Types of Semiconductors

Semiconductors can be classified as:

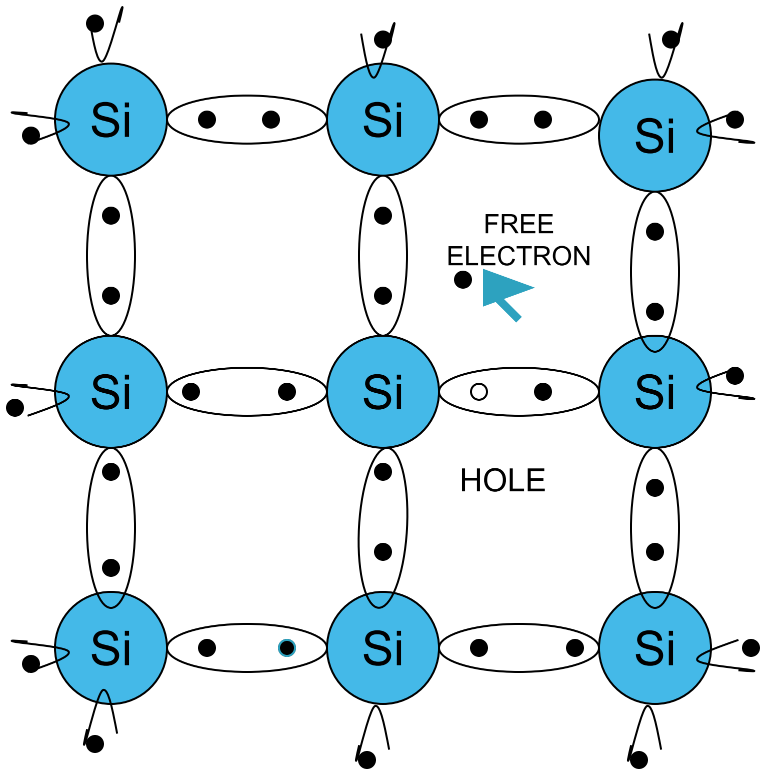
1. Intrinsic Semiconductor.

2. Extrinsic Semiconductor.

Extrinsic Semiconductors are further classified as:

a. n-type Semiconductors.
b. p-type Semiconductors.

Intrinsic Semiconductor



- Semiconductor in pure form is known as Intrinsic Semiconductor.
- Ex. Pure Germanium, Pure Silicon.
- At room temp. no of electrons equal to no. of holes.

Fig 1.

Intrinsic semiconductor energy band diagram

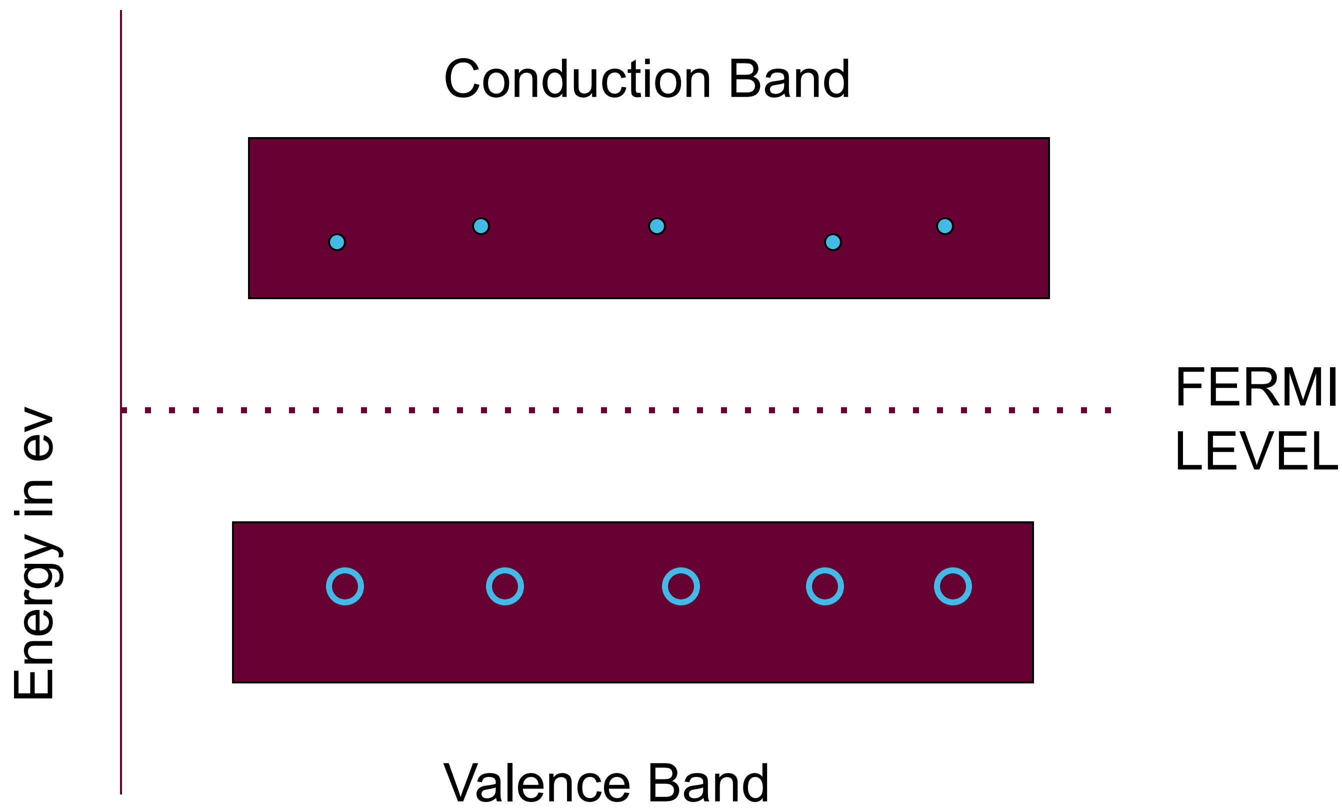


Fig 2.
Fermi level lies in the middle

Extrinsic Semiconductor

- When we add an impurity to pure semiconductor to increase the charge carriers then it becomes an Extrinsic Semiconductor.
- In extrinsic semiconductor without breaking the covalent bonds we can increase the charge carriers.

Comparison of semiconductors

Intrinsic Semiconductor	Extrinsic Semiconductor
1. It is in pure form.	1. It is formed by adding trivalent or pentavalent impurity to a pure semiconductor.
2. Holes and electrons are equal.	2. No. of holes are more in p-type and no. of electrons are more in n-type.
3. Fermi level lies in between valence and conduction Bands.	3. Fermi level lies near valence band in p-type and near conduction band in n-type.
4. Ratio of majority and minority carriers is unity.	4. Ratio of majority and minority carriers are equal.

Comparison between n-type and p-type semiconductors

N-type

- Pentavalent impurities are added.
- Majority carriers are electrons.
- Minority carriers are holes.
- Fermi level is near the conduction band.

P-type

- Trivalent impurities are added.
- Majority carriers are holes.
- Minority carriers are electrons.
- Fermi level is near the valence band.

N-type Semiconductor

- When we add a pentavalent impurity to pure semiconductor we get n-type semiconductor.

- Arsenic atom has 5 valence electrons.

- Fifth electron is superfluous, becomes free electron and enters into conduction band.

- Therefore pentavalent impurity donates one electron and becomes positive donor ion. Pentavalent impurity known as donor.

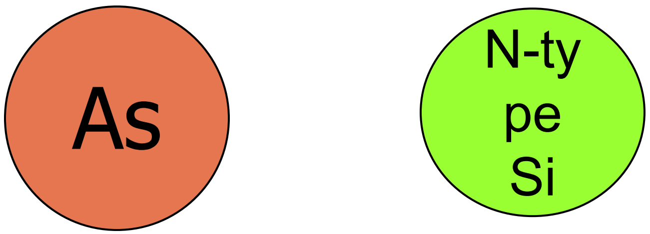


Fig 1.

P-type Semiconductor

- When we add a Trivalent impurity to pure semiconductor we get p-type semiconductor.
- Gallium atom has 3 valence electrons.
- It makes covalent bonds with adjacent three electrons of silicon atom.
- There is a deficiency of one covalent bond and creates a hole.
- Therefore trivalent impurity accepts one electron and becomes negative acceptor ion. Trivalent impurity known as acceptor.

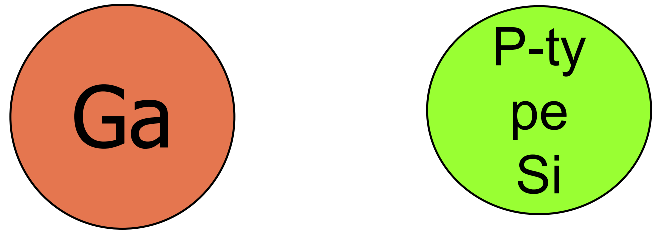


Fig 2.

Carriers in P-type Semiconductor

- In addition to this, some of the covalent bonds break due temperature and electron hole pairs generates.

- Holes are majority carriers and electrons are minority carriers.

P and N type Semiconductors

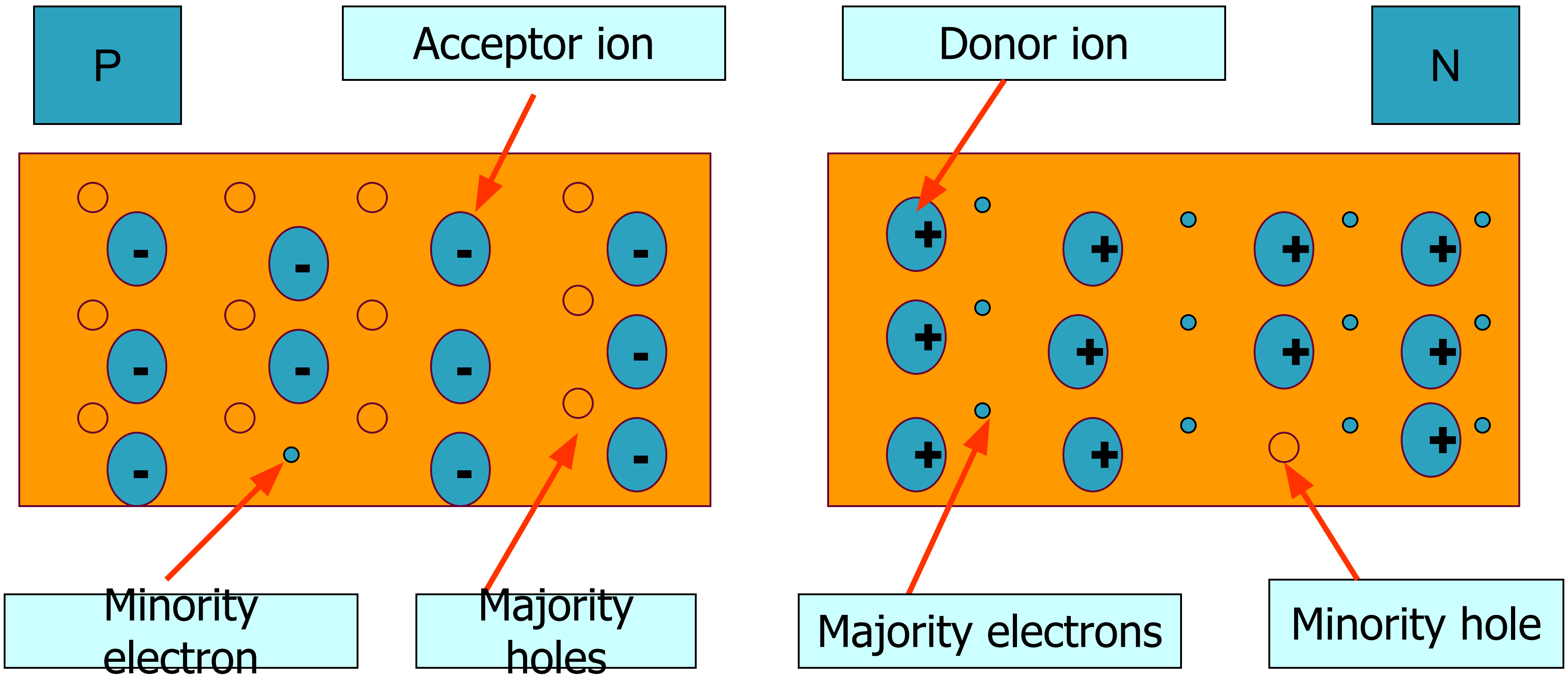


Fig 3.

Comparison of semiconductors

Intrinsic Semiconductor	Extrinsic Semiconductor
1. It is in pure form.	1. It formed by adding trivalent or pentavalent impurity to a pure semiconductor.
2. Holes and electrons are equal.	2. No. of holes are more in p-type and no. of electrons are more in n-type.
3. Fermi level lies in between valence and conduction Bands.	3. Fermi level lies near valence band in p-type and near conduction band in n-type.

Conduction in Semiconductors

Conduction is carried out by means of

1. Drift Process.
2. Diffusion Process.

Drift process

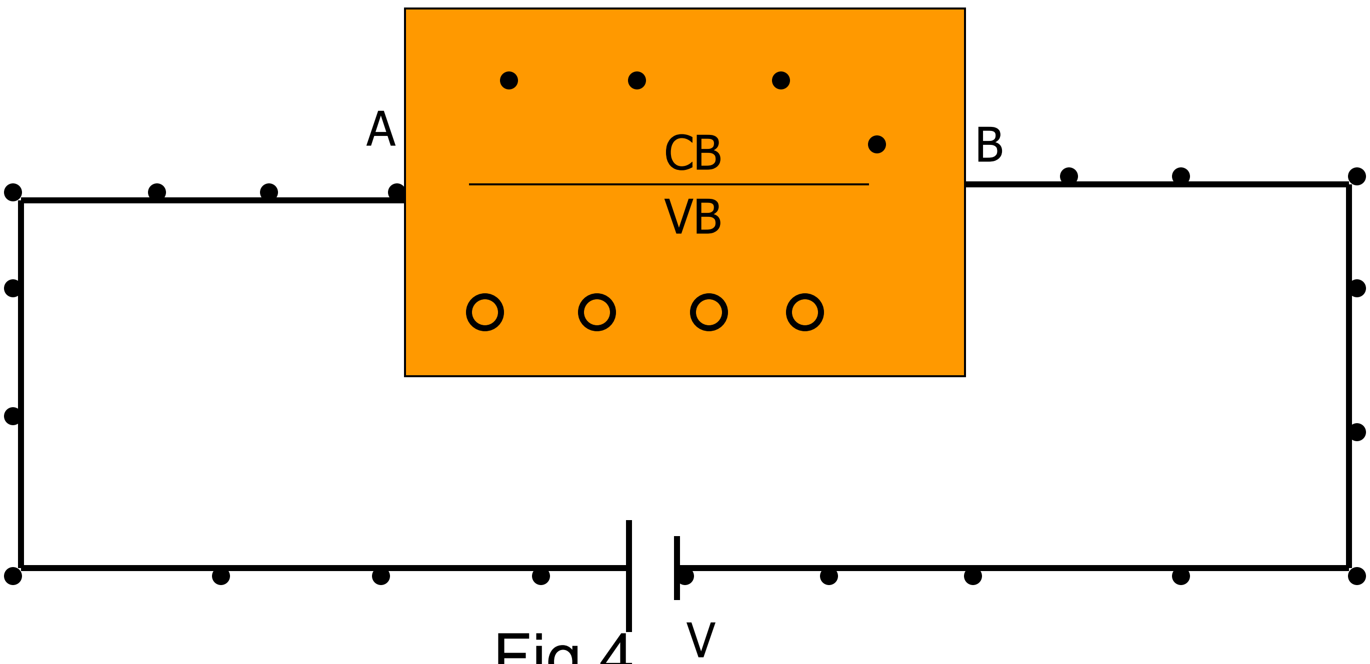


Fig 4.

- Electrons move from external circuit and in conduction band of a semiconductor.

- Holes move in valence band of a semiconductor.

Diffusion process

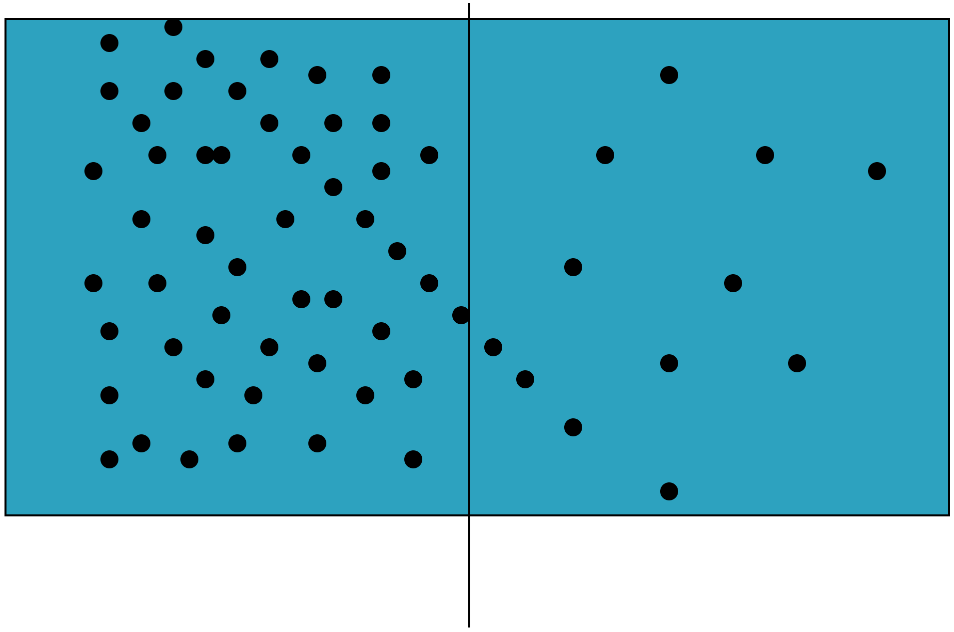


Fig 5.

- Moving of electrons from higher concentration gradient to lower concentration gradient is known as diffusion process.

P and N type Semiconductors

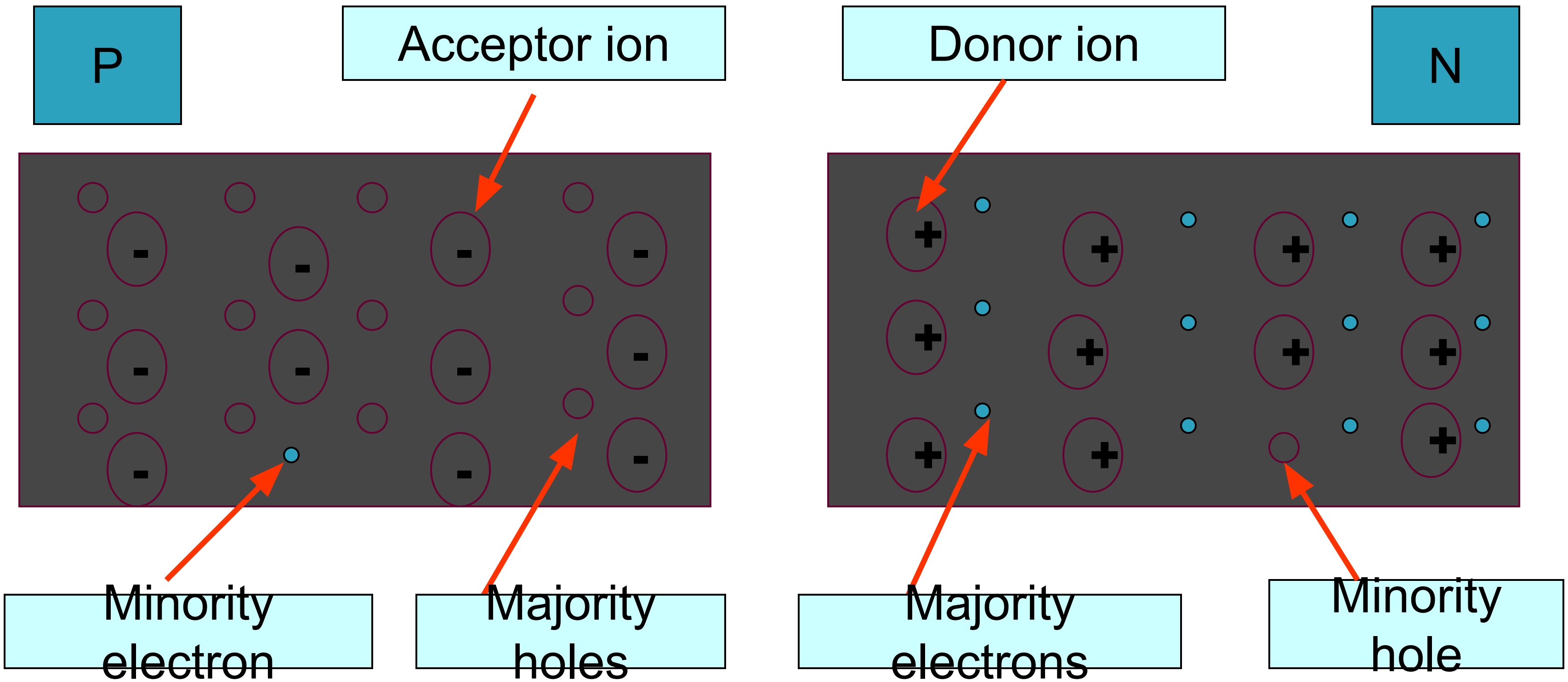


Fig 1.

Formation of pn diode

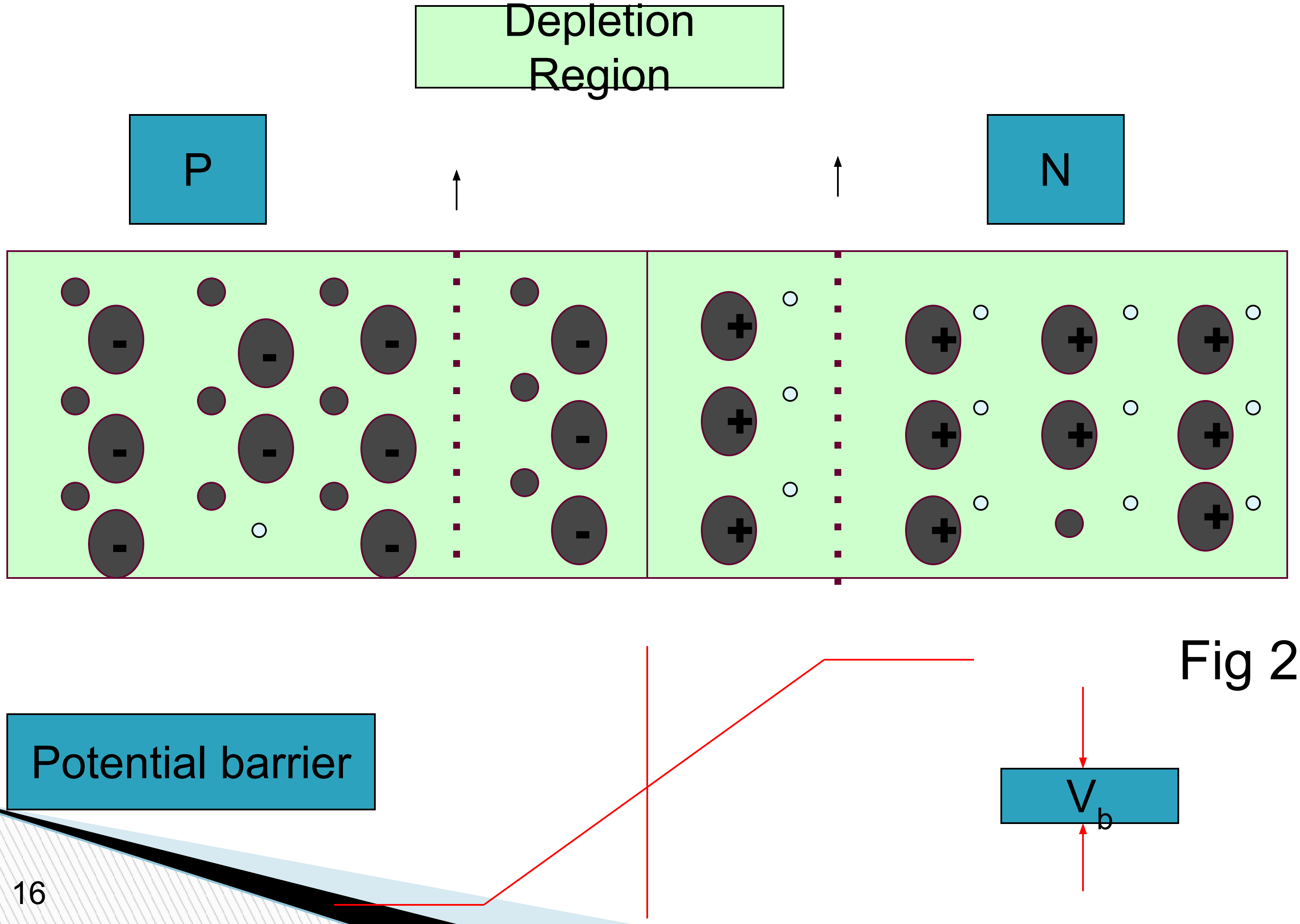


Fig 2.

Semiconductor diodes

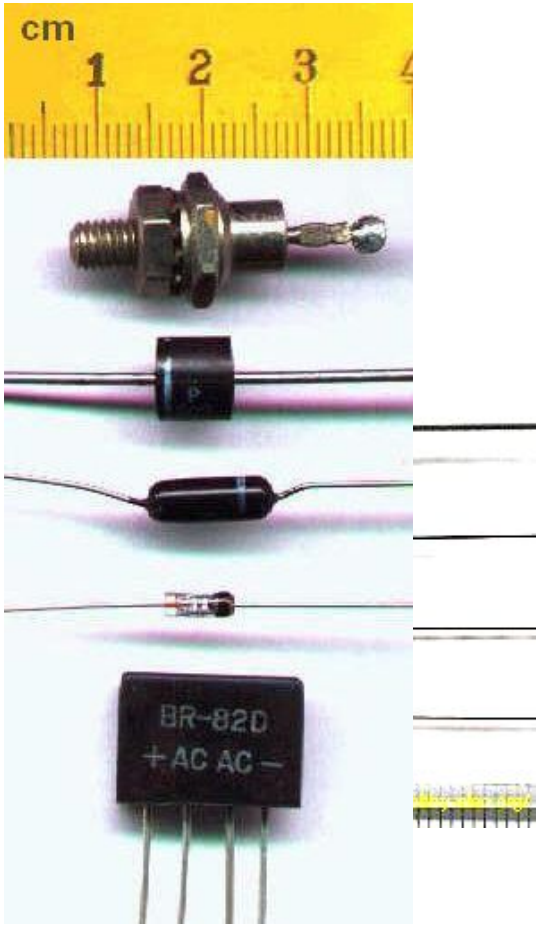
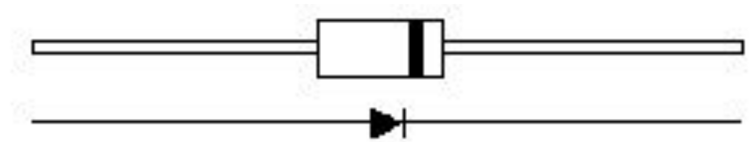


Fig. 1 Diode variants



Visual - 1

Thanks for attention!!!