

Advanced Options for Semiconductor Pedestal Heaters



Highlighting Pedestals with:

- Multiple Heating Zones
- Cooling Capabilities
- High Thermal Uniformity
- High Operating Temps
- Gas Channel Features

CAS is a leader in critical in-chamber thermal components, including multi-zone pedestal heaters, heat/chill plates, high-thermal-uniformity platens, as well as heated chamber rings and covers.

Cast Aluminum Solutions designs and manufactures critical in-chamber heating and cooling devices. Our components are pivotal to some of the industry's most advanced processes.

The technologies described here represent advanced features and functions for pedestal heaters, delivering increased throughput, highly-consistent process results, and compatibility with next-generation wafer processing technologies.

CAS DESIGNS & MANUFACTURES PEDESTAL HEATERS WITH SEVERAL ADVANCED-FUNCTION FEATURES:

- **Multiple Heating Zones:**
To enhance temperature uniformity or create custom thermal profiles, multi-zone heaters are available in cast-in and non-cast pedestals.
- **Cooling Functions:**
Cooling capabilities may be added to single zone or multi-zone pedestals, in the form of liquid or gas-filled SST flow-tubes.
- **High-Uniformity Heaters:**
The CAS Team can achieve temperature variances as low as $\pm 0.5\%$.
- **High-Temperature Heaters:**
CAS manufactures SST and Inconel pedestals with operating temperatures up to 600°C.
- **Gas Channel Features:**
CAS has expertise in designing and manufacturing pedestals containing internal gas flow channels.

All advanced-function pedestals are developed by the CAS New Product Development Team, a dedicated group of highly-skilled engineers & manufacturing technicians. Performance testing is carried-out at our in-house research & development test lab.

ENGINEERING TECHNOLOGIES UTILIZED BY CAS

- Ansys® FEA Thermal & Structural Analysis
- Solidworks® 3-D Solid State Modeling / CAD
- X-Ray & Ultrasonic Testing
- Infra-Red Thermal Imaging
- Vacuum Chamber Testing with Residual Gas Analysis
- Advanced Life-Cycle & Temperature Uniformity Testing
- Instrumented Silicon Wafer Testing

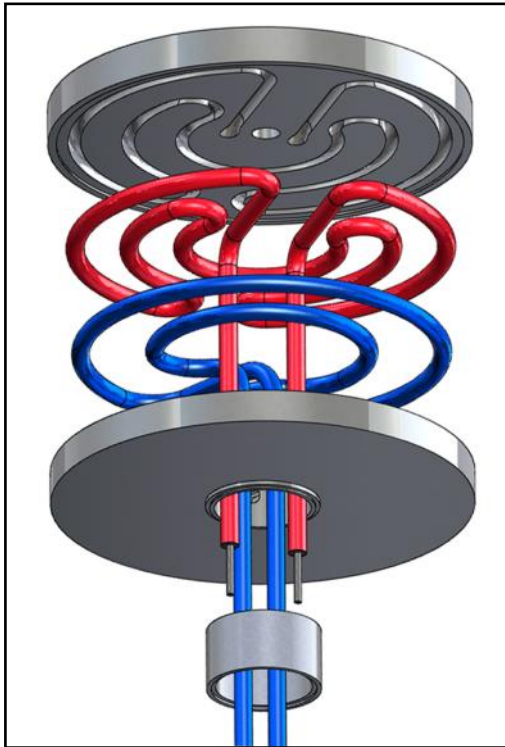
CAS OFFERS A VARIETY OF MATERIAL CHOICES

- Cast and Wrought Aluminum Alloys
- Stainless Steel (316, 304, etc.)
- Copper
- Nickel
- Inconel
- Bronze
- High-Performance Alloys (Hastelloy, etc.)

MULTIPLE SURFACE FINISH OPTIONS

- Hard-Coat Anodizing
- Electroless Nickel Plate
- Micro-Lapping
- Gold and Copper Plate
- Chemical Treatments
- Passivation Options

Multi-Zone Heating: From the Leaders in

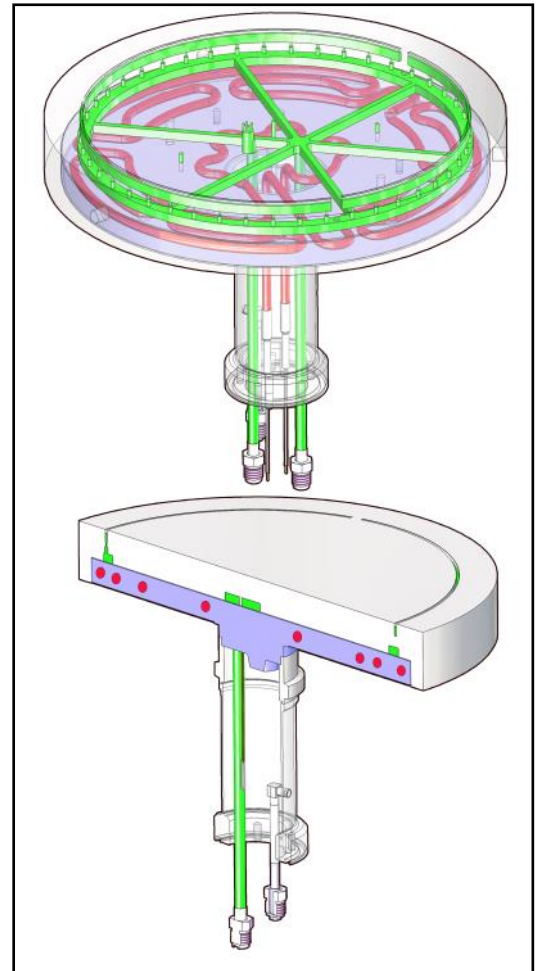


Heating and Cooling Functions

This stainless steel pedestal features heating as well as cooling capabilities. The tubular heating element and SST coolant tube are precision-fit into the plates using our proprietary IFC (interference fit construction) technique. The cooling function works to reduce cycle times and increase machine up-time.

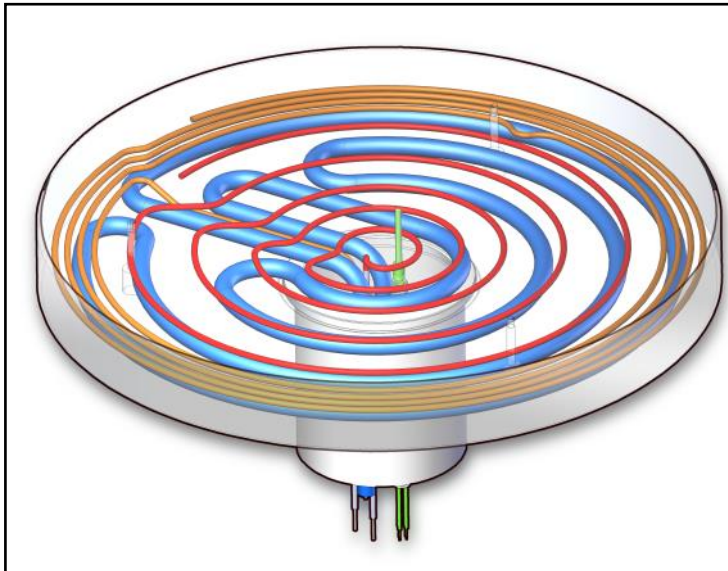
3-Zone Heater with Gas Heating Channels

This sophisticated design features three heated zones: each can be controlled separately. The pedestal body contains fabricated channels (in green) for gas distribution to the working surface via small vent holes (backside gas delivery).



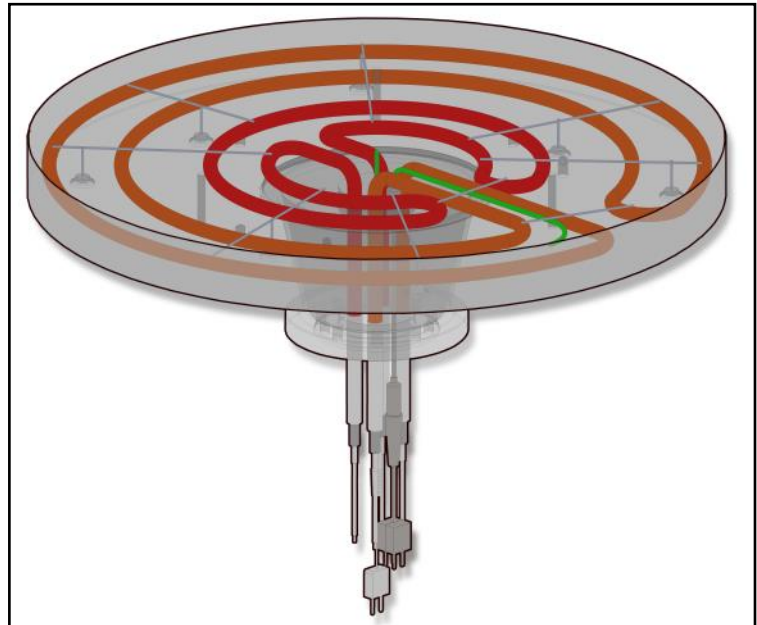
CAS Designs & Manufactures Many Advanced-Function Wafer Heaters

- Pedestals with Multiple Heating or Cooling Zones
- High-Temperature & High-Uniformity Wafer Processing Heaters
- Pedestals with Internal Gas Channels and Venting Zones



Dual-Zone Cast-In Pedestal with Cable Heaters & Cooling Tube

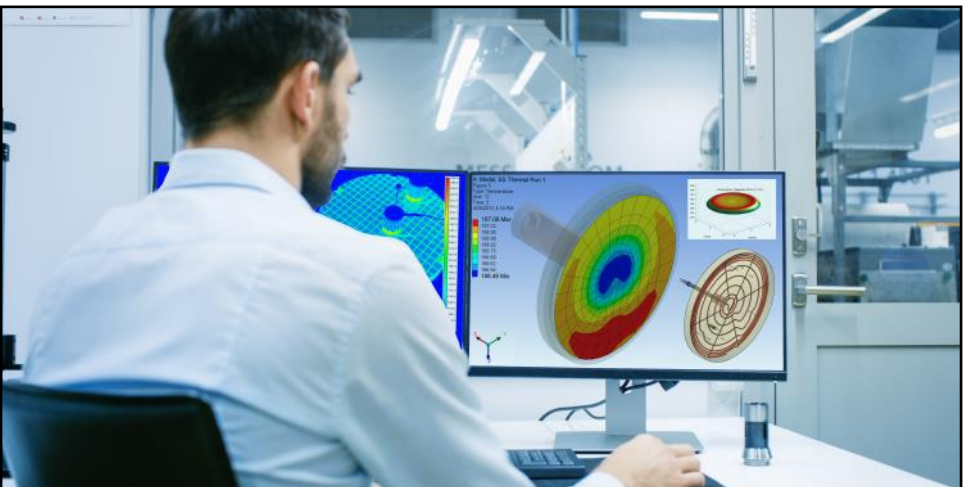
CAS designed and manufactured this pedestal heater using two cable heaters, configured to achieve optimal temperature uniformity. The part also includes a cooling tube and temperature sensors, for easy integration with control systems.



Dual-Zone Cast-In Pedestal with Tubular Heaters

This large 450 mm pedestal heater features two heat zones. The cast-in design was optimized using FEA Thermal Models, to provide outstanding temperature uniformity. Tubular heaters were selected for their higher power output.

Advanced Pedestal Technology

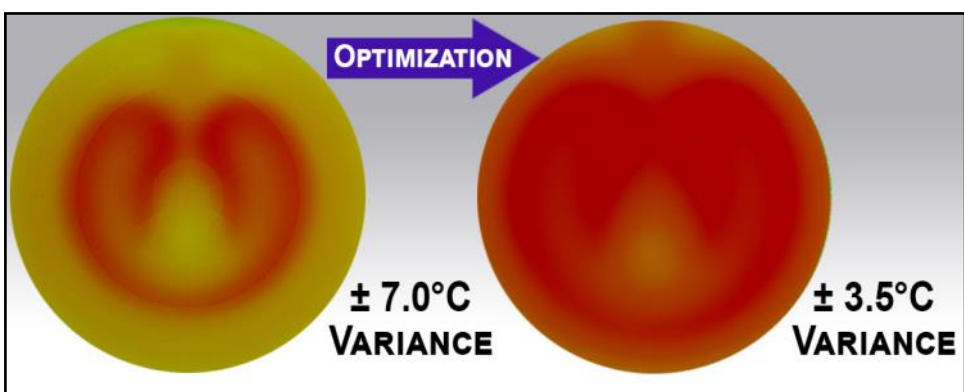


Expertise In Thermal Engineering

The CAS New Product Development Team has tremendous expertise in developing multi-zone pedestals, heat-chill plates, and high-temperature, high-uniformity thermal components for wafer processing.

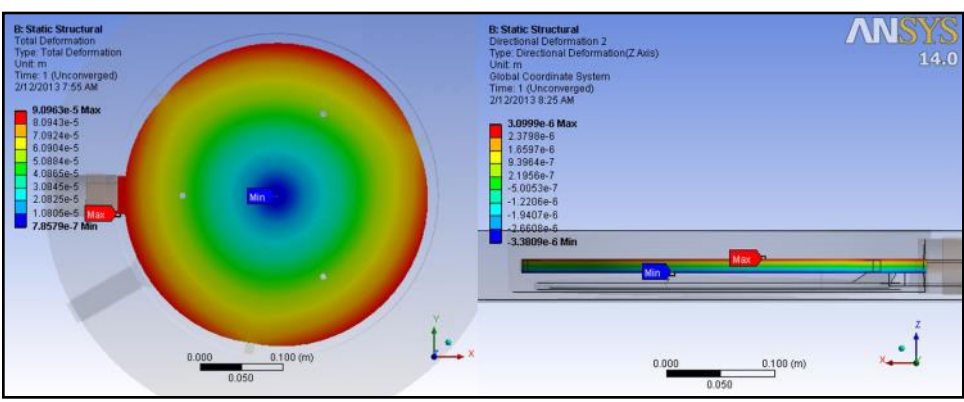
Computer models evaluate thermal and structural behaviors, reducing development timelines and prototype iterations.

Products are then evaluated against models through a rigorous series of real-world performance tests.



Performance Optimization

As part of the development process for all in-chamber components, CAS Engineers complete multiple FEA thermal models and process simulations. Small changes to each simulation drive thermal profiles toward the customer's temperature uniformity and performance targets.



Structural and Thermal Modeling

CAS Engineers employ industry-leading Ansys® FEA applications for thermal as well as structural modeling. This allows us to test and measure structural deflection at elevated temperatures. Internal and dimensional factors can then be adjusted to ensure dimensional stability at full operating temperatures.

Infra-Red Thermal Imaging **Life-Cycle and Uniformity Tests** **Instrumented Wafer Tests**

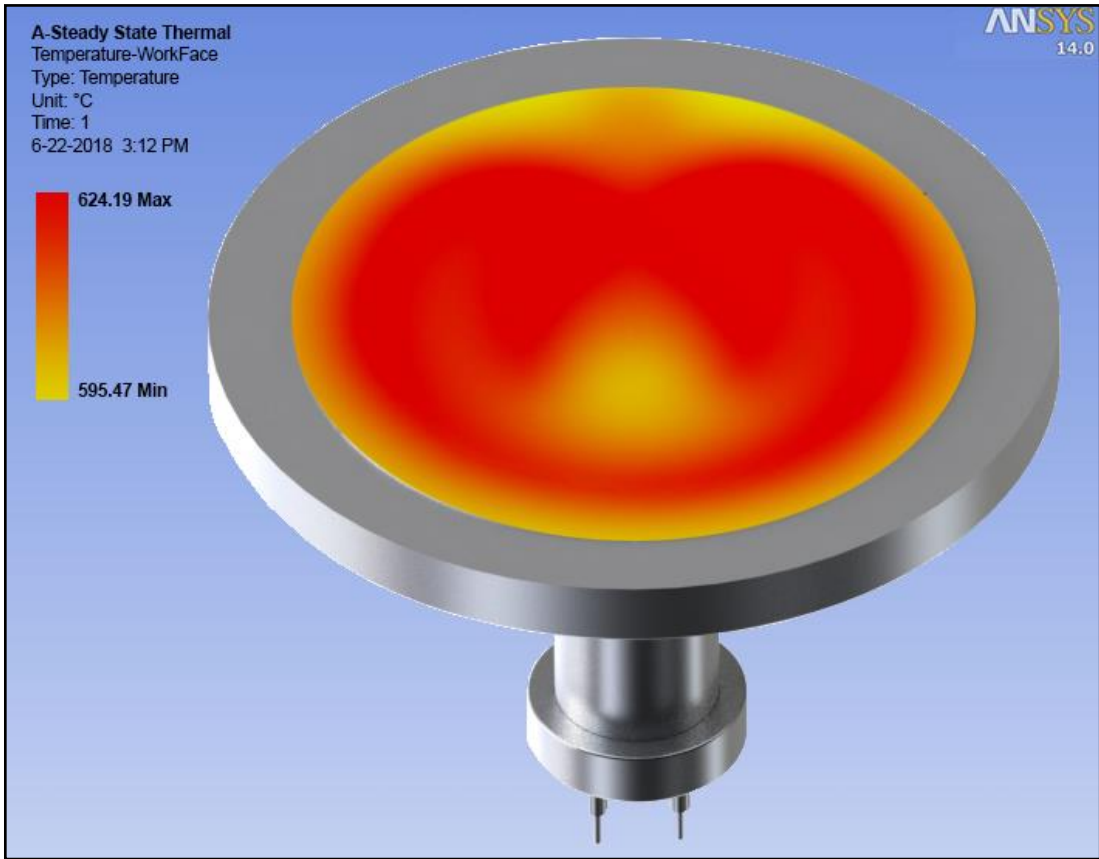
Real-World Testing

Prototypes are manufactured at our dedicated New Product Development cell. Upon completion, new products may undergo a wide array of performance tests at our in-house R&D test lab:

- Infra-Red Thermal Imaging
- Vacuum Chamber Evaluations
- Instrumented Silicon Wafer Profiling
- Life-Cycle Performance Tests
- X-Ray Structural Imaging

Advancements In Temperature Uniformity

Product Optimization Report



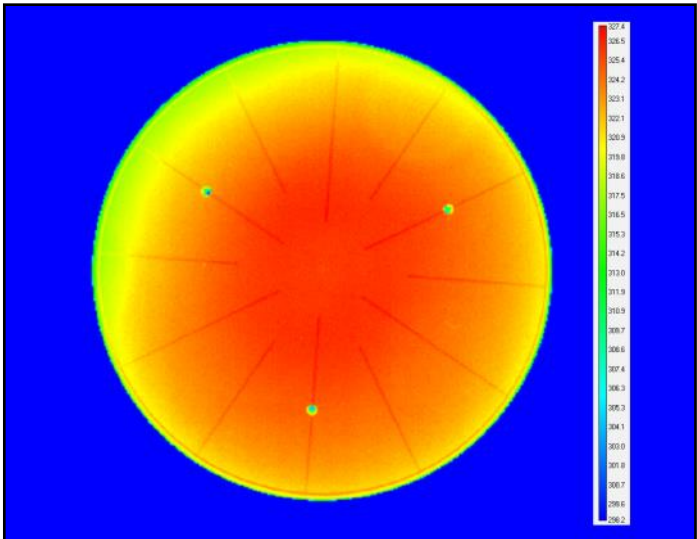
At 624°C, this two-zone pedestal heater has a temperature uniformity of just ±2.3%.

Designed & manufactured by CAS, this 200 mm Inconel heater's uniformity was modeled using the Ansys® FEA application, then performance tested at our fully-equipped R&D Test Lab.



Precision-Machined and Finished

While this pedestal is made from Inconel 625, CAS offers a variety of material choices, and multiple surface finish options. The working surface has a custom groove pattern and lift-pin hole configuration. Pedestal shafts may be TIG or electron-beam welded. Bead blasting was selected to achieve this matte finish.



Testing FEA Models using Infra-Red Imaging

With a fully-equipped on-site test lab, our dedicated New Product Development Team uses technologies such as Infra-Red imaging (here), X-Ray analysis, and Life-Cycle Reliability tests to evaluate the real-world performance of our products. These rigorous trials ensure all CAS products meet or exceed the desired performance parameters, in atmosphere or vacuum