

Characterization of platinum–iron catalysts supported on MCM-41 synthesized with rice husk silica and their performance for phenol hydroxylation

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[Jitlada Chumee](#)¹, [Nurak Grisdanurak](#)^{2,3}, [Arthit Neramittagapong](#)⁴ and [Jatuporn Wittayakun](#)^{1,3}

¹ Material Chemistry Research Unit, School of Chemistry, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand

² Department of Chemical Engineering, Thammasat University, Pathumthani 12120, Thailand

³ Center of Environmental and Hazardous Waste Management (EHWM), Thammasat University, Pathumtani 12120, Thailand

⁴ Department of Chemical Engineering, Khon Kaen University, Khon Kaen 40002, Thailand

E-mail: jatuporn@sut.ac.th

Abstract. Mesoporous material RH-MCM-41 was synthesized with rice husk silica by a hydrothermal method. It was used as a support for bimetallic platinum–iron catalysts Pt–Fe/RH-MCM-41 for phenol hydroxylation. The catalysts were prepared by co-impregnation with Pt and Fe at amounts of 0.5 and 5.0 wt.%, respectively. The RH-MCM-41 structure in the catalysts was studied with x-ray diffraction, and their surface areas were determined by nitrogen adsorption. The oxidation number of Fe supported on RH-MCM-41 was + 3, as determined by x-ray absorption near edge structure (XANES) analysis. Transmission electron microscopy (TEM) images of all the catalysts displayed well-ordered structures, and metal nanoparticles were observed in some catalysts. All the catalysts were active for phenol hydroxylation using H₂O₂ as the oxidant at phenol : H₂O₂ mole ratios of 2 : 1, 2 : 2, 2 : 3 and 2 : 4. The first three ratios produced only catechol and hydroquinone, whereas the 2 : 4 ratio also produced benzoquinone. The 2 : 3 ratio gave the highest phenol conversion of 47% at 70 °C. The catalyst prepared by co-impregnation with Pt and Fe was more active than that prepared using a physical mixture of Pt/RH-MCM-41 and Fe/RH-MCM-41.

Keywords: MCM-41, rice husk, phenol hydroxylation, bimetallic catalysts, platinum, iron

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