Smart Materials: Methods and Applications – 2017 (SMMA-2017)
ST05

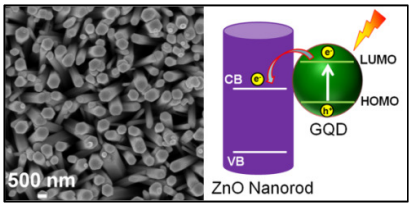
Graphene Quantum Dots Decorated Zinc Oxide Nanorods: Strategies for Exceptional Ultraviolet Photodetection

Dibyendu Ghosh and Sayan Bhattacharyya*

Department of Chemical Sciences and Centre for Advanced Functional Materials, Indian Institute of Science Education and Research (IISER) Kolkata, Mohanpur - 741246, India

*Email for correspondence: sayanb@iiserkol.ac.in

Ultraviolet (UV) photodetectors have shown great promise in communications, environmental monitoring, satellite-based missile plume detection, defence and medical tools.[1,2] The detectors based on ZnO have shown tremendous potential due to their wide bandgap (E_g) of 3.4 eV, large exciton binding energy of 60 meV, high carrier mobility and the ease of synthesizing various morphologies of ZnO. In order to boost the UV detector performance dimensionally reduced graphene quantum dots (GQDs) have been immobilized on vertically aligned ZnO nanorods. The GQD immobilized ZnO nanorod heterostructure shows highly selective visible-blind UV light detection with remarkable responsivity ~6.62×10^4 A/W and detectivity ~1.78×10^{15} Jones under 365 nm (10 μW) incident light and 2V bias potential.[3] The stability was checked up to several cycles and showed fast response time of 2.14 s and recovery time of 0.91 s. The grain boundary assisted electron transport across GQDs has been critically investigated from below-bandgap absorption. The phenomenal performance of ZnO-GQD heterostructure is attributed to the efficient immobilization of GQDs on ZnO nanorods and employing GQDs as photosensitizers than solely as electron transporting medium. The efficiency of GQDs is superior than the carbon quantum dots, graphene oxide or reduced graphene oxide having larger dimensions preventing their immobilization on the ZnO nanorods.



1. Li, W. D.; Chou, S. Y. Solar-blind deep-UV band-pass filter (250–350 nm) consisting of a metal nano-grid fabricated by nanoimprint lithography. *Opt. Express* **2010**, *18*, 931–937.
2. Gong, X.; Tong, M.; Xia, Y.; Cai, W.; Moon, J. S.; Cao, Y.; Yu, G.; Shieh, C. –L.; Nilsson, B.; Heeger, A. J. High-Detectivity Polymer Photodetectors with Spectral Response from 300 nm to 1450 nm. *Science* **2009**, *325*, 1665–1667.
3. Ghosh, D.; Kapri, S.; Bhattacharyya, S. Phenomenal Ultraviolet Photoresponsivity and Detectivity of Graphene Dots Immobilized on Zinc Oxide Nanorods. ***ACS Appl. Mater. Interfaces*** **2016**, *8*, 35496-35504.