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Length scale dependence of the thermal conductivity accumulation in nanograined Si-Ge alloys LONG CHEN, BRIAN DONOVAN, PATRICK HOPKINS, JOSEPH POON, University of Virginia — The manipulation of the lattice thermal conductivity without significantly effecting electronic mobility is a crucial part to optimize the thermoelectric figure of merit. In order to fully understand the contributions to the lattice thermal conductivity, a calculation of the lattice thermal conductivity based on a phonon frequency-dependent model, derived using the effective medium method, is presented. This model predicts the lattice thermal conductivity of the fully nanostructured systems, and helps to understand the dependence of lattice thermal conductivity on various length scales. The simulation results are validated with experimental results obtained via time-domain thermoreflectance. By varying the modulation frequency of the pump-probe technique, the thermal conductivity of Si and Si-Ge systems over a variety of thermal penetration depths is measured. The combination of modeling and experimental findings shows insight into length scale effect on phonon wavelength and mean free path, as well as the resulting impact on the thermal conductivity.

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