Journal of Environmental Chemical Engineering 5 (2017) 1645–1656

Contents lists available at ScienceDirect

Journal of Environmental Chemical Engineering

journal homepage: www.elsevier.com/locate/jece

Efficient and reusable iron-zinc oxide catalyst for oxidative desulfurization of model fuel

Wafaa Abdul-Kadhim[a,b], Mohd. Asyrak Deraman[a], Syamsul Bahari Abdullah[c], Saiful Nizam Tajuddin[a], Mashitah Mohd. Yusoff[a], Yun Hin Taufiq-Yap[d], Mohd. Hasbi Ab. Rahim[a,e,*]

[a] Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang, 26300, Pahang, Malaysia
[b] Oil Technology, University of Technology, Baghdad, Iraq
[c] Faculty of Chemical Engineering & Natural Resources, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang, 26300, Pahang, Malaysia
[d] Catalysis Science and Technology Research Centre, Faculty of Science, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[e] Automotive Engineering Centre (AEC), Universiti Malaysia Pahang, Pekan Campus, 26600, Pekan, Pahang, Malaysia

ARTICLE INFO

Article history:
Received 29 December 2016
Received in revised form 27 February 2017
Accepted 1 March 2017
Available online 2 March 2017

Keywords:
Oxidative desulfurization
Fe-ZnO
Sol-gel
Fuel
Hydrogen peroxide

ABSTRACT

In this study, Fe-ZnO catalyst synthesized via modified sol–gel technique with different Fe doping ratio (2, 3, and 5) wt% was explored for oxidative desulfurization (ODS) of model fuel. The sol-gel technique was adopted without the use of surfactants. The catalysts were characterized by several means of characterization techniques (TGA, XRD, FTIR, N_2- physisorption, XPS, FESEM-EDX and NH_3-TPD). The characterization results clearly showed that sol-gel technique is a suitable method to synthesize highly crystalline metal oxide materials with smaller particle size, higher surface area and tunable acidic properties. The ODS reaction conditions and Fe metal loading were found to influence the dibenzothiophene (DBT) removal efficiency. The catalytic ODS data showed that Fe-ZnO with 5 wt% of Fe catalyst is capable in total removal of DBT within shorter reaction time under mild reaction conditions in the presence of H_2O_2 as an oxidant. The catalyst is reusable for six consecutive cycles of reaction without regeneration steps and the characteristic of spent catalyst was confirmed with XRD and FTIR analysis. The close catalytic cycle involving H_2O_2 as an oxidant was shown through proposed mechanistic pathway.

* Corresponding author at: Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, Gambang, 26300, Pahang, Malaysia.
E-mail addresses: mohdhasbi@ump.edu.my, abrahimmh@yahoo.co.uk (M. H.A. Rahim).

http://dx.doi.org/10.1016/j.jece.2017.03.001
2213-3437/