Ultrasonic Transducers Materials And Design For Sensors Actuators And Medical Applications Woodhead Publishing Series In Electronic And Optical Materials

Discover the fundamental principles of biomedical measurement design and performance evaluation with this hands-on guide. Whether you develop measurement instruments or use them in novel ways, this practical text will prepare you to be an effective generator and consumer of biomedical data. Designed for both classroom instruction and self-study, it explains how information is encoded into recorded data and can be extracted and displayed in an accessible manner. Describes and integrates experimental design, performance assessment, classification, and system modelling. Combines mathematical concepts with computational models, providing the tools needed to answer advanced biomedical questions. Includes MATLAB® scripts throughout to help readers model all types of biomedical systems, and contains numerous homework problems, with a solutions manual available online. This is an essential text for advanced undergraduate and graduate students in bioengineering, electrical and computer engineering, computer science, medical physics, and anyone preparing for a career in biomedical sciences and engineering.

Recent advances in power electronics greatly benefit the multidisciplinary field of modern ultrasonics. More powerful, compact, and versatile electronic chips and software enable new computer-based devices for real-time data capture, storage, analysis, and display and advance the science and technology employed in commercial systems and applications of ultrasound. Reviewing the scientific basis behind these improvements, Ultrasonics: Fundamentals, Technologies, and Applications, Third Edition discusses them in detail, with new and additional figures and references, offering a completely revised and expanded examination of the state of modern ultrasonics. This new edition of a bestselling industry reference discusses the full breadth of ultrasonics applications for industrial and medical use and provides the fundamentals and insights gathered over the authors' collective 80 years in the field. It provides a unique and comprehensive treatment of the science and technology behind the latest advancements and applications in both low and high power implementations. Coverage combines fundamental physics, a review and analysis of sensors and transducers, and the systems required for the full spectrum of industrial, nondestructive testing and medical and biomedical uses. It includes citations of numerous references and covers both main stream and the more unusual and obscure applications of ultrasound. Ultrasonics is ubiquitous in its industrial applications for sensing, NDT, and process measurements, in high power forms for processing and sonochemistry, as well as in medical procedures where it is used for diagnosis, therapy and surgery. This book provides a complete overview of the field, presenting numerous applications, cutting-edge advancements and improvements, additional figures and references, and a look at future

directions.

The industrial interest in ultrasonic processing has revived during recent years because ultrasonic technology may represent a flexible "green" alternative for more energy efficient processes. A challenge in the application of high-intensity ultrasound to industrial processing is the design and development of specific power ultrasonic systems for large scale operation. In the area of ultrasonic processing in fluid and multiphase media the development of a new family of power generators with extensive radiating surfaces has significantly contributed to the implementation at industrial scale of several applications in sectors such as the food industry, environment, and manufacturing. Part one covers fundamentals of nonlinear propagation of ultrasonic waves in fluids and solids. It also discusses the materials and designs of power ultrasonic transducers and devices. Part two looks at applications of high power ultrasound in materials engineering and mechanical engineering, food processing technology, environmental monitoring and remediation and industrial and chemical processing (including pharmaceuticals), medicine and biotechnology. Covers the fundamentals of nonlinear propagation of ultrasonic waves in fluids and solids. Discusses the materials and designs of power ultrasonic transducers and devices. Considers state-of-the-art power sonic applications across a wide range of industries.

The up-to-date review articles in this book on modern developments in the field of sonic and ultra sonic power transducers present various aspects, applications, and possible future developments that are of interest to engineers and researchers.

Since Paul Langevins discovery of active sonar in 1917, ultrasound transducers have evolved in multiple forms that include single element, single element on a wedge, single element with cylindrical lens, single element with spherical lens, linear arrays, annular arrays, two- dimensional (2D) arrays, and phased arrays, among others. They have been applied in sound navigation and ranging (SONAR), structural health monitoring (SHM), nondestructive testing (NDT), nondestructive evaluation (NDE), medical/biomedical sensing/imaging, and biometric sensing/imaging. This dissertation focuses on the development of high frequency phased array transducers for two specific applications scanning acoustic microscopy, and biometric imaging for small electronics. Closed-loop finite element studies were conducted in three dimensions using PZFlex, a commercial finite-element method software. A 5 MHz, thickness-mode, linear array for an acoustic microscope, and a flexible 10 MHz, bending-mode, piezoelectric, micromachined ultrasonic transducer (PMUT) 2D array, plus a flexible 38 MHz bending-mode, PMUT 2D array for finger-print and finger-vein imaging, were virtually prototyped and their respective performances were predicted. The scanning acoustic microscope (SAM) has been a well-recognized tool for both visualization and quantitative evaluation of materials at the microscale, since its invention in 1974. While there have been multiple advances in SAM over the past four decades, some issues still remain to be

addressed. First, the measurement speed is limited by the mechanical movement of the acoustic lens. Second, a single element transducer acoustic lens only delivers a predetermined beam pattern for a fixed focal length and incident angle, thereby limiting control of the inspection beam. Here, a development of a phased array probe as an alternative is proposed to overcome these issues. Preliminary studies to design a practical, high frequency, phased array, acoustic microscope probe were explored. A linear phased array, comprising 32 elements and operating at 5 MHz, was modeled using PZFlex. This phased array system was characterized in terms of electrical input impedance response, pulse-echo and impulse response, surface displacement profiles, mode shapes, and beam profiles.PMUT using lead-zirconate-titanate, PbZr0.52Ti0.48O3 (PZT), thin films are currently being investigated for miniaturized, high frequency, ultrasound systems, and their microfabrication processes explored. For example, Liu et al. developed a process to remove the PZT from an underlying rigid Si substrate, creating the potential for developing curved arrays [138, 139]. This dissertation aims to improve the design of flexible PMUT arrays by developing 3D models using PZFlex. A 10 MHz 2D array PMUT device, working in 3-1 bending mode, was designed. A circular unit-cell was structured from the top, comprising a platinum (Pt) electrode, a PZT active layer, a bottom Pt electrode and a titanium (Ti) passive layer, all placed concentrically on a polyimide (PI) substrate. The active PZT layer had a diameter of 46 m and a thickness of 1 m. The passive Ti layer was 59.8 m diameter and 1 m in thickness. The PI substrate was 20 m thick. Below the passive Ti layer, another 7 m thick PI passive layer and 13 m deep cavity with 46 m diameter was added concentric to the PZT layer. The dimensions were selected to have a resonance frequency at 10 MHz under water load and air backing. The pulse-echo and spectral response analysis of the unit-cell predicted its bandwidth to be 87%. Mode shapes of the unit-cell were modeled to discover undesirable cross coupling to higher modes. A 2D array, consisting of 256 (1616) unit-cells, was created and characterized in terms of pulse-echo response, spectral response, surface displacement profile, cross-talk, and beam profiles.Iterations to find a robust design of the flexible PMUT array with increased resonance frequency and low operating voltage were continued. A PMUT array has to be operated at very low voltage to be embedded and run in small electronic devices, such as smart-phones, and smart-watches. A 38 MHz, flexible, PMUT array operating at 3 Volt peak-to-peak (Vpp) driving voltage was designed. To achieve these goals, a unit-cell, consisting of four 3-1 bending mode diaphragms, were devised. The quad diaphragm unit-cell was structured with 40 m 40 m 500 nm PZT layer on top of 40 m 40 m 1 m Ti elastic layer which had four (22)10 m 10 m 5 m cavities beneath it. The cavities had 11 m of interspacing to next cavities. Four pairs of 10 m 10 m top and bottom Pt electrodes were placed concentrically with the cavities by sandwiching the PZT layer. The top and bottom Pt electrodes had thicknesses of 50 nm and 100 nm, respectively. A PI substrate was placed beneath the Ti layer, surrounding the cavities, with 8 m thick, including the 5 m

deep cavities. The pulse-echo and spectral response analysis of the quad diaphragm unit-cell revealed its bandwidth to be 32.2 %. A 2D array was constructed with 1616 unit-cells, consisting of 1024 (3232) diaphragms. This array was evaluated in terms of pulse-echo response, spectral response, surface displacement profile, cross-talk, and beam profiles.

Ultrasonics International 87 contains the Proceedings of the Ultrasonics International Conference and Exhibition held at London, United Kingdom on July 1987. The conference discussed and reviewed some of the developments in the field of ultrasonics. The compendium consists of over 150 contributed papers, four invited papers and three plenary papers. Topics discussed include generation of unipolar ultrasonic pulses by signal processing; scattering of longitudinal waves by partially closed slots; piezoelectric materials for ultrasonic transducers; and measuring turbulent flow characteristics using a multi- dimensional ultrasonic probe. Fiber optic sensors, medical imaging and inverse methods, and laser generation of ultrasound are covered as well. Physicians, technicians, researchers, and physical scientists will find the book insightful.

Shaped by Quantum Theory, Technology, and the Genomics RevolutionThe integration of photonics, electronics, biomaterials, and nanotechnology holds great promise for the future of medicine. This topic has recently experienced an explosive growth due to the noninvasive or minimally invasive nature and the cost-effectiveness of photonic modalities in

While research on ultrasonics has been covered in earlier volumes of the Physical Acoustics series, Volumes 23 and 24 demonstrate the successful commercialization of devices and instruments arising from research in this area. These volumes will assist in the process of bringing research output into the marketplace to the benefit of customers. The chapters are liberally illustrated with pictures of actual commercial objects which have been or are in use. Included are Medical Ultrasonic Diagnostics, Nondestructive Testing (NDT), Acoustic Emission, Process Control, Surface Acoustic Wave (SAW) Devices, Frequency Control Devices, Research Instruments, Transducers, and Ultrasonic Microscopes. Also contained in the text are six essays covering technology transfer and commercialization.

Foundations of Biomedical Ultrasound provides a thorough and detailed treatment of the underlying physics and engineering of medical ultrasound practices. It covers the fundamental engineering behind ultrasound equipment, properties of acoustic wave motion, the behavior of waves in various media, non-linear waves and the creation of images. The most comprehensive book on the subject, Foundations of Biomedical Ultrasound is an indispensable reference for any medical professional working with ultrasound imaging, and a comprehensive introduction to the subject for students. The author has been researching and teaching biomedical ultrasonics at the University of Toronto for the past 25 years.

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 trans ducers 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 trans ducers could be made but those that are or may be of technical impor tance and which have inherent electro acoustic transducer properties, i.e., materials that are either magnetostrictive, electrostrictive, or piezoelectric. The book has been devided into three parts which somewhat reflect the historic development of ultrasonic transducer materials for important tech nical application. Chapter 1 deals with magnetostrictive materials, magnetostrictive met als and their alloys, and magnetostrictive ferrites (polycrystalline ceramics). The metals are useful especially in cases where ruggednes of the transducers are of overriding importance and in the lower ultrasonic frequency range.
Over the last century, medicine has come out of the "black bag" and emerged as one of the most dynamic and advanced fields of development in science and technology. Today, biomedical engineering plays a critical role in patient diagnosis, care, and rehabilitation. More than ever, biomedical engineers face the challenge of making sure that medical d
ATILA Finite Element Method (FEM) software facilitates the modelling and analysis of applications using piezoelectric, magnetostrictor and shape memory materials. It allows entire designs to be constructed, refined and optimized before production begins. Through a range of instructive case studies, Applications of ATILA FEM software to smart materials provides an indispensable guide to the use of this software in the design of effective products. Part one provides an introduction to ATILA FEM software, beginning with an overview of the software code. New capabilities and loss integration are discussed, before part two goes on to present case studies of finite element modelling using ATILA. The use of ATILA in finite element analysis, piezoelectric polarization, time domain analysis of piezoelectric devices and the design of ultrasonic motors is considered, before piezo-composite and photonic crystal applications are reviewed. The behaviour of piezoelectric single crystals for sonar and thermal analysis in piezoelectric and magnetostrictive materials is also discussed, before a final reflection on the use of ATILA in modelling the damping of piezoelectric structures and the behaviour of single crystal devices. With its distinguished editors and international team of expert contributors, Applications of ATILA FEM software to smart materials is a key reference work for all those involved in the research, design, development and application of smart materials, including electrical and mechanical engineers, academics and scientists working in piezoelectrics, magenetostrictors and shape memory materials. Provides an indispensable guide to the use of ATILA FEM software in the design of effective products Discusses new capabilities and loss integration of the software code, before presenting case studies of finite element modelling using ATILA Discusses the behaviour of piezoelectric single crystals for sonar and thermal analysis in piezoelectric and magnetostrictive materials, before a reflection on the use of ATILA in modelling the damping of piezoelectric structures
Nanomedical Device and Systems Design: Challenges, Possibilities, Visions serves as a preliminary guide toward the inspiration of specific investigative pathways that may lead to meaningful discourse and significant advances in nanomedicine/nanotechnology. This volume considers the potential of future innovations that will involve nanomedical devices and systems. It endeavors to explore remarkable possibilities spanning medical diagnostics, therapeutics, and other advancements that may be enabled within this discipline. In particular, this book investigates just how nanomedical diagnostic and therapeutic devices and systems might ultimately be designed and engineered to accurately diagnose and eradicate pathogens, toxins, and myriad disease states. This text utilizes an author conceptualized exemplar nanodevice and system, the Vascular Cartographic Scanning Nanodevice (VCSN), to explore various prospective design considerations that might facilitate and enable selected functionalities of advanced autonomous nanomedical devices. It showcases a diverse group of expert contributing authors, who describe actual laboratory-based research aimed at the advancement of nanomedical capabilities. It also articulates

more highly conceptual nanomedical possibilities and visions relating to the implementation of nanomedical technologies in remote regions and the developing world, as well as nanomedicine in space applications, human augmentation, and longevity. Investigates nanomedical diagnostic and therapeutic strategies that might be applied in remote regions and the developing world Discusses how nanomedicine might be utilized in space applications, inclusive of spacesuits, spacecraft, future human habitats on the Moon and Mars, and deep space Covers how nanomedicine may be implemented in selected forms of human augmentation and toward the potentially radical extension of the human life span This book benefits undergraduate and graduate students who are studying nanotechnology/nanomedicine, as well as medical administrative, scientific research, and manufacturing professionals in this industry.

Nondestructive evaluation (NDE) inspection schemes are important in design, manufacturing, and maintenance. By correctly applying techniques of NDE, we can reduce machine and system failures and increase reliability of operating systems over an extended lifetime. Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service introduces and discusses primary techniques used in the field, including ultrasonics, acoustic emission, magnetics, radiography, penetrants, and eddy currents. Examples of each of these techniques are included, demonstrating typical applications.

Adaptronics is the term encompassing technical fields that have become known internationally under the names "smart materials", "intelligent structures", and "smart structures". Adaptronics contributes to the optimisation of systems and products. It bridges the gap between material and system or product, and incorporates the search for multi-functional materials and elements and their integration in systems or structures. The authors of this book have taken on the task of displaying the current state of the art in this fascinating field. The system components, actuators, sensors and controllers, technical fundamentals, materials, design rules and practical solutions are all described. Selected sample applications are also presented and current development trends are demonstrated.

Novel Food Fermentation Technologies provides a comprehensive overview of innovations in food fermentation technologies and their application. Current novel technologies for microbial culture production and preservation are covered in detail, as are fermentation techniques for the production of bioactives from various food matrices, including food processing by-products and waste. Readers are provided with a close look at thermal and non-thermal technologies applicable to fermented food products. The text covers immobilization, microencapsulation technologies and novel preservation techniques for cultures in fermentation. In-depth studies of high pressure processing, pulsed electric field, power ultrasound and gamma irradiation in fermentation are provided in addition to novel thermal and non-thermal technologies and process analytical techniques. A wide variety of fermented products are covered, including meat, marine-based, grain-based, dairy and vegetable-based products. Current technologies for extraction of bioactives are examined, as are current innovations in fermented food packaging. Readers are presented with current and future challenges in food fermentation as well. As a comprehensive reference for food fermentation, this work provides up-to-date insights into emerging fermentation technologies which facilitate the processing of wholesome and safe food products.

Physical Acoustics: Principles and Methods, Volume XIV is a five-chapter text that covers significant studies on acoustic microscopy, sound propagation in liquid crystals, ultrasonic transducers, and ultrasonic flowmeters. The opening chapter discusses techniques of acoustic microscopy, aberration and resolution performance, acoustic lens transfer functions, antireflection coatings, and both transmission and reflection acoustic microscopy. The following chapter deals with the applications to the states called liquid crystals or anisotropic liquids, states in which the material flows but yet has a long-range order that makes it macroscopically anisotropic. The third chapter focuses on the

principles and practical applications of electromagnetic transducers for both surface waves and bulk waves. The fourth chapter surveys first the characterization of ultrasonic transducers for materials testing and then compares actual responses to those of an ""ideal"" transducer, elaborating on the many important factors that affect the results obtained with an ultrasonic testing system. The final chapter explains the principles underlying ultrasonic measurements of flow, specifically covering eight different categories of ultrasonic flow measurement principles and their industrial applications indicated. This book will be of great value to researchers in their fields of electronics technology and applied and engineering mechanics.

Diagnostic Ultrasound Imaging provides a unified description of the physical principles of ultrasound imaging, signal processing, systems and measurements. This comprehensive reference is a core resource for both graduate students and engineers in medical ultrasound research and design. With continuing rapid technological development of ultrasound in medical diagnosis, it is a critical subject for biomedical engineers, clinical and healthcare engineers and practitioners, medical physicists, and related professionals in the fields of signal and image processing. The book contains 17 new and updated chapters covering the fundamentals and latest advances in the area, and includes four appendices, 450 figures (60 available in color on the companion website), and almost 1,500 references. In addition to the continual influx of readers entering the field of ultrasound worldwide who need the broad grounding in the core technologies of ultrasound, this book provides those already working in these areas with clear and comprehensive expositions of these key new topics as well as introductions to state-of-the-art innovations in this field. Enables practicing engineers, students and clinical professionals to understand the essential physics and signal processing techniques behind modern imaging systems as well as introducing the latest developments that will shape medical ultrasound in the future Suitable for both newcomers and experienced readers, the practical, progressively organized applied approach is supported by hands-on MATLAB® code and worked examples that enable readers to understand the principles underlying diagnostic and therapeutic ultrasound Covers the new important developments in the use of medical ultrasound: elastography and high-intensity therapeutic ultrasound. Many new developments are comprehensively reviewed and explained, including aberration correction, acoustic measurements, acoustic radiation force imaging, alternate imaging architectures, bioeffects: diagnostic to therapeutic, Fourier transform imaging, multimode imaging, plane wave compounding, research platforms, synthetic aperture, vector Doppler, transient shear wave elastography, ultrafast imaging and Doppler, functional ultrasound and viscoelastic models

The piezoelectric transducer converts electric signals into mechanical vibrations or vice versa by utilizing the morphological change of a crystal which occurs on voltage application, or conversely by monitoring the voltage generated by a pressure applied on a crystal. This book reports on the state of the art research and development findings on this very broad matter through original and innovative research studies exhibiting various investigation directions. The present book is a result of contributions of experts from international scientific community working in different aspects of piezoelectric transducers. The text is addressed not only to researchers, but also to professional engineers, students and other experts in a variety of disciplines, both academic and industrial seeking to gain a better understanding of what has been done in the field recently, and what kind of open problems are in this area.

With its discussion of strategies for modeling complex materials using new numerical techniques, mainly those based on the finite element method, this monograph covers a range of topics including computational plasticity, multi-scale formulations, optimization and parameter identification, damage mechanics and nonlinear finite elements.

This work offers detailed discussions on all aspects of acousto-optic deflectors, modulators and tunable filters, emphasizing hands-on

procedures for design, fabrication and testing. It contains previously unpublished treatments of acousto-optic device design and impedance matching, permitting the actual design of real devices and device-matching circuits.

Engineers, scientists, and technologists will find here, for the first time, a clear and comprehensive account of applications of ultrasonics in the field of process control. Using numerous examples of high-volume, low-cost applications, the author illustrates how the use of new transducer materials and designs, combined with microprocessor-based electronics, make technical and financial sense for concepts that only a few years ago might have been of interest only to academicians. Some of the important topics covered include coupling, acoustic isolation, transducer and sensor design, and signal detection in the presence of noise.

La 4e de couv. indique : "Ultrasonic transducers are key components in sensors for distance, flow and level measurement as well as power 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. Part two goes on to investigate modelling and characterisation. Part three reviews applications, beginning with a review of surface acoustic wave devices and air-borne ultrasound transducers, and going on to consider ultrasonic high temperature and flaw detection systems, power, biomedical and micro scale ultrasonics, therapeutic ultrasound devices, piezoelectric and fibre optic hydrophones, and ultrasonic motors."

Piezoelectric Actuators: Vector Control Method: Base, Modelling and Mechatronic Design of Ultrasonic Devices guides researchers and engineers through the process of implementing the vector control method (VCM) in their systems. The book presents which measurements can be made, how to visualize a variable as a rotating vector, about the angular position of the rotating reference frame, how to calculate the parameters of the controllers, and how to observe key variables. Additionally, the book focuses on the modeling of PE ultrasonic transducers and investigates the energy conversion process in an ultrasonic transducer. Presents the fundamentals of the VCM at a basic level for researchers and practitioners who are new to the field Simulates several MATLAB and Simulink examples for deeper learning of the subject matter Presents the application to several test cases, with actual measurements obtained on experimental test benches Describes practical implementations of the method

Wireless MEMS Networks and Applications reviews key emerging applications of MEMS in wireless and mobile networks. This book covers the different types of wireless MEMS devices, also exploring MEMS in smartphones, tablets, and the MEMS used for energy harvesting. The book reviews the range of applications of wireless MEMS networks in manufacturing, infrastructure monitoring, environmental monitoring, space applications, agricultural monitoring for food safety, health applications, and systems for smart cities. Focuses on the use of MEMS in the emerging area of wireless

applications Contains comprehensive coverage of the range of applications of MEMS for wireless networks Presents an international range of expert contributors who identify key research in the field

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The objective of this research is to enable deployment of Ultrasonic Thermometers (UTs) in irradiations of ceramic and metallic fuels. Research was broken into two main areas; out-of-core development and testing of the UT and its components in a laboratory environment and in-core assessment of the radiation tolerance of the magnetostrictive transducers used to generate and sense the acoustic signals. Significant progress was made toward the deployment of UTs. Appropriate sensor materials were identified. For applications below 1000 °C stainless steel was identified. For temperatures between 1000 and 2500 °C, a variety of molybdenum doped with tungsten and potassium silicate was selected. A new, high frequency coil was developed and used to improve spatial resolution of reflectors by allowing minimization of reflector spacing. This effect is enhanced by the use of a new method of damping developed to remove “back end” reflections, eliminating interference caused by them and simplifying signal processing. A signal processing method was also identified and tested, which changed the difficult identification of Gaussian sinusoids into simple peak detection. An irradiation test capsule design was developed that includes both piezoelectric and magnetostrictive materials, transducers, and sensors. It is the first to include both piezoelectric and magnetostrictive materials, and is scheduled to surpass other ultrasonic transducer irradiations in terms of total fluence. As part of this research, a new design of magnetostrictive transducers was developed, fabricated, evaluated in a laboratory setting, and included in this irradiation test. The irradiation test was initiated to identify transducer materials that can survive in a high radiation environment. The included transducers were operated online during irradiation; and the test capsule was heavily instrumented with real time sensors, resulting in a high degree of confidence in the results. The results shows ultrasonic transducers based on magnetostrictive materials, such as Remendur and Galfenol, to be highly resistant to degradation caused by neutron and gamma radiation.

This volume contains the Proceedings of the International Workshop on the Design of Power Sonic and Ultrasonic Transducers, which was held in the Maison de l'Entreprise et des Technologies Nouvelles, Marcq en Baroeul, near Lille, France, on May 26 and 27, 1987. The main objective of this Workshop was to discuss all aspects of high power problems in the design of electroacoustic transducers and to stimulate an exchange of knowledge and experience between researchers and industrial ists involved in this multidisciplinary field. The scientific program included 13 invited contributions, and there were 80 participants from England, France, Italy, Spain, Sweden and the United States. The editors wish to thank the authors and attendees for their active par ticipation, and they hope that these Proceedings will

allow readers to share in the stimulating atmosphere of the sessions. They also wish to thank eve ryone who undertook simultaneous translation, clerical work, typing of the Proceedings, production of the illustrations, or any other of the numerous tasks connected with this venture. Special mention has to be made of Mrs. E. Litton (ISEN, Lille) for her constant and kind help from the beginning of the project to the very end of the editing, Dr. R. Bossut (ISEN, Lille) for his efficient proofreading, and Dr. H.U. Daniel (Springer-Verlag) for his interest in these Proceedings as well as his kind and efficient support.

Part I: Fundamentals of ultrasound This part will cover the main basic principles of ultrasound generation and propagation and those phenomena related to low and high intensity ultrasound applications. The mechanisms involved in food analysis and process monitoring and in food process intensification will be shown. Part II: Low intensity ultrasound applications Low intensity ultrasound applications have been used for non-destructive food analysis as well as for process monitoring. Ultrasonic techniques, based on velocity, attenuation or frequency spectrum analysis, may be considered as rapid, simple, portable and suitable for on-line measurements. Although industrial applications of low-intensity ultrasound, such as meat carcass evaluation, have been used in the food industry for decades, this section will cover the most novel applications, which could be considered as highly relevant for future application in the food industry. Chapters addressing this issue will be divided into three subsections: (1) food control, (2) process monitoring, (3) new trends. Part III: High intensity ultrasound applications High intensity ultrasound application constitutes a way to intensify many food processes. However, the efficient generation and application of ultrasound is essential to achieving a successful effect. This part of the book will begin with a chapter dealing with the importance of the design of efficient ultrasonic application systems. The medium is essential to achieve efficient transmission, and for that reason the particular challenges of applying ultrasound in different media will be addressed. The next part of this section constitutes an up-to-date vision of the use of high intensity ultrasound in food processes. The chapters will be divided into four sections, according to the medium in which the ultrasound vibration is transmitted from the transducers to the product being treated. Thus, solid, liquid, supercritical and gas media have been used for ultrasound propagation. Previous books addressing ultrasonic applications in food processing have been based on the process itself, so chapters have been divided in mass and heat transport, microbial inactivation, etc. This new book will propose a revolutionary overview of ultrasonic applications based on (in the authors' opinion) the most relevant factor affecting the efficiency of ultrasound applications: the medium in which ultrasound is propagated. Depending on the medium, ultrasonic phenomena can be completely different, but it also affects the complexity of the ultrasonic generation, propagation and application. In addition, the effect of high intensity ultrasound on major components of food, such as proteins, carbohydrates and lipids will be also covered, since this type of information has not been deeply studied in previous books. Other aspects related to the challenges of food industry to incorporate ultrasound devices will be also considered. This point is also very important since, in the last few years, researchers have made huge efforts to integrate fully automated and efficient ultrasound systems to the food production lines but, in some cases, it was not satisfactory. In this sense, it is necessary to identify and review the main related problems to efficiently produce and transmit ultrasound, scale-up, reduce cost, save energy and guarantee the production of safe, healthy and high added value foods.

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

Capacitive micromachined ultrasonic transducers (CMUTs), have been widely studied in academia and industry over the last decade. CMUTs provide many benefits over traditional piezoelectric transducers including improvement in performance through wide bandwidth, and ease of electronics integration, with the potential to batch fabricate very large 2D arrays with low-cost and high-yield. Though many aspects of CMUT technology have been studied over the years, packaging the CMUT into a fully practical system has not been thoroughly explored. Two important interfaces of packaging that this thesis explores are device encapsulation (the interface between CMUTs and patients) and full electronic integration of large scale 2D arrays (the interface between CMUTs and electronics). In the first part of the work, I investigate the requirements for the CMUT encapsulation. For medical usage, encapsulation is needed to electrically insulate the device, mechanically protect the device, and maintain transducer performance, especially the access of the ultrasound energy. While hermetic sealing can protect many other MEMS devices, CMUTs require mechanical interaction to a fluid, which makes fulfilling the previous criterion very challenging. The proposed solution is to use a viscoelastic material with the glass-transition-temperature lower than room temperature, such as Polydimethylsiloxane (PDMS), to preserve the CMUT static and dynamic performance. Experimental implementation of the encapsulated imaging CMUT arrays shows the device performance was maintained; 95 % of efficiency, 85% of the maximum output pressure, and 91% of the fractional bandwidth (FBW) can be preserved. A viscoelastic finite element model was also developed and shows the performance effects of the coating can be accurately predicted. Four designs, providing acoustic crosstalk suppression, flexible substrate, lens focusing, and blood flow monitoring using PDMS layer were also demonstrated. The second part of the work, presents contributions towards the electronic integration and packaging of large-area 2-D arrays. A very large 2D array is appealing for it can enable advanced novel imaging applications, such as a reconfigurable array, and a compression plate for breast cancer screening. With these goals in mind, I developed the first large-scale fully populated and integrated 2D CMUTs array with 32 by 192 elements. In this study, I demonstrate a flexible and reliable integration approach by successfully combining a simple UBM preparation technique and a CMUTs-interposer-ASICs sandwich design. The results show high shear strength of the UBM (26.5 g), 100% yield of the interconnections, and excellent CMUT resonance uniformity (? = 0.02 MHz). As demonstrated, this allows for a large-scale assembly of a tile-able array by using an interposer. Interface engineering is crucial towards the development of CMUTs into a practical ultrasound system. With the advances in encapsulation technique with a viscoelastic polymer and the combination of the UBM technique to the TSV fabrication for electronics integration, a fully integrated CMUT system can be realized.
This volume represents the proceedings of the 21 st International Symposium on Acoustical Imaging, which was held at the Surf and Sand Hotel in Laguna Beach, California, March 28-30, 1994. These unique and highly interdisciplinary series of symposiums have met at intervals of roughly 18 months over the past 30 some years. In general these meetings are devoted to all aspects and all fields of imaging that use acoustics. The meetings are usually small, with 100 to 200 participants, and stimulate useful interchanges across disciplines. These are the only regular meetings where the major researchers in all areas of acoustical imaging can come together to interchange ideas and new concepts. The Acoustical Imaging Symposiums have long been regarded as the premier meeting of this type in the general field of acoustics. The highly regarded and carefully edited proceedings have been published regularly by Plenum Press. I am proud and honored to serve as editor of the 21st volume in this series. The 21st Symposium was attended by well over 100 participants from some 18 countries. During the three day symposium, 94 scientific presentations were given, 66 as formal lectures and 28 in a poster format. Sufficient time was available during the conference, both following the presentations and informally during meals and breaks, for active discussions among all participants. Over 80 of the presentations have been selected for inclusion in these proceedings.

This book discusses the latest advances in the development of artificial intelligence systems and their applications in various fields, from medicine and technology to education. It comprises papers presented at the Third International Conference of Artificial Intelligence, Medical Engineering, Education (AIMEE2019), held at the Mechanical Engineering Institute of the Russian Academy of Sciences, Moscow, Russia, on 1–3 October 2019. Covering topics such as mathematics and biomathematics; medical approaches; and technological and educational approaches, it is intended for the growing number of specialists and students in this field, as well as other readers interested in discovering where artificial intelligence systems can be applied in the future.

Piezoelectric Materials and Devices: Applications in Engineering and Medical Sciences provides a complete overview of piezoelectric materials, covering all aspects of the materials starting from fundamental concepts. The treatment includes physics of piezoelectric materials, their characteristics and applications. The author uses simple language to explain the theory of piezoelectricity and introduce readers to the properties and design of different types of piezoelectric materials, such as those used in engineering and medical device applications. This book: Introduces various types of dielectrics and their classification based on their characteristics Addresses the mathematical formulation of piezoelectric effects and the definition of various piezoelectric constants Describes the structure and properties of practical piezoelectric materials such as quartz, lead zirconate titanate, barium titanate, zinc oxide, and polyvinylidene fluoride Covers the entire gamut of piezoelectric devices used in engineering and medical applications Discusses briefly the use of piezoelectric materials for energy harvesting and structural health monitoring Explores new developments in biomedical applications of piezoelectric devices such as drug delivery, blood flow and blood pressure monitoring, robotic operating tools, etc. Elaborates on design and virtual prototyping of piezoelectric devices through the use of FE software tools ANSYS and PAFEC Giving design engineers, scientists, and technologists the information and guidance they will need to adopt piezoelectric materials in the development of smart devices, this book will also motivate engineering and science students to initiate new research for developing innovative devices. Its contents will be invaluable to both students and professionals seeking a greater understanding of fundamentals and applications in the evolving field of piezoelectrics.

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.