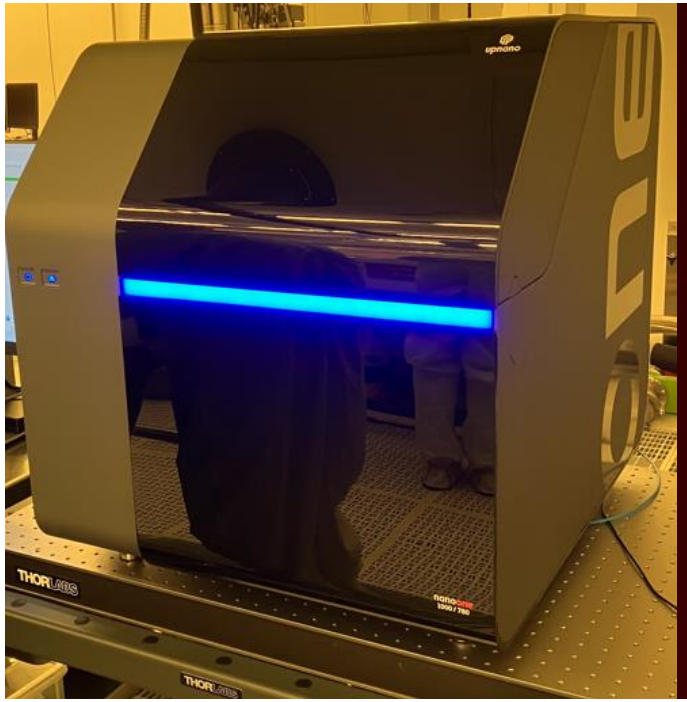
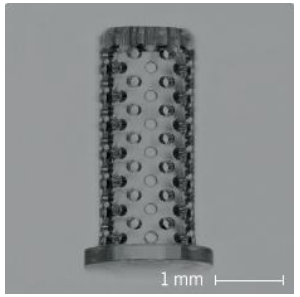
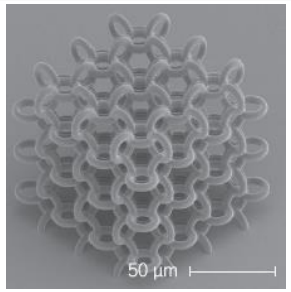
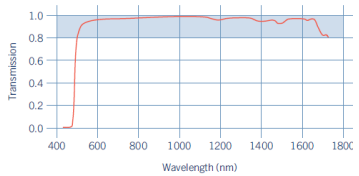
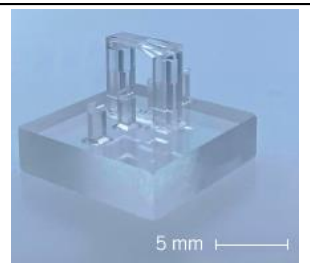


UpNano Nano One 2PP 3D printer Standard Operational procedure AggieFab Texas A&M University

Scope and Safety

- SCOPE
  - The purpose of this document is to describe requirements and basic operating instructions for the UpNano NanoOne 3D printing System. The use of this tool is limited to approved processes only.
- SAFETY
  - Be sure that you are trained and signed off to use this equipment.
  - Be sure to keep all doors and protective shields in place before operating this equipment.
  - Refer the materials datasheets for the printing materials.
  - If you are unsure about any procedure or indication while operating this equipment be sure to contact a staff member or trainer for assistance.

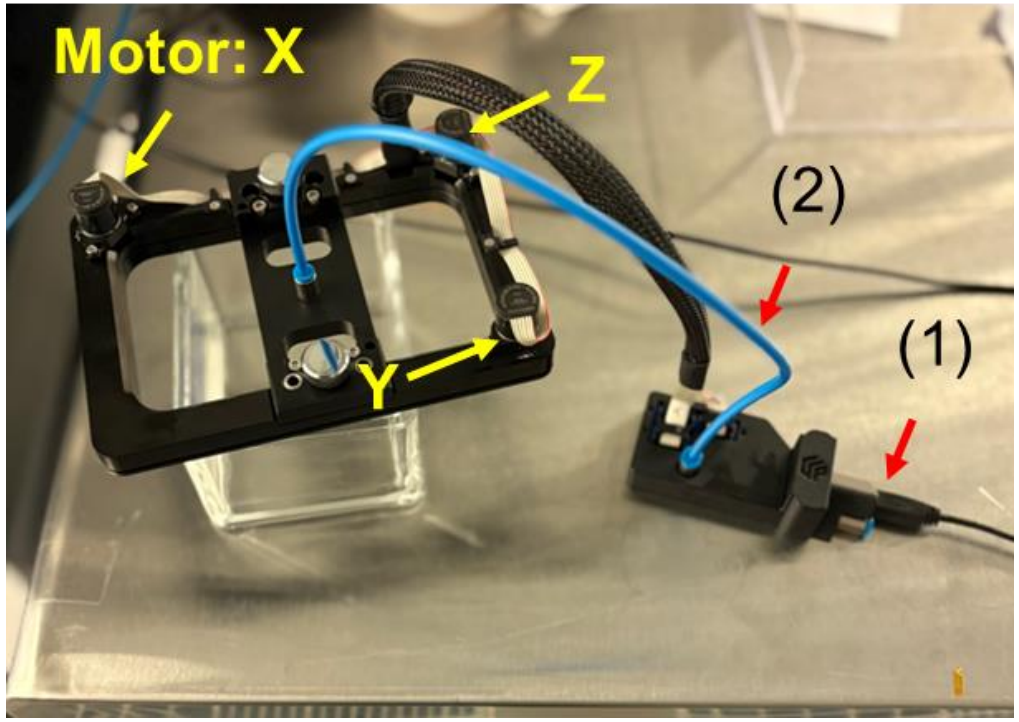
Contents

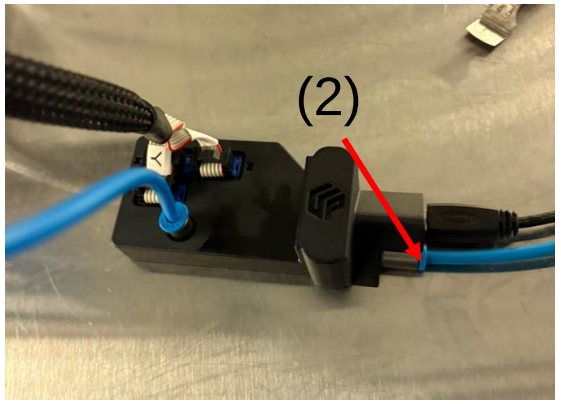
	Resins Oils	Feature		Objective		Development	Post process	Autofocus
				Fine	Coarse			
Glass fabrication	**UpQuartz**	Fused silica (SiO2)		-	5X, 10X	PGMEA (mag stirrer)	1. Debinding: ashing oven (air) 2. Sintering : vacuum tube furnace (10^-2 mbar) *Al-Oxide plates recommended ** temperature profiles avaiable	O
High resolution	**Upbrix**	Ultrahigh-resolution 2.5D material		40X	40X	PGMEA, IPA	-	O
	Updraft	Fast prototype		All	All	IPA	-	O
Transparent Fast prototype	**UpPhoto**	High-performance		All	All	IPA	-	O
Low auto-fluorescent Bio compatible	**Upflow**	Low-autofluorescence Low-viscosity		10, 20, 40X	10, 20, 40X	PGMEA, IPA	UV (365 - 405 nm) ~ 30 min	X
	Upopto	High optical transparency Ultralow-autofluorescence		10, 20, 40X	10, 20, 40X	PGMEA, IPA	UV (365 - 405 nm) 30 - 60 min	X
	Upsol	spining on substrate 2.5D, 3D		10, 40X	10, 40X	1-propanol	-	O

Checking tilt correction stage

Checking gap

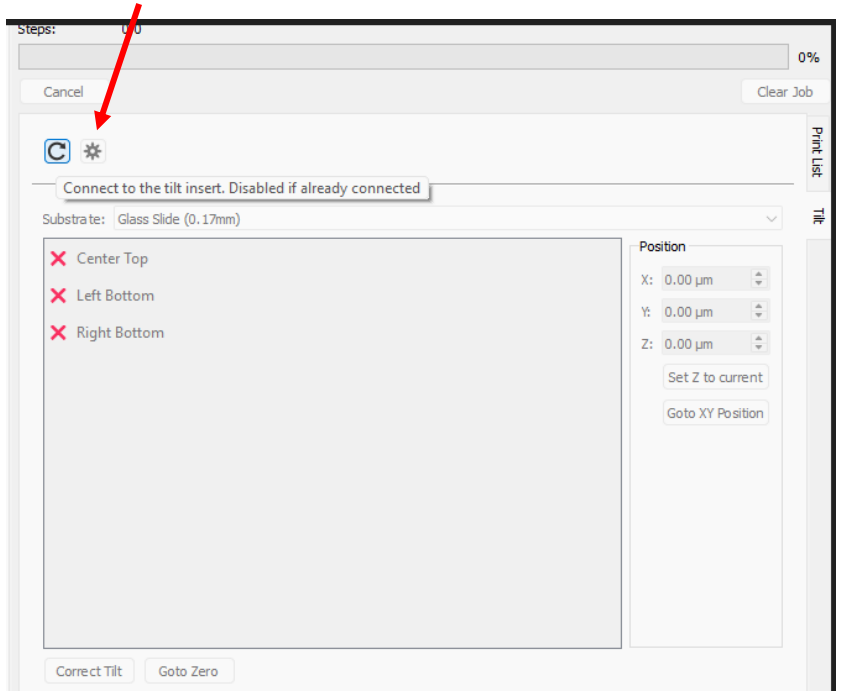
- ❑ try to insert the substrate hold into the top and bottom pieces: X, Y, Z motors
- ❑ Should be inserted while not too much gap



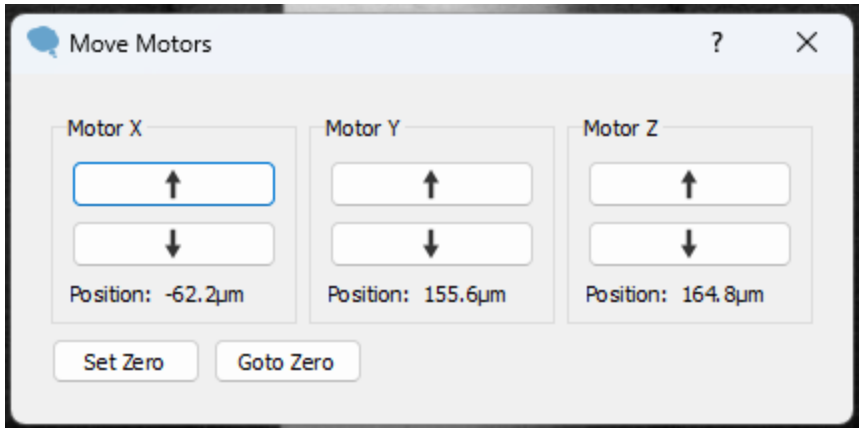


Adjusting the gap – only if needed

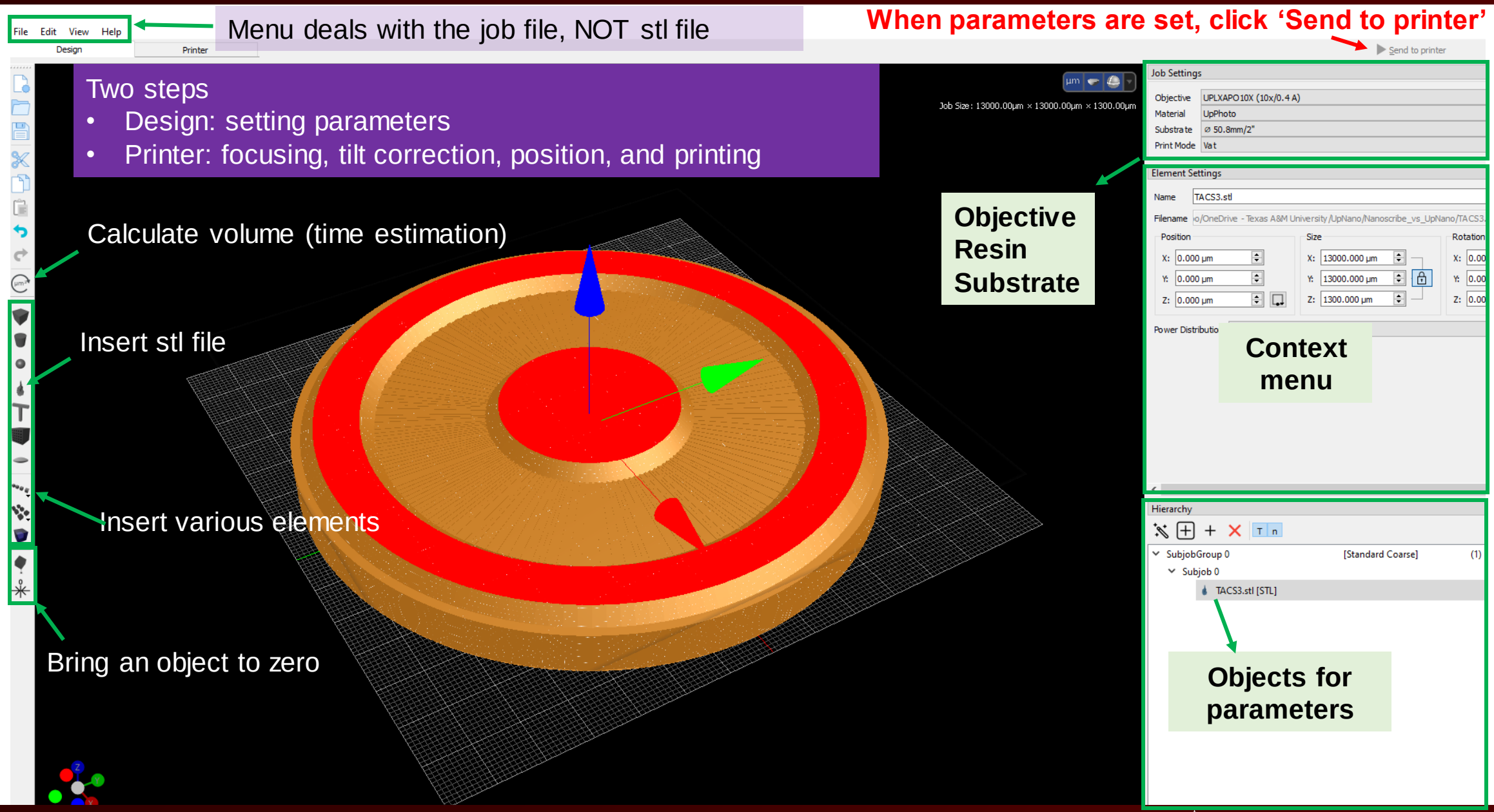
Open ‘tilt’ tap
Click the ‘setting’ icon



Adjust the gap using ONLY arrows
NEVER click ‘Set Zero’ or ‘Goto Zero’



Think 3D – set up parameters



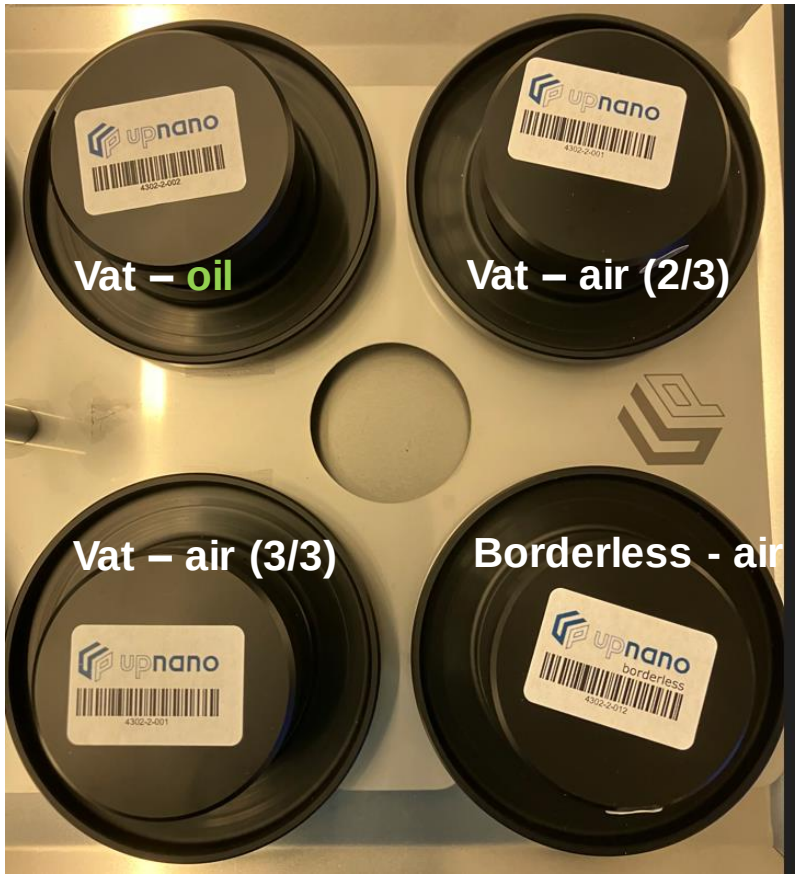
Objectives

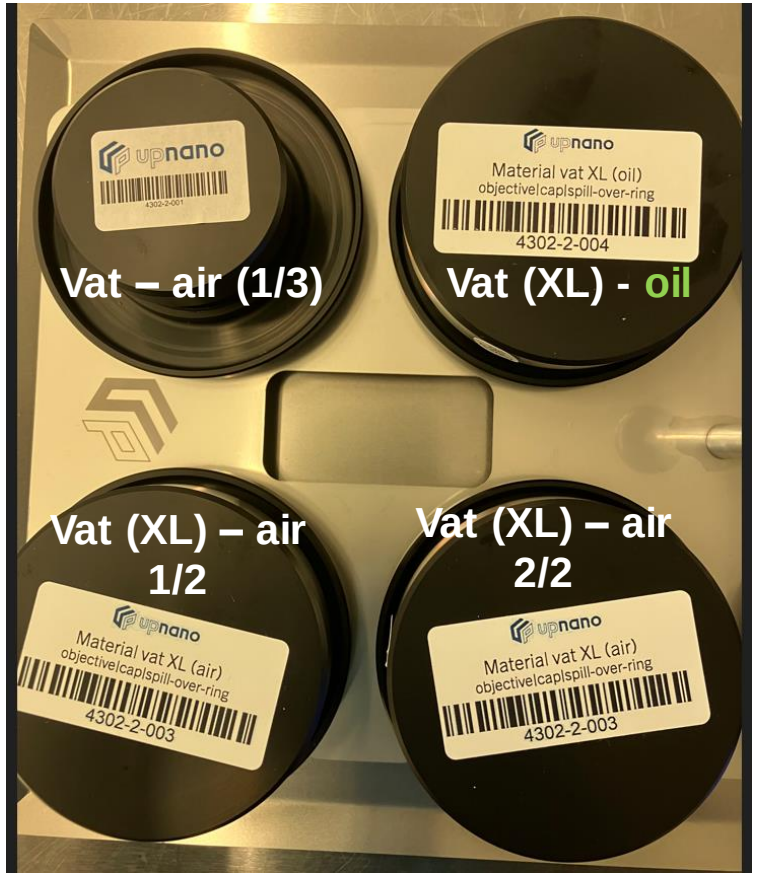
- 5 objectives available
- Consider resolution, size, and parameters

Objective	ID	Media	NA	WD (mm)	FOV (mm)	BH (mm)	Max Bottom Up Height (mm)	XY speed (mm/s)	Volume speed (mm^3/s)
5X	Fluar	air	0.25	12.5	2.8	80	3	1200	300
10X	UPLFLN	air	0.3	10	1.4	60	2	600	60
10X	UPLXAPO	air	0.4	3.1	1.4	60	0.7	600	40
20X	UPLSAPO	DH2O	0.7	0.35	0.7	30	0.25	300	2.25
40X	UPLSAPO40XO	Immersol	1.4	0.13	0.35	10	0.15	150	0.25

Vat: size/medium

Vat (XXL) - air

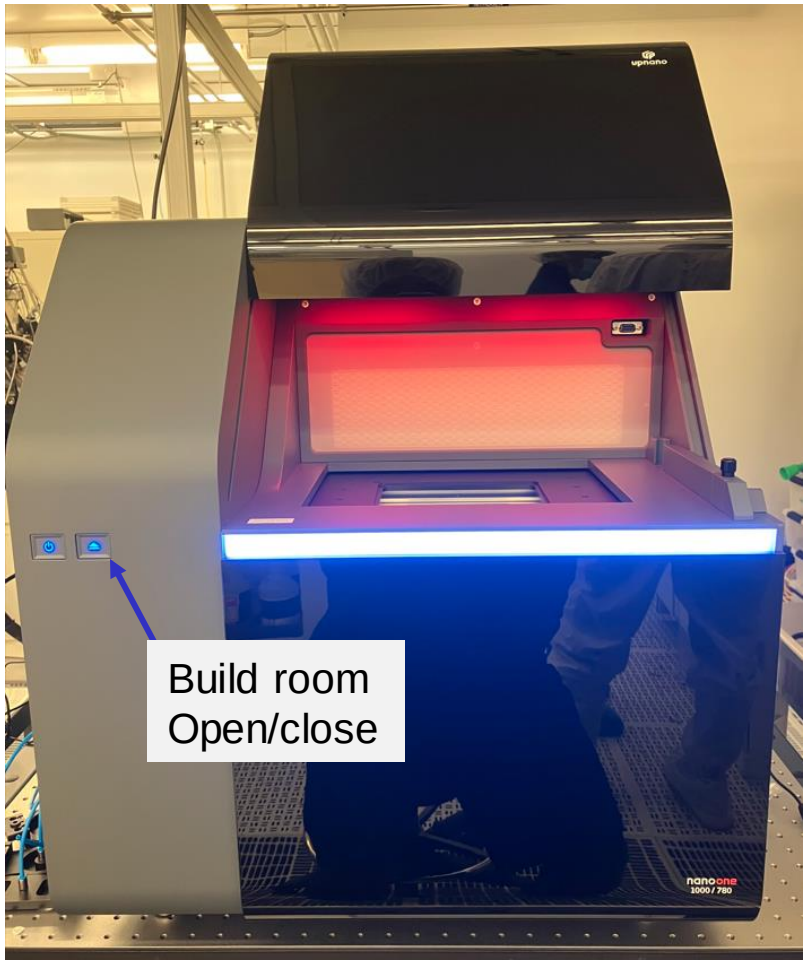




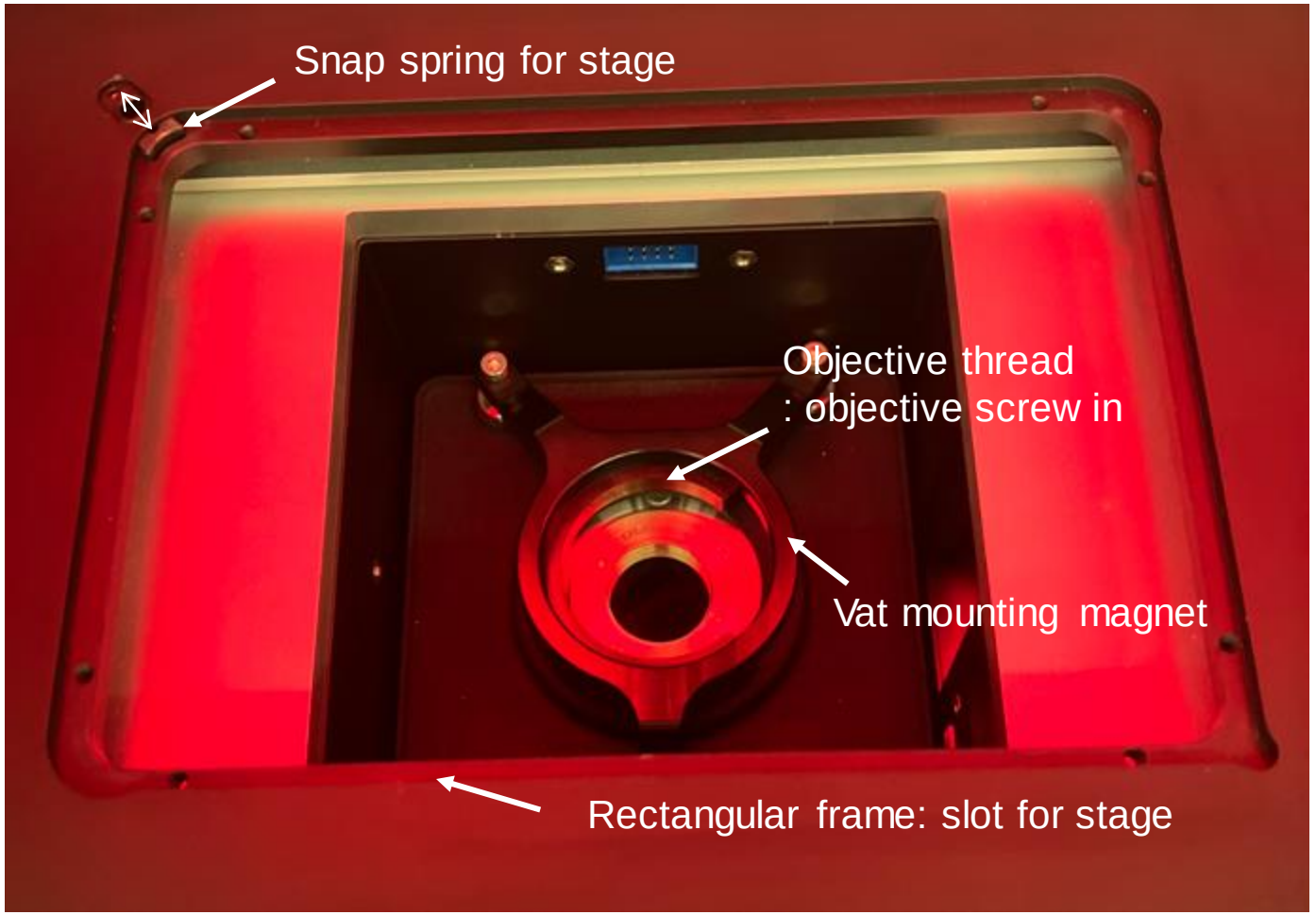
Printing with fluorescent resins

1. Open the build room

Printer: build room opened



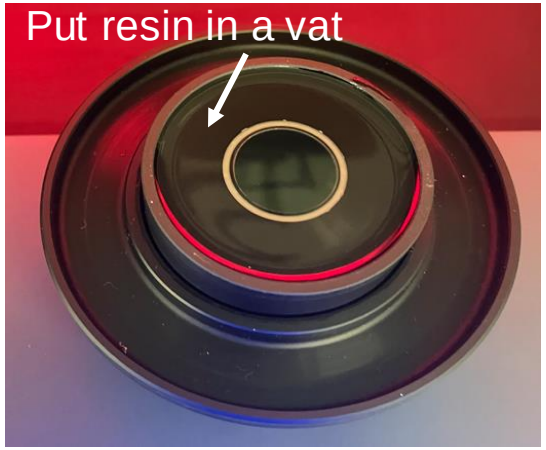
Build room



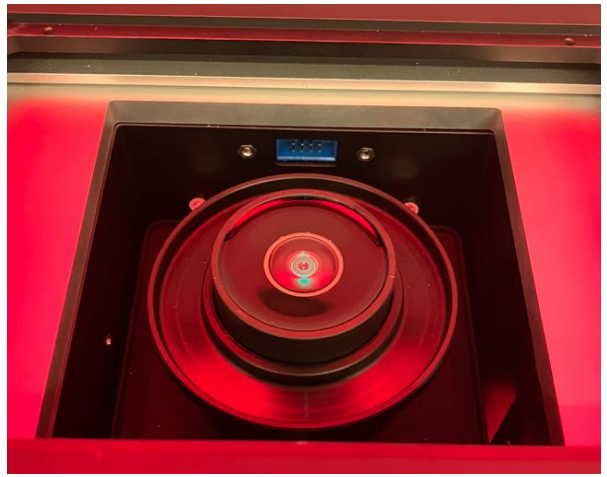
continued

2. Screw in an objective

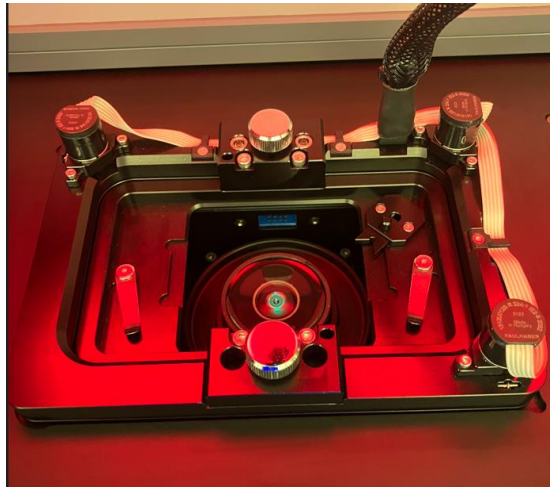
3. Select a vat & put resin

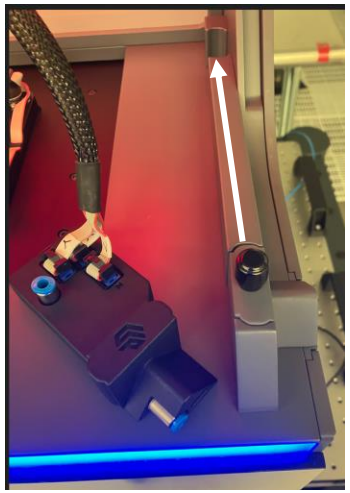


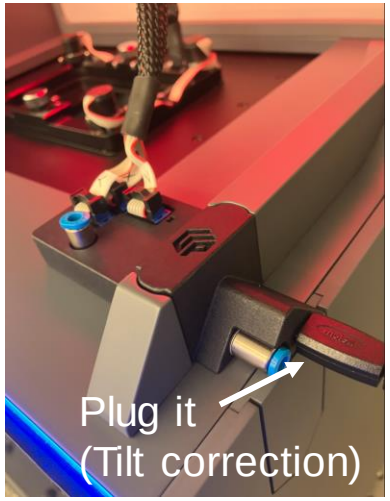
4. Place the vat



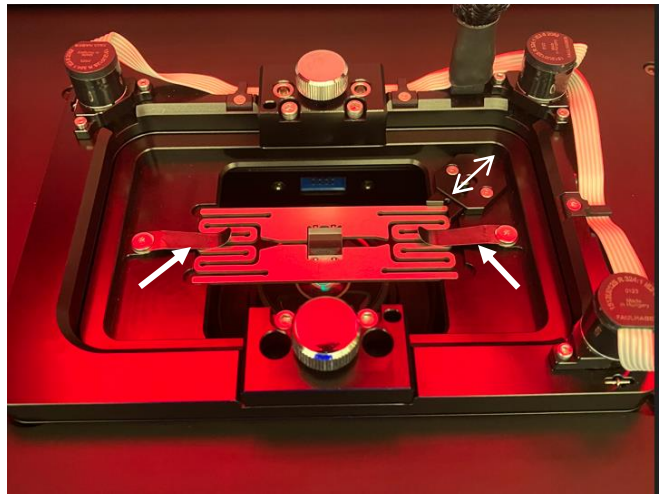
5. Place a stage on the frame





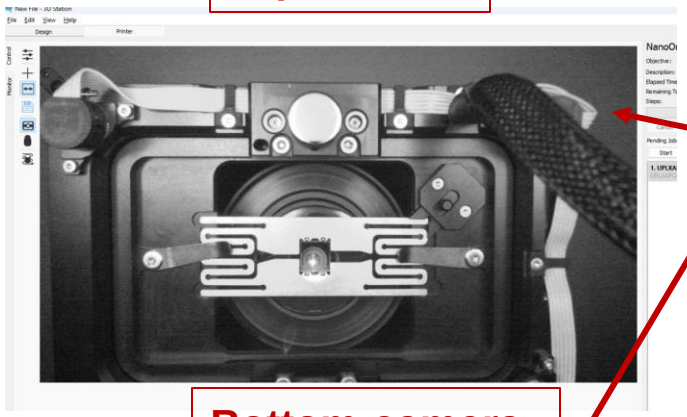


6. Place and secure substrate holder



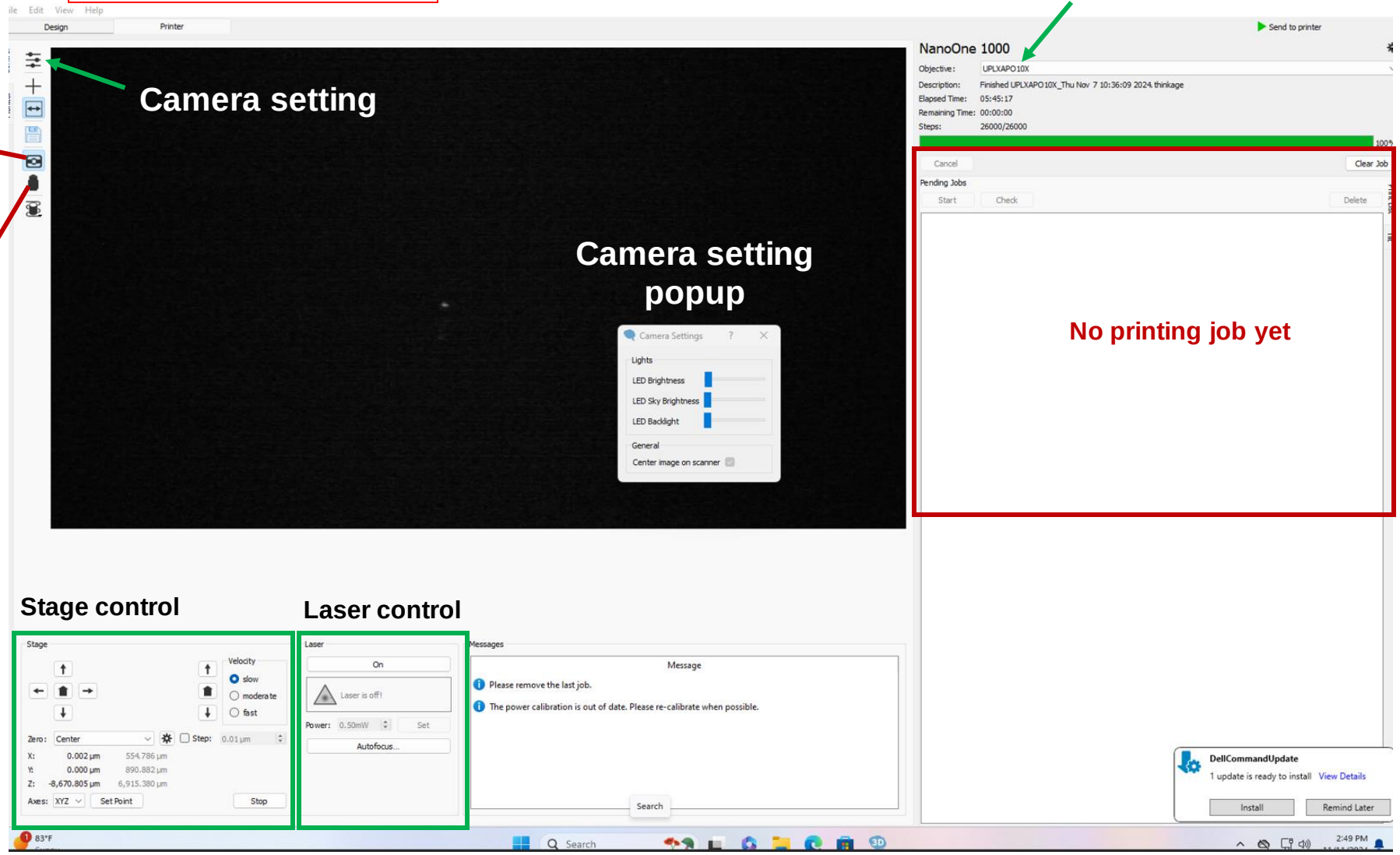
continued

Top camera

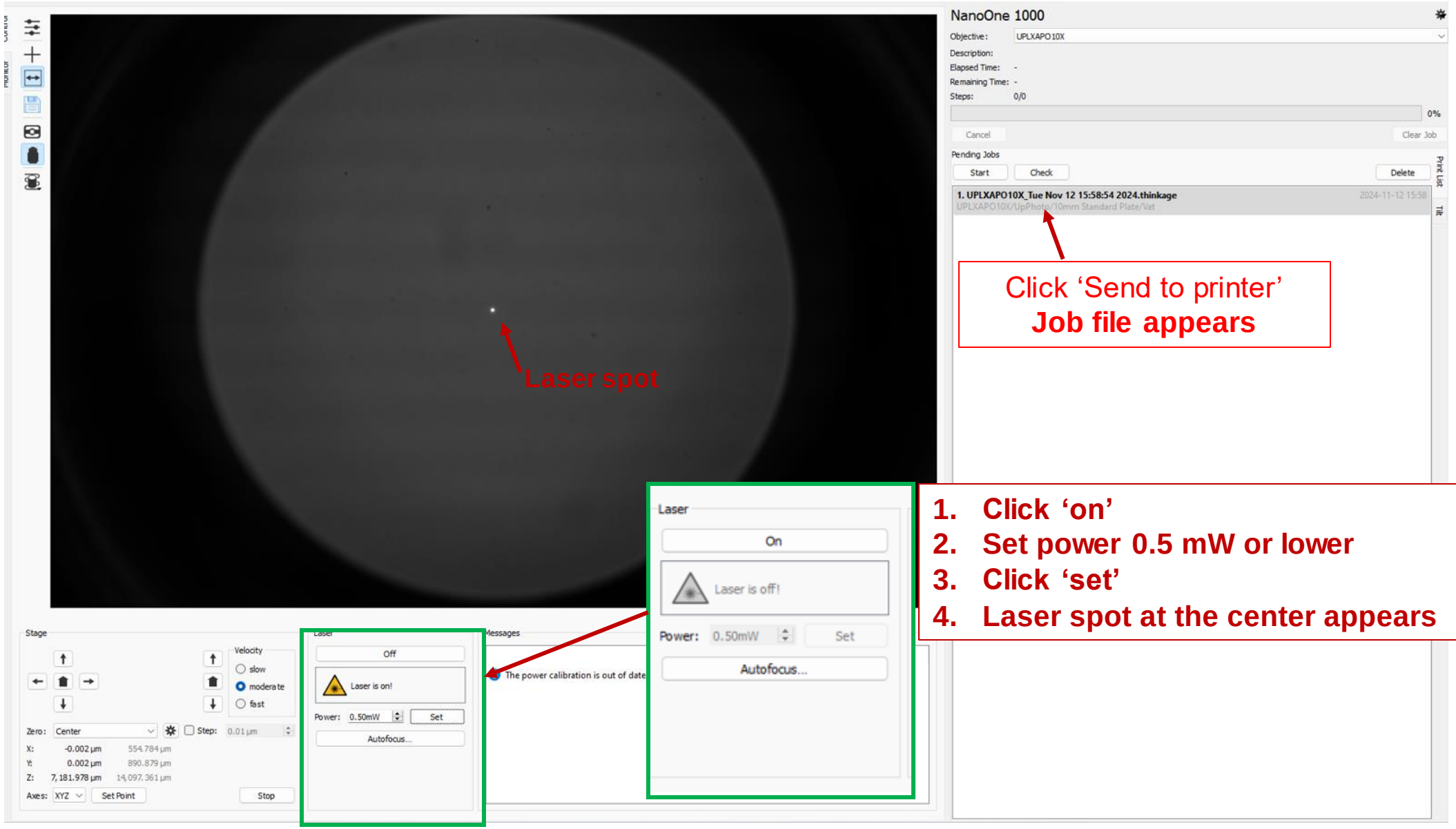


Bottom camera

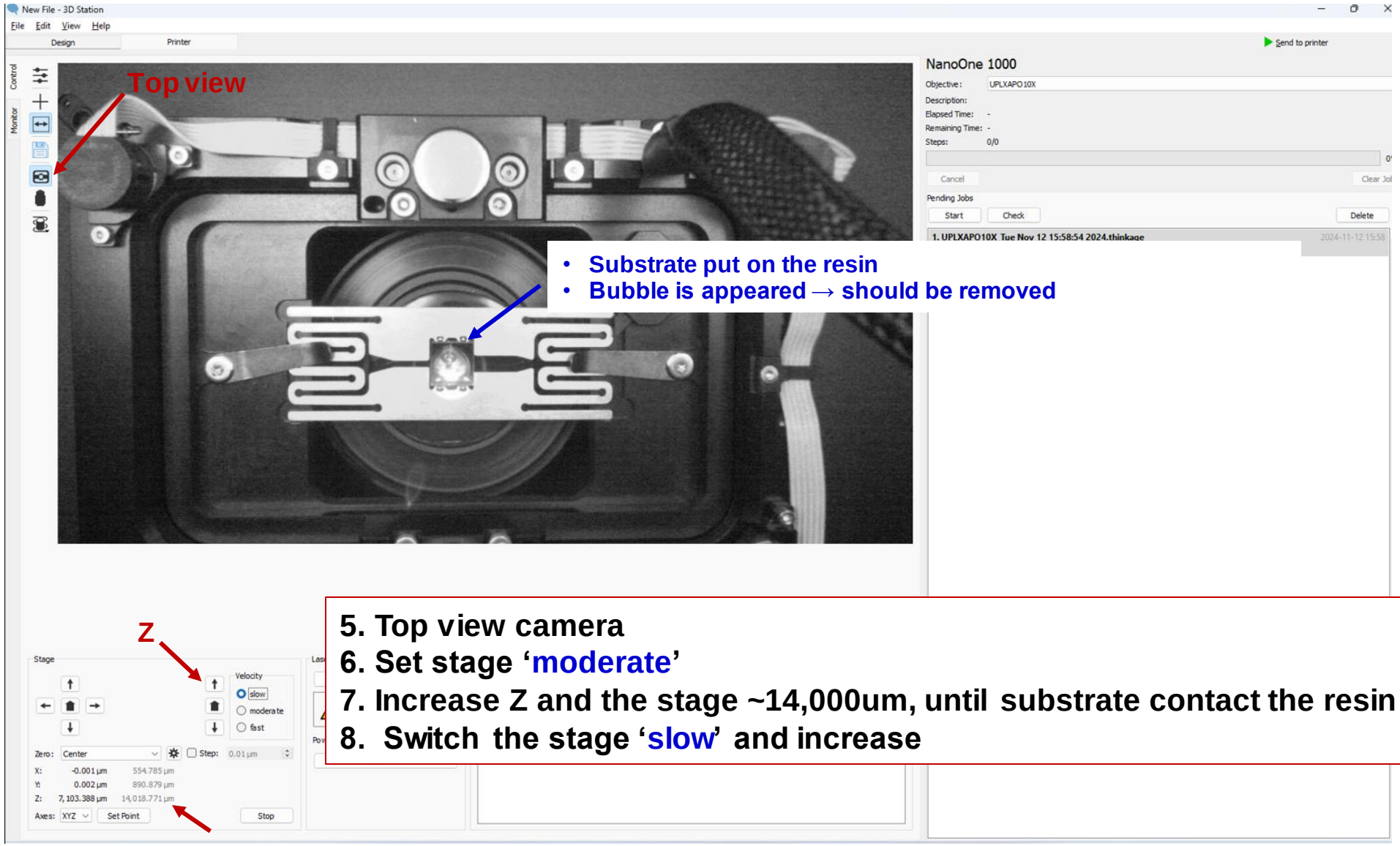
'Printer' tap screen



continued


Laser spot
NanoOne 1000
Objective: UPLXAPO10X
Description:
Elapsed Time: -
Remaining Time: -
Steps: 0/0
0%
Cancel
Clear Job
Pending Jobs
Start
Check
Delete
1. UPLXAPO10X_Tue Nov 12 15:58:54 2024.thinkage
2024-11-12 15:58
Print List
Tile
Click 'Send to printer'
Job file appears
Stage
Velocity
slow
moderate
fast
Zero: Center
Step: 0.01 µm
X: -0.002 µm 554.784 µm
Y: 0.002 µm 890.879 µm
Z: 7,181.978 µm 14,097.361 µm
Axes: XYZ
Set Point
Stop
Laser
Off
Laser is on!
Power: 0.50mW
Set
Autofocus...
Messages
The power calibration is out of date
Laser
On
Laser is off!
Power: 0.50mW
Set
Autofocus...
1. Click 'on'
2. Set power 0.5 mW or lower
3. Click 'set'
4. Laser spot at the center appears

continued

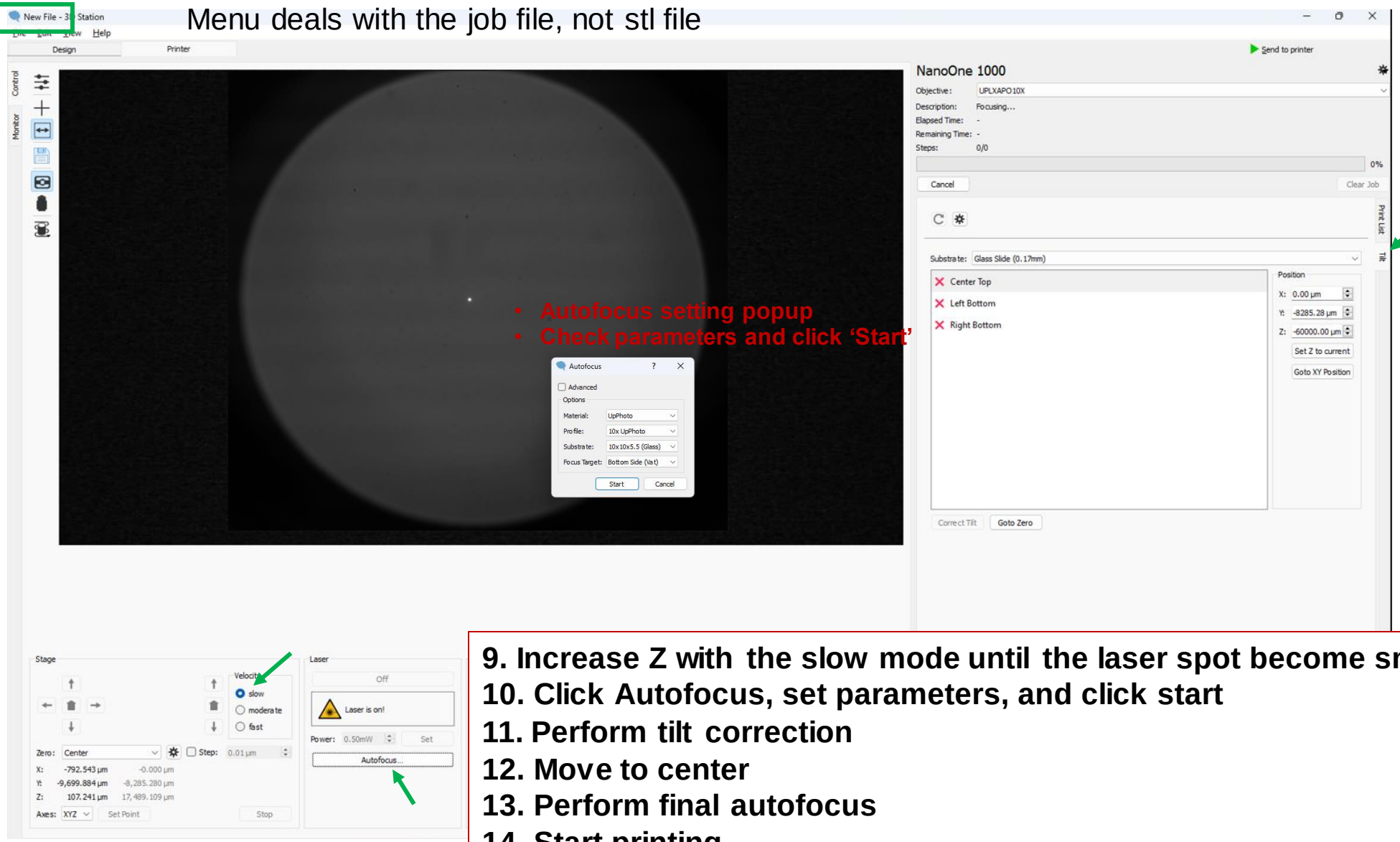


- Substrate put on the resin
- Bubble is appeared → should be removed

5. Top view camera
6. Set stage '**moderate**'
7. Increase Z and the stage ~14,000um, until substrate contact the resin
8. Switch the stage '**slow**' and increase

continued

Menu deals with the job file, not stl file



- Autofocus setting popup
- Check parameters and click 'Start'

Tilt correction
Set substrate
Double 'Center Top'
Click 'Autofocus'
Click 'Set Z to current'
Repeat for the other points.

Repeat the other two

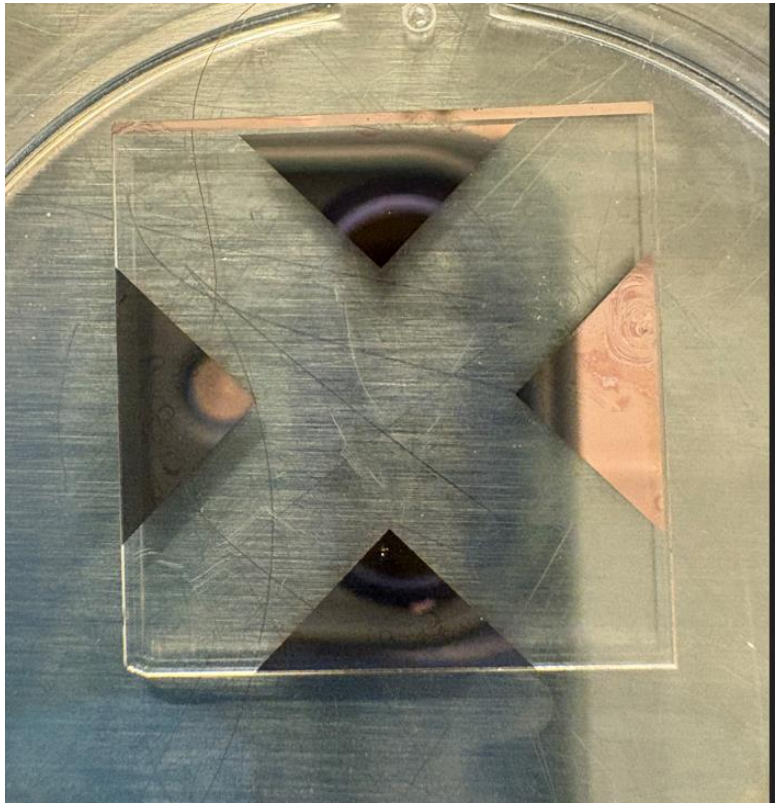
9. **Increase Z with the slow mode until the laser spot become smaller**
10. **Click Autofocus, set parameters, and click start**
11. **Perform tilt correction**
12. **Move to center**
13. **Perform final autofocus**
14. **Start printing**

Printing with NON-fluorescent resins

NON fluorescent resins → Autofocus NOT AVAILABLE → manual focus & tilt correction

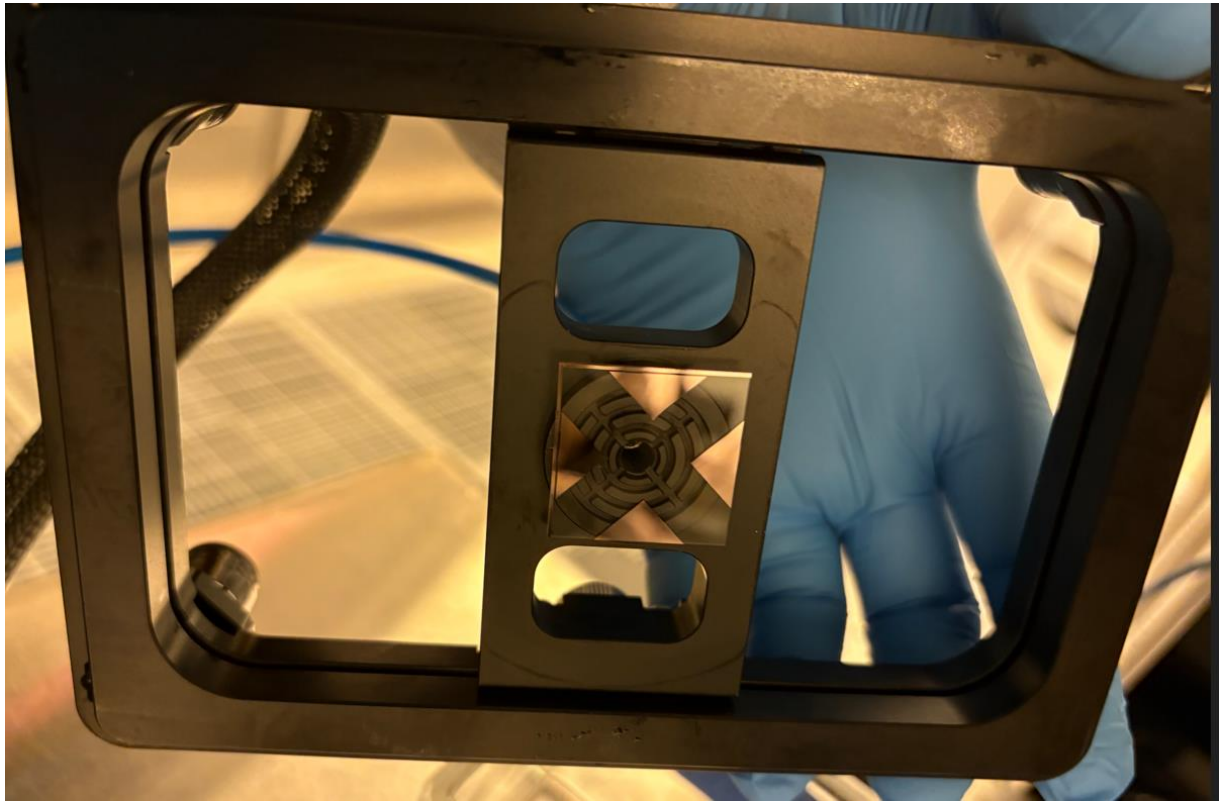
Start with pre-patterned substrate

Ex) 1” X 1” glass (500 μm thick)



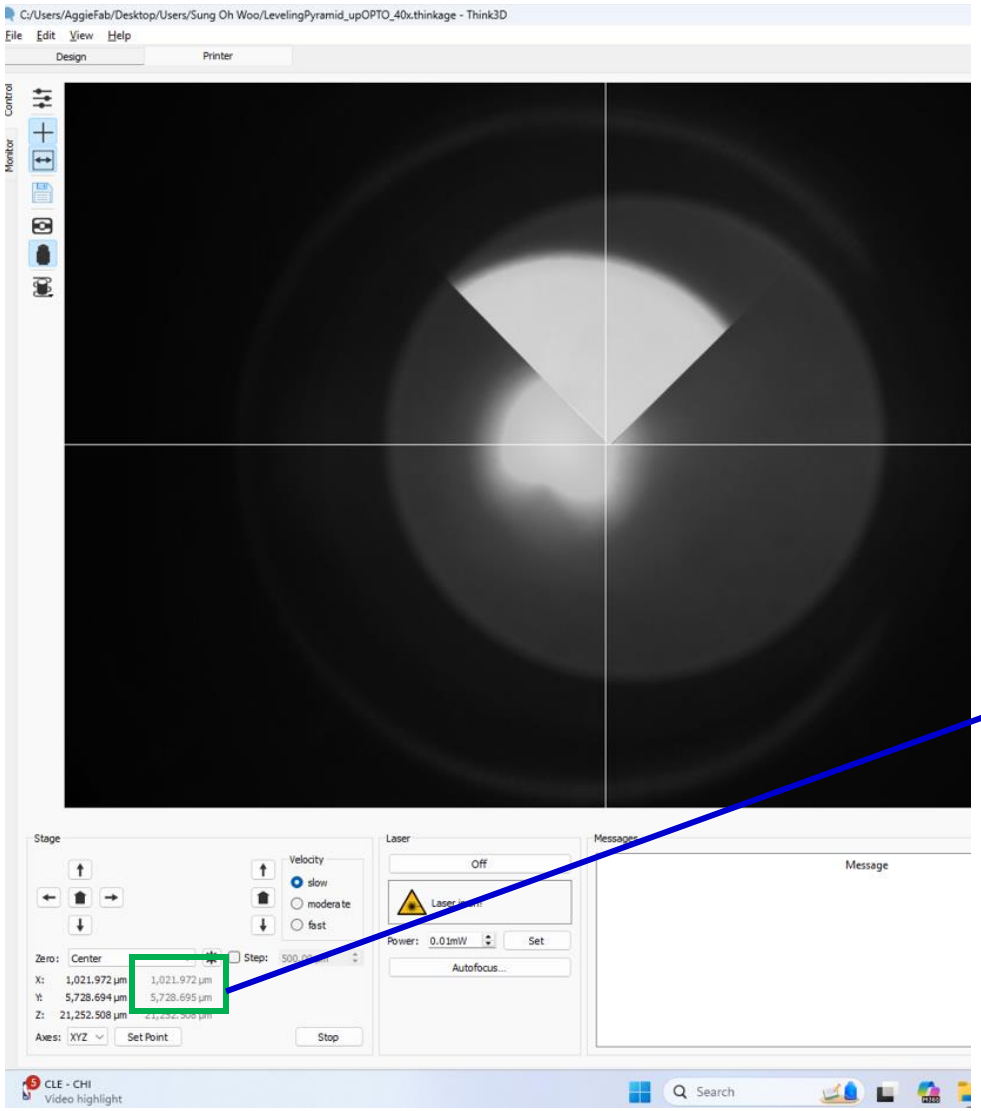
Mounting substrate on vacuum holder

Turn on vacuum pump & Place the substrate

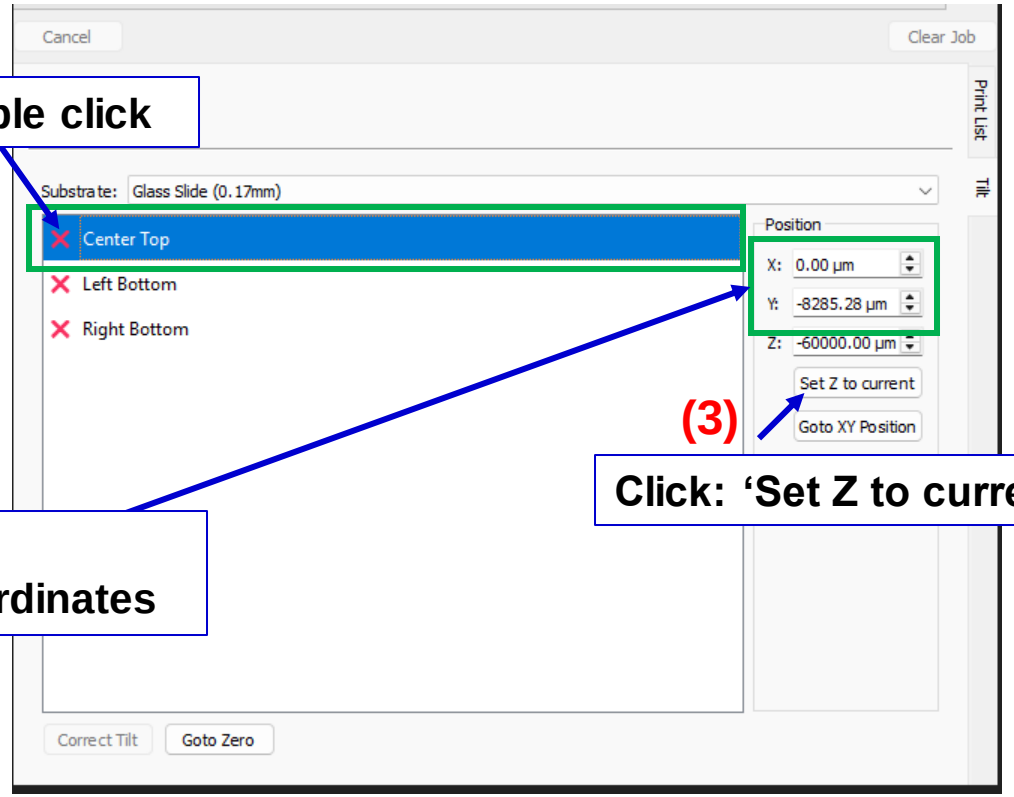


Printing with NON-fluorescent resins

Focus at the 1st point



Click 'Tilt tap' and select the 1st point
!!! NO double click



(2) Double click

(1) Type in X & Y coordinates

(3) Click: 'Set Z to current

(4) Repeat (1) – (3) for the other two point

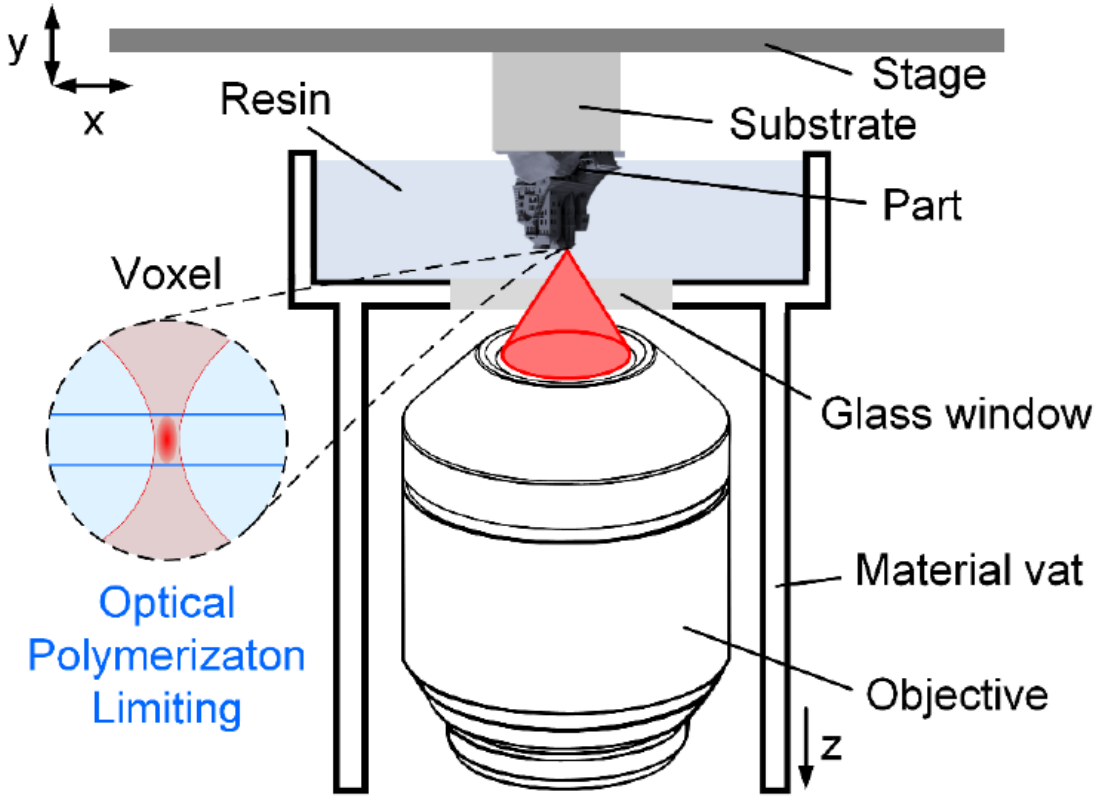
(5) Do final focus at any point

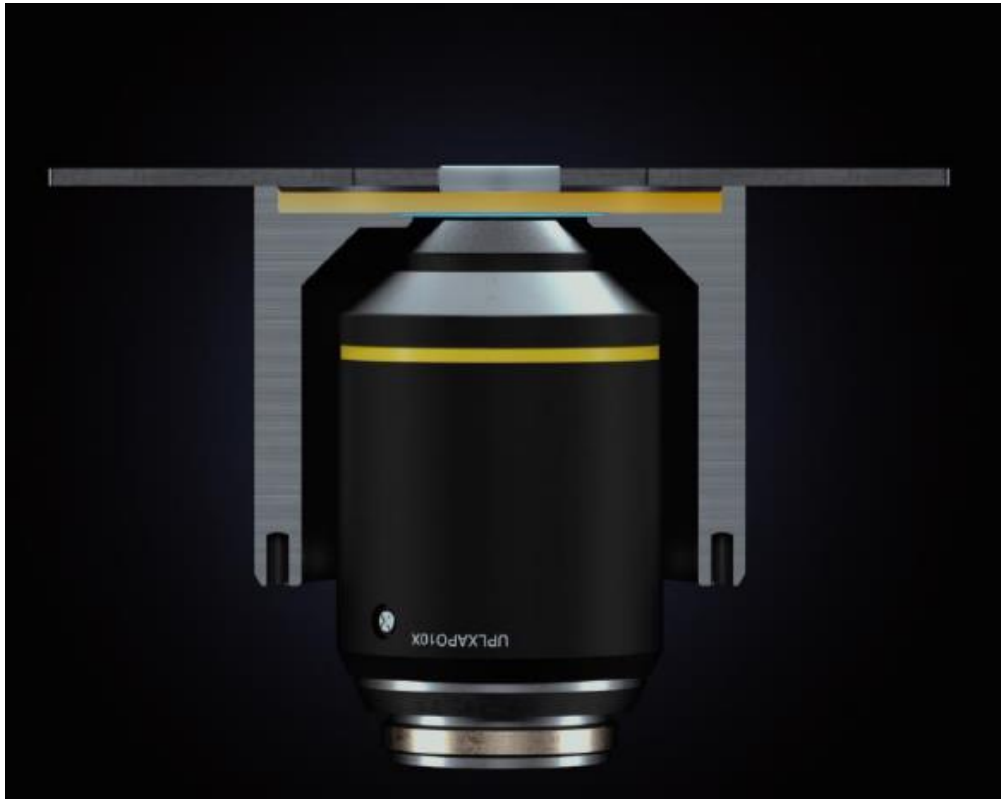
(6) Locate and start printing

Appendix

Vat mode

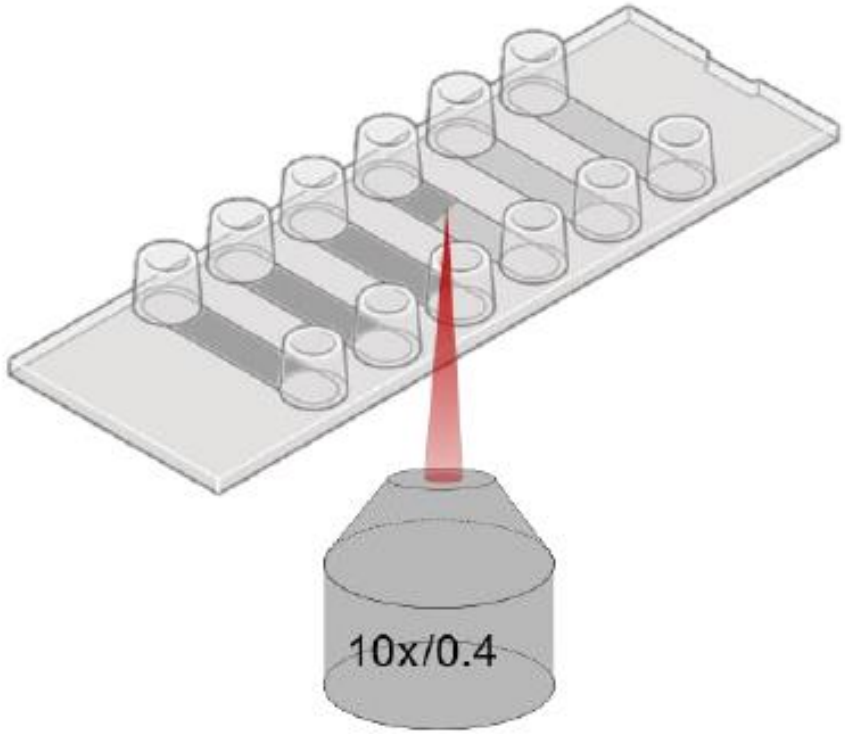
- Combination of various vats and substrates: objective media (oil, air, water) | substrate size
- Printing part height up to 42 mm

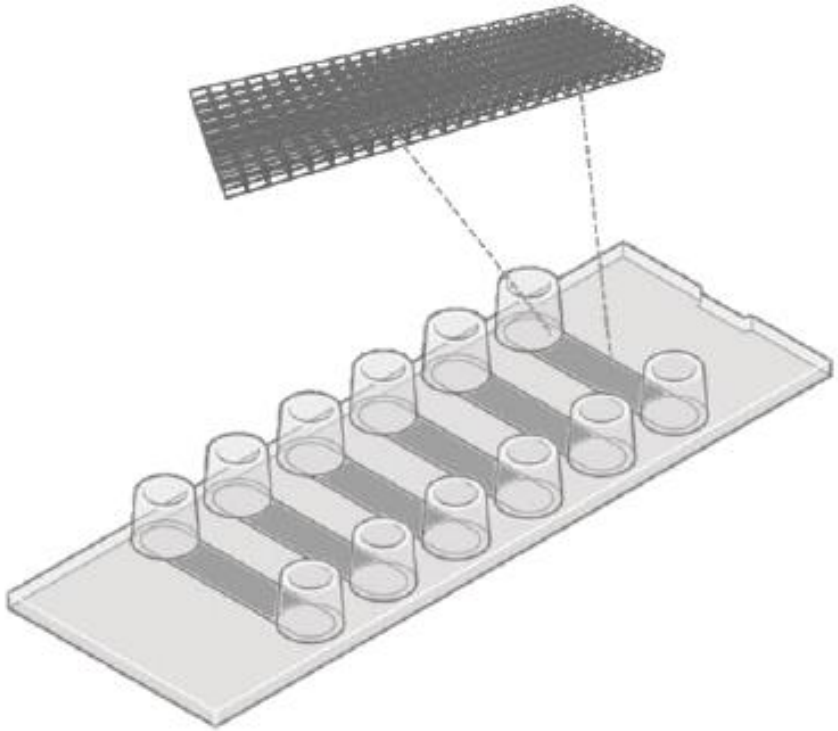




Bottom up mode

- Printing into sterile vessels, petri dishes, or any transparent substrates
- Printing from the bottom of the vessel upwards
  - Printed structure height limit because of the scattering of laser through the polymerized resin.





Printing resins

for any application

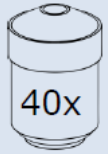
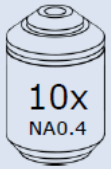
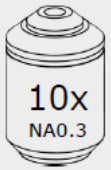
	updraft	upbrix	upsol	upthermo Powered by cubicure	upphoto	upopto	upblack	upflow
Common Objective	20x,10x	40x	40x,20x	10x,5x	20x,10x,5x	40x,20x,10x	10x	40x,20x,10x
Fabrication Speed	+++	++	++	++	++	+	++	++
Highly Transparent						++		+
Vat Mode	✓	✓		✓	✓	✓	✓	✓
High Aspect Ratio	✓	✓		✓	✓	✓	✓	✓
Low Viscosity		✓			✓			✓
Low Fluorescence						✓	✓	✓
Low Transmissive							✓	
Refractive Index Matched		✓						
2.5D Structures		✓	✓					
Sub-µm Printing		✓	✓					
Overhangs Smaller 90°			✓					
Bio Compatible*				✓	✓	✓	✓	✓
High Temperature Stability**				✓				

Objectives (1/3)

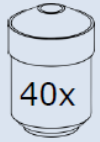
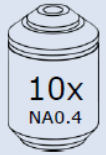
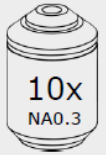
- 5 objectives available
- Select one of them based on the resolution and total size of the printing structure
- Estimation of printing time is available in the 'Think 3D'
  - Refer the excel file on the desktop, 'Print time estimation.xlsx'

Objective	ID	Media	NA	WD (mm)	FOV (mm)	BH (mm)	Max Bottom Up Height (mm)	XY speed (mm/s)	Volume speed (mm^3/s)
5X	Fluar	air	0.25	12.5	2.8	80	3	1200	300
10X	UPLFLN	air	0.3	10	1.4	60	2	600	60
10X	UPLXAPO	air	0.4	3.1	1.4	60	0.7	600	40
20X	UPLSAPO	DH2O	0.7	0.35	0.7	30	0.25	300	2.25
40X	UPLSAPO40XO	Immersol	1.4	0.13	0.35	10	0.15	150	0.25

Objectives (2/3)

		BOTTOM UP	VAT	VERTICAL	HORIZONTAL		
STANDARD OBJECTIVES	 40x	≤ **150** µm	PART HEIGHT UP TO **40** mm	> **0.8** µm	> **1.8** µm	**150** mm/s	**0.25** mm³/h
	 20x	≤ **250** µm		> **2.5** µm	> **5** µm	**300** mm/s	**2.25** mm³/h
	 10x NA0.4	≤ **700** µm		> **5** µm	> **20** µm	**600** mm/s	**40** mm³/h
	 10x NA0.3	≤ **2** mm		> **7** µm	> **50** µm	**600** mm/s	**60** mm³/h
	 5x	≤ **3** mm		> **12.5** µm	> **200** µm	**1,200** mm/s	**300** mm³/h

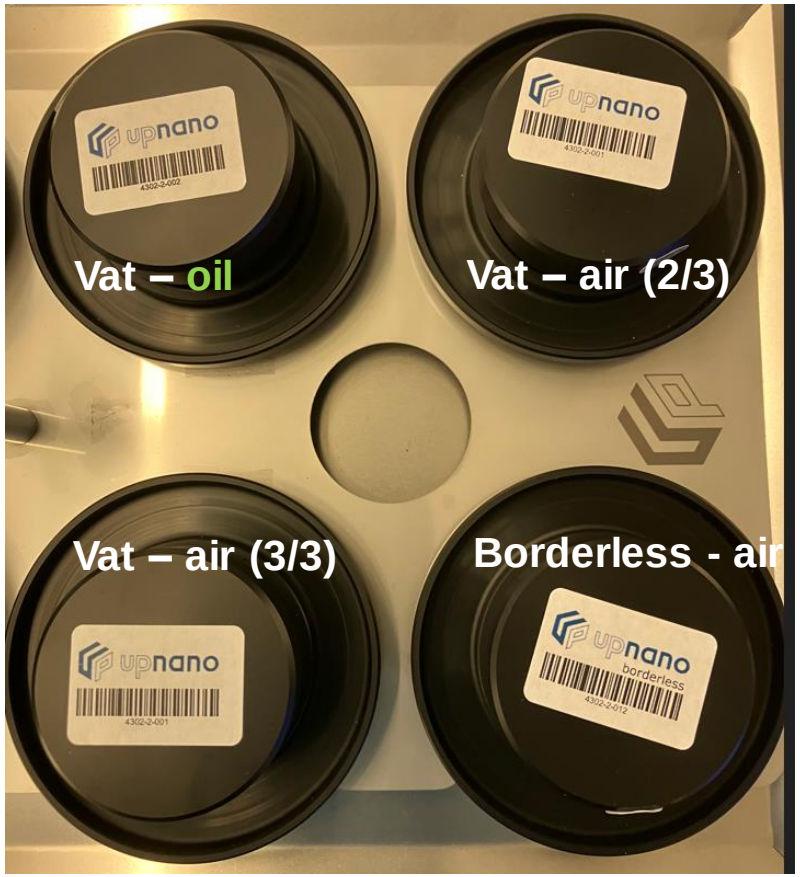
Objectives (3/3)

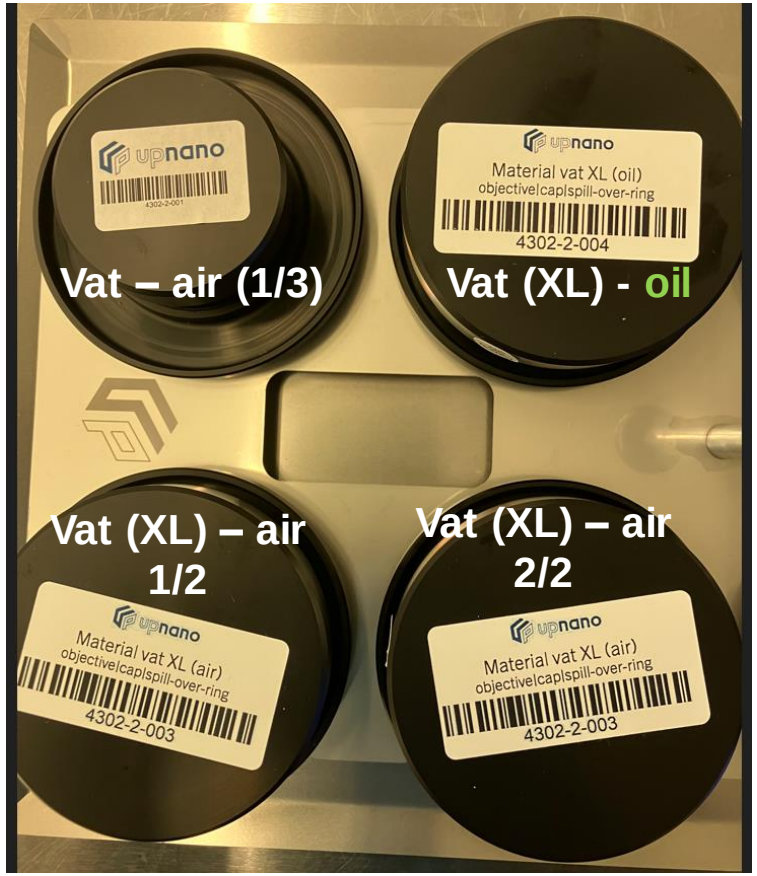
		NA	WD	FOV	BH	IM	FS (XY)	FS (Z)
STANDARD OBJECTIVES	 40x	1.4	0.13	0.35	10	oil	≤ 220 nm	≤ 550 nm
	 20x	0.7	0.35	0.7	30	water	≤ 420 nm	≤ 2.9 µm
	 10x NA0.4	0.4	3.1	1.4	60	air	≤ 730 nm	≤ 9.2 µm
	 10x NA0.3	0.3	10	1.4	60	air	≤ 980 nm	≤ 16.4 µm
	 5x	0.25	12.5	2.8	80	air	≤ 1.2 µm	≤ 23 µm

8.33 x 7.50 in – Numerical Aperture | WD – Working Distance *[mm]* | FOV – Field of View *[mm]* | BH – Block Height *[µm]* | IM – Immersion Media | FS – min. Feature Size

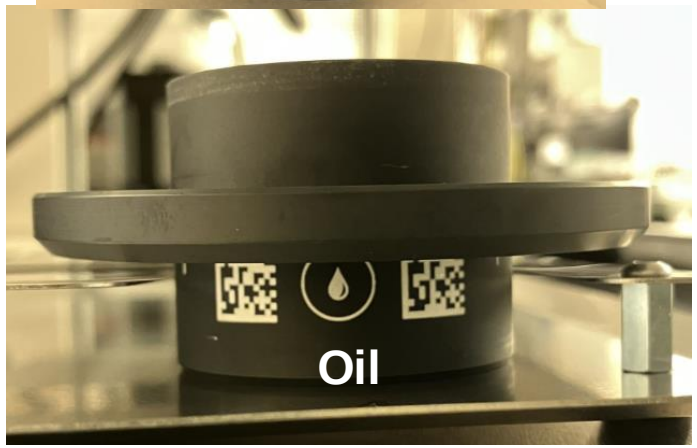
Vat: material tray

Vat (XXL) - air





Vat: material tray



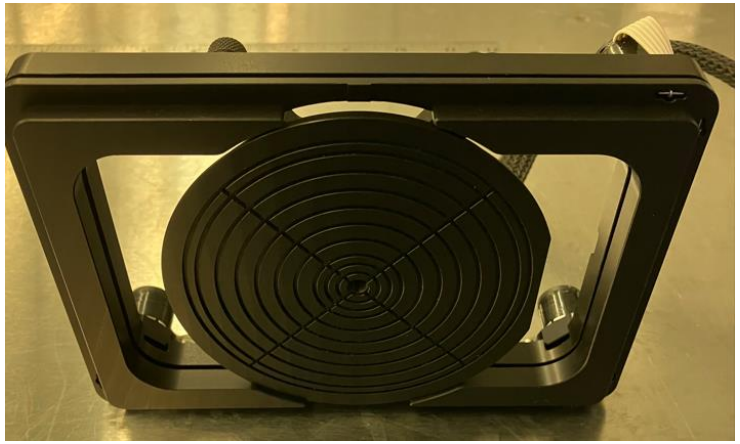
Store resin with label
In the tray

Stages and wafer holders:

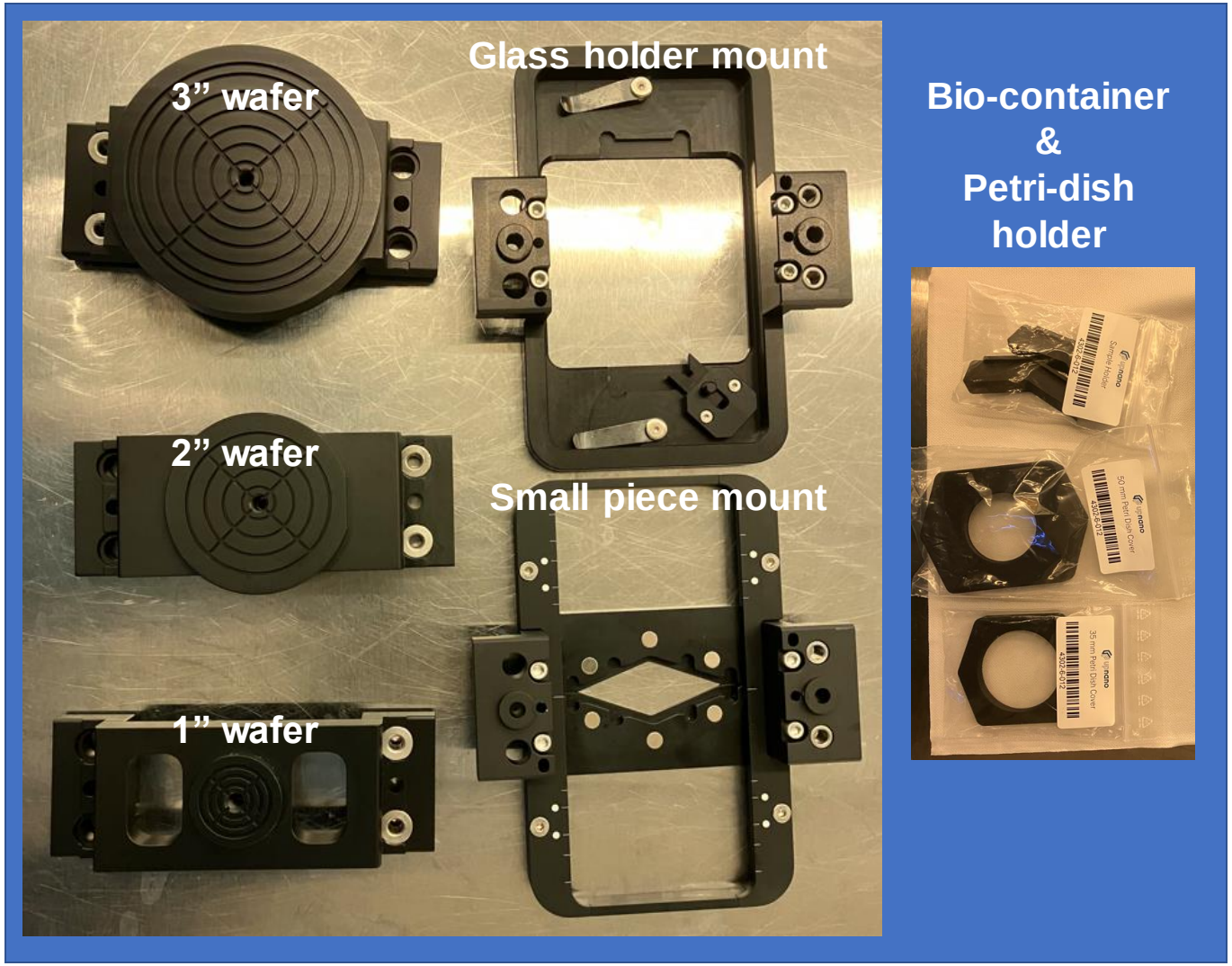
Tilt correction stage
– various sample substrate holders

mount

Tilt correction 4”stage



Various sample substrate holders



Glass substrate & holders

Glass substrates

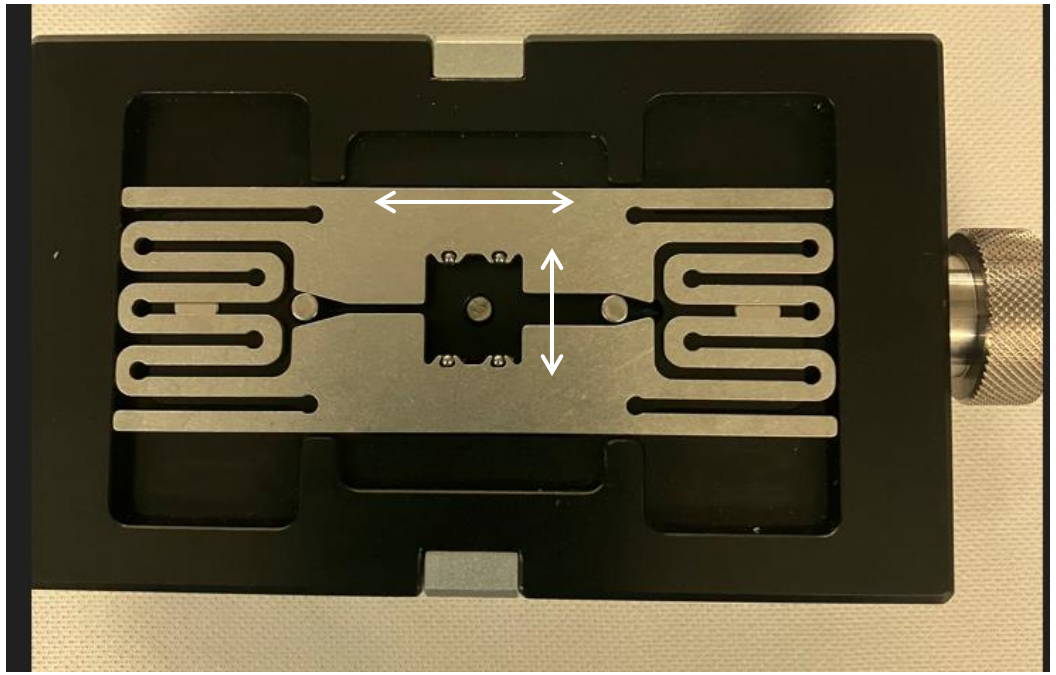
- Square: 10, 20, 40 mm^2
- Round: 1 inch in diameter

Glass substrate holder

Substrate holder manipulation

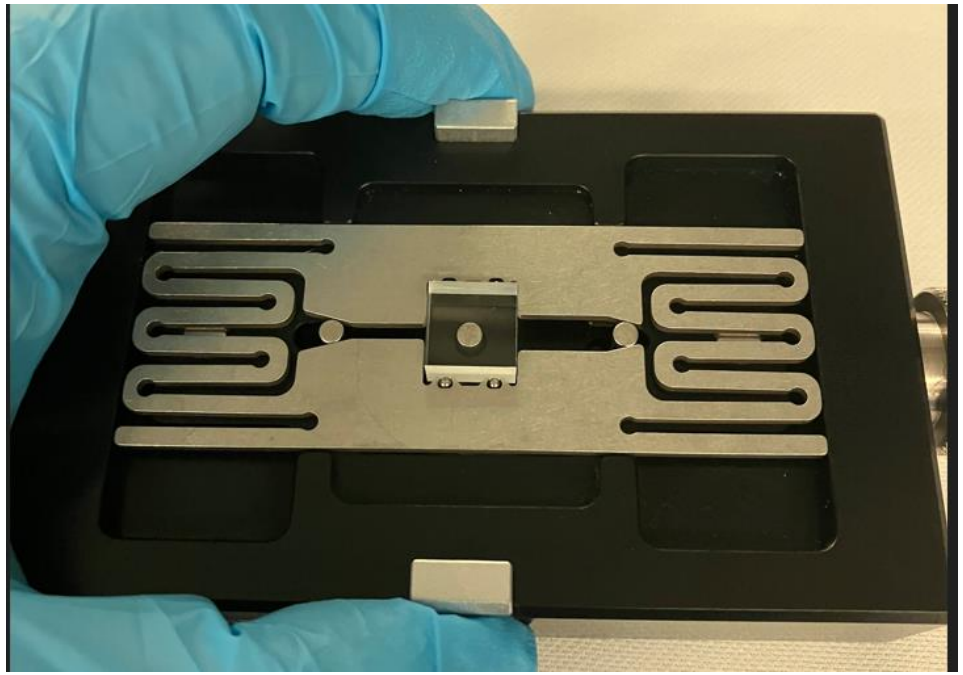
Holding sample

- Place the substrate holder
- Rotate the knob clockwise
- Sample holding square wider
- Place a glass substrate
- Bring back the holder using knob



Knob operation

- Move the stage holder along +X
- Lift up the metal pieces, popping up the glass substrate



Revision history

SIGNATURES AND REVISION HISTORY

1. Original author of this document: Dr. Sung Oh Woo
2. Original author Title or Role: Research Engineer
3. Date of original: 11/12/2024

Approvals:
Technical Manager Signature: GandraG Malhotra

Date: 3/7/25

Revision	Author	Date
Original Issue	Dr. Sung Oh Woo	11/12/2024
Printing technique with the Non-fluorescent resin added	Dr. Sung Oh Woo	03/05/2025