Superconductivity In Graphene And Carbon Nanotubes Proximity Effect And Nonlocal Transport Springer Theses

Carbon-based nanomaterials are rapidly emerging as one of the most fascinating materials in the twenty-first century. Chemical Functionalization of Carbon Nanomaterials: Chemistry and Applications provides a thorough examination of carbon nanomaterials, including their variants and how they can be chemically functionalized. It also gives a comprehensive overview of current advanced applications of functionalized carbon nanomaterials, including the automotive, packaging, coating, and biomedical industries. The book covers modern techniques to characterize chemically functionalized carbon nanomaterials as well as characterization of surface functional groups. It includes contributions from international leaders in the field who highlight the multidisciplinary and interdisciplinary flexibility of functionalized carbon nanomaterials. The book illustrates how natural drawbacks to carbon nanomaterials, such as low solubility, can be countered by surface modifications and shows how to make modifications. It discusses developments in the use of carbon nanomaterials in several critical areas in scientific research and practice, including analytical chemistry, drug delivery, and water treatment. It explores market opportunities due to the versatility and increasing applicability of carbon nanomaterials. It also gives suggestions on the direction of the field from its current point, paving the way for future developments and finding new

applications. Chemical Functionalization of Carbon Nanomaterials: Chemistry and Applications is a significant collection of findings in a rapidly developing field. It gives an in-depth look at the current achievements of research and practice while pointing you ahead to new possibilities in functionalizing and using carbon nanomaterials.

Annotation The first book dealing with the subject of room-temperature conductivity.

Carbon nanotubes belong to new nanomaterials and have been known for almost 20 years, but their history is somewhat lengthier. They have been identified as promising candidates for various applications.High-temperature preparation techniques are conventional techniques for the synthesis of carbon nanotubes using arc discharge or laser ablation, but today these methods are being replaced by low-temperature vapor deposition techniques, since orientation, alignment, nanotube length, diameter, purity, and density of carbon nanotubes can be precisely controlled. The synthesis of carbon nanotubes by chemical vapor deposition on catalyst arrays leads to nanotube models grown from specific sites on surfaces. The controlled synthesis of nanotubes opens up interesting possibilities in nanoscience and nanotechnologies, including electrical, mechanical and electromechanical properties and devices, chemical functionalization, surface chemistry and photochemistry, molecular sensors, and interfacing with moderate biological systems.Carbon nanotubes are used in many applications due to their unique electrical, mechanical, optical, thermal, and other properties. Conductive and high-strength composite materials, energy saving and energy conversion devices, sensors, visualization of field emissions and sources of radiation, means for storing hydrogen, and nanoscale semiconductor devices, probes, and interconnections are some of the many applications of carbon nanotubes.

Superconductors (SCs) are attractive materials in all respects for any community. They provide a deep insight into the physical properties of the condensed matters and also have useful applications as ultra-low-power-dissipation systems that can help resolve the present energy problems. In particular, the recent advancement of carbon-based new superconductors (CNSCs) is significant. Before 2004, the superconducting transition temperature (Tc) of carbon-based SCs was below 1 K, except in fullerene clusters. However, in 2004, a Russian group discovered that diamond highly doped with boron could be an SC at Tc = 4 K. The following year, a group from Cambridge found that calcium-intercalated graphite could be an SC with Tc = 11.5 K. In 2006 and 2008, the editor's group from Japan also discovered that carbon nanotubes could be SCs at Tc = 12 K. Since then, research on CNSCs has increased notably. A small mass of carbon can produce high phonon frequency and high Debye temperature. Combining these with other specified properties of CNSCs (such as one-dimensional electronic states) is highly expected to open doors to high-Tc superconductivity like those of CuO2- and Fe-based SCs, which were the only SCs to show Tc > 40 K in the past. CNSCs, such as diamond, graphite, carbon nanotubes, fullerenes, and others, are a very attractive field of research, and this book is the first to describe their basic physics and the recent advances toward high Tc in this field.

An important introduction to graphene, its physics and potentially significant applications, for graduate students, physicists and materials science researchers.

Named a Top Five Book of 2011 by Physics Today, USA.The BCS theory of superconductivity developed in 1957 by Bardeen, Cooper and Schrieffer has been remarkably successful in explaining the properties of superconductors. In addition, concepts from BCS have been

incorporated into diverse fields of physics, from nuclear physics and dense quark matter to the current standard model. Practical applications include SQUIDs, magnetic resonance imaging, superconducting electronics and the transmission of electricity. This invaluable book is a compilation of both a historical account and a discussion of the current state of theory and experiment.With contributions from many prominent scientists, it aims to introduce students and researchers to the origins, the impact and the current state of the BCS theory.

The discovery of fullerenes (also known as buckyballs) has generated tremendous excitement and opened up a new field of carbon chemistry. As the first book available on this topic, this volume will be a landmark reference in the field. Because buckyballs are essentially closed hollow cages made up of carbon atoms, they can be manipulated in a variety of ways to yield never-before-seen materials. The balls can, for instance, be doped with atoms or pulled out into tubules and filled with lead to provide properties of high-temperature superconductivity. Researchers can now create their own buckyballs in a process that is almost as simple as making soot, making this research as inexpensive as it is exotic (which has doubtless contributed to its popularity). Researchers anticipate that fullerenes will offer boundless opportunities in the development of new products, drugs and materials. Science of Fullerenes and Carbon Nanotubes introduces materials scientists, chemists, and solid state physicists to the field of fullerenes, and discusses the unique properties and applications. both current and future, of all classes of fullerenes. Key Features * First comprehensive resource on fullerenes and their applications * Provides an introduction to the topic * Presents an extensive discussion of current and future applications of Fullerenes * Covers all classes of fullerenes

This book covers the fundamentals and applications of Carbon Nanofiber (CNF). In the first

section, the initial chapter on the fundamentals of CNF is by Professor Maheshwar Sharon, the recognized “Father of Carbon Nanotechnology in India”, which powerfully provides a succinct overview of CNFs. This is followed by a chapter on biogenics that have produced unique morphologies of CNF that makes them suitable to various applications. This is followed by a chapter that mainly focuses on nanocomposites, especially those involving nanocomposites of CNF. The role of nanocatalysts and composites in promoting and enhancing the synthesis and application of CNF is then covered, followed by an important chapter on the characterization of CNF. The second section of the book encompasses the various applications of CNF, such as its use as a possible superconductor to adsorb and store hydrogen, and as a microwave absorber. The application of CNF for environmental concerns is also detailed by assessing its usefulness in dye and heavy metal removal from polluted water. The applications that are addressed include lithium-ion battery, solar cell, antenna, cosmetics, usefulness in regenerative medicine, as well as various aspects of agrotechnology.

This is the second volume in a series of books on selected topics in Nanoscale Science and Technology based on lectures given at the well-known INFN schools of the same name. The aim of this collection is to provide a reference corpus of suitable, introductory material to relevant subfields, as they mature over time, by gathering the significantly expanded and edited versions of tutorial lectures, given over the years by internationally known experts. The present set of notes stems in particular from the participation and dedication of prestigious

lecturers, such as Andrzej Huczko, Nicola Pugno, Alexander Malesevic, Pasquale Onorato and Stefano Bellucci. All lectures were subsequently carefully edited and reworked, taking into account the extensive follow-up discussions. A tutorial lecture by Huczko et al. shows how a variety of carbon and ceramic nanostructures (nanotubes, nanowires, nanofibres, nanorods, and nanoencapsulates) have in particular great potential for improving our understanding of the fundamental concepts of the roles of both dimensionality and size on physical material properties . Bellucci and Onorato provide an extensive and tutorial review of the (quantum) transport properties in carbon nanotubes, encompassing a description of the electronic structure from graphene to single-wall nanotubes, as well as a discussion of experimental evidence of superconductivity in carbon nanotubes and the corresponding theoretical interpretation. In the first contribution by Pugno, new ideas on how to design futuristic self-cleaning, super-adhesive and releasable hierarchical smart materials are presented. He also reviews the mechanical strength of such nanotubes and megacables, with an eye to the visionary project of a carbon nanotube-based ‘space elevator megacable’. In his second contribution, Pugno outlines in detail the role on the fracture strength of thermodynamically unavoidable atomistic defects with different size and shape, both numerically and

theoretically, for nanotubes and nanotube bundles. Focusing on graphitic allotropes, the chapter by Bellucci and Malesevic aims to give a taste of the widespread implications carbon nanostructures have on research and applications, starting from an historical overview, followed by a discussion of the structure and physical properties of carbon nanotubes and graphene, in particular in the context of the several different synthesis techniques presently available. This graduate-level textbook is the first pedagogical synthesis of the field of topological insulators and superconductors, one of the most exciting areas of research in condensed matter physics. Presenting the latest developments, while providing all the calculations necessary for a self-contained and complete description of the discipline, it is ideal for graduate students and researchers preparing to work in this area, and it will be an essential reference both within and outside the classroom. The book begins with simple concepts such as Berry phases, Dirac fermions, Hall conductance and its link to topology, and the Hofstadter problem of lattice electrons in a magnetic field. It moves on to explain topological phases of matter such as Chern insulators, two- and three-dimensional topological insulators, and Majorana p-wave wires. Additionally, the book covers zero modes on vortices in topological superconductors, time-reversal topological superconductors, and topological responses/field theory and

topological indices. The book also analyzes recent topics in condensed matter theory and concludes by surveying active subfields of research such as insulators with point-group symmetries and the stability of topological semimetals. Problems at the end of each chapter offer opportunities to test knowledge and engage with frontier research issues. Topological Insulators and Topological Superconductors will provide graduate students and researchers with the physical understanding and mathematical tools needed to embark on research in this rapidly evolving field.

The purpose of this book is two fold. First to explain the properties of low dimensional solids such as electronic, vibrational and magnetic structure in terms of simple models. These are used to account for the properties of three dimensional materials providing an elementary introduction to the physics of low dimensional materials. The second objective is to discuss the properties of newer low dimensional materials not made of carbon. These are now the subject of research and describe various phenomena in them such magnetism and superconductivity. Contents: Computational Material ScienceElectronic PropertiesVibrational PropertiesCarbon NanotubesOther Kinds of NanotubesGrapheneOther Low Dimensional MaterialsMagnetism in Low Dimensional MaterialsSuperconductivity in Low Dimensional Materials

Readership: Researchers and students in the field of low dimensional materials. Keywords: Graphene;2 Dimensional Materials;Carbon Nanotubes and Tubes of Other Materials;Magnetism in Low Dimensional Materials;Superconductivity in Low Dimensional MaterialsReview: Key Features: This book deals with not only conductivity but a range of other phenomena such as low dimensional magnetism and superconductivity and some very new low dimensional materials such silicene

This book presents selected papers from the fourth edition of the GraphX conference series, GraphITA 2015. Its content range from fundamentals to applications of graphene and other 2D material such as silicene, BN and MoS2. The newest technological challenges in the field are described in this book, written by worldwide known scientists working with 2D materials.The chapter 'Morphing Graphene-Based Systems for Applications: Perspectives from Simulations' is published open access under a CC BY 4.0 license.

Graphene is the first example of two-dimensional materials and is the most important growth area of contemporary research. It forms the basis for new nanoelectronic applications. Graphene, which comprises field-effect structures, has remarkable physical properties. This book focuses on practical applications determined by the unique properties of graphene. Basic concepts are elucidated

by end-of-chapter problems, the answers to which are provided in the accompanying solutions manual. The mechanisms of electric and thermal transport in the gated graphene, interface phenomena, quantum dots, non-equilibrium states, scattering and dissipation, as well as coherent transport in graphene junctions are considered in detail in the book. Detailed analyses and comparison between theory and experiments is complemented with a variety of practical examples. The book has evolved from the author’s own research experience and from his interaction with other scientists at tertiary institutions and is targeted at a wide audience ranging from graduate students and postdoctoral fellows to mature researchers and industrial engineers.

This book presents the deterministic view of quantum mechanics developed by Nobel Laureate Gerard 't Hooft. Dissatisfied with the uncomfortable gaps in the way conventional quantum mechanics meshes with the classical world, 't Hooft has revived the old hidden variable ideas, but now in a much more systematic way than usual. In this, quantum mechanics is viewed as a tool rather than a theory. The author gives examples of models that are classical in essence, but can be analysed by the use of quantum techniques, and argues that even the Standard Model, together with gravitational interactions, might be viewed as a quantum mechanical approach to analysing a system that could be classical at its

core. He shows how this approach, even though it is based on hidden variables, can be plausibly reconciled with Bell's theorem, and how the usual objections voiced against the idea of ‘superdeterminism' can be overcome, at least in principle. This framework elegantly explains - and automatically cures - the problems of the wave function collapse and the measurement problem. Even the existence of an “arrow of time" can perhaps be explained in a more elegant way than usual. As well as reviewing the author’s earlier work in the field, the book also contains many new observations and calculations. It provides stimulating reading for all physicists working on the foundations of quantum theory.

This book provides detailed knowledge about fullerene nanowhiskers and the related low-dimensional fullerene nanomaterials. It introduces tubular nanofibers made of fullerenes, fullerene nanotubes, and single crystalline thin film made of C60, called fullerene nanosheet. Since the discovery of C60 in 1985, various fullerene molecules, including higher fullerenes such as C70, endohedral fullerenes, and fullerene derivatives have been synthesized. In 2001, a new form of crystalline carbon nanofiber, fullerene nanowhisker, was discovered. This book is the first publication featuring the fullerene nanowhiskers made of C60, C70, and C60 derivatives. The synthetic method (liquid–liquid interfacial precipitation method) and the physical and chemical properties such as electrical, mechanical,

optical, magnetic, thermodynamic, and surface properties are shown for the fullerene nanowhiskers, including their electronic device application.

This comprehensive text covers the basic physics of the solid state starting at an elementary level suitable for undergraduates but then advancing, in stages, to a graduate and advanced graduate level. In addition to treating the fundamental elastic, electrical, thermal, magnetic, structural, electronic, transport, optical, mechanical and compositional properties, we also discuss topics like superfluidity and superconductivity along with special topics such as strongly correlated systems, high-temperature superconductors, the quantum Hall effects, and graphene. Particular emphasis is given to so-called first principles calculations utilizing modern density functional theory which for many systems now allow accurate calculations of the electronic, magnetic, and thermal properties.

This book summarizes the basic physics of graphite and newly discovered phenomena in this material. The book contains the knowledge needed to understand novel properties of functionalized graphite demonstrating the occurrence of remarkable phenomena in disordered graphite and graphite-based heterostructures. It also discusses applications of thin graphitic samples in future electronics. Graphite consists of a stack of nearly decoupled two-dimensional graphene planes. Because of the low dimensionality and the presence of Dirac fermions, much of graphite physics resembles that of graphene. On the other hand, the multi-layered nature of the graphite structure together with structural and/or chemical disorder are responsible for

phenomena that are not observed yet in graphene, such as ferromagnetic order and superconductivity. Each chapter was written by one or more experts in the field whose contributions were relevant in the (re)discovery of (un)known phenomena in graphite. The book is intended as reference for beginners and experts in the field, introducing them to many aspects of the new physics of graphite, with a fresh overview of recently found phenomena and the theoretical frames to understand them.

Many bottom-up and top-down techniques for nanomaterial and nanostructure generation have enabled the development of applications in nanoelectronics and nanophotonics. Handbook of Nanophysics: Nanoelectronics and Nanophotonics explores important recent applications of nanophysics in the areas of electronics and photonics. Each peer-reviewed chapter contains a broad-based introduction and enhances understanding of the state-of-the-art scientific content through fundamental equations and illustrations, some in color. This volume discusses how different nanomaterials, such as quantum dots and nanotubes, are used in quantum computing, capacitors, and transistors. Leading international experts review the potential of the novel patterning techniques in molecular electronics as well as nanolithography approaches for producing semiconductor circuits. They also describe optical properties of nanostructures, nanowires, nanorods, and clusters, including cathodoluminescence, photoluminescence, and polarization-sensitivity. In addition, the book covers nanophotonic devices and nanolasers. Nanophysics brings together multiple disciplines to determine the structural, electronic, optical, and thermal behavior of nanomaterials; electrical and thermal conductivity; the forces between nanoscale objects; and the transition between classical and quantum behavior. Facilitating communication across many disciplines, this landmark publication encourages scientists with

disparate interests to collaborate on interdisciplinary projects and incorporate the theory and methodology of other areas into their work.

This book overviews the current status of research and development activities of CNTs in nanodevices, nanomaterials, or nanofabrication. This book presents 15 state-of-the-art review articles that cover CNT synthesis technologies for growing highly orientated CNTs, chirality-pure CNTs and CNTs at a large throughput and low cost, CNT assembly techniques, CNT sorting and separation processes, CNT functionalization engineering for more functionalities, CNT fundamental properties and their practical/potential electrical, electronic, optical, mechanical, chemical and biological applications.

This thesis presents first observations of superconductivity in one- or two-atomic-scale thin layer materials. The thesis begins with a historical overview of superconductivity and the electronic structure of two-dimensional materials, and mentions that these key ingredients lead to the possibility of the two-dimensional superconductor with high phase-transition temperature and critical magnetic field. Thereafter, the thesis moves its focus onto the implemented experiments, in which mainly two different materials thallium-deposited silicon surfaces and metal-intercalated bilayer graphenes, are used. The study of the first material is the first experimental demonstration of both a gigantic Rashba effect and superconductivity in the materials supposed to be superconductors without spatial inversion symmetry. The study of the latter material is relevant to superconductivity in a bilayer graphene, which was a big experimental challenge for a decade, and has been first achieved by the author. The description of the generic and innovative measurement technique, highly effective in probing electric resistivity of ultra-thin materials unstable in an ambient environment, makes this thesis

a valuable source for researchers not only in surface physics but also in nano-materials science and other condensed-matter physics.

This book reflects the current status of theoretical and experimental research of graphene based nanostructures, in particular quantum dots, at a level accessible to young researchers, graduate students, experimentalists and theorists. It presents the current state of research of graphene quantum dots, a single or few monolayer thick islands of graphene. It introduces the reader to the electronic and optical properties of graphite, intercalated graphite and graphene, including Dirac fermions, Berry's phase associated with sublattices and valley degeneracy, covers single particle properties of graphene quantum dots, electron-electron interaction, magnetic properties and optical properties of gated graphene nanostructures. The electronic, optical and magnetic properties of the graphene quantum dots as a function of size, shape, type of edge and carrier density are considered. Special attention is paid to the understanding of edges and the emergence of edge states for zigzag edges. Atomistic tight binding and effective mass approaches to single particle calculations are performed. Furthermore, the theoretical and numerical treatment of electron-electron interactions at the mean-field, HF, DFT and configuration-interaction level is described in detail.

The latest knowledge on mineral ore genesis and the exploration of ore deposits Global demand for metals has risen considerably over the past decade. Geologists are developing new approaches for studying ore deposits and discovering new sources. Ore Deposits: Origin, Exploration, and Exploitation is a compilation of diverse case studies on new prospects in ore deposit geology including atypical examples of mineral deposits and new methods for ore exploration. Volume highlights include: Presentation of the latest research on a range of ore

deposit types Application of ore deposits to multiple areas of geology and geophysical exploration Emphasis on diverse methods and tools for the study of ore deposits Useful case studies for geologists in both academia and industry Ore Deposits: Origin, Exploration, and Exploitation is a valuable resource for economic geologists, mineralogists, petrologists, geochemists, mining engineers, research professionals, and advanced students in relevant areas of academic study.

Independent electrons and static crystals -- Vibrating crystals -- Interacting electrons -- Interactions in action -- Functional formulation of quantum field theory -- Quantum fields in action -- Symmetries: explicit or secret -- Classical topological excitations -- Quantum topological excitations -- Duality, bosonization and generalized statistics -- Statistical transmutation -- Pseudo quantum electrodynamics -- Quantum field theory methods in condensed matter -- Metals, Fermi liquids, Mott and Anderson insulators -- The dynamics of polarons -- Polyacetylene -- The Kondo effect -- Quantum magnets in 1D: Fermionization, bosonization, Coulomb gases and 'all that' -- Quantum magnets in 2D: nonlinear sigma model, CP1 and 'all that' -- The spin-fermion system: a quantum field theory approach -- The spin glass -- Quantum field theory approach to superfluidity -- Quantum field theory approach to superconductivity -- The cuprate high-temperature superconductors -- The pnictides: iron based superconductors -- The quantum Hall effect -- Graphene -- Silicene and transition metal dichalcogenides -- Topological insulators -- Non-abelian statistics and quantum computation Written in a self-contained manner, this textbook allows both advanced students and practicing applied physicists and engineers to learn the relevant aspects from the bottom up. All logical steps are laid out without omitting steps. The book covers electrical transport properties in

carbon based materials by dealing with statistical mechanics of carbon nanotubes and graphene - presenting many fresh and sometimes provoking views. Both second quantization and superconductivity are covered and discussed thoroughly. An extensive list of references is given in the end of each chapter, while derivations and proofs of specific equations are discussed in the appendix. The experienced authors have studied the electrical transport in carbon nanotubes and graphene for several years, and have contributed relevantly to the understanding and further development of the field. The content is based on the material taught by one of the authors, Prof Fujita, for courses in quantum theory of solids and quantum statistical mechanics at the University at Buffalo, and some topics have also been taught by Prof. Suzuki in a course on advanced condensed matter physics at the Tokyo University of Science. For graduate students in physics, chemistry, electrical engineering and material sciences, with a knowledge of dynamics, quantum mechanics, electromagnetism and solid-state physics at the senior undergraduate level. Includes a large numbers of exercise-type problems.

This book provides a comprehensive and up-to-date description of the Josephson effect, a topic of never-ending interest in both fundamental and applied physics. In this volume, world-renowned experts present the unique aspects of the physics of the Josephson effect, resulting from the use of new materials, of hybrid architectures and from the possibility of realizing nanoscale junctions. These new experimental capabilities lead to systems where novel coherent phenomena and transport processes emerge. All this is of great relevance and impact, especially when combined with the

didactic approach of the book. The reader will benefit from a general and modern view of coherent phenomena in weakly-coupled superconductors on a macroscopic scale. Topics that have been only recently discussed in specialized papers and in short reviews are described here for the first time and organized in a general framework. An important section of the book is also devoted to applications, with focus on long-term, future applications. In addition to a significant number of illustrations, the book includes numerous tables for comparative studies on technical aspects.

This textbook is for a course in advanced solid-state theory. It is aimed at graduate students in their third or fourth year of study who wish to learn the advanced techniques of solid-state theoretical physics. The method of Green's functions is introduced at the beginning and used throughout. Indeed, it could be considered a book on practical applications of Green's functions, although I prefer to call it a book on physics. The method of Green's functions has been used by many theorists to derive equations which, when solved, provide an accurate numerical description of many processes in solids and quantum fluids. In this book I attempt to summarize many of these theories in order to show how Green's functions are used to solve real problems. My goal, in writing each section, is to describe calculations which can be compared with experiments and to provide these comparisons whenever available. The student is expected to have a background in quantum mechanics at the level acquired from a graduate course using the textbook by either L. I. Schiff, A. S. Davydov, or I. Landau

and E. M. Lifshiftz. Similarly, a prior course in solid-state physics is expected, since the reader is assumed to know concepts such as Brillouin zones and energy band theory. Each chapter has problems which are an important part of the lesson; the problems often provide physical insights which are not in the text. Sometimes the answers to the problems are provided, but usually not.

The unique electronic band structure of graphene gives rise to remarkable properties when in contact with a superconducting electrode. In this thesis two main aspects of these junctions are analyzed: the induced superconducting proximity effect and the non-local transport properties in multi-terminal devices. For this purpose specific models are developed and studied using Green function techniques, which allow us to take into account the detailed microscopic structure of the graphene-superconductor interface. It is shown that these junctions are characterized by the appearance of bound states at subgap energies which are localized at the interface region. Furthermore it is shown that graphene-supercondutor-graphene junctions can be used to favor the splitting of Cooper pairs for the generation of non-locally entangled electron pairs. Finally, using similar techniques the thesis analyzes the transport properties of carbon nanotube devices coupled with superconducting electrodes and in graphene superlattices.

September 17-18, 2018 Berlin, Germany Key Topics : Graphene Modification and Functionalization, Graphene Synthesis, Applications of Carbon in Energy, Graphene and 2D Materials based Nanocomposites, Emerging Trends in the field of Graphene

Nano, Carbon nanotubes and graphene, Semiconductor Materials and Nanostructures, Graphene-like 2D materials, Graphene nano In Energy and Storage, Carbon nano chips and nanostructures,

Low-dimensional solids are of fundamental interest in materials science due to their anisotropic properties. Written not only for experts in the field, this book explains the important concepts behind their physics and surveys the most interesting one-dimensional systems and discusses their present and emerging applications in molecular scale electronics. The second edition of this successful book has been completely revised to include the remarkable achievements of the last ten years of research and applications. Chemists, polymer and materials scientists as well as students will find this book a very readable introduction to the solid-state physics of electronic materials.

Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses. High temperature superconductors, such as La2-xSrxCuOx (Tc=40K) and YBa2Cu3O7-x (Tc=90K), were discovered in 1987 and have been actively studied since. In spite of an intense, world-wide, research effort during this time, a complete understanding of the copper oxide (cuprate) materials is still lacking. Many fundamental questions are unanswered, particularly the mechanism by which high-Tc superconductivity occurs. More broadly, the cuprates are in a class of solids with strong electron-electron interactions. An understanding of such "strongly

correlated" solids is perhaps the major unsolved problem of condensed matter physics with over ten thousand researchers working on this topic. High-Tc superconductors also have significant potential for applications in technologies ranging from electric power generation and transmission to digital electronics. This ability to carry large amounts of current can be applied to electric power devices such as motors and generators, and to electricity transmission in power lines. For example, superconductors can carry as much as 100 times the amount of electricity of ordinary copper or aluminium wires of the same size. Many universities, research institutes and companies are working to develop high-Tc superconductivity applications and considerable progress has been made. This volume brings together new leading-edge research in the field.

Since the discovery of superconductivity, a great number of theoretical and experimental efforts have been made to describe this new phase of matter that emerged in many body systems. In this regard, theoretical models have been presented; the most famous of which was the BCS theory that can only describe conventional superconductors. With the discovery of new class superconductors, the superconducting mechanism became a new challenge in the field of condensed matter physics. This unexpected discovery opened a new area in the history of superconductivity, and experimental researchers started trying to find new compounds in this class of superconductors. These superconductors are often characterized by the anisotropic character in the superconducting gap function with nodes along a certain

direction in the momentum space. Since the pairing interaction has an important role in the superconducting gap structure, its determination is very important to explain the basic pairing mechanism.In this regard, this book includes valuable theoretical and experimental discussions about the properties of superconductors. Here you will find valuable research describing the properties of unconventional superconductors. Graphene, a single sheet of graphite, has an unconventional electronic structure that can be described in terms of massless Dirac Fermions. This book presents the frontiers of graphene research ranging from important issues in condensed matter physics and chemistry to advanced device applications.

While the macroscopic phenomenon of superconductivity is well known and in practical use worldwide, the current theoretical paradigm for superconductivity suffers from a number of limitations. For example, there is no currently accepted theoretical explanation for the pattern of superconductor critical temperatures in the periodic table. Historical developments in condensed matter were strongly focused on the similarities of all metals and the electron gas model, with little attention paid to their real differences. Accessible by a wide audience, Superconductivity Revisited explores the work of those who investigated the differences, and laid the foundation for all current and future work. Topics Include Pattern of Elemental Superconductors in the Periodic Table High-Temperature Superconductors Electron Spin in Superconductors Heat Capacity and Magnetic Susceptibility in Superconductors Quantum Foundations of Molecular Electricity and Magnetism Metals and Insulators Electron Transport in Metals Magnetoresistance Quantum Hall Effect Type I and Type II Superconductivity

Superconductivity Revisited starts from the foundations and shows that the current theory of the subject cannot explain the pattern of superconductors in the periodic table, as the theory depends on a theory of resistivity not congruent with the Sommerfeld equation. Partial wave scattering is introduced as a route to deal with these issues. The book develops a theory of superconductivity that includes the periodic table. The new, coherent, understandable theory of superconductivity is directly based on thermodynamics, scattering theory, and molecular quantum mechanics.

Superconductivity in Graphene and Carbon NanotubesProximity effect and nonlocal transportSpringer Science & Business Media

When many particles come together how do they organize themselves? And what destroys this organization? Combining experiments and theory, this book describes intriguing quantum phases - metals, superconductors and insulators - and transitions between them. It captures the excitement and the controversies on topics at the forefront of research.

This book is a collection of the chapters intended to study only practical applications of HTS materials. You will find here a great number of research on actual applications of HTS as well as possible future applications of HTS. Depending on the strength of the applied magnetic field, applications of HTS may be divided in two groups: large scale applications (large magnetic fields) and small scale applications (small magnetic fields). 12 chapters in the book are fascinating studies about large scale applications as well as small scale applications of HTS. Some chapters are presenting interesting research on the synthesis of special materials that may be useful in practical applications of HTS. There are also research about properties of high-Tc superconductors and experimental research about HTS materials with potential

applications. The future of practical applications of HTS materials is very exciting. I hope that this book will be useful in the research of new radical solutions for practical applications of HTS materials and that it will encourage further experimental research of HTS materials with potential technological applications.

This book provides a state of the art report of the knowledge accumulated in graphene research. The fascination with graphene has been growing very rapidly in recent years and the physics of graphene is now becoming one of the most interesting as well as the most fast-moving topics in condensed-matter physics. The Nobel prize in physics awarded in 2010 has given a tremendous impetus to this topic. The horizon of the physics of graphene is ever becoming wider, where physical concepts go hand in hand with advances in experimental techniques. Thus this book is expanding the interests to not only transport but optical and other properties for systems that include multilayer as well as monolayer graphene systems. The book comprises experimental and theoretical knowledge. The book is also accessible to graduate students.

This book includes the fundamental science and applications of carbon-based materials, in particular fused polycyclic hydrocarbon, fullerene, diamond, carbides, graphite and graphene etc. During the past decade, these carbon-based materials have attracted much interest from many scientists and engineers because of their exciting physical properties and potential application toward electronic and energy devices. In this book, the fundamental theory referring to these materials, their syntheses and characterizations, the physical properties (physics), and the applications are fully described, which will contribute to an advancement of not only basic science in this research field but also technology using these materials. The book's targets are

researchers and engineers in the field and graduate school students who specialize in physics, chemistry, and materials science. Thus, this book addresses the physics and chemistry of the principal materials in the twenty-first century.

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