

SUMMARY

Crystal violet is a cationic dye widely used in various industries and is difficult to break down in the environment. One effective method for removing it is heterogeneous photocatalytic degradation, which is environmentally friendly and capable of oxidizing organic pollutants into harmless compounds. This method utilizes UV light or sunlight with the assistance of semiconductors such as TiO₂, ZnO, and CuO. NiTiO₃ is known to have good photocatalytic potential, but it is limited by rapid electron-hole pair recombination. In contrast, CuTiO₃ has a narrow bandgap and good charge transfer capability, although it is less suitable as a photocatalyst on its own. By substituting some Ni²⁺ ions with Cu²⁺ in the NiTiO₃ structure to form Ni_{1-x}Cu_xTiO₃, it is hoped that the advantages of both can be combined and the photocatalytic efficiency in degrading crystal violet can be improved. This study aims to develop and analyze the characteristics of Ni_{1-x}Cu_xTiO₃ photocatalytic materials capable of degrading dyes, as well as to identify the optimal degradation capacity through UV-Vis spectrophotometry analysis.

The photocatalyst Ni_{1-x}Cu_xTiO₃ was synthesized using the sol-gel method followed by calcination. Characterization of the Ni_{1-x}Cu_xTiO₃ photocatalyst was carried out using XRD to determine the crystallinity of the material, UV-DRS to determine the band gap of each variation, and SEM-EDX to observe the morphology of each variation. To evaluate the photocatalytic performance, the degradation of crystal violet was conducted in a batch system under ultraviolet (UV) light irradiation. The Ni_{1-x}Cu_xTiO₃ photocatalyst was synthesized by varying the Cu content within the Ni_{1-x}Cu_xTiO₃ structure.

The Ni_{1-x}Cu_xTiO₃ photocatalyst was successfully synthesized with variations of $x = 0$ mmol, 0.1 mmol, 0.3 mmol, 0.5 mmol, 0.7 mmol, 0.9 mmol, and 1 mmol. In the XRD analysis, pure NiTiO₃ was formed according to the database with a crystallinity percentage of 98.92%. However, when Cu was substituted, the crystallinity percentage decreased up to $x = 0.5$ mmol (Ni_{0.5}Cu_{0.5}TiO₃). At $x = 0.7$ to 1 mmol, the crystallinity percentage increased again. The UV-DRS characterization results showed a bandgap range of Ni_{1-x}Cu_xTiO₃ of 2.6–3.07 eV with UV-Visible wavelength absorption. SEM-EDX analysis showed a uniform distribution of Ni, Ti, and O in the form of nanorods, as well as in the Ni_{0.5}Cu_{0.5}TiO₃ variation of Ni_{1-x}Cu_xTiO₃ material, characterized by the detection of Ni, Cu, Ti, and O elements in the EDX analysis. Ni₀Cu₁TiO₃ also formed and was uniformly distributed. The optimum degradation of crystal violet by the Ni_{1-x}Cu_xTiO₃ photocatalyst occurred at the Ni_{0.5}Cu_{0.5}TiO₃ variation, with a degradation percentage of 93.36%.