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Chitin and Chitosan for Regenerative Medicine

 Springer

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Preface

Polymers, the spectacular world of macromolecules have delivered their services to our society in various fields of life. In most cases, biopolymers are vulnerable and their identity to specific functions, especially for medicinal applications are very important. Owing to their biocompatible, nontoxic, and biodegradable nature, biopolymers (rather to say biomaterials in a broad sense) give a better option to be used in advancement of the biomedical field. Regenerative medicine is an area where tissue engineering, stem cell research, gene therapy, and therapeutic cloning are the collective work toward rebuilding or replacement of missing or injured body parts. Regenerative medicine is a blessing for our society where around 10 % of the entire world's populations suffering from a disability. Biomaterials, especially chitin and chitosan match up all the characteristics required in the field of regenerative medicine.

The present two volumes entitled “Chitin and Chitosan for Regenerative Medicine: Part I—Focus on Tissue Engineering and Part II—Focus on Therapeutics, Functionalization and Computer-aided Techniques” were conceived to provide broad and innovative information not only related to tissue engineering but also on other therapeutic and biomedical applications based on chitin/chitosan and their various derivatives in the field of regenerative medicine like quantum dots, nanomedicines, drug delivery, hydrogels, and scaffolds. The book consists of 13 chapters written in such a manner that will surely meet the expectations of scientists as well as researchers from various disciplines.

Part I will mainly focus on tissue engineering and its applications for regenerative medicine. “[Chitosan Hydrogels for Regenerative Engineering](#)” reviews the various methods used for preparing chitosan-based hydrogels and their applications as cell, protein and drug delivery vehicles in pharmaceutical, biomedical sciences, and tissue engineering. “[Prospects of Bioactive Chitosan-Based Scaffolds in Tissue Engineering and Regenerative Medicine](#)” will focus on the synthesis of several biologically active chitin and chitosan-based scaffolds for tissue engineering and other related strategies to enhance the activity of prepared scaffolds. “[Chitosan-Based Scaffolds for Cartilage Regeneration](#)” deals with issues related to cartilage damage which causes osteoarthritis and how different types of chitosan-based scaffolds are synthesized that can be utilized for regeneration of damaged tissues.

“Composite Chitosan Calcium Phosphate Scaffolds for Cartilage Tissue Engineering” explains the processes for the fabrication of chitosan-calcium phosphate (CHI-CaP) composite scaffolds for the enhancement in the field of cartilage tissue engineering along with its physical characteristics and possible aspects of the scaffold’s degradation. “Chitosan-Gelatin Composite Scaffolds in Bone Tissue Engineering” highlights the importance of chitosan-gelatin-based composite scaffolds in bone tissue engineering along with its preparation techniques and its physical and biological characteristics. “Chitin and Chitosan Nanocomposites for Tissue Engineering” provides novel approaches at the juncture between biology and nanotechnology to develop encouraging ecofriendly biopolymer nanocomposites based on chitin and chitosan. “Chitin, Chitosan and Silk Fibroin Electrospun Nanofibrous Scaffolds: A Prospective Approach for Regenerative Medicine” discusses the current advancements in the field of electrospun nanofibrous scaffolds-based chitin, chitosan, and silk fibroin highlighting tissue engineering for regenerative medicine. Part II will focus on various therapeutics and computer aided techniques for regenerative medicine. Here, “Chitosan: A Potential Therapeutic Dressing Material for Wound Healing” will mainly focuses on how to develop dressing material for wound healing by combining natural biopolymers (chitin and chitosan), synthetic polymer and nanoparticles which can be available as a biomaterial for regenerative medicine. “Recent Advances in Chitosan Based Nanomedicines for Cancer Chemotherapy” highlights the fabrication process and the possible function of chitosan-based derivatives in cancer chemotherapy. “Chitosan: A Promising Substrate for Regenerative Medicine in Drug Formulation” reviews the chitosan-based formulation with potential medicinal uses to deliver an enhanced knowledge of utilization of chitosan in regenerative medicine. “D-Glucosamine and N-Acetyl D-Glucosamine: Their Potential Use as Regenerative Medicine” explains the importance of chitin and chitosan oligosaccharides, N-acetylglucosamine, and D-glucosamine, as drug carriers for molecular therapeutics like in the drug and gene delivery systems and also its role in imaging for tumor and cancer detection. “Functionalized Chitosan: A Quantum Dot Based Approach for Regenerative Medicine” explains how chitosan-quantum dots are utilized in regenerative medicine and also discusses their potential barriers of using techniques. “Development and Selection of Porous Scaffolds using Computer Aided Tissue Engineering” describes the selection of biomaterials, its facilitated properties, experimental methods, knowledge of computer-based biomodeling to synthesize scaffolds using computer aided tissue engineering (CATE) which acts as an important tool for the fabrication of scaffolds especially for regenerative medicine.

Last but not the least, I would like to thank all contributors for their generous support, the publisher for accepting our book, all research scholars and staff members of Polymer Research Laboratory, Chemistry Department, and the administrative head of MNNIT Allahabad, India for their encouragement and cooperation, without which it would have been extremely difficult to complete this task on time.

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About the Editor

Dr. Pradip Kumar Dutta obtained his M.Sc. (Chemistry) and Ph.D. (Polymer Chemistry) from Indian Institute of Technology, Kharagpur in 1987 and 1993, respectively. He started his career as a research scientist in Birla Research Institute, Nagda, Madhya Pradesh, India in 1992, before receiving his Ph.D. degree. His strong interest in academics drew him to one of the best engineering institutes, Shri G.S. Institute of Technology and Science (SGSITS) in Indore, Madhya Pradesh in 1993. He served there for about 10 years in different posts such as lecturer, senior lecturer in chemistry and coordinator for Continuing Education Program (All India Council for Technical Education, Government of India). In 2002, Dr. Dutta joined as Reader in Chemistry in Motilal Nehru National Institute of Technology (Deemed University), Allahabad, India. His progress in academic activities through teaching, research projects, guiding doctoral and postdoctoral students, research collaboration with similar researchers in India and abroad is continuing. His research interests include synthesis and modification of polymers, nanomaterials/composites, functional polymers, drug delivery, wound management, tissue engineering, food preservation, etc. He has about 200 papers published in national and international journals, 18 book articles/chapters, delivered 20 h video-lecture programs, and prepared 18 course modules. He has already supervised 16 M.Sc., 18 M.Tech./M.Phil./M.Pharma and nine Ph.D. theses. Presently, five Ph.D. students are working under him. He was awarded Commonwealth Academic Staff Fellowship-2007 and visited York University, York, UK. He was also awarded the Chinese Academy of Sciences & Third World Academy of Sciences (CAS-TWAS) visiting scholar fellowship 2004, 2006 and 2009 and visited Changchun Institute of Applied Chemistry, Changchun, China for collaborative research work. Besides these, Dr. Dutta has extensively visited countries like South Korea, Japan, Turkey, Switzerland, USA for academic purposes. He is the founder editor of International Journal of Asian Chitin Journal since 2005, founder member of Indian Chitin and Chitosan Society, reviewer of various international journals, and Fellow of Royal Society of Chemistry (UK).