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מערכת eLINE – מדריך מקוצר למשתמש

eLINE System – a brief operation guide

Nano-fabrication center

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General Information

General system description:

- Raith Company
- Leo Gemini Coulomb
- Stage position laser interferometer
- Stage height laser interferometer
- Stationary stage movement
- Gaussian beam shape profile
- Vector scan elements

Specifications:

- Encoder resolution 2nm
- Position repeatability « 50nm
- Dwell time 100nm-8s
- Step size 1nm-1mm
- High tension 0.1 kV to 30kV
- Setting time 0-10ms
- Write field 1nm-2mm
- Beam Current 1pA-10nA
- WD 2mm-15mm
- Spot resolution 20nm

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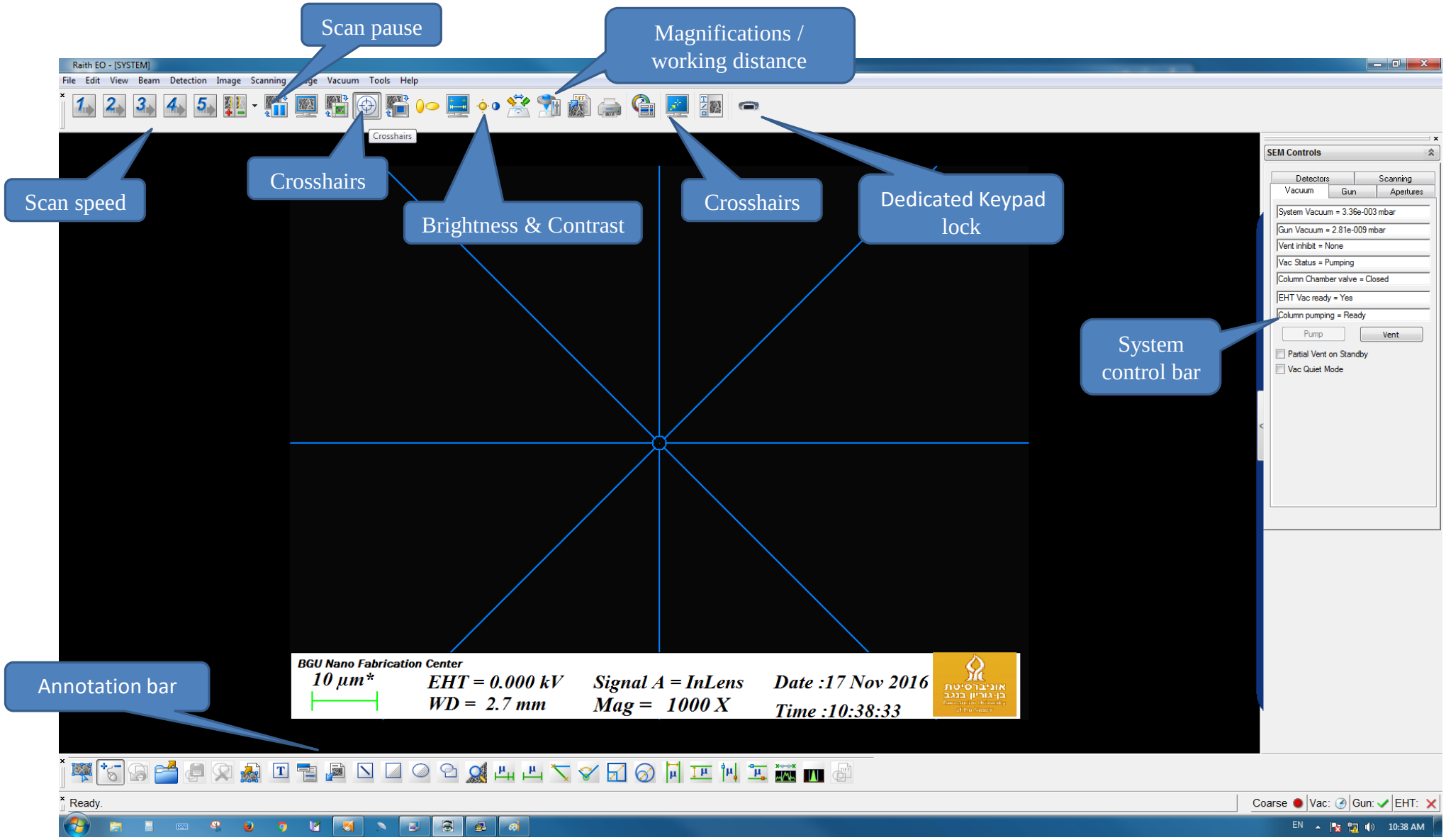
SEM software (right screen)



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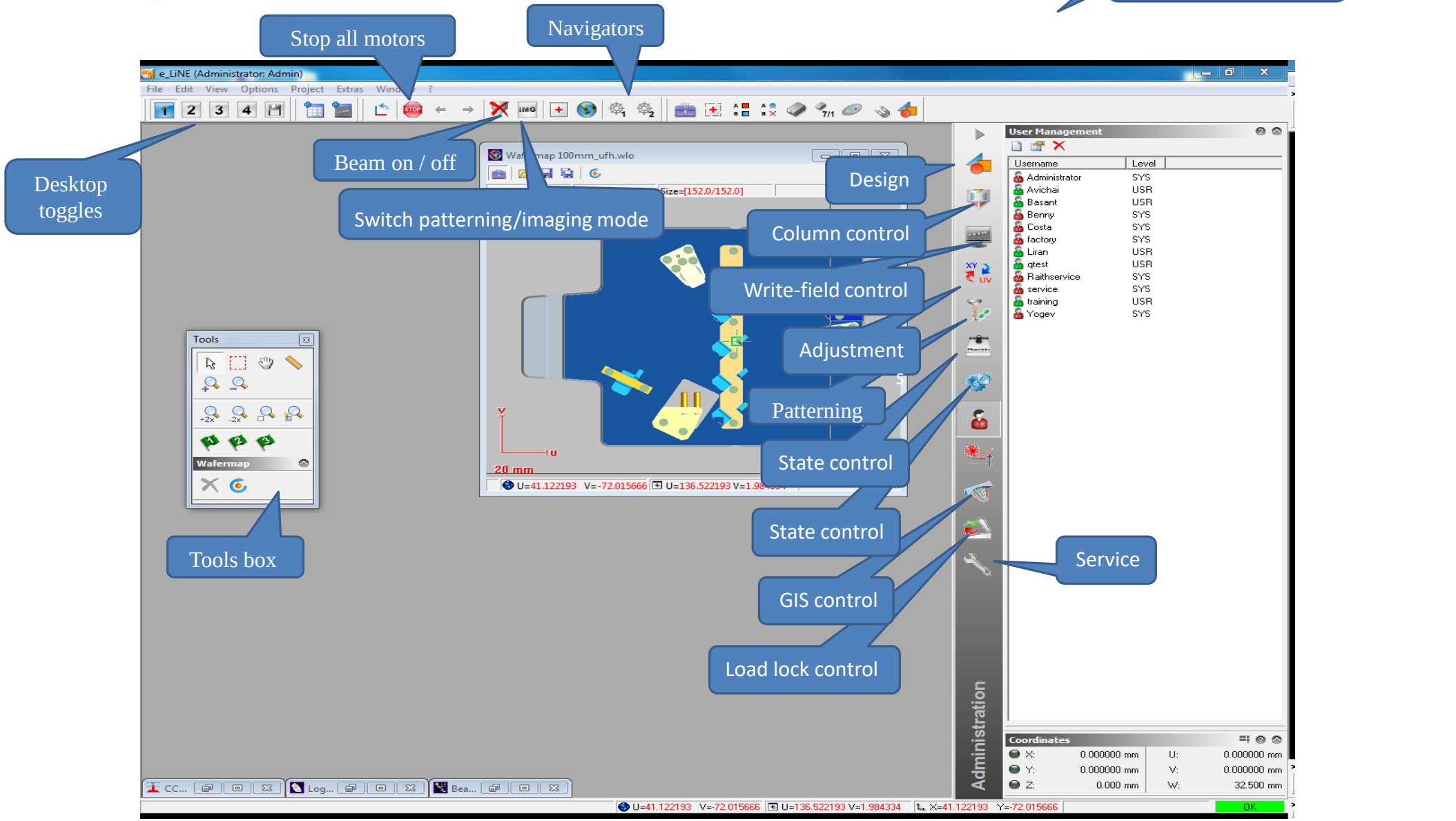
Raith eLINE software (left screen)



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fundamental steps to successful e-beam lithography:

1. Loading sample
2. Set desired EHT, aperture and pattern
3. Measure current and set suitable dose
4. Adjust axes
5. Focus
6. Write-field alignment
7. Exposure
8. Unloading sample and developing

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Enter your user name and password,

choose the project type and click “Login”

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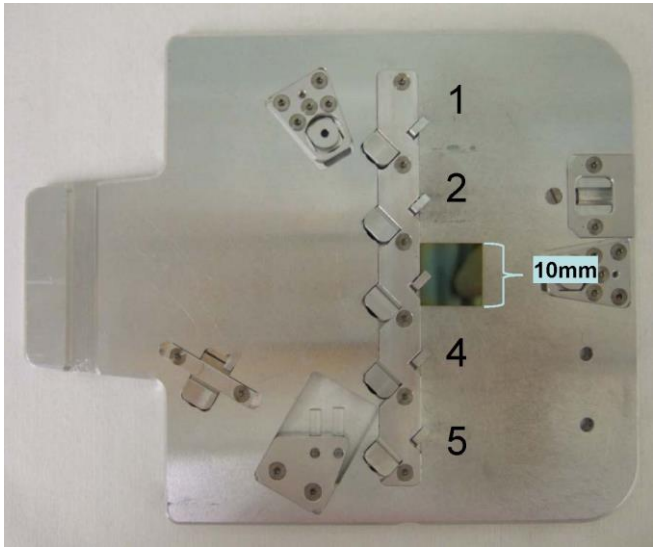
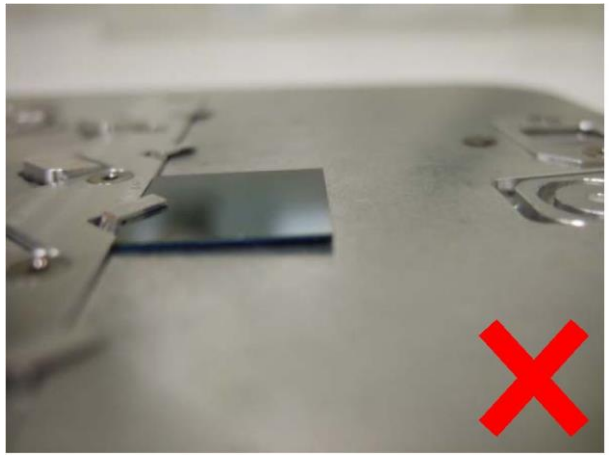
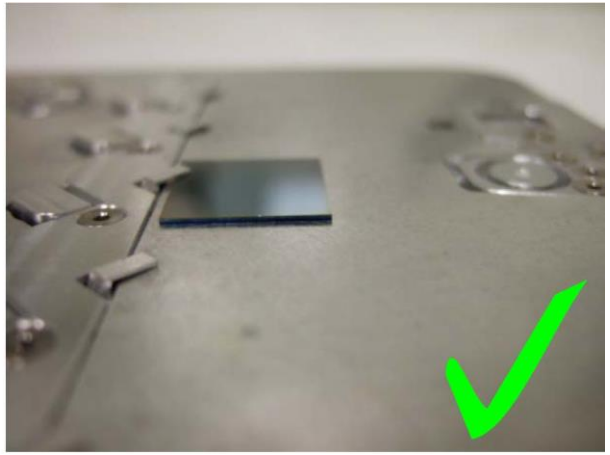
Loading sample

Placing the sample on holder:

- Select the suitable holder
- Take a note of the sample size and position on holder:
- It is recommended that the sample's bottom left corner is bare
- Make sure the sample is flat:







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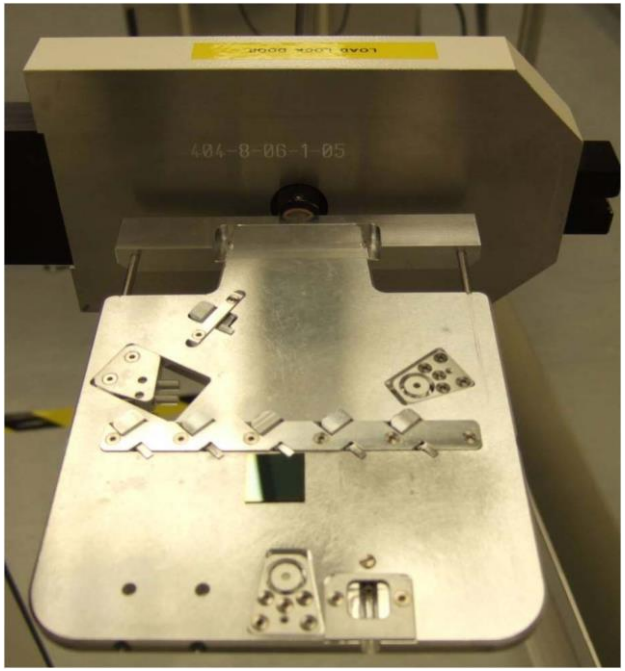
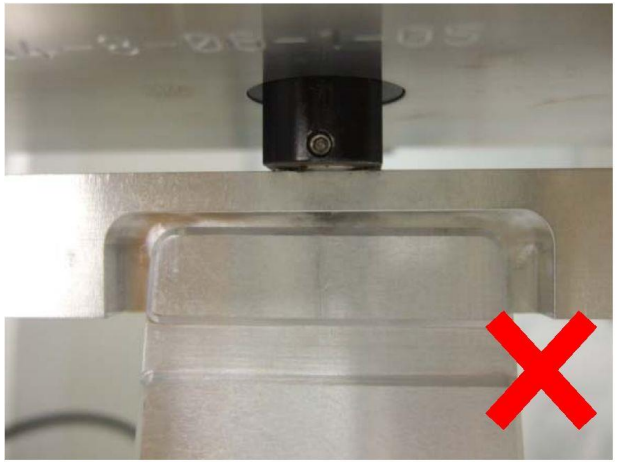
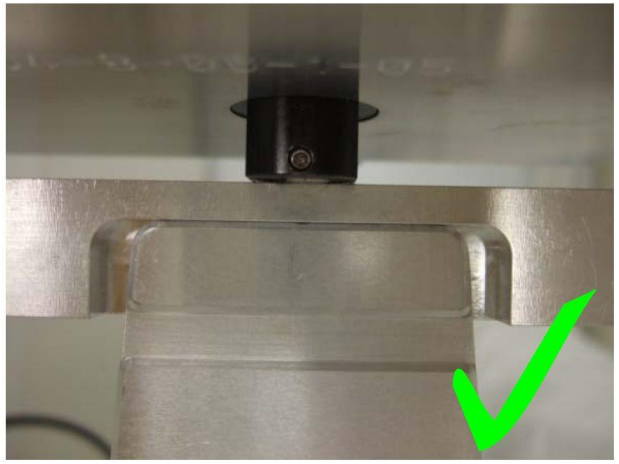
Loading sample

Place holder on transfer rod:

- Make sure it is leveled properly
- Make sure it is anchored correctly
- Close and fasten load-lock door





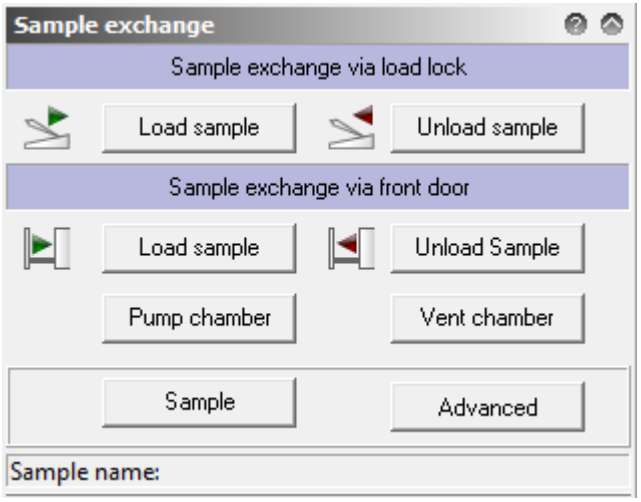


Loading sample

Raith eLINE software:

- Click on **Load-lock** sample exchange menu icon

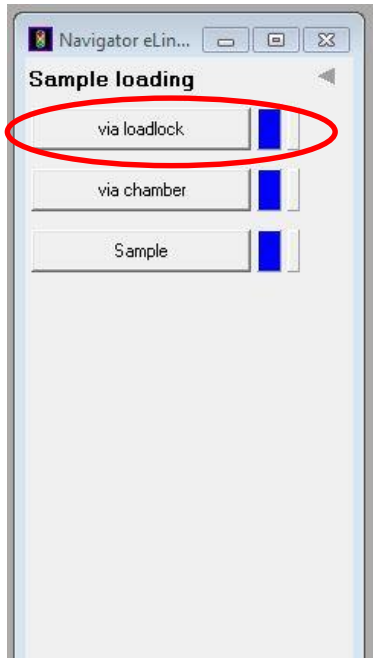
- Click on **Load sample** on “Sample exchange via load lock” bar

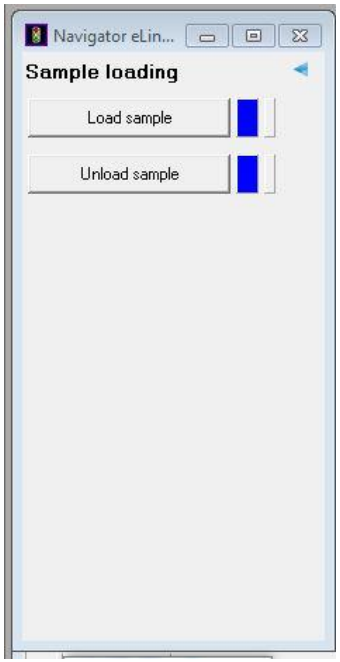


Notice!
Using the “Sample exchange Via front door” menu will open The main chamber and lose the system vacuum!

OR

(1) (2) (3)





- Click icon (1)
- Choose via loadlock (2)
- Choose “Load sample” (3)

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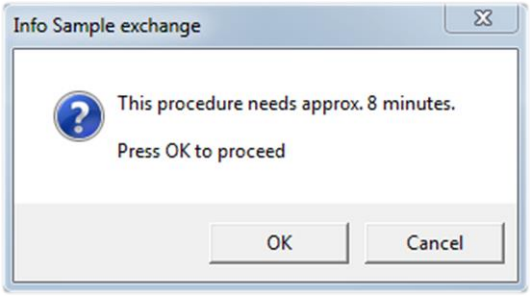
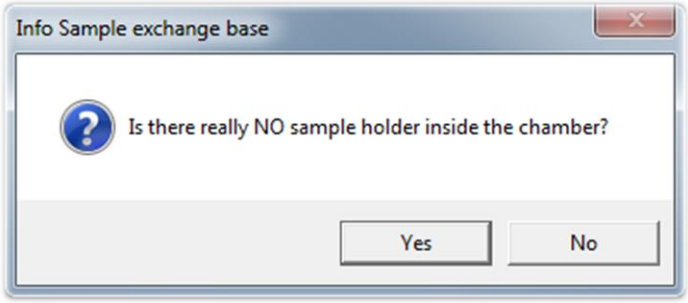
Loading sample

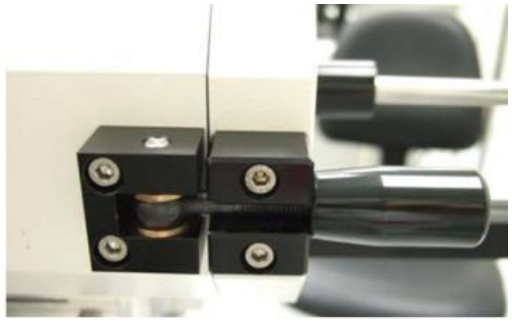
- Click OK to proceed



- Insure that there is no sample holder inside the chamber and the holder is in place and click “Yes”



- Close and fasten the load lock door



- Click OK to proceed
- Wait until next info pop-up window appears

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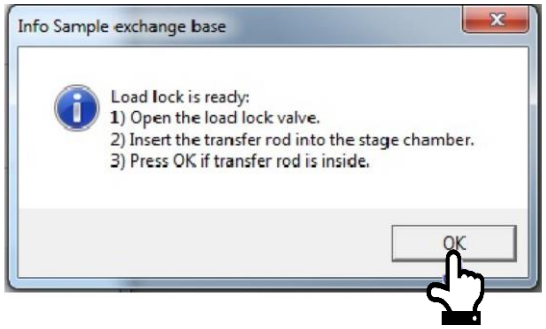
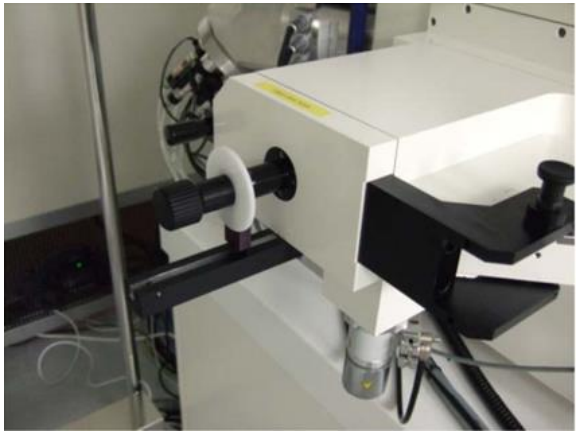
Loading sample

- When this pop-up appears, insure that the load lock vacuum ready indicator is on



- Open the load lock valve

- Insert the transfer rod into the stage chamber and click “OK”



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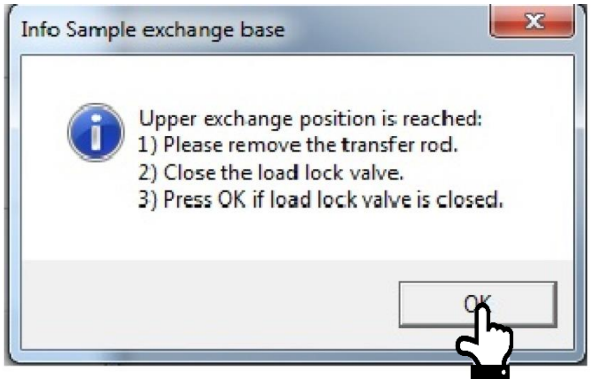
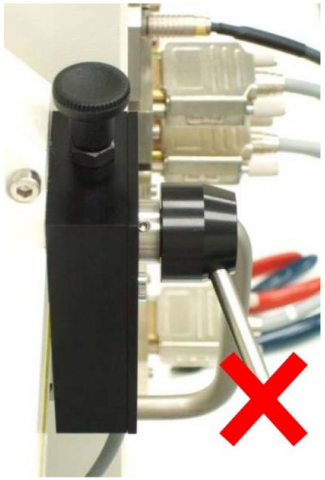
Loading sample

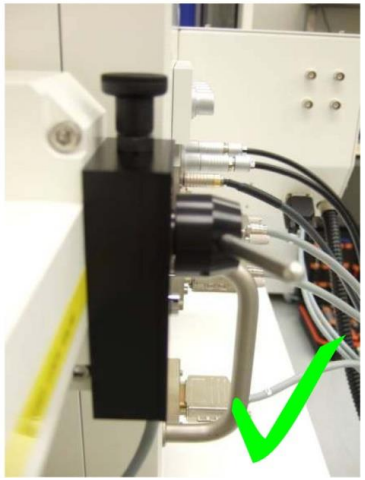
- When this pop-up appears, remove the transfer rod from the stage chamber



- Close the valve. Make sure that it is placed in “Locked” position

- Click OK to proceed





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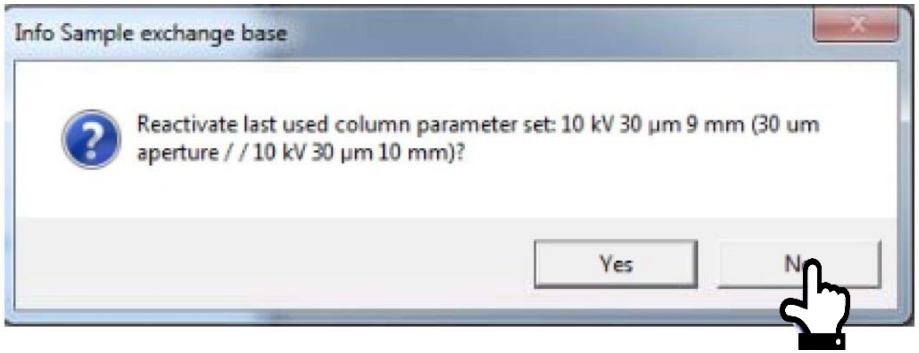
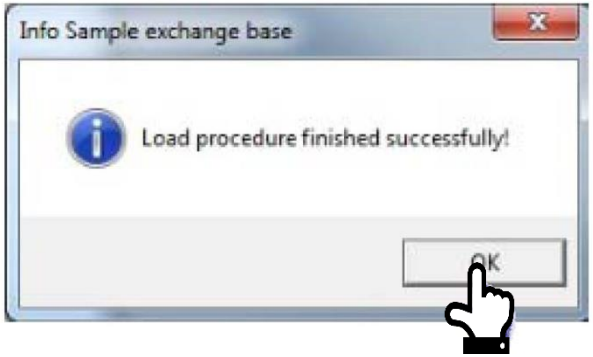
Loading sample

Reset coordinate system? Click as required

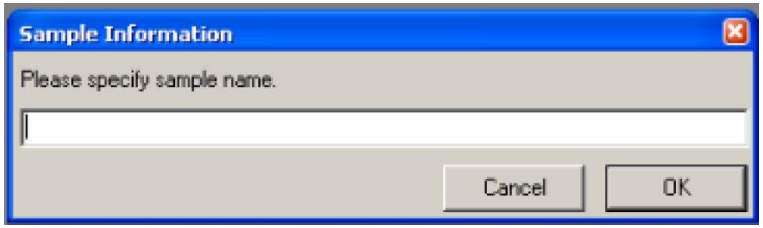
Reactive last used column parameter? Click as required



Load procedure finished successfully ? Click on “OK”



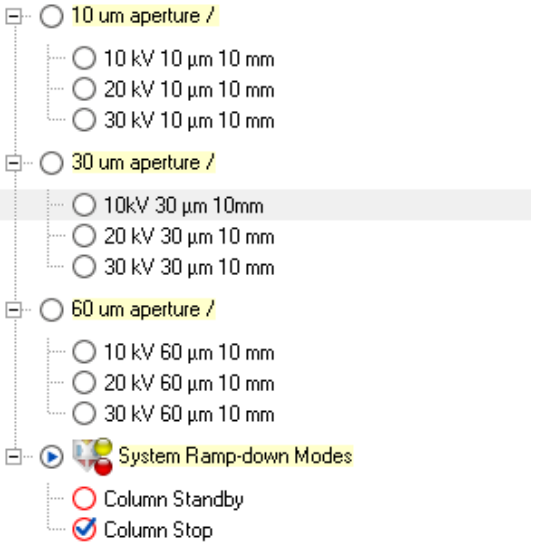
Name the sample



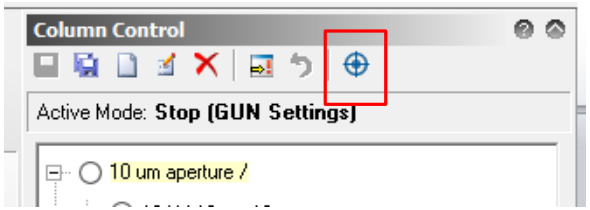
Set desired EHT, aperture and pattern

- Click on “Column control” icon

- Select the desired mode



- Click on “Activate selected mode” icon



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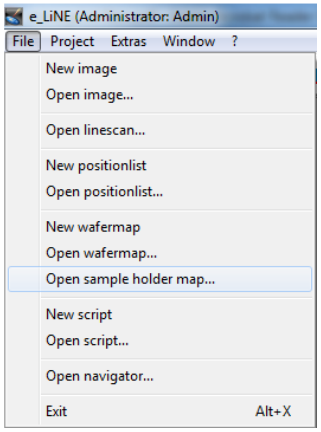
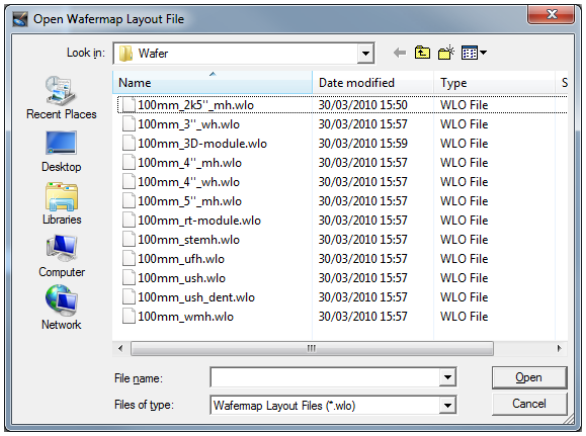
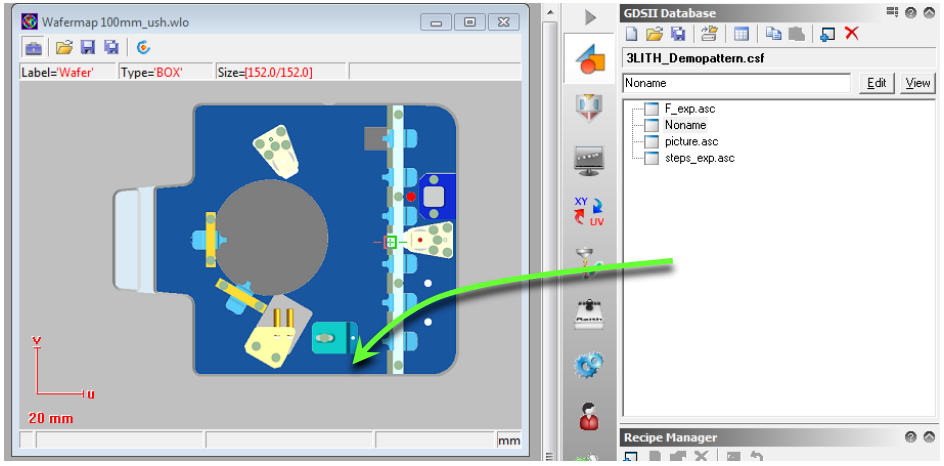
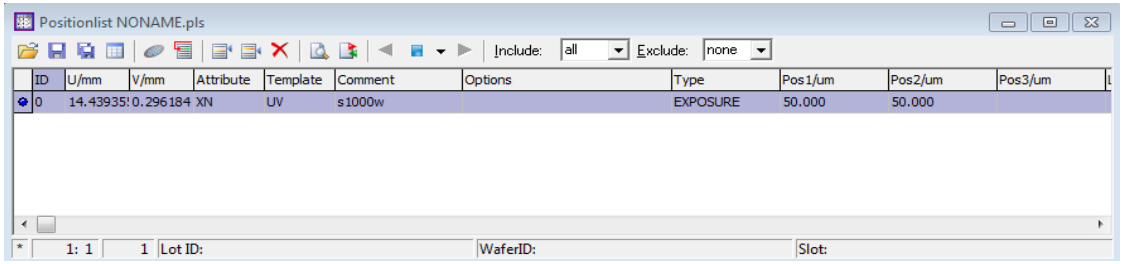
Set desired EHT, aperture and pattern

- Click on “Design” icon 
- Open GDSII database file
- Open the required sample holder map layout
- Choose the desired structure and drag it to the sample position on the wafer-map. A new position list window should appear with the structure position parameters









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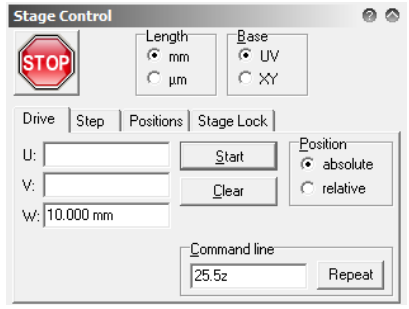
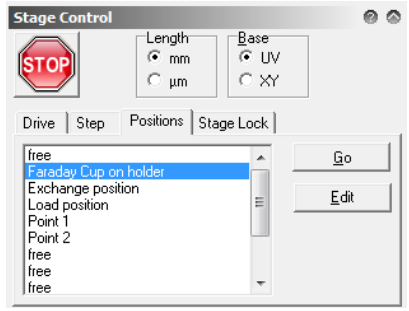
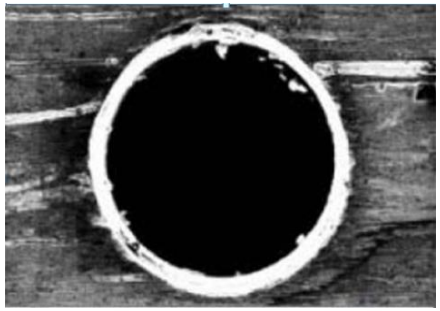
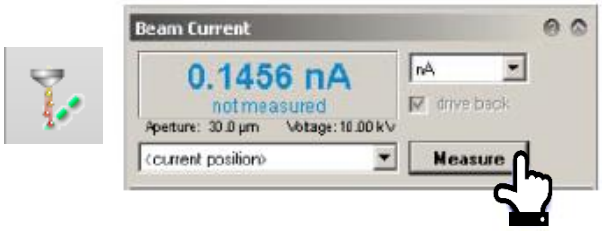
Current measurements and suitable dose set

- Move the stage to be in a working distance of 10mm (use command line **25.5z** or drive to **W=10mm** or to **Z=~25.5mm**)
- Move to the faraday cup position
- Make sure that your on the faraday cup position
- Re-measure the beam current to ensure its stability
- Ensure that the measured current is suite to the official current table









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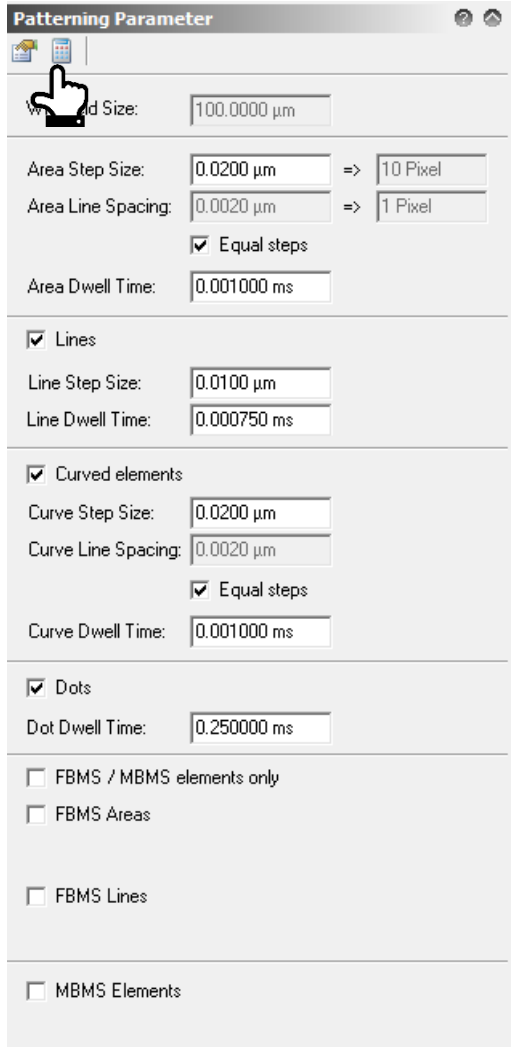
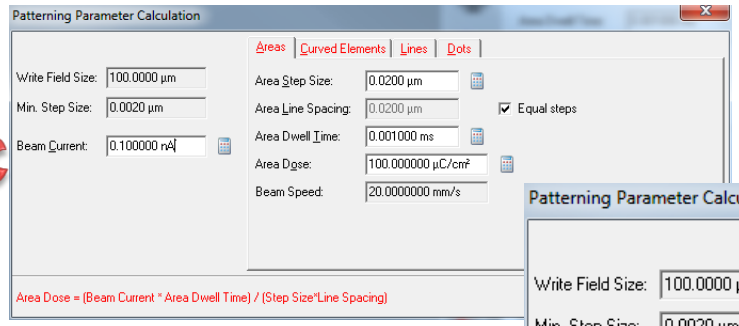
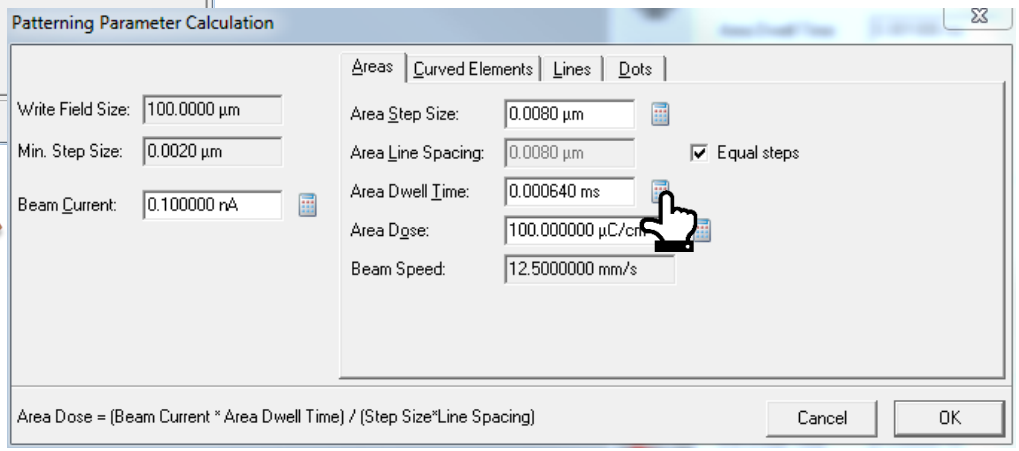
Current measurements and suitable dose set

- In the patterning parameter menu, mark the needed types of elements (Lines, Curved elements, Dots, etc.)

- Click on the patterning parameter calculator icon
- Set the **Step size** and **Dose** for each type of elements
- Calculate the **Dwell time** for each type of elements
- Note that the calculated beam speed should not exceed 15mm/s (otherwise change the parameters or even the EHT and aperture in order to have different beam current)
- Note that the headers and notification area is NOT red







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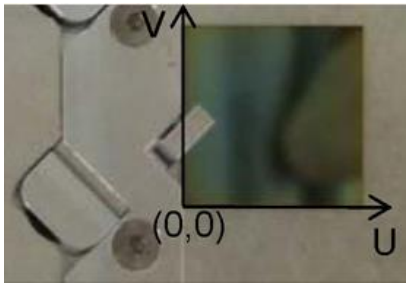
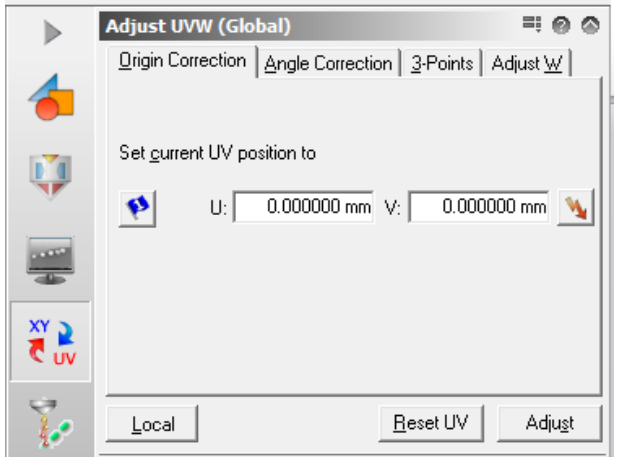
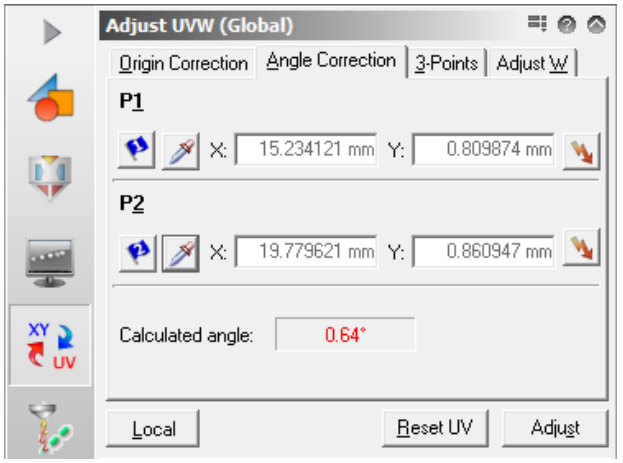
Adjust axes

- Adjust the origin correction by It is recommended to set the down left corner of the sample to U:0,V:0.





- If necessary, Adjust the angle correction by using two points on the x axis of the sample/wafer, read there XY positions (P1, P2) and click “Adjust”. The calculated angle will appear



- If necessary, also perform the 3-point alignment procedure

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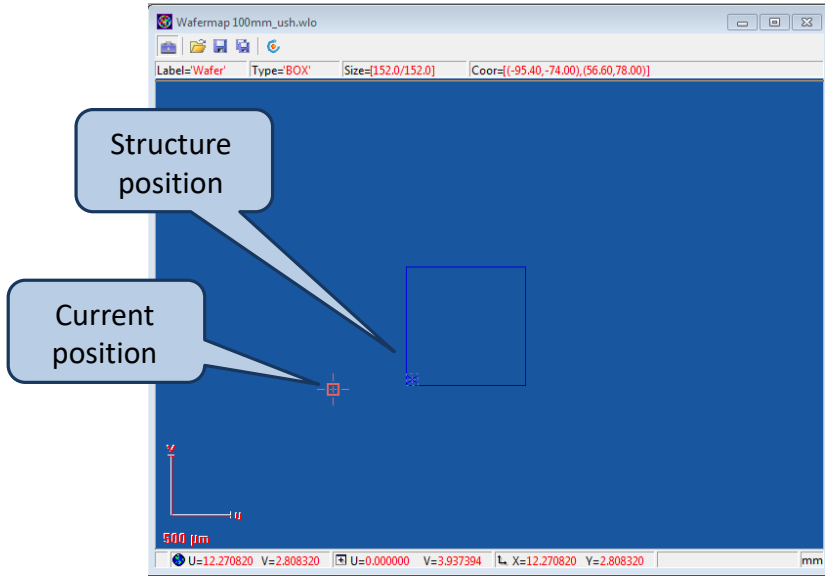
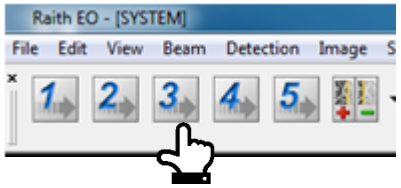
Focus

- Move close to the exposure coordinates of the structure placed on the wafer-map
- Turn the beam on and ensure that the system is in imaging mode
- Reduce the scanning window, increase the magnification and decrease the scan speed
- Focus on the sample surface for optimum image





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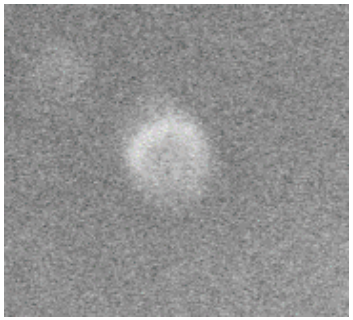
Focus

- While the beam turned on, left click on "**Burn a spot**" icon. Fine tune the focusing until getting a clear and small point (~20nm diameter)

- Adjust the stigmator's XY nodes until the circle is ideal
- Adjust brightness and contrast as needed



- Repeat the spot burning to ensure the focus is ideal
- Ensure that the working distance (WD) from the sample is reasonable (9-10mm)
- Ensure that the spot is clearly visible and the croshairs mark centered to this spot

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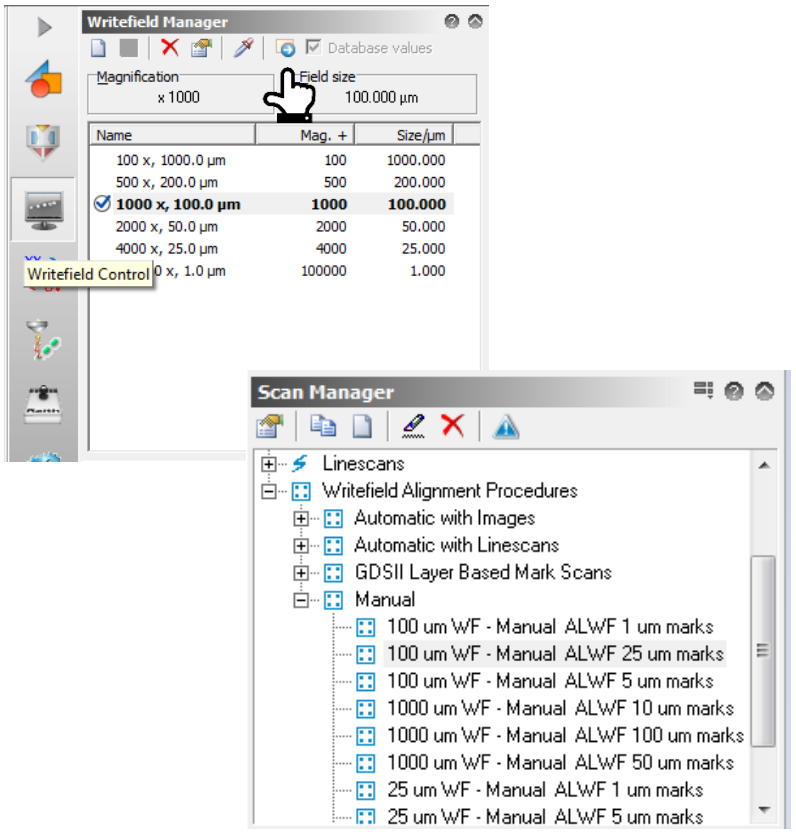
Write-field alignment

- Click on the “Writefield control” icon
- At the “Writefield manager” tab select the proper writefield and click “**F9**” or “**Set new writefield**” icon.
- In the “Scan manager” tab, select the needed alignment procedure, accordingly to the writefield size selected and click “**F9**” or right click and select “**Execute**”. For example at the “Manual” sub header select “100um WF – manual 25um marks” and click execute.
- Usually start with the largest scan size to the smallest one.



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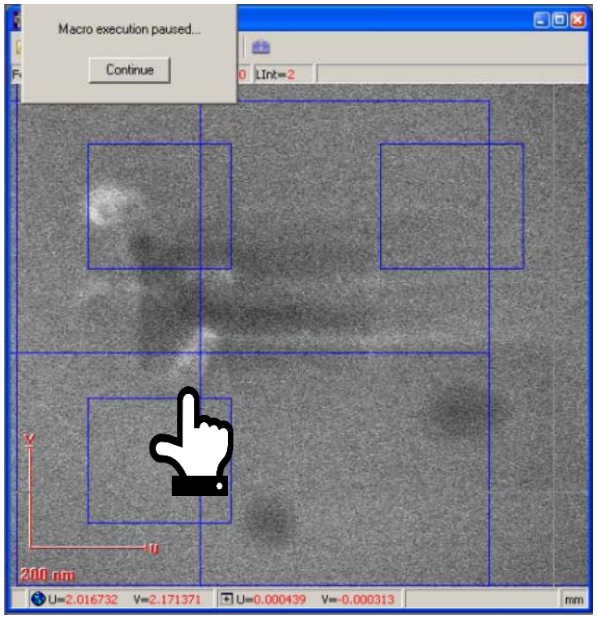
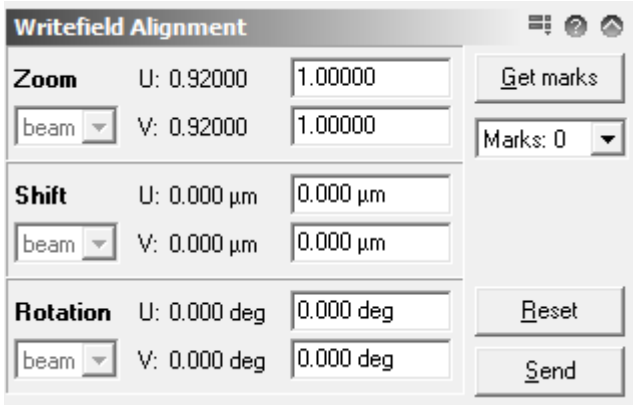
Write-field alignment

- Executing a WF procedure would start a macro that will scan the field from several marks so it can be fine aligned.
- Use a the centered spot as the center reference point and drag the cursor to this point by (**Ctrl+Left click**) and click "**Continue**"
- After the macro will finish, execute another procedure with smaller scan field size until reaching to the smallest scan size for higher resolution
- The Zoom, Shift and rotation parameters will appear after each iteration. Accept them if they seem reasonable. Check the reasonability of the final values of the parameters at the Writefield alignment tab.
- Run the procedure as needed until the cursor change is negligible





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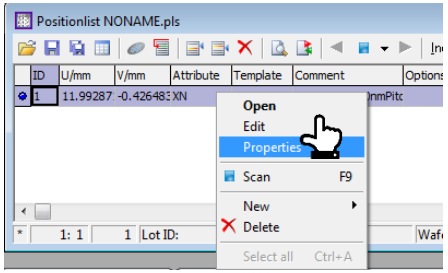
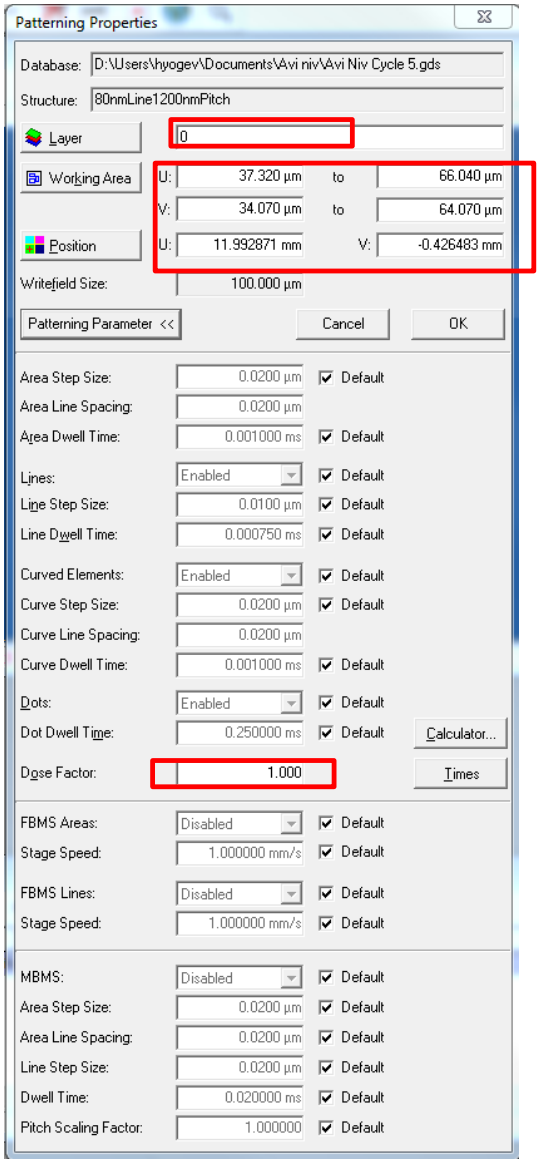
Exposure

- Verify that the final exposing parameters are correct:
  1. Exposing parameters are set correctly

     In the patterning properties pop-up window (**right click** on the structure line and click "**Properties**"):

  1. Structure position is correct
  2. Selected layers are correct
  3. Working area is correct
  4. Dose factor is as needed





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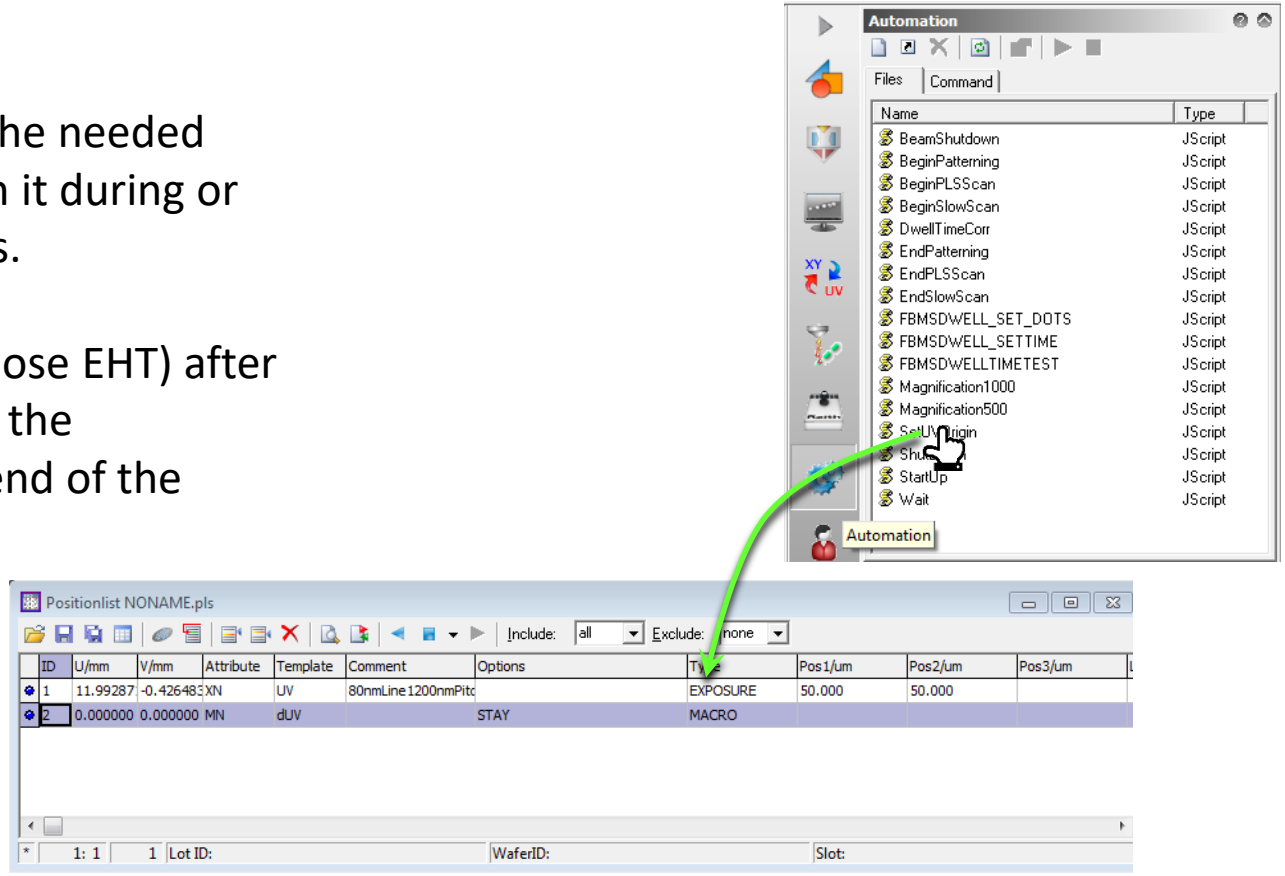
Exposure

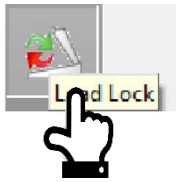
- In the “Automation” tab, drag the needed macro to the position list to run it during or after the scan exposure process.
- For shutting down the beam (close EHT) after scan exposure is finished , drag the BeamShutDown macro to the end of the position list.



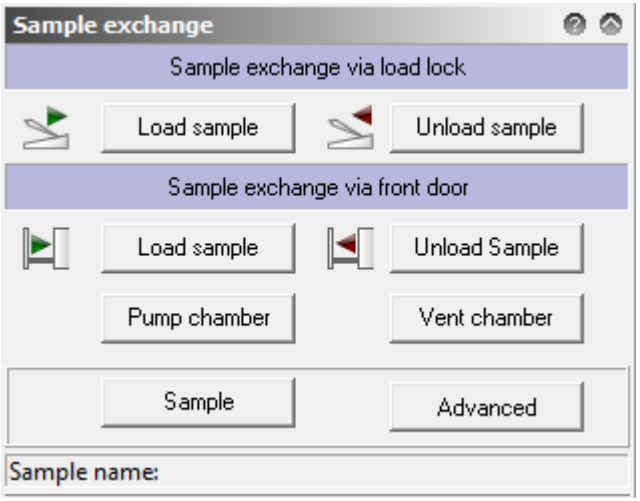
Unloading sample

Raith eLINE software:

- Click on **Load-lock** sample exchange menu icon



- Click on **Unload sample** on “Sample exchange via load lock” bar



Notice!
Using the “Sample exchange Via front door” menu will open The main chamber and lose the system vacuum!

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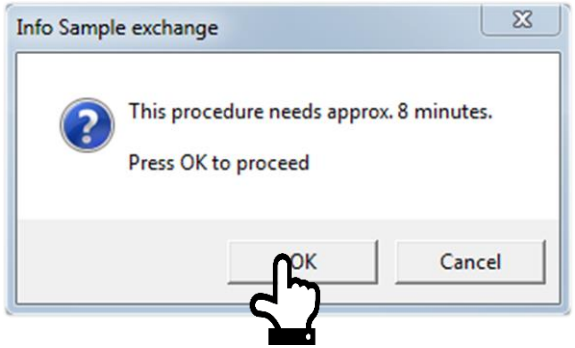
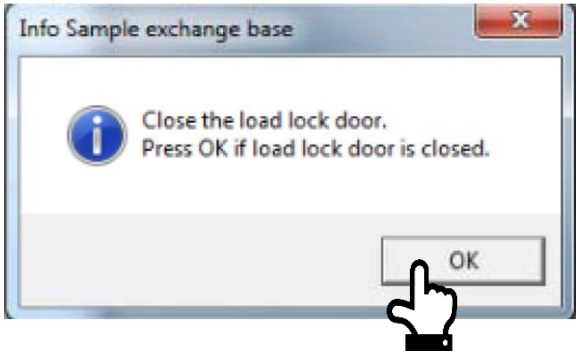
Unloading sample

- Click OK to proceed



- Close and fasten the load lock door

- Click OK to proceed



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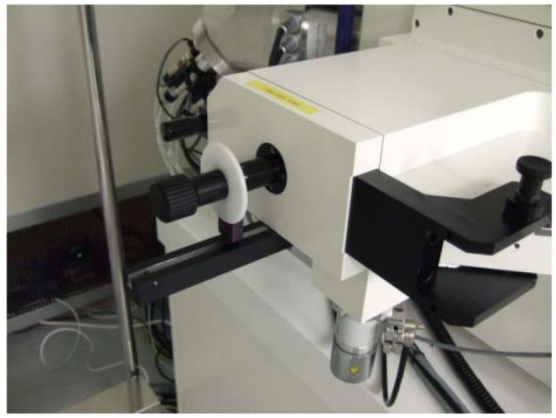
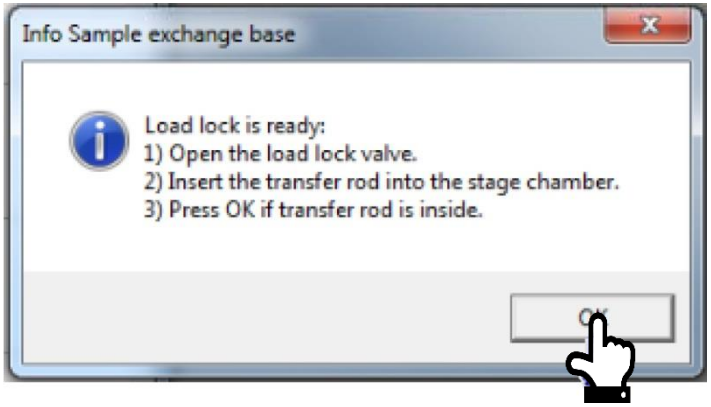
Unloading sample

- When the load lock vacuum is ready, open the load lock valve, insert the rod and click **OK**





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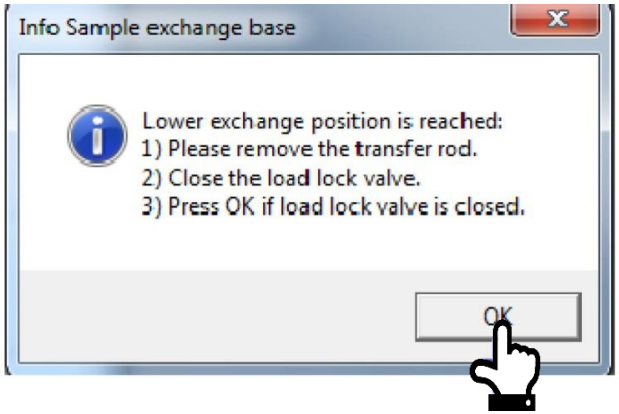
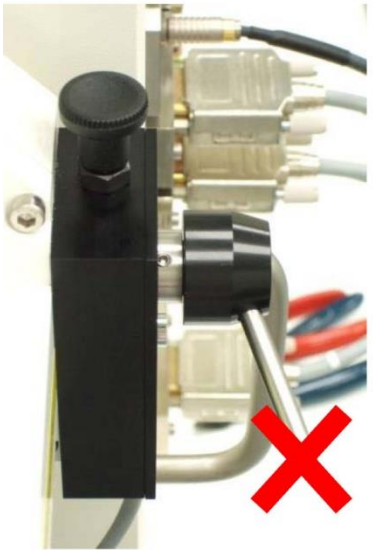
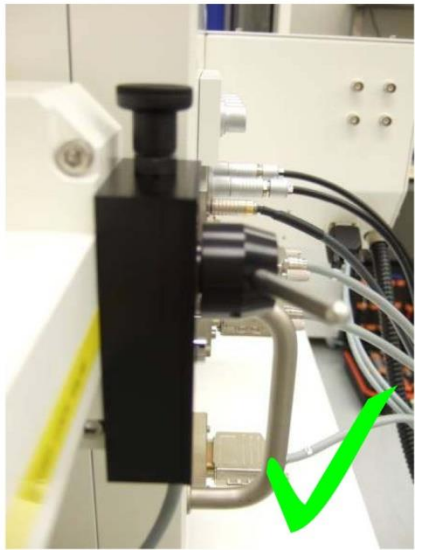
Unloading sample

- After the holder is placed in the exchange place the “Info sample exchange base” pop-up window will appear

- Remove the transfer rod, close the load lock valve and click **OK**







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Unloading sample

- Click **OK** when the unload procedure finished completely. Wait for 1-2 minutes until the load lock chamber is vented, and the venting has stopped.
- Unload the holder and remove the sample.
- Close the load lock door and fasten it gently.
- Place the holder in its dedicated box in the eLINE room bookcase drawer.