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B-4-3 Buried Multi-Heterostructure (BMH) GaAlAs Laser

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Buried heterostructure lasers are very attractive as light sources for optical communications and high density recording, because low threshold currents and stable transverse modes can be obtained.[1,2] In this paper, we describe investigation on BMH laser, which is favorable to realize symmetrical transverse mode and high output power, and on $Ga_{0.4}Al_{0.6}As$ second LPE regrowth mask, which makes the device process simple and easy.

The BMH laser has the separate confinement heterostructure (s.c.h.) embedded in smaller refractive index media. The s.c.h. is one of the most suitable to obtain a fundamental transverse mode oscillation of large mode size. Figure 1 shows schematic of BMH laser. On the mesa top, the laser has a p-GaAs layer, which contributes to lowering p-side contact resistance. A reverse biased pn junction is formed in $Ga_{0.65}Al_{0.35}As$ burying layer. Due to the current blocking structure and the GaAs cap layer, fairly good current confinement is achieved without any insulating layer or selective Zn-diffusion on the mesa top, reducing the number of device process steps.

As the second LPE growth mask, we used $Ga_{0.4}Al_{0.6}As$ which showed high etching selectivity against $Ga_{0.65}Al_{0.35}As$ burying material using HF as etchant. We preliminarily examined dielectric masks such as SiO_2, SiO_2/Al_2O_3 and Si_3N_4, and found that these materials chemically changed during the regrowth and was difficult to remove as previously reported in the case of SiO_2.[3] The $Ga_{0.4}Al_{0.6}As$ mask has significant advantages over the dielectric masks, because it does not alter the chemical nature and requires no additional processes for mask formation.

Figure 2 shows an example of the cross section of the BMH laser. As shown in the figure, a nearly square shaped cavity of the dimension of 1.5μm is obtained. As a result of this structure, almost the same and fairly narrow beam divergencies between parallel and perpendicular directions are obtained ($\theta_\perp=25°$, $\theta_{/\!/}=21°$ at FWHM see Fig.3).

A light-current characteristic of BMH laser is shown in Fig. 4. Typical threshold currents are less than 15mA for 200μm long cavity. The light-current characteristic is "kink" free until the laser stops lasing by optical damage or by junction temperature raising. Typical optical damage power was over 40mW (without facet coating).

Beam waist data measured by using a microscopic lens NA=0.65, which is larger than the laser beam divergencies, show that the beam parameters of the parallel and perpendicular directions are almost the same (Fig.5). All the above data assure a high coupling efficiency and small spot size when the laser beam of BMH laser is collimated by lens. From this point and the power characteristics, it can be said that the BMH laser is one of the most promising laser for optical recording uses.

References

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3) W.T.Tsang and R.A.Logan : Appl. Phys. Lett. 36(1980)730.

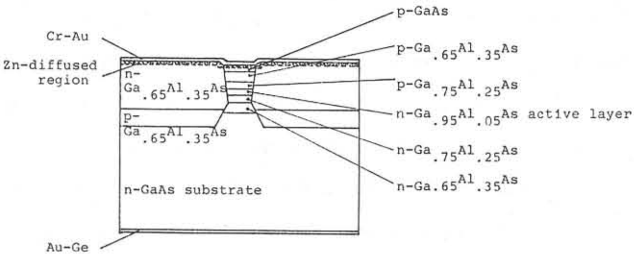

Fig.1 Schematic of the BMH laser.

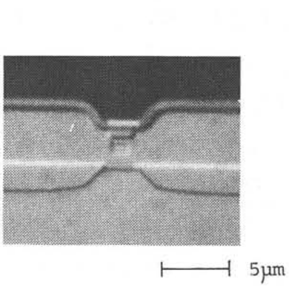

Fig.2 Microphotograph of the cross section of a BMH laser.

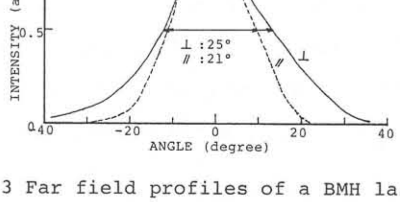

Fig.3 Far field profiles of a BMH laser.

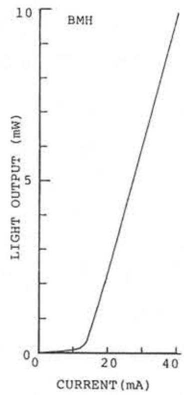

Fig.4 Light-current characterstic.

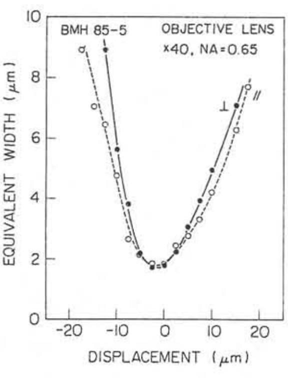

Fig.5 Beam waist measurement data of a BMH laser.