Semiconductor Diode (p-n Junction) →

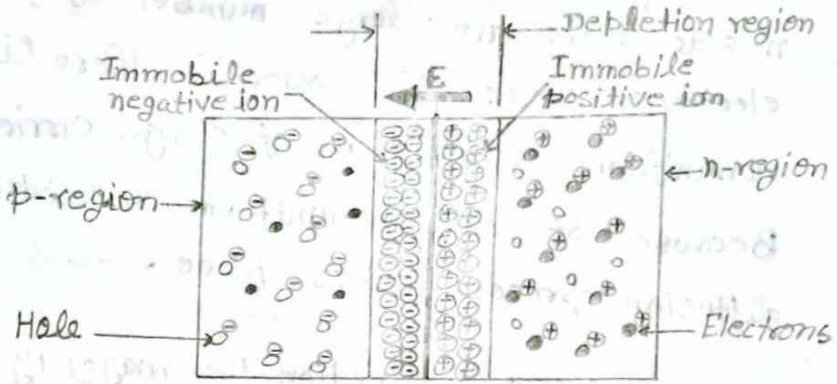
When n-type and p-type are chemically combined with a special fabrication technique to form a p-n junction. Such a semiconductor p-n junction forms a popular electronic device called diode.

In a p-n junction, on p-side there are large number of holes while on n-side there are large number of free electrons. Hence the overall there is nonuniform distribution of charge carriers. Because of such nonuniform distribution, diffusion process takes place.

In unbiased p-n junction the majority holes on p-side start diffusing into n-side while the majority free electrons on n-side start diffusing into p-side.

In n-region, the holes diffusing from p-side, recombine with free electrons. Thus due to additional positively charged holes, these atoms on n-side become positive immobile ions, just near the junction in n-region.

- Similarly in p-region, the free electrons diffusing from n-side, recombine with the holes of the atoms. Thus due to gain of additional negatively charged free electrons, these atoms become negative immobile ions, just near the junction in p-region.



As more holes diffuse on n-side, large immobile positive charge accumulates near the junction n-side. This +Ve charge repels the +Ve charged holes and the diffusion of holes stops.

Similarly large negative charge accumulates near the junction on p-side. This -Ve charge repels the negatively charged electrons and the diffusion of electrons stops.

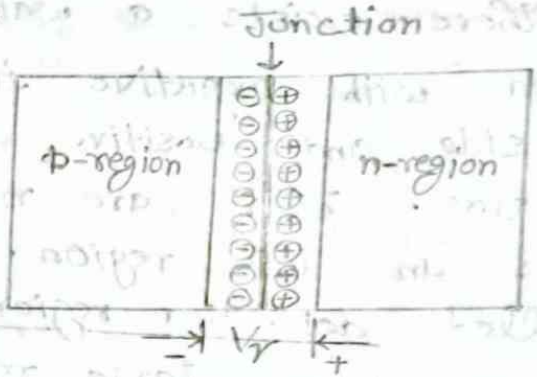
Thus there exists a wall near the junction with negative immobile charge on p-side and positive immobile charge on n-side. There are no charge carriers in this region. This region is called depletion region or depletion layer or space charge region.

In equilibrium condition, the depletion region gets widened upto a point where no further electrons or holes can cross the junction. Thus it acts as a barrier.

Barrier Potential :→

Due to immobile positive ions on n-side and immobile negative ions on p-side, there exists an electric field across the junction.

This creates potential difference across the depletion region which acts as a barrier. This is called barrier potential or built-in potential or cut-in potential of p-n junction.



Barrier potential

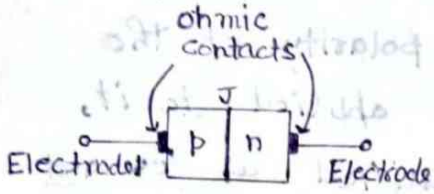
$V_r = 0.7V$ for Si
$V_r = 0.3V$ for Ge

It is denoted as V_r or V_0.

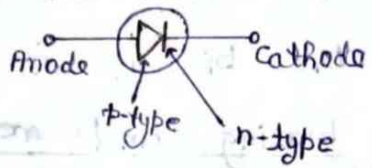
- The barrier potential depends on,
  - (i) Type of semiconductor
  - (ii) Donar impurity added
  - (iii) Acceptor impurity added
  - (iv) Temperature

Symbol of Diode →

Fig(a) shows schematic arrangement of p-n Junction diode while fig(b) shows the symbol of p-n Junction diode.



fig(a)



fig(b)
Symbol

The p-n junction has two terminals called electrodes, one each from p-region and n-region. Due to the two electrodes it is called diode i.e. di + electrode.

The p-region acts as anode while the n-region act as cathode. The arrowhead in the symbol indicates the direction of the conventional current, which can flow when an external voltage is connected in a specific manner