

TOHO THIN FILM STRESS MEASUREMENT FLX-2320-S SOP (w/o Temperature Variation)

Revised April 2020

Introduction

The FLX-2320-S determines stress by measuring the curvature change of a wafer before and after thin film depositions. Stress (σ) in Pascals is calculated from the radius of curvature from the

$$\sigma = Eh^2 / (1-\nu)6Rt$$

where $E/(1-\nu)$ is the biaxial elastic modulus of the substrate or 1.80510^{-11} Pa for <100> silicon, h is the substrate thickness in meters, t is the film thickness in meters, R is the substrate radius of curvature in meters.

Operating Safety

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

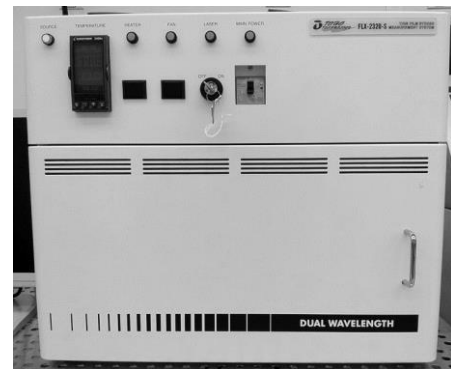


Figure 1. The front of the Toho FLX-2320-S

Starting-Up the Instrument

NOTE: Don't forget to login into your FOM account and login to your session to use the tool.

1. Turn **ON** the Main Power circuit breaker switch on the front of the tool, Figure 1.
2. Turn the key switch to **ON** to turn on the laser.
3. Turn on the computer and select the WINFLX icon. Select the login user name or create a new user name.
4. Wafer locator rings are used to position the wafer at the center of the sample stage. Select the correct wafer locator ring for the substrate and position it in the tool, Figure 2. **Make sure the ring sits flat in the stage.** Available ring locator sizes can accommodate 4", 6" and 8" wafers. Each locator ring is marked at 30° intervals and has a notch at each 15° interval. By rotating the ring and wafer, stress mapping across an entire wafer can be performed.

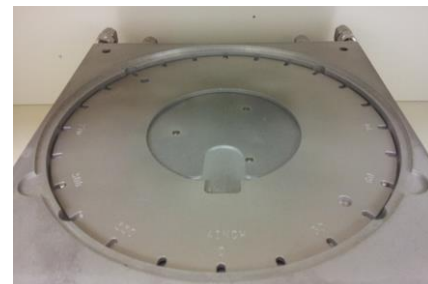


Figure 2. Installed wafer locator ring

Setup a Process Program (*.PRC filetype)

1. Go to the **Edit** menu and select **Process Programs**. A Process Program specifies the type of substrate, wafer diameter and other tool parameters.
2. Either select an existing Process Program and or create a new Process Program using steps 3 through 13 listed below.
3. Set **Maximum scan points** to 50.
4. Set the **Low intensity alarm** to 0.2
5. Set the **Elastic modulus** to the preferred material. For <100> silicon substrates the value should be **1.805 Si 100**.
6. Set the **Substrate thickness** in microns. A micrometer is available for use nearby the Toho to measure substrate thicknesses.
7. Enter the **Wafer diameter** in millimeters.
8. Set the **Hole diameter** to zero.
9. Turn on **Save Scan** and **AutoScan**.
10. For **Units** select **MPa**.
11. For **Wafer** select **Flat**.
12. For **Laser Selection** select **Automatic**.
13. Turn on **Automatic Stress Calculations**.
14. Select **Save** and save the name of your *.PRC program.

First Measurements with No Depositions on the wafer - Baseline Measurements

NOTE: These first measurements are not stress measurements, but establish a baseline before depositions are performed on the wafer. If these steps are not followed, then stress measurements will be incorrect!

1. Go to the **Measure** tab and select **First (no film)**.
2. In the **File** window enter a new file name (**.DAT**) for data to be stored to or select a previous **.DAT** file to append your data.
3. In the **ID:** window enter the angle of the wafer locator ring (i.e. 0, 30, 60, 90 or 0, 45, 90, 135) or some other preferred notation.
4. In the **Orientation** window enter the angle of the wafer locator ring (i.e. 0, 30, 60, 90 or 0, 45, 90, 135).
5. In the **Comment** window enter some preferred notation (i.e. before deposition) or leave blank.
6. Measure the thickness of the substrate and enter the thickness in microns in the **Substrate thickness:** window. A micrometer is available for use nearby the Toho to measure substrate thicknesses.

7. Place the wafer into the wafer locator ring and close the door of the tool.
8. Select the **Measure** box and the tool will perform the first radius of curvature measurement.
9. Open the door, remove the wafer and rotate the wafer locator ring to the next angular increment. It is advised to use either (4) 30 or 45 degree increments (i.e. 0, 30, 60, 90 or 0 45, 90, 135 increments).
10. Make sure the wafer locator ring is sitting flat on the stage.
11. Place the wafer into the wafer locator ring in the new angular position and close the door.
12. Repeat steps 4 through 11 until (4) measurements have been achieved.

Stress Measurements after depositions have been performed on the wafer

1. Go to the **Measure** tab and select **Single**.
2. In the **File** window enter the same **.DAT** file name used for baseline or First data measurements.
3. In the **ID:** window select angle of the wafer locator ring used previously.
4. In the **Orientation** window select angle of the wafer locator ring used previously.
5. In the **Comment** window enter some preferred notation (i.e. after deposition) or leave blank.
6. In the **Film Thickness** window enter the thickness of the deposition film in Angstroms.
7. Place the wafer into the wafer locator ring and close the door of the tool.
8. Select the **Measure** box and the tool will perform the first radius of curvature measurement.
9. Open the door, remove the wafer and rotate the wafer locator ring to the next angular increment used during baseline measurements.
10. Make sure the wafer locator ring is sitting flat on the stage.
11. Place the wafer into the wafer locator ring in the new angular position and close the door.
12. Select the **Measure** box and the tool will perform the radius of curvature measurement.
13. The tool will generate a graph and append the **.DAT** file obtained by comparing baseline and after deposition radius of curvature measurements. Stress values can be obtained from graphs created from each radius of curvature measurement or from the **.DAT** file after all measurements have been obtained (see Data File Contents below).
14. Repeat steps 3 through 13 until (4) measurements have been achieved

Data File Contents

Each *.DAT file stores the following data:

ID
Comment
Date
Temperature (°C)
Radius (m)

Stress (MPa)
Film Thickness (Angstroms)
Substrate Thickness (microns)
Elastic Modulus
Time
Wafer Diameter (mm)
Position
Laser Intensity
Start Position of Laser (mm)
End Position of Laser (mm)
Bow (microns)
Laser Wavelength (670 nm, 780 nm or both)
Orientation

Shutting-Down the Instrument

1. Close all open windows and the WINFLX software.
2. Turn **OFF** the computer.
3. Turn the key switch to **OFF** for the **Laser** on the front of the tool.
4. Turn **OFF** the **Main Power** circuit breaker on the front of the tool.
5. Logout from the tool in your FOM account.