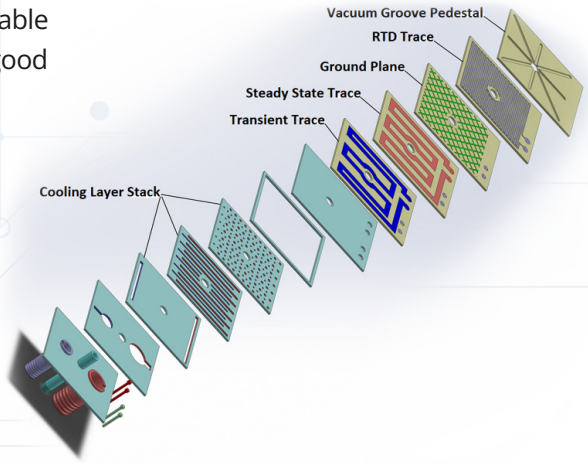
FRALOCK®

Leading the Way in Advanced Materials Solutions®

ELECTRIFIED CERAMIC SOLUTIONS

Multi-Layer Ceramics

When OEMs require specialty components that are heat and fire-resistant, capable of rapid, high-temperature thermal cycling, have high strength and hardness, good electrical insulation, low solubility, or biocompatibility, they choose ceramics.

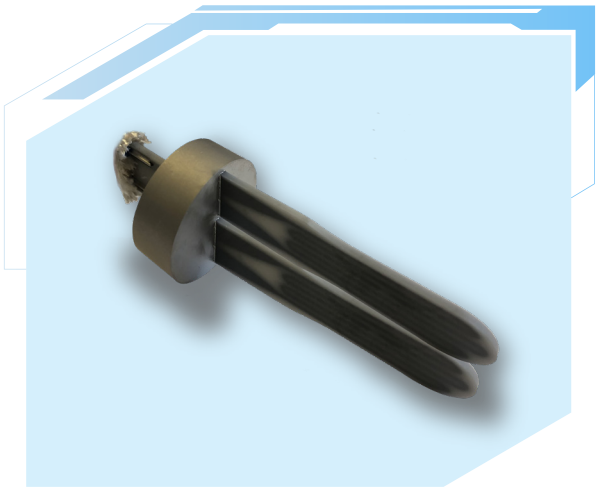


Fralock's advanced in-house ceramic technology equips us to design and manufacture electrically active ceramic components using Aluminum Nitride (AlN), low temperature co-fired ceramic (LTCC), and high temperature co-fired ceramic (HTCC). We incorporate internal circuitry into ceramic components using multiple fine layering of specialty AlN ceramic material with conductive traces between and through the layers. The design is similar to a solid-state high-temperature PCB board, yet provides excellent thermal conductivity for effective heat spreading.

We offer engineered ceramics in a multitude of shapes and sizes (1mm to 380mm) using green machining, lapping, drilling, sintering, laser machining, and polishing, with metalizing and brazing to your specifications. Fralock provides design, engineering and manufacturing expertise for customers in industries such as semiconductor manufacturing, medical, aerospace and defense, industrial, and more.

Thermal Conductivity of Fralock Ceramics

- AlN: 180W/mK
- HTCC: 15 W/mK to 20 W/mK
- LTCC: 2-4 W/mK



Metal Heat Treatment
Industrial Equipment

Fralock offers a wide range of thermally conductive materials for our AlN heaters that can be formulated to your application needs.

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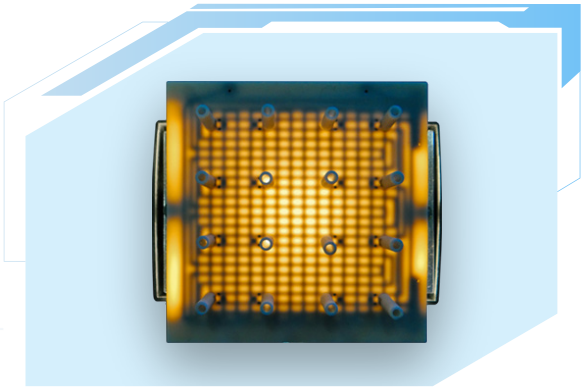
HEATER TECHNOLOGY

Fralock Ceramic heaters are made using high thermal conductivity Aluminum Nitride (AlN) ceramic with embedded Tungsten heating traces, providing tailored power input to achieve your temperature transition and thermal uniformity goals. Integrated channel structure and low density AlN ceramic provide quick cooling rates from 300°C to room temperature in just a few seconds. Multilayer heaters can be configured with built-in sensors (RTDs) to achieve almost instantaneous response.



The Coefficient of Thermal Conductivity and Linear Expansion are closely matched between AlN and Tungsten, allowing us to engineer heaters with extremely rapid thermal cycling and precise control.

PROPERTY	UNITS	TUNGSTEN	ALN
Coefficient of Linear Expansion per °C	°C	4.3 X 10^{-6}	4.3 X 10^{-6}
Thermal Conductivity (RT)	W/mK	170	180

Benefits & Features

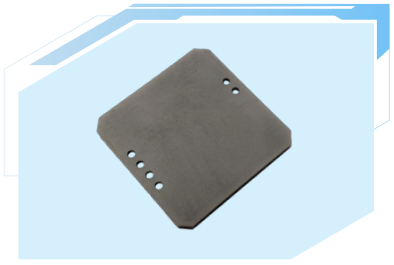
- Low power requirements for portable devices
- Extremely rapid heating in excess of 300°C/sec
- High performance heating combined with micro-channel cooling
- High watt density, up to 2000W per square inch
- Ultra-rapid temperature transition
- Instantaneous temperature feedback
- Precision temperature uniformity
- Complex tungsten circuitry including multiple zones
- Integrated temperature sensing traces
- All shapes and sizes including tubular heaters
- Sizes range from a few millimeters to 15 inches

Applications:

Semiconductor

- Wafer Heaters
- Pedestal Heaters
- Plasma Generator (dielectric deposition)
- Thermal Compression Bonding
- Class Testing
- Burn-In Testing
- Chip Clock Speed Testing

Pedestal Heater
Semiconductor Manufacturing

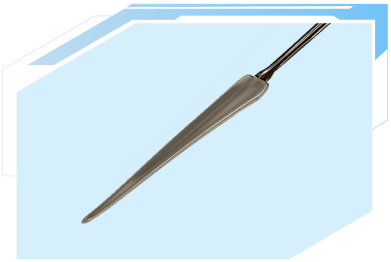


Burn-In Testing Heater
Semiconductor Manufacturing

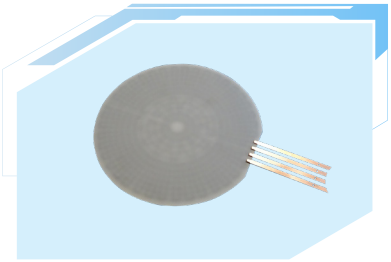
Applications:

Medical

- Polymerase Chain Reaction (PCR) Heaters – precise and consistent temperature control +/- .25°C
- Mass Spectrometry
- Cryoablation (for speeding the thawing process)
- Catheter Coater (for coating wires along a catheter to improve lubricity)
- Tissue Fusion
- Gas Chromatography, Mass Spectrometry
- Cauterizing/Tissue Cutting
- Tissue Sealing
- Bag Sealing



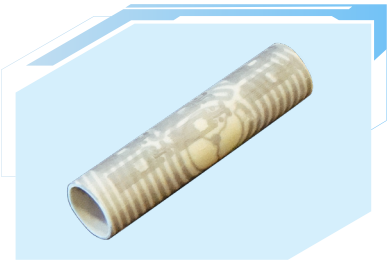
Tissue Cutting Heater
Medical Device



PCR heater
Medical Equipment

Industrial

– Gas chromatography
– Mass Spectrometry
– Seal Bar Heating
– 3-D Printing



Tube Heater
Used in many Industries

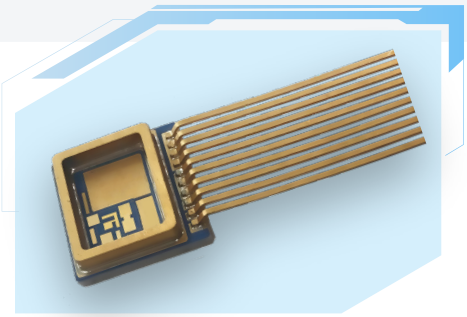
Seal Bar Heater
Industrial Equipment

Aerospace/Defense

– Chip Warming in Aircraft Cameras
– Satellite Propulsion

Other Industries

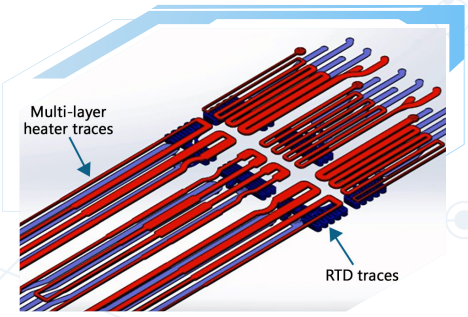
Power Modules
– Inverters for Small Electronics
– Insulated Gate Bipolar Transducers (IGBT) – high voltage, high current switching
– MOSFET (metal oxide semiconductor field effect transfer) – switching devices for automotive electronic control units



Copper Bonded Circuit Package
Aerospace, Defense, Aircraft

Metalization

Heaters are available in multilayer ceramics or metal laminates of copper or stainless steel. We can thick or thin film metalize and plate to provide brazeable, solderable, or wire-bondable surfaces.



Micro Cooling Channels

Internal and External Channels in Aluminum Nitride

The high thermal conductivity and low coefficient of expansion of AlN are key factors for carrying heat away from electronic devices through additional internal or external micro cooling channel layers. This feature can be utilized for either temperature transition applications or simply to remove heat from devices like laser diodes, server processors, or power modules.

Controllers

Fralock can supply temperature control systems mated to our heaters to optimize performance for your application. Due to the unique temperature coefficient of resistance (TCR) curves of internal tungsten sensor traces, a specially calibrated control system is necessary to realize the full performance of our heaters. These control systems can be either stand-alone or modules integrated into an existing control system. They can be configured to respond in milliseconds, virtually eliminating temperature overshoot for applications that require precise temperature control.

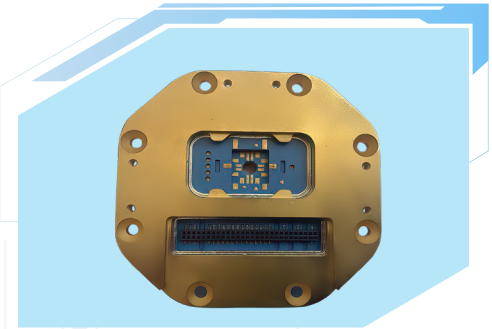
Thermal Head Cooling Solutions

When rapid cooling is needed, Fralock can provide integrated cooling solutions in our heaters for extremely fast temperature transition on the cool-down side of the temperature cycle.

LOW-TEMPERATURE CO-FIRED CERAMICS

Low-Temperature Co-Fired Ceramic (LTCC) substrate is composed of many ceramic layers with conductive circuits attached, and through holes with conductive materials that connect the layers to form a 3-dimensional network. An IC is chip installed on the top layer along with micro components to form a high-density, high-speed reliable circuit structure. Fralock can fabricate LTCC components from both Ferro and DuPont systems. Secondary component brazing is available for a wide array of component types. Please contact us to discuss your application.

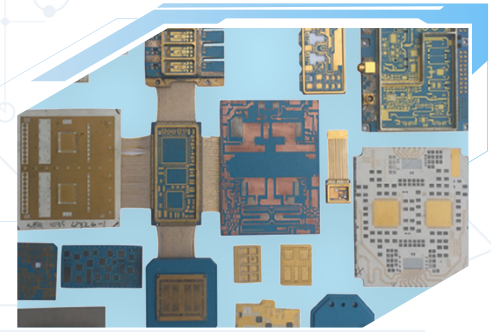
- Ferro system
- DuPont system
- Gold, copper or silver ink systems
- Brazing of seal rings, pins, lead frames, and other components



LTCC Circuit Module
Scanning Electron Microscopy

Capabilities

- Ferro, DuPont, and Heraeus systems
- Multi-layer substrates and packages for custom applications
- Aluminum Nitride
- Prototype to volume production
- Quick-turn prototyping
- All gold and mixed metal systems
- Buried passives – resistors, capacitors, and inductors



LTCC Circuit Board
Aerospace, Defense, Aircraft