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Carrier dynamics in ZnO/ZnMgO multiple quantum well structures with different well widths grown on ZnO substrates

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ZnO-based semiconductor and quantum structures have recently attracted much attention due to their potential applications, such as lighting emitting devices owing to their large binding energy of excitons. However, localization, relaxation, and recombination mechanisms of exitons in these ZnO-based multiple quantum well (MQW) structures are not fully understand. In this work, we report on temperature dependence of excitonic transitions in $ZnO/Zn_{0.9}Mg_{0.1}O$ MQW structures grown on ZnO substrates. Two kinds of MQWs having different well thicknesses grown by molecular-beam epitaxy showed significantly different temperature dependences of photoluminescence (PL) spectra. For the MQWs with a well thickness of 2 nm, the peak energy at 50-200 K was a monotonically increasing function of temperature, and the PL spectra taken at 90-200 K showed two emission peaks. The temperature-induced shift at 10-300 K can be explained by the inhomogeneity and the exciton localization effect. On the other hand, the temperature dependence of PL in the MQWs with a well thickness of 5 nm was similar to that typically observed in bulk II-VI semiconductors, that is, PL peak energy was redshifted due to bandgap shrinkage with increasing temperature. Carrier dynamics related to these phenomena in ZnO/ZnMgO MQW structures will be discussed.