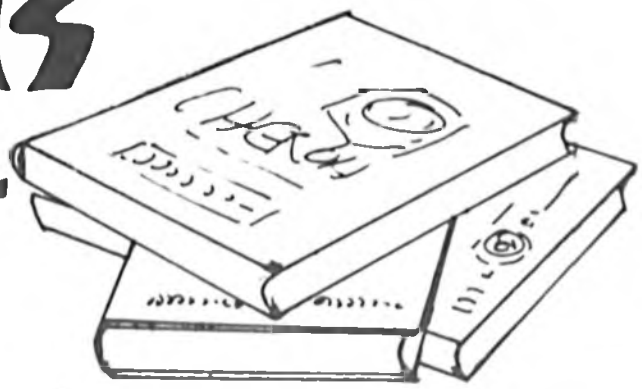
Books section



BATTERIES FOR IMPLANTABLE BIOMEDICAL DEVICES Ed.by Boone B. Owens., *Plenum Press* (1986) 358 pages

The book is one among very rare class of books covering wide range of topics. The topics of the book encompass Electrochemistry, Battery Technology and Physiology. The contributions of the authors reveal their professional expertise

The book contains eleven chapters - Electrically driven implantable prostheses, Key events in the evolution of implantable pacemaker batteries, Lithium primary cells for power sources, Evaluation methods, Battery performance modelling, Lithium/halogen batteries, Lithium solid cathode batteries for biomedical implantable applications, Lithium-liquid oxidant batteries, Mercury batteries for pacemakers and other implantable devices, Rechargeable electrochemical cells as implantable power sources, Nuclear batteries for implantable applications.

Though there are several implantable devices, the most important device is cardiac pacemaker. Scientific background leading to clinical applications and further development of pacemaker is clearly brought out. One of the interesting features of the book is the interviews with the scientists Ruben and Greatbatch who invented mercury and lithium cells respectively for cardiac pacemaker applications. Discussion on the properties of different components of a battery in general and performance characteristics provide useful introduction to readers. Several battery systems based on lithium negative electrode such as lithium/bromine, lithium/iodine, lithium/silver chromate, lithium/cupric sulphide, lithium/vanadium pentoxide, lithium/manganese dioxide, etc.are discussed in depth for electrochemical characteristics, battery performance in view of implantable devices. Though the last few chapters are devoted to Zinc/mercuric oxide, rechargeable nickel-cadmium and nuclear batteries, lithium/iodine battery is widely discussed and projected to be the most important battery system for cardiac pacemakers.

Though the book has a good get-up with clear illustrations of figures, photographs, tables etc., and the style of writing is quiet readable, one will occassionally find minor printing errors such as the spelling of quantity (p.88, line 30), shortcomings (p.278, line 11) to date (p.343, line 21) the formula for lithium perchlorate (p.204 line 6), etc. However these errors do not belittle the standard of the book. It can be a good addition to any library.

Dr. N. Munichandraiah
Dept. of IPC

CHARGE TRANSFER REACTION IN ELECTROCHEMICAL AND CHEMICAL PROCESSES, by L.I. Krishtalik, *Plenum Publishing Company* (1986) 326 pages.

This book, dedicated to the memory of great academecian A.N. Frumkin, deals with important fundamental concepts related to electron transfer reactions.

The book contains seven chapters. In the first chapter entitled 'The phenomenological theory of an elementary act', the author discusses the basic concepts related to electron transfer reactions from the point of view of thermodynamics. Barrierless and activation-less processes are introduced; the kinetic equation is briefly discussed. The second chapter is devoted to cathodic hydrogen evolution reac-

tion at mercury and other electrodes. Purification of electrolytes has been found to be an important factor for achieving reproducible experimental results. Various possible reasons for the presence of inflection in polarisation curves have been discussed. The variation of the Tafel slope under different experimental conditions has been analysed. The activity coefficient of an activated complex and the temperature dependence of the rate of a barrierless discharge have been discussed. In the thrid chapter, the author analyses quantum - mechanical theory of charge - transfer reactions. The discussion is presented in a descriptive form without involving any complicated mathematical equations. In the fourth chapter, two competing models of an elementary act of proton transfer, viz., the model of the stretching of bound O-H or M-H, followed by the proton tunnelling, and the model of reorganization of the polar medium without excitation of proton vibrations, followed by its tunneling are compared on the basis of experimental observations. Most of the experimental results are found to agree with the second model. The electrode processes associated with the transfer of heavy particles are discussed in the fifth chapter, which is devoted to the theoretical and experimental studies of quasi-barrierless and quasiactivationless processes. The reactions discussed are chlorine evolution reaction at graphite and RuO_2 - TiO_2 electodes, oxidation of azide ion at a platinum electode etc.

The sixth chapter deals with the kinetics of cathodic hydrogen evolution reaction. Kinetic isotope effect - φ_1 - potential, hydrogen evolution at various amalgam electodes, as well as iron, cromium and manganese metals, hydrogen evolution in nonaqueous solvents etc. are discussed. The final chapter is devoted to problems concerning homogeneous chemical reactions and enzymatic reactions involving charge transfer.

On the whole, the book is devoted to basic concept of charge transfer reactions, which are useful to provoke thoughts to chemists and electrochemists working in the area of kinetics. This will certainly be a good addtion to any scientific library.

Dr. N. Munichandraiah
Department of I.P.C.

INDUSTRIAL APPLICATIONS OF ELECTROORGANIC SYNTHESIS, Authors **Ralph Robert, Robert P. Ouellette and Paul N. Cheremisinoff,** *Ann Arbor Science. The Butterworth group* (1982) 205 PP.

This book is timely as processes that have better environmental acceptability and use less overall energy are being considered with seriousness by manufacturers. This book gives a detailed survey of electrochemical syntheses and applications highlighting the economic as well as environmental aspects of organic chemical processing. The ennumeration of the current status of industrial electroorganic chemistry, highlights the chemistry, engineering, pilot plant processing, and the difficulties encountered in scaling up. The electrochemical principals and cell components have been well presented with a few diagrams., The laboratory methods for the study of electroorganic reactions include dynamic electrode techniques - rotating microelectrode rotating & ring disc electrode - oscillographic and pulsed techniques - alternating current polarography - cyclic voltametry, and controlled potential electrolysis. Another interesting feature is the cell design for the on line spectroscopic investigations. The next chapter deals with industrial cells and design principles. Here graphic Electrochemical Reactor designs and optimization have been well presented. Several Electroorganic synthetic reactions have been compared with chemical processes giving both the economics as well as the energy use. The next chapter summarises the broad area of electroorganic synthetic reactions and emphasizes those that have been commercialized or investigated in the pilot plant. Specific reactions, such as paired synthesis; use of both anodic and cathodic reaction products to yield one or more desired substances; electrochemical reactions of carbon dioxide, and chiral electrode reactions, use of electrochemically regenerable inorganic oxidants and reductants for the synthesis of organic compounds are described. Polymersiation by electrochemically produced chain initiators is reviewed. In brief is described oxidation-reduction couples that produce both energy and a useful organic compound. Since only a few electrochemical processes have been commercialized, emphasis is given in the next chapater on the technology of commercial and pilot plant synthesis - the comparison of some of the electrochemical processes with secular (non electrochemical) processes. For the industrially important perfluoro compounds the 3 M electrofluorination process is the only process known so far. This process was discovered by Simmons and the 3 M company is the

licensee. A broad spectrum of organic compounds have been electrolysed by this process for commercial products such as Refrigeration fluids, aerosol propellents, anti-strain fabric, anesthetic, papercoating, high performance plastics & electrochemical membranes. The energy characteristics have been presented for all the processes. The present day research activity is covered to some extent to reveal the sustained and continued interest in electroorganic synthesis. The book on the whole is well organised and informative on several aspects of electroorganic synthesis and its industrial impact. It also highlights and sees the need for future growth of this important area with several vantage points. The book is useful to both a researcher as well as an industrialist and recommended for libraries.

Prof. D.K. Padma
Dept. of IPC

ELECTRODE KINETICS- PRINCIPLES AND METHODOLOGY Ed. by C.H. Banford and R.G. Campton, *Elsevier Publication* (1986) 450 pages.

The present volume forms the twentysixth number of a series of manographs that has been planned under comprehensive chemical kinetics and falls under section 10 dealing with Modern methods, Theory and data. Volumes 24 & 25 deal with Modern methods in kinetics and Diffusion-limited reactions. In the present volume the principles and methodology in Electrode Kinetics is dealt with.

The first chapter (E.J. Calvo) gives a survey of the fundamentals of electrode kinetics. The various types of electrode reactions, the structure of the electrochemical interface which is the site of heterogeneous electrode reaction, the transportation of the reactants and products to and from the electrode surface, mechanism of simple and multielectron transfer processes (eg. single two electron step or two successive one electron steps) are discussed. The theories developed by Hush, Marcus and Levich as extended to the case of heterogeneous electrode reaction is given. The influence of adsorption on electrode reactions electrocatalysis and electrocrystallization have all been treated.

Chapter 2 (K.B. Oldham and C.G. Zoski) deals with mass transport (transport of the reactant to the electrode surface and the products away from the surface). The entire scheme is diagramatically presented. The nature and the geometry of the electrode and the mode of transport- migration, diffusion and convection are discussed. Transport between two parallel electrodes (finite and semi infinite), constant current and constant potential experiments have been dealt with. The use of analog and digital methods used to semi-integrate electrochemical current have been discussed. It is pointed out that although for mathematical simplicity, planar electrodes are assumed in mathematical derivation in voltammetry, in practice they are not used because of difficulty in fabrication. The most convenient for experimental voltammetry is the static mercury drop. The limitations of equations in applying to the spherical electrode and their modification is discussed.

The third chapter (V.D. Parker) deals with linear sweep and cyclic voltammetry. Although polarography using dropping mercury electrode happens to be the first linear voltammetry method, the term LSV is used for measurements at stationery electrodes due to significant differences in the mode of transport. The theory of the method is discussed for reversible, quasi-reversible and totally irreversible systems. The experimental set up, complications due to uncompensated solution resistance, the difficulties inherent in measurement precision have been discussed. The improvement in measurement precision by taking the derivative read out is given. The utility of these techniques in the study of electrode kinetics and homogenous chemical reactions coupled to charge transfer at electrodes is discussed. Since the shape of LSV waves depends both on kinetic heterogenous charge transfer and mechanism of reactions coupled to charge transfer, techniques developed - convolution potential sweep voltammetry, normalized potential sweep voltammetry, linear current-potential analysis have been described. A few typical examples illustrating the application of LSV and CV are given.

Chapter 4 (M. Sluyters - Rehbach and J.H. Sluyters) deals mainly with non-stationary or relaxation techniques - Alternating and pulse methods - to the study or both electrochemical and chemical kinetics. The theory of current step (chronopotentiometry, single pulse and double pulse method), potential step (chronoamperometry, chronocoulametry, normal pulse polarography) and alternating current perturbation methods are discussed. In the alternating current perturbation method, the authors have dealt with first order response (fundamental frequency) and second order responses (higher harmonics, faradaic rectifi-

cation, demodulation and intermodulation). The role of Laplace transform method in the analysis of experimental data is discussed. Application of relaxation methods in corrosion studies, electrodeposition, ion transport through biological membranes, elucidation of mechanism of electrode reactions are discussed. The role of reactant adsorption is treated.

Chapter V (C.M.A. Brett and A.M.C.F, Oliveira Brett) deals with hydrodynamic electrodes. The first example of a hydrodynamic electrode is the dropping mercury electrode, the hydrodynamic character being due to drop growth. Later solid hydrodynamic electrodes, which have the advantage of fixed area and wide range of electrode materials, were developed (Rotating disc electrode, rotating ring - disc electode, the tubular electrode, impinging jet electrode). The theory of rotating disc and rotating ring electrodes, rotating ring - disc electrodes, rotating double ring electrode, Tubular and channel electrode, impinging jet electrodes and the dropping mercury electrode are discussed. There is discussion of the construction of solid hydrodynamic electrodes and also the dropping mercury electrode assembly. The application of hydrodynamic electrodes in the study of electrode kinetics and to the study of electrode processes with coupled homogenous reactions is described. The use of hydrodynamic electrodes with transient techniques is discussed and the difficulties pointed out. The use of hydrodynamic electrodes in ESR techniques is given.

All the chapters are very well written. There is extensive bibliography. It is a very useful reference book. Electrode kinetics is multidicipiinary in nature the book will be useful not only to the electrochemist but also to research workers & chemistry, physics metallurgy, materials science.

Prof. R.S. Subrahamanya

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