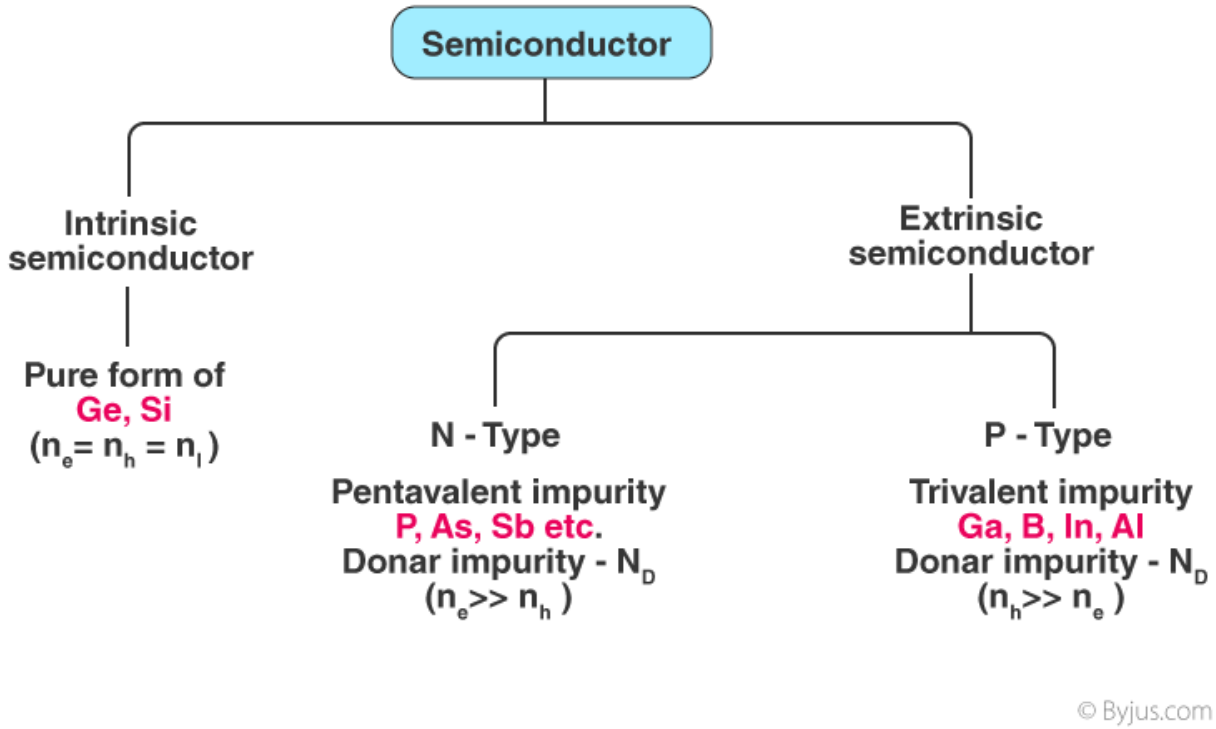
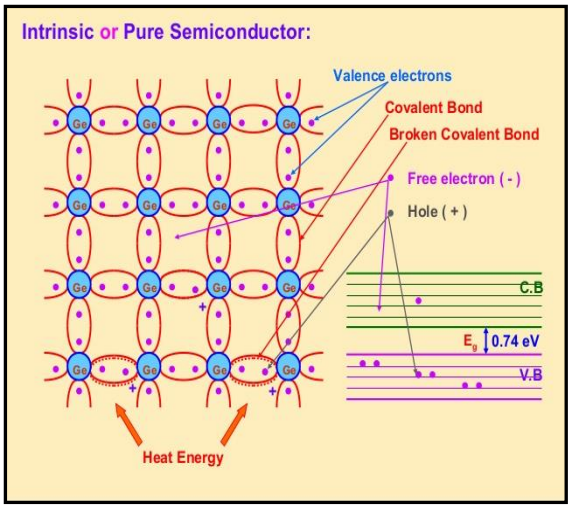
# Semiconductors

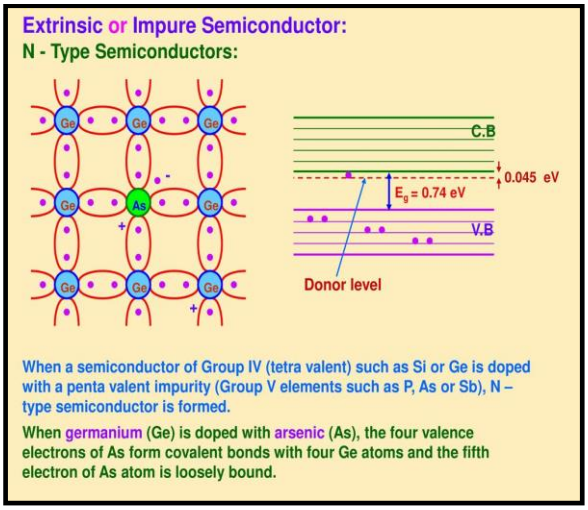
**Semiconductors** are materials which have a conductivity between conductors (generally metals) and nonconductors or insulators (such as most ceramics).

**Semiconductors** can be pure elements, such as silicon or germanium, or compounds such as gallium arsenide or cadmium selenide.

**Types of Semiconductors**

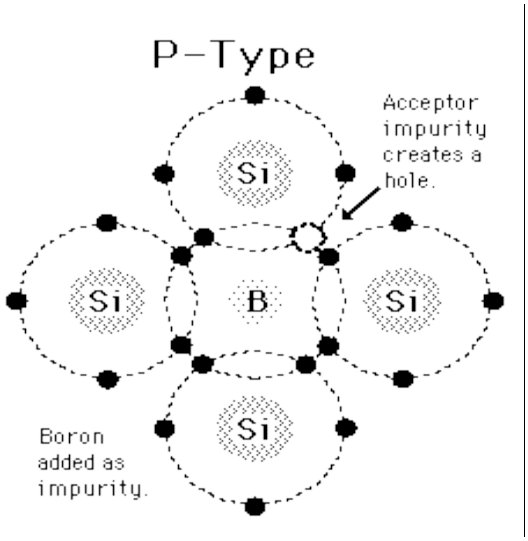


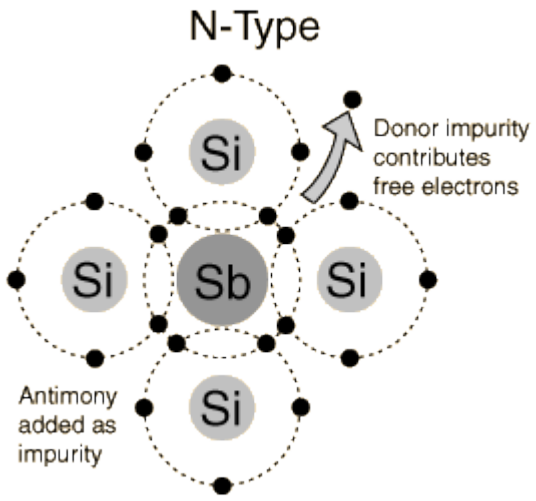



## Distinction between Intrinsic and Extrinsic Semiconductor:

| S. No. | Intrinsic SC | Extrinsic SC |
|---|---|---|
| 1 | Pure Group IV elements. | Group III or Group V elements are introduced in Group IV elements. |
| 2 | Conductivity is only slight. | Conductivity is greatly increased. |
| 3 | Conductivity increases with rise in temperature. | Conductivity depends on the amount of impurity added. |
| 4 | The number of holes is always equal to the number of free electrons. | In N-type, the no. of electrons is greater than that of the holes and in P-type, the no. holes is greater than that of the electrons. |




## Comparison between n-type and p-type semiconductors

| N-type | P-type |
|---|---|
| • Pentavalent impurities are added. | • Trivalent impurities are added. |
| • Majority carriers are electrons. | • Majority carriers are holes. |
| • Minority carriers are holes. | • Minority carriers are electrons. |
| • Fermi level is near the conduction band. | • Fermi level is near the valence band. |

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## Properties of Semiconductors

Semiconductors can conduct electricity under preferable conditions or circumstances. This unique property makes it an excellent material to conduct electricity in a controlled manner as required.

Unlike conductors, the charge carriers in semiconductors arise only because of external energy (thermal agitation). It causes a certain number of valence electrons to cross the energy gap and jump into the conduction band, leaving an equal amount of unoccupied energy states, i.e. holes. Conduction due to electrons and holes are equally important.

- **Resistivity:** $10^{-5}$ to $10^{6}$ Ωm
- **Conductivity:** $10^{5}$ to $10^{-6}$ mho/m
- **Temperature coefficient of resistance:** Negative
- **Current Flow:** Due to electrons and holes

1. Semiconductor acts like an insulator at Zero Kelvin. On increasing the temperature, it works as a conductor.
2. Due to their exceptional electrical properties, semiconductors can be modified by doping to make semiconductor devices suitable for energy conversion, switches, and amplifiers.
3. Lesser power losses.
4. Semiconductors are smaller in size and possess less weight.
5. Their resistivity is higher than conductors but lesser than insulators.
6. The resistance of semiconductor materials decreases with the increase in temperature and vice-versa.

## Applications of Semiconductors

Let us now understand the uses of semiconductors in daily life. Semiconductors are used in almost all electronic devices. Without them, our life would be much different.

Their reliability, compactness, low cost and controlled conduction of electricity make them ideal to be used for various purposes in a wide range of components and devices. transistors, diodes, photosensors, microcontrollers, integrated chips and much more are made up of semiconductors.

## Uses of Semiconductors in Everyday life

- Temperature sensors are made with semiconductor devices.
- They are used in 3D printing machines
- Used in microchips and self-driving cars
- Used in calculators, solar plates, computers and other electronic devices.
- Transistor and MOSFET used as a switch in Electrical Circuits are manufactured using the semiconductors.

## Industrial Uses of Semiconductors

The physical and chemical properties of semiconductors make them capable of designing technological wonders like microchips, transistors, LEDs, solar cells, etc.

The microprocessor used for controlling the operation of space vehicles, trains, robots, etc is made up of transistors and other controlling devices which are manufactured by semiconductor materials.

## Importance of Semiconductors

Here we have discussed some advantages of semiconductors which makes them highly useful everywhere.

- They are highly portable due to the smaller size
- They require less input power
- Semiconductor devices are shockproof
- They have a longer lifespan
- They are noise-free while operating