Graphene

Graphene, a single layer of C-sp² 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 a 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 (SF₆) “ghost gating” [7]. Electron scavenging characteristic of SF₆ [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


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 SF₆ and formation of a negative ions layer, i.e., the “ghost gate”.

Giuseppe V. Bianco
Marco Grande, Alberto Sacchetti, Giovanni Bruno

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

giuseppevalerio.bianco@cnr.it