The joining and heat-treating technologies in the Thin Film, Vacuum, & Packaging department include brazing, heat-treating, diffusion bonding and soldering. The technical staff provides expertise in the filler metal selection, proper joint design, active filler metal brazing and the design of custom alignment fixtures. The department can join large complex parts or micro-mechanical devices of metal, ceramic and composite substrates.

**Capabilities**

- Conventional and active metal brazing of ceramics and cermets
- Binder burnout and densification of cermets and ceramics in reducing or inert atmospheres
- Hydrogen firing, inert gas, high vacuum or partial pressure heat treating
- Oxide coating (Greening) of Stainless Steels using wet hydrogen processes
- Consulting with customers to define and qualify controlled atmosphere and vacuum furnaces for research and development
- Specify bonding interlayer materials for a variety of substrates
- Design of critical joints and selection of proper braze filler metal
- Multiple furnaces for brazing in vacuum, hydrogen or inert gas environments
- Deposition of thin film interlayers for diffusion bonding or ceramic brazing
- Design and manufacture fixtures for brazing and high-temperature treatments
- Perform/Specify step brazing processes for complex assemblies
- Diffusion bonding of metal, ceramic, and cermet substrates with thin film interlayers (silver, gold, copper, aluminum, and gold/copper alloy)
• Energetic multilayer thin film alternatives for brazing of heat-sensitive components. [Contact: David Adams (505) 844-8317, dpadams@sandia.gov]

Resources
• Employ wet and dry hydrogen and inert gas processing furnaces for state-of-the-art brazing and metal oxide reduction up to temperatures of 2000°C, particularly for stainless steels, nonferrous materials, high-temperature alloys, and refractory metals
• Three hydrogen or inert gas processing furnaces
• Three vacuum brazing furnaces, the largest with a 16 ft³ hot zone

Accomplishments
• Demonstrated the feasibility of a thin-film metallization process as a cost-effective alternative to moly-manganese ceramic metallization methods
• Developed and demonstrated a robust, active braze process for joining copper, nickel and alumina for small telecommunications devices. (Small Business Initiative)
• Joined silicon nitride at 1450°C in a nitrogen environment. (External Customer)
• Hermetically joined low temperature cofired ceramic (LTCC) to Kovar using an active braze process. (Internal Customer)
• Brazed fused silica to Kovar at 1000°C in a hydrogen atmosphere using an internally developed active braze filler metal

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Large Vacuum Furnace

High vacuum diffusion bonding