edited by

Vijay Kumar Thakur Manju Kumari Thakur

Handbook of

SUSTAINABLE POLYMERS

Structure and Chemistry



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To my parents and teachers who helped me become what I am today.

Vijay Kumar Thakur

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Preface

Synthetic polymers and their materials have been used frequently as attractive alternatives to conventional materials for a number of applications. Some of the advantages of these materials are resistance to corrosion, acids, and fire; higher fatigue strength, impact energy, and absorption capacity; longer service life; lower life-cycle costs; and non-conductivity. However, most synthetic polymer-based materials suffer from a number of drawbacks such as non-biodegradability, non-recyclability, and non-environmental friendliness. Compared with traditional synthetic polymer-based materials, sustainable polymer-based materials offer a number of advantages such as low-cost, specific mechanical properties, and ease of handling. Furthermore, owing to the increasing environment and sustainability concerns, materials industries worldwide are undergoing a revolutionary shift to developing environmentally sustainable materials. Natural polymers provide renewable resources, and applications of the natural polymer-based materials can also reduce the waste in the environment owing to their biodegradable nature. One of the advantages of these materials is that these materials do not disrupt the established steady-state equilibrium of the environment.

Compared with the traditional synthetic polymer-based materials, the use of biorenewable polymers for a number of applications ranging from biomedical to defense is increasing rapidly. Indeed, biorenewable polymer-based materials have been used by the people of earlier civilizations to meet their material needs. Diversity of materials derived from different natural resources such as natural fibers, wood, animal skin, wool, and silk has played a greater role in the early civilization. These natural polymer-based materials are of high importance even in the modern world as their feedstocks are renewable. Furthermore, natural polymer-based materials can be composted or recycled at the end of their life cycle. Different research efforts all around the globe are

continuing to improve the existing properties of these polymers. Researchers are collectively focusing their efforts to use the inherent advantages of sustainable polymers for their targeted applications. Scientists in collaborations with industries are extensively developing new classes of sustainable materials of renewable nature. Different kinds of sustainable materials can be obtained from different biorenewable polymers as well as some genetically modified organisms. This book is solely focused on sustainable polymers and deals with the different structural and chemical aspects of these materials. Several critical issues and suggestions for future work are comprehensively discussed in this book with the hope that the book will provide a deep insight into the state of the art of sustainable polymers. We would like to thank the publisher for the invaluable help in the organization of the editing process. Finally, we would like to thank our parents for their continuous encouragement and support.

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