Chirped InAs 양자점을 사용한 고휘도 발광소자

Superluminescent diodes using chirped InAs QD

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I. Introduction

Quantum-dot (QD)-based optical devices are known to have a possibility to provide improved performances superior to those of MQW-based optical devices. Most efforts on the QD-based optical devices have focused on the broad area laser diodes and ridge waveguide laser diodes. One of the main issues for the QD-based LD is to grow QD uniformly in terms of size to obtain enough gain to lase. On the contrary, it should be noted that non-uniform growth of QDs can be of benefit to superluminescent diodes (SLD) requiring wider spectral bandwidth. Recently, two studies on the QD-based SLD have been reported. Heo et al. have been developed QD-based SLDs utilizing 3-stacked InGaAs QDs which are grown by atomic layer epitaxy (ALE) technique [(1)]. Zhang et al also have developed QD-based SLDs utilizing 5-stacked InAs QDs which are grown by Stranski-Krastinov mode [(2)]. It is noted that their QD-based SLD have been developed utilizing same kind of multi layers of QD. In this work, the characteristics of InAs chirped QD SLD is reported.

II.Device Structure

The chirped QD active region consists of three parts. Each part is made of 2 stacks of InAs QD layer, but energy band-gap wavelengths of InAs QD for each part are 1.3 ㎛ (corresponding to band-gap energy of 0.95 eV), 1.25 ㎛ (0.99 eV), and 1.2 ㎛ (1.03 eV). The photoluminescence (PL) spectrum shows wide full width at half maximum of 100 nm (Figure 1). To suppress the laser oscillation of SLD, which is originated from the non-zero facet reflectivity, J-shaped waveguide was adapted. The ridge waveguide is 5 ㎛ wide and 2 ㎛ long with 1 mm straight part and 1 mm bent part.

III.Result and Discussion

The optical power and the 3 dB bandwidth were measured as CW 40 mW and 104 nm at room temperature, respectively (Figures 2 and 3). These characteristics for chirped QD SLD are better than multi-quantum-well based SLD when it comes to optical output power and spectral bandwidth, simultaneously. On the other hand, it is shown that the PL characteristics of the chirped QD structures were directly reflected on the EL characteristics of SLD. This result suggests that the chirped QD structure is strongly promising for the SLD with much wider spectral bandwidth.

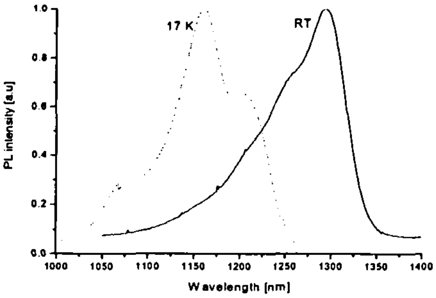

Fig. 1. PL spectra at 17K and RT

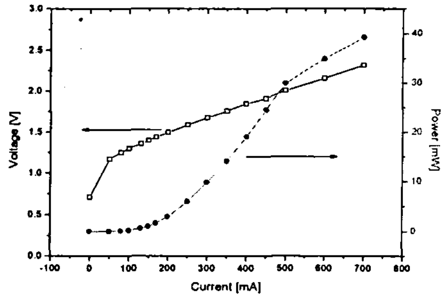

Fig. 2. L-I-V characteristics

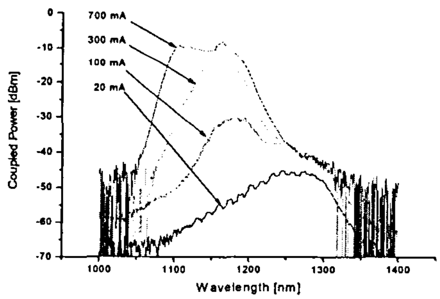

Fig. 3. Emission spectra of the chirped InAs QD SLD

IV. Summary

We have studied on the SLDs utilizing InAs chirped QD structure. The output power and spectral bandwidth are obtained as CW 40 mW at RT and about 100 nm, respectively. More high performance of SLD can be possible with optimized design for the chirped QD structures.

References

[1] D.C. Heo, J.D. Song, W.J. Choi, J.I. Lee, J.C. Jeong and I.K. Han, Electron. Lett. **39**, 863, (2003).

[2] Z.Y. Zhang, Z.G. Wang, B. Xu, P. Jin, Z.Z. Sun and F.Q. Liu, IEEE Photon. Technol. Lett. 16, 27 (2004).