UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Applied Physical Chemistry With Laboratory

2122-1-F5302Q004

Aims

Aims of the lectures (5 CFU) are to supply the student with base knowledge about the physical chemistry of ionic conductors and the electrochemistry and its application in the energy conversion by electrochemical devices and in corrosion and protection of metals.

The lab part (3 CFU) is devoted to the characterization of functional materials. In the lab FT-IR, XRPD, electrochemical and spectroelectrochemial techniques will be used.

Contents

Ionics and Electrodics. Batteries and Fuel Cells. Corrosion. Lab. experience.

Detailed program

Fundamental aspects, development and the relation of electrochemistry to other sciences. Ionic conductors: ion-solvent interaction, ion-ion interaction and Debye-Hückel theory; diffusion, migration and conductivity; solid state electrolytes, polymer electrolytes.

Fundamentals of Electrodics: electrochemical potential, double-layer theories and adsorption phenomena; electrochemical thermodynamics and Nernst law, electrode types.

Electrodics: electron transfer at the interface and overpotential, charge transfer overpotential, exchange current,

symmetry factor, Butler Volmer equation and Tafel law, diffusion overpotential and limiting current, other kinds of overpotential.

Electrochemical conversion of chemical energy into electrical energy: batteries and fuel cells. Thermodynamics and kinetic of corrosion, the galvanic element in short circuit, corrosion prevention.

Lab. experiences:

1) Structural and electrochemical characterization of materials for secondary lithium ion batteries,

2) Preparation and characterization of organic semiconductors,

3) Determination of oxygen impurities in silicon wafers,

4) Corrosion of metals in acidic solutions.

5) Metal/air batteries

Prerequisites

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

Teaching form

Lectures (5 CFU), lab experiences (3 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) chapters 2,3,4

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

Lectures: first semester

Lab class: second semester

Assessment method

Oral exam to verify the student knowledge about the fundamental concepts and their applications.

For each lab experiences, the students will prepare a scientific paper which will be judged regarding the internal coherence, the scientific correctness and the quality of the results.

The final score will be the weighted average of the two scores

Office hours

On appointment