Master Thesis Opportunity

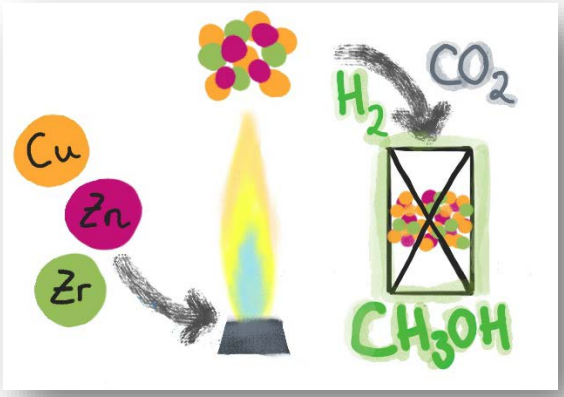
Flame-sprayed Cu/Zn/Zr catalysts for sustainable CO_2-hydrogenation to Methanol

Research Area: Heterogeneous Catalysis | Power-to-X | Flame-spray pyrolysis
Location: Institut für Katalyseforschung und -technologie (IKFT), KIT

Background

Methanol is an increasingly relevant chemical and fuel additive already produced by 100 Mio. tons each year. In the context of the green energy transition and Power-to-X technologies, sustainable methanol (MeOH) synthesis via CO_2 hydrogenation is highly attractive but challenged by catalyst deactivation from byproduct water. While traditional $Cu/ZnO/Al_2O_3$ catalysts face limitations here, replacing Al_2O_3 with less hydrophilic ZrO_2 drastically improves stability.

Flame Spray Pyrolysis (FSP) has emerged as a key method for tailoring crucial metal-support interactions and interphases. It enables the rapid, reproducible, and scalable synthesis of nanostructured multi-component catalysts, allowing precise control over particle size and morphology via parameters like feed rate or nozzle configuration. However, the effects of other critical variable such as precursor selection and solvent mixtures require deeper investigation. Comprehensive material characterization (TGA, XRD, ICP-OES, TPR, BET, TEM-EDX) combined with catalytic performance tests under realistic conditions are essential tools to correlate these synthesis parameters with final catalyst properties.



Your Tasks

Catalyst Design and Preparation: Tailored synthesis of flame-sprayed catalysts

Characterization: Investigation of structural and chemical properties using techniques such as N_2 physisorption, XRD, TEM, TPR, etc.

Catalytic Testing: Evaluation of catalytic performance in CO_2 based methanol synthesis, with micro-GC products analysis.

Identifying guidelines for synthesis and testing: Deriving beneficial synthesis settings and optimize the catalytic testing procedure and setup.

What You Will Gain

- Practical experience **in catalyst synthesis and advanced characterization**
- **Insight into** modern research **approaches in heterogeneous catalysis, central to numerous industrial and sustainable processes**
- Understanding **of Power-to-X technologies**
- Training **in experimental design, data interpretation, and scientific communication**

Your Profile

- Studies in Chemistry, Chemical Engineering, or related field
- Interest in catalysis, materials science, or sustainable technologies
- Motivation to work experimentally and analyze data

Contact

If you are interested, please contact:

Dr. Erisa Saraçi
IKFT - KIT
Email: erisa.saraci@kit.edu