Photoluminescence Dynamics of CdSe Quantum Dot with Single Mn^{2+} Ion Under Modulated Excitation

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Selenide based quantum dots (QDs) with single Mn^{2+} ions are one of the two new solotronic systems discovered recently [1]. They are an example of dots in which exciton energy is larger than intra-ionic transition, which was considered to quench the exciton luminescence. However, it was shown that such a quenching is negligible for the case of single dopants. This opens the possibility of optical studies of a wide range of new systems on which ion-carriers interaction can be examined. In this work we investigate one of such systems - a CdSe QD with a single manganese ion. We present results of photoluminescence (PL) measurements with modulated excitation. We observe that after switching the illumination on two processes occur: spin depolarization of Mn^{2+} ion and modification of an average charge state of the QD. We investigate both of them.

The sample containing self-assambled CdSe QDs was grown by molecular beam epitaxy. During the growth a low amount of manganese ions was introduced, so that selection of dots containing exactly one Mn^{2+} ion is possible with the use of micro-PL setup. PL of a single quantum dots is excited quasi-resonantly with an argon laser at 488 nm. To enable time-resolved measurement detection setup is equipped with a monochromator combined with an avalanche diode or a time-resolved CCD camera. Intensity of the excitation beam is modulated with an acousto-optic modulator similarly to the technique presented in Ref. [2]. Presented research provides knowledge about the dynamics of charge state of the CdSe QDs, as well as can have a contribution to analysis of the dynamics of Mn^{2+} spin state.

[1] J. Kobak, T. Smoleński, M. Goryca, M. Papaj, K. Gietka, A. Bogucki, M. Koperski, J. G. Rousset, J. Suffczyński, E. Janik, M. NAwrocki, A. Golnik, P. Kossacki, and W. Pacuski, *Nature Comm.* **5**, 3191 (2014).
[2] M. Goryca, T. Kazimierczuk, M. Nawrocki, A. Golnik, J. A. Gaj, P. Kossacki, P. Wojnar, and G. Karczewski, *Phys. Rev. Lett.* **103**, 087401 (2009).