Equidistant crystal distortion arrangement of copper doped magnetite for paracetamol degradation and optimization with response surface methodology (RSM)

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ABSTRACT

Copper (Cu) with variable weight loading (5–15 wt%) were doped to magnetite nanoparticles (MNPs) *via* a simple electrochemical method. The physicochemical properties of these catalyst were characterized with XRD, VSM, BET, FTIR and TEM. The nature of Cu distribution was elucidated with relative intensity ratio in XRD and Rietveld refinement. These two methods confirmed that Cu was substituted to iron in octahedral and tetrahedral sites. The presence of Cu in these two sites, enhanced the photodegradation towards Paracetamol (PCT) drastically. The existence of Cu also assisted with the redox reaction between Fe^{3+}/Fe^{2+} and Cu^{2+}/Cu^{+}. The optimum degradation was achieved when Cu equidistantly doped to octahedral and tetrahedral sites. Further optimization was then conducted by response surface methodology (RSM) with central composite design (CCD) model for PCT degradation. RSM revealed that the experimental value of 32.5×10^{-2} mg (L. min)$^{-1}$ was close to predicted value of 32.02×10^{-2} mg (L. min)$^{-1}$ with only 1.47% error for degradation of PCT using 0.53 g L^{-1} of the catalyst at pH 9.56 with 9.2% Cu/MNPs.

KEYWORDS

Photocatalyst; Magnetite; Copper; Doping; Paracetamol

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