CELLULOSE ALLOMORPHS: STRUCTURE, ACCESSIBILITY AND REACTIVITY, Diana Ciolacu, Valentin I. Popa, Polymer Science and Technology Series, Nova Science Publisher, Inc., New York, 2010, 70 pp., ISBN 978-1-61668-323-8

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 increasing use of this abundant organic polymer over the last decade.

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

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

That is why, this book analyzes the current knowledge in the area of research and application of cellulose allomorphs. It both systematizes non-elucidated elements in classical representations and presents current hypotheses on 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 this topic has been the subject of intense discussion lately, the book is focused on what the authors consider to be the most important knowledge acquired in this field. The advantages and limitations of the structural architectures of cellulose allomorphs, reflected on their accessibility, are discussed. The accumulation of knowledge on the versatile transformation of crystalline cellulose leads to the understanding of the region-chemical difference in reactivity.

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

Chapter 1 – *Molecular structure of cellulose* – describes the structure of cellulose at molecular level, from the viewpoint of chain polarity, the equatorial positions of the hydroxyl groups on cellulose macromolecules, as well as of the chain length expressed in the number of constituent AGUs.

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

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

Chapter 3 – *Alkali cellulose* – tries to elucidate the mechanism and the intermediate structures that 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, the chapter discusses the preparation methods and the conformational and/or hydrogen bonding structure of this type of cellulose.

Chapter 5 – *Accessibility of cellulose* – discusses briefly the known methods used to evaluate the accessibility of cellulosic substrata. Also, different possibilities to increase the accessibility of cellulose are presented – classified as mechanical, chemical and enzymatic treatments. Special attention is given to enzymatic hydrolysis, as a topic of great interest, considering its major

contribution to solving problems related to natural environment protection. Moreover, it was shown that the experiments involving the enzymatic hydrolysis of the main allomorphic forms of cellulose proved that both the morphological and the crystalline structures are crucial to the process and the rate of the reaction, implicitly referring to accessibility.

Chapter 6 – *Reactivity of cellulose* – presents the factors playing an important role in the reactivity of cellulose, and the wide industrial applications for each crystalline form of cellulose.

Chapter 7 – *Concluding remarks* – points out the major findings discussed in the book and concludes that the knowledge gained on the structure, accessibility and reactivity of the crystalline forms of cellulose are important to understand the behavior of this natural polymer, on keeping in mind the large area of application in industrial, medical and pharmaceutical fields.

The book is a valuable resource contributing to the understanding of the complexity of cellulose polymorphism and of the uncertainties that still exist in this field. It gives an overview of the state of the art and of recent developments that contribute to elucidating the structure of cellulose allomorphs.

Diana Ciolacu

CURRENT TRENDS OF SUPERCRITICAL FLUID TECHNOLOGY IN PHARMACEUTICAL, NUTRACEUTICAL AND FOOD PROCESSING INDUSTRIES, Edited by Ana Rita C. Duarte, Catarina M. M. Duarte, Bentham Science Publishers Ltd., USA, 2010, 117 pp., ISBN: 978-1-60805-046-8.

The book "Current Trends of Supercritical Fluid Technology in Pharmaceutical, Nutraceutical and Food Processing Industries" provides an overview of the basic principles of SFE and its potential application in pharmaceutical and food industries.

Because of their unique properties and relatively low environmental impact, supercritical fluids have proven highly useful in the extraction and separation of organic compounds, in particle production, as reaction media, as well as for the destruction of toxic waste. During the last decades, more attention was focused on the extraction of organic compounds using supercritical fluids. In "Current Trends of Supercritical Fluid Technology in Pharmaceutical, Nutraceutical and Food Processing Industries", experienced practitioners present detailed accounts of a wide variety of techniques using supercritical fluids.

The book is divided into 4 parts and it comprises 10 chapters. Compiling contributions from international experts in the field, the book presents the state-of-the-science in the application of innovative technologies using supercritical fluids.

In the first chapter, *Introduction to Supercritical Fluids: Basic Principles and Applications* (M. Nunes da Ponte), a concise and comprehensible scientific presentation of the basic principles, proprieties and potential applications of supercritical fluids is made.

The second chapter, *Applications of Supercritical Expansion Processes for Particle Formation* (Ana Rita and C. Duarte) overviews the supercritical expansion processes applied for pharmaceutical purposes. The principles of these technologies and the advantages and disadvantages of the methods are clearly discussed.

As the supercritical processes are often referred to and classified as "green" and "environment-friendly" processes, a number of applications and some examples on the use of supercritical fluid technology for the preparation of controlled release systems are described.

Chapter 3, *Supercritical Anti-Solvent Micronization: Control of Morphology and Particle Size* (Ernesto Reverchon and Iolanda De Marco), approaches SAS precipitation used to micronize different kinds of materials, considering that AntiSolvent (SAS) precipitation has been largely used in many distinct research areas, such as pharmaceuticals, superconductors, coloring matters, explosives, polymers, biopolymers, etc. Furthermore, the SAS experimental apparatus, several procedures and the optimal operating parameters are described, along with details on the morphologies of expanded microparticles.

Chapter 4, *Particles from Gas-Saturated Solutions and Related Methods for Particle Engineering* (A. R. Sampaio de Sousa and Catarina M. M. Duarte), focuses on one of the most promising methods for particle engineering using supercritical fluids – particles from gas saturated solutions (PGSS) – and derived methods. The authors clearly describe the basic principles, the

modeling process, the related methods and their application in the pharmaceutical, cosmetic and nutraceutical fields.

The chapter provides an overview of the basic principles of the method, several developments that were further undertaken, and a compilation of different examples and systems.

Chapter 5, *Fundamentals and Modeling of Supercritical Precipitation Processes* (Ángel Martín and María José Cocero), discusses the fundamental investigation and modeling of supercritical fluid precipitation processes. These aspects are extremely important in the development of a systematic procedure for the design and scale-up of these processes. Different approaches for modeling SCF precipitation processes have been also presented, along with solubility and other phase equilibrium calculations.

Chapter 6, S*upercritical Fluid Impregnation for the Preparation of Controlled Delivery Systems* (Ana Rita C. Duarte and Catarina M. M. Duarte), dwells upon impregnation, using supercritical fluid technology for the preparation of controlled release systems. The development of different successful controlled release systems is presented for obtaining high purity products, free of residual solvents, since no organic solvents are involved in the impregnation process.

Chapter 7, *Ionic Liquids and Carbon Dioxide as Combined Solvents for Reactions and Separations: The Miscibility Switch* (E. Kühne, G. J. Witkamp and C. J. Peters), refers to the use of ionic liquids (ILs) and carbon dioxide (CO2) to replace volatile organic solvents in synthesis and extraction processes. When ILs are used simultaneously with carbon dioxide for reactions and extractions, the process will be based on non-toxic, non-flammable solvents, being therefore applicable for a wide variety of compounds.

Chapter 8, *Supercritical Antisolvent Fractionation of Plant Extracts* (O. J. Catchpole, N. E. Durling, J. B. Grey, W. Eltringham and S. J. Tallon), contains valuable information regarding the fractionation of plant extract solutions using near-critical fluids to give two or more fractions containing bioactives with widely differing polarities.

In particular, the authors describe the use of the SAFT process in detail for the solvent extraction and subsequent supercritical antisolvent fractionation of sage and onion.

Chapter 9, *Mathematical Modelling of Supercritical Fluid Extraction* (H. Sovová), discusses two of the most frequent types of models for supercritical extraction from plants, and the factors influencing the scale-up of the process. Considering that different mathematical models for supercritical fluid extraction have been developed in the last decades, and also the difficulty to choose the most suitable model for a particular extraction, the study presents concisely a simple criterion based on time constants of mass transfer and characteristic time of equilibrium extraction.

In chapter 10, *Supercritical Fluid Processing in Food and Pharmaceutical Industries: Scale-Up Issues* (Fabrice Leboeuf and Frantz Deschamps), the keys for the scale-up of extraction and fractionation processes, together with examples of applications, are briefly discussed. Also, the scale-up issues of the particle engineering processes for industrial applications, the design of SFF Full Scale Plants and cost estimations are given. The accurate knowledge of mass transfer and nucleation processes will form the basis for an efficient scale-up.

Versatile and comprehensive, the book “Current Trends of Supercritical Fluid Technology in Pharmaceutical, Nutraceutical and Food Processing Industries” combines basic fundamentals with industrial applications.

An enhanced concern for the quality and safety of food products, increased preference for natural products, and stricter regulations on the residual level of solvents, all contribute to the growing use of supercritical fluid technology as a primary alternative for the extraction, fractionation, impregnation and particle expansion, which is a key technology in pharmaceutical, cosmetic, food and nutraceutical fields.

Considering the scientific progress, the improved technology and increased utilization of supercritical fluids, a comprehensive, single-source overview of the current and future trends in supercritical fluid technology was absolutely necessary.

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