

ABSTRACT

This study presents the successful synthesis of a novel nanocomposite, namely a germanium quantum dot/nitrogen-doped graphene nanocomposite (GeQD/NGr), and its use in the modification of the photoactive medium of bulk heterojunction solar cells (BHJ-SCs). The nanocomposite was prepared in two sequential steps. Firstly, a reduced graphene oxide-germanium oxide nanocomposite (rGO-GeO₂) was synthesized by microwave-assisted solvothermal reaction. The second step involved simultaneous N-doping of graphene and reduction of GeO₂ to obtain the GeQD/NGr nanocomposite by thermal treatment. The nanocomposite consists of highly crystalline, spherical shaped GeQDs with a mean diameter of 4.4 nm affixed on the basal planes of NGr sheets. Poly-3-hexylthiophene (P3HT), (6-6)phenyl-C60-butyric acid methyl ester (PCBM) and GeQD/NGr were used as the photoactive layer blend in the fabrication of BHJ-SCs. Enhanced short-circuit current density (J_{sc}) and fill factor (FF) is derived from the incorporation of the GeQD/NGr nanocomposite in the active layer. The nanocomposite in the active layer blend serves to ensure effective charge separation and transportation to the respective electrodes. Consequently, an improvement of up to 183% in the power conversion efficiency is achieved in the BHJ-SCs by the GeQD/NGr modification.

Keywords

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