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Rietveld refinement and catalytic properties of of nanosized WO3 and V2O5 dispersed on SBA–15 mesoporous solid

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In the present work, two sets of transition metal oxides dispersed on SBA-15 were synthesized and their crystallite sizes, phase composition, textural properties, and morphological features were characterized with XRD, N2 phsisorption isotherms, TEM, XPS and Raman spectroscopic techniques. Their crystalline structures were refined with the Rietveld method on the basis of X-ray diffraction analysis. Oxygen defect concentrations in the crystalline structure were calculated. The surface acidity including Brϕnsted and Lewis acidity were measured by in situ FTIR of pyridine adsorption technique. In the crystals of WO3 and V2O5, oxygen defects were formed during the synthesis procedure. All the (WO3,V2O5)/SBA–15 catalysts predominantly contained a great number of Lewis acid sites with Brϕnsted acid sites as minor. Creation of Lewis acidity can be correlated with the structural defects. In the oxidation of 4,6-dimethyldibenzothiophene (4,6–DMDBT) in a model diesel, the 4,6–DMDBT oxidation was correlated with the number of Lewis acid sites and the concentration of oxygen defects. When formic acid was added into the reaction system, 4,6–DMDBT oxidation was significantly improved. Formic acid may react with hydrogen peroxide to produce performic acid which interacts with W5+ /W6+ or V4+/V5+ ions in the catalyst surface to form peroxometallic complexes. With respect to the H2O2 oxidant, the peroxometallic complexes are more active for sulfur oxidation due to its asymmetrical character in the bond M–O–O–H (M =W or V) and thus benefits to enhancement of the oxidative desulfurization efficiency. A surface reaction mechanism involving peroxometallic complexes formation, 4,6–DMDBT molecules adsorption, and surface oxidation reaction on structural defects or Lewis acid sites of the catalysts was proposed. This biphasic reaction system consisting of a catalyst bearing Lewis acid sites, a green oxidant, an oxidant promoter, and a polar solvent would simultaneously perform the oxidation and separation of polyaromatic sulfur compounds in one operation which was very practical for ultralow sulfur diesel production.

Biography:

Dr. Jin An Wang is a full professor in Chemical Engineering in the National Polytechnic Institute in Mexico City, Mexico. He is a Mexican National Researcher and a member of Mexican Academy of Sciences. Dr. Wang is coauthor of more than 160 scientific publications and 5 patents and coeditor of 3 books in advanced new catalytic materials and 3 special volumes in Catalysis Today. He served as chair of the First to Fifth International Symposium on New Catalytic Materials. Dr. Wang was a visiting professor of the Universidad Nacional Autónoma de Mexico, Universidad Autónoma Metropolitana-A, and Worcester Polytechnic Institute in USA. His research interest focuses on the synthesis of new catalytic materials, catalysis for petroleum refining, catalysis for clean fuel production and environmental catalysis.

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