Biomaterials Engineering and Processing Series – Vol. 1

Engineering Materials for Biomedical Applications

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FOREWORD

This new text on *Engineering Materials for Biomedical Applications*, edited by Prof. Swee Hin Teoh, will be an especially useful reference book for those working with metals and ceramics for hard tissue applications. After a general introductory chapter, the emphasis of most of the remaining chapters is on the compositions, processing techniques, and physical properties of the metallic and ceramic biomaterials and their composites that are commonly used in orthopedic and dental implants. Metal and ceramic processing techniques are not often covered well in other texts, so this will be a valuable contribution of this book. There is detailed coverage of corrosion and surface treatments of metals in two chapters, another chapter on polymer-ceramic composites, and a special chapter on prosthetic appliances for the disabled — an important application area that is also often overlooked in other biomaterials texts. And to “add icing to this rich cake”, there are additional chapters on polymeric hydrogels — an important class of synthetic polymers, and chitin — one of the most abundant natural polymers that has great potential in the biomaterials field. This text should provide a valuable addition to the library of the biomaterials scientist and engineer.

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The success of any implant or medical device depends very much on the biomaterial used. Synthetic materials (such as metals, polymers, ceramics, and composites) have made significant contributions to many established medical devices. The aim of this publication, Volume 1: Engineering biomaterials for medical applications, is to provide a basic understanding on the engineering and processing aspects of biomaterials used in medical applications. Of paramount importance is the tripartite relationship between material properties, processing methods, and design. As the target audiences cover a wide interdisciplinary field of professions ranging from engineers, scientists, clinicians, and technologists to graduate students, the content of each chapter is written with a detailed background so that audience of another discipline will be able to understand. For the more knowledgeable reader, a detailed list of references is included.

Chapter 1 gives a broad overview of biomaterials engineering and processing. Here the requirements of biomaterials and the effects such as grain size, composite layering, molding conditions on mechanical properties are discussed. It also endeavors to give a foretaste of the new emerging field of tissue engineering and the challenges ahead.

Chapter 2 deals with the durability of common metallic implant materials such as stainless steel and titanium. The host-tissue response to metallic debris, the effect of micro motion that leads to fretting fatigue, and the forecast of metallic biomaterials for the future are discussed here.

The main disadvantage of metallic implant materials is that they corrode. This is an important topic which many students without chemistry background will have difficulty in understanding. Chapter 3 therefore deals with the fundamentals of metallic corrosion, giving the audience a strong basic understanding on the thermodynamics and kinetics aspects of corrosion. The case examples cited will be useful to help the audience appreciate how these principles are applied.

Chapter 4 talks about an important aspect in surface modification of metallic implants: it attempts to describe the interactions of cells and proteins on metallic surfaces. This is an interesting chapter which helps the reader to develop a greater appreciation of the basic science of surface chemistry and the adhesion mechanics of cells and proteins.

Chapter 5 gives a good application chapter on dental restorative biomaterials and the technology advancements in this field. Here one can see how ceramics, metals, and polymers have all been used in the early trials of biomaterials.
Chapter 6 introduces a significant topic — bioceramics, which has been a subject of intense research in the biomaterials field. Not only the inert but also the bioresorbable types are important nowadays.

Chapter 7 describes the polymeric hydrogels which have now earned a place in many useful applications — ranging from contact lenses to control of drug release devices. The structure of polymers is an important topic, especially in the quest to engineer and use polymers as biomaterials.

Chapters 8 and 9 are on composites: the former on polymer-bioceramic composites especially the Hapex material, while the latter describes the textile composite which has found some useful applications such as in vascular grafts.

Chapter 10 may seem out of place. But with the latest prosthetic materials and the new technologies that have gone into this traditional field, this chapter sheds new light into what materials engineers have accomplished in the field of prosthetics: lightweight and intelligent lower limb prostheses. The use of computers has indeed revolutionized the way we design materials.

The last chapter, Chapter 11, describes a natural biomaterial — chitin. Chitin is fast becoming a useful material not only in wound dressings, but also in tissue engineering’s scaffolds because of its special cell mediation properties.

It is hoped that all the 11 chapters written by many distinguished experts will provide a good start to better understanding in engineering materials for biomedical applications.

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