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CONTROLLING THE ACTIVITY AND CHEMOSELECTIVITY IN THE CINNAMALDEHYDE HYDROGENATION BY INSERTION OF NON-NOBLE METALS IN THE MATRIX OF HYDROALCITE-LIKE MATERIALS

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Abstract

The purpose of this study was to prepare new nanocomposite catalysts of Metal/LDHs type by mild reduction of transition metal cations Co^{2+} and Cu^{2+} substituted in the matrix of ZnAl-LDH at 150°C and atmospheric pressure, under hydrogen flow. To this end, a series of ZnCuCoAl layered double hydroxides (LDH) precursors were synthesized by co-precipitation method. M^{2+}/M^{3+} (i.e., Zn^{2+}/Al^{3+}) molar ratios were kept constant while the Cu^{2+}/Co^{2+} molar ratios were varied in order to investigate their influence on the structural and textural properties of the resulted catalysts. The LDH precursors were systematically characterized by different techniques such as powder XRD, nitrogen physisorption, FT-IR and DR UV-Vis spectroscopy as well as temperature programmed reduction (TPR). The results indicate that all the precursors present well-crystallized layered structures and a high degree of substitution of cobalt and copper cations in the ZnAl matrix. Upon the mild reduction treatment the layered structure of precursors was maintained, whereas a certain part of transition cations was reduced to metallic centers acting as highly dispersed catalytic active sites. The effect of chemical composition of the ZnCuCoAl LDHs on the catalytic properties in the selective hydrogenation of cinnamaldehyde was studied in propylene carbonate at 150°C and atmospheric pressure. It was observed that catalytic activity gradually increases with the Cu content of LDH, whereas the selectivity to unsaturated alcohol does not depend on the chemical composition. However, a substantial increased chemoselectivity to cinnamyl alcohol can be attained by replacing Cu with Ni in ZnCoAl LDH precursors at the expense of decreased activity.

Key words: cinnamaldehyde hydrogenation, Co-based catalysts, Cu-based catalysts, layered double hydroxides

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