

## ELECTROCHEMISTRY

### 1. OVER VIEW OF ELECTRODE PROCESSES

Introduction—electrochemical cell and reaction - faradaic and non-faradaic processes, ideal polarized electrode - capacitance and charge of an electrode, description of electrical double layer - double layer capacitance and charging current in electrochemical measurements, factors affecting rate of electrode reaction, and reaction current, electrochemical cell and cell resistance - mass transfer controlled reaction - semi-empirical treatment of steady-state mass transfer, steady semi-empirical treatment of nernstian reaction with coupled chemical reactions.

### 2. POTENTIAL AND THERMODYNAMICS OF CELLS

Basic electrochemical thermodynamics-reversibility and Gibbs free energy, cell emf concentration, reference electrodes, detailed view of interfacial potential differences- interaction between the conducting phases, measurements of potential differences- electrochemical potential, liquid junction potentials - types of liquid junctions, conductance, transference numbers and mobility, calculation of liquid junction potentials, minimizing of liquid junction potentials, selective electrodes, enzyme coupled devices.

### 3. KINETICS OF ELECTRODE REACTIONS

Review of homogeneous kinetics, essential of electrode reactions, Butler volmer model of electrode kinetics, implication of butler volmer model for the one step, one electron process, standard rate constant, equilibrium conditions - current over potential equation - tafel plots, multistep mechanisms - rate determining electron transfer, microscopic theories of charge transfer- marcus microscopic model, prediction from marcus theory, tunneling and extended charge transfer.

### 4. MASS TRANSFER BY MIGRATION AND DIFFUSION, TECHNIQUE BASED ON CONCEPT OF IMPEDANCE

Derivation of general mass transfer equation - migration - mixed migration and diffusion near an active electrode, effect of adding excess electrolyte, Fick's laws of diffusion, solution diffusion equation, introduction to impedance - types of techniques, interpretation of the faradaic impedance, kinetic parameters from impedance measurements, electrochemical impedance spectroscopy, AC voltammetry - AC polarography in a reversible system, linear sweep voltammetry at stationary electrode - cyclic ac voltammetry, chemical analysis of AC voltammetry, instrumentation for electrochemical impedance spectroscopy.

### 5. DOUBLE LAYER STRUCTURE AND ADSORPTION

Thermodynamics of double layer, experimental evaluation of surface excesses and electrical parameters, models of double layer structure, Stern's modification, studies at solid state electrodes, double layer at solids, well defined single crystal electrode surfaces, solid metal solution interface, extent and rate of specific adsorption, effect of electro inactive species adsorption, double layer effects on electrode reaction rates.

### REFERENCES

1. Allen J. Bard and Larry R. Faulkner, "Electrochemical methods fundamental and application", Wiley-Second Edition, 2004
2. Samuel Glasstone, "An Introduction to Electrochemistry", Mauice Press, 30<sup>th</sup> Nov-2008
3. P.W. Atkins; Julio De Paula, "Physical Chemistry", 7<sup>th</sup> Edition, Oxford-2002

*Mrs. Sheela*  
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