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Phonon Relaxation Times in Nanostructures: Toward Accurate Predictions of Heat Transfer in Semiconductors and Magnetic Recording Media

Marcela Madrid
Pittsburgh Supercomputing Center, Pittsburgh, PA

Cristina H. Amon
Director, Institute for Complex Engineered Systems, Carnegie Mellon University, Pittsburgh PA

Abstract

Efficient heat dissipation is an important goal of the semiconductor industry. Efforts towards the miniaturization of circuit elements, results in self-heating, has begun to emerge as a bottleneck to transistor performance.

Heat transfer in semiconductors can be simulated by means of the phonon Boltzmann transport equation. However, the phonon Boltzmann transport equation depends on the relaxation times of the phonons, which are frequency-dependent and not known a priori. To date, all published solutions of the Boltzmann transport equation rely on approximations that do not accurately account for phonon relaxation processes. Knowing the phonon lifetimes is essential to accurately simulate problems of heat transport and diffusion and will allow for accurate solutions of the Boltzmann transport equations. The *objective* of this proposal is to obtain the relaxation times of phonons in silicon.