

# Foreword

In the last few decades, research in the area of tissue engineering has witnessed tremendous progress. The field seeks to replace or facilitate the regeneration of damaged or diseased cells, tissues or organs by applying a biomaterial support system, and/or a combination of cells and bioactive molecules. Meanwhile, advances in new materials provide opportunities to fabricate, characterize and utilize materials systematically to control cell behavior and tissue formation by biomimetic topography which closely replicates the natural extracellular matrix. Tissue morphogenesis is highly dependent on the interaction of cells with the extracellular matrix. Also important are developments of smart materials which can mimic complex interactions between cells and the extracellular matrix will promote functional tissue regeneration.

As an emerging area in materials science, smart materials have achieved extraordinary developments in recent years. Smart materials are materials that respond to small changes in physical or chemical conditions with relatively large property changes. Smart materials for tissue engineering are produced by modifying the physicochemical and biological properties of the scaffolds with response to external stimuli to enhance tissue regeneration. The functions of living cells are regulated by smart materials which respond to changes in the surrounding microenvironment. Smart materials which can respond to external signals and further adapt to their environment are based on various formulas from hard to soft materials. The morphology is from macroscopic to nanoscale dimensions in the form of gels, fibers, particles, colloids, or membranes. All these materials can be smartly designed to respond to specific signals, which range from pH, temperature, light, electrons, magnetism, and enzymes. There are many opportunities for smart materials to aid tissue engineering. Numerous tissue engineering scaffolds

with advanced properties based on smart materials have been developed in recent years, including new discoveries in the field of stem cells.

Fundamental principles and applications are two areas to study smart materials for tissue engineering. The first approach is mostly in the hands of chemists and physicists, the second one is more in the hands of engineers and biologists. The present book tries to bridge the vital gap between these scientific communities. Leading experts in multidisciplinary fields contributing to this book illustrate the fundamentals of smart materials, and their present stage in tissue engineering applications. Applications of a wide range of materials with diverse structures, different processing protocols, and responsiveness to physiological variables are discussed in the current book. An effort has been made to prioritize the concepts that are behind the design and application of smart tissue engineering materials.

The large variety of different smart materials and the large application areas make it difficult to systematically put them together in a single book. This book covers a unique aspect of materials science in tissue engineering, especially the applications of smart materials for tissue engineering. Working in the interface between smart materials and tissue engineering is a long adventure. The editor of this book, Professor Qun Wang of Iowa State University, wants to cover top-down applications. The vision is that there is a need for comprehensive knowledge on different types of smart materials fabrication and their corresponding tissue engineering applications. This book aims to fill this gap and tries to introduce new tissue engineering smart materials to a wide audience, from scientific communities and educational organizations to industrial manufacturers. The book will provide both an introduction to key research areas for new investigators in this highly interdisciplinary field, and a resource for those already working on fundamental materials research for tissue engineering applications. This is an authoritative book in the most recent developments in the area, as well as a valuable reference for anyone contemplating working in the field.

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