High Responsivity and Broadband Photodetector Based on Graphene/Silicon Heterostructure and its Performance Enhancement by Plasmonic Effects

Zefeng Chen and Jian-Bin Xu

Department of Electronic Engineering, and Materials Science and Technology Research Center

The Chinese University of Hong Kong, Hong Kong SAR

**Email of Presenting Author: zfchen@ee.cuhk.edu.hk*

Abstract

We report on an ultra-wide broadband (from visible to infrared) photodetector based on chemical vapor deposition (CVD) graphene–silicon heterostructure, in operation in photoconductor mode. This type of devices show a very high photo-responsivity (>10^4 A W^{-1}) at wavelength of 632 nm. More interestingly, even in the infrared region (1550 nm), where the light absorption solely depends on the graphene sheet, the photo-responsivity of the detector can be as high as 0.23 A W^{-1}. The response time of the device is less than 3 μs, due to the swift transfer mechanism of the interface charges. To further enhance the photo-responsivity in the infrared spectral region, a low-cost method (self-assembly polystyrene sphere as masks) is adopted to fabricate periodic arrays of gold nanostrcutures onto the device atop so as to excite the surface plasmons to promote the optical absorption of graphene in the inferred region. As a result, the photocurrent at wavelength of 1550 nm is increased by about 20 times and the photo-responsivity is significantly gained up to 6.8 A/W.

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