Effect of $TiCl_4$ Treatment on Low-Temperature Processed Brookite TiO_2 Nanoparticle Layers for Electron Transport Layer of Efficient Planar Perovskite Solar Cells

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Interface modification of the electron transport layer (ETL) plays a key strategy to produce efficient planar perovskite solar cells (PSCs). Herein, we demonstrate high-phase-purity, single crystalline, and low-temperature (<180 ºC)-processed brookite TiO_2 nanoparticle scaffold layer as the compact ETL [1], followed by $TiCl_4$ treatment with different concentrations of 40mM, 60mM and 80mM in planar PSCs. An entire perovskite fabrication process was done in the low-temperature process. The optimum concentration of $TiCl_4$ was 40mM and results in the best improvement of charge transfer between the perovskite to ETL layer (BK TiO_2 NPs has a single-crystalline 30nm spherical shape), for which a maximum power conversion efficiency of 15.49% (reverse scan) was obtained as shown in Figure (a). The planar PSCs exhibited higher spectral response from visible light to near-infrared region with a broad, and flat absorption peak intensity of 85%, at 380–750 nm than others concentrations, as shown in Figure (b). Thus, the present work is expected to provide an important sign to obtain the low-cost planar PSCs and enable clean and eco-friendly fabrication of mass production.

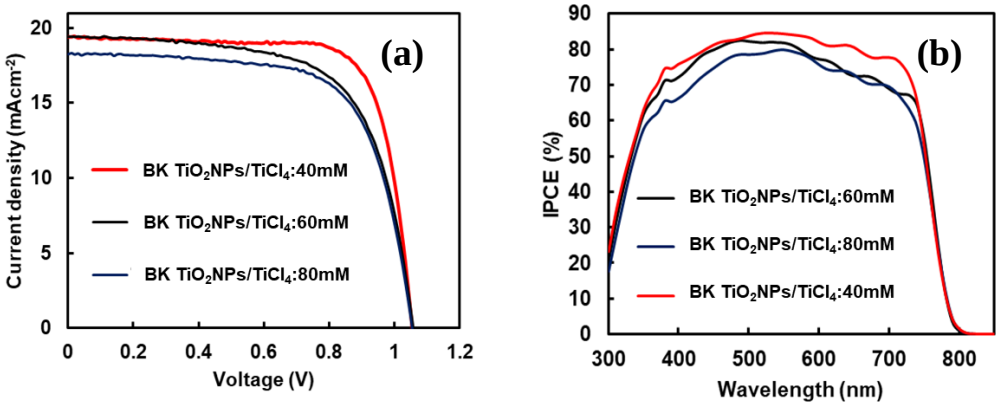

Figure Current density *versus* voltage (*J-V*) characteristics (reverse scan) (a) and photon-to-current conversion efficiency (IPCE) spectra (b) of PSCs with different concentrations of $TiCl_4$.

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Reference

1. Shahiduzzaman, M.; Visal, S.; Kuniyoshi, M.; Kaneko, T.; Umezu, S.; Katsumata, T.; Iwamori, S.; Kakihana, M.; Taima, T.; Isomura, M.; Tomita, K. *Nano Lett.* **2018**. (**DOI:** 10.1021/acs.nanolett.8b04744)