MLA150 – Maskless Aligner

Version of 7.9.2019. Get the latest one at https://cmi.epfl.ch/photo/files/mla150/mla150.manual.php

1. Introduction

This user manual presents the procedure to align and expose a converted design on a photoresist-coated wafer/chip with the MLA150. Follow this guide for the conversion procedure:

cmi.epfl.ch/photo/files/mla150/mla150.convert.php

2. Login & System Initialization

- Login for "Heidelberg MLA 150 – MaskLessAligner" on the zone 5 accounting computer.

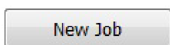
- If the MLA150 menu is not already open, then double-click the icon:

3. Preparing the job

- First be aware of this color rule regarding boxes:

= input required
= input optional

- In the *Job* window, if you want to set up a new job, click:



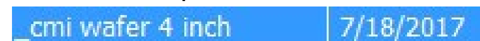
Else, if you want to expose an already saved job a second time, click:

- Give the job a name (initials, LAB name, …) if you are planning to save it.

Name	Number	Exposure Mode
JD_test	12681	Standard

Then, select the exposure mode of the machine. The two main ones are:
  - Standard: will align and expose a global pattern on the wafer with one dose and one focus parameters.
  - Series: will expose a small test pattern (typical 5x5 mm^2) in a matrix of different dose and focus values.
- In the *Substrate* window, double click on "Substrate Template".

- Find a template matching your substrate/chip dimensions, in the list. Alternatively, you can create a new template with known dimensions.

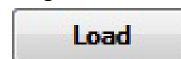


If you are unsure about the dimensions of your wafer/chip, select the _*Automatic* (Round or Rectangular) templates.

_AutomaticRectangular	7/18/2017
_AutomaticRound	7/18/2017

N.B. The thickness of the substrate has no effect on the operation of the tool; it does not need to be correctly set!

- Once the template is selected, click on "Load" to go back to the job settings.



- In the *Layers* window, users can define two types of layers:
  - First Exposure: Exposure without alignment. The 0,0 coordinate of the layout will be at the center of the wafer.
  - Layer "X": Exposure with alignment. Alignment marks will be detected on the wafer to synchronize the coordinate system with the new layout. ! Users should know the position of alignment marks !
- In the Laser field, choose between the 405 nm or 375 nm laser wavelength:

- 405 nm : to expose all positive AZ resists
- 375 nm : to expose AZ nLOF, AZ 40XT and SU8 layers

- Double click on the Design field. This will bring you the list of converted designs. If your design is not yet converted, click on "Convert Design" and follow the conversion guide: cmi.epfl.ch/photo/files/mla150/mla150.convert.php

- After conversion, sort the designs by date or use the "search" option to find your design in the list, double-click or click on "Load".

- For layers with alignment, users will need to load a template for the alignment mark coordinates in the Align Crosses field. Use CAD software such as *KLayout* or *L-Edit* to find the center coordinate of your crosses. You can create "New" templates, "Save" or "Edit" existing templates. The "Top Surface" or "Back Surface" are used to select between top-side alignment or back-side alignment modes.

Alignment Cross Positions

JD_SPC_3C

Top Surface

Pos	X [μm]	Y [μm]
1	0	0
2	25000	0
3	0	25000
4		
Positions	3	

Edit

New | Edit | Save | Delete

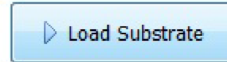
N. B. For back-side alignment exposure, make sure to remove the cache along the x- and y- axes of the table so that the back-side objective can detect the crosses at the back of the wafer.

- The Resist field is optional. However, in this field, it is possible to double the range of the defocus parameter (+/- 10) for the exposure of thick resists such as Su8, AZ 40XT by choosing the "SU8" template with "large" defocus range.

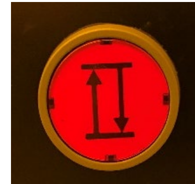
Defoc Range → Large

4. Wafer loading

- Only when all fields of the selected layer are green, users can click on "Load substrate". The MLA150 table will move to loading position.



- Open (and close) the window bay with the appropriate button.



- Follow the instructions on the screen and on the panel inside the machine to load the wafer properly!

- Close the window, and click on “continue”. The wafer will then move under the writehead. In the case of samples defined as “small” (< 12 mm) or for the _*Automatic* shape detection scripts, the overview camera will activate.
  ! Users should make sure that the wafer/chip is under the blue cross !

Automatic Centering:

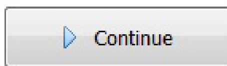
! A T T E N T I O N !

Only press 'Continue' if the substrate center is below the cross!

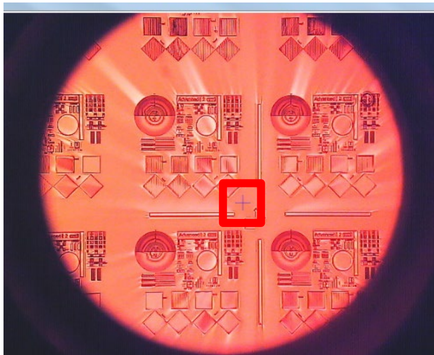
Or press ' **Set Position**' to manually center the substrate.

Else press 'Cancel' to unload the substrate.

Position OK →



Position NOT OK →



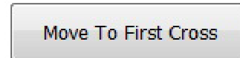
- Press continue. Then, the edge detection script will find the edges of the wafer/chip, before continuing to the alignment/exposure steps.

Find Plate Center:

Finding the center of the Substrate...
Edge 1: Searching ... Found!
Edge 2: Searching ... Found!
Edge 3: Searching ... Found!
Edge 4: Searching ... Found!
Edge 5: Searching ... Found!
Edge 6: Searching ...

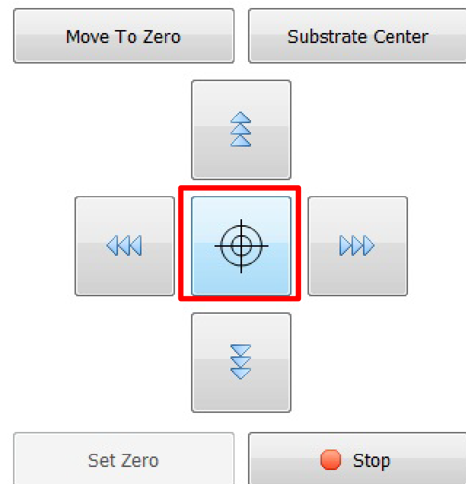
5. Alignment procedure (skip for first exposure layers)

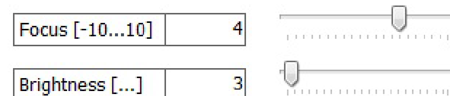
- First click on :



- Starting with the “overview” camera, locate your first cross on the wafer and use the navigation tools to place it of the camera window.

- Using the “target” button and directly clicking in the camera window is the easiest way to center the alignment mark.

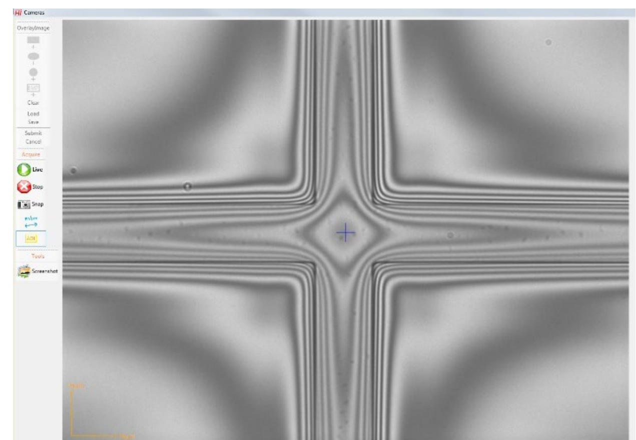




- Once the cross is correctly centered in the “High Res” camera window, users can optimize brightness and focus:

Focus [-10...10] 4

Brightness [...] 3



- Choose your alignment mode and click “measure” to start the detection process:

Cross Measurement

Alignment Mode

CrossAlignment | Skip Position
CrossAlignment
ManualAlignment | Angle [mRad] 0

Measure | Accept Position

- *CrossAlignment* : automatic detection of the center of the cross (image contrast detection)
- *ManualAlignment* : users will click the center of the cross in the camera window

- When the blue cross is positioned correctly at the center of the alignment mark, users can click on “Accept Position” and repeat the operation for all the alignment crosses.

6. Exposure

- Once the alignment procedure is completed, users will access the “Exposure” interface. In the *Alignment Options* tab, users can check alignment corrections to apply: Rotation should always be checked, and users can decide to apply additional scaling and shearing corrections.

Alignment Options

Rotation [mRad]	-3.019	☑ Use
Scaling X / Y	1.000020 / 1.000013	☐ Use
Shearing [mRad]	0.006	☐ Use

- Make sure to enter dose [mJ/cm^2] and defocus, based on your photoresist type and according to recommendations from the CMi website and the “Resist table”.

Required

Design Name	JD_align
Light Source [nm]	405
Dose [mJ/cm²]	400
Defoc [-10...10]	0

- When ready, click on “Start Exposure”. The Progress Info window will follow the process steps, starting with “Converting” → “Coverting & Exposing” → “Exposing”. Users can check the timer left and the countdown of stripes.

7. Unloading and System idle

- When the exposure is finished, unloading is available:
- Open the window, turn-off the vacuum and unload your sample.
- Make sure to close the window bay before leaving the tool!
- Logout of the tool on the zone 5 accounting computer.