

PRINCIPLES OF POLYMERIZATION

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PRINCIPLES OF POLYMERIZATION

Fourth Edition

GEORGE ODIAN

College of Staten Island
City University of New York
Staten Island, New York

 **WILEY-
INTERSCIENCE**

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PREFACE

This book describes the physical and organic chemistry of the reactions by which polymer molecules are synthesized. The sequence I have followed is to introduce the reader to the characteristics which distinguish polymers from their much smaller sized homologs (Chap. 1) and then proceed to a detailed consideration of the three types of polymerization reactions—step, chain, and ring-opening polymerizations (Chaps. 2–5, 7). Polymerization reactions are characterized as to their kinetic and thermodynamic features, their scope and utility for the synthesis of different types of polymer structures, and the process conditions which are used to carry them out. Polymer chemistry has advanced to the point where it is often possible to tailor-make a variety of different types of polymers with specified molecular weights and structures. Emphasis is placed throughout the text on understanding the reaction parameters which are important in controlling polymerization rates, polymer molecular weight, and structural features such as branching and crosslinking. It has been my intention to give the reader an appreciation of the versatility which is inherent in polymerization processes and which is available to the synthetic polymer chemist.

The versatility of polymerization resides not only in the different types of reactants which can be polymerized but also in the variations allowed by copolymerization and stereoselective polymerization. Chain copolymerization is the most important kind of copolymerization and is considered separately in Chap. 6. Other copolymerizations are discussed in the appropriate chapters. Chapter 8 describes the stereochemistry of polymerization with emphasis on the synthesis of polymers with stereoregular structures by the appropriate choice of initiators and polymerization conditions. In the last chapter, there is a discussion of the reactions of polymers that are useful for modifying or synthesizing new polymer structures and the use of polymeric reagents, substrates, and catalysts. The literature has been covered through early 2003.

It is intended that this text be useful to chemists with no background in polymers as well as the experienced polymer chemist. The text can serve as a self-educating introduction to polymer synthesis for the former. Each topic is presented with minimal assumptions

regarding the reader's background, except for undergraduate organic and physical chemistry. Additionally, it is intended that the book will serve as a classroom text. With the appropriate selection of materials, the text can be used at either the undergraduate or graduate level. Each chapter contains a selection of problems. A solutions manual for the problems is available directly from the author.

Many colleagues have been helpful in completing this new edition. I am especially indebted to Chong Cheng, Krzysztof Matyjaszewski, and Stephen A. Miller who graciously gave their time to read and comment on portions of the text. Their suggestions for improvements and corrections were most useful. I also thank the many colleagues who generously responded to my inquiries for their advice on various topics: Helmut G. Alt, Jose M. Asua, Lisa S. Baugh, Sabine Beuermann, Vincenzo Busico, Luigi Cavallo, John Chadwick, Geoff Coates, Scott Collins, James V. Crivello, Michael F. Cunningham, Thomas P. Davis, Pieter J. Dijkstra, Rudolf Faust, Hanns Fischer, Michel Fontanille, Robert Gilbert, Alexei Gridnev, Richard A. Gross, Robert H. Grubbs, Howard Haubenstein, Jorge Herrera-Ordóñez, Walter Hertler, Hans Heuts, Henry Hsieh, Aubrey Jenkins, Jaroslav Kahovec, Mikiharu Kamachi, Walter Kaminsky, Hans Kricheldorf, Morton Litt, Roberto Olayo, Patrick Lacroix-Desmazes, W. V. Metanowski, Michael J. Monteiro, Timothy E. Patten, Stanislaw Penczek, Peter Plesch, Jorge Puig, Roderic P. Quirk, Anthony K. Rappe, Luigi Resconi, Ezio Rizzardo, Greg Russell, Erling Rytter, Richard R. Schrock, Donald Tomalia, Brigitte Voit, Kenneth Wagener, Robert M. Waymouth, Owen W. Webster, Yen Wei, David G. Westmoreland, Edward S. Wilks, Bernard Witholt, Nan-loh Yang, Masahiro Yasuda, and Adolfo Zambelli. Their helpful and insightful comments enriched and improved the text.

I welcome comments from readers, including notice of typographical, factual, and other errors.

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June 2003

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