Fabrication and Optical Properties of ZnO/ZnMgO Quantum Structure Nanorods

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One-dimensional nanorod heterostructures with well-defined crystalline interfaces opens up many new device applications, as already proven in thin film semiconductor electronics and photonics. In particular, embedding quantum structures in a single nanorod would enable novel physical properties such as quantum confinement to be exploited, such as the continuous tuning of spectral wavelength by varying the well thickness. However, quantum confinement effects in heterostructure nanowires have not been clearly observed despite recent synthesis of compositionally modulated nanowire superlattices by the vapor–liquid–solid (VLS) growth process. In contrast, nanoscale heterostructures with abrupt interfaces could be successfully fabricated using a non-catalytic growth technique by utilizing direct adsorption of atoms on the top surface of nanorods. In this presentation, we report photoluminescence (PL) properties of ZnO/ ZnMgO multiple quantum well (MQW) nanorods. The well layer thickness investigated in this study was as thin as 1 nm. From the PL spectra of the MQW nanorods, blueshifts of the excitonic emission were clearly observed, depending on the well layer thickness. Meanwhile, the blueshift decreases with increasing well width and is almost negligible for the MQW nanorods with a well layer thickness of 11 nm. The systematic increase in PL emission energy with reducing well width is consistent with the quantum confinement effect as expected from theoretical calculation in 10 periods of one-dimensional square potential wells.