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Fifty Years of Electron Diffraction

Fifty Years of Electron Diffraction was published in 1981 by D. Reidel Publishing Company for the International Union of Crystallography and is edited by Peter Goodman, CSIRO, Melbourne, Australia. This important publication is the first of its kind to present the history and the current status report of this rapidly growing subject. It provides a

valuable reference source for students and researchers in the associated fields of crystallography, scattering physics, molecular structures in gases and the electron microscopy of solids. Part I gives a lively, newly researched account of the pioneer period, 1924–1928, when industrial research and early quantum mechanics produced the first definite evidence for electron diffraction. Part II completes the history with memoirs from 36 of the most distinguished scholars in the field. Part III is a text-level reference on six branches of the subject, ranging from scattering theory through to structure analysis. Liberally illustrated, the volume incorporates a comprehensive literature survey.

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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.

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Crystals: growth, properties and applications. Vol. 4. Edited by H. C. FREYHARDT. Pp. 219. Berlin, Heidelberg, New York: Springer Verlag, 1980. Price DM 98.00, US \$ approx 57.90.

This volume contains three independent review articles. Each article is well organized, thorough, clear, and, therefore, easy to read. Each includes much practical information about experimental methods and results, with ample discussion of underlying theory.

The first article is *High purity organic molecular crystals* by Norbert Karl. The article begins with a section on purification, which concentrates principally on zone refining, but also discusses sublimation, distillation, recrystallization, chromatography, chemical reaction, and synthesis. Next is a section which covers methods of growing single crystals, including Bridgman, sublimation, pulling, solution, and melt methods. The next section discusses characterization of the crystals, including analysis of their purity and structural perfection. Finally, two sections cover the preparation of oriented and polished specimens, and applications of the materials. This article has 100 pages and 315 references.

The second article is *Rare-earth germanates* by Ludmila N. Demianets, Anatoly N. Lobachev & Gennadi A. Emelchenko. The first section reviews the crystal structures of these materials. The second section discusses single-crystal growth; it concentrates mainly on hydrothermal methods, with a brief discussion of solution (flux) methods. The final section discusses characterization of the materials, principally by spectroscopic methods. This article has 44 pages and 102 references.

The third article is *Growth, properties, and applications of narrow gap semiconductors* by Horst Maier & Joachim Hesse. This article discusses $\text{Pb}_{1-x}\text{Sn}_x\text{Te}$, $\text{Pb}_{1-x}\text{Sn}_x\text{Se}$, and $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$, and their applications as infrared detectors and laser diodes. First, the material requirements of these devices are discussed. Then a discussion of the phase diagrams of the three systems is given. Two following sections cover the growth of single crystals and epitaxial films. Melt, solution, vapor, Bridgman, zone melting, travelling solvent, solid-state recrystallization, and annealing methods are discussed. Liquid phase, vapor phase, molecular beam, and r.f. sputtering methods of epitaxial film growth are covered. The final section discusses infrared detector and laser diode device structures and technologies. This article has 75 pages and 249 references.

This book is highly recommended to anyone interested in the subjects covered. It will be found useful whether or not the reader has previous experience in these subjects.

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Structural phase transitions. I. Edited by K. A. MÜLLER and H. THOMAS. Pp. x + 190. Berlin: Springer Verlag, 1981. Price \$29.50, DM 50.00.

With the inevitable increase in the degree of specialization, one encounters the problem of either having single-author

books in a narrow field or a multi-author book in a wider field. This is a multi-author book in the specialized field of structural phase transitions, and is the first of an intended series of three volumes in this field. It is really a collection of review articles by experts, each one of whom describes the applications of a particular group of experimental techniques to the study of structural phase transitions. It is necessary to warn crystallographers that the book is not concerned with first-order polymorphic transitions of the reconstructive type, or processes of recrystallization, or the amorphous-to-crystalline transitions. It is also not concerned with martensitic phase transformations, though these find some mention in the last chapter. The book is intended primarily for solid-state physicists working on phase transitions involving only small displacements of atoms or their ordering among equivalent sites. These include displacive transformations which are 'weakly' first order, as well as disordering transformations of second order.

The type of phase transitions discussed in this book and the materials displaying them have been classified as follows.

1. *Materials for which strain is order parameter:* (a) Ferroelectric transitions, e.g. KH_2PO_4 , CsH_2AsO_4 , K-Na-tartrate , etc. (b) Non-electronic transitions, e.g. KCN, NaCN and TeO_2 . (c) Electronic transitions: (i) cooperative Jahn-Teller transitions, e.g. $\text{Ni}_x\text{Zn}_{1-x}\text{Cr}_2\text{O}_4$, CsCuCl_3 , TbVO_4 , TmCd , PrAlO_3 , UO_2 , Fe_3O_4 , etc.; (ii) band Jahn-Teller transitions, e.g. Nb_3Sn , V_3Si and $\text{LaAg}_x\text{In}_{1-x}$; (iii) valence transitions, e.g. $\text{Sm}_{1-x}\text{Y}_x\text{S}$, $\text{Ce}_{1-x}\text{Th}_x$, and TmSe ; (iv) martensitic transitions, e.g. $\text{In}_x\text{Tl}_{1-x}$, AuCuZn_2 , La_3Se_4 , etc.

2. *Materials for which strain is not order parameter:* (a) Phonon transitions (phonon coordinate is order parameter), e.g. SrTiO_3 , CsPbBr_3 , $\text{Sn}_x\text{Ge}_{1-x}\text{Te}$, SiO_2 , BaMnF_4 , $\text{Gd}_2(\text{MoO}_4)_3$, etc. (b) Ferroelectric transitions (electric polarization is order parameter), e.g. $\text{Pb}_5\text{Ge}_3\text{O}_{11}$, BaTiO_3 , $\text{Ca}_2\text{Sr propionate}$, NaNO_2 , triglycine sulphate (TGS), SbSI , etc. (c) Orientational transitions (orientational degree of freedom is order parameter), e.g. NH_4Cl and NH_4Br . (d) Charge density wave transitions, e.g. TTF-TCNQ, $2H\text{-TaSe}_2$, $2H\text{-NbSe}_2$ and $\text{K}_2\text{Pt}(\text{CN})_4\text{Br}_{0.3}\cdot 3\cdot 2\text{H}_2\text{O}$. (e) Solid electrolytes, e.g. RbAg_4I_5 . (f) Incommensurate phase transitions, e.g. K_2SeO_4 , Rb_2ZnCl_4 , $\text{K}_2\text{PbCu}(\text{NO}_2)_6$, etc.

The first chapter by Müller gives a brief introduction to the general aspects of such structural phase transitions (SPT) and defines the various physical processes underlying them. This is followed by three chapters on experimental research by different techniques. Chapter 2 by Lyons & Fleury describes optical investigations of SPT. The techniques discussed include measurements of refractive index and birefringence as well as light scattering, infrared and optical absorption, fluorescence and the recent non-linear optical technique of second harmonic generation. The information that can be obtained by the application of these techniques to the various classes of phase transitions mentioned above is then discussed and compared with the results available from other techniques. Applications to magnetic transitions and recent work on plastic crystals have been excluded.

Chapter 3 by Dorner reviews the applications of inelastic neutron scattering to the study of SPT. The effects of the phase transformations on various types of molecular motions (such as librations, rotational reorientations, translations, soft modes, and relaxation of clusters) occurring in molecular crystals are first discussed. In recent years the dynamics of the incommensurably modulated structures has attracted

considerable attention. Besides the conventional excitations like phonons, magnons and excitons, inelastic neutron scattering enables the study of 'phasons', 'amplitudons' and 'solitons' associated with the incommensurable phase transitions. Such studies are also described.

Chapter 4 by Lüthi & Rehwald, which is the last chapter, presents a review of ultrasonic studies of SPT. The ultrasound behaviour as a function of temperature depends on whether the strain in the crystal couples linearly with the order parameter or through a higher order. If it couples linearly then the strain itself can be taken as the order parameter and an elastic constant vanishes at a second-order phase transition. Examples of ferroelectric-ferroelastic as well as Jahn-Teller varieties are discussed in detail. This is followed by a review of cases where the order parameter couples quadratically with the strain. In such cases an enhanced ultrasound attenuation is observed near T_c . The determination of transition points and phase diagrams by elastic constant measurements is described.

This is an interesting book on a fascinating topic of current interest. Our understanding of structural phase transitions is far from complete and this book will constitute essential reading for those working in this field in future. The last two chapters are accompanied by an exhaustive bibliography listing references right up to 1980, which will prove invaluable to anyone wishing to enter this field of research. The second chapter (on optical studies), which apparently had to await the other two for publication, cites references up to 1977.

This book is the first of a planned series of three volumes on SPT. In the second volume the editors propose to describe the applications of EPR and NMR methods, dielectric measurements and calorimetric techniques to the study of SPT. A third volume on theoretical studies starting with dynamic lattice theory and describing the Landau theory, the general symmetry properties, the renormalization group theory, and the Jahn-Teller-induced SPT will complete the set. The editors are to be congratulated on planning this series of three volumes on SPT. If the subsequent volumes maintain the standards set by this one it will be undoubtedly an excellent series providing an invaluable and comprehensive survey of the present state of knowledge in the field of structural phase transitions.

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Proceedings of the VIth international conference on Raman spectroscopy: linear and nonlinear processes.

Edited by W. F. MURPHY. Pp. xxvi + 710. Amsterdam: North Holland, 1981. Price US \$86.50, Dfl 177.50.

All of the papers presented at the Raman Spectroscopy Conference, which took place in Ottawa, in August 1980, are published here 'in condensed form'.

The titles of the chapters in this volume are: *Scattering by condensed matter; Applications of Raman and laser*