Reflectance of pristine and N-doped epitaxial graphene from THz to mid-IR

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Graphene optical properties were first investigated with the motivation to maximize its visibility on various substrates [1], so that graphene flakes could easily be located and then patterned to fabricate electronic devices. But a few key experiments revealed that there was much more to expect from this research area, and, today, one can already state that graphene optical properties offer perspectives for various applications in the near future [2]. Recent experiments demonstrated that a gate voltage could tune graphene reflectance and transmittance, particularly in the infrared (IR) range [3]. This tunability was found to stem from strong changes in the Drude component of the optical conductivity, particularly important in the far-IR, and from gate-induced shift of interband transitions, governed by a peculiar threshold at $2E_F$ in graphene (where E_F is the Fermi energy).

Here we investigate on the IR reflectivity spectra of graphene grown epitaxially on 6H-SiC. Contrary to IR transmission spectroscopy which is hampered over a large part of the IR range by the SiC reststrahlen band [4], IR reflectivity can give access to invaluable information over the full range from terahertz (THz) to mid-IR. Peculiar changes in the IR reflectivity spectra of the SiC substrate are observed when graphene is present. In the THz region, these changes are mostly related to the intraband electronic transitions in graphene, and the corresponding optical conductivity depends on the carrier concentration, carrier mobility, Fermi energy and layer number. These important parameters can be extracted by fitting the reflectivity data using a dielectric function model for the SiC, and the optical conductivity for graphene. We show that a consistent and simultaneous analysis of both intraband and interband transition contributions over this broad spectral range allow to obtain more precise information on the carrier properties and layer number in multilayer graphene. Moreover, we also present IR microscopy data in the mid-IR, which allow to investigate on samples homogeneity and to correlate with conventional IR spectroscopy data. Differences between pristine and N-doped graphene are also discussed.

References

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