Investigation of optical properties of double asymmetric ZnMgO/ZnO/ZnMgO quantum wells grown by PA-MBE

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Zinc oxide as a semiconductor material possesses a range of properties, such as direct band gap of 3,37 eV, the high exciton binding energy of 60 meV in bulk ZnO and up to 100 meV in ZnMgO/ZnO/ZnMgO quantum wells that make it a very good candidate for applications in UV optoelectronics. Coupled double quantum well (CDQW) structures, where the two wells are separated by a narrow barrier, involve both fundamental physical properties and the importance for different devices such as tunable light sources or quantum cascade lasers. In this work we report the investigation of coupling in asymmetric ZnO/ZnMgO CDQWs structures grown by molecular beam epitaxy. As the Bohr radius of exciton in ZnO is ~2 nm the precise control of the ZnMgO barrier thickness is a very important and challenging issue. The results of luminescence studies of ZnMgO/ZnO CDQWs quantum structures containing asymmetric double QWs in order to find dependency of optical properties of such structures on width of ZnMgO barrier between QWs and possibly confirm the existence of coupling between QWs when such barrier is thin enough.

All samples were grown by plasma assisted molecular beam epitaxy on *a*-plane sapphire substrates. The magnesium content in ZnMgO barriers was kept constant in all structure and depending on sample it ranges from about 10% to 20%. As for quantum wells the width of thinner one in every structure was 3 nm while the thicker ones had width of 5 nm or 9 nm and the barrier between them varied from 2 nm to 25 nm.

In order to investigate the aforementioned properties measurements of time-integrated and time resolved photoluminescence spectroscopy were performed, allowing us to analyze differences in PL spectra as well as in PL time decay for samples with thick ZnMgO barrier (where we can be sure coupling does not take place) and the thin barrier (when we suspect the existence of this phenomenon). We found that the major effect of coupling between the wells is reduction of the PL from the narrow well and shortening of the decay time of excitonic emission. The result is interpreted in terms of tunneling of charge carrier trough the narrow ZnMgO barrier.

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