

21COE Programme: Mechanical Systems Innovation Open Seminar

21COE Programme: The Mechanical System Innovation Open Seminar 2007 will be held as follows. Dr. Sebastian Volz is very active in the field of nano-scale thermal engineering. Participants from any departments will be welcome.

Invited Speaker : Dr. Sebastian Volz (Ecole Centrale Paris)
Laboratoire d'Energétique Moléculaire et Macroscopique, Combustion, UPR
CNRS 288, 92295 Châtenay Malabry, France

Title : New thermal mechanisms in sub-10nm structures

Date & Time : September 26, 2007 (Wednesday) 15:00pm~16:30pm

Place: The University of Tokyo, Engineering Building II, 3rd Floor,
Conf. Room (2-31A)

Abstract :

A considerable amount of work has been devoted to the understanding of heat transfer in nanostructures when heat carriers or phonons can be assimilated to particles. Today's fabrication techniques allow for designing structures with sub-10nm sizes. In this case, the wave-like behavior of phonons has to be taken into account. We propose to show the impact of those new phenomena on nanowires and phononic crystals.

Heat transfer in wires with diameters smaller than 10nm are usually characterized in terms of the quantum of conductance that is the contribution of a phonon branch. A previous work proved the existence of this quantum in a junction. However, in the case of a long wire in contact with a plane surface, the transmission of the phonon waves to a substrate introduces an additional conductance. We prove that the conductance at contact is smaller than the wire conductance by several orders of magnitudes. Consequently, heat conduction in wires with sub-10nm diameters is completely driven by the contribution of the contact.

An atomic-scale three-dimensional phononic crystals is modeled by a Si crystal with periodically embedded Ge nanoparticles. After computation of the dispersion curves by lattice dynamics, we prove a very significant decrease of the phonon group velocities. The impact on thermal conductivity is discussed by considering that phonon mean free path should also be drastically reduced.

Other topics will be evocated including transient non-Fourier effects in core-shell structures as well as magnetic contributions in near-field radiation effects.

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