

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

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- SCOPE
 - The purpose of this document is to describe requirements and basic operating instructions for the UpNano Nano One 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.

General work flow

1. Design & Printing
 - 'Think 3D': a software for parameters setting and printing
2. Adhesion promotion (optional)
3. Selecting parts and materials
 - Resin: refer to the material brochure
 - Objective & Stage: resolution and printing volume
 - Vat: Objective type (air or oil) & printing volume
 - Stage inset & substrate holder: substrate type and size
4. Screw in the objective (build room)
5. Insert Vat and stage
6. Insert substrate
7. Print
8. Post process

Think 3D – set up parameters

When parameters are set, click 'Send to printer'

Menu deals with the job file, not stl file

Two taps

- Design: setting parameters
- Printer: focusing, tilt correction, position, and execute printing

Calculate volume (time estimation)

Insert stl file

Insert various elements

Bring an object to zero

Job Settings

Objective	UPLXAPO10X (10x/0.4 A)
Material	UpPhoto
Substrate	∅ 50.8mm/2"
Print Mode	Vat

Element Settings

Name: TACS3.stl
Filename: io/OneDrive - Texas A&M University/UpNano/Nanoscribe_vs_UpNano/TACS3

Position	Size	Rotation
X: 0.000 μm	X: 13000.000 μm	X: 0.00
Y: 0.000 μm	Y: 13000.000 μm	Y: 0.00
Z: 0.000 μm	Z: 1300.000 μm	Z: 0.00

Power Distribution: Profile

Hierarchy

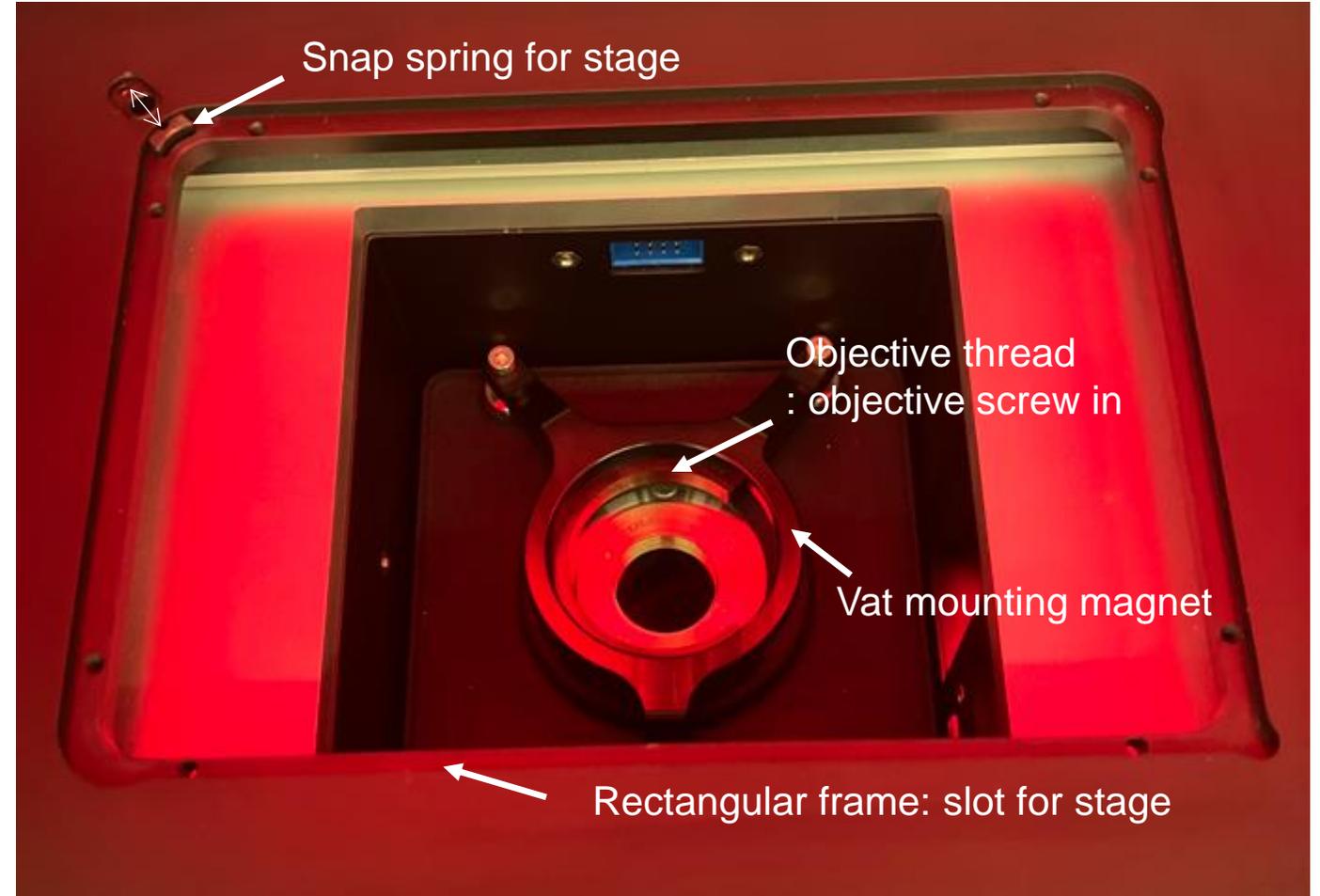
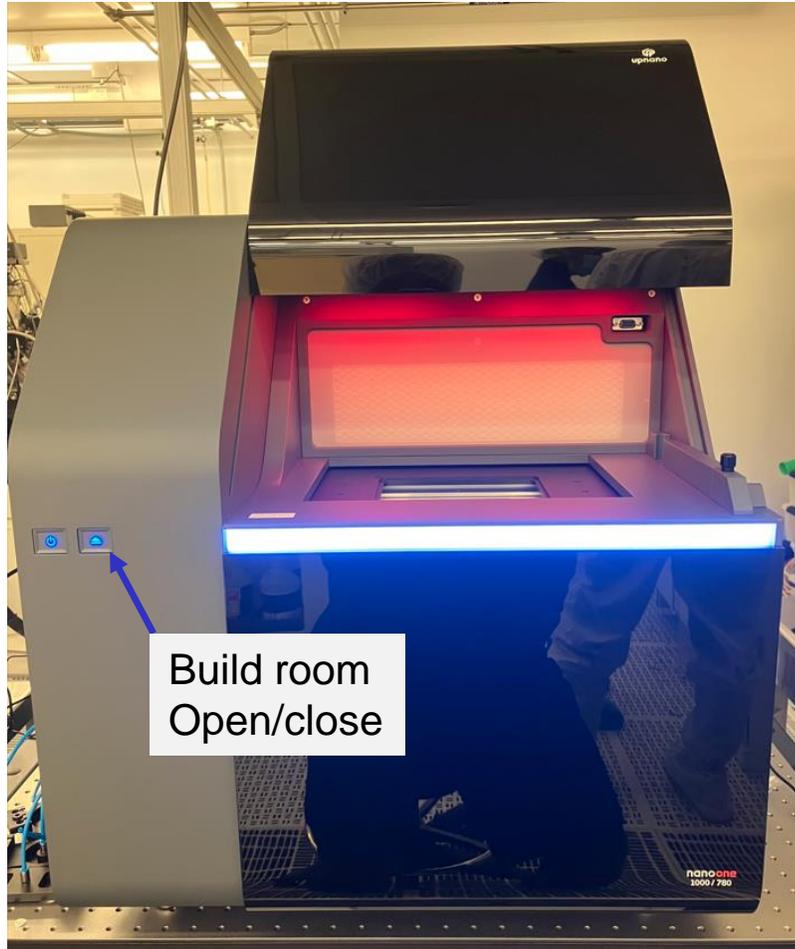
SubjobGroup 0 [Standard Course] (1)
Subjob 0
TACS3.stl [STL]

Set up printer

1. Open the build room

Printer: build room opened

Build room



Set up printer

2. Screw in an objective



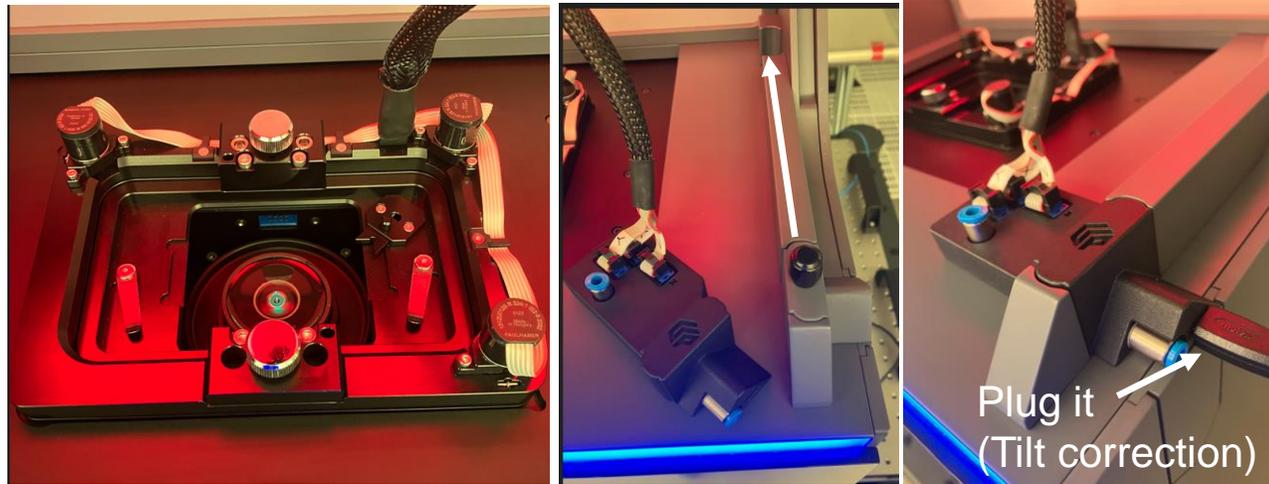
3. Select a vat & put resin



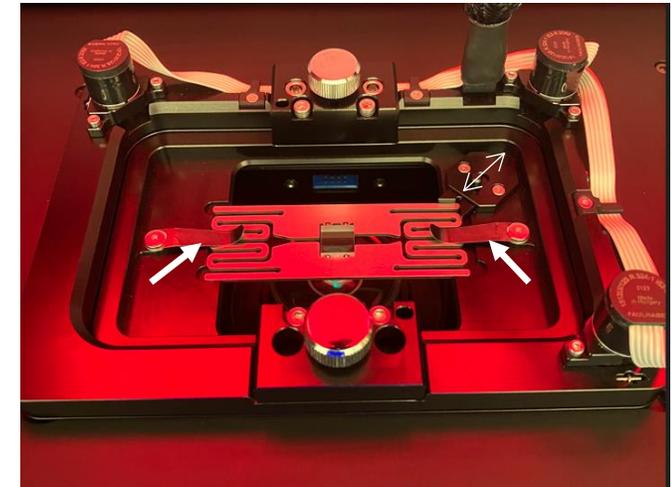
4. Place the vat



5. Place a stage on the frame



6. Place and secure substrate holder



Think 3D – set up printer

'Printer' tap screen

Top camera

Bottom camera

Camera setting

Camera setting popup

Objective setting

No printing job yet

Design Printer

NanoOne 1000

Objective: UPLXAPO 10X

Description: Finished UPLXAPO 10X_Thu Nov 7 10:36:09 2024, thinkage

Elapsed Time: 05:45:17

Remaining Time: 00:00:00

Steps: 26000/26000

Send to printer

Cancel Clear Job

Pending Jobs

Start Check Delete

No printing job yet

Camera Settings ? X

Lights

LED Brightness

LED Sky Brightness

LED Backlight

General

Center image on scanner

Stage control

Stage

Velocity

slow

moderate

fast

Zero: Center

X: 0.002 μm 554.786 μm

Y: 0.000 μm 890.882 μm

Z: -8,670.805 μm 6,915.380 μm

Axes: XYZ Set Point Stop

Laser control

Laser

On

Laser is off!

Power: 0.50mW Set

Autofocus...

Messages

Message

Please remove the last job.

The power calibration is out of date. Please re-calibrate when possible.

Search

DellCommandUpdate

1 update is ready to install View Details

Install Remind Later

83°F

Search

2:49 PM

Think 3D – set up printer: focusing on the substrate

Laser spot

Click 'Send to printer' Job file appears

1. Click 'on'
2. Set power 0.5 mW
3. Click 'set'
4. Laser spot at the center appears

Think 3D – set up printer: focusing on the substrate

The screenshot shows the NanoOne 1000 software interface. The main window displays a top view of the substrate on the resin. A red arrow points to the 'Top view' camera icon in the 'Monitor' toolbar. A blue arrow points to a bubble on the substrate. A text box contains the following instructions:

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

At the bottom left, the 'Stage' control panel is visible. A red arrow points to the 'Z' axis control. The 'Velocity' section has 'slow' selected. The 'Z' position is set to 14,018.771 μm. A red arrow points to the 'Set Point' button.

- 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

Z ~ 14,000um

Think 3D – set up printer: focusing on the substrate

New File - 3 Station
File Edit View Help
Design Printer
Control Monitor
Send to printer

NanoOne 1000
Objective: UPLXAPO 10X
Description: Focusing...
Elapsed Time: -
Remaining Time: -
Steps: 0/0
0%

Cancel Clear Job
Print List Tilt

Substrate: Glass Slide (0.17mm)
Position
X: 0.00 μm
Y: -8285.28 μm
Z: -60000.00 μm
Set Z to current
Goto XY Position

Correct Tilt Goto Zero

Stage
Velocity
slow
moderate
fast
Zero: Center
Step: 0.01 μm
X: -792.543 μm -0.000 μm
Y: -9,699.884 μm -8,285.280 μm
Z: 107.241 μm 17,489.109 μm
Axes: XYZ Set Point Stop

Laser
Off
Laser is on!
Power: 0.50mW Set
Autofocus...

Menu deals with the job file, not stl file

Autofocus ? X
Advanced
Options
Material: UpPhoto
Profile: 10x UpPhoto
Substrate: 10x10x5.5 (Glass)
Focus Target: Bottom Side (via)
Start Cancel

Center Top
Left Bottom
Right Bottom

Autofocus setting popup
Check parameters and click 'Start'

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

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

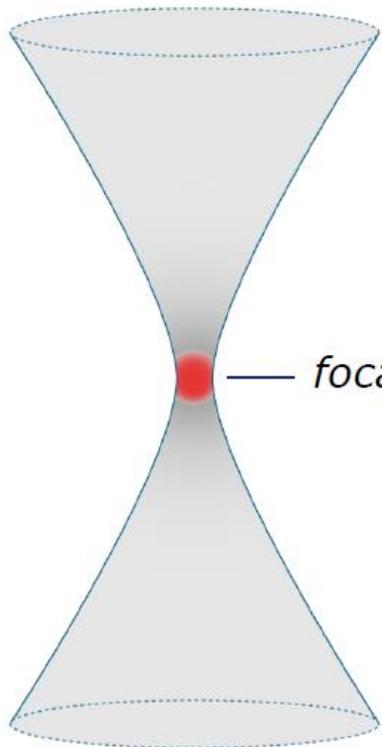
Appendix

1-Photon vs 2-Photon polymerization

2-PHOTON

non-linear

$$Abs \propto I_{laser}$$



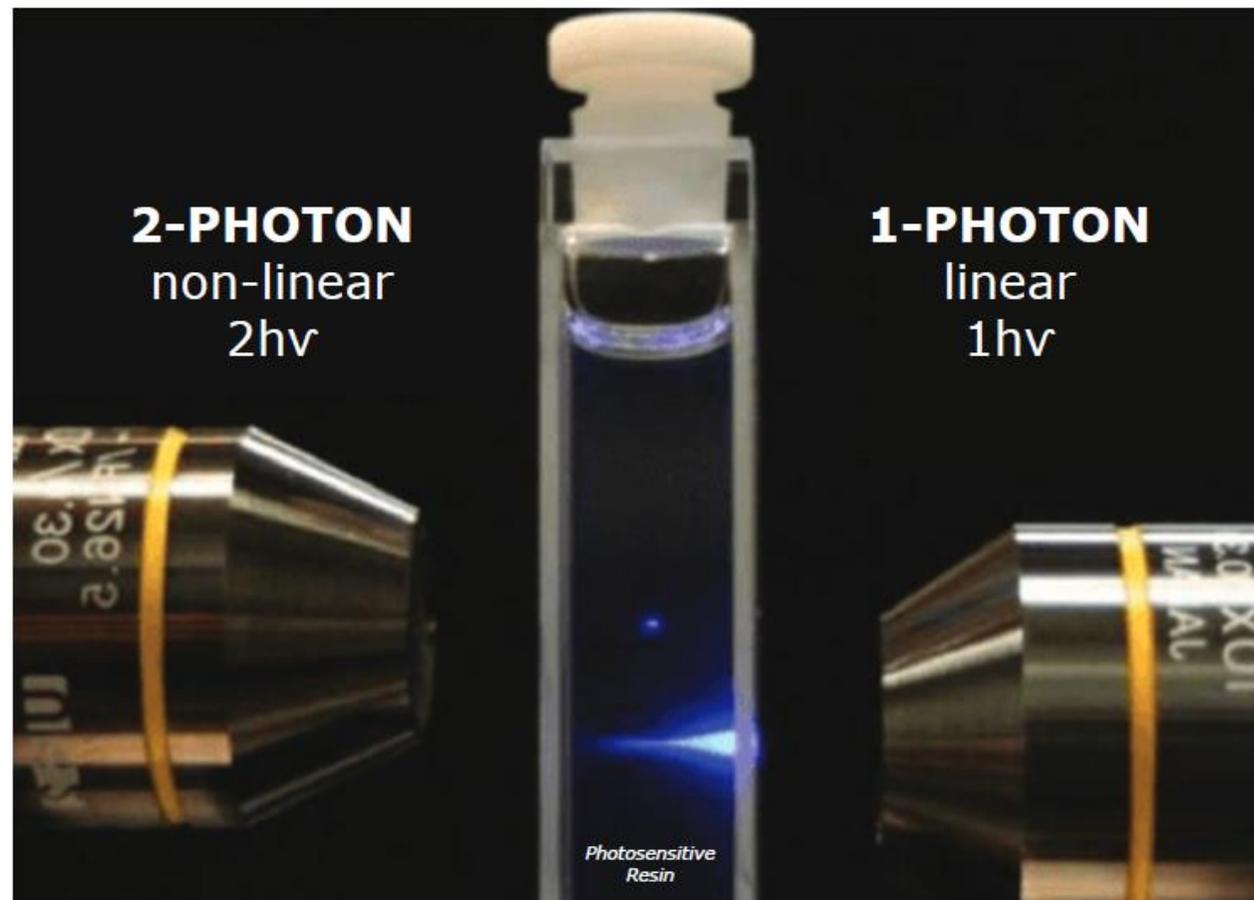
1-PHOTON

linear

$$Abs \propto I_{laser}^2$$

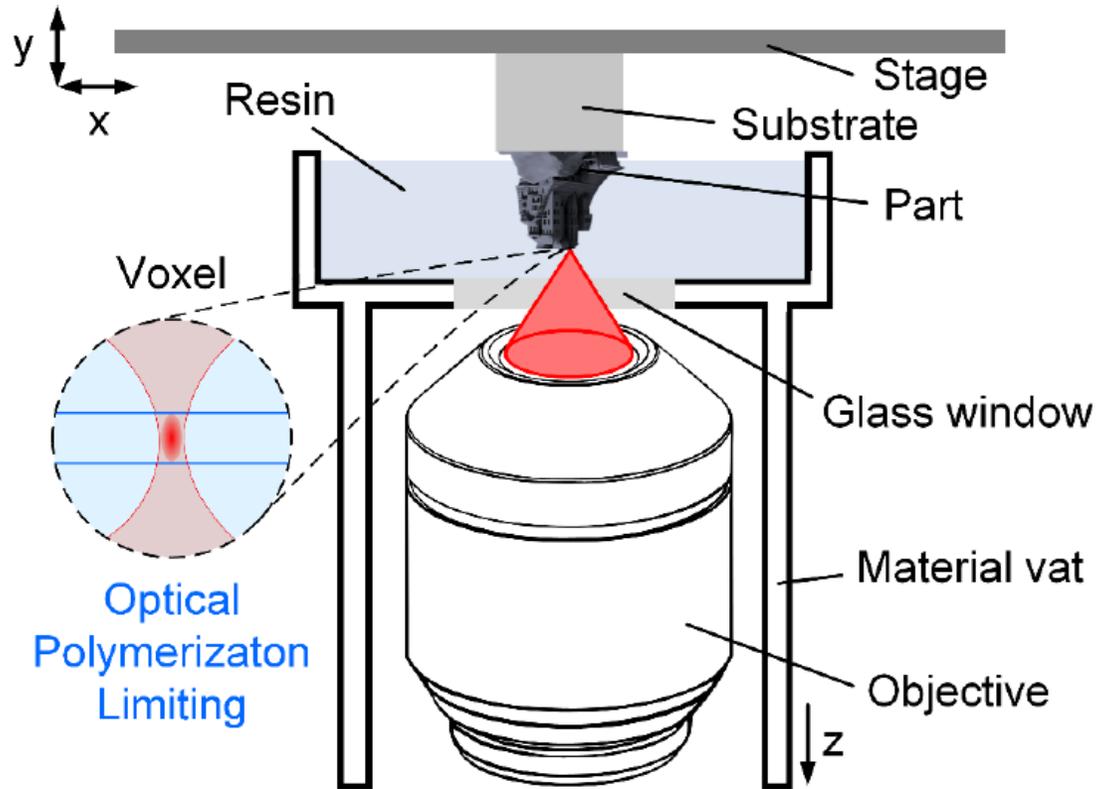


focal plane



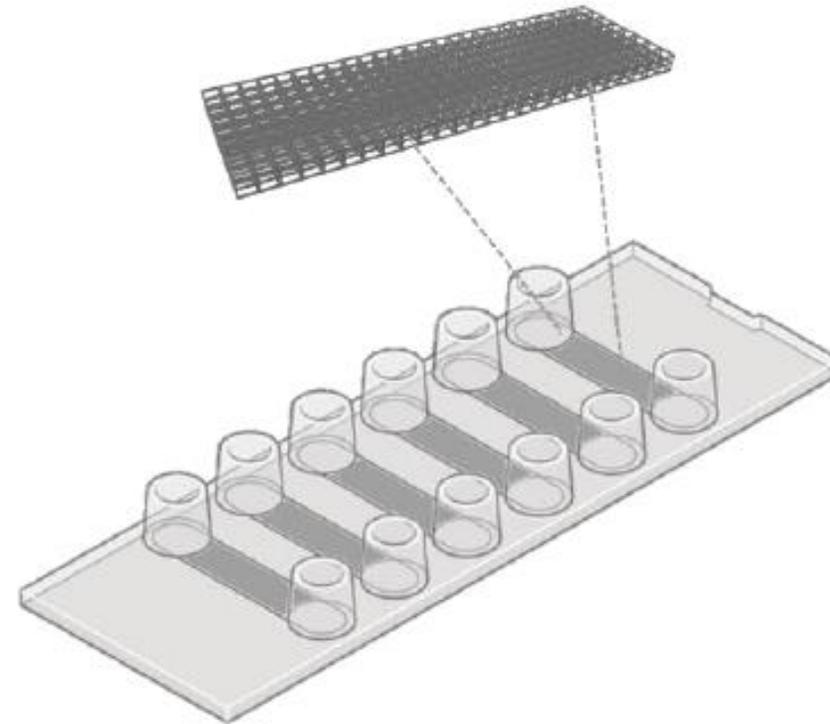
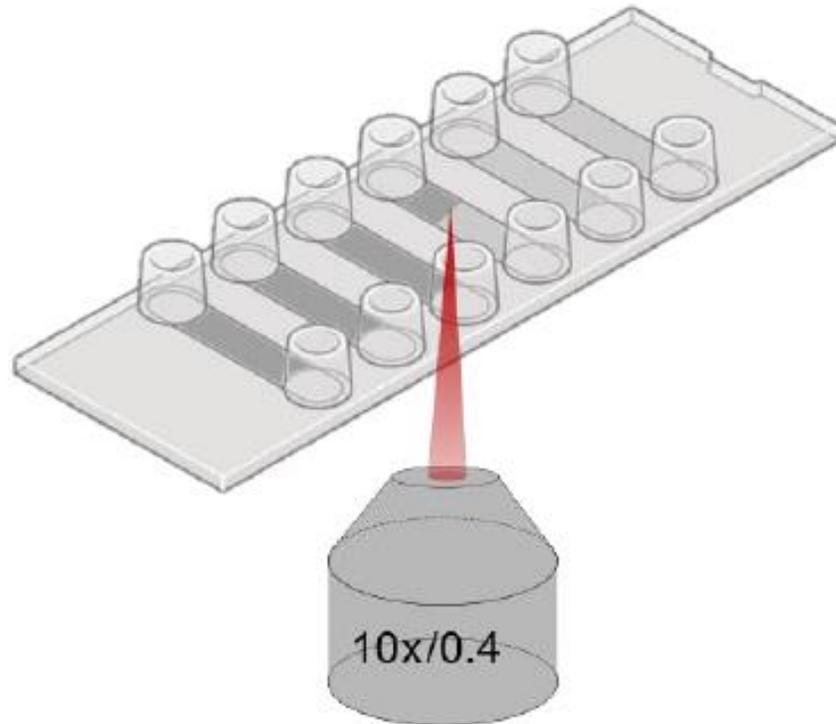
Vat mode

- 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.



Resins

➤ Refer the brochure on the desktop



Printing materials selection guide

Printing resins

for any application

	 updraft	 upbrix	 upsol	 upthermo <small>Powered by cubicure</small>	 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**				✓				



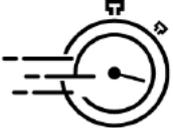
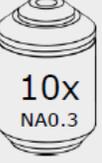
Objectives (1/3)

- 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'

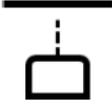


Objective	ID	Media	NA	WD (mm)	FOV (mm)	BH (mm)	Max Bottom Up Height (mm)	XY speed (mm/s)	Volume speed (mm ³ /s)
5X	Fluar	air	0.25	12.5	2.8	80	3	1200	300
10X	UPLFLN	air	0.3	3.1	1.4	60	2	600	60
10X	UPLXAPO	air	0.4	10	1.4	60	0.7	600	40
20X	UPLSAPO	water	0.7	0.35	0.7	30	0.25	300	2.25
40X	UPLSAPO40XO	oil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

Objectives (2/3)

		 BOTTOM UP	 VAT	 VERTICAL	 HORIZONTAL		
STANDARD OBJECTIVES	 40x	$\leq 150 \mu\text{m}$	PART HEIGHT UP TO 40 mm	$> 0.8 \mu\text{m}$	$> 1.8 \mu\text{m}$	150 mm/s	0.25 mm³/h
	 20x	$\leq 250 \mu\text{m}$		$> 2.5 \mu\text{m}$	$> 5 \mu\text{m}$	300 mm/s	2.25 mm³/h
	 10x NA0.4	$\leq 700 \mu\text{m}$		$> 5 \mu\text{m}$	$> 20 \mu\text{m}$	600 mm/s	40 mm³/h
	 10x NA0.3	$\leq 2 \text{ mm}$		$> 7 \mu\text{m}$	$> 50 \mu\text{m}$	600 mm/s	60 mm³/h
	 5x	$\leq 3 \text{ mm}$		$> 12.5 \mu\text{m}$	$> 200 \mu\text{m}$	1,200 mm/s	300 mm³/h

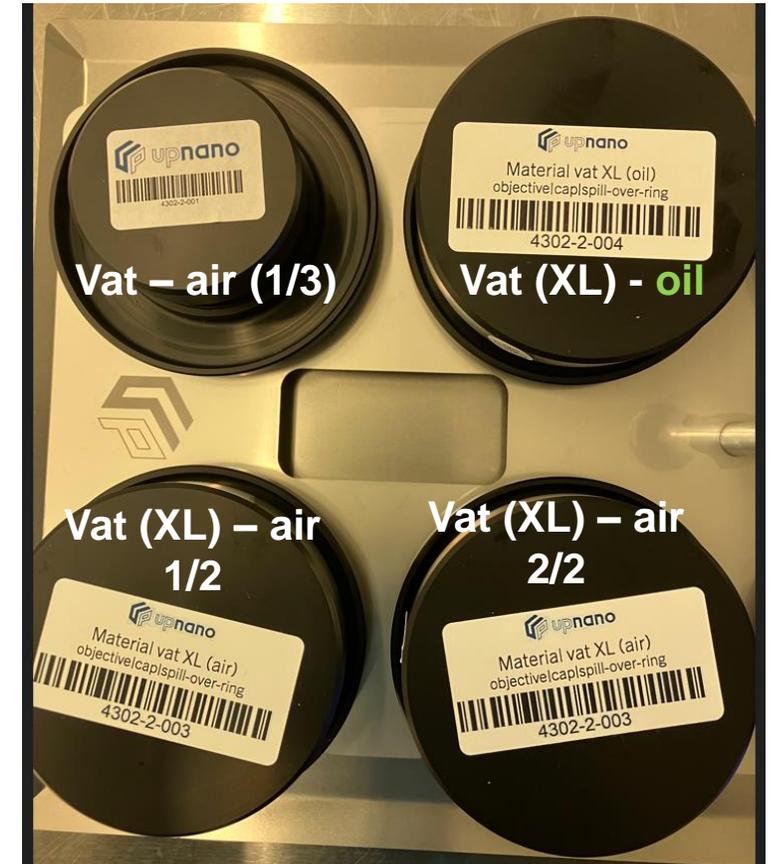
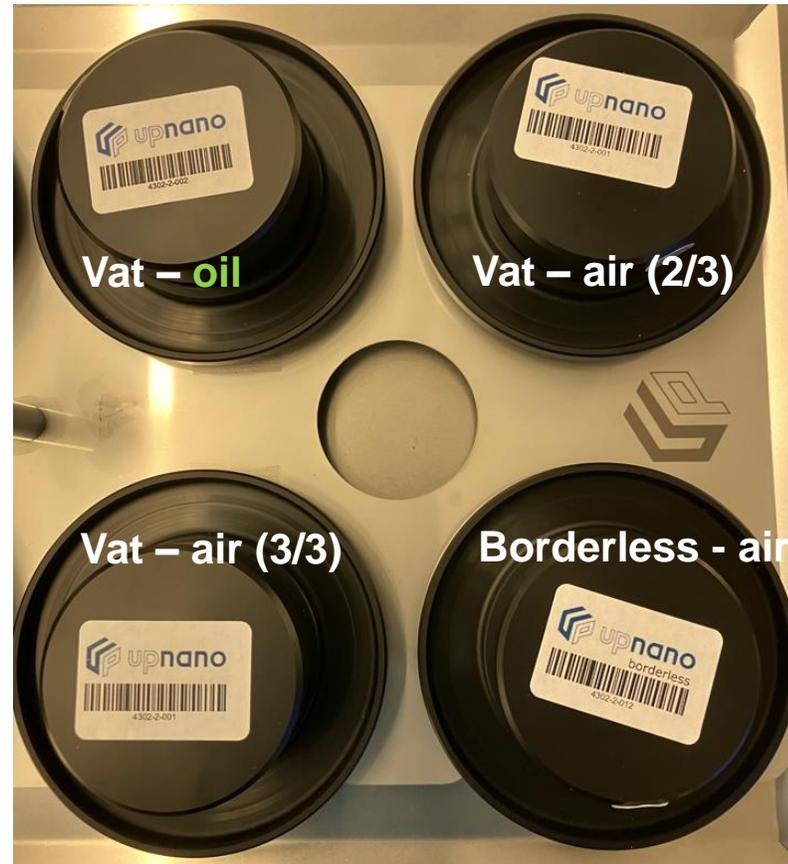
Objectives (3/3)

								
		NA	WD	FOV	BH	IM	FS	FS
STANDARD OBJECTIVES		1.4	0.13	0.35	10	oil	≤ 220 nm	≤ 550 nm
		0.7	0.35	0.7	30	water	≤ 420 nm	≤ 2.9 μm
		0.4	3.1	1.4	60	air	≤ 730 nm	≤ 9.2 μm
		0.3	10	1.4	60	air	≤ 980 nm	≤ 16.4 μm
		0.25	12.5	2.8	80	air	≤ 1.2 μm	≤ 23 μm

8.33 x 750 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

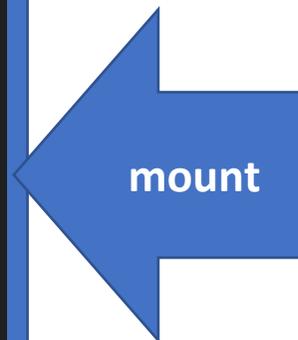


Store resin with label
In the tray



Stages and wafer holders:

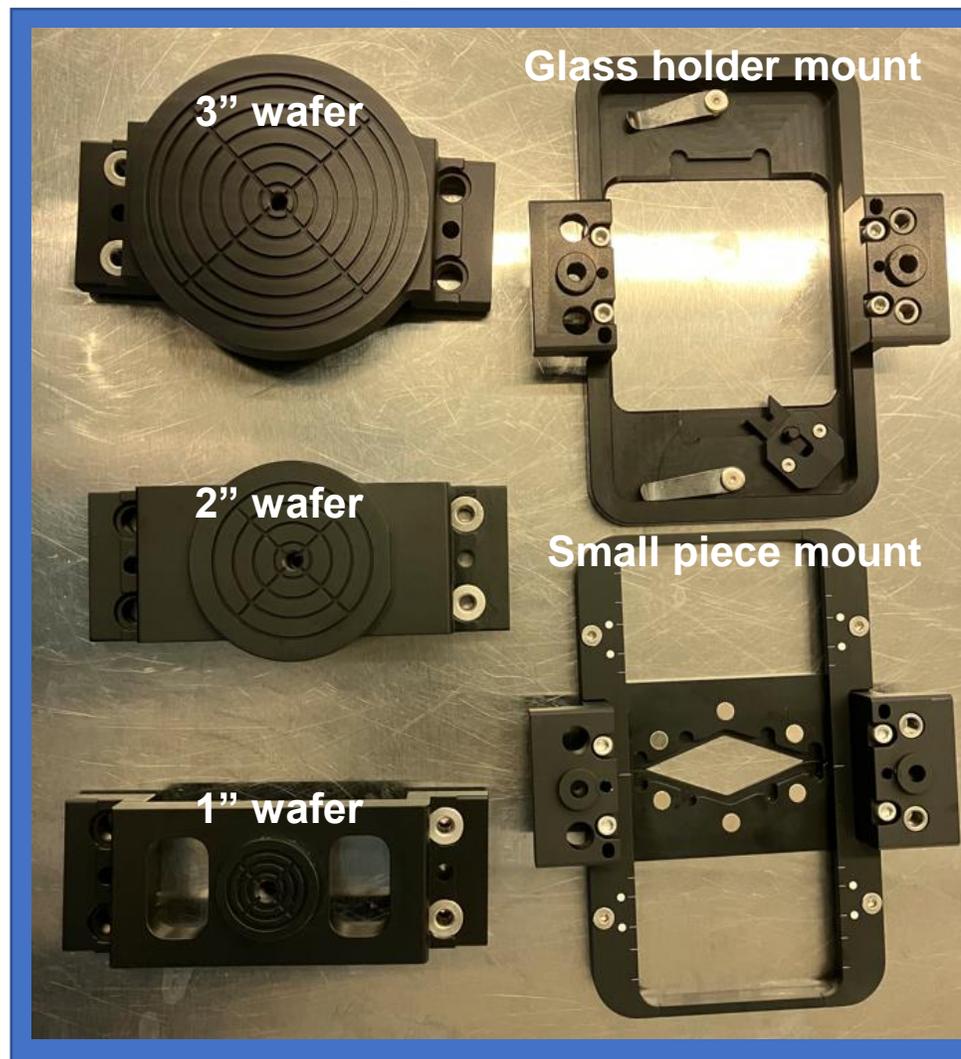
Tilt correction stage
– various sample substrate holders



Tilt correction 4" stage



Various sample substrate holders



Bio-container
&
Petri-dish
holder



Glass substrate & holders

Glass substrates

- Square: 10, 20, 40 mm²
- Round: 1 inch in diameter



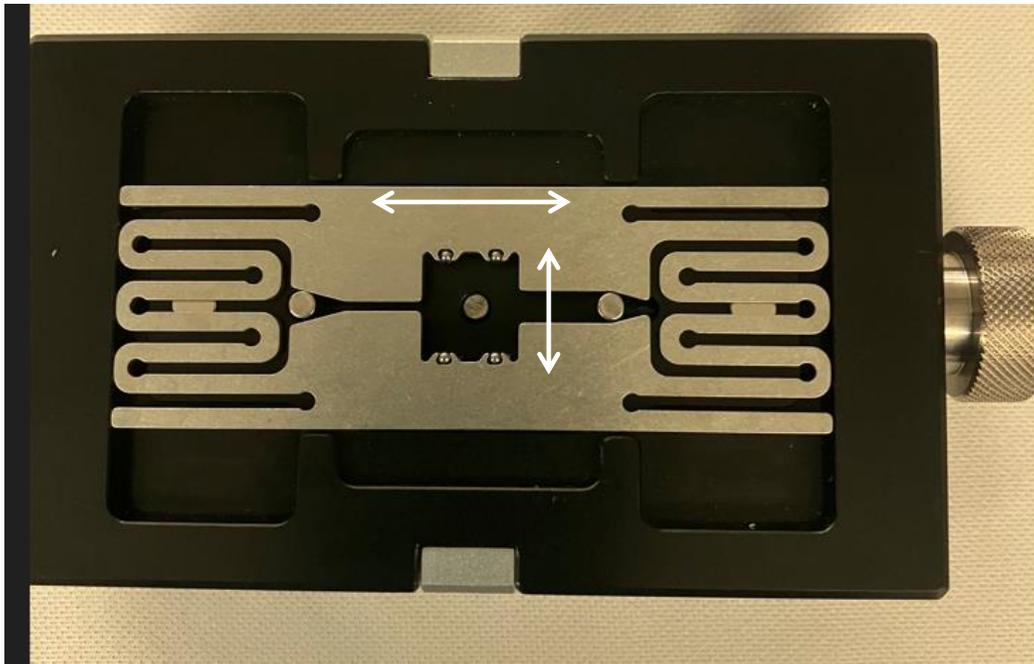
Glass substrate holder



Substrate holder manipulation

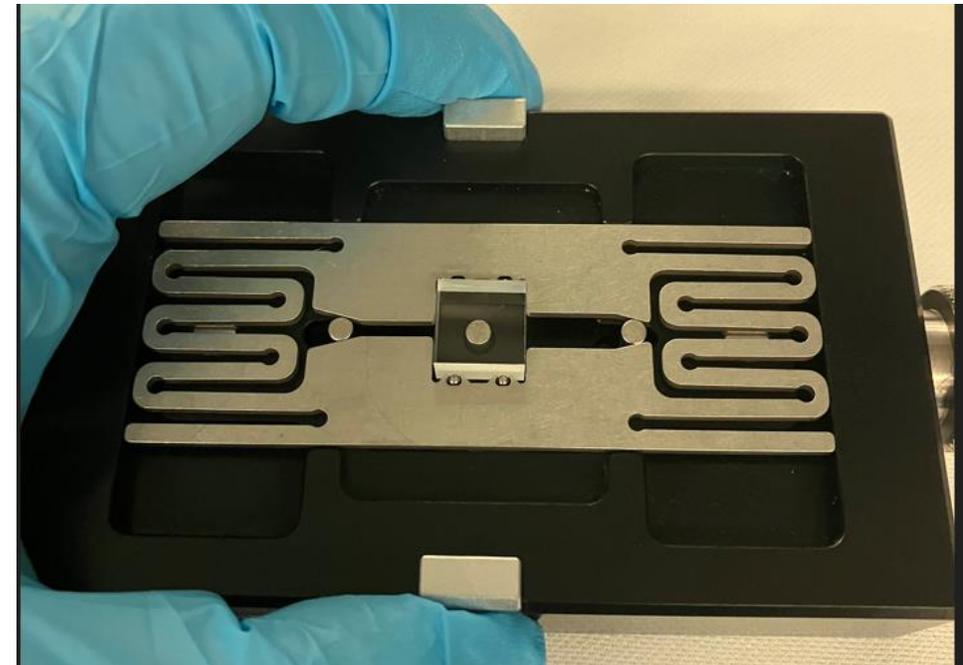
Holding sample

- 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: _____

Date: _____

Revision	Author	Date
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