Thermoelectric properties of Ni-doped $CuInTe_2$

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There is currently a boom in a search for alternative power resources. One of the alternatives is the usage of the thermoelectric effect. Research on thermoelectric (TE) materials is thus a very active field of research. Efficiency of a TE material is expressed in terms of a so-called dimensionless figure of merit, ZT, where ZT = $\alpha^2\sigma$T/ κ. In this formula, α, σ, T and κ are the Seebeck coefficient, electrical conductivity, absolute temperature and thermal conductivity, respectively [1].

Recently, a classes of ternary I-III-VI_2 (I = Cu, Ag, III = Al, Ga, In, and VI = S, Se, Te) and quaternary Cu_2-II-IV-VI_4 (II = Cd, Hg, IV = Sn, Ge, VI = Se, Te) copper-based compounds with diamond-like structures have been reported to show promising TE properties in the middle-temperature range. For example, the maximum ZT values are 0.77 for $Ag_{0.95}GaTe_2$ at 850 K [2], 1.4 for $CuGaTe_2$ at 950K [3], 1.18 for $CuInTe_2$ at 850 K [4].

Polycrystalline samples of composition $Cu_{1-x}Ni_xInTe_2$ (for x = 0 – 0.05) were synthesized from elements of 5N purity using a solid-state reaction. The phase purity of the products was verified by X-ray diffraction. Samples for measurement of the transport properties were prepared using hot-pressing. The samples were then characterized by the measurement of electrical conductivity, the Hall coefficient, the Seebeck coefficient, and the thermal conductivity over a temperature range of 300 – 675 K. All of the samples demonstrate p-type conductivity. We discuss the influence of Ni substitution on the free carrier concentration and the thermoelectric performance. The investigation of the thermoelectric properties shows an improvement up to 50 % improvement of ZT in the temperature range of 300 – 600 K.

[1] G. S. Nolas, J. Sharp, H. J. Goldsmid, Thermoelectrics / Basic Principles and New Material Developments, Springer-Verlag, Berlin, 2001, p. 128.

[2] A. Yusufu, K. Kurosaki, A. Kosuga, T. Sugahara, Y. Ohishi, H. Muta, and S. Yamanaka, Appl. Phys. Lett. 99 (2011) 061902.

[3] T. Plirdpring, K. Kurosaki, A. Kosuga, T. Day, S. Firdosy, V. Ravi, G. J. Snyder, A. Harnwunggmoung, T. Sugahara, Y. Ohishi, Adv. Mater. 24 (2012) 3622.

[4] R. Liu, L. Xi, H. Liu, X. Shi, W. Zhang, L. Chen, Chem. Commun. 48 (2012) 3818.