Dektak 150

SOP

The Dektak 150 is a highly sensitive stylus profilometer. A diamond-tipped stylus is moved laterally across the surface while in contact and measures deflections of the tip. It can be used to measure step heights (film thickness), surface roughness, waviness and stress. Vertical resolution is 1Å max, using the 6.55μm range and the stylus force can be varied from 0.03mg to 15mg. The Dektak can accommodate wafers up to 150mm and features a motorized X-Y stage.

Safety

High Voltage - Voltages supplied to and within certain areas of the system are potentially dangerous and can cause injury to personnel.

1.   Restrictions/Negligence

1.1. No measurement of step heights higher than 1mm. Measuring step heights taller than 1mm will break the stylus. Measuring samples taller than 200um could also break the stylus if not done correctly. The cost of a new stylus is approx. $600 and you may be accountable.

1.2. Warning: Always raise the stylus to exchange another sample, or unload any sample. There is a high risk of impacting the stylus and breaking it. If you break the tip due to negligence of not following this SOP, you can be charged for a new stylus. The cost is approximately $600.00

2.   Operation

2.1. Start Up or Reset

2.1.1. If the Dektak software is not already running, double-click the "Dektak" icon to start the Dektak 150 software.

2.1.2. If the system software is running but is not responding you may attempt to reset the system. Close the Dektak Software using the x in the upper right corner of Dektak screen. Turn off the power the hardware by depressing the "0" on the small gray box ON/OFF power control unit laying to the right of the system on top of the vibration isolation table. Wait 10 seconds and press the "1" ON switch. Start the Dektak software by clicking the "Dektak 150" Icon on the desktop. The software will launch and the system will reset the stage.

2.2. SAMPLE LOADING

2.2.1. Warning: The height of step you are measuring must not be taller than 1000um. Measurement of substrate thicknesses such as wafers or glass slides is not allowed on this system. If you are not absolutely certain the step height of your sample <1000um, do not use the system for your measurements. You will break the stylus tip. Consult with NRF Staff if you are not sure. If you break the tip as a result of negligence by not following this SOP, you may be charged for a new stylus. The cost is approximately $600.00

2.2.2. The stage moves toward the front of the system (i.e. toward you) during measurement scans. If the step height for your sample is between 50-1000um you must measure from high to low meaning the stylus must start on the surface of the highest sample point and scan over the edge "down" i.e. drops off the ledge. Looking at the picture below, the highest step must be toward the front of the stage chuck and the low point on the back side of the stage chuck.

Direction of Scan
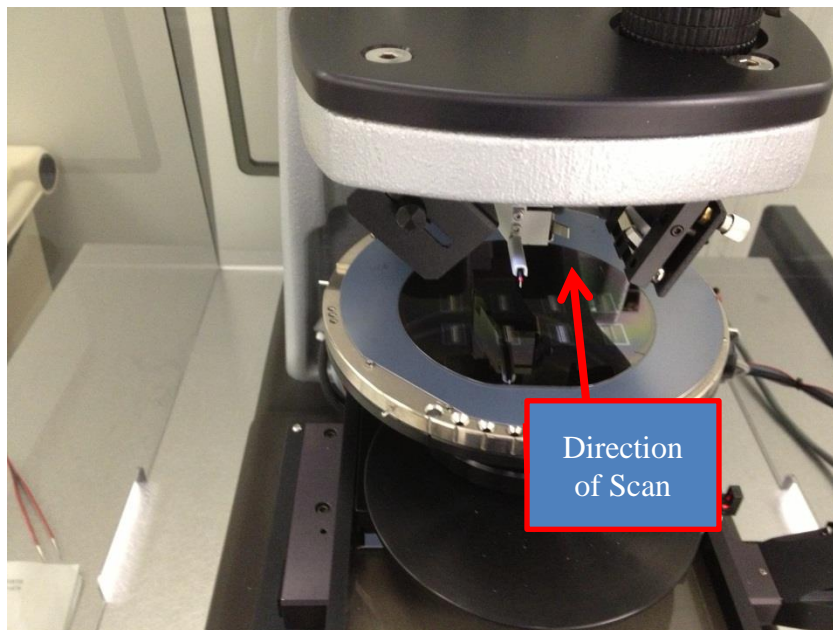
2.2.3. The stage is normally covered with a 5" wafer with the unpolished, bottom side up (shown below). This is for stylus protection, do not remove it.
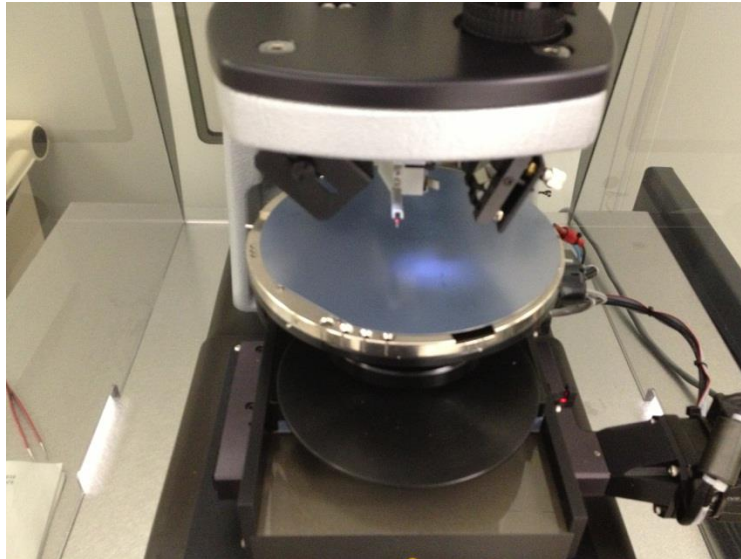
2.2.4.   Verify that the tower is raised. If not, **Profiler** > **Tower Up** or click

icon

2.2.5.   Open the door to the enclosure.
2.2.6.   Position the sample in the center of the stage right below the
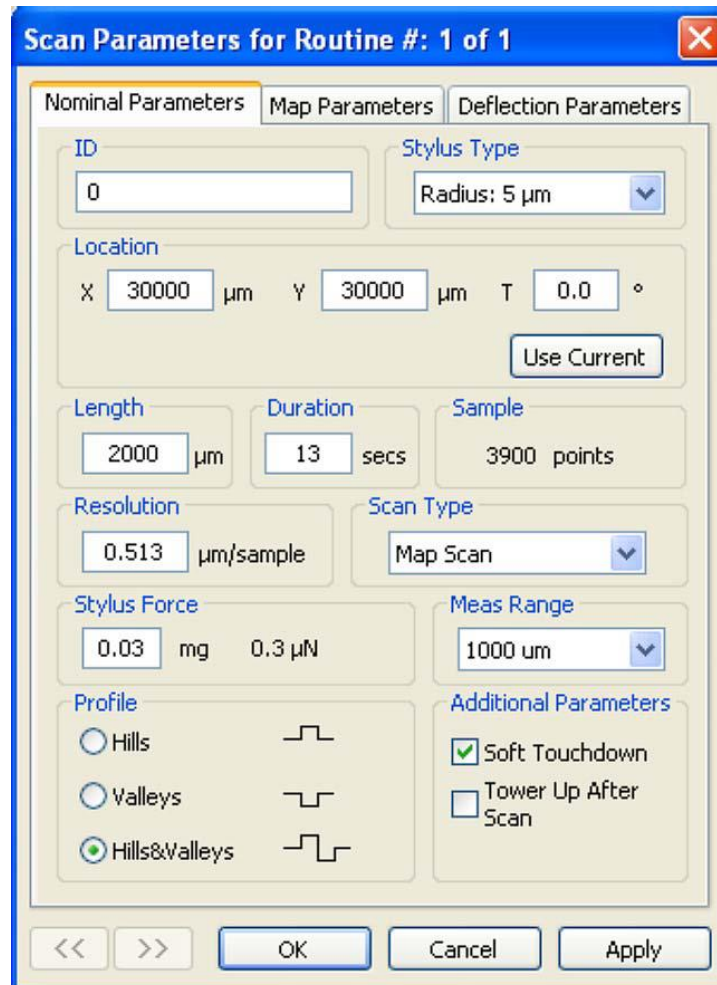stylus.

2.2.7.   Select **Profiler** > **Tower Down** or click icon   .

2.2.8.   Use the **Illumination Adjustment** icons   to adjust the
illumination to view the sample.
2.2.9.   From stage control panel, click arrows to move sample and find
desired area.
2.2.10. Initiate Stage Tracking (left-click in the camera view pane) for fine
sample positioning. The image should now track the motion of the
mouse.
2.2.11. With the stylus reticle properly positioned on the sample, click the
mouse button a second time to deactivate Stage Tracking. This is
your starting point.

2.3. SET SCAN PARAMETERS

2.3.1.   Select **Window > Scan Routines** from the system menu bar or

click the **Switch to Scan Routines Window** icon   to display
the **Scan Routines** window
2.3.2.   Click any of the underlined items in the **Scan Parameters** section
of the window to open the **ScanParameters** dialog box.

Figure 1: Scan Parameters Dialog Box

2.3.3.   If desired, adjust the scan parameters in the dialog box, such as scan **ID**, **Duration**, horizontal **Resolution**, **Stylus Force**, **Measurement Range,** and **Tower Up After Scan**.

2.3.4.   Click **Apply** and then click **OK** to accept your entries and close the dialog box.

2.3.5.   To run a scan routine, click **Run > Scan** from the system menu or click the **Run Currently Active Scan Routine At Current Location** icon .

2.4. SCAN PARAMETERS

2.4.1.   All of the scan parameters are user selectable and can be accessed from the **Scan Routines** window.

2.4.2.   **Scan ID-** This parameter allows you to assign a fifteen-digit scan identification file name or number.

2.4.3. **Stylus Type-** The **Stylus Type** parameter allows you to specify which stylus type is used in your system. Our system is fixed at 12.5µm radius.

2.4.4. **Scan Location-** This parameter displays the X and Y location in µm for this particular scan routine.

2.4.5. **Scan Length-** Scan lengths from 50 µm to 55,000 µm (50 mm) are possible using the standard Dektak 150 system.

2.4.6. **Scan Duration/Speed-** The **Duration** setting displays the amount of time it takes to complete a given scan. Scan duration may be set anywhere from 3 to 200 seconds. Scan duration, in conjunction with scan length, determines the horizontal resolution of a scan. Therefore, scan speed is directly related to the resolution.

2.4.7. **Scan Resolution-** The **Resolution** parameter displays the horizontal resolution for the scan length and scan speed (duration) entered into the scan routine. The scan resolution is expressed in µm/sample, indicating the horizontal distance between data points. Data points are the points along the scan path at which data samples are taken. The more data points taken during a given scan length, the shorter the distance between data samples. Therefore, a scan routine with the lowest number of µm per sample provides the best possible horizontal resolution. The Dektak 150 provides horizontal resolution with a maximum 60,000 data points available per scan. Scan length and scan duration determine the horizontal resolution of the Dektak 150. The profiler maintains a constant sampling rate of 300 data points per second. By slowing scan speed, you can process more samples with a given scan length over a longer period of time.

2.4.8. **Scan Type-** Only **Standard Scan** and **Map Scan** may be selected. Specialized training is needed for map scanning. Contact NRF staff if map scan is needed.

2.4.9. **Stylus Force-** You can set the stylus force from 0.03mg to 15 mg force.

2.4.10. **Measurement Range-** The available vertical resolution depends upon the **Measurement Range** selected. When measuring extremely fine geometries, the 6.5 µm range provides a vertical bit resolution of 1 Å. For general applications, the 10 Å vertical resolution of the 65.5 µm range is usually adequate. When measuring thick films or very rough or curved samples, select the 524 µm or 1000µm range with 80 Å resolution.

2.4.11. **Profile-** The **Profile** setting scales the measurement range according to the profile selected. Three different profiles are available for a variety of sample surface characteristics.
Valleys: Provides 90% of the measurement range below the zero horizontal grid line. Used primarily for measuring etch depths.

Hills and Valleys: Provides 50% of the measurement range above the zero horizontal grid line and 50 percent below. Used in most applications, especially if the surface characteristics of the sample are not well known, or if the sample is out of level.
Hills: Provides 90% of the measurement range above the horizontal grid line. Used primarily for measuring step heights.

2.5. DATA ANALYSIS

2.5.1.   When scan is complete, a data plot window will open as shown in Figure 2.
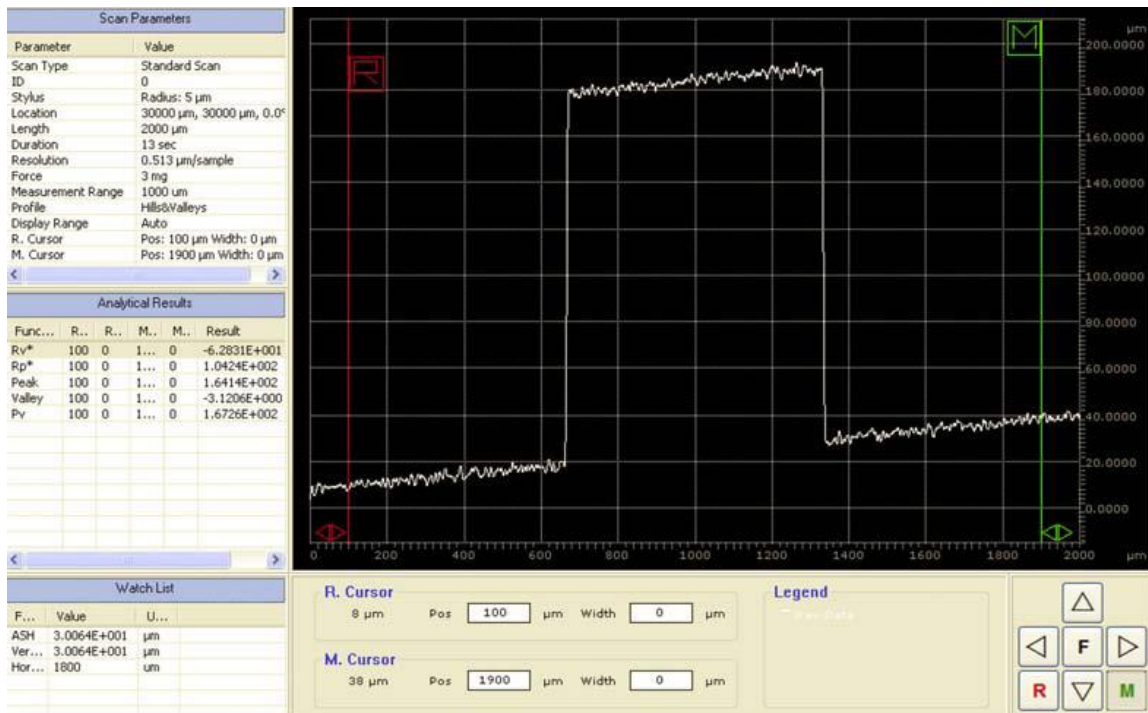
Figure 2 Data Plot Window after Scan Completion

2.5.2.   The reference (**R**) cursor and measurement (**M**) cursor define the portion of the profile trace for leveling or performing analytical functions. You can adjust the bandwidth at each cursor to average the data points within the cursor's bandwidth. This is useful for leveling and average step height measurements.

2.5.3.   Position the **R** and **M** cursors along the baseline of the step and adjust the bandwidth.

2.5.4.   Click the **Level** icon   or press **F7**, or select **Plot** > **Level** from the system menu bar. The profile trace replots and levels with the R and M cursor intercepts at zero.

2.5.5.   Measure the step height with **R** and **M** cursors.

2.5.6.   Setting the display range. The **Automatic Ranging** feature automatically scales and ranges the profile trace to fill 80% of the data plot display. However, in some applications where repetitive or like scans are compared, you can preset the graphic scale by numeric entry.

2.5.6.1. In the **Display Parameters** section of the **Scan Routines** window, click **Display Range** to open the **Range** tab.

2.5.6.2. To allow the system to automatically set the range , click **Automatic Ranging**.

2.5.6.3. To set the display range at a specified value, click **Set Range Values** to activate fields for entering theupper and lower boundaries of the graphic scale. Enter the desired setting for the lower boundary in the**Lower Bound** box and the upper boundary in the **Display Range** box.

2.5.6.4. Click **OK**.

2.6   SAVING THE DATA PLOT

2.6.1   Click **File > Save as** to save the original data in **C/user-data/your folder**.

2.6.2   Click **File > Export** to save as CSV format.

2.6.3   Right click on the data plot, select **Save as Image** if you want the graphic format.

2.7   Sample Unloading

2.7.1   Warning: Always raise the stylus to exchange another sample, or unload any sample. There is a high risk of impacting the stylus and breaking it. If you break the tip due to negligence of not following this SOP, you can be charged for a new stylus. The cost is approximately $600.00

2.7.2   Click **Window** > **Sample positioning** from system menu bar or click **SamplePositioning Window** icon   .

2.7.3   Select **Tower up** from **Profiler** menu bar or click **Tower Up** icon

         .

2.7.4   After the tower is raised, remove your sample carefully.