GSS Summer School 2015

Electrochemical Impedance spectroscopy

Electrochemical impedance spectroscopy is a method widely used in electrochemistry to study the behavior of electrochemical system. It can be used to investigate the response of the system in a wide time frame, from 10^{-6} up to 10^{5} s. During impedance spectroscopy, the electrochemical system is perturbed with an *ac* potential, v(t), of small amplitude (perturbation), which angular frequency, ω, is swept in the range of several decades. Simultaneously, the response of the system, in the form of *ac* current, i(t), is recorded. The *ac* current has the same angular frequency of the perturbation; however, the response and the perturbation are shifted in time with respect to each other. The impedance spectrum, Z(ω), is defined as the ratio between the Fourier transform of the *ac* potential, V(ω), and *ac* current, I(ω):

$$Z(\omega) = \frac{V(\omega)}{I(\omega)}$$

The impedance spectra of a system can be used to understand the reaction mechanism at the interface electrode / electrolyte, mass transport phenomena in the bulk of the electrolyte, as well as solid –state transport of ions, adsorption phenomena, accumulation of ions at the interface, and solvent relaxation at the interface and around ions. The large variety of observed phenomena renders the interpretation of impedance spectra complicated. In this Advanced Module the students will learn how to record and interpret the impedance spectra relative to the electron-transfer phenomenon between a platinum electrode and a redox couple in solution. The students will learn how to distinguish among resistance of the electrolyte, accumulation of charge at the interface, electron-transfer in solution, and transport phenomena. Moreover, the students will have the possibility to learn both graphical and computational methods for the analysis of the impedance spectra.