Contribution ID: **105** Type: **Oral Presentation**

Investigation of Two-dimensional lattice thermal transport in graphene using phonon scattering mechanism

Wednesday, 13 July 2016 15:00 (20 minutes)

Abstract content
   (Max 300 words)
Formatting &
Special chars

The extremely high thermal conductivity observed in graphene and its applications as thermal management material in future nanoelectronic circuits have rattracted significant attention and motivated for theoretical investigations on thermal conductivity. Two-dimensional lattice thermal transport in graphene is investigated using phonon scattering mechanism. The in-plane lattice thermal conductivity is demonstrated by incorporating the scattering of phonons with defects, grain boundaries, electrons, and Umklapp phonon scatterings in the model Hamiltonian. The lattice thermal conductivity dominates in graphene is an artifact of Umklapp phonon scattering mechanism around room temperatures. A very high phonon mean free path of the order of few hundred nanometers is estimated which seems to be responsible for observed high thermal conductivity. It is experienced that heat transport by phonons and scattering rates are substantially different in a quasi-two-dimensional system such as graphene compared to the three-dimensional bulk crystals. The obtained results are in good agreement with the available experimental data and reflect the two-dimensional nature of phonon transport in grapheme which is dominated by phonon scatterings.

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Session Classification: Parallel Track B