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Selective hydrogenation of levulinic acid into γ-valerolactone over Cu/Ni hydrotalcite-derived catalyst

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Abstract: A highly efficient and selective Cu/Ni hydrotalcite-derived catalytic system has been developed for liquid phase hydrogenation of levulinic acid (LA) into γ-valerolactone (GVL) under mild reaction conditions. Full conversion of LA with 100% selectivity towards GVL has been achieved at 140 ^{o}C, 30 bar H_2 pressure in 3 h using dioxane as a solvent over activated Cu/Ni/Mg/Al catalyst with 0.75/0.5/1/1 molar ratios of metal cations in the synthesis mixture. It has been found that the catalytic activity increases with increasing copper content, while the selectivity towards GVL formation increases with increasing nickel content and surface Lewis basic sites (SLB) resulting from MgO promotes the hydrogenation of LA under mild reaction conditions by activating the C=O group of LA for hydrogenation. Influence of various parameters such as reaction temperature, hydrogen pressure, reaction time and the nature of solvent have been studied. A series of Cu-based catalysts have been prepared by co-precipitation method and characterized using XPS, XRD, FEG-SEM, EDS, NH_3-TPD, CO_2-TPD, TPR and N_2 physical adsorption techniques. Furthermore, the catalyst was easily reactivated and recycled for four times without significant loss in catalytic activity and selectivity towards GVL formation.

Graphical abstract