer which seals it and prevents moisture loss during the curing process.

membrane waterproofing. *Verb.* To lay alternate layers of **bitumen** and felt or fabric and concrete to produce a waterproof foundation or roof.

memory resistor. *Noun.* Thin film **titania** that can increase its resistance as current flows through it in one direction but falls when the current flows in the opposite direction. When the current is switched off it maintains the value of its resistance at that point. Often abbreviated to **memristor**.

memristor. *Abbreviation.* Stands for memory resistor. See **memory resistor**.

menhaden fish oil. *Noun.* A natural-product dispersant; used in the ceramics industry, after it has been conditioned by blowing air at 90 °C through it; used to disperse aggregated Al_2O_3 and **ferrite powders** in aqueous and organic suspensions. Reactive toward basic particles.

MEMS. *Acronym.* Stands for microelectro-mechanical devices. See **microelectro-mechanical devices**.

menige. *Noun.* Alternative name for red lead. See **red lead**.

menilite. *Noun.* Another name for **liver opal**.

meniscus. *Noun.* (1) The curvature observed where a still liquid makes contact with the walls of a container. (2) A bulblike mass of glass at the origin of the drawn sheet produced in the **Fourcault process**.

mensuration. *Noun.* (1) Measurement. (2) Geometry applied to calculation of lengths, areas, or volumes from dimensions and angles.

merch brick. *Noun.* Discoloured, off-size or distorted **building brick**.

mercuric. *Adjective.* Containing mercury in the divalent state.

mercuric chloride. *Noun.* HgCl_2 . A soluble white crystalline substance used as a pesticide and preservative. Also called **corrosive sublimate**.

mercuric oxide. *Noun.* HgO . A red or yellow pigment.

mercuric sulphide. *Noun.* Two polymorphs, a red one, **cinnabar** or **vermillion**, and a black one, **metacinnabarite**, both used as pigments.

mercurous. *Adjective.* Containing mercury in the monovalent state in the form of Hg_2^{2+}

mercurous chromate. *Noun.* Hg_2CrO_4 . A green pigment for ceramic decorations.

mercury antimonate. *Noun.* $\text{Hg}_2\text{Sb}_2\text{O}_7$. See **red mercury**.

mercury barometer. *Noun.* A pressure-measuring instrument in which variations in atmospheric pressure are measured in the rise and fall of a column of mercury contained in a partially evacuated glass tube sealed at

the top, the open end resting in a reservoir of mercury exposed to the atmosphere.

mercury cadmium telluride. MCT. *Noun.* A small band gap semiconductor material commonly used in photodetectors.

mercury porosity. *Noun.* The volume fraction of connected pores in a material as determined by injecting mercury metal at high pressure into the solid sample.

merthiolate. *Noun.* A powerful germicide and fungicide; used to prevent fermentation in porcelain-enamel, glaze, and other slips.

merwinite. *Noun.* $\text{Ca}_3\text{Mg}(\text{SiO}_4)_2$. A discrete ionic silicate.

mesa. *Noun.* A raised area with very sharp sides and a flat top: the description given to masked areas of a ceramic microchip when surrounding areas have been etched away.

mesh. *Noun.* (1) The open spaces in a screen or sieve. (2) A woven or expanded metal or ceramic fibre construction resembling an open basket weave.

mesh mark. *Noun.* A fault in screen printed designs caused when the ink does not have good flow properties and it leaves a fine crosshatch of the screen fabric on drying.

mesh number. *Noun.* (1) A code number indicating the number of openings in a screen per linear inch or centimetre, e.g., mesh number 10 has apertures 1.68 mm. (2) The designated size of particles passed through a screen, the number being derived from the number of openings in the screen per linear inch. Also called **mesh size**.

mesh size. *Noun.* See **mesh number**.

mesic. *Adjective.* (1) Containing or needing a moderate amount of moisture. (2) Of a meson.

mesogen. *Noun.* A liquid crystal unit.

mesomorphic. *Adjective.* Existing in or concerned with an intermediate state of matter between a true liquid and a true solid.

mesophase. *Noun.* An intermediate hybrid material describing a transfer between two phases, e.g., graphite-mesophase-pitch. Can act as crack arrester to improve toughness.

mesoporous structures. *Plural noun.* Materials with regularly arranged pores, 2–50 nm wide; used in catalysis, separation and sensing.

mesoscopic. *Adjective.* A description of **capacitors** and **field effect transistors** that are not small (microscopic), consisting of a few atoms nor large (macroscopic).

mesoscopic time scale. *Noun.* An intermediate time scale between atomic vibrational and the macroscopic scale with values between 10^{-13} and 10^{-10} s. Phase transitions, diffusion processes and collective phenomena in nanomaterials occur in this time scale.

metaborate. *Noun.* See **borates**.

metachromatism. *Adjective.* A change in colour caused by a change in temperature.

metacinnabarite. *Noun.* HgS. Black **mercuric sulphide**.

metal. *Noun.* (1) The contents of a glass melting unit. (2) Any of a number of chemical elements such as copper, iron, titanium, etc., which are ductile and have a metallic lustre as well as being good conductors of electricity.

metal base. *Noun.* A metal product to which a coating, such as porcelain-enamel, is applied.

metal blister. *Noun.* A blister-like bloating occurring in sheet metal; a source of defects in porcelain-enamelling.

metal-ceramic. *Noun.* See **cermet**.

metal drift tube. *Noun.* A cylindrical metal tube to which a voltage may be applied so that ions entering the tube are accelerated to change their drift velocity.

metalkase brick. *Noun.* Basic brick contained in thin steel casing or box-like enclosures as protection against hostile environments, particularly corrosive atmospheres at high temperatures, as in flues.

metallic bond. *Noun.* A chemical bond type arising from the increased spatial extension of the valence **electron wave functions** when an aggregate of atoms are brought close together.

metallic colour. *Noun.* A suspension of metallic powders, such as gold, silver, and platinum, in an oil; used to produce metallic decorations when fired onto ceramic ware.

metallic lens. *Noun.* An arrangement of louvres placed to direct and focus sound or electromagnetic waves.

metallic mortar. *Noun.* A ceramic mortar containing substantial amounts of lead powder; used to form plasters, casting sections, and blocks for x-ray and nuclear shielding.

metallic soap. *Plural noun.* Any one of a number of colloidal stearates, palmitates, and oleates, of aluminium, calcium, magnesium, iron, and zinc, used as pressing aids, fungicides, drying agents, waterproofing agents, lubricants, and binders.

metalliferous. *Adjective.* Containing a high concentration of metallic elements.

metal-line. *Noun.* (1) The upper surface of metal or glass in a **melting tank** or **pot**. (2) The line of contact between the upper surface of molten glass and the refractory of a melting tank or pot. (3) A line of maximum corrosion of the refractory by the glass.

metallisation. *Noun.* (1) The process of turning an oxide ore into the metal by chemical reduction. (2) See **metallising**.

metallised ceramic. *Noun.* A ceramic to which a thin metallic coating has been deposited to facilitate making ceramic-to-metal seals.

metallising. *Verb.* To coat or impregnate the surface of glass or ceramic with a metal. Often involves vapour deposition. Also called **metallisation**.

metalloid. *Noun.* Resembling a metal; a non-metallic element, such as silicon, that has some of the properties of a metal.

metallurgical coal-base refractory. *Noun.* A commercial refractory made of metallurgical coke.

metallurgy, powder. *Noun.* See **powder metallurgy**.

metal marking. *Noun.* A line of discoloration formed when a metallic object, such as a knife, is drawn across the surface of a ceramic body, glaze, or porcelain-enamel. **Zircon** opacified ware and **matte glazes** tend to mark the worst.

metal-matrix composite. *Noun.* A composite in which the **matrix** phase is a metal or alloy and the reinforcement is usually ceramic particles, **whiskers** or fibres.

metal nanocluster composite glass. MNCG. *Noun.* A material formed by ion implantation of metal atoms into a glass substrate. The nano-sized metal clusters occur as colloidal particles in a thin surface layer. The glass exhibits an enhanced, intensity dependent, refractive index due to the **Kerr effect**.

metal organic chemical vapour deposition. MOCVD. *Noun.* The evaporation of organo-metallic complexes on to hot substrates to build-up crystalline phases or dope semiconductors. a gas-phase technique for growing ultrathin layers from vaporised organo-metallic compounds, e.g., mixtures of Y, Ba, and Cu- β -diketonates will produce $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ superconducting ceramic films in the presence of oxygen.

metal organic vapour phase epitaxy. MOVPE. *Noun.* A process, like **MOCVD** that uses organo-metallic complexes, where a substrate crystal is used to orientate a growing semiconductor layer so that it adopts the same crystal structure as the substrate.

metal oxide resistor. *Noun.* A resistor consisting of a layer of ceramic oxide deposited onto a ceramic substrate.

metal oxide semiconductor. *Noun.* (1) A metal-insulator-semiconductor system in which the insulating layer is the oxide of the metal substrate. (2) Material, such as NiO of intermediate resistance value, whose resistance decreases as the temperature is increased.

metal oxide semiconductor field effect transistor. MOSFET. *Noun.* A device containing three terminals: **gate**, **source** and **drain**. It has several operational modes depending on which of these terminals are used for signal input and output. The three basic transistor

amplifier arrangements are defined by which terminal remains as common-source, common-gain and common-drain. They are also defined by whether their current carriers are electrons (**n-type**) or holes (**p-type**), which is determined by the **dopant** used in the semiconductor. Critical building blocks in **integrated circuits**.

metal oxide surge arrestor. MOSA. *Noun.* Another designation of varistor; ZnO is an example. See **varistor**.

metal oxide varistor. *Noun.* See **varistor**.

metal tender. *Noun.* A workman supervising the temperature and melting operations of a **glass tank**.

metal transfer. *Noun.* The transfer of material from one electrical contact to another in a mating situation.

metamaterials. *Plural noun.* Artificial materials in which sub-wavelength features in the nanoscale micro-structure control their response to electromagnetic waves. They are composites used in electromagnetic applications. For example AlInAs/InGaAs-doped materials have a 100 layer structure about 80 nm thick and will bend light backwards to simulate a negative **refractive index** material, a feature not found in natural materials. The concept involves the idea that their overall wave qualities rely not only on their composition but also on the pattern, shape and size of irregularities, known as **inclusions** or **meta-molecules**, which are embedded in the host material. Recently found that mechanical stretching is a simple way of tuning their response to light and so change their **photovoltaic** properties.

metameric. *Adjective.* Objects that exhibit **metamerism**.

metameric colour. *Noun.* A colour that will appear the same under one condition of lighting, but will assume a different colour in different lighting.

metamerism. *Noun.* The occurrence whereby the colour difference between two similarly coloured objects changes as the spectral characteristics of the illuminants changes.

metamict. *Adjective.* The **amorphous** state of a substance caused by losing its crystallinity as a result of radioactive bombardment from uranium or plutonium that is contained in the crystal. **Loparite** is an example.

metamict minerals. *Plural noun.* Some minerals appearing non-crystalline. See **metamict**.

meta-molecule. *Noun.* See **metamaterials**.

metamorphic. *Adjective.* Altered considerably from the original structure and composition by pressure and heat.

metamorphosis. *Noun.* Chemical and mineralogical change of rocks by pressure, heat and water into more crystalline compact forms of rock.

metaphosphoric acid. *Noun.* HPO_3 . A glassy, deliquescent, polymeric solid used as a dehydrating agent.

metasilicate. *Noun.* A silicate containing $[\text{SiO}_3]^{2-}$ ions or ionic $[\text{SiO}_3]_n^{2n-}$ chains. Also called **bisilicate**.

metasomatosi. *Noun.* Change in the composition of a rock or mineral by the replacement or addition of chemicals.

metastable. *Adjective.* Having a state of apparent equilibrium but capable of changing to a more stable state. A nonequilibrium state that may persist for a long time. (2) An atom or ion existing in an excited state for a relatively long time.

metastable phases. *Plural noun.* Phases formed under non-equilibrium conditions and which do not appear on a **phase diagram**, they tend to decompose at temperatures where diffusion is appreciable

metastable state. *Noun.* An excited state of an atom capable of existing for as long as a few seconds.

metatitanates. *Plural noun.* Ceramics with the general composition MTiO_3 .

metatungstic acid. *Noun.* See **tungstic acid**.

met-cars. *Plural noun.* Metal cluster carbides, such as Ti_8C_{12} , which have the dodecahedral structure of **fullerene**, C_{20} , but are more stable because of the presence of metal-carbon sigma bonds

meteorite. *Noun.* A rock-like object landing on earth from space.

meter. *Noun.* (1) Any device that measures and records the amount of a material or the size of physical effect or property. (2) The American spelling of **metre**. (3) *Verb trans.* To measure the rate of flow with a meter. (4) *Combining form.* **-meter** Designates an instrument for measuring.

methacrylate resin. *Noun.* An acrylic resin derived from polymerisation of methacrylic acid, $\text{CH}_2\text{C}(\text{CH}_3)\text{COOH}$.

methoxide. *Noun.* A salt-like compound in which the hydrogen atom in the hydroxyl group of methanol is replaced by a metal atom; used in **sol** and **gel** preparations.

methuselah. *Noun.* A glass or ceramic bottle of 6 l capacity for table wines, or 4.5 l for sparkling wines.

methyl acetate. *Noun.* A colourless liquid which can be polymerised into transparent sheets that are used as a liner between sheets of glass in the production of safety glass to prevent the glass from shattering into sharp fragments if broken.

methyl cellulose. *Noun.* A gum made from cotton cellulose; used as a binder, lubricant, wetting agent, plasticiser, and suspension agent in the manufacture of refractories, whiteware, abrasives, and general structural clay products.

methylene blue index. MBI. *Noun.* A measure of clay surface area. A spectrophotometer is used to determine the amount of methylene blue dye absorption on suspended clay particles by detecting a surplus left in solution; expressed as mg g^{-1} of dry clay. $\text{MBI} = \text{vc/w}$, where v is the volume of methylene blue dye added in millilitres, c is the concentration of the dye and w is the dry weight of the sample powder.

metre. *Noun.* The basic **SI unit** of length defined as the length of the path travelled by light in free space in $1/299792458$ of a second.

metricate. *Verb.* To convert a measuring system from non-metric to metric.

metric ton. *Noun.* A unit of mass equal to 1,000 kg. Also called tonne.

Meyer hardness. *Noun.* The hardness value obtained when a spherical indenter is used to indent a polished ceramic surface and the applied load is divided by the projected area of the arc-shaped indent. Although this is the same principle as the **Brinell test** the two scales do not correspond.

Meyer's law. *Noun.* This relates the applied load, P , and indentation diagonal length, d , in a **Vickers hardness test**: $P = P_L d^n$, where P_L is the load needed to make an indent of a size where $d = 1 \mu\text{m}$, and n is the **ISE index**. When $n = 2$, hardness will be load independent.

M-glass. *Noun.* A silica glass containing substantial amounts of **beryllia**, BeO , designed to make high modulus fibres

MHD electrodes. *Abbreviation.* Standing for magnetohydrodynamic electrodes. See **magnetohydrodynamic electrodes**.

mho. *Symbol.* See **siemens**.

MHz. *Symbol.* Stands for megahertz.

mica. *Noun.* A group of mineral **silicates** having similar physical characteristics and crystal structures, but of varying chemical compositions, containing hydroxyl and aluminosilicate groups with charge balancing alkali metal ions; used as electrical insulation. May be colourless, brown, red, yellow, green and black; these minerals are derived from the structure of **talc** or **pyrophyllite** in which some Si^{4+} is replaced by Al^{3+} in the sheets of linked SiO_4 tetrahedra. Electrical neutrality is maintained by inserting cations between sheets and this gives rise to changes in properties and classification depending on whether the cations are monovalent or divalent etc. The micas are grouped in two main types: **Dark** iron- and magnesium-rich mica and **white** aluminium-rich mica. Both have perfect cleavage.

mica, book. *Noun.* See **book mica**.

micaceous. *Adjective.* Leaf-like, foliated or lamella-like.

micaceous crystals. *Noun.* Crystals of **lamella** habit with one very thin dimension and the lamellae can be peeled off along cleavage planes.

mica, crude. *Noun.* See **crude mica**.

mica, dark. *Noun.* See **mica**.

mica, divalent. *Noun.* See **divalent mica, brittle mica**.

mica, full-trimmed. *Noun.* See **full-trimmed mica**.

mica, glass-bonded. *Noun.* See **glass-bonded mica**.

mica, half-trimmed. *Noun.* See **half-trimmed mica**.

mica, hard. *Noun.* See **hard mica**.

mica schist. *Noun.* A variety of laminated mica containing **silica**, **feldspar**, and other minerals; used in refractories and roofing compositions

mica, sodium-4. *Noun.* See **Na-4-mica**.

mica, soft. *Noun.* See **soft mica**.

mica, true. *Noun.* See **true mica**.

mica, white. *Noun.* See **mica**.

micelle. *Noun.* Electrically charged **colloid particle** or ion and its surrounding boundary water molecules, consisting of oriented molecules. They are **agglomerates** fixed by weak binding forces. Some salts, for example, soap, although appearing to dissolve do not do so completely but form a colloidal solution. In the case of soap the cations dissolve but the anions are insoluble in water but the cations cause the anions to cluster into colloidal agglomerates, which are the micelles.

micro. *Adjective.* Meaning very small or more specifically needing a microscope to be seen. It is often scaled as 10^{-6} .

micro-. *Combining form.* Small or minute.

microbalance. *Noun.* A very precise balance designed to weigh quantities between 10^{-6} and 10^{-9} kg.

microchannel plate. MCP. *Noun.* A thin sheet of insulating glass about $500 \mu\text{m}$ thick, containing a large number of small channels about $15 \mu\text{m}$ in diameter. Each channel acts as an electron multiplier from a 1 kV voltage applied down the inner surface of the channel, which is conductive. Electrons entering a channel are accelerated, strike the walls and generate secondary electrons. It is able to function as an image intensifier or ultrafast optical gate. Each primary electron entering the tube can generate 10^3 secondary electrons and by cascading a number of plates an electron multiplication of 10^7 can be obtained.

microchip. *Noun.* A small piece of a semiconductor on which very many circuits have been imprinted.

microcircuit. *Noun.* A number of permanently connected components on a **microchip**.

microcline. *Noun.* KAlSi_3O_8 . Potassium-rich **feldspar** in which the Al^{3+} and Si^{4+} in the tetrahedral sites are ordered within a **triclinic** crystal structure. A white red or green mineral found in **igneous**, **metamorphic** and **sedimentary rocks**. Used in ceramics and glass manufacture. Hardness (Mohs) 6; density 2,540–2,570 kg m^{-3} .

microconstituent. *Noun.* A component of a microstructure. It has a recognisable and characteristic structure and can be identified for phase analysis purposes; **pearlite** is an example.

microcrystalline. *Adjective.* Possessing a microstructure in which all the grains are submicron in diameter.

microcrystalline alumina. *Noun.* Small, rough grains of **alumina**, Al_2O_3 , re-crystallised from the melt for use as an abrasive.

microelectromechanical system. MEMS. *Noun.* Miniature mechanical devices, such as motors and beams that are integrated with electronic components on a silicon **microchip**. The mechanical components act as sensors and actuators and stimulate the electronic components to make decisions and then direct the microactuators etc. to respond.

microelectronics. *Plural noun.* The branch of electronics dealing with electronic components of miniature size usually incorporating solid-state **semiconductors**.

microelement. *Noun.* Any electronic component (resistor, transistor, capacitor, diode, etc.) mounted on a thin ceramic substrate wafer; such components may be potted, stacked, interconnected, and arranged to form **micromodules**.

microfarad. μF . *Noun.* 10^{-6} of a **farad**.

microfibre. *Noun.* A filament or fibre with **linear density** less than 1.0 **dtex**.

microglass. *Noun.* Very thin glass plates used for micro-scope cover slips.

micrograms per gram. *Noun.* A measure of the content of a substance, such as an impurity, in a material; reported as micrograms of substance per gram of parent liquid or solid.

micrograph. *Noun.* A photograph of a polished section of material as viewed through a microscope.

microhardness. *Noun.* The value for the **indentation hardness** of a surface obtained by one of the normal indentation procedures (e.g., **Vickers**) using loads in the range 0.0098–1.96 N, usually involving specialised equipment and high-quality microscopes.

microlens. *Noun.* A lensing shape fashioned on the tip of an **optical fibre**.

microlith. *Noun.* A small **flint** tool from the Mesolithic period.

micrometre. μm . *Noun.* Replacement name for **micron**.

micromodule. *Noun.* See **microelement**.

micron μm . *Noun.* 10^{-6} or one millionth of a metre; approximately 0.00004 in.

micropore. *Noun.* A pore sufficiently small that it will retain water against the force of gravity and retard water flow.

micropore volume. *Noun.* The volume fraction of a porous solid that consists of all interconnected pores whose openings are smaller than any arbitrary set value; in some alumina products the set value is about 14 nm.

micropyrometer. *Noun.* A **pyrometer** for measuring the temperature of very small objects.

microscope. *Noun.* An instrument employing a system of lenses to produce magnified images of objects too small to be seen by the unaided eye.

microscopic. *Adjective.* Objects too small to be seen by the naked eye and a microscope must be used to view them.

microscopy. *Noun.* Investigation by using a microscope. See **ceramography**.

microscopy, liquid-immersion. *Noun.* See **liquid-immersion microscopy**.

microsegregation. *Noun.* The occurrence of concentrations of elements and compounds within the volume of a grain.

microstructure. *Noun.* An outline of the individual grains of a polished and etched specimen that requires a microscope to make it visible. It is defined in terms of grain boundaries, grain size, grain shape, and phase distribution.

microtechnology. *Noun.* Technology involving **micro-electronics**.

microtexture. *Noun.* The combined knowledge of individual crystal orientation and the position of a crystal in a specimen.

microwave. *Noun.* Electromagnetic radiation in the wavelength band 0.3–0.001 m.

microwave drying. *Verb.* To use the polar structure of water to heat it with ultra-short electromagnetic waves and hence evaporate it from solids and suspensions.

microwaves. *Noun.* Electromagnetic radiation with wavelengths ranging from 1 mm to 1 m in free space; frequencies range from 300 MHz to 300 GHz. Depending on a ceramic's dielectric properties, the radiation can be transmitted or absorbed. Now used in drying and firing ceramic ware.

microwave spectroscopy. *Noun.* Information concerning bonding and structure of crystals is obtained by measuring the wavelength of emitted or absorbed **microwaves**.

middle clay. *Noun.* The mid-section of a **ball clay lens**.

midplane. *Noun.* The middle surface of a laminate; usually designated the $z=0$ plane.

midplane symmetric. *Noun.* A **laminated composite** in which the midplane is a mirror plane for the lamination sequence.

Mie cross-section. *Noun.* See **Mie equation**.

Mie theory. *Noun.* An analysis of the scattering of light around spherical particles, reflection of light from their surface and refraction on passing through the sphere. Developed to deal with situations in particle size determination when the particles are about the same size as light wavelengths.

Mie equation. *Noun.* Developed to calculate the scattering effect on glaze **opacity**. Assuming spherical particles of size greater than $0.05\ \mu\text{m}$: $R_s/I_o = 1 - \exp[-N\pi d^2 LK/4]$, where R_s is the reflected light of the incident I_o intensity arising from scattering, N is the number of independent scatterers per cubic metre, d is the particle diameter, L is the effective glaze thickness and K is the effective scattering cross-section or **Mie cross-section**, which is about $4\times$ the real size for particles of optimum size as estimated by the **Weber equation**.

MIF. *Acronym.* Standing for mechanical integrity factor. See **mechanical integrity factor**.

migmatite. *Noun.* A composite **metamorphic rock** body containing two distinguishable types of rock, a dark host rock and a lighter coloured granite. Formed under intense heat parts start to melt and form interesting microstructural swirls.

migration, water. *Noun.* See **water migration**.

mil. *Noun.* One thousandth of an inch or $0.0254\ \text{mm}$.

mild abrasive. *Noun.* An abrasive material, usually in powder form; hardness (Mohs) 1–2; for example, **talc**.

milestone. *Noun.* A pillar of stone that shows the distance from or to a place.

milk glass. *Noun.* Translucent white **opal glass** made by adding alumina, Al_2O_3 , and **fluorspar**, CaF_2 , to a **soda-lime glass**. Originally made to imitate Chinese porcelain.

miliness. *Adjective.* A cloudy appearance in glass.

milk of magnesia. *Noun.* Magnesium hydroxide powder suspended in water.

milk paint. *Noun.* A decorating medium made from milk, **lime** and pigment. used in ancient times now making a return because of its low toxicity.

mill. *Noun.* (1) A machine employed to reduce the particle size of solids. (2) *Verb trans.* To grind, press or pulverise in various combinations. (3) *Verb trans.* To produce a product in a mill.

mill addition. *Noun.* A material, other than **frit**, charged into a mill to complete the batch formula of a porcelain-enamel or other ceramic slip.

mill, agitated media. *Noun.* See **agitated media mill**.

mill, ball. *Noun.* See **ball mill**.

mill, colloid. *Noun.* See **colloid mill**.

milie. ‰ . *Abbreviation.* Stands for parts per thousand as used to express isotope ratios relative to a standard: $\delta x = \{(X_{\text{sample}}/X_{\text{standard}}) - 1\} \times 1,000$, where $X = {}^2\text{H}/{}^1\text{H}$, ${}^{18}\text{O}/{}^{16}\text{O}$ or ${}^{13}\text{C}/{}^{12}\text{C}$. The main standard for oxygen and hydrogen isotope determination is **standard mean ocean water** and for carbon it is the fossil **belemnite** from the Pee Dee formation in South Carolina.

mill, edge-runner. *Noun.* See **edge-runner mill**.

millefiori. *Noun.* (1) A decorative technique meaning thousands of flowers. (2) Glass containing a decorative design of multicoloured glass rods or shapes in a clear glass matrix. Also known as **mosaic glass**. (3) Small-cross-section coloured glass rods that can be fused into the surface of porcelain-enamels in regular or random decorative patterns.

Miller indices. *Plural noun.* The method used to identify and specify parallel planes in crystals and lattices. It consists of parentheses enclosing three integers: (hkl), where h, k, l, are the Miller indices and describe the number of intersections the planes make with the a, b, and c dimensions of the unit cell of the structure. The hexagonal lattice or structure is defined by 4 indices, h, k, i, l, but since i is not independent and equals $h+k$ it is often omitted.

millerite. *Noun.* NiS. Found in some **serpentines** that are used in ceramic preparations; also a component of meteorites. The crystal habit is long slender needles, brass-yellow in colour, the crystal class is hexagonal; exhibits non-basal cleavage; hardness (Mohs) 3–3.5; density $5,360\ \text{kg m}^{-3}$.

mill, flint. *Noun.* See **flint mill**.

mill, fluid-energy. *Noun.* See **fluid-energy mill**.

mill, hammer. *Noun.* See **hammer mill**.

mill, Hardinge. *Noun.* See **Hardinge mill**.

millibar. *Noun.* An atmospheric pressure measurement unit in the **cgs system** equal to $10^{-3}\ \text{bar}$, $10^2\ \text{N m}^{-2}$ or $0.75006\ \text{mm Hg}$.

milligram. *mg.* *Noun.* One thousandth of a gram.

millilitre. *ml.* *Noun.* One thousandth of a litre.

millimeter, mm. *Noun.* One thousandth of a metre.

mill, impact. *Noun.* See **impact grinder**.

milling. *Verb.* To grind, press, or crush in a mill.

milling, dry. *Verb.* See **dry milling**.

milling, wet. *Verb.* See **wet milling**.

millitex, mtex. *Noun.* See **tex**.

mill, jar. *Noun.* See **jar mill**.

mill, jet. *Noun.* See **jet mill**.

mill, pebble. *Noun.* See **pebble mill**.

mill, pin. *Noun.* See **pin mill**.

mill, prall. *Noun.* See **prall mill**.

mill, pug. *Noun.* See **pug mill**.

mill-rind. *Noun.* An iron support fitted across an upper **millstone**.

mill, rod. *Noun.* See **rod mill**.

millrun. *Noun.* The process of powdering an ore and determining its content and quality.

mill scale. *Noun.* A black, magnetic form of iron oxide, mainly Fe_3O_4 formed on the surface of iron and steel before and during rolling and forging.

millstone. *Noun.* One of a pair of flat, disc-shaped, tough stones used to grind minerals and cements.

mill, tube. *Noun.* See **tube mill**.

mill, vacuum pug. *Noun.* See **vacuum pug mixer**.

mill, vibratory. *Noun.* See **vibratory crusher**.

mill, vibroenergy. *Noun.* See **vibroenergy mill**.

mill wash. *Noun.* The residues obtained by washing the interior of a mill after a charge has been removed.

minimete. *Noun.* $\text{Pb}_3\text{Cl}(\text{AsO}_4)_3$. A yellowish mineral containing lead and arsenic.

min. *Abbreviation.* Standing for: (1) minute; (2) minimum; (3) mineralogy.

mine. *Noun.* (1) A series of excavations made to extract minerals and ores. (2) A deposit of ore or minerals.

mineral. *Noun.* A naturally occurring substance of characteristic chemical composition and physical properties, usually expressed by a chemical formula and having a family name; for example, **feldspar**, **ilmenite**, **fireclay**, etc.

mineral dressing. *Noun.* See **ore dressing**.

mineral, economic. *Noun.* See **economic mineral**.

mineral fibre. *Noun.* Non-metallic inorganic fibres either naturally occurring, such as **asbestos**, or synthesised, like **carbon fibre**.

mineral green. *Noun.* See **copper carbonate**.

mineral inclusion. *Noun.* Foreign matter of different physical and chemical characteristics contained in a parent mineral, such as metallic oxides in mica which appear as deep, distinct, and saturated colours in transmitted light.

mineralise or mineralize. *Verb trans.* To impregnate organic matter with an inorganic mineral.

mineraliser. *Noun.* (1) A small quantity of a material, such as a **flux**, added to a refractory brick or other refractory composition to promote crystal growth and aid sintering. (2) An element, such as oxygen, that combines with a metal to form an oxide ore. (3) Various gases dissolved in magma that affects the crystallisation process on cooling.

mineralogy. *Noun.* The branch of geology concerned with the study of minerals.

mineral oil. *Noun.* (1) Any oil of mineral origin, especially petroleum. (2) Liquid paraffin.

mineral pitch. *Noun.* Synonym for **asphalt**.

minerals, accessory. *Plural noun.* See **accessory mineral**.

mineral sands. *Plural noun.* Beach sand deposits found in several parts of the world that contain **zircon**, ZrSiO_4 , in association with other heavy minerals, such as **ilmenite**, FeTiO_3 , **rutile**, TiO_2 , and **monazite**, $(\text{Ce,La,Th})\text{PO}_4$.

mineral tar. *Noun.* A natural, black, viscous tar intermediate in properties between **asphalt** and petroleum.

mineral wax. *Noun.* Another name for **ozocerite**.

mineral wool. *Noun.* Fibrous products of random orientation produced by blowing air or steam through a molten stream of rock, slag, or glass; used for sound and thermal insulation, fireproofing, and as a filter medium. Also called **rock wool**.

minimum thermometer. *Noun.* A thermometer that leaves a marker at the lowest temperature reached during an interval of time.

minium. *Noun.* Alternative name for red lead. See **red lead**. Also called **menige**.

mirabilite. *Noun.* $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$. A mineral form of **sodium sulphate** with some ceramic uses in batching.

mirror. *Noun.* Polished glass with an adherent coating of silver or other shiny metal on the backside to produce a highly reflective unit.

mirror plane. *Noun.* In a crystal structure it is the plane either side of which the structure repeats itself.

miscible. *Adjective.* Capable of mixing.

miscibility. *Noun.* The ability of two or more liquids to mix and blend into one uniform phase.

MISFET. *Acronym.* Stands for metal, insulator, semiconductor field effect transistor. See **MIS field effect transistor**.

MIS field effect transistor. *Noun.* Partial acronym for metal-insulator-semiconductor field effect transistor; a conducting channel formed by a strip of n- or p-type semiconductor adjacent to a gate of p- or n-type material.

misfit layer structures. *Noun.* Crystallographic structures that consist of at least two, more or less independent, layers for which one or two intralayer basic periodicities do not coincide. $A_{1+x}B_m$, where $A=MX$, $B=TX_2$, m is 1–3, $X=S$ or Se , $M=Sn$, Pb , Bi , lanthanide, and $T=Ti$, Ta , V , Cr . Also called **incommensurate layer structures**.

mismatch. *Verb.* (1) To match or fit inaccurately or unsuitably, items such as colours, joints, mould parts, expansion characteristics, etc. (2) *Noun.* The subsequent appearance or the physical result of making a mismatch.

mispickel. *Noun.* Synonym for **arsenopyrite**.

mitre bevel. *Noun.* A bevel made for decorative or aesthetic purposes, or for making a right-angle joint such as with two pieces of glass.

mitre cut. *Noun.* A cut made by the V-shaped edge of an abrasive wheel.

mitre joint. *Noun.* A joint made by bevelling each of two surfaces to be joined, usually at a 45° angle, to form a 90° corner.

Mitscherlich's law of isomorphism. *Noun.* A statement that substances with the same crystal structure have similar chemical formulae. The law can be used to determine the formula of an unknown ceramic material if it is **isomorphous** with a ceramic of known formula.

mix. *Verb.* (1) To combine and blend into a homogeneous mass. (2) *Noun.* A blended mixture or batch ready for processing.

mixed alkali effect. *Noun.* An effect observed in glasses when a second alkali ion is substituted on a cation basis for the alkali in the composition; resistivity is higher for the mixed-alkali glass than for that containing a single type of alkali cation.

mixed crystal. *Noun.* A solid solution of two crystalline phases.

mixed dislocation. *Noun.* A more complex **dislocation** containing both edge and screw components.

mixed halide effect. *Noun.* An effect observed in **lead silicate glasses** into which alkali halides have been dissolved. As a second halide is added the glass resistivity increases sharply from that found for a single halide solute. This is the anion analogue of the **mixed alkali effect** in glasses.

mixer. *Noun.* A machine designed to mix batch ingredients.

mixer, batch. *Noun.* See **batch-type mixer**.

mixer, dual-drum. *Noun.* See **dual-drum mixer**.

mixer, muller. *Noun.* See **muller**.

mixer, pug. *Noun.* See **pug mill**.

mixer, shaft. *Noun.* See **shaft mixer**.

mixer, truck. *Noun.* See **truck mixer**.

mixer, vacuum. *Noun.* See **vacuum mixer**.

mixer, vacuum pug. *Noun.* See **vacuum pug mixer**.

mixing. *Noun.* The process of combining and blending ingredients into one mass or mixture until the individual constituents are indistinguishable.

mix, lean. *Noun.* See **lean mix**.

mix proportions. *Noun.* (1) The ratio, by weight or volume, of ingredients constituting a batch. (2) The actual amounts of ingredients in a batch.

mks units. *Plural noun.* The basis of the **SI units system** with the mks standing for metre, kilogram and second.

MLCC. *Abbreviation.* Standing for multilayer ceramic capacitor. See **multilayer ceramic capacitor**.

MLC capacitor. *Noun.* See **multilayer ceramic capacitor**.

mm. *Abbreviation.* Stands for millimeter, 10^{-3} m.

mmf. *Abbreviation.* Stands for magnetomotive force.

mmHg. *Abbreviation.* Standing for millimeter of mercury, which is a unit of pressure equal to the pressure that can support a column of mercury 1 mm high under standard gravity. It is equal to $13.595 \times 980.67 \times 10^{-2} \text{ N m}^{-2}$.

MMMF's. *Abbreviation.* Standing for man-made mineral fibres. See **man-made mineral fibres**.

MMR. *Abbreviation.* Stands for magnetically modulated microwave reflection spectroscopy. See **magnetically modulated microwave reflection spectroscopy**.

MMVF's. *Abbreviation.* Stands for man-made vitreous fibres. See **man-made vitreous fibres**.

mm waves. *Plural noun.* Electromagnetic radiation with a frequency > 30 GHz.

mobility. *Noun.* (1) The workability or freedom of a plastic mass to move, either in a random motion or under the influence of a force. (2) A measure of the ease of motion of charge carriers, such as electrons and holes. See **electron mobility**. (3) μ_e , μ_h ; the proportionality constant between the carrier drift velocity and the applied electric field.

mobility edge. *Noun.* A concept used to interpret semi-conduction in some amorphous ceramics. It is the critical density of states above which all states show a finite mobility for transport of free carriers but below which all states are localised.

mobilometer. *Noun.* An instrument to evaluate the flow characteristics of slips and slurries. See **Gardner mobilometer**.

mocha stone. *Noun.* Another name for **moss agate**.

mock-up. *Noun.* A scale model of an apparatus for demonstration, testing, or study.

MOCVD. *Abbreviation.* Stands for metal organic chemical vapour deposition. See **metal organic vapour deposition**.

mode. *Noun.* (1) An electromagnetic energy density pattern caused by the interference of two or more waves within a confining structure. The confining volume is called a **cavity**. (2) One of several paths a light pulse can take along an **optical fibre**. A fibre containing several modes causes a signal to spread over distances of several kilometres. See **monomode fibre**.

mode diameter. *Noun.* A diameter that occurs most frequently in a distribution as determined graphically.

model. *Noun.* A pattern or representation of an object that is to be fabricated.

moderate. *Verb trans.* To slow down neutrons to thermal energy ranges by using a suitable ceramic material in a nuclear reactor.

moderating ratio. M. *Noun.* A measure of the efficiency of a material to reduce the energy of neutrons without capturing them; $M = A_s \delta / A_a$, where A_s and A_a are the scattering and absorption cross sections, respectively, and δ is the fractional energy loss per collision.

moderator. *Noun.* A material, such as boron, used in nuclear applications to reduce the energy of neutrons without appreciable capture.

mode spectral density. *Noun.* The density of modes in a given cavity within a frequency band.

mode stirrer. *Noun.* In **dielectric heating** applications it is a device that alters the modes in the cavity to give a more uniform effect.

modification. *Noun.* A change in composition or design in products.

modified design. *Noun.* A change in the specifications of a standard.

modified-design pipe. *Noun.* A concrete pipe of a design different from a standard.

modified-groove pipe. *Noun.* The enlarged end of a pipe into which the normal end of an adjoining pipe is inserted.

modified-tongue pipe. *Noun.* The normal end of a pipe that is inserted into the enlarged end of an adjoining pipe.

modillion. *Noun.* An ornamental bracket under a cornice.

modular brick. *Noun.* A brick of a size that will fill a 10.2 cm modular unit, including the mortar joint.

modular glassmelting. *Noun.* Preparation of glass in a **segmented melter** where the three processes: melting, refractory grain dissolution, bubble removal are physically separated and so convection flows are eliminated making it impossible for **batch** and glass that has passed through one process stage to return to it.

modular masonry unit. *Noun.* A masonry unit of nominal dimensions based on a 10.2 cm module.

modular melter. *Noun.* See **segmented melter**.

module. *Noun.* Any in a series of units of standardised size and shape for use together, as in the design and construction of a building.

modulus. *Noun.* A coefficient indicating the relation between a physical effect and the force producing it.

modulus, iron. *Noun.* See **iron modulus**.

modulus of elasticity. E. *Noun.* The ratio of stress to strain within the elastic range; commonly called **Young's modulus** and is a measure of stiffness.

modulus of resilience. *Noun.* The energy per unit volume capable of being absorbed without producing a permanent distortion. Found by integrating a stress-strain curve from zero to the yield point and dividing by the starting volume of the sample.

modulus of rigidity. G. *Noun.* The resistance of a material to a shearing stress; the ratio of shear stress to the displacement per unit length of sample.

modulus of rupture. MOR. *Noun.* The transverse or crossbending strength of a non-ductile material which is the outer fibre stress, given by: $M = 3Pl/2bd^2$, where M is the modulus of rupture expressed in $N\ m^{-2}$, P is the breaking load in newtons, l is the distance between the knife edges of the test apparatus, b is the width of the test specimen in m, and d is the thickness of the test specimen in m. It is the maximum surface strength in a bent beam at the instant of failure. It has a larger value than strength measured in direct tension for ceramics by a factor of 1.3 because the volume subjected to the maximum stress is small and the probability of a critical flaw lying in it is therefore small while for simple tension all the flaws are in the maximum stress region.

modulus of rupture, effective. *Noun.* See **effective modulus of rupture**.

modulus, secant. *Noun.* See **secant modulus**.

modulus, secondary. *Noun.* See **secondary modulus**.

modulus, silica. *Noun.* See **silica modulus**.

modulus, tangent. *Noun.* See **tangent modulus**.

modulus, torsional. *Noun.* See **torsional modulus**.

modulus, Young's. *Noun.* See **Young's modulus**.

Mohr's circle. *Noun.* A geometrical construction used to transform a state of **plane stress** from one set of axes to another or for transforming strain between different sets of axes in order to show different perspectives of the state of stress or strain in the body. In the case of stress, values of shear stress are plotted on the vertical axis of the diagram but half the value of shear strain only is plotted in the case of strain. The horizontal axis contains values of longitudinal stress or strain. A circle is drawn centred on the point $\epsilon_x + \epsilon_{xy/2}$, 0, with diameter ϵ_x , $\gamma_{xy/2}$ to ϵ_y , $\gamma_{xy/2}$. This circle is the locus of all states of strain that can be obtained by rotating the axes around O_z .

Mohr's theorem. *Noun.* Used to find the slope and deflection of a beam-shaped specimen by relating the slope and deflection to the way the bending moment and force are related to the load.

Mohs hardness. *Noun.* An empirical scale of hardness in which the scratch resistance of a material is rated on a scale of minerals ranging from the softest, **talc**, to the hardest, **diamond**, as follows: 1-talc, 2-gypsum, 3-calcite, 4-fluorite, 5-apatite, 6-orthoclase, 7-quartz, 8-topaz, 9-corundum, and 10-diamond.

moil. *Noun.* (1) The glass remaining on a blowpipe or punty after a gob has been cut off, or after a piece of ware has been blown or severed. (2) Glass, originally in contact with the blowing mechanism or head, which becomes cullet after the article has been severed.

moisture. *Noun.* Water that can be eliminated by heating at 105–110 °C.

moisture adsorption. *Noun.* The mass of water vapour taken from the atmosphere by a surface; distinguished from water absorption which relates to immersing the surface in liquid water and measuring the weight gain.

moisture barrier. *Noun.* A material or coating applied to retard the passage of moisture into a wall.

moisture content. *Noun.* The quantity of water in a substance, expressed as the percentage, by weight, in the mass

moisture distribution. *Noun.* In a composite it is the moisture adsorbed by the reinforcement compared with that of the matrix material.

moisture expansion. *Noun.* The increase in the dimensions or bulk volume of an article caused by the reaction with water or water vapour.

moisture, free. *Noun.* See **free moisture**.

moisture pressure. Ψ . *Noun.* A multifactor concept which recognises the fact that several physical and chemical factors contribute to the tendency of a porous body to change its **moisture content**. It is determined by measuring the vapour pressure in equilibrium with a porous body of a given moisture content.

moisture regain. *Noun.* The percentage weight gain of a dried material held in an atmosphere containing specified amounts of water vapour.

moisture stress. *Noun.* The change in the **specific free energy** of a liquid when it is removed from a gel.

mol. *Symbol.* Used in chemistry to denote **mole**.

mol. *Abbreviation.* Stands for: (1) Molecule. (2) molecular.

molal solution. *Noun.* One **mole** of solute per kilogram of solvent.

molar. *Adjective.* (1) Containing 1 mol of **solute** per litre of **solvent**. (2) Per unit amount of substance.

molar heat capacity. C_p , C_v . *Noun.* The amount of heat energy per **mole**, J mol^{-1} .

molarity. *Noun.* Another name for concentration.

molar quantities. *Noun.* The values of thermodynamic parameters that refer to one **mole** of the material in question. They are **intrinsic** quantities.

molar solution. *Noun.* One **mole** of solute per litre of solution.

molar volume. *Noun.* Traditionally obtained by dividing the **relative molar mass** of a compound in grams by the **density** expressed as g cm^{-3} ; therefore expressed in cm^3 and to express in m^3 such values are divided by 10^6 . It is defined as the volume occupied by a substance that contains as many elementary units as there are atoms in 0.012 kg of ^{12}C . The elementary unit must be specified.

mold. *Noun.* See **mould**.

modalvite. *Noun.* A green **tektite** arising from meteorite impact.

mole. *Noun.* (1) The **SI unit** of amount of substance. A mass equal to the **molecular weight** of the substance. Most commonly expressed in grams. It is the amount of a substance containing the same number of elementary units as there are atoms in 0.012 kg of ^{12}C . The units may be atoms, ions, molecules, radicals, electrons etc., and must be specified. (2) Recently redefined as: the mole is such that the **Avogadro constant** is exactly $6.0221415 \times 10^{23} \text{ mol}^{-1}$.

MOLE. *Acronym.* Stands for molecular optical laser examiner. See **molecular optical laser examiner**.

molecular beam epitaxy. **MBE.** *Noun.* The use of high vacuum methods to project beams of organo-metallic

compounds on to a substrate to produce oriented single crystal growth.

molecular manufacturing. *Noun.* The use of non-biological molecular machinery to direct chemical reactions to construct objects of complex atomic specifications.

molecular nanotechnology. *Noun.* The process of positioning atoms to make nano-devices with some level of atomic precision.

molecular optical laser examiner. **MOLE.** *Noun.* A microscope utilising the **Raman effect** that is used to determine chemical composition and crystalline form of very small areas of surfaces. Also called a Raman microscope.

molecular sieve. *Noun.* Ceramic materials with crystal structures containing large tunnels through which small atoms or molecules can pass quickly while larger ones are held back; used to purify liquids. Naturally occurring examples are **attapulgite**, **sepiolite**, and **zeolite**. Many are manufactured for specific separation purposes.

molecular volume. *Noun.* The volume occupied by 1 mol of a material. It is therefore the molecular weight divided by the density. Also called **molar volume**.

molecular weight. *Noun.* The sum of the atomic weights of all atoms in a molecule.

molecule. *Noun.* The simplest unit of a chemical compound that can exist consisting of two or more atoms held together by chemical bonds.

molendinarius. *Adjective.* Of or pertaining to a **mill**.

molinology. *Noun.* The study of **mills** and milling.

molinologist. *Noun.* A person who studies, is expert in, the technology and science of mills and milling.

Molochite. *Trademark, noun.* A proprietary **shell mould** refractory for investment casting; made by firing china clay to 1,525 °C. Also used to make **kiln furniture** able to withstand intense heat.

molten cast refractory. *Noun.* A refractory product made by casting the molten ingredients into moulds.

mol. wt. *Abbreviation.* Stands for molecular weight.

molybdate. *Noun.* A salt of a molybdic acid.

molybdenite. *Noun.* MoS_2 . Naturally occurring ore with a layered crystal structure. Used as a lubricant and drawing compound. Mp 1,185 °C; density 4,700 kg m^{-3} ; hardness (Mohs) 1.5.

molybdenum. *Noun.* Mo. A metal used as a winding for electrical furnaces, **glass-to-metal seals**, **electro-optical** applications, and for filaments, screens, and grids in vacuum tubes. Mp 2,470 °C; density 1,020 kg m^{-3} .

molybdenum carbide. *Noun.* (1) Mo_2C . Mp 2,687 °C; density 9,200 kg m^{-3} . (2) MoC . Mp 269 °C; density 8,400 kg m^{-3} . Both phases are encountered in **refractory hard metal** compositions where they are bonded by cobalt metal.

molybdenum disilicide. *Noun.* MoSi_2 . Used as a furnace winding for furnaces working at 1,700 °C when it is commonly called **kanthal**; also used in electrical resistors, high-temperature protective coatings, in combination with Al_2O_3 in kiln furniture, sandblast nozzles, **saggers**, induction brazing fixtures, and hot-press and hot-draw **dies**; used on occasion to promote special porcelain-enamel adherence. Mp 1,870–2,030 °C

molybdenum disulfide. *Noun.* See **molybdenite**.

molybdenum enamel. *Noun.* A white or pastel-coloured porcelain-enamel containing molybdenum oxide as an **adherence promoter**.

molybdenum oxide. *Noun.* See **molybdenum trioxide**.

molybdenum trioxide. *Noun.* MoO_3 . An **adherence-promoting agent** in porcelain-enamels, an **opacifier** in enamels, glazes, and glass, and a **wetting agent** in whiteware bodies. Acts as a flame retardant in polyester fabrics. Mp 1,463 °C; density 4,500 kg m^{-3} .

molybdic. *Adjective.* Containing molybdenum in the tri-valent or hexavalent state.

molybdite. *Noun.* $\alpha\text{-MoO}_3$. An oxide with a layer-type structure that has been developed into a **pseudocapacitor** in the form of mesoporous films of oriented molybdate. Electrical charging involves the insertion of Li^+ ions between layers of MoO_3 .

moly-manganese process. *Trade name, noun.* Used to braze alumina, Al_2O_3 , to metals. A slurry of Mo, MoO_3 , Mn, and MnO_2 powders with various glass-formers, is applied to the alumina surface as a paint and the coated ceramic heated in a wet-hydrogen atmosphere to 1,500 °C to produce a metal and glass surface to which metal parts can be brazed.

moment. *Noun.* A stress couple producing a bending or twisting action.

moment arm. *Noun.* The perpendicular distance from an axis to the line of action of a force.

moment of inertia. *Noun.* The sum of the products of all mass elements and the squares of their **moment arms**.

monazite. *Noun.* $(\text{Ce}, \text{La}, \text{Th})\text{PO}_4$. A phosphate mineral found in association with **rutile** and **zircon** as alluvial or beach deposit. Used as a source of rare earths; a component of **mineral sands**. The pure component, LaPO_4 is a candidate oxide for a low thermal conductivity barrier material. The mineral has a structure and composition that make it a possible containment phase for plutonium by **isomorphous replacement** of the lanthanide cations by plutonium ions. Density 4,900–5,300 kg m^{-3} ; hardness (Mohs) 5–5.5. See **fergusonite**.

Monday morning fever. *Noun.* See **zinc shakes**.

monel. *Trademark, noun.* A nickel-copper alloy of high resistance to acids; used in **pickle baskets**.

monitoring. *Verb.* (1) Periodic or continuous examination of a process. (2) Instrumental examination of an area or an individual to determine the amount of radiation or radioactive contamination.

monkey wall. *Noun.* The section between the front and back walls and the port side-walls of an open hearth furnace.

monochromatic light. *Noun.* Light of a single wavelength.

monochrome. *Adjective.* Of or executed in a single colour.

monochrome decoration. *Noun.* A decoration of a single colour.

monoclinic. *Adjective.* Of a crystal system characterised by three axes of unequal length and only one angle between the axes equal to 90°. **Gypsum**, **mica**, **spodumene** and **serpentine** are examples of monoclinic ceramics.

monocoque. *Noun.* A method of construction in which all stresses are carried by the thin covering skin. Suitable for sheet-composite designs.

monodispersion. *Noun.* A system in which all the particles are exactly the same size.

monofilament. *Noun.* A single untwisted strand of synthetic fibre of long length. See **continuous filament yarn**.

monofilamentary. *Adjective.* Formed from long fibres lying parallel to each other.

monohydric. *Adjective.* Containing one atom of hydrogen capable of reacting as an acid.

monolayer. *Noun.* A single continuous layer or film that is one unit thick that can be as small as one atom or molecule.

monolith. *Noun.* (1) An artefact made entirely from one massive piece, be it polycrystalline or polyphase, as opposed to being constructed from units. Casting is a typical forming method used. (2) A single large block of stone, often in the form of a column or **obelisk**.

monolithic. *Adjective.* (1) Formed of a single entity, such as a large stone block. (2) An electric current formed from or in or on a single crystal.

monolithic lining. *Noun.* A furnace lining with no joints, formed from a refractory that is **rammed**, **cast**, **gunned**, or **sintered** into place.

monolithic refractory. *Noun.* See **monolithic lining**.

monolithic refractory construction. *Noun.* A joint-free refractory installation.

monomineralic. *Adjective.* A description of a natural raw material that is essentially pure containing more than 98 % of one kind of mineral.

monomode fibre. *Noun.* An **optical fibre** with diameter <10 µm, which limits the number of paths or **modes** for the light and this reduces **pulse broadening**.

monomolecular layer. *Noun.* An adsorbed layer one molecule thick covering the whole surface of the **adsorbate**.

monomorphic. *Adjective.* A chemical compound having only one crystalline form.

mono particle distribution. *Noun.* A system in which all particles are exactly the same size.

monopressatura. *Noun.* A ceramic concept whereby a body and its glaze are pressed together in one process before a single firing process is employed.

monopole. *Noun.* A magnetic pole considered on its own.

monorail. *Noun.* A conveyor system employing a single overhead rail for the transport of ware.

monotectic. *Noun.* A phase system where a single liquid on cooling decomposes into a solid plus another liquid of different composition than the first liquid, the process being reversible.

monoxide. *Noun.* An oxide containing one oxygen per molecule.

montan wax. *Noun.* A **lignite** wax used as a **mould lubricant**.

Monte Carlo simulation. *Noun.* A technique used in computational statistical mechanics.

monticellite. *Noun.* CaMgSiO_4 . A discrete ionic silicate phase sometimes formed in basic refractories containing silica and **lime**.

montmorillonite. *Toponym, noun.* $\text{Al}_{3.33}\text{Mg}_{0.67}(\text{Si}_2\text{O}_5)_4 \cdot 0.67\text{Na}$. Clay mineral with an expanding structure that is an important component of **bentonite**. First found near the French town of Montmorillon. Used as a lubricant in pottery bodies, as a filler, and a suspending agent. Also known as **fuller's earth**.

Mooney equation. *Noun.* An improvement applied to equations used to model the properties of composites; introduced to take account of the **agglomeration** of the reinforcement phase.

moonstone. *Noun.* A white to translucent form of **feldspar** having a pearly or **opalescent** appearance. Used as a gemstone.

moonstone glass. *Noun.* An **opal glass** resembling moonstone in appearance; made by adding fluorides to the batch composition.

Moore's law. *Noun.* A statement that the number of **transistors** on a silicon chip doubles every 1.5 years with an associated decrease in cost. So far the law has held true for 45 years.

moresque. *Adjective.* Used to describe ceramic designs and architectural features of Moorish style.

morganite. *Noun.* A pink variety of **beryl**. Used as a gemstone.

morion. *Noun.* A smoky-brown or grey variety of **quartz** valued as a **gemstone**.

-morph. *Combining form.* Related to shape, form or structure.

morpholine. *Noun.* C_4H_8NOH . A hygroscopic liquid base used as an **emulsifying agent** for ceramic binders and as a rust inhibitor when grinding or lapping ceramics.

morphology. *Noun.* The study of the physical form of material at **macro**, **micro**, and **crystal structure** levels.

morphotropic phase boundary region. MBP. *Noun.* A region in a phase diagram of a ceramic system where two crystalline polymorphs exist together in variable proportions with an intimate, mixed microstructure.

Morse taper. *Trademark, noun.* A taper that is one of a standard series used in the shaft of tools to fit a matching taper in the mandrel of a machine tool.

mortar. *Noun.* (1) A mixture of cement and sand used as a binder in the placement of brick or masonry. (2) A hard, abrasion-resistant bowl-shaped container in which substances may be broken and powdered with a **pestle**.

mortar admixture. *Noun.* A material added to mortar to control the setting rate and sometimes to serve as a water repellent or colouring agent.

mortar, agate. *Noun.* See **agate mortar and pestle**.

mortar board. *Noun.* See **hawk**.

mortar, fat. *Noun.* See **fat mortar**.

mortar, grog-fireclay. *Noun.* See **grog-fireclay mortar**.

mortar, ground fireclay. *Noun.* See **ground fireclay mortar**.

mortar, heat-setting. *Noun.* See **heat-setting mortar**.

mortar joint. *Noun.* The sand and cement mixture binding **bonding** patterns. The thickness, colour and finish have an impact on the appearance of a wall. They are normally about 10 mm thick and represent 18 % of the finished wall. Adding **lime** to the mortar makes it white and extra sand makes it yellow.

mortar, lean. *Noun.* See **lean mortar**.

mortar, lime. *Noun.* See **lime mortar**.

mortar-mix clay. *Noun.* A finely ground clay used as a plasticiser in masonry mortar.

mortar, pneumatically applied. *Noun.* See **pneumatically applied mortar**.

mortar, refractory. *Noun.* See **refractory mortar**.

MOSA. *Acronym.* Standing for metal oxide surge arrestor. See **metal oxide surge arrestor**.

mosaic. *Noun.* A decorative design or picture made by setting small coloured pieces, such as tile, stone or glass, in mortar.

mosaic faience. *Noun.* Glazed or unglazed **earthenware** tile with characteristic variations in face, edges, and glaze to give a characteristic handmade appearance, and having facial dimensions less than 39 cm, and thicknesses of 8–9.5 mm; usually mounted on a backing to facilitate setting.

mosaic glass. *Noun.* See **millefiori**.

mosaic gold. *Noun.* SnS_2 . A suspension in lacquer of **stannic sulphide** for use in decorating surfaces.

mosaic tile. *Noun.* Glazed or unglazed porcelain or natural clay tile, shaped by dust-pressing or plastic forming to facial dimensions of less than 39×39 cm and thickness of 6.4–9.5 mm; frequently mounted on a backing to facilitate placement.

MOSFET. *Acronym.* Arising from metal oxide semiconductor field-effect transistor. See **metal oxide semiconductor field-effect transistor**.

moss agate. *Noun.* A milky **chalcodony** containing **dendritic** patterns and not the usual agate-banded structure. The dendrites are formed by manganese and iron oxide inclusions. Used as a gemstone.

Mössbauer effect. *Noun.* The study of the energy of emitted γ -rays from nuclei that show no recoil loss because they are rigidly bound into a crystal structure; the γ -ray energy equals that of the excitation energy of the nucleus. Now frequently used in structural studies of ceramics.

moss opal. *Noun.* A form of amorphous **silica** containing branching inclusions.

moss paint. *Noun.* A type of paint developed for plaster and brick decorating which consists of beer or buttermilk and a little sugar into which moss is blended before applying to the wall.

Mossotti catastrophe. *Noun.* The situation where the **electric susceptibility** of a **ferroelectric** material becomes infinite when the ratio $n\alpha/3\epsilon_0$ assumes a value of unity, where n is the number of **dipoles** per unit volume, α is the **polarisability**, and ϵ_0 is the **permittivity of free space**.

mother lode. *Noun.* The principal seam or load in a mining system.

mother-of-pearl. *Noun.* A hard **iridescent** substance composed mainly of **aragonite** in a matrix of biopolymers called the water soluble matrix.

mottle. *Verb trans.* To decorate or colour with streaks or blotches of varying shade.

mottled finish. *Adjective.* A speckled finish, frequently of different colours, produced as a decorative effect on porcelain-enamels and glazes.

Mott transition. *Noun.* The possibility of a sudden metal to insulator transition with variation in atomic spacing as first described by Sir Neville Mott.

mould. *Noun.* (1) A form in or around which an item is shaped. (2) *Verb trans.* The process of forming in or around a mould. The American spelling of **mold** is often encountered.

mouldability. *Noun.* The capability of a material or composition to be shaped by moulding.

mould, blank. *Noun.* See **blank mould**.

mould, block. *Noun.* See **block mould**.

mould, blow. *Noun.* See **blow mould**.

mould brick. *Noun.* An insulating brick shaped to fit the top of an **ingot mould**.

mould, case. *Noun.* See **case mould**.

mould cycle. *Noun.* (1) The time taken to complete the full sequence of operations needed to make a green shape on a moulding press. (2) The complete sequence of operations needed to make the component on a moulding press.

mould, double-cavity. *Noun.* See **double-cavity mould**.

moulded. *Adjective.* Formed in a contoured cavity or around a model.

moulder. *Noun.* A person who moulds items or makes moulds.

mould, finish. *Noun.* See **finish mould**.

moulded glass. *Noun.* Glass shaped in a mould.

mould, hot. *Noun.* See **hot mould**.

moulding. *Noun.* (1) Something moulded. (2) A shaped outline particularly used on a cornice.

moulding, injection. *Noun.* See **injection moulding**.

moulding machine. *Noun.* A machine designed to compact sand around a pattern to form a mould.

mould, ingot. *Noun.* See **ingot mould**.

moulding pressure. *Noun.* The stress required to press a plastic substance into all areas of a mould chamber.

moulding sand. *Noun.* (1) The sand applied to the surface of the wooden moulds in which soft-mud bricks are formed as a means of texturing the surface of the brick and to facilitate removal of the brick from the mould. (2) Sand, low in organic matter, mixed with various bonding agents, used to form moulds in foundries.

moulding, shell. *Noun.* See **shell moulding**.

mouldless manufacture. *Noun.* See **art-to-part**.

mould lubricant. *Noun.* A substance applied over the work surface of a mould to reduce friction, prevent adhesion, and facilitate separation of ware from the mould, e.g., graphite, soap, etc.

mould mark. *Noun.* A seam line on ware at the junction of mould parts.

mould, master. *Noun.* See **master mould**.

mould, neck. *Noun.* See **neck mould**.

mould, parison. *Noun.* See **parison mould**.

mould, paste. *Noun.* See **paste mould**.

mould plug. *Noun.* A refractory clay, graphite, or metal seal for the bottom of an **ingot mould**.

mould, porous. *Noun.* See **porous mould**.

mould release agent. *Noun.* A lubricant such as a metal soap applied to mould surfaces to assist in the release of moulded articles.

mould, ring. *Noun.* See **ring mould**.

mould seam. *Noun.* A line, on a moulded or laminated piece, differing in colour or texture from the general surface; caused by the parting line of the mould.

mould, semi-permanent. *Noun.* See **semi-permanent mould**.

mould, three-cavity. *Noun.* See **three-cavity mould**.

mould wash. *Noun.* A suspension, or emulsion used to coat the cavity of a mould to facilitate the release of ware from the mould after it has been formed.

mould, waste. *Noun.* See **waste mould**.

mould, working. *Noun.* See **working moulds**.

mounted wheel. *Noun.* Small, variously shaped, abrasive products mounted on steel spindles or mandrels.

mouth. *Noun.* The opening in a machine or processing operation into which a **batch** is charged.

moving bed, continuous. *Noun.* See **continuous moving bed**.

moving bed, intermittent. *Noun.* See **intermittent moving bed**.

MOVPE. *Acronym.* Standing for metal organic vapour phase epitaxy. See **metal organic vapour phase epitaxy**.

MOX. *Noun.* The mixed ceramic oxide fuel element, $\text{UO}_2\text{-PuO}_2$ developed for advanced nuclear reactors.

mp. *Abbreviation.* Standing for melting point.

MRAM. *Acronym.* Stands for magnetoresistive random access memory. See **magnetoresistive random access memory**.

MSANS. *Abbreviation.* Stands for multiple small angle neutron scattering. **See** **multiple small angle neutron scattering**.

Mtoe. *Abbreviation.* Stands for million tonnes of oil equivalent. A unit of energy equal to 41.868 GJ.

M-type ferrite. *Trade name, noun.* $(\text{MO})(\text{Fe}_2\text{O}_3)$. One of the six types of hexagonal **ferrimagnetic** material based on **solid solutions** formed from **iron oxide**, Fe_2O_3 , and oxides of divalent metals but most commonly the M^{2+} ion is barium, Ba^{2+} .

mucilage. *Noun.* A sticky preparation used as an adhesive in **green ware** forming.

mucky. *Adjective.* A colloquial expression for a soft cast formed when a mould removes water too slowly.

mud. *Noun.* A fine-grained, soft, wet deposit occurring on certain grounds after rain.

muddy. *Adjective.* (1) Covered with mud. (2) Cloudy. (3) Not bright; dull colours.

mud jacking. *Verb.* To raise a concrete slab by pumping a cement-soil-water slurry under the slab.

mudrock. *Noun.* **See** **mudstone**.

mudstone. *Noun.* A dark-grey, sedimentary, laminated rock similar to shale. It is a water-saturated, highly compacted mixture of fine sized oxides of low atomic number elements, numerous trace elements and hundreds of species of fossilised organic components. Thermal decomposition of mudstone generates hydrocarbons from the organic matter in the pores. Also called **mudrock**.

mud-up. *Verb.* To seal a smelter, furnace, pot, gas line, etc., by the insertion of wet clay.

muff. *Noun.* A blown cylinder of glass that is cut and flattened while plastic to form small segments of window glass.

muffle. *Noun.* A refractory enclosure or chamber in a furnace designed to protect ware from the flame and products of combustion. **See** **muffle kiln**.

muffle kiln. *Noun.* A kiln in which fuel combustion occurs within a refractory enclosure to protect ware from the flame and products of combustion, the heat being transferred by conduction to the area in which the ware is being fired.

Mulcorit. *Trade name, noun.* A porous ceramic of low density containing **mullite** and **cordierite**; maximum working temperature 1,300 °C.

muller. *Noun.* A heavy roller or wheel, usually of metal, mounted in a heavy pan for grinding, mixing, and tempering. The bottom pan is usually perforated to allow powder to be collected.

muller crusher. *Noun.* **See** **muller**.

muller mixer. *Noun.* **See** **muller**.

mullet. *Noun.* A knife-like instrument used to separate hand-blown glass from the blowpipe.

mulling. *Verb.* The wet or dry process of grinding, mixing, and tempering substances by means of a **muller**.

mullite. *Noun.* The highest melting **aluminosilicate**, which, because of its unusual solid-solution behaviour, is of uncertain structure and composition. The composition is expressed as a range in old-fashioned notation: $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ to $2\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$, called respectively 3/2 and 2/1 mullite. The structure is believed to be related to **sillimanite** and its **acicular crystal habit** helps to impart strength to matrices in which it is a common second phase. Used as a refractory in high-temperature applications and as a strength-producing phase in **stoneware** and **porcelain** where it arises via a **topotactic decomposition of kaolinite**. Mp 1,810 °C; softening temperature 1,650 °C.

mullite porcelain. *Noun.* A vitreous whiteware containing mullite as the main crystalline phase; used for spark plugs, laboratory ware, and other products where resistance to thermal shock, chemicals, and deformation under load are important.

mullite refractories. *Noun.* Refractory products in which mullite is the main crystalline phase bonded by a few percent of a high-silica-content glass.

mullite whiteware. *Noun.* Any ceramic whiteware in which mullite is the main crystalline phase formed by the **topotactic** thermal decomposition of **kaolinite**.

mullock. *Noun.* Mine waste.

multiaxial multilayer. *Noun.* A type of reinforcing fabric where yarns are inserted in different directions from 0° to 90°.

multibucket feeder. *Noun.* Machine equipped with a series of buckets mounted on an endless chain to scoop up materials for delivery to a container or vehicle for movement from one location to another.

multicolour machine. *Noun.* A ceramic ware-decorating machine capable of applying more than one colour at a time.

multicrystalline silicon. mc-Si. *Noun.* The form of silicon best suited to building large area solar cells.

multifaceted. *Adjective.* A crystal or gem having many faces.

multiferroic. *Noun.* A material that simultaneously exhibits **ferromagnetic** and **ferroelectric** properties. Most are synthetic ceramics, such as **europium titanate** and their properties are controlled by compositional changes or structural strain changes. **Nickel boracites** are good examples, as too are thin films of europium titanate, EuTiO_3 , deposited on to single crystals of **dysprosium scandate** and cooled to 4 K. Hexagonal rare earth manganites are the dominant class. Also called **Janus materials**.

multiferroism. *Noun.* A state that exists when 2 or 3 of **ferroelectricity**, **ferromagnetism** and **ferroelasticity** are present in the same phase.

multifilament yarn. *Noun.* A yarn made from 5 to 100 monofilament fibres slightly twisted together. See **continuous filament yarn**.

multilayer ceramic. *Noun.* A ceramic made by casting thin layers of **green state** ceramic on top of each other before firing.

multilayer ceramic substrate. MLC. *Noun.* Constructed from layers 4–20 μm thick of doped BaTiO_3 and related materials. Devices up to 250 layers thick are made. Metallic conductive pathways are screen printed on separate layers of unfired ceramic. Specially positioned holes in the layers are filled with conductive paste and the whole assembly is sintered to provide a substrate with a 3-D network of interconnections. This arrangement gives a high density of packing of components and increased reliability by minimising the volume of external wiring.

multilayer ceramic capacitor. MLC. *Noun.* Developed around **barium titanate**, BaTiO_3 , materials in order to achieve size reductions by utilising the **capacitance** density of barium titanate and vapour deposition methodology. An MLC capacitor with n dielectric layers is equivalent to n disk capacitors in parallel.

multilayer ceramic composite. *Noun.* A sandwich structure in which the middle layer contains the main component of the outer layers mixed with partially **stabilised zirconia**. This arrangement increases both strength and toughness.

multilayered disk capacitor. *Noun.* A disk-shaped ceramic capacitor made by building up alternate dielectric and electrode annular layers, firing, and then coating the inner and outer diameters with silver.

multimode cavity. *Noun.* In microwave applications it is a cavity, large in relation to the free wavelength, which then allows a number of different standing waves to be generated.

multimolecular layer. *Noun.* A film or coating more than one molecule thick.

multipass kiln. *Noun.* A kiln consisting of more than one tunnel or passage for the concurrent firing of ware.

multiphase fibres. *Noun.* Fibres made by **CVD**, such as **boron** that contains central cores of substrate, such as tungsten wire or carbon fibre.

multiple small angle neutron scattering. MSANS. *Noun.* A method used to investigate pore size in partially sintered ceramics. It involves analysing the line broadening on a neutron diffraction pattern. For a porous ceramic with μm sized grains fine scale structure

is usually insignificant and for a known porosity value, Φ , the Porod pore diameter, $D_{\text{Porod}} = 6\Phi/S_v$, where S_v is the interfacial surface area per unit volume of sample, can be deduced.

multiplicity. *Noun.* The number of levels into which the energy of an atom, molecule, or nucleus splits as a result of interaction between orbital momentum and spin angular momentum.

multiport burner. *Noun.* A burner with several nozzles for discharge of fuel and air.

multiprogramming. *Verb.* Running several computer programs by a time-sharing method whereby each runs for a short period in rotation.

multivibrator. *Noun.* An electronic oscillator containing two transistors coupled so that the input of each comes from the output of the other.

Munsell colour classification. *Noun.* A classification system used in the geosciences and to some extent in ceramics to measure colour. First colour is defined in terms of **hue** (H), which is position of colour in the spectrum, **chroma** (C), which is the purity of the hue going from grey to a pure colour and **value** (V), the lightness of the colour on a scale ranging from black to white. H, C, and V are plotted on a three dimensional diagram.

Munsell scale. *Noun.* A standard chromaticity scale used to specify colour. It gives approximately equal changes in visual hue between 0 and 10.

Munsell value. *Noun.* The daylight **reflectance** of a material where 0 equals ideal black and 10 equals ideal white.

muntin. *Noun.* See **glazing bar**.

muon. *Noun.* Fundamental particle in the electron family. Two hundred times heavier than an electron, $3 \times$ the **magnetic moment** of a proton and a mean lifetime of 2.2 μs . Used to explore magnetic environments in crystals etc.

Murgatroyd belt. *Noun.* The part of the sidewall of a bottle near the bottom.

muriatic acid. *Noun.* HCl. An old name for hydrochloric acid used to clean and pickle metals for porcelain-enamelling.

murrhine, murrine. *Noun.* A still unknown substance used in ancient Rome to make vases.

murrhine glass. *Noun.* Glassware made in the East from **fluorspar** decorated with pieces of coloured metal.

muscovite. *Noun.* $\text{KAl}_2(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$. A monoclinic, white, aluminium-rich **mica** that is a univalent or **true mica** found in many clays; usually very clear in colour, it has the form of small shiny flakes of a

bronze-golden colour. Used mainly as a paint extender, as a plastic filler, in insulators and as a pigment. The name comes from the old name for mica. See **Muscovy glass**. Density 2,700–3,100 kg m⁻³; hardness (Mohs) 2–2.5.

muscovy glass. *Noun.* An old name used for the mineral mica.

mushroom anvil. *Noun.* A steel form having a mushroom-like appearance used in shaping metal bowls for porcelain enamelling as artware.

mutual inductance. *Noun.* The mutual induction between two magnetically linked circuits; quantified as

the ratio of the induced emf to the rate of change of current producing it; measured in **henries**.

MWNT. *Abbreviation.* Standing for **multiwall nanotube**. See **carbon nanotubes**.

mylonite. *Noun.* A metamorphic rock of many different compositions because it is classified on textural appearance with an extremely fine-grained structure, laminated by the different grain sizes and showing banding formed by shearing the original structure.

MZP. *Abbreviation.* Stands for magnesium zirconium phosphate, MgZr₄(PO₄)₆. See **calcium magnesium zirconium phosphate**.

Nn

N. *Abbreviation.* Standing for (1) **newton(s)**; (2) normal solution.

N. *Symbol.* Stands for (1) nitrogen; (2) **Avogadro's number**.

N3 centre. *Noun.* A defect present in some **diamonds** where three nitrogen atoms that have substituted for carbon atoms are arranged on a plane around a carbon atom vacancy. This defect complex imparts a yellow hue to the diamond.

n. *Adjective.* (1) Signifying an indefinite number; (2) *Informal.* signifying a large number of things.

n, n_p. *Symbol.* (1) Standing for **index of refraction**, generally used with a subscript indicating the spectral line; for example, n_D is the index of refraction for the sodium D line; (2) neutron; (3) nano-.

Na-4-mica. *Noun.* Na₄Si₄Al₄Mg₆O₂F₄·xH₂O. A synthetic fluorine containing **clay** developed to take-up and immobilise radium from water. The 0.26 nm interlayer spacing is too small to capture hydrated Na⁺, Ca²⁺, or Ba²⁺ because Ra²⁺ is less hydrated.

Nabarro-Herring creep. *Noun.* Deformation in heated ceramic structures caused by grain boundary sliding along a few boundaries, combined with grain boundary squeezing on the majority of boundaries. The creep rate is proportional to applied stress and smaller grains undergo faster deformation.

nacre. *Noun.* The technical name for **mother-of-pearl**.

nacreous. *Adjective.* Having the **lustre** of **mother-of-pearl**.

nacrite. *Noun.* Al₂Si₂O₅(OH)₄. A mineral of the **kaolinite** group but the layer stacking in the unit cell leads to monoclinic symmetry.

nailing concrete. *Noun.* A lightweight concrete containing a material such as sawdust in proportions that it will receive nails.

naked glass. *Noun.* Plane ware before decoration.

nano-. n. *Combining form.* (1) Denoting 10⁻⁹. (2) Suggesting extreme smallness; from the Greek word meaning dwarf.

nanobelt. *Noun.* A flat structure that can carry an electric current with nanometre dimensions, such as zinc layers connecting **source** and **drain** on a semiconductor microchip.

nanocharacterisation. *Plural noun.* Ways of analysing and manipulating single atoms.

nanocrystalline solid. *Noun.* See **nanophase ceramics**.

nano-devices. *Plural noun.* See **molecular-nanotechnology**.

nanodot. *Noun.* A particle so tiny that about 80,000 would be needed to span a human hair. They are made from very small colloidal particles of **semiconductor ceramic**, such as CdSe. There are many more surface atoms than those in the bulk of the particle and so the surface properties dominate. They absorb light in the **uv** but emit different wavelengths in the visible spectrum and the wavelength depends on the size of the dot. Also known as **quantum dot**.

nano-flower. *Noun.* One of the spectrum of nano-scale microstructures that can be grown by **CVD**, **VLS**, etc., on suitable substrates. It has the appearance of petal-like planes growing along and outward from the substrate with pointed triangular planes.

nanofluid. *Noun.* A solid-liquid composite material that is a suspension of nanotubes and ceramic nanoparticles, such as Al₂O₃, CuO, in fluids designed to improve heat transfer characteristics in coolants.

nanohardness tester. *Noun.* An instrument that combines a nanoindentation measuring head with a high resolution scanning force microscope. It is capable of making indentations on highly localised sites. The microscope can be used to measure the surface topography of a site before and after the nanoindentation has been made, which gives information on **cracks**, **pile-up**, **fracture toughness** and **stress-strain** behaviour.

nanohorn. *Noun.* Single-walled **carbon nanotubes** shaped like horns that can enhance electron transfer when used in electrode assemblies.

nano-imprint lithography. *Noun.* The substrate is **spin-coated** with a thin film of UV-sensitive **resist**. A **PET** master structure is then put on to imprint a positive **nano-dot** structure by simple hand rolling of the harder PET into the resist, which is then cured by exposure to uv light. Then the master is peeled away from the resist. Final removal of the residual layer is done by etching to leave an array of holes in the resist.

nanomachine. *Noun.* Nanoscale machines that function on their own or as a structural component of a system.

nanomaterial. *Noun.* See **engineered nanomaterial**.

nanometre. nm. *Noun.* 10^{-9} of a metre; used in the measurement of the wavelength of light and the specification of x-ray unit cell dimensions.

nanoparticle. *Noun.* See **engineered nanomaterial**.

nanophase ceramics. *Plural noun.* Articles formed from powders less than 50 nm in diameter, which is some 100 times smaller than conventional powder. Vaporising a source material in a gaseous flow followed by rapid condensation is often used to make the powders. Such ceramics are more ductile and more easily formed as the grain size decreases. Sintering temperatures can be reduced as much as 500 °C below conventional powders. At 10 nm diameter, at least 50 % of the solid consists of low atomic-density boundaries.

nanoscale. *Adjective.* Dimensions and tolerances in the range 0.1–100 nm.

nanostuctured materials. *Plural noun.* See **bulk nanostuctured materials**.

nanostuctured silicon. *Noun.* A silicon **wafer** or **chip** into which nanometre sized pores have been introduced by electrochemical etching with hydrofluoric acid solutions. The nanoporous material has new properties compared to bulk silicon, for example it is strongly **fluorescent** in the visible region.

nanotechnology. *Noun.* A branch of technology concerned with the manipulation of atoms and molecules on an individual basis and the manufacture of objects with dimensions less than 100 nm.

nanothermite. *Noun.* A combination of ceramic oxide nanoparticles and a reducing metal powder, such as aluminium, which, when mixed react in a very exothermic reaction. The components must remain separated until the reaction is needed and filling carbon nanotubes with the oxide powder does this. A carbon dioxide laser can then be used to breakdown the nanotubes and so ignite the reaction. They have potential as pyrotechnic initiators, explosives and rocket propulsion.

nanotube. *Noun.* Usually **graphene** sheets but can be other materials, such as **boron nitride**, rolled into a cylinder.

Used to construct nanoscale structures including probes, pipes, wires and springs. Atoms and ions can be housed in the tubes and the electrical properties can be made to vary from conducting to insulating.

nanowiggles. *Plural noun.* **Graphene** nanoribbons that have been segmented into several different surface structures. Each wiggle has greatly different magnetic and conduction properties and so a **graphene** nanostructure can be tuned to desired properties.

nanowire. *Noun.* A tiny string of silicon atoms used in connecting microchips.

nanoworld. *Noun.* The world at a microscopic level of nanoscale manufacturing.

Naples yellow. *Noun.* See **lead antimonate**.

nascent. *Adjective.* (1) Starting to develop. (2) A reactant, such as hydrogen, produced within a reaction medium and having a high activity.

NASICON. *Acronym.* Standing for Na super ionic conductor. See **nasicon ceramics**.

nasicon ceramics. *Plural noun.* Ceramic materials with the general formula $M_{1-x+4y}Zr_{2-y}Si_{1-x}P_{3-x}O_{12}$, with M usually limited to Na or Li, x in the range 0–3, and y in the range 0–1. The structure is a network of interconnected tunnels formed by a network of SiO_4 tetrahedra and $(Si_2P)O_{12}$ groups containing Na^+ ions and so they are fast three-dimensional ionic conductors. Often made by **sol-gel** methods.

nasil. *Acronym.* Stands for **sodium silicate** when it is used as a **deflocculant**.

natar. *Acronym.* Stands for **sodium tartrate** when it is used as a **deflocculant**.

natch. *Noun.* See **joggle**.

natrium. *Noun.* An obsolete synonym for sodium.

natrolite. *Noun.* $Na_3Al_2Si_3O_{10} \cdot 2H_2O$. A colourless, white, or yellowish **zeolite** mineral found as **acicular** orthorhombic crystals.

natron. *Noun.* $Na_2CO_3 \cdot 10H_2O$. Hydrous **sodium carbonate**; a whitish or yellowish mineral used in glass manufacture. See **soda**.

natural aging. *Noun.* (1) The changes observed in material occurring when it is exposed to normal environmental conditions. (2) Used to describe precipitation hardening carried out at room temperature.

natural alumina. *Noun.* One of two types of alumina abrasives: **corundum**, which is of relatively high purity, and **emery**, which is less pure. Contains iron oxide as the major impurity.

natural cement. *Noun.* A hydraulic cement produced by calcining a naturally occurring **argillaceous limestone** at a temperature below the sintering point and then grinding it to a fine powder.

natural clay tile. *Noun.* A tile made by the dust pressing or plastic method of forming from clays that produce a dense body of distinctive, slightly textured appearance.

natural composite. *Noun.* All kinds exist, for example, wood, which contains very long monofilament cellulose fibres as reinforcement in a matrix of dilute polymer solution, the sap; teeth containing a dentine matrix and **calcium apatite** particles; spider web, which is a gel core enclosed in aligned polymer thread, etc.

natural diamond. *Noun.* A mineral consisting of carbon in its cubic modification the hardest mineral known. The term "bort" sometimes refers to all diamonds not fit for use as gems or for most industrial applications, but is suitable for the preparation of diamond grain and powder for use in lapping or in the manufacture of diamond grinding wheels. This type of bort is known as **fragmented** or **crushed bort**. Such diamonds also are used in glasscutters, diamond drill bits, wire dies, and metal cutting tools. Density 3,510–3,530 kg m⁻³; hardness (Mohs) 10.

natural fibre. *Noun.* Organic or inorganic materials that possess the morphology of fibre, e.g., cellulose, **asbestos**, cotton.

natural finish. *Noun.* Unglazed or uncoated facing tile and other products fired to the natural colour of the raw materials from which the bodies were fabricated.

natural frequency. *Noun.* The frequency at which a system vibrates when set in free vibration.

natural gas. *Noun.* A gas mixture containing mostly methane trapped below ground and exploited for its energy value as a fuel.

natural mica. *Noun.* (K,Na,Ca)(Mg,Fe,Li,Al)₂₋₃(Al,Si)4O₁₀(OH,F)₂. A group of minerals, all of which contain hydroxyl, aluminium, silicon, and alkali ions. All have similar physical properties and crystal structure; all may be split into flexible elastic sheets, but may be of varying chemical compositions. Hardness (Mohs) 2.0–2.5.

natural resource. *Noun.* A deposit or accumulation of minerals, potable water, waterpower, and industrial materials occurring in nature.

natural slope. *Noun.* The maximum angle that sand, soil, etc., will lie in a bank without slipping.

natural uranium. *Noun.* Uranium having an isotopic composition as it occurs in nature, 0.711 wt.% ²³⁵U, which has not been altered.

NBO. *Abbreviation.* Standing for non-bridging oxygen. Important in oxide glass structures.

NDT. *Abbreviation.* Standing for non-destructive testing. See **non-destructive test**.

Nd:YAG. *Abbreviation.* Stands for neodymium doped yttrium aluminium garnet. A powerful **laser** ceramic. See **yttrium aluminate**.

near net shape forming. *Noun.* **Forming** processes designed to limit the amount of final grinding and polishing needed to meet **specification**. **Forging** and **moulding** are two examples. See **net shape forming**.

neat cement. *Noun.* A plastic mixture of **Portland cement**, but without aggregate.

neat grout. *Noun.* A grout consisting only of cement and water.

neat plaster. *Noun.* A base-coat plaster in which sand is added at the site of use.

Nebuchadnezzar. *Noun.* A ceramic or glass wine bottle of 15-l capacity.

nebulise or nebulize. *Verb trans.* To atomise or convert a liquid into a fine spray.

nebuliser. *Noun.* A device for converting a liquid into a fine mist or spray. Sometimes called **atomiser**.

neck. *Noun.* (1) The constricted portion of a bottle between the shoulder and the opening or finish. (2) The part of a **tank furnace** connecting the melting and working chambers. (3) The section of a furnace structure connecting the uptake and part of a furnace where the flame is diminished before reaching the stack. (4) The narrow section of a pot. (5) An area in a solid where plastic flow has concentrated under tension. (6) A column of solidified magma from a volcanic vent.

neck and canal. *Noun.* See **throat**.

neck brick. *Noun.* A brick so modified that one large face is inclined toward one end.

neck growth. *Noun.* Increase in the area of contact between spherical particles in a compact when atomic diffusion occurs on heating; excess **vacancies** in the neck region diffuse away to be replaced by atoms.

necking. *Noun.* (1) The concentration of plastic flow to a small region in a specimen under tension. (2) A plain concave band between the **capital** and shaft of a **Tuscan** column.

neck mould. *Noun.* The segment of a metal mould employed to form the neck and finish of a glass bottle or other similar article.

neck ring. *Noun.* A metal mould part used to form the finish of a hollow glass container.

needle. *Noun.* (1) The vertical reciprocating refractory part of a feeder in a glass-forming machine that alternately forces glass through the orifice and then pulls it upwards after shearing. (2) A potter's tool for removing the uneven top edge of wheel-thrown ware.

needle material transfer. *Noun.* The transfer of material in electrical contacts in which the build-up is needle-like in appearance.

needle valve. *Noun.* (1) A valve with a needle-like controller that can be moved to control fluid flow. (2) The control device in a spray gun assembly designed to control the flow of the fluid.

Néel point. *Noun.* See **Néel temperature**.

Néel temperature. *Noun.* A characteristic temperature of a material at which the susceptibility of an antiferromagnetic material has a maximum value. Above this temperature it becomes **paramagnetic**. Also called **Néel point**. See **antiferromagnetic material**.

negative. *Adjective.* Having a negative charge as demonstrated when an electrode or point possesses a lower electric potential than another point in a system.

negative edge dislocation. *Noun.* A **dislocation** in which the extra half plane of atoms lies below the slip plane.

negative feedback. *Noun.* The return of a part of a mechanical, electronic, or other system to the input in order to produce corrective changes in devices like amplifiers.

negative index material. *Noun.* A material with a negative **refractive index** where waves go in one direction but energy flows in the opposite direction. To obtain this effect both the **electric permittivity** and **magnetic permeability** have to be negative.

negative material transfer. *Noun.* The transfer of material in electrical contacts in which the build-up occurs on the negative contact.

negative pole. *Noun.* The end of a magnet that turns southwards when the magnet hangs freely.

negative resistance. *Noun.* A characteristic of some ceramic electronic components whereby an increase in applied voltage increases the resistance and so lowers the current passed.

nematic. *Adjective.* Existing in the **mesomeric** state in which a linear orientation of the molecules occurs and causes anisotropic properties; one of the two major classes of liquid crystal.

neodymia. *Noun.* Nd_2O_3 . Ceramic terminology for neodymium oxide. See **neodymium oxide**.

neodymium. *Noun.* Nd. A trivalent, lanthanide, metallic element employed in the production of glass filters for colour television plates and in glass lasers having radiation wavelengths beyond the visible range.

neodymium aluminate. *Noun.* NdAlO_3 . An hexagonal **perovskite** ceramic used as substrate for superconducting oxide deposition. Mp $2,160^\circ\text{C}$; becomes cubic at $1,100^\circ\text{C}$.

neodymium gallate. *Noun.* NdGaO_3 . An orthorhombic ceramic **perovskite** used as an alternative to **lanthanum aluminate** as a substrate for superconducting oxide thin films. It undergoes a structural transition at $1,350^\circ\text{C}$, well above the deposition temperature, which is an advantage over LaAlO_3 .

neodymium glass. *Noun.* A glass containing small amounts of neodymium oxide; used in television filter plates; transmits 90 % of the red, blue, and green light rays and 10 % or less of the yellow.

neodymium glass laser. *Noun.* A glass doped with neodymium having properties similar to those of pulsed **ruby laser**, the wavelength of radiation is outside the visible range.

neodymium iron boride. *Noun.* $\text{Nd}_2\text{Fe}_{14}\text{B}$. An hexagonal compound in which the boron atom at the 4 g-point site induces considerable neodymium site anisotropy and hence strong permanent magnetic properties. A **ferromagnetic** material discovered in 1983 to have some of the best magnetic properties ever. Very high **coercivity** and an energy product of 290 kJ m^{-3} but low **Curie temperature**, 312°C .

neodymium iron carbide. *Noun.* $\text{Nd}_2\text{Fe}_{14}\text{C}$. A permanent magnetic material isomorphous with **neodymium iron boride**.

neodymium nickel oxide. *Noun.* NdNiO_3 . A perovskite phase that undergoes a transition from metallic conduction to insulator below 200 K .

neodymium oxide. *Noun.* Nd_2O_3 . Employed in glass manufacture to impart a violet colour (red-violet in artificial light and blue violet in daylight) and to suppress the yellow sodium line in technical glasses of high **boric oxide** content. Glasses containing neodymium oxide are employed in the production of **lasers** and **capacitors**.

neodymium red. *Noun.* $\text{CaNdAl}_{1-x}\text{Cr}_x\text{O}_4$. A nontoxic, high-firing range of ceramic red colours based on the K_2NiF_4 structure.

neodymium sulphate. *Noun.* $\text{Nd}_2(\text{SO}_4)_3$. Used in small amounts as a decolouriser in glass, and in larger amounts as a glass colorant in tableware and in glass blowers' and welder's goggles.

neolith. *Noun.* A Neolithic stone implement.

Neoparies. *Trademark, noun.* A very white glass-ceramic made from **silica**, **feldspar**, **limestone**, ZnO , and BaCO_3 mixtures by melting at $1,480^\circ\text{C}$ and quenching in water. The resultant powdered glass is moulded and reheated at $1,100^\circ\text{C}$ when **acicular** crystals grow from the particle boundaries as they fuse.

neophane glass. *Noun.* A yellow glass tinted with **neodymium oxide** to reduce glare; used in automobile windscreens, sunglasses, etc.

nepheline. *Noun.* $\text{Na}_3\text{KAl}_4\text{Si}_4\text{O}_{16}$. Sodium potassium aluminosilicate; a **feldspathoid** mineral occurring in alkali-rich volcanic rocks usually having higher alkali and alumina contents and a lower silica content than conventional **feldspars**. Used as a substitute for feldspar because of its lower melting point; changed by water to **zeolite**. Used in the manufacture of glass and ceramics. Density $2,500\text{--}2,600 \text{ kg m}^{-3}$; hardness (Mohs) 5.5–6.

nepheline syenite. *Noun.* An igneous rock consisting of a mixture of nephelinic minerals, **microcline** (KAlSi_3O_8), **potash feldspar**, **soda feldspar**, and minor quantities of **magnetite**, **hornblende**, and **mica**; employed as a **fluxing agent** in **sanitary ware**, floor and wall tile, **semi vitreous ware**, **electrical porcelains**, glass, porcelain-enamels, and other ceramic products as a substitute for **feldspar** to lower firing temperature, shorten firing time, and increase firing range; to reduce **warpage**, expansion, and water absorption, and to increase mechanical strength. It tends to increase shrinkage. Its use also results in lower fuel and refractory costs. Mostly obtained from Canada and Norway where it occurs as coarse-grained plutonic rock. It contains 5–10 % K_2O and 8–11 % Na_2O . Density $2,614 \text{ kg m}^{-3}$ (crystalline) and $2,282 \text{ kg m}^{-3}$ (glassy); hardness (Mohs) 6; starts to sinter at **cone 8** and has a **PCE** of about cone 7.

nephelinite. *Noun.* A fine-grained laval rock containing **nepheline** and **pyroxene**.

nephelite. *Noun.* Another name for **nepheline**.

nephelometer. *Noun.* An instrument for measuring the size or density of particles suspended in a fluid.

nephelometry. *Verb.* Measurement of the intensity of light scattered at 90°C to the incident beam in order to measure the size of particles suspended in a fluid.

nephrite. *Noun.* $\text{Ca}_2\text{Mg}_5(\text{Si}_4\text{O}_{11})_2(\text{OH},\text{F})_2$. A compact, fibrous form of the **amphibole**, double-chain silicate, **tremolite**. Also called **kidney stone**. See **jade**.

nephrite jade. *Noun.* See **jade**.

Nernst body. *Noun.* A ceramic body consisting essentially of **zirconia**, **thoria**, and **yttria**, plus small additions of other **rare-earth oxides**; employed as a resistor in laboratory sized, high temperature furnaces.

Nernst heat theorem. *Noun.* The observation that reactions in crystals involve changes in **entropy** that tend to zero as the temperature approaches **absolute zero**.

net. *Adjective.* Remaining after all deductions.

net shape forming. *Noun.* The combination of materials and forming methods that produce a **green shape** product whose dimensions are unchanged after the consolidation, usually sintering, process. This implies no subsequent grinding operations, which keeps costs low. In practise this is difficult to achieve and so near net shape forming is more commonly encountered. See **near net shape forming**.

nett. *Adjective.* Alternative spelling of **net**.

netting analysis. *Noun.* A type of mechanical analysis used for fibre composite structures prepared by **filament winding**. The working assumptions are that the fibres carry all the stress in the structure and that they carry only axial tensile loads.

net weight. *Noun.* The weight of the contents of a container, generally determined as the difference between the **gross weight** and **tare weight** of the container.

network. *Noun.* (1) A system of electrical components assembled to perform a specific function. (2) A system of ions that together will form a three dimensional structure, as in glass or crystalline silicates.

network-forming ion. *Noun.* An ion that will form a partially covalent network with other ions in the structure of a glass, for example, SiO_2 , B_2O_3 , etc.

network-modifying ion. *Noun.* An ion of low valency and of relatively large radius, such as the **alkaline earths** and **alkali metals**, which modify but do not directly form an atomic or ionic network in the structure of glass.

network structure. *Noun.* See **network**.

Neuberg blue. *Noun.* A blue ceramic colorant composed of **copper carbonate** and a mixture of iron ferrocyanide and **iron sulphate**.

Neumann-Kopp rule. *Noun.* A statement that the change in **heat capacity** resulting from the formation of a solid compound from its solid elements is equal to zero; e.g. for a metal silicide it can be written: $C_p(\text{M}_x\text{Si}_y) = xC_p(\text{M}) + yC_p(\text{Si})$.

neural networks. *Noun.* A computer system designed to mimic the thought process that occur within the brain and so solve problems by learning from experience. It may involve the use of **neurochips**.

neurochip. *Noun.* A semiconductor chip designed for use in an electronic neural network.

neutral. *Adjective.* (1) Neither acid nor alkaline; having a pH of 7.0. (2) Possessing zero charge or potential.

neutral atmosphere. *Noun.* An atmospheric condition that is neither oxidising nor reducing; usually the term is applied to the firing zone of a furnace or kiln.

neutral axis. *Noun.* The plane on which there is no compressive or tensile stress in a bent beam specimen.

neutral density. *Noun.* Black, white or grey; a colourless tone.

neutral glass. *Noun.* A term employed to describe a glass that is resistant to chemical attack.

neutralisation. *Noun.* See **carbonation**.

neutraliser. *Noun.* (1) A dilute alkaline solution employed as a treatment in the preparation of sheet-metal ware for porcelain-enamelling in which acids, remaining on the ware following the **pickling** process, are neutralised. (2) An aqueous solution of a chemical or a mixture of chemicals which has a pH greater than 7.

neutraliser, cyanide. *Noun.* See **cyanide neutraliser**.

neutral refractories. *Plural noun.* Refractories that are chemically neutral and are resistant to both acidic and basic refractories, fluxes, and slags at high temperatures.

neutral solution. *Noun.* An aqueous solution that exhibits neither acidic nor alkaline properties and has a pH close to 7.

neutral tinted glass. *Noun.* A glass employed as a light filter to reduce the transmission of light with minimal selective absorption of specific wavelengths.

neutron. *Noun.* A fundamental atomic particle having no electrical charge and a mass slightly greater than that of a hydrogen atom or proton, or 1.00897 **atomic mass units**. It is a constituent of the nuclei of all atoms except those of hydrogen.

neutron-absorbing glass. *Noun.* A **cadmium borate** glass containing additions of **titania** and **zirconia** having a high neutron-capture cross-section.

neutron cross-section. *Noun.* A measure of the probability that nucleus will capture a neutron, the cross section being a function of the neutron energy and the structure of the target nucleus.

neutron diffraction. *Noun.* The interference processes which will occur when neutrons are scattered by atoms in solids, liquids, and gases; the intensities of the diffracted beams are measured by means of a radiation counter or an ionisation chamber.

neutron flux. *Noun.* The number of neutrons that pass through an area of one square centimetre per second, equal to the number of neutrons per cubic centimetre times the average neutron velocity.

neutron leakage. *Noun.* The escape of neutrons from a reactor.

newton. N. *Noun.* A derived **SI unit** of force. It is the unit of force required to accelerate a mass of one kilogram one meter per second; equal to 10^5 dynes or 7.233 **poundals**.

Newtonian. *Adjective.* Used to describe a liquid such as glass when molten which has a viscosity that is independent of stress or velocity gradient over a wide range of values.

Newton's rings. *Noun.* The interference pattern observed where a plano-convex lens is placed in contact with a reflective plate so that the convex face makes a point contact to produce a variable thickness air film which then causes a concentric ring interference pattern emanating from a dark central spot.

Nextel 312. *Trademark, plural noun.* Family name for a group of ceramic reinforcing fibres melt-spun from compositions in the Al_2O_3 - BO_3 - SiO_2 system; non-oxidising, chemically resistant, low thermal conductivity, and good abrasion resistance; used to sew composite laminates when combined with 10 % **fugitive** rayon. Continuous use at 1,200 °C is possible. **Nextel 440** is

another aluminoborosilicate fibre. **Nextel Z-11** is a continuous alumina fibre containing ZrO_2 .

Nextel 440. *Trademark, noun.* See **Nextel 321**.

Nextel Z-11. *Trademark, noun.* See **Nextel 321**.

nib. *Noun.* (1) A **tungsten carbide** die employed in the drawing of wire and similar materials. (2) A small projecting point occurring as a defect or fault in a corner or edge of plate glass during cutting. (3) The protrusion formed on the end of roofing tile to anchor the tile in place in roofing construction.

nibbed sagger. *Noun.* A series of projections on the interior walls of a **sagger** on which ware is placed during the firing operation.

nibber. *Noun.* The blade of a squeegee employed in rubbing colouring pastes and inks through a silk screen in the decoration of ware.

Nicalon. *Trademark, noun.* **Silicon carbide** fibre made by pyrolysing dodecamethylcyclohexasilane; contains considerable amounts of oxygen from the pre-fire needed to stabilise the polymer, along with free carbon; composition is approximately SiC (65.3 %), SiO_2 (23.0 %) and free carbon (11.7 %).

niccolite. *Noun.* The ore **NiAs** that lends its name to a hexagonal group of minerals containing **pyrrhotite**; pale copper-red colour; density $7,830 \text{ kg m}^{-3}$; hardness (Mohs) 5–5.5. Also called **nickeline**.

niche. *Noun.* A recess in a wall usually made to contain a statue.

Nichrome. *Trademark, noun.* A commercial alloy of nickel, iron, and chromium, used to make electrical furnace heating elements.

nickel aluminate. *Noun.* NiAl_2O_4 . A partially **inverse spinel** with **semiconductor** and magnetic uses. Mp $2,020^\circ\text{C}$; density $4,450 \text{ kg m}^{-3}$.

nickel aluminide. *Noun.* (1) NiAl . Excellent oxidation and thermal shock resistance; resistant to molten glass; may be used in turbine blades, combustion chamber applications, and glass-processing equipment. Mp $1,640^\circ\text{C}$; density $5,900 \text{ kg m}^{-3}$, compare the x-ray density of $6,050 \text{ kg m}^{-3}$; hardness (Rockwell A) 68–72; coefficient of thermal expansion $15.1 \times 10^{-6} \text{ K}^{-1}$; electrical resistivity at room temperature is $25 \mu\Omega \text{ cm}$. (2) Ni_3Al ; another cubic alloy used in turbine blade manufacture.

nickel arsenide. *Noun.* **NiAs**. See **niccolite**.

nickel bloom. *Noun.* See **annabergite**.

nickel blues. *Noun.* A generic term for a number of iron blue pigments made from iron ferrocyanide and iron sulphate.

nickel-bonded titanium carbide. *Noun.* A particulate composite of titanium carbide, $\text{TiC}_{0.97}$, with nickel to serve as a bonding agent. Also known as **TiC-Ni cermet**.

nickel carbonate. *Noun.* NiCO_3 . Sometimes used as an ingredient in ceramic colours and glazes.

nickel dip. *Noun.* A thin film of metallic nickel deposited on the surface of steel ware to be porcelain-enamelled; the process involving galvanic action, reduction, or both.

nickel ferrate. *Noun.* NiFe_2O_4 . A partially **inverse spinel** exhibiting variable semiconduction of the hopping charge variety; also **ferromagnetic** with a **Curie temperature** of 858 K. Mp 1,660 °C; density 5,340 kg m^{-3} .

nickel ferrite. *Noun.* NiFe_2O_3 . Used as thin films in memory devices and microwave technologies. When the films have aligned crystal structures the magnetic properties are maximised and doping with zinc preserves the magnetic behaviour to higher temperatures.

nickel flash. *Noun.* See **nickel dip**.

nickeline. *Noun.* Another name for **niccolite**.

nickel manganate. *Noun.* NiMnO_3 . A **ferromagnetic perovskite** with a Curie temperature of 437 K.

nickel nitrate. *Noun.* $\text{NiNO}_3 \cdot 6\text{H}_2\text{O}$. sometimes used in the manufacture of brown ceramic colours.

nickel nitride. *Noun.* Ni_3N . An electrical conductor having a resistivity of $2.8 \times 10^{-3} \Omega \text{ cm}$.

nickel oxide. *Noun.* (1) NiO . Absorbs oxygen at 400 °C to form Ni_2O_3 which is reduced back to NiO at 600 °C; **hopping charge-type semiconductor**; employed as an **adherence-promoting agent** in porcelain-enamel ground coats, as a blue, green, grey, brown, and yellow colouring agent in glazes and porcelain-enamels, and as a decolorising agent in glass. One of the first metal oxide **thermistors**. Mp 1,985 °C; density 6,600–6,800 kg m^{-3} . (2) Ni_2O_3 ; reduced to NiO at 600 °C; employed as a source of NiO in porcelain-enamels, glass, and glazes. Density 4,840 kg m^{-3} .

nickel pickle. *Noun.* See **nickel dip**.

nickel pickling. *Verb.* See **nickel dip**.

nickel stannate. *Noun.* $\text{NiSnO}_3 \cdot 2\text{H}_2\text{O}$. Loses water of hydration at 125 °C; employed in **barium titanate** bodies to lower the **Curie temperature**.

nickel sulphate. *Noun.* (1) NiSO_4 . Loses SO_3 at 840 °C. Density 3,400–3,700. (2) $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$; loses $6\text{H}_2\text{O}$ at 280 °C. Density 2,030–2,070. (3) $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$; loses $7\text{H}_2\text{O}$ at 98–100 °C. density 1,980 kg m^{-3} ; All are employed in nickel-dipping. See **nickel dip**.

Nicol prism. *Noun.* An optical device made by cutting diagonally a **calcite** crystal into two parts and then cementing them back together with **Canada balsam** so that total internal reflection of one of either the **ordinary** or **extraordinary rays** occurs at the interface so formed. It is used to produce and analyse polarised light. See **polarisation**.

nicolo. *Noun.* A type of **onyx** consisting of a bluish coloured layer over black.

niello. *Noun.* (1) Black, artificially made metal sulphides usually lead, silver or copper. Used as inlay decoration. See **rolled inlay**. (2) The process of decorating surfaces with niello. (3) A surface or object decorated with niello. (4) *Verb.* To decorate with niello.

nine-inch brick. 9-brick. *Noun.* A rectangular brick measuring approximately $22.9 \times 11.3 \times 6.4 \text{ cm}$; used as the standard unit of size in the refractories industry.

nine-inch equivalent. *Noun.* The volume of a 9-in. brick, $1.66 \times 10^{-3} \text{ m}^3$ (100 in.³); used to express the amount of material in a single shape, shipment, or period of production of refractory materials.

niobic. *Adjective.* Of or containing niobium in the pentavalent state. Also **columbite**.

niobite. *Noun.* Another name for columbite. See **columbite**.

niobium carbide. *Noun.* (1) NbC_x , x in the range 0.96–0.55. Employed in **cemented carbide**-tipped tools. Mp about 3,500 °C; density 7,820 kg m^{-3} ; hardness (Vickers) 24.7–23.0 GN m^{-2} , depending on the stoichiometry, have been reported (above 9 on Mohs scale); modulus of rupture 240 MN m^{-2} ; specific electrical resistivity 147 $\mu\Omega \text{ cm}$ at room temperature and 254 $\mu\Omega \text{ cm}$ at the melting point. (2) Nb_2C . Mp 3,087 °C; density 7,850 kg m^{-3} .

niobium oxide. *Noun.* (1) Nb_2O_5 . A **ferroelectric** material. Density 4,500–5,000 kg m^{-3} ; mp 1,520 °C; coefficient of linear thermal expansion $6 \times 10^{-7} \text{ K}^{-1}$ (298–675 K); Curie temperature 200–275 °C. (2) NbO . Mp 1,945 °C; density 6,270 kg m^{-3} . (3) Nb_2O_3 . Mp 1,773–1,777 °C.

niobous. *Adjective.* Of or containing niobium in the trivalent state. Also **columbus**.

nip. *Noun.* (1) A small glass bottle of approximately 250 ml capacity. (2) The largest angle that will just grip a lump between the jaws, rolls, or mantle and ring of a crusher. (3) The line of contact in the jaws of a tensile testing machine. (4) The area of contact between two contiguous surfaces that move to compress sheets of material.

nit. *Noun.* A unit of **luminance** equal to one **candela** per square metre.

nitre. *Noun.* KNO_3 . Alternative name for **potassium nitrate**. Employed in glass, glazes, and porcelain-enamels because of its powerful oxidising and fluxing properties. Density 2,090–2,270 kg m^{-3} ; mp 334 °C; decomposes at about 400 °C; hardness (Mohs) 2. Sometimes the name is used for sodium nitrate as well.

nitric acid. *Noun.* HNO_3 . Very strong oxidising acid used to some extent in glass-etching processes and ore flotation. Mp –41.65 °C; decomposes at 86 °C; density 1,503 kg m^{-3} ; viscosity (25 °C) 0.76 cP.

nitride-oxide semiconductor. *Noun.* A semiconductor consisting of a layer of **silica**, SiO_2 , on a substrate of silicon, over a layer of **silicon nitride**, Si_3N_4 .

nitride. *Noun.* (1) Binary compounds of nitrogen and a more electropositive element, characterised by the formula: M_xN_y ; boron and silicon nitrides are stable to about 1,500 °C and nitrides of titanium, zirconium, hafnium, and tantalum are moderately stable in oxidising atmospheres. Most nitrides are stable in reducing atmospheres. **Boron nitride** is used in composite structures for yarns, fibres, and woven products of high strength. BN and Si_3N_4 have assumed considerable importance as engineering ceramics and as reinforcements in composites. Other nitrides are used in particulate composites. (2) *Verb trans.* To form a nitride usually by heating in the presence of nitrogen gas or ammonia.

nitri*fy.* *Verb trans.* To make a material combine with nitrogen.

nitrobarite. *Noun.* $\text{Ba}(\text{NO}_3)_2$. Naturally occurring **barium nitrate**.

nitrogen surface area. *Noun.* The surface area of a powder or a compact as calculated from the relationship: $S_{\text{BET}} (\text{m}^2 \text{ g}^{-1}) = 4.37 V_m$, where V_m is the monolayer capacity ($\text{cm}^3 \text{ g}^{-1}$) calculated from the **adsorption isotherm** and the **BET equation**: $P/(P_s - P) \times 1/V = 1/V_m C + (C - 1)/V_m C \times P/P_s$.

nitrogen-vacancy centre. *Noun.* One of the intrinsic point defects in **diamond** consisting of a nitrogen atom substituted for carbon associated with an adjacent carbon atom vacancy. Its presence in diamond produces a pale pink colour as it absorbs in the blue region. It gives rise to **photoluminescence** that can be detected from an individual centre. Electron spins at **N-V centres** can be manipulated by an electric or magnetic field, or by light giving rise to sharp changes in the emission of photoluminescence. Hence an individual N-V centre has the potential to be a **qubit** and give access to quantum computing. It is a single photon source in diamond but the emission is too spectrally broad for fibre based quantum applications. See **N3 centre**, **H3 centre** and **H4 centre**.

nitroparaffins. *Plural noun.* Any organic compound derived from the methane series in which a hydrogen atom is replaced by a nitro group; employed in formulations for the **electrophoretic deposition** of ceramic materials for a variety of technical ceramic applications.

nitrous. *Adjective.* Relating to or containing nitrogen.

nits. *Plural noun.* See **nitty enamels**.

nitty enamels. *Plural noun.* Defects in dry-process porcelain-enamels characterised by minute surface pits visible only on close examination.

N-melilite. *Noun.* $\text{Y}_2\text{Si}_3\text{O}_3\text{N}_4$. Yttrium silicate containing SiN_4 tetrahedral structural units, made When silicon powder is mixed with Al_2O_3 , Y_2O_3 and then nitrified. See **nitride sense** (2).

NMR. *Abbreviation.* See **nuclear magnetic resonance**.

node. *Noun.* A place where a **wave function** has zero amplitude, and therefore at which the probability of finding an electron is zero. It may be a point, a line, or a surface.

nodular fireclay. *Noun.* A rock containing aluminous or **ferruginous** nodules, or both, bonded by fireclay.

nodule. *Noun.* (1) A rounded or spheroidal mass or agglomerate of solid material. (2) A sedimentary rock in which groundwater has redistributed minerals in a particular pattern. Nodules are sometimes called **concretions**.

no-fines concrete. *Noun.* A concrete containing no aggregate of less than 9.52 mm in maximum cross section.

noggin. *Noun.* A small ceramic cup or mug.

nogging. *Noun.* Brickwork or masonry between timber members of a framed construction

noise. *Noun.* (1) A varying voltage across a pair of electric contacts due to conditions at their interface. (2) Any non-relevant signal that tends to interfere with the normal reception or processing of a desired flaw signal during **electromagnetic testing**. Such signals may be generated by inhomogeneities in the inspected part that are not detrimental to the end use of the part. (3) Any undesired electrical disturbance in a circuit degrading the useful information.

nominal dimension. *Noun.* A dimension that may be greater than the specified masonry dimension by the thickness of a mortar joint.

nominal maximum size. *Noun.* The smallest sieve opening through which the entire amount of aggregate is permitted to pass as designated in specifications or descriptions of the aggregate to be employed in the concrete.

nominal stress. *Noun.* A stress calculated on the basis of the nominal dimensions, which disregards any local necking or the presence of pores, etc.

nomogram or **nomograph.** *Noun.* A graphic representation of information or data which consists of lines marked off to scale and arranged in a manner that, by using a straightedge to connect known values on two lines, an unknown value may be read at the point of intersection of another line.

non-aqueous developer. *Noun.* In liquid penetrant inspection, a developer consisting of fine particles suspended in a volatile solvent which helps dissolve the penetrant out of the discontinuity and bring it to the surface where it dries out, thus fixing the indication.

non-combustible. *Adjective.* Any material that will neither ignite nor actively support combustion in air at 648 °C when exposed to fire.

non-crystalline. *Adjective.* The solid state wherein there is no long range order. Other synonyms are **amorphous**, **glassy** and **vitreous**.

non-destructive. *Adjective.* Said of scientific procedures: not involving harm to the specimen.

non-destructive measurement. *Noun.* A measurement that involves no loss in the utility of a material or product being measured.

non-destructive test. *Noun.* Any test method that does not involve or result in damage to a test sample, e.g., **x-ray**, **IR**, and **ultrasound** investigations.

non-drying oil. *Noun.* Oil that does not form a dry surface film when exposed to the atmosphere.

non-ferromagnetic material. *Noun.* A material that is not magnetisable or affected by magnetic fields, including **paramagnetic** and **diamagnetic materials**.

nonferrous. *Adjective.* Denoting any metal other than iron.

non-linear coefficient. α . *Noun.* An important parameter of a **zinc oxide varistor**; it is the reciprocal of the slope of the device current–voltage curve; defined as $\alpha = \text{dln}I / \text{dln}V$.

non-linear optical materials. *Plural noun.* Transparent ceramic crystals whose structure lacks a **centre of symmetry** and this gives rise to a non-linear interaction of light and matter. For example light is generated at multiples of an incident laser frequency, ω , 2ω , 3ω etc., with decreasing intensity. This is known also as **frequency doubling** or **second harmonic generation**. See **huntite**.

non-linear optics. *Noun.* Optical properties dependent non-linearly on incident energy, that is, frequency or wavelength.

non-linear voltage. *Noun.* The applied voltage in a **varistor** at which the current increases many orders of magnitude for only a small further increase in potential. It is related to the barrier voltage, V_{gb} , the number of grain boundaries, N_{g} , and device thickness, t , according to: $V = V_{\text{gb}} N_{\text{g}} t$.

non-load-bearing tile. *Noun.* Tile designed for use in masonry wall, or other construction, carrying no superimposed loads.

non-lustrous glaze. *Noun.* A glaze or finish on the surface of a product that consists of an inseparable fire-bonded ceramic glaze or enamel of low-gloss or dull appearance.

non-lustrous finish. *Noun.* See **non-lustrous glaze**.

non-mechanical stress. *Noun.* Stresses arising in ceramics and composites from chemical reactions, moisture absorption, matrix curing, etc.

nonmetallic. *Adjective.* Not of metal.

nonmetallic inclusion. *Noun.* A non-metallic particle, such as sand, which is trapped or embedded in steel during solidification or during subsequent processing, and causes defects in porcelain-enamels.

nonmetals. *Noun.* Chemical elements that form negative ions, have acidic oxides and are generally poor conductors.

non-plastic. *Adjective.* (1) A solid material that exhibits only **elastic deformation** prior to fracture when stressed. (2) *Noun.* A trade term referring to ceramic materials other than the plastic clays.

nonpolar. *Adjective.* A solid possessing no concentrations of electric charge in its atomic or molecular units of structure. It therefore shows no **dielectric loss**.

non-reflecting glass. *Noun.* Glass on which a film of transparent material of **refractive index** less than the glass has been deposited to form a layer one-quarter of the wavelength of incident light so that interference suppresses reflection.

non-reinforced pipe. *Noun.* A concrete pipe designed and constructed without reinforcements.

non-relevant indication. *Noun.* An indication observed in an inspection test that cannot be associated with a discontinuity or flaw.

nonrenewable. *Adjective.* Not able to be restored, replaced or restarted.

non-self-sustaining discharge. *Noun.* An electrical discharge that depends, at least partially, on an independent source for the supply or generation of charge carriers.

non-shattering glass. *Noun.* A plastic-laminated or **tempered glass** that will not shatter when broken.

nonslip concrete. *Noun.* Concrete having a mechanically roughened surface or a sand-like surface made by additions of sand to the concrete surface just before it hardens; used for steps and other areas of pedestrian traffic to prevent slipping.

nonspecific adsorption. *Noun.* The process of partition of an **adion** from aqueous solution to a solid surface where the ion does not lose any water of hydration and so only a weak bond is formed to the solid. This is known as **outer sphere adsorption complex** formation.

nonsteady-state diffusion. *Noun.* The situation that can occur in some circumstances when there is some net accumulation or depletion of diffusing species and so the diffusion flux is time dependent.

nonstoichiometric. *Adjective.* A situation in which the numerical relationship or ratio of elements in a compound differs from that expected by the requirement to satisfy formal valencies, e.g., $\text{TiC}_{0.97}$.

nontronite. *Noun.* $(\text{Al}_{0.05}\text{Fe}_{1.93}\text{Mg}_{0.02})(\text{Si}_{3.5}\text{Al}_{0.5})\text{O}_{10}(\text{OH})_2$. A **smectite-type**, **montmorillonite** three-sheet 2:1 layer lattice **clay mineral** in which ferric iron and magnesium replace most of the Al^{3+} in octahedral sites with charge compensation through Al^{3+} replacement of Si^{4+} in tetrahedral sites.

non-vitreous. *Adjective.* The degree of **vitrification** evidenced by relatively high water absorption, more than 3 %, except for floor and wall tile, which are considered non-vitreous when the water absorption exceeds 7 %.

non-volatile direct random access memory. NVDRAM. *Noun.* Usually a **ferroelectric oxide** based on the **perovskite** structure used for memory storage in computer technology.

non-volatile electronics. *Plural noun.* Devices that do not have a stand-by power dissipation. The technique is not possible when using an electron's charge to power devices, such as computer memory chips, but is possible using the electron's spin in nanoscale materials. See **spintronics**.

non-wetting. *Adjective.* Failure of a liquid to coat evenly any substrate to which it is applied.

non-woven mat. *Noun.* A random mass of ceramic fibres used for composite manufacture.

NOR. *Noun.* In electronics it denotes a circuit or **gate** that has an output only if there is no signal on any of the input connections.

norite. *Noun.* A type of **gabbro** containing **ferromagnesian** mineral.

normal cure. *Noun.* A condition of curing asbestos cement at atmospheric pressure with incidental external heat.

normal-cure cure. *Noun.* The method of hardening or setting asbestos-cement products wherein the **Portland cement** is allowed to hydrate at atmospheric conditions of pressure and temperature, preferably under conditions to inhibit water loss.

normalise or normalize. *Verb trans.* (1) To bring into conformity with a standard. (2) To heat steel above a critical temperature and cool to anneal stresses.

normal permeability. *Noun.* The ratio of the induction of electromagnetic materials, made cyclically to change symmetrically about zero, to the corresponding change in magnetising force.

normal segregation. *Noun.* Areas on a **micrograph** that contains constituents in **triple points** that have lower melting points and are the last to solidify in those regions.

normal spinel. *Noun.* AB_2O_4 . A ceramic with the spinel structure and **inversion parameter** of $\frac{1}{2}$ because all A cations occupy tetrahedral sites and all B cations occupy octahedral sites.

normal uranium. *Noun.* Uranium containing the same weight percentage of ^{235}U as occurs in nature. It may be obtained by blending uranium of different isotopic compositions or by processing in a diffusion plant. Loosely, it means uranium as it occurs in nature.

Norman arch. *Noun.* A semicircular arch in the Romanesque style of architecture.

Norman brick. *Noun.* A brick having nominal dimensions of $6.8 \times 10.2 \times 30.5$ cm.

Norman slabs. *Noun.* Square or rectangular panels of clear and coloured glasses cut into special shapes; used in the construction of stained glass windows.

norstrandite. *Noun.* $\text{Al}(\text{OH})_3$. **Aluminium trihydroxide** with an alternate stacking of $\text{Al}(\text{OH})_6$ layers to produce an intermediate structure between **bayerite** and **gibbsite**; occurs in some tropical soils but is usually obtained by reaction of $\text{Al}(\text{OH})_3$ **gels** with aqueous alkylenediamines.

nose. *Noun.* (1) The working end or refining chamber of a glass-melting tank. (2) The refractory opening through which a steel-making converter is charged and discharged.

notch. *Noun.* A flaw on a surface capable of acting as a surface stress raiser.

notch acuity. *Noun.* A method of expressing the severity of a surface flaw as a **stress raiser**; for example, if the depth of the notch is small compared with its width the acuity is d/r , where d is notch depth and r is the radius of curvature at the bottom of the notch.

notch brittleness. *Noun.* Brittle fracture produced at points of stress concentration. Comparing the tensile strength of unnotched and notched specimens assesses it.

notch depth. *Noun.* The distance from the surface to the root of the notch.

notch effect. *Noun.* The increase in stress in an area of a component near a crack, depression or change in section that can be enough to cause failure of the component even though the calculated average stress may seem quite safe.

notch rupture strength. *Noun.* Applied load divided by the original area of minimum cross section in a stress rupture test of a notched specimen.

notch, slag. *Noun.* See **slag notch**.

notch test. *Noun.* A test in which the transverse strength of a notched specimen is correlated with the low-temperature **spalling** resistance of **fireclay** refractories.

notch toughness. *Noun.* See **impact energy**.

Novacite. *Trade name, noun.* Commercial product consisting of microcrystalline **silica**.

Novacubite. *Trade name, noun.* Commercially available **quartz** filler with uniform fine grain size. Used to stiffen and strengthen plastic matrices.

novaculite. *Noun.* A fine grained hard rock containing **quartz** and **feldspar**. Used as a **whetstone**.

nozzle. *Noun.* (1) The opening in a ladle through which steel is poured. (2) The discharge opening of a spray gun in which a suspension is atomised. (3) A projecting pipe or spout used to discharge fluids. (4) In a jet or rocket engine, the duct that directs the effluent to generate thrust.

nozzle brick. *Noun.* A tubular refractory shape with a hole through which steel is teemed at the bottom of a ladle, the upper end of the shape serving as a seat for the stopper.

nozzle, jet. *Noun.* See **jet nozzle**.

nozzle, refractory. *Noun.* See **refractory nozzle**.

nsutite. *Noun.* γ - MnO_2 . A **manganese dioxide** polymorph whose structure consists of irregular intergrowths of the **pyrolusite** and **ramsdellite** forms of MnO_2 ; a potential material for electrodes in lithium batteries.

NTC. *Abbreviation.* Stands for negative temperature coefficient thermistor, in which the electrical resistance decreases as the temperature increases. **Nickel oxide**, NiO , and CoAl_2O_4 , are examples of ceramics that have this property.

nth. *Adjective.* Used to represent an unspecified ordinal number.

NTP. *Abbreviation.* Standing for normal temperature and pressure which are standard conditions of 0 °C and 101.325 kg m⁻².

n-type. *Adjective.* See **n-type semiconductor**.

n-type semiconductor. *Noun.* A semiconductor in which excess electrons in the **conduction band** are responsible for its current-carrying ability. The excess electrons are promoted from energy levels in the **band gap** region provided by suitable **dopant** atoms, for example, phosphorus atoms doped into silicon.

nuance. *Noun.* A subtle difference in colour.

nub. *Noun.* (1) A small lump or protuberance. (2) A small fibrous knot in yarn.

nuclear engineering. *Noun.* The technology dealing with the design, construction, and operation of nuclear reactors and their auxiliary facilities, the development and fabrication of materials, and the handling and processing of reactor products.

nuclear fission. *Noun.* The splitting of an atomic nucleus into approximately equal parts, usually accompanied by energy release.

nuclear fuel. *Noun.* Any fissionable material, such as plutonium 239, uranium 235, and uranium 233, which is capable of acting as a source of energy and a source of

neutrons for the propagation of a chain reaction. They are usually complex multi-component compounds in specific fuel forms, such as oxides, nitrides, carbides, alloys and composites.

nuclear grade. *Adjective.* Material of a quality adequate for use in a nuclear reactor.

nuclear magnetic resonance. NMR. *Noun.* The observation of the absorption of electromagnetic radiation by magnetic nuclei in materials, in the presence of an externally applied magnetic field. Usually a fixed radio-frequency field is applied to the sample and the magnetic field is varied until radiation is absorbed most strongly by the transition between the possible neutron spin energies.

nuclear poison. *Noun.* A material, such as cadmium, having a high neutron-absorption cross section which, if present in a reactor, reduces the neutron flux.

nuclear reaction. *Noun.* A process where the structure and energy of an atomic nucleus are changed by interaction with another nucleus or atomic particle.

nuclear reactor. *Noun.* A device in which the chain reaction of neutrons can be sustained and regulated for production of thermal energy, synthetic elements, and radioisotopes. Often shortened to reactor. Original name was atomic pile.

nuclear reactor ceramics. *Noun.* Ceramics that are employed in nuclear fuel elements, such as the compounds of uranium, as **moderators**, such as carbon and beryllium compounds, and as control materials, such as **boron carbide** and the **rare earth oxides**.

nuclear waste. *Noun.* See **radioactive waste**.

nucleate. *Verb.* To form a nucleus.

nucleated glass. *Noun.* Glass containing a nucleating agent that promotes the formation of a crystalline structure in the glass during cooling or a subsequent heat treatment.

nucleation. *Noun.* The appearance of a critical sized **embryo**, which can sustain a decrease in free energy as it grows in size. It becomes the first step in the process of crystallisation, in which the characteristic atomic arrangement is first established.

nuclei. *Plural noun.* Points at which crystals begin to grow during solidification.

nucleon. *Noun.* A proton or neutron.

nucleonics. *Noun.* The branch of science concerned with the applications of nuclear energy.

nucleon number. *Noun.* Another name for **mass number**.

nucleus of slip. *Noun.* The smallest region of **slip** distortion in a crystal that can be made to grow by applied stress on its own. Any smaller region will return to the original perfect configuration once the thermal fluctuation causing the original slip has passed.

nuclide. *Noun.* An atomic species characterised by its **atomic number** and its **mass number**.

nugget. *Noun.* A small piece or lump.

nuisance dust. *Plural noun.* An airborne contaminant with $TLV \geq 10 \text{ mg m}^{-3}$ that is not associated with any severe toxic effects on the lungs. **Alumina** dust falls into this classification.

null. *Noun.* Involving measurement in which conditions are adjusted so that an instrument has a zero reading.

number density. *Noun.* The number of particles per unit volume.

numerical aperture. *Noun.* A property of an objective lens in a microscope to resolve individual points on an object. The term was coined by Abbé for $nsini$ in the equation: $s = \lambda / 2nsini$, where s is the minimum distance resolvable, λ is the wavelength of the illumination used and i depends on the size and material of the objective lens. For optical systems using visible light the highest value is about 1.6.

nummular. *Adjective.* Disc-shaped; shaped like a coin; circular. Used to describe some parts of microstructures.

nummulitic limestone. *Noun.* A relatively young **limestone** containing many small fossils. Used to make stones for the Egyptian pyramids.

Nusselt number. N_u . *Noun.* A dimensionless surface convection conductance parameter. See **surface convection**. It is related to the solid geometry, the fluid properties and the flow characteristics. In most studies experimental data are used to develop empirical expressions for the parameter.

nu value. *Noun.* Expressed by the Greek letter ν or by the English letter V , designating reciprocal dispersive powers by the formula $\nu = (n_d - 1) / (n_F - n_C)$, in which n_d is the index of refraction for the sodium line at 589.3 nm, and n_F and n_C are the indices for the hydrogen lines at 486.1 and 656.3 nm, respectively. See **dispersion**.

N-V centre. *Abbreviation, noun.* Stands for nitrogen-vacancy centre. See **nitrogen-vacancy centre**.

NVDRAM. *Abbreviation.* Stands for non-volatile direct random access memory. See **non-volatile electronics**, and **non-volatile direct random access memory**.

NZP. *Abbreviation.* Standing for sodium zirconium phosphate, $\text{NaZr}_2(\text{PO}_4)_3$. See **sodium zirconium phosphates**.

NZP glass-ceramics. *Plural noun.* Glass-ceramics containing **sodium zirconium phosphate**, $\text{NaZr}_2(\text{PO}_4)_3$, crystals and related isostructural phosphates containing isolated PO_4 tetrahedra linking chains of MO_6 octahedra. They have negative or zero expansion coefficients. See **sodium zirconium phosphates**.

Oamaru stone. *Noun.* A type of building quality **limestone** quarried in New Zealand.

obelisk. *Noun.* A stone pillar that has a square or rectangular cross section and sides that taper towards a pyramidal top.

oblate. *Adjective.* Having an equatorial diameter greater in length than the polar diameter.

objet trouvé. *Noun.* A natural or manufactured object, such as ceramic **artware**, put forward as having artistic value.

obscure glass. *Noun.* A glass which will transmit and also diffuse light so that objects beyond cannot be distinguished clearly.

obscuring process. *Noun.* Any process, such as acid etching, sandblasting, etc., that is designed to diffuse light and thereby obscure vision, in varying degrees, through glass.

observable quantity. *Noun.* A physical quantity that can be measured.

obsidian. *Noun.* A highly siliceous natural glass, usually of volcanic origin from rapidly quenched lava, which is transparent but dark in colour and which resembles granite in composition. It splits to give a convex surface. Also called **Iceland agate**.

obsolescent. *Adjective.* Going out of use because of improvements or revised requirements.

obsolete. *Adjective.* No longer in use; defunct; outmoded.

obturate. *Verb trans.* To stop-up an opening as with refractory clay in some kilns.

occlude. *Verb trans.* (1) To obstruct or hinder. (2) To take-up or hold by adsorption or absorption.

occlusion. *Noun.* Any material enveloped by a larger mass of another solid. Often formed in the creation process, e.g., coprecipitation or rapid crystallisation.

occult material. *Adjective.* A component of a material that cannot be observed by optical means, but which may be detected by chemical analysis.

oceanite. *Noun.* A basalt rock consisting of at least 50 % **olivine** and up to 50 % **plagioclase**.

ochre. *Noun.* (1) A natural, sometimes plastic earth containing **ferric oxide**, clay, and silica; employed in **engobe** slips, underglaze colours, and overglaze decorations to produce yellow, brown, and red colours. (2) *Adjective.* A moderate yellow-orange colour. (3) *Verb trans.* To colour with ochre.

ochres. *Plural noun.* Pigments in the yellow part of the spectrum exclusively based on iron oxide, Fe_2O_3 .

octahedral site. *Noun.* The empty space in a close packed array of atoms or ions surrounded by 6 spheres just touching.

octahedrite. *Noun.* Another name for **anatase**.

octosilicate. *Noun.* $\text{Na}_2\text{H}_2(\text{Si}_8\text{O}_{18})\text{O}\cdot 9\text{H}_2\text{O}$. Synthetic sodium silicate hydrate containing layers of linked silicon-oxygen tetrahedra. Developed to occlude water and organic molecules between the layers in the structure.

octyl alcohol. *Noun.* $\text{C}_8\text{H}_{17}\text{OH}$. Several isomeric compounds employed as deairing agents during the ball milling of some ceramic slips.

OD grinding. *Verb.* Cylindrical grinding on the circumference of a specimen or item.

odontolite. *Noun.* See **bone turquoise**.

odorant. *Noun.* A material added to an odourless gas, such as fuel gas, for purposes of detection by its smell, identification, safety, etc.

odour test, threshold. *Noun.* See **threshold odour test**.

- oersted.** *Noun.* The **egs** electromagnetic unit of magnetic intensity equal to the intensity of a magnetic field in a vacuum in which a unit magnetic pole experiences a mechanical force of one dyne in the direction of the field. In the **SI system** 1 Oe is equal to 10^{-4} T.
- offal.** *Noun.* Trimmed waste material from formed composite panels.
- off-bender.** *Noun.* An operator who removes excess beading enamel from porcelain-enamelled ware, or smooths porcelain-enamel at the edges of coated ware prior to firing.
- off-beading.** *Verb.* The removal of excess slip from the edge of porcelain-enamelled ware preparatory to the application of beading enamel.
- offhand glass.** *Noun.* Glass prepared by an artisan working without benefit of moulds.
- offhand grinding.** *Verb.* Freehand grinding of work held in the hand of the operator, usually without the use of guides or patterns.
- offhand process.** *Noun.* The forming of glassware without the aid of moulds.
- off-line cracking.** *Adjective.* To split **ferrite yoke** rings in fracture tests a groove is introduced at the **forming** stage to direct the run of the **thermal shock** induced splitting crack. If the crack escapes this groove then off-line cracking has occurred.
- offset.** *Noun.* (1) An imperfection resulting when mould parts are not properly matched. (2) A finish or base offset from the body or neck of an item. (3) The distance on the strain ordinate separating the initial part of a stress-strain curve and a line parallel to that line which intersects the stress-strain curve at a value of stress where permanent set begins, i.e., the **yield strength**.
- offset finish.** *Noun.* A finish that is not symmetrical to the axis of a bottle.
- offset lithography.** *Noun.* A process of printing in which an inked impression from a surface is first made on a rubber cylinder and then transferred to the ware being decorated or printed.
- offset press.** *Noun.* A printing press in which a lithographic stone or a plate of metal, paper, or other material is used to make an inked impression on a rubber blanket which, in turn, transfers the impression to paper, such as is used in the production of **decalcomanias**, or other surface being printed.
- offset punt.** *Noun.* The bottom of a bottle that is asymmetrical to the axis of the bottle.
- off-the-shelf.** *Noun.* Ware available for immediate shipment.
- ohm.** *Noun.* The derived **SI unit** of electrical resistance produced when a current of 1 amp flows in a conductor under a potential difference of 1 V.
- ohmic contacts.** *Plural noun.* Contacts with linear current-voltage behaviour. A contact is ohmic only if the voltage drop across it is negligible compared to the voltage drop across the device. Therefore they are contacts with low electrical resistance used to link the active regions of a semiconductor device to the external circuit. They must have good adhesion and lateral uniformity. Platinum metal is favoured for III-V semiconductors.
- ohmic device.** *Noun.* A circuit component in which the current is proportional to the applied voltage.
- Ohm's law.** *Noun.* The applied voltage is equal to the product of the current and the resistance.
- oil bath.** *Noun.* A heating device.
- oil, bunker.** *Noun.* See **bunker fuel oil**.
- oil, bunker 6.** *Noun.* See **bunker fuel oil**.
- oil burner.** *Noun.* A liquid-fuel burning device in which mixtures of atomised or vaporised oil and air are employed for combustion.
- oil canning.** *Noun.* The **popping** of a composite panel when pressed.
- oil emulsion.** *Noun.* A mixture or suspension of finely divided oil minutely dispersed in a medium, such as water, in which the oil is insoluble.
- oil film parameter. λ .** *Noun.* See **Stribeck curve**.
- oil filter.** *Noun.* A device or a material employed to remove contaminants from circulating oil.
- oil-fired furnace or kiln.** *Noun.* A furnace or kiln in which oil is employed as the heat-producing fuel.
- oil, form.** *Noun.* See **form oil**.
- oil, heavy.** *Noun.* See **heavy oil**.
- oil, light.** *Noun.* See **light oil**.
- oil mark.** *Noun.* A defect in glass consisting of streaky, brown black discoloration in the body of the glass.
- oil-oxygen binder.** *Noun.* A synthetic liquid oil-based binder that reacts with an oxygen release agent to partially harden at room temperature; baking completes the hardening process.
- oil sand.** *Noun.* Sandstone deposits impregnated with **bitumen** or other petroleum product.
- oil shale.** *Noun.* **Shale** from which oil can be distilled.
- oil spots.** *Noun.* Lustrous decorative metallic markings on stoneware glazes produced by excess additions of **iron oxide**, **manganese oxide**, and **cobalt oxide** to the glaze.
- oil, squeegee.** *Noun.* See **squeegee oil**.
- oilstone.** *Noun.* A natural or synthetic abrasive stone, such as **corundum**, generally impregnated with oil, for putting the final edge on cutting tools by abrasion.

oil, vegetable. *Noun.* See **vegetable oils**.

oil-well cement. *Noun.* A special kind of hydraulic cement that is slow setting at the temperatures encountered in oil wells; used to support pipes and to bypass unwanted areas in the wells.

olation. *Noun.* A condensation process in cation polymerisation and **hydrolysis** in which a hydroxyl bridge is formed between two centres. Such a bridge is an “ol bridge”. Hydroxo-aquo precursors are involved $[M(OH)_x(OH)_{2N-x}]^{(x-x)+}$, where $x < N$.

ol-bridge. *Noun.* See **olation**.

Old Red Sandstone. *Noun.* A thick seam of **sedimentary rock** deposited in Britain and North West Europe in the Devonian period. Often red but can be yellow to cream in colour.

oleum. *Noun.* $H_2S_2O_7$. Fuming sulphuric acid.

oligoclase. *Noun.* The name of the **plagioclase** solid solution series in the composition range 90–70 % **albite**, $NaAlSi_3O_8$, to 10–30 % **anorthite**, $CaAl_2Si_2O_8$. Triclinic soda-lime **feldspars**.

olivenite. *Noun.* $Cu_2(AsO_4)(OH)$. Hydrated copper arsenate; a secondary mineral, green to black in colour and with an orthorhombic crystal structure.

olivine. *Noun.* (1) $(Mg,Fe)_2SiO_4$. An olive-green mineral from which the olivine group is named. (2) A group of natural minerals including **chrysolite**, **forsterite**, **fayalite**, **peridot**, **monticellite**, and **tephrolite**, with the general formula: $(Mg,Fe,Mn,Ca)_2SiO_4$. Used in refractories, cement, and foundry sand; purer grades are used in the manufacture of electronic components and ceramic-metal seals. Density 3,200–3,600 $kg\ m^{-3}$; hardness (Mohs) 6.5–7.

olivine sand. *Noun.* Crushed **olivine**. See **black sands**.

once-fired. *Adjective.* Ware manufactured with only one firing stage.

one-coat ware. *Noun.* (1) Articles finished in a single coat of porcelain enamel. (2) A contraction of one-cover-coat ware in which a single porcelain-enamel cover coat is applied over a ground coat.

one-fire finish. *Noun.* A porcelain-enamel applied to ware and subjected to a single firing operation.

one-way shape memory alloy. *Noun.* See **shape memory alloy**.

one-way slab. *Noun.* A steel-reinforced concrete slab in which the reinforcement rods are perpendicular to the supporting beams.

on-glaze. *Verb.* A glaze applied and fired on a previously glazed surface of ceramic ware.

on-glaze decoration. *Noun.* Any decoration applied and fired to 800 °C on a previously glazed surface of ceramic ware. It remains a surface feature.

on-off control. *Noun.* A method of temperature control that allows the heat input to be either on or off only and does not proportion or throttle like a modulating control.

onion. *Noun.* (1) A bulb-like mass of glass at the origin of a drawn sheet produced by the **Fourcault process**. (2) See **carbon onions**.

onium salts. *Plural noun.* Salts in which the cation is formed by attachment of a proton to a neutral compound, for example ammonium. Useful in ceramics for making **nanopowders** and **gels** because they are often soluble in organic solvents.

onset of dilatancy. *Noun.* The shear rate at which shear thickening begins. See **dilatancy**.

on-wire lithography. OWL. *Noun.* A chemistry-based nanofabrication technique for templating nanowires onto ceramic substrates.

onyx. *Noun.* SiO_2 . A variety of **chalcedony** with alternating black and white parallel bands. See **onyx marble**.

onyx marble. *Noun.* $CaCO_3$. A compacted form of **calcite** used as an ornamental stone in architecture. Also just called **onyx**.

oolite. *Noun.* A sedimentary rock, especially limestone, consisting of tiny spherical concentric grains embedded in a fine matrix.

oolith. *Noun.* One of the tiny spherical grains that make-up **oolite**.

oolitic. *Adjective.* Of or concerning **oolite** and its particular microstructure. A material exhibiting rounded, layered grains in a cemented matrix.

oolitic aggregate. *Noun.* An aggregate of prismatic crystals radiating from a common centre to form a spherical surface with each group of crystals being less than 3 mm.

oolitic limestone. *Noun.* **Limestone** formed over 160 Ma ago in the sea as calcite built-up around grains of sand which the sea washed back and forth to produce small very rounded grains known as ooliths. Frequently used as a building stone and sometimes used to make cement.

OOR. *Abbreviation.* Stands for out of roundness. See **out of roundness value**.

ooze. *Noun.* (1) A soft thin mud. (2) A fine-grained siliceous or calcareous deposit formed from plankton. (3) *Verb trans.* To flow or leak out slowly through pores. (4) *Verb.* To emit moisture or gas. (5) *Verb intrans.* To escape gradually.

opacifier. *Noun.* A material used in porcelain-enamels, glazes, and glass to impart or increase the diffuse reflection, refraction, and to produce an opaque appearance, by reducing the transparency of the product.

opacity. *Noun.* (1) The property of reflecting light diffusely and non-selectively. (2) The covering power and relative ability of porcelain-enamel to reflect incident light and produce whiteness. (3) The ratio of the intensity of light incident on the medium to that transmitted through the medium. (4) The extent to which transparency of a glaze is obscured by **reflection** and **scattering** of incident light. The effect depends on: (a) **relative refractive indices**; (b) number of particles per unit volume; (c) particle size and shape. Reflection is a smaller effect than scattering and is governed by the **Rayleigh equation** for particle sizes $< 0.05 \mu\text{m}$ and the **Mie equation** for larger sizes. Optimum particle size for maximum opacity is estimated from the **Weber equation**.

opal. *Noun.* (1) An amorphous form of hydrated silica, $\text{SiO}_2 \cdot n\text{H}_2\text{O}$, found in nature in many varieties, colours, and **iridescence**. Some forms used as gemstones. (2) An **opaque** glass made so by small precipitated particles.

opalesce. *Verb intrans.* To show a milky **iridescence**.

opalescent. *Adjective.* (1) The quality or state of reflecting an **iridescent** light. (2) Having iridescence like that of an **opal**.

opalescent glaze. *Noun.* A ceramic glaze with a milky or **iridescent** appearance caused by the presence of fluorides in the **frit** composition.

opal glass. *Noun.* Glass having a white, milky appearance, usually with a fiery translucence. Made by adding fluorides to the glass composition.

opaline. *Noun.* (1) An opaque or semiopaque, whitish glass. (2) *Adjective.* **Opalescent**.

Opalinus clay. *Noun.* Swiss clay with mineralogy suitable for nuclear waste storage because of its low hydraulic conductivity and high sorption ability for actinides. The average mineralogy is: 66 % clay minerals including **illite**, **smectite**, **chlorite**, and **kaolinite**; 14 % **quartz**, 13 % **calcite**.

opalised glass. *Noun.* See **Vaseline glass**.

opaliser. *Noun.* Any fluoride compound, such as **cryolite**, **fluorspar**, **sodium fluoride**, etc., which will produce an opalescent appearance in glasses and glazes.

opaque. *Adjective.* (1) Not transmitting light as a result of absorption, reflection and scattering; not **transparent** or **translucent**. (2) Not reflecting light; dull; having no **lustre**. (3) Not transmitting radiant energy.

opaque glaze. *Noun.* A non-transparent, white or coloured ceramic coating of bright satin or glossy finish on the surface of a ceramic product.

opaque medium. *Noun.* (1) A material that is not transparent when observed by eye. (2) A medium that does not transmit electromagnetic radiation.

open. *Verb.* To start a hollow or an opening in a ball of clay as it spins on a potter's wheel.

open-arc furnace. *Noun.* A furnace heated by an electric arc held above the charge.

opencast mining. *Noun.* See **open-pit mining**.

open cells. *Noun.* Bodies in which the cells are interconnected.

open circuit. *Noun.* An incomplete electrical circuit in which no current flows.

open-circuit voltage. *Noun.* The voltage of a cell or battery measured when no current is flowing.

open clay. *Plural noun.* Porous or sandy-textured clays

open firing. *Noun.* Firing in which the flame may impinge on or through the ware.

open frontal area. OFA. *Noun.* A physical shape factor of cellular ceramic catalyst support design that relates to component weight: $\text{OFA} = (L - t)^2 / L^2$, where L is the cell repeat distance and t is the cell wall thickness.

open gaseous inclusion. *Noun.* A bubble at the surface of glass that has burst or is open, leaving a cavity at the surface of the ware.

open gold. *Noun.* Non-drying gold.

open-hearth furnace. *Noun.* A steel-making furnace of the reverberatory type in which the charge is laid on a shallow hearth over which play flames of burning gas and hot air.

open-hearth furnace, basic. *Noun.* See **basic open-hearth furnace**.

opening force. *Noun.* The force needed to open electrical contacts.

opening material. *Noun.* Sand, **flint**, **grog**, **chamotte**, **pitchers**, and the like added to plastic clay to increase the porosity, decrease shrinkage, and expedite drying.

open pit. *Noun.* An open or surface-working excavation from which minerals are removed, the opening being the full size of the excavation.

open-pit mining. *Noun.* Another name for **open cast** mining; the removal of minerals located near the earth's surface by first removing the overlying material, or **overburden**, and excavating the minerals. Also known as **opencast mining** or **strip mining**.

open pore volume. P_o . *Noun.* The volume of pores in a solid body which may be penetrated by a liquid or gas applied to the outer surface of the body, expressed by the formula: $P_o = 100[(1 - D_b)/D_a]$, where P_o is the total volume of open pores, D_b is the bulk density, and D_a is the apparent density of the specimen.

open pot. *Noun.* A glass-melting pot open to the flames and gases of combustion.

open setting. *Verb.* Ware placed in a kiln and fired with the flames passing over, around, and between the items.

open storage. *Noun.* The storage of raw materials out doors and exposed to the weather.

operand. *Noun.* A quantity or function upon which a mathematical operation is performed.

operating stress. *Noun.* The stress to which a component is subjected in service.

operation. *Noun.* (1) An item of work, usually performed at one location, consisting of one or more work elements. (2) Any procedure, such as multiplication, differentiation, integration, etc., in which one or more numbers or quantities are operated upon according to stated rules.

operation analysis. *Noun.* A study of all the procedures and activities involved in the design and improvement of production, including materials, equipment, processes, inspection, and conditions of work.

operations research. *Noun.* The application of scientific and mathematical methods to the study and analysis of complex problems.

operator. *Noun.* (1) A person who operates, adjusts, and maintains a piece of equipment. (2) Any symbol or term used to indicate a specific operation or process in mathematics.

ophite. *Noun.* Greenish mottled rocks, such as **dolerite**, with **ophitic** texture.

ophitic. *Adjective.* A microstructure common in some rocks where small elongated, unoriented **feldspar** crystals are embedded in a **ferromagnesian** matrix.

ophthalmic glass. *Noun.* Glass of great compositional uniformity, having specified optical and physical properties; used to make spectacle lenses.

o-plane. *Noun.* Terminology used in the **electrical double layer model** to identify the positively charged outer surface of a ceramic oxide in water when the next layer contains water molecules and **anions** from solution. In this situation the water is estimated to have a **dielectric constant** of 6.

optic. *Noun.* (1) A lens or prism in an optical instrument. (2) Glassware having variations in wall thickness, which produce refractive effects. (3) *Adjective.* Pertaining to the eye.

optical activity. *Noun.* A property of materials having a helical structure based on tetrahedrally coordinated structures, such as those in **quartz**. Such materials have different refractive indices for left- and right-hand circularly polarised light. Thus, a **plane-polarised** light ray on passing through an optically active material will have its plane of polarisation rotated according to $\theta = \pi d(n_L - n_R)/\lambda$, where d is the length of the sample, λ is the wavelength of the light, and n_L and n_R are the refractive indices for left- and right-hand components.

optical amplifier. *Noun.* Lengths of fibre, spliced into a normal **optical fibre**, that are doped with erbium so that when pumped with **laser** light the erbium-enriched section behaves like a laser itself to boost incoming optical signals.

optical analysis. *Noun.* The study of the chemical composition, particle size, and other properties of a material or mixture, by means of transmitted light and measuring changes in absorption, polarisation, refraction, and scattering.

optical annealing temperature. *Noun.* The temperature at which the stresses, as revealed by polarised light, in an unannealed rod disappear when heated at $2\text{ }^{\circ}\text{C min}^{-1}$, the rod being 40 mm long and 6 mm diameter.

optical blank. *Noun.* Optical glass formed to the approximate specified dimensions required, and from which final lenses are made.

optical composites. *Plural noun.* A fibre composite of optical clarity; so far not achieved, the nearest being a transparent to translucent body of polyurethane containing 40 % glass fibre.

optical crown. *Noun.* See **optical crown glass**.

optical crown glass. *Noun.* Optical glass having a **nu-value** between 50.0 and 55.0, and a refractive index greater than 1.6. Used to make lenses.

optical damage. *Noun.* See **photorefractive effect**.

optical density. *Synonym.* Alternative for **transmission density**. See **reflection density** and **transmittance**.

optical disc. *Noun.* In computing an inflexible disk on which digital information is stored using **laser** technology.

optical emission spectrograph. *Noun.* An instrument for recording electromagnetic radiation in one or more of the following regions: ultraviolet, visible, or infrared.

optical fibre. *Noun.* A long, thin, 1–50 μm diameter, thread of a highly transparent substance, such as glass or plastic, which transmits light along the fibre by a series of total internal reflections. To do this the fibre must have a variable composition from the inside to the outside and this is obtained by vapour deposition of **silica** inside a tube and then collapsing the tube by heating and pulling. Information is transmitted along the fibre as light photons.

optical figuring. *Verb.* The final shaping, grinding, and polishing of glass components for optical instruments.

optical flat. *Noun.* A polished flat glass having an overall flatness of 0.05 μm ; used as a standard in comparative linear measurements.

optical flint. *Noun.* See **flint glass**, **optical flint glass**.

optical flint glass. *Noun.* Optical glass having a **nu-value** less than 50.0 or between 50.0 and 55.0 if the **refractive index** is less than 1.6.

optical glass. *Noun.* Glass of great compositional uniformity and free of imperfections having closely specified optical properties in terms of transmission, refraction, and dispersion of light; used in the manufacture of optical systems.

optical glass numerical designation. *Noun.* A numerical designation based on the **index of refraction** for sodium line (n_D) and **nu-value** (v). The unity value for the refractive index is dropped (for example, 1.496 becomes 496) and the decimal point for the nu value is deleted (for example, 64.4 becomes 644). Thus, a glass may be specified as 496/644 without reference to its chemical composition. The numerical designation may be preceded, if required, by symbols to indicate composition.

optical maser. *Noun.* A device that utilises the vibrations atoms or molecules in solids for generating or amplifying electromagnetic waves in the microwave region of the spectrum.

optical parametric oscillator. *Noun.* A device combining **laser** radiation of large amplitude, called the pump wave, with a **non-linear crystal**. This produces two waves called the **signal** and **idler** whose frequencies can be varied by changing the angle of incidence of the pump wave. For example a 532 nm pump radiation can be changed to a signal wave in the range 650–1,060 nm plus idler wave in the 1,060–300 nm range.

optical path. nd. *Noun.* The distance in vacuum that light would travel in the same time that it goes a distance d in the medium of **refractive index** n .

optical phonon. *Noun.* See **phonon**.

optical projection lithography. OPL. *Noun.* The form of **lithography** used in the silicon semiconductor industry. A pattern is created on a mask at four times the desired final size. Using laser light the image of the mask is projected on to the Si wafer by a large reduction lens. Field size is about 20×30 mm and feature sizes about 60 nm are achieved.

optical pumping. *Verb.* To subject a **laser** crystal to an intense flash of white light.

optical pyrometer. *Noun.* An instrument for measuring high temperatures in which the colour of an electrically heated filament in a telescope or similar device is matched with the colour of the surface of a heated object so that against this background the filament disappears; the temperature is shown on a calibrated scale for the instrument.

optical reflectometer. *Noun.* An instrument that measures the surface reflection of light waves in or near the visible region.

optical spectrometer. *Noun.* A calibrated instrument used to measure the wavelength of light transmitted by transparent materials.

optical surface. *Noun.* The interface between two media, such as air and glass, which is used to reflect or refract light.

optical switch. *Noun.* A device with one or two optical fibre inputs and two output fibres; using electronic control. The light can be directed from one input fibre to either of the output fibres with switching speeds in the order of milliseconds. For single mode switching, LiNbO_3 , is used to move the output fibre and align it with the input fibre.

optical system. *Noun.* A collection of mirrors, lenses, prisms, and other devices placed in some specified arrangement that reflect, refract, disperse, absorb, transmit, or polarise light.

optical thickness. *Noun.* The product of the measured thickness and the **refractive index** of a transparent ceramic or glass.

optical transistor. *Noun.* See **optomechanically induced transparency**.

optical waveguide. *Noun.* A dielectric cylindrical fibre immersed in a medium of smaller **refractive index** or epitaxial layers of different **dielectric constant**, such as is obtained when a layer of semiconductor is **ion bombarded** to half depth. Such arrangements have two different refractive indices side by side and the material with the larger refractive index is able to guide optical signals.

optical weave. *Noun.* Reinforcement in which optical fibres form the **warp** and conventional ceramic fibres the **fill**; used to provide background lighting.

optic axis. *Noun.* The one direction in a **birefringent** crystal, such as **calcite** or **quartz**, in which the **ordinary** and **extraordinary rays** behave alike in all respects. It is the direction formed by tilting a rhombohedron of a double refracting crystal so that only one image is seen and remains as a single image on rotation about this direction. The optic axis corresponds to the c -axis in the crystallographic unit cell. Such crystals are called **uniaxial** when only one such axis exists. Orthorhombic, monoclinic and triclinic crystals have two directions so they are **biaxial**.

optics. *Noun.* The science that deals with light, its origin and propagation, the effects it undergoes and produces, and other phenomena with which it is associated.

optimisation. *Verb.* To make as near perfect, functional, or effective as possible.

optimum frequency. *Noun.* In electromagnetic testing, that frequency which provides the largest signal-to-noise ratio obtainable for the detection of an individual material property, each property of a particular material having its own optimum frequency.

Optitherm S3. *Trademark, noun.* See **Pilkington Optitherm S3**.

optoceramic. *Noun.* Usually oxides produced and developed for their optical properties and the way they can be manipulated. See **lithium niobate**.

optoelectronics. *Noun.* The study of devices and materials in which an optical input produces an electrical output.

optomechanically induced transparency. *Noun.* An effect in some ceramic materials whereby they can become transparent to a control laser beam, which affects how a second beam can propagate through the material, due to change in **refractive index** as the control laser couples with **phonons** in the material. Hence an input signal can be used to modulate a second signal, which is the principle of the **transistor**, and so using these materials an **optical transistor** can be made.

optosensor. *Noun.* Ceramics that respond to radiation frequencies, which, via the **piezoelectric**, generate an electrical potential that can be used to make a sensor device; **lithium niobate**, LiNbO_3 , and **zinc sulphide**, ZnS , are examples.

orange mineral. *Noun.* See **red lead**.

orange ochre. *Noun.* Colloquial name for the orange pigment **ferric oxyhydroxide**, $\text{FeO}(\text{OH})$. Also known as the mineral **goethite**.

orange peel. *Noun.* A pattern of roughness or waviness on porcelain-enamelled, glazed, pickled, painted, or other surface which resembles the skin of an orange in texture.

orbital. *Noun.* (1) The quantum-mechanical wave description of the state of an electron. A volume surrounding an atomic nucleus in which the probability distribution of the electron is given by a **wave function** that also includes its energy. (2) *Adjective.* Of or denoting an orbit.

orbiton. *Noun.* **Orbital** wave-particles produced by symmetry breaking in orbitals within materials, such as LaMnO_3 . They may have a role in **high temperature superconductors** by allowing coupling between electrons that enables them to flow without resistance.

order. *Noun.* (1) A repeating sequence of spectral colours that occurs as the thickness of a thin film of material is systematically increased. The thinnest film produces the first order spectrum. (2) Any of the five major styles of architecture as classified by the style of columns and **entablatures** used: **Doric**, **Ionian**, **Corinthian**, **Tuscan** and **Composite**.

ordering. *Noun.* The process within a crystal structure of forming a **superlattice**.

ordering energy. ΔH_{ord} . *Noun.* The difference between the **enthalpy** of an ordered crystalline lattice and the

same crystal with a mixed arrangement of atoms or ions, **ordered** and **disordered spinels** for example. It is a measure of the strength of ordering and determines whether it melts while still ordered or becomes disordered before it melts.

order, short-range. *Noun.* See **short-range order**.

Ordinary Portland Cement. OPC. *Noun.* See **Portland cement**.

ordinary ray. *Noun.* The **refracted ray** of light in a **double refracting** crystal, such as **quartz**, that does obey **Snell's law**: $\sin\phi/\sin\phi' = n$, where ϕ is the angle of incidence, ϕ' is the angle of refraction, and n is the **refractive index** of the crystal.

ore. *Noun.* Any naturally occurring mineral or aggregate of minerals from which economically important constituents can be extracted.

ore dressing. *Noun.* The first stage in the extraction of an economic constituent from an ore in which as much **gangue** as possible is removed. Also called **mineral dressing**.

ore minerals. *Plural noun.* The natural source of most useful metals and products used in the ceramics industries.

ore, refractory chrome. *Noun.* See **refractory chrome ore**.

organically modified ceramic. *Noun.* A substitute for dental amalgam tooth filling consisting of a mixture of polysiloxanes monomer, **calcium fluoroapatite**, and **glass-ceramic** components. Once in the tooth it releases fluoride ions to protect against caries and is highly durable with a good stress resistance.

organic bond. *Noun.* (1) An organic material, such as rubber, synthetic resins, or **shellac**, employed to bond abrasive grains in the production of grinding wheels. (2) A gum, starch paste, or similar material incorporated in a ceramic body or glaze to increase its **green strength**.

organic fibre. *Noun.* A natural or synthetic polymer fibre having an **aspect ratio** of 100 or more.

organic solvent. *Noun.* Any organic liquid used to dissolve or disperse other substances.

organic test. *Noun.* A procedure used to determine the contaminating organic matter in sand. The sand, 50 ml, is suspended in 100 ml of 3 % sodium hydroxide solution, and settled for 24 h. The darkness of the solution above the sand is monitored against preset standards.

organoclay. *Noun.* Functionalised clay made by infiltrating organic compounds into it. It is then used as filler in polymers to modify their properties, for example infiltration with quaternary amines or resorcinol diphenyl phosphate to improve fire retardance.

oriel window. *Noun.* A bay window supported by one or more **corbels**.

oriental almandine. *Noun.* A variety of **corundum** resembling **almandine** in colour. Used as a **gemstone**.

oriental amethyst. *Noun.* See **amethyst**.

oriental emerald. *Noun.* A green form of **corundum** with value as a **gemstone**.

orientation. *Noun.* A process, usually involving heat and applied stress, which realigns the molecular or crystal structure. Uniaxial tension produces uniaxial orientation known as **fibre texture**, biaxial tension produces a sheet texture.

orientational polarisation. *Noun.* When an electric field, E , is applied to materials possessing permanent dipole moments, the moments tend to line up with the field to produce an orientational polarisation, P_o . The value is given as: $P_o = N L_{(a)} p$, where N is the number of dipoles per unit volume, p is the moment of each dipole, and $L_{(a)}$ is the **Langevin function**, $\coth a - 1/a$, where $a = pE/kT$.

orientation factor. *Noun.* See **resolved shear stress**.

oriented inclusions. *Plural noun.* Material trapped in crystals that occupy spaces along definite crystallographic planes of the host crystal so producing a symmetrical pattern; such a microstructure is formed as a result of simultaneous crystallisation or by exsolution.

oriented materials. *Noun.* Anisotropic materials produced by orientation of microstructures such as **acicular** crystals along a rolling axis.

orifice meter. *Noun.* A plate having a central hole that is placed across the flow of a liquid. The pressure difference caused by the flow velocity through the hole makes it possible to determine the flow quantity.

orifice ring. *Noun.* The ring or bushing in the feeder through which glass flows to a forming machine.

o-ring. *Noun.* A flat or toroidal ring of rubber or plastic squeezed between two flat surfaces to produce a vacuum or high-pressure seal.

ormocer. *Acronym.* Derived from organically modified ceramic. See **organically modified ceramic**.

ormolu. *Noun.* A gold-coloured alloy of copper, tin and zinc used to decorate mouldings and some types of ceramic.

Ormosil. *Trademark, noun.* Ceramic composites formed from nanometre-sized powders.

ornamental tile. *Noun.* A decorative tile, frequently having a patterned surface, or tiles of diverse size and shape, to be installed in decorative patterns.

oroide. *Noun.* An alloy of copper, tin, and other metals, used as an imitation gold decoration on pottery and glass.

orpiment. *Noun.* As_2S_3 . Arsenic trisulphide; formed when **realgar** is exposed to light; a yellow mineral with a resinous lustre. Used as the basis for **King's yellow** pigment. Also called **fool's gold**. Density $3,480 \text{ kg m}^{-3}$; hardness (Mohs) 1.5–2.0.

Orsat analyser. *Noun.* A gas analysis arrangement in which the gases are absorbed into a series of solvents and solid phases.

orthicon. *Noun.* See **image orthicon**.

ortho-. *Combining form.* (1) Perpendicular or at right angles. (2) Straight, upright. (3) Correct.

orthoboric acid. *Noun.* H_3BO_3 . The more formal name for **boric acid**.

orthoborates. *Plural noun.* MBO_3 . Salts of boric acid, H_3BO_3 . They contain planar BO_3 groups which, leads to a layered structure and many, such as $Sr_2Be_2(BO_3)_2O$, (**SBBO**), are non-centrosymmetric and so have **non-linear optical** properties. When the cation, M , is any other than europium, but Eu^{3+} is used to dope the salt, a **phosphor** sensitive to ultraviolet light is produced that emits an orange-red colour and is used in plasma display panels. See **borates**.

orthoclase. *Noun.* A word meaning straight fracture. See **orthoclase feldspar**.

orthoclase feldspar. *Noun.* $KAlSi_3O_8$. A potash-bearing feldspar found as monoclinic crystals in **igneous, sedimentary** and **metamorphic** rocks as white, red or green crystals. There is partial ordering of the Si^{4+} and Al^{3+} ions at tetrahedral sites; employed in the manufacture of glass, electrical and other porcelains, vitreous sanitary ware, and pottery. Usually shortened to **orthoclase**.

orthoenstatite. *Noun.* The most common form of the three enstatite polymorphs at room temperature. See **enstatite**, **clinoenstatite** and **protoenstatite**.

orthogonal. *Adjective.* Consisting of right angles; perpendicular.

orthogonal projection. *Noun.* A type of engineering drawing in which projections of the views of the object being described are at right angles to each other.

orthogonal weaves. *Plural noun.* A way of forming three dimensional composites in which fibres are oriented along the x , y , and z -axes. The carbon, glass, or other fibres are woven dry to fill about 40 % of the volume and this reinforcement is impregnated from the liquid or vapour state with a **matrix phase**.

orthographic projection. *Noun.* A style of engineering drawing in which true dimensions are represented as if projected from infinity on three planes perpendicular to each other.

orthopaedic implant. *Noun.* A device, often a metal but is increasingly a composite or a porous glass-ceramic, surgically introduced into the skeleton of the human body. See **osteo ceramics**.

orthophosphoric acid. *Noun.* H_3PO_4 . Used in the manufacture of phosphates. Also called **phosphorus acid**.

orthopyroxene. *Noun.* A member of the **pyroxene group** of minerals with an **orthorhombic** crystal structure, such as **enstatite** and **hypersthene**.

orthorhombic. *Adjective.* The crystal system with three unequal perpendicular axes. **Topaz** and **marcasite** are ceramics within this system.

orthoscopic. *Adjective.* Yielding an undistorted image.

orthotitanates. *Plural noun.* Ceramic phases of general composition M_2TiO_4 .

orthotropic. *Adjective.* A system of three mutually perpendicular planes of elastic symmetry.

orthotropic laminate. *Noun.* A composite laminate whose layup is such that the planar elastic properties have three planes of symmetry, parallel respectively to the sides of the specimen. See **lay-up**.

orthotungstic acid. *Noun.* See **tungstic acid**.

Orton cones. *Plural noun.* Trigonal prisms of standardised shapes, sizes, and ceramic compositions which will deform by bending under predetermined conditions of time and temperature, and which are employed to indicate the thermal history of ceramic ware during a firing operation.

oscillator circuit. *Noun.* A circuit in which ac current is produced by an electronic valve or **transistor** working in conjunction with **inductance** and **capacitance**, the values of which determine the operating frequency.

oscillograph. *Noun.* An instrument for making a graphical record of an oscillating quantity, such as electrical current.

o²-sialons. *Plural noun.* Phases formed by the partial replacement of silicon by aluminium in **silicon oxynitride**; general formula is: $\text{Si}_{2-x}\text{Al}_x\text{O}_{1+x}\text{N}_{2-x}$, where $x < 0.2$.

osmosis. *Noun.* The diffusion of fluids through semipermeable membranes or porous barriers under the influence of capillary forces and concentration gradients.

osteoceramic. *Noun.* A mixture of ceramic phases, one of which is biologically active and able to interact and bond to bone, used in tooth and bone replacement and strengthening. An example is α -calcium triphosphate and MgAl_2O_4 , **spinel**, where the α -calcium triphosphate is biologically active and the spinel gives high strength.

ostracon. *Noun.* A **potsherd** used for voting in the consideration of ostracising.

otavite. *Noun.* CdCO_3 . A **cadmium carbonate** phase precipitated on to substrates from solutions containing CO_3^{2-} anions.

ounce, troy. *Noun.* See **troy ounce**.

outer fibre. *Noun.* The outer layer of a non-ductile material stressed in three-point loading.

outer fibre stress. *Noun.* See **modulus of rupture**.

outer Helmholtz plane. *Noun.* See **d-plane**.

outer-sphere adsorption complex. *Noun.* See **nonspecific adsorption**.

outgas. *Verb.* To remove gaseous products from a substance by applying heat and, or reduced pressure.

outgassing. *Noun.* The release of adsorbed and occluded gases or water vapour from a body or substance by heating and/or applying a vacuum.

out-of-round. *Noun.* A manufacturing defect in glass and other products in which the degree of roundness is no longer perfect.

out-of-roundness value. *Noun.* The difference between the largest and smallest radius of a measured profile.

out-of-square. *Noun.* The deviation from 90° .

outwash deposits. *Plural noun.* Sands formed in front of advancing glaciers; a common source of cement and ceramic sands. The particle size depends on the distance it was originally carried by the ice front.

ovalisation buckling. *Noun.* A type of failure mode that can occur above a critical bending moment to a circular tube, such as a nanotube. Above the critical moment the tube becomes oval in shape.

ovaloid. *Noun.* (1) A surface generated by revolution about a polar axis. (2) The end-closure of a filament-wound cylinder.

oval ring, oval neck. *Noun.* A glass container defect consisting of excessive visual out-of-round condition even though still within dimensional specification.

oven. *Noun.* A heated chamber in which ware is dried, fired, or otherwise thermally treated.

oven, bottle. *Noun.* See **bottle kiln**.

oven, chamber. *Noun.* See **chamber oven**.

oven, drying. *Noun.* See **drying oven**.

oven-drying loss. *Noun.* The reduction in weight that results when a sample is heated in an oven under specific conditions.

oven glass. *Noun.* A glass of low thermal expansion and high resistance to thermal shock employed in the manufacture of articles to be used in the cooking of food; usually **borosilicate** compositions are chosen.

oven, hobmouth. *Noun.* See **hobmouth oven**.

ovenware. *Noun.* Ceramic whiteware or glass of high resistance to thermal shock; formed as casseroles, ramekins etc.

overaging. *Noun.* In precipitation hardening it is heat-treating to a point where the strength and hardness go past their maximum values.

overburden. *Noun.* Top soil, sand, gravel, or silt overlaying a bed of clay, shale, or other mineral of commercial significance.

over-discharge. *Noun.* The discharge of a cell over and above the level specified for correct operation.

overdraught. *Noun.* A current of air passed over a source of heat, as in a kiln.

overfire, overfiring. *Verb.* (1) Heating ware to a temperature sufficient to cause pronounced deformation, **bloating** or other defect. (2) The firing of porcelain-enamel at temperatures too high or for periods too long, resulting in **pinholes**, **pitting**, or an unwanted dull finish.

overflow. *Noun.* An excess of a material, usually liquids, exceeding the capacity of its container.

overflush. *Noun.* A fault in glassware caused by an excessive flow of glass at a mould joint.

overglaze. *Adjective.* A glaze coating applied over a previously glazed surface of ceramic ware.

overglazed. *Adjective.* Ware coated with a glaze.

overglaze decoration. *Noun.* A ceramic or metallic decoration applied and then fired onto a previously glazed surface of ceramic ware.

overgrinding. *Verb.* A reduction in the particle size or particle-size distribution of a material, or mixture, by grinding or milling to a degree less than desired or required.

Overhauser effect. *Noun.* A nuclear interaction whereby nuclear polarisation can be transferred from one group of atoms through mutual relaxation mechanisms.

overlay. *Noun.* A concrete topping employed to repair worn concrete surfaces.

over-mixing. *Noun.* There is an optimum mixing time for powders to achieve maximum homogeneity and exceeding this is over-mixing.

over pickling. *Noun.* Pickling of metal shapes for porcelain enamelling for excessive time, excessive temperature, or in solutions of the wrong pH, with the result that the finished ware has defects, such as **blistering**, **fish scaling**, etc.

overpress. *Noun.* An imperfection in glassware consisting of a projection or fin of excess glass due to an imperfect closing of mould joints.

oversanded. *Noun.* An excess of fine aggregate in a concrete mix.

oversaturated. *Adjective.* Description of rocks containing excess **silica**.

oversize. *Noun.* The material retained in the maximum specified sieve.

overspray. *Noun.* (1) The portion of the slip from a spray gun that passes by or which is not deposited on ware during the spray operation. (2) *Verb.* To apply a second coat of porcelain-enamel over a previously applied, but unfired coat, this, in effect, produces two coats of enamel requiring a single firing operation.

overvoltage. *Noun.* A voltage above the normal level.

ovolo. *Noun.* A convex moulding with an elliptical cross-section.

Ovonic memory switch. *Noun.* A device consisting of two **glassy semiconductor** thin films that form a low-resistance and a high-resistance state around a critical voltage, V_c . The device is in the low-resistance state without a holding current and switching back to the high-resistance state happens when a current pulse is applied.

Ovonic threshold switch. *Noun.* A device formed from a glassy semiconductor thin film with two stable states, one of high resistance, one of low resistance, symmetric with respect to voltage. Switching from a high-resistance to a low-resistance state happens when a voltage greater than the switching voltage, V_T , is applied. The low-resistance state is maintained by a minimum holding current, I_H and if the current falls below I_H the switch returns to the high-resistance state.

Owens process. *Noun.* A bottle forming process in which the blank or **parison mould** is filled by suction.

OWL. *Acronym.* Stands for on-wire lithography. See **on-line lithography**.

oxalic acid. *Noun.* $(\text{COOH})_2$. A colourless crystalline acid. Used as a cleaning agent for metal surfaces prior to enamelling.

oxidant. *Noun.* A substance that is used as an oxidising agent.

oxidation. *Noun.* (1) A chemical reaction in which the oxygen content of a compound is increased. (2) A chemical reaction in which an atom or ion loses electrons or in which the positive valence is increased.

oxidation state. *Noun.* Formalism used to describe the changes that happen to an element in its chemical reactions, for example, when titanium metal, Ti, is burned to the oxide, TiO_2 , the titanium changes from oxidation state zero to oxidation state four, IV.

oxide. *Noun.* A compound of oxygen with one or more elements or radicals.

oxide ceramics. *Plural noun.* Ceramics made by dry-pressing or slip casting essentially pure oxides, such as **alumina**, **magnesia**, **zirconia**, etc., followed by sintering at high temperatures.

oxide colour. *Noun.* An oxide material, usually one of the transition metal oxides, which may be added as a batch ingredient or as a mill addition to produce colour in porcelain-enamels, glazes, and ceramics.

oxide-fuel reactor. *Noun.* A nuclear reactor in which the fuel is uranium dioxide, UO_2 , or plutonium dioxide, PuO_2 .

oxide, graining. *Noun.* See **graining oxides**.

oxide mineral. *Noun.* A naturally occurring mineral in which the components are in essentially oxide form, such as SiO_2 , ZrO_2 , Fe_2O_3 etc.

oxide nuclear fuel. *Noun.* Fissionable uranium or plutonium oxide.

oxide phosphors. *Plural noun.* Electroceramics designed to emit visible light by **luminescence** when exposed to ultraviolet light, x-rays or electrons. Examples are $\text{Eu:Y}_2\text{O}_3$ for uv, CaWO_4 for x-rays and $\text{Tb:Y}_3\text{Al}_5\text{O}_{12}$ for electrons. The last example is a **cathodoluminescent** phosphor. Particle sizes about 1–2 μm and a **brightness** of 20 lm w^{-1} of incident energy are desirable. Crystal perfection is needed to limit non-radiative recombination of electron-hole pairs. The colour range is shown in **Table A.12**.

oxides. *Plural noun.* (1) Compounds containing oxygen ionically or covalently bonded to another element but not as part of a radical, such as sulphate, $[\text{SO}_4]^{2-}$ etc. (2) Colour and opacity-producing additives added to the mill in the preparation of porcelain-enamels and glazes.

oxides-2212. *Noun.* High- T_c superconductors. See **2212-bismuth oxides**.

oxides, surface. *Noun.* See **surface oxides**.

oxide superconductors. *Plural noun.* A group of ternary and quaternary oxides that becomes superconducting at temperatures higher than 30 K; also known as high- T_c superconductors. Examples are given in **Table A.13**.

oxidise, oxidize. *Verb.* (1) To cause to undergo a reaction with oxygen. (2) To cause to form a layer of oxide on a material. (3) To cause to undergo a decrease in the number of electrons.

oxidising agent. *Noun.* A compound that removes or displaces hydrogen in another compound, attracts electrons, or gives up oxygen easily.

oxidising atmosphere. *Noun.* An atmosphere with a partial pressure of oxygen in which oxidation reactions can take place during firing or when using a ceramic.

oxidising condition. *Noun.* The presence of air in a kiln in excess of that needed to completely burn the fuel.

oxidising flame. *Noun.* A flame in which oxygen is present in amounts greater than is required for complete combustion.

oxidising period. *Noun.* The time span of a firing operation in which any carbonaceous material in the composition is burned out.

oxidising temperature. *Noun.* The temperature at which the rate of oxidation of carbon, or other element, or compound in a product becomes detectable.

oxyapatite. *Noun.* $\text{Ca}_{10}(\text{PO}_4)_6\text{O}$. A crystalline phase found in some glass-ceramics. See **Cerapear crown**.

oxygen ionisation process. *Noun.* See **FFC-Cambridge process**.

oxygen parameter. μ . *Noun.* A quantification of the degree of distortion present in the oxygen ion close-packing in the **spinel** structure arising from different sized cations in the tetrahedral sites. Defined as $0.25 + \delta$, where δ is the ratio of the distance from the centre to the corner of a cation filled tetrahedron to the length of the body diagonal of the crystallographic unit cell; $\delta = 0.375$ for perfect cubic-close-packing.

oxyhydrogen. *Noun.* A mixture of oxygen and hydrogen used to produce an intensely hot flame.

oxynitride glasses. *Noun.* Non-crystalline phases with the general composition $\text{SiO}_{2-3x}\text{N}_{2x}$ produced by the reaction of ammonia gas with fumed silica in the temperature range 600–1,200 °C; significant differences in the physical properties in the two ranges of composition: 0–12 wt.% nitrogen 12–28 wt.% nitrogen.

oxynitride pigments. *Plural noun.* **Perovskites**, such as CaTaO_2N and LaTaON_2 , which can have colours in the yellow-red range depending on the **electronegativity difference** between the components. The colour variation is achieved by varying the O:N ratio. A safer alternative to cadmium based pigments.

oxo. *Noun.* $[\text{M}=\text{O}]^{(x-2)+}$. The final stage of hydrolysis of aquo species. See **aquo** and **hydroxo**.

oxolation. *Noun.* A condensation reaction in which oxo bridges, $(-\text{O}-)$, are formed between two metal centres.

ozocerite or ozokerite. *Noun.* A greyish-brown wax found with petroleum deposits; used in ceramics as a green-state binder. Also used to make waxed paper.

P. *Abbreviation.* Standing for: (1) power; (2) **poise**; (3) parity.

P. *Symbol.* Denotes: (1) phosphorus; (2) pressure; (3) power; (4) **poise**.

p. *Abbreviation.* Standing for: (1) pico; (2) pint.

p. *Symbol.* Standing for several scientific entities: (1) momentum; (2) proton; (3) pico.

Pa. *Abbreviation.* Standing for **pascal**, the synonym for N m^{-2} .

pack. *Noun.* (1) The quantity of ware contained in a package. (2) The ratio of ware contained in a package to that theoretically possible.

packaged brick. *Noun.* One or more brick encased in a package to facilitate handling and to minimise breakage.

packaging. *Noun.* The general name given to semiconductor and related circuit supports, such as sintered **cordierite** wafers, disks, and rings.

pack carburising. *Noun.* The process where the surface concentration of an alloy is increased by heating it in a pot containing carbon powder, such as **coke**, that is tightly packed around it.

packerhead. *Noun.* A mechanical device in which concrete pipes are formed by compacting the concrete against a stationary, outside, vertical mould with a revolving shoe known as a packerhead.

packing. *Noun.* (1) A material used to cushion packed goods. (2) A substance used to make watertight or gastight joints. (3) Pieces of material used to adjust the position of a component or a machine before securing in the final position.

packing density. *Noun.* (1) The density of an aggregate, expressed as grams per millilitre, or pounds per

cubic foot, packed in a container under specified and controlled conditions. (2) The percentage of the space of a unit cell occupied by spherical atoms of the same size when ordered into one of the layer sequences, such as cubic close packed.

packing factor. *Noun.* Ratio of true volume to bulk volume.

packing fraction. *Noun.* A measure of the stability of a nucleus. Given by: $[(\text{mass in amu}) - (\text{mass number})] / \text{mass number}$.

pad. *Noun.* The refractory brickwork floor under the molten iron in a blast furnace.

padding. *Verb.* The rough shaping of a piece of glass by paddles or tools prior to the pressing of optical-glass blanks.

paddle and anvil. *Noun.* A procedure for the shaping and decoration of plastic pottery bodies by means of a textile or cord-wrapped paddle on which a design may be carved. The anvil, a smooth piece of wood, stone, or stiff leather, is held against the interior wall to resist the beating of the paddle on the outside. A technique used by ancient civilisations to shape and decorate vessels made from plastic clay; cord-wrapped paddles were used to compact the vessel and produce characteristic patterns.

Padmus method of expansion measurement. *Noun.* A technique for calculating the coefficient of thermal expansion based on the **birefringence** resulting from the stress generated at the juncture when glass and another glass of known expansion and a similar transformation temperature are fused together.

pad print. *Verb.* A way of decorating ware whereby an image is transferred from an engraved plate to an object by means of a silicone rubber pad.

PAFC. *Abbreviation.* Standing for phosphoric acid fuel cell. See **fuel cell**.

paillette. *Noun.* A small piece of metal foil used in enamelling for decoration.

paillons. *Noun.* Small pieces of metal foil over which a porcelain-enamel is applied and fired as a form of artware; for example, jewellery, mobiles, etc.

paint. *Noun.* A mixture of four components: **pigment**, **binder**, solvent/liquid carrier and additives. The pigment is usually a ceramic. Used to provide decoration and protection.

painting. *Verb.* (1) The process of applying a pigmented coating or design to ware by means of a brush, silk-screen, roller, spray gun, dipping, or other technique for the purpose of decoration or protection, or both. (2) *Noun.* A design so applied.

paint mill. *Noun.* A mixer used to suspend enamelling frit in organic liquids.

pale glass. *Noun.* A pale, usually green-coloured, glass.

pale oxide of iron. *Noun.* Fe_2O_3 . Used as a pigment; normally a red colour.

palette. *Noun.* A small board upon which an artist lays and mixes colour for use.

palette knife. *Noun.* A blunt spatula used for blending colours.

Palissy ware. *Noun.* A type of fine **faïence** coated with a bright coloured, tin-enamel glaze.

palladium chloride. *Noun.* PdCl_2 . Sometimes used in porcelain-enamel compositions. Decomposes at 501 °C.

pallet. *Noun.* (1) A low, portable platform upon which materials or products are stacked for easy handling, movement by forklift, and storage. (2) A tool used by potters for smoothing and rounding plastic-clay surfaces consisting of an handle and a flat blade, which is sometimes flexible. (3) A tool used by glassmakers for shaping the foot of **stemware**.

pallet drier. *Noun.* A periodic drier in which ware, stacked on pallets, is charged, dried, and removed.

palletising. *Verb.* The stacking of brick, materials, and other products on a platform to facilitate handling and moving.

pallet knife. *Noun.* Alternative spelling of **palette knife**.

pall ring. *Noun.* A slotted ceramic cylinder used as packing in chemical distillation columns.

palmate. *Adjective.* Shaped like an open hand.

palmette. *Noun.* An ornament or design resembling a palm leaf.

palmitic acid. *Noun.* $\text{CH}_3(\text{CH}_2)_4\text{COOH}$. A white crystalline solid with a greasy texture. Used as a **die lubricant**.

palygorskite. *Noun.* $\text{Mg}_{3-x}\text{Al}_x\text{Si}_8\text{O}_{20}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$. A family of tough, fibrous, lightweight clays related to **attapulgit**

in which a large amount of magnesium is replaced by aluminium; used as a source of both magnesia and alumina.

PAM. *Abbreviation.* Stands for pneumatically applied mortar. See **pneumatically applied mortar**.

PAN. *Abbreviation.* Stands for polyacrylonitrile. See **polyacrylonitrile**.

pancheon. *Noun.* A large shallow **earthenware** bowl used for standing a vessel in that contains setting milk prior to separating the cream.

pan crusher. *Noun.* A large crushing device consisting of a pan in which one or more **mullers** or grinding wheels roll over the material being ground.

pane. *Noun.* A sheet of glass in a window or door.

panel. *Noun.* (1) A brick with depressions in the bed surfaces to improve its adherence with mortar. (2) A large, but relatively thin sheet of material, such as plaster-board, used in construction.

panel brick. *Noun.* A long silica brick employed as the refractory in the wall lining a coke oven. See **stretcher**.

panel spalling test. *Noun.* A test in which the loss in weight, by fragmentation, of a refractory panel subjected to a series of heating and cooling cycles is taken as an indication of spalling behaviour in service.

panel wall. *Noun.* A non-load-bearing wall.

PAN fibre. *Noun.* Fibres derived from **polyacrylonitrile** polymer. A precursor of carbon fibre.

panidiomorphic. *Adjective.* A description of igneous rocks having well developed crystals.

panradiometer. *Noun.* An instrument for measuring radiant heat flux independent of wavelength.

pan, sludge. *Noun.* See **sludge pan**.

pan, tempering. *Noun.* See **tempering pan**.

pantile. *Noun.* S-shaped cross-section roofing tiles which interlock with the sides of adjacent tile.

pantiled. *Adjective.* A surface covered with pantiles.

Pantone system. *Trademark, noun.* A decorating ink matching system that allows an almost infinite shade variation from a range of very few stock colours.

pan, wet. *Noun.* See **wet pan**.

paper. *Noun.* A generic term for matted or felted fibres of any kind formed into sheets from water suspension by pouring on to fine wire mesh screens.

paper resist. *Noun.* A decoration process in which paper, cut in the desired design or configuration, is smoothed tightly on the surface of an item being decorated to

prevent deposition of colours, glazes, or slips in the covered area.

paragenesis. *Noun.* A particular association of minerals in a rock or ore.

paragonite. *Noun.* $\text{NaAl}_2(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$. Monoclinic true mica.

paramagnetic material. *Noun.* A material that possesses paramagnetism, which is a property of atoms or molecules possessing unpaired electrons. As a result of the permanent moment of the atom there is a magnetic moment in the direction of the applied field increasing the permeability to a value greater than unity. The magnetising force has little effect on the change in permeability.

paramelaconite. *Noun.* Cu_3O_4 . See **silver copper oxide**.

parameter. *Noun.* A quality or constant whose value varies with the conditions of its application.

paramorphism. *Noun.* A structural change in a material without change in the chemical composition. Synonym for **polymorphism**.

parasite. *Noun.* A carbonate mineral containing useful amounts of **rare earths**.

paratungstic acid. *Noun.* See **tungstic acid**.

parawollastonite. *Noun.* See **wollastonite-2 M**.

parget. *Noun.* (1) A rough ornamental plaster on a wall, or a rough-cut plaster used to line chimneys. (2) A cement mixture sometimes used to waterproof outer walls. (3) Roughcast. (4) *Verb trans.* Plaster a wall with an ornamental pattern. (5) *Verb trans.* To roughcast. From old French meaning to throw all over. Another name for **gypsum**.

pargeting. *Noun.* Plasterwork that has ornamental patterns incised on it.

parian. *Adjective.* (1) Denoting or relating to a fine white marble mined in classical times in Paros. (2) Denoting or relating to fine **biscuit** porcelain used in statue making. See **Parian ware**. (3) *Noun.* Parian marble. (4) *Noun.* Parian porcelain.

Parian cement. *Noun.* **Gypsum cement** to which **borax** is added to produce a hard finish.

Parian china. *Noun.* **Porcelain** with a high **feldspar** content that can develop a surface self glaze on firing.

Parian paste. *Noun.* A body composed of two parts of **feldspar** and one part of **china clay**; fired at approximately 1,200 °C.

Parian porcelain. *Noun.* See **Parian china**, **Parian ware** and **parian**.

Parian ware. *Noun.* A soft, usually unglazed porcelain resembling white marble in appearance and which is composed of two part of **feldspar** and one part of **china clay**; used in making figurines and statuettes.

Paris green. *Noun.* $3\text{Cu}(\text{AsO}_2)_2 \cdot \text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$. A poisonous, insoluble, double salt of copper arsenite and copper acetate. It has a deep emerald colour and is used as a pigment.

parison. *Noun.* (1) An unshaped mass of glass from which a glass article is formed. (2) A hollow tube from which a glass bottle or other hollow glass object is **blow moulded**.

parison mould. *Noun.* A metal mould that first shapes glass, in the manufacture of hollow ware, prior to final shaping of the item.

parison swell. *Noun.* The ratio of the cross-sectional area of a parison tube to the opening of the die in which an item is to be blow moulded.

Paris white. *Noun.* CaCO_3 . A pure form of **limestone**. Used in **Portland cement**, **soda-lime glass**, pottery and coatings for printed circuits and capacitors. Decomposes at 825 °C; density 2,950 kg m⁻³.

partial dislocation. *Noun.* A **dislocation** whose **Burgers vector** is not a lattice vector and hence is the boundary of a faulted region in a crystal; formed when it is energetically profitable for a dislocation to **slip** in two or more stages where the sum of the Burgers vectors of the partials equals the Burgers vector of the full dislocation

partially densified aerogel. **PDA.** *Noun.* An **aerogel** with a porous structure capable of acting as a host medium for pore-filling materials. The original aerogel has to be sintered to a density in the range 300–1,200 kg m⁻³ to give it sufficient strength to resist the capillary forces on filling with a liquid.

partially stabilised zirconia. **PSZ.** *Noun.* A mixture of **zirconia** polymorphs arising because insufficient cubic phase forming oxide has been added to the ZrO_2 and so a cubic plus tetragonal ZrO_2 mixture is obtained on cooling. A tough ceramic offered as balls for grinding mills that provide very efficient grinding without product contamination.

partial molar quantities. x_i . *Noun.* The change in the thermodynamic parameter with change concentration of the species of the composition of interest at constant temperature, pressure and overall composition: $x_i = (\partial x / \partial n_i)_{T,P,n_j}$. The value of a partial molar quantity is not constant for a given species in a solution but changes with all changes in concentration. The partial molar free energy is particularly important and is called **chemical potential**.

partial reduction. *Verb.* A technique using a controlled atmosphere to reduce a sintered porous ceramic oxide to produce metal-lined pores in the ceramic matrix. Since the pores are contiguous good electrical conductivity is achieved and the composite can be used as an electrode. Used in **solid oxide fuel cell** processing.

particle. *Noun.* A variously shaped very small quantity of matter composed of one or more single crystals. The size and shape depend on the cohesive forces.

- particle crowding index. PCI.** *Noun.* The number of particles in a true cm^3 of powder. It is a parameter that can be calculated from a **particle size distribution**.
- particle density.** *Noun.* The weight of a unit volume of a substance under specified conditions, including its pore volume but excluding inter-particle voids. Also called **block density**.
- particle distribution, continuous.** *Noun.* See **continuous particle distribution**.
- particle distribution, discrete.** *Noun.* See **discrete particle distribution**.
- particle distribution, mono.** *Noun.* See **mono particle distribution**.
- particle distribution, poly.** *Noun.* See **poly particle distribution**.
- particle excitons.** *Plural noun.* The collective name for particles or waves occurring in solids, such as **electrons**, **holes**, **phonons**, **magnons**, **excitons**, **plasmons** and **orbitons**.
- particle inspection flaw indications, magnetic.** *Noun.* See **magnetic particle inspection**.
- particle inspection, fluorescent-magnetic.** *Noun.* See **fluorescent magnetic inspection**.
- particle inspection, magnetic.** *Noun.* See **magnetic particle inspection**.
- particle orientation.** *Noun.* The geometrical relationships between particles in a structure.
- particle-reinforced composite.** *Noun.* A **composite** with ceramic particles, ideally **eqiaxed**, as the reinforcing phase.
- particle shape.** *Noun.* The surface or spatial configuration of a particle.
- particle size.** *Noun.* (1) The general dimensions of the particles of a granular or powdered substance or mixture, usually assuming all particles to be spherical in shape. (2) The controlling linear dimensions of a particle or mixture of particles as determined by a **sieve analysis** or other means.
- particle-size analysis.** *Noun.* The determination of the proportion of particles of defined sizes contained in a powdered or granular sample.
- particle-size distribution.** *Noun.* The percentage of each size fraction into which a powdered or granular sample may be classified.
- particle sizing.** *Verb.* To separate of the particles of a powdered or granular sample into defined size fractions.
- particulate.** *Adjective and noun.* (1) *Adjective.* In the form of separate particles. (2) *Noun.* Matter in this form.
- parting agent.** *Noun.* Another name for **release agent**; a lubricant, often wax, used to coat a mould cavity.
- parting compound.** *Noun.* A powdered or colloidal material applied to a mould to facilitate the separation of a moulded material from the mould.
- parting line.** *Noun.* The line or seam on glass, ceramic, or other moulded product caused by the joints of the mould parts.
- parting wheel.** *Noun.* A thin abrasive wheel, usually **organic bonded**, used to cut, slice, or slot a material.
- partition tile.** *Noun.* Tile used in the construction of non-loadbearing partitions.
- parts per million. ppm.** *Noun.* The measurement of the number of parts of a substance, such as an impurity, per million parts of the parent material, usually expressed as micrograms per gram.
- pascal. Pa.** *Noun.* Derived **SI unit** of pressure or stress equal to one **newton** per square meter. It is equivalent to 10 dyn cm^{-2} and $1.45 \times 10^{-4} \text{ lbs in.}^2$ and $1.013 \times 10^5 \text{ Pa}$ equals 1 atm pressure.
- passivation.** *Verb.* (1) To make a normally chemically active surface stable and inactive. (2) To form a surface layer that impedes the electrochemical reactions at an electrode.
- paste.** *Noun.* (1) The clay body used in the fabrication of ware. (2) The cementing ingredient in concrete consisting of cement and water. (3) A hard sparkling glass used for making imitation gems. Also called **strass**. (4) An imitation gem made from strass.
- paste, graining.** *Noun.* See **graining pastes**.
- paste, hard.** *Noun.* See **hard paste**.
- paste mould.** *Noun.* A carbon-lined mould used in the forming of blown glassware. It is dipped into water before use so that a cushion of steam forms between mould and glass.
- paste, Parian.** *Noun.* See **Parian paste**.
- paste, porcelain.** *Noun.* See **porcelain paste**.
- paste, screening (squeegee).** *Noun.* See **screening ink**.
- paste, soft.** *Noun.* See **soft paste**.
- patch, hot.** *Noun.* See **hot patch**.
- patching cement.** *Noun.* (1) A mixture of **Portland cement** and fine aggregate used to repair concrete. (2) A fireclay cementitious material; used to patch furnace walls, the bottoms of glass moulds, and to make corrections in moulds.
- pâte dure.** *Noun.* Ceramic whiteware fired at relatively high temperatures.
- pâte-sur-pâte.** *Noun.* A technique for the decoration of ceramic ware in which a relief pattern is built up mostly by hand with successive layers of slip.

- pâte tendre.** *Noun.* Ceramic whiteware fired at relatively low temperatures.
- patina.** *Noun.* A thin, usually decorative film with a coloured or metallic sheen, formed in various ways on the surface of ware during firing, frequently in a **reducing atmosphere**.
- pattern burnishing.** *Verb.* Special effects obtained on the surfaces of clay vessels by polishing the **leather-hard clay**, or overglaze gold, with a stone, sand, or steel tool.
- pattern cracking.** *Adjective.* A random distribution of cracks on the surface of concrete as a result of surface shrinkage or internal expansion; also known as a **cracking map**.
- pat test.** *Noun.* An estimate of the soundness of concrete in which thin cylinders of concrete are submerged in either boiling or cold water for specified periods of time, and then examined for cracking, warping, and disintegration.
- Pauli exclusion principle.** *Noun.* The principle that states: two identical **fermions** cannot occupy the same **quantum state** in a body such as an atom. Often stated as no two electrons can be described by the same four **quantum numbers**, which implies that only two electrons can occupy one **orbital** and then only if they spin oppositely.
- Pauli repulsion.** *Noun.* See **scanning tunnelling hydrogen microscopy**.
- pave.** *Verb trans.* To cover a road etc. with paving stones or concrete.
- pavé.** *Noun.* (1) A paved surface. (2) A setting of gems so closely in an ornament or decoration that no substrate shows.
- pavement, flexible brick.** *Noun.* See **flexible brick pavement**.
- paver.** *Noun.* (1) An unglazed porcelain or natural clay tile formed by the **dust-pressing** method, and similar to **mosaics** in composition and physical properties, but relatively thicker, with 37.5 cm² or more, of facial area. (2) Solid brickwork laid end-to-end to completely cover the bottom of a furnace.
- paving.** *Noun.* (1) A paved surface. (2) Material, such as brick, stone or **asphalt**, used for a pavement.
- paving brick.** *Noun.* Low-absorption vitrified brick of high strength, usually with spacing lugs, produced with smooth or **wire-cut** surfaces; used in the construction of roads, driveways, sidewalks, etc.
- paving-brick clay.** *Noun.* Impure refractory **fireclays** and **shales** that are used to form **paving brick** of high tensile strength and durability.
- paving stone.** *Noun.* Stone or concrete slabs used for **paving**.
- paving train.** *Noun.* A battery of road-construction equipment on a road-paving job.
- pay dirt.** *Noun.* A rich deposit of minerals that is worth mining.
- P-B ratio.** *Abbreviation.* Stands for Pilling-Bedworth ratio. See **Pilling-Bedworth ratio**.
- PCB.** *Abbreviation.* Stands for printed circuit board. See **printed circuit boards**.
- PCC.** *Abbreviation.* Stands for precipitated calcium carbonate. See **precipitated calcium carbonate**.
- PCD.** *Abbreviation.* Stands for polycrystalline diamond. See **polycrystalline diamond**.
- PCE.** *Abbreviation.* Stands for pyrometric cone equivalent. See **pyrometric cone equivalent**.
- PCI.** *Abbreviation.* Stands for particle crowding index. See **particle crowding index**.
- PCM.** *Abbreviation.* Stands for: (1) powder co-injection moulding. (2) Phase change memory device. See **powder co-injection moulding** and **phase change memory device**.
- PCSS.** *Abbreviation.* Stands for photoconductive semiconductor switch. See **photoconductive semiconductor switch**.
- PDA.** *Abbreviation.* Stands for partially densified aerogel. See **partially densified aerogel**.
- PDFFA.** *Abbreviation.* Stands for praseodymium-doped fluoride fibre amplifier.
- PDS.** *Abbreviation.* Stands for photothermal deflection spectroscopy. See **photothermal deflection spectroscopy**.
- peach bloom red glaze.** *Noun.* A traditional copper-red glaze often blemished by the appearance of suffuse green areas. These are areas of copper sulphide, CuS, adhering to the surface of bubbles, which give rise to internal reflection and cause the green colour. See **copper-red glaze**.
- peacock ore.** *Noun.* A colloquial name given to the copper ore **bornite**, Cu₃FeS₄, because of its red colour usually overlaid with purple tarnish. Cubic structure. Density 5,073 kg m⁻³; hardness (Mohs) 3.
- peapods.** *Plural Noun.* A structural description for C₆₀ **fullerene** molecules confined within single-walled **carbon nanotubes** forming long, one-dimensional crystal structures.
- peapod structures.** *Noun.* **Peapods** filled with a range of molecules other than **fullerene**.
- pear brilliant.** *Adjective.* Description of a complex style of faceting used on diamond and other colourless gemstones.
- pearl.** *Noun.* A hard, smooth lustrous form of **calcium carbonate** secreted in layers round a sand grain inside an oyster or clam to form a spherical shape valued as a gemstone.

pearl ash. *Noun.* K_2CO_3 . Colloquial name for commercial **potassium carbonate**. A translucent or white, depending on particle size, deliquescent solid, used in glass, glaze and porcelain-enamel batches as a flux. Mp 909 °C; density 2,300 kg m⁻³.

pearlescent. *Adjective.* Having a shimmer effect and give a different colour dependent on the angle of viewing.

pearlescent pigments. *Plural noun.* Colour formulations based on thin oxide layers on specially crystallised **alumina**, **mica** or **silica** flakes.

pearlised or pearly. *Adjective.* Having or given a pearly lustre.

perlite. *Noun.* A lamella aggregate of almost pure iron and **cementite** forming the microstructure of cast iron and carbon steels. Variant spelling of **perlite**.

pearl moss. *Noun.* See **Irish moss**.

pearl ware. *Noun.* Cream-coloured ware coated with a blue-tinged glaze. Developed by Josiah **Wedgwood**.

pearly lustre. *Adjective.* The appearance of a surface of a mineral or ceramic that shows changing colours due to light interference effects.

pebble. *Noun.* (1) A small smooth stone usually rounded by the action of water. See **pebbles**. (2) A colourless, transparent variety of **rock crystal** used to make lenses. (3) A type of very thick lens with a large magnification. (4) See **TRISCO-coated particle fuel** and **pebble bed**.

pebble bed. *Noun.* A nuclear reactor design where the fuel is contained within small **graphite pebbles** to prevent meltdown.

pebble dash. *Noun.* An external wall finish consisting of small pebbles imbedded in **mortar** or **plaster**.

pebble mill. *Noun.* A rotating steel, ceramic, or ceramic-lined cylinder in which materials are pulverised by cascading flint pebbles or porcelain balls.

pebble mill, vibrating. *Noun.* See **vibrating ball mill**.

pebbles. *Plural noun.* (1) **Sedimentary rocks** in the size range 2–64 mm. (2) Hard flint, porcelain, or other heavy, abrasive resistant material used as grinding media in **ball mills**.

PECVD. *Abbreviation.* Stands for plasma enhanced chemical vapour deposition. See **plasma enhanced chemical vapour deposition**.

pedestal. *Noun.* A base that supports a column.

PEEK. *Acronym.* Standing for polyetheretherketone. See **polyetheretherketone**.

peeling. *Noun.* A defect characterised by the separation of flakes of a porcelain-enamel, glaze, or **engobe** from

the base to which it was supplied, usually as a result of poor adherence or subjection to critical compressive stress.

peel strength. *Noun.* The force required to peel apart two sheets of material; units are N m⁻¹ of width.

peen. *Verb trans.* To strike a surface with a high velocity jet of abrasive material or a contained plasma. Used to introduce compressive stresses in surfaces to lower rates of stress corrosion cracking in service. Also called **shot peening**. See **laser shot peening**.

peephole. *Noun.* A small opening in the door or wall of a furnace or kiln to permit observations into the interior of the structure. Sometimes called **peep door**.

PEG. *Acronym.* Denotes polyethylene glycol. See **polyethylene glycol**.

pegmatite. *Noun.* A coarse variety of granite consisting essentially of **feldspar**, **quartz**, and **mica**; used as a source of **lithia**, **zircon**, tin, tungsten, tantalum and uranium.

Peierls distortion. *Noun.* A lattice distortion caused by an electron-phonon coupling effect. The changed periodicity arising from new atom-atom distances introduces energy gaps, the **Peierls gap**, at the **Fermi level**. In one-dimensional systems this is seen as a change from metallic to semiconductor behaviour

Peierls gap. *Noun.* See **Peierls distortion**.

Peierls-Nabarro model. *Noun.* A description of **dislocations** in terms of atomic structures providing semi-quantitative predictions of the anisotropy of dislocation behaviour with crystallographic orientation.

Peierls valley. *Noun.* A straight section of jagged or **kinked dislocations** of low energy.

Pele's hair. *Noun.* A rock with the appearance of a wig. It consists of golden-brown hair-like fibres of **basalt** glass formed from the eruption of basaltic magma as a lava spray. See **basalt lava**.

pelite. *Noun.* Any **argillaceous** rock, such as **shale**.

pellet. *Noun.* A small compacted shape, usually cylindrical, formed by pressing a powdered or granulated material in a die, by casting, or by other technique; used for test or reference purposes.

pellet, green. *Noun.* See **green pellet**.

pelletise. *Verb.* To form powdered or granulated materials into pellets.

pelletising. *Noun.* The process of forming pellets.

pellet, sintered. *Noun.* See **sintered pellet**.

Peltier effect. *Noun.* A thermoelectric effect concerning two dissimilar electrical conductors joined together

which, when a current is passed, results in one junction becoming hot and the other cold depending on the direction of flow of the current. The reverse of the **Seebeck effect**. Silent refrigeration is possible using this effect.

PEM. *Abbreviation.* Stands for photoelectron microscopy. See **photoelectron microscopy**.

PEMFC. *Abbreviation.* Stands for proton exchange membrane fuel cell. See **fuel cell**.

pencil glide. *Noun.* A mode of deformation of a crystal arising when several members of a family of planes, for example, {112} in a body-centred cubic structure, simultaneously act as **slip planes** to produce say (112) and (121) surface planes which have fixed angles between them so that the slipped surface has the appearance of a bundle of hexagonal pencils after the glide has occurred.

pendulum hardness. *Noun.* A measure of hardness based on the time taken to damp the oscillations of a loaded diamond-tipped fulcrum on a polished surface to half the initial amplitude. The diamond usually has the shape of a **Vickers indenter** and the load must be sufficient to cause penetration and be applied below the centre of gravity of the device. Sometimes the instrument is called a **Shore sclerometer**.

penetrant. *Noun.* A liquid capable of permeating a body through openings or discontinuities in the body; usually employed as a test of the surface porosity of a body.

penetrant, fluorescent. *Noun.* See **fluorescent penetrant**.

penetrant, post-emulsifiable. *Noun.* See **post-emulsifiable penetrant**.

penetrant, visible. *Noun.* See **visible penetrant**.

penetration. *Noun.* The process by which a penetrant enters or impregnates a substance.

penetration depth. *Noun.* (1) The depth to which a penetrant permeates a body. (2) The depth at which a magnetic field of induced eddy currents has decreased to 37 % of its surface value. (3) The depth below the polished surface achieved by an indentation diamond test.

penetration, effective depth of. *Noun.* See **effective depth of penetration**.

penetration indication. *Noun.* An observation indicating the presence of a **discontinuity**.

penetration, magnetic flux. *Noun.* See **magnetic flux penetration**.

penetration time. *Noun.* The total time, including application and draining, in which a penetrant is in contact with the surface of a specimen.

penetration twin. *Noun.* Crystal twins where one twin appears to be penetrating the other as the twins are formed about an axis instead of a plane. **Fluorite** is a common example of interpenetrating cubes, while **pyrites** form "iron crosses".

penninite. *Noun.* Thick, bluish-green crystals of **chlorite**.

pentlandite. *Noun.* $(\text{FeNi})_9\text{S}_5$. A cubic iron-nickel sulphide ore that looks like **pyrrhotite** but is non-magnetic.

pentode. *Modifier.* Of a **transistor**, having three terminals at the **base** or **gate**.

peppered sandblast. *Adjective.* A finely textured mottled appearance produced on the surface of an object by sandblasting; usually a decorative treatment.

peptise or peptize. *Verb trans.* (1) To convert to a **colloidal** solution. (2) To liquefy a colloidal **gel** to form a colloidal solution. (3) To **deflocculate** a slurry or slip.

peptisation. *Noun.* The process of stabilising a colloidal **sol** by **adsorption** of electrolytes on to particle surfaces to achieve a good dispersion. Nitric acid is a good **peptising agent** for **boehmite** alumina.

peptising agent. *Noun.* See **peptisation**.

percentage timer. *Noun.* An energy regulator working a simple on-off control to an emitter with the ratio of on/off periods being adjustable.

perborate. *Noun.* $\text{MBO}_3 \cdot x\text{H}_2\text{O}$. Any salt derived, or apparently derived from perboric acid. Used in bleaches.

percentile. *Noun.* One of 99 values of a variable dividing its distribution into 100 groups of equal frequencies.

perchloric acid. *Noun.* HClO_4 . A colourless syrupy liquid with very strong oxidising properties that can be used as a mould wash in special cases.

percolate. *Verb.* (1) To cause a fluid to pass through a porous substance. (2) *Noun.* The product of the percolation process.

percuss. *Verb.* To strike sharply or rapidly.

percussion cap. *Noun.* A detonator consisting of a thin metal or paper cap containing a material that explodes when struck. Used to set-off **self-propagating high temperature reactions**.

percussion mortar. *Noun.* A crushing and powdering device consisting of a block, cylinder, and pestle made of hardened tool steel. The pestle is a close fit into the cylinder and the cylinder fits a depression in the block. The pestle is usually hit with a hammer. Also called **plattner mortar**.

perdurable. *Adjective.* Of some ceramics, extremely durable.

perfect dislocation. *Noun.* A **dislocation** of unit strength, which means that its **Burgers vector** produces an identity translation.

perforated brick. *Noun.* A building brick containing symmetrically arranged holes parallel with the face of the brick to reduce its weight.

performance test. *Noun.* A test to evaluate the ability of a product to meet prescribed conditions of service.

peri. *Prefix.* Indicates enclosing, around, or adjacent to.

periclase. *Noun.* MgO. Natural magnesite used in refractories; density $3,560 \text{ kg m}^{-3}$; hardness (Mohs) 5.5. See **magnesia**.

pericline. *Noun.* Elongated crystals of white, translucent, albite.

peridot. *Noun.* A green, transparent **olivine** used in jewellery. The amount of iron in the crystal structure determines the colour with the more valuable stones having less iron and a deeper green colour.

peridotite. *Noun.* A dark, coarse-grained, plutonic, **igneous rock** containing mostly **olivine** and **pyroxene** with no **feldspar** present.

perimorph. *Noun.* A phase that encloses another of different type; usually used in mineralogical context.

periodic. *Adjective.* Occurring repeatedly, at regular intervals.

periodic drier. *Noun.* A drier in which ware is placed, dried, and removed prior to the introduction of a subsequent batch.

periodic furnace. *Noun.* A furnace in which ware is placed, fired, sometimes cooled, and removed prior to the introduction of a subsequent charge.

periodic kiln. *Noun.* See **periodic furnace**.

periodic table. *Noun.* The arrangement of the elements with increasing atomic number and the periodic variation in the electronic structure. The metals appear on the left hand side, separated from the non-metals on the right-hand side by the d and f-transition metals.

peripheral speed. *Noun.* The rate of movement of a point on the circumference of a revolving wheel, determined as the product of the circumference and the rate of revolution, and expressed as a unit of distance per unit of time, m s^{-1} .

perish. *Verb.* To disintegrate or to be destroyed under conditions of exposure, such as dampness or high temperature.

peritectic reaction. *Noun.* A reaction process occurring on cooling some alloys and ceramic solid solutions. On cooling, first a liquid plus β -phase solid occurs and then, on further cooling to the **peritectic temperature**, the α -phase solid occurs and a change in composition occurs to reach that of the **peritectic point**. The microstructure

will show regions of peritectically generated α along with parts of unconsumed β -phase.

peritectic temperature. *Noun.* The unique temperature at which two solid and a liquid phase coexist.

peritectoid reaction. *Noun.* See **eutectoid reaction**.

perlite. *Noun.* A glassy rock consisting of 65–75 % **silica**, 10–20 % **alumina**, 2–5 % water, and small amounts of **soda**, **potash**, and **lime**; expands on heating to form a light, fluffy material; used as a lightweight aggregate in concrete and plaster, and as heat and acoustic insulation.

perm. *Noun.* A measure of the resistance of a porous material to the penetration of moisture; 1 perm is $10^{-3} \text{ kg (24 h)}^{-1} \text{ m}^{-2} (\text{mmHg})^{-1}$. See **Darcy's law**.

permanent dipole bond. *Noun.* A weak binding force arising from the attraction between **dipoles**.

permanent linear change. *Noun.* The percentage change in the original length of a specimen free of applied stresses, after the specimen is subjected to a prescribed heat treatment; the change is irreversible.

permanent magnet. *Noun.* A strongly magnetised material that retains its magnetic properties for a substantial period of time. It needs a definite demagnetising field to destroy residual magnetism.

permanent mould. *Noun.* A reusable mould.

permanent set. *Noun.* The deformation that remains after the tensile load is removed from a specimen after a definite period.

permanent stress. *Noun.* Stress existing in a body not subject to any external stress.

permeability. Q. *Noun.* (1) $Q = (F/A)(dx/dp)$, where F is the flow rate, A is the area, dp is the pressure drop, and dx is the membrane thickness; it is the property of a porous body that permits liquids or gases to seep into minute openings of the body. It depends on the fluid involved in passage through the connected porosity. The concept of high and low permeability can only be used if the fluid and flow conditions are stated and so the permeability is described in several ways. Semi-empirical equations have given rise to a series of **permeability coefficients** that have a variety of units: ms^{-1} , m, m^2 , **darcy**, **perm**, $\text{cm}^2 (\text{cm H}_2\text{O})^{-1}$. The **darcy** comes from the original modelling. See **Darcy's law**. (2) A property of a material that describes the magnetisation developed in that material when excited by a magnetomotive force. (3) Magnetic permeability, μ , is the ratio of magnetic flux induced in the material to the applied magnetic field strength.

permeability coefficient. k_p . *Noun.* See **Darcy's law**.

permeability constant. P. *Noun.* The product of the diffusion coefficient D and the solubility coefficient δ ; it is the amount of a given species passing through unit volume under unit pressure gradient in unit time.

permeability, effective. *Noun.* See **effective permeability**.

permeability factor. *Noun.* Expressed as kg per day per m²; it is the permeability of a material at a given temperature and pressure.

permeability, incremental. *Noun.* See **incremental permeability**.

permeability, initial. *Noun.* See **initial permeability**.

permeability, magnetic. μ . *Noun.* See **magnetic permeability**.

permeability, normal. *Noun.* See **normal permeability**.

permeability of refractories. *Noun.* The capacity of a refractory to transmit a liquid or gas through the pore structure.

permeability, relative. *Noun.* See **relative permeability**.

permeability test. *Noun.* A test to determine the movement of a liquid or gas through a body under a hydraulic or pressure gradient.

permeability variations. *Noun.* In electromagnetic inspection, changes in the ability of a material to be magnetised that occur along the body of a test specimen; the variations may or may not be indicative of the physical conditions in the part that are detrimental to its end use.

permeance. *Noun.* The ratio of the rate of water vapour transmission per unit area at a steady state through a material between two parallel surfaces to the vapour pressure difference between the surfaces; units are metric **perm**.

permeation rate. *Noun.* Flow of gas per second through a square metre of material under a stated pressure gradient.

per mil. *Abbreviation.* In each thousand.

permissible variation. *Noun.* The maximum allowable error in the value indicated on a testing machine.

permittivity. ϵ . *Noun.* A measure of a materials ability to transmit an electric field, defined as the ratio of its electric displacement to the applied field strength; units are **farads** per metre.

permittivity, absolute. ϵ_0 . *Noun.* See **absolute electric constant**.

permittivity, relative. *Noun.* See **relative permittivity**.

pernetti. *Plural noun.* (1) Small iron pins or tripods used to support ceramic ware in the kiln during firing. (2) Marks on a fired ceramic caused by the ware sticking to the supporting pins during firing.

perovskite. *Noun.* See **calcium titanate**.

perovskites. *Plural noun.* Ceramic oxides of the general formula ABO_3 , where A is a large-sized cation of low charge, such as Pb^{2+} and B is a small highly charged

cation, such as Zr^{4+} ; many of the family have useful **magnetic, electrical, optical, or piezoelectric properties** and are therefore used in a wide range of devices.

peroxide. *Noun.* (1) A class of metallic oxide containing the $[O_2]^{2-}$ anion. (2) Short for hydrogen peroxide.

peroxysulphuric acid. *Noun.* H_2SO_5 . An **hygroscopic**, unstable, crystalline, oxidising acid. Also known as **Caro's acid**.

perpend. *Noun.* A brick extending through a wall from one side to the other, serving to bind two segments of a wall together.

Persian red. *Noun.* Red pigments derived from **ferric oxide** or basic **lead chromate**.

persistent currents. *Noun.* Circulating currents, generated in **superconductors** by a time varying magnetic field. They persist indefinitely because of the zero resistance.

persistent mode operation. *Noun.* A way of operating a **superconducting magnet** by short-circuiting it with a superconducting wire that can be warmed to make it resistive. This produces a voltage across the terminals and the magnet can be charged or discharged. For persistent mode operation the heater is turned off and the switch cools to the superconducting state and when this is achieved the power supply may be turned off without losing the field.

persistent switch. *Noun.* The short length of superconducting wire and its associated heater that connects across the terminals of a superconducting magnet.

perthite. *Noun.* An intergrowth of sodium and potassium **feldspars**, $KAlSi_3O_8$, $NaAlSi_3O_8$, formed by ex-solution when the feldspar cooled.

Pesaro. *Toponym.* (1) Name of a city in Italy that is used to designate **majolica** made there in fifteenth and sixteenth centuries. (2) The potters who made Pesaro ware.

Pesaro ware. *Noun.* See **Pesaro**.

PESM. *Abbreviation.* Standing for photoelectron spectromicroscopy. See **photoelectron spectroscopy**.

pestle. *Noun.* A relatively small club-like instrument, usually composed of **porcelain, quartz, agate** or hard metal alloy, the working end being rounded and slightly roughened, for use in pounding and grinding solid substances in a mortar; may be manipulated manually or by machine.

petalite. *Noun.* $Li_2(Al_2Si_8)O_{20}$. A lithium **feldspathoid**; used as a source of **lithia** in porcelain-enamels, glass, glazes, and speciality bodies as a flux to promote fusion, to reduce thermal expansion, and to improve **thermalshock resistance**. A mineral silicate containing a network of corner-sharing tetrahedra in 5-ring units. mp 1,400 °C; density 2,390–2,460 kg m⁻³; hardness (Mohs) 6–6.5.

Petri dish. *Noun.* A shallow circular, flat-bottomed dish able to be covered and usually made of glass.

petro-. *Combining form.* (1) Indicating stone or rock. (2) Indicating petroleum and its products.

petroglyph. *Noun.* A prehistoric art drawing or carving on rock.

petrography. *Noun.* The science dealing with the description and classification of rocks or the mineral composition of a ceramic body.

petrographic microscope. *Noun.* A high power microscope fitted with attachments, such as a polariser, used for the study of minerals and phase analysis.

petrography. *Noun.* A term used by glass manufacturers for the study of glass defects and furnace refractories by the application of **polarised light** microscopy.

petroleum-coke-carbon refractory. *Noun.* A refractory composed substantially of **calcined** petroleum coke.

petrology. *Noun.* (1) The science concerned with the origin, occurrence, structure, and composition of rock minerals, particularly in terms of their use in ceramic compositions. (2) The optical examination of minerals and rocks.

petrugy. *Noun.* The controlled cooling of a molten glass to allow nucleation of crystals and formation of a **glass-ceramic** article. The final microstructure depends on the batch composition and the cooling rate.

petuntse, petuntze. *Noun.* (1) A fusible **feldspathic** mineral rock. Used in the formulation of **hard paste porcelain**. Used by early Chinese ceramic makers as part of porcelain batches. Also known as **china stone**. (2) The European name for baidunzi. See **baidunzi**

pF. *Noun.* The logarithm of matrix suction in a 1 cm water column. Its characteristic value at pF 1.8 is called the **field capacity** in clay and soil science and is where water is just held against gravity by capillary forces.

PFN. *Abbreviation.* Stands for lead iron niobium oxide. See **lead iron niobium oxide**.

Pfund hardness. H_p . *Noun.* A hardness value based on indentation of a hemisphere into the polished surface of a sample. $H_p = 1.27P/d^2$, where P is the load in newtons, and d is the diameter of the projected indentation in metres.

PG. *Abbreviation.* Stands for lead germanate. See **lead germanate**.

PGA-graphite. *Noun.* Pile grade graphite. It has a suitable high purity and microstructure for use in nuclear reactor cores.

ph. *Abbreviation.* Stands for **phase**.

pH. *Noun.* Potential of hydrogen. A term used to express the hydrogen ion activity or the relative acidity and alkalinity of a solution, measured on a reciprocal log scale, neutral solutions being numerically equal to 7,

decreasing with increasing acidity and increasing with alkalinity.

phanerocrystalline. *Adjective.* A description of a mineral microstructure in which the crystals are so large they can be seen by the unaided eye.

phase. *Noun.* (1) A separate, but homogeneous, fraction of a system with a clearly defined boundary and uniform physical and chemical properties. (2) A fraction of a cycle of a periodic quantity completed at a specified time; expressed as an angle.

phase angle. δ . *Noun.* The angle between two periodic disturbances such as voltage and current. The cosine of δ times 100 is known as the **power factor**.

phase change memory device. PCM. *Noun.* Materials based on **germanium-antimony-tellurium** that can change between crystalline and amorphous states in response to **laser** or electrical energy. An energy pulse applied to the crystalline lattice collapses it to a glassy area and a longer less intense energy pulse restores it to the crystalline state, hence its application as a rewriteable **chip**.

phase change random access memory. PRAM. *Noun.* A device that uses changes in resistance between crystalline and amorphous states of a **chalcogenide special ceramic**.

phase contrast microscopy. *Noun.* A method for making visible transparent objects that normally show little contrast. It is essentially a method of converting phase variations on a wave front leaving the object, into variations of intensity in the plane of the image. To do this a phase plate and an annular diaphragm are added to an optical microscope.

phase diagram. *Noun.* A graphical representation of the equilibrium relationships between different compounds, mixtures, and solid solutions under varying conditions of temperature and pressure.

phase equilibrium. *Noun.* The equilibrium relationships between gas, liquid, and solid states of a compound, mixture, or solid solution under varying conditions of temperature, composition, and pressure. See **equilibrium phase**.

phase field. *Noun.* The range of compositions and temperatures over which a phase exists.

phase, primary. *Noun.* See **primary phase**.

phase rule. *Noun.* A statement that the number of **degrees of freedom** in a material system at equilibrium is equal to the number of **components** minus the number of **phases** plus the constant 2: $F = C + P + 2$.

phase-sensitive detector. PSD. *Noun.* A frequency-changing device that converts the input frequency to a lower frequency by multiplying the input signal by \pm alternately, hence the output signal is a function of the phase difference between the input signal and the reference.

phase-separated glass. *Noun.* A glass like **Vycor**, prepared by quenching from the melt into the two-liquid-phase immiscibility gap, followed by heat treatment to complete the separation into two glasses. One glass is very high in alkali oxide content and so is soluble and can be extracted to leave the high silica glass, **Vycor**.

phase separation. *Verb.* Used in glass-ceramic science to describe glasses that separate into two mutually immiscible liquid phases.

phase shift. *Noun.* A change in the phase relationship between two alternating quantities of the same frequency; noted in electromagnetic measurements.

phase transformation. *Noun.* A change in the number and or character of the phases present in the **micro-structure** of a material.

phase transition. *Noun.* The change of a substance from one phase to another, such as from a solid to a liquid.

phenacite. *Noun.* Be_2SiO_4 . The hexagonal colourless or glassy **orthosilicate** of beryllium. A mineral occurring in granite. The name comes from phenax, meaning cheat because of its deceptive appearance; like that of **quartz**. Sometimes spelled as **phenakite**.

phenakite. *Noun.* See **phenacite**.

pheno. *Prefix.* Indicates shining.

phenocryst. *Noun.* A large crystal embedded in a mass of small crystals in an **igneous rock** giving a shining appearance.

phenol formaldehyde. *Noun.* A thermosetting resin; used as a bonding agent for fiberglass insulation and glass-fibre cloth laminates used in electrical applications.

phenolic laminate. *Plural noun.* Glass-fibre laminates bonded with a thermosetting phenolic resin; used in electrical, structural, and mechanical applications.

phi scale. *Noun.* A scale for particle-size determination in which the diameter value of a sedimentary particle is replaced by the negative logarithm to the base 2 of the particle in millimetres.

philosopher's stone. *Noun.* A ceramic material thought by alchemists to be able to turn a base metal into gold.

philosopher's wool. *Noun.* See **zinc oxide**.

phlogopite. *Noun.* $\text{K}(\text{Mg},\text{Fe})_3(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$. A brownish **biotite** magnesium **mica** found mainly in marble and **dolomite**. A **true mica**. Used in electrical and thermal insulators. Thin sections show **asterism**. Density 2.862 kg m^{-3} ; hardness (Mohs) 2.5–3.0. See **mica**.

phon. *Noun.* A unit of loudness of sound that expresses it as the number of decibels it is above a reference with frequency 1,000 Hz and a root-mean-square sound pressure of $20 \times 10^{-6} \text{ kg m}^{-2}$.

phonochemistry. *Noun.* The study of the effects of sound waves on chemical reactions.

phonolite. *Noun.* A volcanic **igneous rock** containing fine grains of alkaline **feldspar** and **nepheline**.

phonon. *Noun.* A quantised vibration of a crystalline lattice which may be envisaged as a particle of energy h added to the system; **transverse** and **longitudinal phonons** occur and are defined relative to the atom displacements in the lattice. Ionic solids generate **acoustical** and **optical phonons**. In electrical insulators heat is transported by phonons.

phonon glass electron crystals. *Noun.* A concept proposed to increase the **figure of merit**, **ZT**, in **thermoelectric materials**, where phonon transport should be suppressed, as in glasses, and the electrical conductivity maintained, as in crystals. This is mostly achieved by disrupting lattice thermal conductivity.

phononic crystal. *Noun.* An **artificially structured material** or **composite crystal** in which the structure has been periodically modulated with elastic moduli and mass density changes. The wavelength of the modulation is designed to be close to the wavelength of **acoustic waves** made to travel through the crystal and this produces effects, such as **band gaps**, **band edges**, velocity of sound slowing, and **Brillouin zones** analogous to electron waves in normal crystals. A phononic crystal allows acoustic waves with specific frequencies only to travel through because of the band gaps.

phonon, acoustic. *Noun.* See **phonon**.

phonon, longitudinal. *Noun.* See **phonon**.

phonon, optical. *Noun.* See **phonon**.

phonon, transverse. *Noun.* See **phonon**.

phonoscope. *Noun.* A device that makes visible the vibrations of a crystal lattice.

phosgenite. *Noun.* $\text{Pb}_2\text{Cl}_2\text{CO}_3$. Lead chlorocarbonate mineral; recognised by its fluorescence.

phosphate. *Plural noun.* A generic term frequently used to indicate a phosphorus-bearing compound, such as **bone ash**, **calcium phosphate**, potassium phosphate, or similar material; used in glass, ceramic bodies, and glazes.

123 phosphates. *Plural noun.* Phosphates with compositions like $\text{AgTi}_2(\text{PO}_4)_3$, formed either at high temperatures or hydrothermally.

phosphate-bonding agent. *Noun.* Reagents such as H_3PO_4 , $(\text{NH}_4)_3\text{PO}_4$, which react with silicates or oxides to produce **aluminium phosphate** bonding phases so that the products can be used as refractories; used to repair furnace linings.

phosphate crown glass. *Noun.* An optical crown glass containing a substantial amount of **phosphorus pentoxide** as a glass-forming agent. See **optical crown glass**.

phosphate fibre. *Noun.* Fibres of calcium sodium metaphosphate; used as a substitute for asbestos fibre in friction pads.

phosphate glass. *Noun.* A glass in which an essential glassforming ingredient is **phosphorus pentoxide** as a partial replacement for **silica** and which, as a result, is resistant to hydrofluoric acid.

phosphate slag. *Noun.* A phosphate-bearing slag used in glassmaking.

phosphides. *Plural noun.* Binary compounds of phosphorus and metals having a potential use as **semiconducting** and **ferroelectric materials**; not as hard as the corresponding carbides, but generally more thermally stable than the nitrides.

phosphor. *Noun.* (1) A **luminescent** material used to produce fluorescent colours, usually red, green, or violet, in porcelain-enamels and other ceramics when they are subjected to ultraviolet light. (2) More generally any substance capable of converting incident radiation of one wavelength to another, usually lower, wavelength.

phosphorescence. *Noun.* **Luminescence** caused by the absorption of radiation and which persists after the exciting source is removed for times longer than a second.

phosphoric. *Adjective.* Containing phosphorus in the pentavalent state.

phosphoric acid. *Noun.* H_3PO_4 . A rust-proofing agent for metals; sometimes present as an auxiliary **opacifier** in glazes and porcelain-enamels.

phosphorite. *Noun.* (1) Various mineral deposits that are a more or less impure source of **calcium phosphate**, $\text{Ca}_3(\text{PO}_4)_2$. (2) A fibrous form of **apatite**.

phosphorus pentoxide. *Noun.* P_2O_5 . An acidic covalent molecular oxide that is a glass-former.

phosphorus sulphide. *Noun.* P_4S_3 . An essential ingredient in friction matches where its low ignition temperature causes the match to burn. Developed to replace the more dangerous yellow sulphur.

phosphorous butoxide. *Noun.* $\text{P}(\text{OC}_4\text{H}_9)_3$. An **alkoxide** used to prepare **sols** and **gels** by hydrolysis of the butanol solution.

phot. *Noun.* A unit of illumination equal to 1 lm cm^{-2} . One phot equals 10^4 lx .

photic. *Adjective.* Concerned with light.

photoactive coating. *Noun.* Thin, $\leq 1 \mu\text{m}$, transparent coatings of tetragonal TiO_2 , **anatase**, which will photodegrade a wide range of substances including bacteria, viruses, herbicides and pesticides. Ultraviolet light is absorbed and forms a **hole** and free electron in the oxide. The hole migrates to the surface where it oxidises organic species while the electron reduces oxygen to water. This allows contaminants to be washed away from glass and tile surfaces.

photoceramic process. *Noun.* A process in which an emulsion is applied to a ceramic or porcelain-enamel

surface and is developed to produce a positive photographic print, which subsequently is made permanent by firing.

photochemical. *Adjective.* Involving the chemical effect of light; of or relating to photochemistry.

photochemical glass. *Noun.* A photosensitive glass that can be cut by acid. Pictures, designs, etc. can be reproduced on it from photographic film, then it is subjected to an acid bath to leave a 3-D design. Areas subjected to light nucleate glass-ceramic crystals that are insoluble compare: the glassy areas.

photochemical reaction. *Noun.* A chemical reaction initiated by the absorption of light.

photochromic glass. *Noun.* A glass that darkens on exposure to light, but which returns to its original colour and clearness when the light is removed; used in sunglasses.

photoconduction. *Noun.* Conduction of electricity resulting from the absorption of light. **Selenium** is a good example.

photoconductive semiconductor switch. **PCSS.** *Noun.* A device for providing on/off facilities in photo-optics. Often based on **gallium arsenide**, GaAs.

photoconductor. *Noun.* A material, such as **selenium**, in which the conductivity increases when it is exposed to electromagnetic radiation.

photodegradation. *Noun.* A process encountered in some polymer matrix composites where ultraviolet radiation is absorbed, which promotes electrons to higher energy levels. The excited electrons then cause oxidative and cleavage reactions.

photodiode. *Noun.* A semiconductor diode whose conductivity is controlled by incident illumination.

photoelasticity. *Noun.* The effect of stress on the optical properties of transparent materials that leads to a technique for measuring the stress and strains in a transparent material by observing the change in the **double refraction** of the material when it is subjected to stress. When polarised white light passes through a stressed sample the **birefringence** causes coloured patterns.

photoelectrical. *Adjective.* Concerned with electronic effects caused by electromagnetic radiation and in particular light.

photoelectric colorimeter. *Noun.* An instrument that classifies colour by means of a photocell or phototube, a set of standardised colour filters, an amplifier, and a metering device.

photoelectric effect. *Noun.* The emission of electrons from a metal surface when short-wavelength light falls on it.

photoelectric pyrometer. *Noun.* A photoelectric instrument for measuring high temperatures based on the radiant energy given off by a heated object.

photoelectron. *Noun.* An electron ejected from an atom, molecule or solid by an incident photon.

photoelectron spectroscopy. *Noun.* A technique for surface composition and atomic bonding studies that analyses the energy spectrum of **photoelectrons** emitted after bombardment by x rays. See **x-ray photoelectron spectroscopy**.

photoemission. *Noun.* The emission of electrons due to absorption of electromagnetic radiation, especially light.

photographic emulsion. *Noun.* A light-sensitive silver halide suspended in a gelatinous film on glass, porcelain-enamel, or glaze surfaces as a means of producing a photographic print which may be made permanent by firing.

photolithography. *Noun.* A process used to manufacture semiconductor devices, optical devices, printed circuits and thin-film circuits, in which a pattern is transferred from a photograph onto a substrate, producing a pattern that acts as a **mask** during an etching or diffusion process.

photoluminescence. *Noun.* An induced **luminescence** in some materials when exposed to visible, uv, or infra-red radiation.

photoluminescent. *Adjective.* Describing materials that emit **photoluminescence**.

photolysis. *Verb.* (1) The use of radiant energy to change the chemical constitution of a substance. (2) *Noun.* Chemical decomposition caused by light.

photomasking. *Verb.* To make photomasks and then applying them to make windows in photoresist coatings.

photometer. *Noun.* An instrument for measuring light and electromagnetic radiation in the visible range. See **disappearing-filament pyrometer**.

photometry. *Noun.* Measurement of the intensity of light.

photomicrograph. *Noun.* A picture of the highly magnified surface of a material.

photomultiplier. *Noun.* An instrument for measuring electromagnetic radiation consisting of a photocathode, which releases electrons in proportion to the number of incident photons, and an electron multiplier to amplify and produce a detectable pulse of current.

photon. *Noun.* The quantum of electromagnetic energy, generally regarded as a discrete particle having no rest mass, zero charge, unit spin and an indefinitely long lifetime. The energy depends on the wavelength of the photon through the relationship: $E=h\nu$, where h is **Planck's constant** and ν is the frequency of the photon radiation.

photonic band gap material. *Noun.* A **dielectric** material with a fine periodic structure, of the order of light wavelengths, that can reflect and filter specific incident wavelengths.

photonic crystals. *Plural noun.* (1) **Dielectric** materials with structures having periodic microporosity in 3-dimensions. This combination produces a variety of interesting optical properties. (2) A term proposed to describe the propagation of optical waves in refractive index-modulated structures. See **phononic crystals**.

photonic devices. *Plural noun.* These are optical devices the same as **plasmonic devices** but with larger critical dimensions: 500 nm to 100 μm . See **plasmonic devices**.

photonic engineering. *Noun.* Design of optical systems using thin films of different **refractive indices**.

photonics. *Noun.* The study and design of systems, devices and materials, such as optical fibres, which depend on the transmission, amplification or modulation of beams of photons.

photorefractive effect. *Noun.* Commonly known as **optical damage**, it refers to an optically induced change of the **refractive index** and affects an **optoceramic's** ability to act as an optical waveguide. A typical example is a blue-green laser focused onto **lithium niobate**, LiNbO_3 . This causes a change in n value. It is hoped to use the effect to build optical information storage systems.

photorefractive material. *Noun.* Doped ceramic single crystals such as LiNbO_3 , $\text{Bi}_{12}\text{SiO}_{20}$, in which low-power lasers cause excitation of charge carriers from impurity centres and these then migrate to other carriers outside the illuminated area and become trapped. The resulting space-charge field changes the **refractive index** of the crystal. Hence the laser appears to change the crystal optical properties; used in fibre-optic switching devices.

photoresist. *Noun.* A material that has a radiation-induced change, such as crystallisation, which when applied to a substrate, exposed and developed, masks parts of the substrate from subsequent etching.

photosensitive glass. *Noun.* A light-sensitive glass containing sub microscopic particles of gold, silver, or copper which precipitate during the photographic process to produce 3-D colour pictures when developed by heating to 538 $^{\circ}\text{C}$. The precipitation of the metals permits the ultraviolet light to penetrate deeper into the shadowed areas while passing through the negative to promote the 3-D effect.

photothermal deflection spectroscopy. **PDS.** *Noun.* Used to analyse the role of impurities in **varistors** and **PLZT**. A low-power, fine focused **laser** beam is sent parallel to a sample surface that is covered by an organic liquid. Fluctuations in the surface temperature lead to refractive index changes in the liquid, which then deflect the beam into a photocell placed near the opposite end of the sample.

phototransistor. *Noun.* A **junction transistor** where illuminating the base material with light generates the base signal; the emitter current increases with the intensity of the light.

phototube. *Noun.* A photocell in which radiation falling on a piece of photocathode material causes electrons to flow to an anode and so produce an electric current.

photovoltaic. *Adjective.* Of, or using the generation of a voltage when radiation, such as light, falls on the boundary between dissimilar materials in close contact.

photovoltaic effect. *Noun.* An effect produced when electromagnetic radiation falls on a thin film of one substance coated on a dissimilar solid and produces a potential difference between the two solids.

photo zone counter. *Noun.* A light beam passed perpendicularly through a volume and measured to detect the presence of particles in the volume illuminated.

phyllite. *Noun.* A mica-rich rock, compact and lustrous, derived from a shale or other clay-rich rock.

phyllo-. *Combining form.* Having a leaf-like form.

phyllosilicates. *Plural noun.* Minerals of the mica group that exhibit a layered or platy texture and contain exchangeable cations in the inter-silicate layer space. Examples are **hectorite** and **montmorillonite**.

physical adsorption. *Noun.* The binding of an adsorbate to the surface of a solid by forces whose energy levels approximate those of condensation.

physical assay. *Noun.* An analysis of material made by physical means.

physical property. *Noun.* A property of a substance that may be changed without change in its chemical composition.

physical separation. *Verb.* To separate solid particles by mechanical means, such as by **screening**.

physical stability. *Noun.* The ability of a solid substance to resist change in its physical characteristics under conditions of service.

pi-bonding. *Noun.* A form of **covalent bonding** produced by sideways-on overlap of p or d of wave orbitals above and below the plane of the atoms. Most commonly encountered in polymers and ceramic carbides.

piceous. *Adjective.* Resembling or related to pitch.

pick. *Noun.* One **fill** yarn running the complete width of a woven fabric perpendicular to the **warp**.

pick count. *Noun.* The number of **fills** **yarns** per inch of fabric.

pickle, pickling. *Verb.* To clean and etch iron and steel in an acid bath prior to porcelain-enamelling.

pickle acid. *Noun.* The acid, usually sulphuric or hydrochloric, used to pickle iron and steel for porcelain-enamelling.

pickle basket. *Noun.* A woven or perforated, corrosion-resistant metal container in which ware is placed for cleaning and pickling prior to porcelain-enamelling.

pickle pill. *Noun.* A small gelatinous capsule containing prescribed amounts of appropriate chemicals that are used to measure the strength of **pickling** solutions, the strength being estimated by the colour of the solution in which a capsule is dissolved.

pickle stain. *Noun.* The discoloration of metal following the **pickling** operation; usually the result of inadequate washing, improper neutralisation, insufficient drying or undue exposure to the atmosphere.

pickling, anodic. *Noun.* See **anodic pickling**.

pickling, gas. *Noun.* See **gas pickling**.

pickling, nickel. *Noun.* See **nickel dip**.

pick-up. *Noun.* The amount of porcelain-enamel retained on dipped ware per unit of area, usually expressed as grams per square metre or ounces per square foot.

picotite. *Noun.* A chrome **spinel** frequently occurring in basic refractory slag; density 4,080 kg m⁻³; hardness (Mohs) around 8.

picrite. *Noun.* An igneous rock with coarse grains of **olivine**, **augite** and **plagioclase feldspar**.

P-I diagram. *Noun.* A diagram used to correlate the capacity of a structure to resist blast loading from explosions. See **pressure-impulse curve**.

PIED test. *Noun.* A tensile test developed to delay the onset of macrocracking in brittle samples, such as glass and ceramics. The tensile load is applied to the sample through metallic bars glued on to the lateral faces of the specimen to ensure that a uniaxial state of stress exists in the central zone of the specimen. To obtain this the longitudinal strains in the bars and in the material must be made the same and so strain gauges must be attached to the bars and the specimen to validate this condition. Degradation is progressive throughout the specimen due to restraint from the metal bars. **MOR** results from bend tests are 40–45 % higher than **PIED** tensile strength.

pi-electron. *Noun.* An electron wave function involved in **pi-bonding**.

pier glass. *Noun.* A tall mirror usually designed to fit the space between two windows.

piezo-. *Combining form.* Pressure.

piezoelectric. *Adjective.* Pressure produced by means of electricity or vice versa.

piezoelectric actuator. *Noun.* See **actuator**.

piezoelectric ceramic. *Noun.* Crystalline ceramics that can transform electrical signals into mechanical strain and vice-versa; this enables them to be used in electro-mechanical systems as both actuators and sensors. Uses include inkjet printers, vibration controllers, fuel injection, microposition systems, ultrasound generators and sensors and many more. The best are based on the perovskite **lead zirconium titanate**, PbZr_{1-x}Ti_xO₃. See **piezoelectricity**.

piezoelectric ceramic actuator. *Noun.* Composite consisting of two **piezoelectric ceramic** plates either as a pair or as a stack of several plates bonded by adhesive. When an electric field is applied the composite elongates. Applications are in the areas of displacement control for precision machine tools and optical instruments.

piezoelectric d constant. $d_{[xy]}$. *Noun.* A measure of the charge density generated by an applied stress in a piezoelectric ceramic crystal in the parallel, [33], transverse, [31], and shear, [15], directions of a transducer. A high d value is needed to generate motion.

piezoelectric g constant. $g_{[xy]}$. *Noun.* A measure of the field generated by an applied stress in a piezoelectric ceramic crystal in the parallel, [33], transverse, [31], and shear, [15], directions of a transducer. A high g value is needed to generate electrical signals.

piezoelectric generator. *Noun.* See **generator**.

piezoelectricity. *Noun.* A property of some crystalline ceramics, which develop electrical **polarisation** proportional to an applied mechanical stress. Conversely such materials develop a mechanical strain proportional to an applied electric field. Discovered in 1880 by P. J. Curie. After **poling**, only modest stresses generate significant voltages, e.g., 0.25 MN m^{-2} produces 125 V.

piezoelectric sensor. *Noun.* See **sensor**.

piezoelectric strain coefficient. d_{ij} . *Noun.* Units are pC N^{-1} . See **piezoelectric d constant**.

piezoelectric transducer. *Noun.* See **transducer**.

piezomagnetism. *Noun.* The production of a magnetic field by applying pressure, which is a property some ceramic crystals have. It is also the reverse effect when certain crystals develop a strain in a magnetic field.

piezometer. *Noun.* An instrument for measuring pressure or compressibility.

pig. *Noun.* (1) A rest for a blowpipe or **punty** used during the glass-gathering operation for glass blowing. (2) A snug fitting plug able to perform maintenance tasks from the inside of a pipe, such as cleaning or removing a blockage. Gas or liquid are used to push it through the pipe.

pigbed. *Noun.* A sand bed in which pig iron is cast.

pigment. *Noun.* (1) A solid powder employed to give black, white, or other colour to bodies and coatings by reflecting light of certain wavelengths and absorbing light of other wavelengths. They are also used to obscure the under-surface, to improve hardness and improve durability. (2) A powder that is mixed with a liquid to give a **ceramic ink**.

pigment strength. k/s. *Noun.* The ratio of light absorption, k, to light scattering, s. It is found by measuring the **reflectance**, R, at the maximum absorption wavelength of the pigment and using the expression: $k/s = (1 - R)^2/2R$.

The larger the k/s value the greater is the pigment strength and less is needed to produce particular **hues** and colour depths.

Pigment Yellow 37. *Noun.* Cadmium sulphide, CdS. A brilliant yellow colour used in low temperature glazes. Also known as **cadmium yellow** and **greenockite**.

pigskin. *Noun.* A porcelain-enamel or glaze imperfection in which the surface resembles pigskin in appearance.

pig-wrack. *Noun.* See **Irish moss**.

pilaster. *Noun.* A shallow rectangular column built onto the face of a wall.

pile. *Noun.* (1) A column of concrete or other material placed in the ground to support a vertical load or to resist lateral pressure. (2) Nuclear material contained in a reactor in a quantity and order so as to sustain nuclear fission. (3) The yarn in a fabric that stands up or out from the weave.

pile shoe. *Noun.* A pointed iron casting fitted to the lower end of a concrete pile.

Pilkington process. *Noun.* A glassmaking process in which molten glass is poured continuously from the tank and passed between rolls to form a continuous sheet of prescribed thickness.

Pilkington K-glass. *Trademark, noun.* A product developed to decrease heat loss through window glass by depositing a transparent, low emissivity, e, film of fluorine-doped tin oxide ($e=0.17$, compare glass $e=0.84$) on the glass surface. This causes long wavelength radiation to reflect back into a room.

Pilkington optitherm S3. *Trademark, noun.* A development from K-glass whereby the transparent film is a composite stack containing silver ($e=0.04$). See **Pilkington K-glass**.

pillar. *Noun.* (1) A column for supporting a section of a superstructure, such as in a kiln or steel furnace. (2) The upright post, used in conjunction with cranks, to provide support for dinnerware, tile, and other ware during firing. (3) An ornamental column or shaft. (4) A solid mass of ore left standing to support a mine roof. (5) *Verb trans.* To support or decorate a building with or as if with pillars.

pillared. *Noun.* (1) A **layered double hydroxide** in which the interlayer carbonate ions have been exchanged for other anions. This is usually achieved by first calcining the LDH and then soaking it in a solution of desired anions. (2) *Adjective.* A structure in a material in which **pillars** have been created.

pillared particle. *Noun.* A ceramic particle, such as silicon that has been selectively etched to produce a surface with **pillars** projecting some $50 \mu\text{m}$ out and about $100 \mu\text{m}$ thick. This morphology gives the particles greater resistance to fracture when, for example they are used to store Li^+ in lithium batteries.

pill. *Noun.* A bobble of tangled fibres on the surface of a fabric to which they are joined by at least one fibre.

Pilling-Bedworth ratio. P-B ratio. *Noun.* The ratio of metal oxide volume to metal volume. It is used to predict the protective properties of ceramic oxide layers on metals.

pilot plant. *Noun.* A small version of a planned industrial plant; employed to evaluate materials and processes prior to their use on a production scale.

pilular. *Adjective.* In the shape of a small pill.

pilule. *Noun.* A small pill.

PIM. *Acronym.* Standing for powder injection moulding. See **powder injection moulding**.

pimple. *Noun.* A small rounded or conical defect occurring on the surface of porcelain-enamels, glazes, and other coatings during firing.

pin. *Noun.* An item of **kiln furniture** consisting of a triangular refractory bar or peg employed as a support for ware during firing.

p-i-n. *Abbreviation.* Stands for a type of semiconductor device construction that is **p-type**, **intrinsic**, **n-type**.

PIN. *Acronym.* Stands for product identification number.

pinch effect. *Noun.* The crazing of tile due to the contraction of the setting medium.

pinholes. *Noun.* Imperfections occurring in porcelain-enamels, glazes, and ceramic bodies having the appearance of pinpricks, burst bubbles, or small conical holes.

pinite. *Noun.* A form of **mica**, chiefly **muscovite**, used in the production of dense, abrasion-resistant refractories.

pink granite. *Noun.* **Granite** rock with a higher than normal **potassium feldspar** content which gives the overall pink appearance.

pink spinel. *Noun.* A naturally occurring **spinel** that has large crystals that can be cut and used as jewellery.

pink topaz. *Noun.* See **topaz**.

pink tourmaline. *Noun.* A gem quality form of the mineral **tourmaline** that occurs as large crystals in some **pegmatites**.

pink zircon. *Noun.* A naturally occurring form of **zirconium silicate** coloured pink from partial cation substitution. It can be cut and polished when it displays a **lustre** and fire close to that of **diamond**.

pin marks. *Noun.* Visible imprints or marks on the back of porcelain-enamelled ware caused by the firing tools.

pin mill. *Noun.* A disintegrating device consisting of a rotating disk equipped with the pin-like protrusions that provide the disintegrating force or action.

pinning. *Verb.* (1) To arrange pins, such as posts, preparatory for the placement of ware in a kiln for firing. (2) The use of defects in superconductors to localise vortices in magnetic flux. (3) To use precipitates in grain boundaries to prevent their movement in the final stage of sintering.

pin scratching. *Verb.* To make lines or designs in porcelain-enamels and glazes by scratching the coating with a sharp instrument before firing.

pin seal. *Noun.* A wire positioned and sealed through the inside diameter of a ceramic bushing for use in electrical and electronic applications.

pintadera. *Noun.* A decorative stamp or seal made of clay. Used since stone age times.

pip. *Noun.* A type of **kiln furniture** which consists of a rounded refractory with a protruding point upon which ware is rested during firing.

pipage. *Noun.* Material movement by pipes.

pipe. *Noun.* (1) A tubular structure of concrete, metal, or other substances used to convey gases, liquids and finely divided solids. (2) A cavity formed in metal by contraction of the metal during solidification.

pipe, agricultural. *Noun.* See **agricultural pipe**.

pipe blister. *Noun.* A blister-like formation in hand-blown glassware caused by an unclean or scaled blowpipe.

pipe, blow. *Noun.* See **blowpipe**.

pipe body. *Noun.* The clay mixture from which vitrified clay pipes are made.

pipe, bustle. *Noun.* See **bustle pipe**.

pipeclay. *Noun.* Very white fine-grained plastic clay **marl**, or **fireclay**, but usually **ball clay**, containing little or no iron. Used for making tobacco pipes and for whitening leather and cloth belts.

pipe-clay. *Verb trans.* To whiten or clean material, such as leather using **pipe clay**.

pipe, culvert. *Noun.* See **culvert**.

pipe diameter. *Noun.* The inside diameter of a pipe.

pipe, drain. *Noun.* See **drain pipe**.

pipe, field-drain. *Noun.* See **drain pipe**.

pipe, grooved. *Noun.* See **grooved pipe**.

pipe, irrigation. *Noun.* See **irrigation pipe**.

pipe, modified-design. *Noun.* See **modified-design pipe**.

pipe, modified-groove. *Noun.* See **modified-groove pipe**.

pipe, modified-tongue. *Noun.* See **modified-tongue pipe**.

pipe, non-reinforced. *Noun.* See **non-reinforced pipe**.

pipe-rack drier. *Noun.* A steam-heated drier in which ware is placed directly on the steam pipes for drying.

pipe, reinforced. *Noun.* See **reinforced pipe**.

pipe section. *Noun.* A single pipe, usually of standard or specified length.

pipe, sewer. *Noun.* See **sewer pipe**.

pipestone. *Noun.* A type of compressed red clay used to make American Indian tobacco pipes. Compare **pipe clay**.

pipe, tamped. *Noun.* See **tamped pipe**.

pipette, pipet. *Noun.* (1) A calibrated, tubular-glass device drawn to a fine bore at one end employed to transfer small measured volumes of liquids. (2) *Verb trans.* To transfer or measure out liquids using a pipette.

pipe, vibrocast. *Noun.* See **vibrocast pipe**.

pipe, vitreous clay. *Noun.* See **vitreous clay pipe**.

pipe wall. *Noun.* The structural element composed of concrete or concrete and steel between the inside and outside surfaces of a concrete pipe.

pipe, well-hole. *Noun.* See **well-hole pipe**.

pipkin. *Noun.* A small **earthenware** cooking pot.

pisé. *Noun.* An **adobe**-type construction in which the walls are formed by pounding or stamping straw-tempered clay in place. Also called **pise de terre**.

pisolite. *Noun.* A **sedimentary** rock containing pea-sized concentrically formed crystallites in a fine matrix. The crystallites are called **pisoliths**.

pisolith. *Noun.* See **pisolite**.

pisolitic aggregate. *Noun.* Prismatic crystals between 3 and 12 mm radiating from a common centre to form an aggregate of spherical surfaces.

piston extruder. *Noun.* A machine in which clay is forced through a die by a mechanically operated cylinder.

pit. *Noun.* A small shallow depression or dimple in the surface of a porcelain-enamel, glaze, ceramic body, or composite with a width approximately equal to its depth.

pitch. *Noun.* (1) The dark, highly adhesive, sticky residue remaining from the distillation of tar or petroleum. (2) The distance between the centre points of adjacent crests of a corrugated product. (3) The ratio of the rise of a roof to its span.

pitchblende. *Noun.* UO_2 . The major ore of uranium often oxidised to a composition between UO_2 and U_3O_8 ; crystallises in the cubic system; black-brown brittle material; density 8,000–1,088 kg m⁻³; hardness (Mohs) 5–6. Also called **uraninite**.

pitch-bonded basic brick. *Noun.* Unburned basic refractory shapes bonded with pitch; if the shapes subsequently are heat-treated to minimise softening of the bond on reheating, they are identified as a tempered product. In use the residual carbon produces localised reducing atmospheres.

pitch-bonded basic refractories, tempered. *Noun.* See **tempered pitch-bonded basic refractories**.

pitch-catch. *Noun.* A non-destructive sonic test where two **piezoelectric** transducers are used. One generates a pulse in the sample and the second detects it after passage through the specimen. See **pulse-echo**.

pitcher. *Noun.* A large jug usually rounded with a narrow neck made from **earthenware**; used mainly for holding water.

pitchers. *Plural noun.* Fragments of broken pottery, sometimes ground to a powder, for use as an ingredient in bodies, glazes, and colouring compounds. See **shard**.

pitch-impregnated refractories. *Noun.* Burned basic refractories that subsequently are impregnated with pitch after they have been fired.

pitching tool. *Noun.* A masonry tool for rough work.

pitch polishing. *Verb.* To polish glass using **pitch** is the carrier of the polishing agent instead of felt.

pitchstone. *Noun.* A glassy, dark-coloured volcanic rock with composition similar to granite.

pithos. *Noun.* A large **terracotta** ceramic container for oil or grain found on archaeological sites in Greece.

Pitot tube. *Noun.* A small tube used to measure fluid pressure and velocity. The open end is placed against the flow and the bottom is connected to a monometer.

pit, rouge. *Noun.* See **rouge pits**.

pit run. *Noun.* Aggregate in its natural state, as excavated.

pit, sludge. *Noun.* See **sludge pan**.

pit, soaking. *Noun.* See **soaking pit**.

pitting. *Noun.* A form of localised oxidation or corrosion characterised by small holes in the vertical direction.

Pittsburgh sheet-glass process. *Noun.* A procedure for making sheet glass in which the glass is drawn vertically from the surface of the melt through a drawing slot of the desired thickness, the edges of the resultant sheet being formed by rollers.

pixel. *Noun.* Point. A point within a material characterised by a property value at that point, e.g. density in 3-dimensional **computed tomography**.

place. *Verb.* (1) To pour concrete. (2) To pack ware in **saggers** for firing.

place brick. *Noun.* An under-fired, relatively soft brick of generally poor quality, often salmon coloured; used in temporary or noncritical installations.

placing. *Verb.* To set ware in kilns for firing.

placing sand. *Noun.* Silica sand used to prevent ware from sticking to shelves, setter plates, etc., during firing.

placoid. *Adjective.* Flattened, plate-like.

plagio-. *Combining form.* Oblique, inclined or slanting.

plagioclase feldspar. *Noun.* Coupled substitution of Ca^{2+} and Al^{3+} for Na^+ and Si^{4+} in **albite** produces plagioclase feldspar. The series is divided into compositional ranges: **oligoclase** 90–10 to 70–30 % $\text{NaAlSi}_3\text{O}_8$; **andesine** 70–30 to 50–50 %; **labradorite** 50–50 to 30–70 % and **bytownite** 30–70 to 10–90 %.

plain. *Noun.* Molten glass relatively free of **seeds** and bubbles.

plain concrete. *Noun.* Unreinforced concrete.

plain weave. *Noun.* Each fill yarn passes alternately under and over each **warp**.

planar. *Adjective.* (1) Relating to a plane. (2) flat; lying in one plane.

planar helix winding. *Noun.* A composite reinforcement where the filament path on each dome lies on a plane of intersection of the dome and a helical path over the cylinder that connects the dome paths.

planar process. *Noun.* A technique used to produce diffused junctions in semiconductor devices. A pattern of holes are etched into the oxide layer of a silicon substrate down which impurities are diffused.

planar winding. *Noun.* A reinforcement winding in which the filament path lies on a plane of intersection of the winding surface.

planche. *Noun.* A support used in the firing of porcelain-enamel artware.

Planck's constant. h. *Noun.* A universal constant that has a value of 6.626×10^{-34} J-s. The energy of a **photon** of electromagnetic radiation is the product of h and the radiation frequency.

Planck's law. *Noun.* The basis of quantum theory. The energy of electromagnetic radiation is confined to individual quanta each of which has an energy equal to **Planck's constant** times the frequency of the radiation.

plan dimensions. *Noun.* The width and breadth of bricks or **pavers**.

plane polarisation. *Noun.* Light that is vibrating parallel to a plane through the axis of the beam. Such asymmetry is only made apparent in double reflecting or transmission experiments. See **dichroism** and **plane polarised**.

plane polarised. *Adjective.* A description of light when the electric vector of the light wave vibrates only in one plane. Most light is unpolarised because the direction of the electric vector changes randomly every 10^{-8} s and so the time averaged vector takes all orientations.

plane strain. *Noun.* A two-dimensional simplification for stress analysis involving long-length to small diameter cylinders. It applies for tensile loading and assumes that there is zero strain in a direction perpendicular to both the stress axis and the direction of crack propagation. Thick plate-like samples fulfil this condition with the zero strain direction being perpendicular to the plate surface.

plane strain fracture toughness. K_{Ic} . *Noun.* The measure of a materials resistance to fracture when a crack is present as determined under the conditions of **plane strain**. It is the critical value of the **stress intensity factor** and is the value at which a pre-existing crack will become unstable and propagate. See **fracture toughness**.

plane stress. *Noun.* The stress components in a thin plate of material supported at two ends, which can be simplified for analysis, by equating several stress components to zero.

planetary head. *Noun.* A sample holder on an automatic polisher which while holding the sample against the rotating polishing cloth moves in a circular orbital fashion.

planning. The smoothing of **plaster moulds** and other surfaces by means of a tool equipped with a cutting edge.

plant. *Noun.* The building, machinery, tools, fixtures, instruments, equipment, and facilities employed in a manufacturing operation.

plant ash. *Noun.* A soda-rich, low-potassium product obtained by burning plant material that can be used in glass batch compositions.

plant layout. *Noun.* The arrangement of production facilities in a factory.

plant test. *Noun.* A production trial of a material or process development before incorporating it into the manufacturing schedule.

plaque. *Noun.* A flat refractory ceramic upon which **pyrometric cones** are placed, frequently in triangular indentations to go into kilns in which ware is to be fired.

plasma. *Noun.* (1) A hot ionised gas consisting of nuclei and electrons; sometimes considered to be the fourth state of matter. (2) An ionised gas usually produced by passing high-energy electrons through the gas. (3) Green gem stones that are a slightly translucent variety of **chalcidony**.

plasma chemical processing. *Noun.* Deposition of chemical substances onto substrates at relatively low temperatures from a glow discharge with control of layer thickness in the submicron range. Also called **plasma enhanced chemical vapour deposition**.

plasma enhanced chemical vapour deposition. PECVD. *Noun.* See **plasma chemical processing**.

plasma gun. *Noun.* A device to convert gases into high-velocity plasmas. See **plasma torch**.

plasma sintering. *Noun.* A method of producing sintered ceramic ware with a fine-grained smooth surface. A fine powder is melted in a **plasma torch** and projected on to the normally-formed ceramic body by the hot gas plasma.

plasma spraying. *Verb.* To apply a refractory ceramic or metallic coating to a surface by means of a **plasma gun**. The coating material passes through the plasma arc as a fine powder where it is melted and projected along the flame onto the surface to be coated, which is of course, heated by the flame.

plasma torch. *Noun.* A heating device that ionises a gas to form plasma, which gives out heat as the electrons and cations recombine on a surface; very high temperatures are achieved. See **plasma gun**.

plasmon. *Noun.* Collective motion of an electron gas. Surface plasmons are wave-like oscillations in charge distribution caused by interaction with light. they have powerful electromagnetic fields. Colouring glass objects with metal particles is an example of plasmon colour effect.

plasmonic device. *Noun.* A device that exploits an ensemble of electrons. An optical device, such as a fibre optic pipe with an operating speed in the 1 GHz to 1 THz range and size in the 10–100 nm range.

plaster. *Noun.* (1) A mixture of **lime**, **sand**, **gypsum** and water with a paste-like consistency that hardens on drying; used for coating walls and ceilings. (2) A rigid dressing made from **plaster of Paris**, $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$. Often called a **plaster cast**. (3) A mould for casting or **jiggering** ceramic bodies. (4) *Verb trans.* To coat a wall or ceiling with plaster.

plaster, aridised. *Noun.* See **aridised plaster**.

plaster-base finish. *Noun.* A rough, combed, or scored surface on the back of ceramic tiles to help them adhere when placed.

plaster bat. *Noun.* A flat surface made of plaster on which clay is worked.

plasterboard. *Noun.* A flat wallboard consisting of a hardened **gypsum plaster** core encased in an envelope of paper, felt, or pulpboard; used as a substitute for plaster in construction; panel sizes are: 1.22×2.44, 1.22×2.55 or 1.22×3.66 m in area, and 9.5, 12.7, or 15.9 mm thick.

plaster cast. *Noun.* See **plaster**.

plaster, casting. *Noun.* See **casting plaster**.

plaster coat. *Noun.* A layer of plaster applied as a coating on walls and ceilings.

plaster ground. *Noun.* A section of wood, usually placed around doors, windows, archways, and at the floor in building construction as a control for plaster thickness.

plaster, gypsum. *Noun.* See **gypsum plaster**.

plaster, hard-finished. *Noun.* See **hard-finished plaster**.

plastering. *Noun.* (1) A coating with plaster. (2) *Verb.* To apply **plaster** to a wall or ceiling.

plaster of Paris. *Noun.* Calcined, finely powdered **gypsum**, $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$, which forms a quick-setting cement when mixed with water; used in building construction, as a casting mould material, as a bedding medium in glass grinding and polishing, and sometimes as a batch ingredient in glasses and glazes.

plaster retarders. *Plural noun.* Substances, such as dextrin, glue, hair, and blood, which slow the setting rate of plaster.

plasterwork. *Noun.* **Plaster** on interior walls, especially when it has a decorative effect.

plastic. *Adjective.* (1) Showing or involving permanent distortion of a solid shape through the application of a temporary force that does not lead to fracture. (2) A pliant substance capable of being moulded. (3) *Noun.* The common name for a polymer, particularly man-made polymers.

plastic art. *Plural noun.* Visual art, such as ceramics, modelling, architecture, that involves the use of moulding or modelling to produce a three dimensional object.

plastic cement. *Noun.* A pliant cementitious material used to seal holes and openings in concrete.

plastic clay. *Noun.* Any clay that will form a mouldable mass when blended with water.

plastic crack. *Noun.* A crack developing in concrete while it is still **green**.

plastic deformation. *Noun.* Permanent change in the size or shape of a body under stress that exceeds the **elastic limit**. It results in permanent atomic displacements.

plastic fireclay. *Noun.* Fireclay which, when tempered with water, can be moulded, extruded, or tamped into shapes or forms.

plastic flow. *Noun.* Permanent deformation of a solid under a sustained stress greater than the **yield point**.

plasticise or plasticize. *Verb trans.* To add something to a material in order to give it or to increase its flexibility.

plasticity. *Noun.* The property of a material or mixture to change permanently in size or shape when subjected to a measurable force exceeding its yield value.

plasticity index. PI. *Noun.* For a **slip** suspension or a **body** it is the ratio of **yield stress** to **Bingham viscosity**: $PI = \tau_y / \mu_B$. It has units of **shear rate**. Low values of PI for suspensions or bodies indicate poor performance during manufacture.

plasticity, water of. *Noun.* See **water of plasticity**.

plasticiser. *Noun.* A substance that will impart or increase plasticity in a material or mixture.

plastic pressing. *Verb.* To form plastic bodies in dies under pressure.

plastic refractory. *Noun.* See **plastic fireclay**.

plastic refractory fireclay. *Noun.* Water-moulded fireclay chosen to have physical and thermal properties such that it can be rammed into place to form a **monolithic furnace lining**.

plastic shrinkage. *Noun.* The shrinkage of concrete while in the plastic state or before the development of appreciable strength after the concrete has become rigid.

plastic size. *Noun.* An emulsion in water of **polyvinyl acetate** and a resin acceptor; used to protect individual fibre filaments before forming strands and to act as a chemical cement with the chosen matrix when used to make composite-laminates.

plastic viscosity. *Noun.* See **rheogram**.

plastify. *Verb.* Applied to thermoplastics it means to soften such materials by heat alone.

plastisol. *Noun.* Organic coating or moulding material made by dispersing vinyl monomer in a liquid containing **plasticiser**.

plastometer. *Noun.* A device to evaluate the flow properties of plastic materials or mixtures.

plate. *Noun.* (1) A flat, usually circular, dish of fired-clay on which food is served. (2) A thin piece of metal or other conductor used in a **capacitor** or battery as an electrode. (3) The anode in an electron gun device. (4) *Verb trans.* To coat the surface of a material with another.

plate etching. *Verb.* To decorate glassware by acid-etching. First a wax resist is transferred from an etched plate to a glass body and then the article is exposed to hydrofluoric acid. After the resist has been removed the final article has a similar appearance to **cut glass**.

plate feeder. *Noun.* A type of conveyor consisting of overlapping plates between roller chains that delivers pulverised materials to a process or packaging unit.

plate glass. *Noun.* High-quality flat glass with plane, parallel surfaces formed by a rolling process; both sides are ground and polished to permit undistorted vision. Often used in shop windows.

plate glass, polished. *Noun.* See **polished plate glass**.

plate mounted. *Noun.* A bonded abrasive product attached to a steel wheel or plate for use on a grinding machine.

platen. *Noun.* (1) The mounting platform of a press to which the whole mould assembly is bolted. (2) A plate of metal that exerts or receives pressure. (3) A radio-frequency applicator.

plate, screen. *Noun.* See **screening plate**.

plating. *Noun.* (1) A thin coating of metal. (2) *Verb.* To apply a thin coating of a material on to a substrate.

platinum. *Noun.* Pt. A metal used in the production of metallic colours.

platinum, liquid bright. *Noun.* See **liquid bright platinum**.

Platonic body. *Noun.* See **Platonic solid**.

Platonic solid. *Noun.* Any of the five regular polyhedra: cube, tetrahedron, octahedron, icosahedron and dodecahedron. Also called **Platonic body**.

plattng. *Noun.* A layer of fired brick forming the top of a **scove kiln**.

plattner mortar. *Noun.* See **percussion mortar**.

platy. *Adjective.* Occurring as flaky layers.

PLD. *Abbreviation.* Stands for pulsed laser deposition. See **pulsed laser deposition**.

PLE. *Abbreviation.* Stands for pulsed laser evaporation. See **pulsed laser evaporation**.

pleat. *Noun.* Two reversals of direction, that is, folds, in a composite reinforcing fabric.

pleochroism. *Noun.* If **uniaxial** or **biaxial** crystals are viewed in transmitted **plane polarised** white light they change colour on rotation; this is pleochroism and it is caused by anisotropic absorption.

pleochromic. *Adjective.* Many coloured.

plinth. *Noun.* (1) A flat member forming the base of a column or pier. (2) The base of a figurine or vase.

plique-a-jour. *Noun.* A decorative form of porcelain-enamel in which coloured enamel is fused between metal partitions and subsequently polished, giving an appearance of a stained glass window.

PLPP. *Abbreviation.* Stands for pressureless powder packing. See **pressureless powder packing**.

plucking. *Noun.* (1) A blemish in glazed ware where the fused coating adhering to the points of the firing

supports is broken during removal. (2) A surface defect in flat glass caused by the glass adhering to the rollers.

plug. *Noun.* (1) The reciprocating part of a glassblowing machine that forces molten glass into the mould, or forms the initial cavity in a blank mould for subsequent blowing. (2) A wad of plastic fireclay used to seal the tap hole of a smelter.

plug clay. *Noun.* Damp plastic clay used to seal the **tap hole** of a smelter.

plug feeder. *Noun.* A shaped refractory controlling the rate of glass flow in the feeder channel of a **glass tank**.

plug flow. *Noun.* Movement of material without any shearing within the mass.

plugging compound. *Noun.* A mixture of inorganic materials, such as powdered frit, clay, and water, of putty-like consistency used to fill holes and to provide a smooth surface in cast iron prior to porcelain-enamelling.

plug, mould. *Noun.* See **mould plug**.

plumbago. *Noun.* **Graphite** or clay-graphite refractories used as linings in metallurgical furnaces and as a mould and core coating material.

plumbic. *Adjective.* Of or containing tetravalent lead.

plumbing fixtures, sanitary. *Noun.* See **sanitary ware**.

plumbous. *Adjective.* Of or containing divalent lead.

plumbous oxide. *Noun.* See **lead monoxide**.

plume. *Noun.* A cloud of ions and radicals ejected from a surface by ablation. See **laser ablation**.

plumose habit. *Adjective.* A **lamella** crystal of feather-like appearance.

plunge grinding. *Noun.* Grinding and polishing operations in which the grinding wheel rotates and moves radially toward the work.

plunger. *Noun.* The reciprocating section of feeder that forces molten glass into a mould or forms the cavity in a blank mould for subsequent blowing.

pluton. *Noun.* A large body of **igneous rock**.

plutonic. *Adjective.* Derived from magma that has solidified deep beneath the earth's surface.

plutonium oxide. *Noun.* (1) PuO . A rock salt structured non-stoichiometric oxide. Density $13,900 \text{ kg m}^{-3}$. (2) Pu_2O_3 ; mp $2,216^\circ\text{C}$; density $10,200\text{--}11,200 \text{ kg m}^{-3}$. (3) PuO_2 . A **fluorite** structure oxide used with UO_2 as a nuclear fuel. Mp $2,241^\circ\text{C}$; density $11,460 \text{ kg m}^{-3}$.

ply. *Noun.* (1) A layer of fibre in a laminated composite. (2) A layer, fold, or thickness of cloth, wood, or thin sheet material.

plyglass. *Noun.* A generic term for a coloured sandwich-like structure consisting of a layer of glass fibres

between two layers of sheet glass; usually employed in decorative applications, such as light fixtures

plying. *Verb.* To twist together yarns of ceramic fibre.

ply orientation angle. *Noun.* The angle made by single fibres of the **warp** direction in reinforcing fabric with the main reference axis of a reinforced composite part.

PLZT. *Abbreviation.* Stands for lead lanthanum zirconium titanate. See **lead lanthanum zirconium titanate**.

PMC. *Abbreviation.* Stands for polymer-matrix composite. See **polymer-matrix composite**.

PMF. *Abbreviation.* Stands for progressive massive fibrosis. See **silicosis**.

PMMA. *Abbreviation.* Stands for the polymer polymethylmethacrylate.

PMN. *Abbreviation.* Stands for lead magnesium niobate. See **lead magnesium niobate**.

PMN ceramics. *Abbreviation.* Stands for lead magnesium niobate ceramics. See **lead magnesium niobates**.

p-n junction or pn junction. *Noun.* A boundary between a **p-type** and an **n-type semiconductor** that acts as a rectifier in a diode, transistor, photocell etc.

pneumatically applied mortar. *Noun.* A concrete mortar consisting of cement, sand, and water driven into place by compressed air.

pneumatic clay. *Noun.* Natural clay that has been subjected to hot liquids and gases during formation. Also known as **pneumatolytic clay**.

pneumatolytic clay. *Noun.* See **pneumatic clay**.

PNP. *Abbreviation.* Stands for positive-negative-positive and denotes a device consisting of an **n-type** semiconductor sandwiched between two **p-type** semiconductors.

pock. *Noun.* A defect that is a partially closed cavity on the surface of a ceramic or ceramic coating.

pocket, air. *Noun.* See **air pocket**.

pocket, rock. *Noun.* See **rock pocket**.

pocket setting. *Verb.* A technique of hand-placing refractory shapes in a kiln to minimize deformation and the development of stresses in the ware during firing.

pocket, side. *Noun.* See **side pocket**.

pocket, skimming. *Noun.* See **skimming pocket**.

pocket, slag. *Noun.* See **slag pocket**.

podzol. *Noun.* A type of clay soil with a leached grey-white colour; characteristic of coniferous forest regions.

podzolic. *Adjective.* **Residual clay** following acid leaching of soil.

point bars. *Noun.* A rack made from a high-temperature alloy that contains points upon which porcelain-enamelled ware is placed for firing.

point defect. *Noun.* The family name of one of the two basic types of **intrinsic** imperfection in a crystal structure, namely those involving single atoms. Point defects can take two forms either involving just atoms of the parent crystal or impurity atoms. **Vacancies**, **Schottky**, and **Frenkel** defects do not involve impurity atoms. Replacement of a lattice atom by an impurity atom is a **substitutional** point defect.

point group. *Noun.* In crystallography another term for crystal class.

pointillism. *Noun.* A method of applying a painted decoration to ware where the image and colour are built-up by making small dots of colour, making sure that they do not overlap. Decoration applied this way always appears bright and dynamic.

pointing. *Verb.* To insert mortar into unfilled masonry joints, such as brickwork.

point mark. *Noun.* A small fracture on the back of porcelain-enamelled ware occurring at the point of contact with the burning tools during firing.

poise. P. *Noun.* The **egs unit** of dynamic viscosity equivalent to 0.1 Nsm^{-2} in the **SI system**. It is the viscosity of a fluid needing a force of 1 dyn cm^{-2} to move either of two parallel layers 1 cm apart with a velocity of 1 cm s^{-1} relative to the other.

poison, burnable. *Noun.* See **burnable poison**.

poison, nuclear. *Noun.* See **nuclear poison**.

Poisson ratio. v. *Noun.* For **elastic** deformation it is the negative ratio of the transverse contracting strain to the elongation strain in a bar or rod when forces are applied at the ends parallel to its axis. The value for ceramic crystals and glass is $0.21\text{--}0.30$.

Polanyi adsorption potential. e. *Noun.* A thermodynamic parameter used to determine interfacial energies from its variation as a function of surface coverage of **adsorbate** on **adsorbent**: $e = RT \ln(P/P_0)$, where the relative pressures are defined in the **BET equation**.

polar crystal. *Noun.* A crystal containing permanent ionic or molecular dipoles. See **dielectric**.

polarimeter. *Noun.* A device for measuring the amount of polarisation of light.

polarisation or polarization. *Noun.* A term having different meanings in different contexts: (1) In a **dielectric** medium it is the electric **dipole moment** per unit volume. It occurs when an electric field is applied because this results in the creation of an equivalent dipole at the site of each atom as the nuclei are displaced toward the field and the electrons are displaced in the opposite direction. There are two types: **ionic**

polarisation in ionic ceramics as the anions and cations are displaced; and electronic polarisation. See **electronic polarisability**. (2) In an electric cell it refers to increases in internal resistance as bubbles form on the electrodes. (3) The displacement of an electrode potential from its thermodynamic value as a result of current flow. (4) For wave motion it describes the direction of the disturbance relative to the direction of propagation of the wave, e.g., with light, confinement of the wave vibration to a single plane. See **light polarisation**. (5) In particle beams it is the preferential orientation of the particle spins.

polarisation, orientational. *Noun.* See **orientational polarisation**.

polarisation, spontaneous. *Noun.* See **spontaneous polarisation**.

polariscope. *Noun.* An instrument for viewing objects in polarised light to detect strains in transparent materials.

polarise or polarize. *Verb.* To cause to acquire **polarity**.

polarised ceramic. *Noun.* A substance, such as **barium titanate**, having high electromechanical conversion efficiency; used as a **transducer** in an ultrasonic system. The effect arises from small highly charged cations being off-centre in octahedra of oxygen anions.

polariser. *Noun.* A **polar** that is the first of a sequential pair; the second is called the **analyser**.

polarising angle. *Noun.* The angle of incidence of a ray of light for which the reflected **polarised ray** is at 90° to the **refracted ray**.

polarity. *Noun.* (1) The condition of a material or a system in which it has opposing physical properties at different points, especially electric charges or magnetic poles. (2) The situation of having poles.

polarity reversing switch. *Noun.* A device for reversing the current direction in a superconducting magnet.

polar molecule. *Noun.* A molecule that has a permanent electric dipole because of an asymmetrical distribution of positively and negatively charged regions.

polarography. *Noun.* An technique for studying ions in solution using an electrolytic cell and plotting the current against potential to identify the ions and the peak height to determine the concentration. The instrument employed usually has a very small dropping mercury cathode.

Polaroid. *Trademark, noun.* Thin sheets of nitrocellulose, i.e., cellophane, packed with ultramicroscopic polarising crystals with their optic axes all parallel.

polaron. *Noun.* A defect in a crystal that is formed when an excess of charge at a point polarises the adjacent lattice; for example, an electron captured by an ionic crystal forms a polaron at the anion site where it is captured and distorts the lattice locally. Movement of

this electron through the solid requires movement of the distortion too which of course slows it down. A more complex polaron can occur in some ceramics, such as **manganites** with layered structures, which is an electron bound to both an atomic displacement and a disturbance in the magnetic structure.

polars. *Plural noun.* Devices that transmit light vibrating in a single plane, which is referred to as the **vibrational direction** or **allowed direction**. Light passing through a polar is converted into a **plane polarised wave**.

polar winding. *Noun.* A type of composite structure in which the reinforcing filament path passes tangentially to the polar opening at one end of the chamber and tangentially to the opposite side of the opening at the other end.

pole. *Noun.* (1) The part of a magnet toward which the lines of **magnetic flux** converge or from which they diverge. (2) A terminal of a battery. (3) *Verb.* See **poling** (1).

poled ceramic. *Noun.* A **piezoelectric ceramic** that has been subjected to a **poling field** and so has a macroscopic remnant electric field.

pole face. *Noun.* The end surface of the core of a magnet through which magnetic flux passes.

pole piece. *Noun.* The part that supports the mandrel in a filament winding machine.

poling. *Verb.* (1) The mechanical stirring of molten glass or porcelain-enamel with a metal rod to facilitate removal of gases from the molten batch. (2) *Noun.* The process used to align **dipoles** in **piezoelectric materials**, such as $\text{Pb}(\text{Zr,Ti})\text{O}_3$ by applying voltages in excess of 2 MV m^{-1} across a specimen as it is cooled through its **Curie temperature** when the higher symmetry polymorph transforms to the lower symmetry form and M^{n+} ions are aligned in asymmetric sites.

poling field. *Noun.* A high voltage electric field used to align randomly distributed **electric dipole moments** or **domains** of dipole moments to produce a macroscopic remnant electric field in **piezoelectric ceramics**. See **poling** (2).

polish. *Verb.* To render a surface smooth and glossy by rubbing it with a finely milled abrasive, such as **rouge**, **cerium oxide**, or a similar material. (2) *Noun.* The abrasive material used in a polishing operation. (3) *Adjective.* The appearance of a surface after a polishing operation.

polished plate glass. *Noun.* Plate glass ground and polished to render both surfaces flat and parallel to minimise reflection and visual distortion.

polished section. *Noun.* A small sample of a substance, highly polished on one surface, for microscopic examination.

polished wire glass. *Noun.* Wire-reinforced glass that has been ground and polished on both sides.

polishing, acid. *Noun.* See **acid polishing**.

polishing, edge. *Noun.* See **edge polishing**.

polishing filtration. *Noun.* One of the two principal processes for the separation of solids from liquids. Used to remove traces of solid from a bulk liquid stream and usually involves vacuum filters or pressure filters. Also called **clarification filtration**.

polishing, pitch. *Noun.* See **pitch polishing**.

polishing step. *Noun.* The stages in a **tile polishing train** where increasingly smaller grit rollers repair damage inflicted by the **levelling step** and produce the desired gloss and texture.

polishing, surface. *Noun.* See **surface polishing**.

polishing wheel. *Noun.* A fine-grained abrasive wheel or disk used for mechanical polishing.

pollucite. *Noun.* $\text{CsAlSi}_2\text{O}_6 \cdot \frac{1}{2}\text{H}_2\text{O}$. A mineral source of caesium occurring in some coarse granites. A **solid solution** aluminosilicate phase with a framework structure. It is also the main crystalline phase found in pollucite **glass-ceramics** recently developed to fix and store **nuclear waste**.

pollucite glass-ceramic. *Noun.* See **pollucite**.

poly-. *Combining form.* Many or much.

polyacrylamide. *Noun.* $(\text{CH}_2\text{CHOONH}_2)_x$. A water-soluble polymer, employed as a suspension agent or thickening material for **ceramic slips** and slurries.

polyacrylic acid. PAA. *Noun.* A common anionic dispersant used to stop **aggregation** of powder, such as TiO_2 and BiTiO_3 when in suspension.

polyacrylonitrile. PAN. *Noun.* A polymer of CH_2CHCN , fibres of which are used as the starting material in the manufacture of **carbon fibre**.

polybasic. *Adjective.* A chemical compound which, in solution, will yield two or more hydrogen ions per molecule; for example, sulphuric acid, H_2SO_4 .

polybasite. *Noun.* $(\text{Ag,Cu})_{16}\text{Sb}_2\text{S}_{11}$. A blackish mineral with monoclinic plate-like crystals.

polyborates. *Noun.* Solids with a B:O ratio of 3:5 formed by condensation of B_3O_7 rings.

polycerams. *Plural noun.* Alternative name for nanosized ceramics or **Ormosils**.

polychromatic. *Adjective.* (1) Electromagnetic radiation containing more than one wavelength. (2) Having a variety of colours or changing colours.

polychrome. *Adjective.* (1) A multi-coloured decoration. (2) Having changing or various colours.

polychromic glass. *Noun.* Glass containing the additives AgBr, NaF and CeO₂, which after suitable annealing and exposure to ultraviolet light generate needle-like silver deposits on the tips of the silver bromide crystals. Depending on their **aspect ratio** the needles absorb strongly and selectively to produce complimentary coloured glasses.

polychromy. *Noun.* Decoration in many colours.

polycide. *Trade name, noun.* A composite of **polysilicon** and **titanium silicide** or **tungsten silicide**, MSi₂; used in **integrated circuit** devices.

polycrase. *Noun.* A mineral with a useful **rare earth** content.

polycrystal. *Noun.* A structure composed of randomly oriented crystals; usually formed by rapid cooling.

polycrystalline. *Adjective.* Composed of variously oriented crystals.

polycrystalline diamond PCD. *Noun.* A form of abrasive made by **CVD** methods involving methane, hydrogen and electrostatic discharges.

polydimethylsiloxane. *Noun.* A **silicone** elastomer often used mixed with **silica fume** to increase its strength; used as a bonding agent to bind glass fibres to a polymer matrix.

polydispersion particle distribution. *Noun.* A ceramic body containing more than two **monodistributed powders**.

polyelectrolyte. *Noun.* A highly polymerised substance containing ionic components.

polyester laminates. *Plural noun.* Sheets, bars, and structural shapes made by impregnating glass fibres and fabrics with polyester-resin solutions, followed by curing.

polyester resin. *Noun.* A class of thermosetting resins produced by esterification of polybasic organic acids with polyhydric alcohols; in the cured state, they have high strength and resistance to moisture and chemicals; used as a bonding agent for glass fibres and laminated products.

polyetheretherketone. PEEK. *Noun.* A thermoset polymer used as a matrix for carbon fibre and SiC fibre composites that are extremely strong and tough.

polyethylene glycol. PEG. *Noun.* A family of colourless water-soluble liquids and solids used as binders, lubricants, and emulsifying agents. When used as a cold pressing binder it does not need a plasticiser because $T_g < -20\text{ }^\circ\text{C}$.

polyethyleneimine. PEI. *Noun.* A commonly used cationic dispersant used to generate surface hindrance on nanosized powders in suspension to stop them **aggregating**.

polyethylene resins. *Plural noun.* A family of tough, water-repellent, thermoplastic materials composed of polymers of ethylene; used as protective coatings for glass bottles, glass fibres, and fabrics of glass fibres; also used as an injection moulding material for ceramics.

polyethylene terephthalate. PET. *Noun.* A condensation polymer formed from ethylene glycol and terephthalic acid. Extensively used as a fibre and as a mouldable matrix for composites; very hard and wear resistant.

polygluconic acid. poly-G. *Noun.* A component of alginates; see **alginic acid**. Cation binding between poly-G segments on different polymer chains produces a 3-D network that leads to strong **gels**. Ca²⁺ cations are most commonly used to induce gelation.

poly-G. *Abbreviation.* Standing for polygluconic acid. See **polygluconic acid**.

polyglycoldistearate. *Noun.* A distearate ester of **polyethylene glycol**; used as a plasticiser.

polyhedral angle. *Noun.* A geometrical shape formed by the intersection of three or more planes that have a common vertex.

polymeric cement. *Noun.* Cement that is caused to set by the development of an addition-type polymerisation reaction.

polymers, acrylic. *Plural noun.* See **acrylic polymers**.

polymorph. *Noun.* Any of the crystalline forms of a material exhibiting **polymorphism**.

polymorphism. *Noun.* The existence of a solid, such as **silica**, in two or more distinct crystallographic forms.

polymer-matrix composite. PMC. *Noun.* A composite in which the **matrix** is a polymer resin and the strengthening material is carbon or glass fibres.

polyphase. *Noun.* (1) A composite fibre consisting of a polycrystalline core enclosed in an amorphous glassy phase sheath. This arrangement allows high-modulus ceramics to be drawn into fibres as thin as 25 μm . (2) Having more than one phase.

polyphosphoric acid. *Noun.* A glassy or liquid mixture of **orthophosphoric acid** and polyphosphoric acids used as an oxidising and dehydrating agent.

polypivalolactone composite. *Noun.* A composite formed in-situ by anionic polymerisation of pivalolactone monomer mixed with **carbon fibre**.

polysilates. *Plural noun.* Chain and ring polymers with the empirical formula: $M_n[-(\text{SiO}_2)_a-\text{AlO}_2]_n \cdot x\text{H}_2\text{O}$, where n is the degree of condensation and has the values 1, 2 or 3. Used to form **geopolymers**. See **geopolymers** and **sialate**.

polysulphide. *Noun.* Any sulphide of a metal containing anions consisting of chains of sulphur atoms.

polysynthetic twins. *Noun.* Contact twins repeated on the same composition plane at close intervals across the crystal. Results in striated appearance and can cause **chatoyance**.

polytypism. *Noun.* A special 1-D type of polymorphism. Polytypes are the same in two dimensions of the close packed planes that define the structure, but differ in the stacking sequence perpendicular to the close-packed planes, α - and β -SiC are examples.

polyurethane. *Noun.* A class of synthetic polymers made by copolymerising an isocyanate and a polyhydric alcohol. Commonly used as a foam for insulation and packing.

polyvalent. *Adjective.* An atom or radical with more than one half-filled **atomic orbital**.

polyvinyl acetate. *Noun.* A thermoplastic polymer, insoluble in water, employed as a binder in sizing compounds for glass-fibre textiles and as an adhesive for ceramic materials.

polyvinyl alcohol. PVA. *Noun.* A water-soluble polymer; used as an addition to glazes and bodies to improve dry strength prior to firing, as a sizing and adhesive for glass fibres, and as a thickening and suspension agent for ceramic slurries. It is used in conjunction with a plasticiser because of its high, $>60\text{ }^{\circ}\text{C}$, softening temperature.

Polyvinyl-(alcohol-co-acetate). PVAA. *Noun.* A partially hydrolysed form of **PVA** that is used in conjunction with a plasticiser as a binder in ceramic powder compaction.

polyvinyl butyral resin. *Noun.* Used as a plasticiser for the inner layer of laminated glass.

polyvinyl chloride. *Noun.* Used as a coating for glass bottles, glass-fibre fabrics, and as a component of moulding compounds to minimise damage by abrasion.

pontil. *Noun.* An iron rod to which glassware is attached and held for easy manipulation during fire polishing or finishing. Also known as a **punty**.

pop-off. *Noun.* A porcelain-enamel defect in which segments of ground coat separate spontaneously from the base metal.

pop out. *Noun.* A defect in concrete in which a conical piece is pushed out of the surface due to expansion of an aggregate particle at the apex of the cone.

poppers. *Noun.* Porcelain-enamel defects in which small detached disks of ground coat appear in sheet-steel cover coats.

popping. *Noun.* (1) The rapid expansion of aggregate materials in lightweight cellular products. (2) The fracture of small segments from the face of building brick.

pops, lime. *Noun.* See **lime pops**.

population inversion. *Noun.* A state where more ions or atoms in a **lasing** ceramic are in an upper energy state than in the ground state, which, is the situation needed to sustain a high rate of lasing ability.

porcelain. *Noun.* (1) A translucent ceramic material made from **kaolin**, **petuntse**, ground glassy substances, **soapstone**, **bone ash** and other minor ingredients. (2) A generic term for a glazed or unglazed ceramic whiteware of high quality, high strength, low absorption, and often good **translucency** in thin sections. Named from **porcellana** the Italian name for cowrie shell which has a similar appearance to porcelain.

porcelain capacitor. *Noun.* A capacitor in which the dielectric is high-quality porcelain fused to alternate layers of silver electrodes to form an essentially monolithic unit requiring no hermetic seal.

porcelain cement. *Noun.* Cement, such as a mixture of gutta-percha and shellac, used to bond porcelain to porcelain.

porcelain, chemical. *Noun.* See **chemical porcelain**.

porcelain clay. *Noun.* Pure, white **kaolin**. Another name for kaolin.

porcelain, cordierite. *Noun.* See **cordierite porcelain**.

porcelain, dental. *Noun.* See **dental porcelain**.

porcelain, eggshell. *Noun.* See **eggshell**.

porcelain, electrical. *Noun.* See **electrical porcelain**.

porcelain-enamel. *Noun.* A substantially vitreous or glassy, inorganic coating, applied to a metal surface and subsequently fired to temperatures above $425\text{ }^{\circ}\text{C}$ to develop a bond between the coating and the metal.

porcelain-enamel, aluminium. *Noun.* See **aluminium enamel**.

porcelain-enamel fineness. *Noun.* The particle size of porcelain-enamel frit reported as grams of dry residue retained on a designated screen size from a measured sample.

porcelain-enamel frit. *Noun.* Selected ingredients that will form a glass capable of bonding to porcelain are mixed, melted, and then quenched in water or air to form small friable particles which are processed by milling with clay, electrolytes, and colour oxides for application as a coating.

porcelain-enamel reflectivity. *Noun.* The **reflectance** of a porcelain-enamel coating of sufficient thickness that an additional thickness does not change the reflectance value.

porcelain-enamel sanitary ware. *Noun.* Porcelain-enamelled ware, such as bathtubs, lavatories, sinks, and other products used for sanitary and hygienic purposes.

porcelain, forsterite. *Noun.* See **forsterite porcelain**.

porcelain insulator. *Noun.* Any electrical insulator made of porcelain, the body and glaze frequently being fired simultaneously.

porcelainite. *Noun.* A synonym for mullite, an aluminium silicate, $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$. See **mullite**.

porcelain, mullite. *Noun.* See **mullite porcelain**.

porcelain paste. *Noun.* Unfired porcelain bodies, usually in the plastic state.

porcelain process. *Noun.* The process of producing porcelain ware in which the body and glaze are fired simultaneously.

porcelain, Reaumur. *Noun.* See **Reaumur porcelain**.

porcelain, semi. *Noun.* See **semi-porcelain**.

porcelain, steatite. *Noun.* See **steatite porcelain**.

porcelain tile. *Noun.* A dense, fine-grained, smooth, usually impervious tile having a sharp face; normally produced by dust pressing. Colours may be granular or of the clear, luminous type.

porcelain, titania. *Noun.* See **titania porcelain**.

porcelain, zircon. *Noun.* See **zircon porcelain**.

porcelain, zirconia. *Noun.* See **zirconia whiteware**.

porcellana. *Noun.* Italian word for the glossy cowrie shell sometimes used in ceramic batches but has the appearance of porcelain.

porcellaneous. *Adjective.* Resembling unglazed porcelain.

porcelain stone. *Noun.* A rock found in the ceramic producing regions of China that contains the primary clay mineral **sericite** along with **feldspar** and **quartz**. The crystals of sericite are very fine and give the rock considerable malleability.

pore. *Noun.* (1) An internal cavity in a solid substance, usually one that can be exposed by cutting, grinding, or polishing. (2) Voids between grains of a grinding wheel.

pore diameter. *Noun.* The average diameter of pores in a solid substance.

pore diffusion. *Noun.* The passage of a gas or liquid into and through the porous structure of a solid.

pore pressure. *Noun.* The pressure in the liquid phase surrounding solid particles in contact. It arises when the total stress added exceeds the hardness stress cap.

pore size. *Noun.* The average pore volume contained in a solid substance divided by the number of pores.

pore-size distribution. *Noun.* The range of the size variation of pores contained in a solid.

pores, sealed. *Noun.* See **sealed pores**.

pore volume. *Noun.* The total combined volume of open and **closed pores** contained per unit of volume or weight of a solid, calculated by the formula: $P_t = (1 - \rho_b/\rho_t) \times 100$, where P_t is the total volume of pores reported as a percentage of the total bulk volume of the specimen, ρ_b is the bulk density, and ρ_t is the true density of the specimen.

pore volume, closed. *Noun.* See **sealed pores**.

pore volume distribution. *Noun.* The distribution or arrangement of **pore volume** among pores of varying dimensions.

pore volume, open. *Noun.* See **open pore volume**.

pore volume, sealed. *Noun.* See **sealed pores**.

pore water. *Noun.* The tempering water contributing to the pore structure in clays and bodies during and after working and forming.

Porod scattering. *Noun.* The contribution made to multiple small angle scattering made by small pores in a ceramic microstructure. See **multiple small-angle scattering**.

poromeric. *Adjective.* An essentially polymeric solid that will transmit water vapour but remains proof to liquid water.

porosimeter. *Noun.* An instrument used to measure porosity in a solid substance.

porosity. *Noun.* (1) The ratio of the volume of pores, both open and closed, to the total volume of a body. (2) The ability of fired ware to absorb water or other liquid by capillary action.

porosity, apparent. *Noun.* See **apparent porosity**.

porosity, sealed. *Noun.* See **sealed porosity**.

porous. *Adjective.* Containing or being filled with pores.

porous area. *Noun.* A volume in a body into which a dye will penetrate through the surface if an opening should exist.

porous ceramics. *Plural noun.* Ceramics engineered to contain pores to develop desirable properties, such as low density, high thermal shock resistance, controlled permeability, high **specific strength**, and chemical inertness. Used in applications, such as filters for molten metals, performs for metal-matrix composites and bioimplants.

porous carbon. *Noun.* An item fabricated from carbon particles pressed together without use of a binder, greater in strength but less resistant to oxidation than **porous graphite**.

porous graphite. *Noun.* An item fabricated from graphite particles pressed together without use of a binder, lower in strength but more resistant to oxidation than **porous carbon**.

porous mould. *Noun.* A forming mould containing numerous open pores or channels through which gases and liquids can pass as a means of removal for a formed body.

porous wheel. *Noun.* A vitrified or resin-bonded grinding wheel having a porous structure.

porphyritic. *Adjective.* Consisting of **porphyry**.

porphyroid. *Adjective.* **Metamorphic** rock having a **porphyritic** structure.

porphyry. *Noun.* A rock that contains large mineral crystals in a fine matrix. The large crystals are called **phenocrysts**.

porringer. *Noun.* A small ceramic dish with handles for soup.

port. *Noun.* Openings in a furnace wall serving as an entrance for fuels or flames, and as an exit for exhaust gases.

portable grinder. *Noun.* A grinding machine that is supported and manipulated manually by an operator.

portal. *Noun.* An entrance to a **tunnel kiln**.

portico. *Noun.* Covered walkway formed by columns supporting a roof.

Portland blast-furnace slag cement. *Noun.* Hydraulic cement consisting of an intimately ground mixture of **Portland clinker** and granulated **blast-furnace slag**.

Portland cement. *Noun.* Hydraulic cement that can harden under water; produced by finely pulverising a calcium aluminium silicate clinker together with additions of **gypsum** or other forms of **calcium sulphate**. Named after the Isle of Portland because its colour resembles the stone quarried there. It contains four main phases: CaSiO_4 , Ca_3SiO_5 , $\text{Ca}_3\text{Al}_2\text{O}_6$ and $\text{Ca}_2\text{AlFeO}_5$. The construction industry standard ranging from Type 1, general purpose, to Type 5, a very sulphate resistant material, used in highly alkaline and moist conditions.

Portland cement, white. *Noun.* See **white Portland cement**.

Portland clinker. *Noun.* A material made by **clinkering** containing at least 66 wt.% calcium silicates with the balance being aluminium and iron oxides.

portlandite. *Noun.* The name given to calcium hydroxide, $\text{Ca}(\text{OH})_2$, found in **hydrated Portland cement**.

Portland-pozzolan cement. *Noun.* A cement consisting of a mixture of **Portland cement** and **pozzolan cement**.

Portland vase. *Noun.* A striking example of Roman cameo glass. See **cameo glass**.

position tagged spectrometry. *Noun.* A development of **SEM** and **EDS**, where the scanning beam is computer controlled to tag the incoming x-rays from each pixel

so that a full elemental analysis at each pixel can be regenerated later. A 3-D file of position x,y and energy is constructed from which a spectrum from an entire phase, not just one point, can be constructed. This improves the quantitative analysis statistics.

positive edge dislocation. *Noun.* An **edge dislocation** in which the extra half plane of atoms lies above the **slip plane**.

positive temperature coefficient thermistor. *Noun.* A ceramic, such as BaTiO_3 , in which the current decreases as temperature rises.

positron. *Noun.* The positive counterpart of an electron, having approximately the same mass and magnitude of charge.

post. *Noun.* An upright member of a kiln-furniture assembly that holds the pins upon which ware is placed for firing.

post-cleaning. *Verb.* To remove penetrant from a specimen following a penetration-porosity study, usually by wiping or washing.

post-emulsifiable penetrant. *Noun.* A penetrating test liquid for porosity determination that contains an emulsifying agent to make it water washable and hence more easily removed from the specimen.

post-emulsification cleaning. *Verb.* To remove a penetrant from a specimen by means of an emulsifying agent following a penetration-porosity study.

post forming. *Verb.* The heating and then mechanical shaping to a mould of cured composite laminate.

postforming thermolysis. *Noun.* The controlled thermal burn-out of binder prior to sintering of shapes made by **injection moulding** or **art-to-part** methods.

post-HIP. *Verb.* Sintered material is transferred to the HIP-machine for completion after it has reached a state where there is little or no interconnected porosity.

post-shock vaporisation. *Noun.* See **dense medium**.

post-tensioned concrete. *Noun.* A prestressed concrete to which a tensile stress is applied the prestressing tendons after the concrete has attained sufficient strength.

pot. *Noun.* A rounded refractory container or crucible in which glass is melted and refined.

pot arch. *Noun.* A furnace for the preheating or firing of a glass-melting **pot**.

potash. *Noun.* (1) K_2CO_3 . Potassium carbonate. See **potassium carbonate**, or **potassium hydroxide**. (2) Potassium or a potassium compound used in the ceramics industry and agriculture. Originally called pot ashes because it was obtained by leaching wood ashes and evaporating the solution to dryness in iron pots.

potash alum. *Noun.* The full name for **alum**.

potassic feldspars. *Noun.* There are two forms, **orthoclase** is the high temperature form found in many igneous and metamorphic rocks and **microcline** is the low temperature polymorph found in granites and **pegmatites**.

potassium acetate. *Noun.* $\text{KC}_2\text{H}_3\text{O}_2$. Used as a flux in the production of **crystal glass**.

potassium aluminium silicate. *Noun.* (1) $\text{K}_2(\text{Al}_2\text{SiO}_6)$. (2) $\text{K}_2(\text{AlSiO}_4)_2$. Mp 1,749 °C; density 2,600 kg m^{-3} ; hardness (Mohs) 5–7. (3) $\text{K}_2\text{Al}_2\text{Si}_4\text{O}_{12}$. Mp 1,688 °C; density 2,470 kg m^{-3} ; hardness (Mohs) 5–7. (4) KAlSi_3O_8 . **Feldspar**; mp 1,149 °C; hardness (Mohs) 5–7.

potassium bifluoride. *Noun.* KHF_2 . Employed as a glass etchant.

potassium carbonate. *Noun.* K_2CO_3 . Used as a fluxing agent, glass former, and sometimes as an opacifier in glass, glazes and porcelain-enamels. Commonly called **potash**. Mp 909 °C; density 2,300 kg m^{-3} .

potassium chloride. *Noun.* KCl . Used as a set-up agent in porcelain-enamel slips. Mp 776 °C; density 1,980 kg m^{-3} . Also called **sylvite**.

potassium chromate. *Noun.* K_2CrO_4 . Used as a yellow or orange pigment in porcelain-enamels and glazes. Mp 971 °C; density 2,732 kg m^{-3} .

potassium cyanide. *Noun.* KCN . Used as a neutraliser in the pickling of metals for porcelain-enamelling. It is extremely poisonous. Mp 634 °C; density 1,520 kg m^{-3} .

potassium dichromate. *Noun.* $\text{K}_2\text{Cr}_2\text{O}_7$. Used in glass for **aventurine** effects and for the production of green colours; used in glazes for the production of chrome-tin pinks. Low-fire greens, and purplish-red colours. Mp 396 °C; density 2,692 kg m^{-3} .

potassium dihydrogen phosphate. *Noun.* KH_2PO_4 . Large crystals can be grown that possess **double refraction** behaviour. Also known as **KDP**.

potassium feldspar. *Noun.* KAlSi_3O_8 . Potassium-bearing **feldspar**.

potassium fluoride. *Noun.* KF . Employed as a glass etchant and as a flux in the preparation of **ferroelectric crystals** of **barium titanate**. Mp 800 °C; density 2,500 kg m^{-3} .

potassium fluorrichterite. *Noun.* $\text{KNaCaMg}_5\text{Si}_8\text{O}_{22}\text{F}_2$. An **amphibole** with **acicular** crystals that is the main phase of a glass-ceramic of this name. It has a very high chemical **durability**. Glazes bond well to it. It is now used as high-performance institutional **tableware** with an appearance similar to **bone china**.

potassium fluosilicate. *Noun.* See **potassium silicofluoride**.

potassium gold chloride. *Noun.* $\text{KAuCl}_4 \cdot 2\text{H}_2\text{O}$. Used to decorate glass and ceramics.

potassium hydroxide. *Noun.* KOH . A strongly alkaline salt that absorbs moisture from the air. Also called **potash** and **caustic potash**. Mp 360 °C; density 2,044 kg m^{-3} .

potassium jarosite. *Noun.* $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$. A yellow pigment. Also called **yellowboy**.

potassium metatantalate. *Noun.* KTaO_3 . A ceramic with the **perovskite** structure. Used in special **ferroelectric** and **ferromagnetic** applications.

potassium niobate. *Noun.* (1) KNbO_3 . A lead-free **piezoelectric** ceramic when **poled**. Orthorhombic crystal structure with a **Currie temperature** of 435 °C. Single crystals are used in **ultrasonic** and **acoustic** wave transducers. (2) $\text{K}_8\text{Nb}_6\text{O}_{13}$. A ferroelectric compound having a Curie temperature of 420 °C.

potassium nitrate. *Noun.* KNO_3 . Employed in glass, glazes, and porcelain-enamels as a flux and oxidising agent. Mp 337 °C; density 2,100 kg m^{-3} .

potassium nitrite. *Noun.* KNO_2 . employed as a colour stabiliser, anti-tearing agent, and set-up addition in porcelain-enamels. Mp 297–450 °C; density 1,900 kg m^{-3} .

potassium orthophosphate. *Noun.* K_3PO_4 . Used as a suspension and dispersing agent in porcelain-enamel and glaze slips. Mp 1,340 °C.

potassium oxide (potash). *Noun.* K_2O . Used as a flux and colour stabiliser in glass, glazes, and porcelain-enamels, and as a deflocculating agent in **engobes**, in casting and glaze slips. Decomposes on heating; density 2,320 kg m^{-3} .

potassium pyrophosphate. *Noun.* $\text{K}_4\text{P}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$. Used as a suspension and dispersing agent in porcelain-enamel and glaze slips. Mp 1,090 °C; density 2,330 kg m^{-3} .

potassium silicate. *Noun.* K_2SiO_3 . A **pyroxene** group silicate; used as a source of potassium and silica and as an anti **blooming agent**. Density 1,250–1,390 kg m^{-3} .

potassium silicofluoride. *Noun.* K_2SiF_6 . Used as a fluxing ingredient in porcelain-enamels. Density 3,000 kg m^{-3} . Also called **potassium fluosilicate**.

potassium sulphate. *Noun.* K_2SO_4 . Used as a raw material in glassmaking. Mp 1,072 °C; density 2,660 kg m^{-3} .

potassium tantalate. *Noun.* KTaO_3 . A **perovskite** used in **ferroelectric** and **ferromagnetic** applications.

potassium tetrasilicate. *Noun.* $\text{K}_2\text{Si}_4\text{O}_9$. Glasses of this composition show a decreasing viscosity as the pressure is increased; Raman spectra show the presence of SiO_6 -octahedra, a most uncommon occurrence; the high pressure crystalline polymorph has the **wadeite** structure.

potassium titanium phosphate. *Noun.* KTiOPO_4 . A refractory ceramic, which has a network crystal structure consisting of chains of TiO_6 octahedra and PO_4

tetrahedra parallel to both [100] and [010] directions. Developed for nonlinear optical and electro-optical applications because of its good thermal and mechanical stability, large transparency range, resistance to high-power laser damage, thermally stable phase-matching properties, and ease of preparation of large single-domain crystals.

potassium titanate. *Noun.* K_2TiO_3 . Used in the production of thermal insulating fibres. The fibres are in fact **whiskers** with dimensions $6 \times 0.1 \mu m$ and are used to reinforce thermoplastics. Mp $1,370^\circ C$; density $3,200 kg m^{-3}$.

potassium zinc silicate. *Noun.* K_2ZnSiO_4 . A discrete tetrahedral ionic silicate. Mp $1,297^\circ C$.

pot bank. *Noun.* (1) A battery of glass-melting pots or crucibles. (2) A pottery factory.

pot, cannon. *Noun.* See **cannon pot**.

pot clay. *Noun.* Refractory clays used in the manufacture of glassmaking pots and crucibles.

pot, closed. *Noun.* See **closed pot**.

potentiometer. *Noun.* An instrument for the measurement of potential difference in an electric circuit.

potentiometer, sliding. *Noun.* See **slide potentiometer**.

pot furnace. *Noun.* A furnace into which pots and crucibles are placed for the melting of porcelain-enamels, glass, and glazes.

pot glass. *Noun.* Glass melted in pots or crucibles.

pot, glass. *Noun.* See **glass pot**.

pot, glazed. *Noun.* See **glazed pot**.

potiche. *Noun.* A tall **porcelain** jar with a polygonal or round body that becomes narrow near the neck and has a lid that is detachable.

potichomania. *Noun.* The art of decorating plane glass vases on the inside with patterned designs. The technique began in France and spread to Britain in the nineteenth century.

pot, jockey. *Noun.* See **jockey pot**.

pot life. *Noun.* (1) The length of time, or the number of cycles, a **pot** is in actual use before it is discarded. (2) The working time when an hydraulic cement can be shaped and moulded before setting.

pot, open. *Noun.* See **open pot**.

pot, revolving. *Noun.* See **revolving pot**.

pot ring. *Noun.* A floating refractory ring on the surface of glass melted in a pot, to prevent the accumulation of scum in the gathering area.

potsherd. *Noun.* A broken fragment of pottery.

pot, skittle. *Noun.* See **skittle pot**.

pot spout. *Noun.* A connecting refractory shape through which molten glass is transferred from a glass tank to a revolving pot.

potstone. *Noun.* A massive form of **soapstone** originally used to make cooking vessels by hollowing-out the shape.

potter. *Noun.* A workman, usually an artisan, engaged in the production of pottery and similar artware.

Potteries. *Plural noun.* A region in the west Midlands of England where **china** and **earthenware** manufacture is concentrated.

potter's clay. *Noun.* Any **ball clay** used in the production of pottery.

potter's red cement. *Noun.* Cement composed of a mixture of **Portland cement** and sintered **red clay** that has been crushed; used as decorative cement.

potter's rot. *Noun.* An old description of the disease **silicosis**. An environmental hazard for ceramic workers.

potter's wheel. *Noun.* A horizontal rotating wheel or disk, powered manually or mechanically, upon which pottery is shaped by hand.

pottery. *Noun.* (1) A generic term denoting ware, such as vases, bowls, plates, and pots, shaped from moist clay and hardened by firing. (2) The building or establishment in which pottery is made. (3) The craft or occupation of a potter.

pottery-body stains. *Plural noun.* Finely ground pigments used in colouring **terra-cotta**, tile, abrasives, and other ceramic products where the pigment becomes part of the body.

pottery stone. *Plural noun.* A collective for several materials that offer fluxing action in ceramic bodies. The most effective are those that contain a high percentage of **sericite**.

potting. *Verb.* (1) To embed an electronic assembly in a thermosetting material to protect the assembly from the effects of vibration, shock, moisture, and corrosive agents. (2) To make pottery and similar artware.

pottinger. *Noun.* An **earthenware** vessel for soup. Adaptation of the French *potager*.

potting material. *Noun.* The thermosetting insulating material used to protect potted electrical components from shock, vibration, air, moisture, etc.

pot wagon. *Noun.* A cart-like vehicle used to transport pots from a **pot arch** to a **pot furnace**.

pot warping. *Noun.* The distortion of pots during drying or firing.

poultice plaster. *Noun.* A temporary evaporation layer put on to a built wall to control the rate of evaporation from the wall surface in order to prevent salt precipitation from the bricks and prevent serious corrosion.

The plaster is made from fibrous silicates, such as **sepiolite** and **palygorskite**, which contain large volumes of **zeolitic-water** that is lost by evaporation at the surface and is then replaced by salt solutions from the wall bricks. Also called **sacrificial plaster**.

poundal, pdl. *Noun.* The old fps system unit of force. The force that will impart an acceleration of 1 ft per second per second to a mass of 1 lb. It is equivalent to 0.1382 N.

pour. *Verb.* (1) To empty a pot, crucible, or other container of its contents, usually in a stream, by tipping the container. (2) To place concrete. (3) *Noun.* The batch removed from a pot, crucible, or other container by pouring. (4) *Noun.* A batch of concrete in a single continuous placement.

Pourbaix diagram. *Noun.* A graphical representation of the phases that are stable under different oxidation-reduction conditions at different pHs. It is possible to use the diagrams to read the pH at which metal oxide MO will be precipitated from a solution of M^{n+} ions at a given concentration and at which MO will redissolve as MO_x^{n-} .

pour density. *Noun.* The weight of a powdered or granular material poured into a graduated container divided by its volume.

pouring-pit refractory. *Noun.* (1) The refractory shapes used in the flow control of steel between the furnace and the mould. (2) A refractory used in casting molten metal.

pouring, top. *Verb.* See **top pouring**.

pour point. *Noun.* (1) The lowest temperature at which a liquid will flow. (2) The optimum temperature for the pouring of a molten substance or batch, such as glass or a glassy composition.

powder. *Noun.* Dry, finely divided particles of a solid substance in the size range 0.1–1,000 μm .

powder blue. *Noun.* A mixture of **cobalt oxide**, **silica**, and **potassium carbonate** or other flux used as a colorant in glass, glazes, and porcelain-enamels.

powder co-injection moulding. *Noun.* A development of **powder injection moulding**. The injection equipment uses two barrels connected to a single nozzle via a pneumatic valve. Binder and ceramic powder are injected from the barrels sequentially so that in the mould skin layers around cores of different ceramic compositions can be made. Burn-out and sintering then follow.

powder density. *Noun.* The density of a material in powder form, including all pores; calculated as the ratio of the mass of the material to its true volume.

powder, diamond. *Noun.* See **diamond paste**.

powdered activated carbon. *Noun.* Activated carbon predominately of 80-mesh and smaller particle size.

powdered loose splittings. *Noun.* Loose splittings of **mica** dusted with mica powder.

powdering. *Verb.* (1) To reduce the particles of a substance to powder form. (2) To apply powdered coatings or decorations to pottery or other ceramic ware.

powder injection moulding, PIM. *Noun.* A process derived from polymer injection moulding using much of the same technology. A mixture of 35–50 vol% of polymer powder plus 50–65 ceramic powder and additives is injection moulded then carefully debonded followed by sintering. It is a competitive process for making small intricately shaped components.

powder metallurgy. *Noun.* The technologies involve in manufacturing articles by pressing powders and **sintering** to consolidate.

powder, separating. *Noun.* See **separating powder**.

powder, sinterable. *Noun.* See **sinterable powder**.

power density. W dm^{-3} . *Noun.* One of the two parameters fundamental for **energy storage**; it is how quickly energy can be delivered. For cells or batteries it is the power output per unit volume as determined at 80 % depth of discharge. See **intensity**.

power factor. *Noun.* (1) In an alternating electrical circuit it is the ratio of electric power dissipated in a component to the effective voltage and current. When the load is purely resistive the power factor is 100 % but when the load introduces inductance via motors or coils, the sine wave of the current lags behind that of the voltage by an angle, ϕ , called the **phase angle**, which when determined, cosined, and multiplied by 100 gives the power factor. Hence, power factor = $100 \cos\phi$. (2) A part of the **order of merit figure, ZT**, for **thermoelectric** materials. It has a value equal to $S^2\sigma$, where σ is the electrical conductivity and S is the **Seebeck coefficient**.

power law crack velocity relation. *Noun.* An approach to making ceramic failure predictions using the **static fatigue equation**: $t_f = B(S_i)^{n-2} \sigma^{-n}$, where t_f is the time to failure under the applied stress σ , S_i is the initial strength and B and n are crack growth parameters.

power pack. *Noun.* Compact device used to convert the current from a supply into direct or alternating current at a voltage required by an electronic device.

pozzolan. *Noun.* Natural or man made material. Siliceous and aluminous materials, such as certain **fly ashes** and **blast-furnace slags**, which, in finely divided form, will exhibit **cementitious** properties when mixed with **lime** and water. Derived from volcanic rock where the amorphous constituent is glass and the cementitious component is volcanic ash, **tuff**, **pumice**, scoria, or **obsidian**. Alternatively derived from rocks containing **opal** and **diatomaceous earths**, **cherts**, **opaline silica** or lava containing **calcined clay**.

pozzolana. *Toponym.* From the Italian town Pozzuoli, near where it was found. A volcanic ash containing **alumina**, **silica** and **lime**. Used in the production of hydraulic cement. Also called **pozzuolana**.

pozzolan cement. *Noun.* Cement produced by grinding **Portland cement** with a **pozzolan** or a mixture of **pozzolana** with extra **hydrated lime**.

PPI or ppi. *Abbreviation.* Stands for pores per inch. See **reticulated ceramics**.

ppm. *Abbreviation.* Stands for parts per million.

Prague red. *Noun.* A red pigment consisting essentially of **red iron oxide**.

prall mill. *Noun.* An **impact mill** consisting of a rotating impeller, a baffle rotating in the opposite direction, and a stationary baffle.

PRAM. *Acronym.* Stands for phase change random access memory. See **phase change random access memory**.

prase. *Noun.* A **translucent** light-green form of natural silica or **quartz**. See **Chalcedony**.

praseodymium barium copper oxide. *Noun.* $\text{PrBa}_2\text{Cu}_3\text{O}_7$. An oxide isomorphous with $\text{YBa}_2\text{Cu}_3\text{O}_7$ but semiconducting and not **superconducting**; used to pin **vortices** in **YBCO** superconductor materials.

praseodymium nickel oxide. *Noun.* PrNiO_3 . A **perovskite** that undergoes a metal-insulator transition below 135 K when the metallic conduction properties change to insulator behaviour.

praseodymium oxide. *Noun.* (1) Pr_6O_{11} . Used in the production of yellow and green ceramic colours. (2) PrO_2 ; **fluorite structure**. (3) Pr_2O_3 . Mp 2,199 °C; density 1,090 kg m⁻³.

praseodymium silicate. *Noun.* Pr_2OSiO_4 . Mp 1,398 °C.

praseodymium yellow. *Noun.* A glaze colourant composed of a mixture of **silica**, **zirconia**, and approximately 5 % **praseodymium oxide**.

preamp. *Abbreviation.* Short for preamplifier; an electronic device used to improve the signal-to-noise ratio of an electronic device and boost a low-level signal before it is transmitted to the main amplifier.

precast. *Adjective.* Relating to concrete or something made of concrete: cast in the form required before being placed in its final position.

precast concrete. *Noun.* Concrete that has been cast in moulds or forms at a location other than the site of its ultimate use.

preceramic polymers. *Plural noun.* Usually **polysiloxanes** or **alkoxides** that can be calcined to produce Si-O-C-based ceramics, such as **silicon carbide**, **SiC**, or **silicon oxycarbides**.

precious coral. *Noun.* See **red coral**.

precious stone. *Noun.* Any of several rare minerals such as **diamond**, **opal**, **emerald**, **ruby**, or **sapphire**.

precipitant. *Noun.* A chemical agent that causes the formation of a **precipitate**.

precipitate. *Verb trans.* (1) In a chemical sense it is to undergo or cause to undergo a process in which a dissolved substance separates from solution as a fine suspension of solid particles. A common way to produce pure, fine-particle-sized ceramic powders. The solution can be a liquid or a solid solution and the process is brought about by a chemical reaction or a change in temperature. (2) *Verb intrans.* To separate out from a solution or suspension.

precipitated calcium carbonate. PCC. *Noun.* **Calcium carbonate** precipitated in as pure and controlled particle size as possible for use as a paper filler.

precipitation. *Noun.* The process of precipitating or forming a **precipitate**.

precipitation colour. *Noun.* A colour in glass arising from the presence of colloidal particles, usually Cu, Au, or CdS; the colour is usually orange or red.

precipitation hardening. *Noun.* An increase in the measured hardness and strength of a solid brought about by inducing a very fine, well-distributed precipitate in the system to provide obstacles to dislocation movement. Also called **age hardening**.

precipitation heat treatment. *Verb.* To use a heating cycle designed to precipitate a new phase from a **saturated solid solution**.

precision. *Noun.* The highly accurate agreement of repeated measurements, particularly measurements that vary minimally from an established standard.

precision-bore glass tubing. *Noun.* Glass tubing heated to softness and then shrunk over a metal mandrel or core.

precision casting. *Verb.* To form a product of precise dimensional measurements by casting in a mould.

precision grinding. *Verb.* To machine grind an item to specified and precise dimensional measurements.

precleaning. *Verb.* To remove surface contamination prior to subsequent treatment or use.

precoat. *Verb.* To make a preliminary application of a refractory slurry to a casting pattern prior to application of the main slurry.

precursor. *Noun.* Original fibre from which carbon fibres are prepared by **pyrolysis**.

precursor binder. *Noun.* An additive in an extrusion mix composition that does not burn out but adds to the matrix on firing; **silicones**, for example, yield **silica**.

precursor wire. *Noun.* Fibre yarns prepared for **metal matrix composite** manufacture by passing them through liquid metal baths of the chosen **matrix**.

predry. *Verb.* To effect a preliminary drying of a substance prior to further treatment or processing.

prefabricated masonry. *Noun.* Masonry products fabricated in a factory or other location for rapid assembly at the site of construction.

preferential adsorption. *Noun.* The adsorption of certain materials to a greater extent or at a more rapid rate than other materials.

preferred orientation. *Noun.* A situation where crystals in a microstructure or chains in a molecular structure are aligned in the same direction throughout the solid.

preform. *Noun.* (1) The initial fabrication of a shape. (2) A sintered or prefired compact of powdered glass used in the production of glass-to-metal seals. (3) A preshaped fibrous reinforcement formed to the desired shape on a mandrel before being placed in a mould.

preheat. *Verb.* To subject to heat treatment prior to firing.

preheat zone. *Noun.* The section of a **continuous furnace** or kiln preceding the hot or firing zone.

prehnite. *Noun.* $\text{Ca}_2\text{Al}_2\text{SiO}_{10}(\text{OH})_2$. A natural hydrous silicate of calcium and aluminium related to the **zeolites**. Density 2,800–2,950 kg m^{-3} ; hardness (Mohs) 6.0–6.5.

preload. *Noun.* A stated internal tensile stress in an artefact.

premature stiffening. *Noun.* The false or erratic, abnormal quick-setting of cement in concrete due, usually, to the presence of unstable **calcium aluminate** and **gypsum** in the cement.

premix burner. *Noun.* A burner in which the fuel and air are mixed prior to the injection and ignition in the combustion chamber of a furnace or kiln.

prepregging. *Noun.* Initial wetting of fibre surfaces during impregnation with a thermoplastic or thermosetting resin liquid when manufacturing **fibre-reinforced composites**.

prepreg. *Noun.* A resin-impregnated woven ceramic fabric used to form composite shapes; used increasingly in the aerospace industry where the ceramic fabric is often made from carbon fibres.

pre-set crack. *Noun.* A crack occurring in concrete before the concrete has set.

presintering. *Noun.* A preliminary heat treatment prior to subsequent sintering or firing; usually to remove lubricants and binders.

press. *Noun.* An apparatus for maintaining pressure on an assembly.

press-and-blow process. *Noun.* A process of glass manufacture in which the molten, **seed-free** glass is pressed into a preliminary shape and subsequently is blown to the final shape of the ware.

press cloth. *Noun.* The cloth, such as nylon, cotton, or jute, which is used in filter presses for dewatering slurries.

pressed brick. *Noun.* Brick densified under pressure before firing; usually made from clay of low moisture content (5–7 %). A sharp angled brick compared to **wire-cut** and **handmade** brick.

pressed density. *Noun.* Another name for **green density**. See **pressure density**.

pressed glassware. *Noun.* Glassware formed under pressure between a plunger and a mould while in the molten or plastic state.

press, hydraulic. *Noun.* See **hydraulic press**.

pressing. *Verb.* To form ware under pressure, usually in a die.

pressing blank. *Noun.* A rough shape, particularly glass, from which a finished article is formed.

pressing die. *Noun.* A mould in which an item is formed under pressure.

pressing, dry. *Noun.* See **dry pressing**.

pressing, dust. *Noun.* See **dust pressing**.

pressing, hot. *Noun.* See **hot pressing**.

pressing, impact. *Noun.* See **impact pressing**.

pressing, isostatic. *Noun.* See **isostatic pressing**.

pressing, plastic. *Noun.* See **plastic pressing**.

pressing, ram. *Noun.* See **ram pressing**.

pressing, wet. *Noun.* See **wet pressing**.

Pressley index. *Noun.* Used to rationalise the variation of fibre strength as a function of fibre length tested; it is the breaking load per unit mass at theoretically zero gauge length for an 11.8-mm-long fibre bundle.

press moulding. *Verb.* To form ware by pressing in absorbent plaster moulds.

press, offset. *Noun.* See **offset press**.

press, screw. *Noun.* See **screw press**.

press, slug. *Noun.* See **slug press**.

press, swing. *Noun.* See **swing press**.

press, toggle. *Noun.* See **toggle press**.

pressure. *Noun.* The compressive stress applied to a substance or item, expressed as exerted force per unit of area; Nm^{-2} .

- pressure bag technique.** *Noun.* A modification of the **hand lay-up** method of forming glass fibre-polyester composite shapes that allows two smooth-finished surfaces to be obtained simultaneously. A flexible bag is inflated to press against the side of the object not in contact with the mould.
- pressure casting.** *Verb.* To form ware by casting followed by the application of pressure to densify the formed item in the mould, and to minimise drying shrinkage and speed the rate of production.
- pressure check.** *Noun.* A crack in a glass article caused by use of excess forming pressure.
- pressure, contact.** *Noun.* See **contact pressure**.
- pressure density.** *Noun.* The density of a compacted substance prior to firing or sintering.
- pressure dye test.** *Noun.* A porosity test in which a dye solution is applied to a test surface under pressure.
- pressure, hydrostatic.** *Noun.* See **hydrostatic pressure**.
- pressure-impulse (P-I) curve.** *Noun.* A method of quantifying the capacity of a reinforced concrete structure to resist blast loading. P is the peak blast pressure and I is the impulse and a plot of these two parameters gives a graphic representation of a structure's response to an explosive load.
- pressureless powder packing, PLPP.** *Noun.* A way of preparing green shapes for further processing. Powder is packed into a mould by mechanical vibration. A binder solution, for example 2 wt.% PVA in water, is infiltrated over 24 h and after drying the preform is able to be handled.
- pressure measurement.** *Noun.* The measurement of static and dynamic pressures in units of newtons per square metre
- pressure, moulding.** *Noun.* See **moulding pressure**.
- pressure regulator.** *Noun.* An instrument designed to control the pressure exerted on a substance.
- pressure sintering.** *Verb.* To heat-treat a substance under pressure to form a coherent mass with or without the presence of a liquid phase. See **hot pressing**, **HIPing**.
- pressure tank.** *Noun.* An airtight container in which slurries and liquids are placed under pressure and forced into spraying or other distribution system.
- pressure, vapour.** *Noun.* See **vapour pressure**.
- pressurised reactor.** *Noun.* A **nuclear reactor** fuelled by **uranium oxide** encased in zirconium in which water is used as coolant and **moderator** at a pressure too high to allow boiling to occur in the reactor.
- press, vibratory.** *Noun.* See **vibratory pressing**
- prestress.** *Verb.* To introduce internal stresses into a structure to counteract stresses or loads to which the structure will be subjected in service.
- prestressed concrete.** *Noun.* Concrete in which a compression stress is applied by means of prestressed steel rods, wires, or strands incorporated in the concrete mix during the fabrication of a product.
- pretensioned steel.** *Noun.* Steel rods, wires, or strands placed in tension for use in prestressed concrete, the tension being released after the concrete has set, thus placing the concrete under compression.
- primary air.** *Noun.* The air introduced into a burner or combustion chamber together with the fuel.
- primary boiling.** *Noun.* The initial evolution of gas during the firing of porcelain-enamel, sometimes resulting in **blisters** or other surface defects.
- primary bonds.** *Plural noun.* Bond types, such as **ionic**, **covalent** and some metallic bonds, which have high values for their bond energy and so are strong bonds.
- primary clay.** *Noun.* A **feldspathic** type of weathered clay that remains geologically at the site of its formation
- primary colours.** *Plural noun.* (1) In decorating inks: yellow, magenta, also known as process red; cyan, also known as process blue. (2) In light: red, green, and blue
- primary crusher.** *Noun.* The initial crusher of a series employed to pulverise minerals.
- primary firing.** *Verb.* To physically remove gas bubbles, usually with the aid of **fining agents** in glass manufacture. Temperatures in excess of 1,400 °C are needed.
- primary instability.** *Noun.* The occurrence of bowing from end to end in **column failure**.
- primary insulation.** *Noun.* The initial layer of insulating material applied over a conductor.
- primary jacket.** *Noun.* An insulating material applied as mechanical protection over **primary insulation**.
- primary phase.** *Noun.* The first crystalline phase occurring during cooling of a liquid and that exists in addition to the **eutectic** structure.
- primary recrystallisation.** *Noun.* Growth of new crystals from nuclei within strained, work-hardened crystals, to replace the original crystals. The orientation of the new crystals is generally unrelated to the original strained ones and so the growth is incoherent.
- primary refractory stone.** *Noun.* A **stone** in glass that resembles the wall refractory brick as far as mineralogy and microstructure are concerned.
- primary standard.** *Noun.* A specimen in which specific properties have been measured and these measurements have been adopted as standards for comparison.

prime mover. *Noun.* The mechanical energy that drives a generator.

primer. *Noun.* A coating applied to a surface to improve the adhesion of a second coating.

priming. *Verb.* To apply a **primer**.

principal axis. *Noun.* Either of two mutually perpendicular axes that lie in a cross-section plane of a beam or column.

principal direction. *Noun.* Related to the specific coordinate axes orientation when stress and strain components reach maximum and minimum for the perpendicular components and zero for the **shear**.

principle of combined action. *Noun.* The hypothesis that improved properties can be achieved by the engineered combination of two or more distinct materials.

principal moment of inertia. *Noun.* The moment of inertia of an area about either **principal axis**.

principal section. *Noun.* A plane passing through the **optic axis** of a **birefringent crystal** and normal to a crystal surface.

principal stress. *Noun.* The maximum or minimum value of the perpendicular stress at a point in a plane considered for all possible orientations of that plane.

principle of combined action. *Noun.* A proposition that new and better properties or better property combinations can be obtained from the thoughtful combination of two or more distinct materials. This is inevitably the case in composite manufacture and use.

printed circuit. *Noun.* A circuit for electronic apparatus consisting of a deposit of conducting material on an insulating surface in a prescribed pattern.

printed circuit board. *Noun.* Copper-clad laminate where the copper provides point-to-point electrical connections and such materials as glass fibre in the laminate provide strength.

printer's bit. *Noun.* A refractory spacer used in the setting of ware in a **decorating kiln**.

printing ink. *Noun.* A mixture of ceramic pigment and liquid medium used in the decoration of ware.

printing, silk-screen. *Noun.* See **silk-screen printing**.

printing transfer. *Verb.* To mark or decorate ware by means of **decals** made from engravings or **lithographs**. Also called **transfer printing**.

prism. *Noun.* (1) A crystal consisting of three or more faces parallel to the vertical axis. (2) A transparent polygonal solid with triangular ends and rectangular sides, used to disperse light into a spectrum or for deviating light as in a periscope.

prismatic. *Adjective.* (1) Another word for orthorhombic in crystallography. (2) Exhibiting bright spectral colours.

prismatic glass. *Noun.* A **translucent glass** consisting of parallel prisms that produce an **iridescent**, sometimes multicoloured, appearance.

prismatic habit. *Adjective.* A crystal shape that is significantly longer in one direction than the other two; **amphiboles**, **asbestos**, and **pyroxenes** are examples. Other names are: **acicular**, **columnar**, **bladed**, and **fibrous**.

probability. *Noun.* The occurrence or state of being probable; the relative frequency of the occurrence of an event based on the ratio between its occurrence and the total average number of cases necessary to ensure its occurrence.

probe coil. *Noun.* A small coil or coil assembly used in electromagnetic testing that is placed near or on the inside of a test specimen.

process. *Plural noun.* A series of operations directed toward a particular end result, such as a manufacturing process or a forming process.

process control. *Noun.* The manipulation of manufacturing conditions to obtain an end product of desired or specified quality.

process, dry. *Noun.* See **dry-process enamelling**.

process, fishscale. *Noun.* See **fishscale process**.

process function. *Noun.* A quantity or parameter whose value depends not only on the initial and final states of a system undergoing change, but also on the **process route** taken.

processing. *Verb.* In the **electroceramics** industry it is the preparation of a new material with desired properties on a laboratory or industrial scale.

process route. *Noun.* The path taken by a reaction as it occurs.

process time. *Noun.* See **residence time**.

process, wet. *Noun.* See **wet process**.

Proctor drier. *Noun.* A type of tunnel drier in which heat for drying is obtained by circulating air over pipes containing steam or waste heat.

producer gas. *Noun.* The gas produced by burning a solid fuel with a restricted supply of air or by passing air and steam through an incandescent fuel under conditions to convert carbon dioxide to carbon monoxide.

production control. *Noun.* The planning, scheduling, routing, dispatching, and expediting of the flow of materials in an orderly and efficient manner through a manufacturing operation.

proeutectoid cementite. *Noun.* Primary **cementite** that exists in addition to **pearlite** in hypereutectoid steel.

proeutectoid ferrite. *Noun.* Primary **ferrite** that exists in addition to **pearlite** in hypereutectoid steel.

- profile.** *Noun.* Surface contour of a substrate surface in relation to the cross section of the substrate.
- profile depth.** *Noun.* Average distance between valley bottoms and peak tops on a surface.
- profilometer.** *Noun.* An instrument, designed to measure the surface roughness of a flat solid, consisting of a needle drawn across the surface, irregularities being recorded by an appropriate instrument.
- projected area.** *Noun.* Area of a part or an **indent** that is projected onto a plane at right angles.
- projector.** *Noun.* A reflective metal housing containing an infrared emitter; the reflector is shaped to project a beam of radiant energy to a target area.
- promethium doped glass laser.** *Noun.* See **lead indium pyrophosphate**.
- promoter.** *Noun.* A chemical additive that greatly enhances the activity of a catalyst.
- proof.** *Noun.* A sample of molten glass obtained for inspection by means of an iron rod stirred in the molten bath.
- proof load.** *Noun.* A selected load, usually a multiple of the service load, to which a specimen or structure is subjected before acceptance.
- proof stress.** *Noun.* (1) A selected stress applied to a part, which indicates its ability to withstand service loadings. (2) The stress that produces a permanent small set in a specimen.
- proof test.** *Noun.* A specified test that a material or component must pass to show its suitability for an intended purpose.
- prop.** *Noun.* Refractory support on which shelves are arranged for the setting of ware to be fired.
- propellant.** *Noun.* (1) A material, such as the fuel in a rocket, that causes propulsion. (2) The gas used to carry liquid droplets in an aerosol spray.
- propeller mixer.** *Noun.* A rotating shaft to which blades are attached which is used for mixing low-viscosity dispersions and maintaining a well-distributed suspension.
- properties, mechanical.** *Noun.* See **mechanical properties**.
- property.** *Noun.* A characteristic behaviour of a material expressed as the measured response to a specified stimulus.
- proportional limit.** *Noun.* The greatest stress a material can sustain before **Hooke's law** ceases to apply, i.e., the stress at onset of curvature of a stress-strain curve.
- proppant.** *Plural noun.* Any hard, high strength material produced in a bead shape, with a narrow particle size range, used to keep rock fractures apart at the foot of an oil or gas well to increase the flow from the well.
- proprietary.** *Adjective.* An article or process, which belongs to, and is controlled by, the holder who may issue licenses to other manufacturers, etc.
- propylite.** *Noun.* An altered rock of the **andesite** category containing **calcite**, **chlorite** etc. produced by the action of hot springs.
- protium.** *Noun.* The most common isotope of hydrogen having a mass of 1.0.
- proto-.** *Combining form.* Indicating the first of a series or the parent of a chemical compound or element.
- protoenstatite.** *Noun.* The high-temperature polymorph of **enstatite**, MgSiO_3 . It transforms **martensitically** to **clinoenstatite** on cooling a metastable glassy phase.
- proton.** *Noun.* A positively charged elementary particle that forms part of the nucleus of an atom. The number in the nucleus equals the **atomic number** of the element. It is a **baryon** with spin $\frac{1}{2}$, charge of 1.602176×10^{-19} C and rest mass of 1.672621×10^{-27} kg.
- proton microscope.** *Noun.* A microscope with proton optics that give high resolution and sharp contrast.
- proton number. Z.** *Noun.* Alternative name for **atomic number**.
- prototype.** *Noun.* A model built specifically to enable a complete evaluation of the product to be made.
- prototype mould.** *Noun.* A temporary mould, capable of modification, used to test designs; made from **silicone rubber**, plaster, and wood.
- protoxide.** *Noun.* That oxide of a series that has the smallest oxygen-to-metal ratio.
- proustite.** *Noun.* Ag_3AsS_3 . A red mineral consisting of hexagonal silver arsenic sulphide. Also called **ruby silver**.
- provenance.** *Noun.* Place of origin.
- provenancing.** *Verb.* Sourcing or obtaining raw materials
- proximate analysis.** *Noun.* A mineralogical analysis of a substance calculated on the basis of its chemical composition.
- proximity effect.** *Noun.* A phenomenon where metal in intimate contact with a superconductor leaks electrons into the superconductor and vice versa **Cooper pairs** leak from the superconductor into the metal. The effect can be used to drive very thin metal films into the superconducting state.
- prunt.** *Noun.* A handle or other piece fused on art-, dinner- or similar glassware following the forming operation.
- Prussian blue.** *Noun.* The most common of the iron ferricyanide blue pigments.
- Prussian red.** *Noun.* A family of red pigments made from **ferric oxide** or potassium ferrocyanide.

psammite. *Noun.* An old and somewhat rare name for **sandstone**.

PSD. *Abbreviation.* Stands for phase-sensitive detector. See **phase-sensitive detector**.

psephite. *Noun.* Any rock or mineral that has a structure consisting of large crystals or fragments embedded in a fine matrix.

pseudo-. *Combining form.* Having a close resemblance to.

pseudomorph. *Noun.* A crystal or mineral that has an uncharacteristic form as a result of assuming the shape of another crystal or mineral it has replaced.

pseudo-opaque. *Noun.* Microcrystalline aggregate of very small particle size that refracts and reflects light so that no light is transmitted.

pseudoplastic. *Adjective.* An alternative description to **shear thinning** when increased shear stress reduces the viscosity. In ceramic slurries this is often associated with cellulosic thickeners and emulsions.

pseudoplastic index. m. *Noun.* A measurement of the **flocculation** of a suspension: $m = [\log \mu_{RL20} - \log \mu_{RH10}] / [\log R_L - \log R_H]$, where R_L is low revs per min, R_H is high rpm, μ_{RL20} is the viscosity at low rpm after 20 min and μ_{RH10} is the viscosity at high rpm after 10 min.

psuedowollastonite. *Noun.* β -CaSiO₃. The high temperature form of **calcium metasilicate**. The structure contains Si₃O₅-rings.

psi. *Abbreviation.* Stands for pounds per square inch.

psilomelane. *Noun.* BaMnMn₈O₁₆(OH)₄. A black, monoclinic ore of manganese containing a mixture of MnO₂ and MnO(OH); density 4,420 kg m⁻³; hardness (Mohs) 5–6.

psf. *Abbreviation.* Stands for pounds per square foot.

PSN. *Abbreviation.* Stands for lead scandium niobate. See **lead scandium niobate**.

PST. *Abbreviation.* Standing for lead scandium tantalate. See **lead scandium tantalate**.

PSYCCO. *Acronym.* See **lead strontium copper oxide**.

PSZ. *Abbreviation.* Standing for partially stabilised zirconia. See **partially stabilised zirconia**.

PTC. *Abbreviation.* Stands for positive temperature coefficient thermistor. See **positive temperature coefficient thermistor**.

PTS. *Abbreviation.* Stands for position tagged spectrometry. See **position tagged spectrometry**.

p-type semiconductor. *Noun.* A semiconductor containing small quantities of **acceptor** impurity, that is, an element in a lower periodic group, which is able to take a few electrons away from the atoms of the semiconductor to form **holes** which then pass from atom to atom to produce an electric current.

pucalla. *Noun.* A tool used to widen the mouth of a goblet or other glass product during the forming operation.

puckering. *Adjective.* Closely spaced wrinkles on the surface of laminated composites; a form of defect.

pudding stone. *Noun.* A conglomerate rock with a difference in colour or composition between the **pebbles** and the **matrix**.

puddle. *Noun.* (1) A well worked mixture of clay and sand that is impervious to water and is used as a lining for structures conveying water. (2) A small pool of any liquid. (3) *Verb trans.* To make a clay and sand mixture into puddle.

puddling. *Noun.* A process for converting pig iron into wrought iron by mixing it with **ferric oxide** and heating it in a furnace to remove the carbon.

puffing. *Noun.* A term used to describe the volume increase that can occur in the packing coke and coal-tar pitch as an **Acheson furnace** is heated from 1,500 to 2,000 °C. It can subject **graphite ware** in the furnace to excessive stresses. Control is achieved by reducing particle size, minimising the sulphur content of the coke and by adjusting the heating rate.

pugging. *Noun.* The process of blending clays and water by manual or mechanical means to produce tractable bodies of formable consistency.

pug mill. *Noun.* A machine consisting of **auger**-like blades mounted in a trough for use in the mixing, compression, and extrusion of plastic clay bodies. It works at relatively low pressure and so does not align the clay particles and so preserves a hand made appearance of tiles etc.

pug mill, vacuum. *Noun.* See **vacuum pug mixer**.

pug mixer. *Noun.* See **pug mill**.

pulforming. *Verb.* A modification of **pultrusion** to enable articles with variable cross section to be manufactured.

pull. *Noun.* (1) The quantity of glass produced in a glass-melting tank during a designated period of time. (2) The draft in a chimney or flue.

pulled stem. *Noun.* A stem of glassware pulled from the bowl while the glass is in a plastic state.

pullout. *Noun.* A failure mechanism in fibre composites whereby applied stress causes the fibre-matrix bonds to be broken and the fibre to be drawn through the matrix as the crack passes it without fracturing it. This mechanism is a major contributor to increasing the **toughness** of fibre composites.

pullout work. *Noun.* The energy needed to remove fibre from a composite; a major contributor to **composite toughness** as shown by the equation: $P = fd (\sigma_{fu})^2 / 24 \gamma_m$, where P is the pullout work, f is the volume fraction of fibre, d is the fibre diameter, σ_{fu} is the ultimate tensile strength of the fibre, and γ_m is the **shear strength** of the matrix.

- pull strength.** *Noun.* The strength of an adhesive joint measured by pulling in a perpendicular direction to the joint plane.
- pulpstone.** *Noun.* **Sandstone** cut into wheels for use in grinding and polishing operations.
- pulse broadening.** *Noun.* A phenomenon in **fibre optics** where fibres with numerous **modes** cause the initial signal to arrive over a drawn-out time period.
- pulsed laser deposition. PLD.** *Noun.* A process used to grow thin films on substrates by laser vaporisation of a target material. A laser pulse of $1\text{--}10\text{ J cm}^{-2}$ produces a plasma **plume** able to coat a substrate.
- pulsed laser evaporation. PLE.** *Noun.* A process where the high power inherent in a pulsed **laser** removes material from a target in a vapour plating process.
- pulse-echo method.** *Noun.* An ultrasonic test for the detection of defects in which a sonic pulse is transmitted and the reflection from the opposite side is received on the same side. The reflection amplitude is a factor of porosity, defect density and shape.
- pultrusion.** *Noun.* (1) A continuous forming process whereby molten material is drawn through a process. Articles of constant cross section are produced. (2) For fibre composites the continuous fibre reinforcement is drawn through a resin, or other matrix material, impregnation bath and into a shaping die for curing and then cut to length.
- pulverise or pulverize.** *Verb trans.* Reduce to fine particles.
- pulverisation.** *Verb.* Breaking down material to a powder; another word for **comminution**.
- pulveriser or pulverizer.** *Noun.* Any machine designed to reduce solid substances to very small particle sizes.
- pulverulent.** *Adjective.* (1) Consisting of fine particles; powdery. (2) Likely to crumble.
- pumice, pumicite.** *Noun.* (1) A lightweight, porous volcanic ash of glassy texture and composition of **rhyolite**. Used as a polishing medium, as a lightweight concrete aggregate, as a sound and thermal insulator, and as a raw material in brick manufacture. (2) *Verb trans.* Rub or clean with pumice.
- pummel.** *Verb.* To work clay into a mould in hand-made tile manufacture.
- pumpcrete.** *Noun.* (1) Concrete pumped through a pipeline. (2) A machine that pumps concrete through a pipeline.
- pumping.** *Verb.* To lose concrete fines through cracks and joints of a wet pavement under heavy traffic, which creates a pumping action?
- pump, vacuum.** *Noun.* See **vacuum pump**.
- pump wave.** *Noun.* See **optical parametric oscillator**.
- punch test.** *Noun.* A test in which a glaze is fractured by means of a centre punch to determine if the fired coating is under tensile or compressive stress.
- punchware.** *Noun.* Thin, hand-blown glassware, such as tumblers.
- punt.** *Noun.* The bottom section of a glass container.
- punt code.** *Noun.* The hallmark on the bottom of a glass article.
- punt, offset.** *Noun.* See **offset punt**.
- punt, pushed.** *Noun.* See **pushed punt**.
- punty.** *Noun.* (1) An iron rod used to gather glass **gobs** for the production of **pressed ware**. (2) An iron rod to which glass is attached while being shaped and fire polished. Also known as a **pontil**.
- pup.** *Noun.* A long, refractory brick of square cross section.
- purchase order.** *Noun.* An order for the purchase or procurement of merchandise under some condition of payment.
- purchaser.** *Noun.* An individual or organisation issuing an order to purchase.
- pure clay.** *Noun.* $\text{HAl}(\text{Al},\text{Si})\text{O}_5\text{OH}$. Aluminosilicic acid. Clay consisting theoretically of 39.5 % **alumina**, 46.6 % **silica**, and 13.9 % water. In the old ceramic notation: $\text{Al}_2\text{O}_3 \cdot \text{SiO}_2 \cdot \text{H}_2\text{O}$.
- purge.** *Verb.* To sweep a furnace atmosphere of undesirable gases, usually by passing nitrogen through the chamber.
- purification.** *Noun.* A stage in the **viscose suspension spinning process** where the **rayon-ceramic-loaded** fibres are passed through the regeneration bath and slightly stretched in the process. The stretching aligns the cellulose molecules and increases the green strength of the fibre.
- purity grade.** *Noun.* The degree of purity of a substance, determined by chemical analysis.
- purity grade, ultrahigh.** *Adjective.* See **ultrahigh purity**.
- purple of Cassius.** *Noun.* A ceramic pigment composed of mixtures of tin and **gold chlorides**.
- purpling.** *Noun.* The change of **chrome-tin pink** to an off-colour during the firing operation due to an excess of **borax** and alkali and a deficiency of **lime**.
- push-bat kiln.** *Noun.* A kiln in which ware is pushed through the kiln on **bats** or refractory slabs.
- pushed-down cullet.** *Noun.* An imperfection in glassware caused by the presence of **cullet** in the **drawing zone** of a **glass-melting tank**.
- pushed punt.** *Noun.* The concave bottom of a glass article.

pusher. *Noun.* A device designed to push ware through a kiln during the firing operation.

pusher kiln. *Noun.* A kiln, usually small, in which ware, placed on a platform, is pushed manually or mechanically through the firing zone.

push-pull. *Adjective.* Consisting of two transistors operated alternately.

push schedule. *Noun.* The rate at which ware is pushed through a firing kiln.

push-up. *Noun.* The name given to a **pushed punt**.

push-pull. *Adjective.* An arrangement of two transistors in which an alternating input causes alternate transistors to operate.

putty. *Noun.* (1) A dough-like cement composed of **whiting** and linseed oil used to set glass panes in to frames and as filler for holes and cracks. (2) Any substance with a similar appearance, consistency and usage. (3) A mixture of **lime**, **sand**, or **plaster of Paris**, and water used as a finishing coat on plaster. (4) A colour ranging from greyish-yellow to brownish-grey. (5) *Verb trans.* To fix with or fill with putty.

putty, lime. *Noun.* See **lime putty**.

putty powder. *Noun.* A powder used for polishing glass-ware made from **tin oxide** or a mixture of lead oxide and tin oxide.

puzzolan. *Noun.* An alternative spelling of **pozzolan**.

PVA. *Abbreviation.* Stands for poly vinyl alcohol. See **polyvinyl alcohol**.

PVAA. *Abbreviation.* Stands for polyvinyl alcohol-co-acetate. See **polyvinyl-alcohol-co-acetate**.

p-wave. *Noun.* The component of light **polarised** in the plane of incidence when light is reflected from the surface of a **dielectric**.

pycno-. *Combining form.* It indicates thickness or density.

pycnometer. *Noun.* A small glass container of known volume used to determine the relative density of a liquid or solid, the density being calculated from the weight of the liquid in the container.

pyrargyrite. *Noun.* Ag_3SbS_3 . An important ore of silver. Hexagonal crystal system. See **ruby silver**.

Pyrex. *Trademark, noun.* A commercial brand of **borosilicate glass** used for laboratory ware because of its low thermal expansion and good durability. See **Tables A.23** and **A.24**.

pyrite. *Noun.* A cubic yellow mineral found in igneous and metamorphic rocks. A source of sulphur. Used in **amber glass** and as a filler in resin-bonded abrasives and brake linings. Density $4,900\text{--}5,200\text{ kg m}^{-3}$; hardness (Mohs) 6–6.5. See **iron sulphide**.

pyrites. *Noun.* (1) another name for **pyrite**, iron sulphide. (2) Any of several metal disulphides, as in **copper sulphide** or **copper pyrites**.

pyro-. *Abbreviation, prefix.* (1) *Abbreviation.* Standing for **tetrasodium pyrophosphate**, $\text{Na}_3\text{P}_2\text{O}_7$. (2) *Prefix.* Denoting fire, heat, or high temperature. (3) *Prefix.* Denoting a new substance obtained by heating another; for example, pyroboric acid is obtained by heating metaboric acid. (4) *Prefix.* Acid or salt between ortho and meta acids or salts.

pyroaurite. *Noun.* $\text{Mg}_6\text{Fe}_2(\text{OH})_{16}(\text{CO}_3)\cdot 4.5\text{H}_2\text{O}$. A rhombohedral **layered double hydroxide**. The hexagonal polymorph is called **sjogrenite**.

pyroborate. *Noun.* See **borates**.

Pyroceram. *Trademark, noun.* A proprietary, hard, strong, opaque, white **glass-ceramic** with a dense, crystalline structure having good thermal shock resistance and high values of flexural strength. See **Tables A.23** and **A.24**.

pyrochemical. *Adjective.* Concerned with chemical changes at high temperature.

pyrochlore. *Noun.* Compounds with the general formula $\text{A}_2\text{B}_2\text{X}_7$ or $\text{A}_2\text{B}_2\text{X}_6\text{Z}$, where A and B are cations and X and Z are anions. They have a face centred cubic crystal structure with 8 molecules per **unit cell**. There are many ways that defects in the cation and anion sub-lattices can be accommodated, for example those in the **perovskite ferroelectrics** that contain Pb on the A sites can be Pb or Z deficient, such as $\text{Pb}_{1.83}\text{Nb}_{1.71}\text{Mg}_{0.29}\text{O}_{6.39}$ known as **PNM**. Single phase pyrochlore ceramics are widely used because of their electrical, magnetic, dielectric, optical and catalytic properties. Some examples are: $\text{Bi}_2\text{Ru}_2\text{O}_7$ (**thermistor**), $\text{Cd}_2\text{Nb}_2\text{O}_7$ (**high permittivity**), $\text{Pb}(\text{Cd})\text{BiM}^{\text{VI}}\text{SbO}_7$, where M^{VI} is Ti, Zr or Sn, (**microwave dielectric**).

pyrochlore oxides. *Noun.* Ternary oxides of general composition $\text{A}_2\text{B}_2\text{O}_7$, where A is a trivalent ion and B is a smaller tetravalent ion. The unit cell can be viewed as 8 **fluorite** unit cells, each containing a single oxygen **vacancy** which makes their thermal conductivity low, about $1.1\text{--}1.7\text{ W m}^{-1}\text{ K}^{-1}$. $\text{La}_2\text{Ti}_2\text{O}_7$ is a typical example that is thermally stable up to $1,500^\circ\text{C}$.

pyrochroite. *Noun.* $\text{Mn}(\text{OH})_2$. A colourless to blue-black manganese ore with the hexagonal **brucite** structure and a pearly lustre. Density $3,250\text{ kg m}^{-3}$; hardness (Mohs) 2.5.

pyroclastic. *Adjective.* Rocks formed from solids erupted by volcanism.

pyroclastic rock. *Noun.* Rocks that consist of rock and lava pieces originally blown apart by exploding gases. Rocks formed from these fragments are called **agglomerates**.

pyroconductivity. *Noun.* The phenomenon of electrical conductivity in a solid caused by heating it.

pyroelectric. *Adjective.* Concerning charge **polarisation** produced by heat.

pyroelectric ceramics. *Plural noun.* Ceramics exhibiting the pyroelectric effect; $\text{Pb}_2\text{FeNbO}_6$ is an example. See **pyroelectric effect** and **pyroelectric crystal**.

pyroelectric coefficient, p. *Noun.* The rate of change of **polarisation** with temperature, dP/dT . In **poled ceramic ferroelectrics** the effect is greatest in the vicinity of the critical temperature, T_c .

pyroelectric crystal. *Noun.* A polarisation effect produced by heat when negative charge accumulates at one end of the crystal and positive charge at the other. **Tourmaline** is an example which when heated will attract pieces of paper. etc. to its ends.

pyroelectric crystal neutron source. *Noun.* A novel neutron source. Changing the temperature, of a **pyroelectric crystal**, such as **lithium tantalate**, changes its **polarisation**. In a vacuum this causes a surface charge to build-up to about 100 kV. When a sharp tungsten probe is used to touch the crystal face the tip can reach 25 V nm^{-1} and when a low partial pressure of deuterium is bled into the system it is ionised and can be accelerated to a target deuteride a nuclear fusion occurs releasing 2.45 MeV neutrons.

pyroelectric effect. *Noun.* Changes in remanent **polarisation** produced in crystals by a change in temperature. The phenomenon is restricted to ionic materials.

pyrogenic silica. *Noun.* Silica fume; an ultrafine particle sized form of SiO_2 made by the pyrohydrolysis process using SiCl_4 . See **silica fume**.

pyrohydrolysis. *Noun.* The decomposition of a substance by the combined action of heat and water vapour.

pyrolusite. *Noun.* $\beta\text{-MnO}_2$. A black coloured naturally occurring source of **manganese dioxide**. A tetragonal mineral; used as a purple or red colorant in glazes, glass, and porcelain-enamels and as an adherence-promoting agent for porcelain-enamels on sheet iron and steel. A strong oxidising agent used in **dry-cell** manufacture as the **cathode** material. Also called **wad**. Density 5.244 kg m^{-3} ; hardness (Mohs) 6–6.5.

pyrolyse. *Verb trans.* (1) To cause **pyrolysis**. (2) To subject a material to heat.

pyrolysis. *Noun.* Chemical decomposition caused by high temperatures.

pyrolytic coating. *Noun.* (1) A coating formed on the surface of an article by thermal decomposition of a volatile compound, such as a coating of silica by the decomposition of silicon tetrachloride. (2) *Verb.* To for a coating on a substrate by thermal decomposition of vapour.

pyrolytic graphite. *Noun.* A form of graphite of high purity having high thermal and electrical conductivity; used in high-temperature applications. It has an highly

oriented microstructure arising from the vapour deposition method of production.

pyrometer. *Noun.* An instrument used for the measurement high temperatures.

pyrometer, disappearing filament. *Noun.* See **disappearing filament pyrometer**.

pyrometer, optical. *Noun.* See **optical pyrometer**.

pyrometer, photoelectric. *Noun.* See **photoelectric pyrometer**.

pyrometers sentinel. *Noun.* See **sentinel pyrometers**.

pyrometric cone. *Noun.* Small, slender, three-sided pyramids composed of oxide mixtures that deform at known temperatures; used to indicate the thermal history of the fired ware. The degree of vitrification in a firing process is determined from these cones by observing the degree of distortion in a series of cones of different composition, which therefore deform at different temperatures. Ceramic ware compositions are then classified according to the **pyrometric cone equivalent**, which is simply a number; the higher the number the higher is the softening and **vitrification temperature**.

pyrometric cone equivalent, PCE. *Noun.* The assigned identifying number of a pyrometric cone that deforms or bends so that its tip touches the supporting plaque or base during a firing cycle to indicate the approximate temperature and thermal history of ware during the firing operation. See **pyrometric cone**.

pyrometry. *Noun.* The science of thermal measurement.

pyromorphite. *Noun.* $\text{Pb}_3\text{Cl}(\text{PO}_4)_3$. **Lead chlorophosphate** a greenish-brown mineral with a hexagonal structure.

pyrope. *Noun.* $\text{Mg}_3\text{Al}_2(\text{SiO}_4)_3$. A deep-red-purple **garnet**. Large crystals are used as gemstones.

pyrophoric. *Adjective.* The property of igniting spontaneously; usually associated with very fine particle sizes.

pyrophosphoric acid. *Noun.* $\text{H}_4\text{P}_2\text{O}_7$. A crystalline, soluble acid formed from the reaction of P_2O_5 with water.

pyrophotometer. *Noun.* An instrument to measure the light emitted from an incandescent body in order to determine its temperature.

pyrophyllite. *Noun.* $\text{Al}_2\text{Si}_4\text{O}_{10}(\text{OH})_2$. A **phyllosilicate** mineral resembling talc employed in refractories, castables, plastic and gunning mixes, insulator bodies, and tile to reduce thermal expansion and as a source of alumina; also used as a sealer in the pressure forming of synthetic diamonds at elevated temperatures. Also known as **soapstone**. Mp $1,800^\circ\text{C}$; density $2,800\text{--}2,900 \text{ kg m}^{-3}$; hardness (Mohs) 1–2.

pyroplasticity, pyroplastic deformation. *Noun.* High-temperature elasticity resulting in a permanent deformation of a body under stress.

pyroscope. *Noun.* A shaped material such as a cone, ring, bar, or pellet, which melts or softens at a definite temperature and which is placed in a kiln to serve as an indicator of temperature conditions during a firing operation.

pyrosilicate. *Noun.* Those silicates containing the discrete $[\text{Si}_2\text{O}_7]^{6-}$ anion formed from two SiO_4 tetrahedra sharing a common apex.

Pyrox. *Trademark, noun.* A commercially available form of refractory **lanthanum chromite**. Used as furnace heating elements.

pyroxene. *Noun.* $\text{AB}(\text{SiO}_3)_2$. Any group of silicate minerals containing single chains of linked SiO_4 tetrahedra in which each silicon shares two apical oxygen atoms and which can be packed together in several ways; two

types of cation, A and B, balance the $[(\text{SiO}_3)^{2-}]_n$ charge. They occur in many rocks and are formed in industrial process, e.g., **enstatite** comes from heating **serpentine**. Cleavage occurs in a direction along the chain axis.

pyroxenite. *Noun.* A coarse-grained ultra basic rock consisting entirely of **pyroxene** minerals.

pyrrhotite. *Noun.* Fe_{1-x} . A **nonstoichiometric** iron sulphide ore. It has a hexagonal structure related to **niccolite**, NiAs , but with vacancies on some of the Ni sites as well as As sites. The vacancies cause the mineral to become magnetic. It has a bronze colour; density 4,580–4,790 kg m^{-3} ; hardness (Mohs) 3.5–4.5.

PZT. *Abbreviation.* $\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$. Standing for lead zirconium titanate. See **lead zirconium titanate**.

q. *Abbreviation.* Standing for quart.

q. *Symbol.* Stands for **quintal**.

Q. *Symbol.* Used to denote: (1) heat in physics; (2) **Q-factor** in electronics.

QA. *Abbreviation.* Standing for quality assurance. See **quality assurance**.

QC. *Abbreviation.* Standing for quality control.

QD. *Abbreviation.* Stands for quantum dot. See **quantum dot**.

QED. *Abbreviation.* Stands for cavity quantum electrodynamics. See **cavity quantum electrodynamics**.

QCL. *Abbreviation.* Stands for quantum cascade laser. See **quantum cascade laser**.

Q-factor. Q. *Noun.* (1) Short for quality factor it is the ratio of energy stored in an electronic device to the energy dissipated in the device; a measure of device efficiency. (2) The heat released in a nuclear reaction; usually expressed in millions of electron volts.

q-p diagram. *Noun.* A plot of **shear stress** against **isotropic stress**; used to quantify effects present in extrusion processing.

Q-switch. *Noun.* A laser device that has the effect of a shutter moving rapidly in and out of the beam to spoil the resonator Q and prevent lasing action until a high level of stored energy is achieved.

Quacor. *Trademark, noun.* A commercially available form of glassy **amorphous carbon**, formed by pyrolysis of polyfurfuryl alcohol.

quadrant mat. *Noun.* The tension-zone circumferential reinforcement secured to a cage in a concrete-pipe wall.

quadripole. *Noun.* An electric circuit with two input and two output terminals.

quadrupole. *Noun.* A system composed of four equal electric charges or magnetic poles each separated by a short distance. The four electrical charges or the poles are arranged in such a way that leads to neither net charge nor net dipole moment. The electric potential due to a quadrupole falls off with distance as $1/r^6$.

quadrupole spectrometer. *Noun.* An analytical instrument that separates ions in terms of their masses as they pass along the line of symmetry between four parallel cylindrical rods which produce a variable magnetic field.

quaich. *Noun.* A small shallow drinking cup with two handles.

qualification. *Noun.* A product is qualified in order to achieve this state for a give standard.

qualification test. *Noun.* A test or series of tests designed to evaluate the functional, environmental, reliability performance, and other pertinent properties or characteristics of a material, component, or system to assure the producer, supplier, and consumer that the item or product will meet stated performance targets.

qualitative. *Adjective.* Making distinctions between samples based on qualities rather than numerical values of properties.

qualitative analysis. *Noun.* An analysis in which some or all of the components of a sample are identified but not quantified.

quality. *Noun.* (1) The nature of a material or product. (2) Degree or standard of excellence. (3) Fit for intended use; the definition used by the Quality Assurance community.

quality assurance. *Noun.* Activities undertaken by a manufacturer or supplier to assure a customer that a product is acceptable in all respects.

quality circle. *Noun.* A regular meeting of management and shop floor workers to discuss production problems and to explore solutions to technical and managerial problems.

quality control. *Noun.* Activities undertaken by a manufacturer or supplier to achieve the properties and quality specified.

quality-control chart. *Noun.* A graphic representation of data to indicate the properties or quality of a product in the course of manufacture in order to maintain or adjudicate procedures of production to meet prescribed specifications.

quality-control tests. *Plural noun.* Tests performed to verify and maintain a desired level of quality in a product or process.

quality factor. *Noun.* $1/\tan \delta$; reciprocal of the **dissipation factor**; δ is the **loss angle**.

quality verification tests. *Plural noun.* Tests performed to maintain a desired level of quality in a product or process.

quantal. *Adjective.* (1) Of or relating to a quantum or an entity that is quantised. (2) Denoting something that is capable of existing in only one of two states.

quantise or quantize. *Verb trans.* (1) To restrict something to a set of fixed values. (2) To subdivide energy into **quanta**.

quantitative analysis. *Noun.* Analyses in which the relative amounts of some or all of the components of a sample are determined.

quantitative microscopy. *Noun.* The application of statistical procedures to **micrographs** of polished sections of samples in order to determine features, such as average grain size, pore volume, phase distribution, etc.

quantity. *Noun.* (1) Concerned with or related to the amount or number, as opposed to the nature, of a sample. (2) A specified amount in prescribed units. (3) The product of a number and a unit.

quantometer. *Noun.* A spectrometer for measuring the percentage of different metals present in a sample.

quantum. *Noun.* The smallest discrete quantity of some physical property, such as energy, that a system can possess according to the quantum theory. Plural **quanta**.

quantum cascade laser. QCL. *Noun.* A laser formed from layers of **ceramic semiconductors**. The emitted wavelength depends on the thickness of the layers rather than the **band gap**. Electrons cascade down a set of energy drops emitting radiation in the mid- to far-infrared range.

quantum confinement. *Noun.* See **quantum dot**.

quantum dot. *Noun.* A semiconductor nanoparticle with spectral characteristics or nanocrystalline conductors, such as **titania**, **ITO** etc. They range in size from 2 to 10 nm and at this size behave differently from their bulk equivalents. Their small size gives them unique electrical and optical properties, which can be tuned to

desirable values by simply altering the particle size. It is a three dimensionally quantum confined microstructure, such as that obtained when **gallium arsenide**, GaAs, is deposited in pores <6.0 nm in size, in a **phase-separated glass**, by **CVD** methods. Blue shifts in the optical spectrum occur as a result of the **quantum confinement**. By controlling the size of the confining potential on the semiconductor chip a single electron can be allowed on or off the device. If the confinement is in two dimensions the device is a **quantum wire** and a one dimensional confinement produces a **quantum well**. See **cavity quantum electrodynamics**.

quantum dot, cadmium-free. *Noun.* See **cadmium-free quantum dot**.

quantum electrodynamics. *Noun.* The application of **quantum mechanics** to particles having electrical charge and electromagnetic radiation.

quantum jump. *Noun.* See **quantum leap**.

quantum leap. *Noun.* The abrupt change in the state of an electron or atom from one allowed value to another with emission or absorption of energy.

quantum mechanics. *Plural noun.* A branch of mechanics used to interpret the behaviour of elementary particles that do not obey Newtonian mechanics. Devised to work within the constraints of the **quantum theory** wherein the systems studied have only discrete values of energy, separated by forbidden regions.

quantum mechanical. *Adjective.* Of or concerned with systems conforming to the rules of **quantum mechanics**.

quantum number. *Noun.* One of a set of integers, n , l , or m , or half integers, s , that define the value of properties, mainly energy, of a particle or system and so define the state of the particle or system. The three quantum numbers, n , l , and m specify the size, shape and orientation of an electron's probability density.

quantum sieve. *Noun.* A system using the quantum behaviour of hydrogen gas where molecules with high zero point energies are unable to adsorb into narrow pores at ceramic surfaces.

quantum theory. *Noun.* A system based on Planck's idea that certain properties of a system, such as energy, can only be possessed in discrete amounts, i.e., in **quanta**.

quantum well structures. *Noun.* Very thin, about 4 nm, **epitaxial** layers of **semiconductors** on single crystal substrates, for example $\text{Ga}_{1-x}\text{Al}_x\text{As}$ on GaAs. Quantum effects become important as the electrons become confined. This results in the **conduction band** and **valence band** being quantised into sub-bands or quantum wells. See **quantum dot**.

quantum wire. *Noun.* See **quantum dot**.

quarl block. *Noun.* A refractory shape employed as a burner segment for the injection of gaseous or liquid fuel into a glass-melting tank.

quarry. *Noun.* An excavation in the earth from which building stone, limestone, slate, coal, sand, clay, gravel, or other mineral is removed.

quarryman. *Noun.* A person who works in a quarry.

quarry tile. *Noun.* An unglazed tile, usually 39 cm² or more in top surface area, and 13–19 mm thick. Made by extruding natural clays or **shales**; highly resistant to abrasion and corrosion and therefore used as flooring.

quarter. *Verb trans.* To divide a sample of a material, such as an aggregate, into four equal parts to reduce the sample size to one suitable for analysis.

quarter-wave plate. *Noun.* The simplest device for producing, or detecting circularly polarised light. It consists of thin **mica** or **quartz** sheets cut parallel to the **optic axis**. The plate thickness, d , must be such as to produce a 90° phase change, δ , between the ordinary and extraordinary vibrations; d is given by: $d = \lambda \delta / 2\pi(n_o - n_e)$, where λ is the wavelength of the light, n_o and n_e are the sodium yellow line refractive indices of the ordinary and the **extraordinary rays**. When the quarter wave plate is oriented at 45° to the plane of the incident polarised light the emerging light is circularly polarised. See **circular polarisation**.

quarter wave stack. *Noun.* A pack of thin films of alternating high and low **refractive index**, each with a thickness of $\lambda/4$, deposited on to a substrate. Reflectivity of such a stack is: $R = [n_s - (n_L/n_H)^{2N}/n_s + (n_L/n_H)^{2N}]^2$, where n_s , n_L , and n_H are the refractive indices of the substrate, the low value material and high value material respectively, N is the number of layers in the pack. As N increases R approaches 1.0 rapidly, which means perfect reflectivity?

quartz. *Noun.* SiO₂. A naturally occurring crystal appearing in many forms and varieties, such as **agate**, **chaledony**, **chert**, **flint**, **opal**, etc.; it is the most abundant and widespread of minerals. Used extensively as a glass former and as a vitrification aid in ceramic compositions. Mp 1,710 °C; density 2,650 kg m⁻³; hardness (Mohs) 7.

quartz, alpha. *Noun.* See **alpha phase**.

quartz, beta. *Noun.* See **beta phase**.

quartz crystal. *Noun.* A natural or artificial crystal of SiO₂ having **piezoelectric** properties

quartz-crystal filter. *Noun.* An electronic filter in which a quartz crystal is the essential component being cut and ground to a particular size so that it vibrates at a particular frequency.

quartz-crystal resonator. *Noun.* A quartz plate having a natural vibration frequency such that it may be employed to control the frequency of an oscillator.

quartz fibres. *Noun.* Fibres made from high-purity, >99.95 %, SiO₂ in the quartz and not silica modification. They are stronger and have greater high-temperature strength than **silica fibres**.

quartz, fused. *Noun.* See **fused quartz**.

quartz glass. *Noun.* (1) Transparent or translucent vitreous silica made by the fusion of **vein quartz** or **silica sand**. Also known as **fused quartz**. (2) A glass made by the flame hydrolysis of silicon tetrachloride, SiCl₄. Also known as **silica glass**. Both types are characterised by their high melting point, excellent thermal shock resistance, transparency to uv-light, and chemical inertness. Used in high temperature equipment and devices.

quartz inversion. *Noun.* The phase change on heating which occurs at 573 °C in SiO₂ as the tilt on the structural tetrahedra is changed, this is the alpha-to-beta conversion, which is reversible on cooling.

quartz iodine lamp. *Noun.* A bright source of light consisting of a quartz envelope containing an inert gas plus iodine vapour and a tungsten filament. Also called quartz lamp.

quartzite. *Noun.* A very hard metamorphic or sedimentary rock consisting almost entirely of **quartz** grains bonded by **silica**, and usually formed by the metamorphism of **sandstone**; used as a refractory, particularly in **salt-glazing** kilns.

quartz sand. *Noun.* Sand extracted with **china clay**, usually about seven parts sand to one part clay; used to make **calcium silicate brick** and in several civil engineering applications.

quartz, synthetic. *Noun.* See **synthetic quartz**.

quartz, vein. *Noun.* See **vein quartz**.

quasistatic crack propagation resistance parameter.

R_{st}. *Noun.* An experimentally determined **thermal resistance parameter** evaluated from the equation: $R_{st} = [\gamma_{wof} / \alpha^2 E]^{1/2}$, where γ_{wof} is the work of fracture **surface energy**, α is the **linear thermal expansion coefficient** and E is **Young's modulus**.

qubit. *Noun, abbreviation.* Standing for a quantum bit, which is a unit of quantum information. A fundamental building block for a quantum information processor. It is a pair of well-characterised **quantum states** that can be manipulated quickly compared to the time it takes them to decohere by coupling to their environment. Practically they are made by binding electrons to a shallow donor, for example Si or S atoms in a **gallium arsenide**, GaAs, **semiconductor**.

quebracho extract. *Noun.* A tannin-rich material extracted from the quebracho tree used as a **deflocculant** in dressing muds, ore flotation, and ceramic **slips**.

QED. *Abbreviation.* Stands for quantum electrodynamics. See **cavity quantum electrodynamics**.

queen closer. *Noun.* A cut brick having a nominal 50.8 mm horizontal face dimension; used to close courses and spaces less than normal depth in construction.

Queen's ware. *Noun.* A type of white or cream coloured earthenware with a brilliant glaze; developed by Wedgwood in England from 1759 to 1765 in honour of Queen Charlotte.

quench aging. *Verb.* Induced aging produced by rapid cooling from a prolonged heat treatment.

quench crack. *Noun.* A crack formed as a result of high thermal stresses occurring on rapid cooling.

quenching. *Verb trans.* (1) The rapid chilling of molten porcelain-enamel or other glassy material in water, causing it to shatter into small, friable particles or flakes called **frit**. More commonly known as **fritting**. (2) In superconductors it is the restoring of resistance to the conductor by large magnetic fields and the subsequent appearance of heat causes resistance to spread outwards from the first quench volume. (3) The effect that a crystal structure has on the **magnetic moment** of an atom. **Orbitals** are fixed in the crystal structure and cannot change orientation when a magnetic field is applied. In the **lanthanides** because the 4-f orbitals are well shielded this is not observed and so magnets containing these elements have large **magnetisation** values.

quenching of fluorescence. *Verb.* The extinction of **fluorescence** by methods other than the removal of the exciting radiation.

quenching, spray. *Noun.* See **spray quenching**.

quern. *Noun.* Hand-driven mill consisting of a volcanic stone turning in a **mortar**.

quicklime. *Noun.* A calcined material, the major part of which is **calcium oxide**, CaO, or CaO in association with amounts of **magnesium oxide**, MgO. May be slaked with water. Used in mortars, plasters, and as a refractory ingredient in other ceramic products. Mp 2,570 °C; density 3,400 kg m⁻³.

quickset process. *Noun.* A process developed for ceramic **injection moulding**. It uses a solvent-based binder in which the organic binder additives are only 5-wt% and cold injection moulding of the powder slurry is followed by a freezing stage to enable the shape to be removed from the mould. Freeze-drying is then used to remove the solvent and carefully controlled heating only leaves small amounts of residue in the green state before the sintering fire.

quill. *Noun.* A removable **arbor** or spindle; a hollow shaft frequently surrounded by another shaft; employed in mechanical rotating devices.

quintal, q. *Noun.* A unit of weight that can be 100 lb, or 100 kg.

quoin. *Noun.* (1) An external corner of a masonry wall. (2) A wedge-shaped piece employed as the **keystone** in an **arch** or **vault**.

quotient. *Noun.* The result of the division of one number or quantity by another.

Q-value. *Noun.* A synonym for nuclear-disintegration energy, usually expressed in millions of **electron volts** for each individual reaction. Also called **Q-factor**.

R. *Symbol.* Standing for: (1) a chemical radical; (2) **Réamur scale**; (3) electrical resistance; (4) **röntgen**; (5) **universal gas constant**.

R or r. *Abbreviation.* Standing for: (1) radius; (2) registered trademark.

Ra. *Symbol.* For the element radium.

rack-and-pinion. *Noun.* A device in which a gearwheel (the pinion) engages with a flat toothed bar (the rack) in order to convert rotary into linear motion.

rack car. *Noun.* A car containing racks on which ware is placed without stacking for movement through the drier.

rack, comb. *Noun.* See **comb rack**.

rack, hanging. *Noun.* See **hanging rack**.

rack mark. *Noun.* An imperfection on the surface of glass due to malfunction of the rolling mechanism.

rad. *Noun.* (1) A unit used to quantify the energy absorbed from ionising radiation by tissue equal to 10^{-2} J kg⁻¹ of tissue. (2) Abbreviation for **radian**.

raddle. *Noun.* (1) An interweave. (2) **Red ochre** and an alternative spelling of **reddle** and **ruddle**. (3) *Verb trans.* To cover something with red ochre.

radial. *Adjective.* Emanating from a common central point.

radial brick. *Noun.* A brick with each end curved for use in concentric, cylindrical, or circular construction.

radial marks. *Plural Noun.* Lines present on a fracture surface that radiate from the origin of fracture.

radial pressure coefficient. k. *Noun.* When a powder is uniaxially compacted by a punch pressure, σ_z , some of the pressure, σ_r , is transmitted to the container side-walls; $k = \sigma_r / \sigma_z$ and describes the powder fluidity; if $k = 1$ the powder behaves like a fluid and uniaxial compaction will be equivalent to isostatic compaction.

radian. rad. *Noun.* The unit of plane angle; the angle between two radii of a circle that cut off on the circumference an arc equal in length to the radius. 1 rad = 57.296°.

radiance. L_e. *Noun.* The radiant intensity in a given direction of a small element of surface area divided by the orthogonal projection of the area onto a plane at right angles to the direction.

radiant. *Adjective.* Sending out rays of light or other radiation.

radiant efficiency. *Noun.* The ratio of the power emitted by a source of radiation to the power consumed by it.

radiant energy. Q_e. *Noun.* Energy emitted or propagated in the form of particles or electromagnetic radiation; measured in joules.

radiant exitance. M_e. *Noun.* The radiant flux emitted per unit area at a given point on a surface.

radiant flux. Φ_e. *Noun.* The rate of flow of energy as radiation; measured in watts.

radiant heat. *Noun.* Heat transferred as electromagnetic radiation rather than conduction or convection.

radiant heating. *Noun.* A system of heating a space by radiant heat emitted from panels.

radiant intensity. I_e. *Noun.* The radiant flux per unit solid angle leaving a point source.

radiant-tube furnace. *Noun.* A porcelain-enamelling furnace heated by radiant tubes, in which the fuel is burnt within the tubes and does not enter the firing chamber.

radiate. *Verb.* To emit heat, light or some other form of radiation

radiation. *Noun.* (1) The transmission of energy, such as light, heat, x-rays, etc., through space without the presence or movement of matter in or through the space. (2) The particles and rays emitted in nuclear decay.

radiation damage. *Noun.* Changes in the properties of a material induced by radiation-caused changes to the electronic or crystalline structure. Optical and mechanical properties are particularly affected in a way dependent on the acceleration potential, the type of radiation and whether the material is glassy or crystalline.

radiationless transition. *Noun.* The way an excited ion in a crystal loses energy by interaction with the lattice vibrations, **phonons**, so that the crystal heats up but no photons in the visible region are emitted.

radiator. *Noun.* (1) The part of an aerial or transmission line that radiates electromagnetic waves. (2) An electric space heater. (3) A device for heating a room consisting of a series of pipes through which water or gas passes.

radical. *Noun.* A chemical species possessing one or more unpaired electrons and commonly two or more atoms, e.g. carbonate ion, $(\text{CO}_3)^{2-}$.

radioactive blasting halos. *Noun.* The radial fracture pattern found in **quartz** as a consequence of lattice breakdown under the influence of α -particles from **uraninite** trapped in hydrocarbon polymers onto which the quartz has crystallised.

radioactive dating. *Noun.* See **radiometric dating**.

radioactive decay. *Noun.* Spontaneous nuclear disintegration when one or more nuclei are formed and particles and gamma rays are emitted.

radioactive waste. *Noun.* Any waste material containing radionuclides. Also called **nuclear waste**.

radioactivity. *Noun.* The spontaneous emission of radiation from atomic nuclei. It can consist of α -, β -, γ -radiation.

radiocarbon. *Noun.* ^{14}C . A radioactive isotope of carbon.

radioelement. *Noun.* A naturally radioactive element.

radiofrequency. *Noun.* A band of frequencies lying in the range 10 kHz to 300 GHz.

radiofrequency heating. *Noun.* Heating a dielectric substance by means of alternating, induced high-frequency currents, from 3 to 300 MHz. Also called **dielectric heating**, **induction heating** and **RF heating**.

radiograph. *Noun.* A shadow image produced on a photographic film or plate by uneven absorption of radiation, such as x rays, transmitted through the sample.

radiographic testing. *Noun.* A non-destructive procedure for the detection of defects in components by studying their transmission properties of incident radiation relative to the transmission characteristics of the non-defective material.

radioisotope. *Noun.* An isotope that is radioactive.

radiolucent. *Adjective.* Almost transparent to electromagnetic radiation.

radioluminescence. *Noun.* **Luminescence** from a radioactive material that is induced by radiation.

radiolysis. *Noun.* Radiation induced chemical decomposition.

radiometer. *Noun.* Any instrument for the detection or measurement of radiant energy.

radiometric dating. *Noun.* Methods of dating objects based on the decay of its constituent radioactive atoms, such as potassium-argon dating. Also called **radioactive dating**.

radiotoxic. *Adjective.* Of or denoting the toxic effects of radiation or radioactive substances.

radius of gyration. k or r. *Noun.* The radial distance from a given axis at which the mass of a body could be concentrated without altering the rotational inertia of the body about the axis. In a system of mass m and moment of inertia I , $k^2 = I/m$.

radome. *Noun.* A strong, thin, domelike protective covering for radar antennae frequently made from a ceramic dielectric material transparent to radio-frequency radiation.

radon. *Noun.* Symbol Rn. A colourless, radioactive gas that is a member of the inert gas group. Used as a source of α -particles; density 9.73 kg m^{-3} ; half life of ^{222}Rn is 3.82 days.

radwaste. *Compound word.* It signifies waste materials generated by **reactors** fuelled by uranium and uranium ceramics.

raffinate. *Noun.* The aqueous liquid left after a solute has been removed by solvent extraction.

raft. *Noun.* A thick slab of reinforced concrete laid over soft ground to be the foundation for a building.

rag or ragg. *Noun.* (1) See **ragstone**. (2) A roofing slate that is rough on one side.

raggle. *Noun.* A thin groove cut in brickwork or stone.

ragstone. *Noun.* A hard **sandstone** or **limestone** used for building. Also called **rag** or **ragg**.

rail gun. *Noun.* See **coil/rail gun**.

rainbow. *Acronym.* Stands for reduced and internally biased wafer. See **rainbow ceramic**.

rainbow ceramic. *Noun.* A form of monolithic ceramic bender able to achieve very large axial displacements, $> 1,000 \mu\text{m}$. **PZT**, **PLZT**, **PSZT** and **PMN** wafers are chemically reduced at high temperature on one face by contact with **graphite**. This produces a stress-biased dome-like structure. The unreduced dome top is in compression as a result of the tension at the reduced-unreduced interface and this leads to high electromechanical displacement.

rainbow quartz. *Noun.* Another name for iris. See **iris**.

raised gold. *Noun.* Embossing gold by over-printing on fired flux or ceramic colour.

rake. *Noun.* (1) A scratch on the surface of glass caused by particles of **cullet** trapped in the polishing felt. (2) The measure of inclination from a line or plane.

raku. *Noun.* A type of thick, coarse-textured pottery ware covered with a soft **lead borosilicate** glaze.

ram. *Noun.* That part of a moulding press that enters the mould cavity.

Raman band. *Noun.* The wavenumber shift, $\Delta\nu$, from $\nu_o \pm \nu_m$. See **Raman effect**.

Raman effect. *Noun.* Scattering of radiation, usually monochromatic light, with a change in wavelength of the scattered radiation. Raman radiation has very low intensity and so requires special equipment for its detection and measurement. Since wavelength shifts can be related to structural features it is used in structural determinations. Scattered radiation with peaks at increased wavenumbers, $\nu_o + \nu_m$ are called Stokes bands, and those with smaller wavenumber, $\nu_o - \nu_m$ are anti-Stokes bands.

RAMAR. *Acronym.* Standing for the rapid melting and refining modular glass melting procedure. Developed as an all-electric process with physical separation of the three stages in the classic glass making process in order to prevent convection return. See **modular glass melting**.

RAM chip. *Noun.* An integrated circuit that provides random access memory for a digital system such as a computer.

ramekin. *Noun.* A small fireproof baking dish usually made from ceramic materials.

ram force. *Noun.* The total load applied by a ram; expressed as the line pressure multiplied by the cross-sectional area of the ram.

rammelsbergite. *Noun.* NiAs_2 . An orthorhombic mineral white with red tinges and metallic lustre; density $7,100 \text{ kg m}^{-3}$; hardness (Mohs) 5.5–6.

ramming. *Verb.* (1) The process of forcing or driving bodies into place, such as by means of a pneumatic device. (2) To form monolithic furnace linings and shapes.

ramming mix. *Noun.* A mixture of water-tempered refractory materials suitable for **ramming** into place to form monolithic furnace linings.

ramming mix, pitch or tar bearing. *Noun.* See **tar-bearing basic ramming mix**.

ramp. *Noun.* A manufacturer's sign moulded into the side or bottom of a glass bottle or jar.

ram pressing. *Verb.* A process of forming ware in plaster moulds in which water removal is expedited by the

application of a vacuum; ware is released from the mould by applying air pressure through the porous structure of the mould.

ramsdellite. *Noun.* $\gamma\text{-MnO}_2$. A rhombic polymorph of **manganese dioxide**.

Ramsdell notation. *Noun.* A way of denoting the different SiC polytypes, e.g., 2H, 4H, 15R, 24R, etc. The number refers to the number of layers in the unit cell and the letter denotes hexagonal, H, or rhombohedral, R, symmetry.

ram seal. *Noun.* A seal in which a metal sleeve is forced to form a thin circumferential line of contact over the sharp edge of a ceramic shape, and then is completed by bracing or plating a metal over the joint.

rance. *Noun.* A type of red-coloured **marble** with blue and white graining; found in Belgium.

ranch-type roofing. *Noun.* A rectangular asbestos-cement roofing panel that is lapped at the top and one side.

random cracking. *Noun.* Cracks formed on the surface of concrete in a random pattern due to surface shrinkage or internal expansion.

random error. *Noun.* Deviations found in any measured value resulting from averaging operations applied to the data set.

random rubble. *Noun.* Masonry in which undressed stones are set without courses.

random sampling. *Verb.* Sampling without bias toward any combination of considerations.

random spinel. *Noun.* A ceramic with the spinel structure and composition, AB_2O_4 , but with one-half the tetrahedral cations occupying the octahedral sites and one-quarter of the B cations occupying the tetrahedral sites to generate the formula: $(\text{A}_{0.5}\text{B}_{0.5})[\text{A}_{0.5}\text{B}_{1.5}]\text{O}_4$.

rank, coal. *Noun.* See **coal rank**.

Rankine temperature scale. $^{\circ}\text{R}$. *Noun.* A scale of absolute temperature based on Fahrenheit degrees in which a degree Rankine is equal to $^{\circ}\text{F} + 459.67$ that is $5/9 \text{ K}$.

ranking. *Noun.* Method of presenting material property values in definitive order reflecting their importance.

rapid expansion of supercritical solution method. RESS.

Noun. A way of producing amorphous, ultrafine powders. The hot solution is heated to the supercritical condition by adjusting pressure and temperature, after which it is rapidly expanded through a nozzle in to a low-pressure and -temperature chamber where the dissolved solid precipitates very rapidly as an ultrafine, narrow-size-distribution, powder.

rapid manufacturing. *Noun.* Manufacturing using rapid prototyping and rapid tooling. See **rapid prototyping** and **rapid tooling**.

rapid omnidirectional compaction. ROC. *Noun.*

A process also known as **isostatic forging** which involves surrounding a ceramic form, about 66 % dense, with **glass cullet**, preheating, and subjecting to high pressure, about 850 MN m⁻², and then separating the glass. Full densification is achieved in about 10 s.

rapid prototyping. RP. *Noun.* A method for converting a CAD drawing into a three-dimensional artefact that works by slicing the computer model into a sequence of cross-sections. The cross-sections are then built-up, layer-by-layer to form the finished object. It has the aim of checking models for appearance and design. Also called **solid free form fabrication**.

rapid thermal beam processing. RTP. *Plural noun.* Methods developed to reduce the thermal input to integrated circuits of micron and submicron dimensions in order to minimise diffusion and interfacial reactions by using area-focused electron, ion, and laser beams.

rapid thermal processing. RTA. *Noun.* A technique whereby **chips** and semiconductor devices are heated and cooled very quickly to limit **dopant** diffusion; **laser** and **plasma heating** are usually employed.

rapid tooling. RT. *Noun.* Using a prototype as a tooling pattern to produce a mould.

rare earth. *Noun.* Any oxide of a **lanthanide element**. See **rare earths**.

rare earth iron boride magnets. *Plural Noun.* R₂Fe₁₄B, where R is one of the lanthanide elements. High-coercivity materials with hexagonal or rhombohedral crystal structures.

rare earth iron carbides. *Plural noun.* R₂Fe₁₄C and R₂Fe₁₇C. A series of high-coercivity materials with hexagonal or rhombohedral structures. In the 2:14 family the carbon occupies the same site as the lanthanide, R, atoms and so induces site anisotropy; in the 2:17 materials the carbon occupies octahedral interstitial sites.

rare earth nickelates. *Plural noun.* R₂BaNiO₅. Sometimes called 2-1-1-5 oxides. All have a structure containing chains of Ni²⁺ ions parallel to the a-axis of the orthorhombic unit cell. In-chain interactions of the nickel spins are **antiferromagnetic** and since inter-chain coupling is negligible they are examples of 1-D Heisenberg antiferromagnets.

rare earths. *Plural noun.* Oxides of the **lanthanide elements**; lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium. Yttrium, scandium, and thorium, although not lanthanides, are closely associated. These oxides are employed in numerous ceramic applications, including colouring agents, glass decolourisers, ultra-violet absorbers, polishing compounds, cores for arc carbons, incandescent gas mantles, laser glass, electronic

components, magnetic compositions, phosphors, etc. Now essential for modern technology in **semiconductors**, **supermagnets**, energy storage, electronic display units and **superconductors**. Not actually scarce but difficult to separate and process.

rarefaction. *Noun.* The act or process of lowering the density.

Raschig rings. *Noun.* Short pipes made from **stoneware**, glass, carbon, or metal used to fill the columns of absorption and distillation towers.

rasorite. *Noun.* A sodium borate mineral used occasionally as a substitute for **borax**.

raster. *Noun.* A pattern of horizontal scanning lines traced by an electron beam.

ratchet marks. *Noun.* Visible lines on fatigue fractured surfaces resulting from the intersection of fatigue fractures propagating from multiple origins.

rate of absorption. *Noun.* (1) The weight of water absorbed by a partially immersed standard brick in one minute. (2) The weight of water absorbed by a dry ceramic specimen, in grams, divided by the weight of the dry test piece in a test of known time.

rate of flame propagation. *Noun.* The velocity of a flame front as a mixture of fuel and air is burned.

rational analysis. *Noun.* The mineral composition of a material calculated from its chemical composition.

rattler. *Noun.* (1) A cylinder filled with steel balls in which paving brick are rotated to test the impact and abrasion resistance of the brick; calculated as the percentage loss in weight of the brick. (2) See **skutterudites**.

raw batch. *Noun.* (1) A furnace-charge of glass raw materials without **cullet**. (2) A blend or batch of raw materials ready for processing.

raw cullet. *Noun.* A furnace charge of glass consisting entirely of **cullet**.

raw data. *Noun.* Data ready for evaluation.

raw edge. *Noun.* The sheared edge of a porcelain-enamelled panel not completely covered by the coating.

raw glaze. *Noun.* A glaze compounded entirely of raw materials and containing no prefused ingredients.

raw lead. *Plural noun.* A colloquial expression used to cover lead compounds, such as **lead carbonate**, **red lead**, **litharge** and **galena** that are used as **fluxes** in **frit** and **glaze** formulations.

raw material. *Noun.* The starting materials used in a processing operation.

raw refractory dolomite. *Noun.* CaMg(CO₃)₂. A natural mineral suitable for use as a refractory.

raw shape. *Noun.* A metal part ready to be put through the porcelain-enamelling process.

Rayleigh scattering. *Noun.* The effect that small particles have on wave fronts. The electromagnetic radiation is elastically deflected without a change of frequency but with a change of phase. The linear dimensions of the particles must be considerably smaller than the wavelength of the radiation. As well as being dependent on the intensity of the incident radiation and the square of the volume of the scattering particles, the intensity of the scattered radiation is dependent on the wavelength as $1/\lambda^4$.

Rayleigh wave. *Noun.* An **elastic wave** propagating in a surface layer; the particle motion is confined to a layer approximately two wavelengths thick.

Raymond concrete pile. *Noun.* A tapered metal shell driven into the ground and filled with concrete to be used as a structural base.

rayon. *Noun.* Cellulose fibres reformed by spinning a solution of cellulose xanthate in **caustic soda** through an acid bath. See **regeneration bath**.

RBM. *Abbreviation.* Standing for reinforced brick masonry. See **reinforced brickwork**.

R-curve behaviour. *Noun.* A graphical representation of an increased resistance to crack growth with increasing crack length; chiefly a feature encountered in metals but **partially stabilised zirconia** and coarse-grained **alumina**, are ceramic examples. They are **indentation fracture** resistance curves. Studies of their shape indicate the flaw tolerance of a structural ceramic by expressing **toughness** as a function of crack extension. As the toughness, k_{IC} , increases the strength becomes less dependent on flaw size.

reaction. *Noun.* (1) A chemical change where one or more materials are consumed and one or more new ones appear. (2) The equal and opposite effect generated by an applied force.

reactance. *Noun.* (1) The opposition to the flow of alternating current by the capacitance or inductance of an electrical circuit. (2) The opposition that inertia or **stiffness** has to the passage of mechanical vibration or acoustic **phonons** in a material or structure.

reaction-bonded alumina. **RBAO.** *Noun.* A fabrication method whereby aluminium metal powder is added to alumina, Al_2O_3 , powder and compacted before sintering. Volume increase, as aluminium is oxidised, compensates sinter shrinkage to give near net shapes at the expense of strength and toughness.

reaction bonding. *Noun.* A method for producing ceramic shapes in which exothermic reactions are used to lower the processing temperature. A reactive powder is pressed to shape and then heated in a reactive atmosphere; for example, a mixture of **silicon carbide**

fibres and powdered silicon pressed and heated to 1,450 °C in nitrogen gas results in **silicon nitride**, Si_3N_4 , matrix-SiC fibre composites that would otherwise have to be produced above 1,750 °C.

reaction cement. *Noun.* Cement that sets due to a condensation-type hydrolysis, polymerisation reaction.

reaction diagenesis. *Noun.* The transformation of one mineral deposit to another by means of a chemical or physical reaction, for example **ion exchange** transforms **borax** to **ulexite** and ulexite to **colemanite**.

reaction injection moulding. **RIM.** *Noun.* A fabrication method whereby two chemically reactive liquid streams are injected into a mould where they form a solid shape. Including chopped strand ceramic fibres in one of the liquid streams can extend the method and then the process is renamed **reinforced reaction injection moulding** or **RRIM**.

reaction sintering. *Noun.* Simultaneous formation of a ceramic and sintering it to shape; for example, **silicon carbide**, SiC, where a compact of silicon powder is heated in a hydrocarbon atmosphere.

reaction, surface. *Noun.* See **surface reaction**.

reactivation. *Noun.* An oxidation process to restore the adsorptive properties of **activated carbon**.

reactive aggregate. *Noun.* An aggregate that will react chemically, such as some highly siliceous minerals, with alkalis, causing the concrete to expand and crack after it has hardened. See **concrete cancer**.

reactive electrode submerged arc. **RESA.** *Noun.* A method developed to produce very fine particle sized carbides, nitrides or oxides by discharging reactive electrodes submerged in hydrocarbon, liquid ammonia or water in an **autoclave**.

reactive ion etching. *Noun.* A **lithographic** technique used to define **contacts** and **interconnects** on semiconductor **chips**.

reactive powders. *Plural noun.* Powders that give high fired density to shapes pressed from them at relatively low firing temperatures.

reactivity. *Noun.* The susceptibility of a material to chemical change or action; governed by surface area, metastability, composition, and the conditions of temperature, pressure, and atmosphere.

ready-mixed concrete. *Noun.* Concrete mixed by any means prior to delivery at a site.

read-write head. *Noun.* An electromagnet that can both read and write information onto a magnetic ceramic.

reagent blank. *Noun.* The contribution to an analytical result caused by substances in the reagents or the apparatus, as determined by carrying out the analytical procedure in the absence of the sample.

reagent resistance. *Noun.* The resistance of a composite to chemical attack. Also known as **chemical resistance**.

realgar. *Noun.* AsS. Arsenic sulphide; a soft, red to orange mineral that becomes yellow on exposure to light. Used as a pigment or source of arsenic. The yellow material is known as **orpiment**. Hardness (Mohs) 1.5–2.0; density 3,590 kg m⁻³.

ream. *Noun.* An imperfection in flat glass consisting of heterogeneous layers.

rearing. *Verb.* To set glazed ceramic flatware on edge during firing.

Réaumur scale. *Noun.* A temperature scale in which zero is the freezing point of water and the boiling point of water is 80°.

Réaumur porcelain. *Noun.* Porcelain in which a fritted or devitrified glass is the major constituent.

rebar. *Abbreviation.* Stands for a reinforcing bar embedded in concrete.

Rebinder effect. *Noun.* The change in measured **indentation hardness** value when the test is carried out on surfaces covered in water or organic solvent; minimum hardness occurs when the **pH**, or the salts in solution, causes the **zeta potential** to reach a minimum value.

reboil. *Noun.* (1) The release of dissolved gases from a glass as it is subjected to temperatures above that of the **melt section**. (2) The appearance of bubbles in glass after it appears to be bubble-free. (3) A fine boiling occurring in porcelain-enamel ground coat due to the evolution of gas in the metal or the coating during repeated firing cycles.

rebonded fused-grain refractories. *Noun.* A fired refractory brick or other shape made predominantly from sintering powder made from crushed **fused refractory** grains.

rebonded sand. *Noun.* Used moulding sand mixtures restored to usable condition by adding new bonding agent.

recalesce. *Verb intrans.* To undergo **recalescence**.

recalescence. *Noun.* A sudden spontaneous increase in the temperature of a cooling solid resulting from an exothermic change in crystal structure occurring at a particular temperature.

recessed abrasive wheel. *Noun.* A grinding wheel with a contoured central recess on one or both sides.

reciprocal. *Noun.* (1) The value of a specific quantity divided into 1. (2) A back-and-forth motion of a mechanical part.

reciprocating feeder. *Noun.* A tray at the bottom of a bin hopper, or other container that moves back and forth in a horizontal plane as it transfers material from the container to a processing unit or transport car.

reciprocating screen. *Noun.* A screen that moves back and forth in a horizontal plane; used to separate or classify solid particles.

reciprocating screw. *Noun.* A modified extrusion screw that is pushed back by the charge as it rotates. When sufficient material has gathered in front of the screw it is rapidly thrust forward into the die.

recirculating dip tank. *Noun.* A dipping tank for the application of porcelain-enamels that has a mechanical means or a pump to keep the slip in constant circulation and the solid components in uniform suspension.

recirculating fan. *Noun.* A mechanical device to move air from one location, such as a furnace, to another working area, such as a drier.

reclaim. *Noun.* See **reclaimed enamel**.

reclaimed enamel. *Noun.* Porcelain-enamel and glaze residues collected from **spray booths**, **dip tanks**, washed ware etc., and reconditioned for use. Often just called **reclaim**.

reconstructive transformation. *Noun.* Crystal structure changes that require bond breaking.

recovery. *Noun.* (1) A term denoting softening in **work-hardened** crystals that occurs at temperatures below those needed for recrystallisation. (2) The movement of **dislocations** of opposite sign in a heavily strained specimen, toward each other so as to eliminate each other. This process reduces the total **strain energy** in a crystal. Since **vacancy diffusion** is required, the process depends on the temperature. (3) The extraction of useful substances from waste.

recovery time. *Noun.* The time required for a freshly charged periodic furnace to regain its set firing temperature, that is, the temperature that is lost during the period the furnace was open for discharging and loading the ware.

recrystallise or recrystallize. *Verb.* (1) To produce strain-free grains in a matrix that has been plastically deformed. (2) To dissolve and subsequently crystallise a substance for purposes of purification.

recrystallisation, primary. *Noun.* See **primary recrystallisation**.

recrystallisation, secondary. *Noun.* See **secondary recrystallisation**.

recrystallisation temperature. *Noun.* (1) The minimum temperature at which ceramic particles bond together. (2) The temperature at which phase changes occur in the solid state.

rectangular coordinates. *Plural noun.* The Cartesian coordinates in a system of mutually perpendicular axes.

rectangular kiln. *Noun.* A periodic kiln of rectangular shape.

rectifier. *Noun.* A device that converts ac current to dc current, such as a **semiconductor diode**, that suppresses or inverts alternate half cycles.

rectifying junction. *Noun.* A semiconductor **p-n junction** that conducts a current in one direction but has a high resistance to current flow in the opposite direction.

recuperative furnace. *Noun.* A furnace having a heat exchanger in which heat is conducted from the combustion products to incoming air through flue walls or a system of ducts.

recuperator. *Noun.* A continuous heat exchanger in which heat is extracted from combustion products and supplied to incoming cool air through flue walls or a system of thin-walled ducts.

recycle. *Verb.* To recover commercially valuable materials from scrap or discarded products.

red African. *Noun.* See **breche sanguine**.

red banded agate. *Noun.* A form of **agate** with attractive red banding that is popular for **tumbling** to produce decorative stones.

red beds. *Plural noun.* Sequences of **sandstone** or **shale** coloured by oxidation of the iron they contain.

red clay. *Noun.* Any **ferruginous** clay that produces a red colour when fired; used to make bricks, roofing tile, and some types of pottery.

red copper oxide. *Noun.* Cu_2O . used in glass, glazes, porcelain-enamels, and other ceramics to develop red colours. Mp 1,210 °C; bp 1,800 °C; density 5,750–6,090 kg m^{-3} .

red coral. *Noun.* Any of several **coral** skeletons with a pink to red colour used to make ornaments. Also called **precious coral**.

reddle. *Noun.* Red ochre. See **red ochre**, **raddle** and **ruddle**.

red earth. *Noun.* (1) See **ferric oxide**. (2) A clayey soil of tropical grasslands formed by extensive chemical weathering and coloured by iron compounds.

red edge. *Noun.* Small cavities along the edges of plate glass that are filled with **rouge** during the polishing operation.

red heat. *Noun.* The temperature at which a heated body or furnace glows red; approximately 700–750 °C.

red-hot. *Adjective.* Heated to a temperature at which it glows red.

red iron oxide. *Noun.* Fe_3O_4 . A **spinel** phase used extensively in optical, electrical, and tableware glass and in glazes and porcelain-enamels as a fluxing ingredient. Decomposes between 500 and 530 °C; density 9,000–9,200 kg m^{-3} .

red lead. *Noun.* Pb_3O_4 . A brilliant red pigment prepared by converting lead to **massicot** at low temperatures,

grinding to a powder, and carefully reheating. Used in pottery glaze compositions, especially low temperature oxidation glazes and **raku** glazes. Also used in glass manufacture, varnish, paint, and printing ink. Also called **minium**, **menige** and **orange mineral**. Decomposes between 500 and 530 °C; density 8,320–9,160 kg m^{-3} . Also called **lead tetroxide**.

red lead ore. *Noun.* See **crocoite**.

red mud. *Noun.* See **Bayer red mud**.

red mercury. *Noun.* An amalgam of mercury metal and mercury antimony oxide, $\text{Hg}_2\text{Sb}_2\text{O}_7$, irradiated for 20 days in a nuclear reactor. Used to make infrared sensors more efficient but mainly used to reduce the weight of nuclear weapons by mixing it with a neutron emitter, such as 252-californium in a plutonium core to reduce the mass of Pu needed.

red ochre. *Noun.* (1) Natural red earths containing **ferric oxide**; used as pigments. (2) Colloquial name for the red pigment **ferric hydroxide**, $\text{Fe}(\text{OH})_3 \cdot n\text{H}_2\text{O}$. (3) Also called **ferrihydrite**, **raddle**, **reddle**, and **ruddle**.

redox. *Acronym.* A synonym for oxidation-reduction reactions observed in chemical systems.

redox potential. *Noun.* The potential developed when a bright platinum electrode is immersed in a solution containing ions of one substance in two different **oxidation states**, such as Fe^{2+} and Fe^{3+} . The size of the potential is proportional to the concentration of the two species and the temperature. The **standard redox potential**, E° , is that generated when the concentrations are equal and $T = 298 \text{ K}$.

red sandstone. *Noun.* See **red sandstone**.

red spinel. *Noun.* A naturally occurring **spinel** that is found as large crystals of gem quality. When cut it is very like ruby and it was once called **balas ruby**.

reducer. *Noun.* A pipe fitting connecting two pipes of different diameters.

reducer section, manhole. *Noun.* See **manhole reducer**.

reducer, water. *Noun.* See **water reducer**.

reducing agent. *Noun.* A chemical that lowers the state of oxidation of other **batch** ingredients when the temperature is raised, itself being **oxidised** in the process.

reducing atmosphere. *Noun.* A furnace atmosphere deficient in oxygen and containing a reducing gas, such as carbon monoxide, hydrogen, etc.

reducing bushing. *Noun.* A device used as a liner to reduce the size of an **arbor** hole for an axle, shaft, or spindle.

reducing flame. *Noun.* A flame deficient in oxygen resulting in incomplete combustion of the fuel, which often produces a **reducing atmosphere** in a kiln.

reducing glass. *Noun.* A lens or curved mirror that produces an image smaller than the object viewed.

reduction. *Noun.* A chemical reaction in which a species gains electrons, thereby reducing the positive valence of the species.

reduction ratio. *n. Noun.* In the **Bond and Wang crushing theory**, the initial mean particle size divided by the final mean size of the powder.

reduction zone. *Noun.* See **die zones**.

red ware. *Noun.* A type of porcelain body made of iron-bearing clay which fires to a characteristic red colour.

reeding. *Noun.* A set of small semi-circular architectural plaster mouldings.

reef ball. *Noun.* A concrete dome dotted with holes and a textured surface ranging in size from 14 to 3,600 kg dropped into the sea to form a reef for inhabitation by marine wildlife.

reel. *Noun.* Cylinders that turn on an axis and on to which fibre is wound.

reel cutter. *Noun.* A device consisting of a tightly stretched wire on a circular frame in association with a **pugging machine** so that extruded clay billets can be cut to desired lengths.

re-entrant mould. *Noun.* A mould with an undercut, which makes it difficult to withdraw the moulded part.

reeves. *Noun.* Tangled laminations causing imperfect cleavage in **mica**.

reevesite. *Noun.* $\text{Ni}_6\text{Fe}_2(\text{OH})_{16}(\text{CO}_3)_4\cdot 4\text{H}_2\text{O}$. A rhombohedral **layered double hydroxide**.

Refel process. *Trademark, noun.* A manufacturing process for **silicon carbide** shapes, first pressed from **Acheson process** SiC powder, and then molten silicon is made to penetrate the porosity. The liquid silicon reacts with impurity carbon to make secondary silicon carbide before a final heat treatment produces a dense shape by **reaction sintering**. The final body contains about 12 % unreacted silicon.

referee test. *Noun.* Analysis or measurement made by a third party asked to adjudicate.

reference coil. *Noun.* The section of a coil assembly that excites and/or detects the electromagnetic field in the reference standard in a comparative system.

reference standard. *Noun.* A specimen used as a basis for comparison or calibration.

refine. *Verb.* To separate a mixture into pure components.

refined. *Adjective.* Freed from impurities.

refiner. *Noun.* (1) The section of a **glass-melting tank** in which the molten glass becomes virtually free of bubbles and undissolved gases and conditioning for subsequent processing is completed. (2) A person, device or substance that removes impurities.

refining. *Noun.* (1) The fourth stage in **modular glass-melting** where the melt temperature is dropped by 100 °C from the **finishing stage** temperature and the **batch** is held for 2 h. (2) *Verb.* The process in which bubbles and undissolved gases and solids are removed from molten glass.

refining temperature. *Noun.* The temperature just above the melting temperature of glass at which the molten batch is sufficiently fluid to permit the escape of gaseous inclusions or to dissolve them.

re-fire. *Verb.* A second heat treatment given to a porcelain-enamelled item without complete coverage of the item with new frit; the partial coating usually is to make a repair or is an added decoration.

reflectance. **R.** *Noun.* The fraction of incident light that is reflected diffusely by a surface, measured relative to **magnesia** under standardised conditions; used as an indication of the **opacity** or covering power of a porcelain-enamel, glaze, or other coating, as well as the degree of obscuration of a glass. It is equal to the ratio of the reflected flux to the incident flux. It is the square of the **coefficient of reflection** and because the refractive index varies with wavelength R changes across the spectrum. For glass R is 3–4 %. It changes the intensity of reflected light by $I_o R$, where I_o is the initial intensity. Also called **reflection factor**.

reflectance over black backing. **R_o .** *Noun.* Reflectance of a coating applied to a substrate, the ideal reflectance of which is zero but in practice is less than 4 %.

reflection density. **D.** *Noun.* A measure of the extent to which a surface reflects electromagnetic radiation, such as light, equal to \log_{10} (reciprocal of **reflectance**). Also called **optical density**.

reflection factor. *Noun.* See **reflectance**.

reflectivity. **R.** *Adjective.* A measure of the ability of a surface to reflect radiation, equal to the **reflectance** of a layer sufficiently thick for the reflectance not to depend on thickness.

reflectivity, porcelain-enamel. *Noun.* See **porcelain-enamel reflectivity**.

reflectometer. *Noun.* A photoelectric device measuring the reflectance of visible light from a surface.

reflet. *Noun.* An **iridescent** glow or **lustre** sometimes evident on ceramic ware.

reflexion. *Noun.* A less common spelling of reflection.

reforming. *Noun.* An endothermic process where hydrocarbons in fuel cells are turned into hydrogen for use in the cell and residual carbon.

refraction. *Noun.* (1) A change in the direction of a propagated light or sound wave, as when it passes from one medium to another of different density, which changes the velocity, and is bent from its original path.

The effect arises from the fact that the velocity of light is different in the two media. (2) The amount by which a wave is refracted.

refractive coefficient. *Noun.* An empirically determined constant for an oxide that is used in the Gladstone-Dale equation to find the **refractive index** of complex ceramic oxides. See **Gladstone-Dale equation**.

refractive index. *n.* *Noun.* See **index of refraction**.

refractometer. *Noun.* An instrument that measures **refractive index**.

refractories. *Plural noun.* Inorganic, non-metallic materials that have high melting points, >1,200 °C, and will withstand high temperatures. Such materials frequently are hard, resistant to abrasion, corrosion, and rapid thermal fluctuations; examples are **alumina**, **sillimanite**, **silicon carbide**, and **titanium boride**.

refractories, acid. *Noun.* See **acid refractories**.

refractories, air-setting. *Noun.* See **air-setting refractories**.

refractories, aluminium silicate. *Noun.* See **aluminium silicate refractories**.

refractories, basic. *Noun.* See **basic refractory**.

refractories, calcined. *Noun.* See **calcined refractory dolomite**.

refractories, casting. *Noun.* See **casting refractories**.

refractories, electrocast. *Noun.* See **electrocast refractories**.

refractories, fused-grain. *Noun.* See **fused-grain refractories**.

refractories, fusion-cast. *Noun.* See **fusion-cast refractories**.

refractories, high-alumina. *Noun.* See **high-alumina refractories**.

refractories, insulating. *Noun.* See **insulating refractory**.

refractories, mullite. *Noun.* See **mullite refractories**.

refractories, neutral. *Noun.* See **neutral refractories**.

refractories, permeability of. *Noun.* See **permeability of refractories**.

refractories, rebonded fused-grain. *Noun.* See **rebonded fused-grain refractories**.

refractories, silicon carbide. *Noun.* See **silicon carbide refractories**.

refractories, slagging of. *Noun.* See **slagging of refractories**.

refractories, spalling of. *Noun.* See **spalling of refractories**.

refractories, structural spalling of. *Noun.* See **spalling of refractories**.

refractories, thermal spalling of. *Noun.* See **thermal spalling of refractories**.

refractories, unburned. *Plural noun.* See **unburned refractories**.

refractoriness. *Noun.* The ability of a material to withstand high temperatures, the environment, and conditions use without change in its physical or chemical identity.

refractoriness, under load. *Noun.* See **under load refractoriness**.

refractory. *Adjective.* (1) The property of being resistant to high temperatures, usually in excess of 1,200 °C, while maintaining good mechanical behaviour at such temperatures. (2) *Noun.* One of a class of materials used to withstand high temperatures; most ceramics fall in this class.

refractory, aluminium silicate. *Noun.* See **aluminium refractories**.

refractory, anthracite-coal-based carbon. *Noun.* See **anthracite-coal-based refractory**.

refractory brick. *Noun.* Brick containing high percentages of **mullite**, **sillimanite**, etc., which in service is subjected to temperatures in excess of 1,000 °C.

refractory, carbon. *Noun.* See **carbon refractory**.

refractory, carbon-ceramic. *Noun.* See **carbon-ceramic refractory**.

refractory, castable. *Noun.* See **castable refractory**.

refractory casting. *Verb.* The process in which materials are cast at high temperatures into **fireclay** or other refractory moulds.

refractory cement. *Noun.* Any of a variety of mixtures of finely ground refractory materials which, when tempered with water, become plastic and trowelable; used as a mortar for the laying and bonding of **refractory bricks**, and filling of cracks.

refractory, chrome. *Noun.* See **chrome refractory**.

refractory, chrome-magnesite. *Noun.* See **chrome-magnesite brick**.

refractory chrome ore. *Noun.* An ore, often used without purifying, for **refractory brick** manufacture, consisting essentially of **chrome spinel**. See **chrome ore**.

refractory clay. *Noun.* A clay with a melting point in excess of 600 °C used to make refractory products, such as **firebrick**, furnace linings, reactors, kilns, etc.

refractory coating. *Noun.* A coating containing refractory ingredients used to protect metals, brickwork, and other structures subjected to high temperatures.

refractory composite coating. *Noun.* A combination of heat resistant ceramic materials which may or may not require heat treatment prior to application to metal or other ceramic substrates.

- refractory concrete.** *Noun.* A heat-resistant concrete made of a mixture of **high-alumina** or **calcium aluminate cement** and a refractory aggregate.
- refractory corrosion.** *Noun.* The deterioration of refractory surfaces when in service by chemical reaction with gases, slags, and reactive solids.
- refractory dolomite, raw.** *Noun.* See **raw refractory dolomite**.
- refractory enamel.** *Noun.* A porcelain-enamel of special composition used to protect metals from attack by hot, corrosive gases.
- refractory erosion.** *Noun.* Wear of refractory surfaces brought about by fast-moving gases or by the washing action of hot, moving melts.
- refractory fibres.** *Noun.* Inorganic fibres able to be used above 540 °C.
- refractory, fused-grain.** *Noun.* See **fused-grain refractories**.
- refractory, fused-silica.** *Noun.* See **fused-silica refractory**.
- refractory, fusion-cast.** *Noun.* See **fusion-cast refractory**.
- refractory, graphite.** *Noun.* See **graphite refractory**.
- refractory hard metal.** *Noun.* MX_{1-y} . (1) **Nonstoichiometric** interstitial compounds formed from d-group transition metals, such as titanium, hafnium, tungsten, with small atoms, such as carbon, nitrogen, oxygen, boron and beryllium. They are characterised by high hardness, high melting points and large Young's moduli. These properties depend strongly on composition, in particular the value of y in MX_{1-y} . (2) Refractory tungsten carbide cemented with cobalt metal and used as cutting tools. See **carbide tool**.
- refractory, heat-setting.** *Noun.* See **heat-setting refractory**.
- refractory, hydraulic-cement.** *Noun.* See **hydraulic refractory cement**.
- refractory magnesia.** *Noun.* **Dead-burned**, crystalline **magnesium oxide** having a high resistance to heat and corrosion; used to line furnaces and melting tanks, either in the form of brick or cement.
- refractory, magnesite.** *Noun.* See **magnesite refractory**.
- refractory, metal-cased.** *Noun.* See **metalkase brick**.
- refractory, metallurgical coke-base.** *Noun.* See **metallurgical coal-base refractory**.
- refractory, molten cast.** *Noun.* See **molten cast refractory**.
- refractory, monolithic.** *Noun.* See **monolithic lining**.
- refractory mortar.** *Noun.* A mixture of finely ground refractory materials **tempered** with water to produce a plastic trowelable mortar for laying and bonding refractory brick and shapes.
- refractory, mullite.** *Noun.* See **mullite refractories**.
- refractory nozzle.** *Noun.* A refractory shape containing an orifice through which molten metal is poured from a ladle or other container.
- refractory patching cement.** *Noun.* A finely ground mixture of refractory ingredients which become plastic and trowelable when tempered with water; used to repair damaged areas in furnaces, kilns, glass tanks, refractory moulds, etc.
- refractory, petroleum-coke-carbon.** *Noun.* See **petroleum-coke-carbon refractory**.
- refractory, pitch-bonded basic.** *Noun.* See **pitch-bonded basic brick**.
- refractory, plastic.** *Noun.* See **plastic fireclay**.
- refractory, pouring-pit.** *Noun.* See **pouring-pit refractory**.
- refractory, rebonded fused-grain.** *Noun.* See **rebonded fusedgrain refractories**.
- refractory, semi-silica.** *Noun.* See **semi-silica fireclay brick**.
- refractory, sillimanite.** *Noun.* See **sillimanite**.
- refractory, single-screened.** *Noun.* See **single-screened ground refractory material**.
- refractory, tar-bearing basic.** *Noun.* See **tar-bearing basic refractory**.
- refractory, unburned.** *Noun.* See **unburned refractory**.
- refractory, zircon.** *Noun.* See **zircon refractory**.
- refractory, zirconia.** *Noun.* See **zirconia refractories**.
- refrangible.** *Adjective.* Capable of being **refracted**.
- Refrasil.** *Trademark, noun.* A commercially available **silica fibre**; density 2,100 kg m⁻³.
- refrangent.** *Adjective.* Concerned with or causing **refraction**.
- refulgent.** *Adjective.* Shining, brilliant or radiant.
- regal gold.** *Noun.* A wide area of bright gold over a matte design producing a two-tone effect of dull and bright gold.
- regelate.** *Verb.* To undergo or cause to undergo **regelation**.
- regelation.** *Noun.* A phenomenon peculiar to materials which contract on melting, such as **silicon** and ice, which when subjected to an external pressure at a temperature not too far below the melting point, melt and refreeze or regelate on removal of the pressure.
- regenerate.** *Verb.* To restore or be restored to an original chemical or physical state.

- regenerated cellulose.** *Noun.* Fibres of **rayon** made when **viscose** is spun through a fine aperture into an acid bath containing stabilising salts.
- regeneration.** *Noun.* The process of restoring the adsorptive or other properties of a substance. See **wall flow filter**.
- regeneration bath.** *Noun.* A tank containing hot dilute acid used to complete cellulose regeneration and manufacture of ceramic fibre by the **viscose solution spinning process**.
- regenerative furnace.** *Noun.* A furnace equipped with a cyclic heat exchanger that alternately receives heat from gaseous combustion products and transfers it to air or gas before combustion.
- regeneration.** *Verb.* To use exhaust gases to heat **checkers** on one production cycle and then reversing the combustion air flow to extract the heat from the checker walls by convective heat transfer.
- regenerator.** *Noun.* A heat exchanger that utilises heat from the combustion process to preheat fuels and air entering the combustion chamber.
- register.** *Noun.* (1) A mark that tells of recording with the patents office. (2) A method of printing a series of colours in alignment with each other.
- registration.** *Verb.* (1) Putting two or more colours on a ceramic article in relation to each other. (2) *Noun.* The correct alignment of structures, built-up layer by layer, of each subsequent layer to the pattern on the previous layer.
- registration mark.** *Noun.* Marks on the surface of an item used to help align two or more colours in a decorating operation.
- registration pin.** *Noun.* A spring-loaded prong within a chuck that locates the ramp so that ware stops at the **registration** position.
- regolith.** *Noun.* The layer of loose material covering the bedrock.
- regosol.** *Noun.* A type of soil derived from freshly deposited alluvium or sands.
- regression.** *Noun.* The analysis of the association between the dependent variable and one or more independent variables. Usually expressed as a curve arising from an equation in which the independent variables have parametric coefficients. This enables other values of the dependent variable to be predicted.
- regular.** *Noun.* Another word for cubic in crystallography.
- regular alumina.** *Noun.* A recrystallised grade of alumina, Al_2O_3 , containing more than 95 % alumina; has a relatively large crystal size.
- regular tetrahedron.** *Noun.* See **tetrahedron**.
- regulating wheel.** *Noun.* A wheel on a **centreless grinder** that controls the speed and pressure of an item being ground.
- regulator, pressure.** *Noun.* See **pressure regulator**.
- regulus.** *Noun.* Impure metal immediately beneath the slag in ore smelting.
- regur.** *Noun.* Rich, dark, **calcareous** soil rich in clay formed by the weathering of **basaltic** rocks on the Deccan plateau in India.
- regur tins.** *Noun.* A colloquial name for black clay deposits with swelling characteristics found in north-east Nigeria.
- reheat behaviour.** *Noun.* The change in the dimensions or volume of a substance when subjected to a temperature equal or greater than the temperature to which the substance was previously heated.
- reheat test.** *Noun.* A prescribed heat treatment of a fired refractory or other product to determine the change in dimensions or volume that occurs during reheating.
- rehoboam.** *Noun.* A bottle holding the equivalent of six normal bottles. Named after a son of King Solomon.
- reinforce.** *Verb.* To strengthen with the aid of some additional material or support.
- reinforced beam.** *Noun.* A concrete beam supported in tension, compression, or torsion by steel bars, wire, rods, or other structural material, such as ceramic fibres, embedded in the concrete.
- reinforced brickwork.** *Noun.* Brickwork strengthened by metal bars, rods, mesh, or other material embedded in the bed joints or mortar joints.
- reinforced centre.** *Noun.* A grinding wheel in which steel rings have been incorporated near the centre to provide additional strength.
- reinforced column.** *Noun.* A concrete column in which longitudinal metal bars, sometimes with ties, circular ties, or other materials, are incorporated as reinforcing agents.
- reinforced concrete.** *Noun.* Concrete that is strengthened in tension by containing reinforcing steel rods, bars, wire mesh, or other strengthening material. The concrete is allowed to set around the strengthening material when the differential expansion rates put surface layers in the concrete in compression, which improves the tensile strength of artefacts.
- reinforced masonry.** *Noun.* Masonry construction in which steel bars, mesh, or similar materials are used as strengthening components.
- reinforced pipe.** *Noun.* Concrete pipe designed with metal or fibrous reinforcement to make a composite structure of increased strength.

- reinforced plastic.** *Noun.* A polymer composition in which fibres are embedded. The fibres can have a variety of forms but must have strengths greater than the plastic matrix and so are usually ceramic or glass.
- reinforced product.** *Noun.* A **composite** product containing mechanical reinforcements to give added strength.
- reinforced reaction injection moulding, RRIM.** *Noun.* See **reaction injection moulding**.
- reinforced wheel.** *Noun.* A grinding wheel containing mechanical reinforcement to give extra strength and safety during use.
- reinforcement, circumferential.** *Noun.* See **circumferential reinforcement**.
- reinforcement layer.** *Noun.* (1) **Circumferential reinforcement** in a concrete pipe that is one bar or one layer thick. (2) In a **laminated** structure it is that layer which is not the matrix material, usually ceramic fibre or metal wire used to impart strength to the structure.
- reinforcement, line.** *Noun.* See **line of reinforcement**.
- reinforcement, mat.** *Noun.* See **mat reinforcement**.
- reinforcing bars.** *Noun.* Steel bars put into concrete and building materials to increase strength.
- rejected material.** *Noun.* A material or product that fails to meet specifications.
- rejection level.** *Noun.* (1) The composition or property level above or below which a specimen or product is considered rejectable or to be distinguished or sorted from acceptable products. (2) A test level of specified minimum maximum values.
- rejig.** *Verb.* To re-equip a factory.
- relative atomic mass, r.a.m.** *Noun.* The ratio of the average mass per atom of the naturally occurring form of an element to 1/12 th of the mass of an atom of ^{12}C . Formerly called **atomic weight**.
- relative density, d.** *Noun.* The ratio of the density of a substance to the density of a standard substance, usually water at 4 °C.
- relative detector efficiency.** *Noun.* The product of the **detector efficiency** and the detector geometry.
- relative efficiency.** *Noun.* The ratio of the performance characteristics or property of a product or material to that of a standard reference in a defined test.
- relative humidity.** *Noun.* The ratio of the actual amount of water in the air to the maximum amount possible at the same temperature and pressure.
- relative lubricity.** *Noun.* See **lubricity** sense (3).
- relative magnetic permeability, μ_r .** *Noun.* The ratio of **magnetic permeability** in the medium to that in a vacuum.
- relative permittivity.** *Noun.* Also called **dielectric constant** of a **capacitor**; defined as the ratio of its capacitance with a given **dielectric** between the plates to its capacitance with a vacuum between the plates.
- relative pore diameter.** *Noun.* A structural feature of compacts; it is the pore size divided by the mean particle size; used to compare the effects of **forming** and heat treatments.
- relative refractive index, m.** *Noun.* $m = n_1/n_2$, where n_1 and n_2 are the refractive indices of materials either side of an interface. Used to design **optical fibres**. See **Fresnel law**.
- relative standard deviation.** *Noun.* The standard deviation of a value expressed as a percentage of the mean value.
- relaxation frequency.** *Noun.* The reciprocal of the minimum reorientation time for an **electric dipole** in an alternating electric field.
- release agent.** *Noun.* A material applied to a surface, such as a **die**, to prevent adhesion; **talc** is an example. Also called **adhesives**.
- reliability.** *Noun.* The probability that a material or product will satisfactorily perform its intended functions under specified conditions.
- relic processing.** *Noun.* A ceramic fibre making process that uses a host fibre of organic origin, such as wool, cotton etc., which is soaked in an inorganic salt solution, dried and then the organic fibre is burned out.
- relict.** *Noun.* A microstructure in a **glass-ceramic** where the crystals faithfully inherit the original morphology of the parent phase-separated glass or the preceding metastable crystal.
- relief zone.** *Noun.* See **die zones**.
- relieving arch.** *Noun.* A **spring arch** above an opening in a furnace wall; designed to support the wall, give it strength, and reduce the strain on a second arch constructed below it.
- remanence, B_r .** *Noun.* The ability of a **ferrimagnetic**, **ferromagnetic**, **ferrielectric** or **ferroelectric** ceramic to retain magnetisation or electrical polarisation. It is equal to the magnetic or electrostatic **flux density** of the material after removing the magnetising or electrostatic field.
- remnant magnetisation.** *Noun.* The magnitude of the magnetisation that remains in a ferromagnetic material when the applied field is reduced to zero.
- remnant polarisation, P_r .** *Noun.* The magnitude of the **polarisation** that remains in a **ferroelectric** material when the applied field is reduced to zero.
- remote plasma-enhanced chemical vapour deposition, RPECVD.** *Noun.* a method for producing thin films of diamond, Si_3N_4 , GaAs, and other semiconductors, in which the plasma generation tube is physically separated

from the deposition zone. Reactant gases are introduced downstream of the plasma region with back diffusion restricted by the main gas flow.

remover, detergent. *Noun.* See **detergent remover**.

render. *Verb.* To cover the surface of brickwork or stone, etc., with a layer of plaster.

rendering. *Noun.* A coat of plaster or cement mortar applied to a surface.

rensselaerite. *Noun.* A yellowish dense form of **talc** able to be carved for ornament manufacture.

repeatability. *Noun.* The standard deviation of an analysis or test obtained on the same sample by the same operator using the same equipment.

repellent, water. *Noun.* See **water repellent**.

replica processing. *Noun.* A method developed to make porous ceramics, such as **silicon carbide**, SiC. A polymer solution is impregnated into **polyurethane foam** and the body dried, fired in nitrogen gas prior to calcining at 1,100 °C.

replication process. *Noun.* A fibre manufacturing method whereby a carbon fibre is impregnated with a precursor ionic solution and the carbon is then burned out at 550 °C before sintering to consolidate the new fibre so formed.

replicator. *Noun.* A system that can build exact copies of itself given materials and energy.

repoint. *Verb trans.* To repair the joints of brickwork, masonry etc., with **mortar** or **cement**.

representative sample. *Noun.* A sample collected so that every component of a lot is truly represented.

repress. *Noun.* A machine used to press preformed blanks into shape.

repressed brick. *Noun.* A brick formed by repressing blanks cut from a column of clay from an extruding machine.

reprocessing. *Verb.* To recover and separate materials for reuse.

reproducibility. *Noun.* The standard deviation of results obtained by different operators using the same or different instruments in different laboratories on the same sample, using the same analytical method. It is the value below which the absolute difference between two test results may be expected to lie within 95 % probability.

reradiation. *Verb trans.* Radiation arising from previous absorption of primary radiation.

ReRAM. *Acronym.* Stands for resistance random access memory. See **resistance random access memory**.

rededos. *Noun.* (1) Fireback. (2) Wall decoration at the back of an altar.

RESA. *Acronym.* Stands for reactive electrode submerged arc. See **reactive electrode submerged arc**.

reseau. *Noun.* A network of fine lines cut into a glass plate and used as a reference grid on a micrograph.

reserve alkalinity parameter. *Noun.* The volume of **calcium hydroxide** present in concrete that acts as a sacrificial buffer to the **permeability** of carbon dioxide into the concrete. It resists the spread of **concrete cancer**. It is proportional to the CaO content of the cementitious binder in the concrete.

reservoir. *Noun.* A place where a liquid, especially water, is stored for use when wanted.

residence time. *Noun.* The time taken for an emitter to reach its working temperature after full rated voltage has been applied.

residual clay. *Noun.* Part of a classification of clay minerals based on their geological origins and residual clay is material, which, geologically remains at the site of the original rock leached and weathered by time.

residual magnetic field. *Noun.* The field that remains in a magnetised material after the magnetising forces are removed.

residual magnetism. *Noun.* The retention of a magnetic field by **ferromagnetic materials** after magnetisation.

residual strain. *Noun.* A permanent **set** in a sample due to the presence of **residual stress**.

residual stress. *Noun.* (1) The internal stress still present in a glass after **annealing**; complete removal by annealing would take an unacceptable time. (2) Stress that remains in a body as a result of plastic deformation. (3) A stress that remains in a material that is free of external forces or temperature gradients.

residue. *Noun.* Matter remaining after something has been removed.

resile. *Verb intrans.* To shrink or spring back and resume original shape.

resilience. *Noun.* The degree to which a body can rapidly resume its original shape after a deforming stress has been removed.

resilient. *Adjective.* Describing a material or object capable of regaining its original shape after compressing, bending stretching etc.

resin. *Noun.* (1) Any of a class of natural solid or semi-solid yellow-brown plant secretions, such as **amber**, insoluble in water, used to make **lustres** when dissolved in organic solvents. There are now many synthetic materials of an organic composition that have a high molecular weight, are solid, and have no well-defined melting point, that are called resins. (2) *Verb trans.* To treat a surface with resin.

resinate. *Verb trans.* (1) To impregnate something with **resin**. (2) *Noun.* A suspension of colouring oxides, salts or powdered metals in resin-organic solvent solution.

- resin infusion.** *Noun.* A cheaper, faster composite manufacturing process compared to traditional autoclave manufacture. The shape is made from ceramic tape and then resin is vacuum infused and cured as the matrix.
- resinoid bond.** *Noun.* The bonding forces produced by thermosetting resins when joining solids together.
- resinoid wheel.** A grinding wheel in which the abrasive grains are bonded together by a **thermosetting resin**.
- resinous lustre.** *Adjective.* A surface appearance like a brownish, brittle-fracture plane.
- resin, polyester.** *Noun.* See **polyester resin**.
- resin streak.** *Noun.* A surface imperfection on a composite laminate caused by local pockets of excess resin.
- resin transfer moulding, RTM.** *Verb.* To use a pressure injection system of polyester matrix material and ceramic reinforcing fibres to make fibre-composite artefacts.
- resist.** *Noun.* A patterned protective film, layer, or covering, such as wax, paper, metal foil, or plastic, which is laid over an area of surface to shield it from subsequent application of colours, glazes, etching compounds, sandblast, etc.
- resist (negative) or (positive).** *Noun.* Layers used to protect parts of semiconductor substrates and **epitaxial layers** during the manufacture of **integrated circuits**.
- resistance.** *Noun.* Measured in **ohms**, it is the physical property of a circuit element that accounts for permanent energy loss. It is the ratio of the potential difference across a conductor to the current flowing through it. For an ac system it is the real part of the electrical impedance.
- resistance, abrasion.** *Noun.* See **abrasion resistance**.
- resistance, acid.** *Noun.* See **acid resistance**.
- resistance, alkali.** *Noun.* See **alkali resistance**.
- resistance, apparent dc.** *Noun.* See **apparent dc resistance**.
- resistance, apparent dc surface.** *Noun.* See **apparent dc surface resistance**.
- resistance, apparent dc volume.** *Noun.* See **apparent dc volume resistance**.
- resistance, chemical.** *Noun.* See **chemical resistance**.
- resistor furnace.** *Noun.* See **resistance furnace**.
- resistance, crazing.** *Noun.* See **crazing resistance**.
- resistor, glass.** *Noun.* See **glass resistor**.
- resistance, dc insulation.** *Noun.* See **dc insulation resistance**.
- resistance, electrical-erosion.** *Noun.* See **electrical-erosion**.
- resistance element.** *Noun.* A material that resists or opposes the flow of electricity, usually with the production of heat.
- resistance furnace.** *Noun.* An electric furnace where heat is produced by passing a current through a resistor surrounding the furnace chamber, through a resistor embedded in the charge, through the charge itself, or a combination of these procedures.
- resistance heating.** *Noun.* The generation of heat by passing an electric current through a resistor.
- resistance, impact.** *Noun.* See **impact resistance**.
- resistance material.** *Noun.* Any material showing a high resistance to the passage of electric current per unit volume and which may be used as a **resistor**.
- resistance random access memory, ReRAM.** *Noun.* An alternative information storage system based on transition metal oxides, such as $\text{Pr}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$, a **perovskite** example. It is a capacitor-like device composed of insulating or semiconducting transition metal oxides sandwiched between two metal electrodes. A large change in resistance, in excess of 1,000 %, occurs on applying a pulsed voltage. Suitable ceramics are perovskites, **manganites** and **titanates**.
- resistance, surface.** *Noun.* See **surface resistance**.
- resistance, thermal shock.** *Noun.* See **thermal shock resistance**.
- resistance thermometer.** *Noun.* A thermometer in which the temperature is calculated from the resistance of a coil of wire or of a ceramic semiconductor placed where the temperature is measured.
- resistance welding.** *Noun.* Parts to be joined are held together and the join-area heated by passing a current through the resistor represented by the contact area of the two surfaces.
- resistazone counter.** *Noun.* Monitoring devices where changes in electrical resistance in a given volume are measured as particles passing through a chamber change the resistance.
- resistivity, ρ .** *Noun.* A measure of a materials resistance to the passage of electrical current. It is the resistance of unit length of a material having a uniform cross-section of 1 m. It is the reciprocal of conductivity; units are ohm metres. When multiplied by the density it is known as the **mass resistivity**. The old name was **specific resistance**.
- resistor.** *Noun.* A device exhibiting resistance to the flow of electric current through its structure or body and which is used in an electric circuit for protection, operation, or current control.
- resistor colour code.** *Noun.* A series of coloured bands put onto a resistor to show its resistance value. From the left-hand side the first two rings indicate the first and second significant figure, the third gives the multiplier,

and the fourth gives the tolerance. The colour values are given in **Table A.8**.

resistor drier. *Noun.* A drier in which the heat needed is generated by passing an electric current through a resistor.

resistor furnace. *Noun.* See **resistance furnace**.

resistor, glass. *Noun.* See **glass resistor**.

resistor, metal oxide. *Noun.* See **metal oxide resistor**.

resistor-pack. *Noun.* A coarse form of **coke** that is packed between the **green** carbon ware in an **Acheson furnace**.

resist, paper. *Noun.* See **paper resist**.

resist, wax. *Noun.* See **wax resist**.

resnatron. *Noun.* A **tetrode** used in high-frequency power generation.

resolution. *Noun.* (1) The ability of a microscope system to reveal adjacent points without overlaps causing distortion. (2) In a spectrometer it is the smallest change in wavelength detectable.

resolved shear stress, σ_R . *Noun.* In a body under applied stress it is the applied tensile load, P , multiplied by the **correlation factor**, $\cos\phi \cos\lambda$, where ϕ is the angle between the normal to a given crystallographic plane and the tensile axis, and λ is the angle between the slip direction and the tensile axis, divided by the area of cross section, A . Hence: $\sigma_R = (P/A)\cos\phi \cos\lambda$. When the critical resolved shear stress on a plane is exceeded, **crystallographic slip** occurs. More simply it is an applied tensile or compressive stress resolved into a shear component along a specific plane and direction within the plane.

resolving power. *Noun.* See **resolution**.

resonance. *Noun.* (1) Concerning electric circuits, it is the state when the frequency is such that the capacitive **reactance** is just balanced by the inductive reactance so that large alternating currents result. (2) The condition of a system in which there is a maximum probability for the absorption of electromagnetic radiation. (3) The existence of two or more hypothetical molecular structures with the actual structure being the average of the hypothetical ones.

resonant cavity. *Noun.* A space containing standing waves; used as an applicator of microwave energy.

resonant x-ray diffraction. *Noun.* A technique that enhances signals from **magnetic moments** in solids and so enables the magnetic properties of materials to be studied on the atomic scale. Diffraction experiments are performed using wavelengths at the absorption edge of one of the elements present.

resonate. *Verb.* To cause to exhibit resonance.

resonator. *Noun.* A tuned electrical circuit or a conducting cavity in which microwaves are generated by a resonant current.

resonator, quartz-crystal. *Noun.* See **quartz-crystal resonator**.

resorb. *Verb trans.* To absorb again.

resorption. *Noun.* Removal of a solid phase during cooling as a result of equilibrium changes.

respirable. *Adjective.* Capable of being taken in by breathing. Fibres that enter the lungs with respired air are termed respirable.

respirability. *Noun.* The possibility of being taken into the lungs. In the case of fibres this is determined by the density and cross-sectional area, with length being of minor importance.

response time. *Noun.* The time taken for an emitter to reach its working temperature after full rated voltage has been applied.

RESS. *Acronym.* Stands for rapid expansion of supercritical solution. See **rapid expansion of supercritical solution method**.

rest. *Noun.* A platform attached to a grinding wheel stand upon which work, or a dressing tool, is supported during a grinding operation.

rest mass. *Noun.* The mass of an object with zero velocity relative to an observer. It is the mass used in Newtonian mechanics.

resteel. *Noun.* Any form of steel used to reinforce concrete in a construction.

resultant. *Noun.* The total effect of two or more forces on a body.

resultant magnetic field. *Noun.* The magnetic field resulting when two magnetising forces are imposed on the same area of magnetisable material.

retainer plate. *Noun.* A plate used to reinforce the cavity block of an **injection moulder** against the injection pressure; it is often hollow which enables it to be heated or cooled. light waves and thin films.

retaining wall. *Noun.* A wall made to hold back loose rock, sand earth etc. Also called **revetment**.

retardation. *Noun.* The relative slowing down of one light ray relative to another as they pass through a crystal. A synonym for path difference in interference effects involving

retarder. *Noun.* A substance added to cement, mortar, plaster, or **stucco** to slow the setting rate, but which will have little or no effect on the properties of the product after the initial set.

retention aid. *Noun.* A chemical, such as polyethyleneimine, added to improve drainage yet maximise retained solids in the ceramic-paper making process.

retentivity. *Noun.* (1) The residual flux density corresponding to the saturation induction of a magnetic material.

(2) The ability of a material to resist desorption of an adsorbate.

retentivity, water. *Noun.* See **water retentivity**.

reticle. *Noun.* A network of fine lines placed in the focal plane of an optical instrument to aid measurement.

reticulate. *Adjective.* A netlike appearance or covered with a network of openings.

reticulated ceramics. *Noun.* Porous materials used mainly for filtering molten metal. They have a sponge-like appearance and can be used up to 1,650 °C. Both the ceramic and the pores are continuous phases. The structure is one of multiple dodecahedra sintered together. The cross-section of a dodecahedron is the cell and the faces are windows. Pore sizes are reported as the window sizes and they are in the range 10–100 pores per inch, **PPI**. They are usually prepared from templates of polyurethane foam.

reticulated foam. *Noun.* A continuous structure of fibres giving a reticulate framework of high strength, the large openings of which can be filled with ceramic, polymer, or metal; used in heat exchangers, aircraft structures, and energy absorbers.

reticulated glass. *Noun.* Ornamental glassware containing an interlaced network of decorative lines.

reticulated ware. *Noun.* **China ware** on which the relief decoration is carved on the **greenware** before firing, colouring and glazing.

reticulation. *Noun.* (1) Decoration deepening toward its centre, usually resulting from surface contamination by oily or fatty deposits. (2) *Verb.* To rupture the faces of closed-cell foams to make an open-cell structure.

reticule eyepiece. *Noun.* A microscope eyepiece having on its focal plane a scale for measurement.

retinite. *Noun.* A resin of fossil origin.

retort. *Noun.* (1) A closed refractory chamber in which materials are decomposed by heat. (2) A glass vessel with a round bulb and long tapering neck that is bent downwards.

retort carbon. *Noun.* A dense form of carbon or **graphite** formed in the upper sections of a retort used in coal-gas manufacture; used in glazes or other ceramics to bring about localised reduction during firing and in producing reducing atmospheres at high temperatures.

retort clay. *Noun.* Plastic, dense-burning, semi-refractory clay used in the manufacture of gas and zinc retorts.

retort, vertical. *Noun.* See **vertical retort**.

retouch enamel. *Noun.* A fine overspray or brushed-on coating of porcelain-enamel applied to cover or protect areas of potential imperfection.

retund. *Verb.* To weaken some physical property, such as strength.

return. *Noun.* The actual number of cubic feet of concrete in a one-cubic-yard batch based on tests made on the fresh concrete.

reverberatory furnace. *Noun.* A furnace or kiln in which fuel is burned at one end with the flame passing between the charge and the furnace roof, the heat being radiated from the roof onto the charge.

reverse. *Verb.* To reverse the direction of gas and air flow in a **regenerative furnace**.

reversible adsorption. *Noun.* Adsorption in which the **desorption isotherm** approximates the adsorption isotherm with little or no hysteresis.

revet. *Verb.* To face a wall with stone.

revetment. *Noun.* See **retaining wall**.

revivification. *Noun.* An oxidation process to restore the adsorptive properties of **activated carbon**.

revolving pot. *Noun.* The rotating circular container from which glass is gathered in the **Owens process**.

revolving tube. *Noun.* A hollow cylinder, concentric with the needle of a feeder, revolving in a molten glass batch, the feeder delivering **gobs** of glass to a forming unit.

Reynolds number. N_{Re} . *Noun.* A number characterising a fluid system that defines the type of fluid flow occurring within a vessel containing the fluid. For a tank with an axial flow impeller, $N_{Re} = 0.2778 Nd^2\rho/\eta$, where N is the impeller speed in rps, d is the impeller diameter in m, ρ is the fluid density in kg m^{-3} , and η is the dynamic viscosity in $\text{Nm}^{-2} \text{s}$.

RF heating. *Noun, abbreviation.* Stands for radiofrequency heating. See **radiofrequency heating**.

R-glass. *Noun.* A type of glass used to make high strength fibre for glass-reinforced composites.

RH. *Abbreviation.* Standing for relative humidity. See **relative humidity**.

rhe. *Noun.* An old measure of fluidity, the reciprocal of **poise**.

rhenum trioxide. *Noun.* ReO_3 . A cubic oxide consisting of corner-sharing ReO_6 -octahedra with the ABO_3 **perovskite structure** with 100 % vacant A-sites.

rheogram. *Noun.* A plot of **shear stress** against **shear rate** of a slip used to characterise the flow states of slips and powders; the slope of this linear plot gives the **plastic viscosity**.

rheology. *Noun.* The science of flow systems.

rheopexic. *Adjective.* Suspensions that go to higher viscosity when agitated.

rheostat. *Noun.* A resistor employed to regulate an electric current by means of variable resistances, thereby controlling the temperature of furnaces, etc.

rhinestone. *Noun.* An imitation diamond, usually made from **paste** (glass) with a **refractive index** close to 1.52 coated with a $\lambda/4$ thickness film of **titania**, TiO_2 . Used as costume jewellery because of the greatly enhanced reflectivity.

rhodic. *Adjective.* Of or containing rhodium.

rhodochrosite. *Noun.* MnCO_3 . A pink, mineral form of hexagonal manganese carbonate. See **manganese carbonate**.

rhodolite. *Noun.* A pale violet variety of **garnet**.

rhodonite. *Noun.* MnSiO_3 a pink to brown coloured **pyroxene** mineral. It occurs in metamorphic rocks and is often **translucent**. Used in glazes and pigments and as ornamental stone.

rhomb. *Noun.* Another name for **rhombus**.

rhombic. *Adjective.* (1) Another word for orthorhombic. (2) Relating to or shaped like a **rhombus**.

rhombohedral. *Adjective.* Relating to the crystal system that has 4 crystal axes, 3 that intersect at oblique angles. **Calcite**, **corundum** and **quartz** are examples of ceramics in this crystal system.

rhombus. *Noun.* A parallelogram with oblique angles and four equal sides. Also called **rhomb**.

rhyolite. *Noun.* Acid lava; the volcanic equivalent of granite. A fine-grained igneous rock containing **quartz**, **feldspars**, and **mica** or **amphibole**.

rhylon. *Noun.* A horn shaped drinking vessel with a hole in the pointed end from which to drink. Made from a variety of materials including ceramics and glass.

rib. *Noun.* A tool made from hard wood, metal, stone, plastic, or other smooth solid used to smooth the outer surface of a pot or similar item while the item is being **thrown**.

ribbed rolls. *Noun.* A roll-type crusher in which the crushing surface of the rolls are ribbed parallel with their axis.

ribbon. *Noun.* A continuous strip of glass in the plastic state during processing.

ribbon feed. *Noun.* A batch procedure in concrete making in which all ingredients are fed simultaneously into the mixer.

ribbon machine. *Noun.* A double caterpillar track machine, one above the other, where the top track carries **blow heads** and the bottom one **blow moulds**. Pockets of glass hanging down from a continuous glass ribbon passing between the two caterpillar tracks are blown into thin walled articles, such as lamp bulbs.

ribbon process. *Noun.* The process of delivering molten glass to the forming operation in ribbon form.

rib mark. *Noun.* A wavelike front seen on the mirror-like surface of fractured glass. It shows where the propagating

crack front took a slight change of direction; such marks are characteristic of relatively slow-moving cracks.

rice bowl. *Noun.* A specially decorated **porcelain** or **china** bowl for eating rice.

rice hull. *Noun.* A silicon-rich husk covering the rice seed and normally considered to be a waste product that has recently found ceramic use: first, when heated in the air it yields a silica-rich cementitious material; second, when heated in a vacuum or in nitrogen it yields **silicon carbide**, **SiC**, **whiskers**.

rich clay. *Noun.* Plastic clay characterised by good workability and **green strength**.

rich concrete. *Noun.* Concrete with high cement content.

rich mixture. *Noun.* A fuel/air mixture in which the fuel component is high.

riddle. *Noun.* (1) A screen or sieve used to remove foreign substances from granular materials. (2) *Verb trans.* To put through a sieve.

rider arch. *Noun.* An arch or series of arches supporting the **checkerwork** in the **regenerator** of a furnace.

ridge. *Noun.* A long narrow protrusion on a surface.

ridge roll. *Noun.* A half-round section of asbestos cement applied along the hips and ridge of a roof to conceal and waterproof the apex joint of the roofing material.

ridge tile. *Noun.* A tile used in making a roof ridge.

rigid brick paving. *Noun.* A walk or roadway characterised by having mortar joints between the brick pavers that are laid on a bed of mortar, itself on top of a concrete base.

riffle. *Noun.* A series of blocks laid to form grooves on the bottom of a sluice to retain mineral particles in **benefication**.

rigidity. *Noun.* The property of being resistant to change in shape.

rigidity modulus. *Noun.* The measure of the resistance of a body or material to **shear** under stress.

rim. *Noun.* (1) Protrusion bordering a hole, pit, or pock at the surface of a body. (2) The outer edge of a shape.

RIM. *Abbreviation.* Stands for reaction injection moulding. See **reaction injection moulding**.

rim structure. *Noun.* See **high burn-up structure**.

ring. *Noun.* (1) The part of a mould that forms the outer edge of a pressed article. (2) A floating refractory ring on the surface of molten glass that prevents scum from collecting within the ring area from which the glass is gathered.

ring crusher. *Noun.* A type of hammer mill consisting of steel rings held outwardly by the centrifugal force of a horizontal shaft rotating at high speed, the feed material being crushed between the rings and the outer shell of the mill.

ringhole. *Noun.* An opening or hole in a glass-melting tank through which glass is gathered.

ring mould. *Noun.* The metal section of a glass mould that shapes and finishes the neck of a bottle or other hollow glass article.

ring, orifice. *Noun.* See **orifice ring**.

ring, pall. *Noun.* See **pall ring**.

ring, pot. *Noun.* See **pot ring**.

ring, safety. *Noun.* See **safety ring**.

ring section. *Noun.* A narrow peripheral section cut from a glass article for inspection.

ring silicates. *Plural noun.* Silicate structures containing complex anions with a ring structure; $[\text{SiO}_4]^{4-}$ tetrahedra share two oxygen atoms with adjacent tetrahedra to form the ring units: $[(\text{SiO}_3)_3]^{6-}$ or $[(\text{SiO}_3)_6]^{12-}$ which are close packed with charge-balancing cations into the crystal structure.

ring test. *Noun.* (1) A test to evaluate the expansion or contraction properties of a glaze or porcelain-enamel in which ceramic or metal rings, respectively, are coated on the outside and fired; the rings are then cut open, and the distance between previously scored reference marks serve as the basis for evaluating the expansion or contraction properties of the coating. (2) A test to determine the presence of cracks in a grinding wheel by tapping the wheel while it is freely suspended in the **arbor** hold or freestanding to the periphery.

ring wall. *Noun.* The refractory wall of the unit delivering hot air to the **tuyeres** of a blast furnace.

rinse. *Noun.* (1) A liquid bath to remove foreign matter or solutions from the surface of an article or substance. (2) *Verb.* To use a liquid in relatively large amounts to wash debris and deposits from surfaces and fabrics.

rinse dip. *Verb.* To remove foreign matter or solutions from the surface of an item by immersion in a tank of water or other cleaning solution that is sometimes agitated.

ripple. *Noun.* A surface imperfection characterised by uniform waviness over a substantial area of a porcelain-enamelled surface.

rise. *Noun.* The vertical distance between a plane connecting the spring lines and the highest point on the under surface of an arch.

riser. *Noun.* (1) The projection on a casting resulting from an excess of melt supplied to make certain that a mould is completely filled during pouring. (2) A vertical pipe carrying gas or liquid upwards.

riser, manhole. *Noun.* See **manhole riser**.

robocasting. *Noun.* See **solid freeform fabrication**.

ROC. *Acronym.* Standing for rapid omnidirectional compaction. See **rapid omnidirectional compaction**.

rocaille. *Noun.* Decorative rock- or shell-work on ceramic ware or on masonry.

Rochelle salt. *Noun.* $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$. White naturally occurring double salt with **ferroelectric** properties; used in **ceramic capacitors**.

rock. *Noun.* Any aggregate of minerals that make up part of the earth's crust. Can be consolidated, such as **granite**, **limestone**, etc., or unconsolidated, such as sand, clay, etc. A few rocks, such as **quartzite** (pure **quartz**) and **marble** (pure **calcite**) contain only one mineral.

rock crystal. *Noun.* (1) A transparent, colourless form of **quartz** used for lenses and prism components in optical instruments. Frequently polished by **tumbling** to form stones for decoration. (2) Highly polished, hand-cut or engraved, **blown glassware**.

rockier. *Noun.* A glass bottle or other item with a deformed bottom that will rock when placed on a flat surface.

rock flour. *Noun.* Very finely powdered rock produced geologically by grinding along each other in glacier flow.

rocking chair battery. *Noun.* A **cell**, such as $\text{LiCoO}_2/\text{graphite}$, in which the cations are shuttled between the electrodes during discharging and recharging.

rocking furnace. *Noun.* A horizontal melting furnace designed to rock back and forth as a means of producing uniform melts.

Rockingham ware. *Noun.* An ornate **earthenware** or **semi-vitreous ware** coated with a brown or mottled manganese glaze.

rock ladder. *Noun.* A series of inclined steps in a vertical arrangement designed to break the vertical fall and to minimise breakage of concrete aggregate as it is discharged from a conveyor or **chute**.

rocklath. *Noun.* A sheet of **gypsum board** used as a plaster base in construction.

rock pocket. *Noun.* A void in concrete due to incomplete consolidation of the mass.

rock salt. *Noun.* Alternative name for **halite**.

rock-salt moss. *Noun.* See **Irish moss**.

rock salt structure. *Noun.* A classic structure or **aristotype** formed by sodium chloride, in which the sodium ions occupy the corners and face-centres of a simple cubic lattice with chloride ions occupying the edge centres and one in the middle of the cell. The structure is found in several special ceramics, such as **TiC**.

Rockwell hardness. *Noun.* A measure of the hardness of a material based on its resistance to indentation by a steel ball or conical diamond, of various dimensions, with a rounded point, under prescribed static or dynamic load; reported as the depth of impression

increase as the load is increased from a fixed minor load to a major load and then returned to the minor load.

rock wool. *Noun.* A mass of fine intertwined fibres formed by blowing air or steam through molten rock or slag; used for thermal and acoustic insulation, fireproofing, filters, and similar applications. Another name for **mineral wool**.

rod. *Noun.* Solid cylindrical lengths of glass. Also call **cane**.

rod crusher. *Noun.* See **rod mill**.

rod mill. *Noun.* A pulverising apparatus consisting of heavy metal rods impacting on a charge in a rotating metal cylinder. The rods lie parallel to the cylinder axis.

rod proof. *Noun.* A sample of molten glass removed for inspection from a bath by means of a metal rod.

roentgen or röntgen. R. *Noun.* A unit of dose of electromagnetic radiation equal to the dose that will produce by ionisation in air a charge of one electrostatic unit of electricity in 1 cm^{-3} of dry air at 0°C and 1 standard atmosphere. In **SI units** it is $2.58 \times 10^4 \text{ C kg}^{-1}$.

roll back. *Noun.* A form of **crawling** of porcelain-enamels where the fired coating pulls away or rolls up at the edges of the base metal or over areas of dirt or grease.

roll, corner. *Noun.* See **corner rolls**.

roll crusher. *Noun.* A pulveriser consisting of two horizontal rolls rotating toward each other about their axes.

rolled glass. *Noun.* (1) Flat glass made by passing a roller over the glass in a molten or plastic state; sometimes a design may be worked into the glass surface by a patterned roller face. (2) Optical glass rolled into plates instead of being cooled in the melting pot and then processed.

rolled inlay. *Noun.* A decorative process for pottery in which coloured clays are pressed into the surface of the pot or the clay slab from which the pot is formed before firing.

roller. *Noun.* A cylinder of blown glass that is cut in the soft state and then flattened to form window glass.

roller coating. *Verb.* The application or transfer of designs from a pattern to the surface of ware by means of a roller.

roller compacted concrete. RCC. *Noun.* A new technique for road building using a new type of concrete consisting of dry mix concrete mixed with steel fibres from waste car tyres. It is consolidated by roller compaction, which uses less cement, and is similar in practice to laying asphalt roads.

roller conveyor. *Noun.* A gravity-type conveyor consisting of freely rotating, parallel, cylindrical rollers mounted in a rigid steel frame.

roller-head machine. *Noun.* A shaping machine for pottery flatware equipped with a revolving shaping tool having the shape of the back of the article.

roller-hearth kiln. *Noun.* A tunnel-type kiln through which ware is moved on parallel rollers.

roller-quenched frit. *Noun.* Glass flakes used as a **frit** for covering tiles. Made by rapidly cooling a stream of glass between rollers. See **laminato**.

roller rim decorating. *Verb.* Applying colour to the rim of an item by using a rubber roller.

roll, graining. *Noun.* See **graining roll**.

rolling. *Noun.* A synonym for **crawling**; a defect in glazes and porcelain-enamels. See **crawling**.

rolls, bonded. *Noun.* See **ribbed rolls**.

rolls, compound. *Noun.* See **compound rolls**.

rolls, conical. *Noun.* See **conical roll**.

rolls, kibbler. *Noun.* See **kibbler rolls**.

rolls, smooth. *Noun.* See **smooth rolls**.

Roman brick. *Noun.* Brick of dimensions $5 \times 10 \times 30.5 \text{ cm}$.

Roman cement. *Noun.* Naturally occurring, very fast setting cement, as short as 90 s. Not actually Roman but discovered by Rev J Parker who accidentally fired a rock from the Isle of Sheppy.

roof, bonded. *Noun.* See **bonded roof**.

roof, boxcar. *Noun.* See **boxcar roof**.

roofing. *Noun.* (1) Material, such as **pantiles**, used for making a roof on a building. (2) The act of constructing a roof.

roofing granules. *Noun.* Approximately 8-mesh particles of crushed slag, slate, rock, tile, porcelain, or similar substances used in the production of asphalt roofing and shingles.

roofing tile. *Noun.* Any of several designs of concrete or fired clay shapes with edges that overlap or interlock used for **roofing**.

roof, Kruetzer. *Noun.* See **Kruetzer roof**.

roof, shell. *Noun.* See **shell roof**.

roof, sprung. *Noun.* See **sprung arch**.

roof, zebra. *Noun.* See **zebra roof**.

room, drier. *Noun.* See **drier room**.

room temperature. *Noun.* Any temperature in the range $20\text{--}30^\circ\text{C}$.

Rootare-Prenzlow relationship. *Noun.* The equation used to determine surface areas of ceramic compacts from the

mercury-pressure method by integrating the curve of volume of mercury intruded versus pressure: $S = (1/4\gamma \cos\theta) \int^V p dV$, where S is the surface area, γ is the surface tension of mercury, θ is the contact angle, usually $\sim 140^\circ$ for oxides, p is the applied pressure, and V is the volume of mercury intruded.

ropes. *Plural noun.* Defects in **wet-lay non-woven fabric** consisting of assemblages of fibre, with unaligned ends, clearly more **agglomerated** than the general dispersion; formed when fibres encounter a vortex in the stirred suspension medium of about the same dimensions as the fibre length.

roping. *Noun.* A slip-casting defect consisting of a rope-like formation of clay body on the side of the ware.

ropy lava. *Noun.* See **basic lava**.

rose-cut. *Adjective.* The morphology of a precious mineral cut with a hemispherical faceted crown and a flat base.

rose quartz. *Noun.* A rose-pink, often translucent variety of **quartz**. Quite rare most coming from Brazil and the USA. Can be cut and is used for jewellery. The colour comes from iron and titanium impurities in the crystal.

rose topaz. *Noun.* The product of heating normal yellow-brown **topaz** until it adopts a pink hue.

rose window. *Noun.* A circular window with ornamental tracery radiating from the centre.

rosin oil. *Noun.* A yellow, fluorescent distillate of certain resins used in the manufacture of **carbon black**.

rotameter. *Noun.* A small float suspended in a vertical glass tube with the height of the float being a measure of liquid or gas flow.

rotary crusher. *Noun.* A pulveriser in which a cone, rotating at high speed on a vertical shaft, forces solid materials against a metal encasement or shell.

rotary drier. *Noun.* An inclined, rotating cylinder in which tumbling particles are dried by rising hot air.

rotary feeder. *Noun.* A machine in which rotating fins deliver granules or powders to an operation at a predetermined rate.

rotary kiln. *Noun.* An inclined rotating, refractory-lined elongated cylinder, fired from the lower end. It is charged at the upper end and discharged at the lower end; used for melting, **clinkering**, or **calcining** materials.

rotary kiln block. *Noun.* A curved refractory shape, usually with a 22.9-cm chord and a smaller inside chord, 15.2 or 22.9 cm wide and 10.2 cm thick; used as segments in the lining of rotary or circular kilns.

rotary smelter. *Noun.* A batch-type, refractory-lined cylinder with conical ends in which porcelain-enamels or glazes to be fritted are melted; the raw batch is

charged at the burner end, the cylinder is rotated as melting progress and the mass is discharged at the flue end by tilting the furnace when melting is complete.

rotating beam test. *Noun.* A fatigue test where a polished rod is loaded as a beam and rotated about its long axis.

rotating drum kiln. *Noun.* A cylindrical chamber heated externally with the entrance oriented about 5° higher than the exit. The charge enters at the higher end and is tumbled along to the exit by the rotating motion of the kiln.

rotator phase. *Noun.* A crystalline structure within which molecules spin almost unhindered at high temperatures. **Zeolites** are ceramic examples.

rotor. *Noun.* The rotating part of an electrical or mechanical device.

rottenstone. *Noun.* A much weathered silaceous **limestone** rich in **silica**. Similar to but softer than **pumice**. Used as a polishing material. Also known as **tripoli**.

rouge. *Noun.* Finely divided, hydrated **ferric oxide** used as a polishing material and as a red-brown colorant.

rouge flambé. *Noun.* A decorative pottery glaze containing colloidal copper, which produces a typical red colour when fired in a reducing atmosphere.

rouge pit. *Noun.* An imperfections consisting of traces of rouge entrapped in an incompletely polished glass surface. See **rouge**.

rough and burred edges. *Plural noun.* Frayed or serrated edges of a ceramic, metal, or composite shape after cutting, stamping, shearing, trimming, or after fracture.

rough blank. *Noun.* A pre-shape used before final forming or drawing.

roughcast. *Noun.* (1) A rough plaster finish such as is obtained by throwing the plaster on a wall with a trowel. (2) Plaster of **lime** and **gravel** used on outside walls. (3) *Adjective.* Of a wall coated with roughcast. (4) *Verb trans.* To coat a wall with roughcast.

roughcast glass. *Noun.* A flat glass having one textured surface made by using a roller with a patterned face.

rough coat. *Noun.* The first coat of plaster applied to a wall.

rough diamond. *Noun.* An uncut diamond.

roughened finish tile. *Noun.* Tile having a back surface which has been roughened by wire cutting, wire brushing, or other mechanical means before firing to obtain increased bonding with mortar, plaster, or other substance.

rough glass. *Noun.* Rolled glass sheets cut into workable sizes.

rough grinding. *Verb.* To grind glass, metal, ceramic or other materials' surface without regard to the quality of the finish.

- roughing pump.** *Noun.* Usually a mechanical vacuum pump used for the initial evacuation of a system. .
- rough machining.** *Verb.* Machining with no regard to finish; usually a preliminary operation.
- roughness.** *Noun.* (1) The difference between the peaks and valleys of a surface. (2) The relative degree of coarse, ragged, pointed, or bristle-like projections on a surface.
- roughness factor.** *Noun.* A dimensionless number that is a measure of the internal surface area of a thin film. It is the true surface area of the film divided by the geometrically projected area. A typical number for an 8 µm thick film made from nanoparticles is 1,000.
- roughness height rating. RHR.** *Noun.* A measure of surface finish expressed as the arithmetical average from a true flat surface.
- rough turning.** *Verb.* To rapidly and efficiently remove excess stock from a work piece by a grinding or milling machine without regard to the quality of the finished surface.
- round brilliant.** *Noun.* A more complex faceted cut used for colourless gemstones.
- rounded sand.** *Noun.* Fully water-worn sand in which no grains have sharp edges. River sand is a common example.
- round kiln.** *Noun.* A kiln constructed in the form of a circle with a series of fireboxes stationed around the periphery of the structure. See **circular kiln**.
- round table.** *Noun.* A table upon which **plate glass** is laid for grinding and polishing.
- router.** *Plural noun.* Various tools or machines for hollowing out a solid.
- routine.** *Noun.* (1) Usual method or procedure. (2) In computing, a program or part of a program performing a specific function.
- rove.** *Noun.* The product formed when several strands of ceramic fibre are wound together in parallel with no twists being inserted.
- rove, taped.** *Noun.* See **taped rove**.
- roving catenary.** *Noun.* The difference in length of ends, **tows**, or strands in a length of roving.
- row and column braider.** *Noun.* A three-dimensional braiding machine capable of manufacturing very complex shapes from fibre reinforcement.
- rowlock arch.** *Noun.* An arch constructed of wedge-shaped brick arranged in concentric rings.
- rowlock course.** *Noun.* A course of brick laid on edge with the longest dimensions perpendicular to the face of a wall.
- royal blue.** *Noun.* A rich, deep blue ceramic colour composed of **cobalt oxide** and flux.
- Royal Asscher cut.** *Noun.* A patent protected style of **diamond cut** of the Royal Asscher Diamond company.
- Royal Worcester.** *Noun.* **China** made by the Worcester Company in England after 1862.
- RPECVD.** *Abbreviation.* Stands for remote plasma-enhanced chemical vapour deposition. See **remote plasma-enhanced chemical vapour deposition**.
- rpm.** *Abbreviation.* Stands for revolutions per minute.
- rps.** *Abbreviation.* Stands for revolutions per second.
- RRIM.** *Abbreviation.* Stands for reinforced reaction injection moulding. See **reaction injection moulding**.
- RTA.** *Abbreviation.* Stands for rapid thermal processing. See **rapid thermal processing**.
- RTP.** *Abbreviation.* Stands for rapid thermal beam processing. See **rapid thermal beam processing**.
- rub.** *Noun.* (1) Closely arranged scratches produced simultaneously on a glass surface as a decorative treatment. (2) *Verb.* To apply pressure and friction to a surface with circular or backward and forward motion.
- rubbed surface.** *Noun.* A formed concrete surface rubbed with **carborundum** stone, or with burlap and mortar, to obtain an improved appearance.
- rubber bond.** *Noun.* A bonding material based principally on natural or synthetic rubber.
- rubber gasket.** *Noun.* A rubber seal used in the joints of concrete pipe.
- rubber set.** *Noun.* The premature setting of cement in concrete due to the presence of unstable **gypsum**.
- rubber wheel.** *Noun.* A grinding wheel bonded with rubber.
- rubbing brick.** *Noun.* A block abrasive used for rubbing down castings, scouring chilled iron rolls, polishing marble, etc.
- rubbing stone.** *Noun.* A fine-grained abrasive shape used to remove imperfections from porcelain-enamelled and glazed surface by rubbing.
- rubellite.** *Noun.* A transparent red variety of the mineral tourmaline. See **tourmaline**.
- rubidium carbonate.** *Noun.* Rb_2CO_3 . Used in special glass formulations. Mp 837 °C.
- rubiginous.** *Adjective.* Rust-coloured.
- rubstone.** *Noun.* A stone used for smoothing surfaces or sharpening metal.
- ruby alumina.** *Noun.* Al_2O_3 . **Corundum** containing a few percent of Cr^{3+} in place of Al^{3+} where, in the distorted octahedral environment, the chromium ions produce a red colour and bestow lasing ability. Used as an abrasive and as a **laser**.

ruby, artificial. *Noun.* See **Verneuil synthetic**.

ruby glass. *Noun.* A glass of deep red colour produced by additions of selenium, cadmium sulphide, copper oxide, or gold chloride; the colour comes from colloidal metal particles. It was originally made by dissolving 0.01 % of gold in glass, quenching and then annealing at 650 °C. Gold crystals 40–140 nm in size become strongly absorbing at 530 nm and the complementary colour is red.

ruby, selenium. *Noun.* See **selenium ruby**.

ruby silver. *Noun.* Another name for proustite and pyrrargyrite. See **proustite** and **pyrrargyrite**.

ruby spinel. *Noun.* A red transparent form of **spinel** containing some chromium.

rudaceous. *Adjective.* Composed of coarse-grained material.

ruddle or raddle. *Noun.* A name given to **red ochre**. A natural red, earthy substance.

rugose. *Adjective.* Wrinkled or wavy in form.

rule of mixtures. *Noun.* A statement of the linear volume fraction relationship between a composite and its constituent parts for properties such as modulus and strength.

rule of thumb. *Noun.* A non-quantitative practical approach based on experience rather than scientific theory.

Rumpf equation. *Noun.* An expression of the relationship between the strength of a **green body** and the volume fraction of the powder, ϕ . It is given as $\sigma = 1.1\phi A / \{1 - \phi\}^{1/2} r l^2$, where σ is the green body strength, r is the mean particle radius, l is the mean distance between particle centres, and A is a constant on the order of 10^{-19} N m.

runner. *Noun.* Large blocks of chert used in the bottom of **pan mills**. See **chert**.

runner bar. *Noun.* An iron casting attached to a circular grinding head or runner for the abrasive grinding of **plate glass**.

runner brick. *Noun.* A perforated refractory brick through which molten steel is passed during the bottom pouring of ingots. See **bottom teeming**.

runner cut. *Noun.* An imperfection in plate glass resulting from the rupture of the surface by the runner bar. See **runner bar**.

running. *Noun.* A situation where colour runs down the side of ware in droplet form during firing.

running batch. *Noun.* A glass batch formulated to produce a desired composition when used with its own **cullet**.

running bond. *Noun.* A masonry bond involving the placement of each brick as a **stretcher** and overlapping the bricks in adjoining courses.

rupture. *Noun.* (1) The act of breaking, or other complete failure under load. Or the state of being broken. (2) *Verb.* To break or burst or to cause this to happen. (3) *Noun.* Failure accompanied by significant plastic deformation.

rupture, effective modulus of. *Noun.* See **effective modulus of rupture**.

rupture modulus. *Noun.* The transverse strength of a material based on the length of the specimen between supports and the cross-sectional dimensions of the specimen. See **modulus of rupture**.

rustication strip. *Noun.* A strip of wood or other material attached in a form to produce a groove in concrete construction or panel joint.

rutilated. *Adjective.* Containing **acicular** crystals of **rutile**.

rutile. *Noun.* TiO_2 . Titanium ore. A tetragonal mineral; used as an **opacifying agent** and white colorant in porcelain-enamels and glazes and as a component in **titanate dielectrics**. Because of its excellent whiteness it is used in paint formulations. Mp 1,640 °C; density 4,305 kg m⁻³; hardness (Mohs) 6–6.5.

rustic. *Adjective.* Describes a type of joint in brickwork and masonry.

rusticate. *Verb trans.* To cut a groove in the edges of brick and stone blocks in order to make joints look more obvious and primitive.

R-value. *Noun.* A calculation of the partial light-dispersion ratio of glass based on indices of **refraction**, determined by the equation $R = (n_d - n_c) / (n_F - n_c)$, in which R is light dispersive ratio, n_d is the index of refraction for the sodium line at 589.3 nm, and n_F and n_c are the indices for hydrogen lines at 486.1 and 656.3 nm respectively.

ryolex. *Noun.* A volcanic mineral consisting of **silica** and **alumina**; used as lightweight insulation.

Ryshkewitch-Duckworth equation. *Noun.* An equation relating ceramic strength to porosity: $\sigma = \sigma_0 \exp(-bp)$, where σ is the mean strength, σ_0 the strength of pore free material, p is the fractional porosity and b is a constant.

S. *Symbol.* Standing for: (1) **entropy**; (2) **siemens**; (3) sulphur.

S. *Abbreviation.* Used in **cement notation** for **silica**, SiO_2 .

s. *Abbreviation.* Standing for **second**.

sable detail brush. *Noun.* A ware decorating brush with very short, highly pointed hairs; used for feature and fine detail application.

sabulous, sabulose. *Adjective.* Gritty; of sand like texture.

saccharoidal marble. *Noun.* A form of **marble** that has even sized grains between small and large and contains some **pyroxene** impurity to give an overall sugary appearance.

sacrificial plaster. *Noun.* A **lime** putty, **sepiolite**, porous **chalk** and **limestone** aggregate mix put on to brick and stone work to draw-out salt solutions from them while at the same time acting as a plaster for decoration. When the brickwork or stones are dried out the plaster is removed and replaced with normal **facing**. Also called **poultice plaster**.

saddle. *Noun.* An item of wedge-shaped kiln furniture employed as a prop between plates packed on edge in a kiln.

saddle arch. *Noun.* One of a series of arches that supports the checker work in a **regenerator**.

saddle clay. *Noun.* Clay of fine particle size and high **flux** content which fuses at a low temperature; used as a **stoneware** and **electrical porcelain** glaze when it is known as **Albany slip**.

saddle, serrated. *Noun.* See **serrated saddle**.

safety door. *Noun.* A door designed to contain catastrophic conditions to a restricted area in the event of an emergency, such as fire or an explosion.

safety flange. *Noun.* A type of flange with tapered sides designed to hold parts of a wheel intact in the event of its breakage during use.

safety glass. *Noun.* (1) A glass constructed of sheets laminated with plastic films to prevent shattering in the event of breakage. (2) A glass containing a network of wire to improve its resistance to breakage and shattering. (3) A glass that has been tempered by heat treatment and surface quenching so that it has a compressed surface layer and will break into small cube-like fragments that do not scatter when broken and are less liable to cause injury than ordinary glass.

safety glass, tempered. *Noun.* See **safety glass (3)**.

safety requirements. *Plural noun.* The regulations required protecting persons against injury by failure, breakage, or other accidents of a hazardous nature.

safety ring. *Noun.* A metallic ring embedded in organic bonded abrasive wheels to contain pieces if breakage should occur on the grinder.

safety valve. *Noun.* A pressure-activated device designed to permit the escape of steam or gases from boilers or other equipment, and from hydraulic systems, when the internal pressures exceed safe-working limits.

Safil. *Trademark, noun.* A commercially available **aluminosilicate** fibre; density $3,300 \text{ kg m}^{-3}$; high strength, 2.0 GN m^{-2} , and high **Young's modulus**, 310 GN m^{-2} .

sag. *Noun.* See **sagging (2)**.

sagger. *Noun.* A fired refractory container, usually of box-like shape, in which ceramic ware may be **bisque** or **glost** fired to protect the ware from furnace gases, dirt, uneven heating, thermal shock, and physical damage.

sagger clay. *Noun.* A fairly uniform open-firing refractory clay which, when employed in **saggers**, will withstand conditions of repeated heating and cooling.

sagger maker's bottom knocker. *Noun.* The operator who beats out clay-**grog** mixes to form the bottoms of **saggers**.

sagger, nibbed. *Noun.* See **nibbed sagger**.

sagging. *Noun.* (1) *Noun.* A defect consisting of a wavy line or lines, which flow or slide on the vertical surface of porcelain-enamelled ware during firing. (2) *Noun.* A defect characterised by the irreversible downward bending of an article insufficiently supported during the firing operation. (3) *Verb.* The process of forming glass, usually flat glass, by reheating until it conforms to the shape of the mould or form on which it rests.

sagging, spray. *Noun.* See **spray sagging**.

Saint Venant's principle. *Noun.* The statement that the difference between the stresses caused by statistically equivalent load systems is negligible at distances greater than the largest dimension of the stressed area.

sal. *Noun.* An old name for a salt.

sal ammoniac. *Noun.* NH_4Cl . A sublimate found near volcanic fumaroles and in guano deposits; fibrous or dendritic crystals of white to brown colour; brittle; density $1,540 \text{ kg m}^{-3}$; hardness (Mohs) 2. Another name for ammonium chloride.

salamander. *Noun.* (1) Anything able to exist in fire or great heat. (2) A residue of slag and metal sticking to the walls of a furnace. (3) A ceramic poker used to kindle fires. (4) A poker-like ceramic rod suspended in a blast furnace crucible to monitor wear, erosion and corrosion at the completion of a period of use. (5) A small portable stove used to dry-out masonry buildings during their construction.

salic. *Adjective.* Of rocks and minerals having a high content of **silica** and **alumina**.

salicide. *Acronym.* Stands for self-aligned silicide process. See **self-aligned silicide process**.

saliferous. *Adjective.* Rock strata containing or producing salt.

salify. *Verb.* (1) To cause to combine with or mix with a salt. (2) To convert a substance into a salt.

salimeter. *Noun.* See **salinometer**.

saline. *Adjective.* (1) Consisting or concerned with common salt. (2) Concerned with, consisting of or containing any chemical salt, especially metallic salts.

salinometer. *Noun.* A hydrometer for determining the amount of salt in a solution. Also called **salimeter**.

salmanazar. *Noun.* A ceramic or glass wine bottle of 9-l capacity.

salmon, salmon brick. *Noun.* A relatively soft, under fired brick of salmon colour used where strength is not a major consideration. Also known as **chuff** or **place brick**.

sal soda. *Noun.* $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. The crystalline hydrate of **sodium carbonate**. Used as an oxidising agent and flux in glasses and porcelain-enamels and as a neutraliser in the pickling of iron and steel for porcelain enamelling. Mp $32.5\text{--}34.5^\circ\text{C}$; loses water at these temperatures; density $1,440 \text{ kg m}^{-3}$. See **soda ash** and **sodium carbonate**.

salt and pepper effect. *Noun.* A description of the appearance of the surface of a coloured glaze where the colour is not homogeneous and so looks uneven.

salt cake. *Noun.* Impure **sodium sulphate**, Na_2SO_4 . Used in glazes and glass as a source of sodium and as an anti-scumming agent. Mp 888°C ; density $2,670 \text{ kg m}^{-3}$.

salt glaze. *Noun.* A lustrous glaze produced on ceramic surfaces toward the end of the firing cycle by throwing salt into the firing box, the salt volatilising, and the resultant fumes then entering into a thermochemical reaction with the silicates and other components of the ceramic.

salt-glazed tile. *Noun.* Facing tile having a lustrous glaze finish resulting from the thermochemical reaction between the silicates of the clay body and the vapours of salt or other chemicals during firing. The salt is introduced into the kiln near the end of firing.

salt of gems. *Noun.* A powdered mixture of **quartz**, **calcite**, **gypsum** and **orpiment**, As_2S_3 . Used as a varnish filler.

salt out. *Verb trans.* To precipitate a dissolved substance from solution by addition of salt.

saltpan. *Noun.* A shallow land basin where evaporated salt lakes have left deposits of **gypsum**, salt etc.

saltpetre. *Noun.* KNO_3 . Literally means salt of rock or stone. One form of **efflorescence** on brick or stonework. Used in glass, glazes, and porcelain-enamel compositions because of its powerful fluxing and oxidising properties. Mp 334°C ; decomposes at 400°C ; density $2,100 \text{ kg m}^{-3}$.

salt-spray test. *Noun.* An accelerated test of the resistance of a material or product to corrosion in which a specimen is subjected to a spray of a sodium chloride solution under prescribed conditions.

salts, soluble. *Plural noun.* See **soluble salts**.

salt water. *Noun.* Molten sulphates floating on the surface of molten glass in the glass-melting unit.

salvage value. *Noun.* The net worth of a material recovered from a process.

samarium boride. *Noun.* SmB_6 . An example of a Kondo insulator. See **Kondo insulators**.

samarium-doped bismuth ferrite. *Noun.* $\text{Bi}_{1-x}\text{Sm}_x\text{Fe}_2\text{O}_4$. A **ferroelectric spinel** that has been shown to have useful **actuator** and **capacitor** properties at

temperatures or compositions on the ferroelectric to **antiferroelectric** transition. The nanoscale modulated structure allows this when thin films are made via the property of flexoelectricity.

samarium oxide. *Noun.* (1) Sm_2O_3 . Used in **luminescent** glasses, and infrared-absorbing glasses, as a **phosphor** activator, and as a neutron absorber in nuclear applications. Mp 2,300 °C; density 7,430 kg m^{-3} . (2) SmO ; a **rock salt** cubic oxide with samarium in a lower valency state.

samarium silicate. *Noun.* (1) Sm_2OSiO_4 . Mp 1,940 °C; density 6,360 kg m^{-3} . (2) $\text{Sm}_2(\text{SiO}_4)_3$. An ionic **orthosilicate**; Mp 1,921 °C; density 5,770 kg m^{-3} . (3) $\text{Sm}_2\text{Si}_2\text{O}_7$; another discrete ionic silicate but this time in the **pyroxene** silicates; mp 1,777 °C; density 5,200 kg m^{-3} .

samarium sulphate. *Noun.* $\text{Sm}_2(\text{SO}_4)_3$. Used in red and infrared **phosphors**.

samarium sulphide. *Noun.* A group of ceramic materials with thermoelectric properties. (1) SmS ; Mp 1,940 °C; density 6,010 kg m^{-3} . (2) Sm_3S_4 ; Mp 1,799 °C; density 6,140 kg m^{-3} . Sm_2S_3 ; Mp 1,782 °C; density 5,830 kg m^{-3} . (4) SmS_2 ; Mp 1,730 °C; density 5,660 kg m^{-3} .

samariskite. *Noun.* A black mineral of uranium and some **rare earths** of complex composition and with a velvety lustre. It was the mineral from which the element samarium was first discovered.

samel. *Noun.* An under-burned brick usually fired near the outer rim of a **clamp kiln** where the temperature is lower than the interior of the kiln.

Samian ware. *Toponym, noun.* A reddish-brown to glossy red, but occasionally black, fine **earthenware** pottery. Found in large quantities on Roman archaeological sites for the period 0–300 AD. Named after the island of Samos where the earth was of the same colour. Also called **Arretine ware**.

sample. *Noun.* (1) A part taken to be representative of the material. (2) The number of specimens drawn from a batch. (3) A number of fractions drawn from a lot to determine the nature, composition, properties, quality, or other attributes of concern.

sample, archive. *Noun.* See **archive sample**.

sample, composite lot. *Noun.* See **composite lot sample**.

sample, container. *Noun.* See **container sample**.

sample log. *Noun.* A recorded listing of samples preserved for reference purposes.

sampler. *Noun.* A device with which to obtain small samples of materials for analysis.

sample, representative. *Noun.* See **representative sample**.

sample splitter. *Noun.* A device employed to mix and subdivide a sample of powdered or granular material analysis or other evaluation.

sample thief. *Noun.* A device of suitable design employed to remove a sample from a batch or lot of a material for subsequent evaluation or analysis.

sampling. *Verb.* The act of taking samples from a batch etc.

sampling plan. *Noun.* A procedure that specifies the frequency and number of samples taken from a lot and the criteria for accepting or rejecting the lot.

sampling, systematic. *Noun.* See **systematic sampling**.

sand. *Noun.* Fragments of rock composed essentially rounded grains of **quartz** ranging from 0.05 to 2 mm in grain size; employed in glass, glazes, porcelain-enamels, ceramic bodies, Portland cement, building and construction work, as an abrasive, as a setting medium for the firing of ceramic ware, as a core in foundry moulds, and numerous other applications.

sand, bank. *Noun.* See **bank sand**.

sand, bedding course. *Noun.* See **bedding course sand**.

sandblast. *Noun.* (1) A jet of sand blown from a nozzle under pressure from air, water or steam. (2) *Verb trans.* To clean or decorate a surface with a sandblast.

sandblast fireclay. *Noun.* See **slag sand**.

sandblast, Grave. *Noun.* See **Grave sandblast**.

sandblasting. *Verb trans.* The process of projecting sand in a stream of air or steam at high velocity to engrave, cut, obscure, or clean glass, metals, or other surfaces.

sandblast, peppered. *Noun.* See **peppered sandblast**.

sandblast, shaded. *Noun.* See **shaded sandblast**.

sand, blending. *Noun.* See **blending sand**.

sandbox. *Noun.* A box filled with sand that can be shaped for moulding metal.

sand-cast. *Verb trans.* To produce a casting by pouring molten metal into a sand mould.

sand control. *Noun.* The testing and evaluation of the properties of a sand mixture to be used in a foundry.

sand creased. *Noun.* A type of texture produced on the surface of facing brick by sprinkling or rolling the brick in sand before moulding or by texturing the face of the brick during moulding.

sand cutting. *Verb.* Preparing a sand mixture for moulding in any way other than using a **muller**.

sand dissolution. *Noun.* The second stage in a **modular glass melting** process where the batch is held for about 2 h at 1,300–1,350 °C.

sand finish. *Adjective.* Structural clay products having surface faces covered with sand, which is applied to the clay column in the **stiff-mud process** or as a lubricant to the moulds in the **soft-mud process**.

sand, foundry. *Noun.* See **foundry sand**.

sand, furnace. *Noun.* See **furnace sand**.

sand, glass. *Noun.* See **glass sand**.

sand hole. *Noun.* A small fracture in the surface of glass produced during the rough grinding operation and which was not removed during the subsequent fine-grinding or polishing operation.

sanding. *Adjective.* (1) A surface texture produced on brick during manufacture. (2) *Noun.* A bedding material for brick, **saggers**, **earthenware**, etc., in a kiln. (3) *Verb.* To pre-polishing a sample for microscopic investigation or in the process of **faceting gemstones**.

sand-lime brick. *Noun.* A brick made from a mixture of **silica sand** and **lime**, and cured under the influence of high-pressure steam.

sand, Lynn. *Noun.* See **Lynn sand**.

sand, moulding. *Noun.* See **moulding sand**.

sandpaper. *Noun.* An abrasive product in which the abrasive, usually **emery**, is bonded to paper on one side; used for **sanding** and polishing. (2) *Verb trans.* To polish or grind a surface with sandpaper or other abrasive.

sand, placing. *Noun.* See **placing sand**.

sand reclamation. *Verb.* Thermal, hydraulic, or pneumatic processing of used foundry sands to produce an alternative to new sand.

sand seal. *Noun.* A seal consisting of metal plates attached along the sides and bottom of a **kiln car**, and immersed in a trough of sand extending through the length of the kiln and along the car rails, to prevent hot gases from entering under the car.

sand, silica. *Noun.* See **silica sand**.

sand slab. *Noun.* A slab of concrete placed in the bottom of a wet excavation to seal the bottom and facilitate subsequent work.

sand, slag. *Noun.* See **slag sand**.

sand, stamp. *Noun.* See **stamp sand**.

sandstone. *Noun.* A sedimentary rock consisting essentially of **quartz**, sometimes in combination with **feldspar**, **mica**, and other minerals, which have been united by pressure or cemented by **clay**, **silica**, **iron oxide**, **calcium carbonate**, or other material. Colours range from red to pale cream. Used widely in building. Red sandstone was formed in desert conditions and so the grains are rounded and polished while **grit** was quickly buried and so has angular, larger grains.

sand streak. *Noun.* A blemish on a formed concrete surface caused by the loss of **grout** or **mortar** through cracks in the **form**, or by failure of the concrete to consolidate.

sand-struck brick. *Noun.* A wet-clay brick, containing 20–30 % moisture, formed in a mould in which the inside of the mould is coated with sand to prevent the damp clay from sticking to the mould.

sandwich kiln. *Noun.* A kiln in which heat is applied to ware from both top and bottom simultaneously.

sang de boeuf. *Noun.* A red copper-bearing glaze fired under reducing conditions.

sanidine. *Noun.* $(\text{Na,K})\text{AlSi}_3\text{O}_8$. Disordered potassium **feldspar** formed when **microcline** is heated above 900 °C and cooled quickly. It is a high-temperature glassy form of **orthoclase**. Found in lavas.

sanitary ware. *Noun.* Glazed, vitrified whiteware or porcelain-enamelled fixtures having sanitary service functions, such as sinks, lavatories, bathtubs, etc.

sanitary ware, vitreous china. *Noun.* See, **china: vitreous sanitary ware**.

SANS. *Acronym.* Standing for small-angle neutron scattering. See **small-angle neutron scattering**.

Santer mean diameter. $D[3,2]$. *Noun.* See **surface-volume mean diameter**.

saponite. *Noun.* $(\text{Si}_{8-x}\text{Al}_x)\text{Mg}_6\text{O}_{20}(\text{OH})_4\text{Na}_x$. A swelling clay mineral consisting of hydrated magnesium aluminate silicate that occurs in metamorphic rocks, such as **serpentine**. It is also synthesised to control the sodium content and hence the amount of swelling since swelling is caused by hydration of the inter-layer Na^+ cations.

sapphire. *Noun.* A blue form of **corundum**, Al_2O_3 , employed as a bearing material fabricated to high precision, and as an abrasive and polishing material. A gemstone of extreme hardness.

sapphirine. *Noun.* $\text{Mg}_4\text{Al}_{10}\text{Si}_2\text{O}_{23}$. (1) A bluish-green aluminosilicate consisting of monoclinic magnesium aluminium silicate precipitated from glassy phases in the $\text{MgO-Al}_2\text{O}_3\text{-SiO}_2$ system at 1,380 °C. A form of **cordierite solid solution**. (2) A blue variety of **spinel**. (3) *Adjective.* Related to or resembling **sapphire**.

saprolite. *Noun.* A deposit of clay and earth formed by decomposition of rocks and has remained at the site of the original rocks.

sarcophagus. *Noun.* A **marble** or stone coffin or tomb.

sard. *Noun.* A deep orange-red coloured variety of **chalcidony**; used as a gemstone. Also called **sardine**, **sardius**.

sardine. *Noun.* An alternative name for **sard**. See **sard**.

sardius. *Noun.* Another name for **sard**.

sardonyx. *Noun.* A **quartz** mineral laminate consisting of alternate layers of orange-red **sard** and milky-white **chalcedony**. Valued as a gemstone.

sarsen. *Noun.* A large mass of very hard siliceous **sandstone** left after the erosion of a large bed or layer. Used in prehistoric times to construct standing stone monuments.

sassoline. *Noun.* Colloquial name for **boric acid**.

sassolite. *Noun.* The mineralogical name for naturally occurring **boric acid**, HBO_3 , found in the volcanic fumaroles of Tuscany.

satin finish. *Adjective.* Very smooth surfaces finish with low or dull reflective properties.

satin gold. *Adjective.* Elegant and durable decorations made by applying bright gold over **satin finish** colour or over a very fine etch.

satin weave. *Noun.* A weave pattern commonly used to make reinforcing cloths in forms more flexible than the plane weave in order to make them conform more easily to complex shapes; one **warp** runs over several faces and under one **fill** yarn. This produces a smooth fabric free from **twill**.

saturated. *Adjective.* (1) Of a solution or solvent: containing the maximum amount of **solute** that can normally be dissolved at a given temperature and pressure. (2) Of a compound: containing no unpaired **valence electrons**. (3) Of a vapour: containing the maximum amount of gaseous material at a given temperature and pressure. (4) Of a magnetic material: fully **magnetised**.

saturated air. *Noun.* Air containing the maximum amount of water vapour possible at a given temperature and barometric pressure.

saturation. *Noun.* (1) The point at which no more of a material can be dissolved, **absorbed**, or retained by another material. (2) The state of a **ferromagnetic** ceramic when it is fully magnetised and all the **magnetic domains** are completely aligned. (3) The property of a colour that enables an observer to judge its proportion of pure chromatic colour. It is the amount of white light mixed in with the three primary monochromatic colours. When saturation is high a colour is described as **washed-out**.

saturation bonding. *Noun.* A method of making nonwoven fabric whereby a fibre **batt** is treated by overall application of a liquid adhesive.

saturation coefficient. *Noun.* The ratio of the weight of water absorbed by a masonry unit during immersion in cold water to the weight absorbed in boiling water; used as an indication of the resistance of brick to freezing and thawing.

saturation current. *Noun.* In an electronic device it is that current beyond which an increase in voltage does

not lead to an increase in current until breakdown is reached.

saturation, magnetic. *Noun.* See **magnetic saturation**.

saturation magnetisation. *Noun.* The parallel alignment of all electronic spins along the direction of the applied field.

saturation of colour. *Noun.* See **saturation sense (3)**.

saucer wheel. *Noun.* A shallow abrasive wheel of saucer-like shape.

SAW. *Acronym.* Standing for surface acoustic wave. See **surface acoustic wave**.

SAW-delay line. *Noun.* A device based on the use of two **piezoelectric ceramics**, such as **zinc oxide**, ZnO , in which an electrical signal on one generates a **surface acoustic wave** on the second piece of ceramic. The acoustic wave is transmitted to a detector where it is reconverted in to current but, since the velocity of acoustic waves are 10^5 times slower than electromagnetic waves in a wire, a delay between the two identical signals can be produced.

sawdust concrete. *Noun.* A concrete of relatively low strength in which sawdust is incorporated as aggregate; used as a lightweight nailing concrete in construction applications.

sawdust firing. *Noun.* The placement of sawdust in a closed pot containing ware to produce a reducing atmosphere during firing.

saw gummer. *Noun.* A straight or saucer-shaped abrasive wheel; used to grind away punch marks formed between the teeth of saws during manufacture and as a saw sharpener.

sawing machine. *Noun.* Machining employing toothed blades.

sawtooth crusher. *Noun.* A machine in which material is crushed during passage between sawtooth shafts rotating at different speeds.

s-basis. *Noun.* The minimum mechanical property allowed by specification.

SBBO. *Abbreviation.* Stands for strontium beryllium borate. See **orthoborates**.

scab. *Noun.* (1) A defect in metal sheets and castings for porcelain-enamelling consisting of a partially detached metal fin joined to the metal surface. (2) A defect consisting of an undissolved inclusion of **sodium sulphate** or other similar material in glass.

SCADA. *Acronym.* Stands for supervisory control and data acquisition. See **supervisory control and data acquisition**.

scale. *Noun.* White to cream coloured deposit formed in a boiler by evaporation and the action of heat on water.

scagliola. *Noun.* Imitation **marble** made of **gypsum** with a polished surface layer of coloured stone or marble dust glued on.

scaolding. *Verb.* The peeling or popping of un-fused coatings from the surfaces of ware during the early stages of firing.

scale. *Noun.* (1) The oxide formed on the surface of metal during heating, usually before or during porcelain-enamelling. (2) A small fragment of foreign material embedded in the surface of moulded glass articles. (3) A weighing or measuring device. (4) Another name for **limescale**. (5) A series of marks at regular intervals used to make measurements. (6) *Verb trans.* To remove the scale or a coating from a surface.

scale, fish. *Noun.* See **fish scale**.

scalene cylinder, scalene cone. *Noun.* A cylinder or cone with the axis not perpendicular to the base.

scale, shiner. *Noun.* See **shiner**.

scaling. *Verb.* (1) The process of forming **scale** on metals with or without acid fumes, as a means of cleaning and preparing the surface for subsequent **pickling** and porcelain-enamelling. (2) The removal of rust and other unwanted contaminants from the surfaces of metals. (3) *Noun.* The peeling or flaking of concrete, usually pavements under the influence of deicing agents. (4) *Noun.* Deposition of soluble salts onto surfaces of pipes and tanks etc., during solution or slurry processing.

scaling, acid. *Verb.* See **acid scaling**.

scallop. *Noun.* A decorative motif consisting of a connected series of curves forming an edge or design on a product. (2) *Verb trans.* To shape, cut, or finish an edge in decorative scallops.

scalp. *Verb.* (1) To remove surface layers of undesired materials from another bulk material. (2) To remove portions of fine or coarse pit-run aggregate in a preliminary screening operation prior to use of the parent aggregate in concrete.

scalping screen. *Noun.* A screening device used to remove desirable fine and coarse particles from a material.

scan. *Verb.* To make an examination of an area, product, space or property as a monitoring activity.

scandium carbide. *Noun.* (1) ScC. Potentially useful as a high-temperature semiconductor; density 3,590 kg m⁻³. (2) Sc₁₄C₁₉. A reactive carbide containing (C₂)²⁻ anions.

scandium nitride. *Noun.* ScN. Useful in space applications and as crucible material for preparations of high-purity single crystals of **gallium arsenide** and other compounds. Mp 2,700 °C; density 3,600 kg m⁻³.

scandium oxide. *Noun.* Sc₂O₃. A **network former** in glass; also used in high-temperature systems and electronic

applications. Mp 2,300 °C; density 3,864 kg m⁻³; specific heat 0.153 J kg⁻¹ K⁻¹ (0–100 °C).

scandium silicate. *Noun.* (1) Sc₂OSiO₄. Mp 1,950 °C; density 3,592 kg m⁻³. (2) Sc₂Si₂O₇. A **pyroxene**; Mp 1,860 °C; density 3,390 kg m⁻³.

scandium tungstate. *Noun.* Sc₂(WO₄)₃. A discrete ionic tungstate with the unusual property of decreasing in volume as the temperature rises. The decrease in **x-ray unit cell** volume is linear with temperature increase and this is caused by the WO₄-tetrahedra tilting in a coupled manner.

scanistor. *Noun.* An integrated semiconductor optical-scanning device that converts images into electrical signals.

scanning electron microscope. *Noun.* An electron microscope in which a beam of electrons sweeps over a specimen measuring the intensity of the secondary electrons generated at the point of impact of the beam on the specimen, and relaying the signal into a cathode-ray display, which is scanned in synchronism with the scanning of the specimen.

scanning indentation mechanical microprobe. SIMM. *Noun.* A hardness determination technique that uses depth sensing rather than optical measurement of an indentation so that automation can be used which then quickly yields hardness maps. Force applied and vertical displacement are continuously monitored during a complete indentation cycle.

scanning probe microscopy. SPM. *Noun.* A comprehensive term encompassing the family of local probing techniques such as, **STM**, **AFM**, and **SFM**. The images are developed in a sequential scan of the surface. The scanning involves electronically controlled mechanical displacements and feedback is applied between a parameter, such as tunnelling current and height of the tip above the surface. This means that image build-up is slow.

scanning thermal microscopy. SThM. *Noun.* A variant of **scanning tunnelling microscopy** where thermal energy transfer and not a tunnelling electron current is recorded. A very fine Pt/Rh tip scans across a sample surface at a height of a few nanometres to obtain thermal conductivity profiles and from this the surface topography.

scanning transmission electron microscope. STEM. *Noun.* A method of observing and analysing replicas of very thin cross-sections. Useful for determining the phase composition of ceramics. Different phases show-up as different contrast levels in the image because scattering contrast is proportional to: density × atomic number/accelerating voltage, hence for low atomic number atoms, such as those common in ceramics, the accelerating voltage needs to be as low as possible.

scanning tunnelling hydrogen microscopy. STHM.

Noun. A technique developed to improve the sensitivity of **scanning tunnelling microscopy**. A hydrogen molecule is trapped between the surface and the apex of the probe tip and as it is squeezed it generates repulsive forces. As the tip is scanned the surface topography causes variation in the repulsive force. If the H_2 molecule is forced into the electron density of the tip atoms they are pushed away from the apex and so changing the size of the tunnelling current that the **STM** can detect. This effect is called the **Pauli repulsion**.

scanning tunnelling microscopy. STM. *Noun.* A surface analysis technique for conducting surfaces that provides an image of the physical structure of the surface with resolution less than 0.01 nm and also giving electronic information. A surface probe, usually tungsten, sharpened to a 0.1 μm radius tip, is moved through a **piezoelectric** controller toward the surface as a bias voltage of 2–2,000 mV is applied between the tip and the surface. This causes a current to flow across the tip-sample gap, due to **quantum mechanical tunnelling**, just before the tip touches the surface as the **orbitals** of the surface atom and the tip atom overlap. The value of this current is extremely sensitive to the gap distance, such that variations in height of 1 atomic radius can be detected over a lateral area of 0.2 nm. Hence, from a fixed tip, surface **topography** can be scanned.

scapolite. *Plural noun.* A group of minerals with composition between $Na_4Al_3Si_9O_{24}Cl$ and $Ca_4Al_6Si_6O_{24}(CO_3)$; occurs as glassy-grey grains in **limestone**. Also called **wernerite**.

scar. *Noun.* A mark in a porcelain-enamelled surface produced by firing a coating that previously had been scarred or similarly damaged after drying. The term also may be applied to the defect as it appears in the dry state before firing.

scarf joint. *Noun.* A geometry used for adhesive joining of composite and ceramic components that is a development of the **simple lap joint**. The two overlapping pieces are cut each at an angle and the tapered faces carry the adhesive and so a continuous profile is achieved. It gives excellent performance. See **simple lap joint**, **tapered lap joint**.

scatter coefficient. *Noun.* The rate of the increase in the reflectance of porcelain-enamels with thickness at infinitesimal thickness over a black background. See **reflectance**.

scattering. *Verb.* (1) Simultaneously dispersing into different directions. (2) *Noun.* The process in which particles are deflected as a result of collisions.

scheelite. *Noun.* $CaWO_4$. A white to brownish **fluorescent** mineral with a tetragonal crystal structure. Occurs in **metamorphic** rocks and **quartz** veins. Used

as a source of tungsten and in **phosphors**. Density 5,900–6,100 $kg\ m^{-3}$; hardness (Mohs) 4.5–5.

schiller. *Adjective.* An unusual or **iridescent lustre** occurring in some minerals caused by internal reflections from gas cavities or mineral intergrowths.

schist. *Noun.* An important group of metamorphic rocks, such as **mica**, **feldspar**, **hornblende**, and **quartz**. The schists are medium grained rocks formed from **shale** or mud but at a higher temperature than **slate**. It may readily be split into thin plates or slabs because the mica mineral plates have become aligned in parallel bands.

Schlegel representation. *Noun.* A sketch of **fullerene**-type molecules showing the five-membered and six-membered rings in full but different colours to emphasize the 3-D ball-like structure.

schlieren. *Plural noun.* Discernible layers in a transparent ceramic or glass material caused by density or composition variations leading to **refractive index** variations.

Schmid's law. *Noun.* **Dislocation**-initiated slip in crystals takes place along a given **slip plane** and direction when the shear stress acting along them reaches a critical value. See **critical shear stress**.

Schmidt hammer. *Noun.* A test of the compressive strength of set concrete by measuring the height of rebound of a steel hammer.

Schmitt trigger. *Noun.* A bistable **transistor** circuit in which the output increases to a steady maximum when the input rises above a given threshold and decreases to almost zero when the input voltage falls below a second threshold.

schooner. *Noun.* A large glass used to serve sherry.

schorl. *Noun.* $NaFe_3B_3Al_3(Al_3Si_6O_{27})(OH)_4$. A black iron-rich borosilicate variety of **tourmaline**.

Schottky barrier. *Noun.* An electrostatic depletion layer formed at the junction of a metal and a ceramic semiconductor, which causes it to act as an electrical rectifier.

Schottky defect. *Noun.* An anion or cation **vacancy**, V_o or V_m , in **Kroger-Vink** notation, plus a vacancy of the opposite type. The pair forming this crystal defect can be associated or disassociated in the structure. More commonly encountered than **Frenkel defects**.

Schottky diode. *Noun.* A solid-state diode formed when a semiconductor layer with a metal coating is made; hot carriers, electrons or **holes**, are emitted from the **Schottky barrier** of the semiconductor and move into the metal coating but the current passes more readily through the structure in one direction and so the system has rectifying properties. Used in fast switching applications.

Schottky effect. *Noun.* A reduction in the energy needed to remove an electron from a solid in a vacuum when an electric field is applied to the surface

Schottky noise. *Noun.* The inherent electronic noise in an electric current because of the discontinuous nature of conduction electrons.

Schrödinger equation. *Noun.* A differential equation that forms the basis of the Quantum Mechanical description of matter in terms of wave-like properties of particles in a field. Its solution is related to the form of probability density of a particle in space and time.

schwartmanite. *Noun.* FeOHSo_4 . A yellow pigment also known by the colloquial name **yellowboy**.

schwartzites. *Plural noun.* Postulated **polymorphs** of carbon based on carbon atoms decorating the surface of triply periodic minimal surfaces that divide space into two labyrinths or the surface of a torus. These forms have **graphite** with negatively curved Gaussian curved surfaces. Positive Gaussian curvature leads to C_{60} , C_{70} etc. and onion-like structures. Zero Gaussian curvature describes graphite tubes.

scintillating. *Adjective.* Sparkling, twinkling.

scintillation. *Noun.* (1) The act of scintillating. (2) A spark or flash. (3) The spark of light produced in some substance by the absorption of an ionising particle or photon.

scintillation spectroscopy. *Noun.* A scintillation counter adapted to measure the energy and intensity of gamma rays from radioactive elements.

scintillator. *Noun.* A doped ceramic material, such as $\text{Gd}_2\text{SiO}_5\text{:Ce}$ and $\text{LuAlO}_3\text{:Ce}$, which emit optical photons in response to ionising radiation. Used in optical instruments such as spectrometers, scintillation detectors, cameras, counters, etc.

sclerometer. *Noun.* A scratch hardness tester. See **scratch hardness tester**.

scleroscope. *Noun.* An instrument for determining the relative **hardness** of materials by measuring the height to which a standard steel ball rebounds from its surface when the ball is dropped from a standard height.

scleroscope hardness number. *Noun.* A hardness value related to the height of rebound of a diamond-tipped steel ball dropped onto the specimen from a fixed height.

scolecite. *Noun.* $\text{CaAl}_2\text{Si}_2\text{O}_{10} \cdot 3\text{H}_2\text{O}$. A white **zeolite** mineral found in groups of radiating monoclinic crystals.

scoop. *Noun.* A shovel-like instrument designed for the movement or transport of loose materials.

scored finish. *Noun.* The grooved appearance of the face surface of a structural clay body as it comes from the **die**.

scored finish tile. *Noun.* Structural tile having a scored face surface designed to receive and to give increased bond with mortar, plaster, or **stucco**.

scoria. *Noun.* (1) Refuse from smelting operations; **slag**. (2) The rough cinder-like crust on top of solidified lava flows containing many **vesicles**.

scoring. *Verb.* (1) To form a groove, scratch, notch, or similar indentation on the surface of a material, usually before firing. (2) *Noun.* Grooves and scratches made in the direction of sliding during wear tests.

scotch block. *Noun.* A **rammed refractory** gas port in an open-hearth steel furnace.

Scotch method of roofing application. *Noun.* A method of applying rectangular asbestos-cement roofing **shingles** which overlap at the top and one side to form a rectangular or square pattern.

scotch tape test. *Noun.* A way of evaluating the adhesion of a coating by pressing the tape onto the surface and then peeling it off. If the coating is not pulled off with the tape the adhesion is considered adequate.

scouring. *Verb.* (1) To clean and smooth the surface of a **bisque-fired** ceramic ware with a coarse abrasive in a revolving drum. (2) To mechanically clean or finishing a hard surface by using an abrasive and low or light pressure.

scouring block. *Noun.* A chemically bonded abrasive block composed of Al_2O_3 , SiC , or similar material; used in the grinding and polishing of metals and ceramic surfaces.

scove brick. *Noun.* An unfired refractory brick used in the construction of **scove kilns**.

scove kiln. *Noun.* An updraft kiln constructed of unfired brick having no permanent parts, and which may be fired with gas, oil, coal, or wood.

scoving. *Noun.* The outer layer, usually wet clay, applied to a **scove kiln** to make the kiln gastight.

SCR. *Abbreviation.* Stands for silicon-controlled rectifier. See **silicon-controlled rectifier**.

S-crack. *Noun.* An S-shaped lamina defect occurring in a clay body during extrusion from a **pug mill**.

scrap. *Noun.* A reject from a manufacturing operation that is unsuitable for reclaiming or salvage.

scraper. *Noun.* A tool for cleaning-off surface protrusions and excess matter.

scraperboard. *Noun.* Thin card covered with a layer of white **china clay**.

scrapings. *Plural noun.* The overspray of porcelain-enamel collected and recovered from a **spray booth**.

scrapping. *Verb.* To remove excess body from **slip-cast ware** before removal of the ware from the mould.

scraps. *Noun.* The excess body removed from slip-cast ware during forming.

scratch. *Noun.* Any marking or tearing of a surface produced during manufacture or handling having the appearance of being caused by a sharp instrument.

scratch coat. *Noun.* A layer of **plaster** having a scratched surface to improve its bond with a subsequent layer.

scratch hardness, scratch resistance. *Noun.* The resistance of a surface to scratching. See **scratch test**.

scratch test. *Noun.* A **hardness test** in which a loaded diamond point or other cutting instrument is drawn across a surface and the width of the resulting scratch is compared with a related standard. See **Bierbaum scratch hardness**.

SCR brick. *Noun.* A brick 6.8×15.2×30.5 cm in size.

screed. *Noun.* A straight-edged tool or guide of wood or metal for making the first strike-off of a surface of concrete or plaster while removing any excess of the material and for smoothing the concrete or plaster surface.

screeding. *Verb.* To use a **screed** to remove excess concrete or plaster before a final smoothing operation.

screen. *Noun.* (1) A wire mesh or perforated plate mounted on a suitable frame employed to separate coarser part of a loose, flowing conglomerate material from the finer parts by allowing the passage of the smaller parts while retaining those of the larger. (2) A silk, wire, or similar material, in mesh or gauze form, through which pigmented inks are forced on to the surface of ware to produce a design.

screen analysis. *Noun.* A technique to determine the particle size or particle-size distribution of powders and the solid constituents of porcelain-enamels, glazes, and other slips or slurries by calculating the percentage of solids retained in each of a graduated series of sieves of various sizes. Also called **screening**.

screening. *Noun.* See **screen analysis**.

screening ink. *Noun.* An oil suspension of ceramic pigment used in the **silk-screen process** to imprint designs on glass, porcelain-enamel, and other ceramic surfaces and which develops its colour on firing. Also known as **ceramic ink, screening paste, or squeeze paste**.

screening paste. *Noun.* See **screening ink**.

screening plate. *Noun.* A metal plate containing openings of specified size used to control the fineness of grinding in **dry pans** and **hammer mills**.

screen marks. *Noun.* A pattern left by the screen on the surface of an enamel.

screen mesh. *Noun.* The number of openings per linear length on a sieve or screen.

screen printing. *Noun.* See **silk-screen printing**.

screen, scalping. *Noun.* See **scalping screen**.

screen seepage. *Noun.* Seepage through open parts of the stencil of colourant; usually caused by a delay in the printing action while the stencil has excess ink on the top surface.

screen, shaker. *Noun.* See **shaker screen**.

screen test. *Noun.* See **sieve analysis**.

screen, vibrating. *Noun.* See **vibrating screen**.

screw contact. *Noun.* An electrical contact fabricated with external thread for attachment to a support member.

screw conveyor. *Noun.* A conveyor consisting of a helical screw that rotates on a single shaft in a stationary trough or casing such that granular material may be moved along a horizontal, inclined, or vertical plane.

screw dislocation. *Noun.* A type of **line defect** in a crystal involving many atoms; formed by continued crystal growth about an **edge dislocation**.

screw feeder. *Noun.* A device consisting of an auger or rotating helicoid screw employed to transfer pulverised or granular material from one piece of equipment to another.

screw press. *Noun.* A press in which the slide of the press is actuated by a screw mechanism.

scribing. *Verb.* To score a **bisque** porcelain-enamel coating with a sharp tool, often combined with a brushing operation, as a form of decoration.

scrim. *Noun.* A **continuous filament**, nonwoven, reinforcing fabric.

scroller brush. *Noun.* An extremely fine-hair, sharp-pointed china decorating brush for applying fine lines.

scrubber. *Noun.* (1) A machine for cleaning coarse aggregate consisting of a horizontal rotating cylinder containing blades that lift and tumble the aggregate, usually in the presence of water, to remove clay and other soft particles and coatings. (2) Equipment for purifying gases.

scrub mark. *Noun.* A surface blemish on glass, usually appearing as a series of vertical markings, caused by friction during processing or handling.

SCS-2 fibre. *Trademark, noun.* **Alumina fibre** made by the AVCO company.

scuff, scuffing. *Noun.* Physical damage to the surface of glass or other ceramic ware caused by scratching, gouging, abrasion or wear.

sculptured glass. *Noun.* See **cameo glass**.

sculpture stones. *Plural noun.* A collective for easily carved silicates and aluminosilicates, such as the **talcs** (**steatite** and **soapstone**), **serpentine** and **African wonderstone**. They often contain **asbestos** and so **alabaster** has become a common substitute.

scum, scumming. *Noun.* (1) A layer of unmelted material floating on the surface of molten glass. (2) An area of poor gloss on an otherwise bright, glossy surface of porcelain-enamel, glass, and glazes. (3) Clouds appearing around **decalcomania**, which are caused by varnish residues. (4) A layer of soluble salts or fuel residues that are oxidised on the surface of building brick during the firing operation caused by soluble sulphates, such as MgSO_4 and CaSO_4 being brought to the surface in drying water. After firing the calcium scum is **anorthite**, while the magnesium scum is **forsterite** and **enstatite**. Adding barium sulphate to the body to produce insoluble **barium sulphate** reduces the effect.

scurf. *Noun.* (1) A hard carbonaceous deposit on the surfaces of retorts, coke ovens, and the like caused by the cracking of gases during use. (2) *Verb.* To remove scurf by scraping, rubbing, or wiping.

scutch. *Noun.* A bricklayer's steel hammer; used for cutting, trimming, and dressing brick.

seacoal. *Noun.* A finely powdered coal used to face moulds for iron casting.

seal. *Noun.* (1) Any device or system that creates a non-leaking union between two mechanical or process-system elements. (2) A tight closure or joint.

seal, air. *Noun.* See **air seal**.

seal, airborne. *Noun.* See **airborne seal**.

seal, butt. *Noun.* See **butt seal**.

sealed pore. **P_c .** *Noun.* A pore or small bubble trapped in a ceramic body that has no outlet to the exterior of the body.

sealed porosity. *Noun.* The ratio of the volume of sealed pores to the bulk volume of a ceramic, expressed as percent. Calculated by the formula $P_c = (W_d/D_a) - (W_d/D_t)$, where W_d is the dry weight of the specimen, D_a is the apparent density, and D_t is the true density of the specimen.

seal, external. *Noun.* See **external seal**.

seal, foundation. *Noun.* See **foundation seal**.

sealing. *Verb.* To joining two items of glass, or glass and a metal, by heating an interface to reduce the viscosity of the glass to permit it to flow and bond with the other glass or metal.

sealing compound. *Noun.* (1) A **bituminous** material for filling and sealing joints and cracks in concrete. (2) A curing compound for concrete.

sealing glass. *Noun.* A glass with special thermal expansion and flow characteristics to enable it to bond with another glass or solid.

sealing surface. *Noun.* That portion of the finish of a glass container or other ceramic that makes contact with the sealing gasket or liner.

seal, internal. *Noun.* See **internal seal**.

seal, pin. *Noun.* See **pin seal**.

seal, ram. *Noun.* See **ram seal**.

seal, sand. *Noun.* See **sand seal**.

seals, glass-to-metal. *Noun.* See **glass-to-metal seals**.

seal, tapered. See **tapered seal**.

seam. *Noun.* A mark on the surface of glass or a ceramic resulting from the joint of the matching mould parts.

seaming. *Verb.* To join together two edges of sheet material.

seat. *Noun.* (1) A prepared position on the edge of an hearth where a pot is placed. (2) *Verb.* To fit an item to conform to the configuration of another item at the point of contact.

seat earth. *Noun.* A natural deposit or bed of clay situated beneath a seam or layer of another mineral.

seating block. *Noun.* A fireclay refractory shaped to support a boiler.

seawater magnesia. *Noun.* **Magnesia**, MgO , recovered from sea water by treatment with **slaked lime**.

secant modulus. *Noun.* The ratio of change in stress to change in strain between two points on a stress-strain curve.

second. s. *Noun.* (1) The basic **SI unit** of time defined as the duration of 9192631770 periods of radiation corresponding to the transition between two hyperfine levels of the ground state of ^{133}Cs . (2) 1/60 of a minute of time. (3) 1/60 of a minute of angle. (4) A marketable product of inferior grade or one, which does not conform to the quality of a standard product.

secondary. *Adjective.* (1) Formed by the change of pre-existing minerals. (2) The part of an electric circuit in which the current is induced by a changing current in a neighbouring coil.

secondary air. *Noun.* Combustion air injected over the flame or fuel bed of a kiln to enhance completeness of combustion.

secondary cell. *Noun.* An electric cell that can be recharged and used to store electrical energy in the form of chemical energy.

secondary clay. *Noun.* Clay that has been moved geologically from the site of its formation to another and as a result has become mixed with alkalies, **limestone**, **magnesia**, and **iron oxides**. Usually **kaolin** based but is more plastic than **primary clay**.

secondary colour. *Noun.* A colour formed by mixing two primary colours.

secondary crusher. *Noun.* A crushing device used after the initial crushing operation to reduce further the particle size of a material.

secondary deposit. *Noun.* Mineral and ore collections deposited further down from minerals weathered over long time periods. Since they have been frequently dissolved from the original ore they have recrystallised as large colourful crystals.

secondary emission. *Noun.* The emission of electrons from a solid by bombardment with a beam of electrons. Ions or metastable atoms. The principle of the electron multiplier.

secondary expansion. *Noun.* The permanent expansion of fireclay brick during service.

secondary fining. *Noun.* The process of re-dissolving very small bubbles of O_2 , CO_2 and SO_2 left after **primary fining** by slow cooling from 1,350 to 1,200 °C over 1–2 h in a glass making tank. Nitrogen cannot be removed this way.

secondary ion mass spectrometry. *Noun.* An image-depth-profiling technique where ion images are sequentially recorded as a sample is sputtered. Insulating ceramics have to be metal coated to prevent sample charging. Depth resolution as good as 10 nm can be achieved over a 1 μm cross-section. The method can be used to assess composition variability.

secondary maximum of permeability, SMP, k_p . *Noun.* The **orbital magnetic moment** in a **ceramic ferrite** is sometimes not totally quenched and so it interacts with the spin moment to create anisotropy of magnetisation. The interaction is temperature dependent and the temperature at which k_p becomes zero corresponds to a maximum in the temperature dependence of **permeability**, which is the SMP.

secondary modulus. *Noun.* **Young's modulus** of a fibre-reinforced composite at strain values beyond that at which the brittle matrix has fractured but the fibres are still intact.

secondary recrystallisation. *Noun.* The process by which large grains are nucleated and grow at the expense of a fine-grained but essentially strain-free matrix.

secondary reference standard. *Noun.* A standard calibrated relative to a primary standard. Usually prepared from typical production material.

second harmonic generation. *Noun.* Frequency doubling. See **non-linear optical materials**.

second order transition. *Noun.* See **glass transition**.

second side. *Noun.* The final or exposed face side of a **plate glass** to be ground and polished.

sectile. *Adjective.* Able to be cut smoothly.

sedigraph. *Noun.* An instrument designed to indicate the particle size distribution of a powder by suspending it in a fluid and noting the sedimentation rate.

sediment. *Noun.* (1) Material that has been deposited from ice, water or wind. (2) Material that settles to the bottom of a liquid.

sediment analyser, Woods hole. *Noun.* See **Woods hole sediment analyser**.

sedimentary. *Adjective.* (1) Of rocks: formed by the accumulation and consolidation of minerals etc. deposited by water, wind or ice. (2) Characteristic of or resembling **sediment**.

sedimentary clay. *Noun.* Clay, which, geologically, has been moved from its point of origin to another but does not necessarily, becomes mixed like **secondary clay**. It is usually formed when silts are washed into lakes and lagoons.

sedimentary rocks. *Noun.* The group of rocks formed from compacting sediment produced by the erosion of other rocks and organic debris in water and subjected to elevated temperature over a geological time scale.

sedimentation. *Noun.* (1) The process of the deposition or settling of matter suspended in a liquid. (2) The appearance of free water on the surface of fresh concrete resulting from the settlement of solid particles and the consequent relative movement of water upward.

sedimentation rate. *Noun.* The rate at which particles settle from a liquid suspension.

sedimentation volume. *Noun.* The volume of particles settled from a liquid suspension.

SEDS. *Acronym.* Stands for solution enhanced dispersion by supercritical fluids. See **solution enhanced dispersion by supercritical fluids**.

Seebeck coefficient. *Noun.* See **Seebeck effect**.

Seebeck effect. *Noun.* Generation of electricity from heat by some ceramics and inorganic materials that are called **thermoelectric materials**. When two dissimilar electrical conductors are maintained at different temperatures an electromotive force is developed known as the **Seebeck emf** and this finds use in thermocouples. The process is inefficient and the **figure of merit, ZT**, is evaluated as $ZT = S^2 \sigma T / \kappa$, where S is the Seebeck coefficient, σ is the electrical conductivity, T is the absolute temperature, and κ is the thermal conductivity. To maximise ZT the electrical conductivity of the material should be raised whilst the heat **phonon** transport should be reduced.

Seebeck emf. *Noun.* See **Seebeck effect**.

seed. *Noun.* (1) A small, fraction of a millimeter diameter, gaseous inclusion in glass. (2) A small single crystal of a material used to start the growth of a large crystal. (3) *Verb trans.* To add a small crystal to a supercooled or supersaturated solution to bring about crystallisation.

seed-free time. *Noun.* The total melting time needed to produce glass, sufficiently free from gas bubbles, to be used.

seedy glass. *Noun.* Molten glass containing gaseous inclusions ≥ 1 mm in diameter.

Seger cone. *Noun.* Any of a series of pyramidal thermometric devices made of materials or mixtures of materials which deform at known temperatures and which are used to indicate the thermal history of ceramic bodies and glazes during the firing operation.

Seger formula. *Noun.* A molecular formula applied to glazes and porcelain-enamels in which the oxide constituents are classified in three groups whose sum equals 1, MO (the **alkaline oxides**), M_2O_3 (the intermediate oxides), and MO_2 (the so-called **acidic oxides**).

segmental arch. *Noun.* A circular or rounded arch having a curved surface less than a semicircle.

segmented belt. *Noun.* A coated abrasive belt made of sections of belt spliced together. The segments are necessary to obtain belts wider than 1.25 m, the widest coating width generally available.

segmented melter. *Noun.* Also called **modular melter**; it is an industrial glass making process where the stages: **batch blanket**, **sand dissolution**, **fining**, and **refining**, are physically separated. This allows for a smaller tank volume per ton of molten glass per day.

segment. *Noun.* Bonded abrasive section of various shapes that can be assembled to form a continuous or intermittent circular grinding surface.

segmented wheel. *Noun.* An abrasive wheel composed of segments of bonded abrasives assembled to form a complete wheel.

segregate. *Verb.* (1) To separate the ingredients of a mixture, such as fine portions from coarser portions. (2) To separate coarse aggregates in concrete from the mortar or main mass of the concrete.

segregation. *Noun.* (1) The concentration of crystal impurities at free surfaces. (2) Compositional differences occurring during the cooling of some types of solid solution.

seignette-electric. *Noun.* A **ferroelectric** crystal that is used in ceramic capacitors, transducers, and dielectric amplifiers.

selective absorption. *Noun.* The absorption of certain wavelengths of light in preference to others; almost all coloured materials owe their colour to this process.

selective laser sintering. *Noun.* A process involving sintering of successive layers of powder stacked on top of each other by using a laser beam for the heating source.

selective oxidation. *Noun.* A situation where oxygen attacks only one phase in a mixture or composite material.

selectivity. *Noun.* The characteristic of a testing system that is a measure of the extent to which an instrument is capable of differentiating between a desired signal and disturbances of other frequencies or phases in electromagnetic testing.

selenite. *Noun.* A colourless, glassy variety of **gypsum**.

selenium. *Noun.* Se. A **metalloid** that is photovoltaic, photoconductive and semiconducting. Has several allotropic forms the commonest of which is the grey form. Used in glass as a decoloriser, both in elemental and compound forms; also employed to produce red and ruby colours in glass, glazes, and porcelain-enamel. Now widely used in solar cells and photocells. Mp 217 °C; volatilises at 688 °C; density 4,200–4,800 kg m⁻³.

selenium ruby. *Noun.* A ruby-red glass containing selenium oxide, **cadmium sulphide**, **arsenic oxide**, and carbon; produced in a **reducing atmosphere**.

self-aligned silicide process. Salicide. *Noun.* A technique used in semiconductor chip manufacture whereby a metal film is deposited on to **polysilicon** and then heated by a laser or a plasma to induce a reaction to form MSi_2 , where M is Ti, W, or Co. The disilicide connectors or components have a lower electrical resistance than silicon.

self-assembly. *Noun.* A structure that builds itself from modular units. An ordered pattern forms from a disordered state; driven by weak interactions among the building blocks. Absorbing energy from the environment lowers the **entropy**. See **self-replication**.

self-cleaning enamel. *Noun.* Porcelain-enamel coatings containing additions of selected materials which, when applied to culinary ovens, will promote oxidation of grease and oven spills continuously during oven use.

self-consistent field. *Noun.* An approximation method used to calculate the energy levels of electrons in many-electron atoms. It involves the assumption that the energy states are similar to those in the hydrogen atom and following a guess at the electrostatic field a first calculation of the energy levels is made. This process yields a new potential and the process is repeated until the calculated potential agrees with the one used to derive it.

self-diffusion. *Noun.* The interchange of atomic or ionic positions in a pure crystal. Often measured as the diffusion of a tracer atom in a solid of the same element.

self-discharge. *Noun.* The decrease in **capacity** of a **cell** kept in open-circuit conditions that result from short circuits and internal chemical reactions.

self-emulsifier. *Noun.* A penetrating material that emulsifies spontaneously in water, and which may be

rinsed from a specimen more readily than if it were removed by dissolving in the rinse water.

self-propagating high-temperature synthesis. *SHS. Noun.* A combined method of ceramic synthesis and forming which utilises the heat of exothermic reactions between precursor components. Temperatures in excess of 2,500 °C can be achieved without the use of a furnace and processing times are on the order of minutes rather than days as in conventional processing. The **thermite reaction** is an example: $2\text{Al} + \text{Fe}_2\text{O}_3 = \text{Al}_2\text{O}_3 + 2\text{Fe}$.

self-replication. *Noun.* A concept in **nanotechnology** where **nanomachines** build themselves without human intervention. See **self-assembly**.

self-similarity. *Noun.* A fractal property whereby a structure generated by the forming process, for example the addition of equal sized particles around a central particle to form aggregates, is scale invariant: if a portion is enlarged the new object is identical to the initial object.

self-slip. *Noun.* An archaic term describing the fine layer resulting from the wet-surface smoothing of clay vessels.

self-sustaining discharge. *Noun.* An electrical discharge in which all carriers necessary for the transport of current in the discharge are produced by the discharge itself.

self-twist spinning. *Noun.* A method of making **yarn** from rovings fed to a drafting unit and the emerging strand of fibres is subjected to cyclically reversing false twisting action.

seller. *Noun.* The supplier of a material defined by a purchase order.

selsyn. *Noun.* A device for sensing motion of a distant point and producing an electric signal.

selvage. *Noun.* (1) The formed edge of a ribbon of rolled glass. (2) The woven ends of the filling yarns forming a fabric edge. (3) The plasma formed on or just above a surface being sputtered. Also called **selvedge**.

selvedge. *Noun.* Synonym for selvage. See **selvage**.

semiconducting crystal. *Noun.* A crystal, such as silicon or germanium, which exhibits an electrical conductivity between that of a metallic material and an insulator and in which the electrical resistance decreases as the temperature rises. Charge is carried by electrons, **n-type**, or by positive **holes** in the conduction band, **p-type**.

semiconducting glaze. *Noun.* A ceramic glaze containing metal oxides in sufficient quantities to promote a degree of electrical conductivity to prevent surface discharge or flashover.

semiconductor. *Noun.* (1) A substance, such as **germanium**, **silicon**, **gallium arsenide**, that has an electrical conductivity somewhere between that of a metal and an insulator and which increases as the temperature is raised. If the material is pure it is an **intrinsic** semiconductor with both electrons and **holes** contributing to the conductivity. If one type of carrier is made to dominate by **doping** it is either an **n-type** or **p-type** semiconductor. See **semiconducting crystal**. (2) Used as a modifier: semiconductor diode. (3) A device that depends on the properties of such materials, for example **transistor**, **integrated circuit**.

semiconductor device. *Noun.* An electronic instrument in which electronic conduction occurs within a semiconductor.

semiconductor diode. *Noun.* A two-electrode semiconductor or two-terminal device that employs the properties of semiconductors to exhibit rectifying properties at the point of contact.

semiconductor diode laser. *Noun.* A device in which stimulated emission of coherent light occurs at a **p-n junction** when electrons and **holes** are driven into the junction by carrier injection, electron-beam excitation, impact ionisation, optical excitation, or other means and recombine. Emission wavelength is determined by the **band gap** and can be tuned by varying the electric current, temperature and composition of the laser. Very efficient with about 50 % electrical to optical conversion. Based on III–V and II–VI semiconductors. See **diode laser**.

semiconductor, metal oxide. *Noun.* See **metal oxide semiconductor**.

semifriable alumina. *Noun.* A hard abrasive grade of **recrystallised alumina** in which the Al_2O_3 content ranges between 96 and 98 %.

semi-matte glaze. *Noun.* A ceramic glaze exhibiting only a moderate degree of gloss that is considered to be between **high gloss** and **matte** in appearance.

semi-muffle furnace. *Noun.* A gas- or oil-fired furnace constructed with a partial muffle to prevent the flame from impinging directly on the ware being fired, but in which the products of combustion gases can come in contact with the ware.

semipermanent mould. *Noun.* A reusable mould.

semiporcelain. *Noun.* **Stone china**; a trade term designating dinnerware having a moderate water absorption of 0.3–3.0 %; only partly vitreous from a lowish temperature firing; a type of **stoneware**.

semiprecious. *Adjective.* A type of gemstone having commercial value but less than a precious stone.

semi-silica fireclay brick. *Noun.* A **fireclay brick** containing not less than 72 % silica.

semisolid. *Adjective.* Having a rigidity and viscosity in between those of a solid and a liquid. (2) *Noun.* A substance in the adjectival state.

semivitreous. *Adjective.* The degree of **vitrification** indicated by moderate water absorption of 0.3–3.0 %, except for wall and floor tile, in which the water absorption may range from 3.0–7.0 %.

semivitreous china. *Noun.* A **dinnerware** or other ceramic product exhibiting a moderate degree of water absorption.

SEN. *Acronym.* Stands for submerged entry nozzle. See **submerged entry nozzle**.

senarmontite. *Noun.* Cubic **antimony oxide** in a mineral form with a grey to white colour.

sensible heat. *Noun.* The heat that raises the temperature of a body in which it comes in contact; the sum of the **internal energy** of a body or system plus the product of the system's volume multiplied by the pressure exerted on the system by its surroundings.

sensitivity. *Noun.* (1) The lowest concentration that can be determined by a method. (2) The smallest unit load change that can be measured on a tensile testing machine.

sensitiser. *Noun.* An ion added to a **luminescent** material to increase the efficiency of **activation**.

sensitising compounds. *Plural noun.* Metal salts in aqueous or organic solutions that form an invisible film on glass and ceramic surfaces, and which initiate or hasten subsequent surface treatments such as silvering and plating; examples are the chlorides of tin, gold and palladium, some salts of aluminium, barium, cadmium, iridium, and silver.

sensor. *Noun.* A generic term for an instrument that measures or detects a change in a value such as physical property and records, indicates, or otherwise responds to it. Many sensors are **piezoelectric ceramic** semiconductors.

sentinel pyrometer. *Noun.* A small cylinder of standardised composition that melts at a predetermined temperature; used to measure and control thermal treatments of materials in kilns and furnaces.

separated aggregate. *Noun.* Concrete aggregate that has been classified into fine and coarse components.

separating powder. *Noun.* A powder applied to a surface, as in a mould, to facilitate the removal of ware after forming.

separation, chemical. *Noun.* See **chemical separation**.

separation, gravity. *Noun.* See **gravity separation**.

separation, magnetic. *Noun.* See **magnetic separator**.

separation, mechanical. *Noun.* See **mechanical separation**.

separation, physical. *Noun.* See **physical separation**.

separator. *Noun.* (1) A device employed to separate different kinds and sizes of materials from others. (2) In a cell or battery it is an electronically non-conducting, but ion-permeable, material that prevents electrodes of opposite polarity making contact.

separator, air. *Noun.* See **air separator**.

separator, magnetic. *Noun.* See **magnetic separator**.

sepiolite. *Noun.* $\text{Mg}_9\text{Si}_{12}\text{O}_{30}(\text{OH})_6 \cdot 10\text{H}_2\text{O}$. A soft, light-weight, absorbent clay-like mineral. Not strictly a sheet silicate but has a similar structure to **talc** and is a fibrous silicate. Channels in the crystal structure are filled with water molecules which when driven out leave a very reactive material. Used in **poultice plaster** and **sacrificial plaster**. **Meerschaum** is mainly dehydrated sepiolite. Density $2,000 \text{ kg m}^{-3}$; hardness (Mohs) 2–2.5.

sequence. *Noun.* An orderly progression of operations to assure optimum utilisation of production facilities.

sericite. *Noun.* $\text{KAl}_3(\text{Si}_3\text{Al})\text{O}_{10}(\text{OH})_2$. A fine-grained, **potassium mica**; a **pyrophyllite** refractory. It is the major component of **pottery stone**. See **muscovite**.

serpentine. *Noun.* $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$. Sometimes used in **forsterite** refractories. A **two-layer silicate** of green mottled appearance. Density $2,500\text{--}2,650 \text{ kg m}^{-3}$; hardness (Mohs) 2.5–4.

serrated godet. *Noun.* See **godet wheel**.

serrated saddle. *Noun.* A grooved or notched item of **kiln furniture** to support ceramic **whiteware** on edge during firing.

SERS. *Acronym.* Stands for surface enhanced Raman spectroscopy. See **surface enhanced Raman spectroscopy**.

service life. *Noun.* (1) The period of time an item may be used economically before breakdown. (2) The elapsed time until the end-point is reached in an adsorption or other process.

service life, accelerated. *Noun.* See **accelerated-service life**.

service test. *Noun.* A test conducted on a product under simulated or actual conditions of use to determine if the product will perform satisfactorily under such conditions.

servitor. *Noun.* A workman who shapes the stem and base of goblets and footed **stem ware**.

servomechanism. *Noun.* A device for turning electrical signals into mechanical movements.

sesquicarbonate. *Noun.* Carbonate and hydrogen carbonate anions in the same salt, such as: $\text{Na}_3(\text{CO}_3)(\text{HCO}_3) \cdot 2\text{H}_2\text{O}$.

sesquioxide. *Noun.* Oxides in which the unit cell contains three atoms of oxygen to every two of metal, for example, Cr_2O_3 .

sessile. *Adjective.* (1) Attached directly by the base. (2) permanently attached and not free to move about. (3) Cannot **glide** but climbs; a property of a **Frank partial dislocation**.

sessile dislocation. *Noun.* A **partial dislocation** that can exist in a **face-centred cubic** structure. It cannot glide in the usual manner but only by the diffusion of atoms to or from the perimeter of the fault. They can interact with other dislocations and since they cannot glide freely they become strong obstacles to the passage of slip dislocations.

sessile drop. *Noun.* A liquid drop sited on top of a flat horizontal surface and attached to it.

sessile drop method. *Noun.* A method of measuring the **surface energy** of a material, such as a metal or ceramic by determining the **contact angle** the drop makes with the flat surface.

set. *Noun.* (1) The consistency and flow properties of a porcelain-enamel slip which affect its suspension characteristics, rate of drain, residual thickness and uniformity of coating. (2) *Verb.* To place ware in a kiln. (3) Strain remaining after complete removal of stress.

set at break. *Noun.* The elongation of a tensile test specimen measured 10 min after rupture on the reassembled specimen.

set, false. *Noun.* See **false set**.

set, final. *Noun.* See **final set**.

set, flash. *Noun.* See **flash set**.

set, initial. *Noun.* See **initial set**.

sett. *Noun.* A rectangular block of stone or a brick used to pave streets and paths etc.

setter. *Noun.* (1) An item of kiln furniture shaped to conform with the undersurface of ware and which serves to support the ware in the kiln during firing. (2) A type of **sagger** designed to conserve kiln space, the contour of its upper side conforming with the contour of the lower surface of the ware to be fired so that saggars may be stacked or arranged compactly in the kiln. (3) The operator placing ware in a kiln.

setting. *Verb.* (1) The arrangement or placement of ware on a kiln car or in a kiln. (2) The hardening of plaster or cement.

setting block. *Noun.* Blocks of lead or other nonabsorbent material bedded in a glazing compound on which glass is positioned in a window or other opening.

setting dock. *Noun.* An area in a ceramics factory where ware is held prior to loading on a kiln car. Also called a **drawing dock**.

setting pocket. *Noun.* A technique for hand-placing refractory shapes in a kiln to minimise deformation and the development of stresses in the ware during firing.

setting rate. *Noun.* (1) A comparative term referring to the time required for a glass surface to cool within the limits of the working range. (2) The elapsed time in which **lime, mortar, plaster**, or concrete hardens.

setting time. *Noun.* The period of time elapsed between the mixing of water with plaster or cement and certain arbitrary points in the hydration or setting process as determined by the penetration of a standard Vicat needle into a sample of the plaster, cement paste, or concrete in a specified period of time. See **Vicat needle**.

setting-up (setup) agent. *Noun.* An electrolyte, such as MgCO_3 , K_2CO_3 , Na_2CO_3 , or MgSO_4 added to porcelain-enamels, glazes, and other slurries to **flocculate** and improve the suspension properties of clays.

settle mark. *Noun.* A wrinkled surface appearing on glassware as a result of uneven cooling during the forming process.

settlement crack. *Noun.* A crack in the **soffit** of a concrete beam, or at the top of a concrete wall or column where it joins a slab, the crack resulting from stresses developing in the joint during the continuous placement of the concrete.

settling. *Noun.* The sedimentary process which causes particles of clay, glaze, porcelain-enamel, or other materials suspended in water or other liquids to sink to the bottom of a container.

settling tank. *Noun.* A tank or reservoir into which slurries of various components are placed to permit **settling** of solid materials to be accomplished by gravity.

setup wheel. *Noun.* An abrasive wheel fabricated by compressing a series of sheets of abrasive-coated fabrics into wheel form.

Sèvres. *Noun.* An elaborately decorated, clear-coloured porcelain ware made at Sèvres near Paris since 1756.

sewage (wastewater). *Noun.* The spent water of a community, which is a mixture of liquid and water-carried waste.

sewer. *Noun.* A pipeline constructed to convey sewage to a disposal area.

sewer brick. *Noun.* A low-absorption, abrasion-resistant brick intended for use in the construction of drainage systems. Made from **clay** or **shale**.

sewer pipe. *Noun.* An impervious pipe, sometimes glazed; intended for construction of a **sewer** and use in the transport of water and sewage to a disposal area.

sewer, storm. *Noun.* See **storm sewer**.

sewer tile. *Noun.* An impervious tile of circular cross-section intended for use in drainage systems.

SFF. *Abbreviation.* Stands for solid freeform fabrication. See **solid freeform fabrication**.

S-glass. *Noun.* A high-strength, hence the designation S, **magnesia, alumina, silica** glass; used to make glass fibres.

sgraffito. *Noun.* A decoration used on pottery and other ware with an enamelled surface on which a linear drawing is scratched through an unfired **engobe** or glaze to expose a differently coloured body or contrasting fired surface beneath; the item is then re-fired.

shade. *Noun.* A particular depth or intensity of **hue**.

shaded sandblast. *Verb.* To obscure a surface by sand-blasting and obtain textures ranging from clear to full obscuration.

shadow wall. *Noun.* A more or less solid structure built on the top of the **bridge wall** of a **glass tank**, or suspended from the **crown**, to limit the flow of heat from the **glass-melting zone** to the **refining zone** of the tank.

shaft. *Noun.* (1) The vertical conduit or flue for venting combustion and other gaseous wastes. (2) The refractory-lined cone-shaped section of a blast furnace or **cupola** above the hearth and melting zone and extending to the **throat**.

shaft, feed. *Noun.* See **feed shaft**.

shaft kiln. *Noun.* An essentially vertical, refractory-lined furnace for heating lump material; the raw material is normally fed into the top of the kiln, passing through hot gases from burners stationed near the bottom, and emerges as a **calcined** product at the bottom of the kiln.

shaft mixer. *Noun.* A continuous blender consisting of a bladed rotating shaft that mixes and forces materials through an open trough, such as in a **pug mill**.

shaker screen. *Noun.* A mechanically vibrating screening device employed to separate materials into desired particle sizes or to separate larger sizes from the smaller.

shaker table. *Noun.* A slightly tilted vibrating table having a flat, rectangular, and sometimes riffled surface used to separate solid materials according to density and particle size, the larger and heavier particles moving to the bottom edge of the table first.

shaking gold. *Noun.* A liquid burnishing suspension that requires vigorous shaking to redisperse any settled gold particles.

shale. *Noun.* A thinly stratified or laminated, sedimentary and consolidated rock with well-marked cleavage, composed of **clay, quartz, mica** and other minerals.

shale clay. *Noun.* Finely ground **shale**, sometimes used as clay.

shamotte. *Noun.* A **refractory clay** or **grog**, which has been **calcined** for use as a nonplastic material in ceramic body compositions.

shape. *Noun.* (1) The geometrical configuration or visual appearance of a solid body. (2) *Verb.* To form a body to a desired configuration.

shape factor. *Noun.* The ratio of the major dimension of a particle to the minor dimension. Useful when comparing particles that otherwise have similar physical properties.

shape memory alloys. *Plural noun.* Ceramic or metal alloys that can “remember” their previous shape and return to it when stimulated. **One-way alloys** will change shape once and remain in that shape. **Two-way alloys** will alternate repeatedly between two different shapes.

shape, standard. *Noun.* See **standard shapes**.

shaping block. *Noun.* A wood paddle or block used in the shaping of glass on a blowpipe.

shard. *Noun.* (1) A broken piece of brittle material, particularly pottery. Also known as **sherd**, and **pitchers**. (2) Fired pottery milled to a powder that is suitable for use as a replacement for **grog** or **silica** to reduce shrinkage without altering the composition of a ceramic body.

sharp. *Adjective.* Having an edge or point not blunt or rounded.

sharp fire. *Noun.* Combustion with an excess of air and a short flame.

sharp notch strength. *Noun.* The maximum nominal stress a sharply notched specimen can stand.

sharp sand. *Noun.* A sand free of bonding agent; the term has no connection with grain shape.

sharp transition interface. *Noun.* An interface between two phases showing little mixture of atoms on either side of the interface. This is sought after in semiconductor technology because it has a high current efficiency as electrons pass over easily in contrast to **soft transition interface**.

shatter. *Verb trans.* To break into very many small pieces.

shatterproof. *Adjective.* Designed to resist shattering.

shatterproof glass. *Noun.* Two sheets of glass with a sheet of transparent plastic moulded between the sheets under heat and pressure. See **safety glass**.

shaving. *Verb.* (1) To shave, scrape and pare **leather-hard clay** from the wall and foot of a pot on a lathe or potter's wheel. (2) To shape or remove excess material from a grinding wheel before firing the wheel.

Shaw kiln. *Noun.* A gas-fired chamber kiln in which a portion of the heat is introduced beneath the floor of

the kiln to minimise temperature differences in the firing zone.

shear. *Noun.* (1) The deformation or fracture of a solid under a load that causes one face of the fractured solid to slide against an adjoining face along a parallel plane. (2) The lateral displacement between two points in parallel planes divided by the distance between the planes. (3) A manual tool or a mechanical device consisting of two opposing sliding blades between which a material is cut. (4) Scissors. (5) *Verb.* To deform or fracture as a result of excess transverse load or torsion.

shear cake. *Noun.* A counterweighted refractory slab used as a gate or door on a small furnace or oven.

shear coupling. *Noun.* A **shear strain** in **anisotropic** materials induced by normal stress.

shear diagram. *Noun.* A graphical representation of the internal shear load variation along a bent beam.

Shearer plastometer. *Noun.* An instrument to measure the flow properties of slurries calculated as the time for a specified volume of the slurry to flow through a tube of specified diameter.

shear fire. *Noun.* A thin flame employed to sever the **moil** from a shaped glass article.

shear force. *Noun.* A force that is directed parallel to the surface across which it acts.

shear fracture. *Noun.* Failure in crystalline materials due to movement on **slip planes** oriented in the direction of the **shear stress**.

shearing stress. *Noun.* The tangential shearing force divided by the area it is acting on to produce motion or flow.

shear mark. *Noun.* A scar appearing in glassware as a result of the cooling action of the cool cutting shears on the hot, but rigid, glass.

shear modulus. *Noun.* The ratio of **shear stress**, τ , to **shear strain**, γ . $G = \tau/\gamma$, units are N m^{-2} .

shearography. *Noun.* A non-destructive inspection method based on coherent **laser** light which gives a full field video image of component flaws in contrast to the usual point by point scanning methods. The component is uniformly stressed which generates strain, but the surface strain is changed by sub-surface flaws and when the image from the unstressed surface is compared to that from the strained surface an image showing the sub-surface flaws can be constructed.

shear pin. *Noun.* An easily replaceable pin put into a machine at an accessible point and designed to shear and stop the machine if it becomes overloaded.

shear span. *Noun.* On a symmetrically loaded beam it is twice the distance between a reaction and the nearest load point.

shear span to depth ratio. *Noun.* The numerical ratio of the **shear span** divided by the beam depth.

shear strain. γ . *Noun.* The ratio of the relative lateral displacement between two points lying in parallel planes in a solid to the vertical distance between the points shearing.

shear strength. *Noun.* The maximum **shear stress** a material can withstand without rupture.

shear stress. τ . *Noun.* The force exerted by the material on one side of a plane surface pushing on the material on the other side of the surface, the force being parallel to the surface, divided by the area of the plane on which it is acting.

shear stud. *Noun.* A stud-shaped component welded to a metal part that transfers shear stress between metal and concrete in composite structural members.

shear-thinning. *Noun.* A rheology state where increasing the shear rate in a rotational viscometer registers as a drop in measured viscosity over all shear rates. This is desirable for ceramic processing. Most ceramic suspensions are shear-thinning at low shear rates but all ceramic suspensions exhibit dilatancy at high shear rates. See **dilatancy**, **thixotropy**.

shear thickening. *Noun.* A description of **dilatan**t behaviour. See **flow curves**.

shear wave. *Noun.* Where particle motion is parallel to the direction of propagation of the wave front.

sheath. *Noun.* A protective covering.

sheathing. *Noun.* A material used as an outer layer.

sheave. *Noun.* A wheel with a grooved rim.

sheen. *Noun.* A glistening brightness; **lustre**.

sheen matte. *Noun.* A low-firing temperature glaze formed from **zinc borate** (30 wt.%), **talc** (30 wt.%), and **nepheline syenite** (40 wt.%).

sheet. *Noun.* (1) A thick film made by casting or extrusion; the thickness must exceed 0.25 mm to be classed as a sheet. (2) A thin piece of material, usually in rectangular form.

sheet glass. *Adjective.* A generic term including **sheet**, **plate**, **rolled**, **float** and other forms of glass that are of a flat geometry.

sheet moulding compound. **SMC.** *Noun.* A thermosetting compound mixed with fibreglass and rolled into sheets that can be cut and shaped.

sheet silicates. *Plural noun.* Formed when three oxygens in each $(\text{SiO}_4)^{4-}$ tetrahedron are shared to form giant negative ions extending in two-dimensions. The sheet consists of $(\text{Si}_2\text{O}_5)^{2-}$ units held together in a stacking sequence by metal cations.

sheet-steel enamel. *Noun.* A porcelain-enamel designed for application to ware fabricated from sheet steel.

sheet, tangle. *Noun.* See **tangle sheet**.

shelf life. *Noun.* The maximum time a material or artefact can be stored under specified conditions and still meet all specified performance criteria and fulfil its intended function.

shell. *Noun.* Energy levels or groups of **orbitals** occupied by electrons in atoms and molecules. More precisely it is the set of **quantum states** with the same **principal quantum number, n**.

shellac bond. *Noun.* A bonding material in which shellac is the major constituent, and which is used in the manufacture of shellac-bonded abrasives.

shellac wheel. *Noun.* A grinding wheel in which the abrasive grains are bonded together with a shellac-type bonding medium.

shelling. *Noun.* (1) The breaking away of a layer of refractory from the roof of an all-basic, open-hearth furnace. (2) The flaking of glaze from ware due to failure to develop sufficient bond during firing.

shell moulding. *Verb.* To form a rigid, porous, self-supporting refractory mould by sprinkling a mixture of moulding sand thermoplastic material over a preheated metal pattern and then curing in an oven.

shell roof. *Noun.* A thin, curved, plate-like roof, usually constructed of concrete.

shells. *Noun.* (1) The outer walls of hollow structural clay tiles and building blocks. (2) The outer walls of a structure or vessel.

shell wall. *Noun.* A fireclay, refractory wall protecting the metal casing of air preheaters.

shelly limestone. *Noun.* **Limestone** rock containing the remains of, or the impressions made by former plants or animals.

shelving. *Noun.* The erosion of the horizontal joints of **fireclay refractories** in a **glass tank**.

sherd. *Noun.* Alternative spelling of **shard**. See **shard**. Also known as **pitchers**.

SHG. *Abbreviation.* Stands for second harmonic generation. See **non-linear optical materials**.

shield. *Noun.* The material placed around a nuclear reactor, or other source of radiation, to reduce or prevent the escape of radiation or radioactive particles from the reactor.

shield, heat. *Noun.* See **heat shield**.

shielding glass. *Noun.* A transparent glass containing quantities of the oxides of the heavy elements, such as lead, which absorb high-energy electromagnetic radiation and which are employed to shield one region of space from ionising radiation emanating from another, such as in nuclear applications.

shift, phase. *Noun.* See **phase shift**.

shiner, shiner scale. *Noun.* A defect characterised by minute, shiny fish scaling occurring on a thin or over-fired porcelain-enamel ground coat.

shingle. *Noun.* (1) A thin rectangular tile composed of 30 % **asphalt**, 70 % rock granules and a small amount of copper to retard moss lichen, fungus and algal growth. **Stamp sand** can be used to replace the copper and rock. They are placed in overlapping rows as a roof covering or siding of a building. (2) Coarse gravel especially **pebbles** lying on a beach. (3) *Verb trans.* To cover a roof with shingles. (4) *Verb trans.* To squeeze the **slag** out of iron in the manufacture of wrought iron.

ship-and-galley tile. *Noun.* A quarry tile with an indented pattern on its face to produce an anti-slip surface when walked on, particularly when wet.

ship-in-the-bottle-catalyst. *Plural noun.* Catalyst supports formed from **zeolites**, which have been engineered to have cage sites within the structure of a chosen size to contain the catalyst able to selectively assist a given reaction.

shipment. *Noun.* All of the material of a given type obtained from one manufacturer in a delivery.

shipper-receiver difference. *Noun.* The difference between the quantity stated by a shipper as having been shipped and the quantity stated by the receiver as having been received.

shivering. *Noun.* The splintering of fired glazes, porcelain-enamels, or other ceramic coatings from a base material due to critical compressive stresses.

shock. *Noun.* The initial, short-duration part of an impact that subjects the target to the highest force.

shock load. *Noun.* Sudden application of an external force.

shock, resistance to thermal. *Noun.* See **thermal-shock resistance**.

shock, thermal. *Noun.* See **thermal shock**.

shock wave. *Noun.* A wave travelling at a speed greater than sound in a material along the front of which, pressure, density, and **internal energy** rise rapidly.

shoe. *Noun.* An open-ended crucible placed in the opening of a glass-melting pot for heating blowpipes.

shop. *Noun.* (1) A group of workmen engaged in an assigned activity or producing a particular item or end product. (2) A room, area, or other enclosure in which a particular work is done. (3) A factory.

Shore hardness. *Noun.* See **pendulum hardness**.

shorelines. *Noun.* A defect in the surface of porcelain-enamels characterised by a series of lines in a pattern similar in appearance to the lines produced on a shore by receding water.

Shore sclerometer. *Noun.* See **pendulum hardness**.

short. *Adjective.* Fast-setting, as describing some glasses, cements and mortars.

short beam test. *Noun.* A mechanical test designed to measure the interlaminar shear strength of a parallel fibre-reinforced material in three-point flexural loading.

short circuit. *Noun.* A connection of low resistance between two points of different potential in a circuit.

short circuit colloid vibration current. *Noun.* See **electroacoustic spectroscopy**.

short clay. *Noun.* Non-plastic clay having low green strength.

shortest arc. *Noun.* The limiting state of an electric arc in which the total arc voltage approaches the sum of the cathode and anode falls.

short fibres. *Noun.* Fibres falling in the 1–25 mm range.

short finish. *Noun.* An imperfection in plate glass resulting from incomplete polishing.

short fire. *Noun.* An air-deficient reducing flame.

short glass. *Noun.* (1) A fast-setting glass. (2) A body of low or poor workability.

short glaze. *Noun.* An area on the surface of ware in which insufficient glaze was applied to obtain a desired finish or appearance.

short-range order. *Noun.* Identical coordination of only the first near-neighbour atoms around each type of atom; typical of glassy structures.

short-term animal test. *Noun.* A procedure used to assess the safety of **man-made vitreous fibres**, whereby rats are exposed to a fibre aerosol containing 100 fibres cm⁻³ all larger than 20 µm in length, for a period of 5 days. A sample of rats is then killed and the number of fibres longer than 20 µm per lung is determined.

shot. *Noun.* Small glassy spherical particles appearing in fibrous products, such as glass or **mineral wool**, which have been manufactured by **rotary spinning** or **jet flame attenuation**.

shotblasting. *Verb.* To clean or treat the surface of ware by impelling small steel balls by a blast of compressed air.

shotcrete. *Noun.* A mixture of cement, sand, and water, applied through a hose with high-velocity compressed air, which will adhere tenaciously to a prepared concrete or other surface.

shot, flint. *Noun.* See **flint shot**.

shot noise. *Noun.* A form of background interference in photodetectors arising from statistical **phonon** fluctuations in a laser beam.

shot peening. *Verb.* See **peen, laser shock peening**.

shoulder-angle tile. *Noun.* Small wall-tile shapes; used to finish the top and bottom of corner installations.

shovel. *Noun.* (1) A hand tool equipped with a flattened scoop at the end of a handle for moving bulk solid materials. (2) A mechanical device equipped with a flattened, broad blade or scoop for moving bulk solid materials.

showering. *Noun.* A type of corona discharge of luminous streamers or plasma occurring in an electrical field of a value just below that required for a complete breakdown.

SHPB. *Abbreviation.* Stands for split Hopkinson pressure bar. See **split Hopkinson pressure bar test**.

shredder. *Noun.* A mechanical device employed to cut or tear clays and other plastic materials into sizes more amenable to subsequent handling and processing.

shrend. *Verb.* To make **cullet** by directing molten glass into a stream of water.

shrinkage. *Noun.* (1) The reduction in the dimensions of a body or substance during drying or firing. (2) Contraction of concrete in the plastic state or after it has become rigid, but before it has developed appreciable strength.

shrinkage, burning. *Noun.* See **firing shrinkage**.

shrinkage crack. *Noun.* A fissure resulting from uneven shrinkage of a body.

shrinkage, drying. *Noun.* See **drying shrinkage**.

shrinkage factor. *Noun.* The ratio of green state dimensions to the dimensions after firing.

shrinkage, firing. *Noun.* See **firing shrinkage**.

shrinkage, linear. *Noun.* See **linear shrinkage**.

shrinkage, plastic. *Noun.* See **plastic shrinkage**.

shrinkage rate. *Noun.* The amount of shrinkage of a substance per unit of time.

shrinkage volume. *Noun.* The contraction of a moist body during drying or firing, or both, expressed as the volume percent of the original volume.

shrinkage water. *Noun.* That portion of the **water of plasticity** of a body which, when removed, contributes to the drying shrinkage of the body.

shrink film. *Noun.* Prestretched or oriented film.

shrink fit. *Noun.* An annular bond formed by heating the outside member until it slides over the cooled inside member; contraction then produces the bond.

shrink-mixed concrete. *Noun.* Concrete in which the ingredients are partially mixed and then placed in a truck mixer where mixing is completed while in transit to the site of its use.

shrink wrapping. *Verb.* To encase a product in plastic, and then heat the plastic so that it will shrink to fit tightly.

SHS. *Abbreviation.* Stands for self-propagating high-temperature synthesis. Also called **combustion synthesis**. See **self-propagating high-temperature synthesis**.

shunt. *Noun.* In electronics it is a low-resistance conductor connected in parallel across a device, circuit, or part of a circuit to provide an alternative path for a known fraction of current.

shunt wound. *Adjective.* In a generator or electric motor it refers to having the field and armature circuits connected in parallel.

shuttle kiln. *Noun.* A kiln in which loaded cars are introduced at one end, ejecting cars of fired ware at the opposite end; the process is then reversed in which the ejected cars are unloaded, reloaded, and charged into the kiln at the end of ejection, and the process continues in a shuttle-like fashion.

SI. *Abbreviation.* Stands for *Système Internationale (d'Unités)*. See **SI units**.

µc-Si. *Abbreviation.* Stands for microcrystalline **silicon**.

sial. *Noun.* (1) A silica- and alumina-rich rock. (2) A **borosilicate glass** of high thermal and chemical resistance.

sialate. *Abbreviation.* Short for silicon-oxo-aluminate. See **silicon-oxo-aluminate**.

sialons. *Acronym.* Stands for silicon aluminium oxynitrides. See **silicon aluminium oxynitrides**.

sicalons. *Acronym.* Stands for silicon carbide aluminium oxynitrides. See **silicon carbide aluminium oxynitrides**.

siccative. *Adjective.* A material able to absorb moisture and act as a drying agent. Often part of a paint formulation.

side arch brick. *Noun.* A type of brick having face surfaces inclined toward each other in the shape of a wedge.

side-blown converter. *Noun.* A steel converter in which the air or oxygen blast strikes the molten iron through **tuyere** arranged along the refractory wall.

side-construction tile. *Noun.* Tile designed to receive its principal stress at right angles to the axis of the cells.

side-cut brick. *Noun.* An extruded brick which is wire-cut along the side instead of the end.

side-feather brick. *Noun.* A **featheredge brick** cut along the 22.9 by 7.62-cm plane.

side-fired furnace. *Noun.* A furnace in which fuel is supplied through ports in the side.

side-grinding. *Verb.* To grind on the side of an abrasive wheel mounted between flanges.

side lap. *Noun.* The shortest horizontal distance between the exposed side edge of a course of roofing or siding

material and the most proximate underlying area of roof deck or side wall not covered by the preceding adjacent course.

side pocket. *Noun.* A refractory-lined chamber at the bottom of a glass tank to catch slag and dust from waste gases before they enter the **regenerator**.

side-port furnace. *Noun.* A furnace with ports located along the sides through which fuel may be introduced or gases may escape.

siderite. *Noun.* (1) FeCO_3 . A pale-yellow to dark-brown hexagonal mineral used as a colourant in ceramic bodies and glazes, producing yellow-brown effect. Density 3,830–3,880 kg m^{-3} ; hardness (Mohs) 3.5–4. Also called **chalybite**. (2) A meteorite consisting mainly of metallic iron.

sidero-. *Combining form.* Indicating iron.

siderolite. *Noun.* A meteorite consisting of a mixture of iron, nickel, and **ferromagnesian** minerals, such as **olivine** and **pyroxene**.

side skew. *Noun.* A brick having one side inclined at an angle other than 90° to the two largest faces; used in the production of circular or curved structures.

siding. *Noun.* Material attached to the outside of a building to make it weatherproof.

siege. *Noun.* The refractory floor of a **pot furnace** or **glass tank**.

siemens. s. *Noun.* The derived **SI unit** of electrical **conductance** equal to 1 reciprocal ohm. Formerly called **mho**. Named after the electrical engineer W von Siemens.

sienna. *Noun.* A yellowish-brown ore containing hydrated iron and **manganese oxides** that become reddish coloured when fired and at this stage is called **burnt sienna**. Both unburnt and burnt forms are useful as colorants in slips, bodies, and glazes, particularly **celadons**. See **siennas**.

siennas. *Plural noun.* Pigments containing 30–75 % **iron oxide**, Fe_2O_3 , ranging in colour from yellow-brown to red-orange depending on the degree of calcination. See **sienna**.

sieve. *Noun.* A perforated or meshed device through which particles of a material or mixture are passed to separate them from coarser ones; through which soft materials are forced for reduction to particles of finer sizes; or through which liquid is strained.

sieve analysis. *Noun.* The determination of the size distribution of a material on a series of sieves of decreasing size, usually expressed in terms of weight percent of the sample retained on each sieve.

sieve classification. *Verb.* To separate solids into particle size ranges using a graded series of sieves.

sieve fraction. *Noun.* The part of a powder passing through a standard sieve of stated number but retained by a finer specified sieve.

sieve mesh. *Noun.* Any standardised opening, square in shape, bounded by four meshed wires in a sieve.

sieve number. *Noun.* A number, arising from the number of sieve cross-wires per linear 2.54 cm; used to denote the sieve size.

sievert, sv. *Noun.* A unit of ionising radiation equal to the dose equivalent of 1 J kg⁻¹. Named after R Sievert.

Sieverts's law. *Noun.* Hydrogen solubility in materials is proportional to the square root of the molecular hydrogen pressure.

sieve shaker. *Noun.* A mechanical device in which a stack of sieves, arranged in progressively reducing mesh or opening sizes, is shaken vigorously so that size fractions of a sample may be collected for analysis or use.

SIFCON. *Acronym.* Stands for slurry-infiltrated fibre concrete. See **slurry infiltrated fibre concrete**.

sift. *Verb.* (1) To sieve in order to remove coarser particles. (2) To scatter something over a surface through a sieve.

sighting tube. *Noun.* A ceramic tube, inserted in a kiln, through which an **optical pyrometer** is sighted to obtain a measurement of the temperature of the kiln.

sigma function. *Noun.* A property of a mixture of air and water vapour equal to the difference between the **enthalpy** and the product of the **specific humidity** and the enthalpy of water at the thermodynamic wet-bulb temperature.

signal, differentiated. *Noun.* See **differentiated signal**.

signal glass. *Noun.* Glass of various colours used in signal devices.

signal intensity. *Noun.* The electric-field strength of an electromagnetic wave transmitting a signal.

signal-to-noise ratio. *Noun.* An important parameter for ceramic sensors; it is the comparison of the signal the sensor is intended to measure to the background.

signal wave. *Noun.* See **optical parametric oscillator**.

silane coupling agents. *Plural noun.* Polymeric materials based on Si_nH_{2n+2} units that contain Si(OR₃) units and vinyl or amino groups. The Si(OR₃) groups react with inorganic reinforcement, such as glass fibre, alumina fibre, etc., while the vinyl group reacts with the resin. Hence, they bring about strong bonding between reinforcement and **matrix** in composites. They are usually added to the fibres in a pretreatment.

Silar SC-9. *Trademark, noun.* Commercially available **silicon carbide** fibre. Density 3,200 kg m⁻³; high strength 6.9 GN m⁻² and high stiffness 690 GN m⁻².

SILAR. *Acronym.* Stands for successive ionic layer adsorption and rinse. See **successive ionic layer adsorption**.

silc. *Acronym.* Stands for stress induced leakage current. See **gate oxide**.

silcrete. *Noun.* A **silica**-bonded conglomerate of **sand** and **gravel**.

silex. *Noun.* (1) A finely ground, pure form of quartz. (2) A thermal- and physical-shock-resistant glass containing approximately 98 % quartz. From Latin *silex* meaning **flint** or **quartz**.

silica. *Noun.* SiO₂. The overall inclusive name given to **silicon dioxide**, the most common mineral in the majority of sands; occurs in five crystalline polymorphs: **quartz**, **tridymite**, **crystalobalite**, **coesite**, and **stishovite**. Also has a **cryptocrystalline** form called **chalcedony** and has an amorphous and hydrated forms called **opal**. Used in the manufacture of glass, abrasives, numerous whiteware bodies and glazes, porcelain-enamels, refractories, foundry moulds, electric and electronic products, **carborundum**, ferrosilicon concrete and mortars, and other products. The name silica is often taken to mean the glassy, non-crystalline form of silicon dioxide. Mp 1,710 °C; bp 2,230 °C; density 2,200–2,600 kg m⁻³; hardness (Mohs) 7.

silica based fibres. *Plural noun.* A series of fibres containing different amounts of **silica**: **quartz** (>99.5 % SiO₂), high-silica (>95 % SiO₂) and silicate glass (>50 % SiO₂); all are formed through platinum bushes from melts into **single-strand fibre**.

silica brick. *Noun.* A refractory brick usually made from **ganister**, and containing at least 90 wt.% **silica**, bonded with **hydrated lime** and fired at a high temperature; characterised by high strength at elevated temperatures, high thermal conductivity, high abrasion resistance and poor resistance to molten basic slags. Used in furnace and kiln arches, such as the roofs of **open-hearth furnaces**, caps of **glass tanks**, the **crowns** of copper reverberation furnaces, etc. See **ganister**.

silica brick, drop-machine. *Noun.* See **drop-machine silica brick**.

silica brick, superduty. *Noun.* See **superduty silica brick**.

silica cement, silica fireclay. *Noun.* A refractory mortar consisting of a finely ground mixture of **quartzite**, **silica brick**, and **fireclay** in various proportions.

silica fireclay. *Noun.* See **silica cement**.

silica flour. *Noun.* Finely ground **quartz sand** employed as an additive in casting slips.

silica, free. *Noun.* See **free silica**.

silica fume. *Noun.* A by-product of silicon manufacture in the form of SiO₂ with a mean particle size of 0.15 µm. Typically the fume contains >96 % SiO₂ and <0.2 % Fe₂O₃. Used as a refractory filler in low-cement castables.

silica, fused. *Noun.* See **fused silica**.

silica gel. *Noun.* An amorphous, highly absorbent form of **silica** made by the action of hydrochloric acid on **sodium silicate**; hard, glossy, and **quartz**-like in appearance; a regenerative drier.

silica glass. *Noun.* A transparent or **translucent** glass obtained almost entirely from high-purity **quartz** or sand, or by hydrolysis of silicon tetrachloride. Also known as **fused silica**, **vitreous silica**.

silicolite. *Noun.* An **aluminosilicate** of the **zeolite** class containing straight channels along the b-axis interconnected by zigzag channels along the a-axis; both sets of channels are 0.55 nm in diameter.

silica modulus. *Noun.* The ratio of SiO_2 to $\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ in **hydraulic cement**.

silica refractory, fused. *Noun.* See **fused silica refractory**.

silica sand. *Noun.* **Sand** containing a very high percentage of free silica.

silicate. *Noun.* A compound composed of silicon, oxygen, and one or more metals. The structures are based on $[\text{SiO}_4]^{4-}$ tetrahedra linked from zero to four corner oxygen atoms with the appropriate change in ionic charge.

silicate bond. *Noun.* A type of binding phase consisting essentially of **sodium silicate** matured by baking at a temperature of approximately 260 °C.

silicate classification. *Noun.* A structural classification based on the number of shared oxygen ions per $[\text{SiO}_4]^{4-}$ tetrahedron. Any one tetrahedron may share from zero to four oxygens with adjacent tetrahedra; this leads to seven groups of silicates, such as **pyroxenes**, **orthosilicates** etc.

silicate grinding wheel. *Noun.* A grinding wheel in which the abrasive grain is bonded with **sodium silicate** plus filler materials.

silicate of soda. *Noun.* $\text{Na}_2\text{O-SiO}_2$, with ratios of Na_2O and SiO_2 varying widely, and with varying proportions of water; used as a **deflocculant** in ceramic bodies, and as a major component in air- and heat-curing cements.

silica, vitreous. *Noun.* See **vitreous silica**.

silica wash. *Noun.* A mould or core wash in which SiO_2 is the main refractory component.

siliceous or silicious. *Adjective.* Of, relating to or containing a high percentage of **silica**.

siliceous fireclay brick. *Noun.* Fireclay brick containing appreciable quantities of uncombined silica and is usually low in fluxing constituents.

silici-. *Combining form.* Indicates **silica** or **silicon**.

silicic. *Adjective.* Concerned with or containing **silicon**.

silicic acid. *Noun.* $\text{Si}(\text{OH})_4$ or $\text{H}_2\text{SiO}_3 \cdot n\text{H}_2\text{O}$. The monomeric species that exists in aqueous solutions of silicon at $\text{pH} < 9$. In the solid state it consists of a disordered three-dimensional network of $\text{Si}(\text{OH})_4$ tetrahedra and H_2O molecules. Occurs naturally in weathered sediments and it can be made by heating sodium silicate solution with hydrochloric acid.

silicide resistor. *Noun.* A binary compound of silicon, usually with a more electropositive element such as chromium or molybdenum, which is used under conditions where hardness and high resistance values are required.

silicides. *Noun.* Binary compounds of silicon, usually with a more electropositive element or radical such as chromium, molybdenum, titanium, etc. Used as abrasives, refractories, semiconductors, etc.

siliciferous. *Adjective.* Containing or yielding silicon or **silica**.

silicify. *Verb.* To convert or be converted into **silica**.

silicium. *Noun.* Little used alternative word for **silicon**.

silicolite. *Noun.* A generic name for the solid in a colloidal **sol** of **zeolite** nanoparticles.

silicon. *Noun.* Si. (1) A brittle metalloid element existing in two allotropic forms. Very abundant being part of **sand**, **quartz**, **granite**, **clay**, and **feldspar** etc. Used in **transistors**, **rectifiers**, **solar cells**, and high technology ceramics. Used extensively as its compounds in glass making and building materials and now found in plastics as **silicones**. Density 2,330 kg m^{-3} ; Mp 1,414 °C; bp 2,480 °C. (2) *Modifier.* Used to denote an area in a country that contains a high density of high-technology industries, for example **Silicon Valley** in the United States.

Silicon Alley. *Noun.* Area of New York in which industries associated with information technology are concentrated.

silicon aluminium oxynitrides. *Plural noun.* Discrete phases existing in the system $\text{SiO}_2\text{-Si}_3\text{N}_4\text{-Al}_2\text{O}_3\text{-AlN}$. Commonly called **sialons**. They arise because the structural unit of silicates, SiO_4 -tetrahedra, aluminates, AlO_4 -tetrahedra, and **silicon nitride**, SiN_4 -tetrahedra, are very similar in size and can substitute for each other in various parent structures. When AlO_4 -tetrahedra are involved, charge-compensating cations must be included in the structure. There are sialons based on the $\beta\text{-Si}_3\text{N}_4$ structure called β -sialons while α -sialons are based on the $\alpha\text{-Si}_3\text{N}_4$ structure. A general formula can be generated: $\text{M}_x\text{Si}_{12-m-n}\text{Al}_{m+n}\text{O}_n\text{N}_{16-n}$, where M is one of Li, Mg, Ca, Y and most of the lanthanides except La and Eu, m = the number of Si-N bonds in $\alpha\text{-Si}_3\text{N}_4$ replaced by Al-N, n = the number of Si-N bonds in $\alpha\text{-Si}_3\text{N}_4$ replaced by Al-O and $x = m/\text{cation valency}$. Many of the silicate structures have their sialon equivalent. All are extremely hard, many are tough and have sintering advantages.

silicon carbide. *Noun.* SiC. α -SiC has a hexagonal structure in which the packing sequence of SiC₄ and CSi₄ tetrahedra into covalently bonded layers is ABAB.... β -SiC has a cubic structure arising from an ABCABC... layer sequence. Many intergrowth structures of these two basic types are found, for example polytypes 6H, 15R, 4H, 21R, etc., in the **Ramsdell notation**; hence, hardness varies from 25.9 to 36.5 GN m⁻² depending on the polymorph and the method of testing; average value of thermal expansion coefficient is 4.4×10^{-6} up to 1,400 °C. It has very good thermal conductivity and is a useful semiconductor. Made by the **Acheson process** or by chemical vapour deposition. Used as heating elements, as a refractory because of its excellent thermal-shock properties, as kiln furniture, weld nozzles, combustion chambers, etc., also used in **light-emitting diodes** to produce green or yellow light. Sublimes with decomposition about 2,210 °C; density 3,007 kg m⁻³; hardness depends on which polymorph is being measured.

silicon carbide aluminium oxynitrides. Sicalons. *Plural noun.* Phases found in the SiC-Al₂O₃-AlN system that are analogous to the **sialons**. Mixtures of the parent materials heated above 1,800 °C produce these covalent phases containing SiC₄, AlO₄, AlN₄, SiN₄ and SiO₄ tetrahedra in their structures. Typical hardness values (Vickers) are around 20.5 GN m⁻² and k_{ic} values around 4.5 MN m^{-3/2}; very resistant to chemical attack.

silicon carbide composites. *Plural noun.* (1) Engineering materials in which the SiC forms a matrix that is reinforced by fibres or whiskers of materials, such as **boron carbide**, **silicon nitride**, etc. (2) Composites in which another matrix material is reinforced by SiC whiskers or fibres, such as Al₂O₃-SiC, etc. See **silicon carbide fibre**.

silicon carbide fibre. *Noun.* A good reinforcement for metallic or ceramic matrices; made by either **pyrolysis** of polycarbosilane polymers or **chemical vapour deposition** from hydrogen mixed methylchlorosilane vapour.

silicon carbide, green. *Noun.* See **green silicon carbide**.

silicon carbide refractories. *Plural noun.* Refractory products in which silicon carbide is the predominant constituent; characterised by high thermal-shock resistance, wear resistance, and chemical resistance.

silicon carbide-silicon carbide composites. *Plural noun.* Shapes formed by **chemical vapour infiltration** of **silicon carbide fibre** mats by methylchlorosilane and hydrogen. Maintain high strength above 1,000 °C, where values of 750 MN m⁻² have been reported.

silicon carbonitride fibre. *Noun.* Si₂N₂C_{0.83}O_{0.25}. An amorphous fibre prepared by pyrolysis of a spun hydridopolysilazane polymer; stable to 1,400 °C; diameter 10–12 μ m; Young's modulus between 180 and 240 GN m⁻².

silicon chip. *Noun.* A tiny sliver of silicon on which are mounted highly complex arrays of interconnected solid state electronic components mostly made by doping small areas on the silicon to produce n- or **p-type semiconductors**.

silicon-controlled rectifier. SCR. *Noun.* A semiconductor rectifier whose forward current between the anode and the cathode is started by a signal applied to a third electrode, the **gate**. It is also called a **thyristor**.

silicon diode. *Noun.* A crystalline diode in which silicon is the semiconductor.

silicon dioxide. *Noun.* See **silica**.

silicone. *Plural noun.* Any of a number of polymers containing alternate silicon and oxygen atoms whose properties are determined by the organic groups attached to the silicon atoms; the silicones are fluid, resinous, rubbery, water repellent, and stable at high temperatures. Employed as mould-release compounds, as a sealant for porous ceramics, and as a coating for glass and other ceramics to improve scratch resistance, chemical durability, and strength. Now used in mould block forming shops to great effect. They are also good matrix materials for ceramic fibre reinforcement because of high strength at elevated temperature along with good electrical properties.

silicone elastomer. *Noun.* **Polysiloxanes** with cross-link groups bestowing rubberlike properties.

silicon ester. *Noun.* An organic silicate sometimes used as a **ceramic binder**.

Silicon Fen. *Noun.* Area of Cambridgeshire near to Cambridge where industries associated with information technology are concentrated.

silicon-germanium. *Noun.* SiGe. A **transistor** material that can withstand extreme conditions. It combines both elements in an **epitaxial** layer at nanoscale dimensions.

Silicon Glen. *Noun.* Area between Glasgow and Edinburgh where industries associated with information technology are concentrated.

silicon monoxide. *Noun.* SiO. Stable only at high temperatures in the vapour phase. On condensing it disproportionates to give an amorphous mixture of SiO₂ + Si which is a hard, abrasive, amorphous solid employed as a thin surface film to protect optical parts, such as mirrors and the like.

silicon nitride. *Noun.* Si₃N₄. Two polymorphs exist: the α -form, which is hexagonal and has a structure formed from SiN₄ tetrahedra and Si₃N planar groups bonded covalently in three dimensions; α -Si₃N₄ transforms irreversibly on heating to the more common β -Si₃N₄ polymorph which is also hexagonal; exhibits high resistance to thermal shock and chemicals; used as a catalyst support and for stator blades in high-temperature

gas turbines. Sublimes at $>1,871\text{ }^{\circ}\text{C}$; density $3,180\text{ kg m}^{-3}$; hardness (Vickers) $19.6\text{--}34.4\text{ GN m}^{-2}$. See **g-Si₃N₄**.

silicon-oxo-aluminate. *Noun*. Also called **silate**. The silate network consists of SiO_4 and AlO_4 tetrahedra linked by corner oxygen sharing. Charge balancing cations are present in the framework cavities. See **polysilates** and **geopolymers**.

silicon oxynitride. *Noun*. Si_2ON_2 . A stable refractory; used as plates, crucibles, and tubes for the fusing of salts and nonferrous metals.

silicon rectifier. *Noun*. A rectifier made from a semiconductor diode using crystalline **silicon**.

silicon tetrachloride. *Noun*. SiCl_4 . A liquid boiling around $100\text{ }^{\circ}\text{C}$ which when hydrolysed is a source of pure silica for use in the production of **silica glass**.

Silicon Valley. *Noun*. (1) Industrial area south of San Francisco where industries associated with information technology are concentrated. (2) Any area where information technology companies congregate.

silicosis. *Noun*. Fibrosis of the lungs brought on by exposure to various forms of **silica** dust. There are two forms: a rapidly progressing one which occurs in those exposed to massive amounts of dust in a fine form. Exposure for as little as a few weeks can cause severe disability and death within 5 years. The other is a classic or chronic form which develops slowly over 10–20 years. In both forms the dust initiates small whorl-shaped nodules of fibrotic scar tissue scattered throughout the lungs. Symptoms are breathlessness during exercise. It can evolve to complicated silicosis or **progressive massive fibrosis (PMF)** where the nodules increase in size and coalesce. Silicosis has no cure and the only protection is dust control and medical checks.

silk-screen printing. *Noun*. A decorating process in which design is printed on glass, glazes, porcelain-enamels, and other surfaces through a tightly stretched silk mesh, woven wire, or similar screen by means of a rubber squeegee, the areas not to be coated being blocked by a suitable **resist** medium.

silky lustre. *Adjective*. A surface appearance of a ceramic or mineral that gleams like silk.

sill. *Noun*. (1) The horizontal member of a structure forming the bottom of a furnace door. (2) A flat horizontal mass of **igneous rock** sandwiched between two layers of older **sedimentary rock**, formed by an intrusion of magma.

sillimanite. *Noun*. Al_2OSiO_4 . A glossy brown or green to white mineral of needle habit; decomposes at $1,545\text{ }^{\circ}\text{C}$ to form **mullite** and **silica**; on further heating to $1,810\text{ }^{\circ}\text{C}$ it forms **corundum** and glass. Used in special porcelains, refractories, pyrometric tubes, chemical laboratory ware, and patching compounds for furnaces. Density $3,230\text{ kg m}^{-3}$; hardness (Mohs) 6–7.

sillimanite refractory. *Noun*. A refractory shape in which **sillimanite** is the predominant ingredient.

silo. *Noun*. A tall, cylindrical structure or a cylindrical pit, in which large quantities of powder or granulate raw materials are stored and dispensed.

siloxane. *Noun*. A class of organo-silicon polymer containing alternating $\text{Si-O-Si-O}\dots$ chains flanked by hydrogen atoms or organic groups. Used as a source of nanosized forms of silica when pyrolysed and as a coating to assist fibre to matrix bonding in composites.

silt. *Noun*. (1) Particle size classification of minerals denoting particles in the size range 53 down to $2\text{ }\mu\text{m}$. (2) Sedimentary rock particles in the above size range. (3) A fine deposit of clay, mud etc.

Siltemp. *Trademark, noun*. Commercially available continuous **silica** fibre; density $2,200\text{ kg m}^{-3}$.

siltstone. *Noun*. A form of fine **sandstone** formed from consolidated **silt**.

silt test. *Noun*. A test used to determine the amount of very fine particles, $<0.05\text{ mm}$ diameter, in sand because too much silt produces cement-mortar tiles of low strength. A sand-1 % sodium chloride solution, suspension is left to settle for 3 h. The silt is the volume between the settled sand and the clear solution when viewed in a glass measuring cylinder.

silver. *Noun*. Ag. A metal employed in precipitated, powdered, fluxed, or paste form as a decoration for pottery, glass, and porcelain-enamelled ware, as a soft solder, and as an electrical contact material. Mp $961\text{ }^{\circ}\text{C}$; bp $2,212\text{ }^{\circ}\text{C}$; density $1,053\text{ kg m}^{-3}$.

silver carbonate. *Noun*. Ag_2CO_3 . Used to produce **iridescent** stains or sheens on glazes. Mp $230\text{ }^{\circ}\text{C}$; decomposes at $270\text{ }^{\circ}\text{C}$.

silver chloride. *Noun*. AgCl . Employed in producing yellow glazes, **purple of Cassius**, and silver lustres. Mp $455\text{ }^{\circ}\text{C}$; bp $1,550\text{ }^{\circ}\text{C}$; density $6,077\text{ kg m}^{-3}$.

silver copper oxide. *Noun*. (1) $\text{Ag}_2\text{Cu}_2\text{O}_3$. The first mixed oxide of silver and copper to be synthesised in 1999. Isostructural with **paramelaconite**, Cu_3O_4 , which can be described as $\text{Cu}_2^+\text{Cu}_2^{2+}\text{O}_3^{2-}$, with Ag^+ in the Cu^+ sites. (2) $\text{Ag}_2\text{Cu}_2\text{O}_4$. Obtained from (1) by ozonolysis. It has the **crednerite** structure, $\text{Cu}^+\text{Mn}^{3+}\text{O}_2^{2-}$, with silver cations on the Cu^+ sites and copper cations on the Mn^{3+} sites. The silver and the copper sites are partially oxidised to $\text{Ag}^{(1+x)+}\text{Cu}^{(2+y)+}\text{O}_2$ and the electrons delocalised to give high values for conductivity.

silver deposit work. *Noun*. The use of electrolysis to apply a relatively thick deposit of silver as part of a design on glass.

silver foam. *Noun*. A colloquial expression for lead oxide, PbO . See **yellow lead oxide**.

silvering. *Verb.* To chemically apply a film of silver, either directly or by the reduction of a silver compound, onto a glass surface for electrical and light-reflection applications.

silver marking. *Adjective.* Grey marks on glazes made by the abrasion of cutlery.

silver nitrate. *Noun.* AgNO_3 . Used in glass manufacture, as a yellow colorant in glazes, and as a silvering compound for mirrors. Mp 212°C ; decomposes at 444°C ; density $4,328\text{ kg m}^{-3}$. Also known as **lunar caustic**.

silver oxide. *Noun.* Ag_2O . Used as a yellow colorant in glass and glazes and as a glass polishing material. Decomposes above 300°C ; density $7,140\text{ kg m}^{-3}$.

silver sand. *Noun.* Colloquial name for quartz sand. See **quartz sand**.

silver selenide. *Noun.* Ag_2Se . A ceramic phase undergoing a transition at 416 K to a superionic conduction state in which silver ions are able to move freely through a fixed **selenium** lattice.

silver solder. *Noun.* An alloy of silver, copper, and zinc having a melting point lower than that of silver but above that of lead-tin solders; used in making ceramic-metal seals.

silver telluride. *Noun.* See **hessite**.

sim. *Acronym, noun.* Stands for **silica and magnesia**. It is the name given to the lower layer of the earth's crust consisting of rocks rich in silica and magnesia.

similarity exponent. *Noun.* See **fractal dimension**.

similarity ratio. *Noun.* See **fractal dimension**.

SIMM. *Acronym.* Stands for scanning indentation mechanical microprobe. See **scanning indentation mechanical microprobe**.

simple lap joint. *Noun.* A geometry used for adhesive joining of thin sheets of ceramic and composite in which the two pieces simply overlap to produce a stepped appearance and the overlapping pieces are coated with adhesive. It gives a good performance.

simple microscope. *Noun.* A microscope having only one lens.

SIMS. *Acronym.* Stands for secondary ion mass spectrometry. See **secondary ion mass spectrometry**.

simulated annealing algorithm. *Noun.* A procedure for generating phase assemblages theoretically in a computer by simulating the cooling of a system from high temperatures.

Singer test of glaze fit. *Noun.* A glaze is placed in an unfired dish, fired to normal maturing temperature, and examined for defects.

single-chain silicates. *Plural noun.* Each $[\text{SiO}_4]^{4-}$ tetrahedron in the structure shares two oxygen atoms

to create a giant negatively charged ion of linear shape. The chain molecular ions are aligned and held together by metal cations on sites adjacent to the chains. Silicates with this structure have considerable **anisotropy**.

single-circuit winding. *Noun.* A pattern of winding of reinforcing fibre in which the filament goes all the way around the chamber after which the next traverse goes immediately adjacent to that one.

single-crystal alumina. *Noun.* Crystals of high-purity alumina, each grain being essentially a single complete crystal, produced by recrystallisation from a molten bath. See **corundum**.

single embossing. *Noun.* A process in which a design is worked on a glass surface by a **white acid** treatment followed by one further treatment so that two visible shades are produced.

single fire. *Noun.* The process of maturing an unfired body and glaze or a multiple coating of porcelain-enamel in a single firing operation.

single load. *Noun.* Stress in only one direction.

single-roll crusher. *Noun.* Crushing equipment consisting of a corrugated or toothed rotating cylinder that pinches material against stationary bars or plates.

single-screened ground refractory material. *Noun.* Refractory material that contains its original gradation of particle sizes resulting from crushing, grinding or both, minus particles coarser than a specified size.

single-shell tile. *Noun.* A tile with only one outer surface.

single-strength glass. *Noun.* Sheet glass of a thickness between 2.16 and 2.55 mm ; used in windows, picture frames and other applications where great strength is not considered a requirement.

single-table machine. *Noun.* In glass making it is a machine where all the moulds are attached to one table which is circular and rotates.

single-toggle jaw crusher. *Noun.* Mechanical equipment in which solid materials are crushed by passing through two jaws, one oscillating and the other stationary.

single wall carbon nanotube. SWNT. *Noun.* A class of carbon composed of a **graphene** sheet rolled-up into a cylinder. They are made of only sp^2 -carbon atoms and are usually self organised into bundle-like hexagonal crystals containing 10–100 parallel tubes. An ideal SWNT is classified according to the crystallographic configuration: **zigzag** where two opposite C-C bonds of each C_6 hexagon are parallel to the tube axis; **arm-chair** where the two C-C bonds are perpendicular to the tube axis; **helical** or **chiral** where the pair of bonds lies at an angle to the tube axis. Properties can be varied via tube diameter, helical pitch and 2-D packing. See **carbon nanotubes**.

sinkhead. *Noun.* A reservoir of ceramic slip or molten metal placed above a ceramic or metal casting, respectively to supply additional material as the casting solidifies and shrinks.

sinter, sintering. *Verb.* (1) To bond powder compacts by the application of heat that enables one or more of several mechanisms of atom movement into the particle contact interfaces to occur; the mechanisms are: **viscous flow**, **liquid phase solution-precipitation**, **surface diffusion**, **bulk diffusion**, and **evaporation-condensation**. The overall process can occur with or without densification of the compact, but conditions are usually chosen to encourage the mechanism that results in densification as well as in bonding across interfaces. (2) *Noun.* The product of a sintering process. (3) *Noun.* A synonym for **cinder**. (4) *Noun.* A grey-white porous incrustation of **silica** and **magnesia** that is deposited from hot springs.

sinterable powder. *Noun.* A powder or compact of powder in which the bonding of adjacent surfaces and an increase in density may be accomplished by heating only; the driving force is the large surface area decrease that can be achieved.

sintered alumina. *Noun.* A commonly coarse crystalline, but sometimes microcrystalline, abrasive formed by sintering mixtures relatively high in **alumina** but usually containing associated minerals such as **diaspore** and various silicates. It is produced by heating 99.5 % Al_2O_3 material beyond 1,980 °C for a time sufficient to achieve 100 % conversion to the α -form. The powder consists of crystals with a tablet-like habit. Used because of its high density, abrasion resistance, high mechanical and **dielectric** strength, in high-quality refractories, abrasives, spark plugs, machine tools, ceramic-metal seals and protective refractory coatings. Can be made **translucent** by sintering with **zirconia** to restrict grain growth. See **Lucalox**.

sintered filter. *Noun.* A porous article of sintered material, such as glass, silica, or other ceramic employed as a filter medium to separate particulate matter from liquids.

sintered glass. *Noun.* A porous article in which particles of glass of selected or random sizes are compacted and sintered to produce a bonded, but unsealed, item of desired shape and strength sufficient for an intended use, such as aeration, filtration, etc.

sintered pellet. *Noun.* A briquet or compact, usually cylindrical, formed by pressing a powder in a die and then sintering.

sinter-HIP. *Noun.* A process whereby the sample is sintered in situ in the **HIP** equipment under vacuum until a closed pore structure is achieved and then HIPed without prior removal to apply a surface coating.

sintering furnace. *Plural noun.* Any furnace in which materials are sintered. See **sinter**.

sintering, pressure. *Noun.* See **pressure sintering**.

sintern. *Noun.* The process or product obtained by heating a ceramic or a mixture of ceramics to a coherent mass without melting.

sinter point. *Noun.* The temperature at which clay ceases to be porous.

Siporex. *Trademark, noun.* A slurry of **sand**, aluminum powder, and **lime** or **cement** cast into moulds to produce roofing slabs, wall blocks, and other building materials of high sound and heat insulation capacity.

situla. *Noun.* A bucket-shaped pottery container first used in the Iron Age. Often intricately decorated.

SI units. *Noun.* The internationally accepted coherent system of units for all scientific purposes; based on seven fundamental units: **kilogram**, **metre**, **second**, **ampere**, **kelvin**, **candela** and **mole** plus two supplementary units: **radian** and **steradian**. All other units are derived from these by division or multiplication.

size. *Noun.* (1) Any of various glutinous materials, varnishes, resins, etc., employed as a surface treatment to render desired properties to the surfaces of glass, ceramics, and moulds. Usually resistance to abrasion is the desired effect. (2) The representative dimension that best describes the extent in space of a particle or agglomerate. (3) *Verb.* To measure an object.

size analysis. *Noun.* The determination of the proportion of particles of a particular size range in a granular or powdered sample.

sjogrenite. *Noun.* See **pyroaurite**.

skew arch. *Noun.* A vault or arch in a tunnel that is set at an oblique angle to the span.

skewback. *Noun.* The course of brick having a bevelled or inclined face from which an arch is sprung. See **sprung arch**.

skewbrick. *Noun.* A brick having one surface bevelled or inclined, at an angle other than 90°, to at least two other faces.

skew edge. *Noun.* A brick having one side inclined at an angle other than 90° to the ends.

skid. *Noun.* A movable platform on which materials or ware are placed for handling and moving.

skim coat. *Noun.* A thin finish coating of plaster consisting of a **putty** of **lime** and fine **white sand**.

skim gate. *Noun.* A barrier in a glass-melting tank that traps and prevents slag, scum, and unmelted materials from entering the firing chamber of the tank.

skimmer block. *Noun.* A refractory gate or wall designed in a **glass tank**, porcelain-enamel smelter, or similar furnace to prevent **slag** and impurities from passing into the feeder channel or smelting chamber. Also called **skimmer gate** or **skim gate**.

skimmer gate. *Noun.* See **skimmer block** and **skim gate**.

skimming pocket. *Noun.* An area in a **glass-melting tank** from which **slags** and other impurities may be removed from the surface of the molten mass.

skimmings. *Plural noun.* (1) Slag removed from molten metals. (2) Concentrated ore and froth removed during a flotation process.

skin blister. *Noun.* A defect in a glass container consisting of an oval surface blister anywhere on the surface and capable of being broken.

skin depth. *Noun.* Radio-frequency currents flow in the surface layers of conductors penetrating only to a depth known as the skin depth; it is defined as that depth where the magnetic field strength is 1/e of its surface value.

skin effect. *Noun.* The concentration of ac current in the surface layers of a conductor. At high frequencies the effect is enhanced and this adds to the heating effect as the resistance increases.

skin friction. *Noun.* The friction acting on solid particles when they move through a fluid as in **electrophoresis**.

skintle. *Verb.* (1) To place bricks in an irregular pattern so that they are out of alignment with the face. (2) To place bricks in a kiln in an oblique position to the courses above and below.

skip hoist. *Noun.* Equipment used to raise materials to an elevated level for storage or use.

skittle pot. *Noun.* A small, refractory glass-melting pot.

skiving. *Verb.* To shave-, grind-, or machine-off thin layers of excess material in the finishing of spark plugs, insulators, and other ceramic products prior to firing.

skull. *Noun.* (1) The sintered shell of oxide adhering to a water-cooled container within which molten oxide of the same composition is contained and from which crystals are grown inwards from the skull in the **skull melting process**. (2) The solidified material or dross remaining in a vessel after its content has been poured. (3) A protective layer of solid glass about 0.5 cm thick formed between the melt and the metal crucible in a **cold-crucible induction heater**. It stops glass leakage and crucible corrosion. See **CCIM**.

skull melting process. *Noun.* See **skull**.

skutterudites. *Plural noun.* Cubic **cobalt arsenate** minerals named from their source district in Norway. The cubic structure that has large interstices at the centre of the **unit cell**. Atoms sitting in these sites are called **rattlers** and they can increase the **thermoelectric power factor** while at the same time lowering the lattice component of the **thermal conductivity**. Hence these phases are very good **thermoelectric materials**. $\text{In}_{0.2}\text{Co}_4\text{Sb}_{12}$ is a good example. Filled skutterudites are: RM_4X_{12} , where R is La, Ce, Pr, Nd, Eu, and M is Fe, Ru or Os, while X is P, As or Sb.

sky firing. *Verb.* To complete the firing of an **updraft bisque kiln** by inserting and burning wood slivers in the top of the kiln to increase the draft.

skylight. *Noun.* (1) Flat or appropriately contoured glass installed at an angle greater than 15° from the vertical in a building. (2) A glazed opening in a roof to admit light.

skylight glass. *Noun.* Plate glass of very poor quality.

slab. *Noun.* (1) A section of concrete laid as a single unjointed unit. (2) A flat rectangular refractory piece of **kiln furniture** on which ware is placed for firing.

slabbing. *Noun.* (1) The breaking away of a layer of refractory from the roof of a furnace or kiln. (2) The forming of ware, usually square or rectangular, from sheets of damp, plastic clay, the joints being sealed by clay slurry.

slab glass. *Noun.* Optical glass obtained by forming or cutting **chunk glass** into plates or slabs of suitable size for future processing.

slack. *Noun.* Small pieces of coal that burn to produce high ash content.

slag. *Noun.* (1) The partially fused mixture of spilled batch, overflowed glass, **breeze coal**, and clay from the floor of a pot furnace or glass tank. (2) Material formed by the fusion of oxides in a metallurgical process or the fused reaction product between a refractory and a flux. (3) A non-metallic by-product of steel blast furnaces that is crushed and sized for use as concrete aggregate. Known as **slag sand** in this application. (4) An electric furnace by-product in the manufacture of **phosphate**, which may be used as a source of **alumina** in the manufacture of glass. (5) A **pozzolanic** material sometimes used in the production of **Portland cement**.

slag, air-cooled blast-furnace. *Noun.* See **air-cooled blast-furnace slag**.

slag, blast-furnace. *Noun.* See **blast-furnace slag**.

slag cement. *Noun.* An hydraulic cement consisting essentially of an intimate and uniform blend of **granulated blast furnace slag** and **hydrated lime** in which the slag constituent is more than a specified minimum percentage.

slagging of refractories. *Noun.* A destructive chemical reaction between refractories and external agencies at high temperatures resulting in the formation of a liquid.

slag line. *Noun.* A horizontal line formed along the refractory wall of a glass, metal, or similar melting tank which is caused by the erosion and corrosion of the refractories at the air-refractory-batch interface.

slag notch. *Noun.* An opening in the hearth to permit the flow of slag from a blast furnace.

slag, phosphate. *Noun.* See **phosphate slag**.

slag pocket. *Noun.* A refractory-lined area constructed at the bottom of a melting tank to prevent entry of slag and impurities into a **regenerator**.

slag sand. *Noun.* Finely crushed slag used in cement and mortars. See **slag (3)**.

slag-sitall. *Noun.* A Russian form of inexpensive glass-ceramic tile made from **blast furnace slag** nucleated by iron or manganese sulphide. After melting at 1,450 °C they are held at 1,000 °C to grow **diopside** crystals on the sulphide nuclei. The crystals coexist with an **aluminosilicate** glass as 1–5 µm equiaxed grains.

slake. *Verb.* To cause the process whereby **lime** reacts with water to become **calcium hydroxide**.

slaked lime. *Noun.* the name given to **calcium hydroxide** when made by adding water to **calcium oxide**.

slaking. *Verb.* To disintegrate or crumble a material by exposure to, or saturated with, water and air.

slate. *Noun.* (1) A dense fine-grained metamorphic mineral formed by high pressure acting on **shale**. It easily breaks into thin sheets or slabs; used as a flooring material, roofing material, abrasive, blackboards, etc. (2) A roofing tile of slate.

slater's cement. *Noun.* A water-resistant caulking compound, usually grey in colour, used to cover exposed bolt heads, the side and end laps of corrugated roofing, and other areas to prevent penetration of water.

slaty. *Adjective.* (1) A grey-blue colour. (2) Resembling slate or consisting of **slate**.

sllek. *Noun.* A fine, scratch-like, smooth-boundaried imperfection in glass usually caused by a foreign particle in the polishing medium during the polishing operation.

sleeper block. *Noun.* The refractory blocks forming the sides of the **throat** of the submerged passage between the melting and working ends of a **glass tank**.

sleeper wall. *Noun.* The refractory walls of the submerged passage between the melting and working ends of a **glass tank**.

sleeve brick. *Noun.* Tube-shaped firebrick; used for lining slag vents.

sleeves. *Plural noun.* Tubular **fireclay** shapes that encase an immersed metal rod in the valve assembly of a **bottom-pouring ladle**.

sleeve, wheel. *Noun.* See **wheel sleeve**.

sleeving. *Noun.* Cylindrically formed reinforcement either braided, knitted, or woven, having a width less than 10.2 cm.

slide conveyor. *Noun.* A trough or chute for the downward movement of materials under gravity.

slide-off transfer. *Noun.* A printed decoration which, when wet, may be slipped from its backing to the surface

of ware being decorated and which subsequently may or may not be fired. See **decal**.

slide potentiometer. *Noun.* A potentiometer which employs a sliding contact along a length of resistance wire to regulate the voltage in the wire in temperature measuring and control instruments. See **potentiometer**.

sliding. *Noun.* A porcelain-enamel defect similar to **sagging** in which patches of the coating slip or slide during drainage to produce a coating of uneven thickness.

sliding-bat kiln. *Noun.* A type of **tunnel kiln** in which ware is placed on tile or slabs and pushed mechanically or manually through the **firing zone**.

sliding contact. *Noun.* An electrical or other contact which accomplishes its function while sliding against its mating contact.

sliding friction. *Noun.* Resistance to relative movement of surfaces on loaded contact.

sliding wear equation. *Noun.* See **Archard's coefficient**.

slinger process. *Noun.* A forming process in which a wet batch is thrown on a pallet, formed into a column, cut to shape, dried, and fired.

slip. *Noun.* (1) A suspension or slurry of finely divided ceramic materials in a liquid. (2) Movement of crystallographic planes over each other to cause deformation under stress. (3) A suspension of clay in water with a consistency like that of pouring cream used for **slip casting**, decorating or patching and repairing.

slip casting. *Noun.* A forming process in the manufacture of shaped articles in which the material to be cast is ground and mixed to a creamy slurry with water and then poured into plaster moulds which rapidly absorb the added water, producing a solid body shaped to the inside of the mould; when the wall thickness of the cast item is attained, the excess slurry is poured from the mould and the cast item is dried to sufficient strength for safe handling before removing it from the mould for further processing.

slip clay. *Noun.* A clay having a high percentage of fluxing impurities which fuse at a relatively low temperature to produce a natural glaze; characterised by a fine-grained structure and low firing shrinkage.

slip coating. *Noun.* (1) A ceramic or mixture, other than a glaze, which is applied and fired on a ceramic body, to develop specific characteristics or properties. (2) *Verb.* To apply a coating of slip to a ceramic or glass surface.

slip flow. *Noun.* A situation that can occur when pressing shapes from damp powders in a die. A layer of liquid forms at the die wall at a critical shear stress and the flow of the powder under pressure is altered from shear flow.

slip form. *Noun.* A sliding form that produces a continuous placement of concrete as the form is moved along either vertically, as in a **silo**, or horizontally, as for a canal lining.

slip glaze. *Noun.* A glaze consisting primarily of readily fusible clay or **silt** and other ingredients blended to a creamy consistency in water.

sliphouse. *Noun.* The room or area in a factory where ceramic slips are prepared and stored for subsequent use.

slip kiln. *Noun.* A structure, consisting of suitable containers, which employs waste heat to dry or reduce the water content of slurries.

slip, mechanical. *Noun.* See **mechanical slip**.

slippage. *Noun.* (1) The movement of parts being bonded together with respect to each other during bonding. (2) The power lost in a mechanical device as a result of slipping.

slip plane. *Noun.* A crystal plane where atoms move past each other by sliding distances of many atomic diameters along a simple crystallographic direction [uvw].

slip process. *Noun.* A method of preparing a ceramic body in which water is added to dry-blended bodies in a quantity sufficient to produce a fluid suspension for use as such or for subsequent processing.

slip processing. *Noun.* A ceramic fibre manufacturing route whereby **slip** is extruded to form **green** filament which is fired at a temperature sufficient to cause **sintering**.

slip ring. *Noun.* A metal ring mounted on a rotating shaft of a motor, while being insulated from it by a ceramic ring, through which current can be passed.

slip stain. *Noun.* A stain incorporated in a glaze or slip instead of in the body as a means of reducing the amount of colorant needed to get the desired effect.

slipstone. *Noun.* A small slender abrasive stone used to remove blemishes from the surface of ceramic ware and to sharpen metal tools.

slip trailer. *Noun.* A device used to squeeze out or flow lines of slip onto a clay surface.

slip trailing. *Verb.* To form a pattern on a clay surface by flowing or squeezing viscous slip through a fine orifice onto the surface of the ware.

slip, vitreous. *Noun.* See **vitreous slip**.

slipware. *Noun.* **Earthenware** or **stoneware** in the green state has an opaque liquid slip applied, then dried and fired. The opaque glaze can be further decorated.

sliver. *Noun.* (1) Bundles of noncontinuous or short-length glass fibres that have reached the stage of fabrication into yarn wherein they are parallel, overlapping, and have no twist. (2) A long, slender piece or splinter.

slop. *Verb.* (1) To apply an homogeneous slurry of glaze ingredients and water to ware by dipping, spraying, or brushing. (2) *Noun.* The homogeneous slurry of glaze ingredients.

slope. *Noun.* The incline of a roof expressed as a ratio of the number of inches or millimetres of vertical rise per horizontal foot or metre.

slop weight. *Noun.* The weight of a unit volume of a **slop**.

slotting wheel. *Noun.* A thin grinding wheel, usually **organic bonded**, used for cutting grooves or slots in a workpiece.

slow wheel. *Noun.* The practice of perfecting the surface of a handmade article by turning it on a rotating base such as a plate, wood block, or **sherd**

SLS. *Abbreviation.* Stands for selective laser sintering. See **selective laser sintering**.

sludge. *Noun.* A semi-solid waste or collection of settlements from a process.

sludge pan. *Noun.* A container or area in which **sludge** is collected for subsequent recycling or disposal. Also called **sludge pit**.

sludge pit. *Noun.* See **sludge pan**.

slug. *Noun.* (1) Any non-fibrous glass inclusion in a glass-fibre product. (2) A geometric shape made by pressing and which is fed to the granulation step of processing. (3) A small roughly shaped disc or cylinder of material, such as clay or metal, for subsequent processing. (4) A length of clay extruded from a **pug mill**. (5) A magnetic core that is moved into or out of an inductance coil to adjust the tuning of a radiofrequency amplifier. (6) An old unit of mass equal to about 14.6 kg originally defined as the mass that acquires an acceleration of 1 ft s^{-2} when acted on by a force of 1 lb.

slugged bottom. *Noun.* An imperfection in the bottom of a bottle or container in which the glass is heavy, or thick on one side and very light or thin on the opposite side.

slug press. *Noun.* The process of initial compaction of fine powders prior to **granulation** or subsequent processing.

sluice. *Noun.* An inclined trough for washing minerals and ores.

slum. *Noun.* **Fireclay** containing a substantial amount of fine coal particles as an impurity.

slumgullion. *Noun.* A red coloured **mud** deposited in mine **sluices**.

slump. *Verb.* (1) To drop, sag, or slide down suddenly. (2) *Noun.* A measure of the fluidity, softness, or wetness of fresh concrete determined by measuring the number of centimetres a sample slumps or settles when a conical form is removed from the sample

slumping. *Noun.* Deformation of an extruded shape under its own weight after extrusion and before burn out.

slump test. *Noun.* (1) A measure of the consistency of a porcelain-enamel, glaze, or other slip or slurry, made by spreading a specified volume of slip over a flat plate. (2) A test to determine the relative water content of concrete depending on the loss in height of a cone shaped sample.

slurry. *Noun.* A mixture or suspension of ground **frits**, **clays**, or other ceramic materials in water or other liquid.

slurry infiltrated fibre concrete. SIFCON. *Noun.* A preform made from ceramic fibres and very fine aggregate is infiltrated under reduced pressure by an **OPC** slurry of high water to cement ratio and allowed to set.

slurry process. *Noun.* See **slip processing**.

slush. *Noun.* A grout made of **Portland cement**, sand, and water mixed to a relatively thick slurry that may be poured, **slushed**, or spread over a surface area.

slushing. *Verb.* To coat ware by dipping, shaking, or spinning to obtain a uniform distribution of slip and to remove excess material from the surface of the ware.

small-angle grain boundary. *Noun.* A grain boundary formed when neighbouring crystals rotate by less than 5° relative to each other about the z-axis. This operation generates a sheet of parallel **edge dislocations** of the same sign along the x-axis and spaced at h along the y-axis; h is obtained from: $\theta = 2\tan^{-1}(b/2h)$, where θ is the boundary angle and b is the **Burgers vector**.

small-angle neutron scattering. SANS. *Noun.* A technique used to investigate amorphous structures. See **multiple small-angle neutron scattering**.

small polaron. *Noun.* A mobile electron arising from atoms of mixed valency on equivalent lattice sites: $M^{n+} + M^{(n+1)+} \rightarrow M^{(n+1)+} + M^{n+}$ and its associated lattice deformation becoming trapped at specific atomic sites. Small polarons move diffusively with no well-defined momentum vector and so cannot become a **Cooper pair**.

smalt. *Noun.* (1) A type of **silica glass** coloured deep blue by **cobalt oxide**. (2) A blue pigment for glass enamels, and other ceramics consisting of fused cobalt oxide, sand, and potash. (3) The blue colour typified by the pigment in (2).

smaltite. *Noun.* $\text{Co}_{1-x}\text{Ni}_x\text{As}_2$. A silver-grey mineral in cubic form consisting of nickel-doped cobalt arsenide. It is an important ore of both cobalt and nickel.

smalto. *Noun.* Coloured glass or ceramic pieces used in **mosaics**.

smaragd. *Noun.* Any green gemstone.

smaragdite. *Noun.* A green fibrous **amphibole** mineral.

smart composites. *Plural noun.* A colloquial expression for composite structures containing optical fibres dispersed among the reinforcing fibres. The optical fibres allow changes in strain, temperature, and crack propagation to be automatically monitored; used in association with a computer in aircraft wing structures.

smart materials. *Plural noun.* Materials with a property change that can be easily stimulated by changes in the local environment, such as temperature, stress, strain or **chemical potential**. Ceramic examples are $\text{V}_{1-x}\text{Nb}_x\text{O}_2$, which has a temperature controlled metal-insulator transition, **ITO**, which is **thermochromic**, **piezoelectric** materials and reversible hydride formers for energy storage. Also called **ken materials**. See **ken materials**.

smart structures. *Plural noun.* Mechanical structures in which lightweight fibre-type sensors are embedded in order to detect stress and other changes during operation of the system. Optical fibres and **piezoelectric** sheets are most commonly used.

SMD. *Abbreviation.* Standing for surface mounted device. See **surface mounted device**.

smear. *Noun.* (1) A material spread over a surface. (2) A surface crack on the neck of glass bottles. (3) *Verb.* To spread a material over a surface.

smectic. *Adjective.* (1) Existing in a **mesomorphic** state, such as a liquid crystal, in which the molecules are oriented in layers, so causing anisotropic properties. (2) A major class of liquid crystal that possess both longitudinal and positional order.

smectite. *Noun.* Montmorillonitic clays characterised by swelling and high cation-exchange properties. See **montmorillonite**.

smeddum. *Noun.* Any finely ground powder.

smelt. *Noun, verb.* (1) *Noun.* A specific batch or lot of frit. (2) *Verb.* The process of melting a batch of frit. (3) *Verb trans.* To extract a metal from an ore by heating.

smelter. *Noun.* A refractory-lined furnace or tank in which the ingredients of a **frit** are melted.

smelter, batch. *Noun.* See **batch smelter**.

smelter, continuous. *Noun.* See **continuous smelter**.

smelter drippings. *Noun.* Drippings of molten glassy material from an accumulation of the material on the **crown** of a **smelter**.

smelter, rotary. *Noun.* See **rotary smelter**.

SMES. *Acronym.* Stands for superconducting magnetic energy storage system. See **superconducting magnetic energy storage system**.

smithereens. *Plural noun.* Small shattered pieces of a brittle material.

smithsonite. *Noun.* ZnCO_3 . A white mineral consisting of hexagonal **zinc carbonate** occurring in limestone regions.

- A source of zinc. Also called **calamine** or **hemimorphite**. See **zinc carbonate**.
- smoke**. *Noun*. (1) Streaked areas in flat glass appearing as slight discolorations. (2) Glass covered with a smoky film from open-fired **lehrs**.
- smoked glass**. *Noun*. Commercial glassware produced in grey or smoky-brown colours, sometimes by chemical additions to the glass and sometimes by exposure to a reducing atmosphere during melting and cooling.
- smoking**. *Noun*. (1) The slow preheating of a kiln. (2) A reducing kiln atmosphere.
- smoking, water**. *Noun*. See **water smoking**.
- smoky inclusions**. *Plural noun*. Dispersed metal oxide inclusions in **mica**, which appear in various pastel colours when observed in transmitted light.
- smoky quartz**. *Noun*. Another name for the semi-precious stone **cairnngorm**. See **cairnngorm**.
- Smoluchowski effect**. *Noun*. A pattern or structure of the surface charge of a conductor arising from the electrons inside the conductor neutralising the charge on the positive ion cores most efficiently. The pattern on the surface affects the way ionic compounds bond to the surface.
- Smoluchowski equation**. *Noun*. Used to interpret the kinetics of **colloidal** particle **aggregation** as an equation of an irreversible reaction: $[i] + [j] \gg [i + j]$. It has the form $dc_k/dt = \frac{1}{2} \sum_{ij} k_{ij} c_i c_j - \sum_{ijk} k_{ijk} c_i c_j c_k$.
- smooth**. *Adjective*. Finely ground.
- smooth-finish tile**. *Noun*. Tile and other surfaces which are not altered or marked during manufacture, and which retain the plane surface as formed by the die.
- smooth glass**. *Noun*. A finely ground glass surface ready for polishing.
- smoothing mill**. *Noun*. A machine equipped with a fine-grained polishing wheel for the **bevelling** of glass.
- smooth roll**. *Noun*. A crusher in which material is passed between a rotating set of smooth rolls.
- smother kiln**. *Noun*. A kiln into which smoke can be introduced for the blackening of pottery.
- SMP**. *Abbreviation*. Standing for the secondary maximum of permeability. See **secondary maximum of permeability**.
- smut**. *Noun*. A small dark stain caused by **soot** particles.
- snag**. *Noun*. A composite-cloth reinforcement defect caused by pulling yarns or filaments from a fabric surface.
- snagging**. *Verb*. To remove defects and excess materials from ware, such as **gates**, **sprues**, **fins**, **parting lines** and the like by the use of a grinding wheel.
- snagging, automatic**. *Noun*. See **automatic snagging**.
- snagging resistance**. *Noun*. The resistance a weave type gives to a fabric to the formation of a **snag**.
- snake, snaking**. *Noun*. (1) The progressive longitudinal cracking in continuous flat-glass operation. (2) The variation in the width of a sheet during the drawing of sheet glass.
- snakeskin agate**. *Noun*. An attractively patterned form of **agate** polished by **tumbling** to produce decorative stones.
- snakeskin glaze**. *Noun*. A decorative effect on pottery obtained by using glazes of high surface tension or very low expansion, causing the glaze to **crawl** during firing to produce an appearance of snake skin. Also known as **lizard skin**.
- snap**. *Noun*. A device for gripping a piece of formed glass for fire polishing and finishing.
- snap header**. *Noun*. A building brick of half the standard length, roughly $6 \times 10.2 \times 10.2$ cm.
- sneck**. *Noun*. A small squared-off building stone used to fill space between stones of different heights.
- Snell's law**. *Noun*. A definition of the **refractive index** of a material given as: $n = \sin \phi / \sin \phi'$, where n is the refractive index, ϕ is the angle of incidence of the light and ϕ' is the angle of refraction.
- snide**. *Noun*. Colloquialism for sham jewellery containing artificial ceramic stones and not natural gemstones.
- snow-flake obsidian**. *Noun*. An attractively patterned stone well given to **tumbling** to produce decorative pieces.
- soak, soaking**. *Verb*. (1) To hold a kiln at a constant temperature for a long period of time. (2) To maintain a kiln at maximum firing temperature to obtain a desired degree of chemical or physical reaction in a body being fired. (3) To immerse a material or body in a liquid to obtain thorough **wetting** or **infusion**.
- soaking heat**. *Noun*. A conditioning stage where a specimen is completely immersed in an atmosphere at a controlled temperature.
- soaking pit**. *Noun*. A conditioning furnace in which molten glass is brought to a uniform temperature for casting.
- soak period**. *Noun*. The time ceramic ware remains at peak temperature during its firing.
- soap brick**. *Noun*. A brick modified so that the width is one-half the standard dimension. See **standard brick**.
- soapstone**. *Noun*. $Mg_3Si_4O_{10}(OH)_2$. Impure **talc**; generally known in the industry as **steatite** or **massive talc**. Density $2,700\text{--}2,800 \text{ kg m}^{-3}$; hardness (Mohs) 1–1.5. See **talc**.
- SOC**. *Acronym*. Stands for system on a chip. See **system on a chip**.

socket. *Noun.* An opening or hollow that forms a holder into which an item is inserted.

soda. *Noun.* Any of the forms of **sodium carbonate**, **sodium bicarbonate**, or **sodium hydroxide**. Expressed as Na_2O equivalent.

soda alum. *Noun.* See **aluminium sodium sulphate**.

soda ash. *Noun.* Commercial grade of dehydrated **sodium carbonate**, Na_2CO_3 . Used as a fluxing component in glass, porcelain-enamels, and glazes, and as a neutraliser in the treatment of metals for porcelain-enamelling. Decomposes at 852°C ; density $2,530\text{ kg m}^{-3}$. Also known as **sal soda**.

sodaclase. *Noun.* See **albite**.

soda lime. *Noun.* A mixed solid containing calcium and sodium hydroxides. Used as a carbon dioxide absorber and in glass manufacture.

soda-lime glass. *Noun.* Glass containing: approx 72 % SiO_2 (**sand**), 15 % Na_2O (**soda ash**, sodium nitrate, sodium sulphate), and 9 % CaO (**limestone**, **dolomite**); used for window and plate glass, containers, art objects, light bulbs, and industrial products.

sodalite. *Noun.* $\text{Na}_4[\text{Al}_3(\text{Si},\text{Al})\text{O}_4]_6(\text{X}^{2-})\cdot x\text{H}_2\text{O}$. A naturally occurring **aluminosilicate zeolite** mineral. It has a cage structure formed from SiO_4 and AlO_4 tetrahedra sharing all corners. The X^{2-} anions lie in the cage centres. A rapid cation exchanger and a good fast ionic conductor. It is very suitable for **tumbling** to give polished, decorative stones.

soda microcline. *Noun.* See **anorthoclase**.

soda nitre. *Noun.* NaNO_3 . Sodium nitrate; employed in glass, porcelain-enamels, and glazes as an oxidising agent and **flux**. Mp 308°C ; density $2,270\text{ kg m}^{-3}$; hardness (Mohs) 1.5–2.0.

soda orthoclase. *Noun.* See **anorthoclase**.

sodium alanate. *Noun.* NaAlH_4 . A low density hydrogen storage material in which reversible hydrogen sorption is enhanced by titanium doping.

sodium aluminate. *Noun.* NaAlO_2 . Employed in porcelain-enamel and glaze slips to improve suspension and working properties, and in the production of **milk glass** because of its opacifying or obscuration properties. Mp $1,650^\circ\text{C}$.

sodium aluminium borosilicate. *Noun.* See **tourmaline**.

sodium antimonate. *Noun.* NaSbO_3 . Used as an **opacifier** and high-temperature oxidising agent in porcelain-enamels, as a **fining** and decolourising agent in glass, and as a yellow colorant in glazes. Stable to $1,427^\circ\text{C}$.

sodium bicarbonate. *Noun.* NaHCO_3 . Used as a **deflocculating agent**, as a body wash to improve body-glaze reactions, and as a metal cleaning agent in solutions.

sodium bifluoride. *Noun.* NaHF_2 . An etchant for glass.

sodium bisulphate. *Noun.* NaHSO_4 . Used in the manufacture of brick and magnesia cements, and as a flux to decompose minerals.

sodium borate. *Noun.* $\text{Na}_2\text{B}_4\text{O}_7\cdot 10\text{H}_2\text{O}$. See **borax**.

sodium carbonate. *Noun.* Na_2CO_3 . Used as a flux in glass, glazes, enamels and as an acid neutraliser in the treatment of metals for porcelain-enamelling. Decomposes at 852°C ; density $2,532\text{ kg m}^{-3}$.

sodium carboxymethylcellulose. *Noun.* Employed as a thickener and binder in bodies and glazes.

sodium chloride. *Noun.* NaCl . Common salt; used in the production of salt glazes on some types of ceramic ware. Mp 804°C ; density $2,161\text{ kg m}^{-3}$. See **salt glaze**.

sodium cobalt bronze. *Noun.* Na_xCoO_2 , where x is in the range 0.01–1.0. A low thermal conductivity, $1.77\text{ W m}^{-1}\text{ K}^{-1}$, thermoelectric material. Also called **sodium cobaltite**.

sodium cyanide. *Noun.* NaCN . Employed as an addition to improve the performance of neutraliser baths in preparing steels for porcelain-enamelling. Mp 563°C .

sodium dichromate. *Noun.* $\text{Na}_2\text{Cr}_2\text{O}_7\cdot 2\text{H}_2\text{O}$. An orange-yellow colorant for glazes and porcelain-enamels.

sodium diuranate. *Noun.* $\text{Na}_2\text{U}_2\text{O}_7\cdot 6\text{H}_2\text{O}$. A yellow-orange pigment used in bodies, glazes, and porcelain-enamels. Also used in the manufacture of fluorescent uranium glass.

sodium fluoride. *Noun.* NaF . used as a flux and as a gas or bubble-type opacifier in porcelain-enamels. Mp 993°C ; density $2,760\text{ kg m}^{-3}$.

sodium fluosilicate. *Noun.* Na_2SiF_6 . Employed as a flux and **opacifier** in porcelain-enamels, and as an **opacifier** in glass. Decomposes at red heat; density $2,700\text{ kg m}^{-3}$.

sodium gold chloride. *Noun.* $\text{NaAuCl}_4\cdot 2\text{H}_2\text{O}$. Used in the decoration of glass and ceramics.

sodium hexametaphosphate. *Noun.* $\text{Na}_6\text{P}_6\text{O}_{18}$. Used as a bonding agent in **refractory mortars**.

sodium hydroxide. *Noun.* A white, brittle, strongly alkaline solid. Also called **caustic soda**. Mp 318°C ; density $2,130\text{ kg m}^{-3}$.

sodium metagermanate. *Noun.* Na_2GeO_3 . Used in special glasses and in electronic devices such as **diode rectifiers** and **transistors**. Mp $1,078^\circ\text{C}$.

sodium metasilicate. *Noun.* Na_2SiO_3 . Employed to clean drawing compounds from the surface of metals prior to porcelain-enamelling and also employed in cements, concrete hardeners, mortars, and abrasive wheels primarily as a binder and deflocculating ingredient. Mp $1,089^\circ\text{C}$.

sodium metatantalate. *Noun.* NaTaO_3 . A ferroelectric material crystallising in a **perovskite** **ilmenite** structure having a **Curie point** of 475 °C. Mp 630 °C.

sodium-4-mica. *Noun.* $\text{Na}_4\text{Mg}_6\text{Al}_4\text{Si}_4\text{O}_{10}\text{F}_4$. A **fluorophlogopite** made by the **sol-gel process** which has a great preference for strontium ions so that it extracts them from solution and traps them as the structure collapses. Proposed as a way of safely disposing of radioactive strontium and radium. See **Na-4-mica**.

sodium molybdate. *Noun.* Na_2MoO_4 . employed as a **deflocculant**, **adherence promoter**, and rust inhibitor in porcelain-enamelling. Mp 687 °C; density 3,280 kg m⁻³.

sodium niobate. *Noun.* NaNbO_3 . A **ferroelectric** material having a **Curie point** of 360 °C.

sodium nitrate. *Noun.* See **soda nitre**.

sodium nitrite. *Noun.* NaNO_2 . Employed as a metal cleaner, acid neutraliser, rust inhibitor, and tear-resistant additive in porcelain-enamel slips. Mp 271°C; decomposes above 320 °C; density 2,150–2,170 kg m⁻³.

sodium pentaborate. *Noun.* $\text{Na}_2\text{B}_{10}\text{O}_{16}\cdot 10\text{H}_2\text{O}$. Used as a flux in glass manufacture. Density 1,720 kg m⁻³.

sodium perborate. *Noun.* $\text{NaBO}_2\cdot\text{H}_2\text{O}_2\cdot 3\text{H}_2\text{O}$. Sodium metaborate with both hydrogen peroxide and **water of crystallisation**; a white crystalline material used as a deodorant.

sodium peroxide. *Noun.* Na_2O_2 . A yellowish-white solid formed when sodium burns in oxygen; used as a deodorant, a bleaching agent, and for removing carbon dioxide from gas streams.

sodium phosphate. *Noun.* (1) A general term for many compounds of sodium and phosphorus. (2) $\text{Na}_2\text{HPO}_4\cdot 12\text{H}_2\text{O}$. Employed in the production of **opal-essent glass**, in the purification of clays, as a water conditioner, and as a **deflocculant** in porcelain-enamels and glazes. Mp 35 °C; loses 5 H₂O on exposure to air at ordinary temperatures and 10H₂O at 100 °C.

sodium polyacrylate. *Noun.* A low-molecular-weight, short chain, **deflocculant** used in sanitary ware slip casting.

sodium pyrophosphate. *Noun.* $\text{Na}_4\text{P}_2\text{O}_7$. Employed in aqueous solutions as a metal cleaner for porcelain-enamels, as an electrolyte to adjust and control the viscosity and flow characteristics of porcelain-enamels and other slips and slurries. Mp 988 °C; density 1,820 kg m⁻³.

sodium rhenanite. *Noun.* CaNaPO_4 . An intergranular binding phase formed when **magnesite** and **chrome-magnesite** refractories are bonded with compositions containing **sodium hexametaphosphate**, $\text{NaP}_6\text{O}_{18}$.

sodium selenite. *Noun.* Na_2SeO_3 . Used in small amounts as a decolouriser in glass, and in larger concentrations to produce rose and ruby colours in glass, porcelain-enamels and glazes. Density 3,000 kg m⁻³.

sodium silicate. *Noun.* See **sodium metasilicate** and **water glass**.

sodium silicofluoride. *Noun.* Na_2SiF_6 . Employed as a flux and opacifier in porcelain-enamels and to produce **opalescence** in glass. Decomposes at red heat; density 2,700 kg m⁻³.

sodium stannate. *Noun.* $\text{Na}_2\text{SnO}_3\cdot 3\text{H}_2\text{O}$. Used as a source of tin oxide to act as an opacifier in glass, porcelain-enamels and glazes.

sodium sulphate. *Noun.* Na_2SO_4 . Used in glazes and glass as a source of sodium oxide and as an anti-scumming agent. Occurs naturally as the mineral **thenardite** and as the decahydrate when it is known as Glauber's salt. Mp 888 °C; density 2,672 kg m⁻³.

sodium tannate. *Noun.* Sodium salt of **tannic acid**; used as a **deflocculating agent**.

sodium tantalate. *Noun.* See **sodium metatantalate**.

sodium tartrate. *Noun.* An alkaline salt of tartaric acid that is used as a **deflocculant**. See **natar**.

sodium thiosulphate. *Noun.* $\text{Na}_2\text{S}_2\text{O}_3$. A white soluble salt used as a fixer to dissolve silver salts in photography.

sodium uranate. *Noun.* Na_2UO_4 . Used as a yellow-orange colorant for glass, porcelain-enamels, and glazes, and in the production of fluorescent glasses. Mp 1,646 °C.

sodium uranyl carbonate. *Noun.* $\text{Na}_4\text{UO}_2(\text{CO}_3)_3$. Used in the production of fluorescent greenish-yellow glass.

sodium vanadate. *Noun.* Na_3VO_4 . A **ferroelectric** material with a **Curie point** of 330 °C. Mp 866 °C.

sodium vapour lamp. *Noun.* A glass tube containing neon and a low pressure of sodium vapour through which an electric current is passed to give an orange-coloured light.

sodium zirconium phosphates. NZP. *Noun.* A general description of several phases formed by fusing Na_2CO_3 , ZrO_2 , and Na_4PO_4 ; all the phases have ultra low **thermal expansivity**. The general formula is: $\text{X}_{0-4}\text{Y}_2(\text{ZO}_4)_3$, where X is a mono or divalent cation, Y is an octahedrally coordinated tri, tetra or pentavalent cation and Z is a tetrahedrally coordinated cation. They have hexagonal structures with chains of $\text{YO}_6 \pm \text{XO}_6$ octahedra parallel to the c-axis and these chains are cross-linked by isolated PO_4 -tetrahedra. The Y-sites must be occupied but X-sites can be vacant. One in particular, $\text{NaZr}_2(\text{PO}_4)_3$, that has very low thermal conductivity, has been developed as a ceramic coating for advanced heat engine cylinders, pistons, and valves. The isolated PO_4 tetrahedra link chains of YO_6 octahedra in such a way that some structural units expand on heating and some contract which leads to the unusual thermal expansion behaviour.

SOFC. *Abbreviation.* Stands for solid oxide fuel cell. See **solid oxide fuel cell**.

soffit. *Noun.* (1) The underside of a structural component. (2) The upper, inner surface of a drain.

soft. *Adjective.* (1) A term applied to a clay, glaze, porcelain-enamel or glass that is fusible at a relatively low temperature. (2) Has low values of **hardness**.

soft-burned. *Adjective.* Clay-based products fired at low temperatures.

softener. *Noun.* A substance added to another to induce pliability or plasticity.

softening point. *Noun.* The temperature at which a glass fibre elongates at a specific rate under the stress of its mass, when tested according to ASTM method C-338. The viscosity of glass at its softening point depends on the density and surface tension, but it is the temperature where the glass has a viscosity of $10^{6.6}$ N s m⁻².

softening temperature. *Noun.* The temperature, under specified conditions, at which porcelain-enamel or frit, begins to flow.

soft fire. *Noun.* A flame with a deficiency of air.

soft-fired ware. *Noun.* Clay products fired at a relatively low temperature, resulting in ware of relatively high **permeability** and low compressive strength.

soft glass. *Noun.* (1) A glass having a relatively low **softening point** or which is easily melted. (2) A glass that is easily scratched or abraded.

soft mica. *Noun.* **Mica** that tends to **delaminate** when bent.

soft mud. *Noun.* Clay with a water content >20 %.

soft-mud brick, soft-mud process. *Noun.* Moulded brick formed by machine, or frequently by hand, from wet soft clay bodies containing 20–30 % water.

soft mud moulding. *Verb.* To make bricks with a creased pattern on the brick faces by using **soft mud**.

softness. *Adjective.* A porcelain-enamel surface of relative low resistance to abrasion or scratching, or a surface produced by firing at a relatively low temperature.

soft paste. *Noun.* (1) Relatively low-fired china produced from a body containing a glassy frit and a large quantity of fluxes. Also known as **pâte tendre**. (2) The product obtained when **kaolin** and **glass** is mixed and fired instead of kaolin and **feldspar**. It has the appearance of porcelain but not the strength.

soft soap. *Noun.* Soap saponified with **potash**. Used as a parting compound in the making of plaster moulds.

soft transition interface. *Noun.* Interfaces between two phases, usually formed by **CVD**, in which the atoms either side of the boundary are inter-mixed. This leads to electron trapping in semiconductor interfaces and to low current efficiencies. See **sharp transition interface**.

software. *Noun.* The program that can be used with a particular computer system.

soilability. *Adjective.* The relative ease with which dirt and other extraneous matter becomes attached to or builds up on the surface of a material.

soil cement. *Noun.* A compacted mixture of soil, cement, and water used to adjust the engineering properties of the soil.

soil pipe. *Noun.* A ceramic pipe used to convey sewage.

sol. *Noun.* (1) A colloid dispersion of solid particles called the **disperse phase** in a liquid, called the **dispersion medium**; at least one dimension of the particle of solid is between 1 nm and 1 µm and typically they contain 10^3 – 10^9 atoms. Sols are the precursors of ultrapure, ultrafine powders made by the **sol-gel** process. (2) *Abbreviation.* Stands for soluble. (3) *Abbreviation.* Stands for solution.

solar cell. *Noun.* A voltaic cell, often based on **silicon**, which produces electricity from sunlight.

solar furnace. *Noun.* An image-type furnace in which high temperatures are produced by using concave mirrors to focus rays from the sun into a relatively small space.

solarisation. *Noun.* A change in the transmission or colour of glass when the glass is exposed to sunlight or other strong radiation.

solar screen. *Noun.* A structure which blocks or diminishes the influence of the rays of the sun.

solder-sealing glass. *Noun.* A sealing glass having a relatively low softening temperature; used as an intermediate bonding material.

solder, silver. *Noun.* See **silver solder**.

soldier block. *Noun.* A refractory block installed on its end so as to extend below the depth of molten glass in a **glass tank** or ladle.

soldier course. *Noun.* A course of refractory brick set on end in the bottoms of some types of ladles, furnaces, and glass tanks.

sole. *Noun.* The refractory brickwork forming the bed of a coke oven.

solenoid. *Noun.* An assembly consisting of a coil of metal wire wound around a metal, usually iron, core, which slides along the coil axis under the influence of a magnetic field; used to convert electrical to mechanical energy.

sol-gel process. *Noun.* A method for making ultrafine powders, fibres, thin films, or monoliths, in which **sols** are destabilised so that they turn into a **gel** phase by either the rapid or slow addition of water to a sol suspended in an organic dispersion medium. The water brings about hydrolysis and simultaneous condensation

polymerisation. Removal of the liquid phase by warming produces a **xerogel** and heating this leads to an oxide. Submicron, spherical particles of great uniformity can be produced.

solid. *Noun.* (1) Substances in a physical state where the forces between the atoms are sufficient to hold them in fixed positions. (2) *Adjective.* Of or being concerned with a substance that resists change of shape and size. (3) *Adjective.* Consisting of the same substance throughout.

solid angle. *Noun.* A surface composed of lines emanating from a common point, called the vertex, and passing through a closed curve.

solid casting. *Verb.* To form ceramic ware by introducing a body slip into a porous mould usually consisting of two major sections, one section forming the contour of the outside and the other forming the contour of the inside of the ware, and allowing a solid cast to form between the two mould faces.

solid contact. *Noun.* A monolithic electrical contact member.

solid flame technology. *Noun.* Another name for self-propagating high-temperature synthesis. See **self-propagating high-temperature synthesis**.

solid freeform fabrication. **SSF.** *Noun.* The machine capability of converting virtual objects stored in a **computer-aided design**, **CAD**, file to solid objects without part-specific tooling or the use of a mould. The main feature is that material is added rather than machined away from the part being produced. A number of techniques are grouped under this heading, such as, **3-D printing**, **laminated object manufacturing**, **selective laser sintering**, and **robocasting**. Such a layer by layer building procedure makes it possible to realise shapes and material combinations otherwise impossible to achieve.

solid fuel. *Noun.* A fuel, such as **coal** or **coke** that is not a gas or liquid.

solidification. *Noun.* The transition from liquid to the solid phase. Also known as crystallisation. It is not an instantaneous process simply involving a change of temperature but depends on the formation of nuclei from **embryos** and then the growth of the **nuclei** until they impinge to form **grain boundaries**.

solidify. *Verb.* To make or become hard or solid.

solid geometry. *Noun.* The branch of geometry concerned with the shape and properties of 3-dimensional figures.

solid insulator. *Noun.* Any solid material such as glass, porcelain, or other ceramic used as an electrical insulator.

solid masonry unit. *Noun.* A masonry unit whose net cross-sectional area in every plane parallel to the bearing surface is 75 % or more of its gross cross-sectional area measured in the same plane.

solid oxide fuel cell. **SOFC.** *Noun.* A fuel cell operating at high temperatures utilising a ceramic, ion-conducting electrolyte separating the electrodes. The ions transported are O^{2-} or H^+ and the electrolyte must have negligible electronic conductivity. Most electrodes are based on **yttria-stabilised zirconia** and operate between 700–1,000 °C with high values of electronic conductivity. They are porous to allow reactant gases in to form the triple phase boundary: electrode/fuel gas + oxidant/electrolyte. Usually designed for use with natural gas as the fuel. Excess heat is collected along with the electrical power and used to heat water tanks. Sometimes called **solid state fuel cells**.

solid solution. *Noun.* (1) A homogeneous crystalline phase composed of different mineral groups dissolved in one another either in all proportions or over a limited range of compositions. (2) A crystal structure in which an atom, molecule, or ion is substituted for another atom, molecule, or ion that is chemically different, but of similar size and shape. (3) A phase formed when small atoms like carbon occupy **interstitial** sites in a **close packed structure** of metal atoms.

solid-state. *Noun modifier.* (1) Used to denote a device activated by a semiconductor component in which current flow is through solid material. (2) Of or concerned with solid matter and its properties.

solid-state devices. *Plural Noun.* Pertaining to electronic devices that can control electric current without the use of moving parts, heated filaments, or vacuum gaps.

solid state diffusion bonding. *Noun.* See **Diffusion bonding**.

solid state fuel cell. *Noun.* See **solid oxide fuel cell**.

solid-state sintering. *Noun.* Densification of a green powder compact by the action of heat at a temperature and solid composition such that no liquid phase ever exists.

solidus. *Noun.* The portion of a temperature-composition diagram which consists of the curve connecting the temperature at which a solid solution is in equilibrium with its vapour and with the liquid solution, and therefore connecting melting temperatures of solid solutions.

soliton. *Noun.* A specially shaped optical pulse in an optical fibre with the profile adjusted so that as it travels through the fibre each pulse is alternately spread out in duration and then wavelength, but each pulse is returned to its original shape at regular distances. It is a form of delocalised wave motion.

solonchak. *Noun.* An intrazonal soil with a grey surface crust containing large quantities of soluble salts.

solubility. *Noun.* The amount of a substance that can be dissolved in another substance or solution. Expressed as mass or volume percent of solvent.

soluble boron in boron carbide. *Noun.* The boron that dissolves from **boron carbide** by separate reflux digestions with two different acids: 0.1 M HCl (hydrochloric acid-soluble boron that is assumed to be boric acid) and 1.6 M nitric acid (nitric acid-soluble boron that is assumed to be **boric acid** plus free boron).

soluble developer. *Noun.* A developer employed in liquid penetrant inspection that is completely soluble in its carrier, but not a suspension of powder in a liquid that dries to an absorptive coating.

soluble salts. *Plural noun.* In ceramic technology, the term usually refers to sulphates, chlorides, and some silicates of **lime**, **soda**, **potash**, and **magnesia** contained in solution in a body, which before, during or after firing, may cause **efflorescence** on the **ware** surface.

solute. *Noun.* That part of a solution considered to be dissolved in the **solvent**.

solute hardening. *Verb.* To make a solid solution by dissolving larger sized atoms or ions into a matrix solute. The resultant strained areas inhibit the movement of **dislocations** making the material harder and stronger.

solution. *Noun.* A homogeneous mixture of two or more **components**, **solute** plus **solvent**. The solute will not settle and has no fixed proportions in the solution below the saturation point.

solution ceramic. *Noun.* A metal-salt solution applied to a surface, which is converted to a ceramic or glassy coating when a flame is played over the coated surface or the solution is sprayed on to a hot surface, or both; exhibits high resistance to thermal shock.

solution colour. *Noun.* A coloured glass or ceramic in which the colour is produced by the same mechanism as that whereby ions, such as Mn^{2+} , Cr^{3+} , etc., produce colour in aqueous solution which involves electron transitions in the higher energy levels that are split by O^{2-} ion field.

solution-diffusion. *Noun.* A ceramic membrane separation system where gases diffuse through nonporous ceramic membranes; first the gas condenses and then diffuses through the structure. This leads to a very selective method to separate gases.

solution enhanced dispersion by supercritical fluids. **SEDS.** *Noun.* A powder production method that allows simultaneous dispersion, solvent extraction and particle formation. carbon dioxide liquid is commonly used and this leads to highly turbulent flow which creates continuous and uniform crystallisation.

solution hardening. *Verb.* See **solute hardening**.

solution heat treatment. *Noun.* A process used to form a **solid solution** and achieve **solution hardening** by dissolving precipitate particles. Rapid cooling from high temperature causes the precipitation and an appropriate annealing at an intermediate temperature is needed.

solution metallisation. *Noun.* A process developed for joining ceramics to metal components. A solution of 90 % ammonium molybdate, 10 % potassium permanganate in the minimum volume of water to just dissolve both salts is painted on to the ceramic and then fired at 1,050 °C in wet hydrogen. This results in a surface layer containing molybdenum metal to which nickel can be plated and the resultant composite brazed to the metal component.

solvation. *Noun.* The process in which chemical association occurs between ions of a solute and molecules of a solvent.

solvation force stabilisation. *Noun.* Avoidance of specific electrolytes and suspension concentrations that lead to **coagulation** when powders are prepared from solution.

solvent. *Noun.* The constituent of a solution that dissolves the solute.

solvent action. *Noun.* The ability of a liquid to dissolve a material.

solvent developer. *Noun.* Any finely divided solid substance suspended in a volatile solvent which, when the solvent dissolves a penetrant to bring it to the surface of a discontinuity, will absorb the penetrant and dry to fix an indication.

solvent remover. *Noun.* A liquid which will remove excess surface penetrant from test specimens or ceramic components by hand wiping.

solvolysis. *Noun.* A chemical reaction occurring between a dissolved substance and the solvent.

solvus. *Noun.* On a phase diagram it is the boundary marking the limits of composition and temperature over which a phase can exist in the solid state. Also called **solvus line**.

solvus line. *Noun.* See **solvus**.

somatoid. *Adjective.* Body-shaped; often used to describe the microstructure of **bayerite** crystallites.

sonicate. *Verb.* To use **ultrasound** to disperse a suspension or to dislodge solids from membranes.

sonics. *Noun.* The study of vibrations in matter.

sonoluminescence. *Noun.* **Luminescence** produced by sound waves.

soot. *Noun.* Finely divided carbon deposited from flames during the incomplete combustion of organic material.

sooty. *Adjective.* Resembling or consisting of **soot**.

sorb. *Verb.* To take up and hold by either processes of **absorption** or **adsorption**.

sorel cement. *Noun.* Strong, hard cement formed by the interaction of magnesium chloride and calcined **magnesia** with water to produce hydrated $MgOCl$. usually contains fillers, such as **sand**, **tal**c and **wood flour**.

sorption. *Noun.* The process whereby an aqueous cation and anion partition from aqueous solution to a solid surface.

sort, sorting. *Verb.* To classify a product or substance on the basis of some characteristic or property.

sort-mud process. *Noun.* An alternative name for making bricks by hand.

soundness. *Noun.* (1) The degree of freedom of a process or substance from defects or flaws. (2) The volume porosity of **Portland cement** after it has set.

sour. *Verb.* To age a ceramic slurry or clay by storing in a damp environment to improve the plasticity and workability of the material.

source aperture. *Noun.* The solid angle of the light source measured from the centre of the incident beam lens.

souring shed. *Noun.* A working area in a pottery where **kerf** is mixed and water added to make the clay malleable.

spacer. *Noun.* A device serving to hold two members at a specified or predetermined distance from each other.

spall. *Noun.* (1) A fragment or chip broken from a masonry or ceramic unit by a blow, by the sudden reaction to heat, by prolonged exposure to heat or atmospheres that result in dimensional changes in the unit or some other severe conditions. (2) *Verb.* To cause fragmentation by heat or a mechanical process.

spalling, mechanical. *Noun.* See **mechanical spalling**.

spalling of refractories. *Noun.* The chipping, cracking, or breaking of a refractory brick or unit in service which usually results in the detachment of a flake-like portion of brick or unit to expose new surfaces.

spalling of refractories, mechanical. *Noun.* See **mechanical spalling**.

spalling of refractories, thermal. *Noun.* See **thermal spalling**.

spalling, spontaneous. *Noun.* See **spontaneous spalling**.

spalling test, panel. *Noun.* See **panel spalling test**.

spalling, thermal shock. *Noun.* See **thermal shock spalling**.

span. *Noun.* (1) The horizontal distance between the supports of an arch. (2) The numerical difference between the upper and lower range values. (3) The spread of the size distribution of a powder: $\text{span} = (D_{90} - D_{10}) / D_{50}$, where D_{90} , D_{50} and D_{10} are the particle diameters below which 90, 50 and 10 % of the volume of the particles lie.

spandrel. *Noun.* The surface area between two adjacent arches and the horizontal cornice above them.

spandrel glass. *Noun.* Architectural glass which is used as a curtain wall in a non-vision area or in the cladding of a building.

spangles. *Noun.* Magnetic iron fired in a glaze for decorative effects.

Spanish topaz. *Noun.* **Quartz** coloured orange-brown. Used as a gemstone.

spar. *Noun.* Various minerals that are light-coloured, microcrystalline, easily cleavable and translucent to transparent; **feldspar** and **calcite** are examples.

sparge. *Verb.* To sprinkle or scatter a material.

spar, heavy. *Noun.* See **heavy spar**.

spark. *Noun.* A small piece of diamond used to cut glass.

spark erosion. *Noun.* (1) A technique for producing powders, in the 0.01–100 μm size range, of ceramics having some electrical conductivity. Two electrodes of the material are connected to a high-voltage source and advanced toward each other until a spark is formed which vaporises the material. (2) A technique used for shaping objects by using a shaped electrode that erodes the workpiece by an electric spark discharge.

spark-gap inspection. *Noun.* A technique for the detection of pinholes and cracks in glass-coated iron or steel products in which a high-frequency discharge from a spark generator fanned across the surface of the coating collects to form a spark at the site of a pinhole or fracture.

sparkling out. *Noun.* The practice of allowing the work piece and grinding wheel to traverse in relation to each other without additional in feed until all contact between the two ceases.

spark plasma sintering. SPS. *Noun.* A powder sintering process for both conducting and insulating powders. A pulsed electric current heats the powder in the die while a uniaxial pressure is applied. Insulating powders are heated by thermal conduction from the die carrying the current while conducting powders also gain heat by Joule resistive heating and localised spark generation. The process needs less time than normal **hot pressing**.

spark test. *Noun.* See **spark-gap inspection**.

sparry. *Adjective.* Relating to, containing, or resembling **spar**.

spathic. *Adjective.* (1) Resembling **spar**. (2) The ability to be easily cleaved.

spathic iron ore. *Noun.* FeCO_3 . Ferrous carbonate; employed as a colourant in ceramic bodies and glazes. Density 3,830–3,880 kg m^{-3} ; hardness (Mohs) 3.5–4.

spatter. *Verb.* To scatter or splash a material, particularly liquids, in droplets over a surface.

spatterdash. *Noun.* Another name for **rough cast**.

spatula. *Noun.* A tool with a broad, flat, often flexible blade.

SPC. *Abbreviation.* Standing for statistical process control. See **statistical process control**.

spec. *Abbreviation.* Stands for **specification**.

special design, concrete. *Noun.* See **concrete special design**.

special nuclear material. *Noun.* ^{239}Pu , ^{233}U , uranium containing more than the natural abundance of ^{235}U , or material artificially enriched in any of these substances.

special purpose fibres. *Plural noun.* A section of the classification of **man-made mineral fibres** that deals with such materials as boron and techniques like high strength, insulation and filtration.

special-purpose tile. *Noun.* A glazed or unglazed floor or wall tile designed to meet specific physical or appearance requirements not covered by standard tiles, such as size, shape, thickness, decoration, keys or lugs on the backs or sides, electrical properties, high coefficient of friction, or special resistance to staining, frost, alkalis, acids, thermal shock, or impact.

special requirements. *Plural noun.* The requirements provided to meet a particular need not covered or included under established procedures or specifications.

speciation. *Noun.* Physicochemical form of an element in a solvent e.g., **aquo** or **hydroxo** complexes. It is an important factor influencing the properties of metal ions in aqueous solution as well as when they are adsorbed on to oxide surfaces.

specific. *Adjective.* (1) Characteristic of a property of a particular substance usually in relation to the same property of a standard substance. (2) Characteristic of a given substance per unit mass, volume, area etc. (3) Of an extensive property divided by mass.

specific activity. *Noun.* The activity per unit mass of a pure **radionuclide**.

specific adsorption. *Noun.* The partition process of an **adion** from aqueous solution to a surface where the ion loses one or more water molecules from its hydration sphere and forms a strong bond to the solid surface. The adsorbed species is referred to as an **inner shell absorption complex**. The whole process is often called **chemisorption**.

specific capacity of electrode material. *Noun.* The **electrode material capacity** per unit mass, mAhg^{-1} or Ahrg^{-1} . For a cell it is expressed as current times time.

specification. *Noun.* A precise statement of a set of requirements to be satisfied by a material, product, or service indicating, whenever appropriate, the procedure by means of which it may be determined if the requirements are satisfied. As far as is practical, it is desirable that the requirements be expressed numerically, preferably in **SI units**, together with their limits.

specific charge. *Noun.* The charge to mass ratio of an elementary particle.

specific energy. Wh kg^{-1} . *Noun.* The output in Watt-hours of a dry cell per unit mass. More generally it is the ratio of energy stored to density.

specific flexural rigidity. R_c . *Noun.* The flexural rigidity of a filament of unit **tex**.

specific gravity. **sp. gr.** *Noun.* The ratio of the weight of a unit volume of a substance to that of a standard material under standard condition of pressure and temperature; the specific gravity of solids and liquids is based on water at 4°C as the standard. Also called **relative density**.

specific gravity, apparent. *Noun.* See **apparent specific gravity**.

specific gravity, bulk. *Noun.* See **bulk specific gravity**.

specific gravity, true. *Noun.* See **true specific gravity**.

specific gravity, volume. *Noun.* See **volume specific gravity**.

specific heat capacity. c_p , c_v . *Noun.* The quantity of heat required to raise the temperature of a mass of material one degree K without a chemical or phase change at constant volume or pressure. Expressed as $\text{J kg}^{-1} \text{K}^{-1}$.

specific humidity. *Noun.* The ratio of the mass of water vapour in a system of moist air to the total mass of the system.

specific modulus. *Noun.* See **specific stiffness**.

specific power. *Noun.* The power output of a battery per unit mass. W kg^{-1} .

specific resistance. *Noun.* See **resistivity**.

specific stiffness. *Noun.* The ratio of **Young's modulus** to **density** for a material.

specific strength. *Noun.* The ratio of **tensile strength** to **density**.

specific stress. *Noun.* For ceramic fibres it is the ratio of force to the **linear density**. Units are N (tex)^{-1} .

specific surface. *Noun.* The surface area per unit weight or volume of a solid substance.

specific surface Helmholtz energy. a_s . *Noun.* **Helmholtz energy** per unit area of the surface phase.

specific surface work. γ_s . *Noun.* Reversible work required to form unit area of the surface phase.

specific viscosity. *Noun.* The ratio of the absolute viscosity of the fluid to that of a reference fluid which is usually water.

specific volume. *Noun.* The volume of a substance per unit of weight; the reciprocal of the density.

specific wear rate. k_w . *Noun.* Defined by the equation: $k_w = v_w / F.s$, where v_w is the wear volume, F is the applied force and s is the sliding distance. A ceramic is considered wear-resistant if $k_w < 10^{-6} \text{ mm}^3 (\text{Nm})^{-1}$

specific weight. *Noun.* The weight of a substance per unit volume.

specified dimensions. *Noun.* The dimensions to which a product or unit must conform.

specimen. *Noun.* An individual unit of a material or product selected for examination, testing, display, or reference.

specimen, job-cured. *Noun.* See **job-cured specimen**.

speck. *Noun.* A discrete particle of unreacted or unwanted material in a glaze.

specking. *Noun.* A defect in porcelain-enamelled surfaces consisting of small visible specks or spots, frequently dirt, fired on the ware.

speckled ware. *Noun.* A decorative surface finish in which spots of one colour appear in a relatively uniform pattern over a surface of another colour or shade.

spectacular iron. *Noun.* Another name for **iron oxides** used by the pigment industry.

spectral colour. *Noun.* The colour produced by light of a single wavelength.

spectral dimension, d. *Noun.* A dimensional term in fractal analysis used to describe **elastic wave** propagation in fractal bodies as opposed to propagation through fully dense homogeneous bodies. For a fractal solid the **phonon** spectrum varies as ν^{d-1} at low frequencies, where d is the **dimensionality** of the matter and ν is the frequency.

spectral response. *Noun.* How the **attenuation** of a **fibre optic cable** changes with the frequency of the transmitted radiation.

spectrochemical carrier distillation. *Noun.* An emission spectrographic technique in which a carrier material is added to a sample to facilitate the vaporisation of the sample or the fractional distillation of the sample.

spectrofluorometer. *Noun.* An instrument used to measure **fluorescence** emission and spectra.

spectrograph. *Noun.* A **spectrometer** that produces a photographic record of a spectrum.

spectrometer. *Noun.* An instrument equipped with an optical system capable of resolving spectral lines and allowing their wavelength and intensity to be determined.

spectrometry, atomic absorption. *Noun.* See **atomic absorption spectrometry**.

spectrophotometer. *Noun.* An instrument that measures the apparent reflection or transmission of visible light as a function of wavelength, particularly in terms of intensity or colour.

spectroscope. *Noun.* Any of a number of instruments that are used to resolve, observe, and record the intensity, particularly peak intensity, of spectral lines.

spectroscope, scintillation. *Noun.* See **scintillation spectroscopy**.

spectroscopic analysis. *Noun.* The use of **spectroscopy** in determining the chemical and/or physical constitution of a ceramic etc.

spectroscopy. *Noun.* The science and technology of using **spectrometers** and **spectroscopes** in studying materials.

spectrum. *Noun.* (1) The full range of electromagnetic radiation with respect to its frequency. (2) A particular distribution of electromagnetic radiation consisting of lines or bands characteristic of the emitting or absorbing substance. (3) The distribution of colours produced when white light is dispersed through a prism. Seven colours are usually seen beginning with the longest wavelength red to the shortest violet.

specular. *Adjective.* (1) Mirror like (2) The degree to which a surface has the capacity to reflect incident light.

specular gloss. *Noun.* The ratio of specularly reflected light to incident light. It is the combination of surface reflected and body reflected components when incident light is reflected from a surface compared with the incident light; this ratio being multiplied by 1,000. The reflected light must be collected along the mirror image axis of the incident light.

specular gloss-45 degree. *Noun.* The fraction of visible light incident on a specimen at an angle of 45° that is reflected through 90°.

speed, peripheral. *Noun.* See **peripheral speed**.

speed, working. *Noun.* See **work speed**.

spelk. *Noun.* A morphology of **asbestos** in which a rod-like appearance arises from parallel close-packed fibres of uniform diameter.

spent fuel. *Noun.* Nuclear reactor fuel which is no longer effective.

sperrylite. *Noun.* PtAs_2 . An ore from which platinum is extracted.

spessartine. *Noun.* $\text{Mn}_3\text{Al}_2(\text{SiO}_4)_3$. A gem quality **garnet** with an orange-red colour. Also called **spessartite**.

spessartite. *Noun.* See **spessartine**.

sp. gr. *Abbreviation.* Stands for **specific gravity**.

sphalerite. *Noun.* ZnS . Zinc ore; an abundant ore found in sedimentary and volcanic rocks. It crystallises in the cubic system as tetrahedral and dodecahedral crystals. The name comes from the Greek word meaning deceptive because it is sometimes mistaken for other minerals because of its properties and it is now the family name of a structure related to diamond and as a result has perfect cleavage leading to a resinous **lustre**, which was no doubt how it got its Greek name. Density 4,080 kg m^{-3} ; hardness (Mohs) 3.5–4. It has the colloquial name of **blackjack ore**.

sphehne. *Noun.* CaTiOSiO_4 . A monoclinic **orthosilicate**. Employed in colorants such as **chrome-tin pink**. Mp 1,386 °C; density 3,400–5,500 kg m^{-3} ; hardness (Mohs) 5–5.5.

spherical aberration. *Noun.* The effect that occurs when all rays from one object point do not come to a common focus after reflection at a curved mirror or refraction through a lens.

spheroidite. *Adjective.* A microstructure consisting of sphere-like particles. **Cementite** in steel can be made to adopt this morphology.

spherulite. *Noun.* A spherical aggregate of radiating crystals with a fibrous appearance originating from a common nucleus.

sp.ht. *Abbreviation.* Stands for specific heat. See **specific heat**.

spicule. *Noun.* **Acicular** particle of non-fibrous mineral.

spider. *Noun.* (1) A defect appearing as a star-shaped fracture in porcelain-enamelled ware. (2) A wheel-like casting consisting of a rim and radial spokes on which felt polishing pads are mounted. (3) An assembly of radiating tie-rods on the top of a furnace. (4) A metal unit of two or more radial arms employed to hold a core and disintegrate laminations of clays and bodies in a **pug mill**. (5) The part of a moulding press mechanism that operates the ejector pins.

spiegeleisen. *Noun.* A manganese- and carbon-rich pig iron.

spigot. *Noun.* (1) The end of a pipe that is overlapped by a portion of the end of an adjoining pipe. (2) A tap device for drawing a liquid from a pipe or container, for example, a water tap.

spike. *Noun.* A projection of glass, usually very sharp, on the inside of a glass container.

spin bath. *Noun.* The acid plus salts bath within which a viscose solution-ceramic powder suspension can be spun to produce long fibres of ceramic held in a rayon matrix.

spindle. *Noun.* (1) A slender rod that turns or on which something else turns. (2) A rod with a notch in the top used to draw out fibres for spinning into thread, and a long narrow body around which the spun thread is wound.

spinel. *Noun.* The mineral MgAl_2O_4 is spinel but a group of minerals of the general formula AB_2O_4 , in which A is a divalent metal or mixture of divalent metals, such as magnesium, ferrous iron, zinc, manganese, cobalt, calcium, copper, barium, nickel, and strontium, and B is a trivalent metal, such as aluminium, ferric iron, and chromium, are loosely called spinel; used in the manufacture of ceramic colours and refractories but they are more important as magnetic and electrical ceramics. Several of the mineral spinels have large crystals that are coloured and transparent and have gem value, for example **red spinels** are very similar to **rubies**. See **balas ruby**.

spinel black. *Noun.* $\text{Cu}(\text{Cr,Fe})_2\text{O}_4$. A synthetic spinel developed as a pigment.

spin ices. *Noun.* Materials such as **dysprosium titanate** that are believed to have sharply defined magnetic point charge, magnetic monopole, excitations. Spin ices cooled close to 0 K have been used to measure the magnetic monopole give a value of $5 \mu\text{B } \text{\AA}^{-1}$ for the unit of magnetic charge.

spinlaced fabric. *Noun.* See **hydroentangled fabric**.

spin mix. *Noun.* A mixture of ceramic powder dispersed in water in a **ball mill** and then mixed with **viscose** to a loading of 50–90 wt.% relative to the cellulose. Used in the **VSSP** process for ceramic **filament** manufacture.

spinneret, spinnerette. *Noun.* (1) A small platinum thimble containing one or more holes through which molten glass is pulled in the making of glass threads, fibres or filaments. (2) A finely perforated dispenser through which viscous liquids are extruded to form **man-made fibres**.

spinning. *Verb.* To form fibres by extrusion through a **spinneret**.

spinodal. *Noun.* The locus of points within the **binodal** phase separation zone in a phase diagram, where d^2G/dx^2 , the free energy change as a function of composition, is negative and so spontaneous, non-nucleated phase separation will occur. The spinodal forms the inner dome in the immiscibility gap in a liquid-liquid phase separation system.

spin-off. *Noun.* Any product or progress made incidentally from the application of existing knowledge or activity.

spin-stretch ratio. *Noun.* In fibre extrusion it is the ratio of take-up or haul-off speed to the average speed of the product at the exit from the **spinneret** hole. Also known as **draw-down**.

spintronic devices. *Noun.* Techniques and tools that use the spin of an electron as well as its charge.

spintronics. *Noun.* Manipulation of electron spin by magnetic and electric fields for use in memory storage devices.

spiral conveyor. *Noun.* A conveyor consisting of a screw-type shaft employed to transfer materials on a horizontal, inclined, or vertical plane, and which is based on the principle of the Archimedes screw.

spirit. *Noun.* Commercial ethyl alcohol.

spirits of hartshorn. *Noun.* An old name for aqueous ammonia.

spitout. *Noun.* A glaze defect consisting of aggravated pinholes or craters that are developed during **glost firing** due to the evolution of gas bubbles from the body or glaze constituents or to vapours in the decorating fire.

splash back. *Noun.* A sheet of glass, ceramic, or plastic attached to a wall above a basin to protect the wall against splashing.

- splat cooling.** *Noun.* A technique whereby a small molten bead on a water-cooled hearth is hit by a spring loaded cylinder and spreads rapidly to a thin sheet as the arc furnace current is stopped. Cooling rates of 10^4 – 10^6 °C s⁻¹ can be achieved, which can freeze-in metastable phases.
- splatter.** *Verb.* To splash with small liquid or colloidal blobs.
- splice.** *Noun.* A joint between two or more separate lengths of cable involving both the conductor and the protecting sheaths.
- spline.** *Noun.* (1) A flat-edged tool used to shape surfaces. (2) Any one of a series of narrow keys formed longitudinally around the circumference of a shaft that fit into corresponding grooves in a mating part; used to prevent movement between the parts.
- splining.** *Verb.* To prepare a surface to desired contours while it is in a plastic state.
- splinter.** *Noun.* A very sharp, long, thin piece of glass, etc., broken from a piece.
- split.** *Noun.* (1) A brick modified to a thickness of one-half of the usual dimensions. (2) A glass defect consisting of a crack or check extending from one surface to the other. (3) *Verb.* To divide a sample into smaller parts.
- split feed.** A liquid-phase adsorption process in which a powder is added to a solution to be treated in two or more steps.
- split Hopkinson pressure bar test. SHPB.** *Noun.* A technique developed in the 1940s to examine the effect of strain rate on brittle materials, such as ceramics, concrete and minerals, which allows interpretation as uniaxial stress-strain curves at high strain rates.
- split mould.** *Noun.* A casting mould made in two or more parts to permit the easy removal of ware after casting.
- splittings.** *Noun.* Trimmed or untrimmed mica produced by splitting blocks to a thickness less than 0.03 mm.
- splittings, bookform.** *Noun.* See **bookform splittings**.
- splittings, loose.** *Noun.* See **loose splittings**.
- splittings, powdered loose.** *Noun.* See **powdered loose splittings**.
- splittings, thick.** *Noun.* See **thick splittings**.
- splittings, thin.** *Noun.* See **thin splittings**.
- splitting tensile strength.** *Noun.* A test procedure which employs disks of material broken in tension along a vertical diameter by applying a compressive load. Also known as the **Brazil test** or **diametral compression test**.
- spluttering.** *Noun.* The **popping** of glaze fragments from ware during firing, which fuses to the **setters** or shelves.
- SPM.** *Abbreviation.* Stands for scanning probe microscopy. See **scanning probe microscopy**.
- Spode.** *Trademark, noun.* China or porcelain manufactured by Josiah Spode, 1754–1827, or by the Spode Company.
- spodumene.** *Noun.* LiAl(SiO₃)₂. An ore of lithium having very low thermal expansion employed as a flux, and to improve resistance to **thermal shock** in glass, porcelain-enamels, glazes, and ceramic bodies. Good crystals are used as gemstones. A **chain pyroxene** occurring in glass-ceramics. Density 3,130–3,200; hardness (Mohs) 6.5–7.
- spoil.** *Noun.* Bricks which may be placed and removed at the base of a kiln flue to control the draw of the flue, the pressure in the firing chamber, and to maintain the oxidation or reduction characteristics of the kiln atmosphere.
- sponging.** *Verb.* To remove surface blemishes from unfired ceramic ware by the use of a damp sponge.
- spongy.** *Adjective.* Resembling a sponge in texture, porosity, elasticity, and compressibility.
- spongy enamel.** *Noun.* A defect in fired porcelain-enamel characterised by masses of large bubbles occurring in localised areas and having a **spongy** appearance.
- spontaneous chipping.** *Noun.* See **spontaneous spalling**.
- spontaneous combustion.** *Noun.* The ignition of a substance without the application of external sources of heat; usually caused by oxidation of fine powders.
- spontaneous emission.** *Noun.* The return of an excited atomic species to a lower energy level by emitting a photon in the absence of external influences.
- spontaneous polarisation.** *Noun.* The value of polarisation of a **ferroelectric** ceramic, obtained by extrapolating the linear part of the **hysteresis curve** to zero applied electric field.
- spontaneous spalling.** *Noun.* Spontaneous fracture, chipping or flaking of porcelain-enamel from ware without apparent external cause. Also known as **spontaneous chipping**.
- spoon proof.** *Noun.* A specimen of molten glass taken for analysis and observation from a ladle during various stages of melting and fining.
- spot check.** *Verb.* To randomly sample a material or observation of a process.
- spout.** *Noun.* (1) A device through which a material is charged into or discharged from an area. (2) The part of a glass feeder that carries the orifice, revolving tube, and needle. (3) The refractory block through which molten glass flows to a forming machine.

SPP. *Abbreviation.* Stands for surface plasmon-polariton. See **surface plasmon-polariton**.

spray booth. *Noun.* A chamber, open on one side, in which coatings are applied to ware by means of an atomising gun; booths are usually equipped with exhaust fans and collectors to collect overspray materials and to prevent dust from entering work areas.

spray drier. *Noun.* A device in which an atomised suspension of solids in a liquid is dried by direct contact with hot gases or by impingement on a hot surface.

spray drying. *Noun.* An important powder preparation technique in the ceramics industry. It involves the atomisation of a ceramic fluid feedstock into droplet sprays that are very rapidly dried to individual powder particles on contact with hot air.

spray frost. *Noun.* An inorganic salt sprayed onto a glass surface and then fired to simulate acid etching.

spray gun. *Noun.* A device of gun-like shape designed to deliver an atomised liquid or suspension.

spraying, electrostatic. *Noun.* See **electrostatic spraying**.

spraying, flame. *Noun.* See **flame spraying**.

spraying, plasma. *Noun.* See **plasma spraying**.

spraying, thermal. *Noun.* See **thermal spraying**.

spray nozzle. *Noun.* The discharge opening of a **spray gun** in which a suspension is atomised.

spray quenching. *Verb.* To rapidly cool a molten material in a spray of water or other liquid.

spray sagging. *Noun.* A defect characterised by wavy lines in glazes and porcelain-enamel on the vertical surfaces of the ware during and after spraying, but before the coating has dried.

spray thermal decomposition. *Noun.* A technique for the preparation of ceramic powders whereby appropriate salt solutions are sprayed into a vertical tube furnace at temperatures above 800 °C when solvent evaporation and salt decomposition rapidly occur leading to hollow, dry particles of **aggregated** powder of about 5 µm diameter.

spray-up. *Noun.* A forming method for **fibre-reinforced composites** in which resin-matrix and ceramic or glass fibres are blown simultaneously into a mould from a **spray gun**. Large-sized products, such as boat hulls, water tanks, etc., are made this way.

spreader. *Noun.* (1) A machine that deposits, distributes, and spreads concrete on a pavement prior to the finishing operation. (2) A steel or wood spacer put temporarily in a **form** to keep the walls apart and hold them in alignment until concrete is poured.

spreader block. *Noun.* A refractory block of triangular cross-section employed to divide and distribute coal being charged into a coke oven.

spreading dimension. *d.* *Noun.* Sometimes called chemical dimension; a term used in **fractal analysis** of solids. Defined as: starting from a point on the object cover a distance L entirely contained within it; this can be done several ways, hence count all the mass cover by the several paths and if the mass varies as $m_{(L)} = L^d$, then d is the spreading dimension. It only depends on the exact way the individual masses or particles in the fractal are connected and is therefore a measure of connectivity.

SP resin infusion technology. **SPRINT.** *Noun.* Two layers of dry ceramic reinforcement, such as glass or carbon fibre, sandwich a pre-cast, pre-catalysed resin film. The shape is put into moulds, vacuumed bagged and the air removed. Heat is applied and the resin film softens and runs and flows into the air-free reinforcement.

springed ware. *Noun.* Pottery that is decorated by the application of a **bas-relief** ornamentation by hand pressing or by casting in moulds.

springing. *Noun.* A method of decorating by adding more wet clay to a body while forming to be shaped into a decoration or to fill out thin sections.

spring constant. *Noun.* An old textile test applied to composite reinforcement cloths; it is the pounds weight needed to compress a specimen one inch in a prescribed test procedure.

spring contact. *Noun.* A contact between surfaces effected by means of a spring device or by means of a spring-like property of one or both materials.

spring crack. *Noun.* A circumferential crack in a pot or vase caused by faulty firing. This crack is a through thickness defect.

springer. *Noun.* A course of brickwork having an inclined face from which an arch or furnace roof may be sprung.

springing. *Noun.* The breaking of handles from cups, mugs, pots, etc., due to inherent stresses at one or both joints.

spring line. *Noun.* (1) The line of contact between the inside surface of a skewback and an arch in a furnace. (2) The points on an internal surface of the transverse section of a pipe intersected by the line of maximum horizontal dimension. (3) The mid-height of the internal wall in box sections of furnaces.

spring zone. *Noun.* The region of the liquid in a glass making furnace between the end of the **batch blanket** and the **fining pool**. To the **doghouse** side of this region the liquid convects anti-clockwise and assists **batch** melting and to the **throat side** the liquid convects clockwise to exit. It is the zone where **primary fining** takes place.

SPRINT. *Acronym.* Stands for SP resin infusion technology. See **SP resin infusion technology**.

spue. *Noun.* (1) A slug-like material that forms in the discharge channel of a porcelain-enamel frit smelter or **glass tank**. (2) The discharge channel of a **melting tank** or furnace.

sprung arch, sprung roof. *Noun.* A curved structure spanning the working zone in a furnace, and which is supported by abutments at the sides or at the ends of the furnace

SPS. *Abbreviation.* Stands for spark plasma sintering. See **spark plasma sintering**.

spud. *Noun.* A type of orifice found on high-pressure gas mixers; used to control the fuel usage in a mixer-burner torch.

spun glass. *Noun.* An individual filament or a mass of fine threads of attenuated glass, often having a delicate spiral threading or filigree. See **fibreglass**.

spun roving. *Noun.* A low-cost glass-fibre strand in which the continuous filaments are doubled back on each other.

spur. *Noun.* A triangular item of **kiln furniture**; used to support glazed ware to prevent it from sticking to the shelves of the kiln during firing.

sputtering. *Verb.* (1) To apply porcelain-enamel or glaze to ware in droplets to produce a mottled or speckled appearance instead of the usual smooth, uniform surface. (2) A physical process by which atoms or molecules can be deposited onto a substrate to form a thin film, or conversely, removed from a surface to etch it, by application of intense heat or electrical pulses of short duration.

square-cut glass. *Noun.* Optical glass cut into squares which are separated and designated by weight; used in the production of ground and polished optical units.

squareness ratio. *Noun.* The ratio of magnetisation at $-H/2$ to the magnetisation at H , where H is the field strength of the completed hysteresis loop.

squeegee. *Noun.* A rubber-like blade for distributing and rubbing oil suspensions of ceramic pigments over and through silk screens in the decoration of ware.

squeegee oil. *Noun.* A mixture of liquid organic materials employed as the suspension vehicle in screening inks and pastes.

squeegee paste. *Noun.* See **screening ink**.

squeegee silver. *Noun.* Silver metal powder in suspensions formulated for screen printing.

squeeze casting. *Noun.* A process developed initially to fabricate metal matrix-ceramic-reinforced composites in which a porous ceramic preform is subjected to a molten metal at high pressure. Connected porosity is filled with supercooled liquid, which then crystallises under pressure to form a fine-grained **equiaxed** matrix. The resulting composite has near net shape after sintering.

SQUID. *Acronym.* Stands for superconducting quantum interference device. See **superconducting quantum interference device**.

ssF. *Abbreviation.* Stands for stainless steel fibres. See **stainless steel fibre**.

stability. *Noun.* (1) The resistance of a glass to **devitrification**. (2) The chemical and weather resistance of a glass. (3) Variation in measured averages when the measuring instrument values are recorded over a specified time interval.

stability map. *Noun.* A diagram that shows the **pH** plotted against the **dispersant** content needed to efficiently disperse **refractory castables**. A variety of techniques, such as **apparent viscosity** and **suspension yield stress**, are used to define the maps and show optimum dispersion regions.

stability, physical. *Noun.* See **physical stability**.

stabilisation. *Verb.* (1) To make a precursor fibre infusible in the manufacture of carbon fibre. It usually involves a surface oxidation process. (2) To lower the internal stresses and control grain size by a heat treatment stage and so improves mechanical, aging resistance, and chemical resistance properties.

stabilise. *Verb.* See **stabilisation**.

stabiliser. *Noun.* An oxide, such as CaO , Al_2O_3 , and TiO_2 , added to a frit, glaze, or colouring oxide to stabilise the colour during firing.

stack. *Noun.* Any structure or part of a structure that contains a flue or flues for the discharge of gases, particularly combustion gases from smelters, kilns, and furnaces.

stacker. *Noun.* A device for placing and spacing glass articles properly on a continuous **lehr** belt for thermal treatment.

stack gas. *Noun.* Furnace and kiln gases that have been exhausted into a **stack** or a **flue**.

stacking fault. *Noun.* A break in the sequence in which planes occur along a stated direction in a crystal; for example, in a **face-centred cubic** structure the stacking sequence is ABCABCABC... and a stacking fault could be ... ABCACABC ... which introduces a thin layer of close-packed hexagonal structure into the crystal. ABCABCCBACBA ... is a stacking fault which introduces a **twin boundary**.

stacking sequence. *Noun.* (1) The order in which perceived layers in a crystal structure are stacked perpendicularly to the c -axis of the **unit cell**. For example, if the pattern repeats every fourth layer-ABCABC ... -the structure of the ceramic is cubic. See **stacking fault**. (2) In laminated **ceramic composites** it is the **ply** ordering perpendicular to the plane of the reinforcing cloth or tape.

staddlestone. *Noun.* A support for stacking corn or hay consisting of truncated conical stone surmounted by a flat circular stone.

stain. *Verb.* (1) To colour glass by dipping the item in a solution of a colour-forming metal salt and then heating the dipped item to a temperature at which the colour is formed and absorbed by the glass surface. (2) To colour glassware by subjecting items to the vapours of a colour-forming salt at elevated temperatures in a closed furnace. (3) *Noun.* A ceramic colour, usually one of the transition metals in combination with other elements, applied to a body, glaze, or porcelain-enamel as an addition to the body, glaze, or porcelain-enamel composition. (4) *Noun.* An imperfection such as chemical corrosion of the glass or ceramic coating surface. (5) *Noun.* An unwanted discoloration of the surface of a body or coating.

stainability. *Noun.* The relative ease by which a material is penetrated and discoloured by a foreign material.

stain brush. *Noun.* A ware decorating brush in which the hairs have a sharp chisel edge with flat aspect; used for obtaining colour shading effects.

stained glass. *Noun.* Glass sheets that have been coloured by various means, such as by incorporating colorants in the glass batch, by applying and firing a clear-coloured enamel on the surface of the glass, fusing with a film of ceramic oxide or firing pigment into the surface. Used in the production of **mosaics**, church windows, etc.

stainless steel fibre. ssF. *Noun.* Used as additions to low-cement **castables** in order to achieve better thermal-shock or **spalling** resistance of castable installations.

stains, glaze. *Noun.* See **glaze stains**.

stain, slip. *Noun.* See **slip stain**.

stamnos. *Noun.* An ancient Greek ceramic vase.

stamping. *Verb.* To decorate or mark ware by the use of a rubber stamp to apply a stamping ink to the surface of the ware.

stamping ink. *Noun.* A suspension of finely milled ceramic pigment in a suitable medium, usually an oil, which may be applied by means of a stamp, and which develops its colour and permanence on firing.

stamp sand. *Noun.* A by-product of the copper mining and refining industry. It contains some residual copper and is already crushed, hence it can be used in the manufacture of **shingles** as a replacement for the added copper and crushed rock granules.

standard. *Noun.* (1) A reference used as the basis for comparison or calibration. (2) A concept that has been established to serve as a model or rule in the measurement of quantity or quality, or the establishment of a procedure or practice.

standard, acceptance. *Noun.* See **acceptance standard**.

standard brick. *Noun.* A brick $6.8 \times 10.2 \times 20.3$ cm in size.

standard, calibration. *Noun.* See **calibration standard**.

standard chemical potential. μ_1° . *Noun.* See **chemical potentials**.

standard consistency. *Noun.* An **OPC** cement paste into which a 10 mm diameter plunger with a 2.94 N load applied penetrates to 5 ± 1 mm from the bottom of the mould.

standard design. *Noun.* A proven or published design for a product.

standard deviation. *Noun.* A measure of the variability of data about the population mean. The standard or allowable deviation of a single determination (sigma) divided by the square root of the group (nu).

standard enthalpies. *Plural noun.* Internationally defined but arbitrary zero values for the enthalpies of materials from which all other enthalpies and enthalpy changes are measured. See **International zero of enthalpy, standard enthalpy of formation** and **standard enthalpy of formation of an ion**.

standard enthalpy of formation. *Noun.* The enthalpy change occurring when a pure compound is formed from its constituent elements in their **zero enthalpy** condition at 298 K and 1 atm pressure.

standard enthalpy formation of ions. *Noun.* The heat of formation of 1 mol of the ion from its element or constituent elements in their **zero enthalpy states** at 298 K and 1 atm pressure, referred to the standard enthalpy of formation of the hydrogen ion, H^+ , in 1 M aqueous solution taken to be zero.

standard free energy. *Noun.* By international definition the standard free energy of an element in its most stable state is zero at 298 K and 1 atm pressure.

standard free energy of formation. *Noun.* The free energy change accompanying its formation from its constituent pure elements in their zero free energy condition at 298 K and 1 atm pressure.

standard free energy of formation of a compound. *Noun.* This is defined as the free energy change associated with its formation from its constituent pure elements in their most stable form in their zero free energy condition at 298 K and 1 atm pressure.

standard laboratory atmosphere. *Noun.* Defined relative to the moisture content of the air, it is an atmosphere having a relative humidity of $50 \pm 2\%$ at $23 \pm 1^\circ C$.

standard mean ocean water. *Noun.* See **mille ‰**.

standard, primary. *Noun.* See **primary standard**.

standard redox potential. *Noun.* See **redox potential**.

standard, reference. *Noun.* See **reference standard**.

standard shapes. *Plural noun.* A series of refractory units in various sizes and shapes which, because of their extensive or essential use, are stocked by the manufacturer or can be made from stock moulds.

standard test and evaluation bottle. STEB. *Noun.* A test vehicle used to compare composite materials and designs.

standard, working. See **working standard**.

stand oil. *Noun.* A thick oil made by heating linseed or soya to 300 °C. Used in oil **enamel** paints.

stannic. *Adjective.* Of or containing tin in the tetravalent state.

stannic chloride. *Noun.* SnCl_4 . A volatile salt used to produce an abrasion-resistant coating on glass and as an electrically conducting film on glass and ceramics. Mp -33 °C; bp 114 °C; density 2.28.

stannic oxide. *Noun.* See **tin oxide**.

stannic sulphide. *Noun.* SnS_2 . A yellowish-brown powder used as a pigment and in the decoration paint called **mosaic gold**.

stanniferous. *Adjective.* Containing tin.

stannite. *Noun.* $\text{Cu}_2\text{FeSnS}_4$. A grey metallic mineral. A source of tin.

stannous. *Adjective.* Containing tin in the divalent state.

stannous chloride. *Noun.* SnCl_2 . Used as a conductor and resistor coating on glass, porcelain-enamels and ceramics for surface heating. Mp 246.8 °C. See **stannous chloride hydrate**.

stannous chloride hydrate. *Noun.* $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$. Used to produce the **Tiffany** effect on glazes. Also called **tin crystals** and **tin salt**.

stannous chromate. *Noun.* SnCrO_4 . Used as a colorant in the decoration of porcelain and pottery.

stannous oxide. *Noun.* See **tin oxide**.

Stanton fibres. *Plural noun.* Any fibre with length greater than a critical threshold, between 5 and 20 μm , and whose diameter is substantially below 1 μm ; fibres of such morphology are capable of causing cancer.

staple fibre. *Noun.* An individual filament made by attenuating molten glass; the fibres are of relatively short length, generally less than 42.5 cm.

starch. *Plural noun.* A group of carbohydrates or polysaccharides with the general composition $(\text{C}_6\text{H}_{10}\text{O}_5)_n$; used as a component in sizes for glass textile yarns.

star dresser. *Noun.* A tool using star-shaped metal cutters which may be rotated for trueing and dressing grinding wheels.

star marks. *Noun.* A porcelain-enamel defect characterised by a star-shaped fracture in which lines radiate from a point opposite a firing pin or from impact with a sharp object prior to firing.

starred glaze. *Noun.* A partially devitrified glaze in which star-shaped crystals develop at the surface during firing.

star sapphire. *Noun.* A **sapphire** with a crystal structure and a cut that shows a star-like figure in reflected light.

starved glaze. *Noun.* A glaze applied on ware to an insufficient thickness to obtain good coverage.

starved gold. *Noun.* A weak deposit of very low gold content.

statcoulomb. *Noun.* A unit of electrical charge defined in terms of the **SI unit**, the **coulomb**, as 3.3356×10^{-10} c.

state function. *Noun.* A thermodynamic quantity that has definite values for given states of a system, such as **enthalpy**, **free energy**, **entropy** etc.

static balance. *Noun.* The condition which permits a grinding wheel, or other rotating part on a frictionless horizontal **arbor** to remain at rest in any position.

static fatigue. *Noun.* Mechanical failure of a material under continuous static load at values below the measured ultimate tensile strength of the material. In glass in particular it is associated with stress-accelerated corrosion.

static modulus. *Noun.* The ratio of stress to strain under static conditions.

statistical analysis. *Noun.* The evaluation of data by statistical methods.

statistical bias. *Noun.* A constant or systematic error in experimental results as may exist between the true value and a test result obtained from one method, between test results obtained from two methods, or between test results from a single method between, for example, different operators or laboratories.

statistical process control. SPC. *Noun.* A process is seen as a set of sequential operations with each step controlled and analysed by plant operators using simple, formalised statistical procedures; an important component of **TQM**, which is an overall management scheme to improve product quality and reliability.

statistical quality control. *Noun.* A means of controlling the quality of a product or process by the use of statistical techniques.

statistics. *Noun.* The drawing of inferences from data on samples obtained under specified conditions by use of the probability theory.

stator blade. *Noun.* A structural member of the stationary part of a motor, dynamo, turbine, or other machine about which a rotor turns.

steady rest. *Noun.* A supplementary support for pieces being ground on a cylindrical grinder.

steady state. *Noun.* The condition of a **system** when some or all of the variables describing it are time independent but not necessarily in thermodynamic or chemical equilibrium.

steady-state current. *Noun.* The current in a circuit after it has reached equilibrium.

steady state diffusion. *Noun.* The diffusion flux is independent of time and so there is no net accumulation or depletion of diffusing species.

steam. *Noun.* Water in a gaseous state at a minimum temperature of 100 °C.

steam coal. *Noun.* A grade of coal suitable for use in a steam generating boiler.

steam curing. *Verb.* To rapidly cure concrete in an atmosphere of steam, either at atmospheric or elevated pressures, as achieved in an **autoclave**.

steam-generating heavy-water reactor. **SGHWR.** *Noun.* A type of nuclear reactor that uses **uranium oxides** as the fuel, encased in zirconium. It is moderated by **heavy water** with ordinary water as the coolant.

steam point. *Noun.* The temperature at which the maximum water vapour pressure equals one **atmosphere**. On the Celsius scale this is 100°.

steam-rack drier. *Noun.* A room equipped with steam pipes as the source of heat arranged so as to permit the stacking of pallets of wet **greenware** for drying.

stearates. *Plural Noun.* Salts or esters of **stearic acid** used as internal lubricants in the **dry pressing** of **technical ceramics**.

stearic acid. *Noun.* $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$. A colourless wax-like solid used as a lubricant in ceramic products and to promote abrasion resistance in heavy clay items.

steatite. *Noun.* $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. A three-layer sheet structure silicate, i.e., **talca**, but massively impure; mp above 1,300 °C; density 2,700–2,800 kg m⁻³; hardness (Mohs) 1–1.5; used in the production of low-loss electrical insulators, dinnerware, wall tiles and as a component in **forsterite** and **cordierite** bodies. It is also another name for **soapstone**.

steatite porcelain. *Noun.* A vitreous ceramic whiteware for technical application in which the steatite decomposition product **serpentine**, **magnesium metasilicate**, MgSiO_3 , is the essential crystalline phase.

steatite talc. *Noun.* **Massive talc** containing gross impurities or its pulverised product having the general formula $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. Although the compound term appears in the literature, the use of the terms **steatite** and **talc** together actually is a redundancy.

steatite whiteware. *Noun.* Any ceramic whiteware in which **magnesium metasilicate**, MgSiO_3 , is the essential crystalline phase.

STEB. *Acronym.* Stands for standard test and evaluation bottle. See **standard test and evaluation bottle**.

steel, cold-rolled. *Noun.* See **cold-rolled steel**.

steel, decarburised. *Noun.* See **decarburised steel**.

steel, glass-lined. *Noun.* See **glass-lined steel**.

steel, high-carbon. *Noun.* See **high-carbon steel**.

steel lines. *Noun.* Lines visible in a porcelain-enamel coating that follow the rolling pattern of the steel.

steel, pretensioned. *Noun.* See **pretensioned steel**.

steel, zero-carbon. *Noun.* See **zero-carbon steel**.

Stefan's law. *Noun.* The total **emissive power**, e , of a perfect **blackbody radiator** is proportional to the fourth power of the thermodynamic temperature, T , of the body: $e = \sigma T^4$, where σ is the Stefan-Boltzmann constant, $5.670 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$.

Steinbuhl yellow. *Noun.* See **barium chromate**.

stellate aggregate. *Noun.* Groups of crystals radiating from a common centre so as to resemble a star.

stellite. *Noun.* A family of hard, temperature- and wear-resistant alloys of cobalt, chromium, and tungsten; used as firing racks and tools in porcelain-enamelling.

STEM. *Acronym.* Stands for scanning transmission electron microscopy. See **scanning transmission electron microscopy**.

stem, pulled. *Noun.* See **pulled stem**.

stemware. *Noun.* Glass tableware, such as goblets, compotes, etc., constructed with a slender stem between the bowl and the base.

stencil. *Noun.* A sheet of heavy paper, plastic, or metal in which lettering or designs are cut and through which designs are applied to ware by spraying or brushing; in some instances, a dried but unfired coating is brushed from a previously fired undercoating to produce the design.

step cut. *Adjective.* See **emerald cut**.

stepped godet. *Noun.* See **godet wheel**.

stepped index multimode fibre. *Noun.* **Optical fibre** with abrupt changes in **refractive index** of the fibre material. It is high in the middle and sharply different in the outer regions.

stepped lap joint. *Noun.* Another development of the simple lap joint where the two ceramic pieces to be joined are ground to half thickness at the ends and these are coated with adhesive and overlapped. This gives a very good joint of smooth aspect like a **butt joint**. See **simple lap joint**.

stepping stone. *Noun.* One of a series of large flat stones set to make it possible to cross a shallow river, marsh or stream.

steradian. sr. *Noun.* A unit **solid angle**.

stereo-. *Combining form.* Indicates a 3-dimensional quality of a solid.

stereobate. *Noun.* A masonry platform forming the foundation of a building.

stereochrome. *Noun.* (1) A wall picture made by **stereochromy**. (2) *Verb trans.* To make a picture by the process of **stereochromy**.

stereochromy. *Noun.* A method of painting murals in which **water glass** is used as the painting medium or as a fixative.

stereoscopic. *Adjective.* The use of binocular optics to view see objects three-dimensionally.

stereotomy. *Noun.* The technology and art of cutting 3-dimensional solids into particular shapes.

steric stabilisation. *Noun.* Prevention of powder **coagulation** or **agglomeration** by attaching to the individual particles large molecules which prevent any two particles achieving a distance of approach equal to or less than the critical value, l_0 , which causes the interaction energy to be at the minimum in an interaction energy versus distance curve.

Stern layer. *Noun.* A compact, tightly held layer of solvent molecules and counter-ions at the surface of a solid suspended in a liquid, such as a **slip**. The surface potential of the solid decays linearly through the thickness of the Stern layer, which cannot be moved under the influence of shear stress, hence electric fields induce a tangential movement of the liquid phase just beyond the Stern layer.

stibium oxide. *Noun.* Sb_2O_3 . An old name for **antimony oxide**. Made by burning **stibnite**. Used in low fire glazes but is highly toxic, irritating and toxic. Also called **valentinite**.

stibnite. *Noun.* Sb_2S_3 . A principal ore of antimony; formed at relatively low temperatures and pressures; metallic-grey colour producing a grey streak; orthorhombic crystal system. Because of its low melting point it is beneficiated by **liquation** with liquid stibnite being allowed to drain away from the **gangue**. Used in glaze formulations with yellow trioxide when low temperature glazes are needed. Density $4,633 \text{ kg m}^{-3}$; hardness (Mohs) 2.

stichite. *Noun.* $\text{Mg}_6\text{Cr}_2(\text{OH})_6(\text{CO}_3)_4\cdot 4\text{H}_2\text{O}$. The rhombohedral form of a **layered double hydroxide**. The hexagonal form is called **barbertonite**.

stick. *Noun.* (1) A **bonded abrasive**; stick-like in form, used for hone-sharpening, for precision honing, and for the dressing of abrasive wheels. (2) A type of defect in

non-woven fabric consisting of bundles of fibres with aligned cut ends. Usually caused by poor agitation when the dispersion was made.

sticking up. *Verb.* To join two ceramic articles, such as a handle to a cup or a knob on a tureen.

sticky. *Noun.* A **fat**, rich-appearing, plastic concrete mix.

stiff. *Adjective.* A concrete mix that is too dry, lacks plasticity, and exhibits low **slump** characteristics.

stiffening, premature. *Noun.* See **premature stiffening**.

stiff glaze. *Noun.* A glaze that exhibit little or no run, either after application or during firing.

stiff-mud brick. *Noun.* Brick produced by extruding a stiff but still plastic clay, containing approximately 12–15 % moisture, through a die.

stiff-mud process. *Noun.* The process of extruding a stiff but plastic clay through a die.

stiffness. *Noun.* The extent of deformation produced by a load. Used mostly in a comparative sense but in a strict sense it is the ratio of applied stress and resultant strain.

STHM. *Abbreviation.* Stands for scanning tunnelling hydrogen microscopy. See **scanning tunnelling hydrogen microscopy**.

stilbite. *Noun.* $(\text{Ca}, \text{Na}_2, \text{K}_2)\text{Al}_2\text{Si}_2\text{O}_{18}\cdot 7\text{H}_2\text{O}$. An aluminosilicate **zeolite** occurring as a **geode** showing perfect cleavage in one direction.

still. *Noun.* An apparatus consisting of a vessel in which a liquid is heated and vaporised, and then cooled in a tower or chamber in which the vapour is condensed and collected.

stilliard. *Noun.* A rack used for storage or for transporting clayware from one point to another prior to firing.

stilt. *Noun.* A tripod-like **setter** with sharp points at the end of each arm on which glazed ware is placed and fired.

stilt mark. *Noun.* A mark left on the bottom of a glazed item caused by its sticking to the **stilt** following the firing operation; these marks are stoned or ground-off before shipment of the item.

stimulated emission. *Verb.* To cause the return to the **ground state energy** of an excited atomic species by irradiating it with a photon of the same energy as that which will be emitted by the return; hence, this is a process of energy, frequently visible light, amplification.

sting-out. *Noun.* Hot air and flame exhausted through openings in furnaces, kilns, and glass tanks due to the existence of positive pressures in the firing zones.

stinker. *Noun.* A soured storage barrel used for the aging of clays and slips to obtain improved qualities of the ware.

stipple. *Verb.* (1) To engrave in dots or separate touches. See **pointillism**. (2) To give **cement mortar** or **paste** a granular effect.

stippled finish. *Adjective.* (1) Spattered or pebbly textured porcelain-enamelled or glazed finishes produced by distributing and firing droplets of different colored enamels or coloured glazes over the surface of the ware. (2) A stippled or mottled effect produced on the surface of glass by treatment with a mixture of acid and an inert substance, resulting in a variable penetration of acid over the surface of the glass.

stishovite. *Noun.* A **quartz**, SiO_2 , polymorph formed at high pressures.

STM. *Abbreviation.* Stands for scanning tunnelling microscopy. See **scanning tunnelling microscopy**.

stochastic. *Adjective.* Relating to or denoting random sequential process in which the probabilities of each step depend on the outcome of previous steps.

stockpile. *Noun.* A reserve of materials or products accumulated for future use or shipment.

stoichiometric. *Adjective.* Having the precise weight relationship of elements as demanded by the chemical formula, and by which the quantities of reactants and products of a chemical reaction are determined.

stoke or stokes. *Noun.* A **cgs unit** of kinematic viscosity equal to the kinematic viscosity of a fluid having a dynamic viscosity of 1 **poise** and a density of 1 g cm^{-3} . To convert 1 stoke to the **SI unit** of $\text{m}^2 \text{ s}^{-2}$ multiply by 10^{-4} .

stoker. *Noun.* A mechanical device for feeding coal or solid fuel to a furnace.

Stokes bands. *Noun.* See **Raman effect**.

Stokes-Einstein equation. *Noun.* See **dynamic light scattering**.

Stokes laws. *Noun.* (1) The frictional force on a sphere moving through a fluid at constant velocity is equal to 6 times the product of the velocity, the fluid viscosity, and the radius of the sphere, hence large particles suspended in a liquid settle more rapidly than smaller particles. See **dynamic light scattering**. (2) A second law concerns **fluorescence** and states that fluorescent light has a wavelength longer than that of the absorbed light causing the fluorescence.

stone. *Noun.* (1) A defect consisting of a crystalline inclusion in glass. (2) To rub a concrete surface with a carborundum stone. (3) To remove blemishes from fired ware by means of a fine-grained rubbing stone. (4) Short for **Cornish stone**.

stone china. *Noun.* An opaque, nonporous dinnerware made from a clay that will vitrify; the ware may be glazed or unglazed.

stone, Cornish. *Noun.* See **Cornish stone**.

stone, crushed. *Noun.* See **crushed stone**.

stone, rubbing. *Noun.* See **rubbing stone**.

stoneware. *Noun.* A vitreous or semi-vitreous ceramic ware of fine texture and high chemical resistance made primarily from non-refractory fireclay, for laboratory, industrial, and some domestic uses, such as tanks, sinks and chemical containers.

stoneware, chemical. *Noun.* See **chemical stoneware**.

stoneware clay. *Noun.* A semi-refractory plastic clay that will fire to a dense, vitrified body of high strength, which may or may not be glazed.

stoning. *Verb.* To remove imperfections and undesirable portions of porcelain-enamelled ware and glazed ceramics by means of an abrasive rubbing stone.

stopper, stopper head. *Noun.* (1) A refractory shape, usually made of clay and graphite, which is employed as a movable valve-head seating in a nozzle brick, the assembly forming a valve for molten metal in a bottom-pouring ladle. (2) A movable refractory controlling the flow of molten glass from a tank. (3) A refractory or clay plug at the discharge channel of a porcelain-enamel smelter or glass tank.

stopping. *Verb.* To fill holes and cracks in **bisque ware** with clay mixtures prior to glazing.

storm anchor. *Noun.* A corrosion-resistant metal fastener with a flat base and a shank that fastens the concealed lower corner of each asbestos-cement shingle to an exposed edge of an adjacent shingle.

storm sewer. *Noun.* A pipeline designed to carry storm or surface water from an area.

storm water. *Noun.* The collection of run-off water during or following rainfall.

stotite. *Noun.* $\text{FeGe}(\text{OH})_6$, a tetragonal mineral source of **germanium**; it has the **perovskite** structure but small tilts in the octahedral sharing angles make it non-cubic.

stove clay. *Noun.* A seldom used synonym for **fireclay**.

stoving. *Verb.* To bake ware.

STRAFI. *Acronym.* Stands for stray field magnetic imaging. See **stray field magnetic imaging**.

straight brick. *Noun.* A rectangular brick, 34.3 cm or less in length, in which the thickness is less than the width.

straight throat. *Noun.* The passage between the **melting** and **refining zones** of a **glass melter**, which is located at the same level as the bottom of the melter.

straight wheel. *Noun.* A grinding wheel having sides or faces that are straight and parallel, with each side at right angles to the **arbor hole**.

strain. *Noun.* Elastic deformation due to stress. See **straining**.

strain disk. *Noun.* A disk of strained glass having a calibrated amount of **birefringence** at a specified location; used as a comparative measure of the degree of stress or the degree of annealing of glassware.

strain energy. *Noun.* The mechanical energy stored in the atomic bonds of stressed materials.

strain, engineering. *ε.* *Noun.* See **engineering strain**.

strainer core. *Noun.* A porous refractory employed to remove slag and sand inclusions during the pouring of cast iron.

strain gauge. *Noun.* A small device, either a metallic grid or a small piece of ceramic **piezoelectric crystal**, bonded to the surface of an article, which measures the deformation occurring beneath it. The deformation either causes a change in electrical resistance of the grid or generates an electric current in the crystal proportional to its magnitude.

strain harden. *Verb.* To increase the hardness and strength of a specimen by plastic deformation at temperatures below the recrystallisation temperature whereby interlocking **dislocations** are formed.

straining. *Verb.* (1) To change the dimensions of a sample by the application of stress. (2) To mechanically separate coarse particles from a liquid without the use of a porous filter and using a decantation process.

strain line. *Noun.* A defect in finished porcelain-enamelled ware appearing as a line or series of lines in a strain pattern, and having the appearance of cracks healed by fusion.

strain point. *Noun.* (1) The temperature which corresponds to a specific rate of elongation (when measured by ASTM Method C336) or a specific rate of midpoint deflection of a glass beam (when measured by ASTM Method C598). (2) At the strain point of glass, internal stresses are substantially relieved in a matter of hours. (3) Temperature at which the viscosity of glass is $10^{13.5} \text{ N s m}^{-2}$.

strain rate. *Noun.* The time rate of loading a test sample.

strain ratio. *Noun.* In a tensile test it is the ratio of the width to thickness strain.

strain, true. *Noun.* See **true strain**.

strain viewer. *Noun.* A **polariser** and **analyser** set with the planes of polarisation at right angles so that any stressed glass placed between them rotates the plane of polarisation of the light from the polariser and allows some light to pass through the analyser; hence, darker areas define larger stress in the sample.

strake. *Noun.* A fibre composite strengthening strip.

strand. *Noun.* (1) Glass fibres twisted or laid together in thread or **yarn** form. (2) In composites it is the primary bundles of **continuous filaments** combined without twist. The number of filaments in a strand is usually 52, 102, or 204. Also known as **single fibre**, **filament**, or **monofilament**. (3) *Verb trans.* To form a thread or a rope by winding strands together.

strand count. *Noun.* (1) The thickness of a strand of glass filaments reported as the number of specified lengths per unit of weight. (2) A measure of strand density expressed in **denier** or **tex**. (3) The number of strands in a plied yarn.

strand traverse. *Noun.* A mechanism that moves fibre strands backwards and forwards across the **collet** to make a correctly shaped collet or a **cheese**.

strap joint. *Noun.* A development of the butt joint to improve performance when thin sheets of composite or ceramic need to be joined adhesively. The butt joint is supported by a separate bottom piece. This gives one butt joint and two small lap joints. It has a fair performance. See **butt joint** and **lap joint**.

strass. *Noun.* A hard, shiny glass used to make imitation gemstones. Also called **paste**.

stratification. *Noun.* The formation of layers in a body during pugging or other process.

stratigraphy. *Noun.* The order and relative position of industrial layers of pigment in a painting or painted decoration.

stratlingite. *Noun.* A stable **gehlenite hydrate** cement paste with the **cement notation** formula C_2ASH_8 . Discovered as a natural mineral with a trigonal lattice and a lamella structure closely related to **calcium aluminate hydrate**.

stray field electrode system. *Noun.* A radiofrequency heating system where all the electrodes are on one side of the work and the penetration depth is very small. The field produced is horizontal but non-uniform.

stray field magnetic imaging. **STRAFI.** *Noun.* A magnetic resonance imaging technique where the ceramic sample is put in the stray field gradient and a radiofrequency pulse is used to excite resonance in the sample at right angles to the gradient, the sample slice is moved through the gradient.

streak. *Noun.* (1) A simple test used to help identify minerals. Samples with hardness less than that of an unglazed porcelain plate (Mohs 5.5) will leave a streak of finely powdered mineral when rubbed across the plate, the colour of which can be characteristic of the mineral. (2) A term used to describe the short wavelength i.e., mm, thickness variation in glass sheet.

streamline flow. *Noun.* Flow of a fluid in which its velocity at any point is constant. Also called **viscous flow**.

strength. *Noun.* (1) The ability of a material or product to resist force. There are many forms of strength measurement but the method most closely satisfying the performance related requirements is usually adopted; for example, **pavers** do not fail in compression and so this form of strength test is not considered to be performance related. (2) A term indicating the relative thickness of sheet glass.

strength, bond. *Noun.* See **bond strength**.

strength, busting. *Noun.* See **busting strength**.

strength, compressive. *Noun.* See **compressive strength**.

strength, crushing. *Noun.* See **crushing strength**.

strength, dielectric. *Noun.* See **dielectric strength**.

strength, double. *Noun.* See **double-strength glass**.

strength, dry. *Noun.* See **dry strength**.

strength, fatigue. *Noun.* See **fatigue strength**.

strength, film. *Noun.* See **film strength**.

strength, flexural. *Noun.* See **flexural strength**.

strength, green. *Noun.* See **green strength**.

strength, hydrostatic. *Noun.* See **hydrostatic strength**.

strength, impact. *Noun.* See **impact strength**.

strength, magnetic field. *Noun.* See **magnetic field strength**.

strength, shear. *Noun.* See **shear strength**.

strength, single. *Noun.* See **single-strength glass**.

strength, tearing. *Noun.* See **tearing strength**.

strength, tensile. *Noun.* See **tensile strength**.

strength, transverse. *Noun.* See **transverse strength**.

strength, ultimate. *Noun.* See **ultimate strength**.

strength, wet. *Noun.* See **wet strength**.

strength, yield. *Noun.* See **yield strength**.

stress. *Noun.* (1) Any condition of tension or compression existing within a glass, particularly due to incomplete annealing, temperature gradient, or inhomogeneity. (2) A mutual force of action between bodies in contact with each other caused by external forces, such as tension or shear, the intensity of the force usually being reported in terms of newtons per square meter. (3) An applied force or system of forces that tend to strain or deform a body.

stress amplitude. *Noun.* The maximum ratio of the applied force to the cross-sectional area of the unstressed specimen.

stress circle. *Noun.* See **Mohr's circle**.

stress concentration. *Noun.* Localised amplification of a stress as the **isostatic** lines become denser around microcracks, fibre-matrix interfaces, notches, voids, or inclusions. A useful equation relating the concentration to dimensions is: $\sigma_t = \sigma_a (1 + 2[l/r]^{0.5})$, where σ_t is the stress at the defect, σ_a is the applied stress, l is the length of the defect, and r is the radius of the defect at its extremity.

stress concentration factor. β . *Noun.* The maximum stress in the region of a **stress concentrator** to the stress in an equally strained area free of stress concentrators; $\beta = \sigma_t / \sigma_a$.

stress corrosion. *Noun.* Preferential chemical attack at areas of high stress as the stress helps to overcome the chemical **activation energy** barrier.

stress crack. *Noun.* An internal or external crack in a solid body resulting from tensile, compressive, or shear forces. The environment to which the solid is exposed frequently accelerates the appearance of such a crack in ware.

stress deviator. *Noun.* The difference between the major and minor principal stress in a triaxial strength test.

stress, engineering. *Noun.* See **engineering stress**.

stress, grinding. *Noun.* See **grinding stress**.

stress, impact. *Noun.* See **impact stress**.

stress intensity factor. k_{Ic} . *Noun.* A measure of the stress field intensity near the tip of an ideal crack in a linear elastic solid as the crack is wedged open; units are $\text{MN m}^{-3/2}$. Used as an indication of **brittleness** since almost all ceramics and glasses have values less than $5 \text{ MN m}^{-3/2}$ and materials having values above $30 \text{ MN m}^{-3/2}$ are considered to be tough; some ceramics containing metastable **tetragonal zirconia**, and many composites, containing ceramic phases, have k_{Ic} values in the tough region.

stress, internal. *Noun.* See **internal stress**.

stress raiser. *Noun.* Any scratch, groove defect, or discontinuity leading to **stress concentrations**.

stress relaxation. *Noun.* (1) The time-dependent decrease in stress under sustained strain. (2) Stress release due to **creep**.

stress relief. *Verb.* Usually a heat treatment sufficient to allow **dislocation** movement and hence a reduction in **residual stress**.

stress-strain diagram. *Noun.* The curve that can be drawn through the points of **tensile stress** and their corresponding strains when each pair of points are established experimentally at a constant strain rate.

stress, thermal. *Noun.* See **thermal stress**.

stress, true. *Noun.* See **true stress**.

stress, unit. *Noun.* See **unit stress**.

stress wrinkle. *Noun.* A defect on the surface of a composite laminate caused by uneven web tension or faulty matrix bonding.

stress, yield. *Noun.* See **yield stress**.

stretcher. *Noun.* A brick laid flat in a wall with its length parallel to the face of the wall. Also known as **stretcher bond**.

stretcher strains. *Plural noun.* See **Lüders bands**.

stretch ratio. *Noun.* See **draw ratio**.

stria. *Noun.* (1) A **cord** of low intensity, generally of major interest in **optical glass**, but also of concern in other glasses in which uniformity of the glass is important. (2) Occurring or produced in layers.

striations. *Noun.* Steps in fracture surfaces of brittle materials that appear to radiate from the curvature of **rib marks**. They are caused when adjacent sections of a crack front follow different levels within a body.

Stribeck curve. *Noun.* A way of representing the dynamics of friction by making a plot of **friction coefficient**, μ , and an **oil film parameter**, λ . The oil film parameter is the ratio of the oil film thickness to surface roughness. The plot has three regions or lubrication regimes: **hydrodynamic** where a substantial oil film is present and where the oil shear viscosity is the major property of interest; **elastohydrodynamic** which is characterised by small λ values and a sharply rising coefficient of friction as λ decreases. Solids, such as MoS_2 , added to the oil help to lower μ and so reduce energy losses in this stage. The third region is the **boundary lubrication region** where λ is very small and μ is constant with the result that pressures in excess of 36 Nm^{-2} and shear rates greater than 10^7 s^{-1} occur and high viscosities are produced and extended contact areas occur as points are flattened.

strike plate. *Noun.* A metal plate carrying raised lettering and numbers that is impressed on to malleable clay to impart product identification information.

striking. *Noun.* The development of **opacity** or colour in porcelain-enamels and glasses during cooling, reheating, or special thermal treatment.

string. *Noun.* (1) An imperfection in glass consisting of a straight or curled line, usually resulting from the solution of a large grain of sand or other substance. (2) A thread of porcelain-enamel drawn from a molten smelter batch for observation as a means of estimating the degree or completeness of the smelting operation

string drier. *Noun.* An intermittent tunnel-type drier of high humidity used in the treatment of building brick.

stringer. *Noun.* A lightweight structural member that shapes and reinforces an aerodynamic surface.

stripe phases. *Plural noun.* A form of electronic order in some ceramics, characterised by parallel lines of **hole** defects separating regions of electron spins ordered antiferromagnetically ordered. A classic system is $\text{La}_{1.66}\text{Sr}_{0.33}\text{NiO}_4$, which contains **holes**, Ni^{3+} , and Ni^{2+} ordered antiferromagnetically. The role of this order in the existence of **high temperature superconductivity** in oxides is a matter of debate.

strip mining. *Noun.* See **open-pit mining**.

stripping time. *Noun.* The time when a **mould core** box may be satisfactorily removed from the sand.

stripping yard. *Noun.* The area in which **plate glass** is removed from the polishing table following the grinding and polishing operation.

strobe. *Noun.* See **stroboscope**.

strobic. *Adjective.* Spinning.

stroboscope. *Noun.* (1) An instrument designed to produce a light flash whose frequency can be tuned to a multiple of the frequency rotation, vibration, or operation of an object such that it is made to appear stationary. It is used to measure the speed of vibration etc. Sometimes called a **strobe**. (2) A light device synchronised with the opening and closing of a camera shutter so that a series of still photographs of a moving object can be taken. *Adjective* **stroboscopic**. *Adverb* **stroboscopically**.

stroke. *Noun.* (1) Any one of a series of linear movements of a reciprocating part, such as a piston. (2) The distance travelled by such a part from one end of the movement to the other. (3) Terminal point separation in a reciprocating press.

stromatolite. *Noun.* A sedimentary rocky mass formed from layers of **calcareous** material and fossilised blue-green cyanobacteria in pre-Cambrian times.

strontia. *Noun.* SrO . A white insoluble ceramic used in sugar purification. Old name for **strontium oxide**.

strontianite. *Noun.* A natural ore of strontium carbonate, SrCO_3 . See **strontium carbonate**.

strontium aluminate. *Noun.* $\text{SrAl}_4\text{O}_{25}$. A host ceramic structure for blue emitting **phosphors** containing Eu^{2+} ions.

strontium aluminium silicate. *Noun.* $\text{SrAl}_2(\text{SiO}_4)_2$. A discrete ionic orthosilicate mineral. Mp $1,660^\circ\text{C}$; density $3,120 \text{ kg m}^{-3}$; hardness (Mohs) 5–7.

strontium boride. *Noun.* SrB_6 . A material with potential for use in energy sources when using the radioisotope, for high-temperature insulation, for nuclear absorption control rods, and as control additives. Contains B_6 octahedra linked at corners with Sr^{2+} ions occupying octahedral interstices in the close-packed $(\text{B}_6)^{2-}$ structure. Mp $2,235^\circ\text{C}$; density $3,420 \text{ kg m}^{-3}$.

strontium carbonate. *Noun.* SrCO_3 . Used in television tubes and **iridescent** glasses, ceramic **ferrites**, and ceramic bodies and glazes. Decomposes at 1,100–1,340 °C; density 3,620 kg m⁻³.

strontium ferrate. *Noun.* SrFeO_3 . A **perovskite** in which iron is in the unusual Fe^{4+} state; readily loses oxygen to become $\text{SrFeO}_{2.5}$, i.e., $\text{Sr}_2\text{Fe}_2\text{O}_5$, which is a grossly defective **perovskite** material.

strontium fluoride. *Noun.* SrF_2 . Used as single-crystal components in **lasers**. Mp 1,190 °C; density 2,400 kg m⁻³.

strontium oxide. *Noun.* SrO . Converts to the hydroxide in water; used as a colorant in glass. Mp 2,430 °C; density 4,700 kg m⁻³. See **strontia**.

strontium silicate. *Noun.* (1) SrSiO_3 . A **pyroxene** structure material; mp 1,580 °C; density 3,650 kg m⁻³. (2) Sr_2SiO_4 . A discrete tetrahedral ionic silicate. Mp >1,705 °C; density 3,840 kg m⁻³; hardness (Mohs) 5–7.

strontium stannate. *Noun.* SrSnO_3 . A **perovskite**; used in titanate bodies to reduce the **Curie temperature**. Mp >1,400 °C.

strontium sulphate. *Noun.* SrSO_4 . Used to impart **iridescence** on the surfaces of glass and pottery glazes, and as a **fining agent** in the production of crystal glasses. Mp 1,605 °C; density 3,710–3,940 kg m⁻³; hardness (Mohs) 3–3.5.

strontium titanate. *Noun.* SrTiO_3 . A **dielectric perovskite**. It is one of the few perovskites that retains the undistorted Pm3m structure at ambient conditions. Used in electronics and as an electrical insulator, and in low-melting glazes. As a single crystal it is used as a substrate for high temperature superconducting thin films but its dominant use is as a **polycrystalline internal boundary layer capacitor**. Mp 2,080 °C; theoretical density 5,110 kg m⁻³.

strontium unit. *SU.* *Noun.* The concentration of ^{90}Sr in materials, such as bone and soil, relative to the concentration of Ca in the material.

strontium zirconate. *Noun.* SrZrO_3 . A **perovskite** used in dielectric compositions to reduce the **Curie temperature**. Mp 2,700 °C; density 5,480 kg m⁻³.

structural bond. *Noun.* A bond joining essential load-bearing components of an assembly.

structural clay facing tile. *Noun.* Tile designed for use in interior and exterior un-plastered walls, partitions, and columns.

structural clay tile. *Noun.* Hollow burned clay masonry building units with parallel cells or cores, or both; used as facing tile, partition tile, load-bearing tile, fireproofing tile, header tile, and furring tile.

structural clay products. *Plural noun.* Ceramic products made chiefly from clay and used in applications where structural integrity is important.

structural colour. *Noun.* **Iridescent** colour produced by the interference of light due to multiple reflections and diffraction within the physical structure of a material.

structural composite. *Noun.* A composite whose properties depend to a significant amount on the geometrical design of the components.

structural energy storage composite. *Noun.* Composites constructed from ceramics capable of simultaneously carrying mechanical loads whilst also storing electrical energy. The storage function is usually achieved as a **supercapacitor**.

structural facing unit. *Noun.* A structural or building unit designed for use in areas where one or more faces will be exposed in the finished wall and for which specifications include colour, finish, and other properties influencing appearance.

structural foam. *Noun.* A material with a smooth integral skin contiguous with a rigid cellular core.

structural glass. *Noun.* (1) Opaque or coloured glass, frequently ground and polished; used for structural purposes, particularly in windows. (2) Glass block, usually hollow and often with patterned faces, used for structural purposes such as in walls, partitions, and windows.

structurally engineered materials. *Noun.* Materials, often **piezoelectric ceramics**, whose properties have been optimised by one of the structural engineering techniques, such as domain engineering, grain-size optimisation, or templated grain growth.

structural products. *Plural noun.* Building-material units which, when assembled into structures, may be load-bearing (loads in addition to their own weight) or non-loadbearing (only their own weight).

structural sandwich. *Noun.* A **lamina** construction composite material.

structural spalling of refractories. *Noun.* **Spalling** of a refractory unit resulting from stresses caused by differential changes in the structure of the unit.

structure. *Noun.* (1) The spatial relationship of atoms and molecules in the **x-ray unit cell** of a material. (2) The spatial arrangement and energies of electrons in atoms. (3) The shape and arrangement of **grains** in a microstructure. (4) The proportion and arrangement or spacing of abrasives in a grinding wheel. Usually given as a number from 0 to 15. (5) The arrangement and interrelation of the parts of an object. (3) The state of **agglomeration** of particles in **carbon black**.

structure number. *Noun.* The number, generally from 0 to 15, designating the spacing of abrasive grains relative to their **grit size** in a grinding wheel.

struvite. *Noun.* MgNH_4PO_4 . A hard crystalline mineral deposit formed when sewage containing soluble orthophosphates is treated by raising the pH and adding Mg^{2+} ions. It has potential as a slow release fertiliser.

stub. *Noun.* The portion of a grinding wheel remaining after it has been worn down to the discarding diameter.

stucco. *Noun.* A mixture of **Portland cement**, sand, and a small percentage of **lime** blended into a smooth, plaster-like consistency, which is applied to exterior walls and other surfaces of a building or structure to provide protection and decoration.

stuck. *Noun.* A defect in glassware in which a sharp piece of glass gets stuck on the outside.

stylobate. *Noun.* A continuous horizontal course of masonry that supports a **colonnade**.

stylolite. *Noun.* A small striated columnar structure within the structure of some **limestone** deposits.

subbase. *Noun.* A compacted layer of material placed on the **subgrade** to support the base on which a concrete pavement is constructed.

subgrade. *Noun.* The foundation on which a concrete pavement is constructed.

sublimate. *Noun.* The product of a **sublimation** process.

sublimation. *Noun.* The direct conversion of solid to vapour without first going through the liquid phase.

sublot. *Noun.* Subdivision of a lot or shipment of a material.

submarine throat. *Noun.* A throat with the level below the bottom of a glass **melter**. Also called **submerged throat**.

submerged entry nozzle. **SEN.** *Noun.* A hollow ceramic tube, often polyphasic, for example **graphite** bonded **zirconia**, down which molten metal is poured into a mould. The liquid exits through a nozzle near the bottom of the tube and as result the exterior surface of the tube is subjected to a rising metal-slag-air interface. Corrosion and wear is enhanced at the interface.

submerged throat. *Noun.* See **submarine throat**.

submerged wall. *Noun.* A refractory wall submerged below the level of molten glass in a glass-melting tank forming the **throat** between the melting and **refining chambers** of the tank.

submicron reinforcement. *Noun.* Fibres or **whiskers** in the size range 0.2–5 μm in diameter capable of being dispersed more easily and uniformly in **injection moulded** composite parts.

submicroscopic. *Adjective.* Too small to be seen using conventional optical microscopy.

suboxide. *Noun.* An oxide of an element that has less oxygen than the common oxide of the element.

subpotassic phlogopite. *Noun.* $\text{K}_{1-x}\text{Mg}_3\text{Al}_{1-x}\text{Si}_{3+x}\text{O}_{10}\text{F}_2$. A **fluormica** phase formed in fluorine-containing internally nucleated glass-ceramics. Its presence bestows machinability to the final ceramic material

subsaturate silicates. *Plural noun.* Minerals containing discrete $[\text{SiO}_4]^{4-}$ tetrahedra along with O^{2-} ions distinct from the oxygen atoms of the $[\text{SiO}_4]^{4-}$ tetrahedra; **kyanite**, Al_2OSiO_4 , is an example.

subside. *Verb intrans.* Concerning suspended particles it is to sink to the bottom.

subsieve size. *Noun.* Parts of a powder which pass through a 325 or 400 mesh sieve and so have diameters less than 44 or 37 μm . Such small particle sizes are analysed by sedimentation methods in suspension.

substance. *Noun.* (1) A chemical entity defined by a fixed formula that gives the composition so that mixtures and solutions, etc., are excluded. (2) The thickness of sheet or rolled glass expressed as weight per unit of area.

substitutional solid solution. *Noun.* A compound formed by one component dissolving into the crystal structure of another by replacing atoms in the unit cell in either a random or an ordered way. For example, a solid solution is readily formed between **TiC** and **TaC** to give $\text{Ti}_{1-x}\text{Ta}_x\text{C}$.

substrate. *Noun.* (1) A surface on which a coating or film has been applied. It is usually a board or a layer of material, as for example an electronic circuit laid on **alumina**, Al_2O_3 . (2) The semiconductor base on which other material is deposited to make integrated circuits.

subsurface discontinuity. *Noun.* A defect that does not extend through the surface of the item in which it exists. **Blisters** and **bubbles** are examples.

subtractive colouration. *Verb.* To produce colour in a glass or glaze by introducing absorption centres. The colour remaining when some wavelengths are absorbed from white light is called the complementary colour.

successive ionic layer adsorption. **SILAR.** *Noun.* A thin layer growth process in which cations and anions of a desired thin film ceramic are adsorbed on the substrate for different precursor solutions and in between the surface is rinsed with water so that only the strongly adsorbed ions stay on the substrate.

successive ply failure. *Noun.* Sequential failure of reinforcing **plies** due to increasing loads.

sucking. *Verb.* To suck or draw vaporised lead and other glaze constituents into a porous refractory.

suction. *Noun.* (1) The absorption of liquids into the pores of a concrete surface. (2) A force generated by lowering the pressure to below atmosphere.

suction blowing. *Noun.* A glass container manufacturing method where the **parison** fills the **blow mould** by sucking the air out from between parison and blow mould instead of blowing compressed air down the neck of the container.

suction process. *Noun.* Any process in which molten glass is gathered into a mould by vacuum.

suction rate. *Noun.* The weight of water absorbed by a partially immersed brick in one minute, usually expressed as unit of weight per minute.

Sue ware. *Noun.* Dating from about 600 AD it is almost the oldest pottery found in Japan. It is characterised by its delicate, thin walls and light-blue to grey colour.

sugar cube. *Noun.* A colloquial name for **tritium** trapped in an inorganic solid **phosphor** that glows to produce light. **Zinc sulphide** is the most commonly used phosphor when it is dispersed in an **aerogel** to which tritium is chemically bound.

sugar of lead. *Noun.* See **lead acetate**.

sullage. *Noun.* Sediment deposited by running water as in ore **beneficiation**.

sulphate resisting cement. *Noun.* **Portland cement** containing additives to make it resistant to sulphate ions. Used in concrete for underwater work and for flues.

sulphation. *Noun.* A powder, stain, or scum forming on the surface of a glaze, during or after firing, caused by sulphur compounds emanating from the body or present in the furnace atmosphere.

sulphide. *Noun.* A compound in which one or more sulphur atoms are attached to atoms other than oxygen, such as carbon or a metal. Refractory sulphides have received minimal consideration for technical applications, but now are of interest in nuclear fuels and direct-energy conversion, particularly the sulphides of plutonium, thorium and uranium. The sulphides, in general, are prone to chemical and physical instabilities. Melting points range from 1,100 °C to approximately 2,428 °C, although some decompose above 593 °C.

sulphide stain. *Noun.* Discoloration of a glass enamel cause by sulphide compounds. Commonly occurs if the ware is stored in cardboard in moist atmospheres.

sulphoaluminate cement. *Noun.* A hydraulic cement consisting of a mixture of **gypsum** and high-**alumina cement**.

sulphonated oils. *Plural noun.* Sulphuric acid-treated animal and mineral oils; used as **wetting agents** and defoaming agents in glazes, porcelain-enamels, and other **slips** and **slurries**.

sulphosalts. *Plural noun.* Sulphide ores in which sulphur is combined with one or more metals and metalloids, which occupy metal atom positions in the crystal structure.

sulphur. *Noun.* S. Used as a colorant in glass to produce yellows and ambers. Combined with **cadmium sulphide** it is used in selenium **ruby glass**. Mp 119.3 °C; bp 444.6 °C; changes to the β -form at 94.5 °C; density 2,060 kg m⁻³; index of refraction 1.957.

sulphuric acid. *Noun.* H₂SO₄. Used in the pickling of steel for porcelain-enamelling, and occasionally as a

mill addition for acid-resisting porcelain-enamels to counteract the alkaline nature of the coating. Boils from 210 to 338 °C; density 1,800 kg m⁻³.

sulphur-impregnated abrasive. *Noun.* A bonded abrasive product in which all connected pores are filled with sulphur.

sulphuring. *Noun.* The **scumming** or staining of a glaze caused by sulphur compounds in the atmosphere during and after firing. Usually long, needle-shaped crystals forming **spherulites** occur in the glaze after the exposure to sulphur dioxide gas. Avoided by maintaining good air supply to the kiln and using purer fuels.

sump throat. *Noun.* The submerged passage between the **melter** and **refiner** of a **glass tank** situated at a level below the bottom of the melter.

sun-dried brick. *Noun.* Large, roughly moulded clay brick of varying sizes, frequently made with additions of damp straw, which are dried in the sun. See **adobe**.

sun-pumped laser. *Noun.* A continuous-wave laser in which the energy of the sun is focused on the **laser crystal**.

sunstone. *Noun.* Another name for **aventurine**. See **aventurine (3)**.

supercapacitors. *Noun.* An alternative to batteries for storing electrical energy, usually involving special ceramics, such as monolithic carbon films etched into TiC. It consists of two electrodes, a **separator** and an **electrolyte**. The energy is stored as electrical charge at the nanometre scale boundary between electrode and electrolyte, which does not damage the electrodes and so millions of charge/discharge cycles are possible. The amount of energy stored is a function of the available electrode surface and the electrolyte stability. Batteries store the energy as chemical reactants and so recharging eventually ends the electrode life after about a thousand cycles. They are less energy dense than batteries. The systems have ultra high discharge rates and trade high power for low energy density. Nanosized LiFePO₄ particles with a glossy LiPO₄ coating are a good example.

superconducting cable. *Noun.* Power transmission cables cooled to temperatures near absolute zero sufficiently well protected to be buried underground.

superconducting energy gap. *Noun.* The small amount of energy below the energy levels of normal electron states that characterise **Cooper electron pairs** at low temperatures.

superconducting flux flow transistor. SFFT. *Noun.* A superconducting analogue to the **field effect transistor**, consisting of parallel, weak superconducting links, approximately 10 μ m long that separate two pieces of **YBCO superconductor** and a control line to vary the local magnetic field. Output voltage is controlled by varying the input current in the control line and so changing the magnetic field in the active region.

superconducting glass-ceramic. *Noun.* Glasses formed in the Bi-Ca-Sr-Cu-O system by quenching melts from 1,150 °C that can be recrystallised at 700 °C to ceramic phases of general composition $\text{Bi}_2(\text{Ca,Sr})_{1+x}\text{Cu}_x\text{O}_8$, which have an oriented plate-like morphology some 600 µm long; the principal phase is $\text{Bi}_2(\text{Ca,Sr})_3\text{Cu}_2\text{O}_8$ which is superconducting with a $T_c = 85$ K.

superconducting magnet. *Noun.* An electromagnet wound with superconducting wire capable of generating magnetic fields of 10 T with almost zero power loss.

superconducting magnetic energy storage system. SMES. *Noun.* A coil of superconducting wire in which an electric current circulates until needed to perform an operation.

superconducting memory. *Noun.* A computer memory made up of superconducting storage devices operated under cryogenic conditions. Power dissipation only occurs during the read or write operations which allows very dense memory banks to be built.

superconducting quantum interference device. SQUID. *Noun.* Made from two **Josephson junctions** connected in parallel into which a small magnetic flux is introduced to make the current oscillate; used to detect magnetic signals.

superconductivity. *Noun.* The property observed in some materials where the electrical resistivity disappears at low temperatures.

superconductor. *Noun.* A material that shows the complete loss of all electrical resistance at a temperature below the **critical temperature**, T_c . The superconductivity is destroyed by a magnetic induction greater than the critical value, B_c . Until recently attaining the superconducting state meant cooling the conductor to temperatures below 20 K but now several **ceramic oxides** are known to possess this property. See **yttrium barium copper oxide**.

1-2-3 superconductor. *Noun.* High-temperature, ceramic **superconductors** based on **yttrium barium copper oxide** in the ratio Y, or other lanthanide, 1, barium, 2, and copper, 3; typical transition temperatures to the superconducting state are above 90 K. Also known as **1-2-7 superconductor**. It is actually a **semiconductor** until some oxygen is removed from the crystal to produce a $(7-x)$ oxygen content when it then becomes a superconductor. The superconductivity is associated with Cu-O chains in the structure some of the copper being in the **oxidation state 3**.

1-2-4 superconductor. *Noun.* $\text{YBa}_2\text{Cu}_4\text{O}_8$. The structure of this ceramic contains double Cu-O chains and has a more stable oxygen stoichiometry than **1-2-7** material; T_c is 80 K but doping with calcium to produce $\text{Y}_{0.9}\text{Ca}_{0.1}\text{Ba}_2\text{Cu}_4\text{O}_8$ raises T_c to 90 K.

1-2-7 superconductor. *Noun.* See **1-2-3 superconductor**.

2-2-1-2 superconductor. *Noun.* See **2212-bismuth oxide**.

2-4-7 superconductor. *Noun.* $\text{Y}_2\text{Ba}_4\text{Cu}_7\text{O}_{15}$. A derivative of the original **1-2-7 superconductor** containing both single and double Cu-O chains in the structure.

superconductor, type-I. *Noun.* See **type-I superconductor**.

superconductor, type-II. *Noun.* See **type-II superconductor**.

supercooled liquid. *Noun.* A liquid cooled below its freezing point without solidification or crystallisation. The liquid enters a **metastable state**.

supercritical. *Adjective.* A fluid at a temperature and pressure above its critical temperature and pressure where its chemical properties change.

supercritical drying. *Noun.* A gel drying process using temperatures and pressures greater than those values which denote the **critical point** of the liquid phase so that no menisci are present in the pores of the gel, thus eliminating **Laplace capillary forces** which are often sufficient to crack the emerging solid phase.

superduty fireclay brick. *Noun.* A fireclay refractory having a **pyrometric cone equivalent** not less than cone 33, 1,598 °C, not more than 1 % linear shrinkage in the reheat test, and not more than 4 % weight loss in the panel spalling test. See **panel spalling test**.

superduty silica brick. *Noun.* **Silica brick** having a total **alumina**, **titania**, and **alkali** content significantly lower than normal.

superfines. *Noun.* A powder fraction whose mean size is less than 10 µm.

superheating. *Noun.* The phenomenon of heating a liquid above its boiling point without boiling occurring. In a more general sense it is raising the temperature of a sample above that at which a phase change should occur without the change occurring.

superheterodyne. *Noun.* A radio receiver that combines two radio-frequency signals by **heterodyne** action to produce a signal above the audio-frequency limit. After amplification the signal is demodulated to give the audio signal.

superlattice. *Noun.* A feature of some types of crystal structure where ordered arrangements of one type of atom into distinct layers in a **solid solution** of two or more components, or a regular arrangement of **lattice vacancies**, make it necessary to redefine the x-ray **unit cell**, usually in terms of multiples of the original cell parameters. It is characterised by faint diffraction spots in an x-ray or electron diffraction investigation of the material.

superlubricity. *Noun.* The act of slipping with zero friction. Observed on micron-sized **graphite** blocks with applied force across the surface of the block causing a flake to shear off.

supernatant. *Noun.* The liquid lying above sediment or settled precipitate.

superoxide. *Noun.* Metal oxides whose structures contain the $[O_2]^-$ ion, for example, KO_2 .

superplasticity. *Noun.* An exceptionally high strain value shown by some ceramics and metal alloys. The phenomenon is associated with the production of a carefully controlled microstructure consisting of very small, **equiaxed** grains capable of sliding past each other above a critical temperature at a controlled, defined strain rate. Extensions of several hundred percent have been reported.

superplasticisers. *Plural noun.* Admixtures to **OPC** mortars and concretes that reduce the amount of water needed to obtain a plastic mix. They act by being adsorbed onto cement particles where they electrostatically repel and so break up **agglomerates** to decrease the viscosity of the system. They may also decrease the surface tension of the water. They are low-molecular-weight polymers, from 100 to 105 **amu**, in the systems: sulphonated melamine-formaldehyde, sulphonated naphthalene-formaldehyde, sulphonic esters, or modified lignosulphates.

superposition principle. *Noun.* Boltzmann formulated the principle that since **strain** is a linear function of **stress** the total effect of applying several stresses is the sum of applying each separately.

supersonic. *Adjective.* Velocities greater than sound waves possess.

superstabiliser. *Noun.* A large coil of wire wrapped around the coils of a magnet to give the very stable magnetic fields required in **NMR spectrometers**.

superstructure. *Noun.* The parts of a **glass tank** above the side-wall tank blocks.

supervisory control and data acquisition. *Noun.* A computer software package able to store data from such equipment as **tunnel kiln** operations and then interact with a **neural network system** to control the process against a set of target reference values.

supplementary cementitious materials. *Plural noun.* Powders added to **Portland cement clinker** to reduce the amount of clinker needed to produce satisfactory mortars and concretes. Common additives are: **lime-stone**, **pozzolan**, **volcanic ash** and **blast furnace slag**.

supply voltage. *Noun.* The potential voltage available from a power source of electric current.

surface. *Noun.* The outer layer of a substance.

surface acoustic wave. *Noun.* A mechanical wave propagated on the surface of a solid; similar to a wave on the surface of water but the disturbance is concentrated to a depth of only approximately one wavelength of the wave. Such a wave has a velocity slightly slower than

the velocity of an acoustic wave through the bulk of the solid, a fact that forms the basis of **SAW-delay devices**. Also known as **Rayleigh wave**. Commonly generated on surfaces normal to the c-axis of single crystal **lithium niobate**.

surface area. *Noun.* (1) The measured extent of an area covered by a surface, excluding thickness. (2) The total exposed area of the surface of a powdered solid usually expressed as some unit of area per kilogram.

surface-area distribution. *Noun.* The distribution of surface area in accordance with some parameter, such as pores of different size or diameter.

surface clay. *Noun.* Unconsolidated, unstratified clay occurring on the surface of the earth.

surface coefficient. *Noun.* The ratio of the steady-state exchange rate between a surface and its external surroundings to the temperature difference between the surface and its surroundings.

surface colour. *Noun.* A colour caused by light reflection from the surface of a solid without light penetrating below the surface, and since some surfaces, such as gold, have a higher reflecting power for some wavelengths than others they appear to be coloured.

surface combustion. *Noun.* The combustion of fuel gases or mixtures of gases and air by impingement on or through a heated refractory.

surface conductance. *Noun.* The direct current conductance between two electrodes in contact with a specimen of solid insulating material when only a thin film at the surface passes the current.

surface convection. *Noun.* The most dominant effect in the heat transfer between a hot solid and a fluid. For a fluid flowing over the solid the **convective heat flux** at a distance x from the solid surface is given by: $J_Q = Nu \kappa \Delta T/x$, where κ is the thermal conductivity, Nu is the **Nuselt number**, and ΔT is the temperature difference between the solid surface and the bulk fluid.

surface cord. *Noun.* Very fine striations on the surface of a glass container; considered to be a defect.

surface density. *Noun.* The quantitative distribution of a substance on a surface expressed as $kg\ m^{-2}$.

surface diffusion. *Noun.* Movement of atoms or ions on the surface of a solid particle leading to interparticle neck growth without the particle centres approaching each other and hence no densification of the compact occurs in **solid-state sintering**.

surface distance, mean. *Noun.* See **mean surface distance**.

surface energy. *Noun.* The amount of **free energy** that surfaces possess relative to the bulk free energy. It is always a positive quantity and so systems work to reduce their surface area. It is a significant quantity in the reactivity and properties of nanopowders.

surface enhanced Raman spectroscopy. *Noun.* A technique where a thin silver layer is deposited on carbon-based materials to enhance the scattering and so enable examination of the subsurface chemical structure to be made.

surface enthalpy. h. *Noun.* An energy function for a surface of a solid defined by the equation: $h = \gamma_\pi - T(d\gamma_\pi/dT)$, where γ_π is the **specific surface work** and T is the **absolute temperature**.

surface finish. *Noun.* The character of a solid surface in terms of roughness and irregularities after final treatment.

surface, gassy. *Noun.* See **gassy surface**.

surface grinding. *Verb.* To **abrade** or grind a plane surface.

surface mark. *Noun.* A relatively long, narrow, shallow groove, cut, or other abrasion in the surface of a solid.

surface mounted device. SMD. *Noun.* A ceramic resistor, capacitor, etc., mounted on top of a printed circuit board.

surface oxides. *Plural noun.* Oxygen-containing compounds and complexes formed on the surface of a substance or object.

surface plasmon-polariton. SPP. *Noun.* An electromagnetic wave that propagates along a ceramic/metal interface and is coupled to the free electrons in the metal. It can be considered to be a special type of light wave with a diameter normal to the interface that can be significantly smaller than the wavelength of light, which allows interaction between nanoscale electronics and optical devices. See **plasmon**.

surface polishing. *Verb.* The polishing of plate glass and the surfaces of other materials to remove imperfections.

surface potential. *Noun.* The electrical field generated at the surface of a ceramic by the imbalance of chemical bonds compared to the bulk. It is related to, and measured as the **zeta potential**.

surface preparation. *Noun.* Physical and/or, chemical treatment of a surface prior to adding adhesive for bonding purposes.

surface reaction. *Noun.* A chemical or physical reaction taking place only on the surface of an item.

surface resistance. *Noun.* The electrical resistance of an insulating product usually measured between the opposite sides of a square on the surface of the insulator.

surface roughness. *Noun.* See **roughness height rating**.

surface, sealing. *Noun.* See **sealing surface**.

surface sheen. *Adjective.* A bright surface.

surface, specific. *Noun.* See **specific surface**.

surface stress. γ_s . *Noun.* The reversible work required to form a unit area of new surface by stretching; it is related to **specific surface work, γ_π** , by $\gamma_s = \delta_\epsilon \gamma_\pi + (d\gamma_\pi/d\epsilon)$, where δ_ϵ is the **deviatoric strain** and ϵ is the tensile strain.

surface tensiometer. *Noun.* An instrument used to measure **surface tension** of a liquid.

surface tension. *Noun.* Cohesive forces that attract molecules of a liquid to each other, tending to minimise the surface area and cause the surface to act somewhat like a plastic film.

surface texture. *Noun.* The feel of a surface caused by the presence or absence of irregularities.

surface treatment. *Noun.* Any treatment of the surface of a material to render it receptive to subsequent coating or to develop a desired property such as resistance to abrasion, weathering, or increasing the hardness.

surface-volume mean diameter. $D[3,2]$. *Noun.* A particle size average found from a measure of the volume distribution of particles in a batch from the equation: $D[3,2] = D_2^3 \int_{D_1}^{D_2} n(D)dD / D_1^3 \int_{D_1}^{D_2} n(D)dD$, where D_1 and D_2 are the limits of integration and $n(D)$ is the diameter distribution function, which is the number fraction of particles with diameter D. Also known as the **Santer mean diameter**.

surfactant. *Noun.* A contraction of surface-active agent. Usually an organic compound or organic acid salt that alters the surface tension of a liquid in which it dissolves. The overall effect is then to improve **wetting**, suppress foaming, or assist emulsification.

surfi-sculpt. *Noun.* The technique of developing features on a surface by sweeping a power beam across the surface to give very localised melting. The beam, which is either a laser or electron beam, makes multiple rapid returns to the same point to build-up the feature. The molten material moves in part in response to the **surface tension** generated by the temperature gradient across the molten surface.

surge. *Noun.* A transient increase in current or potential at a point in a circuit.

surge suppressor. *Noun.* A semiconducting ceramic with **varistor** properties, such as **zinc oxide** and **silicon carbide**, made into units that are used to protect electrical systems from transient large currents.

surkhi. *Noun.* An artificial **pozzolana** consisting essentially of powdered brick.

Sursulphatec cement. *Trademark, noun.* A type of cement composed of **slag** (70 %) and **calcium sulphate** (30 %); an artificial **pozzolana** developed and used in France.

susceptibility, magnetic. k. *Noun.* See **magnetic susceptibility**.

suspended arch. *Noun.* An arch in a furnace in which the brick shapes are suspended from overhead supports.

suspender. *Noun.* See **suspension agent**.

suspension. *Noun.* A system in which denser particles, usually solid, are distributed throughout a less dense liquid or gas.

suspension agent. *Noun.* A chemical compound such as an inorganic salt that is added to a porcelain-enamel or glaze slip to promote suspension of the solid particles in the liquid medium.

suspenoid. *Noun.* A suspension of solid particles in a liquid.

sustainable development. *Noun.* Materials use and production methods that meet the needs of the present without compromising the ability of future generations to meet their needs.

swab test. *Noun.* A low-voltage test in which an electrical discharge is fanned across a porcelain-enamelled surface to detect a discontinuity in the coating by means of a spark concentrating in the discontinuity.

swage. *Noun.* A decorative moulding.

swallow-tail. *Noun.* Twinned **gypsum** crystals with a characteristic arrow head habit.

swarf. *Noun.* A mixture of grinding chips, fine particles of an abrasive, and bond resulting from a grinding operation.

s-wave. *Noun.* The component of light **polarised** perpendicular to the plane of incidence when light is reflected from the surface of a **dielectric**.

sweat, sweating. *Verb.* To place a heated and hence expanded metal ring or collar around a ceramic part and allow it to shrink around the ceramic to produce a tight, adherent seal or joint.

sweet. *Noun.* An easily workable glass.

swelling. *Noun.* A volume increase in a material caused by absorption of moisture.

swelling clays. *Plural noun.* Clay that will absorb large quantities of water. The structure is a layered aluminosilicate formed from two tetrahedral layers (SiO_2) sandwiching an octahedral layer of aluminium magnesium hydroxide. Isomorphous replacement of Si^{4+} by Al^{3+} leads to the presence of cations between the octahedral and tetrahedral layers and their hydration causes the structure to swell.

swing-field magnetisation. *Noun.* A magnetic field induced in two different directions to detect defects that are oriented in different directions in the part.

swing-frame grinder. *Noun.* A grinding machine suspended above the work piece by a chain at its centre of gravity so that it may be turned and swung in any direction for the in-place grinding of work too heavy for manual handling.

swing press. *Noun.* A screw press, often hand operated, used to form special shapes in small quantities.

switch. *Noun.* A mechanical device for opening and closing an electric circuit.

switching voltage. *Noun.* See **ovonic threshold switch**.

SWNT. *Abbreviation.* Stands for single walled nanotube. See **single wall carbon nanotube**, and **CNT**.

sworl. *Noun.* Marks formed on the bottom of a pot by a cutting or grinding wheel.

SXA. *Abbreviation.* A trade identification name for aluminium alloy reinforced with **chopped strand** silicon carbide, SiC , fibre.

syalon ceramics. *Noun.* Alternative spelling of sialon ceramics. See **sialons**.

syenite. *Noun.* An igneous rock composed chiefly of alkali **feldspar** containing **quartz**, **feldspathoids**, **mica**, or **hornblende** in minor quantities.

sylvanite. *Noun.* $(\text{Au}, \text{Ag})\text{Te}_2$. A silver-white mineral with striated crystals.

Sylvin. *Trade name, noun.* Alternative name for **potassium chloride** used to make single crystal infrared spectrometer cells.

sylvine. *Noun.* Another name for sylvite. See **sylvite**.

sylvite. *Noun.* See **potassium chloride**.

symmetric. *Adjective.* Possessing a plane or axis of symmetry across which or around which the structure is identical.

symmetric laminate. *Noun.* A composite with a ply stacking sequence containing a mirror plane ply-layer above and below which the stacking sequence is a mirror image.

symmetric matrix. *Noun.* A mathematical matrix with equal off-diagonal components. Matrix representations of the **mechanical moduli** are always symmetrical.

symmetry. *Noun.* (1) The independence of a property with respect to direction. (2) Correspondence or balance among systems or parts of a system. (3) The number of orientations that a structure can attain by the use of symmetry operators, such as reflection across a mirror plane, rotation around an axis, translation plus reflection, etc., that are indistinguishable.

symmetry operator. *Noun.* An operation that leaves a structure apparently unchanged after it has been carried out, for example, rotation of a cube through 90° .

synchrotron. *Noun.* A particle accelerator capable of producing high energies, in the GeV range, by using an electric field of fixed frequency and a changing magnetic field.

synchrotron radiation. *Noun.* A narrow beam of electromagnetic radiation emitted tangentially to the

orbit of very high-energy charged particles. Now used in structural and spectroscopic studies of solids.

synchysite. *Noun.* A carbonate mineral that contains workable amounts of **rare earth oxides**.

syneresis. *Noun.* (1) The contraction in volume of a **gel** when no evaporation of liquid occurs but rather the liquid phase is expelled directly as the solid phase. (2) The phenomenon of **greenware** cracking with the passage of time. It occurs in the presence of excess **flocculation** when the normal gel structure of the suspension, which forms quickly after removal of shear, densifies with time and expulsion of fluid leads to crack formation. It is controlled with cation additives that adjust the suspension to a less **flocculent** state.

synergism. *Noun.* A phenomenon where the observed effect of two or more influences is greater than the sum of the influences acting alone.

syngenite. *Noun.* $\text{K}_2\text{Ca}(\text{SO}_4)_2 \cdot \text{H}_2\text{O}$. A double sulphate salt that occurs as **efflorescence** on some types of brick.

Synroc. *Trademark, noun.* A synthetic rock in which zirconolite is a major phase. Has potential as a material to act as an immobilising matrix for highly active nuclear waste. See **zirconolite**.

syntatic foams. *Plural noun.* Composites consisting of micron sized hollow spheres in a polymeric matrix; commonly glass spheres are used.

synthetic diamond. *Noun.* A manufactured form of carbon with the cubic diamond structure made by two different processes: the thermodynamic method whereby graphite or carbon-containing gases are subjected to

extremely high temperatures and pressures, in excess of 2,500 K and 10^5 k bar; or the metastable route controlled by kinetic factors where diamond-type films are prepared for semiconductor substrate use, or as protective hard films, by heating hydrocarbon gases in the presence of radio-frequency discharges or laser beams.

synthetic fluorine mica. *Noun.* $\text{BaMg}_3\text{Al}_2\text{Si}_2\text{O}_{10}\text{F}_2$. A **mica** product produced by the glass-ceramic process. Used to toughen alumina and other ceramics.

synthetic graphite. *Noun.* A crystalline graphitic material made by processing carbon at high temperature and pressure.

synthetic magnesite. *Noun.* Magnesite made by chemically processing seawater. See **magnesite**.

synthetic quartz. *Noun.* A **quartz** crystal grown at high temperature and pressure around a seed of quartz that is suspended in a solution containing natural quartz crystals.

synthetic test solution. *Noun.* A solution of two or more components prepared under specified conditions for use in the evaluation of adsorbents.

systematic sampling. *Noun.* The taking of samples from a batch or manufacturing operation at fixed time intervals or in fixed quantities, or both.

system on a chip. SOC. *Noun.* A project containing at least an embedded **processor** core or embedded **discrete random access memory**.

Système International d'Unités. *French, noun.* The international system of units. See **SI units**.

Tt

- T.** *Noun.* Something shaped like a T, for example a T-piece.
- t.** *Symbol.* Standing for: (1) ton(s); (2) **tonne**(s); (3) in statistics, distribution.
- T.** *Symbol.* Standing for: (1) the hydrogen isotope tritium; (2) **absolute temperature**; (3) **tesla**.
- tab gate.** *Noun.* A small removable tab of approximately the same thickness as a moulded item that is used as a site for **edge gate** location.
- table.** *Noun.* The platform of a grinding machine supporting work being ground.
- table cut.** *Noun.* A relatively simple shaped cut used to facet gemstones. One of the first cuts developed. See **tabular**.
- table, round.** *Noun.* See **round table**.
- table, shaker.** *Noun.* See **shaker table**.
- tablet.** *Noun.* (1) A pill made from compressed powder. (2) A slab of stone.
- table, traverse.** *Noun.* See **traverse table**.
- tableware.** *Noun.* Plates, cups, saucers, and related items employed on the dining table in the serving of food.
- Tabor abrader.** *Noun.* An instrument for measuring the resistance of surfaces to abrasion consisting of loaded abrasive wheels rotating on the surface being tested.
- tabular.** *Adjective.* Flat and shaped like a tabletop.
- tabular alumina.** *Noun.* α -Al₂O₃. Used in refractories, electroceramics, high-quality porcelains and other ceramics, and abrasive products; produced by heating high purity **alumina**, >99.5 %, to 1,980 °C until all is converted to the α -form; the crystal habit is **tabular**. Mp 2,040 °C; density 3,400–4,000 kg m⁻³; Vickers hardness around 26.5 GPa, equivalent to (Mohs) 9.
- tabular crystal.** *Noun.* A flat crystal with parallel faces; a type of **lamella** habit.
- ta-C.** *Abbreviation.* Stands for tetrahedral amorphous carbon. See **tetrahedral amorphous carbon**.
- taccimeter.** *Noun.* A device employing a lightly weighted piece of paper at the surface of a dried coating or film that has been applied to a material's surface to measure the coating stickiness.
- tachylite or tachylite.** *Noun.* A black glassy form of **basalt**.
- tack.** *Noun.* (1) Stickiness of a filament reinforced prepreg material. (2) The force required to separate a bonding material without either face separating being completely free of bonding agent. (3) The self-bonding behaviour of a material.
- tack, dry.** *Noun.* See **dry tack**.
- tack range.** *Noun.* The working time of a spread adhesive; the period of time it remains in the **tacky-dry** condition. It will vary depending on the humidity and temperature.
- tacky-dry.** *Adjective.* The condition of a surface adhesive when volatile constituents have been absorbed or have evaporated.
- taconite.** *Noun.* A low-grade iron ore containing **hematite**, **magnetite**, and fine-grained **silica**.
- tactoid.** *Noun.* A type of colloid particle distribution in a liquid where the particles inside a small domain of **sol** are ordered in a crystal-like fashion; these small domains are tactoids.
- tailings.** *Noun.* (1) Screened particles of a material that are too coarse or too fine for an intended use. (2) The undesirable residue from a magnetic separation. (3) Worthless residue from a mining, milling, or similar process.
- tails.** *Noun.* A finger-like spray pattern on a surface.

tain. *Noun.* An alloy of tin, silver and lead used to back glass mirrors.

takeout. *Noun.* A mechanical device for removing a finished glass article from a glass-forming machine.

take-up twist. *Noun.* The decrease in length of a reinforcing filament caused by twisting; expressed as a percentage of the original untwisted length.

takovite. *Toponym, noun.* $\text{Ni}_6\text{Al}_2(\text{OH})_{16-x}[(\text{OH})_x(\text{CO}_3)] \cdot 4\text{H}_2\text{O}$. A bluish-grey, clay-like mineral that is a hydrated aluminate and carbonate of nickel. The toponym is from the area of Serbia where it is found. It is a **layered double hydroxide** that can have some exchange between the OH^- and the CO_3^{2-} in the active layer so that x is in the range 0–8 in the above formula.

Takwhisker. *Trade name.* Discontinuous SiC fibre sold commercially; density $3,190\text{ kg m}^{-3}$; modulus values in the range $400\text{--}700\text{ GN m}^{-2}$.

takyr. *Noun.* Wide expanses of clay found in the central Asian part of Russia.

talc. *Noun.* $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$. A three-layer sheet structure silicate in a monoclinic crystal form that is soft and slippery as a result of its layer structure. Found in **metamorphic** rocks. Employed in electrical insulators, wall tiles, refractories, electroceramics, dinnerware, and other ceramic bodies; particularly valuable in improving **thermal-shock resistance**. Density $2,600\text{--}2,800\text{ kg m}^{-3}$; Mp above $1,400\text{ }^\circ\text{C}$; hardness (Mohs) 1–1.5, Knoop 8 GN m^{-2} . See **talcum powder**.

talcum powder. *Noun.* A powder made from purified **talc**, usually scented and used for perfuming the body. Also used as a surface drying aid and sometimes as a surface lubricant.

talus. *Noun.* (1) Another word for scree. (2) The sloping side of a fortification wall.

Talwalker-Parmellee plasticity index. *Noun.* The ratio of total deformation of clay at fracture to the average stress beyond the proportional limit.

tambour. *Noun.* A wall that is circular in plan.

tamp. *Verb trans.* To pack down firmly by using repeated blows.

tamped pipe. *Noun.* Concrete pipe formed by tamping dry, no-slump concrete into rotating, vertical moulds.

tamping. *Verb.* The forming of articles by the repeated pounding of dampened bodies into moulds.

tanagra. *Toponym, noun.* A **terracotta** figurine made in the ancient town of Tanagra.

tan δ_{eff} . *Symbol.* See **loss tangent**.

tandoor. *Noun.* A clay oven.

tangent line. *Noun.* In a bottle-shaped filament-wound composite structure, it is any diameter at the equator.

tangent modulus. E_t . *Noun.* The ratio of change in stress to change in strain obtained by drawing a tangent to any point on a stress–strain curve.

tangle. *Noun.* A confused or complicated mass of fibres.

tangle sheet. *Noun.* Pieces of **mica** that split well in some sections, but tear in others.

tank. *Noun.* (1) A refractory-lined, glass-melting unit. (2) A container in which ceramic slips and slurries are stored for subsequent use.

tankard. *Noun.* A large one-handled, glass drinking vessel.

tank block. *Noun.* A refractory block used to line the melting zone of a glass tank.

tank, continuous glass. *Noun.* See **continuous glass tank**.

tank, day. *Noun.* See **day tank**.

tank furnace. *Noun.* A furnace containing a refractory receptacle or tank in which glass is melted and which is continuously charged at a rate equal to that at which the glass is continuously withdrawn. Also known as a **glass tank**.

tank glass. *Noun.* Glass melted in a large tank as distinct from a pot.

tank, glass. *Noun.* See **tank furnace**.

tank, pressure. *Noun.* See **pressure tank**.

tank, settling. *Noun.* See **settling tank**.

tannic acid. *Noun.* A water-soluble, organic powder obtained from nutgalls, tree bark, and other plants; used as a deflocculant and binder in **slips** and slurries. Commonly called **tannin**.

tannin. *Noun.* See **tannic acid**.

tantalate. *Noun.* Salts formed when **tantalum pentoxide**, Ta_2O_5 , is dissolved in alkali.

tantallic acid. *Noun.* The hydrolysis product of tantallic halides; a white gelatinous product.

tantalite. *Noun.* $(\text{Fe}, \text{Mn})(\text{Ta}, \text{Nb})_2\text{O}_6$. A heavy brown orthorhombic material. The main mineral from which tantalum metal is extracted; usually associated with granitic rocks.

tantalum boride. *Noun.* (1) TaB_2 . Mp $3,200\text{ }^\circ\text{C}$; density $12,500\text{ kg m}^{-3}$. (2) TaB . Mp $2,400\text{ }^\circ\text{C}$; density $14,300\text{ kg m}^{-3}$. (3) Ta_3B_4 . Mp $2,650\text{ }^\circ\text{C}$; density $13,600\text{ kg m}^{-3}$. (4) Ta_2B . Mp $1,899\text{ }^\circ\text{C}$. (5) Ta_3B_2 . Mp $2,038\text{ }^\circ\text{C}$. All are used in some **cemented hard metal** cutting tools.

tantalum carbide. *Noun.* (1) TaC . Mp $3,875\text{ }^\circ\text{C}$; density $14,500\text{ kg m}^{-3}$; hardness (Mohs) 9. (2) Ta_3C . Mp $3,400\text{ }^\circ\text{C}$. Used in cutting tools and dies. All are components in sintered refractory hard metals.

tantalum nitride. *Noun.* (1) TaN. Mp 3,360 °C. (2) Ta₂N. Loses nitrogen at 1,900 °C. Both used as special crucible materials.

tantalum nitride resistor. *Noun.* A thin-film resistor with a deposit of **tantalum nitride** on a substrate such as **sapphire**.

tantalum oxide. *Noun.* Ta₂O₅. Used in optical glass and ferroelectric components. Mp 1,800 °C; density 7,600 kg m⁻³.

tap. *Verb.* (1) To drain molten vitreous compositions from a smelter through an opening in the smelter floor. (2) To remove excess slag from the bottom of a pot furnace. (3) To centre an inverted pot on a wheel for trimming and decoration.

tap density. *Noun.* The apparent density of a powder or granulated material resulting when the receptacle containing the material is vibrated or tapped manually under standard or specified conditions.

tape. *Noun.* A **pregreg** of finite width made from unidirectional fibres in resin.

tape laying. *Noun.* A cheaper, faster composite manufacturing process compared to traditional autoclave manufacture.

taped rove. *Noun.* Separately wound fibre strands are made to stick together into a ribbon-like shape; made for weaving or pipe wrapping.

tape placement. *Noun.* A machine method for laying tape in a non-overlapped fashion onto a flat or curved mould.

tapered cheese. *Noun.* See **cheese**.

tapered double strap joint. *Noun.* A geometry used for adhesive joining of thin sheets of ceramic or composite in which a **butt** joint is supported top and bottom by **lap** joints formed by extra pieces of material that are cut to a pyramidal aspect with 20° tapers. It has an excellent performance record.

tapered godet. *Noun.* See **godet wheel**.

tapered lap joint. *Noun.* A geometry used for adhesive joining of thin sheets of ceramic or composite where the two overlapping sections are cut or ground to a 10° taper. The non-tapered faces are bonded. Over all this produces a very good performance in operation.

tapered seal. *Noun.* A thin metal sleeve fitted over a thick, tapered ceramic cylinder so as to form a tight seal.

tapered wheel. *Noun.* A flat-faced grinding wheel tapered with the greater thickness at the hub.

tapestry brick. *Noun.* A brick having a rough, unscored, textured surface.

tap hole. *Noun.* A hole in the bottom of a smelter or ladle through which a molten batch is drained.

tap-hole clay. *Noun.* Damp, plastic, refractory clay formed into a wad and used to seal the tap hole of a smelter or melting furnace.

tapiolite. *Noun.* FeTa₂O₆. A magnetic mineral having the normal **rutile** unit cell tripled along the tetragonal c-axis. The ordering that causes the c-axis tripling separates Fe²⁺-layers by two Ta⁵⁺-layers and gives rise to two-dimensional magnetic ordering in the Fe²⁺-layers.

tapping. *Verb.* The removal of the tap-hole plug to drain a smelter or furnace of its molten charge.

tappit hen. *Noun.* A ceramic or glass bottle of 3 l capacity.

tar. *Noun.* A black, bituminous, semisolid material consisting of a mixture of condensates from the inert, destructive distillation of coal, oil, wood, or organic materials.

tar-bearing basic ramming mix. *Noun.* A tar-bearing basic refractory mixture, which is rammed into place to form a monolithic structure in the heat zone of a furnace. See **pitch**.

tar-bearing basic refractory. *Noun.* A refractory shape composed of basic refractory grains to which tar has been added during manufacture. See **pitch**.

tare weight. *Noun.* The combined weight of an empty container and its accessories.

tarnish. *Verb trans.* (1) The dulling discoloration, or staining of a surface by exposure to air or reactive atmospheres. (2) *Noun.* A film of oxidised material on the surface of a mineral or metal.

tarras cement. *Noun.* A volcanic **tuff** having **pozzolanic** properties; used as **hydraulic cement**. Also known as **trass**.

tartar. *Noun.* See **calculus**.

tartaric acid. *Noun.* Dihydroxy dicarboxylic acid; used to prepare salts which are often used as plasticisers.

tass. *Noun.* A cup, goblet or glass for drinking.

Tateho. *Trade name, noun.* A commercially available **chopped strand** form of Si₃N₄ fibre. Density 3,180 kg m⁻³.

tazza. *Noun.* A glass or ceramic wine vessel with a shallow circular foot.

TBC. *Abbreviation.* Standing for thermal barrier coating. See **thermal barrier coating**.

TBCCO. *Abbreviation.* Standing for **thallium barium calcium copper oxide**. A high temperature superconductor material.

T-bend flexibility test. *Noun.* A test designed to compare the flexibility of a surface coating whereby the coated metal is bent over on to itself.

TBP. *Abbreviation.* Stands for tributylphosphate, $(C_4H_9)_3PO$; a complexing agent used to extract uranium species from solutions of burned-up nuclear fuel elements.

TC. *Abbreviation.* Standing for texture coefficient. See **texture coefficient**.

TCC. *Abbreviation.* Stands for temperature compensated capacitor. See **Class 1 capacitors**.

TCE. *Abbreviation.* Standing for thermal coefficient of expansion. See **thermal coefficient of expansion**.

TCO. *Abbreviation.* Stands for transparent conducting oxide. See **transparent conducting oxide**.

TDM. *Abbreviation.* Stands for time division multiplexing. See **time division multiplexing**.

tea dust glaze. *Noun.* An opaque, iron oxide-bearing stoneware glaze of greenish colour.

teapot. *Noun.* A lidded container with a spout and handle in which tea is made and from which it is served.

teapot ladle. *Noun.* A type of ladle containing a refractory dam under which molten metal flows; designed to prevent slag from reaching the ladle spout.

tear. *Noun.* A crack or a torn section in glass caused by sticking to hot metal.

tear failure. *Noun.* A mode of failure in a tensile test where a crack initiated at one edge propagates across only slowly to give an anomalous load-extension curve.

tearing. *Noun.* A pattern of healed cracks in porcelain-enamel in which the undercoat or metal may be observed. See **crawling**.

tearing energy. *Noun.* The work done in a tensile test to propagate tear failure to completion.

tearing strength. *Noun.* The stress required to start or propagate a tear in a fabric under specified conditions

teaser. *Noun.* A workman supervising the charging, temperature control, and operations of a glass-melting tank or furnace.

tea service. *Noun.* China or pottery articles, including a teapot, saucers, etc., used in serving tea.

tectonics. *Plural noun.* (1) The science and art of building. (2) The study of structural features connected to the earth folding as tectonic plates slide.

teeming. *Verb trans.* The pouring of a molten batch from a pot or ladle into moulds.

teeming, bottom. *Verb.* See **bottom teeming**.

teeming, uphill. *Verb.* See **uphill teeming**.

teeth. *Noun.* (1) The crenulations on the rim of a gear. (2) Surface irregularities formed when adhesive-bonded surfaces are separated.

tektite. *Noun.* Naturally occurring **silica glass** believed to have been formed by meteorite impact.

telegraphing. *Verb.* In reinforced composite laminates this is transmitting to the surface of any pattern of internal imperfections as subsequent layers are laid over the fault.

tellurium. *Noun.* Te. A silvery non-metallic element with semiconductor properties. Used as a yellow, green, and blue colorant in glass and glazes. Mp 452 °C; bp 1,390 °C; density 6,240 kg m⁻³.

TEM. *Abbreviation.* Stands for transmission electron microscope. See **transmission electron microscope**.

temper. *Verb.* (1) To moisten and mix clay, plaster, mortar, etc., to a proper consistency for use. (2) To strengthen, harden, or toughen glass by rapid cooling above the annealing point. (3) *Noun.* The degree of residual stress in annealed glass. (4) *Noun.* The moisture content of a sand mixture.

tempera. *Noun.* A decorating technique in which the pigment is suspended in glue-like material such as casein or wax. In ancient times egg yolk was commonly used.

temperature. *Noun.* The thermal state of a body in terms of its ability to transfer heat to other bodies.

temperature, absolute. *Noun.* See **absolute temperature**.

temperature, annealing. *Noun.* See **annealing temperature**.

temperature compensated capacitor. **TCC.** *Noun.* See **class 1 capacitor**.

temperature, deformation. *Noun.* See **deformation temperature**.

temperature, fictive. *Noun.* See **fictive temperature**.

temperature, firing. *Noun.* See **firing temperature**.

temperature gradient. *Noun.* The rate of temperature change between two points of reference in a substance or in an area.

temperature-gradient furnace. *Noun.* A slender laboratory furnace of relatively small cross section in which a controlled temperature gradient is maintained along its length.

temperature, ignition. *Noun.* See **ignition temperature**.

temperature, liquidus. *Noun.* See **liquidus temperature**.

temperature, maturing. *Noun.* See **maturing temperature**.

temperature, melting. *Noun.* See **melting temperature**.

temperature, oxidising. *Noun.* See **oxidising temperature**.

temperature range code. *Noun.* See **capacitor range code**.

temperature, recrystallisation. *Noun.* See **recrystallisation temperature**.

temperature, refining. *Noun.* See **refining temperature**.

temperature, softening. *Noun.* See **softening temperature**.

temperature, transformation. *Noun.* See **transformation temperature**.

temperature tolerance code. *Noun.* See **capacitor code**.

temperature, yield. *Noun.* See **yield temperature**.

tempered glass. *Noun.* Glass that has been cooled from near its softening point to room temperature under rigorous control to increase its mechanical strength and thermal endurance by the formation of a compressive layer at its surface. Jets of cold nitrogen gas induce rapid surface cooling and the slower cooling of the inner parts induces the compression in the surface layer.

tempered martensite. *Noun.* A microstructure consisting of very small uniformly dispersed **cementite** grains embedded in a continuous matrix of α -ferrite.

tempered pitch-bonded basic refractories. *Noun.* Pitch-bonded basic refractory that is heat-treated to minimise softening of the bond on reheating.

tempered safety glass. *Noun.* A glass that has been tempered, so that it will break into granular instead of jagged fragments as a result of particular stress patterns created in the glass, by a rigidly controlled heat treatment. See **tempered glass**.

tempering. *Verb.* (1) The treatment of clays, ceramic bodies, plaster, mortar, and similar materials with water or steam to obtain desired working and forming characteristics. (2) The rapid surface cooling of glass to develop improved resistance to mechanical and thermal damage through a compressive surface layer. (3) *Noun.* The slow, low-temperature annealing of metals to reduce strain energy.

tempering pan. *Noun.* A mechanical, pan-type mixer in which clays and bodies are blended with water to working consistencies.

tempering tub. *Noun.* A vertical pan-type mixer in which materials are blended with water and then fed directly into a vertical **pug mill**, the same shaft serving the mixer and pug mill.

tempering water. *Noun.* The water or moisture added to a body of clay mix to develop desired working properties.

template. *Noun.* (1) A guide pattern used in the shaping of ware during manufacture. (2) A pattern through which porcelain-enamel may be sprayed on ware or through

which previously applied and dried porcelain-enamel may be removed by brushing to produce a desired design.

temporary hardness. *Noun.* Hardness of water caused by calcium and magnesium hydrogen carbonates that can be removed by boiling when they precipitate out as carbonates.

temporary wicket. *Noun.* Temporary closure of refractory or insulating block in a furnace or kiln, such as at the ends of **checker-chambers**.

tenacity, gd^{-1} . *Noun.* This denotes the strength of a yarn or reinforcing filament; it is the breaking force in grams per **denier** unit of filament size when the filament or yarn is pulled at 30.5 cm min^{-1} .

tendon. *Noun.* A tensioned steel bar or strand of wires anchored in concrete to induce compressive stress in the outer layers of concrete when set.

tenmoku. *Noun.* A **lustrous**, iron-bearing, black, **stone-ware** glaze that blends to a red-dust colour on thinner parts, on firing.

tenorite. *Noun.* A black mineral form of **copper oxide**, CuO .

tensile specimen. *Noun.* A bar of a material of specified dimensions used to measure the resistance of the material to fracture in tension.

tensile strength. *Noun.* The maximum stress a material subjected to a pulling or stretching load can withstand without breaking, calculated as the load in kilograms per square meter, reported for the cross-sectional area of the specimen at the point of fracture. Often called **ultimate tensile strength**.

tensile stress. *Noun.* The stress developed in a specimen under a pulling load; the applied force divided by the cross-sectional area of the specimen; units are N m^{-2} .

tensiometer. *Noun.* (1) An instrument designed to deliver measurable tensile forces to specimens to be tested. (2) An instrument for measuring the moisture content of soils. (3) An instrument, usually consisting of two bulbs connected to a manometer, used to compare the pressure of two liquids. (4) An instrument, consisting of a sensitive balance and a lightweight ring, which is used to measure the surface tension of a liquid by finding the mass needed to just pull the ring from the liquid surface. (5) An instrument for measuring differences of vapour pressure.

tension. *Noun.* A force that tends to lengthen a solid, such as by pulling.

tension member. *Noun.* A component carrying horizontal loads.

tension set. *Noun.* The strain that remains after a tensile stress has been removed.

tension, surface. *Noun.* See **surface tension**.

TEOS. *Acronym.* Stands for tetraethoxysilane. See **tetraethoxysilane**.

tephra. *Noun.* Tiny particles of solid ceramic matter ejected into the atmosphere by a volcano.

tephra mantle. *Noun.* A layer of **tephra** of varying depth lying on the ground downwind of a volcano. Sometimes a mineral resource.

tephrite. *Noun.* **Basalt** containing **augite**, **nepheline**, or **plagioclase**.

terbia. *Noun.* Old ceramic name for terbium oxide. See **terbium oxide**.

terbium oxide. *Noun.* (1) Tb_2O_3 . Used in electronic ceramics. Mp 2,380 °C; Also called **terbia**. (2) Tb_4O_7 .

terminal fracture velocity. **TFV.** *Noun.* The maximum speed of propagation that a crack can achieve in a brittle solid; given by the equation: $TFV = 0.5(\sigma_y/\rho)^{1/2}$, where σ_y is the **yield stress** and ρ is the density of the material.

terminal solid solution. *Noun.* A **solid solution** that exists over a composition range that extends to either end member of a binary phase diagram.

ternary. *Adjective.* An alloy having three different components.

ternary diagram. *Noun.* A phase diagram of a 3-component system.

terotechnology. *Noun.* The technology of the installation and efficient use of equipment and machinery.

terra alba. *Noun.* (1) Very white, uncalcined **gypsum**, $CaSO_4 \cdot 2H_2O$. (2) Several white earthy substances, such as **kaolin**, **magnesia** and **pipeclay**.

terracotta. *Noun.* (1) Unglazed, low-fired, ornamental **earthenware**, such as tile, roofing, vases, statuettes, building block and primitive pottery. (2) A **hard-fired** glazed or unglazed, clay building unit, generally larger than facing tile or brick; used for ornamental purposes in architectural applications. (3) Something made of terracotta. (4) A strong reddish-orange brown colour. (5) *Adjective.* Of the colour terracotta or made from terracotta.

terra di sienna. *Noun.* A **ferric oxide** pigment used in glazes

terra rosa. *Noun.* A variety of **haematite**; sometimes used as a red pigment in glazes.

terra sigillata. *Noun.* (1) A fine-textured, glossy, embossed, pottery. (2) A reddish-brown clayey earth found on the island of Lemnos and used to make **Samian ware**.

terrazzo. *Noun.* A mosaic-type floor obtained by embedding special **aggregate**, such as **marble** or **granite**

chips, in concrete, followed by grinding and polishing to smooth surface after the concrete has set.

terre verte. *Noun.* Greyish-green pigment made from milled **glaucanite**, $K_2(Mg,Fe_2)Al_6(Si_4O_{10})_3(OH)_{12}$.

terrigenous. *Adjective.* Of or produced by the earth deposited by erosion.

terrine. *Noun.* An oval **earthenware**-cooking dish with a tightly fitting lid.

tertiary air. *Noun.* Preheated air added to the waste-gas flue of a furnace or kiln being fired under **reducing** conditions to minimise smoke emission.

tesla, T. *Noun.* The measure of magnetic field strength; that is the magnetic flux density in the **SI system** of units equivalent to 10^4 **gauss** in the **cgs system**.

tesla coil. *Noun.* A step-up transformer with an air core; used to produce high frequency, high voltages.

tessellate. *Verb.* To pave or inlay with a **mosaic** of small tiles.

tessera. *Noun.* A small rectangular ceramic tile or glass used in **mosaic** design.

tessha. *Noun.* A more metallic and broken version of **tenmoku**. See **tenmoku**.

tesson. *Noun.* A fragment of glass or pottery. Adaptation of the French for a piece of broken glass or pottery, "test".

test, acceptance. *Noun.* See **acceptance test**.

test batch. *Noun.* A sample of concrete taken from a production mix for testing.

test bed. *Noun.* A sound, strong base for securing equipment to and equipped with instruments, etc.; used for testing machinery, engines, etc., under working conditions.

test certificate. *Noun.* A document certifying the validity of a performed test.

test coil. *Noun.* A section of a coil assembly that excites or detects the magnetic field in a material in a comparative system.

test, compression. *Noun.* See **compression test**.

test cone. *Noun.* See **pyrometric cone**.

test cylinder. *Noun.* A cylinder of concrete used as a test specimen.

test, eddy-current. *Noun.* See **eddy-current testing**.

test, electromagnetic. *Noun.* See **electromagnetic test**.

test method. *Noun.* A definitive standard procedure used to ascertain properties of materials or products.

test, non-destructive. *Noun.* See **non-destructive test**.

test of significance. *Noun.* A procedure used in statistical analysis to see if a particular result arose by mere chance.

test, performance. *Noun.* See **performance test**.

test specimen. *Noun.* A sample prepared to prescribed size and shape from which mechanical, physical, and chemical properties are determined.

tetracarbon. *Noun.* A possible fifth **allotrope** of carbon consisting of linear chains perpendicular to the surface on which they are grown. The chains are densely packed, held together by **van der Waal forces**. Nearly as hard as **diamond** and an order of magnitude stronger than **carbon fibre**.

tetraethoxysilane. **TEOS.** *Noun.* An organo-silicon compound soluble in alcohols. The alcoholic solutions can be slowly hydrolysed with water or ammonia solution in a controlled way to yield sub-micron sized **silica** spheres.

tetragonal. *Adjective.* The crystal system characterised by three mutually perpendicular axes, two of which are equal in length. **Cassiterite**, **rutile** and **zircon** are ceramic examples of this crystal system.

tetrahedral amorphous carbon. **carbon(ta-C).** *Noun.* **Diamond-like carbon** with the maximum C-C sp^3 bond content. Made by **pulsed laser deposition**. See **diamond-like carbon**.

tetrahedral site. *Noun.* The empty space in a close-packed structure of atoms or ions that is surrounded by four atoms or ions.

tetrahedrite. *Noun.* $(Cu,Fe)_{12}Sb_4S_{13}$. A common sulphide ore and important source of copper; crystallises in the cubic system as twinned tetrahedral crystals. Density 4,600–5,100 $kg\ m^{-3}$; hardness (Mohs) 3–3.5.

tetrahedron. *Noun.* A solid figure having four plane faces; a regular tetrahedron, such as the SiO_4 unit, has faces that are equilateral triangles.

tetrasodium pyrophosphate. *Noun.* $Na_4P_2O_7$. Used as a **suspension** and **dispersing agent** in porcelain-enamels and ceramic glazes.

tetrode. *Noun.* A **transistor** having two terminals on the base or **gate** to improve its high-frequency performance.

tex. $g\ km^{-1}$. *Noun.* A unit derived from the textile industry and now applied to ceramic fibres to show linear density and indicate fibre diameter; the weight in grams of a fibre that is 1 km long. The tex is a recognised **SI unit**. **Millitex** (mtex) is milligrams per kilometre; **decitex** (dtex) is decigrams per kilometre; **kilotex** (ktex) is kilogram per kilometre.

textile size. *Noun.* A starch-water-oil emulsion used to coat individual ceramic or glass fibres before **stranding** them in order to protect their surfaces from abrasion and to help **strand** formation.

texture. *Noun.* (1) The visual and tactile characteristics of a surface. (2) The relationship between shapes and sizes of pores and grains in a refractory product.

texture coefficient. **TC.** *Noun.* A measure of the **preferred orientation** of crystals in a polycrystalline vapour deposited film; if $TC=10$, the preferred orientation is said to be perfect.

textured brick. *Noun.* A brick treated to alter its surface appearance from that produced by the mould, such as by scratching, scoring or sand rubbing in the plastic state.

TFT. *Abbreviation.* Stands for thin film transistor. See **thin film transistor**.

TFV. *Abbreviation.* Stands for terminal fracture velocity. See **terminal fracture velocity**.

T_g . *Symbol.* Used to denote the **transformation temperature** of a glass, where the second order change from supercooled liquid to glassy state occurs on cooling.

TGA. *Abbreviation.* Stands for thermogravimetric analysis. See **thermogravimetric analysis**.

thallium calcium barium copper oxide. *Noun.* $Tl_2Ca_2Ba_2Cu_3O_{10-x}$. A **high-temperature superconductor** that can be made into thin films on substrates for use in microwave circuits.

thallium oxide. *Noun.* Tl_2O_3 . Used to increase the **index of refraction** of **optical glass**. Mp 300 °C; bp 1,865 °C.

thaumasite. *Noun.* The product of a form of sulphate attack in cementitious materials.

thenardite. *Noun.* Na_2SO_4 . Anhydrous **sodium sulphate** found as a white, vitreous mineral.

Thenard's blue. *Noun.* Another name for **cobalt blue**.

theoretical air. *Noun.* The amount of air theoretically required for complete combustion.

theoretical density. *Noun.* The density of a material calculated from the number of atoms per **unit cell** and the lengths of the x-ray unit cell parameters. See **x-ray density**.

theoretical strength. *Noun.* The strength a material would have if it were free from **Griffith flaws**, **dislocations**, **grain boundaries**, or any other form of defect. Various ways of estimating it have been developed.

theoretical stress concentration factor. *Noun.* Arises in a solid from the presence of notches and other flaws that cause stress concentrations. It is the ratio of the greatest stress to the average stress in the body.

theoretical weight. *Noun.* The mass of a body calculated from the dimensions of the body and its density.

therm. *Noun.* A unit of heat equal to 10^5 **British Thermal Units** or 1.055056×10^8 J.

thermal. *Adjective.* Related to, caused by or generating heat.

thermal analysis. *Noun.* The analysis of the properties of materials that are heat-related.

thermal analysis, differential. *Noun.* See **differential thermal analysis**.

thermal barrier. *Noun.* An insulating material that will prevent or deter the transfer of heat or cold from one body or area to another.

thermal barrier coating. TBC. *Noun.* Complex films from 100 μm to 2 mm thick of a refractory material applied to a metal surface to protect it from extreme temperatures in a gas flow. They enable metals to be used in gas temperatures above their mp. Yttria **stabilised zirconia** is an example.

thermal black. *Noun.* A relatively coarse **carbon black** made by the pyrolytic process for use as a pigment.

thermal capacity. *Noun.* (1) The amount of heat a body will absorb, expressed as joules per degree of temperature per unit of mass, $\text{J kg}^{-1} \text{K}^{-1}$. (2) The quantity of heat required to raise the temperature of a body or substance one degree. See **British Thermal Unit**.

thermal conductance. C. *Noun.* The rate of heat flow through a unit area of a body induced by unit temperature difference between the body surfaces; C is expressed in $\text{W m}^{-2} \text{K}^{-1}$.

thermal conductivity. k. *Noun.* The measure of heat flow in a temperature gradient for a solid as defined by **Fourier's law**. It is a temperature dependent property, decreasing as the temperature rises. It concerns the process whereby heat energy is passed through a material by the dissipation of vibrational energy between adjacent atoms. In a solid it has two components, the lattice component k_L and the electronic k_e . The electronic component is proportional to the electrical conductivity, σ , according to the **Wiedermann-Franz law**: $k_e = L_o T \sigma$, where L_o is **Lorentz number** ($2.44 \times 10^{-8} \text{ W } \Omega \text{K}^{-1}$). The thermal conductivity, k, is measured as $\text{W m}^{-1} \text{K}^{-1}$. At room temperature amorphous materials have the lowest values around $1 \text{ W m}^{-1} \text{K}^{-1}$ and diamond has the highest value at $2,300 \text{ W m}^{-1} \text{K}^{-1}$. When materials have nanoscale dimensions such that the mean free path of **phonon** or electron scattering is larger than the grain dimensions or layer thickness etc., scattering from imperfections, **defects**, interfaces etc., dominate and thermal conductivity ceases to be a material property.

thermal convection. *Noun.* See **heat transfer**.

thermal diagenesis. *Noun.* The transformation of one mineral deposit to another by means of heat, for example a transformation to a lower **hydration** state as in the case of **borax** to **kernite**.

thermal diffusion. *Noun.* The phenomenon in which the presence of a temperature gradient in a mixture of fluids causes the heavier molecules to diffuse into the cooler regions. The effect has been used to separate isotopes.

thermal diffusivity. D_t . *Noun.* Heat flux per unit of area of a solid per unit of time, h, divided by the product of **specific heat**, C_p , density, ρ , and temperature gradient, $T - T_s$, where T_s is the sink temperature: $D_t = h / C_p \rho (T - T_s)$. It is used in the equation to determine thermal shock failure parameter. See **thermal shock failure parameter**.

thermal efficiency. *Noun.* The ratio of heat radiated by a body to that of a perfect **blackbody** at the same temperature.

thermal endurance. *Noun.* The ability of glass or other body to resist **thermal shock** or to withstand deterioration during exposure to high temperatures.

thermal etching. *Verb.* Heating polished ceramic surfaces to a temperature some 100–200 $^{\circ}\text{C}$ below the sintering temperature for 10–30 min to reveal the grain boundary structure by intergranular corrosion, **surface diffusion** or by vapour transport. The method is described as standard ISO 6474 and time is not critical but temperature is.

thermal excitations. *Noun.* The process in which atoms and molecules attain excess energy via collisions.

thermal expansion. *Noun.* The reversible or permanent change in the dimensions of a body when heated.

thermal expansion coefficient. α_t . *Noun.* The fractional change in the length or volume of a material per degree temperature change.

thermal fatigue. *Noun.* A failure mode that can occur in non-cubic materials; such materials are thermally anisotropic and so intergranular stresses occur when grains expand anisotropically against each other; a cause of weathering in rocks and powdering in some materials

thermal glass. *Noun.* A low-expansion glass in which **boron oxide** is substituted for **calcium oxide** in ordinary **soda-lime glass**, and which may be heated and cooled rapidly without breaking.

thermal gradient furnace. *Noun.* A tubular furnace of small cross section in which a controlled temperature gradient is maintained along its length.

thermal growth. *Noun.* See **thermal ratcheting**.

thermal incompatibility. *Noun.* A condition in which part of an aggregate in concrete exhibits a different coefficient of expansion or other thermal property from the constituents, resulting in damage or distress to the concrete when hardened, particularly crumbling.

thermal-insulating cement. *Noun.* A dry cementitious composition containing additions of substances of low thermal conductivity which, when blended with water, form a mixture which may be placed or applied as a covering to provide a thermal barrier.

thermal insulation. *Noun.* Ceramic materials used to give resistance to heat flow.

thermal integrity factor. TIF. *Noun.* A performance indicator for square cell, cellular-ceramic catalyst supports that relates to **thermal shock resistance**: $TIF = L/t$, where t is the cell wall thickness and L is the cell repeat distance.

thermal interface material. *Noun.* In electronic systems these are materials that are spread between the microprocessor chip and the **heat spreader** to improve contact and aid heat removal. Commonly they are polymer based materials filled with high thermal conductivity particles such as **carbon nanotubes**.

thermal ionisation. *Noun.* The evaporation from a heated surface of both positive and negative ions as well as neutral particles; extremely high temperatures are usually required.

thermally activated. *Noun.* A reaction that depends on atomic thermal fluctuations and atoms that have thermal energies greater than the **activation energy** will spontaneously react or transform.

thermally reduced graphene oxide. TRGO. *Noun.* A chemically modified **graphene** analogue used because its properties are very similar to graphene but it is easier to manufacture.

thermal neutron. *Noun.* A neutron with a mean velocity about $2,200 \text{ m s}^{-1}$.

thermal radiation. *Noun.* Electromagnetic waves emitted by a body as a consequence of the thermal excitation of the atoms. The wavelength spans from infrared to ultraviolet with the intensity distribution depending on the temperature of the body.

thermal ratcheting. *Noun.* The irreversible volume expansion found in some systems when they are thermally cycled.

thermal reactor. *Noun.* A nuclear reactor where most fission is caused by slow thermal neutrons.

thermal resistance. *Noun.* (1) The resistance of a body to the flow of heat; calculated as the temperature difference between the opposite faces of the body divided by the rate of heat flow; reciprocal of **thermal conductance**. (2) R_{JA} . A measure of a structure's, particularly a computer chip and its package's, ability to remove heat. Given by the temperature difference divided by input power; units K W^{-1} . It is not a material constant but relates to the materials used and the package architecture. The differences between the junction and air temperatures are used to specify R_{JA} . For example, R_{JA} of 13 C/w mean the temperature difference between a **transistor junction**, T_J , and ambient, T_A , is steady at 13°C , if 1 W is dissipated in the transistor junction layer. $T_J = T_A + wR_{JA}$.

thermal resistance parameter. *Noun.* Several experimentally determined quantities used to characterise the

thermal shock resistance of a ceramic. See, for example, **fracture initiation parameter**.

thermal resistivity. *Noun.* The temperature difference between the parallel surfaces of an infinite slab of a homogeneous material of unit thickness when a unit thermal transmission in unit time by conduction only through a unit area is maintained in a direction perpendicular to the surface.

thermal runaway. *Noun.* In radio-frequency heating this is caused when an increase in temperature of the **dielectric** causes a **loss factor** increase which then leads to a greater temperature increase and so on.

thermal shock. *Noun.* Exposure of a body or coating to sudden and severe changes in temperature.

thermal shock damage resistance parameter. R_w^{III} . *Noun.* A development of the **thermal shock failure parameter** using a **fracture mechanics** approach. $R_w^{\text{III}} = E\gamma_f / \sigma_f^2(1-\nu)$, where γ_f is the **work of fracture**, σ_f is the **failure stress**, ν is **Poisson's ratio** and E is **Young's modulus**. It is used to compare the **thermal shock** characteristic of ceramic bodies.

thermal-shock failure. *Noun.* The fracture or crazing of a porcelain-enamel, glass, or glaze when subjected to sudden cooling from an elevated temperature, as by the application of cold liquids.

thermal shock failure parameter. R'' . *Noun.* This is derived from the **thermal shock fracture parameter** by including a shape factor and a more general rate of cooling parameter. $\Phi_{\text{max}} = R''G = DG(1-\nu) \sigma_f/E \alpha$, where Φ is the constant rate of change of surface temperature, D is the **thermal diffusivity** and equals $k/\rho c_p$, where k is the **thermal conductivity**, ρ is the **density** and c_p is the **specific heat**, G is the shape factor incorporating the characteristic dimension a . R'' enables predictions to be made of the effect of change in the rate of surface temperature change on **thermal shock** characteristics to be made.

thermal shock fracture parameters. R, R' . *Noun.* A measure of the temperature interval, ΔT , which, if imposed instantaneously, a ceramic body can just withstand. $R = \Delta T = \sigma_f/E \alpha$, where σ_f is the **fracture strength**, α is the **linear expansion coefficient** and E is **Young's modulus**. No temperature is specified as to which values of σ_f , α and E to use which is important since all are temperature dependent. It is re-defined when the rate of heat dissipation is included and R becomes $R' = \Delta TK = K \sigma_f/E \alpha$, where K is the **thermal conductivity** of the body. Both parameters are adjusted for biaxial tensile stress by including **Poisson's ratio**: $R' = K(1-\nu) \sigma_f/E \alpha$.

thermal-shock resistance. *Noun.* The ability to withstand sudden changes in temperature without fracture.

thermal shock spalling. *Noun.* Fracture and chipping of porcelain-enamel produced by the sudden cooling or quenching of the hot enamel surface by inadvertent exposure to water or other liquid.

thermal shock strength. *Noun.* The maximum sudden change in temperature that a body can withstand without fracture occurring; usually determined by quench cooling.

thermal-shock test. *Noun.* A test in which a body, glass, glaze or porcelain-enamel is subjected to selected conditions of sudden temperature change to determine its thermal endurance properties.

thermal spalling. *Noun.* The breaking or cracking of refractories sufficient to expose new surfaces caused by sudden or non-uniform temperature changes that create planar fracture stresses in the unit.

thermal spraying. *Verb.* To spray droplets of molten powders on to a substrate by means of a heated applicator.

thermal strength. *Noun.* The physical strength of a solid at an elevated temperature.

thermal stress. *Noun.* Stress induced by temperature changes in a body unable to expand or contract freely.

thermal stress cracking. *Noun.* Cracking that occurs in some matrix thermoplastic resins resulting from over exposure to raised temperatures.

thermal tempering. *Verb.* Increasing the strength of glass by introducing a residual compressive stress in the outer surface layers by quench cooling them.

thermal toughening. *Verb.* To heat a glass to a temperature near the top of the **annealing range** and then air-jet quenching it.

thermal transmittance. *Noun.* The heat flow per second per square meter under equilibrium conditions through a body.

thermal vibration. *Noun.* The motion of atoms in a solid about equilibrium positions. Such motion is quantised and the **specific heat** of a solid is largely associated with thermal vibration. The quantum of thermal vibration is the **phonon**; hence, as the temperature of a solid rises, phonons are created.

thermion. *Noun.* An electron or ion emitted by a high-temperature body.

thermionic. *Adjective.* The flow of an electrically charged particle or ion emitted by a conducting material at high temperatures.

thermionic emission. *Noun.* The ejection of electrons from very hot solids. Used to produce x-rays.

thermistor. *Noun.* A ceramic semiconductor whose resistance decreases sharply with increases in temperature, for example, **nickel oxide**, NiO.

Thermit. *Trade name, noun.* Used for the **thermite process**.

thermite process. *Noun.* An **exothermic reaction** in which a metal oxide is reduced when heated with finely

divided aluminium to yield a molten metal plus aluminium oxide. See **self-propagating high-temperature synthesis**.

thermobalance. *Noun.* An analytical balance fitted with temperature controllable furnaces around weighing pans extended well below the balance arm or other weighing mechanism.

thermochemistry. *Noun.* A branch of chemistry concerned with the measurement of heat evolved or absorbed during chemical reactions.

thermochromic. *Adjective.* Of or related to colour changes caused by temperature change.

thermochromism. *Noun.* The changes in colour in a solid that occur with changes in temperature.

thermocouple. *Noun.* A temperature-measuring device consisting of two dissimilar conductors joined together at their ends, which generate a thermoelectric voltage when heated; the voltage, being proportional to the temperature difference between the junctions allows calibration to indicate temperature.

thermodynamic equilibrium. *Noun.* The final steady state of a thermodynamic system the characteristic of which is the absence of any tendency for spontaneous change. Thermodynamics as a study area is largely concerned with systems in thermodynamic equilibrium.

thermodynamic functions. *Noun.* The five quantities: **internal energy**, **enthalpy**, **entropy**, **Gibbs function**, and **Helmholtz function**, which are used to describe thermodynamic systems. They depend only on the state of the system and not on the method used to reach that state.

thermodynamic parameter. ($\frac{1}{2}-\delta$). *Noun.* δ is an interaction parameter and the $\frac{1}{2}-\delta$ determines the sign of ΔG_s , the free energy change occurring when spherical particles suspended in a liquid interact. If δ is less than $\frac{1}{2}$, ΔG_s is positive and coagulation is prevented; when $\delta > \frac{1}{2}$ powder **aggregates** are formed.

thermodynamics. *Noun.* The study of the relationships between the properties of matter influenced by changes in temperature, and the conversion of energy from one form to another, the conversion of heat into work and vice versa.

thermodynamic temperature. *Noun.* The basic physical quantity used to measure the average thermal energy of particles in motion. Also known as the **absolute temperature** and is measured in **kelvins** defined so that the **triple point** of water is 273.16 K.

thermoelectric figure of merit. ZT. *Noun.* See **Seebeck effect**.

thermoelectricity. *Noun.* Electricity produced in a circuit consisting of two different conductors or semiconductors whose junctions are at different temperatures; used in thermocouples for the measurement and control of temperatures. See the **Seebeck effect**.

thermoelectric material. *Noun.* Materials that generate electricity when a temperature difference across a sample causes an electrical current due to the different behaviour of p- and n-type semiconductors within the structure. They often contain bismuth, tellurium, and antimony compounds and generate power densities up to $10 \text{ mW cm}^{-2} \text{ K}^{-1}$.

thermoelectric power. S. *Noun.* The potential drop per-degree temperature difference across a conductor or semiconductor caused by the electrons or **holes** moving toward the cold end.

thermoelectron. *Noun.* An electron emitted at high temperature.

thermogram. *Noun.* (1) A curve showing weight change of a specimen as a function of temperature. (2) The record produced by a **thermograph**.

thermograph. *Noun.* A thermometer producing a continuous record of a fluctuating temperature.

thermography. *Noun.* (1) A writing, printing or recording process involving the use of heat. (2) A flaw detection method for solids whereby isothermal contour lines are mapped and discontinuities in the solid then cause gradients in the detected contours.

thermogravimetric analysis, differential. *Noun.* See **differential thermogravimetric analysis**.

thermoluminescence. *Noun.* **Phosphorescence** in some solids caused by heating. It results from the removal of irradiation defects in the solid, the **strain energy** of which appears as light.

thermolysis. *Noun.* The dissociation of a material by heat.

thermomagnetic. *Adjective.* Concerning the change in temperature when a material is magnetised and demagnetised.

thermomechanical effect. *Noun.* The tendency of liquid helium to flow from a low-temperature region to one of higher temperature if such regions are connected.

thermometer. *Noun.* An instrument that measures temperature.

thermometer, maximum. *Noun.* See **maximum thermometer**.

thermometer, minimum. *Noun.* See **minimum thermometer**.

thermometry. *Noun.* A branch of science concerned with the design of thermometers and the measurement of temperature.

thermonuclear reactions. *Plural noun.* Nuclear transformations involving nuclear fusion of light atoms, as in the hydrogen bomb.

thermopile. *Noun.* A series-linked number of thermocouple junctions; used to detect heat radiation or conversely to generate thermoelectric current from a heat source.

thermoplastic. *Noun.* (1) The property of softening when heated and hardening when cooled without change in properties. (2) An organic polymer, such as polythene, that behaves thermoplastically.

thermoplastic decoration. *Noun.* A process of applying colours dispersed in a thermoplastic medium through a hot screen, the design freezing in place on contact with the cold surface of ware being decorated.

thermopower wave. *Noun.* An intense pulse of heat travelling along a **carbon nanotube** that drives electrons along creating an electric current and a voltage.

Thermos. *Trademark, noun.* See **vacuum flask**.

thermoscope. *Noun.* A device for estimating temperature changes of a body especially one that does not measure the actual temperature, for example based on measuring corresponding changes in the volume of the body.

thermoset. *Noun.* A cross-linked epoxy or polyester resin which decomposes but does not melt on heating; relatively insoluble, inert material; used as matrices for composite manufacture.

thermosetting. *Adjective.* The property of a body or material to solidify when heated, and then cannot be re-melted without destroying its original characteristics.

thermosonometry. *Noun.* The science of studying sound waves emitted by phase changes in heated bodies.

thermostat. *Noun.* A device used to keep a system at a constant temperature, often by controlling the electrical current delivered to a heater.

thermo-spintronic material. *Noun.* See **gallium manganese arsenide**.

thermotensile. *Adjective.* Relating to tensile strength as it is affected by temperature.

thick edge. *Noun.* A cleaved **mica** sample with one edge 1.5 times thicker than at any other point, or greater than the maximum average thickness for its grade.

thickener. *Noun.* Additive used to increase the viscosity of coating materials; **silica**, SiO_2 , and **calcium carbonate**, CaCO_3 , are commonly used in this respect.

thicken. *Verb.* To increase the viscosity of a slip.

thick film. *Noun.* A resistor or other circuit component with a resist film over 0.025 mm thick.

thickness. *Noun.* (1) The vertical depth of a coating. (2) The dimension of a product, such as tile, measured at right angles to the wall, floor, or other surface to which it is applied.

thickness gauge. *Noun.* Any device designed to measure the thickness of a coating, sheet, or object.

thickness gauge, magnetic. *Noun.* See **magnetic thickness gauge**.

thick splittings. *Noun.* Loose splittings of **mica** of thicknesses greater than 0.03 mm, powdered loose splittings of thickness greater than 0.025 mm, or **bookform** splittings greater in thickness than the average permitted for the grade.

thief, sample. *Noun.* See **sample thief**.

thimble. *Noun.* (1) An L-shaped refractory device used to stir pot-made **optical glass**. (2) A conical refractory item of **kiln furniture** with a projection at its bottom on which ware is supported during the **decorative fire**.

thin body. *Noun.* A defect in a glass container where the glass in the main part of the container is too thin to make it usable.

thin film transistor. *Noun.* A film a few molecules thick deposited on a glass, ceramic or other semiconductor substrate to form a capacitor, resistor, or other circuit component.

thin section. *Noun.* A material which is ground and polished to a thickness of about 0.03 mm for examination of its optical properties by a polarising microscope.

thin splittings. *Plural noun.* Splittings of **mica** having thicknesses less than the average for the grade

thiobacilli concretivorous. *Noun.* A microorganism consisting of sulphur oxidising bacteria that oxidise hydrogen sulphide, released by sewage, to sulphuric acid, which then attacks **concrete sewage pipes**.

Thiokol. *Trade name, noun.* A series of polysulphide rubbers highly resistant to oils and solvents; used as tank linings, tubing, gaskets, and in other applications where chemical and weather resistance is required.

third party. *Noun.* A person or organisation other than the principals involved in a dispute.

thixotrophy. *Noun.* The property of a suspension to go to lower viscosity when agitated and to thicken or solidify on standing. Materials with a freezing range over which they are neither fully solid nor fully liquid and with **spheroidal** particles tend to have this behaviour. Often called **shear thinning**.

Thomson effect. *Noun.* If a conductor has a temperature gradient and an electrical current is passed along it, then a heating or cooling of the conductor occurs given by $dQ/dt = \mu IdT/dl$, where μ is the Thomson coefficient, I is the current flowing, dT/dl is the temperature gradient, and dQ/dt is the rate of heat evolution or absorption per unit length of conductor.

thomsonite. *Noun.* A fairly widespread silicate mineral containing colour bands that produced unusual patterns when polished by **tumbling** and so is used as a decorative stone. One particular pattern resembles **eyeballs**.

Thomson scattering. *Noun.* The scattering of electromagnetic waves by free charged particles such as electrons; to see the effect intense **laser** light is required.

thoria. *Noun.* See **thorium oxide**.

thorianite. *Noun.* ThO_2 . Radioactive mineral sometimes containing uranium and rare earth metals. Mp 3,300 °C; density 9,700–9,800 kg m⁻³; hardness (Mohs) 7.

thorite. *Noun.* ThSiO_4 . **Thorium silicate**, an ionic **orthosilicate** which is the thorium analogue of **zircon**; brown or orange ore. Radioactive. Density 4,500–5,400 kg m⁻³ depending on the extent of hydration; hardness (Mohs) 4.5; its radioactivity often destroys the crystal structure.

thorium beryllide. *Noun.* ThBe_{13} . Hardness (Knoop) 11.6–13.2 GN m⁻²; density 4,100 kg m⁻³.

thorium carbide. *Noun.* (1) ThC ; mp 2,625 °C; density 10,650 kg m⁻³. (2) ThC_2 ; mp 2,655 °C; density 9,600 kg m⁻³. Both forms are used in nuclear fuels.

thorium dioxide. *Noun.* See **thorium oxide**.

thorium fluoride. *Noun.* ThF_4 . Used as an additive in ceramic formulations for ware needed in high temperature applications; mp 1,111 °C.

thorium nitrate. *Noun.* $\text{Th}(\text{NO}_3)_4 \cdot 6\text{H}_2\text{O}$. A salt which when heated to 110 °C first undergoes a melting-solution process in its own water of crystallisation and then loses nitric acid fumes as it hydrolyses, then above 180 °C a polymerisation reaction occurs to produce a **sol** of **thoria**, ThO_2 , particles in the 10–15 nm size range.

thorium oxalate. *Noun.* $\text{Th}(\text{CH}_2\text{O}_4)_2 \cdot 2\text{H}_2\text{O}$. Used as a source of ThO_2 in ceramics. Decomposes to ThO_2 above 300–400 °C.

thorium oxide. *Noun.* ThO_2 . Used in high-temperature crucibles, cermets, incandescent gas mantles, non-silica optical glass, cathodes and coatings in electron tubes, and in nuclear fuels. Also called **thoria**. Mp 3,300 °C; density 9,700 kg m⁻³; hardness (Mohs) 7.

thorium silicate. *Noun.* ThSiO_4 . Found as the ore **thorite**; mp 1,979 °C; density 5,300 kg m⁻³; hardness (Mohs) 5–7.

thoron. *Noun.* A constituent isotope of radon gas that arises from radioactive decay of thorium.

Thorpe's ratio. *Noun.* A method of assessing the relative solubility or leachability of ceramic glazes. It is the ratio of **basic** chemicals in the formulation divided by the amount of copper in the formulation. Copper compounds greatly increase the solubility of lead containing glazes and should never be used with lead salts.

thread count. *Noun.* The number of **yarns** per cm in either lengthwise or crosswise direction of a woven reinforcement.

thread grinding. *Verb.* To cut threads on a part by the use of a **bonded abrasive** tool.

three-cavity mould. *Noun.* A mould containing three cavities for the simultaneous forming of three glass articles.

three-dimensional printing. *Noun.* See **solid freeform fabrication** and **DCJP**.

three-edge bearing test. *Noun.* A technique for applying load to a concrete pipe in testing its external load-crushing strength, the load being applied at the centre of a specimen resting on two outside points. See **load-crushing strength test**.

three level laser. *Noun.* A **laser** system, such as Cr^{3+} doped **alumina** that is **ruby**, which involves three electronic energy levels in the guest ion. A relatively inefficient process.

three-terminal device. *Noun.* A device that, like a **transistor**, can amplify by large amounts.

threshold concentration. *Noun.* The minimum concentration at which a substance can be detected by odour or taste.

threshold level. *Noun.* A value of a specified property above or below which a specimen is rejected.

threshold limit value. TLV. *Noun.* Concentration of gas or vapour in a million parts of air by volume, **ppm**, or milligrams of solid material per cubic meter of air, mg m^{-3} , to which workers may be exposed. The TLV is set assuming an eight hour day, for example **cristobalite** has a TLV of 0.05 mg m^{-3} , and **quartz** has 0.1 mg m^{-3} and **silica gel** 5.0 mg m^{-3} .

threshold odour test. *Noun.* Estimation of the odour level in a fluid by dilution with an odour-free fluid until no odour is detected.

threshold temperature. *Noun.* The first detectable movement from the baseline in **differential thermal analysis** indicating when a reaction involving heat in the sample begins.

throat. *Noun.* (1) The submerged passage between the **melting** and **refining chambers** of a **glass-melting tank**. (2) The constricted area between the **port** and firing chamber of an **open-hearth furnace**. (3) The place where molten glass exits the furnace in the TV-glass, **container glass** and **tableware** glass industry. This exit is known as the **neck and canal** in **float glass** manufacture.

throat, straight. *Noun.* See **straight throat**.

throat, submarine. *Noun.* See **submarine throat**.

throat, submerged. *Noun.* See **submarine throat**.

throat, sump. *Noun.* See **submarine throat**.

throttling process. *Noun.* The slow expansion of a gas through a porous ceramic plug such that the pressure on each side remains almost constant.

through field electrode. *Noun.* A single plate electrode for microwave heating of thick specimens. The simplest configuration consists of two flat metal plates between which the sample is placed.

through-transmission method. *Noun.* The use of **ultrasound** to locate flaws by passing the pulse through the test piece and detecting the amplitude of the pulse on the reverse side.

throw. *Verb.* (1) The throwing of a prepared pottery body on a revolving potter's wheel and shaping by hand. (2) To impart a twist to a reinforcement yarn.

throwing marks. *Plural noun.* Grooves and ridges on the surface of a shape formed by hand-throwing.

thucholite. *Noun.* A naturally radioactive mineral hydrocarbon produced by the irradiation of oil by uranium-bearing rocks.

thulium. *Noun.* Tm. A ductile metal obtained from **monazite sand**. Thulium-170 is radioactive and is used as an electron source in portable x-ray units. Mp $1,545^\circ\text{C}$; density $9,321 \text{ kg m}^{-3}$.

thulium oxide. *Noun.* Tm_2O_3 . Used as a radiation source in x-ray equipment after irradiation in a nuclear reactor. Density $8,700 \text{ kg m}^{-3}$.

thunderstone. *Noun.* A long tapering stone.

thwacking. *Verb.* The final shaping of clay roofing tile by pounding it on a wooden form of a desired shape and size with a wooden paddle.

thyristor. *Noun.* A group of semiconductor devices, such as the silicon-controlled rectifier, that can be switched between two states and so be an on/off switch. See **silicon-controlled rectifier**.

tialite. *Noun.* Al_2TiO_5 . **Aluminium titanate**; a refractory material with two forms, α and β . The β form has excellent thermal shock properties.

TiAlON. *Acronym.* Stands titanium aluminium oxynitride. See **titanium aluminium oxynitride**.

tie. *Noun.* Beam or tie rod.

tie beam. *Noun.* A horizontal beam that prevents two other structural members from separating.

tied concrete column. *Noun.* A column of concrete reinforced by internal longitudinal bars bound by horizontal ties for stability.

tie line. *Noun.* A horizontal line drawn on a two-phase region of a binary phase diagram. The line's intersections with the phase boundaries at either end represent the equilibrium compositions of the phases at the temperature in question.

tiemannite. *Noun.* A grey coloured mineral consisting essentially of mercury selenide, HgSe .

tiering. *Verb.* To point roofing tiles with mortar or cement.

Tiffany effect. *Noun.* An **iridescent** rainbow effect at the surface of a glaze or glass produced by introducing **stannous chloride hydrate** to hot kilns or annealing ovens whereby very thin surface deposits of tin are produced.

Tiffany glass. *Noun.* Another name for **Favrile glass**. See **Favrile glass**.

tiger eye. *Noun.* (1) A decorative glass-like formation in an **aventurine glaze** applied to pottery. (2) A **quartz** pseudomorph where quartz has replaced an **asbestos mineral**, such as **crocidolite**, but retains the fibrous structure. The variegated colour produces attractive tumble polished stones of brown and purple hues.

tiger skin. *Noun.* A type of **salt glaze** characterised by **crawling** and beading of the glaze to produce the appearance of tiger or leopard skin.

tile. *Noun.* (1) A relatively thin piece of fired clay, concrete, stone, or other material used in functional and ornamental applications on walls, floors, roofs, etc. (2) A hollow or concave **earthenware** or **concrete** product used for drainage and other purposes. (3) Collective noun for tiles.

tile, antistatic. *Noun.* See **antistatic tile**.

tile, combed finish. *Noun.* See **combed finish**.

tile, cove. *Noun.* See **cove tile**.

tile, double-shelled. *Noun.* See **double-shelled tile**.

tile, drain. *Noun.* See **drain tile**.

tile, encaustic. *Noun.* See **encaustic tile**.

tile, end-construction. *Noun.* See **end-construction tile**.

tile, exposed finish. *Noun.* See **exposed finish tile**.

tile, extra-duty glazed. *Noun.* See **extra-duty glazed tile**.

tile, facing. *Noun.* See **facing tile**.

tile, faience. *Noun.* See **faience**.

tile, finish. *Noun.* See **finish tile**.

tile, fireproofing. *Noun.* See **fireproofing tile**.

tile, floor. *Noun.* See **floor tile**.

tile, furring. *Noun.* See **furring tile**.

tile, gable. *Noun.* See **gable tile**.

tile, garden. *Noun.* See **garden tile**.

tile, glazed. *Noun.* See **glazed tile**.

tile, glazed interior. *Noun.* See **glazed interior tile**.

tile, header. *Noun.* See **header tile**.

tile, hip. *Noun.* See **hip tile**.

tile, horizontal-cell. *Noun.* See **horizontal-cell tile**.

tile, interlocking. *Noun.* See **interlocking tile**.

tile, load-bearing. *Noun.* See **load-bearing tile**.

tile, mosaic. *Noun.* See **mosaic tile**.

tile, natural clay. *Noun.* See **natural clay tile**.

tile, natural finish. *Noun.* See **natural finish**.

tile, non-load-bearing. *Noun.* See **non-load-bearing tiles**.

tile, non lustrous. *Noun.* See **non-lustrous glaze**.

tile, ornamental. *Noun.* See **ornamental tile**.

tile, pan. *Noun.* See **pan tile**.

tile, partition. *Noun.* See **partition tile**.

tile polishing train. *Noun.* An automatic process consisting of a set of rollers with various grits that run over the tile surface to get the desired gloss and texture. There are two stages: the **levelling step** and the **polishing step**. See **levelling step** and **polishing step**.

tile, porcelain. *Noun.* See **porcelain tile**.

tile, quarry. *Noun.* See **quarry tile**.

tile, roofing. *Noun.* See **roofing tile**.

tile, rough-finish. *Noun.* See **roughened finish tile**.

tile, salt-glazed. *Noun.* See **salt-glazed tile**.

tile, scored-finish. *Noun.* See **scored-finish tile**.

tile, sewer. *Noun.* See **sewer tile**.

tile, ship-and-galley. *Noun.* See **ship-and-galley tile**.

tile, shoulder-angle. *Noun.* See **shoulder-angle tile**.

tile, side-construction. *Noun.* See **side-construction tile**.

tile, smooth-finish. *Noun.* See **smooth-finish tile**.

tile, solar screen. *Noun.* See **solar screen**.

tile, special-purpose. *Noun.* See **special-purpose tile**.

tile, structural clay. *Noun.* See **structural clay tile**.

tile, under-ridge. *Noun.* See **under-ridge tile**.

tile, unglazed. *Noun.* See **unglazed tile**.

tile, valley. *Noun.* See **valley tile**.

tile, wall. *Noun.* See **wall tile**.

tile, wind-ridge. *Noun.* See **wind-ridge tile**.

tiling. *Noun.* (1) Collective word for tiles. (2) A surface or object made from tiles.

till. *Noun.* A deposit left by a melting glacier consisting of crushed rock pieces.

tillite. *Noun.* Ancient **tills** compressed into hard rock.

tilt boundary. *Noun.* A grain boundary described as having an axis of rotation, about which one grain can be brought into coincidence with the other, that is, parallel to the boundary plane. It is viewed as consisting of an array of **edge dislocations**.

tilt up. *Noun.* A method of building construction in which wall panels are precast in a horizontal position, usually on the building floor, and then tilted into vertical position when the concrete has hardened.

TIM. *Acronym.* Stands for thermal interface material. See **thermal interface material**.

time division multiplexing. *Noun.* A mechanism for increasing data capacity of one **optical fibre** by decreasing the length of the light pulse. See **wave-length division multiplexing**.

time of final setting. *Noun.* Concerning concrete and other hydraulic cements it is the elapsed time after the initial mixing with water to reach a penetration resistance of 27.6 MN m^{-2} .

time of flight. TOF. *Noun.* The difference between the time taken for two signals to reach a detector and then the difference is used to probe the specimen. For example, an ultrasound wave reflected from the top plane surface has a TOF difference to the same sound reflected from a lower plane or internal defect. Resolution of the TOF signals in terms of their amplitude allows internal imaging to be made.

time of set. *Noun.* The time required for freshly mixed concrete to attain **initial set** or a specified degree of hardness.

time-weighted average. *Noun.* Concentration expressed in **ppm** of a chemical entity multiplied by the time of each individual sampling period, summed for all samples and divided by the total sampling time.

tin ash. *Noun.* A mixture of **tin oxide** and **lead oxide** used as an **opacifier** in glazes.

tincal. *Noun.* $\text{Na}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$. A major mineral found in USA and exploited for **borate** and **boride** ceramics production. Colloquial name for **borax** in sedimentary borate deposits.

tin crystals. *Noun.* See **stannous chloride hydrate**.

tin-doped indium oxide. ITO. *Noun.* A material used as a solid electrolyte in **electrochromic** devices. For example an $\text{ITO}/\text{WO}_3/\text{IrO}_x \cdot n\text{H}_2\text{O}$ device becomes blue on application of a negative bias as electrons from ITO and H^+ ions from $\text{IrO}_x \cdot n\text{H}_2\text{O}$ transfer to the WO_3 in the sandwich.

tin enamel. *Noun.* A white porcelain-enamel or glaze **opacified** by **tin oxide** added to the **slip** in the mill.

tin-glazed ware. *Noun.* Pottery coated with a tin-enamel type of coating, such as that on **majolica** or **delftware**.

tin lustre. *Noun.* An **iridescent** lustre produced by the reduction of **tin oxide** in a glaze.

tin oxide. *Noun.* (1) SnO_2 . Used as an opacifier in porcelain-enamels, glazes, and glass and as a constituent of pink, maroon, purple, yellow, ruby, and gold colours

for glass and glazes. Mp $1,127^\circ\text{C}$; density 6,600–6,900; hardness (Mohs) 6–7; see **cassiterite**. (2) SnO . Tin II oxide or **stannous oxide**; a black oxide containing lattice defects bestowing electrical conductivity; decomposes by oxidation to SnO_2 ; used as a vapour-deposited thin-film electrode in the manufacture of stack-type capacitors, usually with TiO_2 films as the dielectric and to prepare stannous salts for **surface tempering** in the glass industry.

tin salt. *Noun.* See **stannous chloride hydrate**.

tin sphene. *Noun.* See **malayaite**.

tinstone. *Noun.* See **cassiterite**.

tinsel. *Noun.* Thin platelets of glass used to produce a glittering effect in glazes and glass.

tinter brush. *Noun.* A squirrel hair decorating brush, 12–20 mm wide with short evenly cut bristles of square aspect.

tinting. *Verb.* To apply shading to artwork.

tint plate. *Noun.* A device producing a uniform retardation over the field of a strain viewer that makes strains in glass appear as bright colours instead of grey shades.

tin-vanadium yellow. *Noun.* A ceramic colorant composed of 80–90 % **tin oxide**, SnO_2 , and 10–20 % **vanadium oxide**, V_2O_5 .

tired clay. *Noun.* Clay that has lost its strength by being over-worked.

tit. *Noun.* An imperfection consisting of a protrusion on a glass article.

titanate. *Noun.* Any salt of **titanic acid**.

titanate ceramics. *Plural noun.* Electroceramic compositions with general formulae: ATiO_3 and ATi_2O_4 , where A is an atom such as barium, boron, beryllium, niobium, tin, zirconium, etc.; because of their high **dielectric constant**, used in capacitors, transducers, etc.

titanate coupling agent. *Noun.* An **alkoxide** compound of titanium, X-TiOR , where X is an organic group; used to form strong bonds between fibres and epoxy resin or thermoplastic matrices; they are useful plasticisers for thermoplastics.

titania. *Noun.* TiO_2 . See **titanium dioxide**.

titania porcelain. *Noun.* A **vitreous**, white, technical porcelain in which **titanium dioxide** is the essential crystalline phase.

titania whiteware. *Noun.* Ceramic whiteware in which **titanium dioxide** is the essential crystalline phase.

titanic. *Adjective.* Containing tetravalent titanium.

titanic acid. *Noun.* Any of several white hydrated forms of **titanium dioxide**, such as H_3TiO_3 and H_4TiO_4 .

titaniferous. *Adjective.* Of or containing titanium.

titanite. *Noun.* CaTiOSiO_4 . A calcium silicon titanate, used to produce a crystalline effect or appearance in glazes; density 3,400–3,550 kg m^{-3} ; hardness (Mohs) 5–5.5.

titanium aluminium oxynitride. *Noun.* A ceramic composite containing a **spinel**-type titanium aluminium oxynitride; made from AlN , TiN , and Al_2O_3 ; has high strength. 292 MN m^{-2} and moderate **fracture toughness**, 1.79 $\text{MN m}^{-3/2}$.

titanium boride. *Noun.* (1) TiB . Used as a refractory, high-temperature electrical conductor, and as the reinforcing phase in some **cermets**. Mp 2,060 °C; density 5,260 kg m^{-3} ; hardness (Mohs) 9. (2) Ti_2B_5 . Mp 2,093 °C. (3) TiB_2 . See **titanium diboride**.

titanium carbide. *Noun.* TiC . Used in wear-resistant cutting tools, bearings, cermets, arc-melting electrodes, refractories, and high-temperature conductors; characterised by high thermal-shock resistance. **Nonstoichiometric**, $\text{TiC}_{0.52}\text{--TiC}_{0.97}$; TiC is therefore a mixture containing free carbon. Mp 3,140 °C; density 4,930 kg m^{-3} ; hardness (Mohs) 9.

titanium carbide composite. *Noun.* Most commonly particulate $\text{TiC}_{0.97}$ in a transition metal matrix, such as cobalt. However, since TiC whiskers and vapour formed fibres are now available, these composites are also formed with thermoplastic resin matrices and aluminium alloy matrices.

titanium carbide, nickel-bonded. *Noun.* See **nickel-bonded titanium carbide**.

titanium diboride. *Noun.* TiB_2 . Used in refractory, wear-resistant products, bearings and bearing liners, cutting tools, jet nozzles and Venturi, crucibles, arc and electrolytic electrodes, resistance elements, high-temperature electrical conductors, contact points, hard-faced welding-rod coatings, metallurgical addition agents, and similar high-temperature applications. Mp 2,930 °C; density 4,520 kg m^{-3} .

titanium dioxide. *Noun.* TiO_2 . A mineral available as **rutile**, **anatase**, and **brookite**; used as an opacifier in porcelain-enamels, glazes, and glass, as a component in various dielectrics, and as a constituent in welding rod coatings. Mp 1,560 °C; density 3,800 kg m^{-3} . Often called **titania**.

titanium disulphide. *Noun.* TiS_2 . A ceramic sulphide that absorbs light across a broad spectrum. The energy can be used to split water into hydrogen and oxygen that are first stored in the $\text{SiO}_2\text{--TiO}_2$ that protects the TiS_2 from further corrosion. They can subsequently be released separately by cooling to ambient to release the hydrogen by heating to 100 °C in the dark to release the oxygen.

titanium fluoride. *Noun.* TiF_3 . Used as a flux in the production of **rubies** and **sapphire** abrasives.

titanium hydride. *Noun.* TiH_2 . Used as a solder in bonding glass to metals.

titanium niobate. *Noun.* TiNb_2O_7 . Dielectric ceramic used in various electrical applications. Mp 1,483 °C.

titanium nitride. *Noun.* TiN . Used in refractories, **cermets**, and semiconductors and as a gold decoration on some dinnerware. Mp 2,930 °C; density 5,290 kg m^{-3} .

titanium opalescence. *Adjective.* The optical effect obtained by including nanosized particles of **titania** together with **mica** or aluminium powder in surface coatings. Incident light rays are reflected from the flakes but the shorter wavelengths are scattered by the titania so that the emergent beam contains mostly longer wavelengths giving a yellow-gold appearance at angles near to the normal. However at sharp angles the reflection is blue. Observer eye position changes then generate changing **hues**.

titanium oxide. *Noun.* (1) TiO ; widely nonstoichiometric; Mp 1,749 °C; density 4,930 kg m^{-3} ; gold-coloured semiconductor. (2) Ti_2O_3 . Mp 2,077 °C; density 4,600 kg m^{-3} . (3) Ti_3O_5 . Density 4,242 kg m^{-3} . (4) TiO_2 . See **titanium dioxide**. (5) TiO_3 . See **titanium trioxide**.

titanium silicide. *Noun.* (1) Ti_3Si_3 . A special ceramic with the hexagonal D8_8 structure. Used in high-temperature applications where thermal shock is not a factor. Mp 2,010 °C; density 4,200 kg m^{-3} . (2) TiSi . Mp 1,760 °C; density 4,340 kg m^{-3} . (3) TiSi_2 . Used in n-p transistor connections. It is a semiconductor that absorbs light across a broad spectrum and so is a good photocatalyst for water decomposition. Mp 1,499 °C; density 4,150 kg m^{-3} .

titanium silicide carbide. *Noun.* Ti_3SiC_2 . An interesting special ceramic that combines the high temperature properties of a ceramic with toughness at ambient temperatures. It can be prepared in useful quantities by **SHS** methods when the early production of TiC from the starting powders is avoided.

titanium tetrachloride. *Noun.* TiCl_4 . Volatile liquid; used to produce iridescence in glass and as a vapour-phase reagent to produce ultrafine powders of TiO_2 when reacted with steam.

titanium trioxide. *Noun.* TiO_3 . Used in ivory-coloured ceramics, dental porcelain, and dental cements.

titanising. *Noun.* A commercial hot end glass coating process for improving the strength of glass containers. Tin is more commonly used than titanium; both are applied as an organotin or organotitanium compound.

titanomagnetite. *Noun.* $\text{Fe}_{3-x}\text{Ti}_x\text{O}_4$. A **ferromagnetic spinel** with Fe^{3+} and Ti^{4+} ions occupying the tetrahedral sites.

titanous. *Adjective.* Containing titanium in the trivalent form.

titrant. *Noun.* The solution in a titration that is added from a burette.

TLV. *Abbreviation.* Stands for threshold limit value. See **threshold limit value**.

toadstone. *Noun.* A rare, green-mottled basalt rock occurring in limestone regions as almond-shaped inclusions in the **limestone**.

toby. *Noun.* See **toby jug**.

toby jug. *Noun.* A ceramic beer mug shaped like a man wearing a three cornered hat. Usually just **toby**.

to crush. *Verb.* To break down to a powder by applying pressure.

TOF. *Acronym.* Stands for time of flight. See **time of flight**.

tog. *Noun.* A unit of thermal resistance concerned with fibres and cloth; it indicates insulating properties. A tog of 10 is equivalent to wearing 10 layers of clothing. A more quantitative measurement puts it as one tenth of the fundamental **SI unit** of thermal resistance which is the square-metre kelvin per watt, m^2KW^{-1} .

toggle mechanism. *Noun.* A knee-shaped joint consisting of two bars fastened together at one end; when pressure is placed on the joint to straighten it, opposite pressures are transmitted to the open ends.

toggle press. *Noun.* A mechanical press in which the slide is actuated by a toggle mechanism.

tohdite. *Noun.* An aluminium oxide hydroxide with hexagonal symmetry. Probably a hydrogen-type **spinel** containing O^{2-} ions; contains no water although the composition is quoted as $5\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$.

tokamak. *Noun.* A device designed around an evacuated toroidal ceramic chamber and an axial magnetic field within which plasma can be maintained. To confine the plasma three types of applied magnetic field are used. Often acts as an experimental nuclear fusion reactor.

tole. *Noun.* Brightly painted or lacquered enamelled metal used for decorative purposes.

tolerance. *Noun.* Permissible variations in specified dimensions or other values.

tolerance factor. t. *Noun.* A term used in discussing the deviation of **perovskite oxide** structures from the cubic modification. For ABO_3 the tolerance factor is given by: $t = (r_A + r_O) / 1.414(r_B + r_O)$, where r is the radius of the A, B, and O ions in the structure respectively; a perovskite arises when $0.75 < t < 1.0$ and when $t = 1.0$ the cubic structure is achieved.

tolerance interval. *Noun.* An interval computed to include a stated number of items from a sample that is compared with a stated probability in a statistical analysis.

tolerance limit. *Noun.* The statistics defining a tolerance interval. See **tolerance interval**.

tolerance, water. *Noun.* See **water tolerance**.

tomographic. *Adjective.* Spatial analysis; three-dimensional examination beneath the surface of a specimen.

tomography. *Noun.* A technique to reconstruct a 3-day inner section of an object obtained from **density** differences measured by **ultrasonic pulses**, x-rays or neutrons. Digital image capture of two-dimensional sections is used to build-up a virtual three-dimensional copy of the object.

tone. *Noun.* A shade of colour made darker by adding black or its complementary colour.

toner. *Noun.* Highly concentrated pigment used to modify the colour strength or **hue** of a **screen printing ink**.

tongs. *Plural noun.* Various grasping devices consisting of two pieces joined by a pivot near one end.

tongue. *Noun.* (1) The male end of a pipe that is overlapped by the end of an adjoining pipe. (2) Fine scale height elevations or fine steps found on flat surfaces made by transgranular fracture.

tongue tile. *Noun.* The projecting partition between the streams of gas and the **port** of a **glass-melting tank**.

tonne. *Noun.* See **metric ton**.

tool, machine. *Noun.* See **machine tool**.

tool tips. *Noun.* Ceramic tips bonded to cutting and machining tools.

tools, ceramic. *Noun.* See **ceramic tools**.

tooth. *Adjective.* A coarse-grain structure, causing roughness in clay.

toothing. *Noun.* A projection of bricks in a building wall to permit future extensions of the wall.

topaz. *Noun.* $\text{Al}_2(\text{F,OH})_2\text{SiO}_4$. A white or colourless mineral often coloured by impurities. Used as a substitute for, or in conjunction with, **kyanite** in the production of **mullite**-type, high alumina refractories. In some **granites** and **pegmatites** very large crystals have grown that are of gem quality, the most valuable of which are the golden yellow, **imperial topaz**, or the pink variety. Density 3,400–3,600 kg m^{-3} ; hardness (Mohs) 8.

topazolite. *Noun.* A form of **andradite** garnet with a yellowish green colour.

top brick. *Noun.* Fireclay brick lining the top section of a blast furnace.

top clay. *Noun.* One of the layers between **lignite** and **sand** that confines a ball clay lens. See **ball clay**.

top down nanotechnology. *Noun.* Describes the process of using advanced microscopy and creating a nanostructure material whereby material is selectively removed by ion beams etc., as opposed to selectively adding nanoscale material, the **bottom up** method.

top-fired kiln. *Noun.* A kiln in which the fuel is introduced into the firing zone through apertures in the kiln roof.

top-hat kiln. *Noun.* A kiln in which the firing zone, placed immediately above the ware on a refractory base, is lowered to surround the ware to be fired. Also known as an **envelope kiln**.

top lap. *Noun.* The shortest distance between the lower edge of an overlapping roofing **shingle** and the upper edge of the lapped unit below.

top, manhole. *Noun.* See **manhole top**.

topochemical. *Adjective.* See **topotactic**.

topochemistry. *Noun.* Structure controlled chemical reactivity.

topography. *Noun.* (1) A description or delineation of surface features of a solid and their structural relationships. (2) *Verb.* Diffraction imaging in order to produce a detailed configuration of a surface.

topology. *Noun.* (1) The way in which physical features of something are interrelated. (2) The area of mathematics that deals with geometric properties that are unaltered by elastic deformations, such as twisting or stretching.

topotactic. *Adjective.* Structurally controlled chemical reaction.

topping. *Noun.* (1) A thin layer of high quality, high-strength concrete applied as a finish to a concrete slab. (2) A dry mixture of cement and fine aggregate scattered over a concrete slab before final finishing producing a wearresistant surface.

top pouring. *Verb.* To directly transfer molten steel from a **ladle** into **ingot moulds**, usually by means of **refractory nozzles**.

torbernite. *Noun.* $\text{CuUO}_2(\text{PO}_4)_2 \cdot 12\text{H}_2\text{O}$. A green-coloured hydrated copper-uranium phosphate ore.

toric. *Adjective.* Shaped like a torus or part of a **torus**.

toroid. *Noun.* A doughnut-shaped figure. The surface of the figure is generated by a plane-closed curve, such as circle or ellipse, rotated about a line that lies in the same plane as the curve but does not intersect it.

toroidal. *Adjective.* Shaped like a **toroid** or torus.

torpedo ladle. *Noun.* A large half-torpedo refractory-lined ladle used to transport molten steel and pour it via a top-rim lip. Made from steel lined with a safety lining of insulating **fireclay brick** under a thick wear-lining of fired or unfired bricks containing $>60\%$ Al_2O_3 .

topochemistry. *Noun.* The study of chemical reactions that are determined by crystal structures and occur at specific points in a crystal.

torque. *Noun.* The moment of forces trying to produce rotation or torsion.

torr. *Noun.* A unit of pressure equal to $1/760$ of an **atmosphere**, that is, $1.33322 \times 10^2 \text{ N m}^{-2}$.

torsion. *Noun.* (1) Stress caused by twisting a sample. (2) *Verb.* The process of twisting, especially by force applied to one end of a rod while the other is fixed or twisted in the opposite direction.

torsional modulus. *Noun.* The ratio of torsional rigidity of a bar to its length.

torsional viscometer. *Noun.* An instrument designed to estimate the viscosity and **thixotropy** of a slurry which consists of an outer cylinder containing the slurry to be tested and an inner cylinder supported in the slurry by a wire twisted one complete turn; when released, the overswing of the inner cylinder is taken as an indication of the viscosity of the slurry; the thixotropy of the slip is a comparison of the degree of over swing within a specified time interval.

torsion balance. *Noun.* An instrument used to measure minute forces by torsion of a wire.

tortoise-shell finish. *Noun.* A type of decorative finish for pottery and other **earthenware** resembling the shell of a tortoise, produced by sprinkling and firing coloured metal oxides over a dampish unfired glaze surface.

tortuosity, λ . *Noun.* The exponent in **fractal analysis** of **aggregates** that relates the twists in direction necessary to go from point to point in a fractal body while remaining totally within the body. Total length travelled by the shortest path, l_{\min} , is related to the direct distance in space between the two points by: $l_{\min} = l^\lambda$. Tortuosity depends upon connectivity and mass of the fractal body.

tortuosity factor. *Noun.* The distance a molecule must travel to diffuse through a solid divided by the thickness of the specimen.

torus. *Noun.* (1) A ring-shaped surface generated by a circle rotated about an axis in its plane that does not intersect the circle. (2) A large convex semi-circular moulding.

total air. *Noun.* The total quantity of air supplied in the combustion of a fuel.

total equivalent boron content. *Noun.* The sum of the individual equivalent boron values in a neutron cross section. See **boron equivalent**.

total heat. *Noun.* Another name for **enthalpy**.

total internal reflection. *Noun.* One hundred percent reflection of a light ray at a boundary between two materials. In order to occur the light ray must be in the material with the greater **refractive index**. The basis of fibre optics. See **critical angle**.

total mass loss. *Noun.* Decrease in the mass of a solid due to outgassing on heating and applying reduced pressure; expressed as a percentage of the initial sample mass.

total porosity. *Noun.* The ratio of total void spaces in a body to its bulk volume.

total pressure. *Noun.* The gross load applied to a surface.

total quality management. *Noun.* The application of management techniques to ensure that the most up-to-date technology is used to monitor raw materials, process variables, and product specifications throughout a company.

total solids. *Noun.* The sum of the suspended and dissolved solids in a slip.

touchstone. *Noun.* A black form of **flint** that when rubbed by gold or silver shows a coloured streak; used some time ago to test the purity of these precious metals.

touf (pisée). *Noun.* An **adobe**-type wall construction of rammed, straw-tempered, sun-dried clay without forming bricks first.

tough alumina. *Noun.* A relatively impure, regular **alumina** with a block-like, **equiaxed** microstructure in which the Al_2O_3 content ranges from 90 to 96 %, the balance being impurities.

toughened glass. *Noun.* A glass highly resistant to mechanical and thermal shock produced by rapid and rigid control of its cooling rate from near its softening point to room temperature to produce residual internal tension and external compression which remain after the glass has cooled and acts to compress micro-cracks to prevent their extension. Used in windows, doors, and other installations where breakage may be dangerous. When it fractures it breaks into very many small cubes.

toughness. *Noun.* (1) Defined as a material's resistance to crack propagation and can be expressed in terms of crack velocity. Brittle materials are those in which crack velocities reach the speed of sound very rapidly. (2) A definition more used in composite science is the energy required to break a material, which is the total area under an engineering stress-strain curve for the material. (3) Usually associated with a yield point in a stress-strain curve.

tourmaline. *Noun.* $\text{Na}(\text{Mg}, \text{Al})_3\text{Al}_6(\text{Si}_6\text{O}_{18})(\text{BO}_3)_3(\text{OH}, \text{F})_4$. An hexagonal sodium aluminium borosilicate containing six-membered silicate rings and three-membered borate rings; these ionic units are bonded to positive ions such as Na^+ and Al^{3+} . It has **pyroelectric** properties as it becomes **polarised** by heat and is also a **dichroic** crystal capable of **plane polarising** light in transmission. **Pegmatites** that contain tourmaline often have large gem quality crystals that show the greatest range in colour of any gemstone.

tow. *Noun.* An untwisted bundle of untwisted fibres.

tower packing. *Noun.* Various shaped ceramic pieces, such as rings, spheres, etc., used to fill columns so as to provide inert surfaces for chemical reactions to take place.

towing. *Verb.* To smooth the outer edges of dried ware with sandpaper, scrapers, cloth wheels, or similar items.

towpreg. *Noun.* A **prepreg** fabricated from **tow**.

toxicity. *Noun.* A quantitative statement of the adverse effects to health of a material.

toxic material. *Noun.* A material that is harmful to the human body.

TP. *Abbreviation.* Stands for thermoplastic.

TQM. *Abbreviation.* Stands for total quality management. See **total quality management**.

trabeated. *Adjective.* Constructed with horizontal beams and no arches.

trace. *Noun.* (1) An extremely small, but detectable, quantity of a constituent or impurity in a substance. (2) A constituent present in amounts less than 10^{-3} kg kg⁻¹. (3) *Verb trans.* To adorn ware with ornamental lines.

traceability. *Noun.* The ability to follow the history, application or location of an item or activity by means of recorded identification.

trace element. *Plural noun.* An extremely small quantity of an element, frequently non-essential, in a substance.

tracery. *Noun.* A fine pattern composed of interlacing ribs applied to masonry, pottery, or glass.

trachyte. *Noun.* Volcanic rock, light in colour with a rough texture but fine-grained containing **feldspars** and **pyroxenes**.

trachytic. *Adjective.* A macro or microstructure characterised by parallel arrangement of the crystals.

track. *Noun.* A path of localised deterioration on the surface of an insulator along which some conduction can occur.

tracking. *Noun.* (1) The act of producing conducting tracks on an insulator surface by electric discharges on or near the surface. (2) The lateral play in a **lehr** belt as it moves through a lehr tunnel. Little or no tracking is desirable.

tracking resistance. *Noun.* The product of voltage and time required to develop a conducting track on the surface of an insulator.

tractable. *Adjective.* Readily worked; malleable.

tragacanth. *Noun.* A mucilaginous gum from Asian shrubs. Used as a binder in glazes and porcelain-enamels. Also known as **gum tragacanth**.

trailing. *Noun.* A method of decorating **leather-hard** pottery in which a pattern of thick, adherent slip is squeezed through a small orifice onto the pottery surface.

training effect. *Noun.* An effect observed in superconducting magnets caused by wire windings moving slightly due to **polarisation** forces which causes frictional heating so that the conductor loses superconductivity at a field lower than expected. Several cycles of energising “trains” the magnet toward higher fields.

tramp constituents. *Noun.* Undesirable, small amounts of oxides that often form a glassy grain boundary phase in **glass ceramics**.

tramp glass. *Noun.* Loose glass in a manufactured container that has dropped inside and stuck to an inside surface.

tramp iron. *Noun.* Unwanted metal, such as a nail, bolt, nut, or screw which finds its way into a bulk material batch of ceramic raw materials.

transducer. *Noun.* A device or a crystal structure type that inter-converts different forms of energy or stimulations, for example electrical energy to mechanical energy and vice versa. **PZT** is an example from the field of ceramics.

transfer car. *Noun.* A car equipped with a set of rails on which loaded cars from a drier or kiln may be moved for transfer from one set of tracks to another set.

transfer decoration. *Noun.* See **slide-off transfer**.

transfer glass. *Noun.* Optical glass cooled to room temperature in the pot in which it was melted.

transfer, heat. *Noun.* See **heat transfer**.

transfer ladle. *Noun.* A refractory-lined ladle used to transport molten pig iron from the blast furnace to the next processing operation.

transfer printing. *Verb.* To decorate using patterns embossed on paper in colour from engraving lithographs and transferring them to **bisque**, glazed, porcelain-enamelled, or other ware. Also called **printing transfer**.

transfer ring. *Noun.* A raised ring around the outside circumference of a parison used as a gripping aid in the transfer of the parison to the blow mould.

transfer, slide-off. *Noun.* See **slide-off transfer**.

transfer track. *Noun.* A set of rotating rail tracks by which kiln or furnace cars may be transferred from one set of tracks to another set.

transfer zone, mass. *Noun.* See **mass transfer zone**.

transformation. *Noun.* (1) Change of phase. (2) Strength, strain, etc., variations due to coordinate transformations according to a set of mathematical equations. **Mohr's circles** geometrically represent such transformations.

transformation, displacive. *Noun.* See **displacive transformation**.

transformation, glass. *Noun.* See **glass transformation**.

transformation point. *Noun.* An experimentally determined temperature at which a molten glass has a **viscosity** of a $10^{13.5}$ N s m⁻².

transformation range. *Noun.* A temperature range over which a glass goes from the thermodynamic **glassy state**, low temperature, to supercooled liquid state, high temperature. Many commercial glasses have ranges around 400–500 °C.

transformation rate. *Noun.* The reciprocal of the needed for a reaction to reach half way to completion.

transformation, reconstructive. *Noun.* See **reconstructive transformation**.

transformation strain. *Noun.* See **Mohr's circle**.

transformation stress. *Noun.* See **Mohr's circle**.

transformation temperature. *Noun.* (1) The temperature at which a change occurs in a phase of a material during heating or cooling. (2) The temperature at which the viscosity in a glass melt reaches $10^{13.5}$ N s m⁻². See **fictive temperature**.

transformation toughening. *Noun.* A process designed to increase the crack resistance of ceramics whereby metastable **tetragonal zirconia**, which is produced by control of particle size and composition, is included in a matrix of the ceramic. The stress field associated with the tip of an advancing crack nucleates the transformation back to monoclinic ZrO₂ which, because of an increased volume, hinders crack advancement via the stress field this generates.

transformer. *Noun.* An electrical component that transfers electric energy from one or more alternating-current circuits to one or more other circuits by magnetic induction.

transgranular. *Adjective.* Confined to an effect across a grain and not along grain boundaries.

transgranular fracture. *Noun.* Fracture of a polycrystalline solid by crack propagation through grains and not along grain boundaries.

transient liquid phase diffusion bonding. *Noun.* See **diffusion bonding**.

transistor. *Noun.* An electronic device consisting of a small lock of a semiconducting material to which three or more electrical contacts are made, usually with two rectifying contacts being spaced in close proximity, and one non-rectifying contact; for use as an amplifier, detector, switch, or similar application.

transition. *Noun.* A phase change.

transition alumina. *Noun.* Non-equilibrium reordered structures arising from the **amorphous** products of the

initial thermal decomposition of **gibbsite**, **bayerite**, **norstrandite**, **boehmite**; each precursor gives a different **metastable** form of Al_2O_3 .

transition curve. *Noun.* A line on a pressure-temperature diagram indicating values at which two solid phases are in congruent equilibrium.

transition metal. *Noun.* An element with partially occupied d and f-orbitals.

transition point. *Noun.* (1) A temperature at which a substance undergoes a phase change. (2) The temperature at a given pressure at which two solid phases are in congruent equilibrium.

transition state. *Noun.* A higher energy state than either the reactants or products in a chemical reaction through which any transformation has to pass to obtain the products.

transition structure. *Noun.* A metastable phase according to thermodynamic predictions, which exists due to coherency with a matrix phase as it is precipitated from solid solution.

transition temperature. *Noun.* (1) The temperature below which a substance becomes superconducting. (2) The temperature at which one polymorph changes into the next thermodynamically stable state.

transit-mixed concrete. *Noun.* Concrete mixed in a truck mixer en route from the proportioning plant to the job site.

translucency. *Noun.* The property of a material to admit and diffuse light so that objects beyond cannot be clearly distinguished. An almost transparent material is translucent.

translucent. *Adjective.* Description of a material that transmits some light but not enough to see through clearly. The limited transmission is accompanied by diffusion of the light so that objects beyond are indistinct; semitransparent.

translucent glass. *Noun.* A glass transmitting light with varying degrees of diffusion and which impedes or obscures vision to the degree that objects seen through it cannot be seen distinctly.

transmission density. τ . *Noun.* A quantitative value of the extent to which a substance transmits electromagnetic radiation; numerically it is expressed as the logarithm to base 10 of the reciprocal of the **transmittance**. Formerly known as **optical density** and is also called **absorbance**.

transmission electron microscope. **TEM.** *Noun.* A microscope that produces an image from beams of electrons that pass through the specimen. Very high magnification of internal features is possible.

transmission line. *Noun.* A cable carrying electrical signals from one place to another or an optical cable carrying signals.

transmissivity. *Noun.* The internal transmittance of a material over a path of unit length.

transmittance. **A.** *Noun.* A measure of a body or material to transmit **electromagnetic radiation**. $A = \epsilon[J]l$, where l is the path length of the light, $[J]$ is the **molar** concentration of absorption centres and ϵ is the molar absorption coefficient or **extinction coefficient**.

transmutation. *Noun.* The transformation of a nuclide into a nuclide of a different element.

transmutation colour. *Noun.* A colour, such as in a porcelain-enamel, glaze, or glass, which may be changed by the intentional or accidental introduction of another colorant or impurity into the batch, or by melting a composition in a crucible in which a composition of a different colour previously had been melted.

transmutation glaze. *Noun.* A **flambé** or flow glaze containing copper to produce a variegated appearance. Also known as **rouge flambé**.

transom. *Noun.* An horizontal member across a window.

transparency. *Noun.* (1) A piece printed on a clear sheet with transparent or **translucent** inks whose full brilliance is brought out by backlighting. (2) A positive image on a photographic film.

transparent. *Adjective.* Describing transmission of light without scattering.

transparent coating. *Noun.* A clear colourless or tinted porcelain-enamel, glaze, or other coating, through which the base material or intermediate coating may be seen.

transparent conducting oxide. *Noun.* Semiconducting oxides, such as **ITO**, **zinc oxide**, and **antimony tin oxide**. Used in photovoltaics and conductive panels for **LCD** displays.

transudate. *Noun.* Any fluid that passes through a porous solid.

transude. *Verb.* To pass through pores in a solid in a slow manner.

transuranium elements. *Plural noun.* Radioactive elements having atomic numbers greater than that of uranium, 92.

transverse-arch kiln. *Noun.* A chamber kiln in which the arch of the roof is set at right angles to the length of the kiln.

transverse compression. *Noun.* A test for strength in composites where the load is applied perpendicularly to the oriented fibres so that **buckling** becomes less of a problem

transverse crack. *Noun.* In unidirectional ceramic-matrix composites this is caused by tensile stress applied transversely to the fibres.

transverse direction. *Noun.* A direction perpendicular to the lengthwise or longitudinal direction.

transverse phonon. *Noun.* See **phonon**.

transverse rupture strength. *Noun.* Breaking stress calculated from the **flexural strength** formula; typically found for beams supported near the ends and centre loaded.

transverse strain. *Noun.* The linear strain in a plane perpendicular to a specimen axis

transverse strength. *Noun.* The maximum bending stress per unit of area that a specimen can withstand without breaking. See **modulus of rupture**.

transverse wave. *Noun.* A wave motion in which particle displacement is perpendicular to the propagation direction of the wave.

trap. *Noun.* (1) A device to prevent the passage of selected substances, such as dust, sulphur, water, gas, etc. while permitting the passage of other substances. (2) Various dark-grained igneous rocks, such as **basalt**. Used in road making.

traprock. *Noun.* Any fine grained, dark, columnar, igneous rock such as **basalt**. Often shortened to **trap**.

trass. *Noun.* A variety of **tuff**. A light-coloured, powdered volcanic ash resembling **pozzolana** in composition and which is used in hydraulic cements. Also known as **tarras**.

travelling microscope. *Noun.* A magnifying system, able to traverse in both x and y directions, the eyepiece of which contains a graticule and the traverse directions contain two **Vernier scales**; used to measure distance between points on surfaces with great accuracy.

travelling thermocouple. *Noun.* A long thermocouple made to run the length of a **lehr** in order to plot the temperature profile.

travelling wave applicator. *Noun.* A microwave applicator where all the input power is absorbed by the work or by a water load having negligible reflected power and hence no standing waves.

traverse. *Verb.* To travel or move across, over, or through. Crossing from side to side

traverse length. *Noun.* The distance between points of reversal in the traverse direction in a reciprocating mechanism.

traverse table. *Noun.* A reciprocating platform on a grinding machine supporting the ware being ground.

traverse, wheel. *Noun.* See **wheel traverse**.

travertine. *Noun.* A porous rock that is mainly **calcium carbonate**, CaCO_3 , used for building. Can be polished to reveal a beautiful swirling pattern. Also called **calc-sinter**.

treading clay. *Verb.* A primitive process whereby a suitable clay is kneaded by the heel of the potter's foot.

treadle bar. *Noun.* The foot pedal operating a potter's wheel.

treater. *Noun.* A grouping of machinery able to prepare dry, resin-impregnated fibre reinforcement consisting of winders, resin tanks, and drying or curing ovens.

treatment. *Noun.* A material incorporated in a grinding wheel during manufacture to improve its grinding action and to minimise its tendency to fill with grinding residues.

tremie. *Noun.* A large metal tube with a hopper at the top and a valve arrangement at the bottom; used in the placement of concrete under water.

tremie seal. *Noun.* A foundation seal placed under water by a **tremie**, usually in an area enclosed by sheet piling.

tremolite. *Noun.* $\text{Ca}_2\text{Mg}_5[\text{Si}_4\text{O}_{11}]_2(\text{OH},\text{F})_2$. An **amphibole double-chain silicate** mineral common in metamorphic rocks. A fibrous **talc**; used as a substitute for **asbestos** in acid-resisting applications and in reinforced cements, etc. Also used in lagging and wall insulation; transparent to opaque. A compact form is called **nephrite**. Density 3,000–3,400 kg m^{-3} ; hardness (Mohs) 5–6. Also known as **Italian asbestos**.

TRGO. *Abbreviation.* Stands for thermally reduced graphene oxide. See **thermally reduced graphene oxide**.

trial mix. *Noun.* A preliminary batch of concrete mixed to determine the optimum proportions of ingredients that produce concrete having specified properties.

trials. *Plural noun.* Small samples that are withdrawn from a kiln during firing for use as a guide to temperature and atmospheric conditions therein.

triangle bar. *Noun.* Alloy bars of triangular cross section on which porcelain-enamelled ware is placed for firing.

triaxial cable. *Noun.* A multi part electrical conductor consisting of an inner braided coaxial cable, which is surrounded by an exterior conductive shield to provide extra protection from external fields.

triaxial porcelain. *Noun.* Pore-free material based on three components: plasticiser, flux and filler. Porous versions of porcelain are excluded from this description. It is essentially a material consisting of a crystalline phase in a glass matrix covered with a compressively pre-stressed glaze that adds a tensile stress component to the porcelain body. The term is usually reserved to describe industrial ware, such as **refractories**, **electrical** and **chemical porcelains**. Hard-fired **dinnerware** and **stoneware** can be included.

triaxial stress. *Noun.* A state of stress in which none of three principal stresses is zero.

triaxial weaving. *Noun.* Three yarn systems that are woven typically at 60° to one another in a plane.

triaxial weaving machine. *Noun.* A loom using three **yarn** directions to weave yarns at 60°.

triaxial whiteware. *Noun.* Ceramic bodies formed from only **clay**, **feldspar** and **quartz** fired to **vitrification**.

tribasic calcium phosphate. *Noun.* $\text{Ca}_3(\text{PO}_4)_2$. Used in porcelains, pottery, porcelain-enamels, and milk glass both as an opacifier and as a glass former; also used in castable compositions. Mp 1,670 °C; density 3,140 kg m⁻³.

tribology. *Noun.* The science of wear and friction at surfaces.

triboluminescence. *Noun.* The emission of light from solids produced by mechanical action, such as compression, fracture or rubbing. In most cases the intensity of the glow is very weak and there is no universal explanation of the phenomenon that covers all types of materials.

trichroism. *Noun.* Three colour crystals as seen when **biaxial** crystals are rotated in **plane polarised white** light.

trichromatic lamp. *Noun.* A mercury vapour lamp with a **phosphor** coating that is adjusted to emit equal amounts of red, blue and green colour.

trickle. *Verb.* To drip slowly or to flow in a gentle intermittent stream.

triclinic. *Adjective.* Relating to the crystal system that has 3 unequal length axes that intersect at oblique angles. **Kyanite**, **turquoise** and **plagioclase** are examples of ceramics in this crystal system.

tridymite. *Noun.* SiO_2 . A high-temperature polymorph of **silica** that is used in ceramic bodies to improve **thermal-shock resistance** as well as to minimise crazing. Density 2,280–2,300 kg m⁻³; hardness (Mohs) 7.

Trier process. *Noun.* A process for making concrete in which a slurry of wet-ground **slag** is mixed with **Portland cement** and aggregate.

trilayer graphene. *Noun.* A very thin carbon film consisting of 3-**graphene** layers. Depending on whether the layers are stacked ABA (hexagonal) or ABC (cubic), the material is either conducting or insulating. See **graphene**.

trim. *Verb.* To remove edges and excess material and shape **leather-hard** bodies by means of a wheel.

trimmed block. *Noun.* Dressed or crude **mica** that has been split into prescribed thicknesses and has been side trimmed to remove irregularities, imperfections, and contaminants.

trimmer. *Noun.* (1) Tile of various sizes and shapes, such as bases, caps, corners, mouldings, etc., employed to complete tile installations. (2) A workman employed to remove fins, edges, and other irregularities from ware.

trimorphous. *Noun.* The property of crystallising in three different forms.

trioctahedral. *Adjective.* Atoms in all the sixfold, octahedral sites in a close-packed array of anions.

triode. *Noun.* Any electronic device having three electrodes, such as a thermionic valve used as the main amplifier oscillator for radio-frequency heating.

trioxide. *Noun.* Any oxide that contains oxygen in a three to one ratio with the metal atom, for example WO_3 .

triphyllite. *Noun.* LiFePO_4 . A bluish-gray lithium iron phosphate mineral with an orthorhombic structure found in some **pegmatites**. It is an **olivine** mineral with a good theoretical capacity for energy storage in a solid state cell of 170 mAhg⁻¹ at 3.5 V. Its low conductivity has to be overcome by coating it with graphite.

triple brick. *Noun.* A brick 13.5×10.2×30.5 cm in size.

triple-cavity mould. *Noun.* A mould containing three cavities for the simultaneous forming of three glass articles.

triple-cavity process. *Noun.* A process in which three **gobs** of glass are accepted and formed in a mould simultaneously. Also called **triple-gob process**.

triple-gob process. *Noun.* The triple-cavity process of glass forming. See **triple-cavity process**.

triple point. *Noun.* (1) The unique temperature and pressure at which all three phases of a pure stable substance can coexist in equilibrium. Water has a triple point at 273.16 K at a pressure of 611.2 Pa and this is the basis of the definition of the degree **Kelvin**. (2) Areas on a micrograph defined by three grains mutually touching. They can be **voids** or filled with the lowest melting **eutectic**.

Triplex. *Trademark, noun.* A laminated safety glass made for car windows.

tripoli. *Noun.* Another name for rottenstone; porous, siliceous, sedimentary rock; used as an abrasive and polishing powder. See **rottenstone**.

tripoli powder. *Noun.* Various fine grades of powdered **rottenstone** used specifically in lapidary for polishing **gemstones**.

TRISCO-coated particle fuel. *Acronym, noun.* Acronym for tristructural-isotropic and the whole is a type of coated ceramic nuclear fuel developed for high temperature gas reactors. The particle is a kernel of **uranium dioxide** or uranium oxycarbide surrounded by a porous graphite layer, which is surrounded by a dense **pyrolytic graphite** layer called the **inner pyrolytic carbon layer**. Next follows a **silicon carbide** layer and a dense pyrolytic carbon layer called the outer pyrolytic layer. Hence there are essentially three layers: fuel, porous graphite to collect fission products, and a dense carbon-silicon carbide case that provides strength and containment. The particles are either compacted into small cylinders, called **compacts**, or tennis-ball-sized spheres called **pebbles**.

- trisodium phosphate.** *Noun.* Na_3PO_4 , a cleaning compound and water softener.
- tristimulus colorimeter.** *Noun.* An instrument that measures colour by determining the intensities of three different colours, white, blue, and yellow, although other colours may be used.
- tristimulus coordinates.** *Noun.* See **colour-order system**.
- tritium.** *Noun.* T or ^3H . A radioactive isotope of hydrogen; half-life 12.5 years. Tritiated compounds are often used as tracers.
- triton.** *Noun.* A nucleus of an atom of tritium containing two neutrons and one proton.
- triturate.** *Verb.* To grind a material to a fine powder.
- triuranium octoxide.** *Noun.* U_3O_8 . A natural uranium oxide occurring in **uraninite**; used in nuclear applications. Decomposes at $1,450^\circ\text{C}$; density $8,390\text{ kg m}^{-3}$.
- trivet.** *Noun.* A stainless steel or heat-resistant alloy formed into a shape suitable to support porcelain-enamelled ware during firing.
- trolling atomic force microscopy.** *Noun.* A technique for keeping the cantilever head higher above the surface being examined to cause less interference. A long thin nanoneedle of nanocrystalline platinum is attached to the end of the probe. See **atomic force microscopy**.
- trommel.** *Noun.* A tilted, revolving, cylindrical screen; used to separate coarsely crushed materials by density. From the German for a drum.
- trona.** *Noun.* $\text{Na}_3\text{H}(\text{CO}_3)\cdot 2\text{H}_2\text{O}$. Hydrous sodium acid carbonate; occurs as a mineral from evaporated **soda** lakes.
- troostite.** *Noun.* A reddish coloured mineral that is a variety of **willemite** formed by substitution of some of the zinc by manganese.
- Tropenas converter.** *Noun.* A refractory-lined converter in which the air blast strikes the molten batch through **tuyeres**.
- trough.** *Noun.* A channel through which materials flow from one point to another.
- trowel.** *Noun.* A flat, rectangular- or triangular-shaped hand tool; used to apply, spread, and shape concrete, mortar, and plaster.
- troweling.** *Verb.* To use a **trowel** to apply the final smooth coat to a concrete laying or a plaster wall etc.
- troy ounce.** *Noun.* A unit of weight of precious-metal decorating materials equal to 31.1 g.
- truck chamber kiln.** *Noun.* A chamber-type kiln through which ware is pushed on refractory platforms or **bats**.
- truck-mixed concrete.** *Noun.* Concrete mixed in a truck-mounted mixer.
- truck mixer.** *Noun.* A rotating mixer mounted on a motor truck in which concrete is mixed en route from the proportioning plant to the job site.
- true.** *Noun.* Correct alignment.
- true density.** *Noun.* The weight of a unit volume of a substance excluding its pore volume and inter-particle voids when measured under standard or specified conditions.
- true strain.** ϵ_r . *Noun.* The natural logarithm of the ratio of instantaneous gauge length to original gauge length of a specimen being deformed by uniaxial stress.
- truing.** *Verb trans.* To remove the outside layer on a grinding wheel so as to restore its grinding face to even, true running.
- true mica.** *Noun.* A univalent **mica** where monovalent cations balance the charges on the Si-Al-O layers. This weak binding between layers leads to perfect basal cleavage to form tough and flexible very thin sheets.
- true porosity.** *Noun.* The ratio of the total volume of open and closed pores and inter-particle voids to the bulk volume of a material.
- true specific gravity.** *Noun.* The ratio of the density of a material to the density of water at 4°C that has a volume equal to the true solid volume at standard conditions of pressure and temperature.
- true strain.** ϵ_r . *Noun.* Defined relative to the distance between two marks made on the **gauge length**, L_0 ; it is the natural logarithm of L/L_0 , where L is the distance between the gauge marks at any time.
- true stress.** *Noun.* The stress calculated from the actual measured cross-sectional area at the moment of observation ignoring the original cross-sectional area.
- true volume.** *Noun.* The volume of a solid material, neglecting pore volume.
- trumeau.** *Noun.* A section of wall between two openings.
- truncated.** *Adjective.* Description of a crystal having edges or corners cut off.
- truss.** *Noun.* (1) A bundle or pack. (2) Another name for a **corbel**. (3) *Verb.* To support or stiffen a structure, such as a roof or bridge, etc., with structural members.
- T-stake.** *Noun.* T-shaped steel form; used to shape metal bowls and the like to be processed into porcelain-enamelled artware.
- tubbing.** *Noun.* Brick or concrete lining of drilled shafts to prevent water ingress.
- tube furnace.** *Noun.* A furnace in which the fuel combustion takes place in a design of heat-resisting alloy tubes to prevent combustion gases coming into contact with ware being fired.

tube lining. *Noun.* A ceramic decorative technique in which a design is drawn onto the surface of a pot using soft clay, piped from a fine diameter tube.

tube mill. *Noun.* A revolving cylinder containing grinding media in which the material to be ground is introduced as slurry at one end and removed, after grinding, at the opposite end. It is often compartmented with smaller grinding media in successive compartments. The product is a fine mud.

tube, revolving. *Noun.* See **revolving tube**.

tubing, lens-fronted. *Noun.* See **lens-fronted tubing**.

tub, tempering. *Noun.* See **tempering tub**.

tuckstone. *Noun.* Shaped refractory blocks placed on top of **flux blocks** in a **glass tank** to protect the flux blocks against combustion gases, and to serve as a seal between the flux blocks and the side and end walls of the glass tank.

tuck wall. *Noun.* (1) A course of **tuckstone** (2) a wall in a **glass tank**.

tufa. *Noun.* A soft porous rock consisting of **calcium carbonate** deposited from **lime-rich** springs.

tuff. *Noun.* (1) A form of rock made when small, 2 mm, rock fragments, ejected from a volcano, are fused together on the ground. (2) A hard volcanic ash.

tuille. *Noun.* A vertically operated damper or counter-weighted door in a glass tank to control the flow of molten glass or to protect a newly set pot.

tumbler. *Noun.* (1) A drinking glass without a foot, stem, or handle. (2) A part that moves a gear in a train of gears into or out of engagement.

tumbler gear. *Noun.* A train of gears in which selection is made by a **tumbler**.

tumbling. *Verb.* A surface-finishing operation in which small articles are loosely rotated in a barrel with abrasives or polishing compounds to remove **burrs**, protrusions, and surface imperfections, and to produce polished surfaces.

tuned circuit. *Noun.* Used in **radio-frequency heating**, it is a circuit where a **capacitor** and **inductance**, in series or parallel, offer a low or high **impedance** respectively at the resonant frequency.

tungstates. *Plural noun.* Compounds of tungsten and oxygen and other metals in which linked polyhedra of WO_x are present, WO_4 tetrahedra and WO_6 octahedra being the most common; melting points usually in the range 1,480–1,705 °C.

tungsten boride. *Noun.* (1) WB. Mp 2,860 °C; density 16,000 kg m⁻³. (2) WB₂. Mp 2,900 °C. (3) W₂B. Dissociates at 1,900 °C; density 16,700 kg m⁻³. (4) W₂B₃. Used as a refractory for furnaces and for chemical equipment. Mp 2,200 °C; density 17,200 kg m⁻³.

tungsten carbide. *Noun.* (1) W₂C. Mp 2,855 °C; density 17,200 kg m⁻³. (2) WC. Mp 2,780 °C; density 15,500 kg m⁻³; hardness 21–23 GN m⁻², with either **Knoop** or **Vickers** indenters. Used in tools, dies, cermets, and wear-resistant parts, and as an abrasive. Highly **nonstoichiometric** composition within the **hexagonal close-packed** tungsten structure.

tungsten carbide, cemented. *Noun.* See **cemented carbides**.

tungsten carbide composite. *Noun.* Originally this referred to the **cemented carbide** WC-Co containing about 96 % WC but now this covers any **matrix material** strengthened by the addition of WC **whiskers** and particles

tungsten trioxide. *Noun.* WO₃. Used as a yellow colorant in ceramics. Mp 1,473 °C; density 72,000 kg m⁻³.

tungstic acid. *Noun.* Oxyacids of tungsten obtained by neutralising alkaline tungstates solutions; polymeric solids, examples are orthotungstic acid, H₂WO₄, metatungstic acid, H₂W₄O₁₃, and paratungstic acid, H₁₀W₁₂O₁₄.

tungstite. *Noun.* WO₃. A yellow secondary mineral found in some tungsten ores.

tunnel. *Noun.* The passageway through which ware passes in a **lehr**.

tunnel diode. *Noun.* An extremely stable semiconductor diode containing a very narrow, highly doped p-n junction across which electrons travel using the **tunnel effect**. Also called the **Esaki diode**.

tunnel drier. *Noun.* A tunnel-shaped, continuous drier through which loaded cars are moved.

tunnel effect. *Noun.* The quantum wave mechanical phenomenon of elementary particles whereby a particle passes through a barrier even though it does not have sufficient energy to surmount the barrier.

tunnel kiln. *Noun.* A tunnel-shaped, continuous kiln or furnace consisting of preheating, firing, and cooling zones through which ware is transported on cars.

tunnel updraught kiln. *Noun.* A tunnel kiln in which air and combustion gases are caused to move upward through a ware getting to the exhaust flues.

turbid. *Adjective.* A liquid clouded with a suspension; muddy.

turbidimeter. *Noun.* A device that measures the loss in intensity of a light beam passing through a slip or suspension of particles as a means of determining the concentration of solids in the suspension. See **Klein turbidimeter**, **Wagner turbidimeter**.

turbidite. *Noun.* Sediment deposited by a **turbidity current**.

turbidity current. *Noun.* A swirling mass of water and suspended solids.

turbine. *Noun.* A type of engine in which a central drive shaft equipped with curved vanes is spun at high speed by water, steam, or gas pressure to convert kinetic energy to mechanical power.

turbine blade. *Noun.* A bucket, paddle, or blade composed of a strong, high-temperature- and thermal-shock-resistant ceramic, cermet, or alloy used as a vane on the drive shaft of a turbine.

turbine, gas. *Noun.* See **gas turbine**.

turbostratic. *Adjective.* A type of crystal structure found in materials where planes of rings such as those in BN or **graphite** are stacked perpendicular to the c-axis instead of atoms being superimposed the rings in successive layers are rotated relative to those in the layer below.

turbulence. *Noun.* Flow occurring in a non-streamline way due to relatively high shear rates.

turbulent. *Adjective.* Being in a state of **turbulence**.

turbulent flow. *Noun.* A rapid, irregular variation in the velocity of flow of a fluid at any point in the fluid.

tureen. *Noun.* A large, deep, round and covered dish usually made from **earthenware** and used for serving soup. From French terrine meaning **earthenware**.

turgite. *Noun.* $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$. A red or black mineral of hydrated **ferric oxide**.

turmeric paper. *Noun.* A paper impregnated with turmeric that is used as a test for **boric acid**, which turns it red-brown or alkali, which turns it brown.

turn. *Noun.* A complete 360° revolution around the strain axis by a filament; expressed as number of turns per meter.

turn-back. *Noun.* An effect seen when graphite is subjected to neutron bombardment in a reactor, when irradiation-induced shrinkage in volume stops and it expands toward its original dimensions.

turndown. *Noun.* The ratio of maximum to minimum input rates in a firing cycle.

turnery. *Plural noun.* Objects made on a lathe.

turning. *Verb.* (1) To shape an article on a lathe or potter's wheel. (2) *Noun.* An object made on a lathe. (3) *Noun.* The waste produced from turning an article on a lathe.

turning, rough. *Verb.* See **rough turning**.

turn-on voltage. *Noun.* The applied voltage in a **varistor** where the transition from a linear to a nonlinear current relationship occurs.

turquoise. *Noun.* $\text{CuAl}_6(\text{PO}_4)_4(\text{OH})_8 \cdot 4\text{H}_2\text{O}$. Hydrous basic copper aluminium phosphate found in igneous rocks rich in aluminium; a popular gemstone because of its blue colour; density 2,600–2,800 kg m⁻³; hardness (Mohs) 5–6.

turret. *Noun.* A lathe part that has a number of tools projecting radially from it.

Tuscan. *Adjective.* Relating to one of the five classical orders of architecture. Characterised by a column with an unfluted shaft and capitals and base with mouldings but no decoration.

Tuscan red. *Noun.* An iron oxide pigment used in glazes.

tuyère. *Noun.* An opening through the walls of a blast furnace or forge containing a nozzle through which air is forced to facilitate combustion.

tuyère brick. *Noun.* A refractory shape containing one or more holes or passages through which air is introduced into a furnace.

tteitite. *Noun.* $\text{Ca}_{14}\text{Y}_5\text{F}_{43}$. An ordered yttriofluorite mineral.

Twaddell. °T_w. *Noun.* A relative density scale. °T_w = 200 (relative density – 1). See **Twaddell hydrometer**.

Twaddell hydrometer. *Noun.* An instrument used to measure the density or the **specific gravity** of liquids. The reading is in degrees Twaddell, °T_w and when °T_w = 200, the sp. gr. is 1.0 or density is 1,000 kg m⁻³.

tweel. *Noun.* A refractory door or damper in a glass tank to control the flow of molten glass or to protect a newly set pot.

tweel block, tuille block. *Noun.* A refractory block used in the production of a counterweighted door of a glass furnace to protect a newly set pot or control the flow of molten glass. See **tuille**.

twill weave. *Noun.* A more pliable weave where one or more warp yarns runs over and under two or more fill yarns. A weave that repeats on three or more ends and picks and so produces diagonal lines on the faces of fabric. Used for some types of ceramic composite.

twin. *Noun.* See **twinned crystal**.

twinned crystal. *Noun.* A single crystal that appears to consist of two or more crystals grown together along a plane known as the composition plane. Each has a definite orientation to the other. Microstructurally they appear as parallel-sided regions. Also called **macle**.

twin-plate polishing. *Noun.* A process in which both faces of sheet glass are ground and polished simultaneously.

twist. *Noun.* (1) The number of turns per unit length about the axis in a yarn. (2) Longitudinal progressive rotation occurring during **pultrusion**.

twist boundary. *Noun.* The second type of grain boundary, different from the **tilt boundary** in that the rotation axis for grain coincidence is perpendicular to the boundary plane.

two-dimensional electron system. 2DES. *Noun.* Layer compounds with unusual electron band structures that confer high mobility, unparalleled thermal conductivity, 98 % optical transparency and huge current carrying capability. Freely suspended **graphene** is the ultimate 2DES. See **low dimensional materials**.

2-1-4 compounds. *Plural noun.* M_2CuO_4 . **Inverse spinel cuprates**, such as $La_{1.9}Sr_{0.1}CuO_4$, which are superconductors in the 25–50 K region. See **high temperature superconductors**.

two-table machine. *Noun.* A glassmaking machine with parison moulds mounted on one table and blow moulds on another.

two-way shape memory alloy. *Noun.* See **shape memory alloy**.

two-way mirror. *Noun.* A half silvered sheet of glass that acts as a mirror from one side but is translucent from the other

two-way slab. *Noun.* A slab of concrete supported by beams along the four edges or sides with steel-bar reinforcement parallel to the two faces of the slab.

twyer. *Noun.* Alternative name for tuyère. See **tuyère**.

Tyndall blue. *Adjective.* The colour of a dilute suspension of colloidal particles when viewed from the side.

Tyndall effect. *Noun.* Light scattering by particles of matter in its path. It is the effect whereby dust particles in an atmosphere enable a light beam to be seen. The effect depends on particle concentration and can

be used to determine this property of a system. See **tyndallimetry**.

tyndallimetry. *Noun.* A method of determining the concentration of particles in a suspension, such as a slip, by measuring the intensity of a scattered light beam.

type-F flat sheet. *Noun.* Flexible fire-resistant flat asbestos-cement sheets of low moisture absorption for interior or exterior building work.

type-I superconductor. *Noun.* A material capable of showing zero electrical resistance that is also a perfect **diamagnet**, i.e., magnetic flux totally excluded from the material, so that an external magnetic field effects the transition from superconductor to normal state very sharply. Not found for ceramic superconductors.

type-II superconductor. *Noun.* A material capable of showing zero electrical resistance at low temperatures but is not a perfect **diamagnet** and therefore experiences magnetic flux penetration. An external magnetic field effects the superconducting transition via a broad mixed-state region. **High Temperature Oxide Superconductors** are in this class.

type U flat sheet. *Noun.* Strong grades of flat asbestos-cement sheets for fire-resistant building construction.

Tyranno. *Trademark, noun.* Commercially available continuous strand SiTi-carbide fibre produced from polytitanocarbosilane polymer; density 2,300 kg m⁻³; strength 2.0 GN m⁻².

TZP. *Abbreviation.* Standing for tetragonal zirconia polycrystals. See **tetragonal zirconia**.

Uu

U. *Noun.* Shaped like a U.

U. *Symbol.* Stands for **uranium**.

U-bolt. *Noun.* A bar bent into the shape of a U and threaded at both ends to receive nuts.

UDC. *Abbreviation.* Standing for unidirectional composite. See **unidirectional composite**.

UHF. *Abbreviation.* Standing for ultrahigh frequency. See **ultrahigh frequency**.

UHM. *Abbreviation.* Stands for ultrahigh modulus. See **ultrahigh modulus**.

UHPC. *Abbreviation.* Stands for ultra-high strength concrete. See **ultra-high performance concrete**.

ulexite. *Noun.* $\text{NaCaB}_3\text{O}_9 \cdot 8\text{H}_2\text{O}$; a mineral used in glazes as a flux and glass former. In nature it occurs with an unusual, **cotton ball**, structure of white, silky masses. Density $1,960 \text{ kg m}^{-3}$; hardness (Mohs) 1–2.5.

ullage. *Noun.* The percentage of a closed volume occupied by vapour. The volume defined by the surface of the liquid in a tank and the lid.

ultimate analysis. *Noun.* The chemical composition of a ceramic reported on the basis of its constituent oxides.

ultimate elongation. *Noun.* The increase in length of a body in tension at the point of rupture.

ultimate strength. *Noun.* (1) The maximum stress that a material or product can withstand when subjected to an applied load; usually reported as newtons per square meter at the instant of failure. (2) The maximum load supported by a concrete pipe as determined by three edge testing methods (**3-point bend test**) and reported as newtons per linear meter per millimeter of inside diameter or horizontal span.

ultimate tensile strength. σ_{UTS} . *Noun.* See **tensile strength**.

ultrabasic. *Adjective.* Describing igneous rocks, such as **peridotite**, that contain less than 45 % silica.

ultracapacitor. *Noun.* A device that combines the advantages of a capacitor and of a battery. It works by suspending high surface area electrodes in an electrolyte and when the electrode is charged with electrons or ions it causes the electrolyte to polarise and oppositely charged ions lie against the surface. Because the electrode has a high surface area a very large charge can be stored on it.

ultracentrifuge. *Noun.* An apparatus designed to make very fine particles settle out by generating centrifugal forces up to 10^6 times the force of gravity.

ultra filtration. *Noun.* Filtration that removes particles less than $10 \mu\text{m}$ in diameter.

ultrahigh frequency. *Noun.* Usually abbreviated to **UHF**; a radio-frequency band from 3,000 to 300 MHz.

ultrahigh modulus. **UHM.** *Noun.* A term used to describe the newer engineering ceramics, such as **carbon fibre**, **boron carbide**, B_4C , etc., that have exceptionally high values for **Young's modulus**.

ultra-high performance concrete. **UHPC.** *Noun.* Concrete with a compressive strength in excess of 150 MN m^{-2} , high **Young's modulus** and low porosity. Material control achieves this performance by using high-strength **coarse** and **fine aggregates** with larger than normal amounts of fine aggregates, high strength cement and low **water to cement ratio**.

ultrahigh purity. *Noun.* A grade of a reagent material of extreme purity that is, containing extremely low levels of impurities normally less than $1 \mu\text{g/g}$.

ultramarine. *Noun.* (1) A vivid deep blue pigment made by powdering **lapis lazuli** or synthetically from a mixture of sodium and **aluminium silicates** and some sodium sulphide. The colour arises from $[\text{S}_3]^-$ polysulphide ions in the structure. Natural material comes from "over the seas" which is mainly Afghanistan. (2) *Adjective.* Of a vivid deep blue colour.

ultramicroscope. *Noun.* Also known as a **dark-field microscope** in which a sample, such as a colloid, is illuminated from the side and the colloid particles are seen as bright spots on a dark background.

ultrasonic. *Adjective.* Concerned with, of, or producing waves with the same properties as sound waves but frequencies above audio frequencies.

ultrasonic cleaning. *Noun.* The use of ultrasonic vibrations as an auxiliary force in the cleaning bath to remove soil from sheet metal being prepared for porcelain-enamelling.

ultrasonic devices. *Noun.* Instruments employed to generate ultrasonic conditions or to evaluate materials or products under such conditions.

ultrasonic extrusion. *Noun.* Extruder and die are mounted on an ultrasonically vibrated plate. Dilatant mixes can be used; lower extrusion pressures; faster extrusion rates and better surface finishes are achieved.

ultrasonic machining. *Noun.* A form of abrasive machining that uses a tool vibrating at ultrasonic frequencies and a grit-loaded slurry, via cavitation in the liquid phase, to break off surface material.

ultrasonics. *Noun.* The science dealing with phenomena occurring in ultrasonic ranges; that is, frequencies above range of human hearing.

ultrasonic testing. *Noun.* A non-destructive test applied to elastic sound-conductive materials to locate inhomogeneities or structural flaws.

ultrasound. *Noun.* (1) Ultrasonic waves of the same nature as sound, used in cleaning equipment and materials, in testing for flaws and in medical scanning. (2) An effect caused by liquid particles oscillating about an equilibrium position with an induced constant displacement called acoustic streaming. The streaming causes liquid to move away from a vibrating transducer surface which then gives rise to ultrasound. It is defined by frequency and intensity of oscillation, where the intensity is defined as the acoustic energy per second passing through a unit area of medium perpendicular to the direction of sound propagation. Intensity is related to the oscillating pressure amplitude and the square of the displacement amplitude. For ultrasound the frequency must exceed 16 kHz. It consists of cycles of compression and expansion.

ultratrace. *Noun.* An indication that an element in a material is present in extremely low amounts, usually as an impurity, and at levels below 1 $\mu\text{g/g}$.

ultraviolet-absorbing glass. *Noun.* Glass, usually containing small amounts of cerium, chromium, cobalt, copper, iron, lead, manganese, neodymium, nickel, sulphur, titanium, uranium, or vanadium, which absorb ultraviolet rays without appreciable effects on the transmission of visible wavelengths.

ultraviolet radiation. *Noun.* The continuous range of frequencies and wavelengths between the visible range and x-rays, i.e., from about 400 nm to about 20 nm; produced by excitation of high-energy-level electrons in atoms.

ultraviolet transmitting glass. *Noun.* Glass whose composition contains only traces of ultraviolet-absorbing elements; pure **silica**, SiO_2 , glass is the most efficient in this respect.

ulvospinel. *Noun.* Fe_2TiO_4 . A ceramic with the **inverse spinel** structure.

umber. *Noun.* (1) A powdered mineral consisting mainly of **hydrated iron oxide**, and sometimes of oxides of manganese, used as a brown or red-brown colourant in bodies and glazes. (2) *Adjective.* A characteristic brown or reddish-brown colour.

umber paint. *Noun.* Powdered green clay suspended in oil and used as a pigment.

umpire. *Noun.* A person or laboratory of recognized capability selected to resolve or arbitrate a difference of fact between a supplier and receiver.

unakite. *Noun.* A mottled rock consisting of pink **feldspar** and green **epidote** that tumble polishes to decorative ware.

unary. *Adjective.* Consisting of or affecting, a single element or component.

unary system. *Noun.* Single-component systems, such as silicon, carbon, etc.

unbalanced capacitance. *Noun.* The difference in capacitance of the two insulated conductors to the shield, expressed as the percentage of the capacitance between the conductors, or % unbalance.

unburned brick. *Noun.* Brick manufactured by processes which do not require kiln firing to develop the strength of the finished product; for example, **adobe** brick, chemically bonded refractories; mixtures of **dolomite**, **magnesite**, **olivine**, or **andalusite** with resin, **pitch**, **tar**, **bitumen**, **phosphate**, **water glass**, or **cement** are dry pressed into shape.

unburned refractory. *Noun.* Refractory shapes that are installed for use without prior firing.

uncertainty principle. *Noun.* The statement that simultaneous measurements of pairs of related variables, such as momentum and position, energy and time, etc., are subject to a specific indeterminacy related to **Plank's constant**. For example, $\Delta x \Delta p = h/2\pi$, where Δx is the uncertainty in position, Δp is the uncertainty in momentum and h is Plank's constant.

uncombined water. *Noun.* Water added to a body or slip to produce plasticity, or workability, and which is removed by evaporation or during the early stages of firing. Also known as **mechanical water**.

unctuous. *Adjective.* Rich in organic matter and easily workable as a clay; having an oily appearance and soapy feel.

under-car temperature. *Noun.* The temperature in the area or segment of a kiln beneath a kiln car as it transports ware through.

underclay. *Noun.* A layer of **argillite** or **claystone** immediately underlying a bed of coal; sometimes used as a component in ovenware bodies. When used as a refractory it is known as **fireclay**.

undercloak. *Noun.* An intermediate layer of material between the tile and the supporting laths in a tile roof construction.

undercut. *Noun.* (1) A protruding section that impedes the withdrawal of an article from a two-piece rigid mould. (2) The action or result of **undercutting**.

undercutting. *Verb trans.* (1) To cut away a material so as to leave an overhanging portion. (2) Faulty cutting of flat glass resulting in an edge that is oblique to the surface.

underdrain. *Noun.* A type of asbestos-cement pipe having a multiplicity of perforations along its length; used in surface or subsurface draining of fields, streets, etc.

underfire. *Verb trans.* Incomplete fusion of porcelain-enamels or glazes resulting in a failure to form a smooth, glassy surface.

underglaze, underglaze decoration. *Adjective.* A finely milled ceramic colour, decoration, or other coating applied directly to the unfired or bisque-fired surface of ceramic ware mixed with the glaze frit and fired at 1,080 °C when it becomes covered with a transparent glaze.

underglaze inks. *Noun.* Screen printing formulations containing fluxes used to decorate ceramics and glass.

underloading. *Verb.* (1) Insufficient charging of a **ball mill** for the proper grinding of materials. (2) Reducing the charge of a ball mill to obtain faster grinding. (3) Insufficient loading of a furnace or kiln to obtain faster furnace comeback and as a result, faster firing.

under load refractoriness. *Noun.* A measure of the resistance of a refractory to the combined effect of heat and loading, often expressed as the temperature of shear or 10 % deformation when heated under a stress of 173 or 345 kN m⁻².

under ridge tile. *Noun.* Roofing tile used under the tile forming the ridge in the construction of the top of tile roofs.

undersanded. *Adjective.* The condition of concrete in which it appears to contain insufficient additions of fine aggregate.

undersize. *Noun.* Aggregate materials smaller than the specified minimum screen size.

undulator. *Noun.* See **wiggler**.

unexcited. *Adjective.* Of an atom remaining in its ground state.

unfired brick. *Noun.* See **unburned brick**.

unglazed tile. *Noun.* A hard, dense tile, employed on floors and walls, composed of a whiteware body of homogeneous composition throughout, and which derives its colour and texture from the materials of which the body is made. The colour and characteristics of the body are determined by the raw materials, the forming method, and the thermal treatment.

UNH. *Abbreviation.* Standing for uranyl nitrate. See **uranyl nitrate**.

uniaxial. *Adjective.* Description of a crystal having only one direction along which double refraction of light does not occur.

uniaxial crystal. *Noun.* See **optic axis**.

uniaxial orientation. *Noun.* A method of microstructure control in composites in which an orienting stress is applied only in one direction.

uniaxial stress. *Noun.* The state in which two of the three principal stresses are zero.

unidirectional composite. **UDC.** *Noun.* A composite where the long reinforcing fibres are all aligned parallel. When in use the tensile stresses are applied along the fibre direction and compressive stresses at 90° to the fibre direction.

unidirectional fabric. *Noun.* A strengthening fabric used in composite manufacture in which the bulk of the reinforcing fibres run lengthwise to give longitudinal strength and only enough warp fibres are present to ensure a weaving pattern and ease of handling.

uniform flow. *Noun.* A flow of constant velocity or volume of a gas, liquid, powder, or granulated solid.

unipolar structure. *Noun.* Electronic devices for which only a single sign of charge carrier is important and for which junctions are formed between a semiconductor, n- or p-type, and a metal; an example is a **Schottky diode**.

unit cell. *Noun.* The smallest group of atoms, ions, or molecules that is characteristic of the particular crystal lattice. Three axial lengths and the angles between them define it. There are 14 types of unit cell defined by their symmetry, for example the cubic unit cell has three equal axial lengths all mutually perpendicular and all other unit cells represent a decrease in symmetry from this.

unit cost. *Noun.* The total cost of producing one unit of a product; decreases as the production volume is increased.

unit magnetic pole. *Noun.* The strength of a magnetic pole that will repel a similar pole 1 cm from it in a vacuum with a force of 1 dyn.

unit melter. *Noun.* A narrow tank furnace with burners along both sides and no heat recovery system; hence, it is compact and saves on space and construction costs.

unit mould. *Noun.* A one-piece mould in which ware is cast.

unit stress. *Noun.* The load per unit area on a material or artefact.

universal gas constant. *Noun.* Another name for gas constant. See **gas constant**.

universal grinding machine. *Noun.* A machine on which cylindrical, internal, or face grinding may be done as required.

universal motor. *Noun.* An electric motor able to utilise either direct current or single-phase alternating current with approximately the same efficiency.

universal testing machine. *Noun.* An instrument capable of measuring loads and test specimen deflections encountered in tensile, compressive, or flexural tests.

unscrambler. *Noun.* A device on a conveyor belt which feeds ware single file from a mass of randomly placed pieces.

unslaked lime. *Noun.* Another name for **calcium oxide**. See **slaked lime**.

unsound. *Adjective.* Lacking strength, solidity, or firmness.

unsoundness. *Noun.* An indication of the expansion after setting of **Portland cement**, a feature that frequently causes cracking or crumbling of the mortar or concrete.

unstable. *Adjective.* (1) Lacking stability; readily decomposing. (2) A tendency to self-oscillation in an electrical circuit or mechanical body.

unstan. *Toponym.* Early Neolithic pottery originally found in the chambered tomb at Unstan on Orkney.

unstratified. *Adjective.* Not occurring in distinct layers.

unsymmetrical laminate. *Noun.* A composite laminate with no midplane symmetry.

up-conversion. *Noun.* The conversion of infrared radiation into visible light by **laser** pumping of suitable ions in a ceramic crystal structure, such as the **garnet** structure.

up-conversion laser. *Noun.* See **up-conversion**.

updraft kiln. *Noun.* A kiln in which the movement of combustion gases proceeds upwards from the firebox through the kiln setting to the exhaust flues.

updraw. *Verb.* The process of continuous drawing of glass of various cross sections in a vertical plane from an orifice to make glass rod or tubing.

u-phase. *Noun.* A grain boundary phase in the Y-Si-Al-O-N system with a decomposition temperature around 1,450 °C.

uphill teeming. *Verb.* To discharge molten material from a ladle through refractory tubes into moulds such that the liquid is introduced at the bottom of the mould instead of at the top.

upper critical point. *Noun.* The locus of composition, temperature, or pressure, at the maximum in temperature or pressure where two or more conjugate phases can coexist and also where the conjugate phases become identical.

upper range value. *Noun.* The highest value of a property that an instrument is designed to measure.

upright. *Noun.* An item of kiln furniture used to support ware during firing.

upstroke press. *Noun.* A hydraulic press where pressure is applied by an upward movement of the ram.

uptake. *Noun.* (1) A refractory-lined passage in an open-hearth furnace to conduct hot air and gaseous fuels into the combustion area. (2) A pipe or shaft connecting a furnace to a chimney for the removal of exhaust gases.

uralite. *Noun.* An **amphibole** mineral similar to **hornblende** that substitutes for **pyroxene** in some **igneous** and **metamorphic** rocks.

uranium. *Noun.* UO_2 . Uranium dioxide; used as a nuclear fuel element and as a red, yellow and orange colorant in ceramic glazes; very non-stoichiometric, both hyper and hypo within the **fluorite** structure, so that UO_2 is only an ideal composition. Mp 3,000 °C; density 10,900 kg m⁻³.

uranic. *Adjective.* Of or containing uranium.

uranide. *Noun.* Any element having an atomic number greater than that of protactinium.

uraninite. *Noun.* A black, radioactive mineral, containing cubic urania, UO_2 , radium, lead, helium, and **radon**. It occurs in coarse granites and is the major ore of uranium when it occurs as **botryoidal** masses called **pitchblende**. Hardness (Mohs) 5.5–6; density 8,000–10,900 kg m⁻³ depending on the uranium oxidation state between UO_2 and U_3O_8 .

uranite. *Noun.* Cover all name for minerals containing uranium.

uranium. *Noun.* (1) A white lustrous, radioactive, metal. (2) In a ceramic context it is a term referring to **uranium** or compounds of uranium.

uranium barium oxide. *Noun.* See **barium diuranate**.

uranium borocarbide. *Noun.* UB_2C . A polymorphic ternary carbide, the α -form is orthorhombic and paramagnetic; the β -form is hexagonal and also paramagnetic, $T_c = 85$ K; the β -form is easily formed but the α -form requires a long anneal at 1,670 °C.

uranium carbide. *Noun.* See **uranium monocarbide** or **uranium dicarbide**.

uranium content equivalent. *Noun.* A concentration of ^{235}U that will provide a fast-neutron cross-section equivalent to that of a specific impurity element.

uranium, depleted. *Noun.* See **depleted uranium**.

uranium dicarbide. *Noun.* UC_2 . A tetragonal phase containing $(\text{C}_2)^{2-}$ ionic units; transforms to the cubic form at about 1,900 °C and melts around 2,370 °C; density 11,280 kg m^{-3} . Pyrophoric, ignites in air at 400 °C; decomposes in hot water, acids, and alkalis with the evolution of hydrocarbon gases. Used as a **nuclear fuel**.

uranium dioxide. *Noun.* See **urania**.

uranium, enriched. *Noun.* See **enriched uranium**.

uranium monocarbide. *Noun.* UC . A special ceramic carbide with the rock salt cubic crystal structure and highly **nonstoichiometric**. Used as a nuclear fuel. Mp 2,550 °C; density 13,630 kg m^{-3} .

uranium monoxide. *Noun.* UO_{1-x} . A highly nonstoichiometric oxide with the **rock salt cubic structure**.

uranium, natural. *Noun.* See **natural uranium**.

uranium nitrate. *Noun.* See **uranyl nitrate**.

uranium, normal. *Noun.* See **normal uranium**.

uranium oxide. *Noun.* One of the several oxides of uranium, including UO , U_2O_3 , UO_2 , U_3O_8 and $\text{UO}_4 \cdot x\text{H}_2\text{O}$. Used in nuclear applications and as green and yellow ceramic colorants.

uranium peroxide. *Noun.* $\text{UO}_4 \cdot x\text{H}_2\text{O}$. Used as a red, orange, or yellow colorant. Decomposes at 115 °C; density 12,500 kg m^{-3} at 15 °C. Also called **uranium tetroxide**.

uranium ruthenium carbide. *Noun.* U_2RuC_3 . A tetragonal phase, and $\text{URuC}_{0.7}$, a cubic **perovskite** phase; both occur as precipitates in irradiated UC_{1+x} nuclear fuel pins.

uranium tetroxide. *Noun.* See **uranium peroxide**.

uranium trioxide. *Noun.* UO_3 . A radioactive red or yellow powder; used as an orange colouring agent in ceramics. Density 8,340 kg m^{-3} ; decomposes when heated.

uranium yellow. *Noun.* $\text{Na}_2\text{U}_2\text{O}_7 \cdot 6\text{H}_2\text{O}$. Sodium diurate, a yellow to orange solid; used as a yellow pigment

in glazes and enamels, and in the manufacture of fluorescent uranium glass.

uranous. *Adjective.* Of or containing uranium in a low valency state.

uranous oxide. *Noun.* U_2O_3 . A **bixbyite** structure oxide with no obvious ceramic uses.

uranous-uranyl oxide. *Noun.* U_3O_8 . Naturally occurring uranium oxide, used in nuclear applications. Decomposes at 1,450 °C; density 8,390 kg m^{-3} .

uranyl. *Noun.* Consisting of, or containing the divalent ion UO_2^{2+} or the group UO_2 .

uranyl nitrate. *Noun.* $\text{UO}_2(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$. Used in ceramic glazes and porcelain-enamels as a red, yellow or orange colorant depending on the concentration and other components of the glaze frit. Mp 60.2 °C, bp 118 °C; density 28,070 kg m^{-3} .

urea. *Noun.* $\text{CO}(\text{NH}_2)_2$. Inorganic compound used as a binder in porcelain-enamels to minimise **tearing**. Mp 132.7 °C; density 1,335 kg m^{-3} .

urn. *Noun.* A large vase like vessel usually bulbous in shape with a foot.

UTS. *Abbreviation.* Ultimate tensile strength. See **ultimate tensile strength**.

U-type ferrite. *Trade name, noun.* $(\text{MO})_6(\text{Fe}_2\text{O}_3)_{18}$. One of the six types of hexagonal **ferrimagnetic** material based on **solid solutions** formed from **iron oxide**, Fe_2O_3 , and oxides of divalent metals but most commonly the M^{2+} ion is barium, Ba^{2+} .

U-type furnace. *Noun.* A continuous furnace shaped like a hairpin in which porcelain-enamels during firing enter and leave the furnace at adjacent stations; the firing zone is usually located in the bend of the hairpin shape.

u-value. *Noun.* Thermal transmittance value. See **thermal transmittance**.

uvarovite. *Noun.* $\text{Ca}_3\text{Cr}_2(\text{SiO}_4)_3$. A variety of green **garnet**; used as a colouring agent and as an abrasive. Density 3,500–4,300 kg m^{-3} ; hardness (Mohs) 6.5–7.5.

Uviol glass. *Tradename, noun.* A glass that is highly transparent to ultraviolet radiation.

V. *Noun.* Something shaped like a V.

v. *Symbol.* Standing for: (1) velocity; (2) specific volume of a gas.

V. *Symbol.* Standing for: (1) volume in the sense of capacity; (2) **volt**; (3) Roman numeral for five; (4) vanadium; (5) **luminous efficiency**.

vacancy. *Noun.* A defect in a crystal consisting of an unoccupied lattice position in the crystal structure.

vacancy diffusion. *Noun.* The diffusion mechanism whereby atomic migration is from lattice site to vacancy and then on to lattice site etc.

vacuum. *Noun.* (1) A space devoid of matter. (2) A space in which air or gas is contained at a reduced pressure, usually below normal atmospheric pressure.

vacuum and blow process. *Noun.* The process employed in the manufacture of bottles in which glass is gathered by vacuum and subsequently blown.

vacuum bag. *Noun.* A flexible membrane used to maintain a vacuum during some moulding and curing processes.

vacuum bottle. *Noun.* A bottle or other container made as a double-walled vessel with the cavity evacuated to limit the conduction of heat or cold into the contents of the container from the surrounding environment. Also called **vacuum flask**.

vacuum casting. *Verb.* The forming of ceramic ware by introducing a slip into a permeable mould and hastening the removal of water from the slip by the application of a vacuum to the outer walls of the mould to produce a rigid or semi rigid article.

vacuum chamber. *Noun.* The section of an **auger** extrusion machine through which plastic clay is kneaded under a vacuum to remove air and gases from the mass.

vacuum coating. *Verb.* Deposition of a volatile material onto a substrate in a vacuum. Also known as **vapour deposition**.

vacuum concrete. *Noun.* A fast-curing concrete of improved durability, high strength, increased surface hardness, and improved resistance to crushing obtained by subjecting freshly poured concrete to a vacuum to remove entrapped air and the excess water not required for setting the concrete.

vacuum degassing. *Verb.* The removal of gases from materials and bodies by subjection to a vacuum at elevated temperatures.

vacuum deposition. *Noun.* The condensation of a vaporised material to form a coating on the cold surface of another material. The whole operation takes place in a partial vacuum.

vacuum diffusion. *Noun.* The process whereby diffusion of selected impurities into a semiconducting material is achieved in a vacuum to induce desired properties.

vacuum drying. *Noun.* The technique of speeding the removal of moisture from a material or body by means of a vacuum applied in conjunction with a conventional drying system.

vacuumed clay. *Noun.* Clay that has been subjected to vacuum treatment to remove air bubbles to increase its density and improve its green strength in ceramic bodies.

vacuum firing. *Verb.* Firing of ware in an evacuated furnace to reduce the porosity and to prevent oxidation of the body.

vacuum flask. *Noun.* An insulating flask made with double walls usually of silvered glass, with an evacuated space between them. Used to maintain substances at high or low temperatures. See **vacuum bottle**. Also called **Thermos**, **Dewar flask**.

vacuum forming. *Verb.* A method used to form thermoplastic polymer matrix composites into 3-D shapes starting from sheets. The sheet is clamped above an evacuated mould and heated to the softening point whence it is drawn down into the mould and shaped.

- vacuum furnace.** *Noun.* A furnace or heating device constructed so as to permit the firing chamber to operate under a vacuum.
- vacuum gauge.** *Noun.* Any of a number of instruments capable of measuring pressures below an atmosphere.
- vacuum infiltration.** *Verb.* A type of pressure infiltration whereby molten metal is brought into contact with a porous ceramic body or woven preform in a vacuum container.
- vacuum mat.** *Noun.* A combination screen and textile filter placed over freshly poured concrete and through which by application of a vacuum, air and water are sucked out to produce a dense concrete.
- vacuum metalising.** *Verb.* A vacuum method of evaporating metal onto a surface.
- vacuum mixer.** *Noun.* A machine in which the clay or body is moistened and deaired concurrently as it enters the mixing chamber to be blended to a forming consistency.
- vacuum pug mixer.** *Noun.* A **pug mill** consisting of a trough with a longitudinal shaft on which blades are mounted for the pugging of clay mixtures, the trough being situated in a vacuum chamber to permit concurrent deairing of the mixture.
- vacuum pump.** *Noun.* A device for exhausting air or other gases from an enclosed space.
- vacuum tube.** *Noun.* An electronic valve.
- valence or valency.** *Noun.* The property of an atom or group of atoms that determines the number of other atoms or groups with which it will unite chemically.
- valence band.** *Noun.* In a solid material it is the **energy band** that contains the valence electrons.
- valence electron.** *Noun.* A high energy level electron that takes part in bonding.
- valentinite.** *Noun.* Another name for **stibium oxide**.
- validation protocol.** *Noun.* The document that outlines a process, highlights the critical parameters, sets the specification to which the parameters are tested and defines the testing required to prove the viability of the process.
- valley.** *Noun.* In fatigue testing it is the point where the slope of the load versus time curve becomes positive.
- valley tile.** *Noun.* A V-shaped or appropriately curved roofing tile used in the valley or junction at the bottom of two sloping roof segments.
- validation.** *Noun.* A process is evaluated in order to achieve this state (validation) for a given application in a given facility.
- value.** *Noun.* The degree of lightness or darkness of a colour on a scale ranging from black to white. See **Munsell colour classification**.
- valve, air-relief.** *Noun.* See **air-relief valve**.
- vanadic.** *Adjective.* Of or containing vanadium.
- vanadinite.** *Noun.* $\text{Pb}_5(\text{VO}_4)_3\text{Cl}$. A red to yellowish mineral with a hexagonal crystal structure; results from the weathering of lead ores in desert regions; a source of vanadium.
- vanadium.** *Noun.* In the ceramic context, a term for an oxide of vanadium; V_2O_5 , V_2O_3 and VO_2 .
- vanadium carbide.** *Noun.* (1) VC. Cubic, nonstoichiometric phase used as a component in ceramic cutting tool compositions. Mp 2,830 °C; density 5,772 kg m⁻³. (2) V₂C. Another nonstoichiometric refractory phase; mp 2,166 °C; density 5,750 kg m⁻³.
- vanadium dioxide.** *Noun.* VO_2 . An oxide with the fluorite crystal structure that forms **Magneli phases**. Mp 1,541–1,637 °C; density 4,650 kg m⁻³.
- vanadium monoxide.** *Noun.* VO. Highly nonstoichiometric, rock salt cubic oxide of gold; metallic hue. Mp 2,049 °C.
- vanadium pentoxide.** *Noun.* V_2O_5 . Used as a red, green, pink or yellow colorant and flux in glasses, porcelain-enamels, and glazes; inhibits ultraviolet transmission in glass. It is a glass former itself. Also used as a catalyst in sulphuric acid production. Mp 690 °C; density 3,362 kg m⁻³.
- vanadium sulphate.** *Noun.* $\text{VOSO}_4 \cdot 2\text{H}_2\text{O}$. Used as a green and blue pigment in glass, porcelain-enamels, and glazes.
- vanadium tetroxide.** *Noun.* V_2O_4 . Used in refractory compositions fusing at temperatures above 1,540 °C but the refractories tend to be unstable in air. Forms a low-porosity body with **beryllia**, BeO. Mp 1,967 °C; density 4,339 kg m⁻³.
- vanadium trioxide.** *Noun.* V_2O_3 . Used in glazes as a flux, and as a yellow pigment in various combinations with **tin oxide** or **zirconium oxide**, and as a blue pigment when used in combination with **zirconium silicate**. Mp 1,970 °C; density 4,840 kg m⁻³.
- van der Waals adsorption.** *Noun.* The binding of an adsorbate to the surface of a solid by forces having amounts of energy approximating those of condensation.
- van der Waals attraction.** *Noun.* An important factor in the aggregating tendencies of suspended particles. Attraction to form **aggregates** depends on the distance between surfaces of the particles which is related to Δx in the **Brownian motion** equation and the volume fraction, F, in the van der Waals attraction: $h = d_p [(1/3\pi F + 5/6)^{1/2} - 1]$, where h is the mean surface distance. This predicts that only small F values can be attained before aggregation of nanosized particles and so surface treatments, such as polymer dispersants, have to be used.

van der Waals bond. *Noun.* A weak dipole-dipole interaction arising from small fluctuations in the electronic distributions in atoms and molecules. Its existence accounts for why gases do not follow the simple gas laws.

van der Waals equation. *Noun.* A thermodynamic equation relating the pressure, volume, and absolute temperature of a gas with reference to the finite size of the molecules and the attractive force between them; calculated by the formula $P = [RT/(v - b)] - (a/v^2)$, where P is the pressure, v is the volume per mole, T is the absolute temperature, R is the gas constant, and a and b are constants.

van der Waals forces. *Noun.* (1) Compared with bonding forces involving electron pairing or electron transfer, these are extremely weak forces caused by the momentary fluctuation in the electronic structure of an atom producing a dipole in the atom, this then induces a dipole in the neighbouring atom which stabilises the first dipole and allows attractive interaction. (2) Induced polarisation effects in molecules that are very weak and so only evident at low temperatures.

Vandyke brown. *Noun.* A brown pigment consisting of **ferric oxide** and **lampblack**.

vane feeder. *Noun.* A device consisting of a rotating horizontal shaft equipped with blades to feed ground clay from the bottom of a hopper or bin to a mixer or other receptacle.

van t' Hoff equations. *Plural noun.* Equations that relate the values of the equilibrium constant of a reaction at different temperatures to the enthalpy of the reaction. The basic equation is: $d(\ln K)/d(1/T) = -\Delta H^\circ_T/R$, where K is the measured equilibrium constant, ΔH°_T is the **standard enthalpy of reaction** and R is the **gas constant**. This equation is integrated to give the temperature dependence of K on T .

vapour. *Noun.* A gas that is at a temperature below its critical temperature and which can be liquefied by the application of appropriate pressure without reduction in temperature.

vapour barrier. *Noun.* A layer of plastic or other impervious sheeting placed under concrete floors and on walls to prevent the passage of air and moisture through the concrete.

vapour deposition. *Noun.* See **vacuum deposition**.

vapour glaze. *Noun.* A glaze composed of lead, sodium, and boric oxides that volatilise from a melt during firing, but will condense and reliquefy on ceramic surfaces on cooling.

vaporisation. *Noun.* The conversion of a liquid or solid to its vapour state, particularly by heating.

vaporisation, heat of. *Noun.* See **latent heat of vaporisation**.

vaporiser. *Noun.* A device that causes vaporisation or a substance that vaporises.

vapour phase epitaxy. VPE. *Noun.* Growth on a substrate from the vapour phase.

vapour pressure. *Noun.* The pressure exerted by the vapour of a solid or liquid when in equilibrium with its solid or liquid form.

var. *Noun.* A measure of reactive power of an alternating current equal to the product of current (amperes) and voltage (volts).

varactor. *Noun.* A semiconductor diode used as a voltage-dependent capacitor operated with a reverse bias.

variable. *Adjective.* Having a range of possible values.

variance. *Noun.* (1) A measure of the dispersion of a series of results around their average; it is the sum of the squares of the individual deviations from the average of the results divided by the number of results minus one. (2) The sum of squared deviations or errors of observations compared with their arithmetic mean divided by the number of observations. (3) The square of the standard deviation. (4) Used in the **phase rule** to denote the number of degrees of freedom of a system.

variegated. *Adjective.* Having different coloured spots, streaks, etc.

variform. *Adjective.* Varying in shape.

varindor. *Noun.* An inductor in which the inductance varies markedly with the current in the winding.

variole. *Noun.* Rounded masses that make-up the rock **variolite**.

variolite. *Noun.* A basic **igneous rock** consisting of **variole** made-up of radiating, fibrous crystals, which give it a pockmarked appearance.

variometer. *Noun.* A variable inductor.

variscite. *Noun.* A green mineral containing hydrated **aluminium phosphate**.

varistor. *Noun.* A ceramic semiconductor device with a highly nonlinear current voltage characteristic that can be engineered by composition and sintering control, to be insulating up to a certain breakdown field, F_s . Above F_s it becomes highly conducting. Such characteristics make it good at protecting other solid-state devices in a circuit from transient voltage surges. ZnO is the common base material doped with other oxides; for example: ZnO (97 mol %), Sb_2O_3 (1 %), plus 0.5 % each of Bi_2O_3 , CoO, MnO, and Cr_2O_3 .

varistor power law equation. *Noun.* An empirical relationship between breakdown field, F and the current, J , flowing in a ceramic varistor: $\ln J_1/\ln J_2 = (\ln F_1/\ln F_2)\alpha$; if $\alpha = 1$ the device is ohmic and as α tends to infinity the material is a perfect varistor, i.e., the current varies infinitely for small changes in applied field; α is in the range 25–50 for typical ZnO devices.

- varnish.** *Noun.* A solution or suspension of resins in a liquid, which evaporates and leaves a decorative or protective coating on a surface painted with it.
- varnish mounts.** *Plural noun.* **Decals** applied on varnished ware from a facedown position.
- Varsol.** *Trademark, noun.* An aliphatic petroleum solvent used to clean silk screens.
- varved clay.** *Noun.* A natural clay deposited in layers or in a sequence of layers, one coarse and the other fine or silty.
- vaseline glass.** *Noun.* Opalised glass, an art effect produced in glasses containing phosphorous and calcium where regions of spherical **apatite** cause light scattering to give changing colours depending on the angle of incident light in a similar way to colour production in **opal**.
- vat.** *Noun.* A large container for holding liquids. A vessel or tank.
- vaterite.** *Noun.* An unstable polymorph of CaCO_3 in which the ab plane, perpendicular to the c-axis, contains the Ca^{2+} ions while the $[\text{CO}_3]^{2-}$ ions are parallel to the ac plane. It can be stabilised as a biocer. See **biocer**.
- vault.** *Noun.* An arched structure that forms a roof or ceiling.
- vault effect.** *Noun.* The sudden decrease in pressure observed during a pressure-density determination as powders are dry pressed. It is due to the sudden collapse of interconnected powder particles into the voids formed by the interconnections.
- V-chip.** *Noun.* A computer chip that can be installed in a **VDU** and can be programmed to block material. See **visual display unit**.
- VCSEL.** *Abbreviation.* Stands for vertical cavity surface-emitting laser. See **vertical cavity surface-emitting laser**.
- v-cut.** *Noun.* A V-shaped edge cut with an included angle 120° or less in **mica** sheets that are used as electrical insulators in special applications.
- v-drain.** *Noun.* A manufacturing defect evidenced by a second flowing of porcelain-enamel slip on ware which occurs after it appears that draining has been completed; a double draining type of phenomenon.
- VDU.** *Abbreviation, noun.* Standing for visual display unit.
- vector.** *Noun.* A variable that has magnitude and direction and can be resolved into components, such as force.
- vector field.** *Noun.* A region of space controlled by some vector quantity, such as magnetic field strength, in which each point can be described by a vector value.
- Veegum T.** *Trademark, noun.* A highly refined magnesium aluminium silicate suspending and plasticising agent that fires to a bright white colour.
- Vegard's law.** *Noun.* The linear relationship between the x-ray **lattice parameters** and the composition of solid solutions
- vegetable ash.** *Noun.* A source of alkali made by burning **barilla** and kelp; originally used in glass manufacture.
- vegetable inclusions.** *Noun.* A misnomer used to describe inclusions of dispersed metal oxides in electrical insulation; these appear as areas of pastel colours in transmitted light.
- vegetable oil.** *Noun.* Hydrogenated oils of peanuts, soybeans coconut, and the like which are employed in the **sizing** for glass-textile yarns as lubricants to improve the resistance of the fibres to abrasion.
- vehicle.** *Noun.* A fluid in which a material is dissolved or held in suspension to facilitate a subsequent operation, such as an oil or varnish in graining pastes printing inks and pigments for ceramic decoration.
- veil.** *Noun.* A very thin mat of fine long fibres used in the outermost layers of a composite to improve its surface properties.
- veiling.** *Verb.* Gold and organic colours sprayed onto ware in such a way as to give a threadlike texture.
- vein.** *Noun.* (1) A well-defined mass of ore or mineral occurring as layers between rock strata. (2) An irregular streak of colour or impurity substance in a material.
- vein graphite.** *Noun.* Highly crystalline, naturally occurring **graphite** with a **metallic lustre**; found in massive form, from 2 mm to 2 m seams; believed to arise from oil deposits under pressure and heat.
- veining.** *Adjective.* A network of streaks or veins over a surface.
- vein quartz.** *Noun.* **Quartz** occurring as **gangue** in a vein of valuable ore.
- veinstone.** *Noun.* Synonym for **gangue**.
- Vello process.** *Trade name, noun.* A continuous drawing process for the production of glass tubing or **cane** in which the molten glass is fed downward to the draw through an annular orifice.
- vellum glaze.** *Noun.* A semi-matte glaze having a satin-like appearance due to the presence of minute crystals of **zinc silicate**, **zinc titanate**, or **lead titanate** in the fired glaze surface.
- velocity.** *Noun.* The rate of change in the position or displacement of a body in a particular direction with time; expressed as a unit of length per unit of time.
- velocity gradient.** *Noun.* The change in relative velocity of two parallel plates, separated by a distance r , as a function of fraction of r .

velocity head. *Noun.* The velocity of a fluid expressed in terms of the head or static pressure required to produce that velocity. It equals $\rho v^2/2$, where ρ is the density of the fluid and v is the velocity.

velocity modulation. *Noun.* The modulation in velocity of a beam of electrons or ions when it passes through a high-frequency electric field. See **cavity oscillator**.

velvet finish. *Noun.* A surface finish on glass produced by two **white-acid treatments**; a tinge of colour is embossed on the surface during the process to obtain complete obscuration.

veneer. *Noun.* (1) A single **wythe** of masonry not structurally bonded but applied for facing purposes. (2) The decorative surface of an asbestos-**shingle** or sheet that is usually pigmented or granular to provide colour to the areas in which the shingle or sheet is installed.

veneer, adhesion-type. *Noun.* See **adhesion-type ceramic veneer**.

Venetian glass. *Noun.* Fine ornamental glassware made in or near Venice. Murano is particularly associated with its manufacture.

Venetian red. *Noun.* A red to brown ceramic pigment composed of 15–40 % of a high-grade **ferric oxide** and 60–85 % of **calcium sulphate**.

vent. *Noun.* (1) An opening to permit the discharge or release of pressure from enclosed areas such as a pressure tank, steam boiler, etc. (2) An opening to permit passage or escape of liquids, gases, vapour, fumes, heat, etc. from an area such as a **pickling room**, furnace room, the interior of a furnace, etc. (3) To change the atmosphere in a confined space.

ventilating fan. *Noun.* An electrically or mechanically operated device to remove contaminated spent air and to introduce fresh or cooling air into a desired area.

ventilate. *Verb.* To replace air in an area with fresh air.

ventilator. *Noun.* A device that exhausts and replaces stale, contaminated, or other air from an area with circulating fresh air.

verd antique. *Noun.* A dark-green, mottled impure form of **serpentine** marble.

Verdet constant. *Noun.* The rotation per unit path, per unit field strength; for **flint glass** at 18 °C it has a value of 0.0317. See **Faraday effect**.

verdigris. *Noun.* $\text{Cu}_2(\text{OH})_2(\text{C}_2\text{H}_3\text{O}_2)_2$. (1) Basic copper acetate; an important green pigment made by reacting copper sheets with grape skins from wine making. (2) A green or bluish patina of copper salts and copper oxide found on copper, bronze or brass. Also known as **aerugo**.

verditer. *Noun.* See **copper carbonate**.

verge. *Noun.* The edge of a sloping roof projecting over a **gable**, the point where roofing tile are edge bedded for improved appearance and to deflect rain water onto the roof for drainage.

verification tests, quality. *Plural noun.* See **quality verification tests**.

vermiculate. *Verb trans.* To decorate with wavy or worm-like tracery or markings.

vermiculation. *Noun.* Decoration consisting of a worm-like designs.

vermiculite. *Noun.* A member of a group of **micaceous** minerals of the general formula $(\text{Mg}, \text{Fe})_3(\text{Si}, \text{Al}, \text{Fe})_4\text{O}_{10} \cdot 4\text{H}_2\text{O}$; when heated, they exfoliate from 16 to 20 times their original size as the water in the mineral flashes into steam. They are used as ingredients in lightweight concrete, acoustic and fireproof plaster, asbestos tile, acoustic tile, and refractory insulators, for their insulating values and low density. Also used to grow young plants on.

vermilion or vermillion. *Noun.* **HgS. Mercuric sulphide**; used by the Chinese for 1,000 years and considered to be the best red pigment. Also called **cinnabar**. See **cinnabar**.

vermillion zircon. *Noun.* A naturally occurring form of **zirconium silicate** coloured vermillion from partial cation substitution. It can be cut and polished when it displays a **lustre** and fire close to that of **diamond**.

Verneuil method of crystal growth. *Noun.* A process in which a powder, such as **corundum**, is dropped through an oxy-hydrogen flame so that it falls in a molten state onto a crystal seed of the same material, the mass then growing to form jewels and bearings for watches and other delicate instruments.

Verneuil synthetic. *Eponym.* Another name for artificial **ruby**.

vernier. *Noun.* A short, specially graduated scale that slides along the main scale allowing fine measurements of parts of graduations to be made.

vertical cavity surface-emitting laser. VCSEL. *Noun.* Semiconductor diode laser that emits light from the surface instead of the end.

vertical retort. *Noun.* A vertical refractory chamber lined with **silicon carbide brick** in which zinc is smelted.

Verwey transition. *Noun.* An electrical transition observed in **magnetite**, Fe_3O_4 , at $T = 123 \text{ K}$; above and below 123 K the material behaves as a semiconductor but with a sharp drop in conductivity and different temperature characteristics. At the same temperature there is a **latent heat** effect and a change in volume. Thought to be due to an ordering effect of Fe^{2+} and Fe^{3+} ions on octahedral sites in the **spinel** lattice.

very high frequency. VHF. *Noun.* A radio frequency lying between 30 and 300 MHz.

very large scale integrated. VLSI. *Noun.* A term applied to **transistor chips** indicating approximately 10^{17} transistors per 1 cm^3 of chip.

very low frequency. VLF. *Noun.* A radio frequency lying between 3 and 30 kHz.

VLSI. *Abbreviation.* Stands for very large scale integrated. See **very large scale integrated**.

vesicular. *Adjective.* Having a cellular structure; a term applied to fireclay that has become **bloated** by overfiring.

vesicular basalt. *Noun.* Basalt is the most common **extrusive rock** containing **olivine** and **augite** formed from solidified lava. The **vesicular structure** comes from gases trapped in the lava scum on cooling and produces a low density rock. See **amygdaloidal basalt**.

vesicular structure. *Noun.* A body containing a conglomeration of small, spherical cavities, usually filled with air or a gas.

vesuvianite. *Noun.* $\text{Ca}_{10}\text{Al}_4(\text{MgFe})_2\text{Si}_9\text{O}_{34}(\text{OH})_4$. Occurs as brown, green, or yellow tetragonal crystals in limestone. It contains large $[\text{Si}_9\text{O}_{34}]^{28-}$ ring units in a tetragonal structure. First found in Vesuvius lava. Also called **idocrase**.

vestibule. *Noun.* The area at the entrance of a **drier tunnel** where cars of **greenware** may be stored. Designed to reduce end heat losses.

vesuvian. *Noun.* Another name for **vesuvianite**.

vesuvianite. *Noun.* $\text{Ca}_{10}(\text{MgFe})_2\text{Al}_4\text{Si}_9\text{O}_{34}(\text{OH})_4$. A green to brown hydrated silicate mineral occurring as tetragonal crystals in **limestone**. first found in the lava of Vesuvius. Used as a gemstone. Also called **vesuvian**, **idocrase**.

veve apparatus. *Noun.* A vibrating **slump-testing** device employed to evaluate the consistency of concrete.

VHF. *Abbreviation.* Stands for very high frequency. See **very high frequency**.

VHN. *Abbreviation.* Stands for Vickers hardness number, which is the hardness as determined using a **Vickers diamond indenter**, expressed as kg mm^{-2} or GN m^{-2} . See **Vickers hardness**.

via. *Noun.* Vertical metallic connections linking successive layers in **integrated circuits** deposited on to semiconductor chips and ceramic substrates. See **interconnects**.

vibrating ball mill. *Noun.* A **ball mill** in which conventional milling is combined with a vibratory or bouncing action of the mill to obtain more efficient and rapid grinding.

vibrating feeder. *Noun.* An electrical or mechanical device employed to impart a vibrating or jarring action

on a hopper or bin to prevent packing of its contents, and to increase and control the rate of flow of the material from the hopper or bin.

vibrating parts feeder. *Noun.* A device on a feed-line that supplies small components to a machine in single file and all facing the same way by imparting a vibratory motion.

vibrating pebble mill. *Noun.* See **vibrating ball mill**.

vibrating screen. *Noun.* Wire-mesh screens that are vibrated by any of a variety of means to increase efficiency and minimise clogging; sometimes the screens may be heated to obviate the influence of moisture on the material being screened.

vibration. *Noun.* (1) Rapid periodic motion in alternately opposite directions. (2) The act of rendering fresh concrete into a quasi-liquid state by subjecting the mass, in forms, to high-frequency vibratory impulses to consolidate the concrete in the forms.

vibrational direction. *Noun.* See **polars**.

vibration limit. *Noun.* The setting or hardening point of concrete, as determined by a penetration needle test, beyond which the concrete no longer can be made plastic by vibration. See **Vicat needle**.

vibrator. *Noun.* (1) A device for producing a vibratory motion such as used when wet concrete is poured into moulds. (2) A device in which a vibrating conductor interrupts a circuit to produce an oscillating current suitable for amplification or voltage transformation.

vibratory crusher. *Noun.* A ball mill attached to a vibrating mechanism in order to increase the shattering effects by causing the grinding balls to bounce.

vibratory mill. *Noun.* See **vibratory crusher**.

vibratory pressing. *Verb.* A process for forming refractory and other ceramic shapes in which the ground particles of the material being formed are packed closely together by rapid impact-type vibrations of the top and bottom dies.

vibrocast pipe. *Noun.* Concrete pipe made by placing fresh concrete in a stationary vertical mould or form and then subjecting the unit to internal or external vibratory forces.

vibro-energy mill. *Noun.* A ball mill designed to vibrate on both horizontal and vertical planes.

vibronic. *Adjective.* Concerned with both vibrational and electronic energy levels in a crystal or molecule.

Vicat hardness. *Noun.* A penetration hardness test using a flat-ended needle with an area of 1 mm^2 loaded with a kilogram. When penetration is 1 mm the time of set for a concrete is recorded or the temperature needed to achieve this in polymeric materials.

Vicat needle. *Noun.* A needle of diameter 1.13 mm to which a total load of 2.94 N is applied for testing the

- degree of **set** of **OPC cements** and **mortars**. It is released at the surface and the time taken to penetrate to 5 ± 1 mm from the bottom of the mould is determined.
- vice**. *Noun*. A clamping device consisting of two jaws, which a screw or lever may operate and which is designed to hold a work-piece in position.
- vicinal prominence**. *Noun*. A form of surface imperfection on a crystal consisting of a small elevation with its own set of faces.
- vicinal water**. *Noun*. Interfacial water between two solids; plays an important part in colloidal stability and sedimentation.
- Vickers diamond indenter**. *Noun*. A small diamond mounted at the end of a rod on a microscope assembly through which a vertical load can be applied to make the diamond penetrate the surface. The diamond has a pyramid shape with an angle of 136° between the faces and leaves a square impression when the diamond is withdrawn.
- Vickers hardness**. *Noun*. A measure of the hardness of glasses, glazes, and other surfaces in which a diamond pyramid indenter with a 136° angle between opposite faces is forced into the surface of a test specimen under variable loads; the hardness is reported as the **Vickers hardness number**, kg mm^{-2} or GN m^{-2} , by measuring the diagonal distance of the diamond-shaped indent left on the surface and using this to determine the projected contact area.
- Vienna lime**. *Noun*. A mixture of **dead burned dolomite** with extra added **magnesia**; used to polish nickel metal to produce the deep under-surface blue colour.
- villiaumite**. *Noun*. NaF . Naturally occurring **sodium fluoride**. It has a deep red in colour arising from lattice defects. Density $2,810 \text{ kg m}^{-3}$; hardness (Mohs) 2–2.5.
- villiform**. *Adjective*. Having a shape with numerous thin finger-like projections.
- Vingerling clay**. *Noun*. Highly pure clays manufactured in Holland mainly from British raw materials.
- virescent**. *Adjective*. Greenish.
- virgate**. *Adjective*. Rod-shaped, long thin and straight.
- viridescent**. *Adjective*. Greenish or tending towards a green colour.
- viridian**. *Noun*. A hydrated form of **chromic oxide** used as a bluish-green pigment.
- viscid**. *Adjective*. Having thick, syrupy, and adhesive qualities.
- viscoelastic**. *Adjective*. The strain behaviour of materials, such as plastics and glass, near the **transformation range**. There are three stages in the strain-time behaviour: instantaneous recoverable elastic part, slow elastic part, and also recoverable over the same time period, and a viscous, non-recoverable, strain occurring at a constant rate as long as a load is applied.
- viscoelasticity**. *Noun*. A way of responding to applied stress as if the solid was both an elastic solid and a viscous liquid most plastics exhibit this behaviour. See **viscoelastic**.
- viscoid**. *Adjective*. Somewhat viscous.
- viscometer**. *Noun*. An instrument designed to measure the flow resistance of fluids.
- viscometer, Brookfield**. *Noun*. See **Brookfield viscometer**.
- viscometer, torsion**. *Noun*. See **torsional viscometer**.
- viscose**. *Noun*. A **rayon** precursor whose chemical name is **cellulose xanthate**, which is dissolved in **caustic soda** to give the honey coloured liquid known as viscose. The liquid is used to make cellulose fibres when spun into an acid bath to release the xanthate groups and is now a route to ceramic fibres. See **viscose suspension spinning process**.
- viscose suspension spinning process, VSSP**. *Noun*. A method developed in 1987 to make long ceramic fibres. The ceramic powder is suspended in **viscose** and spun through a tiny orifice into a sulphuric acid bath. The resultant **rayon**-ceramic fibres are dried and the cellulose burned-out before sintering to consolidate the fibre.
- viscosity, η** . *Noun*. The resistance of a fluid to free flow expressed in old units as **poises** or dyne-seconds per centimetre. It is the resistance resulting from internal friction in the liquid due to molecular attraction or the combined effects of **cohesion** and **adhesion**. It is the ratio of applied shear stress to the velocity gradient that it produces and for a crystalline solid it is its resistance to permanent deformation **SI units** are Ns m^{-2} .
- viscous**. *Adjective*. Characterised by viscosity, usually high viscosity.
- viscous flow**. *Noun*. Another name for **streamline flow**.
- visible penetrant**. *Noun*. A liquid of low surface tension containing a fluorescent chemical or a dye of intense colour, usually red, which is employed as a visual indication of the porosity, the existence of cracks and other discontinuities, and other surface and subsurface defects.
- vitrain**. *Noun*. The hard black compact constituent of **coal** that often fractures conchoidally. It is the hardened colloidal, carbonaceous gel resulting from the complete decomposition of plant material in the absence of oxygen. See **vitritinite**.
- vitreous, vitrified**. *Adjective*. The state of being glassy in brilliance, brittleness, and composition, the degree of vitrification being evidenced by low water absorption, generally 0.3 % or less in floor and wall tile, low-voltage electrical porcelains, and products of similar compositions and usage, however, bodies with up to 3.0 % water absorption are considered to be vitreous.

vitreous china. *Noun.* Any glazed or unglazed vitreous ceramic product, such as dinnerware, sanitary ware, and artware, which is completely matured hence, water absorption is less than 0.3 %.

vitreous china sanitary ware. *Noun.* This is defined as strong, high grade ceramic ware used for sanitary ware appliances, made from a mixture of white burning clays and finely ground minerals. After firing it will not, even when unglazed, have a mean value of water absorption <0.5 % of the weight of the ware when dry. It is coated on all exposed surfaces with an impervious, non-crazing vitreous glaze giving a white or coloured finish.

vitreous clay pipe. *Noun.* A clay pipe fired in a kiln to induce **vitrification** and which then is glazed to assure water tightness for use in drainage applications.

vitreous enamel. *Noun.* A substantially vitreous or glassy inorganic coating bonded to a metal base by fusion at a temperature above 425 °C for protective purposes. More widely known as **porcelain-enamel**.

vitreous lustre. *Adjective.* A glassy appearance.

vitreous sanitary ware. *Noun.* See **sanitary ware**.

vitreous silica. *Noun.* A transparent or translucent glass consisting almost entirely of **silica**, and which exhibits low thermal expansion, high resistance to thermal shock, high resistance to chemical attack, and is transparent to ultraviolet light. Also known as **silica glass**, **fused silica**.

vitreous slip. *Noun.* A ceramic material or mixture of materials that will produce a vitrified surface when applied and fired on a ceramic body.

vitrescence. *Noun.* (1) The quality of being or becoming vitreous. (2) The process of turning crystalline material into a glass.

vitrescent. *Adjective.* Capable of being transformed into a glass.

vitric. *Adjective.* Of, or relating to, or having the properties of glass.

vitriform. *Adjective.* Having the appearance of glass.

vitrification. *Verb.* The progressive reduction in the porosity of a body as a result of heat treatment and fusion during which a glassy or non-crystalline material is formed that acts as a glass-bonding matrix.

vitrification clay. *Noun.* A clay that will tend to vitrify on heating to elevated temperatures, but usually without deformation until its vitrification temperature is reached.

vitrification range. *Noun.* The temperature interval between the temperature at which a body or substance first begins to fuse and the temperature at which the body begins to deform due to melting.

vitrified bond. *Noun.* The bond between different crystalline phases created by the fusion of ceramic materials in the grain boundaries.

vitrified wheel. *Noun.* A grinding wheel the abrasive ingredients of which are strongly bonded or held together by means of an intergranular glassy phase.

vitriform. *Adjective.* Having the appearance and form of glass.

vitrify. *Verb trans.* To convert material into a glass or glassy state, usually by heat and fusion.

vitrine. *Noun.* A glass display cabinet for showing works of art, such as ceramic vases.

vitrinite. *Noun.* A **coal maceral** formed from the cellulose and glucose/fatty parts of plants in anaerobic conditions. They eventually become **vitrain** and **durain**. Vitrain is one of the three lithotypes in whole **coal** along with **inertinite** and **exinite**.

vitriol. *Noun.* A sulphate of any of various metals such as copper, iron, zinc, etc.

vitroceramic. *Noun.* A glass containing nucleating agents, such as TiO_2 , which may be formed in the conventional glass-forming manner and then devitrified by heat treatment to produce a body of mostly crystalline rather than amorphous structure.

vitro dissolution test. k_{diss} *Noun.* A procedure used to determine the biopersistence of **man-made vitreous fibres** in lungs. The fibres are subjected to a simulated lung fluid at 37 °C and the soluble components measured as a function of time to obtain the dissolution rate, k_{diss} . The target is 95 ng $\text{cm}^{-2} \text{h}^{-1}$.

vivianite. *Noun.* $\text{FePO}_4 \cdot 8\text{H}_2\text{O}$. A phosphate mineral produced in reducing environments, such as under the surface of lakes. Easily reduced by carbon to Fe_3P .

V-K curve. *Noun.* A plot of crack velocity against **fracture toughness** usually determined on double torsion specimens but also by the **indentation** method of late. such a plot indicates the effects of the environment on fracture toughness and on long-term strength.

VLF. *Abbreviation.* Stands for very low frequency. See **very low frequency**.

void audit. *Noun.* A quantitative determination of the number and type of voids in fresh concrete.

void. *Noun.* An unfilled space enclosed within an apparently solid body.

void ratio. *Noun.* The ratio of the volume of void space to the volume of the solid.

void space. *Noun.* The ratio of the volume of voids in a packed powder to the overall volume of the powder bed.

- void swelling.** *Noun.* A phenomenon where lattice **point defects** migrate and cluster together in a way that causes severe lattice distortion and eventual **amorphatisation**.
- volatiles.** *Plural noun.* Materials that vaporise during firing.
- volatile memory.** *Noun.* The type of computer memory, such as **DRAM**, where the data is lost when the power is switched off because it is stored as charge in ceramic capacitors. See **DRAM**.
- volatility.** *Noun.* The tendency of a material to vaporise at a given temperature and pressure.
- volborthite.** *Noun.* $\text{Cu}_3\text{V}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$. A mineral found in some volcanic fumaroles in which layers of CuO_6 -octahedra are connected by V_2O_7 , pyrovanadate groups, analogous to Si_2O_7 units.
- volcanic bombs.** *Noun.* Blobs of lava thrown out of a volcano that solidify in the air and land as hard bombs. They form part of **agglomerate rock**.
- volcanic glass.** *Noun.* Several types of glassy volcanic igneous rocks, such as **obsidian** and **pitchstone**.
- volt.** *Noun.* A unit of electric force equal to the difference in electric potential between two points on a conducting wire carrying a constant current of one ampere when the power dissipated between the two points is one watt.
- voltage.** *Noun.* The value of an electromotive force or difference in potential expressed in volts.
- voltage coefficient.** *Noun.* The ratio of the fractional change in resistance to the change in voltage for any resistor whose resistance depends on the voltage.
- voltage, dielectric breakdown (breakdown voltage).** *Noun.* See **dielectric breakdown voltage**.
- voltage, fritting.** *Noun.* See **fritting voltage**.
- voltage gradient.** *Noun.* (1) Difference in potential per unit thickness of a **dielectric**. (2) Difference in potential per unit length of a conductor.
- voltage, supply.** *Noun.* See **supply voltage**.
- voltaic current.** *Noun.* The electric current produced by chemical action as in a battery composed of a primary cell or cells.
- voltammeter.** *Noun.* An instrument for measuring a current or potential.
- volt-ampere.** *Noun.* The unit of power equal to the product of one volt and one ampere, the equivalent of one **watt**.
- Volterra dislocation.** *Noun.* A line defect in which the displacement vector (**Burgers vector**), is given by the integral $\int (\text{du}/\text{dl})\text{dl}$, satisfies the condition of rigid displacements on the surfaces of the cuts made in a closed ring within the material u is the displacement vector and dl is an element of any large closed path around the line of the singularity caused by introducing the defect.
- voltmeter.** *Noun.* An instrument, such as a galvanometer, calibrated in volts, for the direct measurement of differences in electric potential.
- volume.** *Noun.* The space occupied by a substance.
- volume, apparent.** *Noun.* See **apparent volume**.
- volume, bulk.** *Noun.* See **bulk volume**.
- volume burning shrinkage.** *Noun.* See **firing shrinkage**.
- volume change.** *Noun.* The change in the volume of hardened concrete resulting from expansion and contraction due to wetting and drying or to variations in temperature.
- volume diffusion.** *Noun.* A mechanism responsible for densification in **solid-state sintering** where atoms or ions move through the bulk of the material counter to **vacancies** that move away from sharply curved surfaces such as pores.
- volume drying shrinkage.** *Noun.* Percentage volume change of a moist body on drying given by $100(V_w - V_d)/V_w$ where V_w is the volume of the plastic or wet body and V_d is the volume of the dry body.
- volume fraction, j_v .** *Noun.* The part of the whole volume occupied by a particular constituent.
- volume-moment mean diameter.** *Noun.* See **Herdan mean diameter**.
- volume, sedimentation.** *Noun.* See **sedimentation volume**.
- volume shrinkage.** *Noun.* The contraction of a moist body during the drying or the firing process, or both, expressed as the volume percent of the original volume. See **drying shrinkage**, **firing shrinkage**, and **volume drying shrinkage**.
- volume specific gravity.** *Noun.* The specific gravity of a body based on the volume of solid material plus all included pores.
- volume swelling.** *Noun.* A macroscopic consequence of radiation damage in **nuclear fuels** and installations. It is an increase in the **molar volume** due to atomic displacements caused by α -particle collisions and nuclear recoil. It can lead to micro-cracking.
- volumeter.** *Noun.* A graduated cylinder type of apparatus used for the measurement of the volume of a measured mass of powder so that its density can be found.
- volumetric analysis.** *Noun.* Quantitative analysis in which accurately titrated volumes of standard chemical solutions are employed to estimate the amount of a particular constituent present in solution.
- volumetric energy density.** *Noun.* See **energy density**.

volumetric glassware. *Noun.* Glassware that is marked with gradations for volumetric measuring.

volume, true. *Noun.* See **true volume**.

vortices. *Plural noun.* Eddies of magnetic flux that creates resistance to the flow of current in superconductors unless they are pinned by defects.

voussoir. *Noun.* A wedge-shaped stone or ceramic brick that is part of the curve of an arch or vault.

voxel. *Noun.* A nanosized change in the structure of a glass caused by an intense, ultra-short **laser** pulse. The tiny dots this produces can be used like a 3-D pixel for information storage in **silica**.

VPE. *Abbreviation.* Stands for vapour phase epitaxy. See **vapour phase epitaxy**.

VSSP. *Abbreviation.* Stands for viscose suspension spinning. See **viscose suspension spinning process**.

Vuppor. *Trademark, noun.* A commercial, surface active product used in clay-brick manufacture to increase the water content without affecting the **plasticity** so that a more porous brick can be made on firing. It is a white emulsion made from aldehyde condensates. It burns out to leave no residue but more pores and so increases the **thermal resistance** of the brick. Density $1,100 \text{ kg m}^{-3}$.

v-value. *Noun.* The reciprocal of the light-dispersive power of a material. See **nu value**.

Vycor. *Trademark, noun.* A nearly pure **silica glass** containing approximately 4 % B_2O_3 made from a phase-separated sodium borosilicate glass in which the acid-soluble phases have been removed by an appropriate acid treatment.

W. *Symbol.* Standing for: (1) **watt**; (2) work in physics; (3) tungsten.

wacke. *Noun.* Various soft earthy rocks derived from basaltic rocks.

wad. *Noun.* (1) A hand-shaped rope of stiff clay mud placed around a pottery body or **Plaster of Paris** mould to hold the body in place on a potter's wheel during the shaving and trimming process. (2) A strip of low-grade fireclay separating **saggers** and for levelling the supports and shelves in a kiln. (3) An impure ore of manganese containing **braunite**; soft, dark earthy, amorphous material found in marshy areas. Used as a black pigment. (4) Colloquial name for **pyrolusite**, MnO_2 . (5) A ball or mass of fibrous material, such as cotton wool, used for packing or stuffing.

wadding. *Noun.* (1) Loose coherent masses of fibre in sheet form. (2) Small pads of textile used to protect brittle ceramic samples from the platens in disc compression strength tests.

wadeite. *Noun.* $\text{K}_2 \text{ZrSi}_3\text{O}_9$. A ring silicate containing $[\text{Si}_3\text{O}_9]^{6-}$ rings formed from three linked SiO_4 tetrahedra with Zr^{4+} ions in octahedral sites connecting the rings.

wafer. *Noun.* Small slice of a semiconductor, such as **silicon**, **barium titanate**, etc., on which matrices of microcircuits can be fabricated, or which can be cut into dice to make capacitors, transistors, diodes, resistors, and other devices.

Wagner turbidimeter. *Noun.* An apparatus for the determination of the particle size of powders based on the turbidity of a suspension of the powder in a suitable medium at specified levels and settling times.

wagon, pot. *Noun.* See **pot wagon**.

wake. *Noun.* The volume behind the front zone of an advancing crack where the tensile loading experienced in the frontal zone is unloaded as the crack advances. It is the volume of ceramic where important contributions to **transformation toughening** in **zirconia** containing systems occur.

waler, whaler. *Noun.* A horizontal reinforcement to prevent the forms for newly poured concrete from bulging.

wall anchor. *Noun.* A steel strap attached to a joist and built into brickwork as reinforcement.

wallboard. *Noun.* Panels of **gypsum plasterboard**, asbestos-cement sheet, and similar products used in the surfacing of walls and ceilings.

wall, bridge. *Noun.* See **bridge wall**.

wall, farren. *Noun.* See **farren wall**.

wall, flash. *Noun.* See **flash wall**.

wall flow filter. *Noun.* A gas stream cleaning system to remove particulate, in particular carbon. Exhaust gases enter plugged cells in an extruded honeycomb ceramic or **glass-ceramic** and diffuse through the walls into adjacent cells that are plugged at the opposite end to the entry channels. The cells are cleaned periodically by burning of the **soot** that has collected. This is known as **regeneration**.

wall, gable. *Noun.* See **gable wall**.

wall, jamb. *Noun.* See **jamb wall**.

wall, monkey. *Noun.* See **monkey wall**.

Wallner lines. *Noun.* Rib like features formed from the interaction of a propagating crack front with a stress wave reflected back toward the crack. They are observed in a low-power microscope that is slightly out of focus. They provide a method for determining the **terminal fracture velocity** of a crack in a brittle solid.

wall, panel. *Noun.* See **panel wall**.

wall, pipe. *Noun.* See **pipe wall**.

wall, ring. *Noun.* See **ring wall**.

wall rock. *Noun.* Rock that denotes the boundary of a mineral vein.

wall, shadow. *Noun.* See **shadow wall**.

wall, shell. *Noun.* See **shell wall**.

wall, sleeper. *Noun.* See **submerged wall**.

wall stress. *Noun.* In filament-wound composites it is the stress calculated using the applied load divided by the entire laminate cross-sectional area.

wall, submerged. *Noun.* See **submerged wall**.

wall tile. *Noun.* (1) A thin, flat, glazed tile used primarily as the exposed surface in interior wall construction.

wally. *Adjective.* (1) Made of **china**. (2) Lined with ceramic tiles.

wake. *Noun.* The track or path left by anything that has passed. In brittle fracture it is the area or volume behind the moving crack-front.

ware. *Noun.* (1) A manufactured article or product of the same type or material. (2) Pottery or porcelain of a specified type.

ware clay. *Noun.* A synonym for **ball clay**.

wares. *Plural noun.* Manufactured articles considered as being for sale.

warming in. *Verb trans.* The reheating of glass for further working or to develop opacity.

warm superconductor. *Noun.* Semiconductors that carry current with no loss of power at temperatures in excess of 77 K. Most of those so far discovered are complex ceramic oxides. See **superconductor**.

warp. *Noun.* (1) Changes in dimensions of a cured laminate compared to the mould dimensions. (2) Fibres in a fabric that run lengthwise or are placed lengthwise in the loom through which the **weft** yarns are woven. (3) Alluvial sediment deposited by water. (4) *Verb.* To twist or cause to twist, as with heat, out of shape.

warpage. *Noun.* Distortion arising from non-uniform changes in internal stresses.

warp beam. *Noun.* A large **spool** holding all the **warp** yarns in a parallel way for weaving composites.

warp direction. *Noun.* The long length of a woven material.

warping. *Verb.* To turn, bend, twist, or bow out of shape.

warping joint. *Noun.* A joint in a pavement that permits movement of concrete slabs so as to minimise uncontrolled cracking.

wash. *Noun.* (1) A thin slurry of powdered **clay**, **talca**, **alumina** or other substance applied as a coating on the face of a mould before casting to prevent the cast item from sticking to the mould. (2) An area in a composite where reinforcement is less dense, resulting in a matrix-rich area. (3) *Verb trans.* To apply a thin coating to a surface. (4) *Verb trans.* To separate **ore** etc. from **sand**, **gravel** etc. by immersion in water.

washability. *Noun.* The relative ease with which a porcelain-enamel, glaze, or other surface can be cleaned by washing with ordinary soap and water.

wash banding. *Verb.* The application of a thin, brush coating of colour over a glaze as a decoration.

washboard. *Noun.* An unintended and undesirable wavy or rippled glass, glaze, or porcelain-enamelled surface.

washbowl. *Noun.* A ceramic, metal or plastic bowl for washing the face and hands.

Washburn relation. *Noun.* Used in **mercury porosimetry** for cement and concrete specimens: $p = -4\gamma\cos\theta/d$, where γ is the surface tension of mercury, 484 MN m⁻¹, θ is the contact angle, usually in excess of 110°, d is the diameter of the intruded pore, and p is the external pressure applied to the mercury above the sample.

washcoat. *Noun.* A fine-grained coating applied to the cell surfaces in a **reticulated ceramic** to increase the total surface area for catalytic applications.

washed clay. *Noun.* Purified clay of low **silica** and **grit** content obtained by making thin slurry with water and removing the impurities by settling.

washed-out. *Adjective.* The appearance of a colour that has large amounts of white light mixed with the three primary wavelengths that define colour. See **saturation** (3).

washer. *Noun.* (1) A person or machine that washes. (2) Any flat ring used to spread the load and provide a seal under a nut. (3) A device for cleaning gases and vapours.

washery. *Noun.* A plant at a mine where water or other liquid is used to remove dirt from a mineral, such as **washed clay**.

washing off. *Verb.* To remove **decal** papers from glaze and porcelain-enamel surfaces before firing.

washing soda. *Noun.* Na₂CO₃·10H₂O. The crystalline decahydrate of **sodium carbonate** when used as a cleaning agent.

wash, kiln. *Noun.* See **kiln wash**.

wash, mill. *Noun.* See **mill wash**.

wash, mould. *Noun.* See **mould wash**.

wash water. *Noun.* Water carried on a truck mixer or agitator for use in washing the mixer drum after a batch of concrete has been discharged.

wassonite. *Noun.* A mineral found in some meteorites consisting of crystals formed from only titanium and sulphur.

waste. *Noun.* Any material remaining, after the completion of an operation or process, which is no longer useful or of value or the producer is required to discard.

- waste heat.** *Noun.* Sensible heat emanating from a combustion or other heating system that may be exhausted into the atmosphere or may be put to some subsequent use, such as in a drier or in heating a working area.
- waste heat recovery.** *Noun.* The use of heat from a furnace etc., in another process instead of venting it to the atmosphere.
- waste-heat drier.** *Noun.* A drier heated by energy retrieved from a kiln, furnace, and flue gases, etc.
- waste mould.** *Noun.* A mould, such as a plaster mould, into which concrete is poured and allowed to harden, and is then destroyed to retrieve the cast.
- waster.** *Noun.* A defective refractory product that is broken up or crushed for use as **grog**.
- watch glass.** *Noun.* A curved glass disk used in laboratories for evaporating small samples of solution.
- water absorption.** *Noun.* A measure of the amount of water a body will infiltrate under standardised conditions, expressed as a percentage of the dry weight of the body.
- water absorption test.** *Noun.* Water is added drop wise to a 10 g mass of powder to determine the volume required to make a paste.
- water, adsorbed.** *Noun.* See **adsorbed water**.
- water break.** *Noun.* A discontinuous film of water on a surface indicating non-uniform wetting because of surface contamination. See **water break test**.
- water break test.** *Noun.* A test involving the covering ability of a water film on a surface; used in quality control to test for surface contamination.
- water-cement ratio.** *Noun.* (1) The ratio of the weight of water added to the weight of dry cement in a concrete or mortar batch. (2) The number of gallons of water per sack of cement in a batch of concrete.
- watercolour.** *Noun.* Water-soluble pigment applied in transparent washes or as **gouache** and **tempera**.
- water column. wc.** *Noun.* A unit used to quantify the resistance to flow of liquids and gases through a porous ceramic or **reticulated structure**. The unit is inches of height of the column needed to produce a stated flow rate.
- water, combined.** *Noun.* See **combined water**.
- water content.** *Noun.* The quantity of liquid water present in a substance or mixture of substances.
- water, deionised.** *Noun.* See **deionised water**.
- water expansion.** *Noun.* The increase in the dimensions of a body resulting from the absorption of, or reaction with, water.
- water-extractable material.** *Noun.* Substances that can be removed from a body or material by solution in water when washed.
- waterfall process.** *Noun.* The process of applying a porcelain-enamel, glaze, or other coating by pouring or flowing the coating over an object and allowing it to drain to the desired thickness which is controlled by the viscosity and flow properties of the slip and angle of drain.
- water finishing.** *Verb trans.* The process of producing a smooth surface on ceramic greenware by washing and wiping the ware carefully with a soft damp sponge, chamois, or cloth.
- water-floc test.** *Noun.* A test in which the tendency of an hydraulic cement to resist **flocculating** when aged in a substantial volume of water is taken as a measure of the durability of the cement.
- water, free.** *Noun.* See **mechanical water**.
- water gain.** *Noun.* The appearance of a free water film on the surface of concrete due to the migration of water from the interior to the surface as solid particles settle.
- water gas.** *Noun.* A mixture of hydrogen and carbon monoxide used as a fuel; made by passing steam over hot carbon.
- water glass.** *Noun.* Na_2SiO_3 . (1) A water-soluble glass used in viscous aqueous solutions as a binder and deflocculant in ceramic bodies and glazes; sometimes used as a fluxing agent in porcelain-enamels and glazes; also used as a concrete hardener. (2) An open box or tube with a glass bottom used for viewing objects under water.
- water, heavy.** *Noun.* See **heavy water**.
- water hull.** *Noun.* The thin layer of fluid inside the **shear plane** that defines the **zeta potential** of a powder particle in suspension.
- water, hygroscopic.** *Noun.* See **hygroscopic water**.
- water, interlayer.** *Noun.* See **interlayer water**.
- water, lattice.** *Noun.* See **lattice water**.
- water lines.** *Plural noun.* (1) Visible lines where water condensed on to the surface of an unfired porcelain-enamel and washed the coating in streaks or lines from the surface of the coated article before drying was completed. (2) The separation of water from a freshly applied porcelain-enamel during draining, resulting in a streaked appearance. (3) Lines where the movement of water in an unfired porcelain-enamel has produced a concentration of salts, colour, blisters, or depressions.
- water load.** *Noun.* A load for absorbing radiofrequency and microwave power in which water is both the dissipative and cooling element.

water marks. *Noun.* (1) Shallow depressions in a porcelain-enamel or glaze caused by the presence of an accidental drop of water on the unfired coating. (2) A discolouration in pottery glazes caused by the leaching of soluble salts from the glaze by a drop of water accidentally splashed on the unfired glaze surface.

water, mechanical. *Noun.* See **mechanical water**.

watermelon tourmaline. *Noun.* A gem-quality form of the mineral **tourmaline** that occurs as large opaque, mauve-grey, crystals in some **pegmatites**.

water migration. *Noun.* The capillary flow of water through the interstices of a body, such as the flow from the interior to the surface of a body during drying.

water of constitution. *Noun.* See **combined water**.

water of crystallisation. *Noun.* See **combined water**.

water of hydration. *Noun.* Water included as part of the crystal structure of a material, which can be removed by heating, without changing the fundamental molecular or atomic composition of the material.

water of plasticity. *Noun.* Water contained in a body, which contributes to its working and forming properties; reported as a percentage by weight of the dry body.

water, pore. *Noun.* See **pore water**.

waterproof. *Adjective.* (1) Impervious to water, especially if covered or treated with a material to prevent the passage of water. (2) *Verb trans.* To make something waterproof. See **hydrophobic**.

waterproof concrete. *Noun.* A concrete in which a waterproofing admixture has been incorporated or to which an impervious coating, such as **water glass**, has been applied to its surface to decrease its permeability.

waterproofer, integral. *Noun.* See **integral waterproofer**.

waterproofing agent. *Noun.* A substance incorporated as an integral component, or a coating applied to the surface of concrete, brick, or other structure to make it impervious to water penetration.

waterproofing, membrane. *Noun.* See **membrane waterproofing**.

waterproofness. *Noun.* The resistance of a material to water penetration.

water reducer. *Noun.* An **admixture** that reduces the amount of water required per batch of concrete without deleterious influence on the workability and **slump** characteristics of the concrete.

water repellent. *Noun.* Any hydrophobic materials, such as waxes, silicones, soaps, and the like; used to render a surface resistant to wetting by water, but not completely.

water resistance. *Noun.* The ability to hinder but not necessarily prevent penetration by water.

water retentivity. *Noun.* The property of concrete, mortars, and plasters, which prevents loss of water to adjoining masonry units of high capillarity, or which prevents bleeding when in contact with impervious units.

water sapphire. *Noun.* A deep blue variety of **cordierite** that occurs in Sri Lanka and is used as a gemstone.

water, shrinkage. *Noun.* See **shrinkage water**.

water smoking. *Verb.* To remove mechanically held water in a body during the early stages of firing.

water spot. *Noun.* A shallow depression in a porcelain-enamel or glaze caused by an accidental drop of water onto the surface before firing.

water, storm. *Noun.* See **storm water**.

water streak. *Noun.* A striped or washed-out pattern occurring in an unfired porcelain-enamel or glaze; this may be due to a thin and uneven coating thickness as a result of poor draining of the coating during the dipping and some times the spraying operations, the slip usually being too thin.

water-struck brick. *Noun.* Brick formed in wetted moulds to minimise sticking during removal

water, tempering. *Noun.* See **tempering water**.

water tolerance. *Noun.* The amount of water a body can assimilate before its workability is impaired.

water, uncombined. *Noun.* See **uncombined water**.

water vapour. *Noun.* Water in a vaporous form diffused in the atmosphere below the boiling point of water.

water vapour diffusion. *Noun.* The way that water vapour moves through permeable materials as a result of water vapour pressure differences.

water vapour permeability. *Noun.* The rate of transport of water vapour per unit area per unit of vapour pressure difference at a stated temperature. The units are expressed as permcm: $\text{g}(24 \text{ h})^{-1} \text{m}^{-2} (\text{mmHg})^{-1} \text{cm}^{-1}$. Also known as **water vapour permeance**.

water vapour permeance. *Noun.* See **water vapour permeability**.

water vapour pressure. *Noun.* (1) That component of atmospheric pressure contributed by water vapour. (2) The pressure of water vapour at any specified temperature.

water vapour resistance. *Noun.* The reciprocal of **water vapour permeance** and numerically is the product of **water vapour resistivity** and thickness.

water vapour resistivity. *Noun.* The vapour pressure difference producing unit time rate of flow of vapour through a unit volume of a flat material at a defined temperature and **relative humidity** at each surface.

water vapour transmission. WVT. *Noun.* The rate of water vapour flow under specified conditions, through a unit area of material bounded by two parallel surfaces and proceeding normal to the surface; measured as $\text{g (24 h)}^{-1}\text{m}^{-2}$.

water, wash. *Noun.* See **wash water**.

watt. W. *Noun.* The **SI unit** of power; defined as the power resulting in the dissipation of one joule in one second. In electrical circuits it is a current of one ampere flowing across a potential difference of one volt.

watt current. *Noun.* See **active current**.

wattage. *Noun.* (1) Power measured in watts. (2) The power rating of an electrical appliance.

watt-hour. *Noun.* An energy unit equal to a power of 1 W operating for 1 h. It is equal to 3,600 J.

wattle and daub. *Noun.* A form of wall construction consisting of interwoven twigs **plastered** with a mixture of **clay, lime** and water.

wattmeter. *Noun.* A device for measuring electric power in watts.

wauk. *Noun.* A plastic clay body that has been beaten and rolled into the approximate shape of the mould into which it is to be formed.

wave. *Noun.* (1) An imperfection of sinuous or wavy appearance on glass or other surface, usually due to uneven thickness or striations. (2) An oscillation propagated through space or a medium such that energy is periodically exchanged between two kinds of disturbance, for example a wave on a fluid comprises vertical and horizontal displacements.

wave equation. *Noun.* A partial differential equation describing wave motion: $L^2\phi = (1/c^2) \times (\partial^2 \phi / \partial t^2)$, where L^2 is the Laplace operator, t is the time, c the speed of propagation and ϕ is a function defining the displacement of the wave.

wavefront. *Noun.* A surface associated with a propagating wave. It usually is perpendicular to the direction of propagation.

wave function. ψ . *Noun.* A solution of the **Schrödinger equation** that describes the state of a system. The square of the modulus of the wave function is a component of the electron wave probability density.

waveguide. *Noun.* A solid rod of **dielectric material** used as a device for channelling radio and microwave energy from place to place with little loss and no radiation hazard.

wavelength. *Noun.* The distance between two corresponding points on the oscillating curve obtained by plotting the physical quantity oscillating in space against distance in the direction of the wave.

wavelength division multiplexing. WDM. *Noun.* A mechanism for increasing data capacity of an **optical fibre** by using more than 1 wavelength of light. See **time division multiplexing**.

wavellite. *Noun.* $\text{Al}_3(\text{PO}_4)_2(\text{OH})_3 \cdot 5\text{H}_2\text{O}$. A mineral of varying colours, from grey to brown, found in clusters of orthorhombic crystals.

wave-mechanical model. *Noun.* A model of the atom in which electrons are treated as waves and the principles of **wave mechanics** are applied.

wave mechanics. *Noun.* A branch of science concerned with statements and solutions of differential equations describing wave behaviour.

wave number. $1/\lambda$. *Noun.* The reciprocal of wavelength, where λ is the wavelength of the radiation in cm; used to quantify spectroscopic transitions.

wave shape ($8 \times 20 \mu\text{s}$). *Noun.* An impulse current used to test **varistors** with a wave shape of $8 \mu\text{s}$ rise time to peak value and a $20 \mu\text{s}$ decay time to half peak value.

wave train. *Noun.* A succession of identical waves arising from the same source moving in the same direction.

waviness. *Noun.* A departure from flatness of a surface that has a long-range order in terms of the surface finish and no sharp discontinuities.

wax. *Noun.* Several types of substance composed of hydrocarbons, fatty acids, esters, and alcohols, that are solid at room temperature; used in vacuum impregnation, insulations and coatings for ceramic capacitors and other electronic components, as a binder to hold ceramic parts to steel plates for attachment to magnetic chucks for mechanical grinding, and as a binder in dry-pressed bodies and glaze suspensions.

wax emulsion. *Noun.* A colloidal suspension of **wax** in a solvent; used as a binder, lubricant, and **suspension agent** in ceramic bodies and glazes.

wax resist. *Noun.* A coating of wax applied to the surface of ware to prevent or inhibit glazes, slips, colours, or etching agents from adhering to specific areas in a decoration process.

WAXS. *Acronym.* Standing for wide-angle x-ray scattering. See **wide-angle x-ray scattering**.

waxy fracture. *Adjective.* See **adamantine**.

wc. *Abbreviation.* Stands for water column. See **water column**.

WDM. *Abbreviation.* Stands for wavelength division multiplexing. See **wavelength division multiplexing**.

weakened-plane joint. *Noun.* A groove formed in freshly poured concrete, or sawed in hardened concrete, to form a line of weakness along which the concrete will crack during drying or use rather than forming random cracks.

wear. *Verb.* To impair or reduce a surface under the physical conditions of use.

wear cycles. *Noun.* The number of abrasion cycles in a **Tabor abrader** test required to wear a film of specified thickness through to the test plate.

wear factor, k. *Noun.* A number used to quantify **wear** in a three-pin-on-disk machine: $k = V/PD$, where V is the volume of material removed by wear (mm^3), P is the normal load (N), and D is the sliding distance (m). Particularly helpful in comparing wear rates in different classes of material.

wear index. *Noun.* In the **Tabor abrader test** it is the loss of weight in mg per 1,000 cycles.

wearing course. *Noun.* (1) The top component of a flexible pavement system consisting of **brick pavers** and bedding sand. (2) The final layer of a concrete floor or foundation, usually made with very fine aggregate.

wear, mechanical. *Noun.* See **mechanical wear**.

wear number. *Noun.* An index given as: $1/V_L$, where V_L is the total volume loss of the specimen in cm^3 .

wear rate, specific. *Noun.* See **specific wear rate**.

weatherability. *Noun.* The inherent resistance of a product to weather influences when subjected to exterior exposure conditions.

weathered. *Adjective.* (1) Eroded, decomposed or changed by the action, of water, frost, wind and heat. (2) Artificially stained so as to appear weather-beaten.

weathering. *Noun.* (1) Deterioration of a surface during exposure to atmospheric conditions such as wetting, drying, sunlight, freezing, thawing, chemical attack and changes in temperature. (2) The aging of clay by exposure to the weather to disintegrate the clay and improve its plasticity.

weatherometer. *Noun.* An instrument designed to simulate the conditions encountered in weathering; used in accelerated evaluation tests of the resistance of materials and finishes to weathering.

weave. *Verb.* Formation of fabric by interlacing threads, yarns, or strips to form fabric.

web. *Noun.* (1) The partitions dividing hollow structural tile into cells. (2) A tangled mass of single filament fibres. Also spelled batt.

Webb effect. *Noun.* The increase in volume of a pottery slip during deflocculation.

weber W_b . *Noun.* SI derived unit of **magnetic flux**. The flux that when linking a circuit of one turn, produces in it an emf of 1 V as it is reduced to zero at a uniform rate in 1 s. 1 weber = 10^8 maxwells.

Weber equation. *Noun.* An equation expressing the relationship between several parameters and the opacity

of a **glaze**: $d = \lambda/2.1\Delta n$, where d is the optimum particle size, λ is the light wavelength and Δn is the difference in **refractive indices** between glass and ceramic crystals. See **opacity**.

weberite. *Noun.* $\text{Na}_2\text{MgAlF}_7$. A mineral fluoride sometimes employed as a **flux**.

wedge brick. *Noun.* A brick with its two main faces meeting at an acute angle.

wedged bottom. *Noun.* An imperfection in the bottom of a glass bottle characterised by thick glass on one side and thin glass on the other side.

wedge stilt. *Noun.* A tripod-like item of **kiln furniture** with cone shaped points at the end of each of the arms; used as a **setter** in the **glost firing** of ware.

Wedgwood. *Noun.* Pottery produced at the Wedgwood factory near Stoke-on-Trent; characterised by pale-coloured bodies, blue or green usually, with applied classical decoration in white.

Wedgwood blue. *Adjective.* A pale blue or bluish-grey colour.

wedging. *Verb.* To homogenise moist clay by kneading and hand working.

weep hole. *Noun.* An opening in mortar joints and concrete structures positioned to allow accumulated moisture to pass through the structure to a point where it may drain or be evaporated away.

weeping. *Adjective.* A symptom of deteriorating glass. See **crizzle** (2).

Weibull cumulative failure probability distribution. *Noun.* A way to describe the dependence of ceramic strength on sample size. The failure probability at an applied stress is given by: $F = 1 - \exp[-(\sigma/\sigma_0)^m dA/A_0]$, where m is the **Weibull modulus**, A is the surface area under stress σ , A_0 is the surface area corresponding to the characteristic strength σ_0 .

Weibull distribution. *Noun.* A statistical parameter reflecting the distribution of for example, **flaw sizes** on a ceramic surface: $\ln \ln 1/(1 - F) = m \ln s - m \ln \sigma$, where F is the failure probability, s is the initial or short-term strength, and m and σ are the **Weibull modulus** and scaling parameters, respectively.

Weibull modulus. *Noun.* See **Weibull distribution**.

weigh. *Verb.* To measure the **weight** of.

weight. *Noun.* (1) A measure of the heaviness of an object. (2) The vertical force experienced by a mass as a result of gravitation. It is equal to the mass of the object multiplied by the acceleration of free fall. The units are units of force, such as **newtons**, but is usually given as a mass unit, kg etc.

weight, application. *Noun.* See **application weight**.

weight, atomic. *Noun.* See **atomic weight**.

weight, dipping. *Noun.* See **dipping weight**.

weighted average. *Noun.* An average calculated by taking into account the frequencies of the values of a variable plus some other factor, such as their variance.

weight, equivalent. *Noun.* See **equivalent weight**.

weight, gross. *Noun.* See **gross weight**.

weighting. *Noun.* A factor by which some quantity is multiplied to make it comparable with others.

weight, molecular. *Noun.* See **molecular weight**.

weight, net. *Noun.* See **net weight**.

weight percent, wt%. *Noun.* A concentration definition on the basis of mass of an element relative to the total material mass.

weight, slop. *Noun.* See **slop weight**.

weight, tare. *Noun.* See **tare weight**.

weld. *Noun.* (1) A fused joint formed between two components. (2) *Verb.* To form such joints.

weld aspect ratio. *Noun.* The depth to width ratio of a weld.

weld blister. *Noun.* An imperfection in porcelain-enamels consisting of broken or unbroken bubbles caused by the evolution of gases along the line of a weld in the base metal during the firing operation.

welding glass. *Noun.* A special coloured and tempered glass designed to protect the eyes of a welder from ultraviolet radiation and flying sparks during the welding operation.

weld mark. *Noun.* A groove formed at the junction of two or more parts when the intended fusion of the parts is incomplete.

well. *Noun.* A reservoir constructed in a melting furnace to collect glass, slag, etc.

well-hole pipe. *Noun.* A refractory pipe or tube directing the flame upwards from the **well** in a melting furnace.

well-ordered graphite, WOG. *Noun.* A form of **graphite** with over 90 % parallelism of the hexagonal planes. The crystallites in a sample have their c-axes lying within a cone of solid angle 0.2° or less.

Wentworth scale. *Noun.* A scale for use in specifying the diameters of sedimentary particles. The range is from clay particles at 1/256 mm to boulders at 256 mm.

wernerite. *Noun.* See **scapolite**.

Westlake process. *Noun.* An automatic glass-forming process simulating the procedures in a hand shop where molten glass is gathered by vacuum and formed by blowing into moulds.

Westphal balance. *Noun.* A direct weighing balance enabling the specific gravity of solids to be determined directly.

wet. *Adjective.* (1) A term describing the consistency of fresh concrete. (2) Covered, saturated etc. with liquid. (3) Employing a liquid, usually water. (4) *Verb.* To make or become wet.

wet-bag isostatic pressing. *Noun.* Powder to be processed is sealed in a deformable skin and submerged in a liquid to allow pressure to be applied.

wet blasting. *Verb.* A surface finishing process whereby a slurry of fine particles is propelled by compressed air.

wet-bulb thermometer. *Noun.* A thermometer with its bulb covered with a wet muslin bag. Used in conjunction with a normal thermometer to measure **humidity**.

wet chemical powder preparation. *Noun.* The manufacture of synthetic ceramic powders from solution. Variations in the method centre on how the water or other solvent is removed, for example, freezing to give salt plus ice is called **freeze-drying**.

wet film thickness. *Noun.* The thickness of a coating film immediately after application.

wet flexural strength. *Noun.* The strength of a material measured after boiling the test specimen for 2 h in water.

wet-grinding. *Verb.* (1) To mill ceramic bodies, glazes, and porcelain-enamels in a liquid medium, usually water. (2) To apply a liquid coolant to a work-piece and also the grinding wheel during abrasive grinding.

wet laying. *Verb.* To form a fibre sheet by paper-making techniques.

wet-lay non-woven fabric. *Noun.* A reinforcing cloth made by dispersing **chopped strand** fibre in water containing **dispersing agents** and then allowing the fibres to settle out as a **mat** while the water is evaporated or filtered through the fabric as it forms.

wet milling. *Verb.* To grind porcelain-enamel **frits** with selected mill additions and water in a ball mill to form a **slip** suitable for application to metal by dipping, spraying, or other technique.

wet pan. *Noun.* A machine containing heavy **mullers** revolving on the bottom of a slotted revolving pan in which wet or damp materials are mixed and ground.

wet pressing. *Verb.* To form plastic ceramic bodies in dies by the mechanical or manual application of pressure.

wet process. (1) *Verb.* The prepare ceramic bodies by blending the ingredients with sufficient liquid, usually water, to form a castable slurry. (2) *Noun.* The process in which the batch for **Portland cement** manufacture is charged into the cement kiln as a slurry.

wet-process porcelain-enamelling. *Noun.* The technique of applying porcelain-enamel to metal in slip form, usually by dipping or spraying, followed by drying and firing to a smooth, impervious, glassy finish.

wet-rubbing test. *Noun.* A test of the resistance of porcelain-enamel, glaze, and tile, to abrasion by rubbing with damp abrasives.

wet spinning. *Noun.* A process for making fibre where the viscous liquid stream of polymer plus ceramic powder is forced through a small orifice into a coagulation bath.

wet strength. *Noun.* (1) The strength of an adhesive joint determined immediately after removal from an immersion liquid. (2) See **wet flexural strength**.

wettability. *Noun.* The ability of a liquid film to spread over, and adhere to, the surface of a solid.

wetting. *Verb.* To make **wet**.

wetting agent. *Noun.* A substance, such as soap, detergent, or other surface-active material, which will lower the surface tension of water or other liquid and cause them to spread over or to penetrate the surface of another material more easily.

wetting off. *Verb.* To use a fine jet of water to sever a hand-blown glass article from a **blowpipe**.

wet ware. *Noun.* Ware placed into the **glost kiln** without prior drying.

WFS. *Abbreviation.* Stands for wet flexural strength. See **wet flexural strength**.

whaler. *Noun.* See **waler**.

wheel, abrasive. *Noun.* See **abrasive wheel**.

wheel, composite. *Noun.* See **composite wheel**.

wheel, concentric. *Noun.* See **concentric wheel**.

wheel, cone. *Noun.* See **cone wheel**.

wheel, cup. *Noun.* See **cup wheel**.

wheel, cut-off. *Noun.* See **cut-off wheel**.

wheel, cylinder. *Noun.* See **cylinder wheel**.

wheel, diamond. *Noun.* See **diamond wheel**.

wheel, dish. *Noun.* See **dish wheel**.

wheel, disk. *Noun.* See **disk wheel**.

wheel, feed. *Noun.* See **feed wheel**.

wheel, grinding. *Noun.* See **grinding wheel**.

wheel head. *Noun.* The outer or upper surface of a grinding wheel.

wheel, kick. *Noun.* See **kick wheel**.

wheel, magnesite. *Noun.* See **magnesite wheel**.

wheel, mounted. *Noun.* See **mounted wheel**.

wheel, parting. *Noun.* See **parting wheel**.

wheel, polishing. *Noun.* See **polishing wheel**.

wheel, recessed. *Noun.* See **recessed abrasive wheel**.

wheel, regulating. *Noun.* See **regulating wheel**.

wheel, resinoid grinding. *Noun.* See **resinoid wheel**.

wheel, rubber. *Noun.* See **rubber wheel**.

wheel, saucer. *Noun.* See **saucer wheel**.

wheel, segmented. *Noun.* See **segmented wheel**.

wheel, setup. *Noun.* See **setup wheel**.

wheel, shellac. *Noun.* See **shellac wheel**.

wheel sleeve. *Noun.* A flange used as an adaptor for grinding wheels when the hole in the wheel is larger than the **arbor**.

wheel, slotting. *Noun.* See **slotting wheel**.

wheel, slow. *Noun.* See **slow wheel**.

wheel, straight. *Noun.* See **straight wheel**.

wheel, tapered. *Noun.* See **tapered wheel**.

wheel traverse. *Noun.* The rate at which a grinding wheel moves across a workpiece.

wheel, vitrified. *Noun.* See **vitrified wheel**.

whelp. *Noun.* A refractory of standard cross-sectional dimensions, but substantially longer; for example, a brick approximately 8 cm thick, 10 cm wide, but more than 20.5 cm long.

whet. *Verb.* To sharpen by grinding or friction.

whetstone. *Noun.* A stone used for sharpening edged tools.

whewellite. *Noun.* $\text{Ca}(\text{COO})_2 \cdot \text{H}_2\text{O}$. Calcium oxalate monohydrate. Found in some **limestone** deposits as a result of fungal action that excretes oxalic acid.

whinstone. *Noun.* Any dark-coloured, hard, fine-grained rock. **Basalt** is an example.

whirler. *Noun.* (1) Flat ceramic ware in which the bottom sagged during firing. (2) A rotating plaster mould in which **bone china** is sometimes cast to obtain a uniform thickness. (3) A faulty plate, platter, saucer, or dish that will not rest firmly on its foot.

whiskers. *Noun.* Short discontinuous fibres with diameters less than 0.1 μm so small as to be nearly perfect and so possess very high strengths; usually man-made by vapour methods.

white. *Adjective.* (1) Having no **hue** due to the reflection of all incident light. (2) *Noun.* A ceramic glaze containing no pigment but **opacifier**.

white acid. *Noun.* A mixture of hydrofluoric acid and ammonium bifluoride used to etch glass.

white-acid embossed. *Adjective.* A fully obscured glass surface obtained by a single treatment with **white acid**.

white alkali. *Noun.* (1) Refined **sodium carbonate**. (2) The white deposit on some soils in dry weather, which consists of **sodium sulphate**, **sodium chloride** and **magnesium sulphate**.

white alumina. *Noun.* A recrystallised alumina abrasive.

white arsenic. *Noun.* As_2O_3 . **Arsenic trioxide**; used to introduce arsenic into glazes, enamel and glass in order to remove unwanted colour from clear glazes and to produce opacity in very low fire glazes and enamels.

white asbestos. *Noun.* The serpentine mineral, **chrysotile**, with fibrous habit.

white cement. *Noun.* A very white **Portland cement** made from raw materials containing very low concentrations of iron or by sintering in a reducing atmosphere.

white clay. *Noun.* A high-quality **kaolin** that fires to a white colour.

white coal. *Noun.* Water when used as a source of power as in a hydroelectric scheme.

white diamond. *Noun.* A form of polycrystalline diamond grown by **CVD** methods from hydrocarbon gases in the presence of excess atomic hydrogen. The process is maintained at a very slow rate to obtain almost pure diamond with very few graphite inclusions. Used in electrical and optical applications.

white, drier. *Noun.* See **drier white**.

white feldspar. *Noun.* A milky-white or colourless variety of **albite**.

white flint. *Noun.* Another name for **flint**.

white flint glass. *Noun.* A colourless glass with good light-dispersing qualities; used in optical instruments.

white graniteware. *Noun.* A term used to describe white **earthenware** bodies of exceptionally high strength.

white graphene. *Noun.* Single-atom-thick layers of hexagonal **boron nitride** (h-BN). Made by chemical vapour deposition on to a copper substrate at 1,000 °C. Elastic and nearly as strong as **graphene**.

white graphite. *Noun.* See **boron nitride**.

white-hard clay. *Noun.* A clay from which the water of plasticity has evaporated at its surface.

white heat. *Noun.* Intense heat signifying a very high temperature. Any body that is at white heat emits white light.

white-hot. *Adjective.* At such a high temperature that white light is emitted.

white, kiln. *Noun.* See **kiln white**.

white lead. *Noun.* (1) $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$. A mixture of **lead hydroxide** and **lead carbonate** and thus called **basic lead carbonate**. Used in paint and putty. Also known as **hydrocerussite**. (2) Two similar white pigments, one based on **lead silicate** and the other on **lead sulphate**. (3) A type of putty made by mixing white lead with linseed oil. Also called **ceruse**.

white lead ore. *Noun.* $\text{Pb}_3\text{CO}_3(\text{OH})_2$. Basic **lead carbonate** of variable composition; used as a flux in glazes, porcelain-enamels, and glass. Decomposes at 400 °C; density 6,140 kg m⁻³. Another name for **cerussite**.

white light. *Noun.* Light that contains all the wavelengths of visible light at almost equal intensities, such as that from **white-hot** solids.

white mica. *Noun.* Common name for **muscovite**.

whitening. *Noun.* See **whiting**.

white Portland cement. *Noun.* Finely milled white cement made from pure **calcite limestone** and white burning clay.

white sapphire. *Noun.* A pure variety of **corundum**; used as a gemstone.

white schorl. *Noun.* See **albite**.

white-specking. *Noun.* An effect in decorated ware produced by using **lead soap**.

white spot. *Noun.* An imperfection in a coloured glaze caused by separation of pigment as the glaze flows and heals when fired over an already existing defect.

White's test. *Noun.* A method for finding free lime, CaO, in **dolomite refractories** and **Portland cement** by wetting the powder with a mixture of nitrobenzene, phenol, and water and noting the presence of elongated needles in the microstructure.

white vitriol. *Noun.* Synonym for **zinc sulphate**.

whitewash. *Noun.* (1) A suspension of **lime** or **whiting** in water used as a cover on walls. (2) *Verb.* To cover a surface with whitewash.

whiteware. *Noun.* A general term for a clay-based ceramic body which fires to a white or ivory colour. Plumbing and sanitary ware are examples.

whiteware, alumina. *Noun.* See **alumina whiteware**.

whiteware, cordierite. *Noun.* See **cordierite whiteware**.

whiteware, forsterite. *Noun.* See **forsterite whiteware**.

whiteware, mullite. *Noun.* See **mullite whiteware**.

whiteware, steatite. *Noun.* See **steatite whiteware**.

whiteware, titania. *Noun.* See **titania whiteware**.

whiteware, zirconia. *Noun.* See **zirconia whiteware**.

whiting. *Noun.* CaCO_3 . Natural **limestone**; used in **earthenware** and **vitreous sanitary ware** bodies, **glazes**, **glasses**, and **porcelain-enamels** as a refractory or neutral component. When finely ground and washed it is used as **whitewash** when suspended in water with size added. Density $2,700 \text{ kg m}^{-3}$. Also called **whitening**.

whitlockite. *Noun.* $\text{Ca}_3(\text{PO}_4)_2$. An orthophosphate with biological activity used in prosthetic devices because of its excellent durability. It has a structure related to **hydroxyapatite**.

wicket. *Noun.* A temporary refractory closure or door in a furnace or kiln, such as may be placed near the ends of the **checker chamber** for charging and removing ware from the kiln.

wicking. *Verb.* To absorb liquid into a material by capillary action.

wide-angle lens. *Noun.* A lens system that can cover an angle of 60° or more; to enable it to do this it must have a very short focal length.

wide-angle x-ray scattering. **WAXS.** *Noun.* A technique used to investigate crystallinity of ceramic materials.

Widmanstätten structure. *Noun.* A type of microstructure; arising from second-phase precipitates occurring within the primary grains as well as at grain boundaries and the precipitates within the grains being preferentially ordered on definite planes of the primary phase. This leads to the appearance of needle-like or plate-like crystals in parallel arrays.

Wiedemann-Franz law. *Noun.* A relationship between the **electronic thermal conductivity** and the **electrical conductivity** of a solid. It is expressed as: $k_e = L_0 T \sigma$, where L_0 is the Lorentz number $= 2.44 \times 10^{-8} \text{ W}\Omega \text{ K}^{-1}$, σ is the electrical conductivity and T is the absolute temperature.

Wien's displacement law. *Noun.* A statement that when the temperature of a **black body** increases, the wavelength, λ_{max} , corresponding to the maximum energy density of thermal radiation decreases such that $\lambda_{\text{max}} T = \text{constant}$. The constant has a value of $2.898 \times 10^{-3} \text{ mK}$.

wiggler. *Noun.* An array of permanent magnets of alternating **polarity** arranged to make an electron beam wiggle in the horizontal plane and so radiate photons in a forward direction; an essential part of an **FEL**. Also called an **undulator**.

Wigner crystal. *Noun.* A theoretically predicted state of matter. A metallic system with sufficiently few electrons such that they arrange themselves into an ordered array to become a "lattice of conduction electrons". This lattice allows the electron spins to order **ferromagnetically** and the electrons flow while maintaining the lattice. Now discovered in LaB_6 - CaB_6 solid solutions with 0.005 e^- per formula unit.

Wigner-Seitz radius. r_{ws} . *Noun.* The radius of a sphere whose volume equals the volume per atom in the material. For N atoms per unit volume, $N 4\pi r_{\text{ws}}^3 / 3 = 1$, defines this radius.

wilkenite. *Noun.* A type of **bentonite** used in a variety of ceramic bodies and refractories, and as a suspension agent in porcelain-enamels and glazes.

willemite. *Noun.* Zn_2SiO_4 . A zinc ore used to make crystalline glazes. Density $3,300 \text{ kg m}^{-3}$; hardness (Mohs) 5.5.

Williamson kiln. *Noun.* A cross-fired tunnel kiln in which both direct-fire and muffle segments are incorporated. See **muffle kiln**.

Williamson's blue. *Plural noun.* A range of iron-bearing blue pigments.

willow blue. *Noun.* A dilute **cobalt-blue** colourant.

willow pattern. *Noun.* A design for **slipware** developed in England with a busy, blue pattern telling a tale of young elopers chased by the girl's father.

wimply. *Adjective.* A condition of unusual flexibility.

winchester. *Noun.* A straight-sided glass bottle of 2.5 l capacity.

wind. *Noun.* A term sometimes used to describe air bubbles in ware.

wood opal. *Noun.* Petrified wood with **opal** as the petrifying agent.

winding. *Noun.* A wire wound in the shape of a coil or spiral around a ceramic core.

wood pitch. *Noun.* A dark, viscous residue left after the distillation of wood tar; used as a binder in **carbon briquette** formation.

winding collet. *Noun.* A drum onto which continuous ceramic or glass fibre is wound as they are manufactured; winding speeds at the periphery in excess of 180 km h^{-1} are required to achieve the fine diameters needed in these products.

window dip. *Verb.* The dipping of ware sideways into a slip or glaze.

window glass. *Noun.* A continuously drawn **soda-lime glass** produced in sheet form; used mainly to make windows.

windowpane. *Noun.* A sheet of glass forming a window.

wind-ridge tile. *Noun.* A specially shaped ceramic or concrete tile made to cover the ridge of a pitched roof.

windscreen. *Noun.* A sheet of flat or curved **toughened glass** that forms a window of a motor vehicle, especially the front window.

wineglass. *Noun.* A glass vessel consisting of a small bowl on a narrow stem with a flared foot that is used for drinking wine.

Winkler diagram. *Noun.* A system used to classify clays based on particle size fractions. The x-axis is the % of particle fractions <2 µm and the y-axis is % particle fractions >20 µm. Brick clay is typically 55, 15.

winning. *Noun.* The process of extracting a raw material from some source, such as an ore or reclaimed product, and converting the material to a useful product.

wipe test. *Noun.* A procedure for investigating powder particle melting and coating potential in **plasma spraying** technology. It usually consists of one horizontal traverse at high velocity of the **spray gun** in front of a stationary substrate. Sometimes called **line scan**.

wire, brass. *Noun.* See **brass wire**.

wire cloth. *Noun.* A fabric of wire mesh woven in squares to be used in sieves and screens.

wire-cut brick. *Noun.* Brick units cut from extruded clay columns by means of a taut wire. A smoother, more precise brick than handmade.

wired safety glass. *Noun.* Glass containing an embedded network of wire that resists shattering when broken.

wire glass. *Noun.* See **wired safety glass**.

wire glass, polished. *Noun.* See **polished wire glass**.

withe. *Noun.* A wall just half a brick wide as is one leaf of a cavity wall. See **wythe**.

witherite. *Noun.* BaCO₃. An orthorhombic mineral form of **barium carbonate** found in lead ore veins as white, grey or yellow deposits. Used in **optical, plate, and tableware** glasses, pottery bodies, and as a low temperature flux in glazes and porcelain-enamels. It produces a wide variety of glaze effects ranging from shiny to matte and clear to opaque depending on temperature and other ingredients with which it reacts. Used in structural clay bodies to prevent **efflorescence** and sometimes added to high sulphur-content clays to reduce the glaze scumming effect of sulphur. Mp 1,360 °C; density 4,270–4,350 kg m⁻³; hardness (Mohs) 3–3.5.

witness hole. *Noun.* A small opening provided to verify that mating parts do so up to the specification.

Witten-Sanders model. *Noun.* A kinetic model of diffusion-limited **aggregate** formation; able to produce a model of a **fractal aggregate** having the observed structure of colloidal particle combinations.

WOG. *Acronym.* Stands for well-ordered graphite. See **well-ordered graphite**.

wolframite. *Noun.* The chief ore of tungsten occurring as black to brown deposits in quartz veins. A mono-

clinic crystal form of iron manganese tungstate, (Fe,Mn)WO₄.

wollastonite. *Noun.* See **calcium metasilicate**.

wollastonite-2 M. *Noun.* A form of **calcium metasilicate** with similar properties to **wollastonite**. Transforms to β-CaSiO₃, **psuedowollastonite**, at 1,125 °C. Also known as **parawollastonite**.

wonderstone. *Noun.* A synonym for **pyrophyllite**.

Wood's glass. *Noun.* Glass with a high transmission factor for ultraviolet radiation but which has high opacity in visible light.

Woods Hole sediment analyser. *Noun.* A technique for determining the particle size distribution in a clay suspension based on changes in pressure resulting from the settling of the clay particles.

wood spirit. *Noun.* Another name for methanol.

Wood's process. *Noun.* A technique used to make glass tubing and rod in which molten glass is drawn from an orifice and the tubing formed by drawing rod around a refractory cone.

wool. *Noun.* An entangled mass of fibres without any obvious arrangement.

wool drag. *Noun.* The smearing of colour during the application of background colour on pottery and other ceramic ware.

wool, glass. *Noun.* See **glass wool**.

wool, mineral. *Noun.* See **mineral wool**.

wool, rock. *Noun.* See **rock wool**.

Worcester china. *Noun.* Porcelain articles made in Worcester, England, from 1751.

work. *Noun.* (1) A form of energy associated with action and is the transfer of energy expressed as the product of a force and the distance through which its point of application moves in the direction of the force. It is a more useful form of energy and is usually encountered as mechanical or electrical power. The units are **Joules**. (2) Piece or item being operated on in the process of manufacture, such as grinding, polishing, or other process. (3) Physical or mental effort directed toward doing or making something.

workable. *Adjective.* Capable of being worked.

workability. *Noun.* (1) The property of being workable. (2) The combination of properties which contribute to the ease, with which concrete, mortar, ramming mixes, and plastic masses can be mixed, handled, transported, and placed with a minimum of effort or loss of homogeneity.

workability agent. *Noun.* An admixture used in concrete, mortar, and other plastic mixes to improve their workability.

wolframite. *Noun.* A solid solution of **huebnerite**, MnWO_4 , and **ferberite**, FeWO_4 . Used as a source of tungsten; brown to black colour with **adamantine lustre**; prismatic or tabular crystals. Density 7,120–7,510 kg m^{-3} ; hardness (Mohs) 4–4.5.

workability index. *Noun.* A measure of the consistency and moulding properties of plastic masses, particularly refractories.

work board. *Noun.* A long narrow board on which greenware is placed for drying and transport.

work function. *Noun.* The energy needed to remove an electron to infinity; expressed as the height of the energy barrier at the surface of a solid. Usually very high for a ceramic, around 10 eV, except for **special ceramics** containing electron energy bands, such as LaB_6 , which is a good electron emitter because of its low work function.

working point for glass. *Noun.* The temperature that corresponds to a **viscosity** of $10^3 \text{ Nm}^{-2} \text{ s}$.

wood ash. *Noun.* The residue from burned timber; rich in **potash** but containing only small amounts of **soda**; used in early European glass manufacture.

wood flour. *Noun.* Finely ground wood used as a filler.

work hardening. *Noun.* When a solid is plastically deformed more **dislocations** are introduced on intersecting planes, which can become entangled, and so making them difficult to move; thus, a greater stress is needed to cause further strain and the material is said to be work hardened.

working end. *Noun.* The end compartment or section of a glass-melting tank from which molten glass is taken for forming.

working moulds. *Plural noun.* **Plaster of Paris** moulds in which ceramic bodies are shaped by casting, **jiggering**, or roller forming.

working point. *Noun.* The temperature at which the viscosity of glass is $10^3 \text{ N m}^{-2} \text{ s}$ and suitable for most forming processes.

working range. *Noun.* The temperature range in which glass may be shaped into ware, the lower temperature being such that the glass is sufficiently fluid or plastic for forming, and the upper temperature being such that the formed ware will retain its shape as formed. Expressed as the glass **viscosity** it is the range 10^2 – 10^6 N s m^{-1} .

working standard. *Noun.* Any specification or standard of quality in current or regular use.

working stress. *Noun.* A stress specified to be just below the damaging stress.

working substance. *Noun.* The fluid, usually water, steam, or air, which operates an engine.

working time. *Noun.* The period of time during which a sand mixture can be used to make cores.

work of adhesion. W_{ad} . *Noun.* The change in energy in separating glass from a substrate. It is given by: $W_{ad} = k[\gamma_v + l\gamma_v - \gamma_l - f\Delta\alpha]A$, where k is a constant, γ_v is the free energy of the solid-vapour interface, $l\gamma_v$ the liquid-vapour interface, γ_l solid-liquid interface, $f\Delta\alpha$ is the thermal expansion mismatch and A is the contact area.

work piece. *Noun.* The article, product, or sample being heated by an infrared source.

work size. **d.** *Noun.* The dimension of the area to be covered by bricks or **pavers**. (2) The dimensions of a standard clay brick. See **Standard brick**.

work speed. *Noun.* (1) The rate of table traverse during abrasive grinding. (2) The rate at which work is rotated during centreless and internal grinding operations.

work-to-break. *Noun.* In a tensile test it is the total energy needed to rupture a specimen; the integral of the stress-strain curve.

worm gear. *Noun.* A threaded shaft, the worm that mates with a gear wheel so that rotary motion can be transferred between two shafts at right angles to each other.

Woulfe bottle. *Noun.* A glass bottle with more than one neck used to pass gases through liquids.

wreathing. *Noun.* A slightly raised crescent on the inside wall of slip-cast ware.

wrinkle. *Noun.* A defect in glass containers consisting of a series of horizontal marks, one above the other.

writing, magnetic. *Noun.* See **magnetic writing**.

wt. *Abbreviation.* Signifying weight.

W-type ferrite. *Trade name, noun.* $(\text{MO})_3(\text{Fe}_2\text{O}_3)_8$. One of the six types of hexagonal **ferrimagnetic** material based on **solid solutions** formed from **iron oxide**, Fe_2O_3 , and oxides of divalent metals but most commonly the M^{2+} ion is barium, Ba^{2+} .

wulfenite. *Noun.* PbMoO_4 . A yellow-orange mineral with **tabular** crystal form; a source of molybdenum and sometimes used as a ceramic pigment.

wustite. *Noun.* FeO . An intermediate in iron ore reduction. A black, **non-stoichiometric**, **rock salt** structure material.

WVT. *Abbreviation.* See **water vapour transmission**.

wye. *Noun.* Any item made in the shape of a “Y.”

wythe. *Noun.* (1) Each continuous vertical section of masonry one unit in thickness. (2) The thickness of the masonry units separating flues in a chimney. See **withe**.

x. *Symbol.* Stands for: (1) the x-axis or a coordinate measured along the x-axis in a Cartesian coordinate system; (2) an algebraic variable.

X. *Symbol.* The Roman numeral for ten.

xanthates. *Noun.* Various salts of xanthic acid, ROC(S)SH, employed as flotation agents in the beneficiation of minerals for ceramic and other uses.

xanth or xantho. *Combining form.* Forming words with the meaning yellow.

xanthic. *Adjective.* Of or tending towards a yellow colour.

xantho. *Combining form.* See xanth.

x-axis. *Noun.* The horizontal axis in a Cartesian coordinate system with two axes at 90° or one of three axes in a 3-dimensional rectangular coordinate system, usually the horizontal one.

x-band. *Noun.* Electromagnetic radiation with a frequency between 8 and 10 GHz.

Xe. *Symbol.* The chemical symbol for the gaseous element xenon.

xenocryst. *Noun.* A crystalline material that is not in equilibrium with other minerals in a rock.

xenolith. *Noun.* A rock inclusion that is unrelated to the rock in which it occurs.

xenomorph. *Adjective.* A description of any mineral not sharing its characteristic crystal habit because of deformation pressures from adjacent rocks.

Xenon. *Noun.* Xe. A gaseous element atomic number 54. A member of the noble gas group. Used in lamps and electronic tubes.

xenothermal deposit. *Noun.* A mineral that has been formed at low pressure and high temperature, usually at shallow to moderate depths.

xenotime. *Noun.* (1) YPO_4 . A lustrous, vitreous, naturally occurring phosphate ranging from white to brown in colour; density 4,400–5,100 kg m⁻³; hardness (Mohs) 4–5. See **fergusonite**. (2) A phosphate mineral containing **rare earths**. The Chinese deposits are richer in dysprosium oxide than others.

xerogel. *Noun.* A porous solid that is the last stage of the **gelation** of a **sol** when all the interstitial liquid dispersion medium is removed. It usually has to be heated to produce the desired ceramic shape or ceramic powder.

xerography. *Noun.* A dry method of photocopying, often involving ceramic powders, in which an image is projected through a camera lens on to a smooth electrostatically charged metallic plate which has been coated with selenium or other photoconductive material a pigmented powder containing a developing resin is cascaded or dispersed over the plate, adhering to the plate in thicknesses proportional to the patterned charges remaining on the plate after exposure, the intensity of the pattern varying with the darkness and shading of the image; the image then is transferred electrostatically to paper or other surface placed in contact with the plate, and fixed by heat or other means to provide a positive reproduction of the subject. *Adjective* **xerographic**.

xeroradiography. *Noun.* A xerographic technique in which x-rays are employed to project an image onto a photosensitive plate.

Xerox. *Noun. Trademark.* (1) A xerographic copier. (2) A copy produced by this process. (3) *Verb.* To produce a copy by this process.

xerex. *Verb transitive.* To copy something on a **Xerox** machine.

xenotlite. *Noun.* $\text{Ca}_6(\text{SiO}_3)_6 \cdot \text{H}_2\text{O}$. In cement notation $\text{C}_6\text{S}_6\text{H}$; a well-crystallised calcium silicate hydrate with a needle-like habit; formed under hydrothermal conditions from SiO_2 and CaO in an **autoclave**; a constituent of insulating and lightweight building materials.

X-phase. *Noun.* $\text{Si}_3\text{Al}_6\text{O}_{12}\text{N}_2$. A **sialon** that crystallises from a nitrogen glass in the Li-Al-Si-O-N system when annealed. It is a grain boundary phase in the resultant **glass ceramic**. It is responsible for the deterioration of the mechanical properties of **silicon nitride** at high temperatures.

XPMA. *Abbreviation.* Formed from the first letters of x-ray photoelectron microanalysis. See **x-ray photoelectron microanalysis**.

XPS. *Abbreviation.* See **x-ray photoelectron spectroscopy** or **ESCA**.

x-ray. *Noun.* A high-frequency electromagnetic ray of extremely short wavelength, 0.006–12 nm, produced when a high energy electron beam interacts with a target metal in a vacuum and removes one of the **orbital** s, p or d-electrons. This allows an electron from a higher energy orbital to fall in to the hole so created and so emitting an x-ray.

x-ray absorption. *Noun.* The absorption of energy from an x-ray beam by a medium through which the x-ray is passing.

x-ray analysis. *Noun.* Determination of the **unit cell** of the crystal **lattice**, the **lattice parameters**, the atomic distribution, structure, chemical analysis, and anisotropic features of crystalline materials by means of x rays.

x-ray computed tomography. **CT.** *Noun.* A bulk, non-destructive examination method able to display 2-D sections of complex ceramic parts; density variations ranging from 0.01 to 0.02 % and flaws as small as 5 μm can be found.

x-ray crystallography. *Noun.* The study of the structure, identity, texture, and properties of crystals by x-ray techniques. This is mainly achieved by passing a beam of x-rays of known wavelength through the solid and analysing the diffraction pattern so produced.

x-ray density. *Noun.* The density of a solid calculated from the measured x-ray **unit cell** parameters and the number and atomic mass of atoms per unit cell. Sometimes called the **absolute** or **theoretical density**.

x-ray diffraction. *Noun.* Scattering of an x-ray beam into many beams at definite angles to the original beam as dictated by the Bragg equation: $\lambda = 2d\sin\theta$, where λ is the wavelength of the incident x-ray beam, d is

the interplanar spacing and θ is the angle between the diffracted beam and the incident beam used to analyse crystal structure and to determine **unit cell lattice parameters**.

x-ray lithography. *Noun.* Using x rays to etch out integrated circuits on chips. Because x rays have shorter than visible light they produce finer patterns and hence a denser array of circuits per chip.

x-ray photoelectron microanalysis. **XPMA.** *Noun.* A technique of chemical analysis where the energies of ejected electrons from solids irradiated with high energy x-rays are analysed.

x-ray photoelectron spectroscopy. **XPS.** *Noun.* A sample is irradiated with monochromatic x-rays, which produces photoelectrons whose energies are analysed. This gives electron binding energies in the atoms present in the solid. Also known as **XPS** and **photoelectron spectroscopy**. See **x-ray photoelectron microanalysis**.

x-ray photograph. *Noun.* A darkened line, spot or general shadow produced on photosensitive film by exposure to x-rays that have passed through powders, crystals or any general body.

x-ray protective glass. *Noun.* A glass containing a high percentage of **lead oxide** and, occasionally, **barium oxide**, which exhibits a high degree of opacity to x-rays. Sometimes known as document glass.

x-ray spectroscope. *Noun.* An instrument for comparing the colour intensity between corresponding parts of different spectra, or between parts of the same spectrum.

x-ray spectrum. *Noun.* Patterns of emission from matter bombarded by high-velocity electrons.

x-ray tube. *Noun.* A vacuum tube containing a metal target in which x-rays are produced by impact of electrons on the water-cooled target.

X-type ferrite. *Trade name, noun.* $(\text{MO})_4(\text{Fe}_2\text{O}_3)_{14}$. One of the six types of hexagonal **ferrimagnetic** material based on **solid solutions** formed from **iron oxide**, Fe_2O_3 , and oxides of divalent metals but most commonly the M^{2+} ion is barium, Ba^{2+} .

x-unit. **xu.** *Noun.* An old unit used to express the wavelength of x rays or gamma rays; equal to 1.00202×10^{-13} m.

Yy

- y.** *Symbol.* The y-axis or a coordinate measured along the y-axis in a Cartesian coordinate system.
- y.** *Abbreviation.* Standing for: (1) yard; (2) year.
- Y.** *Symbol.* Stands for the element yttrium.
- Y 123.** *Abbreviation.* Stands for the **high temperature superconductor** $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$.
- yafsoanite.** *Noun.* $\text{Ca}_3\text{Te}_2\text{Zn}_3\text{O}_{12}$. A naturally occurring **garnet** in which Zn^{2+} is the small ion in the B-site.
- YAG.** *Acronym.* Stands for yttrium aluminium garnet. See **yttrium aluminium garnet**.
- yard, laying.** *Noun.* See **laying yard**.
- yard, stripping.** *Noun.* See **stripping yard**.
- yarn.** *Noun.* A group of continuous strands of glass, ceramic, asbestos, or other fibre twisted to a form suitable for weaving.
- yarn filament.** *Noun.* A yarn composed of continuous filaments assembled with or without a twist.
- yarn number.** *Noun.* Relates size or fineness of a yarn by stating the material as mass per unit length or as length per unit mass.
- YAS.** *Acronym.* Standing for yttria aluminosilicate glass. See **yttria aluminosilicate glass**.
- y-axis.** *Noun.* (1) The vertical axis that intersects the horizontal x-axis in a Cartesian coordinate system having two axes at right angles. (2) One of the three axes in a three-dimensional rectangular coordinate system. (3) Refers in laminates to the axis in the plane of the laminate, that is, perpendicular to the x-axis.
- y-bar.** *Noun.* The distance from an arbitrary axis to the centre of gravity of a plane section of a fibre composite.
- YBCO.** *Abbreviation.* Standing for $\text{YBa}_2\text{Cu}_3\text{O}_7$, a high-Tc **superconducting oxide**.
- Y-compounds.** *Noun.* See **Ferroxcube** and **Ferroxplanas**.
- Y-connection.** *Noun.* A three-phase star connection in electrical engineering.
- yellow, antimony.** *Noun.* See **lead antimonate**.
- yellowboy.** *Noun.* Colloquial name for yellow pigments based on ferric hydroxy sulphates, such as **schwartmanite**, FeOHSO_4 , and **potassium jarosite**, $\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6$.
- yellow cake.** *Noun.* Semi-refined uranium ore.
- yellow-green tourmaline.** *Noun.* A gem quality form of the mineral **tourmaline** that occurs as large crystals in some **pegmatites**.
- yellowing.** *Noun.* A defect in the lasting quality of a finish that changes to yellowish hues with time. Usually associated with clear, white, or light-coloured coatings.
- yellow lead oxide.** *Noun.* PbO . Used extensively in table, optical, and electrical glass to increase the density, refractive index, brilliance, durability, and working properties. Also used in glazes and enamels as a fluxing ingredient. Density $9,530 \text{ kg m}^{-3}$; mp 888°C . Known commercially as **litharge** and colloquially as **silver foam**.
- yellow ochre.** *Noun.* (1) $\text{FeO}(\text{OH})\cdot n\text{H}_2\text{O}$. Used as a yellow pigment. Also known as **limonite**. (2) Another name used in the pigment industry for **iron oxides**.
- yellow quartz.** *Noun.* See **citrine**.
- yellow ware.** *Noun.* A buff or yellow **semivitreous** or **earthenware** body that sometimes is coated with a clear colourless glaze.
- yellow zinc.** *Noun.* See **zinc chromates**.
- yellow zircon.** *Noun.* A naturally occurring form of **zirconium silicate** coloured yellow from partial cation substitution. It can be cut and polished when it displays a **lustre** and fire close to that of **diamond**.

yield. *Noun.* (1) The measure of stress at which a permanent change will occur in the shape of a solid body without causing the body to fracture. (2) The number of cubic feet of concrete produced per sack of cement, calculated as total volume per batch divided by the number of sacks per batch. (3) *Verb intr.* To give way under the action of a physical force, such as stretching or bending, but only to establish and maintain a new position.

yield factor. *Noun.* A multiplier used to limit loads to ensure that the structure will sustain no permanent set if subjected to a limit load.

yield point. *Noun.* (1) Minimum unit of stress at which continuous flow will occur in a clay-water or similar mass when subjected to some force such as tension, compression, torsion, or shear. (2) The minimum unit of stress at which a solid material will deform without an increase in the applied load. (3) The point on a stress-strain curve at which the increase in strain is no longer proportional to the increase in stress. Several methods exist to determine yield point, e.g., **Coplan's construction**, which defines it as the stress corresponding to the intersection of the tangent at the origin with the tangent having least slope. Also called **yield stress**, **yield strength**.

yield strength. σ_y . *Noun.* The stress at the **yield point**.

yield stress. σ_y . *Noun.* The minimum stress at which creep will occur in a solid body. See **creep**.

yield temperature. *Noun.* The minimum temperature at which permanent deformation will occur in a solid body underspecified conditions of stress.

yield value. *Noun.* The force that will just cause flow in a moulded mass of sand or a **thixotropic** suspension. See **Bingham plasticity**.

YIG. *Acronym.* Standing for yttrium iron garnet. See **yttrium iron garnet**.

ylem. *Noun.* The primordial matter from which the chemical elements are postulated to have been formed in the big bang that started the universe.

yoke. *Noun.* (1) A C-shaped solid or laminated piece of soft magnetic material around which a coil to carry magnetising current has been wound. (2) A steel framework around the formwork during the casting of concrete.

yoke magnetisation. *Noun.* A longitudinal magnetic field induced in a material, or in an area of a material, by means of an external yoke-shaped electromagnet.

Young-Dupre equation. *Noun.* An equation representing the balance of forces acting on a molten liquid drop in contact with a solid substrate: $\gamma_v - \gamma_l = \gamma_g \cos \theta$, where the symbols γ_v , γ_l and γ_g represent the free energy of the solid-vapour, solid-liquid, and liquid-glass interfaces, respectively, and θ is the **contact angle**.

Young's modulus. *E.* *Noun.* The ratio of tensile stress to tensile strain within the elastic limit of a solid body; also known as the modulus of elasticity. $E = \sigma/\epsilon$. Related to **shear modulus**, G , and **bulk modulus** K : $E = 2G(1 + \nu)$; $E = 3K(1 - 2\nu)$ where ν is **Poisson's ratio**.

yr. *Abbreviation.* Stands for year.

ytterbia. *Noun.* Ceramic name for **ytterbium oxide**.

ytterbite. *Noun.* $(\text{Ce}, \text{La}, \text{Nd}, \text{Y})_2\text{FeBe}_2\text{Si}_2\text{O}_{11}$. Now called **gadolinite**. A mineral from which several **rare earths** are extracted.

ytterbium aluminium boride. *Noun.* YbAlB_4 . A superconductor with unusual electrical and magnetic properties.

ytterbium oxide. *Noun.* Yb_2O_3 . Used as a component in electrically conducting ceramics, **glass-ceramics**, special refractories, **phosphors**, etc. Mp 2,346 °C; density 9,180 kg m⁻³.

ytterbium silicate. *Noun.* (1) Yb_2OSiO_4 . Mp 1,979 °C; hardness (Mohs) 5–7. (2) $\text{Y}_4(\text{SiO}_4)_3$. Mp 1,949 °C; density 4,390 kg m⁻³; hardness (Mohs) 5–7; (3) $\text{Y}_2\text{Si}_2\text{O}_7$. Mp 1,777 °C; density 4,064 kg m⁻³; hardness (Mohs) 5–7.

yttria. *Noun.* Ceramic name for yttrium oxide. See **yttrium oxide**.

yttrium aluminate. *Noun.* (1) YAlO_3 . A **perovskite** host for Nd^{3+} to form a laser with a wavelength of 1.06 μm and variable power: 35 W along crystal b-axis, 6 W along c-axis. Density 5,500 kg m⁻³. (2) $\text{Y}_4\text{Al}_5\text{O}_{19}$; mp 2,838 °C. (3) $\text{Y}_3\text{Al}_5\text{O}_{12}$. Acts as an host for Nd^{3+} ions to form a laser of 25 W power and a wavelength of 1.06 μm . See **yttrium aluminium garnet**.

yttrium aluminium garnet. *Noun.* $\text{Y}_3\text{Al}_5\text{O}_{12}$. Yttrium aluminium garnet, crystals of which are capable of sustaining laser activity when doped with neodymium. See **yttrium aluminate**.

yttria aluminosilicate glass. **YAS.** *Noun.* The composition contains up to 20 % yttria and **rare earths** and 0 % **soda**. They are very hard and durable. Developed to deliver high β -radiation doses to organs such as the liver.

yttrium barium copper oxide. *Noun.* See **1-2-4 superconductor**, **2-4-7 superconductor**, and **Y123**.

yttrium boride. *Noun.* YB_6 . One of several **borides** compositions, e.g., YB_2 , YB_4 , YB_6 , with special semi-conducting properties developed for use as a soft x-ray monochromator.

yttrium carbonate. *Noun.* $\text{Y}_2(\text{CO}_3)_2 \cdot 3\text{H}_2\text{O}$. Used as a **phosphor** in refractory gas mantles.

yttrium doped zirconia. *Noun.* A cubic stabilised form of ZrO_2 having the appearance of diamond and used as a substitute in some applications. The refractive index,

dispersion, and hardness have values 2.18, 0.06, and 8.5 (Mohs) compared with 2.42, 0.044, and 10, respectively, for **diamond**.

yttrium indium manganese oxide. *Noun.* $\text{YIn}_{1-x}\text{Mn}_x\text{O}_3$. When yttrium indium **perovskite** is substituted with Mn^{3+} ions so that the manganese is in a trigonal bipyramidal site an intense blue-coloured pigment is produced that can be very similar to **ultramarine**. The colour intensity can be varied from pale blue to almost black as the manganese content is increased. These are **cool pigments**.

yttrium iron garnet. YIG. *Noun.* $\text{Y}_3\text{Fe}_5\text{O}_{12}$, which is equivalent to $\text{Y}_3\text{Fe}_2(\text{FeO}_4)_3$. Used as a resonator at microwave frequencies.

yttrium ferrite. *Noun.* YFeO_3 . A **ferromagnetic** ceramic. Mp 1,560 °C; density 5,174 kg m⁻³.

yttrium magnesium sialon. *Noun.* $\text{YMgSi}_2\text{O}_5\text{N}$. A **pyroxene** phase containing $\text{Si}(\text{O},\text{N})_3$ chains which means it may be a useful grain boundary stabiliser in the **W-sialon** phases. Mp > 1,450 °C.

yttrium oxide. *Noun.* Y_2O_3 . Used to make red **phosphors** for television tubes, in the production of microwave filters, and, with ZrO_2 in the manufacture of special high-temperature refractories. Also used in incandescent mantles. Density 4,840 kg m⁻³; mp 2,410 °C. Also called **yttria**.

yttrium oxysulphide. *Noun.* $\text{Y}_2\text{O}_3\text{S}$. The host material for Eu^{3+} ions to act as red **phosphors** for colour TV tubes.

yttrium partially stabilised tetragonal zirconia. *Noun.* A tough ceramic offered as balls for grinding mills

that provide very efficient grinding without product contamination. Often referred to as **Y-PZT**. See **partially stabilised zirconia**.

yttrium red phosphor. *Noun.* $\text{Y}_2\text{O}_3:\text{Eu}^{3+}$. A red light emitting material prepared by replacing some Y^{3+} sites in **yttria** with europium.

yttrium silicate. *Noun.* (1) Y_2OSiO_4 ; mp 1,979 °C; density 4,490 kg m⁻³; hardness (Mohs) 5–7. (2) $\text{Y}_4(\text{SiO}_4)_3$; mp 1,949 °C; density 4,390 kg m⁻³; hardness (Mohs) 5–7. (3) $\text{Y}_2\text{Si}_2\text{O}_7$; mp 1,777 °C; density 4,060 kg m⁻³; hardness (Mohs) 5–7.

yttrium silicon oxynitride. *Noun.* YSiO_2N . A grain boundary phase occurring in the Si_3N_4 - Y_2O_3 - Al_2O_3 system when the three components are heated together. Also known as **K-phase**.

Y-type ferrite. *Trade name, noun.* $(\text{MO})_4(\text{Fe}_2\text{O}_3)_6$. One of the six types of hexagonal **ferrimagnetic** material based on **solid solutions** formed from **iron oxide**, Fe_2O_3 , and oxides of divalent metals but most commonly the M^{2+} ion is barium, Ba^{2+} .

YTZ. *Abbreviation.* Standing for yttrium partially stabilised tetragonal zirconia. See **partially stabilised zirconia**.

Y-TZP. *Abbreviation.* Standing for yttria-doped tetragonal zirconia polycrystals. See **yttria partially stabilised tetragonal zirconia**.

Yuan. *Adjective.* Of, or relating to the Chinese porcelain produced during the Yuan imperial dynasty (1279–1368) characterised by the appearance of under-glaze blue, and whiteware.

z. *Symbol.* Standing for the z-axis or a coordinate measured along the z-axis in a Cartesian or cylindrical coordinate system.

Z. *Symbol.* Standing for: (1) **atomic number**; (2) **impedance**.

Zacharaisson rules of glass formation. *Noun.* The four rules are: (1) an oxygen atom is linked to no more than two glass-forming atoms. (2) The coordination number of glass-forming atoms is small. (3) The oxygen atom polyhedra share corners with each other, but not faces or edges. (4) The polyhedra are linked in a random 3-D network.

zaffer. *Noun.* An impure form of **cobalt oxide**; used in the production of **smalt**.

Zahn cup. *Noun.* An orifice-type viscometer in which the time required for a measured quantity of glaze or porcelain-enamel slip to flow through an opening of specified size is taken as a measure of the slip viscosity.

zaratite. *Noun.* $\text{Ni}_3(\text{CO}_3)(\text{OH})_4 \cdot 4\text{H}_2\text{O}$. An amorphous mineral containing mainly green, hydrated **nickel carbonate**.

z-axis. *Noun.* The reference axis at 90° to the laminate plane in a composite.

ZBLAN. *Acronym.* Stands for commercially available fluorozirconate glass fibers containing ZrF_4 , BaF_2 , LaF_3 , AlF_3 , and NaF . Developed for doping with Pr^{3+} to make a fibre laser system because of its low loss properties by the **Rayleigh mechanism**. See **fluorozirconate glass**.

z-chart. *Noun.* A statistical aid used in industry; constructed by plotting weekly data, the moving annual total and the cumulative total dating from the start of the current year.

Z-compounds. *Trade name, plural noun.* See **Ferroxcube** or **Ferroxplanas**.

zebra roof. *Noun.* A roof used in basic open-hearth furnaces consisting of silica and **chrome magnesite** refractories arranged in alternate rings, resulting in a striped appearance.

Zeeman effect. *Noun.* The splitting of the spectroscopic lines of a source of radiation when subjected to a moderately intense magnetic field.

Zener current. *Noun.* The current through an insulator when placed in an electric field of sufficient intensity to excite an electron directly from the valence to the conduction band

Zener diode. *Noun.* A semiconductor voltage regulator that gives a sharp increase in reverse current at a well-defined reverse current at a specific reverse voltage. Used as a voltage regulator. Named after C. M. Zener 1905–1993.

Zener voltage. *Noun.* The field required to excite the Zener current; usually on the order of 107 V cm^{-1} . See **Zener current**.

zeolite. *Noun.* A class of hydrous aluminum silicates of approximate composition $\text{Na}_6\text{Al}_2\text{Si}_7\text{O}_{18} \cdot 7\text{H}_2\text{O}$. They appeared to boil when heated and got the name from that: zeo (to boil) + lithos (stone). They can be dehydrated and rehydrated without destroying the structure. They are nanoporous with channels and interstitial sites of molecular dimensions. Used in ion-exchange reactions and as drying agents.

zeolite process. *Noun.* A water-softening process involving the cationic exchange of the sodium in zeolite for the calcium and magnesium in hard water.

zeolite structure code. *Noun.* A convention in which zeolites are referred to by the first three letters of their name in capitals, for example FAU is **faujasite**, and SOD is **sodalite**.

zeotype. *Noun.* A generic name used in **zeolite** technology to denote the different **polytypes** that can be produced. They are isotypic when they have the same arrangement of tetrahedra.

zero, absolute. *Noun.* See **absolute temperature**.

zero-carbon steel. *Noun.* Sheet steel of extremely low carbon content on which porcelain-enamel cover coats usually may be applied and fired without the need of a ground coat.

zero-cement refractory castables. *Noun.* Refractory high **alumina** compositions containing no **calcium aluminate-hydrating** component. Binding is achieved through a $\gamma\text{-Al}_2\text{O}_3$ gel and in some cases methylacrylamide polymerisation.

zero crossing. *Noun.* A number equal to the number of times the load-time curve crosses the zero load level in a cyclic fatigue test.

zero enthalpy condition. *Noun.* See **International zero of enthalpy**.

zero-point energy. *Noun.* The energy remaining in a substance at absolute zero as a result of the energy levels only being able to define two electrons and so higher levels must be used to accommodate all the electrons in each atom.

zeta potential. *Noun.* The electrical potential measured at the shear plane formed between the **Stern layer** and the movable liquid layer close to the surface of a solid immersed in an aqueous solution. It is not the electrostatic potential at the solid-liquid interface but it is related to it and hence to the dispersibility of solid particles in a colloid. It is in effect the effective potential of the particle as it moves in a fluid and might be called the particles **water hull potential**. It is determined by measuring the **electrophoretic mobility** of colloidal particles in suspension as they flow in a controlled electric field.

zigzag CNT. *Noun.* See **carbon nanotubes**.

zigzag kiln. *Noun.* A type of kiln in which the dividing walls are staggered in a manner so as to force the heat to flow through the kiln in a zigzag pattern.

zinc acetate dihydrate. *Noun.* $\text{Zn}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$. A high purity reagent soluble in some alcohols and used in **sol-gel** technology to make nanocomposite and nanoceramics.

zinc aluminate. *Noun.* ZnAl_2O_4 ; a **spinel** used as a refractory lining in the refining of more uncommon metals. Mp 1,950 °C; density 4,580 kg m⁻³.

zinc ammonium chloride. *Noun.* $\text{Zn}(\text{NH}_4)_2\text{Cl}_4$. A salt used as a soldering flux in the preparation of glass to-metal and ceramic to-metal seals; density 1,800 kg m⁻³.

zinc antimonate. *Noun.* A spinel phase of approximate composition $\text{Zn}_7\text{Sb}_2\text{O}_{12}$ that occurs in over fired ZnO **varistors**. It is an insulating precipitate that affects the overall varistor performance and acts as a grain growth inhibitor during artefact sintering.

zinc antimonide. *Noun.* ZnSb . A **p-type semiconductor** used in thermionic power generation at temperatures up to 1,000 °C after which it is unstable.

zinc antimony spinel. *Noun.* See **zinc antimonite**.

zincate bath. *Noun.* A solution containing $[\text{ZnO}_2]^{2-}$ anions or $[\text{Zn}(\text{OH})_4]^{2-}$ ions and 10 g l⁻¹ of zinc from which zinc metal layers are galvanically plated.

zinc beryllium silicate. *Noun.* A **phosphor** material formerly much used in fluorescent lamps but withdrawn after its implication in berylliosis.

zinc blende. *Noun.* Natural ZnS ; see **zinc sulphide**.

zinc borate. *Noun.* Various compounds of ZnO and B_2O_3 ; used as fluxes in ceramic compositions; a white amorphous powder of uncertain composition used as a flame retardant.

zinc carbonate. *Noun.* ZnCO_3 . Used in **Bristol glaze** and other glazes; density 4,420–4,440 kg m⁻³; loses CO_2 at 300 °C. Also known as **smithsonite calamine** or **hemimorphite**.

zinc cement. *Noun.* Quick-hardening cement composed of **zinc oxide** made into a paste by the use of a **zinc chloride** solution.

zinc chloride. *Noun.* ZnCl_2 . Used in special cements, glass-etching compositions, dental cements, etc. Mp 290 °C; bp 732 °C; density 2,910 kg m⁻³. Has an old name: **butter of zinc**.

zinc chromates. *Noun.* Various compounds of ZnO and Cr_2O_3 ; used as a yellow ceramic colorant, originally described as $\text{ZnCrO}_4 \cdot 4\text{Zn}(\text{OH})_2$ but now known to be $\text{K}_2\text{Zn}_4\text{Cr}_4\text{O}_{16}(\text{OH})_2 \cdot 2\text{H}_2\text{O}$. Also known as **yellow zinc**.

zinc crown glass. *Noun.* An optical glass containing substantial amounts of zinc oxide as an auxiliary flux. See optical crown glass.

zinc ferrate. *Noun.* ZnFe_2O_4 . A partially **inverse spinel** melting at about 1,590 °C; used for its magnetic and semiconducting properties. Density 5,330 kg m⁻³.

zinc flash. *Noun.* A coloured surface produced on brick by the introduction of zinc into the fireboxes of the kiln at the end of the firing operation, the zinc vapours depositing on the surface of the brick to form various shadings ranging from yellow to green. The process is called **flashing**.

zinc, flowers of. *Noun.* See **zincite**.

zinc fluoride. *Noun.* ZnF_2 . Used as a gaseous opacifier and flux in porcelain-enamels and glazes. Mp 872 °C, density 4,840 kg m⁻³.

zinc fluosilicate. *Noun.* $\text{ZnSiF}_6 \cdot 6\text{H}_2\text{O}$. Used as a concrete hardener but decomposes on heating. Density 2,100 kg m⁻³.

zinc glass. *Noun.* Glass of the ordinary soda-lime type in which part of the calcium content is replaced by zinc when ZnO replaces some CaO in the formulation.

zincite. *Noun.* (1) ZnO . Rare mineral used in the production of zinc oxide of high purity; hexagonal structure with pyramidal crystals often twinned at the base. Density 5,400–5,700 kg m⁻³; hardness (Mohs) 4–4.5. (2) Alternative name for **zinc oxide**. A common glaze ingredient where it is used as an opacifier, colour modifier and crystal growth promoter. Other names are **Chinese white**, **zinc white** and **flowers of zinc**.

zinc molybdate. *Noun.* ZnMoO_4 . Occasionally used as an adherence-promoting agent in white porcelain-enamels. Mp about 900 °C, uncertain because of decomposition at this temperature.

zinc niobate. *Noun.* There are several zinc-niobium oxides carrying this name but two are more common and used in **dielectric** packaging components: ZnNb_2O_6 , mp 1,398 °C and $\text{Zn}_3(\text{NbO}_4)_2$.

zinc nitride. *Noun.* Zn_3N_2 . A semiconducting ceramic material used in electronic applications.

zinc oxide. *Noun.* ZnO . Used as an opacifier and fluxing ingredient in glass, glazes, porcelain-enamels, **magnetic ferrites**, dental cements, and special **piezoelectric** compositions. Finds growing application when doped with **antimony oxide**, Sb_2O_3 , as a ceramic **varistor** for protection of electronic circuits from transient overvoltages. As a thin film doped with silicon it is a semiconductor that is transparent and is a common component of thin films used for photovoltaic applications. Sublimes at 1,800 °C; density 5,600–5,800 kg m^{-3} . Also called **zinc white**, **Chinese white**, **flowers of zinc**, and **philosopher's wool**. See **zincite**.

zinc palmitate. *Noun.* $\text{Zn}[\text{CH}_3(\text{CH}_2)_4\text{CO}_2]_2$. A low friction soapy salt used as a **die lubricant**.

zinc phosphate. *Noun.* $\text{Zn}_3(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$. Used in dental cements and in a very pure form in the production of **phosphors**; mp 900 °C; density 3,080 kg m^{-3} .

zinc selenide. *Noun.* ZnSe . A ceramic semiconductor used for infrared optical windows; mp approx 1,100 °C; density 5,330 kg m^{-3} .

zinc shakes. *Noun.* A disease caused by exposure to zinc fumes in processes, such as **flashing**. Symptoms include: fever, nausea, depression, dryness of throat and headache. No cumulative effect. Also called **founder's ague** and **Monday morning fever**.

zinc silicate. *Noun.* Since zinc can form all the common silicate compositions and structures this is a loose term that often implies the two commonest compositions: (1) Zn_2SiO_4 ; mp 1,509 °C; density 3,300 kg m^{-3} ; hardness (Mohs) 5.5. (2) ZnSiO_3 ; mp 1,510 °C; density 4,100 kg m^{-3} ; hardness (Mohs) 5–7. Both are naturally occurring minerals. See **zircon**.

zinc sulphide. *Noun.* ZnS . A semiconducting ceramic used in **phosphor** compositions and similar high tech materials as well as manufacture of white opaque glasses and in x-ray and television tubes. Density 3,900–4,100 kg m^{-3} ; mp 1,020 °C; sublimes at 1,180 °C making it capable of thin film deposition for device manufacture; hardness (Mohs) 3.5–4. Also called **zinc blende** and is the **aristotype** of a classical crystal structure.

zinc telluride. *Noun.* ZnTe . A II–VI semiconductor with the **zinc blende**, structure; mp 1,238 °C; density 5,540 kg m^{-3} .

zinc titanate. *Noun.* The name covers two compositions with classic structures and both are dielectrics used in a number of microwave applications: (1) ZnTiO_3 . A **perovskite** that can be either cubic or hexagonal depending on the particle size when in the nano-size range; mp above 1,500 °C; (2) TiZn_2O_4 . A **spinel**; mp above 1,500 °C.

zinc titanium oxynitride. *Noun.* ZnTiON . A cation-deficient **oxynitride** phase with a **spinel** structure; used as a photo catalyst. Prepared from nano-sized ZnO colloid by the **sol-gel** method.

zinc white. *Noun.* Another name for **Chinese white**. See **zincite**.

zinc zirconium silicate. *Noun.* ZnZrOSiO_4 . Used primarily as an ingredient in ceramic glazes; mp 1,080 °C.

zinkenite. *Noun.* PbSb_2S_4 . A mineral of metallic appearance consisting of a lead and antimony sulphide.

zinnwaldite. *Noun.* $\text{KLiFeAl(AlSi}_3\text{)}\text{O}_{10}(\text{F,OH})_2$. A monovalent **mica** capable yielding tough, strong sheets from perfect cleavage.

Zintl phases. *Plural noun.* Materials whose composition is rationalised on an electron counting scheme when electropositive elements donate electrons to electronegative elements and the electro negative elements use the extra electrons to form bonds so that all elements satisfy the 8-N rule. Thus these phases consist of cations and covalently bonded polyatomic anions, e.g. K_8Sn_{25} .

Zircar. *Trade mark, noun.* A commercially available yttria-stabilised zirconia fibre usually supplied as chopped strand; density 5,600–5,900 kg m^{-3} .

zircon. *Noun.* ZrSiO_4 . Naturally occurring mineral with occasional large crystals valued as gemstones; used in porcelain-enamels and glazes as an opacifier and to improve colour stability and crazing resistance; also used in refractories, abrasives, grinding wheels, precision moulds for the casting of alloys, electrically resisting cements and in conventional electrical and technical porcelains; softening temperature 850–950 °C due to the presence of SiO_2 and ZrO_2 from dissociated zircon; mp 2,250 °C; density 4,680 kg m^{-3} ; hardness (Mohs) 7.5.

zircon colours. *Noun.* A spectrum of colours produced when ZrO_2 is heated with SiO_2 in the presence of colour inducing ions so that they take up Zr^{4+} sites in ZrSiO_4 . For example, Y^{3+} ions give blue colours; Pr^{3+} ions give yellow colours. Alkali halide mineralisers are important in the process because by producing volatile silicon halides, SiX_4 , the reaction with ZrO_2 is expedited.

zircon flour. *Noun.* Finely milled **zirconium silicate** used as a **mill wash**.

zirconia. *Noun.* ZrO_2 . A widely available, naturally occurring ceramic material whose widespread use has been restricted by its **polymorphism**; used as an opacifier in porcelain-enamels and glazes, as an abrasive

in polishing and grinding compounds, as setter plates for the firing of ceramics, ferrites, and titanates, as wind-tunnel liners, as a refractory, structural material in nuclear applications, as a highly corrosion-resistant ceramic, and as a refractory for high-temperature use, but all these applications are subject to restricted firing ranges or the zirconia has to be stabilised by solid solution formation with a number of other cubic oxides, such as yttria or lime; mp 2,715 °C; density 5,735 kg m⁻³; hardness (Mohs) 6.5.

zirconia brick. *Noun.* A refractory brick composed of >50 mol% of zirconia; used to line metallurgical furnaces because of its resistance to basic slags.

zirconia glow. *Noun.* The burst of heat and light that is observed when an amorphous nanosized powder of hydrated zirconia transforms to the tetragonal crystalline form when calcined.

zirconia refractories. *Noun.* A refractory composed essentially of **zirconium oxide**.

zirconia-toughened alumina. ZTA. *Noun.* A composite consisting of an **alumina** matrix and a dispersion of **partially stabilised tetragonal zirconia**.

zirconia toughening. *Noun.* The inclusion of a mixture of stabilised tetragonal and monoclinic crystalline forms of ZrO₂ into ceramic systems to increase K_{IC}, their **fracture toughness** parameter. Crack propagation energy is absorbed ahead of a crack tip in such a sintered composite by mechanisms involving tetragonal to monoclinic phase transformation and microcrack generation according to the following toughening equation: $K_{IC} = K_0 + (2E\gamma_{tr}r_p)^{1/2} + (2E\gamma_m r_m)^{1/2}$, where K₀ is the **fracture toughness parameter** of the matrix ceramic, E is its elastic modulus, γ is the energy density absorbed ahead of the crack, r is the radius of the process zone, subscript T indicates the stress-induced tetragonal to monoclinic phase transformation, and subscript m indicates a microcrack nucleation mechanism.

zirconia whiteware. *Noun.* Any whiteware product containing substantial amounts of zirconia, ZrO₂, as an essential ingredient.

zircon iron corals. *Noun.* A synthetic inorganic stain formed from **zirconia**, **silica**, and **iron oxide**, Fe₂O₃, which is a type of **core-shell** material where the zircon crystals completely coat the α-**haematite** iron oxide. The stability of the colour depends on the integrity of the zirconium silicate shell around the iron oxide core, which is determined by the initial calcining programme. When powdered and mixed with glaze frit a range of colours can be developed when fired on to pottery.

zirconium aluminate. *Noun.* ZrAl₂O₄. A synthetic **spinel** phase used as a component of high-temperature refractories. See **zirconium spinel**.

zirconium beryllides. *Noun.* Zirconium can form up to six binary phases with beryllium two of which find uses as moderator rods in nuclear reactors because of

their good mechanical strength at high temperatures (1) ZrBe₁₃; mp 1,930 °C; density 2,720 kg m⁻³. (2) Zr₂Be₁₇; mp 1,980 °C; density 3,082 kg m⁻³.

zirconium carbide. *Noun.* ZrC_{1-x}, where x is in the range 0.5–0.97; the physical and some mechanical properties vary linearly with the non-stoichiometric composition to reach values that make these ceramics amongst the hardest and most refractory available; electronic conductors with the conductivity increasing as the carbon content approaches 1.0. Employed as an abrasive, as refractories; incandescent filament, and cutting tools; mp 2,850–3,540 °C; density rising to 6,440 kg m⁻³; hardness (Mohs) in the range 7–9.

zirconium diboride. *Noun.* ZrB₂. A special ceramic suitable for many high temperature uses due to a protective glassy layer of zirconia and boric oxide used in cutting tools, metal-casting refractory moulds, refractory pouring spouts, rocket nozzles, combustion chamber liners, thermocouple tubes, and other high-temperature products. Mp 3,040 °C; density 6,100 kg m⁻³. See **borides**.

zirconium dioxide. *Noun.* ZrO₂. See **zirconia**.

zirconium dioxide porcelain. *Noun.* A porcelain in which **zirconia** is a major component.

zirconium dioxide refractory. *Noun.* A refractory of low thermal conductivity in which zirconium dioxide, ZrO₂, is a major ingredient; the stabilised ZrO₂ refractories in which, by the addition of Y₂O₃ or other cubic stabilisers to the ZrO₂, the zirconia remains in the cubic or tetragonal polymorph. They are used at temperatures above 2,200 °C.

zirconium hydroxide. *Noun.* Zr(OH)₄. Used in glass manufacture. Density 3,250 kg m⁻³; decomposes to ZrO₂ at 550 °C.

zirconium naphthenate. *Noun.* An amber-coloured, transparent, liquid of high density sometimes used in porcelain-enamel and glaze formulations.

zirconium nitride. *Noun.* ZrN_{1-x} where x is in the range 0.5–0.9. The physical and some mechanical properties vary linearly with the non-stoichiometric composition to reach values that make these ceramics amongst the hardest and most refractory available; electronic conductors with the conductivity increasing as the nitrogen content approaches 0.9; all are brassy coloured employed as an abrasive, in refractories, crucibles, and cermets and used as a false gold colour in decorations; mp 2,700–2,930 °C; density 7,300 kg m⁻³.

zirconium oxide. *Noun.* See **zirconia**.

zirconium phosphate. *Noun.* See **zirconyl phosphate**.

zirconium silicate. *Noun.* See **zircon**.

zirconium spinel. *Noun.* ZrAl₂O₄. A **spinel** that occurs as a mineral but is usually manufactured. Mp 1,710 °C.

zirconium sulphate. *Noun.* $\text{Zr}_5\text{O}_8(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$. A precipitate from solutions containing **zirconyl** cations and sulphate anions obtained by adding ammonia; used to make nanosized particles of ZrO_2 .

zirconium tetra n-butoxide. *Noun.* $\text{Zr}(\text{n-OBu})_4$. An **alkoxide** salt soluble in butyl alcohol that can be oxidised by hydrogen peroxide and nitric acid to a transparent **sol** from which zirconia fibres can be spun.

zirconium titanate. *Noun.* ZrTiO_4 . A dielectric resonator material used for microwave filters and oscillators. It has the $\alpha\text{-PbO}_2$ structure and a **dielectric constant** in the range 20–100 depending on doping with Sn^{4+} .

zirconium tungstate. *Noun.* $\text{Zr}(\text{WO}_4)_2$. A cubic structural ceramic with the unusual property of contracting in volume when heated from just above absolute zero to its decomposition temperature of 777 °C. This effect is due to the W-O-Zr shared oxygen vibrating above and below the axis so that the mean W-Zr distance decreases with increasing temperature.

zirconolite. *Noun.* $\text{CaZrTi}_2\text{O}_7$. A monoclinic derived from a defect **fluorite** lattice; a major phase in **Synroc**, a synthetic material being considered for immobilising high-level nuclear waste prior to disposal by deep burying.

zircon porcelain. *Noun.* A vitreous ceramic **whiteware** used in technical applications, crucibles, combustion boats, thermocouple tubes, etc., and in which **zirconia**, ZrO_2 is an essential component.

zircon praseodymium yellow. *Noun.* An inorganic stain produced by reacting **silica** and **zirconia** with small amounts of praseodymia, Pr_2O_3 so that some Zr^{4+} is replaced by Pr^{3+} in the **zircon** structure. When mixed with glaze frit and fired onto ware it develops a range of yellow colours.

zircon refractory. *Noun.* Any refractory product composed substantially of **zircon**, ZrSiO_4 .

zircon sand. *Noun.* Natural sand containing useful amounts of **zirconia**, ZrO_2 , **titania**, TiO_2 , and related materials, but mainly powdered ZrSiO_4 .

zircon vanadium turquoise. *Noun.* A stain formed from **zircon**, ZrSiO_4 , in which a few Zr^{4+} sites are substituted by Y^{4+} ; when powdered and mixed with glaze frit it develops a range of blue colours on firing.

zircon whiteware. *Noun.* Any ceramic whiteware containing zircon, ZrSiO_4 , as an essential ingredient.

zirconyl. *Noun.* The complex cation ZrO^{2+} .

zirconyl phosphate. *Noun.* $(\text{ZrO})_2(\text{PO}_4)_2$. A potential semi-refractory as it can stand temperatures up to 1,600 °C and is now used in the production of some types of glass containers.

zirkite. *Noun.* A mineral source of **zirconium dioxide**, ZrO_2 ; used in refractories and low-expansion bodies of high thermal-shock resistance.

Zisman apparatus. *Noun.* An instrument for measuring contact-potential differences between solid-solid and solid-liquid interfaces.

zoisite. *Noun.* $\text{Ca}_2\text{Al}_3(\text{SiO}_4)_3(\text{OH})$. An orthorhombic orthosilicate mineral of pink colour;

zone control. *Noun.* A system of independent heating and temperature controls for each zone of a furnace or kiln.

zone melting. *Noun.* A method of separating or purifying a substance by differential solubility in which a series of molten zones traverse a rod or charge of a semiconductor or other substance. A slow moving coil attached to an induction heater often produces the zone.

zone refining. *Noun.* A procedure for purifying materials in which a narrow molten zone is moved slowly along the length of a specimen in such a manner that impurities are retained in and moved along with the molten material to the end of the specimen where they are collected and removed by severing; the process may be repeated until the desired degree of purity is attained. A slow moving coil attached to an induction heater often produces the zone.

Z-score. *Noun.* A statistical function: $Z = (x - X)/s$, where x is the reported value, X is the assigned value and s is the target for **standard deviation**.

ZT. *Symbol.* Stands for thermoelectric figure of merit. See **Seebeck effect**.

ZTA. *Abbreviation.* Stands for zirconia-toughened alumina. See **zirconia-toughened alumina**.

zwitterion. *Noun.* An ion that has both positive and negative charged atoms.

Appendix

Table A.1 Basic SI units

Parameter	Unit	Abbreviation
Length	Metre	m
Mass	Kilogram	kg
Time	Second	s
Electric current	Ampere	A
Thermodynamic temperature	Kelvin	K
Amount of substance	Mole	mol
Luminous intensity	Candela	cd

Table A.2 Prefixes for factors

Factor	Prefix	Factor	Prefix
10^{18}	exa (E)	10^{-18}	atto (a)
10^{15}	peta (P)	10^{-15}	femto (f)
10^{12}	tera (T)	10^{-12}	pico (p)
10^9	giga (G)	10^{-9}	nano (n)
10^6	mega (M)	10^{-6}	micro (μ)
10^3	kilo (k)	10^{-3}	milli (m)
10^2	hecto (h)	10^{-2}	centi (c)
10^1	deka (da)	10^{-1}	deci (d)

Table A.3 Acceptable SI units

Parameter	Unit	Abbreviation	Accepted alternative	Abbreviation
Length	Metre	m	—	—
Mass	Kilogram	kg	Gram	g
			Metric ton	t
Volume	Cubic metre	m^3	—	—
Force	Newton	N	—	—
Pressure, stress	Pascal	Pa	—	—
Density	Kilograms per cubic metre	kg m^{-3}	Grams per cubic centimetre	g cm^{-3}
Energy	Joule	J	—	—
Power	Watt	W	—	—
Time	Second	s	Year	yr
			Day	d
			Hour	h
			Minute	min
Amount of substance	Mole	mol	—	—
Plane angle	Radian	rad	Degree	$^\circ$
			Minute	'
			Second	"
Solid angle	Steradian	sr	—	—
Temperature	Kelvin	K	Degree Celsius	$^\circ\text{C}$

(continued)

Table A.3 (continued)

Parameter	Unit	Abbreviation	Accepted alternative	Abbreviation
Thermal conductivity	Watts per metre-kelvin	W (m·K) ⁻¹	—	—
Entropy	Joules per kelvin	J K ⁻¹	—	—
Specific heat	Joules per kilogram-kelvin	J (kg·K) ⁻¹	—	—
Permeability (porous material)	Darcy	D	—	—
Frequency	Hertz	Hz	—	—
Electric current	Ampere	A	—	—
Electric potential	Volt	V	—	—
Electrical resistance	Ohm	Ω	—	—
Quantity of electricity	Coulomb	C	—	—
Capacitance	Farad	F	—	—
Conductance	Siemens	S	—	—
Inductance	Henry	H	—	—
Magnetic flux	Weber	Wb	—	—
Magnetic flux density	Tesla	T	—	—
Luminous intensity	Candela	cd	—	—
Luminous flux	Lumen	lm	—	—
Illuminance	Lux	lx	—	—
Radioactivity	Becquerel	Bq	curie	Ci
Absorbed dose	Gray	Gy	rad	rad

Table A.4 Metric weights and measures

Weight	Unit	Unit	Abbreviation
1000	Grams	1 kilogram	kg
100	Grams	1 hectogram	hg
10	Grams	1 decagram	dag
1	Gram	1 gram	g
0.1	Gram	1 decigram	dg
0.01	Gram	1 centigram	cg
0.001	Gram	1 milligram	mg
Length			
1000	Metres	1 kilometre	km
100	Metres	1 hectometre	hm
10	Metres	1 decametre	dam
1	Metre	1 metre	m
0.1	Metre	1 decimetre	dm
0.01	Metre	1 centimetre	cm
0.001	Metre	1 millimetre	mm
Liquid capacity			
1000	Litres	1 kilolitre	kl
100	Litres	1 hectolitre	hl
10	Litres	1 decilitre	dal
1	Litre	1 litre	l
0.1	Litre	1 decilitre	dl
0.01	Litre	1 centilitre	cl
0.001	Litre	1 cubic centimetre	cm ³

Table A.5 USA weights and measures

Weight (Avoirdupois)	Unit	Unit	Abbreviation
1.0	Long ton	2,240 pounds	lb
1.0	Short ton	2,000 pounds	lb
1.0	Pound	16 ounces	oz
1.0	Ounce	437.5 grains	
1.0	Grain		gr
Weight (Troy)			
1.0	Pound	12 ounces	lb
1.0	Ounce	20 pennyweight	oz
1.0	Pennyweight	24 grains	dwt
1.0	Grain		
1.0	Avoirdupois pound	1.21528 troy pounds	
Length			
1.0	Inch		in.
1.0	Foot	12 inches	ft
1.0	Yard	36 inches	yd
1.0	Rod	198 inches	rd
1.0	Chain	792 inches	ch
1.0	Mile	5,280 feet	mi
Liquid capacity			
1.0	Fluid ounce		fl oz
1.0	Pint	16 fluid ounces	pt
1.0	Quart	2 pints	qt
1.0	Gallon	4 quarts	gal

Table A.6 Conversion from American units to metric units

Parameter	Unit (from)	Multiply by	Unit (to)
Length	inch	2.54×10^{-2}	m
	foot	0.3048	m
	yard	0.9144	m
	mile	1.609×10^3	m
Area	inch ²	6.4516×10^{-4}	m ²
	foot ²	9.2903×10^{-2}	m ²
	yard ²	0.83613	m ²
	mile ²	2.5900×10^6	m ²
	acre	4.0469×10^3	m ²
Volume	inch ³	1.6387×10^{-5}	m ³
	foot ³	2.8317×10^{-2}	m ³
	yard ³	0.76455	m ³
	quart (USA)	9.4635×10^{-4}	m ³
	gallon (USA)	3.7854×10^{-3}	m ³
	barrel (oil)	1.5899	m ³
Mass	ounce	2.835×10^{-2}	kg
	pound	0.45360	kg
	ton	9.0718×10^2	kg
Density	pound inch ⁻³	2.7680×10^4	kg m ⁻³
	pound foot ⁻³	16.018	kg m ⁻³
	g cm ⁻³	10 ³	kg m ⁻³

(continued)

Table A.6 (continued)

Parameter	Unit (from)	Multiply by	Unit (to)
Velocity	foot s ⁻¹	0.3048	m s ⁻¹
	mile hour ⁻¹	0.44704	m s ⁻¹
Acceleration	foot s ⁻²	0.3048	m s ⁻²
	inch s ⁻²	2.54×10^{-2}	m s ⁻²
Force	poundal	0.13825	N
	pound force	4.4482	N
	dyne	10^{-5}	N
Pressure, stress	psi	6.8948×10^3	Pa or N m ⁻²
	dyne cm ⁻²	10^{-1}	Pa or N m ⁻²
	pound foot ⁻²	47.880	Pa or N m ⁻²
	torr	1.3332×10^2	Pa or N m ⁻²
Energy	Btu	1.0544×10^3	J
	calorie	4.184	J
	erg	10^{-7}	J
	kilowatt hour	3.6×10^6	J
Power	Btu s ⁻¹	1.0544×10^3	W
	Btu hour ⁻¹	0.29288	W
	calorie s ⁻¹	4.184	W
	horsepower	7.4570×10^2	W
Heat capacity	cal (g °C) ⁻¹	4.184×10^3	J (kg·K) ⁻¹
	Btu (lb °F) ⁻¹	4.187×10^3	J (kg·K) ⁻¹
Thermal conductivity	Btu in. (h ft ² °F) ⁻¹	0.14413	W (m·K) ⁻¹
	Btu (h ft °F) ⁻¹	1.7296	W (m·K) ⁻¹
	cal (s cm °C) ⁻¹	4.184×10^2	W (m·K) ⁻¹
Viscosity	centipoise	10^{-3}	N·s m ⁻²
Angle	degree	1.7453×10^{-2}	rad
	minute	2.9089×10^{-4}	rad
	second	4.8481×10^{-6}	rad

Table A.7 Conversion from metric to American units

Parameter	Units (from)	Multiply by	Units (to)
Length	m	39.370	inch
	m	3.2808	foot
	m	6.2137×10^{-4}	mile
Area	m ²	1.5500×10^3	inch ²
	m ²	10.764	foot ²
	m ²	3.8610×10^{-7}	mile ²
Volume	m ³	6.1024×10^4	inch ³
	m ³	35.315	foot ³
	m ³	1.0567×10^3	quart (USA)
	m ³	2.0288×10^5	teaspoon
Mass	kg	2.2046	pound
	kg	1.1023×10^{-3}	ton
Density	kg m ⁻³	3.6127×10^{-5}	pound inch ⁻³
	kg m ⁻³	6.2428×10^{-2}	pound foot ³
	kg m ⁻³	10^{-3}	g cm ⁻³

(continued)

Table A.7 (continued)

Parameter	Units (from)	Multiply by	Units (to)
Velocity	m s ⁻¹	3.2808	foot s ⁻¹
	m s ⁻¹	2.2369	mile hour ⁻¹
Acceleration	m s ⁻²	3.2808	foot s ⁻²
Force	N	0.22481	pound force
	N	7.2330	poundal
	N	10 ⁵	dyne
Pressure, stress	Pa or N m ⁻²	1.454 × 10 ⁻⁴	psi
	Pa or N m ⁻²	10	dyne cm ²
	Pa or N m ⁻²	2.0885 × 10 ⁻²	pounds foot ²
	Pa or N m ⁻²	7.5006 × 10 ⁻³	torr
Energy	J	9.4845 × 10 ⁻⁴	Btu
	J	0.23909	calorie
	J	10 ⁷	erg
	J	2.7778 × 10 ⁻⁷	kilowatt hour
Power	W	9.4845 × 10 ⁻⁴	Btu s ⁻¹
	W	3.4144	Btu hour ⁻¹
	W	0.23901	calories s ⁻¹
	W	1.3410 × 10 ⁻³	horsepower
Heat capacity	J (kg·K) ⁻¹	2.3901 × 10 ⁻⁴	Btu (lb °F) ⁻¹
	J (kg·K) ⁻¹	2.901 × 10 ⁻⁴	cal (g °C) ⁻¹
Thermal conductivity	W (m·K) ⁻¹ or J (s·m·K)	6.9380	Btu.in. (h ft ² °F) ⁻¹
	W (m·K) ⁻¹ or J (s·m·K)	0.57816	Btu (h ft °F) ⁻¹
	W (m·K) ⁻¹ or J (s·m·K)	2.93901 × 10 ⁻⁹	cal (s cm °C) ⁻¹
Viscosity	N·s m ⁻²	10 ³	centipoise
Angle	rad	57.296	degree
	rad	3.4377 × 10 ³	minute
	rad	2.0626 × 10 ⁵	second

Table A.8 Ceramic resistor colour code (the four coloured rings are read from left to right on the resistor)

Ring 1 and Ring 2		Ring 3 multiplier		Ring 4 tolerance	
Colour	Value	Colour	X	Colour	%
Black	0	Black	1	No colour	20
Brown	1	Brown	10	Black	20
Red	2	Red	10 ²	Silver	10
Orange	3	Orange	10 ³	Gold	5
Yellow	4	Yellow	10 ⁴	White	10
Green	5	Green	10 ⁵	Green	5
Blue	6	Blue	10 ⁶		
Violet	7	Violet	10 ⁷		
Grey	8	Silver	0.01		
White	9	Gold	0.1		
		Grey	0.01		
		White	0.01		

For example: a resistor with rings Green, Red, Violet and Silver has a: 52 × 10⁷ Ω ± 10 % resistance

Table A.9 Ceramic capacitor colour code (the five coloured rings are read from left to right)

Capacitance pF							
Ring 1 temperature coefficient		Ring 2 and Ring 3 first and second figures		Ring 4 multiplier		Ring 5 tolerance	
Colour	ppm °C ⁻¹	Colour	Value	Colour	x	Colour	>10 pF ±% <10 pF ±%
Black	0	Black	0	Black	1.0	Black	20 2
Brown	−30	Brown	1	Brown	10	Brown	1 0.1
Red	−80	Red	2	Red	10 ²	Red	2 –
Orange	−150	Orange	3	Orange	10 ³	Green	5 0.5
Yellow	−220	Yellow	4	Grey	10 ^{−2}	Grey	0.25 –
Green	−330	Green	5	White	10 ^{−1}	White	10 1
Blue	−470	Blue	6				
Violet	−750	Violet	7				
Grey	+30	Grey	8				
White	+500	White	9				

For example a capacitor with Grey, Red, Violet, Brown and White rings has a capacity of 270 pF ± 10 % with temperature coefficient of +30 ppm °C^{−1}

Table A.10 Sieve mesh and equivalent grain size

Mesh N°	60	80	100	220	240	320	400	600
Grain size mm	0.4	0.27	0.17	0.066	0.063	0.045	0.033	0.022

Table A.11 Stones of the week

Sunday	Topaz or diamond
Monday	Pearl or crystal
Tuesday	Emerald or ruby
Wednesday	Amethyst or loadstone
Thursday	Cornelian or sapphire
Friday	Emerald or catseye
Saturday	Diamond or turquoise

Table A.13 Oxide phosphors

Dopant	Host crystal	Colour
Eu	Y ₂ O ₃	Red
Mn	Zn ₂ SiO ₄	Green
Ce	Y ₂ SiO ₅	Blue
Tb	Y ₃ Al ₅ O ₁₂	Green
None	CaWO ₄	Blue
Tb	CeMgAl ₁₁ O ₁₉	Green
Tm	LaOBr	Blue

Table A.12 Birthstones

Month	Colour	Stone	Alternative
January	Dark red	Garnet	Red jasper
February	Purple	Amethyst	Spinel
March	Pale blue	Aquamarine	Tourmaline
April	Translucent	Diamond	Rock crystal
May	Bright green	Emerald	Chrysoprase
June	Cream	Pearl	Moonstone
July	Red	Ruby	Cornelian
August	Pale green	Peridot	Aventurine
September	Deep blue	Sapphire	Sodalite
October	Variegated	Opal	Abalone
November	Yellow	Topaz	Citrine
December	Sky blue	Turquoise	Amazonite

Table A.14 Data for some early cuprate superconductors

Superconductor	T _c (K)	B _c (T)
(LaBa) ₂ CuO ₄	35	36
YBa ₂ Cu ₃ O ₇	92	100
Bi ₂ Sr ₂ Ca ₂ Cu ₃ O ₁₀	110	120
Tl ₂ Ba ₂ Ca ₂ Cu ₃ O ₁₀	128	120

Table A.15 Effect of firing atmosphere on ceramic colours

Colour	Fired under oxidising conditions	Fired under reducing conditions
White	Aluminium oxide	—
	Antimony oxide	—
	Arsenic oxide	—
	Calcium borate	—
	Calcium compounds	—
	Magnesium carbonate	—
	Magnesium oxide	—
	Silver oxide	—
	Tin oxide	—
	Titanium dioxide	—
	Zinc oxide	—
	Zirconium dioxide	—
Black	Chrome ore + pyrolusite + cobalt oxide	Bismuth salts
	Chromium oxides	Carbides
	Cobalt oxides	Carbon
	Iridium compounds	Iridium sesquioxide
	Iron oxides	Lead salts
	Manganese oxides	Molybdenum compounds
	Nickel oxides	Nickel monoxide
	Pyrolusite	Sulphides
	Uranium oxide + copper oxide	Uranium monoxide
Grey	Antimony grey	Metallic antimony
	Iridium oxide	Carbon compounds
	Osmium oxide	Chromium compounds
	Palladium oxide	Cobalt salts
	Platinum salts	Copper salts
	Rhodium oxide	Manganese salts
	Ruthenium oxide	Molybdenum compounds
		Nickel compounds
		Stannous oxide
		Uranium oxide
		Vanadium salts
Silver	Palladium salts	—
	Platinum salts	—
	Metallic silver	—
Red	Bismuth uranate	Copper salts
	Cadmium sulphide + cadmium selenide + barites	
	Iron oxides, iron salts	
	Basic lead chromate	
	Lead uranate	
	Manganese oxide	
	Manganese pink	
	Neodymium salts	
	Purple of cassius	
	Sodium diuranate	
Pink	Chrome-tin compounds	

(continued)

Table A.15 (continued)

Colour	Fired under oxidising conditions	Fired under reducing conditions
Orange	Bismuth uranate	—
	Cadmium sulphide and selenide	
	Chrome iron ore	
	Iron oxide + chromates	
	Iron titanate	
	Basic lead chromate	
	Lead uranate	
	Manganese oxide + titanates	
	Manganese tungstate	
	Sodium diuranate	
	Uranium titanate	
Gold	Metallic gold	
Yellow	Barium chromate	Praseodymium salts
	Barium salts	Vanadium stannate
	Cadmium sulphide	
	Ceric oxide	
	Gold salts	
	Iron oxide + litharge	
	Lead chromate	
	Lead oxide + antimony oxide	
	Manganese dioxide	
	Molybdenum salts	
	Nickel oxide	
	Praseodymium salts	
	Pyrolusite	
	Silver salts	
	Sodium diuranate	
	Vanadium stannate	
	Zinc chromate	
Sea Green	Cobalt antimonate	Chromic oxide
	Copper compounds	Cobalt titanate
	Nickel-zinc oxides	
Leaf Green	Chromic oxide	Cobalt titanate
	Cobalt titanate	Praseodymium salts
	Copper salts	
	Nickel oxide + zinc oxide	
	Praseodymium salts	
Ice Blue	Copper compounds	Titanium dioxide
	Nickel oxide + zinc oxide	
Deep Blue	Cobalt compounds	Titanium dioxide
	Neodymium compounds	Vanadium compounds
Violet	Nickel oxide	Colloidal copper metal
	Pyrolusite	Titanium dioxide
	Purple of cassius	

Table A.16 Chemical elements

Element	Symbol	Atomic number	Atomic mass	Element	Symbol	Atomic number	Atomic mass
Actinium	Ac	89	227	Mercury	Hg	80	200.59
Aluminium	Al	13	26.98	Molybdenum	Mo	42	95.94
Americium	Am	95	243.13	Neodymium	Nd	60	144.24
Antimony	Sb	51	121.75	Neon	Ne	10	20.18
Argon	Ar	18	39.95	Neptunium	Np	93	237.00
Arsenic	As	33	74.92	Nickel	Ni	28	58.71
Astatine	At	85	210	Niobium	Nb	41	92.91
Barium	Ba	56	137.34	Nitrogen	N	7	14.01
Berkelium	Bk	97	248	Nobelium	No	102	255
Beryllium	Be	4	9.01	Osmium	Os	76	190.20
Bismuth	Bi	83	208.98	Oxygen	O	8	16.00
Boron	B	5	10.81	Palladium	Pd	46	106.40
Bromine	Br	35	76.91	Phosphorus	P	15	30.97
Cadmium	Cd	48	112.40	Platinum	Pt	78	195.09
Calcium	Ca	20	40.08	Plutonium	Pu	94	239.05
Californium	Cf	98	251	Polonium	Po	84	210.05
Caesium	Cs	55	132.91	Potassium	K	19	39.10
Carbon	C	6	12.01	Praseodymium	Pr	59	140.91
Cerium	Ce	58	140.12	Promethium	Pm	61	145
Chlorine	Cl	17	35.45	Protactinium	Pa	91	231.10
Chromium	Cr	24	52.00	Radium	Ra	88	226.00
Cobalt	Co	27	58.93	Radon	Rn	86	222.00
Copper	Cu	29	63.55	Rhenium	Re	75	186.20
Curium	Cm	96	247	Rhodium	Rh	45	102.91
Dysprosium	Dy	66	162.5	Rubidium	Rb	37	85.47
Einsteinium	Es	99	252	Ruthenium	Ru	44	101.07
Erbium	Er	68	167.26	Samarium	Sm	62	150.35
Europium	Eu	63	151.96	Scandium	Sc	21	44.96
Fermium	Fm	100	257	Selenium	Se	34	78.96
Fluorine	F	9	19.00	Silicon	Si	14	28.09
Francium	Fr	87	223	Silver	Ag	47	107.87
Gadolinium	Gd	64	157.25	Sodium	Na	11	22.99
Gallium	Ga	31	69.72	Strontium	Sr	38	87.62
Germanium	Ge	32	72.59	Sulphur	S	16	32.06
Gold	Au	79	196.97	Tantalum	Ta	73	180.95
Hafnium	Hf	72	178.49	Technetium	Tc	43	97
Helium	He	2	4.00	Tellurium	Te	52	127.60
Holmium	Ho	67	164.93	Terbium	Tb	65	158.92
Hydrogen	H	1	1.01	Thallium	Tl	81	204.37
Indium	In	49	114.82	Thorium	\Th	90	232.04
Iodine	I	53	126.9	Thulium	Tm	69	168.93
Iridium	Ir	77	192.2	Tin	Sn	50	118.69
Iron	Fe	26	55.85	Titanium	Ti	22	47.90
Krypton	Kr	36	83.80	Tungsten	W	74	183.85
Lanthanum	La	57	138.91	Uranium	U	92	238.03
Lawrencium	Lr	103	256	Vanadium	V	23	50.94
Lead	Pb	82	207.19	Xenon	Xe	54	131.30
Lithium	Li	3	6.94	Ytterbium	Yb	70	173.04
Lutetium	Lu	71	174.97	Yttrium	Y	39	88.90
Magnesium	Mg	12	24.31	Zinc	Zn	30	65.37
Manganese	Mn	25	54.94	Zirconium	Zr	40	91.22
Mendelevium	Md	101	258				

Table A.17 Temperature conversion table

	0	10	20	30	40	05	60	70	80	90		
°C	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°C	°F
−200	−328	−346	−364	−382	−400	−418	−436	−454				
−100	−148	−166	−184	−202	−220	−238	−256	−274	−292	−310		
−0	+32	+14	−4	−22	−40	−58	−76	−94	−112	−130		
0	32	50	68	86	104	122	140	158	176	194		
100	212	230	248	266	284	302	320	338	356	374	1	1.8
200	392	410	428	446	464	482	500	518	536	554	2	3.6
300	572	590	608	626	644	662	680	698	716	734	3	5.4
400	752	770	788	806	824	842	860	878	896	914	4	7.2
500	932	950	968	986	1,004	1,022	1,040	1,058	1,076	1,094	5	9.0
600	1,112	1,130	1,148	1,166	1,184	1,202	1,220	1,238	1,256	1,274	6	10.8
700	1,292	1,310	1,328	1,346	1,364	1,382	1,400	1,418	1,436	1,454	7	12.6
800	1,472	1,490	1,508	1,526	1,544	1,562	1,580	1,598	1,616	1,634	8	14.4
900	1,652	1,670	1,688	1,706	1,724	1,742	1,760	1,778	1,796	1,814	9	16.2
1,000	1,832	1,850	1,868	1,886	1,904	1,922	1,940	1,958	1,976	1,994	10	18.0
1,100	2,012	2,030	2,048	2,066	2,084	2,102	2,120	2,138	2,156	2,174		
1,200	2,192	2,210	2,228	2,246	2,264	2,282	2,300	2,318	2,336	2,354		
1,300	2,372	2,390	2,408	2,426	2,444	2,462	2,480	2,498	2,516	2,534	°F	°C
1,400	2,552	2,570	2,588	2,606	2,624	2,642	2,660	2,678	2,696	2,714	1	0.56
1,500	2,732	2,750	2,768	2,786	2,804	2,822	2,840	2,858	2,876	2,894	2	1.11
1,600	2,912	2,930	2,948	2,966	2,984	3,002	3,020	3,038	3,056	3,074	3	1.67
1,700	3,092	3,110	3,128	3,146	3,164	3,182	3,200	3,218	3,236	3,254	4	2.22
1,800	3,272	3,290	3,308	3,326	3,344	3,362	3,380	3,398	3,416	3,434	5	2.78
1,900	3,452	3,470	3,488	3,506	3,524	3,542	3,560	3,578	3,596	3,614	6	3.33
2,000	3,632	3,650	3,668	3,686	3,704	3,722	3,740	3,758	3,776	3,794	7	3.89
2,100	3,812	3,830	3,848	3,866	3,884	3,902	3,920	3,938	3,956	3,974	8	4.44
2,200	3,992	4,010	4,028	4,046	4,064	4,082	4,100	4,118	4,136	4,154	9	5.00
2,300	4,172	4,190	4,208	4,226	4,244	4,262	4,280	4,298	4,316	4,334	10	5.56
2,400	4,352	4,370	4,388	4,406	4,424	4,442	4,460	4,478	4,496	4,514	11	6.11
2,500	4,532	4,550	4,568	4,586	4,604	4,622	4,640	4,658	4,676	4,694	12	6.67
2,600	4,712	4,730	4,748	4,766	4,784	4,802	4,820	4,838	4,856	4,874	13	7.22
2,700	4,892	4,910	4,928	4,946	4,964	4,982	5,000	5,018	5,036	5,054	14	7.78
2,800	5,072	5,090	5,108	5,126	5,144	5,162	5,180	5,198	5,216	5,234	15	8.33
2,900	5,252	5,270	5,288	5,306	5,324	5,342	5,360	5,378	5,396	5,414	16	8.98
3,000	5,432	5,450	5,468	5,486	5,504	5,522	5,540	5,558	5,576	5,594	17	9.44
3,100	5,612	5,630	5,648	5,666	5,684	5,702	5,720	5,738	5,756	5,774	18	10.00
3,200	5,792	5,810	5,828	5,846	5,864	5,882	5,900	5,918	5,936	5,954		
3,300	5,972	5,990	6,008	6,026	6,044	6,062	6,080	6,098	6,116	6,134		
3,400	6,152	6,170	6,188	6,206	6,224	6,242	6,260	6,278	6,296	6,314		
3,500	6,332	6,350	6,368	6,386	6,404	6,422	6,440	6,458	6,476	6,494		
3,600	6,512	6,530	6,548	6,566	6,584	6,602	6,620	6,638	6,656	6,674		
3,700	6,692	6,710	6,728	6,746	6,764	6,782	6,800	6,818	6,836	6,854		
3,800	6,872	6,890	6,908	6,926	6,944	6,962	6,980	6,998	7,016	7,034		
3,900	7,052	7,070	7,088	7,106	7,124	7,142	7,160	7,178	7,096	7,214		

Examples: 1,648 °C=2,984+14.4=2,998 °F; 3,267 °F=1,790+7.22=1,797 °C

Table A.18 Comparison of metric to USA weights and measures

Mass							
Metric		Avoirdupois		Troy		Metric	
Number	Unit	Number	Unit	Number	Unit	Number	Unit
1	g	0.35274	oz	0.032151	oz		
1	kg	35.274	oz	32.151	oz		
1	tonne	2.2046	lb	2.6792	lb		
1	tonne	2204.62	lb	–	–		
1	tonne	1.10231	short ton	–	–		
1	tonne	0.984206	long ton	–	–		
28.3495	g	1	oz				
453.5924	g	1	lb				
907.185	kg	1	short ton				
1016.647	kg	1	long ton				
31.1035	g			1	oz		
373.2418	g			1	lb		

Convert by multiplication: 3.5 kg into avoirdupois oz multiply by 35.275 = 123.46 oz

Length							
Metric		USA		USA		Metric	
1	mm	0.03937	in.	1	in.	2.5400	cm
1	cm	0.3937	in.	1	ft	30.480	cm
1	m	39.37	in.	1	yd	91.440	cm
1	m	3.2808	ft				
1	m	1.09361	yd				

Convert by multiplication: 8.12 cm into inches multiply by 0.3937 = 3.197 in.

Liquid capacity							
Metric		USA		USA		Metric	
1	L	33.815	fl oz	1	gal	3.7853	L
1	L	2.1134	pt	1	quart	0.9463	L
1	L	1.0567	quart	1	pt	0.47317	L
1	L	0.26418	gal	1	fl oz	29.5729	cm ³

Convert by multiplication: 1.76 l into gal multiply by 0.26418 = 0.465 gal

Volume							
Metric		USA		USA		Metric	
1	cm ³	0.061623	in. ³	1	in. ³	16.3872	cm ³
1	m ³	35.3145	ft ³	1	ft ³	0.028317	m ³
1	m ³	1.30794	yd ³	1	yd ³	0.76456	m ³

Area							
Metric		USA		USA		Metric	
1	mm ²	0.00155	in. ²	1	ft ²	929.034	cm ²
1	cm ²	0.15501	in. ²	1	yd ²	0.83613	m ²
1	m ²	1550.1	in. ²				
1	m ²	10.7643	ft ²				
1	m ²	1.19603	yd ²				

Table A.19 Conversion factors for weights and volumes

Multiply by							
Convert to →							
from ↓	in. ³	ft ³	yd ³	fl oz	pint	quart	gallon
in. ³	1.00000	0.0000578	0.00000214	0.55411	0.034632	0.017316	0.00433
ft ³	1728.00	1.00000	0.037037	957.505	59.8442	29.9221	7.48052
yd ³	46656.0	27.0000	1.00000	25852.6	1615.79	807.896	201.974
fl oz	1.80469	0.00104	0.00000387	1.0000	0.06250	0.03125	0.00781
pint	28.8750	0.016710	0.0000619	16.0000	1.0000	0.5000	0.12500
quart	57.7500	0.03342	0.001238	32.0000	2.0000	1.0000	0.25000
gallon	231.000	0.133681	0.004951	128.000	8.0000	4.0000	1.0000
oz troy	1.89805	0.001098	0.0000041	1.05173	0.06573	0.03287	0.008217
oz avdp	1.72999	0.001001	0.0000037	0.95861	0.05991	0.02996	0.00750
lb troy	22.7766	0.013181	0.0000488	12.6208	0.78880	0.39440	0.0986
lb avdp	27.6799	0.016018	0.0000593	15.3378	0.95861	0.47937	0.11983
cm ³ or g	0.06102	0.0000035	0.00000013	0.03381	0.00211	0.001057	0.0000264
litre or kg	61.0237	0.035315	0.001308	33.814	2.11337	1.05669	0.264172
m ³	61023.7	35.3146	1.30795	33814.0	2113.37	1056.69	264.172

Multiply by							
Convert to →							
from ↓	oz troy	oz avdp	lb troy	lb avdp	cm ³ or g	litre or kg	m ³
in. ³	0.526857	0.57803	0.043905	0.03613	16.3871	0.016387	0.0000016
ft ³	910.408	998.848	75.8674	62.428	28316.9	28.3169	0.028317
yd ³	24581.0	26968.9	2048.42	1685.56	764556	764.556	0.764556
fl oz	0.950813	1.04318	0.079234	0.06520	29.5736	0.029574	0.000003
pint	15.2130	16.6908	1.26775	1.04318	473.177	0.47318	0.000047
quart	30.4260	33.3816	2.53550	2.08635	946.354	0.94635	0.000094
gallon	121.704	133.527	10.142	8.34541	3785.42	3.78542	0.003785
oz troy	1.0000	1.09714	0.08333	0.068571	31.1035	0.031104	0.0000031
oz avdp	0.911457	1.0000	0.07596	0.06250	28.3495	0.02835	0.000003
lb troy	12.000	13.1657	1.0000	0.822857	373.242	0.37324	0.000037
lb avdp	14.5833	16.0000	1.21528	1.0000	453.593	0.45359	0.000045
cm ³ or g	0.03215	0.035274	0.002679	0.002205	1	10 ⁻³	10 ⁻⁶
litre or kg	32.1507	35.2739	2.67923	2.20462	10 ³	1.00000	10 ⁻³
m ³	32150.7	35273.9	2679.23	2204.62	10 ⁶	10 ³	1.00000

Table A.20 Some factors for calculating properties of glass compositions

Composition	Thermal expansion × 10 ⁻⁷	Heat conductivity × 10 ⁻⁴	Density kg m ⁻³	Tensile strength MN m ⁻²	Crushing strength MN m ⁻²	Hardness (SiO ₂) difference %
SiO ₂	0.8	220	2,240	0.88	12.2	+3.32
Al ₂ O ₃	5.0	220	2,750	0.49	9.8	+10.1
B ₂ O ₃	0.1	160	3,000	0.63	8.9	+0.75
Na ₂ O	10.8	160	320	0.19	5.1	-2.65
K ₂ O	8.5	10	320	0.099	0.48	+3.9
PbO	3.6	80	1,030	0.23	4.6	+1.45
ZnO	1.85	160	5,940	1.4	5.8	+7.1

(continued)

Table A.20 (continued)

Composition	Thermal expansion $\times 10^{-7}$	Heat conductivity $\times 10^{-4}$	Density kg m^{-3}	Tensile strength MN m^{-2}	Crushing strength MN m^{-2}	Hardness (SiO_2) difference %
CaO	5.0	320	4,300	1.95	1.9	-6.3
MgO	0.1	—	3,250	0.099	10.6	—
BaO	3.9	110	7,200	0.49	6.3	+1.95
As ₂ O ₅	2.0	—	2,900	0.28	10	—
P ₂ O ₅	2.0	160		0.73	7.3	+1.32
Sb ₂ O ₅	3.6					
SnO ₂	2.0					
TiO ₂	4.1					
ZrO ₂	2.1					
Na ₃ AlF ₆	7.4					
NaF	7.4					
AlF ₃	4.4					
CaF ₂	2.5					
Cr ₂ O ₃	5.1					
CoO	4.4					
CuO	2.2					
Fe ₂ O ₃	4.0					
NiO	4.0					
MnO ₂	2.2					

Table A.21 End points of orton pyrometric cones

Cone N°	End point (large cone) °C	End point (small cone) °C	Cone N°	End point (large cone) °C	End point (small cone) °C
022	585	—	1	1,136	1,179
021	602	643	2	1,142	1,179
020	625	666	3	1,152	1,197
019	668	723	4	1,168	1,209
018	696	752	5	1,177	1,221
017	727	784	6	1,201	1,255
016	764	825	7	1,215	1,264
015	790	843	8	1,236	1,300
014	834	—	9	1,260	1,317
013	869	—	10	1,285	1,330
012	876	—	11	1,294	1,336
011	886	—	12	1,306	1,355
010	897	919	13	1,321	1,349
09	915	955	14	1,388	1,398
08	945	983	15	1,424	1,430
07	973	1,008	16	1,455	1,491
06	991	1,023	17	1,477	1,512
05	1,031	1,062	18	1,500	1,522
04	1,050	1,098	19	1,520	1,541
03	1,086	1,131	20	1,542	1,564
02	1,101	1,148	23	1,586	1,605
01	1,117	1,178	26	1,589	1,621

(continued)

Table A.21 (continued)

Cone N°	End point (large cone) °C	End point (small cone) °C	Cone N°	End point (large cone) °C	End point (small cone) °C
27	1,614	1,640	34	1,757	1,763
28	1,614	1,646	35	1,784	1,785
29	1,624	1,659	36	1,798	1,804
30	1,636	1,665	37	—	1,820
31	1,661	1,683	38	—	1,850
31.5	—	1,699	39	—	1,865
32	1,706	1,717	40	—	1,885
32.5	1,718	1,724	41	—	1,970
33	1,732	1,743	42	—	2,015

All large cones heated at a rate of 60 °C h⁻¹

Table A.22 Refractive coefficients for use in the **Gladstone-Dale Equation** for common oxides

Oxide	k	Oxide	k	Oxide	k
H ₂ O	0.34	BaO	0.13	SiO ₂	0.21
Li ₂ O	0.31	PbO	0.15	TiO ₂	0.40
Na ₂ O	0.18	B ₂ O ₃	0.22	ZrO ₂	0.20
K ₂ O	0.19	Al ₂ O ₃	0.20	SnO ₂	0.15
BeO	0.24	Y ₂ O ₃	0.14	N ₂ O ₅	0.24
MgO	0.20	La ₂ O ₃	0.15	P ₂ O ₅	0.19
CaO	0.23	Bi ₂ O ₃	0.16	Nb ₂ O ₅	0.30
SrO	0.14	CO ₂	0.22	SO ₃	0.18

Table A.23 Data for some acousto-optic ceramic materials

Ceramic	λ , μm	ρ , kg m ⁻³	n	Velocity of sound, ms ⁻¹
Quartz	0.633	2,200	1.46	5,950
GaAs	1.15	5,340	3.43	5,150
LiNbO ₃	0.633	4,700	2.29	6,570
LiTaO ₃	0.633	7,450	2.18	6,190
PbMoO ₄	0.633	6,950	2.4	3,750
ZnS	0.633	4,100	2.35	5,510

Table A.24 Mechanical properties for some ceramics

Material	Density		Young's modulus		Poisson's ratio	Tensile strength, MN m ⁻²	Toughness, MN m ^{-3/2}
	kg m ³	lb in. ³	GN m ⁻²	10 ⁶ psi			
Al ₂ O ₃	3,980	0.144	380	55	0.22	403	5.1
Diamond	3,510	0.127	1,100	162	0.20	1,050	3.4
GaAs	5,320	0.192	116	16.8	0.30	61	0.42
Pyrex glass	2,230	0.081	70	10.1	0.20	69	0.77
Soda-lime-glass	2,500	0.090	69	10	0.23	69	0.75
E-glass fibre	2,580	0.093	73	10.6	0.22	—	—
Pyroceram	2,600	0.091	120	17.4	0.25	233	1.8
Graphite	1,710	0.062	11.5	1.6	—	34	—
Carbon fibre	1,810	0.065	400	58	—	—	—
Fused SiO ₂	2,200	0.079	74	10.8	0.17	104	0.8
Si	2,330	0.084	163	22.7	0.29	92	0.92
SiC	3,330	0.119	346	50	0.17	510	5.8
Si ₃ N ₄	3,300	0.119	304	44.1	0.27	610	5.1
ZrO ₂ (3%Y ₂ O ₃)	6,000	0.217	205	30	0.31	900	10.3

Table A.25 Miscellaneous properties for some ceramics

Material	Coefficient of expansion, 10 ⁻⁶ °C ⁻¹	Thermal conductivity, W(m·K) ⁻¹	Specific heat C _p , J kg ⁻¹ K ⁻¹	Electrical resistivity, Ωm
Al ₂ O ₃	7.4	39	775	>10 ¹³
Diamond	0.11	3,040	520	10–10 ¹⁴
GaAs	5.9	45.5	350	10 ⁶
Pyrex glass	3.3	1.4	850	10 ¹²
Soda-lime-glass	9.0	1.7	840	10 ¹¹
E-glass fibre	—	1.3	810	4 × 10 ¹⁴
Pyroceram	6.5	3.3	975	10 ¹⁴
Graphite	2.7	160	830	14 × 10 ⁻⁶
Carbon fibre	–0.5 longwise	70	74	13.5 × 10 ⁻⁶
Fused SiO ₂	0.4	1.4	700	>10 ¹⁸
Si	2.5	141	630	2,500
SiC	4.3	78	900	1–10 ⁹
Si ₃ N ₄	3.0	23	481	>10 ¹²
ZrO ₂ (3%Y ₂ O ₃)	9.6	3.0	—	10 ¹⁰

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C 460 Asbestos cement

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