Phonon-limited transport coefficients in extrinsic graphene

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Abstract

The effect of electron-phonon scattering processes over the thermoelectric properties of extrinsic graphene was studied. Electron-phonon interaction is described within the deformation potential approximation. Electrical and thermal resistivity, as well as the thermopower, were calculated within the Bloch theory approximations. Analytical expressions for the different transport coefficients were obtained from a variational solution of the Boltzmann transport equation. The phonon-limited electrical resistivity ρ_{e-ph} shows a linear in temperature dependence at high temperatures, and follows a $\rho_{e-ph} \sim T^4$ at low temperatures, in agreement with experiments. The phonon-limited thermal resistivity at low temperatures exhibits a $\sim T$ dependence and achieves a nearly constant value at high temperatures. The predicted Seebeck coefficient at very low temperature is $Q(T) \sim \pi^2 k_B T/(3eE_F)$, which shows a $n^{-1/2}$ dependence with the carrier density n, in agreement with experiments.

[1] E. Muñoz, Journal of Physics: Condensed Matter 24 (2012), 195302.

[2] E. Muñoz, J. Lu and B. I. Yakobson, Nano Letters 10 (2010), 1652.