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The series *Advances in Polymer Science* presents critical reviews of the present and future trends in polymer and biopolymer science. It covers all areas of research in polymer and biopolymer science including chemistry, physical chemistry, physics, material science.

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Orlando J. Rojas

Editor

Cellulose Chemistry and Properties: Fibers, Nanocelluloses and Advanced Materials

With contributions by

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Preface

This volume of *Advances in Polymer Science* is centered on the very timely topic of cellulose chemistry and properties and makes special emphasis on fibers, nanocelluloses and the development of advanced materials from such sources. The subject is important as polymer science and associated fields gravitate towards bio-based materials and products in developments current to the “bioeconomy”. As such, ten expert groups were invited to provide their input in complementary areas and to draft a cohesive text that is now brought to fruitful completion and that I hope you find of interest and use.

The opening is by Thomas Heinze, from Friedrich Schiller University of Jena, who discusses the structure and properties of cellulose. It soon becomes obvious to the reader that cellulose is a fascinating polymer, making part of fibers and other structures that are ubiquitous in a variety of products and processes. Besides addressing the issue of solubility and chemical reactivity, bottom-up approaches to nanostructures of cellulose and the use of ionic liquids are presented. Both subjects are expanded in other chapters within this volume. It strikes the fact that while “cellulose” has been a topical subject, still there is a major need for better understanding of associated interactions and interfacial properties.

Antje Potthast and co-workers from the University of Natural Resources and Life Sciences in Vienna enlighten the volume with their discussion on the preparation and analysis of cello- and xylooligosaccharides. They provide a comprehensive and up-to-date overview about related preparation, separation, and analytical methods. This is extremely relevant to the sugar platform in biorefinery processes. On a higher structural scale, colleagues, also in Austria, David Reishofer and Stefan Spirk (Graz University of Technology), provide a comprehensive review towards understanding of cellulose accessibility, structure and function, with a particular focus on deuteration and allied methods, including small angle neutron scattering and 2H-NMR spectroscopy. Further on characterization of cellulose and its structures, a team led by Seong Kim and Sunkyu Park, from Penn State University, North Carolina State University and the National Renewable Energy Laboratory

expand on cellulose crystallinity and its measurements and correlations as determined by XRD, NMR, IR, Raman, and SFG.

Returning to the topic of ionic liquids but now looking into their deployment, a group led by Herbert Sixta and Michael Hummel, from Aalto University in Finland, introduces the production of man-made cellulosic fibers. They give a comprehensive account of opportunities and challenges. The summary of the reports on the preparation of pure cellulosic and composite fibers is complemented with an overview of the rheological characteristics and thermal degradation of cellulose-ionic liquid solutions, in light of the production of textile yarns and their applications. Recognizing that physical and chemical features in cellulose can be exploited to adjust its use, Alessandro Gandini and Mohamed Naceur Belgacem, from the Print Media and Biomaterials (Pagora) in Grenoble, expand on the topic of surface and in-depth modification of cellulose fibers and compile the most relevant advances achieved in the field. Their report includes cellulose nanocrystals (CNC), cellulose nanofibrils (CNF), microfibrillated cellulose (MFC) and bacterial cellulose (BC), as well as conventional lignocellulosic fibers.

Further on nanocellulose, as introduced in the previous contribution, our team in North Carolina and Aalto University, adds with a discussion on the importance of nanocellulose-protein interactions, including immobilization and synthesis of biocompatible materials. The topic is supplemented with the work of Isabel Gouveia and coworkers from five different research centers in Portugal, who discuss the biofunctionalization of cellulosic fibers with emergent antimicrobial agents, mainly using the layer-by-layer assembly approach.

Yoshiyuki Nishio and coworkers in Kyoto University as well as Wadood Hamad, from FPInnovations and University of British Columbia, introduce the fascinating topic of cellulose liquid crystals. Striking ordered structures are described for the design of functional material systems, mainly from cellulose nanocrystals. Both fundamental and applied research covering chiral nematic order and the development of photonic and semiconductor materials based on cellulose are offered.

To end, I would like to personally express my appreciation for the time and energy devoted by all contributing authors in making this project a reality. I am also very thankful for their patience as we approached the conclusion of this volume that took more time than expected. Also very deserving are the reviewers for their excellent service and feedback as well as the editorial team of *Advances in Polymer Science*, who assisted all of us through the process of editing and processing the manuscripts. I am confident the readers of this volume appreciate cellulose prospects and its outlook for future explorations. I also hope that the chapters are found informative and beneficial to those entering the field as well as those from academia and industry who are already familiar with cellulose, a fascinating natural polymer.

Raleigh, USA
Espoo, Finland

Orland J. Rojas

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