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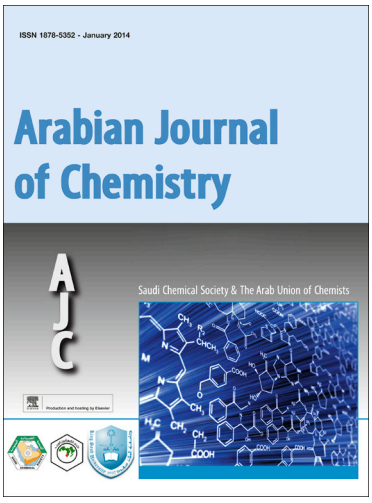

Original article

Metal Doped Manganese Oxide Octahedral Molecular Sieve Catalysts for Degradation of Diclofenac in The Presence of Peroxymonosulfate

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Metal Doped Manganese Oxide Octahedral Molecular Sieve Catalysts for Degradation of Diclofenac in The Presence of Peroxymonosulfate

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Abstract

Manganese oxide octahedral molecular sieve (OMS-2) and a series of OMS-2 doped with Co, Cu, and Ce were prepared via a solvent-free method, and tested in heterogeneous activation of peroxymonosulfate (PMS) for diclofenac (DCF) degradation in aqueous solutions. X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM), N2adsorption/desorption isotherms, Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) and X-ray photoelectron spectroscopy (XPS) were used to characterize the properties of those materials. It was found that (Co+Ce)-OMS-2 seemed to be most efficient and had the best adsorption capacity, which may due to most abundant lattice oxygen and more macropore than other materials caused by cerium ions enter into the channel. Results from XPS suggested that the highly catalytic efficiency possible involved the activation of PMS to sulfate and hydroxyl radical meditated by the redox pair of Mn(IV)/Mn(III) and Co(III)/Co(II) in catalysts.

KEYWORDS: Manganese oxide octahedral molecular sieve, diclofenac, peroxymonosulfate

1. Introduction

Diclofenac (DCF) is a non-steroidal anti-inflammatory drug (NSAID) derived from phenylacetic acid, commonly used as its sodium salt for medical application (Ziylan et al., 2011). It has the highest acute aquatic toxicity within the class of NSAIDs, and microorganisms that usually comprise of lotic biofilms are inhibited by concentrations around 100μg/L, which indicated that conventional wastewater treatment processes cannot degrade DCF effectively(Fent et al., 2006; Paje et al., 2002). To effectively remove DCF, many novel DCF treatment methods such as Fenton reactions under UV-light irradiation, ozone oxidation, gamma irradiation,sonolysis and electrochemical incineration have been proposed (Perez-Estrada et al., 2005; Coelho et al., 2009; Homlok et al., 2011; Hartmann et al., 2008; Brills et al., 2010). Advanced oxidation processes based on sulfate radical ($SO_4^{\bullet-}$) (SR-AOPs) have become a promising alternative owing to some merits compared with those $^{\bullet}OH$-generating methods, such as higher oxidation potential (2.5-3.1V vs. NHE), more selectively via electron transfer with organic compounds that contain unsaturated bonds or aromatic π electrons, and longer half-life period (30-40μs) which enables $SO_4^{\bullet-}$to have more stable mass transfer(Antoniou et al., 2010; Olmez-Hanci and Arslan-Alaton, 2013).$SO_4^{\bullet-}$can be produced by UV-based photolysis, heat,