Extrinsic semiconductor

What Are Extrinsic Semiconductors?

Those semiconductors in which some impurity atoms are embedded are known as extrinsic semiconductors.

An extrinsic semiconductor is one that has been doped, that is, into which a doping agent has been introduced, giving it different electrical properties than the intrinsic (pure) semiconductor. This doping involves adding dopant atoms to an intrinsic semiconductor, which changes the electron and hole carrier concentrations of the semiconductor at thermal equilibrium, the temperature at which two adjacent substances exchange no heat energy. Dominant carrier concentrations in an extrinsic semiconductor classify it as either an n-type or p-type semiconductor. The electrical properties of extrinsic semiconductors make them essential components of many electronic devices.

Doping

Doping intentionally introduces impurities into an extremely pure intrinsic semiconductor for the purpose of modulating its electrical properties. The impurities are dependent upon the type of semiconductor and the properties that it needs to have for its intended purpose. Lightly and moderately doped semiconductors are referred to as extrinsic semiconductors. A semiconductor doped to such high levels that it acts more like a conductor than a semiconductor is referred to as a degenerate semiconductor.

Extrinsic semi-conductors are basically of two types:

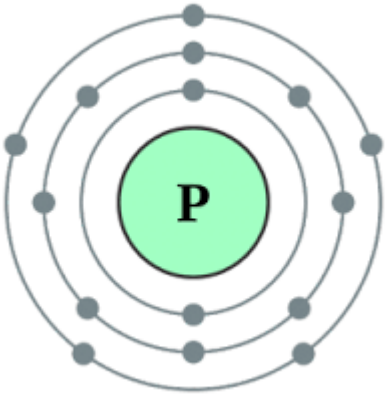
1. P-type semi-conductors
2. N-type semi-conductors

Types of impurities

Two types of impurities are added to the semiconductor. They are pentavalent and trivalent impurities.

Pentavalent impurities

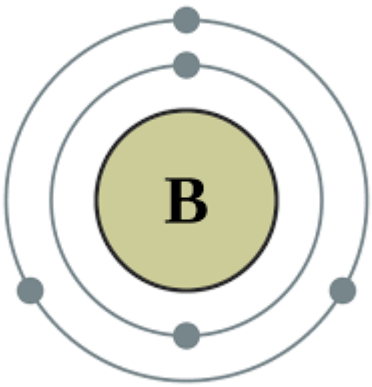
Pentavalent impurity atoms have 5 valence electrons. The various examples of pentavalent impurity atoms include Phosphorus (P), Arsenic (As), Antimony (Sb), etc. The atomic structure of pentavalent atom (phosphorus) and trivalent atom (boron) is shown in below fig.



Phosphorus is a substance consisting of atoms which all have the same number of protons. The atomic number of phosphorus is 15 i.e. 15 protons. The number of protons in the nucleus of an atom is called atomic number. Phosphorus atom has 15 electrons (2 electrons in first orbit, 8 electrons in second orbit and 5 electrons in the outermost orbit).

Trivalent impurities

Trivalent impurity atoms have 3 valence electrons. The various examples of trivalent impurities include Boron (B), Gallium (G), Indium(In), Aluminium(Al).



Boron is a substance consisting of atoms which all have the same number of protons. The atomic number of boron is 5 i.e. 5 protons. Boron atom has 5 electrons (2 electrons in first orbit and 3 electrons in the outermost orbit).