LIGNIN AND LIGNANS: ADVANCES IN CHEMISTRY, Cyril Heitner, Donald R. Dimmel and John A. Schmidt (Eds.), CRC Press Taylor & Francis Group, 2010, 651 pp., ISBN 978-1-57444-486-5, $121

It is known that lignin represents the main constituent in almost all dry-land plant cell walls, being second only to cellulose in natural abundance. The structure and reactions of lignin have been studied for over 100 years and the extensive output of this research has been summarized in several comprehensive review texts. This book is devoted to new aspects concerning the natural compounds with aromatic structure – lignin and lignans – and contains 17 chapters.

In chapter 1 – *Overview*, the subjects related to lignin discussed in this book – occurrence, formation and structure, isolation and structure proofs, reactivity and uses – are presented. One of the greatest challenges in the structural biochemistry of the lignified cell wall is to determine the nature and proportion of building units and interunit linkages in native lignin structure, a topic discussed in chapter 2 – *Determining lignin structure by chemical degradations*. The main reactions used to elucidate lignin structure presented in this chapter are oxidative degradation, thioacidolysis, derivatization, followed by reductive cleavage and ozonation.

Electronic spectroscopy of lignins represents the subject of chapter 3, which summarizes well-known data on the solution properties of lignin and lignin model compounds, along with newer work on the application of diffuse reflectance spectroscopy, luminescence spectroscopy and transient spectroscopy to problems in lignin chemistry. These techniques allow obtaining information about chromophore groups appearing in lignin structure during the processing of raw materials with the aim of manufacturing cellulosic products.

Another possibility to characterize lignin is based on *Vibrational spectroscopy* (chapter 4). In the past two decades, thanks to significant improvements in instrumentation and the development of new interpretive tools, vibrational spectroscopy has become increasingly important for studies of lignin. This chapter presents three methods – Raman spectroscopy, infrared spectroscopy and near-infrared spectroscopy –, summarizing their contributions to analytical, mechanistic and structural studies of lignin.

NMR spectroscopy – chapter 5 – has enormously facilitated investigations into structural aspects of complex lignin polymers. Principally, due to its high resolution and the high dispersion of chemical shifts, ^{13}NMR has played a major role in the qualitative and quantitative understanding of lignin structure. Now modern two- and three-dimensional correlative methods are powerful tools for identifying structural units. Additional structural information can be gained by applying derivatization procedures that covalently link other NMR active nuclei to lignin and observing the resulting NMR spectrum of those nuclei. Important considerations in selecting NMR-active nuclei for labeling functional groups in lignin are sensitivity of the nuclei in an NMR experiment, the availability of suitable derivatizing reagent, and the ease of obtaining derivatization under mild conditions.

Several heteronuclear NMR cases are discussed in chapter 6 – *Heteronuclear NMR spectroscopy of lignins* – with primary emphasis on the most informative one, phosphorous-31 NMR. It is known that the lignin has a complex structure determined by plant species and isolation procedures.

The results obtained in the studies of lignin *in situ* and isolated products are commented upon in chapter 7 – *Functional groups and bonding pattern in lignin (including the lignin-carbohydrate complexes)*. The establishment of different bonds between structural units is determined by the biosynthesis process, including a radical mechanism with the participation of specific enzymes. At the same time, the chemical interaction between lignin with carbohydrates, through the addition of nucleophiles to quinone methides, formed as intermediates, has as a result the formation of the lignin-carbohydrate complex.

Despite numerous studies devoted to this topic, there are still many aspects that are not completely understood, but are very important for reactivity of lignin *in situ*. In chapter 8 – *Thermal properties of isolated and* in situ *lignin* – polymer properties related to thermal stability and molecular motion of lignin in solid state are discussed. The results presented suggest that the molecular motion of lignin is similar to that of synthetic polymers having phenyl groups in the main chain. At the same time, due to the presence of hydroxyl groups, the molecular chain is markedly influenced by hydrogen bonds to water molecules. The molecular properties of *in situ* lignin are affected by coexisting polysaccharides through the formation of lignin-carbohydrate complexes.

Chapter 9 presents the *Reactivity of lignin-correlation with molecular orbital calculation***.** The results obtained by this technique can be correlated with those obtained by chemical and spectroscopic methods, describing past, present and potential applications of electronic structure calculations to the chemistry of lignin. The improvements in computer hardware and software, computational chemical methods have become increasingly accessible, making it possible to obtain information concerning the formation and reactivity of phenoxy radicals, pulping and bleaching processes (conventional, alternative pulping catalyst and enzymatic bleaching), and interpretation of spectroscopy, conformation and the influence of hydrogen bonds.

The *Chemistry of alkaline pulping*, the most important chemical pulping process, is dwelt upon in chapter 10. The discussion in this chapter focuses on the lignin reactions that occur during the chemical pulping of wood by soda, kraft, AQ and polysulfide processes. The kinetics aspects along with the structure of residual and dissolved lignin are presented. The possibility to change the process is offered by obtaining new information concerning the reaction mechanism to improve selectivity or by modification of the chemical composition and structure of compounds by genetic engineering.

Pulp bleaching (chapter 11 – *Chemistry of pulp bleaching*) has as its main purpose to increase the whiteness and the cleanliness of the fibers to obtain better contrast and color reproduction in printing, water absorption together with improved machine runnability. The utilization of different agents is known, such as peroxides, oxygen, chlorine dioxide, ozone, peracids, along with newer ones (polyoxometalates and laccase/mediator oxidation). The chemistry of each agent is presented.

Other aspects of pulp bleaching with some of the above-mentioned agents are detailed in chapter 12 – *The chemistry of lignin-retaining bleaching: oxidative agents.* Thus, the reactions of the hydrogen peroxide and peracetic acid are discussed from the point of view of their interactions with lignin chromophores. Also, the possibilities to use hydrogen peroxide along with other reagents (ozone, persulfuric acid and dimethyldioxirane) are mentioned. The only oxidative agents known to brighten mechanical pulps are peroxides. Alkaline hydrogen peroxide is the only one that is used commercially, but there has been significant research on the use of various peracids, ozone and active-oxygen species formed *in situ* from these agents.

Mechanical pulps may be also bleached by reductive processes that remove colored chrompohores, as indicated in chapter 13 – *The chemistry of lignin-retaining bleaching: reductive bleaching agents.* The main agents studied for this process are hydrosulfite, formamidine sulfinic acid, phosphorus derivatives, phosphinates and phosphines, sulfurated borohydride and amineboranes. There have been some notable advances in the elucidation of the reaction mechanisms of hydrosulfite itself. The importance of the radical anion species has been demonstrated in detail and the implication of these discoveries has opened up new vistas to bleach wood pulps using reductive chemistry. The last decades have thus shown that some new interesting chemicals, either phosphorous based or boron based, can be used as new reductive bleaching chemicals for high-yield softwood pulps. These chemicals can be used in multistage bleaching sequences along with hydrogen peroxide. Phosphines and amineboranes can both be used to reduce lignin chromophores.

It is known that wood-rotting fungi play an important role in lignin biodegradation. This aspect is discussed in chapter 14 – *Lignin biodegradation.* The biological stability of lignin is influenced by the nature of microorganisms and their cultivation conditions. In the degradation of lignin, a lot of enzymes are involved, but the most important for practical applications seem to be manganese peroxidases and laccases along with redox mediators.

The elucidation of mechanisms involved in lignin biodegradation has determined the interest some aspects concerning *Biopulping and biobleaching* – chapter 15. The most important results were obtained in biomechanical pulping and biochemical pulping. In the first case, the application of biological treatment facilitates wood defibration, significantly reducing energy consumption, maintaining the integral characteristics of fibers and ensuring increased strength properties of papers. In the second case, biological treatment can be associated with chemical treatments using the kraft, sulfite and organosolv procedures. Pulp bleaching can be performed by utilizations of enzymes, such as manganese peroxidases, lignin peroxidases and laccase together with mediators. But the practical development of these processes has indicated the inaccessibility of enzymes to lignin in a cell wall structure.

In contrast to cellulose and hemicelluloses, lignin is the only polymeric component of the plant fiber that absorbs both visible and near-UV light. This characteristic is analyzed in chapter 16 – *The photochemistry of lignin*. After light absorption, the excited electronic states are formed, generating reactive radical species, which in turn react with oxygen to form chromophores. Alternatively, the excited states can sensitize the conversion of triplet oxygen to the very reactive singlet oxygen. Thus the photooxidation of lignin causes depolymerization through cleavage of interunit bonds and yellowing through the oxidation of the aromatic groups. Both mechanisms are discussed and it is concluded that photooxidation can be used to obtain a large number of products, which after isolation may yet be useful components and feed-stock in a biorefinery.

Another large group of natural products besides lignin is represented by lignans, which are biosynthesized from the same phenylpropane units. These compounds are characterized by interesting properties treated in chapter 17 – *Pharmacological properties of lignans.* An important number of lignans exhibiting various biological activities have been isolated from medicinal plants that are used in traditional and folk medicine. The chapter presents very well-documented information, permitting the conclusion that lignans are a group of polyphenols with antioxidant activity, effective in preventing diseases linked to active oxygen species. The lignans are formed in the intestinal tract from precursors present in fiber-rich food, and stimulate the synthesis of sex hormone, binding globulin. This causes a reduction in hormone bioavailability and may protect against certain hormone-dependent cancers (breast, endometerium and prostate). These aspects, to be developed in the future, can also be correlated with lignin, considering that, by its degradation, some products with similar properties to those of lignans can result.

This book was accomplished with the contributions of renowned specialists in the field of lignin chemistry and it is a very useful tool for many scientists, students and postgraduates aiming at opening a new era for this valuable compound accessible from renewable resources processed by biorefining. It may be helpful not only in research and development, but also in the line of teaching.

I hope that you as a reader will enjoy the volume.

Valentin I. Popa

POLYMERIC BIOMATERIALS: STRUCTURE AND FUNCTION, Founding Editor Severian Dumitriu, Editor Valentin I. Popa, volume 1, third edition, CRC Press, Taylor & Francis Group, LLC, 2013, 902 pp., ISBN 978-1-4200-9470-1

The first volume from a completely revised and expanded two-volume set contains information about the structure and properties of synthetic and natural polymers, as well as their blends or composites, and describes the drug carriers and delivery systems, gene and nucleic acids delivery, and polymer synthesis and processing techniques. The work comprehends 25 chapters, which provide systematically the latest developments in different areas of polymeric materials.

Chapter 1 – *Synthesis and Fabrication of Polyesters as Biomaterials (Philippe Lecomte and Christine Jérôme)* – reviews the most important techniques for synthesis of the aliphatic polyesters with tailored properties, such as bioadherence, mechanical properties and the kinetics of biodegradation, in order to use them as implants, scaffolds in tissue engineering, and as carriers for drug delivery. Due to the fact that the biomedical applications require a very high purity of aliphatic polyesters, special attention has been paid to the advanced polymerization based on less toxic metals or even on metal-free processes.

Chapter 2 – *Hydrogels Formed by Cross-Linked Poly(Vinyl Alcohol) (Gaio Paradossi)* – discusses in detail the obtaining and the characterization of PVA chemical hydrogels based on di-functional cross-linkers, the recent advancements in hydrogels synthesis by using functionalized PVA as precursors for photo- and chemo-selective cross-linking processes, and also elaborates upon hydrid hydrogels, which combine the features of PVA with the other polymer components into a multifunctional matrix.

Chapter 3 – *Development and Evaluation of Poly(Vinyl Alcohol) Hydrogels as a Component of Hybrid Artificial Tissues for Orthopedics Surgery Application (Masanori Kobayashi)* – focuses on the application of PVA hydrogels in the orthopedic surgery, as arthroplasty implants, artificial meniscus, as well as implants for spine surgery, and explaines the findings in clinical applications.

Chapter 4 – *Polyphosphazenes as Biomaterials (Meng Deng, Cato T. Laurencin, Harry R. Allcock and Sangamesh G. Kumbar)* – presents the fundamental knowledge on the synthesis of polyphosphazene, the main types of biodegradable polyphosphazenes and discusses their degradation mechanisms. In addition, it touches upon the medical applications of biodegradable polyphosphazenes as candidate materials for developing drug delivery matrices and tissue engineering scaffolds.

Chapter 5 – *Biodegradable Polymers as Drug Carrier Systems (Abraham J. Domb and Wahid Khan)* – reviews the chemistry and properties of different biodegradable polymers, such as polyesters, poly(amides), poly(phosphate esters), polyphosphazenes, poly(orthoesters), polyanhydrides, and discusses some biocompatibility considerations related to them.

Chapter 6 – *Bioresorbable Hybrid Membranes for Bone Regeneration (Akiko Obata and Toshihiro Kasuga)* – refers to various poly(L-lactic acid)/vaterite composites releasing silicon and calcium species, with good hydroxyapatite-forming ability and cellular and tissue compatibilities.

Chapter 7 – *Mucoadhesive Polymers: Basics, Strategies, and Future Trends (Andreas Bernkop-Schnürch)* – emphasizes some of the recent research on mucoadhesive polymers, as well as the future trends in this filed.

Chapter 8 – *Biodegradable Polymeric/Ceramic Composite Scaffolds to Regenerate Bone Tissue (Catherine Gkioni, Sander Leeuwenburgh and John Jansen)* – provides an overview of the basic polymers and ceramics used for the manufacturing of bone-substituting composite biomaterials and their properties, which are related to tissue engineering applications.

Chapter 9 – *Amphiphilic Systems as Biomaterials Based on Chitin, Chitosan and Their Derivatives (Jacques Desbrieres)* – focuses on some of the fundamental aspects regarding the amphiphilic systems based on chitin, chitosan and their derivatives and on their biomedical applications as potential candidates for drug delivery, gene transfection, tissue engineering and cell and protein adhesion.

Chapter 10 – *Biomaterials of Natural Origin in Regenerative Medicine (Vijay Kumar Nandagiri, Valeria Chiono, Piergiorgio Gentile, Franco Maria Montevecchi and Gianluca Ciardelli)* – provides a brief overview of the biomaterials based on natural polymers – cellulose, starch, agar-agarose, alginate, chitin and chitosan and hyaluronan/hyaluronic acid/hyaluronate, as well as on proteins – collagen, gelatin and fibrin-fibrinogen-fibronectin, which are attractive materials for tissue regeneration applications.

Chapter 11 – *Natural Polymers as Components of Blends for Biomedical Applications (Alina Sionkowska)* – presents a new trend in the development of polymeric blends as potential materials for medicine, food industry and for the electronic industry, focusing on the preparation and the applications of materials based on blends of collagen with synthetic polymers, chitosan, elastin, silk and keratin with different polymers, as well as composites based on natural and synthetic polymers and their blends containing inorganic particles.

Chapter 12 – *Metal–Polymer Composite Biomaterials (Takao Hanawa)* – discusses the production of a wide variety of metal–polymer composites, followed by the applications in medicine not only for orthopedic and dental implants, but also for cardiovascular devices and other purposes.

Chapter 13 – *Evolution of Current and Future Concepts of Biocompatibility Testing (Menno L.W. Knetsch)* – investigates the biocompatibility testing procedures, as *in vitro* (cytotoxicity, cell proliferation and cell function), *ex vivo* and *in vivo* biocompatibility testing (local and systemic toxicity, sensitization, irritation, acute, subchronic and chronic systemic toxicity and local implant effects), which are described extensively.

Chapter 14 – *Biocompatibility of Elastomers (Dominique Chauvel-Lebret, Pascal Auroy and Martine Bonnaure-Mallet)* – is focused on the classification of elastomers, their chemistry and synthesis, as well as on the methods to evaluate the biocompatibility of different classes of elastomers.

Chapter 15 – *Preparation and Applications of Modulated Surface Energy Biomaterials (Blanca Vázquez, Luis M. Rodríguez-Lorenzo, Gema Rodríguez-Crespo, Juan Parra, Mar Fernández and Julio San Román)* – reviews the methods used to modify the biomaterial surfaces, the surface characterization methods and the interactions of host tissues with different types of surfaces.

Chapter 16 – *Electrospinning for Regenerative Medicine (Toby D. Brown, Cedryck Vaquette, Dietmar W. Hutmacher and Paul D. Dalton)* – discusses the processing, the properties and the application of electrospun scaffolds.

Chapter 17 – *Polymeric Nanoparticles for Targeted Delivery of Bioactive Agents and Drugs (Cesare Errico, Alberto Dessy, Anna Maria Piras and Federica Chiellini)* – elaborates on the technical aspects of nanoparticles preparation and provides an overview of the exploitable targeting approaches that make them suitable for the treatment of a multitude of diseases.

Chapter 18 – *Polymeric Materials Obtained through Biocatalysis (Florin Dan Irimie, Csaba Paizs, and Monica Ioana Tosa)* – presents the state of the art in obtaining polymers by enzymatic biotransformation, as enzymatic synthesis of oligo- and polysaccharides, polyesters, phenolic polymers and enzymatic polymerization of vinylic monomers.

Chapter 19 – *Polymer-Based Colloidal Aggregates as a New Class of Drug Delivery Systems (Cesare Cametti)* – evaluates the recent progress obtained in polymer-based drug delivery systems, focusing on preparation, characterization and potential applications of the most important types of polymeric aggregates.

Chapter 20 – *Photoresponsive Polymers for Control of Cell Bioassay Systems (Kimio Sumaru, Shinji Sugiura, Toshiyuki Takagi and Toshiyuki Kanamori)* – provides a brief review of the research on the photoresponsive biopolymers as technology components to construct and control integrated cell bioassay system.

Chapter 21 – *Lignin in Biological Systems (Valentin I. Popa)* – evaluates the possibilities to use lignins in biological systems, due to their antibacterial, antifungal, antioxidant and photoprotector properties, as well as anti-HIV, anticarcinogenic and antibiotic activities.

Chapter 22 – *Carbohydrate-Derived Self-Crosslinkable In Situ Gelable Hydrogels for Modulation of Wound Healing (Lihui Weng, Christine Falabella and Weiliam Chen)* – summarizes the investigations on the natural materials derived and crosslinker-free *in situ* gelable, formable/conformable hydrogels, and on their potential biomedical applications.

Chapter 23 – *Dental and Maxillofacial Surgery Applications of Polymers (E. C. Combe)* – presents an overview of the biomedical polymers used in dentistry and a detailed consideration of their principal applications.

Chapter 24 – *Biomaterials as Platforms for Topical Administration of Therapeutic Agents in Cutaneous Wound Healing (Rhiannon Braund and Natalie J. Medlicott)* – reviews the current use of biomaterials in wound healing treatments and also appreciates the potential of biomaterials to enhance wound healing outcomes through their promotion of an optimal environment for healing and use as drug delivery platforms.

Chapter 25 – *Polymers for Artificial Joints (Masayuki Kyomoto, Toru Moro and Kazuhiko Ishihara)* – evaluates the most common type of joint replacements and the design of the polymeric biomaterials used in the orthopedic field.

This book is a valuable source of data on the complex subject of polymeric biomaterials, written by world-renowned scientists with major contributions in this field and reflects the current state of knowledge of nearly the entire spectrum of polymeric biomaterials.

Diana Ciolacu

POLYMERIC BIOMATERIALS: MEDICINAL AND PHARMACEUTICAL APPLICATIONS, Founding Editor Severian Dumitriu, Editor Valentin I. Popa, volume 2, third edition, CRC Press, Taylor & Francis Group, LLC, 2013, 770 pp., ISBN 978-1-4200-9468-8

The second volume addresses processing of polymeric biomaterials into specific forms that ensure biocompatibility and biodegradability for various uses in the medical and pharmaceutical areas. The book is divided into 28 chapters covering a variety of medical issues and various applications of the biomaterials, like drug delivery systems, tissue engineering bioartificial organs, medical devices, biological uses for hydrogels, anticancer therapies and nanotechnology.

Chapter 1 – *Antithrombin–Heparin Complexes (Leslie R. Berry and Anthony K. C. Chan)* – elaborates on the structure and activities of heparin, its *in vivo* occurrence and biochemistry, as well as some assessments of clinical advantages for conjugation of antithrombin and heparin and the novel applications of antithrombin-heparin (ATH) products. Each ATH complex is reviewed according to its synthetic chemistry, physicochemical properties, effect of conjugation on anticoagulant activities, performance in animal models, and particular clinical advantages.

Chapter 2 – *Glucose-Sensitive Hydrogels (Seong Hoon Jeong, Kyung T. Oh and Kinam Park)* – is focused on the specific hydrogels, such as glucose-sensitive hydrogels, which can monitor the glucose level in blood and release insulin in a timely manner to maintain optimal blood glucose concentration, or can act as biosensors by changing the physicochemical properties, such as sol-gel transition, shrinking-swelling, and oxidation-reduction reaction depending on the glucose.

Chapter 3 – *Advances in Polymeric and Lipid-Core Micelles as Drug Delivery Systems (Tiziana Musacchio and Vladimir P. Torchilin)* – decribes the lipid-core and polymeric micelles as drug carriers, with important applications as therapeutic agents or diagnostic agents.

Chapter 4 – *Modular Biomimetic Drug Delivery Systems (Carmen Alvarez-Lorenzo, Fernando Yañez-Gomez and Angel Concheiro)* – presents the fundamental knowledge on the drug carriers, which have a biomimetic surface or bulk, as self-assembling peptides and copolymers, liposomes and lipidic bilayers, layer-by-layer assemblies, hydrogels, cell-responsive systems for tissue regeneration, biomimetic movements and inorganic-based biomimetic drug delivery systems (DDS).

Chapter 5 – *Polymeric Nanoparticles for Drug Delivery (Karine Andrieux, Julien Nicolas, Laurence Moine and Gillian Barratt)* – reviews the results obtained for nanoparticles (NPs) systems prepared from synthetic polymers and discusses the distribution of NPs within the organism, after intravenous, oral, subcutaneous, intramuscular and other routes of administration.

Chapter 6 – *Drug Carrier Systems for Anticancer Agents (Hiroyuki Koide, Tomohiro Asai, Kosuke Shimizu and Naoto Oku)* – refers to several types of targeting tools for drug delivery, including liposomes, polymeric micelles, and lipid microspheres, for application in cancer therapy.

Chapter 7 – *Application of Polymer Drugs to Medical Devices and Preparative Medicine (M. R. Aguilar, L. García-Fernández, M. L. López-Donaire, F. Parra, L. Rojo, G. Rodríguez, M. M. Fernández and J. San Román)* – presents the most important applications of the pharmacologically active macromolecules, as antitumoral, antiangiogenic and proangiogenic, antibacterial, antithrombogenic and low friction polymer drugs.

Chapter 8 – *Polymer Implants for Intratumoral Drug Delivery and Cancer Therapy (Brent D. Weinberg and Jinming Gao)* – describes the use of intratumoral implants to treat unresectable liver tumors as part of a combined treatment strategy using ablation and intratumoral implants. Moreover, it presents the overall goals, which must be considered when developing any local delivery device, the techniques for measuring local drug concentrations and the use of these measurements to customize drug release, as well as some future goals to facilitate the use of these implants to treat larger tumors similar to unresectable human cancers.

Chapter 9 – *Biological Stimulus-Responsive Hydrogels (A. K. Bajpai, Sanjana Kankane, Raje Chouhan and Shilpi Goswami)* – focuses on the variable architectures and the wide range of applications of smart drug delivery systems. The importance of stimuli-sensitive polymeric materials, which can respond to a relevant stimuli action, such as biological target, magnetic or electric field, redox potential, pH, temperature, ultrasound, light and mechanical stress, is discussed.

Chapter 10 – *Polymeric Materials for Surface Modification of Living Cells (Yuji Teramura, Hao Chen, Naohiro Takemoto, Kengo Sakurai and Hiroo Iwata)* – provides an overview of polymeric materials that have been developed and used for modifying the surfaces of living animal cells and their applications in biomedical engineering and science.

Chapter 11 – *Biomedical Applications of Shape Memory Polymers and Their Nanocomposites (I. Sedat Gunes and Sadhan C. Jana)* – presents a classification of shape memory polymers (SMPs) based on the underlying physical mechanism responsible for the SM properties, the current state of knowledge on SMP and its nanocomposites, with emphasis on biomedical applications and illustrates future outlooks.

Chapter 12 – *Bioadhesive Drug Delivery Systems (Ryan F. Donnelly and A. David Woolfson)* – discusses four main theories explaining the interactions during the bioadhesive process, i.e. wetting, electrostatic, diffusion and adsorption theories, as well as the factors that affect bioadhesion. The polymers for bioadhesive drug delivery systems are classified, characterized and the most notable applications are evaluated.

Chapter 13 – *Nanomedicines Coming of Age (Radoslav Savic, Jinzi Zheng, Christine Allen and Dusica Maysinger)* – investigates the model, nanosized delivery systems based on block copolymer micelles, and the new imaging tools, as quantum dots (QDs). Also, an overview of the drug development problems, costs, and search for solutions, as well as of the current obstacles and opportunities needed for successful translation of these investigational delivery and imaging systems into the clinic, is provided.

Chapter 14 – *Polymers for Myocardial Tissue Engineering (J. A. Roether, H. Jawad, R. Rai, N. N. Ali, S. E. Hardling and A. R. Boccaccini)* – gives an overview of biomaterials developed and applied in the most significant myocardial tissue engineering (MTE) strategies and analyzes the potential breakthroughs in the field of MTE, highlighting several important points as avenue for future research.

Chapter 15 – *Acellular Tubular Grafts Constructed from Natural Materials in Vascular Tissue Engineering (M. J. W. Koens, A. G. Krasznai, J. A. van der Vliet, T. Hendriks, R. G. Wismans, K. A. Faraj, W. F. Daamen and T. H. van Kuppevelt)* – focuses on the construction and application of acellular tubular grafts made from natural materials. The review presents the structure and composition of the native blood vessel, the methods for graft construction, *in vitro* criteria with respect to biocompatibility, biodegradability, and mechanical strength prior to *in vivo* experimentation, the clinically applied acellular natural grafts and a future outlook upon new directions of vascular graft development.

Chapter 16 – *pH-Responsive Polymers for Delivery of Nucleic Acid Therapeutics (Yu Nie and Ernst Wagner)* – discusses the possibility to use the pH as a trigger, as it offers the potential to discriminate between different tissues and also between different intracellular compartments. The ability of pH-sensitive drug carriers to promote the cytoplasmatic delivery of proteins, antisense ODN drugs, or DNA plasmid-based genes, has been evaluated.

Chapter 17 – *Adhesive Biomaterials for Tissue Repair and Reconstruction (Sujata K. Bhatia)* – reviews the current status of adhesive biomaterials for tissue reconstruction and highlights new developments in bioadhesive platforms. The chapter presents the practical considerations for the development of adhesive biomaterials, describes the existing commercial adhesives for wound closure, including fibrin-based adhesives, cyanoacrylate-based adhesives, cross-linked protein-based adhesives, and PEG-based adhesives and highlights the novel bioadhesives under development, including bio-inspired adhesives, polysaccharides-based adhesives, and dendrimer-based adhesives.

Chapter 18 – *Polymeric Interactions with Drugs and Excipients (James C. DiNunzio and James W. McGinity Tosa)* – describes the behavior of pharmaceutical polymers in terms of their interactions with active pharmaceutical ingredients, other commonly used pharmaceutical excipients, and various environmental factors to ultimately yield desired or undesired behavior of the system.

Chapter 19 – *Manufacturing Multifunctional Scaffolds for Tissue Engineering (Vincenzo Guarino, Antonio Gloria, Roberto De Santis and Luigi Ambrosio)* – discusses the basic functions and requirements of scaffolds in tissue engineering, underlining the ability of specific manufacturing techniques to impart all morphological and functional features in order to satisfy the specific demands of tissue regeneration.

Chapter 20 – *Virus-Based Nanoparticles as Drug Delivery Systems (Eva Roblegg and Andreas Zimmer)* – presents the current state of progress regarding the main tools for potent drug delivery and particularly focusing on virus-based nanoparticles as drug delivery systems.

Chapter 21 – *Polymeric Biomaterials in Pulmonary Drug Delivery (Nicole A. Beinborn and Robert O. Williams)* – provides basic information regarding the structure of the lungs and an extensive review of the various polymeric biomaterials currently being investigated for use in pulmonary drug delivery.

Chapter 22 – *Polymeric Gene Delivery Carriers for Pulmonary Diseases (Xiang Gao, Regis R. Vollmer and Song Li)* – discusses the principles for developing safe and efficient polymer-based gene and RNA transfer methods, identifies the barriers for *in vivo* gene delivery, presents the advances made in pulmonary gene delivery in experimental animal models and in humans, and summarizes the implications of novel therapeutic strategies of gene therapy for various inherited and acquired pulmonary diseases, including infectious, inflammatory, and malignant disorders.

Chapter 23 – *Biomedical Application of Membranes in Bioartificial Organs and Tissue Engineering (Thomas Groth, Xiao-Jun Huang and Zhi-Kang Xu)* – presents a comprehensive overview of the preparation of typical polymer membranes for biomedical and technical applications, of the tailoring of essential membrane features, like morphology, transport, and surface properties, and also of the application of membranes in the field of bioartificial organs, with emphasis on liver replacement and tissue engineering of skin.

Chapter 24 – *Controlled Release Systems for Bone Regeneration (Hossein Hosseinkhani)* – reviews the basic principles of controlled release systems and the recent developments of new materials for their potential applications in regenerative medicine therapy for bone regeneration.

Chapter 25 – *Controlled Release Systems Targeting Angiogenesis (Stéphanie Deshayes, Karine Gionnet, Victor Maurizot and Gérard Déléris)* – gives a short overview of current pro- or anti-angiogenesis therapies, describes the angiogenesis with associated mediators and highlights recent advances regarding the polymeric systems that may be used for targeting angiogenesis in different pathologies.

Chapter 26 – *Bioceramics for Development of Bioartificial Liver (Tomokazu Matsuura and Mamoru Aizawa)* – presents different biomaterials, as hydroxyapatite beads or hydroxyapatite fiber scaffold (AFS) used for the development of bioartificial liver (BAL). In addition, it describes the extracorporeal circulation experiments conducted using the extracorporeal BAL constructed with the radial-flow bioreactor (RFB) filled with porous hydroxyapatite beads, as well as with the liver organoid produced by co-culturing AFS with immortalized hepatocytes, hepatic stellate cells, and sinusoidal endothelial cells.

Chapter 27 – *Materials Biofunctionalization for Tissue Regeneration (Laura Cipolla, Laura Russo, Nasrin Shaikh and Francesco Nicotra)* – discusses about the biomaterials that play an important role in tissue engineering strategies, referring to extracellular matrix, smart biomaterials, and biomolecules for biomaterial design, such as protein and peptides, and glycidic structures.

Chapter 28 – *Polymer-Based Devices for Dermal and Transdermal Delivery (Donatella Paolino, Margherita Vono and Felisa Cilurzo)* – evaluates the innovative devices for dermal and transdermal delivery and presents the most used polymer in dermal and transdermal delivery, classified in natural (polysaccharides, gelatin, rosin, gums and their derivatives) and synthetic polymers (polyvinyl alcohol, silicon, polyethylene, polypropylene, polyacrylate, polyvinylpyrrolidone, polymethylmethacrylate).

This third edition set is a versatile and comprehensive book, presenting new and substantially revised topics, and combining the basic fundamentals of the field of biomaterials with the industrial applications. Thus, the book is a very useful tool for scientists, engineers, pharmacists and other experts from different disciplines, as well as for teachers, graduate and undergraduate students interested in this area.

Diana Ciolacu