Environmental Engineering and Management Journal March 2011, Vol.10, No. 3, 467-468
http://omicron.ch.tuiasi.ro/EEMJ/

"Gheorghe Asachi" Technical University of Iasi, Romania

Book Review

CELLULOSE ALLOMORPHS: STRUCTURE, ACCESSIBILITY AND REACTIVITY

Diana Ciolacu, Valentin I. Popa

Polymer Science and Technology Series, Nova Science Publisher, Inc., New York,
ISBN 978-1-61668-323-8, 2010, 70 pages

The trend towards cellulose and the tailoring of innovative products for science, medicine, and technology has led to a global renaissance of interdisciplinary cellulose research and the use of this abundant organic polymer over the last decade.

The progress in understanding of cellulose structure has continued during recent decades and will be ongoing in the future. A significant importance is the capacity of cellulose to aggregate in a wide variety of secondary and tertiary structures.

The polymorphism of cellulose always intrigued us through the non-elucidated aspects regarding both the obtaining and the structural organization of allomorphic forms. Although until today, the polymorphism of cellulose was proved through a series of techniques of investigation, an approach through a systematic study of the influence of crystalline forms of organization over the structural accessibility and the reactivity of cellulosic substrata has never been put into practice.

That is why this book analyzes the current knowledge in research and application in the field of allomorphs of cellulose. It performs both a systematization of the no elucidated elements in classical representations and the current hypotheses of the supramolecular organization of cellulose allomorphs. Particular attention has been paid to the understanding of the hydrogen bonding system of various structural organizations of cellulose allomorphs. Although, information about this subject has been published, the book is focused on what the authors considered to be the most important and representative knowledge. The advantages and limitation of the structural architectures of the cellulose allomorphs which are reflected on the accessibility of these are discussed. The accumulation of knowledge on the versatile transformation of crystalline forms of cellulose leads to the understanding of the region-chemical difference in reactivity.

This book has been structured into seven main chapters, as follow:

Chapter 1 - *Molecular structure of cellulose* – which describes the structure of cellulose at the molecular level, from the point of view of chain polarity, the equatorial positions of the hydroxyls groups on cellulose macromolecules, and also of the chain length expressed in the number of constituent AGUs.

Chapter 2 – *Cellulose allomorphs* – reviews four major types of cellulose allomorphs focused on the crystal structure of these, especially on the formation of intra- and inter-molecular hydrogen-bonding, the packing of the chains (parallel or antiparallel) and the unit-cell dimensions:

- *cellulose I* - represents the largest biomass on the earth and is the major structural component of all plant cell walls. Further, was found that cellulose I is a composite of cellulose Iα and Iβ crystalline forms, discovery which led to a revival of interest in the study of cellulose chemistry. The cellulose Iβ is close to the model proposed in literature for cellulose I, while the crystalline structure for cellulose Iα it is still in discussion because the difficulties in obtaining of pure cellulose Iα;
- *cellulose II* - the second crystalline form of cellulose, obtained by regeneration or mercerization processes;
- *cellulose III* - prepared with anhydrous liquid ammonia, at -80ºC or organic amine;
- *cellulose IV* - is known to be prepared by thermal treatments (in glycerol, at about 260ºC).

Chapter 3 - *Alkali cellulose* - tries to elucidate the mechanism and the intermediate structures which appear during the mercerization process.

Chapter 4 - *Amorphous cellulose* – focuses on amorphous cellulose which has often been used for model experiments to understand the behavior of the noncrystalline domains in cellulose under various conditions. Thus, this chapter discus the preparation methods and the conformational and/or hydrogen bonding structure of this cellulose.

Chapter 5 - *Accessibility of cellulose* – discusses briefly the known methods used to evaluate the accessibility of cellulosic substrata. Also, are presented different possibilities to increase the accessibility of cellulose, classified as, mechanical, chemical and enzymatic treatments, persisting on the enzymatic hydrolysis, as a topic of great interest, with a major influence on solving the problems connected with protecting natural environment. Moreover, it was shown that the experiments involving the enzymatic hydrolysis of the main allomorphic forms of cellulose proved that both the morphological structure and the crystalline one are crucial aspects to the process and the rate of the reaction and implicitly regarding the accessibility.

Chapter 6 - *Reactivity of cellulose* - presents the factors which have an important role on the reactivity of cellulose and the broad industrial applications for each crystalline form of cellulose.

Chapter 7 - *Concluding remarks* – discuss briefly the important findings of each chapters and concluded that knowledge gained about the structure, accessibility and reactivity of crystalline forms of cellulose are important to understand the behavior of this natural polymer keeping in mind the large area of application in industrial, medical and pharmaceutical fields.

The book is a valuable source of information which contribute to the understanding of the complexity and uncertainties that still exist about polymorphism of cellulose and to synthesize the old knowledge and the developments of different studies which contribute to elucidate the structure of cellulose allomorphs.