Magnetic order and magnetic inhomogeneities in SnCrTe-PbCrTe solid solutions

L. Kilanski[1], M. Szymański[1,2], B. Brodowska[1], M. Górska[1], R. Szymczak, A. Podgórni[1], A. Avdonin[1], A. Reszka[1], B.J. Kowalski[1], V. Domukhovski[1], W. Dobrowolski[1], V.E. Slynko[3], and E.I. Slynko[3]

[1] *Institute of Physics, Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland*

[2] *Faculty of Materials Engineering Warsaw University of Technology, ul. Wołoska 141, 02-507 Warsaw, Poland*

[3] *Institute of Materials Science Problems, Ukrainian Academy of Sciences, 5 Wilde Street, 274001 Chernovtsy, Ukraine*

Complex composite semiconductors offer possibilities to observe room temperature ferromagnetism related to the presence of magnetic clusters. The bulk systems show applicable magnetotransport phenomena related to the presence of nanoclusters.

We present the studies of electrical and magnetic properties of bulk $Sn_{1-x-y}Pb_xCr_yTe$ mixed crystals with chemical composition $0.18 \le x \le 0.35$ and $0.007 \le y \le 0.071$.

The magnetometric studies indicate that for high Cr-content, $y = 0.071$, the alloy shows ferromagnetic alignment with the Curie temperature, T_C, around 265 K. The CrTe clusters observed in scanning electron microscope (SEM) images are responsible for the ferromagnetic order. The magnetization vs magnetic field $M(B)$ has a Brillouin-like shape with narrow hysteresis loops.

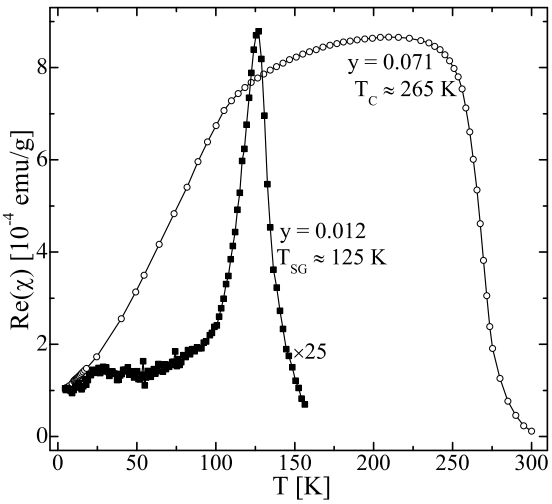

Figure 1: Temperature dependence of the ac magnetic susceptibility for the selected $Sn_{1-x-y}Pb_xCr_yTe$ samples.

At low Cr content, $y \approx 0.01$, a peak in the ac magnetic susceptibility is observed at a temperature about 130 K. The frequency shifting of the peak allowed us to identify the spin-glass-like transition in our samples. The $M(B)$ curves have a nearly square shape with coercive field around 0.5 T, slow saturation at high fields, and low effective magnetic moment per Cr-ion. That indicates rather large magnetic disorder in the samples with $y \approx 0.012$. The detailed SEM studies in our samples with low y indicated a presence of $Sn_{1-x-y}Pb_xCr_yTe$ clusters with Cr-content larger than the nominal value. From comparison with other IV-VI semiconductors containing Cr it follows that the rather high spin-glass-like transition temperatures observed in our samples may be due to carrier mediated magnetic interactions.

The transport characterization of the samples indicated strong metallic p-type conductivity with relatively high carrier concentration $n > 10^{20}$ cm^{-3} and carrier mobility $\mu > 150$ cm^2/(Vs). The scattering mechanisms responsible for the observed magnetotransport properties will be presented and discussed.

The research was supported by the Foundation for Polish Science - HOMING PLUS Programme co-financed by the European Union within European Regional Development Fund.