

6th International Conference and Exhibition on

Materials Science and Engineering

September 12-14, 2016 Atlanta, USA

Analysis and simulation guided processing of hierarchical porous and multi-layered ceramics for energy applications

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Our current research is focused on developing processing strategies to control the microstructure of ceramics at different length scales. Although the projects are diverse, they all share common features including integration of mechanics in processing and coupled theory, simulations and experimental investigations. In this presentation, two examples will be highlighted. The first project is focused on microstructural control in hierarchical and/or anisotropic porous ceramics. Porous ceramics are used in a broad range of technologies including electrochemical applications like electrodes for SOFCs and batteries. For these applications, the properties of interest are mechanical, thermal, electrical and ionic conductivity, gas diffusion and chemical reactivity. Results will be presented on the processing approaches to make designed microstructures, the quantification of the 3D microstructure and meso-scale simulations of the mechanical and transport properties. The second project is focused on constrained sintering of multilayered ceramics. Due to the differential densification rates of the layers stresses are generated during sintering, which biases the microstructural evolution and have the potential to cause serious defects like cracks. Experimental, analytical and numerical results will be presented on the crack growth in constrained sintering systems including factors that control this and strategies to mitigate the problem.

Biography

Rajendra Bordia is a Professor and Chair of the Materials Science and Engineering Department at Clemson University in Clemson, SC, USA. He received his PhD (1986) from Cornell University, Ithaca, NY, USA. His research is at the intersection of materials and mechanics and is focused on fundamental and applied studies in the processing and properties of complex material systems for energy, environmental and medical applications. He has authored or co-authored over 125 peer-reviewed technical publications, over 120 technical reports and has presented over 250 invited lectures and seminars. His many awards include election as the Fellow of the American Ceramic Society.

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