

<<生物材料>>

图书基本信息

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内容概要

本书全面介绍了纳米生物材料的基本概念、多种过程方法、表征方法及其潜在的应用。首先介绍了生物材料的发展概况、人体生物学基础，然后介绍了生物材料的代谢与腐蚀，讨论了多种生物材料，如金属生物材料、陶瓷生物材料、聚合物生物材料、多功能生物材料等，最后介绍了组织工程纳米生物材料。

本书适合生物工程、材料、医学工程等相关专业的学生、研究人员及科技人员、管理人员阅读。

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章节摘录

1 Overview of Biomaterials

1.1 Introduction

Human life is invaluable; however, quality and survival of life is greatly affected by numerous factors, including medical complications caused by diseased, damaged, or aged tissues or organs. These circumstances often call for surgical treatments to repair, replace, maintain, or augment the functions of affected tissues or organs using some additional functional components. Traditionally, they have been treated with the help of tissues or organs procured from patients or donors. Depending on the location of reimplantation of the procured tissue (also known as graft), they are termed autograft, allograft, or xenograft (see Figure 1.1). If the graft is implanted in the same patient, it is termed autograft and if it is placed in another individual of the same species, it is termed allograft. If the graft is placed in another species (e.g., bone from animal to human), then it is termed xenograft. Among them, autograft is considered the gold standard and has been used for a long time with good clinical results, but the supply of autograft is limited. In addition, allograft and xenograft are not much preferred because of the possibility of pathogen transfer and graft rejection. Furthermore, tissue/organ procurement is complex, expensive, and requires additional surgery. As an alternative, attention has been focused on the use of synthetic material that holds the ability to repair or restore the functions of a defective system into a normal healthy system upon implantation, which is termed alloplastic graft. The synthetic material used for this purpose is called biomaterial. The biomaterial is used either as such or to manufacture implantable devices or prostheses; some of them are illustrated in Figure 1.2. Currently, there are many definitions for the term “biomaterial,” depending on the user’s own verdict. Biomaterial by definition is a substance or a combination of substances, other than drugs, derived either from natural or synthetic origin, which can be used for any period of time as a whole or as a part of the system that treats, augments, or replaces any tissue, organ, or function of the body (Williams 1987). Later, Black (1992) defined the term biomaterial as a material of natural or manmade origin that is used to direct, supplement, or replace the functions of living tissues of the human body. A biomaterial is delineated, according to authors’ own description, as any material that is used for repairing or restoring the functionality of a defective biological system into a normal healthy system. The field “biomaterials science and engineering” is a multidisciplinary theme that essentially coalesces materials science and engineering with biomedical sciences for the invention of new health-care systems. Since it is a multidisciplinary field, many experts, in particular materials scientists and engineers, mechanical engineers, physicists, chemists, biologists, and clinicians must work together for its continuous development. It has also witnessed stable growth over about half a century of existence with the major contribution from these experts. However, further research and development is directed at the design and fabrication of novel biomaterials that hold the features and properties analogous to natural tissues or organs. In the following section, some imperative successes that have come in the biomaterials field are provided.

1.2 Biomaterials: From Then to Now

The use of biomaterials to repair human body parts is not new, dating far back into ancient civilizations. The Egyptians used linen as a suture for wound closure in around 2000 BC. They also used elephant’s tusks, walrus teeth, and some kinds of wood to replace bone or missing teeth (Williams and Cunningham 1979). Substitution of bone parts in the human body was also carried out at that time using copper, but the implant was not successful due to the effect of copper ion poisoning. As per historical evidence, the Indians and the Chinese used waxes, glues, and tissues in reconstructing defective parts of the human body. It was stated in the Vedic period (1800?1500 BC) of the ancient Indian literature that artificial legs, eyes, and teeth were used. In those days, Hindu surgeons performed surgery using autogeneous tissues for restoring missing parts. Around 600 BC, Sushruta repaired an injured nose with a patch of living flesh taken from the region of the cheek (Bhat 2002). Around 200 BC, the Greek literature pointed out the use of metals (e.g., gold). Hippocrates, who is known as the father of medicine, alleged that metallic wires made of gold might have been used for the treatment of bone fractures at that time. In the seventeenth century, iron and bronze were employed in human systems, but they are more corrosive than gold. Some of the major developments that have occurred in biomaterials are summarized in Table 1.1 (Park 1984, 2003; Sportnitz 1987; Friedman 1994; Greco 2005; Murugan 2005a, 2005b). The first reported clinical application of biomaterials was carried out in the mid-eighteenth century.

In 1759, Hallowell united the edges of a lacerated brachial artery using a wooden peg and twisted thread (Wesolowski 1963). The use of biomaterials has progressed much since his initial contribution. By the mid-nineteenth century, Mathijsen introduced a notable material called lint-reinforced plaster as a bandage in the treatment of bone fractures. In those days, however, infection was the most common problem of the materials that were implanted in the human body. Due to the threat of infection, clinical application of biomaterials was not very successful. In the 1860s, Lister introduced aseptic techniques, which made some significant changes in the surgical implant procedures and paved the way to realize the potential of biomaterials. In 1860, catgut was one of the first naturally occurring materials used as a suture for wound closure. In 1880, Gluck used ivory clamps and, in 1889, Jassinowsky used silk on fine curved needles to repair vessels. In this period, Lane introduced metallic implants for orthopedics. The twentieth century was a milestone in the field of biomaterials because most of the currently used biomaterials and surgical implants were developed in this period. The practice of using metals and alloys to repair or replace human body parts was well established at that time. The first metallic bone plate made of vanadium steel was introduced in 1912 by Sherman, but it was not very successful because of mechanical failure, corrosion, and poor biocompatibility. Since this initiation, many metallic implants have been introduced into the surgical field. Bone plates are surgical tools that are used to assist in the healing of broken and fractured bones. It is worth pointing out that bone plates are designed essentially to be very strong and absorb the large stress forces generated when the bone moves. On the other hand, corrosion is also a significant concern that typically leads to the disintegration of

Source: Adapted from Park, J. B., *Biomaterials science and engineering*, Plenum Press, New York, 1984; Spotnitz, H. M., *Handbook of biochemistry*, McGraw-Hill, New York, 1987; Park, J. B. and Bronzino, J. D., *Biomaterials principles and applications*, CRC Press, Boca Raton, FL, 2003; Friedman, D. W., Orland, P. J., and Greco, R. S., *Implantation biology*, CRC Press, Boca Raton, FL, 1994; Bhat, S. V., *Biomaterials*, Alpha Science International, Pangbourne, 2002; Greco, R. S., Prinz, F. B., and Smith, R. L. *Nanoscale technology in biological systems*, CRC Press, Boca Raton, FL, 2005; Murugan, R. and S. Ramakrishna, *Handbook of nanostructured biomaterials and their applications in Nanobiotechnology*, American Scientific Publishers, Stevenson Ranch, CA, 2005a; Murugan, R. and S. Ramakrishna, *Comp. Sci. Tech.*, 65, 2385, 2005b.

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编辑推荐

主要特点 全面讲解生物材料历史、现在和未来发展趋势，涵盖纳米生物材料及其潜在应用。写作方式通俗易懂，图文并茂，包含最新数据的图表。

用纳米生物材料的概念整合材料科学与工程、纳米技术、生物工程和生物科学。

适合生物材料、化学化工、组织工程等领域的师生、科研人员阅读参考。

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