Synergistic combination of electronic and electrical properties of SnO_2 and TiO_2 in a single SnO_2-TiO_2 composite nanofiber for dye-sensitized solar cells

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A B S T R A C T

Tin dioxide (SnO_2) and titanium dioxide (TiO_2) are popular metal oxide semiconductors; they are explored for many applications because of their unique properties. This paper details that electronic and electrical properties of SnO_2 and TiO_2 can be synergistically combined in an one-dimensional nano-structure, such as electrospun nanofibers. The resulting composite nanofibers (CNFs) showed beneficial properties when used as a photoanode in dye-sensitized solar cells (DSSCs). In particular, the CNFs showed higher conduction band energy than SnO_2 and higher electrical conductivity than TiO_2. The SnO_2-TiO_2 CNFs are synthesized by electrospinning a polymeric solution containing equimolar concen-tration of tin chloride and titanium alkoxide precursors and subsequent annealing. The composite for-mation is demonstrated by X-ray diffraction and energy dispersive X-ray measurements and morphology by scanning electron microscopy. Synergy in electronic and electrical properties are demonstrated by cyclic voltammetry, absorption spectroscopy, and electrochemical impedance spectroscopy. Dye-sensitized solar cells fabricated using the CNFs as photoanode showed higher open circuit voltage and short circuit current density than those achieved using pure SnO_2 and pure TiO_2, respectively.

Keywords: Renewable energy, Energy conversion materials Photovoltaics, Hybrid nanofibers Electrospinning