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A novel and highly efficient Nb promoted Cu/Zr-porous silica catalyst for the conversion of levulinic acid to valeric acid and alkyl valerates

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PURPOSE OF THE ABSTRACT

Biomass, one of the most commonly available renewable energy resources, has been considered as a promising candidate to produce sustainable liquid fuels and value-added chemicals. However, high oxygen contain biomass-derived molecules as a feedstock makes the transformation route complex and unselective. Therefore, it is essential to develop a highly efficient process through which high-quality fuels and chemicals can be produce in a large scale from direct transformation of biomass platform molecules. Levulinic acid (LA) has considered one of the most promising renewable platform molecules and it can be produced in high yield from cellulosic feedstocks with the simple acid hydrolysis process. Several derivatives of LA have been investigated as cellulosic fuels or fuel additives; these include ?-valerolactone, 2-methyltetrahydrofuron, and valeic acid (VA) and its esters. VA and its esters has been considered as an excellent alternative biofuel candidate for conventional liquid transportation fuels and commodity chemicals. Herein, we developed a Nb promoted Cu/Zr-porous silica (Nb-Cu/ZPS) catalyst, which was found to be highly selective toward hydrodeoxygenation (HDO) of ketonic (>C=O) group in the LA to VA with a maximum yield of >95% under mild reaction conditions (150 ?C, 3 MPa H2 and 2h) in an aqueous medium. The HDO performance of Nb-Cu/ZPS catalyst was found extraordinarily high as compared to previous reports on noble or non-noble metal-based catalyst. The main rationales behind the designing of Nb-Cu/ZPS catalyst include (1) incorporation of Zr into the porous silica framework created potential Lewis acid sites on the catalyst surface, which enhanced the adsorption strength of carbonyl group, and (2) the doping of Nb as a promotor not only reduced the particle size of Cu NPs, but also prevented the Cu leaching problem of the catalyst.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Biomass conversion | Hetrogeneous catalyst | Levulinic acid | Valeric acid

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