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Imaging of CdSe-ZnSe Quantum Wells as a Function of Electron Dose and Accelerating Voltage

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Low dose imaging and the use of low accelerating voltage are effective techniques to reduce beam sample interaction in transmission electron microscopy. In some sensitive materials, especially those with mostly light elements, beam interaction produces a well-known decay of the sample during observation. Semiconductors are very sensitive to the beam and some of them develop planar and linear defects as wells as clear signs of knock on damage at accelerating voltages above 200 KeV. Normally the sample is heavily damaged after only a short time under the beam (minutes). This complicates acquisition of data for procedures such as exit wave reconstruction. Experiments with graphene show that low dose imaging can be used to reduce beam interaction with the sample and thus this investigation has been undertaken by using high dose and low dose conditions at 80 and 50 KeV to characterize quantum wells in the system CdSe-ZnSe. The samples have been prepared by atomic layer epitaxy on semi-insulating GaAs(001) substrates. These QWs are of interest for the fabrication of light emitting devices. CdSe and ZnSe have similar crystalline structures (fcc, zinc blende) but the strong lattice mismatch leads to strained interfaces when the QW is sufficiently thin (1 to 3 ML) and generation of defects above 4 ML of thickness. Thus the knowledge of their true structure and composition is of prime importance. The main result in this investigation is to reach atomic resolution under low dose and low voltage conditions without altering visibly the sensitive sample. Quantum wells are imaged under low dose conditions (around 100 e/A2s) at 50 and 80 KeV after exit wave reconstruction.