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TB-212 Specifying a Sample or Wafer Heater

In order to accurately specify a heater, the following items should be considered and provided with the request for quotation. This can apply to a simple sample heater or to a complex, custom engineered, heating system. It is not always necessary to have a detailed, scaled drawing but the issues below must be considered. It can be helpful to have a sketch or even a photo to help define the user's requirements. It is also useful to know that the required heater is "like #… except…"

Don't get too hung up on the fine details, as these can be address at a later time. The important thing is to define the features to be able to give a reasonably accurate quotation so that an order can be accepted. HeatWave Labs will then do the detailed design and provide this back to the user for approval before fabrication starts.

A price sheet for our standard heaters, temperature controllers, thermocouples and accessories is available by request at techsales@cathode.com. This information includes examples (photos) of many customized and standard heaters. They can also be seen at www.cathode.com.

1. **Operating Temperature.** Heaters quoted by HeatWave Labs specify the temperature of the heater face. The user must consider the heater face temperature required to get the sample or wafer to the desired temperature. There can easily be a 200C+ difference between the heater face temperature and the wafer temperature. This can be even higher if the coupling between the sample and the heater is known to be poor.
2. **Atmosphere.** User must specify the atmosphere the heater will see both during low temperature as well as high temperature operation. For vacuum application, indicate working pressure. For reactive atmosphere, indicate pressure and components of working gas as well as flow patterns and rates.
3. **Heating and cooling rates.** If this is important, indicate the requirements for rapid heating or cooling. Indicate if secondary cooling is required. Certain materials (alumina for example) are not good for rapid changes in temperature.
4. **Temperature uniformity.** Indicate the desired uniformity across the face of the heater. Remember, in most cases, the heater will be designed to a heater face temperature specification and will only secondarily consider the sample or wafer temperature. Extreme requirements for temperature uniformity can significantly add to the cost. In very extreme cases, the heater and surrounding structure can be computer modeled and heaters with profiled heating patterns can be provided. As a guideline, materials for UHV or inert atmospheres have better uniformity that do materials for reactive atmospheres. For extreme uniformity, the heater diameter is typically larger than the wafer to help overcome edge losses.
5. **Heat Shielding.** All high temperature heaters should be surrounded by radiation shielding to minimize power input to the heater and prolong lifetime. HeatWave Labs generally includes the heat shields but the user can choose to provide their own shielding.
6. **Materials.** Typical materials for UHV heater include Tungsten, Molybdenum, Moly-Rhenium, Rhenium, Tantalum, Alumina, SST, Copper, etc. For reactive atmospheres, these materials can be Nickel, SST, Inconel (or other Ni based alloys), Alumina, etc.
7. **Sealed heaters vs. non-sealed.** Heaters can be designed that isolate the internal heating element from the working chamber. The internal portion can be purged or

differentially pumped. Otherwise, as with most heaters, the internal portion of the heater is shielded from but not sealed from the chamber atmosphere.

8. **Added features for wafer or sample positioning.** Features such as grooves, pins, counter bores, lift pin holes, sample clips, sample motion, etc., can be included. Specify the user's requirements as thoroughly as possible.
9. **Linear/rotary motion.** Specify if the heater is to move in any direction. HeatWave Labs' heaters can be flange mounted with X-Y or X-Y-Z or Z motion and with optional rotary motion.
10. **Thermocouples.** HeatWave Labs can design in thermocouples. This can consist of one, removable Type K TC or could be several permanent TCs distributed across the heater face.
11. **Heater lead (and TC) routing.** Heater and TC leads usually come out the rear of the heater package, off center. These leads could instead be routed radially outward from the side of the heater. The heater and TC leads could also be routed within a hollow heater support tube (common with sealed heaters).
12. **Mounting.** The heater package can have a simple bolthole pattern on the backside or can have a supporting stem. The orientation of the heater can be vertical or horizontal. It can also be perpendicular or normal (or any angle) to its mounting surface.

Where to Get More Information

For the latest information, please visit our website: www.cathode.com.

We may also be reached in the following ways:

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