This instruction covers the set-up and safe use of the KLA-Tencor P7 Stylus Profiler. This machine is a stylus contact profiler capable of 150mm scan lengths with ~10Å resolution and ~20Å noise floor. It is capable of measuring step height, roughness, and waviness on samples with a firm surface.

1.   SAFETY REQUIREMENTS
   1.1.   Safety glasses must be worn whenever in the cleanroom, except when using a microscope or when wearing protective goggles.
   1.2.   Information regarding the hazardous materials used in the cleanroom may be found through MSDS documentation located in the gowning room.
   1.3.   Operate the P7 Stylus Profiler with all protective shields and doors in place.
   1.4.   Do not reach into the tool except to place your sample on the chuck. Do not put your hands under the scan head, or you may damage the stylus.

2.   EQUIPMENT
   2.1.   KLA-Tencor P7 Stylus Profiler
       2.1.1.   Manufacturer: KLA-Tencor, Model: P-7 (0389982-000), S/N: 7300213, Schematic Drawing: 0242789
       2.1.2.   Computer, keyboard and monitor
       2.1.3.   Isolation table
       2.1.4.   VLSI Standards;
           2.1.4.1.   VLSI Step Height Standard, 23.00 μm
           2.1.4.2.   VLSI Step Height Standard, 850Å (85nm)
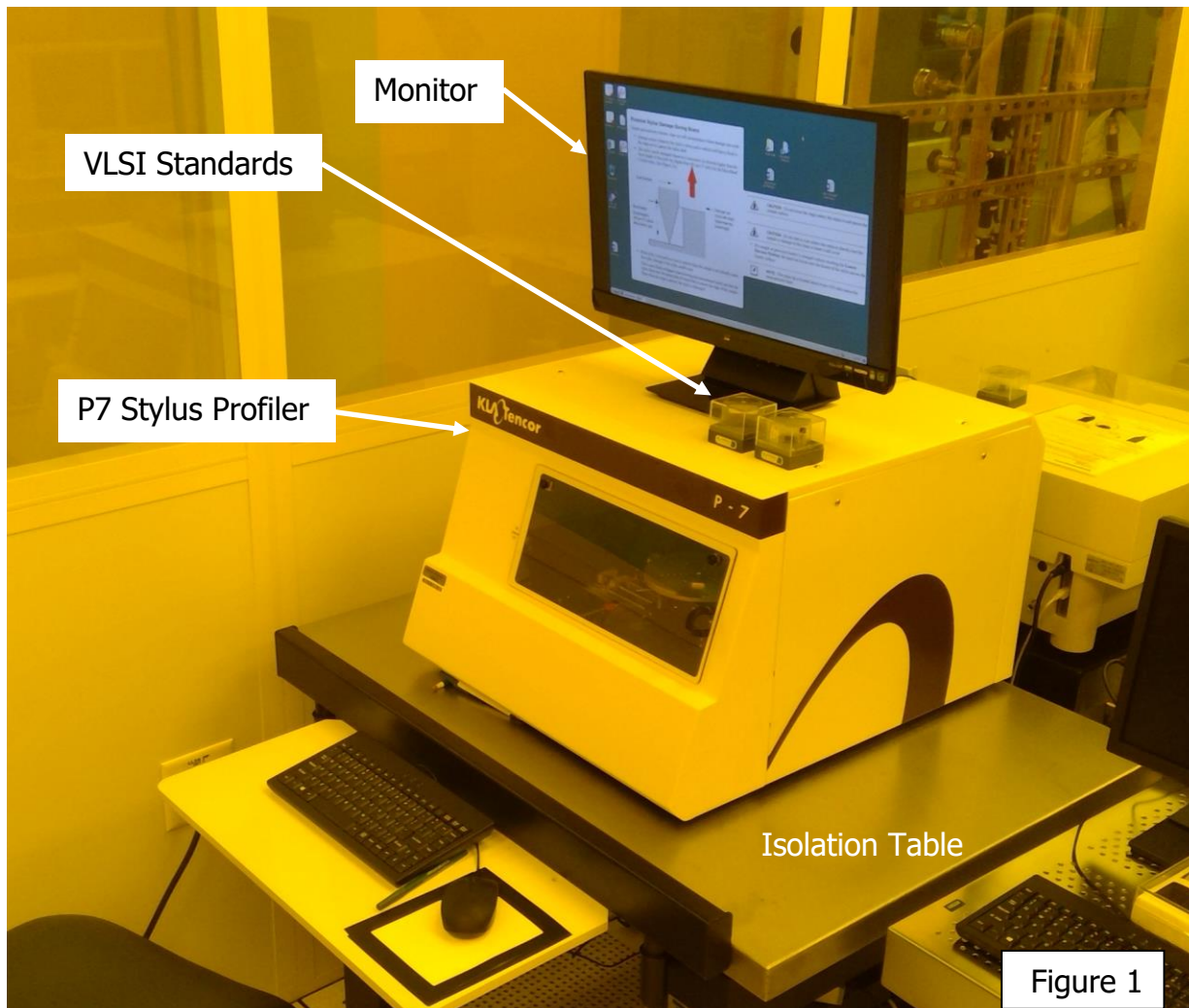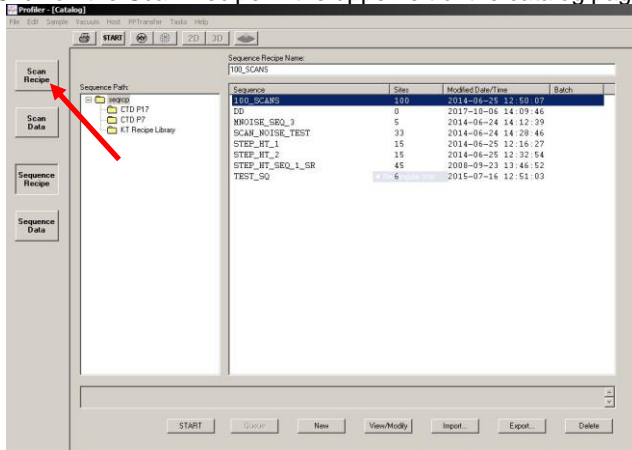
3.   TOOL CONFIGURATION

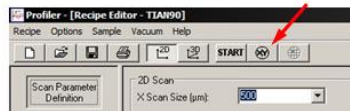Figure 1

4.   CYCLE OF OPERATION

4.1.   Enable the tool in iLab

4.2.   Double click the Profiler 8.0 icon

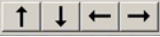4.3.   Click on the Scan Recipe in the upper left of the catalog page

4.4.   Choose an existing recipe by selecting a recipe then pressing **View/Modify** button or make a new recipe by pressing **New** button


4.5.   Press **XY** button to switch to camera mode

4.6.   Press the **MAN LOAD** button which will cause the stage to move toward the front of the tool.

4.7.   After the stage movement stops, open the door

BASELINE

4.8.   Load the VLSI standard sample with extreme care placing it in the **exact center** of the chuck covering all 5 small vacuum ports. *Note: Keep your hand away from the stylus head to avoid damage to the instrument.*

4.9.   Turn on the vacuum switch to prevent the sample from moving
   Note: Small samples that do not cover all 5 vacuum ports require the exposed vacuum ports be covered with small pieces of silicon or glass OR the sample can be mounted to a larger carrier

4.10.   Close the door

4.11.   Press the **MAN LOAD** again to move the chuck into the measurement position

4.12.   Verify the sample is in the center of the stage and under the stylus

4.13.   Press the FOCUS [FOCUS], this will move the stylus head down to the surface of the sample

4.14.   Use the arrows [↑ ↓ ← →] or click on the image to position the sample for measurement

4.15.   Click and drag (from left to right) to define the stylus scan path. The path will be indicated by a blue line with an arrow indicating the scan direction.

4.16.   Press OK when complete

4.17.   Refer to Section5 of this document if the scan parameters need be adjusted

4.18.   Press the START button at the top of the menu bar

LEVELING

4.19.   Once the scan is finished, press the LEVEL button at the top menu bar

4.20.   Drag, pull and manipulate the left and right Level bar cursors to define a flat and even plane

4.21.   Press the LEVEL button a second time to planarize the scan results
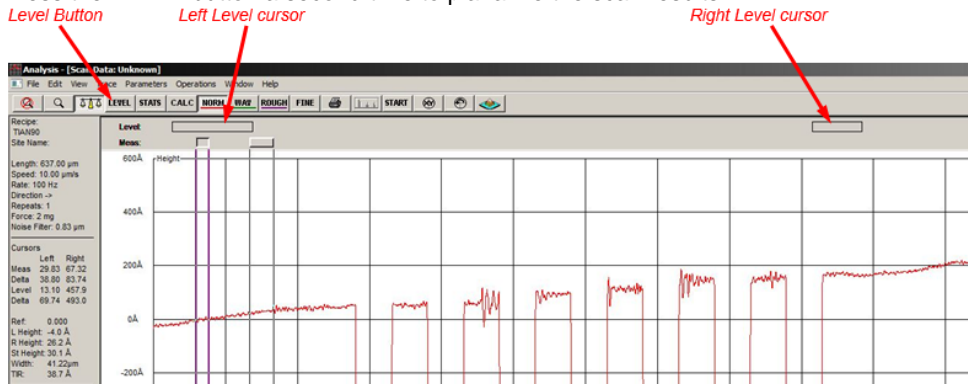
STEP MEASUREMENT

4.22.   Position the left and right Measurement cursors to define the differential step
4.23.   Record the difference in height between the two cursors displayed next to St Height
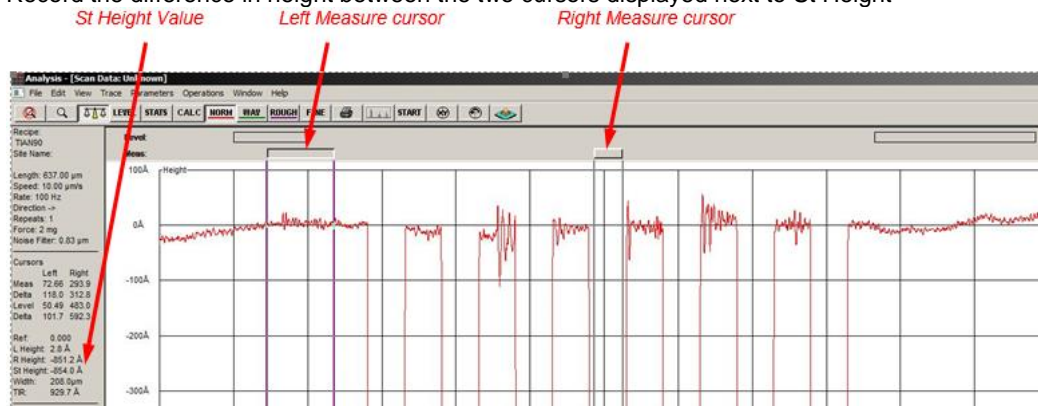
4.24.   Press the STATS button on the top menu bar to view more analysis options. Select the analysis option before pressing the Calc button to recalculate for the selection
4.25.   Press the Apex Analysis button for additional analysis software options. There will be different options available to save the data.
4.26.   If another measurement location is to be measured, press the XY button to move the sample and redefine the scan path.
4.27.   When finished, press the **XY** button
4.28.   Press the **MAN LOAD** button which will cause the stage to move toward the front of the tool
4.29.   After the stage movement stops, open the door
4.30.   Turn off the vacuum switch
4.31.   Carefully remove your sample from the stage
4.32.   Close the door
4.33.   Press the **MAN LOAD** button which will cause the stage to move toward the home position
4.34.   Exit the software and log out of iLab

5.   SUPPLEMENTAL DATA (Edit Recipes and Performance Specifications)

EDITING RECIPES

5.1.   Review and configure the scan parameters
  5.1.1.   X Scan Size = scan length *(blue arrow length)*
  5.1.2.   Scan Speed *(slower for less noise)*
  5.1.3.   Sampling Rate *(amount of data collected)*
  5.1.4.   Scan Direction *(Always scan left to right)*
  5.1.5.   Applied Force *(Use 1 mg force for soft metals or polymers & use 2 mg force for metals and semiconductors*
  5.1.6.   Range/Resolution *(Ensure the step height maximum of the feature on interest is within this range)*
5.2.   For short scans, 2mm and smaller, the general rule of thumb is to keep the scan time between 5 and 10 seconds
5.3.   The General Parameters tab, and the Roughness Waviness tab may be used to determine slope, area, roughness, and other parameters from your scan analysis.
5.4.   The MicroHead V SR (standard range) has a vertical range of 327 um, and is capable of scanning at forces between 0.5 and 5 mg
5.5.   The BNC unit has a 2 μm radius tip with a 60° angle installed that limits the maximum force to 2mg
5.6.   A manual theta stage with stops at 45° increments and a fine theta adjustment of $\pm$ 5°.

PERFORMANCE SPECIFICATIONS

5.7.   The P7 Stylus profiler at Purdue is equipped with the standard head configuration capable of 150mm scan lengths
5.8.   Resolution is approximately 10 angstroms and a 20 angstroms noise floor
5.9.   The software controlled motorized stage rides on a 12-inch optical flat
5.10.   Vertical range 0 μm to 327μm
5.11.   Substrate size from 3mmX3mm up to 150mm diameter
5.12.   2μm radius diamond stylus with 60° cone angle tip
5.13.   Sample Surface Limitations
  5.13.1.   No uncured SU8
  5.13.2.   No uncured PDMS
  5.13.3.   No uncured photoresists
  5.13.4.   No other soft materials that might stick to the stylus

6.　STARTUP and SHUTDOWN

STARTUP
6.1.　　Verify the tool is enabled in iLab
6.2.　　Verify the computer is powered on
6.3.　　Login if the KLA-Tencor software is not running (shown in Figure1)
　　　6.3.1.　　Username: Operator
　　　6.3.2.　　Password: research
6.4.　　Double click on the Profiler 8.0 icon

SHUTDOWN
6.5.　　Verify the sample has been removed sample from the stage and the stage is in the home position
6.6.　　Exit out of the software
6.7.　　Disable the tool in iLab

REVISION RECORD

Reason for Revision	Date of Revision	Person Responsible
Initial Release	Jan 2018	Sean Rinehart
Significant revisions and changes	Nov 2018	Dan Hosler
Change formatting and general updates	Mar 2020	Rich Harlan