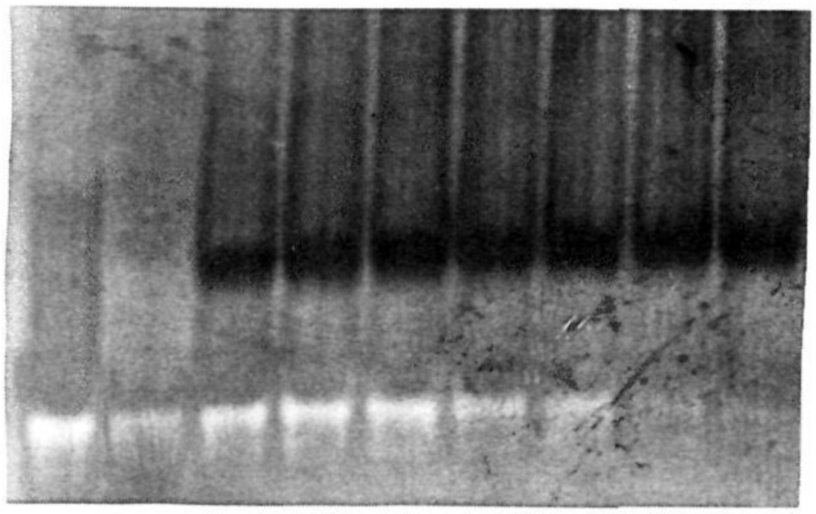
Additions and Corrections

Basic−Helix−Loop−Helix Region of Tal: Evaluation of Structure and DNA Affinity [*J. Am. Chem. Soc.* **1995**, *117*, 8283−8284]. PATRICIA BISHOP, INDRANEEL GHOSH, CORY JONES, AND JEAN CHMIELEWSKI*

Page 8284: Figure 3 did not print well and has been reproduced below.

Lane 1 2 3 4 5 6 7 8 9



← Heterodimer
← Homodimer
← Free DNA

Book Reviews

The Theory of Chemostat: Dynamics of Microbial Competition. Edited by Hal L. Smith (Arizona State University) and Paul Waltman (Emory University). Cambridge University Press: New York. 1995. xvi + 312 pp. $59.95. ISBN 0-521-47027-7.

The decision a 26 year old man made in 1936 on whether to spend a year at the California Institute of Technology or ship out on the research vessel, Pourquoi Pas, helps set the stage for this book's subject. The man was Jaques Monod. His decision to not join the Pourquoi Pas expedition turned out to be a good one for two reasons. First, the Pourquoi Pas sank along the Greenland coast with all hands lost. Secondly, he gained the experience he needed to grow and broaden scientifically which ultimately culminated in his thesis, Recherches sur le croissance des cultures bacteriennes.

Monod's thesis defined microbial growth rate and yield and determined the dependence of growth rate on limiting nutrient (e.g., glucose) concentration. Later, in 1950, Monod independently developed the principle of continuous growth and designed a reactor for elucidating microbial growth kinetics. A fixed volume, well-mixed vessel was provided with a constant in-flow of limiting nutrient while the cells and residual nutrient in the vessel were removed at the same flow rate. Eventually, a steady state (cell growth balances removal rate) could be established, thereby allowing the relationship between sustained cellular growth rate and time-invariant (residual) nutrient concentration to be determined. The relationship he found, now often referred to as the "Monod Model", proved to be a hyperbolic dependence on nutrient concentration akin to enzyme kinetics.

The growth vessel he referred to as the "bactogene" is now commonly referred to as the "chemostat". The chemostat has become an omnipresent apparatus in ecology, microbiology, environmental engineering, and biochemical engineering laboratories. Most chemists and chemical engineers will recognize the chemostat as a variation of the continuous-flow stirred-tank reactor, but with additional constraints. For those who work with microbes, the ability to manage growth conditions and observe the time-dependent behavior of microbes or population constituents allows for physiological, kinetic, and interspecies competition information to be gleaned. Alternately, chemostat experiments provide a means for testing theories or models.

The literature on using the chemostat as a research, production, and model system as well as analyzing the data it provides is widely distributed in biomathematics, ecology, and engineering journals. The different communities utilizing the chemostat and attendant scattering of literature have arisen, in part, due to the different problem statements each community focuses on. For example, an engineer is interested in yield maximization in the "production reactor" whereas stability in a "simple lake model" may be of more concern to some ecologists or microbiologists. However, when viewed with a broader lens, some overlap also exists. For example, a "contamination problem" to a biochemical engineer is equivalent to an ecologist's "competition problem".

Because many communities extensively utilize the chemostat, and as is often the case, interfield communication can benefit from facilitation, the authors have attempted to collect, unify, and synthesize the literature on chemostat theory and microbial dynamics. The framework and language is the mathematics of differential equations and nonlinear systems. Additionally, they have sought to resolve some questions on the generality of some concepts such as competitive exclusion (when one microbe out competes another for a single resource).

The reader will find the book organized much like the way one would study an ecosystem. A chapter will define and investigate a simplified situation. The following chapters then introduce additional factors or relationships to the analysis to see how the prior conclusions hold up. For example, the first chapter, The Simple Chemostat, deals with steady states and competition between two microbes where the simple (Monod) hyperbolic relationship between growth rate and nutrient availability applies. The aim is to arrive at competitive exclusion criteria. The next chapter explores the validity of the ideas deduced from the simpler description, but now assuming that alternative relationships between growth and nutrient availability are operative. The following eight chapters address expansions such as adding a predator to the system (add trophic levels), allowing for spatial nonuniformity, and periodic inputs. The book concludes with New Directions, which include the biotechnical problem of competition between plasmid-free and plasmid-bearing microbes. Finally, six Appendices harbor mathematical details and supplementary background. Within each chapter, there is mathematical development, referral to data when available, and a discussion that boils things down or shows how uncertainties on some problems are or are not resolved. Nomenclature and coaching the reader as to what to read or skip at a given point depending on interest and mission are both handled well.

As with any book, there are omissions and room for improvement. For example, the book is by design, competition/coexistence and differential equation (i.e., deterministic) oriented; hence, readers will not be brought up to speed on stochastic phenomena. The Fokker–Planck equation has, for example, been used to describe how chemostats behave to "white noise" inputs or perturbations which can occur in nature as well as production systems. Additionally, although the scope of chemostat theory is large, chemostat variants such as fed-batch and recycle configurations might be worth considering since they have altered stability characteristics and arise frequently in practice. Concerning format, the abbreviated nomenclature in theorems and proofs is quite readable by mathematicians but could slow down students or those with more applied backgrounds in differential equations.

The authors did provide a "pendulum analysis" caveat meaning that some of the essence can be captured by the analyses, but many other factors still exist. Thus, readers should be aware that, in some cases, the potential applications are mainly demonstrative or only part of the story. The waste treatment example given on p 41 is an example. There, two microorganisms in a chemostat can metabolize a component in a waste stream. A situation may arise where the population exclusion properties may not allow for the contaminant concentration to be controlled at an acceptable (i.e., legal) level. One solution is to add another microorganism. However, in practice, most waste treatment systems recycle cells, which alters interactions and can increase stability. Thus, practitioners may find interesting and useful puzzle pieces, but they may have to extend what is provided to their domain.

Who would benefit from reading book? If you work with microbial systems and contend with dynamic and competition phenomena, this book will serve as a good, concise reference for problems and approaches that are applicable to many fundamental and applied areas. Although some additions could be made, overall, the list of references is quite extensive and covers the engineering, applied mathematics, microbiology/biology, and biomathematics literature. Getting a copy for yourself or in the library would thus be worthwhile. If you teach systematics, applied differential equations, advanced environmental engineering, microbial physiology, toxicology, or biochemical engineering, you may find some of the chapters transportable to classroom lectures. The text could be a useful reference book for advanced undergraduate courses if the instructor provides some guidance. If you have never worked with microbes, but find reactor or reaction dynamics interesting, the biological examples could introduce you to some new areas to explore.

Michael Domach, *Carnegie Mellon University*

JA955166S

The Materials Science of Microelectronics. Edited by Klaus J. Bachmann (North Carolina State University). VCH: New York. 1994. viii + 541 pp. $79.95. ISBN 0-89573-280-7.

This new text on microelectronics manufacturing is another in a line of tutorials aimed at addressing specialized aspects of what is a highly interdisciplinary enterprise. The book is clearly aimed at the material science specialist and may serve as an important reference book for the inorganic chemist's library. The book attempts to provide a bridge between the very specialized world of molecular orbital theory and the practical aspects of material processing in semiconductor manufacturing. In order to accomplish this, the author roughly divides the contents into two halves. The first half deals heavily with the electronic and bonding characteristics of crystalline solids. The second half deals with the minimal requisites of semiconductor manufacturing, namely deposition, lithography, etching, oxidation, doping, and metalization.

The book does sufficiently cover the germane aspects of materials and processing issues of semiconductor manufacturing to say it fulfills the goal of providing a reasonably comprehensive overview of materials science and microelectronics. However, the perspective this book takes would not be suited for the generalist. The author in the first half of the book spends a great deal of time reviewing the last 100 years of development in the theory of atomic structure and bonding. It is a most comprehensive and up to date review of molecular orbital theory, and interesting in that regard. But the comparison between theoretically calculated and experimentally measured density states of Si using nonlocal pseudopotentials, for example, is simply not going to hold much interest for the typical fab engineer. This kind of detail is likely to be relevant only to the advanced inorganic chemist.

Similarly, the author devotes more than 80 pages to the subject of crystal growth. Although this subject contains much interesting information and it is instructive in the principles of detailed chemical balances, the subject is rarely of significance compared to the day-to-day materials problems encountered by engineers making microprocessors in a fab. Simply put, crystal growth is a very small part of the business of microelectronics manufacturing and the author may have appealed to a wider audience if this space had been saved for a more in depth treatment of critical manufacturing steps presented later in the book. For example, there have been significant changes in the past 5 years in the type plasma tools used for plasma processing (a shift from relatively high pressure capacitively coupled discharges to low pressure inductive discharges) and a great deal of activity in the first principle modelings of these systems. The author's treatment of dry etching in general is rather abbreviated and already dated in the above regard. This is unfortunate since a more in depth discussion could have provided a link to the molecular bonding theory of Chapter 2 and the data base requirements of advanced plasma modeling for new reactor design. These types of connections between theory and application capture the tone that the author appears to want to set with the book. This approach is to be commended, but it would have been of wider interest if there were a somewhat more judicious choice of subject matter. Nevertheless, the book is well written and contains a nicely integrated approach to a highly multidisciplinary field. The essentials of device theory, material science, crystalline structure, and process technology are all covered in sufficient depth to make this book a recommended library addition.

Harold M. Anderson, *The University of New Mexico*

JA955194A

Surface Reactions. Springer Series in Surface Science 34. Edited by R. J. Madix (Stanford University). Springer Verlag: Berlin. 1994. xii + 282 pp. ISBN 3-540-57605-3.

This volume is the most recent in a series which has covered a wide range of topics in fundamental surface science ranging from electronic structure and spectroscopy over chemical reactivity to adhesion and friction. The present volume contains seven contributions under the somewhat broad title *Surface Reactions*. In fact, the volume contains only contributions dealing with reactions on metal surfaces, rather than the whole field.

The intent of the editor in assembling this volume was to provide a resource to scientists interested in current research at the atomic level in the area of heterogeneous reactions on metal surfaces. Rather than to put together a set of reviews, Robert Madix has constructed a casebook in which the individual authors develop principles and describe experimental methods as well provide results drawn from their research.

Following a brief introduction by the editor, the first part of the volume consists of chapters on the mechanism of selective oxidation by silver by R. J. Madix and J. T. Roberts, desulfurization by C. M. Friend, alkyne cyclization by R. M. Lambert and R. M. Ormerod, and rearrangement of organic molecules on aluminum by L. H. Dubois, B. E. Bent, and R. G. Nuzzo. This part deals with the breaking of bonds and the rearrangements of adsorbed molecules and reaction intermediates. The final two chapters deal with a different topic, activated adsorption, which is central to an understanding of chemical reactivity at surfaces. The first contribution, by H. A. Michelson, C. T. Rettner, and D. A. Auerbach, deals with the classic case of activated adsorption, the dissociation of the hydrogen molecule on copper surfaces. The second contribution, by C. B. Mullins and W. H. Weinberg, deals with the kinetics and dynamics of alkane activation on transition metal surfaces.

Each of these contributions is written by a leading researcher in the field. Taken together, they provide an excellent picture of the growing maturity of the field. Surface science has progressed in large part through the development of instrumental techniques by researchers. The methods which occur most often in these case studies, namely temperature-programmed reaction spectroscopy, core and valence level photoelectron spectroscopy, vibrational spectroscopy using both photons and low-energy electrons, and isotopic labeling, are clearly presented, and their utility is made clear. The last two chapters illustrate how molecular beam techniques can be used to investigate the complexities of the adsorption event.

A major strength in several of the contributions is the emphasis on connecting the fundamental experiments done on single crystal surfaces under conditions of ultrahigh vacuum with the real world processes which are carried out under very different conditions. This is particularly important for work in surface science where the parallels to technology are both near and difficult to demonstrate. Professor Madix and the individual authors are to be congratulated in putting together a casebook which will serve as an introduction to scientists in related fields as well as a guidebook for practitioners of surface science.

Thomas Engel, *University of Washington*

JA955101P

Jet Spectroscopy and Molecular Dynamics. Edited by J. M. Hollas (University of Reading) and D. Phillips (University of London). Chapman & Hall: London. 1995. xiii + 446 pp. $49.95. ISBN 0-7514-0035-1.

During the last two decades, supersonic jet expansions have come to play an important role in spectroscopic studies of the fundamental properties of chemical systems. It would be impossible to completely review all of the many applications of jet spectroscopy in a single volume, but this book gives a very good overview. The first half of the book appears to be organized according to spectroscopic techniques and wavelength ranges rather than chemical topics. Emphasis in these chapters is given to structure of molecules and molecular clusters. The second half of the book lives up to its name, with excellent articles on rotational and vibrational coherence and internal relaxation dynamics in both molecules and clusters.

The individual chapters have been written by experts and stand alone. Nevertheless greater guidance by the editors would have reduced redundancy and increased coherency of the overall work. There are no introductory chapters, which tends to limit the readership to those already familiar with the use of jets and the various spectroscopic techniques. However, Chapter 2 (by Arno and Bevan) includes a lucid discussion of the principles of supersonic expansion. Introductions to most of the other chapters are probably too advanced for those who are not already familiar with the concepts presented but too brief to give further insight to those with some knowledge of the field. The index of the book appears to be good at first glance, but in using the book, I found that it was not as useful as I had hoped. There are also a disconcerting number of typographical errors, incorrect figures, and errors in equations.

A few chapters lean toward being merely a listing of various techniques or of published studies rather than providing any synthesis of understanding from the various studies nor perspective on different experimental approaches. However, the quality of most articles is high (especially those by Felker and Zewail, Topp, and Arno and Bevan), and overall, the book succeeds in its goal to "convey much of the excitement which has been generated." The book should be a valuable addition to the libraries of spectroscopists working in the area.

Steven R. Goates, *Brigham Young University*

JA955207K

Physical Electrochemistry: Principles, Methods and Applications. Edited by Israel Rubinstein (Weizmann Institute of Science, Rehovot, Israel). Marcel Dekker, Inc.: New York. 1995. viii + 595 pp. $150.00. ISBN 0-8247-9452-4.

This volume presents 11 authoritatively written chapters covering a broad range of electrochemical subjects. Following a brief introduction written by the editor on electrochemical principles and nomenclature, the first three chapters present seminal theoretical discussions on the topics of electron-transfer reactions at metal electrodes (C. Miller), digital simulation (M. Rudolph), and ultramicroelectrodes (C. Amatore). The chapter on digital simulations is an especially important contribution, presenting the first detailed overview of the fast implicit finite difference algorithm employed in recently released commercial software (DigiSim) for simulation and analysis of voltametric experiments. Five chapters of the volume cover experimental techniques employed in electrochemical research: electrochemical impedance spectroscopy (C. Gabrielli), scanning electrochemical microscopy (A. J. Bard, F.-R. Fan, and M. Mirkin), quartz crystal microbalance (M. Ward), synchrotron methods (J. McBreen), and ellipsometry and spectroellipsometry (S. Gottesfeld, Y.-T. Kim, and A. Redondo). Each of these presents a short description of the fundamental principles and instrumentation, followed by recent applications demonstrating the particular strengths of the method. A chapter on molecular and atomic surface layers on well-defined electrodes (A. T. Hubbard, E. Cao, and D. A. Stern) emphasizes the elucidation of voltametric waveshapes using ultra-high-vacuum analytical methods. The remaining two chapters cover electrochemical materials issues: electrode position of II–VI semiconductors (G. Hodes) and electronically conducting soluble polymers (A. F. Diaz, My T. Nguyen, and M. Leclerc). These latter chapters are presented in a more literature review style.

Overall, *Physical Electrochemistry* provides very readable introductions to many active research areas of electrochemistry. However, potential readers should be warned that considerable expertise and existing knowledge in electrochemistry is required to fully digest any of the chapters. Each chapter is supported by extensive lists of references (more than 1200 in the text), although in many chapters, the literature is covered only through 1992.

Henry S. White, *University of Utah*

JA955182P

Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life. Edited by Wolfgang Kaim and Brigette Schwedrski (Universitat Stuttgart). Wiley & Sons: Chichester, U.K. 1994. xii + 401 pp. $39.95. ISBN 0-471-94369-X.

The several introductory bioinorganic textbooks that have recently become available are gratefully welcomed by those who have long been teaching such courses from original sources and reviews. In all such texts, the organization of the material is a difficult undertaking as it spans a broad range of chemistry and biochemistry. Designed as a two-semester text, the coverage of this text is broader than necessary for the more common one-semester courses. However, it does provide a single, convenient, and reasonably current (1993) source for most topics that might be covered in a bioinorganic course. While perhaps the most comprehensive text at the introductory level, it is not as didactically well organized as *Principles of Bioinorganic Chemistry* by Lippard and Berg nor does it have its visual appeal. After a short chapter on historical background and an eclectic chapter on chemical principles, the body of material is launched with a chapter on cobalamins followed by one on photosynthesis, which most students may find bewildering at the outset. It might have been better to lead in with a conceptually more straightforward chapters, such as the one on iron uptake followed by that on oxygen binding, transport, and storage. The chapter on electron transfer and oxygen activation in hemoproteins would then follow easily in sequence with the one on iron–sulfur and nonheme iron proteins. In general, individual chapters are well presented and adequately illustrated. As in other texts, important physical methods are covered in a synoptical fashion in conjunction with the study of individual proteins. Most of the book is organized around elements with separate chapters for proteins involving Ni, Cu (Mo, W, V, and Cr), Zn, electrolytes, Mg, and Ca regulation of bioenergetic processes, biomineralization (B, Si, As, Br, F, I, and Se), toxic metals, radionuclides and metallopharmaceuticals. Each chapter is well referenced. As a text for courses in bioinorganic chemistry, it merits serious consideration. The reasonable price of the paperback edition also makes it desirable as a general reference for current bioinorganic topics.

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JA955117F

Sol Gel Processing and Applications.. Edited by Yosry A. Attia (TAASI Corporation). Plenum Press: New York. 1994. xii + 394 pp. $115.00. ISBN 0-306-44837-8.

Several topics are developed in this book, from sol formation to aerogels and their applications. Since most of the topics are not on an elementary level, this book can serve as a very good reference for readers already involved in sol–gel research but is perhaps not the right book for the chemist who is not yet familiar with sol–gel chemistry.

This book is a very welcome contribution to the vast literature which already exists on sol–gel chemistry. It covers extensively the application of sol–gel technology. Its emphasis on the technology of the sol–gel process, combined with the large number of references provided, makes it a very valuable volume for industrial as well as academic researchers.

Azzedine Bensalem, *Long Island University*

JA9551852