Low Dimensional Structures For Optical And Electrical

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New Horizons in Low-Dimensional Electron Systems
Low-Dimensional Electronic Properties of Molybdenum Bronzes and Oxides
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ICONO '98
Materials, Physics, Technology, Devices
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Characterization, Modeling and Applications
Spectroscopy of Semiconductors
Optical Properties of Low-dimensional Materials
Nanotechnology
Compound Semiconductors 1995, Proceedings of the Twenty-Second INT Symposium on Compound Semiconductors held in Cheju Island, Korea, 28 August-2 September, 1995
Lower-Dimensional Systems and Molecular Electronics
Electron-phonon Interactions in Low-dimensional Structures
Waveguide Spectroscopy of Thin Films

Defects in Advanced Electronic Materials and Novel Low Dimensional Structures
Science and Engineering of One- and Zero-Dimensional Semiconductors
Advanced Electronic Technologies and Systems Based on Low-Dimensional Quantum Devices
An Introduction
ICONO '98
Low-Dimensional Semiconductor Structures

LEWIS KAILEY

Fundamentals and Device Applications
Springer Science & Business Media
This book deals with the Effective Electron Mass (EEM) in low dimensional semiconductors. The materials considered are quantum confined non-linear optical, III-V, II-VI, GaP, Ge, PtSb2, zero-gap, stressed, Bismuth, carbon nanotubes, GaSb, IV-VI, Te, II-V, Bi2Te3, Sb, III-V, II-VI, IV-VI semiconductors and quantized III-V, II-VI, IV-VI and HgTe/CdTe superlattices with graded interfaces and effective mass superlattices. The presence of intense electric field and the light waves change the band structure of optoelectronic semiconductors in fundamental ways, which have also been incorporated in the study of the EEM in quantized

structures of optoelectronic compounds that control the studies of the quantum effect devices under strong fields. The importance of measurement of band gap in optoelectronic materials under strong electric field and external photo excitation has also been discussed in this context. The influence of crossed electric and quantizing magnetic fields on the EEM and the EEM in heavily doped semiconductors and their nanostructures is discussed. This book contains 200 open research problems which form the integral part of the text and are useful for both Ph. D aspirants and researchers in the fields of solid-state sciences, materials science, nanoscience and technology and allied fields in addition to the graduate courses in modern semiconductor nanostructures. The book is written for post graduate students, researchers and engineers, professionals in the fields of solid state sciences, materials science, nanoscience and technology, nanostructured materials and condensed matter physics.
Optical Switching in Low-Dimensional Systems Springer Science & Business Media
This volume contains the

Proceedings of the NATO Advanced Research Workshop on "Optical Properties of Narrow-Gap Low-Dimensional Structures", held from July 29th to August 1st, 1986, in St. Andrews, Scotland, under the auspices of the NATO International Scientific Exchange Program. The workshop was not limited to optical properties of narrow-gap semiconductor structures (Part III). Sessions on, for example, the growth methods and characterization of III-V, II-VI, and IV-VI materials, discussed in Part II, were an integral part of the workshop. Considering the small masses of the carriers in narrow-gap low dimensional structures (LOS), in Part I the enhanced band mixing and magnetic field effects are explored in the context of the envelope function approximation. Optical nonlinearities and energy relaxation phenomena applied to the well-known systems of HgCdTe and GaAs/GaAIAs, respectively, are reviewed with comments on their extension to narrow gap LOS. The relevance of optical observations in quantum transport studies is illustrated in Part IV. A review of devices based on epitaxial narrow-gap materials defines a frame of reference for future ones based on two-dimensional narrow-gap semiconductors; in addition, an analysis of the physics of quantum well lasers provides a guide to relevant parameters for narrow-gap laser devices for the infrared (Part V). The roles and potentials of special techniques are explored in Part VI, with emphasis on hydrostatic pressure techniques, since this has a pronounced effect in small-mass, narrow-gap, non-parabolic structures.

New Physics and Applications

Clarendon Press

This volume represents the written account of the NATO Advanced Study Institute "Lower-Dimensional Systems and Molecular Electronics" held at Hotel Spetses, Spetses Island, Greece from 12 June to 23 June 1989. The goal of the Institute was to demonstrate the breadth of chemical and physical knowledge that has been acquired in the last 20 years in inorganic and organic crystals, polymers, and thin films, which exhibit phenomena of reduced dimensionality. The interest in these systems started in the late 1960's with lower-dimensional inorganic conductors, in the early 1970's with quasi-one-dimensional crystalline organic conductors. which by 1979 led to the first organic superconductors, and, in 1977, to the fITSt conducting polymers. The study of monolayer films (Langmuir-Blodgett films) had progressed since the 1930's, but reached a great upsurge in . the early 1980's. The pursuit of non-linear optical phenomena became increasingly popular in the early 1980's, as the attention turned from inorganic crystals to organic films and polymers. And in the last few years the term "moleculw' electronics" has gained ever-increasing acceptance, although it is used in several contexts. We now have organic superconductors with critical temperatures in excess of 10 K, conducting polymers that are soluble and processable, and used commercially; we have films of a few monolayers that have high in-plane electrical conductivity, and polymers that show great promise in photonics; we even have a few devices that function almost at the molecular level. Elementary Excitations and Applications Springer Science & Business Media This work represents the account of a NATO Advanced Research Workshop on

"Thin Film Growth Techniques for Low Dimensional Structures", held at the University of Sussex, Brighton, England from 15-19 Sept. 1986. The objective of the workshop was to review the problems of the growth and characterisation of thin semiconductor and metal layers. Recent advances in deposition techniques have made it possible to design new material which is based on ultra-thin layers and this is now posing challenges for scientists, technologists and engineers in the assessment and utilisation of such new material. Molecular beam epitaxy (MBE) has become well established as a method for growing thin single crystal layers of semiconductors. Until recently, MBE was confined to the growth of III-V compounds and alloys, but now it is being used for group IV semiconductors and II-VI compounds. Examples of such work are given in this volume. MBE has one major advantage over other crystal growth techniques in that the structure of the growing layer can be continuously monitored using reflection high energy electron diffraction (RHEED). This technique has offered a rare bonus in that the time dependent intensity variations of RHEED can be used to determine growth rates and alloy composition rather precisely. Indeed, a great deal of new information about the kinetics of crystal growth from the vapour phase is beginning to emerge. *Spectroscopy of Systems with Spatially Confined Structures* Springer Science & Business Media Low-Dimensional Semiconductor Structures offers a seamless, atoms-to-devices introduction to the latest quantum heterostructures. It covers their fabrication; electronic, optical, and transport properties; role in exploring new physical phenomena; and utilization in devices. The authors describe the epitaxial growth of semiconductors and the physical behavior of electrons and phonons in low-dimensional structures. They then go on to discuss nonlinear optics in quantum heterostructures. The final chapters deal with semiconductor lasers, mesoscopic devices, and high-speed heterostructure devices. The book contains many exercises and comprehensive references. Low Dimensional Semiconductor Structures Springer Science & Business Media The field of low-dimensional structures has been experiencing rapid development in both theoretical and experimental research. Phonons in Low Dimensional Structures is a collection of chapters related to the properties of solid-state structures dependent on lattice vibrations. The book is divided into two parts. In the first part, research topics such as interface phonons and polaron states, carrier-phonon non-equilibrium dynamics, directional projection of elastic waves in parallel array of N elastically coupled waveguides, collective dynamics for longitudinal and transverse phonon modes, and elastic properties for bulk metallic glasses are related to semiconductor devices and metallic glasses devices. The second part of the book contains, among others, topics related to superconductor, phononic crystal carbon nanotube devices such as phonon dispersion calculations using density functional theory for a range of superconducting materials, phononic crystal-based MEMS resonators, absorption of acoustic phonons in the hyper-sound regime in fluorine-modified carbon nanotubes and singlewalled nanotubes, phonon transport in carbon nanotubes, quantization of phonon thermal conductance, and phonon Anderson localization.

A Festschrift in Honour of Professor H. Kamimura

Oxford University Press on Demand

The optical properties of semiconductors have played an important role since the identification of semiconductors as "small" bandgap materials in the thinies, due both to their fundamental interest as a class of solids baving specific optical propenies and to their many important applications. On the former aspect we can cite the fundamental edge absorption and its assignment to direct or indirect transitions, many-body effects as revealed by exciton formation and photoconductivity. On the latter aspect, large-scale applications sucb as LEDs and lasers, photovoltaic converters, photodetectors, electro-optics and non-linear optic devices, come to mind. The eighties saw a revitalization of the whole field due to the advent of heterostructures of lower-dimensionality, mainly two-dimensional quantum wells, which through their enhanced photon-matter interaction yielded new devices with unsurpassed performance. Although many of the basic phenomena were evidenced through the seventies, it was this impact on applications which in turn led to such a massive investment in fabrication tools, thanks to which many new structures and materials were studied, yielding funher advances in fundamental physics. *Optical and Electrical Studies of Low Dimensional Structures* Springer Science & Business Media

In Bird of Passage by Rudolf Peierls, we find a paragraph in which he de scribes his Cambridge days in the 1930s: On these [relativistic field theory] problems my main contacts were Dirac, and the younger theoreticians. These included in particular Nevill (now Sir Nevill) Mott, perhaps the friendliest among many kind and friendly people we met then. Professor Kamimura became associated with Sir Rudolf Peierls in the 1950s, when he translated, with his colleagues, Peierls's 1955 textbook, Quantum Theory of Solids, into Japanese. This edition, to which Sir Rudolf himself contributed a preface, benefitted early generations of Japanese solid state physicists.

Later in 1974/5, during a sabbatical year spent at the Cavendish Laboratory, Professor Kamimura met and began a long association with Sir Nevill Mott. In particular, they developed ideas for disordered systems. One of the outcomes is a paper coauthored by them on ESR-induced variable range hopping in doped semiconductors. A series of works on disordered systems, together with those on two-dimensional systems, have served as building blocks for Physics of Interacting Electrons in Disordered Systems, in the International Series of Monographs on Physics, coauthored by Aoki and published in 1989 by the Oxford University Press. Soon after Professor Kamimura obtained a D. Sc. in 1959 for the work on the ligand field theory under the supervision ofMasao Kotani, his strong con nections in the international physical community began when he worked at the Bell Telephone Laboratories in 1961/64. *The Physics of Low-dimensional Semiconductors* Springer Science & Business Media Optical Properties of Narrow-Gap Low-Dimensional StructuresSpringer *Compound Semiconducto* *rs 1995, Proceedings of the Twenty-Second INT Symposium on Compound Semiconductors held in Cheju Island, Korea, 28 August-2 September, 1995* Elsevier Defects in Advanced Electronic Materials and Novel Low Dimensional Structures provides a comprehensive review on the recent progress in solving defect issues and deliberate defect engineering in novel material systems. It begins with an overview of point defects in ZnO and group-III nitrides, including irradiation-induced defects, and then look at defects in one and two-dimensional materials, including carbon nanotubes and graphene. Next, it examines the ways that defects can expand the potential applications of semiconductors, such as energy upconversion and quantum processing. The book concludes with a look at the latest advances in theory. While defect physics is extensively reviewed for conventional bulk semiconductors, the same is far from being true for novel material systems, such as low-dimensional 1D and 0D nanostructures and 2D monolayers. This book fills that necessary gap. Presents an in-depth overview of both conventional bulk semiconductor s and low-dimensional, novel material systems, such as 1D structures and 2D monolayers Addresses a range of defects in a variety of systems, providing a comparative approach Includes sections on advances in theory that provide insights on where this body of research might lead Springer Science & Business Media Compound Semiconductors 1995 focuses on emerging applications for GaAs and other compound semiconductors, such as InP, GaN, GaSb, ZnSe, and SiC, in the electronics and optoelectronics industries. The book presents the research and development work in all aspects of compound semiconductors. It reflects the maturity of GaAs as a semiconductor material and the rapidly increasing pool of research information on many other compound semiconductors. Covering the full breadth of the subject, from growth through processing to devices and integrated circuits, this volume provides researchers in materials science, device physics, condensed matter physics, and electrical and electronic engineering with a comprehensive overview of developments in this well-established research area.

A Crash Course

Springer Science & Business Media

The book describes how the electrons in small "low-dimensional" structures interact with their surroundings. It contains a series of linked up to date review chapters as well as explanatory material and is written to be understandable to graduate students and newcomers to the field. All contributions come from leading scientists.

Thin Film Growth Techniques for Low-Dimensional Structures

Springer

Starting with the first transistor in 1949, the world has experienced a technological revolution which has permeated most aspects of modern life, particularly over the last generation. Yet another such revolution looms up before us with the newly developed capability to control matter on the nanometer scale. A truly extraordinary research effort, by scientists, engineers, technologists of all disciplines, in nations large and small throughout the world, is directed and vigorously pressed to develop a full understanding of the properties of matter at the nanoscale and its possible applications, to bring to fruition the promise of nanostructures to introduce a new generation of electronic and optical devices. The physics of low dimensional semiconductor structures, including heterostructures, superlattices, quantum wells, wires and dots is reviewed and their modeling is discussed in detail. The truly exceptional material, Graphene, is reviewed; its functionalization and Van der Waals interactions are included here. Recent research on optical studies of quantum dots and on the physical properties of one-dimensional quantum wires is also reported. Chapters on fabrication of nanowire – based nanogap devices by the dielectrophoretic assembly approach. The broad spectrum of research reported here incorporates chapters on nanoengineering and nanophysics. In its presentation of tutorial chapters as well as advanced research on nanostructures, this book is ideally suited to meet the needs of newcomers to the field as well as experienced researchers interested in viewing colleagues' recent advances. Fundamental Aspects of Laser-matter Interaction, And, New Nonlinear Optical Materials and Physics of Low-dimensional

Structures : 29 June-3 July 1998, Moscow, Russia World Scientific Low-dimensional structures can be defined as structures and components with novel and improved physical, chemical, and biological properties that result in new phenomena and processes due to their nanoscale size. This work, discusses the fabrication and characterization of low-dimensional structures such as Germanium-rich islands on Silicon, Germanium nanocrystals, Silicon nanomembranes, and quantum dot and quantum well structures made from III-V compounds, that have applications in on-chip and inter-chip optical interconnects, novel photovoltaic devices, and other optoelectronic devices. Silicon-Germanium quantum dots have been receiving considerable attention lately as a means to achieve high-performance hybrid photonics circuitry within CMOS platforms. Strain in Silicon-Germanium heterostructures has shown increased carrier mobility that leads to better performance. Moderate tensile strains in combination with heavy n-type doping have proven to favor direct band-to-band radiative recombination in

Germanium, at optical telecommunication wavelengths. Self-assembled doped Germanium islands on Silicon have shown improved light-emission properties at telecommunication wavelengths with higher activation energies and improved ratio of radiative to non-radiative recombination. It is well known that the Stranski-Krastinov growth mode of these islands by molecular-beam-epitaxy is based on the strain due to the 4.2% lattice mismatch between the Germanium and Silicon atoms. Therefore it is extremely important to understand the strain in these structures and their influence on the optical properties of the islands, using various characterization techniques such as Raman spectroscopy, absorption measurements, photoluminescence spectroscopy, temperature-dependent, excitation-intensity-dependent, and time-resolved photoluminescence and spectroscopy. Band-engineered Germanium nanocrystals are considered to be highly promising for Silicon photonics integration due the near-direct band structure of the material. Germanium is fully-compatible with CMOS and the nanocrystals provide stronger confinement than Silicon nanocrystals due to the higher dielectric constant and larger Bohr-radius. In addition, large Germanium nanocrystals provide efficient emission, at room temperature, in the spectral range suitable for optical telecommunications. Fabrication of free-standing Germanium nanocrystals has been successful using a simple and inexpensive process. Their excellent light-emission properties, simple fabrication, and compatibility with standard microelectronic processes make them highly attractive for Silicon photonics integration and it is essential to understand their structural and optical properties. Raman spectroscopy, high-resolution-transmission-electron-microscopy, excitation-intensity-dependent photoluminescence spectroscopy, and time-resolved photoluminescence spectroscopy are used to gain insight into the structural properties, strain, photo-emission and recombination mechanisms in these structures. Thin, flexible semiconductor nanoscale membranes are superior platforms for high-performance flexible optoelectronic devices and high-efficiency flexible solar cell designs. Existing processes are extremely complicated and expensive. We develop a simple and inexpensive process for the fabrication of Silicon thin films for application in flexible solar cells. The structural properties are studied with techniques such as surface-enhanced Raman spectroscopy. Further characterization of optical properties and strain are being contemplated using x-ray diffraction, photoluminescence spectroscopy, and Raman spectroscopy techniques. In addition, this work will discuss the optical characterization of various III-V materials systems such as Gallium-Arsenide/Gallium-Arsenide-Antimonide and Indium-Gallium-Arsenide/Gallium-Arsenide to study effects of surface passivation using Antimony and delta doping in these structures. These structures are of great interest for lasers and photodetectors in the long wavelength range and novel photovoltaic devices such as intermediate band solar cells. Room temperature photoluminescence spectroscopy and variations such as excitation-intensity dependent and temperature-dependent spectroscopy techniques have been used to determine emission properties and sub-band level occupancies and other structural characteristics such as defect densities and crystal quality.

Phonons in Low Dimensional Structures

Cambridge University Press

Gives a comprehensive and coherent account of the basic methods to characterize a solid through its interaction with an electromagnetic field.

Low-dimensional Semiconductors BoD – Books on Demand

The history of low dimensional conductors goes back to the prediction, more than forty years ago, by Peierls, of the instability of a one dimensional metallic chain, leading to what is known now as the charge density wave state. At the same time, Frohlich suggested that an "ideal" conductivity could be associated to the sliding of this charge density wave. Since then, several classes of compounds, including layered transition metal dichalcogenides, quasi one-dimensional organic conduc tors and transition metal tri- and tretrachalcogenides have been extensively studied. The molybdenum bronzes or oxides have been discovered or rediscovered as low dimensional conductors in this last decade. A considerable amount of work has now been performed on this subject and it was time to collect some review papers in a single book. Although this book is focused on the molybdenum bronzes and oxides, it has a far more general interest in the field of low dimensional conductors, since several of the molybdenum compounds provide, from our point of view, model systems. This is the case for the quasi one-dimensional blue bronze, especially due to the availability of good quality large single crystals. This book is intended for scientists belonging to the fields of solid state physics and chemistry as well as materials science. It should especially be useful to many graduate students involved in low dimensional oxides. It has been written by recognized specialists of low dimensional systems.

Low Dimensional Structures Prepared by Epitaxial Growth or Regrowth on Patterned Substrates

Cambridge University Press

Compound Semiconductors 1995 focuses on emerging applications for GaAs and other compound semiconductors, such as InP, GaN, GaSb, ZnSe, and SiC, in the electronics and optoelectronics industries. The book presents the research and development work in all aspects of compound semiconductors. It reflects the maturity of GaAs as a semiconductor material and the rapidly increasing pool of research information on many other compound semiconductors. Covering the full breadth of the subject, from growth through processing to devices and integrated circuits, this volume provides researchers in materials science, device physics, condensed matter physics, and electrical and electronic engineering with a comprehensive overview of developments in this well-established research area.

Theory Numerical Methods Applications

Springer Science & Business Media

This book contains all the papers presented at the NATO workshop on "Optical Switching in Low Dimensional Systems" held in Marbella, Spain from October 6th to 8th, 1988. Optical switching is a basic function for optical data processing, which is of technological interest because of its potential parallelism and its potential speed. Semiconductors which exhibit resonance enhanced optical nonlinearities in the frequency range close to the band edge are the most intensively studied materials for optical bistability and fast gate operation. Modern crystal growth techniques, particularly molecular beam epitaxy, allow the manufacture of semiconductor microstructures such as quantum wells, quantum wires and quantum dots in which the electrons are only free to move in two, one or zero dimensions, of the optically excited electron-hole pairs in these low respectively. The spatial confinement dimensional structures gives rise to an enhancement of the excitonic nonlinearities. Furthermore, the variations of the microstruture extensions, of the compositions, and of the doping offer great new flexibility in engineering the desired optical properties. Recently, organic chain molecules (such as polydiacetilene) which are different realizations of one dimensional electronic systems, have been shown also to have interesting optical nonlinearities. Both the development and study of optical and

electro-optical devices, as well as experimental and theoretical investigations of the underlying optical nonlinearities, are contained in this book.
Devices Based on Low-Dimensional Semiconductor Structures
Springer Science & Business Media
Low-dimensional semiconductor quantum structures are a major, high-technological development that has a considerable industrial potential. The field is developing extremely rapidly and the present book represents a timely guide to the latest developments in device technology, fundamental properties, and some remarkable applications. The content is largely tutorial, and the book could be used as a textbook. The book deals with the physics, fabrication, characteristics and performance of devices based on low-dimensional semiconductor structures. It opens with fabrication procedures. The fundamentals of quantum structures and electro-optical devices are dealt with extensively. Nonlinear optical devices are discussed from the point of view of physics and applications of exciton saturation in MQW structures. Waveguide-based devices are also described in

terms of linear and nonlinear coupling. The basics of pseudomorphic HEMT technology, device physics and materials layer design are presented. Each aspect is reviewed from the elementary basics up to the latest developments. Audience: Undergraduates in electrical engineering, graduates in physics and engineering schools. Useful for active scientists and engineers wishing to update their knowledge and understanding of recent developments.
Fundamental Aspects of Laser-matter Interaction and New Nonlinear Optical Materials and Physics of Low-dimensional Structures : 29 June-3 July 1998, Moscow, Russia
Springer Science & Business Media
The past few decades have seen an explosive increase in our ability to create nanostructures and nanosystems with a great degree of control, using a diversity of techniques. This ability has been accompanied by a similar enhancement in our ability to characterize structures and systems at the nanoscale. This book provides a broad overview of those nanostructures and nanosystems (together termed Nanotechnology). It covers structural

characteristics and properties of nanostructures, nanofabrication techniques, methods for characterizing nanostructures, and applications for nanomaterials. The book also provides a thought-provoking assessment of the possible implications of nanotechnology in society, and likely future trends. Nanotechnology: A Crash Course is accessible to a wide readership and will meet the immediate needs of college graduates, doctoral students, professors, and researchers alike, who are looking for a quick yet inclusive grasp of this cutting-edge technology.Contents: To the Reader; Nomenclature; Low-Dimensional Structures; Properties of Nanostructures; Nanofabrication; Characterization of Nanostructures and Nanomaterials; Nanomaterials and Applications; Future Prospects; Index Suppose that you recently graduated with a B.S. degree in science or engineering and will commence your first professional employment tomorrow. Earlier this afternoon, your manager called to ask if you know something about nanotechnology, so that tomorrow you can begin developing an internal proposal for your division. But either your college did not offer a course on nanotechnology or you decided not to take one. You need a crash course in nanotechnology, just to get you off the ground.Suppose that you are a doctoral student in a department whose candidacy examination requires you to write a 5 10-page research proposal on an emerging topic assigned by the faculty committee. Suppose that your assigned topic intersects with nanotechnology, but all that you know about nanotechnology came from a couple of hour-long graduate seminars that you attended the previous semester.You need a crash course in nanotechnology, not only to write an impressive introduction but also to acquaint yourself with terminology to conduct efficient searches on Google Scholar, Web of Science, Scopus, etc. Suppose that you are a post-doctoral researcher at either an academic or an industrial research institution. Your supervisor has asked you to advise a shining undergraduate student for a summer project in nanotechnology, although the focus of your own research is elsewhere. You need a crash course in nanotechnolo gy, to start the youngster off in a promising direction. Suppose that you are a new assistant professor. Your departmental head advises that your research proposal to a government program to assist new faculty members begin research programs lacks that wow factor that would virtually guarantee success. Put in a nano angle, you are told. You need a crash course in nanotechnology, to clothe your proposal in the glory of nano. Suppose that you are a middle-aged professor undergoing a midlife crisis. Instead of changing your family or lifestyle, you may choose to change your research focus to an emerging research area.You need a crash course in nanotechnology, to assess your current resources and future needs. With your particular need in mind, we persuaded SPIE Press to publish our short and readable introduction to nanotechnology. WhileNanotechnology: A Crash Course is unlikely to convert you overnight into a nanostar, it would meet your immediate need and very likely help you steer your professional life in a new direction.

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