

# Click Chemistry for Biotechnology and Materials Science

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Edited by

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# Preface

Over the last few years, click chemistry has taken a dramatic upturn. Since K. Barry Sharpless defined click chemistry as a “set of powerful, highly reliable, and selective reactions for the rapid synthesis of useful new compounds and combinatorial libraries” in 2001, many researchers have recognized the power of this conceptual framework. It was recognized early on that click chemistry is not limited to a specific type of reaction, but stands for a synthetic concept that is built on common reaction trajectories, rather than common reaction mechanisms. As a specific example of a click reaction, Sharpless suggested the copper-catalyzed Huisgen’s 1,3-dipolar cycloaddition of azides and terminal alkynes, which has now been used for a wide range of different applications. The area of click chemistry is a highly creative area of research, which has literally exploded over the last few years.

While the concept of click chemistry might have initially been introduced with a firm eye on drug discovery, its applications to materials synthesis and biotechnology have been a startling success story. Thus, as I look ahead toward the advances coming from click chemistry in the next decade, some of the most promising applications are related to materials science and biotechnology. With this book, it is my intention to share some of the excitement surrounding click chemistry by describing the most recent progress with respect to (i) the development of a conceptual framework of click chemistry, (ii) its application to the precise design and synthesis of macromolecules, and (iii) its numerous applications in materials science and biotechnology.

Chapter 1 offers an introduction of the concept of click chemistry and its potential value as a universal ligation strategy for materials science and biotechnology. In the following three chapters, synthetic capabilities and limitations of click chemistry are discussed. Schilling, Jung and Bräse describe common synthons for click chemistry, while Baskin and Bertozzi review recent progress in the rapidly emerging field of copper-free click chemistry. In addition, Broyer, Kolodziej and Maynard describe a very exciting sub group of reactions involving oxime chemistry.

Chapters 5 to 8 outline the versatility of click chemistry for the synthesis of a range of different materials. Starting from the use of click chemistry for polymer synthesis (Lutz and Sumerlin), the journey takes us to the more complex branched polymer structures highlighted by Sinwell, Inglis, Stenzel and Barner-Kowollik. In chapter 7, Sachsenhofer and Binder review supramolecular materials prepared via click chemistry. This extensive survey of recent progress in this very exciting field is nicely complemented by a chapter on dendrimer-related click reactions authored by McNerny, Mullen, Majoros, Banaszak Holl, and Baker Jr (Chapter 8).

An interesting feature of Diels–Alder cycloadditions is their potential to be reversible. In chapter 9 Peterson and Palmese demonstrate that this is a very attractive property,

when designing multifunction polymer networks. Moving from polymers to biohybrid and nanomaterials, chapters 10 and 11 authored by Kitto, Lauko, Rutjies and Rowan and van Berkel, Nijhuis, Löwik and van Hest, respectively, highlight truly emerging applications of click chemistry at the boundary of organic chemistry.

This synthesis-focused section of the book is followed by five chapters that describe potential applications of click chemistry in a wide range of important materials and biotechnology areas. In chapter 12, the use of click chemistry for surface engineering is described with a clear focus on biotechnological applications. This chapter is complemented by chapter 13, authored by Dieterich and Link, which surveys recent progress with the use of click chemistry for protein engineering. In chapter 14, LeDroumaguet and Wang describe the benefits of fluorogenic Huisgen's 1,3-dipolar cycloaddition reactions for bioconjugation. This section of the book is concluded by a comprehensive review of recent work in the area of biofunctionalization provided by Schilling, Jung and Bräse. Finally, in chapter 16, Luo, Kim, and Jen highlight unusual electro-optic properties enabled by Diels–Alder reactions of polymers and dendrimers.

When I initially decided to write a book about click chemistry for materials science and biotechnology, it was my main goal to share with a broader readership some of the excitement that was so apparent in discussions with colleagues at conferences and elsewhere. Thanks to my co-authors who have, in 16 loosely-connected chapters, provided a comprehensive view on this rapidly emerging field, I truly feel that this book has delivered on its mission.

Joerg Lahann  
Michigan, April 2009

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