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The optical properties of m-plane ZnO/$Zn_{0.9}Mg_{0.1}O$ multiple quantum wells grown by pulsed laser deposition

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In order to prevent the quantum confined Stark effect (QCSE), the nonpolar ZnO/(Zn,Mg)O multiple quantum well (MQWs) structure are highly demanded. However, there are no paper reports on grown the *m*-ZnO/(Zn,Mg)O QWs on *m*-sapphire substrate. A 5-pairs m-plane ZnO/$Zn_{0.9}Mg_{0.1}O$ MQWs were fabricated on the m-sapphire substrate with m-ZnO buffer layers by pulsed laser deposition. The MQWs have fixed barrier thickness of 55 nm and three different well widths of 4, 8 and 16 nm, respectively. The PL spectra measured at 13K in Fig. 1 show progressively blue shifted two dominant peaks at 3.326 and 3.370 eV for 16-nm QWs, 3.342 and 3.382 eV for 8 nm, and 3.395 and 3.429 eV for 4 nm. They are attributed to BSFs emission[1] and near-band edge (NBE) emission from QWs, respectively. Comparing with bulk ZnO excitonic peak (~3.365 eV), the blue-shifted NBE emission of MQWs even with 16-nm QWs at 3.370 eV reveals the quantum confinement effect with absence of QCSE.

The integrated NBE PL intensities and exciton energies as a function of inverse temperature[2] are plotted in Fig. 2(a) and (b), respectively. The larger exciton binding energy of 63, 67 and 91 meV than the bulk value are obtained for 16, 8 and 4 nm, respectively. In addition, the A_1-LO shows weaker coupling strength with exciton as decreasing the well width that is consistent with our quantum dots results.[2] However, there is an opposite trend of E_2-low phonon mode with decreasing the well width. It should be significantly affected by the spatial phonon confinement and/or interface phonon that reduces the coupling strength with the exciton as reducing the well width to increase in surface effect. In addition, the unshifted PL peaks with the increasing pumping power density in all samples evidences no QCSE due to non-polar quantum structures.

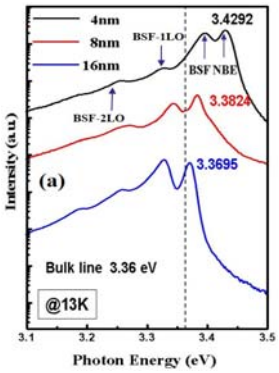

Fig. 1. The PL spectra of various well widths.

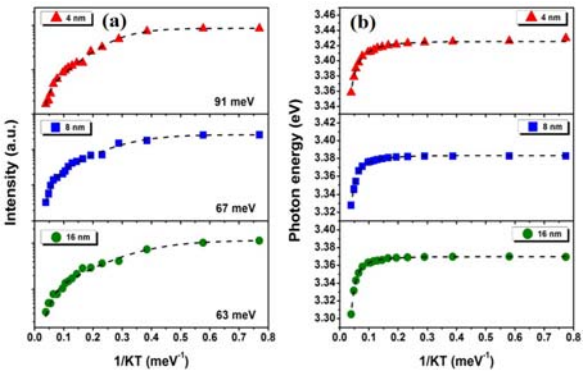

Fig. 2. Integrated NBE intensities (a) and exciton energies (b) as a function of the inverse temperature.

1. M. Schirra, R. Schneider, A. Reiser, G. M. Prinz, M. Feneberg, J. Biskupek, U. Kaiser, C. E. Krill, K. Thonke, and R. Sauer, Phys. Rev. B **77**, 125215 (2008).

2. W. T. Hsu, K. F. Lin, and W. F. Hsieh, Appl. Phys. Lett. **91**,181913 (2007).