ChE-410

Catalysis for emission control and energy processes

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Cursus	Sem.	Type
Chemistry and Chemical Engineering		Obl.
Ing.-chim.	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The course is an introduction to heterogeneous catalysis for environmental protection and energy production. It focusses on catalytic exhaust gas cleaning as well as catalytic systems relevant for gaseous and liquid fuel production. The course ends with two days of experimental exercises at PSI.

Content

- Basic introduction into heterogeneous catalysis
- Preparation of heterogeneous catalysts
- Characterization of heterogeneous catalysts
- Exhaust gas catalysis for stationary power plants and internal combustion engines: Three-way-catalysis, oxidation catalysts, selective catalytic reduction, NOx storage reduction catalyst, soot filtration/oxidation, methane oxidation, SOx, volatile organic compounds, ...
- Short introduction to gaseous and liquid fuels: refinery, coal, biomass gasification and renewable fuel production
- Control the CO/CO2/H2 ratio and downstream synthesis: water-gas-shift (WGS) reaction, partial oxidation (POX), reforming reactions, methanation, Fischer-Tropsch synthesis
- Interesting experiments on the topics emission control, catalyst characterization and gaseous fuel synthesis will be conducted.

Emission control and energy processes will be teached partly by means of examples from research, showing how the basics of catalysis, advanced catalyst preparation and catalyst characterization are used to understand and develop catalytic systems in this field.
Another highlight will be a two-day lab excursion to the Paul Scherrer Institut (PSI) in the northern part of Switzerland, where interesting experiments will be conducted on 5-6 Jan 2021. In case of more than 10 students a second two-day lab excursion will be offered on 7-8 Jan 2021. In case of time conflicts the dates can be shifted by agreement with all students.

Keywords

Heterogeneous catalysis
Emission control
Exhaust gas catalysis
Fuel synthesis
Renewable fuels

Learning Prerequisites

Recommended courses

Introduction to chemical engineering
Chemical engineering of heterogeneous reactions
Chemical kinetics and thermodynamics
Mass & heat transfer

Learning Outcomes

By the end of the course, the student must be able to:

- Select appropriately catalytic systems for different reactions
- Describe different catalytic exhaust cleaning technologies
- Explain the composition and structure-function relationships of different catalytic systems
- List the relevant chemical reactions
- Design an experiment for catalytic tests
- Select appropriately catalyst characterization methods
- Use the specific nomenclature in the field and calculate basic parameters
- Assess / Evaluate the performance of heterogeneous catalysts
- Conduct simple catalytic tests
- Perform basic catalyst characterizations

Teaching methods

2 hours per week ex cathedra using Powerpoint slides. Examples will be shown to illustrate theory.
Excersises will be conducted in form of an experimental two-day lab excursion at PSI on 5-6 Jan 2021. In case of more than 10 students a second two-day lab excursion will be offered on 7-8 Jan 2021.

Expected student activities

Taking notes in the course hours.
Preparing, conducting and reporting exercises.

Assessment methods

One final written exam.
Credit points:

- Two credit points for attending the lectures and conducting small exercises at home.
- One credit point for attending the mandatory two-day lab excursion at the Paul Scherrer Institute.

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Notes/Handbook

Students have access to the slides few days before each lesson.

Moodle Link

- https://moodle.epfl.ch/course/view.php?id=14942#section-0