Contribution ID: **71** Type: **Oral contribution**

A microreactor for ambient pressure NEXAFS studies of Fischer-Tropsch catalysts

Tuesday 6 December 2022 16:40 (20 minutes)

Establishing relationships between structure and performance can enable a 'smart design'approach in the development of next generation catalysts, processes and the advanced materials used, for example, in energy storage and conversion. Heterogeneous catalysts and energy materials are often dynamic in nature with respect to structure, composition and local electronic environment. Structural evolution under operating conditions then places further demands on structure determination; to be meaningful this must be achieved under relevant pressures, temperatures and feed compositions.

We present the first results from a prototype microreactor for soft XAS measurements at the VerSoX B07 beamline, at elevated pressure and temperature (tested up to 0.9 bar and 400 ℃) using the Total Electron Yield detection mode to probe the first few nanometres of a sample. We have selected the Fischer-Tropsch (FT) reaction as our test case; the combination of high temperature and pressures of toxic, flammable gases, the undoubted mechanistic complexity and a product slate comprising both gases and liquids makes this an ambitious but highly rewarding study. There has been a resurgent interest in FT chemistry in recent years, driven partly by the potential to generate fuels and chemicals from above ground sources of carbon (e.g. biomass, waste and CO2) via synthesis gas.

Figure 1. Photograph of the prototype microreactor and Co L edge NEXAFS showing the in-situ reduction of Co3O4 nanoparticles acquired at 0.9 bar H2 at 350 C.

if "Other", please specify:

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No

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