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Organic Nanostructures

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Cover illustration
The front cover shows a space-filling image illustrating the packing of the ligands in the optically pure cage complex $[Zn_4(L^{o\text{-}Ph*})_6(ClO_4)](ClO_4)_7$ and is adapted from Figure 9.5 with the permission of Michael Ward. The structure is superimposed on an SEM image of the helical fibrous structure of a chiral supramolecular xerogel.

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In memory of Professor Dimitry M. Rudkevich
(1963–2007)

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Preface

Current research in chemistry and materials science is now vigorously pushing the boundaries of the components studied firmly into the multi-nanometer length scale. In terms of traditional "molecules" a nanometer (10^{-9} m) is relatively large. As a result, it is only relatively recent advances in analytical instrumentation capable of delivering a molecular-level understanding of structure and properties in this kind of size regime that have allowed access to and the study of such large molecules and assemblies. The key interest in multi-nanometer-scale structures (nanostructures) is the fact that their size allows them to exhibit a significant degree of functionality and complexity – complexity that is mirrored in biological systems such as enzymes and polynucleotides, Nature's own nanostructures. However, this functionality is compressed into a space that is very small on the human scale, sparking interest in fields such as molecular computing and molecular devices. Thus one of the great opening frontiers in molecular sciences is the upward synthesis, understanding of structure and application of molecules and molecular concepts into the nanoscale.

In compiling this book we have sought to bring together chapters from leading experts working on the cutting edge of this revolution on the nanoscale. Each chapter is a self-contained illustration of the way in which the nanoscale view is influencing current thinking and research across the molecular sciences. The focus is on the "organic" (loosely applied) since it is generally carbon-based building blocks that are the most versatile molecular components that can be induced to link into nanoscale structures. As chapters by Mohammed Eddaoudi and Lee Cronin show, however, hybrid organic–inorganic materials and well-defined inorganic building blocks as just as capable of assembling into well-defined and well-characterized discrete and polymeric nanostructures.

Crucial to the whole field of nanochemistry is the cross-fertilization between researchers from different disciplines that are approaching related structures from very different perspectives. It is with this aspect in mind that we have deliberately mixed together contributions from the solid-state materials community as in Dario Braga's perspective on the crystal engineering or organic nanostructures and from experts in discrete molecular assemblies such as Dimitry Rudkevich, Kay Severin, Thomas Rauchfuss and Bruce Gibb. Of course, nanostructures are not

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always so well defined and so these aspects are balanced nicely by David Smith's chapter on gel-phase materials – in some respects a "halfway house" between solution-phase and solid-state assemblies. We also felt it of key importance to illustrate ways to use small-scale molecular concepts in order to "synthesize-up" nanostructures. Chapters by Paul Beer, Steve Loeb and Len MacGillivray provide very different perspectives on templation and assembly in the field, while Makoto Fujita and Mike Ward deal with larger-scale self-assembly. Finally, all-important functional nanostructured devices are illustrated by Vincenzo Balzani's chapter.

Although a book of this size can only be illustrative of such a burgeoning field, it is our sincere hope that the juxtaposition of these different perspectives and systems in one place will stimulate and contribute to the ongoing process of cross-fertilization that is driving this fascinating and emerging area of molecular science. It has certainly been a fascinating and pleasurable experience to work on this project and we thank all of the authors wholeheartedly for their enthusiastic contributions to this project. We are grateful also to Manfred Köhl and Steffen Pauly at Wiley-VCH for their belief in the book and for their help in making it a reality. As this book went to press we learned of the sad and untimely death of Dimitry Rudkevich. We would like to dedicate this book to his memory and legacy to science.

December 2007

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