Preface

In recognition of the recent formation of the Bioceramics division by the American Ceramic Society, this special issue on bioceramics has been developed to highlight the recent advances and technological challenges in the field. These issues are important to ceramics researchers in academia, small and medium-sized enterprises, large companies, in addition to clinicians in medicine and dentistry.

The special issue describes cutting edge research from around the globe, across the length scales and chemistries of bioceramics; from nanoporous nanospheres that can deliver active ions inside cells through antimicrobial glasses, advanced composites and 3D printed scaffolds to dental cements and glass seals.

Bioceramic science is an interdisciplinary research field of great societal relevance. A variety of bioceramics have been commercialized for use as medical implants; nearly inert ceramics including aluminum oxide, partially stabilized zirconium oxide and leucite glass-ceramics, and bioactive ceramics such as bioactive glass, calcium phosphates, synthetic hydroxyapatite (HA) and their composites. All these medical devices needed an understanding of how the material interacts with the biological environment, in terms of their mechanical properties, degradation/corrosion rate and cell/material interactions over their intended lifetime. Potential systemic effects away from the implant site also need to be considered, especially for biodegradable materials or injectable nanomaterials.

Alumina and zirconia have long been prized for their low wear rates and coefficient of friction values, ideal for bearing surfaces in joint replacements. However, nearly inert materials can be encapsulated by fibrous tissue, so for bone reconstruction, bioactive ceramics and glasses are used as maxillofacial implants and orthopedic implants, due to their ability to form bonds to bone. Calcium phosphate coatings continue to find wider clinical adoption, particularly in bioactive fixation of metal orthopedic prostheses and dental implants. Considerable efforts are underway to incorporate drugs within bioceramic implants to enhance their biological functionality. Some bioactive ceramics can also deliver a therapeutic effect through their biodegradation via the delivery of ions that can cause a specific cellular response, from promoting bone growth through stimulating blood vessel formation to killing bacteria or cancer cells without harming other cells.

The future of bioceramics will involve ever closer matching between the bioceramic implant and the biomechanical and biological characteristics of the surrounding host tissue. A key challenge for innovation in this field of research is the manufacturing of affordable bioceramic and composite for dentistry, orthopedics, and drug delivery. For example, smart biomaterials are being developed, which respond to the body's stimuli by localized drug release, pH changes, or other responses.

A major bottleneck in the entire process is the regulatory framework that must approve individual bioceramics before the commercialization of medical and dental products in many nations. Enhancing the policies of national regulatory bodies and developing translational research programs with strong involvement of clinicians and industrial researchers will enable the discovery and deployment of new bioceramic implants.

It is the Guest Editors' vision that this special issue would not only encourage young researchers to be passionate about understanding the current challenges in the bioceramics field, but also inspire them to form strong collaborations for adaptive problem solving in order to facilitate further innovations. We wish to acknowledge the support of the journal's Managing Editor, Jonathon Foreman, and editor-in-chief, Bill Fahrenholtz, whose enthusiasm and unbroken support have allowed us to bring you

this issue. Most of all, we also would like to express our deep appreciation to the many authors who chose to submit their exciting work to this issue.

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Acknowledgments: One of the Guest Editors, Bikramjit Basu, acknowledges the support received from the Scheme for Promotion of Academic and Research Collaboration (SPARC) of the Government of India.