



ME Department Seminar

Thermal Transport and Management in Nanostructured Materials



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Abstract

Heat transfer plays an important role in a variety of technologies such as energy conversion and storage, building energy efficiency, and cooling of microelectronics. The fundamental length scales associated with the basic heat carriers, such as phonons, photons, and fluid molecules, generally fall in the range of nanometer to microns. Therefore, exploring and exploiting basic nanoscale thermal transport and conversion phenomena hold the key for developing high performance devices and systems for thermal processes. There has been extensive research and progress in this area, which leads to both a deeper understanding of thermal transport phenomena as well as technological impacts. Furthermore, the trend of continuous miniaturization of electronic and optoelectronic devices poses daunting challenges for thermal management, as the accompanied increasing power density, often exceeding 1 kilowatt per square centimeter, or equivalent of 10,000 suns, has often become one of the bottlenecks of continuous scaling of these devices.

In this presentation, I will introduce work being conducted in my group on both the fundamental and application aspects of thermal energy transport and management in nanostructured materials. Specifically, we study thermal transport properties in crystalline and amorphous Si nanostructures, and show that these structures possess unusual size dependent thermal transport properties at nanoscale, which are unexpected from conventional theoretical understanding. We also show a new phase change heat transfer mechanism that exploits the large latent heat associated with vaporization of liquid to achieve a record-high heat dissipation capability (>1 kilowatt per square centimeter, or equivalent of 10,000 suns) enabled by nanostructured substrates.

Bio

Renkun Chen is an associate professor at the University of California, San Diego. He received his B.S. degree in Engineering Thermo-physics from Tsinghua University in 2004, and Ph.D. degree in Mechanical Engineering from the University of California, Berkeley in 2008. Following a one-year stint as a postdoctoral fellow at Lawrence Berkeley National Laboratory, he joined the faculty of UC San Diego in the Department of Mechanical and Aerospace Engineering in 2009. His research group is interested in fundamental nanoscale heat transfer as well as engineering applications of nanotechnology in thermal transport and management.