

Efficient Bulk Heterojunction Hybrid Solar Cells with Microwave-Processed Ag-Graphene Nanocomposites in Active Layer

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Herein, we present a simple, eco-friendly one-step method that can produce silver nanoparticles (Ag NPs) and reduced graphene oxide (rGO) in the form of Ag-rGO composites through one-step microwave-assisted reduction (MWAR). As-synthesized Ag-rGO composite was introduced into the active layer of bulk hetero-junction solar cell based on P3HT:PCBM. Compared to the P3HT:PCBM only device (i.e., control device), the Ag-rGO implemented best device showed a power conversion efficiency (PCE) of 4.23 %, which is about 42 % increase over the control device (i.e. PCE=2.98 %). This dramatic increase in PCE was found to be mainly due to the increase in short-circuit current (J_{sc}) from 9.54 to 12.7 mA/cm² (about 33 % increase), suggesting that the incorporation of Ag-rGO enhances the charge carrier generation and fast extraction to the electrode. More interestingly, the Ag-rGO composite based solar cells without encapsulation showed remarkable air stability with retaining ~90 % of its original PCE and ~92% of J_{sc} and ~98% of fill factor for 30 days under ambient environment.