

## Dendrimers

Almost every year a new book on dendrimers emerges from the depths of scientists' offices to excite and delight the research community. This trend is now continued by a group of respected dendrimer scientists from Université de Toulouse (France) headed by Anne-Marie Caminade. The group has taken on an impressive challenge to write a reference book about dendrimers and their applications. Dendrimers are repeatedly branched macromolecules with a perfectly defined structure—a key feature, which has allowed dendrimers to find important applications in biotechnology and materials science. The field of dendrimer science has consequently evolved quickly during the past 35 years from the synthesis of first “cascade” molecules to a rapidly developing area of multidisciplinary research spanning most disciplines in natural sciences. The field of dendrimer research and number of publications is now vast and this book therefore limits itself to catalytic, material and biomedical uses of dendrimers, although the area that it covers is still impressively large.

The book is organized into four parts that orchestrate a train of 21 individual chapters written mostly in a review style. Part 1 opens the book logically by introducing dendrimers briefly from a historical perspective and quickly moves to the synthetic and characterization methods used to prepare monodisperse dendrimeric compounds. Finally, luminescent, stimuli-responsive, liquid-crystalline, and nanoparticle-conjugated dendrimers are introduced. Unfortunately, Part 1 seems to be the weakest link of the book, especially Chapter 2 on methods of characterization of dendrimers just rushes through the techniques, leaving the reader with little useful information.

Part 2 is devoted for applications in catalysis and, no doubt, the laboratory's strong background in this area is also reflected in the text, which offers an excellent focus and more insight to the applications than Part 1. Not surprisingly, the focus is on homogeneous catalysis, which is the most active research area of dendrimeric catalysts. However, also heterogeneous catalysis with dendrimers is included, offering a nice comparison with the two catalyst types.

Part 3 introduces the use of dendrimers in preparing gels, layered nanostructures and, importantly, as chemical and biological sensors, which are of utmost importance for future applications. The connection between the chapters is limited, however the individual chapters are again of high quality and pave way for the last part of the book.

Subject of the final Part 4 is the biological and medical uses of dendrimers in imaging, nucleic acid transfection and drug delivery. This part gives the reader a coherent and well-written overview of the area. Special care has been taken to present the large variety of cationic dendrimeric compounds used as transfection agents with detailed evaluation of poly(amido amine) dendrimers.

The book is aimed at scientists already familiar with the field; throughout the chapters the large amount of information is clearly organized, different applications listed and importance well pointed out. However, the style of the book is to present the literature data, not to analyze and explain it. Therefore its didactic impact remains low. For example, complementing the text with illustrative figures and adding exercises or questions to the chapters might have eased the undergraduate students and lecturers to approach the book and widen its impact. The figures in the book are clear and have a uniform look, but the black-and-white graphical presentation is not eye-catching and makes it less attractive. Cited literature is up to date and includes well over two thousand references, which come up to 2010 or even 2011.

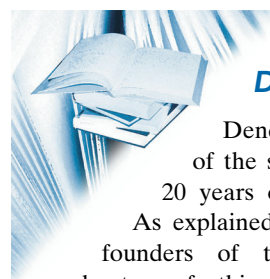
In summary, *Dendrimers—Towards Catalytic, Material and Biomedical Uses* needs time and thought to read through, but also rewards the reader with an up-to-date overview of recent literature. The book is of high quality and recommended reading for anyone working with dendrimers or wanting to have a good reference book; rich in information, clearly organized and thoroughly referenced with topical primary publications.

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**Dendrimers**  
Towards Catalytic, Material and Biomedical Uses. By Anne-Marie Caminade, Cédric-Olivier Turrin, Régis Laurent, Armelle Ouali, and Béatrice Delavaux-Nicot. John Wiley & Sons, Hoboken, 2011. 566 pp., hardcover, € 155.00.—ISBN 978-0470748817



## Designing Dendrimers

Dendrimer chemistry is one of the success stories of the last 20 years of synthetic nanoscience.

As explained by Tomalia, one of the founders of the field, in the first chapter of this book, dendrimers and dendrons can be considered as unique quantized building blocks for nanoscience. Each generation (or layer) or growth on the surface of the branched dendritic architecture increases the size of the object in a controllable and predictable way, and modulates its properties.

Hierarchical assembly of these dendritic building blocks can then be used to precisely assemble even larger nanoscale aggregates. Perhaps most excitingly, as synthetic nanoscale objects, the structures and properties of the individual dendritic building blocks are hugely versatile, as indicated by the contribution from Newkome, another pioneer of the field. Unlike many other nanoscale objects, such as metal nanoparticles or carbon nanotubes, dendrimers are inherently synthetically versatile. As such, dendrimers and dendrons have hugely wide ranging potential applications across a wide range of areas of interdisciplinary science.

This book is a collection of chapters from some of the leading experts in the field and is logically organized to convey the development of the field. Early chapters focus on how synthetic methods in dendrimer chemistry have recently been upgraded to allow easier access to high-quality dendritic products. These advances have taken advantage of widely-applied approaches such as the “click” methodologies. This has allowed dendritic architectures to be incorporated into ever more elaborate nanostructures, as is elegantly illustrated by the contributions by Müllen and Schlüter, describing the breakthroughs from their laboratories.

The collection of articles in this book is particularly strong in considering the redox and photo-optical behavior and potential applications of dendritic systems. The article from Nierengarten describing dendritic fullerenes makes clear how dendritic modification can enable the interaction of fullerenes with a wide variety of different environments and the effect this has on the electron acceptor nature of the fullerene unit. The redox theme is continued in a series of articles exploring redox-cored dendrimers, electrochemical sensors and the use of dendritic systems in organic electronic devices. A number of the articles deal with the spectroscopic behavior of dendrimers. In particular, the nanosize and precise molecular-level control of dendritic architectures makes them of interest for single molecule spectroscopy, a complex topic which is clearly described.

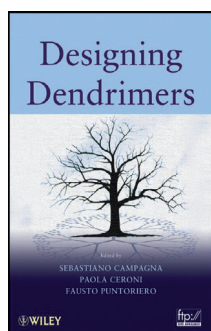
Finally, the collection moves on to properties such as biodegradability and the ability of dendritic

systems to act as mimics of biological systems, or to operate in biological environments. The articles here are nice, but to my view there is a significant missed opportunity in the lack of articles describing the application of dendritic structures in biology, pharmacy and medicine. For example, perhaps the first commercial application of dendritic molecules was the sale of gene transfection kits based on degraded PAMAM dendrimers (under the trademark Superfect). Dendrimers and dendrons have great potential in therapeutic areas as a consequence of their well-defined and predictable molecular structures combined with their inherent branching, which allows them to carry multiple pharmaceutically active ingredients, or have high-affinity interfaces with biological targets through multivalent binding. There is real vibrancy in studies of the fundamental dendrimer design chemistry needed to develop the most effective biologically active systems. There has been huge interest in multivalent dendritic molecules as antiviral drugs, gene delivery vehicles, multi-warhead antibacterial agents etc. Indeed, companies such as Starpharma have carried out clinical trials of dendritic systems, and developed a licensed condom coating with antiviral activity based on this technology. However, unfortunately little of this exciting research is described in this volume.

It is my view that this book provides a very good overview of the core of dendrimer chemistry. It branches out well in the materials, and particularly photo-optical areas of the subject, but is perhaps a few generations short of the current state-of-the-art in terms of biomedical applications of these fascinating molecules. Nonetheless, the book is recommended for researchers in the area as an up-to-date collection of high-quality articles—hopefully someone can follow up with a more biologically and medically focused volume.

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