Technology and Thermoelectric Properties of Semiconductor Materials Based Systems Pb-Sb-Te

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Compound $A^{IV}B^{VI}$ semiconductor materials promising for creating thermoelectric devices operating in the temperature range from room to 900K. Among which compares favorably with properties PbTe - many valley nature of the energy spectrum (N = 4); lattice thermal conductivity of low value (χ_g = 2,09·10 $^{-2}$ W·K^{-1}·cm^{-1}) relatively high carrier mobility ($\mu \approx 10^3$ cm^2·V^{-1}·s^{-1}); the most important values $\mu\chi^{-1,}$ leading to a significant increase maximum thermoelectric figure of merit (Z_{max}).

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 Seebek 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].

The electrical resistance of pure Lead Telluride depends on the temperature and changes in metals, increases with increasing temperature. Absolute Seebeck coefficient for PbTe show a tendency to increase with increasing temperature. PbTe samples with maximum values of power factor $\alpha^2\sigma$ at room temperature (16 mW·cm^{-1}·K^{-2}), which decreases with temperature. The value of thermoelectric figure of merit (ZT) for PbTe has a maximum at 723 K, ZT = 0,48.

Established that doping Sb lead telluride leads to increase basic thermoelectric material characteristics. In particular, when the content of impurities 0,3 at.%. electrical conductivity is ≈ 700 (Ohm cm)$^{-1,}$ and thermoelectric coefficient ≈ 300 μV/K of solid solutions PbTe-Sb_2Te_3 containing 0,3 mol.% defined $\sigma \approx$ 350 (Ohm cm)$^{-1,}$ $\alpha \approx$ 350 μV / K [2].

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).
2. Freik D.M., Mudry S.I., Gorichok I.V., Dzumedzey R.O., Krynytsky O.S., Lyuba T.S. Charge carrier scattering mechanisms in thermoelectric PbTe: Sb // Ukrainian Journal of Physics 2014. - Vol. 59, № 7. - P.706-711.