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1997

Mass production of a large-output laser diode for in-vehicle LIDAR (Denso Corporation)

~ Discrete Semiconductor/Others ~

Lasers used in optical communications and optical disks emit laser beams from stripes with a width of 2-5μm. Optical output is limited by optical damage etc. on the light emitting facet, and the upper limit is about 200~300mW. If the laser stripe width is extended to 50~300μm, the light output can be increased to 1-5 W or more. Such a watt-class high power semiconductor laser is widely used as a solid-state laser excitation light source and laser processing light source.

Watt class high power lasers were developed mainly in the group of Xerox and Spectra Diode Lab in the 1980s. A basic structure of high-power semiconductor laser was developed in the following structure. In the thickness direction of the epitaxial layer, a separate confinement heterostructure (SCH) was developed in which a light guide layer (waveguide layer) having a refractive index larger than that of the clad layer was provided on both sides of a quantum well (QW), and in the horizontal direction, a broad stripe structure with widened current injection region (stripe width) was developed. By adopting the SCH structure, the light seep to the outside of the active layer is increased to lower the optical power density inside, and the internal loss is reduced by confinement of electrons in the active layer, thus high light output and light conversion efficiency can be realized. In the early 1990s, continuous oscillation power of several tens of watts with a laser chip (bar), and a several hundred watts or more with stacked laser bars were obtained, and several domestic companies commercialized them.

The major problems of high-power semiconductor lasers are optical damage on the laser mirror surface due to strong laser light and performance deterioration due to temperature rise of the element, and various measures have been taken against them. DENSO developed an AlGaAs/GaAs laser with an output of 15W, and it used it for an ACC (Adaptive Cruse Control) system in 1997, which was adopted in a commercial passenger car. In order to ensure high reliability for automotive use, miller coating design technology and die bonding technology were developed through the analysis of device degradation.

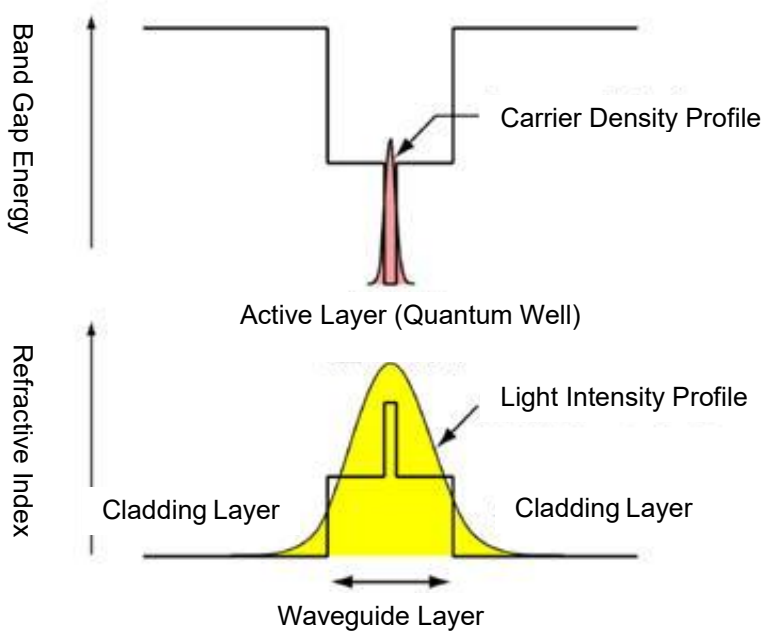

Fig.1: Schematic explanation of SCH (Separate Confinement Heterostructure)

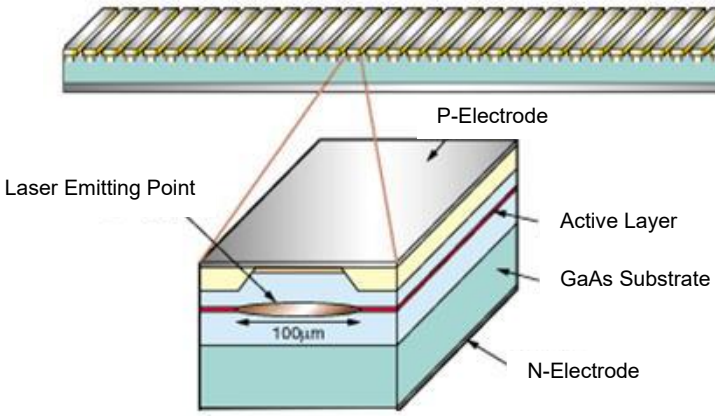

Fig.2: Monolithic array laser bar

(Single-striped high-power lasers are arranged in one dimension)

Fig.3: Laser stack (stacking laser bars)

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