LOW THRESHOLD CURRENT OPERATION FOR 0.65\(\mu m\) InGaAsP/GaAsP VISIBLE LASER DIODE

I.Mito, M.Inai, T.Matsumoto, A.Usui and K.Kobayashi

Opto-Electronics Res. Labs., Fundamental Res. Labs., NEC Corporation

4-1-1, Miyazaki, Miyamae-ku, Kawasaki-city, 213 Japan

0.6\(\mu m\) band visible laser diodes have many attractive applications as light sources for high density optical information-processing systems use as well as optical communications use with plastic fibers whose minimum loss exist in 0.65-0.66\(\mu m\) wavelength region. However, the threshold current densities \(J_{th}\) so far reported, is considerably high; 119 KA/cm\(^2\) for 0.621\(\mu m\) InGaAsP/GaAsP LD\(^1\) and 32KA/cm\(^2\) for 0.66\(\mu m\) InGaAlP/GaAs LD\(^2\). These values are too high to achieve room temperature cw operation. This paper reports low threshold current operation for 0.65\(\mu m\) InGaAsP/GaAsP LD.

Figure 1 shows an SEM cross section of DH wafer grown by hydride-transport vapor phase epitaxial (HT-VPE) method using the dual-growth-chamber-reactor.\(^3\) Epitaxial layer qualities has been improved by optimizing the growth conditions, such as, growth temperature and epitaxial layer lattice constant.

Planar stripe (PS) and mesa stripe (MS) laser structures were fabricated. Basic characteristics of these samples were measured at pulsed condition. Lasing wavelength was 0.65-0.66\(\mu m\) as shown in Fig.2. Threshold current densities \(J_{th}\) are shown in Fig.3 as a function of the stripe width. Current spreading reduction in MS LD decreased \(J_{th}\) to the average value of 9KA/cm\(^2\) and the lowest value of 5.6KA/cm\(^2\) resulted in the lowest threshold current of 100mA. Temperature dependence of L-I curve is shown in Fig.4. Characteristic temperature \(T_c\) was 85K at around room temperature.

Cw operation up to -27\(^\circ\)C was achieved as shown in Fig.5. In spite of the low threshold current, cw operable temperature was relatively low. This can be attributed to the large thermal resistance \(R_{th}\) of 100-150\(\circ\)C/W at -200\(^\circ\)-50\(^\circ\)C. The thermal resistance problem must be solved to realize room temperature cw operation.

In summary, low threshold current density operation as low as 5.6KA/cm\(^2\) at room temperature and cw operation up to -27\(^\circ\)C have been achieved for 0.65\(\mu m\) InGaAsP/GaAsP LD. These results give good prospect for room temperature cw operation at 0.65\(\mu m\) wavelength region.

Acknowledgement: The authors wish to thank F.Saito, D.Shinoda, S.Matsushita and H.Watanabe for their continuous encouragement in the visible laser diodes development.
References

Fig. 1 SEM cross section of DH wafer

Fig. 2 Oscillation spectrum at room temperature

Fig. 3 $J_{th}$ of PS and MS LD as a function of stripe width

Fig. 4 Temperature dependence of pulsed L-I curve

Fig. 5 Temperature dependence of cw L-I curve