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Infrared spectroscopy of disordered graphene: a theoretical analysis

In this presentation, I will report on experiments of the optical response of covalently functionalized graphene samples. We have found that these systems display, upon doping, sharp transparency windows (or antiresonances) in the mid-infrared at frequencies corresponding to center-of-zone phonons as well as edge-of-zone (K point) phonons. Surprisingly, these antiresonances map the presence of unreachable (optically inactive) phonon densities in a process similar in appearance to D-band double resonance in Raman spectroscopy. Our work shows that the mechanism is however very different and results from an intraband scattering mechanism mediated by disorder-induced electron-phonon coupling. I will present a model that involves coherent intraband scattering with defects and phonons, thus relaxing the optical selection rule allowing scattering to phonon other than those at Γ. Numerical simulations based on the model reproduce the features of the experimental observations.

Figures