MSE-658

Electrochemistry in Corrosion Research

Mischler Stefano, Various lecturers

Cursus	Sem.	Type
Materials Science and Engineering		Obl.

Language of teaching	English
Credits	1
Session	
Exam	Project report
Workload	30h
Hours	**19**
Courses	7
Exercises	3
TP	9
Number of positions	**15**

Frequency

Every year

Summary

This course introduces the basic principles of electrochemistry, focusing on corrosion research. It covers the basics of corrosion testing and monitoring techniques, such as linear polarization, cyclic voltammetry and electrochemical impedance spectroscopy (EIS).

Content

This course introduces the basic principles of electrochemistry, focusing on corrosion re- search. It covers the basics of corrosion testing and monitoring techniques, such as linear polarization, cyclic voltammetry and electrochemical impedance spectroscopy (EIS) for rou- tine applications such as rapid screening of corrosion inhibitors, materials selection, failure analysis, corrosion rate measurement, life prediction, evaluation of paints, coatings, elec- troplating, determination of resistance to local corrosion such as pitting and crevice corro- sion and studies of passivating system.
Introduction to Corrosion
The basics of the electrochemical theory of corrosion will be presented: corrosion reactions, electrochemical nature of corrosion, electrode potential (half cells, corrosion cells), electro- chemical kinetics (charge transfer and mass transport control), corrosion in acids, corrosion in neutral solutions.

Module 1 Uniform corrosion rate
The theoretical concepts and the experimental issues underlying the measurement of uni- form corrosion rates using electrochemical methods will be discussed: Tafel extrapolation, polarisation resistance, reference electrodes, galvanostatic and potentiostatic methods, potential drops due to ohmic resistance of the solution, sample preparation.

Module 2: Passivity and localized corrosion
The basics of metals/alloys passivation mechanisms including a short presentation of the most relevant characterization methods (electrochemical/surface analytical) to assess oxide film growth, stability and composition will first be introduced. The passivity breakdown and different localized corrosion propagation mechanisms will then be described. Critical con- trolling factors such as environment and aggressive ion types but also examples of alloying element influence will finally be discussed.
In the second part, concepts and dedicated electrochemical methods/setup related to crev- ice corrosion and aeration cells will be discussed. The theory and measurement of oxygen concentration/diffusion control will briefly be introduced in relation with the lab work.

Module 3
This module will be focused on the method of Electrochemical Impedance Spectroscopy. The basics on AC and DC electronic circuit and how this can be correlated to real electro- chemical cases will taught. It will be based on concrete example to see how to extract prac- tical information on the system, based on impedance measurements. Programing on the NOVA software and the best parameters of the EIS measurements will also be discussed.

Keywords

electrochemistry
corrosion

Learning Prerequisites

Recommended courses

Introduction to materials, General chemistry