Carrier-optical phonon scattering and quasiparticle lifetime in CVD-grown graphene

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Ultrafast carrier dynamics in graphene grown by chemical vapor deposition (CVD) has been investigated by UV pump/white-light probe spectroscopy. Transient differential transmission spectra of monolayer and stacked graphene films are observed in the visible range from 380 (3.3 eV) to 670 nm (1.9 eV). After photoexcitation, the intraband carrier equilibration by carrier-carrier scattering occurs within 60 fs. The subsequent carrier relaxation process is governed by carrier-optical phonon (c-op) scattering. As extending the probe ranges from visible to infrared wavelengths, we find the evolution of carrier relaxation channels from monoexponential c-op scattering to double exponential decay including c-op and optical phonon-acoustic phonon scattering. Moreover, quasiparticle lifetimes of these graphene samples are continuously obtained for the probe photon energies from 1.9 to 2.3 eV. With the increase of the number of graphene layers, the dependence of quasiparticle decay rate on the probe photon energy becomes obvious and exhibits a clear linear feature for 10-layer stacked graphene films. From the linear fit, a dimensionless coupling constant *W* [1] is derived, which characterizes the scattering strength of quasiparticles by lattice points in graphene. The origin of this dependence is attributed to the dominant c-op intervally scattering and the linear density of states in the probed electronic band of graphene.

Reference:

[1]. T. Ando, Zero-mode anomalies of massless Dirac electron in graphene, Proceedings of 30th International Conference on the Physics of Semiconductors (2010).