4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

Multiphase ceramic composites for energy conversion and storage

Kyle S. Brinkman

Department of Materials Science and Engineering, Clemson University, Clemson, South Carolina 29634, USA

Accepted for publication on 4th December 2014

The emergent properties arising from the interactions of phases including interfacial contributions and phase evolution at the mesoscale present new opportunities, as well as challenges, for materials performance and functionality. This presentation will highlight interfacial contributions to system level performance in two diverse fields: i) Mixed Ionic and Electronic Conducting (MIEC) separation membranes and ii) Ceramic waste forms for nuclear waste storage. MIECs are widely used in semiconductors, electrochemical storage materials, electrodes of fuel cells and batteries, separation membranes, and catalysts with various requirements for chemical, electrical, thermal, and mechanical properties. The microstructure and connectivity of the ionic and electronic conductive phases in composite ceramic membranes are directly related to device performance. Durable ceramic waste forms that incorporate a wide range of radionuclides have the potential to broaden the available disposal options and to lower the storage and disposal costs associated with advanced nuclear fuel cycles. Recent work has shown that they can be produced from a melting and crystallization process similar to melter technology currently in use for High Level Waste (HLW) vitrification in several countries around the world. However, differences in microstructure and elemental partitioning were observed compared with traditional processing methods, which may impact the long-term stability and propensity for elemental release. Performance implications will be discussed with regards to the design of new material systems, which evolve under non-equilibrium conditions.

Keywords: mixed ionic and electronic conductivity, ceramic membranes, ceramic waste forms, grain boundary