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Solids and Surfaces Solid and Surfaces **Solids and Surfaces** *Chemistry and Physics of Solid Surfaces V* **Supramolecular Chemistry at Surfaces** *Chemical Bonding at Surfaces and Interfaces* Physical Chemistry of Surfaces Chemistry of Functional Materials Surfaces and Interfaces *Chemistry and Physics of Solid Surfaces VII* **The Structure and Chemistry of Solid Surfaces** *Reactions at Solid Surfaces* **Physics and Chemistry of Interfaces** Physical Chemistry and Acid-Base Properties of Surfaces *An Introduction to the Principles of Surface Chemistry* **Surface Chemistry** Supramolecular Chemistry on Surfaces **Dynamic Chemical Processes on Solid Surfaces Chemical Properties of Material Surfaces SURFACES. Edition en anglais The Structure and Chemistry of Solid Surfaces** *Physics and Chemistry at Oxide Surfaces* **Surface Science Principles of Adsorption and Reaction on Solid Surfaces** *Supramolecular Chemistry at Surfaces* **Physical Chemistry of Surfaces Treatise on Solid State Chemistry** *The Physics and Chemistry of Mineral Surfaces* Chemical Physics of Solids and Their Surfaces **Chemistry in Two Dimensions** *Non-wettable Surfaces Surface Chemistry* **The Chemical Physics of Surfaces The Plasma Chemistry of Polymer Surfaces Films on Solid Surfaces** Physics of Surfaces and Interfaces Metal Clusters at Surfaces *Physical Chemistry of Surfaces Adhesion Science and Engineering* **Surface and Interface Chemistry of Clay Minerals** *Chemistry and Physics of Solid Surfaces VIII*

Physics and Chemistry of Interfaces This general yet comprehensive introduction to the field focuses on the essential concepts rather than specific details, on intuitive understanding rather than learning facts. The text reflects the many facets of this discipline by linking fundamentals with applications. The theory behind important concepts is backed by scientific-engineering aspects, as well as by a wide range of high-end applications. Examples of applications from biotechnology to microelectronics are used to illustrate the basic concepts. New to this third edition are topics as second harmonic generation spectroscopy, surface diffusion, atomic layer deposition, superlubricity, and bioadhesion. At the same time, the discussions of liquid surfaces, the Marangoni effect, electric double layers, measurement of surface forces, wetting, and adsorption have been updated. The number and variety of exercises are increased and the references are updated. From the Contents: Introduction Liquid Surfaces Thermodynamics of Interfaces Charged Interfaces and the Electric Double Layer Surface Forces Contact Angle Phenomena and Wetting Solid Surfaces Adsorption Surface Modification Friction, Lubrication, and Wear Surfactants, Micelles, Emulsions, and Foams Thin Films on Surfaces of Liquids Solutions to Exercises Analysis of Diffraction Patterns Expanding on the ideas first presented in Gerhard Ertl's acclaimed Baker Lectures at Cornell University, Reactions at Solid Surfaces comprises an authoritative, self-contained, book-length introduction to surface reactions for both professional chemists and students alike. Outlining our present understanding of the fundamental processes underlying reactions at solid surfaces, the book provides the reader with a complete view of how chemistry works at surfaces, and how to understand and probe the dynamics of surface reactions. Comparing traditional surface probes with more modern ones, and bringing together various disciplines in a cohesive manner, Gerhard Ertl's Reactions at Solid Surfaces serves well as a primary text for graduate students in introductory surface science or chemistry, as well as a self-teaching resource for professionals in surface science, chemical engineering, or nanoscience. Surface and Interface Chemistry of Clay Minerals, Volume 9, delivers a fundamental understanding of the surface and interface chemistry of clay minerals, thus serving as a valuable resource for researchers active in the fields of materials chemistry and sustainable chemistry. Clay minerals, with surfaces ranging from hydrophilic, to hydrophobic, are widely studied and used as adsorbents. Adsorption can occur at the edges and surfaces of clay mineral layers and particles, and in the interlayer region. This diversity in properties and the possibility to tune the surface properties of clay minerals to match the properties of adsorbed molecules is the basis for study. This book requires a fundamental understanding of the surface and interface chemistry of clay minerals, and of the interaction between adsorbate and adsorbent. It is an essential resource for clay scientists, geologists, chemists, physicists, material scientists, researchers, and students. Presents scientists and engineers with a resource they can rely on for their own research and work involving clay minerals Includes an in-depth look at ion exchange, adsorption of inorganic and organic molecules, including polymers and proteins, and catalysis occurring at the surfaces of clay minerals Includes materials chemistry of clay minerals with chiral clay minerals, optical materials and functional films Supramolecular Chemistry on Surfaces 2D Networks and 2D Structures Explore the cutting-edge in 2D chemistry on surfaces and its applications In Supramolecular Chemistry on Surfaces: 2D Networks and 2D Structures, expert chemist Neil R. Champness delivers a comprehensive overview of the rapidly developing field of two-dimensional supramolecular chemistry on surfaces. The book offers explorations of the state-of-the-art in the discipline and demonstrates the potential of the latest advances and the challenges faced by researchers in different areas. The editor includes contributions from leading researchers that address new spectroscopic methods which allow for investigations at a sub-molecular level, opening up new areas of understanding in the field. Included resources also discuss important supramolecular strategies, like hydrogen-bonding, van der Waals interactions, metal-ligand coordination, multicomponent assembly, and more. The book also provides: A thorough introduction to two-dimensional supramolecular chemistry on surfaces Comprehensive explorations of the characterization and interpretation of on-surface chemical reactions studied by ultra-high resolution scanning probe microscopy Practical discussions of complexity in two-dimensional multicomponent assembly, including explorations of coordination bonds and quasicrystalline structures In-depth examinations of covalently bonded organic structures via on-surface synthesis Perfect for polymer chemists, spectroscopists, and materials scientists, Supramolecular Chemistry on Surfaces: 2D Networks and 2D Structures will also earn a place in the libraries of physical and surface chemists, as well as surface physicists. The Mechanics of Adhesion shows that adhesion science and technology is inherently an interdisciplinary field, requiring fundamental understanding of mechanics, surfaces, and materials. This volume comprises 19 chapters. Starting with a background and introduction to stress transfer principles; fracture mechanics and singularities; and an energy approach to debonding, the volume continues with analysis of structural lap and butt joint configurations. It then continues with discussions of test methods for strength and constitutive properties; fracture; peel; coatings, the case of adhesion to a single substrate; elastomeric adhesives such as sealants. The role of mechanics in determining the locus of failure in bonded joints is discussed, followed by a chapter on rheology relevant to adhesives and sealants. Pressure sensitive adhesive performance; the principles of tack and tack measurements; and contact mechanics relevant to wetting and surface energy measurements are then covered. The volume concludes with sections on fibermatrix bonding and reinforcement; durability considerations for adhesive bonds; ultrasonic non-destructive evaluation of adhesive bonds; and design of adhesive bonds from a strength perspective. This book will be of interest to practitioners in the fields of engineering and to those with an interest in adhesion science. 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. This volume contains review articles which were written by the invited speak ers of the Sixth International Summer Institute in Surface Science (ISISS), held at the University of Wisconsin-Milwaukee in August 1983. The objective of ISISS is to bring together a group of internationally recognized experts on various aspects of surface science to present tutorial review lectures over a period of one week. Each speaker is asked, in addi tion, to write a review paper on his lecture topic. The collected articles from previous Institutes have been published under the following titles: Surface Science: Recent Progress and Perspectives, Crit. Rev. Solid State Sci. 4, 124-559 (1974). Chemistry and Physics of Solid Surfaces, Vol. I (1976), Vol. II (1979), Vol. III (1982) (CRC Press, Boca Raton, FL), and Vol. IV (1982), Springer Ser. Chern. Phys. , Vol. 20 (Springer-Verlag Berlin, Heidelberg, New York 1982) No single collection of reviews (or one-week conference for that matter) can possibly cover the entire field of modern surface science, from heter ogeneous catalysis through semiconductor surface physics to metallurgy. It is intended, however, that the series Chemistry and Physics ofSolid Sur faces as a whole should provide experts and students alike with a comprehen ve set of reviews and literature references on as many aspects of the subject as possible, particular emphasis being placed on the gas-solid interface. Each volume is introduced with a historical review of the devel opment of one aspect of surface science by a distinguished participant in that development. This unique book shows how chemistry and physics come together in the solid state and on surfaces. Using a lively, graphic, descriptive approach, it teaches chemists the language that is necessary to understand the electronic structure of extended systems. And, at the same time, it demonstrates how a chemical, frontier-orbital, approach to solid state and surface bonding and reactivity may be constructed. The book begins with the language of crystal orbitals, band structures and densities of states. The tools for moving back from the highly delocalized orbitals of the solid are then built up in a transparent manner; they include decompositions of the densities of states and crystal orbital overlap populations.

Using these tools, the book shapes a meeting ground between detailed quantum mechanical calculations and a chemical frontier orbital perspec- tive. Applications include a general picture of chemisorption, bond-breaking and making in the solid state, bonding in metals, the electronic structure of selected conducting and supercon- ducting structures, dissociation, migration and coupling on surfaces and the forces controlling deformation of extended systems. Numerous experiments and calculations have shown that isolated metal clusters possess many interesting features, quite different from those known from surface and solid- state physics or from atomic and molecular physics. The technological exploitation of these new properties, e.g. in miniature electronic or mechanical components, requires the cluster to be brought into an environment such as an encapsulating matrix or a surface. Due to the interaction with the contact medium, the properties of the clusters may change or even disappear. Thus the physics of cluster-on-surface systems -- the main subject of this book -- is of fundamental importance. The book addresses a wide audience, from the newcomer to the expert. Starting from fundamental concepts of adsorbate-surface interactions, the modification of electronic properties through electron confinement, and concepts of cluster production, it elucidates the distinct properties of the new metallic nanostructures. Films on Solid Surfaces presents the physics and chemistry of physical adsorption. This book contains 10 chapters that are ordered according to the flow of a course given in a graduate study in University of Washington during 1973. The introductory chapter presents the motivation for the completion of the book. As the motivating factors are established, the book follows with the topic on atomic nature of physical adsorption and the states of single adsorbed atoms. A review of experimental techniques for the study of solid surfaces and films is given, as well as a discussion of substrate preparation and equilibrium thermodynamics. The various states of films and their phase transitions encompass four chapters. Lastly, the book also reviews thin film superfluidity. This book specifically caters to scientists in the fields of physics and biology working on physical adsorption and surface science. The last two decades have brought a near exponential increase in the amount known about mineral surfaces. Get a handle on this overwhelming mountain of information with The Physics and Chemistry of Mineral Surfaces. This much-needed text will save you hours of tedious journal searches by providing an excellent condensation and overview of the entire field, including its future direction. Top researchers outline atomistic controls on mineral surface structure and reactions; apply these concepts to explain sorption, mineral corrosion and growth; and ultimately consider the role of surfaces in environmental and geochemical processes. This unique text provides a rich and rigorous treatment of these subjects by combining surface physics and chemistry - highlighting their useful, yet often ignored, complementary nature. Unlike other texts, The Physics and Chemistry of Mineral Surfaces also stresses the linkage between fundamentals of mineral surface science and specific real-world problems. This connection facilitates the application of surface physics and chemistry to macroscopic, global processes, such as the origins of life, global warming, and environment degradation. Nowhere else will you find a text on this topic that combines expansive coverage with clear-cut practical applications. Don't miss out! The Physics and Chemistry of Mineral Surfaces has it all. "Should be on every surface chemist's reading list." —Spectroscopy (on the Fifth Edition) Bridging the methodologies of "wet" and "dry" surface chemistry to present surface chemistry as a single broad field, Physical Chemistry of Surfaces, Sixth Edition retains its position as the standard work of surface science. This heavily revised and updated edition provides thorough coverage for students and professionals. New features of the Sixth Edition include: Expanded treatment of films at the liquid-air and liquid-solid interfaces, with contemporary techniques and macromolecular films Techniques for tunneling and atomic force scanning microscopes In-depth coverage of heterogeneous catalysis, including the case of CO on metals Increased emphasis on the flexible surface and restructuring of surfaces when adsorption occurs A new chapter on macromolecular films The book begins with the basics of the physical chemistry of liquid-gas and liquid-solid interfaces, including electro-chemistry, long-range forces, and the various methods of spectroscopic and structural study of surfaces. These are followed by descriptive treatments of topics such as friction, lubrication, adhesion and emulsion, foams, and aerosols. Closing chapters present a quantitative approach to physical and chemical adsorption of vapors and gases as well as heterogeneous catalysis. For senior-level undergraduates and graduate students, each chapter presents the basic surface chemistry of the topics with full derivations, end-of-chapter problems, and reviews of recent advances. This book is also an excellent reference for professional chemists interested in applying surface chemistry to their work. Nothing provided The first chapter of the book summarizes classical approaches, introduces the concept of ionicity, and describes the mixed iono-covalent character of the oxygen cation bond in bulk materials. The next three chapters focus on the characteristics of the atomic structure (relaxation, rumpling and reconstruction effects), the electronic structure (band width, gap width, etc.) and the excitations of clean surfaces. The first part of this book looks at the consequence of chemical and topological defects existing on real surfaces, which explain the wettability of super hydrophilc and super hydrophobic surfaces. There follows an in-depth analysis of the acido-basicity of surfaces with, as an illustration, different wettability experiments on real materials. The next chapter deals with various techniques enabling the measurement of acido basicity of the surfaces including IR and XPS technics. The last part of the book presents an electrochemical point of view which explains the surface charges of the oxide at contact with water or other electrolyte solutions in the frame of Bronsted acido-basicity concept. Various consequences are deduced from such analyses illustrated by original measurement of the point of zero charge or by understanding the basic principles of the electrowetting experiments. More than 99% of all visible matter in the universe occurs as highly ionized gas plasma with high energy content. Electrical low- and atmospheric-pressure plasmas are characterized by continuous source of moderate quantities of energy or enthalpy transferred predominantly as kinetic energy of electrons. Therefore, such energetically unbalanced plasmas have low gas temperature but produce sufficient energy for inelastic collisions with atoms and molecules in the gas phase, thus producing reactive species and photons, which are able to initiate all types of polymerizations or activate any surface of low reactive polymers. However, the broadly distributed energies in the plasma exceed partially the binding energies in polymers, thus initiating very often unselective reactions and polymer degradation. The intention of this book is to present new plasma processes and new plasma reactions of high selectivity and high yield. This book aims to bridge classical and plasma chemistry, particularly focusing on polymer chemistry in the bulk and on the surface under plasma exposure. The stability of surface functionalization and the qualitative and quantitative measurement of functional groups at polymer surface are featured prominently, and chemical pathways for suppressing the undesirable side effects of plasma exposure are proposed and illustrated with numerous examples. Special attention is paid to the smooth transition from inanimate polymer surfaces to modified bioactive polymer surfaces. A wide range of techniques, plasma types and applications are demonstrated. of available information. Even more importantly, some authors who have contributed substantially to an area may have been overlooked. For this I apologize. I have, however, not attempted to trace techniques or observa tions historically, so there is no implication (unless specified) that the authors referred to were or were not the originators of a given method or observation. I would like to acknowledge discussions with co-workers at SFU for input relative to their specialties, to acknowledge the help of students who have pointed out errors and difficulties in the earlier presentation, and to acknowledge the infinite patience of my wife Phyllis while I spent my sabbatical and more in libraries and punching computers. S. Roy Morrison 0 1 Contents Notation XV 1. Introduction 1 1. 1. Surface States and Surface Sites . 1 1. 1. 1. The Chemical versus Electronic Representation of the Surface. 1 1. 1. 2. The Surface State on the Band Diagram 4 1. 1. 3. The Fermi Energy in the Surface State Model. 6 1. 1. 4. Need for Both Surface Site and Surface State Models 6 1. 2. Bonding of Foreign Species to the Solid Surface 7 1. 2. 1. Types of Interaction. 7 1. 2. 2. The Chemical Bond . 10 1. 2. 3. Acid and Basic Surface Sites on Solids . 13 1. 2. 4. Adsorbate Bonding on Various Solid Types. 16 1. 2. 5. Movement of Surface Atoms: Relaxation, Reconstruction, and Relocation . Specialist Periodical Reports provide systematic and detailed review coverage of progress in the major areas of chemical research. Written by experts in their specialist fields the series creates a unique service for the active research chemist, supplying regular critical in-depth accounts of progress in particular areas of chemistry. For over 80 years the Royal Society of Chemistry and its predecessor, the Chemical Society, have been publishing reports charting developments in chemistry, which originally took the form of Annual Reports. However, by 1967 the whole spectrum of chemistry could no longer be contained within one volume and the series Specialist Periodical Reports was born. The Annual Reports themselves still existed but were divided into two, and subsequently three, volumes covering Inorganic, Organic and Physical Chemistry. For more general coverage of the highlights in chemistry they remain a 'must'. Since that time the SPR series has altered according to the fluctuating degree of activity in various fields of chemistry. Some titles have remained unchanged, while others have altered their emphasis along with their titles; some have been combined under a new name whereas others have had to be discontinued. This volume contains review articles written by the invited speakers at the eighth International Summer Institute in Surface Science (ISISS 1987), held at the University of Wisconsin-Milwaukee in August of 1987. During the course of ISISS, invited speakers, all internationally recognized experts in the various fields of surface science, present tutorial review lectures. In addition, these experts are asked to write review articles on their lecture topic. Former ISISS speakers serve as advisors concerning the selection of speakers and lecture topics. Em phasis is given to those areas which have not been covered in depth by recent Summer Institutes, as well as to areas which have recently gained in significance and in which important progress has been made. Because of space limitations, no individual volume of Chemistry and Physics of Solid Surfaces can possibly cover the whole area of modem surface science, or even give a complete survey of recent pro gress in the field. However, an attempt is made to present a balanced overview in the series as a whole. With its comprehensive literature references and extensive subject indices, this series has become a valu able resource for experts and students alike. The collected articles, which stress particularly the gas-solid interface, have been published under the following titles: Surface Science: Recent Progress and Perspectives, Crit. Rev. Solid State Sci. 4, 125-559 (1974) Chemistry and Physics of Solid Surfaces, Vols. I, II, and III (CRC Press Boca Raton, FL 1976, 1979, and 1982); Vols. This volume contains review articles written by the invited speakers at the ninth International Summer Institute in Surface Science (ISISS 1989), held at the Uni versity of Wisconsin-Milwaukee in August of 1989. During the course of ISISS, invited speakers, all internationally recognized experts in the various fields of surface science, present tutorial review lectures. In addition, these experts are asked to write review articles on their lecture topic. Former ISISS speakers serve as advisors concerning the selection of speakers and lecture topics. Emphasis is given to those areas which have not been covered in depth by recent Summer Institutes, as well as to areas which have recently gained in significance and in which important progress has been made. 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Supramolecular Chemistry at Surfaces covers different methods of preparing and studying self-assembled structures at surfaces and interfaces. The book starts with a general introduction concerning the nature of surfaces followed by specific sections discussing different techniques to characterise surface-based supramolecular systems. Each chapter then goes on to address different surface systems including the surface of water; physisorbed layers at interfaces; chemisorbed layers at interfaces; polyelectrolyte systems; thin films; dynamic systems; and patterning. Written by a leading expert in the field, this is the first book to give a multidisciplinary view of the supramolecular aspects of interfaces providing the reader with an objective summary of all the deposition methods and their characterisation. The book will appeal to students and researchers in supramolecular chemistry, nanoscience, polymer chemistry and physics, surface science and materials science. Surface Chemistry Theory and Applications focuses on liquid-gas, liquid-liquid, solid-gas, solid-liquid, and solid-solid surfaces. The book first offers information on liquid-gas surfaces, including surface tension, measurement of surface tension, rate of capillarity rise, capillary attraction, bubble pressure and pore size, and surface tension and temperature. The text then ponders on liquid-liquid and solid-gas surfaces. Discussions focus on surface energy of solids, surface roughness and cleanness, adsorption of gases and vapors, adsorption hysteresis, interfacial tension, and interfacial tension in multicomponent systems. The manuscript takes a

look at solid-liquid surfaces, as well as stagnant layers at solid-liquid interfaces, heat transfer, surface roughness or electrodes, adsorption of liquids heat of wetting, and thin metal films condensed from vapor. The text also examines solid-liquid-gas and solid-liquid-liquid surfaces and electric surface phenomena. The book is a vital source of information for readers interested in surface chemistry. 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 A discussion of the adsorption of inorganics from aqueous solution on inorganic adsorbents. It emphasizes the relationship between adsorption and surface charging, highlighting simple and complex adsorption systems sorted by the adsorbent as well as the adsorbate. The author includes a comprehensive collection of pristine PZC of different materials - covering crystallographic structure, methods of preparation, impurities in the solid, temperature and ionic composition of the solution, experimental methods to determine PZC, and the correlation between zero points and other physical quantities. In this book, the author determines that a surface is itself a new material for chemical reaction, and the reaction of the surface provides additional new materials on that surface. The revelation of that peculiarity is what makes this book different from an ordinary textbook, and this new point of view will help to provide a new impetus when graduate students and researchers consider their results. The reaction of surface atoms provides additional new compounds, but these compounds cannot be detached from the surface. Some compounds are passive, but others work as catalysts. One superior feature of the surface is the dynamic cooperation of two or more different functional materials or sites on the same surface. This fact has been well established in the preferential oxidation of CO on platinum supported on a carbon nanotube with Ni-MgO at its terminal end. The Pt and Ni-MgO are perfectly separated, but these two are indispensable for the selective oxidation of CO in H2, where the H2O molecule plays a key role. The reader will understand that the complexity of catalysis is due to the complexity of the dynamic processes on the surface. Surface chemistry is an essential and developing area of physical chemistry and one that has become increasingly interdisciplinary. The Second Edition of Surface Science: Foundations of Catalysis and Nanoscience has been fully revised and updated to reflect all the latest developments in the field and now includes an extensive discussion about nanoparticle growth and the quantum confinement effects in nanoscale systems. Two new chapters have been added and discuss The Liquid/Solid Interface and Non-Thermal Reactions, and Photon and Electron Stimulated Chemistry and Atom Manipulation. There are now many more worked examples included throughout to help students develop their problem-solving skills. This primer provides an introduction to the subject of surfaces at the level of undergraduates and first year postgraduates. There are four chapters, the first concerns basic thermodynamic material used to understand the properties of surfaces including; surface tension, Gibbs adsorption, surface pressure and surface phase equilibria, surfactants and micelles, wetting, detergency, and contact angle. The second chapter concentrates on gas adsorbtion at solid surfaces and covers topics including adsorbtion, Langmuir isotherms, heats of adsorbtion, BET isotherms, physisorbtion, chemisorbtion, precursor adsorbtion kinetics, well-defined surfaces, UHV, surface sensitivity and selectivity, surface diffusion and electrons interacting with matter. Chapter three then outlines the physico- chemical principles of XPS, AES, LEED, STM, AFM, work function measurements, UPS, TPD, molecular beams, HREELS and PAIRS and the types of fundamental surface information each of these techniques provides. The final chapter contains a series of worked examples and problems, bringing together the various strands developed in Chapters 1-3 in order to elucidate surface phenomena. The book is unique in its mix of 'Classical' and 'Modern' surface science and should be relevant to physicists, chemists and material scientists. Contents: Surface Chemistry, Equations and Transport Phenomena in Gases, Solutions and their Theories, Physical and Constitutive Properties, Catalysis and Kinetics of Heterogeneous Reactions. This graduate-level textbook covers the major developments in surface sciences of recent decades, from experimental tricks and basic techniques to the latest experimental methods and theoretical understanding. It is unique in its attempt to treat the physics of surfaces, thin films and interfaces, surface chemistry, thermodynamics, statistical physics and the physics of the solid/electrolyte interface in an integral manner, rather than in separate compartments. It is designed as a handbook for the researcher as well as a study-text for graduate students. Written explanations are supported by 350 graphs and illustrations. The last quarter-century has been marked by the extremely rapid growth of the solid-state sciences. They include what is now the largest subfield of physics, and the materials engineering sciences have likewise flourished. And, playing an active role throughout this vast area of science and engineer ing have been very large numbers of chemists. Yet, even though the role of chemistry in the solid-state sciences has been a vital one and the solid-state sciences have, in turn, made enormous contributions to chemical thought, solid-state chemistry has not been recognized by the general body of chemists as a major subfield of chemistry. Solid-state chemistry is not even well defined as to content. Some, for example, would have it include only the quantum chemistry of solids and would reject thermodynamics and phase equilibria; this is nonsense. Solid-state chemistry has many facets, and one of the purposes of this Treatise is to help define the field. Perhaps the most general characteristic of solid-state chemistry, and one which helps differentiate it from solid-state physics, is its focus on the chemical composition and atomic configuration of real solids and on the relationship of composition and structure to the chemical and physical properties of the solid. Real solids are usually extremely complex and exhibit almost infinite variety in their compositional and structural features. Chemistry of Functional Materials Surfaces and Interfaces: Fundamentals and Applications gives a descriptive account of interfacial phenomena step-by-step, from simple to complex, to provide readers with a strong foundation of knowledge in interfacial materials chemistry. Many case studies are provided to give real-world examples of problems and their solutions, allowing readers to make the connection between fundamental understanding and applications. Emerging applications in nanomaterials and nanotechnology are also discussed. Throughout the book, the author explains the common interface and surface equations, models, methods, and applications in the creation of functional materials. The goal of Chemistry of Functional Materials Surfaces and Interfaces is to provide readers with the basic understanding of the common tools of surface and interface chemistry for application in materials science and nanotechnology. This book is suitable for researchers and practitioners in the disciplines of materials science and engineering and surface and interface chemistry. Includes numerous real-world examples and case studies throughout Addresses emerging applications of interfacial materials chemistry in nanomaterials and nanotechnology Provides the foundational concepts of surface and interfacial science with models, equation, and methods A complete overview of the different methods of preparing and studying self-assembled structures at surfaces and interfaces.

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