

Ru 和 Cu 助剂对费托合成 Fe 基催化剂反应性能的影响

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摘要 研究了 Ru 和 Cu 助剂对无 K 的费托 (F-T) 合成 Fe 基催化剂的织构性质、物相结构、还原和碳化行为的影响。在 $n(\text{H}_2)/n(\text{CO}) = 2.0$, $t = 260\text{ }^\circ\text{C}$, $p = 1.5\text{ MPa}$ 和 $\text{GHSV} = 2000\text{ h}^{-1}$ 的条件下, 采用固定床反应器考察了 Ru, Cu 助剂对 Fe 基催化剂费托合成反应性能的影响。采用低温 N_2 物理吸附、X 射线衍射、穆斯堡尔谱和程序升温还原技术对催化剂进行了详细表征。结果发现, Ru 或 Cu 的添加均提高了铁氧化物的分散度, 不同程度地促进了催化剂的还原和碳化, Cu 的作用更为显著。反应结果表明, Ru 或 Cu 的添加均提高了催化剂上 F-T 合成反应活性, 其中 Cu 的添加降低了 CH_4 选择性, 促进了 C_{5+} 的生成; 而 Ru 的作用则相反。

关键词:

Abstract: The effects of Ru and Cu promoters on the textural properties, phase composition, reduction and carburization behavior, and catalytic performance of Fe-based Fischer-Tropsch synthesis (FTS) catalysts without K promoter were investigated. The catalysts were characterized by N_2 physical adsorption, X-ray diffraction, H_2 and CO temperature-programmed reduction, Mössbauer effect spectroscopy. The FTS performance of the catalysts was tested in a fixed-bed reactor under the conditions of $n(\text{H}_2)/n(\text{CO}) = 2.0$, $t = 260\text{ }^\circ\text{C}$, $p = 1.5\text{ MPa}$ and $\text{GHSV} = 2000\text{ h}^{-1}$. The results indicated that both Ru and Cu enhance the dispersion of iron oxides and facilitate the reduction and carburization of the catalysts, which was more obvious for the Cu promoter. Ru and Cu both increase the activity of the catalysts to some extent. Besides, the Cu promoter increased the C_{5+} selectivity and hindered the CH_4 formation while Ru exhibited the opposite trend.

Keywords: Fischer-Tropsch synthesis, ruthenium, copper, promoter, iron-based catalyst, fixed-bed reactor

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