DIFFERENT QW STRUCTURES WITH Bi FOR INFRARED-EMITTING SEMICONDUCTOR LASERS

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Development of semiconductor laser diodes with temperature-insensitive oscillation wavelengths is expected to open up a new era of widespread application in telecommunication network. There have been strong efforts over many years to improve threshold current and temperature stability of commercial 1.3–1.55 μm wavelength InGa(Al)As(P)/InP with quantum well (QW) lasers. In recent years, the promising results were achieved developing the growth technology of GaAsBi quantum structures for optoelectronic applications including lasers. The first successful operation of an electrically injected $GaAs_{0.978}Bi_{0.022}$ single quantum well laser employing $Al_{0.2}Ga_{0.8}As$ barriers deposited by MOCVD was proposed by Ludewig *et al* in 2013, meanwhile electrically driven lasing from GaAsBi MQW diode grown by MBE with 6% of Bi at room temperature was reported by Butkute *et al* in 2014. By incorporating a small amount of Bi in a III–V semiconductor, such as GaAs, a strong bandgap reduction and increased spin–orbit splitting energy, ΔSO, occur, what reduces Auger recombination in IR wavelength range [1].

In this work series of different QWs structures with Bi were epitaxially grown by molecular beam epitaxy (MBE) on semi-insulating GaAs(100) substrates using GaAs buffer under stoichiometric conditions. The surface morphology of the structures was examined using atomic force microscopy. The lattice parameters of GaAsBi and Bi concentration have been evaluated from high resolution X-ray diffraction (XRD) spectra. Optical measurements showed the photoluminescence peak attributed to the GaAsBi QWs in the energy interval from 1 to 1.5 μm depending on different Bi concentration (Fig. 1).

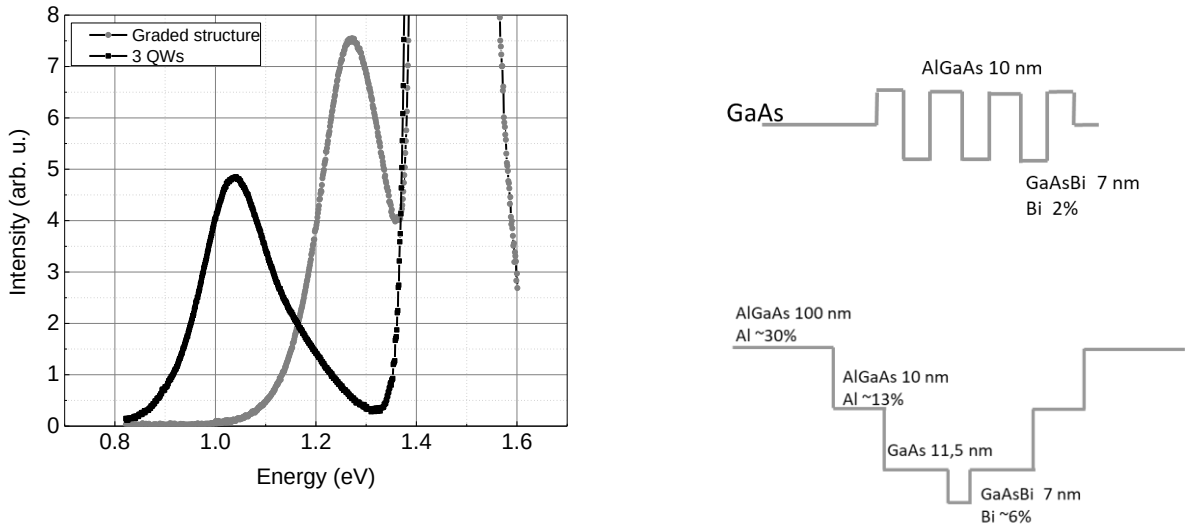

Fig. 1. RT photoluminescence measurements of different QWs structures with the different concentration of Bi. Peaks at 1.05 and 1.26 eV are attributed to 3 QW and graded QW structure, respectively.

After optimization of growth condition, the laser diode structures with a bismide QW in active area were grown on n-GaAs substrate. Laser diodes were fabricated by a UV photolithography. As-cleaved diodes were investigated.

[1] K. Alberi, J. Wu, W. Walukiewicz, K. M. Yu, O. D. Dubon, S. P. Watkins, C. X. Wang, X. Liu, Y.-J. Cho, and J. Furdyna. Valence-band anticrossing in mismatched III-V semiconductor alloys. Phys. Rev. B, 75:045203, Jan 2007