signal. A practicable value is 100 μm. Thus microscopic resolution is not achievable, but other properties of solid materials varying on a macroscopic scale now seem to become amenable to investigation. Examples are the material's response to nonlinear mechanical wear, crazing, locally controlled polymerization, crystallization, and self-organization of molecular segments as well as strain, heat conductivity, convection and diffusion in composite materials.

Bernhard Blümich
Max-Planck-Institut für Polymerforschung
Mainz (FRG)

[1] F. W. Wehrli, D. Shaw, J. B. Kneeland (Eds.): *Biomedical Magnetic Resonance Imaging; Principles, Methodology and Applications*, VCH Publishers, New York 1988; P. Mansfield, P. G. Morris (Eds.): *Adv. Magn. Reson. Suppl. 2*, Academic Press, New York 1982; P. G. Morris: *Nuclear Magnetic Resonance Imaging in Medicine and Biology*. Clarendon Press, Oxford 1986; K. Roth: *NMR-Tomographie und -Spektroskopie in der Medizin*, Springer, Berlin 1984.

[2] W. A. Ellingson, J. L. Ackerman, L. Garrido, J. D. Weyand, R. A. diMilia, *Ceram. Eng. Sci. Proc. 8* (1987) 503; L. Garrido, J. L. Ackerman, W. A. Ellingson, J. D. Weyand, *Proc. Conf. Comp. Adv. Ceram.*, 18-20 January 1988, Cocoa Beach, FL, USA.

[3] W. P. Rothwell, D. R. Holecek, J. A. Kershaw, *J. Polym. Sci. Polym. Lett. Ed. 22* (1984) 241.

[4] S. Blackband, P. Mansfield, J. R. Barnes, A. D. H. Clague, S. A. Rice, *SPE Form. Eval. 1* (1986) 31; L. D. Hall, V. Rajanayagam, C. Hall, *J. Magn. Reson. 68* (1986) 185.

[5] J. L. Ackermann, application note, Doty Scientific Instruments, Inc., Columbia, SC, USA, 1988.

[6] B. H. Suits, D. White, *J. Appl. Phys. 60* (1986) 3772.

[7] P. O. Frickland, *Int. SAMPE Tech. Conf. 18* (1986) 876.

[8] J. L. Ackerman, D. P. Raleigh, R. G. Griffin, M. J. Glimcher, *Soc. Magn. Reson. Med., 6th Annu. Meet.*, New York 1987.

[9] U. Haeberlen: *Adv. Magn. Reson. Suppl. 1*, Academic Press, New York 1976; M. Mehring: *Principles of High Resolution NMR in Solids*, Springer, Berlin 1983; B. C. Gerstein, C. Dybowski, *Transient Techniques in NMR of Solids*, Academic Press, New York 1985.

[10] P. Mansfield, P. K. Grannell, *Phys. Rev. 12* (1975) 3618.

[11] J. B. Miller, A. N. Garroway in D. O. Thompson, D. E. Chimenti (Eds.): *Review of Progress in Quantitative Nondestructive Evaluation*, Plenum Press, New York 1988, p. 287.

[12] R. A. Wind, C. S. Yannoni, US-Pat. 4301410 (17 November 1981), IBM; D. G. Cory, J. W. M. van Os, W. S. Veeman, *J. Magn. Reson. 76* (1988) 543; D. G. Cory, A. M. Reichwein, J. W. M. van Os, W. S. Veeman, *Chem. Phys. Lett. 143* (1988) 467; S. Matsui, K. Sekihara, H. Shiono, H. Kohno, *J. Magn. Reson. 77* (1988) 182.

Book Reviews

Corrosion of Materials

DECHEMA Corrosion Handbook: Corrosive Agents and their Interaction with Materials, Volume 1. Edited by *D. Behrens*. VCH, Weinheim 1987, 333 pp., bound, DM 775.00.—ISBN 3-527-26652-6

Materials scientists have developed a huge number of technically important materials based on metals, inorganic and organic compounds and composites, suitable for applications which are sometimes very specific. One criterium for choosing a material for a given technical use is its corrosion behavior. However, the prediction of corrosion properties is a rather difficult task due to the complex nature of corrosion processes, involving in a typical case a metallic substrate, a corrosive medium, the hydrodynamic properties of the medium, and the geometric properties of the construction itself. Therefore, a *Corrosion Handbook* collecting together the vast literature and knowledge in this area is highly welcome.

The DECHEMA Corrosion Handbook—a series of at least twelve volumes is planned—is a completely new English edition of the DECHEMA-Werkstoff-Tabelle. The chapters are arranged according to the aggressive media, but instead of being arranged alphabetically these are treated in an apparently random order. Each chapter, which reviews the data concerning one medium, is divided into metallic materials, non-metallic inorganic materials, organic materials and materials with special properties. In this first volume metallic materials predominate. At the beginning of each chapter all materials are classified in a table according to their corrosion properties in the given medium; following this table a detailed description of their corrosion behavior is given. Owing to the very different technical applications for the different materials in the given medium, the ratings in the table may be misleading, if the detailed description is not taken into account. For example, in the chapter "Chlorine" the material gold is classified from resistant to unsuitable due to the fact that on the one hand the contact resistance of Au contacts is high in chlorine atmospheres, whereas on the other hand Au has only limited resistance to high temperature corrosion. In the same table high alloy cast iron is classified as fairly resistant, yet in the detailed description it is stated that not much literature is available about the corrosion of this material in chlorine atmospheres, and therefore the rating is based only on very specific applications.

It is therefore essential for the user of this handbook to read and understand the detailed description and not to rely on the ratings in the well presented tables by themselves. In order to understand the data presented in the different chapters, the reader needs to have a sound background in corrosion science, as the handbook offers only very limited background information concerning the basic mechanisms of corrosion processes. As some interested users might not have this background in electrochemistry or physical chemistry of solids, the reviewer would have liked the first chapter "General remarks and instructions for use" to contain much more information than the one page can offer to the reader. In this chapter only corrosion rates are classified, by which the different materials are evaluated. There is a lengthy explanation of how to convert rates given in g/m^2d into mm/y (with some mistakes: the symbols < and > are mixed up, the comparison of light and heavy metals is wrong), yet no information is provided concerning the different types of corrosion (general corrosion, and localized corrosion such as pitting corrosion, grain-boundary attack, crevice corrosion etc.), nor on standards used in corrosion (ASTM, DIN), typical corrosion tests, etc. Nothing is said in this chapter concerning the basic mechanisms of corrosion, e.g. the extent to which metallic corrosion is governed by anodic and cathodic reactions and the resulting electrode potentials, how the corrosion rate is calculated using polarization curves, and how corrosion can be accelerated or retarded by an external polarization or by galvanic elements (see e.g. cathodic protection potential). This is important, since in later chapters numerous electrochemical data are presented and—to give only one example—many different reference systems are used for the potential scale (potentials quoted without any reference!, potentials vs. NHE, vs. SHE, vs. H, vs. SCE etc.), which might be quite confusing for some readers. In order to avoid dangerous mistakes, it would be very helpful if this handbook had contained a chapter in which the user could find this basic information which is necessary to understand the different figures and tables. At least some textbooks or standards on corrosion should be cited, so as to provide the missing background. The same comment applies to high temperature corrosion. In later chapters different time laws are mentioned (e.g. the parabolic law), which are sometimes explained and sometimes not, and again this will provide information only to those readers who have a thorough knowledge of the corrosion field.

The next two short chapters are concerned with acetates and aluminum chloride as corrosive media. The introduction to the chapter dealing with acetates is rather long, and contains information concerning the chemistry and preparation of acetates which belongs more appropriately to a chemistry textbook. The rest of both chapters is clearly written and easy to understand, but does not contain as many diagrams as the longer chapters which follow.

The fourth chapter discusses the corrosion behavior of different materials in contact with chlorine and chlorinated water. In general, this chapter is a well written and adequately illustrated summary, including both the wet corrosion of materials in chlorine-containing electrolytes and in chlorine atmospheres, and high temperature corrosion in different chlorine-containing gases. The information is illustrated by numerous figures and tables. Considering the very different corrosion conditions (wet corrosion, atmospheric corrosion, high temperature corrosion), the distinction between these conditions could be more clear. Again, this chapter is presumably addressed to corrosion scientists with a sound background of knowledge in the field; other readers will find that the diagrams and tables are not easy to understand. Some topics in this chapter are discussed in detail (e.g. the high temperature corrosion of Ni), but there are some mistakes and ambiguous diagrams. Some examples: in Table 1 rate constants are given in cm^2/h (?); Figure 4 shows rate constants for the chlorination of Ag in mol/cm s; page 40 cites 50 K instead of 50 bar; in Table 11 the duration of the experiment is given without any unit (s?, h?) and a "theoretical rate" is mentioned, which seems to be an experimental one; in Table 21 the activity of O_2 is given in the wrong order, and Figure 52 shows a potential axis in V without mentioning any reference electrode. In the part of this chapter devoted to Ti the importance of the passivity of Ti to its corrosion resistance in Cl_2-containing media is emphasized, but the electrochemical basis of the effect of alloying Pd to Ti (acceleration of the cathodic reaction and therefore passivation) is not very clearly explained. This is one example, representative of many other instances in this handbook, of a situation where a large number of empirical facts regarding the corrosion of materials would be made much easier to understand if they were also discussed from a fundamental standpoint.

Whereas the chapter "Chlorine" is mainly concerned with high temperature and atmospheric corrosion, the fifth chapter "Fluorides" deals predominantly with the corrosion behavior in wet media and melts. The introduction is well written, short and precise. In general the same is true for the rest of this chapter, the text again being illustrated by a number of diagrams. Two reservations should be mentioned: the reference electrode for the potentials which are quoted is indicated by three different subscripts: V_H, V_{SHE}, and V_{NHE} (all three meaning the same), whereas V_{SCE} refers to a different standard. A number of the figures (e.g. 12, 20, 28) show a potential axis in "Volt" without mentioning any reference. Since there is no uniform reference system in this first volume of the Corrosion Handbook, these figures are useless, as the reader does not know to which reference the potentials refer. The second reservation refers to some statements such as "the corrosion of steel is reduced by the exclusion of oxygen" (page 114), or "the corrosion is promoted by oxygen" (page 124), which are trivial if one considers the O_2-reduction as the cathodic part of the corrosion process.

The sixth chapter deals with the corrosion properties of materials in KOH. Like the others, this chapter contains much valuable information with many illustrations. The reservations are the same as the ones mentioned above: potentials are frequently given without any reference (Figs. 1, 2, 4, 13, 22, 26, 38), and some electrochemical information is not very precise (distinction between increasing voltage and increasing anodic polarization?, page 165; negative protection potential $= -1$ V vs. which reference?, page 168). The part dealing with iron contains only a little information about the stress corrosion cracking of this material in KOH electrolytes and on the range of potentials in which the material is susceptible to this localized attack.

The last two chapters deal with steam and sulfonic acid as aggressive media. In general, both chapters are well written. The chapter "Steam" in particular contains a good introduction, and the detailed description of the corrosion behavior of the different materials is clearly arranged. The part dealing with iron discusses high temperature oxidation in depth, and contains a description of the parabolic rate law, which is missing from the chapter "Chlorine", where also parabolic rate constants are discussed. It would be much better to summarize this fundamental theory in an introductory chapter than to distribute the information over the different chapters of the handbook.

Altogether the DECHEMA Corrosion Handbook is a very valuable reference book for all engineers working in the area of corrosion, provided that the reader has a thorough knowledge of this area and is thus able to critically evaluate the information in the figures, tables and text of individual chapters. The organization of the Handbook is clear, and it is rather easy for the user to find the desired information. In addition to this, the large number of literature references cited in the Handbook (about 400 for most chapters, citations up to 1980) offers even more information to users who have to solve special corrosion problems.

Martin Stratmann
Max-Planck-Institut für Eisenforschung
Düsseldorf (FRG)

Miscellanea

Photophysics of Polymers. Edited by *Charles E. Hoyle* and *John M. Torkelson.* American Chemical Society, Washington, D.C., USA 1987. 531 pp., $ 119.95.—ISBN 0-8412-1439-5

This clearly structured and nicely presented book stems from a symposium of the Division of Polymer Chemistry of the American Chemical Society which took place in Anaheim, CA, in September 1986. The book is designed to provide scientists engaged in basic and applied polymer research with a comprehensible text on polymer photophysics. The philosophy of the book is that photophysical phenomena allow one to gain an accurate picture of the properties of polymers, both in solution and in solid phases. Based on the historical development as well as on current practice, the book is divided into six main sections: 1) Overviews, 2) Polymer Dynamics and Complexation, 3) Excimer Photophysics, 4) Energy Migration, 5) Luminescent Polymerization Probes, 6) Photophysics of Silicon-Based Polymers.

On the whole, the book is a timely and most welcome addition to the literature in a field which has recently seen a strong increase of interest. In fact several works on related subjects have been published over the last few years: the monographs by *J. Guillet:* "Polymer Photophysics and Photochemistry; an Introduction to the Study of Photoprocesses in Macromolecules" (Cambridge Univ. Press, 1985) and *J. F. Rabek:* "Mechanisms of Photophysical Processes and Photochemical Reactions in Polymers; Theory and Applications" (Wiley, New York 1987) as well as the multi-author volumes: "Polymer Photophysics, Luminescence, Energy Migration and Molecular Motion in Synthetic Polymers" (edited by *D. Phillips*, Chapman and Hall, London 1985), "Photophysical and Photochemical Tools in Polymer Science: Conformation, Dynamics, Morphology" (edited by *M. A. Winnik,* NATO ASI-Series C, Vol. 182, D. Reidel, Dordrecht, Netherlands 1986) and "New Trends in the Photochemistry of Polymers" (edited by *N. S. Allen* and *J. F. Rabek*, Elsevier, London 1986). In my opinion the new book edited by *Hoyle* and *Torkelson* is extremely valuable, since it stands at the forefront of this dynamic field which offers many possibilities for future developments. The presentation is—unusually for a multi-author book!—balanced; most of the active research groups in the field are well represented. Of course, one cannot expect a book with some eighty contributors to present a unified viewpoint; however, one gets a good snapshot of the situation. Furthermore, even the camera-ready printing does not impair the presentation too much.

The individual contributions stress the application of photophysical methods to polymers, and it is indeed gratifying for a physicist to see such devoted use of physical methods in chemistry research. While most groups have realized the importance of time-resolved measurements (the contributions by the groups of *M. D. Fayer, H. F. Kauffmann* and *S. E. Webber* highlight this trend), an intimate connection between theory and experiment is—in general—still lacking. Several contributors have, in my opinion, not always been cautious in interpreting their data, and one sometimes gets the feeling that the method is over emphasized; in many cases I would welcome a comparison of photophysical results with data obtained by other physicochemical methods.

In summary, the editors have achieved their goal of providing a picture of the state-of-the-art situation in the photophysics of polymers. I view the book as a valuable addition to the library of scientists actively involved in polymer research.

Alexander Blumen
Experimentalphysik IV
Universität Bayreuth (FRG)

Physics at Surfaces. By *A. Zangwill.* Cambridge University Press, Cambridge 1988. xiii, 454 pp., hardcover £ 40.00.—ISBN 0-521-32147-6

Physics at Surfaces is an excellent introductory book for students or other researchers interested in surface processes. It is certainly the best source of general information about the concepts and techniques of surface physics/chemistry, painting a broad-brush picture of the current state of the field and covering a broad range of topics. Characteristics of both metal and semiconductor surfaces, clean and adsorbate-covered are described. Topics such as the thermodynamics and electronic structure of surfaces, and adsorption/desorption phenomena are discussed. Several emerging, albeit not understood areas, such as metal organic chemical vapor deposition (MOCVD) and energy transfer at or near surfaces are also introduced.