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Development of ternary PANI/GO-Fe_3O_4@AgNps nanocomposites for photocatalytic remediation of toxic dye effluent under energy-efficient system

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Abstract

The environmental toxicity of effluents contaminated with synthetic industrial dyes and their resistance to conventional treatments drive the need for developing innovative treatment technologies such as visible photoactive catalysts in a photocatalytic system. In this study, novel nanocomposite photocatalysts were synthesized for photocatalytic remediation of toxic dye effluent under energy-efficient Light Emitting Diode (LED) irradiation. Concise instrumental analysis was used to investigate the morphological, functional, particle size, thermal and optoelectronic features of the developed photocatalytic nanocomposites. Their performance was tested with cationic (methylene blue) and anionic (methyl orange) model dyes. The instrumental elucidation reveals the coating of amorphous polyaniline with other composites, giving the blend rapid reactivity, which promotes photocatalyst-dye interaction. The composites exhibit lowered bandgap (2.66 eV, 2.85 eV and 2.27 eV) when compared to polyaniline (3.34 eV) used as macromolecular support via in situ coupling. This accounts for the efficiency of 95 % and 98 % reported for methylene blue and methylene orange, respectively, at optimal experimental conditions of 90 min irradiation time, pH of 5 and dosage of 20 mg/100 mL dye effluent. The study also proposed a Z-scheme mechanism with the vital role of $\bullet O^{2-}$, •OH and h^+ reactive species in the photodegradation of the dye molecules.