	<b>Department of Physics</b> <b>National University of Singapore</b>		<b>Ref. No</b> <i>SOP/001</i>
	<b>Standard Operation Procedure</b> <b>Title:</b> Heidelberg Instruments $\mu$ MLA		<b>Rev. No</b> <i>001</i>
			<b>Pages:</b> <i>6</i>
<b>Lab: Nanomaterials &amp; Devices Group</b>			
<b>Written by</b>	<b>Approved by</b>	<b>Issue date</b>	<b>Review date</b>
Justin Zhou Yong	A/Prof Eda Goki		(usually 3 yrs after date of issue)

## 1. Purpose

The objective of this SOP is to provide guidelines to all the laboratory personnel on operating Heidelberg Instruments  $\mu$ MLA.

## 2. Scope

The procedure is applicable to all research staff, research students and technical staff working in the laboratory.

## 3. Responsibility

It is the responsibility of the PI in conjunction with the laboratory I/C to ensure that all research and technical staff and students are advised, prepared and trained.


### 3.1. Principal Investigator

The Principal investigator is responsible for the implementation of these guidelines and takes ownership of all research and technical staff, graduate and undergraduate students under his charge in ensuring that they will carry out their activities in a reasonably practicable manner. The PI has to ensure that all the above mentioned personnel are adequately advised, prepared and trained.

### 3.2. Staff / Students

All research and technical staff and graduate students are under the obligation to work and behave safely and are responsible for taking care of their own health and safety and not placing themselves or others at risk of injury

## 4. Personal protective equipment

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At a minimum, safety glasses with side shields, long sleeved laboratory coats, chemically resistant gloves, and closed toed shoes should be worn. This is to be considered as minimum protection and must be upgraded if necessary.

## 5. Safety precautions

Inspect equipment to be used and ensure all are in proper working condition. Report any equipment deficiencies prior to use.

## 6. Procedure


### 6.1. Loading the design

- Transfer design file into the *designs* folder located at the desktop of the PC if you wish to write a new design. Supported common file formats are .cif, .dxf, and GDSII.
- Open the *MLA 100* software and allow it to load.
- Select .
- Double-click the orange box under the *Substrate Template* tab.
- Select from a list of substrate presets.

If none of the presets is suitable, you can define the geometry of your substrate with the *Load Substrate* panel on the left.

- Click on  under the *Edit* section.
- Enter a descriptive name for your substrate under *Characteristics* section.
- Set the other parameters according to your substrate's geometry and subsequent intended writing procedure. **Note: Under *Advanced Parameters, Autofocus Mode must be Pneumatic.***
- Click .
- Click .

#### 6.1.1. Writing without alignment


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- Double-click on orange box under the *Design* tab in the *Layer* section.
- Select from a list of designs (see 6.1.3. for how to add new designs).
- Click  .



#### 6.1.2. Writing with alignment

- Click on  .
- Double-click on orange box under the *Design* tab for the newly-created, second layer.
- Select from a list of designs (see 6.1.3. for how to add new designs).
- Click  .
- Double-click on the orange box under *Alignment Settings*.
- Double-click on the alignment setting named *Manual* in the list.

#### 6.1.3. Adding a new design

- Click on  under the *Prepare* section. Note: Staff user privilege is required for this step. Consult equipment superuser for access.
- In the *GUI HIMT Converter* window, click on  in the toolbar menu to create new job.
- Enter a job name and click *Ok*.
- Under *Source File* section, click on  and select the file format that matches that of your design file.
- Select your design file and click *Create Default*.
- Check if the correct design file has been loaded by clicking on  . Your design will be rendered in another new window. You may wish to toggle the *Fill* option to have a clearer view of your design. Close the window once done.

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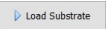
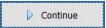
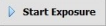
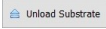
- With the *Justification* tab selected, check/uncheck Automatic Centering option according to your needs. In general if you wish to align design to a sample/reference, uncheck Automatic Centering, else check it.
- Once done, click *Complete Tasks* and save the job.
- Click on *Complete Expose Jobs*, then *Ok*, followed by *Finish*.
- Click on  to exit.
- Click  and select your design.

## 6.2. Loading the sample


- Lift the lid of the  $\mu$ MLA up.
- Locate the 4-hole suction array and place sample on top of it. **Note: Align sample according to the orientation sticker.**
- Activate the suction by pushing on the vacuum switch located to the left of the stage.
- Close the lid.

## 6.3. Writing the pattern

### 6.3.1. Writing without alignment

- Click  and allow the  $\mu$ MLA to focus and determine substrate dimensions.
- Click on .
- Focus on the substrate to be written if possible and note the focus value.
- Set the appropriate dosage and focus values; set focus to 0 if focus is not possible. Typical dose value for S1805 photoresist is around 150-200 mJ/cm<sup>2</sup>. Check *Auto-Unload the Substrate*.
- Click .
- After exposure is completed, click .


### 6.3.2 Writing with alignment

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- Click  and allow the  $\mu$ MLA to focus and determine substrate dimensions.
- Click on .
- Focus on the substrate.
- Navigate to feature on which the pattern is to be written and refocus. Note the focus value.
- Under the alignment settings panel to the left, insert reference coordinates for  $\mu$ MLA to orientate design. Note: Determination of reference coordinates had to be done beforehand in a design software e.g. *DesignCAD*.
- Select *ManualAlignment* for *Alignment Mode*.
- Click .
- In the optical live image, position cross-hair to the location that corresponds to current reference coordinate and right-click.
- Click on .
- Inspect position on the optical image. Determine if position is acceptable. If yes, click , else click  to redo the cross-hair positioning again.
- Repeat the optical positioning steps for the remaining reference coordinates.
- Set the appropriate dosage and focus values; set focus to 0 if focus is not possible. Typical dose value for S1805 photoresist is around 150-200 mJ/cm<sup>2</sup>. Check *Auto-Unload the Substrate*.
- Click .
- After exposure is completed, click .

#### 6.4. Unloading the sample

- Lift the lid up.
- Switch the vacuum off.
- Retrieve sample from stage.
- Close the lid.
- Clean up area.

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## 7. Revision History

Date Revised	Revision No.	Author	Revision Summary
20.12.2021	001	Justin Zhou Yong	