Course Syllabus

Department/Faculty
School of Engineering

Graduate Program
Materials Engineering and Nanotechnology

Degree
☒ Academic Master's ☒ Doctorate (PhD) ☐ Professional Master's

Course Name
Advanced Electrochemistry

Professor(s)
Não Preencher

Office hours
48

Course Overview

The course deals with the basic definitions and concepts of electrochemistry. Models of electrical double layer. Charge transfer kinetics. Butler-Volmer and Tafel empirical equations. Marcus's theory of electron transfer. Activation potentials, ohmic and mass transfer. Faradic electrode processes. Experimental methods for studying solid/liquid interface and the charge transfer kinetics. Electrochemical devices for charge storage, sensors and biosensors with electrochemical detection.

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Topics outline

1 – Basic concepts and definitions;

2 - Electrochemical interface: models of electrical double layer formation;

3 – Kinetics of charge transfer; empirical Butler-Volmer and Tafel equations;

4 – Marcus's theory of electron transfer;

5 - Activation, ohmic and mass transfer overpotentials;

6 - Faradic electrode processes;

7 - Electrochemical instrumentation (potentiostatic, galvanostatic and potentiometric techniques)

8- Experimental methods for the study of the solid/liquid interface and charge transfer kinetics (linear and cyclic voltammetry scan rate, pulse voltammetric techniques and electrochemical impedance spectroscopy);

9 – Mechanisms of electrocatalytic processes;

10 - Electrochemical devices for charge storage and chemical sensing (basic principles on the operation of lithium-ion batteries, supercapacitors, sensors and electrochemical biosensors;

Classes will be expository and experimental.

Letter Grade Assignment
Grade A (Excellent) - Grade points between 9 and 10
Grade B (Good) - Grade points between 8 and 8.9
Grade C (Satisfactory) - Grade points between 7 and 7.9
Grade D (Unsatisfactory) - Grade points between 0 and 6.9

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Basic References

COMPTON, R. G; BANKS, C.E. **Understanding Voltammetry.** 3rd Edition. World Scientific Publishing Europe: 2018.

ELIAZ, N; GILEADI, E. **Physical Electrochemistry: Fundamentals, Techniques, and Applications** 2nd ed., John Wiley & Sons, 2019.

BARD, A. J.; FAULKNER, L. R. **Electrochemical Methods: Fundamentals and Applications**. 2nd ed., New York: Wiley, 2001.

BRETT, A. M. O.; BRETT, C. M. A. **Electroquímica: princípios, métodos e aplicações**. Coimbra: Almedina, 1996.

Ciucci, F. Modeling electrochemical impedance spectroscopy, **Current Opinion in Electrochemistry**, v 3, p. 132–139, 2019.

PAJKOSSY, T.; JURCZAKOWSKI, R. Electrochemical impedance spectroscopy in interfacial studies, **Current Opinion in Electrochemistry**, v 1, p. 53-58, 2017.

Supplementary References

MEMMING, R. **Semiconductor Electrochemistry.** 2nd Edition. Germany: John Wiley & Sons, 2015.
Literature Review Articles.