Preface

This book acknowledges that the key to success of modern structural components is tailored behaviour of materials. A relatively inexpensive way of obtaining macroscopically desired responses is to enhance base material properties by addition of micro or nanoscopic matter, i.e. to manipulate the macrostructures. Accordingly, in many modern engineering designs, materials with high complex microstructures are now in use.

The macroscopic characteristics of modified base materials are the aggressive change of an assemblage of different 'pure' components especially at nanoscale. A key challenge to nano-enhancement is dispersion methods for the development of polymeric nanocomposites, which is covered in "Dispersion Methods of Carbon Nanotubes for the Development of Polymeric Nanocomposites: Characterization and Application". Nanostructured materials have great potential as reinforcement materials in polymers (polymer matrix) when used to modify and improve their physical and mechanical properties. Examples of unique properties achievable today are covered on nanotubes/thermoplastic nanocomposites on nanotubes/thermoplastic nanocomposites (Thermoplastic Nanocomposites with Carbon Nanotubes) and thermal and mechanical properties of graphite-based nanocomposites (Graphite-based Nanocomposites to Enhance Mechanical Properties). With ease to manufacture in bulk, nanomaterials are finding increasingly more practical applications (e.g. in the manufacture of plastic auto-aero parts, structures, implants and ceramics to microelectronics). "Optimization and Scaling up of the Fabrication Process of Polymer Nanocomposites: Polyamide-6/Montmorillonite Case Study" therefore focuses on optimization and scaling up of the fabrication process of polymer nanocomposites.

Due to the molecular size of their reinforcement, polymer nanocomposites offer the possibility to develop new materials with unusual properties. These include photoactivity (Influences of Morphology and Doping on the Photoactivity of TiO_2 Nanostructures), foam-glass-crystal materials presented in "Foam-Glass-Crystal Materials" and high temperature polymer nanocomposites covered in "High Temperature Polymer Nanocomposites" is focused both on physical modification of traditional polymers as well as synthesis of new monomers from which new polymers are obtained with interesting new properties that can provide opportunities for novel applications. Impact and energy absorption performance (experiments, modelling and simulations) are presented in both "Energy

Absorption and Low-Velocity Impact Performance of Nanocomposites: Cones and Sandwich Structures" and "Predictions of Energy Absorption of Aligned Carbon Nanotube/Epoxy Composites". It is shown that nanotechnolgy and nanoscience indeed offers promising results and a unique level of mechanical properties enhancement and/or control by involving the use of nano-sized organic and inorganic particles. An important area of research on antibacterial applications is the central focus of "Silver Nanocluster/Silica Composite Coatings Obtained by Sputtering for Antibacterial Applications", Materials with antibacterial properties are more and more requested in several fields where the risk of microbial contamination is considered a relevant issue.

Foams play a key role in many technological applications. A huge amount of research was done in the last two decades to develop low-toxicity fire retardants on foams. The use of flame retardants to reduce the flammability of polymers and production of smoke or toxic products during their combustion is nowadays an important aspect of the research, development and application of new materials. As an example, "Recent Advances on the Utilization of Nanoclays and Organophosphorus Compounds in Polyurethane Foams for Increasing Flame Retardancy" looks into recent advances on the utilization of nanoclays and organophosphorus compounds in polyurethane foams for increasing flame retardancy. Finally, "Ecological Assessment of Nano Materials for the Production of Electrostatic/Electrochemical Energy Storage Systems" covers the ecological assessment of nanomaterials for the production of electrostatic/electrochemical energy storage systems. The ecological implications (regarding known environmental effects) of carbon-based nanomaterials are analysed using Life Cycle Assessment (LCA) approach.

This book covers important issues and topics that are attractive to the scientific community. It is a useful tool for scientists, academicians, research scholars, polymer engineers and industries as it is a unique set of valuable contributions from renowned experts. This book is also supportive for undergraduate and postgraduate students and hope fully an inspiration to many young scientists to devote their efforts in nanomaterials research.

The editor acknowledges the great effort put into this book by the contributing authors. He is very thankful to all the contributors and also to a great team at Springer for brilliant editorial support.

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