



NANOTECHNOLOGY IN TEXTILES

Advances and Developments in
Polymer Nanocomposites

edited by **Mangala Joshi**





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Preface

In recent times, polymer nanocomposites have attracted a great deal of scientific interest due to their unique properties over conventional plastic materials, such as superior strength, modulus, thermal stability, thermal and electrical conductivity, and gas barrier. They are thus finding real and fast-growing applications in wide-ranging sectors such as automotive, aerospace, electronics, packaging, and sports. This book focuses on the development of polymer nanocomposites as an advanced material for textile applications such as fibers, coatings, and nanofibers.

It compiles and details cutting-edge research in the science and engineering of nanotechnology in textiles with special reference to polymer nanocomposites in the form of invited chapters from research scientists and subject experts from various premier academic institutes all over the world. These academicians and scientists are actively involved in the research and development of polymer nanocomposites with a wide range of functionalities, such as antimicrobial, flame-retardant, gas barrier, shape memory, energy-scavenging, sensors, as well as medical applications, such as in tissue engineering and wound dressings, for creating a new range of smart and intelligent textiles. Like other industrial fields, nanotechnology has shown huge promise in developing high-performance multifunctional materials with prospects for application in the field of specialty fibers and technical textiles.

Although the origin of nanotechnology can be traced back to the fourth century, the first nano-based textiles were introduced only during the 1980s in the form of nanofiber-based membranes for filtration. Nano-Tex, a company founded in 1998 in California, is a pioneer for nanofinishing technology particularly made for fabrics. The first commercial Nano-Tex product was introduced in December

2000. Today, over a hundred fabric industries globally are using nanotechnology for enhanced fabric properties. Nanotreatments are everlasting and do not endanger the visual or automated characteristics of the fabric. During the past 40 years, sales of nanotextiles have expanded steadily and are currently experiencing very strong growth due to their increasing use in the fabrication of mass-market products in a range of sectors.

The book has been divided into three major parts: (I) Polymer Nanocomposite Fibers, (II) Polymer Nanocomposite Nanofibers, and (III) Polymer Nanocomposite Coatings. It covers the research and development in the field of nanotechnology in textiles, with special reference to polymer nanocomposite-based functional fibers, coatings, and nanofibers for use in technical textiles covering several areas of applications.

Part I covers the advances in the research and development of polymer nanocomposite fibers, including high-strength fibers based on nylon-clay nanocomposites, carbon nanomaterial and POSS-based nanocomposite fibers, and antimicrobial fibers based on nanomaterials. It also discusses the dyeability of nanocomposite fibers and silk-based bionanocomposites.

Part II focuses on polymer nanocomposite nanofibers and nanofibrous webs for a wide spectrum of applications, including gas sensing, filtration, biopolymer-based electrospun webs, drug delivery, tissue engineering, energy scavenging, renewable cellulose nanofibers, carbon nanofibers, and green electrospinning.

Part III reviews the developments in polymer nanocomposite coatings and their potential applications for a range of functional properties, such as gas barrier coatings, fire-retardant coatings, superhydrophobic and water-repellant nanocoatings, carbon nanomaterial-based conductive polymeric nanocomposite coatings for smart and intelligent textiles, coating textiles with antibacterial nanoparticles using the sonochemical technique, electromagnetic interference (EMI) shielding materials derived from polymeric nanocomposites, and shape memory polymer nanocomposite-based textiles.

The main strength of the book is its concept, design, content, and presentation. What sets it apart from other published titles in this area is its focus on the advances and developments of polymer

nanocomposites from a textile perspective. I strongly believe that it will be essential reading for scientists and engineers working in this domain and students taking advanced courses in the area of textile materials with high-performance properties for a varied range of technical applications.

I am highly indebted to all the authors for their invaluable contributions and excellent efforts. I would like to thank all of them for accepting my invitation and sparing their valuable time for adding value to this book. Special thanks to my colleagues and research students at the Indian Institute of Technology, Delhi, India, who have contributed to this book. Last but not the least, I acknowledge the support from the publishing team of Jenny Stanford Publishing, Singapore, including Stanford Chong, who invited me to write this book, Jenny Rompas, Sarabjeet Garcha, and Shambhu Mishra, for their great help in bringing this book to its final shape. Finally, I thank God for his inspiration and blessings and my family who constantly supported me in this endeavor.

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