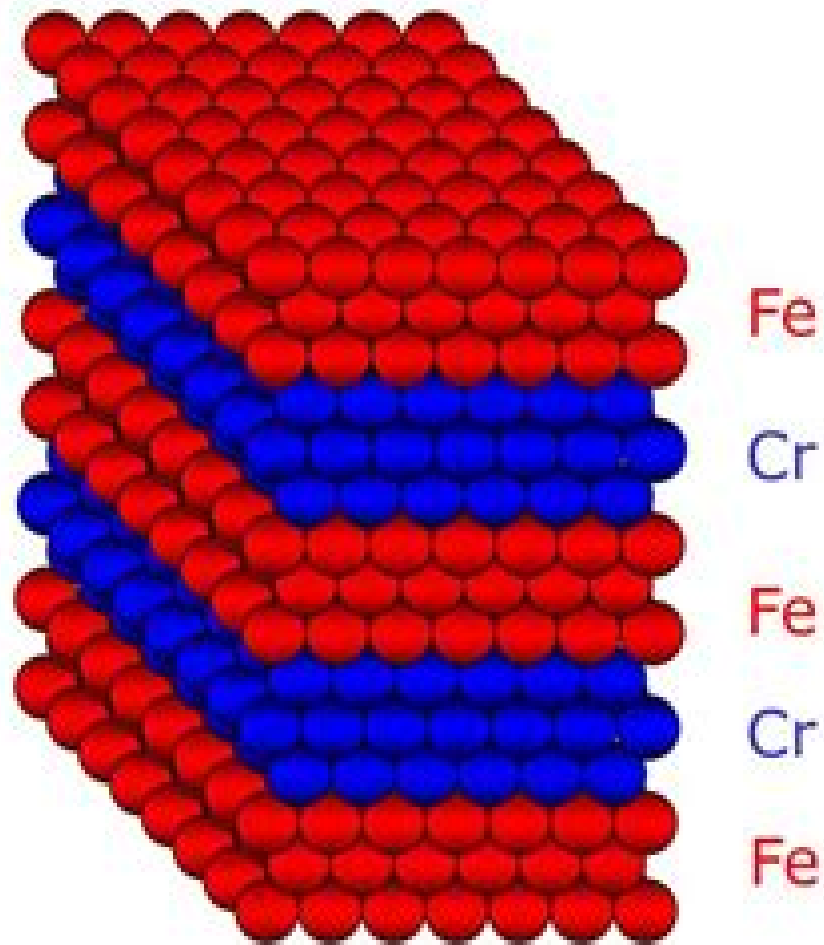


- **Magnetic multilayers**



# Magnetic Multilayers

**Lawrence H Bennett, Dick Watson**



## **Magnetic Multilayers:**

**Magnetic Multilayers and Giant Magnetoresistance** U. Hartmann, 2013-03-14 Magnetic multilayers is a rapidly growing and multidisciplinary field of research The purpose of this book is to give a unified overview of recent progress giving special emphasis to the most important industrial applications A general introduction is followed by six chapters that describe a wide range of physical aspects together with experimental and theoretical methods Scientists and students alike will benefit from the comprehensive discussion of numerous devices and their physics As the technology matures these devices for example spin valves and magnetic random access memories are likely to become widely used *Magnetic*

*Multilayers* Lawrence H Bennett, Dick Watson, 1994-12-16 This book focuses on an increasingly important area of materials science and technology namely the fabrication and properties of artificial materials where slabs of magnetized materials are sandwiched between slabs of nonmagnetized materials It includes reviews by experts on the theory and descriptions of the various experimental techniques such as those using nuclear or electron spin probes as well as optical X ray or neutron probes It also reviews potential applications such as the giant magnetoresistance and one specialized preparation technique the electrodeposition The various chapters are tutorial in nature making the subject accessible to nonspecialists as well as useful to researchers in the field **Optics in Magnetic Multilayers and Nanostructures** Stefan Visnovsky, 2018-10-03

In the continuing push toward optical computing the focus remains on finding and developing the right materials Characterizing materials understanding the behavior of light in these materials and being able to control the light are key players in the search for suitable optical materials Optics in Magnetic Multilayers and Nanostructures presents an accessible introduction to optics in anisotropic magnetic media While most of the literature presents only final results of the complicated formulae for the optics in anisotropic media this book provides detailed explanations and full step by step derivations that offer insight into the procedure and reveal any approximations Based on more than three decades of experimental research on the subject the author explains the basic concepts of magneto-optics nonreciprocal wave propagation the simultaneous effect of crystalline symmetry and arbitrarily oriented magnetization on the form of permittivity tensors spectral dependence of permittivity multilayers at polar longitudinal transverse and arbitrary magnetization the effect of normal or near normal incidence on multilayers and anisotropic multilayer gratings Making the subject of magneto-optics and anisotropic media approachable by the nonspecialist Optics in Magnetic Multilayers and Nanostructures serves as an ideal introduction to newcomers and an indispensable reference for seasoned researchers

Magnetic Multilayers Lawrence Herman Bennett, R. E. Watson, 1994 This book focuses on an increasingly important area of materials science and technology namely the fabrication and properties of artificial materials where slabs of magnetized materials are sandwiched between slabs of nonmagnetized materials It includes reviews by experts on the theory and descriptions of the various experimental techniques such as those using nuclear or electron spin probes as well as optical X

ray or neutron probes It also reviews potential applications such as the giant magnetoresistance and one specialized preparation technique the electrodeposition The various chapters are tutorial in nature making the subject accessible to nonspecialists as well as useful to researchers in the field

**Magnetic Ultra Thin Films, Multilayers and Surfaces** F. Petroff, M.A.M. Gijs, 1997-12-18 The Symposium on Magnetic Ultrathin Films Multilayers and Surfaces hosted by the European Materials Research Society was held at the Palais de la Musique et des Congr in Strasbourg France on June 4 7 1996 Its central theme was the relationship of magnetic properties and device performance to structure at the nano and micrometer length scale Research on the magnetism of surfaces ultrathin films and multilayers has increased dramatically during recent years This development was triggered by the discovery of coupling between ferromagnetic layers across nonmagnetic spacer layers and of the giant magnetoresistance effect in systems of reduced dimension using various micro and nanofabrication techniques has become a subject of special interest It is certainly the promising application potential of these effects in new magnetic recording device geometries which causes this intensive research which is done both by companies and at universities and research institutes A selection of invited and contributed papers presented at the Symposium and accepted for publication is contained in this volume The contents of these proceedings are organized into seven sections A Nanowires Nanoparticles Nanostructuring B Ultrathin Films and Surfaces Characterization C Giant Magnetoresistance D Coupling Tunneling E Growth Structure Magnetism F Growth Structure Magnetoresistance G Coupling Magnetic processes Magneto optics The first four sections contain invited and oral contributed papers in the listed research domains while the last three sections contain the contributions presented during three large poster sessions

**Magnetic Thin Films, Multilayers and Superlattices** A. Fert, G. Güntherodt, B. Heinrich, E.E. Marinero, M. Maurer, 1991-06-06 Materials Research in thin and ultrathin magnetic structures is a multidisciplinary field which heavily relies on state of the art growth characterization and theoretical approaches to build a comprehensive physical picture on how magnetic properties depend on interfacial structural issues interlayer coupling and transport phenomena Often in this field the critical properties and characterization required necessitates knowledge of structural and magnetic phenomena extending over several atomic planes Atomic controlled growth techniques are required and atomic sensitivity is needed from magnetic and structural probes This critical knowledge is vital for device applications providing the basis for the synergistic interactions that are predominant in this field of research This volume is the definitive reference source for anyone interested in the latest advances and results of current experimental research in ultrathin film magnetism

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

Advanced Magnetic Nanostructures D.J. Sellmyer, Ralph Skomski, 2006-07-02 Advanced magnetic nanostructures is an emerging field in magnetism and nanotechnology but the literature consists of a rich variety of original papers and parts of reviews and books whose scope is comparatively broad This calls for a book with specific emphasis on state of the art synthetic methods for fabricating characterizing and theoretically modeling new magnetic nanostructures This book is intended to provide a comprehensive overview of the present state of the field Leading researchers world wide have contributed a survey of their special ties to guide the reader through the exploding literature in nanomagnetic structures The focus is on deliberately structured nanomagnets It includes cluster assembled self organized and patterned thin films but excludes for example multilayered thin films We target both industrial and academic researchers in magnetism and related areas such as nanotechnology materials science and theoretical solid state physics

Nanomagnetism, 2006-03-27 Nanoscience is of central importance in the physical and biological sciences and is now pervasive in technology However nanomagnetism has a special role to play as magnetic properties depend uniquely on both dimensionality and lengthscales Nanomagnetism is already central to data storage sensor and device technologies but is increasingly being used in the life sciences and medicine This volume aims to introduce scientists computer scientists engineers and technologists from diverse fields to this fascinating and technologically important new branch of nanoscience The volume should appeal to both the interested general reader but also to the researcher wishing to obtain an overview of this fast moving field The contributions come from acknowledged leaders in the field who each give authoritative accounts of key fundamental aspects of nanomagnetism to which they have themselves made a major contribution After a brief introduction by the editors Wu first surveys the fundamental properties of magnetic nanostructures The interlayer exchange interactions within magnetic multilayer structures is next discussed by Stiles Camley then discusses the static dynamic and thermal properties of magnetic multilayers and nanostructures followed by an account of the phenomenon of exchange anisotropy by Berkowitz and Kodama This latter phenomenon is widely in current read head devices for example The transport properties of nanostructures also are spectacular and again underpin computer technology as we see from the discussion of giant magnetoresistance GMR and tunnelling magnetoresistance TMR presented by Fert and his colleagues Beyond GMR and TMR we look to the field of spintronics where new electronic devices are envisioned and for which quantum computing may depend as discussed in the chapter by Flatte and Jonker The volume

concludes with discussion of the recently discovered phenomenon of current induced switching of magnetization by Edwards and Mathon Subject is in the forefront of nanoscience All Section authors are leading figures in this key field Presentations are accessible to non specialists with focus on underlying fundamentals *Fundamental Properties Of Nanostructured Materials - Proceedings Of The National School Of The Condensed Matter Group* Dino Fiorani, Giorgio Sberveglieri, 1994-10-26 The purpose of this school addressed to young researchers and graduate students physicists chemists and engineers was to provide the basis of fundamental properties of nanostructured materials and an introduction to more specialized and up to date topics The topics were remarkably interdisciplinary covering theory materials preparation structural characterization thermodynamic aspects and mechanical optical electrical and magnetic properties

**Nanomagnetism and Spintronics** Jun-ichiro Inoue, 2013-10-07 Novel magnetotransport phenomena appear when magnet sizes become nanoscale Typical examples of such phenomena are giant magnetoresistance GMR in magnetic multilayers tunnel magnetoresistance TMR in ferromagnetic tunnel junctions and ballistic magnetoresistance BMR in magnetic nanocontacts In this chapter we first briefly review the relationship between spin dependent resistivity and electronic structures in metals and alloys and describe microscopic methods for investigating electrical transport We then review the essential aspects of GMR TMR and BMR emphasizing the role of the electronic structures of the constituent metals of these junctions and the effects of roughness on the electrical resistivity or resistance The important factors that control GMR are shown to be the spin dependent random potential at interfaces and band matching mismatching between magnetic and nonmagnetic layers For TMR several factors are shown to be important in determining the MR ratio including the shape of the Fermi surface of the electrodes the symmetry of the wave functions electron scattering at interfaces and spin slip tunneling An interpretation of TMR in Fe MgO Fe and of an oscillation of TMR is presented TMR in granular films and in the Coulomb blockade regime is also described We also provide a brief explanation for other MR effects such as normal MR anisotropic MR AMR and colossal MR CMR in order to clarify the essential difference between these MRs and GMR TMR and BMR These MR effects are attributed to the spin dependent electrical currents produced in metallic ferromagnets After the discovery of these different MR effects the role of spin current was proposed for example spin Hall effect and the effects of spin transfer torque which will be briefly explained in this chapter The former originates from the spin orbit interaction and can be observed even in nonmagnetic metals and semiconductors It is closely related to the anomalous Hall effect observed in ferromagnetic metals The spin transfer torque is an inverse effect of the MR The MR is the resistivity change produced by magnetization rotation in ferromagnetic junctions while the spin transfer torque is an effect in which spin polarized current makes the magnetization rotate Finally we briefly introduce the coupled effects of spin charge and heat transport which are called spin caloritronics **Solid State Physics** Henry Ehrenreich, Frans Spaepen, 2001-09-12 Solid state physics is the branch of physics that is primarily devoted to the study of matter in its solid phase especially at the

atomic level This prestigious serial presents timely and state of the art reviews pertaining to all aspects of solid state physics

**Solid State Physics**, 2001-10-04 Solid state physics is the branch of physics that is primarily devoted to the study of matter in its solid phase especially at the atomic level This prestigious serial presents timely and state of the art reviews pertaining to all aspects of solid state physics

**Magnetism and Structure in Systems of Reduced Dimension** Robin F.C. Farrow, Bernard Dieny, Markus Donath, Albert Fert, B.D. Hermseier, 2013-06-29 This volume contains the papers presented at the NATO Advanced Research Workshop on Magnetism and Structure in Systems of Reduced Dimension held at l Institut d Etudes Scientifiques de Cargese U M S C N R S Universite de Corte Universite de Nice Sophia Antipolis during June 15 19 1992 The ordering of papers in the volume reflects the sequence of papers presented at the workshop The aim was not to segregate the papers into rigidly defined areas but to group the papers into small clusters each cluster having a common theme In this way the parallel rather than serial development of areas such as preparation of films magnetic and structural characterization was highlighted Indeed the success of the field depends on such parallel development and is assisted by workshops of this nature and the international collaborations which they foster The organizers and participants of the NATO workshop express their thanks to Mme Marie France Hanseier and the staff at l Institut d Etudes Scientifiques de Cargese U M S C N R S Universite de Corte Universite de Nice Sophia Antipolis for making the workshop and local arrangements a memorable success Warm thanks are also expressed to Varadachari Sadagopan and Pascal Stefanou for their encouragement and help in making the workshop a reality We are also grateful to Kristl Hathaway Larry Cooper and Gary Prinz for advice in developing the workshop program

*Science and Technology of Nanostructured Magnetic Materials* G.C. Hadjipanayis, Gary A. Prinz, 2013-11-11 Proceedings of a NATO ASI held in Aghia Pelaghia Crete Greece June 24 July 6 1990

**Handbook of Spin Transport and Magnetism** Evgeny Y. Tsybal, Igor Zutic, 2016-04-19 In the past several decades the research on spin transport and magnetism has led to remarkable scientific and technological breakthroughs including Albert Fert and Peter Grunberg s Nobel Prize winning discovery of giant magnetoresistance GMR in magnetic metallic multilayers Handbook of Spin Transport and Magnetism provides a comprehensive bal

*Ordering at Surfaces and Interfaces* Akio Yoshimori, Teruya Shinjo, Hisatsune Watanabe, 2012-12-06 This volume contains the proceedings of the third in a series of biennial NEC Symposia on Fundamental Approaches to New Material Phases sponsored by the NEC Corporation Tokyo Japan The symposium was held from October 7 to 11 1990 at the Hakone Kanko H9tel in Hakone About 40 invited participants stayed together became involved in intense discussions and freely exchanged ideas both in and out of the conference room which faced Mt Fuji the beautiful lake Ashinoko and the quiet landscape in the old crater The title of this volume Ordering at Surfaces and Interfaces which was also the title of the third symposium describes the aim of the symposium to discuss ordering properties and their underlying mechanisms at surfaces and interfaces The topics treated include the reconstruction of surfaces of semiconductors and metals atomic and magnetic ordering at interfaces theoretical

tools to study or dering mechanisms at surfaces and interfaces ordering in adsorbate surface sys tems such as alkali adsorbed silicon surfaces electric current effects on semicon ductor surfaces and many related STM scanning tunneling microscopy results      **Nanomagnetism and Spintronics** Teruya Shinjo,2009-06-29 Spintronics is a newly developing area in the field of magnetism in which the interplay of magnetism and transport phenomena is studied experimentally and theoretically This book introduces the recent progresses in the research relating to spintronics Presents in depth analysis of this fascinating and technologically important new branch of nanoscience Edited text with contributions from acknowledged leaders in the field This handbook and guide will appeal to students and researchers in the fields of electronic devices and materials      **Structural Dynamics with X-ray and Electron Scattering** Kasra Amini,Arnaud Rouzée,Marc J J

Vrakking,2023-12-20 Since the early 20th century X ray and electron scattering has provided a powerful means by which the location of atoms can be identified in gas phase molecules and condensed matter with sub atomic spatial resolution Scattering techniques can also provide valuable observables of the fundamental properties of electrons in matter such as an electron s spin and its energy In recent years significant technological developments in both X ray and electron scattering have paved the way to time resolved analogues capable of capturing real time snapshots of transient structures undergoing a photochemical reaction Structural Dynamics with X ray and Electron Scattering is a two part book that firstly introduces the fundamental background to scattering theory and photochemical phenomena of interest The second part discusses the latest advances and research results from the application of ultrafast scattering techniques to imaging the structure and dynamics of gas phase molecules and condensed matter This book aims to provide a unifying platform for X ray and electron scattering

*Magnetism of Surfaces, Interfaces, and Nanoscale Materials* Robert E. Camley,Zbigniew Celinski,Robert L. Stamps,2015-10-27 In the past 30 years magnetic research has been dominated by the question of how surfaces and interfaces influence the magnetic and transport properties of nanostructures thin films and multilayers The research has been particularly important in the magnetic recording industry where the giant magnetoresistance effect led to a new generation of storage devices including hand held memories such as those found in the ipod More recently transfer of spin angular momentum across interfaces has opened a new field for high frequency applications This book gives a comprehensive view of research at the forefront of these fields The frontier is expanding through dynamic exchange between theory and experiment Contributions have been chosen to reflect this giving the reader a unified overview of the topic Addresses both theory and experiment that are vital for gaining an essential understanding of topics at the interface between magnetism and materials science Chapters written by experts provide great insights into complex material Discusses fundamental background material and state of the art applications serving as an indispensable guide for students and professionals at all levels of expertise Stresses interdisciplinary aspects of the field including physics chemistry nanocharacterization and materials science Combines basic materials with applications thus widening the scope of the book



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