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# Structural Characterization and Visible Light-Induced Photoelectrochemical Performance of Fe-Sensitized $TiO_2$ Nanotube Arrays Prepared via Electrodeposition

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Surface modification of $TiO_2$ nanotube arrays via metal doping is one of the approaches to narrow the wide bandgap of $TiO_2$ in order to increase its adsorption to the visible region. The present work focuses on the fabrication of a Fe-sensitized $TiO_2$ nanotube arrays (Fe-TNT) photoanode. Ordered Fe-TNTs were successfully synthesized using a facile two-step electrochemical method by varying the deposition voltage (2-4 V). The morphology, structure, composition, and visible light response were characterized by field-emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), energy-dispersive X-ray spectroscopy (EDX), UV-Vis diffusion reflection spectroscopy (DRS), and photoelectrochemical (PEC) test. The XRD investigation demonstrated that the sensitization of Fe did not destroy the nanotube array structure, and the Fe-TNTs had an anatase phase composed of cubic-like particles at higher deposition voltages. The UV–Vis absorption spectra of the Fe-TNTs showed a redshift of photoresponse towards visible light. Such a redshift was characterized by a decrease in bandgap energy and the photo efficiency was enhanced. The optimal photoelectrochemical performance was observed at 2.5 V deposition voltage for 10 minutes and surpassed that of pristine titania nanotube arrays. The present work demonstrates feasible modification of $TiO_2$ with Fe as a potential photoanode in solar conversion devices.

**Key words:** Electrodeposition; titania nanotubes; photoelectrochemical; iron

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