Electrospun iron-containing sustainable carbon submicron fibers as Fischer-Tropsch catalyst

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The problems derived from fossil fuels usage such as climate change and energy crises have led to seek for alternatives. Biomass is a renewable source which can be used to produce fuels and olefins via Fischer-Tropsch from synthesis gas. The fixed bed reactors used in this process usually presents pressure drops and heat transfer limitations. In this sense, the use of structured catalytic bed reactor with fibrillar morphology would allow the reduction of these problems. In this work carbon fibers loaded with iron were prepared in just one step and tested as Fischer-Tropsch catalysts in a fixed bed reactor.

Carbon fibers were prepared by electrospinning in a coaxial configuration, using a solution of lignin, ethanol, and iron nitrate. The electrospun fibers were stabilized in air and carbonized with N_2 flow at 500, 650 and 800 ºC. The used nomenclature was "FLFeX", where X was the carbonization temperature. The catalysts were tested under High-Temperature Fischer-Tropsch (HTFT) conditions, at 20 bar, 340 ºC and 150 $L_{syngas}\ g_{Fe}^{-1}\ h^{-1}$.

The thermal treated catalyst at 500 and 650 ºC presented a narrow microporosity, while the fibers carbonized at 800 ºC, FLFe800, developed a wider microporosity and mesoporosity. The change in porous texture was associated to the effect of iron, as evidenced by X-ray diffraction, where cementite was detected in FLFe800 while iron oxides were present in the rest of catalysts. The reaction results are presented in Fig. 1. The best results were obtained with the catalysts treated at high temperature, FLFe800, showing the highest CO conversion and the best product distribution. FLFe500 and FLFe650 generated mainly CO_2 and CH_4 due to the narrow microporosity.

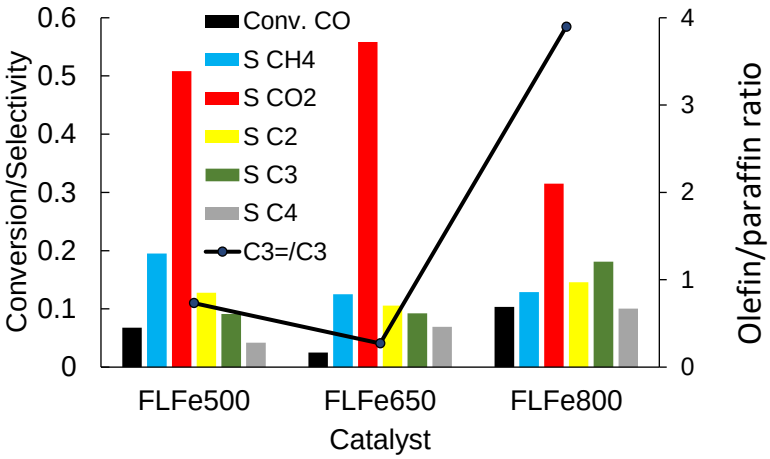

Figure 1. CO conversion, selectivity to main products and olefin/paraffin ration for the different catalysts under HTFT conditions: 20 bar, 340 ºC, $H_2/CO=1$, SV=150 $L_{syngas}\ g_{Fe}^{-1}\ h^{-1}$, TOS=9 h

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