PPDO-113

Hierarchical Modeling of Thermal Transport With Applications to Data Storage and Nanoelectronic Technologies

Dr. Marcela Madrid
Pittsburgh Supercomputing Center, Pittsburgh, PA

Cristina H. Amon
Director, Institute for Complex Engineered Systems and Department of Mechanical Engineering, Carnegie Mellon University, Pittsburgh, PA

Industry Participants
Yiao-Tee Hsia
Seagate Research, Pittsburgh PA

Charles Buenzli
Novocel, Pittsburgh, PA

<u>Abstract</u>

The current trend towards miniaturization in data storage and microelectronics has resulted in device components with features with dimensions in the nanometers. At these scales, thermal phenomena which become important, such as self-heating and localized heating, cannot be resolved and predicted with continuum macro-scale models such as Fourier diffusion. Instead, we need to resort to the Boltzmann Transport for phonons and electrons, Lattice Bolzmann and Molecular Dynamics models. These thermal phenomena also affect the reliability of the device and are current bottlenecks to further miniaturization. To date, models to simulate these phenomena have only represented simplified geometries, and thus are not very representative of real systems. In order to be able to model heat transfer in macro-devices with components and features in the nanoscale regime, it is essential to take into account widely different scales, from the nanometers to the macroscopic. In this project, we propose to develop a computational multi-scale methodology that will allow us to model how heat is dissipated across the different device components and further the understanding of nanoscale, sub-continuum heat transport. This knowledge is important for the design of the next generation devices with improved heat dissipation characteristics.