Preface

In 1987, Gro Harlem Brundtland, ex-Prime Minister of Norway, introduced the concept of sustainable development as "addressing the needs of the present without compromising the ability of the future generations to meet their needs," at the UN Commission on Sustainable Development. Nowadays, the technological development is globally improving the quality of human life, but the impact on the environment is increasingly destructive as the progress we are experiencing is not sustained by the limited natural resources of our limited planet. Therefore, an inversion on our daily approach is mandatory and the linear economy based on the take–make–dispose concept must be replaced by a circular economy model.

In the field of plastic materials, current growing concern on waste management and plastic pollution is pushing international institutions, as well as scientific and industrial community, toward a more sustainable economy for plastic products. In this frame, the design and development of a nature-mimicking circular system, where waste is transformed back to resources through the production of biobased and waste-derived precursors and polymers, represent a significant evolution toward a sustainable approach. In this respect, the optimization of innovative, low-cost, and low-energy-consuming processes for plastic production, and the definition of new strategies for the management of end-of-life oil-based plastics are becoming key importance for bioinnovation.

This book aims to offer a comprehensive overview on the green approaches to the research and technology of plastic materials. A critical perspective concerning both oil-based plastics and novel biobased and waste-derived polymer formulations is provided, with a special focus on the application fields in which biopolymers have the potential to compete with traditional plastics. This book is intended as a complimentary textbook for students as well as a reference for researchers and practitioners working on sustainable polymers and their applications.

Chapter 1 illustrates the key principles of the circular economy in comparison to linear approach and analyzes the new business, industry, and consumer models in the frame of a circular sustainable model. Chapter 2 discusses on the impact of microplastics on aquatic environments, providing remarkable data on the current scenarios in freshwater, sea, oceanic, and coastal environments, and the consequences that microplastics are having particularly on the fauna. Chapter 3 describes the current research trends on polyhydroxyalkanoates (PHAs), biopolyesters synthesized by a variety of microorganisms. This chapter also illustrates the potential applications PHAs can have due to their biodegradable and biocompatible nature, and their inherent properties. Chapter 4 provides an overview on chitosan and alginate polymers, and summarizes the most important novel concepts and inventions regarding marine biopolymer engineering. Chapter 5 emphasizes knowledge and recent advances in terrestrial biopolymers, such as cellulose, starch, and lignin, providing information on the current market and commercial distribution of this class

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of bioplastics. Chapter 6 gives an insight on biobased thermosetting polymers, obtained by novel building blocks based on bioderived molecules designated to substitute petroleum-derived precursors. It also describes the properties of biobased thermosets in comparison with the traditional systems. Chapter 7 describes the most important synthetic methods and degradation mechanism of aliphatic biodegradable polyesters, such as polylactic acid, as well as current and promising applications in various fields. Chapters 8 and 9 provide a comprehensive description on natural and biobased functional and structural additives for polymers. Finally, chapter 10 provides an interesting insight on the use of additive manufacturing for the processing of biopolymers.

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