



Application Notes

Overlay procedures using the MicroWriter ML[®] 3 direct write photolithography system

EXECUTIVE SUMMARY

Here we present the overlay procedures to expose designed patterns aligned with existing patterns using the MicroWriter ML[®] 3 direct write lithography system.

INTRODUCTION

Through this process we can expose patterns (hereafter referred as “the second layer”) which are aligned with existing patterns (hereafter referred as “the first layer”) on top of the resist-coated chips. This is achieved via transforming coordinates of the first layer to the MicrWriter software (MW3) through existing three or four alignment markers.

PROCESS

A. Load the resist-coated chip with existing patterns.

B. Bring the top surface of the chip in focus.

Here we will be using our typical overlay layer pattern (Figure 1). In this design, we have three alignment markers (Marker 1, Marker 2, and Marker 3) and four boxes patterns.

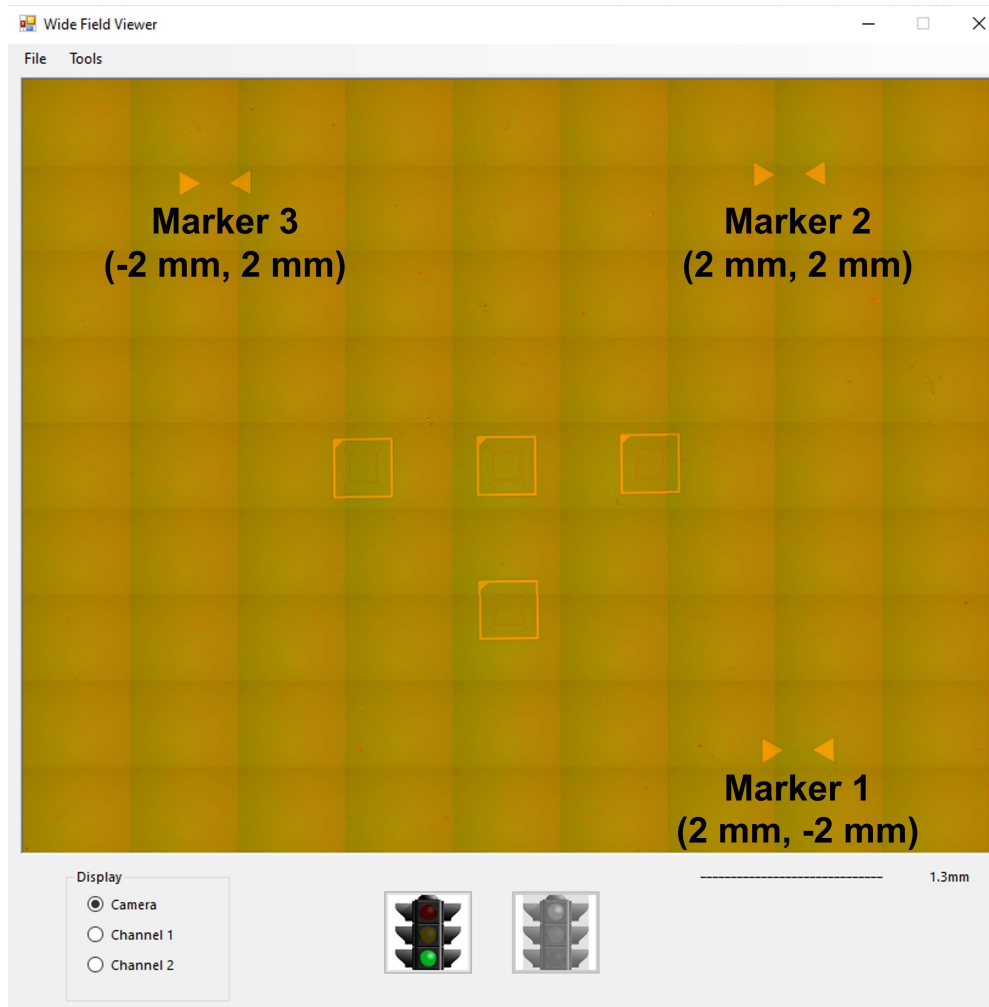


Figure 1 Overview of the existing patterns through the software tool "Wide Field Viewer."

C. Transform the coordinates

- Locate the first alignment marker (here Marker 1). Move the centre of the real-time microscope view to the centre of the Marker 1 (Figure 2).

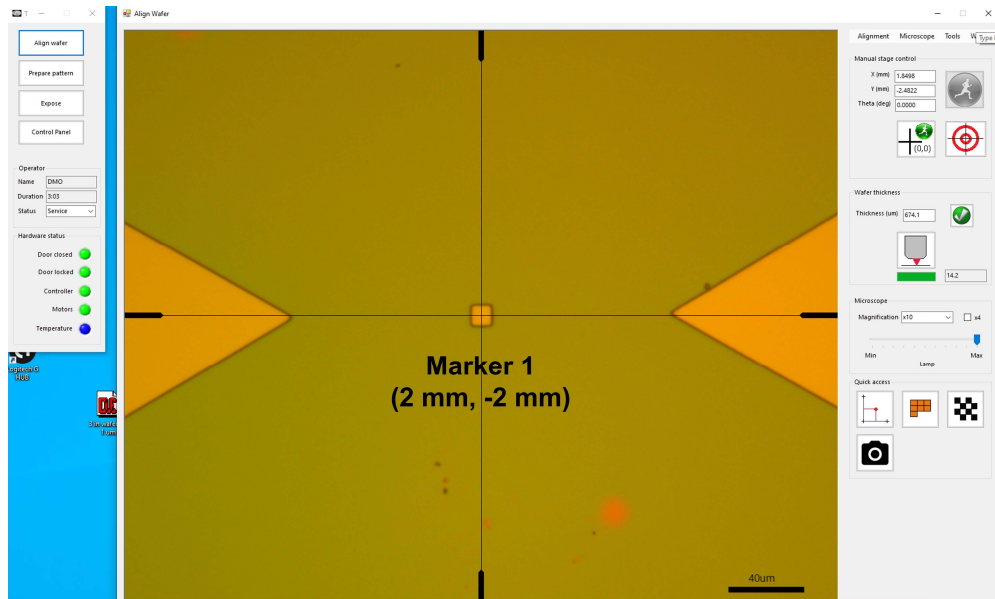


Figure 2 Camera centre (cross centre) overlaid with the centre of the Marker 1.

- Go to Centre wafer in the Quick access section (Figure 3).

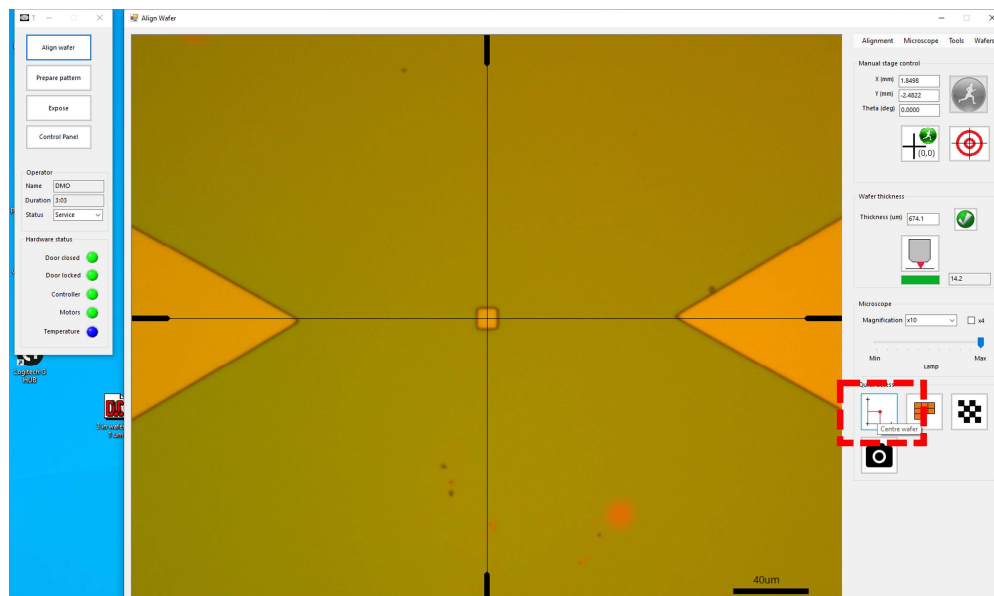


Figure 3 Centre wafer option in the "Quick access" section under the "Align wafer" form.

- c. Place Marker 1 here: In the Global markers window, click the Green downward arrow next to Marker 1 (Figure 4(a) before placing and Figure 4(b) after placing the Marker 1).



Figure 4 Place the Marker 1 on top of the first alignment marker. (a) Before and (b) after placing the Marker 1 in the "Global markers" window.

- d. Click OK to exit Global markers window.

- e. Move the centre of the real-time microscope view to the centre of the second alignment marker.
- f. Go to the Centre wafer in the Quick access section (Figure 3).
- g. Place Marker 2 here: click the Green downward arrow next to Marker 2 (Figure 5 before placing and Figure 5 after placing the Marker 2).

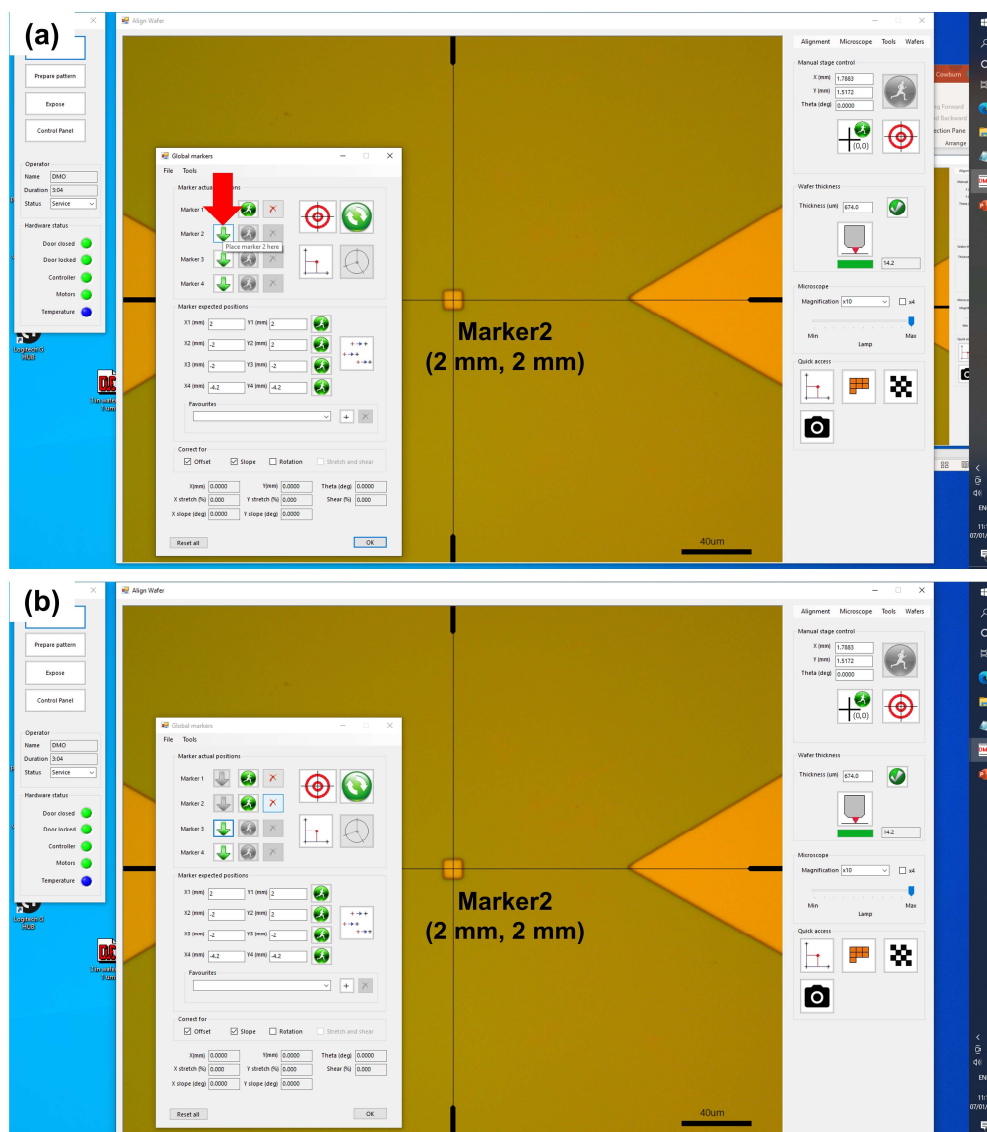


Figure 5 Place the Marker 2 on top of the second alignment marker. (a) Before and (b) after placing the Marker 2 in the “Global markers” window.

- h. Click OK to exit Global markers window.

- i. Move the centre of the real-time microscope view to the centre of the third alignment marker.
- j. Go to Centre wafer in the Quick access section (Figure 3).
- k. Place Marker 3 here: click the Green downward arrow next to Marker 3 (Figure 6(a) before placing and Figure 6(b) after placing the Marker 3).

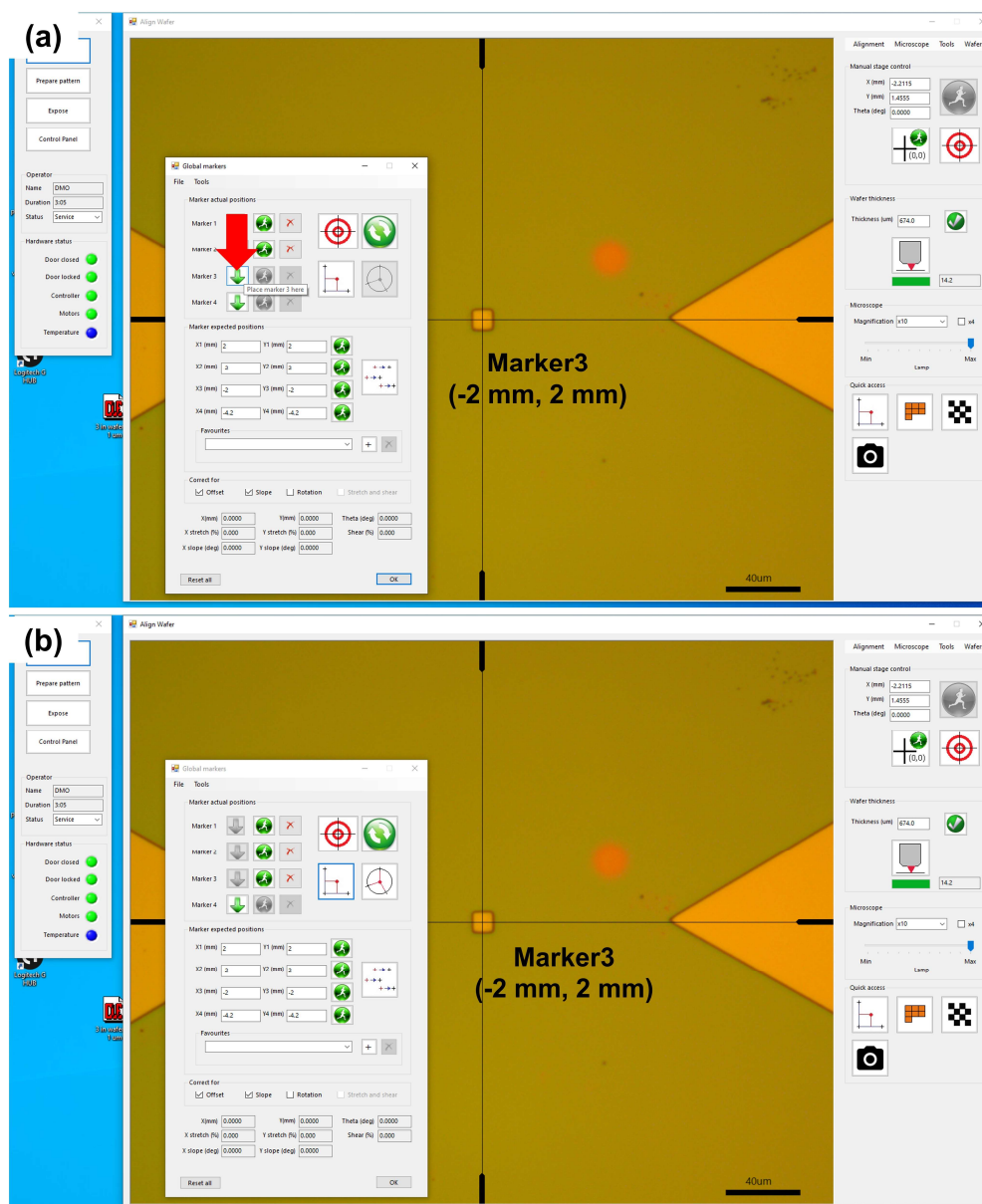


Figure 6 Place the Marker 3 on top of the second alignment marker. (a) Before and (b) after placing the Marker 2 in the “Global markers” window.

- I. (Optional) Refresh marker positions: Click the “Refresh marker positions” button (Figure 7).

The system will revisit the three markers’ positions. On each marker position, the software will automatically identify the centre position of each alignment marker via applying the Bulls-eye function once.

Note 1: While the system is refreshing marker positions, please see if the system correctly identifies the centre of each marker through the real-time microscope view.

Note 2: Bulls-eye function works better with a marker with a symmetric shape, e.g., a square or a circle shape.

Note 3: In the Alignment menu > Bulls-eye options, we can further adjust the marker size to have the algorithm work better on our samples.

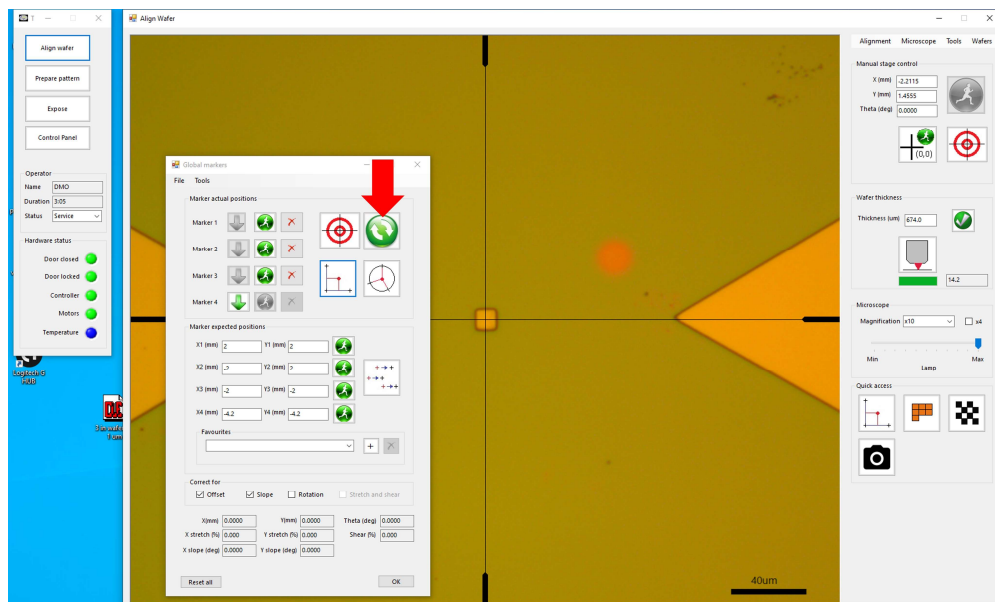


Figure 7 Refresh markers positions after placing markers positions.

- m. Input the marker expected positions: Enter the expected positions of the three markers into the designed boxes in the “Marker expected positions” section (Figure 8). Here X1 (mm) and Y1 (mm) are for the Marker 1 position, and X2 (mm) and Y2 (mm) are for the Marker 2 position etc.

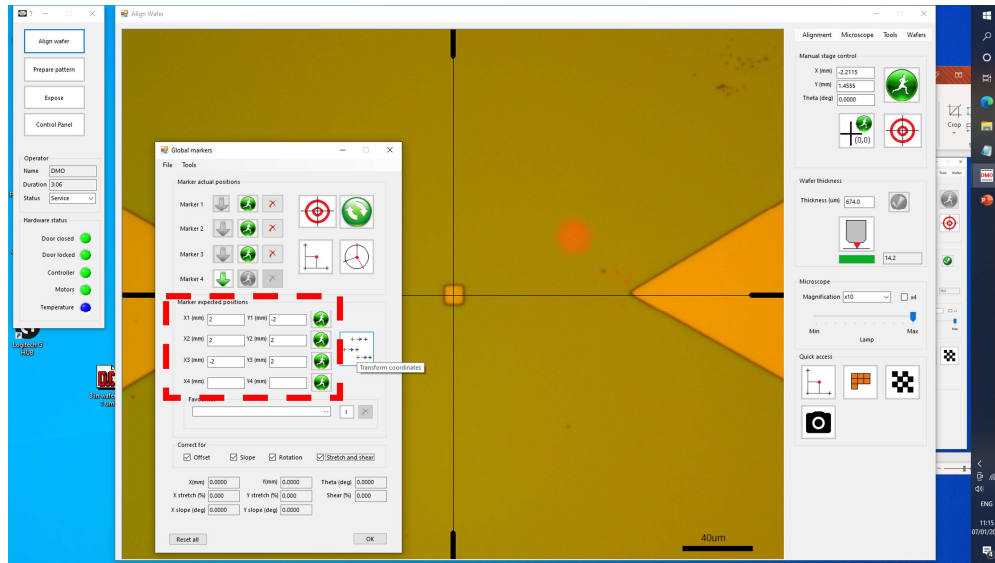


Figure 8 Enter expected positions for Marker 1, Marker 2, and Marker 3.

- n. Check all four options (Offset, Slope, Rotation, and Stretch and shear) in the “Correct for” section (Figure 9).

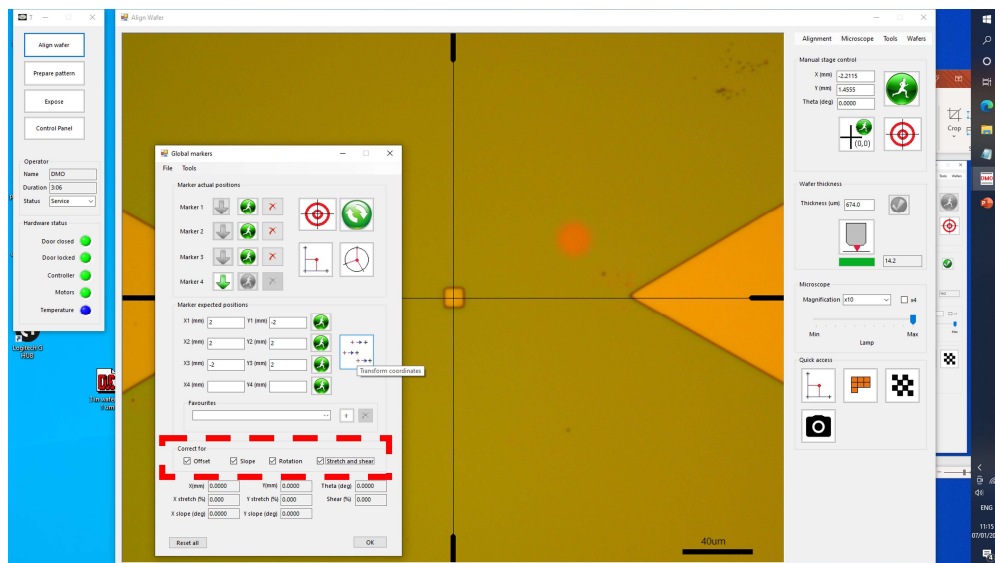


Figure 9 Select options in the Correct for section.

- o. Transform coordinates: Click the “Transform coordinates” button (indicated by an arrow in Figure 10(a)). We would see some reasonable correction values shown at the bottom of the “Global markers” window (Figure 10(a) before transforming and Figure 10(b) after transforming the coordinates).

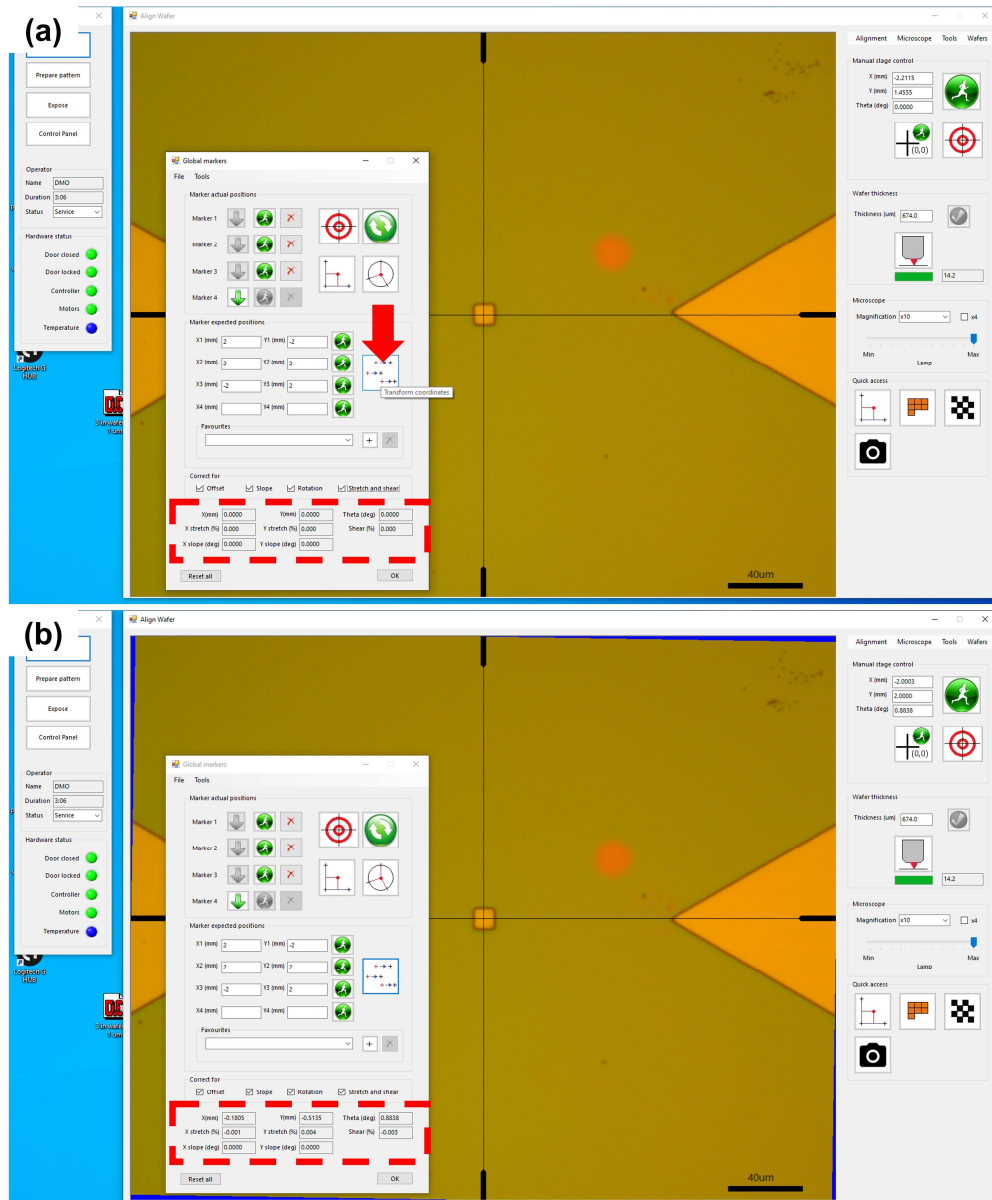


Figure 10 (a) Before and (b) after transforming coordinates. After transforming clicking coordinates, we should see some reasonable correction values (highlighted in (b)).

- p. Click Ok to exit the “Global markers” window.

D. Continue exposures

Go back to (0, 0) position. Run autofocus. Go to Prepare pattern window and load the designed pattern file. Then go to the Exposure panel and start exposure by clicking the green traffic light.

E. Options

a. Local alignment:

The local alignment function allows users to perform a local alignment during exposures. This could further improve the overlay accuracy. This is a per-job based option. By default, this function is disabled.

1. To enable this function for a job, first select this job in the Prepare Patterns window, and then go to Advanced (Figure 11(a)).
2. In the Local alignment section, select Manual or Automatic (Figure 11(b)).

Note 1: Automatic relies on the Bulls-eye function.

3. Enter the coordinates in the Alignment point section (Figure 11(b)).
4. Click OK to exit this window.

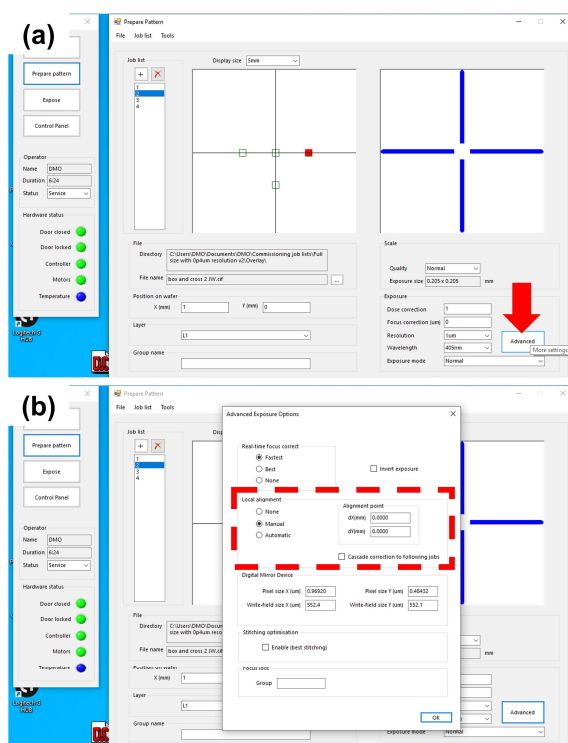


Figure 11 (a) Advanced options for a job. (b) Enable the Local alignment function, with Manual selected here. The alignment point is at (0 mm, 0 mm).

5. Start exposure: Go to Expose panel. Click green traffic light.
 6. (Only for the manual local alignment) Perform the manual local alignment: After the focus lock measurement, the software pauses and asks for local alignment (A in Figure 12(a)). When see this message in the status, go back to Align wafer window.
 7. In the real-time microscope view, move the centre of the view to the centre of the local alignment point (Figure 12(b)).
- Note: If we cannot see the local alignment marker in the real-time microscope view, it is possible that we have input wrong coordinates for the local markers. To double check the coordinates, we suggest stopping the exposure and go back to Advanced options for this job in the Prepare pattern window.
8. Go back to Expose window. Click green traffic light to continue the exposure (B in Figure 12(a)).

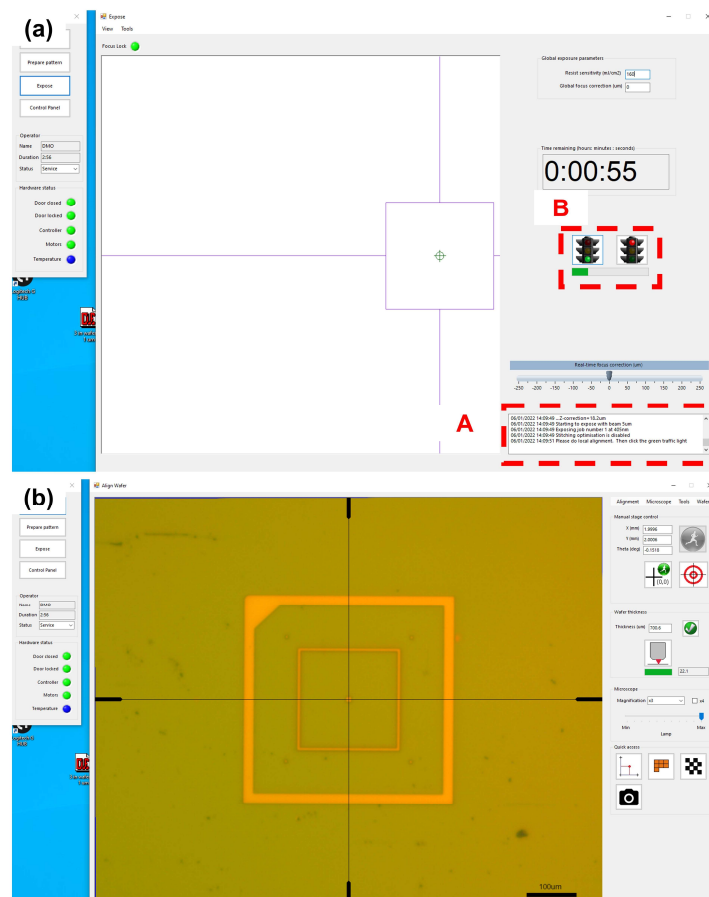


Figure 12 Manual local alignment during an exposure. (a) the software pauses after the focus lock measurement and asks for manual local alignment. (b) Real-time microscope view in the Align wafer window, where we can perform the local alignment by moving the camera centre to the expected local marker's position.