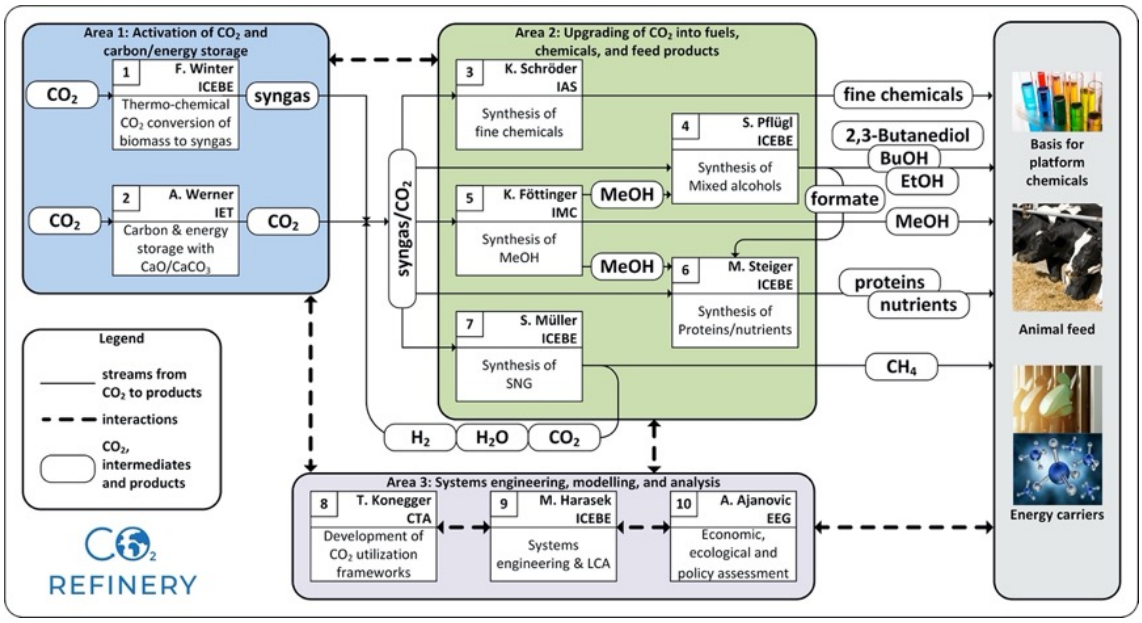
Open Position PhD #8: Porous ceramic frameworks for CO2 utilization

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:

Chemical conversion processes, in particular with regard to CO_2 utilization, typically take place at elevated temperatures and/or under chemically demanding conditions. Ceramics are ideal framework materials – e.g. as substrates or carriers – for catalytic reactions and biosynthetic processes due to their excellent thermal stability, chemical and biological inertness, and corrosion resistance. This project involves the development of porous ceramics with tailored pore structures suitable for a variety of CO_2 utilization processes, employing new methodological approaches.

Key goals and tasks:

The primary aim of this PhD thesis is the development and implementation of new approaches towards generating ceramic materials with graded and/or hierarchical porosity, with direct applicability in various fields of CO_2 utilization. The main focus will be set on the development of new solidification templating methods, both towards the fabrication of monolithic structures as well as towards obtaining spherical particulates. In addition to conventional, powder-based systems, preceramic polymers will be used as starting materials, thereby combining the distinct advantages of the polymer-precursor technique (such as chemical modifiability and shapability) with the versatility and robustness of solidification templating towards achieving well-defined pore structures.

In terms of prospective applications, the generated structures will be developed and evaluated for their applicability in catalysis (e.g., as catalyst carriers in methanol formation), biosynthesis (e.g., as biomass retention filters or as carriers for cells), and in fluid-bed-based conversion processes, carried out in close collaboration with PIs and PhD students active in these areas.

Experience and skills:

- Master studies in chemistry, technical chemistry, materials science, or related
- Lab experience in materials processing (ideally ceramics), inorganic materials chemistry, and materials characterization (structural, chemical, and mechanical property investigation)
- Basic knowledge and interest in designing and implementing new experimental setups, ideally experience in data acquisition and instrument control (e.g. LabView)
- Scientific experience: Presentation, scientific writing, publications, conference attendance.
- Excellent written and verbal communication skills, and a safe command of English
- Personal skills: independence, creative thinking, systematic and structured work approach, hands-on mentality
- Willingness to participate in teaching and supervision of students

Supervisors:

Thomas Konegger / Karin Föttinger / Matthias Steiger