Interfacial Electrochemistry of Metals and Semiconductors for Energy Conversion and Storage

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Cursus
Chimie et génie chimique

Sem. Obl.

ChE-603

Language English
Credits 2
Session Exam Multiple
Workload 60h
Hours 28
Lecture 28
Number of positions

Frequency
Every year

Remarque
Next time: Spring 2019

Summary
The course presents, with emphasis to fundamental physicochemical principles, the basic principles of electrochemical thermodynamics and physical and chemical kinetics as applied to electrochemical conversion systems: batteries, fuel and biofuel cells, electrolyzers and photoelectrochemical cells.

Content
1. Summary of the principles of chemical and electrochemical thermodynamics of relevance to electrochemical energetics.
2. Outline of basic concepts of solid-state physics of metals and semiconductors.
3. Thermodynamics of the metal-electrolyte and semiconductor-electrolyte interface on the basis of the electrochemical potential concept. Absolute electrode potential, electrochemical vs. vacuum electrode potential scale for aqueous and nonaqueous electrolyte-based systems.
5. Electrochemical kinetics and catalysis at metal and semiconductor electrodes, complex multi-step electrode reactions, adsorption effects.
6. Comparative description of electrochemical and photoelectrochemical systems: primary and secondary batteries, fuel and biofuel (enzymatic and microbial) cells, water electrolyzers, electrochemical photovoltaic (electricity-producing) cells, photoelectrosynthetic cells (including e.g. photoelectrochemical water splitting and electrochemical carbon dioxide reduction), photocatalytic cells, including electrochemical fuel and biofuel cells.
7. Application of electrochemical principles to microdispersed photocatalytic systems for energy conversion.

Note
Next session Spring semester 2017 (Mo+Fri)

Assessment methods
Examination:Written examination, homework assignments and one term paper.

Resources
Bibliography
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Ressources en bibliothèque

- Interfacial electrochemistry / Schmicker
- Semiconductor photoelectrochemistry / Pleskov
- Modern electrochemistry / Bockris
- Electrochemical power sources : batteries, fuel cells, and supercapacitors / Bagotsky
- Fundamentals of electrochemistry / Bagotsky
- Electrochemistry at semiconductor and oxidized metal electrodes / Morrison
- Précis de thermodynamique & cinétique électrochimiques / Besson
- Electrochemistry : the basics, with examples / Lefrou
- Fuel cells : problems and solutions / Bagotsky
- Electrochimie : concepts fondamentaux illustrés / Lefrou