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Enhanced photocatalytic performance of $CdFe_2O_4/Al_2O_3$ nanocomposite for dye degradation

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Abstract

In the present work, $CdFe_2O_4/Al_2O_3$ magnetic nanocomposite photocatalyst is successfully synthesized by simple sol-gel auto-combustion method. The role of this sample is studied as a photocatalyst. The influence of Al_2O_3 concentration with $CdFe_2O_4$ on the photocatalytic property is also studied. We have considered three weight percentage of Al_2O_3, 5%, 10%, and 20% with $CdFe_2O_4$. All the samples are characterized with X-ray diffraction (XRD), Brunauer-Emmett-Teller (BET), Fourier transform infrared spectroscopy (FTIR), field

emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM) with selected area electron diffraction (SAED), vibrating sample magnetometer (VSM), UV-Visible, and photoluminescence (PL) spectroscopy techniques. The 10% composite sample showed the lower particle size, higher surface area, enhanced porosity, higher saturation magnetization, and considerable band gap as compared to that of 5% and 20% $CdFe_2O_4/Al_2O_3$ as well as bare $CdFe_2O_4$ nanoparticles. The photocatalytic activity of the sample is evaluated towards the degradation of the xylenol orange (XO) dye under UV light. The degradation process of the dye is monitored spectrophotometrically. The performance in terms of removal efficiency is studied by varying the contact time, dye concentration and amount of catalyst. Among the three concentrations of Al_2O_3, the 10% weight concentration of Al_2O_3 with $CdFe_2O_4$ is found to be the optimal concentration and showed the higher degradation rate. After 30 min photocatalytic reaction, the degradation rate is 92.29% for 10% $CdFe_2O_4/Al_2O_3$ and for bare $CdFe_2O_4$, it is 85.79%. This work provides a new reference for designing Al_2O_3-based spinel ferrite nanocomposites and their role in wastewater management.

Data availability

The data used to support the findings of this study are included within the article.

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Contributions

ASV conducted the experimental work and drafted the initial manuscript. MDD supervised the work equally. DRT and AVB equally contributed in catalytic experiments. All authors contributed to the final manuscript.

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Ethics declarations

Consent to participate

All authors agree to participate in the editing of the paper.

Consent for publication

All authors agree to publish this manuscript in your journal.

Conflict of interest

The authors declare no competing interests.

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