EXTRINSIC MATERIALS: n-type AND P-type Materials

The characteristics of a semiconductor material can be altered by the addition of specific impurity atoms to pure semiconductor material. These impurities, although only added at 1 part in 10 million, can alter the band structure to totally change the electrical properties of the material.

A semiconductor material that has been subjected to the doping process is called an extrinsic material.

n-Type Material:

* An n-type material is created by introducing impurity elements that have five valence electrons (pentavalent), such as antimony, arsenic and phosphorus.

* An additional fifth electron due to impurity atom, which is unassociated with any particular covalent bond, considered free electron n-type material.

* The newly formed n-type material, Since the inserted impurity atom has denoted “free” electron to the structure.

* Diffused impurities with five valence electrons are called donor atoms.

* The effect of this doping process on the relative conductivity described in Fig (1-7).

p-Type Material:

* The p-type material is formed by doping a pure silicon crystal with impurity atoms having three valence electrons, such as boron, gallium, and indium.

* The resulting vacancy is called a hole and is represented by plus sign, these atoms called acceptor atoms.

Fig (1-6) Antimony impurity in Si

Fig (1-7) Effect of donor impurities on the energy band structure