Spectral dependence of magnetooptical Kerr effect in EuS-based ferromagnetic semiconductor multilayers

M. Szot[1], L. Kowalczyk[1], E. Smajek[1], V.V. Volobuev[2], A.Yu. Sipatov[2], and T. Story[1]

[1]*Institute of Physics, Polish Academy of Sciences, Lotników 32/46, Warsaw 02-668, Poland*
[2]*National Technical University KPI, Kharkov 310002, Ukraine*

Ferromagnetic EuS-based multilayers with ultrathin diamagnetic PbS or SrS spacers form all-semiconductor ferromagnetic/nonmagnetic model system for the study of the mechanisms of interlayer exchange interactions in non-metallic heterostructures. In this work magnetooptical Kerr effect magnetometry (MOKE) was used to study the magnetic hysteresis loops of EuS-PbS and EuS-SrS multilayers grown epitaxially on KCl (001) or PbS (001) substrates with ultrathin 1 nm spacers. These multilayers exhibit antiferromagnetic interlayer exchange coupling below the Curie temperature of T_c =16 K (Fig.1). The spectral dependence of MOKE in EuS-based semiconductor multilayers was studied in the photon energy range covering the interband electronic transitions in EuS (Fig. 2). The measurements of the longitudinal MOKE carried out in the temperature range T = 4-35 K and in external magnetic field $H \leq 300$ Oe applied in the plane of the multilayer established two maxima on spectral dependence of Kerr rotation for light energy $h\nu$ = 1.65 eV and $h\nu$ = 2.1 eV (Fig. 2). The first maximum corresponds to the absorption edge of EuS whereas the second one matches to the maximum of absorption in this material.

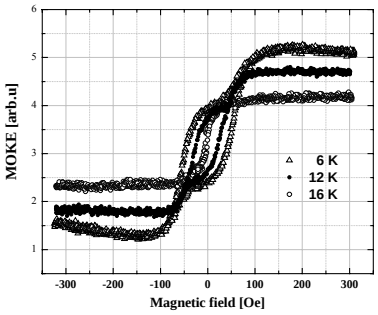

Fig. 1. Hysteresis loops of EuS-SrS/KCl multilayer for different temperatures (He-Ne laser, photon energy 1.93 eV).

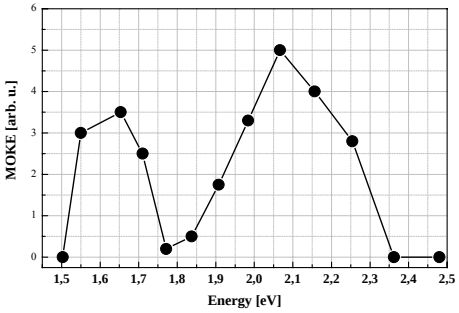

Fig. 2. Kerr rotation *vs.* light energy for EuS-PbS/KCl multilayer at T = 4.2 K.

For qualitative understanding of our findings we discuss electronic structure of EuS taking into account *5d-6s* conduction band splitting induced by crystal field and *sd* exchange interaction. We find that observed maxima of Kerr rotation correspond to the transitions involving localized *4f* levels of Eu^{2+} ions $4f^7 \rightarrow 4f^6 5d(t_{2g})$ and valence band to conduction band electronic transitions.

Name of the presenting author (poster session II): Michał Szot
e-mail address: szot@ifpan.edu.pl
http://www.ifpan.edu.pl