Surface modification of TiO₂ nanotube arrays with metal copper particle for high efficient photocatalytic reduction of Cr(VI)

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ABSTRACT

Highly ordered TiO₂ nanotube arrays (NTs) have been widely used for photocatalysis application. In this study, to further improve the photocatalysis activity of TiO₂ NTs, Cu/TiO₂ NTs were prepared through an anodic oxidation and impregnation-reduction method. The morphology and crystalline phase of the pure TiO₂ NTs and Cu/TiO₂ NTs were characterized by SEM and X-ray diffraction. The photocatalytic performance of Cu/TiO₂ NTs was evaluated by photocatalytic reduction of Cr(VI) under UV light. The rate constant of photocatalytic reduction of Cr(VI) on Cu₀.₀₁/TiO₂ NTs which had the optimal Cu loading content was 9.5 times higher than that on unmodified TiO₂ NTs. And the experiment results of different initial concentration of Cr(VI) and pH demonstrated that they greatly influenced the removal efficiency of Cr(VI). The photoelectric properties of TiO₂ NTs with Cu particle loading were investigated by photoelectrochemical characterization, including photocurrent response, open-circuit voltage, electro-chemical impedance spectroscopy Nyquist plots, and Mott-Schottky plots. The enhancement of the photocatalytic performance of Cu/TiO₂ NTs indicated that the electrons could transfer faster and be utilized more easily due to the formation of Schottky barrier on the interface of Cu and TiO₂. The detailed electrons transfer mechanism of Cu/TiO₂ NTs was proposed.

Keywords: Cu/TiO₂ NTs; Cr(VI); Photocatalytic reduction

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