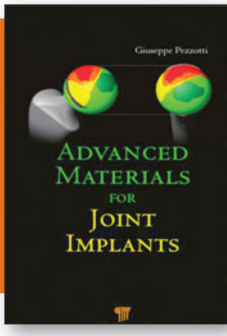


Advanced materials for joint implants

Giuseppe Pezzotti

Pan Stanford Publishing, 2013
604 pages, $179.95
ISBN 9789814316880

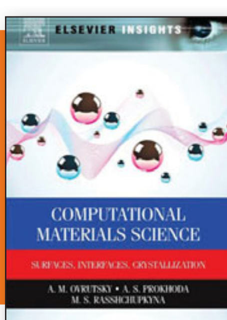
The performance of joint implants is determined by the interplay among designs, materials, manufacturing processes, and the way patients use them. This is similar for many implantable medical devices. Because of the statistical nature of manufacturing processes and human use conditions, the product performance is a statistical function of not only the relevant parameters and their interactions, but also the variations that those parameters can have under the normal processing and use conditions. It has been a goal of many scientists to develop a transfer function to predict the product performance from the properties of materials. Pezzotti's book represents this effort.

This book begins with a review of joint implants and the common failure modes of each material used in the joints. An introduction to some analytical and characterization methods such as atomic force microscopy, Raman and infrared spectroscopy, cathodoluminescence spectroscopy, and tribology assessments is presented. Detailed descriptions of individual materials are provided next.

Alumina is best for load bearing and wear resistance. The weakness of this material is its brittleness, which is discussed in terms of pores, grain size, and inclusions. Methods to overcome this weakness such as using additives and hydraulic compression are presented. Zirconia has been used successfully for implants, but the phase transition from the tetragonal to monoclinic polymorph has been a problem. The book discusses the methods and mechanisms to inhibit this transition, such as the addition of yttrium oxide. Compounding alumina with zirconia is presented. The use of gamma irradiation to improve the current ultrahigh-molecular-weight polyethylene (UHMWPE) is also detailed. Different methods for treating gamma-irradiated UHMWPE parts for reducing free radicals and therefore improving wear resistance are discussed using products available in market as examples. In addition, using additives such as vitamin E and antioxidants for reducing radiation-induced free-radical oxidation of UHMWPE is described. A free-radical depth profile and correlation with wear properties are presented using Raman spectroscopy and wear test data. In the last chapter, new materials, designs, and testing methods are discussed as future technologies.

Overall, this is a good reference of joint implant research. Extensive literature papers have been cited, though a number of them are by the author. An area of improvement can be to include other important research topics and tools. for example, use of electron spin resonance to monitor free-radical oxidation of UHMWPE.

***Reviewer: SuPing Lyu** is a Principal Researcher at Medtronic Inc., Mounds View, Minn., USA.*



Computational materials science: Surfaces, interfaces, crystallization

A.M. Ovrutsky, A.S. Prokhoda, and M.S. Rasshchupkyna

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388 pages, $125.00
ISBN 9780124202078

This book is an excellent summary of principles of computational modeling of physical phenomena in materials science, especially in surfaces, interfaces, and crystallization. Modern technology development allows people to simulate highly complicated systems with lots of variables and nonlinearities associated with design, synthesis, processing, characterization, and utilization. The field is very broad to include everything in one book, thus this book is specifically focused on establishing kinematics and dynamics models at a molecular level, which should attract a large number of readers who specialize in such fields, for providing appropriate guidance for their studies and research.

The book comprises nine chapters. Chapter 1 is an overview of the scope of computational modeling and the two simulation methods: Monte Carlo and molecular dynamics. The mathematical algorithms, boundary conditions, and their applications are introduced. This chapter clearly defines how to apply each model to different applications. Chapter 2 summarizes high-level thermodynamics of one-component and multicomponent systems, including phase transformation, solution, crystallization, and a little bit of interfacial tension. This chapter contains most equations necessary for solving thermodynamics problems, but the chapter title, "Basic Concepts of Theory of Phase Transformations," is slightly narrower than the content it covers. Chapter

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