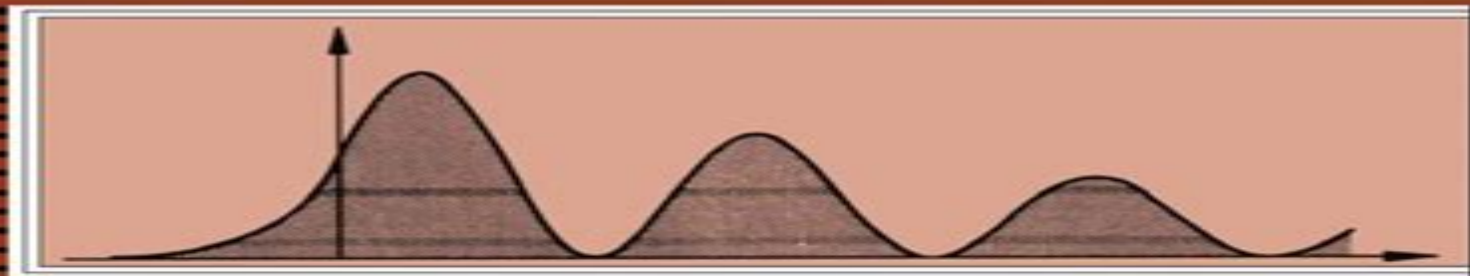


**Surface Sciences**

**Winfried Mönch**

# **Semiconductor Surfaces and Interfaces**



**Second Edition**

**Springer**

# Semiconductor Surfaces

**Peter Grutter, Werner A Hofer, Federico  
Rosei**



## **Semiconductor Surfaces:**

**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 surface 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 and models. Where available results of more refined calculations are considered. A final chapter is devoted to the band lineup at semiconductor interfaces.

*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 surface 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.

**Guide to Characteristics and Characterization of Semiconductor Surfaces** Jerzy Ruzyllo, 2023-02-28 This comprehensive compendium explores aspects of semiconductor surface characteristics and characterization from the perspective of applied semiconductor device research and process development rather than an in depth coverage of surface science related issues. It provides guidance to the features of semiconductor surfaces affecting performance of the practical semiconductor devices as well as selection of methods used to characterize those features. Based on the author's thirty years of research and teaching in semiconductor surface processing and characterization this unique reference text addresses the needs of graduate students, researchers and professionals who are familiar with semiconductor engineering and would like to learn about the practical aspects of semiconductor surface characteristics processing techniques and characterization methods used in device process development, process diagnostics and monitoring.

*Functionalization of Semiconductor Surfaces* Franklin Tao, Steven Bernasek, 2012-03-16 This book presents both fundamental knowledge and latest achievements of this rapidly growing field in the last decade. It presents a complete and concise picture of the state of the art in the field encompassing the most active international research groups in the world. Led by contributions from leading global research groups, the book discusses the functionalization of semiconductor surface. Dry organic reactions in vacuum and wet organic chemistry in solution are two major categories of strategies for functionalization that will be described. The growth of multilayer molecular architectures on the formed organic monolayers will be documented. The immobilization of biomolecules such as DNA on organic layers chemically attached to semiconductor surfaces will be introduced. The patterning of complex structures of organic layers and metallic nanoclusters toward sensing

techniques will be presented as well

**Theoretical Modelling of Semiconductor Surfaces** G. P. Srivastava, 1999 The state of the art theoretical studies of ground state properties electronic states and atomic vibrations for bulk semiconductors and their surfaces by the application of the pseudopotential method are discussed Studies of bulk and surface phonon modes have been extended by the application of the phenomenological bond charge model The coverage of the material especially of the rapidly growing and technologically important topics of surface reconstruction and chemisorption is up to date and beyond what is currently available in book form Although theoretical in nature the book provides a good deal of discussion of available experimental results Each chapter provides an adequate list of references relevant for both theoretical and experimental studies The presentation is coherent and self contained and is aimed at the postgraduate and postdoctoral levels

**Electronic Processes on Semiconductor Surfaces during Chemisorption** T. Wolkenstein, 2012-12-06 Hands are useless if there are no eyes to see what is obvious M V Lomonosov Dear Reader I invite you to open this book and step on the semiconductor surface where the processes that form the subject of the book come into play The surface of the semiconductor is attracting more and more interest among researchers in fact researchers in two different fields These are notably the physicists and engineers engaged in research in semiconductor physics and the making of semiconductor devices The entire industry of semiconductor instruments hinges on the problem of the surface The quality of semiconductor devices whose use is growing steadily depends essentially on the properties of the surface The instability of these properties and their uncontrollable alterations with temperature and under the influence of environmental conditions result in a lack of stability in the performance of semiconductor devices hence the high percentage of waste in their industrial production The methods used in factory laboratories to prevent such waste are largely empirical The properties of the surface the nature of the physicochemical processes that take place on it and the role of environmental factors still remain obscure A major task of the semiconductor industry is to learn to control the properties of the surface

**Guide To Characteristics And Characterization Of Semiconductor Surfaces** Jerzy Ruzyllo, 2025-04-11 This comprehensive compendium explores aspects of semiconductor surface characteristics and characterization from the perspective of applied semiconductor device research and process development rather than an in depth coverage of surface science related issues It provides guidance to the features of semiconductor surfaces affecting performance of the practical semiconductor devices as well as selection of methods used to characterize those features Based on the author's over thirty years of research and graduate advising in semiconductor surface processing and characterization this unique reference text addresses the needs of graduate students researchers and industry professionals who are familiar with semiconductor engineering and would like to learn about the practical aspects of semiconductor surface characteristics processing techniques and characterization methods used in device process development process diagnostics and monitoring

**Semiconductor Surfaces** Abraham Many, Yehuda Goldstein, Norman B. Grover, 1965

**Functionalization of Semiconductor Surfaces** Franklin Tao, Steven

Bernasek,2012-04-10 This book presents both fundamental knowledge and latest achievements of this rapidly growing field in the last decade It presents a complete and concise picture of the the state of the art in the field encompassing the most active international research groups in the world Led by contributions from leading global research groups the book discusses the functionalization of semiconductor surface Dry organic reactions in vacuum and wet organic chemistry in solution are two major categories of strategies for functionalization that will be described The growth of multilayer molecular architectures on the formed organic monolayers will be documented The immobilization of biomolecules such as DNA on organic layers chemically attached to semiconductor surfaces will be introduced The patterning of complex structures of organic layers and metallic nanoclusters toward sensing techniques will be presented as well *Principles of Adsorption and Reaction on Solid Surfaces* Richard I. Masel,1996-03-22 Principles of Adsorption and Reaction on Solid Surfaces As with other books in the field Principles of Adsorption and Reaction on Solid Surfaces describes what occurs when gases come in contact with various solid surfaces But unlike all the others it also explains why While the theory of surface reactions is still under active development the approach Dr Richard Masel takes in this book is to outline general principles derived from thermodynamics and reaction rate theory that can be applied to reactions on surfaces and to indicate ways in which these principles may be applied The book also provides a comprehensive treatment of the latest quantitative surface modeling techniques with numerous examples of their use in the fields of chemical engineering physical chemistry and materials science A valuable working resource and an excellent graduate level text Principles of Adsorption and Reaction on Solid Surfaces provides readers with A detailed look at the latest advances in understanding and quantifying reactions on surfaces In depth reviews of all crucial background material 40 solved examples illustrating how the methods apply to catalysis physical vapor deposition chemical vapor deposition electrochemistry and more 340 problems and practice exercises Sample computer programs Universal plots of many key quantities Detailed class tested derivations to help clarify key results The recent development of quantitative techniques for modeling surface reactions has led to a number of exciting breakthroughs in our understanding of what happens when gases come in contact with solid surfaces While many books have appeared describing various experimental modeling techniques and the results obtained through their application until now there has been no single volume reference devoted to the fundamental principles governing the processes observed The first book to focus on governing principles rather than experimental techniques or specific results Principles of Adsorption and Reaction on Solid Surfaces provides students and professionals with a quantitative treatment of the application of principles derived from the fields of thermodynamics and reaction rate theory to the investigation of gas adsorption and reaction on solid surfaces Writing for a broad based audience including among others chemical engineers chemists and materials scientists Dr Richard I Masel deftly balances basic background in areas such as statistical mechanics and kinetics with more advanced applications in specialized areas Principles of Adsorption and Reaction on Solid Surfaces was also designed to provide

readers an opportunity to quickly familiarize themselves with all of the important quantitative surface modeling techniques now in use To that end the author has included all of the key equations involved as well as numerous real world illustrations and solved examples that help to illustrate how the equations can be applied He has also provided computer programs along with universal plots that make it easy for readers to apply results to their own problems with little computational effort Principles of Adsorption and Reaction on Solid Surfaces is a valuable working resource for chemical engineers physical chemists and materials scientists and an excellent text for graduate students in those disciplines

**Frontiers in Surface Science and Interface Science** C.B. Duke, E. Ward Plummer, 2002-05-21 Any notion that surface science is all about semiconductors and coatings is laid to rest by this encyclopedic publication Bioengineered interfaces in medicine interstellar dust DNA computation conducting polymers the surfaces of atomic nuclei all are brought up to date Frontiers in Surface and Interface Science a milestone publication deserving a wide readership It combines a sweeping expert survey of research today with an educated look into the future It is a future that embraces surface phenomena on scales from the subatomic to the galactic as well as traditional topics like semiconductor design catalysis and surface processing modeling and characterization And great efforts have been made to express sophisticated ideas in an attractive and accessible way Nanotechnology surfaces for DNA computation polymer based electronics soft surfaces interstellar surface chemistry all feature in this comprehensive collection

**Handbook of Compound Semiconductors** Paul H. Holloway, Gary E. McGuire, 2008-10-19 This book reviews the recent advances and current technologies used to produce microelectronic and optoelectronic devices from compound semiconductors It provides a complete overview of the technologies necessary to grow bulk single crystal substrates grow hetero or homoepitaxial films and process advanced devices such as HBT's QW diode lasers etc

**Handbook of Surfaces and Interfaces of Materials, Five-Volume Set** Hari Singh Nalwa, 2001-10-26 This handbook brings together under a single cover all aspects of the chemistry physics and engineering of surfaces and interfaces of materials currently studied in academic and industrial research It covers different experimental and theoretical aspects of surfaces and interfaces their physical properties and spectroscopic techniques that have been applied to a wide class of inorganic organic polymer and biological materials The diversified technological areas of surface science reflect the explosion of scientific information on surfaces and interfaces of materials and their spectroscopic characterization The large volume of experimental data on chemistry physics and engineering aspects of materials surfaces and interfaces remains scattered in so many different periodicals therefore this handbook compilation is needed The information presented in this multivolume reference draws on two decades of pioneering research on the surfaces and interfaces of materials to offer a complete perspective on the topic These five volumes Surface and Interface Phenomena Surface Characterization and Properties Nanostructures Micelles and Colloids Thin Films and Layers Biointerfaces and Applications provide multidisciplinary review chapters and summarize the current status of the field covering important scientific and

technological developments made over past decades in surfaces and interfaces of materials and spectroscopic techniques with contributions from internationally recognized experts from all over the world Fully cross referenced this book has clear precise and wide appeal as an essential reference source long due for the scientific community The complete reference on the topic of surfaces and interfaces of materials The information presented in this multivolume reference draws on two decades of pioneering research Provides multidisciplinary review chapters and summarizes the current status of the field Covers important scientific and technological developments made over past decades in surfaces and interfaces of materials and spectroscopic techniques Contributions from internationally recognized experts from all over the world

**Physical Methods of Chemistry, Investigations of Surfaces and Interfaces** Bryant W. Rossiter, Roger C.

Baetzold, 1993-01-12 Each volume of this series heralds profound changes in both the perception and practice of chemistry This edition presents the state of the art of all important methods of instrumental chemical analysis measurement and control Contributions offer introductions together with sufficient detail to give a clear understanding of basic theory and apparatus involved and an appreciation of the value potential and limitations of the respective techniques The emphasis of the subjects treated is on method rather than results thus aiding the investigator in applying the techniques successfully in the laboratory

Ordering at Surfaces and Interfaces Akio Yoshimori, Teruya Shinjo, Hisatsune Watanabe, 2012-12-06 This volume contains the proceedings of the third in a series of biennial NEC Symposia on Fundamental Approaches to New Material Phases sponsored by the NEC Corporation Tokyo Japan The symposium was held from October 7 to 11 1990 at the Hakone Kanko H9tel in Hakone About 40 invited participants stayed together became involved in intense discussions and freely exchanged ideas both in and out of the conference room which faced Mt Fuji the beautiful lake Ashinoko and the quiet landscape in the old crater The title of this volume Ordering at Surfaces and Interfaces which was also the title of the third symposium describes the aim of the symposium to discuss ordering properties and their underlying mechanisms at surfaces and interfaces The topics treated include the reconstruction of surfaces of semiconductors and metals atomic and magnetic ordering at interfaces theoretical tools to study ordering mechanisms at surfaces and interfaces ordering in adsorbate surface systems such as alkali adsorbed silicon surfaces electric current effects on semiconductor surfaces and many related STM scanning tunneling microscopy results

**Properties Of Single Organic Molecules On Crystal Surfaces**

Peter Grutter, Werner A Hofer, Federico Rosei, 2006-05-03 Within nanoscience an emerging discipline is the study of the physics and chemistry of single molecules Molecules may be considered as the ultimate building blocks and are therefore interesting for the development of molecular devices and for surface functionalization Thus it is interesting to study their properties when adsorbed on a suitable substrate such as a solid or crystal surface and also for their potential applications in nano or molecular electronics and nanosensing Investigations have been made possible by the advent of high resolution surface imaging and characterization techniques commonly referred to as Scanning Probe Microscopes This book focuses on

the fascinating properties of the single molecules and the difference between single molecules and ensembles of molecules is emphasized As the first book intended for graduate courses in the field after each chapter students should be able to answer the question What physical or chemical properties do you learn from a single molecule in this particular context Contributed by experts across the disciplines the book provides useful reference material for specialized practitioners in surface science nanoscience and nanoelectronics

### **Chemical Bonding at Surfaces and Interfaces** Anders Nilsson,Lars G.M.

Pettersson,Jens Norskov,2011-08-11 Molecular surface science has made enormous progress in the past 30 years The development can be characterized by a revolution in fundamental knowledge obtained from simple model systems and by an explosion in the number of experimental techniques The last 10 years has seen an equally rapid development of quantum mechanical modeling of surface processes using Density Functional Theory DFT Chemical Bonding at Surfaces and Interfaces focuses on phenomena and concepts rather than on experimental or theoretical techniques The aim is to provide the common basis for describing the interaction of atoms and molecules with surfaces and this to be used very broadly in science and technology The book begins with an overview of structural information on surface adsorbates and discusses the structure of a number of important chemisorption systems Chapter 2 describes in detail the chemical bond between atoms or molecules and a metal surface in the observed surface structures A detailed description of experimental information on the dynamics of bond formation and bond breaking at surfaces make up Chapter 3 Followed by an in depth analysis of aspects of heterogeneous catalysis based on the d band model In Chapter 5 adsorption and chemistry on the enormously important Si and Ge semiconductor surfaces are covered In the remaining two Chapters the book moves on from solid gas interfaces and looks at solid liquid interface processes In the final chapter an overview is given of the environmentally important chemical processes occurring on mineral and oxide surfaces in contact with water and electrolytes Gives examples of how modern theoretical DFT techniques can be used to design heterogeneous catalysts This book suits the rapid introduction of methods and concepts from surface science into a broad range of scientific disciplines where the interaction between a solid and the surrounding gas or liquid phase is an essential component Shows how insight into chemical bonding at surfaces can be applied to a range of scientific problems in heterogeneous catalysis electrochemistry environmental science and semiconductor processing Provides both the fundamental perspective and an overview of chemical bonding in terms of structure electronic structure and dynamics of bond rearrangements at surfaces

### Trends in Surface Science Research

Charles P. Norris,2006 This book covers the physics and chemistry of surfaces The scope includes the structure thermodynamics and mobility of clean surfaces as well as the interaction of gas molecules with solid surfaces The energetic particle interactions that are the basis for the majority of techniques developed to reveal the structure and chemistry of surfaces are explored including auger electron spectroscopy photoelectron spectroscopy inelastic scattering of electrons and ions low energy electron diffraction scanning probe microscopy and interfacial segregation Crystal nucleation and growth are



also considered Principles such as adsorption desorption and reactions between adsorbates are examined with coverage also of new developments in the growth of epitaxial and Langmuir Blodgett films as well as treatment of the etching of surfaces Modern analytical techniques and applications to thin films and nanostructures are included The latest in depth research from around the world is presented     **Surface and Interface Science, Volumes 5 and 6** Klaus Wandelt, 2016-03-14 In eight volumes Surface and Interface Science covers all fundamental aspects and offers a comprehensive overview of this research area for scientists working in the field as well as an introduction for newcomers Volume 5 Solid Gas Interfaces I Topics covered Basics of Adsorption and Desorption Surface Microcalorimetry Adsorption of Rare Gases Adsorption of Alkali and Other Electro Positive Metals Halogen adsorption on metals Adsorption of Hydrogen Adsorption of Water Adsorption of Small Molecules on Metal Surfaces Surface Science Approach to Catalysis Adsorption Bonding and Reactivity of Unsaturated and Multifunctional Molecules Volume 6 Solid Gas Interfaces II Topics covered Adsorption of Large Organic Molecules Chirality of Adsorbates Adsorption on Semiconductor Surfaces Adsorption on Oxide Surfaces Oscillatory Surface Reactions Statistical Surface Thermodynamics Theory of the Dynamics at Surfaces Atomic and Molecular Manipulation

**Proceedings of the 17th International Conference on the Physics of Semiconductors** J.D. Chadi, W.A.

Harrison, 2013-12-01 The Proceedings of the 17th International Conference on the Physics of Semiconductors are contained in this volume A record 1050 scientists from 40 countries participated in the Conference which was held in San Francisco August 6 10 1984 The Conference was organized by the ICPS Committee and sponsored by the International Union of Pure and Applied Physics and other professional government and industrial organizations listed on the following pages Papers representing progress in all aspects of semiconductor physics were presented Far more abstracts 765 than could be presented in a five day meeting were considered by the International Program Committee A total of 350 papers consisting of 5 plenary 35 invited and 310 contributed were presented at the Conference in either oral or poster sessions All but a few of the papers were submitted and have been included in these Proceedings An interesting shift in subject matter in comparison with earlier Conferences is manifested by the large number of papers on surfaces interfaces and quantum wells To facilitate the use of the Proceedings in finding closely related papers among the sometimes relatively large number of contributions within a main subject area we chose not to arrange the papers strictly according to the Conference schedule We have organized the book as can be seen from the Contents into specific subcategories and subdivisions within each major category Plenary and invited papers have been placed together with the appropriate contributed papers

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