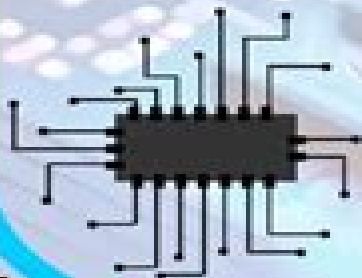


Atomic and molecular clusters

- Atomic and molecular clusters are small assemblies of atoms or molecules ranging from a few to millions
- They exhibit unique properties that differ from individual atoms and bulk materials, often bridging the gap between these states
- These clusters are crucial in understanding chemical reactions, material strength, and electronic properties
- Due to their size, clusters have potential applications in nanotechnology and targeted drug delivery

Practical example: Electronics

- Atomic and molecular clusters play a crucial role in electronics, influencing the behavior and properties of materials
- In semiconductors, clusters affect electrical conductivity and the efficiency of devices like transistors and solar cells
- As technology advances, manipulating these clusters allows for miniaturization of electronic components, enhancing device performance and energy efficiency
- Understanding and controlling these clusters are key to developing faster, smaller, and more powerful electronic devices



Physics Of Clusters

Karl-Heinz Meiwes-Broer



Physics Of Clusters:

Physics of Clusters G. N Chuev, 1996 *Progress in the Physics of Clusters* Gennady N. Chuev, Viktor D. Lakhno, A. P. Nefedov, 1999 The findings reported in this book on the methods of cluster measurements will lead to new avenues using nondestructive mass spectrometry and dipole mass isomers Much attention is given to the physics and chemistry of fullerenes and nanotubes including the problems surrounding the formation and growth of nanotubes electron characteristics of fullerenes the influence of solvents simulation of the properties of carbon clusters etc Some unique experimental data on the conversion of aerosols into aerogels with the formation of fractal structures is provided In addition the book covers one of the most interesting subjects of modern physics fractal clusters Contribution of Clusters Physics to Materials Science and Technology Joel Davenas, P.M. Rabette, 2012-12-06 During the last decade there has been an increasing interest in clusters and small particles because of the peculiar proper ties induced by their large area to volume ratio For that reason small particles are often considered as an intermediate state of matter at the border between atomic or molecular chemistry and physics of the condensed matter The importance of the surface effect can explain the anomalous properties for example the exis tence of the five fold symmetry observed in different circumstan ces beams of rare gas clusters gold particles deposited on a substrate However the question of the critical size at which the transition to bulk properties occurs cannot be simply answered since the reply depends on the peculiar property which is studied The importance of the size effect was emphasized in the last International Meetings However the situation remains confused in most cases since the exact role of the cluster environment cannot be clearly elucidated and is a main difficulty except in cluster beam experiments In fact ideally free clusters constitute a labo ratory exception In most applications small particles must be supported on a surface or embedded in a matrix in order to be stabilized which obviously shows the role of the environment *Clusters and Small Particles* Boris Mikhailovich Smirnov, 2000-06-08 Not merely a discussion of small particles or clusters of atoms molecules but also the systems they constitute The goal is to analyse the properties of such finite aggregates and their behaviour in gases and plasmas and to investigate processes that involve such clusters based on lectures and seminar problems for graduates The main part of the book includes more than 200 problems covering collisions charge transfer chemical reactions condensed systems and their structures kinetics of cluster growth excited clusters the transition from clusters to bulk particles and small particles dust and aerosols in plasmas Reference data for corresponding parameters of systems under consideration is given in the appendices Of interest to physicists astrophysicists and chemists Metal Clusters at Surfaces Karl-Heinz Meiwes-Broer, 2012-12-06 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 *Physics and Chemistry of Small Clusters* P. Jena, 2013-06-29 Recent advances in experimental techniques now enable researchers to produce in a laboratory clusters of atoms of desired composition from any of the elements of the periodic table This has created a new area of research into novel materials since clusters cannot be regarded either as a large molecule or as a fragment of the bulk Both experimental and theoretical studies are revealing unusual properties that are not observed in solid state environments The structures of micro clusters are found to be significantly distorted from the most symmetric arrangement some even exhibiting pentagonal symmetry commonly found in icosahedric structures The unusual stability of certain clusters now described as magic number species shows striking similarities with the nuclear shell structure The relative stabilities of clusters depend not only on the composition of the clusters but also on their charged states The studies on spontaneous fragmentation of multiply charged clusters commonly referred to as Coulomb explosion illustrate the role of electronic bonding mechanisms on stability of clusters The effect of foreign atoms on geometry and stability of clusters and the interaction of gas atoms with clusters are showing promise for an in-depth understanding of chemisorption and catalysis The magnetic and optical properties are dependent not only on cluster size but also on its geometry These findings have the potential for aiding industry in the area of micro electronics and catalysis

Clusters and Small Particles Boris M. Smirnov, 2012-10-23 Not merely a discussion of small particles or clusters of atoms molecules but also the systems they constitute The goal is to analyse the properties of such finite aggregates and their behaviour in gases and plasmas and to investigate processes that involve such clusters based on lectures and seminar problems for graduates The main part of the book includes more than 200 problems covering collisions charge transfer chemical reactions condensed systems and their structures kinetics of cluster growth excited clusters the transition from clusters to bulk particles and small particles dust and aerosols in plasmas Reference data for corresponding parameters of systems under consideration is given in the appendices Of interest to physicists astrophysicists and chemists

Introduction to Cluster Dynamics Paul-Gerhard Reinhard, Eric Suraud, 2003-12-19 Cluster als mesoskopische Teilchen bilden das Bindeglied zwischen der Atom und Molekülphysik auf der einen und der Physik der kondensierten Materie auf der anderen Seite Die technische Entwicklung hin zu immer kleineren Dimensionen erfordert eine umfassende Kenntnis von Systemen die aus nur wenigen Teilchen bestehen Als Einführung in das Gebiet der Cluster Physik mit Ausrichtung auf die Clusterdynamik schließt das Buch eine Lücke in der vorhandenen Literatur Die Beschreibung der Clusterdynamik berücksichtigt sowohl aktuelle Entwicklungen in der Femtosekunden Spektroskopie als auch im Bereich der zeitabhängigen

Dichtefunktionaltheorie **An Introduction to Cluster Science** Phuong Mai Dinh, Paul-Gerhard Reinhard, Eric Suraud, 2013-09-30 Filling the need for a solid textbook this short primer in cluster science is ideal for a one semester lecture for advanced undergraduate students It is based on a series of lectures given by the well established and recognized authors for the past ten years The book covers both the basics of the domain as well as up to date developments It can be divided roughly into two parts The first three chapters introduce basic concepts of cluster science Chapter 1 provides a general introduction complemented by chapter 2 on experimental and chapter 3 on theoretical aspects The second half of the book is devoted to a systematic presentation of free cluster properties and to a thorough discussion of the impact of clusters in other domains of science These explicitly worked out links between cluster physics and other research areas are unique both in terms of fundamental aspects and of applications and cannot be found elsewhere in the literature Also suitable for researchers outside of the field looking for an introduction to cluster science *Microcluster Physics* Satoru Sugano, 2013-03-08 This book aims at providing graduate students and researchers with fundamental knowledge indispensable for entering the new field of microclusters Microclusters consisting of 10 to 10 atoms exhibit neither the properties of the corresponding bulk nor those of the corresponding molecule of a few atoms The microclusters may be considered to form a new phase of materials lying between macroscopic solids and microscopic particles such as atoms and molecules showing both macroscopic and microscopic features However research into such a new phase has been left untouched until recent years by the development of the quantum theory of matter The microscopic features of microclusters were first revealed by observing anomalies of the mass spectrum of a Na cluster beam at specific sizes called magic numbers Then it was experimentally confirmed that the magic numbers come from the shell structure of valence electrons Being stimulated by these epoch making findings in metal microclusters and aided by progress of the experimental techniques producing relatively dense non interacting micro clusters of various sizes in the form of micro cluster beams the research field of microclusters has developed rapidly in these 5 to 7 years The progress is also due to the improvement of computers and computational techniques which have made it possible to perform ab initio calculations of the atomic and electronic structure of smaller microclusters as well as to carry out computer simulations of their dynamics *Atomic and Molecular Clusters* Roy L. Johnston, 2002-04-25 Cluster physics is the foundation of the increasingly important field of nanotechnology Clusters ranging in size from a few to many millions of atoms constitute a fascinating field of research in physics chemistry and materials science They are formed by most of the elements of the Periodic Table and the types of bonding and the resultant clusters are equally as varied This book introduces atomic clusters ranging from weakly bonded clusters of argon to strongly bonded carbon clusters and metal nano particles It includes worked examples to enable lecturers and students to gauge their understanding and progress Atomic and Molecular Clusters describes the experimental generation detection and interrogation of clusters and theoretical approaches developed to aid understanding of their physical properties It classifies

clusters according to their bonding types and gives examples of present and possible future applications of clusters in electronic optical and magnetic devices

Theory of Atomic and Molecular Clusters Julius Jellinek, 2012-10-13 The emergence and spectacularly rapid evolution of the field of atomic and molecular clusters are among the most exciting developments in the recent history of natural sciences The field of clusters expands into the traditional disciplines of physics chemistry materials science and biology yet in many respects it forms a cognition area of its own This book presents a cross section of theoretical approaches and their applications in studies of different cluster systems The contributions are written by experts in the respective areas The systems discussed range from weakly van der Waals bonded through hydrogen and covalently bonded to semiconductor and metallic clusters The theoretical approaches involve high level electronic structure computations more approximate electronic structure treatments use of semiempirical potentials dynamical and statistical analyses and illustrate the utility of both classical and quantum mechanical concepts

Clusters in Nuclei Christian Beck, 2012-02-16 Following the pioneering discovery of alpha clustering and of molecular resonances the field of nuclear clustering is today one of those domains of heavy ion nuclear physics that faces the greatest challenges yet also contains the greatest opportunities After many summer schools and workshops in particular over the last decade the community of nuclear molecular physicists has decided to collaborate in producing a comprehensive collection of lectures and tutorial reviews covering the field This second volume follows the successful Lect Notes Phys 818 Vol 1 and comprises six extensive lectures covering the following topics Microscopic cluster models Neutron halo and break up reactions Break up reaction models for two and three cluster projectiles Clustering effects within the di nuclear model Nuclear alpha particle condensates Clusters in nuclei experimental perspectives By promoting new ideas and developments while retaining a pedagogical style of presentation throughout these lectures will serve as both a reference and an advanced teaching manual for future courses and schools in the fields of nuclear physics and nuclear astrophysics

[Physics and Chemistry of Small Clusters](#) P Jena, 2014-01-15

Advanced Topics in Contemporary Physics for Engineering Rui F. M. Lobo, Mário J. Pinheiro, 2022-12-21 This book highlights cutting edge topics in contemporary physics discussing exciting advances and new forms of thinking in evolving fields with emphases both on natural phenomena and applications to modern engineering It provides material for thought and practice in nanophysics plasma physics and electrodynamics Nanophysics and plasmas are synergic physical areas where the whole is more than the sum of the parts quantum atomic and molecular electrodynamics photonics condensed matter thermodynamics transport phenomena The authors emphasize both fundamentals and more complex concepts making the contents accessible as well challenging Nanoscale properties and physical phenomena are explained under the umbrella of quantum physics Advances made in the physical knowledge of the nanoworld and its metrology are addressed along with experimental achievements which have furthered studies of extreme weak forces present at nano or sub micron scales The book does not focus in detail on the diversity of applications in nanotechnology and

instrumentation considering that the reader already has basic prior knowledge on that It also covers an introduction to plasma universe phenomenology the basics of advanced mathematics applied to the electromagnetic field longitudinal forces in the vacuum concepts of helicity and topological torsion SU 2 representation of Maxwell equations 2D representation of the electromagnetic field the use of the fractional derivative and ergotropic dynamics The chapters include theory applications bibliographic references and solved exercises The synergies of the book s topics demonstrate their potential in critical issues such as relieving humans from barriers imposed by energetic and entropic dependencies and penetrating the realm of weak forces at the nanoscale The book will boost both post graduate students and mature scientists to implement new scientific and technological projects

Clusters of Atoms and Molecules II Hellmut Haberland,1994 Cluster science studies the transition from atomic and molecular physics or chemistry to the science and technology of condensed matter Two main topics from this large field will be emphasized in this second volume of Atomic and Molecular Clusters After an Introduction Chap 2 deals mainly with molecular clusters how they react to positive or negative charges Sect 2 1 to 2 5 how they decompose and how they can be charged Sect 2 6 and 2 7 and how one can do chemistry with them 2 8 and 2 9 Clusters in contact with a macroscopic medium are treated in Chap 3 It is from this domain that one can expect possible new applications of cluster science The optical spectra of silver clusters in a dielectric medium are discussed in Sect 3 1 Their properties have since long been used unknowingly to stain glass windows Large clusters floating in an ambient pressure gas are called aerosols Sect 3 2 Their properties can be used to monitor air pollution Development of a photographic film is due to supported silver clusters in a liquid environment Sect 3 3 Large semiconductor clusters also called quantum dots have novel optical and electronic properties Sect 3 4 The optical properties of large clusters in general are reviewed in Sect 3 5 and properties of clusters supported on clean surfaces are discussed in Sect 3 6

Library of Congress Subject

Headings Library of Congress,Library of Congress. Office for Subject Cataloging Policy,2012 Physics and Chemistry of Finite Systems: From Clusters to Crystals Peru Jena,S.N. Khanna,B.K.N. Rao,2013-11-11 Recent innovations in experimental techniques such as molecular and cluster beam epitaxy supersonic jet expansion matrix isolation and chemical synthesis are increasingly enabling researchers to produce materials by design and with atomic dimension These materials constrained by size shape and symmetry range from clusters containing as few as two atoms to nanoscale materials consisting of thousands of atoms They possess unique structural electronic magnetic and optical properties that depend strongly on their size and geometry The availability of these materials raises many fundamental questions as well as technological possibilities From the academic viewpoint the most pertinent question concerns the evolution of the atomic and electronic structure of the system as it grows from micro clusters to crystals At what stage for example does the cluster look as if it is a fragment of the corresponding crystal How do electrons forming bonds in micro clusters transform to bands in solids How do the size dependent properties change from discrete quantum conditions as in clusters to boundary constrained bulk conditions as in

nanoscale materials to bulk conditions insensitive to boundaries How do the criteria of classification have to be changed as one goes from one size domain to another Potential for high technological applications also seem to be endless Clusters of otherwise non magnetic materials exhibit magnetic behavior when constrained by size shape and dimension Nanoscale metal particles exhibit non linear optical properties and increased mechanical strength Similarly materials made from nanoscale ceramic particles possess plastic behavior

Springer Handbook of Science and Technology Indicators Wolfgang Glänzel, Henk F. Moed, Ulrich Schmoch, Mike Thelwall, 2019-10-30 This handbook presents the state of the art of quantitative methods and models to understand and assess the science and technology system Focusing on various aspects of the development and application of indicators derived from data on scholarly publications patents and electronic communications the individual chapters written by leading experts discuss theoretical and methodological issues illustrate applications highlight their policy context and relevance and point to future research directions A substantial portion of the book is dedicated to detailed descriptions and analyses of data sources presenting both traditional and advanced approaches It addresses the main bibliographic metrics and indexes such as the journal impact factor and the h index as well as altmetric and webometric indicators and science mapping techniques on different levels of aggregation and in the context of their value for the assessment of research performance as well as their impact on research policy and society It also presents and critically discusses various national research evaluation systems Complementing the sections reflecting on the science system the technology section includes multiple chapters that explain different aspects of patent statistics patent classification and database search methods to retrieve patent related information In addition it examines the relevance of trademarks and standards as additional technological indicators The Springer Handbook of Science and Technology Indicators is an invaluable resource for practitioners scientists and policy makers wanting a systematic and thorough analysis of the potential and limitations of the various approaches to assess research and research performance

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