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High-Resolution Electron Microscopy for Materials Science High-Resolution Electron Microscopy Electron Diffraction and High-Resolution Electron Microscopy of Mineral Structures In-situ Electron Microscopy at High Resolution High-Resolution Transmission Electron Microscopy High-resolution Electron Microscopy In-Situ Electron Microscopy at High Resolution Quantitative Atomic-Resolution Electron Microscopy High-resolution Electron Microscopy Experimental High-resolution Electron Microscopy Electron Diffraction and High-Resolution Electron Microscopy of Mineral Structures Introduction to Electron Microscopy Aberration-Corrected Imaging in Transmission Electron Microscopy High-Resolution Electron Microscopy for Materials Science Scanning Transmission Electron Microscopy Advanced Computing in Electron Microscopy High-resolution Transmission Electron Microscopy and Associated Techniques Low Voltage Electron Microscopy High-resolution Electron Microscopy of Advanced Materials Quantitative high-resolution electron microscopy and holography Liquid Cell Electron Microscopy High Resolution Electron Microscopy Transmission Electron Microscopy High resolution electron microscopy High-resolution electron microscopy : proceedings of the Arizona State University Centennial Symposium on High-Resolution Electron Microscopy, Tempe, Arizona, USA, 7 - 11 January 1985 4D Electron Microscopy Quantitative High Resolution Electron Microscopy The Operation and Calibration of the Electron Microscope High-voltage and High-resolution Electron Microscopy Atomic-Resolution 3D Electron Microscopy with Dynamic Diffraction High-Resolution Imaging and Spectrometry of Materials High Resolution and High Voltage Electron Microscopy Transmission Electron Microscopy High-voltage and High-resolution Electron Microscopy High Resolution Electron Microscope Imaging and Quantification of Interface Structure in X-Ray Multilayers Single Atom Imaging in High Resolution Electron Microscopy Characterization of High Tc Materials and Devices by Electron Microscopy Electron Microscopy at Atomic Resolution Single-particle Cryo-electron Microscopy High Resolution Electron Microscopy of Nephrite

High Resolution Electron Microscopy of Nephrite Dec 23 2019

High resolution electron microscopy May 08 2021

Characterization of High Tc Materials and Devices by Electron Microscopy Mar 25 2020
This is a clear account of the application of electron-based microscopies to the study of high-Tc superconductors. Written by leading experts, this compilation provides a comprehensive review of scanning electron microscopy, transmission electron microscopy and scanning transmission electron microscopy, together with details of each technique and its applications. Introductory chapters cover the basics of high-resolution transmission electron microscopy, including a chapter devoted to specimen preparation techniques, and microanalysis by scanning transmission electron microscopy. Ensuing chapters examine identification of superconducting compounds, imaging of superconducting properties by low-temperature scanning electron microscopy, imaging of vortices by electron holography and electronic structure determination by electron energy loss spectroscopy. The use of scanning tunnelling microscopy for exploring surface morphology, growth processes and the mapping of superconducting carrier distributions is discussed. Final chapters consider applications of electron microscopy to the analysis of grain boundaries, thin films and device structures.

Detailed references are included.

High-resolution Electron Microscopy Nov 25 2022

Quantitative Atomic-Resolution Electron Microscopy Sep 23 2022 Quantitative Atomic-Resolution Electron Microscopy, Volume 217, the latest release in the Advances in Imaging and Electron Physics series merges two long-running serials, Advances in Electronics and Electron Physics and Advances in Optical and Electron Microscopy. The series features extended articles on the physics of electron devices (especially semiconductor devices), particle optics at high and low energies, microlithography, image science, digital image processing, electromagnetic wave propagation, electron microscopy, and the computing methods. Chapters in this release include Statistical parameter estimation theory, Efficient fitting algorithm, Statistics-based atom counting , Atom column detection, Optimal experiment design for nanoparticle atom-counting from ADF STEM images, and more. Contains contributions from leading authorities on the subject matter Informs and updates on the latest developments in the field of imaging and electron physics Provides practitioners interested in microscopy, optics, image processing, mathematical morphology, electromagnetic fields, electrons and ion emission with a valuable resource

Atomic-Resolution 3D Electron Microscopy with Dynamic Diffraction Nov 01 2020 Achievement of atomic-resolution electron-beam tomography will allow determination of the three-dimensional structure of nanoparticles (and other suitable specimens) at atomic resolution. Three-dimensional reconstructions will yield ''section'' images that resolve atoms overlapped in normal electron microscope images (projections), resolving lighter atoms such as oxygen in the presence of heavier atoms, and atoms that lie on non-lattice sites such as those in non-periodic defect structures. Lower-resolution electron microscope tomography has been used to produce reconstructed 3D images of nanoparticles [1] but extension to atomic resolution is considered not to be straightforward. Accurate three-dimensional reconstruction from two-dimensional projections generally requires that intensity in the series of 2-D images be a monotonic function of the specimen structure (often specimen density, but in our case atomic potential). This condition is not satisfied in electron microscopy when specimens with strong periodicity are tilted close to zone-axis orientation and produce ''anomalous'' image contrast because of strong dynamic diffraction components. Atomic-resolution reconstructions from tilt series containing zone-axis images (with their contrast enhanced by strong dynamical scattering) can be distorted when the stronger zone-axis images overwhelm images obtained in other ''random'' orientations in which atoms do not line up in neat columns. The first demonstrations of 3-D reconstruction to atomic resolution used five zone-axis images from test specimens of staurolite consisting of a mix of light and heavy atoms [2,3]. Initial resolution was to the 1.6Å Scherzer limit of a JEOL-ARM1000. Later experiments used focal-series reconstruction from 5 to 10 images to produce staurolite images from the ARM1000 with resolution extended beyond the Scherzer limit to 1.38Å [4,5]. To obtain a representation of the three-dimensional structure, images were obtained in zone-axis projections 100, 010, 001, 101, 310, and combined to produce a three-dimensional map of Coulomb potential. Images of specimen sections are much more easily interpreted than projection images such as electron micrographs, reducing the need for techniques such as imaging at sub-Rayleigh resolution [6]. Sections through the 3D staurolite potential show atom positions as density peaks that display streaking from insufficient sampling in direction [1]. Three different specimens of perfect crystal were required to achieve the five projection directions; this makes the technique atomic-resolution electron crystallography rather than atomic-resolution tomography. Nevertheless, our results illustrate that dynamic diffraction need not be a limiting factor in atomic-resolution tomographic reconstruction. We have proposed combining ultra-high (sub-Angstrom) resolution zone-axis images with off-zone images by first using linear reconstruction of the off-zone images while excluding images obtained within a small range of tilts (of the order of 60 milliradian) of any zone-axis orientation [7], since it has been shown that dynamical effects can be mitigated by slight off-axis tilt of the specimen [8]. The (partial) reconstruction would then be used as a model for forward calculation by image simulation [9] in zone-axis directions and the structure refined iteratively to achieve satisfactory fits with the experimental zone-axis data. Another path to atomic-resolution tomography would combine ''zone-axis tomography'' with high-resolution dark-field hollow-cone (DFHC) imaging. Electron diffraction theory indicates that dynamic (multiple) scattering is much reduced under highly-convergent illumination. DFHC TEM is the analog of HAADF STEM, and imaging theory shows that image resolution can be enhanced under these conditions [10]. Images obtained in this mode could provide the initial reconstruction, with zone-axis images used for refinement [11].

High-resolution Electron Microscopy Aug 23 2022

High-resolution Transmission Electron Microscopy and Associated Techniques Dec 15 2021

Advanced Computing in Electron Microscopy Jan 16 2022 This updated and revised edition of a classic work provides a summary of methods for numerical computation of high resolution conventional and scanning transmission electron microscope images. At the limits of resolution, image artifacts due to the instrument and the specimen interaction can complicate image interpretation. Image calculations can help the user to interpret and understand high resolution information in recorded electron micrographs. The book contains expanded sections on aberration correction, including a detailed discussion of higher order (multipole) aberrations and their effect on high resolution imaging, new imaging modes such as ABF (annular bright field), and the latest developments in parallel processing using GPUs (graphic processing units), as well as updated references. Beginning and experienced users at the advanced undergraduate or graduate level will find the book to be a unique and essential guide to the theory and methods of computation in electron microscopy.

High-Resolution Electron Microscopy Mar 30 2023 This book describes how to see atoms using electron microscopes. This new edition includes updated sections on applications and new uses of atomic-resolution transmission electron microscopy. Several new chapters and sources of software for image interpretation and electron-optical design have also been added.

Quantitative High Resolution Electron Microscopy Feb 02 2021

High Resolution Electron Microscope Imaging and Quantification of Interface Structure in X-Ray Multilayers May 27 2020 We discuss the applications and limits of high resolution electron microscopy (HREM) to quantifying atomic-scale structure in X-Ray mirror multilayer (XMM) structures. It is shown how detailed processing of HREM images can yield quantitative measurements of interface planarity and diffuseness, which are critical parameters in determining the reflectivity of XMM structures. Application of HREM to the study of atomic-scale interface structure is established in a wide range of materials systems. For many classes of structures, including XMMs, absolutely abrupt, planar interfaces are desired. Deviations from ideality of such interfaces may be defined-in terms of the interface roughness, delta R and interface diffuseness, delta D. In Figure 1 we illustrate a simple model which defines interface structure in terms of these concepts, and which is amenable to measurement by HREM (2). The interface normal is along the z direction and lies between two materials A and B. The reference position of the interface is arbitrarily-defined as the limit of pure material A.

High Resolution Electron Microscopy Jul 10 2021

High-voltage and High-resolution Electron Microscopy Dec 03 2020

High-Resolution Transmission Electron Microscopy Dec 27 2022 This book provides an introduction to the fundamental concepts, techniques, and methods used for electron microscopy at high resolution in space, energy, and even in time. It delineates the theory of elastic scattering, which is most useful for spectroscopic and chemical analyses. There are also discussions of the theory and practice of image calculations, and applications of HRTEM to the study of solid surfaces, highly disordered materials, solid state chemistry, mineralogy, semiconductors and metals. Contributors include J. Cowley, J. Spence, P. Buseck, P. Self, and M.A. O'Keefe. Compiled by experts in the fields of geology, physics and chemistry, this comprehensive text will be the standard reference for years to come.

Electron Diffraction and High-Resolution Electron Microscopy of Mineral Structures Jun 20 2022

High-Resolution Imaging and Spectrometry of Materials Oct 01 2020 The characterisation of materials and material systems is an essential aspect of materials science. A few decades ago it became obvious that, because the properties of materials depend so critically on the microstructure of their components, this characterisation must be determined to the atomic level. This means that the position - as well as the nature - of individual atoms has to be determined at "critical" regions close to defects such as dislocations, interfaces, and surfaces. The great impact of advanced transmission electron microscopy (TEM) techniques became apparent in the area of semiconducting materials, where the nature of internal interfaces between silicon and the corresponding silicides could be identified, and the results used to enhance the understanding of the properties of the compounds studied. At that time, advanced TEM techniques existed predominantly in the US. However, advanced TEM instrumentation was not available in the ma terials science and solid-state science communities in Germany. This gap was bridged by the late Peter Haasen who, after a visit to the US, initiated a Priority Programme on Microstructural Characterisation at the Volkswagen Foundation (Hannover). The programme was in effect from 1985 to 1997 and supported a wide range of research projects - from fundamental, trendy, innovative projects to projects in applied materials science.

High-voltage and High-resolution Electron Microscopy Jun 28 2020

The Operation and Calibration of the Electron Microscope Jan 04 2021

<u>High Resolution and High Voltage Electron Microscopy</u> Aug 30 2020

<u>High-resolution Electron Microscopy of Advanced Materials</u> Oct 13 2021 This final report chronicles a three-year, Laboratory Directed Research and Development (LDRD) project at Los Alamos National Laboratory (LANL). The High-Resolution Electron Microscopy Facility has doubled in size and tripled in quality since the beginning of the three-year period. The facility now includes a field-emission scanning electron microscope, a 100 kV field-emission scanning transmission electron microscope (FE-STEM), a 300 kV field-emission high-resolution transmission electron microscope (FE-HRTEM), and a 300 kV analytical transmission electron microscope. A new orientation imaging microscope is being installed. X-ray energy dispersive spectrometers for chemical analysis are available on all four microscopes; parallel electron energy loss spectrometers are operational on the FE-STEM and FE-HRTEM. These systems enable evaluation of local atomic bonding, as well as chemical composition in nanometer-scale regions. The FE-HRTEM has a point-to-point resolution of 1.6 Å, but the resolution can be pushed to its information limit of 1 Å by computer reconstruction of a focal series of images. HRTEM has been used to image the atomic structure of defects such as dislocations, grain boundaries, and interfaces in a variety of materials from superconductors and ferroelectrics to structural ceramics and intermetallics.

Transmission Electron Microscopy Jul 30 2020 This groundbreaking text has been established as the market leader throughout the world. Profusely illustrated, the book provides the necessary instructions for successful hands-on application of this versatile materials characterization technique.

In-Situ Electron Microscopy at High Resolution Oct 25 2022

<u>Electron Microscopy at Atomic Resolution</u> Feb 23 2020 The direct imaging of atomic structure in solids has become increasingly easier to accomplish with modern transmission electron microscopes, many of which have an information retrieval limit near 0.2 nm point resolution. Achieving better resolution, particularly with any useful range of specimen tilting, requires a major design effort. This presentation describes the new Atomic Resolution Microscope (ARM), recently put into operation at the Lawrence Berkeley Laboratory. Capable of 0.18 nm or better interpretable resolution over a voltage range of 400 kV to 1000 kV with +- 40° biaxial

specimen tilting, the ARM features a number of new electron-optical and microprocessor-control designs. These are highlighted, and its atomic resolution performance demonstrated for a selection of inorganic crystals.

4D Electron Microscopy Mar 06 2021 Structural phase transitions, mechanical deformations, and the embryonic stages of melting and crystallization are examples of phenomena that can now be imaged in unprecedented structural detail with high spatial resolution, and ten orders of magnitude as fast as hitherto. No monograph in existence attempts to cover the revolutionary dimensions that EM in its various modes of operation nowadays makes possible. The authors of this book chart these developments, and also compare the merits of coherent electron waves with those of synchrotron radiation. They judge it prudent to recall some important basic procedural and theoretical aspects of imaging and diffraction so that the reader may better comprehend the significance of the new vistas and applications now afoot. This book is not a vade mecum - numerous other texts are available for the practitioner for that purpose.

High-Resolution Electron Microscopy for Materials Science Apr 30 2023 High-resolution electron microscopy (HREM) has become a most powerful method for investigating the internal structure of materials on an atomic scale of around 0.1 nm. The authors clearly explain both the theory and practice of HREM for materials science. In addition to a fundamental formulation of the imaging process of HREM, there is detailed explanation of image simulationindispensable for interpretation of high-resolution images. Essential information on appropriate imaging conditions for observing lattice images and structure images is presented, and methods for extracting structural information from these observations are clearly shown, including examples in advanced materials. Dislocations, interfaces, and surfaces are dealt with, and materials such as composite ceramics, high-Tc superconductors, and quasicrystals are also considered. Included are sections on the latest instruments and techniques, such as the imaging plate and quantitative HREM.

High-resolution electron microscopy : proceedings of the Arizona State University Centennial Symposium on High-Resolution Electron Microscopy, Tempe, Arizona, USA, 7 - 11 January 1985 Apr 06 2021

Introduction to Electron Microscopy May 20 2022 Basic theory of electron microscopy; Nature of light beams; Resolution; Diffraction; Limit of resolution; Nature of electron beams; Electron emission; Electron optics; Introduction; Magnetic fields; Action of magnetic fields as lenses; Magnetic focusing; Evolution of magnetic lenses for electron microscopy; Analogy between light and electron microscopes; The electron microscope; Illuminating system; Electron gun; Filament; Shield; Anode; Non-biased and biased guns; Self-biased gun; Operation of self-biased gun; Condenser lens; Aperture angle; Intensity; Depth of field; Condenser lens operation; Imaging system; Objective lens; Pole pieces; Lens aberration spherical and chromatic; Limitation of objective lens aberration; Contrast and image formation; Objective lens operation; Projecton lens; magnification and final image formation; Range of magnification; Image translating system; Fluorescent observation screen; Photographic recording; Summary of general considerations in image translation; Beam intensity level; Choice of photographic emulsion; Other electron microscope components; Specimen chamber and holder; Photographic chamber; Vacuum supply; Filament current supply; High voltage supply; Operational requirements; Alignment; Electron gun-condenser alignment; Lens alignment; Detection of lens asymmetry; Disturbances; Magnetic fields; Mechanical; Specimen instability; Contamination; Vacuum leaks; Operation of the electron microscope; Manipulation; Photography; Determination of magnification; Test of resolution; Differences between light and electron microscope.

In-situ Electron Microscopy at High Resolution Jan 28 2023 In-situ high-resolution electron microscopy is a modern and powerful technique in materials research, physics, and chemistry. In-situ techniques are hardly treated in textbooks of electron microscopy. Thus, there is a need to collect the present knowledge about the techniques and achievements of in-situ electron microscopy in one book. Since high-resolution electron microscopes are available in most modern laboratories of materials science, more and more scientists or students are starting to work on this subject.In this comprehensive volume, the most important techniques and achievements of in-situ high-resolution electron microscopy will be reviewed by renowned experts. Applications in several fields of materials science will also be demonstrated.

Single-particle Cryo-electron Microscopy Jan 22 2020 The book reproduces 55 of more than 300 articles written by the author, representing milestones in methods development of single-particle cryo-EM as well as important results obtained by this technique in the study of biological macromolecules and their interactions. Importantly, neither symmetries nor ordered arrangements (as in two-dimensional crystals, helical assemblies, icosahedral viruses) are required. Although the biological applications are mainly in the area of ribosome structure and function, the elucidation of membrane channel structures and their activation and gating mechanisms are represented, as well. The book is introduced by a commentary that explains the original development of concepts, describes the contributions of the author's colleagues and students, and shows how challenges were overcome as the technique matured. Along the way, the ribosome served as an example for a macromolecule with intricate structure and conformational dynamics that pose challenges for three-dimensional visualization. Toward the end of the book -- bringing us to the present time -- molecular structures with near-atomic resolution are presented, and a novel type of computational analysis, manifold embedding, is introduced. Single-particle cryo-EM is currently revolutionizing structural biology, presenting a powerful alternative to X-ray crystallography as a means to solve the structure of biological macromolecules. The book presents in one place a number of articles containing key advances in mathematical and computational methods leading up to the present time. Secondly, the development of the technique over the years is reflected by ever-expanding discoveries in the field of ribosome structure and function. Thirdly, as all histories of ideas, the history of concepts pertaining to this new method of visualization is fascinating all in itself.

Quantitative high-resolution electron microscopy and holography Sep 11 2021

Electron Diffraction and High-Resolution Electron Microscopy of Mineral Structures Feb 26 2023 The decision of Springer-Verlag to publish this book in English came as a pleasant surprise. The fact is that I started writing the first version of the book back in 1978. I wished to attract attention to potentialities inherent in selected-area electron diffraction (SAED) which, for various reasons, were not being put to use. By that time, I had at my disposal certain structural data on natural and synthetic minerals obtained using SAED and high-resolution electron microscopy (HREM), and this stimulated my writing this book. There were several aspects concerning these data that I wished to emphasize. First, it was mostly new and understudied minerals that possess the peculiar structural features studied by SAED and HREM. This could interest mineralogists, crystallo chemists, and crystallographers. Second, the results obtained indi cated that, under certain conditions, SAED could be an effective, and sometimes the only possible, method for structure analysis of minerals. This inference was of primary importance, since fine dispersion and poor crystallinity of numerous natural and synthe tic minerals makes their structure study by conventional diffrac tion methods hardly possible. Third, it was demonstrated that in many cases X-ray powder diffraction analysis of dispersed miner als ought to be combined with SAED and local energy dispersion analysis. This was important, since researchers in structural min eralogy quite often ignored, and still ignore even the simplest in formation which is readily available from geometrical analysis of SAED patterns obtained from microcrystals.

Transmission Electron Microscopy Jun 08 2021 The aim of this monograph is to outline the physics of image formation, electron–specimen interactions, and image interpretation in transmission el- tron microscopy. Since the last edition, transmission electron microscopy has undergone a rapid evolution. The introduction of monochromators and - proved energy ?lters has allowed electron energy-loss spectra with an energy resolution down to about 0.1 eV to be obtained, and aberration correctors are now available that push the point-to-point resolution limit down below 0.1 nm. After the untimely death of Ludwig Reimer, Dr. Koelsch from Springer- Verlag asked me if I would be willing to prepare a new edition of the book. As it had served me as a reference for more than 20 years, I agreed without hesitation. Distinct from more specialized books on speci?c topics and from books intended for classroom teaching, the Reimer book starts with the basic principles and gives a broad survey of the state-of-the-art methods, comp- mented by a list of references to allow the reader to ?nd further details in the literature. The main objective of this revised edition was therefore to include the new developments but leave the character of the book intact. The presentation of the material follows the format of the previous e- tion as outlined in the preface to that volume, which immediately follows. A few derivations have been modi?ed to correspond more closely to modern textbooks on quantum mechanics, scattering theory, or solid state physics.

Low Voltage Electron Microscopy Nov 13 2021 Part of the Wiley-Royal Microscopical Society Series, this book discusses the rapidly developing cutting-edge field of low-voltage microscopy, a field that has only recently emerged due to the rapid developments in the electron optics design and image processing. It serves as a guide for current and new microscopists and materials scientists who are active in the field of nanotechnology, and presents applications in nanotechnology and research of surface-related phenomena, allowing researches to observe materials as never before.

Experimental High-resolution Electron Microscopy Jul 22 2022 The new edition of this highly practical microscopy guide covers a wider range of applications and includes a new chapter on associated techniques along with new material on high-resolution images of periodic structures.

Aberration-Corrected Imaging in Transmission Electron Microscopy Apr 18 2022 Aberration-Corrected Imaging in Transmission Electron Microscopy provides an introduction to aberration-corrected atomic-resolution electron microscopy imaging in materials and physical sciences. It covers both the broad beam transmission mode (TEM; transmission electron microscopy) and the scanning transmission mode (STEM; scanning transmission electron microscopy). The book is structured in three parts. The first part introduces the basics of conventional atomic-resolution electron microscopy imaging in TEM and STEM modes. This part also describes limits of conventional electron microscopes and possible artefacts which are caused by the intrinsic lens aberrations that are unavoidable in such instruments. The second part introduces fundamental electron optical concepts and thus provides a brief introduction to electron optics. Based on the first and second parts of the book, the third part focuses on aberration correction; it describes the various aberrations in electron microscopy and introduces the concepts of spherical aberration correctors and advanced aberration correctors, including correctors for chromatic aberration. This part also provides guidelines on how to optimize the imaging conditions for atomic-resolution STEM and TEM imaging. This second edition has been completely revised and updated in order to incorporate the very recent technological and scientific achievements that have been realized since the first edition appeared in 2010.

Single Atom Imaging in High Resolution Electron Microscopy Apr 26 2020

Liquid Cell Electron Microscopy Aug 11 2021 2.6.2 Electrodes for Electrochemistry

High-Resolution Electron Microscopy for Materials Science Mar 18 2022

Scanning Transmission Electron Microscopy Feb 14 2022 Scanning transmission electron microscopy has become a mainstream technique for imaging and analysis at atomic resolution and sensitivity, and the authors of this book are widely credited with bringing the field to its present popularity. Scanning Transmission Electron Microscopy(STEM): Imaging and Analysis will provide a comprehensive explanation of the theory and practice of STEM from introductory to advanced levels, covering the instrument, image formation and scattering theory, and definition and measurement of resolution for both imaging and analysis. The authors will present examples of the use of combined imaging and spectroscopy for solving materials problems in a variety of fields, including condensed matter physics, materials science, catalysis, biology, and nanoscience. Therefore this will be a comprehensive reference for those working in applied fields wishing to use the technique, for graduate students learning microscopy for the first time, and for specialists in other fields of microscopy.

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