Chemical Routes for the Heavy p-Doping of CVD Graphene

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In addition to its fascinating properties such as one-atom thickness, transparency, electrical and thermal conductivity, the good reputation of graphene as a promising material for technological applications is also due to the possibility to modulate its chemical and physical properties through chemical functionalization and, in particular, doping.
In this contribution we explore several chemical routes for the "heavy" p-doping of graphene by both (i) surface chemical functionalization doping and (ii) substitutional doping methodologies.
We present a doping methodology combining the effect of $SOCl_2$ covalent functionalization with a synergic p-doping effect of non-covalent functionalization with gold nanoparticles [1,2].
Direct growth of substitutional nitrogen doped graphene is also presented. We explore for the first time the possibility of chemically modifying nitrogen functionalities in the sp^2 carbon lattice by post growth treatment to further improve p-type conductivity of graphene.
We demonstrate that these original doping strategies can provide multilayer CVD graphene with record conductive performances, which meet the technical target required by several industrial applications. [1,2]

References

[1] Bianco G.V. et al., Carbon 170 (2020) 75-84;
[2] Bianco G.V et al, Applied Surface Science 564 (2021)150377.

Figures

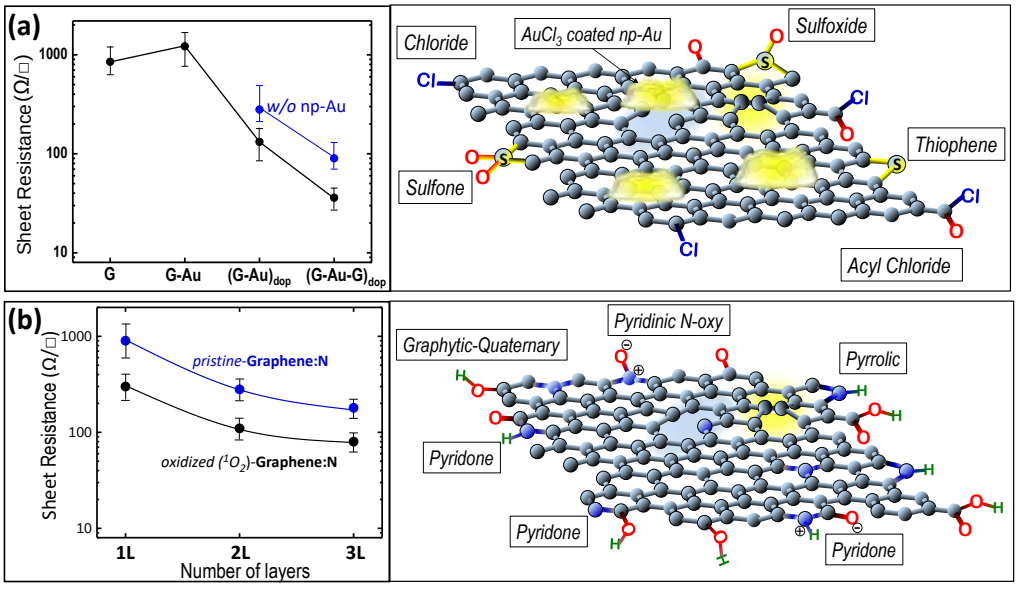

Figure 1: (a) Sheet resistance data of a bilayer graphene on Corning glass following the preparation steps of $SOCl_2$ doping with (black line) and without (blue line) np-Au. **(b)** Sheet resistance of pristine (blue line) and oxidized (black line) N-doped graphene as a function of the layer numbers. Graphic sketches of Au & $SOCl_2$ co-doped multilayers graphene and N-doped graphene are also reported.