

Preface

There is no doubt that the progress of medicine could not be achieved without biomaterials research. The elucidation of biological defense mechanisms by molecular biology and cell biology has enhanced biomaterials research. This, however, does not mean that numerous artificial organs have been realized; even though, by all rights, more products should be clinically available.

Human tissues or organs in the body have complicated functions and are not easy to replace with conventional artificial materials. We should design and synthesize materials with better performance than ever before.

Biofunctional polymers have been extensively studied for more than 40 years. Many interesting research results have been obtained, but their clinical applications are limited, even though the concepts are superlative. Investigations on a wide range of biofunctional polymers are driven by a number of researchers. Some of these polymers are defined as materials that respond to chemical stimuli, such as the concentration of certain chemicals and pH change, and physical stimuli, such as heat (temperature change), magnetic field, light, and electric field. They are also classified as intelligent or smart materials. Needless to say, human beings are dynamic organisms. Stimuli-responsive materials with intelligence and drive are also dynamic. To achieve more sophisticated drug treatment, or to substitute biological functions, the use of smart materials is inevitable.

The development of polymer chemistry with precise control of the molecular chain has contributed to the development of smart materials. Precise polymerization is a very important technology in designing actual materials with higher functions, because, by utilizing a low-molecular-weight distribution, it is possible to further improve the performance of smart materials. Moreover, integration with nanotechnology is also essential.

In this book, how to design smart materials and how to apply them to biomedical fields are described by experts in these fields. In [Chap. 1](#), the significance of monomer design in preparing uniform functions is explained on the basis of simple polymer fundamentals. [Chapter 2](#) provides descriptions on the preparation and application of stimuli-responsive smart hydrogels, aiming at biomedical applications. Materials showing dynamic movement in response to internal or external stimuli are used as actuators, and their combination with nanotechnology can realize new diagnostic devices. In [Chap. 3](#), nanoassemblies and nanoparticles are described. They are key

materials in developing drug-targeting systems. Some passive drug-targeting systems based on enhanced permeation and retention effects are actually in clinical use. Smart nanoassemblies are promising for more efficient drug targeting. [Chapter 4](#) deals with smart surfaces. It is one of the outstanding examples of a flat solid or particle surface modified to control the interaction of biomolecules for chromatographic separation. In [Chap. 5](#), nanofibers with smart properties are described. Their biomedical applications are currently few, but they will surely be expanded through combination with other materials, such as nanoparticles, or surface modification. [Chapter 6](#) presents smart bioconjugates. Precise polymerization techniques contribute to the preparation of the precursor, and the resulting bioconjugates are very useful in diagnosis. Some of them will be applied to the prevention of severe infections in developing countries. Finally, in [Chap. 7](#), shape-memory materials are described. There is much research on the dynamic movement of polymeric shape-memory materials. This chapter also deals with surface shape-memory materials that will be of concern in mechanobiology.

This volume is sure to benefit materials researchers and developers, and we feel that it will serve as an invaluable textbook for anyone interested in smart biomaterials.

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Smart Biomaterials

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