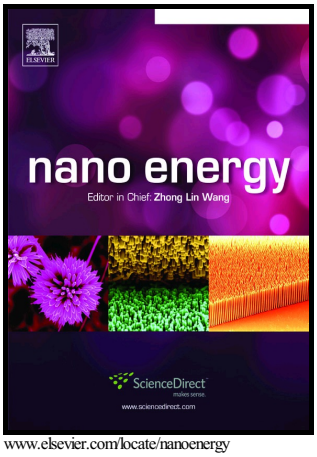

www.elsevier.com/locate/nanoenergy

Reduced Graphene Oxide-Assisted Crystallization of Perovskite via Solution-Process for Efficient and Stable Planar Solar Cells with Module-Scales

Jun-Seok Yeo, Cheol-Ho Lee, Dawon Jang, Sungho Lee, Seung Mu Jo, Han-Ik Joh, Dong-Yu Kim

PII: S2211-2855(16)30483-9
DOI: http://dx.doi.org/10.1016/j.nanoen.2016.10.065
Reference: NANOEN1590

To appear in: *Nano Energy*

Received date: 14 August 2016
Revised date: 30 October 2016
Accepted date: 30 October 2016

Cite this article as: Jun-Seok Yeo, Cheol-Ho Lee, Dawon Jang, Sungho Lee Seung Mu Jo, Han-Ik Joh and Dong-Yu Kim, Reduced Graphene Oxide Assisted Crystallization of Perovskite via Solution-Process for Efficient an Stable Planar Solar Cells with Module-Scales, *Nano Energy* http://dx.doi.org/10.1016/j.nanoen.2016.10.065

Reduced Graphene Oxide-Assisted Crystallization of Perovskite via Solution-Process for Efficient and Stable Planar Solar Cells with Module-Scales

Jun-Seok Yeo[a], Cheol-Ho Lee[a], Dawon Jang[a], Sungho Lee[a], Seung Mu Jo[a], Han-Ik Joh[a,*], and Dong-Yu Kim[b*]

[a]Carbon Convergence Materials Research Center, Institute of Advanced Composite Materials, Korea Institute of Science and Technology, San 101, Eunha-ri, Bongdongeup, Wanju-gun, Jeollabukdo, 565-905, Republic of Korea.

[b]School of Materials Science and Engineering, Gwangju Institute of Science and Technology, Gwangju, 500-712, Republic of Korea

hijoh@kist.re.kr (H.-I. Joh)

kimdy@gist.ac.kr (D.-Y. Kim)

[*]Corresponding author. Tel.: +82-63-219-8137; Fax: +82-63-219-8242.

[*]Corresponding author. Tel.: +82-62-715-2319; Fax: +82-62-715-2304.

Abstract

Organometal trihalide perovskite solar cells (PeSCs) have recently opened a new era for photovoltaics power sources via the tremendous increase in power conversion efficiency (PCE) in the past five years. The next achievement will occur when scalable and processable PeSCs are realized because of a fundamental understanding of the interfacial characteristics and perovskite crystallization in PeSCs. Here, we report solution-processed planar PeSCs with well-tailored functional graphene, successfully demonstrating excellent module PCEs of 10.0% and 8.1% for rigid and flexible substrates, respectively, with active-area of 10 cm^2. Systematic investigations reveal that molecular-doped reduced graphene oxide with fluorine atoms (MFGO) exhibits fast charge-extraction ability and well-aligned energetic interface characteristic due to its intrinsic structure, and MFGO promotes perovskite crystallization and orientation with minimized stoichiometric defects. The solution-processable graphene can function not only as an efficient and stable interlayer but also as an inducer of the crystallization of the perovskite layer in simplified device architectures without a complex process.

Keywords: perovskite solar cells, graphenes, interfacial layers, solar cell modules, flexible electronics

1. Introduction