Broad Spectral Response MoS_2/rGO Photodetector for Optoelectronic Applications

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Abstract

In this research work, a two-dimensional molybdenum disulphide/reduced graphene oxide (2D MoS_2/rGO)-based photodetector has been designed. The two-dimensional MoS_2 is well known for its higher carrier mobility, a suitable direct bandgap, compatibility with flexible and transparent substrates, and atomically thin structure that provides strong light-matter interaction, making it a suitable candidate for photodetectors [1,2]. The rGO is known for its superior charge transport pathways and higher electrical conductivity. Hence, this combination will help to develop high-performance photodetectors [3, 4]. The MoS_2 is synthesised through a solid-state reaction route, and rGO is through a modified Hummers method. The structural, electrical, and morphological characterisations have shown the successful formation of MoS_2/rGO. The Raman analysis shows the in-plane and out-of-plane modes, such as the E'_{2g} and A_{1g} of Mo-S, and the D and G bands, appear due to the presence of rGO [4]. The sheet resistance obtained is in the 200-500 kΩ range. The FESEM images show that rGO nanoparticles are decorated over MoS_2 nanosheet-like morphology. The photodetector sensor is fabricated on an Ag screen-printed IDE patterned glass substrate (1×1 cm²) having a finger gap of 300 micrometres. The insertion of rGO into MoS_2 facilitates improved charge separation during illumination and diminishes carrier recombination. The MoS_2/rGO photodetector is able to detect wavelengths ranging from 300 nm to 1100 nm. The maximum output generated from the photodetector is 200 millivolts of photovoltage at 1 mW input, indicating that photocarriers can be generated and conveyed rapidly. The findings indicate that the 2D MoS_2/rGO combination may serve as an advanced material for high-performance photodetector applications.

References

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Figures

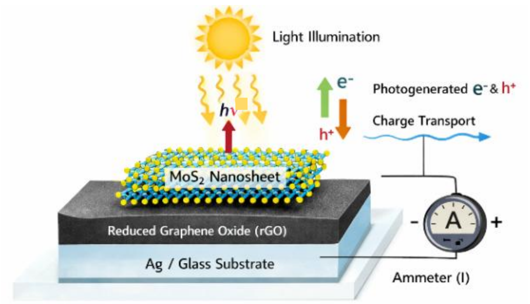

Figure Schematic of MoS2/rGO photodetector