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Designing of Nano-materials for Waste Heat Conversion into Electrical Energy Thermoelectric generator

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Abstract : The electrical and thermal properties of the doped Tellurium Telluride (Tl10Te6) chalcogenide nano-particles are mainly characterized by a competition between metallic (hole doped concentration) and semi-conducting state. We have studied the effects of Sn doping on the electrical and thermoelectric properties of Tl10-xSnxTe6 (1.00 ≤x≤ 2.00), nano-particles, prepared by solid state reactions in sealed silica tubes and ball milling method. Structurally, all these compounds were found to be phase pure as confirmed by the x-rays diffractometery (XRD) and energy dispersive X-ray spectroscopy (EDS) analysis. Additionally crystal structure data were used to model the data and support the findings. The particles size was calculated from the XRD data by Scherrer's formula. The EDS was used for an elemental analysis of the sample and declares the percentage of elements present in the system. The thermo-power or Seebeck co-efficient (S) was measured for all these compounds which show that S increases with increasing temperature from 295 to 550 K. The Seebeck coefficient is positive for the whole temperature range, showing p-type semiconductor characteristics. The electrical conductivity was investigated by four probe resistivity techniques revealed that the electrical conductivity decreases with increasing temperature, and also simultaneously with increasing Sn concentration. While for Seebeck coefficient the trend is opposite which is increases with increasing temperature. These increasing behavior of Seebeck coefficient leads to high power factor which are increases with increasing temperature and Sn concentration except For Tl8Sn2Te6 because of lowest electrical conductivity but its power factor increases well with increasing temperature.

Keywords : Sn doping in Tellurium Telluride nano-materials, electron holes competition, Seebeck co-efficient, effects of Sn doping on Electrical conductivity, effects on Power factor
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