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Cascade catalytic systems for CO_2 hydrogenation to liquids

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Cascading and tandem catalysis concepts, involving the use of multiple catalytic species to facilitate multi-step reactions in a single pot, have proven to be effective for the design of homogeneous catalytic processes with higher rates and selectivities and are emerging as a useful strategy for the design of high performance heterogeneous catalytic systems. This paper will describe our efforts to design heterogeneous catalysts for CO_2 hydrogenation using cascading/tandem catalysis concepts. Nano-structured early transition metal carbides and nitrides have proven to be very useful, serving as catalysts for key steps and supports for nanoscale metal particles that catalyze other steps. The results provide useful insights into the design of more effective catalytic materials and the potential use of early transition metal carbides and nitrides.

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Synthesis of biodiesel from palm kernel oil using mixed clay-eggshell heterogeneous catalysts

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The synthesis and characterization of clay-eggshell mixed catalysts was carried out for the transesterification of palm kernel oil with methanol as solvent. Clay from anthill and waste chicken eggshells were powdered and mixed via incipient wet impregnation in 50-50, 80-20 and 20-80% proportions of clay to eggshell on mass basis. The resulting mixtures were oven dried at 120°C and calcined in the furnace at 900°C for 4 hrs. The un-calcined raw clay sample was characterized via the X-ray fluorescence method while the as-synthesized catalyst samples were characterized via the Fourier transform infrared radiation spectroscopy and scanning electron microscopy. The performance of the as-synthesized catalysts was tested in transesterification of palm kernel oil (PKO) via a 2 level factorial experimental design optimizing four variables including reaction time, reaction temperature, methanol/oil molar ratio and catalyst loading in which case the yield was the required response. The 50-50 catalyst attained a maximum yield of 56.2% at 70°C, methanol/oil ratio of 12:1, reaction time of 180 min., catalyst loading of 5 wt.% compared to the 65.2% achieved with the 80-20 catalyst at 90°C, methanol/oil ratio of 12:1, reaction time of 180 min., catalyst loading of 5 wt.% and the 70.7% obtained for the 20-80 catalyst at 70°C, methanol/oil ratio of 12:1, reaction time of 180 min. and catalyst loading of 3 wt.%, thus, indicating mixed effect of variables as fully discussed. The developed catalysts were found to be good for biodiesel production and have the ability of improved performance.

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