Ultrasound and Microwaves: Recent Advances in Organic Chemistry

Editors

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Preface

Sonochemistry or sound chemistry…. what the matter? Sonochemistry is about the use of ultrasound in chemistry. Indeed, power ultrasound is able to enhance chemical reactivity in a liquid medium through the generation of cavitation micro-bubbles. The growth and collapse of these micro-bubbles result in the transfer and focusing of energy from the macro scale motion of an acoustic transducer to the micro scale gaseous phase inside the bubbles. During their violent collapse, extremely high pressures and temperatures are generated in the vapour phase inside the bubble leading to the production of highly reactive free radicals, enormous heating and cooling rates and liquid jet streams. This unique energy focusing mechanism provides a means of reacting compounds in an aqueous solution and generates energy for interesting chemical and mechanical effects. The potential applications of this technology range from surface cleaning to organic synthesis. This first part of this book (chapters 1 and 2, M. Draye, J.M. Leveque) gives an overview of the present advances in the use of ultrasound and the potential of their combination with microwave for organic synthesis. The chapters concerning sonochemistry are dedicated to Professor Jean-Louis Luche in recognition of his deep and lasting contributions to theory and practice of ultrasound for organic synthesis. Professor Luche has played an important role at the LCME of the University of Savoie where he has initiated this research topic; enabling practicing scientists to further develop their own original research through a pioneering research area.

Since the first report of microwave synthesis in 1981 by Bhargava Naresh for production of plasticizer esters, the spectacular growth of this technique is undoubtedly connected to the development of new and adapted reactors enabling accurate control and reproducibility of the microwave-assisted organic synthesis procedures but also to the increasing involvement of pharmaceutical and industrial laboratories. This success is also due to the fact that microwave heating is instantaneous, very specific and there is no contact required between the energy source and reaction reactor. The objective of the second part of this book is to focus on different and new fields of applications of this technology in particular aspects of organic synthesis. In this context, five new fields of applications have been developed and were written by the most European eminent scientists, all well recognized in their fields. This book is a suitable complement of the second edition of the "Microwave in Organic Synthesis" Wiley-VCH book edited by André Loupy in 2006. In this "Ultrasound and microwave: recent advances in organic synthesis" book, the chapter 3 described the synthesis of ionic liquids using solventless conditions under microwave followed by a survey of several applications of ionic liquids in organic synthesis (G. Vo-Thanh). In chapter 4,
applications in which microwave-assisted combinatorial approaches on ionic liquid-phases, liquid- and solid-phases have afforded spectacular results and applications in medicinal chemistry (J.P. Bazureau). This chapter is dedicated to Professor Jack Hamelin in recognition of his important contribution for microwave chemistry in the Chemical Department of the University of Rennes 1 (as he says: "under microwave, the best solvent is no solvent", an article of Gavin Whittaker entitled "Fast and Furious", for New Scientist, published on 28\textsuperscript{th} Feb. 1998). The next and original topics to be treated are coupling of microwave activation for reduction reactions in chapter 5 (T. Besson) and biocatalysis in chapter 6 (V. Thiery). The last chapter 7 (J.J. Vanden Eynde and D. Barbry) focused on a promising technique under intense development in industry (cosmetic, pharmacy, essential oils extraction, etc) is continuous flow chemistry under microwave irradiation. Finally, we would like to thank all the authors of this book who are at the cutting edge of their areas of study for their kind contribution to these very stimulating chapters despite their very busy schedules.

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