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Thesis Defense

entitled

Boltzmann Model for the Lattice Thermal Conductivity in Semiconductor Nanowires

by

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In this thesis, we have developed a theoretical model to predict the thermal conductivity for cylindrical and pristine nanowires. Boltzmann equation is solved including spatial dependence of the phonon distribution function and taking into account all the phonon scattering mechanisms and the differences in their physical nature.

Vibrational parameters such as Debye temperature and Grüneisen parameter are derived as a function of temperature and crystallographic directions using the lattice dynamics approach to be employed in the calculation of the lattice thermal conductivity. Houston's method is used for the calculation of the phonon spectrum, which will be involved further in the general formalism of the lattice thermal conductivity.

In an attempt to draw an understanding of the effects of the size and surface on the lattice thermal conductivity, we have studied the effect of the scattering of the phonons by the boundaries of a nanowire with a circular cross section. Expression for the boundary scattering relaxation time of phonons in the presence of other anharmonic phonon scattering mechanisms are developed. The intrinsic phonon scattering rates are calculated from Fermi's Golden Rule.

With this presented model, the lattice thermal conductivity for cylindrical and pristine nanowires can be calculated. This model shows the different behavior of the lattice thermal conductivity for nanowires, in comparison to bulk, demonstrated with reference to experimental measurements.

Date: Tuesday, February 7, 2017

Place: Rm. 310

Time: 4:00 p.m.