Nanoparticle-Graphene hybrid Schottky junction Silicon photodiodes with enhanced performance

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Photodetectors and optoelectronic devices based on graphene have recently gained significant attention in the scientific community for their unique properties and characteristics, in particular, because of there the broad spectral bandwidth and faster response [1]. For instance, graphene-based vertical Schottky junction photodetectors with interdigitated patterned silicon dioxide / silicon (SiO_2/Si) structures having high absolute responsivity (635 mA/W at wavelength (λ) 850 nm) and external quantum efficiency (above 80% for wavelength 380 nm to 930 nm) were reported [2]. Further, the ability of metal nanoparticles to absorb and scatter light based on their physical characteristics because of excitation of surface plasmons has been studied [3]. In this work, we demonstrate that the performance of such graphene-silicon vertical Schottky junction diodes can be increased by decorating its interface with metal NPs having diameter from 10 nm – 20 nm. It was observed that the presence of the AuNPs increased the performance of the photo diode (upto 56%), even under broadband illumination.

References

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[2] Riazimehr, S., et al., High Responsivity and Quantum Efficiency of Graphene/Silicon Photodiodes Achieved by Interdigitating Schottky and Gated Regions. Acs Photonics, 2019. 6(1): p. 107-115.
[3] Huang, X. and M.A. El-Sayed, Gold nanoparticles: Optical properties and implementations in cancer diagnosis and photothermal therapy. Journal of Advanced Research, 2010. 1(1): p. 13-28.

Figures

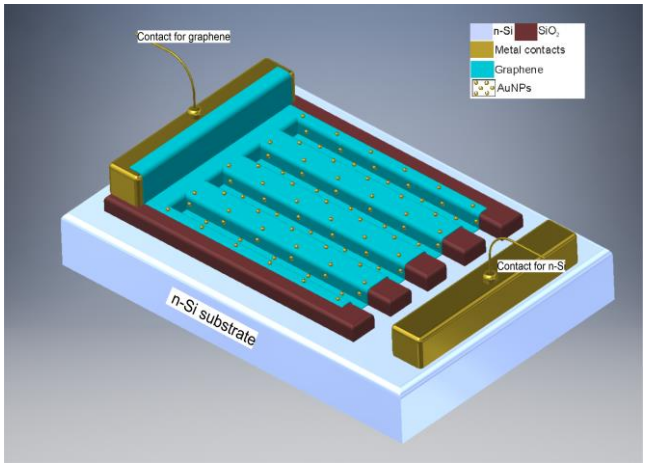

Figure 1: Schematic illustration of a Graphene Si Schottky junction photodetector decorated with metal NPs

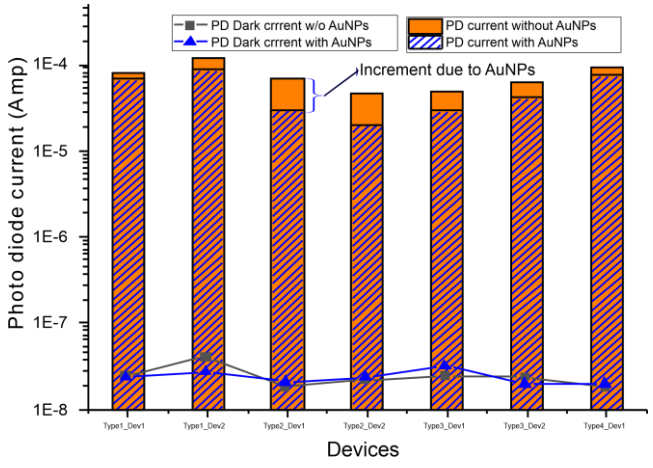

Figure 2: Increment of photodiode current after modification of diode interface with AuNPs