Polariton lasing of semimagnetic exciton-polaritons.

K. Lekenta, R. Mirek, M. Król, J.-G. Rousset, M. Nawrocki,
W. Pacuski, J. Szczytko and B. Piętka

Institute of Experimental Physics, Faculty of Physics, University of Warsaw, Poland

The past decade has encounter extremely fast development in the studies on quantum phenomena in a semiconductor microcavity field. The works devoted to the interaction between light and matter show that as a result of strong coupling between a photonic and an excitonic ground state, two new states arise: upper and lower exciton-polaritons. Studies include the area of nonlinear interactions as Bose-Einstein condensation [1], polariton lasing [2] or superfluidity [3].

In our work we investigate polariton lasing in a semimagnetic semiconductor microcavity. Our microcavity sample consist of two Bragg mirrors consisting of alternating (Cd,Zn,Mg)Te layers with various magnesium concentration embedding a cavity with four quantum wells containing 1% of manganese [4,5]. We modified a confocal optical microscopy setup to detect angularly resolved photoluminescence spectra. Sample was pumped nonresonantly with a fs laser pulses. The II-VI semiconductor structures suffer from photonic disorder, more pronounced than in III-V semiconductors. However in the confocal microscopy setup we have the ability to a precise positioning of the excitation spot on the sample surface and we could determine the places with homogenous (over tens of μm) potential distribution.

We observe different effects depending on excitation power (Figure). Starting from low power we could observe accumulation of polaritons at the bottleneck at lower polariton branch. For higher excitation power the population at the bottleneck decreases and the polaritons accumulate at the bottom of lower polariton branch, where the intensity starts to dominate over the intensity at the bottleneck. Above threshold we observe polariton lasing, what turn on to the nonlinear interaction regime. The energy shift due to polariton - polariton interactions is clearly visible. In our work we demonstrate a detailed study of the threshold of polariton lasing in semimagnetic semiconductor microcavity for large excitation spots and in a localised minima, where the non-linear effects are much stronger.

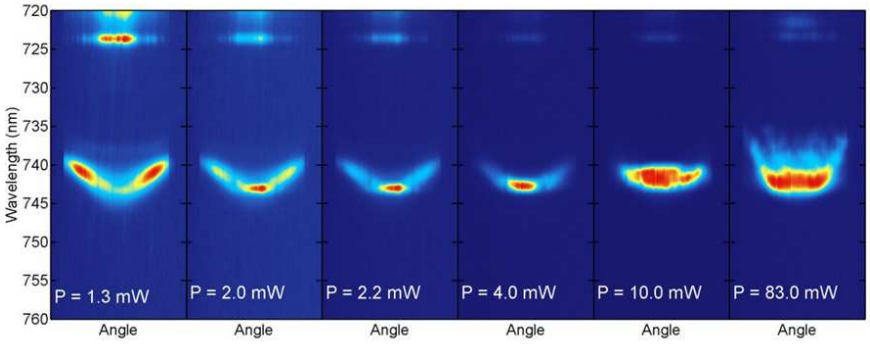

Figure: Angularly resolved photoluminescence maps of semimagnetic exciton-polariton lasing as a function of power excitation in a homogenous photonic potential distribution.

[1] J. Kasprzak et al. *Nature* **443**, 409 (2006). [2] R. Balili et al., *Science* **316**, 1007 (2007). [3] A. Amo et al. *Nature Phys.* **5**, 805 (2009) [4] J.-G. Rousset et al., J. Cryst. Growth 378, 266 (2013). [5] J.-G. Rousset et al., Appl. Phys. Lett. 107, 201109 (2015).