ZnTe-based microcavity with 8 CdSe/MgSe quantum wells

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The strong coupling of the exciton and photon leads to the formation of mixed light-matter quasiparticle called exciton-polariton. This effect is particularly strong in structures with an optical microcavity confining photons and quantum wells confining excitons. The semiconductor microcavity can be formed as a space between two Distributed Bragg Reflectors (DBRs) composed of multiple layers of alternating materials with different refractive indices. Quantum wells can be introduced inside the spacer layer of the cavity, ensuring that the photon mode is close to the resonance energy of the excitons.

We present II-VI semiconductor structure grown by molecular beam epitaxy with CdSe multiple quantum wells. The sample is grown on 3" GaAs substrate followed by a sequence of GaAs, ZnSe and ZnTe buffers. DBRs are made of ZnTe (high refractive index layer) and short period superlattice ZnTe/MgTe/MgSe/MgTe (low refractive index layer). The superlattice is similar to reported in [1] (ZnTe/MgSe/ZnTe/MgTe), but here reaction of Zn with Se is avoided due to a different sequence of interfaces. There are 13 Bragg pairs on the top and 16 on the bottom with a refractive index contrast Δn ≈ 0.67. The structure contains 8 CdSe quantum wells (each close to 20 nm thick) in MgSe barriers placed at the anti-node of the $\lambda/2$ microcavity. Relatively high number of QWs was designed to enhance photon-exciton coupling and to improve parameters such as lasing threshold. In order to provide a wide range of microcavity mode spectral tuning (between 600 and 750 nm), the sample was not rotatad during the growth, creating a gradient of layers thickness. This allowed the tuning of the cavity mode through a change of position on the sample surface and, in pariticular, selecting the mode energy corresponding to the emission from quantum wells ($\lambda \approx 700$ nm).

The strong coupling is confirmed by observation of two polariton branches, appearing in reflectance spectra. From the PL and reflectivity spectra, we determine the linewidth of the exciton and cavity mode as: $FWHM_{exciton} \approx 3.6$ meV and $FWHM_{cavity\,mode} \approx 3$ meV. Linewidth of the cavity mode reveals microcavity Q factor about 500 at 7 K. We note in angle-resolved reflection measurments large value of Rabi splitting, estimated at 18 meV. Nonlinear behaviour in emission from a bottom of lower polariton branch with threshold about 1 mW is observed. The above features suggest that the observed effect meets characteristics of a polariton lasing.

[1] W. Pacuski, at al., *Appl. Phys. Lett.* **94**, 191108 (2009).