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Book Reviews

High-Energy Electron Diffraction and Microscopy. By L.-M. Peng, S. L. Dudarev and M. J. Whelan. Monographs on the Physics and Chemistry of Materials 61. 535 pages. Oxford University Press: Science Publications 2004. (ISBN 0-19-850074-2) £ 69.95 (Hardbound).

An excellently written monograph is presented, which is strongly recommended for all scientists working in the field of electron diffraction, electron microscopy and X-ray scattering. In 14 chapters the theory of high-energy electron diffraction is given in detail (chs. 1–8) and the ability is discussed (chs. 9–14) to apply the theory for analyses of different types of electron diffraction pattern (e.g. CBED, HOLZ, Kikuchi) as well as for electron microscope imaging. The presentation is at a very high level with respect to the content, quality of figures and pedagogical arrangement. The advantage of the present monograph is due to the stringent combination of the well known former formulations of diffraction theories with very actual new concepts. The latter may especially become very important for new technical developments and methodical enhancements of the last decade towards a more quantitative electron microscopy and spectroscopy.

The volume starts with the fundamentals of high-energy electron diffraction (ch. 1) and resumes the kinematical (ch. 2) and the dynamical theory (chs. 3–5: general, transmission and reflection case, respectively). Chapter 6 considers resonance effects occurring in very special situations of flat surfaces and for narrow intervals of angles of the incident beam, which may be the most comprehensive description of this interesting topic up to now. Chapters 7 and 8 deal with the diffuse and inelastic scattering, considering the elementary processes and the multiple scattering effects, respectively. The latter are consequently based on the van Hove dynamic form factor formulation. The thorough treatment to relate the different theoretical descriptions to a general matrix theory and the justification of the derivations within the density matrix framework of modern quantum theory of many particle physics should be mentioned as two of the new aspects in the presentation. It is pointed out that the dynamical theory is necessary to obtain relevant results in nearly all cases, especially when the phases are important. Nevertheless, whenever possible valuable approximations are discussed.

Chapter 9 provides one of the best ever seen survey in space group analysis by applying CBED techniques. Chapter 10 presents a perturbation description with respect to the crystal potential which is a kind of linearization of the dynamical theory. This allows a simplified analytic description as well as a direct inversion of THEED data, both actual developments in this field of research. Chapters 11 and 12 provide surveys of the digital recording of images (CCD-cameras) and of the image formation discussing the influence of coherence and the exit wave retrieval. Finally, chapters 13 and 14 introduce the approximations of the optical potential and the temperature dependent Debye-Waller factors, respectively, including extensive tables of recalculated data in parametrized form.

The book has 4 appendices providing valuable mathematical tools used many times in the book, as e.g. the Green's function theory, and FORTRAN listings to calculate potential coefficients, scattering factors and to solve RHEED dynamically. Whoever believe that newer programming languages may be better, should accept that for work in progress most physicists still prefer programming in FORTRAN.

Finally, some criticism should be mentioned. Whereas due to one of the authors (Dudarev) the excellent Russian work done in the past is now adequately included, the developments of Radi, Yoshioka, and especially the dynamic mixed form factor theory by Rose and the Green's function theory of half spaces by the Amelinckx group are insufficiently considered. Completely missing are such important new developments as the electron holography and the defocus variation technique to reconstruct the exit wave function, the inverse solutions of the object reconstruction, and the very well known Lamla's and others solution for the degeneracy of the eigenvalue equations if equal z-components of the scattering vectors occur, etc. However, all this is marginal. The monograph is excellent and highly recommended by the referee.

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Epitaxy. Physical Principles and Technical Implementation. By M. A. Herman, W. Richter, and H. Sitter. Springer Series in Materials Science Vol. 62. XV + 522 pp., with 305 figures. Springer-Verlag Berlin, Heidelberg. (ISBN 3-540-67821-2) EUR 99.95, US $ 119.00 (Hardcover).

The understanding of epitaxial growth processes is mandatory for the development of material research, solid state physics, -chemistry, and several new technologies. The book on hand as part of the Springer Series in Materials Science contains experimental and theoretical aspects of the epitaxial growth process including very recent developments in a compact and clear manner. The book is divided into 5 parts: I. Basic Concepts, II. Technical Implementation, III. In-situ Analysis of the Growth Processes, IV. Physics of Epitaxy, and V. Heteroepitaxy.

In part I (1. Introduction, 2. Homo- and Heteroepitaxial Crystallization Phenomena, 3. Application Areas of Epitaxially Grown Layer Structures) the basics of epitaxy, i.e. growth mechanisms, creation of lattice defects, low-dimensional structures, and problems of heteroepitaxy are introduced. These topics are further extended in the following parts. Part II gives a detailed and informative overview of the most important epitaxial growth techniques (4. Solid Phase Epitaxy, 5. Liquid Phase Epitaxy, 6. Vapor Phase Epitaxy, 7. Molecular Beam Epitaxy, 8. Metal Organic Vapor Phases Epitaxy). Part III (9. In-situ Analysis of the Growth Processes, 10. In-situ Surface Analysis) contains a complete discussion of methods for the determination of gas phase products, surface species, and –reconstructions in molecular beam epitaxy and metalorganic vapor phase epitaxy. The complex nature of epitaxial growth processes is shown in part IV (11. Thermodynamic Aspects, 12. Atomistic Aspects, 13. Quantum Me-