IIT Bombay Nanofabrication Facility

Tool Name: Microwriter ML 3

Standard Operating System (SOP)

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Tool's Overview

Fig.: Microwriter ML 3

Checklist (Before starting the tool)

General safety: CAUTION

1)	Do not place any heavy object on the instrument.
2)	Avoid severe impact or rough handling that leads to damaging the instrument.
3)	Only operate the instrument in accordance with the procedures given in this manual. Failure to do so may result in the protection provided by the equipment being impaired.
4)	Do not insert samples thicker than the maximum specified limit for the instrument.
5)	Do not increase camera magnification when the sample is not in focus.
6)	The front door presents a pinch point hazard – if the door is dropped from fully open it may injure hands or fingers. Do not allow the door to drop.

7)	Hazardous ultraviolet light is accessible to the user if the interlocks are defeated or if any of the locked panels of the environmental enclosure are removed. Do not disassemble the instrument or operate it without all enclosure panels in place or with the door interlock defeated unless you are qualified.

Cleaning

1)	Isolate from power supply before cleaning
2)	Use a soft cloth dampened in IPA . Do not spray any liquid.
3)	Do not use chemicals containing harsh solvents such as benzene, toluene, xylene, and acetone.

Operation environment

1)	Location: indoor, dust free, near-non-conductive pollution (degree 2 of EN61010-1:2010)
2)	Relative humidity 70% (no condensation)
3)	Altitude <2000m
4)	Temperature 5-40C

Starting the system

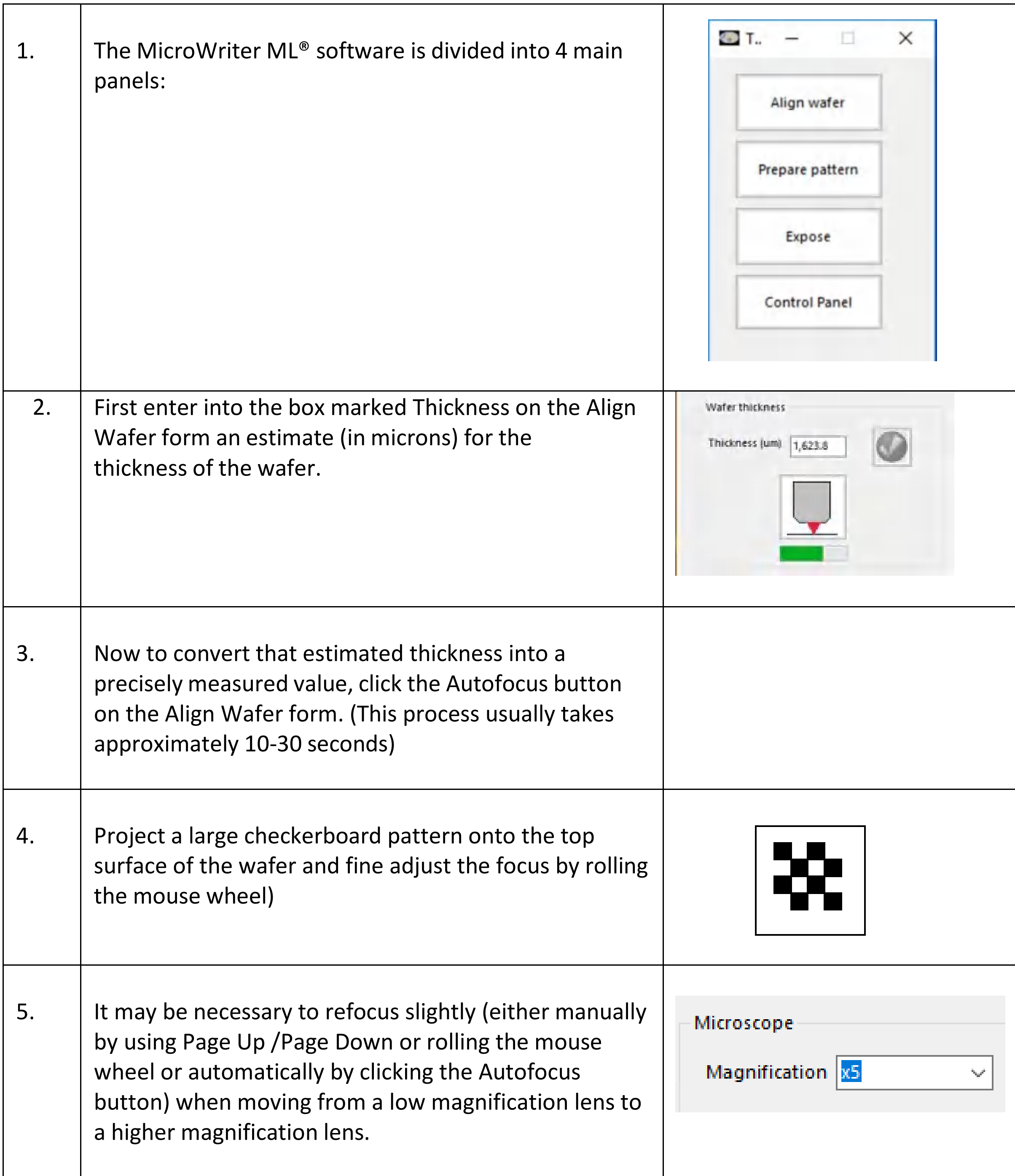
1.	Switch on the power switch on the bottom right of the front panel of the environmental enclosure.	

2.	Start the computer.	
3.	Log onto Windows	Password (**Micro3Writer**)
The red door locked light may flash with varying speed while the instrument initialises its on-board electronics. In this case, wait until the light stops flashing. If there is no flashing, wait a minimum of 3 minutes.		
4.	Double-click on the 'MicroWriter ML' icon on the computer.	DMO MW3
5.	When the Toolbar comes up, check that all of the hardware status lights show light or dark green. Green indicates OK; Red indicates a problem.	Hardware status Door closed Door locked Controller Motors Temperature

Loading wafers

1.	Check that the front door of the MicroWriter ML®3 is unlocked ('Lock' button extinguished).	
2.	If the door is locked ('Lock' button illuminated red) then press the 'Lock' button and wait for it to stop flashing.	
3.	Open the front door.	
4.	Place the wafer onto the stage, centred as well as possible.	
You may add a small drop of DI water on the backside of your sample to enhance the adhesion of the wafer to the chuck.		

Focusing the sample

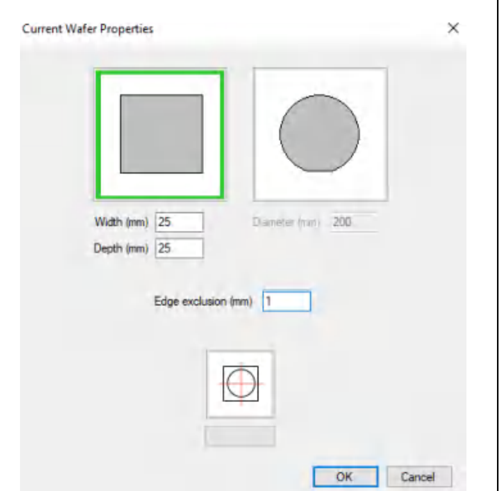


1.	The MicroWriter ML® software is divided into 4 main panels:	
2.	First enter into the box marked Thickness on the Align Wafer form an estimate (in microns) for the thickness of the wafer.	
3.	Now to convert that estimated thickness into a precisely measured value, click the Autofocus button on the Align Wafer form. (This process usually takes approximately 10-30 seconds)	
4.	Project a large checkerboard pattern onto the top surface of the wafer and fine adjust the focus by rolling the mouse wheel)	
5.	It may be necessary to refocus slightly (either manually by using Page Up /Page Down or rolling the mouse wheel or automatically by clicking the Autofocus button) when moving from a low magnification lens to a higher magnification lens.	

Setting Current wafer properties

1.	Click on the wafer tab on the Align wafer panel. Then choose the current wafer properties option in it.	Align wafer

2.	Enter the relevant wafer shape and then enter its size. -By setting the width and depth dimensions in case of square/rectangular shaped samples or -By setting diameter in case of circular shaped samples	
3.	Set an edge exclusion value. This will reduce the effective size of the wafer further. This is useful where there is a bevel or resist edge bead atthe edge of the wafer.	



Please make sure that you feed the exact shape and size of the sample in the current wafer properties. For small sized wafers it's always recommended to have rectangular and square shaped sizes.

Preparing exposure pattern

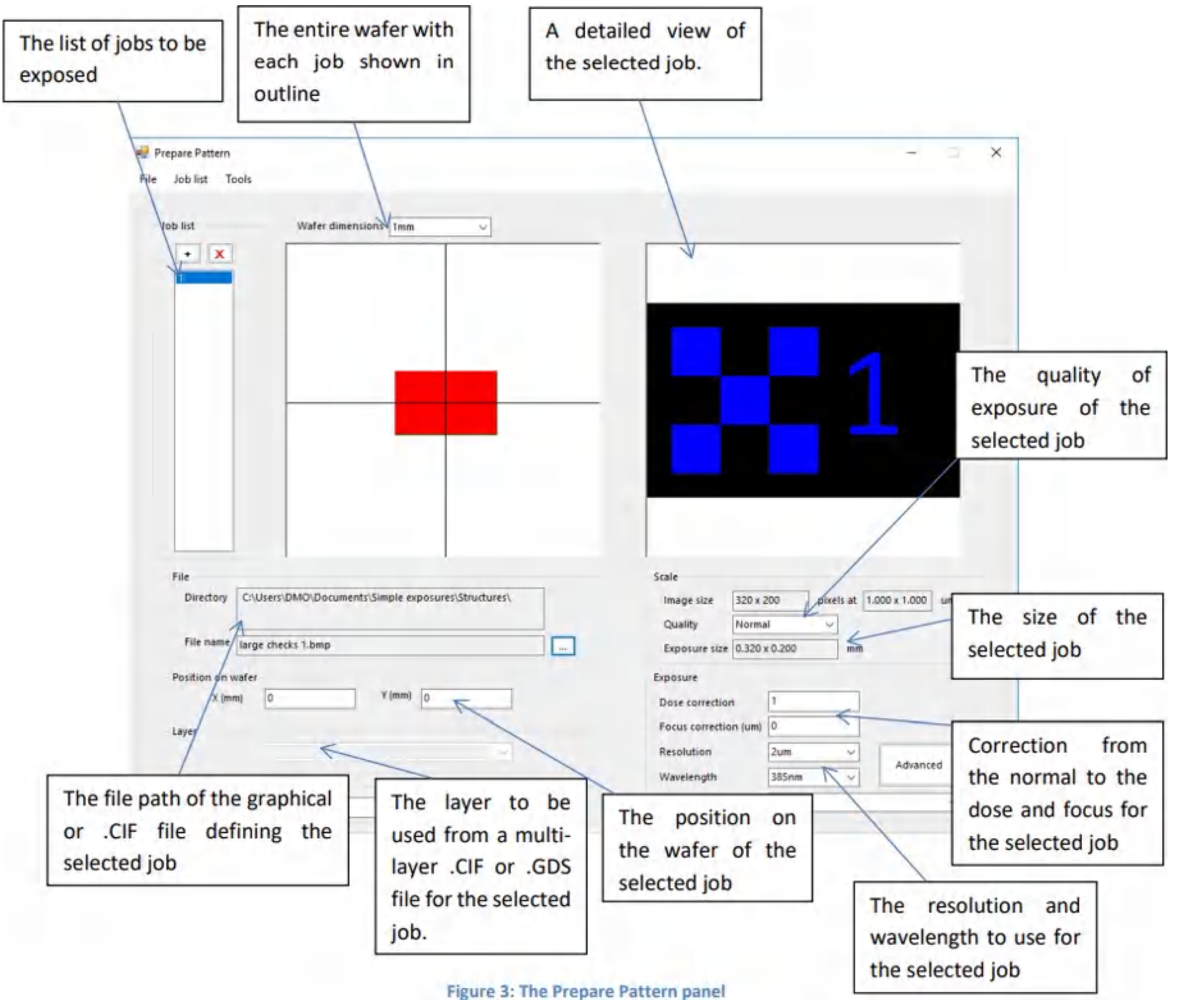
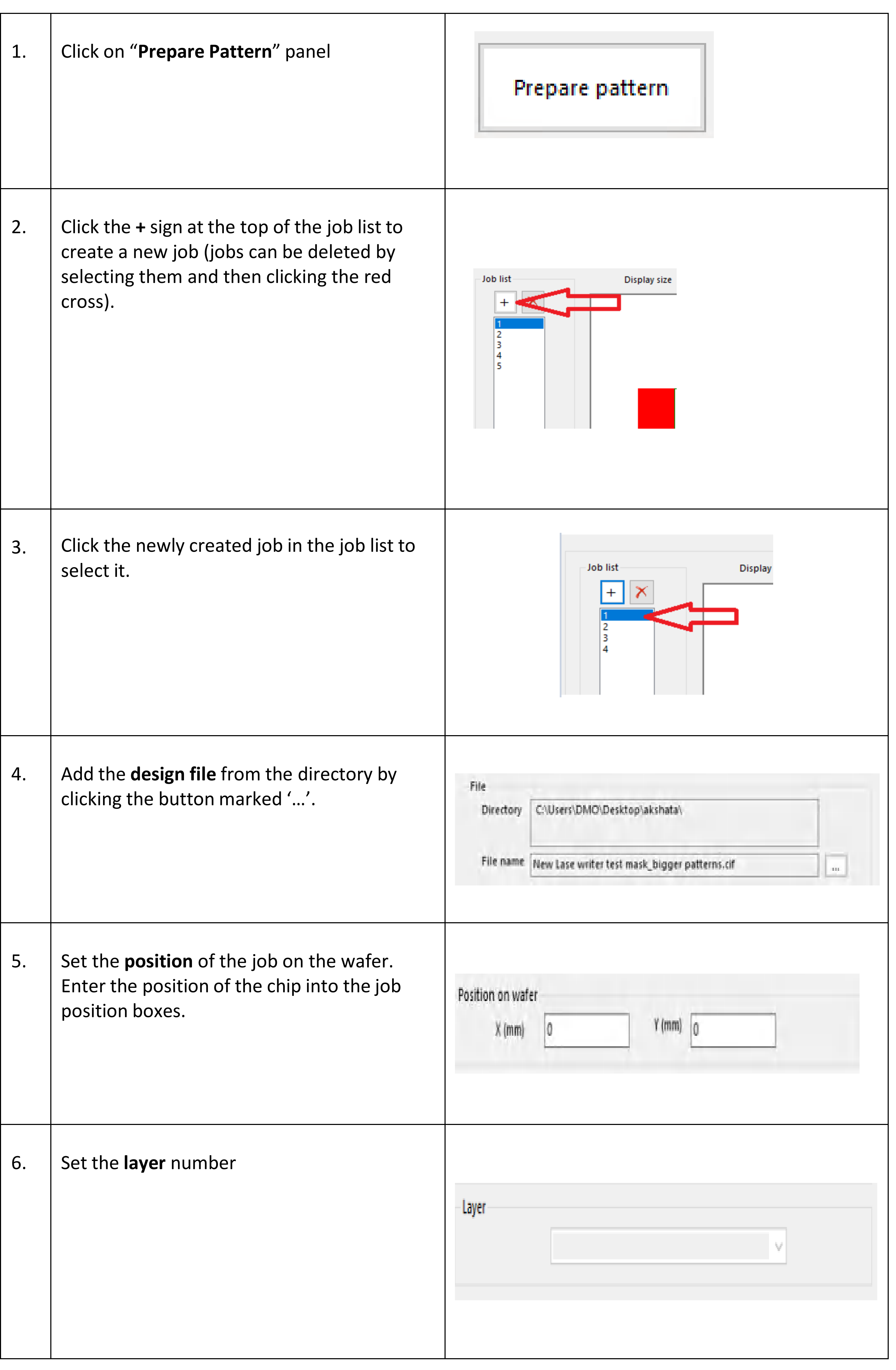


Figure 3: The Prepare Pattern panel



1.	Click on "**Prepare Pattern**" panel	
2.	Click the **+** sign at the top of the job list to create a new job (jobs can be deleted by selecting them and then clicking the red cross).	
3.	Click the newly created job in the job list to select it.	
4.	Add the **design file** from the directory by clicking the button marked '…'.	
5.	Set the **position** of the job on the wafer. Enter the position of the chip into the job position boxes.	
6.	Set the **layer** number	

For CIF and GDS files a given job can only access one layer. To expose multiple layers from the same CIF or GDS2 file, you will need to create a new job for each layer and give them all the same position and file name.

7.	Set the **exposure quality**, chosen from Fastest, Normal, High, Super or Native. It is recommended that **Normal** quality is used the first time a new pattern is being exposed.	
8.	Keep **"Dose correction"** equal "**1**.	
9.	Keep **"Focus correction"** equal "**0**" that is provided by the autofocus mechanism.	
10.	Set the desired **optical resolution**. This will determine which objective lens is selected during the exposure. The larger the optical resolution value, the faster the exposure.	

Exposure

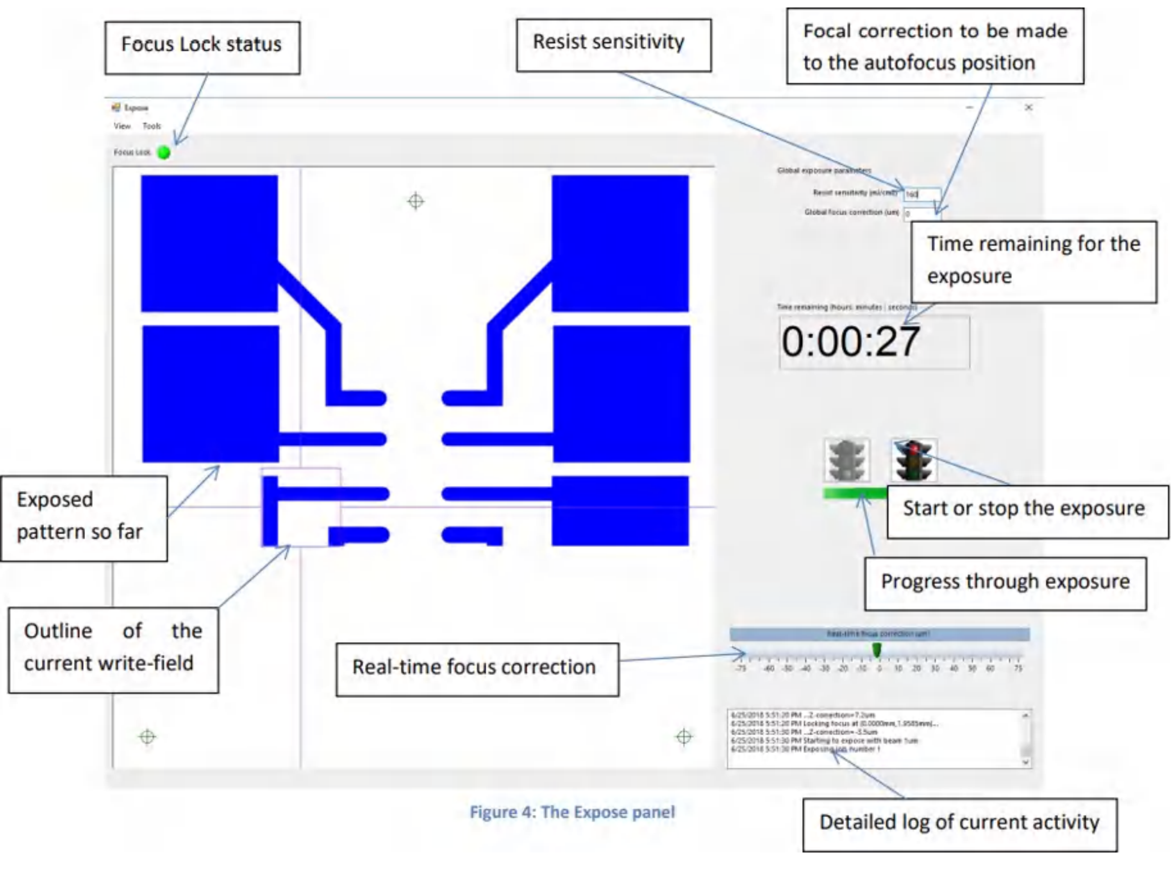


Figure 4: The Expose panel

1.	Click on the exposure panel	Expose
2.	Enter the resist dose into the text box marked Resist Sensitivity.	Global exposure parameters Resist sensitivity (mJ/cm2) 37.5 Global focus correction (um) 0
3.	You can check how much writing timing the tool will take for the created joblist. For that you will have to click the tools option in the exposure panel and start rendering.	Expose View Tools Focus Lock options Exposure options Favourites Notifications Start rendering
3.	Then click the green traffic light button in the Exposepanel to start the exposure.	

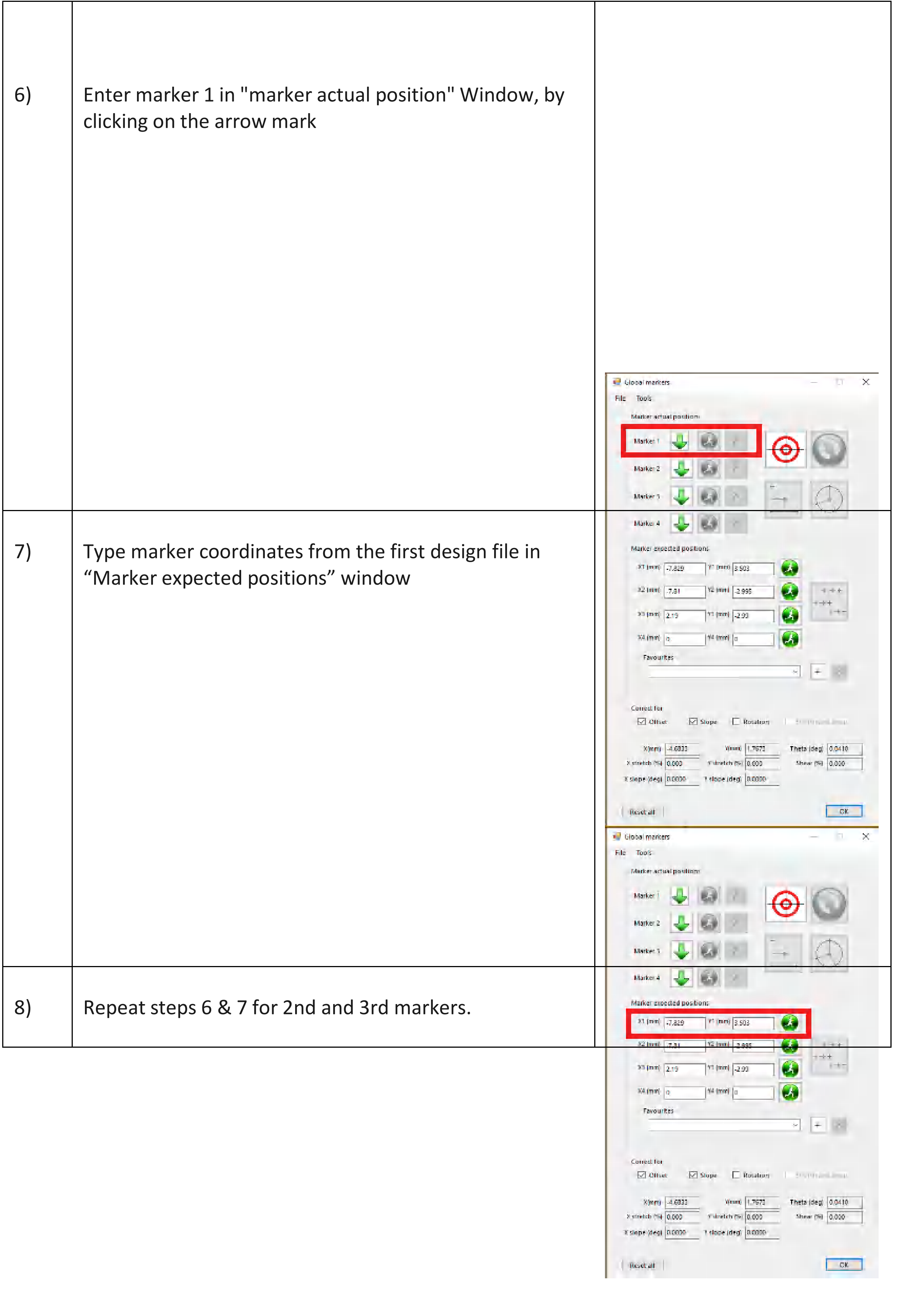
4.	A count-down timer shows an estimate of the timing remaining and a progress bar shows progress through the complete exposure	
5.	After exposure is completed, a message “finished” will be displayed in the log located at the bottom left corner of the screen.	

Removing wafers

1.	As soon as the exposure is complete you can remove the wafer. Unlock the door by pressing the ‘Lock’ button.	
2)	Open the front door of the enclosure	
3)	Remove the wafer and close the door again.	

2nd level Alignment

1)	Load the wafer.	
2)	Find the pattern and focus.	
3)	Navigate to the first alignment mark on the sample	
4)	Open the “Global markers” window.	
5)	Remove all the markers positions by clicking cross symbols	



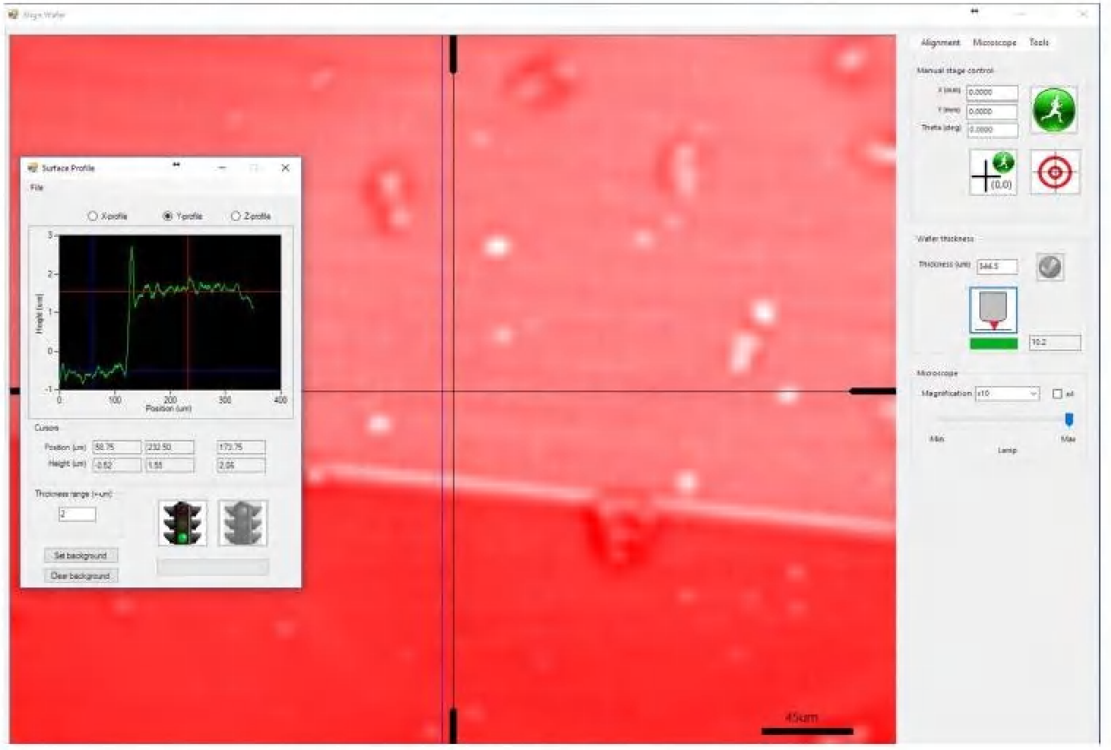
6)	Enter marker 1 in "marker actual position" Window, by clicking on the arrow mark	
7)	Type marker coordinates from the first design file in “Marker expected positions” window	
8)	Repeat steps 6 & 7 for 2nd and 3rd markers.	

9)	Check in offset, slope, rotation, stretch and shear options in "correct for" window.	
10)	Press coordinate- transform button.	
11)	Navigate to the design centre.	
12)	Select the second level design file in the prepare exposure pattern panel.	
13)	Set the dose value and expose.	

Sample Imaging

1)	Load the wafer	
2)	Find the pattern, by putting the X and Y coordinate of the pattern in the "Manual stage control" window	Manual stage control X (mm) 2.6715 Y (mm) -1.7972 Theta (deg) 0.0410
3)	Double click (the left button of the mouse) on the centre of the device that you want to image	
4)	Increase the magnification and simultaneously focus the device.	Microscope Magnification x20 x4 Min Max Lamp
5)	You can click on x4 option to get a maximum magnified image of the device.	
6)	To measure the device - - left click on one edge of the device - right click and choose measure option - left click on other edge of the device	
7)	If you want to take an image with measurement. Press the Prt sc option on the keypad and save the file.	
8)	If you only need an image of the device (no measurement) then press the snapshot option.	

Surface profiler



1)	Open the Align wafer panel
2)	Focus the real-time microscope onto the area of the sample you wish to profile.
3)	Click on the tools tab (top right hand side corner).
4)	Open the Surface profiler window (see Figure 25).
5)	Enter an estimate for the total thickness range to be profiled in the Thickness range box.
6)	Click the green traffic light.
7)	The system will spend several minutes analysing the surface height.

8)	Once completed, the real-time microscope window will show a false colour image, with red being the lowest parts of the surface and white being the highest parts.
9)	The numerical data in the profile can be exported as a text file via the File menu for opening in 3-D rendering packages such as NIH ImageJ.
10)	Single clicking the microscope image plots the thickness profile along an X or Y line passing through the clicked point (shown in blue on the microscope image).
11)	Step heights can be measured using the cursors in the Surface profiler window. Double click the profile graph to reset them, and then drag them to make measurements.
12)	Closing the Surface Profiler tool reverts the real-time microscope image to its normal contrast image mode.