

Semiconductor Technology from A to Z

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Optoelectronics

How does an LED work?

At a p-n junction made of a direct-bandgap semiconductor, injected electrons and holes recombine and emit a photon. The light's wavelength is set by the material system's bandgap (e.g., InGaN for blue, AlGaInP for red). Quantum well structures in the active region significantly boost the efficiency of this recombination.

[Learn more in the chapter Light-Emitting Diodes \(LED\) →](#)

How does a laser diode work?

As with an LED, light is generated by recombination at a p-n junction, but here inside an optical resonator that reflects the light back and forth repeatedly. Above a threshold current, stimulated emission dominates over spontaneous emission — population inversion occurs and coherent laser light is produced. Depending on the resonator design, this yields Fabry-Pérot, DFB, or VCSEL lasers, among others.

[Learn more in the chapter Laser Diodes →](#)

How does a solar cell work?

When light hits a solar cell's p-n junction, photons with sufficient energy generate electron-hole pairs in the semiconductor. The junction's built-in electric field separates these charge carriers before they can recombine and drives them into the external circuit. This photovoltaic effect converts light energy directly into electrical energy.

[Learn more in the chapter Fundamentals of Optoelectronics →](#)