



Supermagnets, Hard Magnetic Materials

Edited by

Gary J. Long and Fernande Grandjean

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Supermagnets Hard Magnetic Materials

K.H.J Buschow, F.R. de Boer



Supermagnets Hard Magnetic Materials:

Supermagnets, Hard Magnetic Materials G.J Long,F. Grandjean,2012-12-06 The book you are now holding represents the final step in a long process for the editors and organizers of the Advanced Study Institute on hard magnetic materials The editors interest in hard magnetic materials began in 1985 with an attempt to better understand the moments associated with the different iron sites in Nd Fe B These 14 moments can be obtained from neutron diffraction studies but we quickly realized that iron 57 Mossbauer spectroscopy should lead to a better determination of these moments However it was also realized that the complex Mossbauer spectra obtained for these hard magnetic materials could not be easily understood without a broad knowledge of their various structural electronic and magnetic properties Hence it seemed useful to the editors to bring together scientists and engineers to discuss in a tutorial setting the various properties of these and future hard magnetic materials We believe the inclusion of engineers as well as scientists in these discussions was essential because the design of new magnetic materials depends very much upon the mode in which they are used in practical devices

Rare-earth Iron Permanent Magnets J. M. D. Coey,1996 Rare earth iron permanent magnets combine the magnetization of iron or cobalt with the anisotropy of a light rare earth in intermetallic compounds which exhibit nearly ideal hysteresis The rare earth iron magnets are now indispensable components of a vast range of electronic and electromechanical devices This book covers the principles of permanent magnetism magnet processing and applications in a series of interlocking chapters written by experts in each area Born of experience of the Concerted European Action on Magnets it is a definitive account of the field designed to be read by physicists materials scientists and electrical engineers

Applications of Analytical Techniques to the Characterization of Materials D.L. Perry,2013-06-29 Over the last several years the field of materials science has witnessed an explosion of new advanced materials They encompass many uses and include superconductors alloys glasses and catalysts Not only are there quite a number of new entries into these generic classes of materials but the materials themselves represent a wide array of physical forms as well Bulk materials for example are being synthesized and applications found for them while still other materials are being synthesized as thin films for yet still more new and in some cases as yet unknown applications The field continues to expand with thankfully no end in sight as to the number of new possibilities As work progresses in this area there is an ever increasing demand for knowing not only what material is formed as an end product but also details of the route by which it is made The knowledge of reaction mechanisms in their synthesis many times allows a researcher to tailor a preparative scheme to either arrive at the final product in a purer state or with a better yield Also a good fundamental experimental knowledge of impurities present in the final material helps the investigator get more insight into making it

Micromagnetism and the Microstructure of Ferromagnetic Solids Helmut Kronmüller,Manfred Fähnle,2003-08-28 The main theme of this book is micromagnetism and microstructure as well as the analysis of the relations between characteristic properties of the hysteresis loop and

microstructure Also presented is an analysis of the role of microstructure in the fundamental magnetic properties for example magnetorestriction or critical behaviour of crystalline and amorphous alloys The authors apply the theory of micromagnetism to all aspects of advanced magnetic materials including domain patterns and magnetization processes under the influence of defect structures Coverage includes modern developments in computational micromagnetism and its application to spin structures of small particles and platelets It will be of interest to researchers and graduate students in condensed matter physics electrical engineering and materials science as well as to industrial researchers working in the electrotechnical and recording industry

Hexaferrite Permanent Magnetic Materials Sami H. Mahmood, Ibrahim

Handbook of Magnetic Materials K.H.J. Buschow, 2002-09-20 Magnetoelectronics is a novel and rapidly developing field. This new field is frequently referred to as spin electronics or spintronics. It includes spin-utilizing devices that need neither a magnetic field nor magnetic materials. In semiconductor devices, the spin of the carriers has only played a very modest role so far because well-established semiconductor devices are non-magnetic and show only negligible effects of spin. Nanoscale thin

films and multilayers nanocrystalline magnetic materials granular films and amorphous alloys have attracted much attention in the last few decades in the field of basic research as well as in the broader field of materials science Such heterogeneous materials display uncommon magnetic properties that virtually do not occur in bulk materials This is true in particular with respect to surface interface magnetic anisotropy and surface interface magnetostrictive strains and giant magnetoresistance The local atomic arrangement at the interface differs strongly from that in the bulk The local symmetry is lowered so that some interactions are changed or are missing altogether The interface atoms may be envisaged as forming a new phase and some properties characteristic of this phase may become predominant for the entire system This becomes particularly evident in the case of interfacial magnetostriction which can lead to a decrease almost to zero or to an increase over the bulk value of the resulting magnetostriction of the nanoscale system There are various forms of the interplay of magnetism and superconductivity which can be divided into competition and coexistence phenomena For instance a strong competition is found in high T_c cuprates In these materials depending on the doping rate either Neel type antiferromagnetism or superconductivity is known to occur in systems where the concentration of these moments is sufficiently small or where they are antiferromagnetically ordered and only weakly coupled to the conduction electrons During the years intermetallic gadolinium compounds have adopted a special position in the study of 4f electron magnetism The reason for this is the fact that the gadolinium moment consists only of a pure spin moment orbital contributions to the moment being absent As a consequence gadolinium compounds have been regarded as ideal test benches for studying exchange interactions free from complications due to crystal effects Volume 14 of the Handbook of Magnetic Materials as the preceding volumes has a dual purpose As a textbook it is intended to be of assistance to those who wish to be introduced to a given topic in the field of magnetism without the need to read the vast amount of literature published As a work of reference it is intended for scientists active in magnetism research To this dual purpose volume 14 of the Handbook is composed of topical review articles written by leading authorities In each of these articles an extensive description is given in graphical as well as tabular form much emphasis being placed on the discussion of the experimental material in the framework of physics chemistry and material science

Handbook of Advanced Magnetic Materials Yi Liu, D.J. Sellmyer, Daisuke Shindo, 2008-11-23 In December 2002 the world's first commercial magnetic levitation super train went into operation in Shanghai The train is held just above the rails by magnetic levitation maglev and can travel at a speed of 400 km/hr completing the 30km journey from the city to the airport in minutes Now consumers are enjoying 50 GB hard drives compared to 0.5 GB hard drives ten years ago Achievements in magnetic materials research have made dreams of a few decades ago reality The objective of the four volume reference Handbook of Advanced Magnetic Materials is to provide a comprehensive review of recent progress in magnetic materials research Each chapter will have an introduction to give a clear definition of basic and important concepts of the topic The details of the topic are then elucidated theoretically and

experimentally New ideas for further advancement are then discussed Sufficient references are also included for those who wish to read the original work In the last decade one of the most significant thrust areas of materials research has been nanostructured magnetic materials There are several critical sizes that control the behavior of a magnetic material and size effects become especially critical when dimensions approach a few nanometers where quantum phenomena appear The first volume of the book Nanostructured Advanced Magnetic Materials has therefore been devoted to the recent development of nanostructured magnetic materials emphasizing size effects Our understanding of magnetism has advanced with the establishment of the theory of atomic magnetic moments and itinerant magnetism Simulation is a powerful tool for exploration and explanation of properties of various magnetic materials Simulation also provides insight for further development of new materials Naturally before any simulation can be started a model must be constructed This requires that the material be well characterized Therefore the second volume Characterization and Simulation provides a comprehensive review of both experimental methods and simulation techniques for the characterization of magnetic materials After an introduction each section gives a detailed description of the method and the following sections provide examples and results of the method Finally further development of the method will be discussed The success of each type of magnetic material depends on its properties and cost which are directly related to its fabrication process Processing of a material can be critical for development of artificial materials such as multilayer films clusters etc Moreover cost effective processing usually determines whether a material can be commercialized In recent years processing of materials has continuously evolved from improvement of traditional methods to more sophisticated and novel methods The objective of the third volume Processing of Advanced Magnetic Materials is to provide a comprehensive review of recent developments in processing of advanced magnetic materials Each chapter will have an introduction and a section to provide a detailed description of the processing method The following sections give detailed descriptions of the processing properties and applications of the relevant materials Finally the potential and limitation of the processing method will be discussed The properties of a magnetic material can be characterized by intrinsic properties such as anisotropy saturation magnetization and extrinsic properties such as coercivity The properties of a magnetic material can be affected by its chemical composition and processing route With the continuous search for new materials and invention of new processing routes magnetic properties of materials cover a wide spectrum of soft magnetic materials hard magnetic materials recording materials sensor materials and others The objective of the fourth volume Properties and Applications of Advanced Magnetic Materials is to provide a comprehensive review of recent development of various magnetic materials and their applications Each chapter will have an introduction of the materials and the principles of their applications The following sections give a detailed description of the processing properties and applications Finally the potential and limitation of the materials will be discussed

Inorganic Materials Chemistry Desk Reference D. Sangeeta, John R. LaGraft, 2004-11-29 The updated second edition of the popular Inorganic

Materials Chemistry Desk Reference remains a valuable resource in the preparation of solid state inorganic materials by chemical processing techniques It also expands upon new chemical precursors available to materials scientists the applications of those materials and existing or emerging topics

Advanced Topics in Materials Science and Engineering J.L. Morán-López, José M. Sánchez, 2012-12-06 This volume contains the papers presented at the First Mexico U S A Symposium on Materials Sciences and Engineering held in Ixtapa Guerrero Mexico during September 24-27 1991 The conference was conceived with the primary objective of increasing the close ties between scientists and engineers in both Mexico and the U S with an interest in materials The conference itself would have not taken place without the drive determination and technical knowledge of John K Tien of the University of Texas at Austin and of Francisco Mejia Lira of the Universidad de San Luis Potosi This book is dedicated to their memory The event brought together materials scientists and engineers with interests in a broad range of subjects in the processing characterization and properties of advanced materials Several papers were dedicated to structural materials ranging from ferrous alloys to intermetallics ceramics and composites The presentation covered properties processing and factors that control their use such as fatigue and corrosion Other materials and properties were also explored by U S and Mexican participants Several papers dealt with the characterization and properties of magnetics optical and superconductor materials nanostructured materials as well as with computational and theoretical aspects likely to impact future materials research and development

High Density Digital Recording K.H.J Buschow, G.J Long, F. Grandjean, 2012-12-06 High density digital magnetic and magneto optical storage devices are widely used in audio video and data processing information technology as well as in CAD CAM computer systems These widespread uses generate a continually increasing demand for both increased information storage densities and capacities and for reduced access times Hence the materials engineering of high density storage media with a high signal to noise ratio and the associated design of sophisticated read and write heads form the basis of major technological research This research is especially complex because ideally the recorded information should be both erasable and at the same time secure and accessible over periods of many decades As a result research on these complex problems requires a multidisciplinary approach which utilizes the expertise in such widely differing fields as organic inorganic and solid state chemistry metallurgy solid state physics electrical and mechanical engineering and systems analysis Often further research specialization is necessary in each of these different disciplines For instance solid state physics and chemistry address the problems of crystallographic structure and phase diagram determination magnetism and optics but more advanced research methods such as high resolution electron microscopy and electronic band structure calculations are necessary to understand the microstructure of particulate recording media or the electronic spectra of magneto optical recording media

Magnetic Microwires Alexander Chizhik, Julian Gonzalez, 2014-01-17 A comprehensive overview this book focuses on two directions of study discovery of new effects that take place in magnetic wires and optimization of the magnetic electrical and mechanical properties of the wires

taking into account the technological application The book presents the idea of moving to nanoscale maintaining the achieved optimal parameters of microwires While the focus remains on glass covered wires of micrometer scale it covers the first steps of the movement to nano range as an example of the versatility of the basic effects initially discovered for microscale

□□□□□□□□3□:□□□□□□□□□□□ David J. Sellmyer,Yi Liu,2005 *Magnetism* Etienne du Trémolet de Lacheisserie,Damien Gignoux,Michel Schlenker,2012-12-06 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 Trémolet de Lacheisserie and published in 1999 The present version involves beyond the translation many corrections and complements

Handbook on the Physics and Chemistry of Rare Earths L. Eyring,K.A. Gschneidner,G.H. Lander,2002-01-10 This volume of the handbook covers a variety of topics with three chapters dealing with a range of lanthanide magnetic materials and three individual chapters concerning equiatomic ternary ytterbium intermetallic compounds rare earth polysulfides and lanthanide organic complexes Two the chapters also include information of the actinides and the comparative lanthanide actinide behaviors

Modern Ferrites, Volume 1 Vincent G. Harris,2022-11-01 MODERN FERRITES Volume 1 A robust exploration of the basic principles of ferrimagnetics and their applications In Modern Ferrites Volume 1 Basic Principles Processing and Properties renowned researcher and educator Vincent G Harris delivers a comprehensive overview of the basic principles and ferrimagnetic phenomena of modern ferrite materials Volume 1 explores the fundamental properties of ferrite systems including their structure chemistry and magnetism the latest in processing methodologies and the unique properties that result The authors explore the processing structure and property relationships in ferrites as nanoparticles thin and thick films compacts and crystals and how these relationships are key to realizing practical device applications laying the foundation for next generation technologies This volume also includes Comprehensive investigation of the historical and scientific significance of ferrites upon ancient and modern societies Neel's expanded theory of molecular field magnetism applied to ferrimagnetic oxides together with theoretic advances in density functional theory Nonlinear excitations in ferrite systems and their potential for device technologies Practical discussions of nanoparticle thin and thick film growth techniques Ferrite based electronic band gap heterostructures and metamaterials Perfect for RF engineers and magnetitians working in the field of RF electronics radar communications and spintronics as well as other emerging technologies Modern Ferrites will earn a place on the bookshelves of engineers and scientists interested in the ever expanding technologies reliant upon ferrite materials and new processing methodologies Modern Ferrites Volume 2 Emerging Technologies and Applications is also available ISBN 9781394156139

Interstitial Intermetallic Alloys F. Grandjean,G.J Long,K.H.J Buschow,2012-12-06 It is well known that the density of molecular hydrogen can be increased by compression and or cooling the ultimate limit in density being that of

liquid hydrogen It is less well known that hydrogen densities of twice that of liquid hydrogen can be obtained by intercalating hydrogen gas into metals The explanation of this unusual paradox is that the absorption of molecular hydrogen which in TiFe and LaNi₅ is reversible and occurs at ambient temperature and pressure involves the formation of hydrogen atoms at the surface of a metal The adsorbed hydrogen atom then donates its electron to the metal conduction band and migrates into the metal as the much smaller proton These protons are easily accommodated in interstitial sites in the metal lattice and the resulting metal hydrides can be thought of as compounds formed by the reaction of hydrogen with metals alloys and intermetallic compounds The practical applications of metal hydrides span a wide range of technologies a range which may be subdivided on the basis of the hydride property on which the application is based The capacity of the metal hydrides for hydrogen absorption is the basis for batteries as well as for hydrogen storage gettering and purification The temperature pressure characteristics of metal hydrides are the basis for hydrogen compressors sensors and actuators The latent heat of the hydride formation is the basis for heat storage heat pumps and refrigerators

Concise Encyclopedia of Magnetic and Superconducting Materials K.H.J. Buschow, 2005-12-28 Magnetic and superconducting materials pervade every avenue of the technological world from microelectronics and mass data storage to medicine and heavy engineering Both areas have experienced a recent revitalisation of interest due to the discovery of new materials and the re evaluation of a wide range of basic mechanisms and phenomena This Concise Encyclopedia draws its material from the award winning Encyclopedia of Materials and Engineering and includes updates and revisions not available in the original set making it the ideal reference companion for materials scientists and engineers with an interest in magnetic and superconducting materials Contains in excess of 130 articles taken from the award winning Encyclopedia of Materials Science and Technology including ScienceDirect updates not available in the original set Each article discusses one aspect of magnetic and superconducting materials and includes photographs line drawings and tables to aid the understanding of the topic at hand Cross referencing guides readers to articles covering subjects of related interest

[A Review: Chill-Block Melt Spin Technique, Theories & Applications](#) Mustafa Kamal, Usama S. Mohammad, 2013-03-15 Rapid Solidification Processing of molten metals and alloys has proved to be a reliable route for producing new and advanced materials The Chill Block Melt Spin CBMS technique is important because its simplicity flexibility and perfection High quality materials can be produced with lower costs as compared to other routes by refining the microstructure and trapping the nucleated new metastable phases Melt spun ribbons subsequently produced can then be consolidated to produce billets and sheets that can be used in many industries especially high tech industries such as aerospace and racing automobiles This book contains several perspectives about CBMS technology and should be a useful review for undergraduate and post graduate metallurgy students

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Supermagnets Hard Magnetic Materials Introduction

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