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Book Review

Hans-Jörg Schneider and Anatoly Yatsimirsky, *Principles and Methods in Supramolecular Chemistry*, John Wiley & Sons, Ltd., Chichester, England, 1999. ISBN 0 471 97370 X (HB) 0471 97253 3 (PB)

In the 30 years since the discovery of crown ethers and their complexation properties, supramolecular chemistry, which is the chemistry of intermolecular interactions, has become one of the major fields of chemistry. Intensive work has been devoted to the design and directed-synthesis of macromolecules providing a wealth of information about the construction of receptor molecules involved during the formation of supramolecular systems. These fundamental advances have been gathered, analysed and organised in a large number of reviews, special issues, books, and recently as a comprehensive set of 10 volumes. As a consequence, the present work of Hans-Jörg Schneider and Anatoly Yatsimirsky, *Principles and Methods in Supramolecular Chemistry* represents an approach to supramolecular chemistry different from the existing ones.

The book contains nine chapters A-I.

The first chapter (A) reports on the basic concepts of host–guest chemistry with selected examples from ionophore chemistry. More particularly, it shows the basic need of complementary interactions to give host–guest stability. The intervention of thermodynamic parameters is pointed out. This leads to several concepts well-known in host–guest chemistry: differences between open chain structures and cyclic ones, macrocyclic, chelate and cryptate effects associated with typical ionophores for cations. The hole-size concept and its limitations are illustrated by complexation selectivity. Preorganization principles are defined and numerous examples are given. This chapter also illustrates ionophores for anions. It ends with the report of macrocycles with secondary binding sites and multinuclear complexes which leads to cooperativity, allosteric effects and the induced fit concept.

The second chapter (B) introduces the reader to the different non-covalent interactions and organic host–guest complexes. Non-covalent forces are characterized and identified along with quantification: ion-pairs, hydrogen bonds, cation-π electron and related interactions, van der Waals interactions, dispersive forces, charge transfer complexes and related interactions, stacking and hydrophobic interactions. Each kind of interaction is illustrated with very recent examples. For instance, one can find calixarenes and their complexes with fullerenes to define charge transfer complexes.

Chapter (C) gives considerations to medium effects such as solvent and salts on supramolecular equilibria in relation to the selectivity of complexation.

After these chapters introducing the principles used by supramolecular chemists the book moves to the experimental methods for investigating supramolecular systems in relation to quantification of the principles.

Chapter (D) is the longest chapter and presents the experimental methods for evaluating the energetics of supramolecular complexes. It gives the different methods to determine association free energies and the respective enthalpic and entropic contributions for a thermodynamical description of host–guest systems: electrochemical methods (potentiometry, protonation constants, polarography and cyclic voltammetry, conductometry), spectroscopic methods (UV-visible, infrared and fluorescence spectroscopy), chiroptical methods, chromatography, nuclear magnetic resonance, mass spectrometry, calorimetry, kinetic methods and surface plasmon resonance.

Some of these methods are repeated in chapter (E) which details the different methods for elucidating the molecular structures and arrangement of atoms of the complexes (diffraction techniques, supermicroscopy such as STM, AFM, CFM and SNOM, NMR methods, chiroptical methods, vibrational spectroscopy and computer aided molecular modeling).

Chapter (F) illustrates two fundamental aspects of supramolecular systems: firstly the kinetics of formation and dissociation of complexes and higher structures, and secondly the conformational changes induced by complexation. These two aspects are mainly investigated by NMR and fluorescence methods as well as stopped-flow and related techniques.

Supramolecular chemistry does not involve only host–guest systems: chapter (G) describes surfactant-based supramolecular systems such as monolayers, micelles and bilayers, vesicles, and dendrimers.

Chapter (H) briefly discusses shape recognition and molecular imprinting in carcerands and cavitands, clathrates and solid state inclusion complexes.

The last chapter (I) discusses selected applications of supramolecular chemistry. Chiral discrimination is achieved thanks to recognition between one selective chiral binding site and one enantiomer. Several examples are given relying on chosen interactions for selective separation. Supramolecular synthesis occurs via template association. Template assisted syntheses are also used for more sophisticated molecular structures such as rotaxanes and catenands, met-

alorganic analogues of double stranded nucleic acids and cyclic oligonucleotides. Applications have been found in self-replication and autocatalysis, micellar catalysis, optical devices, electrochemical devices, molecular switches and membrane transport associated with molecular signals.

The main interest in the book remains the fact that supramolecular chemistry is not presented from an organic synthetic point of view, as usually done, but rather is based on the energetics of supramolecular systems. It is a comprehensive overview of non-covalent interactions and a guide to characterizing molecular complexes by physical methods. From this point of view it will be read by researchers starting in the field as well as practising supramolecular chemists. The book has been written by an organic chemist and a bioorganic chemist and the choice of the examples are taken from both fields.

Almost every chapter ends with questions answerable from the chapter contents, corresponding to examples taken from the literature. The answers are also given in case one runs into difficulties!

The foreword is provided by Jean-Marie Lehn.

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