

Thermal solutions for The Semiconductor Industry



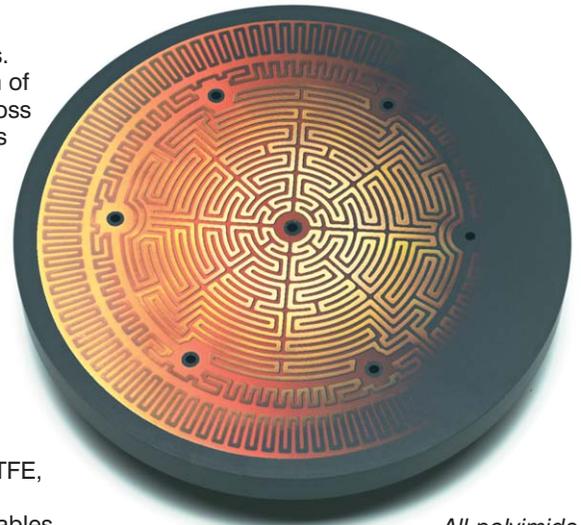
Uniform, responsive, reliable heat

Heat is a critical factor in processing and testing semiconductors. A high level of available heat allows faster throughput. Reduction of temperature gradients across a heater means less variability across a wafer and more repeatable processes. A heating element that's less prone to failure cuts the risk of downtime. All these translate to productivity and profits.

Minco Thermofoil™ heater technology helps you achieve your thermal design goals.

A Thermofoil heater consists of an etched-foil element laminated between flat or flexible insulating layers. In comparison to traditional tubular or cast-in heaters, the Thermofoil construction provides more surface area for heat output. As a result, the element runs cooler and with greater efficiency even at high watt densities.

Minco offers heaters with Kapton® polyimide, silicone rubber, PTFE, and mica insulations for temperatures up to 600°C. We can also manufacture complete thermal subassemblies with heat sinks, cables, connectors, temperature sensors, thermostats, or fuses.



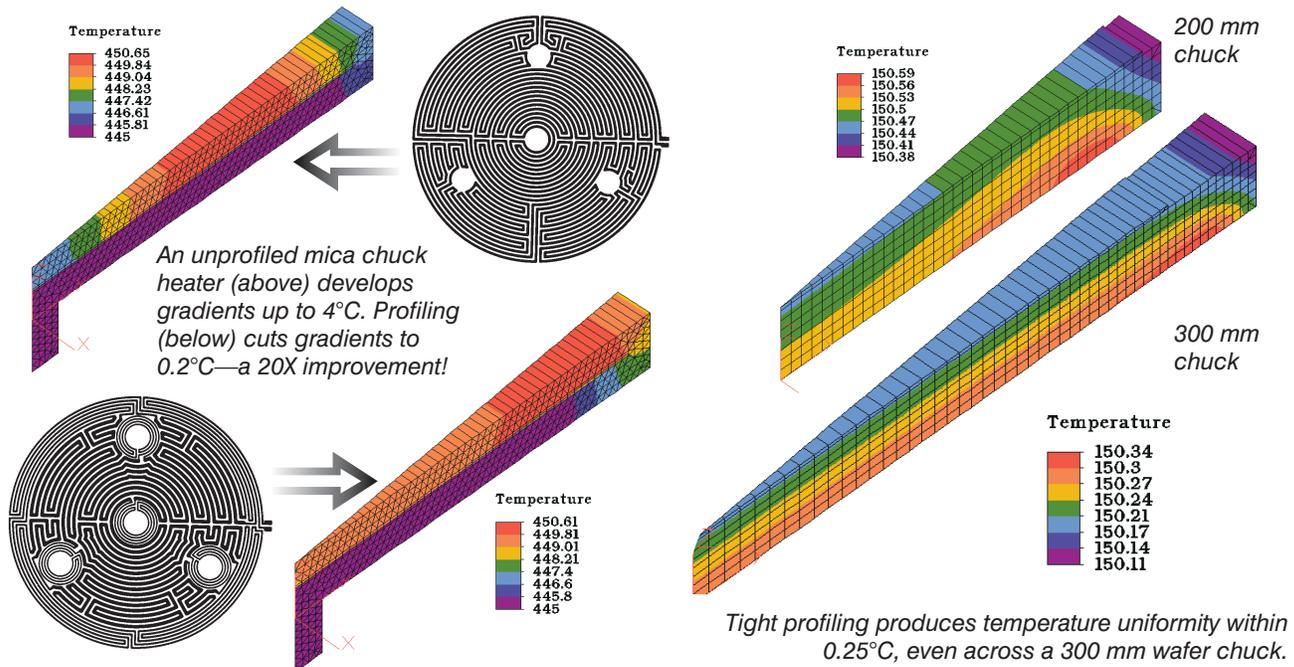
All-polyimide heaters provide clean heat with low outgassing to 250°C!

Exceptional temperature control through profiling

The electrical element of a standard Thermofoil heater is laid out to uniformly distribute heat across its surface. If heat losses are also uniform across the surface, so are resulting temperatures.

But in most cases heat dissipates faster at the edges of objects than the center. Mounting structures also sink away heat. Cool spots appear and uniformity suffers.

A Minco profiled heater design puts more replacement heat where it's needed: at edges and other loss points. This makes it possible to reduce gradients by 10 times or more. And because profiling is determined by a master artwork in the photo etching process, it's repeatable from heater to heater and adds nothing to unit cost.



Exceptional temperature uniformity

Heated chucks with temperature uniformity of $\pm 0.5^{\circ}\text{C}$ or better, for temperatures to 260° . Minco's "All-Polyimide" heater construction breaks the old 200°C temperature limit of Kapton insulation while maintaining high dielectric strength,

long life, excellent chemical resistance and fast reaction time.

These chucks are ideal for critical photo resist applications and pre-processing degas chambers.

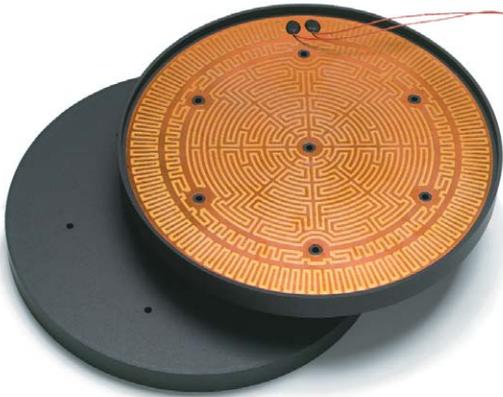


Photo resist coating

PVD, CVD and ashing

Optimum temperature control to 300°C

Sealed, welded Aluminum chucks provide higher temperature capabilities with optimum temperature uniformity. Flatness and parallelism specifications to $\pm 0.0005"$ (0.013 mm) or better are possible from edge-to-edge.

Tight tolerance proximity pins may also be specified as an integral feature of the wafer working

surface. Other mechanical features may include integral vacuum feedthroughs, mounting stems and temperature sensors.

These chucks can be used in atmospheric or vacuum chambers for applications including PVD, CVD and ashing processes.





Flexible and preformed process heaters

Silicone insulated heaters with etched or wire elements provide precise, controlled heat to process lines, valves and solenoids. Etched element designs can conform to diameters as small as 0.25" (6.4 mm).

Preformed designs and molded shells provide an exact fit with heating, mounting and insulation in one step and may include integral temperature sensors and thermal cutouts.

Wafer probing

Our precision machined chuck components and precise thermal profiling deliver the exceptional flatness and thermal uniformity required for elevated profiling of

completed or in-process wafers. Hard coat anodizing may be specified to improve durability or various plating finishes including nickel and gold.



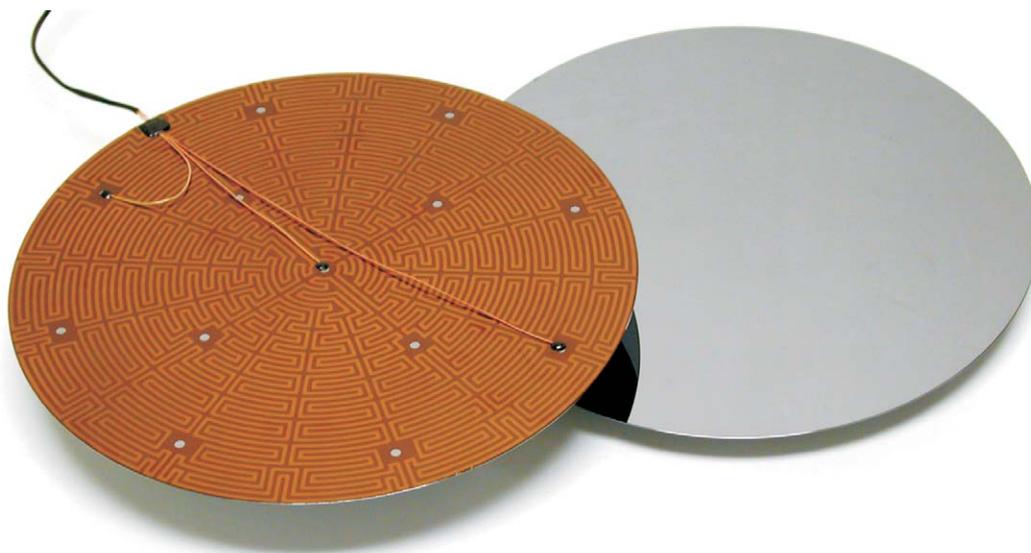
Process line heating

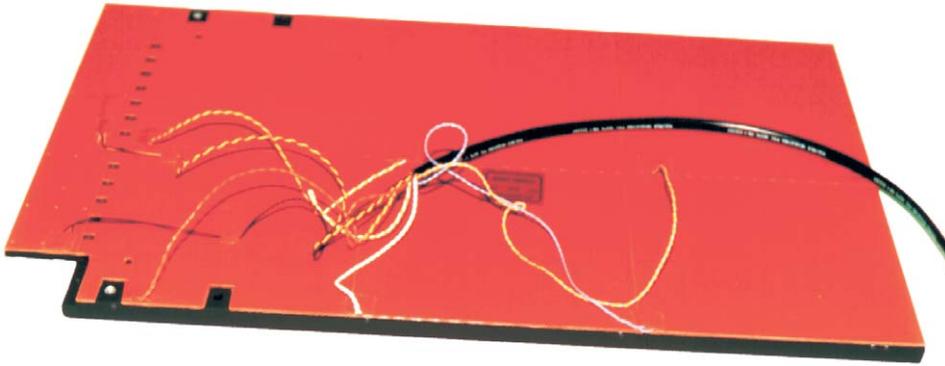
Wafer testing

Heated silicon wafers for load testing

Minco can provide uniform or profiled power density heaters which can be mounted directly to silicon wafers for testing cooling performance of cold chucks and other applications.

Integral surface mounted thermocouples or RTD's may be included for precise measurement of wafer temperature.





Chip handling and testing

Minco heaters provide controlled consistent heat for elevated temperature testing of chips. Multiple zone heaters with individual control allow you to preheat/soak chips and hold for specific time and temperature requirements. High watt density, precision heaters at

the test site assure reliable results and thermal control not possible with heated-air convection systems.

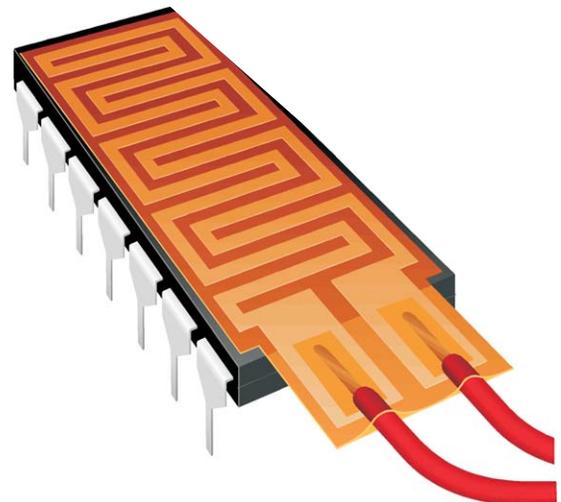
Custom machined components assembled with our heaters provide a complete thermal subassembly.

Chip testing and simulation

Chip simulation

Chip-size heaters are ideal for thermal simulations when designing new machines. Use these heaters to determine overall temperature gains,

verify system cooling requirements and determine self heating effects of components.





Thermal design: The Minco Thermofoil™ advantage

Etched element Thermofoil™ heaters from Minco provide the proven solution to the problems of heating process chucks for semiconductor processing machines. The thin profile heater allows designers to specify designs that have lower mass than bulky, cast metal chucks.

Minco's thinner, low-mass chucks offer several advantages in processing machines:

- ◆ Faster time response, allowing faster in-line process changes
- ◆ Lower total power requirements to reach required temperatures
- ◆ Lower profile means more process stations can be stacked into the same vertical space

Minco heater assemblies can be configured for almost any process. You can use 260°C polyimide insulated heaters for photoresist processing, etching, and testing. 600°C mica heater assemblies are ideal for CVD and PVD processes.

Etched elements can be profiled in a repeatable pattern to compensate for heat losses around edges and holes. Adding extra heat at these strategic locations reduces temperature gradients. Uniformity of better than $\pm 0.25^\circ\text{C}$ is possible at 150°C, even across 300 mm configurations!

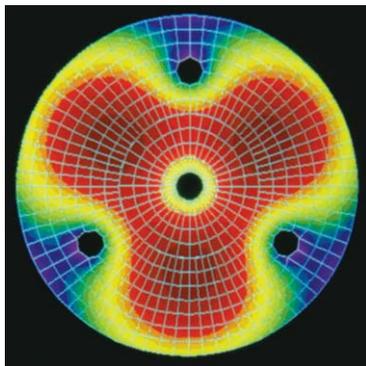
For more information on specifying and designing precision heated chuck solutions request Application Aid #29, "Designing Heated Chucks for Semiconductor Processing Equipment".

Finite Elements Analysis (FEA)

Minco offers complete FEA services and interpretation for predictive modeling of thermal systems. FEA can simulate both steady state and transient conditions. It shows the effects from heat losses at edges and other points, making it particularly useful for initial determination of heater profiling patterns.

FEA does not completely eliminate the need for empirical testing but it can reduce the design iterations required.

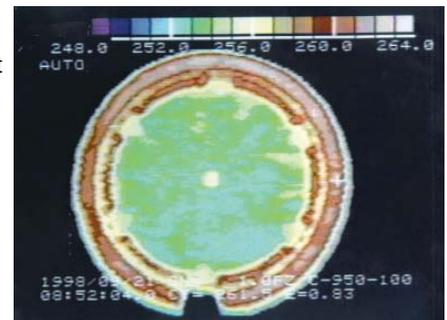
Thermographs on page 1 were generated by FEA.



Thermal imaging

Minco's infrared imaging camera opens a window into thermal processes. You can see thermal gradients develop as parts heat up, and record events to videotape for later analysis. There are no heat sink effects from contact sensors to induce errors.

Thermal imaging requires line-of-sight access to heaters, which may not be possible under actual use conditions. Nevertheless, it is a valuable addition to the thermal designer's toolkit.



Mechanical design: Minco builds custom solutions

A major consideration in designing fast response, low mass chucks is the dimensional stability of various materials at elevated temperatures. Minco's extensive data, testing capabilities, and expertise in thermal design have identified specific metal materials and alloys that allow us to meet demanding requirements for exceptional flatness and stability.

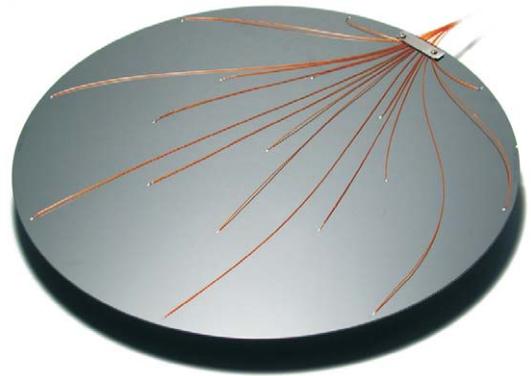
Minco can supply plates of specialized aluminum alloys, ceramics, or non-metallic materials that provide performance beyond the limits of cast aluminum assemblies.

The versatility and repeatability of the etched element construction allows complex machined features, including vacuum ports, proximity pins, and exceptional surface finish requirements.

Custom design options include integrated temperature sensors with either point or averaging designs. Minco can build RTD, thermocouple, or thermistor sensors to match your instrumentation.

Instrumented wafer system

Now available is a complete instrumented wafer system which offers tight accuracy, higher temperature limits and ease of use not previously available for wafer process thermal verification and system calibration. Contact Minco for more information on this high-performance system.



Why choose Minco?

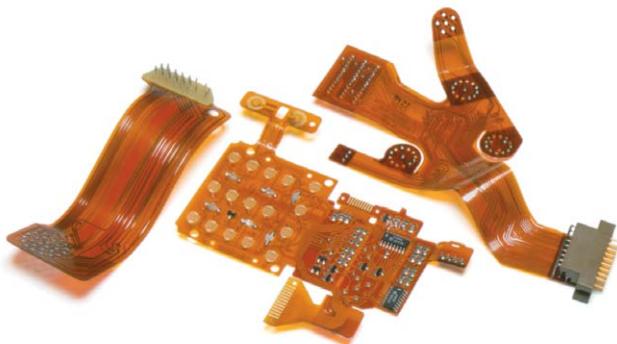
Minco Products has produced heating and temperature sensing components for over 40 years. Our experience in critical applications and solving unique problems lets us provide you with not just a heater, but a complete thermal system optimized to your requirements.

Minco's Engineering and Sales groups work together to understand your requirements and provide innovative solutions. Our Semiconductor Systems Engineering Team creates a custom design for you and our prototype and thermal simulation equipment produce and verify the product. Our production facilities assure consistent, repeatable product delivered on-time, and to exacting customer performance requirements.

The result? Thermal solutions that maximize the performance, reliability and profitability of your equipment.



RTD, thermocouple and thermistor temperature sensors that can measure from -269 to 850°C and higher!



Flexible circuit interconnects for high-reliability, error-proof connections. Single layer to rigid flex. Options include connectors and pin terminations. Integrated heater/flex designs are available.



A full range of bulletins featuring products and technical design information. Request copies on-line or download at www.minco.com.



Temperature controllers and indicators, from standard off-the-shelf to application specific designs.

MINCO
ISO 9001

Minco Products, Inc. (Main Office)

7300 Commerce Lane
Minneapolis, MN 55432-3177
U.S.A.
Tel: 1-763-571-3121
Fax: 1-763-571-0927

Stock order desk:
Tel: 1-763-571-3123
Fax: 1-763-571-9142

Internet:
sales@minco.com
www.minco.com



Minco S.A.

Usine et Service
Commercial, Z.I.
09310 Aston, France
Tel: (33) 5 61 03 24 01
Fax: (33) 5 61 03 24 09

Minco EC

Hirzenstrasse 2
CH-9244 Niederuzwil
Switzerland
Tel: (41) 71 952 79 89
Fax: (41) 71 952 79 90