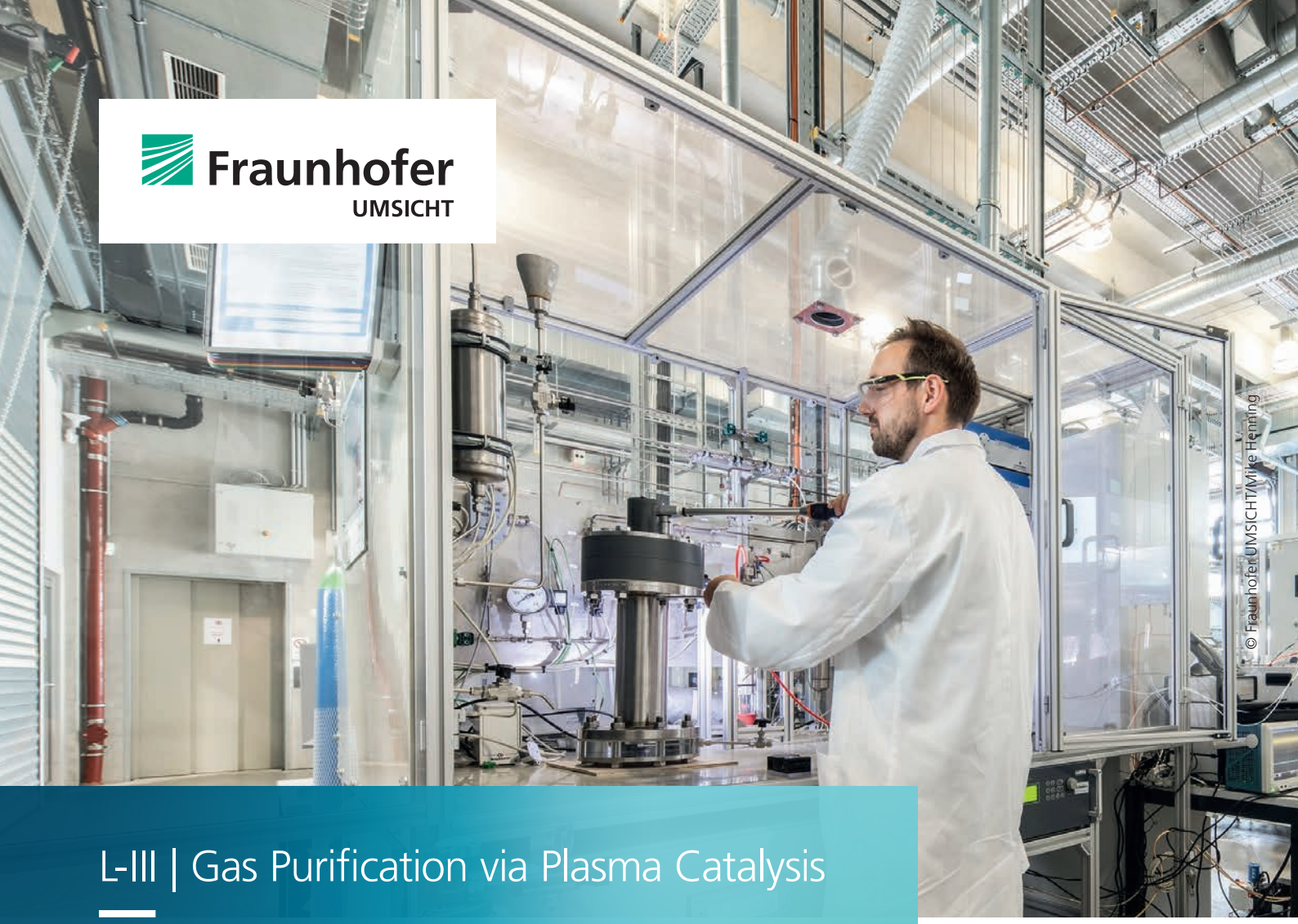

Fraunhofer UMSICHT

L-III | Gas Purification via Plasma Catalysis

Conversion of oxygen traces via non-thermal plasma

Background

Within the Carbon2Chem® joint project, technologies are being developed to reduce CO_2 emissions at large industrial sites by using gases with CO and CO_2 as a source of raw materials for the chemical industry.

The focus lies on forming cross-industrial value cycles and increasing energy efficiency by establishing cross-industrial networks for a climate-neutral production.

This will be shown using the steel production location Duisburg in North Rhine-Westphalia as an example.

Objective

Subproject L-III aims to develop and experimentally test concepts to purify and prepare steel mill gases for the planned downstream chemical syntheses.

Non-thermal plasma catalysis is investigated here as an attractive option to remove trace oxygen from coke oven gas. In the current project phase, the first application in real gas takes place alongside further analyses on a pilot-plant scale.

The experimental analyses of plasma-catalytic reactor systems focus on efficiency, scalability and applicability in the real coke oven gas.

> "It is not possible to use gas flows containing CO_2 from a steel mill without suitable gas treatment."
>
> Dr.-Ing. Barbara Zeidler-Fandrich
> Head of the Carbon2Chem®-subproject "Synthesis Gas"

Carbon2Chem®

Tasks

The experiment was conducted at a test station set up during the first project phase, which provides model coke oven gas mixtures. As part of the current project phase, this test station is being expanded for further investigations with regard to the additional dosing of selected trace components and corresponding online analyses and equipped for operation with process overpressures.

Fraunhofer UMSICHT uses a reactor with dielectric barrier discharge, which transforms the entire gas volume into a semi-homogeneous plasma state (volume DBD). The influence of catalysts, bulk materials, pressure, process dynamics and selected trace components is being investigated.

These investigations serve as the basis for upscaling to a volume flow rate of 10 Nm³/h and testing a volume DBD prototype reactor in the real coke oven gas at the Carbon2Chem® pilot plant station in Duisburg.

Milestones

- The planning, design and setup of a test station to examine plasma and plasma catalysis reactors in model coke oven gas or other complex gas mixtures with volume flows of up to 1 Nm³/h
- Proof of concept for the conversion of O_2 traces in model coke oven gas mixtures via non-thermal plasma in a volume DBD reactor
- Determination of the influences of relevant variables (e.g., residence time, generator parameter, filling, reactor geometry) on the conversion factor and energy efficiency
- Manufacturing and commissioning of a scalable volume DBD test reactor with steel casing for higher pressure resistance and further modification options

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Project duration

The green light for the Carbon2Chem® project was given on March 15, 2016. In the second project phase (start: June 1, 2020, duration: 4 years), the focus lies on deepening knowledge of plasma-chemical oxygen removal, upscaling and investigating under real process conditions. During the project phase, a plasma-chemical reactor for volume flows of up to 10 Nm³/h is being designed, built and tested with real coke oven gas.

Further information

Other projekt partners in L-III

- Linde GmbH (coordination)
- thyssenkrupp AG
- Clariant Produkte (Deutschland) GmbH
- Ruhr University of Bochum

Project website

www.umsicht.fraunhofer.de/carbon-cycle

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