TOHO FLX-2320-S STRESS MEASUREMENT SOP

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Introduction

The FLX-2320-S determines stress by measuring the curvature change of pre- and post-film deposition. The stress calculation is based on Stoney's equation, which relates the biaxial modulus of the substrate, thickness of the film and the substrate, and the curvature change.

Operating Safety

- **Laser:** The FLX-2320 contains two 4 mW solid-state lasers with wavelengths of 670 nm and 780 nm. A shutter will automatically block the laser beam when the chamber door is opened for loading and unloading a wafer. Therefore, there will be no reflected laser light from sample.
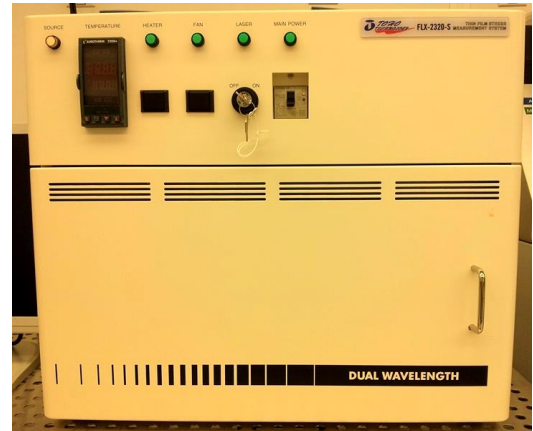
Starting-Up The Instrument

1. Turn **ON** the Main Power switch.
2. Turn **ON** the Laser.
3. Turn **ON** the computer and select the Toho Icon.

Using Wafer Locator Rings

1. The wafer locator ring is used to position the wafer at the center of the sample stage. Available ring sizes are 4", 6" and 8" wafers. Wafers will fit into the center of the locator ring. The locator ring is marked at 30° intervals and is notched at 15° intervals. Rotating the locator ring and wafer will map stress across the entire wafer.
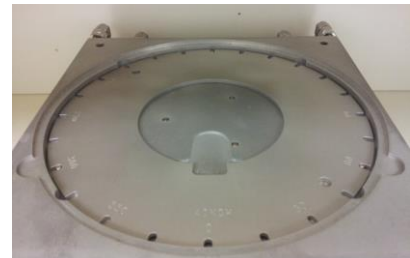
Performing Measurements

NOTE: The first step in measuring

1. Setting up a Process Program

    a. From the **Edit** menu, choose **Process Program**

    b. In the **Process Program** dialog box, select the desired parameters (referencing followings):

Field	Description
Maximum Scan Points	A maximum of 1250 points per scan can be used but 50 points are sufficient for an accurate measurement. Also only 50 data points are saved with each scan to save space on the hard disk

Low Intensity Alarm	Specify an intensity limit below which measurement points will be ignored; 0.2 is recommended.
Elastic Modulus	The biaxial elastic modulus of the substrate.
Hole Diameter	The diameter of the center region of the substrate. This can be skipped.
Laser Selection	Use the drop-down list to select Automatic, 670 nm or 780 nm.

2. Go to **Measure** tab and select **First Stress Measurement.** With the door closed the laser will travel across the substrate and measure the stress before your film deposition or other process.

3. Go to **Measure** and Select **Single Stress Measurement**
   a. Enter the same **filename** as in the First Stress Measurement
   b. Enter the same **ID** as entered in the First Measurement
4. Stress-Time Measurement
   a. Total number of records in a data file are limited to 1000
   b. Enter the same **filename** as in the First Measurement
   c. Enter the same **ID** as entered in the First Measurement
   d. Enter the **Time Interval** the wafer will be measured
   e. Enter the **Total Time** the wafer will be measured
5.
Creating and Displaying Graphs
1. Creating Graphs
   a. Display a data file in the **Data Editor** window
   b. Choose **Create** from the **Graph** menu
   c. Enter desired parameters
   d. Choose the **Create Graph** button, the graph for the selected file is displayed
   e. To display a graph of only some records, select the block of records, then choose **Create Graph**
2. Creating a Trend Plot
   a. Display a data file in the **Data Editor** window
   b. Choose **Trend Plot** from the **Graph** menu in the **Data Editor** window
   c. Enter desired parameters using following references:

Field	Description
Upper SL	The Upper Specification Limit in stress
Lower SL	The Lower Specification Limit in stress Calculate STD Y calculates the standard deviation; the specification limits will not be displayed.

   d. Choose **Trend Plot** from the **Trend Plot** dialog.

Data Analysis

1. Diffusion Coefficient

NOTE: The diffusion coefficient graphs only can be calculated from Stress-Time graphs.

   a. To calculate the diffusion coefficient and plot it in a **Graph** window, choose **Diffusion Coefficient** from the **Analysis** menu

   b. Select the desired filename

   c. Select two points on the graph by double-clicking on the points.

   d. A plot of Diffusion Coefficient vs. Time will be displayed.

2. Materials Database

   Use the Materials Database option in the Edit menu to display a list of available elastic & expansion coefficients.

3. Elastic and Expansion Coefficient Calculation

NOTE: Elastic and Expansion Coefficient only can be calculated from Stress-Temperature graphs.

   a. Use the Stress-Temperature mode to run two temperature cycles on two different substrates with the same film. For best results, use slow heating or cooling (<5°C/min) to minimize the lag of wafer temperature behind the heating stage

   b. Choose Elastic & Expansion from the Analysis menu

   c. Enter the film names

   d. Click on two points to plot and display the expansion coefficient

   e. The average values of the expansion coefficient and the biaxial modulus display in a dialog box

4. Thermal Stress

NOTE: Use the Thermal Stress option to display the thermal stress superimposed on the stress-temperature measurement data.

   a. Choose Thermal Stress from the Analysis menu

   b. Enter the file name

   c. Enter the temperature range

5. Displaying Deflection Maps

NOTE: Use the Deflection Maps to display 3-D view of the deflection. By taking several measurements at different angles, you can display a complete 3D map of deflection over the wafer surface. The deflection can be plotted as the difference of two groups of measurements (before- and after- a film deposition) or as an absolute deflection of a single measurement.

   a. Measure the wafer at different angles using a wafer locator ring.

   b. The IDs for each measurement in a group should be identical and in the format xxxx-###, where XXX is any character (including spaces) and ### is the angular orientation. For example, the IDs for wafer T12 measured every 15° would be as follows:

T12 – 0	T12 – 60	T12 –120
T12 – 15	T12 – 75	T12 -135
T12 – 30	T12 – 90	T12 -150
T12 – 45	T12 -105	T12 -165

   c. When comparing two scans (before and after deposition), the first four ID characters must be identical for both scans and the orientation steps used must also be the same. Also, the dash must be in the fifth column and the ### portion must be right justified.

   d. Choose 3D Plotting from the Analysis menu.

   e. To change the viewing angle, use the following key combinations:

Key Combination	Description
F7	30° increment
CTRL + F7	Face on view
ALT+F7	10° increment
F8	30° increment
CTRL + F8	Face on view
ALT+F8	10° increment
F9	45° increment
CTRL + F9	90° increment
ALT+F9	15° increment
F10	45° increment
CTRL + F10	90° increment
ALT+F10	15° increment
F11	Compress the view vertically by 50%
F12	Stretch the view vertically by 50%

Shutting-Down the Instrument

1. Close all open windows and turn **OFF** the computer.
2. Turn **OFF** the Laser and Main Power Breaker on the front of the tool.