On the other hand, different kinds of defects are induced in the grey tin during the transformation, as shown in Fig. 1. The image (a), which is in the 110 orientation as seen in the corresponding diffraction pattern (b), shows many defects, mostly rectangular in shape as indicated with the arrows, and the diffraction pattern gives rise to clear streaks in the ⟨111⟩ direction and extra spots marked "T". The {002} spots which are forbidden for the diamond structure appear by double diffraction and the extra spots seem to be {111} twin spots because they are at one-third of the distance between the original spots of the untwinned lattice as expected for the case of cubic lattices [2]. The streaking may be caused by stacking faults or alternatively by microtwins. In fact, diffraction patterns which showed similar streaks but no extra spots were also observed.

Fig. 2 shows an example of surface structure of the grey tin spontaneously fractured by the large increase in volume. We can see a large number of fine ripples formed by fracture and many narrow parallel bands (interpreted as microtwin lamellae) obliquely intersecting the ripples. The width of these bands is widely distributed ranging from a few thousand to a few hundred Ångstroms and even narrower. The fact that the ripples interruptedly disappear on the edges of the bands clearly demonstrates the repeating structure of the microtwin.

It is concluded from these facts that many lattice defects, mainly microtwins and stacking faults, are introduced in the grey tin during the $\beta \rightarrow \alpha$ transformation. The lattice defects are very similar to those in some martensites of Fe-Ni alloys and high carbon steels, and thus the $\beta \rightarrow \alpha$ transformation can be considered to be done martensitically.

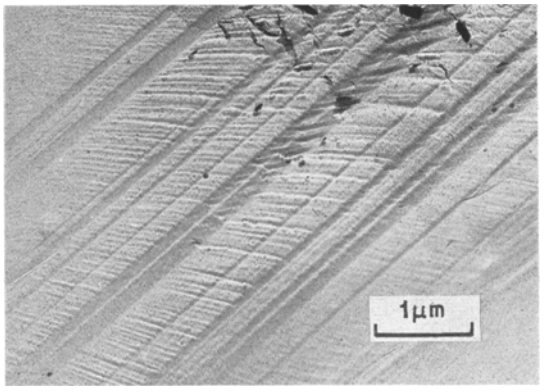

Figure 2 Surface structure of fractured grey tin showing fine ripples and parallel twin bands.

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Short Notices

Surface and Defect Properties of Solids

M. W. Roberts and J. M. Thomas
(editors and senior reporters) and others
(A Specialist Periodical Report). Vol. 1.
The Chemical Society, London, 1972. 264 pp. £6.00

This volume is sub-headed "A Review of the Literature Published between January 1970 and April 1971", but in fact the reviews published here cover a longer time-span and are more in the nature of interpretative essays than the sub-heading suggests, and all the better for it.

For readers of *Journal of Materials Science* the *pièce de résistance* is a remarkable essay by J. S. Anderson on "Shear Structures and Non-stoicheiometry" (one day, an opinion poll should be organized on the spelling of that dread word). The essay deals entirely with transition metal oxides (though a few other substances, such as the alloy Ni_3Mo, are known to behave similarly), and explains very clearly and fully how planar

defects, so-called crystallographic shear planes, often in regular arrays, provide for a wide range of off-stoicheiometric compositions in these materials. The discussion of the possible mechanisms by which these structures came into existence is especially intriguing to a reader trained in metallurgy. This is the best available survey of a major new field of crystal chemistry.

Other essays deal with high-resolution TEM as applied principally to imperfect forms of carbon (L. L. Ban); the role of defects (in the crystalline monomer) on solid-state polymerization (C. H. Bamford and G. C. Eastwood); structural imperfections in inorganic molecular crystals (J. M. Thomas and J. O. Williams) – an ecumenical article, this, explaining recent work according to the categories of the physicist and metallurgist; surface studies by photoemission (M. W. Roberts); application of electron spectroscopy to surface studies (C. R. Brundle) – another very rapidly growing field, of major potential. Three further chapters, of more narrowly chemical interest, deal with certain chemical reactions at metal surfaces, with some other aspects of metal catalysts, and with infrared spectra of adsorbed species on metals.

The volume is highly recommended to materials scientists, especially for Anderson's, Ban's, and Thomas and Williams' articles.

R.W.C.

Landolt-Bornstein: Numerical Data and Functional Relationships, Science & Technology, New Series

Editor in Chief *K. -H. Hellwege*

Group III: Crystal and Solid State Physics, Vol. 6

P. Eckerman and H. Kandler,
assisted by *A. Stegherr*

Structure Data of Elements and Intermetallic Phases

General Editors, *K. -H. Hellwege* and *A. M. Hellwege*

Springer-Verlag, Berlin, 1971. 1019 pp. US$179

This massive volume, numbered 6 in the new Landolt-Börnstein series of reference books, is devoted to elements, intermetallic compounds and carbides, borides and hydrides. Volume 5 of Group III, the immediate predecessor in the present series, was devoted to the structures of organic crystals. Further volumes currently in preparation include Volume 7, to be concerned with structures of inorganic compounds (those containing O, N, F, Cl, Br, I), and Volume 8, a novel compilation of "epitaxy data". This information is included here to set Volume 6, the subject of the present review, in perspective.

The data assembled in Volume 6 are comprehensive up to 1967, and it is fair to say that there is no compilation to compete with it for both completeness and modernity. The nearest rival is the American volume "Crystal Data", soon to appear in third edition, which however is quite differently organized, with classification according to axial ratio. "Crystal Data" is invaluable for working crystallographers, but the present volume should be of lasting value to a very wide range of scientists. Information about composition (and homogeneity range where applicable), space group, lattice parameters (range thereof where applicable), dependence of these properties on temperature and pressure, density, melting and polymorphic transformation temperatures, structure type and of course references to the original literature, are all included. Information from "Hansen" and "Pearson" is included here, but without graphical presentation. The inclusion of the extensive information about carbides, borides and hydrides, on which much research has been done in recent years, is particularly welcome.

This Landolt-Börnstein volume can by no stretch of the imagination be described as cheap, but it is to be noted that the publishers receive no financial support from foundations or learned societies, and hence the high cost is justifiable, especially in view of the enviable reputation the whole series has for accuracy and completeness. The book belongs in all major reference libraries in the materials science field.

R.W.C.

Microscopic Analysis of the Opaque Minerals

R. E. Galopin and N. F. M. Henry

W. Heffer and Sons, Cambridge, England. 1972. 322 pp. £8.75

Many books have been published on the behaviour of transparent crystals in transmitted plane-polarized light, and the technique is central to practical mineralogy and petrography. Some minerals, however, are too opaque to be examined by transmitted light, and then the more esoteric technique of examination by reflected polarized light must be used, as one of a battery

of techniques that also includes microhardness measurement, microchemical tests, study of polyphase textures, and electron microprobe analysis. This book deals in a very thorough manner with all of these except the last, which is not discussed at all.

For the non-mineralogist, more especially the metallurgist, the most interesting part of the book is the major section dealing with the response of opaque materials to plane-polarized light. The plane of polarization can be rotated, it can be turned into elliptically polarized light (rotated or not); for anisotropic sections there are two reflectivities and various dispersive effects, pleochroism in particular. The complexities involved in examining isogyres in convergent reflected polarized light, and in making accurate quantitative measurements of reflectivity, are clearly set out, as are the systematic procedures for identification of ore minerals. Metals are not discussed, but it may well be that some of these techniques will prove to have applications to the study of anisotropic metallic alloys (e.g., of U, Sn or Zn) under the microscope.

R.W.C.

The Friction and Lubrication of Elastomers

Desmond F. Moore

Pergamon Press, 1972. 288 pp. £7.50

This book is one of Pergamon's series of monographs on materials science and technology. While it is an unusual and valuable volume, it is really a text in mechanical engineering which pays rather more attention to the special peculiarities of one class of materials than mechanical engineers are apt to do. The core of the book is concerned with the detailed mechanics of adhesion, hysteretic friction, squeeze-film and elastohydrodynamic lubrication and wear under the special circumstances of a low-modulus, high-hysteresis slider: but there are also useful, compact surveys of friction and lubrication more generally, as well as a historical survey of the study of friction. Material variables come in repeatedly, but they are presented as god-given rather than man-designed; this is especially true of the chapter on viscoelasticity. The reader who wants primarily a discussion of such topics must refer to a text such as I. M. Ward's recent "Mechanical Properties of Solid Polymers".

However, provided the reader does not expect a materials science approach, anyone professionally concerned with applications of rubbers will find this volume useful, especially since the author takes pains to provide many practical illustrations of his principles. In particular, the subtle considerations involved in the friction between a rubber tyre and a road surface run like a refrain through the book.

R.W.C.

Notes on Dental Materials

E. C. Combe

Churchill Livingstone, Edinburgh & London, 1972. 265 pp. £2.90

This concisely-written book, intended for dental students, summarizes the composition, preparation, mode of use and properties of a range of materials, such as metallic, polymeric, ceramic and composite filling materials, waxes and investment materials, materials for making and installing dentures, inlay alloys, etc. The treatment is not deep and analytical but the notes give a useful bird's-eye view of this field not only to budding dentists but also to materials scientists on the prowl for new fields to conquer, and the book is recommended for this limited purpose.

The book also has a short introductory section on "dental materials science". This section, unfortunately, is not to be taken seriously. The statements (p. 9) that NaCl has a simple cubic lattice and, baldly, that dislocations contribute to the liability of ceramic materials to fracture (p. 12), and the imaginative phase diagram for Cu-Au (p. 55) are instances of information that not only is excessively concise but also is not so. Dental students deserve a better basic introduction than this.

R.W.C.