

Optical properties of dielectric plates coated with gapped graphene

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Abstract

© 2017 American Physical Society. The optical properties of dielectric plates coated with gapped graphene are investigated on the basis of first principles of quantum electrodynamics. The reflection coefficients and reflectivities of graphene-coated plates are expressed in terms of the polarization tensor of gapped graphene and the dielectric permittivity of plate material. Simple approximate expressions for the required combinations of components of the polarization tensor applicable in the wide frequency region, where the presence of a gap influences the optical properties, are found. Numerical computations of the reflectivities of graphene-coated SiO₂ plates are performed for different values of the mass-gap parameter at different temperatures. It is shown that with an increasing gap width the reflectivity of a graphene-coated plate at the normal incidence decreases by up to a factor of 8 depending on the values of frequency and mass-gap parameter. The angle dependences of reflectivities for both polarizations of the incident electromagnetic waves have been computed for Si and SiO₂ plates coated with gapped graphene. We demonstrate that the TM reflectivity has a minimum value at some angle of incidence depending on the mass-gap parameter, frequency and temperature, whereas the TE reflectivity depends on the angle of incidence monotonously. However, for the graphene coatings with a nonzero mass-gap parameter the reflected light cannot be fully polarized. Possible applications of the obtained results are discussed.

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