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Synthetic Fuel from Syngas Using Supported Co Catalysts †

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Abstract: Fischer-Tropsch synthesis (FTS) is an attractive catalytic process for the industrial production of clean fuels and chemicals from syngas. Cobalt-based catalysts are of special interest for the FTS reactions because of their selectivity towards higher hydrocarbons. In this work, mesoporous metallosilicate (metal = Al, Ti, Zr, V, and Ce) supports possessing high surface area, and large pore volumes were synthesized by a surfactant-free one-pot templating process for use as catalytic supports. The catalysts were prepared by incipient wetness impregnation of cobalt nitrate (15 wt.% cobalt) and extensively characterized using BET, XRD, H_2-chemisorption, TPR, and XPS. The catalysts had a 20-25 % decrease in surface area after the addition of cobalt. XRD and H_2-chemisorption results revealed that the cobalt was well dispersed and possessed particle sizes of 7-17 nm. The FTS activities of the catalysts were tested in a fixed-bed reactor under industrially relevant conditions (220 °C, 250 psi, 2000 $mL_{syngas}/mL_{catalyst}/h$). The catalysts supported on silicates of Ti and Zr exhibited higher CO conversion (81 and 85 %) than the catalyst supported on silica (75 %). The FTS activities of the catalysts were found to be in the order Co/TiTUD-1 > Co/TUD-1 > Co/ZrTUD-1 > Co/AlTUD-1 > Co/CeTUD-1 > Co/VTUD-1. Mesoporous titanosilicate was found to be optimal support for cobalt-based FTS catalysts.

Keywords: Fischer-Tropsch synthesis; cobalt catalyst; metallosilicate; mesoporous support.

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Conflicts of Interest

The authors declare no conflict of interest.