Tinnavat Permsirivanich 2015: Direct Synthesis of Dimethyl Ether from CO_2 Hydrogenation over Cu-loaded Bimodal Porous Alumina Catalysts. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Assistant Professor Thongthai Witoon, Ph.D. 81 pages.

Dimethyl ether (DME) has emerged as a potential alternative energy and a chemical intermediate for producing various feed stocks such as methyl acetate, dimethyl sulfate and light olefin. In this research, DME was synthesized from CO_2 by using Cu-loaded bimodal porous alumina catalysts. Effects of calcination temperature (600, 700, 800 and 900 °C) and bimodal pore structure on the physicochemical properties of the catalysts were investigated. The catalysts were characterized by means of thermal gravimetric and difference temperature analysis (TG-DTA), X-ray diffraction (XRD), scanning electron microscope (SEM) and energy dispersive spectroscopy (EDS), H_2-temperature program reduction (H_2-TPR), X-ray adsorption near edge structure (XANES), Fourier transform infrared spectroscopy (FT-IR) and pyridine-temperature program desorption (Pyridine-TPD). The increase of calcination temperature of alumina support caused the increase in the acid strengths and the decrease in the number of acid sites. In addition, the CuO crystallite size was found to increase with increasing calcination temperature as well as decrease the interaction between CuO and the support. The CO_2 conversion of Cu-loaded unimodal alumina catalysts was found to be slightly higher thand that of Cu-loaded bimodal alumina catalyst when the supports were calcined at identical temperature. Cu loaded on unimodal alumina support calcined at 800 °C provided the highest CO_2 conversion of 19.27 percent at the reaction temperature of 280 °C. However, The product selectivity was found to strongly depend on the pore structure of alumina support. Cu loaded on bimodal alumina support calcined at 600 °C exhibited the highest selectivity of DME and methanol of 8.44 and 21.69 percent, respectively. Moreover, the existence of macropore of bimodal alumina support enhanced the stability of the catalyst.

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