THz Conductivity of Graphene

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Since its discovery [1] in 2004, graphene, a single layer of carbon atoms arranged in a honeycomb lattice, attracted enormous attention in many scientific fields. This is not only due to the fact that two-dimensional crystalline systems like graphene were supposed not to exist, but mainly due to the unique electronic properties and possible applications in nanoelectronics.

The crystal structure of graphene consists of two equivalent sublattices. Interaction of electrons between these sublattices leads to the formation of two energy bands that intersect at the points K and K' in k-space. In contrast to conventional metals and semiconductors, the electron dispersion relation is linear and gapless around these crossing points. Under certain conditions, this fact is expected to result into strong interaction between graphene and terahertz radiation and hence makes graphene a very interesting material for the terahertz spectral range.

We present an experimental approach to measure the optical conductivity of a graphene monolayer by means of THz time-domain-spectroscopy involving an on-chip coplanar waveguide structure for generation and detection of THz pulses. While the optical conductivity of graphene is constant in the visible spectral region, it is expected to show strong deviation from this behavior in the THz frequency region [2]. This is due to the fact that interband transitions dominate in the visible range, whereas below the mid-infrared range, intraband transitions are dominant.

References

[1] K. S. Novoselov et al., Science 306, 666 (2004)

[2] L. Falkovsky et al., Phys. Rev. B 76, 153410 (2007)