

μMLA Manual (Pattern Alignment)

1. Startup Checklist

- a. Turn on computer.
- b. Completely open compressed air line by rotating the valve counterclockwise.
- c. Switch on the machine on backside. Wait for a sound “beep” after approximately 5 s (if not, contact Bianca).
- d. Wait another 5 min before starting the software.
- e. Starting software (HIMT MLA) by double click on it (desktop shortcut).
- f. The stage might not be initialized, click “Yes” if you will be asked to. Wait until it is finished < 1 min. Click “OK”.

2. Set up Your Job

- a. Job:
 - i. Note your “Job Name” in your lab journal. Don’t change it.
 - ii. Exposure mode: Standard
(Standard: if you have one structure to expose
Series: also for dose test).
- b. Substrate:
 - i. Substrate Template: by double click on the red field you will be directed to a given list.
 - ii. Select the approximate size. Later, it will be measured accurately. Choose (in case of SiO₂ samples): “SiO Wafer 0.5 x 0.5 cm oAF” (optical autofocus), 1 x 1 cm oAF or 2 x 2 cm oAF respectively. (If it is not approximately chosen, it will ask you to center the sample under the overview camera.)
(For mostly used SiO₂ wafer, no matter which layer thickness as long as the wafer thickness is not bigger than 0.6 mm in total).
 - iii. Click the bold “Load” button. You will be redirected to the start page. The red field should be green now.
- c. Layer:
 - i. For some photoresist it is necessary to go below 70 mJ/cm² (which is the lower limit of the machine) for that case you can adjust the LED power to 15% or 25%. You can click on the standard 100% to change in drop down menu.
 - ii. Add another layer by clicking “Add Layer”. In the layer list “Layer2” appears. (First layer will always be called “First Exposure”).
 - iii. Double click on the Design field of Layer2!
 - iv. Select in the redirected list your structure you want to expose. (see 2.c.ix. for inserting a new exposure structure.)
 - v. Click the bold “Load” button.
 - vi. Double click on the red field of “Alignment Settings”. Here you set reference position of your file, which you will match in the next steps with the position on your wafer.
 - vii. Select “_Manual” if you have currently no reference position file, otherwise select your corresponding “Jobname’_L1” and click “Load”. Note: **If you load a wafer with alignment marks already exposed, the design field of “FirstExposure” remains red!** (Only in

case you want to pattern both your structure and alignment marks in one job, double click on the red field and load your pattern of alignment marks.)

- viii. Click “Load Substrate”.

Optional:

- ix. Insert a new exposure structure:
1. Copy your GDSII file or DXF file in the corresponding “Design” folder on the desktop (in “gdsii” or “dxf”). Assure that you are writing closed polylines! (Check within i.e. Klayout if all structures are dashed indicating closed polylines. Otherwise, the whole file can not be written!)
 2. **Inserting a new structure is only possible when you are in staff mode** in the HIMT MLA software, on the very top of the program click “User”, “Change User”. In the pop-up window, change username to “Staff” and tip in the correct password (ask Bianca for excess) and login.
 3. In Staff mode the button “Convert Design” must be bold. Now you can click on it. A new window will be open (GUI HIMT CONVERT).
 4. “File” -> “New Job”.
 5. Name your Job as follow: JJJMMDD_”your Initials”_”short description” i.e. 20230302_BH_subElyps (maximum of **25** letters, **no space bar allowed**). Click “ok”.
 6. “Add” your Source File as GDSII or DXF file and select in the popped-up window and “Open”.
(When choosing GDSII files, it might happen that you miss them in the list, then change the File Type to “All(*)” they should be visible now).
DXF: Change DXF unit to 1000 nm when using um in your .dxf file! Otherwise, your structure can not be depicted correctly. And choose the right layer in selection menu.
GDSII: choose your right layer.
 7. Click “Create default”, you will be redirected to previous Window, don’t change anything else and click “Complete Tasks”.
 8. Click “Save” for saving the job file in the pop-up window.
 9. Click “Complete Exposure Jobs” and “Finish”.
 10. Close window GUI HIMT CONVERT.
 11. Update your list of Designs in the HIMT MLA software by clicking “Refresh”.
 12. Don’t forget to “Load” your new imported structure.
 13. In case you want to “Delete Design” there is a button on the left side of the screen (under Load Design, Characteristics, Edit).
 14. Continue with point 2.c.vi.

3. Load Substrate: Optical mode

- a. Place your sample over the four vacuum holes in the middle of the black chuck of the stage system with correct xy orientation (see label in the machine and keep time of open shutter as short as possible). Keep the rotation angle as small as possible.
- b. Flip the vacuum switch (to the back), now a constant noise is present (don't get confused when you are still able to move your substrate, it is a slight vacuum but sufficient).
- c. Click "Continue".
- d. Check if your sample moved to the red spot in the front (it is the write head; the spot in the back belongs to the overview camera), if yes then click "Continue", if not it will move to the back camera, here you have to select the middle of the sample with the cross hair on the screen to ensure the write head is placed over the sample while approaching.
Now your sample will be moved to the focus and the size will be scanned. If your sample is a different size than being told the program will ask you to continue with different size. Depending on, if it still fits your needs, click "Yes" to continue or "No" to exchange the sample.

4. Alignment

- a. When you start with "_Manual" as your file's reference position, you can adjust them clicking "Edit" in Alignment Settings on the left. (If you already loaded a corresponding reference position file, go on with 4.b.) You can easily add another position by just writing in the next field (otherwise an error will occur). At this point, you must know which position in your file and sample you want to overlay. **Be aware: these positions are dependent on the origin of your file!**
- b. Click "Apply". Numbered crosses will appear on the blue square indicating their position.
- c. Now a connection of the real position and the position within the file is made. Therefore, move to the first cross by using, on the right, either arrows or the crosshair with overview camera (switching afterwards back to high resolution camera). Repeat for fine tuning.
- d. Check Focus in the Camera Control Panel, set it to "-6". The image is probably clearer now.
- e. On the left side, choose your Alignment Mode in the Cross Measurement Panel. It is recommended to use "CrossAlignment". When your Alignment marks are not filled the whole video screen, click "Resize Detection Area". (An orange square appears upon the alignment mark.) Click "Measure" to find the middle of the cross automatically.
- f. Check position, if you agree with it, click "Accept Position", otherwise repeat it by "Re-Measure". (It might be that the orange square disappear, as long as you don't "Maximize", the procedure is still going to work.)
- g. You will be moved to the second cross, center the cross if necessary (*via* i.e. overview and crosshair) and repeat the last two steps for each reference position. When you accept the last overlay, you will immediately be redirected to the Exposure Settings.

5. Alignment: Exposure
 - a. Check your overall design structure (red, not detailed) for plausible position, otherwise repeat alignment or check your file's property.
 - b. Select your "Dose".
 - c. Set "Defoc" to "-6".
 - d. In Alignment Correction Options detected Rotation, Scaling and Shearing is documented, while the first is checked "Use" by default. You can check the others as well, which compensate small size deviation and distortion.
 - e. Click "Start Exposure".

6. Unload Substrate:
 - a. After exposure you will be asked to unload, click "Yes" otherwise click "Unload Substrate" on the bottom left and "OK".
 - b. The chuck of the stage system will move in the front, turn off the vacuum switch, remove your sample and close the shutter! (Keep time of open shutter as short as possible).
 - c. (If you want to expose multiple times, click "New Job" or "Restart Job" for the same pattern.)

7. Shutting Down:
 - a. By closing the software and confirming with "Yes" the μMLA is shutting down (the camera software on the right doesn't have to be closed).
 - b. When software is closed, switch off the μMLA on the backside.
 - c. Turn off the compressed gas by rotating the valve clockwise.
 - d. Shut down computer.