Temperature-dependent Photoluminescence of Nonpolar ZnO/ZnMgO Quantum Wells

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Zinc oxide has drawn great attention recently for its possible applications in a short wavelength optoelectronics. ZnO has a wide direct band-gap of 3.37 eV at room temperature, which also can be tuned towards higher energies by alloying it with MgO [1,2]. In this work, we compared nonpolar m- $[10\bar{1}0]$ and a- $[11\bar{2}0]$ ZnO/ZnMgO QWs grown by molecular beam epitaxy on a lattice-matched (100) and (010) $LiGaO_2$ substrates. Temperature dependent (3–300 K) photoluminescence (PL) spectroscopy was used to study optical properties of QW structures with a particular interest in polarized optical response.

Low temperature PL spectra of m-ZnO/ZnMgO QW show three distinct optical features (see Fig. 1 a). High-energy feature spanning the region 3.5–3.42 eV is associated with the excitonic transition from ZnO/ZnMgO QWs. Then a sharp peak at 3.3 eV is related to the near-band emission from ZnO buffer layer. In the low photon energy region, a broad "green" band centred at 2.5 eV is due to the defects. An optical response from a-ZnO/ZnMgO QW merges with a PL from ZnO epilayer (see Fig. 1 b). It was found that the relative intensity of established features varies with excitation power density due to the saturation of defects for both QW structures. Furthermore, a significant in-plane optical anisotropy was found for both nonpolar QWs and is discussed in detail.

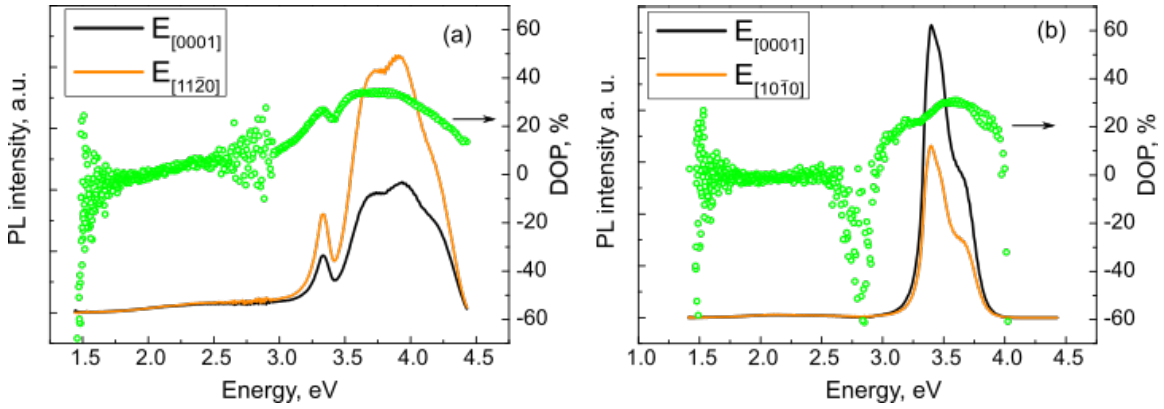

Figure 1: Polarized PL emission and degree of polarization (DOP) of (a) m-ZnO/ZnMgO QW and (b) a-ZnO/ZnMgO QW.

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