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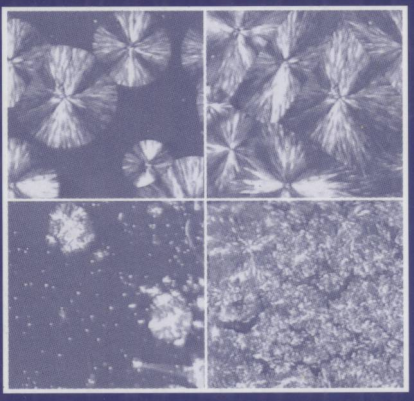

# Polymer nanocomposites

Edited by Yiu-Wing Mai and Zhong-Zhen Yu

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# Polymer nanocomposites

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# Preface

Polymer nanocomposites are commonly defined as the combination of a polymer matrix and additives that have at least one dimension in the nanometer range. The additives can be one-dimensional (examples include nanotubes and fibres), two-dimensional (which include layered minerals like clay), or three-dimensional (including spherical particles). Over the past decade, polymer nanocomposites have attracted considerable interests in both academia and industry, owing to their outstanding mechanical properties like elastic stiffness and strength with only a small amount of the nanoadditives. This is caused by the large surface area to volume ratio of nanoadditives when compared to the micro- and macro-additives. Other superior properties of polymer nanocomposites include barrier resistance, flame retardancy, scratch/wear resistance, as well as optical, magnetic and electrical properties.

This book covers both fundamental and applied research associated with polymer-based nanocomposites, and presents possible directions for further development of high performance nanocomposites. It has two main parts. Part I has 12 chapters which are entirely dedicated to those polymer nanocomposites containing layered silicates (clay) as an additive. Many thermoplastics, thermosets, and elastomers are included, such as polyamide (Chapter 1), polypropylene (Chapter 4), polystyrene (Chapter 5), poly(butylene terephthalate) (Chapter 9), poly(ethyl acrylate) (Chapter 6), epoxy resin (Chapter 2), biodegradable polymers (Chapter 3), water soluble polymers (Chapter 8), acrylate photopolymers (Chapter 7) and rubbers (Chapter 12). In addition to synthesis and structural characterisation of polymer/clay nanocomposites, their unique physical properties like flame retardancy (Chapter 10) and gas/liquid barrier (Chapter 11) properties are also discussed. Furthermore, the crystallisation behaviour of polymer/clay nanocomposites and the significance of chemical compatibility between a polymer and clay in affecting clay dispersion are also considered.

Part II of this book deals with the most recent developments of polymer nanocomposites with other nanoadditives such as carbon nanotubes, graphite, nanoparticles and other inorganic–organic hybrid systems and has eight

chapters. Carbon nanotubes, since their discovery in 1991, have attracted a great deal of attention because of their exceptional elastic modulus, bending strength, aspect ratio, electrical and thermal conductivity, chemical and thermal stability, and adsorbability. Chapters 13 and 14 are concerned with carbon nanotubes as a means of reinforcement. The former is concerned with the mechanical properties and long-term performance of carbon nanotube/epoxy composites; and the latter illustrates the fabrication and potential applications of nanocomposites fabricated by using carbon nanotubes as the fibre and carbon 60 crystals as the matrix. Three chapters are entirely devoted to functional polymer nanocomposites. The design and fabrication of polymer nanocomposites filled with functional nanoparticles for specific functional properties (Chapter 15), the synthesis and characterisation of magnetic polymer nanocomposites (Chapter 17), and the conducting polymer/graphite nanocomposites (Chapter 19) are discussed. The wear characteristics of polymer nanocomposites reinforced with different nanoparticles are studied in Chapter 20. The effect of different surface treatment techniques of nanoparticles on the wear behaviour is investigated. In addition, the latest progress on surface modification of $CaCO_3$ nanoparticles and their polymer nanocomposites in terms of toughening and reinforcement is given in Chapter 16. Phenolic resin/silica nanocomposites synthesised by sol-gel techniques are described in Chapter 18.

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