Temperature Controlled Fabrication of TiO₂ Nanotube-Based Arrays Electrode and Its Application for Photoelectrocatalytic Degradation of RhB

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TiO₂ nanotube arrays electrodes at different temperature were successfully synthesized via anodization method. The as-prepared samples were characterized by FE-SEM, XRD, I-V curve, I-t curve, EIS and Mott-Shottky measurement. The FE-SEM and XRD results showed that temperature could affect the surface morphology, nanotube length and crystal structure of the electrodes. The photoelectrochemical measurements revealed that the photocurrent, flat band potential (V_{fb}), donor concentration (N_D) and the width of the space charge layer (W_{sc}) varied with the temperature. Rhodamine B (RhB) degradation experiment was conducted to investigate the photoelectrocatalytic activity of the electrodes. It was found that the electrode fabricated at 30°C exerted the best catalytic activity and a strong reusability. The enhanced catalytic activity could be attributed to its fast charge transport and increased electrons-holes separation efficiency. Moreover, the main reactive species and degradation mechanism during the photoelectrocatalytic degradation process were also studied. It was observed that holes (h^+), $\cdot OH$ and $\cdot O_2^-$ benefited RhB degradation. Finally, a possible RhB degradation mechanism during the photoelectrodegradation was proposed. The results provided a specific RhB degradation pathway for photoelectrodegradation. These findings gave us a great insight to understand the property and photoelectrocatalytic process on TiO₂ nanotube arrays.

Keywords: TiO₂ nanotube arrays, Temperature, Photoelectrocatalytic, RhB degradation mechanism

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