

Investigation of fischer–tropsch synthesis using carbon nanotube as cobalt catalyst support

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Abstract

The effect of the support on the reducibility of the cobalt oxide species, dispersion of the cobalt, average cobalt clusters size, CO conversion, activity and selectivity of FTS is investigated. Carbon Nanotubes (CNTs) were synthesized by chemical vapor decomposition (CVD) method over Co-Mo/MgO nanocatalyst. In this method methane was used as a carbon source. The FT synthesis was carried out in a fixed-bed micro reactor (220 °C, 1 bar, CO/H₂ = 2). Using carbon nanotubes as cobalt catalyst support was found to cause the reduction temperature of cobalt oxide species to shift to lower temperatures. The strong metal-support interactions are reduced to a large extent and the reducibility of the catalysts improved significantly. CNT aided in well dispersion of metal clusters and average cobalt clusters size decreased. Results are presented showing that the hydrocarbon yield obtained by inventive CNT supported cobalt catalyst is surprisingly much larger than that obtained from cobalt on alumina supports. The maximum concentration of active surface Co⁰ sites and FTS activity for CNT supported catalysts are achieved at 40 wt. % cobalt loading.

References

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Figures

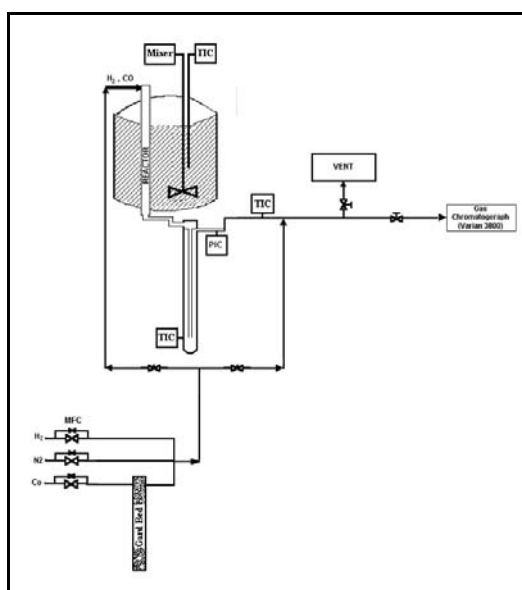


Fig. 1. Experimental setup

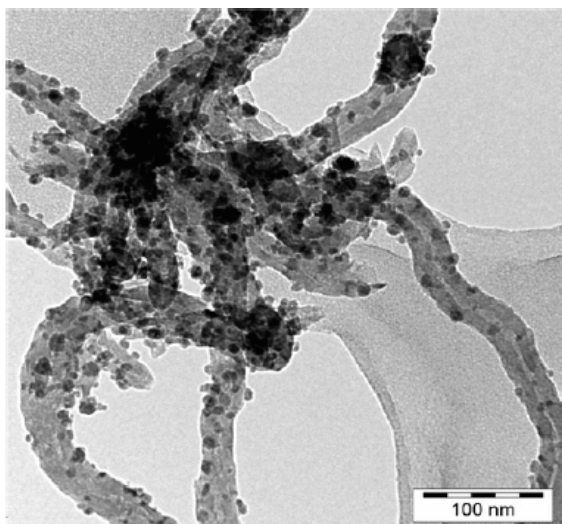


Fig. 2: TEM image of the S_1 catalyst (15wt.% Co/CNT)

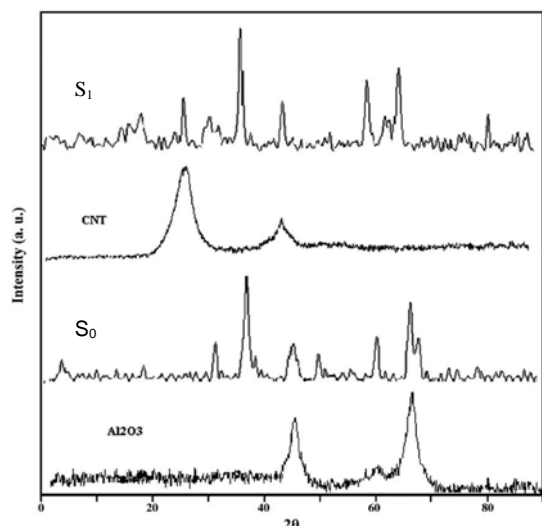


Fig. 3: XRD patterns

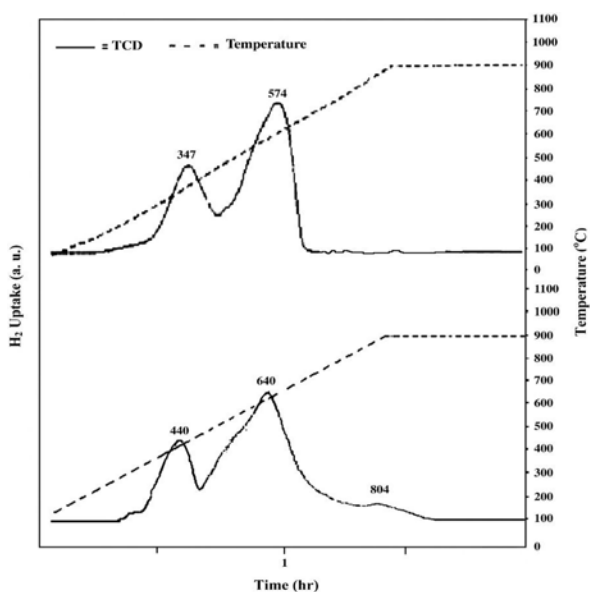


Fig. 4: TPR profiles

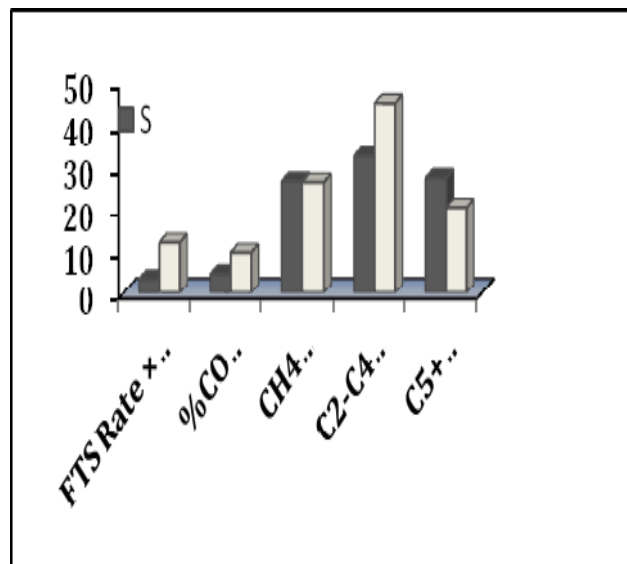


Fig5: Activity and Selectivity of FTS ($T=220\text{ }^\circ\text{C}$, $P=1\text{ bar}$, $H_2/CO=2$) for S_0 and S_1 catalysts

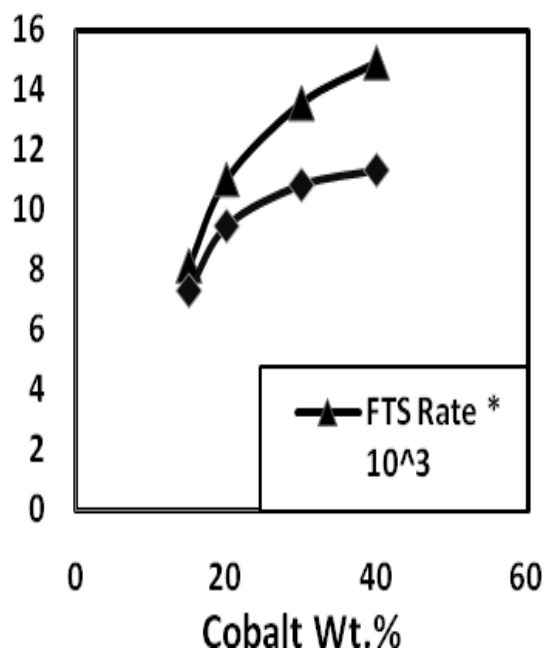


Fig. 6: FTS Rate and No. of Active sites variation with Cobalt loading for CNT supported catalysts