

Piezoelectric Ceramics Principles And Applications

The book discusses the underlying physical principles of piezoelectric materials, important properties of ferroelectric/piezoelectric materials used in today’s transducer technology, and the principles used in transducer design. It provides examples of a wide range of applications of such materials along with the appertaining rationales. With contributions from distinguished researchers, this is a comprehensive reference on all the pertinent aspects of piezoelectric materials.

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.

Ultrasonic transducers are key components in sensors for distance, flow and level measurement as well as in power, biomedical and other applications of ultrasound. Ultrasonic transducers reviews recent research in the design and application of this important technology. Part one provides an overview of materials and design of ultrasonic transducers. Piezoelectricity and basic configurations are explored in depth, along with electromagetic acoustic transducers, and the use of ceramics, thin film and single crystals in ultrasonic transducers. Part two goes on to investigate modelling and characterisation, with performance modelling, electrical evaluation, laser Doppler vibrometry and optical visualisation all considered in detail. Applications of ultrasonic transducers are the focus of part three, beginning with a review of surface acoustic wave devices and air-borne ultrasound transducers, and going on to consider ultrasonic transducers for use at high temperature and in flaw detection systems, power, biomedical and micro-scale ultrasonics, therapeutic ultrasound devices, piezoelectric and fibre optic hydrophones, and ultrasonic motors are also described. With its distinguished editor and expert team of international contributors,Ultrasonic transducers is an authoritative review of key developments for engineers and materials scientists involved in this area of technology as well as in its applications in sectors as diverse as electronics, wireless communication and medical diagnostics. Reviews recent research in the design and application of ultrasonic transducers Provides an overview of the materials and design of ultrasonic transducers, with an in-depth exploration of piezoelectricity and basic configurations Investigates modelling and characterisation, applications of ultrasonic transducers, and ultrasonic transducers for use at high temperature and in flaw detection systems

Advanced Ceramics for Versatile Interdisciplinary Applications describes recent progress in ceramic synthesis and their applications in areas of catalysis, lithium-ion batteries, microbial fuel cells, and biomedical applications. Advancements in ceramic syntheses, such as laser additive manufacturing technologies are also discussed, as are developments in magnetic-based, doped and piezoelectric ceramics and their applications. Other sections cover mixed ionic-electronic conducting ceramic membranes for electrochemical applications, ceramic separators for microbial fuel cells, ceramic polymer composites for lithium-ion batteries, and hybrid ceramic nanocomposites for catalysis applications. The use of metal and metal oxide nanostructures as antimicrobial agents offer a wide range of advantages, ranging from straightforward synthesis to less prone towards resistance development by microbes. Finally, the development of biocompatible ceramic materials, mechanical and chemical properties, and applications are discussed in detail. The book will be useful for new researchers, academics and postgraduate students all working in the area of ceramics and their potential applications. Focuses on the optical and electrochemical properties of advanced ceramic materials and MXenes Covers synthesis, characterization techniques and a diverse range of applications, including energy and biomaterials Contains contributions from a diverse range of backgrounds across chemistry, physics, materials science, engineering, medical science, environmental and industrial technology, biotechnology and biomedical engineering

Electric and Magnetic Ceramics, Bioceramics, Ceramics and Environment

Ferroelectrics

Electronic Ceramics

Handbook of Advanced Ceramics

Ultrasonic Transducer Materials

Piezoelectric Nanomaterials for Biomedical Applications

Piezoelectric CeramicsPrinciples and Applications

Discovered in 1880, piezoelectric materials play a key role in an innovative market of several billions of dollars. Recent advances in applications derive from new materials and their development, as well as to new market requirements. With the exception of quartz, ferroelectric materials are used for they offer both high efficiency and sufficient versatility to meet adequately the multidimensional requirements for application. Consequently, strong emphasis is placed on tailoring materials and technology, whether one deals with single crystals, ceramics or plastic materials. Tailoring requires a basic understanding of both physical principles and technical possibilities and limitations. This report elucidates these developments by a broad spectrum of examples, comprising ultrasound in medicine and defence industry, frequency control, signal processing by SAW-devices, sensors, actuators, including novel valves for modern motor management. It delivers a mutual fertilization of technology push and market pull that should be of interest not only to materials scientists or engineers but also to managers who dedicate themselves to a sound future-oriented R&D policy.

The current book consists of twenty-four chapters divided into three sections. Section I includes fourteen chapters in electric and magnetic ceramics which deal with modern specific research on dielectrics and their applications, on nanodielectrics, on piezoceramics, on glass ceramics with para-, anti- or ferro-electric active phases, of varistors ceramics and magnetic ceramics. Section II includes seven chapters in bioceramics which include review information and research results/data on biocompatibility, on medical applications of alumina, zirconia, silicon nitride, ZrO2, bioglass, apatite-wollastonite glass ceramic and b-tri-calcium phosphate. Section III includes three chapters in applications of ceramics in environmental improvement and protection, in water cleaning, in metal bearing wastes stabilization and in utilization of wastes from ceramic industry in concrete and concrete products.

Piezoelectric Ceramics focuses on the relationship between piezoelectricity and ferroelectricity as they apply to ceramics, taking into consideration the properties of materials that are being used and possibly be used in the industries. Composed of 12 chapters, the book starts by tracing the history of piezoelectricity and how this affects ceramics. The different measurement techniques are discussed, including dielectric, ferroelectric, and piezoelectric measurements. The book proceeds by discussing Perovskite structure and barium titanate. Covered areas include electric field, piezoelectric properties, particle size effect, and dielectric strength. The properties, compositions, and reactions of various perovskites are discussed. Numerical analyses are presented in this regard. The book also offers interpretations of the experiments conducted. The discussions end with the processes involved in the manufacture and applications of piezoelectric ceramics. Concerns in manufacturing include calcination, grinding, mixing, electroding, firing, and quality control. Piezoelectric ceramics are applied in air transducers, instrument transducers, delay line transducers, underwater sound ultrasonic power, and wave filters. The book is important for readers interested in doing research on ceramics.

Organic and Inorganic Materials and Applications

Materials and Design for Sensors, Actuators and Medical Applications

Advanced Ceramics for Versatile Interdisciplinary Applications

Recent Developments in Piezoelectric Ceramic Composites

An Introduction to the Theory of Piezoelectricity

Characterisation of Ferroelectric Bulk Materials and Thin Films

Second in two-volume series covers properties and techniques of quartz, Rochelle salt, ferroelectric crystals, various applications of piezoelectricity, pyroelectricity, optical properties of crystals, and atomic theory of piezoelectricity. 1946 edition.

Presents the fundamental physics of piezoelectric sensors. Only book with this scope Targeted to those engineers, physicists and chemists who are involved in materials processing, device design and manufacturing.

For the first time, this book covers the entire field of piezoelectric sensors for mechanical measurands. It gives extensive practical advice along with an overview of the most important piezoelectric materials and their properties, plus consistent terminology for describing sensors.

This book focuses on the properties and configuration of the ceramic which facilitates proper application of material to the task at hand. It is intended for workers in electronics, ceramics, computers, or telecommunications fields, to broaden their expertise in the area of electroceramics.

An Introduction to the Theory and Applications of Electromechanical Phenomena in Crystals

Ferroelectric Materials and Their Applications

Ultrasonic Micro/nano Manipulations: Principles And Examples

Piezoelectric Ceramic Materials

Mechanical, Dielectric, and Thermodynamical Properties of Piezoelectric Materials

Structural Health Monitoring with Piezoelectric Wafer Active Sensors

Piezoelectricity is the ability of certain crystalline materials to develop an electric charge proportional to a mechanical stress. Since its discovery the piezoelectricity effect has found many useful applications, such as the production and detection of sound, generation of high voltages and frequency, microbalances, and ultra fine focusing of optical assemblies. This book reviews the state of art in polycrystalline piezoelectric ceramic materials, which covers the processing, properties, characterisation, and applications of piezoelectric ceramic materials.

A two-volume reference set for all ceramicists, both in research and working in industry The only definitive reference covering the entire field of advanced ceramics from fundamental science and processing to application Contributions from over 50 leading researchers from around the world This new Handbook will be an essential resource for ceramicists. It includes contributions from leading researchers around the world, and includes sections on: Basic Science of Advanced Ceramic, Functional Ceramics (electro-ceramics and optoelectro-ceramics) and engineering ceramics. Contributions from over 50 leading researchers from around the world

This book is based on lecture notes for a graduate course that has been offered at University of Nebraska-Lincoln on and off since 1998. The course is intended to provide graduate students with the basic aspects of the continuum modeling of electroelastic interactions in solids. A concise treatment of linear, nonlinear, static and dynamic theories and problems is presented. The emphasis is on formulation and understanding of problems useful in device applications rather than solution techniques of mathematical problems. The mathematics used in the book is minimal. The book is suitable for a one-semester graduate course on electroelasticity. It can also be used as a reference for researchers. I would like to take this opportunity to thank UNL for a Maude Hammond Fling Faculty Research Fellowship in 2003 for the preparation of the first draft of this book. I also wish to thank Ms. Deborah Derrick of the College of Engineering and Technology at UNL for editing assistance with the book, and Professor David Y. Gao of Virginia Polytechnic Institute and State University for recommending this book to Kluwer for publication in the series of Advances in Mechanics and Mathematics. JSY Lincoln, Nebraska 2004 Preface Electroelastic materials exhibit electromechanical coupling. They experience mechanical deformations when placed in an electric field, and become electrically polarized under mechanical loads. Strictly speaking, piezoelectricity refers to linear electromechanical couplings only.

APC International, Ltd.'s textbook on the principles and applications of piezoelectric ceramics covers: general principles of piezoelectricity and behavior of piezoelectric ceramic elements fundamental mathematics of piezoelectricity traditional and experimental applications for piezoelectric materials, and related physical principles for each application: audible sound producers, flow meters, fluid level sensors, motors, pumps, delay lines, transformers, other apparatus introduction to single crystals, composites, and other latest-generation piezoelectric materials Contents Introduction piezoelectricity / piezoelectric constants behavior / stability of piezoelectric ceramic elements new materials: relaxors / single crystals / others characteristics of piezoelectric materials from APC International, Ltd. Generators generators solid state batteries Sensors axial sensors flexional sensors special designs and applications: composites / SAW sensors / others Actuators axial and transverse actuators: simple / compound (stack) / multilayer flexional actuators / flextensional devices applications for piezoelectric actuators Transducers audible sound transducers generating ultrasonic vibrations in liquids or solids transmitting ultrasonic signals in air or water flow meters / fluid level sensors / delay lines / transformers / composites Miscellaneous securing a piezoelectric ceramic element attaching electrical leads testing performance Note: This is a 2nd edition to APC's textbook published in 2002. Updates in the 2nd edition reflect changes to APC's product lines and corrections outlined on the errata sheet distributed with the 2002 edition.

Synthesis, Properties and Applications

Piezoelectric Ceramic Resonators

Internet of Things

Fundamentals and Applications

Properties: Devices, and Applications

Piezoelectricity: Volume Two

Combining both fundamental principles and real-life applications in a single volume, this book discusses the latest research results in ferroelectrics, including many new ferroelectric materials for the latest technologies, such as capacitors, transducers and memories. The first two chapters introduce dielectrics and microscopic materials properties, while the following chapter discusses pyroelectricity and piezoelectricity. The larger part of the text is devoted to ferroelectricity and ferroelectric ceramics, with not only their fundamentals but also applications discussed. The book concludes with a look at the future for laser printed materials and applications. With over 600 references to recent publications on piezoelectric and ferroelectric materials, this is an invaluable reference for physicists, materials scientists and engineers.

Fundamental Biomaterials: Ceramics provides current information on ceramics and their conversion from base materials to medical devices. Initial chapters review biomedical applications and types of ceramics, with subsequent sections focusing on the properties of ceramics, and on corrosion, degradation and wear of ceramic biomaterials. The book is ideal for researchers and professionals in the development stages of design, but is also helpful to medical researchers who need to understand and communicate the requirements of a biomaterial for a specific application. This title is the second in a three volume set, with each reviewing the most important and commonly used classes of biomaterials and providing comprehensive information on material properties, behavior, biocompatibility and applications. In addition, with the recent introduction of a number of interdisciplinary bio-related undergraduate and graduate programs, this book will be an appropriate reference volume for large number of students at undergraduate and post graduate levels Provides current information on findings and developments of ceramics and their conversion from base materials to medical devices Includes analyses of the types of ceramics and a discussion of a range of biomedical applications and essential properties, including information on corrosion, degradation and wear, and lifetime prediction of ceramic biomaterials Explores both theoretical and practical aspects of ceramics in biomaterials

Scientifically defined in 1880 by the Curie brothers, piezoelectricity - from the Greek piezein, meaning to press (squeeze), and ilektron, meaning amber, a material with electrostatic properties - is a phenomenon with many applications. The related piezoelectric materials have been undergoing a long-lasting evolution over the years until today. The field of organic and inorganic piezoelectric materials is continuously expanding in terms of new substances used, new structures, and new applications. The seven chapters of this book present modern aspects and technological advances in the field of piezoelectric materials and applications. To present a balanced view of the field, some chapters focus on new piezoelectric materials and structures, while others examine interesting applications of piezoelectric sensors, energy harvesters, and actuators.

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 Through 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.

Design of Resonant Piezoelectric Devices

Piezoelectric Sensors and Actuators

Piezoelectric and Acoustic Materials for Transducer Applications

Electroceramics

Piezoelectricity

This unique compendium presents some new topics related to thin-walled structures, like beams, plates and shells used in aerospace structures. It highlights their dynamic behaviors and also the correlation between compressive loading and natural frequency to enable a correlation between the two, yielding a valuable non-destructive tool, to predict buckling for thin-walled structures.This useful reference text combines valuable data on metal materials and composite materials together with new adaptive and smart materials like piezoelectricity, shape memory alloys and optic fibers, which form the present state of the art in thin-walled structure domain.

This Critical Review and Technology Assessment Report presents the results of an assessment of the status of piezoelectric ceramic composites. Research on advanced piezoelectric materials has been driven by needs for various devices. The three primary application areas which have provided the research funding are: hydrophones for underwater sound detection; ultrasonic imaging; and sound and vibration absorbers. This report addresses issues such as basic principles and theory of ultrasonic transducer design, piezoceramic and other piezoelectric materials used for transducers, processing of piezoelectric ceramics, properties, applications and devices. Special attention is given to design and application of piezoelectric ceramics for military applications. New developments in thin films and fibers have also been reviewed and their application to new devices assessed.

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.

This book presents the basic physical properties, structure, fabrication methods and applications of ferroelectric materials. These are widely used in various devices, such as piezoelectric/electrostrictive transducers and actuators, pyroelectric infrared detectors, optical integrated circuits, optical data storage, display devices, etc. The ferroelectric materials described in this book include a relatively complete list of practical and promising ferroelectric single crystals, bulk ceramics and thin films. Included are perovskite-type,

lithium niobate, tungsten-bronze-type, water-soluble crystals and other inorganic materials, as well as organic ferroelectrics (polymers, liquid crystals, and composites). Basic concepts, principles and methods for the physical property characteristics of ferroelectric materials are introduced in the first two chapters for those readers new to the subject of ferroelectricity. Not only professional researchers and engineers but also students and other readers who have limited physical knowledge and an interest in ferroelectrics, will welcome this book.

Challenges, Advances, and Applications

Principles and Applications

Materials, Applications, Processing and Properties

Piezoelectric Sensorics

Processing, Properties, Characterization, and Applications

Advances in Ceramics

In recent years remarkable progress has been made in the development of materials for ultrasonic transducers. There is a continuing trend towards increasingly higher frequency ranges for the application of ultrasonic transducers in modern technology. The progress in this area has been especially rapid and articles and papers on the subject are scattered over numerous technical and scientific journals in this country and abroad. Although good books have appeared on ultrasonics in general and ultrasonic transducers in particular in which, for obvious reasons, materials play an important part, no comprehensive treatise is available that represents the state-of-the-art on modern ultrasonic transducer materials. This book intends to fill a need for a thorough review of the subject. Not all materials are covered of which, theoretically, ultrasonic transducers could be made but those that are or may be of technical importance and which have inherent electroacoustic transducer properties, i.e., materials that are either magnetostrictive, electrostrictive, or piezoelectric. The book has been divided into three parts which somewhat reflect the historic development of ultrasonic transducer materials for important technical application. Chapter 1 deals with magnetostrictive materials, magnetostrictive materials and their alloys, and magnetostrictive ferrites (polycrystalline ceramics). The metals are useful especially in cases where ruggedness of the transducers are of overriding importance and in the lower ultrasonic frequency range.

Demands for high-performance micro/nano manipulations, from the manufacture of microelectronic and photonic devices, biomedical apparatus, nanoscience and nanotechnology, renewable energy, environment protection, and high-end appliances, have been rapidly increasing in recent years. However, there are very few books on ultrasonic manipulation technology, which is one of the important means in micro/nano manipulations. This unique title gives the basic physical principles of ultrasonic micro/nano manipulations, and highlights methods of implementing these principles. The nonlinear effects of ultrasound are described in details after piezoelectric transduction and acoustic field are introduced and discussed. Numerous important examples are given in this book, to help readers better understand the applications of these principles and characteristics of ultrasonic manipulators utilizing these principles. The examples cover the manipulations of micro solids, nanoscale entities, droplets and microfluid. This indispensable book will contribute positively to the development and application of micro/nano manipulation technology.

Electroceramics, Materials, Properties, Applications, Second Edition provides a comprehensive treatment of the many aspects of ceramics and their electrical applications. The fundamentals of how electroceramics function are carefully introduced with their properties and applications also considered. Starting from elementary principles, the physical, chemical and mathematical background of the subject are discussed and wherever appropriate, a strong emphasis is placed on the relationship between microstructure and properties. The Second Edition has been fully revised and updated, building on the foundation of the earlier book to provide a concise text for all those working in the growing field of electroceramics. Fully revised and updated to include the latest technological changes and developments in the field includes end of chapter problems and an extensive bibliography an invaluable text for all Materials Science students. A useful reference for physicists, chemists and engineers involved in the area of electroceramics.

Internet of Things: Challenges, Advances, and Applications provides a comprehensive introduction to IoT, related technologies, and common issues in the adoption of IoT on a large scale. It surveys recent technological advances and novel solutions for challenges in the IoT environment. Moreover, it provides detailed discussion of the utilization of IoT and its underlying technologies in critical application areas, such as smart grids, healthcare, insurance, and the automotive industry. The chapters of this book are authored by several international researchers and industry experts. This book is composed of 18 self-contained chapters that can be read, based on interest. Features: Introduces IoT, including its history, common definitions, underlying technologies, and challenges Discusses technological advances in IoT and implementation considerations Proposes novel solutions for common implementation issues Explores critical application domains, including large-scale electric power distribution networks, smart water and gas grids, healthcare and e-Health applications, and the insurance and automotive industries The book is an excellent reference for researchers and post-graduate students working in the area of IoT, or related areas. It also targets IT professionals interested in gaining deeper knowledge of IoT, its challenges, and application areas.

Handbook of Advanced Dielectric, Piezoelectric and Ferroelectric Materials

Piezoelectric Energy Harvesting

Materials, Properties, Applications

Lead-Free Piezoelectrics

Principles and Applications of Ferroelectrics and Related Materials

Piezoelectric Ceramics

This book introduces physical effects and fundamentals of piezoelectric sensors and actuators. It gives a comprehensive overview of piezoelectric materials such as quartz crystals and polycrystalline ceramic materials. Different modeling approaches and methods to precisely predict the behavior of piezoelectric devices are described. Furthermore, a simulation-based approach is detailed which enables the reliable characterization of sensor and actuator materials. One focus of the book lies on piezoelectric ultrasonic transducers. An optical approach is presented that allows the quantitative determination of the resulting sound fields. The book also deals with various applications of piezoelectric sensors and actuators. In particular, the studied application areas are · process measurement technology, · ultrasonic imaging, · piezoelectric positioning systems and · piezoelectric motors. The book addresses students, academic as well as industrial researchers and development engineers who are concerned with piezoelectric sensors and actuators.

This book helps the reader to understand the specific properties of piezoelectric ceramic resonators. It provides their theoretical description by impedance and equivalent circuit method. The numerical modelling described is accompanied by examples of properties measured experimentally. Piezoelectric ceramic transformers are also covered, followed by a series of solved and unsolved problems prepared specially for students.

This comprehensive book covers recent developments in advanced dielectric, piezoelectric and ferroelectric materials. Dielectric materials such as ceramics are used to manufacture microelectronic devices. Piezoelectric components have been used for many years in radioelectronics, time-keeping and, more recently, in microprocessor-based devices. Ferroelectric materials are widely used in various devices such as

piezoelectric/electrostrictive transducers and actuators, pyroelectric infrared detectors, optical integrated circuits, optical data storage and display devices. The book is divided into eight parts under the general headings:

High strain high performance piezo- and ferroelectric single crystals; Electric field-induced effects and domain engineering; Morphotropic phase boundary related phenomena; High power piezoelectric and microwave dielectric materials; Nanoscale piezo- and ferroelectrics; Piezo- and ferroelectric films; Novel processing and new materials; Novel properties of ferroelectrics and related materials. Each chapter looks at key recent research on these materials, their properties and potential applications. Advanced dielectric, piezoelectric and ferroelectric materials is an important reference tool for all those working in the area of electrical and electronic materials in general and dielectrics, piezoelectrics and ferroelectrics in particular. Covers the latest developments in advanced dielectric, piezoelectric and ferroelectric materials Includes topics such as high strain high performance piezo and ferroelectric single crystals Discusses novel processing and new materials, and novel properties of ferroelectrics and related materials

The transformation of vibrations into electrical energy through the use of piezoelectric devices is an exciting and rapidly developing area of research with a widening range of applications constantly materialising. With Piezoelectric Energy Harvesting, world-leading researchers provide a timely and comprehensive coverage of the electromechanical modelling and applications of piezoelectric energy harvesters. They present principal modelling approaches, synthesizing fundamental material related to mechanical, aerospace, civil, electrical and materials engineering disciplines for vibration-based energy harvesting using piezoelectric transduction. Piezoelectric Energy Harvesting provides the first comprehensive treatment of distributed-parameter electromechanical modelling for piezoelectric energy harvesting with extensive case studies including experimental validations, and is the first book to address modelling of various forms of excitation in piezoelectric energy harvesting, ranging from airflow excitation to moving loads, thus ensuring its relevance to engineers in fields as disparate as aerospace engineering and civil engineering. Coverage includes: Analytical and approximate analytical distributed-parameter electromechanical models with illustrative theoretical case studies as well as extensive experimental validations Several problems of piezoelectric energy harvesting ranging from simple harmonic excitation to random vibrations Details of introducing and modelling piezoelectric coupling for various problems Modelling and exploiting nonlinear dynamics for performance enhancement, supported with experimental verifications Applications ranging from moving load excitation of slender bridges to airflow excitation of aeroelastic sections A review of standard nonlinear energy harvesting circuits with modelling aspects.

Tutorial reviews, theory, processing, and applications

Piezoelectric Actuators and Ultrasonic Motors

Fundamental Biomaterials: Ceramics

Ultrasonic Transducers

Force Strain Pressure Acceleration and Acoustic Emission Sensors Materials and Amplifiers

Ferroelectric Ceramics

One of the fascinating aspects of the field of ferroelectric ceramics is its interdisciplinary nature. This aspect is also a source of difficulty for the people working in the field. In a successful team of ferroelectricians the physics theoretician must understand the sintering technologist, the electrical engineer has to communicate with the crystallographer, the organic chemist will interact with the microelectronics engineer, the electron microscopist should collaborate with the systems engineer. It was the purpose of the summer school on ferroelectric ceramics that took place at the Centro Stefano Franscini (ETHZ), Monte Verità, Ascona, Switzerland, in September 1991 to help to build bridges between people from the different disciplines and to draw for them, in the form of tutorial lectures, some of the different facets of ferroelectrics. The book is a written version of this summer school. It contains the following subjects: ferroelectric materials, physics of ferroelectrics, thin films, processing of ferroelectrics and their applications. It represents a cross section of topics of current interest. Materials are presented (L. E. Cross) from the point of view of the user, i.e. the tailoring of materials for specific applications. Two reviews address the important topic of ferroelectric domains and domain walls (I. Fousek and H. Schmid). In the part devoted to theory, three subjects of current interest are presented: phase transition in thin films (D. R. Tilley), weak ferroelectrics (A. K. Tagantsev) and dielectric losses (A. K. Tagantsev).

This is a standard work on ferroelectrics.

Remarkable developments have taken place in the field of mechatronics in recent years. As symbolized by the "Janglish (Japanese English)" word, mechatronics, the technology and the social adaptation for introducing electronics into mechanics has been readily accepted in Japan. Currently robots are producing many products under computer control in Japanese factories, and supermarkets are utilizing automation systems for sample displays and sales. Further, the fast paced change in semiconductor chip technology has given rise to the need for micro-displacement positioning techniques. Actuators utilizing piezoelectrostrictive effects are expected to meet these needs in mechanical components in the next micro mechatronic age. This book, in English, builds on my earlier publications concerned with ceramic actuators. The first edition titled "Essentials for Development and Applications of Piezoelectric Actuators" was published in 1984 through the Japan Industrial Technology Center. The second edition "Piezoelectric/Electrostrictive Actuators" published in Japanese through Morikita Pub. Co. (Tokyo) became one of the best sellers in that company in 1986, and was then translated into Korean. The problem solving edition "Piezoelectric Actuators -Problem Solving" was also published through Morikita, which was sold in conjunction with a 60 minute video tape to provide easy understanding.

Structural Health Monitoring with Piezoelectric Wafer Active Sensors, Second Edition provides an authoritative theoretical and experimental guide to this fast-paced, interdisciplinary area with exciting applications across a range of industries. The book begins with a detailed yet digestible consolidation of the fundamental theory relating to structural health monitoring (SHM). Coverage of fracture and failure basics, relevant piezoelectric material properties, vibration modes in different structures, and different wave types provide all the background needed to understand SHM and apply it to real-world structural challenges. Moving from theory to experimental practice, the book then provides the most comprehensive coverage available on using piezoelectric wafer active sensors (PWAS) to detect and quantify damage in structures. Updates to this edition include circular and straight-crested Lamb waves from first principle, and the interaction between PWAS and Lamb waves in 1-D and 2-D geometries. Effective shear stress is described, and tuning expressions between PWAS and Lamb waves has been extended to cover axisymmetric geometries with a complete Hankel-transform-based derivation. New chapters have been added including hands-on SHM case studies of PWAS stress, strain, vibration, and wave sensing applications, along with new sections covering essential aspects of vibration and wave propagation in axisymmetric geometries. Comprehensive coverage of underlying theory such as piezoelectricity, vibration, and wave propagation alongside experimental techniques Includes step-by-step guidance on the use of piezoelectric wafer active sensors (PWAS) to detect and quantify damage in structures, including clear information on how to interpret sensor signal patterns Updates to this edition include a new chapter on composites and new sections on advances in vibration and wave theory, bringing this established reference in line with the cutting edge in this emerging area

Lead-Free Piezoelectric Materials

Fundamentals of Piezoelectric Sensorics

Evolution and Future of a Technology

Advanced Topics Of Thin-walled Structures

Nanoscale structures and materials have been explored in many biological applications because of their novel and impressive physical and chemical properties. Such properties allow remarkable opportunities to study and interact with complex biological processes. This book analyses the state of the art of piezoelectric nanomaterials and introduces their applications in the biomedical field. Despite their impressive potentials, piezoelectric materials have not yet received significant attention for bio-applications. This book shows that the exploitation of piezoelectric nanoparticles in nanomedicine is possible and realistic, and their impressive physical properties can be useful for several applications, ranging from sensors and transducers for the detection of biomolecules to "sensible" substrates for tissue engineering or cell stimulation.

APC International's first textbook on piezoelectric ceramics covers general principles of piezoelectricity and behaviors of piezoelectric ceramic elements; the fundamental mathematics of piezoelectricity; traditional and experimental applications for piezoelectric materials, and related physical principles for each application: audible sound producers, flow meters, fluid level sensors, motors, pumps, delay lines, transformers, other apparatus; and provides an introduction to single crystals, composites, and other latest-generation piezoelectric materials. Contents: Introduction Piezoelectric Principles piezoelectricity / piezoelectric constants behavior / stability of piezoelectric ceramic elements new materials: relaxors / single crystals / others characteristics of piezoelectric materials from APC International, Ltd. Generators generators solid state batteries Sensors axial sensors flexional sensors special designs and applications: composites / SAW sensors / others Actuators axial and transverse actuators: simple / compound (stack) / multilayer flexional actuators / flextensional devices applications for piezoelectric actuators Transducers audible sound transducers generating ultrasonic vibrations in liquids or solids transmitting ultrasonic signals in air or water flow meters / fluid level sensors / delay lines / transformers / composites Miscellaneous securing a piezoelectric ceramic element attaching electrical leads testing performance.