

Comparison of Fe and Co Catalysts for the Direct Synthesis of Light Alkenes from Syngas

J. Schneider, S. Dietrich, S. Rönsch

DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH, Leipzig, Germany

Abstract

A sustainable way to produce plastics like polyethylene is the direct synthesis of light alkenes from biomass-derived syngas. While respective selectivities to light alkenes are still too low with commercial Fischer-Tropsch catalysts, promising lab-scale results with catalysts containing iron and cobalt as active components exist for catalyst amounts of 1 g and below [1].

In the present work, the most promising results from [1] are reproduced in a fixed bed with catalyst amounts between 35 and 70 g and classic synthesis gas (H_2 and CO). Selectivities to ethene of 11 and 7 % are found for Fe/Mn|MgO [2] and Fe/Na/S [3], respectively, at temperatures of 440 °C and 310 °C at 1.5 bar. Besides, CO_2 and CH_4 are the main products at these conditions with selectivities of ca. 65 and 20 %. Ethane selectivities are below 3 % for Fe/Mn|MgO but > 12 % for Fe/Na/S. The chain growth probability is between 0.1 and 0.2 with Fe/Na/S at 320 – 350 °C and $H_2/CO = 3$, indicating that C_{3+} hydrocarbons are produced additionally.

These preliminary results will be complemented by additional measurements in order to close the mass balance and quantify gaseous and liquid hydrocarbons as well as oxygenated products.

References:

- [1] H.M. Torres Galvis, K.P. de Jong, Catalysts for Production of Lower Olefins from Synthesis Gas: A Review, *ACS Catal.* 3 (9) (2013) 2130–2149.
- [2] Xu-Longya, Wang-Qingxia, Xu-Yide, Huang-Jiasheng, A new supported Fe-MnO catalyst for the production of light olefins from syngas. I. Effect of support on the catalytic performance, *Catal Lett* 24 (1-2) (1994) 177–185.
- [3] G.F. Botes, T.C. Bromfield, R.L. Coetzer, R. Crous, P. Gibson, A.C. Ferreira, Development of a chemical selective iron Fischer Tropsch catalyst, *Catalysis Today* 275 (2016) 40–48.