Polymer Blends and Composites

Chemistry and Technology

Muralisrinivasan Natamai Subramanian

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Preface

The emerging area of polymer blends and composites allows choosing a suitable combination of polymers and tailoring them for a desired performance. Although polymer blends and composites are relatively independent, history has shown that the interplay of new methods and ideas results in advancements in the development of new materials via properties and multifunctional approaches.

As part of the significant progress of science, engineering, and technology, it is highly gratifying that polymer blends and composites continue to advance at such a rapid pace. Today, continuously changing environmental aspects and natural resources dictate what is not allowed in the manufacture of new polymeric materials. Hence, blends and composites provide a powerful means of expanding new product development as well as new concepts in applications.

Today's challenge for material scientists is to develop technologies that can produce blends and composite products with extended lifetime, increased safety and perhaps with little or no maintenance. Therefore a technical reference is needed to help address this challenge, with text that provides the necessary value-added information to the reader. Consequently, an important motivation behind this book was to provide information that ultimately leads to advances in blends and composites. This along with the structure-property relationships in blends and composites are presented in order to achieve a new level of understanding of the area, resulting in the synergistic outcome of new materials.

The main objectives of this book are to present state-of-the-art preparation of novel materials, and to discuss their performance and application potentials. The wide scope of material covered provides a high-level of knowledge on polymer blends and composites. At the same time, the book gives young scientists the opportunity to understand areas of blends and composites and to develop professionally as quickly as possible. In addition, this book will encourage scientific and technological investigators to expand their knowledge of commercially relevant blends and composites.

I thank Mrs. Himachala Ganga, Mr. Venkatasubramanian and Mr. Sailesh for providing the encouragement to get the job done and help bring this book to fruition. Special thanks also to Mr. Martin Scrivener, Ms. Jean Markovich and to my professors. Above all, I thank the almighty Nataraja for bringing me into this wonderful earth to complete this work.

Dr. Muralisrinivasan Natamai Subramanian
Madurai
January 1, 2017

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1

Introduction

Polymers are considered as matrix materials in blends and composites. These polymers, which are a result of the mixing of two or more polymers, enable the production of blends and composites with required properties. As the performance requirements of polymers become more demanding, their physical properties through the use of blends and composites has become increasingly important.

Polymers have recently been used more frequently as blends and composites, resulting in good technological qualities of each of the components. Polymer blend processing has emerged as an inexpensive and versatile route to control the microstructural characteristics of polymers and enhance their properties [1–4].

Polymers are macromolecules and are insoluble material. The physical properties of the material dictate the complex structure of polymer by their ability to establish a structure-property relationship that predicts various physical properties. With the introduction of food packaging, the use of polymers has grown greatly, particularly the use of thermoplastic polymers such as high- and low-density polyethylene (HDPE and LDPE), polypropylene (PP), polyethylene terephtalate (PET), polyvinyl chloride (PVC), and polystyrene (PS). Polymers have been widely used

as a route to develop a combination of desired properties by blending or by composites.

1.1 Polymer Blends

Polymer blends have become a broad field that aims to tailor polymer functionality. The blending of polymers is an inexpensive route to the modification of various polymer properties. It is a viable and versatile way to control the performance of polymeric materials with available polymers [5]. There has been a significant increase in the use of polymer blends to obtain new high-performance organic materials without any synthesis, resulting in a new polymeric material. Polymer blends are composed of two or more polymers with or without compatibilizer, depending on the composition and viscoelastic properties of individual components. They have complicated properties which display elasticity and viscosity at different strain rates and temperatures [6, 7].

Polymer blending is a relatively simple process and cheaper than polymer synthesis. The blending of conventional polymers has been extensively employed to develop new polymeric materials. Polymer blends have become a traditional method for producing new, high-performance polymeric materials. Mechanical, optical and electrical properties of polymer blends depend on their morphological characteristics [8]. They are produced in order to achieve improvements in properties such as thermal stability, mechanical properties or chemical resistance [9]. Many important polymer blends are incompatible polymers [4]. Due to its utility and simplicity, blending is currently a feasible method for improving polymer surface properties [10, 11]. Polymer blends and composites improve product performance by combining different polymers with specific properties in order to combine as one material.

1.2 Polymer Composites

Polymer matrix composite is a material with at least two phases, a continuous phase as polymer and a dispersed phase as filler or fiber. The continuous phase is responsible for filling the volume and transferring loads to the dispersed phase. The dispersed phase is responsible for enhancing one or more properties of the composite.

Polymer matrix composites, due to their outstanding mechanical properties, are widely used as special engineering materials in applications