

## Semiconducting materials

Semiconductors are the materials which has conductivity and resistivity inbetween conductors and insulators. The resistivity of a semiconductor is in the order of  $10^4$  to  $0.5$  ohm-metre.

It is not that resistivity alone decides whether a substance is a semiconductor (or) not, because some alloys have resistivity which are in the range of semiconductor's resistivity. Hence there are some other properties like band gap which distinguish the materials as conductors, semiconductors and insulators.

A semiconductor is a solid which has the energy band similar to that of an insulator. It acts as an insulator at absolute zero and act as conductor at high temperatures and in the presence of impurities.

### Properties of Semiconductors:-

- ① The resistivity of semiconductors lies between conducting and insulating materials, i.e.,  $10^4$  to  $0.5$  ohm-metre.
- ② At  $0\text{K}$  they behave as insulators.
- ③ When the temperature is raised or when impurities are added, their conductivity increases.  
$$\rho \propto \frac{1}{T}$$
- ④ They have negative temperature coefficient of resistance.

## Elemental and Compound Semiconductors:

Based on the composition of semiconductors they are classified as  
i) Elemental Semiconductors    ii) Compound Semiconductors

Elemental Semiconductor (or) Indirect band gap semiconductor	Compound Semiconductor (or) Direct band gap semiconductor
<p>① They are made of single element Eg., Ge, Si etc</p> <p>② electron-hole recombination takes place through traps which are present in the band gap (i.e., indirect band gap semiconductors)</p> <p>③ Here, Heat is produced due to recombination</p> <p>④ Current amplification is more</p> <p>They are used for manufacture of diodes and transistors etc</p>	<p>They are made of compounds Eg., GaAs, GaP, CdS etc</p> <p>electron-hole recombination takes place directly with each other (i.e., direct band gap semiconductors)</p> <p>Here, the photons are emitted during recombination. Current amplification is less.</p> <p>They are used for making LED's, Laser diodes, IC's etc</p>

## Types of Semiconductors:-

Based on the purity, Semiconductors are classified into the following two types

- i) Intrinsic Semiconductor
- ii) Extrinsic Semiconductor

A Semiconductor in an extremely pure form is called as intrinsic Semiconductor.

Examples:- Germanium, Silicon.

Impure Semiconductors in which the charge carriers are produced due to impurity atoms are called extrinsic Semiconductors. They are obtained by doping an intrinsic Semiconductor with impurity atoms.

Based on the type of impurity added they are classified into n-type and p-type Semiconductors

n-type Semiconductor	p-type Semiconductor
n-type Semiconductor is obtained by doping an intrinsic Semiconductor with Pentavalent (5 electrons in valence band) - impurity atoms like phosphorus, arsenic, antimony etc.	p-type Semiconductor is obtained by doping an -intrinsic Semiconductor with trivalent (3 electrons in valence band) impurity atoms like boron, Gallium, indium etc