Abstract

Due to the strong coupling interaction between photon and exciton in semiconductor microcavities, two new quantum mechanical eigenstates, so-called polariton states, are manifested. Polariton states show an “anti-crossing” behavior of the coupled polariton dispersion with a minimum energy difference, the Rabi-splitting energy Ω_{Rabi}, which is observed in the resonance between photon and exciton.

In this thesis, I report on the investigation of strong coupling between photonic and excitonic modes in ZnSe/(Zn,Cd)Se multi quantum well microcavities. The results of the optimization of crystallographic and optical properties of the ZnSe/(Zn,Cd)Se quantum structure as well as the implementation of a cavity length gradient are discussed in detail. The active layer is covered with polycrystalline dielectric Bragg-mirrors of ZnS/YF_3 or ZnSe/YF_3 and a high reflectivity (R>0.995) in the blue and green spectral range is achieved.

A large room temperature Rabi-splitting energy of Ω_{Rabi}>35 meV has been measured in microcavities containing four ZnSe/(Zn,Cd)Se quantum wells as active layers. The “anti-crossing” behavior of the polariton modes has been demonstrated by reflectivity as well as photoluminescence investigations.

Therefore two different methods of microcavity resonance tuning have been performed. In reflectivity measurements the photonic mode has been tuned in resonance with the excitonic mode by varying the spot position on the sample in direction of the microcavity length gradient. In temperature dependent photoluminescence measurements, the polariton dispersion is obtained by modifying the resonance via the temperature shift of the quantum well transition energy.