Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

The Nanocomposite Approach to Enhanced Thermoelectric Performance G. CHEN, R. YANG, H. LEE, Q. HAO, M. TANG, M. S. DRESSELHAUS, MIT, Cambridge, MA, D. WANG, Z. REN, BC, Chestnut Hill, MA, J. P. FLEURIAL, P. GOGNA, JPL, Pasadena, CA — Model calculations and experimental results confirm that a nanocomposite approach leads to an enhancement in the thermoelectric performance of a bulk nanocomposite sample based on Si-Ge relative to its 3D alloy counterpart, though the predictions are quite general and should be applicable to a variety of nanocomposite systems. Modeling and experimental results here are reported for nanocomposites of Si-Ge made of Si and Ge nanoparticles (typically the particles are 20 nm or less in size prepared from the liquid phase or by ball milling or other techniques) and consolidated by hot press in an inert argon atmosphere to theoretical density. Most important is the large decrease in the thermal conductivity, well below that of the alloy of the same composition, both at room temperature and up to 1000K. Although the electrical conductivity decreases somewhat, the selective filtering of the high energy electron carriers enhances the Seebeck coefficient much more than the decrease in electrical conductivity, resulting in a gain in the power factor as well over a large temperature range. Emphasis is given to physical phenomena associated with nanostructures that serve to enhance the thermoelectric performances generally, and can be used for other Nanocomposite systems. The authors acknowledge support from NASA under the Radio Isotope Power Conversion program.

Mildred S. Dresselhaus
Department of Electrical Engineering and Computer Science and Department of Physics, MIT, Cambridge, MA

Date submitted: 30 Nov 2005 Electronic form version 1.4