



Fundamental Aspects of Heterogeneous Catalysis Studied by Particle Beams

Edited by
**H. H. Brongersma and
R. A. van Santen**

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Fundamental Aspects Of Heterogeneous Catalysis Studied By Particle Beams

**Alan R. Bishop, V.L. Pokrovsky, V.
Tognetti**



Fundamental Aspects Of Heterogeneous Catalysis Studied By Particle Beams:

Fundamental Aspects of Heterogeneous Catalysis Studied by Particle Beams H. H. Brongersma, R. A. Van Santen, 1991-10-01 **Fundamental Aspects of Heterogeneous Catalysis Studied by Particle Beams** H.H.

Brongersma, R.A. van Santen, 2013-03-08 Present day heterogeneous catalysis is rapidly being transformed from a technical art into a science based technology A major contribution to this important change is the advance of surface spectroscopic techniques able to characterize the complex surfaces of the heterogeneous catalytic system The Advanced Study Institute on which the current proceedings is based has as its primary aim the bringing together of a variety of lecturers outstanding in those fields of experience to enable a broad coverage of different relevant approaches Not only catalyst characterization but also catalytic reactivity had to be covered in order to relate catalyst properties with catalyst performance Since modern catalysis relates catalytic performance to microscopic molecular catalyst features theoretical electronic aspects also had to be included The Advanced Study Institute had a unique feature in that it brought together physicists catalytic chemists and chemical engineers whom rarely directly interact From physics especially new experimental possibilities of beams were emphasized At present it is possible to obtain very detailed information on model catalysts whilst the applications to practical catalysts are gaining rapidly in sophistication Apart from the plenary lectures the Institute included hot topics to highlight special developments and offered participants the opportunity to present contributed papers either orally or as a poster These contributions formed an integral part of the summer school and significantly enhanced the interaction between participants Inclusion of the hot topics and contributed papers in these proceedings give them an added topical value

Science of Ceramic Interfaces II J. Nowotny, 1995-01-13 This collection of papers arose from the Proceedings of the International Workshop on Interfaces of Ceramic Materials held in Australia 1993 and is a continuation of the previous book published under the same title The objective of the Workshop was to discuss research progress on the chemistry of ceramic interfaces and related industrial aspects Due to the multidisciplinary character of ceramic interfaces the book contains articles covering several areas of expertise including ceramics surface science solid state electrochemistry metallurgy and high temperature chemistry Some technical papers are also included in this volume Scientists and engineers working in these areas as well as students in materials science and engineering will find this book of particular significance **Surface Science** Russel F. Howe, Robert N. Lamb, Klaus Wandelt, 2013-03-07 Surface science has existed as a recognized discipline for more than 20 years During this period the subject has expanded in two important ways On the one hand the techniques available for studying surfaces both experimental and theoretical have grown in number and in sophistication On the other hand surface science has been applied to an increasing number of areas of technology such as catalysis semiconductor processing new materials development corrosion prevention adhesion and tribology There is however no sharp division between fundamental and applied surface science New techniques can immediately be applied to technologically important

problems Improvements in understanding of fundamental phenomena such as epitaxial growth of one metal on another or the bonding of hydrocarbons to metal surfaces to name just two examples have direct consequences for technology Surface science has also become very much an interdisciplinary subject physics chemistry materials science chemical and electronical engineering all draw upon and contribute to surface science The intimate relationship between principles and applications of surface science forms the theme of this proceedings volume The contributions were all presented as invited lectures at an Australian German Workshop on Surface Science held at Coogee Beach Sydney Australia in December 1991 The contributors all active surface scientists in their respective countries were asked to highlight recent developments in their own areas of activity involving new techniques advances in fundamental understanding or new applications in technology

Characterization of Solid Materials and Heterogeneous Catalysts Michel Che, Jacques C. Vedrine, 2012-04-16

This two volume book provides an overview of physical techniques used to characterize the structure of solid materials on the one hand and to investigate the reactivity of their surface on the other Therefore this book is a must have for anyone working in fields related to surface reactivity Among the latter and because of its most important industrial impact catalysis has been used as the directing thread of the book After the preface and a general introduction to physical techniques by M Che and J C Vedrine two overviews on physical techniques are presented by G Ertl and Sir J M Thomas for investigating model catalysts and porous catalysts respectively The book is organized into four parts Molecular Local Spectroscopies Macroscopic Techniques Characterization of the Fluid Phase Gas and or Liquid and Advanced Characterization Each chapter focuses upon the following important themes overview of the technique most important parameters to interpret the experimental data practical details applications of the technique particularly during chemical processes with its advantages and disadvantages conclusions

Spectroscopy in Catalysis J. W. Niemantsverdriet, 2008-07-11

Spectroscopy in Catalysis describes the most important modern analytical techniques used to investigate catalytic surfaces These include electron spectroscopy XPS UPS AES EELS ion spectroscopy SIMS SNMS RBS LEIS vibrational spectroscopy infrared Raman EELS temperature programmed techniques TPR TPO TDS diffraction XRD LEED EXAFS and microscopy TEM SEM STEM STM AFM FEM and FIM Each chapter uses current applications to illustrate the type of information that the technique provides and evaluates its possibilities and limitations This second edition includes significant new developments for example scanning probe microscopies the imaging and vibrational techniques have been revised the case studies expanded with an example on polymerization catalysts and all the other chapters updated with recent examples and relevant new literature From reviews of the First Edition This is a truly valuable book very useful for industrial practitioners who need to be aware of the type of information that can be obtained from modern surface spectroscopies The book has a superb pedagogic value Journal of Catalysis this is an excellent text on spectroscopies in catalysis and I highly recommend it for introductory courses on heterogeneous catalysis or as a general introductory

monograph Journal of the American Chemical Society *Catalysis* J.A. Moulijn, P.W.N.M. van Leeuwen, R.A. van Santen, 1993-09-09 Catalysis is a multidisciplinary activity which is reflected in this book The editors have chosen a novel combination of basic disciplines homogeneous catalysis by metal complexes is treated jointly with heterogeneous catalysis with metallic and non metallic solids The main theme of the book is the molecular approach to industrial catalysis In the introductory section Chapter 1 presents a brief survey of the history of industrial heterogeneous and homogeneous catalysis Subsequently a selection of current industrial catalytic processes is described Chapter 2 A broad spectrum of important catalytic applications is presented including the basic chemistry some engineering aspects feedstock sources and product utilisation In Chapter 3 kinetic principles are treated The section on fundamental catalysis begins with a description of the bonding in complexes and to surfaces Chapter 4 The elementary steps on complexes and surfaces are described The chapter on heterogeneous catalysis 5 deals with the mechanistic aspects of three groups of important reactions syn gas conversion hydrogenation and oxidation The main principles of metal and metal oxide catalysis are presented Likewise the chapter on homogeneous catalysis 6 concentrates on three reactions representing examples from three areas carbonylation polymerization and asymmetric catalysis Identification by in situ techniques has been included Many constraints to the industrial use of a catalyst have a macroscopic origin In applied catalysis it is shown how catalytic reaction engineering deals with such macroscopic considerations in heterogeneous as well as homogeneous catalysis Chapter 7 The transport and kinetic phenomena in both model reactors and industrial reactors are outlined The section on catalyst preparation Chapters 8 and 9 is concerned with the preparation of catalyst supports zeolites and supported catalysts with an emphasis on general principles and mechanistic aspects For the supported catalysts the relation between the preparative method and the surface chemistry of the support is highlighted The molecular approach is maintained throughout The first chapter 10 in the section on catalyst characterization summarizes the most common spectroscopic techniques used for the characterisation of heterogeneous catalysts such as XPS Auger EXAFS etc Temperature programmed techniques which have found widespread application in heterogeneous catalysis both in catalyst characterization and simulation of pretreatment procedures are discussed in Chapter 11 A discussion of texture measurement theory and application concludes this section 12 The final chapter 13 gives an outline of current trends in catalysis Two points of view are adopted the first one focusses on developments in process engineering Most often these have their origin in demands by society for better processes The second point of view draws attention to the autonomous developments in catalysis which is becoming one of the frontier sciences of physics and chemistry In this book emphasis is on those reactions catalyzed by heterogeneous and homogeneous catalysts of industrial relevance The integrative treatment of the subject matter involves many disciplines consequently the writing of the book has been a multi author task The editors have carefully planned and harmonized the contents of the chapters **Microscopic Aspects of Nonlinearity in Condensed Matter** Alan R. Bishop, V.L. Pokrovsky, V.

Tognetti,2012-12-06 Proceedings of a NATO ARW held in Florence Italy June 7 13 1990 Adsorption on Ordered Surfaces of Ionic Solids and Thin Films Hans-Joachim Freund,Eberhard Umbach,2013-03-07 Adsorption on Ordered Surfaces of Ionic Solids and Thin Films introduces to a new and topical field of surface science for which rather little experience is available at present It reviews the recent results of the employed analytical methods comprising all modern surface techniques including scanning tunneling microscopy and various kinds of electron spectroscopies The present status of this new clearly defined field of surface science is nearly completely overviewed by contributions from most of the research groups active in this field The book is meant as a basis for the expected rapid development in this area with applications in catalysis thin film and semiconductor technology sensors electrochemistry controlled preparation of ultrathin epitaxial surfaces and interfaces of insulators as well as future molecular electronics Catalysis James J Spivey,Sanjay K Agarwal,2007-10-31 There is an increasing challenge for chemical industry and research institutions to find cost efficient and environmentally sound methods of converting natural resources into fuels chemicals and energy Catalysts are essential to these processes and the Catalysis Specialist Periodical Report series serves to highlight major developments in this area This series provides systematic and detailed reviews of topics of interest to scientists and engineers in the catalysis field The coverage includes all major areas of heterogeneous and homogeneous catalysis and also specific applications of catalysis such as NO_x control kinetics and experimental techniques such as microcalorimetry Each chapter is compiled by recognised experts within their specialist fields and provides a summary of the current literature This series will be of interest to all those in academia and industry who need an up to date critical analysis and summary of catalysis research and applications Catalysis will be of interest to anyone working in academia and industry that needs an up to date critical analysis and summary of catalysis research and applications Specialist Periodical Reports provide systematic and detailed review coverage in major areas of chemical research Compiled by teams of leading experts in their specialist fields this series is designed to help the chemistry community keep current with the latest developments in their field Each volume in the series is published either annually or biennially and is a superb reference point for researchers www.rsc.org/spr X-ray Absorption Fine Structure for Catalysts and Surfaces Yasuhiro Iwasawa,1996 X ray absorption fine structure XAFS is a powerful technique in characterization of structures and electronic states of materials in many research fields including e g catalysts semiconductors optical ingredients magnetic materials and surfaces This characterization technique could be applied in a static or a dynamic state in situ condition The XAFS can provide information that is not accessible by other techniques for characterization of materials particularly catalysts and related surfaces Furthermore XAFS can provide a molecular level approach to the study of reaction mechanisms for the understanding of catalysts and development of new catalysts A number of synchrotron radiation facilities have been planned to be built in Asian countries in addition to the high brilliant synchrotron radiation facilities under construction in the USA Europe and Japan The applications of XAFS have now expanded to catalytic chemistry and

engineering surface science organometallic chemistry materials science solid state chemistry geophysics etc This book caters to a wide range of researchers and students working in the domain or related topics

Catalysis By Ceria And Related Materials Alessandro Trovarelli, 2002-01-18 The use of CeO₂ based materials in catalysis has attracted considerable attention in recent years particularly in applications like environmental catalysis where ceria has shown great potential This book critically reviews the most recent advances in the field with the focus on both fundamental and applied issues The first few chapters cover structural and chemical properties of ceria and related materials i e phase stability reduction behaviour synthesis interaction with probe molecules CO O₂ NO and metal support interaction all presented from the viewpoint of catalytic applications The use of computational techniques and ceria surfaces and films for model catalytic studies are also reviewed The second part of the book provides a critical evaluation of the role of ceria in the most important catalytic processes three way catalysis catalytic wet oxidation and fluid catalytic cracking Other topics include oxidation combustion catalysts electrocatalysis and the use of cerium catalysts additives in diesel soot abatement technology

Interaction of Charged Particles with Solids and Surfaces Alberto Gras-Martí, Herbert M. Urbassek, Nestor R. Arista, Fernando Flores, 2012-12-06 Early in 1989 while most of us were gathered in the Mediterranean five centuries old city of Alacant the idea of a school on stopping and particle penetration phenomena came to our minds Later that year when discussing this plan with some of the participants in the 13th International Conference on Atomic Collisions in Solids in Aarhus we were pleased to note that the proposal was warmly welcomed indeed by the community An Advanced Study Institute on this or a related subject had not been organized in the last decade Because of the progress made particularly in the interaction of high energy beams with matter and the many applications which the general subject of the stopping of charged particles ions and electrons in matter enjoys a Study Institute appeared a worthy enterprise Even though several international conference series cover developments in these areas they miss tutorial introductions to the field The title chosen was Interaction of Charged Particles with Solids and Surfaces and the objectives were stated as follows to cover theory and experiments including selected applications and hot topics of the stopping of charged particles ions and electrons in matter The emphasis will be on outlining the areas where further effort is needed and on specifying the basic needs in applications Fundamental concepts will prevail over applications and the character of the Institute as a school will be stressed The school was directed by Fernando Flores Spain Herbert M Urbassek Germany Nestor R

Electrochemical Science for a Sustainable Society Kohei Uosaki, 2017-06-15 This book honors Professor John O M Bockris presenting authoritative reviews on some of the subjects to which he made significant contributions i e electrocatalysis fuel cells electrochemical theory electrochemistry of single crystals in situ techniques rechargeable batteries passivity and solar fuels and revealing the roles of electrochemical science and technology in achieving a sustainable society Electrochemistry has long been an object of study and is now growing in importance not only because of its fundamental scientific interest but also because of the central role it is

expected to play in a future sustainable society Professor John O M Bockris contributed greatly to various aspects of fundamental and applied electrochemistry such as the structure of the double layer kinetics and mechanism of the electrochemistry of hydrogen and oxygen electrocatalysis adsorption and electrochemical oxidation of small organic molecules fuel cells electrocrystallization theoretical electrochemistry new methods photoelectrochemistry bioelectrochemistry corrosion and passivity hydrogen in metals ionic solutions and ionic liquids and molten silicates and glasses as well as socio economic issues such as the hydrogen economy for over half a century from 1945 until his retirement in 1997

Biologically Inspired Physics L. Peliti, 2013-06-29 The workshop Biologically Inspired Physics was organized with the support of the NATO Scientific Affairs Division and the Directorate General for Science Research and Development of the Commission of the European Communities in order to review some subjects of physics of condensed matter which are inspired by biological problems or deal with biological systems but which address physical questions The main topics discussed in the meeting were

- 1 Macromolecules In particular proteins and nucleic acids Special emphasis was placed on modelling protein folding where analogies with disordered systems in condensed matter glasses spin glasses were suggested It is not clear at this point whether such analogies will help in solving the folding problem Interesting problems in nucleic acids in particular DNA deal with the dynamics of semiflexible chains with torsion and the relationship between topology and local structure They arise from such biological problems as DNA packing or supercoiling
- 2 Membranes This field has witnessed recent progress in the understanding of the statistical mechanics of fluctuating flexible sheets such as lipid bilayers It appears that one is close to understanding shape fluctuations in red blood cells on a molecular basis Open problems arise from phenomena such as budding or membrane fusion Experiments on model systems such as vesicle systems or artificial lipids have great potential Phenomena occurring inside the membrane protein diffusion ionic pumps were only discussed briefly

Random Surfaces and Quantum Gravity Orlando Alvarez, Enzo Marinari, Paul Windey, 2013-03-09 The Cargèse Workshop Random Surfaces and Quantum Gravity was held from May 27 to June 2 1990 Little was known about string theory in the non perturbative regime before October 1989 when non perturbative equations for the string partition functions were found by using methods based on the random triangulations of surfaces This set of methods provides a description of non critical string theory or equivalently of the coupling of matter fields to quantum gravity in two dimensions The Cargèse meeting was very successful in that it provided the first opportunity to gather most of the active workers in the field for a full week of lectures and extensive informal discussions about these exciting new developments The main results were reviewed recent advances were explained new results and conjectures which appear for the first time in these proceedings were presented and discussed Among the most important topics discussed at the workshop were The relation of KdV theory to loop equations and the Virasoro algebra new results in Liouville field theory effective 1+1 dimensional theory for 2 D quantum gravity coupled to $c=1$ matter and its fermionization proposal for a new geometrical interpretation of the

string equation and possible definition of quantum Riemann surfaces discussion of the string equation for the multi matrix models links with topological field theories of gravity issues in using target space supersymmetry to define good theories definition of the partition function via analytic continuation new models of random surfaces

Phase Transitions in Surface Films 2 H. Taub, G. Torzo, H.J. Lauter, S.C. Fain Jr., 2012-12-06 The Advanced Study Institute AS I entitled Phase Transitions in Surface Films was held at the Ettore Majorana Centre for Scientific Culture in Erice Sicily from June 19 to June 29 1990 It reviewed the present understanding experimental and theoretical of phase transitions of surfaces interfaces and thin films as well as the related structural and dynamical properties of these systems From its inception this ASI was envisioned as a sequel to one of the same title organized eleven years earlier by J G Dash and J Ruvalds which was also held at the Ettore Majorana Centre The previous ASI reflected the progress which had been made in understanding quasi two dimensional 2D states of matter particularly adsorbed monolayers and the phase transitions which occur in them At that time the field was barely ten years old The modern field to which we are referring here can be traced to the landmark experiments of A Thorney and X Duval Beginning in 1967 they published a series of papers presenting evidence from vapor pressure measurements of 2D phases of krypton and other gases adsorbed on polycrystalline exfoliated graphite Their work led to a large number of thermodynamic and scattering experiments on physisorbed films This in turn motivated a great deal of theoretical interest in 2D systems and their phase transitions

Diamond and Diamond-like Films and Coatings Robert E. Clausing, Linda L. Horton, John C. Angus, Peter Koidl, 2012-12-06 Diamond films grown by activated chemical vapor deposition have superlative thermal mechanical optical and electronic properties combined with a very high degree of chemical inertness to most environments These properties together with the ability to fabricate films and shapes of considerable size promise an exciting new material with many applications Some applications are on the verge of commercialization but many await a few more technological developments Diamond like films are already employed in both commercial and military applications The popular press as well as the scientific and technological and industrial communities are increasingly interested in the potential for future development of these materials Although there are many technical papers and review articles published there is no Single comprehensive introduction to these technologies The Scientific Affairs Division of NATO recognized the need and the future importance of these technologies and authorized an Advanced Study Institute on diamond and diamond like films NATO Advanced Study Institutes are high level teaching activities at which a carefully defined subject is presented in a systematic and coherently structured program The subject is treated in considerable depth by lecturers eminent in their fields and of international standing The presentations are made to students who are scientists in the field or who possess an advanced general scientific background

Methods and Mechanisms for Producing Ions from Large Molecules K.G. Standing, W. Ens, 2012-12-06 A NATO Advanced Research Workshop on Methods and Mechanisms for Producing Ions from Large Molecules was held at Minaki Lodge Minaki Ontario Canada from 24 to 28 June 1990 The

workshop was hosted by the time of flight group of the Department of Physics at the University of Manitoba and was attended by 64 invited participants from around the world Twenty nine invited talks were given and 19 papers were presented as posters Of the 48 contributions 38 are included in these proceedings The conference was organized to study the rapidly changing field of mass spectrometry of biomolecules Particle induced desorption especially with MeV particles has been the most effective method of producing molecular ions from biomolecules An important part of the workshop was devoted to recent developments in this field particularly to progress in understanding the fundamentals of the desorption process In this respect the meeting was similar to previous conferences in Marburg FRG 1978 Paris F 1980 Uppsala S 1981 College Station USA 1983 1984 Wangerooze FRG 1986 Orsay F 1988 Spiekeroog FRG 1989 and to the IFOS series of meetings at Munster FRG 1981 1983 1985 1987 and L6vAnger S 1989 As in the most recent of these meetings there was some emphasis on new developments particularly cluster bombardment A departure from the concentration on particle bombardment processes at this conference was inspired by the dramatic results obtained with two new methods for producing molecular ions from large molecules matrix assisted laser desorption and electrospray

The Global Geometry of Turbulence Javier Jiménez, 2012-12-06 The aim of this Advanced Research Workshop was to bring together Physicists Applied Mathematicians and Fluid Dynamicists including very specially experimentalists to review the available knowledge on the global structural aspects of turbulent flows with an especial emphasis on open systems and to try to reach a consensus on their possible relationship to recent advances in the understanding of the behaviour of low dimensional dynamical systems and amplitude equations A lot has been learned during recent years on the non equilibrium behaviour of low dimensional dynamical systems including some fluid flows Rayleigh Benard Taylor Couette etc These are mostly closed flows and many of the global structural features of the low dimensional systems have been observed in them including chaotic behaviour period doubling intermit tency etc It has also been shown that some of these flows are intrinsically low dimensional which accounts for much of the observed similarities Open flows seem to be different and experimental observations point to an intrinsic high dimensionality However some of the tran sitional features of the low dimensional systems have been observed in them specially in the intermittent behaviour of subcritical flows pipes channels boundary layers with suction etc and in the large scale geometry of coherent structures of free shear flows mixing layers jets and wakes

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