Photoluminescence Excitation Spectroscopy of InAs/GaAs Quantum Dots in High Magnetic Field

A. Babinski[1], **S. Awirothananon**[2], **S. Raymond**[2], **S. Studenikin**[2], **P.Hawrylak**[2], **Shun-Jen Cheng**[2], **Weidong Sheng**[2], **Z. Wasilewski**[2], **M.Potemski**[1], **and A. Sachrajda**[2]

[1] *LCMI, MPI/CNRS, 25 Avenue Des Martyrs, 38042 Grenoble Cedex 9, France*
[2]*Institute for Microstructural Sciences, NRC Canada, Ottawa, Ontario, K1A 0R6, Canada*

Semiconductor quantum dots (QDs) are a class of novel semiconductor materials engineered on a nano-scale to produce tailored electronic and optical properties. Beside their applications they are also perfect objects to study basic properties of interacting quasi-particles. One of the implications of interactions between excitons in the QDs is expected effect of the QDs occupation on their absorption spectrum. In this work we present the results of the photoluminescence excitation (PLE) measurements of QDs in high magnetic field and we explain their relation to the absorption spectrum of the QDs with low exciton occupation. Usually the PLE spectrum is dominated by phonon resonances, which increase inter-level relaxation, otherwise weakened by a non-radiative recombination. However in high-quality samples, where non-radiative processes are of relatively lesser importance, an absorption spectrum of the QDs dominates the PLE.

We present our results of measurements performed on a single layer structure of InAs/GaAs QDs grown by MBE. The investigated sample shows a relatively small inter-level spacing and relatively small broadening effects, which has been achieved by a post-growth annealing treatment. Measurements were performed at $T = 4.2$K in magnetic field up to 28T. We have found that at zero magnetic field the PLE spectrum, with detection energy set at the ground state (*s*-shell) of the QDs, is dominated by two features, which we attribute to resonant excitation of the QDs in the *p*- and *d*-shell respectively. The peaks split in magnetic field following the pattern of the Fock-Darwin potential and up to four features, attributed to the lowest Landau level in the QDs can be observed at the highest field.

Relation of the PLE spectrum to the emission spectrum observed in PL measurements will be discussed.