

Preface

The application of materials science to medicine (so-called ‘biomaterials science’) is a subject of growing importance at the start of the 21st century. Over the last forty years or so, numerous artificial materials (metals, ceramics and polymers) have been used, often in the form of implantable devices, to repair a variety of diseased or traumatised parts of the body. Applications range from orthopaedics (hips, knees, fingers), craniofacial reconstruction, cardiovascular surgery (heart valves, stents, vascular implants), ophthalmic surgery, dentistry and so on.

Somehow, though, implants have not made the same impact on the public mind as transplants, yet the latter suffer from several serious problems. These include the need for extremely high levels of surgical skill, a ready supply of donor organs, and the necessity for constant medication for the patient in order to prevent post-operative rejection of the transplanted organ. By contrast, implants are less demanding of surgical skill, and they require neither a ready supply of donors nor life-long medication for their recipients. Despite their relative neglect by the public, these advantages mean that implants have made a major impact on the health of millions of patients throughout the world. Moreover, with an ageing population, the need for new and improved implantable materials continues to increase.

The development of implants and devices is a multidisciplinary subject, drawing for its success on contributions from *inter alia* engineering, materials science, cell biology and surgery. However, the major emphasis of this book is on the chemistry of these materials, and the book is written from the perspective that chemistry has a significant contribution to make to the subject. Chemistry is important because it tells us about the composition of the materials, the nature of their surface behaviour, their potential for degradation *in vivo* and so on, and all of these aspects impinge on the durability and useful service life of the material or device. There is also the fact that we have a growing understanding of biology at the molecular level – the level at which biology shades into chemistry – so that an understanding of chemistry actually underpins all that we know about the biological interactions of synthetic materials. These include the deposition of proteins on their surfaces, the sequential displacement of these proteins, and later the adhesion of cells to the materials and the biochemistry of their continued viability.

This book is divided into seven chapters. The first deals with the various end uses of implants and devices, and shows how the use of these materials has permeated various branches of surgery. Chapters 2 to 4 deal with the materials used under the conventional divisions respectively of polymers, ceramics and metals. Chapter 5 covers dental materials, and these are dealt with separately for two reasons. Firstly, they are often elaborate hybrids, and cannot easily be classified into one of the major materials groups. Secondly, this is an especially vibrant part of the subject, and many materials have begun life in a dental application, and then found uses in parts of the body well removed from the mouth. Chapter 6 deals with the variety of biological responses, and also safety testing, a critical part of the subject. Finally, the important subject of tissue engineering is touched on briefly in Chapter 7. This is a very large topic and one that includes, but extends beyond, the use of artificial materials in intimate contact with cells, and employed for long-term repair of some part of the body.

Writing a book of this sort, with over 1000 references, is a form of madness. It has, though, also been a labour of love, and certainly made easier by some significant help I have received. Most notably, I was assisted at the planning stage by my friend and former colleague Dr Mary Anstice, now of 3M-ESPE. Circumstances prevented her from continuing as co-author, but I must thank her for her input to shaping the book. I know it would have been a better book had she been able to help write it.

I also want to acknowledge the support of my wife Suzette. No major work I have ever undertaken, beginning with my PhD thesis and extending through all my books, including this one, would have been possible without her patience and forbearance. Once again, I thank her for all her practical help and kindness over the considerable time that I have been engaged in writing this book.

Dr John Nicholson
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