Hydroxyapatite Coatings For Biomedical Applications Advances In Materials Science And Engineering

Hydroxyapatite Coatings for Biomedical ApplicationsCRC Press

This book examines the most novel and state-of-the-art applications of biomaterials, with chapters that exemplify approaches with targeted drug delivery, diabetes, neurodegenerative diseases and cranioplasty implants. Expert contributors analyze biomaterials such as calcium phosphate, sol-gel and quenched glasses, metallic and polymer implants, bioactive glass, and polymer composites while also covering important areas such as the soft tissue replacement, apatites, bone regeneration and cell encapsulation. This book is appropriate for biomedical engineers, materials scientists, and clinicians who are seeking to implement the most advanced approaches and technologies with their patients.

The development of biodegradable implants which can remain in the human body to fix a problem and subsequently dissolve, or be absorbed, consumed or excreted, without warranting a secondary surgery, is very appealing to scientists. Due to their excellent biocompatibility and biodegradability, magnesium implants

provide a viable option many problems associated with permanent metallic implants such as, restenosis, thrombosis, permanent physical irritation, and inability to adapt to growth and changes in human body. Volume 2 of this important new book explores practical issues of magnesium and magnesium alloys, physical and mechanical modification and coatings to enhance this material for biomedical applications. Includes expert analysis on chemical solution deposition of hydroxyapatite (HAp) and octacalcium (OCP) phosphate coatings for magnesium Comprehensive coverage of biomimetic modifications, surface functionalization of biomolecules, natural, conducting and biodegradable polymeric coatings Lucid dissection of chemical, physical, mechanical and electromechanical modifications of magnesium and its alloys for biomedical applications

Hydroxyapatite is the most widely accepted biomaterial for the repair and reconstruction of bone tissue defects. It has all the characteristic features of biomaterials, such as, biocompatible, bioactive, osteoconductive, non-toxic, non-inflammatory and non-immunogenic properties. In this book, the authors present current research in the study of the synthesis, properties and applications of hydroxyapatites. Topics discussed include nanodimensional and nanocrystalline hydroxyapatite and other calcium orthophosphates; application of biomimetic

nanocrystalline apatites in drug delivery and tissue engineering; polymer matrix mediated synthesis of nano hydroxyapatite crystals; osteointegration of titanium porous implants with carbon nanocoating and hydroxyapatite particles into the pores; hydroxyapatite thin film prepared by sputtering technique for medical applications; and hydroxyapatite application in dentistry and maxillofacial surgery. Reflecting the progress in recent years, this book provides in-depth information on the preparation, chemistry, and engineering of bioceramic coatings for medical implants. It is authored by two renowned experts with over 30 years of experience in industry and academia, who know the potentials and pitfalls of the techniques concerned. Following an introduction to the principles of biocompatibility, they present the structures and properties of various bioceramics from alumina to zirconia. The main part of the work focuses on coating technologies, such as chemical vapor deposition, sol-gel deposition and thermal spraying. There then follows a discussion of the major interactions of bioceramics with bone or tissue cells, complemented by an overview of the in-vitro testing methods of the biomineralization properties of bioceramics. The text is rounded off by chapters on the functionalization of bioceramic coatings and a look at future trends. As a result, the authors bring together all aspects of the latest techniques for designing, depositing, testing, and implementing improved

and novel bioceramic coating compositions, providing a full yet concise overview for beginners and professionals.

This book presents an introduction to biomaterials with the focus on the current development and future direction of biomaterials and medical devices research and development in Indonesia. It is the first biomaterials book written by selected academic and clinical experts experts on biomaterials and medical devices from various institutions and industries in Indonesia. It serves as a reference source for researchers starting new projects, for companies developing and marketing products and for governments setting new policies. Chapter one covers the fundamentals of biomaterials, types of biomaterials, their structures and properties and the relationship between them. Chapter two discusses unconventional processing of biomaterials including nano-hybrid organic-inorganic biomaterials. Chapter three addresses biocompatibility issues including in vitro cytotoxicity, genotoxicity, in vitro cell models, biocompatibility data and its related failure. Chapter four describes degradable biomaterial for medical implants, which include biodegradable polymers, biodegradable metals, degradation assessment techniques and future directions. Chapter five focuses on animal models for biomaterial research, ethics, care and use, implantation study and monitoring and studies on medical implants in animals in Indonesia.

Chapter six covers biomimetic bioceramics, natural-based biocomposites and the latest research on natural-based biomaterials in Indonesia. Chapter seven describes recent advances in natural biomaterial from human and animal tissue, its processing and applications. Chapter eight discusses orthopedic applications of biomaterials focusing on most common problems in Indonesia, and surgical intervention and implants. Chapter nine describes biomaterials in dentistry and their development in Indonesia.

This contribution book collects five among reviews and original articles from eminent experts working in the interdisciplinary area of biomaterial synthesis and application. From their direct and recent experience, the readers can access the novel and ongoing potentialities of different synthetic and engineered biomaterials. Contributions reflect the fundamental studies, with a particular attention to the physico-chemical mechanical characterization of biomaterials, along with biocompatibility studies and potential clinical use. After an introductory chapter on the question of storage stability for biomaterial-based devices and products and for polymeric nanomedicines, a first review deals with the use and commercial sources of hydroxyapatite in tissue engineering and other biomedical applications. A study follows on optical fiber laser marking on the properties of stainless steel in implant manufacturing. Two other reviews, respectively, focused

on the approaches to prevent or treat the effects of calcification that occurs in vivo on biomaterial-based implants and on the encapsulation of pancreatic islet cells for the treatment of type I diabetes will be presented. Finally, an overview on the physical bases and application in biomaterial science of the spray-drying process will close the volume. This setting will allow to achieve a general view of how classical and novel biomaterials can be applied, along with the methodologies necessary to design, develop, and characterize them, without the restrictions necessarily imposed by industrial or profit concerns. Readers will be apprised about the methodologies used to develop biomaterials possessing the physical and biological properties needed for specific medical and clinical applications.

Shortly after the demonstration of the first laser, the most intensely studied theoretical topics dealt with laser-matter interactions. Many experiments were undertaken to clarify the major ablation mechanisms. At the same time, numerous theoretical studies, both analytical and numerical, were proposed to describe these interactions. These studies paved the ways toward the development of numerous laser applications, ranging from laser micro- and nanomachining to material analysis, nanoparticle and nanostructure formation, thin-film deposition, etc. Recently, more and more promising novel fields of laser

applications have appeared, including biomedicine, catalysis, photovoltaic cells, etc. This book intends to provide the reader with a comprehensive overview of the current state of the art in laser ablation, from its fundamental mechanisms to novel applications.

Hydroxyapatite, (HAP), a calcium phosphate bioceramic material, has been widely used in both dentistry and orthopedics due to its biocompatibility and osteoconductivity. However, its poor bulk mechanical properties have limited its use as load bearing material. An effective approach to solve this problem is to form a composite coating of HAP and titanium, in which titanium will be the matrix and HAP will act as reinforcement. In this research, two novel approaches, namely cold gas dynamic spraying (CGDS) and argon atmosphere plasma spraying (AAPS), were applied to manufacture HAP/Ti composite coatings. The aim was to produce thick and dense deposits and investigate the mechanical, electrochemical and incubation behavior of such biocomposites as potential load bearing materials for biomedical applications.

With contributed papers from the 2011 Materials Science and Technology symposia, this is a useful one-stop resource for understanding the most important issues involved in the processing, properties, and applications of biomaterials science. Logically organized and carefully selected, the articles cover the themes of the symposia: Next Generation Biomaterials: and Surface Properties of Biomaterials. An essential reference for government labs as well as academics in mechanical and chemical engineering, materials and or ceramics, and chemistry.

This handbook describes several current trends in the development of bioceramics and biocomposites for clinical use in the repair, remodelling, and regeneration of bone tissue. Comprehensive coverage of these materials allows fundamental aspects of the science and engineering to be seen in close relation to the clinical performance of dental and orthopaedic implants. Bioceramics and biocomposites appear to be the most dynamic area of materials development for both tissue engineering and implantable medical devices. Almost all medical specialties will continue to benefit from these developments, but especially dentistry and orthopaedics. In this Handbook, leading researchers describe the use of bionanomaterials to create new functionalities when interfaced with biological molecules or structures. Also described are technologies for bioceramics and biocomposites processing in order to fabricate medical devices for clinical use. Another important section of the book is dedicated to tissue regeneration with development of new matrices. A targeted or personalized treatment device reduces drug consumption and treatment expenses, resulting in benefits to the patient and cost reductions for public health systems. This authoritative reference on the state-of-the-art in the development and use of bioceramics and biocomposites can also serve as the basis of instructional course lectures for audiences ranging from advanced undergraduate students to post-graduates in materials science and engineering and biomedical engineering.

The medical device and drug industries standards in analytical methodology and are consistently among the strongest techno- quality control. logical performers. Materials are a key The users of Biomaterials Engineering ingredient in their dynamic growth. Devel- and Devices: Human Applications will r- opment of these materials is in a constant resent a broad base of backgrounds ranging state of activity, with the challenge of re- from the basic sciences

(e. g. , polymer placing old materials that cannot withstand chemistry and biochemistry) to more the tests of time, and the new materials' applied disciplines (e. g. , mechanical/ needs coming to the forefront in modern chemical engineering, orthopedics, and applications. This new reference text, pharmaceutics). To meet varied needs, each Biomaterials Engineering and Devices: chapter provides clear ancd fully detailed Human Applications, focuses on materials discussions. This in-depth, but practical, used in or on the human body—materials coverage should also assist recent indu- that define the world of "biomaterials. " ees to the biomaterials circle. The editors Biomaterials Engineering and Devices: trust that this reference textbook conveys Human Applications focuses on mate- the intensity of this fast moving field in an rials development and characterization. enthusastic presentation. Chapters deal with issues in the selection of Donald L. Wise, PHD proper biomaterials from biocompatibility Debra J. Trantolo, PHD to biostability to structure/function relation- Kai-Uwe Lewandrowski, MD ships. Chapters also focus on the use of Joseph D. Gresser, PHD specific biomaterials based on their physio- Mario V.

Surface engineering has rapidly expanded in recent years as the demand for improved materials has increased. Surface engineering is a valuable tool for conceiving both surface and bulk properties, which cannot be achieved simultaneously either by the coating material or by the substrate material alone. The book is written on the current trends of surface engineering and relevant research. The applied and basic research as well as some worthy concepts of materials related to this area is explained clearly to understand the need for surface engineering in industrial applications. The different surface modification processes, properties, and their characterizations are discussed elaborately for future research and as a text book.

Modification of surface properties by films or coatings is used in industrial applications. This is an area of interest to numerous fields: fabrication of parts, mechanics, transport, catalysis, energy, production, microelectronics, optoelectronics, the leisure industry, etc. The properties are considered for protection against corrosion, oxidation or wear, biocompatibility, wetting, adhesion, durability, catalytic activity, and toughness. The modern concept of engineering is discussed to ensure that the contributions of this subject minimize energy consumption. The book will be used as a state of the art for present and future researchers, industrial components design, and control.

Hydroxyapatite coatings are of great importance in the biological and biomedical coatings fields, especially in the current era of nanotechnology and bioapplications. With a bonelike structure that promotes osseointegration, hydroxyapatite coating can be applied to otherwise bioinactive implants to make their surface bioactive, thus achieving faster healing and recovery. In addition to applications in orthopedic and dental implants, this coating can also be used in drug delivery. Hydroxyapatite Coatings for Biomedical Applications explores developments in the processing and property characterization and applications of hydroxyapatite to provide timely information for active researchers and newcomers alike. In eight carefully reviewed chapters, hydroxyapatite experts from the United States, Japan, Singapore, and China present the latest on topics ranging from deposition processes to biomedical applications in implants and drug delivery. This book discusses: Magnetron sputtering and electrochemical deposition The modification of hydroxyapatite properties by sol–gel deposition to incorporate other elements found in natural bones, such as zinc, magnesium, and fluorine The use of pure hydroxyapatite in drug delivery applications The

growth or self-assembly of hydroxyapatite on shape memory alloy Hydroxyapatite composite coatings—with carbon nanotubes, titanium dioxide (TiO2), and others—on the titanium alloy Offering valuable insights and a wealth of data, including numerous tables and figures, this is a rich source of information for research on hydroxyapatite coatings. Each chapter also covers material that provides an accessible stepping stone for those who are new to the field.

The apatites and related calcium phosphates have been of considerable interest to biologists, mineralogists, and inorganic and industrial chemists for many years. This book contains a detailed description of the structures and structural interrelationships of the calcium orthophosphates, including the apatites. Their preparation, crystal growth and dissolution, chemical reactions including thermal decomposition, IR, Raman and NMR spectra and various physical properties are discussed. Apatites other than those containing calcium and phosphorus are included. Synthetic, mineral and biological carbonate apatites are also considered. A wide, but critical coverage of the literature is given, which includes a substantial amount not written in English. Research from many disciplines is included which results in a comprehensive compilation of recent work.

"Hydroxyapatite (Ca10(PO4)6(OH)2, HA) has drawn considerable interest in biomedical and catalytic applications due to its excellent biocompatibility, adsorption capacity, and ion exchange capacity. The first part of this thesis focused on imparting antibacterial property to HA coatings for biomedical applications. Ag nanoparticles were electrochemically deposited on HA coatings. The Ag/HA composite coatings displayed inconsistent antibacterial properties. Heat treatment was found to improve the antimicrobial activity of the composite coatings because the oxidation of Ag nanoparticles was enhanced by the heat treatment and thus more

Ag+ ions can be released to inhibit the bacterial growth. Antibacterial coatings were also obtained by electrochemically depositing HA coatings on TiO2 nanotubes prepared by anodization of Ti plates. A model drug compound was loaded in the HA/nanotubular TiO2 composite coatings. The drug release profile of the coating exhibited an initial burst release followed by a sustained release. Tests of bacterial growth and deposition of calcium phosphate from simulated body fluid suggest that the antibioticsloaded HA/nanotubular TiO2 composite coatings can inhibit the growth of bacteria without compromising bioactivity."--Pages xi-xii.

Metallic Biomaterials Processing and Medical Device Manufacturing details the principles and practices of the technologies used in biomaterials processing and medical device manufacturing. The book reviews the main categories of metallic biomaterials and the essential considerations in design and manufacturing of medical devices. It bridges the gap between the designing of biomaterials and manufacturing of medical devices including requirements and standards. Main themes of the book include, manufacturing, coatings and surface modifications of medical devices, metallic biomaterials and their mechanical behaviour, degradation, testing and characterization, and quality controls, standards and FDA regulations of medical devices. The leading experts in the filed discuss the requirements, challenges, recent progresses and future research directions in the processing of materials and manufacturing of medical devices. Metallic Biomaterials Processing and Medical Device Manufacturing is ideal for those

working in the disciplines of materials science, manufacturing, biomedical engineering, and mechanical engineering. Reviews key topics of biomaterials processing for medical device applications including metallic biomaterials and their mechanical behavior, degradation, testing and characterization Bridges the gap between biomaterials design and medical device manufacturing Discusses the quality controls, standards, and FDA requirements for biomaterials and medical devices

One area of science that has shown an explosive growth over the last few decades is materials science. Inherently by nature products of both basic and applied research, materials make possible life and society as we know it today. Materials, ranging from ceramics to semiconductors to composites, are such that new ones must not only be designed and made ... they must also be characterized in terms of their physical, chemical, and mechanical properties. Thus, many new state of-the-art techniques involving spectroscopy, microscopy, and other approaches are now routinely used. Modem materials have wide applications in many sectors of technology. Films, for example, constitute an enormous area of materials and are used extensively. Films in tum can be integrated with other systems such as superconducting metal oxides and organic superconductors. Additionally, ceramics can also be synthesized and fabricated

as films for different applications. Catalysts, too, can vary widely in both composition and form. The number of applications for catalysts in industry must easily rank as one of the highest number of applications for any class of materials. Catalysis is impOltant for a wide range of activities in industry, from petroleum refining to the synthesis of a large number of industrial feedstock materials. Researchers in this area of materials are constantly trying to unravel new approaches to making better catalysts.

Reflecting the progress in recent years, this book provides in-depth information on the preparation, chemistry, and engineering of bioceramic coatings for medical implants. It is authored by two renowned experts with over 30 years of experience in industry and academia, who know the potentials and pitfalls of the techniques concerned. Following an introduction to the principles of biocompatibility, they present the structures and properties of various bioceramics from alumina to zirconia to calcium phosphates. The main part of the work focuses on coating technologies, such as biomimetic deposition, sol-gel deposition, magnetron sputtering, and thermal spraying. Then follows a discussion of the major interactions of bioceramics with bone and connective tissue cells, complemented by an overview of the "in-vitro "testing methods of the biomineralization properties of bioceramics. The text is rounded off by chapters

on the functionalization of bioceramic coatings and a look at future trends. As a result, the authors bring together all aspects of the latest techniques for designing, depositing, testing, and implementing improved and novel bioceramic coating compositions, providing a full yet concise overview for beginners and professionals.

The book contains six chapters and covers topics dealing with biomedical applications of titanium alloys, surface treatment, relationships between microstructure and mechanical and technological properties, and the effect of radiation on the structure of the titanium alloys.

The biomaterials sector is rapidly expanding and significant advances have been made in the technology of biomedical coatings and materials, which provide a means to improve the wear of joints, change the biological interaction between implant and host and combine the properties of various materials to improve device performance. Coatings for biomedical applications provides an extensive review of coating types and surface modifications for biomedical applications. The first part of the book explores a range of coating types and their biomedical applications. Chapters look at hydrophilic, mineral and pyrolytic carbon coatings in and ex vivo orthopaedic applications and finally at surface modification and preparation techniques. Part two presents case studies of orthopaedic and

ophthalmic coatings, and biomedical applications including vascular stents, cardiopulomonary by-pass equipment and ventricular assist devices. With its clear structure and comprehensive review of research, Coatings for biomedical applications is a valuable resource to researchers, scientists and engineers in the biomedical industry. It will also benefit anyone studying or working within the biomedical sector, particularly those specialising in biomedical coatings. Provides an extensive review of coating types and surface modifications for biomedical applications Chapters look at hydrophilic coatings for biomedical applications in and ex vivo, mineral coatings for orthopaedic applications, pyrolytic carbon coating and other commonly-used biomedical coatings Presents case studies of orthopaedic and ophthalmic coatings, and biomedical applications including vascular stents, cardiopulomonary by-pass equipment and ventricular assist devices

Scientists and researchers are looking for new smart materials to replace old or conventional materials for better performance and for new applications. The use of polymeric materials and nanomaterials is increasing due to their wide-spectrum tunability and many properties. It is now easier to formulate materials for special purposes using these materials than using conventional materials and methods. Many commercial products made from polymeric materials and

nanomaterials are now in use and on the market. This book presents a diverse selection of cutting-edge research on the development of polymeric materials and nanomaterials for new and different applications. These include electrical applications, biomedical applications, sensing applications, coating applications, and others. A few chapters dedicated to materials for construction applications are also included. Discussions include the properties, behavior, preparation, processing, and characterization of various polymeric materials, nanomaterials, and their composites. Some of the chapter authors present theoretical studies of these systems, which can help readers to develop a better understanding in this area.

Provides comprehensive coverage of the research into and clinical uses of bioceramics and biocomposites Developments related to bioceramics and biocomposites appear to be one the most dynamic areas in the field of biomaterials, with multiple applications in tissue engineering and medical devices. This book covers the basic science and engineering of bioceramics and biocomposites for applications in dentistry and orthopedics, as well as the state-of-the-art aspects of biofabrication techniques, tissue engineering, remodeling, and regeneration of bone tissue. It also provides insight into the use of bionanomaterials to create new functionalities when interfaced with biological

molecules or structures. Featuring contributions from leading experts in the field, Bioceramics and Biocomposites: From Research to Use in Clinical Practice offers complete coverage of everything from extending the concept of hemopoietic and stromal niches, to the evolution of bioceramic-based scaffolds. It looks at perspectives on and trends in bioceramics in endodontics, and discusses the influence of newer biomaterials use on the structuring of the clinician's attitude in dental practice or in orthopedic surgery. The book also covers such topics as biofabrication techniques for bioceramics and biocomposites; glass ceramics: calcium phosphate coatings; brain drug delivery bone substitutes; and much more. Presents the biggest trends in bioceramics and biocomposites relating to medical devices and tissue engineering products Systematically presents new information about bioceramics and biocomposites, developing diagnostics and improving treatments and their influence on the clinicians' approaches Describes how to use these biomaterials to create new functionalities when interfaced with biological molecules or structures Offers a range of applications in clinical practice, including bone tissue engineering, remodeling, and regeneration Delineates essential requirements for resorbable bioceramics Discusses clinical results obtained in dental and orthopedic applications Bioceramics and Biocomposites: From Research to Use in Clinical Practice is an excellent

resource for biomaterials scientists and engineers, bioengineers, materials scientists, and engineers. It will also benefit mechanical engineers and biochemists who work with biomaterials scientists.

This is the second edition of the classic book An Introduction to Bioceramics which provides a comprehensive overview of all types of ceramic and glass materials that are used in medicine and dentistry. The enormous growth of the field of bioceramics is due to the recognition by the medical and dental community of the importance of bioactive materials to stimulate repair and regeneration of tissues. This edition includes 21 new chapters that document the science and especially the clinical applications of the new generation of bioceramics in the field of tissue regeneration and repair. Important socioeconomic factors influencing the economics and availability of new medical treatments are covered with updates on regulatory procedures for new biomaterials, methods for technology transfer and ethical issues. The book contains 42 chapters that offer the only comprehensive treatment of the science, technology and clinical applications of all types of bioceramic materials used in medicine and dentistry. Each chapter is written by leaders in their specialized fields and is a thorough review of the subject matter, unlike many conference proceedings. All chapters have been edited to reflect the same writing style,

making the book an easy read. The completeness of treatment of all types of bioceramics and their clinical applications makes the book unique in the field and invaluable to all readers.

As the subject of tribology comprises lubrication, friction and wear of contact components highly relevant to practical applications, it challenges scientists from chemistry, physics and materials engineering around the world on todays sophisticated experimental and theoretical foundation to complex interdisciplinary research. Recent results and developments are preferably presented and evaluated in the context of established knowledge. Consisting of eleven chapters divided into the four parts of Lubrication and Properties of Lubricants, Boundary Lubrication Applications, Testing and Modeling, and Sustainability of Tribosystems, this textbook therefore merges basic concepts with new findings and approaches. Tribology Fundamentals and Advancements, supported by competent authors, aims to convey current research trends in the light of the state of the art to students, scientists and practitioners and help them solve their problems.

This volume contains papers that were presented at the NATO Advanced Research Workshop on Nanostructured Materials and Coatings for Biomedical and Sensor Applications held in Kyiv, Ukraine, 4-8 August, 2002. A total of 104 scientists from 14 countries participated in our ARW, making it a really international event. Participants ranged from graduate students to senior researchers. They presented 16 tutorial

lectures, 20 short talks and more than 70 posters. Invited speakers, from NATO and Partner countries, presented some of the most recent developments in physics, chemistry and technology of nanosized materials. A broad range of speakers having international standing and representing NATO and partner countries, as well as university, industrial and govemment research laboratories participated in this meeting and wrote papers for this volume. Foregoing ARW gathered together the scientists working in the area of nanosized materials and coatings and their applications in biomedicine and sensors. The first objective of this AR W was to discuss the current research covering a wide range of physical and chemical properties of biomaterials and their use. Active discussion of oral presentations and posters, and the round table discussion gave a good opportunity to researchers from academia and industry to discuss the achievements in this field and outline future directions in terms of technological developments and product commercialisation in the fields of biomedicine and sensors. Particularly, advanced ceramics and nanostructured carbons were covered in many presentations.

Advances in Calcium Phosphate Biomaterials presents a comprehensive, state-of-the-art review of the latest advances in developing calcium phosphate biomaterials and their applications in medicine. It covers the fundamental structures, synthesis methods, characterization methods, and the physical and chemical properties of calcium phosphate biomaterials, as well as the synthesis and properties of calcium phosphate-

based biomaterials in regenerative medicine and their clinical applications. The book brings together these new concepts, mechanisms and methods in contributions by both young and “veteran” academics, clinicians, and researchers to forward the knowledge and expertise on calcium phosphate and related materials. Accordingly, the book not only covers the fundamentals but also open new avenues for meeting future challenges in research and clinical applications. Besim Ben-Nissan is a Professor of Chemistry and Forensic Science at the University of Technology, Sydney, Australia

Thin Film Coatings for Biomaterials and Biomedical Applications discusses the latest information on coatings, including their historic use by scientists who are looking to improve the properties and biological responses of the material-host interface. Thin films, in particular, are becoming more widely researched and used as an alternative to traditional sprayed coatings because they have a more uniform structure and therefore greater stability. This book provides readers with a comprehensive guide to thin film coatings and their application in the biomaterials field. Part One of the book details the fundamentals of thin films for biomedical application, while Part Two looks at the special properties of thin films, with a final section reviewing functional thin films and their usage in biomedical applications. Provides a comprehensive review on the fundamentals, properties, and functions of thin film coatings for biomaterials Covers a broad range of applications for implantable biomaterials Written by an international team of contributors who carefully tailor the presented information in a way that

addresses industry needs
Audience Applied biomathematicians, orthopedists, clinical orthopedists.
This book summarises the up-to-date status of the field, covers important scientific and technological developments by many distinguished experts, who came together to contribute their research work and comprehensive, in-depth and up to date articles. Written in a versatile and contemporary style, this book can be used as an invaluable reference source for graduate students, scientist, researcher working in chemistry, polymer chemistry, polymer engineering, chemical engineering and materials science. We are thankfully appreciate the tremendous efforts and co-operation of all contributing authors for their devotion, valuable time in preparing state-of-art chapters for this book. We would also like to express our gratitude to the publishers and all authors, and others for granting us the copyright permissions to use their illustrations. Although sincere efforts were made to obtain the copyright permissions from the respective owners to include the citation with the reproduced materials, we would like to offer our sincere apologies to any copyright holder if unknowingly their right is being infringed.
Hydroxyapatite in the form of hydroxycarbonate apatite is the principal mineral component of bone tissue in mammals. In Bioceramics, it is classed as a bioactive material, which means bone tissue grows directly on it when placed in apposition without intervening fibrous tissue. Hydroxyapatite is hence commonly used as bone grafts, fillers and as coatings for metal implants. This important book provides an

overview of the most recent research and developments involving hydroxyapatite as a key material in medicine and its application. Reviews the important properties of hydroxyapatite as a biomaterial Considers a range of specific forms of the material and their advantages Reviews a range of specific medical applications for this important material

This book is open access under a CC BY 4.0 license. This volume broadens understanding of dentistry and promotes interdisciplinary research across a wide range of related fields, based on the symposium entitled "Innovative Research for Biosis–Abiosis Intelligent Interface 2016". It aims to create highly functional and autonomic intelligent interface by combining highly functional interface science with the technology of an evaluation and a control at the interface, with the various topics of biomaterials, innovation for oral science and application, regenerative oral science, and medical engineering. Since 2002, the Tohoku University Graduate School of Dentistry has hosted “Interface Oral Health Science” several times as the main theme of dental research in the twenty-first century, and this is the sixth proceedings of the symposiums following the ones in 2005, 2007, 2009, 2011, and 2014. This book benefits not only dental scientists but also other health scientists including medical physicians and pharmacologists, material scientists, engineers, and any scientist who is involved in variety of disciplines.

Written in a versatile, contemporary style that will benefit both novice and expert alike,

Biological and Biomedical Coatings Handbook, Two-Volume Set covers the state of the art in the development and implementation of advanced thin films and coatings in the biological field. Consisting of two volumes—Processing and Characterization and Applications—this handbook details the latest understanding of advances in the design and performance of biological and biomedical coatings, covering a vast array of material types, including bio-ceramics, polymers, glass, chitosan, and nanomaterials. Contributors delve into a wide range of novel techniques used in the manufacture and testing of clinical applications for coatings in the medical field, particularly in the emerging area of regenerative medicine. Building on the theoretical and methodological fundamentals of coatings as presented in the first volume, Applications covers: Biological/biomedical implants and other applications of carbon-based materials Control of drug release from coatings MIcrofluidic and biosensing/bioactive coatings and applications Surfaces and coatings of orthopedic, dental, and other implants Sol–gel-derived hydroxyapatite coatings on metallic implants Impedance spectroscopy With chapters authored by world experts at the forefront of research in their respective areas, this timely set provides searing insights and practical information to explore a subject that is fundamental to the success of biotechnological pursuits.

The goal of this book is to provide readers with a broad appraisal of topics in global advancements in theoretical and experimental facts, and practical applications of nano-HAp materials based on their synthesis, properties, prospects, and potential biomedical

treatments. The perspective of this book involves the preparation of crystalline nano-HAP materials including preferential orientation, various properties and new prospects in biomimetics, bone tissue infections, biomedical implants, regenerative medicinal treatments and a wide range of technological applications. This book is categorized into two main sections: Hydroxyapatite: synthesis, properties, perspectives, and prospects; and the application of hydroxyapatite: a synergistic outlook. Individual chapters provide a base for a wide range of readers from diversified fields, including students and researchers, who will find in this book simply explained basics as well as advanced techniques of specific subjects related to these phenomena. The book is made up of nine contributions, compiled by experts from wide-ranging fields involved in biomaterials/materials in science and technology from over 15 research institutes across the globe.

The first section of the book includes the following topics: fusion-based additive manufacturing (AM) processes of titanium alloys and their numerical modelling, mechanism of ?-case formation mechanism during investment casting of titanium, genesis of gas-containing defects in cast titanium products. Second section includes topics on behavior of the (? + ?) titanium alloys under extreme pressure and temperature conditions, hot and super plasticity of titanium (? + ?) alloys and some machinability aspects of titanium alloys in drilling. Finally, the third section includes topics on different surface treatment methods including nanotube-anodic layer

formation on two phase titanium alloys in phosphoric acid for biomedical applications, chemico-thermal treatment of titanium alloys applying nitriding process for improving corrosion resistance of titanium alloys.

Over the past two decades, thermal spraying of metallic, ceramic and composite coatings has emerged as a powerful tool for surface engineering, with many new applications and markets continually being developed. This book will help materials scientists and engineers to choose the most appropriate combination of materials, equipment, and operation parameters for the design of high-performance coatings with new functional properties and improved service life. Includes: * a thorough treatment of the fundamental physical processes governing plasma spray technology; * a critical assessment of advantages and disadvantages of the method compared with other suface coating techniques; * a discussion of basic equipment requirements and limitations; * case studies and typical applications to solve industrial problems. Plasma-Spray Coating offers a stimulating combination of basic concepts and practical applications. Materials scientists and engineers, as well as graduate students will find this book of enormous value.

As the inorganic constituents of skeletons, dentine and the enamel of teeth in all vertebrates, as well as antlers of male deer, calcium orthophosphates ($CaPO_4$) appear to be the key materials to sustain all life on Earth. Therefore, biologically relevant $CaPO_4$ possess all the necessary features of the biomaterials, such as biocompatibility,

bioactivity, bioresorbability, osteoconductivity, osteoinductivity, and appear to be non-toxic, non-inflammatory and non-immunogenic. In this book, the author presents current state-of-the-art applications of CaPO4 as bioceramics, deposits (coatings, films and layers) and in dentistry. Topics discussed include chemical composition and preparation, forming and shaping, sintering and firing for CaPO4-based bioceramics, chemical composition and preparation, pre- and post-deposition treatments for CaPO4-based deposits, followed by the detailed description of their major properties, biomedical applications and in vivo behavior. The detailed description of current CaPO4 applications in dentistry both for dental caries prevention and as various types of dental treatments is given in the last section of this book.

This new book synthesizes a wide range of interdisciplinary literature to provide the state-of-the art of biomedical implants. It discusses materials and explains the three basic requirements for implant success from a surface engineering perspective: biological compatibility, biomechanical compatibility, morphological compatibility. Biomedical, mechanical, and materials engineers will find this book indispensable for understanding proper treatment of implant surfaces in order to achieve clinical success. Highlights include: • Coverage of surface engineering of polymer, metallic, ceramic and composite implant materials; • Coverage of chemical, mechanical, physical, thermal, and combined surface modification technologies; • Explanations of interfacial reaction between vital tissue and non-vital implant surface; and • Methodologies and

technologies for modification of surface layer/zone to promote the osteo-integration, the ultimate success for biomedical implants in both dental and medical practice.

There is a high demand for antimicrobials for the treatment of new and emerging microbial diseases. In particular, microbes developing multidrug resistance have created a pressing need to search for a new generation of antimicrobial agents, which are effective, safe and can be used for the cure of multidrug-resistant microbial infections. Nano-antimicrobials offer effective solutions for these challenges; the details of these new technologies are presented here. The book includes chapters by an international team of experts. Chemical, physical, electrochemical, photochemical and mechanical methods of synthesis are covered. Moreover, biological synthesis using microbes, an option that is both eco-friendly and economically viable, is presented. The antimicrobial potential of different nanoparticles is also covered, bioactivity mechanisms are elaborated on, and several applications are reviewed in separate sections. Lastly, the toxicology of nano-antimicrobials is briefly assessed.