ChE-603(1)  Interfacial Electrochemistry of Metals and Semiconductors for Energy Conversion and Storage

Hagfeldt Anders, Vlachopoulos Nikolaos

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Frequency
Every year

Remarque
Spring semester 2020

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.
4) Physical, chemical and electrochemical properties of aqueous, nonaqueous and solid electrolytes. Electrical conductivity and diffusion in electrolytes.
5) Electrochemical kinetics and catalysis at metal and semiconductor electrodes, introduction to 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 photoelectrochemical fuel and biofuel cells).
7) Application of electrochemical principles to microdispersed photocatalytic systems for energy conversion.

Basic Textbooks

Supporting references

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

Keywords
Electrochemistry, Energy Conversion, Thermodynamics, Kinetics, Photoelectrochemistry

Learning Prerequisites

Required courses
Undergraduate-level physical chemistry.