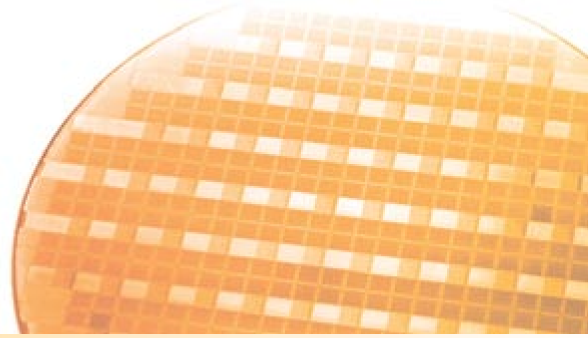
Toho Technology Corporation



FLX-2320-S

Film Stress Measurement System

THE FLX-2320-S FILM STRESS MEASUREMENT SYSTEM *provides accurate stress measurements on various films and substrates. This tabletop system is ideal for research and development purposes, resolving problems such as metal and dielectric film cracking, voiding, and lifting formation.*

The FLX-2320-S is equipped with a heating element for stress monitoring at high temperature temperatures, and an optional cooling unit that allow a thorough understanding of film properties at temperatures from -65°C to 500°C. An inert flush capability offers a controlled atmosphere in nitrogen or argon, preventing oxidation and moisture effects.

STRESS CALCULATION The FLX-2320-S determines stress by measuring the curvature change of pre- and post-deposition of the film. This difference in curvature is used to calculate stress by way of Stoney's equation, which relates the biaxial modulus of the substrate, thickness of the film and substrate, and the radius of curvatures of pre- and post-process. Curvature is measured by directing a laser at a surface with a known spatial angle. The reflected beam strikes a position sensitive photodiode. The geometry of the film is recorded by scanning the surface.

THERMAL PROCESS DEVELOPMENT A key FLX-2320-S feature is it's ability to produce stress temperature correlations. In-situ stress measurements can be made from -65°C to 500°C at heating rates up to 30°C per mintue (the cooling unit to -65°C is optional). An understanding of stress variations with temperature is essential for characterizing material properties such as stress relaxation, moisture evolution, and phase changes. In turn, this helps monitor and control process parameters such as sputtering power, furnace temperature, and gas flow rate.

ADVANCED LASER TECHNOLOGY The FLX-2320-S features KLA-Tencor's patented dual wavelength technology, which enables the system to select the wavelength most suitable for the particular application. Pre-selecting the optimal wavelength minimizes destructive interference patterns from transparent films such as silicon nitride. In addition, the laser assembly has only a single moving component ensuring low vibration and high accuracy.

COMPREHENSIVE DATA ANALYSIS The intuitive, Windows-based analysis software displays any combination of stress, time, surface deflection, or reflected light intensity measurements. Data analysis features includes:

- Calculation of biaxial modulus of elasticity, linear expansion coefficient, stress uniformity, and file subtraction
- Trend plotting for Statistical Process Control (SPC)
- Calculation of water diffusion coefficient in dielectric films
- Automatic recalculation of stress when film or substrate thickness is corrected
- Two- and three-dimensional views of wafer topography
- Plotting of the measured stress-temperature curve

In general stress is induced when materials of dissimilar coefficients of thermal expansion are bonded together. Films may behave similarly at high temperatures but as films are cooled, materials may contract/expand differently, thus causing stress in the film. With a stressed film, defects such as dislocations, voids, and cracking may occur. The FLX stress measurement system helps troubleshoot applications listed below:

- Aluminum stress-induced voids
- Passivation cracking (nitride, oxide)
- Stress-induced dislocations in silicon
- Electrical test yeild degradation
- Tungsten silicide cracking
- Stress increase in oxides during temperature cycling
- Constant current stress test (CCST) degradation
- Matching metallization expansion on GaAs
- Silicon cracking due to high film stress

Film Stress Measurement System

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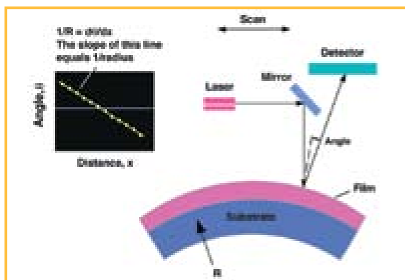
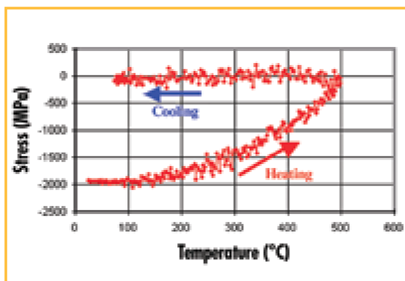
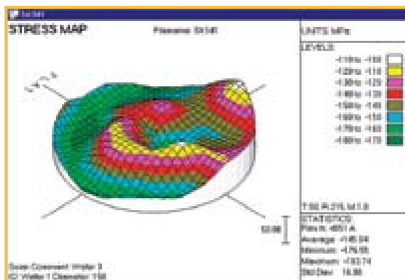
Windows XP Software Platform



The FLX stress measurement system uses the laser lever technique.



The FLX-2320-S provides the ability to draw stress temperature correlations.



3D contour maps help monitor film stress uniformity.

SYSTEM SPECIFICATIONS

- **Temperwature Range:** Standard is Room Temp to 500°C, Optional, -65°C to Room Temp
- **Computer-controlled forced gas cooling:** Allows cooling from 500°C to 100°C in 60 minutes (30 minutes with liquid nitrogen)
- **Wafer Sizes:** 50 mm (optional), 75 mm, 100 mm, 125 mm, 150 mm, and 200 mm
- **Scan Range:** User programmable up to 200 mm
- **Minimum Scan Step:** 0.02 mm
- **Maximum Points Per Scan:** 1250
- **Measurement:**
  - Speed: 6 seconds per wafer
  - Range: 1 x 10^7* to 4 x 10^{10} dyne/cm^2**
  - Repeatability (1s): 1 x 10^7 dyne/cm^2*
  - Accuracy: Less than 2.5% or 1 MPa, whichever is larger*
- **Minimum Radius:** 2.0 m*

* For typical 0.525 mm Si 100 wafer with 10,000Å film and 80 mm scan length.

* Stress upper limit increases and minimum radius of curvature decreases with shorter scan length.

- **Compliance:** a class IIIa laser at 670 nm with 4mW power and a Class IIIb laser at 780 nm with 4mW power. Both lasers comply with 21CFR, Chapter 1, Subchapter J.
- **Computer: (Minimum Configurations)** Pentium 700 MHz, 256MB RAM, 20 GB hard disk, 15" Flat Panel color monitor, and all applications software included. Applications software is based on Windows XP. Printer optional.
- **Physical Characteristics: (Measurement Module)**
  - Height: 46 cm (18 in.)
  - Depth: 46 cm (18 in.)
  - Width: 56 cm (22 in.)
  - Weight: 45.5 kg (100 lbs.)
  - Shipping Weight: 72.7 kg (160 lbs.)
- **Power Requirements**
  - Measurement Module: 200-240 VAC, 50/60Hz, 13A
  - Computer: 115 VAC, 50/60 Hz, 5.4A

U.S. Patent Nos. 5134303, 5248889
Specifications subject to change

* For a typical 525 μm Si (100) wafer with 10,000Å film and 80 mm scan length.

** Stress upper limit increases with shorter scan length.

Toho Technology manufactures the FLX-2320 on the original KLA-Tencor design KLA Tencor

All brands or product names may be trademarks of their respective companies.
Toho Technology reserves the right to change the hardware and/or software specifications without notice.

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