Ions, Electrodes and Membranes

By J. Koryta, John Wiley & Sons, New York, 2nd Ed., 1992, $74.95.

This book is a basic introduction to electrochemistry with an emphasis on applications of electrode techniques for investigating biological membranes. Although designed for biochemists interested in electrochemical science, the text should be equally useful to electrochemists interested in biochemical phenomena that are based on electron-transfer and potential-driven reactions. The book is concisely written and very readable, but requires a rudimentary knowledge of the physical chemistry of aqueous solutions to appreciate fully the concepts. No previous knowledge of electrochemistry, however, is presumed.

Chapter 1 (Ions) presents an overview of the basic concepts of solvation, solvent polarity, ionic and electronic conduction, acid-base chemistry, and transport phenomena (diffusion and migration). Chapter 2 (Electrodes) presents the fundamentals of electrochemistry (thermodynamics and kinetics of simple redox reactions); electrochemical technologies (such as corrosion, fuel cells, synthesis); electroanalyses based on amperometric techniques; and brief treatments of electrocatalysis and the electrical double layer. Chapter 3 (Membranes) is an overview of pH and ion-selective electrodes, bilayer liquid membranes, and membrane transport. This chapter culminates with descriptions of the role of ion- and electron-transfer reactions in neurophysiology, photosynthesis, and ATP production. Each topic is covered in a short section, typically 1–5 pages long. Because of the brevity of coverage, the text has an encyclopedia writing style. A short list of current literature (after 1980) at the end of each section allows the reader to pursue further details.

Koryta presents a very appealing picture of electrochemical science, emphasizing the relevance and utility of basic phenomena to technologies and biological sciences. Many of the topics are accompanied by excellent qualitative descriptions of microscopic- and molecular-level phenomena that provide insight into how and why electron- and ion-transfer occurs. There is also a good balance between basic principles and experimental methods, allowing the reader to see how electrochemists put their science to use. The book is not intended for seasoned electrochemists interested in rigorous treatments of practical or theoretical topics.

Small annoyances are present. A number of the figures are labeled incorrectly, or the symbols are undefined in the caption and the text. A more serious problem is encountered in the section on electrochemical thermodynamics where the author develops a fictitious description of free electrons in solution "jumping" between redox species (supposedly defining the solution potential). This mechanistic scheme is inaccurate and undermines the development of the foundation necessary to appreciate fully electrochemical measurements. Similarly inaccurate descriptions can be found in the discussions of solution transport phenomena. However, because the text is intended primarily to acquaint newcomers to electrochemistry, these problems are not critical. Serious researchers entering the field will undoubtedly consult one of a number of classic texts that give more detailed and comprehensive treatments of the subject.

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High Performance Polymers and Composites

Edited by Jacqueline I. Kroschwitz, Encyclopedia Reprint Series, Wiley, 1991.

This book is a collection of reprints from the *Encyclopedia of Polymer Science and Engineering*, published in 1985. The 30 entries in this book were selected in the field of advanced polymers and composites. Topics in this book can be divided into four areas:

Polymers: thermoplastics such as acetal, polycarbonate, engineering thermoplastics.

LCP, PEEK, PS, PI: thermosets such as epoxy and unsaturated polyester, and specialty polymers such as electrically conductive and heat resistant.

Fibers: carbon, engineering fibers, high modulus polymers, and ultimate fiber properties.

Blends and Composites: compatability, composites fabrication and testing, and polymer blends.

Material in each chapter covers both technical and economic issues, focusing on chemical and process fundamentals, technical literature and patents (at least prior to 1985), market applications, and material suppliers. In addition to numerous specific references, each chapter listed several general texts for more background. The chapters are well written and are cross-referenced with other chapters in the original Encyclopedia.

This book was designed to reduce the 18-volume Encyclopedia into a single volume for a select audience. Selection of topics was, no doubt, a difficult task. Comparing the selected chapters to the original Encyclopedia, one finds that a number of important chapters were not included in this edition. Clearly, space limitations restricted the selection of many chapters on composites, forcing the editor to choose breadth rather than completeness.

For example, chapters were included on novel high-performance polymers such as polybenzimidazolds, polybenzothiazoles, and polyquinolines, while not including chapters on phenolics, laminates, vinyl esters, and composite tooling. The substantial collection of chapters on various composites processing methods was also abridged, including only two of the available ten chapters on the subject.

In summary, the individual chapters in this book give a good overview of many important aspects of high-performance polymers and composites. However, the lack of continuity and focus diminishes the value of the book from its potential impact. This book is a useful backup for

other technical handbooks in composites and materials.

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Powder Technology Handbook

Edited by Koichi Iinoya, Keishi Gotah, and Ko Higoshitani, English Translation of Japanese handbook published in 1986, 2nd Ed., 1991.

This "sort of encyclopedia" is a rather unique and comprehensive guide to a wide-ranging technological and scientific field of world importance. Editing and translation are excellent. In nearly eight-hundred pages, this handbook introduces to English readers nearly 40 years of important Japanese research and development in the many subjects covered.

As in any other publication of this type, there are problems of classification, emphasis, and duplication; but, the three editors here appear to have maintained a reasonable balance and control. As an encyclopedia, 40 authors cover 70 items. They are classified into six divisions whose imbalance can be attributed to the specialized separation of sciences and technologies under this handbook umbrella. The titles of six divisions are: I. Particle Characterization and Measurement; II. Physical and Chemical Properties of Powder; III. Transport Phenomena and Related Topics; IV. Preparation of Powder; V. Powder Handling Operations; and VI. Instrumentation.

The oldest and most developed technologies (Powder Handling Operations Section) are described in about one-third of the text. Here, one finds varied items such as crushing and grinding, classification and separation, conveying and storage, crystallization and filtration, dewatering and drying, mixing and kneading, molding and firing in ceramic operations, thickeners and clarifiers, fluidized particle reactors. The next largest classification (Physical and Chemical Properties Section) is analytical. Here, newer measuring techniques, small-scale analysis, and physical-chemical modeling have revived interest in powder handling operations, which always have been a demand-art at very large scales. As an offshoot of new measuring techniques, these arts are becoming a modern technology for creating new materials at intermediate scales. In Section II, one finds items such as powder mechanics, adhesion and mechanical strength of sintered contacts, fluidity, permeation, adsorption, moisture content, rheology of slurries, electrical and magnetic properties, and vibrational and acoustic properties.

Nearly as large a section as Section II (Transport Phenomena and Related Topics Section) treats the more difficult actions and changes occurring where condensed-state particulates are used or formed in systems of commercial and environmental interest. Here, small-scale actions are magnified to anticipate what can become obvious at a large scale. A reader is introduced to items such as thermal and turbulent diffusion, agglomeration in fluids, impact and bounce, deposition and separation, condensation and vaporization, solution and dissolution, electrophoretic and optical phenomena, mechano-chemistry....all matters of new materials research and essential to development of new materials processing.

Three sections (Sections I, IV and VI) occupy text space not much more than action Section III. Section I is concerned primarily with small-scale geometry and distributed values of a major characterizing variable, particle size. Section IV treats more action items and can be considered an extention of Section III. Here, one finds aerosol generation, dispersion and sampling, electric charge control, coating and encapsulation, and specialized particulate generation by physical-chemical reactions. The final section (Instrumentation) concerns practical and standard test procedures for controlling powder processing.

Typical solid materials processes at particle sizes greater than 10^{-3}m have become today larger bulk processes with smaller particle sizes of 10^{-2}m. Now particle sizes of 10^{-6}m are handled routinely in fine chemicals manufacture. Super molecules of 10^{-9}-m size encapsulate larger particles and adhere to 10^{-8}-m pore walls of 10^{-4}-m catalysts constructed by sol-gel techniques. There is a continuum of scales between 10^{-10}m and 10^{-3}m, which appear to conceal states and actions as complex as one can easily observe in our technological landscape between 10^{-3}m and 10^{+3}m. This powder technology handbook should be of general use to the vocational classifications of mineral engineering, chemical engineering, environmental engineering, materials science, materials processing, ceramic engineering, soil mechanics, geoengineering, food processing, even activities as diverse as pharmaceutical manufacture (pills) and production of construction materials (cement and polymer composites).

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The Kinematics of Mixing: Stretching, Chaos, and Transport

By J. M. Ottino, Cambridge Texts in Applied Mathematics, 1989, 364 pp., $94.95 (Hard Cover), $39.95 (Soft Cover).

Until recently, methods to describe the operations of mixing, blending, or stirring of fluids have been based largely on deductions from dynamic equations expressing balances of mass and momentum. Usually the transport of mass by molecular diffusion and turbulent convective motions play key roles. The content of this book, however, is based on another method that introduces the notion of chaos in a low-dimensional dynamical system as the descriptive framework. The development relies on a correspondence between the motion of fluid in physical space and the trajectory of points in the phase space of a general dynamical system. Accordingly, the concept arises of producing chaotic particle trajectories in a deterministic flow field by passive convection. Thus, molecular diffusion certainly yields mixing, although the process is slow and turbulent flows yield fast mixing. However, there are many mixing problems in chemical engineering, planetary science, and other fields for which neither molecular diffusion nor turbulence is responsible for the mixing that occurs. For example, diffusion is absent in the mixing of fluids that are insoluble in each other. In the case of very viscous fluids, the energy cost of producing turbulent motions is uneconomic and is avoided. If the substance to be blended contains long-chain polymers, turbulence may be further undesirable as the accompanying large deformation rates could break the polymeric molecular bonds.

This book, containing much original work of the author, is unique in providing a unified treatment of relationships