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KLA P-7 Contact Profiler

1. Purpose

Standard operating procedure for the KLA P-7 Contact Profiler. The KLA P-7 is a stylus contact profiler capable of measuring up to 150 mm scan lengths and sub-10 nm step heights. The stylus has a 2 μm tip radius and 60° bevel. This system is ideal for measuring thin film step heights, surface roughness, and etch depths. It is not ideal for exceptionally soft substrates (as the stylus may damage the sample), step heights over 440 μm (as this will damage the stylus), and step heights where the feature width is smaller than 2 μm (as the stylus will not fit into the feature).

2. Scope


This SOP is intended for general purpose use of the KLA P-7 Contact Profiler.

3. Prerequisites

Users must have cleanroom access.

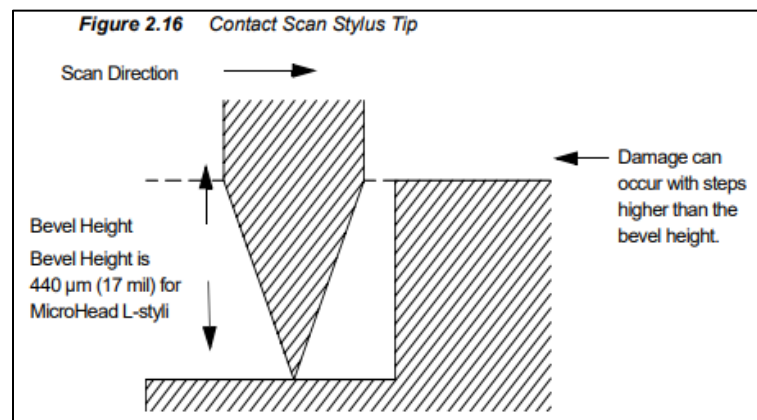
4. Responsibilities

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Yeongjae Shin	(203) 215-9987	
Kelly Woods	(203) 436-0300	

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5. Procedure

Before Your Start: This P-7 profiler stylus has a bevel height of $440\ \mu\text{m}$. Dragging the stylus over a higher step height can snap the **\$1000** tip, and damage the **\$10000** sensor, requiring very expensive repairs. If you drop a sample in the system do not retrieve it yourself. Do not shut down the system. Contact the tool manager before doing anything else. Mark the tool as offline if no manager is present.

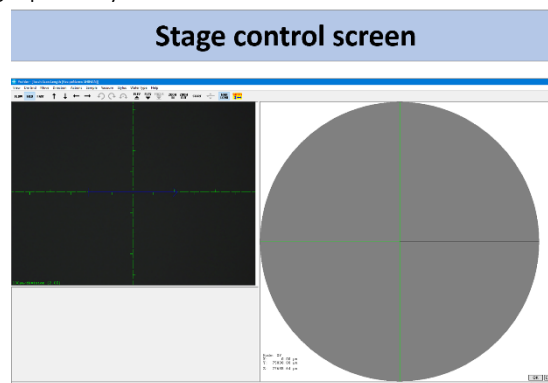


Log In:


1. Make a reservation and log in to the tool through FOM to enable the system.




Determining scanning parameters:

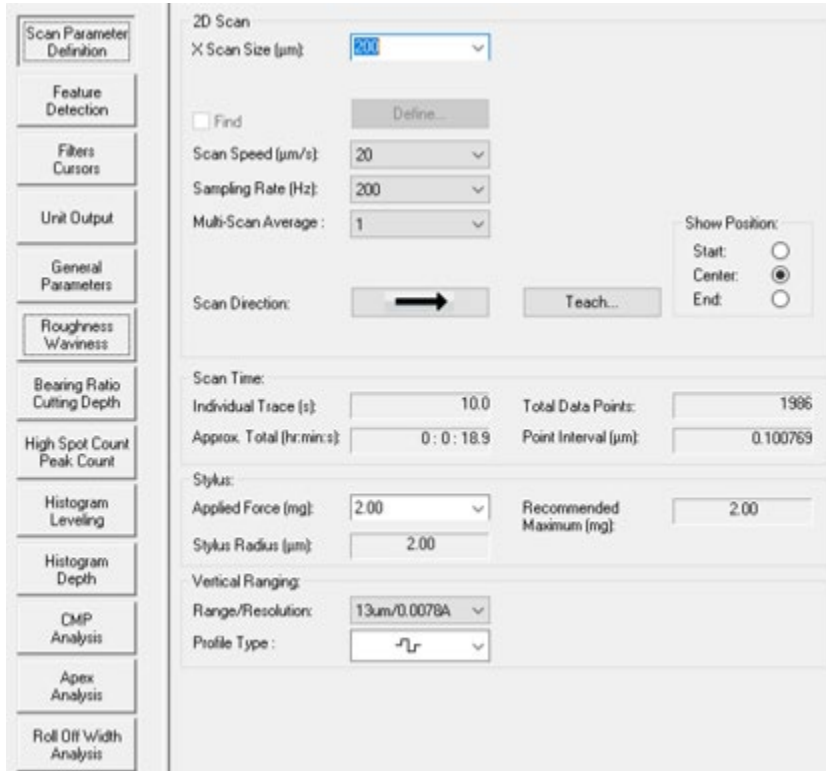
1. In the usual case, the system remains on the stage control screen. If the software is off, refer to the "Starting-up the system" section.




2. Press the "Cancel (**Cancel**)" button located at the bottom left to return to the scanning recipe menu.




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3. On the toolbar, you can find buttons to create a new recipe or to load/save the recipe (  ). You may load the previously made scan recipe or create your own. While you can save the recipe, remember to never overwrite your recipe with someone else's.
4. Define your scan parameters at “Scan Parameter Definition” tab.




- a. In the recipe editor several parameters can be modified using General Parameters and Roughness and Waviness.
- b. X Scan Size: Total length of the scan, up to 150 mm.
- c. Show position: Determine if the origin in the XY screen is the start, center, or end of a scan.
- d. Scan speed: Faster speeds reduce scan time at the cost of data resolution and some accuracy.
- e. Sampling rate: Higher sampling rates increase data resolution, but can introduce noise above 200 Hz.
- f. Scan Direction: Always scan left to right for tool safety reasons. Rotate the sample 180 degrees if needed.
- g. Applied Force: 2.00 mg maximum, but use 0.50 mg for softer substrates such as resists
- h. Range/Resolution: Defines vertical resolution by limiting the scan range. Always set this higher than your expected step height.

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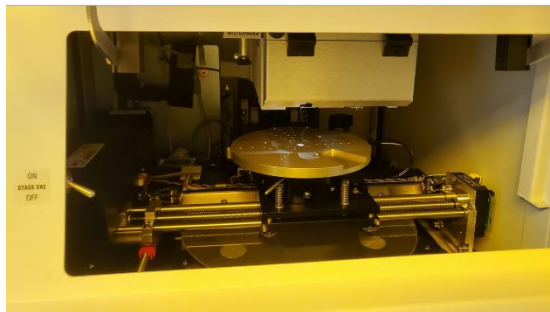
- i. Profile Type: Determines whether the recipe is for peaks () , valleys () , or both () .

5. Once the scanning parameters are determined, press the "Stage Control ()" button to return to the stage control screen.

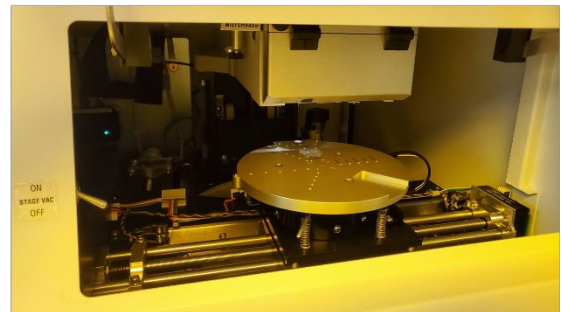
Loading the sample:

1. Check if the stage is in the sample-loading position. If the stage is not in the loading position, press "MAN LOAD ()" to bring up the stage to the sample loading position. Do not open the door until this motion is completed.

Stage in the scan position

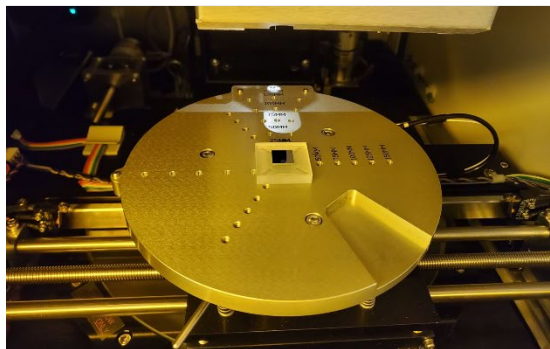


Stage in the loading position




2. Open up the case cover, then load the sample to the stage. **Make sure the tallest part of your sample is over the center vacuum hole. Failure to do so could result in system damage.**
3. If desired, flip the vacuum switch on the left side of the door. This is not required for non-sequence scans and will not work unless all five vacuum holes are fully covered.

Load the sample to the center



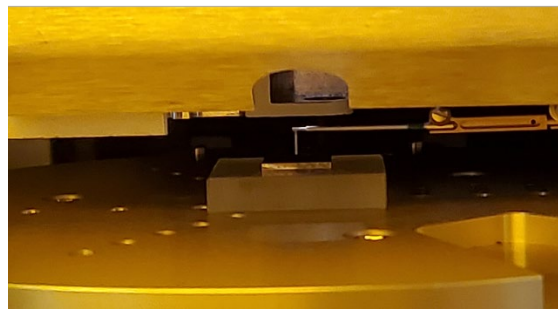
Turn the vacuum switch on, if desired



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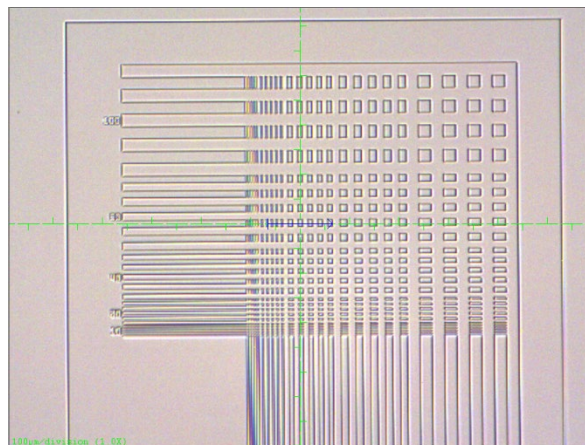
4. Press “MAN LOAD (^{MAN}LOAD)” to return the stage to the scan position.
5. Press “Focus (^{FOCUS})” to bring the sample into focus. **Once focused visually confirm that the stylus is higher than the tallest part of the sample.** If it is not, raise it to a safe height by pressing “Elevate Up (^{ELEV})”.

Ensure that the tip is positioned above the tallest part of the sample




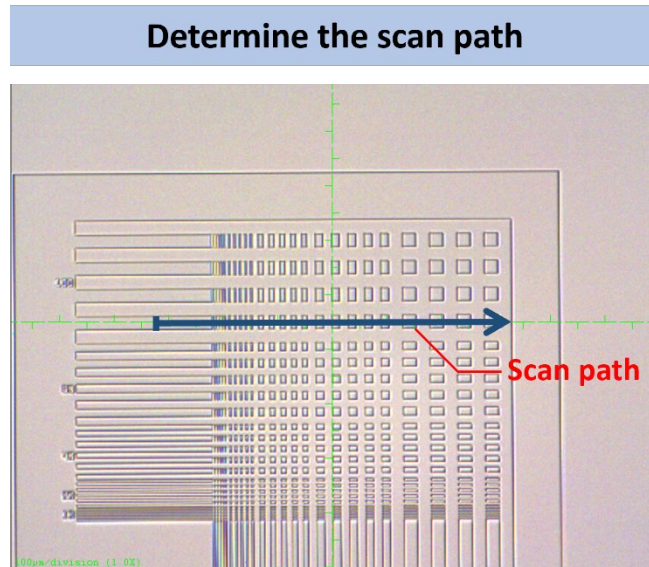
6. Once the stylus is at a safe height, navigate the sample using the keyboard arrow keys, **↑ ↓ ← →** buttons, the rotation arm on the stage, or simply by clicking on the live video.

Navigate to the sample location for measurement.



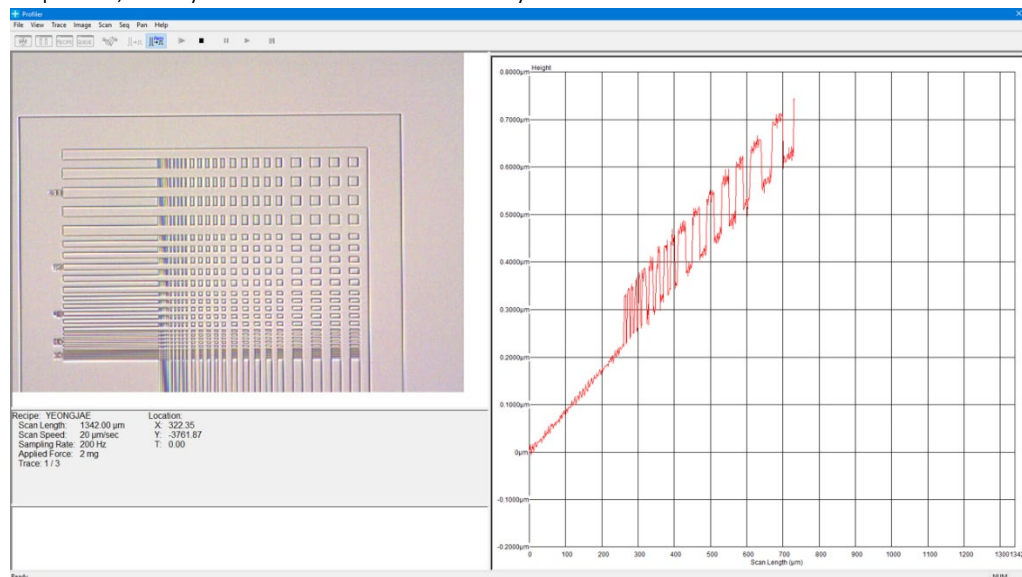
7. Determine the scan path:
 - a. For a short scan, click and drag across the desired feature. A trace line showing the scan path will be generated, and the video focus will center on the feature.
 - b. For a longer scan, determine the start, center, or finish position, and then press OK (located in the bottom left) to return to the recipe editor.


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Performing a scan:

1. Once the scan recipe and position have been set, **double-check to ensure that the scan path won't pass over any vertical steps higher than 440 μm (e.g., deep etch features). Also, double check to make sure the scan length will not start or finish off the sample's edge.**
2. Press the "Start" button (**START**) from either the recipe editor or the XY screen to begin your scan. The screen will freeze while the scan is performed. Once the scan is completed, the system will move to the Analysis tab.





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Analyzing the data:

1. Before performing analysis, level the data.
 - a. Press the **LEVEL** button.
 - b. Drag the level cursors to two points you know are level.
 - c. Press **LEVEL** again to save the tilt position.
2. Analyze data by dragging the measurement cursors across the scan data. Position and step height will update on the left side of the screen.
3. Press **STATS** to view any parameters checked in the recipe dialogue.
 - a. Press **CALC** to update STATS after the cursors have been moved.
4. To save your data, use the "File" menu to save the scan to the computer. The file cannot be read plaintext but will be available for future analysis.
5. To save data plaintext, press  to load your data in the Apex Analysis Suite.
 - a. Right-click on your profile in the analysis workflow (right-side window) to save plaintext data.


Finishing up:

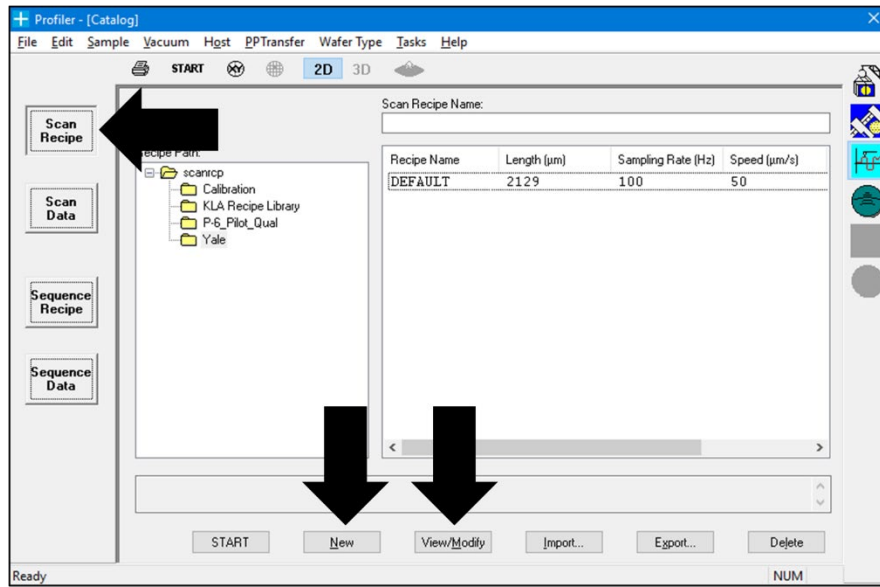
1. Save the data as desired, then exit the Analysis screen by clicking the X button in the top right corner.
2. Navigate to the Control Stage screen by pressing "Stage Control ()" button.
3. Press "MAN LOAD ()" to bring up the stage to the sample loading position then unload your sample.
4. Log out of the system on FOM.

*Starting the software: The system remains turned on after use. However, if the user finds the system is off for some reason, follow the sequence below.

1. Open the software to the main menu using the Profiler 9.0 desktop icon.
2. Wait for the system to initialize before selecting a menu option.
3. Press the "Scan Recipe button" to bring up existing recipes.
4. View/Modify a pre-existing scan recipe or create a new one.



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5. Refer to step 4 in the "Determining Scanning Parameters" section for the next procedure.