information for advanced researchers, contributing to a better communication between scientists of different disciplines, but also a valuable introduction for graduate students. The book appears at the right time, since structures are available and have already been used for some years to interpret data, and the work now provides a comprehensive review of recent developments concerning PSI. In conclusion, everybody who works with PSI or plans to do so in the near future should have the book on his or her desk.

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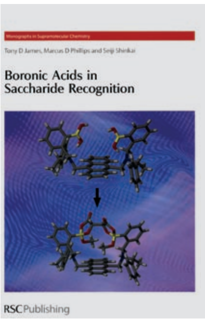
Boronic Acids in Saccharide Recognition



By *Tony D. James*, *Marcus D. Phillips* and *Seiji Shinkai*. Royal Society of Chemistry, Cambridge 2006.
174 pp., hardcover
£ 99.95.—ISBN 978-0-85404-537-6

Supramolecular chemistry is a broad area that encompasses many activities, but the design of synthetic receptors remains a core business. There are good specific reasons for wishing to have receptors that bind many substrates. For example, receptors may be used in analytical or separation systems, and may potentially have biological or catalytic activity. There is also a strong general motivation, in that the field serves as a proving ground for techniques and ideas in supramolecular chemistry. Just as synthetic chemists use natural products to hone their skills, supramolecular chemists can learn by setting themselves targets for binding and recognition. Among such targets, carbohydrates are both topical and challenging. On the one hand, the role of saccharide recognition in biology is under intensive investigation, and carbohydrate sensing (specifically glucose sensing) is important for the management of diabetes. At the same time, carbohydrates are quite "difficult" substrates, being large compared to other supramolecular targets, and only subtly different from each other. Moreover, their dominant functional group is hydroxy, which is very similar to the water molecules that surround them in their natural environment. Discrimination between substrate and solvent, the first job of a receptor, is therefore a major challenge.

Two strategies have been used to design synthetic carbohydrate receptors. One approach is essentially biomimetic, employing the noncovalent interactions used by carbohydrate-binding proteins such as lectins. Progress is being made, but it is only recently that receptors of this type have succeeded in water (as opposed to organic media, where substrate–solvent discrimination is far less challenging). The second strategy, which is discussed in this monograph, exploits the tendency of boronic acids to form cyclic boronate esters with 1,2- and 1,3-diols. This latter approach relies on the formation of covalent bonds, which raises the issue of whether it is truly "supramolecular", but complexation is kinetically fast, and most chemists would accept that this research conforms to the spirit of supramolecular chemistry. Importantly, the strategy works. Even simple boronic acids bind carbohydrates in water with quite respectable association constants, so molecular design can focus on controlling selectivity and improving affinity from a fairly high baseline. Reporter units (e.g., fluorophores) may also be incorporated, and the development of carbohydrate sensors is a key objective.

James and Shinkai were pioneers in this area, and have already written several reviews. It is appropriate that they should now expand their coverage to give a comprehensive account in book form. They begin with a short introduction and a brief chapter on carbohydrate recognition in general. In particular, they highlight the medical potential of a supramolecular nonbiological glucose sensor. Although the current enzyme-based methods are effective and user-friendly, improvements are certainly possible. For example, a synthetic receptor is likely to be more robust than a protein-based system, and therefore longer-lasting and amenable to sterilization. Chapter 3 provides a clear and detailed account of the principles behind the boronate–diol equilibrium. This is especially useful, as it was not covered in previous accounts in review journals. Chapters 4–7 then survey the large number of systems that have been reported in the primary literature. Chapters 4 and 5 focus on boronate-based fluorescent sensors for carbohydrates. The former chapter considers systems that employ internal charge transfer (ICT) and photoelectron transfer (PET). It also illustrates the value of ditopic structures to control selectivity, and intramolecular amine–borane interactions to mediate fluorescence detection. Developing these themes, Chapter 5 describes a modular approach to fluorescent carbohydrate sensors, which is currently being explored by one of the authors. Chapter 6 reviews other sensing strategies such as colorimetric and electrochemical detection. Chapter 7 covers "other systems for saccharide recognition", including receptors that operate at or across interfaces, CD receptors, and materials formed by molecular imprinting. Finally there is a short (two-page) conclusion.

Overall, the book does an excellent job of assembling the large body of literature in this area, explaining the operation of boronate-based carbohydrate receptors and suggesting routes to improved performance. This will be very valuable to workers in the field and interesting to many others. One might have welcomed a more substantial conclusion, perhaps discussing the medical application of these systems. For the nonspecialist reader, it is difficult to assess whether a clinical glucose sensor is just around the corner, or whether there are still major problems to be solved. However, this monograph certainly belongs on library shelves and in the laboratories of many supramolecular chemists.

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