High-performance Planar Perovskite Solar Cells Exploiting a Compact TiO_2/Anatase TiO_2 Nanoparticles Electron Transport Bilayer

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Interface engineering plays a promising strategy to produce highly efficient planar heterojunction (PHJ) perovskite solar cells. Higher potential single-crystalline anatase titania nanoparticles (TiO_2 NPs) with average diameter sizes about 6 to 10 nm, were synthesized by a novel one-step hydrothermal route using water-soluble titanium complex as a titanium source. Herein, a novel compact TiO_2/Anatase TiO_2 NPs bilayer was introduced as an electron transport layer (ETL) by comprising spray pyrolysis (SP) deposition and spin-coating (SC) technique, respectively, in PHJ perovskite solar cells. A SP-TiO_2/SC-Anatase TiO_2 NPs bilayer based perovskite solar cells are facilitated more efficient electron transport, charge extraction, and low interfacial recombination, and thus leads champion efficiencies up to 17.05% by a significant decrease of current density *versus* voltage (*J-V)* hysteresis, presenting almost 12% enhancement compared to the TiO_2 single layer based counterparts. The PHJ perovskite solar cells exhibited a spectral response that extended from the visible to the near-infrared region with a broad, flat absorption peak of intensity 80%–85% at approximately 380–750 nm. The higher IPCE value of the device with a bilayer in the visible-to-near-infrared wavelength region than those of the other devices suggests that the bilayer layer collect electrons more efficiently at the perovskite/TiO_2 edge because it successfully lowers the interfacial energy barrier. This facial process and significant performance enhancement revealed that the resulted bilayer could be good ETL candidates for high-performance PHJ perovskite solar cells.

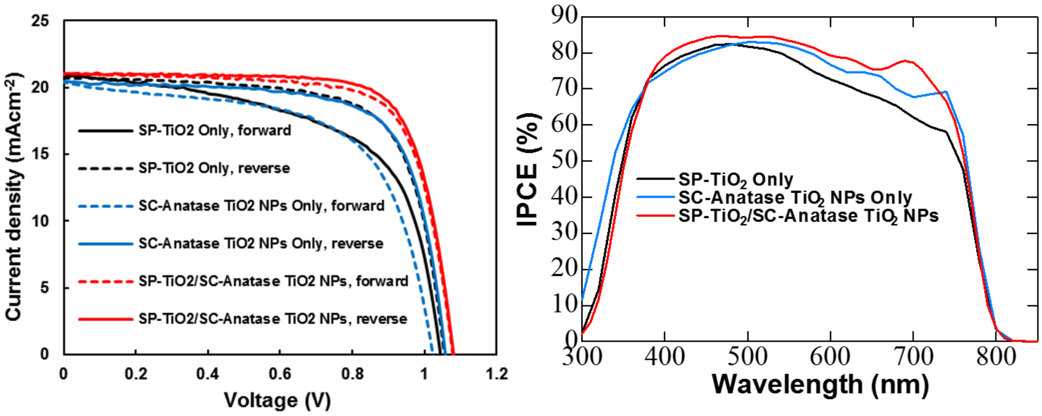

Fig. (a) Current density *versus* voltage (*J-V*) characteristics and (b) incident photon-to-current conversion efficiency (IPCE) spectra of devices with and without bilayer.

Keywords: Planar Perovskite Solar Cells, Interface Engineering; SP-TiO_2/SC-Anatase TiO_2 NPs Bilayer.

Acknowledgement: This study was supported in part by Research and Study Project of Tokai University General Research Organization.