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Heat Capacity:

↳ Ability of a material to absorb heat.

$$C = \frac{dQ}{dT}$$

Heat capacity J/mol-k

dQ → energy J/mol

dT → Temp k

↳ Amount of Energy required to cause a unit rise in temp for one mole of material

- C_p → Heat capacity at const P ⇒ $C_p = \frac{5}{2}R$
- C_v → Heat capacity at const V. ⇒ $C_v = \frac{3}{2}R$

$C_p > C_v$

1) Polymers
2) Ceramics
3) Metals

↓ Heat capacity

Thermal expansion:

$$(T_f - T_i)\,\alpha_l = \frac{L_f - L_i}{L_i} \Rightarrow \Delta L = \alpha_i \Delta T L_i$$

Thermal coefficient of thermal expansion

1) Polymers
2) Metals
3) Ceramics

↓ Thermal coefficient of thermal expansion

NOTE:

More bond energy, more stronger bond. Thus, they restrict movement of atoms. Therefore, α decreases with increasing bond energy.

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Thermal conductivity:

→ Ability of a material to transport heat.

$$\underset{\substack{\text{Heat}\\\text{flux}\\J/m^2s}}{q} = -\underset{\substack{\text{Thermal}\\\text{conductivity}\\J/mks}}{K}\underbrace{\frac{dT}{dx}}_{\text{Temp gradient}}$$

1) Metals
2) Ceramics
3) Polymers

↓ Thermal conductivity

Why stainless steel has low thermal conductivity than plain carbon steel?

The thermal conductivity of a plain carbon steel is greater than for a stainless steel because the stainless steel has much higher concentrations of alloying elements. Atoms of these alloying elements serve as. scattering centers for the free electrons that are involved in the thermal transport process.

Magnetic moment:

→ Motion of $\bar{e}$s gives rise to magnetism.

- Two kinds of motion:
  - Around nucleus
  - about it's axis
- These motion make them act as tiny magnets.

1) Diamagnetic:

Magnetic moment of each atom/molecule is zero.

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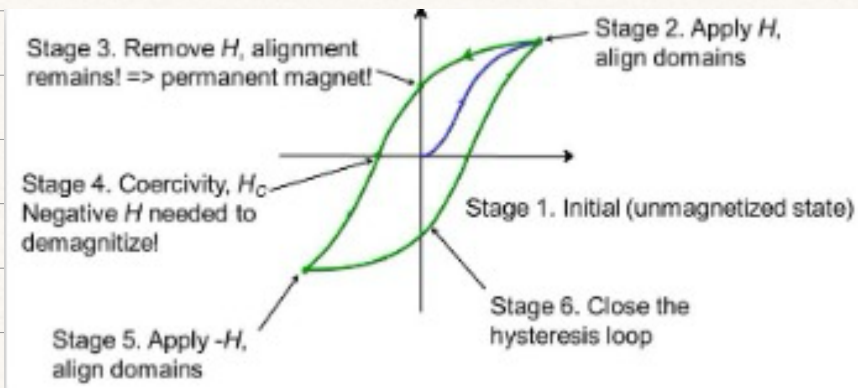
2) Paramagnetic:

- There is little magnetic moment, if orbitals partially filled.
- They are randomly orientated
- Upon applying an external magnetic field, they allign & there is magnetism.

3) Ferromagnetic:

- Remain magnetized even after removing magnetic field.
- At one temp, material loses it's magnetic properties. This point is called curie point/temp.

PROPERTIES	FERROMAGNETIC	PARAMAGNETIC	DIAMAGNETIC
State	They are solid.	They can be solid, liquid or gas.	They can be solid, liquid or gas.
Effect of Magnet	Strongly attracted by a magnet.	Weakly attracted by a magnet.	Weakly repelled by a magnet.
Behavior under external field	They preserve the magnetic properties after the external field is removed.	They do not preserve the magnetic properties once the external field is removed.	They do not preserve the magnetic properties once the external field is removed.



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Hard magnetic materials:

-- large coercivities
-- used for permanent magnets
-- add particles/voids to inhibit domain wall motion
-- example: tungsten steel -- H_c = 5900 amp-turn/m)

Soft magnetic materials:

-- small coercivities
-- used for electric motorsThey minimize the energy loss and heating associated with periodically reversing the magnetic field in AC electrical applications
-- example: commercial iron 99.95 Fe