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Green Synthesis and Characterization of LED-Irradiation-Responsive Nano ZnO Catalyst and Photocatalytic Mineralization of Malachite Green Dye

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Abstract: The green synthesis of nanoparticles is an emerging branch of nanotechnology in recent times, as it has numerous advantages such as sustainability, cost-effectiveness, biocompatibility, and eco-friendliness. In the present research work, the authors synthesized ZnO nanoparticles (ZnO NPs) by a green and eco-friendly method. The synthesized ZnO NPs were characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), and Fourier transform infrared (FTIR) spectroscopic techniques. The calculated average crystallite size of ZnO NPs was observed at 36.73 nm and FESEM images clearly showed the cylindrical shape of nanoparticles. The absorption peak at 531 cm^{-1} was observed in the FTIR spectrum of the ZnO NPs sample, which also supports the formation of the ZnO wurtzite structure. Finally, the synthesized ZnO NPs potential was analyzed for the remediation of malachite green from an aqueous solution. The ZnO NPs showed a desirable photocatalytic nature under LEDs irradiation.

Keywords: nanoparticles; zinc oxide; photocatalytic degradation; wastewater; green chemistry

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1. Introduction

Heterogeneous photocatalysis is a sustainable and green technology used for contaminated water treatment and recycling [1]. It is considered a suitable technique because of its cost-effectiveness, eco-friendliness, high efficiency, and broad applicability and offers great potential for the overall mineralization of hazardous materials from the environment. Almost complete degradation and mineralization of organic pollutants such as pesticides, herbicides, phenols, antibiotics, hydrocarbons, plastics, etc., are achieved even under mild cases of temperature and pressure [2–5]