

electroactive polymer eap actuators as artificial muscles reality potential and challenges second edition

[#electroactive polymer](#) [#EAP actuators](#) [#artificial muscles](#) [#biomimetic robotics](#) [#smart materials](#)

Explore the fascinating world of electroactive polymer (EAP) actuators, often termed 'artificial muscles,' and delve into their current reality, groundbreaking potential, and the significant challenges that lie ahead in their development. This second edition provides an in-depth look at these smart materials driving innovation in robotics and prosthetics.

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Electroactive Polymer (EAP) Actuators as Artificial Muscles

Covers the field of EAP with attention to all aspects and full infrastructure, including the available materials, analytical models, processing techniques, and characterization methods. This second edition covers advances in EAP in electric EAP, electroactive polymer gels, ionomeric polymer-metal composites, and carbon nanotube actuators.

Electroactive Polymers for Robotic Applications

This book covers the fundamental properties, modeling, and demonstration of Electroactive polymers in robotic applications. It particularly details artificial muscles and sensors. In addition, the book discusses the properties and uses in robotics applications of ionic polymer-metal composite actuators and dielectric elastomers.

Biologically Inspired Intelligent Robots

The multidisciplinary issues involved in the development of biologically inspired intelligent robots include materials, actuators, sensors, structures, functionality, control, intelligence, and autonomy. This book reviews various aspects ranging from the biological model to the vision for the future.

Biomedical Technology and Devices, Second Edition

Biomedical Technology and Devices, Second Edition focuses on the equipment, devices, and techniques used in modern medicine to diagnose, treat, and monitor human illnesses. Gathering together and compiling the latest information available on medical technology, this revised work adds ten new chapters. It starts with the basics, introducing the history of the thermometer and measuring body temperature, before moving on to a medley of devices that are far more complex. This book explores diverse technological functions and procedures including signal processing, auditory systems,

magnetic resonance imaging, ultrasonic and emission imaging, image-guided thermal therapy, medical robotics, shape memory alloys, biophotonics, and tissue engineering. Each chapter offers a description of the technique, its technical considerations, and its use according to its applications and relevant body systems. It can be used as a professional resource, as well as a textbook for undergraduate and graduate students.

Artificial Muscle Actuators using Electroactive Polymers

The 27 peer-reviewed papers collected here together offer a plenitude of up-to-date information on "Artificial Muscle Actuators using Electroactive Polymers". The papers are conveniently arranged into the chapters: 1: Materials; 2: Analysis, physical mechanisms and characterization; 3: Devices and applications. This special volume has also been published online in the series, "Advances in Science and Technology" Vol. 61.

Handbook of Active Materials for Medical Devices

This book covers biodevices, mainly implantable or quirsurgical, for the diagnosis or treatment of different pathologies, which benefit from the use of active materials as sensors or actuators. Such active or "intelligent" materials are capable of responding in a controlled way to different external physical or chemical stimuli by changing some of their properties. These materials can be used to design and develop sensors, actuators, and multifunctional systems with a large number of applications for developing biodevices and medical appliances. Current work on these fields entails problems related to synthesis, characterization, modeling, simulation, processing, and prototyping technologies, as well as device testing and validation, all of which are treated in depth in this book, for the several types of active or intelligent materials covered. The research presented in this book helps further development of medical devices, based on the additional functionalities that the use of active or "intelligent" materials, both as sensors and actuators, supplies. The main results exposed may help with the industrial expansion of this kind of materials as part of more complex systems.

Humanoid Robots

In this book the variety of humanoid robotic research can be obtained. This book is divided in four parts: Hardware Development: Components and Systems, Biped Motion: Walking, Running and Self-orientation, Sensing the Environment: Acquisition, Data Processing and Control and Mind Organisation: Learning and Interaction. The first part of the book deals with remarkable hardware developments, whereby complete humanoid robotic systems are as well described as partial solutions. In the second part diverse results around the biped motion of humanoid robots are presented. The autonomous, efficient and adaptive two-legged walking is one of the main challenge in humanoid robotics. The two-legged walking will enable humanoid robots to enter our environment without rearrangement. Developments in the field of visual sensors, data acquisition, processing and control are to be observed in third part of the book. In the fourth part some "mind building" and communication technologies are presented.

Biomaterials Fabrication and Processing Handbook

Focusing on a lucrative and increasingly important area of biomedicine, the Biomaterials Fabrication and Processing Handbook brings together various biomaterials production and processing aspects, including tissue engineering scaffold materials, drug delivery systems, nanobiomaterials, and biosensors. With contributions from renowned international experts and extensive reference lists in each chapter, the volume provides detailed, practical information to produce and use biomaterials. The different facets of biomaterials technology are split into four sections in the book— Part I The development of new materials and devices capable of interacting specifically with biological tissues and the preparation of scaffolds using materials with appropriate composition and structure Part II The necessary materials to create a drug delivery system capable of controlled release and the incorporation of drug reservoirs into implantable devices for sustained controlled release Part III The significant role nanotechnology plays in the biomedical and biotechnology fields Part IV More biomaterials, including synthetic and natural degradable polymeric biomaterials, electroactive polymers as smart materials, and biomaterials for gastrointestinal and cartilage repair and reconstruction

Smart and Functional Textiles

Smart and Functional Textiles is an application-oriented book covering a wide range of areas from multifunctional nanofinished textiles, coated and laminated textiles, wearable e-textiles, textile-based sensors and actuators, thermoregulating textiles, to smart medical textiles and stimuli-responsive textiles. It also includes chapters on 3D printed smart textiles, automotive smart textiles, smart textiles in military and defense, as well as functional textiles used in care and diagnosis of Covid-19.

Biomimetics

A review of the current state of the art of biomimetics, this book documents key biological solutions that provide a model for innovations in engineering and science. Leading experts explore a wide range of topics, including artificial senses and organs; mimicry at the cell-materials interface; modeling of plant cell wall architecture; biomimetic composites; artificial muscles; biomimetic optics; and the mimicking of birds, insects, and marine biology. The book also discusses applications of biomimetics in manufacturing, products, medicine, and robotics; biologically inspired design as a tool for interdisciplinary education; and the biomimetic process in artistic creation.

Electroactive Polymer Gel Robots

By the dawn of the new millennium, robotics has undergone a major transformation in scope and dimensions. This expansion has been brought about by the maturity of the field and the advances in its related technologies. From a largely dominant industrial focus, robotics has been rapidly expanding into the challenges of the human world. The new generation of robots is expected to safely and dependably co-habitat with humans in homes, workplaces, and communities, providing support in services, entertainment, education, health care, manufacturing, and assistance. Beyond its impact on physical robots, the body of knowledge robotics has produced is revealing a much wider range of applications reaching across - verse research areas and scientific disciplines, such as: biomechanics, haptics, neurosciences, virtual simulation, animation, surgery, and sensor networks among others. In return, the challenges of the new emerging areas are providing an abundant source of stimulation and insights for the field of robotics. It is indeed at the intersection of disciplines that the most striking advances happen. The goal of the series of Springer Tracts in Advanced Robotics (STAR) is to bring, in a timely fashion, the latest advances and developments in robotics on the basis of their significance and quality. It is our hope that the wider dissemination of research developments will stimulate more exchanges and collaborations among the research community and contribute to further advancement of this rapidly growing field.

Adaptronics and Smart Structures

Adaptronic structures and systems are engineered to adjust automatically to variable operating and environmental conditions, through the use of feedback control. The authors of this book have taken on the task of comprehensively describing the current state of the art in this highly modern and broadly interdisciplinary field. The book presents selected examples of applications, and goes on to demonstrate current development trends.

Impedance Spectroscopy and its Application in Biological Detection

This book includes basics of impedance spectroscopy technology, substrate compatibility issues, integration capabilities, and several applications in the detection of different analytes. It helps explore the importance of this technique in biological detection, related micro/nanofabricated platforms and respective integration, biological synthesis schemes to carry out the detection, associated challenges, and related future directions. The various qualitative/quantitative findings of several modules are summarized in the form of the detailed descriptions, schematics, and tables. Features: Serves as a single source for exploring underlying fundamental principles and the various biological applications through impedance spectroscopy. Includes chapters based on nonbiological applications of impedance spectroscopy and IoT-enabled impedance spectroscopy-based methods for detection. Discusses derivations, substrates, applications, and several integrations. Describes micro/nanofabrication of impedance-based biological sensors. Reviews updated integrations like digital manufacturing and IoT. This book is aimed at researchers and graduate students in material science, impedance spectroscopy, and biosensing.

Dielectric Elastomers as Electromechanical Transducers

Dielectric Elastomers as Electromechanical Transducers provides a comprehensive and updated insight into dielectric elastomers; one of the most promising classes of polymer-based smart materials and technologies. This technology can be used in a very broad range of applications, from robotics and automation to the biomedical field. The need for improved transducer performance has resulted in considerable efforts towards the development of devices relying on materials with intrinsic transduction properties. These materials, often termed as “smart or “intelligent”, include improved piezoelectrics and magnetostrictive or shape-memory materials. Emerging electromechanical transduction technologies, based on so-called ElectroActive Polymers (EAP), have gained considerable attention. EAP offer the potential for performance exceeding other smart materials, while retaining the cost and versatility inherent to polymer materials. Within the EAP family, “dielectric elastomers”, are of particular interest as they show good overall performance, simplicity of structure and robustness. Dielectric elastomer transducers are rapidly emerging as high-performance “pseudo-muscular actuators, useful for different kinds of tasks. Further, in addition to actuation, dielectric elastomers have also been shown to offer unique possibilities for improved generator and sensing devices. Dielectric elastomer transduction is enabling an enormous range of new applications that were precluded to any other EAP or smart-material technology until recently. This book provides a comprehensive and updated insight into dielectric elastomer transduction, covering all its fundamental aspects. The book deals with transduction principles, basic materials properties, design of efficient device architectures, material and device modelling, along with applications. Concise and comprehensive treatment for practitioners and academics Guides the reader through the latest developments in electroactive-polymer-based technology Designed for ease of use with sections on fundamentals, materials, devices, models and applications

Soft Actuators

This book is the second edition of Soft Actuators, originally published in 2014, with 12 chapters added to the first edition. The subject of this new edition is current comprehensive research and development of soft actuators, covering interdisciplinary study of materials science, mechanics, electronics, robotics, and bioscience. The book includes contemporary research of actuators based on biomaterials for their potential in future artificial muscle technology. Readers will find detailed and useful information about materials, methods of synthesis, fabrication, and measurements to study soft actuators. Additionally, the topics of materials, modeling, and applications not only promote the further research and development of soft actuators, but bring benefits for utilization and industrialization. This volume makes generous use of color figures, diagrams, and photographs that provide easy-to-understand descriptions of the mechanisms, apparatus, and motions of soft actuators. Also, in this second edition the chapters on modeling, materials design, and device design have been given a wider scope and made easier to comprehend, which will be helpful in practical applications of soft actuators. Readers of this work can acquire the newest technology and information about basic science and practical applications of flexible, lightweight, and noiseless soft actuators, which differ from conventional mechanical engines and electric motors. This new edition of Soft Actuators will inspire readers with fresh ideas and encourage their research and development, thus opening up a new field of applications for the utilization and industrialization of soft actuators.

Bioinspired Actuators and Sensors

From experts in engineering and biology, this is the first book to integrate sensor and actuator technology with bioinspired design.

Introduction to Adaptive Lenses

Presents readers with the basic science, technology, and applications for every type of adaptive lens. An adaptive lens is a lens whose shape has been changed to a different focal length by an external stimulus such as pressure, electric field, magnetic field, or temperature. Introduction to Adaptive Lenses is the first book ever to address all of the fundamental operation principles, device characteristics, and potential applications of various types of adaptive lenses. This comprehensive book covers basic material properties, device structures and performance, image processing and zooming, optical communications, and biomedical imaging. Readers will find homework problems and solutions included at the end of each chapter—and based on the described device structures, they will have the knowledge to fabricate adaptive lenses for practical applications or develop new adaptive devices or concepts for advanced investigation. Introduction to Adaptive Lenses includes chapters on: Optical lenses

Elastomeric membrane lenses Electro-wetting lenses Dielectrophoretic lenses Mechanical-wetting lenses Liquid crystal lenses This is an important reference for optical engineers, research scientists, graduate students, and undergraduate seniors.

Constitutive Modelling of Solid Continua

This volume consists of a collection of chapters by recognized experts to provide a comprehensive fundamental theoretical continuum treatment of constitutive laws used for modelling the mechanical and coupled-field properties of various types of solid materials. It covers the main types of solid material behaviour, including isotropic and anisotropic nonlinear elasticity, implicit theories, viscoelasticity, plasticity, electro- and magneto-mechanical interactions, growth, damage, thermomechanics, poroelasticity, composites and homogenization. The volume provides a general framework for research in a wide range of applications involving the deformation of solid materials. It will be of considerable benefit to both established and early career researchers concerned with fundamental theory in solid mechanics and its applications by collecting diverse material in a single volume. The readership ranges from beginning graduate students to senior researchers in academia and industry.

Ionic Polymer Metal Composites (IPMCs)

A comprehensive resource on ionic polymer metal composites (IPMCs) edited by the leading authority on the subject.

Simulation, Modeling, and Programming for Autonomous Robots

Why are the many highly capable autonomous robots that have been promised for novel applications driven by society, industry, and research not available - day despite the tremendous progress in robotics science and systems achieved during the last decades? Unfortunately, steady improvements in specific robot abilities and robot hardware have not been matched by corresponding robot performance in real world environments. This is mainly due to the lack of advancements in robot software that master the development of robotic systems of ever increasing complexity. In addition, fundamental open problems are still awaiting sound answers while the development of new robotics applications suffers from the lack of widely used tools, libraries, and algorithms that are redesigned in a modular and performant manner with standardized interfaces. Simulation environments are playing a major role not only in reducing development time and cost, e. g. , by systematic software- or hardware-in-the-loop testing of robot performance, but also in exploring new types of robots and applications. However, their use may still be regarded with skepticism. Seamless migration of code using robot simulators to real-world systems is still a rare circumstance, due to the complexity of robot, world, sensor, and actuator modeling. These challenges drive the quest for the next generation of methodologies and tools for robot development. The objective of the International Conference on Simulation, Modeling, and Programming for Autonomous Robots (SIMPAR) is to offer a unique forum for these topics and to bring together researchers from academia and industry to identify and solve the key issues necessary to ease the development of increasingly complex robot software.

Actuators and Their Applications

As demand has increased for new types of equipment that are more suited to the ever-evolving world of industry, demand for both new and traditional types of actuators has soared. From automotive and aeronautical to biomedical and robotics, engineers are constantly developing actuating devices that are adapted to their particular needs in their particular field, and actuators are used in almost every field of engineering that there is. This volume not only lays out the fundamentals of actuators, such as how they operate, the different kinds, and their various applications, but it also informs the engineer or student about the new actuators that are being developed and the state-of-the-art of actuators. Edited and written by highly experienced and well-respected engineers with a deep understanding of their subject, there is no other volume on actuators that is more current or comprehensive. Whether as a guide for the latest innovations in actuators, a refresher reference work for the veteran engineer, or an introductory text for the engineering student, this is a must-have for any engineer's or university's library. Covering the theory and the practical applications, this breakthrough volume is a "one stop shop" for any engineer or student interested in actuators.

Electroactive Polymers for Robotic Applications

This book covers the fundamental properties, modeling, and demonstration of Electroactive polymers in robotic applications. It particularly details artificial muscles and sensors. In addition, the book discusses the properties and uses in robotics applications of ionic polymer–metal composite actuators and dielectric elastomers.

New Polymeric Composite Materials

Polymeric and composite materials are in high demand and their continuing development is making our life style more comfortable. The present book reviews the latest research results in the field and explores the technological advantages of these materials in environmental, biomedical, actuator and fuel cell applications. Also discussed are applications of polymeric and composite materials in such areas as shape memory polymers, green composites for artificial organs, geomembranes for the safe disposal of waste, removal of heavy metals and dyes, adhesives, sensors and actuators, fuel cells, membrane and environmental sustainability, etc.

Actuators

The book promotes new research results in the field of modern actuators and their applications. New coverage of dielectric barrier discharge plasma actuators, polymeric microgripper based on the cascaded V-shaped electrothermal actuators, ionic polymer actuators, wideband actuators and energy harvesters, electromagnetic actuators and shape memory alloy actuators are comprehended. The book is structured in four sections: design, fabrication and simulation; control systems; medical applications and fault detection. Seven chapters are published following a rigorous selection process. In the first section, a study carried out to investigate experimentally and by numerical simulations a microscale plasma actuator; the design, fabrication, numerical simulations, and experimental investigations of a polymeric microgripper designed using the cascaded V-shaped electrothermal actuators; a review of the development of ionic polymer actuator with introduction of two kinds of typical polymer actuators - ionic polymer-metal composites and bucky gel actuator - with their basic principle and fabrication process and typical applications and a methodology of designing and testing wideband actuators and energy harvesters, treated as one mechanical resonator, with a discussion on shock harvester, resonant harvester and energy transmission system, are presented. The second section has a chapter dedicated to modeling, system identification and control of electromagnetic actuators with main focus on the actuators used in magnetic levitation, in fuel injection systems and in variable valve timing. The third section presents a study focused on quantifying the decline in tactile sensation associated with diabetic neuropathy and developed a measurement device that used a thin-shaped memory alloy wire as the actuator. The fourth section includes a chapter presenting a two-level fault diagnosis and root-cause analysis scheme for a class of interconnected invertible dynamic systems, which aims at detecting and identifying actuator fault and causes.

Smart Structures and Materials

The maturation of nanotechnology has revealed it to be a unique and distinct discipline rather than a specialization within a larger field. Its textbook cannot afford to be a chemistry, physics, or engineering text focused on nano. It must be an integrated, multidisciplinary, and specifically nano textbook. The archetype of the modern nano textbook

Introduction to Nanoscience and Nanotechnology

WINNER 2009 CHOICE AWARD OUTSTANDING ACADEMIC TITLE! Nanotechnology is no longer a subdiscipline of chemistry, engineering, or any other field. It represents the convergence of many fields, and therefore demands a new paradigm for teaching. This textbook is for the next generation of nanotechnologists. It surveys the field's broad landscape, exploring the physical basics such as nanorheology, nanofluidics, and nanomechanics as well as industrial concerns such as manufacturing, reliability, and safety. The authors then explore the vast range of nanomaterials and systematically outline devices and applications in various industrial sectors. This color text is an ideal companion to Introduction to Nanoscience by the same group of esteemed authors. Both titles are also available as the single volume Introduction to Nanoscience and Nanotechnology. Qualifying instructors who purchase either of these volumes (or the combined set) are given online access to a wealth of instructional materials. These include detailed lecture notes, review summaries, slides, exercises, and more. The authors provide enough material for both one- and two-semester courses.

Fundamentals of Nanotechnology

The book focuses on the development of high performance, high efficiency electroactive polymers (EAPs), and electromechanically active polymers by controlling molecular chemical structure and morphology for all applications. This book is ideal for academicians and researchers in polymer and materials science.

Electroactive Polymers

Is it possible to construct an artificial person? Researchers in the field of artificial intelligence have for decades been developing computer programs that emulate human intelligence. This book goes beyond intelligence and describes how close we are to recreating many of the other capacities that make us human. These abilities include learning, creativity, consciousness, and emotion. The attempt to understand and engineer these abilities constitutes the new interdisciplinary field of artificial psychology, which is characterized by contributions from philosophy, cognitive psychology, neuroscience, computer science, and robotics. This work is intended for use as a main or supplementary introductory textbook for a course in cognitive psychology, cognitive science, artificial intelligence, or the philosophy of mind. It examines human abilities as operating requirements that an artificial person must have and analyzes them from a multidisciplinary approach. The book is comprehensive in scope, covering traditional topics like perception, memory, and problem solving. However, it also describes recent advances in the study of free will, ethical behavior, affective architectures, social robots, and hybrid human-machine societies.

Artificial Psychology

Engineering Design with Polymers and Composites, Second Edition continues to provide one of the only textbooks on the analysis and design of mechanical components made from polymer materials. It explains how to create polymer materials to meet design specifications. After tracing the history of polymers and composites, the text describes modern des

Engineering Design with Polymers and Composites

Electroactivity in Polymeric Materials provides an in-depth view of the theory of electroactivity and explores exactly how and why various electroactive phenomena occur. The book explains the theory behind electroactive bending (including ion-polymer-metal-composites –IPMCs), dielectric elastomers, electroactive contraction, and electroactive contraction-expansion cycles. The book also balances theory with applications – how electroactivity can be used – drawing inspiration from the manmade mechanical world and the natural world around us.

Electroactivity in Polymeric Materials

Nanotechnology is no longer a merely social talking point and is beginning to affect the lives of everyone. Carbon nanotechnology as a major shaper of new nanotechnologies has evolved into a truly interdisciplinary field, which encompasses chemistry, physics, biology, medicine, materials science and engineering. This is a field in which a huge amount of literature has been generated within recent years, and the number of publications is still increasing every year. Carbon Nanotechnology aims to provide a timely coverage of the recent development in the field with updated reviews and remarks by world-renowned experts. Intended to be an exposition of cutting-edge research and development rather than a kind of conference proceeding, Carbon Nanotechnology will be very useful not only to experienced scientists and engineers, who wish to broaden their knowledge of the wide-ranging nanotechnology and/or to develop practical devices, but also to graduate and senior undergraduate students who look to make their mark in this field of the future. · A comprehensive treatment from materials chemistry and structure-property to practical applications · Offers an in-depth analysis of various carbon nanotechnologies from both fundamental and practical perspectives · An easily accessible assessment of the materials properties and device performances based on all of the major classes of carbon nanomaterials, including: carbon fiber; diamond; C60; and carbon nanotubes · A concise compilation of the practical applications of carbon nanotechnologies from polymer-carbon nanocomposites to sensors, electron emitters, and molecular electronics

Carbon Nanotechnology

The book addresses fundamental issues faced by experimentalists, modelers and engineers interested in different physical, mechanical and transport aspects of biological tissues and chemically active

geological materials, mainly clays and shales. The focus is on the couplings between electro-chemical and mechanical aspects involved in swelling and chemical consolidation. Emphasis is laid on the influence of these phenomena on mechanical properties and on transport properties. Applications in geo-environmental and geotechnical technologies, including nuclear and hazardous waste isolation, oil recovery, engineering geology, are addressed directly or implied. Control of long term effects of surgery and mechanical performance of prostheses may benefit from the modeling of irreversibilities that are of utmost importance in geological materials. Conversely, understanding the self-regulation mechanisms of biological tissues may be helpful in the design of efficient engineering materials.

Chemo-Mechanical Couplings in Porous Media Geomechanics and Biomechanics

Swarm robotics can be defined as the study of how a swarm of relatively simple physically embodied agents can be constructed to collectively accomplish tasks that are beyond the capabilities of a single one. Unlike other studies on multi-robot systems, swarm robotics emphasizes self-organization and emergence, while keeping in mind the issues of scalability and robustness. These emphases promote the use of relatively simple robots, equipped with localized sensing ability, scalable communication mechanisms, and the exploration of decentralized control strategies. This state-of-the-art survey is the first book devoted to swarm robotics. It is based on the First International Workshop on Swarm Robotics held in Santa Monica, CA, USA in July 2004 as part of SAB 2004

Swarm Robotics

This book constitutes the refereed proceedings of the second International Conference on Biomimetic and Biohybrid Systems, Living Machines 2013, held in London, UK, in July/August 2013. The 65 revised full papers presented were carefully reviewed and selected from various submissions. The papers are targeted at the intersection of research on novel live-like technologies inspired by scientific investigation of biological systems, biomimetics, and research that seeks to interface biological and artificial systems to create biohybrid systems

Forms and Concepts for Lightweight Structures

Piezoelectric materials produce electric charges on their surfaces as a consequence of applying mechanical stress. They are used in the fabrication of a growing range of devices such as transducers (used, for example, in ultrasound scanning), actuators (deployed in such areas as vibration suppression in optical and microelectronic engineering), pressure sensor devices (such as gyroscopes) and increasingly as a way of producing energy. Their versatility has led to a wealth of research to broaden the range of piezoelectric materials and their potential uses. Advanced piezoelectric materials: science and technology provides a comprehensive review of these new materials, their properties, methods of manufacture and applications. After an introductory overview of the development of piezoelectric materials, Part one reviews the various types of piezoelectric material, ranging from lead zirconate titanate (PZT) piezo-ceramics, relaxor ferroelectric ceramics, lead-free piezo-ceramics, quartz-based piezoelectric materials, the use of lithium niobate and lithium in piezoelectrics, single crystal piezoelectric materials, electroactive polymers (EAP) and piezoelectric composite materials. Part two discusses how to design and fabricate piezo-materials with chapters on piezo-ceramics, single crystal preparation techniques, thin film technologies, aerosol techniques and manufacturing technologies for piezoelectric transducers. The final part of the book looks at applications such as high-power piezoelectric materials and actuators as well as the performance of piezoelectric materials under stress. With its distinguished editor and international team of expert contributors Advanced piezoelectric materials: science and technology is a standard reference for all those researching piezoelectric materials and using them to develop new devices in such areas as microelectronics, optical, sound, structural and biomedical engineering. Provides a comprehensive review of the new materials, their properties and methods of manufacture and application Explores the development of piezoelectric materials from the historical background to the present status Features an overview of manufacturing methods for piezoelectric ceramic materials including design considerations

Biomimetic and Biohybrid Systems

The book covers experiments and theory in the fields of ferroelectrics, ferromagnets, ferroelastics, and multiferroics. Topics include experimental preparation and characterization of magnetoelectric multiferroics, the modeling of ferroelectric and ferromagnetic materials, the formation of ferroic microstruc-

tures and their continuum-mechanical modeling, computational homogenization, and the algorithmic treatment in the framework of numerical solution strategies.

Advanced Piezoelectric Materials

The world is on the threshold of a revolution that will change medicine and how patients are treated forever. Bringing together the creative talents of electrical, mechanical, optical and chemical engineers, materials specialists, clinical-laboratory scientists, and physicians, the science of biomedical micro-electromechanical systems (bioMEMS) promises to deliver sensitive, selective, fast, low cost, less invasive, and more robust methods for diagnostics, individualized treatment, and novel drug delivery. This book is an introduction to this multidisciplinary technology and the current state of micromedical devices in use today. The first text of its kind dedicated to bioMEMS training. Fundamentals of BioMEMS and Medical Microdevices is Suitable for a single semester course for senior and graduate-level students, or as an introduction to others interested or already working in the field.

Ferroic Functional Materials

Biomimetic Robotic Artificial Muscles presents a comprehensive up-to-date overview of several types of electroactive materials with a view of using them as biomimetic artificial muscles. The purpose of the book is to provide a focused, in-depth, yet self-contained treatment of recent advances made in several promising EAP materials. In particular, ionic polymer-metal composites, conjugated polymers, and dielectric elastomers are considered. Manufacturing, physical characterization, modeling, and control of the materials are presented. Namely, the book adopts a systems perspective to integrate recent developments in material processing, actuator design, control-oriented modeling, and device and robotic applications. While the main focus is on the new developments in these subjects, an effort has been made throughout the book to provide the reader with general, basic information about the materials before going into more advanced topics. As a result, the book is very much self-contained and expected to be accessible for a reader who does not have background in EAPs. Based on the good fundamental knowledge and the versatility of the materials, several promising biomimetic and robotic applications such robotic fish propelled by an IPMC tail, an IPMC energy harvester, an IPMC-based valveless pump, a conjugated polymer petal-driven micropump, and a synthetic elastomer actuator-enabled robotic finger are demonstrated. Contents: Introduction Physical Principles of Ionic Polymer-Metal Composites New IPMC Materials and Mechanisms A Systems Perspective on Modeling of Ionic Polymer-Metal Composites Conjugated Polymer Actuators: Modeling and Control Synthetic Dielectric Elastomer Materials Dielectric Elastomer Actuator Integrated Sensory Feedback for EAP Actuators Device and Robotic Applications of EAPs Readership: Graduate students, academics and professionals in the field of materials engineering and robotics. Keywords: Artificial Muscles; Biomimetics; Robotics; Electroactive Polymers; EAPs; Ionic Polymer-Metal Composites; IPMCs; Dielectric Elastomers; Conjugated Polymer Actuators; Soft Actuators; Sensors; Synthetic Elastomers; Modeling; Control; PVDF

Fundamentals of BioMEMS and Medical Microdevices

Biomimetic Robotic Artificial Muscles