

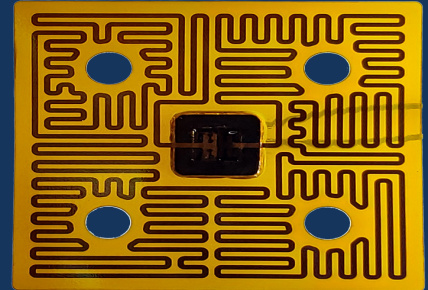
FRALOCK HEATERS FOR HIGH RELIABILITY APPLICATIONS

Fralock provides custom-engineered heating solutions used in today's most demanding applications for many market sectors including industrial, electronics, energy, and other sectors. We offer multiple material constructions to optimize your temperature, thermal control, and packaging requirements.

POLYIMIDE HEATERS

Fralock's polyimide heaters provide high flexibility, low mass, and can be shaped and formed to solve complex packaging challenges. They can be fabricated using multiple material configurations to meet your needs. Thermal management can be assembled to the surface of the heater, or embedded inside for a one-piece solution. There are also several mounting options available to ensure quick and effective heat transfer.

We offer **Adhesiveless Lamination Technology (ALT™)** bonding for applications requiring high reliability, as well as traditional adhesive bonding constructions.



Kapton® Film

Etched Metal Substrate

Kapton® Film

FEATURES AND BENEFITS

- Several dielectric and foil options available. Heaters as thin as 0.0635mm (.0025")
- Flexibility for heating complex, three-dimensional applications
- Multi-layer and multi-zone heating; can include embedded thermocouples
- Excellent temperature range -269°C to +220°C
- Low out-gassing



Applications Include

- Electronics in Extreme Environments
- Liquid and Gas Warming
- Test Equipment
- Battery Warming
- Optics Defogging
- Oil Drilling/Exploration
- Automation/Robotics
- Additive Manufacturing
- Commercial Drones
- High-Performance Digital Cameras
- Quantum Computing
- Telecommunications
- Measurement and Sensor Equipment



Thermoscan Camera

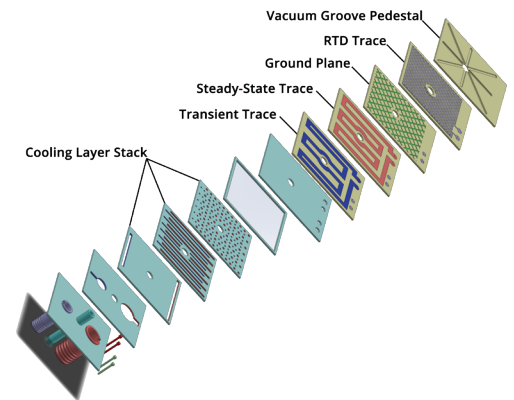
CERAMIC HEATERS

Fralock Ceramic heaters are designed for thermal uniformity and extremely rapid thermal cycling in capital equipment. They are made using high thermal conductivity **Aluminum Nitride (AlN) with embedded Tungsten resistance heating traces**, providing tailored power input to achieve your temperature transition goals.

Extremely rapid heating in excess of 300°C/sec is made possible because the coefficients of thermal expansion of Aluminum and Tungsten are equal (4.3×10^{-6} Co). Integrated channel structure and low density AlN ceramic provide quick cooling rates, from 300°C to room temperature in a just few seconds.

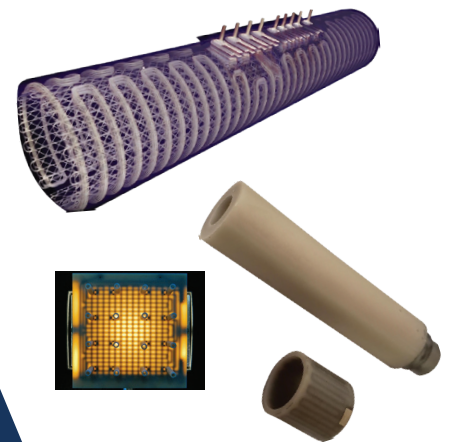
| Density - g/cc | 3.36 | 19.3 |
|--|----------------------|----------------------|
| Linear Coefficient of Expansion per °C | 4.3×10^{-6} | 4.3×10^{-6} |
| Thermal Conductivity (RT) - W/mK | 180 | 170 |

Exceptional thermal uniformity and seamless transfer of temperature is achieved due to matched coefficients of thermal conductivity.



FEATURES AND BENEFITS

- Robust reliability, proven with millions of cycles in the field
- Multiple zones of heater and sensor traces in various layers
- Tungsten traces are fully integrated and chemically bonded into the AlN microstructure
- Ground plane shielding
- Thin substrates: flat, round or any that geometry can be CNC milled
- Complex geometries that include venting, vacuum, and blind features
- Large format sizes up to 380mm diameter
- Internal cooling channels
- Sub-micron flatness possible



Applications Include

- Analytical Equipment (Spectrometry, Chromatography)
- Packaging and Sealing Applications
- Vaporizing
- Industrial Heat Treatment
- 3-D Printing
- Optical Lens Fabrication Equipment



Capsule blister packaging machine

