Excitonic Properties of Asymmetric Triple CdSe Quantum Wells

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Asymmetric triple quantum wells (ATQWs) present interesting optical properties that can be modulated as a function of the separating barriers thicknesses. The number of excitonic transitions and their energies will depend on the degree of overlap of the exciton wave functions in the quantum wells. If the barriers are thick enough, we will observe three fundamental optical transitions, one for each (single) QW. If the barriers are very thin, which allow strong quantum well coupling, the ATQW will present only one fundamental transition because the three QWs constitute a *single quantum system*. ATQWs with barrier thicknesses within those extremes can present two or three emission peaks with energies and intensities depending on the thickness of each separating barrier. A previous study on asymmetric double ultra-thin quantum wells of CdSe within ZnSe barriers demonstrated that the thinner QWs required several tens of nm to decouple the QWs and that ZnSe barriers of around 5 nm caused a strong coupling of the ultra-thin CdSe QWs [1].

Here, we present the results of the epitaxial growth and the low temperature photoluminescence characterization of the excitonic emission of three different ATQW heterostructures, two made with thin ZnSe barriers of 5 nm that produce strong coupling, and one heterostructure with thick 100 nm ZnSe barriers. Each heterostructure contains three CdSe QWs, with thicknesses of 1, 2 and 3 MLs. In the coupled heterostructures the QWs were grown in two sequences 1-2-3 and 3-2-1; the uncoupled heterostructure was grown with the sequence 3-2-1; the first QW is always closer to the GaAs(001) substrate. The QWs were grown by atomic layer epitaxy within ZnSe barriers grown by molecular beam epitaxy, all samples were grown at 275 °C. For the coupled ATQW heterostructures we observed only one optical transition around 2.34 eV, for the uncoupled ATQW we observed three excitonic peaks around 2.32, 2.48 and 2.67 eV, as expected. The electronic structure of each ATQW system as well as the peculiarities of their excitonic spectra will be explained in terms of the structural properties of the heterostructures and the degree of coupling of the QWs.

[1] J. A. Lorenzo-Andrade, F. Sutara, I. Hernández-Calderón, Superlattices and Microstructures 87, **47** (2015).
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