Graphene Sensing with IR Plasmonics

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Following the discovery of graphene [1], there has been growing interest in its use and integration in nanocircuitry and as a sensor platform [2,3]. Although the intrinsic properties of graphene have been investigated theoretically [4], its experimental behaviour in combination with other material systems is far less well explored and understood.

Here, we present a detailed study of the optical properties of commercial CVD grown graphene through its interaction with metallic plasmonic nanoantennas. In addition, we show how it is possible to extract its properties from contact-less optical measurements. Indeed, the combination of graphene with plasmonic sensors increases significantly its fingerprint and allow precise spectral observations at the contrary of usual absolute intensity-related measurements. We report both blue- and red-shifts of the plasmonic resonances of gold structured arrays due to graphene coating. These shifts can be attributed to differences between the type of plasmonic structure and localized mode considered, as illustrated in Fig. 1, as well as the dielectric properties of the graphene itself. In this presentation we will discuss the physics behind these observations by combining measurements with full electrodynamic calculations from the near to mid-infrared. These results open up new schemes for the study of graphene as well as the control of plasmonic resonances.

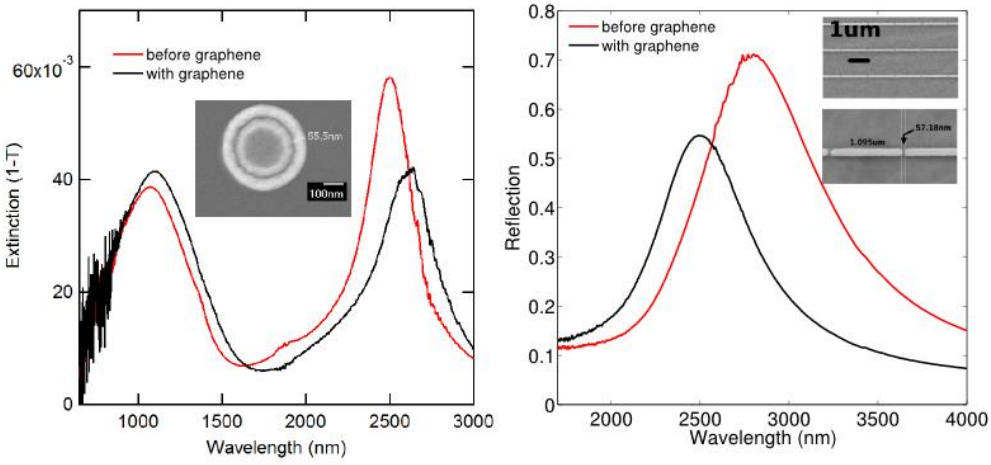

Fig. 1: The shift induced by a single sheet of graphene depends on the kind of localized resonance it is interacting with. For a ring-disk (left), the resonance is redshifted while it is blueshifted for a periodic array of nanorods (right).

[1] K. S. Novoselov, et al., *Science* **306**, 666 (2004).
[2] A. K. Geim, and K. S. Novoselov, *Nat. Mater.* **6**, 183 (2007).
[3] M. J. Allen, V. C. Tung, and R. B. Kener, *Chem. Rev.* **110**, 132 (2010).
[4] A. H. Castro Neto, et al., *Rev. Mod. Phys.* **81**, 109 (2009).