Charge transport through electrospun SnO_2 nanoflowers and nanofibers: Role of surface trap density on electron transport dynamics

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ABSTRACT

Abstract Image

A larger amount of tin precursor was dispersed in electrospun polyvinyl acetate fibers than that required for SnO2 fiber formation upon annealing, thereby creating a constraint such that all nuclei formed during annealing could not be accommodated within the fiber, which leads to enhanced reaction kinetics and formation of highly crystalline–cum–higher surface area SnO2 flowers. The flowers are shown to have a lower density of surface trap states than fibers by combining absorption spectra and open circuit voltage decay (OCVD) measurements. Charge transport through the SnO2 flowers in the presence of the iodide/triiodide electrolyte was studied by OCVD, electrochemical impedance spectroscopy, and transient photodecay techniques. The study shows that the flowers are characterized by higher chemical capacitance, higher recombination resistance, and lower transport resistance compared with fibers. Photocurrent transients were used to extract the effective electron diffusion coefficient and mobility which were an order of magnitude higher for the flowers than that for the fibers. The flowers are also shown to have an enhanced Fermi energy, on account of which as well as higher electron mobility, dye-sensitized solar cells fabricated using the SnO2 flowers gave VOC ∼700 mV and one of the highest photoelectric conversion efficiencies achieved using pure SnO2.

KEYWORDS:

Chemical capacitance; Dye-Sensitized solar cell; Electron diffusion coefficient

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