

Guest editorial: Chemical and bio-ceramics

There have been tremendous advances in the area of “Chemical and Bio-Ceramics” over the past two decades, primarily to meet the demanding needs for industrial innovations and societal welfare. Recognizing this, we originally proposed to compile the latest development in this area into a book, and Kluwer Academic Publishers accepted the idea based on a peer review process. Later, Gregory Franklin, Senior Editor of Kluwer, approached us to consider publishing the book chapters as overview papers in a special issue of the *Journal of Materials Science*. His main rationale for the suggestion was that it would reach a much wider audience. For example, these papers will be available online to over 1100 institutions having access to the *Journal*. The papers will also be added to *CrossRef*, which is creating a protocol that allows publishers to create links to references of over 4,700 journals. We viewed this offer as a unique opportunity and upon consultation with all the contributing authors, we decided to publish this collection of overview articles in a special issue of the *Journal*.

We are happy to bring to the reader this collection of five overview papers from a distinguished group of international authors. The authors were invited based on their extensive contribution and established reputation in the area. The papers cover a range of topics, presenting a comprehensive overview of emerging areas in “Chemical and Bio-Ceramics.” The papers are written as overview articles connecting the fundamentals to device fabrication and performance, and highlights of recent advances. The topics are written by experts and presented at a level that can be easily comprehended by students and researchers interested in venturing into these areas.

The first two articles by Park and Akbar focus on chemically active ceramics used in chemical sensing, an area showing tremendous growth in recent years. The application of chemical sensors has resulted in many benefits including improved energy efficiency in combustion and chemical processes with reduced emissions. Chemical sensors are also being applied in domestic appliances and air quality monitoring. Lately, chemical sensors are attracting attention in applications such as early detection of smoke/fire as well as hazardous chemical agents to provide safety and security in public places and mass transportation systems.

Resistive/semiconductive type sensors, based on ceramic oxides, are particularly attractive because of their low cost, wide range of applications and potential for use in electronic nose. The first article focuses on the surface conductive ceramic oxide type gas sensors with an emphasis on the basic principles involving gas-solid reactions. Also discussed are selected applications with an emphasis on sensor design issues. While the semiconductive sensors suffer from lack of selectivity, the electrochemical method involving solid electrolytes has been known as a selective way of sensing chemical species in the environment and even in liquid metal. The second article presents an overview of basic principles of various types of electrochemical sensors, highlighting recent advances in oxygen (O₂), carbon dioxide (CO₂) and hydrogen (H₂) sensors.

The third article by Keane also falls within the category of chemically active ceramics and deals with an application that is growing in importance, i.e., as catalytic material. Heterogeneous catalysis and ceramics overlap in terms of solid state inorganic chemistry, but the development of ceramic materials as effective catalyst supports and catalytic agents has meant a closer synergy in terms of research and development. The latter has focused on a tuning of the chemical reactivity of the oxide surfaces to modify the interaction with adsorbed reacting species. The article starts with an introduction to the fundamental principles of heterogeneous catalysis. The author then chooses three important case studies to illustrate the role of ceramic materials in practical heterogeneous catalysis: catalysis using zeolites, catalytic converters and solid oxide fuel cells.

The fourth article by Verweij deals with the emerging area of ceramic membranes with wide ranging applications such as energy/environment-related in H₂, CO₂ and O₂ separation, H₂O pervaporation, hydrocarbon separation/partial oxidation and water purification. Thin membrane films can be applied on porous supports by particulate, wet-chemical or vapor phase deposition techniques. This article focuses on two important issues in supported membranes: morphology and transport. The author attempts to provide proper definitions and correct transport approximations. In addition, new approaches to synthesis of optimized ceramic membrane systems by particulate processing and random-packed structures, self-organization and micro-manufacturing techniques are occasionally highlighted.

The final article by Shirtliff and Hench deals with bio-active ceramics for tissue engineering, an area that is expected to yield major innovations and see sustained growth for some time. This article begins with an overview of the use of biomaterials as implants, leading to the reasons for the dramatic shift in focus regarding the approach to repairing damaged tissues. The major emphasis is on the ways in which biomaterials can be developed to implement the concept of tissue engineering. Finally, the article discusses the implications of these developments for future treatment of damaged/diseased tissues.

We are grateful to the authors for their contributions and cooperation in adhering to the timetable. The fact that they were invited to write on selected topics is a clear recognition of their reputation in the area. As is often the

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case, scientific writing does not associate financial rewards. The greatest reward is perhaps being able to inspire young minds through our insights, and the authors will be greatly appreciated for sharing their knowledge. The reviewers are particularly acknowledged for their time in critiquing these papers. Special acknowledgement goes to Gregory Franklin for his vision, guidance and cooperation throughout the process of this publication. Finally, we acknowledge the Editorial Office at Kluwer, and Angela DePina in particular, for making this a reality.

S. A. Akbar and C. O. Park
E-mail: Akbar@mse.eng.ohio-state.edu