Magnetic field induced polaritons Bose condensation in microcavities

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Abstract: Polarized photoluminescence (PL) has been studied in microcavities with pillars as a function of the excitation intensity and external magnetic fields. Quality factor of the microcavity reached 20000, which allows to realize the strong exciton - photon coupling regime.

If the excitation intensity exceeds a certain threshold, a set of narrow intense peaks appears in the emission spectrum. The halfwidth of these peaks was less than 0.5 meV. These peaks are connected with the lateral quantization of the exciton polaritons in nonlinear regime, which corresponds to the polariton lasing (when generation occurs at the lower polariton branch). It was found that the excitation intensity threshold for the polariton laser could be reduced by the order of magnitude by applying external magnetic fields.

At higher excitation intensity transition to the photon lasing (when generation occurs at the upper polariton branch) was found to appear at a fixed magnetic field. This transition has demonstrated a threshold character. In magnetic fields the threshold for photon laser decreased. To describe the relationships a theoretical model was developed taking into account the influence of the magnetic field on the resonant frequency, the diffusion of carriers and excitons and the exciton oscillator strength.

For fixed excitation intensity, we have found a magnetic field induced transition from polariton lasing (when generation takes place on the upper branch) to photon lasing. This transition appears as a phase transition. The magnetic field, in which this sharp transition occurs, increases by the excitation intensity increase.

At small detuning between the photon and exciton modes it has been found that magnetic field leads to an abrupt change of the Zeeman sublevels populations. A the same time the chemical potential of the exciton system tends to zero, reflecting the phenomenon of the Bose condensation of excitons on the low Zeeman sublevel.