COURSE SYLLABUS

Fundamentals of Electrochemistry for Energy Storage

2425-1-FSM01Q017

Aims

The course aims to provide students with the principles and fundamentals to understanding the behaviour of electrochemical technologies for energy conversion and storage, and to classify them in the broader contest of the current energy scenario.

Contents

Thermodynamic and kinetic principles of the ionic conductors and electrochemical interfaces will be presented and the method for their electrochemical characterization discussed. The electrochemical technologies for energy conversion (fuel cells, electrolyzers, primary batteries) and storage (secondary batteries, supercapacitors) will be classified and the basic reaction mechanisms discussed.

Detailed program

Introduction to the basic ideas of electrochemical cells and elements (electrodes, electrolytes). Fundamentals of electrochemical thermodynamic and the electrochemical equilibrium at the electrode interface. Type of electrodes and IUPAC definitions in electrochemistry. Kinetic treatment of simple electrochemical reactions at the electrode. Charge transfer control and the mass transport problem. Electrolytes classification, conductivity, and mobility. The solid crystalline electrolyte.
Problems and solutions in experimental electrochemistry. Electrochemical methods, DC chrono methods and potential sweeps methods. Fundamentals of electrochemical impedance spectroscopy.
Galvanic cells and electrolyzers. Energy and power of electrochemical power sources. The Ragone plot, open and closed systems. Fuel cell classification and fundamentals of fuel cell thermodynamic. The current potential characteristic of an ideal fuel cell. Primary and secondary batteries, the general battery scheme, and the role of the

electrolyte. Discharge curves in batteries. Efficiencies in secondary batteries. Electrochemical double layer capacitors, current potential curves. The concepts of super- and pseudo-capacitors.

Prerequisites

Standard physic and mathematic knowledge , thermodynamic and kinetic of chemical systems

Teaching form

Lectures (5 CFU), lab experiences (1 CFU) in group of 3 to 5 students.

Textbook and teaching resource

Teacher's slides and slected chapters from the following books:
Bockris Reddy, Modern Electrochemistry 1 – Ionics (second edition) chapter 4
Bockris Reddy Gamboa-Aldeco, Modern Electrochemistry 2A – Fundamental of Electrodics (second edition), chapters 6,7
Bard Faulkner: Electrochemical Methods, Fundamental and Applications (2° Edition), chapters 3,4
Selected scientific papers

Semester

I semester

Assessment method

Oral exam and reports on the lab. experiences

Office hours

on appointment

Sustainable Development Goals

QUALITY EDUCATION | AFFORDABLE AND CLEAN ENERGY | RESPONSIBLE CONSUMPTION AND