

## Green Synthesized Palladium Loaded Titanium Nanotube Arrays for Simultaneous Azo-Dye Degradation and Hydrogen Production

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**Abstract :** In this study, palladium loaded titanium dioxide nanotube arrays (Pd/TNAs) was successfully synthesized by anodic oxidation etching method combined with microwave hydrothermal method, using tea or coffee as a green reductant. Pd/TNAs was employed as an electrode in a photoelectrochemical (PEC) system to simultaneously remove azo-dye and to generate hydrogen in the anodic and cathodic chamber, respectively. The chemical and physical properties of as-synthesized Pd/TNAs were characterized by scanning electron microscopy (SEM), ultraviolet-visible spectroscopy (UV-vis), X-ray diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). SEM image indicates the diameter and the length of Pd/TNAs were approximately 300 nm and 2.5  $\mu\text{m}$ , respectively. XPS analyses indicate that 1.13% (atomic %) of Pd was loaded onto the surface of TNAs. UV-vis results show that the band gap of TNAs was reduced from 3.2 eV to 2.37 eV after Pd loading. In addition, the electrochemical performances of Pd/TNAs were investigated by photocurrent density test and electrochemical impedance spectroscopy (EIS). The photocurrent ( $4.0 \text{ mA/cm}^2$ ) of Pd /TNAs was higher than that of the uncoated TNAs ( $1.4 \text{ mA/cm}^2$ ) at a bias potential of 1 V (vs. Ag/AgCl), indicating that Pd/TNAs-C can effectively separate photogenerated electrons and holes. The mechanism of our PEC system was proposed and discussed in detail in this study.

**Keywords :** Pd/TNAs, photoelectrochemical, azo-dye degradation, hydrogen generation

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