Photoactive Graphene Through Sulfur Hexafluoride Ghost Gating

Giuseppe V. Bianco[1]
Marco Grande[1,2], Alberto Sacchetti[1], Giovanni Bruno[1]

[1]Istituto di Nanotecnologia–CNR-NANOTEC, Via Orabona, 4, 70125 - Bari, Italy; [2]Dipartimento di Ingegneria Elettrica e dell'Informazione, Politecnico di Bari, Via Re David 200, 70125 - Bari, Italy.

giuseppevalerio.bianco@cnr.it

Graphene, a single layer of C-sp^2 atoms in a hexagonal lattice, is expected to have great potential for applications in photonics and optoelectronics as evidenced by the great number of research works aimed at the realization of photoactive graphene. Two different approaches are typically applied to graphene for providing photoactivity. The first is based on the opening of an energy band gap through distortion of graphene electronic structure (by functionalization, quantum confinement or electric field perturbation) [1,2]. The second approach relies in the decoration of transparent graphene with photoactive moieties [3-6].

Indeed, a single layer of pristine graphene (only 3.4 Å in thickness) alone absorbs 2.3% of light. Moreover, the linear dispersion relation of graphene electrons implies that for any photon energy there will always be an electron–hole pair in resonance. However, fast electron interband relaxation processes (on the picosecond timescale), prevents any pristine graphene photoactivity referred as the possibility of providing a response in terms of physical or chemical processes when graphene interacted with light.

We demonstrate the possibility of *freezing* interband relaxation of photoexcited electrons in pristine chemical vapor deposition (CVD) graphene by sulfur hexafluoride (SF_6) "ghost gating" [7]. Electron scavenging characteristic of SF_6 [8] is exploited for providing light induced charge accumulation in CVD graphene without any photoactive moieties. Experimental results open new possibilities for applications based on transparent photoactive graphene.

References

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Figures

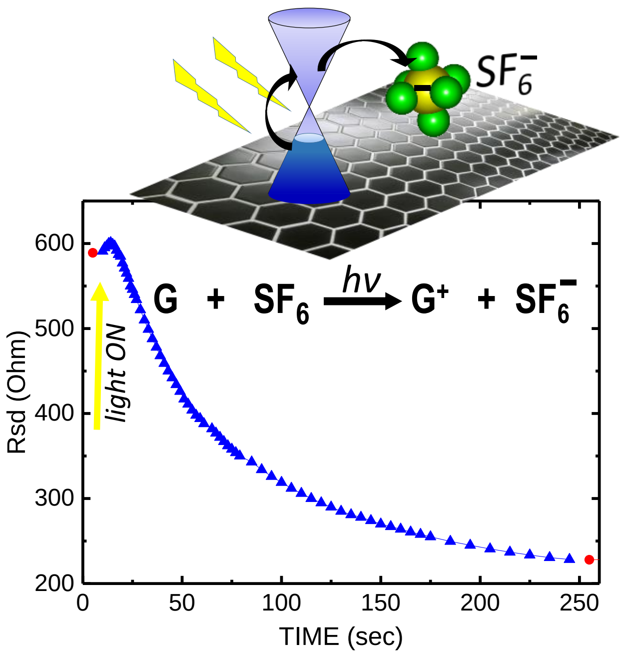

Figure 1: Time evolution of source-drain resistance (Rsd) in a single-layer graphene field effect device under light irradiation. The scheme shows the transfer of the graphene photogenerated electrons to SF_6 and formation of a negative ions layer, i.e, the "gost gate".