Abstract
The goal of this project is to construct advanced simulation tools for nanoscale heat transfer in solids based on fundamental scientific principles. A 3-D simulation code based on the Lattice Boltzmann Method (LBM) will be developed. The LBM, which stems from the Boltzmann Transport Equation (BTE) and lattice gas automata, is an alternative numerical technique for modeling nanoscale heat transfer in solids. While portraying similar behavior as the BTE, the LBM requires considerably less computational effort. To verify our LBM code, we intend to study the thermal behavior of complex and relevant geometries by solving the numerically intense BTE, as well as verifying the various heat transfer hierarchy equations (e.g., Fourier, BTE, and LBM). Our applications so far are geared towards semiconducting solids, in which the dominant carriers are phonons. With proper implementation of physics, our numerical scheme will be enhanced to examine the metallic solids, in which the dominant heat carriers are electrons (although interaction of both energy carriers and electron-phonon coupling will make the problem challenging). This project aims for a multidisciplinary, high technology enabling research program that will create viable applications within nanotechnology and promote collaborative opportunities among the faculty and students of CIT.