

## 1978

### **Release of a commercial gallium-arsenide/aluminum-gallium-arsenide semiconductor laser (Hitachi and Mitsubishi Electric)**

#### **~ Discrete Semiconductor/Others ~**

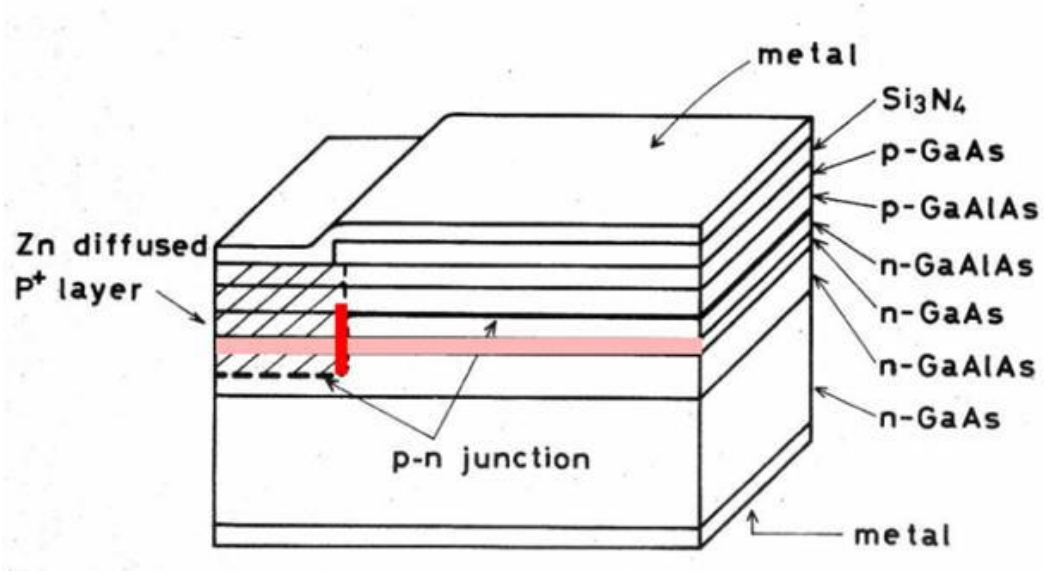
The GaAs / AlGaAs semiconductor laser is a so-called double heterostructure in which a GaAs active layer to be a light emitting layer is sandwiched between clad layers of p-type AlGaAs and n-type AlGaAs having larger band gap and smaller refractive index than GaAs. Current is applied in the forward direction between the clad layers to inject holes and electrons from the cladding layers into the active layer. As a result, light emission accompanying band-to-band transition occurs inside the active layer.

On the other hand, since there is no difference in refractive index in the lateral direction, while there is a difference in refractive index for each semiconductor material in the thickness direction, mode-distortion and mode-shift are caused by spatial hole burning phenomenon, and the operation of the laser becomes unstable, and shift in the light emitting direction and the like occurs. This was inadequate as a light source for optical communication, and a structure that stabilized the laser by implementing the difference in the refractive index in the lateral direction was studied.

In the TJS laser developed by Mitsubishi Electric shown in the Figure, by diffusing impurities in the shaded portion of the semiconductor laser, the refractive index of the tip portion (red line) became high and total reflection occurs not only in the thickness direction but also in the width direction in the area where the pink line crosses the red line (active region).

A single mode oscillation was achieved in this structure with very low threshold current of 15mA. Lifetime of more than one million hours was also realized.

Hitachi developed a Channeled Substrate Planar (CSP) type and a Buried Heterostructure (BH) type. By these developments, Japan came ahead of US in mode stabilization technologies.



Cross-sectional structure of TJS type laser

Reference:

- (1) H. Namizaki, H. Kan, M. Ishii, & A. Ito "Transverse-Junction-Stripe-Geometry double-hetero structure lasers with very low threshold current" J. Appl. Phys. Vol.45, pp 2785-2786 (1974)

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