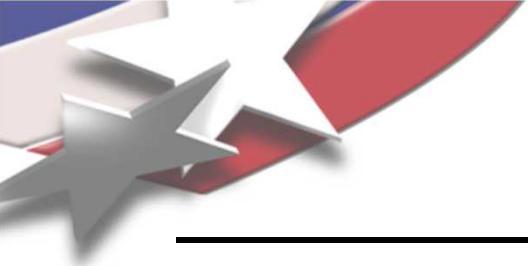


SNL Joining Capabilities

Sandia National Laboratories New Mexico

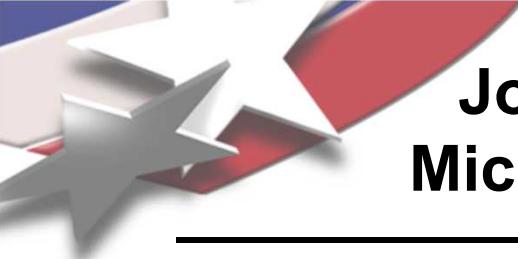
**Ford Meeting
Sandia National Laboratories, NM
5/6/2008**

**Gerald A. Knorovsky
Joining & Coating Department
Sandia National Laboratories, Albuquerque, NM**



Joining at SNL

- **Materials Science and Engineering (1800)**
 - **1813 Joining & Coating Dept (mgr: Mike Hosking)**
 - **1824 Microsystem Materials (mgr: Jon Custer)**
- **Manufacturing Science and Technology Center (2400)**
 - **2430 Manufacturing Enterprise**
 - **2450 Manufacturing Process Science and Technology**
- **Other Centers**
 - **Microsystems Science, Technology & Components (1700)**
 - **Responsive Neutron Generator Product Deployment (2700)**
 - **Energetic Components Realization (2500)**
 - **Includes battery, explosive components groups**



Joining & Coating 1813, Mike Hosking, Mgr. Microsystems Materials 1824, Jon Custer, Mgr.

Welding staff:

Charlie Robino

Jerry Knorovsky

Jerome Norris

Brazing/Soldering staff:

Paul Vianco (1824)

Don Susan (1813)

Brad Boyce (1824)

Technologists:

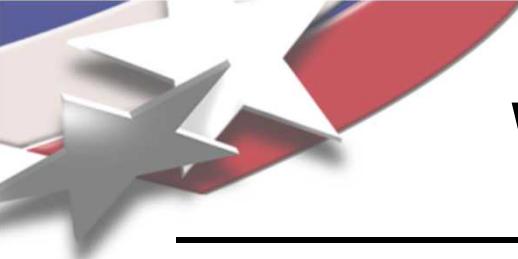
Danny MacCallum

Mark Reece

Peter Duran

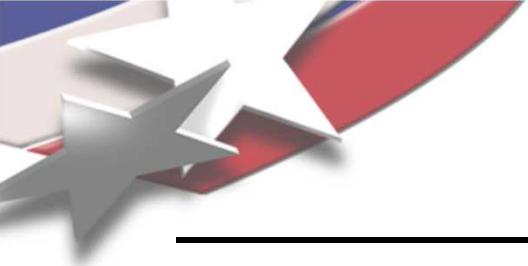
Jerry Rejent (1824)

Mark Grazier (1824)



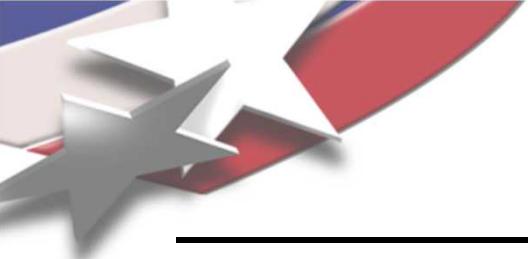
Weld Process Capabilities

- **Laser joining (weld, braze, solder)**
- **Laser thermal processing (heat treat, glaze, cut, drill)**
- **Arc welding (GTAW, PAW, GMAW, Percussive, Stud)**
- **Resistance Spot Welding**
- **Electron Beam Welding**
- **Ultrasonic Welding**
- **Friction Welding* (conventional and stir**)**
- **Upset Welding***
- **Many soldering procedures (reflow, wave, resistance, IR, manual, etc.)**
- **Exotic matls. joining (Ni, Co, Ti, Ta, Mo-base, etc.)**
- **Ceramic to metal brazing (conventional & active alloys)**



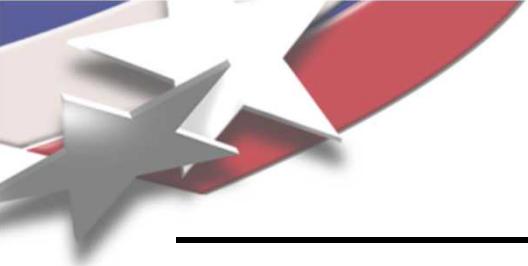
Diagnostic Capabilities

- Varestraint weldability testing
- Gleeble thermal-mechanical simulator
- Weld calorimetry
- High speed, variable magnification video (record dendrites growing, cracks cracking)
- Data acquisition systems
- Laser beam diagnostic tools
- Digital Image Correlation full-field strain measurement
- Holography
- ESPI strain measurement capability
- Solderability (meniscograph, meniscometer)
- ASTM F19 Braze Test (strength & hermeticity)



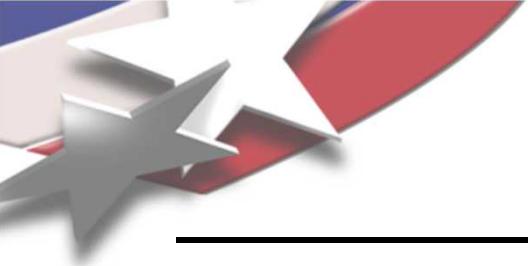
Ancillary Capabilities

- Complete metallography lab
- State-of-the-art electron/ion microscopy facilities
- SOTA chemical analysis capabilities
- SOTA mechanical test capabilities (nano-to-macro, very slow-to-very fast, fatigue, impact, fracture toughness, wear, hardness)
- Arc button melter (produces small amounts of specialty alloy compositions)
- Robotic, CNC stage manipulators
- SOTA thermal, structural, material modeling (massively parallel Tflop computers, MD, level sets, FEM, meshless, Lattice Boltzman, CA, etc.)
- Thermal spray of metals and ceramic coatings



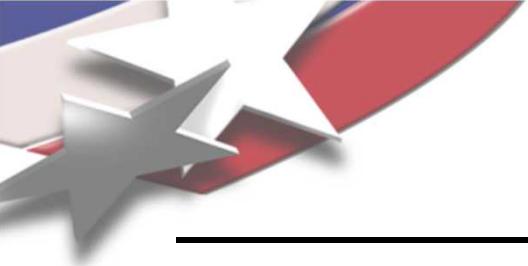
Recent Projects

- Commercialization of Gd-containing alloy for nuclear waste storage
- Analysis of Ta alloy weld cracking
- DIC measurement of dissimilar weld strain fields
- HS video of keyhole laser welds
- Calorimetry of absorbed/reflected laser energy in keyhole welds
- Laser scabbling of concrete
- Effect of process parameters on porosity in LBW
- Pb-free solder characterization & qualification
- Active braze alloy development & qualification for production



More Projects

- **Laser Ultrasonic NDE**
- **Lead-free solders**
- **Growth of Sn whiskers**
- **Thermal fatigue of solders**
- **Welding of glass, glass-ceramic, brazed ceramic connectors**
- **Analysis of shear test results**
- **Specification of stainless steel composition for weld critical applications, glass-to-metal seals**
- **Diagnostic method for determining resistance projection weld quality**



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