ATAMI Standard Operating Procedure

KLA Alpha-Step D-600

Last saved by Randy Greb on 12/11/2019 4:23 PM

Revision	Date	Description/Change	Curator
0	12/11/19	New document	Randy Greb

Contents

Scope:

Operation and Measurement of the D-600 Alpha-step profiler at Atami.

System Specifications:

- Precision step height measurement from less than 10 angstroms to 1.2 mm.
- Maximum vertical step height (in both directions) is 1.2 mm (1200 microns).
- Up to 400k data points per profile.
- Sample size up to 200mm in diameter, and 30 mm maximum height.
- 2D and 3D profiling.
- Stress measurements for films on wafers.

Safety

General

Follow all normal safety protocols for the room.

PPE Required

Normal room PPE.

Nitrile glove must be used for handling all samples on and off the stage to prevent surface contamination.

Hazardous Energies

Electrical

NA

Mechanical

NA

Stored/Potential

NA

Thermal

The system contains a Class IIIa laser (635 nm, 5mW max). Only qualified persons should remove the cover or attempt to service the unit due to the risk of eye injury.

Never

Materials/Consumables Hazards

The stylus tip can be damaged if operated improperly. Follow all procedures carefully to prevent damage.

Interlocks

Never remove the main unit cover.

Training Requirements

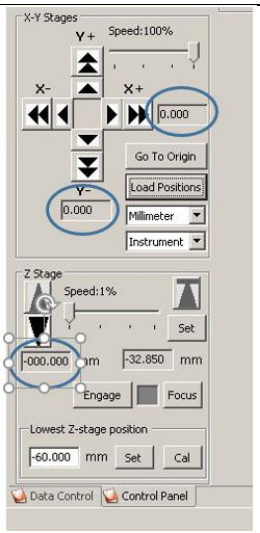
1. Pass all ATAMI required safety courses
2. Finish lab tour with qualified ATAMI trainer.
3. Complete all hands on training for this system and signed off by trainer.
4. Verify access to this document for reference.

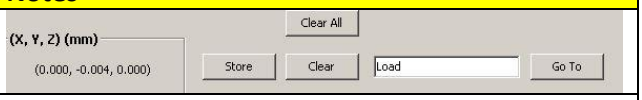
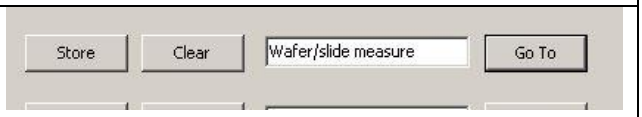
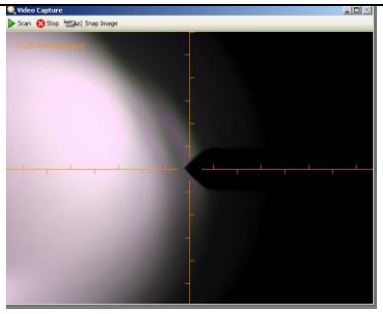
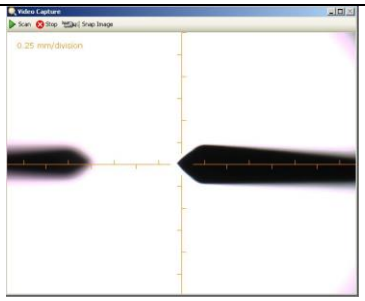
Standby Condition:

Use this section to tell users how to leave the system when done using.

Procedures

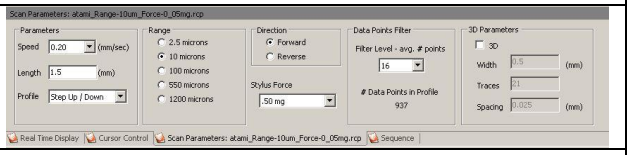
How to Start the System and Load a Sample:

Step	Action	Notes
1	Log in to card reader and bring PC out of sleep.	
2	Turn on D-600 with switch on the back right corner.	
3	Start Alpha-step software with the AlphaStep D Profiler icon on the desktop.	
4	If the stage is not at X,Y,Z of 0, press "Load Positions" and then Press “Go To”, next to the "Load" position.	

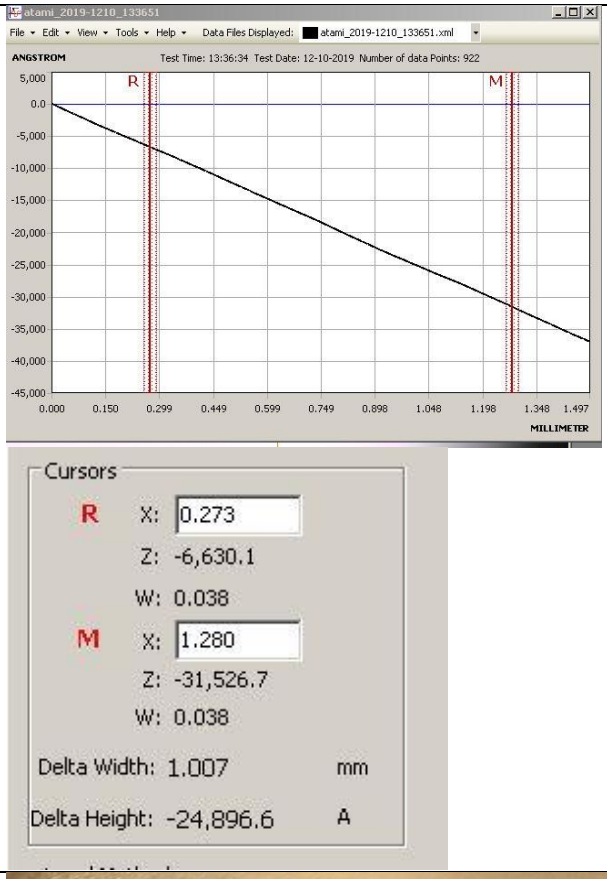
Step	Action	Notes
		
5	Open the front, dark plastic cover.	**Always use gloves when handling specimens on the stage.**
6	Place your sample at roughly the center of the stage.	There are pins that can be used to position your sample. You can also rotate the stage. The stage does not currently have a vacuum pump set up. Do not rotate the dial at the front of the stage. This is used for stage levelling, and shouldn't be changed unless you need to do sample specific levelling.
7	For wafer or glass slide samples, you can move to the Wafer/slide measure position. This will take you roughly to the center of the wafer.	
8	Use the Z-stage arrows to bring the illumination into view as shown.	
9	Then very carefully bring the z-stage a bit further until the tip is roughly as shown to the right.	
10	Press "Engage".	This will move the tip down until it contacts the sample with the stylus force specified in the Scan Parameters tab.

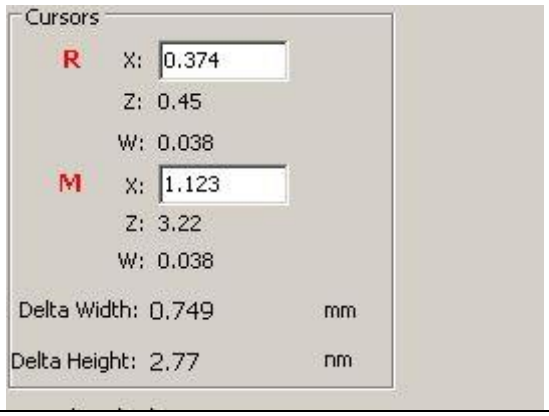
Step	Action	Notes
		When the box is red, it is calculating force. When it is green it is set at the correct force.
11	Go to the “Tools” drop-down menu. Make sure Tip retract is set at 2.0mm. Press “Retract Now”.	
12	You can then move the stage to the feature of interest. **<u>You must ensure that there are no features higher than 1 mm above the surface that you set the tip to. If there are, use the z-stage control to move the tip up (less negative, closer to zero).</u>**	

How to Load and Run a 2D Scan:

Step	Action	Notes
1	Choose "File -> Load Scan Recipe" from the drop-down menu.	
2	Choose a default recipe, or your custom recipe from the available recipes. Scan recipes have a *.rcp extension.	If you have a custom recipe, always put initials for your name as the first two characters in the recipe name. For example, "rg_2d_range10.."
3	Go to the scan parameters tab and make adjustments there as needed.	
4	Position your sample correctly using the load procedure described above. Be sure the tip is retracted properly and will not hit any high features.	
5	Press the Scan button.	 The tip will engage again, and run the with the values specified in the Scan Parameters tab. The scan result will then appear and can be processes. Data from each scan will be saved in it's own window.
6	When you are done running scans, you can choose the load Home load position to unload your sample.	

How to level the stage:

Step	Action	Notes
1	If the stage is grossly out of level for your sample, you may have more consistent measurement results with a more level stage in the	
2	Run your scan and place cursors in regions of interest to level. See example to the right. Then read the Delta height value.	
3	If you want to level a profile with the slope down to the right, rotate the dial on the front, counter-clockwise.	 20 degrees on the dial correlates to roughly a 0.025 deg change in slope.

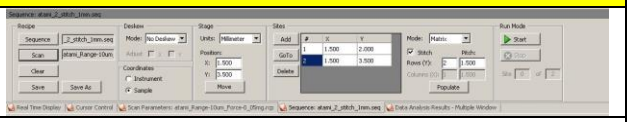
Step	Action	Notes
4	After adjusting, re-check the scan so that the Delta height for the same cursor locations is smaller than 2-5 nm (depending on scan length, step height,…).	This may take several iterations.  

How to Load and Run a 3D scan:

Step	Action	Notes
1	Position the tip at the upper left corner of the area of interest. Be sure to retract after positioning.	
2	Open the “Scan Parameters” tab and load the scan recipe you want to start with. Or just adjust the parameters in the tab.	
3	Check the "3D" box.	
4	Adjust the width of and Traces to get the scan pitch you want and x-width of the 3D image.	The scan length will be the Y-length. You'll need to optimize for throughput (large scan pitch) and resolution (small scan pitch).
5	Once the parameters are set up, press Scan to start. The profiler will then run all the scans you set up and save each data file as specified in the Automated Saving box.	After the scans are done, the 3D processing software will be opened and will contain the results of the scan.
6	If you get an error message, "*.amb" does not exist, that indicates that the software opened before the alpha-step completed processing of the input file.	You will then get a very basic color map of z-height.

Step	Action	Notes
	If you get this, use F4 or "File->Load a Studiable" to load the 3D data output (*.amb file in the specified directory) by the alpha step.	
7	To get the 3D view, you can open the Studies tabe at the top and click on "3D view". This will then produce a 3D view of the data that can be rotated and re-sized.	
8	You can then do all kinds of processing to change the display and see different data, including statistics and varying views (including video displays with motion...).	

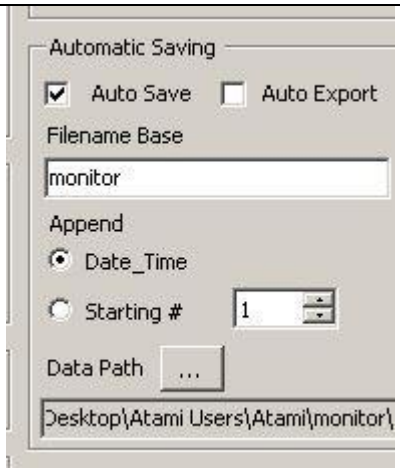
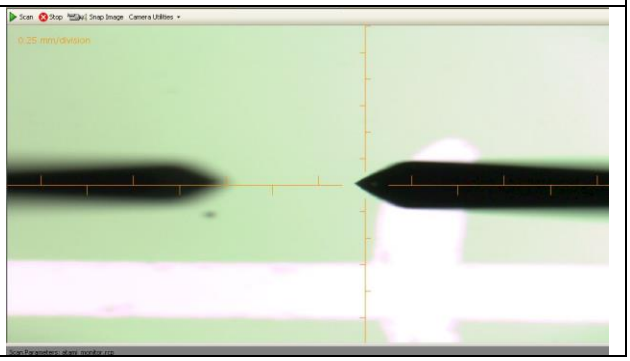
How to Stitch Together Multiple Scans using the Sequence Window:

Step	Action	Notes
1	Open the sequence tab.	
2	Press Sequence to open an existing Sequence recipe.	You can use an existing standard recipe, or create your own. Be sure to use the recipe naming convention (initials_... for example, rg_...)
3	Change the scan recipe if you want.	The pitch and the scan length will affect the results. The atami 2 stich recipe uses a pitch that is 100 microns less than the scan length to achieve some overap. If pitch is larger than the scan length, the two scan will just be attached. You can also just have pitch and scan length be the same value.
4	Move the tip the position you want to start.	
5	Press "Delete" to clear the sites matrix.	
6	Press Populate to re-fill the sites matrix with scans starting at the current position. Be sure that the "Stitch" checkbox is checked.	
7	Press "Save".	This will overwrite parameters for the existing Sequence file. So if you change anything other than the starting point, go ahead and use "Save As" to rename it.
8	Press Start to start the sequence of scans.	

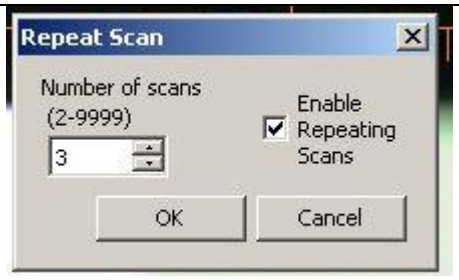
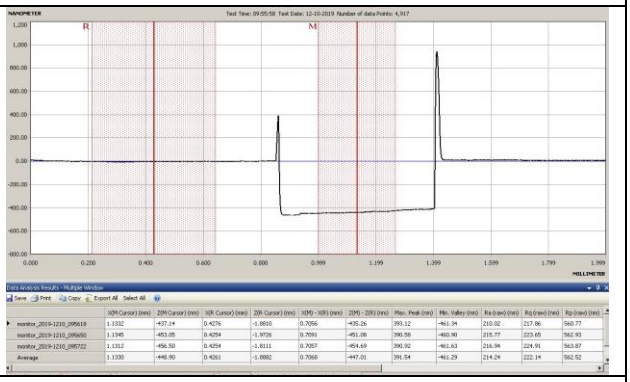
Full Shutdown and Re-start:

Step	Action	Notes
1	Make sure to move the stage back to the load position. Press "Load Positions" and then Press “Go To”, next to the "Load" position selection.	
2	After the stage has fully completed motion, use “File->Exit” to close the software.	
3	After the software is closed, power down the tool with the power switch at the back right of the profiler.	
4	To restart, power up in reverse order (tool, then software).	

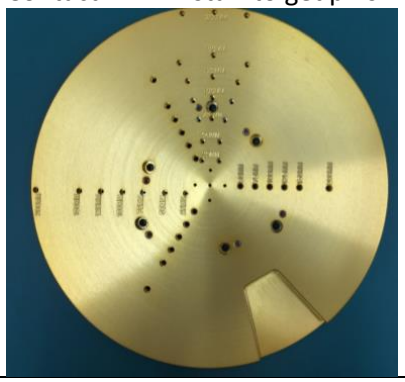
How to Run Atami Tool Monitor (Atami staff only):

Step	Action	Notes
1	Load the Atami monitor chip.	
2	Change file save to "C:\Users\KLA-TENCOR\Desktop\Atami Users\Atami\monitor", FilenameBase to "monitor and Append to Date_Time.	
3	Position the stylus on the monitor sample as shown. Be sure that the zoom is set to 0.25mm/division, so the start of the scan will be 0.75mm above the top edge of the step.	

(back to contents)

Step	Action	Notes
4	Set repeat scans to 3.	
5	Press scan.	The scan will run three repeats and cursors should be in the correct location for measurement.
6	Verify that all data is in the Data Analysis Results window and that the measurement cursors are in the correct locations.	
7	Press "Export All" and verify the naming convention is correct, then save.	
8	Then you can take this data and add it to the Alpha step monitor control chart.	
9	Return the system to standard condition (no repeat scan, "C:\Users\KLA-TENCOR\Desktop\Atami Users\Atami" as the auto-save folder).	

Run a Film Stress Test:

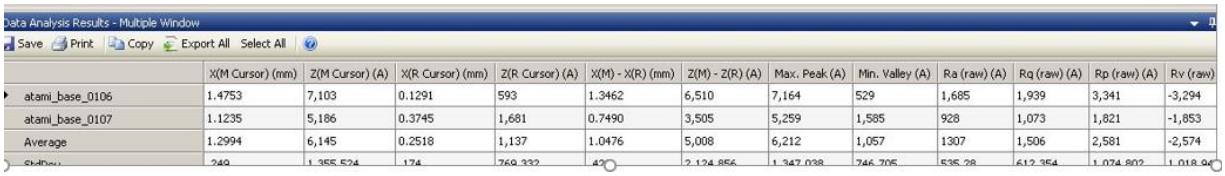
Step	Action	Notes
1	Film stress tests require an intact Si wafer between 50 and 200mm, and use of the wafer locater and support pins.	Contact ATAMI staff to get pins. 

Step	Action	Notes
2	Refer to chapter 9 of the Alpha-step manual for detailed instructions.	The manual is on the system and is also available from ATAMI staff.

Misc How to:

Get all scans into a CSV file with statistics

1 Press the "Data Analysis" button to get all of the runs and statistics into the Data Analysis Results Window.



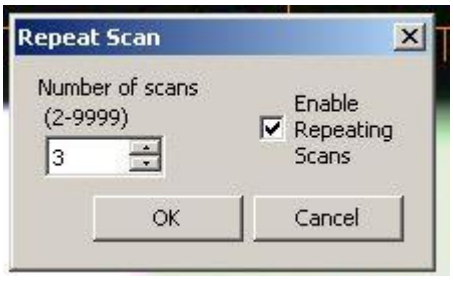
	X(M Cursor) (mm)	Z(M Cursor) (A)	X(R Cursor) (mm)	Z(R Cursor) (A)	X(M) - X(R) (mm)	Z(M) - Z(R) (A)	Max. Peak (A)	Min. Valley (A)	Ra (raw) (A)	Rq (raw) (A)	Rp (raw) (A)	Rv (raw)
atami_base_0106	1.4753	7,103	0.1291	593	1.3462	6,510	7,164	529	1,685	1,939	3,341	-3,294
atami_base_0107	1.1235	5,186	0.3745	1,681	0.7490	3,505	5,259	1,585	928	1,073	1,821	-1,853
Average	1.2994	6,145	0.2518	1,137	1.0476	5,008	6,212	1,057	1307	1,506	2,581	-2,574

2 Then you can select Export All to export to a CSV file. Be sure to export to your user folder. You can open the data files on the alpha-step computer with excel.

Run Repeat Scans:

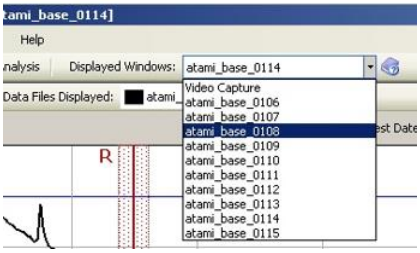
Go to "Settings->Repeat scans", and set the number of scans. Check “Enable Repeating scans”. Then run the scans.

After you’re done, be sure to go back and uncheck “Enable Repeating Scans”.



Switch between live window and data

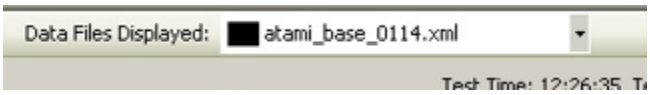
Choose Video Capture, or the data file, in the dropdown next to "Displayed Windows".



Add more than one data file to the display:

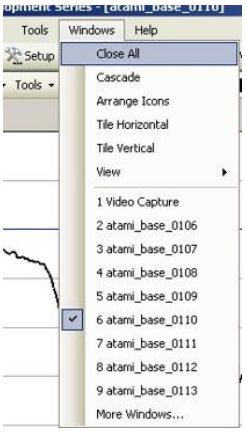
Choose “File->Add Data File…” and then pick the data file that you want to add to the existing scan.

Selecting dropdowns next to “Data Files Displayed:” will display the color of the different scans.



Close all the data file windows:

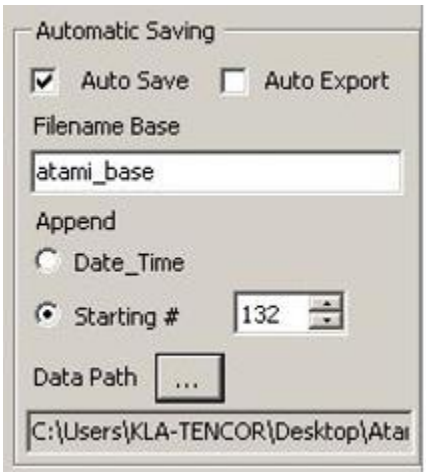
Choose “Windows->Close All”. You can also select any other files saved during the current session.



Change data file names and locations:

The data file naming convention is not recipe specific. Change it when you do your scans.

Go to the "Control Panel" tab, and change the naming under Automatic Saving. It's recommended to use automatic saving.



Standard or Example Recipes

Location of User Data Files, Recipes, File Naming Convention:

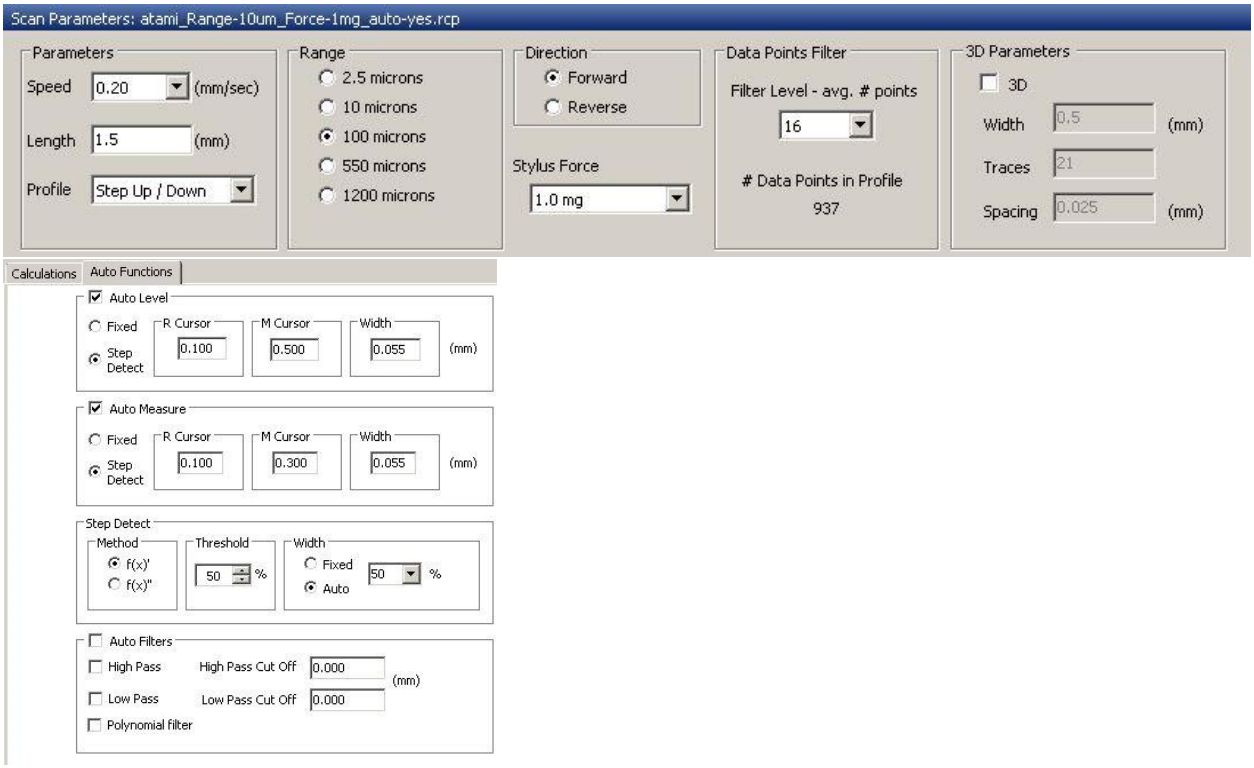
For your data directory in the Atami Users folder, use firstname and last initial. For example, JohnL, PaulM or RingoS

For any user recipes, be sure to put your initials or your company name followed by underscore before the recipe name. For example jl_scan1, pm_test5, atamai_scan7…..

C:\Users\KLA-TENCOR\Desktop\Atami Users

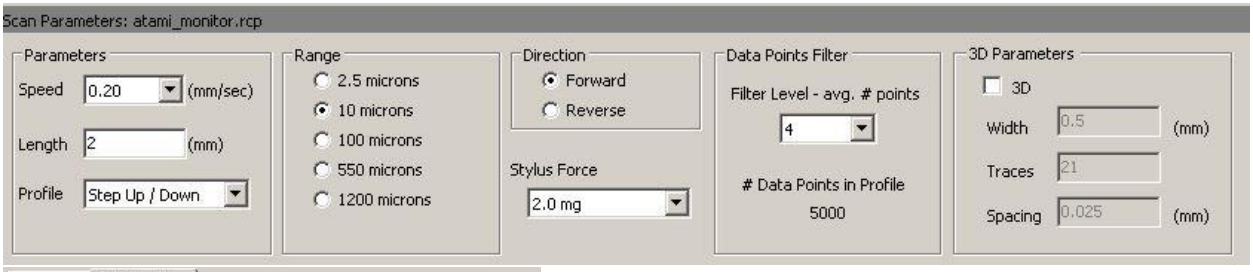
C:\KLA-Tencor\AlphaStep D\Setup\atami_and_user_recipes

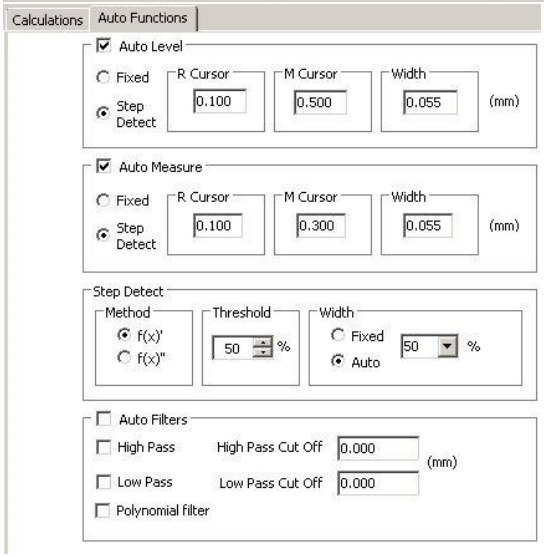
atami_Range-10um_Force-1mg_auto-yes (scan):



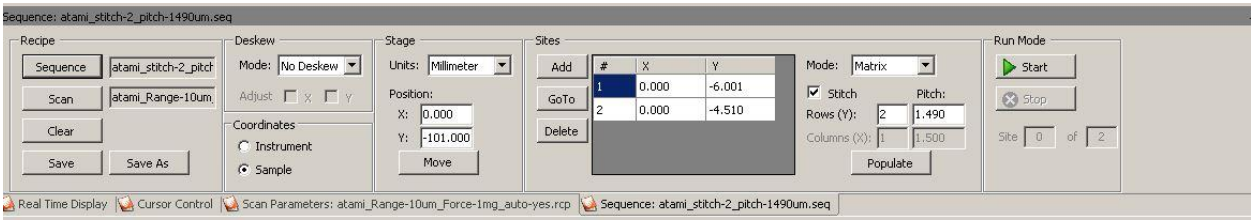
atami_Range-10um_Force-50ug_auto-no (scan):

atami_monitor1 (scan):





atami_stitch-2_pitch-1490um (sequence):



Basic Troubleshooting (none, so far)

Attachments

Scan Ranges and Standards at Atami:

Long Range Scans: 550, 1200 um

Short Range Scans: 2.5, 10, 100 um

50 Micron Standard:

VLSI Standards Incorporated

NVLAP CALIBRATION NVLAP Lab Code 200302-0

CERTIFICATE OF CALIBRATION

STEP HEIGHT STANDARD

Model Number : KTS - 50.0 QS
Serial Number : 30262-155
Calibration Date : June 4, 2019

Substrate Material: Quartz
Step Material: Step etched in silicon

CALIBRATED STEP HEIGHT :

Mean Value		Expanded Uncertainty[1]
(50.009	±	0.268) µm

1 Micron Standard:

KLA Tencor **Document #:** 0343450-000 **Rev:** AA

CERTIFICATE OF CONFORMITY

KLA-Tencor Corporation certifies that the Thin Film Step Height Standard, identified by serial number below, meets or exceeds the specification for this device as described in the accompanying technical information. The measurements made on this device were made with a stylus profiler, having sufficient repeatability and accuracy to insure said compliance. Prior to making ten repeated measurements on this device the stylus profiler was calibrated with a standard traceable to the National Institute of Standards and Technology.

Serial Number: 30262-170

Certified Step Height: 9680 Å

Uncertainty: 53 Å

Certified by: Liu Yang

Certifier's title: Calibration Technician

Date: Aug 20, 2019

REFERENCE STANDARD: VLSI calibrated specimen, model number SHS-9400 QC
Serial Number: 12392-09-13

183 Nanometer Standard:

CERTIFICATE OF CALIBRATION

STEP HEIGHT STANDARD

Model Number :	KTS-1800 QS
Serial Number :	30217-168
Calibration Date :	May 22, 2019

Substrate Material:	Quartz
Step Material:	Silicon Dioxide

CALIBRATED STEP HEIGHT :

Mean Value		Expanded Uncertainty[1]	
(182.8	±	3.0	) nm