

SEMI CONDUCTING MATERIALS:-

Introduction:-

A Semiconductor is a solid which has the definite energy band. A band gap of the semiconductor is less than the band gap of any insulator.

* The resistivity of semiconductor lies between conducting and insulating materials ($10^{-4} \Omega\text{-m}$ to $0.5 \Omega\text{-m}$)

* When the temperature is raised (or) when impurities are added, their conductivity increases. ($\rho \propto \frac{1}{T}$).

* They have negative temperature Co-efficient of resistance.

* In Semiconductors, both electrons and holes are charge carriers. Total conductivity (σ) = $\sigma_e + \sigma_h$.

General properties of Semiconducting Materials:-

- 1) They are formed by the Covalent bonds.
- 2) They have an empty conduction band.
- 3) They have almost filled valence band.
- 4) These materials have a small energy gap.
- 5) They possess crystalline structure.
- 6) These materials have -ve temp. coefficient of resistance.
- 7) If impurities are added, it will increase the electrical conductivity of semiconductor.
- 8) If we increase the temperature of semiconductor, its electrical conductivity also increases.

Conduction in SemiConductors:-

In a Pure Semiconductor, the number of free e^- is equal to the number of holes. Hence the total current density (J).

$$J = J_e + J_h$$

$$= qn\mu_e E + qP\mu_h E$$

$$= qE(n\mu_e + P\mu_h)$$

$$J = \sigma E \quad (\because \sigma = q(n\mu_e + P\mu_h))$$

Where,

- $q \Rightarrow$ charge of e^- (or) hole, $n \Rightarrow$ Concentration of e^- s,
- $P \Rightarrow$ Concentration of holes, $E \Rightarrow$ applied Electric field
- $\sigma \Rightarrow$ Conductivity of SemiConductor, $\mu_e \Rightarrow$ mobility of e^- s,
- $\mu_h \Rightarrow$ mobility of holes.

Since $n = P = n_i$ (intrinsic Carrier Concentration)

$$J = n_i (\mu_e + \mu_h) q E$$

$$\text{Conductivity } (\sigma) = q n_i (\mu_e + \mu_h)$$

Hence, Conductivity of an intrinsic Semiconductor depends on it's intrinsic carrier concentration and mobility of the electrons and holes.

1) Intrinsic SemiConductor:-

A SemiConductor is an extremely pure form, without addition of impurities is known as an intrinsic semi-conductor.

