Book Review

Flash Chemistry, Jun-ichi Yoshida, ed. (John Wiley & Sons Ltd., 2008) 234 pp., ISBN: 9780470035863, $150.00, (hardcover)

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The scale of chemical reactions can vary enormously, and yet most laboratories seem to be stuck carrying out chemistry in "fist size" reaction vessels. As the author of *Flash Chemistry* points out, what may have seemed the most appropriate scale of chemistry one hundred or so years ago does not necessarily provide the ideal molecular environment for reactions. From a practical standpoint, ever-growing concern for research's environmental impact and laboratory operating costs (solvents costs continue to increase and some are scarcely available) further enhance the appeal of flash chemistry.

Yoshida defines flash chemistry as "a field of chemical synthesis where extremely fast reactions are conducted in a highly controlled manner to produce desired compounds with high selectivity." These techniques typically utilize a "continuous flow system" in which the desired reaction is often carried out within a millisecond time frame. The book's introductory chapters cover these concepts and demonstrate how microflow systems can grant chemists a clearer view of the otherwise masked kinetics of ultrafast reactions.

Chapters five and six, entitled "Methods of Activating Molecules" and "Control of Extremely Fast Reactions," leave the reader with an appreciation for the potential impact of flash chemistry. Here Yoshida discusses the advantages of flash variants of photo, electrochemical, microwave, and chemical activation over traditional non-flash (macrobatch) methods. He then details the major factors impacting the outcomes of these flash reactions, such as mixing, temperature control, and reaction time (also known as residence time). Yoshida takes time to describe the importance of these seemingly simple processes, which all too often are lumped under the category "chemical intuition." This approach provides readers not only with working knowledge for optimization of flash chemical reactions, but also with fresh perspective on the reactions that they have been carrying out their entire lives.

In chapter seven Yoshida offers an overview of the different styles of microfluidics devices and microflow systems typically used in flash chemistry. Accessible even to a non-chemist, this chapter provides insight into beautifully executed solutions to heat-transfer and mixing challenges. After reviewing the theory and engineering behind flash chemistry, Yoshida highlights published work in which flash chemistry triumphs over the challenges that have historically plagued macro-batch reactions. This sentiment continues through a discussion of flash polymer chemistry until Yoshida points out that because long reaction times are required, even at high temperatures, "living-radical polymerization is not a suitable technique for flash chemistry." This antithetical statement sparks curiosity as to why more limitations of flash chemistry are not discussed further. While it is inspirational to learn of flash chemistry's ability to overcome the challenges of traditional macrobatch chemistry, in the interest of experimental time and effort, it is equally valuable to understand its limits and failures. Perhaps a chapter dedicated to this topic would prove useful to chemists looking to employ flash chemistry in their laboratories.

Throughout the book Yoshida offers a large number of black-and-white schemes and diagrams which effectively depict the topics being discussed. Numerous photographs help to convey a sense of size and capture details which could be lost in a drawing. It is clear from the tone of book that Yoshida is passionate about his research interests. In the final pages he boasts: "Flash chemistry is expected to produce a paradigm shift not only in chemical synthesis, but also in the industrial production of chemicals and drugs." This bold statement is made plausible by the practical and controllable nature of microflow reactors. Flash chemistry's development in a world dominated by macrobatch reactions is reminiscent of Henry Ford's contributions to the auto industry, as microflow reactors distinctly resemble an assembly line. Like the proliferation of Ford's revolutionary process to many other corners of industry, flash chemistry will undoubtedly continue to grow. Yoshida's *Flash Chemistry* can provide chemists, both industrial and academic, with the knowledge base necessary for further exploration of this fast and tiny field.