

Spin-lattice relaxation in Co and Mn co-doped CdTe/(Cd,Mg)Te Quantum Wells

A. Łopion, K. Oreszczuk, A. Bogucki, K.E. Połczyńska,
W. Pacuski, T. Kazimierczuk and P. Kossacki

*Faculty of Physics, Institute of Experimental Physics, University of
Warsaw, ul. Pasteura 5, 02-093 Warszawa, Poland*

The cobalt Co^{2+} ion has a non-zero d-shell orbital moment, which makes its ground state much more sensitive to strain than the Mn^{2+} ion. Therefore, the use of Co^{2+} ions would significantly increase the sensitivity of the methods for testing local strains in samples, i.e., optically detected magnetic resonance [1].

Unfortunately, using Co^{2+} has severe disadvantages. Adding cobalt ions to semiconductors, such as CdTe, was shown to cause strong quenching of photoluminescence, due to the intraionic transitions at lower energy than the gap energy of the host material [2-4]. Circumventing this obstacle requires the content of cobalt ions in CdTe to be sufficiently low, but it results in a tradeoff of less visible magnetic or magneto-optical effects. Such a difficulty does not occur in case of the Mn^{2+} in CdTe, since its intraionic transitions have an energy about 2.1 eV, above the bandgap of the CdTe. Therefore, the addition of manganese does not hinder optical studies quench photoluminescence, even at relatively high manganese contents [5].

In our experiments we exploited the properties of both these ions by studying samples containing simultaneously manganese and cobalt dopants. The cobalt concentration was kept at relatively low level of 0.02% in order to maintain good optical properties. The manganese concentration of about 0.3% assured sufficiently strong giant magnetic effect, allowing us to efficiently employ time resolved ODMR techniques.

We observe that spin-lattice relaxation of Mn^{2+} significantly changes with the presence of even a small concentration of Co^{2+} in the same sample. The spin-lattice relaxation becomes faster and starts to exhibit multiexponential characteristics. The effect observed for such low dopants concentrations suggests the far-reaching interactions between manganese and cobalt ions.

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