Tunable graphene based optics, electronics and photonics

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Graphene, which consists of a single atom-thick plane of carbon atoms arranged in a honeycomb lattice, exhibits unique both “bulk” and “surface” properties of materials due to its tunable electronic structure. In this talk, I would like to present the tunable platform of graphene-based materials including graphene and graphene oxide in optical, electronic and photonic applications by manipulating their corresponding atomic and interfacial structures. By controlling the sp^2/sp^3 ratio of graphene oxide (GO), interesting PL emission of GO and r-GO can be tuned from blue to red color with a wide spectrum [1,2]. Through tuning the atomic structures, several interesting applications of GO in optoelectronic or photovoltaic devices will be also presented as a result of tunable electrical conductivity from a thin tunneling layer of GO to a transparent electrode of graphene[3,4]. The tunable workfunction of graphene makes it an ideal candidate as an “active” electrode.

In addition, we would like to demonstrate an interesting tunable doping mechanism in graphene using so-called self-encapsulated doping or organic/inorganic hybrid doping platform,[5,6] which allows us to fabricate air-stable n- and p-type graphene based transistors with excellent tunability by using chemical or optical ways. I would like to demonstrate the wavelength-selective *p*- and *n*-typed carrier transport behaviors of a graphene transistor based on the organic/inorganic hybrid doping platform, which enables us to control the *dual* carrier-typed transport behaviors of a graphene transistor by wavelength-selective illumination. Finally, we would like to present a unique graphene transfer technique called “clean-lifting transfer (CLT)“, which was just recently developed in our lab.[7], which enables the fabrication of clean and residue-free graphene films with excellent scalability.

Reference:

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