



# Dektak XTa Stylus Profilometer

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## Process Overview

The Dektak XTa is a stylus profilometer that measures surface height while scanning a stylus across the surface of a sample. It is a very robust, trustworthy measurement tool for getting the thickness of a variety of samples and for measuring roughness and curvature. Please see this website for more info: <https://www.nanoscience.com/techniques/optical-profilometry/stylus/>

## Safety

- Keep your hands away from the stage and stage motors.

## Allowed Materials and Processes

- Cured Photoresist
- Metal and dielectric step heights
- Etch depths
- Surface roughness
- Film Stress
- 3D maps

## Restricted Materials and Processes

- Do not measure soft, wet, gooey, or tacky samples (anything that can get the stylus dirty).
- Do not measure samples that could flake and get stuck on the stylus.
- Do not attempt to measure features taller than 750  $\mu\text{m}$ . For example, do not try to measure from the stage up to the wafer. The stylus can get caught and damage the instrument.
- Do not change the stylus.

## Important Equipment Notes

- Never move the stage when the stylus is in contact with the sample.
- Do not load samples while the stage is under the measurement head. Always ensure the stage is out.
- Make sure the stylus is well above your sample surface before moving the sample under the stylus.
- When setting DekTak ranges, be sure to select the range most applicable to your sample so that the measurements are not restricted.



## Operating Procedures

### 1. Startup:

- a. Turn on the Dektak XTa by pressing the white “ON” button on the EPO (Emergency OFF) box to the right of the instrument. The “ON” button will illuminate.
- b. Select the Vision64 software on the taskbar.
  - i. The first Operator Prompt will tell you that the XY Stage is about to initialize. Select "OK" and wait for the stage to finish moving.
  - ii. The second Operator Prompt will tell you that the Theta Stage is about to initialize. Select “OK” and wait for the stage to finish moving.
- c. Once the software loads, the Measurement Setup button on the ribbon should be highlighted. Click "Unload Sample" on the “Live Video” window, then place your sample on the stage.
- d. Select “Load Sample” to move the stage back into its home position. Visually confirm your sample is underneath the stylus. If it is not aligned, use the slider in the XY control window to move the sample so it is under the stylus.
- e. Select "tower down" so the stylus is lowered onto the surface of your sample. Be prepared to select “Cancel” if the stylus will not land on your sample. After towering down the stylus retracts to a safe distance.
- f. Control the stylus and theta stage by using the Instrument Control to the right of the live video display. You can adjust the speed of the stage movement using Slow, Med, and Fast buttons, and you can also double click on the screen to move the stylus to a new position.

### 2. Taking a basic measurement

- a. If it is not already selected, press the "Measurement Setup" button on the ribbon.
- b. Under “More Settings” on the left, select “Measurement” to show the Measurement box with additional options.
- c. Ensure that the scan type that is selected is "Standard Scan".
- d. Change the parameters according to the sample that you wish to measure.
  - i. The “Range” is total height that can be measured. Select the value that is greater than but closest to the depth or height of the feature on your sample.
  - ii. The “Profile” is determined by the starting height of the stylus. If your features will only be above the starting point, select Hills. If the features will only be lower, select “Valleys.” If you expect both up and down features or if the range is much greater than your features, select “Hills and Valleys.”
  - iii. Ensure that the stylus type that is selected is "Radius: 2 um"
- e. Change the stylus force. (Higher force for harder samples, length, and duration according to the dimensions and properties of your sample. (It may take a couple scans to get the length as desired). The resolution will change based on the parameters that you give.
- f. Ensure the crosshair is at the bottom of the feature you wish to scan.



- g. Press "Single Acquisition" on the ribbon to start a measurement. Once the measurement is finished, you may use the data analyzer to adjust the visuals of your scan. You may want to use the data leveling option:
- h. Select "Terms Removal (F-Operator)".
- i. Drag the Red "R" and green "M" to opposite ends of an area that you know is flat. Use the small square under the letter to adjust the size of the cursor.
- j. Right click on the graph and select "Level – Two Point Linear".
- k. Drag the cursors to different points on the graph to view the position and height values displayed beneath it.
- l. Repeat this step if you wish to take another scan.

### 3. Taking a Map Scan:

- a. Using the live video display, ensure the crosshair is at the bottom right of the feature or sample you wish to measure.
- b. A map scan is a series of standard scans: begin setting your measurement up as if you were setting up a standard scan by determining the Range, Profile, Length, and duration of a scan).
- c. Change the scan type to "Map Scan".
- d. Select the drop-down arrow next to "3D Map".
- e. Change the map extent:
  - i. Select the "Teach Map Extent" icon to the right of "Map Extent".
  - ii. Select "next" if your crosshair is already positioned at the beginning (bottom right edge) of your feature or sample, otherwise, drive the stage to the desired location and select "next".
  - iii. Drag the crosshair to the bottom left of the feature or sample, indicating the width of your map scan, and select "done". The stylus will automatically readjust to its original position. (You can follow this procedure with the map length as well).
- f. Determine the number of traces (the number of times that the tool will take a standard scan).
  - i. The map resolution value will automatically change based on the value that is given for "Number of Traces".
- g. Double check parameters and select "measurement" when you are ready to take a map scan.
- h. After the scan is complete use the 3D Filter to analyze the 3D Plot. (The suggested terms removal to add may be the "remove tilt" setting in the 3D filter toolbox).
  - i. You should also right click on the Y profile graph to do data leveling in places that you know are level.

### 4. Stress Measurements

- a. Begin by taking thickness measurements of wafer using the drop gauge in Barnard 107. make sure to record measurements for stress calculations (acting as the substrate thickness value).
- b. Setup the Dektak:
  - i. Select "Unload Wafer Stage".
  - ii. Place the three ball bearings in the slots closest to the center of the wafer stage.



- iii. Place wafer on the ball bearings, aligning the wafer flat to the screws on the bottom, and the right side of the wafer against the screw on the right side of the stage.
- iv. Select Load stage.
- c. Select “open” -> “Analyzer Recipe” -> “Stress Measurement”.
- d. Make sure not to adjust any measurement settings.
- e. Notice that the coordinate positions are at (0,0). In the Y position: manually enter -40,000 um, and then select “move”.
- f. Select the green measurement button in the upper lefthand corner to conduct an 80,000-um scan.
- g. Verify that the measurement ran properly and then save the file as a dataset.
- h. Go to measurement setup and select “Unload Sample” to collect your substrate.
- i. After putting a layer of film on the wafer, perform steps 3.a -3. f. (including drop gauge measurement)
- j. After conducting a measurement, right click on stress measurement, and click “edit”.
- k. Use your original thickness measurement for the substrate thickness.
- l. Subtract your substrate thickness from your post deposition thickness to find your film thickness.
- m. Import you Pre-Deposition file data (original measurement on the plane wafer).
- n. Press ok and view you stress curves.
- o. To export data: right click on the graph and select “export data.” Save as a csv file in the proper file location.

## Troubleshooting

- Stylus will not re-null after towering down:
  - Wait for 30 seconds. If stylus continues to be stuck on a feature or sample, select cancel in the top left corner.
  - If this does not work, restart the program, or find an MMF staff member.
- Upon starting the software, an operator prompt appears saying “Initialization Error.”
  - Force quit the software and restart the Dektak.
  - If this does not work find an MMF staff member.
- Stage does not respond to X-, X+, Y-, or Y+ movements.
  - Close software. Turn off the tool using the power switch on the back left. Wait ten seconds and then turn on the tool using the power switch. Wait another ten seconds and then start the software. Home the system and continue.
- USB Communications Error
  - Close the software. If the software will not close, use Ctrl-Shift-Escape and end the task for the software with the Task Manager.
  - Shut off the tool using the switch on the back left. Wait ten seconds and turn the tool on. Wait another ten seconds and restart the software.
  - Proceed from Step 1 – Startup.
- Tool is frozen.
  - Close software and shut off tool using power switch. You may need to use Ctrl-Alt-Delete to terminate the program using the Task Manager.
  - Proceed from Step 1 – Startup.



- Error: Service Initialization Error
  - Contact an MMF staff member

## Version History

- 2022.1 – Original document written by Carson Kapp and Andrew Lingley.
- 2022.2 – Creating automation setup, minor syntax edits, added version history.
- 2023.1 – Edited language and clarified instructions.
- 2024.1 – Improved troubleshooting and clarified language.
- 2025.1 - Added section on stress measurements. Improved language.
- 2025.2 – Converted to Accessible PDF Version by Owen Bunn.