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Enhanced performance of the CuO-ZnO-ZrO₂ catalyst for CO₂ hydrogenation to methanol by WO₃ modification

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Abstract

A series of WO₃ modified CuO-ZnO-ZrO₂ mixed oxides with different WO₃ contents (0~20 at.%) were prepared by co-precipitation method and used as catalyst for methanol synthesis from CO₂ hydrogenation. The effects of WO₃ content on the physicochemical and catalytic properties of the CuO-ZnO-ZrO₂-WO₃ catalysts were investigated by X-ray diffraction, X-ray photoelectron spectra, temperature-programed reduction of hydrogen, temperature-programed desorption of CO₂, N₂ adsorption and desorption, reactive N₂O adsorption, and activity testing. The results indicated that both CO₂ conversion and methanol selectivity of the CuO-ZnO-ZrO₂ catalyst was enhanced by the addition of small amounts (2 and 5 at.%) of WO₃. However, the activity was significantly decreased by the addition of excessive WO₃ (20 at.%). The activity was closely related to the specific surface area of metallic Cu (S_{Cu}), amount of weak basic sites, and reducibility of the catalyst.

Key words: CuO-ZnO-ZrO₂ catalyst; CO₂ hydrogenation; methanol synthesis; tungsten oxide

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