

BOOK REVIEWS

Electronic Processes in Noncrystalline Materials

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tation of chemical reactions is of this nature. Other papers, for instance J Kalnay's 'The localization problem', are basically surveys of existing literature.

The philosophical papers are regretably weak and one can only hope that a physicist reading the volume will regard them as atypical. S A Kleiner in his 'Criteria for meaning changes in theoretical physics' deals with a standard philosophical problem without reference to the standard objections to his position. And T W Settle appears to have written 'The relevance of philosophy to physics' under the sad delusion that something is proved in philosophy merely by the proliferation of symbols and the advancement of bold, sweeping and undefended claims. W NEWTON-SMITH

A Review of the Structure and Physical Properties of Liquid Crystals

G H Brown, J W Doane and V D Neff
London: Butterworth 1971 pp 94
price £5

This work is a review of the nature and some of the properties of liquid crystals. In the 80 pages or so of text, it is quite clear that it could not be exhaustive or complete. The writers have assumed from the outset some acquaintance with the fundamentals of the subject.

The review consists of 11 sections, the first four being devoted to structure while the fifth is concerned with the effects of external forces on liquid crystals. A section on thermodynamic measurements and the statistical theory of phase transitions follows.

Infrared and Raman spectra, light scattering and spin-lattice relaxation are then reviewed, followed by an account of about 10 pages on the information that can be obtained from NMR, EPR and Mössbauer measurements.

The penultimate section reviews viscosity and a group of other physical properties including very brief comments on Brillouin scattering and on positron annihilation. The final section deals with lyotropic liquid crystals (whereas the main emphasis is on the thermotropic materials), the various structure classes and the transition between different liquid crystal phases.

Particularly in view of both the fundamental and technological interest in this area, this is a valuable review, brief and fairly critical of the literature of this subject since about 1960. Some 250 references are included, including a few on the relatively new topic of diffusion in liquid crystals. N H MARCH

Coherence of Light

J Perina
London: Van Nostrand 1972 pp 315
price £6

This book brings under one cover in a clear presentation much of a stream of

work which has appeared in the literature over the last decade or so, concerned with the interrelation between classical and quantum theories of optical coherence. Only in the 11th of 18 chapters, however, is the optical field quantized so that there is at first a very extensive treatment of classical results. In both parts only the free electromagnetic field is considered.

Beginning with introductory and standard material on the classical theory of the second order (mutual) coherence function, Dr Perina (the middle consonant is pronounced 'zh') moves on to more advanced discussions of matrix formulations of partial coherence, including an interesting interpretation of the degree of coherence as the metric tensor in a noneuclidean space. After a three page chapter on higher order statistical formalism and a useful chapter on imaging, this part of the book concludes with a semiclassical treatment of detection and correlation by absorption detectors.

In the second part of the book there are again short introductory chapters in which one is led up to the quantum mechanical correlation functions of the free transverse field. Disappointingly here we miss treatments of the crucial concept of phase – sine and cosine operators are not mentioned; the basic concept of a spectrum – off diagonal matrix elements of the density matrix are not discussed; and the nature of localized states – the detection operator for massless particles of spin 0 is uncritically and, to be exact, erroneously used for the photon of spin 1.

The specialized machinery of coherent states and the diagonal representation of the density matrix in terms of ultra-distributions over their overcomplete set is then meticulously covered, including the necessary discussions of existence and operator orderings, so that formal relationship between classical and quantum mechanical correlation functions of a particular type can be achieved. The merely formal nature of these relations, which was thought highly fundamental by some authors in earlier years, is now stressed throughout Perina's book. This reviewer cannot help but wonder why everyone does not therefore go back to pre-Glauber days to be spared ultra-distributions and quasiprobabilities in favour of ordinary quantum electrodynamics, for it is difficult to name any one problem in optical theory which is not better done in the time honoured fashion. The statement on p155 that the Glauber states *must* be used to discuss phase is not correct.

Apart from two further short (five page) chapters the remaining substantial content is given in a chapter on the special states of chaotic, laser and super-

posed radiation. Since the analysis of the statistics of laser radiation concerns more than the free field it lies outside the scope of the book and a brief summary only is given. (One is startled, for instance, to read in reference to the laser theory 'the same result was also obtained by Scully and Lamb!'). The other two topics, however, are treated fully, particularly the last one which is an area in which Perina himself has contributed notable theoretical research.

One must give credit for the up to date and thorough coverage of this particular branch of the theoretical literature. In places in fact the book almost reads as a review article. A brave attempt is made also to include experimental research with more limited success, but certainly better than that achieved in the similar book by Klauder and Sudarshan. However, after personally borrowing a large amount of nuclear electronics from Harwell in days of great excitement in 1964, to produce with my colleagues really accurate photon counting distributions for the first time, and to find these first experiments not even referenced (Proceedings of the 1965 Puerto Rico Quantum Electronics Conference) I can only half heartedly recommend this aspect of Perina's coverage. This separation from experiment, not only of this author but of others in the field, may be one of the reasons for – to my mind – the curious orientation towards constructing new formal theory in a basically well understood subject. The practical application of photon statistics and correlation are now widespread in fields of biology, chemistry, physics and engineering where such formal theory has little relevance but where, nevertheless, there is much theoretical progress to be made.

The quasiprobability methods covered are of undoubted mathematical interest and the book can be recommended fully to postgraduate level students with leanings in this direction as well as to those who might wish to have a compact treatment of the second order classical theory. E R PIKE

Electronic Processes in Noncrystalline Materials

N F Mott and E A Davis
London: Oxford University Press 1971
pp xiii + 437 price £7.50

It is hard to think of a physicist other than Professor Mott who would be able to attempt successfully a book of such a broad compass and in Dr Davis, a specialist in the field of amorphous semiconductors, he has found an ideal co-author. The book is divided into two parts: the first deals with the theory of electrons in a noncrystalline medium and its application to liquid metals,

amorphous semimetals and semiconductors. Also discussed are impurity bands, the metal-nonmetal transition and polarons. The second part is devoted to a review of amorphous semiconductors and contains a detailed account of recent experimental work. This is related to a model that has been built up over the past few years by the authors, but it is pleasing that the emphasis is on completeness, rather than on proving their model correct.

Despite the inevitability that in such a rapidly expanding topic some of the information will soon be out of date, this book comes at a time when the ground work of the subject is fairly well established and an overall view is particularly helpful. It is regrettable, therefore, that there are several typographical errors in the text and one hopes that these can be removed in later editions. However it will be necessary reading as well as a valuable source of information to those involved in this field.

R A STREET

Liquid Metals: Chemistry and Physics

S Z Beer

New York: Marcel Dekker 1972

pp x + 731 price \$35

This volume, edited by Sylvan Beer of Conventa Enterprises in Syracuse, New York, consists of 15 chapters, with different authorship for each, except for the chapters on sound propagation and on viscosity, which are both written by R T Beyer and E M Ring, and the chapters on diffraction analysis and on noncrystalline metal alloys, where C N J Wagner is an author in each case. This fact means that the problem of the work lacking a theme, and therefore any real unity, is hard to avoid. Thus, while there is a great deal of valuable information collected between the covers of this volume, it is hardly a *book* about liquid metals.

To give some rough idea of the balance, without wanting to overstress the difference in outlook of different disciplines, five chapters are contributed by authors from physics departments, three from chemistry departments and the remainder from materials sciences and metallurgy schools. This interdisciplinary character of the subject of liquid metals is indeed one of the reasons for its fascination to workers in the field. However, there are not quite enough pegs here to hang the many facts on, and perhaps some more attention should have been given to the basic theory of atomic dynamics and its connections with atomic transport. In this sense, it is a pity that neutron inelastic scattering was not given a chapter, though as remarked above, structural measurements are covered by Wagner. Such a discussion of liquid correlation functions would have helped to tie together the

chapters on viscosity, the one on diffusion by Nachtrieb, the sound propagation discussion and to a lesser extent perhaps, the interesting account of electromigration in alloys by Epstein. These various chapters taken alone are valuable and helpful, but somehow they seem to need linking to fundamental theory, though this would have further increased the size of an already substantial volume.

The opening chapter by C H P Lupis is appropriately enough, about the thermodynamics of metallic solutions followed by Ohno on kinetics of evaporation, while chapter 3 by Lee and Lichter has some further discussion of thermodynamics of alloys, along with electrical properties. Optical properties are dealt with by Hodgson from an experimental and theoretical point of view.

The theory of electron states in liquid metals is drawn on in the articles by Enderby, who deals mainly with pseudopotentials applied to calculate electrical properties, and to find interionic forces, and by Dupree and Seymour on magnetic properties of liquid metals.

In a quite different vein is the article on significant structure theory applied to liquid metals in one chapter by its originator, Eyring, in conjunction with Breiling. To the reviewer, who believes that electron theory must be put right at the centre of the interpretation of properties of liquid metals, it seems worrying that, while we are told that 'conducting (nonlocalized) electrons of a metal are spread out over the positive ions', it is not made clear that any detailed account of this is ever included in the application of significant structure theory to liquid metals.

One of the most interesting articles is by Rappoport on pressure effects on liquid metals, though here it is a bit disconcerting to find as a major heading in the Contents 'Is there short range order in liquids?'! With increasing interest in surface properties, it is nice to find a substantial article on surface tension, by B C Allen, with ten tables and at least the same number of figures, all representing a valuable collection of data. Once again, from the theory side, it would have been helpful to have had at least a reference to Fowler's theory and its later refinements, relating surface tension to structure and forces.

Nevertheless, as remarked at the outset, this book does reflect well the exciting interdisciplinary nature of this field, which was very evident indeed at the second international conference on liquid metals recently concluded in Tokyo. The criticisms offered in this review in no way deny the usefulness of the great majority of the articles in this volume. There are more than 1200 references in the work.

N H MARCH

Semiconductors and Semimetals Vol 8 Transport and Optical Phenomena

Vol 9 Modulation Techniques

R K Willardson and A C Beer (eds)

New York: Academic Press 1972

pp xiii + 574 price \$29.50

This series of books on semiconductors is now in its seventh year, and in the next two years we will have at least four more volumes. The past seven volumes have set a high standard, and they are commonly used as reference works on compound semiconductors.

The current books, volumes 8 and 9, deal mainly with optical properties, though volume 8 is more of a mixed bag, with two chapters on electrical properties. It is a pity these were included, not just because they are out of place, but because they have a number of serious omissions. The first chapter, on indirect gap semiconductors, ignores the important applications of GaP as a light emitting diode and secondary emitter, and refers to its potential for high temperature rectifiers. The second chapter, on thermoelectric effects in III-V compounds, has no reference later than 1967, and reads as though it were written some years ago. The first half of the book concludes with a sound chapter on Faraday rotation.

More than half of this volume is devoted to a treatment of photoluminescence, a timely inclusion since this technique is now becoming an important analytical tool. The subject is divided into two chapters. The first deals with the theory of photoluminescence, but includes a section on experimental techniques. This chapter is well written, and is certainly thorough. The accompanying chapter is not, curiously enough, on general experimental results, but is restricted to GaAs. This presumably reflects the specialist experience of the authors, since there has been much work reported on other semiconductors, especially GaP.

Volume 9 gives a much smoother impression. Not only is it coherent in scope, concentrating on modulation techniques as a tool for studying semiconductors, but the individual chapters are well written accounts of the separate topics, and they mesh nicely. The most thorough description is given to electric field modulation, with chapters on electroreflectance, electro-absorption and the theory of electric field effects on the dielectric function. Other techniques described include magnetic field modulation, temperature and wavelength modulation, and stress modulation. The collection provides a unique description of a branch of experimental physics in