LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 125, 9052 Gent, Belgium

Coaches	**Supervisor(s)**	**Funding**
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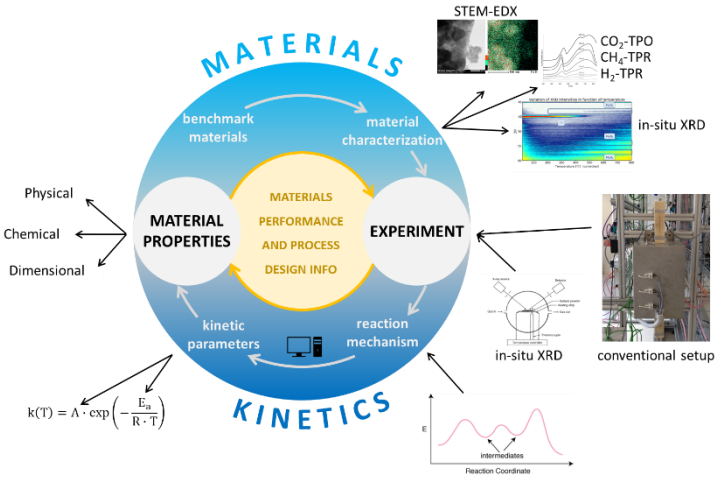
Super-dry reforming for CO_2 conversion into CO: a kinetic study

Aim

This project aims to investigate the kinetics of reactions relevant to the super-dry reforming process experimentally. The goal is to gain new insights into the redox kinetics of oxygen storage materials and the (de)carbonation kinetics of CO_2 sorbents towards optimizing the conversion of CO_2 into CO. To this end, powerful techniques such as in situ X-ray diffraction and in situ DRIFT spectroscopy can be applied alongside more conventional (temperature-programmed) reactions.

Justification

Carbon monoxide is a versatile building block for the chemical industry as well as an important feedstock for the steel industry. The transformation of carbon dioxide into carbon monoxide therefore provides a promising pathway to improve the carbon circularity of these industries. Through the super-dry reforming chemical looping process, a reductant such as methane-containing biogas can be used to realize the direct conversion of CO_2 into CO with high selectivity. A thorough understanding of the kinetics of the involved reactions is an essential aspect of upscaling this process.



Program

Main focus 1st semester (2021):

- Detailed literature survey on chemical looping processes, chemical looping thermodynamics and chemical looping reaction kinetics, with particular attention for applications towards carbon dioxide conversion.
- Design and perform kinetic experiments for a selected oxygen storage material and carbon dioxide sorbent. A variety of operando characterization techniques are available to investigate solid-state transformations.
- Development of a kinetic model for (1) oxygen storage material reduction and oxidation and (2) carbon dioxide carbonation and decarbonation.

Main focus 2nd semester (2022):

- Investigate the evolution of kinetic behaviour over 1000 chemical looping cycles.
- Identification of deactivation mechanisms through materials characterization techniques such as X-ray diffraction, nitrogen adsorption and electron microscopy.
- Development of a kinetic model for (1) oxygen storage material reduction and oxidation and (2) carbon dioxide carbonation and decarbonation taking into account potential deactivation mechanisms. Based on this, the required reactor size and solids lifetime will be determined, and possible improvements of the benchmark materials will be proposed.

Candidate

The ideal candidate for this project is eager to perform both theoretical computational work and hands-on experimental work.

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