Effect of uniaxial strain on the optical Drude scattering in graphene

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Abstract

Strain, or gauge, fields were demonstrated to have profound effect on the electronic structure, transport and optical properties of graphene[1,2,3,4]. However, effect of strain on graphene in far-infrared (FIR) and terahertz (THz) regime is poorly understood [3] and no systematic reproducible results were achieved so far. Nevertheless, this needs to be explored for low energy flexible optoelectronics.

Using Fourier transform infrared spectroscopy, we systematically studied the far infrared transmission of CVD-monolayer of graphene on a flexible PET (polyethylene terephthalate) substrate subjected to 0.8% of strain [5]. Effective strains were calibrated by Raman spectroscopy and were smaller than the nominal ones due to the relaxation of wrinkles/folds observed from our AFM micrographs when strained. We have observed a strong and unexpected increase in scattering rate by 13% per 1% of strain(Figure1(a)). Also, Drude weight (Figure1(b)) remains constant indicating that substrate acts as a charge reservoir to take into account the strain-induced changes in the density of states. Importantly, found that these effects are reproducible and reversible during the strain cycling.

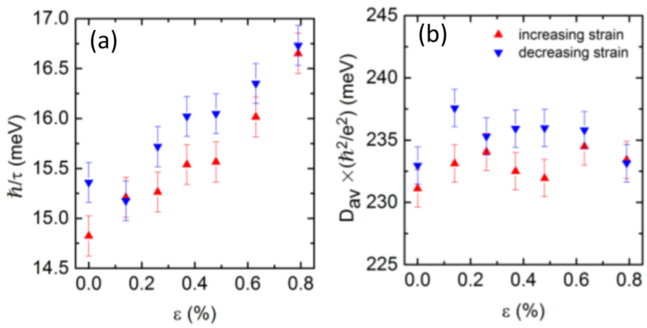

Figure1: (a) Drude scattering and (b)Drude weight as a function of strain over a complete cycle

The strain dependence of the Drude weight and Drude scattering rate studied in our work can have important implications for benchmarking the potential of graphene-based flexible low energy devices.

References

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