Unit-3

Lecture -4

LED, Structures, DOME LED, Planner LED, Surface Edge LED

LIGHT-EMITTING DIODES

- A light-emitting diode (LED) is a semiconductor device that emits incoherent light, through spontaneous emission
- when a current is passed through it. Typically LEDs for the 850-nm region are fabricated using GaAs and AlGaAs.
- LEDs for the 1300-nm and 1550-nm regions are fabricated using InGaAsP and InP.

Types of LED

The basic LED types used for fiber optic communication systems are

- Surface-emitting LED (SLED),
- Edge-emitting LED (ELED), and

LED performance differences (1)

- LED performance differences help link designers decide which device is appropriate for the intended application.
- For short-distance (0 to 3 km), low-data-rate fiber optic systems, SLEDs and ELEDs are the preferred optical source.
- Typically, SLEDs operate efficiently for bit rates up to 250 megabits per second (Mb/s). Because SLEDs emit light over a wide area (wide far-field angle), they are almost exclusively used in multimode systems.

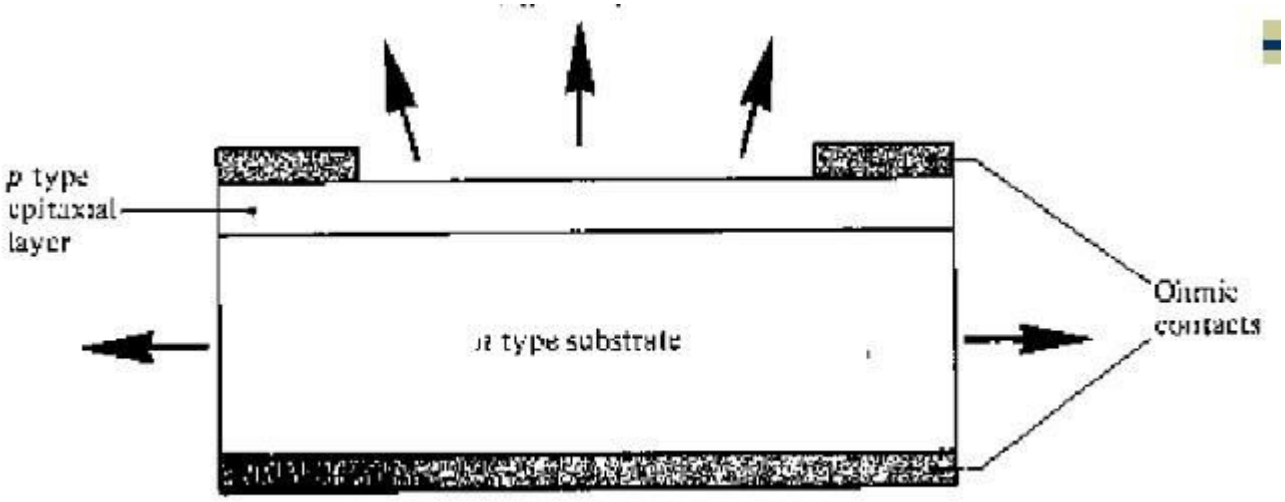
LED performance differences (2)

- For medium-distance, medium-data-rate systems, ELEDs are preferred.
- ELEDs may be modulated at rates up to 400 Mb/s. ELEDs may be used for both single mode and multimode fiber systems.
- Both SLDs and ELEDs are used in long-distance, high-data-rate systems. SLDs are ELED-based diodes designed to operate in the super luminescence mode.
- SLDs may be modulated at bit rates of over 400 Mb/s.

Surface-Emitting LEDs

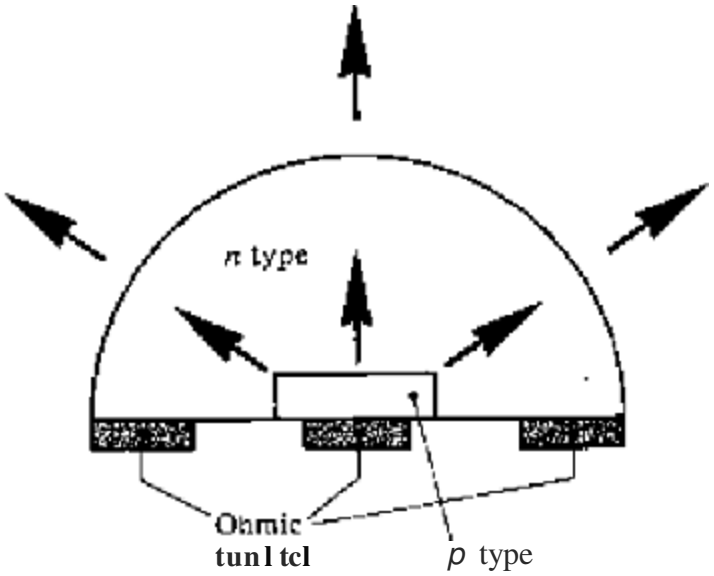
- The surface-emitting LED is also known as the Burrus LED in honor of C. A. Burrus, its developer.
- In SLEDs, the size of the primary active region is limited to a small circular area of 20 mm to 50 mm in diameter.
- The active region is the portion of the LED where photons are emitted. The primary active region is below the surface of the semiconductor substrate perpendicular to the axis of the fiber.
- A well is etched into the substrate to allow direct coupling of the emitted light to the optical fiber. The etched well allows the optical fiber to come into close contact with the emitting surface.

Planer LED

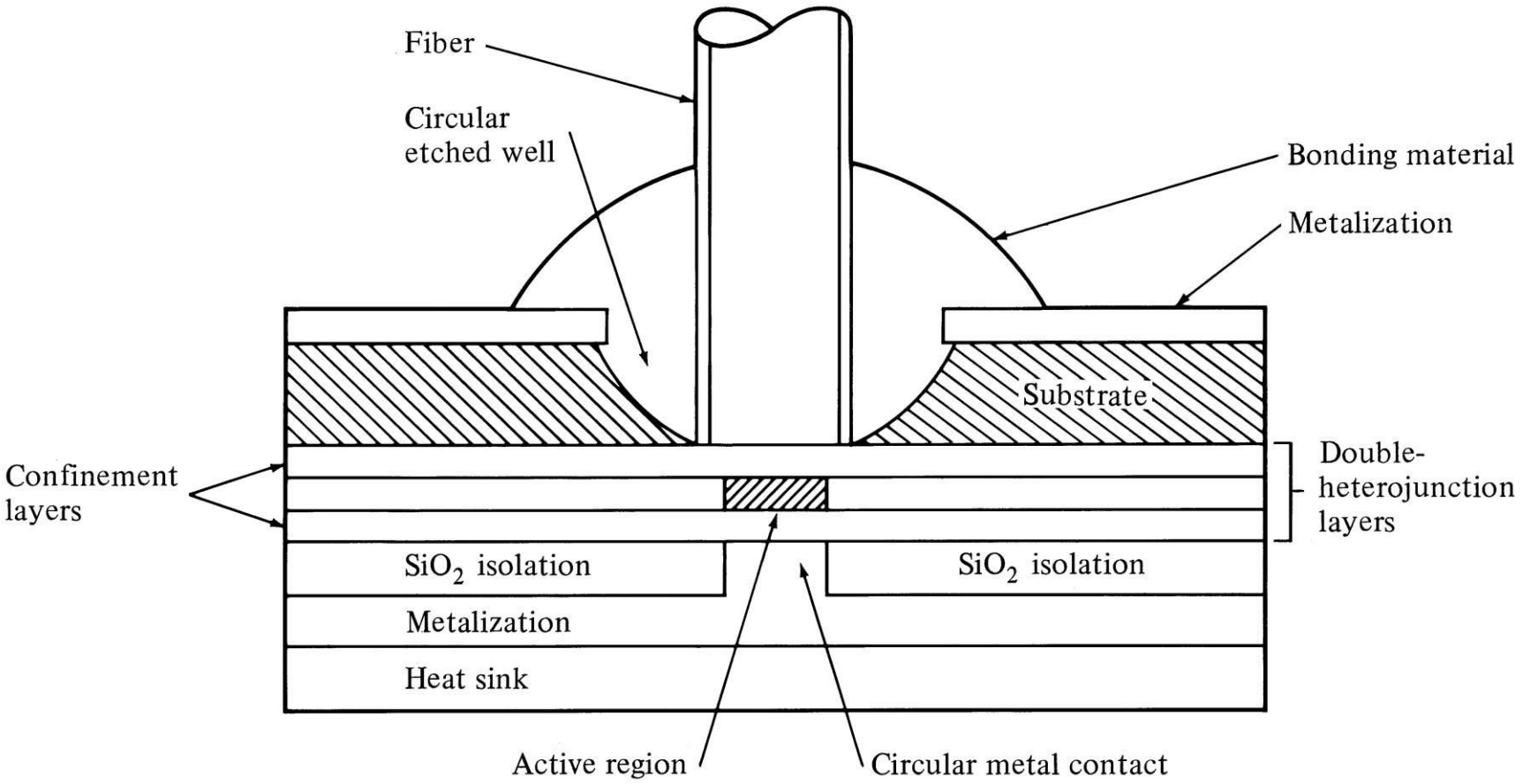


Dome LED

- In this structure, a hemisphere of n type GaAs is formed around a diffused p type region.
  - This device has high external power efficiency.
  - This is because of the hemisphere structure.
  - In this structure dome is used to maximize the internal emission at the substrate – air interface.


n type
Ohmic
tunl tcl
p type

Surface-emitting LED



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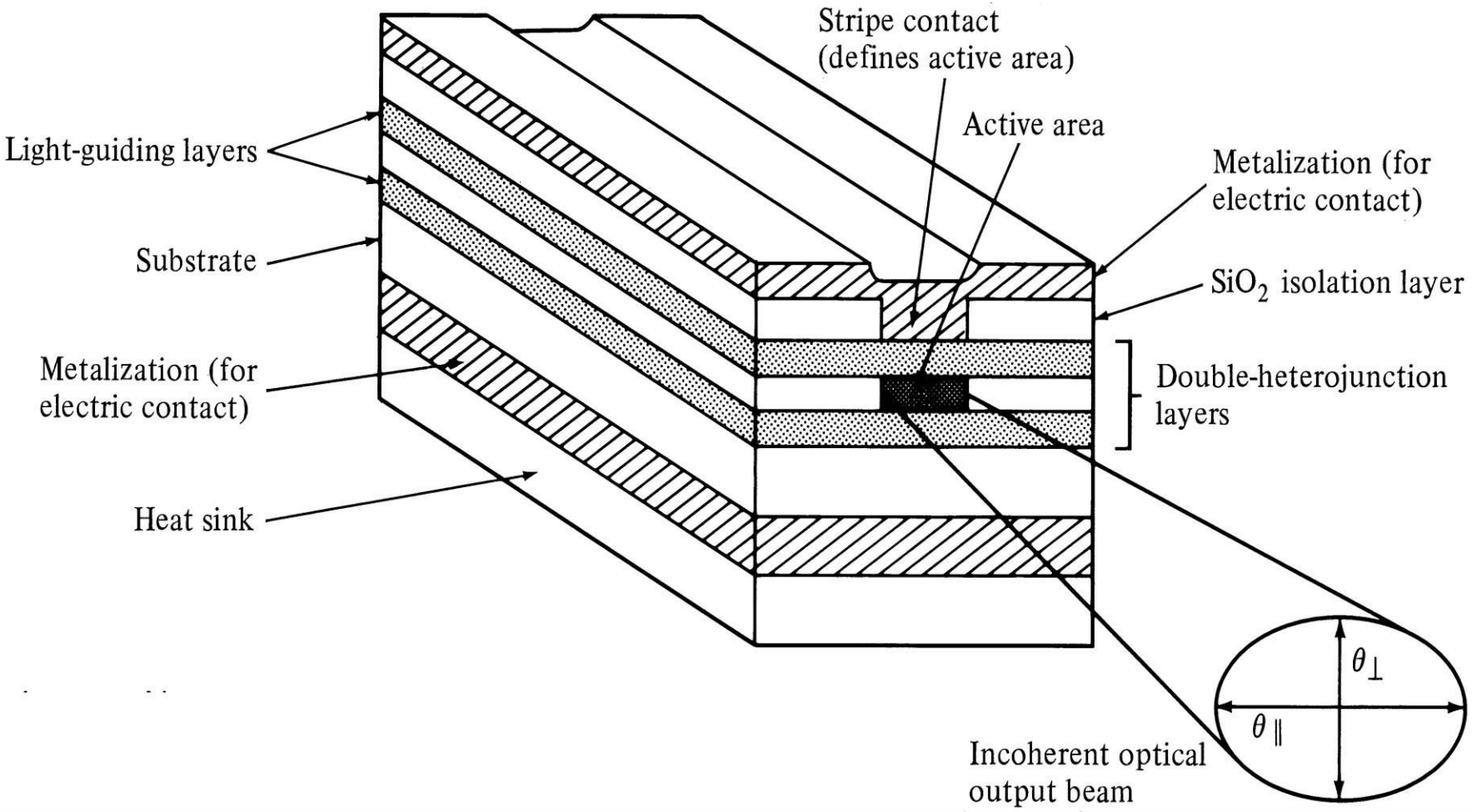
Edge-emitting LED



The active region is embedded into a waveguide structure so that the light is directed an edge

- Larger active region
- More directional radiation (similar to LASER)