Semiconductor Laser:

Semiconductor lasers are diodes that emit coherent light by stimulated emission. They consist of a p-n junction inside a slab of semiconductor that is typically less than a millimeter in any dimension. Excitation is provided by current flow through the device, and the cleaved ends of the diode provide the feedback mirrors.

The output characteristics of diode lasers differ from those of other laser types in two important ways. Because of their small size they have beam divergence angles of as much as 20. The nature of the active medium also allows lasing over a broad wavelength range and produces an output that is far less monochromatic than other laser types.

Energy Transfer in Semiconductor Lasers

Semiconductors are materials that have electrical conductivity intermediate between the high conductivity of metals and the low conductivity of insulators. In a good electrical conductor, such as a metal, so that conduction of electricity is easy. In an insulating material (for example, common table salt), the electrons are tightly bound to their parent atoms and are not free to move through the material when a voltage is applied to it. Therefore, the electrical conductivity is low. In a semiconductor the outer electrons are usually bound to their parent

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atoms, but a small fraction of them can migrate through the material, so that there is a small amount of electrical conductivity, the most commonly known semiconductors are silicon and germanium, which have been used for electronic applications such as rectifiers and transistors. However, silicon and germanium have not yet been used in lasers. The most common semiconductor material that has been used in lasers is gallium arsenide, which is a compound of chemical element 31, gallium, and chemical element 33, arsenic. Its chemical designation is GaAs.

The output power available from this laser is limited by the loop gain available within the laser cavity. The amplifier gain of the active medium is dependent on the current density through the junction. Higher currents produce greater power, but higher currents also increase heating effects that can damage the device

Loss in the laser cavity has two primary contributors.

1- The first of these is diffraction loss. The active region has a width of only about a micron. Thus, light quickly diverges out of the active region. This loss may be reduced by making the junction wider and by better confining the light to the active region.

2- The second loss factor is absorption of the laser light by free carriers in the junction region. This loss may be reduced by reducing the number of free carriers. This reduction is accomplished by lowering the temperature of the device.

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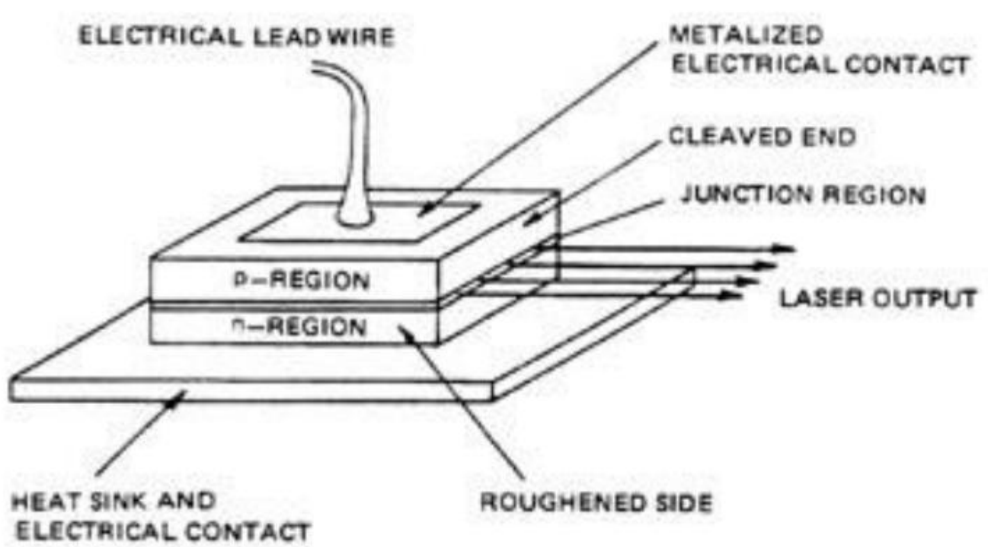

Fig.(11): Basic Semiconductor Laser Design

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