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

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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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-atoms-thick layers of transition metal carbides, nitrides or carbonitrides

3.1.49
MAX phase
layered, hexagonal carbide and nitride which have the general formula:

$M_{n+1}AX_n$, (MAX)

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
nanostructured 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.