Standard Operating Procedure II
PHI 5000 VersaProbe II XPS/UPS
(UPS, XPS Depth Profile, Angle Profile, Line and Map)

Yale West Campus
Materials Characterization Core
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ESC II, Room E119E
810 West Campus Drive
West Haven, CT 06516

Version 1.0, May 2016
Please **FOLLOW the SOP strictly** to keep the facility in good condition. Any explorations are strongly prohibited unless permitted by lab manager.

> **NEVER** use your own USB drive on the XPS computer. Data can be retrieved from Yale data server.

> **NEVER** surf the web on the XPS computer in order to minimize the risk of the computer being hacked.

> Yale West Campus MCC facility users must acknowledge MCC in their publications that rely significantly on MCC resources. The general acknowledgement for SEM should read: “The spectra were taken using the PHI VersaProbe II at Yale West Campus Materials Characterization Core (MCC).”

> The core reserves the right to use the data for core promotion.
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Yale West Campus Materials Characterization Core
PHI 5000 VersaProbe II XPS/UPS Standard Operating Procedure (UPS, XPS Depth Profile, Angle Profile, Line and Map)

1 Introduction

1) Features of this Instrument:
   > Micro-area element composition and chemical state determination on material surfaces
   > Analysis of insulating samples with dual beam charge neutralization method
   > Depth profile analysis of structures and interfaces

2) Location
   Materials Characterization Core
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   810 West Campus Dr
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The Yale West Campus MCC Facilities are operated for the benefit of all researchers. If you encounter any problems with this facility, please contact the staff member listed above immediately. There is never a penalty for asking questions. If the equipment is not behaving exactly the way it should, contact a staff member.

Notice: Please follow strictly the SOP to keep the facility under good condition. We DO NOT recommend user explorations on program unless endorsed by core manager.
2 UPS Spectral Scan

1) Perform XPS scan on samples FIRST before UPS setup to examine the sample surface. Follow the steps in SOP Basic for sample preparation, transfer and position definition. **Warning: make sure** the main chamber pressure is kept below $5 \times 10^{-7}$ Pa before UPS setup.

**Notice:**
- UPS scan CAN be performed at UPS positions (90 degree tilted sample holder), Keep in mind that using a 90 take off angle for the photoelectrons is more sensitive to the bulk material than lower take-off angles.
- UV source need to be turned to standby during XPS scan at UPS position.
- Ar sputtering can be performed on UPS positions (90 degree tilted sample holder). However, the sputtering is NOT as efficient as on flat positions because of incident Ar$^+$ beam at grazing angles.
- UV source can be kept ON during Ar sputtering.

2) UPS position definition

a) Click Sample on top tab menu to enter Sample window, define and Z-Align the position ready for XPS first with flat stage (Tilt = 45 degree).

b) Click Stage tab on the right side of Sample window to enter Stage Parameters window and change stage tilt angle $T(\text{deg})$ from 45.0 (flat stage) to 90.0 (tilted stage perpendicular to analyzer column), hit Enter and then hit Eucentric tab below to tilt stage to entered angle.
**Warning:** the optics configuration (UV source vs. Analyzer) inside the chamber requires sample stage to be perpendicular to the analyzer for optimized UPS signals.

c) Hit \[ Z \] button on top of SXI image window to start **Z-Align**

![Z-Align button](image)


d) **Click** above **Position List Table** to Update Position after **Z-Align**, check through chamber window to see the stage perpendicular to the analyzer column (Tilt = 90 degree, if NOT, report Core staff immediately.)

**Warning:** this step is **critical**, or the sample will stay at FLAT

<table>
<thead>
<tr>
<th>Active/ID</th>
<th>Name</th>
<th>Comment:</th>
<th>Type</th>
<th>U</th>
<th>V</th>
<th>Z</th>
<th>Rotation</th>
<th>Tilt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Au/film/mica</td>
<td></td>
<td>Point</td>
<td>7.68</td>
<td>-2.083</td>
<td>17.538</td>
<td>-0.85</td>
<td>90.00</td>
</tr>
</tbody>
</table>

3) UV light source ignition

a) Turn **ON** the UV source controller (UV40A-PS) on the rack.

![UV source controller](image)

b) Go to the back of the vacuum chamber and check to MAKE SURE UPS differential pumping system **ON**.

**Warning:**
- This step is **CRUCIAL**, violation will lead to accident venting of the main chamber and damage of XPS optics system inside. Violated user account will be suspended and repair charges will be on user’s PI account!
- The differential pumping system needs to be turned **ON 12 hours before UPS**. **DO NOT** run UPS if the system is **OFF**. Contact Core stuff instead.
  > **Touch** the rotary pump on the ground, MAKE SURE it is **RUNNING**!
> Make sure the OPEN button on turbo molecular pump is ON (lit in GREEN), and check the rotating speed on the status panel, make sure it is running at full speed (1500 Hz), REPORT to Core stuff immediately if NOT.

> Open the He gas bottle by turning the highlighted He bottle valve counterclockwise ~45 degree

> Check to make sure the pressure is 1000 ~ 1500 psi on the Regulator Gauge. Report to Core stuff if dropped below 100 psi and have the He bottle replaced.

c) TOUCH the high voltage (HV) window on the UV source controller to see the kV number flashing in WHITE and THEN turn the knob on the right side to 1.00 kV

d) Open UPS differential pumping valves

> Turn the UPS 1 valve (connected to rotary pump) counterclockwise to fully open the valve; the main chamber pressure should drop slightly.

> Turn the UPS 2 valve (connected to turbo pumping unit) counterclockwise to fully open the valve; the main chamber pressure should improve.
e) Turn **SLIGHTLY** the **UPS leak valve** **counterclockwise** to leak helium gas into the UV source

**Warning:**

- This step is **CRUCIAL**, violation will lead to **high pressure helium backfill of the main chamber** and **XPS system shutdown**! Violated user account will be **suspended** and possible repair charges will be on user’s **PI account**!

- **Always press and turn** the **leak valve knob** to introduce helium manually.
> **Watch main chamber pressure VERY CLOSELY** while slowly turning the leak valve knob and **stop turning** when a little pressure increase is seen.

![Image of controller with pressure readings](image1)

> **Then, watch the pressure window on UV source controller VERY CLOSELY** and **continue slowly turning** the leak valve knob and **stop turning** when the pressure increases to ~ 4e-02 mbar. The main chamber pressure should increase from **high 10-8 Pa** to **mid or lower 10-7 Pa**.

![Image of UV source controller](image2)

> Press **HV button** on the controller, the **OPERATE** and **HV ON LED** should be **ON**.

> Press **ignition** icon on the controller to ignite the UV light. If **FAILURE** light is not turned **ON**, then the **purple light spot** appears on the controller and the **HV** drops to **0.5 kV**. The UV light should be visible through the **UV window** on the UV source.

![Image of UV light and pressure readings](image3)
> VERY SLOWLY turn the leak valve clockwise to lower the He pressure reading on the controller from ~4e-02 mbar to 2e-02 mbar, and then wait for 15 minutes to stabilize the UV light.

**Warning:** For He I UPS, it is important to keep the helium pressure at 2e-02 mbar in order to maximize the He I emission line intensity.

4) In SmartSoft window, click [XPS] tab on top tab menu to enter XPS analysis window and click Spectrum tab on the right side. In Source window, choose UPS (Ultraviolet Photoelectron Spectroscopy) and in Source window.

5) Click on top left of Regions window to enlarge the Regions (Spectrum) window:

6) Click on button on the Regions window to open the Periodic Table, and click on the table to start a Spectral Survey (Su) Scan, then close the table.

7) In XPS Regions window, click Pass to change Pass Energy to typically 2.950 eV, and eV Step to typically 0.0250 eV. Close the window. Set Lower energy to -5 eV and Range to 21 eV.

**Notice:** for UPS scan, typically smaller Pass Energy (2.95 – 5.85 eV), smaller Step size (0.025 – 0.05 eV), and 20 ms Time Per Step should be chosen to increase spectral energy resolution.

8) Click button, in XPS Acquisition Setup window:
   a) In Setup tab, choose OFF in XPS: E-Neut Neutralization
   b) In Setup tab, choose OFF in XPS: I-on Gun Neut
   c) In Region tab, choose OFF in 5V Bias
9) Hit \( \text{S} \) in Spectrum window to start UPS scan

10) The Survey spectrum will appear in the **Spectral Window**.

11) To measure **Work Function** using UPS

   a) Click \( \text{XPS Setup} \) button, in **XPS Acquisition Setup** window:

   > In Setup tab, choose **OFF** in XPS: E-Neut Neutrelization → Auto [A] → Off
   > In Setup tab, choose **OFF** in XPS: Ion Gun Neut → Auto [A] → Off
   > In Region tab, choose **Enabled** in -5V Bias → Enabled → Disabled
   > In XPS Regions window, set Lower energy at -7 eV, Range to 21 eV, smaller Step size (0.025 – 0.05 eV), and 20 ms Time Per Step should be chosen to increase spectral energy resolution.

12) Hit \( \text{S} \) in Spectrum window to start UPS scan, and the UPS spectrum will appear in the **Spectral Window** with both the cutoff edge on the left side and Fermi energy edge collected:
13) Closing UPS measurement

a) Press \textit{ignit/STBY} icon ONCE on the controller to turn OFF the UV light
b) Turn the controller \textit{knob} on the right side to decrease the HV to 0 kV
c) Hit the \textit{Power button} on the left side to turn OFF the UV source controller.
d) Turn the UPS leak valve clockwise to close the valve
   \textbf{Warning:} it is CRUCIAL to perform this step before the following steps, otherwise the main chamber will be filled with high pressure He gas and the SmartSoft software will fail for sample transfer! (Stage “\textit{Initialize}” may need to be performed for sample extraction, contact Core stuff if happened.)
e) Turn the UPS 1 valve clockwise to fully close the valve; the main chamber pressure should increase slightly to higher 10-7 Pa
   \textbf{Warning:} DO NOT overtighten both UPS 1 and 2 valves to cause mechanic damage. To judge if the valves are closed properly, the main chamber pressure should be improved after a brief increase.
f) Turn the UPS 2 valve clockwise to fully close the valve; the main chamber pressure should increase up to higher 10-7 Pa
g) Go to the back of the vacuum chamber, turn the He bottle valve clockwise to fully close the valve
h) On SmartSoft window, click \textit{Stage} tab on the right side of Sample window to enter \textbf{Stage Parameters} window and change stage tilt angle T(deg) from 90.0 (tilted stage perpendicular to analyzer column) BACK to 45.0 (flat stage) to, hit Enter and then hit \underline{Eucentric} tab below to tilt stage to entered angle
i) Check to make sure the sample is flat through the vacuum chamber window.
j) Then, follow the steps in SOP Basic to finish the sample extraction.
3 XPS Depth Profile

A sputter depth profile consists of a series of spectra that have been collected at different depths as material was removed from the sample. An XPS depth profile is generally made by alternating sputtering with data acquisition.

**NOTE:** The sputtering process may cause some chemical damage and broaden the peaks.

**NOTE:** Before depth profile analysis, the Survey or Multiplex (Region) acquisitions should have been performed to identify Regions of interest and that analysis areas have been defined.

1) Select the desired Active analysis positions in the Position List Table.
2) Enable the Auto Z before Acquire (XPS>Profile>Setup...) if the analysis positions have NOT been previously aligned
3) Enable the Automated Neutralization (XPS>Profile>Setup... or Status Bar) if the sample is insulating
4) Open the XPS Profile Application window (XPS>Profile tab).
5) Optional use of Profile Settings
   - Select a setting from the Profile Settings combo box.
   - Click the Load button.
6) Optional use of Previous Acquisition file from Profile Settings
   - Click the File... box.
   - Choose a Profile file with desired settings.
   - Click Open. The Profile Parameters will update with the acquisition file settings.
7) Select the Source type from the combo box.
8) Select an X-Ray Setting picking the largest diameter X-Ray probe that is possible, while confining the analysis to the feature of interest.
9) Select the desired UnScanned or Scanned Analyzer Mode.
10) Select a Pass Energy (typically 187.85 eV) and Time Per Step (ms) (Scanned mode) or Time Per Region (ms) (UnScanned mode) (typically 20 ms) that meets your needs.
    **Note:** The Pass Energy in the Profile Parameters area will set the Pass Energy for all current and new Regions
    **Note:** Unique Pass Energy settings can be applied for each Region using the Pass Energy in the Region Table area
11) Select Regions for analysis:
    - Selecting Elements Using the Periodic Table
      - Click the Period Table tool to select elements for analysis.
      - Click the button for each element to be analyzed in the Element Table. This will define a narrow energy range for the most commonly used peak for each element
    - Selecting Elements Using the Import Elements Tool
> Click the **Import Elements** tool to select elements for analysis. This brings up the **Import Element** box.

> Click the desired button to import elements used in previous **Multiplex**, **Angle**, **Line** or **Map** acquisitions. Selecting the **Import Spectral Display** will import elements identified in the “highlighted” **Spectral Viewer** [elements identified with **Peak ID**]

12) Select a number of **Sweeps** for each **Region**. Define a higher number of Sweeps for elements that are present at lower concentrations to optimize the acquisition.

13) Customize the setup of each **Region** if desired. Modify the energy range of an element or change the **Pass Energy** of a specific element.

   **Notice:**
   > **Larger Pass Energy** (117.4 or 187.85 eV) should be chosen to increase signal sensitivity as **no need** to examine sputter-damaged chemical states by improving energy resolution (smaller **Pass Energy**).
   > **Step** size can be set **smaller** (0.125 or 0.2 eV) to improve **S/N**.
   > To see the entire table without using the scroll bar, click the **Show Table Details** icon in the table toolbar; this brings up the **Profile Regions** window.

14) Select the desired **Sputter Mode** [**Alternate**; **Alternate w/Zalar**; **Continuous** or **No Sputter**].

15) Open the **XPS>Properties>Profile** window.

   > If **Zalar** is desired; Select **Zalar Accuracy**; **Zalar Interval (cycle)** and **Rotation Speed (rpm)**

   > Click **XPS>Profile>** button to select desired **PreSputter Cycles** in

   > Close the **XPS>Properties>Profile** window

16) Setup **Sputter** parameters and **Cycles** depending on the **Sputter Mode**

   **Note:** the related **Sputter Rate**; **Sputter Depth**; **# of Cycles**; **Total Cycles** fields will be updated as parameters are entered.

   **Note:** the **Total Cycles** will include the Pre-Sputter Cycles
Alternate | Continuous | No Sputter
---|---|---
Open the **Sputter Rate Table** window | Select the desired Sputter Setting | Select the # of Cycles
Use the edit keys to create the desired number of sputter **Layers** and assign **Names** if desired | | Select the # of Cycles
Select the desired **Gun Type** for each **Layer** Ar, C60 or GCIB | | 
Select the desired **Time** for each Layer
*Total time sputtered for this layer for this Gun Type. This time will be broken up into sub Cycles resulting in each sputter cycle etching a duration of the Interval time*
Select the desired **Interval** (sputter time at each **Cycle**) The # of **Cycles** will be update to full-fill the Time (min) requested
Select the desired **Sputter Setting** for each **Layer**
Select the desired total **Time (min)** at each **Sputter Layer**
Select the desired **Interval** (sputter time at each Cycle) The # of **Cycles** will be update to full-fill the **Time (min)** requested
Close the **Sputter Rate Table** window

17) Click the ⬆️ **Profile** button in the **Profile** tab.
   > The **Queue: Acquire Profile-1** box appears displaying progress of the job and the **Acquisition Status** box appears displaying progress of the acquisition and the **Remaining Time** in the acquisition.
   ![Acquisition Status](image)
   > One file will be saved for each analysis area with multiple traces [a set of traces for each region (or energy)]
   > Each file will contain **Spectral Data** and **Depth Profile Intensity Data** for each **Region**
> The Filename will be:

\(<\text{filename}>. \text{<file number>}.\text{<platen name>}. \text{<position #>}. \text{<position list name>\_n}. \text{pro} \) with the \text{n} indexed corresponding to each analysis area (e.g. \text{sample.101\_1.pro} and \text{sample.101\_2.pro}).

\(<\text{filename}>. \text{<file number>}.\text{<platen name>}. \text{<position #>}. \text{<position list name>}\) will remain the same for each analysis area file.

> The \text{SmartSoft-VersaProbe} Spectral data will be displayed in the Spectral Viewer. Each Region will be displayed separately within the viewer. There will be a Spectral Viewer for each analysis area.

> The Profile intensity plot will be displayed in the Profile Viewer. There will be a Profile Viewer for each analysis area.

> All Active analysis positions in the Position List Table that are assigned a valid analysis area for the current acquisition will be visited sequentially.

> To \text{Stop} or \text{Abort} the acquisition before all \text{Cycles} are completed, use the \text{Stop} button within the \text{Queue: Acquire Profile-1} window.

18) Click the \text{More} button in the Profile tab

If a Depth Profile had Stopped or completed; the file will be loaded in the Profile Settings and the acquisition parameters will be updated.

> \text{Continue below by modifying desired parameters}

If the last Depth Profile had been aborted,

> An \text{Open File} window will appear.

> Select the aborted \text{Profile} file and click \text{Open}

\text{Note}: the filename for an aborted Profile will appear with the following format:

\text{PlatenName.121 aborted at May 13 2008 14 7\_1.pro}

> The \text{Profile Acq Warning} window will appear with a message

> Follow the instructions to re-select the analysis position in the \text{Sample>Position List Table} and Drive the stage to this position if the stage has been moved

> \text{Continue below by modifying desired parameters}

19) Modify desired parameters.

20) Click the \text{Start} button

> The original acquisition file will be preserved with its previous name.

> One new file will be saved with multiple traces [one for each analysis area]

The new \text{Filename} will be:

\("\text{previous name\"}+1\).\text{.pro}

Subsequent \text{More} acquisitions will preserve previous files; acquire new data and save a new file with the \text{Filename}:

\("\text{previous name\"}+2\).\text{.pro}
4 XPS Angle Profile

**Angle-Resolved** (angle-dependent) profiles are used to probe the near surface region of a platen (sample) in a non-destructive manner. **Survey** or **Multiplex** acquisition should have been performed and analysis areas have been defined (Sample Session) before Map acquisition.

1) Select the desired **Active** analysis positions in the Sample>Position List Table.
2) Enable the **Auto Z Before Acquire** (XPS>Properties>Setup) if the analysis positions have not been previously aligned.
3) Enable the **Automated Neutralization** (XPS>Properties>Setup or Status Bar) if the sample is insulating.
4) Open the XPS Angle Application window.
5) **Optional use of Angle Settings**
   - Select a setting from the Angle Settings combo box.
   - Click the Load button.
6) **Optional use of Previous Acquisition file Angle Settings**
   - Click the File... box.
   - Choose a Angle file with desired settings.
   - Click Open. The Angle Parameters will update with the acquisition file settings.
7) Select the **Source** type from the combo box.
8) Select an **X-Ray Setting** picking the largest diameter X-Ray probe that is possible, while confining the analysis to the feature of interest.
9) Select the desired **UnScanned** or **Scanned** Analyzer Mode.
10) Select a **Pass Energy** and **Time Per Step (ms)/Time Per Region (ms)** combination that meets your needs.
    *Note: The Pass Energy [Default] in the Spectrum Parameters area will set the Pass Energy for all current and new Regions*
    *Note: Unique Pass Energy settings can be applied for each Region using the Pass Energy in the Region Table area*
11) Select **Regions** for analysis.
    - **Selecting Elements Using the Periodic Table**
      - Click the **Period Table** tool to select elements for analysis.
      - Click the button for each element to be analyzed in the **Element Table**. This will define a narrow energy range for the most commonly used peak for each element.
    - **Selecting Elements Using the Import Elements Tool**
      - Click the Import Elements tool to select elements for analysis. This brings up the Import Element box. Click the desired button to import elements used in previous Multiplex, Profile, Line or Map acquisitions. Selecting the Import Spectral Display will import elements identified in the “highlighted” Spectral Viewer [elements identified with Peak ID].
12) Select a number of **Sweeps** for each **Region**. Define a higher number of Sweeps for elements that are present at lower concentrations to optimize the acquisition.
13) Customize the setup of each Region if desired. Modify the energy range of an element or change the Pass Energy of a specific element.

Note: To see the entire table without using the scroll bar, click the Show Table Details icon in the table toolbar; this brings up the Angle Regions window.

14) Select Standard or Narrow Acceptance Angle in the XPS>Properties>Profile window.

15) Select the XPS>Angle>Angle Table button to open the Angle Table window.

   > Use the edit keys to add the desired number of angles
   > Enter the desired Angle and Cycles for each angle

Note: The intensity response of the Versa Probe II varies with the sine of the platen (sample) tilt angle. For this reason, you should collect data for a longer time (more Cycles) at low angles.

   > Close the Angle Table window

Note: the Analysis Time; Runtime and Cycles will be calculated as a function of the Region parameters, Angle Table parameters and Angle Application tab parameters.

16) Click the Start button in the Angle tab.

   > The Queue: Acquire Angle-1 box appears displaying progress of the job and the Acquisition Status box appears displaying progress of the acquisition and the Remaining Time in the acquisition.

   > One file will be saved for each analysis area with multiple traces [a set of traces for each region (or energy)]

   > Each file will contain Spectral Data and Angle Intensity Data for each Region

   > The Filename will be:
   
   <filename>.<file number>.<platen name>.<position #>.<position list name>_n.ang
   
   with the _n indexed corresponding to each analysis area (e.g. sample.101_1.ang and sample.101_2.ang)

   <filename>.<file number>.<platen name>.<position #>.<position list name> will remain the same for each analysis area file

   > The SmartSoft-VersaProbe Spectral data will be displayed in the Spectral Viewer. Each Region will be displayed separately within the viewer. There will be a Spectral Viewer for each analysis area.

   > The Angle intensity plot will be displayed in the Profile Viewer. There will be a Profile Viewer for each analysis area.
> All **Active** analysis positions in the **Position List Table** that are assigned a valid analysis area for the current acquisition will be visited sequentially.

> To **Stop** or **Abort** the acquisition before all Cycles are completed, use the **Stop** button within the **Queue: Acquire Angle-1** window.
5 XPS Line

Lines provide a two-dimensional display of elemental or chemical state information. Typically, Lines are used in situations where it would be too time consuming either to collect a Map or to determine the detailed shape of an edge or interface. A Line is a single row of pixels or data points. A complete spectrum is collected at each pixel. These spectra are collected in what is called an “UnScanned” mode. That is, the entire spectrum is collected in one step, like a snapshot, which greatly reduces the time required to collect a line. Survey or Multiplex acquisition should have been performed and that analysis positions and analysis areas have been defined (Sample Session) before Line acquisition.

1) Select the desired Active analysis positions in the Sample>Position List Table.
   Note: there must be at least one “line” analysis area selected
2) Enable the Auto Z Before Acquire (XPS>Properties>Setup) if the analysis positions have NOT been previously aligned
3) Enable the Automated Neutralization (XPS>Properties>Setup or Status Bar) if the sample is insulating
4) Open the XPS Line Application window.
5) Optional use of Line Settings
   > Select a setting from the Line Settings combo box.
   > Click the Load button.
6) Optional use of Previous Acquisition file Line Settings
   > Click the File... box.
   > Choose a Line file with desired settings.
   > Click Open. The Line Parameters will update with the acquisition file settings.
7) Select an X-Ray Setting picking a spot size that is similar in size to the features you expect to see in the Line.
8) Set the Pass Energy to 117.4 eV
9) Select the desired Time Per Pixel (ms)
10) Select Regions for analysis.
   Selecting Elements Using the Periodic Table
   > Click the Period Table tool to select elements for analysis.
   > Click the button for each element to be analyzed in the Element Table. This will define a narrow energy range for the most commonly used peak for each element
   Selecting Elements Using the Import Elements Tool
   > Click the Import Elements tool to select elements for analysis. This brings up the Import Element box. Click the desired button to import elements used in previous Multiplex, Profile, Angle or Map acquisitions. Selecting the Import Spectral Display will import elements identified in the “highlighted” Spectral Viewer [elements identified with Peak ID]
11) Select a number of Sweeps for each Region. Define a higher number of Sweeps for elements that are present at lower concentrations to optimize the acquisition.
12) Customize the setup of each Region if desired. Modify the energy range of an element or change the Pass Energy of a specific element.
**Note:** Unique Pass Energy settings can be applied for each Region using the Pass Energy in the Region Table area.

**Note:** To see the entire table without using the scroll bar, click the Show Table Details icon in the table toolbar; this brings up the Line Regions window.

13) Click the **Start** button in the Line tab:

> The Queue: Acquire Line-1 box appears displaying progress of the job and the Acquisition Status box appears displaying progress of the acquisition and the **Remaining Time** in the acquisition.

> One file will be saved for each analysis area with multiple traces [a set of trace for each region (or energy)]
> Each file will contain **Spectral Data, Line Intensity Data** and a memory map file for each Region
> The Filename will be:

\[ \text{<filename>}. \text{<file number>}.\text{<platen name>}. \text{<position #>}. \text{<position list name>}_n.\text{lin} \]

with the \_n indexed corresponding to each analysis area (e.g. `sample.101_1.lin` and `sample.101_2.lin`)

\[ \text{<filename>}. \text{<file number>}.\text{<platen name>}. \text{<position #>}. \text{<position list name>}_n \]

will remain the same for each analysis area file
> The SmartSoft-VersaProbe Spectral data will be displayed in the Spectral Viewer. Each Region will be displayed separately within the viewer. There will be a Spectral Viewer for each analysis area.
> The Line intensity plot will be displayed in the Image Viewer. There will be an Image Viewer for each Region of each analysis area.
> All Active Line analysis positions in the Position List Table will be visited sequentially.
> To **Stop** or **Abort** the acquisition before all Cycles are completed, use the Stop button within the Queue: Acquire Line-1 window.

> Acquire **More Line**:

> Click the More button in the Line tab to add additional data to the Stopped or completed Line acquisition
> Add the more Cycles to increase the Analysis Time

**Note:** If the Line acquisition was stopped; the current number of Cycles can be used to continue the acquisition
> Click the **Start** button
> The original acquisition file will be preserved with its previous name.
> One new file will be saved
> The new Filename will be
> "**previous name**"+1. **lin**
> Subsequent More acquisitions will preserve previous files; acquire new
> data and save a new file with the Filename:

> "**previous name**"+2. **Lin**
6 XPS Map

Maps provide a two-dimensional display of elemental or chemical state information. Maps consist of an array of individual pixels. A complete spectrum is collected at each pixel. These spectra are collected in an “UnScanned” mode. That is, the entire spectrum is collected in one step, like a snapshot, which greatly reduces the time required to collect a Map. Survey or Multiplex acquisition should have been performed and that analysis positions and analysis areas have been defined (Sample Session) before Map acquisition.

2) Select the desired Active analysis positions in the Sample>Position List Table.
   Note: there must be at least one “area” analysis area selected
3) Enable the Auto Z Before Acquire (XPS>Properties>Setup) if the analysis positions have NOT been previously aligned
4) Enable the Automated Neutralization (XPS>Properties>Setup or Status Bar) if the sample is insulating
5) Open the XPS Map Application window.
6) Optional use of Map Settings
   > Select a setting from the Map Settings combo box.
   > Click the Load button.
7) Optional use of Previous Acquisition file Map Settings
   > Click the File... box.
   > Choose a Map file with desired settings.
   > Click Open. The Map Parameters will update with the acquisition file settings.
8) Select an X-Ray Setting picking a spot size that is similar in size to the features you expect to see in the Map.
9) Set the Pass Energy to 117.4 eV
10) Select the desired Time Per Pixel (ms)
11) Select Regions for analysis.
   Selecting Elements Using the Periodic Table
   > Click the Period Table tool to select elements for analysis.
   > Click the button for each element to be analyzed in the Element Table. This will define a narrow energy range for the most commonly used peak for each element
   Selecting Elements Using the Import Elements Tool
   > Click the Import Elements tool to select elements for analysis. This brings up the Import Element box. Click the desired button to import elements used in previous Multiplex, Profile, Angle or Line acquisitions. Selecting the Import Spectral Display will import elements identified in the “highlighted” Spectral Viewer [elements identified with Peak ID]
12) Select a number of Frames for each Region. Define a higher number of Frames for elements that are present at lower concentrations to optimize the acquisition.
13) Customize the setup of each Region if desired. Modify the energy range of an element or change the Pass Energy of a specific element.
   Note: Unique Pass Energy settings can be applied for each Region using the Pass Energy in the Region Table area
**Note:** To see the entire table without using the scroll bar, click the Show Table Details icon in the table toolbar; this brings up the Map Regions window.

14) Click the **Start** button in the Map tab:

> The **Queue: Acquire Map-1** box appears displaying progress of the job and the Acquisition Status box appears displaying progress of the acquisition and the **Remaining Time** in the acquisition.

> The **Queue: Acquire Map-1** box appears displaying progress of the job and the Acquisition Status box appears displaying progress of the acquisition and the **Remaining Time** in the acquisition.

> Each **Region** will be acquired sequentially.

> The Map acquisition begins. The incident X-Ray beam steps point by point along a line while “**unscanned**” spectral data is collected at each point. A pixel intensity is calculated using the **Peak Intensity** method that is selected in the XPS>AcquisitionProperties>Region tab. The spectral data and calculated intensity values are then saved for each pixel.

> This is then repeated for the next line, and so on until all the lines have been acquired. This is one “**frame**.” This is then repeated for the next frame, at each point calculating and saving only the average of [**peak-minus-background** intensity at this point on this sweep] and [the value stored at this point during the preceding sweep]. When the specified number of frames/sweeps is completed, the acquisition for the next region (element) begins.

> One file will be saved for each analysis area with multiple traces [a set of trace for each region (or energy)]

> Each file will contain **Spectral Data, Map Intensity Data** and a memory map file for each **Region**

> The Filename will be:

```
<filename>. <file number>.<platen name>. <position #>. <position list name> _n. map
```

with the _n indexed corresponding to each analysis area (e.g. sample.101_1.map and sample.101_2.map)

> The **SmartSoft-VersaProbe Spectral** data will be displayed in the **Spectral Viewer**. Each **Region** will be displayed separately within the viewer. There will be a **Spectral Viewer** for each analysis area.

> The **Map** intensity plot will be displayed in the **Image Viewer**. There will be an **Image Viewer** for each **Region** of each analysis area.
> All Active Area analysis positions in the Position List Table will be visited sequentially.
> To Stop or Abort the acquisition before all Maps are completed, use the Stop button within the Queue: Acquire Map-1 window.
> Acquire More Map:
  > Click the More button in the Map tab to add additional data to the Stopped or completed Map acquisition
  > Increase the Sweeps Multiplier to increase the Analysis Time
  *Note: If the Map acquisition was stopped during the first Region of the first analysis area; the new Sweeps Multiplier will be used to continue the acquisition. This will result in the first Region completing with the new number of sweeps and the remaining Regions performed with the new number of sweeps*
  > Otherwise:
    *If the Map acquisition was stopped during the first Region of the first analysis area; the current Sweeps Multiplier will be used to continue the acquisition. This will result in the first Region completing and the remaining Regions performed."
> Click the Start button
  > The original acquisition file will be preserved with its previous name.
  > One new file will be saved
  > The new Filename will be
    `<"previous name">+1>.Map`
  > Subsequent More acquisitions will preserve previous files; acquire new data and save a new file with the Filename:
    `<"previous name">+2>.map`