Opto-electronic properties of graphene oxide

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In this presentation, a solution based method that allows uniform and controllable deposition of reduced graphene oxide (GO) thin films with thicknesses ranging from a single monolayer up to several layers over large areas will be described. The oxidation treatment during synthesis of GO creates sp^3 C-O sites where oxygen atoms are bonded in the form of various functional groups. GO is therefore a two dimensional network of sp^2 and sp^3 bonded atoms, in contrast to an ideal graphene sheet which consists of 100% sp^2 carbon atoms. The most notable difference between GO and graphene is that photoluminescence from blue to red emission can be observed. The atomic and electronic structure along with tunable photoluminescence of graphene oxide at various degrees of reduction will be described.

High temperatures (~ 1000 ^{o}C) are typically required for efficient removal of oxygen functional groups from GO. Furthermore, the attractive properties of graphene are not fully recovered due to creation of structural defects and the presence of residual oxygen in the reduced material. In the second part of the talk, the synthesis and properties of partially oxidized graphene (POG), a material that exhibits significantly different chemical structure to GO will be described. Due to low initial oxygen content, as-synthesized POG can be reduced in mild annealing conditions (< 300 ^{o}C). Our results suggest that fine-tuning the oxidation chemistry of graphene will allow bulk production of highly soluble graphene without extensively compromising its intrinsic properties. We will demonstrate that partial oxidation approach opens up new promising routes to high-performance graphene-based electronics plastic platforms.