Fe-Co-Mn/MgO nanocatalyst for CO hydrogenation: effect of precursor drying conditions on the performance, structure and surface reaction rates

M. Arsalanfar, M. Abdouss[*]*, M. Assar*

Department of chemistry, Amirkabir University of technology, Hafez Ave, Tehran, Iran

Abstract:
In recent years, it is highly desired to establish the practical method of producing clean alternative fuels from the aspects of environmental preservation and energy security [1]. Natural resources, such as coal, natural gas and biomass, can be converted into liquid hydrocarbon fuels via the Fischer–Tropsch synthesis (FTS) reaction [2]. In the nanocatalyst preparation via precipitation method drying of the obtained precipitate is one of the main steps. Drying manner (in view point of drying time and temperature) leads to various structure, texture, porosity, surface area, morphology of the final nanocatalyst and also affect the reduction behavior; this subject leads to different catalytic performance of the nanocatalyst for CO hydrogenation. In the present work co-precipitated Fe-Co-Mn/MgO nanocatalysts were tested for production of light olefins via CO hydrogenation reaction. The effect of a range of drying conditions including drying temperature and drying time on the structure and catalytic performance of Fe-Co-Mn/MgO nanocatalyst for FTS was investigated in a fixed bed micro-reactor under the same operational conditions of T=350°C, P=1bar, H_2/CO=2/1 and GHSV=4500h^{-1}. It was found that the nanocatalyst dried at 120°C for 16h has shown the best catalytic performance for CO hydrogenation. Furthermore the effect of drying conditions on different surface reaction rates was also investigated and it was found that the precursors drying conditions influenced the rates of different surface reactions (Figure 1). Characterization of nanocatalyst precursors and calcined samples (fresh and used) using XRD, SEM, TEM, BET, TPR, TGA and DSC showed that different investigated variables (drying conditions) influenced the structure, porosity, morphology and catalytic performance of the ternary nanocatalysts.
Keywords: Fe-Co-Mn nanocatalyst, Drying conditions, CO hydrogenation, Characterization
Figure 1: Effect of precursor drying temperature on different surface reactions rates.

References:

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