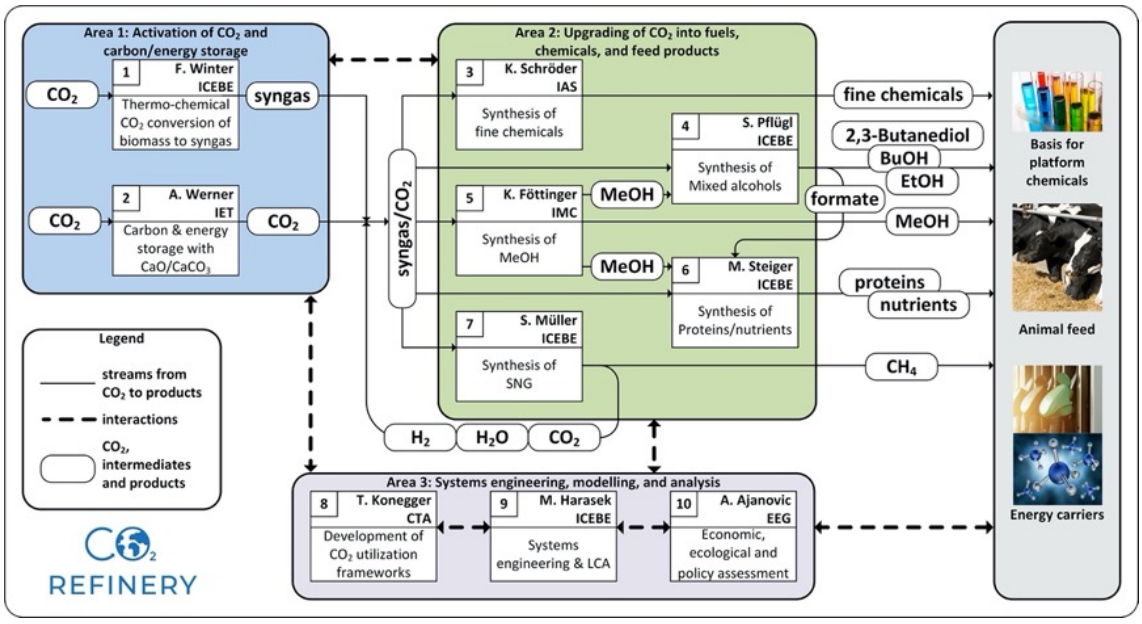
Open Position PhD #5: Versatile and robust catalysts for CO_2 hydrogenation to methanol

General

The TU Wien doctoral school **CO_2Refinery** covers a wide range of methods and will integrate multiple disciplines required to implement a fully functional facility for refining and upgrading CO_2 on a technical center scale. With its integrated research and training program, the doctoral school targets to train "**one carbon engineers**" will work together on the development of technologies to efficiently utilize CO_2 as a carbon source to make a broad variety of products using chemical and biological catalysts. In addition to synthesis of products from CO_2, **CO_2Refinery** will focus on the activation of CO_2 for utilization as a carbon source in synthesis processes. Moreover, using renewable resources such as biomass and energy, and energy storage with CO_2 as the scaffold will be investigated. The strategy of **CO_2Refinery** is complemented by research on systems engineering, modelling, and analysis to provide the framework of the individual unit operations. Additionally, life cycle analysis will be used as a powerful tool to evaluate performance of the refinery on an economic scale. The research topics are structured into three research areas as shown below.



Within the proposed research framework, the members of the TU Wien doctoral school will be trained interdisciplinary to obtain a unique skillset. Graduates are envisioned to work at the forefront of groundbreaking research, but also to implement the concepts and ideas of a CO_2 refinery in industry. **CO_2Refinery** offers excellent scientific research, combined with a multi- and interdisciplinary curriculum (lectures and lab rotation) and a dedicated supervision and mentoring program. The PhD students are in the center of attention and their training and scientific advancement is the key to a successful implementation of this program. Research training will be obtained through work embedded into high-quality scientific research environments provided by supervisors that are internationally recognized experts in their fields and the close support through junior faculty members.

Project description:

The conversion of CO_2 to value-added platform chemicals such as methanol provides a route to address global climate change but also to reduce the dependency on fossil fuels. In this respect, catalysis plays a key role. This PhD thesis is dedicated to catalyst development for CO_2 conversion, preferentially to methanol, by combining synthesis, materials characterization, reaction kinetics, and operando spectroscopy. Fundamental insights into the elementary reaction steps occurring at the catalyst surface will be the basis for a rational design and improvement of the catalytic materials.

Key goals and tasks:

This PhD project aims at the development of versatile and stable catalysts operating under CO_2-containing feed streams of varying compositions by combining synthesis, (operando) characterization, catalytic tests and reaction kinetics. The main focus will be set on establishing relationships between composition and structure, physico-chemical properties and catalytic performance, and on exploring the chemical processes at the catalyst surfaces. The experimental tasks include synthesis and modification of materials, basic characterization (e.g. by TEM, XRD, physi- and chemisorption, XPS, IR), reaction kinetics, and operando spectroscopy.
In close interaction with PIs and PhD students within the doctoral school CO2Refinery, functionalized ceramic materials with hierarchical porosity will be evaluated as CO_2 hydrogenation catalysts, and the catalytic methanol synthesis will be integrated with upstream and downstream processes in the CO2Refinery. The successful candidate will publish the scientific results, and present them at conferences. Supervising students and teaching activities will also be part of the responsibility.

Experience and skills:

- Master studies in chemistry, materials science, chemical engineering, physics or related
- Lab experience in catalysis, materials characterization (e.g. XRD, electron microscopy), spectroscopy (e.g. IR, XPS), physical chemistry
- Interest in working with experimental setups, their development and adaptation
- Experience in using data analysis software (e.g. Origin, Matlab)
- Willingness to participate in teaching and supervision of students
- Scientific experience: Presentations, scientific writing, publications, conferences
- Personal skills: independence, creative thinking, team working ability, communication, problem-solving skills, self-organization
- excellent written and verbal communication skills, and a safe command of English

Supervisors:

Karin Föttinger / Thomas Konegger / Franz Winter / Christoph Rameshan