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Effect of $Ag/TiO_2/g\text{-}C_3N_4$ Composites Loading in the Removal of Methyl Orange

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Structured Abstract

Background: The widespread industrial use of methyl orange in the textile industry leads to significant wastewater discharge during dyeing and rinsing, poses risks to the environment and human health. Photocatalysis efficiently degrades organic pollutants in wastewater. $Ag/TiO_2/g\text{-}C_3N_4$ composites are used as photocatalysts due to their enhanced photocatalytic activity. This study focuses on synthesizing $Ag/TiO_2/g\text{-}C_3N_4$ photocatalysts via a hydrothermal process followed by a photo-deposition method and evaluating the effect of different catalyst loadings on methyl orange degradation.

Methods: The $TiO_2/g\text{-}C_3N_4$ composite was synthesized via a hydrothermal method by mixing ethanol, water and TBOT, followed by adding $g\text{-}C_3N_4$, sonication and stirring. The mixture was autoclaved at 80 °C and calcined at 500 °C. $Ag/TiO_2/g\text{-}C_3N_4$ was prepared via photo-deposition method. The physiochemical properties were characterized using FESEM, XRD and UV-DRS. Photodegradation was tested with 0.05–0.20 g Ag-TCN under visible and UV light, with periodic sampling analyzed via UV-Vis spectrophotometry at 464 nm.

Results: The study successfully synthesized $Ag/TiO_2/g\text{-}C_3N_4$ composites. XRD analysis confirmed the anatase phase of TiO_2 and hexagonal crystallization of C_3N_4 at $2\theta = 27.5°$. After Ag introduction via photo-deposition, a minor peak appeared at $2\theta = 44.3°$ confirming the presence of Ag. FESEM images revealed uniformly spherical particles for pure TiO_2 and block-like, layered structures typical of $g\text{-}C_3N_4$. The $Ag/TiO_2/g\text{-}C_3N_4$ composite showed presence of TiO_2 and $g\text{-}C_3N_4$ phases decorated with Ag nanoparticles. UV-DRS analysis showed bandgaps of 3.35 eV for TiO_2, 2.88 eV for C_3N_4 and 3.22 eV for $Ag/TiO_2/g\text{-}C_3N_4$. Upon visible light irradiation, the highest MO degradation was achieved with 0.15 g of Ag-TCN

Conclusion: The $Ag/TiO_2/g\text{-}C_3N_4$ composite demonstrated enhanced photocatalytic performance, making it effective for the removal of methyl orange. This study highlights the potential of $Ag/TiO_2/g\text{-}C_3N_4$ for environmental applications and emphasizes the importance of optimizing mass loading to achieve maximum efficiency.

Keywords: Composites, Hydrothermal, Photocatalysis, Methyl orange

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