Fabrication of Titanium Dioxide Nanotubes and their Photovoltaic Performance for Dye-sensitized Solar Cells

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TiO₂ nanotubes (TNTs) were prepared by the electrochemical anodization method using titanium thin films deposited on indium tin oxide (ITO) substrates by the DC magnetron sputtering technique. The effect of voltage (20 - 40 V) and amount of ammonium fluoride (NH₄F) (0.4 - 1.4 wt%) were investigated. The fabricated TNTs were characterized by field emission scanning electron microscopy (FE-SEM), X-Ray Diffraction (XRD), X-ray Photoemission spectroscopy (XPS), and Fourier-Transformed Infrared Spectrophotometry (FT-IR) techniques. XRD pattern data exhibited anatase phase when TNTs were annealed at 400°C for 3 h. The XPS results revealed complement of Ti, O, F, Sn, In and C. The FT-IR spectrum exhibited the characteristic bands of the TiO₂ which indicate the Ti-O stretching mode. The average diameter and length of TNTs depend on ammonium fluoride, water and voltage and the optimal conditions were found to be 0.8 wt% ammonium fluoride, and voltage at 30 V. The obtained TNTs have an averaged diameter of 38 nm and length of 763 nm. For dye-sensitized solar cells (DSSCs) application, ruthenium complex (N719) was used as a sensitizer in this work. The energy conversion efficiency (η) of TNTs was also evaluated.

Keywords: TiO₂ nanotubes, Electrochemical anodization method, Dye-sensitized solar cell, N719 ruthenium-based dye, Photovoltaic performance

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