APPLICATIONS OF SEMICONDUCTORS

Intrinsic Semiconductors

Conduction in pure substances, such as silicon and germanium, is termed intrinsic conduction, and these pure substances that display electrical conductivity are referred to as intrinsic semiconductors.

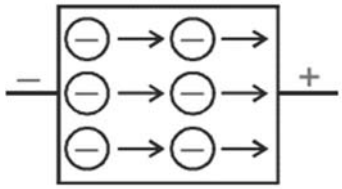
Type of Semiconductors

(1) n-Type Semiconductors

Compounds with an excess of metal conduct electricity through the conventional electron conduction mechanism, classifying them as n-type semiconductors.

Creation n-Type Semiconductor

1. The introduction of a small quantity of group-15 elements, such as P, As, or Sb, into silicon results in a significant increase in its electrical conductivity.
2. In its pure state, each silicon atom utilizes its four valence electrons to form four covalent bonds with neighboring silicon atoms.
3. Doping silicon with certain group-15 elements involves substituting some positions in the lattice with atoms from group 15, which possess five valence electrons. After forming four covalent bonds with silicon (or another group-14 element like germanium), these atoms have one excess electron that is not involved in bonding.
4. As this uninvolved electron becomes delocalized, it contributes to electrical conduction. Silicon doped with a group-15 element exhibits behavior characteristic of an n-type semiconductor.



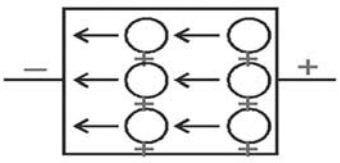
n-type semiconductor

(2) p-Type Semiconductors

Compounds with a deficiency of metal conduct electricity through a positive hole conduction mechanism, classifying them as p-type semiconductors.

Creation p-Type Semiconductor

1. The electrical conductivity of silicon or germanium can be enhanced by doping with certain group-13 elements like B, Al, or Ga.
2. Group-13 elements possess only three valence electrons, and when combined with group-14 elements, they create an electron-deficient bond or an electron vacancy known as a hole. These holes can move through the crystal, acting like a positive charge and contributing to electrical conductivity.
3. Group-14 elements doped with group-13 elements exhibit behavior characteristic of p-type semiconductors. In the presence of an electric field, the holes move in a direction opposite to that of electrons.



p-Type Semiconductors