3-4-5

Quantum-wire gain-coupled DFB lasers by constant MOCVD growth

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A study of quantum-wires (QWRs), especially V-groove ones and its device applications, has been intensively carried out with noticeable success in the past decade. However, parasitic quantum-wells (QWLs) simultaneously grown with QWRs often hampered the unique feature of the QWRs, otherwise a lot better via its two-dimensional quantum-confinement effects. As one of the ways to circumvent this problem, the so-called QWR gain-coupled distributed-feedback (GC-DFB) laser has been proposed with anticipation for one-grade up device performance in terms of the GC-DFB effects using a QWR active grating; however, the research on these devices is still taking a footstep of infancy due to the problems such as nonradiative recombination centers at the etching and regrowth interface, structural complexity, etc. So far, only a few reports have been made at low temperatures.

In this work, a challenge was made to have such QWR GC-DFB lasers achieved, importantly, by means of a single MOCVD growth step so that we can eliminate the interface problems and thus increase operating temperature at low threshold current. We came to know during the endeavor to materialize our device structures the initial profile of the substrate grating is as important a factor as growth temperature to preserve the grating profile even after growth of a μm-thick AlGaAs cladding layer. As for device performance, to our knowledge, record-low threshold currents of 13mA and 65mA have been achieved so far at room temperature, for each direction perpendicular (DFB) and parallel (QWR array) to the wire axis. In addition, little trace of the stop band and/or the wavelength consistency in between photoluminescence and lasing spectra increase the possibility of DFB lasing through the QWR gain modulation. A basic device structure and some characteristics are displayed in Fig. 1, and more exciting features including growth behavior on the sub-μm pitch gratings will be shown in the poster session (3-4-5)

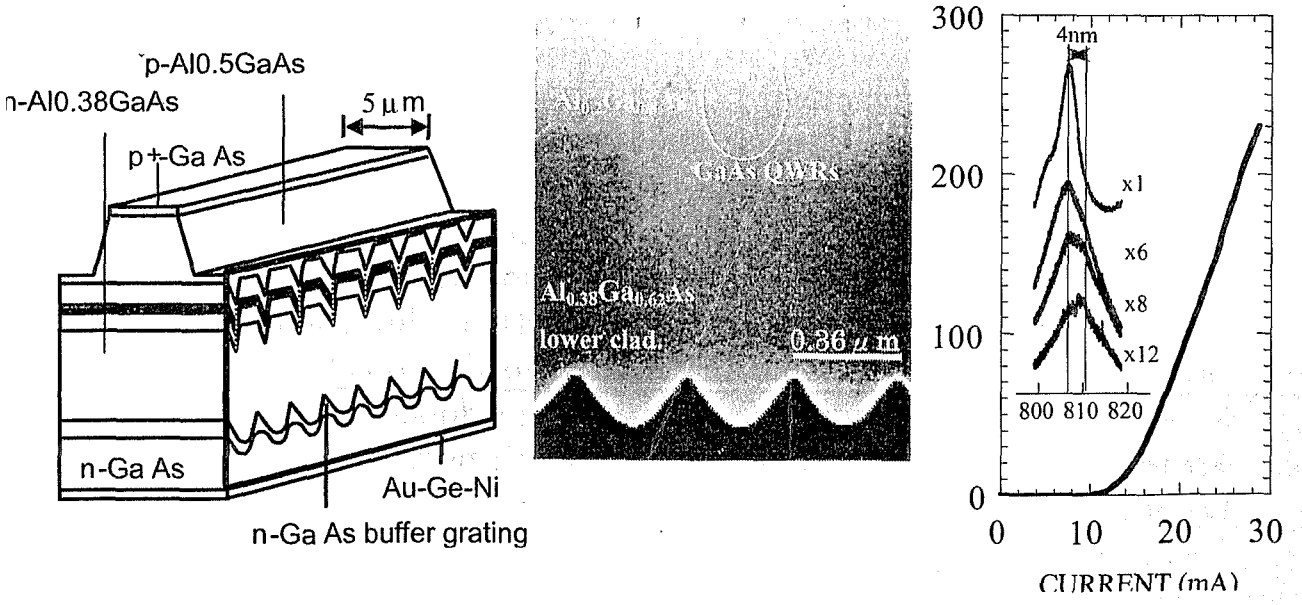

Fig. 1 Laser structures (left) and its optical characteristics (right) in the DFB direction.