
**Fine ceramics (advanced ceramics,
advanced technical ceramics) —
Vocabulary**

Céramiques techniques — Vocabulaire

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

This third edition cancels and replaces the second edition (ISO 20507:2014), which has been technically revised.

The main changes to the previous edition are as follows:

- abbreviations integrated into Clause 3;
- many composite-related terms added.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Fine ceramics (advanced ceramics, advanced technical ceramics) — Vocabulary

1 Scope

This document specifies terms and associated definitions which are typically used for fine ceramic (advanced ceramic, advanced technical ceramic) materials, products, applications, properties and processes. This document also contains those abbreviated terms which have found general acceptance in scientific and technical literature; they are given together with the corresponding full terms and definitions or descriptions.

In this document, terms are defined using the term 'fine ceramic'. The definitions apply equally to 'advanced ceramics' and 'advanced technical ceramics', which are considered to be equivalent.

This document does not include terms which, though used in the field of fine ceramics, are of a more general nature and are also well known in other fields of technology.

NOTE Terms and definitions of a more general nature are available in ASTM C 1145-2019, EN 14232 and JIS R 1600.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 General terms

3.1.1

advanced ceramic

advanced technical ceramic

fine ceramic

highly engineered, high performance, predominately non-metallic, inorganic, ceramic material having specific functional attributes

Note 1 to entry: The use of fine ceramic, advanced ceramic and advanced technical ceramic is interchangeably accepted in business, trade, scientific literature and International Standards.

3.1.2

antibacterial ceramic

fine ceramic that reveals surface antibacterial activity, usually associated with an antibacterial agent or photocatalytic behaviour, and is widely used for sanitary ware, tiles and various kinds of apparatus

3.1.3

bio-sourced ceramic

fine ceramic produced from bio-sourced material

3.1.4

bioceramic

fine ceramic employed in or used as a medical device which is intended to interact with biological systems

Note 1 to entry: Bioceramics typically comprise products to repair or replace bone, teeth and hard tissue or to support soft tissue and/or control its function.

Note 2 to entry: Implants require a degree of biocompatibility.

Note 3 to entry: Bioceramics that are intended to interact actively with biological systems are often based on crystalline hydroxy(l)apatite; partially crystallized glass or glass-bonded ceramic is also used.

3.1.5

carbon-carbon composite

fine ceramic composed of a carbon matrix containing carbon fibre reinforcement

Note 1 to entry: A carbon-carbon (C/C) composite is mainly used for airplane breaks; it can also be used for furnace parts or heat-resistant tiles for aerospace applications.

Note 2 to entry: The reinforcement is generally continuous.

3.1.6

ceramic, adj

pertaining to the essential characteristics of a ceramic and to the material, product, manufacturing process or technology

3.1.7

ceramic, noun

essentially inorganic and non-metallic material

Note 1 to entry: The concept "ceramic" comprises products based on clay as raw material and also materials which are typically based on oxides, nitrides, carbides, silicides, borides and carbon.

3.1.8

ceramic armour

armour used by armour vehicle and personnel for its attenuative properties

3.1.9

ceramic capacitor

capacitor in which the dielectric material is a ceramic

EXAMPLE Boundary layer (BL) capacitor; multi-layer ceramic capacitor.

3.1.10

ceramic catalyst carrier

non-reactive ceramic substrate to support a catalyst

Note 1 to entry: A ceramic catalyst carrier is typically made with a thin wall, has a large surface area and is used in contact with fluid matter.

3.1.11

ceramic coating

layer of oxide ceramic and/or non-oxide ceramic adhering to a substrate

Note 1 to entry: Ceramic coatings are produced by a variety of processes, e.g. dipping, plasma spraying, sol-gel coating, physical vapour deposition and chemical vapour deposition coating.

Note 2 to entry: Ceramic coatings are usually subdivided into thin coatings (<10 µm) and thick coatings (>10 µm).

3.1.12**ceramic cutting tool**

tool for machining operations, consisting of a fine ceramic having excellent wear, damage and heat resistance

Note 1 to entry: Machining includes operations such as turning, drilling and milling.

3.1.13**ceramic filter**

<electrical> filter using a piezoelectric ceramic as a resonator

3.1.14**ceramic filter**

<porous> porous ceramic matter to be used in filtering a gas or a liquid

3.1.15**ceramic for electrical applications****ceramic for electronic applications**

DEPRECATED: electrical ceramic

DEPRECATED: electronic ceramic

DEPRECATED: electroceramic

fine ceramic used in electrical and electronic engineering because of intrinsic, electrically related properties

Note 1 to entry: These intrinsic properties include electrical insulation, mechanical strength and corrosion resistance.

Note 2 to entry: This term includes ceramics for passive electrical applications, i.e. a ceramic with no active electrical behaviour, having a high electrical resistivity, used for electrical insulation functions.

Note 3 to entry: This term may apply to silicate ceramics such as steatite and electrical porcelain.

3.1.16**ceramic for nuclear applications**

DEPRECATED: nuclear ceramic

fine ceramic having specific material properties required for use in a nuclear environment

Note 1 to entry: Ceramics for nuclear applications include materials for nuclear fuels, neutron absorbers, burnable neutron poisons, diffusion barrier coatings, inert container elements, fuel cladding and assembly duct.

3.1.17**ceramic for optical applications**

DEPRECATED: optical ceramic

fine ceramic used in optical applications because of its intrinsic properties

Note 1 to entry: For example, transparent alumina is used for high-pressure sodium lamp envelopes.

Note 2 to entry: Optical ceramics are typically tailored to exploit transmission, reflection and absorption of visible and near-visible electromagnetic radiation.

3.1.18**ceramic heating resistor**

heater making use of an electric conductive or a semiconductive property of ceramics

3.1.19**ceramic honeycomb**

fine ceramic body having multiple channels typically arranged in a honeycomb structure

Note 1 to entry: A ceramic honeycomb is typically used as a ceramic catalyst carrier, a filter or a heat exchanger regenerator, and is typically made of cordierite, mullite or aluminium titanate.

3.1.20

ceramic ionic conductor

ceramic for electrical applications in which ions are transported by an electric potential or chemical gradient

3.1.21

ceramic matrix composite

CMC

fine ceramic composed of a ceramic matrix containing reinforcement

Note 1 to entry: The reinforcement is often continuous, i.e. ceramic filaments, distributed in one or more spatial directions, but this term is also used for discontinuous reinforcement, e.g. short ceramic fibres, ceramic whiskers, ceramic platelets or ceramic particles.

Note 2 to entry: Carbon-carbon (C/C) composites are included.

Note 3 to entry: The acronym CFCC (continuous fibre ceramic composite) is often used for ceramic matrix composite in which one or more reinforcing phases consist of continuous fibres.

3.1.22

ceramic optical waveguide

optical waveguide formed on the surface of a ceramic substrate

Note 1 to entry: Optical single crystal of LiNbO_3 is typically used as a substrate for a ceramic optical waveguide.

3.1.23

ceramic sensor

sensor making use of semiconductive, piezoelectric, magnetic or dielectric properties of a fine ceramic

3.1.24

ceramic substrate

ceramic body, sheet or layer of material on which some other active or useful material or component may be deposited or laid

EXAMPLE An electronic circuit laid on an alumina ceramic sheet. In catalysis, the formed, porous, high-surface-area carrier on which the catalytic agent is widely and thinly distributed for reasons of performance and economy.

3.1.25

ceramic varistor

ceramic material having high electrical resistivity at low voltage but high electrical conductivity at high voltage

Note 1 to entry: A zinc oxide varistor can be used as a protector in an electronic circuit.

3.1.26

cermet

composite material consisting of at least one distinct metallic phase and one distinct ceramic phase, the latter normally being present at a volume fraction greater than 50 %

Note 1 to entry: The ceramic phase, typically, has high hardness, high thermal strength, and good corrosion resistance; the metallic phase has good toughness and elastoplastic behaviour.

Note 2 to entry: The term "cermet" is a contracted form of ceramic metal.

Note 3 to entry: Materials containing typically less than 50 % by volume of ceramic phase are commonly called "metal matrix composites".

3.1.27**diamond-like carbon****DLC**

form of carbon made by a CVD or PVD process, having hardness much higher than graphite but lower than diamond

Note 1 to entry: Diamond-like carbon is typically used as a hard coat material for engineering components or memory disks.

3.1.28**dielectric ceramic****ceramic dielectric**

ceramic for electrical applications having controlled dielectric properties

3.1.29**discontinuous fibre-reinforced ceramic composite**

ceramic matrix composite material reinforced by chopped fibres

3.1.30**electro-optic ceramic**

fine ceramic with a refractive index which changes in response to an applied electric field

Note 1 to entry: An electro-optic ceramic is a type of non-linear optical ceramic used, for example, in optical shutters, optical modulating devices and optical memory devices. Transparent ferroelectrics are used as electro-optic ceramics, LiNbO_3 single crystals or PLZT polycrystals with low light scattering. The term "electro-optic" is often erroneously used as a synonym for "optoelectronic".

3.1.31**environmental barrier coating****EBC**

ceramic coating, possibly multi-layered, used to protect fine ceramics from environmental aggression

3.1.32**far-infrared radiative ceramic**

fine ceramic with specific property to radiate in the far-infrared

Note 1 to entry: Far-infrared radiative ceramics are typically used as heaters for industrial and domestic applications.

3.1.33**ferrite**

fine ceramic with ferrimagnetic behaviour, having ferric oxide as a major constituent

Note 1 to entry: Magnetic ceramic is used as a synonym of ferrite but encompasses non-oxide-containing materials as well.

3.1.34**ferroelectric ceramic**

non-linear polarizable ceramic for electrical applications, generally with a high level of permittivity, exhibiting hysteresis in the variation of the dielectric polarization as a function of the electric field strength and in the temperature dependence of the permittivity

Note 1 to entry: Polarization results in electrostrictive, piezoelectric, pyroelectric and/or electro-optic properties, which disappear above the transition or Curie temperature.

3.1.35**ferromagnetic ceramic**

fine ceramic that exhibits a spontaneous magnetization without an applied external magnetic field, in which unpaired electrons with a small magnetic field of their own align with each other and show a large net magnetic moment

Note 1 to entry: Most ferrites that contain iron oxide as the main constituent show ferromagnetism.

3.1.36

functional ceramic

fine ceramic, the intrinsic properties of which are employed to provide an active function

EXAMPLE Electronic or ionic conductor, component with magnetic, chemical or mechanical sensing function.

3.1.37

functionally graded ceramic

fine ceramic, the properties of which are deliberately varied from one region to another through spatial control of composition and/or microstructure

3.1.38

geopolymer

inorganic polymeric ceramics formed from both aluminium and silicon sources

3.1.39

glass-ceramic

fine ceramic derived from bulk glass or glass powder by controlled devitrification

Note 1 to entry: The glass is thermally treated to induce a substantial amount of crystallinity on a fine scale.

3.1.40

hard ferrite

ferrite having strong magnetic anisotropy and high coercivity

EXAMPLE Barium hexaferrite, used as permanent magnets in loudspeakers; strontium hexaferrite, used as permanent magnet segments in electric motors.

3.1.41

high-temperature superconductor

HTS

HTSC

superconducting ceramic having superconducting properties at temperatures above 77 K, the boiling point of liquid nitrogen

Note 1 to entry: Superconducting ceramics typically comprise certain combinations of oxides of copper, rare earths, barium, strontium, calcium, thallium and/or mercury.

3.1.42

hybrid photocatalyst

photocatalyst (material) combined with other functional materials in order to complement and enhance the photocatalytic function

Note 1 to entry: Examples include photocatalytic air-purifying materials combined with an adsorbent and antibacterial material, in turn combined with an antibacterial agent, to continue to function in the absence of light.

3.1.43

indoor-light-active photocatalyst

substance that carries out many functions based on oxidization and reduction reactions produced by an artificial light source for general lighting service, including decomposition and removal of air and water contaminants, deodorization, and antibacterial, antifungal, self-cleaning and antifogging actions

3.1.44

in-plane reinforced ceramic matrix composite 2D material

ceramic matrix composite where the reinforcements are placed along at least two directions in a single plane

3.1.45

low-emission ceramic

ceramic matrix composite with continuous reinforcement, which is distributed principally in two directions

3.1.46**machinable ceramic**

ceramic that, after the last consolidation heat treatment, can be machined to tight tolerances using conventional hardmetal or abrasive tools

EXAMPLE Boron nitride, glass-ceramics and porous aluminas.

Note 1 to entry: The natural mineral talc and pyrophyllite, machined and heat-treated, are sometimes also referred to as machinable ceramics.

3.1.47**matrix**

ceramic phase(s) used to bind together the dispersed particles, platelets, fibres and filaments of a composite

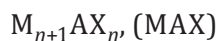
Note 1 to entry: Ceramic phase(s) bind the constituent fibres of a fibrous reinforcement of a composite material.

3.1.48**MXenes**

class of two-dimensional inorganic compound consisting of a few-atom-thick layers of transition metal carbides, nitrides or carbonitrides

3.1.49**MAX phase**

layered, hexagonal carbide and nitride which have the general formula:



where

$n = 1$ to 4 ;

M is an early transition metal;

A is an A-group (mostly IIIA and IVA, or groups 13 and 14) element;

X is carbon and/or nitrogen.

3.1.50**metallized ceramic**

fine ceramic product with a coherent, predominantly metal layer applied to its surface

Note 1 to entry: Processes for metallization include painting, printing, electrolytic deposition and physical vapour deposition.

Note 2 to entry: Metallization is carried out for specific modification of surface properties or to produce an interlayer for promoting the formation of a high-integrity bond with another material (often metallic).

3.1.51**monolithic ceramic**

fine ceramic which has undergone consolidation through sintering to obtain a microstructure consisting predominantly of ceramic grains of one or more phases which are homogeneously distributed on a scale which is small compared to the dimensions of the part

Note 1 to entry: Ceramic parts with low or moderate porosity are included, whereas ceramic matrix composites with ceramic filaments are excluded.

Note 2 to entry: A secondary phase can also be non-ceramic.

3.1.52

multiferroic ceramic

fine ceramic that exhibits more than one ferroic characteristic, i.e. ferromagnetism, ferroelectricity and ferroelasticity, simultaneously

Note 1 to entry: Multiferroic ceramics consist of two categories, i.e. single-phase multiferroics and composites or heterostructures exhibiting more than one ferroic characteristic. Typical single-phase multiferroics include TbMnO_3 and BiFeO_3 .

3.1.53

multidirectional ceramic matrix composite xD (x > 2) material

ceramic matrix composite where the continuous fibre reinforcement is spatially distributed in at least three directions not in a single plane

3.1.54

multi-layered ceramic matrix composite

ceramic matrix composite where the matrix is composed of layers of different chemical compositions

3.1.55

nanocomposite ceramic

composite with highly designed microstructure in which fine particles of nanometric size are dispersed in a ceramic matrix

Note 1 to entry: See *particulate reinforced ceramic matrix composite* ([3.1.60](#)).

3.1.56

nanostuctured ceramic

ceramic material of which at least one structural or microstructural element has dimensions of 1 nm to 100 nm

3.1.57

non-oxide ceramic

fine ceramic produced primarily from substantially pure metallic carbides, nitrides, borides or silicides, or from mixtures and/or solid solutions thereof

3.1.58

opto-electronic ceramic

ceramic for electrical applications, typically a ferroelectric ceramic in which the optical properties are controlled by electrical means

3.1.59

oxide ceramic

fine ceramic produced primarily from substantially pure metallic oxides or from mixtures and/or solid solutions thereof

Note 1 to entry: This term may also be applied to ceramics other than fine ceramics.

3.1.60

particulate-reinforced ceramic matrix composite

ceramic matrix composite in which the reinforcing components are particles of equiaxed or platelet geometry (in contrast to whiskers or short fibres)

Note 1 to entry: See *nanocomposite ceramic* ([3.1.55](#)).

3.1.61**piezoelectric ceramic
piezoceramic**

ceramic for electrical applications, typically a ferroelectric ceramic in which the elastic and dielectric properties are coupled, with practically linear dependence, between the magnitude and direction of mechanical force applied and the electric charge created, or conversely, between the strength and direction of an electric driving field and the elastic deformation obtained

Note 1 to entry: Typical piezoelectric ceramics include barium titanate and lead zirconium titanate.

Note 2 to entry: Elastic deformation under the influence of an electric driving field is termed the inverse piezoelectric effect.

Note 3 to entry: Piezoelectric ceramics are capable of transforming mechanical energy into electrical energy or signals and vice versa.

3.1.62**photocatalyst**

substance that performs one or more catalytic functions based on oxidation or reduction reactions under photoirradiation

Note 1 to entry: The functions include decomposition and removal of air and water contaminants, deodorization, antibacterial, self-cleaning and antifogging actions. A photocatalyst can also be used for light energy conversion.

3.1.63**photocatalytic material**

material in which or on which the photocatalyst is added by coating, impregnation or mixing

Note 1 to entry: Materials include ceramic, metal, plastic, paper and cloth for general purposes.

3.1.64**porous ceramic**

ceramic with pores

Note 1 to entry: Porosity and pore diameter range widely and are typically 30 % to 60 % and 0,05 µm to 100 µm, respectively.

Note 2 to entry: Porous ceramics are applied to filters, catalyst carriers, humidity sensors or molecular sieves, excluding structured honeycomb cellular channels.

3.1.65**pre-stressed ceramics**

ceramic components with high strength and damage tolerance because of residual compressive stresses in the surface layer and residual tensile stresses in the inner body, and the total force in a section is zero due to stress balance

3.1.66**relaxor dielectric**

class of perovskite ferroelectric that shows significant changes in permittivity and loss tangent with frequency

3.1.67**semiconducting photocatalyst**

substance that displays photocatalytic action based on its electronic band structure

Note 1 to entry: This applies to metal oxides, like titanium dioxide, and sulfides. Photocatalysts which are not semiconducting include metal complexes.

3.1.68

silicate ceramic

ceramic made mainly from minerals and/or other siliceous raw materials, resulting in a microstructure with a substantial amount of silicate phases

Note 1 to entry: Electrical porcelain and steatite ceramics are typical silicate ceramics.

3.1.69

soft ferrite

ferrite having a weak magnetic anisotropy, resulting in high magnetic permeability and low magnetic loss

EXAMPLE Manganese-zinc-ferro-ferrite with spinel type crystal structure, used for coils, transformers for energy conversion; ferrite with garnet-type crystal structure, such as yttrium iron garnet, used for microwave applications.

3.1.70

structural ceramic

fine ceramic employed primarily in structural applications for its mechanical or thermomechanical performance

Note 1 to entry: The term “structural ceramic” is also applied to clay products for constructional purposes.

3.1.71

spintronic ceramic

ceramic that utilizes the charge (electronic conductivity) and the spin (magnetization) of electrons

Note 1 to entry: Typical applications include the magnetic head on a hard disk utilizing the giant magneto resistivity (GMR) effect, as well as non-volatile magneto-resistive random-access memory (MRAM).

3.1.72

superconducting ceramic

ceramic for electrical applications showing practically zero electrical resistance below a certain temperature

Note 1 to entry: Superconducting ceramics typically comprise certain combinations of oxides of copper, rare earths, barium, strontium, calcium, thallium and/or mercury and most of them are high-temperature superconductors.

3.1.73

surface-modified ceramic

fine ceramic in which the surface has been subjected to a deliberate physical or compositional modification

Note 1 to entry: Surface modification is normally intended to enhance properties or performance.

Note 2 to entry: Modification processes include ion diffusion, ion implantation, ion exchange and chemical reactions such as oxidation.

3.1.74

thick ceramic coating

ceramic coating of a thickness typically equal to or greater than 10 µm

Note 1 to entry: Thick ceramic coatings are produced typically by thick film technology such as dipping (slurry), screen printing or plasma spraying.

3.1.75

thin ceramic coating

ceramic coating of a thickness typically less than 10 µm

Note 1 to entry: Thin ceramic coatings are produced typically by thin film technology such as the sol-gel coating process (dipping, spin coating) and the chemical and physical vapour deposition process.

3.1.76**ultra-high-temperature ceramic
UHTC**

class of refractory ceramics that offer excellent stability at temperatures exceeding 2 000 °C being investigated as possible thermal protection system (TPS) materials, coatings for materials subjected to high temperatures and bulk materials for heating elements

Note 1 to entry: Broadly speaking, UHTCs are borides, carbides, nitrides and oxides of early transition metals.

3.1.77**unidirectional (1D) ceramic matrix composite**

ceramic matrix composite with continuous reinforcement which is distributed in one single direction

Note 1 to entry: The reinforcement typically comprises ceramic filaments.

3.2 Terms for forming and processing**3.2.1****as-fired surface**

external surface of a ceramic product after sintering

Note 1 to entry: The as-fired surface may be relatively rough compared with surfaces machined after sintering and may have, for example, pits and adherent debris.

3.2.2**binder**

one or more mainly organic compounds which are added to the ceramic body in order to enhance compaction and/or to provide enough strength to the green body to permit handling, green machining or other operations prior to sintering

3.2.3**binder phase**

tough matrix phase embedding a rigid, hard, main, ceramic phase in a composite material

Note 1 to entry: Binder phase: cobalt, nickel; hard phase: tungsten carbide, tantalum carbide.

Note 2 to entry: A tough matrix phase reduces the brittleness and crack sensitivity and improves the strength and toughness of the composite material.

3.2.4**calcining
calcination**

process for changing the chemical composition and/or phases of a powder or powder compact by the action of heat and atmosphere prior to consolidation and processing

Note 1 to entry: This process is typically used for the removal of organic material, combined water and/or volatile material from a powder or powder compact.

3.2.5**casting
drain (hollow) casting
slip casting**

forming ceramic ware by introducing a body slip into an open, porous mould and then draining off the remaining slip when the cast piece has reached the desired thickness

3.2.6**ceramic agglomerate**

accretion of ceramic particles forming a coherent, but weakly bonded, mass

Note 1 to entry: Ceramic agglomerates are unintentionally generated during manufacture and preparation of ceramic powders for ceramic production and can be difficult to break down.

3.2.7

ceramic aggregate

accretion of ceramic particles forming a coherent mass with strong interfacial bonding

Note 1 to entry: Ceramic aggregates are intentionally generated during manufacture and preparation of ceramic powders and are difficult to break down.

3.2.8

ceramic body

totality of all inorganic and organic raw material constituents after preparation of ceramic powder but before the shaping and heat treatment to produce a ceramic

3.2.9

ceramic fibre

unit of ceramic matter constituting a fibrous reinforcement of a composite material, characterized by a high length-to-diameter ratio (at least > 100)

Note 1 to entry: Three main types of ceramic fibres can be distinguished: carbon fibres, silicon carbide fibres and oxide fibres (essentially alumina, basalt and mullite).

Note 2 to entry: Depending on aspect ratio value, short fibres can be distinguished from continuous or long fibres, also called ceramic filaments.

3.2.10

ceramic filament

single ceramic fibre of small diameter considered to be continuous

Note 1 to entry: Ceramic filaments are typically used as reinforcement in continuous fibre ceramic matrix composites, as tow and as woven or non-woven fabrics.

3.2.11

ceramic grain

individual crystal within the polycrystalline microstructure of a ceramic

Note 1 to entry: This term is also used for individual, usually hard, particles of abrasive or refractory materials.

3.2.12

ceramic granulate

mass of granules produced from a ceramic body, usually in a free-flowing form, used as a feedstock for producing a green body

Note 1 to entry: There are many granulation processes; the size of the granules is typically $40\text{ }\mu\text{m}$ or greater.

3.2.13

ceramic particle

small quantity of ceramic matter, monocrystalline, polycrystalline or amorphous, in a discrete mass of size and shape controlled by its fabrication process

Note 1 to entry: Individual particles may accrete into unintentional ceramic agglomerates or intentional ceramic aggregates or may be processed to form a ceramic granulate.

3.2.14

ceramic platelet

unit of ceramic matter, consisting typically of a single crystal in a plate-like shape

Note 1 to entry: Ceramic platelets may consist of oxide or non-oxide material.

Note 2 to entry: Ceramic platelets are used as reinforcement in ceramic matrix composites, in which case the width of the platelets is usually smaller than $50\text{ }\mu\text{m}$.

3.2.15**ceramic (powder) preparation**
preparation of ceramic powder

process of converting powders and additives into a ceramic body, usually by comminution and/or mixing of the powder with binders and lubricants to provide the required chemical and physical characteristics

3.2.16**ceramic precursor**

chemical or mixture of chemicals employed for the manufacture of a ceramic powder, ceramic granulate, thin ceramic coating, monolithic ceramic or ceramic matrix composite, or ceramic fibres, ceramic whiskers or ceramic platelets, differing in composition from the fabricated ceramic product

EXAMPLE Gaseous silicon tetrachloride used for the formation of silicon nitride and silicon carbide; metal alkoxides used for the formation of metal oxide powders.

Note 1 to entry: This term is usually applied to gas or liquid mixtures which are decomposed to form ceramic materials.

3.2.17**ceramic whisker**

unit of ceramic matter, consisting typically of a single crystal having a needle-like shape

Note 1 to entry: Ceramic whiskers may consist of oxide or non-oxide material.

Note 2 to entry: Ceramic whiskers may be used as reinforcement in ceramic matrix composites, in which case the diameter of the crystals is usually smaller than 3 µm, the aspect ratio being less than 100.

3.2.18**chemical vapour deposition**
CVD

process for producing a fine ceramic by reacting gaseous species and condensing the reaction product or by heterogeneous reaction at the surface of a substrate

Note 1 to entry: This process may be used for the preparation of a solid ceramic, a ceramic powder or a ceramic coating or for infiltration of a heated substrate.

3.2.19**chemical vapour deposition coating process**
CVD coating process

chemical vapour deposition used for the formation of a fine ceramic coating on a substrate

3.2.20**chemical vapour infiltration**
CVI

chemical vapour deposition through heterogen reactions on pore surfaces, used for ceramic matrix composite consolidation and/or densification

3.2.21**cold isostatic pressing**
CIP

process of preparing a green body from a ceramic powder or a ceramic granulate by the use of (pseudo-) isostatic pressure at or near room temperature

Note 1 to entry: This process is sometimes called "CIPing".

3.2.22**consolidation**

process that, in a composite, consists in binding the fibres of a fibrous reinforcement with sufficient quantity of matrix in order to keep it in final shape

Note 1 to entry: Consolidation methods include mechanical densification, chemical bonding and sintering.

3.2.23

densification

increase in bulk density with decreasing the volume fraction of voids by consolidation and/or sintering

Note 1 to entry: This operation in a ceramic matrix composite is dedicated to fill fibrous reinforcement voids with one or several reinforcing matrix phases, and it usually occurs after the consolidation.

3.2.24

doctor blade process

process to form a ceramic sheet in which ceramic powder, binder and solvent are mixed and spread by a knife edge (or a doctor blade) on to a carrier film

Note 1 to entry: The doctor blade process is used to form a ceramic sheet with good dimensional accuracy by adjusting the distance between a knife edge (or a doctor blade) and a carrier film.

Note 2 to entry: The doctor blade process is frequently called *tape casting* (3.2.77).

3.2.25

electrophoretic deposition

EPD

colloidal processing technique in which ceramic particles suspended in a liquid medium migrate under the influence of an electric field and are deposited onto an electrode having the desired shape of the object to form

Note 1 to entry: This technique enables both the shaping of free-standing objects and the deposit of thin films and coatings on substrates.

3.2.26

extrude, verb

shape a plastic body by forcing material through a die

3.2.27

fibrous preform

form of fibrous reinforcement, generally of complex geometry, used to obtain near net shape composite part after consolidation and/or densification

3.2.28

fibrous reinforcement

fibre arrangement conferring to the composite, mechanical properties higher than those of its constituents

3.2.29

filler

organic or inorganic additive to a fine ceramic, polymer or metallic body to control processing or properties

Note 1 to entry: Examples of the use of this term include: (a) organic (or rarely, inorganic) additives to a fine ceramic body which decompose or burn out during consolidation to create intentional porosity, e.g. discrete polymer particles; (b) predominantly inert, usually particular, fine ceramic substances introduced into a fine ceramic body to control processing or properties, e.g. silicon carbide particles used in a silicon-based polymer precursor for dimensional control during subsequent consolidation; (c) predominantly inert, usually particular fine ceramic materials introduced into a different matrix in order to modify properties, e.g. aluminium oxide or hydroxide introduced into a polymer to modify stiffness or wear resistance.

3.2.30

gel casting

process of shaping and forming a green body using the phenomenon of gelation of a suspension

3.2.31**gas pressure sintering****GPS**

sintering by the combined application of heat and gas pressure

EXAMPLE Gas pressure sintered silicon nitride (GPSSN).

Note 1 to entry: The gas pressure is typically not greater than 10 MPa.

3.2.32**green body****green part**

ceramic body that is compacted and/or shaped, but not yet heat-treated

3.2.33**green machining**

machining of a green body to a predetermined shape

3.2.34**hot isostatic pressing****HIP**

process of making a fine ceramic by application of an isostatic gas pressure at elevated temperatures

Note 1 to entry: The object may be an encapsulated powder or green body, or a pre-densified fine ceramic. Gas pressures are typically much greater than 10 MPa.

Note 2 to entry: This process is sometimes called "HIPing".

3.2.35**(uniaxial) hot pressing****HP**

process of making a fine ceramic, normally by application of a unidirectional (uniaxial) force at elevated temperature

Note 1 to entry: For uniaxial hot pressing, an inductively heated graphite die is usually employed.

3.2.36**hydrothermal synthesis**

process of preparing fine ceramics and other inorganic materials by chemical reaction in aqueous solution under high temperature and pressure in a pressure vessel

Note 1 to entry: An example of a pressure vessel is an autoclave.

Note 2 to entry: Fine ceramics in powder, film or bulk forms may be prepared by hydrothermal synthesis.

3.2.37**injection moulding****IM**

process of shaping a green body by injecting an appropriately formulated mass into a mould or die

3.2.38**interphase**

thin layer between the fibre and the matrix

Note 1 to entry: In ceramic matrix composite this interphase provides mechanical and chemical protection to fibres.

3.2.39

liquid phase sintering

LPS

sintering achieved by the presence of a liquid phase

Note 1 to entry: The amount and properties of the liquid phase are determined by the composition of the green body, temperature and pressure. This process is enhanced by accelerated diffusion and dissolution-precipitation phenomena.

3.2.40

low-pressure chemical vapour deposition

LPCVD

chemical vapour deposition at low gas pressure

Note 1 to entry: The gas pressure is typically less than 0,01 MPa.

3.2.41

machined and refired

state of a fine ceramic component ground, polished and heat-treated to modify the surface properties

3.2.42

manufacture of ceramic powders by flame pyrolysis

process of formation of ceramic particles by passing reactants through the combustion zone of a flame

3.2.43

manufacture of ceramic powders by gas-phase reaction

process of formation of ceramic particles from gaseous reactants using an external stimulus

EXAMPLE Silicon nitride powder produced by reaction between silicon tetrachloride gas and ammonia gas.

Note 1 to entry: External stimuli include heating, electrical discharge and laser irradiation.

3.2.44

manufacture of ceramic powders by sol-gel technique

process of formation of ceramic particles by using sol-gel processing in which the sol is dispersed into fine droplets before conversion into a gel, followed by further processing

Note 1 to entry: See *sol-gel processing* (3.2.71).

Note 2 to entry: The conversion of sol into gel can be by a reaction such as dehydration. The common route is a hydrolysis reaction followed by condensation to give direct precipitation of fine ceramic particles.

Note 3 to entry: Further processing includes drying and calcining of gel.

3.2.45

melt infiltration process

process used to fill ceramic matrix composite porosity by liquid infiltration of melt metal

3.2.46

metal-organic chemical vapour deposition

MOCVD

chemical vapour deposition using single or mixed metal-organic vapours

3.2.47

microcomposite

composite reinforced by a single filament

Note 1 to entry: This specimen is employed to determine the properties of constituents for modelling or computing

3.2.48**microwave sintering**

use of high-power, high-frequency electromagnetic waves (microwaves) to heat a green body by internal dielectric loss to a sufficient temperature for sintering

Note 1 to entry: The action of the microwaves may in some cases accelerate the sintering process.

3.2.49**minicomposite**

composite reinforced by a single tow

Note 1 to entry: This specimen is employed to determine the properties of constituents for modelling or computing.

3.2.50**physical vapour deposition****PVD**

process for producing, for example, a ceramic film by transport of the required chemical species, some or all of which are generated from a source or sources by physical means such as thermal, electron beam, arc or laser evaporation or sputtering, and deposition onto a prepared substrate with or without the assistance of a reactive atmosphere, ionic bombardment or a gas plasma

3.2.51**plasma-enhanced chemical vapour deposition****PECVD**

chemical vapour deposition using a plasma-assisted reaction

Note 1 to entry: The reaction in the gaseous phase can, for example, be stimulated by application of a plasma formed by coupled laser or other plasma generator.

Note 2 to entry: Also known as plasma-activated chemical vapour deposition (PACVD).

3.2.52**plasma process**

process for producing fine ceramics by using a high-temperature plasma, based on the vaporization of raw materials by the plasma and a subsequent condensation or deposition process

Note 1 to entry: Fine ceramics in powder, film or bulk forms may be formed by plasma processes.

3.2.53**ply**

constitutive layer of a fibrous reinforcement that contains one or several principal directions of fibres

Note 1 to entry: Alternative common names used for this item are layer and laminate.

3.2.54**polycrystalline diamond****PCD**

polycrystalline form of carbon with cubic crystalline structure

Note 1 to entry: Polycrystalline diamond is normally prepared by high-pressure and high-temperature processing to achieve direct bonding between diamond grains.

Note 2 to entry: Polycrystalline diamond film is normally prepared by low-pressure chemical vapour deposition.

3.2.55**polymer-derived ceramic****PDC**

polymer used to obtain ceramics by pyrolysis

3.2.56

polymer impregnation pyrolysis

PIP

process of ceramic matrix composite densification consisting of several cycles of impregnation and polymer pyrolysis

3.2.57

post-sintering

PS

sintering after a previous consolidation stage

EXAMPLE Post-sintered reaction-bonded silicon nitride (PSRBSN).

3.2.58

pressureless sintering

PLS

sintering in the absence of a raised mechanical or gas pressure

EXAMPLE Pressureless sintered silicon nitride (PLSSN).

3.2.59

pyrolytic carbon

form of carbon produced through deposition of gaseous hydrocarbon compounds on fibrous reinforcement at high temperatures (higher than 1 000 K), constituting the matrix and/or the carbon interphase of ceramic matrix composites

Note 1 to entry: A wide range of microstructures, i.e. isotropic, lamellar, substrate-nucleated and a varied content of remaining hydrogen, can occur in pyrolytic carbon, depending on the deposition conditions (e.g. temperature, type, concentration and flow rate of the source gas, surface area of the underlying substrate).

Note 2 to entry: Carbon-carbon (C/C) composites are mainly composed of graphitizable pyrolytic carbon, such as rough laminar or regenerated rough laminar, allowing through composite heat treatment the drastic improvement of composite thermal properties.

Note 3 to entry: "Pyrocarbon", which has the same signification as pyrolytic carbon, is a trademark. Use "pyrolytic carbon" instead.

3.2.60

pyrolytic graphite

form of high-purity graphite produced from the vapour phase by thermal decomposition of carbon-containing gas and deposition on to a substrate

Note 1 to entry: Pyrolytic graphite usually has a highly oriented microstructure and strongly anisotropic properties.

3.2.61

reaction bonding

RB

process for producing a fine ceramic by consolidation of a green body by a chemical reaction between gaseous, liquid or solid species at elevated temperature, producing a bond between ceramic particles

Note 1 to entry: Silicon nitride objects can be produced by the reaction of silicon with nitrogen. See *RBSN* ([3.4.32](#)).

Note 2 to entry: The use of this term for a process that falls under the definition of reaction sintering is deprecated.

3.2.62

reaction sintering

RS

process for producing a fine ceramic by consolidation of a green body by a solid-state chemical reaction accompanied by solid-state sintering at high temperatures to produce a bond between ceramic particles

Note 1 to entry: During the production of aluminium titanate ceramics, aluminium titanate can be formed by a solid-state reaction between aluminium oxide and titanium oxide.

Note 2 to entry: The use of this term for liquid or gaseous reaction bonding process is deprecated.

3.2.63

reactive melt infiltration

RMI

process of ceramic matrix composite densification consisting of the generation of a specific matrix phase by reactive metal injection through porosity

3.2.64

reinforcement

ceramic particles, ceramic whiskers, ceramic platelets, ceramic fibres or ceramic filaments incorporated in a fine ceramic, normally for the purpose of improving mechanical properties

Note 1 to entry: The reinforcement may alternatively be non-ceramic.

Note 2 to entry: The mechanical properties may be improved as regards their strength, toughness, wear resistance, hardness, creep resistance or other characteristics.

Note 3 to entry: For ceramic matrix composites, continuous reinforcement, i.e. ceramic filaments, is often used.

3.2.65

roll compaction

process of shaping a green body by feeding a granulated ceramic body between contra-rotating rollers which compact it into a strip or sheet

3.2.66

seal coat

continuous matrix layer over the surface of a ceramic matrix composite

3.2.67

self-healing matrix

ceramic phase introduced in the matrix of a ceramic matrix composite generating a glass that fills cracks and protects the fibrous reinforcement from chemical degradation

3.2.68

self-sustained high-temperature synthesis

SHS

process for producing a solid fine ceramic in which primarily the heat of the exothermic reaction from reactant(s) is utilized

Note 1 to entry: Also known as self-propagating high-temperature synthesis.

3.2.69

sintering

process of densification and consolidation of a green body by the application of heat with resulting joining of ceramic particles and increasing contact interfaces due to atom movement within and between the ceramic grains of the developing polycrystalline microstructure

Note 1 to entry: Sintering may take place either directly or through the agency of a secondary phase, for example in reaction sintering and liquid-phase sintering.

3.2.70

slip

suspension of a ceramic powder in a liquid medium (water or organic solvent)

Note 1 to entry: The term slurry is often used as an equivalent to slip; often this implies the use of dispersants, deflocculants and other processing aids

3.2.71

sol-gel processing

chemical synthesis of ceramic materials typically based on hydrolysis of ceramic precursors (alkoxides, acids, hydroxides) and subsequent condensation or aggregation to form sols followed by conversion to a gel and further processing

Note 1 to entry: A sol is a liquid dispersion of colloidal solid particles of up to several hundred nanometers in size, while a gel is a rigid interconnected network filled with either gas or liquid.

Note 2 to entry: Further processing includes, for example, drying, calcining and sintering.

Note 3 to entry: Organically modified inorganic networks (ormocers) can be formed by sol-gel processing.

3.2.72

sol-gel coating process

process for producing a fine ceramic coating on a product by initially covering the surface with ceramic precursor followed by sol-gel processing

3.2.73

sol-gel consolidation technique

processing technique to produce a fine ceramic by using sol-gel processing in combination with casting, extrusion or impregnation with subsequent drying and sintering

Note 1 to entry: The size of articles produced by this technique is often limited by the large shrinkage arising from such processes.

3.2.74

solid casting

slip casting of a ceramic material without pour-off residue, especially forming solid pieces or hollow ware if the mould has a core

3.2.75

spark plasma sintering

SPS

sintering process in which a compact of powder is pressed using a die and is rapidly heated by pulsing current through the powder and/or the die

Note 1 to entry: Spark plasma sintering is sometimes called pulsed electric current sintering (PECS), field-assisted sintering (FAST) or current-activated, pressure-assisted densification (CAPAD).

3.2.76

supercritical field synthesis

process for producing fine ceramics in a supercritical fluid of carbon dioxide or water

Note 1 to entry: Since a supercritical condition has the diffusivity characteristics of a gas phase and the solubility characteristics of a liquid phase, it is possible to prepare different chemical products compared with other liquid and gas phase processes.

Note 2 to entry: Supercritical field synthesis may be used to form fine ceramic powders, films and bulk materials.

3.2.77

tape casting

process of shaping a green body in the form of a tape by casting a slurry of ceramic body (slip) as a film on a flat surface, followed by drying

Note 1 to entry: Organic additions to the slip give the tape flexibility and permit forms to be made from it by cutting, stamping or punching, from which components such as substrates, packages and capacitors can be manufactured.

Note 2 to entry: Most tape casting uses a *doctor blade process* ([3.2.24](#)).

3.2.78**tow**

whole ceramic parallel filaments, generally hundreds to thousands, that constitute the basic element of a fibrous reinforcement of composite materials

Note 1 to entry: The fibrous reinforcement can also be composed of twisted tows, also called bundles.

3.2.79**vitreous carbon**

form of carbon derived through solid-phase carbonization from a preform comprising an appropriate highly cross-linked polymer

Note 1 to entry: Vitreous carbon is characterized by a pseudo-amorphous, isotropic structure with low density and non-permeability for gases.

3.3 Terms for properties and testing**3.3.1****antibacterial**

condition inhibiting the growth of bacteria on the surface of flat surface materials or cloths

3.3.2**antifungal activity**

inhibition of germination or inactivation of fungal spores on the surface of materials

3.3.3**apatite-forming ability**

capability to develop apatite on the surface

3.3.4**bulk density of ceramics**

value obtained by dividing the mass of test specimen by the bulk volume of ceramic specimen

3.3.5**chip**

piece of material broken off the edge or corner of a ceramic test-piece or component

Note 1 to entry: When pieces of material break off the edges or corners of a test-piece or component they leave a "chipped area".

3.3.6**competing failure modes**

distinguishably different types of fracture initiation processes in ceramic test-pieces or components that result from concurrent critical flaw distributions

3.3.7**compound critical flaw distribution**

flaw distribution in ceramic test-pieces or components which contain more than one type of strength-controlling flaw not occurring in a purely concurrent manner

Note 1 to entry: All test-pieces contain one type of flaw and some contain a second, independent, type of flaw.

3.3.8**compressive strength**

maximum value of uniaxial compressive stress at the instant of collapse of a ceramic test-piece, either by shearing or fragmentation

3.3.9

concurrent critical flaw distribution

competing critical flaw distribution

type of flaw distribution where every ceramic test-piece or component contains representative defects of each independent flaw type, which compete with each other to cause failure

3.3.10

crack

plane of fracture in a ceramic test-piece or component without complete separation

3.3.11

critical flaw

flaw acting as the source of a failure in a ceramic test-piece or component

3.3.12

critical flaw distribution

distribution of type, shape and size of critical flaws in a population of ceramic test-pieces or components

3.3.13

damage of ceramic

changes introduced into ceramic or ceramic matrix composite that adversely affect its current or future performance

Note 1 to entry: Micro cracks network is generated in ceramic matrix composite when loading is greater than the fracture strain of the weakest brittle phase.

3.3.14

elastic damage behaviour in ceramic matrix composite

elastic behaviour in the presence of damage specific to ceramic matrix composite

Note 1 to entry: This usually manifests in elastic modulus decrease and a low residual stress compared to plastic behaviour.

3.3.15

exclusive critical flaw distribution

type of flaw distribution where each test-piece or component contains defects from a single population, but more than one population is present in the batch

3.3.16

extraneous flaw

type of flaw which is not created during manufacturing

Note 1 to entry: Test-pieces may have flaws from machining which do not occur in the manufactured components.

3.3.17

flaw

inhomogeneity, discontinuity or other structural irregularity in ceramic material

EXAMPLE Grain boundary, large grain, pore, impurity, crack.

Note 1 to entry: The term “flaw” should not be taken to mean that the material is functionally defective, but rather as an inevitable microstructural inhomogeneity.

Note 2 to entry: When the material is mechanically loaded, a flaw provides a stress concentration and enhances the risk of mechanical failure.

3.3.18

flaw distribution

spread of type, shape and size of flaws within a single ceramic test-piece or component

3.3.19**flexural strength**

maximum stress supported by a specified beam in bending at the instance of failure, as determined at a given stress rate in a particular environment

3.3.20**flexural bond strength**

maximum bending stress in the interface at fracture of a specified bonded ceramic test-piece elastic beam under bending load

3.3.21**four-point flexural strength****four-point bending strength**

strength determined by bending a beam-shaped ceramic test-piece, whereby the test-piece is supported on bearings near its ends and is loaded equally at two positions symmetrically disposed about the centre of the supported span

Note 1 to entry: The term “quarter-point flexural strength” is sometimes used for the strength as measured by the four-point flexure geometry, wherein the load positions are each one-quarter of the support span from the support bearings.

3.3.22**indoor lighting environment**

indoor environment with an artificial light source for general lighting service that does not include sunlight

3.3.23**interfacial stress**

shear stress in a cracked fibre matrix interface

Note 1 to entry: This stress allows transfers of load from the matrix to the fibre.

3.3.24**micro cracking**

generation of micro cracks by cyclic loading condition at the interface of the matrix and the filler

Note 1 to entry: Network of micro cracks in the matrix and/or at interface is responsible for elastic damage behaviour in ceramic matrix composite.

Note 2 to entry: Micro cracks can initiate permanent plastic deformation, which results in large crack propagation or failure. During the cyclic loading, several factors also contribute to micro crack generation, such as frictional sliding of the mating surface, progressive wear, residual stresses at grain boundaries or stress due to shear.

3.3.25**photocatalyst antibacterial activity value**

numerical difference between the logarithmic values of the total number of viable bacteria on the material with and without photocatalytic treatment after photoirradiation

Note 1 to entry: This value includes the decrease in the number of bacteria without UV irradiation.

Note 2 to entry: In ISO 27447, the film adhesion method and glass adhesion method are used for flat surface materials and textiles, respectively.

3.3.26**photocatalyst antifungal activity value**

numerical difference between the logarithmic values of the total number of surviving fungal spores (colonies) on the material with and without photocatalytic treatment after UV irradiation

Note 1 to entry: This value includes the decrease in the number of fungal spores (colonies) without UV irradiation.

3.3.27

photonic efficiency

percentage of the incident photon flux that induces a photochemical reaction in a photocatalyst

Note 1 to entry: It is assumed that one photon can induce the decolorization of one dye molecule in the case of methylene blue.

3.3.28

pore

cavity in a ceramic

Note 1 to entry: Pores may be located in the interior or at the surface. Pores at the surface are usually called pits.

3.3.29

porous region

inhomogeneity comprising a concentration of pores in a ceramic

Note 1 to entry: If interconnected to the surface of a ceramic test-piece or component, such a region will retain dye when dye-tested.

3.3.30

precrack

crack that is intentionally induced into the test specimen prior to testing the specimen to fracture

3.3.31

proof testing

application of a predetermined stress to a ceramic test-piece or component over a defined period of time to ascertain whether it contains a serious strength-limiting defect

Note 1 to entry: Removal of the failed test-pieces or components from a batch modifies the failure statistics of the survivors, such that the two-parameter Weibull distribution is typically no longer valid.

3.3.32

pull-out

extraction of a ceramic fibre from the matrix under mechanical loading

Note 1 to entry: The pull-out test allows the bonding resistance between fibre and matrix to be characterized.

3.3.33

ring-on-ring strength

maximum value of equibiaxial flexural stress, at fracture, generated in a symmetrical plate-shaped ceramic test-piece by applying forces to opposing sides through dissimilar-sized concentric ring contacts

3.3.34

R-curve behaviour

increase in apparent toughness with crack growth in ceramic test-pieces or components

Note 1 to entry: This effect may arise as a consequence of changes to micro crack distributions ahead of the crack or of local internal stressing, for example through phase transformations, or through uncracked or wedged ligaments behind the crack tip.

3.3.35

self-loaded deformation

deformation that results when a ceramic test-piece or component distorts under its own weight at elevated temperatures

Note 1 to entry: Self-loaded flexural deformation is sometimes referred to as "sagging".

3.3.36**self-cleaning effect**

maintenance of surface cleanliness of a material by employing a photocatalyst loaded onto the surface

Note 1 to entry: Self-cleaning using photocatalysis is achieved through decomposition of surface contaminants by redox reactions and/or hydrophilicity that allows stains or dirt to be easily removed by the flow of (rain) water over the surface.

Note 2 to entry: Examples include glass, tiling and other facings for buildings, and plastics and coatings for general purposes.

3.3.37**shear bond strength**

maximum mean shear stress applied to the ceramic interface during a shear bond strength test

Note 1 to entry: Shear bond strength is calculated using the shear failure load and the shear area.

3.3.38**specific photocatalytic activity**

measure of capacity of a material to promote a specific photochemical reaction under defined conditions

Note 1 to entry: Specific photocatalytic activity is expressed in mole per square metre hour [mol/(m²h)].

3.3.39**static fatigue**

degradation of strength under a constant load smaller than the failure load

Note 1 to entry: Weakening typically occurs by subcritical crack growth (or slow crack growth).

3.3.40**subcritical crack growth****slow crack growth**

extension of existing cracks or flaws in the microstructure of a ceramic test-piece or component under a stress which does not produce instantaneous failure

Note 1 to entry: Subcritical crack growth can be caused by stress corrosion, creep crack growth or active corrosion.

3.3.41**subcritical crack growth parameters****slow crack growth parameters**

parameters describing the relationship between crack growth velocity and stress intensity factor at the crack tip in a ceramic test-piece or component

3.3.42**strength by sphere indentation**

maximum force to the fracture of a test-piece when a compressive force is applied to the test-piece through the spherical indenter

3.3.43**tensile bond strength**

maximum mean tensile stress applied to the ceramic interface during a bond strength test

Note 1 to entry: Tensile bond strength is calculated from the tensile failure load and the bonded area.

3.3.44**thermal shock resistance**

ability of a ceramic test-piece or component to withstand stress induced by rapid changes of temperature

Note 1 to entry: Thermal shock resistance is determined by the material properties, the shape and size of the test-piece or component and the thermal environment.

Note 2 to entry: This term may be used in a more specific sense for a specified type of test, e.g. quenching into water from a high initial temperature.

3.3.45

three-point flexural strength

three-point bending strength

strength determined by bending a beam-shaped ceramic test-piece, whereby the test-piece is supported on bearings near its ends and a central load is applied

3.4 Terms for ceramic materials

3.4.1

ALN

fine ceramic based principally on aluminium nitride

Note 1 to entry: Aluminium nitride typically contains a small amount of oxygen.

3.4.2

ALON

fine ceramic based principally on aluminium oxynitride

Note 1 to entry: Aluminium oxynitride is generally in a cubic crystalline phase form.

3.4.3

Ap

apatite

group of calcium-phosphates, including bone mineral and the main inorganic constituent of bones and teeth similar to hydroxy(l)apatite, which has the composition $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$

Note 1 to entry: Bone mineral may also contain ions such as CO_3^{2-} , F^- , Na^+ and Mg^{2+} .

Note 2 to entry: In the mineralogical field, the term "apatite" is used as a group name for apatite minerals, including fluorapatite and chlorapatite.

3.4.4

AT

fine ceramic based principally on aluminium titanate

Note 1 to entry: Aluminium titanate as a crystalline phase is sometimes referred to as tialite.

3.4.5

ATZ

alumina-toughened zirconia

zirconium oxide-based fine ceramic, normally of the TZP type, with aluminium oxide added

Note 1 to entry: The aluminium oxide addition increases hardness, stiffness and strength.

3.4.6

BL

electrically insulating grain boundary layer in boundary layer capacitor

Note 1 to entry: A typical boundary layer capacitor is made of semi-conductive strontium titanate.

3.4.7

BN

fine ceramic based principally on boron nitride

Note 1 to entry: The chemical formula of the compound boron nitride and the abbreviated term are identical.

Note 2 to entry: The abbreviated term "BN" is normally applied to material having the hexagonal crystalline structure.

3.4.8**BT****BTO**

fine ceramic based principally on barium titanium oxide

Note 1 to entry: Barium titanium oxide typically comprises a crystalline perovskite structure phase.

3.4.9**CAS****calcium aluminosilicate**

fine ceramic, glass or glass-ceramic material based principally on oxides of calcium, aluminium and silicon

Note 1 to entry: Calcium aluminosilicate typically contains the crystalline phases anorthite, gehlenite or other calcium silicate-based phases.

Note 2 to entry: Cement phase literature may incorporate numbers into this abbreviated term.

3.4.10**CBN****cubic boron nitride**

fine ceramic based principally on boron nitride having a cubic crystalline structure

Note 1 to entry: Boron nitride in the cubic crystalline form is analogous in structure to diamond.

3.4.11**C/C****carbon-carbon**

carbon fibre and carbon matrix

Note 1 to entry: See *carbon-carbon composite* (3.1.5).

3.4.12**CFCC****continuous fibre ceramic composite**

ceramic matrix composite in which one or more reinforcing phases consists of continuous fibres

Note 1 to entry: See Note 3 to entry in *ceramic matrix composite* (3.1.21).

3.4.13**CSZ****cubic stabilized zirconia**

fine ceramic based principally on zirconium oxide, which contains sufficient additional oxide species to retain the cubic crystal modification on cooling from the processing temperature to room temperature

Note 1 to entry: Theoretically, CSZ should contain only the cubic crystal modification, but depending on the composition and the thermal history, small amounts of other crystal modifications can be present.

Note 2 to entry: Typically, stabilizers include magnesia, calcia, yttria or other rare-earth species.

3.4.14**FSZ****fully stabilized zirconia**

fine ceramic based principally on zirconium oxide, which contains sufficient stabilizing oxide species to retain only the high-temperature cubic crystal modification on cooling from the processing temperature to room temperature

Note 1 to entry: The stabilizer is typically one or more of magnesia, calcia, yttria and other rare earth species.

3.4.15

GPSSN

gas pressure sintered silicon nitride

fine ceramic based principally on silicon nitride, densified by gas pressure sintering

Note 1 to entry: When sintering silicon nitride, the gas atmosphere elected should normally contain nitrogen in order to inhibit the dissociation of the nitride at elevated temperatures.

3.4.16

HA

HAp

hydroxy(l)apatite

fine ceramic based principally on oxides of calcium and phosphorus with hydroxyl ions

3.4.17

HPSC

hot-pressed silicon carbide

fine ceramic based principally on silicon carbide, densified by the action of an applied force (normally unidirectional) at elevated temperature

3.4.18

HPSN

hot-pressed silicon nitride

fine ceramic based principally on silicon nitride, densified by the action of an applied force (normally unidirectional) at elevated temperature

3.4.19

ITO

indium tin oxide

fine ceramic based principally on oxides of indium and tin

Note 1 to entry: Indium tin oxide typically comprises a crystalline bixbyite structure phase.

3.4.20

LAS

lithium aluminosilicate

fine ceramic, typically a glass or glass-ceramic, based principally on oxides of lithium, aluminium and silicon

Note 1 to entry: Lithium aluminium silicate typically contains crystalline phases such as petalite, beta-eucryptite or their solid solutions.

3.4.21

LPSSC

liquid-phase sintered silicon carbide

fine ceramic based principally on silicon carbide, densified by liquid-phase sintering at high temperatures

3.4.22

MAS

magnesium aluminosilicate

fine ceramic, typically a glass or glass-ceramic, based principally on oxides of magnesium, aluminium and silicon

Note 1 to entry: Magnesium aluminium silicate typically contains the crystalline phase cordierite.

3.4.23**MAT****magnesium aluminium titanate**

fine ceramic based principally on oxides of magnesium, aluminium and titanium

Note 1 to entry: Magnesium aluminium titanate typically contains the crystalline phase pseudo-brookite.

3.4.24**PLZT****lead lanthanum zirconium titanate**

fine ceramic, based principally on oxides of lead, lanthanum, zirconium and titanium

Note 1 to entry: Lead lanthanum zirconium titanate typically comprises a crystalline perovskite structure phase.

3.4.25**PMN****lead magnesium niobate**

fine ceramic based principally on oxides of lead, magnesium and niobium

Note 1 to entry: Lead magnesium niobate typically comprises a crystalline perovskite structure phase.

3.4.26**PMNT****lead magnesium niobium titanate****PMN-PT****lead magnesium niobate-lead titanate**

fine ceramic based principally on oxides of lead, magnesium, niobium and titanium

3.4.27**PSRBSN****post-sintered reaction-bonded silicon nitride**

fine ceramic based principally on silicon nitride, which as a green body, comprising elemental silicon and liquid-phase forming sintering aids, is first reaction-bonded in a nitrogen atmosphere, followed by sintering at higher temperatures

Note 1 to entry: When sintering silicon nitride, the gas atmosphere selected should normally contain nitrogen in order to inhibit the dissociation of the nitride at elevated temperatures.

3.4.28**PSZ****partially stabilized zirconia**

fine ceramic based principally on zirconium oxide, which contains insufficient stabilizing oxide species to retain only the high-temperature cubic crystal modification on cooling from the processing temperature to room temperature

Note 1 to entry: The stabilizer is typically magnesia, calcia, yttria or ceria. Normally the material partially destabilizes on cooling to comprise two or more different modifications.

3.4.29**PZT****lead zirconium titanate**

fine ceramic based principally on oxides of lead, zirconium and titanium

Note 1 to entry: Lead zirconium titanate typically comprises crystalline perovskite structure phases.

3.4.30**RBAO****reaction-bonded aluminium oxide**

fine ceramic based principally on aluminium oxide, typically densified by the in-situ reaction between oxygen and elemental aluminium inside a green body containing aluminium oxide and aluminium powders