Effect of Magnetic Field on the Condensation Threshold of Semimagnetic Cavity Polaritons

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In the last years, there has been a growing interest for the magneto-optical and spin polarization properties of cavity polaritons and their Bose-Einstein condensates. Theoretical and experimental investigations, conducted mainly on III-V based microcavity structures, have evidenced, among others, the suppression in magnetic field of superfluidity and the quenching of the Zeeman effect for polariton Bose-Einstein condensates [1, 2]. More recently, the condensation of polaritons triggered by magnetic field and the phase transition between polariton lasing and photon lasing in magnetic field have been investigated and interpreted in the frame of the shrinkage of the exciton wave function in magnetic field, the diamagnetic shift and the influence of magnetic field on free carriers and excitons diffusion [3]. In contrast, we have designed a II-VI based microcavity structure embedding semimagnetic quantum wells containing Mn ions in order to enhance the magneto optical effects on cavity polaritons [4, 5]. In such a structure, the exchange interaction between the *d*-shell electrons of Mn ions and the *s*-shell electrons and *p*-shell holes results in the giant Zeeman splitting of semimagnetic cavity polaritons [6]. Interestingly, in our structure and for magnetic fields up to 10T, the diamagnetic shift is negligible compared to the Zeeman splitting.

Starting from the magnetic field triggered condensation of semimagnetic polaritons, in this work, we study the magnetic field dependence of the polaritons condensation threshold power for various zero magnetic field exciton-photon detunings. We evidence that the threshold power reaches a minimum for a magnetic field of a few teslas. Consequently, we show the possibility of switching on and off the polariton condensation by increasing the magnetic field under fixed excitation power. The analysis of our experimental results in the light of studies conducted on nonmagnetic cavity polaritons [7, 8] allows us to identify that the main mechanism underlying the decrease of the condensation threshold power in magnetic field is the decrease by a factor of two of the accessible states at the bottom of the lower polariton branch, making it easier for the stimulated scattering to set on. This mechanism is modulated by intrinsic limitations originating from detuning induced changes of the lower polariton branch: less efficient polariton-polariton scattering when the detuning decreases from zero, and increase of the number of accessible states at the bottom of the lower polariton branch when the detuning increases from zero.

These results underline the specificity of semimagnetic cavity polariton condensates and constitute a step towards deeper investigation of spinor Bose-Einstein condensates.

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