

APPLICATION NOTE

In-Situ Temperature Measurement and Control of Water-Cooled Electrostatic Chuck Using Fluoroptic Thermometry

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The use of electrostatic chucks to hold wafers during processing is becoming more and more frequent. Precise, repeatable temperature measurement and control of these electrostatic chucks is one of the challenges faced by semiconductor equipment manufacturers. Luxtron technology, Fluoroptic™ Thermometry (FOT), can provide the semiconductor equipment manufacturers with the measurement precision needed for temperature measurement and control of these electrostatic chucks. Luxtron's FOT systems offer temperature measurement from -195°C to +450°C, up to .01°C resolution, control to 0.1°C, repeatability of 0.1°C and immunity to all forms of electromagnetic interference.

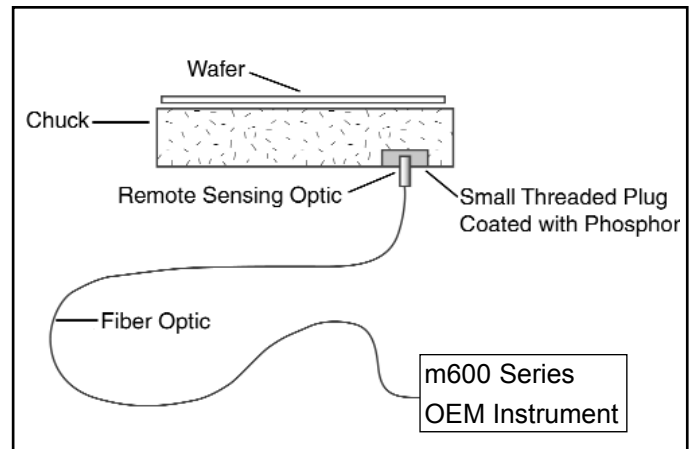
One Luxtron OEM customer has demonstrated 0.5°C control of their electrostatic chuck with a remote phosphor fiberoptic probe. The electrostatic chuck temperature was measured by installing a small threaded plug (0.25 in. diameter) coated with phosphor on the surface, monitoring the phosphor with a remote fiberoptic probe located near the chuck and using a Luxtron OEM m600 Series temperature measuring system.

The phosphor powder, mixed with a binder, was directly coated on to the surface of the plug, which was installed on to the electrostatic chuck. A 400µm-core fiber, with polished open end, located at a small distance (up to 0.25 in.) was used to communicate with the sensor-coated surface. If the sensor coating is thin, the sensor essentially stays in continuous thermal equilibrium with the surface with very little thermal gradient. A coating

of 0.005 in. is adequately thick from an optical standpoint, yet sufficiently thin from a thermal standpoint.

A 400µm-core fiberoptic extension was used to connect the remote fiberoptic probe, located near the chuck, to a Luxtron OEM m600 Series fiberoptic thermometer measurement and control system.

These FOT measurement capabilities represent significant improvement over traditional temperature measurement technologies and are making it possible to achieve advances in understanding and control of a variety of semiconductor processes.

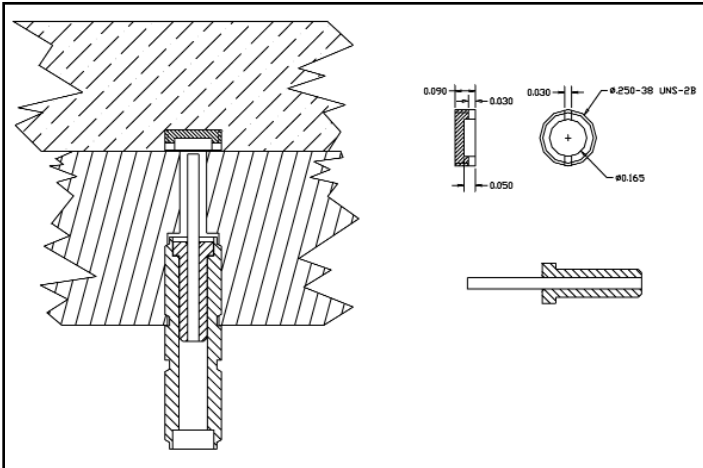


Fluoroptic Thermometer for E-Chuck Temperature

Luxtron's m600 Series Fluoroptic® Thermometer, designed specifically for OEM applications, is a board level solution to measuring temperatures requiring immunity from aggressive electromag-



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netic environments. This is ideally suited for precise and repeatable temperature measurement and control of electrostatic chucks during semiconductor wafer processing. The m600 Series Series Fluoroptic® Thermometer features a broad temperature range of -195°C to $+300^{\circ}\text{C}$ and an accuracy of $\pm 0.5^{\circ}\text{C}$ with calibration. An RS-232 interface and analog outputs are provided. A wide variety of non-metallic, optical fiber based probes, both contact and non-contact, are available to satisfy virtually any application.

Luxtron OEM customers have demonstrated $\pm 0.5^{\circ}\text{C}$ control of their water-cooled electrostatic chucks and cathode plates using m600 Series Fluoroptic® Thermometer with remote phosphor fiberoptic probes.

Luxtron m600 Series fiberoptic thermometer measurement and control system offers:

- 0.01°C Temperature Resolution
- Continuous Temperature Measurement from -195°C to $+300^{\circ}\text{C}$
- Repeatability of 0.5°C
- Complete immunity from RF, Microwave and all other forms of EMI