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## Standard Terminology of Advanced Ceramics<sup>1</sup>

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### 1. Scope

1.1 This terminology contains definitions and explanatory notes for the principal words, phrases, and terms used in advanced ceramics technology. The given definitions are technology-specific and are directly applicable to the design, production, testing, analysis, characterization, and use of advanced ceramics for structural, electronic, coating, energy, chemical, nuclear, biomedical, and environmental applications.

1.2 The purpose of the standard terminology is to provide a collected technical resource and reference that promotes a common understanding of the principal technical terms used within the advanced ceramics community and encourages the use of uniform terminology in specifications and reports.

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

**C242 Terminology of Ceramic Whitewares and Related Products**

**C1259 Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio for Advanced Ceramics by Impulse Excitation of Vibration**

**C1368 Test Method for Determination of Slow Crack Growth Parameters of Advanced Ceramics by Constant Stress-Rate Strength Testing at Ambient Temperature**

**C1421 Test Methods for Determination of Fracture Toughness of Advanced Ceramics at Ambient Temperature**

### 3. Terminology

**absorbed moisture**, *n*—water held within the materials and having physical properties not substantially different from ordinary water at the same temperature and pressure.

**advanced ceramic**, *n*—a highly engineered, high performance, predominately non-metallic, inorganic, ceramic material having specific functional attributes.

<sup>1</sup> This terminology is under the jurisdiction of ASTM Committee C28 on Advanced Ceramics and is the direct responsibility of Subcommittee C28.91 on Nomenclature and Editorial.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**agglomerate**, *n*—as used in *fractography*, a cluster of grains, particles, platelets, or whiskers, or a combination thereof, present in a larger solid mass.

**aggregate**, *n*—a dense mass of particles held together by strong intermolecular or atomic cohesive forces. It is stable to normal handling and ordinary mixing techniques including high-speed stirring and ultrasonics. (C242)

**back-face strain**, *n*—the strain as measured with a strain gage mounted longitudinally on the compressive surface of the specimen, opposite the crack or notch mouth (often this is the top surface of the specimen as tested). (C1421)

**base exchange**, *n*—a surface property exhibited by colloidal inorganic materials, usually clays, whereby absorbed surface cations are replaced by other cations.

**body**, *n*—the structural portion of a ceramic article, or the material or mixture from which it is made. (C242)

**calcine**, *v* (**calcination**, *n*)—firing or heating a granular or particulate solid at less than fusion temperature, but sufficient to remove most of its chemically combined volatile matter (that is, H<sub>2</sub>O, CO<sub>2</sub>) and otherwise to develop the desired properties for use. (C1421)

**capillary action**, *n*—the phenomenon of intrusion of a liquid into interconnected small voids, pores, and channels in a solid, resulting from surface tension.

**casting, drain (hollow casting)**, *v*—forming ceramic ware by introducing a body slip into an open, porous mold, and then draining off the remaining slip when the cast piece has reached the desired thickness. (C242)

**cermet**, *n*—a composite material or article comprised of a ceramic and a metal or metal alloy, interdistributed in any of various geometrical forms but intimately bonded together.

**chatter**, *n*—an undesirable pattern created on the surface of a work piece, usually at regularly spaced intervals, due to an out-of-round, out-of-balance condition or due to an induced natural frequency, or its harmonics, or both, in a grinding machine.

**colloidal particle**, *n*—a dispersed particle with a linear dimension of 5 to 100 nm.

- comminution**, *n*—the act or process of reduction in particle size, usually but not necessarily by grinding or milling.
- compositional inhomogeneity, (CI)**, *n*—*as used in fractography*, a volume-distributed flaw that is a microstructural irregularity related to the nonuniform distribution of an additive, a different crystalline or glass phase or in a multiphase material, the nonuniform distribution of a second phase.
- continuous fiber-reinforced ceramic matrix composite**, *n*—a ceramic matrix composite in which the reinforcing phase(s) consists of continuous filaments, fibers, yarn, braid, or knitted or woven fabrics.
- crack, (CK)**, *n*—*as used in fractography*, a volume-distributed flaw that is a plane of fracture without complete separation.
- crack deflection**, *n*—a toughening mechanism in advanced ceramics or ceramic matrix composites characterized by fracture surface roughening and crack tilting/twisting during propagation around grains or a reinforcing component caused by stress fields around the grains or component developed through mismatches in thermal expansion or mechanical properties (such as elastic modulus), or both, between grains or between reinforcement and matrix.
- crack orientation**, *n*—a description of the plane and direction of a fracture in relation to a characteristic direction of the product. This identification is designated by a letter or letters indicating the plane and direction of crack extension. The letter or letters represent the direction normal to the crack plane and the direction of crack propagation. **(C1421)**
- creep**, *n*—the time-dependent part of a strain resulting from stress.
- deairing**, *n*—the process of removing entrapped air or absorbed air from a mass or slurry, usually by application of a vacuum.
- depth of penetration**, *n*—(1) the distance a penetrant has entered into a solid material as measured from the surface of the material; (2) the maximum depth at which a magnetic or ultrasonic indication can be measured in a test specimen.
- diamond paste**, *n*—diamond dust dispersed in a paste or slurry for use as a grinding or polishing compound.
- diamond tool**, *n*—any tool in which the working area is inset with diamonds or diamond dust.
- diamond wheel**, *n*—a bonded grinding wheel in which the abrasive grains are crushed and sized natural or synthetic diamonds.
- discontinuous fiber-reinforced composite**, *n*—a ceramic matrix composite material reinforced by chopped fibers.
- dish grinder**, *n*—a grinding machine equipped with a dish-shaped abrasive wheel as a grinding mechanism
- dish wheel**, *n*—dish-shaped abrasive grinding wheel.
- disk feeder**, *n*—a rotating disk beneath the opening of a bin which delivers material from the bin at a specified rate by controlling the rate of rotation of the disk and the size of the gate opening of the bin.
- disk grinder**, *n*—a grinding machine equipped with a large abrasive disk as the work mechanism.
- disk wheel**, *n*—a bonded abrasive wheel mounted on a plate so that grinding may be done on the side of the wheel.
- drag**, *n*—the resistance of the foot or base of a ceramic article to shrinkage during firing time due to friction with the slab or sagger on which it rests.
- dressing**, *n*—(1) the process of restoring the efficiency of an abrasive grinding wheel by removal of dulled grains; (2) reshaping the faces of grinding wheels to special contours.
- drum dryer**, *n*—a heated, rotating drum in which tumbling or cascading raw materials are dried.
- drying oven**, *n*—a closed unit in which specimens are dried by heating.
- dry milling**, *n*—the process of reducing the particle size of a substance by milling without the use of a liquid medium.
- dry screening**, *n*—the process of separating small sizes of granular or powdered solids from coarser particles by passing them through a screen of desired mesh size while in the dry state.
- drying shrinkage**, *n*—the contraction of a moist body during the drying process, expressed as linear percent of the original length or volume percent of the original volume.
- drying, vacuum**, *n*—the technique of expediting the removal of moisture from a material or body by the use of a vacuum in conjunction with a conventional drying system.
- dual-drum mixer**, *n*—a mixer consisting of a long drum containing two compartments separated by a bulkhead with a swinging chute extending through the unit.
- durability**, *n*—the property of an article of being resistant to physical or chemical damage, or both, under the usual conditions of service, and of being useful over extended periods of time and use.
- dust pressing**, *n*—the process of forming ceramic bodies of 1.5 % or less water content by pressing in a mold.
- elastic limit**, *n*—the greatest stress that a material is capable of sustaining without permanent strain remaining upon complete release of the stress. **(C1259)**
- elastic modulus**, *n*—the ratio of stress to strain below the proportional limit. **(C1259)**
- electric furnace**, *n*—a furnace or kiln in which the main source of heat is provided by electrical means.
- electrical contact**, *n*—any physical contact between two or more parts which will permit the flow of electricity between the parts.
- electrophoresis**, *n*—the movement of colloidal particles or macromolecules through a solution under the action of an electromotive force applied through electrodes in contact with the solution.

- emissivity, *n***—the ratio of the radiation given off by the surface of a body to the radiation given off by a perfect black body at the same temperature.
- emulsification, *n***—the process of dispersing an immiscible liquid in another liquid.
- endothermic reaction, *n***—a chemical reaction in which heat is absorbed.
- endurance, thermal, *n***—the ability of a ceramic product to withstand thermal shock or to withstand deterioration during exposure to high temperatures.
- erosion resistance, electrical, *n***—the resistance of electrical insulating materials to erosion by the action of electrical discharges.
- exothermic reaction, *n***—a chemical reaction in which heat is evolved.
- extrude, *v***—to shape a plastic body by forcing the body through a die.
- extruder, *n***—a device, such as a pug mill, that forces plastic bodies through a die of appropriate shape and size in a continuous column.
- feed, gravity, *n***—the movement of materials from one container to another container or location by force of gravity.
- filament, *n***—a long flexible thread of small cross section, usually extruded or drawn.
- film, *n***—a thin coating or layer of a substance over the surface of another material.
- fineness, *n***—a measurement number designating the particle size of a material, usually reported as passing a screen of a particular standard size.
- fines, *n***—the portions of a powder composed of particles smaller than a specified size.
- finish grinding, *n***—the completion of a grinding operation to obtain a desired surface appearance or accurate dimensions.
- firing expansion, *n***—the increase in the dimensions of a substance or product during thermal treatment.
- fissures, *n***—surface defects consisting of narrow openings or cracks.
- fixed-feed grinding, *n***—the process of feeding a material to be ground to a grinding wheel at a given rate or in specific increments.
- flexural strength, *n***—a measure of the ultimate strength of a specified beam in bending.
- flexural strength, *n***—a measure of the strength of a specified beam specimen in bending determined at a given stress rate in a particular environment. **(C1368)**
- fluid carrier, *n***—a fluid in which particles are suspended to facilitate their movement or application.
- fluid-energy mill, *n***—a size-reduction apparatus in which grinding is achieved by the collision of the particles being ground in a high-velocity steam of air, steam, or other fluid.
- fluorescent penetrant, *n***—an inspection penetrant which fluoresces or glows in ultraviolet light.
- fluxing agent, *n***—any substance which will promote fusion of ceramic materials.
- four-point- $\frac{1}{4}$  point flexure, *n***—configuration of flexural strength testing where a specimen is symmetrically loaded at two locations that are situated one quarter of the overall span, away from the outer two support bearings.
- fractionation, elastic, *n***—a process in which soft aggregate is separated from harder aggregate by hurling the composite aggregate against a steel plate, the hard particles rebounding farther from the plate than the softer, more friable particles.
- fractography, *n***—means and methods for characterizing a fractured specimen or component.
- fracture origin, *n***—the source from which brittle fracture commences.
- fracture, spontaneous, *n***—cracking or chipping which occurs without immediately apparent external causes.
- fracture toughness, *n***—a generic term for measures of resistance to crack extension.
- furnace, arc-image, *n***—a furnace in which high temperatures are produced by focusing radiation from high-temperature arcs into the furnace chamber.
- furnace, image, *n***—a furnace in which high temperatures are generated by focusing radiation from a high-temperature source, such as the sun or an electric arc.
- furnace, recuperative, *n***—a furnace equipped with a heat exchanger in which heat is conducted from the combustion products through a system of ducts or through flue walls in a manner so as to preheat the air as it enters the burner to unite with the fuel.
- furnace, regenerative, *n***—a furnace having a cyclic heat exchanger which alternately receives heat from gaseous combustion products and transfers heat to the air or gas of the fuel mixture before combustion takes place.
- furnace, solar, *n***—an image-type furnace in which solar radiation is focused into a relatively small area as a source of heat producing extremely high temperatures.
- furnace, thermal gradient, *n***—a tubular furnace in which a controlled temperature gradient is maintained along its length.
- fuse, *v***—to melt or join by the use of heat.
- fusion casting, *n***—the process of forming items by casting molten materials in mold.
- fusion point, *n***—the temperature or range of temperatures at which melting or softening, as a result of partial melting, of a composition, will occur.