



HIGH TEMPERATURE STRESS AND CURVATURE ANALYSIS

FAST AND FLEXIBLE SCANNING

Leveraging k-Space Associates' expertise in integrating critical thin film metrology equipment, the **Thermal Scan** system combines the patented MOS (Multi-beam Optical Sensor) stress measurement technology with a high performance thermal processing chamber and gas delivery system. By integrating a single axis scanning stage, spatially-resolved curvature and stress measurement as a function of sample temperature is now possible. For rapid thermal processing measurement, the Thermal Scan system can acquire data at fast rates at a single wafer point in order to ensure accurate, time-resolved stress information is obtained.



Simple loading for samples up to 300mm

Applications include:

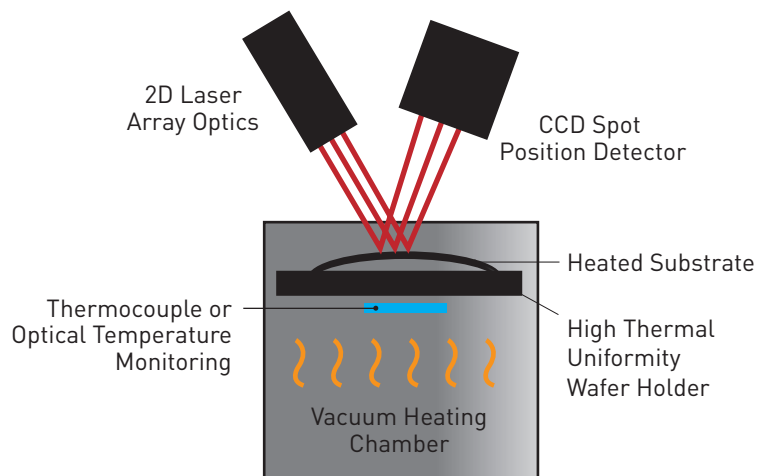
- Semiconductor wafers (Silicon, SOI, Compound Semiconductor)
- High performance optical coatings (mirrors, lenses, glass)
- Rapid thermal annealing (RTA) and tempering processes

> FEATURES

- Patented Multi-beam Optical Sensor (MOS) technology
- Annealing in vacuum and low pressure inert gas environments at temperatures from RT to 1000 °C
- Sample heating via cross lamp halogen array
- Rapid cooling option available
- Real time thermal stress analysis with 30 data points/second
- Stress vs. temperature curves
- Curvature vs. temperature curves
- Customized gas delivery options available (Nitrogen, Argon, Oxygen)

> BENEFITS

- High speed data acquisition for stress analysis during annealing, tempering, or other high temperature processes
- 2D quantitative film stress analysis
- Uniform sample heating yields accurate spatially-resolved stress measurement



> PATENTED 2D OPTICAL ARRAY TECHNOLOGY

2D LASER ARRAY DIRECTLY MEASURES CURVATURE WITHOUT USING ROTATING MIRRORS OR COMPLEX OPTICS

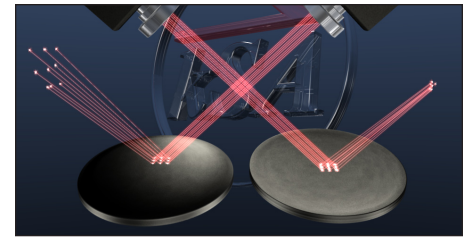
A single laser is used to generate a two-dimensional laser array. Changes in the beam spacing are used to determine curvature and subsequent stress during thermal ramping and soaking at up to 30 data points/second. In this way, the MOS Thermal Scan measures a true physical property in two dimensions that other systems, which use a point/line scan with mechanical restoring technique, cannot capture.

The ability to directly image and view the entire reflected laser array greatly simplifies use and alignment compared with position-sensitive detector techniques. Simultaneous detection of the array makes the measurement inherently less sensitive to sample vibration compared with scanning-laser systems, leading to increased curvature resolution capability (10x). And because all the laser spots move together at the same frequency, movement or tilt is not detected as a change of curvature. Through the use of sophisticated image processing and data analysis algorithms, the Thermal Scan can easily detect micron-sized changes in spot position. With multiple chamber and gas introduction options, kSA MOS Thermal Scan provides unprecedented curvature and stress resolution during high temperature sample heating/cooling/annealing in most any gas environment.

> THERMAL SCAN STANDARD SPECIFICATIONS

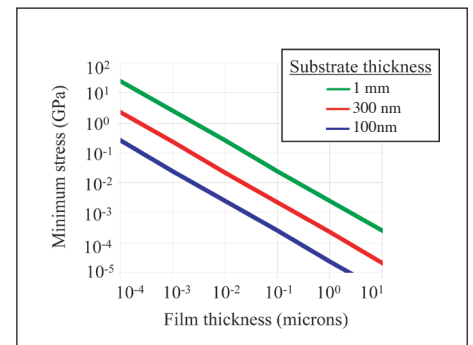
Substrate Capability	Any polished surface with > 2% reflectivity (@ 658 nm)
Substrate Size	Up to 8"
Temperature Range	RT- 1000 °C (cooling stages also available)
Ramp Rates	Heating: >10 °C/sec. Cooling: 600 °C max 50 °C/min, 400 °C to RT max 5°C/min *Faster heating and cooling rates available
Spatial Scan Resolution	User selectable, up to 2 µm* *Higher resolution stages available
Radius of Curvature Resolution	Up to 100 km (1 sigma) at RT 20 km at High Temperature
Average Tilt Repeatability	<1 microradian (1 sigma)
Average Curvature Repeatability	<2x10 ⁻⁵ 1/m (1 sigma)

> HOW IT WORKS



Stress in thin films induces curvature in the substrate. The kSA MOS Thermal Scan system measures localized curvature by monitoring the deflection of parallel beams of light. Tensile film stress induced within the sample creates convex sample curvature changes (left image), while compressive film stress induces concave curvature changes (right image). kSA MOS Thermal Scan measures these changes in 2D with high resolution and speed.

> STRESS RESOLUTION



Depending upon substrate and film thickness, kSA MOS Thermal Scan can detect stress in the MPa range.

> HARDWARE CONFIGURATIONS

Option/ Part Number	Description
kSA MOS Thermal Scan with 100mm Sample Capability MOS-TS100	kSA MOS Ultra-Scan with Line Scan and integrated vacuum heating chamber, pumping, and inert gas delivery for samples up to 100 mm in diameter.
kSA MOS Thermal Scan with 200mm Sample Capability MOS-TS200	kSA MOS Ultra-Scan with Line Scan and integrated vacuum heating chamber, pumping, and inert gas delivery for samples up to 200 mm in diameter

Features: Provides multi-segment ramp/soak recipe control and is a convenient solution for annealing studies. Curvature and stress can be monitored and plotted as a function of temperature. Standard operating range of RT-1000 degrees C for non-IR transparent substrates.