Fischer-Tropsch synthesis over bimetallic Co₅Fe₅/HMS catalysts

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Introduction

The renewable “green gasoline and diesel” from biomass are of special interest. The Fischer–Tropsch Synthesis (FTS) is an alternative attractive for the production of ultra-clean, sustainable and renewable free-sulfur liquid fuels from syngas conversion [1]. FTS is of great industrial importance due to the great variety of hydrocarbon products obtained, whose abundance depends on the catalysts employed, as well as on operating conditions [2]. Recently, mesoporous materials such as MCM-41, SBA-15 and HMS, have attracted widespread attention as novel supports for the synthesis of Fischer–Tropsch catalysts [3-7]. For example, Yin and coworkers[4] studied the FTS over Co-based catalysts supported on HMS and MCM-41. The Co/HMS catalysts showed higher catalytic performance and selectivity toward C₅ products than the Co/MCM-41 catalyst. The superior performance of Co/HMS sample was ascribed to their smaller domain size with shorter channels and larger textural mesoporosity. Lira and coworkers [8] compared Co/HMS and Co/SiO₂ catalysts in the FTS. Both catalysts showed selectivity toward C₁₅ products, specifically towards the diesel fraction (C₁₁₋₁₅).

In the present work, the HMS support was used for the preparation of Co-based catalysts. The catalysts were tested in the FTS at 220 °C to 20 atmospheres of hydrogen pressure.

Materials and Methods

The HMS material was synthesized by neutral SiT templating route as described previously [9]. The catalysts were prepared by successive impregnation using the pore-filling method, using solutions of cobalt acetate and iron nitrate. The obtained samples were dried at room temperature for 18 h and then at 100 °C for 2 h. Then the samples were calcined at 500 °C for 4.5 h, reaching this temperature within 3.5 h. The catalysts were characterized by ICPAES, SBET, XRD, TPR and DRS UV-vis. The catalysts were tested in the FTS at 220 °C to 20 atmospheres of hydrogen pressure.

Results and Discussion

All bimetallic catalysts reached CO conversion in the 50-75% interval. The products yields of the FTS over bimetallic Co₅Fe₅/HMS catalyst are showed in the Figure 1. We can notice that the increment in the Co-content favors the selectivity towards lighter fractions (Fig. 1 (a)). Contrary to these samples, the increment in the Fe-content the selectivity shifts towards heavy hydrocarbon fraction.

![Graph showing product fraction yields](image-url)

**Figure 1.** Products yield of the FTS over bimetallic Co₅Fe₅/HMS catalyst. The reaction was performance at 220 °C and 20 atmospheres of hydrogen pressure. (The nomenclature denoted 03, 06, 09, 05, 2.5 and 7.5 correspond to the % wt. of the content-metal)

Significance

Generally the catalysts used showed conversion to 50% with selectivity to fractions waxes. Our materials achieve conversions above 50%, and the selectivity are centered on liquid fractions.

References