ADAPTIVE AND FUNCTIONAL POLYMERS, TEXTILES AND THEIR APPLICATIONS

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Preface

As smart materials, adaptive polymers can show sharp, controllable and predictable changes as responses to the external stimuli and have attracted more and more interests in their properties, structures, innovative design and applications. Many technological breakthroughs have been achieved during the past several decades. As the demands in new functions and enhanced performance of industrial and consumer products, some functional polymers have also been extensively explored and shown tremendous application potential.

In order to provide a resource for people in different professions in searching for knowledge and applications in adaptive and versatile functional polymers, this book has covered their latest developments as well as their applications in textiles, medical and cosmetics fields. The concepts and adaptive mechanisms are introduced. Their characteristics through different application fields have been presented. The applications of adaptive polymers to textiles have been highlighted. One of the unique features of this book is its interdisciplinary in nature.

In Chapter 1, basic concepts are suggested and definitions of adaptive polymers and textiles are reviewed. Following that, the characteristics, structures and potential applications of adaptive polymers are summarised. In Chapter 2, shape memory polymers according to their molecular structures, trigger patterns and applications are introduced based on literature review. One of the novel functional shape memory polymers with substrate bonded antibacterial activity is detailed and a new design of supramolecular shape memory polymers is discussed. Finally, shape memory fibers are compared with other existing man-made fibers to clarify the uniqueness of such smart textile materials.

Adaptive polymeric gels are a class of smart materials and such hydrogels can respond to changes in different environment such as temperature and pH. It is an exciting feature of intelligent materials. Due to their hydrophilic and biocompatible nature, most of them are used as biomaterials in medical and cosmetics areas. In Chapter 3, we have detailed this type of adaptive polymeric materials.

Adaptive polymeric particles can be made in different forms. One of the major features, which affect their properties and applications, is their particle size. The structure of core-shell and microencapsulation has made the adaptive polymeric particles incomparable position. The new developments of synthesis and characterization techniques of adaptive polymers have provided various ways in textiles and cosmetics. Therefore, Chapter 4 has focused on the discussions of polymeric particles and their applications.

Some groundbreaking contributions to the advancement of adaptive polymers, particularly in relation to textiles, have been made in the Hong Kong Polytechnic University. Towards the goal, fundamental adaptive textiles researches were carried out and some related models have been developed. The novel applications are the issues of Chapter 5 in adaptive textiles.

Many advances of adaptive composites with adaptive polymers are made in the past several decades. As a newborn, adaptive polymeric composite has brought new applications in modern academics and industries. The research into the interrelationship of processing, structure, property and performance is now the essence of adaptive polymeric composites. We have detailed the progress in this area in Chapter 6.

In Chapter 7, fabrication of nanofibres and nanofilms by electrospinning and self-assembly methods are introduced. At the same time, the principles and parameters of electrospinning and self-assembly are discussed. The morphologies and structures of nanofibres and nanofibrous nonwovens are described briefly. A comprehensive understanding of adaptive nanofibres and nanofilms can be obtained in this chapter.

Many original developments of cosmetics are founded on the combination of materials, biomedical sciences and technologies. Adaptive polymeric materials would greatly promote their innovation of

cosmetics applications. The research efforts in adaptive polymers can improve the quality of life for beauty in a substantial trend. In our Chapter 8, we have detailed the above contents.

The technological advances of life sciences in the last decades significantly accelerated the medical research and developments. New horizons for the applications of adaptive and functional polymers in medical kingdom have been opened and more and more methods are developed to meet the practical requirements. Modern adaptive polymers and textiles are tailor-made to meet a wide variety of innovative applications including the biomimic and intelligent textiles. The medical applications of adaptive and functional polymers have been discussed and an outlook into the potential future developments is provided in Chapter 9.

The subsequent contents of the book focus on the four types of versatile functional polymers: dendrimers, hyperbranched polymers, chitosan and cyclodextrin. The major advancements in relative fields are detailed. Various application examples are presented. Their characteristics are highlighted and challenges to be addressed in the near future are pointed out.

The following are the major features of this book:

1. Focused on adaptive polymers. There are many smart and functional materials and adaptive systems, but we have mainly focused on adaptive polymers with some functional ones, which we have experience with and which we believe are important for new generations of materials and products.
2. Integrative in nature. The book has covered molecular design, synthesis, structure and properties, characterisation method and applications of adaptive polymers.
3. Cross-disciplinary teams' research work. Since the book needs to cover wide spectrum of contents from a vertical and horizontal points of view cross-disciplinary knowledge, understanding is very important. This is reflected in the book and is from our research work and team in the Shape Memory Textile Center in the Hong Kong Polytechnic University where we have more than 20 people in

the group every year with research expertise in polymer synthesis, physics, engineering and applications, biological and medical and cosmetics, textiles and apparel processing and evaluation.

4. Application oriented. Over the past ten years, we have been looking for materials for textile applications and once we started to research into Shape Memory Polymers, we have been working on different applications of adaptive polymers. Every week we have at least one meeting to review, brainstorm, design, discuss and develop different applications of adaptive materials and products. This application oriented research can benefit the readers with a good understanding of the potentials of these adaptive polymers.
5. Extensive partnership with different organizations, particularly companies. In the past ten years, we have been working with local and international companies (including market players P&G, TAL, etc.) to develop new materials and products. These cover textile, apparel and intimate products, medical devices, cosmetics, etc. In addition, because of our pioneering work, companies visited us and we visited over 200 including market players such as BASF, Clariant, Smith and Nephew. This experience has given us a very unique opportunity to penetrate into the market and understand the needs of industries. This is a very important driving force for us to explore adaptive polymers day and night for many years and this partially reflected in the book.
6. Long term and pioneering research in adaptive polymers, particularly shape memory polymers.

With the above features and contents, we believe that this book will be a valuable reference to many people in different professions and at different levels/stages of their research careers in companies, universities and research institutes.

Prof J. L. HU

The Hong Kong Polytechnic University

August 8, 2009

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