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Optoelectronic Nanodevices

KHAN ANIYAH

Selected Papers from Eleven Years of the Proceedings of the International Symposium of Integrated Ferroelectronics BoD – Books on Demand
Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses. High temperature superconductors, such as La2-xSrxCuOx (Tc=40K) and YBa2Cu3O7-x (Tc=90K), were discovered in 1987 and have been actively studied since. In spite of an intense, world-wide, research effort during this time, a complete understanding of the copper oxide (cuprate) materials is still lacking. Many fundamental questions are unanswered, particularly the mechanism by which high-Tc superconductivity occurs. More broadly, the cuprates are in a class of solids with strong electron-electron interactions. An understanding of such "strongly correlated" solids is perhaps the major unsolved problem of condensed matter physics with over ten thousand researchers working on this topic. High-Tc superconductors also have significant potential for applications in technologies ranging from electric power generation and transmission to digital electronics. This ability to carry large amounts of current can be applied to electric power devices such as motors and generators, and to electricity transmission in power lines. For example, superconductors can carry as much as 100 times the amount of electricity of ordinary copper or aluminium wires of the same size. Many universities, research institutes and companies are working to develop high-Tc superconductivity applications and considerable progress has been made. This volume brings together new leading-edge research in the field.
Chemical Vapour Deposition Springer Nature
This work is about two-step epitaxial growth using metalorganic vapor-phase epitaxy (MOVPE) for the realization of edge-emitting near-infrared laser diodes. The fabricated gallium arsenide-based devices fall into two categories: high-power lasers (watt range, multimodal) and tunable lasers (milliwatt range, monomodal). Common to both cases is that surface contamination – particularly that due to oxygen – needs to be removed before regrowth. Thus, in-situ etching with carbon tetrabromide (CBr4) is first studied. The experimental results include kinetic data, the effects of different etching conditions as well as substrate characteristics, and the effectiveness in reducing surface contamination. These investigations pave the way to devices based on 2-step epitaxy combined with in-situ etching. Correspondingly, thermally-tuned SG-DBR lasers operating around 975 nm have been successfully realized,

obtaining a tuning range of 21 nm. In addition, the possibility of using electronic tuning in similar devices has been explored. High-power broad-area lasers have also been realized, using two-step epitaxy combined with ex-situ and in-situ etching, to create a buried, shallow “mesa” containing the active zone. This approach allows introducing lateral electrical and optical confinement, and – simultaneously – non-absorbing mirrors at the laser facets. Additionally, a different strategy to create a buried current aperture is presented, which is based on ion implantation followed by epitaxial regrowth. This enables to improve device performance and simultaneously introduce non-absorbing mirrors at the facets with correspondingly increased reliability.

Recent Advances and Applications in Optical, Solar Cells and Solid State Devices World Scientific

This comprehensive book set includes four volumes, covering the methods and protocols for the synthesis, fabrication, and characterization of nanomaterials. The first two books introduce the solution phase and gas synthesis approaches for nanomaterials, providing a number of most widely used protocols for each nanomaterial. An exhaustive list of nanomaterials are included, which are arranged according to the atomic number of the main element in the compound for easy search. For each material, the protocols are categorized according to the morphology of the nanostructure. A detailed reference is included in each protocol to point the readers to the source of the protocol. The third book describes many unconventional methods for the fabrication of nanostructures, including lithography and printing, self-assembly, chemical transformation, templated synthesis, electrospinning, laser induced synthesis, flame and plasma synthesis, and atomic layer deposition processes. The fourth book covers the typical methods for structural characterization of nanomaterials, including electron diffraction, electron microscopy, atomic force microscopy, scanning tunneling microscopy, X-ray diffraction, in-situ and operando X-ray techniques, X-ray absorption fine structure spectroscopy, static and dynamic light scattering, vibrational characterization methods, and NMR spectroscopy. In addition to the introduction of the basic operational principles of these tools, the book focuses explicitly on how they can be applied for analyzing nanomaterials. The handbook is a complete reference that can provide readers easily accessible information on how to synthesize and characterize nanomaterials desired for their target applications.

State-of-the-Art Program on Compound Semiconductors XLI and Nitride and Wide Bandgap Semiconductors for Sensors, Photonics and Electronics V Springer

During the last decade, novel graphene related materials (GRMs), perovskites, as well as metal oxides and other metal nanostructures have received the interest of the scientific community. Due to their extraordinary physical, optical, thermal, and electrical properties, which are correlated with their 2D ultrathin atomic layer structure, large interlayer distance, ease of functionalization, and bandgap tunability, these nanomaterials have been applied in the development or the improvement of innovative optoelectronic applications, as well as the expansion of theoretical studies and simulations in the fast-growing fields of energy (photovoltaics, energy storage,

fuel cells, hydrogen storage, catalysis, etc.), electronics, photonics, spintronics, and sensing devices. The continuous nanostructure-based applications development has provided the ability to significantly improve existing products and to explore the design of materials and devices with novel functionalities. This book demonstrates some of the most recent trends and advances in the interdisciplinary field of optoelectronics. Most articles focus on light emitting diodes (LEDs) and solar cells (SCs), including organic, inorganic, and hybrid configurations, whereas the rest address photodetectors, transistors, and other well-known dynamic optoelectronic devices. In this context, this exceptional collection of articles is directed at a broad scientific audience of chemists, materials scientists, physicists, and engineers, with the goals of highlighting the potential of innovative optoelectronic applications incorporating nanostructures and inspiring their realization.

Proceedings of the 26th International Symposium on Compound Semiconductors, 23-26th August 1999, Berlin, Germany John Wiley & Sons

This issue covers in detail all aspects of the physics and the technology of high dielectric constant gate stacks, including high mobility substrates, high dielectric constant materials, processing, metals for gate electrodes, interfaces, physical, chemical, and electrical characterization, gate stack reliability, and DRAM and non-volatile memories.

Handbook of GaN Semiconductor Materials and Devices CRC Press

Emerging wide bandgap (WBG) semiconductors hold the potential to advance the global industry in the same way that, more than 50 years ago, the invention of the silicon (Si) chip enabled the modern computer era. SiC- and GaN-based devices are starting to become more commercially available. Smaller, faster, and more efficient than their counterpart Si-based components, these WBG devices also offer greater expected reliability in tougher operating conditions. Furthermore, in this frame, a new class of microelectronic-grade semiconducting materials that have an even larger bandgap than the previously established wide bandgap semiconductors, such as GaN and SiC, have been created, and are thus referred to as “ultra-wide bandgap” materials. These materials, which include AlGaN, AlN, diamond, Ga2O3, and BN, offer theoretically superior properties, including a higher critical breakdown field, higher temperature operation, and potentially higher radiation tolerance. These attributes, in turn, make it possible to use revolutionary new devices for extreme environments, such as high-efficiency power transistors, because of the improved Baliga figure of merit, ultra-high voltage pulsed power switches, high-efficiency UV-LEDs, and electronics. This Special Issue aims to collect high quality research papers, short communications, and review articles that focus on wide bandgap device design, fabrication, and advanced characterization. The Special Issue will also publish selected papers from the 43rd Workshop on Compound Semiconductor Devices and Integrated Circuits, held in France (WOCSDICE 2019), which brings together scientists and engineers working in the area of III–V, and other compound semiconductor devices and integrated circuits. In particular, the following topics are addressed: – GaN- and SiC-based devices for power and optoelectronic

applications – Ga2O3 substrate development, and Ga2O3 thin film growth, doping, and devices – AlN-based emerging material and devices – BN epitaxial growth, characterization, and devices

Espionage, Cyberwar, Communications Control and Related Threats to United States Interests, 2d ed. Nova Publishers

Chemical growth methods of electronic materials are the keystone of microelectronic device processing. This book discusses the applications of metalorganic chemistry for the vapor phase deposition of compound semiconductors. Vapor phase methods used for semiconductor deposition and the materials properties that make the organometallic precursors useful in the electronics industry are discussed for a variety of materials. Topics included: * techniques for compound semiconductor growth * metalorganic precursors for III-V MOVPE * metalorganic precursors for II-VI MOVPE * single-source precursors * chemical beam epitaxy * atomic layer epitaxy Several useful appendixes and a critically selected, up-to-date list of references round off this practical handbook for materials scientists, solid-state and organometallic chemists, and engineers.

Growth, Materials Properties and Applications The Electrochemical Society

An international perspective on the latest research, Compound Semiconductors 1999 presents an overview of important developments in all III-V compound semiconductors such as GaAs, InP, and GaN; II-VI compounds such as ZnS, ZnSe, and CdTe; IV-IV compounds such as SiC and SiGe; and IV-VI compounds such as PbTe and SnTe. The book emphasizes piezoelect

15th European Workshop on Metalorganic Vapour Phase Epitaxy (EWMOVPE XV) June 2-5, 2013, Aachen, Germany Springer Science & Business Media

This report examines the development of the diode laser industry over a six-year period, 2000 to 2005, incorporating analysis of trends in markets, technologies and industry structure. It is designed to provide key information to users and manufacturers of substrates, epitaxial wafers (epiwafers) and devices. The coverage includes components, laser diodes, and the semiconducting (SC) wafers and epiwafers on which most of these devices are made. The geographical coverage of the report includes North America, Japan and Europe, which together will account for over 90% of the production and consumption of diode laser materials and devices over the next five years. However, many other countries have activities in this field including South-East Asia (Taiwan, South Korea, Singapore, Malaysia etc), China, India, Australia and Eastern Europe (Russia, Poland, Hungary, the Czech Republic) amongst others. Activities in these countries are commented on in the text where relevant, but are not quantified in the market data. Chapter 1 is an introduction to the market study. Chapter 2 contains an executive summary. Chapter 3 overviews materials markets. The size, quality, and particularly the price, of substrates and wafers are key factors in determining the ability of companies to produce competitive laser products. Chapter 3 also examines trends in materials technologies for laser diodes, the impact of the device markets on wafer demand, and the main suppliers. This chapter introduces the semiconductor materials that are presently or will likely become

important to the fabrication of diode laser devices. The principal distinguishing properties of these materials are explained with reference to their application. Chapter 4 chapter examines the basic application sectors for laser diode devices as well as the basic commercial opportunities, changes and forces acting within each sector. The chapter also examines the market for the basic types of device as well as the promising newer types. For each type of device, market data and forecasts are provided and future prospects described. The application data are presented for the following industrial groups: • Automotive • Computers • Consumer • Industrial • Military and Aerospace • Telecommunications • Others A full 5-year forecast and analysis is provided by application and region. Chapter 5 is a technology overview. In this chapter a background and overview of developments in the principal technological R&D and production processes for devices is provided. The main focus is on the most important enabling technology for the production of the present and future generations of laser diodes and related devices. This process is crystal growth and involves the following sequence: • Bulk growth of single crystals • Epitaxial growth of semiconductor single crystal layers • Ion implantation • Device fabrication, ie gate and contact formation, etc • Packaging & test Chapter 6 profiles substrate suppliers, epiwafers suppliers and merchant and captive producers of GaAs devices. Chapter 7 lists universities and selected industrial labs involved in the areas of diode laser research. Chapter 8 is a directory of suppliers. Chapter 9 provides acronyms and exchange rates. For a PDF version of the report please call Tina Enright on +44 (0) 1865 843008 for price details.

Proceedings of the First International Symposium on Long Wavelength Infrared Detectors and Arrays: Physics and Applications CRC Press

Chemical Vapour Deposition (CVD) involves the deposition of thin solid films from chemical precursors in the vapour phase, and encompasses a variety of deposition techniques, including a range of thermal processes, plasma enhanced CVD (PECVD), photon- initiated CVD, and atomic layer deposition (ALD). The development of CVD technology owes a great deal to collaboration between different scientific disciplines such as chemistry, physics, materials science, engineering and microelectronics, and the publication of this book will promote and stimulate continued dialogue between scientists from these different research areas. The book is one of the most comprehensive overviews ever written on the key aspects of chemical vapour deposition processes and it is more comprehensive, technically detailed and up-to-date than other books on CVD. The contributing authors are all practising CVD technologists and are leading international experts in the field of CVD. It presents a logical and progressive overview of the various aspects of CVD processes. Basic concepts, such as the various types of CVD processes, the design of CVD reactors, reaction modelling and CVD precursor chemistry are covered in the first few chapters. Then follows a detailed description of the use of a variety CVD techniques to deposit a wide range of materials, including semiconductors, metals, metal oxides and nitrides, protective coatings and functional coatings on glass. Finally and uniquely, for a technical volume, industrial and commercial aspects of

CVD are also discussed together with possible future trends, which is an unusual, but very important aspect of the book. The book has been written with CVD practitioners in mind, such as the chemist who wishes to learn more about CVD processes, or the CVD technologist who wishes to gain an increased knowledge of precursor chemistry. The volume will prove particularly useful to those who have recently entered the field, and it will also make a valuable contribution to chemistry and materials science lecture courses at undergraduate and postgraduate level.

Physics of Semiconductor Devices Elsevier

The standard incandescent light bulb, which still works mainly as Thomas Edison invented it, converts more than 90% of the consumed electricity into heat. Given the availability of newer lighting technologies that convert a greater percentage of electricity into useful light, there is potential to decrease the amount of energy used for lighting in both commercial and residential applications. Although technologies such as compact fluorescent lamps (CFLs) have emerged in the past few decades and will help achieve the goal of increased energy efficiency, solid-state lighting (SSL) stands to play a large role in dramatically decreasing U.S. energy consumption for lighting. This report summarizes the current status of SSL technologies and products-light-emitting diodes (LEDs) and organic LEDs (OLEDs)-and evaluates barriers to their improved cost and performance. Assessment of Advanced Solid State Lighting also discusses factors involved in achieving widespread deployment and consumer acceptance of SSL products. These factors include the perceived quality of light emitted by SSL devices, ease of use and the useful lifetime of these devices, issues of initial high cost, and possible benefits of reduced energy consumption.

Physics, Chemistry and Application of Nanostructures Recent Developments in Superconductivity Research

A wide range of progress in materials development [single crystals, ceramics, thin films, wire and tapes] is reported in the 169 papers in this volume. The main focus of the papers is in attaining a better understanding of the relationship between microstructure and electrical properties. Invited papers cover topics such as the effects of substitution and doping; multilayers; nanostructure characterisation; electric field effects in High Tc Superconductors [HTS]; surface stability; critical currents; flux pinning and magnetooptic imaging of flux patterns; effects of irradiation induced defects; properties and preparation of materials; microwave properties and electronic devices. A clearly broadened basis for understanding processes and mechanisms in [HTS] is portrayed. Appreciable progress has been achieved in the reproducible manufacturing of high quality materials supported by very efficient methods in microstructural analysis. This essential improvement is reflected in the increased number of practical devices encouraging the use of HTS in applications for electronics and power engineering, all of which are reviewed in depth in this work.

Wide Bandgap Based Devices National Academies Press

This multidisciplinary book provides up-to-date coverage of carrier and spin dynamics and energy transfer and structural interaction among nanostructures. Coverage also includes

current device applications such as quantum dot lasers and detectors, as well as future applications to quantum information processing. The book will serve as a reference for anyone working with or planning to work with quantum dots.

High Tc Superconductors MDPI

In a uniform and comprehensive manner the authors describe all the important aspects of the epitaxial growth processes of solid films on crystalline substrates, e.g. processes in which atoms of the growing film mimic the arrangement of the atoms of the substrate. Emphasis is put on sufficiently fundamental and unequivocal presentation of the subject in the form of an easy-to-read review. A large part of this book focuses on the problems of heteroepitaxy. The most important epitaxial growth techniques which are currently widely used in basic research as well as in manufacturing processes of devices are presented and discussed in detail.

Metalorganic Vapor Phase Epitaxy (MOVPE) Elsevier

Electron microscopy is now a mainstay characterization tool for solid state physicists and chemists as well as materials scientists. Electron Microscopy and Analysis 2001 presents a useful snapshot of the latest developments in instrumentation, analysis techniques, and applications of electron and scanning probe microscopies. The book is ideal for

Proceedings of the International Symposia World Scientific

The Institute of Physics Conference Series is a leading International medium for the rapid publication of proceedings of major conferences and symposia reviewing new developments in physics and related areas. Volumes in the series comprise original refereed papers and are regarded as standard referee works. As such, they are an essential part of major libration collections worldwide. The twelfth conference on the Microscopy of Semiconducting Materials (MSM) was held at the University of Oxford, 25-29 March 2001. MSM conferences focus on recent international advances in semiconductor studies carried out by all forms of microscopy. The event was organized with scientific sponsorship by the Royal Microscopical Society, The Electron Microscopy and Analysis Group of the Institute of Physics and the Materials Research Society. With the continual shrinking of electronic device dimensions and accompanying enhancement in device performance, the understanding of semiconductor microscopic properties at the nanoscale (and even at the atomic scale) is increasingly critical for further progress to be achieved. This conference proceedings provides an overview of the latest instrumentation, analysis techniques and state-of-the-art advances in semiconducting materials science for solid state physicists, chemists, and materials scientists.

Proceedings of the International Conference, Nanomeeting--2009 : Reviews and Short Notes : Minsk, Belarus, 26-29 May 2009 John Wiley & Sons

Optics and photonics offer new and vibrant approaches to meeting the challenges of the 21st century concerning energy conservation, education, agriculture, personal health and the environment. One of the most effective ways to address these global problems is to provide updated and reliable content on light-based technologies. Optical thin films and meta-materials, lasers, optical

communications, light-emitting diodes, solar cells, liquid crystal technology, nanophotonics and biophotonics all play vital roles in enriching our lives. We hope to raise readers' awareness of how optical technologies are now promoting sustainable development and providing reliable solutions to basic human needs. Furthermore, in order to broaden new research fields, we hope to inspire them to pursue further cutting-edge breakthroughs on the basis of the accomplishments that have already been made.

III-nitride Springer

This book is an introduction to the fundamentals of emerging non-volatile memories and provides an overview of future trends in the field. Readers will find coverage of seven important memory technologies, including Ferroelectric Random Access Memory (FeRAM), Ferromagnetic RAM (FMRAM), Multiferroic RAM (MFRAM), Phase-Change Memories (PCM), Oxide-based Resistive RAM (RRAM), Probe Storage, and Polymer Memories. Chapters are structured to reflect diffusions and clashes between different topics. Emerging Non-Volatile Memories is an ideal book for graduate students, faculty, and professionals working in the area of non-volatile memory. This book also: Covers key memory technologies, including Ferroelectric Random Access Memory (FeRAM), Ferromagnetic RAM (FMRAM), and Multiferroic RAM (MFRAM), among others. Provides an overview of non-volatile memory fundamentals. Broadens readers' understanding of future trends in non-volatile memories.

Design, Fabrication and Applications Springer Science & Business Media

The book presents invited reviews and original short notes with recent results obtained in fabrication study and application of nanostructures, which are promising for new generations of electronic and optoelectronic devices.

Microscopy of Semiconducting Materials 2001 World Scientific

Recent Developments in Superconductivity ResearchNova Publishers

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