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Enhanced activity and stability of CuO-ZnO-ZrO2 catalyst by addition of colloidal SiO2 nanoparticles for CO2 hydrogenation

In this study, a series of CuO-ZnO-ZrO2-SiO2 catalysts were prepared by co-precipitation of Cu, Zn and Zr precursors with dispersed colloidal silica nanoparticles. The effect of silica content (0–5 wt%) on the physicochemical properties of the resulting catalysts as well as their catalytic activity in CO2 hydrogenation were investigated. The catalysts were characterized by thermal gravimetric analysis (TG), X-ray diffraction (XRD), H2-temperature programmed reduction (H2-TPR), transmission electron microscope (TEM), time-resolved x-ray absorption spectroscopy (TRXAS), CO2 and H2 temperature-programmed desorption (CO2 and H2-TPD). The promotional effect was most effective for low amounts of SiO2 (<1.5 wt%). An increase in methanol synthesis activity of 25% compared to the ternary SiO2 free system was observed. Promotion was characterized by a geometric modification which was expressed by a higher inter-dispersion of metal oxides. Moreover the presence of SiO2 nanoparticles in the CuO,ZnO,ZrO2 system enhanced the stability of the catalyst.

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