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Measurements Of The Effects Of Grain Boundary And Alloy Scattering On Spectral Phonon Mean Free Path Distributions.[1] SEAN LUBNER, MD. IMRAN KHAN, Lawrence Berkeley National Lab, CHRIS DAMES, University of California, Berkeley — In the electronics and clean energy fields, it is increasingly necessary to reliably model the dissipation of heat from micro and nanostructures or nanostructured materials such as in batteries, computer chips, and thermoelectrics. In these regimes where length scales are comparable to the mean free paths (MFPs) of energy carriers, the diffusion law of heat conduction begins to break down. In this talk, I present our recent results from using a time domain thermoreflectance (TDTR) technique with laser spot 1/e-squared radii less than 2 microns to measure sub-diffusion thermal transport in silicon, nanograined-silicon (ng-Si), and silicon germanium (SiGe) alloys. Our results experimentally demonstrate that alloy scattering skews phonon spectra toward longer MFPs, while nanostructuring skews phonon spectra toward shorter MFPs. As a consequence, we show that a significant fraction of the heat-carrying phonons in SiGe have MFPs greater than 10 microns at room temperature, and that the thermal conductivity of ng-Si overtakes that of SiGe after microstructuring.

[1]NSF

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