Synthesis setup for CO₂ conversion to hydrocarbons

Graduate



Gian Grob

the Earth's climate system. However, these changes have proven to be detrimental for humanity and the Earth's biosphere. Therefore, reducing the emission of GHG is more important than ever.

Introduction: Since the usage of the first steam engines during industrialization, the increased consumption of fossil fuels has led to an increase in greenhouse gases (GHG) in the atmosphere.

Through the combustion of fossil fuels, carbon dioxide (CO₂) as well as other GHG are released, changing

The transportation industry relies primarily on fossil fuels. As a replacement for fossil fuels, alternatives such as batteries have been proposed. However, due to the significantly lower energy density of batteries compared to gasoline, diesel or kerosene, batteries work best for smaller vehicles. Hence, synthetic fuels are a promising short-term alternative for heavy-duty vehicles, ships, and aircraft. The two most common pathways for the commercial production of synthetic fuels are the methanol to hydrocarbons (MtH) conversion and the Fischer-Tropsch (FT) process. However, the current MtH and FT process still rely on fossil fuels. Therefore, the incentive is to investigate alternative production routes, starting from CO₂.

Definition of Task: The goal is to construct a lab-scale experimental setup, comprising a reactor performing the MtH conversion. The setup should also allow the implementation of a second reactor in which the CO2 to methanol conversion can be implemented. Therefore, it needs to be capable of achieving high temperatures (up to 500 °C) and withstanding high pressures (up to 64 bar), allowing the investigation of a wide range of conditions.

Result: To verify the functionality of the setup, two common catalysts base of zeolites, have been tested for the MtH conversion. The first zeolite is ZSM-5 and the second one is zeolite Y. They have also been tested with a copper loading to assess the effect of copper on the MtH conversion. The data obtained from X-ray diffraction (XRD) and N2 physisorption for the characterization of the zeolites, as well as from online mass spectrometry, match expectations, making the setup a success. It shows that zeolite topology and its acidity can be tuned to favour a range of hydrocarbons. The effect of copper on MtH conversion also indicates that the copper loading has to be adjusted carefully to minimize the impact on the yield.

Advisor Prof. Dr. Andre Heel

Co-Examiner

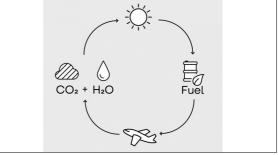
Dr. Julien Anet, ZHAW Zürcher Hochschule für Angewandte Wissenschaften, Winterthur, ZH

Subject Area

Energy and Environment

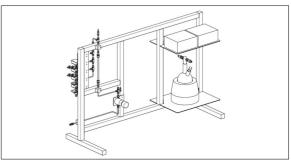


Idealization of the closing of the carbon cycle with synthetic Synhelion.com/solar-fuels-and-plants/solar-fuels



Drawing of experimental setup Own presentment

fuels



Experimental setup comprising reactor for MtH conversion Own presentment

