

# Preface

The book, “Advances in Elastomers-I: Their Blends and Interpenetrating Networks” summarizes many of the recent technical accomplishments in the area of elastomer-based blends and interpenetrating networks (IPNs). As the title indicates, the book emphasizes the various aspects of preparation, structure, morphology, processing, properties, and applications of elastomer-based blends and IPNs, in a systematic and comprehensive manner. Recent advances in the development and characterization of multicomponent polymer blends and IPNs based on elastomers are discussed in detail. It is important to mention that till date, there are limited books published on the recent advances in the synthesis, morphology, structure, properties, and applications of elastomer-based blends and IPNs. The various chapters in the book discuss general purpose elastomers, special purpose elastomers, compounding, vulcanization, processing of elastomers, rubber/rubber blends: micro and nanostructured, rubber/thermoplastic blends: micro and nanostructured, rubber/thermoset blends: micro and nanostructured, interphase modification and compatibilization of rubber-based blends, elastomer-based IPNs, micro and nanofillers in rubber-based blends, magnetorheological elastomers and applications: ionizing radiation processing of elastomers and electro-elastic continuum models for electrostrictive elastomers.

In this sense, the content of the book is unique. It covers an up-to-date record on the major findings and observations in the field of elastomer-based blends and IPNs. The book is intended to serve as a “one stop” reference resource for important research accomplishments in this area. The chapters in the book have been contributed by prominent researchers from the industry, academia, and government/private research laboratories across the globe. This book will be a valuable reference source for university and college faculties, professionals, post-doctoral research fellows, senior graduate students, polymer technologists, and researchers from R&D laboratories working in the area of elastomer-based blends and IPNs. The first chapter, “Advances in Elastomers: Their Blends and Interpenetrating Networks”, gives an overview of the advances in elastomers on state-of-art new challenges and opportunities. This chapter is essential for beginners in these fields as it provides a thorough basic understanding of the elastomer-based blends and IPNs. The following chapter on general purpose elastomers discusses the structure, chemistry, physics, and performance. The first part of this chapter

gives an introduction to thermodynamics, kinetics, structure, and polymerization. Focus is made on specific elastomer structure, properties, and thermoplastic elastomers. Later in this chapter, several topics such as elastomer-filler compositions, elastomer blends, interpenetrating elastomer blends, formulation, compounding, and shape-memory polymers are presented. Finally, the future trends are discussed. In the third chapter, special purpose-based elastomers are explained with different types of elastomers used as special purpose applications. This chapter explains different elastomers such as butyl rubber nitrile rubber, silicone rubber, fluoro rubber, polyurethane rubber, polysulfide rubber, and phlorosulfonated polyethylene rubber. The synthesis, structure–property relationship, compounding, processing, and applications of each special purpose-based elastomers are discussed in detail.

A survey on compounding and vulcanization is done in the fourth chapter. The authors deal with compounding, different types of compounding equipments, processes, and compounding ingredients. Each of the topics, single-step processes, batch process compounding ingredients and their function, different types of vulcanizing agents and vulcanizing systems, and double networking of elastomers is detailed. Finally, details are added on the advantages and disadvantages of the compounding and vulcanization process. The fifth chapter is on processing of elastomers and comprises different subtopics. The first section contains the different processing methods used for the preparation of elastomer-based blends and composites such as latex blending, two-roll mixing, extrusion blending, and other processes and the second section deals with the different types of compounding equipment, processes such as single-step processes, batch process, and other processes and advantages and disadvantages of each process. The last section of this chapter discusses the fabrication of products such as compression molding, dipping, coating, and other types of products.

The following chapter is on Rubber/Rubber Blends: Micro and Nanostructured mainly focusing on different studies on rubber/rubber blends such as recent developments, different manufacturing methods, and different characterization methods. This chapter explains various topics such as rubber/rubber-based micro blends, rubber/rubber-based nano blends, recent studies on rubber/rubber-based micro blends, recent studies on rubber/rubber-based nano blends, different manufacturing methods of rubber/rubber-based micro blends, different manufacturing methods of rubber/rubber-based nano blends, characterization methods of rubber/rubber-based micro blends, and characterization methods of rubber/rubber-based nano blends. Finally, the application of these rubber/rubber blends is detailed. The next chapter discusses the Rubber/Thermoplastic Blends: Micro and Nanostructured. The authors discussed the different rubber blends of thermoplastic with micro and nanoscale, and their recent studies, manufacturing methods, and characterization methods are discussed in detail. Finally, the application of these rubbers/thermoplastic blends is explained. The eighth chapter describes Rubber-Thermoset Blends: Micro and Nanostructured. The first part of this chapter gives an introduction, morphology, and various types of rubber-thermoset blends. The second part discusses rubber-epoxy-based blends with the subtopics of epoxy

toughening by liquid rubber, chemistry, thermodynamic consideration, liquid rubbers other than CTBN, saturated liquid rubbers, toughening by preformed particles and some miscellaneous studies with rubber-epoxy blends; the last part of this chapter discusses rubber toughening of cyanate esters.

The chapter on Interphase Modification and Compatibilization of Rubber-Based Blends analyzes the different topics on interphase modification and compatibilization. The current trends in development of grafts/block copolymers, crosslinking etc., are given. The other main topics discussed are compatibilizing agents, surface modifiers, plasticisers, properties of interphase modified/compatibilised elastomeric blends, interphase characterisation, and finally the future prospects. The tenth chapter focuses on elastomer-based IPNs; this is an important chapter in the book, where the basics related to IPNs, such as introduction, recent studies, different manufacturing methods, characterization methods, phase morphology, properties, and finally applications of IPNs are discussed in detail. The chapter on Micro and Nanofillers in Rubber-Based Blends discusses with an introduction to micro fillers, nano fillers and their recent studies, and finally compatibilization of rubber–rubber blends by the addition of fillers and application. The following chapter discusses the applications of elastomers, mainly focussing on magnetorheological elastomers and applications. Here, the topics discussed after the introduction are, fabrication of isotropic and anisotropic MR, rheological properties, sensing properties of MR elastomers, and other applications. The thirteenth chapter explains ionizing radiation processing of elastomers, with topics such as the basics of radiation chemistry, definitions, units, sources of ionizing radiation as applied to processing of elastomers, and primary and secondary chemical reactions induced by radiation in elastomers. Finally, radiation-induced crosslinking—the most important application, selected cases and applications: radiation induced grafting, degradation of tyres, etc., are discussed. The last chapter discusses Electro-Elastic Continuum Models for Electrostrictive Elastomers. Along with an Introduction, the manufacturing process, chemical structure, physical properties, thermal properties, mechanical properties, crystallinity, and applications are explained. In the last part of this chapter the authors correlate between structure properties and applications.

Finally, the editors wish to express their sincere gratitude to all the contributors of this book, who provided excellent support for the successful completion of this venture. We are grateful to them for the commitment and the sincerity they showed in contributing to this book. Without their enthusiasm and support the compilation of this book series could not have been possible. We thank all the reviewers who spent their valuable time to make critical comments on each chapter. We also thank the publisher Springer for recognizing the demand for such a book, and for realizing the increasing importance of the area of Blends and Interpenetrating Network.

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Advances in Elastomers I

Blends and Interpenetrating Networks

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