

**Solid-State Sciences**

R. A. Evarestov V. P. Smirnov

# Site Symmetry in Crystals

Theory and Applications

Second Enlarged Edition



Springer

# Site Symmetry In Crystals Theory And Applications

**Kiyoyuki Terakura, Hisazumi Akai**



## **Site Symmetry In Crystals Theory And Applications:**

**Site Symmetry in Crystals** Robert A. Evarestov, Vyacheslav P. Smirnov, 2012-12-06 Site Symmetry in Crystals is the first comprehensive account of the group theoretical aspects of the site local symmetry approach to the study of crystalline solids The efficiency of this approach which is based on the concepts of simple induced and band representations of space groups is demonstrated by considering newly developed applications to electron surface states point defects symmetry analysis in lattice dynamics the theory of second order phase transitions and magnetically ordered and non rigid crystals Tables of simple induced representations are given for the 24 most common space groups allowing the rapid analysis of electron and phonon states in complex crystals with many atoms in the unit cell

**Site Symmetry in Crystals** Robert A Evarestov, Vyacheslav P Smirnov, 1997-01-16 Low-Dimensional Electronic Systems Guenther Neubauer, Friedemar Kuchar, Helmut Heinrich, 2013-03-13 Owing to new physical technological and device concepts of low dimensionalelectronic systems the physics and fabrication of quasi zero one and two dimensional systems are rapidly growing fields The contributions presented in this volume cover results of nanostructure fabrication including recently developed techniques for example tunneling probe techniques and molecular beam epitaxy quantum transport including the integer and fractional quantum Hall effect optical and transport studies of the two dimensional Wigner solid phonon studies of low dimensional systems and Si SiGe heterostructures and superlattices To the readers new in the field this volume gives a comprehensive introduction and for the experts it is an update of their knowledge and a great help for decisions about future research activities

**Products of Random Matrices** Andrea Crisanti, Giovanni Paladin, Angelo Vulpiani, 2012-12-06 At the present moment after the success of the renormalization group in providing a conceptual framework for studying second order phase transitions we have a nearly satisfactory understanding of the statistical mechanics of classical systems with a non random Hamiltonian The situation is completely different if we consider the theory of systems with a random Hamiltonian or of chaotic dynamical systems The two fields are connected in fact in the latter the effects of deterministic chaos can be modelled by an appropriate stochastic process Although many interesting results have been obtained in recent years and much progress has been made we still lack a satisfactory understanding of the extremely wide variety of phenomena which are present in these fields The study of disordered or chaotic systems is the new frontier where new ideas and techniques are being developed More interesting and deep results are expected to come in future years The properties of random matrices and their products form a basic tool whose importance cannot be underestimated They play a role as important as Fourier transforms for differential equations This book is extremely interesting as far as it presents a unified approach for the main results which have been obtained in the study of random matrices It will become a reference book for people working in the subject The book is written by physicists uses the language of physics and I am sure that many physicists will read it with great pleasure

**Electronic Properties of High-Tc Superconductors** Hans Kuzmany, Michael Mehring, Jörg

Fink, 2012-12-06 The International Winter School on Electronic Properties of High Temperature Superconductors held between March 7-14 1992 in Kirchberg Tyrol Austria was the sixth in a series of meetings to be held at this venue. Four of the earlier meetings were dedicated to issues in the field of conducting polymers while the winter school held in 1990 was devoted to the new discipline of high  $T_c$  superconductivity. This year's meeting constituted a forum not only for the large number of scientists engaged in high  $T_c$  research but also for those involved in the new and exciting field of fullerenes. Many of the issues raised during the earlier winter schools on conducting polymers and the last one on high  $T_c$  superconductivity have taken on a new significance in the light of the discovery of superconducting C materials. 60 The Kirchberg meetings are organized in the style of a school where experienced scientists from universities, research laboratories and industry have the opportunity to discuss their most recent results and where students and young scientists can learn about the present status of research and applications from some of the most eminent workers in their field. In common with the previous winter school on high  $T_c$  superconductors, the one on the cuprate superconductors presents one focused on the electronic properties. In addition, consideration was given to related compounds which are relevant to the understanding of the electronic structure of the cuprates in the normal state, to other oxide superconductors and to fulleride superconductors.

### **The Quantum Hall**

**Effects** Tapash Chakraborty, Pekka Pietiläinen, 2013-03-12 The experimental discovery of the fractional quantum Hall effect (FQHE) at the end of 1981 by Tsui, Stormer and Gossard was absolutely unexpected since at this time no theoretical work existed that could predict new structures in the magnetotransport coefficients under conditions representing the extreme quantum limit. It is more than thirty years since investigations of bulk semiconductors in very strong magnetic fields were begun. Under these conditions only the lowest Landau level is occupied and the theory predicted a monotonic variation of the resistivity with increasing magnetic field depending sensitively on the scattering mechanism. However, the experimental data could not be analyzed accurately since magnetic freeze-out effects and the transitions from a degenerate to a nondegenerate system complicated the interpretation of the data. For a two-dimensional electron system the positive background charge is well separated from the two gas where dimensional system magnetic freeze-out effects are barely visible and an analysis of the data in the extreme quantum limit seems to be easier. First measurements in this magnetic field region on silicon field-effect transistors were not successful because the disorder in these devices was so large that all electrons in the lowest Landau level were localized. Consequently, models of a spin glass and finally of a Wigner solid were developed and much effort was put into developing the technology for improving the quality of semiconductor materials and devices, especially in the field of two-dimensional electron systems.

### **Interatomic Potential and Structural Stability**

Kiyoyuki Terakura, Hisazumi Akai, 2013-03-08 Structural stability is of fundamental importance in materials science. Up-to-date information on the theoretical aspects of phase stability of materials is contained in this volume. Most of the first-principles calculations are based on the local density approximation (LDA). In contrast, this volume contains very recent results of going beyond LDA such

as the density gradient expansion and the quantum Monte Carlo method. Following the recently introduced theoretical methods for the calculation of interatomic potentials forces acting on atoms and total energies such as the Car Parrinello the effective medium and the bond order method attempts have been made to develop even more sophisticated methods such as the order N method in electronic structure calculations. The present status of these methods and their application to real systems are described. In addition in order to study the phase stability at finite temperatures the microscopic calculations have to be combined with statistical treatment of the systems to describe e.g. order disorder transitions on the Si 001 surface or alloy phase diagrams. This book contains examples for this type of calculations.

*Phonon Scattering in Condensed Matter VII* Michael Meissner, Robert O. Pohl, 2012-12-06 This volume contains the proceedings of the Seventh International Conference on Phonon Scattering in Condensed Matter held August 3-7 1992 at Cornell University in Ithaca NY USA. The preceding conferences were held at St Maxime and Paris France 1972 Nottingham UK 1975 Providence USA 1979 Stuttgart Germany 1983 Urbana USA 1986 and Heidelberg Germany 1989. The Heidelberg conference was held jointly with the Third International Conference on Phonon Physics. The next conference to be held in August 1995 in Sapporo Japan and hosted by Professor T Nakayama and his colleagues will also be such a joint conference. This conference was attended by 227 scientists from 27 countries and covered all aspects of phonon scattering in condensed matter ranging from the more traditional topics of thermal conductivity Kapitza resistance and ballistic phonon propagation to the recently added topics such as electron phonon interaction in high T<sub>c</sub> superconductors the use of phonons in particle detection and phonons in confined geometries. The 207 papers arranged in 11 chapters in this volume are a cross section of the present activities in the quite obviously vibrant field of phonons and their interactions.

*Structural Analysis of Point Defects in Solids* Johann-Martin Spaeth, Jürgen R. Niklas, Ralph H. Bartram, 2012-12-06 Structural Analysis of Point Defects in Solids introduces the principles and techniques of modern electron paramagnetic resonance EPR spectroscopy essential for applications to the determination of microscopic defect structures. Investigations of the microscopic and electronic structure and also correlations with the magnetic properties of solids require various multiple magnetic resonance methods such as ENDOR and optically detected EPR or ENDOR. This book discusses experimental technological and theoretical aspects of these techniques comprehensively from a practical viewpoint with many illustrative examples taken from semiconductors and other solids. The nonspecialist is informed about the potential of the different methods while the researcher faced with the task of determining defect structures is provided with the necessary tools together with much information on computer aided methods of data analysis and the principles of modern spectrometer design.

*Correlation Effects in Low-Dimensional Electron Systems* Ayao Okiji, Norio Kawakami, 2012-12-06 Correlation Effects in Low Dimensional Electron Systems describes recent developments in theoretical condensed matter physics emphasizing exact solutions in one dimension including conformal field theoretical approaches the application of quantum groups and numerical diagonalization techniques. Various key properties are presented for two

dimensional highly correlated electron systems      **Spectroscopy of Mott Insulators and Correlated Metals** Atsushi Fujimori, Yoshinori Tokura, 2012-12-06 Extensive studies of high T<sub>c</sub> cuprate superconductors have stimulated investigations into various transition metal oxides Mott transitions in particular provide fascinating problems and new concepts in condensed matter physics This book is a collection of overviews by well known active researchers in this field It deals with the latest developments with particular emphasis on the theoretical spectroscopic and transport aspects      **Fundamentals of Semiconductors** Peter YU, Manuel Cardona, 2007-05-08 This third updated edition of Fundamentals of Semiconductors attempts to fill the gap between a general solid state physics textbook and research articles by providing detailed explanations of the electronic vibrational transport and optical properties of semiconductors The approach is physical and intuitive rather than formal and pedantic Theories are presented to explain experimental results This textbook has been written with both students and researchers in mind Its emphasis is on understanding the physical properties of Si and similar tetrahedrally coordinated semiconductors The explanations are based on physical insights Each chapter is enriched by an extensive collection of tables of material parameters figures and problems Many of these problems lead the student by the hand to arrive at the results      *Fundamentals of Semiconductor* Peter YU, Manuel Cardona, 2013-11-11 Fundamentals of Semiconductors attempts to fill the gap between a general solid state physics textbook and research articles by providing detailed explanations of the electronic vibrational transport and optical properties of semiconductors The approach is physical and intuitive rather than formal and pedantic Theories are presented to explain experimental results This textbook has been written with both students and researchers in mind Its emphasis is on understanding the physical properties of Si and similar tetrahedrally coordinated semiconductors The explanations are based on physical insights Each chapter is enriched by an extensive collection of tables of material parameters figures and problems Many of these problems lead the student by the hand to arrive at the results      **Symmetry and Condensed Matter Physics** M. El-Batanouny, F. Wooten, 2008-03-13 Unlike existing texts this book blends for the first time three topics in physics symmetry condensed matter physics and computational methods into one pedagogical textbook It includes new concepts in mathematical crystallography experimental methods capitalizing on symmetry aspects non conventional applications such as Fourier crystallography color groups quasicrystals and incommensurate systems as well as concepts and techniques behind the Landau theory of phase transitions Adopting a computational approach to the application of group theoretical techniques to solving symmetry related problems it dramatically alleviates the need for intensive calculations usually found in the presentation of symmetry Writing computer programs helps the student achieve a firm understanding of the underlying concepts and sample programs based on Mathematica are presented throughout the book Containing over 150 exercises this textbook is ideal for graduate students in condensed matter physics materials science and chemistry Solutions and computer programs are available online at [www.cambridge.org](http://www.cambridge.org) 9780521828451      **Topology in Condensed Matter** Michael I.

Monastyrsky,2006-02-04 This book reports new results in condensed matter physics for which topological methods and ideas are important It considers on the one hand recently discovered systems such as carbon nanocrystals and on the other hand new topological methods used to describe more traditional systems such as the Fermi surfaces of normal metals liquid crystals and quasicrystals The authors of the book are renowned specialists in their fields and present the results of ongoing research some of it obtained only very recently and not yet published in monograph form Electron Scattering in Solid Matter Jan Zablouil,Robert Hammerling,Lászlo Szunyogh,Peter Weinberger,2005-12-12 Addressing graduate students and researchers this book gives a very detailed theoretical and computational description of multiple scattering in solid matter Particular emphasis is placed on solids with reduced dimensions on full potential approaches and on relativistic treatments For the first time approaches such as the screened Korringa Kohn Rostoker method are reviewed considering all formal steps such as single site scattering structure constants and screening transformations and also the numerical point of view Furthermore a very general approach is presented for solving the Poisson equation needed within density functional theory in order to achieve self consistency Special chapters are devoted to the Coherent Potential Approximation and to the Embedded Cluster Method used for example for describing nanostructured matter in real space In a final chapter physical properties related to the single particle Green s function such as magnetic anisotropies interlayer exchange coupling electric and magneto optical transport and spin waves serve to illustrate the usefulness of the methods described Physics of Zero- and One-Dimensional Nanoscopic Systems Sachindra Nath Karmakar,Santanu Kumar Maiti,Chowdhury Jayeeta,2007-09-04 In recent years submicron and nanoscale systems have featured strongly on the research agenda due to the technological progress and new physics that have emerged from studies of ultra small systems A fundamental understanding of basic physical phenomena on the mesoscopic and nanoscopic scales is required to exploit the technological potential offered by these exotic materials The present book contains review like chapters by some of the leading experts in the field covering topics such as the Kondo effect electron transport disorder and quantum coherence with electron electron interaction persistent current thermoelectric phenomena etc in quantum dots quantum wires carbon nanotubes and more This book will be valuable to researchers and students in condensed matter physics *Magnetism in the Solid State* Peter Mohn,2006-06-09 This book presents a phenomenological approach to the field of solid state magnetism Beginning with basic concepts in statistical thermodynamics and electronic structure theory the text discusses models for localized moments Weiss Heisenberg and delocalized moments Stoner This is followed by a chapter about exchange and correlation in metals again considering the results for the localized and delocalized limit The book ends with a chapter about spin fluctuations which are introduced as an alternative to the finite temperature Stoner theory The book will be a useful reference for researchers and a valuable accompaniment to graduate courses on magnetism and magnetic materials **Green's Functions in Quantum Physics** Eleftherios N. Economou,2006-08-02 Of interest to advanced students this book focuses on Green s functions for

obtaining simple and general solutions to basic problems in quantum physics It demonstrates the unifying formalism of Green's functions across many applications including transport properties carbon nanotubes and photonics and photonic crystals

**Magnetism** Joachim Stöhr, Hans Christoph Siegmann, 2007-01-19 This text book gives a comprehensive account of magnetism one of the oldest yet most vibrant fields of physics It spans the historical development the physical foundations and the continuing research underlying the subject The book covers both the classical and quantum mechanical aspects of magnetism and novel experimental techniques Perhaps uniquely it discusses spin transport and magnetization dynamics phenomena associated with atomically and spin engineered nano structures against the backdrop of spintronics and magnetic storage and memory applications The book is for students and serves as a reference for scientists in academia and research laboratories



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