Physics And Engineering Applications Of Magnetism

#magnetism #engineering applications #physics principles magnetism #electromagnetic technology #magnetic materials

Explore the profound impact of magnetism across physics and engineering applications. This field delves into fundamental principles, from electromagnetism to material science, enabling the development of critical technologies like medical imaging, data storage, power generation, and advanced sensors. Understanding these concepts is essential for innovation in magnetic technology and shaping our modern world.

Physics and Engineering Applications of Magnetism

This book was originally published in Japanese in honour of Professor S. Chikazumi on the occasion of his retirement from the University of Tokyo in March 1982. Physicists who had been supervised by him or had closely col laborated with him wrote articles on recent developments in magnetism and its engineering applications. In the preface of his excellent textbook Physics of Magnetism (Wiley, 1964), Professor Chikazumi says that recent research in magnetism deals with fundamental physical problems and, at the same time, with more secondary magnetic phenomena, as well as with engineering applications of magnetic materials to electromagnetic machines, permanent magnets and electronic computers, and that the purpose of his textbook is to give a general view of these magnetic phenomena, focusing its main interest at the center of such a broad field. Always keeping such a viewpoint in mind, Professor Chikazumi has contributed a great deal to both fundamental physics and applications of magnetism. This is described in Chap. 1 of this book. Many books have been published on both the physics and applications of magnetism. However, no single book has a viewpoint covering both of them. The recent development of high technology needs such a broad viewpoint for scientists and engineers since it is a product of both fundamental science and technology. Research in magnetism is based on the response which materials show to the application of magnetic fields.

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Magnetic Materials and Their Applications

Magnetic Materials and their Applications discusses the principles and concepts behind magnetic materials and explains their applications in the fields of physics and engineering. The book covers topics such as the principal concepts and definitions related to magnetism; types of magnetic materials and their electrical and mechanical properties; and the different factors influencing magnetic behavior. The book also covers topics such as permanent-magnet materials; magnetic materials in heavy-current engineering; and the different uses of magnetic materials. The text is recommended for physicists and electrical engineers who would like to know more about magnetic materials and their applications in the field of electronics.

Magnetism

This textbook is aimed at engineering students who are likely to come across magnetics applications in their professional practice. Whether designing lithography equipment containing ferromagnetic brushes, or detecting defects in aeronautics, some basic knowledge of 21st century magnetism is needed. From the magnetic tape on the pocket credit card to the read head in a personal computer, people run into magnetism in many products. Furthermore, in a variety of disciplines tools of the trade exploit magnetic principles, and many interdisciplinary laboratory research areas cross paths with magnetic phenomena that may seem mysterious to the untrained mind. Therefore, this course offers a broad coverage of magnetism topics encountered more often in this millenium, revealing key concepts on which many practical applications rest. Some traditional subjects in magnetism are discussed in the first half of the book, followed by areas likely to spark the curiosity of those more interested in today’s technological achievements. Although sometimes some aspects may seem difficult to comprehend at first, bibliography directs the reader to appropriate further study. Throughout the chapters, the student is encouraged to discover the not-so-obvious associations between different magnetics topics, a task that will prove to be at the very least rewarding.

Solid · State Magnetism

Solid state magnetism is important and attempts to understand magnetic properties have led to an increasingly deep insight into the fundamental make up of solids. Both experimental and theoretical research into magnetism continue to be very active, yet there is still much ground to cover before there can be a full understanding. There is a strong interplay between the developments of materials science and of magnetism. Hundreds of new materials have been dis covered, often with previously unobserved and puzzling magnetic prop erties. A large and growing technology exists that is based on the magnetic properties of materials. Very many devices used in everyday life involve magnetism and new applications are being invented all the time. Under standing the fundamental background to the applications is vital to using and developing them. The aim of this book is to provide a simple, up-to-date introduction to the study of solid state magnetism, both intrinsic and technical. It is designed to meet the needs and interests of advanced undergraduate students reading physics; of postgraduates in physical and materials sciences and in engineering; and also those of the practising scientist specializing in another area who requires an introduction to magnetism.

Magnetism, Magnetic Materials and their Applications

Volume is indexed by Thomson Reuters CPCI-S (WoS). This publication contains the proceedings of the sixth Latin-American Workshop on "Magnetism, Magnetic Materials and their Applications". The 85 peer-reviewed academic and technical papers cover a wide spectrum of the many interesting aspects of this subject. The contents are grouped under the headings: fundamental properties, thin films and magneto-optics, manganites and oxides, magneto-resistance and magneto-impedance, hard magnets, low temperature magnetism, ferrites and steels, and fluids and particles.

Magneto-science

This book provides an overview of the physical phenomena discovered in magnetic molecular materials over the last 20 years. It is written by leading scientists having made the most important contributions to this active area of research. The main topics of this book are the principles of quantum tunneling and quantum coherence of single-molecule magnets (SMMs), phenomena which go beyond the physics of individual molecules, such as the collective behavior of arrays of SMMs, the physics of one-dimensional single–chain magnets and magnetism of SMMs grafted on substrates. The potential applications of these physical phenomena to classical and quantum information, communication technologies, and the emerging fields of molecular spintronics and magnetic refrigeration are stressed. The book is written for graduate students, researchers and non-experts in this field of research.

Molecular Magnets

Few subjects in science are more difficult to understand than magnetism, according to Encyclopedia Britannica. However, there is a strong demand today for scientists and engineers with skills in magnetism because of the growing number of technological applications utilizing this phenomenon. This textbook responds to the need for a comprehensive introduction of the basic concepts of the science. Introduction to Magnetism and Magnetic Materials has been thoroughly revised since the first edition to include recent developments in the field. The early chapters comprise a discussion of the fundamentals of magnetism. These chapters include more than 60 sample problems with complete solutions to reinforce learning. The later chapters review the most significant recent developments in four important areas of magnetism: hard and soft magnetic materials, magnetic recording, and magnetic evaluation of materials. These later chapters also provide a survey of the most important areas of magnetic materials for practical applications. Extensive references to the principal publications in magnetism are listed at the end of each chapter, which offer the reader rapid access to more specialized literature. Students in various scientific areas will benefit from this book, including those in physics, materials science, metallurgy, and electrical engineering.

Introduction to Magnetism and Magnetic Materials, Second Edition

It is a dream of chemists and physicists to use magnetism, an important physical property of many materials, to control chemical and physical processes. With new manufacturing technologies for superconducting magnets, it has become possible to produce strong magnetic fields of 10 Tesla or more for applications in chemistry and physics. New magnetic phenomena, useful for processing functional molecules with improved quality, have been discovered recently. They open up exciting possibilities for studying and applying magnetic field effects in the chemical and physical processes of diamagnetic, paramagnetic and ferromagnetic materials. This volume will serve as a useful reference for specialists and non-specialists interested in this exciting new area of megneto-science.

Magneto-Science

Students and researchers looking for a comprehensive textbook on magnetism, magnetic materials and related applications will find in this book an excellent explanation of the field. Chapters progress logically from the physics of magnetism, to magnetic phenomena in materials, to size and dimensionality effects, to applications. Beginning with a description of magnetic phenomena and measurements on a macroscopic scale, the book then presents discussions of intrinsic and phenomenological concepts of magnetism such as electronic magnetic moments and classical, quantum, and band theories of magnetic behavior. It then covers ordered magnetic materials (emphasizing their structure-sensitive properties) and magnetic phenomena, including magnetic anisotropy, magnetostriction, and magnetic domain structures and dynamics. What follows is a comprehensive description of imaging methods to resolve magnetic microstructures (domains) along with an introduction to micromagnetic modeling.

The book then explores in detail size (small particles) and dimensionality (surface and interfaces) effects -- the underpinnings of nanoscience and nanotechnology that are brought into sharp focus by magnetism. The hallmark of modern science is its interdisciplinarity, and the second half of the book offers interdisciplinary discussions of information technology, magnetoelectronics and the future of biomedicine via recent developments in magnetism. Modern materials with tailored properties require careful synthetic and characterization strategies. The book also includes relevant details of the chemical synthesis of small particles and the physical deposition of ultra thin films. In addition, the book presents details of state-of-the-art characterization methods and summaries of representative families of materials, including tables of properties. CGS equivalents (to SI) are included.

Fundamentals and Applications of Magnetic Materials

If you are studying physics, chemistry, materials science, electrical engineering, information technology or medicine, then you'll know that understanding magnetism is fundamental to success in your studies and here is the key to unlocking the mysteries of magnetism..... You can: obtain a simple overview of magnetism, including the roles of B and H, resonances and special techniques take full advantage of modern magnets with a wealth of expressions for fields and forces develop realistic general design programmes using isoparametric finite elements study the subtleties of the general theory of magnetic moments and their dynamics follow the development of outstanding materials appreciate how magnetism encompasses topics as diverse as rock magnetism, chemical reaction rates, biological compasses, medical therapies, superconductivity and levitation understand the basis and remarkable achievements of magnetic resonance imaging In his new book, Magnetism, Derek Craik throws light on the principles and applications of this fascinating subject. From formulae for calculating fields to quantum theory, the secrets of magnetism are exposed, ensuring that whether you are a chemist or engineer, physicist, medic or materials scientist Magnetism is the book for our course.

Magnetism

Magnetic materials are all around us, and understanding their properties underlies much of today's engineering efforts. The range of applications in which they are centrally involved includes audio, video and computer technology, tele-communications, automotive sensors, electric motors at all scales, medical imaging, energy supply and transportation, as well as the design of stealthy airplanes. This book deals with the basic phenomena that govern the magnetic properties of matter, with magnetic materials and with the applications of magnetism in science, technology and medicine. Although an in-depth understanding of magnetism requires a quantum mechanical approach, a phenomenological description of the mechanisms involved has been deliberately chosen in most chapters in order for the book to be useful to a wide readership. The emphasis is placed, in the part devoted to the atomic aspects of magnetism, on explaining, rather than attempting to calculate, the mechanisms underlying the exchange interaction and magnetocrystalline anisotropy, which lead to magnetic order, hence to useful materials. This theoretical part is placed, in Volume I, between a phenomenological part, introducing magnetic effects at the atomic, mesoscopic and macroscopic levels, and a presentation of magneto-caloric, magneto-elastic, magneto-optical and magneto-transport coupling effects.

Magnetism

Magnetic Nanoparticles Learn how to make and use magnetic nanoparticles in energy research, electrical engineering, and medicine In Magnetic Nanoparticles: Synthesis, Characterization, and Applications, a team of distinguished engineers and chemists delivers an insightful overview of magnetic materials with a focus on nano-sized particles. The book reviews the foundational concepts of magnetism before moving on to the synthesis of various magnetic nanoparticles and the functionalization of nanoparticles that enables their use in specific applications. The authors also highlight characterization techniques and the characteristics of nanostructured magnetic materials, like superconducting quantum interference device (SQUID) magnetometry. Advanced applications of magnetic nanoparticles in energy research, engineering, and medicine are also discussed, and explicit derivations and explanations in non-technical language help readers from diverse backgrounds understand the concepts contained within. Readers will also find: A thorough introduction to magnetic materials, including the theory and fundamentals of magnetization In-depth explorations of the types and characteristics of soft and hard magnetic materials Comprehensive discussions of the synthesis of nanostructured magnetic materials, including the importance of various preparation methods Expansive treatments of the surface modification of magnetic nanoparticles, including the technical resources

employed in the process Perfect for materials scientists, applied physicists, and measurement and control engineers, Magnetic Nanoparticles: Synthesis, Characterization, and Applications will also earn a place in the libraries of inorganic chemists.

Magnetic Nanoparticles

With the coexistence of magnetic and liquid properties, magnetic fluids provide opportunities to create numerous innovative products and to solve complex technical problems. This book, for the first time, presents the whole circle of magnetic fluid application problems, including preparation of magnetic fluids, their physical properties, and the numerous technical devices based on magnetic fluids. Because they are the basis for all technical devices, the fluid mechanical and magnetic phenomena are examined in detail. The design and operational principles of numerous magnetic fluid devices, such as seals, bearings, shock-absorbers, dampers, and printers, are presented in a practical format. New technological processes (ore separation, drag reduction, heat and mass transfer enhancement) are explained in detail with a view to assisting the user with an in-depth understanding of the technology. Material in the book is presented in an accessible, user-friendly manner so that mechanical and electrical engineers as well as students and specialists in magnetic fluids will find this a useful and informative book.

Magnetic Fluids

This first book to focus on the applications of nanomagnetism presents those already realized while also suggesting bold ideas for further breakthroughs. The first part is devoted to the concept of spin electronics and its use for data storage and magnetic sensing, while the second part concentrates on magnetic nanoparticles and their use in industrial environment, biological and medical applications. The third, more prospective part goes on to describe emerging applications related to spin current creation and manipulation, dynamics, spin waves and binary logic based on nano-scale magnetism. With its unique choice of topics and authors, this will appeal to academic as well as corporate researchers in a wide range of disciplines from physics via materials science to engineering, chemistry and life science.

Nanomagnetism

This book begins by introducing magnetism and discusses magnetic properties of materials, magnetic moments of atoms and ions, and the elements important to magnetism. It covers magnetic susceptibilities and electromagnetic waves in anisotropic dispersive media among other topics. There are problems at the end of each chapter, many of which serve to expand or explain the material in the text. The bibliographies for each chapter give an entry to the research literature.

Spin Waves

Magnetic materials are the foundation of multi-billion dollar industries and the focus of intensive research across many disciplines. This book covers the fundamentals, basic theories and applications of magnetism and conventional magnetic materials. Based on a lecture course given by Nicola Spaldin in the Materials Department at University of California, Santa Barbara, the book is ideal for a one-semester course in magnetic materials. It contains numerous homework problems and solutions.

Magnetic Materials

In this book, the authors gather and present current research in the study of the principles, engineering applications and biophysical effects of electromagnetic fields. Topics discussed include the thermodynamics of surface electromagnetic waves; exposure to magnetic fields produced by power lines; microwave heating for metallurgical engineering; the effect of electromagnetic fields exposure on cytokines production; high frequency induction heating for high quality injection moulding; electromagnetic techniques for non-invasive detection of malignancies in biological tissue; the entropy production rate in a cell under electromagnetic field; studies of cerebral activity in humans and in animal models after exposure to modulated radio frequency of mobile phones; electromagnetic induction data sets in archaeology; and single and two-photon interactions of radiators with electromagnetic bath.

Electromagnetic Fields

A unique resource for physicists and engineers working with magnetic fields An understanding of magnetic phenomena is essential for anyone working on the practical application of electromagnetic

theory. Magnetic Fields: A Comprehensive Theoretical Treatise for Practical Use provides physicists and engineers with a thorough treatment of the magnetic aspects of classical electromagnetic theory, focusing on key issues and problems arising in the generation and application of magnetic fields. From magnetic potentials and diffusion phenomena to magnetohydrodynamics and properties of matter-topics are carefully selected for their relevance to the theoretical framework as well as current technologies. Outstanding in its organization, clarity, and scope, Magnetic Fields: * Examines a wide range of practical problems, from magnetomechanical devices to magnetic acceleration mechanisms * Opens each chapter with reference to pertinent engineering examples * Provides sufficient detail enabling readers to follow the derivation of the results * Discusses solution methods and their application to different problems * Includes more than 300 graphs, 40 tables, 2,000 numbered formulas, and extensive references to the professional literature * Reviews the essential mathematics in the appendices

Magnetic Fields

A short introduction to magnetism and magnetic resonance New applications in the magnetism of matter and magnetic resonance phenomena are major factors in the current technological revolution. The world market for magnetic media and recording equipment is roughly $100 billion a year, and the application of magnetic resonance to medicine continues to revolutionize the diagnostic process and alter our understanding of the human body. This volume offers a concise treatment of these fascinating and interrelated topics. It explains the fundamentals and describes the latest research activity in various disciplines, including physics, materials science, and engineering. Magnetism and Magnetic Resonance in Solids features clear and concise overviews of: * The properties of magnetic materials * Hyperfine interactions in condensed matter * The microscopic study of magnetism of matter * Applications of nuclear magnetic resonance and magnetic resonance in materials. Supplemented with numerous exercises, solutions, and tables as well as many suggestions for further reading, Magnetism and Magnetic Resonance in Solids is an excellent text for senior-undergraduate and graduate courses in physics, materials science, and engineering. Practicing scientists in other fields will find this a useful introduction to the field of magnetism. It is also an important reference for researchers in medical imaging technology.

Magnetism and Magnetic Resonance in Solids

A long overdue update, this edition of Introduction to Magnetism and Magnetic Materials is a complete revision of its predecessor. While it provides relatively minor updates to the first two sections, the third section contains vast updates to reflect the enormous progress made in applications in the past 15 years, particularly in magnetic recordin

Introduction to Magnetism and Magnetic Materials

Magnetostatic Waves and their Applications is the first book devoted to magnetostatic waves. The book gives a thorough review of the field suitable for scientists, engineers and advanced students involved in magnetism and microwave electronics new to this area. It covers the field from essential physics to applications in microwave electronics, with details of the materials and materials processing methods included.

Magnetostatic Waves and Their Application

This book presents practical and relevant technological information about electromagnetic properties of materials and their applications. It is aimed at senior undergraduate and graduate students in materials science and is the product of many years of teaching basic and applied electromagnetism. Topics range from the spectroscopy and characterization of dielectrics, to non-linear effects, to ion-beam applications in materials.

Applied Electromagnetism and Materials

This book contains all information regarding magnetism and magnetic materials that an electrical engineer needs to know to be able to understand and design magnetic devices.The handbook comprises chapters comprising basic electromagnetism, basic quantum mechanics, ferromagnetism, magnetic materials, magnetic material characterization, modeling of magnetic materials, and magnetic design. A comprehensive description of the physical origin of magnetism of materials is given chapter two and a thorough review of the physics behind ferromagnetism is given in chapter three.All chapters

are written in a textbook fashion such that they can easily be assimilated separately. The book gathers in an understandable the multidisciplinary topic of magnetism and magnetic materials in way that it can serve as a comprehensive introduction to engineers that considers use of magnetic materials in their designs.The book covers all major modeling techniques of magnetic materials including the well-known Presiach, Jiles-Atherton and lag models. General magnetic design approaches including major and new design tools also are presented.The book also serves as a guideline regarding the choice of feasible materials in specific applications regarding both soft and hard magnetic materials with an inventory of alternatives to electrical steel. Relevant performance criteria then are given such that appropriate materials can be selected. The final chapter offers a list of current electrical steel and magnetic material suppliers.

Handbook Of Electrical Steel

This book [earlier titled as Electromagnetism: Theory and Applications which is bifurcated into two volumes: Electromagnetism: Theory and Electromagnetism: Applications (Magnetic Diffusion and Electromagnetic Waves) has been updated to cover some additional aspects of theory and nearly all modern applications. The semi-historical approach is unchanged, but further historical comments have been introduced at various places in the book to give a better insight into the development of the subject as well as to make the study more interesting and palatable to the students. Key Features • Physical explanations of different types of currents • Concepts of complex permittivity and complex permeability; and anisotropic behaviour of constitute parameters in different media and different conditions • Vector co-ordinate system transformation equations • Halbach magnets and the theory of one-sided flux • Discussion on physical aspects of demagnetization curve of B-H loop for ferromagnetic materials • Extrapolation of Frohlich-Kennely equation used for the design and analysis of permanent magnet applications • Physical aspects of Faraday’s law of electromagnetic induction (i.e., Fourth Maxwell’s field equation) through the approach of special relativity • Extrapolation and elaboration of the concept of electromechanical energy conversion to both magnetic as well as electric field systems Appendices contain in-depth analysis of self-inductance and non-conservative fields (Appendix 6), proof regarding the boundary conditions (Appendix 8), theory of bicylindrical co-ordinate system to provide the physical basis of the circuit approach to the cylindrical transmission line systems (Appendix 10), and properties of useful functions like Bessel and Legendre functions (Appendix 9). The book is designed to serve as a core text for students of electrical engineering. Besides, it will be useful to postgraduate physics students as well as research engineers and design and development engineers in industries.

ELECTROMAGNETISM Volume I (Theory)

The book provides both the theoretical and the applied background needed to predict magnetic fields. The theoretical presentation is reinforced with over 60 solved examples of practical engineering applications such as the design of magnetic components like solenoids, which are electromagnetic coils that are moved by electric currents and activate other devices such as circuit breakers. Other design applications would be for permanent magnet structures such as bearings and couplings, which are hardware mechanisms used to fashion a temporary connection between two wires. This book is written for use as a text or reference by researchers, engineers, professors, and students engaged in the research, development, study, and manufacture of permanent magnets and electromechanical devices. It can serve as a primary or supplemental text for upper level courses in electrical engineering on electromagnetic theory, electronic and magnetic materials, and electromagnetic engineering.

Permanent Magnet and Electromechanical Devices

This book is intended as a textbook for students and researchers interested in the physical aspects of ferromagnetism. The level of presentation assumes only a basic knowledge of electromagnetic theory and atomic physics and a general familiarity with rather elementary mathematics. Throughout the book the emphasis is primarily on explanations of physical concepts rather than on rigorous theoretical treatments which require a background in quantum mechanics and high level mathematics. The purpose of this book is to give a general view of magnetic phenomena, focusing it's main interest at the centre of the broad field of ferromagnetism, ranging from theory to the engineering applications such as soft and hard magnetic materials and magnetic memories. Substantially different from the author's previous book Physics of Magnetism published in 1964, the present edition is neatly organized and includes more recent developments.

Physics of Ferromagnetism

This textbook can be used to teach electromagnetism to a wide range of undergraduate science majors in physics, electrical engineering or materials science. By making lesser demands on mathematical knowledge than typical texts, and by emphasizing electromagnetic properties of materials and their applications, this text is particularly appropriate for students of materials science. Many competing books focus on the study of propagation waves either in the microwave or optical domain, whereas Basic Electromagnetism and Materials covers the entire electromagnetic domain and the physical response of materials to these waves.

Basic Electromagnetism and Materials

A succinct summary of the field as it stands after extraordinary developments over the past few decades, particularly the advent of rare-earth permanent magnets, which combine a high magnetization with a magnetic hardness that allows magnets to be formed into the extreme shapes and small dimensions required in the modern devices that are increasingly being used both domestically and industrially. No index. Annotation copyrighted by Book News, Inc., Portland, OR.

Permanent-magnet Materials and Their Applications

The book is intended for graduate students and researchers who wish to master the main properties of magnetic materials in the bulk state and at the nanometric scale such as for thin films and multilayers. This textbook provides the theories and methods of simulation to study and to understand these properties in an explicit manner.In the first part of the book, the quantum theory of magnetism is presented while the second part of the book is devoted to the application of the theory of magnetism to surface physics. Numerous examples covering typical cases in ferromagnets, antiferromagnets, ferrimagnets, helimagnets, and frustrated spin systems are all illustrated. Fundamental surface effects are shown and discussed. Lastly, the spin transport is described — in which the basic formulation of the Boltzmann's equation is recalled — and the recent methods of Monte Carlo simulation to deal with the spin resistivity are explained.This book contains a large number of detailed solutions for the problems given in each chapter to help readers discover new related phenomena and applications, as well as an appendix on elements of statistical physics included at the end to make the book self-contained.

Theory Of Magnetism: Application To Surface Physics

Modern Permanent Magnets provides an update on the status and recent technical developments that have occurred in the various families of permanent magnets produced today. The book gives an overview of the key advances of permanent magnet materials that have occurred in the last twenty years. Sections cover the history of permanent magnets, their fundamental properties, an overview of the important families of permanent magnets, coatings used to protect permanent magnets and the various tests used to confirm specifications are discussed. Finally, the major applications for each family of permanent magnets and the size of the market is provided. The book also includes an Appendix that provides a Glossary of Magnetic Terms to assist the readers in better understanding the technical terms used in other chapters. This book is an ideal resource for materials scientists and engineers working in academia and industry R&D. Provides an in-depth overview of all of the important families of permanent magnets produced today Includes background information on the fundamental properties of permanent magnets, major applications of each family of permanent magnets, and advances in coatings and coating technology Reviews the fundamentals of permanent magnet design

Modern Permanent Magnets

This book deals with the basic phenomena that govern the magnetic properties of matter, with magnetic materials and with the applications of magnetism in science, technology and medicine. It is the collective work of twenty-one scientists, most of them from Laboratoire Louis Neel du CNRS in Grenoble, France. The original version, in French, was edited by Etienne du TrÃ©molet de Lacheisserie, and published in 1999. The present version involves, beyond the translation, many corrections and complements.

Magnetism

The manufacture of silicon single crystals is one of the most important processes in the information technology industry. This book explains the details of liquid metal convection, providing a guide for the elegant operation and control of Czochralski crystal growth, including the effect of magnetic control.

Also covered is the newly emerging research field of the application of strong magnetic field using a superconducting magnet. Model equations for the phenomena in the magnetic field are treated in detail, which will be of much use to researchers and engineers in the field. The coverage includes the effect of the Lorentz force in materials processing and the magnetic force of recently developed superconducting magnets. It examines heat, mass and momentum transfer in electro-conducting and non-conducting fluids under normal and very strong magnetic fields. The book also treats the Czochralski single crystal growth process and continuous steel casting process as the most important current applications of magnetic fields. Numerical approaches are compared with the corresponding experimental measurements.

Magnetic Convection

The 2nd edition emphasizes two areas not emphasized in the 1st edition: 1) high-temperature superconductor (HTS) magnets; 2) NMR (nuclear magnetic resonance) and MRI (magnetic resonance imaging) magnets. Despite nearly 40 years of R and D on superconducting magnet technology, most areas, notably fusion and electric power applications, are still in the R and D stage. One exception is in the area of NMR and MRI. NMR magnets are very popular among chemists, biologists, genome scientists, and most of all, by drug manufacturers for drug discovery and development. MRI and NMR magnets have become the most successful application of superconducting magnet technology and this trend should continue. The 2nd edition will have new materials never treated formally in any other book of this kind. As with the 1st, most subjects will be presented through problem format to educate and train the designer.

Case Studies in Superconducting Magnets

This book is a comprehensive design text for permanent magnets and their application. Permanent magnets are very important industrially, and are widely used in a variety of applications, including industrial drives, consumer products, computers and cars. In the early 1970s a new class of magnet - the rare earths - was discovered, the properties of which showed sustained improvement over the following two decades. New materials such as these have spawned many new markets for magnets, with significant performance gains in the devices for which they are used. Until now, however, there has been no text that unified all the relevant information on the wide range of modern permanent magnet materials. This book is a comprehensive review of the technology, intended for scientists and engineers involved in all stages of the manufacture, design and use of magnets.

Permanent Magnet Materials and their Application

Advances in Magnetic Materials: Processing, Properties, and Performance discusses recent developments of magnetic materials, including fabrication, characterization and applications in the aerospace, biomedical, and semiconductors industries. With contributions by international professionals who possess broad and varied expertise, this volume encompasses both bulk materials and thin films and coatings for magnetic applications. A timely reference book that describes such things as ferromagnetism, nanomaterials, and Fe, ZnO, and Co-based materials, Advances in Magnetic Materials is an ideal text for students, researchers, and professionals working in materials science. Describes recent developments of magnetic materials, including fabrication, characterization, and applications Addresses a variety of industrial applications, such as aerospace, biomedical, and semiconductors Discusses bulk materials and thin films and coatings Covers ferromagnetism, nanomaterials, Fe, ZnO, and Co-based materials Contains the contributions of international professionals with broad and varied expertise Covers a holistic range of magnetic materials in various aspects of process, properties, and performance

Advances in Magnetic Materials

This book is written to introduce experimental magnetism in a comprehensive manner to advanced undergraduate, postgraduate, and doctoral students pursuing studies in physics, material sciences, and engineering. It is an excellent resource providing an overview of the various experimental techniques in magnetism and magnetic materials. The text is partitioned into three parts. Part I deals with a brief history of magnetism and magnetic materials along with their role in modern society. A concise account of their current technological applications is also provided. Part II focusses on the basic phenomena of magnetism. Part III consists of chapters discussing a variety of experimental practices needed to

study the microscopic as well as macroscopic aspects of different kinds of magnetic phenomena and materials.

Experimental Techniques in Magnetism and Magnetic Materials

Since the discovery of the giant magnetoresistance (GMR) effect in 1988, spintronics has been presented as a new technology paradigm, awarded by the Nobel Prize in Physics in 2007. Initially used in read heads of hard disk drives, and while disputing a piece of the market to the flash memories, GMR devices have broadened their range of usage by growing towards magnetic field sensing applications in a huge range of scenarios. Potential applications at the time of the discovery have become real in the last two decades. Definitively, GMR was born to stand. In this sense, selected successful approaches of GMR based sensors in different applications: space, automotive, microelectronics, biotechnology ... are collected in the present book. While keeping a practical orientation, the fundamentals as well as the current trends and challenges of this technology are also analyzed. In this sense, state of the art contributions from academy and industry can be found through the contents. This book can be used by starting researchers, postgraduate students and multidisciplinary scientists in order to have a reference text in this topical fascinating field.

Giant Magnetoresistance (GMR) Sensors

Since the discovery of the giant magnetoresistance (GMR) effect in magnetic multilayers in 1988, a new branch of physics and technology, called spin-electronics or spintronics, has emerged, where the flow of electrical charge as well as the flow of electron spin, the so-called "spin current\

Spin Current