



Sandia National Laboratories

Design and Development of High Performance Ceramic and Glass Seals at Sandia National Laboratories

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SOFCs Present Some of the Most Challenging Performance Criteria in All of Ceramic Joining

- long-term HT stability in oxidation and reduction
(decomposition, vaporization, phase transitions)
- low reactivity with environment and other components
- strength and toughness at the use temperature
- thermal shock resistance
- ability to accommodate CTE mismatch
- hermeticity

All for lifetimes of up to 10,000 hours

There is No Universally-Applicable Seal Material or Process

- Seal design is an engineering optimization that requires frequent tradeoffs
- Sealing techniques are specific to the application
- Rational design must be based on a thorough understanding of fundamental science, e.g.,
 - materials synthesis
 - reaction thermodynamics and kinetics
 - interface structure and properties
 - micromechanics of interfaces

Sandia's Component Development Responsibilities Have Fostered a Multidisciplinary Approach to Seal Design and Manufacture

- Experimental Tools (Materials & Process Science Understanding)
- Computational Predictive Tools (Thermal, Fluid Flow, Mechanical, & Interface)
- Analytical Tools (Microstructural & Compositional Analyses)
- Design & Production Feedback (Development, Characterization, Qualification, & Failure Analysis)

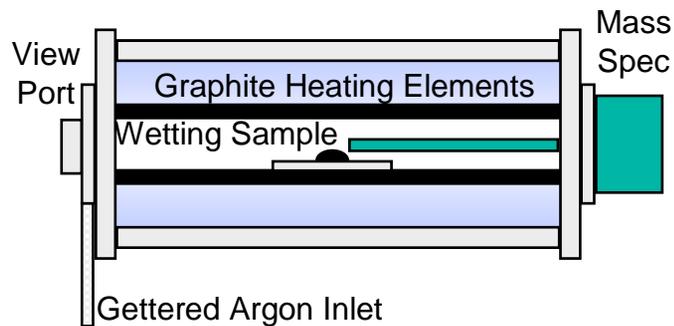


MC4277 Tube



Joining Research Spans Many Disciplines

Fundamental



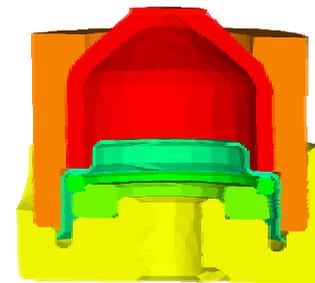
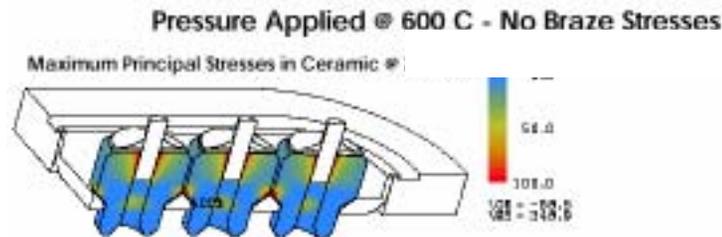
Applied

- Ceramics
- Joining
- Characterization
- Computation
- Modeling
- Design
- Development
- Process
- Production



Typical Ceramics & Metal Brazed Products

- switch tubes
- neutron tubes
- stronglinks
- thermal batteries
- storage containers
- plasma facing components
- feedthrough connectors/headers
- solid oxide fuel cells
- auxiliary power units
- liquid metal thermoelectric cells
- electrochemical potential sensors



What Are the Issues?

- materials/process selection
- surface conditions
- interfacial reactions
- wetting & flow
- fillet geometry
- microstructures
- hermeticity
- strength/residual stresses
- corrosion/oxidation resistance
- post-processing requirements
- service conditions/reliability

More Details on the Sandia Approach to Component Seal Development Will be Presented by:

- Stress Modeling for Component Design and Manufacture

Steve Burchett, Solid Mechanics Engineering Department

- Advanced Brazing Techniques for Component Development

Mike Hosking, Joining and Coating Department

- Failure and Reliability Analysis of Multimaterial Components

Jill Glass, Ceramic Materials Department