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Hydrogenation of CO2 to Methanol over Copper-Zinc Oxide-Based Catalyst

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Abstract : Carbon dioxide is highly thermochemical stable molecules where it is very difficult to activate the molecule and achieve higher catalytic conversion into alcohols or other hydrocarbon compounds. In this paper, series of the bimetallic Cu/ZnO-based catalyst supported by SBA-15 were systematically prepared via impregnation technique with different Cu: Zn ratio for hydrogenation of CO₂ to methanol. The synthesized catalysts were characterized by transmission electron microscopy (TEM), temperature programmed desorption, reduction, oxidation and pulse chemisorption (TPDRO), and surface area determination was also performed. All catalysts were tested with respect to the hydrogenation of CO₂ to methanol in microactivity fixed-bed reactor at 250^oC, 2.25 MPa, and H₂/CO₂ ratio of 3. The results demonstrate that the catalytic structure, activity, and methanol selectivity was strongly affected by the ratio between Cu: Zn, Where higher catalytic activity of 14 % and methanol selectivity of 92 % was obtained over Cu/ZnO-SBA-15 catalyst with Cu:Zn ratio of 7:3 wt. %. Comparing with the single catalyst, the synergetic between Cu and Zn provides additional active sites to adsorb more H₂ and CO₂ and accelerate the CO₂ conversion, resulting in higher methanol production under mild reaction conditions.

Keywords : hydrogenation of carbon dioxide, methanol synthesis, Cu/ZnO-based catalyst, mesoporous silica (SBA-15), metal ratio

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