SNS COLLEGE OF ENGINEERING

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AN AUTONOMOUS INSTITUTION

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai.

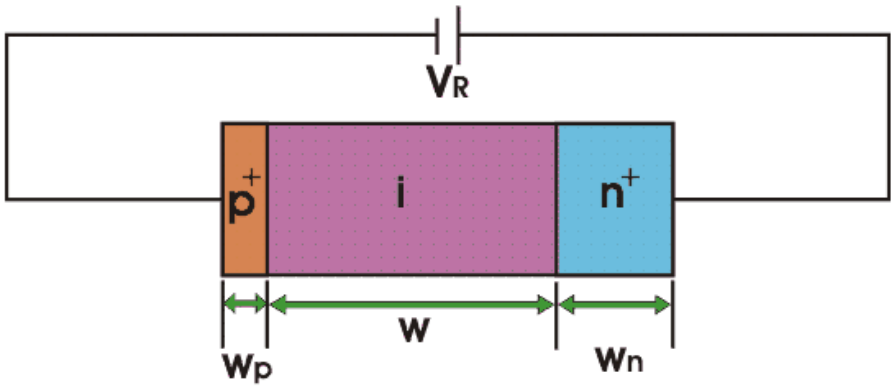
UNIT -III SEMICONDUCTOR PHYSICS

TOPIC – VII PHOTODETECTORS PIN AND AVALANCHE DIODE

PIN Diode

PIN photodiode is a kind of photo detector, it can convert optical signals into electrical signals. This technology was invented in the latest of 1950's. There are three regions in this type of diode. There is a p-region an intrinsic region and an n-region. The p-region and n-region are comparatively heavily doped than the p-region and n-region of usual p-n diodes. The width of the intrinsic region should be larger than the space charge width of a normal pn junction. The **PIN photo diode** operates with an applied reverse bias voltage and when the reverse bias is applied, the space charge region must cover the intrinsic region completely. Electron hole pairs are generated in the space charge region by photon absorption. The switching speed of frequency response of photodiode is inversely proportional to the life time.

The switching speed can be enhanced by a small minority carrier lifetime. For the photo detector applications where the speed of response is important, the depletion region width should be made as large as possible for small minority carrier lifetime as a result the switch speed also increases. This can be achieved **PIN photodiode** as the insertion of intrinsic region the space charge width larger. The diagram of a normal PIN photodiode is given below.



Avalanche Photo Diode

Avalanche photo diode is a kind of photo detector which can convert signals into electrical signals pioneering research work in the development of avalanche diode was done mainly in 1960's. **Avalanche photodiode** structural configuration is very similar to the PIN photodiode. A **PIN photodiode** consists of three regions-

1. p-region,
2. intrinsic region,
3. n-region.

The difference is that reverse bias applied is very large to cause impact ionization. For silicon as the sc material, a diode will need between 100 to 200 volts. Firstly electron- hole pairs are generated by photon absorption in the depletion region. These generate more electron hole pairs through impact ionization. These are swept out of the depletion region quickly, i.e, the transit time is very less.

Avalanche Photodiodes

- High gain due to avalanche multiplication effect
- Increased noise
- Silicon has high gain but low noise
- Si-InGaAs APD often used(diagram on right)