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High photosensitivity and broad spectral response of multi-layered germanium sulfide transistors

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In this paper, we report the optoelectronic properties of multi-layered GeS nanosheets (~28 nm thick)-based field-effect transistors (called GeS-FETs). The multi-layered GeS-FETs exhibitremarkably high photoresponsivity of Rλ ~ 206 AW-1under illumination of1.5 μW/cm2at λ = 633 nm, Vg = 0 V, and Vds = 10 V. The obtained Rλ ~ 206 AW-1 is excellent as compared with a GeSnanoribbon-based and the other family members of group IV-VI-based photodetectors in the two-dimensional (2D) realm, such as GeSe and SnS2. The gate-dependent photoresponsivity of GeS-FETs was further measured to be able to reach Rλ ~655 AW-1operated at Vg = -80 V. Moreover, the multi-layered GeS photodetector holds high external quantum efficiency (EQE~4.0 × 104 %) and specific detectivity (D* ~ 2.35 × 1013 Jones). The measured D* is comparable to those of the advanced commercial Si- and InGaAs-basedphotodiodes. The GeS photodetector also shows an excellent long-term photoswitching stability with a response time of ~7ms over a long period of operation (>1 h). These extraordinary properties of high photocurrent generation, broadspectral range, fast response, and long-term stability make the GeS-FET photodetector a highly qualified candidate for future optoelectronic applications.

Keywords: Germanium sulfide, photodetector, photoresponsivity, external quantum efficiency, specific detectivity

Biography:

U. Rajesh Kumar obtained his Bachelor of Technology in Biotechnology from Anna University (2008) and Master ofTechnology in Nanotechnology from Indian Institute of Technology Roorkee (2010). Later he joined the Nanoscale Materials and Bio-analytical Chemistry lab through Taiwan International Graduate Program (TIGP) offered by Academia Sinica to pursue his doctorate in Nanoscience and Nanotechnology under the supervision of Professor Yit-Tsong Chen. His current research interests are the fabrication of field-effect transistors using 2D layered materials and biosensing.