Effect of Electrospun Hierarchical Mesoporous Anatase TiO_2 Nanofibers on Dye-Sensitized Solar Cells

Yu Pin Lin[1], Sih Yin Lin [1], Yuan Ching Lee[1], Yui Whei Chen-Yang[1,2,*]

[1]Department of Chemistry, [2]Center for Nanotechnology, Chung Yuan Christian University, 200 Chung-Pei Road, Chung-Li 32023, Taiwan (R.O.C.)

*Corresponding Author e-mail: yuiwhei@ cycu.edu.tw.

Abstract

In this study, a hierarchical mesoporous anatase TiO_2 nanofiber material (HTNF) was synthesized *via* the electrospinning method followed with a template-free hydrothermal method. The surface morphology, crystal phase and mesopore property of the HTNF were investigated in detail by SEM, TEM, XRD and N_2 adsorption-desorption measurements. Compared to the pure electrospun TiO_2 nanofiber material (TNF), it was found that HTNF exhibited dense nanotube branches grafted on the fiber surface and about 5 times larger surface area. The effect of the hierarchical TiO_2 nanofibers as the photoanode on the photovoltaic performance of the dye-sensitized solar cells (DSSCs) were investigated by the UV-vis absorption and diffuse reflectance spectra, photocurrent density-voltage (*J-V*) curves, incident photon to current conversion efficiency (IPCE) spectra, electrochemical impedance spectroscopy (EIS), intensity-modulated photocurrent spectroscopy (IMPS), and intensity-modulated photovoltage spectroscopy (IMVS) measurements. The highest power conversion efficiency (7.86%) was achieved by the HTNF-based bilayered photoanode and was about 26% higher than that by the TNF-based bilayered photoanode (6.24%). The significant improvement is mainly attributed to the higher dye loading and better light scattering that leaded to the higher light harvesting, as well as the faster electron transport and lesser charge recombination that resulted in the higher charge collection efficiency.

Acknowledgement:

The authors gratefully acknowledge National Science Council, Taiwan, ROC for supporting the research work under the grant number: NCS 100-2113-M-033-002-MY3.