Technology and Thermoelectric Properties of Semiconductor Materials Based System Pb-Bi-Te

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Lead telluride – efficient thermoelectric materials for medium field (500-850) K. The high interest in his research that does not diminish over the years, due to a unique physical and chemical properties and relatively simple technology to obtain high-quality crystals.

The efficiency of thermoelectric materials is determined by a dimensionless figure of merit, figure of merit (ZT): $ZT = (\alpha^2\sigma / \chi)T$, where α, σ, χ, T respectively Seebeck coefficient, electrical conductivity, thermal conductivity and absolute temperature. Low values of ZT commercially available thermoelectric materials limits the use of thermoelectric devices. To thermoelectric generators were competitive in the large and powerful business devices need to look for materials with significantly higher values of ZT [1]. One of the main methods for improving thermoelectric material parameters are doping and formation of solid solutions.

For the synthesis of semiconductor thermoelectric compounds used method of direct fusion of mixing of the components. The resulting ingots ground in an agate mortar and by selecting the size fraction (0,05 – 0,5) mm and pressed. Thermoelectric coefficient α and specific conductivity σ was determined by the standard method. The specimen is clamped two copper rods placed in a furnace U_1, which heats the sample to the desired temperature measurement. For one copper rods wound furnace U_2 to create a temperature gradient (≈10 K) in the sample. Temperature measurements were carried out by two chromel-alumel thermocouples placed in holes drilling in the sample. Electrical conductivity was determined by measuring the voltage drop on the sample generated by voltage source U_3. Thus, one of the legs of each thermocouple was used as conductor of current.

A study was conducted of lead telluride doped Bi and the main characteristics of the thermoelectric material. In particular, when the content of impurities 0,1 at.% Electrical conductivity is ≈ 630 $(\text{Ohm cm})^{-1}$, and thermoelectric coefficient ≈ 350 μV/K concerning solid solution is for $PbTe\text{-}Bi_2Te_3$ containing 1 mol.% defined $\sigma \approx 1000$ $(\text{Ohm cm})^{-1}$, $\alpha \approx 350$ μV/K.

1. Freik D.M., Galushchak M.O., Krynytsky O.S., Matkivsky O.M. New thermoelectric nanocomposite materials (review) // Physics and Chemistry of Solids 14 (2) (2013).