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Mechanical Engineering Seminar Series

Thermal metamaterials – for efficient directing, harvesting, and dissipation of heat

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Abstract

A significant contributor to energy wastage is the inevitable generation as well as the uneven dissipation of heat. Practical methods to adeptly channel heat flux would have applications enabling improved energy utilization and thermal energy management. The aim of this talk is to review the use of metamaterials for thermal energy harness. A larger scientific objective is to describe thermal energy transfer on a unified basis, which may perhaps be provided through a metamaterials type description.

Thermal metamaterials will be first described through the anisotropy of the thermal conductivity tensor, and the consideration of an effective thermal medium. An overarching aim is to implement functionalities, well known from light optics, such as thermal refraction which may yield novel applications, such as thermal lensing. The efficient dissipation of heat, *e.g.,* through a metamaterial-based "perfect" diffuser, will be discussed. Finally, the implications for thermal management in electronics packaging will be considered.

Bio

Prab Bandaru is a professor of Mechanical Engineering in UC, San Diego and is also affiliated with the Electrical Engineering and Nanoengineering departments. After his Ph.D. from UC, Berkeley, he worked in Applied Materials Inc., on non-volatile random access memories and was a postdoctoral fellow in the Electrical Engineering/Physics departments at UCLA on aspects related to quantum information processing.

Prab Bandaru and his research group are mainly interested in analytical and experimental materials physics and chemistry and related applications, broadly looking at the electrical, thermal, electrochemical, photonic, and mechanical properties of materials at the nano-meso-, and macro-levels. Related research accomplishments range from synthesis of new magneto-optic materials, establishing the maximum efficiency for thermoelectrics, measurement of the electrical conduction at the single molecule level, use of helical and Y-shaped carbon nanostructures for inductors and nanoelectronics, non-contact optical measurements of thin film thermal conductivity, sub 1 nanometer pore diagnostics in single layer graphene, *etc.* Professor Bandaru has been recognized through awards such as the Flint Seminar lectureship at Yale University, and career awards from the National Science Foundation, ONR, and the Scientific American Top 50.

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