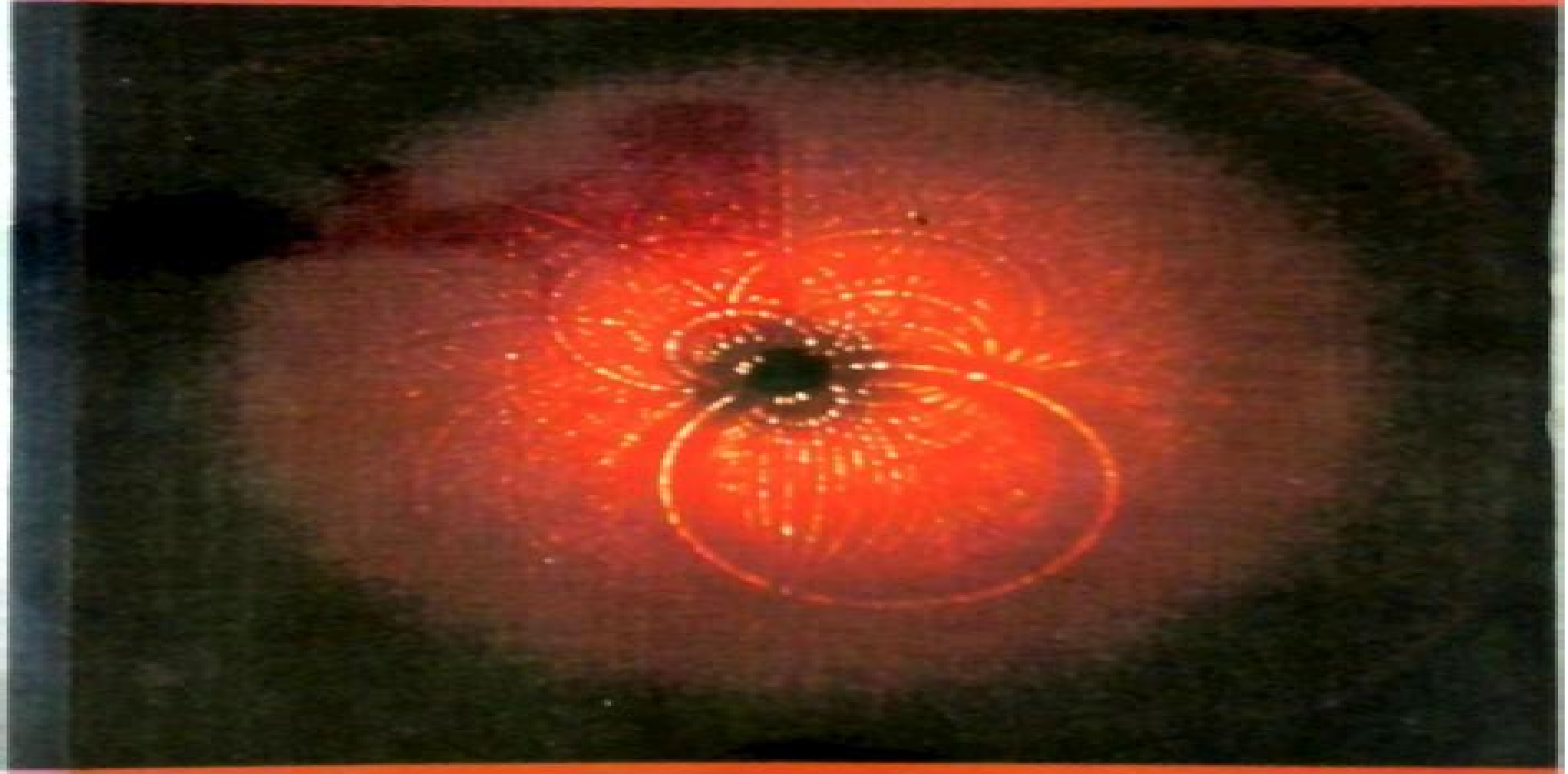
Elements of Modern X-Ray Physics



Jens Als-Nielsen
Des McMorrow

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Elements Of Modern X Ray Physics

D. Moebius,R. Miller

Elements Of Modern X Ray Physics:

Elements of Modern X-ray Physics Jens Als-Nielsen,Des McMorrow,2011-04-20 Eagerly awaited this second edition of a best selling text comprehensively describes from a modern perspective the basics of x ray physics as well as the completely new opportunities offered by synchrotron radiation Written by internationally acclaimed authors the style of the book is to develop the basic physical principles without obscuring them with excessive mathematics The second edition differs substantially from the first edition with over 30% new material including A new chapter on non crystalline diffraction designed to appeal to the large community who study the structure of liquids glasses and most importantly polymers and bio molecules A new chapter on x ray imaging developed in close cooperation with many of the leading experts in the field Two new chapters covering non crystalline diffraction and imaging Many important changes to various sections in the book have been made with a view to improving the exposition Four colour representation throughout the text to clarify key concepts Extensive problems after each chapter There is also supplementary book material for this title available online http booksupport wiley com Praise for the previous edition The publication of Jens Als Nielsen and Des McMorrow s Elements of Modern X ray Physics is a defining moment in the field of synchrotron radiation a welcome addition to the bookshelves of synchrotron radiation professionals and students alike The text is now my personal choice for teaching x ray physics Physics Today 2002 **Elements of Modern X-ray Physics** Jens Als-Nielsen,Des McMorrow,2001-03-13 The availability of intense X ray beams from synchroton storage rings has revolutionised the field of X ray science This is illustrated by the cover pictures Von Laue s first observation of X ray diffraction from a single crystal of ZnS used an exposure time of around 1000 seconds whereas the diffraction from a single crystal of myoglobin using modern X ray synchroton radiation was obtained within the duration of a single pulse lasting only 0 00000000001 seconds In this book the basics of X ray physics as well as the completely new opportunities offered by synchrotron radiation are viewed from a modern perspective The style of the book is to develop the basic physical principles without obscuring them in too much mathematical rigour This approach should make the book attractive to the wider community of material scientists chemists biologists and geologists as well as to physicists who use synchrotron radiation in their research The book should be useful both to students taking course in X rays and to more experienced professionals who have the desire to extend their knowledge into new areas Novel Methods to Study Interfacial Layers D. Moebius,R. Miller,2001-10-30 This book presents a number of selected papers given at the LB9 conference held in Potsdam Germany in August 2000 It is dedicated to new techniques and methodologies for studying interfacial layers One group of manuscripts deals with the application of surface plasmons at solid interfaces used for example in resonance spectroscopy and light scattering New applications of various types of Atomic Force Microscopy are reported making use of various modifications of tips A number of chapters are dedicated to light emitting diodes built with the help of LB layers The aim of these studies is the improvement of efficiency Electrochemical methods were described as

tools for developing sensors in particular miniaturised pH or gas sensors The application of synchrotron X ray and NMR techniques have been described in detail in two extended chapters It is demonstrated how molecular information can be detected by these methods for various types of interfacial layers This monograph along with 130 papers that have been submitted for publication in the special issues of relevant journals represent the proceedings of the LBP conference

Spectroscopic Methods in Mineralogy and Material Sciences Grant Henderson,Daniel Neuville,Robert Downs,2014-11-21 Spectroscopic Methods in Mineralogy and Material Science covers significant advances in the technological aspects and applications of spectroscopic and microscopic techniques used in the Earth and Materials Sciences The current volume compliments the now classic Volume 18 Spectroscopic Methods in Mineralogy and Geology which became an essential resource to many scientists and educators for the past two decades This volume updates techniques covered in Volume 18 and introduces new techniques available for probing the secrets of Earth materials such as X ray Raman and Brillouin spectroscopy Other important topics including Transmission Electron Microscopy TEM and Atomic Force Microscopy AFM are also covered Phase-Contrast and Dark-Field Imaging Simon Zabler,2019-01-08 This book is a printed edition of the Special Issue Phase Contrast and Dark Field Imaging that was published in J Imaging Molecular Soft-Interface Science Mizuo Maeda,Atsushi Takahara,Hiromi Kitano,Tetsuji Yamaoka,Yoshiko Miura,2019-05-09 This book offers a comprehensive treatment of the molecular design characterization and physical chemistry of soft interfaces At the same time the book aims to encourage the fabrication of functional materials including biomaterials During the past few decades there has been steady growth in soft interface science and that growth has been especially rapid in the twenty first century The field is interdisciplinary because it involves chemistry polymer science materials science physical chemistry and biology Based on the increasing interdisciplinary nature of undergraduate and graduate programs the primary goal of this present work is to serve as a comprehensive resource for senior level undergraduates and for graduate students particularly in polymer chemistry materials science bioconjugate chemistry bioengineering and biomaterials Additionally with the growing interest in the fabrication of functional soft materials this book provides essential fundamental information for researchers not only in academia but also in industry Ordering Phenomena in Rare-Earth Nickelate Heterostructures Matthias Hepting,2017-06-28 This thesis presents an experimental study of ordering phenomena in rare earth nickelate based heterostructures by means of inelastic Raman light scattering and elastic resonant x ray scattering RXS Further it demonstrates that the amplitude ratio of magnetic moments at neighboring nickel sites can be accurately determined by RXS in combination with a correlated double cluster model and controlled experimentally through structural pinning of the oxygen positions in the crystal lattice The two key outcomes of the thesis are a demonstrating full control over the charge bond and spin order parameters in specifically designed praseodymium nickelate heterostructures and observation of a novel spin density wave phase in absence of the charge bond order parameter which confirms theoretical predictions of a spin

density wave phase driven by spatial confinement of the conduction electrons and b assessing the thickness induced crossover between collinear and non collinear spin structures in neodymium nickelate slabs which is correctly predicted by drawing on density functional theory Multifunctional Oxide Heterostructures Evgeny Y. Tsymbal,2012-08-30 This volume explores the rapidly developing field of oxide thin films and heterostructures which exhibit unusual physical properties interesting from the fundamental point of view and for device application The chapters discuss topics that represent some of the key innovations in the field over recent years *X-Rays and Extreme Ultraviolet Radiation* David Attwood,Anne Sakdinawat,2017-02-16 With this fully updated second edition readers will gain a detailed understanding of the physics and applications of modern X ray and EUV radiation sources Taking into account the most recent improvements in capabilities coverage is expanded to include new chapters on free electron lasers FELs laser high harmonic generation HHG X ray and EUV optics and nanoscale imaging a completely revised chapter on spatial and temporal coherence and extensive discussion of the generation and applications of femtosecond and attosecond techniques Readers will be guided step by step through the mathematics of each topic with over 300 figures 50 reference tables and 600 equations enabling easy understanding of key concepts Homework problems a solutions manual for instructors and links to YouTube lectures accompany the book online This is the go to guide for graduate students researchers and industry practitioners interested in X ray and EUV interaction with matter Lung Imaging and CADx Ayman El-Baz,Jasjit Suri,2019-04-24 Developing an effective computer aided diagnosis CAD system for lung cancer is of great clinical importance and can significantly increase the patient s chance for survival For this reason CAD systems for lung cancer have been investigated in a large number of research studies A typical CAD system for lung cancer diagnosis is composed of four main processing steps segmentation of the lung fields detection of nodules inside the lung fields segmentation of the detected nodules and diagnosis of the nodules as benign or malignant This book overviews the current state of the art techniques that have been developed to implement each of these CAD processing steps Overviews the latest state of the art diagnostic CAD systems for lung cancer imaging and diagnosis Offers detailed coverage of 3D and 4D image segmentation Illustrates unique fully automated detection systems coupled with 4D Computed Tomography CT Written by authors who are world class researchers in the biomedical imaging sciences Includes extensive references at the end of each chapter to enhance further study Ayman El Baz is a professor university scholar and chair of the Bioengineering Department at the University of Louisville Louisville Kentucky He earned his bachelor s and master s degrees in electrical engineering in 1997 and 2001 respectively He earned his doctoral degree in electrical engineering from the University of Louisville in 2006 In 2009 he was named a Coulter Fellow for his contributions to the field of biomedical translational research He has 17 years of hands on experience in the fields of bio imaging modeling and noninvasive computer assisted diagnosis systems He has authored or coauthored more than 500 technical articles 132 journals 23 books 57 book chapters 211 refereed conference papers 137 abstracts and 27 U S patents and disclosures Jasjit S

Suri is an innovator scientist a visionary an industrialist and an internationally known world leader in biomedical engineering He has spent over 25 years in the field of biomedical engineering devices and its management He received his doctorate from the University of Washington Seattle and his business management sciences degree from Weatherhead School of Management Case Western Reserve University Cleveland Ohio He was awarded the President s Gold Medal in 1980 and named a Fellow of the American Institute of Medical and Biological Engineering for his outstanding contributions in 2004 In 2018 he was awarded the Marquis Life Time Achievement Award for his outstanding contributions and dedication to medical imaging and its management **Fundamentals of Powder Diffraction and Structural Characterization of Materials** Peter Y. Zavalij,Vitalij K. Pecharsky,2025-09-26 This expanded updated third edition features many new color illustrations timely practical examples and experimental and computational tools introduced in the past ten years while retaining its excellent introduction to structural characterization and crystallography The book is written for those interested in a fundamental conceptual understanding powder diffraction and structural characterization of materials as well as in practical skills in examining phase composition and structure of materials using modern experimental powder diffraction tools Special attention is given to proper collection of powder diffraction data using laboratory x ray synchrotron and neutron radiation Exemplary data sets serve as a springboard for readers to develop knowledge about modern approaches algorithms and software as well as to gain proficiency in extracting precise structural information about crystalline materials from powder diffraction data The book requires nospecialized knowledge so it is useful to beginners Suitable for upper level undergraduate and graduate students as well as practitioners in the research labs and the field the authors in depth treatment helps readers from various disciplines including crystallography materials science solid state chemistry and physics geology and mineralogy become experts on this subject Synchrotron Radiation in Materials Science Chunhai Fan,Zhentang Zhao,2018-02-12 Endlich ein Fachbuch mit detaillierten Informationen zu einer der fortschrittlichsten Methoden zur Materialcharakterisierung Ein herausragendes Team aus Herausgebern und Autoren von renommierten Einrichtungen und Institutionen besch ftigt sich mit Synchrotron Verfahren die sich in der Materialforschung bew hrt haben Nach einer Einf hrung in die Synchrotronstrahlung und ihrer Quellen werden die verschiedenen Techniken beschrieben die von diesem besonders hellen Licht profitieren u a R ntgenabsorption Diffraktion Streuung Bildgebung und Lithographie Zum Schluss folgt ein berblick ber die Anwendungen der Synchrotronstrahlung in den Materialwissenschaften Dieses einzigartige unabdingbare Referenzwerk f r akademische Forscher und Forscher aus der Industrie verbindet Spezialisten aus der Synchrotronforschung und Materialwissenschaftler *Molecular Imaging: Basic Principles And Applications In Biomedical Research (3rd Edition)* Markus Rudin,2020-04-04 The area of molecular imaging has matured over the past decade and is still growing rapidly Many concepts developed for molecular biology and cellular imaging have been successfully translated to in vivo imaging of intact organisms Molecular imaging enables the study of processes at a molecular level in their full

biological context Due to the high specificity of the molecular readouts the approach bears a high potential for diagnostics It is fair to say that molecular imaging has become an indispensable tool for biomedical research and drug discovery and development today This volume familiarizes the reader with the concepts of imaging and molecular imaging in particular Basic principles of imaging technologies reporter moieties for the various imaging modalities and the design of targeted probes are described in the first part The second part illustrates how these tools can be used to visualize relevant molecular events in the living organism Topics covered include the studies of the biodistribution of reporter probes and drugs visualization of the expression of biomolecules such as receptors and enzymes and how imaging can be used for analyzing consequences of the interaction of a ligand or a drug with its molecular target by visualizing signal transduction or assessing the metabolic physiological or structural response of the organism studied The third edition has been extended considerably This holds for the chapter on imaging modalities which now includes sections on intravital microscopy and mass spectrometric imaging All chapters have been updated and a new chapter on the challenges of translating molecular imaging solutions for clinical use has been added **Fundamentals of Powder Diffraction and Structural Characterization of Materials, Second Edition** Vitalij Pecharsky,Peter Zavalij,2008-11-24 A little over ve years have passed since the rst edition of this book appeared in print Seems like an instant but also eternity especially considering numerous developments in the hardware and software that have made it from the laboratory test beds into the real world of powder diffraction This prompted a revision which had to be beyond cosmetic limits The book was and remains focused on standard laboratory powder diffractometry It is still meant to be used as a text for teaching students about the capabilities and limitations of the powder diffraction method We also hope that it goes beyond a simple text and therefore is useful as a reference to practitioners of the technique The original book had seven long chapters that may have made its use as a text convenient So the second edition is broken down into 25 shorter chapters The rst fteen are concerned with the fundamentals of powder diffraction which makes it much more logical considering a typical 16 week long semester The last ten ch ters are concerned with practical examples of structure solution and re nement which were preserved from the rst edition and expanded by another example R solving the crystal structure of Tylenol Ion Correlations at Electrified Soft Matter Interfaces Nouamane Laanait,2013-07-30 Ion Correlations at Electrified Soft Matter Interfaces presents an investigation that combines experiments theory and computer simulations to demonstrate that the interdependency between ion correlations and other ion interactions in solution can explain the distribution of ions near an electrified liquid liquid interface The properties of this interface are exploited to vary the coupling strength of ion ion correlations from weak to strong while monitoring their influence on ion distributions at the nanometer scale with X ray reflectivity and on the macroscopic scale with interfacial tension measurements This thesis demonstrates that a parameter free density functional theory that includes ion ion correlations and ion solvent interactions is in agreement with the data over the entire range of experimentally tunable

correlation coupling strengths The reported findings represent a significant advance towards understanding the nature and role of ion correlations in charged soft matter Ion distributions underlie many scientific phenomena and technological applications including electrostatic interactions between charged biomolecules and the efficiency of energy storage devices These distributions are determined by interactions dictated by the chemical properties of the ions and their environment as well as the long range nature of the electrostatic force The presence of strong correlations between ions is responsible for counterintuitive effects such as like charge attraction Small Angle Scattering and Diffraction Margareth Kazuyo Kobayashi Dias Franco,Fabiano Yokaichiya,2018-06-06 Reasoned and based on the difference between discovery and invention according to the traditional conception science can be distinguished between basic science and applied science Nevertheless we know that the sciences are inseparable A century or more ago Louis Pasteur said there is no applied science there are applications of science With this assertion he establishes the logic of complementarity between them Science certainly goes beyond its own material application and brings us to issues that have intrigued humanity for a long time During the many years that we have been working with techniques of material characterization we observed that this complementarity was not always understood by the researchers In line with the reasoning that the technique joined with science generates technology the application of techniques that use x ray and neutron sources seems to us of fundamental importance for the development of technology In this way we present in this book how the existing technology of material characterization can contribute to science and applied technology The authors who contributed with this book sought to show the importance of applying the existing techniques in the development of their works **III-V Compound Semiconductors** Tingkai Li,Michael Mastro,Armin Dadgar,2016-04-19 Silicon based microelectronics has steadily improved in various performance to cost metrics But after decades of processor scaling fundamental limitations and considerable new challenges have emerged The integration of compound semiconductors is the leading candidate to address many of these issues and to continue the relentless pursuit of more Thin metal films on weakly-interacting substrates Andreas Jamnig,2020-09-30 Vapor based growth of thin metal films with controlled morphology on weakly interacting substrates WIS including oxides and van der Waals materials is essential for the fabrication of multifunctional metal contacts in a wide array of optoelectronic devices Achieving this entails a great challenge since weak film substrate interactions yield a pronounced and uncontrolled 3D morphology Moreover the far from equilibrium nature of vapor based film growth often leads to generation of mechanical stress which may further compromise device reliability and functionality The objectives of this thesis are related to metal film growth on WIS and seek to i contribute to the understanding of atomic scale processes that control film morphological evolution ii elucidate the dynamic competition between nanoscale processes that govern film stress generation and evolution and iii develop methodologies for manipulating and controlling nanoscale film morphology between 2D and 3D Investigations focus on magnetron sputter deposited Ag and Cu films on SiO2 and amorphous carbon a C

substrates Research is conducted by strategically combining of in situ and real time film growth monitoring ex situ chemical and micro structural analysis optical modelling and deterministic growth simulations In the first part the scaling behavior of characteristic morphological transition thicknesses i e percolation and continuous film formation thickness during growth of Ag and Cu films on a C are established as function of deposition rate and temperature These data are interpreted using a theoretical framework based on the droplet growth theory and the kinetic freezing model for island coalescence from which the diffusion rates of film forming species during Ag and Cu growth are estimated By combining experimental data with ab initio molecular dynamics simulations diffusion of multiatomic clusters rather than monomers is identified as the rate limiting structure forming process In the second part the effect of minority metallic or gaseous species Cu N2 O2 on Ag film morphological evolution on SiO2 is studied By employing in situ spectroscopic ellipsometry it is found that addition of minority species at the film growth front promotes 2D morphology but also yields an increased continuous layer resistivity Ex situ analyses show that 2D morphology is favored because minority species hinder the rate of coalescence completion Hence a novel growth manipulation strategy is compiled in which minority species are deployed with high temporal precision to selectively target specific film growth stages and achieve 2D morphology while retaining opto electronic properties of pure Ag films In the third part the evolution of stress during Ag and Cu film growth on a C and its dependence on growth kinetics as determined by deposition rate substrate temperature is systematically investigated A general trend toward smaller compressive stress magnitudes with increasing temperature deposition rate is found related to increasing grain size decreasing adatom diffusion length Exception to this trend is found for Cu films in which oxygen incorporation from the residual growth atmosphere at low deposition rates inhibits adatom diffusivity and decreases the magnitude of compressive stress The effect of N2 on stress type and magnitude in Ag films is also studied While Ag grown in N2 free atmosphere exhibits a typical compressive tensile compressive stress evolution as function of thickness addition of a few percent of N2 yields to a stress turnaround from compressive to tensile stress after film continuity which is attributed to giant grain growth and film roughening The overall results of the thesis provide the foundation to i determine diffusion rates over a wide range of WIS film substrates systems ii design non invasive strategies for multifunctional contacts in optoelectronic devices iii complete important missing pieces in the fundamental understanding of stress which can be used to expand theoretical descriptions for predicting and tuning stress magnitude La morphologie de films minces m talliques polycristallins labor s par condensation d une phase vapeur sur des substrats faible interaction SFI poss de un caract re 3D intrins que De plus la nature hors quilibre de la croissance du film depuis une phase vapeur conduit souvent la g n ration de contraintes m caniques ce qui peut compromettre davantage la fiabilit et la fonctionnalit des dispositifs opto lectroniques Les objectifs de cette th se sont li s la croissance de films m talliques sur SFI et visent i contribuer une meilleure compr hension des processus l chelle atomique qui contr lent l volution morphologique des films ii lucider les processus dynamiques qui r

gissent la g n ration et l volution des contraintes en cours de croissance et iii d velopper des m thodologies pour manipuler et contr ler la morphologie des films l chelle nanom trique L originalit de l approche mise en uvre consiste suivre la croissance des films in situ et en temps r el par couplage de plusieurs diagnostics compl t par des analyses microstructurales ex situ Les grandeurs mesur es sont confront es des mod les optiques et des simulations atomistiques La premi re partie est consacr e une tude de comportement d chelonnement des paisseurs de transition morphologiques caract ristiques savoir la percolation et la continuit du film lors de la croissance de films polycristallins d Ag et de Cu sur carbone amorphe a C Ces grandeurs sont examin es de fa on syst matique en fonction de la vitesse de d p t et de la temp rature du substrat et interpr t es dans le cadre de la th orie de la croissance de gouttelettes suivant un mod le cin tique d crivant la coalescence d lots partir duquel les coefficients de diffusion des esp ces m talliques sont estim s En confrontant les donn es exp rimentales des simulations par dynamique mol culaire ab initio la diffusion de clusters multiatomiques est identifi e comme l tape limitante le processus de croissance Dans la seconde partie l incorporation et l impact sur la morphologie d esp ces m talliques ou gazeuses minoritaires Cu N2 O2 lors de la croissance de film Ag sur SiO2 est tudi A partir de mesures ellipsom triques in situ on constate que l addition d esp ces minoritaires favorise une morphologie 2D entravant le taux d ach vement de la coalescence mais donne galement une r sistivit accrue de la couche continue Par cons quent une strat gie de manipulation de la croissance est propos e dans laquelle des esp ces minoritaires sont d ploy es avec une grande pr cision temporelle pour cibler s lectivement des stades de croissance de film sp cifiques et obtenir une morphologie 2D tout en conservant les propri t s opto lectroniques des films d Ag pur Dans la troisi me partie l volution des contraintes r siduelles lors de la croissance des films d Ag et de Cu sur a C et leur d pendance la cin tique de croissance est syst matiquement tudi e On observe une tendance g n rale vers des amplitudes de contrainte de compression plus faibles avec une augmentation de la temp rature vitesse de d p t li e l augmentation de la taille des grains la diminution de la longueur de diffusion des adatomes galement l ajout dans le plasma de N2 sur le type et l amplitude des contraintes dans les films d Ag est tudi L ajout de quelques pourcents de N2 en phase gaz donne lieu un renversement de la contrainte de compression et une volution en tension au del de la continuit du film Cet effet est attribu une croissance anormale des grains g ants et le d veloppement de rugosit de surface L ensemble des r sultats obtenus dans cette th se fournissent les bases pour i d terminer les coefficients de diffusion sur une large gamme de syst mes films SFI ii concevoir des strat gies non invasives pour les contacts multifonctionnels dans les dispositifs opto lectroniques iii apporter des l ments de compr hension l origine du d veloppement de contrainte qui permettent de pr dire et contr ler le niveau de contrainte intrins que la croissance de films minces polycristallins *Spin Spirals and Charge Textures in Transition-Metal-Oxide Heterostructures* Alex Frano,2014-05-28 This thesis presents the results of resonant and non resonant x ray scattering experiments demonstrating the control of collective ordering phenomena in epitaxial nickel oxide and copper oxide based superlattices Three outstanding results are reported 1 LaNiO3

LaAlO3 superlattices with fewer than three consecutive NiO2 layers exhibit a novel spiral spin density wave whereas superlattices with thicker nickel oxide layer stacks remain paramagnetic The magnetic transition is thus determined by the dimensionality of the electron system The polarization plane of the spin density wave can be tuned by epitaxial strain and spatial confinement of the conduction electrons 2 Further experiments on the same system revealed an unusual structural phase transition controlled by the overall thickness of the superlattices The transition between uniform and twin domain states is confined to the nickelate layers and leaves the aluminate layers unaffected 3 Superlattices based on the high temperature superconductor YBa2Cu3O7 exhibit an incommensurate charge density wave order that is stabilized by heterointerfaces These results suggest that interfaces can serve as a powerful tool to manipulate the interplay between spin order charge order and superconductivity in cuprates and other transition metal oxides *Polymers and Electromagnetic Radiation* Wolfram Schnabel,2014-01-10 This first book to cover the interaction of polymers with radiation from the entire electromagnetic spectrum adopts a multidisciplinary approach to bridge polymer chemistry and physics photochemistry photophysics and materials science The text is equally unique in its scope devoting equal amounts of attention to the three aspects of synthesis characterization and applications The first part deals with the interaction of polymers with non ionizing radiation in the frequency range from sub terahertz via infrared radiation to visible and ultraviolet light while the second covers interaction with ionizing radiation from the extreme ultraviolet to ray photons The result is a systematic overview of how both types of radiation can be used for different polymerization approaches spectroscopy methods and lithography techniques Authored by a world renowned researcher and teacher with over 40 years of experience in the field this is a highly practical and authoritative guide

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