Spin Coating Process for Highly Efficient 10cm × 10cm Perovskite Solar Modules Enabled by Self-Assembly of SnO2 Nanocolloids

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Abstract

Currently, perovskite solar cells (PSCs) are competitive in the market and require the development of scalable deposition techniques that are compatible with perovskite solar module (PSM) manufacturing. Recently, scalable perovskite fabrication techniques for large, uniform, and highly crystalline perovskite layers have been developed by controlling the crystal chemistry of perovskite precursors. However, scalable techniques for the electron transport layer (ETL) and hole transport layer (HTL) have rarely been investigated. A major challenge in a scalable technique is obtaining a uniform, highly crystalline, and ultrathin ETL at a low temperature. Here, large-area SnO_2 ETLs (100 cm^2) are fabricated by an electrostatic self-assembly method. The ETLs coated onto haze fluorine-doped tin oxide (FTO) show high uniformity without pin holes, as confirmed by an electroluminescence image of the PSM. In addition, the uniform and pin-hole free SnO_2 coating is indirectly verified by observing the unchanged shunt resistance of the PSC with increasing active area, compared to the conventional SnO_2 ETL-based PSC. Based on this self-assembly method, PSMs of areas 25 cm^2 and 100 cm^2 are fabricated with a power conversion efficiency (PCE) of 15.3% and 14.0% without shunt resistance loss, respectively.

Keywords: *Large scale, perovskite solar module, self-assembly, scalable ETL process, low temperature*

Biography

Gill Sang Han is a research professor in the School of Advanced Materials Science & Engineering at Sungkyunkwan University. He received his PhD degree in School of Advanced Materials Science & Engineering from Sungkyunkwan University in 2015 and joined University of Pittsburgh as a post doctor, from 2015 to 2018. He has published over 50 peer-reviewed papers regarding the synthesis of nanostructured semiconductors and perovskite solar cells.