ISGC 2019
May 13th - 17th

N°884 / PC
TOPIC(s) : Biomass conversion / Homogenous, heterogenous and biocatalysis

Synergistic effect of Zn promoted copper and nickel on H-ZSM-5 for selective hydrogenation of levulinic acid to 1,4-pentanediol

AUTHORS

NEHA KARANWAL / SUNGKYUNKWAN UNIVERSITY (NATURAL SCIENCE CAMPUS),, 2066, SEOBU-RO, JANGAN-GU, SUWON-SI, GYEONGGI-DO, KOREA, SUWON-SI
DEEPAK VERMA / SUNGKYUNKWAN UNIVERSITY (NATURAL SCIENCE CAMPUS),, 2066, SEOBU-RO, JANGAN-GU, SUWON-SI, GYEONGGI-DO, KOREA, SUWON-SI
Malayil Gopalan SIBI / SUNGKYUNKWAN UNIVERSITY (NATURAL SCIENCE CAMPUS),, 2066, SEOBU-RO, JANGAN-GU, SUWON-SI, GYEONGGI-DO, KOREA, SUWON-SI
Corresponding author : JAEHOON KIM / jaehoonkim@skku.edu

PURPOSE OF THE ABSTRACT

In view of depletion of petroleum feedstocks, new synthetic routes for the sustainable production of chemicals and fuels from renewable biomass resources are highly demanded. Nowadays, the interest in the direct conversion of biomass or biomass-derived compounds to diols, polyols and diacids, and subsequently polyols over a heterogeneous catalyst is increased. Among the various biomass-generated platform chemicals, levulinic acid (LA), which can be easily synthesized from cellulose, has been considered as one of the top building block chemicals from biomass. Up to now, considering the flexible molecular structure with highly reactive carbonyl and carboxyl functional groups, it can be transferred to value-added chemicals such as ?-valerolactone, valerate esters, 1,4-pentanediols, methyl tetrahydrofuran, hydroxy propanoic acid etc. However, there are few catalytic systems for the selective transformation of levulinic acid to 1,4-pentanediol (1,4-PDO) despite its importance as a useful monomer to produce polyesters and an intermediate to prepare fragrances and lubricants.1-3 Herein we presented ZnO-promoted Cu-Ni-H-ZSM-5 catalyst, which has been found highly selective towards hydrogenation of ketonic (>C=O) group in LA to 1,4-PDO under mild reaction conditions (120 °C, 2.5 MPa and 2 hrs) in an aqueous medium, which yielded up to 93.7% selectivity of 1,4-PDO. The formation of intermetallic Cu-Ni, Cu-Zn and Ni-Zn sites confirmed by HAADF-STEM analysis and further proved by XPS provide highly active site for reactant adsorption, thus improved the activity among bimetallic and monometallic systems. Not only this, the change in acid density of the catalyst proximate to the metal sites, the weak Lewis acid sites increased upon increasing the metal content and both the moderate and strong acid sites decreased, accelerating the reaction in the forward direction. The catalyst could be efficiently recycled and reused through simple treatments, offering above 90% LA conversions and high-yield 1,4-PDO in consecutive reactions.

FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

Biomass resources | Diols, Polyols | Levulinic acid | 1,4 Pentanediol

BIBLIOGRAPHY