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B-4-4 Reliability of InGaAsP/InP Buried Heterostructure Lasers

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InGaAsP/InP diode lasers have been considered as promising light sources for fiber optic communication systems. Intensive efforts have been made to estimate their lives by accelerated aging.[1-4] Recent studies have revealed that it is essential to reduce lasing threshold in order to ensure stable cw operation at high temperatures, e.g. 50- 70 °C.[1,2] Buried Heterostructure (BH) lasers, emitting at 1.3 μm, with threshold currents of 20- 30 mA were found to operate cw up to 110 °C.[5] These BH lasers could stably operate at an ambient temperature of 70 °C and an output power of 5 mW/facet for 8,000 hours. Thus, InGaAsP/InP BH lasers are expected to have fairly long lives compared to AlGaAs/GaAs lasers. However, we have found that there really exists considerable scattering of laser lives between individual lasers. It was observed that the nominal rate of increase in driving current during constant output power aging strongly depends on the maximum temperature, Tmax, for cw lasing.[5] That is, lasers with lower Tmax tend to show larger degradation rates.

The lasers investigated here had Tmax of more than 90 °C. High temperature accelerated aging (50- 70 °C) was performed at a constant output power (3- 5 mW/facet). Among the degradation modes observed during aging are, 1) rapid degradation within about 1,000 hours, 2) rapid degradation followed by long-term stable operation, and 3) gradual or no appreciable degradation from the beginning of aging.

Figure 1 shows the results of 50 °C, 5 mW/facet aging. The increases in driving current during aging are illustrated, along with corresponding electroluminescence (EL) patterns observed in the stripe active regions after removing the n-side electrode metals. Results show that the appearance of dark regions and/or dark line defects are responsible for rapid degradation.

Figure 2 shows the results of 70 °C, 3 mW/facet aging, as an example of degradation mode 2. The degradation rates were found to saturate during the first stage of aging. The reason for such behavior is under investigation.

Median lives of InGaAsP/InP BH lasers were expected to be 1.4×10^5 hours at 50 °C, 5 mW/facet and 1.7×10^4 hours at 70 °C, 5 mW/facet. Details will be presented at the conference.

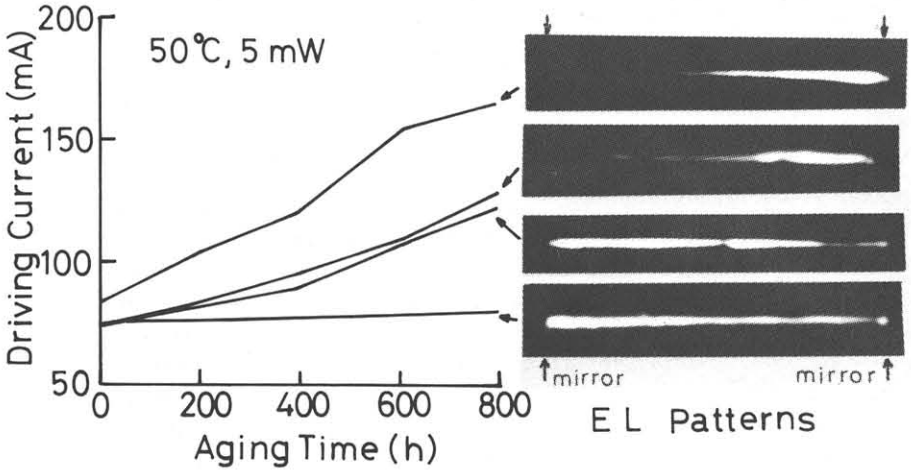

Figure 1

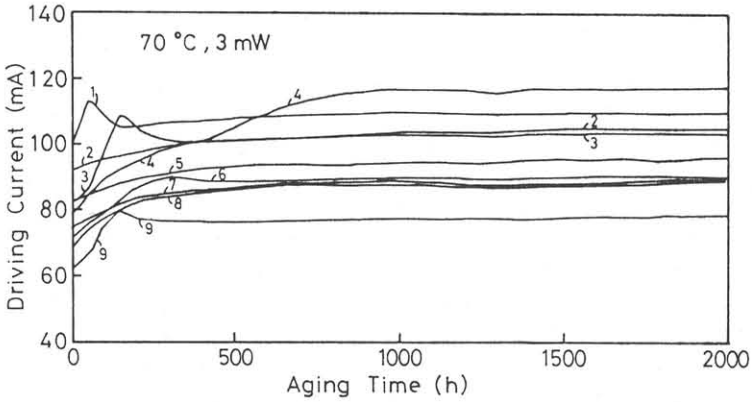

Figure 2

References

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5) K.Mizuishi, H.Hirao, S.Tsuji, H.Sato, and M.Nakamura: to be presented at IOOC '81.