NANOCATALYSTS FOR THE CO HYDROGENATION TO FUELS

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INTRODUCTION

- Production of synthetic liquid fuels from CO_2 is proposed as an alternative for lowering the CO_2 emissions of the aviation industry
- 4AirCRAFT project aims at development of single multistep catalytic reactor for direct transformation of CO_2 to jet-fuel lenght hydrocarbons (C_8-C_{16}) [1]
- Presented work focuses on one step of the process, which includes development of nanocatalyst for the conversion of CO to fuel-lenght hydrocarbons in a Fischer-Tropsch catalytic system.
- Design of the catalyst targeted CO hydrogenation and chain growth on the Fe sites, and cracking and oligomerization on the zeolite sites.

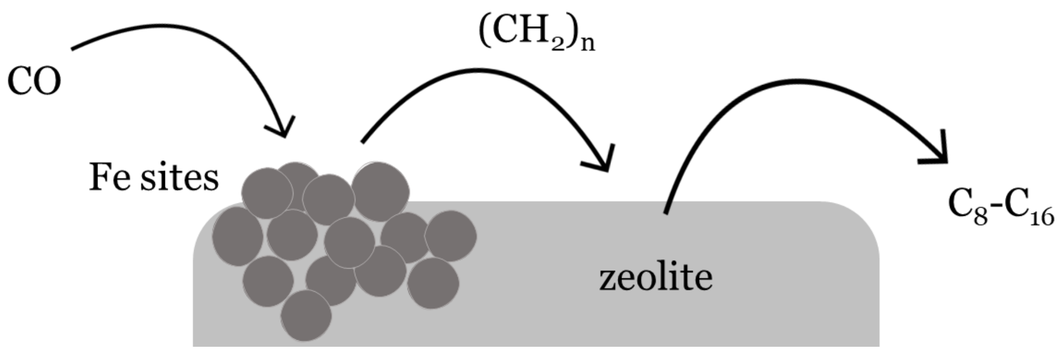

Figure 1. Scheme of the catalytic reaction on the nanocatalyst

METHODS

- Studied catalysts were based on Fe_3O_4 nanoparticles supported on zeolite HZSM-5. [2]
- Precipitated Fe_3O_4 nanoparticles were incorporated with commercial zeolite by mixing in mortar (dried, physical mixing) or in form of a slurry (dry impregnation).
- Catalytic tests were performed in an automated continuous fixed-bed reactor with control of gas flow, temperature, and pressure. Products were analyzed by gas chromatography.

RESULTS AND DISCUSSION

- Based on characterization, the dry impregnation catalyst presented a smaller Fe particle size compared to the physical mixing. Both samples exhibited Fe_3O_4 an Fe_2O_3 phases after calcination.
- Tests showed the conversion to increase with increased temperature
- Best results were obtained with sample prepared with dry impregnation, for which up to 89% conversion (at 350 °C) and improved selectivity to fuel-length hydrocarbons was reached.

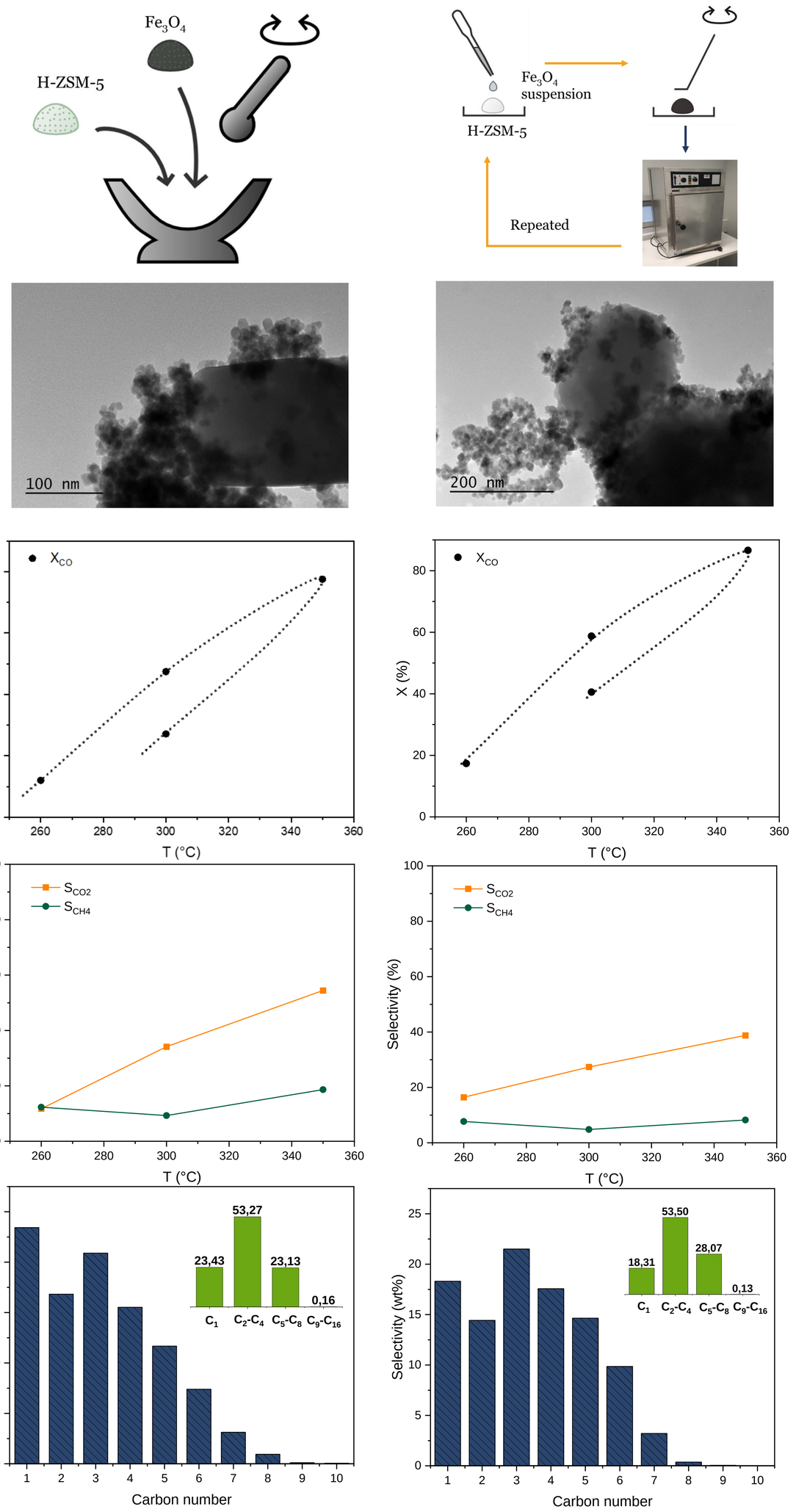

Figure 2. Selected data on physical mixing (left) and dry impregnation (right) prepared Fe_3O_4/HZSM-5 catalysts. From top to bottom: preparation method, transmission electron micrograph, conversion, gas selectivity (at 300°C, 20 bar) and liquids selectivity (at 300°C, 20 bar).

CONCLUSIONS

- Prepared Fe_3O_4/HZSM-5 catalyst showed catalytic activity that varied based on the chosen preparation method.
- Further optimisation of components of the catalyst is still needed to reach better selectivity to target products at mild conditions.

References: [1] 4AirCRAFT - Air Carbon Recycling for Aviation Fuel Technology https://4aircraft-project.eu/. Accessed 13.7.2023 [2] J. Wei et al. Nat. Commun. **2017,** 8, 15174

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