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Magnetic Core–Shell-Structured FeO_x/CN Catalyst Mediated Peroxymonosulfate Activation for Degradation of 2,4-Dichlorophenol via Non-Radical Pathway

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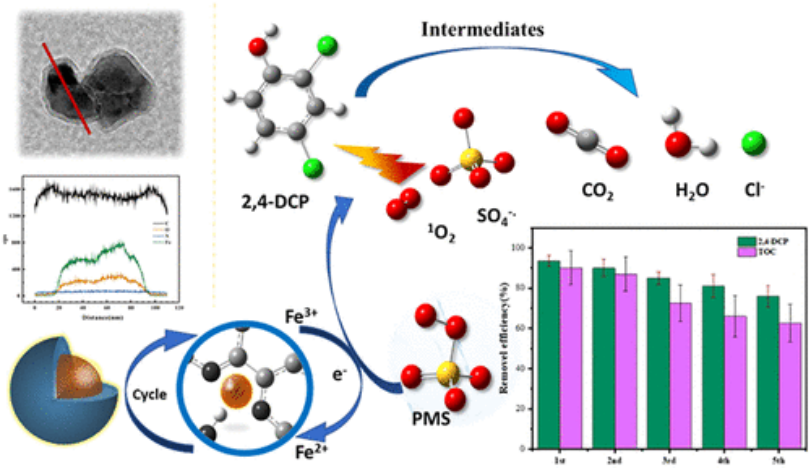
Degradation, Iron,

Abstract



In this study, a magnetic nano-FeO_x/CN core–shell-structured catalyst with a high operating stability was successfully prepared by a coordinating polymer pyrolysis strategy. It exhibited high catalytic activity in peroxymonosulfate (PMS)-based advanced oxidation processes. Under neutral and room temperature conditions, the removal efficiency of 2,4-dichlorophenol (2,4-DCP) via FeO_x/CN/PMS system reached more than 90% within 60 min, and the removal of total organic carbon reached 89% within 90 min. The key operating parameters were evaluated and analyzed. Besides, in five consecutive degradation experiments, Fe-3/CN showed high stability, low iron ion loss, and excellent magnetic separation and recovery performance, demonstrating its potential as a practical Fenton-like catalyst. The abundant and orderly N pores in the CN structure provided key conditions for the anchoring and dispersion of nano-FeO_x particles. Electron paramagnetic resonance and free radical scavenging experiments proved that $^1O_2$ is the main reactive oxygen species (ROS) that causes 2,4-DCP degradation (about 76.4% of the total contribution). Combined with density functional theory, the degradation pathway of 2,4-DCP was reasonably predicted. This study provides new ideas for the design and synthesis of Fenton-like catalysts with high stability and high activity.

KEYWORDS: heterogeneous Fenton-like catalyst, non-radical pathway, iron oxide, peroxymonosulfate

Supporting Information

conditions, degradation intermediate of 2,4-DCP detected by GC–MS, iron contents, and comparison of catalytic activities, and figures of schematic illustration for the synthesis FeO_x/CN catalyst, SEM and TEM images, XRD spectra, XPS spectra, N 1s, C 1s, O 1s, and Fe 2p peaks, nitrogen adsorption–desorption isotherms, adsorption–desorption equilibrium diagram, consumption of PMS under different systems, electrochemical impedance spectra, effect of Fe dosage on 2,4-DCP removal, ζ potentials and *k* values at different pHs, concentration of Fe leaching, relative concentration of sulfate radical and hydroxyl radical, effect of different doses of TBA and MeOH on 2,4-DCP degradation, magnetization curves, Fukui function isosurface, and GC–MS spectra (PDF)

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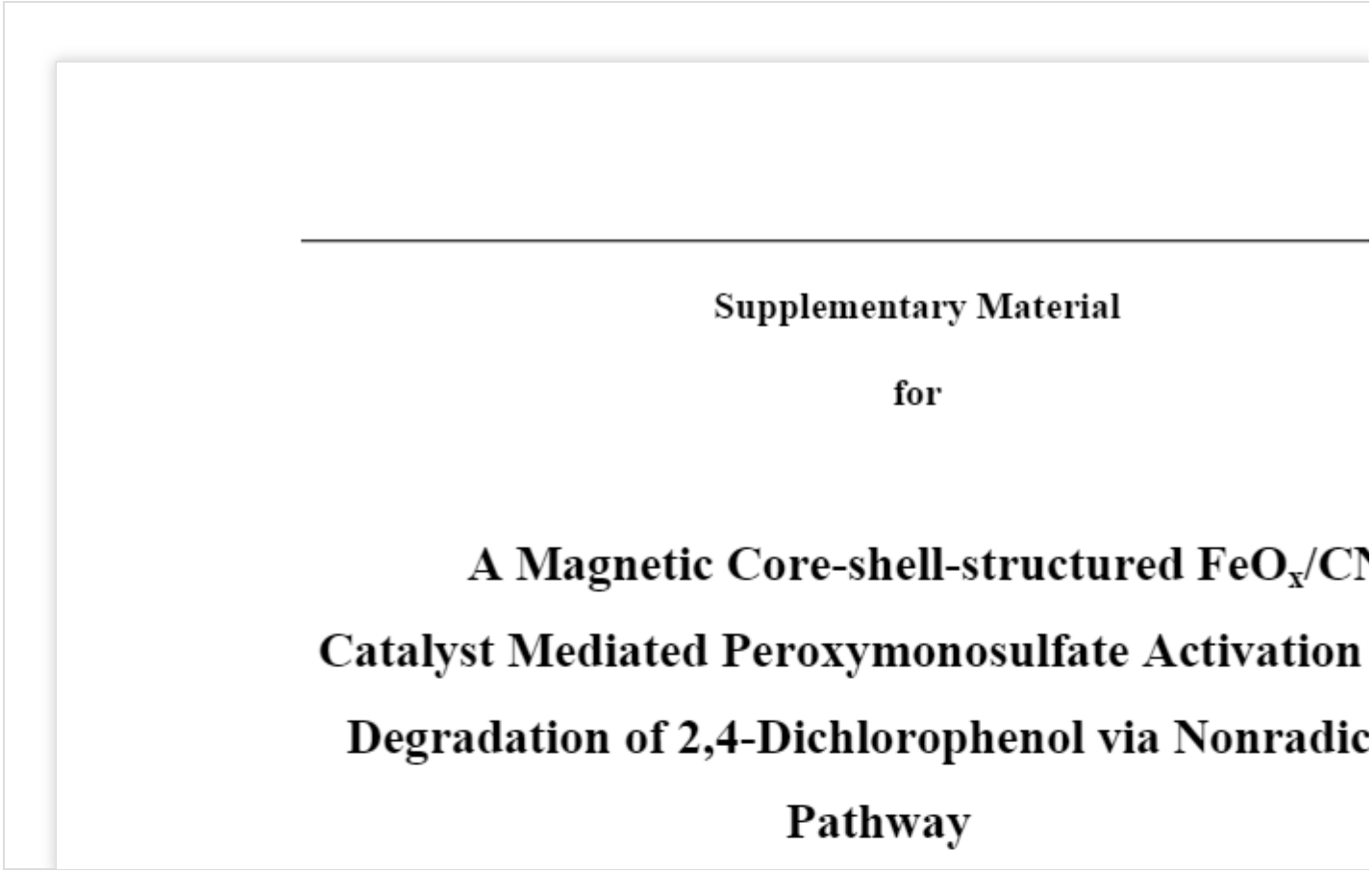

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