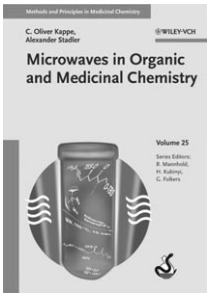
Things are Hotting Up

Methods and Principles in Medicinal Chemistry 25: Microwaves in Organic and Medicinal Chemistry

By *C. Oliver Kappe* and *Alexander Stadler*.

Wiley-VCH, Weinheim 2005. xii + 410 pp., hardcover € 139.00.—ISBN 3-527-31210-2



Since microwave heating of organic synthesis was first reported in 1986, the technique has been employed extensively to speed reactions, sometimes dramatically. However, the mechanisms of microwave heating, the range of technologies and methodologies now available and the numerous, diverse applications reported are not so broadly known or understood. In this book, the authors have aimed to provide "a well-structured, up-to-date and exhaustive overview of known synthetic procedures involving the use of microwave technology".

In the mid-1990s, the first dedicated commercial microwave systems to allow chemists to conduct reactions under controlled and reproducible conditions at above atmospheric pressure were reported. Although the authors suggest that the technique now is "making a comeback", delays in commercial development of suitable and safe reactors precluded release much before the turn of the century. Several commercial systems now are available (as described in Chapter 3) and they facilitate reactions in organic solvents at temperatures considerably higher than the boiling points at atmospheric pressure. Most microwave systems can operate under moderate pressures (around 1–2 MPa). Some are more sophisticated than others and, by incorporating robotics, they enable the chemist to perform reactions automatically and remotely. Over the past five years (the period of main focus of the book), adoption of the technology has escalated and it is now is employed routinely in several academic and industrial chemical research laboratories around the world. With an ever-increasing number of creative chemists practising microwave-assisted organic synthesis, the scope of reactions and applications has broadened accordingly. Hence, the appearance of a book on the use of microwaves in organic and medicinal chemistry is timely. The authors, having begun their work in the field in the mid-1990s, have more experience with the technique than most and are well versed in recent developments as well as having contributed to them.

Their book comprises seven chapters, each being self-contained in terms of references and content. This arrangement has led to some duplication, particularly, but not exclusively in the opening few paragraphs of chapters. Although a little tedious for the reader, this overlap does not detract greatly from the merit of the work. The first chapter is a short introduction to the microwave technique (seven pages, including one page of references) and is followed by an excellent short chapter (19 pages) on microwave theory, again amply referenced, and written in context for the organic chemist. Chapter 3 outlines equipment no longer available (in the case of Prolabo instruments that were distributed in the 1990s and remain in use in some laboratories), currently available, or in the late stages of development by four main suppliers: Milestone, CEM, Biotage and Anton Paar. Many illustrations of commercial units, reaction vessels and fittings are reproduced. This chapter mainly consolidates information that could be obtained through promotional material available from individual manufacturers. Critical comment regarding advantages and disadvantages of the various systems is not presented. Hence, chemists seeking to purchase a microwave reactor for the first time will be made aware of the range available through this chapter, but may not be sufficiently briefed as to systems most suitable for particular requirements.

Chapter 4 describes various ways of performing microwave-assisted organic synthesis and includes sections on solvent-free reactions with and without phase-transfer catalysis, applications of high-temperature water, use of ionic liquids, parallel processing and scale-up. This is followed by another short chapter (15 pages) entitled "Starting with Microwave Chemistry", in which the authors have cited their own extensive studies into microwave-assisted Biginelli reactions to derive appropriate reaction conditions and to optimize microwave processes. By page 107, the first five chapters have been completed, and the next 284 pages are devoted to two chapters dealing with literature surveys on general organic synthesis (Chapter 6) and combinatorial chemistry and high-throughput synthesis (Chapter 7). Chapter 6 is a comprehensive overview, well referenced (with perhaps 1000 individual citations or more) and amply illustrated through reaction schemes. Complementing a recent review by Professor Kappe in *Angewandte Chemie*, it summarises hundreds of reactions mainly reported between 2002 and 2004 and starkly demonstrates the utility and scope of the microwave technique to areas such as decarboxylation, addition and elimination, rearrangement and metal-catalysed carbon–carbon bond-forming processes. Chapter 7 deals with an emerging area of microwave-assisted organic chemistry. With examples, the authors highlight the potential of microwave technology for combinatorial and high-throughput synthesis but, at the time of writing, much of the equipment described therein was in the prototype or early commercial stages of development. Thus Chapter 7, which contains considerably fewer references than does Chapter 6, reflects a "work in progress" in that area of microwave chemistry. In the brief Outlook and Conclusion (Chapter 8) the authors reiterate the benefits of controlled microwave heating, particularly in sealed vessels and predict that as equipment prices will be reduced, "microwave reac-

tors will become standard equipment in every chemical laboratory".

Although the most part of the book is focused upon a literature survey of reactions carried out between 2002 and 2004, this easy to read work is essential for chemists wishing to learn about the state of the art in microwave-assisted organic synthesis chemistry and will be a handy reference volume for more experienced microwave chemists. Unfortunately, the indexing is poor, with few page entries listed against most terms (e.g. *microwave heating* has only one entry!) and few if any of the researchers cited in the text are listed in the index.

Finally, the authors have highlighted the rapid pace of technological development in microwave equipment for organic chemistry and in the range of microwave chemistry reported. With this level of innovation expected to continue unabated in the immediate future, a second edition may soon be warranted!

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Biopolymers for Medical and Pharmaceutical Applications

Edited by *Alexander Steinbüchel* and *Robert Marchessault*.

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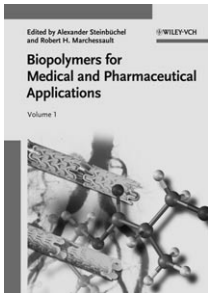
Biopolymers, defined broadly as biosynthesized materials, play a central role in medicine and pharmacy with applications in tissue engineering, regenerative medicine, and drug-carrier systems. In general, materials from natural sources cover a wide range of macromolecules such as polyphenols, polyesters, polysaccharides, and polyamides. Such materials are advantageous in biomedical and pharmaceutical applications because of their inherent properties of biocompatibility and biodegradation. To cover all classes of the biopolymers within one text is a difficult task. However, the editors Alexander Steinbüchel and Robert H. Marchessault have undertaken this venture in a two-volume book with wonderful contributions by experts in the field from academic as well as industrial research groups. Together, editors and authors have succeeded in providing a complete picture of biomedical biopolymers, describing their history, occurrence and structure, isolation, biosynthesis, biodegradation, application, perspectives, and patent information. This is an ideal reference of biopolymers for both basic and applied science research laboratories.



Over the past decade, many reviews and books have been written on biopolymers with wide range applications in areas such as medicine, pharmacy, agriculture, textiles, food, chemical, and packaging industries. The book *Biopolymers for Medical and Pharmaceutical Applications* comprises 32 chapters that were selected from the published ten-volume text *Biopolymers* (Alexander Steinbüchel, 5924 pp, 2001–2003, Wiley-VCH, ISBN: 3-527-30290-5). The chapters in *Biopolymers for Medical and Pharmaceutical Applications* are arranged in five sections according to biopolymer chemical structure. The first volume is divided into three sections covering polyphenols, polyesters, and polysaccharides. In detail, Volume 1 begins with an introductory preface by the editors, followed by a section with three chapters describing polyphenols and natural rubbers. The second section contains four chapters dealing with various polyesters including the polyanhydrides. The 14 chapters in the third section focus on the various polysaccharides. In Volume 2, Section 4 includes eight chapters focusing on polyamides and complex proteinaceous materials. The final section is comprised of three chapters dealing with miscellaneous biopolymers.

Overall, this two-volume text concentrating on biopolymers for biomedical and pharmaceutical applications is well organized by the editors and provides knowledgeable insight from many of the leaders in the field. Each chapter focuses on one kind of biopolymer, highlighting discovery, occurrence, chemical and physical properties, analysis, biosynthesis, molecular genetics, physiological role, fermentative production, isolation, purification, and application as well as patent information. Not only did the book cover broad areas of individual biopolymer, it also provided detailed information in each issue. Thus, *Biopolymers for Medical and Pharmaceutical Applications* provides a comprehensive overview of the interdisciplinary fields of biopolymers. Moreover, the contents are easily accessible through the table of contents and the keyword index. One notable shortcoming of this treatise is that most of the literature cited in all chapters is pre-2002, this is understandably due to selection from previously published books and the time frame of publication. Therefore, one can hope for a second or revised edition in which recent research data will be added so as to provide up-to-date insights into the world of biopolymers. Even so, both skilled researchers and those new to the field will find something worthwhile and interesting in this wide-range treatise. Furthermore, the price of this two-volume book is much less than that of the ten-volume *Biopolymer* series. Still, it might be a little expensive for graduate students or younger scientists to purchase.

Finally, as the editors wrote in the introductory preface, "it has been our intention to provide the scientific and industrial community with a comprehensive view of the current state of knowledge on biopolymers and their derivatives in medicine and pharmacy". In my view, they have successfully achieved this goal. The text provides thorough coverage by illustrating a complete picture of individual biopolymers from both academic and industrial practice. Therefore, the book is not only an excellent guidebook in technological aspects of biopolymers, but also a supreme teaching and reference book for graduate students and academic and industrial researchers who want to learn about biopolymers from discovery to application.

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