Characteristics of ZnO-SnO2 composite nanofibers as a photoanode in dyesensitized solar cells

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Abstract

Composites materials are aimed to combine properties of their components to achieve a desired device functionality; however, synthesizing them in morphologies such as one dimensional nanofibers is challenging. This article compares optical and electrical properties of ZnO-SnO2 composite nanofibers (CNFs) synthesized by electrospinning technique for energy harvesting applications with a similar CNFs (TiO2-SnO2) and their single component nanofibers (NFs). The composites formation is confirmed by X-ray and electron diffraction, energy dispersive X-ray, high-resolution transmission electron microscopy (HRTEM), and Xray photoelectron spectroscopy analyses; the morphology is examined by HRTEM and field emission scanning electron microscopy. The electrochemical properties of the CNFs are studied by cyclic voltammetry, absorption spectroscopy, and electrochemical impedance spectroscopy. The CNFs behaved as a single semiconducting material of band gap ~3.32 (ZnO-SnO2) and ~3.15 (TiO2-SnO2) eV. The CNFs showed superior photoconversion efficiency (PCE ~5.60% for ZnO-SnO2 and ~8.0% for TiO2-SnO2 CNFs) compared to its binary counterparts SnO2 (~3.90%), ZnO (~1.38%) and TiO2 (~5.1%) when utilized as photoanodes in dye-sensitized solar cells.