Engineering the electrical and optical properties of graphene materials

Prof Saverio Russo, Centre for Graphene Science, Physics, University of Exeter

Graphene –a single layer of carbon atoms with honeycomb structure- has emerged as a new paradigm in condensed matter physics due to the gamut of unique physical properties which also make it the ideal platform for novel transparent and flexible opto-electronic devices. These unique properties can be further tailored to fit specific device functionalities by means of a perpendicular electric field applied onto few-layer graphene [1] or by chemical bonding of a molecule or a chemical element to the pristine graphene [2, 3]. For example a perpendicular electric field applied onto some of the few-layer graphene systems can result in the opening of a gate tuneable energy gap [1] which has only been directly measured in optical spectroscopy experiments. At the same time, the functionalization with $FeCl_3$ of few-layer graphene results in a new system which is the best known flexible and transparent material able to conduct electricity –i.e. GraphExeter [2]- whereas the functionalization with fluorine makes graphene a wide gap semiconductors [3]. In this talk I will review our most recent contributions to engineer the electrical and optical properties of graphene materials *via* a perpendicular electric field and chemical functionalization to develop whole-graphene flexible and transparent electronics [4].

[1] Appl. Phys. Lett. **100**, 013114 (2012)
[2] Advanced Materials **24**, 2844 (2012)
[3] Nano Lett. **11**, 3912 (2011)
[4] ACS Nano **7**, 5052 (2013)