VIDEO ARTICLE

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Highly Stable and Efficient Perovskite Solar Cells with Graphene-Based Functional Nanocomposites

Yoon-Bong Hahn

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

Corresponding and Presenting Author. E-mail: ybhahn@jbnu.ac.kr

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Abstract

For practical use of perovskite solar cells (PSCs) the instability issues of devices, attributed to degradation of perovskite molecules by moisture, ions migration, and thermal- and light-instability, have to be solved. Furthermore, most of presented high efficiency PSCs utilize halogenated antisolvents such as toluene and chlorobenzene to assist perovskite crystal growth with large grain-size and high uniformity, but they are toxic and detrimental to environment. To solve such issues, we developed simple methods for production of functional nanocomposites such as Ag-graphene, Al_2O_3/graphene, NiO-graphene, perovskite/Ag-graphene and perovskite/NiO-graphene, and utilized them for the fabrication of PSCs. We reported highly efficient and stable PSCs based on perovskite/Ag-reduced graphene oxide (Ag-rGO) and mesoporous Al_2O_3/graphene (mp-AG) composites. The mp-AG composite was conductive with one-order of magnitude higher mobility than mp-TiO_2 and used for electron transport layer (ETL). Compared to the mp-TiO_2 ETL based cells, the champion device based on perovskite/Ag-rGO and $SrTiO_3$/mp-AG composites showed overall a best performance (i.e., $V_{OC} = 1.057$ V, $J_{SC} = 25.75$ mA/cm^2, FF = 75.63 % and PCE = 20.6 %). More importantly, the champion device without encapsulation exhibited not only remarkable thermal- and photo-stability but also long-term stability with retaining 97-99 % of the initial values of photovoltaic parameters with sustaining ~ 93% of initial PCE over 300 days under ambient conditions.

Biography of Presenting Author

Yoon-Bong Hahn is Fellow of the American Ceramic Society (ACerS), Fellow of the Korea Academy of Science and Technology (KAST), Director of BK21 Center for Future Energy Materials and Devices, and Head of School of Semiconductor and Chemical Engineering, Jeonbuk National University (JBNU). He joined JBNU in 1991, prior to which he worked for LG Metals Research Center for 1988-1991 after he received his Ph.D. in Metallurgical Engineering from University of Utah in 1988. His research interest is synthesis of metal and metal oxide nanostructures and their applications for solar cells, chemical and biological sensors and

printed electronics, resulting in over 295 peer-reviewed SCI papers (total citations over 12,000 and h-index 57 by Google Scholar) and 14 registered patents. He co-authored 6 books including Metal Oxide Nanostructures and Their Applications (5 volume sets) published by American Scientific Publishers in 2010. He received MCARE Outstanding Research Award in 2019 by KIChE, Woo SeongIl Materials Awards 2018 by KIChE, Asian Energy Technology Award 2017 by IAAM, Rudolf A. Marcus Award for outstanding research in the area of chemical science in 2016, the American Ceramic Society Global Ambassador Award 2016, the Scientist of the Month Award in 2011 by Korea Ministry of Education, Science and Technology, the CBNU's Best Research Professor Award consecutively in 2008-2010, and Top 100 Scientists Award four times in 2005, 2011, 2014 and 2015 accredited by International Biographical Center, Cambridge, UK.

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