P-type electronic and thermal transport properties of Mg$_2$Sn$_{1-x}$Si$_x$  

SUNPHIL KIM, Department of Mechanical and Aerospace Engineering, The Ohio State University, Columbus, OH, BARTLOMIEJ WIENDLOCHA, Faculty of Physics and Applied Computer Science, AGH University of Science and Technology, 30-059 Krakow, Poland, JOSEPH P. HEREMANS, Department of Mechanical and Aerospace Engineering, Department of Physics, The Ohio State University, Columbus, OH — P-type Mg$_2$Sn doped with various acceptors$^{(1)(2)}$ has been studied as a potential thermoelectric material. Because of its narrow band gap and high lattice thermal conductivity, the $zT$ values of the binary compound are limited: $zT_{\text{max}}$ reported is 0.3$^{(3)}$. In this work, we synthesize and characterize p-type-doped Mg$_2$Sn$_{1-x}$Si$_x$ with various acceptors. Silicon is added in order to widen the band gap and scatter the phonons. The conduction band degeneracy that yields excellent $zT$ in n-type material in the Mg$_2$Sn$_{1-x}$Si$_x$ alloy system unfortunately does not apply to p-type material. Thermomagnetic and galvanomagnetic properties (electrical resistivity, Seebeck, Hall, and Nernst coefficients) are measured, along with thermal conductivity and band gap measurements. Finally, $zT$ values are reported. 


$^{1}$The work is supported by the joint NSF/DOE program on thermoelectrics, NSF-CBET-1048622

Sunphil Kim
The Ohio State University

Date submitted: 08 Nov 2012

Electronic form version 1.4