Graphene photodetectors with p-p+ junctions induced by femtosecond laser irradiation

Aleksei Emelianov[1]
Dmitry Kireev[2]
Ivan Bobrinetskiy[3]

[1]*National Research University of Electronic Technology, Shokin square 1, Zelenograd, Russia*
[2]*The University of Texas at Austin, J.J. Pickle Research Center 160, Austin, Texas, USA*
[3]*BioSense Institute, University of Novi Sad, Dr Zorana Djindjica 1a, Novi Sad, Serbia*

emmsowton@gmail.com

Graphene is one of the most promising materials for advanced electronic applications, due to its extraordinary chemical and physical properties. The interaction between graphene lattice and photons opens the way for the development of new optoelectronic and photovoltaic devices [1]. The photoresponse in graphene is a very promising effect that can be important for the integrated optoelectronics devices because of the wide range of sensitivity from UV to far infrared wavelengths, as well as the low power consumption and high efficiency [2].

Pristine graphene shows a very weak response to visible light, hence fabrication of complex graphene-based detectors is a challenging task. In this work, we utilize the ultrafast laser functionalization of single-layer CVD graphene for highly desirable maskless fabrication of micro- and nanoscale devices. We investigate the optoelectronic response of pristine and functionalized devices under femtosecond and continuous wave lasers irradiation. We demonstrate that the photocurrent generation in p-p+ junctions formed in single-layer graphene is related to the photo-thermoelectric effect. The photoresponsivity of our laser patterned single-layer graphene junctions is shown to be as high as 100 mA/W with noise equivalent power less than 6 kW/cm^2 [3]. These results open a path to a low-cost maskless technology for fabrication of graphene-based optoelectronic devices with tunable properties for spectroscopy, signal processing, and other applications.

References

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[3] Emelianov A. V. et al., ACS Photonics 5 (2018), 3107.

Figures

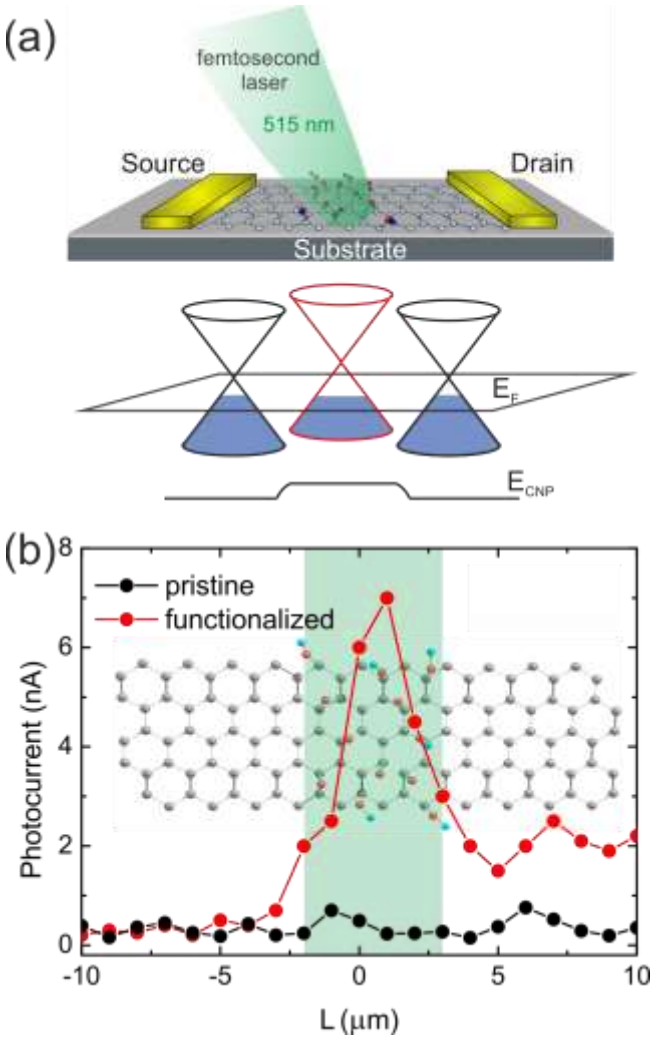

Figure 1: (a) Device geometry and schematic band structure of each region of graphene. (b) Photocurrent profile of graphene FET before and after femtosecond laser functionalization.