Molecular Beam Epitaxy

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Molecular Beam Epitaxy - Brian R. Pamplin 1980

Proceedings of the Eighth Molecular-Beam Epitaxy Workshop - 1988

Advanced Silicon & Semiconducting Silicon-Alloy Based Materials & Devices - Jo Nijs 2021-05-30

One of the first books to cover advanced silicon-based technologies, Advanced Silicon and Semiconducting Silicon Alloy-Based Materials and Devices presents important directions for research into silicon, its alloy-based semiconducting devices, and its development in commercial applications. The first section deals with single/mono crystalline silicon, focusing on the effects of heavy doping; the structure and electronic properties of defects and their impact on devices; the MBE of silicon, silicon alloys, and metals; CVD techniques for silicon and silicon germanium; the material properties of silicon germanium strained layers; silicon germanium heterojunction bipolar applications; FETs, IR detectors, and resonant tunneling devices in silicon, silicon germanium, and d-doped silicon; and the fascinating properties of crystalline silicon carbide and its applications. The second section explores polycrystalline silicon. It examines large grain polysilicon substrates for solar cells; the properties, analysis, and modeling of polysilicon TFTs; the technology of polysilicon TFTs in LCD displays; and the use of polycrystalline silicon and its alloys in VLSI applications. With contributors from leading academic and industrial research centers, this book provides wide coverage of fabrication techniques, material properties, and device applications.

Molecular Beam Epitaxy Growth and Structural Property of Self-assembled InAs Quantum Dots on GaAs - Kai Zhang 2000

Materials Fundamentals of Molecular Beam Epitaxy - Jeffrey Y. Tsao 2012-12-02

The technology of crystal growth has advanced enormously during the past two decades. Among, these advances, the development and refinement of molecular beam epitaxy (MBE) has been among the msot important. Crystals grown by MBE are more precisely controlled than those grown by any other method, and today they form the basis for the most advanced device structures in solid-state physics, electronics, and optoelectronics. As an example, Figure 0.1 shows a vertical-cavity surface emitting laser structure grown by MBE. * Provides comprehensive treatment of the basic materials and surface science principles that apply to molecular beam epitaxy * Thorough enough to benefit molecular beam epitaxy researchers * Broad enough to benefit materials, surface, and device researchers * Referenes articles at the

forefront of modern research as well as those of historical interest

Molecular Beam Epitaxy - Mohamed Henini 2012-12-31

This multi-contributor handbook discusses Molecular Beam Epitaxy (MBE), an epitaxial deposition technique which involves laying down layers of materials with atomic thicknesses on to substrates. It summarizes MBE research and application in epitaxial growth with close discussion and a 'how to' on processing molecular or atomic beams that occur on a surface of a heated crystalline substrate in a vacuum. MBE has expanded in importance over the past thirty years (in terms of unique authors, papers and conferences) from a pure research domain into commercial applications (prototype device structures and more at the advanced research stage). MBE is important because it enables new device phenomena and facilitates the production of multiple layered structures with extremely fine dimensional and compositional control. The techniques can be deployed wherever precise thin-film devices with enhanced and unique properties for computing, optics or photonics are required. This book covers the advances made by MBE both in research and mass production of electronic and optoelectronic devices. It includes new semiconductor materials, new device structures which are commercially available, and many more which are at the advanced research stage. Condenses fundamental science of MBE into a modern reference, speeding up literature review Discusses new materials, novel applications and new device structures, grounding current commercial applications with modern understanding in industry and research Coverage of MBE as mass production epitaxial technology enhances processing efficiency and throughput for semiconductor industry and nanostructured semiconductor materials research community

Molecular Beam Epitaxy - Hajime Asahi 2019-04-15

Covers both the fundamentals and the state-of-the-art technology used for MBE Written by expert researchers working on the frontlines of the field, this book covers fundamentals of Molecular Beam Epitaxy (MBE) technology and science, as well as state-of-the-art MBE technology for electronic and optoelectronic device applications. MBE applications to magnetic semiconductor materials are also included for future magnetic and spintronic device applications. Molecular Beam Epitaxy: Materials and Applications for Electronics and Optoelectronics is presented in five parts: Fundamentals of MBE; MBE technology for electronic devices application; MBE for optoelectronic devices; Magnetic semiconductors and spintronics devices; and Challenge of MBE to new materials and new researches. The book offers chapters covering the history of MBE; principles of MBE and fundamental mechanism of MBE growth; migration enhanced epitaxy and its application; quantum dot formation and selective area growth by MBE; MBE of III-nitride semiconductors for electronic devices; MBE for Tunnel-FETs; applications of III-V semiconductor quantum dots in optoelectronic devices; MBE of III-V and III-nitride heterostructures for optoelectronic devices with emission wavelengths from THz to ultraviolet; MBE of III-V semiconductors for mid-infrared photodetectors and solar cells; dilute magnetic semiconductor materials and ferromagnet/semiconductor heterostructures and their application to spintronic devices; applications of bismuth-containing III–V semiconductors in devices; MBE growth and device applications of Ga2O3; Heterovalent semiconductor structures and their device applications; and more. Includes chapters on the fundamentals of MBE Covers new challenging researches in MBE and new technologies Edited by two pioneers in the field of MBE with contributions from well-known MBE authors including three Al Cho MBE Award winners Part of the Materials for Electronic and Optoelectronic Applications series Molecular Beam Epitaxy: Materials and Applications for Electronics and Optoelectronics will appeal to graduate students, researchers in academia and industry, and others interested in the area of epitaxial growth.

Molecular Beam Epitaxy 1994 - 1995

Growth and Defect Characterization of Low Temperature Molecular Beam Epitaxy GaAs - Ri-an Zhao 2002

Growth Processes and Surface Phase Equilibria in Molecular Beam Epitaxy - Nikolai N. Ledentsov 1999-07-02

The book considers the main growth-related phenomena occurring during epitaxial growth, such as thermal etching, doping, segregation of the main elements and impurities, coexistence of several phases at the crystal surface and segregation-enhanced diffusion. It is complete with tables, graphs and figures, which allow fast determination of suitable growth parameters for practical applications.

Gas Source Molecular Beam Epitaxy - Morton B. Panish 2011-12-30

The first book to present a unified treatment of hybrid source MBE and metalorganic MBE. Since metalorganic MBE permits selective area growth, the latest information on its application to the INP/GaInAs(P) system is presented. This system has been highlighted because it is one of rising importance, vital to optical communications systems, and has great potential for future ultra-highspeed electronics. The use of such analytical methods as high resolution x-ray diffraction, secondary ion mass spectroscopy, several photoluminescence methods, and the use of active devices for materials evaluation is shown in detail.

Optoelectronic Devices - M Razeghi 2004

Tremendous progress has been made in the last few years in the growth, doping and processing technologies of the wide bandgap semiconductors. As a result, this class of materials now holds significant promis for semiconductor electronics in a broad range of applications. The principal driver for the current revival of interest in III-V Nitrides is their potential use in high power, high temperature, high frequency and optical devices resistant to radiation damage. This book provides a wide number of optoelectronic applications of III-V nitrides and covers the entire process from growth to devices and applications making it essential reading for those working in the semiconductors or microelectronics. Broad review of optoelectronic applications of III-V nitrides

Molecular Beam Epitaxy - Mohamed Henini 2018-06-27

Molecular Beam Epitaxy (MBE): From Research to Mass Production, Second Edition, provides a comprehensive overview of the latest MBE research and applications in epitaxial growth, along with a detailed discussion and ‘how to’ on processing molecular or atomic beams that occur on the surface of a heated crystalline substrate in a vacuum. The techniques addressed in the book can be deployed wherever precise thin-film devices with enhanced and unique properties for computing, optics or photonics are required. It includes new semiconductor materials, new device structures that are commercially available, and many that are at the advanced research stage. This second edition covers the advances made by MBE, both in research and in the mass production of electronic and optoelectronic devices. Enhancements include new chapters on MBE growth of 2D materials, Si-Ge materials, AIN and GaN materials, and hybrid ferromagnet and semiconductor structures. Condenses the fundamental science of MBE into a modern reference, speeding up literature review Discusses new materials, novel applications and new device structures, grounding current commercial applications with modern understanding in industry and research Includes coverage of MBE as mass production epitaxial technology and how it enhances processing efficiency and throughput for the semiconductor industry and nanostructured semiconductor materials research community

Molecular Beam Epitaxy - Marian A. Herman 2013-10-03

Molecular Beam Epitaxy describes a technique in wide-spread use for the production of high-quality semiconductor devices. It discusses the most important aspects of the MBE apparatus, the physics and chemistry of the crystallization of various materials and device structures, and the characterization methods that relate the structural parameters of the grown (or growing) film or structure to the technologically relevant procedure. In this second edition two new fields have been added: crystallization of as-grown low-dimensional heterostructures, mainly quantum wires and quantum dots, and in-growth control of the MBE crystallization process of strained-layer structures. Out-of-date material has been removed.

Lead Chalcogenides - D. Khokhlov 2021-12-17

Lead Chalcogenides remain one of the basic materials of modern infrared optoelectronics. This volume presents the properties of lead chalcogenides, including the basic physical features, the bulk and epitaxial growth technique, and the 2-D physics of lead chalcogenide-

based structures. In addition, the theoretical appraoches for band structure and impurity state calculations are reviewed.

Dilute Nitride Semiconductors - Mohamed Henini 2004-12-15

This book contains full account of the advances made in the dilute nitrides, providing an excellent starting point for workers entering the field. It gives the reader easier access and better evaluation of future trends, Conveying important results and current ideas. Includes a generous list of references at the end of each chapter, providing a useful reference to the III-V-N based semiconductors research community. The high speed lasers operating at wavelength of 1.3 μm and 1.55 μm are very important light sources in optical communications since the optical fiber used as a transport media of light has dispersion and attenuation minima, respectively, at these wavelengths. These long wavelengths are exclusively made of InP-based material InGaAsP/InP. However, there are several problems with this material system. Therefore, there has been considerable effort for many years to fabricate long wavelength laser structures on other substrates, especially GaAs. The manufacturing costs of GaAs-based components are lower and the processing techniques are well developed. In 1996 a novel quaternary material GaInAsN was proposed which could avoid several problems with the existing technology of long wavelength lasers. In this book, several leaders in the field of dilute nitrides will cover the growth and processing, experimental characterization, theoretical understanding, and device design and fabrication of this recently developed class of semiconductor alloys. They will review their current status of research and development. Dilute Nitrides (III-N-V) Semiconductors: Physics and Technology organises the most current available data, providing a ready source of information on a wide range of topics, making this book essential reading for all post graduate students, researchers and practitioners in the fields of Semiconductors and Optoelectronics Contains full account of the advances made in the dilute nitrides, providing an excellent starting point for workers entering the field Gives the reader easier access and better evaluation of future trends, conveying important results and current ideas Includes a generous list of references at the end of each chapter, providing a useful reference to the III-V-N based semiconductors research community

Silicon Molecular Beam Epitaxy - E. Kasper 2018-05-04

This subject is divided into two volumes. Volume I is on homoepitaxy with the necessary systems, techniques, and models for growth and dopant incorporation. Three chapters on homoepitaxy are followed by two chapters describing the different ways in which MBE may be applied to create insulator/Si stackings which may be used for three-dimensional circuits. The two remaining chapters in Volume I are devoted to device applications. The first three chapters of Volume II treat all aspects of heteroepitaxy with the exception of the epitaxial insulator/Si structures already treated in volume I.

Silicon Molecular Beam Epitaxy - E. Kasper 2017-12-14

This subject is divided into two volumes. Volume I is on homoepitaxy with the necessary systems, techniques, and models for growth and dopant incorporation. Three chapters on homoepitaxy are followed by two chapters describing the different ways in which MBE may be applied to create insulator/Si stackings which may be used for three-dimensional circuits. The two remaining chapters in Volume I are devoted to device applications. The first three chapters of Volume II treat all aspects of heteroepitaxy with the exception of the epitaxial insulator/Si structures already treated in volume I.

Molecular Beam Epitaxy and Properties of Magnetite Thin Films on Semiconducting Substrates - Markus Christian Paul 2011

Silicon-Molecular Beam Epitaxy - E. Kasper 2018-05-04

This subject is divided into two volumes. Volume I is on homoepitaxy with the necessary systems, techniques, and models for growth and dopant incorporation. Three chapters on homoepitaxy are followed by two chapters describing the different ways in which MBE may be applied to create insulator/Si stackings which may be used for three-dimensional circuits. The two remaining chapters in Volume I are devoted to device applications. The first three chapters of Volume II treat all aspects of heteroepitaxy with the exception of the epitaxial insulator/Si structures

already treated in volume I.

Molecular Beam Epitaxy - R. F. C. Farrow 1995

In this volume, the editor and contributors describe the use of molecular beam epitaxy (MBE) for a range of key materials systems that are of interest for both technological and fundamental reasons. Prior books on MBE have provided an introduction to the basic concepts and techniques of MBE and emphasize growth and characterization of GaAs-based structures. The aim in this book is somewhat different; it is to demonstrate the versatility of the technique by showing how it can be utilized to prepare and explore a range of distinct and diverse materials. For each of these materials systems MBE has played a key role both in their development and application to devices.

Epitaxial Growth of Complex Metal Oxides - Gertjan Koster 2015-05-14

The atomic arrangement and subsequent properties of a material are determined by the type and conditions of growth leading to epitaxy, making control of these conditions key to the fabrication of higher quality materials. Epitaxial Growth of Complex Metal Oxides reviews the techniques involved in such processes and highlights recent developments in fabrication quality which are facilitating advances in applications for electronic, magnetic and optical purposes. Part One reviews the key techniques involved in the epitaxial growth of complex metal oxides, including growth studies using reflection high-energy electron diffraction, pulsed laser deposition, hybrid molecular beam epitaxy, sputtering processes and chemical solution deposition techniques for the growth of oxide thin films. Part Two goes on to explore the effects of strain and stoichiometry on crystal structure and related properties, in thin film oxides. Finally, the book concludes by discussing selected examples of important applications of complex metal oxide thin films in Part Three. Provides valuable information on the improvements in epitaxial growth processes that have resulted in higher quality films of complex metal oxides and further advances in applications for electronic and optical purposes Examines the techniques used in epitaxial thin film growth Describes the epitaxial growth and functional properties of complex metal oxides and explores the effects of strain and defects

Gas Source Molecular Beam Epitaxy - M. B. Panish 1993-01-01

The Technology and Physics of Molecular Beam Epitaxy - E.H.C. Parker 2014-05-14

Molecular Beam Epitaxy - Robin F.C. Farrow 1995-12-31

In this volume, the editor and contributors describe the use of molecular beam epitaxy (MBE) for a range of key materials systems that are of interest for both technological and fundamental reasons. Prior books on MBE have provided an introduction to the basic concepts and techniques of MBE and emphasize growth and characterization of GaAs-based structures. The aim in this book is somewhat different; it is to demonstrate the versatility of the technique by showing how it can be utilized to prepare and explore a range of distinct and diverse materials. For each of these materials systems MBE has played a key role both in their development and application to devices.

Molecular Beam Epitaxy of Graphene on Gold Foils: Growth and Characterization - Anand Sampat 2013-01-21

Master's Thesis from the year 2012 in the subject Materials Science, University of California, Berkeley , language: English, abstract: The application of graphene for large-area electronics requires controllable growth of single crystalline quasi-freestanding graphene films. Controllable growth of graphene films on gold foils at various temperatures using molecular beam epitaxy is shown. Film quality and electrical characteristics probed using Hall measurement, Raman spectroscopy, and Rutherford backscattering spectrometry are shown to improve at lower temperature possibly peaking at ~825°C. Further experiments are required to assess a stronger correlation between growth parameters and film characteristics. In particular, varying carbon flux and increasing the number of growths are discussed.

Gallium Oxide - Masataka Higashiwaki 2020-04-23

This book provides comprehensive coverage of the new wide-bandgap

semiconductor gallium oxide (Ga2O3). Ga2O3 has been attracting much attention due to its excellent materials properties. It features an extremely large bandgap of greater than 4.5 eV and availability of large-size, high-quality native substrates produced from melt-grown bulk single crystals. Ga2O3 is thus a rising star among ultra-wide-bandgap semiconductors and represents a key emerging research field for the worldwide semiconductor community. Expert chapters cover physical properties, synthesis, and state-of-the-art applications, including materials properties, growth techniques of melt-grown bulk single crystals and epitaxial thin films, and many types of devices. The book is an essential resource for academic and industry readers who have an interest in, or plan to start, a new R&D project related to Ga2O3.

Crystal Growth in Science and Technology - H. Arend 2012-12-06

Science and art of crystal growth represent an interdisciplinary activity based on fundamental principles of physics, chemistry and crystallography. Crystal growth has contributed over the years essentially to a widening of knowledge in its basic disciplines and has penetrated practically into all fields of experimental natural sciences. It has acted, more over, in a steadily increasing manner as a link between science and technology as can be seen best, for example, from the achievements in modern microelectronics. The aim of the course "Crystal Growth in Science and Technology" being to stress the interdisciplinary character of the subject, selected fundamental principles are reviewed in the following contributions and cross links between basic and applied aspects are illustrated. It is a very well-known fact that the intensive development of crystal growth has led to a progressive narrowing of interests in highly specialized directions which is in particular harmful to young research scientists. The organizers of the course did sincerely hope that the program would help to broaden up the horizon of the participants. It was equally their wish to contribute within the traditional spirit of the school of crystallography in Erice to the promotion of mutual understanding, personal friendship and future collaboration between all those who were present at the school.

Microprocessor-Based Parallel Architecture for Reliable Digital Signal Processing Systems - Alan D. George 2018-01-18

This book presents a distributed multiprocessor architecture that is faster, more versatile, and more reliable than traditional single-processor architectures. It also describes a simulation technique that provides a highly accurate means for building a prototype system in software. The system prototype is studied and analyzed using such DSP applications as digital filtering and fast Fourier transforms. The code is included as well, which allows others to build software prototypes for their own research systems. The design presented in Microprocessor-Based Parallel Architecture for Reliable Digital Signal Processing Systems introduces the concept of a dual-mode architecture that allows users a dynamic choice between either a conventional or fault-tolerant system as application requirements dictate. This volume is a "must have" for all professionals in digital signal processing, parallel and distributed computer architecture, and fault-tolerant computing.

Molecular-beam-epitaxy Grown Channeled-substrate Multiple-quantum-well Lasers, Surface-emitting Laser Diodes, and Study of Dopant Effect on Disordering of Superlattice - Yao-Hwa Wu 1986

Silicon-molecular Beam Epitaxy - Erich Kasper 1988

Molecular Beam Epitaxy - Marian A. Herman 2013-03-08

This first-ever monograph on molecular beam epitaxy (MBE) gives a comprehensive presentation of recent developments in MBE, as applied to crystallization of thin films and device structures of different semiconductor materials. MBE is a high-vacuum technology characterized by relatively low growth temperature, ability to cease or initiate growth abruptly, smoothing of grown surfaces and interfaces on an atomic scale, and the unique facility for in situ analysis of the structural parameters of the growing film. The excellent exploitation parameters of such MBE-produced devices as quantum-well lasers, high electron mobility transistors, and superlattice avalanche photodiodes have caused this technology to be intensively developed. The main text of the book is divided into three parts. The first presents and discusses the

more important problems concerning MBE equipment. The second discusses the physico-chemical aspects of the crystallization processes of different materials (mainly semiconductors) and device structures. The third part describes the characterization methods which link the physical properties of the grown film or structures with the technological parameters of the crystallization procedure. Latest achievements in the field are emphasized, such as solid source MBE, including silicon MBE, gas source MBE, especially metalorganic MBE, phase-locked epitaxy and atomic-layer epitaxy, photoassisted molecular layer epitaxy and migration enhanced epitaxy.

Molecular Beam Epitaxy of III–V Compounds - K. Ploog 1984-03-01

Epitaxial growth and electronic properties of semiconductor thin films are becoming increasingly important for fundamental and applied research and for device applications. This book contains a comprehensive collection of over 1500 references covering the first 25 years of molecular beam epitaxy of III-V compound semiconductors. Molecular beam epitaxy is a versatile thin film growth technique which emerged from the 'Three-temperature method' de veloped in the 1950s and from surface kinetic studies performed in the 1960s. III-V semiconductors such as GaAs, AlAs, (Galn)As, InP, etc. , play an important role in the application to optoelectronic and high-speed devices. Over the past three years the technology of molecular beam epitaxy has spread rapidly to most major research and development laboratories through out the world, and an increasing number of highly refined III-V semiconduc tor structures with exactly tailored electronic properties have been pro duced and explored for fundamental studies as well as for device appl ica tion. The comprehensive bibliography on this dramatically expanding topic helps chemists, engineers, materials scientists, and physicists working in semiconductor research and development areas to sort out the important lit erature of their particular interest. A direct reproduction of the output of a computer printer has been used to enable rapid publication and to keep printing costs low. The work was sponsored by the 'Bundesministerium fUr Forschung und Technologie' of the Federal Republic of Germany. Stuttgart, January 1984 K. Ploog . K. Graf Subject Categories and References Introduction . . . . . Year 1977 . . . . . .

Nitride Semiconductor Technology - Fabrizio Roccaforte 2020-07-30

The book "Nitride Semiconductor Technology" provides an overview of nitride semiconductors and their uses in optoelectronics and power electronics devices. It explains the physical properties of those materials as well as their growth methods. Their applications in high electron mobility transistors, vertical power devices, LEDs, laser diodes, and vertical-cavity surface-emitting lasers are discussed in detail. The book further examines reliability issues in these materials and puts forward perspectives of integrating them with 2D materials for novel high-frequency and high-power devices. In summary, it covers nitride semiconductor technology from materials to devices and provides the basis for further research.

Molecular Beam Epitaxy and Heterostructures - L.L. Chang 2012-12-06

The NATO Advanced Study Institute on "Molecular Beam Epitaxy (MBE) and Heterostructures" was held at the Ettore Majorana Center for Scientific Culture, Erice, Italy, on March 7-19, 1983, the second course of the International School of Solid-State Device Re search. This volume contains the lectures presented at the Institute. Throughout the history of semiconductor development, the coupling between processing techniques and device structures for both scientific investigations and technological applications has time and again been demonstrated. Newly conceived ideas usually demand the ultimate in existing techniques, which often leads to process innova tions. The emergence of a process, on the other hand, invariably creates opportunities for device improvement and invention. This intimate relationship between the two has most recently been witnessed in MBE and heterostructures, the subject of this Institute. This volume is divided into several sections. Chapter 1 serves as an introduction by providing a perspective of the subject. This is followed by two sections, each containing four chapters, Chapters 2-5 addressing the principles of the MBE process and Chapters 6-9 describ ing its use in the growth of a variety of semiconductors and

heteros tructures. The next two sections, Chapters to-II and Chapters 12-15, treat the theory and the electronic properties of the heterostructures, respectively. The focus is on energy quantization of the two dimensional electron system. Chapters 16-17 are devoted to device structures, including both field-effect transistors and lasers and detec tors.

Molecular Beam Epitaxy Growth and Characterization of ZnO-based Layers and Heterostructures - Abdelhamid Abdelrehim Mahmoud Elshaer 2008

Molecular Beam Epitaxy and Heterostructures - Organización Del Tratado Del Atlántico Norte. Advanced Study Institute on Molecular Beam Epitaxy (MBE) and Heterostructures 1985

Proceedings of the NATO Advanced Study Institute on Molecular Beam Epitaxy (MBE) and Heterostructures, Erice, Italy, March 7-19, 1983

Study of III -Nitrides Heterostructures Grown by Molecular Beam Epitaxy - Che Woei Chin 2011-05

Various techniques have been used to grow III-nitride heterostructures including metalorganic vapor deposition, hydride vapor epitaxy and molecular beam epitaxy (MBE). Among these techniques, MBE presents a number of advantages such as precise control of layer thickness and composition. MBE is a highly sophisticated system which thin film quality is sensitive to the growth parameters. From the literature, a systematic growth procedure has not been well-documented. This book presents an in depth understanding of MBE growth mechanism which is essential for thin film quality improvement. Detailed study on the growth mechanism allows the acquisition of the fundamental knowledge in growing precise optoelectronics device structures. This book focuses on the study of III-nitride thin films grown by MBE on various aspects, supported by analysis using a variety of structural and optical characterization techniques. The book starts with the introduction of the MBE architecture, follows by the detailed growth procedures. The characterization and analysis of various III-nitride thin films grown on Si and sapphire will be presented in the last part of the book.

Molecular Beam Epitaxy - John Wilfred Orton 2015

The book is a history of Molecular Beam Epitaxy (MBE) as applied to the growth of semiconductor thin films (note that it does not cover the subject of metal thin films). It begins by examining the origins of MBE, first of all looking at the nature of molecular beams and considering their application to fundamental physics, to the development of nuclear magnetic resonance and to the invention of the microwave MASER. It shows how molecular beams of silane (SiH4) were used to study the nucleation of silicon films on a silicon substrate and how such studies were extended to compound semiconductors such as GaAs. From such surface studies in ultra-high vacuum the technique developed into a method of growing high quality single crystal films of a wide range of semiconductors. Comparing this with earlier evaporation methods of deposition and with other epitaxial deposition methods such as liquid phase and vapour phase epitaxy (LPE and VPE). The text describes the development of MBE machines from the early 'home-made' variety to that of commercial equipment and show how MBE was gradually refined to produce high quality films with atomic dimensions. This was much aided by the use of various in-situ surface analysis techniques, such as reflection high energy electron diffraction (RHEED) and mass spectrometry, a feature unique to MBE. It looks at various modified versions of the basic MBE process, then proceed to describe their application to the growth of so-called 'low-dimensional structures' (LDS) based on ultra-thin heterostructure films with thickness of order a few molecular monolayers. Further chapters cover the growth of a wide range of different compounds and describe their application to fundamental physics and to the fabrication of electronic and opto-electronic devices. The authors study the historical development of all these aspects and emphasise both the (often unexpected) manner of their discovery and development and the unique features which MBE brings to the growth of extremely complex structures with monolayer accuracy.

Heterostructure Bipolar Transistors by Molecular Beam Epitaxy - Michael James Werner 1988