ChE-603(1)

Interfacial Electrochemistry of Metals and Semiconductors for Energy Conversion and Storage 1- Basic concepts

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Cursus	Sem.	Type
Chemistry and Chemical Engineering		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Written
Workload	60h
Hours	**28**
Courses	28
Number of positions	

Frequency

Every year

Remark

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, electrolysers 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 electrolysers, 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.

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

Keywords

Electrochemistry, Energy Conversion, Thermodynamics, Kinetics, Photoelectrochemistry

Learning Prerequisites

Required courses

Undergraduate-level physical chemistry.

Resources

Bibliography

Basic Textbooks

1) Bagotsky, V.S., Fundamentals of Electrochemistry, 2nd Ed., Wiley, 2005.
2) Memming, R., Semiconductor Electrochemistry, 2nd Ed., Wiley, 2015.

Supporting references
1) Albery, J., Electrode kinetics, Clarendon Press, 1975.
2) Bagotsky, V.S., Fuel Cells, 2nd Ed., Wiley, 2012.
3) Bagotsky, V.S., Skundin, A., and Volfkovich, Y.M., Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors, Wiley, 2015.
4) Bard, A.J., Inzelt, G., Scholz, F., Electrochemistry Dictionary, 2nd Ed., Springer,2012.
5) Grimes, C.A., Varghese, O.K., and Ranjan, S., Light,Water, Hydrogen: The Solar Generation of Hydrogen by Photoelectrolysis, Springer, 2008.
6) Koryta, J. Dvorak, J. and L. Kavan, L., Principles of Electrochemistry, Second Edition, Wiley, 1993
7) Lefrou, C., Fabry, P., Poignet, J.-C., Electrochemistry, the Basics, with Examples, Springer, 2012.
8) Oldham, K.B., Myland, J.C., Bond, A.M., Electrochemical Science and Technology, Wiley, 2012. Student companion site: http://bcs.wiley.com/he-bcs/Books?action=index&bcsId=7004&itemId=0470710845 (accessed 21-08-2018)
9) Pletcher, D., Greff, R., Peat, R., Peter, L.P., Robinson, J., Instrumental Methods in Electrochemistry, Southampton Electrochemical Group, University of Southampton, Ellis Horwood Limited, 1985.
10) Scott, K., Sustainable and Green Electrochemical Science and Technology, Wiley, 2017.

Ressources en bibliothèque

- Fundamentals of electrochemistry / Bagockij
- Semiconductor electrochemistry / Memming

Références suggérées par la bibliothèque

- Electrode kinetics / Albery
- Fuel cells / Bagotsky
- Electrochemical power sources / Bagotsky
- Electrochemical dictionary / Bard
- Light, water, hydrogen / Grimes
- Principles of electrochemistry / Koryta
- Electrochemistry / Lefrou
- Electrochemical science and technology / Oldham
- Instrumental methods in electrochemistry / Robinson
- Sustainable and green electrochemical science and technology / Scott