Optical reflectivity in potassium doped graphene

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Nowadays, two main techniques exist for graphene's production: micromechanical cleavage and CVD. Understanding the graphene's optical response and the substrate effect are essential for graphene's optoelectronics. The optical reflectivity of graphene in the visible spectral range has been investigated in detail [1] using Fresnel equations. The light absorption and contrast analysis in 2D-nanostructures brings fundamental information about the thickness and morphology of multilayered heterostructures and their interaction with their substrate.

In this work we have conducted a systematic reflectivity analysis of mono and multi-layered graphene (2L, 4L and 5L) on different substrates (SiO_2, and BN), as well as in suspended graphene. Every system was then exposed to a K vapour in a sealed high-vacuum capsule at ~10^{-8} mbar. The optical reflectivity in each system was measured in a perpendicular orientation to the graphene/substrate and their respective contrast was analyzed. To disclose and explain our findings, the optical contrast from each heterostructure was simulated using a simplified mathematical model including the corresponding Fresnel coefficient, and refractive index from each layer.

We confirmed that the interaction of K with the graphene structure changes its optical contrast/reflectivity as expected from the literature. [1,2] We observed (experimentally) the contrast of graphene to be independent of the substrate, and the number of layers when exposed to K. We then consider the potential formation of a potassium superoxide layer on top of the graphene despite of our high-vacuum conditions (10^{-8} mbar). Our preliminary calculations showed that a thin (0.6699 nm) KO_2 layer on a K-doped graphene quenches its intrinsic optical response leading to a relatively constant contrast in every sample. Our findings should be taken into account when considering the use of doped graphene or multi-layered graphene heterostructures for future optoelectronic devices.

References

[1] Z. H. Ni, H. M. Wang, J. Kasim, H. M. Fan, *et al.* Nano Letters, 7-9 (2007) 2758-2763.

[2] C. A. Howard, M. P. M. Dean, and F. Withers. Physical Review B, 84 (2011) 241404.

Figures

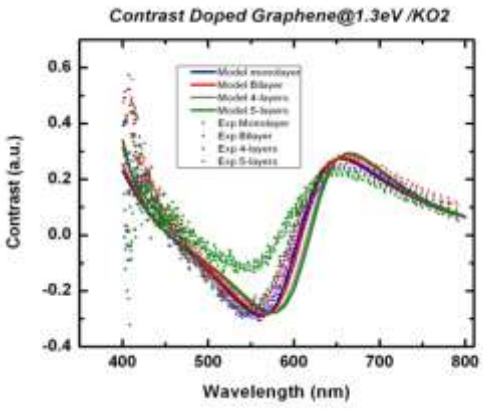

Figure 1: Contrast analysis of mono and multi-layered graphene (2L, 4L and 5L) doped with potassium.