Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.

Acta Cryst. (1982). B**38**, 348

Liquid crystals of one- and two-dimensional order. Edited by W. HELFRICH and G. HEPPKE. Pp xii + 416. Springer-Verlag, 1980. Price DM69·00, US $39·50.

This book compiles the abstracts and papers of a conference on liquid crystals of one- and two-dimensional order and their applications. The papers were presented at the Third European Conference on Liquid Crystals which was held at Garmisch-Partenkirchen, Federal Republic of Germany, January 21–25, 1980. Although the meeting was limited to smectogenic mesomorphs, some nematogenic and cholesteric ones were discussed at the meeting and are consequently included in the book. The abstracts of the papers are grouped into ten sections on the basis of the mesomorphic substance studied or the property investigated.

The first of these sections includes those papers that deal with ordered smectic phases and their structures. Here the historical accidents which resulted in the present ambiguity of smectic nomenclature are enumerated. The characterizations of phases based on miscibility and on structure investigations have resulted in a double use of the terms smectic *G* and *H* phases. After evidence for this multiple use is presented, a joint paper recommends a unified nomenclature in this area. Such uniformity in nomenclature will reduce future ambiguity in the literature of these mesomorphic phases. Other papers in the first section present structural data on smectic liquid crystals and plastic crystals gathered mainly by X-ray and neutron diffraction experiments and by magnetic resonance experiments.

Part II of the book includes papers describing *A* and *C* smectic phases and their structures. Here the reader will find techniques in addition to X-ray diffraction used to illuminate these structures. Included are data from dielectric properties, molecular-packing coefficients, refractive indices, far infrared, nuclear magnetic resonance, and theoretical considerations of packing and molecular motion.

Papers on defects, elasticity, rheology, and special phase transitions are grouped in parts III and IV. The special transitions include a description of re-entrant nematics and $S_{A1} \rightarrow S_{A2}$ transitions, and they include theoretical discussions of order parameters, simple free-energy functions, and transition entropy.

The remaining five parts of the book group papers presenting special applications of mesomorphic structures. Here one finds papers on electro-optical applications of smectogenic compounds with commercial possibilities, cholesteric 'blue phases', polymers that exhibit liquid-crystalline behavior, nematic gels, lyotropic liquid-crystalline materials, applications to biological systems including interfaces, vesicles, and bilayers, and finally the disk-like molecules that also exhibit mesophases.

The papers collected in this book summarize the present state of research in the area. Since 42 of the 83 papers are presented only as one- or two-page abstracts, and as such are limited in the amount of data that can be included, the reading is sometimes frustrating, since it leaves the reader wanting more information. Nevertheless, in each section there are invited papers and other papers that are of sufficient length for both the ideas and the supporting data to be presented.

The final tenth section lists the titles and authors of 28 additional papers which were presented at the meeting.

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Acta Cryst. (1982). B**38**, 348–349

Solid state chemistry: a contemporary overview. Edited by SMITH L. HOLT, JOSEPH B. MILSTEIN and MURRAY ROBBINS. Pp. x + 437. American Chemical Society (Washington, DC), 1980. Price US $59·50.

This interesting and well produced book consists of 21 papers presented at the *First Summer Symposium on Solid State Chemistry*, sponsored by the Solid State Subdivision of the American Chemical Society's Division of Inorganic Chemistry, and held at Laramie, Wyoming, in 1978.

Modern solid-state chemistry is as much a mission as a field. Its fast growth in the last twenty years and its present technological bias are a direct result of the electronic industry's need for large crystals with precisely defined composition and defect structure, plus a more recent, powerful impulse towards the chemical problems that arise in the search for new ways of extracting, storing, and transmitting energy. Such an orientation requires that theorists and practitioners from widely different fields of study be brought together; and the result in this case is a book as stimulating and enlightening as the meeting no doubt was – if, perhaps, a little hard to digest.

The book is divided into three sections: *Application of Physical Techniques to Solid State Chemistry*, *Materials for Energy Conversion, Storage, and Transmission*, and *Preparation and Properties of Diverse Solids* (a subdivision that seems something of an editorial afterthought, needed to put some structure on a stubbornly heterogeneous collection). The first contains papers on some relatively new or unusual techniques. A. B. Denison describes muon spin rotation – 'an exotic probe of the atomic environment': muons (generated with intrinsic spin polarization as a result of the non-conservation of parity) interact with the electrons and local electric and magnetic fields in a solid, and by following their precession and depolarization (actually one traces the positron offspring of their brief lives) one can monitor these fields at various sites. The author suggests that

the present state of this technique can be compared with that of magnetic resonance in its early days, though it seems unlikely that the instrumentation will ever be as widely available. A nicely illustrated paper by L. Eyring surveys the application of high-resolution transmission electron microscopy to crystals. This technique, potentially able to reveal individual atoms as they undergo reaction in a solid (a resolution of 2 Å has been obtained on instruments using 1 MeV or more), has had a profound impact on solid-state chemistry and shows exciting promise for the future. Shear and other defects are made visible (though a practised eye seems necessary to recognize the calculated pattern in the real image), and crystallographers will be fascinated by these photographs and by those of intergrowth domains. The final paper in this section by a group from Argonne is an interesting progress report on the design of a user-orientated single-crystal neutron diffractometer which ingeniously adapts the Laue technique to structure analysis by using the possibility for time-of-flight analysis inherent in a pulsed source.

In the second section, R. A. Laudise (who sees electronic materials as the 'learning medium' on which the science of solid-state chemistry grows as it helps in their development) presents five examples of research at Bell Laboratories, including intercalation compounds (Li in VS_2) as storage-battery electrodes, barium titanates 'engineered' to dielectric specification, and a study of oxide precipitation in 'perfect' silicon crystals. J. B. Goodenough gives a detailed and authoritative analysis of bulk and surface states of pure and doped rutile in relation to its use as a photoelectrode for solar-energy conversion; his passing remark that 'Chemists trained in the concepts of solid state physics are already in too short a supply for industrial demand, and the problem is destined to become more acute in the near future' deserves attention. Other papers in this section include: Robbins on solar cells employing CdSe and CdTe electrodes and a sulphide–polysulphide electrolyte solution (pressure-sintered materials seem as efficient as single crystals in this system); Wold and Dwight on the use of F^- substitution (rather than O^{2-} deficiency) in TiO_2 photoelectrodes, to give conduction without loss of chemical stability; Miller and Epstein on replacement of the *N*-methylphenazinium ion by the neutral phenazine molecule in $NMP^+.TCNQ^-$, which enabled them to study electrical properties as a function of band filling, and the role of disorder in one-dimensional conduction; and Street and Clarke on the structures and properties of the conducting polymers $(SN)_x$ and $(CH)_x$ and their derivatives with such electron acceptors as Br_2, AsF_5, and Ag^+. Finally, the storage problems associated with the 'hydrogen economy' are considered by Wallace, Craig and Rao in an article on hydrogen absorption by intermetallic compounds, where the interest lies in speed of absorption and desorption as much as storage capacity: $LaNi_5H_6$ is typical in dehydrogenating in minutes when pressure is reduced. The structural mysteries here are now being resolved – by neutron diffraction, naturally – and are discussed in some detail.

The last (and longest) section covers very varied ground. R. S. Feigelson discusses crystal growth by electrolysis of molten salts, *e.g.* Si, GaP, and InP from eutectics such as 'Flinak' (LiF–NaF–KF) and 'Pofnak' ($NaPO_3$–NaF–KPO_3–KF); M. A. DiGiuseppe describes the difficult techniques used to grow large rare-earth gallium garnet crystals, needed as substrates for oriented 'magnetic-bubble' films of the Fe analogues (matching of lattice parameters is crucial here); while Milstein discusses methods of growing large crystals of rare-earth intermetallics ($Ho/Tb/DyFe_2$), whose enormous room-temperature magnetostriction directs their use in transducer devices. The 'subtle, but interesting, structural and magnetic properties' of A_xVF_3 systems, described and interpreted by Lee, Williamson and Boo, include superstructures and magnetism–composition discontinuities. J. D. Corbett discusses extended metal–metal interactions in low-valent transition-metal halides, *e.g.* the remarkable chain structure of Gd_2Cl_3 – 'the so-called eighth wonder of the rare-earth world' – from a structural viewpoint, and H. Steinfink shows how conductance and other properties of $Ba_xFe_yS_z$ compounds can be understood on the basis of the clusters and chains of condensed FeS_4 tetrahedra revealed by X-rays and the Fe valency distribution indicated by Mössbauer spectroscopy. Other papers include one on the hydrothermal stability of simulated radioactive-waste glass by G. J. McCarthy and co-workers ('The record for chemical complexity . . . may well be held by problems involving the stability of radioactive wastes'), and one on phase equilibria in the system K_2O–MgO–Fe_2O_3–Al_2O_3–SiO_2 by R. S. Roth.

This was a timely symposium and the authors, editors, printer, and publisher have done a fine job in bringing us their contemporary overview of an important area of research. (My only regret is that no verbal discussion of the papers is included – if it occurred, it was surely fascinating.) Attractive print, few errors, excellent figures, and a good index maintain the high standard of the series, and I think most chemists with an interest in the solid state will want their library to have a copy.

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Acta Cryst. (1982). B**38**, 349–350

Mixed-valence compounds. Edited by D. B. BROWN. Pp. viii + 519. Reidel, 1980. Price Dfl. 115.00, US $60.50.

This book comprises the series of lectures which were given at the NATO Advanced Study Institute at Oxford in 1979. It gives an excellent survey of the present state of mixed-valence chemistry and is likewise interesting for chemists, physicists, mineralogists and biologists. The first part, which consists of three introductory, but instructive chapters (P. Day, A. Ludi, D. B. Brown), is an overview of mixed valency and outlines the essential features of mixed-valence behaviour. Classical examples such as Prussian Blue and others, which are thoroughly investigated and well understood, are discussed. In the second part the different theoretical approaches to the understanding of the electronic structure in mixed-valence compounds are presented in three chapters (T. J. Meyer, P. N. Schatz, N. S. Hush). The considerable development and also the controversy in this field are immediately obvious. The third part describes the application of some experimental methods, which are sensitive to the electronic properties of mixed-valence compounds – such as magnetism (W. E. Hatfield),