

Book Reviews

Electrodeposition and Corrosion Processes

J. M. West

Pp 189 (Van Nostrand, 1965) 50s, paperback
27s 6d

It is now commonplace to regard as "interdisciplinary" those fields, particularly in applied science, whose development requires the insights of a number of more basic sciences. This recognition was not always so readily given; and early workers on the corrosion of metals, one of the older interdisciplinary topics, must have had some difficulty in explaining their subject to chemists, physicists, metallurgists, and even biologists, whose studies are all relevant to corrosion and related processes. However, the efforts of pioneer workers gave corrosion research its due status, and there is now a large literature which ranges widely for its supporting principles.

To this literature, Dr West has contributed a book, designed primarily for the first-degree student, which surveys the chemistry, electrochemistry, and metallurgy underlying the corrosion and electrodeposition of metals. By avoiding technical and experimental details, he is able to deal with basic processes in some detail. The treatment is, however, not purely theoretical: reality is given to the discussion by numerical data and examples, and all the chapters conclude with numerical problems (with answers).

The first and second chapters cover the electrochemistry of metals in contact with solutions, considering equilibrium and non-equilibrium situations respectively. The presentation is clear, though the numerous footnotes give a restless air, and some readers may not like Dr West's rather conversational style. Application of electrochemical principles to corrosion reactions follows in Chapter 3. Here the treatment of cathodic reactions is particularly full, including detailed discussion of the reduction of some anions, e.g. nitrate. It is however surprising to see little mention of the methods, developed by Stern and others, for deriving corrosion parameters from polarisation curves. In Chapter 4 we meet oxide films, here presented very much as features of the electrochemistry (Pourbaix

diagrams, Flade potential, passivity). Thicker oxide films are not considered, for high temperature oxidation is deliberately excluded from the book's scope. The discussion of pitting corrosion is rather slight; and the derivation and import of Table 4.4, illustrating film breakdown, are obscure.

Chapter 5 discusses electropolishing and bright electrodeposition, with attention to the crystallography of the metal surface and to the role of complexants in the solution. In discussing the latter, and also the question of stress in electrodeposits, Dr West introduces what he admits to be speculative passages, but these provide a useful account of contemporary thinking. Chapter 6 reverts to corrosion, with a description of preventive methods, including inhibitors, cathodic protection, and a rather sketchy discussion of alloying.

Chapter 7 is the most speculative and controversial, for it discusses stress corrosion cracking, in which Dr West himself has been deeply engaged. Nevertheless he discusses the metallurgical and chemical factors fully and gives a fair account of all the present day theories. This chapter should be of use to the research worker as well as the student.

The figures and printing are clear, with few misprints. There are two short appendices, on metal deformation (dislocations, stacking faults and work hardening) and on modern valency theory, with particular reference to complex formation.

J. N. WANKLYN

Physical Metallurgy Principles

R. E. Reed-Hill

Pp 630 (Van Nostrand, 1965) 85s

There are currently a number of books which set out to introduce students to physical metallurgy. Several of these have already earned much praise from reviewers, and, perhaps more significantly, from students who have used them in conjunction with their university or college courses. This means that new books in the same

field face stern competition and must be of an unusually high standard, if they are to compete with or displace existing texts. Let me say straightaway that the book by Reed-Hill is certainly in this category. It presents a beautifully-disciplined and clear account of the fundamental ideas of physical metallurgy. The treatment throughout is logical, and arguments are worked out from first principles with the minimum amount of factual burden. Many topics, e.g. the elementary theory of metals, vacancies, annealing, diffusion, deformation twinning and martensite reactions and fracture, are covered in much more detail than in corresponding books, with added benefit from the reader's point of view, since the subject matter is thereby presented in a more unified way.

The chapters on vacancies, annealing and diffusion are particularly good in the way the reader is led, by clear, straightforward writing, through the basic concepts. The same is true of the chapter on twinning and martensite reactions – a subject which is of increasing importance, although it is not always easy to find clear introductions in existing books. By studying Reed-Hill's treatment, however, the student should have no difficulty in following the essential arguments, and thus be prepared for more detailed reviews. There are many similar examples. Indeed, the whole book is extremely refreshing to read. Problems are worked out in the text in amplification of the arguments, and at the end of each chapter there are further problems designed to test the students' understanding of principles.

The book runs to 630 pages, including a good index. The cost is 85 shillings, which by present-day standards is extremely reasonable for the subject matter it contains. It can be highly recommended to students of metallurgy at all levels. The freshman will gain a first-class introduction to the subject, but will still find himself consulting many chapters when he is well into his final year.

G. C. SMITH

Structural Transformation in Glasses at High Temperatures

The Structure of Glass Volume 5

N. A. Toporov and E. A. Porai-Koshits (editors)

Pp ix + 223 (Consultants Bureau, New York, 1965) \$25.00

The development of glass-ceramics, which are made by the controlled crystallisation of glasses and which are achieving considerable technological importance, has stimulated research into nucleation and crystallisation processes in glasses. In connexion with this, the importance of metastable glass-in-glass phase separation as a precursor to crystallisation of certain types of glasses has been realised and a significant expansion of research into this subject has taken place. This book reports work carried out at the IV Grebenshikov Institute of Silicate Chemistry, the principal centre for this type of research in Russia.

After a useful review-type introduction, the book deals with theoretical and practical aspects of nucleation and crystallisation and discusses in detail the development of chemically heterogeneous structures in glasses as a result of heat treatment. The influence of these structural changes on the nucleation and crystal growth processes is considered. Later sections of the book deal with the properties of crystallised glasses and attempt to relate these with the structure of the materials. Finally, a theoretical discussion of the possibilities of producing silicates with the "elasticity" of organic polymers is included.

This book cannot be regarded as an introduction to the subject of glass-ceramics, and its greatest value will be to specialists concerned with research in this field and in problems concerning glass structure. Nevertheless, materials scientists in general could find it of value in illustrating the theoretical and experimental methods being used in these studies.

Since a large number of authors have contributed to the book, it suffers from the usual deficiencies of a collection of papers, including a certain amount of repetitiveness and one or two contradictions. The failure of the experimental papers to make more extensive use of the theoretical treatments, dealt with at great length in the earlier sections of the book, is somewhat surprising.

Criticism can be levelled at some of the figures, for containing too much data for easy assimilation, and at the presentation of some of the electron micrographs, for which the descriptions appear separately from the actual figures. In places, statements are made which may be regarded as controversial and for which the experimental evidence is slight. For example, the statement that barium ions take part in glass structure in the form of groupings in the silicon-oxygen network would not be widely accepted.

The rather high price of the book means that its purchase may well be restricted to reference libraries.

P. W. MCMILLAN

Molecular Symmetry

D. Schonland

Pp 320 (Van Nostrand, 1965) 80s

Most of us who graduate in metallurgy, chemistry, or physics find it necessary to take on trust some of the mathematical truths which provide the essential foundation for the theoretical treatment of many phenomena of basic interest. This is perhaps particularly true with regard to spectroscopy and crystallography, both of which depend upon the methods of *group theory* for their full description.

Although this situation has been a matter of concern for at least two decades, the implications have become more widely recognised as constituting a serious impediment to research during the last few years, when new branches of spectroscopy have found wide application, and when crystallography has become a vital technique (on computerised tap!) for both the inorganic chemist in the proliferating study of co-ordination compounds and the organic chemist in his structural elucidation of substances of biological importance. Great emphasis has thus come to be placed on the application of mathematical techniques in the study of symmetry properties.

Dr Schonland's new book states and explains the basic principles of group theory clearly, without undue formal elaboration and with immediate application to problems in molecular orbitals, spectroscopy, and crystallography. This treatment deals with, *inter alia*, point groups, vectors, matrices, representations of several

important kinds, molecular vibrations, orbitals, and spectra. It is aimed at the advanced reader, that is the graduate in a physical science who will be well equipped, through general familiarity with the broad results of symmetry calculations, to understand the mathematical theory as presented here and to reinforce substantially his command of the techniques which group theory provides.

In a world in which there is never time to fit this mathematical content into an undergraduate course in molecular, materials, or physical science, this book is to be welcomed for the bridge it provides for the interested reader between faith and understanding in the elucidation of the structural significance of symmetry properties.

A. D. JENKINS

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