Books section



COMPREHENSIVE TREATISE OF ELECTROCHEMISTRY VOL. 8 EXPERIMENTAL METHODS IN ELECTROCHEMISTRY

Edited by, **Ralph E. White, J.O'M Bockris, Brain E. Conway** and **Ernest Yeager**, *Plenum Press, New York* **(1984) 620 pages.**

Electrochemistry, one of the oldest and important disciplines of physical chemistry developed very fast in the begining of 20th century with respect to electrode processes and solution chemistry. Though it fell into a period of decline later on, a new impeteus was given when fuel cells were introduced to provide auxillary power for space vehicles and the role of electrochemical technology was widened with regard to energy storage, conversion, conservation and direct use of electricity from nuclear and solar plants. Electrochemical concepts and interpretations are applicable to redox processes, biological problems and in organic chemistry-giving it an interdisciplinary status. The purpose of this multivolume comprehensive treatise is to look at the whole field of electrochemistry and to give an overall statement of the modern view. It attempts to make a mature statement about the position in this field.

Current volume which contains 11 chapters describes the diverse experimetal methods in electrochemistry, both old and new. The first two chapters review the electronic instrumentation and methods for the use of microcomputer for experimental data acquisition and reduction. The classical and well established methods of electrochemical analysis-ion selective electrodes and polarography-are treated at length in third and fourth chapters respectively. The newer methods described include ellipsometry, Raman spectroscopy, electronspin resonance, electronspectroscopy, field ion microscopy and electrode microscopy. An extensive list of references is given at the end of each chapter. Last chapter presents a classified Bibliography of Electrochemical Applications, old as well as new methods of analysis which include polarography, cyclic voltammetry Stripping Voltammetry, ion selective electrodes, Coulometry, Chronopotentiometry, spectroelectroa nalytical chemistry and special electrode materials, cells and electrode configurations.

Each chapter is the authoritative contribution by a preeminent expert in the field. High standard is maintained as in previous volumes. The book is well brought out and is immensely useful to electrochemists and it can serve as a valuable reference book. It is a must for an electrochemistry library.

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COMPREHENSIVE TREATISE OF ELECTROCHEMISTRY, VOL. 9 ELECTRODICS: EXPERIMENTAL TECHNIQUES.

Edited by, **Ernest Yeager, J.O'M Bockris, Brain E. Conway** and **S. Sarangapani,** *Plenum Press New York* **(1984) 450 pages.**

This volume contains invited contributions from various authors on the conventional electrochemical techniques used in the study of electrochemical interfaces and kinetics of the electrode processes.

The first chapter by S. Sarangapani and Ernest Yeager, gives a general account of the steady state and nonsteady state methods used in Electrochemistry. In the steady state methods, a direct current or potential is applied and response is observed. In the nonsteady state methods, the system is perturbed by a signal and its relation to equilibrium or another stationary state is studied as a function of time. There is a good

discussion of these two methods. A table containing the list of steady state and nonsteady state methods (with critical notes on each technique) is given.

To obtain meaningful and reproducible results in Electrode kinetic studies, clean electrode surfaces are needed. The second chapter by H.Angerstein-Kozlow deals with procedures for the preparation and cleaning of solid electrodes. Treatment for obtaining a stable surface is described. The author points out how very convenient mercury is in kinetic studies as against solid electrodes. The construction and use of reference electrodes and the purification of electrolytes used have been dealt with quite exhaustively. It is stressed that althrough glass is normally used for electrochemical cell, plastic material such as Teflon are used in cases where glass is attacked. The properties of eight plastic materials used are tabulated.

In chapter three (I. Epelboin, C. Gabrielli and M. Keddam) there is a discussion of nonsteady state technique which are essential for studying the reaction or mechanism and/or kinetic parameters in the case of complicated processes. New trends in nonsteady state techniques (convolution procedure, oscillation analysis, electrochemical noise measurements) have been given due emphasis. Considering an electrochemical system as nonlinear system, a general introduction is given to the study of electrochemical system - large and small amplitude signal analysis of NLS, state equation of the interface and interface models. The methods of solving the state equation have also been touched upon. The electrical relaxation methods that have been discussed include convolutive potential sweep volamenetry which overcomes a number of disadvantageous of linear potential sweep voltammetry. Potential step method, application of convolution procedure to chronopotentimetry, analysis of responses in complex plane, exponential - shaped current pertubation, area, pressure, concentration and rotation speed perturbation techniques, are all described. The other non-steady techniques described are oscillatory electrochemical systems and analysis of electrochemical noise.

The fourth chapter (M. Sluyters-Rehbach and J.H. Sluyters) on A.C. Techniques starts with a general introduction discussing linear and nonlinear systems. The Faradaic impedance concept is discussed with reference to steady state behaviour. This is followed by a historical account. Kohlrausch used the a.c., technique to measure electrical conductance. Randles equivalent circuit is discussed and complex plane representation of impedance data is presented. The analysis of data for obtaining the values of various elements R_Ω, C_d, , R_{ct} and σ are given, Instrumentation for steady state and transient state measurements are given. Second order a.c. techniques, Faradaic rectification, second harmonic polarography, modulation, demodulation and intermodulation polarography have been considered. The application of impedance method to more complicated models as compared to Randles model have been discussed. The mechanism of adsorbed intermediates, reactant adsorption, nonfaradaric heterogeneous processes, coupled homogeneous reactions are all dealt with.

Chapter V (V.Yu. Filinovsky and Yu. V. Pleskov) deals with Rotating Disk and Ring- Disk Electrodes (RDE). The Rotating Disk Electrode (RDE) method is a comparatively simple but highly accurate technique ameanable for quantitative theoretical analysis. It is one of the main techniques used in modern electrochemical experiments. As early as 1942 Levich gave the first theorotical treatment. This chapter contains a historical account of the development of the RDE followed by the theoretical treatment. Applications of the techniques for diffusion coefficient measurements, analytical determination of electro active substrances (for reversible electrode reactions lower limit 10^{-7}M . Kinetics of electrode reactions have been discussed. It has been pointed out that RDE can be used under non-stationary conditions also. While the stationary state experiments can give information about the number of electrons transfered, the nonstationerty conditions give information about the rates of electrode processes, adsorption etc. Conditions for the establishment of limiting diffusion current, electrode prasization with liner potential sweep and application for studying the kinetics of homogeneous reactions are discussed. In the last section the way the rotating Ring-Disk electrode differs from rotating Disk electrode and the underlying theory is given. Application to the multistage processes and investigations on adsorption are given.

In chapter 6 (Floyd E. Woodard and Charles N. Rerillery) thin layer electrochemical techniques are discribed. This technique has a large number of applications. The wide acceptance is due to the simplicity of equations describing the process, and contamination problem is not very large since the working electrodes are exposed to a very small amount of the solution. The model used for the theory is a thin layer of the solution (2 to 50 μ) bounded by two parallel working electrodes connected to the reference and anxiliary electrodes through salt bridges. Different types of thin layer cells are described. Using thin layer cells, coulometric chronopotentiometric, cyclic voltammetric, and steady-state voltammetric, investigations have been made. The applications include measurement of rate constant, number of electrons involved in reduction processes, adsorption on platinum electrodes and investigations of steady-state chemiluminescence.

In the last chapter (chapter 7 by V.E. Kazarinov and V.N Andreev) the application of tracer methods in electrochemical studies have been described.

It is pointed out that tracer method is one of the important techniques that has lead to the advancement of electrochemistry during the last 25 years. The applications include, study of adsorption on electrodes, dissolution process of metals and alloys, metal deposition and also the mechanism of electrochemical processes.

All the chapters have been written by experts in the respective fields. This volume covers all the conventional electrochemical techniques. This is a very valuable and indispensable book to all workers interested in electrochemistry and should find a place in all libraries.

Prof. R.S. Subrahmanya

"ELECTROCHEMICAL SYNTHESIS OF INORGANIC COMPOUNDS" - A Bibiligraphy by **Zoltan Nagy, Argonne** *National Laboratory Argonne. Illinois,* **Plenum Press New York and London 1985.**

This book is worthy of recommendation to any library and for synthetic chemists it is definitely very useful. The author has taken pains and a good compilation of literature has been made. It is quite exhaustive and essentials have been incorporated. The alphabetical order according to the chemical formula of the final product covering a gamut of 75 years up to 1983 helps easy identification.

Electrochemical processes have important advantages over chemical routes: often the selectivity of the reaction can be better controlled through the use of potential control at the electrode, and the creation of environmentally harmful waste material can be avoided more easily since one is using the purest reagent - the electron. In addition to development of new synthetic routes, many old ones, which were found to be uneconomical in the past, are worth reexamination in the light of the considerable advance in cell design principals, materials, together with an improved understanding of electrode materials and electrocatalysis. This bibliography helps to accelerate this process.

A few processes already in large-scale industrial practice, are not included in this compitation such as production of hydroxides, hypochlorites, chlorates and perchlorates sodium and potasium by brine electrolysis and the production of persulphuric acids, persulphate and hydrogen peroxide through the persulphate route as these are well known technologies with voluminous literature. References describing the bulk synthesis of compounds are emphasised. Purification of chemicals, deposition of thin films and kinetic and mechanistic aspects are given secondary importance. And also, references dealing with the production of materials in their elemental form, such as metals, the halogens, hydrogen, oxygen, and nitrogen are not included.

The Main source of this compilation is chemical Abstracts, and the citation number is included for all references. However, if these references were followed by text of abstract and presented in two volumes, it would have been a complete reference book. I have pleasure in recommending this book, with a fine get up and library binding to Electrochemists, Synthetie chemists, industrialists and libraries for guide and ready reference.

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AUSTENITIC STAINLESS STEELS - MICROSTRUCTURE AND MECHANICAL PROPERTIES - by **P. Marshall** - Published by *Elsevier Applied Science Publishers,* **(1984), 432 pages.**

The first two chapters deal with the phase equilibria of the various binary and ternary Fe-Cr-Ni system associated with stainless steels. The phase transformations occuring in these systems and the microstructures have been considered. The effect of temperature and the role of elements like, carbon, nitrogen and molybdenum have been dealt with.

Thermomechanical treatments which induce precipitation types of carbides that occur during such transformations have been discussed. Apart from Ms, the temperature of starting martensite formation, the significance of Md, the starting temperature for deformation induced transformation is brought out. Transformations in deposited austenitic weld metal and their microstructures have been dealt with.

The chapter on short term mechanical properties comprehensively deals with the tensile, yield strengths and ductility of the austenite stainless steels. The emperical relation between tensile/proof stress and the composition of the alloy/microstructure factors have been considered. An attempt has been made to explain the significant aspects of these emperical relationships, by considering the various factors which contribute to the change in strength properties.

Quite a number of factors such as cold work, short term ageing, effect of prior creep and fatigue damage on the subsequent tensile and ductulity have been discussed. Effect of environment, such as surface effects, bulk effects, such as neutron irradiation etc have been considered.

The next two chapters are devoted to fatigue behaviour and creep. The mechanism of failure in high and low cycle fatigue has been discussed. Initiation of crack and the stages of growth vis

a vis the effect of various factors such as temperature, surface defects, have been discussed. The mechanism in which these factors influence the different stages of fatigue failure have been discussed. Influence of microstructure which are based on thermally activated changes on the fatigue and creep fatigue of austenitic stainless steels have been dealt with. Carbide precipitation during such microstructural changes and how they effect these mechanical properties have been explained.

In the chapter dealing with creep properties, consideration of microstructure developed prior to and during creep and their influence on creep properties have been dealt with. Mechanism of creep, various models advanced for explanation of cavity nucleation and growth in the creep in the case of steels have been enumerated.

Chapter on stress corrosion cracking and hydrogen embrittlement briefly deals with the conditions under which these occur, and the effects of various environments, influence of minor and residual elements, metallurgical variables such as grain size, cold work, segregation etc and how they effect the tendency for stress corrosion cracking.

The last chapter deals very briefly with the application aspects of stainless steels in various industries such a petrochemical, food, marine, cryogenic, nuclear reactions etc.

The book is a useful treatise for advanced students.

T.G. Shamanna

ION EXCHANGE & SOLVENT EXTRACTION VOL. 9

Edited by Jacob A. Marinsky & Yizhak Marcus
Marcel Dekker Inc New York 482 pages with index.

This is the nineth volume in the specialised field of solvent extraction & ion exchange, in the series published by Marcel Dekker. Processes utilising Ion exchange of solvent extraction have found a wide range of application ranging from analysis to metal extraction. Many of the topics covered are extension of the work reported in earlier volumes. In this particular volume considerable stress has been laid on the practical utility and approach of the ion exhange process, however the theoritical approach based on fundamental research is provided for a clear understanding of the subject.

There are seven chapters. In the first chapter on Ion exchange processes used in the production of Ultra-pure water required in fossil fuel power plants, C. Calmon reviews the subject of water treatment for feed water of fossil fuelled power plants and the need for ultapure water for high temperature high pressure boiler systems. The ion exchange processes for meeting the stringent needs of such power plants are discussed.

The second chapter on A Systematic approach to reactive ion exchange by G.E. Janasuer is devoted to the basic considerations in the utilisation of reactive ion exchange processes, the major reaction types and their typical application. The scope of extension of the RIEX process in a wide range of industrial applications is elaborated.

Chapter three may be considered to be an extension of the subject of ion exchange kinetics discussed by Helfferich in volume one. In this chapter on, 'Ion-exchange kinetics in selective systems L. Liberti et al. examine the therodynamics and kinetics of exchange involved in a typical instance of $Cl^-/SO4^{--}$ and find the usual classical theory of rate processes in interpreting the reactions. The authors feel the need for a better approach which can account for direct interaction between selectivity and exchange rate. Authors are attempting to find a solution by utilisation of modern analytical techniques.

G.V. Samsonov & G.E. Elkin discuss in the Chapter on Sorption and chromatography of organic ions' examine the interaction between various ion exchange resins and organic ions. With the aid of several equations derived on the basis of certain data, the authors have attempted to explain the kinetic behaviour of several systems.

Based on experimental work and data on Dowex 1 of different cross linking & ionic form Z.I. Sosinovich et al. discuss the thermodynamics of water sorption on the resin in chapter five and utilize the Sorption model in explaining the formation of different hydrates. This explanation of the anion-exchange resin solvation helps in understanding the selectivity exhibited by them.

F.F. Cantwell analyses the surface adsorption process in low capacity anion exchanger in the sixth chapter on ' Double layer ionic adsorption and exchange on porous polymers'. The dependence of sorption on ionic strength and the experimental work relating to NBS, NBTA, PDA throws considerable light on its behaviour. This presentation together with earlier chapters on 'Partition chromatography of sugars, sugar alcohols & sugar derivatives by 'O. Samelson and 'interaction between organic ions and ion exchange resins 'by J.Feitelson in vol.2, and 'Bellicular ion exchange resins in chromatography' by C. Hovath in vol.5, give a full picture of such ion exchangers. It also supplements the chapter four in the present volume.

Chapter seven on 'Humic-Trace metal ion equilibria in natural waters' by D.S. Gamble et. al. provides a concise physical-chemical approach to an understanding of the influence of humic & fulvic acids

on the composition of natural waters. The discussion is based on the polyelectrolyte model for ion exchangers.

This volume would be of immense interest to those investigating ion excahnge processes from both the theoritical view-point and commercial application. This publication together with the earlier volumes in the series should find a place in the library of institution interested in chemical and biological sciences.

J. Balachandra

LABORATORY TECHNIQUES IN ELECTRO-ANLYTICAL CHEMISTRY Editors: **Peter T. Kissinger** and **William R. Heineman,** *Marcel Dekkar Inc, New York,* **(1984) 776 pages.**

There was rapid advancement in modern organic, inorganic and biological Eletroanalytical chemistry in 1960s. Many new technique-cyclic voltammetry pulse chronoamperometry, rotating ring disc electrodes, differential pulse polarography, anodic stripping voltammetry and the use of ESR and optical measurements coupled to electrochemical experiments were developed. The 1970s saw electroanalytical chemistry refine its fundamental basis and develop more powerful and more reliable instrumentation. Photoelectrochemistry and chemically modified electrodes were two important fundamental new directions in 1970s. An important practical analytical tool-electrochemical flow cells for liquid chromatography-helped non electrochemists, phormocologists, toxicologists and clinical chemists to a great extent.

This text places electroanalytical techniques in perspective by introducing the most promising methods and evaluating their relative merits for specific applications. It provides a means of enabling a beginner to get started in the laboratory. Functional details with fundamental concepts and techniques necessary to begin laboratory experimentation including instrumentation principles are given. The text inctroduce electroanalytical techniques gradually from prinples through methodology to applications.

There are 24 chapters in all. After the introductory chapter, chapters 2 to 5 discuss most commonly used techniques which have become routine now. Second chapter details with the fundamental concepts and underlying principles of electroanalytical techniques. Instrumentation for selected aspects of these techniques are detailed in chapters 6 to 8. Chapters 9 through 15 deal with the practical aspects which contain something useful for everyone and some insight into the understanding of electrochemical cells and solutions. The 16th chapter is devoted for digital simulation of electrochemical problems whereas 17th chapter illustrates the technique contained in chapter 3 with respect to the selection of techniques useful for unravelling mechanism. Chapterts 18 throgh 24 contain various topics which describe the applications of various techniques including hybrid techniques. They are: Transition metal electrochemistry, stripping analysis, constant current coulometry, application of electrochemistry to pharamaceutical analysis, electrochemical detection in liquid chromatography and flow injection analysis, photo electochemistry and electrochemilumiscence and principles of electrochemical ESR experiments.

The emphasis of this book is entirely on analytical, mechanistic, kinetic and synthetic applications of these techniques. It does not include equilibrium methods, fuel cells, corrosion, battery and membrane potentials etc. Electrochemistry is a broad area and some value judgements have been made with respect to some sections. Authors have chosen experimental approaches that work best. There are hundreds of illustrations and key equations. There are references to key reviews and papers of historic interest at the end of each chapter. This is one of the best book available for research workers and students needing a solid working knowledge of the subject. The book is very useful to research workers using electroanalytical techniques in their analytical, inorganic, organic, pharmaceutical corrosion and solar energy development work .

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MODERN TRENDS IN ANALYTICAL CHEMISTRY Edited by **E. Pungor, I. Buzas** and **G.E. Veress** **Analytical chemistry symposia series-volume 18,** *Elsevier applied science publishers* **(1984) 432 and 195 pages.**

Almost every scientific tool in physical chemistry has been used in Analysis at one time or the other. Some of these tools get more and more refined as the underlying principles get better understood and the analytical method gets wide acceptability. Thus newer techniques are being included into analytical chemistry. So, it becomes almost a necessity for the analytical scientists to make themselves familiar with newer developments. Symposia on a specilized subject is an occasion when one can update his knowledge on the subject. A printed proceedings of such a symposia helps the interested scientists who can not attend such symposia for various reasons. Analytical chemistry symposia series in thus a great help to Analytical Scientists.

This book is the proceedings of the symposia held at Matrafured in Hungary during October 1982. Part A of this book covers the porceedings of the symposeum on "Electrochemical detection in flow analysis", which was held during 17-20 October 1985. With the increasing use of flow techniques in analytical chemistry, it is timely that this

symposeum has discussed problems related to the application of electrochemical sensors in flow analysis. The physical parameters of the detectors which are most important in flow application and use of these detectors in other fields like liquid chromatography has been discussed in this part of the book (495 pages).

A closely following symposeum on "Pattern recognition in Analytical chemistry" held during 20-22nd October 1982 is covered in part B. Need for measurement of minute quantities and need for large number of such analysis has brought revolutionary changes in analytical chemistry. Automatic analysis, application of monitors, telemetry, computer based automatic analysis and chemometry h come to stay. The pepers in the symposeum ern recognition deal with some aspects of

As is usual with the Matrafured symposea ions after the lecture are extensive. B papers and discussions have been included proceedings. The papers are authoritative adable but some of the errors in spelli language could be avioded. But the scienti tent of the book, makes it a must in sc libraries.

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Back volumes and individual issues of the Journal of Electrochemical Society of India are available at concessional rates.

Limited number of copies of the proceedings of the Annual Technical Meetings are also available for sale.

The following publications of the Electrochemical Society of India are available at the original price.

1. DIRECTORY OF ALUMINIUM, 1955, pages 65 Price 15/-
2. REFRESHER COURSE IN METAL FINISHING, 1974 edited by Prof. K.I. Vasu, 14 articles 128 pages, Price Rs. 40/-
3. ELECTRODEPOSITION & METAL FINISHING, Proceedings of the Symposium held at Karaikudi on Dec. 27-28, 1957-Price: Rs.20/-
4. MATERIALS FOR MACHINE TOOLS, 1976 Rs. 50/-
5. PROCEEDINGS OF THE ANNUAL TECHNICAL MEETINGS, 1979-1984, Rs. 100/- per copy of each year.