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Aims and Scope

The series *Advances in Polymer Science* presents critical reviews of the present and future trends in polymer and biopolymer science including chemistry, physical chemistry, physics and material science. It is addressed to all scientists at universities and in industry who wish to keep abreast of advances in the topics covered.

Review articles for the topical volumes are invited by the volume editors. As a rule, single contributions are also specially commissioned. The editors and publishers will, however, always be pleased to receive suggestions and supplementary information. Papers are accepted for *Advances in Polymer Science* in English.

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Preface

This is truly an exciting time to be in the field of polymer science. Advances in polymerization methods are providing polymer scientists with the ability to specify and control polymer composition, structure, architecture, and molecular weight to a degree that was not possible just a decade ago. This, in turn, is resulting in many novel application possibilities of polymers ranging from drug delivery systems and nanolithography to stimuli-responsive materials and many others. In addition, many of the application areas of polymers – such as coatings, adhesives, thermoplastics, composites, and personal care – are also taking advantage of the ability to design polymers during their development efforts. Not to forget, many of these applications of polymers involve mixing polymers with solvents, catalysts, colorants, and many other ingredients to prepare a formulated product.

However, the tuning of polymer composition and structure as well as polymer formulations to optimize the final performance properties can be challenging, especially since in many cases several interacting variables need to be optimized simultaneously. This is where the methodologies and techniques of combinatorial and high-throughput experimentation to synthesize and characterize polymer libraries can be an invaluable approach. Simply put, a polymer library is a collection of multiple polymer samples having a systematic variation in one or more variables related to composition, structure, or process. Various methods and strategies have been explored to efficiently prepare a large number of polymer samples and also to screen these samples for key properties of interest. In this way, a broad range of compositions can be prepared and evaluated in a similar time frame required to prepare one or two samples, significantly increasing the efficiency of the experimental process. In addition, because the variable space is explored more thoroughly and in more detail than when using conventional laboratory methods, often materials having a unique combination of properties are identified.

While the use of these methods can be shown to be of benefit to a large number of polymer research programs, the widespread implementation of these concepts has not been realized. Thus, we would encourage those working in complex polymer systems to carefully consider the examples provided in this volume and identify how these could be implemented in their research work.

In Chap. 1, we provide an introduction to the strategies that have been reported for the preparation and characterization of polymer libraries and then highlight a few selected examples where polymer libraries have been effectively used to identify novel materials. In Chap. 2, Becer and Schubert describe the preparation of polymers using controlled/living polymerization methods. Automated reactors have been used both to optimize the synthetic conditions and for preparing libraries of novel block copolymers. Next, Fasolka, Stafford, and Beers describe strategies used to study the interfaces of polymer systems using a gradient combinatorial approach. In the gradient approach, a single physical sample is prepared that has a systematic change in properties such as composition, thickness, surface energy, etc. A number of truly unique and creative methods have been developed to prepare the samples and characterize the gradient libraries for properties such as adhesion, surface energy, modulus, and so on. Finally, one of the challenges in the use of combinatorial and high-throughput methods is in the analysis and modeling of the data obtained. In Chap. 4, Adams discusses various approaches and especially the challenges involved in the modeling of the polymer data which may be generated using combinatorial and high-throughput experiments.

While providing a compendium of work done in the past, our primary aim is that this volume will provide inspiration and motivation for polymer scientists to employ combinatorial and high-throughput methods in their research efforts and generate even greater and novel discoveries from their research work.

In addition, we would like to thank all those who have contributed to this volume to make it a success: C. Remzi Becer, Ulrich S. Schubert, Michael J. Fasolka, Christopher M. Stafford, Kathryn L. Beers, and Nico Adams. Without your excellent contributions, this volume would not have been a reality.

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