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Commentary

Recent Advances in Electro Chemical Analysis

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ABOUT THE STUDY

Electro Chemical Analysis (ECA) is a group of techniques that use electric stimulation to analyze the chemical reactivity of a solution. Oxidation and reduction reaction rates are controlled and measured through a static potential, connected to electrodes sub-merged in an electrolyte. It is used for the study of corrosion, i.e. degradation of a material because of reaction with its environment. The test conditions i.e. composition of electrolyte, temperature, exclusion of oxygen can be varied to gain insight in the corrosion mechanism in specific environments. ECA is useful for materials selection during the prediction of failure mechanisms and lifetime during operation.

In electro chemical corrosion studies, the Working Electrode (WE) is the material under investigation, which is oxidized in a controlled way. The complementary reactions to maintain charge stability take place at usually inert Counter Electrode (CE) for example platinum. A Reference Electrode (RE) is used to control the potential close to the working electrode surface. Various methods are used to measure corrosion resistance. In static potential measurements, the capacity of the working electrode is constant and the current is monitored as a function of time. In dynamic potential measurements, the potential is generally ramped up slowly and the current as a function of voltage is measured. The current-voltage curve across the corrosion potential the ability where current is zero can be fitted Tafel analysis, giving the corrosion rate in equilibrium. Scans to higher voltage can be used to determine passivation breakdown. Cyclic Voltammetry (CV) is a special form of dynamic potential analysis, where the voltage is swung up and down repeatedly.

In Electrochemical Impedance Spectroscopy (EIS), is an AC voltage around zero or non-zero offset is implemented over usually a large frequency range sub-Hz up to MHz's. Electrochemical impedance spectroscopy provides information on time-dependent phenomena like ion conduction in dielectric films, solid state chemical reactions, dipole relaxation etc.

Uses of electrochemical analysis: Corrosion resistance of materials in specific environments, Quality of corrosion-resistant passivation and Efficiency of corrosion inhibitors in cooling water circuits.

Limitations of electrochemical analysis: Complete information interpretation often requires additional information for example from surface microscopy.

Sample size and geometry is limited and complete product testing is often not possible.

Electrochemical techniques for therapy of water which includes electro-coagulation, oxidation and electro-dialysis. Iron and aluminum are used in electrocoagulation metal electrodes.

Electrochemical techniques are not as widely used in technique analysis as spectroscopic techniques and methods based on measurement of physical rather than chemical properties of the material to be characterized.

Electro chemical techniques are based on the detection of a small anodic modern that is generated through oxidation of hydrogen that permeates from one side of the membrane to another side of the membrane it is known as Electrochemical Monitoring Technique (EMT), which monitors modern over time for the diffusion limiting conditions through the membrane, has been widely used to characterize gas permeation rates for Protein Energy Malnutrition (PEM's).

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