Computational Modeling of Joining Processes

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Sandia's Broad Mission Translates Into A Broad Range of Applications

- SNL responsible for weapon system design & integration
- SNL is responsible for the design, development, manufacture, and stockpile health of non-nuclear components in nuclear weapons.
  - Neutron generators
  - Radars
  - Thermal Batteries
  - Actuators / explosive components
  - Others
- Modeling and simulation must support
  - System design
  - Component design
  - Manufacturing
  - Reliability
  - Forensic evaluation
  - Qualification
Increased Reliance on Modeling & Simulation

Test-Based Design & Qualification
- Testing
- Modeling & Simulation
- Expert Judgement

Model-Based Design & Qualification
- Modeling & Simulation
- Validation & Discovery Experiments
- Testing
- Expert Judgement

Cost of Test & Test Hardware
Loss of Test Facilities
Dramatic Increase in Computational Capability
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy’s National Nuclear Security Administration under contract DE-AC04-94AL85000.
Glass-to-Metal Seals

Symmetry Planes

Stresses @ RT Due to Glassing

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SECA Core Technology Program
SOFC Seal Meeting

GTM + Laser Weld

GTM Header

Header welded into housing

Stresses @ RT after glassing

Temperature due to laser spot weld – end of weld

Stresses in header due to laser spot weld
SECA Core Technology Program
SOFC Seal Meeting

Soldering
SECA Core Technology Program
SOFC Seal Meeting

Ceramic-to-Metal Brazing
SECA Core Technology Program
SOFC Seal Meeting

Model the Integrated Process

1.) Thermal Modeling of Braze Furnace Temp vs. time response

2.) FLOW MODELING: Model Solidification Process with Temp vs. Time: Provides fillet shape for stress model

3.) Stresses computed based on temp. history and fillet shape

4.) Compute failure probability of joint

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