Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Spectral Analysis of Surface Controlled Phonon Transport in Nanophononic Metamaterials[1] SANGHAMITRA NEOGI, University of Colorado at Boulder, DAVIDE DONADIO, University of California Davis — Phonon engineering in nanostructured semiconductors has shown promises to further advance the performance of energy applications beyond the state-of-the-art limit. In nanostructured materials, phonon transport is greatly affected by the surface nanoscale character[1]. The concept of nanophononic metamaterial (NPM) was introduced recently [2] to affect nanoscale thermal transport with the inclusion of local surface resonators. We carried out a systematic investigation of phonon transport in locally resonant silicon-based NPMs. We used classical equilibrium molecular dynamics and a Boltzmann transport equation approach with the relaxation time approximation to investigate the nature of phononic thermal transport in nanopatterned silicon membranes with thicknesses of the order of 10 nm and below. We find the presence of local surface resonators has a significant effect on the phonon dispersion and has a direct consequence of suppression of group velocities of phonons in the NPMs. We completed the investigation by relating nanoscale resonant character (geometry and material composition) with phonon scattering, and consequently, phonon transport in the locally resonant silicon membrane NPMs. [1] Neogi et al, ACS nano, 9(4), 3820-3828 (2015) [2] Davis Hussein, PRL, 12, 055505 (2014)

[1]This project is funded by the program FP7-ENERGY-2012-1-2STAGE under contract number 309150.

Sanghamitra Neogi
University of Colorado at Boulder

Date submitted: 06 Nov 2015 Electronic form version 1.4