CH-421

Catalysis for energy storage

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Cursus	Sem.	Type
Chimiste	MA1, MA3	Opt.
Ing.-chim.	MA1, MA3	Opt.
Minor in Engineering for sustainability	H	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	During the semester
Workload	90h
Weeks	14
Hours	**2 weekly**
Lecture	2 weekly
Number of positions	

Summary

This course covers the fundamental and applied aspects of electrocatalysis related to renewable energy conversion and storage. The focus is on catalysis for hydrogen evolution, oxygen evolution, and CO2 reduction reactions. Both homogeneous and heterogeneous catalysts are discussed.

Content

1. Introduction to energy, solar fuel, and hydrogen economy
2. Molecular catalysis for hydrogen evolution
3. Molecular catalysis for oxygen evolution
4. Molecular catalysis for CO2 reduction
5. Heterogeneous catalysis for hydrogen evolution
6. Heterogeneous catalysis for oxygen evolution
7. Heterogenous catalysis for CO2 reduction

Learning Prerequisites

Recommended courses

Coordination chemistry; organometallic chemistry; electrochemistry

Learning Outcomes

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

- Describe the capacity of available renewable energy resources; explain the major advantages of hydrogen economy.
- Compare major hydrogen storage methods
- Derive the overall reactions of hydrogen evolution, oxygen evolution, and CO2 reduction.
- Assess / Evaluate overpotential; judge efficiency of electrocatalysts using a few key parameters; apply exchange current density and Tafel slope to compare catalysts.
- Interpret heterogeneous and homogeneous electrocatalysis from electrochemical data.
- Elaborate the key bond forming steps in hydrogen evolution, oxygen evolution, and CO2 reduction reactions.
- Construct catalytic cycles for electrochemical hydrogen evolution, oxygen evolution, and CO2 reduction reactions, if sufficient information about the catalyst and reaction condition is provided. The catalyst can be homogeneous or heterogeneous.
- Construct catalytic cycles for chemical CO2 reduction; Judge the origin of catalyst selectivity in CO2 reduction reactions. Differentiate coordination modes of CO2;

Teaching methods

Lectures // Paper reading and analysis

Expected student activities

Paper reading and anylsis; execises

Assessment methods

Written exams; one mid term and one final exam during the semester

Resources

Moodle Link

- https://go.epfl.ch/CH-421