ODMR studies of (Cd,Mn)Te Quantum Well with micrometer spatial resolution

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Optically Detected Magnetic Resonance (ODMR) is an effective technique for studying the local environment of paramagnetic ions in quantum wells (QWs)[1]. ODMR takes advantage of the selectivity provided by optical detection methods while maintaining the sensitivity of paramagnetic resonance. A common practice in optical studies of QWs is focusing the light with relatively low-NA lenses, which yields a large focal spot and relatively low resolution. Such an approach makes it easier to integrate the optical experiment with the microwave setup. In our studies, to get better access to local properties revealed in the optical spectrum, we employed μ-photoluminescence and μ-reflectance techniques, which allowed us to perform μ-ODMR experiments.

Using this new approach we investigate the correlation between local carrier gas density and ODMR signal. Our (Cd,Mn)Te/(Cd,Mg)Te quantum wells are intrinsically p-doped, with the hole gas derived from the structure's surface [2]. Its local density is determined by measurement of the relative intensity between X^+ and X in reflectivity spectra. As a result of the presence of the hole gas, we observe a shift of the magnetic resonance towards lower magnetic fields (Knight shift) and acceleration of the spin-lattice relaxation time. We find that local fluctuations in carrier density are reflected in strong changes of ODMR signal monitored on the X^+ line, which can be exploited in future studies of low-dimensional semimagnetic nanostructures.

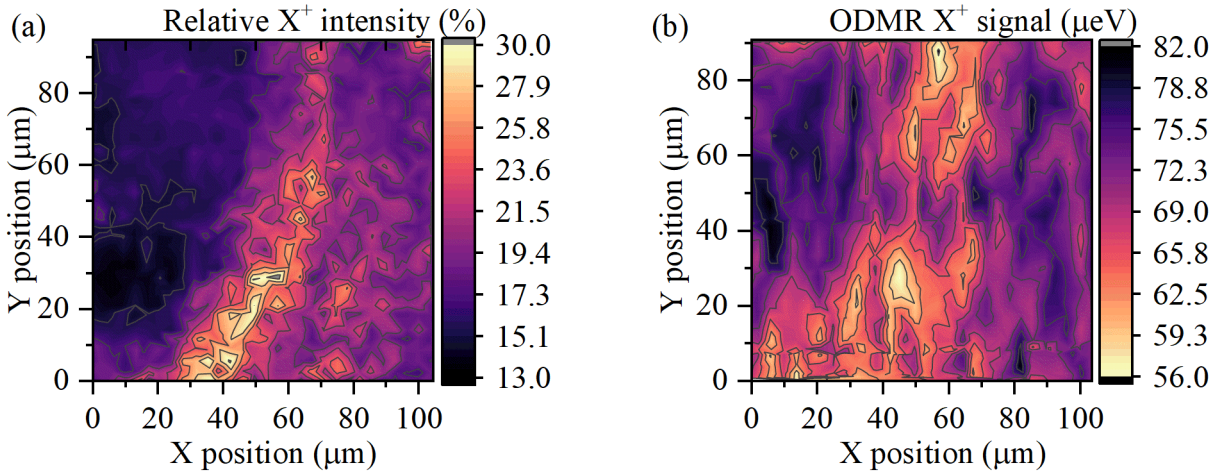

Figure 1: Maps across the sample of: (a) charged exciton to neutral exciton relative intensity, (b) charged exciton ODMR shift.

[1] A. Bogucki, et al., *Phys. Rev. B* **105**, 075412 (2022).
[2] W. Maślana, et al., *Phys. Lett.* **82**, 1875 (2003).