CORAL Name: DirectWrite-MLA150-OptAF

Location: Bay L8
Category: Photolithography
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Contents

Introduction 1
Safety 1
User Qualifications and Responsibilities 2
Operating Procedures 2
Appendices 5

Introduction



The Heidelberg MLA-150 Maskless Aligner is a direct-write photolithography tool for samples ranging from small pieces to 200mm wafers or 7" photomasks. The tool utilizes diode lasers (375 nm or 405 nm) and a high-precision stage to directly pattern photoresists from a CAD file. Both lasers can write a minimum feature size of 1 micron with alignment accuracy between layers of 500 nm. Alignment from front to back of the substrate is also possible. Write time will depend on the pattern, substrate size and the laser source; a small piece can be patterned in <5 minutes while a 150 mm wafer can take up to 60 minutes.

Design files should one of the following formats: GDSII, DXF, CIF, or GERBER. CAD files are converted to "Job Files" which the tool uses to write the pattern on a substrate. Users should refer to the SOP for MLA-150 Job Conversion for more information on this procedure. This document describes the procedure for exposing a substrate from an existing job.

Safety

The MLA-150 uses two types of lasers: one for position measurement of the stage and one for design exposure. When the window is closed the system is a Class 1 laser. When the window is open for sample loading and unloading the stage interferometer laser is accessible and the system is a Class 2 laser.

The exposure lasers are very powerful diode lasers which are normally covered by optics covers and should not be accessible to users. If the optics covers are removed then the 405 nm (<10 W) and 375 nm (<3 W) are rated Class 4 and can be damaging to eyes and skin. The exposure lasers must not be accessed by unqualified users under any circumstances.

To protect the operator from hazards, interlock circuits prevent stage movement and access to laser light as soon as the window opens. A safety switch stops the stage, holds it in position, and closes the laser shutter even if an exposure has been running at the moment the window is opened. Users must observe safety labels and not make any attempt to bypass safety measures.

User Qualifications and Responsibilities

Read and understand this SOP before use. Only trained personnel may operate this system.
Users must observe safety labels and not make any attempt to bypass safety measures.

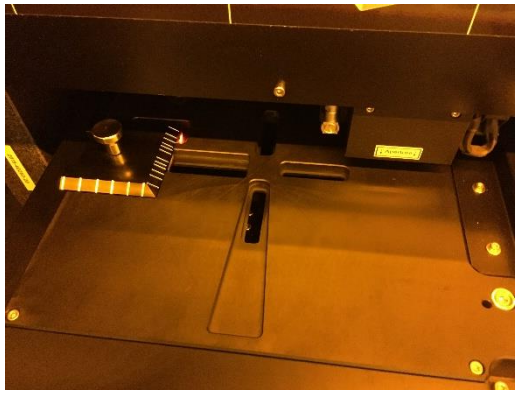
Operating Procedures

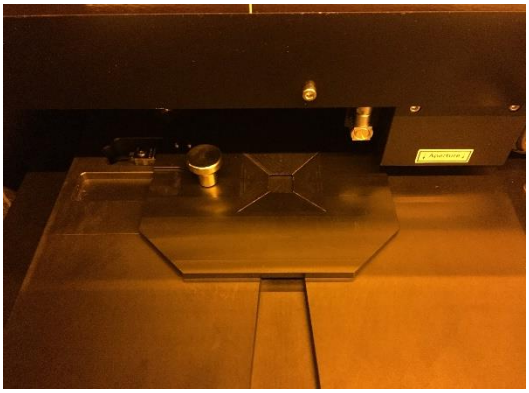
1. Check reservations in CORAL to ensure you have reserved the correct machine at the correct time. Engage the tool in CORAL.

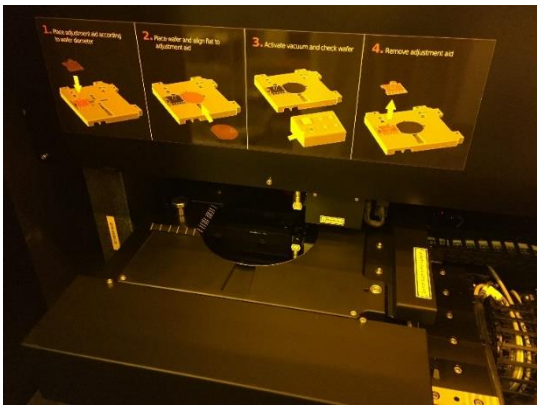
2. Load your sample onto the stage:
    a. Press the Yellow Light Button to illuminate the interior of the tool, then press the Red Window Up/Down Button to open the window.

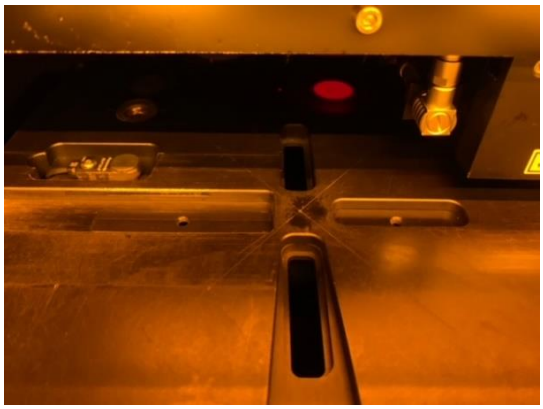
    b. Select the Wafer (Left) or Piece (Right) adjustment aid and place it on the stage according to the Substrate size. The Piece aid locks into place for pieces 10x10 mm^2 or smaller (down to 5X5 mm^2) the Wafer aid has notches for 150 mm, 125 mm, 100 mm, 75 mm, 50 mm, and 25 mm. The aid centers your sample on the chuck and aligns the flat parallel to the stage. Center of the substrate should be directly over the X in the stage where vacuum is applied. The position of the aid/flat corresponds to the –Y direction in your design.











c. Place wafer or piece on the stage and center the flat on the alignment tool.

d. Activate the vacuum by pressing the round, silver vacuum button. The button will illuminate RED and the gauge will indicate the vacuum level. Check that the vacuum level indicator text is GREEN and check the substrate with your tweezers to ensure it is held in place. If vacuum is insufficient, the most likely reason is that there is resist on the back of the substrate. Remove substrate, clean the back of the sample and try again.



Good Vacuum

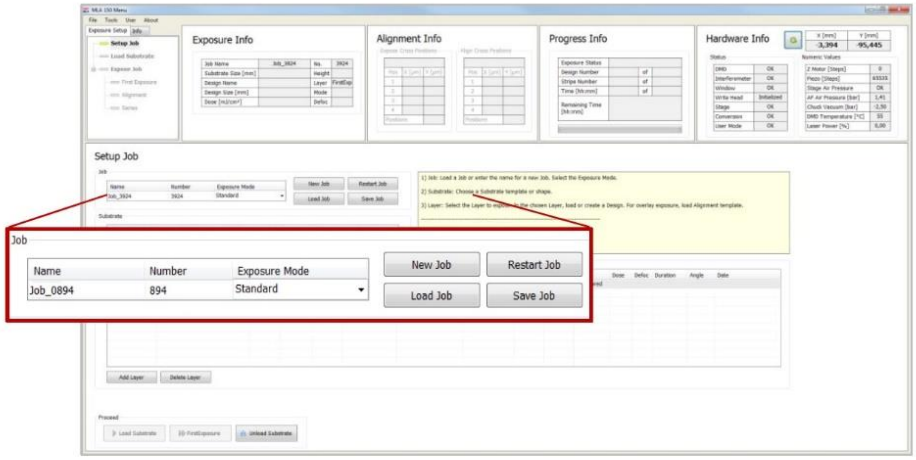


Poor Vacuum

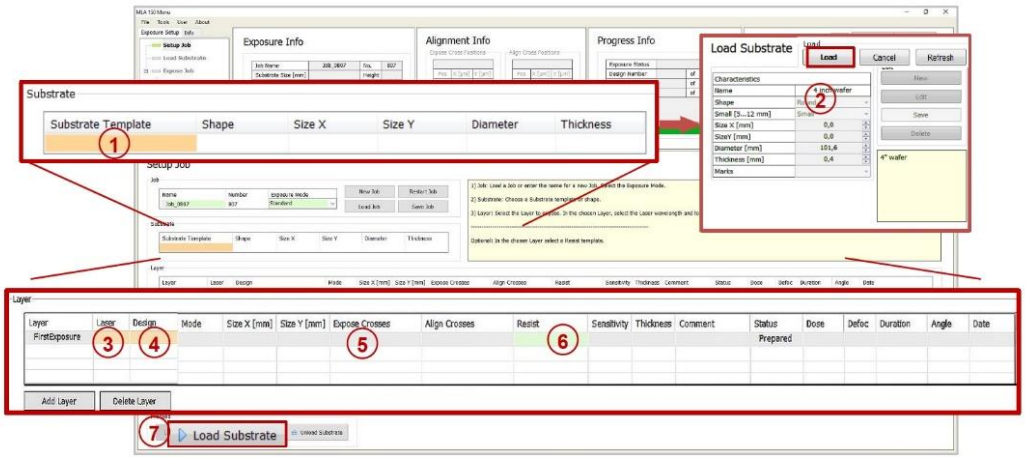
e. Remove the adjustment aid (system will not run if aid is still in place), close the window by pressing the Red Window Up/Down Button, and turn off the system light by pressing the Yellow Light Button.

3. In the Job Setup window of the software load the job file that you wish to expose. For more information on creating a new job, see the SOP for MLA-150 Job Conversion.
   a. To continue or repeat a job, click Load Job and select from the list that pops up.
   b. To repeat an exposed layer you can select Restart Job which will create a copy of the currently selected job with the previous process data removed.
   c. To start a new job, click New Job and select the exposure mode
      i. STANDARD to expose a single design for each layer (alignment overlay is available in this mode)
      ii. SERIES to expose a small design "stepped" across the substrate. Dose and defocus can be modified across the grid in this mode for a quick test to optimize exposure conditions.
      iii. DRAW MODE for exposing various shapes of arbitrary sizes limited only by the camera field. Used for making repairs in an exposed layer or exposing standard alignment crosses.

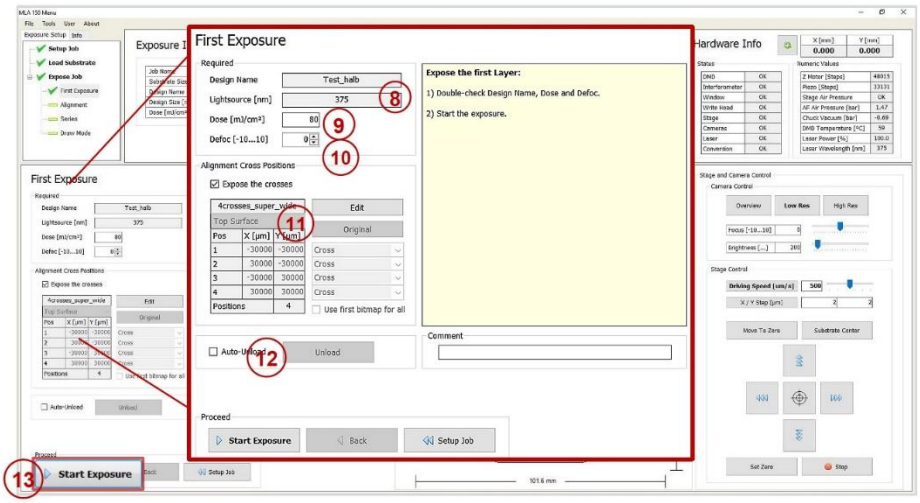
iv. Inspection Mode allow the user to inspect a substrate and/or take pictures.



4. To run a standard exposure without alignment (first layer) complete the orange boxes (mandatory) and green boxes (optional) in the Substrate and Layer panels.
   a. In the Substrate panel (1) double click Substrate Template and select your substrate size or shape (auto-round or auto-rectangle). Then click load (2).
   b. In the Layer panel select the laser from the dropdown list (3). Double click Design (4) and load the converted design file (see Job Conversion SOP). Optionally select Expose Crosses (5) to select a bitmap template for exposing alignment crosses. Optionally select Resist (6) to load a resist template that will auto-populate the Dose field.



5. Click Load Substrate (7) and follow the onscreen instructions. The stage will move to the center position. Confirm the substrate is located under the write-head by verifying that the reflection of the red diode can be seen on the substrate, and click Continue. The tool will focus on the substrate and then search for the edges of the substrate to find the center position.



6. In the First Exposure panel double check the design name and light source (8). Set the dose (9) and defocus (10) that you have determined is ideal for your photoresist and process. Optionally you can expose alignment crosses (11) at selected positions on the substrate (with respect to the center). If desired, activate the auto-unload (12) so the system executes the substrate unloading process automatically.

7. Click Start Exposure. The system will begin the exposure and display an approximate clock for when the exposure will be completed. Note, the actual exposure time is typically shorter than the time displayed on the clock.

8. When the exposure is complete a window will pop up and ask if you want to unload the substrate (or will auto-unload if that option was selected). Click Unload. The stage will move back to the home position. The red Up/Down button will now be illuminated.
   a. Press the Yellow Light Button to illuminate the interior of the tool.
   b. Press the Red Window Up/Down Button to open the window.
   c. Press the round, silver vacuum button to release the chuck vacuum and remove your substrate.
   d. Press the Red Window Up/Down Button to close the window. The window should be kept open as little time as possible
   e. Press the Yellow Light Button to turn off the chamber light.

9. Ensure the system is in a safe state and Disengage the tool in CORAL, being sure to enter the correct data in the report fields.

Appendices

TIPS:
If vacuum is insufficient, the most likely reason is that there is resist on the back of the substrate. Remove substrate, clean the back of the sample and try again.