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Series Editor

Prof. Min Wang
Department of Mechanical Engineering
The University of Hong Kong
Pokfulam Road, Hong Kong
e-mail: memwang@hku.hk

Aims and Scope

The Springer Series in Biomaterials Science and Engineering addresses the manufacture, structure and properties, and applications of materials that are in contact with biological systems, temporarily or permanently. It deals with many aspects of modern biomaterials, from basic science to clinical applications, as well as host responses. It covers the whole spectrum of biomaterials – polymers, metals, glasses and ceramics, and composites/hybrids – and includes both biological materials (collagen, polysaccharides, biological apatites, etc.) and synthetic materials. The materials can be in different forms: single crystals, polycrystalline materials, particles, fibers/wires, coatings, non-porous materials, porous scaffolds, etc. New and developing areas of biomaterials, such as nano-biomaterials and diagnostic and therapeutic nanodevices, are also focuses in this series. Advanced analytical techniques that are applicable in R & D and theoretical methods and analyses for biomaterials are also important topics. Frontiers in nanomedicine, regenerative medicine and other rapidly advancing areas calling for great explorations are highly relevant.

The Springer Series in Biomaterials Science and Engineering aims to provide critical reviews of important subjects in the field, publish new discoveries and significant progresses that have been made in both biomaterials development and the advancement of principles, theories and designs, and report cutting-edge research and relevant technologies. The individual volumes in the series are thematic. The goal of each volume is to give readers a comprehensive overview of an area where new knowledge has been gained and insights made. Significant topics in the area are dealt with in good depth and future directions are predicted on the basis of current developments. As a collection, the series provides authoritative works to a wide audience in academia, the research community, and industry.

Iulian Antoniac
Editor

Biologically Responsive Biomaterials for Tissue Engineering

Springer

Editor
Iulian Antoniac
University Politehnica of Bucharest
Faculty Materials Science and Engineering
Bucharest, Romania

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Preface

The field of biomaterials science represents a unique integration of biology, physics, chemistry, materials science, engineering, and medicine for the purpose of developing new materials solutions to address a variety of medical problems. The past years have witnessed a rapid expansion of the field, and the newest generation of biomaterials, which incorporates biomolecules, therapeutic drugs, and living cells, offers both greater challenges and increased potential for effective medical solutions. Developments in the area of biomaterials, bionanotechnology, tissue engineering, and medical devices are becoming the core of health care. Many critical diseases, such as cancer, cardiovascular disease, and trauma injuries, could be alleviated by regenerative medicine. Almost all medical specialties involve the use of biomaterials, and research plays a key role in the development of new and improved treatment modalities. When a biomaterial is used inside the human body, a biological response is triggered almost instantaneously.

The ultimate goal of tissue engineering is to regenerate tissues that restore normal physiological function, and for this purpose as well as for biocompatibility it is very important for biomaterials to be biologically responsive. An ideal biomaterial for tissue regeneration enhances cell attachment, proliferation, and differentiation, must integrate with the host tissue, and exhibits mechanical properties that are compatible with the native tissue. To reconstruct tissues by tissue engineering, three components are needed: cells, biomaterials, and bioactive molecules. Scaffolds made with different biomaterials play a key role in the organization of new tissue. Also, the manufacturing methods of the scaffold are crucial because the resulting properties need to be correlated with targeted tissue properties.

This book focuses on several current trends in tissue engineering, remodeling, and regeneration. Leading researchers describe the use of nanomaterials to create new functionalities when interfaced with biological molecules or structures. The use of polymers, alloys, and composites, or a combination of these, for biomaterials applications in orthopedics is also explored.

The book is organized into nine chapters which show different aspects of biologically responsive biomaterials for tissue engineering. Key topics include scaffold design, the use of carbon nanotubes in bone cements, endothelial cell response,

hydrogel scaffolds processing techniques, synthetic morphogens, bioabsorbable screws, molecular scissors, and bioadhesives.

In addition to coverage of basic science and engineering aspects, a range of applications in bionanotechnology are presented, including diagnostic devices, contrast agents, analytical tools, physical therapy applications, and vehicles for targeted drug delivery.

Biomaterials researchers must be ready to address growing healthcare needs and understand these needs. Innovative biomaterials for tissue engineering will reach the clinic only if these biomaterials will be biologically responsive and if innovative technologies for processing can be translated into industry use. The present volume aspires to bridge the gap between the new biomaterials and processing techniques developed in the laboratory and the clinical effects of currently used biomaterials applications.

These contributions represent essential reading for the biomaterials and biomedical engineering communities and can serve as instructional course lectures targeted at graduate and postgraduate students. This book advocates for biologically responsive biomaterials research, so that emerging technologies can most effectively offer tissue engineering products as clinical solutions for existing diseases. The global imperative for novel biomaterials for tissue engineering is clear, and it is a particularly exciting time to work in the field of biomaterials science for researchers who are successful in achieving this clinical impact.

Bucharest, Romania Iulian Antoniac

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Contributors

Marco A. Alvarez-Perez Institute of Composite and Biomedical Materials, National Research Council, Naples, Italy

Luigi Ambrosio Institute of Composite and Biomedical Materials, National Research Council, Naples, Italy

Iulian Antoniac University Politehnica of Bucharest, Bucharest, Romania

Thomas Billiet Polymer Chemistry & Biomaterials Research Group, Ghent University, Krijgslaan, Ghent, Belgium

Valentina Cirillo Institute of Composite and Biomedical Materials, National Research Council, Naples, Italy

Cosmin Cotrut University Politehnica of Bucharest, Bucharest, Romania

Carmen Elena Cotrutz Cell Biology Department, G.T. Popa University of Medicine and Pharmacy, Iasi, Romania

Peter Dubruel Polymer Chemistry & Biomaterials Research Group, Ghent University, Ghent, Belgium

Nicholas Dunne School of Mechanical & Aerospace Engineering, Queen's University of Belfast, Belfast, UK

Vincenzo Guarino Institute of Composite and Biomedical Materials, National Research Council, Naples, Italy

C. James Kirkpatrick Institute of Pathology, University Medical Center of the Johannes Gutenberg University, Mainz, Germany

Dan Laptoiu Colentina Clinical Hospital Bucharest, Bucharest, Romania

José Miguel Martín-Martínez Adhesion and Adhesives Laboratory, University of Alicante, Alicante, Spain

Christina A. Mitchell School of Medicine, Dentistry and Biomedical Sciences, Queen's University of Belfast, Belfast, UK

Ross Ormsby School of Mechanical & Aerospace Engineering, Queen's University of Belfast, Belfast, UK

Radu Parpala University Politehnica of Bucharest, Bucharest, Romania

Kirsten Peters Department of Cell Biology, University of Rostock, Rostock, Germany

Tudor Petreus Cell Biology Department, G.T. Popa University of Medicine and Pharmacy, Iasi, Romania

Diana Popescu University Politehnica of Bucharest, Bucharest, Romania

Maria Grazia Raucci Institute of Composite and Biomedical Materials, National Research Council, Naples, Italy

Alfredo Ronca Institute of Composite and Biomedical Materials, National Research Council, Naples, Italy

Matteo Santin Brighton Studies in Tissue-mimicry and Aided Regeneration (BrightSTAR), School of Pharmacy and Biomolecular Sciences, University of Brighton, Brighton, UK

Dieter Scharnweber Max Bergman Center of Biomaterials, Technische Universität Dresden, Dresden, Germany

Jorg Schelfhout Polymer Chemistry & Biomaterials Research Group, Ghent University, Ghent, Belgium

Paul Sirbu Cell Biology Department, G.T. Popa University of Medicine and Pharmacy, Iasi, Romania

Dan Ioan Stoia University Politehnica of Timisoara, Timisoara, Romania

Rafael Torregrosa-Coque Adhesion and Adhesives Laboratory, University of Alicante, Alicante, Spain

Mirela Toth-Tascau University Politehnica of Timisoara, Timisoara, Romania

Roman Tsaryk Institute of Pathology, University Medical Center of the Johannes Gutenberg University, Mainz, Germany

Ronald E. Unger Institute of Pathology, University Medical Center of the Johannes Gutenberg University, Mainz, Germany

Mieke Vandenhaute Polymer Chemistry & Biomaterials Research Group, Ghent University, Ghent, Belgium

Ana María Villarreal-Gómez Bioadhesives Medtech Solutions, Elche, Alicante, Spain

Sandra Van Vlierberghe Polymer Chemistry & Biomaterials Research Group, Ghent University, Ghent, Belgium