

Standard Operating Procedure for PHOTO3

Durham Magneto Optics MicroWriter ML 3 Pro

- 1 - Preparing your sample prior to exposure:** Coat your sample with the desired photoresist using the appropriate process parameters. (Max sample size: 230mm x 230mm. Max write area: 195mm x 195mm)



NOTE: Ensure that your sample is fully baked and free of ANY resist residue that could transfer to the ML 3 stage. Check the back-side of your sample, too. Cleanliness is paramount!

- 2 - Loading your sample:** (If prompted for Windows password: Micro3Writer)

- a) Press the round button on the front of the enclosure (to the right of the door)... wait for the button to stop flashing (at which time there is an audible 'click' of the door lock releasing)
- b) **Gently** open the door and rest it in the fully open position
- c) Place your sample on the glass stage (it is usually desirable to center your sample on the stage)
- d) Gently close the door → press the round button again → wait for the button to stop flashing

- 3 - Aligning your sample:**

- a) Click on the [Align wafer] button on the left floating menu window
- b) Enter your sample thickness (in microns) in the "Wafer Thickness" section of the UI → click the Green Check -OR- press Enter on the keyboard. This initiates the z-axis motion of the microscope such that the sample surface is approximately at the focal point of the microscope objective.

- c) Click the "Focus Assist" button in the "Quick access" section:



- d) With the checkerboard pattern visible, click the "Autofocus" button:



(the 'thickness' will adjust to automatically focus on the sample and the pattern will turn off)

- e) Optional: Precisely align your wafer in x- and y- directions:

NOTE: This section describes how to 'center' your sample (i.e. establish the center of your sample as the origin: $x=0$, $y=0$). For layer-to-layer alignment, see "Layer-to-layer alignment" section in the appendix.

- Click the "Wafers" file menu option at the top/right of the main UI window
- Click "Current wafer properties" and enter your sample dimensions → click "OK"

- Click the "Centre wafer" button in the "Quick access" section of the UI:
- Within the "Global markers" window:



- For a rectangular wafer:

- Move to a **corner** → click "Place marker" for Marker 1:




- Repeat for 2 more corners (using Marker 2 and Marker 3)

- Click “Centre a square/rectangular wafer” 

(The coordinate 0,0 should now be adjusted to your sample center)

- For a circular wafer:
 - Move to a point **on the circumference** → click “Place marker” for Marker 1:
 - Repeat for 2 more points on circumference (using Marker 2 and Marker 3)

Note: avoid the wafer flat; use points far from each other (e.g. *North, East* and *West*)


- Click “Centre a circular wafer” 

(The coordinate 0,0 should now be adjusted to your sample center)

4 - Loading your pattern:

- Click on the [Prepare pattern] button on the left floating menu window
- If there are any existing numbered items in the “Job list” section (e.g. from the previous user), click “Job list” file menu option → click “Delete All” → click “Yes” to confirm
- Click “File” menu option at the upper/left of the main UI window → Click “Open job list” ^[1]
[1]: See “Creating a job list” section in the appendix for detailed instructions on creating your job list
- You can make any last minute changes to your job list now, if desired

5 - Exposing your pattern:

- Click on the [Expose] button on the left floating menu window
- Enter your exposure dose in the (mJ/cm²) in the “Global exposure parameters” section of the UI
- Enter any global focus offset if desired (no offset = 0)
- Click the Green traffic light to start your exposure: 
- When exposure is complete, the text window at the bottom/right of the UI will indicate “Finished”


6 - Removing your sample:

- When your exposure is finished, press the round button on the front of the enclosure (to the right of the door)... wait for the button to stop flashing (at which time there is an audible ‘click’ of the door lock releasing)
- Gently** open the door and rest it in the fully open position
- Remove your sample from the glass stage.
- Gently close the door → press the round button again
- You are finished.

➤ Appendix 1: Creating a job list

NOTE: Acceptable file types: graphical formats (BMP, TIFF, etc) or CAD files CIF or GDS2. If needed, users can access LayoutEditor on the SMIF CAD PC (outside of the cleanroom) to convert from many standard formats (e.g. DXF) to CIF or GDS2.

NOTE: When creating your drawing (using external CAD software), be conscious of the location of the origin with respect to your pattern. To avoid confusion during job creation, you may prefer to place your origin at what will be: the center of your wafer/substrate -OR- a corner (e.g. lower left) of your rectangular substrate -OR- an existing physical mark/feature on your substrate.

- a) Open the DMO MW3 software (NOTE: this can be done outside of the cleanroom on the SMIF CAD PC free of charge)
- b) Click on the [Prepare pattern] button on the left floating menu window
- c) If there are any existing numbered items in the “Job list” section (e.g. from the previous user), click “Job list” file menu option → click “Delete All” → click “Yes” to confirm
- d) Click the  sign button in the “Job list” section of the UI to add an item to the Job list. Each item you add will have a CAD file associated with it, along with all the appropriate exposure conditions you assign.
- e) Click on the desired item number in the job list...
- f) In the “File” section: click “...” and select the file you wish to use for this job list item number
- g) “Position on wafer” section: Input any desired x- and y- offset in the (this moves the origin of your CAD file with respect to the origin of your wafer that you defined in section 3 - **Aligning your sample:** above)
- h) “Layer” section: If applicable, select the desired Layer from your CAD file
- i) “Group name” section: Add a name to this job list item if desired
- j) “Scale” section: Select “Quality” (NOTE: this is typically set to “Normal”; see manual for exceptions to this rule). Note: the “Exposure size” is listed in this section; this is a good opportunity to verify your drawing scale is correct. For CAD files, this will NOT change with *spot size* (*i.e. the objective lens you select*), but for graphics files (e.g. BMP), the exposure area DOES depend on the *spot size*.
- k) “Exposure” section:
 - Input your desired “Dose correction” (1.0 being 100%; 0.8 is 80%, etc.)
 - Input any “Focus correction” you desire (0 means no offset from the auto-focus point)
 - Select “Resolution” (this defines which objective lens is used)
 - Select “Wavelength” (e.g. 405nm for broadband resists, 365nm for SU-8)
 - Select “Exposure mode” (typically “Normal”)
- l) Repeat steps **d)** through **k)** for each item you wish to add to the job list

m) Click menu item “File” → “Save job list” to save your job list

NOTE: To expedite creating repetitive job list items (e.g. when creating a *dose array*), you can utilize the Job List Builder: Click the “Tools” file menu option → click “Job list builder” and complete the fields as desired. When satisfied with the inputs, click [Add to position list] button to update the job list.

➤ Appendix 2: Layer-to-layer alignment

a) At this point, your sample surface should be in focus and optionally your wafer is centered (not necessary, but can make locating your alignment marks easier)

b) Click the “Centre wafer” button in the “Quick access” section of the UI:



c) Navigate to your 1st alignment mark on your substrate (type in X(mm) and Y(mm) coordinates in the “Manual stage control” section of the main UI and/or use the mouse to click the microscope live view).

d) With your alignment mark centered, you can use the x4 digital zoom to make additional adjustments

e) Within the “Global markers” window, click the green arrow for Marker 1:



This establishes the physical position of your 1st alignment mark relative to your sample origin.

f) Repeat steps c) through e) for Mark 2 (and optionally for Mark 3)

g) In the “Marker expected positions” section, enter in the theoretical locations of your alignment marks (the 2 or 3 that you established above). These coordinates are the positions of your alignment marks as defined in your CAD file. Once these positions are known, whatever pattern you expose will use the same coordinates as your CAD file.

h) In the “Correct for” section, select “Offset” and “Slope” and “Rotation” (optionally “Stretch and shear)

i) Click the transform coordinates button:



j) Click “OK” in the “Global markers” window

k) Your sample should now be ready for exposure, with the alignment mark positions established. The origin of your coordinate system should now match that of your CAD file (with respect to your alignment mark locations)