The effect of photon energy on hot-carrier mediated photoresponse in graphene

M. Massicotte, K.J. Tielrooij and F.H.L. Koppens

ICFO - Institut de Ciéncies Fotoníques, Mediterranean Technology Park, Castelldefels (Barcelona) 08860, Spain

mathieu.massicotte@icfo.es

Graphene is a promising material for optoelectronic applications requiring efficient and fast light-to-current conversion. Over the last years, its intrinsic photoresponse has been the subject of intensive studies, which generally suggest that the photo-thermoelectric effect can play an important role in the generation of photoresponse [1]. This mechanism relies on the heating of carriers near a junction between regions with different Seebeck coefficients. These hot carriers are generated directly after electron-hole pair excitation by photons and subsequent energy relaxation through carrier-carrier scattering [2].

Here, we address the role of the photon energy on the photo-response driven by hot carriers.

We perform the first comprehensive study of the role of the photon energy on the photoresponse for various graphene photodetectors. In order to unravel the effect of photon energy on the graphene photo-thermoelectric photoresponse, we use a photodetector fabricated on a transparent substrate such that interference effects [3] are inhibited. We find that the power-normalized photocurrent as a function of wavelength is constant, which corresponds to a quantum efficiency that scales linearly with photon energy. Thus a photon with higher energy generates a larger photocurrent, in agreement with efficient carrier heating in graphene [2].

References

[1] Gabor N. M., et al. Science, 334, 6056 (2011)
[2] Tielrooij K. J., et al. Nature Physics, 2564 (2013)
[3] Blake P., et al. Applied Physics Letters, 91(2007)