SnO_2–TiO_2 Hybrid Nanofibers for Efficient Dye-Sensitized Solar Cells

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ABSTRACT
Pristine SnO_2 nanostructures typically result in low open circuit voltage (V_{OC}) <500 mV due to the lower Fermi energy (E_F) when employed as a photoanode materials in dye sensitized solar cells (DSSCs). On the other hand, the most successful photoanode material, i.e., TiO_2 nanoparticle although provides a high $V_{OC} \geqslant 800$ mV result in poor charge collection owing to their inferior electron mobility (μ_n). Herein, we employ nanofiber–nanoparticle composite of SnO_2–TiO_2 which showed similar V_{OC} and short circuit current density (J_{SC}) to a reference TiO_2 based DSSCs. The nanocomposite developed here involves multi-porous SnO_2 nanofibers characterized by a lower E_F; however, with higher μ_n and TiO_2 nanoparticles of higher E_F and lower μ_n. The TiO_2particles in the pores of SnO_2 nanofibers were developed by $TiCl_4$ treatment, whose concentration is optimized for the saturated J_{SC} and V_{OC}. The best performing DSSCs fabricated using the composite electrodes deliver power conversion efficiency (PCE) of ≈7.9% (V_{OC} ≈ 717 mV; J_{SC} ≈ 21 mA cm^{-2}), which is significantly higher than pure SnO_2photoanode with PCE ≈ 3.0%
(J_{SC} ≈ 14.0 mA cm^{-2} and V_{OC} ≈ 481 mV) at similar experimental conditions.

KEYWORDS: Photovoltaic; SnO_2 nanofibers; TiO_2–SnO_2 composite; Interfacial charge recombination; Electron life time

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