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Synthesis and Characterization of g-C3N4/ZnO for Degradation of Methylene Blue Under Visible Light Irradiation.

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Structured Abstract

Background: Industries generate large amounts of organic pollutants, particularly toxic and non-biodegradable dyes, which pose significant environmental and health risks. Traditional water purification methods often fail to remove these pollutants effectively. Synthetic dyes are especially concerning due to their stability and resistance to biodegradation. Recent advancements in photocatalytic water treatment have highlighted semiconductor materials like TiO_2 and ZnO, with ZnO gaining popularity for its affordability, eco-friendliness, and ease of synthesis, making it a promising solution for addressing industrial water pollution.

Methods: The preparation of the g-C_3N_4/ZnO composite catalyst involves the sol-gel method for ZnO synthesis, thermal decomposition for g-C_3N_4 preparation, and wet impregnation for the composite formation. Characterization techniques such as XRD, FESEM, and UV-Vis spectroscopy are employed to analyze the crystal structure, morphology, and optical properties of the catalyst, providing crucial insights into its photocatalytic performance in addressing the challenges of industrial water pollution.

Results: X-ray diffraction (XRD) confirmed the successful synthesis of pure ZnO, g-C_3N_4, and their composite, with ZnO exhibiting characteristic hexagonal wurtzite peaks and g-C_3N_4 showing graphite-like peaks. The composite demonstrated enhanced photocatalytic activity due to improved mobility of photogenerated charge carriers. Field Emission Scanning Electron Microscopy (FESEM) revealed a spherical morphology with crystallite sizes ranging from 42 nm to 169 nm. Methylene blue (MB) degradation rates were optimal at 0.75 g of catalyst, achieving complete degradation, while efficiency varied with pH, peaking at 100% at pH 9, where better adsorption and hydroxyl radical generation occurred.

Conclusion: These findings highlight the potential of g-C_3N_4/ZnO as a highly efficient photocatalyst for environmental remediation, particularly for degrading organic pollutants under visible light. This research provides valuable insights into the synthesis, characterization, and optimization of photocatalytic materials, setting the stage for future studies aimed at enhancing photocatalytic processes for wastewater treatment and other applications.

Keywords: g-C_3N_4/ZnO, Methylene blue, Photocatalysis, Degradation dyes, Wastewater Treatment

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