

Photocatalytic Activities of ZnO/CdS Coated on Fabric via Degradation of Tetracycline

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Structured Abstract

Background: TC antibiotics compounds are frequently found in surface water, groundwater, and sediment as a result of the exploitation of antibiotics in the medical industry. TC antibiotics are difficult to break down, and several metabolites and breakdown of products frequently exhibit greater toxicity and harm the parent substance. The ZnO/CdS will be coated on fabric to exhibit outstanding photocatalytic efficiency in the degradation of TC.

Methods: The fabric coated ZnO/CdS (ZnO/CdS-fabric) was prepared by using the wet impregnation technique. In this study, X-Ray Diffraction (XRD), Field Emission Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (FESEM-EDX), Brunauer-Emmett-Teller (BET), Fourier Transform Infrared (FTIR), and Ultraviolet-Visible-Near Infrared spectrophotometry (UV-VIS NIR) to characterize the photocatalysts based on their crystallinity, morphology, N₂ sorptions analysis, functional groups, and band gap. To investigate the photocatalytic activity of ZnO/CdS-fabric, tetracycline (TC) was used as the antibiotic model for degradation analysis. In the experiment, a piece of ZnO/CdS-fabric (10–15 mg) was dissolved in 50 mL of a 10 ppm TC solution. The reaction was conducted while stirring at 300 rpm under 18-Watt Philips LED cool daylight visible lamps. The scavenger reagents, such as EDTA, 2-propanol, and 1,4-benzoquinone, were used to evaluate the existence of h⁺, OH[•], and •O₂, respectively.

Results: From the FTIR spectra, the ZnO and CdS absorption bands were present in ZnO/CdS-fabric in the range of 700-500 cm⁻¹. ZnO/CdS-fabric displayed the peaks of ZnO/CdS in XRD diffractogram proving the successful coating on the fabric. Based on the photocatalytic activity, the ZnO/CdS-fabric in all ratios showed a trend in degradation of TC which ZnO/CdS-fabric. Photocatalysis is the best rather than adsorption and photolysis. Scavenger testing revealed that •O₂⁻ and h⁺ were the two most prevalent active species as compared to •OH and e⁻ in the degradation of TC.

Conclusion: As a whole, the synthesized ZnO/CdS-fabric photocatalyst has excellent photocatalytic activity when exposed to visible light, has the capacity to degrade TC solution, and can be further examined for various types of organic pollutants.

Keywords: Photocatalyst, Supported Catalyst, Antibiotics, Water Treatment

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