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High Surface Area Cu/γ-Al2O3 Catalyst Synthesized by Reverse Microemulsion Method for CO2 Conversion via Reverse Water Gas Shift

The accumulation of CO2 in the atmosphere results in adverse environmental issues. The most attractive and profitable way to mitigate CO2 emissions is to convert CO2 into useful chemicals and fuels. Particularly, the reverse water gas shift (RWGS) reaction converts CO2 into CO which can be upgraded into synthetic gas and then valuable chemicals. The high surface area Cu/γ-Al2O3 catalyst was synthesized by the reverse microemulsion (RME) method. The RME method is introduced to overcome the limitations of the catalyst activity due to low surface area. The synthesis in reverse micelles allows to form nanoparticles with large-to-volume ratio. Number of analytical techniques were used for catalyst characterization, including the Brunauer-Emmett-Teller (BET) method, X-ray diffraction (XRD), temperature-programmed reduction (TPR), and thermogravimetric analysis coupled with Fourier transform infrared spectroscopy (TGA/FTIR). The catalytic activity and selectivity were investigated in a fixed bed kinetic flow reactor. The catalyst was successfully synthesized with a high surface area of approximately 439 m2/g. High catalytic performance was achieved in the fixed bed reactor at 600 °C, 3 bar, under a 10,000 mL gcat-1 h-1 flow

(H2:CO2=4:1): the selectivity to CO reached 100 % and the conversion of CO2 was 60 %, which is close to the equilibrium value.

Future work will focus on the catalytic performance evaluation, including stability tests, and further catalyst characterization using the inductively coupled plasma optical emission spectrometry (ICP-OES), transmission electron microscopy (TEM), and scanning electron microscope (SEM). The reaction mechanism will be investigated by in situ Fourier-transform infrared spectroscopy (FTIR). The absorbed intermediates and species on the catalyst and pathways from CO2 to CO conversion will be investigated.