

# Nanoscribe Photonic Professional GT 3D Lithography System



The Nanoscribe Photonic Professional GT system utilizes two-photon polymerization for 3D micro printing and maskless lithography. Printing of 3D structures can be achieved using conventional direct laser writing (DLW) or Nanoscribe's dip-in laser lithography (DiLL). The system is equipped with a piezo for printing in high resolution arbitrary 3D trajectories and a galvanic mirror for fast layer-by-layer printing. Features 200 nm in size to structures of several millimeters can be printed. Significant reduction of printing time can be achieved with the "scaffold and shell printing" method with post development UV curing. The system accepts STL files which can be created using CAD software. The files can be converted to Nanoscribe's GWL code using its Describe software. Users may also opt to create structures by writing GWL code directly. Nanowrite software allows for easy operation of tool with AxioVision software allowing for live monitoring of the process. The system can be used for a broad range of applications on the nano-, micro-, and mesoscale including; from optics, plasmonics, microfluidics, sensors, micro-robotics, biomimetics, to life sciences, and more.

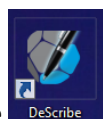
## Technical Specifications:

- **Objectives** - 63X immersion, 25X immersion, 10X Immersion and 20X (for air)
- **Laser** - Class 3 120 mW, 780 nm, 150 fs, 80MHz fiber laser
- 100 x 100 mm<sup>2</sup> motorized XY stage range
- 300 x 300 x 300 µm piezo range for 25X and 1mm diameter for 10X
- Sample holders: DiLL (dip-in laser lithography) 1 X 1-inch glass slides, users can bring their own substrates
- **Nanoscribe's Proprietary Photoresists:** IP Dip, IP-L 780, IP-S, IP-Q, IP-Visio
- **Dymax BlueWave 200** curing system available for curing of structures post-writing

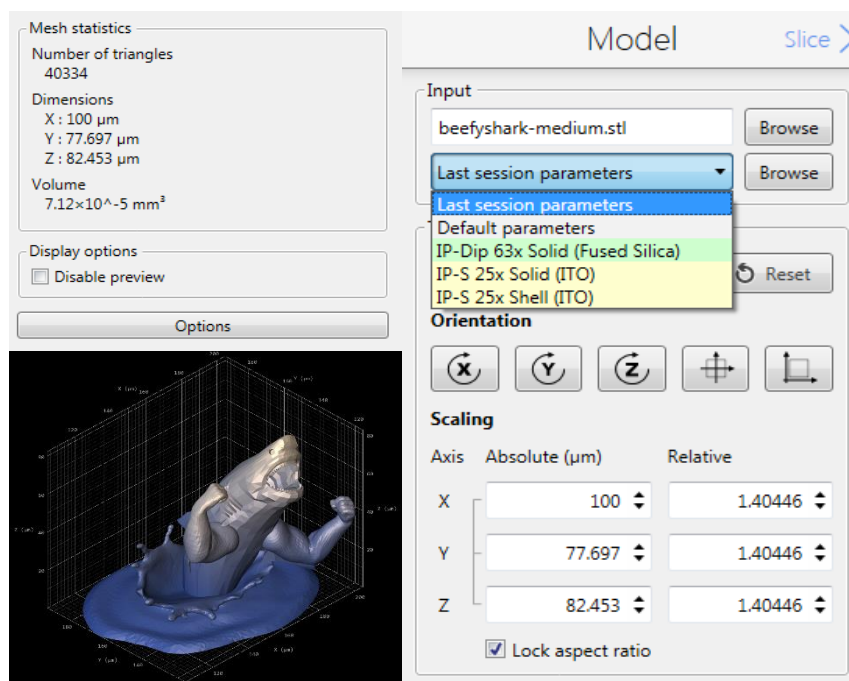
## Parameter Edits

You will need to edit the parameters to be used for your print job. The editing is done in Nanoscribe's Describe software and is converted to GWL code upon saving the file. **A detailed description of each parameter is given in the appendix. This manual only covers Dip in Lithography (DILL). Other forms of printing are covered in supplementary manuals that the user can request.**

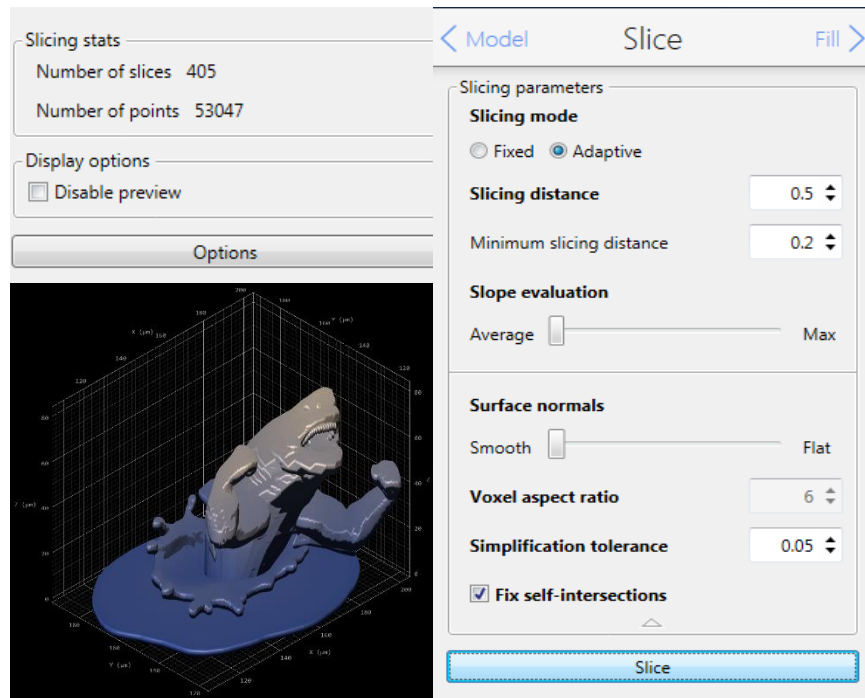
DILL printing uses the 25x objective along with IP-S. It can also be done with the 63x objective along with IP-DIP. The objective moves away from the substrate during printing so ITO covered glass or other substrates can be used.



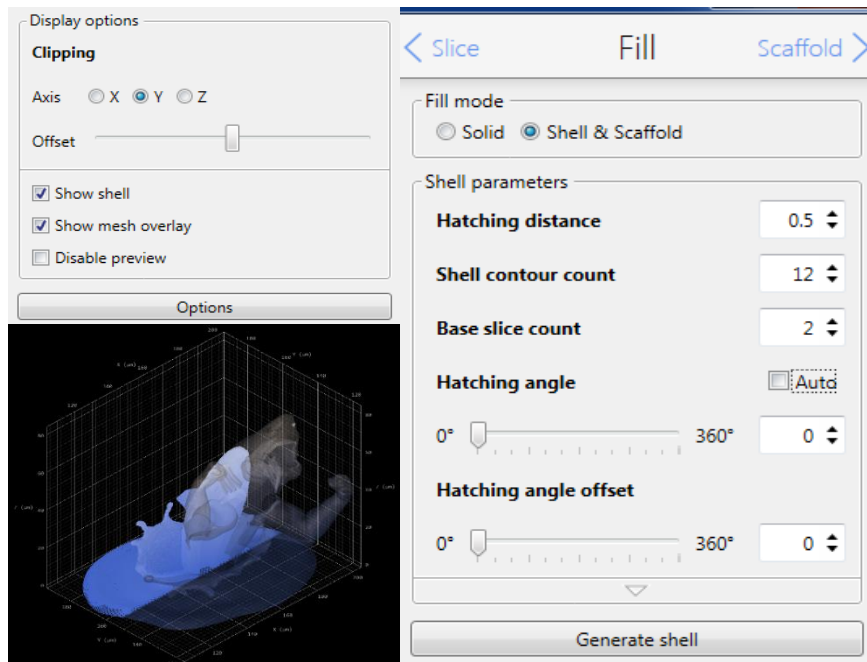
1. Open your **.STL** file in the **Describe software**.
2. You will see the following page come up. From the **Input** dropdown menu, select the 25x objective. Once done, click **Slice** at the top of the page. If you wish, change the size of the structure using **Scaling**. The **Lock Aspect Ratio** option can be used to scale the structure in all 3 dimensions simultaneously.



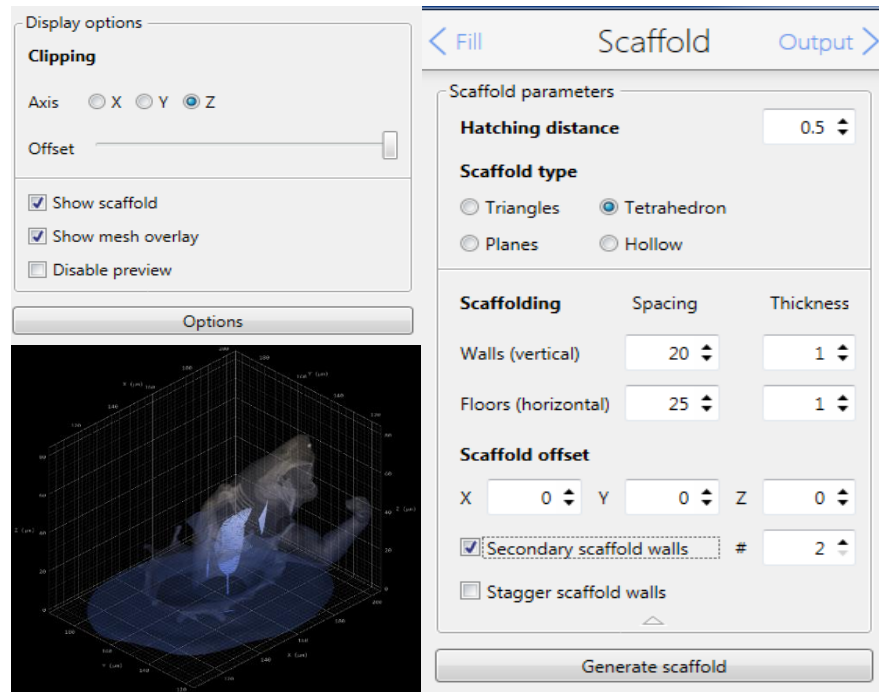
3. In the **Slice** window, select the **Slicing Mode** you want. Also, enter the maximum and minimum **Slicing Distances** you want. Click **Slice** at the bottom to save any changes. Once done, click **Fill** at the top.



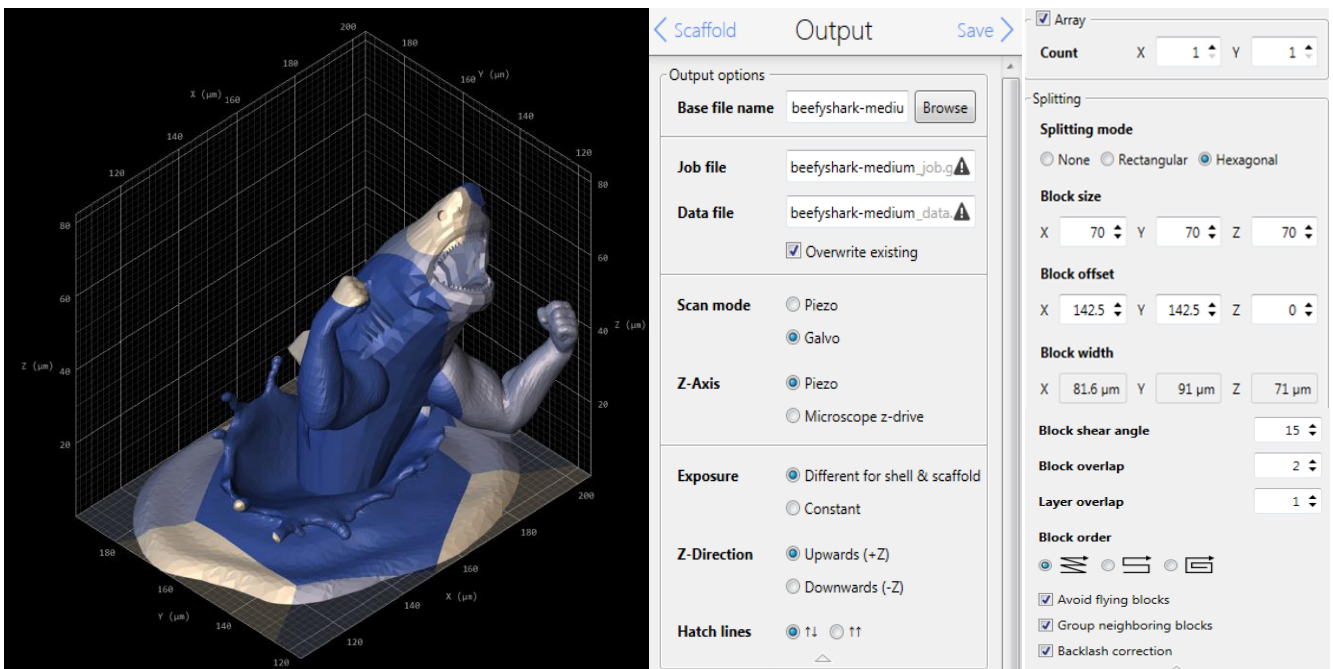
4. In the **Fill** window, select the **Fill Mode** you want. Also, changes any other parameters you want. Click **Generate Shell** at the bottom to save any changes. Once done, click **Scaffold** at the top.



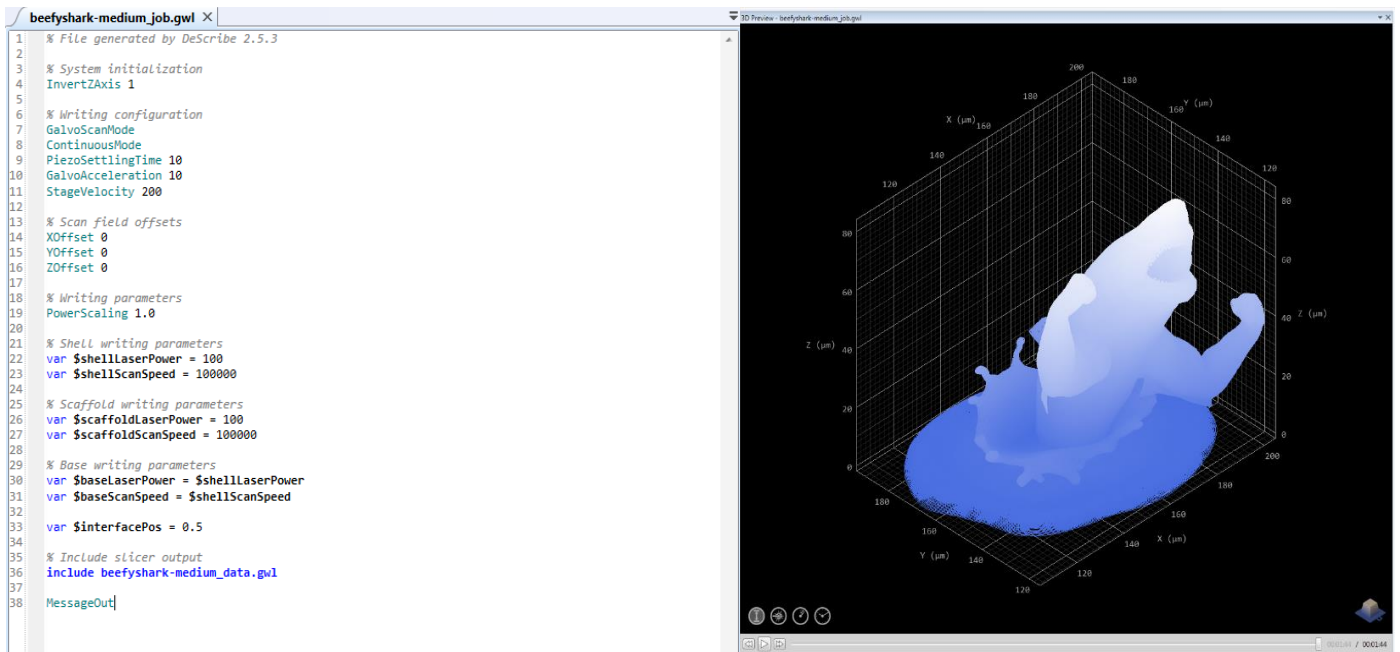
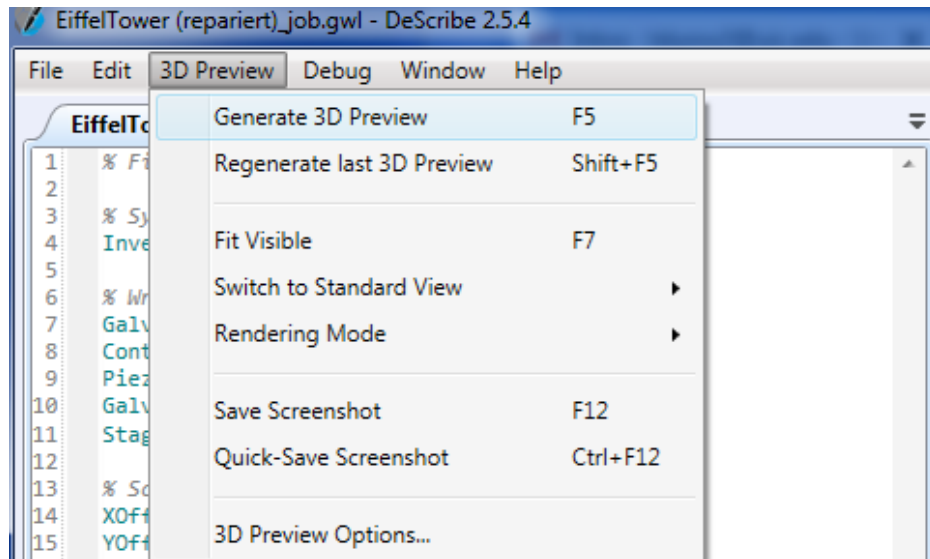
5. In the **Scaffold** window, select the **Scaffold Parameters** you want. Change any other parameters you want. Click **Generate Scaffold** at the bottom to save any changes. Once done, click **Output** at the top.



6. In the **Output** window, select the **Overwrite Existing**. Change any other parameters you want. Once done, click **Save** at the top. Close the Describe software.



7. In new window that comes up, you will see the GWL code that has been generated. Click the **3D Preview**, then click **Generate 3D Preview**. A preview will be generated. You can click play at the bottom to watch an animation of the printing process.





## Sample Preparation and Writing

The sample holders are in the cabinet next to system. This section of the manual will cover how to use 25x objective for DILL with IP-S photoresist on ITO coated glass. The preparation for other resists for other printing modes is similar.

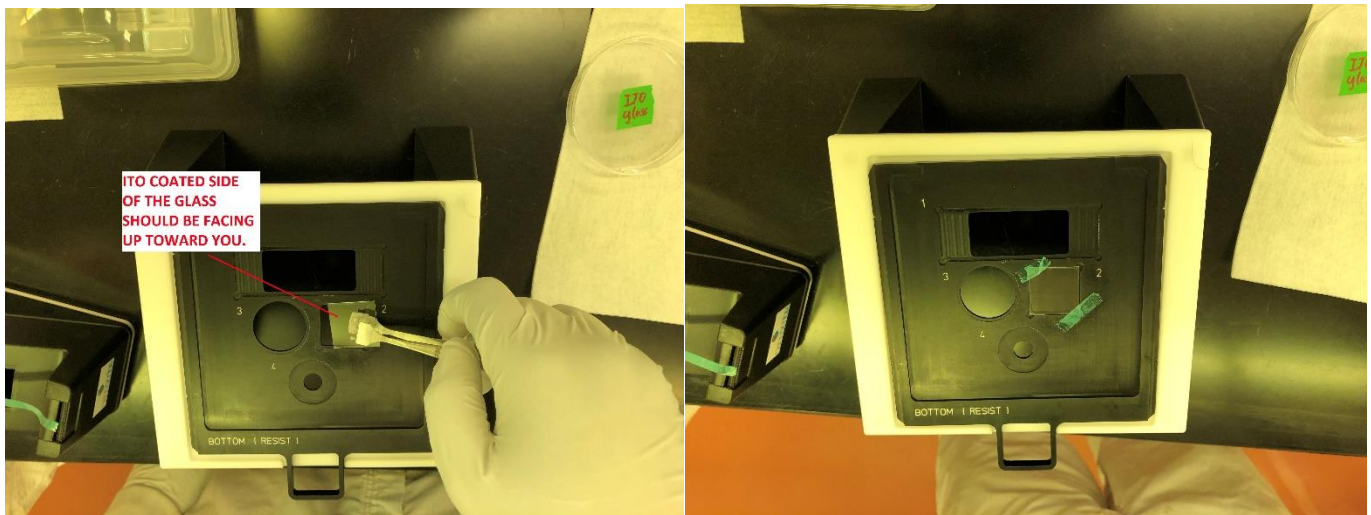
1. Open the cabinet and take out the sample holders, tape, and sample holder stand. Depending on the size of your sample, choose the holder appropriate for you.



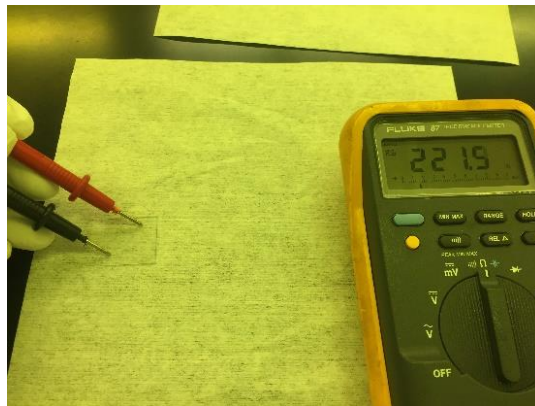
2. Place the sample holder on the sample holder stand with the part labeled **BOTTOM {RESIST}** facing up towards you.



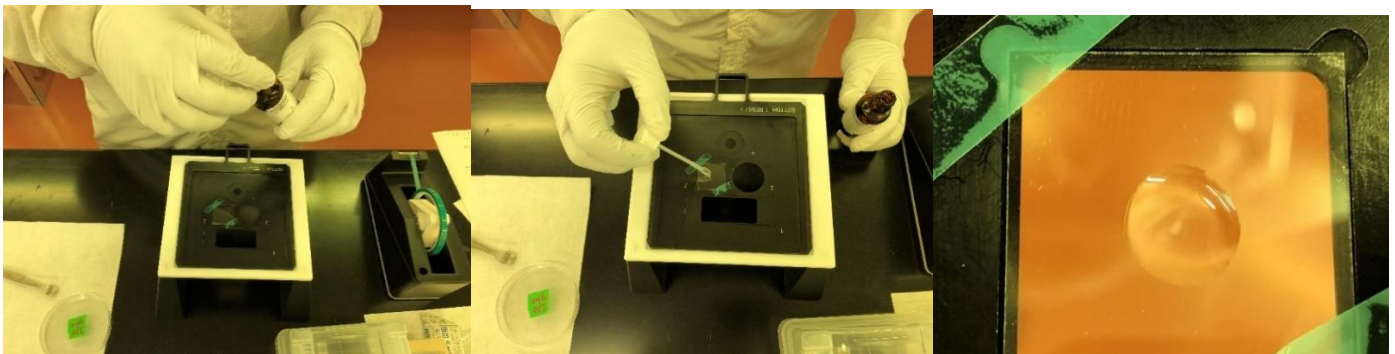
3. Place the sample in the appropriate shape. For ITO coated glass piece, make sure the ITO coated part of the sample is facing up toward you. Tape down the sample.



**NOTE:** To find the side with the ITO on the glass sample, use a multimeter to measure the resistance of the sample.

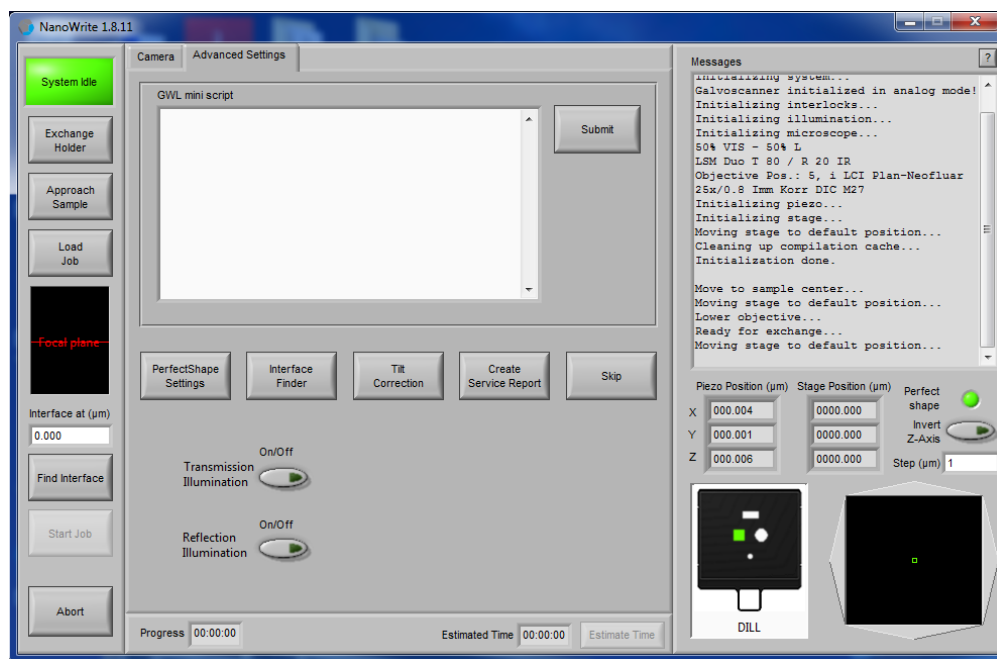
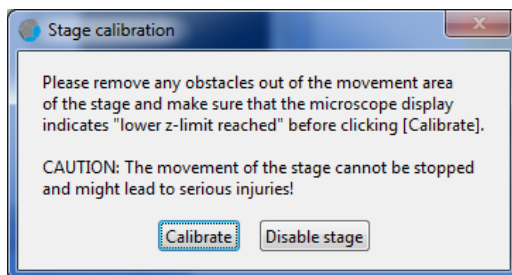


4. Pick up the photoresist bottle and wipe off the excess on the bottles edge. Place a drop of resist on the glass. You don't need a lot of resist. Let the resist spread out on the glass for about 5 minutes.

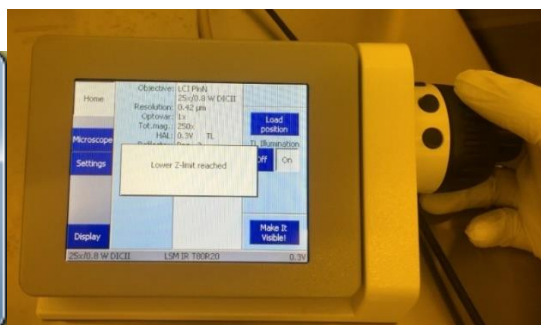
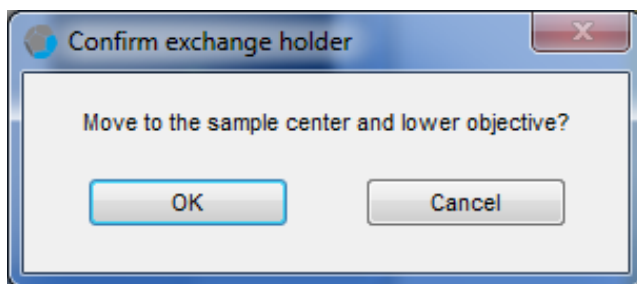




5. Open **Nanowrite** software. You will be asked if you want to calibrate the stage. Click **Calibrate** and allow initialization to complete. Once done, the message **Initialization Done** will appear in the Nanowrite dialog box.

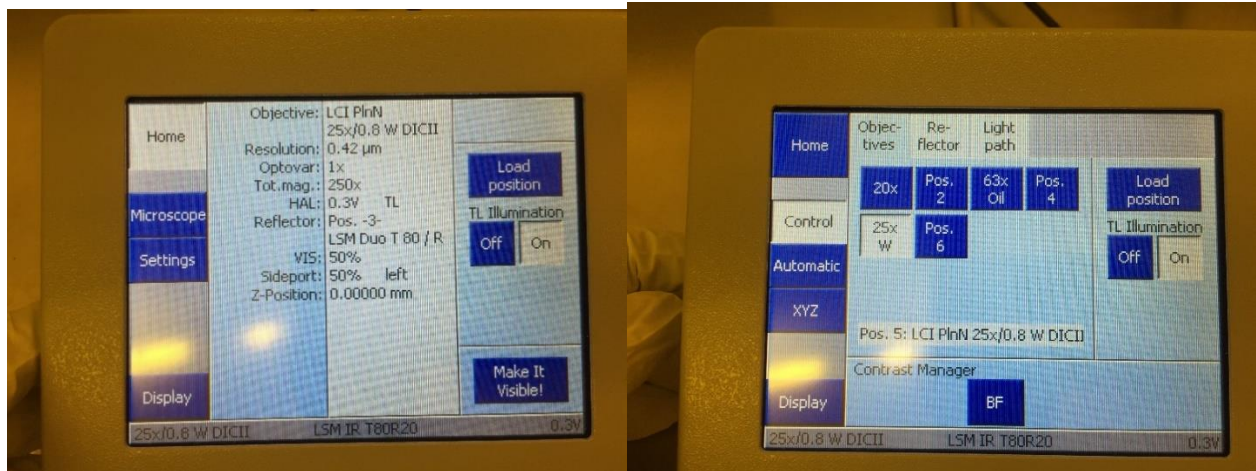


6. Click on the **Exchange Holder** tab in **Nanowrite**. Check the LCD monitor (Nanoscribe Control Display) on the table and make sure the message **LOWER Z LIMIT REACHED** is displayed. If not, turn the large knob on the side of the monitor anti-clockwise to display the message. Click **OK** on the **Confirm Exchange Holder** dialog box.





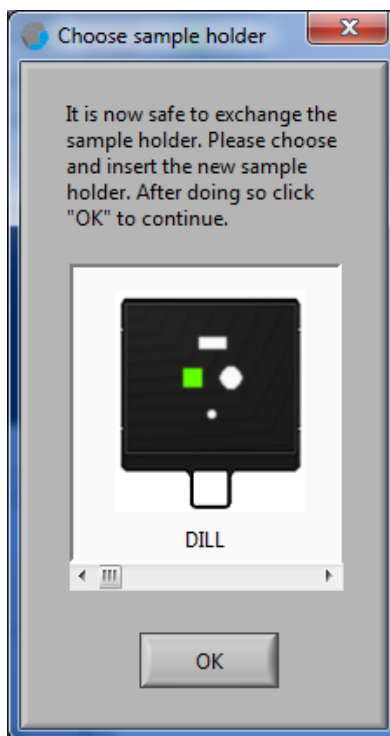
7. On the LCD monitor on the table, press **Microscope** and choose the objective lens you want to use for writing.



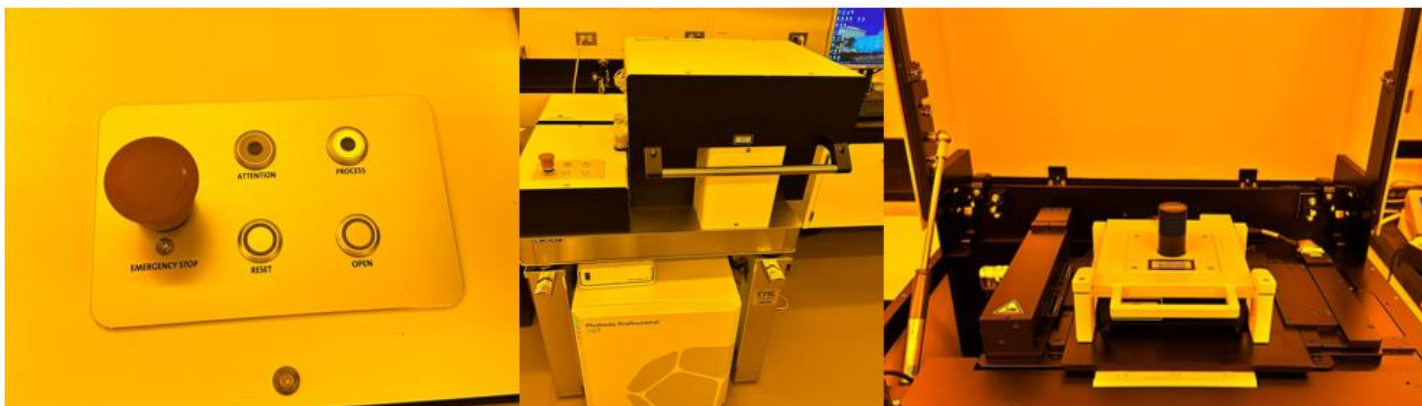
**NOTE: SOMETIMES THE CURRENT MIGHT NOT ROTATE TO POSITION. IN THAT CASE, FEEL FREE TO ROTATE IT INTO POSITION BY HAND. BE GENTLE.**

**NOTE: THE 20X OBJECTIVE IS FOR AIR ONLY. DO NOT DIP IN PHOTORESIST OR OIL. PLEASE TELL NCF STAFF IMMEDIATELY IF THIS HAPPENS SO THAT THE OBJECTIVE CAN BE CLEANED.**

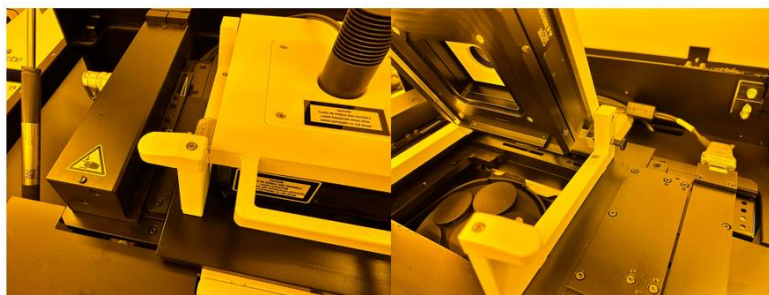
8. The Desktop should show this screen. **PLEASE NOTE: DO NOT EXCHANGE, UNLOCK OR TOUCH SAMPLE HOLDER IF THIS SCREEN IS NOT DISPLAYED.**



9. Hit “Open” on the interlock panel on the machine. Then lift the handle to open the loading area.



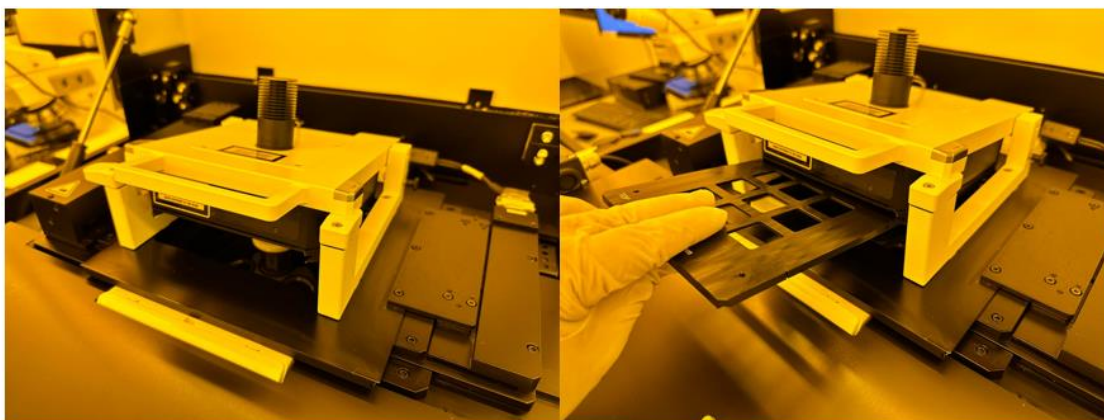
10. Gently open the locks on the piezo and lift up until it locks. Once locked, pull the pin on the right to make it completely vertical. **MAKE SURE IT IS LOCKED. IF IT FALLS, IT CAN COST A LOT TO FIX.**



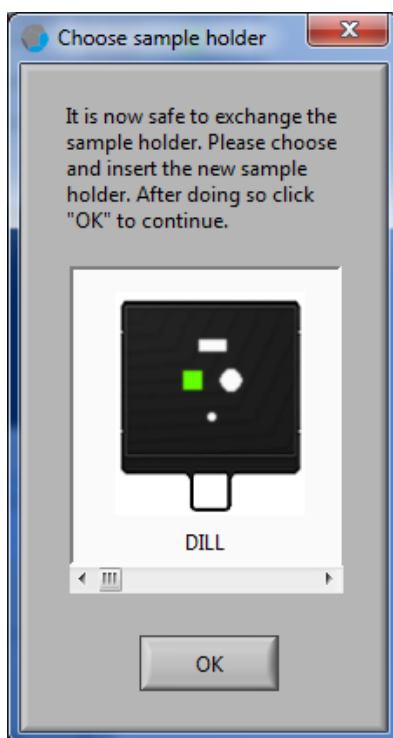
11. Choose the lens you are using on the Nanoscribe control display and then screw the lens in the spot.



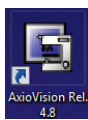
12. Once done, engage the locks of piezo and gently rest piezo on the locks for putting in the sample holder. **DO NOT FORCE THE HOLDER IN.**



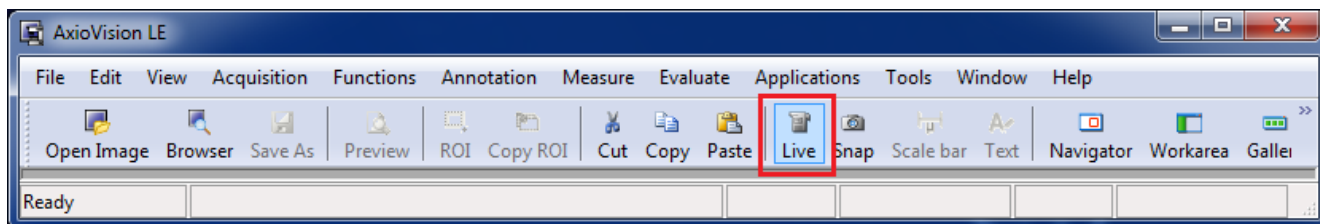
13. Once sample is in, lift piezo and disengage locks of piezo to put piezo back and then lock it in place.
14. Close the lid and press gently until locked.
15. On the computer, choose the position your sample is in on the picture and click **OK**.



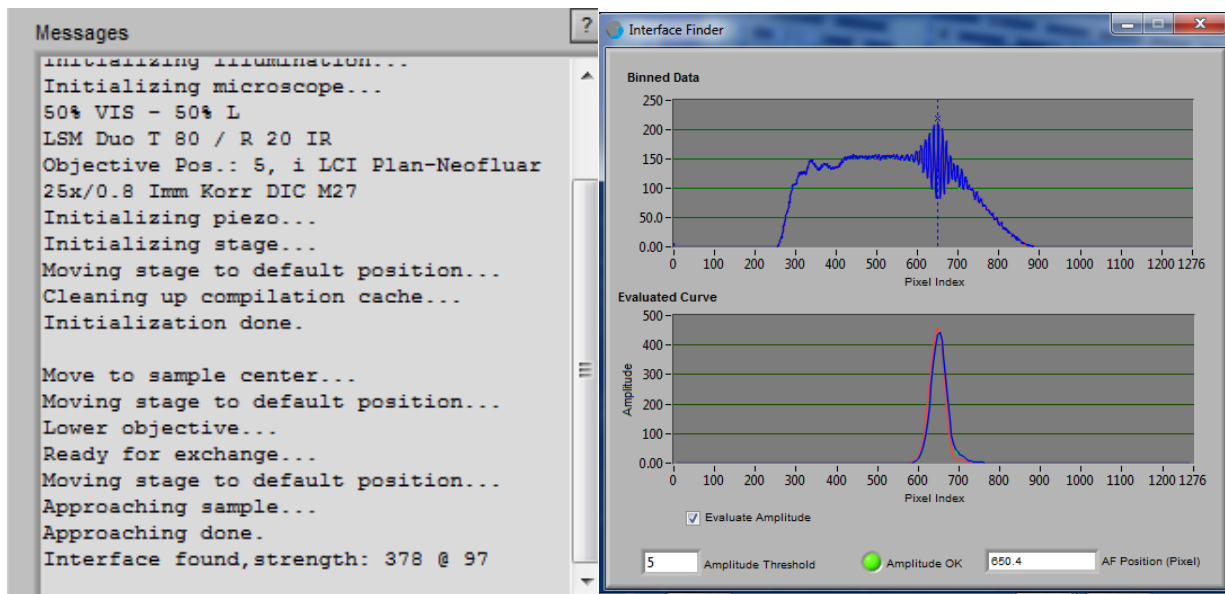
16. Click on **Transmission/Illumination** in **Nanowrite**.



17. Open the **AxioVision** software and click on **Live View**.

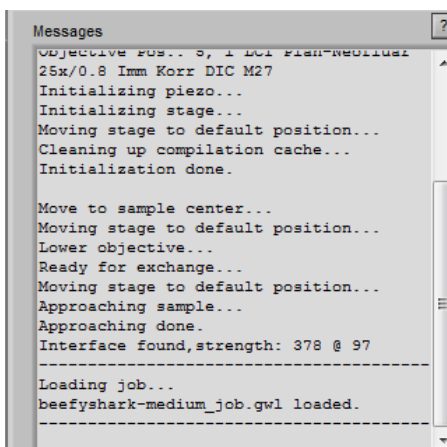


18. Click **Approach Sample** in **Nanowrite**. For ITO coated glass and IP-S resist, the software should find the interface automatically. Once found, you should see the message **Interface Found, Strength: XX @ XX**. You should also see the ripples in the **Interface Finder** window.



19. Click **Load Job** in **Nanowrite** and choose the desired job file. In your folder, click on the **ABC\_job.gwl** file. You should see the message **ABC\_job.gwl Loaded** in the message box.

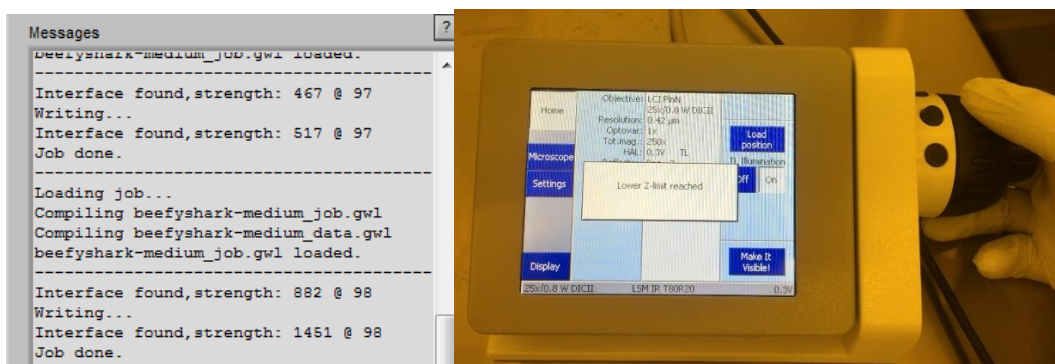




20. If you have not found the interface of the sample and resist yet, click on **Find Interface** in **Nanowrite** find the interface.

**NOTE:** The microscope is equipped with an autofocus system to automatically focus the laser spot at the substrate surface. The autofocus system approaches a grating on the front focal plane of the microscope objective. The position of the image of the grating on the autofocus camera is an indicator of the position of the focal spot of the laser on the substrate. A detailed description of the autofocus system may be found in the supplied manual of the Definite Focus.

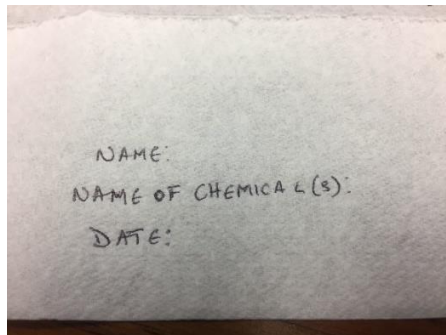
21. Click **Start Job** in **Nanowrite** to start printing. At any time, the job can be aborted by clicking **Abort**.
22. Once done. You will see the message **Job Done**. Click **Exchange holder** and ensure the message **Lower Z Limit Reached** appears.



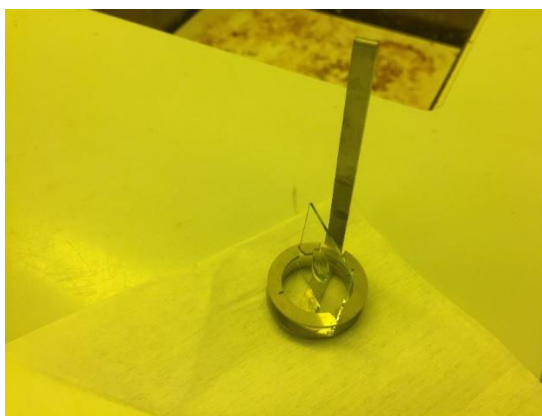
23. Pull out sample holder.

## DEVELOPING THE SAMPLE

1. Place a cleanroom wipe in the fume hood and label the wipe with your name, the name of the chemical (s), and the date. There is dedicated Nanoscribe glassware in the cabinet where the sample holders are located.



2. Place the sample in the special holder for glass slide and put it in **SU-8 Developer**. Once all the resist is gone, remove the sample and place it in **IPA**. The let the sample air dry. **Do not use N2 gas to dry the sample. It could damage the structure(s) you just printed.**



3. Put the chemicals in the waste bottle once done. Rinse the sample holder and glassware. Put glassware back into their box.

**NOTE: You may bring your own sample holder for development. You may also bring your own glassware.**

### Cleaning Up and Shutting Down

1. Clean the sample holder with **IPA**.
2. Put the sampler holder and sample holder stage back in the cabinet. Put the resist back in the fridge.
3. Clean up the glass ware and rinse them with DI water.
4. Exit all software. Wait for the program to close completely (including all overlapping icons in the task bar)
5. Make sure the objective z-drive is completely lowered. If not, press on **Load position** on the touch panel and wait for the movement and the press **Set work position**.
6. Log out from the PC. **DO NOT SHUT DOWN**.