

# **Advanced Structured Materials**

Volume 53

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Editor

# Biocompatible Glasses

From Bone Regeneration  
to Cancer Treatment

 Springer

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*To my parents, Flavia and Alvaro  
(in memoriam) for being my life example;  
to my husband Cleidson due to his  
complicity; to my brother Sergio due to our  
conversations that always enrich my scientific  
productions; and to my sons Beatriz and  
Gabriel.*

# Foreword

Bioglasses are an intriguing and challenging class of biomaterials, which present important technological application, involving health and life.

The results of the elaboration of this book, which involve historic concepts, evolution and knowledge consolidation, and directions for the future of the developed glass materials and its application as a biomaterial, are a precious contribution not only for researchers, but for students that intent to start or are developing their studies as well as for professionals from correlated areas.

The contribution of authors from different places of the world, allowed the covering of current issues presented in 13 consistent chapters, which allow the general comprehension of each explained subject and encourage the continuing to learn more about the development and application of these always innovative materials.

At the end of this book, we are certain that this is an important work and a great gift to all material science community.

Frank Ferrer Sene  
José Roberto Martinelli (in memorian)  
Materials Science and Technology Center,  
Energy and Nuclear Research Institute,  
São Paulo, Brazil

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To Dr. José Roberto Martinelli (in memoriam) for sharing an incredible desire of working with biocompatible glasses, and appreciating distinct applications of these materials that will make difference in life quality of many people in a near future. I hope to give you some flavors of these huge knowledges along these chapters.

To my research group (counting those who do not work direct with biocompatible glasses) including undergraduate and graduate students, as well as all my professional colleagues; In special, Roger Borges for the operational support and for being always available to help me when required.

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## Editor's Notes

The aim of this book is to provide an in-depth understanding about the main technological breakthroughs in biocompatible glasses and their applications. Recently, thanks to the scientific progress in biology, materials science, and computational simulation, it has been observed significant evolution in the knowledge concerning glass structure, mechanism of reactions, and biological response of biocompatible glasses.

This book was didactically organized; therefore, even a layperson will easily be introduced to the fascinating biocompatible glasses world, since the basic concepts are shown over the initial chapters, being followed by more advanced topics.

The first two chapters refer to the history of biomaterials focused on bioactive glasses. Concepts regarding tissue engineering, tissue regeneration, and bioactivity are explored as from the advent of bioactive glasses. The history of these materials is presented taking into consideration not only the most common compositions, but also those recently developed. These two chapters offer the basic concepts needed to understand very specific and advanced issues in the field of biocompatible glasses. On third, fourth, and fifth chapters, it is established a relationship between concepts of chemical composition and structure of bioactive glasses and their bioactivity properties, including both experimental and theoretical approach. In addition, on the sixth chapter, it is given a deep description about preparation and properties of the different forms of bioactive glasses, in which suggestive applications related to microstructure are addressed. From Chapters “[45S5 Bioglass Based Scaffolds for Skeletal Repair](#)” to “[Glasses for Treatment of Liver Cancer by Radioembolization](#)”, these applications are discussed from bone regeneration (Chapter “[45S5 Bioglass Based Scaffolds for Skeletal Repair](#)”) to cancer treatment (Chapter “[Biocompatible Glasses for Cancer Treatment](#)”). Chapter “[Glasses for Treatment of Liver Cancer by Radioembolization](#)” highlights the usage of biocompatible glasses for cancer treatment by radioembolization due to the importance of this issue in the field of glasses. Many of these applications have used glasses as biomaterial, however, these glasses have compositions that exceed the usual ones of bioactive glasses. These specific glasses are reviewed on Chapters “[Vitreous Materials for Dental Restoration and Reconstruction](#)” and “[Glasses for Treatment of](#)

Liver Cancer by Radioembolization.” Chapter “[Biocompatible Glasses for Controlled Release Technology](#)” shows how bioactive glasses can be used as technologies for controlled release such as drug delivery systems. This chapter also shows how these glasses can be used to improve the aforementioned applications. Finally, on Chapter “[Future Applications of Bioglass](#)” future perspectives and applications of biocompatible glasses are addressed.

The usage of glass materials for biomedical applications goes beyond the use of common bioactive glasses, such as the Bioglass 45S5<sup>®</sup>. Other glasses like borate and phosphate have been explored, as well as those doped with therapeutic ions. Then, this book have authors who use the term bioglass, bioactive glass and biocompatible glasses as synonym. Particularly, in Chapters “[45S5 Bioglass Based Scaffolds for Skeletal Repair](#)” and “[Vitreous Materials for Dental Restoration and Reconstruction](#),” bioglass is generically used for glasses made of quaternary, ternary or binary systems similar to Bioglass 45S5<sup>®</sup>. On Chapters “[Biocompatible Glasses for Cancer Treatment](#)” and “[Biocompatible Glasses for Controlled Release Technology](#),” the authors used the term biocompatible glasses, which is a more comprehensive term including not only silicate glasses like bioactive glasses, but phosphate and borate glasses which also show bioactivity and biocompatibility properties. On Chapters “[Bioactive Materials: Definitions and Application in Tissue Engineering and Regeneration Therapy](#),” “[Structure and Percolation of Bioglasses](#),” “[Bioactive Glasses: Advancing From Micro to Nano and Its Potential Application](#)” and “[Future Applications of Bioglass](#)” the term bioactive glass is used as synonym of bioglass. On the other hand, on Chapters “[An Introduction and History of the Bioactive Glasses](#),” “[The Evolution, Control, and Effects of the Compositions of Bioactive Glasses on their Properties and Applications](#),” “[What Can We Learn From Atomistic Simulations of Bioactive Glasses?](#)” and “[Special Applications of Bioactive Glasses in Otology and Ophthalmology](#),” the term bioactive glass is used as synonym of biocompatible glass. These terms are exchangeable because bioactivity is synonym of biocompatibility, and both terms are strongly related one to each other along bioactive materials history.

In conclusion, it is expected that the reader can have the knowledge needed to understand biocompatible glasses under a critical point of view, and be able to use this expertise to conduct its own scientific research in this field, contributing to the scientific community by developing materials for new applications not yet covered in this book.

Enjoy it!

Santo André, Brazil

Juliana Marchi