

GLOSSARY

- adiabatic:** Referring to any process in which there is no gain or loss of heat.
- aggregate:** Inert filler material such as sand or gravel used with a cementing medium to form concrete or mortar.
- alloy:** A material having metallic properties and consisting of two or more elements.
- anisotropic:** Showing different physical or mechanical properties in different directions.
- aramid:** Lightweight polyaromatic amide fibers having excellent high temperature, flame, and electrical properties. These fibers are used as high-strength reinforcement in composites.
- brittle fracture:** A break in a brittle material due to the propagation of cracks originating at flaws.
- carbon/graphite:** These fibers, which are the dominant reinforcement in "advanced" composites, are produced by pyrolysis of an organic precursor, e.g. polyacrylonitrile (PAN), or petroleum pitch, in an inert atmosphere. Depending on the process temperature, fibers having high strength or high elastic modulus may be produced.
- cement:** A dry powder made from silica, alumina, lime, iron oxide, and magnesia which forms a hardened paste when mixed with water; it may be used in this form as a structural material, or used as a binder with aggregate to form concrete.
- ceramic:** An inorganic, nonmetallic solid.
- chemically bonded ceramics:** Used here to distinguish advanced cements and concretes, which are consolidated through chemical reactions at ambient temperatures (generally involving uptake of water) from high-performance ceramics, such as silicon nitride and silicon carbide, which are densified at high temperatures.
- chromatographic adsorption:** Preferential adsorption of chemical compounds (gases or liquids) according to chemical affinity onto a solid adsorbent material.
- composite:** Any combination of particles, whiskers, or fibers in a common matrix.
- compressive stress:** A stress that causes an elastic body to shorten in the direction of the applied force.
- concrete:** A mixture of aggregate, water, and a binder (usually portland cement) which hardens to stone-like condition when dry.
- consolidation of parts:** Integration of a number of formerly discrete parts into a single part which encompasses several functions; a key advantage of engineered materials such as ceramics and composites.
- continuous fiber:** A reinforcing fiber in a composite which has a length comparable to the dimensions of the structure.
- creep:** A time-dependent strain of a solid, caused by stress.
- cross-linking:** The formation of chemical bonds between the formerly separate polymer chains.
- crystal:** A homogeneous solid in which the atoms or molecules are arranged in a regularly repeating pattern.
- deflection:** Deformation of a material produced without fracturing the material.
- deformation, plastic deformation:** Any alteration of shape or dimensions of a body caused by stresses, thermal expansion or contraction, chemical or metallurgical transformations, or shrinkage and expansions due to moisture change.
- delamination:** Separation of a layered structure into its constituent layers.
- dielectric:** A material which is an electrical insulator or in which an electric field can be sustained with a minimum dissipation in power.
- diffusion:** The movement of mass, in the form of discrete atoms or molecules, through a medium.
- dispersion:** Finely divided particles of one material held in suspension in another material.
- ductility:** The ability of a material to be plastically deformed by elongation without fracture.
- E-glass:** A borosilicate glass most used for glass fibers in reinforced plastics.
- elasticity:** The property whereby a solid material deforms under stress but recovers its original configuration when the stress is removed.
- engineered materials:** Materials whose physical and mechanical properties and function are tailored for a particular application.
- extrusion:** A process in which a hot or cold semisoft solid material, such as metal or plastic, is forced through the orifice of a die to produce a continuous, formed piece in the shape of the desired product.
- failure:** Collapse, breakage, or bending of a structure or structural element such that it can no longer fulfill its purpose.
- fatigue:** Failure of a material by cracking resulting from repeated or cyclic stress.
- filtration:** A process of separating particulate matter from a fluid, by passing the fluid carrier through a medium that will not pass the particulate.
- finishing:** Final processing operations on a part.

- flexure:** Any bending deformation of an elastic body in which the points originally lying on any straight line are displaced to form a plane curve.
- fracture stress:** The minimum stress that will cause fracture, also known as fracture strength.
- glass:** A state of matter that is amorphous or disordered like a liquid in structure, hence capable of continuous composition variation and lacking a true melting point, but softening gradually with increasing temperature.
- glass-ceramic:** Solid material, partly crystalline and partly glassy, formed by the controlled crystallization of certain glasses.
- grain:** One of many crystallite comprising a polycrystalline material.
- green state, greenware:** A term for formed ceramic articles in the unfired condition.
- hardness:** Resistance of a material to indentation, scratching, abrasion, or cutting.
- heat treatment:** Heating and cooling of a material to obtain desired properties or conditions.
- holography:** A technique for recording and later reconstructing the amplitude and phase distributions of a wave disturbance.
- hot isostatic pressing:** A form of ceramic or powder metallurgical forming or compaction process in which the mold is flexible and pressure is applied hydrostatically or pneumatically from all sides.
- hot pressing:** Forming a metal powder compact or a ceramic shape by applying pressure and heat simultaneously at temperatures high enough for sintering to occur.
- impact strength:** Ability of a material to resist shock loading.
- inclusion:** A flaw in a material consisting of a trapped impurity particle.
- injection molding:** Forming metal, plastic, or ceramic shapes by injecting a measured quantity of the material into shaped molds.
- internal stress, residual stress:** A stress system within a solid (e. g., thermal stresses resulting from rapid cooling from a high temperature) that is not dependent on external forces.
- interphase, interface:** The boundary layer between the matrix and a fiber, whisker, or particle in a composite.
- lay-up:** A process for fabricating composite structures involving placement of sequential layers of matrix-impregnated fibers on a mold surface.
- load:** The weight that is supported by a structure, or mechanical force that is applied to a body.
- matrix:** The composite constituent that binds the reinforcement together and transmits loads between reinforcing fibers.
- metal:** An opaque material with good electrical and thermal conductivities, ductility, and reflectivity; properties are related to the structure in which the positively charged nuclei are bonded through a field of mobile electrons which surrounds them, forming a close-packed structure.
- microstructure:** The internal structure of a solid viewed on a distance scale on the order of micrometers. The microstructure is controlled by processing, and determines the performance characteristics of the structure.
- modulus of elasticity:** A parameter characterizing the stiffness of a material, or its resistance to deformation under stress. For example, steel has a relatively high modulus, while Jello has a low modulus.
- monolithic:** Constructed from a single type of material.
- near-net-shape:** The original formation of a part to a shape which is as close to the desired final shape as possible, requiring as few finishing operations as possible.
- nondestructive testing, evaluation:** Any testing method which does not involve damaging or destroying the test sample; includes use of X-rays, ultrasonics, magnetic flux, etc.
- phase:** A region of a material that is physically distinct and is homogeneous in chemical composition.
- plasticity:** The property of a solid body whereby it undergoes a permanent change in shape or size when subjected to a stress exceeding a particular value, called the yield value.
- polymer:** Substance made of giant molecules formed by the union of simple molecules (monomers); for example, polymerization of ethylene forms a polyethylene chain.
- pore, porosity:** Flaw involving unfilled space inside a material which frequently limits the material strength.
- prepreg:** Fiber reinforcement form (usually tape, fabric, or broadgoods) which has been preimpregnated with a liquid thermosetting resin and cured to a viscous second stage. Thermoplastic prepregs are also available.
- proof test:** A predetermined test load, greater than the intended service load, to which a specimen is subjected before acceptance for use.
- radiography:** The technique of producing a photographic image of an opaque specimen by transmitting a beam of X-rays or gamma rays through it onto an adjacent photographic film; the transmitted intensity reflects variations in thickness, density, and chemical composition of the specimen.
- radome:** A strong, thin shell made from a dielectric material, used to house a radar antenna.
- reciprocating (engine or machinery):** Having a motion that repeats itself in a cyclic fashion.
- refractory:** Capable of enduring high-temperature conditions.
- S-glass:** A magnesia-alumina-silicate glass that pro-

- vides very high tensile strength fiber reinforcement. Often regarded as the reinforcement fiber dividing “advanced” composites from reinforced plastics.
- shearing stress: A stress in which the material on one side of a surface pushes on the material on the other side of the surface with a force which is parallel to the surface.
- sintering: Method for the consolidation and densification of metal or ceramic powders by heating without melting.
- slip casting, slip, slurry: A forming process in the manufacture of shaped refractories, cermets, and other materials in which slip is poured into porous plaster molds. Slip or slurry is a suspension of ceramic particles in water with a creamy consistency.
- strain: Change in length of an object in response to an applied stress, divided by undistorted length.
- stress: The force acting across a unit area in a solid material in resisting the separation, compacting, or sliding that tends to be induced by external forces.
- structural materials or assembly: Those parts of a system that support most of the loading on the whole system.
- substrate: Base surface on which a material adheres, for example a surface to be coated.
- systems approach (to cost or to design): Consideration of product design, manufacture, testing, and lifecycle as an indivisible whole; see *comoliation of parts*.
- tensile strength, ultimate tensile strength: The maximum stress a material subjected to a stretching load can withstand without breaking.
- thermal conductivity:** The rate of heat flow under steady conditions through unit area per unit temperature in the direction perpendicular to the area—the ability of a material to conduct heat.
- thermoplastic resin:** A material containing discrete polymer molecules that will repeatedly soften when heated and harden when cooled; for example, polyethylene, vinyls, nylons, and fluorocarbons.
- thermosetting resin: A matrix material initially having low viscosity that hardens due to the formation of chemical bonds between polymer chains. Once cured, the material cannot be melted or remolded without destroying its original characteristics; examples are epoxies, phenolics, and polyamides.
- toughness: A parameter measuring the amount of energy required to fracture a material in the presence of flaws.
- tribology: The study of the phenomena and mechanisms of friction, lubrication, and wear of surfaces in relative motion.
- turbocharger: A centrifugal air compressor driven by the flow of exhaust gases and used to increase induction system pressure in an internal combustion reciprocating engine.
- ultrasonic testing: A nondestructive test method that employs high-frequency mechanical vibration energy to detect and locate structural discontinuities or differences and to measure thickness of a variety of materials.
- unibody: Integrated structure containing the chassis as well as elements of the body of an automobile.
- viscoelasticity: Property of a material that is viscous but which also exhibits certain elastic properties such as the ability to store energy of deformation, and in which the application of a stress gives rise to a strain that approaches its equilibrium value slowly.
- wear: Deterioration of a surface due to material removal caused by relative motion between it and another material.
- wettability: The ability of any solid surface to be wetted when in contact with a liquid.
- whisker: A short, single crystal fiber with a length-to-diameter ratio of 10 or more, often used to improve the fracture toughness of ceramics.
- yield strength: The lowest stress at which a material undergoes plastic deformation. Below this stress, the material is elastic.