Foreword

The year 2017 marks the 50th anniversary of the so-called "hypothesis of bioactive glass." Before 1967, the concept of a material that could form a direct bond with living tissues seemed impossible. The foundations of this revolutionary discovery are to be found within a friendly conversation between Prof. Larry Hench and a US Army colonel who have just returned from the Vietnam War in the summer of 1967. The topic of the talk was the rejection of polymeric and metallic implants in amputated soldiers, as these materials were surrounded by a capsule of fibrous tissue and were not biointegrated within the host tissues of the body. After listening to the recent studies on gamma-rays applied to vanadium-phosphate semiconductors, the colonel asked a question that changed Hench's life and posed the basis of regenerative medicine: "If you can make a material that will survive exposure to high energy radiation, can you make a material that will survive exposure to human body?" After being fascinated by this issue, Hench submitted a research proposal to the US Army and eventually, in 1969, the era of bioactive glasses officially began.

Hench's glass, marketed under the trade name 45S5 Bioglass, was the first material that was able to bond to the bone forming a tight interface. Many other silicate, borate and phosphate glasses, and glass-ceramic compositions have been developed over the years, which have controllable degradation rates, so that the implant dissolution can be closely matched to the rate of new bone formation. Bioactive glasses can be doped with trace quantities of metal elements that, once released, are known to be beneficial for the regeneration of healthy bones or to elicit a therapeutic effect in situ, such as antimicrobial properties.

Recent advances in bioactive glass processing have led to the creation of surface coatings, 3D porous scaffolds, fibrous constructs, and injectable cements with a range of mechanical and functional properties suitable for the repair of load-bearing and nonload bearing bones. Furthermore, emerging applications of bioactive glasses in contact with soft tissues are increasingly attracting the interest of researchers. Recent work has shown the ability of bioactive glasses to promote angiogenesis, which is a key requirement for promoting the healing of injuries in both hard and soft tissues. The development of glass-based composites and hierarchical biomaterials allows the incorporation and controlled delivery of therapeutic biomolecules, which are key for treating a number of diseases like chronic infections and malignant tumors.

New, continuous advances in bioactive glass processing technologies and novel applications of biomedical glasses in tissue engineering and advanced therapies are bringing further honor to the long history of glass in medicine and open unexpected scenarios for patients' treatment and rehabilitation.

This book, edited by Dr. Gurbinder Kaur, is a tribute to the cherished memory of Prof. Larry Hench and provides an overview of the most recent advances in bioactive glass design, processing, and applications. The emphasis on key topics such as nanotechnology (mesoporous glasses, hierarchical materials, and nanostructured coatings), injectable (cements) and multifunctional implants (local therapy via drug and ion release), tissue engineering (scaffolds, angiogenesis), and targeted therapies (cancer treatment) make this book a valuable resource for today's scientists, who are building novel high added-value research on to Prof. Hench's legacy.

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