SINCHEM doctoral research subject

Electrolyzing Bio-refineries – Dynamic Catalytic Processes for Biomass Valorization

Due to the finite nature of fossil resources, renewable feedstocks become more and more important as source for energy generation as well as for bulk chemical production. In chemical industry, transformation of renewable carbon sources such as CO_2 or biomass feedstock results in new challenges.

Future energy generation will strongly rely on renewable energy sources such as wind, water, and solar. The discrepancy between the need for a constant energy supply and the fluctuating nature of energy from renewable sources asks for new technological innovations regarding suitable energy storage on different time scales.

To increase the synergy between chemistry and energy as well as to bridge the gap between constant energy supply and fluctuating renewable energies, it seems reasonable to use chemical storages such as hydrogen from water electrolysis, methane, methanol, and higher hydrocarbons. The production of hydrogen or reductive equivalents in times of surplus electricity is even more suitable because it can be used for the sustainable reduction of biomass which typically contains a large amount of oxygen.

A promising approach to tackle the challenges of future energy systems and renewable carbon source usage is the development of dynamic electrochemical reactions. Therefore, an intelligent dynamic process control is necessary. Imaginable are production plants that produce one product during the day but another one at night (for example reduction by hydrogen from surplus electricity during the day and oxidation by atmospheric oxygen during the night).

This project shall include:

- Investigating dynamic (electro-)catalytic transformations,
- Examining the consequences of switching between process conditions,
- Tailoring of adaptive catalyst systems,
- Thus, realizing an alternating process control.

Interested candidates should be highly motivated to work in an interdisciplinary research field. Synthesis of novel materials requires an excellent chemical knowledge and very good experimental capabilities. At the same time, successful candidates possess a broad knowledge on material characterization such as physisorption, NMR, FTIR, etc. and at least theoretical knowledge concerning fundamental aspects of electrochemistry and catalysis on the surface of solid materials including transport phenomena.

Home: Prof. Dr. Regina Palkovits, RWTH Aachen University, Germany

Host 1: Prof. Fabrizio Cavani, Prof. Albonetti, University of Bologna, Italy

Host 2: CAT Catalytic Center, Aachen, Germany