Chapter 19:

- Heat capacity is a property that is indicative of a material's ability to absorb heat from the external surroundings (J/mol-K, or cal/mol-K).;
- The magnitude of *Cp* is almost always greater than *Cv*

In most solids the principal mode of thermal energy assimilation is by the increase in vibrational energy of

- the atoms.

Debye temperature θD, *Cv* levels

- off and becomes essentially independent of temperature at a value of approximately 3*R*,
- electronic contribution are minor relative to the magnitude of the vibrational contribution.

A large spike is produced on the heat capacity-versus-temperature curve at the temperature

- of this transformation for ferromagnetic
- coefficient of thermal expansion is in (deg C)^-1

For materials in which the thermal

- expansion is isotropic, α*v* is approximately 3α*l*.

Ceramic materials that are to be subjected to temperature changes must have coefficients of thermal

- expansion that are relatively low, and in addition, isotropic for there to be no thermal shock

With increased crosslinking, the magnitude of the expansion coefficient

- diminishes;

Thermal conduction is the phenomenon by which heat is transported from high- to lowtemperature

- regions of a substance.
- The units of *q* and *k* are W/m2 (Btu/ft2-h) and W/m-K (Btu/ft-h-°F),

In high-purity metals, the electron mechanism of heat transport is much more efficient than the phonon contribution because electrons are not as easily scattered as phonons and have higher

- velocities.

The

- theoretical value of *L*, 2.44 × 10−8 Ω-W/(K)2, inWeidemann-Franz law
- there is a difference between heat capacity and thermal conductivity. One says that electrons don't contribute, the other one says that electrons can be the main contributors

For noncrystalline ceramics and also those having cubic crystal structures, α*l* is

- isotropic. Otherwise, it is anisotropic;

the thermal conductivity of most ceramic materials normally diminishes with increasing temperature, at least at relatively low temperatures (Figure 19.5). As Figure 19.5 indicates, the

- conductivity begins to increase at higher temperatures, which is due to radiant heat transfer:

the coefficient of thermal

- expansion is probably most easily changed and controlled. For thermal shock resistance

Chapter 6:

Normally,

- the cross section is circular, but rectangular specimens are also used.

resulting elongations

- (using an extensometer)
- the test specimen is permanently deformed and usually fractured in stress tests

Compressive tests are used when a material's behavior under large and permanent (i.

- e., plastic) strains is desired, as in manufacturing applications, or when the material is brittle in tension.

This modulus may

- be thought of as stiffness, or a material's resistance to elastic deformation.

Values of the modulus of elasticity for ceramic materials are about the same as for metals; for

- polymers they are lower (Figure 1.4).

The stress–strain characteristics at low stress levels are virtually the same for

- both tensile and compressive situations,

This time-dependent elastic behavior is known as anelasticity, and it is due to time-dependent microscopic and atomistic processes that are attendant to the deformation. For metals the anelastic component is normally small and is often neglected. However, for some polymeric materials its magnitude is significant; in this

- case it is termed *viscoelastic behavior*,

If the applied stress is uniaxial (only in the *z* direction),

- and the material is isotropic, then ε*x* = ε*y*. Cause isotropic materials are the same no matter which way you look at them.

the maximum value for ν (or that value for which there is no net volume change) is 0.50. For many metals and other alloys, values of Poisson's ratio range between 0.25 and

- 0.35.
- In most metals *G* is about 0.4*E*

The tensile strength *TS* (MPa or psi) is

- the stress at the maximum on the engineering stress–strain curve (Figure 6.11).

However, at this maximum stress, a small constriction or neck begins to form at some point, and all

- subsequent deformation is confined at this neck,

when the strength of a metal is cited for design purposes,

- the yield strength is used.

Ductility is another important mechanical property. It is a measure of the degree of plastic deformation that

- has been sustained at fracture.

The shorter l_0, the greater is the fraction of total elongation from the neck

- and, consequently, the higher the value of %EL.

Percent
reduction in area values are independent of both l_0 and A_0. Furthermore, for a given material the magnitudes of %EL and %RA will, in general, be different. Most metals possess at least a moderate degree of ductility at room

- temperature; however, some become brittle as the temperature is lowered
- Brittle materials are *approximately* considered to be those having a fracture strain of less than about 5%.

yield strength, tensile strength, and ductility for
several of the common metals. These properties are sensitive to any prior deformation, the presence of impurities, and/or any heat treatment to which the metal has been subjected. The modulus of elasticity is one

- mechanical parameter that is insensitive to these treatments.

As with modulus of elasticity, the magnitudes of
both yield and tensile strengths decline with increasing temperature; just the reverse holds for ductility—it usually increases with temperature. Figure 6.14 shows how the stress–strain behavior of iron varies with

- temperature.

Resilience is the capacity of a material to absorb energy when it is deformed elastically and then, upon

- unloading, to have this energy recovered.

U_r, which is the

- strain energy per unit volume required to stress a material from an unloaded state up to the point of yielding.

Thus, resilient materials are those having high yield strengths and low moduli of elasticity; such alloys would be

- used in spring applications.

Toughness is a mechanical term that is used in several contexts; loosely speaking, it is a measure of the

- ability of a material to absorb energy up to fracture.

FYI: fracture toughness is a property indicative of a material's resistance

- to fracture when a crack is present
- toughness: It is the area under the σ–ε curve up to the point of fracture. More ductile = tougher (usually)