

# Volumetric 3D Bioprinter

- Tomolite by Readily3D
- 400nm light
- 12,5mm $\varnothing$  x 25mm high build volume



## Benefits



### Fast

Shape hydrogels in 30 seconds



### Modular

Choose between a range of build volumes and wavelengths



### Cell and organoid-friendly

Low light dose, high viability (>90%)



### Contamination-free

Print through sealed, autoclavable containers



### Optical resolution

Pixel size of 28 microns



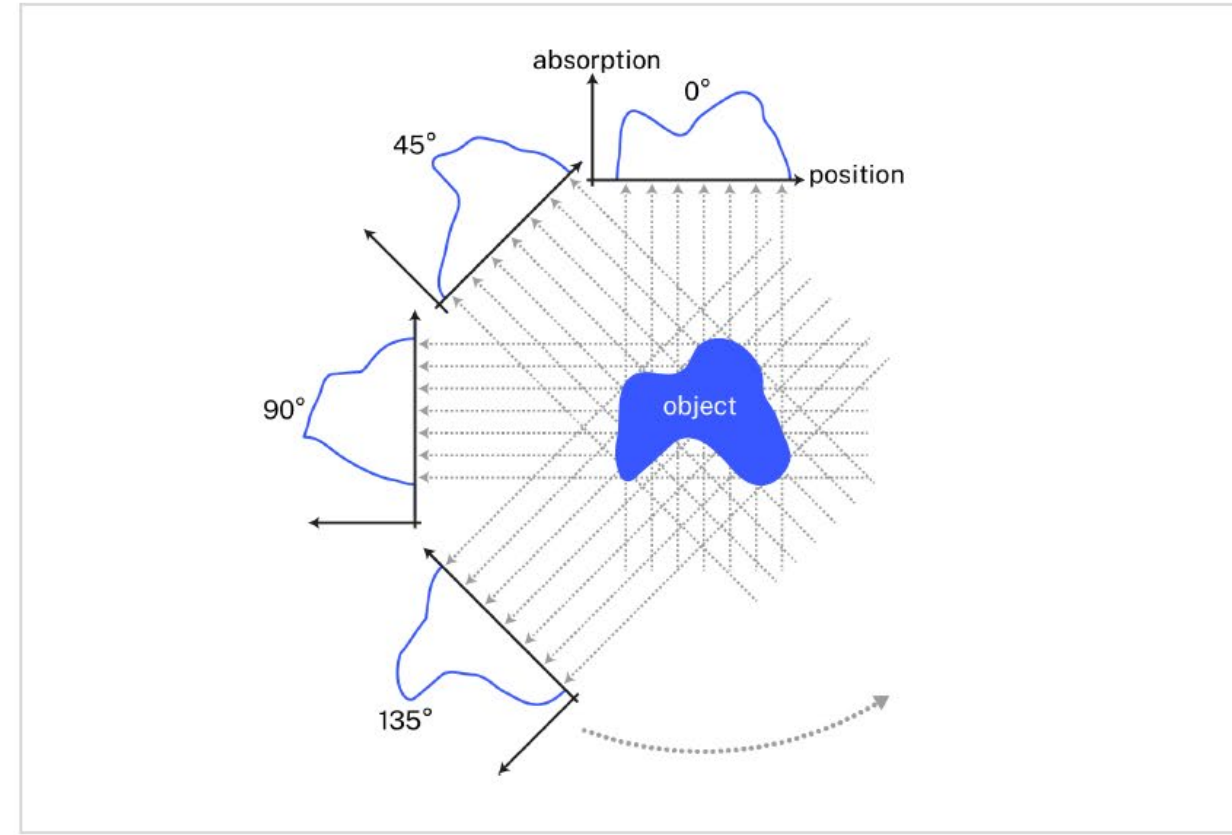
### Design freedom

Easily print hollow, embedded or overhanging structures

# Inspired by medical tomography

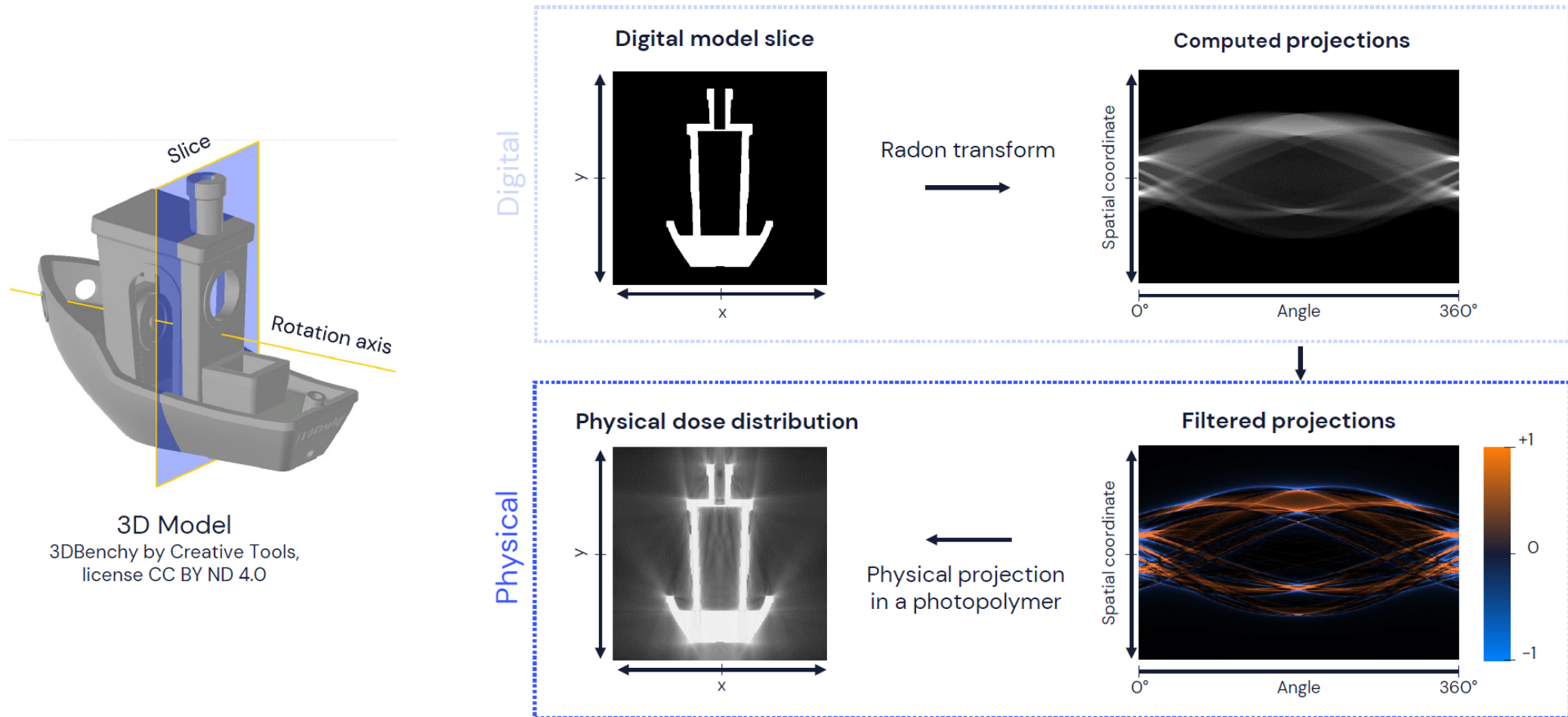


CT scanner

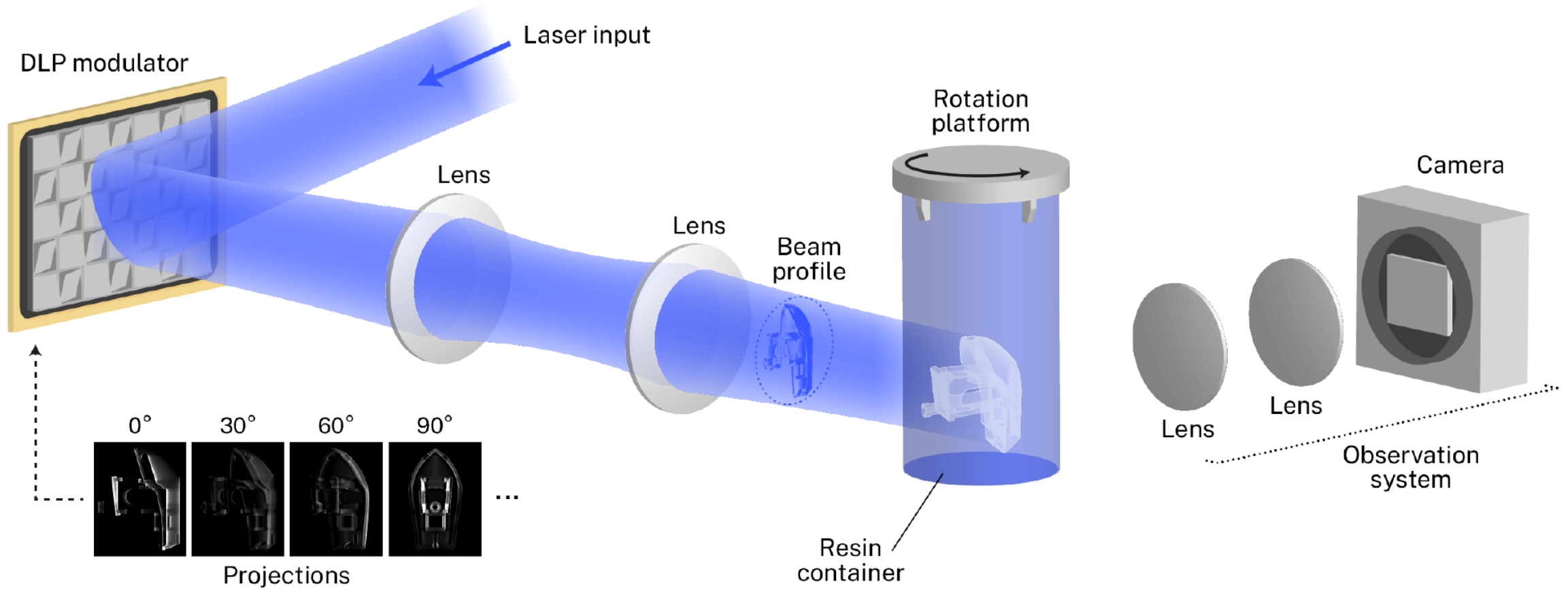


Radon transform  
(relates an object and its projections)

# Illustration of the Radon transform in volumetric 3D printing



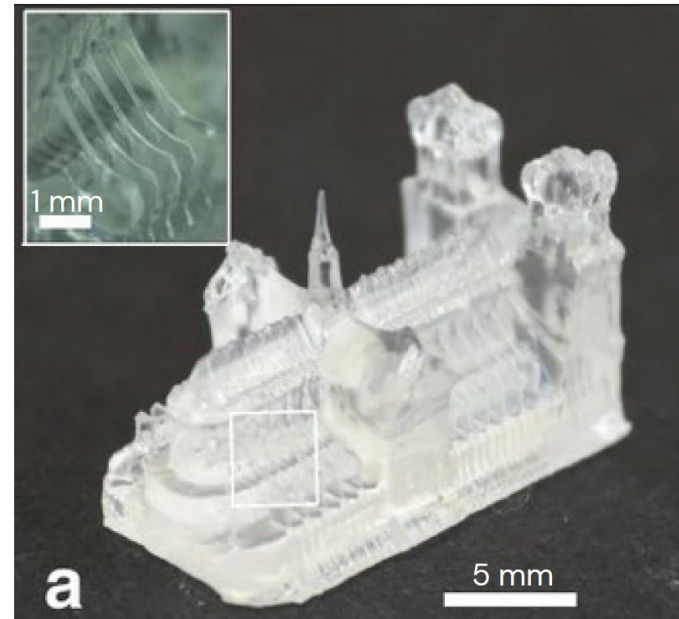
# Tomographic 3D printing process





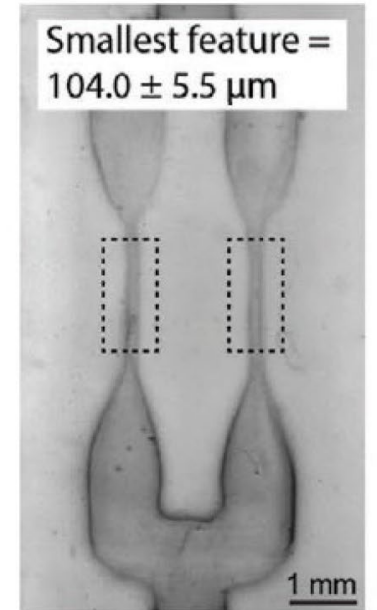
Printing containers

80  $\mu\text{m}$  positive resolution



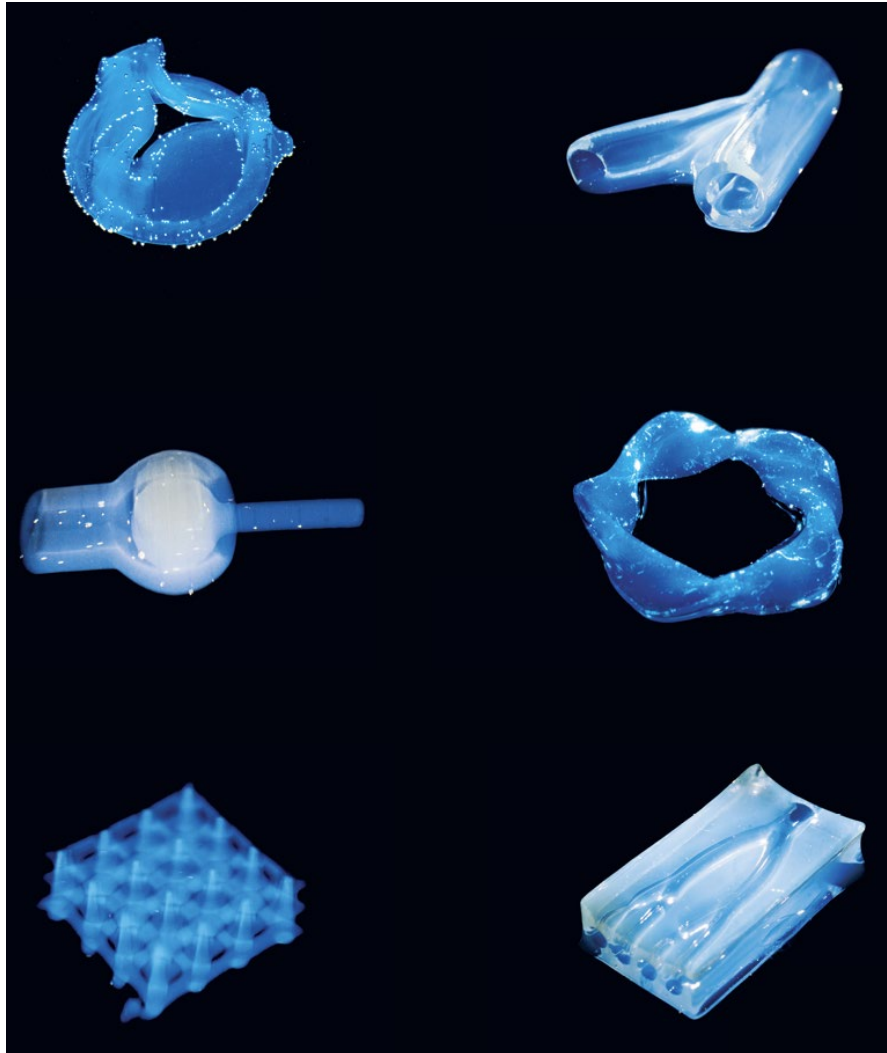
Credit: Loterie et al., Nat. Com., 2020

Negative resolution



Credit: Bernal et al., Adv. Mat., 2022

# Volumetric 3D Bioprinter



## Extrusion

Shear stress  
< 60% Viability

Limited design freedom

Low-throughput  
< 0,1cm<sup>3</sup>/min



## DLP

Slow (< 0,5cm<sup>3</sup>/min), large dose light  
Low viability

Limited design freedom, supports struts

Limited viscosity



## Volumetric bioprinting

No shear stress  
Increased viability > 90%

Freeform, no support struts

High-throughput  
> 10cm<sup>3</sup>/min



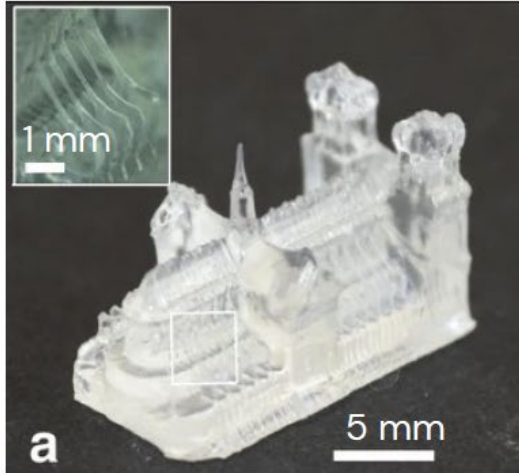
## Volumetric bioprinting

30s to 60s to print  
High viability > 90%

Organic shapes with tunable porosity  
and vasculatures

Can process gels

## Acrylics



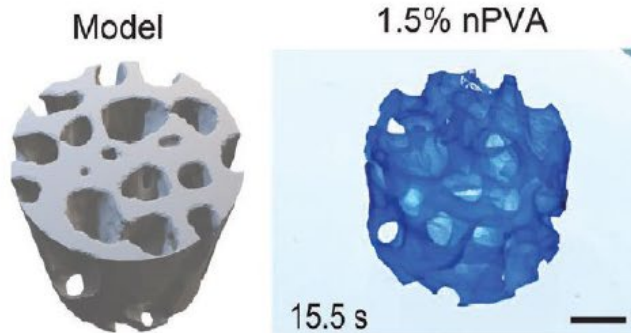
Credit: Loterie et al., Nat. Com., 2020

## Thiol-ene hydrogels



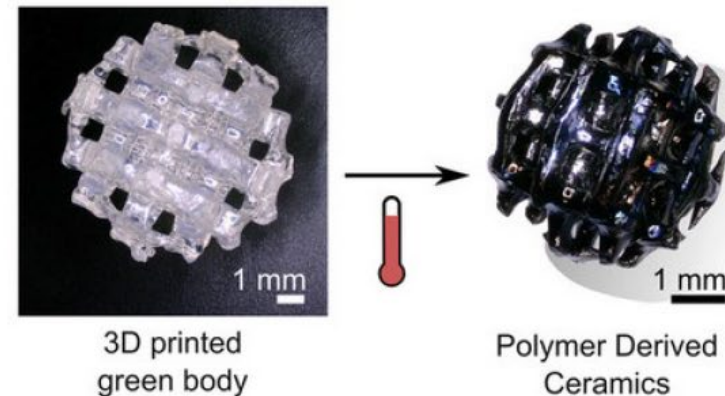
Credit: Rizzo et al., Adv. Mat., 2021

## PVA



Credit: Qiu et al., Adv. Func. Mat., 2023

## Ceramics



Credit: Kollep et al., Adv. Eng. Mat., 2022

# Open platform compatible with many materials

Any transparent to translucent photopolymers:

- Hydrogels
  - acellular/cell-laden
  - Pluronic
- Acrylics
- Silicones
- Ceramics
- Glass

Works with any light-triggered chemistry:

- Free-radical chain polymerization
- Thiol-ene
- Cationic

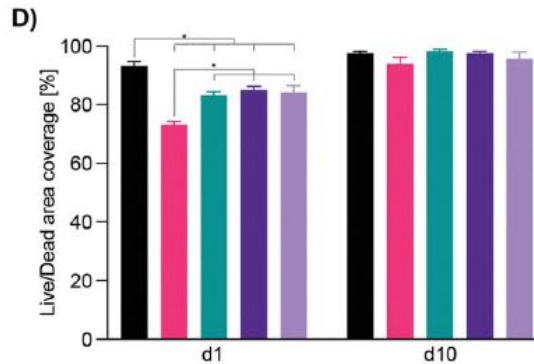
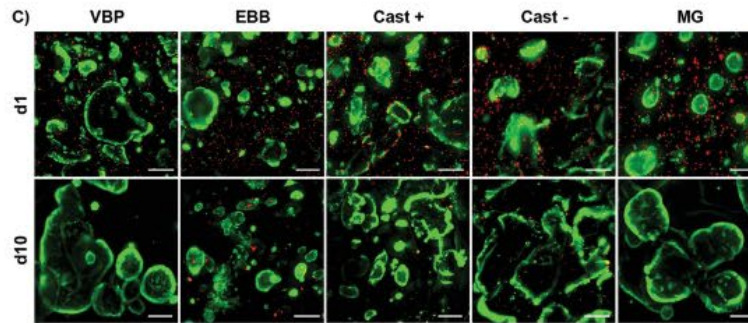
# Organoid and cell friendly printing process

Thanks to:

- Fast printing time (< 30s)
- Low light dose (< 150mJ/cm<sup>2</sup>)
- Sterile conditions
- Contactless optical process

## Example 1: Hepatic organoids

printed at  $1 - 1.5 \cdot 10^7$  cells/mL



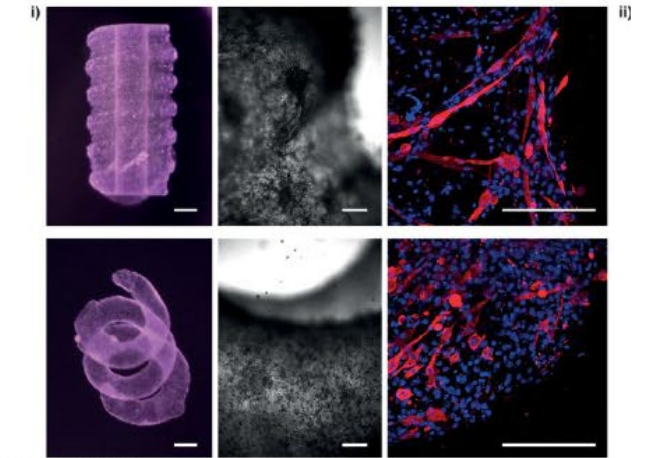
Viability of volumetrically printed hepatic organoids >93%

Scale bar: 250  $\mu$ m

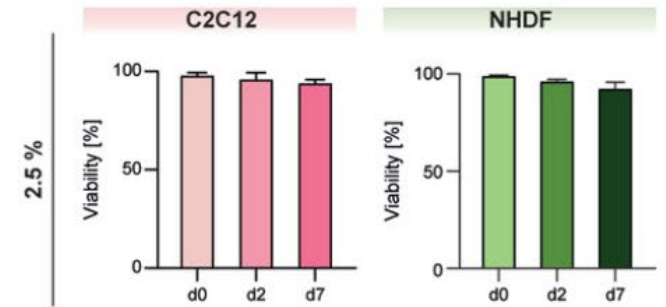
## Example 2: Mouse myoblasts

printed at  $1 \cdot 10^6$  cells/mL

F) Cellular constructs



E) Cell viability



Viability of volumetrically printed mouse myoblasts >90%

Scale bar: 500  $\mu$ m

Right: adapted from Rizzo et al., Adv. Mat., 2021

Left: adapted from Bernal et al., Adv. Mat., 2022

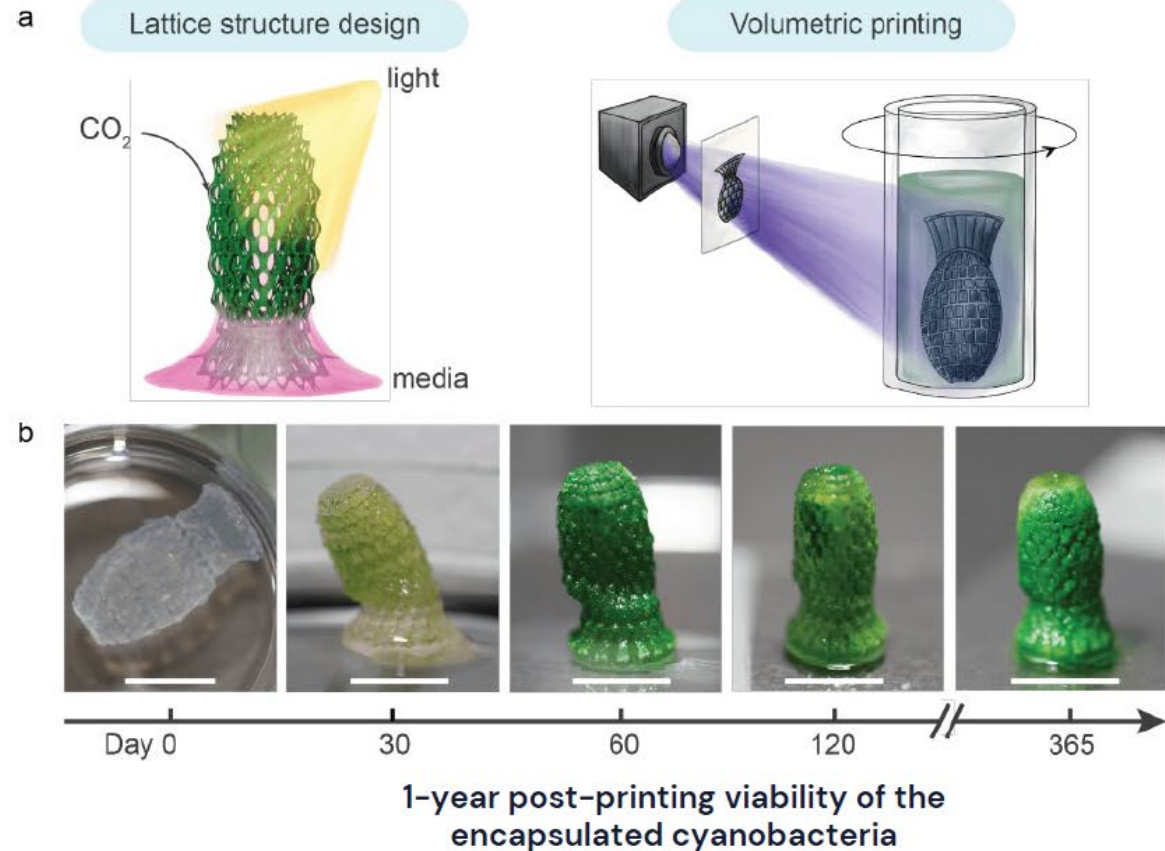
# Organoid and cell friendly printing process

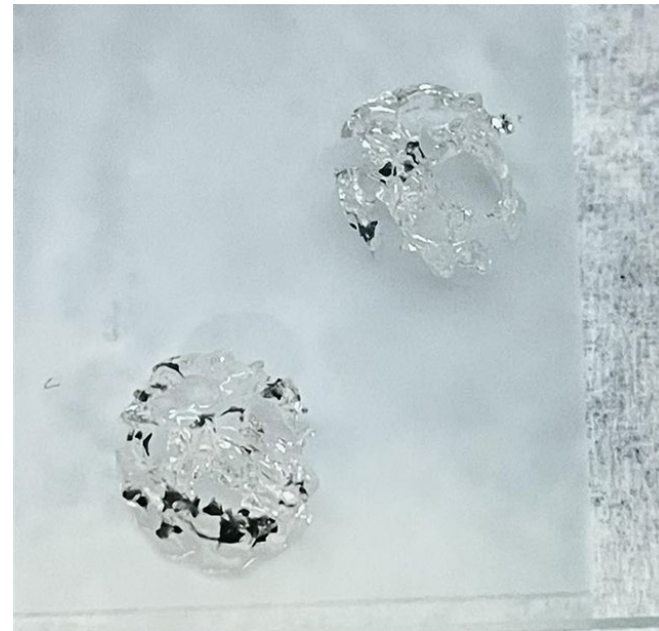
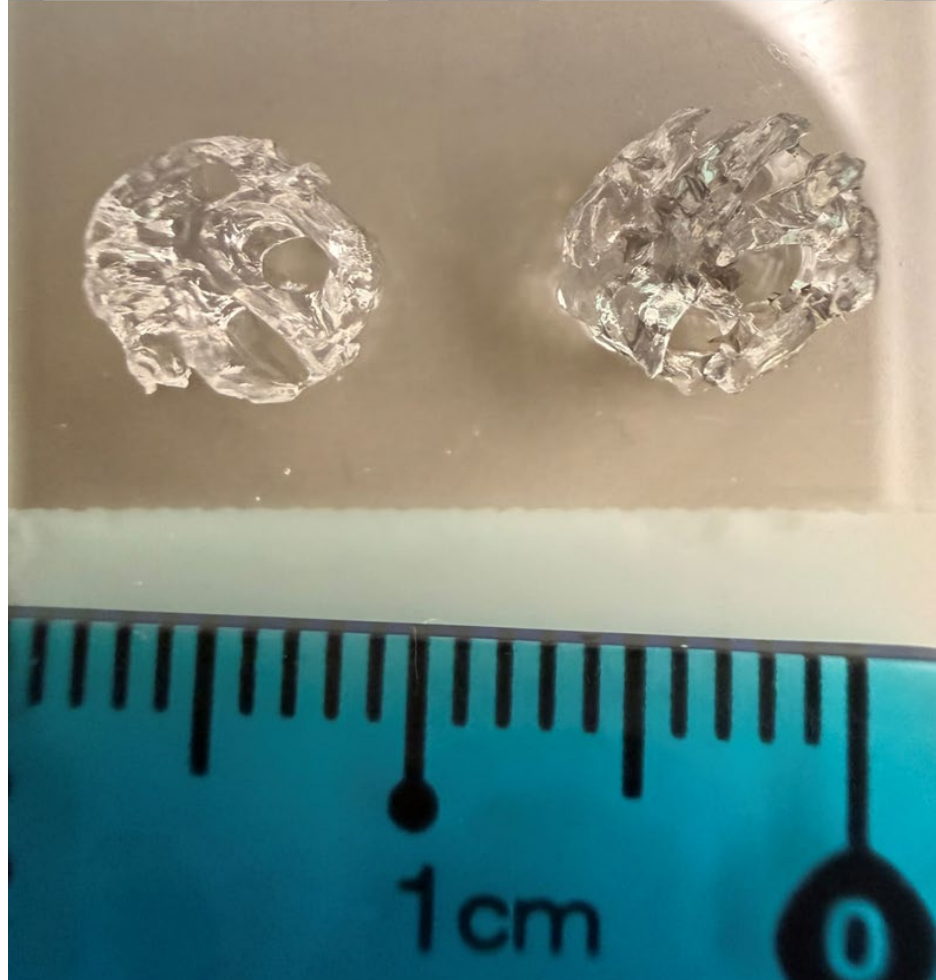
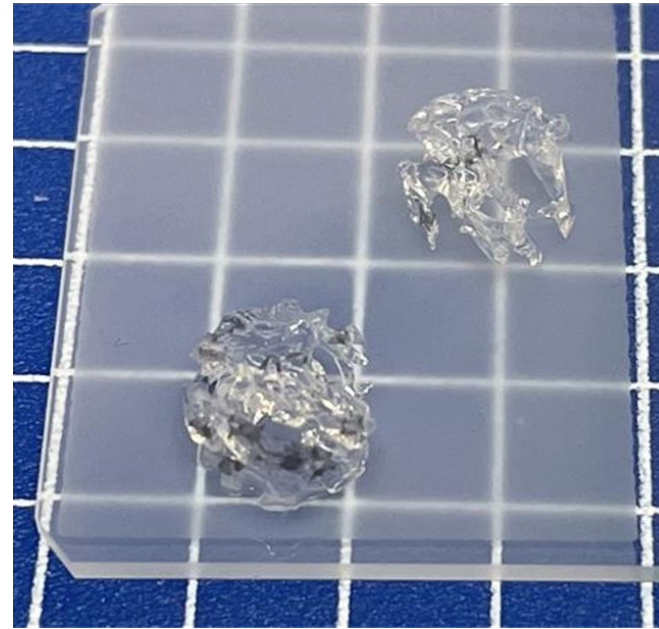
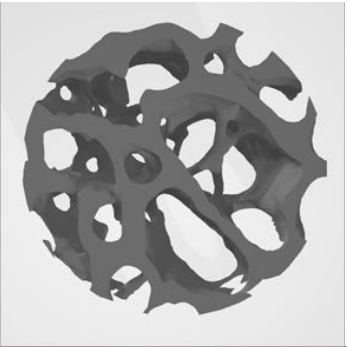
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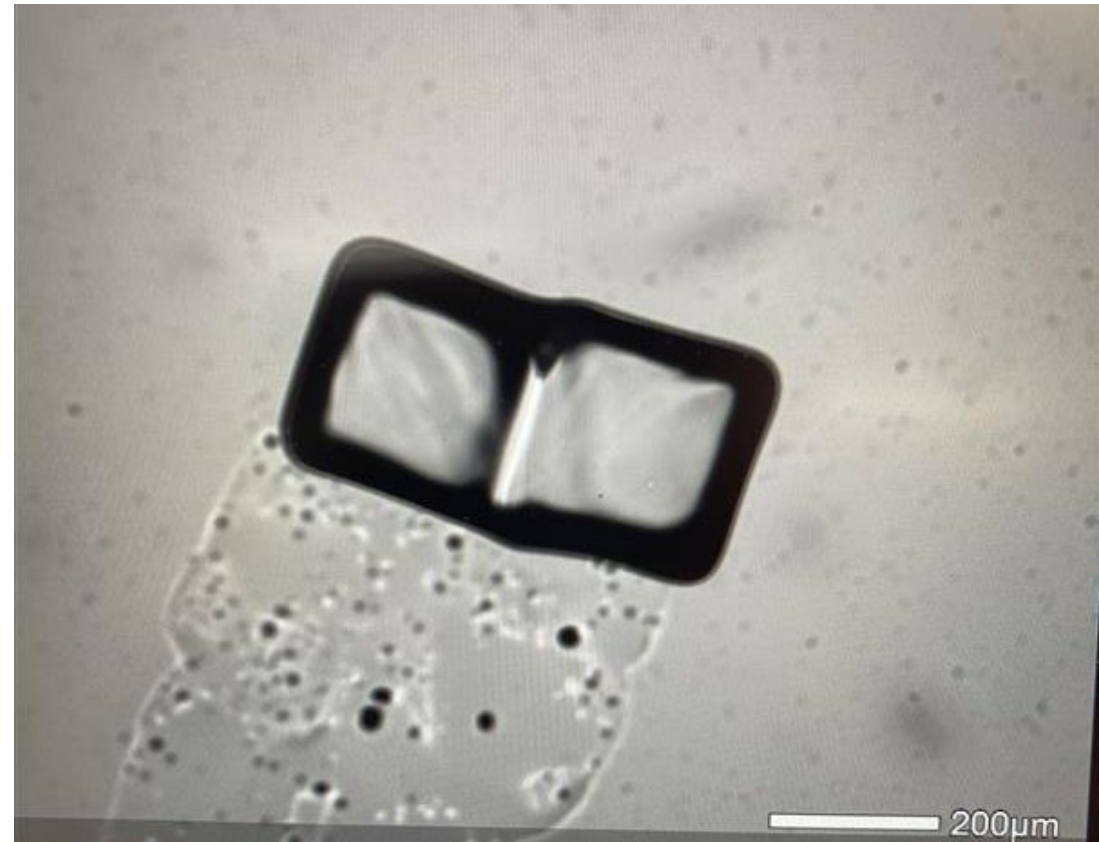
## Example 3: Photosynthetic cyanobacteria

printed at 0.5g/cm<sup>2</sup>





- 250 $\mu$ m cubes
- Printed inside 1mm glass capillary
- 40% PEGDA hydrogel
- LAP initiator



# Volumetric 3D Printer

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