

# Strain Compensation in ZnSe/CdSe Quantum Wells: Analytical Model and Experimental Evidence

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Optically active devices based on ZnSe/CdSe heterostructures are in principle capable to provide light emission over the whole visible spectrum via a variation of the dimensions. However, the lattice mismatch between ZnSe and CdSe of about 7 % limits the thickness of coherently grown CdSe layers on ZnSe to  $\sim 2$  monolayers (MLs). Between 2 and 3 MLs CdSe, Stranski-Krastanov quantum dots develop and afterwards plastic relaxation takes place for CdSe thicknesses exceeding 3 MLs. This leads to quenching of the emission via dominant non-radiative recombination in the devices [1]. In a recent publication, we observed efficient light emission from ZnSe/CdSe/ZnSe quantum well (QW) structures with CdSe thicknesses up to 6 MLs [2]. The latter was achieved with a dedicated strain compensation technique involving  $\text{In}_{0.12}\text{Ga}_{0.88}\text{As}$  pseudo-substrates that induce alternately strained ZnSe and CdSe layers. Due to the alternating strain in the ZnSe and CdSe, the strain of the entire ZnSe/CdSe/ZnSe stack is compensated with respect to the  $\text{In}_{0.12}\text{Ga}_{0.88}\text{As}$  buffer.

Here, we present a study of the strain compensation by transmission electron microscopy (TEM) and compare experimentally determined strain profiles to simulated ones [3]. Moreover, we demonstrate that ZnSe/CdSe/ZnSe QWs with CdSe thicknesses up to 5 MLs grow fully coherent due to the dedicated strain compensation technique. Finally, we introduce a simple model approach to tailor a variable sample structure towards efficient strain compensation. This model approximation is sufficiently general and valid to be applied to other highly mismatched epitaxial systems and paves the way for novel designs of advanced strain compensated heterostructures.

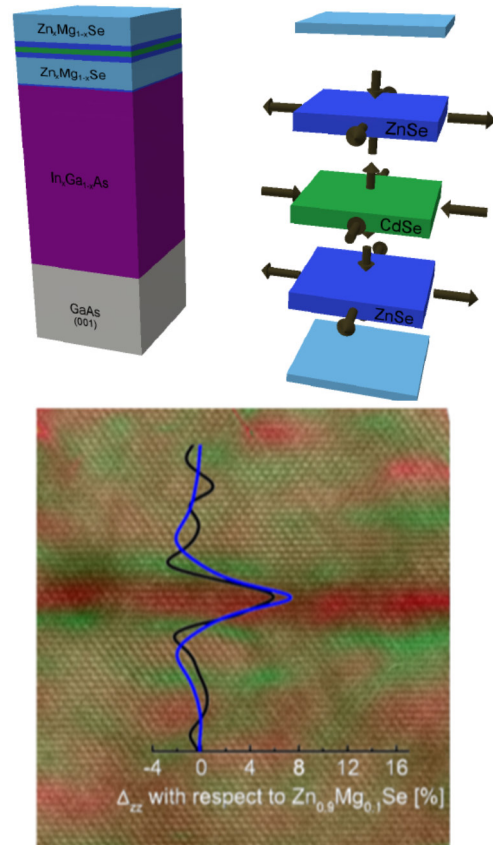


Fig. 1: Upper part: Sample structure and layer sequence of a typical ZnSe/CdSe/ZnSe strain compensated QW. Lower part: TEM image of the CdSe QW region with superimposed strain distribution along the growth direction.

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