Saucers Full of Secrets?

Handbook of Ceramic Hard Materials. Vols. 1 + 2. Edited by *Ralf Riedel*. WILEY-VCH, Weinheim 2000. 1020 pp., hardcover DM 598.00 (ca. 305 €).—ISBN 3-527-29972-6

Extremely hard ceramics are essential for the effective industrial processing of hard materials. During the last few decades the search for ever harder materials has produced much new knowledge, which is presented here in an impressive way in the two-volume work *Handbook of Ceramic Hard Materials*. The editor, Ralf Riedel, has set out not only to describe the present state of research in this field but also to explain the fundamental principles in detail. It soon becomes evident to the reader that to understand the complex area of hard materials it must be viewed within the larger context of chemistry, physics, materials science, and engineering.

The work is arranged in three parts. First, about two-thirds of Volume 1 is devoted to the structure and properties of hard ceramic materials. This is followed by a description of their synthesis and processing. Volume 2 then presents a detailed survey of typical areas in which they are applied.

In his introductory chapter, "Novel Ultrahard Materials", Riedel comes straight to the point with a clear and concise description of the hardest materials that currently exist. Diamond, unchallenged in the top place, is followed by cubic boron nitride, c-BN, and by boron carbide, B_4C (which can be used at temperatures up to and beyond 1100 °C in nonoxidizing atmospheres), and these three set standards against which many of the materials subsequently described are measured. The possibility of finding a material harder than diamond is a (usually unstated) recurring thought throughout the first two parts of the work. Here the author does not keep the author in suspense very long on this question—he explains the claims of the potential candidate C_3N_4, while also discussing the possibility that this compound may be ruled out by a low thermodynamic stability. In this connection the question of the definition of hardness, and the limitations of the concept in relation to comparable quantities (such as bulk modulus), is answered comprehensively.

Part one is opened by Jeitschko, Pöttgen, and Hoffmann with a chapter on structural chemistry as a basis for hardness. Starting with diamond and structurally related substances, the most important ceramics (silicon, boron, and metal carbide, nitridic and oxidic ceramics) are described with their solid-state structures. A short contribution to amorphous hard materials gives an overview of a topic, where structural aspects are difficult to describe. In the following phase transformation, mechanical properties, microstructure, nanostructuring, corrosion, and grain boundaries are discussed. The first part is closed with an extensive contribution about transition metal carbides, nitrides, carbon nitrides, a part about calculated modeling of new structures based on semi-empirical and ab initio methods, and calculations for the effective doping of sp^2-bonded carbon allotropes.

The second part of the work deals with synthesis and processing, beginning with the oxidation of metals and the high-temperature synthesis of novel hard materials. It also covers the latest developments in the area of hydrothermal synthesis and the vapor-phase deposition of synthetic diamond and c-BN films, as well as processes for converting suitable polymers into ceramics.

The third part (Volume 2) describes the technical applications of some of the most important ceramics discussed in Volume 1. The first chapter, which describes (in 92 pages!) the many different areas of application of diamond and cubic boron nitride, is excellent, with a good systematic arrangement of this large subject, and many figures to illustrate the very interesting text. This is followed by chapters on carbon films with a diamond-like structure, and ceramics based on Al_2O_3, SiC, Si_3N_4, and boron. The volume ends with a discussion of the hardness of tungsten carbide, and a compilation of data on the properties of hard materials.

The 24 chapters are the work of 57 authors altogether. As a consequence of this large number, the topics of some of the chapters are rather closely related, leading inevitably to some overlapping. For example, the concept of hardness is discussed in detail in several chapters, as also are the structural variations of diamond, and one's first reaction is to criticize such repetitions. However, on closer reflection it would have been wrong to eliminate these instances of overlapping, because the different facets presented by the chapters combine to give a rounded whole, and also the reader benefits from the authors' different points of view. Thus, this is not purely a work of reference.

The work offers a refreshing overview of the field of hard ceramics, including the necessary fundamentals. The specialist areas are presented concisely and informatively, enabling the interested

reader to get a wide-ranging and up-to-date overview without losing sight of the basic essentials. This is helped by the well arranged list of contents, the excellent layout, and the comprehensive bibliography at the end of each chapter. The work is suitable for everyone with an interest in this field, admirably fulfills the expectations raised by its title, and should be available in every well-equipped library.

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X-Ray Characterization of Materials. Edited by *Eric Lifshin*. WILEY-VCH, Weinheim 1999. xiv + 261 pp., 142 figs., 19 tables, hardcover DM 248.00.—ISBN 3-527-29657-3

As is evident from the title, this book edited by Eric Lifshin is devoted to the interaction of X-radiation with condensed matter, and its application to obtaining information about structure and properties. It consists of four chapters giving a very comprehensive overview of this broad subject, from the fundamentals to the present state of the art. The chapters have been written by well-known experts in their special fields.

The chapter on X-ray diffraction begins with an introduction to the subject, such as one also finds in standard textbooks. The aspects covered include the X-ray generator, the different ways in which X-ray photons can interact with the electron shell of atoms, the principles of X-ray detectors, the basics of crystallography, and diffraction by a crystal. The rest of the chapter is devoted to a detailed description of powder diffractometry. There is an excellent and detailed discussion of how the diffractogram is affected by factors such as system geometry, recording time, crystallite size, texture, and stress in the sample. The causes that can produce a diffraction pattern of a given shape are explained, as also is the mathematical formalism needed for describing the shape of a pattern. Towards the end of the chapter comes a description (rather too detailed) of different approaches to the quantitative phase analysis of materials. It must be emphasized that X-ray diffraction by single crystals is only touched on in passing in this book. The reader wishing to learn about single-crystal structure analysis (phase problems, direct methods, etc.) should look elsewhere in the literature.

Chapter 2 shifts away from the "DIY" sources that generate X-radiation within the user's laboratory, and concentrates instead on synchroton radiation. After briefly describing the construction of a storage ring and discussing the advantages and disadvantages of synchrotron radiation, the chapter presents an interesting and varied selection of examples of the use of such radiation. These range from studies of the fine structure of X-ray absorption edges (EXAFS, etc.), through high-resolution powder diffraction measurements, to the more exotic techniques of X-ray standing wave spectroscopy and X-ray topography. The large variety of examples gives a good impression of the versatility of synchrotron radiation, and may provide the reader with ideas for solutions to specific problems.

In Chapter 3 there comes a break in the continuity of the book. Whereas the first two chapters (and also the fourth) are mainly concerned with diffraction and the interpretation of interference phenomena, this chapter is devoted to X-ray spectroscopy. It begins with yet another complete introduction to the generation of X-radiation and its interaction with matter. This unnecessary overlapping with Chapter 1 could have been avoided by having one general chapter covering the fundamentals. Apart from that criticism, the chapter contains a clear description of qualitative and quantitative elemental analysis and the use of reference substances, which is easily understood and requires no special previous knowledge. This is followed by a discussion of random error statistics, limits of detection, and trace analysis. In contrast to the previous chapter, no examples are presented.

The last chapter is devoted to small angle scattering, and is therefore linked to Chapter 2. Small angle scattering is a very useful method that has been well established for many years, especially in polymer research, metallurgy, and even biology. Measurements with very small X-ray scattering angles mainly give information about periodic variations of density in the material under study, with a spatial resolution down to 100 nm. (However, in the case of neutrons with longer wavelengths it is not necessary to use such small scattering angles). This technique, which is not so routinely used as those described earlier, is described thoroughly and carefully, although the first part is very theoretical. The chapter is completed by various examples of the use of the method, such as studies of the mixing properties of organic polymers in the melt, and phase separation in alloys. The subject of small angle scattering is, of course, not limited to the case of X-radiation, and therefore the chapter also covers neutron scattering. In that respect the chapter departs slightly from the book's title.

Having thus outlined the contents of the book, we need to ask who will benefit from it. Its suitability as a textbook is limited, as the fundamentals are not treated thoroughly enough to convey a deeper understanding. It also seems unsuitable as a practical introduction to using the various methods. On the other hand, it gives good descriptions of modern X-ray techniques for obtaining structural information, at a level that is quite ambitious but mainly easily understandable, and includes the essential mathematical formalism. It is mainly suitable for advanced science students and for scientists other than X-ray specialists, who wish to obtain an overview of modern X-ray methods, or who need an introduction to special aspects of X-ray diffraction or X-ray spectroscopy. The book contains a wealth of references to other monographs and primary literature, so that the interested reader can explore special topics in greater depth. Unfortunately, the book is not very suitable for reading through continuously; users are more likely to concentrate on selected chapters. To produce an integrated and self-consistent work on the subject would require much better matching of the chapters with regard to content, style, and level of treatment.

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Phosphorus 2000. Chemistry, Biochemistry and Technology. By *Derek E. C. Corbridge*. Elsevier, Amsterdam 2000. 1267 pp., hardcover $ 573.50.—ISBN 0-444-82550-9

Phosphorus 2000 is an ambitious title for a book and raises high expectations. Is the aim of this book to give an account of the history of the element phosphorus, or to review the most recent developments in phosphorus chemistry, or to set out the basis for the further development of this large area of chemistry during the next century? In his preface the author, Derek E. C. Corbridge, sees it as an "end of century overview of the whole subject", and explains that it originates from the fifth edition of his book *Phosphorus: An Outline of its Chemistry, Biochemistry and Technology*. In fact it can be regarded as a sixth edition of that work. It has been extended and reorganized in various respects, but the main difference is the increase in content, not necessarily in the number of pages but in the density of the printed text, as it now appears for the first time in a typeset version. This gives it a much more attractive appearance than the fifth edition, which was reproduced directly from typescript and was less easy to read. However, the revision is not yet complete, as many tables, figures, and schemes have been taken over directly from the previous editions, with numerous special symbols and diagrams drawn by hand.

The chemistry of phosphorus is now so extensive that to treat it within the space of 1267 pages is certainly a difficult undertaking. Nevertheless, the coverage of the subject in *Phosphorus 2000* is remarkably wide-ranging, and that must certainly be seen as the book's greatest strength. It introduces the field with a historical survey, describes the occurrence of phosphorus in nature and its atomic and molecular properties, then treats the different classes of phosphorus compounds in turn (phosphides of nonmetals, then compounds of phosphorus with oxygen, carbon, nitrogen, metals, and lastly other p-block elements). Biopolymers and the biochemistry of phosphorus are covered in 170 pages, then almost 250 pages are devoted to applications of phosphorus and its compounds, followed by a short chapter on analysis and characterization and an appendix consisting of tables and notes. The author has succeeded well in linking the various topics by means of cross-references, so that the reader gains, almost accidentally, much knowledge of a sort that is not covered adequately in more-specialized monographs.

Which groups of readers will benefit most from this broad survey of the chemistry, biochemistry, and technology of one element? Everyone who wishes to learn about a particular area of phosphorus chemistry without, however, neglecting its wider connections. That means all research scientists, technologists, and teachers who are concerned in one way or another with phosphorus chemistry, and seek information about some particular aspect. The chapters of the book offer easy access to the world of phosphorus chemistry, as they give a wealth of references, mainly to the secondary literature and review articles, but also to some original publications. The choice of subject matter is good, as it avoids concentrating unduly on currently fashionable trends which may be only short-lived, while most space is devoted to areas that have been well researched and where results have been confirmed. There are quite a few instances where the treatment is unnecessarily long, for example in the introduction to the chemistry of biopolymers.

The title *Phosphorus 2000* suggests that the book presents the current state of knowledge. One cannot expect a book covering such a broad field to include every detail of advances in the last few years, but some of the chapters contain material that is not up-to-date. For example, at the beginning of the book the author continues to introduce the concept of the $p_\pi - d_\pi$ bond and uses it frequently, without explaining the modern theoretical treatment of bonding in hypervalent compounds or mentioning the relevant publications. In many cases where corrected data have recently been published, especially relating to molecular structures, these have not been included. On the other hand one finds examples such as a reference to cyclic N_6 or speculation about P_5^+, merely on the ground that the homologous N_5^+ has recently been discovered. An example from the end of the book: in the chapter on ^{31}P NMR spectroscopy, although formulas for calculating chemical shifts of phosphaalkynes from the ^{14}N or ^{15}N NMR chemical shifts of the homologous nitriles are given, there is not a single word about multidimensional ^{31}P NMR spectroscopy. Some short chapters on rather specialized topics such as X-ray structural analysis have been included, presumably with the well-intentioned aim of completeness, but these are likely to be of very limited use to the reader.

The text contains many errors that should have been prevented by proper editorial work in a scientific publishing house such as this. As well as the more trivial slips and printing errors there are obvious mistakes in tables, missing footnotes where these were signaled in the text, and especially errors in literature references. The most common faults in the latter are incompleteness, errors in authors' names (especially non-English ones); sometimes it is impossible to find the publication referred to, and a standardized style of citation is not maintained. Often references are grouped together at the beginning of the chapter after the title, but not repeated in the text, so that one has to look up several references to find which one relates to a topic of interest. The practice of citing chapter-by-chapter leads to redundancy, which could have been avoided in favor of more directly relevant primary citations.

Despite these criticisms, *Phosphorus 2000* is a remarkable achievement, and I do not know of any other monograph that covers the field of phosphorus chemistry so comprehensively in a single volume. If one is prepared to ignore the weaknesses and cannot find any secondary source covering one's area of interest, *Phosphorus 2000* certainly qualifies as a comprehensive reference source for the field as a whole. However, due to the high price (one dollar per sheet of paper!), some readers will perhaps prefer the alternative of buying several more specialized and more up-to-date works, with a total cost about the same or even less.

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Organic Conformational Analysis and Stereochemistry from Circular Dichroism Spectroscopy. By *David A. Lightner* and *Jerôme E. Gurst*. (Series: Methods in Stereochemical Analysis.) WILEY-VCH, New York 1999. xiii+487 pp., hardcover £61.50.—ISBN 0-471-35405-8

150 years of stereochemistry also means 150 years of chirality! In 1848 Pasteur reported for the first time his simple experiments with crystals of sodium ammonium tartrate, which the polarimeter showed to be of different types. What a stroke of genius it was, to see the connection between the opposite optical rotations and the mirror-image structures of the crystals and their constituent molecules! And what far-reaching developments in our understanding of the three-dimensional structures of molecules were inspired by this idea! Nowadays these concepts are an essential part of every basic chemistry course: the asymmetric carbon atom model of Van't Hoff and Le Bel, Emil Fischer's "cathedral" of sugar molecule conformations (and his stroke of luck in correctly assigning the foundation structure), and the first experimental determination of an absolute configuration by Bijvoet. Chirality still continues to exercise the same fascination. When a structural model predicts that nonidentical mirror image forms can exist; when one even succeeds, by whatever means, in separating material which is actually the same into two halves; and when finally one achieves a preliminary assignment by means of a chiroptical measurement, namely, by polarimetry or by measuring the circular dichroism (CD): there can be no more direct manifestation of the three-dimensional structure of a molecule than its chirality. And in our era of supramolecular chemistry, bioorganic chemistry, and bioinorganic chemistry, no other concept in stereochemistry is as topical as this!

Thus, this book by Lightner and Gurst is certainly in tune with the times. It is a volume in a continuing series, *Methods in Stereochemical Analysis* (series editor: A. P. Marchand), and describes the application of CD spectroscopy to elucidating stereochemical details for ten different classes of compounds. In principle the CD spectrum of a molecule enables one to determine the absolute configuration. Moreover, conformational changes induced by changing the solvent or temperature alter the CD spectrum. However, although it is easy enough to record a CD spectrum, its interpretation is not straightforward. It is a representation of the three-dimensional structure of the molecule, but in an obscurely coded form. Thus, even today we often do not know why the CD of one absorption band is positive while that of another is negative, despite approaches based on quantum-chemical calculations, the Rosenfeld equation, or sector rules. In any case there are differences depending on the type of compound being studied. The interpretations are most reliable for bichromophoric compounds, in which the CD effect arises from the interaction of localized electronic transitions. This method, sometimes called the exciton method, has gained popularity through the book by Harada and Nakanishi. It is nonempirical, and gives an unambiguous assignment of the absolute configuration, provided that a good structural model exists. There is a growing number of examples of applying ab initio quantum-mechanical calculations to compounds with an inherently chiral chromophore, such as a helix or a twisted double bond system. The development of CI and DFT methods and the availability of better computing facilities are likely to yield many new and more reliable results in the near future.

In their monograph Lightner and Gurst concentrate their attention mainly on the third class of chiral compounds, in which a normally symmetrical chromophore is asymmetrically distorted, and they choose those with a carbonyl group as examples. In these compounds the chirooptical properties arise from the fact that the chromophore is chirally distorted by its environment. Thus the chromophore is in effect a sort of window through which the spectroscopist looks into the molecule. In contrast to the two other classes of compounds mentioned (bichromophoric and inherently chiral), theoretical methods only yield a very limited amount of information in this case, since in order to learn more one would need a very precise description of the wave function of the entire molecule, which is not possible at present (one need only think of the extreme case where the chirality of the molecule arises solely from an isotopic substitution). Here instead one must rely on the so-called sector rules, which are three-dimensional interpolation schemes, whereby the spatial disposition of "distorting" substituents relative to the chromophore is translated into a contribution to the circular dichroism. This method works best when the structure of the molecule is known and an adequately large data base exists, making this kind of interpolation possible. The wealth of data that the authors have compiled and discussed here becomes apparent when one scans through the pages of this carefully prepared volume and finds such a vast number of tables and reproduced spectra. The text contains about 800 literature references, and an index of CD spectra lists about 500 that are reproduced or discussed in the text.

The types of compounds treated range from substituted cyclohexanones (for which the octant rule is discussed in detail) and other cycloalkanones, through bi- and polycyclic ketones, to isotopically substituted ketones and diketones. The compilation is completed by unsaturated ketones, dienes, and biaryls, for which the sector rules encounter difficulties because of the increasing delocalization of the chromophore. The authors also provide an outline of the exciton theory, presumably for completeness. A short chapter on optical activity gives a phenomenological explanation of optical rotatory dispersion and of circular dichroism, and some useful hints for interpreting a spectrum.

Of course one cannot write about conformational analysis without discussing dynamic NMR data, as CD spectroscopy cannot give quantitative data about dihedral angles. In contrast to the experimentally time-consuming analysis of molecular fragments, the latter gives instead a picture of the whole molecule, resulting in an ideal combination.

X-ray structural analysis—including the determination of absolute configuration—has now become a routine procedure, and it has been said (though in questionable taste) that crystals are chemical graveyards (Ruzicka, cited by Heilbronner and Dunitz)—their dynam-

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ic processes, which might be called the fourth dimension of molecules, only get going when the solution state is reached. Thus chiroptical methods are just as important nowadays as they were 25 years ago, even for the nonspecialist.

In this book molecular structures are regularly discussed on the basis of geometries calculated using the program PCMODEL, and this illustrates the powerful capabilities of force field programs in combination with a PC for compounds of this kind, at least for estimating the magnitude of the force field, or for deciding whether the method is applicable to the system being studied.

This is not a textbook, as the depth and detail of the treatment would be inappropriate in a textbook. It is a book to be used for reference, and it complements the work by Harada and Nakanishi mentioned earlier and the CD-monograph by Nakanishi, Berova, and Woody, by providing more information and detail about the capabilities of CD spectroscopy. It is a must for libraries and for all research groups engaged in experimental or theoretical work in this area.

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Catalysis from A to Z. A Concise Encyclopedia. Edited by *Boy Cornils, W. A. Herrmann, R. Schlögl* and *Ch.-H. Wong*. WILEY-VCH, Weinheim 2000. 640 pp., hardcover DM 398.00.—ISBN 3-527-29855-X

In this work of reference some well-recognized experts in heterogeneous and homogeneous catalysis and biocatalysis from academia and industry have taken on the difficult task of collecting together in a concentrated form the fundamental principles, important concepts, definitions, methods, reactions, and techniques of the whole field of catalysis. The editors, leaders in the area, are highly competent. They have brought together a team of 165 internationally respected scientists to prepare this encylopedia, which defines and explains all the most important and essential catalytic terms, collected under about 3000 headings.

As pointed out in the introduction to the work, catalysis is involved in almost every area of science and technology. Over the years these various disciplines have developed different terminologies, which even now still hinders the understanding between them and the sharing of knowledge. Therefore a comprehensive and multidisciplinary survey of present knowledge, technology, and definitions of terms, with up-to-date explanations of catalytic principles, ranging from heterogeneous catalysis to the life sciences, was long overdue.

The terms used in the area of fundamental principles are explained in detail and amplified by diagrams and illustrations. Abbreviations, acronyms, and terms that are used in the different areas of science and technology are explained precisely, as also are named reactions, mechanisms, and chemical structures. Although the explanations of technological processes are limited to the essentials because of the vast number of topics covered, the carefully prepared text and process schemes provide the reader with all the necessary basic information. The same also applies to modern methods of characterization, to basic reaction kinetics, to screening methods and catalyst preparation, and to the principles of reactor engineering. The many drawings and the schemes showing catalytic reaction cycles are very helpful, as also are the synonyms and cross-references. There is also information about important people, the size of the market for different products, and the historical development of catalysis. The articles are completed by French and German translations of technical terms and by lists of references for further reading.

The information contained in this work of reference goes far beyond the level of a dictionary, as great care has been devoted to the accuracy of the definitions and the thoroughness of the explanations of basic principles. For the first time there is now a comprehensive and reliable standard work which offers information in a compact and easily accessible form, and also provides a picture of developments and advances in catalysis. It will make an important contribution to improving understanding between different disciplines, and it should be made available to everyone working on scientific or enginering aspects of catalysis. For advanced students especially it offers an excellent overview of the field and will help them to become involved in interdisciplinary studies. In view of the pace of research and the rapid development of new methods and processes, it is likely that further updated editions taking into account advances in catalytic research will be needed. It would be highly desirable to have such a work of reference in CD-ROM form, with appropriate updates, and also for the price to be reduced to make this important standard work accessible to a wide readership.

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Rhodium Catalyzed Hydroformylation. Edited by *Piet W. N. M. van Leeuwen* and *Carmen Claver*. (Series: Catalysis by Metal Complexes, Vol. 22.) Kluwer, Dordrecht 2000. xii + 284 pp., hardcover $ 125.00.—ISBN 0-7923-6551-8

The long-running Kluwer Series *Catalysis by Metal Complexes*, the first volume of which appeared in 1976, has now reached Volume 22. In it Piet van Leeuwen, a renowned specialist in the field of oxo chemistry and its various ramifications, and co-editor Carmen Claver present a progress report on hydroformylation using rhodium catalysts, a subject that has long needed such an update. From the preface one already guesses that the contents will reflect van Leeuwen's special interests, and the titles of the chapters confirm that: they include ligand effects (phosphane and phosphite ligands), characterization of catalysts, asymmetric hydroformylations, catalyst preparation, and catalyst degradation (all these chapters having been written by van Leeuwen and colleagues). Other chapters are concerned with the synthesis of fine chemicals (by a Spanish group), with aqueous two-phase catalysis (by authors from Ruhrchemie, where this method has been developed into an industrial process), and with the process technology of rhodium-catalyzed hydroformylation (by Arnold of Shell).

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The discussion of ligand effects in rhodium-catalyzed hydroformylation is impressive and instructive, treating the topic thoroughly and from different standpoints. It is especially useful when read in combination with Chapter 2 on the use of unmodified rhodium catalysts. It is also relevant that the historical survey in Chapter 1 begins not with the central atom (as expected from the title) but with the "History of Phosphorus Ligand Effects". Surprisingly, however, the first rhodium oxo-reaction patent (Schiller, 1956) is not mentioned in Chapter 1, but in Chapter 2. One is also surprised to find no reference to the book *Carbon Monoxide in Organic Synthesis* by Falbe, which was published in 1970, before rhodium catalysts were used in industrial oxo syntheses, and is therefore above suspicion as a witness. The subject of asymmetric synthesis is not mentioned at all in Falbe's book of 1970, and even in the more recent version (*New Syntheses with Carbon Monoxide*, 1980) is only referred to briefly. One of the strengths of the book by van Leeuwen and Claver is that it describes examples of the development of ligands for asymmetric hydroformylation. Also the chapter on "Hydroformylations in Organic Synthesis" rightly emphasizes regio- and stereoselective syntheses, in discussions backed up by interesting examples and literature references.

Chapter 8, "Process Aspects of Rh-Catalyzed Hydroformylation", is of particular interest for readers with a practical interest in the subject. Among other aspects, the chapter discusses the economics of such processes. It includes an interesting calculation (presumably the author's own work, as no literature reference is given) for a manufacturing process (product not specified) in which rhodium loss must account for no more than 1 % of the overall cost. This means that one must achieve a TON value of at least 4.3×10^6—an interesting method of calculation giving a result that is not entirely incorrect! Apart from cost aspects (including a highly speculative guess at the effect of changes in the price of rhodium over a 30-year period, giving an increase by half an order of magnitude!), the special value of this chapter lies in the discussion of process design considerations for a rhodium-catalyzed oxo synthesis, even though the table "Survey of Commercial Applications..." is lacking in some fine details. Chapter 10, "Novel Developments in Hydroformylation", is also interesting and detailed. As well as catalysts with two metal atoms (restricted, however, to Rh–Rh carbonyl clusters, and omitting reference to the work of Süss-Fink in Neuchâtel), the chapter covers the new and not yet technically developed areas of micellar catalysis, the SAPC concept, supercritical and "fluorous" liquids, and various aspects of heterogenized rhodium catalysts (dendrimers, cyclodextrins). One notices, however, that the topic of NAILs (non-aqueous ionic liquids) is not mentioned!

The book certainly treats the subject from a remarkably wide variety of viewpoints, but also very selectively in some parts. One of the "blind spots" is the neglect of the "UCC viewpoint", and therefore of the technology of the LPO process, which (as also in all the available literature on rhodium-catalyzed oxo processes) is not given enough attention, although that is certainly partly due to deliberate secrecy. Similarly Chapter 8, on the hydroformylation of higher olefins using rhodium catalysts according to the UCC principle, is limited to plans and announcements of intended commercialization. The hydroformylation of propylene using unmodified rhodium catalysts (*n*/*i* ratio approximately 1) should also have been covered, even though (as on p. 216) a complaint is made about the excessive selectivity of aqueous catalyst systems for producing *n*-butyraldehyde. It is also unfortunate that (except in Chapter 8 and in van Leeuwen's introduction) only a few references to patents are given. Anyone familiar with the literature on oxo reactions knows that most of the technological advances are to be found in patents.

However, these details, although of vital interest to practitioners in the area, do not detract from the value of the book as an up-to-date source of information on this very active field of research and development, which is a fascinating playground of homogeneous catalysis offering enormous variety.

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Iron Metabolism. Inorganic Biochemistry and Regulatory Mechanisms. Edited by *Glória C. Ferreira, José J. G. Moura,* and *Ricardo Franco.* WILEY-VCH, Weinheim 1999. 379 pp., hardcover DM 268.00 (ca. 137 €).—ISBN 3-527-29653-0

This book stems from a conference on iron metabolism organized by the editors of this book in 1998 in Portugal, which assembled experts from different fields who work on the many aspects of iron metabolism. The 21 chapters of this book cover the subject ranging from structure/function studies to gene regulatory mechanisms. Topics covered include: iron transport, regulation, and storage, heme biosynthesis, new roles for iron-sulfur proteins, redox regulation of signal transduction, oxygen activation at nonheme diiron centers, and iron-mediated gene expression. The 60 authors in this book include microbiologists, molecular biologists, inorganic biochemists, spectroscopists, and crystallographers. The book provides a broadly based examination of the subject matter to help readers assess the current status of the field and identify new directions and problems to be tackled. Thus it is useful not only for current investigators in the field and related areas, but also for novices desiring a broad and up-to-date description of the impact of iron chemistry in biology. This book has many excellent features, and hence will remain a valuable resource for many years to come.

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