



Molecular Chemistry of Sol-Gel Derived Nanomaterials

Molecularly modified nanomaterials made by soft techniques are now without doubt the basis of a rapidly burgeoning field involving a wide community of chemists. The stimulus for this lively area of research is the great potential of these materials for nanotechnology-based applications in the domains of energy, environment, biotechnology, and communications. In the last 15 years, the development of sophisticated synthetic routes and characterization techniques have paved the way to the design of complex nanomaterials using all the available chemical tools. Therefore, books presenting a molecular approach to the synthesis of nanomaterials are most welcome, as proven by the success of recent texts devoted to hybrid materials or nanochemistry.

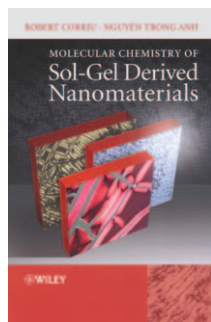
The book by Corriu and Trong Anh aims at positioning chemistry in the center of the scene of nanomaterials. The authors argue convincingly in their preface that nanotechnology should not be associated exclusively with miniaturization and physics. The “bottom-up” approach is indeed the natural way that chemists think about matter: from bonds and molecules to the material. The huge amount of information that is now available from fundamental studies in molecular and supramolecular chemistry is a sound basis for the creation of “any conceivable structure”. The authors focus their message on the possibilities opened up by sol-gel processing, which gives access to the unlimited world of hybrid and nanocomposite materials.

This work is roughly divided into two parts: the first three chapters introduce the reader to the basic concepts of materials chemistry, then Chapters 4 to 6 illustrate different aspects of molecular approaches to “nanochemistry”, from the simplest to the more complex systems. The first part deals with the basics, and identifies the most relevant features: the fundamental role of molecular chemistry in nanomaterials, the need for controlled and reproducible synthetic procedures, and the kinetic control that is attained with sol-gel techniques. The approach is focused on “nanoobjects”, a very nice and modern way to refer to molecules, clusters, or colloids. The authors make a clear distinction between these nanoobjects and the actual nanomaterials, stressing that the processing and shaping are essential steps towards applications. This is a useful insight, and the examples are well chosen. However, the approach is based only on the molecular chemistry aspects. A short section on physical chemistry features related to the colloidal state, including the role of the surface, would have been welcome. The text is sometimes

repetitive, and the contrast between the more detailed and the more sketchy sections could confuse an inexperienced reader. This part would have benefited by establishing a more even and concise development. Chapter 3 gives a quick review of a variety of soft chemical routes to the production of materials. Sol-gel procedures are introduced here, with a focus on silica. This is useful for understanding the examples described later, but more information about recent advances with systems other than silica would have been desirable. The authors introduce four types of hybrid nanomaterials that will be further discussed: nanocomposites, grafted, single-phase nanostructured, and interactive. The use of examples that are discussed in depth is a positive aspect, and the presentation is very clear. However, the examples are mostly from the authors’ experience, and the resulting high proportion of self-citations would be more appropriate for a report than for a general introductory text, where a wider choice of topics would lead to a better understanding of the whole picture.

The second part describes hybrid nanomaterials, with selected examples. After a rather repetitive introduction, Chapter 4 introduces a variety of examples in the area of nanocomposites. Chapter 5 describes the processes that take place when self-assembling organic functions occur in combination with silica polycondensation, and presents beautiful examples, mostly selected from Prof. Corriu’s extensive work. Even though it resembles a feature article, this part alone is worth the book. Chapter 6 is devoted to what the authors call “interactive nanomaterials”, also called “multifunctional hybrids”, in which chemical properties can be coupled in the same material (e.g., sensing and actuating), or in different regions thereof. The important concept of spatial location of different chemical functions that can interact is exemplified by descriptions of mesoporous materials. This section, while well placed, is a little outdated, and more varied and authoritative referencing would have been desirable. The following sections develop several examples of periodic mesoporous organosilica materials, and describe some targeted applications. The information presented gives a glimpse into the fascinating possible applications of complex materials.

Finally, Chapter 7 considers the future outlook: molecular methods have come of age, opening up unique pathways to produce nanomaterials. Some likely future applications in fields as diverse as catalysis, selective separations, water treatment, drug delivery, and solar energy are briefly discussed. These potential applications effectively convey the versatility of these polyfunctional materials.



Molecular Chemistry of Sol-Gel Derived Nanomaterials
 Edited by Robert J. P. Corriu
 and Nguyen Trong Anh. John
 Wiley & Sons, Hoboken
 2009. 200 pp., hardcover
 € 99.90.—ISBN 978-
 0470721179

In summary, this book presents in a succinct way some relevant concepts that are essential to the “bottom-up” processing of nanomaterials. In this text, Corriu and Trong Anh have not attempted a comprehensive in-depth study of this wide field. Instead they open a window to this new world, set out the grounds for discussion, and illustrate them through selected examples. The development of the text is mostly lively and appealing, although it sometimes alternates sketchy sections with detailed analysis. The specialist will find an interesting, albeit sometimes narrow selection of subjects, attractive systems, and some inspiring views. Remarkable conceptual phrases are strewn across the whole text. Beginners, though, might have a harder time to follow the scientific thread, because of some digressions and the style of organization, which sacrifices precision and order for freedom of

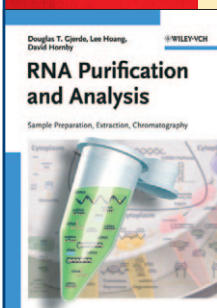
subject choice. Overall, this book has more the quality of a “personal voyage” by the authors in the world of nanomaterials chemistry, rather than being an organized primer. A fantastic journey, though, nurtured by their experience. Let other more complete reviews and books discuss in detail this domain and cite abundant references. This work might not dig deeply into the roots of nanomaterials synthesis, but it will certainly help to spread the wings of a growing and creative field of chemistry, where plenty of exciting work is waiting to be done.

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DOI: 10.1002/anie.200904371

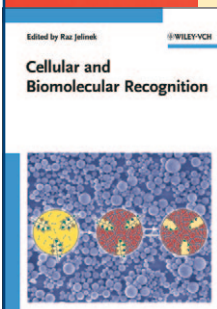
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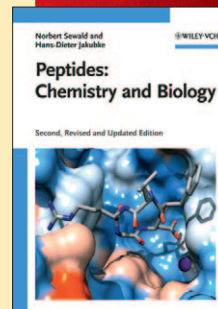
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