Photoluminescence Characterization of a 1 ML CdSe Fully-Strained Ultra-Thin Quantum Well with Very Thin ZnSe barriers

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In fully strained CdSe/ZnSe ultra-thin quantum wells (UTQWs) grown on GaAs (001) substrates, both ZnSe and CdSe are under biaxial compressive stress. The critical thickness under these strains is around 90 nm for ZnSe and around 3.5 monolayers (1.2 nm) for CdSe. The physical properties of the 1 ML CdSe UTQW still deserve a detailed explanation and interpretation regarding its high excitonic emission intensity, full width at half maximum (FWHM) and peak energy [1]. Here, we present a study of a nominal 1 ML CdSe UTQW grown by atomic layer epitaxy at 275 °C within a ZnSe barriers of 20 nm and 25 nm (cap layer). The thickness of each layer and the total thickness of the heterostructure are chosen in such a way that each material is below its critical thickness. The 19 K photoluminescence spectrum presents an intense excitonic peak at 2.685 eV with a FWHM of 12.3 meV, which is lower than previous results of CdSe UTQWs grown on relaxed ZnSe barriers [2]. The evolution of the excitonic peak as a function of temperature suggests the absence of QW potential fluctuations, which in this case would correspond to composition fluctuations or to the formation of quantum islands. Since the actual CdSe coverage depends on growth temperature, the coverage of the studied structure is expected to be slightly lower than 1 ML. The results will be discussed and explained in terms of two different descriptions: a 1 ML $Zn_{1-x}Cd_xSe$ UTQW with very low Zn content, and large area 1 ML thick CdSe islands.

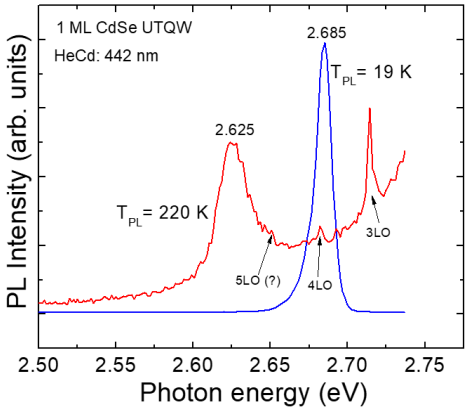

Figure. 1 Photoluminescence spectra at 19 and 220 K of the nominal 1 ML CdSe UTQW grown at 275 °C. ZnSe LO phonons at 220 K are indicated with arrows.

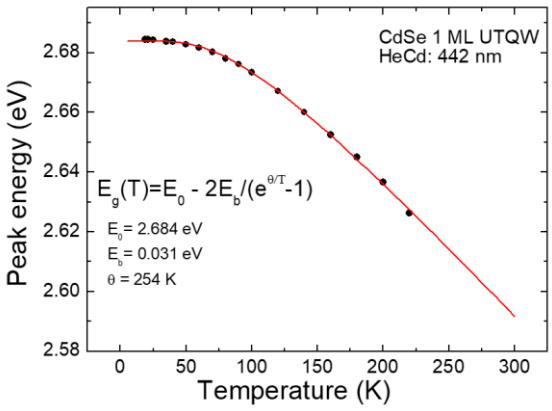

Fig. 2 Evolution of the energy of the excitonic peak with temperature (black dots) and their fitting (red line).

[1] See, for example, T. V. Shubina, G. Pozina, A. A. Toropov, Phys. Status Solidi B254, 1600414 (2017).
[2] I. Hernández-Calderón, AIP Conf. Proc. 809, 343 (2006).

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