Book reviews

CELLULOSE DERIVATIVES – SYNTHESIS, STRUCTURE, AND PROPERTIES, Thomas Heinze, Omar A. El Seoud, Andreas Koschella, Springer, 2018, 531 pp, ISBN 978-3-319-73167-4

The study of cellulose and cellulose derivatives has attracted numerous new researchers within the last decades, due to the development in recent years of the bio-based industries, biorefinery, bio- and circular economy concepts, which are foreseen to replace the need for fossil-based products and to lead to a greener and more environmentally friendly growth. Despite this, comprehensive textbooks that present systematically the main results of accessible research literature on the chemistry, physics and technology of cellulose and its derivatives are published at long intervals. Just to mention the last five monographs[1-5] devoted to this subject, we have to turn 65 years back in time.

Lately, however, an ambitious work by Thomas Heinze, Omar A. El Seoud, and Andreas Koschella collected, classified, and summarized recent progress in cellulose and cellulose derivatives. The purpose of the book was to introduce the reader to the unique opportunities, challenges and principles underlying the development of unconventional methods for the synthesis of derivatives, the introduction of novel solvents and novel approaches to regioselective derivatization of cellulose, the preparation of nano-particles and nano-composites for specific applications.

The first chapter of the book, *Production and Characteristics of Cellulose from Different Sources*, provides an overview of the most abundant renewable polymer resources available worldwide. Their focus on cellulose derivatives stems from the availability of cellulose sources from conventional and unconventional sources, but also from the possibility to structurally modify cellulose to be used as starting material for chemical modification reactions.

In the second chapter, *Structure and Properties of Cellulose and Its Derivatives*, molecular and structural aspects of the most abundant biopolymer and its derivatives are discussed. Consistent with the logical progression of the book, the authors dwell upon molar mass and the investigation of its distribution by rheology and viscometry methods, Size Exclusion Chromatography and Light Scattering, followed by structural information given by X-ray diffraction, spectroscopy (IR, Raman, NMR), chromatography and thermal analysis.

Chapter 3, *Cellulose Activation and Dissolution*, is devoted to the essential steps in cellulose derivatization and in controlling the reactions to turn it to esters and ethers. While activation is extensively employed by the treatment of cellulose with aqueous alkali to make the biopolymer more accessible to future reactions, the dissolution is carried out with a large number of solvents, classified into two categories: derivatizing and non-derivatizing solvents.

Derivatization under heterogeneous and homogeneous reaction conditions is described in Chapter 4, *Principles of Cellulose Derivatization*, starting from the known reactions in organic chemistry, with polymers carrying the same functional groups. Cellulose can be converted into a myriad of derivatives involving different functionalities, some of the commercially available ones being described in Chapter 5, *Cellulose Esters*, and in Chapter 6, *Etherification of Cellulose*.

In the last chapter, *Miscellaneous Cellulose Derivatives and Reactions*, the authors present various cellulose derivatives obtained *via* oxidation of cellulose, click chemistry and grafting of cellulose. Compared with commercially important reactions, these old and new paths to modify the properties of this biopolymer to get value-added products have been attempted only at a laboratory scale, but the latest research in the field has contributed to fundamental and quantitative understanding at the molecular level and has revealed the way these new findings can be applied in the industrial sphere.

Authored by experts with many years of experience, the aim of the book to describe the most important features of the chemistry and chemical technology of cellulose and its derivatives was fully accomplished. Therefore, the content is of interest to all those concerned with the production and use of cellulosic products whether in academic or industrial circles, new in the domain or experienced cellulose scientists.

REFERENCES

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Bogdan Marian Tofanica

STARCH, CHITIN AND CHITOSAN BASED COMPOSITES AND NANOCOMPOSITES, Merin Sara Thomas, Rekha Rose Koshy, Siji K. Mary, Sabu Thomas, Laly A. Pothan, Springer, 2019, 57 pp., ISBN 978-3-030-03157-2

Part of the SpringerBriefs in Molecular Science book series and of the Biobased Polymers book subseries published under the patronage of The European Polysaccharide Network of Excellence (mostly knows as EPNOE), the new contribution of M.S. Thomas, R.R. Koshy, S.K. Mary, S. Thomas, L.A. Pothan, represents an attempt to understand the characteristics of naturally occurring polysaccharides and their importance for material applications, with special focus on processing techniques, properties and applications.

Although over the years many original and review papers, textbooks and book chapters, contributions to symposia and workshops have been published on starch-, chitin- and chitosan-based composites and nanocomposites, the book aims to examine recent developments in the field, focusing on their composition, properties, characterization, and chemistry, while also reviewing up-to-date research performed on their applications.

The first chapter provides an overview of the structure and properties of starch, chitin and chitosan, from the point of view of biomaterials with potential applications in various fields. The characteristics that are essential to address the challenges of innovative biopolymers, such as biodegradability, biocompatibility, renewability, and sustainability, make natural polymers the most viable alternative for producing green materials in the near future.

In the second chapter of this book, *Processing Techniques*, the authors describe different conversion methods adopted for the preparation of starch, chitin and chitosan composites from their natural sources. Various conventional processing techniques, such as solution casting, moulding, extrusion, and blending, as well as some new techniques, such as freeze-drying methods and electrostatic interactions, have been briefly presented for processing polysaccharide-based materials. The achievements described in this chapter have increased our knowledge of polymer science, in particular, related to biobased polymers.

Divided into different sections featuring thermal, mechanical, barrier properties and morphological analysis, Chapter 3, *Properties of Composites*, presents the main advantages and weaknesses of biodegradable polymers towards a wide range of applications, and outlines the improvement in various properties achieved by composites after reinforcement.

Chapter 4, *Applications of Polysaccharide Based Composites*, outlines the various applications of the biopolymer-reinforced composites, such as packaging, water treatment, biosensors and biomedical applications. The development of the next generation of materials is based on the relationships between polymer structure, properties, and applications, which are of obvious importance to chemists and engineers working in the natural polymer industries, but also of great interest are their sustainability, eco-efficiency, and behaviour in a wide range of applications.

The book concludes highlighting the role of future biomaterials in a multitude of potential applications in a wide range of fields. Still, the most important among various scientific and technological challenges for

industrial applications of starch, chitin and chitosan in chemical industry is to require a favourable balance between the expected performance of the composite materials and their cost.

This book will prove to be an important resource for all those who are interested in the processing, properties and applications of biobased composites and nanocomposites, both undergraduate and postgraduate students of Chemistry, Physics, Materials Science and Engineering, researchers, but also for the general audience.

Bogdan Marian Tofanica