Standard Operating Procedure (SOP)

IPG Green Laser Micromachining

(LMM-02)

In case of emergency please call 911

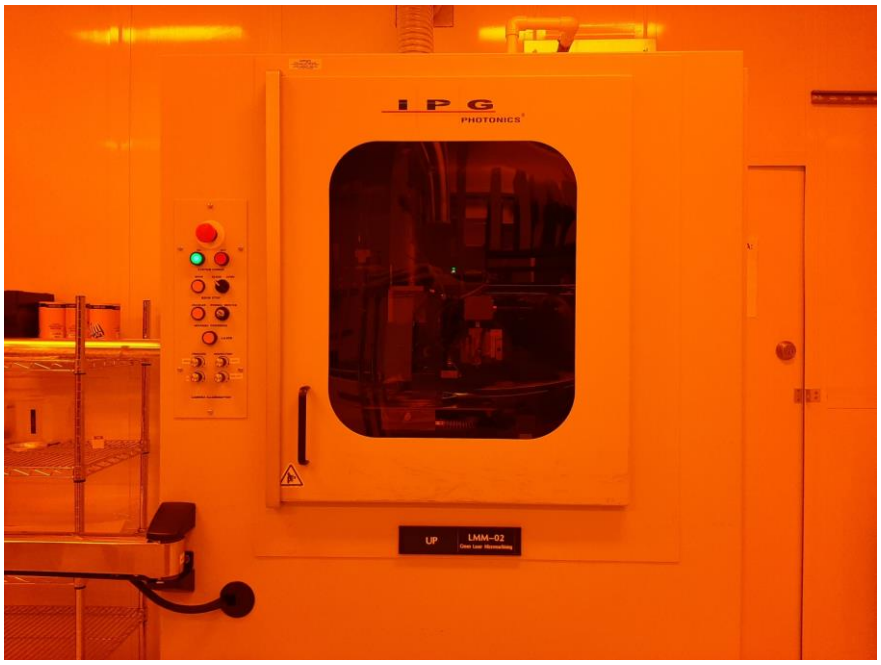
For any other major safety concern contact EHRS at: 215-898-4453 or via email: ehrs@ehrs.upenn.edu

If there is an error on the system/tool please report it on IRIS, we will take care of it

General safety tips and common mistakes

1) If the screen will not turn on, make sure you are logged into the tool on IRIS.
2) If you need to abort a recipe, you must run the footer: [Global] MacroFooter
3) For through cuts, you must adhere your sample to a base material such as a wafer to prevent the laser from machining the chuck.
4) Be sure that the "Processing State" (upper right) is in the IDLE state before starting a different macro. Otherwise the software will crash.
5) When using a CAD file, be sure the origin is located near or within the drawing extent. If alignment is necessary, be sure it is at a useful reference point.

IPG Green Laser Micromachining



Procedure Overview

1) Loading the sample
2) Unloading the sample
3) Using CAD Builder

Tool Overview:

The IPG Green Laser is a highly flexible laser micromachining system for multi-purpose, R&D and production applications. The system combines a Class 1 workstation integrated with a green (532nm) laser for machining silicon and metals.

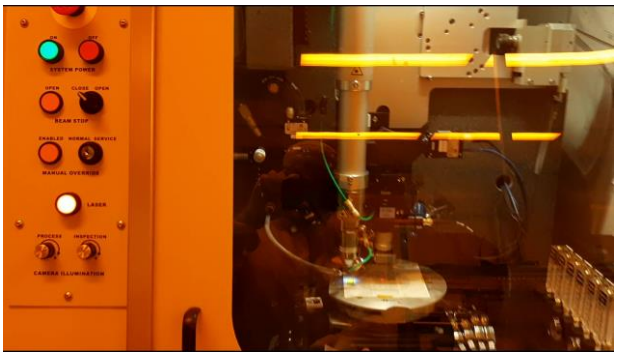
Full procedure:

Log into the tool via IRIS

1. Loading the Green Laser

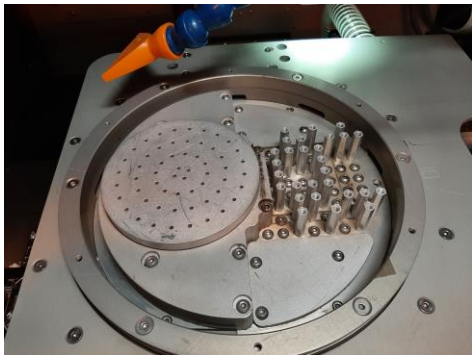
1.1. Confirm that the light for "**OPEN**" Beam Stop is **OFF**. If it is on, contact staff.

1.2. Open the door to the stage.



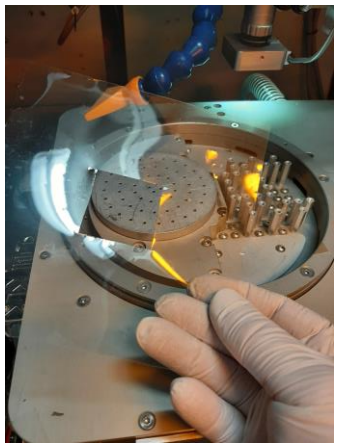
1.3. The Green's stage should be in the unload configuration. If it is not, refer to section 3 below.

1.4. The stage allows for vacuum mounting of samples.



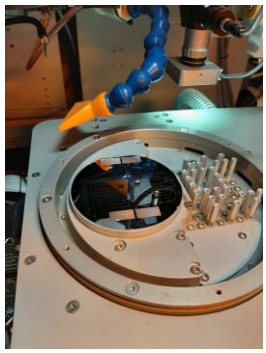
1.5. If the sample is smaller than the chuck, use a plastic film as shown to help with vacuum mounting.

Attention! The rectangular cut out must be smaller than the slide.



1.6. **If surface machining:**

1.6.1. Sample may be placed directly on the chuck.

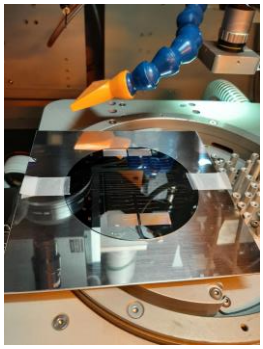


1.7. **If through-cut machining:**

1.7.1. Place a protective material such as a wafer or aluminum sheet over the chuck.

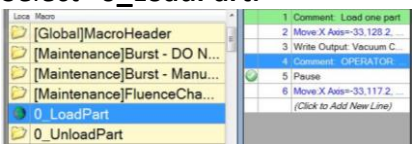
1.7.2. Secure the sample using tape. (Folding in one edge of the tape makes it easier to remove)

Attention! Make sure the wafer covers most of the stage to improve vacuum.



2. Loading the Green (IPG Chroma NET):

2.1. Select "**0_LoadPart.**"



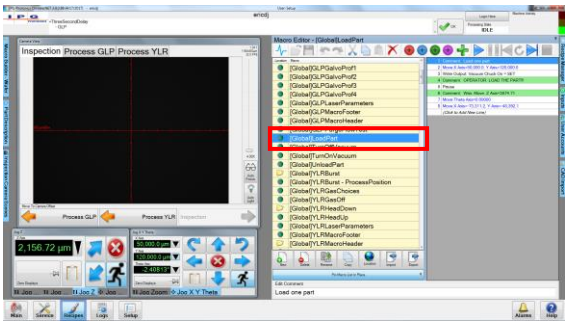
2.2. Select the Blue Triangle (Run Button) to begin the loading process. 

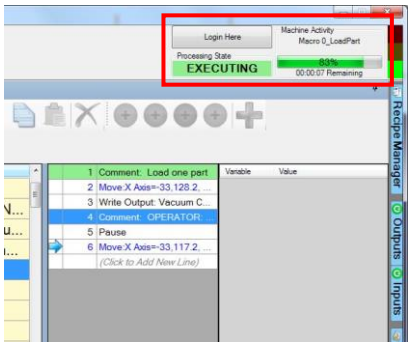
2.3. A **PAUSE** icon will appear at the top right corner of the screen. This pause allows you to test that your sample is firmly held in place.

2.4. Press the "**Run**" button again to complete the program. 

2.5. The **PAUSE** icon will change to **EXECUTING**.

2.6. Once **EXECUTING** changes to **IDLE** the program is complete and the stage has been successfully loaded.

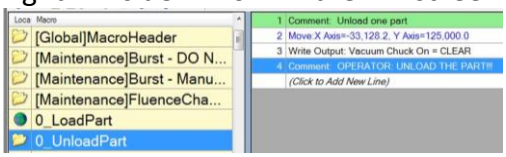




3. Unloading:

3.1. Click on the "**0_UnloadPart**" folder.

3.2. A dropdown menu will appear on the right side of the screen.

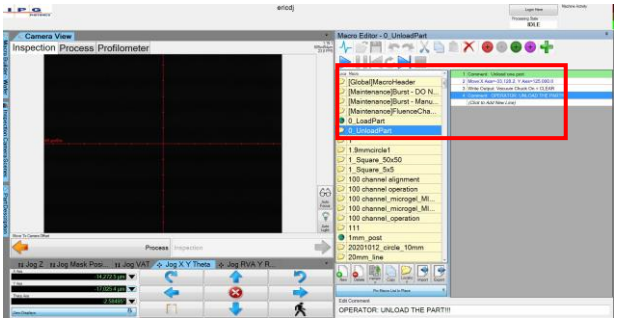


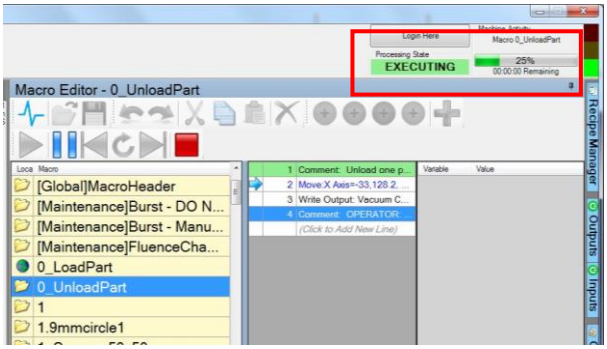
3.3. Select the blue play button. 

3.3.1. The action has been completed when the green "**EXECUTING**" icon changes to "**IDLE**."

3.4. Open the door, and remove the sample.

3.5. Close the door.





4. Focusing

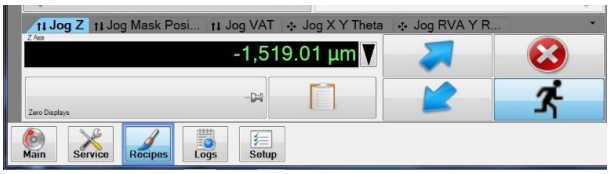
4.1. Focusing is done using Jog Z.

Fine motion

Coarse motion

Zero display

Also note these toggles:



4.2. Note about light level:

4.2.1. Materials like aluminum, platinum, and gold reflect more light than silicon, so the camera can be saturated.

4.2.2. The easiest solution is to bring a less reflective material (stage, tape, etc) under the camera, get the light level under control, then bring the highly reflective material under the camera.

5. Using CAD Builder

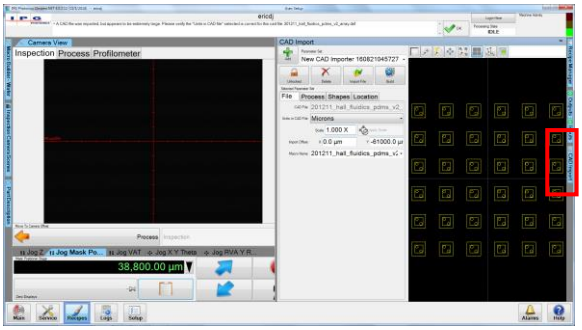
5.1. Before using the CAD Builder, make sure:

5.1.1. the origin of your drawing is near or within the features

5.1.2. the CAD file is saved as a DWG or DXF

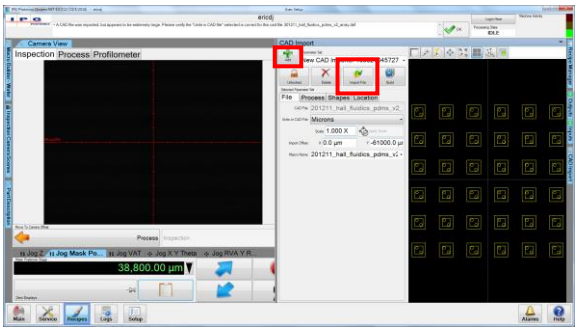
5.1.3. the file is on a USB drive

5.2. Insert the drive into the computer and select the CAD Import tab.



5.3. Once in CAD Import, select “Import File”

5.3.1. File Explorer will open up. Find and select your file to import it.



5.4. At the top right of the screen you will see 7 icons

1 2 3 4 5 6

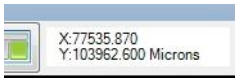
5.4.1. 1:  Zoom - Dragging the cursor vertically on the screen allows you to zoom out

5.4.2. 2:  Zoom window

5.4.3. 3:  Expands to the full field

5.4.4. 4:  Pan

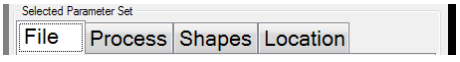
5.4.5. 5:  Hide and reveal the axes

5.4.6. 6: 

Cursor location field in microns

5.5. **FILE** tab

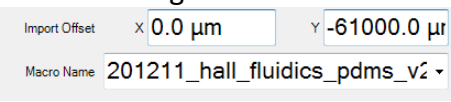
5.5.1. “Units in CAD File” SHOULD be the proper units imported from your file.



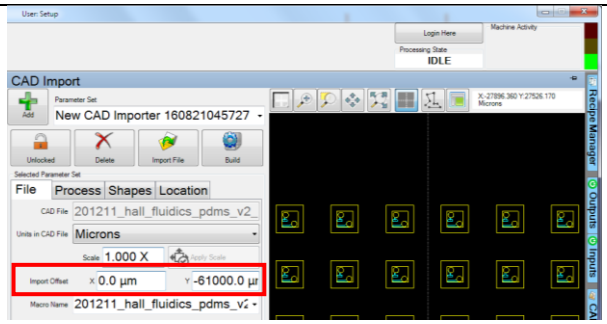
5.5.2. The software usually takes the units directly your file, but always confirm and change accordingly

5.5.3. Confirm that the units are correct by moving the cursor across the graphic display and observing the values in field #6.

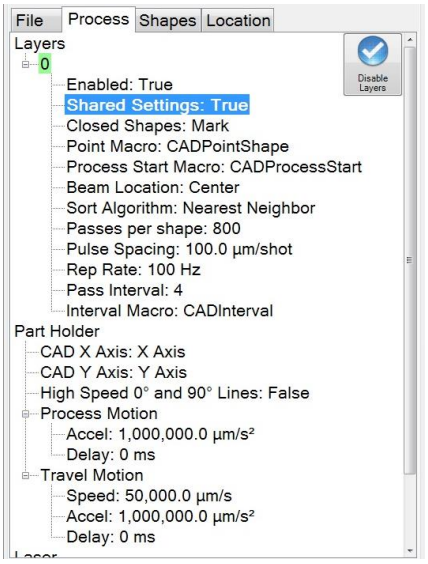
5.5.4. “Import Offset” allows you to offset the origin.



5.5.4.1. This is important if the origin is far from the features.

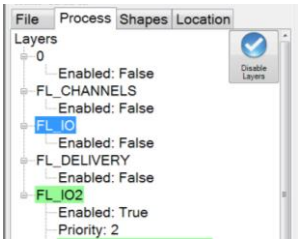


5.6. **PROCESS** tab: Sets values for how the layers and features are processed.



5.6.1. **Layers**

5.6.1.1. Enabled: Double-click to toggle layer from active to inactive. Only enabled layers will be written.

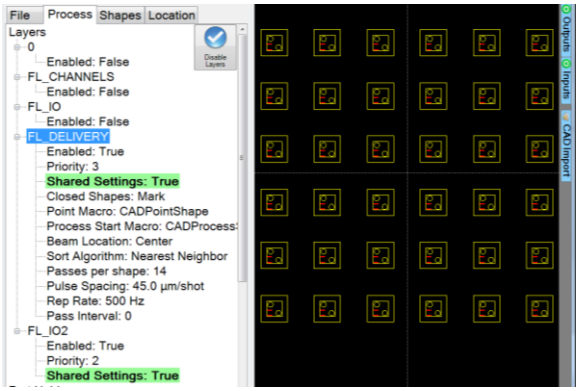


5.6.2. **Priority**

5.6.2.1. Defines which layer will run first, second, etc.

5.6.3. **Shared Settings**

5.6.3.1. “True” forces the first settings to be applied to all enabled layers.



5.6.4. **Closed Shapes**

5.6.4.1. "Mark" will cause laser to write on all lines.

5.6.5. **Process Start Macro**

5.6.5.1. The default is CADProcessStart.

5.6.6. **Beam Location**: The default is "Center."

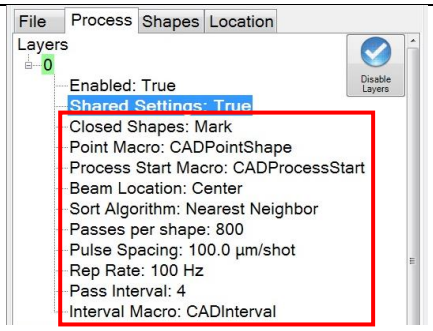
5.6.7. **Sort Algorithm:** This describes the order in which the features are cut. Default is "Nearest Neighbor".

5.6.8. **Passes per shape:** Program repeats entire pattern this number of times.

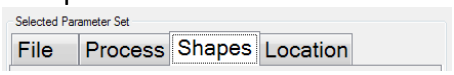
5.6.9. **Pulse Spacing:** Moves this distance between laser pulses.

5.6.10. **Rep Rate:** This is the number of laser pulses per second.

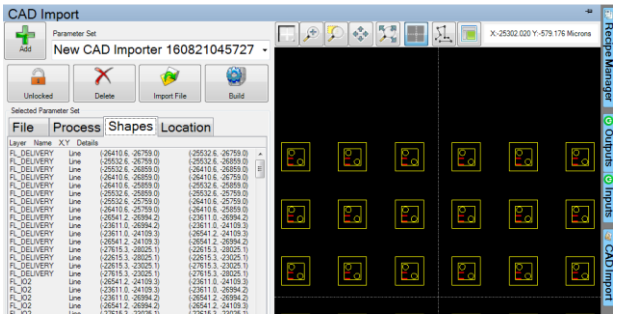
5.6.11. **Pass Interval:** The default is 0.



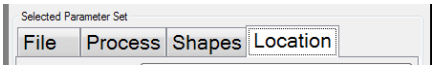
5.7. "Shape" Tab.



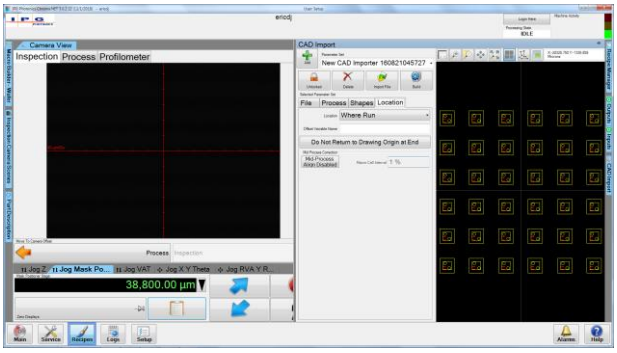
5.7.1. The possible shapes are displayed in the tab, but they cannot be edited.



5.8. "Location" Tab.

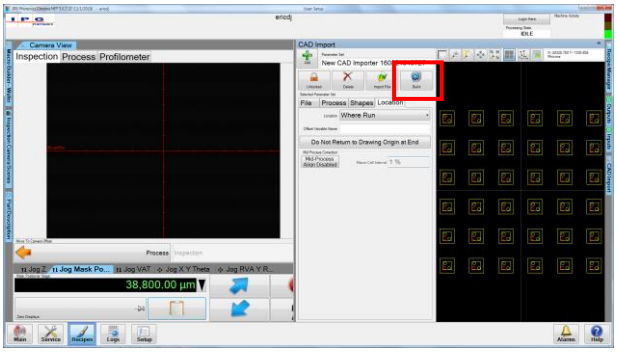


5.8.1. "Where Run" aligns the origin of the drawing with the position of the inspection camera on the substrate.



5.9. Select the Build Button to create a recipe for your design

5.9.1. You will be taken back to the main page of the IPG Software and where the new recipe is displayed.



5.10. Header and Footer: The header and footer must be added for your recipe. Select on the first line of the program then click the Green “plus” button to add the header. 

5.10.1. This adds new text to the top of the recipe that locks the door and moves the stage into the correct position.

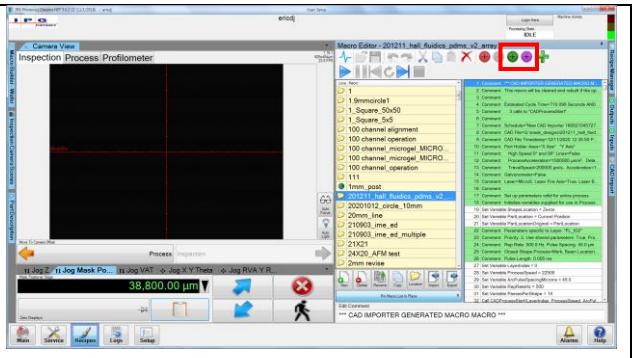
5.10.2. Scroll to the bottom of the recipe and click on “Add New Line”

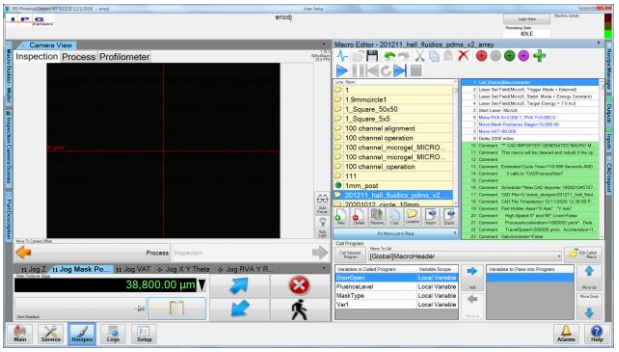
5.10.3. Click on the Purple plus button to add the footer 

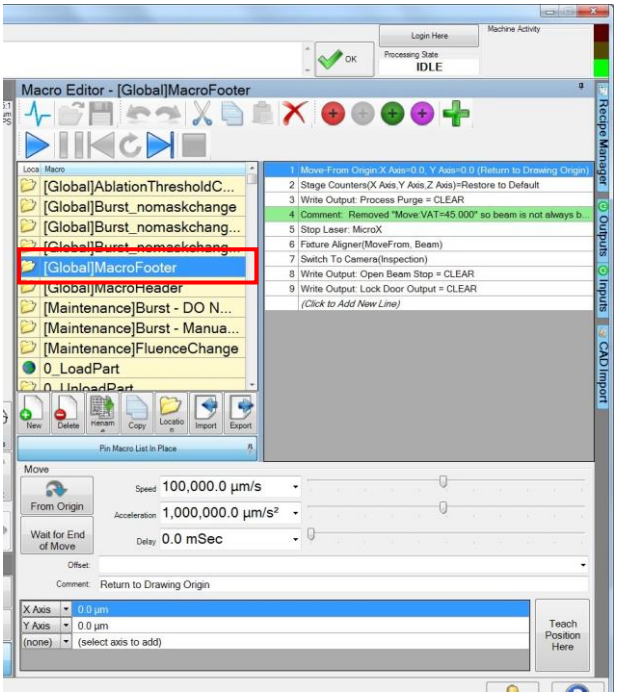
5.10.4. Now your recipe is ready to be run. Click on the blue “Run” button to start your recipe 

5.10.5. If the process needs to be aborted, press the STOP button.

5.10.5.1. *Note: you MUST run the* [Global]MacroFooter *to return the stage to the inspection camera and unlock the door.*







Feel free to contact the staff members with any questions about your process and the tool.

Last modified: 11Feb2023 by Eric Johnston