World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:18, No:07, 2024

Asymmetrically Contacted Tellurium Short-Wave Infrared Photodetector with Low Dark Current and High Sensitivity at Room Temperature

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Abstract : Large dark current at room temperature has long been the major bottleneck that impedes the development of high-performance infrared photodetectors towards miniaturization and integration. Although infrared photodetectors based on layered 2D narrow bandgap semiconductors have shown admirable advantages compared with those based on conventional compounds, which typically suffer from expensive cryogenic operations, it is still urgent to develop a simple but effective strategy to further reduce the dark current. Herein, a tellurium (Te) based infrared photodetector is reported with a specifically designed asymmetric electrical contact area. The deliberately introduced asymmetric electrical contact raises the electric field intensity difference in the Te channel near the drain and the source electrodes, resulting in spontaneous asymmetric carrier diffusion under global infrared light illumination under zero bias. Specifically, the Te-based photodetector presents promising detector performance at room temperature, including a low dark current of≈1 nA, an ultrahigh photocurrent/dark current ratio of 1.57×10^4, a high specific detectivity (D*) of 3.24×10^9 Jones, and relatively fast response speed of ≈720 μs at zero bias. The results prove that the simple design of asymmetric electrical contact areas can provide a promising solution to high-performance 2D semiconductor-based infrared photodetectors working at room temperature.

Keywords : asymmetrical contact, tellurium, dark current, infrared photodetector, sensitivity
Conference Title : ICMON 2024 : International Conference on Microelectronics, Optoelectronics and Nanoelectronic Engineering
Conference Location : Tokyo, Japan
Conference Dates : July 22-23, 2024