Reversible optical doping of graphene

Antoine Tiberj[a], Miguel Rubio-Roy[b], Matthieu Paillet[a], **Jean-Roch Huntzinger**[a], Périne Landois[a], Mirko Mikolasek [a], Sylvie Contreras [a], Jean-Louis Sauvajol [a], Erik Dujardin [b], and Ahmed-Azmi Zahab [a]

[a] Laboratoire Charles Coulomb
[a] Université Montpellier 2 – CNRS, Place Eugène Bataillon, 34095, Montpellier cedex 05, France
[b] CEMES
[b] CNRS – Université de Toulouse, 29 rue Jeanne Marvig, 31055, France

Antoine.Tiberj@univ-montp2.fr

Abstract
The ultimate surface exposure provided by graphene monolayer makes it the ideal sensor platform but also exposes its intrinsic properties to any environmental perturbations. We show in this work that structural and electronic characterization of graphene in air by Raman spectroscopy is significantly affected by the substrate surface cleaning method and moderate laser power conditions. In particular, we demonstrate that the charge carrier density of graphene exfoliated on a SiO2/Si substrate can be finely and reversibly tuned between electron and hole doping with visible photons. The amplitude of this photo-induced doping is found to require hydrophilic substrates and to vanish in suspended graphene. These findings suggest that optically gated graphene devices operating with a sub-second time scale can be envisioned but also that Raman spectroscopy might not be as non-invasive as generally assumed.