Growth and Optical Characterization of ZnO/MgZnO Single- and Multi-Quantum Wells

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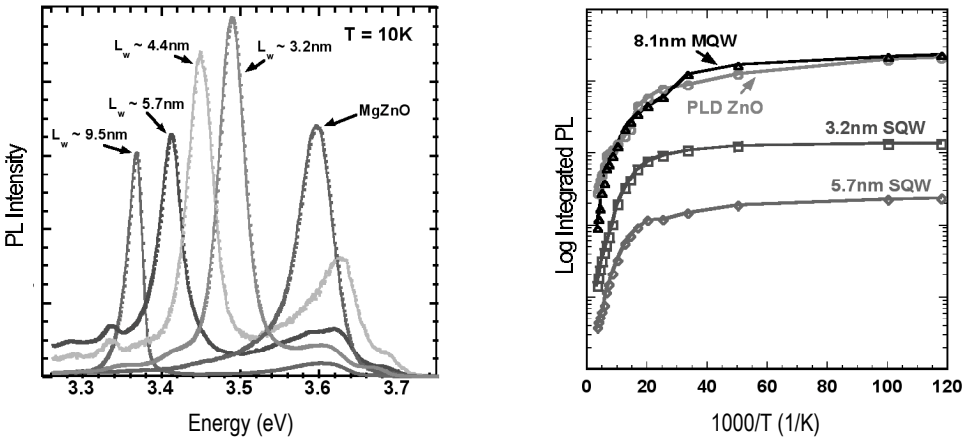

Photoluminescence (PL) spectra of blueshift for ZnO/MgZnO quantum wells with decreasing well thickness and integrated PL intensity for single- and multi-quantum well.

Quantum wells based on the ZnO/MgZnO material system are attractive for short wavelength (UV) optoelectronic and transparent high-speed electronic device applications because of the 2-dimensional density of states, enhanced radiative recombination oscillator strength, and properties of ZnO and related alloy materials. In this work, ZnO/$Mg_xZn_{1-x}O$ (x0.3) quantum wells have been grown on c-plane sapphire substrates by pulsed laser deposition (PLD) using targets of ZnO and 85%/15% ZnO/MgO. Luminescent properties of the ZnO/MgZnO single- (SQW) and multi-quantum well (MQW) structures have been characterized by low-temperature photoluminescence (PL). PL spectra of the SQW structures reveal quantum confinement with a systematic blueshift of the electron-hole subband transition energy as a function of decreasing ZnO well width. Integrated PL intensities as a function of inverse temperature for two ZnO/MgZnO SQWs (L_w of 3.2 and 5.7nm) and a MQW consisting of five periods are compared to the band-edge integrated intensity of a 530nm thin-film layer of ZnO grown by PLD. Increased quantum efficiency is observed with narrower well width (increased quantum confinement) for all temperatures. This project is supported by AFOSR under contract number FA9550-04-1-0390, the Center for Optoelectronic Nanostructured Semiconductor Technologies, a Defense Advanced Research Projects Agency UPR award number HR0011-04-1-0040, and the ONR/HBEC Fellowship Program.