Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Theory of the thermoelectric properties of semiconductor-matrix nanocomposites NATALIO MINGO, NASA-Ames Center for Nanotechnology, DAVID BROIDO, Boston College — We theoretically investigate the thermoelectric properties of a nanocomposite nanowire array where the matrix material is a semiconductor. We take InSb to be the nanocomposite matrix that surrounds an array of cylindrical holes, and we calculate the density-optimized power factor, P, and the lattice thermal conductivity, k, employing a relaxation time approach and including band nonparabolicity. For fixed aspect ratio of wire diameter to cylindrical-hole period, we obtain universal curves for P. For small period, we find that P is enhanced above the bulk value with the magnitude of this enhancement increasing with the aspect ratio. For k, we model the phonon scattering by a frequency-dependent relaxation time [1] and use a boundary-scattering geometry introduced by Prasher [2]. For fixed aspect ratio and small periods we find reductions in k of around 50%. Our results for P and k suggest that choosing a thermoelectric material as the matrix of a nanowire composite can contribute to enhance the composites ZT. [1] N. Mingo and D. A. Broido, Phys. Rev. Lett. 93, 246106 (2004). [2] R. Prasher, submitted.

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Date submitted: 05 Dec 2005 Electronic form version 1.4