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Cryogenic Thermoelectric Properties of the Bismuth-Magnesium and Bismuth-Antimony-Magnesium Systems[1] CHRISTINE OROVETS, HYUNGYU JIN, Department of Mechanical and Aerospace Engineering, The Ohio State University, BARTLOMIEJ WIENDLOCHA, AGH University of Science and Technology, Krakow, Poland, JOSEPH P. HEREMANS, Department of Mechanical and Aerospace Engineering, The Ohio State University — There is a need to increase the Figure of Merit of thermoelectric materials used in low temperature cooling applications. Band structure calculations show that substitutional magnesium in bismuth can form sharp density of states peaks, suggesting the presence of a resonant level. Single crystal samples of $(Bi_{1-x}Sb_x)_{1-y}Mg_y$ ($0 \leq$ x $\leq 12\%$ and $0 \leq$ y $\leq 0.7\%$ nominally) were synthesized in evacuated ampoules. The composition of each ingot was analyzed using x-ray diffraction, and transport properties were measured using a Thermal Transport Option (TTO) in a Physical Properties Measurement System (PPMS) from 300K to 2K. It is apparent that the addition of magnesium strongly influences thermopower; the data for $Bi_{90}Sb_{10}Mg_{0.7}$ shows a second minimum in thermopower at 20K, in addition to the expected minimum at approximately 50-60K. This could be due to the resonant scattering at the cryogenic temperatures which arises from the excess density of states. The addition of magnesium also appears to decrease thermal conductivity below 30K. We present systematic experimental approaches and the results to elucidate the role of magnesium in bismuth and bismuth-antimony systems.

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