Edited by
Andreas Lendlein and Adam Sisson

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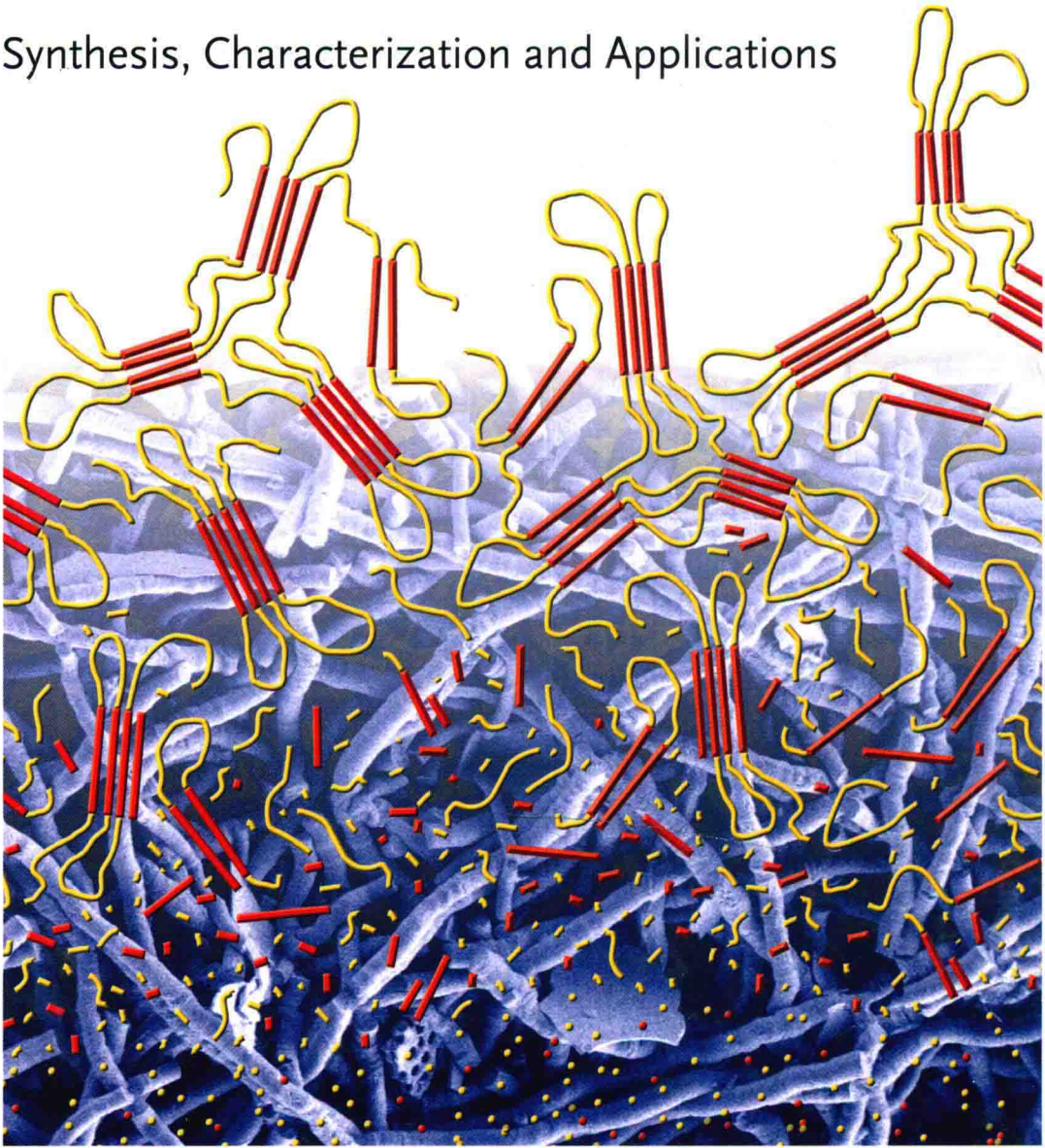
Handbook of Biodegradable Polymers

Synthesis, Characterization and Applications



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The Editors

Prof. Andreas Lendlein
GKSS Forschungszentrum
Inst. für Chemie
Kantstr. 55
14513 Teltow
Germany

Dr. Adam Sisson
GKSS Forschungszentrum
Zentrum f. Biomaterialentw.
Kantstraße 55
14513 Teltow
Germany

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Further Reading

Loos, K. (Ed.)

Biocatalysis in Polymer Chemistry

2011
Hardcover
ISBN: 978-3-527-32618-1

Mathers, R. T., Maier, M. A. R. (Eds.)

Green Polymerization Methods

Renewable Starting Materials, Catalysis and Waste Reduction

2011
Hardcover
ISBN: 978-3-527-32625-9

Yu, L.

Biodegradable Polymer Blends and Composites from Renewable Resources

2009
Hardcover
ISBN: 978-0-470-14683-5

Elias, H.-G.

Macromolecules

2009
Hardcover
ISBN: 978-3-527-31171-2

Matyjaszewski, K.,
Müller, A. H. E. (Eds.)

Controlled and Living Polymerizations

From Mechanisms to Applications

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ISBN: 978-3-527-32492-7

Matyjaszewski, K., Gnanou, Y.,
Leibler, L. (Eds.)

Macromolecular Engineering

Precise Synthesis, Materials Properties, Applications

2007
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ISBN: 978-3-527-31446-1

Fessner, W.-D., Anthonsen, T. (Eds.)

Modern Biocatalysis

Stereoselective and Environmentally Friendly Reactions

2009
ISBN: 978-3-527-32071-4

Janssen, L., Moscicki, L. (Eds.)

Thermoplastic Starch

A Green Material for Various Industries

2009
Hardcover
ISBN: 978-3-527-32528-3

Preface

Degradable polyesters with valuable material properties were pioneered by Carothers at DuPont by utilizing ring-opening polymerization approaches for achieving high molecular weight aliphatic poly(lactic acid)s in the 1930s. As a result of various oil crises, biotechnologically produced poly(hydroxy alkanoates) were keenly investigated as greener, non-fossil fuel based alternatives to petrochemical based commodity plastics from the 1960s onwards. Shortly afterwards, the first copolyesters were utilized as slowly drug releasing matrices and surgical sutures in the medical field. In the latter half of the 20th century, biodegradable polymers developed into a core field involving different scientific disciplines such that these materials are now an integral part of our everyday lives. This field still remains a hotbed of innovation today. There is a burning interest in the use of biodegradable materials in clinical settings. Perusal of the literature will quickly reveal that such materials are the backbone of modern, biomaterial-based approaches in regenerative medicine. Equally, this technology is central to current drug delivery research through biodegradable nanocarriers, microparticles, and erodible implants, which enable sophisticated controlled drug release and targeting. Due to the long historic legacy of polymer research, this field has been able to develop to a point where material compositions and properties can be refined to meet desired, complex requirements. This enables the creation of a highly versatile set of materials as a key component of new technologies. This collected series of texts, written by experts, has been put together to showcase the state of the art in this ever-evolving area of science.

The chapters have been divided into three groups with different themes. Chapters 1–8 introduce specific materials and cover the major classes of polymers that are currently explored or utilized. Chapters 9–14 describe applications of biodegradable polymers, emphasizing the exciting potential of these materials. In the final chapters, 15–16, characterization methods and modelling techniques of biodegradation processes are depicted.

Materials: Lendlein *et al.*, then Ienczak and Aragão, start with up-to-date reviews of the seminal polyesters and biotechnologically produced polyesters, respectively. Other chapters concern polymers with different scission moieties and behaviors. Domb *et al.* provide a comprehensive review of polyanhydrides, which is followed by an excellent overview of poly(ortho esters) contributed by Heller. Amino

acid- based materials and degradable polyurethanes make up the subject of the next two chapters by Katsarava and Gomurashvili, then Puiggali *et al.*, respectively. Synthetic polysaccharides, which are related to many naturally occurring biopolymers, are then described at length by Dumitriu, Dräger *et al.* To conclude the individual polymer-class section, biodegradable polyolefins, which are degraded oxidatively, and are intended as degradable commodity plastics, are covered by Wiles *et al.*

Applications: The two chapters by Ikada and Shakesheff give a critical update on the status of biodegradable materials applied in regenerative therapy and then in drug delivery systems. From there, further exciting applications are described; shape-memory polymers and their potential as implant materials in minimally invasive surgery are discussed by Lendlein *et al.*; Huh *et al.* highlight the importance of biodegradable hydrogels for tissue expander applications; Franke *et al.* cover how implants can be used to aid regenerative treatment of mucosal defects in surgery; Khandare and Kumar review the relevance of biodegradable dendrimers and dendritic polymers to the medical field.

Methods: Van der Zee gives a description of the methods used to quantify biodegradability and the implications of biodegradability as a whole; Watanabe and Kawai go on to explain methods used to explore degradation through modelling and simulations.

The aim of this handbook is to provide a reference guide for anyone practising in the exploration or use of biodegradable materials. At the same time, each chapter can be regarded as a stand alone work, which should be of great benefit to readers interested in each specific field. Synthetic considerations, physical properties, and erosion behaviours for each of the major classes of materials are discussed. Likewise, the most up to date innovations and applications are covered in depth. It is possible upon delving into the provided information to really gain a comprehensive understanding of the importance and development of this field into what it is today and what it can become in the future.

We wish to thank all of the participating authors for their excellent contributions towards such a comprehensive work. We would particularly like to pay tribute to two very special authors who sadly passed away during the production time of this handbook. Jorge Heller was a giant in the biomaterials field and pioneered the field of poly(ortho esters). Severian Dimitriu is well known for his series of books on biodegradable materials, which served to inspire and educate countless scientists in this area. Our sincerest thanks go to Gloria Heller and Daniela Dumitriu for their cooperation in completing these chapters. We also acknowledge the untiring administrative support of Karolin Schmälzlin, Sabine Benner and Michael Schroeter, and the expert cooperation from the publishers at Wiley, especially Elke Maase and Heike Nöthe.

Teltow, September 2010

Andreas Lendlein
Adam Sisson

List of Contributors

Gláucia Maria Falcão de Aragão
Federal University of Santa Catarina
Chemical and Food Engineering
Department
Florianópolis, SC 88040-900
Brazil

Marc Behl
Center for Biomaterial Development,
Institute of Polymer Research
Helmholtz-Zentrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Emo Chiellini
University of Pisa
Department of Chemistry and
Industrial Chemistry
via Risorgimento 35
Pisa 56126
Italy

Andrea Corti
University of Pisa
Department of Chemistry and
Industrial Chemistry
via Risorgimento 35
Pisa 56126
Italy

Salvatore D'Antone
University of Pisa
Department of Chemistry and
Industrial Chemistry
via Risorgimento 35
Pisa 56126
Italy

Avi Domb
Hebrew University
School of Pharmacy
Department of Medicinal Chemistry
Jerusalem 91120
Israel

Gerald Dräger
Gottfried Wilhelm Leibniz Universität
Hannover
Institut für Organische Chemie
Schneiderberg 1B
30167 Hannover
Germany

Severian Dumitriu†
University of Sherbrooke
Department of Chemical Engineering
2400 Boulevard de l'Université
Sherbrooke, Quebec J1K 2R1
Canada

Lourdes Franco
Universitat Politècnica de Catalunya
Departament d'Enginyeria Química
Av. Diagonal 647
08028 Barcelona
Spain

Ralf-Peter Franke
Centre for Biomaterial Development and Berlin-Brandenburg Centre for Regenerative Therapies (BCRT)
Institute of Polymer Research
Helmholtz-Zentrum Geesthacht GmbH
Kantstr. 55
14513 Teltow
Germany
and
University of Ulm
Central Institute for Biomedical Engineering
Department of Biomaterials
89069 Ulm
Germany

Yourong Fu
Akina, Inc.
West Lafayette, IN 47906
USA

Rosemarie Fuhrmann
University of Ulm
Central Institute for Biomedical Engineering
Department of Biomaterials
89069 Ulm
Germany

John Garner
Akina, Inc.
West Lafayette, IN 47906
USA

Zaza Gomurashvili
PEA Technologies
709 Mockingbird Cr.
Escondido, CA 92025
USA

Jorge Heller†
PO Box 3519, Ashland, OR 97520
USA

Bernhard Hiebl
Centre for Biomaterial Development and Berlin-Brandenburg Centre for Regenerative Therapies (BCRT)
Institute of Polymer Research
Helmholtz-Zentrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Kang Moo Huh
Chungnam National University
Department of Polymer Science and Engineering
Daejeon 305-764
South Korea

Jaciane Lutz Ienczak
Federal University of Santa Catarina
Chemical and Food Engineering Department
Florianópolis, SC 88040-900
Brazil

Yoshito Ikada
Nara Medical University
Shijo-cho 840
Kashihara-shi
Nara 634-8521
Japan

Jay Prakash Jain
National Institute of Pharmaceutical Education and Research (NIPER)
Department of Pharmaceutics
Sector 67
S.A.S. Nagar (Mohali) 160062
India

Friedrich Jung
Centre for Biomaterial Development and Berlin-Brandenburg Centre for Regenerative Therapies (BCRT)
Institute of Polymer Research
Helmholtz-Zentrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Ramaz Katsarava
Iv. Javakhishvili Tbilisi State University
Institute of Medical Polymers and Materials
1, Chavchavadze ave.
Tbilisi 0179
Georgia
and
Georgian Technical University
Centre for Medical Polymers and Biomaterials
77, Kostava str.
Tbilisi 75
Georgia

Fusako Kawai
Kyoto Institute of Technology
Center for Nanomaterials and Devices
Matsugasaki
Sakyo-ku, Kyoto 606-8585
Japan

Jayant Khandare
Piramal Life Sciences Ltd.
Polymer Chem. Grp
1 Nirlon Complex
Off Western Express Highway
Goregaon (E), Mumbai 400063
India

Andreas Krause
Gottfried Wilhelm Leibniz Universität Hannover
Institut für Organische Chemie
Schneiderberg 1B
30167 Hannover
Germany

Neeraj Kumar
National Institute of Pharmaceutical Education and Research (NIPER)
Department of Pharmaceutics
Sector 67
S.A.S. Nagar (Mohali) 160062
India

Sanjay Kumar
Piramal Life Sciences Ltd.
Polymer Chem. Grp
1 Nirlon Complex
Off Western Express Highway
Goregaon (E), Mumbai 400063
India

Andreas Lendlein
Center for Biomaterial Development and Berlin-Brandenburg Center for Regenerative Therapies, Institute of Polymer Research
Helmholtz-Zemtrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Lena Möller
Gottfried Wilhelm Leibniz Universität Hannover
Institut für Organische Chemie
Schneiderberg 1B
30167 Hannover
Germany

Kinam Park
Purdue University
Department of Biomedical Engineering and Pharmaceutics
West Lafayette, IN 47907-2032
USA

Jordi Puiggalí
Universitat Politècnica de Catalunya
Departament d'Enginyeria Química
Av. Diagonal 647
08028 Barcelona
Spain

Dorothee Rickert
Marienhospital Stuttgart
Böheimstrasse 37
70199 Stuttgart
Germany

Alfonso Rodríguez-Galán
Universitat Politècnica de Catalunya
Departament d'Enginyeria Química
Av. Diagonal 647
08028 Barcelona
Spain

Michael Schroeter
Center for Biomaterial Development
Institute of Polymer Research
Helmholtz-Zentrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Kevin M. Shakesheff
The University of Nottingham
School of Pharmacy, STEM
NG 7 2RD
UK

Adam L. Sisson
Center for Biomaterial Development and Berlin-Brandenburg Center for Regenerative Therapies, Institute of Polymer Research
Helmholtz-Zentrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Thanh Huyen Tran
Chungnam National University
Department of Polymer Science and Engineering
Daejeon 305-764
South Korea

Masaji Watanabe
Okayama University
Graduate School of Environmental Science
1-1, Naka 3-chome
Tsushima, Okayama 700-8530
Japan

David Mckeen Wiles
Plastichem Consulting
Victoria, BC V8N 5W9
Canada

Maarten van der Zee
Wageningen UR
Food & Biobased Research
P.O. Box 17
6700 AA Wageningen
The Netherlands

Jörg Zotzmann
Center for Biomaterial Development
Institute of Polymer Research
Helmholtz-Zentrum Geesthacht
Kantstr. 55
14513 Teltow
Germany

Contents