A Facile Synthesis of Fe-doped Zirconium Oxide Nanoparticles for Enhancement of Rhodamine B Dye Degradation

Yuanfeng Hui*, Shuyue Zhang

College of resources and environment engineering, Jilin Institute of Chemical Technology, Jilin 132022, China

*E-mail: huiyuranbaba@sina.com

doi: 10.20964/2021.06.53

Received: 5 March 2021 / Accepted: 13 April 2021 / Published: 30 April 2021

This work presents a synthesis of undoped and Fe-doped zirconium oxide nanoparticles (ZrO₂ NPs) as photocatalyst for degradation of Rhodamine B dye (RB). The undoped and doped ZrO₂ photocatalysts were successfully synthesized using co-precipitation process. Structural and morphological studies using XRD and FESEM showed that spherical shapes of undoped and Fe-doped ZrO₂ NPs prepared in high crystallinity and tetragonal phase. The optical characterization of photocatalysts using UV–Vis absorbance spectra revealed that the band gap was increased with increasing the dopant concentration. The band gap values of 4.98, 4.44, 4.29, 4.05 and 3.88 eV were obtained for undoped ZrO₂, 2wt%, 5wt%, 8wt% and 10wt% Fe-doped ZrO₂ NPs, respectively, which indicates narrowing of band gap with increasing the Fe concentration. The results of photodegradation studies showed that the complete removal of 100 mg/l RB was obtained after 55 minutes UV irradiation for the 8wt% Fe-doped ZrO₂. The maximum photodegradation efficiency on 8wt% Fe-doped ZrO₂ than undoped ZrO₂ can be associated with the presence of Fe³⁺ ions that can act as a sink and trap and transfer holes and electrons to minimize recombination of photoexcited electrons and holes. The stability response of 8wt% Fe-doped ZrO₂ photocatalyst to degradation of Rhodamine B under UV irradiation showed that the photocatalyst had great recycling stability.

Keywords: Fe-doped zirconium oxide Nanoparticles; Photocatalyst; Rhodamine B; Photodegradation; Cycle voltammetry

[FULL TEXT](#)

© 2021 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).