Preparation and transport properties of $Bi_{2-x}Cr_xSe_3$

Pavlína Ruleová, Anna Kostelníková, and Čestmír Drašar

*University of Pardubice, Faculty of Chemical Technology, Studentská 573,
Pardubice 532 10, Czech Republic*

The objective of this work is the synthesis of single crystals Bi_2Se_3 with the greatest concentrations of chromium and determine its influence on the transport properties of Bi_2Se_3. The use of chromium, according to our ideas should lead to a reduction in the concentration of free electrons due to the different value of electronegativity Cr and Bi, and thus positively influence the thermoelectric (TE) properties of Bi_2Se_3. In addition to practical application in TE applications, Bi_2Se_3 is also examined with respect to magnetic or topological properties [1]. Another issue is the possible development of ferromagnetism or change in topological properties due to the presence of chromium substitution.

Own work describes both the preparation and characterization of single crystal Bi_2Se_3 doped with chromium [2]. Single crystals of the composition $Bi_{2-x}Cr_xSe_3$ where x = 0; 0.02; 0.03; 0.04 were grown from elements of high purity. The purity of the prepared samples was confirmed by X-ray diffraction, which was also used to measure the lattice parameters. Transport properties comprising the Seebeck coefficient S, Hall coefficient RH and the electrical conductivity σ were measured in the temperature range 80-470 K. The transport measurements suggest that the incorporation of chromium atoms in the crystal structure Bi_2Se_3 actually leads to a decrease in concentration of free charge carriers apparently due to increased activation energy of formation of native point defects in the crystal. From the data was calculated the value of the power factor σS^2 and the estimated value of the figure of merit ZT at 370K.

[1] Hor Y.S., Williams A.J., Checkelsky J.G., Roushan P., Seo J., Xu Q., Zandbergen H.W., Yazdani A., Ong N.P., Cava R.J.: Phys. Rev. Lett. 104, 057001-4 (2010).

[2] 2. Kostelníková A., Ruleová P., Drašar Č: SVOČ-FChT Pardubice 77-84 (2014).