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ferroelectric and piezoelectric materials. The control of functional properties of piezoelectric and ferroelectric materials at decreasing length-scales can open up possibilities to build new □smart devices□. Characterization of piezoelectric thin films with high accuracy and reliability is essential to understand all

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This book presents recent advances in the field of nanoscale characterization of ferroelectric materials using scanning probe microscopy (SPM). It addresses various imaging mechanisms of ferroelectric domains in SPM, quantitative analysis of the piezoresponse signals as well as basic physics of ferroelectrics at the nanoscale level, such as nanoscale switching, scaling effects, and transport behavior.

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Ferroelectric Materials - Synthesis and Characterization. Edited by: Aime Pelaiz Barranco. ISBN 978-953-51-2147-3, PDF ISBN 978-953-51-6380-0, Published 2015-07-29. Ferroelectric materials receive great attention from the scientific international community because of the interesting phenomena they exhibit and their multiple applications such as transducers, capacitors, pyroelectric sensors, sonars, random access memories, etc.

~~Ferroelectric Materials - Synthesis and Characterization ...~~
Characterisation of ferroelectric bulk materials and thin films . By Markys G Cain. Abstract. This book presents a comprehensive review of the most important methods used in the characterisation of piezoelectric, ferroelectric and pyroelectric materials. It covers techniques for the analysis of bulk materials and thick and thin film materials ...

This book presents a comprehensive review of the most important methods used in the characterisation of piezoelectric, ferroelectric and pyroelectric materials. It covers techniques for the analysis of bulk materials and thick and thin film materials and devices. There is a growing demand by industry to adapt and integrate piezoelectric materials into ever smaller devices and structures. Such applications development requires the joint development of reliable, robust, accurate and □ most importantly □ relevant and applicable measurement and characterisation methods and models. In the past few years there has been a rapid development of new techniques to model and measure the variety of properties that are deemed important for applications development engineers and scientists. The book has been written by the leaders in the field and many chapters represent established measurement best practice, with a strong emphasis on application of the methods via worked examples and detailed experimental procedural descriptions. Each chapter contains numerous diagrams, images, and measurement data, all of which are fully referenced and indexed. The book is intended to occupy space in the research or technical lab, and will be a valuable and practical resource for students, materials scientists, engineers, and lab technicians.

Ferroelectric field effect transistor (FeFET) memories based on a new type of ferroelectric material (silicon doped hafnium oxide) were studied within the scope of the present work. Utilisation of silicon doped hafnium oxide (Si:HfO2 thin films instead of conventional perovskite ferroelectrics as a functional layer in FeFETs provides compatibility to the CMOS process as well as improved device scalability. The influence of different process parameters on the properties of Si:HfO2 thin films was analysed in order to gain better insight into the occurrence of ferroelectricity in this system. A subsequent examination of the potential of this material as well as its possible limitations with the respect to the application in non-volatile memories followed. The Si:HfO2-based ferroelectric transistors that were fully integrated into the state-of-the-art high-k metal gate CMOS technology were studied in this work for the first time. The memory performance of these devices scaled down to 28 nm gate length was investigated. Special attention was paid to the charge trapping phenomenon shown to significantly affect the device behaviour.

The need to more efficiently harvest energy for electronics has spurred investigation into materials that can harvest energy from locally abundant sources. Ferroelectric Materials for Energy Harvesting and Storage is the first book to bring together fundamental mechanisms for harvesting various abundant energy sources using ferroelectric and piezoelectric materials. The authors discuss strategies of designing materials for efficiently harvesting energy sources like solar, wind, wave, temperature fluctuations, mechanical vibrations, biomechanical motion, and stray magnetic fields. In addition, concepts of the high density energy storage using ferroelectric materials is explored. Ferroelectric Materials for Energy Harvesting and Storage is appropriate for those working in materials science and engineering, physics, chemistry and electrical engineering disciplines. Reviews wide range of energy harvesting including solar, wind, biomechanical and more Discusses ferroelectric materials and their application to high energy density capacitors Includes review of fundamental mechanisms of energy harvesting and energy solutions, their design and current applications, and future trends and challenges

This book highlights current trends and research advances in nanotechnology and its applications. It discusses the synthesis and characterization of nanomaterials / nanocomposites for novel applications in environmental monitoring and sustainability, and presents new findings on wastewater treatment technologies using nanofiltration membranes.

This book presents recent advances in the field of nanoscale characterization of ferroelectric materials using scanning probe microscopy (SPM). It addresses various imaging mechanisms of ferroelectric domains in SPM, quantitative analysis of the piezoresponse signals as well as basic physics of ferroelectrics at the nanoscale level, such as nanoscale switching, scaling effects, and transport behavior. This state-of-the-art review of theory and experiments on nanoscale polarization phenomena will be a useful reference for advanced readers as well for newcomers and graduate students interested in the SPM techniques. The non-specialists will obtain valuable information about different approaches to electrical characterization by SPM, while researchers in the ferroelectric field will be provided with details of SPM-based measurements of ferroelectrics.

Provides in-depth knowledge on lead-free piezoelectrics - for state-of-the-art, environmentally friendly electrical and electronic devices! Lead zirconate titanate ceramics have been market-dominating due to their excellent properties and flexibility in terms of compositional modifications. Driven by the Restriction of Hazardous Substances Directive, there is a growing concern on the toxicity of lead. Therefore, numerous research efforts were devoted to lead-free piezoelectrics from the beginning of this century. Great progress has been made in the development of high-performance lead-free piezoelectric ceramics which are already used, e.g., for power electronics applications. Lead-Free Piezoelectric Materials provides an in-depth overview of principles, material systems, and applications of lead-free piezoelectric materials. It starts with the fundamentals of piezoelectricity and lead-free piezoelectrics. Then it discusses four representative lead-free piezoelectric material systems from background introduction to crystal structures and properties. Finally, it presents several applications of lead-free piezoelectrics including piezoelectric actuators, and transducers. The challenges for promoting applications will also be discussed. Highly attractive: Lead-free piezoelectrics address the growing concerns on exclusion of hazardous substances used in electrical and electronic devices in order to protect human health and the environment Thorough overview: Covers fundamentals, different classes of materials, processing and applications Unique: discusses fundamentals and recent advancements in the field of lead-free piezoelectrics Lead-Free Piezoelectric Materials is of high interest for material scientists, electrical and chemical engineers, solid state chemists and physicists in academia and industry.

Degradation is apparent in all things and is fundamental to both manufactured and natural objects. It is often described by the second law of thermodynamics, where entropy, a measure of disorder, tends to increase with time in a closed system. Things age! This concise reference work brings together experts and key players engaged in the physics of degradation to present the background science, current thinking and developments in understanding, and gives a detailed account of emerging issues across a selection of engineering applications. The work has been put together to equip the upper level undergraduate student, postgraduate student, as well as the professional engineer and scientist, in the importance of physics of degradation. The aim of The Physics of Degradation in Engineered Materials and Devices is to bridge the gap between published textbooks on the fundamental science of degradation phenomena and published research on the engineering science of actual fabricated materials and devices. A history of the observation and understanding of physics of degradation is presented and the fundamentals and principles of thermodynamics and entropy are extensively discussed. This is the focus of this book, with an extended chapter by Alec Feinberg on equilibrium thermodynamic damage and non-equilibrium thermodynamic damage. It concludes with two particular technologies to give examples of areas of application.

This book thoroughly reviews the present knowledge on silicon micromechanical transducers and addresses emerging and future technology challenges. Readers will acquire a solid theoretical and practical background that will allow them to analyze the key performance aspects of devices, critically judge a fabrication process, and then conceive and design new ones for future applications. Envisioning a future complex versatile microsystem, the authors take inspiration from Richard Feynman's visionary talk "There is Plenty of Room at the Bottom" to propose that the time has come to see silicon sensors as part of a "Feynman Roadmap" instead of the "More-than-Moore" technology roadmap. The sharing of the author's industrially proven track record of development, design, and manufacturing, along with their visionary approach to the technology, will allow readers to jump ahead in their understanding of the core of the topic in a very effective way. Students, researchers, engineers, and technologists involved in silicon-based sensor and actuator research and development will find a wealth of useful and groundbreaking information in this book.

The first book on this topic provides a comprehensive and well-structured overview of the fundamentals, synthesis and emerging applications of magnetoelectric polymer materials. Following an introduction to the basic aspects of polymer based magnetoelectric 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.

My Ph. D. work is on altering material properties to improve or apply in device applications and probing the manipulated properties through linear/ nonlinear optical methods. I focused my study on three types of structural modifications. First, in Chapter 2, I applied strain on a 3D integrated silicon circuit structure and BaTiO3 thin film. Silicon, well-understood bulk material and most popular semiconductor platform, acquires new electronic and optical properties under strain. In addition, one can significantly control the ferroelectric and electro-optic properties of BaTiO3 thin film, a traditional perovskite ferroelectric, by applying strain via a piezoelectric substrate, as shown in Chapter 5. Second, I engineered well-characterized bulk materials into thin films, as thin as 1 nm. In Chapter 4, I measured retention time of ferroelectric polarization on BaTiO3 film thicknesses in the range of 10-20 nm. In addition, the thickness of the layers of a 2D material, e.g. In2Se3, introduces variations in bandgaps, dielectric functions, and/or absorption, which will be shown in Chapter 6. Lastly, I characterized the displacive and disorder-to-order transitions in ferroelectric materials. For example, in Chapter 3, we discovered order-disorder ferroelectric mechanism in double perovskites synthesized by Spark-plasma-sintering method and studied their Curie temperatures. Through these projects, I discovered new ways of controlling material properties and studied their underlying origins of the emerging phenomena using optical methods