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# A Review of Intrinsic and Extrinsic Semiconductors.

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**Abstract :** All the industrial and domestic electronic devices are made of a semiconductor. As the name suggests, semiconductor materials are neither good conductor nor good insulator of electrical current like Silicon and Germanium. Because of the very few current carriers (free electrons) available at the conducting shell, the specific resistance of the materials is comparatively higher than conductor and lower than that of an insulator.

Semiconductors are the perfect insulator at $0^{o}$K temperature, at higher temperature the materials are neither conductor nor insulator. The energy gap of semiconductors is lower as almost 1ev. At normal temperature, when electrons at valance shell gain energy, the gap between the valence band and conduction band is reduced. Very few numbers of electrons become available at conduction band, so a very low current flow could be expected.

**Key Words :** Semiconductors, Intrinsic, Extrinsic

## Semiconductor

The semiconductor is divided into two types. One is Intrinsic Semiconductor and other is an Extrinsic semiconductor. The pure form of the semiconductor is known as the intrinsic semiconductor and the semiconductor in which intentionally impurities is added for making it conductive is known as the extrinsic semiconductor. The conductivity of the intrinsic semiconductor become zero at room temperature while the extrinsic semiconductor is very little conductive at room temperature.

## Intrinsic Semiconductor

An intrinsic semiconductor is an undoped semiconductor. This means that holes in the valence band are vacancies created by electrons that have been thermally excited to the conduction band, as opposed to doped semiconductors where holes or electrons are supplied by a "foreign" atom acting as an impurity. An extremely pure semiconductor is called as Intrinsic Semiconductor. On the basis of the energy band phenomenon, an intrinsic semiconductor at absolute zero temperature is shown below.

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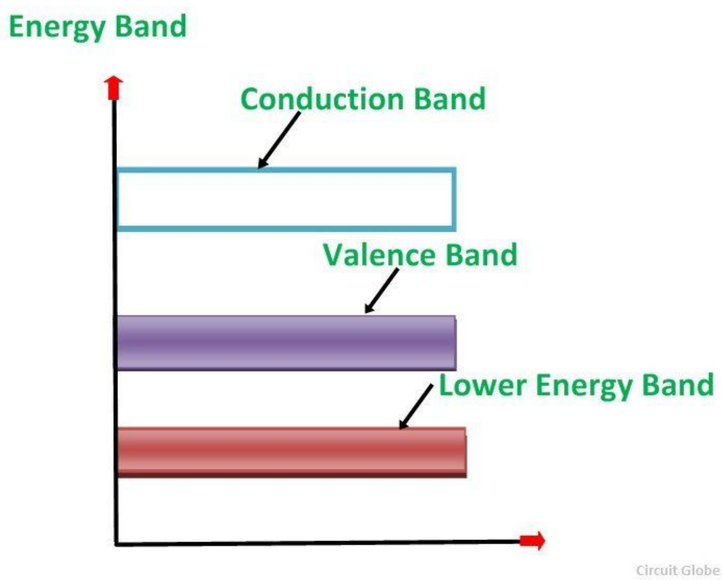
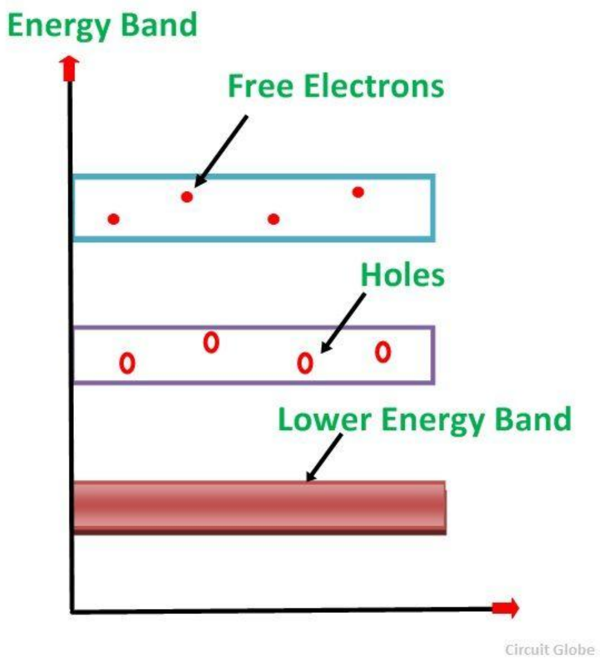



Its valence band is completely filled and the conduction band is completely empty. When the temperature is raised and some heat energy is supplied to it, some of the valence electrons are lifted to conduction band leaving behind holes in the valence band as shown below.




The electrons reaching at the conduction band move randomly. The holes created in the crystal also free to move anywhere. This behavior of the semiconductor shows that they have a negative temperature coefficient of resistance. This means that with the increase in temperature, the resistivity of the material decreases and the conductivity increases.

**Extrinsic Semiconductor**

A semiconductor to which an impurity at controlled rate is added to make it conductive is known as an extrinsic Semiconductor.

An intrinsic semiconductor is capable to conduct a little current even at room temperature, but it is not useful for the preparation of various electronic devices. Thus, to make it conductive a small amount of suitable impurity is added to the material.

**Doping**

The process by which an impurity is added to a semiconductor is known as Doping. The amount and type of impurity which is to be added to a material has to be closely controlled during the preparation of extrinsic semiconductor. Generally, one impurity atom is added to a 108 atoms of a semiconductor.

The purpose of adding impurity in the semiconductor crystal is to increase the number of free electrons or holes to make it conductive. If a Pentavalent impurity, having five valence electrons is added to a pure semiconductor a large number of free electrons will exist.

If a trivalent impurity having three valence electrons is added, a large number of holes will exist in the semiconductor.

Depending upon the type of impurity added the extrinsic semiconductor may be classified as n type semiconductor and p type semiconductor.

Doped semiconductors (either n-type or p-type) are known as extrinsic semiconductors. The activation energy for electrons to be donated by or accepted to impurity states is usually so low that at room temperature the concentration of majority charge carriers is similar to the concentration of impurities. It should be remembered that in an extrinsic semiconductor there is an contribution to the total number of charge carriers from intrinsic electrons and holes, but at room temperature this contribution is often very small in comparison with the number of charge carriers introduced by the controlled impurity doping of the semiconductor.

**Conclusion :**

The semiconductor devices are used for all electronic devices nowadays, like a diode, transistor, thyristors. Every electrical appliance has these semiconductor devices in it, either if it is Television, Computer, Refrigerator for home and industrial machinery like CNC machines, Telecommunication equipment etc.

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