MicroSense

UltraMap UMA-C200-STR

Thin Film Stress Measurement System

In Process Geometric Characterization of Silicon Wafers and Thin Film Stress using Full Wafer Mapping

Automatic, non-contact measurement of filmed, patterned and bare wafers - 150mm & 200mm diameter.

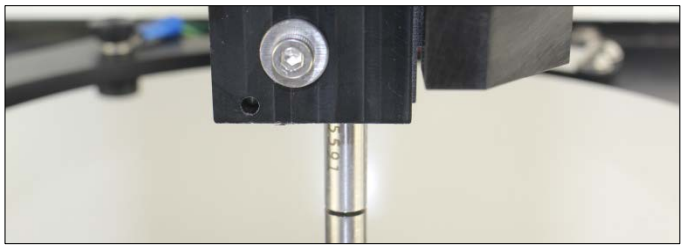
The MicroSense UltraMap UMA-C200-STR measurement system provides full wafer, high speed geometry measurement of silicon wafers using non-contact capacitance sensors with nanometer level thickness resolution. Over 120,000 data are measured on each wafer to generate high resolution wafer maps.

The system measures the thickness, flatness, bow and warp of the wafer in compliance with SEMI standards. MicroSense UltraMap StressMap software provides accurate measurement of wafer stress based on high resolution wafer pre- and post deposition shape data.

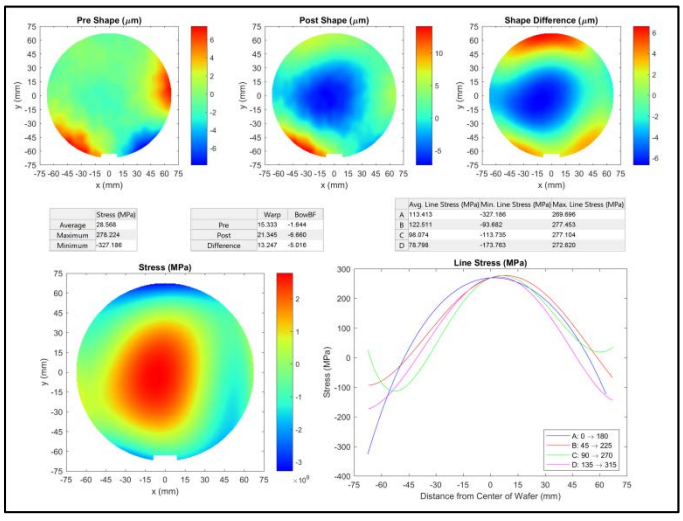
The system automatically calibrates before and after each wafer is measured for best repeatability. Wafers are robotically loaded into the system, then automatically positioned during measurement by a precision direct drive air bearing X-Y stage.

UltraMap Measurement Software – a powerful, versatile wafer data analysis tool for precise process control

MicroSense UltraMap software provides a complete range of SEMI standard wafer thickness/flatness/shape measurements, including local and global flatness, and wafer stress. Both 2D and 3D wafers maps are provided. MicroSense Stress Map software provides a comprehensive set of wafer stress metrics based on full wafer mapping.



Nanometer resolution capacitance sensors



Wafer thickness, wafer shape and full wafer stress, based on full wafer mapping

UltraMap UMA-C200-STR

Thin Film Stress Measurement System

Full Wafer Local Stress Mapping for Process Optimization

Get your thin film process under control to improve yield with UltraMap

Stress measurement of the critical thin film layers is required for process tool monitoring, optimization and matching for yield maximization.

- Stress non-uniformity can have an effect on device performance.
- Stress non-uniformity can lead to device failure due to peeling/cracking.
- High stress causes chucking problems (defocus) at lithography because of excessive wafer bow.
- As manufacturers transition from 150mm silicon wafers, stress metrology for 200mm wafers helps to reduce wafer edge exclusion zones to increase yield, it is a useful tool for solving yield issues with near edge die.

UltraMap system does high speed, full wafer mapping, providing high density data to generate local stress maps for the entire wafer

Legacy stress measurement tools, typically using a single sided laser measurement of the wafer, have significant limitations. These include very limited data – typically a single diameter scan of the wafer with typically 50 or 75 data points, large edge exclusion – 10mm to 25mm, and low throughput. The MicroSense UltraMap rapidly *scans the entire wafer* before and after deposition, generating a full wafer shape difference map with *120,000 measured points*. The *full wafer* shape difference map (*figure 1*) is used to generate wafer Radius of Curvature, one of the key variables in Stoney's equation which is used to calculate stress.

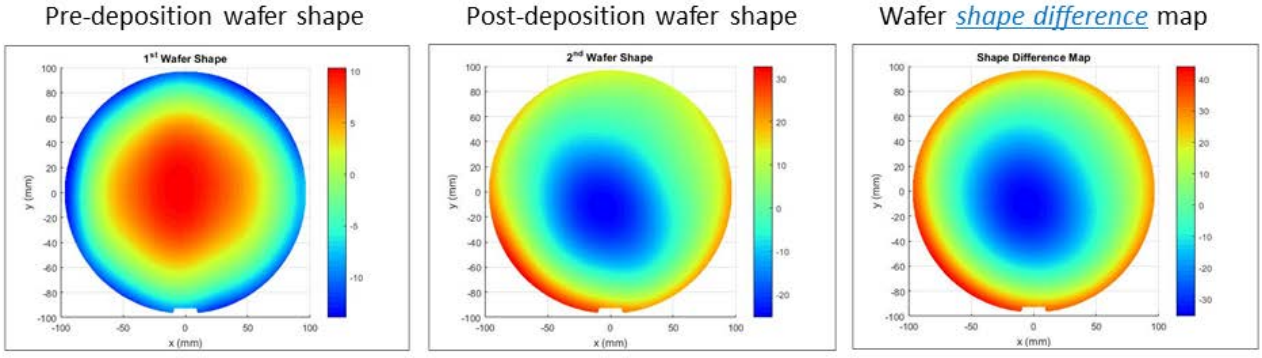


Figure 1 – full wafer shape difference map(r) derived form pre- and post deposition shape maps

UltraMap UMA-C200-STR

Thin Film Stress Measurement System

Achieving good yield as quickly as possible when starting up a new fab or a new process is critical, and the MicroSense UltraMap provides a powerful tool for identifying and correcting stress related yield issues. Full wafer stress mapping offers the process engineer a powerful diagnostic tool. For example, figure 2 shows a local stress map with asymmetrical stress non-uniformity and near edge (5mm edge exclusion effects).

One problem that can occur in production with multiple thin film deposition systems is that there is chamber-to-chamber variation. Two chambers with the same settings can yield different results. Full wafer local stress maps can help to identify system-to-system variation and determine what needs to be done for correction, to eliminate cracking or peeling.

The MicroSense UltraMap also generates local line stress graphs (figure 4). These are particularly useful for comparison to existing manufacturing baseline from legacy systems.

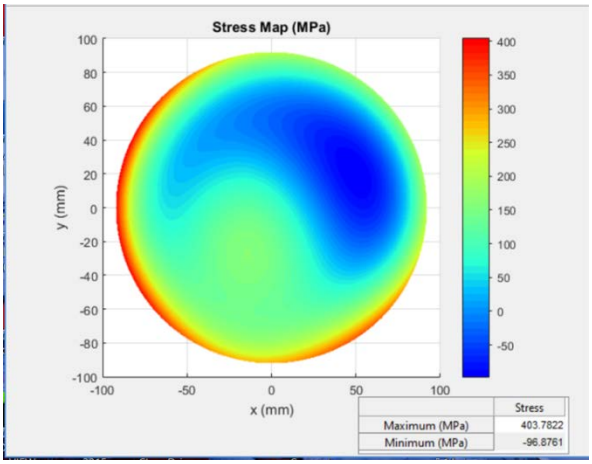


Figure 2 – 2D local stress map

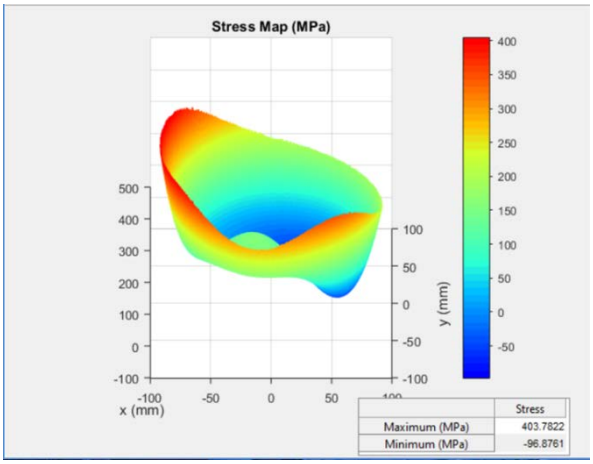


Figure 3 – 3D local stress map

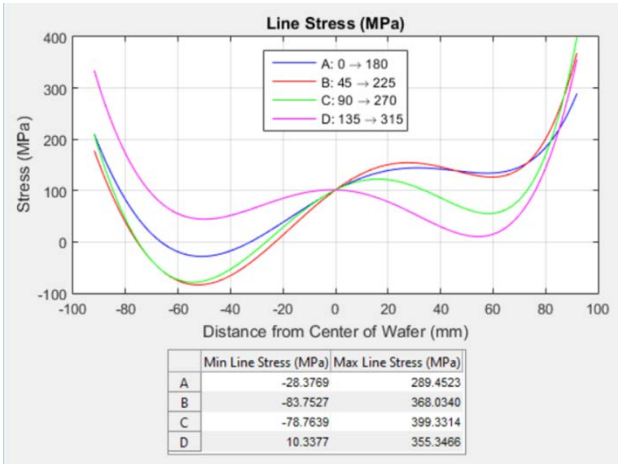


Figure 4 – Select Line Stress

The MicroSense UltraMap UMA-C200-STR provides comprehensive data for every wafer measured:

- Wafer thickness
- Average wafer bow and warp, Average wafer radius of curvature
- Average wafer film stress
- 2D Local Stress Map with Min and Max values
- 3D Local Stress Map with Min and Max values
- Local Line Stress Profiles with specified orientation, including Min and Max values.
- All data and maps are exportable

UltraMap C200-STR System

Measurement Parameters	Accuracy[1]	Repeatability[2] One Sigma	Display Resolution
Thickness: Center, Minimum, Maximum, Average	± 0.10 µm	0.05 µm	10 nm
Global Flatness: TTV TIR FPD	± 0.05 µm	0.05 µm	10 nm
Local Flatness[3]: Local Thickness Variation (LTV) Local Total Indicator Reading (LTIR) Local Focal Plane Deviation (LFPD)	± 0.05 µm	0.05 µm	10 nm
Bow and Warp Bow Warp Sori		0.25 µm + 0.5% of reading	10 nm

1 Accuracy to a known standard. Multiple C200 metrology systems will match to within the accuracy spec.
2 Repeatability one sigma specification based on ten passes, wafer load and unload.
3 LTV = SBIR, LTIR = SFQR, LFPD = SFQD

	150mm	200mm
Measurement Throughput (Wph) – full wafer mapping	65	50

Data Analysis	Measurement Parameters: Thickness, TTV, TIR, LTV, Bow, Warp Wafer Maps: Contour, 3D Surface, Site LTV, Wafer Stress

Wafer Specifications

Diameters: 150mm, 200mm
Diameter Tolerance: ± 0.5mm
Thickness Range: 300 to 1400 µm
Dynamic Range:
- Thickness: ± 150 µm
- Bow/Warp: ± 250 µm

Surfaces:
- Sawn, Lapped, Polished

Fiducials: Semi Flat, Notch

System Configuration

Wafer Handling: Robotic
Measurement Positioning: Precision Air Bearing
Pre-aligner: Included
OCR Reader: Optional
SECS/GEM: Optional
Cassette Stations: 2 cassettes standard,
Calibration: Automated
Reliability (MTBF): 10,000

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