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## **KEY=MAGNETOELECTRICITY - CLARA WILSON**

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### **MAGNETOELECTRICITY IN COMPOSITES**

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**CRC Press** This book brings together numerous contributions to the field of magnetolectric (ME) composites that have been reported since the beginning of the new millennium. It presents assimilation of facts into the established knowledge, so that the potential of the field can be made transparent to the new generations of talent to advance the subject matter. This book discusses these bulk and nanostructured magnetolectric composites from both experimental and theoretical perspectives. From application viewpoint, microwave devices, sensors, transducers, and heterogeneous read/write devices are among the suggested technical implementations of magnetolectric composites.

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### **MAGNETOELECTRIC POLYMER-BASED COMPOSITES**

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#### **FUNDAMENTALS AND APPLICATIONS**

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**John Wiley & Sons** The first book on this topic provides a comprehensive and well-structured overview of the fundamentals, synthesis and emerging applications of magnetolectric polymer materials. Following an introduction to the basic aspects of polymer based magnetolectric materials and recent developments, subsequent chapters discuss the various types as well as their synthesis and characterization. There then follows a review of the latest applications, such as memories, sensors and actuators. The book concludes with a look at future technological advances. An essential reference for entrants to the field as well as for experienced researchers.

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### **MODELING OF MAGNETOELECTRIC EFFECTS IN COMPOSITES**

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**Springer** This book brings together numerous contributions to the field of magnetolectric (ME) composites that have been reported so far. Theoretical models of ME coupling in composites relate to the wide frequency range: from low-frequency to microwave ones and are based on simultaneous solving the elastostatic/elastodynamic and electrodynamic equations. Suggested models enable one to optimize magnetolectric parameters of a composite. The authors hope to provide some assimilation of facts into establish knowledge for readers new to the field, so that the potential of the field can be made transparent to new generations of talent to advance the subject matter.

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### **MAGNETOELECTRIC INTERACTION PHENOMENA IN CRYSTALS**

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**Springer Science & Business Media** In the quest for higher data density in information technology manipulation of magnetization by other means than magnetic fields has become an important challenge. This lead to a startling revival of the magnetolectric effect, which characterizes induction of a polarization by a magnetic field or of a magnetization by an electric field. The magnetolectric crosslink of material properties opens just those degrees of freedom which are needed for the mutual control of magnetic and electric states. The book gives a state-of-the-art review on magnetolectrics research, classifies current research tendencies, and points out possible future trends. Novel compounds and growth techniques and new theoretical concepts for the understanding of magnetolectric coupling phenomena are introduced. Highlights are the discovery of "gigantic" magnetolectric effects which are strong enough to trigger electric or magnetic phase transitions; the concept of magneto chirality; and development "structural" magnetolectric effects in artificial multiphase compounds. The book is addressed to condensed-matter physicists with a particular focus on experts in highly correlated systems.

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### **LEAD-FREE PIEZOELECTRICS**

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**Springer Science & Business Media** Ecological restrictions in many parts of the world are demanding the elimination of Pb from all consumer items. At this moment in the piezoelectric ceramics industry, there is no issue of more importance than the transition to lead-free materials. The goal of Lead-Free Piezoelectrics is to provide a comprehensive overview of the fundamentals and developments in the field of lead-free materials and products to leading researchers in the world. The text presents chapters on demonstrated applications of the lead-free materials, which will allow readers to conceptualize the present possibilities and will be useful for both students and professionals conducting research on ferroelectrics, piezoelectrics, smart materials, lead-free materials, and a variety of applications including sensors, actuators, ultrasonic transducers and energy harvesters.

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### **EXTENDED CHARACTERIZATIONS OF THE CONVERSE MAGNETOELECTRIC EFFECT OF 1-3 CONCENTRIC COMPOSITE MULTIFERROIC RINGS**

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Multiferroic composites have had a great emergence of recent popularity for their promising usage in electromagnetic

coupling applications. By pairing ferroelectric and ferromagnetic phases together, the composite can directly convert magnetic fields to polarization or conversely transduce electric fields to magnetization. These composites have higher efficiency of magnetoelectric coupling than their conventional counterparts, and can perform at a wider range of temperatures than their single-phase multiferroic comparable. Herein, the focus will be on the converse magnetoelectric effect to produce magnetic flux from an applied voltage on a concentric ring structure. Our previous studies have reported on the effect of the electric field direction on these composites as well as the optimal location of magnetic flux measurement on the ring. This thesis will continue characterizing the converse magnetoelectric coupling of these concentric multiferroic composite rings by reporting on three factors of DC and AC magnetic field components. The first is to look at the effect of the DC magnetic field direction in otherwise optimal conditions with respect to a bias magnetic field sweep from 0 to 2625 Oe. Second, results report the magnetoelectric coupling coefficients components at the optimal measurement location, while measuring orthogonal to the optimal measurement direction. Third, the magnetoelectric coupling coefficient components are measured at the center of the ring. For the latter two results, the converse magnetoelectric behavior reported at electric fields from 20 to 80 V/mm applied at frequencies from 1 to 50 kHz, while bias magnetic fields from 0 to 2250 Oe are applied. It was found that the DC magnetic field direction did play a role in the behavior of the ring, such that the maximum measurement was at a 60° angle from the magnetic field. Additionally, the axial component exhibited a larger magnetoelectric coefficient than the opposing orthogonal component due to the demagnetizing field's affinity towards the magnetocrystalline anisotropy. Furthermore, the inclusion of the composite ring had a notable magnetoelectric coupling at high magnetic fields due to magnetic shielding reducing the efficiency at lower magnetic fields.

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## **HANDBOOK OF MAGNETIC MATERIALS**

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Elsevier Volume 19 of the Handbook of Magnetic Materials, as the preceding volumes, has a dual purpose. As a textbook it is intended to help 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 19 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 in tabular form, much emphasis being placed on the discussion of the experimental material in the framework of physics, chemistry and material science. It provides readers with novel trends and achievements in magnetism. Composed of topical review articles written by leading authorities intended to be of assistance to those who wish to be introduced to a given topic in the field of magnetism. As a work of reference it is intended for scientists active in magnetism research. Provide the readership with novel trends and achievements in magnetism.

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## **MAGNETOELECTRIC COMPOSITES**

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CRC Press This book is dedicated to modeling and application of magnetoelectric (ME) effects in layered and bulk composites based on magnetostrictive and piezoelectric materials. Currently, numerous theoretical and experimental studies on ME composites are available but few on the development and research of instruments based on them. So far, only investigation of ME magnetic field sensors has been cited in the existing literature. However, these studies have finally resulted in the creation of low-frequency ME magnetic field sensors with parameters substantially exceeding the characteristics of Hall sensors. The book presents the authors' many years of experience gained in ME composites and through creation of device models based on their studies. It describes low-frequency ME devices, such as current and position sensors and energy harvesters, and microwave ME devices, such as antennas, attenuators, filters, gyrators, and phase shifters.

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## **HYBRID AND HIERARCHICAL COMPOSITE MATERIALS**

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Springer This book addresses a broad spectrum of areas in both hybrid materials and hierarchical composites, including recent development of processing technologies, structural designs, modern computer simulation techniques, and the relationships between the processing-structure-property-performance. Each topic is introduced at length with numerous and detailed examples and over 150 illustrations. In addition, the authors present a method of categorizing these materials, so that representative examples of all material classes are discussed.

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## **NANOSCALE FERROELECTRICS AND MULTIFERROICS**

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### **KEY PROCESSING AND CHARACTERIZATION ISSUES, AND NANOSCALE EFFECTS**

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John Wiley & Sons "Covers topics such as nanostructuring, functional ceramics based on nanopowders micromechanical systems, self-assembling and patterning, porous structures etc."--

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## **COMPOSITE TECHNOLOGIES FOR 2020**

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### **PROCEEDINGS OF THE FOURTH ASIAN-AUSTRALASIAN CONFERENCE ON COMPOSITE MATERIALS (ACCM 4)**

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Elsevier The Asian-Australasian Association for Composite Materials (AACM) has been playing a leading role in the field of composite science and technology since its inception in 1997. AACM aims to encourage the interchange of knowledge in all aspects of composite materials both in the scientific and engineering communities. Following the success of the first three ACCM conferences ACCM 4 was held in Sydney, Australia, in July 2004. Composite technologies for 2020 provides current state-of-the-art achievements and recent advances in composite science and

technologies bringing together leading experts and innovators in the field. Nearly 200 selected papers, classified under 18 different categories ranging from general manufacturing and processing techniques to the latest and hottest topics such as nano-composites and eco-bio composites. Together they represent an authoritative documentation of current advances in the field of composite materials.

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### **FRONTIERS OF FERROELECTRICITY**

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#### **A SPECIAL ISSUE OF THE JOURNAL OF MATERIALS SCIENCE**

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Springer Science & Business Media This book presents theory, fundamentals and applications of ferroelectricity. 24 chapters gather reviews and research reports covering the spectrum of ferroelectricity. It describes the current levels of understanding of various aspects of ferroelectricity as presented by authorities in the field. Topics include relaxors, piezoelectrics, microscale and nanoscale studies, polymers and composites, unusual properties, and techniques and devices. The book is intended for physicists, engineers and materials scientists working with ferroelectric materials.

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### **FERROELECTRICS**

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#### **PHYSICAL EFFECTS**

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BoD - Books on Demand Ferroelectric materials have been and still are widely used in many applications, that have moved from sonar towards breakthrough technologies such as memories or optical devices. This book is a part of a four volume collection (covering material aspects, physical effects, characterization and modeling, and applications) and focuses on the underlying mechanisms of ferroelectric materials, including general ferroelectric effect, piezoelectricity, optical properties, and multiferroic and magnetoelectric devices. The aim of this book is to provide an up-to-date review of recent scientific findings and recent advances in the field of ferroelectric systems, allowing a deep understanding of the physical aspect of ferroelectricity.

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### **ADVANCED MATERIALS RESEARCH VIII**

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Trans Tech Publications Ltd 8th International Conference on Advanced Materials Research (ICAMR-2018) Selected, peer reviewed papers from the 8th International Conference on Advanced Materials Research (ICAMR-2018, January 20-22, 2018, Fukuoka, Japan)

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### **HANDBOOK OF MAGNETIC MATERIALS**

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Elsevier Handbook of Magnetic Materials covers the expansion of magnetism over the last few decades and its applications in research, notably the magnetism of several classes of novel materials that share with truly ferromagnetic materials the presence of magnetic moments. Volume 24 of the Handbook of Magnetic Materials, much like the preceding volumes, has a dual purpose. With contributions from leading authorities in the field, it includes a variety of self-contained introductions to a given area in the field of magnetism without requiring recourse to the published literature. The book is an ideal reference for scientists active in magnetism research, providing readers with novel trends and achievements in magnetism. Each article contains an extensive description given in graphical, as well as, tabular form, with much emphasis placed on the discussion of the experimental material within the framework of physics, chemistry, and material science. Comprises topical review articles written by leading authorities Includes a variety of self-contained introductions to a given area in the field of magnetism without requiring recourse to the published literature Introduces given topics in the field of magnetism Describes novel trends and achievements in magnetism

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### **HIGH-PERFORMANCE CERAMICS IV**

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Trans Tech Publications Ltd Volume is indexed by Thomson Reuters CPCI-S (WoS).

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### **MAGNETOELECTRICITY IN COMPOSITES**

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CRC Press This book brings together numerous contributions to the field of magnetoelectric (ME) composites that have been reported since the beginning of the new millennium. It presents assimilation of facts into the established knowledge, so that the potential of the field can be made transparent to the new generations of talent to advance the subject matter. This book discusses these bulk and nanostructured magnetoelectric composites from both experimental and theoretical perspectives. From application viewpoint, microwave devices, sensors, transducers, and heterogeneous read/write devices are among the suggested technical implementations of magnetoelectric composites.

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### **ADVANCES IN MANUFACTURING SCIENCE AND ENGINEERING**

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Trans Tech Publications Ltd Selected, peer reviewed papers from the 4th international Conference on Manufacturing Science and Engineering (ICMSE 2013), March 30-31, 2013, Dalian, China

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### **PROCEEDINGS OF THE SEVENTH ASIA INTERNATIONAL SYMPOSIUM ON MECHATRONICS**

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#### **VOLUME II**

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Springer Nature This book presents high-quality papers from the Seventh Asia International Symposium on Mechatronics (AISM 2019). It discusses the latest technological trends and advances in electromechanical coupling and

environmental adaptability design for electronic equipment, sensing and measurement, mechatronics in manufacturing and automation, micro-mechatronics, energy harvesting & storage, robotics, automation and control systems. It includes papers based on original theoretical, practical and experimental simulations, development, applications, measurements, and testing. The applications and solutions discussed here provide excellent reference material for future product developments.

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## **MATERIALS, MECHANICAL ENGINEERING AND MANUFACTURE**

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Trans Tech Publications Ltd These proceedings contain the accepted papers from the Second International Conference on Applied Mechanics, Materials and Manufacturing (ICAMMM 2012), held in Changsha, China, November 17-18, 2012. Volume is indexed by Thomson Reuters CPCI-S (WoS). The papers are grouped as follows: Chapter 1: Composites and Polymers; Chapter 2: Micro/Nano Materials; Chapter 3: Environmental-Friendly Materials and Biological Materials; Chapter 4: Iron, Steel and Alloys; Chapter 5: Materials Processing and Chemical Technologies; Chapter 6: Buildings and Constructions. Materials and Technologies; Chapter 7: CAD/CAM/CAE; Chapter 8: New Energy and Heat Transfer; Chapter 9: Applied Mechanics and Mechanical Engineering; Chapter 10: Mechatronics and Control Technology; Chapter 11: Measurement, Testing and Detection; Chapter 12: Applications of Information Technology and Computer in Industry; Chapter 13: Product Design Technology; Chapter 14: Engineering Management and Engineering Education.

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## **MULTIFERROIC MATERIALS**

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### **PROPERTIES, TECHNIQUES, AND APPLICATIONS**

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CRC Press "a very detailed book on multiferroics that will be useful for PhD students and researchers interested in this emerging field of materials science" —Dr. Wilfrid Prellier, Research Director, CNRS, Caen, France Multiferroics has emerged as one of the hottest topics in solid state physics in this millennium. The coexistence of multiple ferroic/antiferroic properties makes them useful both for fundamental studies and practical applications such as revolutionary new memory technologies and next-generation spintronics devices. This book provides an historical introduction to the field, followed by a summary of recent progress in single-phase multiferroics (type-I and type-II), multiferroic composites (bulk and nano composites), and emerging areas such as domain walls and vortices. Each chapter addresses potential technological implications. There is also a section dedicated to theoretical approaches, both phenomenological and first-principles calculations.

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## **JJAP**

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### **MULTIFUNCTIONAL OXIDE HETEROSTRUCTURES**

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OUP Oxford This book is devoted to the rapidly developing field of oxide thin-films and heterostructures. Oxide materials combined with atomic-scale precision in a heterostructure exhibit an abundance of macroscopic physical properties involving the strong coupling between the electronic, spin, and structural degrees of freedom, and the interplay between magnetism, ferroelectricity, and conductivity. Recent advances in thin-film deposition and characterization techniques made possible the experimental realization of such oxide heterostructures, promising novel functionalities and device concepts. The book consists of chapters on some of the key innovations in the field over recent years, including strongly correlated oxide heterostructures, magnetoelectric coupling and multiferroic materials, thermoelectric phenomena, and two-dimensional electron gases at oxide interfaces. The book covers the core principles, describes experimental approaches to fabricate and characterize oxide heterostructures, demonstrates new functional properties of these materials, and provides an overview of novel applications.

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## **SCIENCE AND TECHNOLOGY HYBRID MATERIALS**

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Trans Tech Publication Advances in the welfare of humans tends to be directly related to advances in the science and technology of advanced materials. Hybrid materials make up just one such class of materials, and they are unique in the sense that they exhibit properties that cannot be achieved by using conventional materials design and - at the same time - cannot be predicted by using conventional extrapolations: such as a simple weighted average of the constituents' properties.

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## **ADVANCED LIGHTWEIGHT MULTIFUNCTIONAL MATERIALS**

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Woodhead Publishing Advanced Lightweight Multifunctional Materials presents the current state-of-the-art on multifunctional materials research, focusing on different morphologies and their preparation and applications. The book emphasizes recent advances on these types of materials as well as their application. Chapters cover porous multifunctional materials, thermochromic and thermoelectric materials, shape memory materials, piezoelectric multifunctional materials, electrochromic and electrorheological, soft materials, magnetic and photochromic materials, and more. The book will be a valuable reference resource for academic researchers and industrial engineers working in the design and manufacture of multifunctional materials, composites and nanocomposites. Provides detailed information on design, modeling and structural applications Focuses on characteristics, processing, design and applications Discusses the main types of lightweight multifunctional materials and processing techniques, as well as the physico-chemical insights that can lead to improved performance

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## **MAGNETIC, FERROELECTRIC, AND MULTIFERROIC METAL OXIDES**

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Elsevier **Magnetic, Ferroelectric, and Multiferroic Metal Oxides** covers the fundamental and theoretical aspects of ferroics and magnetolectrics, their properties, and important technological applications, serving as the most comprehensive, up-to-date reference on the subject. Organized in four parts, Dr. Biljana Stojanovic leads expert contributors in providing the context to understand the material (Part I: Introduction), the theoretical and practical aspects of ferroelectrics (Part II: Ferroelectrics: From Theory, Structure and Preparation to Application), magnetic metal oxides (Part III: Magnetic Oxides: Ferromagnetics, Antiferromagnetics and Ferrimagnetics), multiferroics (Part IV: Multiferroic Metal Oxides) and future directions in research and application (Part V: Future of Metal Oxide Ferroics and Multiferroics). As ferroelectric materials are used to make capacitors with high dielectric constant, transducers, and actuators, and in sensors, reed heads, and memories based on giant magnetoresistive effects, this book will provide an ideal source for the most updated information. Addresses ferroelectrics, ferromagnetics and multiferroelectrics, providing a one-stop reference for researchers Provides fundamental theory and relevant, important technological applications Highlights their use in capacitors with high dielectric constant, transducers, and actuators, and in sensors, reed heads, and memories based on giant magnetoresistive effects

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## **NANOSTRUCTURES AND THIN FILMS FOR MULTIFUNCTIONAL APPLICATIONS**

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### **TECHNOLOGY, PROPERTIES AND DEVICES**

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Springer This book is focused on recent advances in the development of thin films for photovoltaic applications, TiO<sub>2</sub>/WO<sub>3</sub> bi-layers for applications with enhanced photo-catalytic properties, nanometer oxide and hydroxide films for anticorrosive coatings, surface passivation in chemical industries, micro- and nanoelectronics, trilayers of metglas and lead free piezoelectrics for magnetic field sensors, current sensors, spintronics, microwave and read/write devices. Diluted ferromagnetic alloy films are also considered for superconducting spintronics based on superconducting spin-valves. Thermal properties of segmented nanowires are analyzed with respect to thermoelectric applications. Recent advances in template production of nanocomposites are also reviewed with particular focus on technologies for template assisted formation of metal nanotubes. Some elements related to abrasive flow machining (AFM), specifically state of the art elements of technological systems and construction of equipment are presented. The book is written for researchers in materials science, nanotechnologies, PhD students and graduate student.

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## **HYBRID PEROVSKITE COMPOSITE MATERIALS**

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### **DESIGN TO APPLICATIONS**

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Woodhead Publishing **Hybrid Composite Perovskite Materials: Design to Applications** discusses the manufacturing, design and characterization of organic-inorganic perovskite composite materials. The book goes beyond the basics of characterization and discusses physical properties, surface morphology and environmental stability. Users will find extensive examples of real-world products that are suitable for the needs of the market. Following a logical order, the book begins with mathematical background and then covers innovative approaches to physical modeling, analysis and design techniques. Numerous examples illustrate the proposed methods and results, making this book a sound resource on the modern research application of perovskite composites with real commercial value. Discusses the composition of perovskite materials and their properties, manufacturing and environmental stability Includes both fundamentals and state-of-the-art developments Features the main types of applications, including solar cells, photovoltaics, sensors and optoelectronic devices

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## **MULTIFUNCTIONAL NANOSTRUCTURED METAL OXIDES FOR ENERGY HARVESTING AND STORAGE DEVICES**

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CRC Press Metal oxide nanoparticles exhibit potential applications in energy and environmental fields, such as solar cells, fuel cells, hydrogen energy, and energy storage devices. This book covers all points from synthesis, properties, and applications of transition metal oxide nanoparticle materials in energy storage and conversion devices. Aimed at graduate-level students and researchers associated with the energy and environment sector, this book addresses the application of nontoxic and environmentally friendly metal oxide materials for a clean environment and deals with synthesis properties and application metal oxides materials for energy conversion, energy storage, and hydrogen generation.

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## **PROCEEDINGS OF THE ASME CONFERENCE ON SMART MATERIALS, ADAPTIVE STRUCTURES AND INTELLIGENT SYSTEMS--2009**

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### **PRESENTED AT ASME 2009 CONFERENCE ON SMART MATERIALS, ADAPTIVE STRUCTURES AND INTELLIGENT SYSTEMS, SEPTEMBER 21-23, 2009, OXNARD, CALIFORNIA USA**

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A collection of 81 full-length, peer-reviewed technical papers that covers such topics as: Bio-inspired Smart Materials and Structures; Enabling Technologies and Integrated System Design; Multifunctional Materials; and, Structural Health Monitoring/NDE.

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## **A MICROMECHANICS STUDY ON CARBON-BASED AND MULTIFERROIC COMPOSITES**

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In this thesis, two physical properties of modern composites are studied. One is the electrical conductivity of carbon nanotube- and graphene-based polymer nanocomposites, and the other is the magnetolectric coupling of highly

anisotropic piezoelectric-piezomagnetic multiferroic composites. Along the way, several related issues have also been examined. These include percolation threshold, interfacial resistance, electron tunneling, and filler agglomeration in the first case, and, in the second one, the influence of aspect ratio of inclusions, imperfect interface, and phase connectivity. The studies of these two problems are linked by the common theme of micromechanics theory but cast in different settings. The effective electrical conductivity and percolation threshold of CNT-based nanocomposites are investigated with the effective-medium approach as the backbone. We then introduce of a diminishing layer of interface with an interfacial resistivity that is further modified by Cauchy's statistical distribution function to account for the additional tunneling-assisted interfacial conductivity. The issue of filler agglomeration is examined in details for graphene-based nanocomposites, in which a two-scale effective-medium approach with graphene-rich and graphene-poor regions is also developed. Our predictions are shown to be in close agreement with experimental data. For multiferroic composites, our focus is on the intriguing property of magnetoelectric coupling coefficient which is absent in either piezoelectric or piezomagnetic phase but owned by overall composites. We study this iconic effect in depth for BaTiO<sub>3</sub>-CoFe<sub>2</sub>O<sub>4</sub> system with different types of connectivity, including 1-3, 0-3, 2-2, that display the inclusion-matrix morphology, and 1-1, 0-0 connectivity that are marked by their symmetric geometrical footing. These two classes of composites are analyzed by the Mori-Tanaka method and the effective-medium approach, respectively. We demonstrate how the magnetoelectric coupling coefficients are highly dependent on the phase volume concentration, inclusion aspect ratio, interface effect, and phase connectivity. Our results also reveal that the magnetoelectric coupling of 0-0 connectivity are substantially higher than that of 0-3 connectivity, but the difference between 1-1 and 1-3 connectivity is limited. In the end, we point to the need of exploring the physical mechanism of interfacial resistance for carbon-based nanocomposites and the nonlinear coupling behaviors for ferroelectric-ferromagnetic composites in our future work.

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## **SUSTAINABLE MATERIALS**

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Trans Tech Publications Ltd This book contains articles which were introduced at the International Conference on Sustainable Materials (ICoSM 2018, 16 April, 2018, Bangkok, Thailand) and presents to readers the results of the innovative research in the area of the sustainable materials - one of the most dynamics directions of research in the modern materials science.

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## **MECHATRONICS AND INDUSTRIAL INFORMATICS**

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Trans Tech Publications Ltd This volume records the accepted papers of 2013 International Conference on Mechatronics and Industrial Informatics (ICMII 2013) which took place in Guangzhou, China between 30-31 March 2013. Volume is indexed by Thomson Reuters CPCI-S (WoS). The papers are grouped as follows: Chapter 1: Theory of Mechanisms and Mechanical Engineering, Dynamics of System Applications; Chapter 2: Materials Research, Manufacturing Technologies in Materials; Chapter 3: Electronics and Microelectronics Technology; Chapter 4: Optoelectronic Devices and Technology; Chapter 5: Sensors and Information Fusion Technology; Chapter 6: Measurement Technology and Instruments; Chapter 7: Modeling and Simulation Technology of Systems; Chapter 8: Voice, Image and Video Processing; Chapter 9: Signal Processing Systems Design and Implementation; Chapter 10: Power Engineering and Automation; Chapter 11: Industrial Robotics and Automation; Chapter 12: Vehicle Control Systems; Chapter 13: Design and Control in Modern System Engineering and Mechatronics; Chapter 14: Intelligent Control, Structural Engineering Analysis, CAD Optimized Design; Chapter 15: Artificial Intelligence Techniques; Chapter 16: Intelligent Optimization Algorithms and Applications; Chapter 17: Computer Information Processing Technology; Chapter 18: Industrial Informatics and Applications; Chapter 19: Database System; Chapter 20: Information Security; Chapter 21: Computer Networks and Communication; Chapter 22: Software Engineering; Chapter 23: E-Commerce/E-Government; Chapter 24: Engineering Management and Engineering Education

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## **THIN FILM PHYSICS AND DEVICES: FUNDAMENTAL MECHANISM, MATERIALS AND APPLICATIONS FOR THIN FILMS**

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World Scientific Thin films have an extremely broad range of applications from electronics and optics to new materials and devices. Collaborative and multidisciplinary efforts from physicists, materials scientists, engineers and others have established and advanced a field with key pillars constituting (i) the synthesis and processing of thin films, (ii) the understanding of physical properties in relation to the nanometer scale, (iii) the design and fabrication of nano-devices or devices with thin film materials as building blocks, and (iv) the design and construction of novel tools for characterization of thin films. Against the backdrop of the increasingly interdisciplinary field, this book sets off to inform the basics of thin film physics and thin film devices. Readers are systematically introduced to the synthesis, processing and application of thin films; they will also study the formation of thin films, their structure and defects, and their various properties — mechanical, electrical, semiconducting, magnetic, and superconducting. With a primary focus on inorganic thin film materials, the book also ventures on organic materials such as self-assembled monolayers and Langmuir-Blodgett films. This book will be effective as a teaching or reference material in the various disciplines, ranging from Materials Science and Engineering, Electronic Science and Engineering, Electronic Materials and Components, Semiconductor Physics and Devices, to Applied Physics and more. The original Chinese publication has been instrumental in this purpose across many Chinese universities and colleges.

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## **INORGANIC MATERIALS**

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**MAGNETOELECTRIC COUPLING IN MULTIFUNCTIONAL NANOSTRUCTURED COMPLEX OXIDE THIN FILMS**

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**PROCEEDINGS OF THE ASME AEROSPACE DIVISION**

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**COMPOSITE MULTIFERROICS AND MAGNETOELECTRIC SKYRMIONS**

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Condensed matter physics has made an enormous progress in the understanding and developing of materials, such as ferromagnets, ferroelectrics, multiferroics, chiral-magnets and composite systems. This offers possibilities to investigate new material devices, where these properties can be utilized for future technologies. In my Ph.D. thesis, we study the magnetic and electrical responses of field-driven behaviors in materials. Chapter 1: Magnetic Spins and their Dynamics. We study the conventional magnetic spins with a classical Heisenberg model to characterize the energy of magnetization in micromagnetics. Particularly, the dynamics of spins are solved by the well-known Landau-Lifshitz-Gilbert equation. Chapter 2: Electric Pseudospins and their Dynamics. We investigate a pseudospin model to describe the electric polarization in ferroelectric materials. Pseudospins are based on a transverse Ising model to characterize the local energy, is generally believed to be a good microscopic description of the electric dipoles. The novelty here is that, a spin dynamics approach has been developed to solve the time evolution of pseudospins by a modified Landau-Lifshitz-Gilbert equation. Results show a flipping-like behavior with respect to the electric dipole moments. Chapter 3: Dynamical Responses in Composite Multiferroics. Composite multiferroics are the heterostructures of ferromagnetic and ferroelectric materials with a remarkable magnetolectric effect at the interface. We support the ferromagnetic structure with magnetic spins and the ferroelectric structure with pseudospins who act as the electric dipoles in microscopic models. To demonstrate the performances of responses in the driving and driven parts is the aim of this chapter. In this work, four numerical models are considered, such as a 1D composite chain, 1D composite ladder, 2D composite film and 2D composite film with twisted boundary conditions, to investigate different field-driven behaviors in composite multiferroics. Chapter 4: Magnetolectric Skyrmions in Composite Systems. Skyrmions are topologically particle-like magnetic textures realized with a range of sizes from 10nm to approximately 100nm. They occur in chiral-magnetic materials where an asymmetric exchange interaction breaks the inversion symmetry. The study of Skyrmions in composite systems has attracted much interest in recent years. This chapter reports the magnetic Skyrmions are induced by electric fields in a composite bilayer model. By using the spin dynamics method, a classical magnetic spin model and an electric pseudospin model are coupled with a strong magnetolectric coupling have been proposed in the dynamical simulations. Interestingly, we observe some Skyrmion-like objects in the electric component either by applying an electric field or a magnetic field, which is due to the connection between the electric and magnetic structures. Chapter 5: Mechanical Methods of the Skyrmion Transport. The inherent stability of Skyrmions combined with their low pinning probability to defects are intriguing characteristics that have attracted lately much attention within the spintronics community for possible applications in memory devices. In order to efficiently use Skyrmions as information carriers their motion must be controllable. Recent studies revealed several non-mechanical methods, such as by using magnetic fields, spin-polarized currents, electric currents, magnons and temperature gradients. However, inducing Skyrmions in a composite system by means of external driving has not been explored. In this chapter, we aim to develop two innovative electrical techniques to create and manipulate Skyrmions in composite systems. One is driven by a movable and polarized ferroelectric film, and the other is driven by a mobile electric field source. Effects caused by different propagation velocity, film size, and magnetolectric coupling strength strongly impacting on stability and efficiency of the Skyrmion transport.

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**ANNUAL MEETING ABSTRACTS**

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**BEHAVIOR AND MECHANICS OF MULTIFUNCTIONAL AND COMPOSITE MATERIALS 2007**

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**19-22 MARCH, 2007, SAN DIEGO, CALIFORNIA**

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Society of Photo Optical Proceedings of SPIE present the original research papers presented at SPIE conferences and other high-quality conferences in the broad-ranging fields of optics and photonics. These books provide prompt access to the latest innovations in research and technology in their respective fields. Proceedings of SPIE are among the most cited references in patent literature.