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Advances in Polymer Science

Aims and Scope

The series Advances in Polymer Science presents critical reviews of the present and future trends in polymer and biopolymer science. It covers all areas of research in polymer and biopolymer science including chemistry, physical chemistry, physics, material science.

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Patrick Theato
Editor

Multi-Component and Sequential Reactions in Polymer Synthesis

With contributions by

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Preface

The synthesis of functional polymers is currently seeing a revival. Within the last decade, numerous new polymerizations and functionalization routes for the synthesis of polymers have been described. This is an extremely positive development, considering the ever increasing demand of novel and complex polymeric materials in advanced applications.

Within the present series on "Multi-Component and Sequential Reactions in Polymer Synthesis", I have the honor to compile recent developments in multi-component reactions (MCRs) or sequences of reactions that are used for the synthesis of polymers or the post-modification of polymers. From the early times on, polymer synthesis has been inspired by novel organic reactions. However, it took usually several decades until new and efficient organic reactions found their way into polymer synthesis. This relatively slow trend has changed recently – likely due to the faster access to interdisciplinary information – and it can be observed that modern organic reactions now find their use in polymer synthesis within a couple of years after their discovery. Noteworthy, the fundamental requirement for a reaction to be useful for the synthesis of polymers is efficiency. Reactions must proceed in high conversions without the formation of any side products via side reactions. After the advent of "click-reactions" in polymer synthesis, a second generation of highly efficient reactions employing multiple components in one step or in defined sequences of steps has found use in polymer synthesis. Consequently, one could easily speak in modern terms of "click 2.0" reactions. I do not claim this book to be a comprehensive compilation of all ongoing synthetic developments in this area, but rather an inspiring source providing a first overview on numerous ongoing advances.

Thankfully, numerous experts have kindly agreed to provide up-to-date chapters on several aspects in the area, thereby contributing to a collection of recent developments. In the first chapter, Ryohei Kakuchi discusses the use of metal-catalyzed MCRs for the synthesis of polymers. Special attention is laid to Cu-catalyzed developments. In the second chapter, Rongrong Hu and Ben Zhong Tang summarize developments of multi-component polymerizations of alkynes and

it beautifully complements the first chapter. Additionally, they highlight fascinating properties of the synthesized polymers, which include aggregation-induced/-enhanced emission, light refractivitiy, photopatternability, or magnetism. In the third chapter, Lei Tao and coworkers review the Biginelli MCR for the synthesis of polymers, which can be used in coupling reactions or the post-polymerization modification. The fourth chapter, written by Ansgar Sehlinger and Michael A.R. Meier covers the intensively utilized Passerini and Ugi multi-component reactions in polymer science. Mihaiela C. Stuparu and Anzar Khan highlight in fifth chapter sequential thio-epoxy and esterification reactions. Although based on relatively old reactions, it is the simplicity of this approach that makes it a very potent reaction sequence. Pieter Espeel and Filip E. Du Prez elaborate on the one-pot multi-step reaction based on thiolactones in sixth chapter. Thiolactones can be ring-opened with amines, expressing a thiol, which can be converted in a subsequent reaction in a thiol-X reaction. The seventh chapter by Fenja Moldenhauer and Patrick Theato summarizes numerous other sequential reactions for the synthesis and modification of polymers. Last but not least, the eighth chapter by Gerrit A. Luinstra and coworkers focuses on the industrial relevant modification of polybutadiene with sequential reactions, thereby providing an insight into demands for industrial relevant materials and their synthesis.

Experts in the respective fields wrote these chapters for chemists working in academia or industry. I sincerely hope that chemists, biochemists, material scientists or simply any researcher interested in modern polymer synthesis will find this book and its chapters useful. May it be an inspiring source or reference!

Hamburg, Germany Patrick Theato
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