KE2110 Applied Electrochemistry 7.5 credits

Tillämpad elektrokemi

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for KE2110 valid from Autumn 2007

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Chemical Science and Engineering,Chemistry and Chemical Engineering

Specific prerequisites

To be able to do the course within a normal workload you are supposed to have background knowledge corresponding to the courses Chemical Equilibrium, Chemical Thermodynamics, Chemical Dynamics, Transport Phenomena and Engineering Thermodynamics (3C1715), Reaction and Separation Engineering (3C1616) and Numerical Methods. If you are lacking some of this background you will most likely be able to read up on that as the course proceeds.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completion of the course you should be able to:

Explain the concepts electrod potential, cell potential and current density, and to describe hoe the cell potential of an electrochemical cell is built up by its components during rest and under load. Calculate cell potential and electrode potential for electrochemical systems at equilibrium.

Describe theories for the structure of the electrochemical double layer and double layer capacitance.

Explain and implement relationships between current density and electrode potential. Implement these relationships to compute either current density or electrode potential from data, and to extract kinetic parameters from polarization data and to. Extract kinetic parameters from polarization data.

Describe mechanisms of and relationships for mass transfer in electrolytes, and to explain the concepts of limiting current density and Nernst diffusion layer. Explain and implement relationships between current density and electrode potential under conditions of mixed mass transport and kinetic control.

Use the concept of rate determining steps to explain the kinetics for multi electron reactions, e.g. hydrogen evolution and copper deposition, and qualitatively explain the relationship between adsorption energy and catalytic activity.

Use the concept of mixed potential to analyze, for example, cases of electrochemical corrosion.

Formulate models for calculation of primary and secondary current distribution in electrochemical cells with flat electrodes. Perform qualitative predictions based upon given conditions. Solve a fairly advanced and realistic current distribution problems using the FEMLAB or similar software.

Describe the design and function of porous gas diffusion electrodes. Describe the theories for porous electrodes and apply the macro homogenous model on current distribution problems without variation of concentrations

Describe the operating principle for the different types of fuel cells, the most common types of batteries and super capacitors as well as the major electrolytical processes

Analyse, discuss and perform calculations for applied electrochemical systems, such as fuel cells, batteries and electrolytic processes based upon the course contents. Discuss comparative and efficiency figures of merit for such systems

Describe some electrochemical experimental methods such as; cyclic voltammetry, recording polarisation curves, and potential and galvano static step experiments. Perform simple electrochemical experiments such as current and potential measurements for a three-electrode cell. Perform qualitative and quantitative evaluation of data from the course laboratory or similar experiment.

These objectives are meant to correspond to grade 5.

Course contents

The electrochemical double layer, electrode kinetics, mass transfer in electrochemical systems, electrocatalysis. Design of electrochemical reactors, current distribution. Porous electrodes. Survey of electrochemical processes and power sources.

Experimental techniques.

Course literature

Carl H Hamann, Andrew Hamnett, Wolf Vielstich, ”Electrochemisty”, Wiley-VCH, 1998. Booklet “ Utformning av elektrokemiska reaktorer” utgiven vid avdelningen, Daniel Simonsson.

Examination

- LAB1 - Laboratory Course, 1.5 credits, grading scale: P, F
- TEN1 - Written exam, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- ÖVN1 - Homework, 1.5 credits, grading scale: P, F

Based on recommendation from KTH’s coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Written and oral examination TEN1, 4,5 credits. Laboratory work including written reports (LAB1), 1,5 credit. Homework assignments and one group assignment (ÖVN1), 1,5 credit.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.