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

Céramiques techniques — Vocabulaire

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Foreword

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ISO 20507 was prepared by Technical Committee ISO/TC 206, *Fine ceramics*.

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

1 Scope

This International Standard provides a list of terms and associated definitions which are typically used for fine ceramic (advanced ceramic, advanced technical ceramic) materials, products, applications, properties and processes. The document contains, in separate lists, those abbreviations which have found general acceptance in the scientific and technical literature; they are given together with the corresponding terms and definitions or descriptions.

In this International Standard, the terms are defined using the words “fine ceramic”. The definitions apply equally to “advanced ceramics” and “advanced technical ceramics”, which are considered to be equivalent.

This International Standard 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[1], CEN/WI 89[2] and JIS R 1600:1998[3]. A list of some ISO Standards and Draft ISO Standards of ISO/TC 206 “Fine ceramics” containing terms defined in this ISO Standard is given in the Bibliography.

2 Terms and definitions

2.1 General terms

2.1.1
advanced ceramic
advanced technical ceramic
fine ceramic
highly engineered, high performance, predominately non-metallic, inorganic, ceramic material having specific functional attributes

NOTE The use of fine ceramics, advanced ceramics and advanced technical ceramics is interchangeably accepted in business, trade, scientific literature and ISO Standards.

2.1.2
bioceramic
fine ceramic employed in or used as a medical device which is intended to interact with biological systems

NOTE 1 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 Implants require a degree of biocompatibility.

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

2.1.3
carbon-carbon composite
fine ceramic composed of a carbon matrix containing carbon fibre reinforcement

NOTE A carbon-carbon composite can be used as furnace parts or heat resistant tiles for a space shuttle.

2.1.4
ceramic, adj
pertaining to the essential characteristics of a ceramic and to the material, product manufacturing process or technology

2.1.5
ceramic, noun
inorganic, essentially non-metallic, substantially crystalline product manufactured under the influence of elevated temperatures

NOTE The concept "ceramic" comprises products based on clay as raw material and also materials which are typically based on oxides, nitrides, carbides, silicides, borides.

2.1.6
ceramic capacitor
capacitor in which the dielectric material is a ceramic

NOTE e.g., BL (Boundary Layer) capacitor; multi-layer ceramic capacitor.

2.1.7
ceramic catalyst carrier
nonreactive substrate to support a catalyst

NOTE A ceramic catalyst carrier is typically made with a thin wall, has a large surface area and is used in contact with fluid matter.

2.1.8
ceramic coating
layer of oxide ceramic and/or non-oxide ceramic adhering to a substrate

NOTE 1 Ceramic coatings are produced by a variety of processes, e.g. dipping, plasma spraying, sol-gel coating process, physical vapour deposition or chemical vapour deposition coating process.

NOTE 2 Ceramic coatings are usually subdivided into thin ceramic coatings (< 10 µm) and thick coatings (⩾ 10 µm).

2.1.9
ceramic cutting tool
tool for machining operations, consisting of a fine ceramic having excellent wear, damage and heat resistance

NOTE Machining includes operations such as turning, drilling and milling.

2.1.10
ceramic filters

2.1.10.1
electrical
filter using a piezoelectric ceramic as a resonator

2.1.10.2
porous
porous ceramic matter to be used in filtering gas or liquid

2.1.11
ceramic for electrical applications
electrical ceramic (deprecated)
electroceramic used in electro-technical applications because of its intrinsic properties

NOTE 1 These intrinsic properties include electrical insulation, mechanical strength and corrosion resistance.

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

NOTE 3 This term may apply to silicate ceramics such as steatite and electrical porcelain.

2.1.12
ceramic for electronic applications
electronic ceramic (deprecated)
fine ceramic used in electrical and electronic engineering because of intrinsic, electrically related properties

2.1.13
ceramic for nuclear applications
nuclear ceramic (deprecated)
fine ceramic having specific material properties required for use in the generation of nuclear energy

NOTE Ceramics for nuclear applications include materials for nuclear fuels, neutron absorbers, burnable neutron poisons, diffusion barrier coatings and inert container elements.

2.1.14
ceramic for optical applications
optical ceramic
fine ceramic used in optical applications because of its intrinsic properties

NOTE 1 e.g., transparent alumina is used for high pressure sodium lamp envelopes.

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

2.1.15
ceramic heating resistor
heater making use of an electric conductive or a semiconductive property of ceramics

2.1.16
ceramic honeycomb
fine ceramic having many holes with a typically honeycomb shape

NOTE 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.

2.1.17
ceramic ionic conductor
electroceramic in which ions are transported by an electric potential or chemical gradient

2.1.18
ceramic matrix composite
CMC
fine ceramic composed of a ceramic matrix containing reinforcement

NOTE 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.

2.1.19
ceramic optical waveguide
optical waveguide formed on the surface of a ceramic substrate

NOTE Optical single crystal of $LiNbO_3$ is typically used as a ceramic substrate.

2.1.20
ceramic sensor
sensor making use of semiconductive, magnetic or dielectric properties of a fine ceramic

2.1.21
ceramic substrate
ceramic body, sheet or layer of material on which some other active or useful material or component may be deposited or laid

NOTE e.g., 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.

2.1.22
ceramic varistor
ceramic material having high electrical resistivity at low voltage but high electrical conductivity at high voltage

NOTE A zinc oxide varistor can be used as a protector in an electronic circuit.

2.1.23
cermet
composite material consisting of at least one distinct metallic and one distinct ceramic phase, the latter normally being present at a volume fraction greater than 50 %

NOTE 1 The ceramic phase, typically, has high hardness, high thermal strength, good corrosion resistance and the metallic phase has good toughness and elastoplastic behaviour.

NOTE 2 The term “cermet” is a contracted form of ceramic metal.

NOTE 3 Materials containing typically less than 50 % by volume of ceramic phase are commonly called “metal matrix composites”.

2.1.24
coated ceramic
ceramic coated by a layer or multi-layers of organic or inorganic material

2.1.25
continuous fibre ceramic composite
CFCC
ceramic matrix composite in which the reinforcing phase(s) consist(s) of continuous filaments, fibres, yarn or knitted or woven fabrics

2.1.26
diamond-like carbon
form of carbon made by a CVD process, having hardness much higher than ordinary carbon but lower than diamond

NOTE Diamond-like carbon is typically used as a hard coat material for cutting tools or memory disks.

2.1.27
dielectric ceramic
ceramic dielectric
electroceramic having controlled dielectric properties

2.1.28
discontinuous fibre-reinforced ceramic composite
ceramic matrix composite material reinforced by chopped fibres

2.1.29
far-infrared radiative ceramic
fine ceramic with specific property to radiate in the far-infrared

NOTE Far-infrared radiative ceramics are typically used as heaters for industrial and domestic applications.

2.1.30
ferrite
fine ceramic with ferrimagnetic behaviour, having ferric oxide as a major constituent

NOTE Magnetic ceramic is used as a synonym of ferrite, but encompasses non-oxide containing materials as well.

2.1.31
ferroelectric ceramic
non-linear polarizable electroceramic, 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 Polarization results in electrostrictive, piezoelectric, pyroelectric and/or electro-optic properties, which disappear above the transition or Curie temperature.

2.1.32
functional ceramic
fine ceramic, the intrinsic properties of which are employed to provide an active function

NOTE e.g., electronic or ionic conductor, component with magnetic, chemical or mechanical sensing function.

2.1.33
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

2.1.34
glass-ceramic
fine ceramic derived from bulk glass or glass powder by controlled devitrification

NOTE The glass is thermally treated to induce a substantial amount of crystallinity on a fine scale.

2.1.35
hard ferrite
ferrite having strong magnetic anisotropy and high coercivity

NOTE e.g., barium hexaferrite, used as permanent magnets in loudspeakers; strontium hexaferrite, used as permanent magnet segments in electric motors.

2.1.36
high-temperature superconductor
HTS
HTSC
superconducting ceramic having superconducting properties at temperatures above 77 K, the boiling point of liquid nitrogen

NOTE Superconducting ceramics typically comprise certain combinations of oxides of copper, rare earths, barium, strontium, calcium, thallium and/or mercury.

2.1.37
in-plane reinforced (2D) ceramic matrix composite
ceramic matrix composite with continuous reinforcement, which is distributed principally in two directions

NOTE The reinforcement comprises typically ceramic filaments.

2.1.38
machinable ceramic
ceramic that, after the last consolidation heat treatment, can be machined to tight tolerances using conventional hardmetal or abrasive tools

NOTE 1 e.g., boron nitride, glass-ceramics and porous aluminas.

NOTE 2 The natural mineral talc and pyrophyllite, machined and heat-treated, are sometimes also referred to as a machinable ceramics.

2.1.39
metallized ceramic
fine ceramic product with a coherent, predominantly metal layer applied to its surface

NOTE 1 Processes for metallization include painting, printing, electrolytic deposition and physical vapour deposition.

NOTE 2 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).

2.1.40
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 Ceramic parts with low or moderate porosity are included, whereas ceramic matrix composites with ceramic filaments are excluded.

NOTE 2 A secondary phase can also be non-ceramic.

2.1.41
multidirectional ceramic matrix composite
ceramic matrix composite with continuous reinforcement which is spatially distributed in at least three directions

NOTE The reinforcement typically comprises ceramic filaments.

2.1.42
nanocomposite ceramic
composite with highly designed microstructure in which fine particles of nanometers in size are dispersed in a ceramic matrix

SEE **particulate reinforced ceramic matrix composite** (2.1.46).

2.1.43
non-oxide ceramic
fine ceramic produced primarily from substantially pure metallic carbides, nitrides, borides or silicides or from mixtures and/or solid solutions thereof

2.1.44
opto-electronic ceramic
electroceramic, typically a ferroelectric ceramic in which the optical properties are controlled by electrical means

2.1.45
oxide ceramic
fine ceramic produced primarily from substantially pure, metallic oxides or from mixtures and/or solid solutions thereof

NOTE This term may also be applied to ceramics other than fine ceramics.

2.1.46
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)

SEE **nanocomposite ceramic** (2.1.42)

2.1.47
piezoelectric ceramic
piezoceramic
electroceramic, 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 Typical piezoelectrics are barium titanate and lead zirconium titanate.

NOTE 2 Elastic deformation under the influence of an electric driving field is termed the inverse piezoelectric effect.

NOTE 3 Piezoelectric ceramics are capable of transforming mechanical energy into electrical energy or signals and vice versa.

2.1.48
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 Electrical porcelain and steatite ceramic are typical silicate ceramics.

2.1.49
soft ferrite
ferrite having a weak magnetic anisotropy, resulting in high magnetic permeability and low magnetic loss

NOTE e.g., 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.

2.1.50
structural ceramic

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

NOTE The term “structural ceramic” is also applied to clay products for constructional purposes.

2.1.51
superconducting ceramic
electroceramic showing practically zero electrical resistance below a certain temperature

NOTE 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.

2.1.52
surface-modified ceramic
fine ceramic in which the surface has been subjected to a deliberate physical or compositional modification

NOTE 1 Surface modification is normally intended to enhance properties or performance.

NOTE 2 Modification processes include ion diffusion, ion exchange and chemical reactions such as oxidation.

2.1.53
thick ceramic coating
ceramic coating of a thickness typically equal to or greater than 10 μm

NOTE Thick ceramic coatings are produced typically by thick film technology such as dipping (slurry), screen printing or plasma spraying and so on.

2.1.54
thin ceramic coating
ceramic coating of a thickness typically less than 10 μm

NOTE Thin ceramic coatings are produced typically by thin film technology such as sol-gel coating process (dipping, spin coating), physical vapour deposition coating process.

2.1.55
unidirectional (1D) ceramic matrix composite
ceramic matrix composite with continuous reinforcement which is distributed in one single direction

NOTE The reinforcement typically comprises ceramic filaments.

2.2 Terms for form and processing

2.2.1
as-fired surface
external surface of a ceramic product after sintering

NOTE The as-fired surface may be relatively rough compared with surfaces machined after sintering and may have e.g. pits and adherent debris.

2.2.2
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

2.2.3
binder phase

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

NOTE 1 e.g., binder phase: cobalt, nickel; hard phase: tungsten carbide, tantalum carbide.

NOTE 2 A tough matrix phase reduces the brittleness and crack sensitivity and improves the strength and toughness of the composite material.

2.2.4
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 This process is typically used for the removal of organic material, combined water and/or volatile material from a powder or powder compact.

2.2.5
casting
drain (hollow) 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

2.2.6
ceramic agglomerate
accretion of ceramic particles forming a coherent, but weakly bonded mass

NOTE Ceramic agglomerates are unintentionally generated during manufacture and preparation of ceramic powders for ceramic production and may be difficult to break down.

2.2.7
ceramic aggregate
accretion of ceramic particles forming a coherent mass with strong interfacial bonding