Abstract No: 286 ***Physical Sciences***

ENHANCEMENT OF THERMOELECTRIC PROPERTIES OF COPPER (I) THIOCYANATE USING GRAPHITE

J.A.J. Heshan*, T.M.W.J. Bandara and L.K. Narangammana

Department of Physics, University of Peradeniya, Peradeniya, Sri Lanka
**heshanjaj@gmail.com*

The effects of global warming and the depletion of fossil fuels led the world to pursue reliable renewable energy sources and to improve the efficiencies in current energy conversions. Thermoelectricity is the direct conversion of heat energy into electricity. Recently, this phenomenon has been applied as an efficient waste heat recovery mechanism. Thermoelectric generators (TEGs) are incorporated in generating thermoelectricity under applied temperature differences. A TEG contains an array of p-n junctions created using two dissimilar thermoelectric materials (TEMs). Using expensive and toxic rare earth materials such as Tellurium in room temperature TEGs has limited the commercialisation of this technology. Copper (I) thiocyanate (CuSCN) has recently earned significant attention as a p-type semiconductor due to its excellent hole-transporting characteristics. Thus, it is used in many optoelectronic applications, including perovskite solar cells. This project investigates and optimises the thermoelectric properties of CuSCN pellets by doping with a carbonaceous material. Pellets pressed with a diameter of 13 mm and a thickness of 1.5 mm using commercial CuSCN powder were used to investigate thermoelectric properties. Graphite was used as a dopant to modify the thermoelectric performance of CuSCN pellets. Electrical conductivity, thermal conductivity, and Seebeck coefficient were measured for CuSCN pellets as well as for graphite-doped CuSCN (G-CuSCN) pellets. The figures of merit values were also calculated at the respective temperatures. The obtained electrical conductivities of CuSCN and G-CuSCN pellets at 373 K were 722.2 and 77.4 S m^{-1}, respectively. The thermal conductivities of CuSCN and G-CuSCN pellets at 373 K were 1.28 and 0.81 W m K^{-1}, respectively. G-CuSCN showed a positive Seebeck coefficient of 0.67 mV K^{-1} at 373 K, confirming the p-type semiconductor nature of this material. In order to generate a steady state voltage, CuSCN should be heated up to 423 K. G-CuSCN resulted in a figure of merit value of 1.69×10^{-8} at 373 K. CuSCN and G-CuSCN generated maximum output power of 29.9 and 139.9 nW at average temperature gradients of 393 K and 343 K, respectively. After the incorporation of graphite into CuSCN, the thermal conductivity of the material decreased, indicating the improvement of favourable properties needed for an efficient TEM. In addition, G-CuSCN generated more power than CuSCN, revealing that graphite can improve the thermoelectric properties of CuSCN.

Keywords: CuSCN, Figure of merit, Renewable energy, Seebeck coefficient, Thermoelectricity