2:45pm - 3:00pm Room 203

DLTA1.4

Modulation Bandwidth Enhancement in Single Quantum Well GaAs Lasers through a Novel Design of Graded Index Separate Confinement Heterostructure

T. R. Chen, B. Zhao,Y. Yamada, Y. H. Zhuang, and A. Yariv
T. J. Watson Sr. Laboratories of Applied Physics, 128-95
California Institute of Technology, Pasadena, CA 91125, USA

The state filling effect has been suggested as a source responsible for the degradation of modulation bandwidth in quantum well lasers compared to the expected value previously calculated [1]. According to this theory, an increase in energy difference between the confined quantized energy state in the well and the energy states in the graded index separate confinement heterostructure (GRINSCH) region will restore the differential gain to a certain extent. A proper tailoring of the GRINSCH region will therefore (increase) improve the speed behavior of the quantum well lasers.

We have designed a GRINSCH in which the Al concentration varied from 0.3 to 0.5 instead of the, often used, 0.2 to 0.5. The added 100 meV (about 4kT) have a major effect on the state filling in the QW lasers [2]. The molecular beam epitaxy technique was used to grow a GRINSCH single quantum well (SQW) GaAs laser structure. A buried heterostructure (BH), as schematically shown in Fig.1, with an active layer stripe width of 4 μm was then accomplished by a liquid phase epitaxy regrowth technique. It has been shown theoretically that the device parameters, such as cavity length and mirror reflectivities, are closely related to the speed performance of QW lasers in terms of the maximum obtainable modulation bandwidth and operation conditions. Thus, we tried to optimize these device parameters to obtain the maximum modulation bandwidth. In Fig.2, we show the modulation response of a BH laser of cavity length 150 μm. The threshold of the laser was 12 mA. A modulation bandwidth in excess of 9 GHz was obtained which, to our knowledge, is the largest bandwidth ever reported in GaAs SQW lasers with uniform current pumping (*i.e.* without introducing any intracavity saturable absorber [3]).

The idea is now extended to other material system, such as strained layer InGaAs SQW and multiple quantum well lasers. The modulation dynamics is under investigation.

Reference

[1] B. Zhao, T. R. Chen, and A. Yariv, *Appl. Phys. Lett.* **60**, 1930 (1992).
[2] B. Zhao, T. R. Chen, Y. Yamada, Y. H. Zhuang, N. Kuze, and A. Yariv, to be published.
[3] K. Y. Lau, and N. Bar-Chaim, *IEEE Photon.Technol. Lett.* **4**, 118 (1992).

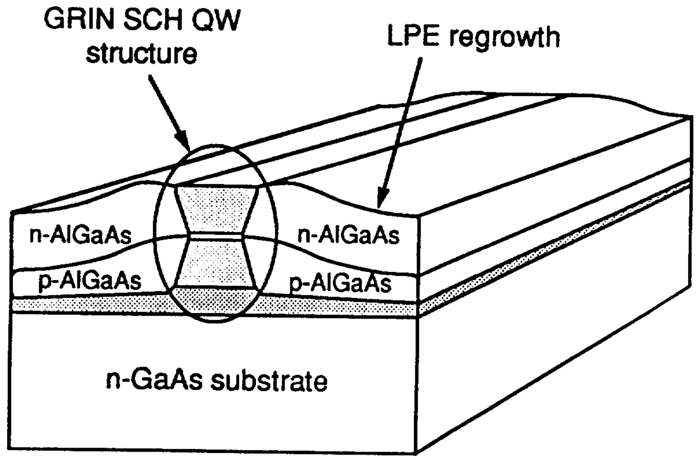

Fig.1. Schematic structure of the GaAs/AlGaAs single quantum well buried heterostructure lasers.

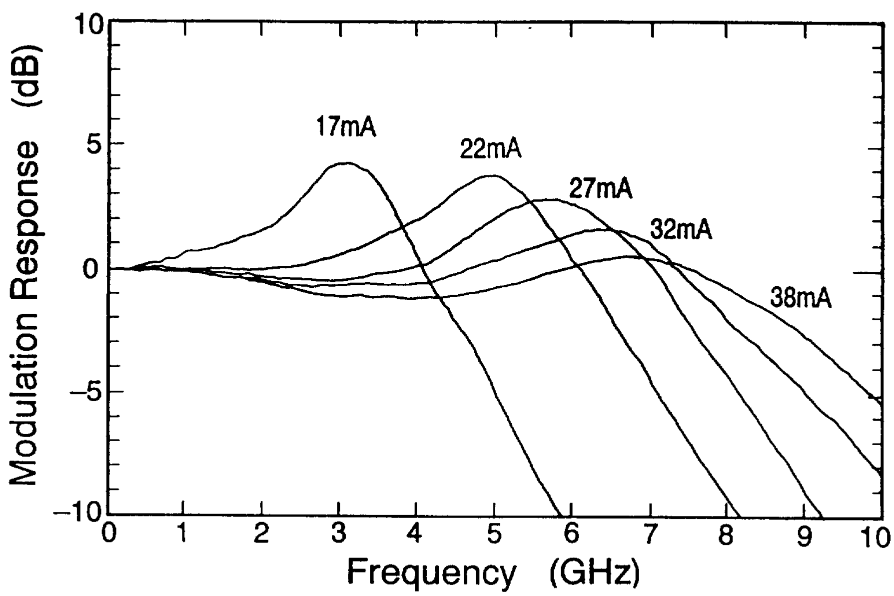

Fig.2. Modulation response of a GaAs/AlGaAs SQW BH laser with a cavity length of 150 μm. I_{th} = 12 mA.