Abstract

The swift expansion of industry has led to a marked increase in the discharge of industrial wastewater containing organic dyes into natural water sources, which raises substantial environmental concerns. As a result, MOF@metal oxide composite-based photocatalysts have garnered significant interest due to their ability to eliminate organic pollutants from wastewater using natural sunlight. This study reports the effective solvothermal synthesis of a new light-driven photocatalyst, Ni/Zn MOF@MnO2. Under visible light irradiation, the photocatalyst—a bimetallic Ni/Zn based Metal Organic Framework (MOF) modulated manganese oxide (MnO2)—degrades the cationic methylene blue dye (MB) in an aqueous solution. XRD, SEM, UV-visible spectroscopy, and FTIR were some of the methods used to characterize the prepared samples. X-ray Diffraction revealed that Ni/Zn MOF and Ni/Zn MOF @MnO2 are manufactured. The bandgap energy of Ni/Zn MOF supplemented with MnO2 was found to be reduced from 3.7 eV to 2.73 eV in a UV-visible research. The Ni/Zn MOF has exhibited photocatalytic behavior with 65□ MB dye degradation in 80 min. The ability to visible light was found to be significantly enhanced by Ni/Zn MOF in combination with MnO2 which increased the photocatalytic degradation of MB dye up to 92.6□ in just 80 min in an aqueous solution without the need of any chemical additives. Due to synergistic effects, a narrowing of the energy band gap, and a decrease in rapid electron-hole pair recombination, the photocatalytic activity of Ni/Zn MOF@MnO2 composites toward MB was greatly improved, over 27.6□ greater than that of the bimetallic Ni/Zn MOF. The photodegradation process of MB was mostly mediated by superoxide radicals (O2•-), as demonstrated by the trapping experiment findings. Additionally, the Ni/Zn MOF@MnO2 photocatalyst maintains its effectiveness for up to five cycles, suggesting that the MOF composite in its produced state might be used as a highly efficient photocatalyst to degrade organic dyes found in water supplies that are contaminated.