



Figure 1 Spheroidal defects and isolated dislocations in sintered and rolled platinum annealed at 801° C ($\times 80\,000$).

that there is a dispersion of porosity, is correct.

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References

1. A. B. MIDDLETON, L. B. PFEIL, and E. C. RHODES, *J. Inst. Metals* **75** (1949) 595; discussion, *ibid*, p. 1142.
2. W. BETTERIDGE, *Powder Metallurgy* **7** (1964) 142.
3. P. A. JACQUET, *Met. Rev.* **1** (1956) 157.

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Book Reviews

The Chemistry of Hydrometallurgical Processes

A. R. Burkin

Pp 160 (Spon, 1966) 50s

The stated objective of the author of this monograph is to cover the basic chemical theory of hydrometallurgy processes. This objective has been realised with fair success, although there is some unevenness in the general presentation and one serious omission, namely discussion of the chemical principles underlying the subject of solid-liquid separation processes in hydrometallurgy. Obviously, any hydrometallurgical process must contain one or more solid-liquid separation stages, and such operations are always expensive and often difficult to operate in a satisfactory manner. A discussion of the basic physico-chemical factors underlying liquid-solid separation processes would have been most welcome, e.g. what are the mechanisms of operation of the different types of flocculating agents?

The monograph is divided into seven chapters, of which the first four are of an introductory

character. These present condensed fundamental discussions of equilibria in solutions, thermodynamics of reactions, and the kinetics of heterogeneous reactions. The main body of the book is made up of three chapters on, respectively, leaching reactions, methods of purification and separation, and the precipitation of metals and oxides by reduction. The relative lengths of these three chapters are in about the correct ratio to the corresponding importance of these topics in hydrometallurgy.

The chapter on leaching reactions commences with an account of the dissolution of metals (Au, Ag, Cu), which is a useful and interesting summary. This is followed by an account of the leaching of metal sulphides, which includes a full thermodynamic treatment. However, in between these sections is one on the leaching of silicate minerals which is totally inadequate. A section of one half page does not do justice to the importance of silicate minerals in hydrometallurgy! Similarly, the coverage given to the subject of bacterial leaching of ores is less than is warranted by the real importance of this subject. This chapter is completed with an interesting survey of reaction

mechanisms, particularly with regard to oxidative processes.

The chapter on methods of purification and separation gives a concise account of the chemical principles underlying solvent extraction, together with briefer references to other topics such as ion-exchange.

The final chapter on the precipitation of metals and oxides by reduction is the best in

the book, bringing together into one collection facts that are scattered throughout the literature. The discussion of the underlying thermodynamic principles is a particularly valuable part of this survey. There is much information in this chapter which would be of interest to the materials scientist as well as to the extractive metallurgist.

D. A. EVEREST

Creep and Stress Relaxation in Metals

I. A. Oding (editor)

Pp x + 377 (Oliver and Boyd, Edinburgh, 1965)
105s

This book should be important to western readers for its presentation of the numerous Russian contributions, and those of Oding in particular, to the understanding of creep and relaxation. However, as "a textbook for students of metallurgy and engineering in general" (the words are from the book's dust cover), its value is severely limited by faults which cannot be overlooked. The most serious of these is that seven years have elapsed since the book's first Russian edition, and it has not been brought up to date. In fact, there are no references to work carried out later than 1957, and in a field where the development of transmission electron microscopy and the application of dislocation dynamics have contributed so immensely to our understanding in the past five years alone, it is clear that such a book is inadequate for today's students. As the English editor observes in his foreword, no reference is made to stacking faults or cross-slip, and there is scarcely any discussion of microstructural observations. But these omissions, and rather doubtful inter-

pretations which have been made of some atomistic phenomena, are mainly a consequence of the book's being so much out of date. The phenomenological treatments and discussions, of such topics as generalised creep criteria, creep under complex stresses, and testing methods, are of more permanent value than those analyses which are based on contemporary dislocation theory, but extrapolation techniques are handled somewhat uncritically considering their importance to the designer. Minor faults that may be cited are the lack of an index, somewhat haphazard arrangement of material, a tendency to obscure reasoning, and the occasional use of Russian designations for alloys without reference to their compositions.

To make specific criticism of the ideas and theories presented would be unjustified. One cannot take issue with Oding's work or opinions, for at the time of its compilation this was undoubtedly a complete and up-to-date text. But, instead of attempting to translate it almost *in toto*, it would surely have been preferable to limit the translation to that part of the work which is uniquely Russian, leaving some of the more recently-published texts to supply the theoretical background.

B. HARRIS

Composite Materials

L. Holliday (editor)

Pp xiii + 540 (Elsevier Publishing Co, 1966)
130s

This is an excellent book. It is the first of the Elsevier Publishing Company's Materials Science Series, and is distinguished by an attractive layout with clear pleasant diagrams. The

practice of indicating at the foot of each page where the appropriate literature references for the chapter are to be found is a useful one.

The choice of composite materials as an introduction to the Materials Science Series is a particularly appropriate one, as the subject is a materials science in itself. A study of composite materials in fact demands a thorough knowledge of the properties of the possible com-

ponent materials before an understanding of the composite whole can be attempted.

The first two chapters, by L. Holliday and W. D. Biggs, deal respectively with the general aspects of complex materials, such as the geometrical variables and the possible phase relationships, and the effect of these on a number of physical properties.

Each subsequent chapter deals with a particular class of complex materials. Metal systems are discussed by R. W. Cahn, who surveys the physical properties governing the microstructural morphology of alloys and cermets, and the ways in which the microstructure governs properties. The potential of fibre-strengthened materials is also mentioned.

Ceramic systems are surveyed by D. E. Lloyd, who discusses the structure and properties of ceramic-pore, ceramic-glass, ceramic-ceramic, and ceramic-metal systems, including the question of fibre-reinforced ceramic systems.

K. L. Loewenstein deals with glass systems and concentrates largely on glass fibre-resin composites, paying particular attention to the glass/resin interface and the effect on properties of interaction with the environment.

Three authors handle thermoplastic systems – H. A. Lanceley, J. Mann, and G. Pogany, and discuss them under the following headings: (i) thermoplastic-rubber systems; (ii) thermoplastic-solid filler systems; (iii) thermoplastic-gas systems.

Elastomer systems are covered by A. R. Payne, who discusses the effect on physical properties of the incorporation of a range of fillers into rubbers.

K. Newman discusses concrete systems in considerable detail, and shows how the phenomenological properties of concrete are affected by its internal structure. He points out that ironically enough one of man's oldest and most widely accepted polyphase materials has been found to be one of the most variable and

complex. It is only in the last two decades, however, that concrete technologists have realised the limitations of the empirical "engineering" approach and turned their attention to the internal structure of the material.

Another familiar system – asphalt – is treated by R. N. J. Saal who considers a number of polyphase systems based on bitumen as the continuous phase.

Paper and board are discussed as cellulose-water-air systems by H. Corte.

Although cross-referencing between the various chapters does occur, it is perhaps a little unfortunate that the familiar system names – metal, ceramic, etc. – are used as headings, since this does tend to emphasise in one's mind the separation into classes.

One of the main objects of materials science is to teach people to think in terms of the physical properties needed for a particular application rather than the capability of a specific material, and this could perhaps have been highlighted by including another general summarising chapter in which the emphasis is on properties rather than on systems. It would also perhaps have given a greater feeling of unity to the book as a whole. However, for the specialist, this division is useful since it does provide a reference point for looking out at other systems and comparing them with one's own speciality.

Finally, there are some trivial errors in the text, and it seems almost churlish to fault such a polished product, but it would have given greater uniformity if a consistent system of units had been given. For example, in Chapter IV, lb/in.² occurs throughout, while in Chapter V, p.s.i. is used. Also, on page 133, both the forms 1,000,000 and 10⁶ are used.

Altogether, however, the editor and publishers are to be congratulated on producing such a valuable and interesting book.

W. A. HOLMES-WALKER