Plasmonic Graphene-Antenna Photodetector and Transistor

Zheyu Fang, Ziwei Li, Xing Zhu ,Pulickel M Ajayan, Peter Nordlander

School of Physics, State Key Lab for Mesoscopic Physics, Peking University, Beijing 100871, China
Department of Electrical and Computer Engineering, Laboratory for Nanophotonics, and Mechanical Engineering and Materials Science Department, Rice University, Houston, Texas 77005, United States

zhyfang@pku.edu.cn

Nanoscale antennas sandwiched between two graphene monolayers yield a photodetector that efficiently converts visible and near-infrared photons into electrons with an 800% enhancement of the photocurrent relative to the antennaless graphene device [1]. The antenna contributes to the photocurrent in two ways: by the transfer of hot electrons generated in the antenna structure upon plasmon decay [2], as well as by direct plasmon-enhanced excitation of intrinsic graphene electrons due to the antenna near field. This results in a graphene-based photodetector achieving up to 20% internal quantum efficiency in the visible and near-infrared regions of the spectrum. This device can serve as a model for merging the light-harvesting characteristics of optical frequency antennas with the highly attractive transport properties of graphene in new optoelectronic devices [3].

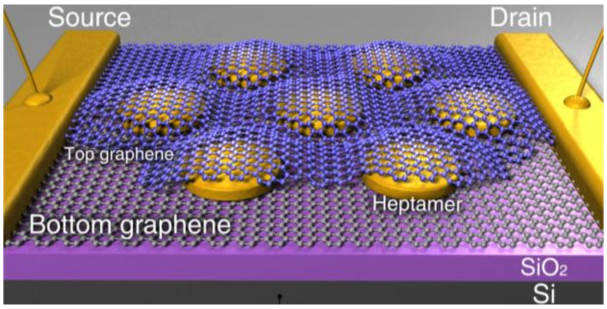

Fig.1. Schematic illustration of a single gold heptamer sandwiched between two monolayer graphene sheets.

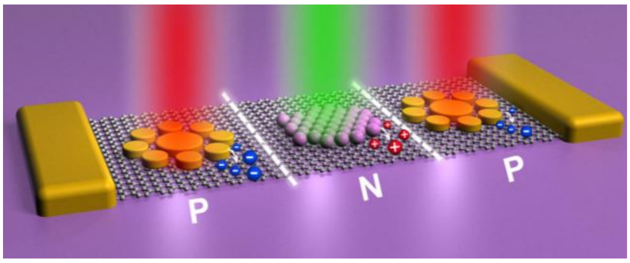

Fig.2. Schematic illustration of optically induced electronics (OIE) by nanoantenna n-doping and quantum dot p-doping for an n-p-n transistor.

References

[1] Z. Fang*, Z. Liu, Y. Wang, P. M. Ajayan, et. al. Nano Lett. 12, 3808, 2012.

[2] Z. Fang*, Y. Wang, Z. Liu, A. Schlather, P. M. Ajayan, et. al. ACS Nano 6, 10222, 2012.

[3] Z. Fang, S. Thongrattanasiri, A. Schlather, et. al. ACS Nano 7, 2388, 2013.