relationship, we should expect to find da/dN = 2.4 μm, and CTOD = 4.8 μm. (The CTOD was calculated on the basis of a correction to account for the crack tip plastic zone size $r_p = 0.1 (\Delta K/\sigma_y)^2$ [3], which was added to the measured crack length.)

There is good agreement between the observed and calculated CTOD, but the calculated da/dN is much larger than the macroscopic growth rate, and significantly greater than the average striation spacing. While it is often possible to correlate da/dN or striation spacing changes with changes in CTOD [5], in the present instance there is certainly no one-to-one quantitative relationship between any of the three parameters. On the other hand, there must exist some physical correlation, based on the actual dynamic opening and closing of the crack front and the associated development of micro-instabilities at the blunted tip during the unloading portion of the load cycle. We are presently looking into the details of this process, for 304 stainless steel and for 6061-T6 aluminium, by loading and unloading crack tips in increments and replicating at each increment. In this way, the sequential development of features such as those shown in Fig. 2 are observed. Key questions involve whether striations are actually formed on the loading or unloading half-cycle, whether multiple striations can form on a given half-cycle, and why there exists a correlating relationship between CTOD and da/dN changes even though they may differ in absolute magnitude by a factor of 100. Results of this work in progress will be reported in detail in a subsequent paper.

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Short Notices

Fast Ion Transport in Solids: Solid State Batteries and Devices

Edited by *W. van Gool*

North-Hollad, Amsterdam, 1973. 728 pp. Dutch florins 100, approx. US $35

This large and very impressive volume contains the proceedings of an international "study institute" held in Italy in September 1972. The field covered by the many participants has recently expanded very rapidly, partly under the impetus of the sodium-sulphur battery in which two molten reactants are separated by a "super-ionic conductor", solid β-alumina. Super-ionic conductors are crystals with little or no electronic conductivity in which some of the constituent ions occupy a minority of a particular type of site, and by easy hopping to adjacent vacancies contribute a large ionic conductivity. The papers in this collection deal predominantly with the theory of this fast diffusion; existing methodologies for treating normal diffusion are distinctly creaky when applied to this new complex problem. Experimental methods, contributions of interfaces, a number of particular established solid electrolytes, and a number of promising newcomers are all reviewed, and a pithy envoi by R. A. Huggins summarizes the achievements to date and the road-blocks which must next be tackled. A stimulating, difficult book.

R.W.C.

The Superalloys: Vital High Temperature Gas Turbine Materials for Aerospace and Industrial Power

Edited by *C. T. Sims* and *W. C. Hagel*

Wiley, London, 1972. 614 pp. £13·25

This is the first major text on gas-turbine alloys since Betteridge's survey of the Nimonics, anno 1959. A comparison of the two books shows the unbelievable strides which have been made during the intervening years, in the performance of the various nickel, cobalt and chromium base alloys. The physical metallurgy of the alloys, the convoluted theories of particle-strengthening, principles of surface protection, and especially the complex process technology (including controlled casting for coarse grain structure, heat-treatment, welding and machining) are all covered clearly and expertly by a number of American authors.

The architects of the superalloys are the modern equivalents of the Japanese swordsmiths who centuries ago brought the metallurgy of hard, tough steels to its finest flowering, but to the tenacious empiricism of these professional ancestors they add a detailed scientific understanding. The one omission from this book is a historical survey of how the present mastery of the superalloys was attained: I believe such a survey shows that while scientific understanding set the feet of these explorers in the right direction, the end-result owes nearly as much to dogged empirical investigation as did the Japanese swords of an earlier generation. But this observation is not intended to detract from a record of remarkable achievement, and as such this book belongs in all materials science libraries: where it is not needed to guide usage, it can be read for instruction and for encouragement.

R.W.C.

Titanium Science and Technology

Edited by *R. I. Jaffee* and *H. M. Burte*

A Proceedings of the Metallurgical Society of AIME, published by Plenum Press, New York and London, 1973. 4 Volumes, 2735 pp. US $132.50

This imposing skyscraper of a Proceedings is the record of the Second International Conference on Titanium held in Cambridge, Mass., in 1972, four years after the first of the series, held in London. The Conference was organised with some anxiety, for the industry is currently contracting. However, 350 delegates came, and the present publication, containing only a fraction of the papers submitted, is evidence of the sustained interest in the Wonder Metal. The index of paper titles alone occupies 18 pages, including no fewer than four Introductions!

The papers are divided between basic and applied metallurgy, with a notable emphasis on applications. Though much comment was made on non-aeronautical uses, the representatives of aircraft firms such as Rolls-Royce were well to the fore, as in the past. Much attention is paid to processing, including joining, corrosion and of course to smelting. The physical metallurgy is strong as ever; some of it masquerades under the mysterious generic title of "Metallurgical Synthesis", which sounds like something out of Marcuse. A welcome section is one concerned with refractory alloys. Each section is opened by a Critical Review: an excellent feature, this. The papers are truly international, with a significant Soviet contribution, although characteristically, the Soviet member of the Organising Committee failed to turn up.

This is a very well produced record of an important metallurgical occasion.

R.W.C.

Computed Electron Micrographs and Defect Identification

A. K. Head, P. Humble, L. M. Clarebrough, A. J. Morton and *C. J. Forwood*

North-Holland, Amsterdam, 1973. 400 pp. Dfl 100.00, approx. US $35

Following the very successful series of papers by Head *et al.* on the computer simulation and identification of defects in the electron microscope the authors have now presented most of this information together with details of computer programs in a single volume. The first three chapters discuss the background of the Howie-Whelan two-beam theory and the necessary experimental procedures for the optimum observation of defects. This is followed by a very detailed analysis of programs for the simulation of images of first one and then two dislocations and associated stacking faults. Finally the applications and limitations of the technique are discussed and listings of the programs are

presented. The calculations use linear anisotropic elasticity theory in cubic materials, although the more simple dislocation configurations are also computed in tetragonal and hexagonal structures.

It could be argued of course that a full anisotropic calculation may not always be necessary and that if one particular dislocation configuration is being investigated in detail, it may be easier to write a new program rather than extensively modify an existing suite of programs. However, the authors do go to some lengths to explain how various modifications can be effected; hence in principle a wide range of configurations may be simulated. The question remains whether the reader, who needs to be told in chapter three how to orient a diffraction pattern with the corresponding micrograph, will have difficulty interpreting detailed simulations after implementing the program in the later parts of the book.

Although it covers a very limited field, the book should prove to be a comprehensive text for postgraduate students and a useful reference for other workers using the transmission electron microscope for the examination of defects.

G.J.T.