Synthesis and characterization of zinc oxide/maghemite nanocomposite: influence of heat treatment on photocatalytic degradation of 2,4-dichlorophenoxyacetic acid

ABSTRACT

In the current study, ultraviolet-active zinc oxide/maghemite (ZnO/γ-Fe2O3) nanocomposite catalysts were prepared and applied to the photodecomposition of 2,4-dichlorophenoxyacetic acid (2,4-D). 2,4-D is a herbicide that is widely used in agriculture and landscape turf management. The ZnO/γ-Fe2O3 nanocomposite catalyst was prepared using a simple and efficient precipitation–thermal decomposition method. Comprehensive experimental studies and characterizations such as X-ray diffraction (XRD), TEM, Brunauer–Emmett–Teller (BET) and UV–vis diffuse reflectance spectrum (UV-DRS) analyses were conducted to optimize the photoactivity of the nanoparticles. Interestingly, the synthesized ZnO/γ-Fe2O3 nanocomposite catalyst exhibited a hexagonal phase with wurtzite structure, and their active surface area decreased with increasing calcination temperature. Based on the TEM micrographs, the appearance of the ZnO/γ-Fe2O3 nanocomposite catalyst is nearly spherically shaped with a mean particle size in the range of 13–35 nm. The nano-ZnO/γ-Fe2O3 that underwent heat treatment at 450 °C exhibited better photodecomposition of 2,4-D, which was primarily due to the highest specific surface area and the smallest particle size among the synthesized samples.

Keyword: Iron oxide; Photocatalyst; Precipitation; Zinc oxide; 2,4-D