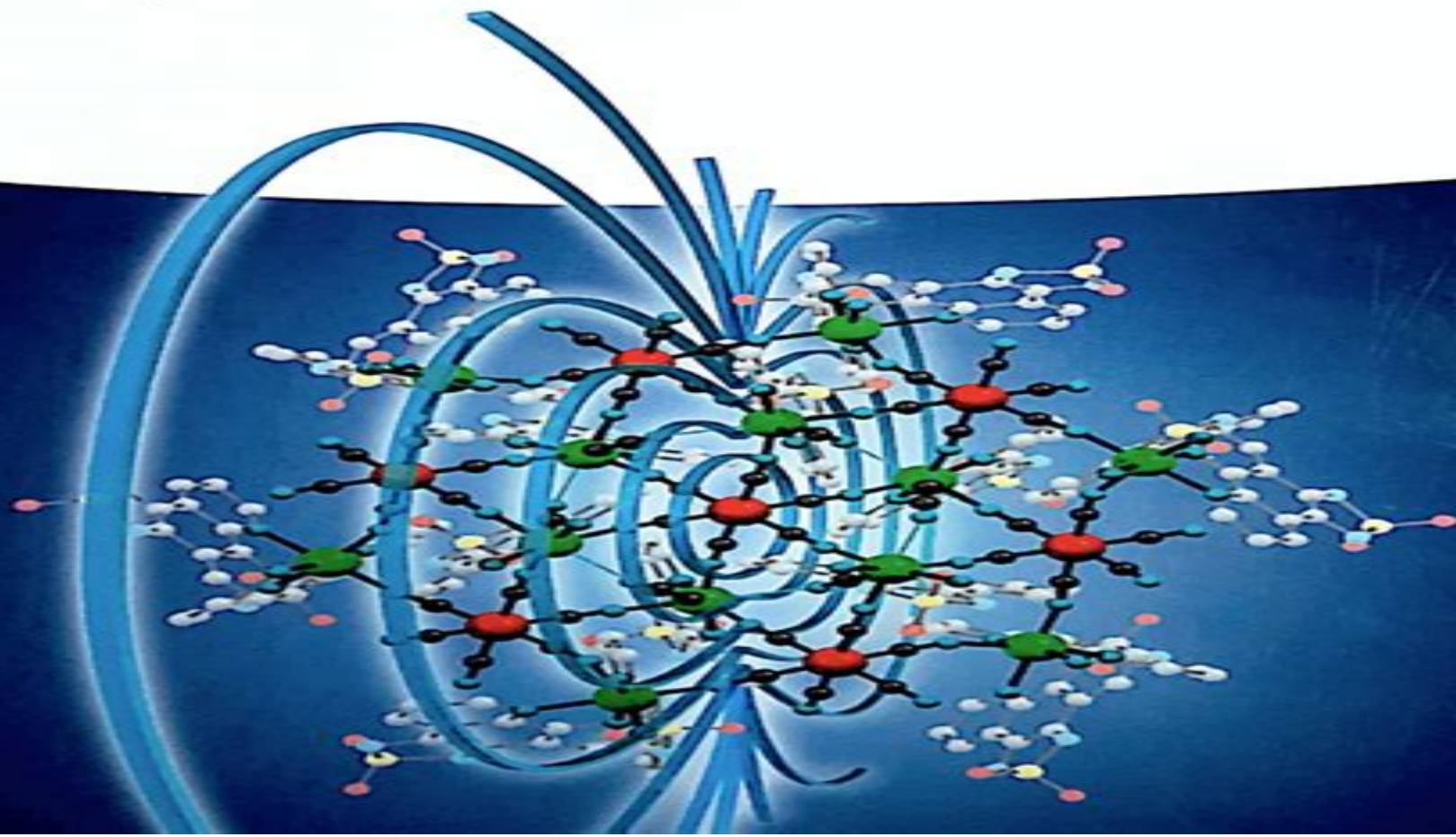


Edited by Barbara Sieklucka and Dawid Pinkowicz

# Molecular Magnetic Materials

Concepts and Applications



# Magnetic Molecular Materials

**VM Jensen**

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## **Magnetic Molecular Materials:**

**Magnetic Molecular Materials** D. Gatteschi, O. Kahn, Joel S. Miller, Fernando Palacio, 2012-12-06 One of the major challenges of science in the last few years of the second millennium is learning how to design materials which can fulfill specific tasks. Ambitious as it may be, the possibilities of success are not negligible provided that all the different expertises merge to overcome the limits of existing disciplines and forming new paradigms. The NATO Advanced Research Workshop on Magnetic Molecular Materials was organized with the above considerations in mind in order to determine which are the most appropriate synthetic strategies, experimental techniques of investigation and theoretical models which are needed in order to develop new classes of magnetic materials which are based on molecules rather than on metallic or ionic lattices. Why molecules? The answer may be obvious: molecular chemistry in principle can tune the structures and the properties of complex aggregates and nature already provides a large number of molecular aggregates which can perform the most disparate functions. The contributions collected in this book provide a rather complete view of the current research accomplishments of magnetic molecular materials. There are several different synthetic approaches which are followed, ranging from purely organic to inorganic materials. Some encouraging successes have already been achieved even if the critical temperatures below which magnetic order is observed still are in the range requiring liquid helium.

**Conducting and Magnetic Organometallic Molecular Materials** Marc Fourmigué, Lahcène Ouahab, 2009-06-17 For several years the two parallel worlds of Molecular Conductors in one hand and Molecular Magnetism in the other have grown side by side: the former essentially based on radical organic molecules, the latter essentially based on the high spin properties of metal complexes. Over the last few years, however, organometallic derivatives have started to play an increasingly important role in both worlds and have in many ways contributed to open several passages between these two worlds. This volume recognizes this important emerging evolution of both research areas. It is not intended to give a comprehensive view of all possible organometallic materials and polymers; for example, they were not considered here. Rather, we present a selection of the most recent research topics where organometallic derivatives were shown to play a crucial role in the setting of conducting and/or magnetic properties in crystalline materials. First, the role of organometallic anions in tetrafulvalene-based molecular conductors is highlighted by Schlueter, while Kubo and Kato describe very recent ortho-metalated chelating ligands appended to the TTF core and their conducting salts. The combination of conducting and magnetic properties and the search for p-d interactions are analyzed in two complementary contributions by Miyazaki and Ouahab, while Valade focuses on the only class of metal bis-dithiolene complexes to give rise to superconductive molecular materials in association with organic as well as organometallic cations.

**Functional Molecular Materials** Matteo Atzori, Flavia Artizzu, 2018-04-17 The field of molecular materials represents an exciting playground for the design, tailoring and combination of chemical building blocks as carriers of physical properties and aims at the understanding and development of novel functional molecular

devices Within this extraordinarily widespread framework the realization of materials with the desired functionalities can only be achieved through a rational design strategy based on a solid understanding of the chemical and physical features of each constituting building block This book provides a general overview of molecular materials discussing their key features in a simple and organic way by focusing more on basic concepts rather than on specialized descriptions in order to supply the non expert reader with the immediate fundamental tools and hints to understand and develop research in this field With this view it is a step by step guide toward the preparation of functional molecular materials where the knowledge and understanding so far attained by the scientific community through the investigation of significant archetypical examples is deconstructed down to the fundamental basis and then presented in reverse from the base to the top **Molecular**

**Magnetism: From Molecular Assemblies to the Devices** E. Coronado, Pierre Delhaès, D. Gatteschi, Joel S.

Miller, 2013-03-09 Molecular Magnetism From Molecular Assemblies to the Devices reviews the state of the art in the area It is organized in two parts the first of which introduces the basic concepts theories and physical techniques required for the investigation of the magnetic molecular materials comparing them with those used in the study of classical magnetic materials Here the reader will find i a detailed discussion of the electronic processes involved in the magnetic interaction mechanisms of molecular systems including electron delocalization and spin polarization effects ii a presentation of the available theoretical models based on spin and Hubbard Hamiltonians and iii a description of the specific physical investigative techniques used to characterize the materials The second part presents the different classes of existing magnetic molecular materials focusing on the possible synthetic strategies developed to date to assemble the molecular building blocks ranging from purely organic to inorganic materials as well as on their physical properties and potential applications These materials comprise inorganic and organic ferro and ferrimagnets high nuclearity organic molecules and magnetic and metallic clusters spin crossover systems charge transfer salts including fulleride salts and organic conductors and superconductors and organized soft media magnetic liquid crystals and Langmuir Blodgett films **Magnetism** Joel S. Miller, Marc Drillon, 2001 Combining the contemporary knowledge from widely scattered sources this is a much needed and comprehensive overview of the field In maintaining a balance between theory and experiment the book guides both advanced students and specialists to this research area Topical reviews written by the foremost scientists explain recent trends and advances focusing on the correlations between electronic structure and magnetic properties The book spans recent trends in magnetism for molecules as well as inorganic based materials with an emphasis on new phenomena being explored from both experimental and theoretical viewpoints with the aim of understanding magnetism on the atomic scale The volume helps readers evaluate their own experimental observations and serves as a basis for the design of new magnetic materials Topics covered include Metallocenes Salts of Radical Anion Bis dithiolate metalates Chiral Molecule Based Magnets Cooperative Magnetic Behavior in Metal Dicyanamide Complexes Lanthanide Ions in Molecular Exchange Coupled Systems

Monte Carlo Simulation Metallocene Based Magnets Magnetic Nanoporous Molecular Materials A unique reference work indispensable for everyone concerned with the phenomena of magnetism      **Multifunctional Molecular Materials** Lahcene Ouahab, 2013-01-24 This book provides a comprehensive overview on multifunctional molecular materials that involve coexistence or interplay or synergy between multiple physical properties focusing on electrical conductivity magnetism single molecule magnets behavior chirality spin crossover and luminescence The book's coverage ranges from transition metals and lanthanide coordination complexes to genuine organic materials The book also discusses some potentialities of applications of these materials in molecule based devices      Molecular Materials Duncan W. Bruce, Dermot O'Hare, Richard I. Walton, 2011-04-04 the book does an excellent job of putting together several different classes of materials Many common points emerge and the book may facilitate the development of hybrids in which the qualities of the parents are enhanced Angew Chem Int Ed 2011 With applications in optoelectronics and photonics quantum information processing nanotechnology and data storage molecular materials enrich our daily lives in countless ways These materials have properties that depend on their exact structure the degree of order in the way the molecules are aligned and their crystalline nature Small delicate changes in molecular structure can totally alter the properties of the material in bulk There has been increasing emphasis on functional metal complexes that demonstrate a wide range of physical phenomena Molecular Materials represents the diversity of the area encapsulating magnetic optical and electrical properties with chapters on Metal Based Quadratic Nonlinear Optical Materials Physical Properties of Metallomesogens Molecular Magnetic Materials Molecular Inorganic Conductors and Superconductors Molecular Nanomagnets Structured to include a clear introduction a discussion of the basic concepts and up to date coverage of key aspects each chapter provides a detailed review which conveys the excitement of work in that field Additional volumes in the Inorganic Materials Series Low Dimensional Solids Molecular Materials Porous Materials Energy Materials      **Magnetic Properties of Organic Materials** Paul M. Lahti, 2023-01-20 Provides an extensive overview of the last three decades of research on the structures and magnetic behaviors of organic and organometallic substances building a solid foundation for future research into applications of molecular materials based on organic paramagnetic and polymeric systems Provides the essential body of knowledge for an organically oriented materials science of electronic materials      Metal-Organic and Organic Molecular Magnets Peter Day, Alan E Underhill, 2007-10-31 Traditionally magnetic materials have been metals or inorganic compounds such as oxides of continuous lattice type However in recent years chemists have synthesized increasing numbers of crystalline solids based on molecular building blocks in the form of coordination and organometallic complexes or purely organic molecules which exhibit spontaneous magnetization In striking contrast to conventional magnets these materials are made from solutions close to room temperature rather than by metallurgical or ceramic methods This book which originates from contributions to a Discussion Meeting of The Royal Society of London brings together many of the leading international

practitioners in the field who survey their own recent work and place it in the context of the wider fields of magnetism and supramolecular chemistry All aspects of molecular based magnets are addressed including synthesis structure property relations and physical properties Contents include details of the characterization of the first purely organic ferromagnet the synthesis of high coercivity materials and a unique description of new materials with Curie temperatures well above ambient A coherent survey of this rapidly developing field for the more general reader Metal Organic and Organic Molecular Magnets will also be welcomed by researchers and lecturers in materials science and inorganic or solid state chemistry *Molecular Magnets* Maria Balanda, Magdalena Fitta, 2019-03-19 Molecular magnets show many properties not met in conventional metallic magnetic materials i e low density transparency to electromagnetic radiation sensitivity to external stimuli such as light pressure temperature chemical modification or magnetic electric fields and others They can serve as functional materials in sensors of different types or be applied in high density magnetic storage or nanoscale devices Research into molecule based materials became more intense at the end of the 20th century and is now an important branch of modern science The articles in this Special Issue written by physicists and chemists reflect the current work on molecular magnets being carried out in several research centers Theoretical papers in the issue concern the influence of spin anisotropy in the low dimensional lattice of the resulting type of magnet as well as thermodynamics and magnetic excitations in spin trimers The impact of external pressure on structural and magnetic properties and its underlying mechanisms is described using the example of Prussian blue analogue data The other functionality discussed is the magnetocaloric effect investigated in coordination polymers and high spin clusters In this issue new molecular magnets are presented i ferromagnetic high spin Mn6 single molecule magnets ii solvatomagnetic compounds changing their structure and magnetism dependent on water content and iii a family of purely organic magnetic materials Finally an advanced calorimetric study of anisotropy in magnetic molecular superconductors is reviewed **Magnetism of Molecular Conductors** Manuel Almeida, 2018-06-22 This book is a printed edition of the Special Issue Magnetism of Molecular Conductors that was published in Magnetochemistry

Molecular Magnets Recent Highlights Wolfgang Linert, Michel Verdaguer, 2012-12-06 The book deals with recent scientific highlights on molecular magnetism in Europe Molecular magnetism is a new interdisciplinary discipline gathering together chemists and physicists theoreticians and experimentalists The book intends to provide the reader with documented answers to many current questions How can chemists use soft conditions to transform molecules in light and transparent magnets How does a molecular system can behave as a single molecule magnet How to combine several functions in the same molecular system How light can be used to switch molecular magnetic properties How can molecules be used for ultimate high density information storage or in quantum computing What kind of methods do physicists develop and use to explore these new properties of matter What kind of concepts and calculations can be provided for theoreticians to design new objects and to better understand the field and to enlarge its exciting developments **Photophysics of Molecular**

**Materials** Guglielmo Lanzani, 2006-05-12 Carbon based pi conjugated materials offer a broad range of applications going from molecular electronics and single molecule devices to nanotechnology plastic electronics and optoelectronics The proper physical description of such materials is in between that of molecular solids and that of low dimensional covalent semiconductors This book is a comprehensive review of their elementary excitations processes and dynamics which merges the two viewpoints sometimes very different if not contrasting In each chapter a broad tutorial introduction provides a solid physical background to the topic which is further discussed based on recent experimental results obtained via state of the art techniques Both the molecular intra chain character and the solid state inter molecular physics is addressed Reports on single molecule and single polymer chain spectroscopy introduce the on site phenomena Several chapters are dedicated to nano probes steady state and transient spectroscopies The highly ordered state occurring in single crystals is also discussed thoroughly Finally less conventional tools such as THz spectroscopy are discussed in detail The book provides a useful introduction to the field for newcomers and a valid reference for experienced researchers in the field

**Spin Correlations**

**and Excitations in Spin-frustrated Molecular and Molecule-based Magnets** Zhendong Fu, 2012

**Rare Earth**

**Coordination Chemistry** Chun-Hui Huang, 2011-09-23 Edited by a highly regarded scientist and with contributions from sixteen international research groups spanning Asia and North America Rare Earth Coordination Chemistry Fundamentals and Applications provides the first one stop reference resource for important accomplishments in the area of rare earth Consisting of two parts Fundamentals and Applications readers are armed with the systematic basic aspects of rare earth coordination chemistry and presented with the latest developments in the applications of rare earths The systematic introduction of basic knowledge application technology and the latest developments in the field makes this ideal for readers across both introductory and specialist levels

**Magnetism: A Supramolecular Function** O. Kahn, 2013-03-09 Molecular magnetism is a new field of research dealing with the synthesis and study of the physical properties of molecular assemblies involving open shell units It is essentially interdisciplinary joining together organic organometallic and inorganic chemists as well as theoreticians physicists and materials scientists At the core of research into molecular magnetism lie design and synthesis of new molecular assemblies exhibiting bulk properties such as long range magnetic ordering or bistability with an hysteresis effect which confers a memory effect on the system In such terms magnetism may be considered a supramolecular function The first eight contributions to this volume present the state of the art in organic supramolecular chemistry emphasising interlocked systems and molecular trees The following six articles are devoted to molecular materials constructed from organic radicals and transition metal units Molecular bistability is then focused on followed by metal organic and coordination magnetic materials A new approach to nano sized particles closes the work

**Advanced**

**Structural Chemistry** Rong Cao, 2021-06-28 Advanced Structural Chemistry Discover the relationships between inorganic chemical synthesis structure and property with these comprehensive and insightful volumes Advanced Structural Chemistry

Tailoring Properties of Inorganic Materials and their Applications 3 Volume Set offers readers the opportunity to discover the relationship between the structure and function of matter develop efficient and precise synthesis methodology and to understand the theoretical tools for new functional substances Advanced Structural Chemistry clarifies the relationships between synthesis and structure as well as structure and property both of which are central to the creation of new materials with unique functions In addition to subjects like the syntheses of metal oxide clusters metal organic cages and metal organic frameworks with tailored optical electric ferroelectric magnetic adsorption separation and catalytic properties the accomplished editor Rong Cao provides readers with information on a wide variety of topics such as Coordination assembled metal organic macrocycles and cages including metallacycles and metallacages The structural chemistry of metal oxo clusters including the oxo clusters of transition metal main group metal and lanthanides Synthetic approaches structural diversities and biological aspects of molybdenum based heterometallic sulfide clusters and coordination polymers Group 11 15 metal chalcogenides including discrete chalcogenide clusters synthesized in ionic liquids The structures of metal organic frameworks including one two and three dimensional MOFs Perfect for inorganic chemists structural chemists solid state chemists material scientists and solid state physicists Advanced Structural Chemistry also belongs on the bookshelves of catalytic and industrial chemists who seek to improve their understanding of the structure and functions of inorganic materials

Polyoxometalates: From Platonic Solids to Anti-Retroviral Activity M.T. Pope, Achim Müller, 2012-12-06  
MICHAEL T POPE AND ACHIM MULLER Department of Chemistry Georgetown University Washington DC 20057 2222 U S A Department of Chemistry University of Bielefeld D 4BOO Bielefeld 1 F R G Polyoxometalates from their discovery and early development in the final decades of the 19th century to their current significance in disciplines as diverse as chemistry mathematics and medicine continue to display surprisingly novel structures unexpected reactivities and applications and to attract increasing attention worldwide Most of the contributors to the present volume participated in the workshop held at the Center for Interdisciplinary Research at the University of Bielefeld July 15 17 1992 The choice of topics illustrates some of the variety of directions and fields in which polyoxometalates can play an important role Although many of the leading polyoxometalate research groups are represented here we regret that time constraints financial limitations and in some cases difficulties of communication did not allow us to include significant and important work from other groups outside Europe and North America In the following we briefly review the current status of the field of polyoxometalates

**Magnetic Molecular Materials** Dante Gatteschi, Olivier Kahn, Commission of the European Communities, European Commission. Directorate-General XII, Science, Research, and Development, Europäische Kommission Generaldirektion Wissenschaft, Forschung und Entwicklung, 1996

Functional Metal-Organic Frameworks: Gas Storage, Separation and Catalysis Martin Schröder, 2010-09-07 Microporous Organic Polymers Design Synthesis and Function By J X Jiang and A I Cooper Hydrogen Methane and Carbon Dioxide Adsorption in Metal Organic Framework Materials By X Lin N R Champness and M Schröder



Doping of Metal Organic Frameworks with Functional Guest Molecules and Nanoparticles By F Schröder and R A Fischer  
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## **Table of Contents Magnetic Molecular Materials**

1. Understanding the eBook Magnetic Molecular Materials
  - The Rise of Digital Reading Magnetic Molecular Materials
  - Advantages of eBooks Over Traditional Books
2. Identifying Magnetic Molecular Materials
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Magnetic Molecular Materials
  - User-Friendly Interface
4. Exploring eBook Recommendations from Magnetic Molecular Materials
  - Personalized Recommendations
  - Magnetic Molecular Materials User Reviews and Ratings
  - Magnetic Molecular Materials and Bestseller Lists
5. Accessing Magnetic Molecular Materials Free and Paid eBooks
  - Magnetic Molecular Materials Public Domain eBooks
  - Magnetic Molecular Materials eBook Subscription Services
  - Magnetic Molecular Materials Budget-Friendly Options

6. Navigating Magnetic Molecular Materials eBook Formats
  - ePub, PDF, MOBI, and More
  - Magnetic Molecular Materials Compatibility with Devices
  - Magnetic Molecular Materials Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Magnetic Molecular Materials
  - Highlighting and Note-Taking Magnetic Molecular Materials
  - Interactive Elements Magnetic Molecular Materials
8. Staying Engaged with Magnetic Molecular Materials
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Magnetic Molecular Materials
9. Balancing eBooks and Physical Books Magnetic Molecular Materials
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Magnetic Molecular Materials
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Magnetic Molecular Materials
  - Setting Reading Goals Magnetic Molecular Materials
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Magnetic Molecular Materials
  - Fact-Checking eBook Content of Magnetic Molecular Materials
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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