Magnetic coupling of (Eu,Gd)Te-EuTe epitaxial layers

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Europium chalcogenides are well known magnetic semiconductors (insulators) which are excellent materials to study Heisenberg model of ferromagnets [1]. Substituting Eu^{2+} ions by Gd^{3+} supplies these materials with very high concentration of electrons of 10^{20}-10^{22} cm^{-3} resulting in an additional carrier mediated (RKKY) interaction. In the case of antiferromagnetic EuTe with $T_N = 9.6$ K such doping can change magnetic ordering to ferromagnetic with $T_C \approx 15$ K in (Eu,Gd)Te for small Gd content (up to 10 at.%) [2].

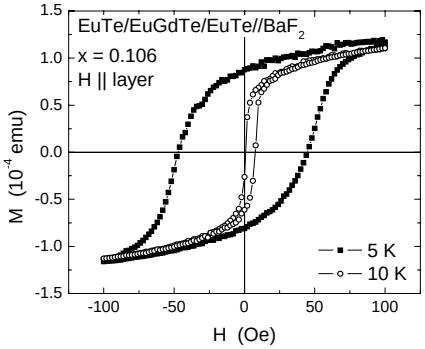

Fig. 1. Shift of magnetic hysteresis loops observed by SQUID magnetometry.

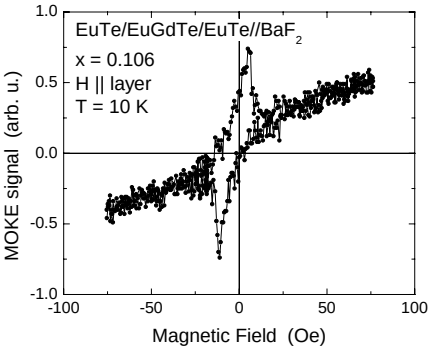

Fig. 2. Anomalous behavior of magnetization found out by magneto-optical Kerr effect.

The samples were grown on freshly cleaved (111)-oriented BaF_2 monocrystals in MBE system equipped with effusion cells with Eu, Gd and Te elemental sources. We have prepared both (Eu,Gd)Te-EuTe bilayer and EuTe-(Eu,Gd)Te-EuTe trilayer structures with EuTe layer serving as buffer layer and (in trilayers) as capping layer. Magnetic properties of samples investigated using SQUID magnetometry demonstrates shift of magnetic hysteresis loops (Fig. 1) for EuTe-(Eu,Gd)Te-EuTe trilayer structures as distinct for (Eu,Gd)Te-EuTe bilayers which exhibits only typical response of ferromagnetic material on applied external field [2]. Anomalous behavior was also observed in magneto-optical Kerr effect showing symmetrical peaks on M(H) curves at temperatures range from 10 to 14 K (Fig. 2). Exchange bias is expected due to a ferromagnetic moment induced in the antiferromagnet material nearby the interface antiferromagnet-ferromagnet.

[1] A. Mauger, C. Godart, Phys. Rep. **141** (1986) 51
[2] P. Dziawa, V. Osinniy, B. Taliashvili, V. Domukhovski, E.Łusakowska, K. Dybko, W. Dobrowolski, L. Kowalczyk, T. Story, M. Goiran, The Institute of Physics Conference Series **187** (2006) 21

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