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Two-dimensional lattice thermal transport in graphene using phonon scattering mechanism: Application as heat management material

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The extremely high electrical and thermal conductivity observed in graphene make it a suitable candidate as heat management material for various applications. Two-dimensional lattice thermal transport in bilayer graphene is investigated using phonon scattering mechanism. In the plane layer of carbon atoms the thermal conductivity (κ) is demonstrated by incorporating the phonon- defect, phonon-electron, phonon-grain boundaries, phonon-phonon umklapp scatterings and out-of-plane phonon scattering process in the model Hamiltonian. A typical $T^{1.5}$ dependence of thermal conductivity at observed at low temperatures (lower than 150 K) is the resultant of various operating phonon scattering mechanisms. Above room temperatures, the thermal conductivity decreases and follows almost T^{-2} dependence which is an artifact of the dominant Umklapp phonon scattering at higher temperatures. The phonon peak appear at around 225 K is due to the competition between the increase in the phonon population and decrease in phonon mean free path due to umklapp phonon scattering with increasing temperature. The results obtained from present model are in good agreement with the available experimental data and reflect the two-dimensional nature of phonon transport in graphene which is dominated by phonon scatterings

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