Chemical strategies to improve CVD graphene's functionalities in technological applications

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Graphene is gaining increasing technological interest due to its broad applicability from electronics, photonics, photovoltaics and sensoristics to biomedical devices and to a variety of structural applications. The majority of graphene applications take advantage from the unique combination of transparency, conductivity and flexibility. These three properties represent the "graphene core-values" that identify univocally graphene (defined as a single sp^2 carbon layer) in the landscape of graphene-based materials (graphene oxide, reduced graphene oxide, graphene nanoplatelets, etc.). Although many graphene applications have been experimentally demonstrated (1, 2), the technological transfer from laboratory to industrial scale is still limited. The reasons are related to both production cost and quality of graphene currently available.
The discovery of the metal catalyzed chemical vapor deposition, CVD, methodology (3) opened the way for the large scale growth of single layer graphene. However, CVD graphene layers are polycrystalline and, the morphology/structure at atomic level is well far to be free of defects, which affect graphene properties. These defects are often perceived as performance limiters, but in the case of graphene their chemical functionalization can help overcome the current material limitations.
The talk will touch on topics that are explored in our lab: CVD graphene growth and transfer on substrates, graphene doping and functionalization (4). We will present chemical processes that effectively act as "point-defect healing" resulting in: (i) high quality graphene layers, (ii) tuning of the graphene electrical transport properties (iii) p-doping of graphene to very low sheet resistance. Last results on graphene-based devices, from solar cells to sensors and transparent antennas will be presented to validate our chemical strategies for tuning graphene properties.

References:
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