Condensation of semimagnetic exciton-polaritons in localised potential minima in magnetic field

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Over the last years exciton-polaritons are attracting significant attention. Many effects like Bose-Einstein condensation [1] and polariton lasing [2] were observed. However, the investigation on the effect of magnetic field on exciton-polariton coherent phenomena is still at early stage, even though many interesting phenomena such as the Meisner [3] or magnetopolaron [4] effects are predicted.

In our work we focused on magnetic field dependence of exciton-polariton condensate in semimagnetic semiconductor microcavity. Our structure contains four quantum wells (QWs) with 1% of manganese, placed between two Distributed Bragg Reflectors [5, 6]. Excitons confined inside QWs couple to the photonic mode giving rise to two eigenstates called upper and lower exciton-polaritons. Incorporation of manganese in QWs leads to the increased magnetic effects due to the s,p-d exchange interaction between localised electrons of d^5 shell of Mn^{2+} and band electrons. By using a confocal microscope with built in magnet up to 9 T we scanned a large area of a sample surface and detected angularly resolved photoluminescence and reflectivity spectra for different positions on the sample.

The emission maps below and above the condensation threshold in magnetic field are illustrated in the Figure. For small pumping power and low magnetic field we observe incoherent emission distributed over a large area. This map allows to track the potential distribution for polaritons due to the photonic disorder. By increasing the excitation power and/or magnetic field we observe a condensation of exciton-polaritons into potential minima. Above the threshold the condensate gets further localised and we observe the emission from localised spots, multicomponent in energy. In our work we demonstrate the spectral and spatial distributions of exciton-polaritons and we examine the polarisation of emitted light, very sensitive to magnetic field due to semimagnetic semiconductor structure.

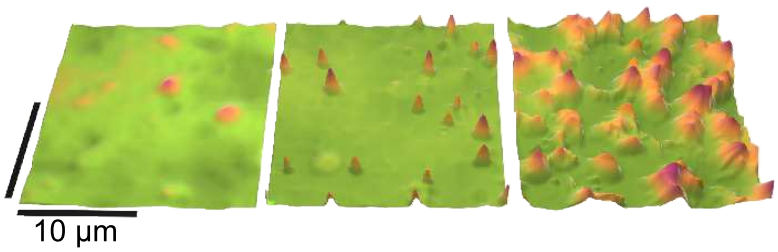

Figure: Emission maps (energy integrated) of exciton-polaritons in magnetic field of 8 T below condensation threshold (left panel), at the threshold (center) and above the threshold (right).

[1] J. Kasprzak et al. Nature 443, 409 (2006). [2] R. Balili et al., Science 316, 1007 (2007). [3] Y. G. Rubo, et al., Phys. Lett. A 358, 227 (2006). [4] I. A. Shelykh et al., Phys. Rev. B 80, 201306Í (2009) [5] J.-G. Rousset et al., J. Cryst. Growth 378, 266 (2013). [6] J.-G. Rousset et al., Appl. Phys. Lett. 107, 201109 (2015).