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Observation of polaronic effects in electron transport in graphene by infrared spectroscopy KELIANG HE, LIANG ZHAO, JIE SHAN, Case Western Reserve University, KIN FAI MAK, NICK PETRON, JAMES HONE, TONY F. HEINZ, Columbia University, G. LARRY CARR, NSLS, Brookhaven National Laboratory — Polarons, quasi-particles consisting of electrons and the accompanying lattice polarization, are generally considered to be unimportant for the electrical transport properties of nonpolar crystals such as graphene. The distinctive linear dispersion relation found in graphene and the drastically reduced screening of Coulomb interactions associated with the material's reduced dimensionality, however, lead to strong coupling between Dirac electrons and high-energy optical phonons in graphene. In this work, we apply the infrared absorption spectroscopy to investigate the optical conductivity of graphene as a function of electrostatic doping density. We have observed a phonon side band in the intraband optical conductivity with a significant spectral weight transfer from the Drude response, indicating the importance of the polaronic effects. The effects can also be tuned by doping. The conductivity spectra have been analyzed in the framework of the extended Drude model to yield the spectral dependence of the mass enhancement factor (band structure renormalization) and the scattering rate (with an onset for phonon scattering) at different doping levels. Our results are in good agreement with many-body calculations for graphene conductivity with polaronic corrections.

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