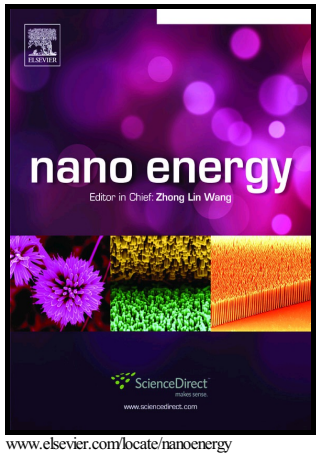

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Tahmineh Mahmoudi, Seunghui Seo, Hwa-Young Yang, Won-Yeop Rho, Yousheng Wang, Yoon-Bong Hahn*

School of Semiconductor and Chemical Engineering, Nanomaterials Processing Research Center, Chonbuk National University, 567 Baekje-daero, Deokjin-gu, Jeonju 561-756, Republic of Korea

Abstract

Herein, we present a simple, eco-friendly one-step microwave-assisted reduction (MWAR) that can produce silver nanoparticles (Ag NPs) and reduced graphene oxide (rGO) in the form of Ag-rGO composites for application in heterojunction hybrid solar cells. The field-effect transistor fabricated with the MWAR Ag-rGO composite showed p-type behavior with a high mobility of 3.3×10^5 $cm^2V^{-1}s^{-1}$ and conductivity of 9×10^6 S/m which is one-order of magnitude greater than pristine graphene (i.e., 1.59×10^5 S/m). As-synthesized Ag-rGO composite was introduced into the active layer of bulk heterojunction solar cell based on P3HT:PCBM. Compared to the P3HT:PCBM only device (i.e., control device), the Ag-rGO implemented 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 an increase in short-circuit current (J_{sc}) from 9.55 to 12.76 mA/cm^2 (about 33 % increase), suggesting that the incorporation of p-type Ag-rGO into the active layer enhances the charge carrier generation and fast extraction of holes to the electrode. Furthermore, the Ag-rGO composite based solar cells without encapsulation showed remarkable air stability with retaining ~90 % of its original PCE and ~93% of J_{sc} for 30 days under ambient environment, attributed to gas barrier feature of the randomly distributed graphene sheets.

Keywords: Hybrid solar cells, Ag-graphene composite, Microwave-assisted reduction, Air stability

* Corresponding author:

Email address: ybhahn@chonbuk.ac; Phone: +82-63-270-2439, Fax: +82-63-270-2360