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Hydrodeoxygenation of bio-oil model compounds over supported nickel catalysts

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Lignocellulosic biomass becomes very attractive as feedstockfor the production of pyrolysis bio-oils, both scientifically and economically. Still, theseproducts cannot be used as a liquid fuel or additive due to their excessive oxygen content, and poor chemical stability. Therefore, upgrading treatments are required. Catalytic hydrodeoxygenation is considered to be one of the most effective routes for bio-oil transformation. The present work involves the study and understanding the reaction pathway of the hydrodeoxygenation of guaiacol as a representative chemical of the bio-oil obtained from pyrolysis of lignocellulosic biomass, which contains 25.8% of oxygen due to the characteristic of methoxyphenol linkages. For this purpose, catalysts based on Ni (5 wt%) are loaded on various supports (hierarchical ZSM-5, SBA-15, Al-SBA-15 and commercial H-ZSM-5). The samples were characterized in detail using N_2 adsorption-desorption isotherms, Powder X-ray diffraction (XRD), Transmission Electron Microscopy (TEM), Temperature Programmed Reduction and Desorption (H_2-TPR/NH_3-TPD). Subsequently, all the prepared catalysts were tested in HDO of guaiacol (3.3 wt% in decaline (50 ml) in a 100ml stainless steel (SS) high pressure stirred batch reactor. The reaction was carried out below 40 bars of hydrogen partial pressure and the temperature was 260˚C, with the constant stirring speed (1000 rpm) for 2 hours.The liquid and gas products were analyzed by GC and GC-MS. These catalysts reveal different hydrogenation and hydrogenolysis routes based on supports. Ni/h-ZSM-5 exhibits a better deoxygenation activity with a percentage of HDO around 98% at 260˚C, 2 hours. In addition, we correlated hydrophobic and hydrophilicity of the catalysts with HDO results.

Biography

T M Sankaranarayanan is a Postdoctoral Researcher at the Thermochemical Processes Unit of the IMDEA Energy Institute. Before joining IMDEA, he worked as a Senior Research Fellow at the National Centre for Catalysis Research for his doctoral research (2008-2013). During his Doctoral research, he studied the transesterification and hydroprocessing of vegetable oil (non-edible oils) on mixed metal oxides. He was also involved in collaboration with others for the hydrogenolysis of polyols, catalytic cracking and hydrotreating (viz. HDS, HDM, HDN and HDO) reactions. His Postdoctoral research is focused on the second generation biofuels from lignocellulose biomass. He has 11 publications in international journals.

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