Property Classifications

mechanical	stiffness, strength, toughness
electrical	electrical conductivity, dielectric constant
thermal	heat capacity, thermal conductivity
magnetic	response to magnetic field
optical	index of refraction, reflectivity
deteriorative	chemical reactivity

Design, Production, and Utilization

proccessing	structure	properties	performance

Material performance is a function of its properties, properties are a function of structure, and structure is the result of processing.

Materials Selection Process

in-service conditions	what compromises have to be made?
deterioration during operation	is mechanical strength lost in operating environment?
economics	what will final product cost?

Solid Material Classifications

metals	composed of metallic elements, nonlocalized electrons	orderly, dense, stiff, strong, ductile, resist fracture, good electrical/thermal conductors, opaque, luster, magnetic properties
ceramics	compound of metallic and nonmetallic elements	stiff, strong, hard, brittlemess, susceptible to fracture, insulative to electricity and heat, resistant to harsh environment, variable optical and magnetic characteristics
polymers	large molecular structure	not strong, not stiff, low density, ductile, pliable, chemically inert, soften/decompose at moderate temperautre, low electrical conductivity, nonmagnetic
composite	composed of two or more materials	depends on materials combined

Advanced Materials

semiconductors	intermediate electrical properties
biomaterials	nontoxic and biocompatible
smart materials	sensor, actuator respond to changes in environment
nanomaterials	less than 100 nanometers in size

Smart Materials and Systems

shape-memory alloy

pieoelectric ceramics

magnetostrictive materials

electroheological and magntorheological fluids

Smart materials are able to sense environmental changes and respond to them in a predetermined manner. They are composed of a sensor (detects signal) and an actuator (performs predetermined function).

Nanotechnology