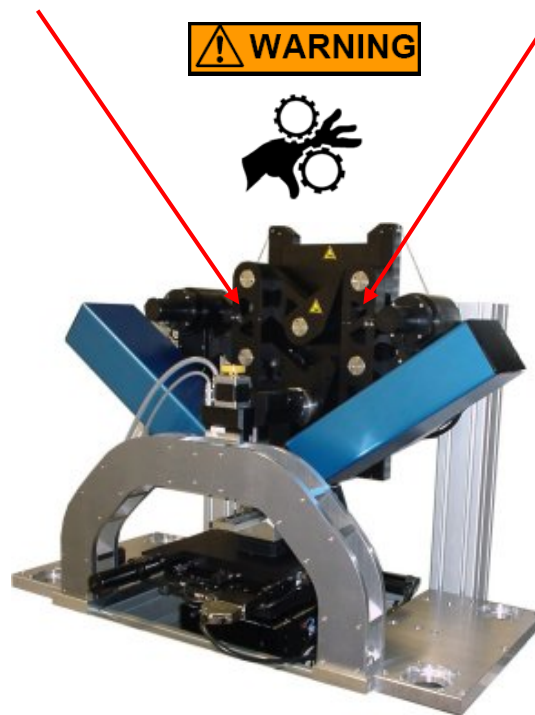


## Starting the EP3 Imaging Ellipsometer

1. Log onto the system (central login computer in service corridor)
2. The computer monitor and the instrument will turn on
  - a) The blue colored start button on the Laser Control Box should be ON (blue glow). If this is not the case, turn the knob clockwise to start the instrument (like starting a car...)
  - b) The Xenon lamp Spectroscopic Box should be OFF
  - c) Turn On the spectroscopic box (power switch on the front left of box) if you need to use any other wavelength than 532 nm or if you plan to use the 2x objective.

**Before doing anything else be sure that there is nothing on the XYZ stage and that nothing is getting pinched/crushed by the goniometer arms**

**THE GONIOMETER ARMS ARE VERY POWERFULL  
THEY ARE A CONSIDERABLE PINCHING/CRUSHING HAZARD**



3. Log onto the EP3 computer using login: **EP3** password: **EP3**
4. Start the EP3 software by clicking on the desktop icon
5. Press OK when software asks for login name - “NBTC user” is the only available choice - this will initialize the instrument to its default settings

## General instrument setup

6. After initialization, the default windows will be displayed.
  - a) These are the Control and Live Image and the EP3View windows. See figure below
  - b) The script tree in the EP3View window contains a function tree with all available measurement options which are divided into groups depending on measurement (examples below):
  - c) The Control and Live Image window contains the real time view of the sample plus controls for the instrument that could be changed by clicking on them (optical shutter, wavelength selection, image grab, angle of incidence selection, polarizer angles etc.)
7. Go to **File** in the menu and select **change data path**
  - a) This will allow you to choose where to save your data files
  - b) Browse to your folder in *D:\User data\user name\selected folder* so you are inside the folder you want to save your files to
  - c) Click on **Select Cur Dir** to activate the data path
  - d) The data path should be visible in the top corner of the script window
8. Go to the objectives menu in the Control and Live Image and select the current objective - (2x or 10x objective)
9. Go to the **Cells** menu in the Control and Live Image and select **none**. If you are using a prism or a liquid cell, choose the appropriate setting.



## Typical sample setup for standard measurements

10. Put your sample on the XYZ table, close to the right hand side if possible.

**!!! CAUTION !!!**

### **BEFORE MOVING THE STAGE**

**THE 10X OBJECTIVE WILL CRASH INTO THE STAGE AT ANGLES  $\geq$  60 DEG IF THE STAGE IS MOVED TOO FAR TO THE RIGHT. ALWAYS LOOK AT THE STAGE WHILE MOVING TO BE SURE THAT IT WON'T CRASH INTO THE OBJECTIVE**

**\$\$ YOU CRASH - YOU PAY \$\$**

11. Move the stage so the sample is positioned under the red alignment laser using game pad or XYZ stage control buttons.
12. Click the Align button in the Control and Live Image window and do an initial horizontal plane alignment (automatic alignment).
  - a) If the auto alignment fails you may need to increase the CCD gain – middle left of the Control and Live Image window
  - b) If the auto alignment fails, move the crosshair with the mouse until the laser spot is centered.
13. Close the align window to return to the live image
14. Click on the wavelength selection button and choose 532 nm laser or choose another wavelength if desired – in that case the Xenon lamp spectroscopic box must have been turned on.
15. If working with the laser source click on the laser intensity button and adjust to 1% (lowest setting possible)
16. Open the optical shutter by clicking on the “shutter open/close” button
17. Click in the AOI control box and select the angle you want to use – AOI is sample dependent –  $55^{\circ}$  works for silicon substrates.

**!!! CAUTION !!!**

**ALWAYS WATCH THE STAGE/OBJECTIVE**

18. Press the **gain** button to adjust CCD gain to correct level
19. Adjust the XYZ stage up/down in Z (gamepad or software controls) until the real time ROI signal is maximized
  - a) Do a quick check with a piece of paper to see where the laser spot is reflecting into the objective (it should be slightly below the center of the objective)

- b) Moving the stage up/down you will start to see a bright spot in the real time view. This is the illuminated area on the sample and the light from the surface reflection can be seen in the CCD
  - c) Adjust height of sample until this spot is centered in the real time view window and the real time ROI signal is close to being maximized
  - d) It might be necessary to adjust the CCD gain and/or laser power as to not saturate the camera
  - e) **IMPORTANT:** Avoid saturation at all times as this will affect the response of the CCD
20. Once the sample is adjusted in Z, move the sample stage to the general area you want to measure.

**!!! CAUTION !!!**  
**ALWAYS WATCH THE STAGE/OBJECTIVE**

21. Click the **focus calib** button and adjust the focus on a small particle/edge etc.
- a) There will be a red horizontal line through the image
  - b) Focus on an edge or other identifiable feature on the sample surface
  - c) Focus using the **focus scan** slider or click in the number box below and use the up/down arrows on the keyboard
  - d) NOTE: The motor offset values for a center focal plane at  $60^{\circ}$  angle is **~5700** for the 2x objective and **~15400** for the 10X objective (a starting point to find the absolute focus)
  - e) Use the slider bar and adjust the red line so it is positioned above the focused feature
  - f) The software knows where the plane of focus is and can adjust the focal position automatically
  - g) You should test the focus scanner by selecting the **cross hair** icon in the image window, when clicking on an unfocused area the focus should change to that area.
  - h) Once this is done close the **focus calibration** window
22. Do an horizontal plane alignment as above before any measurement to be sure that the sample plane is good
23. Choose the ROI that you want to measure by clicking in the “box” icon in the “Control and Live Image” window and draw a rectangle over the area(s) you want to measure.
- a) Multiple ROI's can be selected by holding the shift button while drawing additional boxes
24. Set CCD gain below 20
25. Click on the + sign in front of the **Measurements** script tree
26. Double click on **Course Adjust** from the options

- a) This will adjust the analyzer/polarizer angles to a position where the intensity of the reflected polarized light is minimized in the CCD - Remember that this will find the average minima of *all* ROI's combined
- b) NOTE – we are using nulling ellipsometry. This means that we are trying to find the position of the optical components where no light is passing through to the detector.

27. Select the measurement script you want to use from the function script menu

Example using the **AOI\_variation** script:

- a) Click on the + sign in front of the **AOI\_variation** group to expand the tree
- b) Click on the + sign in front of the **one\_zone** script to display the parameters
- c) Adjust the parameters by clicking on them and change to desired values:

AOI start	start angle
AOI end	end angle
AOI step	angle increment between each measurement
plrange	± angle rotation of the polarizer (P) from the initial value displayed in the control box
alrange	± angle rotation of the polarizer (A) from the initial value displayed in the control box
sample points	how many steps the rotation of (P) and (A) will be divided into (200 is a good average value)

28. Double click on the script to start the measurement

29. During the measurement the results are recorded in the active log file.

30. To see the measured data select **Log Editor** from the **Windows** menu in the EP3View window

**REMEMBER - You have to manually save the data in order to keep it**

- a) To save the data, enter an appropriate name in the top text box of the logfile and select **Save current logfile** from the **File** menu. This will save the log file to your selected data path.
- b) If you wish to do another measurement and not have the data recorded in the same logfile, choose **New log file** from the menu to create a new empty logfile.

31. This is an general description on how to make a measurement and how to save the acquired data

32. To analyze the data you need to set up an optical model and fit the measured data to that model

## Shutting down the EP3 Imaging Ellipsometer

33. Move the XYZ table far to the left so it clears the objective with a wide margin
34. Remove all your samples and clean up around instrument
35. If you used any liquid/SPR cells, be sure to very carefully clean the cell and any used prism properly. Once clean and dry, return all items to their storage location
36. **VERY IMPORTANT:** Turn off the spectroscopic box
37. Close down the EP3 software
38. Log off EP3 user on the EP3 computer
39. Log off the instrument at the central login computer (this will shut the system down)