Time Resolved Electron Diffraction For Chemistry Biology And Material Science Volume 184 Advances In Imaging And Electron Physics

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13-14 July 1995, San Diego, California
Time-resolved Low-energy Electron Diffraction and Photoemission Pump-probe Experiments
Springer Handbook of Microscopy
A Technique and Procedure to Study the Photoexcitation of Molecules
Investigating Photoinduced Structural Changes in Si Using Femtosecond Electron Diffraction
Nanosecond Time Resolved Electron Diffraction Studies of the (Alpha) to (Beta) Transition in Pure Ti Thin Films Using the Dynamic Transmission Electron Microscope (DTEM).
Ultrafast Electron Diffraction
Advances in Electronics and Electron Physics

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JUSTICE BAKER

Time Resolved Electron Diffraction Royal Society of Chemistry The Dynamic Transmission Electron Microscope (DTEM) project is developing an in situ electron microscope with nanometer- and nanosecond-scale resolution for the study of rapid laser-driven processes in materials. We report on the results obtained in a year-long LDRD-supported effort to develop DTEM techniques and results for phase transitions in molecular crystals, reactive multilayer foils, and melting and resolidification of bismuth. We report the first in situ TEM observation of the HMX [beta]-[delta] phase transformation in sub-[mu]m crystals, computational results suggesting the importance of voids and free surfaces in the HMX transformation kinetics, and the first electron diffraction patterns of intermediate states in fast multilayer foil reactions. This project developed techniques which are applicable to many materials systems and will continue to be employed within the larger DTEM effort.

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Academic Press

The acceleration of the technical capabilities of X-ray, electron and neutron diffraction techniques in recent years has been driven by developments in synchrotron and neutron sources, detectors and computers. These allow the rapid and repeated acquisition of diffraction data as a chemical and biological structural process proceeds, following its initiation. This opens up completely new studies from timescales ranging from the sub-picosecond, at the fastest, through all the time domains up to kiloseconds, for the slower molecular processes.

Time-resolved Low-energy Electron Diffraction and Photoemission Pump-probe Experiments

Springer

The Schottky electron emitter is a predominant electron-emitting source in today's electron beam equipment. This book comprehensively covers the Schottky emitter, dealing with its theoretical as well as practical aspects. The main questions that are addressed in this book are: what is the Schottky electron emitter? How does it work? And how do its properties affect the performance of electron beam equipment? The focus is on the direct link between the operating conditions of the source and the properties of the beam at the target level. This coupling is made clear by discussing the effect of the operating conditions and the geometry of the source and gun on the emission properties of the emitting surface, the effect of Coulomb interactions on the brightness and energy spread in the first few millimeters of the beam path, and the effect of the operating conditions and the shape of the emitter on the consequences of the beam at the target. The final chapter combines all these effects to demonstrate that there is a trade-off to be made between brightness, energy spread, and shape stability.

Springer Handbook of Microscopy BoD –

Books on Demand
An rf photocathode electron gun is used as an electron source for ultrafast time-resolved pump-probe electron diffraction. We observed single-shot diffraction patterns from a 160 nm Al foil using the 5.4 MeV electron beam from the Gun Test Facility at the Stanford Linear Accelerator. Excellent agreement with simulations suggests that single-shot diffraction experiments with a time resolution approaching 100 fs are possible.

A Technique and Procedure to Study the Photoexcitation of Molecules Society of Photo Optical
Advances in Imaging & Electron Physics merges two long-running serials—Advances in Electronics & Electron Physics and Advances in Optical & 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 and digital image processing, electromagnetic wave propagation, electron microscopy, and the computing methods used in all these domains. Contributions from leading authorities Informs and updates on all the latest developments in the field

Investigating Photoinduced Structural Changes in Si Using Femtosecond

Electron Diffraction Springer Nature 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.

Nanosecond Time Resolved Electron Diffraction Studies of the (Alpha) to (Beta) Transition in Pure Ti Thin Films Using the Dynamic Transmission Electron Microscope (DTEM). CRC Press This book features reviews by leading experts on the methods and applications of modern forms of microscopy. The recent awards of

Nobel Prizes awarded for super-resolution optical microscopy and cryo-electron microscopy have demonstrated the rich scientific opportunities for research in novel microscopies. Earlier Nobel Prizes for electron microscopy (the instrument itself and applications to biology), scanning probe microscopy and holography are a reminder of the central role of microscopy in modern science, from the study of nanostructures in materials science, physics and chemistry to structural biology. Separate chapters are devoted to confocal, fluorescent and related novel optical microscopies, coherent diffractive imaging, scanning probe microscopy, transmission electron microscopy in all its modes from aberration corrected and analytical to in-situ and time-resolved, low energy electron microscopy, photoelectron microscopy, cryo-electron microscopy in biology, and also ion microscopy. In addition to serving as an essential reference for researchers and teachers in the fields such as materials science, condensed matter physics, solid-state chemistry, structural biology and the molecular sciences generally, the Springer Handbook of Microscopy is a unified, coherent and pedagogically attractive text for advanced students who need an authoritative yet

accessible guide to the science and practice of microscopy.
World Scientific
These two volumes on Femtochemistry present a timely contribution to a field central to the understanding of the dynamics of the chemical bond. This century has witnessed great strides in time and space resolutions, down to the atomic scale, providing chemists, biologists and physicists with unprecedented opportunities for seeing microscopic structures and dynamics. Femtochemistry is concerned with the time resolution of the most elementary motions of atoms during chemical change -- bond breaking and bond making -- on the femtosecond (10-15 second) time scale. This atomic scale of time resolution has now reached the ultimate for the chemical bond and as Lord George Porter puts it, chemists are near the end of the race against time. These two volumes cover the general concepts, techniques and applications of femtochemistry.Professor Ahmed Zewail, who has made the pioneering contributions in this field, has from over 250 publications selected the articles for this anthology. These volumes begin with a commentary and a historical chronology of the milestones. He then presents a broad perspective of the current state of

knowledge in femtochemistry by researchers around the world and discusses possible new directions. In the words of a colleague, "it is a must on the reading-list for all of my students ... all readers will find this to be an informative and valuable overview."The introductory articles in Volume I provide reviews for both the non-experts as well as for experts in the field. This is followed by papers on the basic concepts. For applications, elementary reactions are studied first and then complex reactions. Volume I is complete with studies of solvation dynamics, non-reactive systems, ultrafast electron diffraction and the control of chemical reactions.Volume II continues with reaction rates, the concept of elementary intramolecular vibrational-energy redistribution (IVR) and the phenomena of rotational coherence which has become a powerful tool for the determination of molecular structure via time resolution. The second volume ends with an extensive list of references, according to topics, based on work by Professor Zewail and his group at Caltech.These collected works by Professor Zewail will certainly be indispensable to both experts and beginners in the field. The author is known for his clarity and for his creative and systematic contributions. These volumes will be of interest and should prove useful to chemists, biologists and physicists. As noted by Professor J Manz (Berlin) and Professor A W Castleman, Jr. (Penn State): femtochemistry is yielding exciting new discoveries from analysis to control of chemical reactions, with applications in many domains of chemistry and related fields, e.g., physical, organic and inorganic chemistry, surface science, molecular biology, ... etc.

Ultrafast Electron Diffraction John Wiley & Sons

The aim of this project was to record time-resolved electron diffraction patterns of aligned molecules and to reconstruct the 3D molecular structure. The molecules are aligned non-adiabatically using a femtosecond laser pulse. A femtosecond electron pulse then records a diffraction pattern while the molecules are aligned. The diffraction patterns are then be processed to obtain the molecular structure.

Advances in Electronics and Electron Physics World Scientific Publishing Company

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.

Advances in Imaging and Electron Physics Springer Science & Business Media Advances in Imaging & Electron Physics merges two long-running serials-Advances in Electronics & Electron Physics and Advances in Optical & 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 and digital image processing, electromagnetic wave propagation, electron microscopy, and the computing methods used in all these domains. Contributions from leading authorities Informs and updates on all the latest developments in the field

Development of an Ultrafast Low-Energy Electron Diffraction Setup Oxford University Press The construction and utilization of the fourth-generation ultrafast electron diffraction apparatus, UED4, is the subject of this thesis. With UED4 and its novel and universal sample delivery method based on laser desorption, we were able to vaporize thermally labile molecular samples and determine their ground-state structures and the structures of their photochemical and photophysical reaction products. Each component part of the new UED4 apparatus is described, and the experimental and computational procedures used to extract structural information from the time-resolved diffraction patterns are presented. Several molecules were studied in their ground states and photoinduced excited states or product states on the time scale of picoseconds and nanoseconds. With UED3, nitrobenzene was shown to undergo intramolecular rearrangement prior to NO loss in an ultrafast fragmentation reaction. In indole, the chromophore of the amino acid tryptophan, the involvement of a dark structure, formed on the picosecond time scale, was revealed in the nonradiative decay pathway of the initially excited state. By determining the ground state structures of the thermally labile nucleobases uracil and guanine, the first use of surface-assisted laser desorption in a pulsed electron diffraction experiment was reported using the newly developed UED4 apparatus. The determined structures of the photochemically generated species of the photochromic molecule 6-nitro-BIPS further demonstrated the capability of laser desorption electron diffraction to function as a time-resolved experiment. Finally, the fragmentation reaction of the amino acid tryptophan upon UV laser irradiation was studied with UED4. The ability to deliver increasingly large and conformationally heterogeneous molecules into the gas phase now provides new challenges and opportunities of both experimental and theoretical nature for the field of ultrafast electron diffraction.

Time-Resolved Spectroscopy

Academic Press

It is the goal of this research to construct an instrument for Time-Resolved Electron Diffraction (TRED) studies of the structures of short-lived, energetic molecular states and of the dynamics of primary dissociation processes found in molecules of energetic materials. The TRED experiments will be performed by focusing a pulsed ArF excimer laser onto the cold photocathode of a high voltage electron gun, where electron pulses will be generated by field-assisted photoelectric emission. These electron pulses will be scattered off the gas-phase molecules in an effusive molecular beam after some fraction of the beam population has been excited by a pulse from a XeCl excimer-pumped dye laser. Electron diffraction intensities will be recorded using the real-time gas electron diffraction (GED) technology developed at the University of Arkansas. By synchronizing the dye laser excitation pulse and the diagnostic electron pulse, intensity data can be obtained from molecules which all have the same age relative to the time of excitation. Thus, time-resolved observations of excited molecular states and of transient reaction products should be possible.

4D Visualization of Matter Springer Science & Business Media

This concise and carefully developed text offers a reader friendly guide to the basics of time-resolved spectroscopy with an emphasis on experimental implementation. The authors carefully explain and relate for the reader how measurements are connected to the core physical principles. They use the time-dependent wave packet as a building block for understanding quantum dynamics, progressively advancing to more complex topics. The topics are discussed in paired sections, one discussing the theory and the next presenting the related experimental methods. A wide range of readers including students and newcomers to the field will gain a clear and practical understanding of how to measure aspects of molecular dynamics such as wave packet motion, intramolecular vibrational relaxation, and electron-electron coupling, and how to describe such measurements mathematically.

Ultrafast Time-Resolved Electron Diffraction with Megavolt Electron Beams Academic Press

Advances in Imaging and Electron Physics merges two long-running serials--Advances in Electronics and Electron Physics and Advances in Optical and Electron Microscopy. This series features extended articles on the physics of electron devices (especially semiconductor devices), particle optics at high and low energies, microlithography, image science and digital image processing, electromagnetic wave propagation, electron microscopy, and the computing methods used in all these domains. Contributions from leading authorities Informs and updates on all the latest developments in the field

An Experimental Perspective Springer Nature

Attosecond science is a new and rapidly developing research area in which molecular dynamics are studied at the timescale of a few attoseconds. Within the past decade, attosecond pump–probe spectroscopy has emerged as a powerful experimental technique that permits electron dynamics to be followed on their natural timescales. With the development of this technology, physical chemists have been able to observe and control molecular dynamics on attosecond timescales. From these observations it has been suggested that attosecond to few-femtosecond timescale charge migration may induce what has been called “post-Born-Oppenheimer dynamics", where the nuclei respond to rapidly time-dependent force fields resulting from transient localization of the electrons. These real-time observations have spurred exciting new advances in the theoretical work to both explain and predict these novel dynamics. This book presents an overview of current theoretical work relevant to attosecond science written by theoreticians who are presently at the forefront of its development. It is a valuable reference work for anyone working in the field of attosecond science as well as those studying the subject.

Time-Resolved Electron Diffraction

Academic Press

This front line reference work defines the science behind the key technology of the 21st century. The reader gets an in-depth and comprehensive overview of everything there is to know about nanotechnology and nanoscience by using a cross-disciplinary approach. Not only fundamentals but also applications of nanotechnology are presented in close to 100 contributions by leading professionals in this field. With topics ranging from engineering to electronics, life and medical sciences, chemistry, materials science and analytics, the following key areas are covered: Principles and Fundamentals of Nanotechnology, Philosophical and Ethical Aspects, Types of Nanosystems, Generation of Nanostructures, Environmental Nanotechnology, Nanoparticles in the Environment, Semiconductor Technology, High-Density Memories, Nanofabrication, Nanomedicine, Nanobiotechnology, Nanoprobes, Light and Energy, Nanostructured Surfaces.

Attosecond Molecular Dynamics BoD – Books on Demand

We report the experimental demonstration of femtosecond electron diffraction using high-brightness MeV electron beams. High-quality, single-shot electron diffraction patterns for both polycrystalline aluminum and single-crystal 1T-TaS2 are obtained utilizing a 5 fC (~3 × 104 electrons) pulse of electrons at 2.8 MeV. The high quality of the electron diffraction patterns confirms that electron beam has a normalized emittance of ~50 nm rad. The transverse and longitudinal coherence length is ~11 and ~2.5 nm, respectively. The timing jitter between the pump laser and probe electron beam was found to be ~100 fs (rms). The temporal resolution is demonstrated by observing the evolution of Bragg and superlattice peaks of 1T-TaS2 following an 800 nm optical pump and was found to be 130 fs. Lastly, our results demonstrate the advantages of MeV electrons, including large elastic differential scattering cross-section and access to high-order reflections, and the feasibility of ultimately realizing below 10 fs time-resolved electron diffraction.

The Generation and Characterization of Ultrashort Electron Pulses and Their Application to Time-Resolved Electron Diffraction World Scientific

This report describes the progress that has been made over the last years toward the generation of ultrashort electron pulses, and their application to time resolved electron diffraction. We have generated electron pulses of picosecond duration using an ultrafast laser system, tested a number of photocathode materials, built an apparatus to measure electron pulse durations in the femtosecond domain, and designed and built an electron diffractometer for time resolved electron diffraction. We demonstrated that the diffractometer, which uses a novel one dimensional detection scheme, is well capable of determining atomic distances in molecules to better than on hundredth of an Angstrom. A sophisticated noise suppression system maintains a signal to noise ratio sufficient for pump probe experiments. Further developments include the design of a reflectron electron gun for femtosecond electron pulses, and a two dimensional electron diffraction detector. Finally, significant progress has been made in the interfacing of adaptive optics to a learning algorithm, and the generation of spectrally tunable ultrashort laser pulses at 200 nm. *Cathodoluminescence Microscopy of Inorganic Solids* John Wiley & Sons Microcharacterization of materials is a rapidly advancing field. Among the many electron and ion probe techniques, the cathodoluminescence mode of an electron probe instrument has reached a certain maturity, which is reflected by an increas ing number of publications in this field. The rapid rate of progress in applications of cathodoluminescence techniques in characterizing inorganic solids has been especially noticeable in recent years. The main purpose of the book is to outline the applications of cath odoluminescence techniques in the assessment of optical and electronic proper ties of inorganic solids, such as semiconductors, phosphors, ceramics, and min erals. The assessment provides, for example, information on impurity levels derived from cathodoluminescence spectroscopy, analysis of dopant concentra tions at a level that, in some cases, is several orders of magnitude lower than that attainable by x-ray microanalysis, the mapping of defects, and the determination of carrier lifetimes and the charge carrier capture cross sections of impurities. In order to make the book self-contained, some basic concepts of solid-state phys ics, as well as various cathodoluminescence techniques and the processes leading to luminescence phenomena in inorganic solids, are also described. We hope that this book will be useful to both scientists and graduate students interested in microcharacterization of inorganic solids. This book, however, was not intended as a definitive account of cathodoluminescence analysis of in organic solids. In considering the results presented here, readers should re member that many materials have properties that vary widely as a function of preparation conditions.

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