

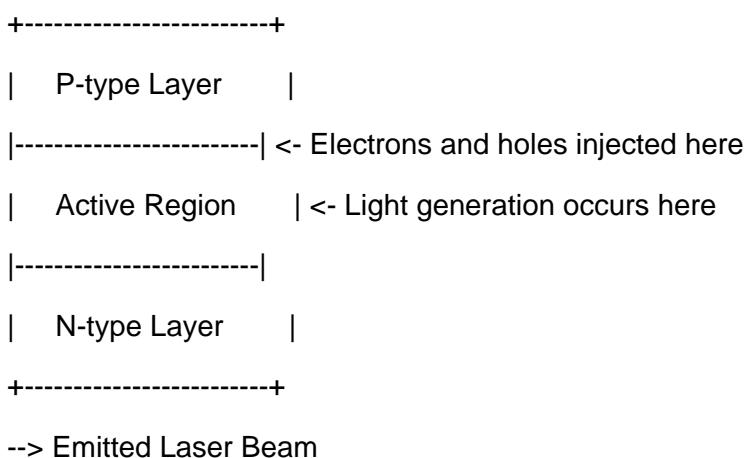
Operation of Semiconductor Lasers

1. Structure of a Semiconductor Laser

A semiconductor laser, also known as a laser diode, consists of a p-n junction with an active region in between.

Light is generated when electrons and holes recombine in this region.

Illustration 1: Basic Structure



2. Working Principle

When a forward bias is applied, electrons and holes are injected into the active region. Their recombination emits photons.

Illustration 2: Energy Band Diagram

Conduction Band

^ ^ ^ <- Electrons injected

Active Region

v v v <- Holes injected

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Valence Band

=> Electrons recombine with holes => Photons emitted (Light)

3. Optical Feedback and Emission

The cavity mirrors provide feedback by reflecting light back and forth. Stimulated emission amplifies the light, and part of it exits as a laser beam.

Illustration 3: Laser Cavity

|<- Mirror ->|<- Gain Medium (Active Region) ->|<- Mirror ->|

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^ Coherent light is amplified with each round-trip ^

-> Output beam comes out from one partially transparent mirror

Conclusion

Semiconductor lasers are compact, efficient sources of coherent light. They are widely used in devices like CD/DVD players, barcode scanners, optical communication, and laser pointers.