

contributions to the total bonding system in the crystal makes it still impossible to predict the structure that will result.

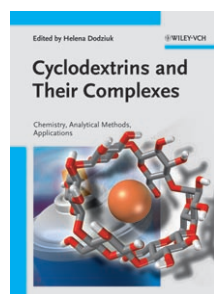
*Frontiers in Crystal Engineering* offers an interesting collection of individual reports about selected, mostly highly specialized, topics in the field, without claiming to cover all its aspects. Up to now, and for the immediately foreseeable future, it remains easier to understand the principles of crystal engineering for compounds that have been structurally characterized than to “design” crystal structures of complex compounds. Therefore, *Frontiers in Crystal Engineering* cannot provide a patent recipe for the targeted synthesis and crystallization of functional networks, but instead explains the many different influences on the crystal structures that are formed, and shows the importance of a thorough and sound interpretation of structural data.

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## Cyclodextrins and Their Complexes



Chemistry, Analytical Methods, Applications. Edited by Helena Dodziuk. Wiley-VCH, Weinheim 2006. 489 pp., hardcover € 149.00.—ISBN 978-3-527-31280-1

The field of cyclodextrins has made tremendous advances in recent years.

10625 articles on cyclodextrins were published between 2001 and 2006 (data from Cyclolab website, <http://www.cyclolab.hu>) in various areas ranging from organic chemistry to pharmaceutical and analytical applications. The field is not only very large but also highly diversified and is expanding rapidly. Indeed, as claimed by the editor of this book, since 2005 more than 5.6 articles per day have been published on cyclodextrins. *Cyclodextrins and their Complexes* offers a fresh look, providing a broad survey of the field with numerous references. It can serve both as a textbook for scientists newly interested in the cyclodextrins field and as an advanced monograph.

This work is organized in 16 chapters with 36 contributing authors, and contains 489 pages. It assumes a basic knowledge of advances in cyclodextrins research. Most chapters are highly referenced to original research papers and review articles for further reading. However, the balance between different aspects does not accurately reflect their relative importance. The characterization of cyclodextrins and their inclusion complexes by different spectroscopic and physical-chemical methods is very well described and discussed. This part represents almost half of the book. The various applications of cyclodextrins and their derivatives in industry are also well covered. On the other hand, the chemistry of modified cyclodextrins, as well as separations by cyclodextrins, would have benefited from a more in-depth treatment. Various special aspects of cyclodextrins, such as polymers, catalysis, rotaxanes, and large-ring cyclodextrins, are covered in other chapters.

The introduction to the subject of cyclodextrins and modified cyclodextrins provides useful structural data to enable the reader to understand the properties and applications of these molecules. It is complemented by Chapter 13, which describes large-ring cyclodextrins, and their synthesis, properties, and applications.

The second chapter deals with the organic chemistry of cyclodextrins and modified cyclodextrins. The very useful selective mono-modification of cyclodextrins is well presented, followed by per-modification. Examples of modification at other positions are also descri-

bed. The grafting of various moieties onto cyclodextrins (charged junctions, saccharides, peptides, metal ligands) is discussed with examples. However, amphiphilic derivatives are not discussed anywhere in this chapter, which is regrettable since these derivatives lead to many, often exciting, applications. Enzymatic modifications of cyclodextrins, which have been studied very thoroughly and are widely used, are given only a brief paragraph. The organic chemistry of cyclodextrins, a very large topic, is summarized here in a dense 30 pages, and is one of the less well treated areas of this book.

Chapters 3 and 12 focus on supramolecular polymers and rotaxanes, respectively. Chapter 3 explains, with examples, how polymers are formed when a hydrophobic moiety of a modified cyclodextrin becomes included in the cavity of another cyclodextrin. Analytical data are added to provide proof of their polymeric structures. In Chapter 12, rotaxanes and pseudorotaxanes, as well as catenanes, are described, but only a few structures and applications are presented. Nevertheless, these two chapters provide a well-written overview of the field.

Reactions catalyzed by cyclodextrins (covalent and noncovalent catalysis, acid-base catalysis) are explained well in Chapter 4, and examples are provided to illustrate each case. This is a short but useful section, clearly written.

One of the most important applications of cyclodextrins is their use in chromatographic separation, and particularly that of enantiomers. Chapters 5 and 6 briefly summarize chiral recognition by cyclodextrins, and its applications to enantiomer separation. This part starts by discussing characterization of the complexes by GC and LC, and leads into enantiomer separation by GC, LC, supercritical fluid chromatography, and capillary electrophoresis. The first three of these are treated briefly, whereas the latter one is well documented with the help of some examples. The chiral selectivity of  $\alpha$ -,  $\beta$ -, and  $\gamma$ -cyclodextrins towards a mixture of enantiomers is explained as being due to differences in complexation. Unfortunately, the lack of a chapter devoted specifically to relevant advances in the chromatography of cyclodextrins and

modified cyclodextrins misses an opportunity to underline the importance of this area.

A main part of the book, divided into several chapters, is devoted to analytical techniques. Crystallographic studies of cyclodextrins and modified cyclodextrins are well covered in the 50 pages of Chapter 7, in which each of the systems described is analyzed in detail. This chapter, which is authored by the leading expert in this field, is well written with many helpful illustrations and numerous references.

Chapter 8 is devoted to microcalorimetry, with interesting examples of this useful technique for the characterization of complexes and the determination of thermodynamic parameters involved in host–guest interactions.

That is followed by a chapter on NMR spectroscopy, which describes its use for structural elucidation of complexes, and the determination of association constants and stoichiometry. However, the choice of  $\alpha$ -cyclodextrins as examples of characterization by 1D and 2D spectra is not representative of the complexity of NMR spectroscopic analysis with cyclodextrins, because the symmetry of the molecule results in spectra that are relatively easy to analyze. It is regrettable that characterization by dedicated NMR experiments on more complex structures, such as modified cyclodextrins, is not clearly described in this chapter. This is a key point in the field of cyclodextrin chemistry. However, the chapter contains short

but well-written sections on chiral recognition and NMR experiments in the solid state.

Chapter 10 gives an overview of the use of other techniques in the field (MS, UV spectroscopy, circular dichroism, electrochemistry, and microscopy). Applications of these techniques to the characterization or study of complexes are well documented. This exciting and well-written chapter is very pleasant to read. All these analytical techniques can also be used in parallel with molecular modeling, to study energies of cyclodextrin complexes by computational methods, as explained by the authors of Chapter 11.

The three last chapters describe applications of cyclodextrins and their derivatives to pharmaceuticals, food, cosmetics, textiles, agrochemistry, and electronics. Numerous pharmaceutical applications are cited. Examples of complexes of various cyclodextrin derivatives with drugs to enhance solubility and bioavailability are described. The potential role of cyclodextrins as drug carriers, and the properties of cyclodextrins in living organisms, are discussed in detail. Dispersed systems are defined and described, and examples of each system are given in a very convenient table. The format of these two chapters provides both a pedagogical overview, which is of great value to the more general reader in the chemistry community, and in-depth literature surveys for the pharmaceutical specialists working in this area.

Finally, Chapter 16 reviews the industrial applications of cyclodextrins as stabilizers, enhancers of solubilization, and for reducing the volatility.

Although few chapters delve into much more specialist topics, they are generally very accessible. This is an important feature for such a multidisciplinary area, and ensures that the book will be useful to all parts of the target community. The table of contents and the indexes are detailed. This means that there is no need to follow the book in a set order to access each topic, which makes it appropriate for specialist researchers who wish to dip into particular aspects. The book is strongly focused on analytical methods and pharmaceutical applications.

In summary, this text is a timely contribution and promises to play a prominent role in disseminating knowledge in the field. We recommend this book to all chemists who are interested in the characterization of inclusion complexes and applications of cyclodextrins, in both industry and academia. The format provides both a pedagogical overview that is a great value for the more general readers, and in-depth articles useful to specialists in the area.

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