

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.

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