



A facile impregnation synthesis of Ni-doped TiO₂ nanomaterials for dye-sensitized solar cells

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ABSTRACT

This study reports a facile impregnation method for synthesizing Ni-doped TiO₂ nanomaterials using P25-TiO₂ as a starting material. The as prepared nanomaterials were subjected to structural and optical characterizations and subsequently employed in photovoltaic studies. X-ray diffraction (XRD) and Raman studies confirmed that Ni doping did not alter the anatase and rutile contents of P25-TiO₂. Also, the presence of the constituent dopants and their ionic states were confirmed by Energy-Dispersive X-ray (EDX) and X-ray photoelectron (XPS) spectroscopies. Topographic Atomic Force Microscopic (AFM) images illustrated that Ni doping had increased the surface roughness of the TiO₂. Optical characterization by UV-Visible spectroscopy revealed that the Ni doping had caused red shift in light absorption due to reduced TiO₂ bandgap and improved the dye adsorption on TiO₂ films. Then, the photocurrent–photovoltage property of the fabricated devices was investigated and the optimized 0.10 wt% Ni-doped TiO₂ photoanode based device exhibited pronounced power conversion efficiency (PCE) of 6.29% under air mass (AM) 1.5 conditions (100 mWcm⁻², 1 sun). Improved charge transport properties were also observed by the electrochemical impedance spectroscopic (EIS) study for the device with optimized Ni-doped TiO₂ compared to the control device.