

JOINT PROJECT

Carbon2Chem[®]

KEEPING CARBON
IN THE LOOP



¹ Dr.-Ing. Heiko Lohmann,
Head of Carbon2Chem[®] sub-
project "Higher Alcohols".

L-IV | SYNTHESIS OF C₂+ ALCOHOLS AND C₂+ OLEFINS

CATALYST TESTING AND SCALE-UP

Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

Osterfelder Strasse 3
46047 Oberhausen
Germany

Dr.-Ing. Heiko Lohmann
Group Manager
Catalytic Processes
Telefon +49 208 8598-1197
heiko.lohmann@umsicht.fraunhofer.de

www.umsicht.fraunhofer.de

Background

Within the Carbon2Chem[®] project, technologies are being developed to reduce CO₂ emissions at large industrial sites by using the emissions as a new source of raw materials for the chemical industry.

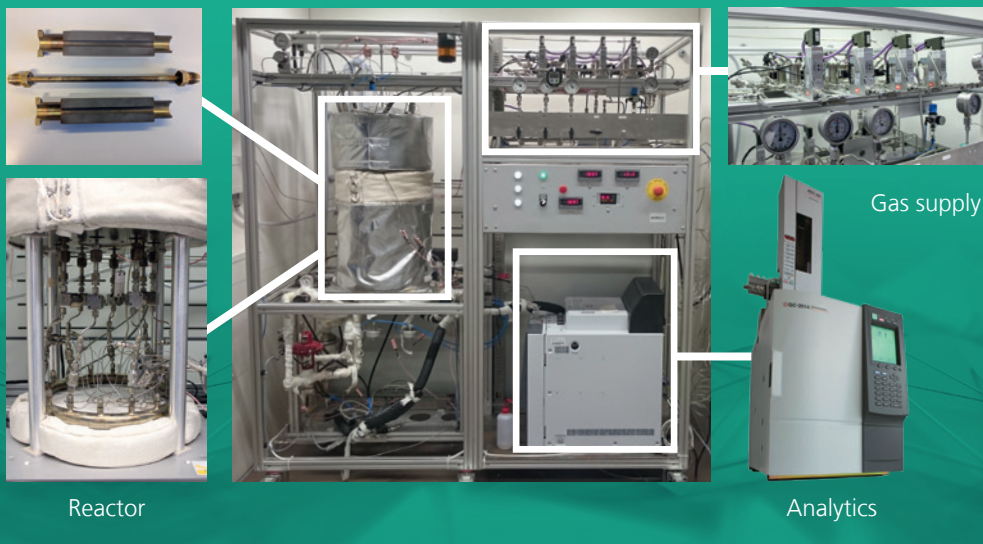
The focus lies on forming cross-industrial value creation chains and increasing energy efficiency by establishing cross-industrial networks.

This will be shown using the steel production site Duisburg/NRW as an example.

Aims

Within the framework of the subproject L-IV, Fraunhofer UMSICHT is testing new heterogeneous catalyst samples for the production of C₂+ alcohols and C₂+ olefins from steel mill gas.

In the second phase of the project, the project consortium will develop a stage catalytic process as the core of a process chain for processing steel mill gas into short-chain C₂+ alcohols and olefins to demonstration stage.



1 Test station used for screening the catalysts at Fraunhofer UMSICHT in Oberhausen.

Tasks

Project duration 2020 to 2024

Fraunhofer UMSICHT is testing a catalyst developed by Evonik Resource Efficiency GmbH in differently scaled test plants. In addition to lab-scale and mini plants, a demonstration plant, which is being built on the site of the Carbon2Chem® technical shop in Duisburg, will be used to demonstrate the scale-up of the catalytic processes of alcohol and olefin synthesis to technical scale.

In order to determine the optimal catalyst design for an industrial process, detailed investigations of both the powder of the active components and the shaped technical catalyst are necessary to evaluate and control the influences of, for example, mass and heat transport.

In addition, questions regarding process dynamics (load changes, temperature variations, variations in feed quality) and the long-term stability of the technical catalyst must be answered during the tests in order to obtain a valid database for implementing the technical process.

Milestones

Project duration 2016 to 2020

The work at Fraunhofer UMSICHT focused on the screening of over 70 newly developed catalyst samples from Evonik Resource Efficiency GmbH using the "Spider" test system. Since each catalyst was tested for at least 140 h "time on stream" (TOS), a large amount of measurement data was generated, which was recorded, arranged and evaluated.

The development of the catalysts was done iteratively. This means that the most promising catalyst samples were selected, modified, characterized and retested based on the test results.

The screening results of the "Spider" test system helped Evonik Resource Efficiency GmbH to develop a catalyst system that successfully met the milestone criterion of the first project phase: Selectivity of at least 50 % at a productivity of at least $150 \text{ g}_{\text{products}}/(\text{kg}_{\text{catalyst}} \cdot \text{h})$.

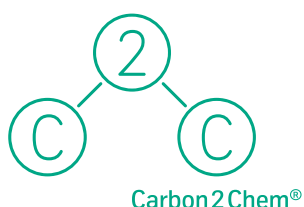
Project duration

The first project phase of Carbon2Chem® ended on May 31, 2020. In the current project phase of L-IV, the catalytic processes are to be brought to demonstration maturity.

Fraunhofer UMSICHT contributes to this by testing the technical catalyst with artificial and real steel mill gases in differently scaled test facilities in the Carbon2Chem® laboratory in Oberhausen, in the Carbon2Chem® technical shop in Duisburg and at the Fraunhofer UMSICHT institute branch Sulzbach-Rosenberg.

Further project partners in L-IV

- thyssenkrupp Industrial Solutions AG
- Evonik Resource Efficiency GmbH (Coordination)
- Ruhr-Universität Bochum, Laboratory of Industrial Chemistry
- Ruhr-Universität Bochum, Department of Energy Plant Technology
- RWTH Aachen, Institute of Technical and Macromolecular Chemistry



Further information

www.umsicht.fraunhofer.de/carbon-cycle

#Carbon2Chem

SPONSORED BY THE



Federal Ministry of Education and Research