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

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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 H_2O_2 as the oxidant at phenol : H_2O_2 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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