Magnetic field pecularities of three distinct excitation regimes of a quantum-well microcavity

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In this work we investigate three distinct working regimes of a GaAs multi-quantum well microcavity by exploiting an external magnetic field applied in Faraday configuration. By exciting the sample off-resonantly, we investigate uncondensed exciton-polaritons, the polariton-condensate and cavity mediated photon-lasing at high excitation densities.

We study the Zeeman splitting and the diamagnetic shift of the exciton-polaritons and fundamental resonances of the microresonator. In the uncondensed case we measured both quantities for a wide detuning range from about δ=-10 meV to δ=+3 meV. We observe a clear dependence of the Zeeman splitting and the diamagnetic shift on the excitonic fraction $|X(\delta,B)|^2$ (the excitonic Hopfield coefficient), in agreement with previous works [1]. For the other two working regimes of the microcavity, we chose a detuning of δ=-6.5 meV for which we can observe polariton condensation and photonic lasing on the same sample position. Fig. 1 depicts the mode-splitting for the three different regimes at $P=0.1P_{th}$ (a), $P=1.6P_{th}$ (b) and $P\approx20P_{th}$ (c) for magnetic fields up to B=5T. Below the polariton-condensation threshold P_{th}, the Zeeman splitting increases linearly with the magnetic field and results in a splitting of ΔE=23μeV at B=5T. In the condensate case we observe strong indications of the "spin-Meissner"-effect [2,3,4] and an unexpected sign reversal of the Zeeman splitting (ΔE(5T)= -146μeV). At high excitation powers above the Mott density of excitons in the quantum-wells, both the Zeeman splitting and the diamagnetic shift are completely absent (Fig. 1 (c)).

We believe that this characterization method can be used to clearly and unambiguously distinguish between polaritons in the linear regime, polariton condensates and photonic lasers.

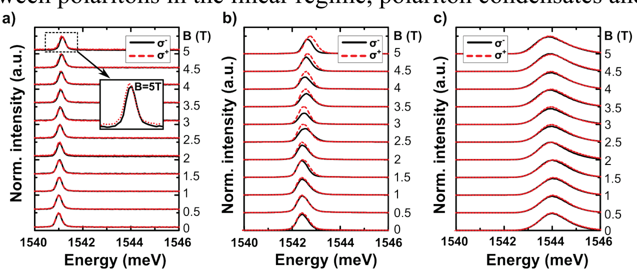

Fig. 1: Polarization resolved measurements of the ground state emission for (a) P=0.1Pth, (b) P=1.6Pth and (c) P≈20Pth. The black line indicates the σ^-- and the red dashed line the σ^+-component. In the photonic regime (c) the emission is not affected by the magnetic field.

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