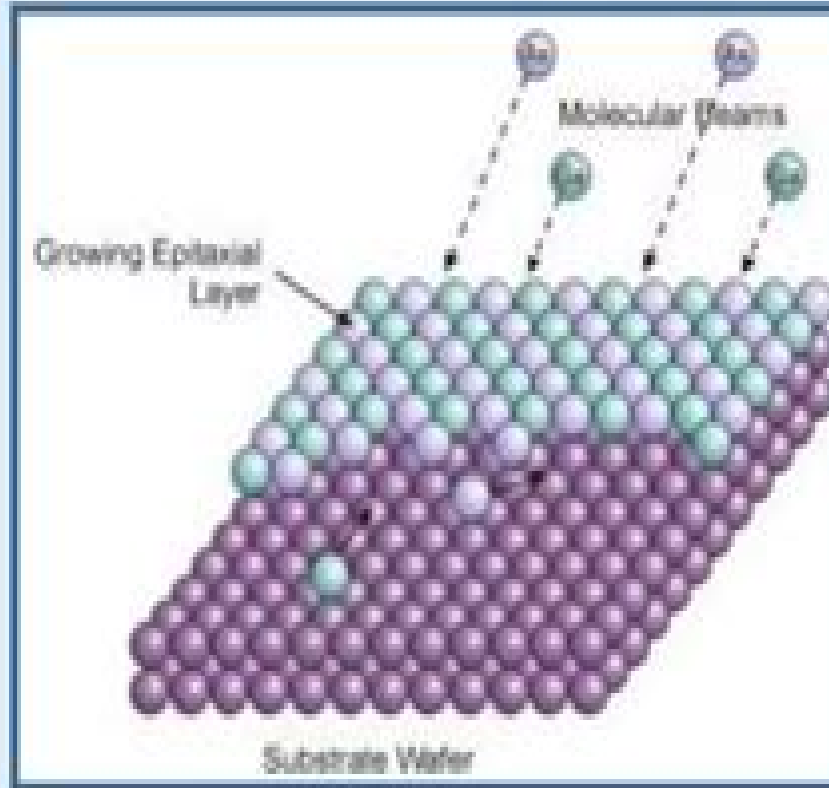


Molecular Beam Epitaxy



What is Molecular Beam Epitaxy?

Molecular Beam Epitaxy

Erwin Kasper, E.H.C. Parker



Molecular Beam Epitaxy:

Molecular Beam Epitaxy Marian A. Herman, Helmut Sitter, 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 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 and Heterostructures L.L. Chang, K. Ploog, 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 Research 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 innovations 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 describing its use in the growth of a variety of semiconductors and heterostructures The next two sections Chapters 10 11 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 detectors

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 John Orton, Tom Foxon, 2015-06-25 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 SiH_4 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

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 most 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 References articles at the forefront of modern research as well as those of historical interest

Molecular Beam Epitaxy Brian R. Pamplin, 2017-08-31 Molecular Beam Epitaxy introduces the reader to the use of molecular beam epitaxy MBE in the generation of III V and IV VI compounds and alloys and describes the semiconductor and integrated optics reasons for using the technique Topics covered include semiconductor superlattices by MBE design considerations for MBE systems periodic doping structure in gallium arsenide GaAs nonstoichiometry and carrier concentration control in MBE of compound semiconductors and MBE techniques for IV VI optoelectronic devices The use of MBE to fabricate integrated optical devices and to study semiconductor surface and crystal physics is also considered This book is comprised of eight chapters and opens with an overview of MBE as a crystal growth technique The discussion then turns to the deposition of semiconductor superlattices of GaAs by MBE important factors that must be considered in the design of a MBE system such as flux uniformity crucible volume heat shielding source baffling and shutters and control of stoichiometry deviation in MBE growth of compound semiconductors along with the effects of such deviation on the electronic properties of the grown films The following chapters focus on the use of MBE techniques for growth of IV VI optoelectronic devices for fabrication of integrated optical devices and for the study of semiconductor surface and crystal physics The final chapter examines a superlattice consisting of a periodic sequence of ultrathin p and n doped semiconductor layers possibly with intrinsic layers in between This monograph will be of interest to chemists physicists and crystallographers

Silicon Molecular Beam Epitaxy Erwin Kasper, E.H.C. Parker, 2012-12-02 This two volume work covers recent developments in the single crystal growth by molecular beam epitaxy of materials compatible with silicon their physical characterization and device application Papers are included on surface

physics and related vacuum synthesis techniques such as solid phase epitaxy and ion beam epitaxy A selection of contents
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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 John Wilfred Orton, Tom Foxon, 2015 This volume describes the development of molecular beam epitaxy from its origins in the 1960s through to the present day It begins with a short historical account of other methods of crystal growth both bulk and epitaxial to set the subject in context emphasising the wide range of semiconductor materials employed This is followed by an introduction to molecular beams and their use in the Stern Gerlach experiment and the development of the microwave MASER Source inconnue

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Molecular Beam Epitaxy Hajime Asahi, Yoshiji Horikoshi, 2019-01-30 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

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Proceedings of the First International Symposium on Silicon Molecular Beam Epitaxy John Condon Bean,1985 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 Papers from the 16th North American Conference on Molecular Beam Epitaxy North American Conference on Molecular Beam Epitaxy (16, 1997, Ann Arbor, Mich.),1998

Chemical Beam Epitaxy and Related Techniques John S Foord,G. J. Davies,W. T. Tsang,1997-12-08 Chemical Beam Epitaxy CBE is a powerful growth technique which has come to prominence over the last ten years Together with the longer established molecular beam epitaxy MBE and metal organic vapour phase epitaxy MOVPE CBE provides a capability for the epitaxial growth of semiconductor and other advanced materials with control at the atomic limit This the first book dedicated to CBE and closely related techniques comprises chapters by leading research workers in the field and provides a detailed overview of the state of the art in this area of semiconductor technology Topics covered include equipment design and safety considerations design of chemical precursors surface chemistry and growth mechanisms materials and devices from arsenide phosphide antimonide silicon and II VI compounds doping selected area epitaxy and etching The volume provides an introduction for those new to the field and a detailed summary for experienced researchers Silicon-molecular Beam Epitaxy ,1988

The Technology and Physics of Molecular Beam Epitaxy E.H.C. Parker,2014-05-14 **Proceedings of the Second International Symposium on Silicon Molecular Beam Epitaxy** John Condon Bean,Leo J. Schowalter,1988

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