T01.P39 Thermoelectric proprieties of Bi_2Te_3/Sb_2Te_3 films

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The deposition and characterization of n-type Bi_2Te_3 and p-type Sb_2Te_3 semiconductor films is reported. The films were deposited by thermal co-evaporation on a 25 μm thick polyimide (Kapton) substrate. Kapton film was chosen as a substrate because of its low thermal conductivity of 0.16 $Wm^{-1}K^{-1}$, its high glass transition temperature (Tg = 360 °C) and its value of thermal expansion coefficient ($12\times10^{-6}K^{-1}$) that matches the thermal expansion coefficient of the semiconductor films, thus reducing residual stress and improving adhesion. The co-evaporation method is inexpensive, simple, and reliable, when compared to other techniques that need longer time periods to prepare the starting material or require more complicated and expensive deposition equipment. The films were fabricated by co-evaporation, using two molybdenum boats, of Bi and Te for the n-type film, and Sb and Te for the p-type film. Each evaporation rate is controlled and the best results were obtained using an evaporation rate of Te twice as high as the evaporation rate of Bi or Sb. The substrate was heated during deposition at 275 °C for Bi_2Te_3 films and at 235 °C for Sb_2Te_3 films.

Seebeck coefficients of -190 μVK^{-1} and +150 μVK^{-1}, electrical resistivities of 8 μΩm and 15 μΩm and power factors of 4.6×10^{-3} $Wm^{-1}K^{-2}$ and 1.3×10^{-3} $Wm^{-1}K^{-2}$, were measured at room temperature on n-type and p-type films, respectively. These values are higher than reported for films deposited by co-sputtering or electrochemical deposition, and are close to those reported for films deposited by metalorganic chemical vapor deposition or flash evaporation. X-ray diffraction analysis and Energy-dispersive X-ray spectroscopy show the stoichiometry of these films. The Seebeck coefficient and electrical resistivity of p-type films can be further improved. The n-type film presents excellent thermoelectric proprieties and high figures of merit were achieved, suitable for the fabrication of micro peltier elements, useful in telecommunications laser-cooling and temperature control.