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Valorization of lignocellulosic biomass using the synergetic effect of sulfate ion promoted zirconia catalyst and imidazolium based ionic liquid

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Non-renewability of fossil fuels and the challenges associated with its utilization such as price fluctuation due to political instability of oil rich regions, environmental concerns, imbalance between energy supply and population growth and uneven distribution of these resources in the globe are some of the compelling factors to research for sustainable and renewable energy resources. Biomass is one of the most promising candidates along with solar, wind and hydrothermal energies for sustainable and renewable energy demand. Being the most abundant and bio-renewable resource, lignocellulosic biomass has the potential to serve as feed stock for the production of second generation bioethanol and platform chemicals without computing with food supply. Lignocellulosic biomass is composed of three bio-polymeric components: Cellulose (35-50%), hemicellulose (20-35%) and lignin (5-30%). In this work, the transformation of lignocellulosic biomass to value added chemicals in a synergetic effect of sulfated zirconia (SZ) catalyst and ionic liquid was found to effectively depolymerize microcrystalline cellulose (MCC) to sugars and dehydrate sugars to 5-hydroxylmethylfurfural (5-HMF) and levulinic acid (LA). SZ was catalyst synthesized by wet impregnation method with predetermined concentration of sulfuric acid and then characterized using techniques such as X-ray diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR), BET-surface area analyzer, thermo-gravimetric analysis (TGA) and temperature programmed desorption of ammonia (Ammonia-TPD). SZ catalyst was effective in depolymerizing MCC yielding a maximum of total reducing sugar (TRS) of 57% (38% glucose and 14% fructose), 9.5% LA and 5.1 of 5-HMF at a temperature of 180 oC and 3 hours of depolymerization time. In addition, SZ was tested for dehydration of glucose and fructose and a yield of 26% and 62% of 5-HMF were obtained, respectively.

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