



## L-III | Gas Purification and Gas Conditioning

**Catalytic processes, thermal desorption and simulation**

*Front view high-temperature fixed-bed reactor for thermal deoxygenation.*

### Background

Within the Carbon2Chem® joint project, technologies are being developed to reduce CO<sub>2</sub> emissions at large industrial sites by using gases with CO and CO<sub>2</sub> 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 implement gas purification and treatment technologies for steel mill gases.

The task of Fraunhofer UMSICHT is to develop catalytic deoxygenation that should be connected upstream of pressure swing adsorption. Pressure swing adsorption is used to provide hydrogen for catalytic processes. Fraunhofer UMSICHT also develops and simulates thermal desorption processes.

“

It is not possible to use gas flows containing CO<sub>2</sub> from a steel mill without suitable gas treatment.”

Dr.-Ing. Barbara Zeidler-Fandrich  
Head of the Carbon2Chem®-  
subproject “Synthesis Gas”



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## Tasks

### Thermal deoxygenation

- Investigation of different catalysts and process conditions in a complex gas matrix

### Deoxygenation via non-thermal plasma

- Investigation of different catalysts and process conditions in a non-thermal plasma

### Thermal adsorption and desorption

- Testing of the electric swing technology to separate minor components and recyclable materials from various steel mill gases

### Simulation of thermal adsorption and desorption

- Development of a deepened physical model to simulate adsorption and desorption processes

## Milestones

### Thermal deoxygenation

- High-temperature fixed-bed reactor (artificial steel mill gas), metering system for minor components, MS analyzer, O<sub>2</sub> sensor

### Deoxygenation via non-thermal plasma

- Coaxial volume DBD reactor with optional fixed bed (0.1 Nm<sup>3</sup>/h)
- Gas metering and analysis for steel mill gases

### Thermal adsorption and desorption

- Electric Swing Adsorption 6 Nm<sup>3</sup>/h (designed and built)

### Simulation of thermal adsorption and desorption

- Multiscale model developed
- Further development of the microscale model (view of an individual particle)
- Verification and validation of the created model
- Implementation of multi-component adsorption isotherms

## Specific expertise

- Catalytic gas purification
- Gas purification using non-thermal plasma or plasma catalysis
- Adsorbents and adsorption processes
- Simulation of process engineering processes
- Construction and operation of process plants

## Further information

### Other project partners in L-III

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

### Project website

[www.umsicht.fraunhofer.de/carbon-cycle](http://www.umsicht.fraunhofer.de/carbon-cycle)

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