



Figure 2 Porous copper: variation of thermal conductivity at 40°C with density.

sprayed copper (fig. 2) and Smirnov *et al* [14] for plasma-sprayed copper (fig. 1) are in general agreement with the picture presented by the present work. The general conclusion is that the Grootenhuys relationship, while applicable to normally sintered powder compacts, is not suitable for unsintered, sprayed copper although sintering does permanently increase the thermal conductivity to values significantly nearer the Grootenhuys line. The relationship given by Mitoff appears to be even less appropriate for this type of material.

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## Short Notices

### Solid State Surface Science: Volume I

Mino Green (editor)

Pp 420 (Marcel Dekker, New York, 1970) \$18.50

This first volume of a new series contains articles on the nature and statistical thermodynamics of chemisorbed hydrogen on the surface anomaly of electrical transport in crystals, the structure of chemical complexes at semiconductor surfaces

(the editor's special interest), a detailed survey on the methods of measuring the work function of surfaces followed by a critical survey of values for various materials, and an essay on properties (transport properties in particular) of epitaxial lead chalcogenide films compared with the same substances in bulk form. As is proper to the theme, the book pays equal attention to physical and chemical aspects of surfaces, and it should be of particular interest to readers in the semiconductor industry.

R.W.C.

**Phase Transformations***American Society For Metals*

Pp 632 (Chapman &amp; Hall Ltd, 1970) £12·5

This book contains the contributions to a seminar organised by the American Society for Metals in October 1968. It shows in an impressive manner, how improved experimental techniques can be used to test a quantitative theory, which has become increasingly important since Zener published his celebrated theoretical papers in 1946. Such tests have now been performed in such a great number that "comparisons between theory and experiment" could well serve as a subtitle for this collection of papers.

The contributions are arranged in such a manner, that even readers, who are not acquainted with the complex field of phase transformations, may profit by this book. A summarised representation of the crystal geometry and mechanisms in solid-state phase transformations, together with the quoted literature, supplies the background knowledge necessary for the ensuing papers. Since each contribution is also provided with numerous references, the book might serve as a modern introduction to phase transformations. The sole shortcoming results from the fact that phase transformations are considered only in alloys and not in pure metals. As opposed to other Symposia concerned with this topic, where examinations of particular transformations were discussed separately, the contributions to this book deal with the principal aspects of the field illustrating the general features with numerous examples. A subject index enables the reader to find information on any especially interesting transformation.

Particularly remarkable is the extent of that part of the book which is dedicated to the role of imperfections in nucleation and growth mechanisms.

P. R.

**Tensor Properties of Materials  
Generalized Compliance and  
Conductivity***A. R. Billings*

Pp xv + 171 (Wiley—Interscience, London, New York, Sydney, Toronto, 1969) £3·50

The title of this book is somewhat misleading. It does not treat the physical causes of the many

properties of crystals which may be represented in the form of tensors. The author's aim is the generalised mathematical formulation and manipulation of these properties. This is an important undertaking. Everybody who convinced himself of the advantage of the tensor calculus in a special field will be able to see through many other fields of physics and materials science using the generalisation given in Billings book. Real beginners will have to surmount some barrier of notation formalism. To help them was a didactic problem which the author solved very well. In the referees opinion the proportions of explanatory text and mathematical formulae is just the right one.

The unifying concepts used by Billings are, besides the tensor calculus, the definition of elastic properties (in the widest sense) in terms of energy and co-energy state functions (chapters 1 to 5) and Onsager's principle in the last three chapters, concerned with the transport of heat and charge in non-magnetic materials, both in the presence and absence of magnetic fields.

Starting with the total energy density in the presence of electric and magnetic fields the author comes to the interpretation of  $H$  as an intensive and of  $B$  as an extensive parameter. The second Maxwellian equation and the theory of relativity, however, show that  $B$  is an intensive quantity and has the character of a field intensity.

Of course, this does not change the total energy density, but it does affect the partitioning of an energy density as a product of an intensive quantity times the increment of an extensive one.

In conclusion, the book is well recommended, especially for readers who have a knowledge of the effects and their physical meaning, but need a powerful tool for the handling of more complicated problems. The mathematical prerequisites are small. The book contains several valuable appendices concerning the crystal and magnetocrystalline classes and the restrictions on tensor components in these classes.

H. A.

**Crystals and the Polarising Microscope  
(4th ed.)***N. H. Hartshorne and A. Stuart*

Pp xi + 614 (Edward Arnold, London 1970) £9 net.

The fourth edition of the book implies a widening of the group of addressees. It is no longer

intended especially for chemists but for all users of the polarising microscope. The development from edition to edition resulted in a comprehensive presentation of the theory and the applications of the instrument. From this the authors drew the reasonable conclusion to separate the more elementary material for real beginners in a shorter work. "Practical Optical Crystallography" (Edward Arnold, 2nd ed. 1969). So the advanced book kept a handy size. By the way: the explanation of the methods and the instruction for realising them are so detailed in the book under consideration that people with some basic knowledge of optics should not need any other book.

Out of the new material in the book has to be mentioned:

(i) The use of the concept of bond polarisability besides that of atom polarisability in treating the quantitative relationship between optical properties and crystal structure.

(ii) A new chapter on special methods of determining refractive indices (phase contrast illumination, index variation methods, dispersion staining).

(iii) For research workers in materials science most important is the expansion of the section on preparation of hard compact materials. There are new examples of the application of polarisation microscopy to slags, refractories and ceramics. The only drawback is the exclusion of the polarising microscopy of opaque materials. After Berek's and other's work this field should not be missing in such a book and we hope that the authors will write a separate introduction to this field.

(iv) The expanded chapter on liquid crystals deserves special mention.

In accordance with the essentially practical approach the book contains information about all important instruments (and accessories) available throughout the world today.

Many drawings and photographs on an excellent paper supplement the text, and so the price is justified.

H. A.

### **Ordered Alloys – Structural Applications and Physical Metallurgy – Proceedings of the Third Bolton-Landing Conference, 1969.**

(Claitors Publishing Division, Baton Rouge, 1970) \$20.00.

For a long time, intermetallic compounds have been known for their high strength, and they

have been successfully used to provide materials for a variety of engineering applications ranging from dental fillings to aeroengine turbine blades. What is not well known is the underlying mechanism that contributes to the high strength. Only recently, thanks to the electron microscope, is it becoming possible to study the behaviour of these alloys in detail and to generalise their properties on the basis of superdislocations in ordered lattices.

In this context, the publication of the Proceedings of the Third Bolton-Landing Conference on ordering alloys is a timely event. The scope of this conference was sufficiently wide to include contributions on both fundamental aspects of ordering as well as on structural applications of these alloys.

The principal sections are devoted to the theory of order stability, stacking and stacking faults, mechanism and kinetics of ordering, mechanical behaviour of single phase intermetallics as well as multiphase alloys, and engineering properties and applications of these alloys.

In his keynote address, Westbrook explores the history of intermetallics and gives a perspective view of the state-of-art today. He enumerates various important avenues of technology where ordered alloys could fit the bill.

There are several excellent papers, too numerous to justify individual attention here, and many new experimental results are available in this volume that could be of relevance in our understanding of ordering in alloys.

Nickel-based superalloys have been mainly responsible for the phenomenal progress in jet engine technology. These alloys have been developed on an empirical basis, and only now is the microstructure of these alloys being studied in sufficient detail to understand the underlying strengthening mechanisms. There are several lively papers in this volume dealing with this class of alloys, ranging from the metallurgical design of a superalloy to its behaviour during fatigue and creep. These papers suggest that perhaps the day is not far off when useful structural alloys with controlled microstructure could be successfully designed from our fundamental understanding of the mechanisms involved. For twenty dollars, this book is a good buy and the price has really come down. The Proceedings of the second Bolton-Landing Conference cost \$56!

V. S. A.