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Novel Biomaterials for Regenerative Medicine

 Springer

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Preface

Regenerative medicine is a branch of multidisciplinary research in tissue engineering and molecular biology, which deals with the process of replacing, engineering, or regeneration of human cells, tissues, or organs to restore or establish normal function. Regenerative medicine is leading the innovation of life sciences and medicine with various expansion toward stem cells, cell therapy, and tissue engineering, and hence it is now becoming a pillar of the advanced medical industry. In regeneration medicine fields, biomaterials are essential tools for replacing part of a living system or to function in intimate contact with the living tissue. Therefore, this book introduces the recent trends of biomaterials derived either from nature or synthesized in the laboratory using a variety of chemical approaches utilizing metallic components, polymers, ceramics, or composite materials. The book consists of 5 main parts and 28 chapters containing recent topics reported by a number of prominent researches in these fields.

Part I reviews the fate of stem cells regulated by biomaterials.

Chapter 1 is an introduction to the human placenta laminin-111 as a multifunctional protein for tissue engineering and regenerative medicine. In Chap. 2, a novel strategy for simple and robust expansion of human pluripotent stem cells using botulinum hemagglutinin is introduced. Polycaprolactone scaffolds used for the growth and differentiation of dental stem cells of apical papilla are summarized in Chap. 3. The impact of three-dimensional culture systems on hepatic differentiation of pluripotent stem cells and beyond is introduced in Chap. 4.

Controlling of signal pathway of stem cell by biomaterials is discussed in Part II.

In Chap. 5, modulation of the osteoimmune environment in the development of biomaterials for osteogenesis is reviewed. For tissue regeneration and disease modeling, novel biomimetic microphysiological systems are summarized in Chap. 6. Chapter 7 contains the feasibility of silk fibroin in wound healing process. In Chap. 8, the role of natural-based biomaterials in advanced therapies for autoimmune diseases is described.

Part III describes functional biomaterials for regenerative medicine.

Content of Chap. 9 includes recent advancements in decellularized matrix-based biomaterials for musculoskeletal tissue regeneration. In Chap. 10, clinical applications of injectable biomaterials are introduced. Advanced injectable alternatives for osteoarthritis are discussed in Chap. 11. Chapters 12, 13 and 14 introduce fabrication of hydrogel materials, injectable nanocomposite hydrogels and electrosprayed nano(micro)particles, and advances in waterborne polyurethane-based biomaterials for biomedical applications, respectively. Content reviewed in Chap. 15 is medical applications of collagen and hyaluronan in regenerative medicine.

Part IV shows the review on inorganic biomaterials for regenerative medicine.

Calcium phosphate biomaterials for clinical application in dentistry are described in Chap. 16. In Chap. 17, stem cell and advanced nano bioceramic interactions are discussed. Chap. 18 introduces recent trend in hydroxyapatite (HAp) synthesis and the synthesis report of nanostructure HAp by hydrothermal reaction. Use of TiO_2 in the bone regeneration is discussed in Chap. 19.

Finally, Part V introduces the recent trends of smart natural biomaterials for regenerative medicine.

Chapter 20 reviews the feasibility of silk fibroin-based scaffold for bone tissue engineering. Chapter 21 explains characteristics of collagen Type I as a versatile biomaterial. Techniques of tissue-inspired interfacial coatings for regenerative medicine are described in Chap. 22. Chapters 23, 24 and 25 introduce naturally derived biomaterials, mussel-inspired biomaterials, and chitosan for tissue engineering applications, respectively. Chapter 26 reviews demineralized dentin matrix (DDM) as a carrier for recombinant human bone morphogenetic proteins (rhBMP-2). Prospects of natural polymeric scaffolds in peripheral nerve tissue regeneration are introduced in Chap. 27. In Chap. 28, chitosan-based dressing materials for problematic wound management are reviewed.

We offer a special thanks to all participants who have generously devoted their time, energy, experience, and intelligence for successful completion of this book. Their efforts will contribute to next generation who studies regenerative medicine based on biomaterials. Finally, we really appreciate the effort of Dr. Sue Lee, the publishing editor of biomedical sciences of Springer Nature, who made a great effort to publish this book. Also we would like to appreciate Mrs. Ok Kyun Choi and Yong Woon Jeong at Gilson's Lab for e-mailing all authors, editing, pressing, and so on as boring

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