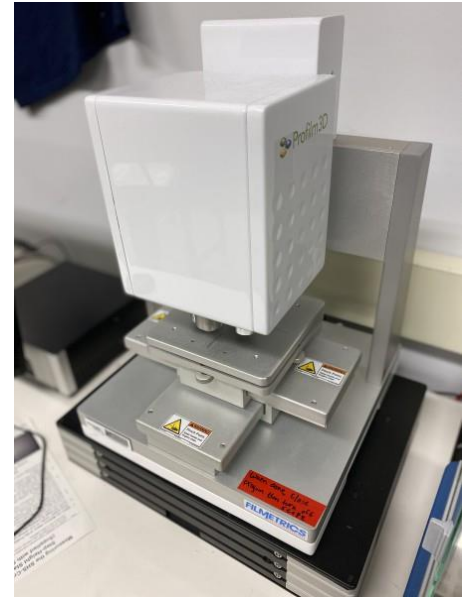


Filmetrics Profilm 3D Operating Procedure

Primary Use

The Profilm 3D Optical Profilometer uses white light interferometry to measure surface profiles and roughness. There is currently a 10x objective. From each image, ProFilm's analysis software can generate analyzable topological maps, which can also be exported as .STL files. Samples should be somewhat reflective (0.05%-100% reflectance) and not transparent like nitride or oxide, have a maximum feature size of 100mm and thickness range of 50nm-5mm or the profilometer will struggle to capture high quality images.



Operating Principle

Optical profilometers use the interference effects that occur when the light reflected from the sample is superimposed with the light reflected by a high-precision reference mirror to create a 3-d image.

Safety

- Do not place your sample before the machine has fully booted up. Take care not to hit the lens with your sample.
- To avoid electrical shocks, do not use the system if it is missing panels and electrical equipment is exposed.
- Do not have your hands near the tool when the stage or optical head is moving.

Allowed Materials and Processes

- Max substrate size: 100mm+ in diameter and up to 5 mm in height.

Restricted Materials and Processes

- Do not place wet or dirty substrates on the stage.

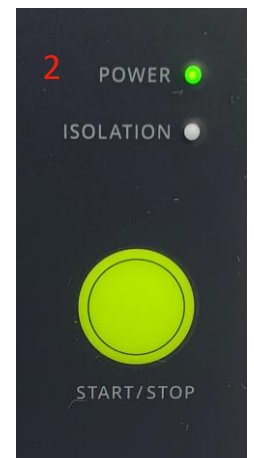
Important Equipment Notes

- Never bump the objective into anything.

- Do not change the zero position in the software.
- Verify that you will not hit the sample when rotating the objectives.
- Verify that you will not hit the sample if you enter a Current Position in the Focus tab or for X and Y in the X-Y Stage tab Move To box.
- The 50x objective working distance (WD) is 3.4 mm. The z-zero position is not set at zero from the stage to help avoid bumping the objective. With a normal silicon wafer, the z height in the software will read close to 1.5 mm when using the 50x objective.
- 5x objective working distance (WD) is 7.4 mm. Do not turn the two silver knobs on the 5x objective. With a normal silicon wafer, the z height in the software will read close to 5.5 mm when using the 5x objective.
- You should not have to adjust the stage tilt very much if at all. If you find you need to, contact staff to get help.
- Do not adjust the mirror on the 5x objective without explicit permission.

Basic Measurement Procedure:

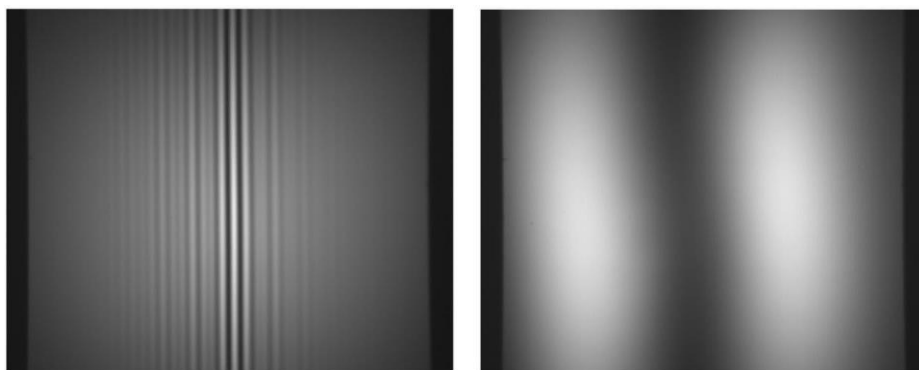
- Using the switch on the back (1), power on the Profilm3D.
- Press the **Start/Stop** button (2) on the Accurion isolator power supply.
- Log in to start the Profilm software. The screen will be blank at first while the hardware initializes. This can take a minute or so; please be patient. Once the initialization is complete, the “Live” tab below the tool ribbons will become active in the software, with a camera view of the stage and three control tabs: **Focus**, **X-Y Stage**, and **Acquisition Settings**.
- If desired, you can change the units in the **Focus** and **X-Y Stage** tabs by selecting **Units** in the **Preferences** ribbon above. An **Edit Units and Numbers** preferences window will pop-up. Millimeters is the default for both.
- If there is not enough vertical height between the objective and the stage for your sample, click and hold the  button in the **Focus** tab to raise the objective head to an appropriate height.
- Press the **Load/Unload** button in the **X-Y Stage** tab to move the stage out. Place your sample on the stage, and then press the  button to move the stage back under the objective.
- Position your sample under the objective using the buttons in the **X-Y Stage** tab.



Running a Manual Scan

- Begin by focusing the image with the 10x objective.
- Move the sample stage to find the desired area of the sample for scanning. It is significantly easier to find the desired area at lower magnification.

- Leveling the stage is important to have an accurate scan of the sample taken. The interference fringes are key for determining how flat the sample is before taking the scan. **The more spread out the interference fringes are, the flatter the sample.**
 - a. If the interference fringes are angled, use both tilt adjustment knobs to level the stage. Use one knob until they are as spread out as possible and switch to the other knob.
 - b. If the interference fringes are vertical, use the tilt knob on the right side of the stage.
 - c. If the interference fringes are horizontal, use the tilt knob on the front of the stage.
 - d. It is some trial-and-error work so just keep twisting one knob until the interference fringes get wider. If they aren't getting wider, try turning the knob the other direction.
 - e. The interference fringes indicate at what height on the sample that is most in focus, this is important to keep in mind when setting up scan length and back scan.



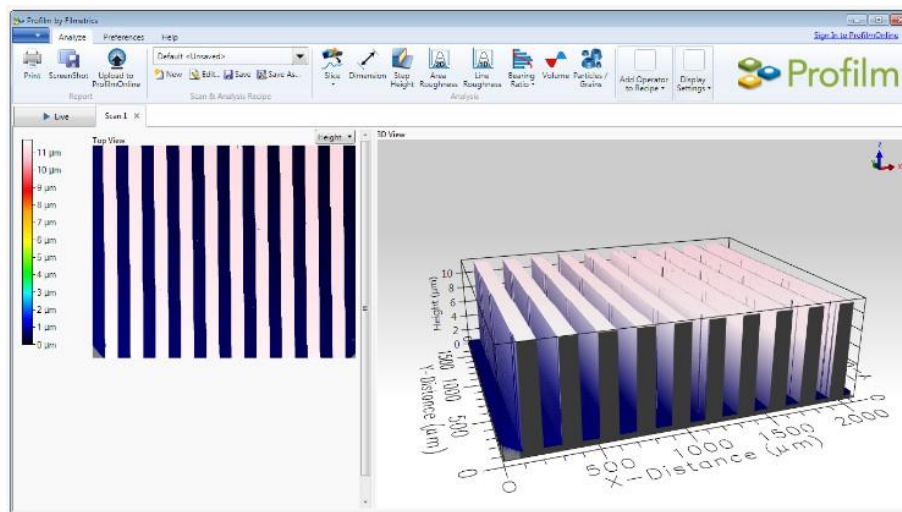
Left: A tilted sample. Right: The same sample but flat after adjustments were made.

- Adjust the leveling and acquisition settings as desired. Be sure that you are focused on the highest point of your sample. This is where intimate knowledge of your sample topography is essential. The backscan and scan lengths should be in relation to the highest sample point.
- Press the play button to take a scan.

Running an Auto-Scan

- Remove interference fringes with the steps listed above.
 - Underneath the stage height arrows, choose a top and bottom height for your scan.
 - After doing so, the scan length will automatically adjust.
 - Based on the magnitude of the scan length, choose an appropriate interferometry method (0-6 micrometers should be scanned with PSI, while WLI can be used for all else).
 - Set the backscan to 0.
 - Press the play button to take a scan.
1. In the **Focus** tab, use the course-focus buttons —  and  — to focus on the *top* focal plane of your sample. Use the fine-focus buttons —  and  — until interference patterns appear. If the pattern is tight like the image at right, the stage tilt may need adjustment. Please consult the User Manual for instructions on adjusting the stage tilt. Once the top focal plane of your sample is in focus, click the **Set Zero** button in the **Focus** tab.

2. Use the course-focus buttons —  and  — to focus on the *bottom* focal plane of your sample. Alternately, if you know the approximate depth/height of your sample structures, you can enter that value (as a negative) into the **Move To** field and click the **Move** button to find the bottom focal plane. Use the fine-focus buttons —  and  — until interference patterns appear. Make note of the value in **Current Position** field.
3. In the **Acquisition Settings** tab, enter a **Backscan** value of 10 μm into the appropriate field. In the **Scan Length** field, enter the *absolute value* of the **Current Position** field *plus* 20 μm (2x the **Backscan** value). For example, if the **Current Position** value is -18.35 μm , enter 38.35 μm . These values tell the tool to start and stop the measurement 10 μm below and above your bottom and top focal planes, respectively. Set the **Scan Speed** to your desired setting.
4. In the **Measure** ribbon, click the **Start** button. A new “Scan” tab will pop up next to the “Live” tab with results similar to those below. The **Analyze** ribbon will replace the **Measure** ribbon.



5. To save your scan data, there are two options:
 - a. Take a screen capture of the “Scan” tab by selecting **ScreenShot** in the **Analyze** ribbon.
 - b. Export your data as a CSV file (readable in Excel) by selecting **General** in the **Preferences** ribbon. A side panel will open; select **Data Recording**.
6. When you have finished taking measurements, go to the “Live” tab and press the **Load/Unload** button in the **X-Y Stage** tab to move the stage out. Remove your sample, and then press the  button to move the stage back under the objective.
7. Close the Profilm software.
8. Press the **Start/Stop** button on the Accurion power and power off the Profilm 3D.