ELECTRONIC STRUCTURE OF METAL-SEMICONDUCTOR CONTACTS

edited by
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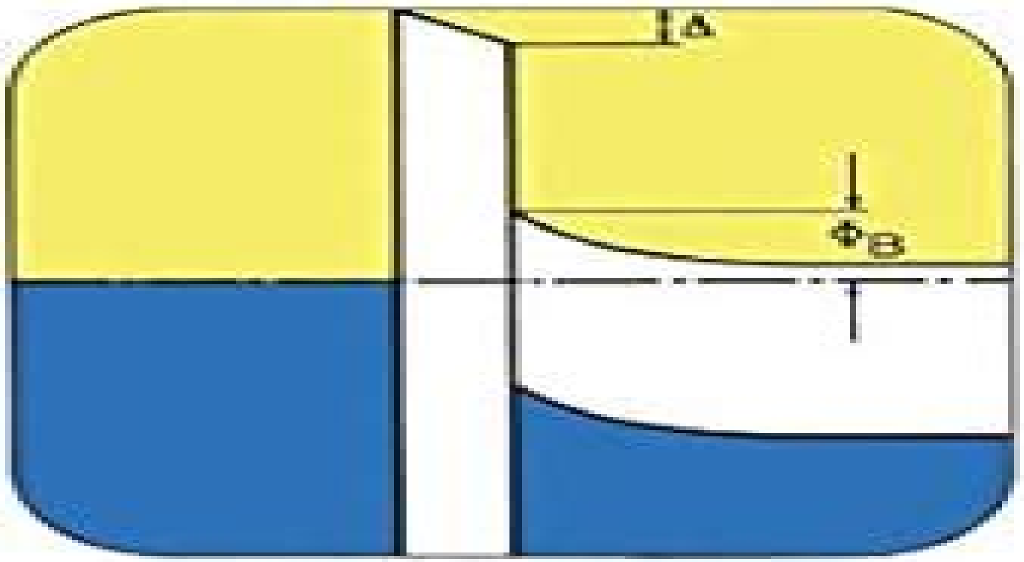

PERSPECTIVES IN CONDENSED MATTER PHYSICS

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Electronic Structure Of Metal Semiconductor Contacts

Dietmar Schroeder

Electronic Structure Of Metal Semiconductor Contacts:

Electronic Structure of Metal-Semiconductor Contacts Winfried Mönch,2012-12-06 Interface and surface science have been important in the development of semicon ductor physics right from the beginning on Modern device concepts are not only based on p n junctions which are interfaces between regions containing different types of dopants but take advantage of the electronic properties of semiconductor insulator interfaces heterojunctions between distinct semiconductors and metal semiconductor contacts The latter ones stood almost at the very beginning of semi conductor physics at the end of the last century The rectifying properties of metal semiconductor contacts were first described by Braun in 1874 A physically correct explanation of unilateral conduction as this deviation from Ohm s law was called could not be given at that time A prerequisite was Wilson s quantum theory of electronic semi conductors which he published in 1931 A few years later in 1938 Schottky finally explained the rectification at metal semiconductor contacts by a space Electronic Structure of Metal-Semiconductor Contacts Winfried Monch,1990-11-30 *The electronic structure of metal semiconductor contacts* Regina Mach,1979 **Electronic Structure of Semiconductor Interfaces** Winfried Mönch,2024-06-14 This concise volume examines the characteristic electronic parameters of semiconductor interfaces namely the barrier heights of metal semiconductor or Schottky contacts and the valence band discontinuities of semiconductor semiconductor interfaces or heterostructures Both are determined by the same concept namely the wave function tails of electron states overlapping a semiconductor band gap directly at the interface These interface induced gap states IFIGS result from the complex band structure of the corresponding semiconductor The IFIGS are characterized by two parameters namely by their branch point at which their charge character changes from predominantly valence band to conduction band like and secondly by the proportionality factor or slope parameter of the corresponding electric dipole term which varies in proportion to the difference in the electronegativities of the two solids forming the interface This IFIGS and electronegativity concept consistently and quantitatively explains the experimentally observed barrier heights of Schottky contacts as well as the valence band offsets of heterostructures Insulators are treated as wide band gap semiconductors **Electronic Structure of Semiconductor Heterojunctions** Giorgio Margaritondo,2012-12-06 E se non che di cid son vere prove A nd were it not for the true evidence Per piti e piti autori che sa ra nno Of many authors who will be Per i miei versi nominati altrove Mentioned elsewhere in my rhyme Non presterei alla penna 10 mana I would not lend my hand to the pen Per nota1 cid ch io vidi can temenza And describe my observations for fear ehe non fosse do altri casso e van 0 That they would be rejected and in vane Mala lor chiara e vera esperienza But these authors clear and true experience Mi assicura nel dir come persone Encourages me to report since they Degne di fede ad ogni gra n sentenza Should always be trusted for their word From Dittamondo by Fazio degli UbertiJ Heterojunction interfaces the interfaces between different semiconducting materi als have been extensively explored for over a quarter of a century The justifica tion for this effort is clear these interfaces could become the building blocks of lllany novel solid state devices Other interfaces involving semiconductors are al ready widely used in technology These are for example metal semiconductor and insulator semiconductor junctions and hOll1ojunctions In comparison the present applications of heterojunction int erfaces are limited but they could potentially becOlne lnuch lllore ext ensive in the neal future The path towards the widespread use of heterojunctions is obstructed by several obstacles

Metal – Semiconductor Contacts and Devices Simon S. Cohen,Gennady Sh. Gildenblat,2014-12-01 VLSI Electronics Microstructure Science Volume 13 Metal Semiconductor Contacts and Devices presents the physics technology and applications of metal semiconductor barriers in digital integrated circuits The emphasis is placed on the interplay among the theory processing and characterization techniques in the development of practical metal semiconductor contacts and devices This volume contains chapters that are devoted to the discussion of the physics of metal semiconductor interfaces and its basic phenomena fabrication procedures and interface characterization techniques particularly ohmic contacts Contacts that involve polycrystalline silicon applications of the metal semiconductor barriers in MOS bipolar and MESFET digital integrated circuits and methods for measuring the barrier height are covered as well Process engineers device physicists circuit designers and students of this discipline will find the book very useful **Semiconductor Surfaces and Interfaces** Winfried Mönch,2013-03-09 Semiconductor Surfaces and Interfaces deals with structural and electronic properties of semiconductor surfaces and interfaces The first part introduces the general aspects of space charge layers of clean surface and adatom induced surfaces states and of interface states It is followed by a presentation of experimental results on clean and adatom covered surfaces which are explained in terms of simple physical and chemical concepts Where available results of more refined calculations are considered This third edition has been thoroughly revised and updated In particular it now includes an extensive discussion of the band lineup at semiconductor interfaces The unifying concept is the continuum of interface induced gap states Wide-Gap Chalcopyrites Susanne Siebentritt,Uwe Rau,2006-02-25 Chalcopyrites in particular those with a wide band gap are fascinating materials in terms of their technological potential in the next generation of thin film solar cells and in terms of their basic material properties They exhibit uniquely low defect formation energies leading to unusual doping and phase behavior and to extremely benign grain boundaries This book collects articles on a number of those basic material properties of wide gap chalcopyrites comparing them to their low gap cousins They explore the doping of the materials the electronic structure and the transport through interfaces and grain boundaries the formation of the electric field in a solar cell the mechanisms and suppression of recombination the role of inhomogeneities and the technological role of wide gap chalcopyrites *Modelling of Interface Carrier Transport for Device Simulation* Dietmar Schroeder,2013-03-09 This book represents a comprehensive text devoted to charge transport at semiconductor interfaces and its consideration in device simulation by interface and boundary conditions It contains a broad review of the physics modelling and simulation of electron transport at interfaces in semiconductor devices Particular emphasis is put on the consistent deriva tion of interface or boundary conditions for semiconductor device simula tion The book is of interest with respect to a wide range of electronic engineering activities as process design device design process character ization research in microelectronics or device simulator development It is also useful for students and lecturers in courses of electronic engineering and it supplements the library of technically oriented solid state physicists The deepest roots of this book date back to the mid seventies Being a student of electrical engineering who was exposed for the first time to the material of semiconductor device electronics I was puzzled by noticing that much emphasis was put on a thorough introduction and understand ing of the basic semiconductor equations while the boundary conditions for these equations received very much less attention Until today on many occasions one could get the impression that boundary conditions are unimportant accessories they do not stand on their own besides the bulk transport equations although it is clear that they are of course a necessary complement of these *Electronic Properties of Semiconductor Interfaces* Winfried Mönch,2013-04-17 Almost all semiconductor devices contain metal semiconductor insulator semiconductor insulator metal and or semiconductor semiconductor interfaces and their electronic properties determine the device characteristics This is the first monograph that treats the electronic properties of all different types of semiconductor interfaces Using the continuum of interface induced gap states IFIGS as a unifying theme M nch explains the band structure lineup at all types of semiconductor interfaces These intrinsic IFIGS are the wave function tails of electron states which overlap a semiconductor band gap exactly at the interface so they originate from the quantum mechanical tunnel effect He shows that a more chemical view relates the IFIGS to the partial ionic character of the covalent interface bonds and that the charge transfer across the interface may be modeled by generalizing Pauling s electronegativity concept The IFIGS and electronegativity theory is used to quantitatively explain the barrier heights and band offsets of well characterized Schottky contacts and semiconductor heterostructures respectively **Physics and Technology of Amorphous-Crystalline Heterostructure Silicon Solar Cells** Wilfried G. J. H. M. van Sark,Lars Korte,Francesco Roca,2011-11-16 Today s solar cell multi GW market is dominated by crystalline silicon c Si wafer technology however new cell concepts are entering the market One very promising solar cell design to answer these needs is the silicon hetero junction solar cell of which the emitter and back surface field are basically produced by a low temperature growth of ultra thin layers of amorphous silicon In this design amorphous silicon a Si H constitutes both emitter and base contact back surface field on both sides of a thin crystalline silicon wafer base c Si where the electrons and holes are photogenerated at the same time a Si H passivates the c Si surface Recently cell efficiencies above 23% have been demonstrated for such solar cells In this book the editors present an overview of the state of the art in physics and technology of amorphous crystalline heterostructure silicon solar cells The heterojunction concept is introduced processes and resulting properties of the materials used in the cell and their heterointerfaces are discussed and characterization techniques and simulation tools are presented *Electric and*

Electronic Applications of Metal Oxides Srikanta Moharana,Bibhuti Bhusan Sahu,Santosh Kumar Satpathy,Tuan Anh Nguyen,2025-05-23 Electric and Electronic Applications of Metal Oxides provides a comprehensive guide to the use of metal oxides in a variety of electronic and electric applications The book delivers a thorough understanding of the fundamental properties of metal oxides and their use across a wide range of electronic devices including Schottky diodes p n diodes thin film transistors field effect transistors Mott transition field effect transistors varistors high K dielectric capacitors devices with electron emission cold cathodes microelectronic technology high power and high temperature electronics transparent and flexible electronics resistive switching memory spintronics magnetic memory and piezoelectric devices In addition the book covers the latest advances and offers a glimpse of future prospects and challenges in the field The book is a valuable resource for researchers graduate students and professionals working in the field of materials science chemistry physics and engineering Provides a comprehensive overview of metal oxide fundamental properties related to electric and electronic applications Includes prospective challenges offering insights into future applications of metal oxides in electric and electronics Presents an outstanding reference for researchers material scientists engineers and students working in the fields of materials science chemistry physics and other related disciplines **Solid State Physics** ,2000-10-18 Solid State Physics Physics Briefs ,1992 **Power Semiconductors** M. Kubat,2013-04-17 The book contains a summary of our knowledge of power semiconductor structures It presents first a short historic introduction Chap I as well as a brief selection of facts from solid state physics in particular those related to power semiconductors Chap 2 The book deals with diode structures in Chap 3 In addition to fundamental facts in pn junction theory the book covers mainly the important processes of power structures It describes the emitter efficiency and function of microleaks shunts the p p and n n junctions and in particular the recent theory of the pin pvn and p1tn junctions whose role appears to be decisive for the forward mode not only of diode structures but also of more complex ones For power diode structures the reverse mode is the decisive factor in pn junction breakdown theory The presentation given here uses engineering features the multiplication factor M and the experimentally detected laws for the volume and surface of crystals which condenses the presentation and makes the mathematical apparatus simpler The discussion of diode structures is complemented by data on the tunnel phenomenon as well as on the properties of the semiconductor metal contact which forms the outer layers of the diode or more complex structure A separate chapter Chap 4 is devoted to the two transistor equivalent of the four layer structure and the solution of the four layer structure in various modes This presentation is also directed mainly towards the power aspect and the new components **1955-1999: Overview, Contents, and Authors** ,1999-09-01 The explosion of the science of mesoscopic structures is having a great impact on physics and electrical engineering because of the possible applications of these structures in microelectronic and optoelectronic devices of the future *Silicon-Based Millimeter-Wave Devices* Johann-Friedrich Luy,Peter Russer,2013-03-07 Silicon Based Millimeter Wave Devices describes field theoretical methods for the design and analysis of planar waveguide structures and antennas The principles and limitations of transit time devices with different injection mechanisms are discussed as are aspects of fabrication and characterization The physical properties of silicon Schottky contacts and diodes are treated in a separate chapter Two chapters cover the silicon germanium devices physics and RF properties of the heterobipolar transistor and quantum effect devices such as the resonant tunneling element are described The integration of devices in monolithic circuits is explained and advanced technologies are presented along with the self mixing oscillator operation Finally sensor and system applications are considered Thin Film Growth Techniques for Low-Dimensional Structures R.F.C. Farrow,S.S.P. Parkin,P.J. Dobson,J.H. Neave,A.S. Arrott,2013-03-09 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 **Solid State Ionic Devices 6 – Nano Ionics** E. D. Wachsman,2009-09 Solid state electrochemical devices such as batteries fuel cells membranes and sensors are critical components of technologically advanced societies in the 21st Century and beyond The development of these devices involves common research themes such as ion transport interfacial phenomena and device design and performance regardless of the class of materials or whether the solid state is amorphous or crystalline The intent of this international symposia series is to provide a forum for recent advances in solid state ion conducting materials and the design fabrication and performance of devices that utilize them The papers in this issue of ECS Transactions were presented at the 6th Solid State Ionic Devices symposium at the 214th meeting of The Electrochemical Society October 12 17 2008 in Honolulu Hawaii Dopants and Defects in Semiconductors Matthew D. McCluskey,Eugene E. Haller,2018-02-19 Praise for the First Edition The book goes beyond the usual textbook in that it provides more specific examples of real world defect physics an easy reading broad introductory overview of the field Materials Today well written with clear lucid explanations Chemistry World This revised edition provides the most complete up to date coverage of the fundamental knowledge of semiconductors including a new chapter that expands on the latest technology and applications of semiconductors In addition to inclusion of additional chapter problems and worked examples it provides more detail on solid state lighting LEDs and laser diodes The authors have achieved a unified overview of dopants and defects offering a solid foundation for experimental methods and the theory of defects in semiconductors Matthew D McCluskey is a professor in the Department of Physics and Astronomy and Materials Science Program at Washington State University WSU Pullman Washington He received a Physics Ph D from the University of California UC Berkeley Eugene E Haller is a professor emeritus at the University of California Berkeley and a member of the National Academy of Engineering He received a Ph D in Solid State and Applied Physics from the University of Basel Switzerland

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