Title

Alkali-driven selectivity of products on carbon-supported Ni-based catalysts during the HDO of guaiacol

Abstract

The catalytic hydrodeoxygenation (HDO) of guaiacol as a representative bio-oil molecule was studied using a series of carbon-supported Ni-based catalysts. The promoter effect of alkali metals (Ca and Mg) on the catalytic activity and selectivity was verified. Catalysts were prepared by wetness incipient method and N2 gas adsorption/desorption isotherms, X-ray diffraction, reduction/desorption temperature-programed, and CO chemisorption analysis were performed to characterize the catalysts. In terms of the initial reaction-rate catalysts with 1 wt% alkali-promotors showed an increase in the activity up to ca. 1.4 and 1.2 times higher on Ni-Ca(1 %)/AC and Ni-Mg(1 %)/AC, respectively, compared to Ni/AC catalyst. The increase to 5 wt% in alkali promotors slightly reduced the initial activity of Ni. However, the turn-over frequencies estimated showed higher values when alkali content is increased from 1 wt% to 5 wt%. These apparent contradictorial results suggest the formation of new actives sites along reaction, probably constituted by a mixture of oxides NiO-CaO and NiO-MgO. The selectivity of products showed remarkable changes due to the presence of alkali-promotors and a mechanism or reaction is proposed based on the kinetics of formation and evolution of products. Mg-promoted led to the formation of cyclohexane. On the contrary, Ca-promoted catalysts led the mechanism to representative benzene yields. This is remarkable result regarding the efficiency of a HDO biorefinery. In general, it can be concluded that Ni-based catalysts promoted with alkali metals are an economical alternative for the catalytic conversion of representative target molecules from a bio-oil feed. © 2024 Elsevier Ltd

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Author Keywords

Alkali-promotors; Biorefinery; Guaiacol conversion; Ni-based catalysts; Selectivity

Index Keywords

Alcohols; Alkali metals; Binary alloys; Catalyst activity; Catalyst selectivity; Catalyst supports; Gas adsorption; Magnesia; Magnesium alloys; Molecules; Nickel oxide; Reaction kinetics; Refining; Alkali promotors; Bio-oils; Biorefineries; Guaiacol conversion; Hydrodeoxygenation; Ni-based catalyst; Oil molecules; Promoter effect; Selectivity;]+ catalyst; Carbon

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