Tailoring light-matter coupling in ZnSe-based samples by different designs

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Abstract

Cavity-exciton polaritons have attracted much interest because these light-matter quasiparticles are very promising for various optoelectronic applications. Bragg-polaritons and Tamm-plasmons (TPs) have been discussed as new tools for tailoring light-matter interactions. Bragg-polariton structures can be created by incorporating quantum wells (QWs) periodically into a distributed Bragg reflector (DBR). The advantage of this sample type is the high number of QWs which can be embedded into the sample in order to increase the Rabi-splitting energy. TPs can be formed at the interface between a metallic layer and a DBR. This concept enables a specific spectral variation of the cavity resonance allowing for the manipulation of the light-matter interaction.

We will report on the optical properties of Bragg-polariton samples and the influence of TPs on the properties of ZnSe-based microcavities (MCs). For the Bragg-polaritons three ZnSe QWs are embedded into the high-index material of each DBR pair. For the TPs Ag layers with different thicknesses were deposited on the MCs. Microreflectivity measurements were performed and the findings are compared to a theoretical model. When the energy position of the Bragg-mode and the exciton was tuned relative to each other an anticrossing of the Bragg-polariton branches was observed. The energy splitting between the branches reaches values of up to 60meV at T=150K. The deduced splitting energy is considerably larger than the Rabi-splitting energy of 19meV found in comparable MC samples. When depositing an Ag film on MCs with different designs a blue shift of the cavity resonance relative to the metal-free areas in dependence on the metal layer thickness can be achieved, due to the influence of TPs. These results, showing strong coupling in Bragg-polariton samples and the specific manipulation of the cavity resonance by TPs, are promising with respect to the realization of electrically tunable polariton-based devices operating near room temperature.

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