Book Reviews

Corrosion, Thin Films, Glasses, Sensors ...

DECHEMA Corrosion Handbook, Vol. 3. Edited by *D. Behrens*. VCH Verlagsgesellschaft, Weinheim 1988. ix, 282 pp., bound, DM 775. – ISBN 3-527-26654-2

The DECHEMA Corrosion Handbook is a completely new English edition of the DECHEMA Werkstoff-Tabelle and describes the corrosion properties of metallic, inorganic non-metallic, organic and composite materials in different corrosive media. The third volume summarizes the corrosion in acid halides, amine salts, bromides, bromine, carbonic acids and lithium hydroxide, the literature being cited approximately up to 1985.

The general layout of the third volume is identical to the previous ones. Again, the contents are clearly arranged and it is therefore easy for the user to find the desired information quickly. A criticism of the earlier volumes was the rather frequent statement of electrode potentials without any reference system. In the third volume, most of the potentials mentioned in the text, figures or tables refer explicitly to different reference systems (standard hydrogen electrode, standard calomel electrode) although in the chapters concerning bromide (p. 115, 116, Table 12), carbonic acids (Figs. 17, 44, 45) and lithium hydroxide (Fig. 1) the reference system is missing. A list of all reference electrodes used in the Corrosion Handbook, should be included into the introduction, citing their potentials versus the Standard Hydrogen Electrode.

Chapter 1 discusses corrosion properties in acid halides. The introduction to this chapter is very extensive and makes up half of the chapter. Different acid halides are described in detail, including their chemical properties, technical importance and corrosivity with respect to different materials. Then, a detailed description of the corrosion properties of the individual materials with respect to the different acid halides is given. The discussion of the properties of the corrosion system, the medium (introduction), as well as the material is clearly arranged for the reader, despite the overlap in the information provided in the introductory and the later part of the chapter. At the end of this chapter, informative tables summarize the usability of the individual materials in varying concentrations of the different acid halides.

Chapter 2 summarizes the corrosion properties of materials in amines. The short introduction touches only slightly the major importance of amines as inhibitors, and a detailed discussion of the adsorption properties of inhibitors, their technological use and the dangers accompanied with their use (e.g. localized corrosion, if the inhibitor concentration is too low, H-embrittlement in certain solvents) is missing. In the second part of this chapter a detailed description of the corrosion properties of the different materials in solvents containing amines is given. The inhibiting properties of the individual amines are discussed in detail, with special emphasis on their use as vapor-phase-inhibitors in order to inhibit the atmospheric corrosion of Cu and Fe.

Chapters 3 and 4 summarize the corrosion induced by bromides and bromine. In this context, especially the localized corrosion induced by bromides is of importance. The first part of chapter 3 gives a short introduction to the topic, but the determination of pitting potentials by potentiostatic and potentiodynamic experiments is described insufficiently as is the determination of repassivation potentials (although repassivation potentials are mentioned on p. 115). In addition, there is no discussion of the importance of corrosion potentials with respect to pitting potentials nor one on cathodic currents, which have to balance the anodic dissolution of the metal in pits in order to allow pitting corrosion to occur.

Chapter 5 is concerned with corrosion in carbonic acid with special emphasis on the corrosion of Cu and steel in CO_2 containing tap-water. The well written introduction provides the reader with a lot of information concerning the physical properties of CO_2 containing water, water hardness and the electrochemical principles of the corrosion in this system. The general background which is provided in this introduction, is complementary to the detailed description of the individual corrosion properties which are presented in the following part of the chapter. The latter parts are well written, providing lots of information on the corrosion of materials in CO_2 containing media. Techniques mentioned (CERT-test, Fig. 32), should have been explained in more detail for the non-specialist users of the handbook. Figures 44 & 45 discuss pitting corrosion and repassivation, using techniques and terms which have been introduced in chapter 3. It would have been much better to summarize such important techniques and corrosion mechanisms in an individual chapter than to distribute this type of information widely throughout the book. The last chapter is devoted to lithium hydroxide, and is in general well written.

Overall, as a reference book, the third volume of the DECHEMA Corrosion Handbook is highly recommended to anyone working as an engineer or scientist in the corrosion area.

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Ionized-Cluster Beam Deposition and Epitaxy. Edited by *T. Takagi*. Noyes Publications, Park Ridge, NJ, USA 1988. viii, 231 pp., bound, US $ 48. – ISBN 0-8155-1168-X

The various techniques for ion-assisted deposition of thin films composed of metals, semiconductors, insulators, magnetic materials, composites etc. are of great importance for application in industrial production as well as for fundamental studies in research laboratories. This volume, of the series Materials Science and Process Technology, deals with the deposition of thin films by means of beams composed of

ionized aggregates of a few hundred to a few thousand atoms rather than individual atoms or molecules. These clusters are formed by the condensation of evaporated atoms during adiabatic expansion through a narrow aperture into a high vacuum region. They are then ionized by electron impact and uniformly accelerated in an electric field between source and substrate surface. A single charge on the cluster is thus used to accelerate many hundreds of atoms. A cluster consisting of 500 atoms has a diameter of the order of 30 Å. The size, charge, and acceleration voltage of the clusters are intimately related with the film formation process.

The author of this book is considered to be the pioneer of the ionized-cluster beam technique. He started the research in this field at Kyoto University (Japan) in 1972. The various activities of the author to promote the spreading of this method throughout the world largely determine also the character of this book. In 60 of the 100 references *T. Takagi* is one of the authors. This unbalanced selection of the material implies that a critical comparison of the ionized-cluster beam deposition with both conventional evaporation and sputter deposition as well as low-energy ion deposition is unfortunately not given. Throughout the entire text the author emphasizes the advantages of "his" technique. In the case of crystalline semiconducting materials, like e.g. Si or GaAs, this point of view is totally misleading, because the quality of thin films prepared by ionized-cluster deposition is far inferior to that of films prepared by either chemical vapor deposition or by molecular beam epitaxy. Unfortunately, most aspects of ionized-cluster beam deposition discussed in this book are treated only qualitatively. A number of misprints and errors should be eliminated in a following edition.

Due to the partiality and the lack of an in-depth treatment of the subject this book is of limited use only. It can, however, serve as an introduction to the field.

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Mathematical Approach to Glass. By *M. B. Volf.* Elsevier Science Publishers, Amsterdam 1988. 420 pp., bound, DFL 275.–ISBN 0-444-98951-X

There are different approaches to glass science and technology. One approach is based on chemistry and attempts to answer the question of how the properties of a glass change after the substitution of one component by another. A second approach investigates the structure of the glasses and tries to set up structural models. Of course, structure and properties are related to each other. Glass formation, on the other hand, may also be related to thermodynamic and kinetic arguments, both being of equal importance.

In this book the chemical approach to glass is stressed. The text is essentially based on the finding that the properties of glass are roughly determined by the properties of the constituent atoms or ions and by their bonds. Projected into calculations, this in most cases makes it possible to predict in what way an element will behave when bound to oxygen in an oxide glass. Optimization of properties may then also be possible in a given type of glass. Thanks to the rapid introduction of computer technology ranging from pocket calculators to large computers, the field of applied mathematics in glass is expanding.

The book contains four main chapters. In the first, general ideas and models are described, e.g. models on the chemistry and technology of glass, the chemical model as a theoretical base for the calculations in the chemistry of glass, questions of composition and composition factors, characteristics of mass and volume, activation energy for describing temperature dependencies, and questions of acidobasicity.

The second chapter deals with the affinity of properties, that means, how one property is related to another property. This interdependence of properties is, of course, essential for the approach described in this book.

The third main chapter, on the dependence of properties on composition, contains the known and developed methods, e.g. additivity principles, the methods of *Winkelmann* and *Schott, Gehlhoff* and *Thomas, Huggins* and *Sun, Appen, Gan Fu-Xi, Demkina, Mackenzie* et al., and some regressive and statistical schedules.

The fourth main chapter is the most comprehensive one and discusses the physical dependence of properties. The properties investigated are density, optical properties, permittivity, thermal properties, elasticity, strength, hardness, photoelasticity constant, thermal expansion coefficient, resistance to thermal shock, surface tension, viscosity, electrical properties, and chemical durability. Some supplements and a list of references conclude the book.

This book is of importance to people working in the glass industry and who want to know how a property changes with the change of a component. In most cases the absolute value is not necessary. However, the tendency of the change is more important. This book, of course, has also some value to people who are not so familiar with glasses and their properties and who want to get a feeling of how chemistry influences glass properties. However, there are many anomalously behaving glasses, e.g. borate-containing or mixed alkali glasses. In those cases possible differences between prediction and measurements have to be checked.

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Encyclopedia of Materials Science and Engineering, Supplementary Volume 1. Edited by *R. W. Cahn,* Senior advisory Ed. *M. B. Bever.* Pergamon Press, Oxford 1988. xiii, 653 pp., hardcover, US $ 295.—ISBN 0-08-032551-1.

The Encyclopedia of Materials Science and Engineering, published in the spring of 1986, is a comprehensive reference work and source of information for a wide readership, including but not restricted to practitioners in the broad domain of materials. It consists of eight volumes containing 1580 articles, the production of which involved almost 1500 experts all over the world. The Encyclopedia has been well received by reviewers and has been acquired by institutions worldwide.

It is clear that change in some areas is so rapid that publication must be a continuing activity if the Encyclopedia is to