BOOK REVIEWS

Colloidal Systems and Interfaces

By S. Ross and I. D. Morrison, Wiley-Interscience, New York, 1988, 422 pp., $49.95

As indicated by its authors, this book is closely related to a four-day course on emulsions and dispersions that has been taught by Professors S. Ross and F. M. Fowkes since 1967, joined by Dr. I. D. Morrison in 1985, which, to date, has gathered some 2000 alumni. The topics discussed in the course and reflected in the book, are those considered by the authors to be of central importance to those confronted by research and development problems in the industrial environment. The authors claim that the book, like the course, is intended for the industrial chemist or chemical engineer who may not have had a formal university course in colloid and interface chemistry, but finds that the nature of the problems that must be solved necessitates the rapid acquistion of some knowledge of that subject.

This book displays the broad spectrum of fundamental concepts and experimental techniques that are available in the field of colloid and interface science, with a clear realization that every topic is treated at greater length and depth in existing monographs and reviews. The authors recognize that the main goal of the book is to outline the nature of the topic, define its terms, explain its elementary concepts, and direct the reader to sources of fuller information. The authors state that: "This book constitutes an index of related topics, by means of which the enquirer, with a specific problem in mind, may hope to find the appropriate context to help formulate it. A great body of organized knowledge is at hand, but many who could use it are only vaguely aware of it existence or are intimidated by its bulk and impenetrability. This book is a guide to those so perplexed."

With this view in mind, I believe that this book can become a valuable source of reference for those interested in the area of colloid and interface science. The book is well written and provides a balanced exposition of theory, experiment, and application. The list of references is comprehensive and current.

To give some idea about the breadth of this book, I will briefly describe its contents. The book is divided into four parts. Part I deals with Particulates: Optical Properties-Light Scattering, Kinetic Properties-Rheology, Statistical Properties, Size and Surface Area, Processing Methods for Making Emulsions, References for Part I. Part II deals with Interfaces: Capillarity of Pure Liquids, The Relation of Capillarity to Phase Diagrams, Surface-Active Solutes, Physical Properties of Insoluble Monolayers, Aqueous Solutions of Surface-Active Solutes, Surface Activity in Nonaqueous Media, Thermodynamics of Adsorption from Solution, References for Part II. Part III deals with Stability of Dispersions: Forces of Attraction, Forces of Repulsion, Stability of Systems, Kinetics of Coagulation, References for Part III. Part IV deals with Dispersed-Phase Systems: Emulsions, Foams, Suspensions, References for Part IV. In addition, the book contains a Bibliography and nine Appendices.

In summary, if you are looking for an accurate and updated guide to a broad spectrum of fundamental, experimental, and applied topics in the area of colloid and interface science, this book is a worthwhile investment.

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Ion-Exchange Chromatography of Proteins

By S. Yamamoto, K. Nakanishi, R. Matsuno, Marcel Dekker, New York, 1988, 401 pp., $110

This treatise comprehensively covers ion exchange chromatography of proteins and enzymes, a key technique in purification of these biochemicals on both laboratory and production scales. Although in the 15 pages of bibliography there are decidedly few citations of Japanese work before 1980, this substantial monograph is an indication of the importance attached to protein purification in Japan's recent, vigorous development of modern biotechnology. The authors have drawn heavily on their major contributions to chromatographic theory and experimentation over the past ten years.

Chromatographic theory is treated on two levels so that both the chemical engineering scientist and the nonengineer are served. Chemical engineers will appreciate the mixing-cell transport-rate models applied by the authors to attain expressions for temporal moments of concentration responses, leading to equations for separation resolution and number of theoretical plates. How each variable affects the separation, based on theoretical principles and experimental evidence, is discussed. The authors emphasize the value of mathematical theory to guide experimentation and to optimize production.

An outstanding strength of this book is the physical and mathematical insight provided into chromatographic processes. This deep understanding is based on: 1. a thorough study of the extensive chromatographic literature: and 2. their own intensive experimental investigations. Numerous illustrations, tables, and plots of data enhance the discussion of principles.

The work contains chapters on chromatographic theory, ion-exchange equilibria, diffusion in ion-exchange particles, and axial dispersion. Experimental methods and apparatus get proficient coverage. Separation behavior and design calculations for elution techniques, both linear and stepwise gradients, are discussed at length. A chapter on large-scale operation of ion-exchange purification of proteins will be especially useful to readers in industry.

Aside from a few sentences that could have been edited into more conventional modern English, the book is clearly and carefully written.

The field of biochemical separation and purification, rich in complexity and opportunity, is rapidly developing and changing. Books such as this one, provide useful benchmarks for understanding and evaluating the state of the art, and for monitoring the frequent changes.

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Transport Properties of Ions in Gases

By Edward A. Mason and Earl W. McDaniel,
John Wiley and Sons, New York, 1988,
560 + xvi pp.

This monograph is largely an updated version of an earlier book by the same authors (McDaniel and Mason, 1973). Both works are surveys of experimental and theoretical treatments of the transport of ions in neutral gases under the application of an electric field. The main motivation for the new book (not a second edition) is to detail the advances that have taken place in the kinetic theory of ion transport in gases since 1975. In addition, several new experimental techniques are described along with updates of traditional methods. The intended audience appears to be scientists and engineers with interests in gas discharge phenomena (e.g., plasma chemistry and gas discharge lasers); atmospheric and interstellar ionic phenomena; ion-neutral chemistry; and in general, any application in which ion-neutral collisions at energies below about ten electron volts, are important. Chemical engineers involved with plasma processing of electronic materials, combustion, or atmospheric chemistry fall into this group.

The transport coefficients of interest here are the mobility (ratio of ion velocity to electric field strength) and diffusivity. The mobility is a scalar, but diffusivity is in general a tensor. This is because the diffusion coefficient parallel to the applied electric field is not equal to diffusivity in the perpendicular direction, which is related to a corresponding anisotropy in the ion velocity distribution. The general goal of ion transport theory is to relate the macroscopic transport coefficient to molecular properties (i.e., the interaction potential) of the ion and neutral involved.

The first chapter is a phenomenological treatment of ion transport with key concepts and definitions presented. Chapters 2 through 4 (about 100 pages) cover experimental methods, mainly drift tubes and afterglows. In a drift tube, ions are released repeatedly in pulses from one electrode, and drift to another at which they are collected. Afterglows can be either stationary (the electric field sustaining a discharge is turned off and time decay of ion density reveals rate and transport coefficients) or flowing (a rapidly flowing gas traverses a discharge, and density is measured as a function of position downstream from the discharge). Both techniques have been employed for many decades to measure electron rate and transport coefficients (e.g., Huxley and Crompton, 1974); application to ions has been more recent (since the early sixties) because ions tend to react with the background gas and change identity.

Chapters 5 through 7 (300 pages) form the heart of the book, covering the kinetic theory of ion transport (Chapter 5); applications of kinetic theory to predict transport coefficients (Chapter 6); and the use of ion-neutral interaction potentials (Chapter 7). The authors initially emphasize a physical description of the concepts underlying kinetic theory of ion transport, with a progressively more mathematical treatment later. I find this section to be the most complete, readable and insightful discussion of charged particle transport that I have come across. The fundamental differences between classical neutral gas transport theory, electorn transport, and ion transport are clearly described. The essence of the difficulty with charged particle transport theory is that the traditional perturbation/expansion methods (Chapman-Enskog) rely small deviations from local equilibrium. Unfortunately, with even quite small electric fields, electrons and ions begin to deviate substantially from local equilibrium with the neutral gas. As a result, the expansions fail to converge under conditions of interest. Electron transport theory can effectively exploit the small ratio of electron to neutral mass: this leads to nearly spherically symmetric velocity distribution functions, and expanding the distribution function in spherical harmonies therefore converges rapidly. For not too large electric field to gas number density ratio (E/N), electron velocity distributions tend to be nearly isotropic, but not, in general, Maxwellian. Ion velocity distribution functions tend to be highly anisotropic, and modern theories rely on methods that focus on the velocity moments of the ion distribution function rather than the distribution function itself. The velocity moments are, of course, of greatest interest macroscopically, as they are directly related to drift velocity, mean energies, diffusivities, etc. The key step is based on a rather standard technique in physics: represent the solution in the form of a basis function expansion with the basis functions made orthogonal with respect to some weighting function. The trick is to properly choose the weighting function and basis functions, and much discussion is provided for the choices that have proven successful for ion transport.

The eighth and last chapter is an abbreviated collection of some applications of ion transport and kinetic theory. This chapter is the weakest in the book, but is intended to give only a flavor and an introduction to the literature for some selected subjects. It does not detract significantly from the book's strengths.

Finally, an index to the literature containing original data is provided in an Appendix, as are several other tables of useful quantities (cross sections for model potentials and parameters for ion-neutral interaction energies). In addition, literature citations throughout the book appear to be unusually thorough. I anticipate that this book will become a standard refverence for ion transport in gases. It will certainly be useful to chemical engineers interested in plasma chemistry and gaseous electronics, and I wholeheartedly recommend it to anyone interested in the subject.

Literrture cited

Huxley, L. G. H., and R. W. Crompton, *The Diffusion and Drift of Electrons in Gases*, John Wiley, New York (1974).

McDaniel, E. W., and E. A. Mason, *The Mobility and Diffusion of Ions in Gases*, John Wiley, New York (1973).

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