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Mesoporous Manganese Cobaltite Nanocages as Effective and Reusable Heterogeneous Peroxymonosulfate Activators for Carbamazepine Degradation

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Abstract: Mesoporous $Mn_xCo_{3-x}O_4$ nanocages with high cobalt content, large surface area and high pore volume were synthesized through a self-assembly method. The as-prepared $Mn_xCo_{3-x}O_4$ nanocages displayed satisfactory catalytic activity toward peroxymonosulfate (PMS) and the metal ions leaching concentration could be negligible. Sulfate radical was identified as the predominant active species through radical quenching experiments and electron spin resonance spin-trapping technique. The kinetics of the oxidation process was of pseudo-first order. The increasing cobalt content in $Mn_xCo_{3-x}O_4$ NCs was in favor of enhancing the decomposition of PMS. $Mn_xCo_{3-x}O_4$ nanocages dosage, PMS concentration and reaction temperature put the promoting effect on the degradation, while initial CBZ concentration had the retarding impact. $Mn_xCo_{3-x}O_4$ nanocages could efficiently operate over a wide pH range of 5.0-8.0. Coexisting chloride ions exerted a dual role in the decomposition of PMS and this role was concentration-dependent. XPS analysis confirmed the reversible valence equilibrium between metal ions and the recovery of surface adsorbed oxygen, which ensured their sustainable catalytic activity even after five consecutive

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