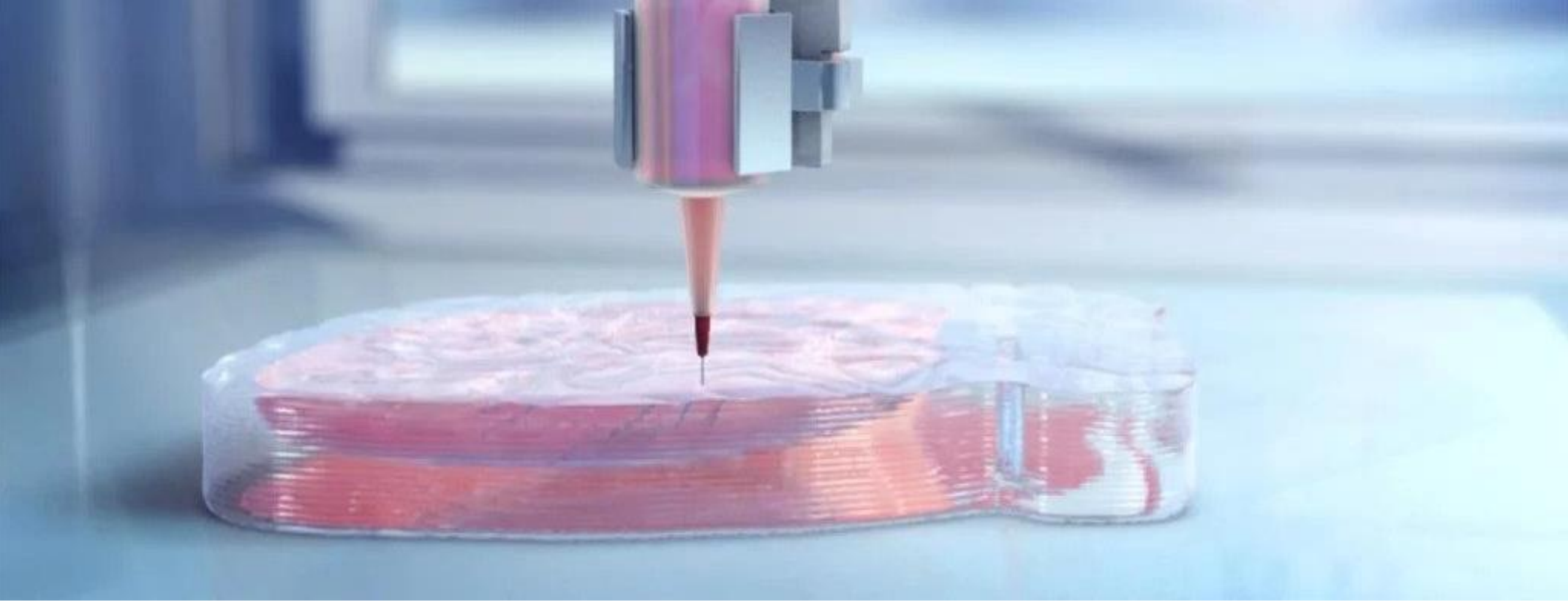


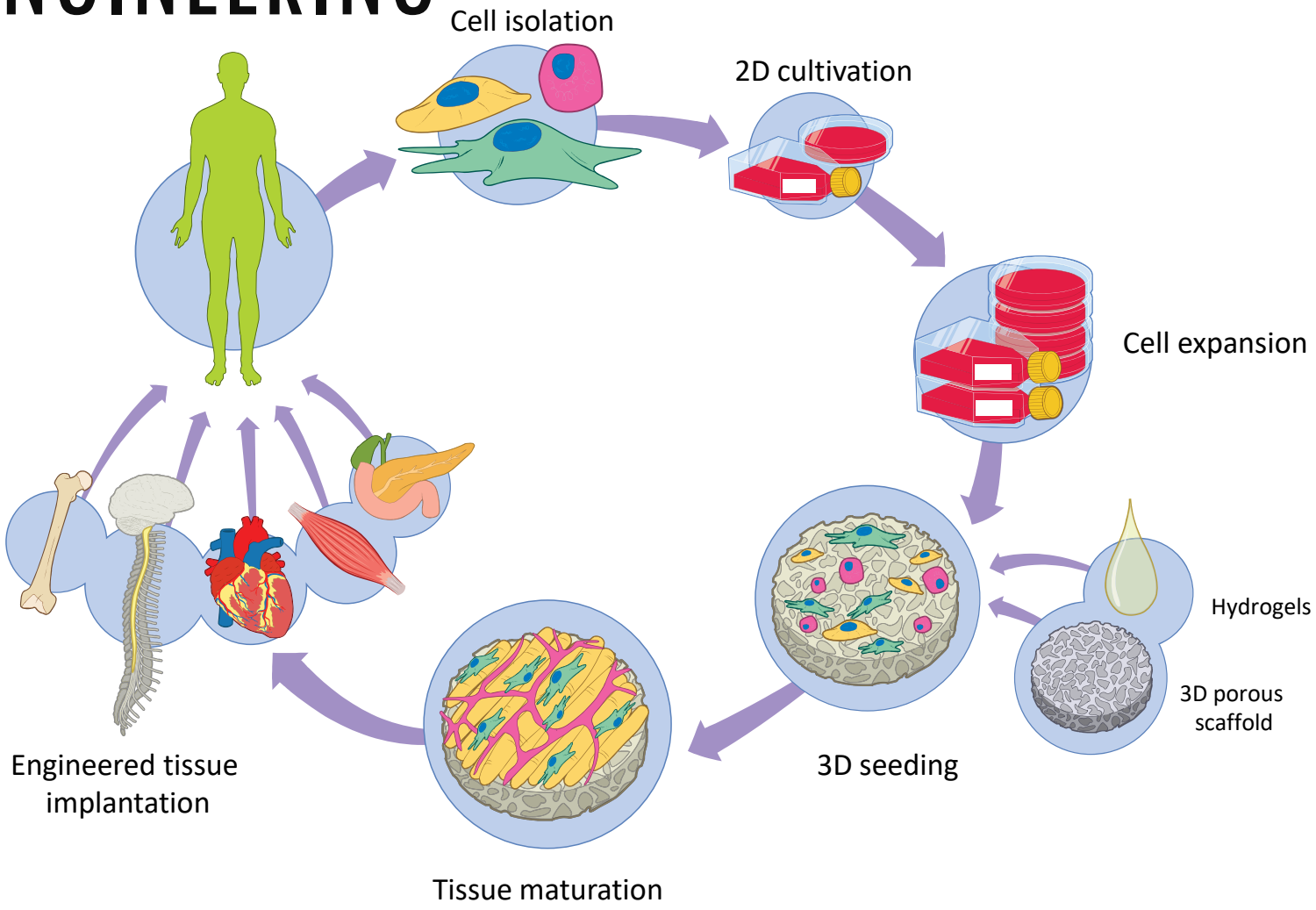
Levenberg Lab

Technion

3D BIOPRINTING OF COMPLEX TISSUES

TAM RETREAT
MAY 10 2022

TISSUE ENGINEERING



Credit: Ariel Szklanny

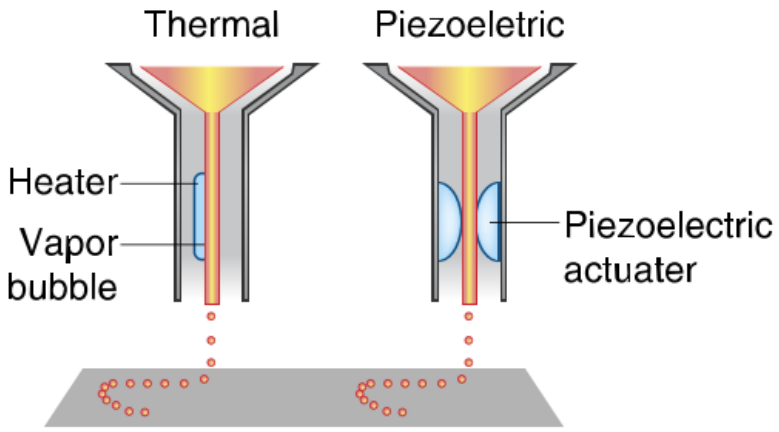
WHAT IS 3D BIOPRINTING?

Is the fabrication of complex *in vitro* tissue structures using a layer-by-layer technique, with living organisms and biomaterials as building blocks.

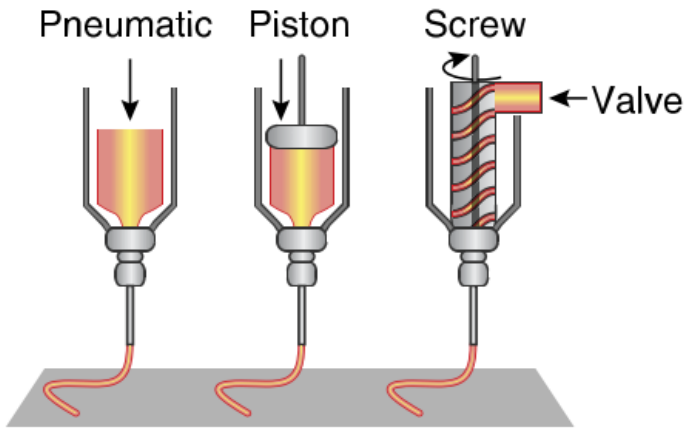
WHY USING THIS TECHNOLOGY?

- Complex and hierarchical structures
- Uniform distribution of cells along the construct, even for increased thickness
- Simultaneous use of several cell types and materials
- Automated and scalable process
- Reproducible results
- Patient specific desing

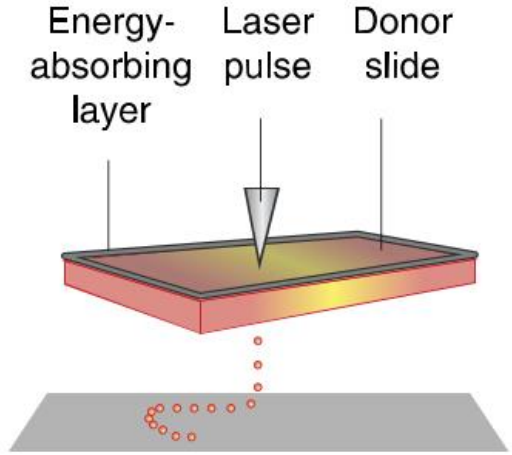
3D BIOPRINTING TECHNOLOGIES



Ink-Jet bioprinting



Pressure-assisted bioprinting



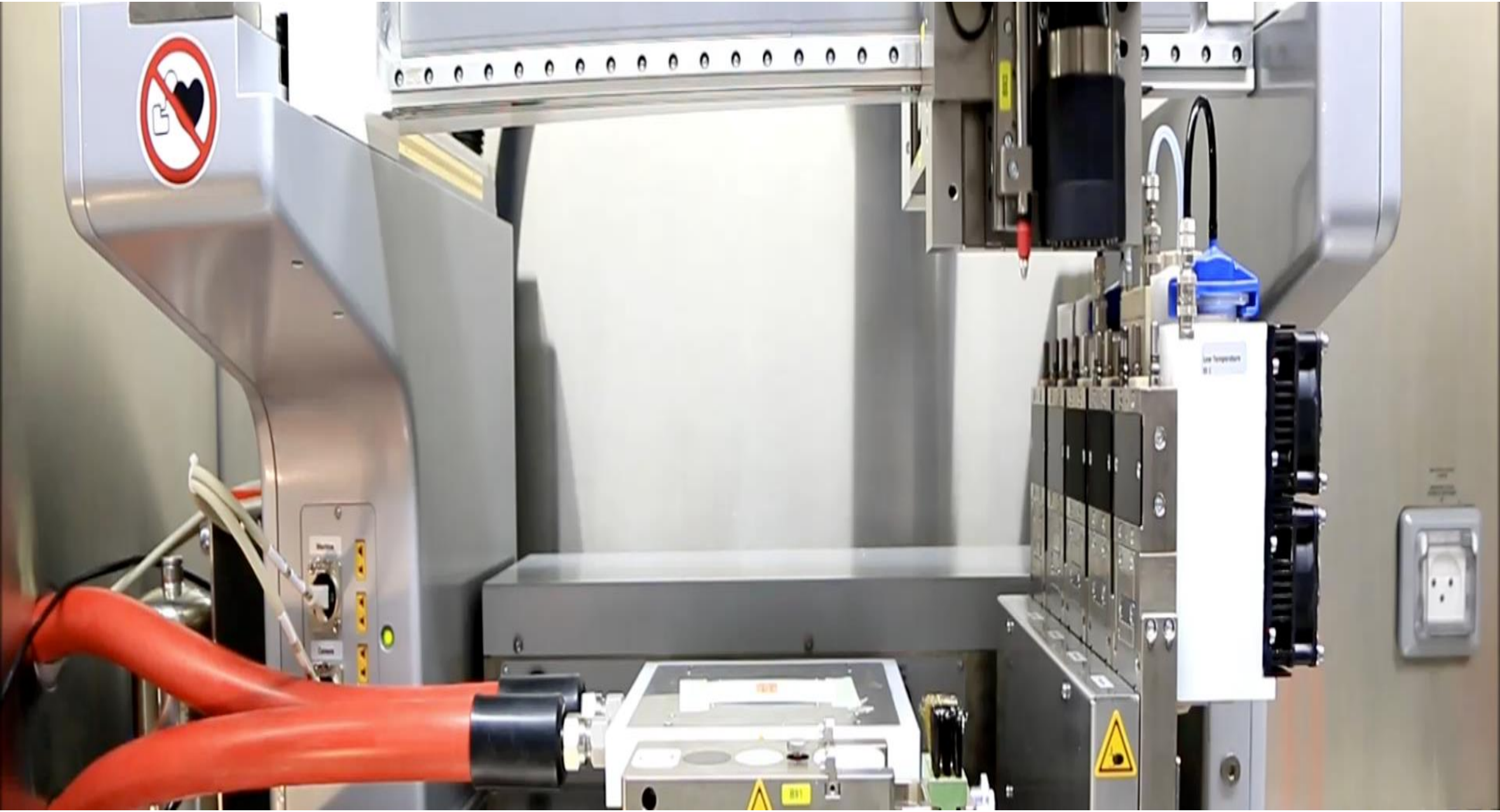
Laser-assisted deposition

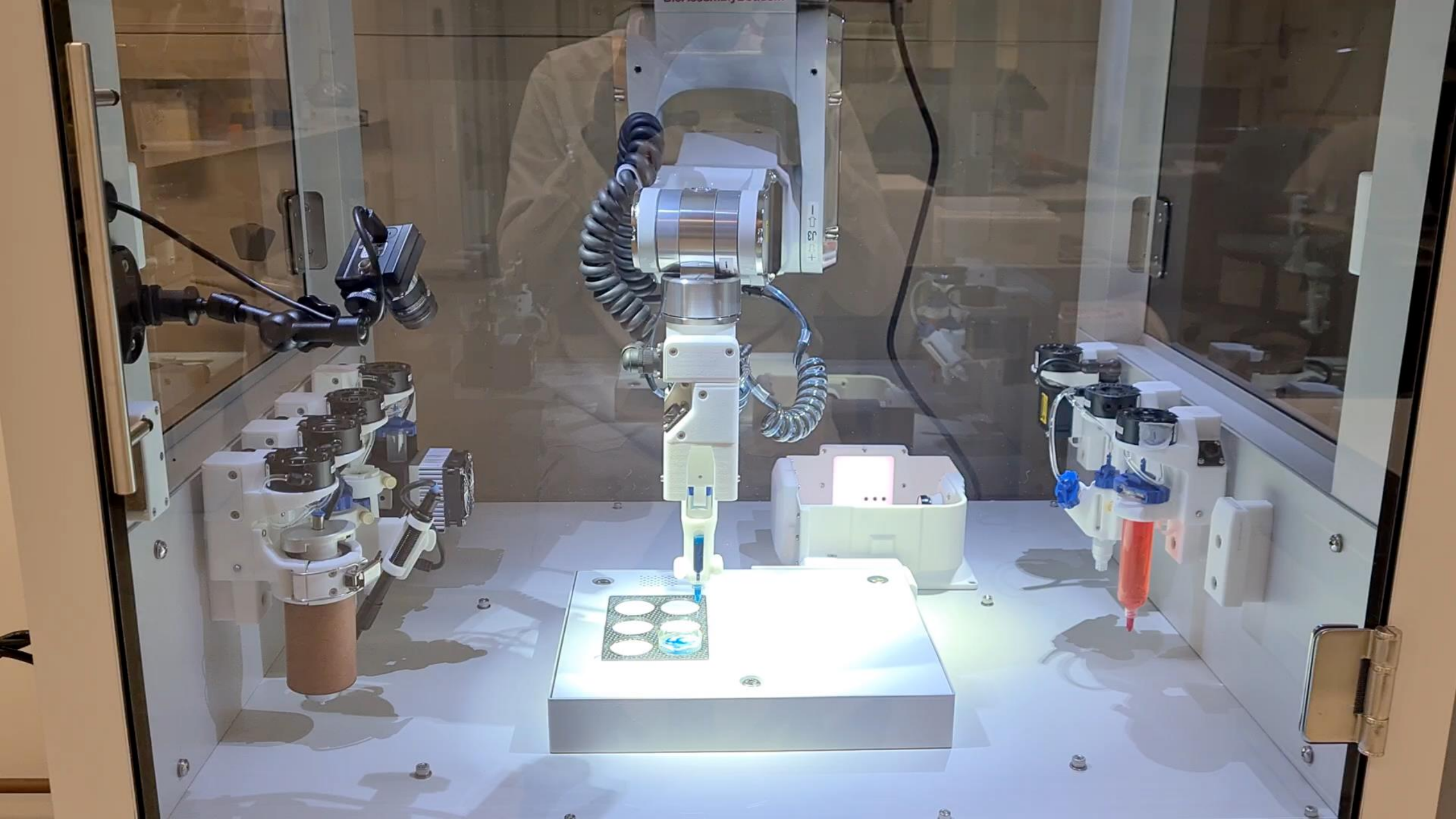
Cells + Biomaterial = Bioink

Sean Murphy & Anthony Atala., *Nat. Biotech.,* 2014

CURRENTLY USED BIOINKS

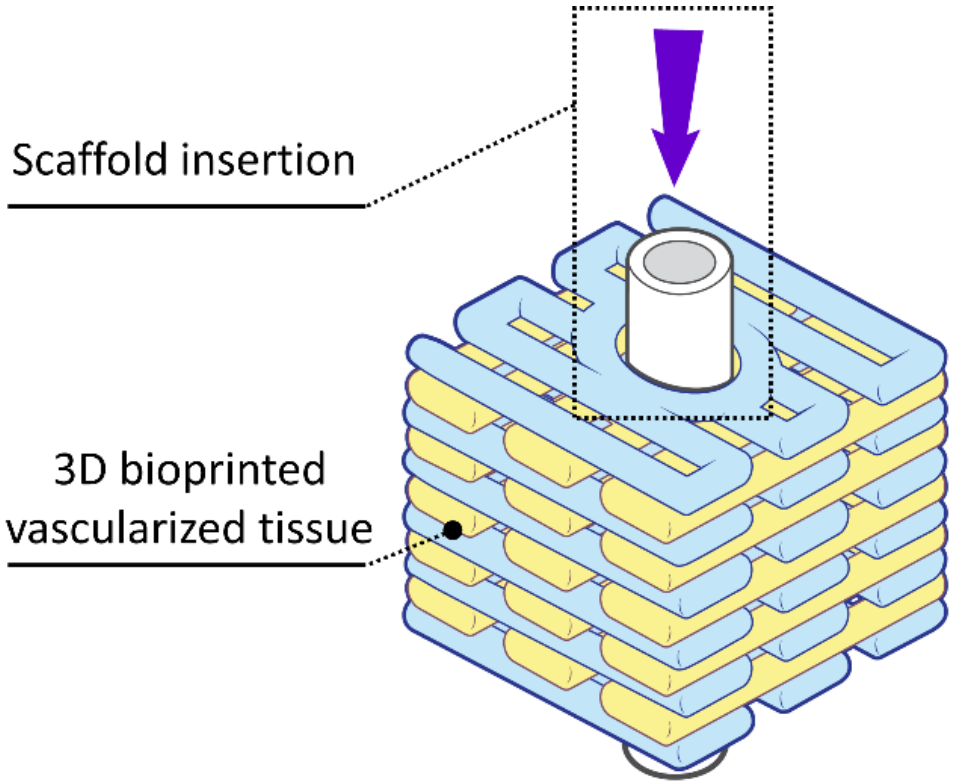
- **Naturally derived polymers –** including proteins (collagen, fibrin, gelatin, Matrigel), glycosaminoglycans (hyaluronan) and polysaccharides (agarose, alginate, chitosan). Low immunogenicity, resemble ECM or can be modified to allow cell adhesion and proliferation. Gelation mostly mediated by chemical or thermal means.
- **Synthetic polymers** – including polyethers (PEG), polyesters (PCL, PGA, PLA). Highly tunable materials, although they don't provide proper environment for cell growth. Usually combined with a natural polymer to create a bioink (e.g., gelatin-PEG). Cross-linking using UV light or printed molten material that later solidifies.
- **Decellularized ECM** – can be created using explanted tissue by chemical and physical modifications. They contain molecules present in native tissue. Protocols are long, and they present variability from batch to batch.

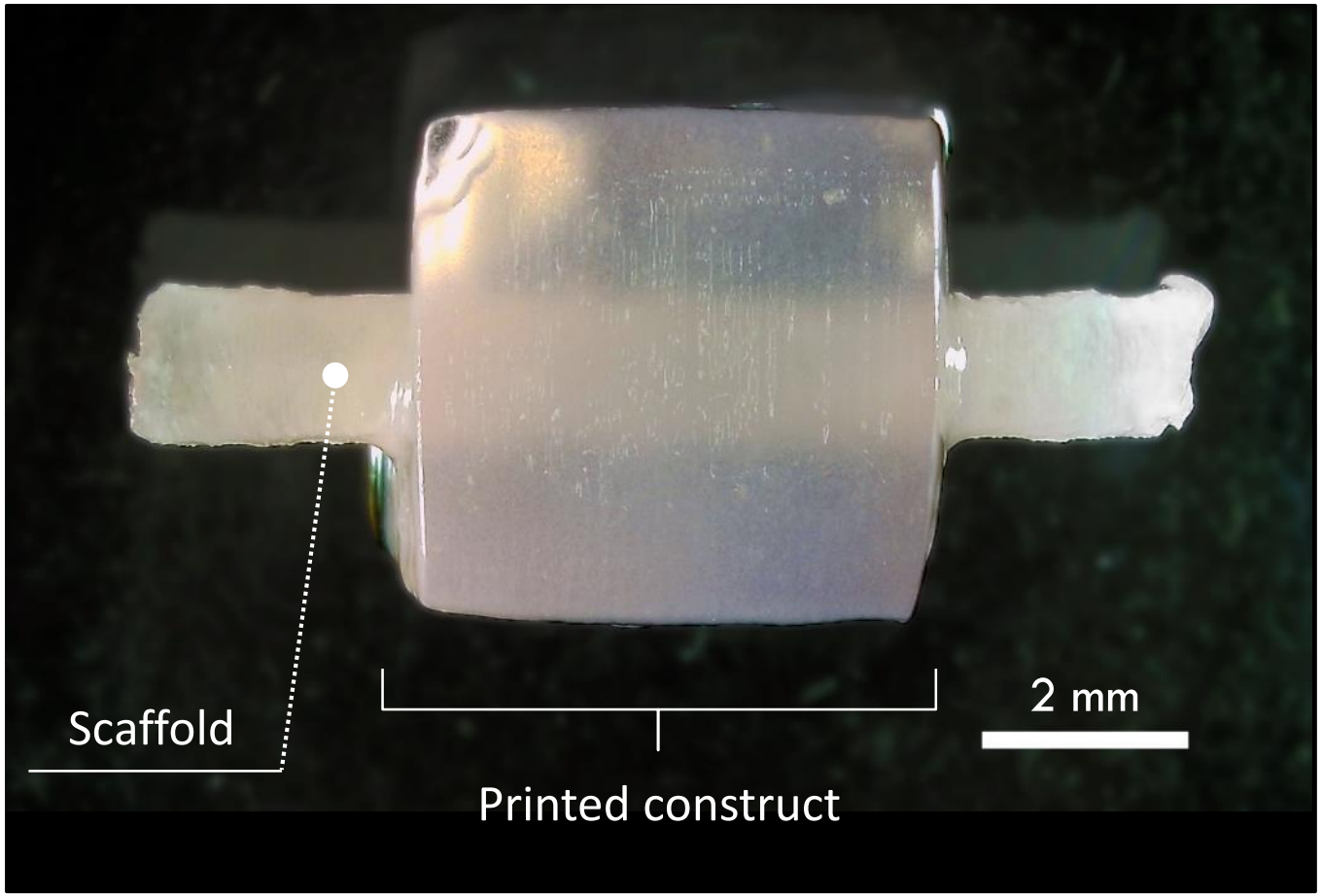




FULL CONSTRUCT ASSEMBLY

SCAFFOLD AND PRINTED GEL

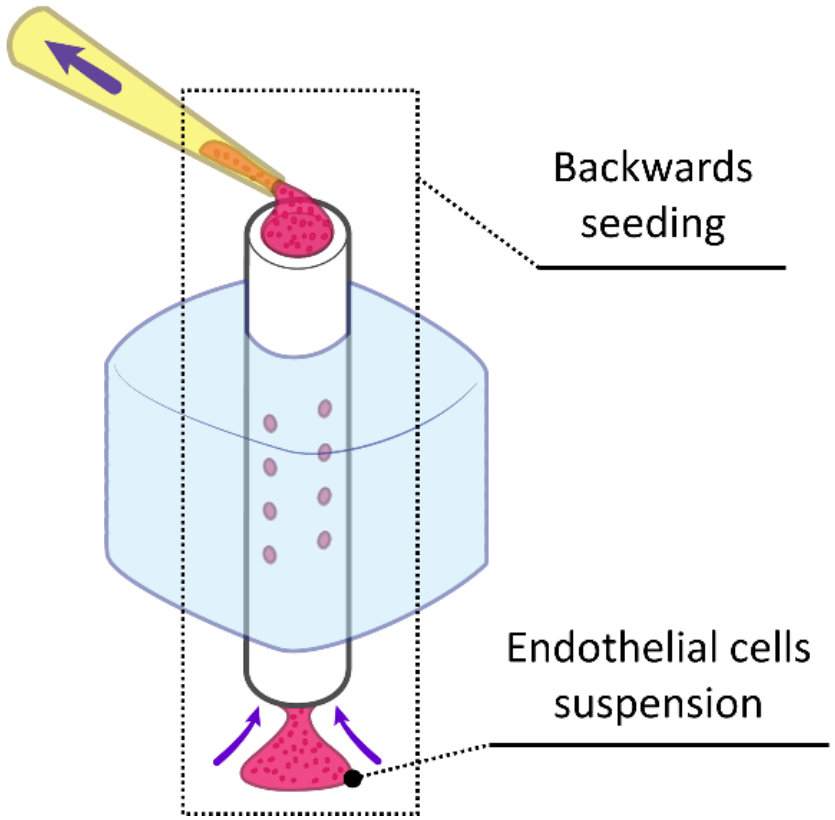




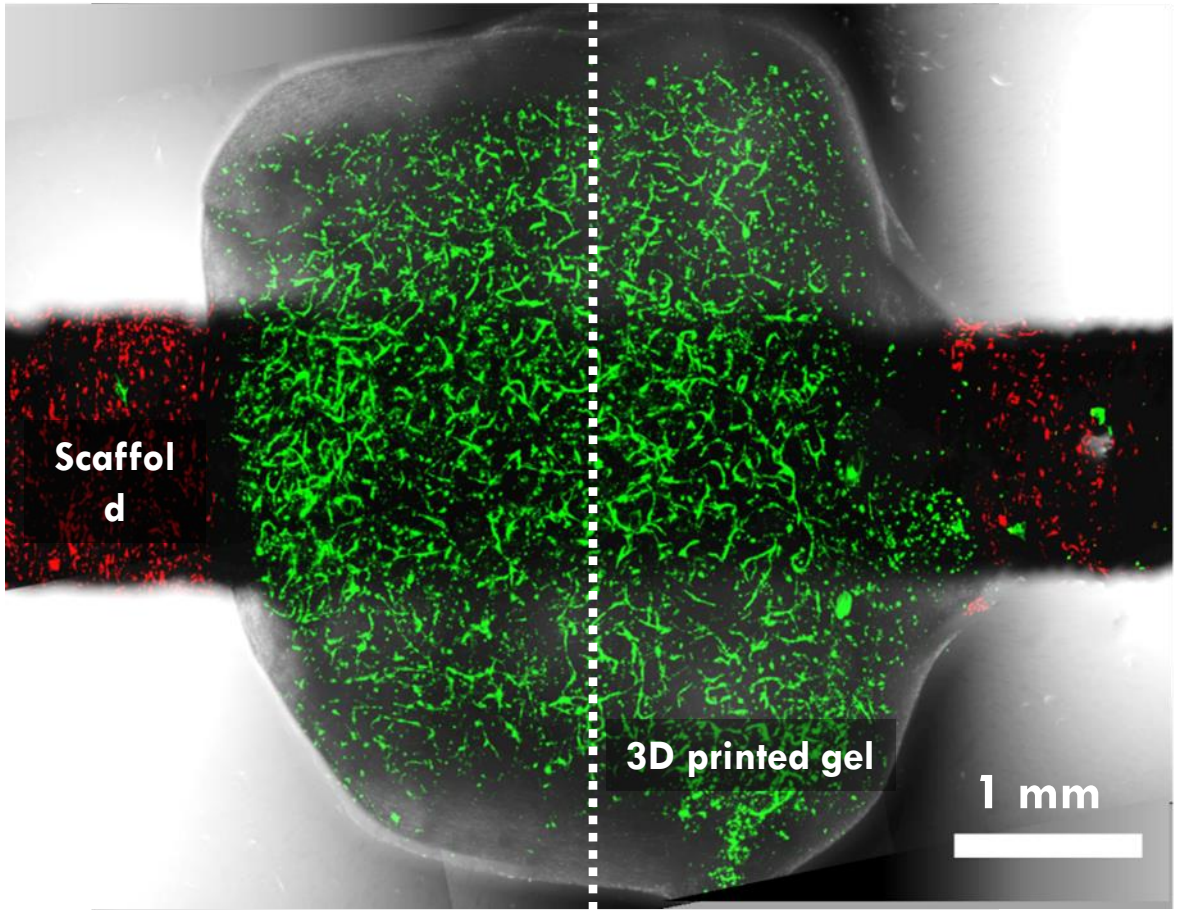
A. Szklanny *et al*. Advanced Materials 2021

ENGINEERING THE VASCULAR HIERARCHIZATION

ENDOTHELIUM-MICROVASCULATURE ANASTOMOSES

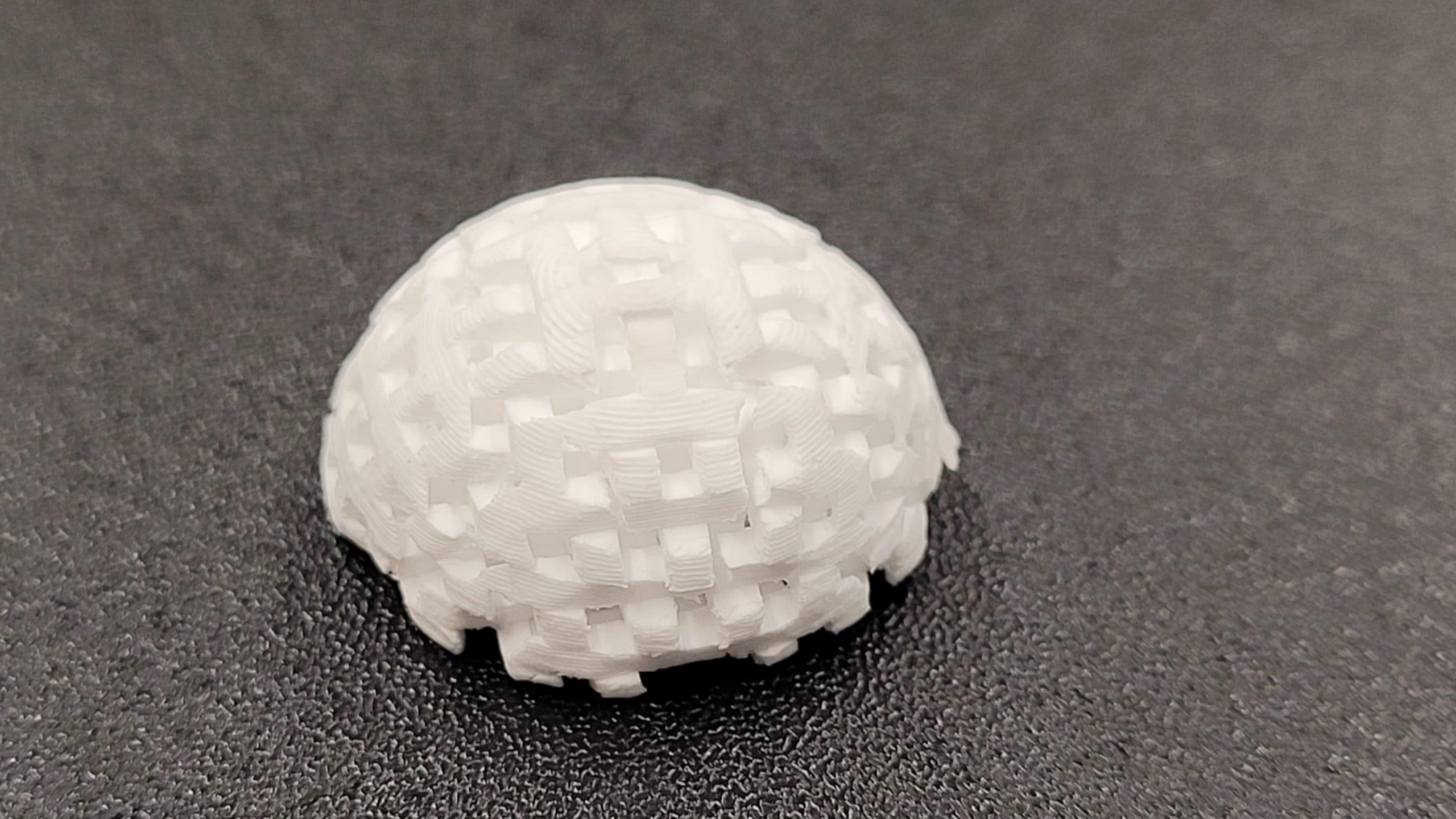


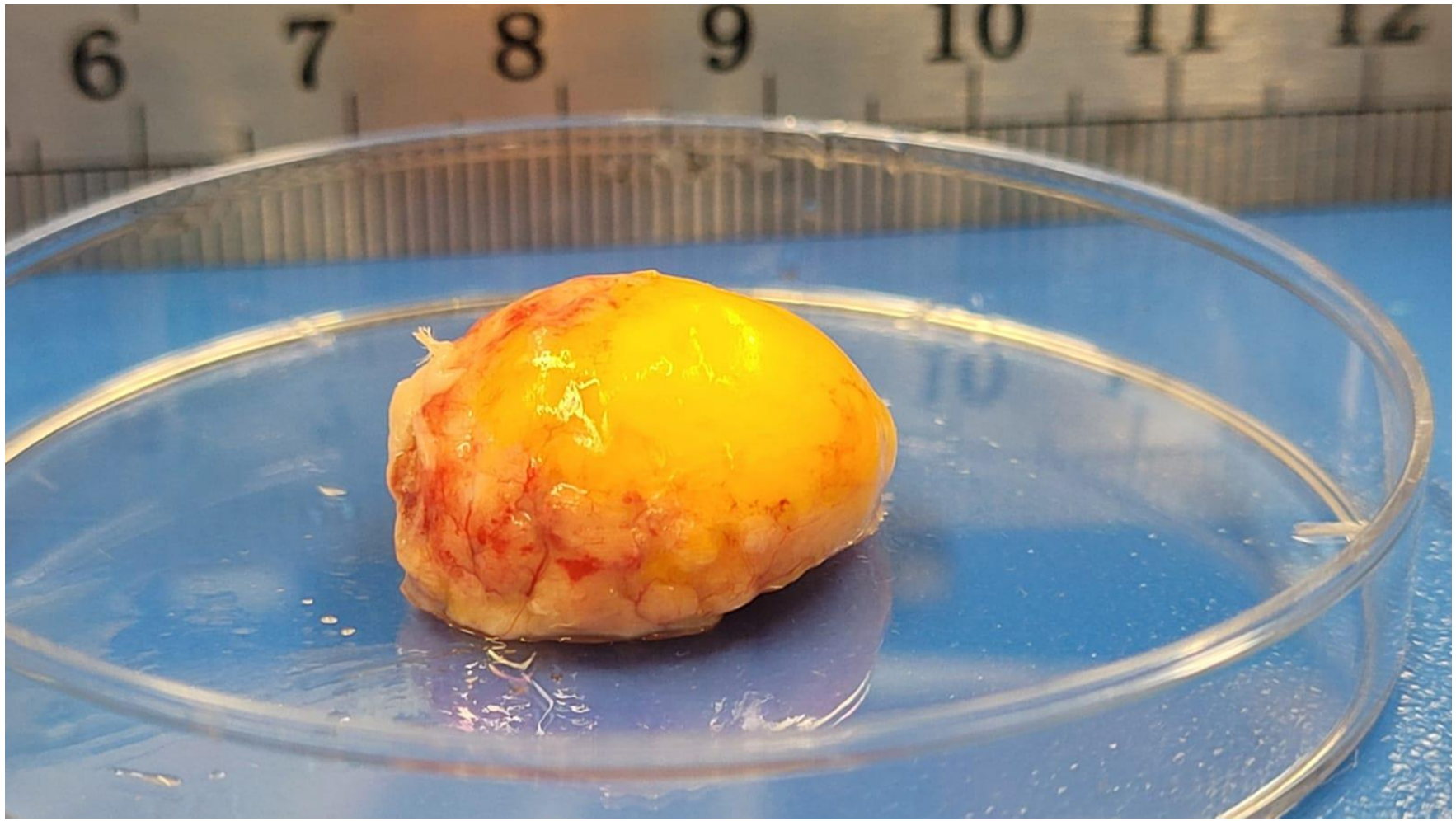
Side view



·Gel microvasculature ECs ·Scaffold Endothelium ECs

A. Szklanny *et al*. Advanced Materials 2021

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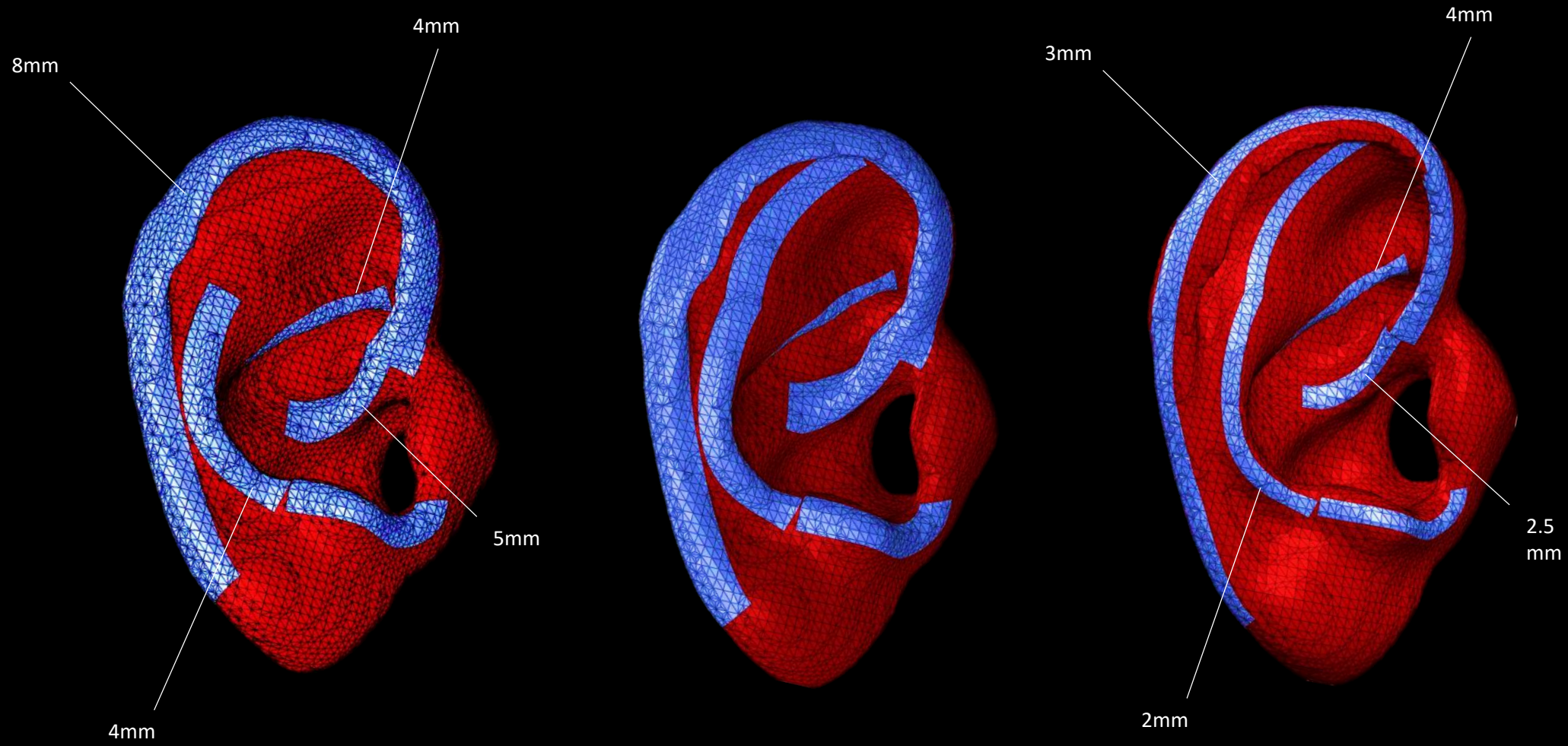
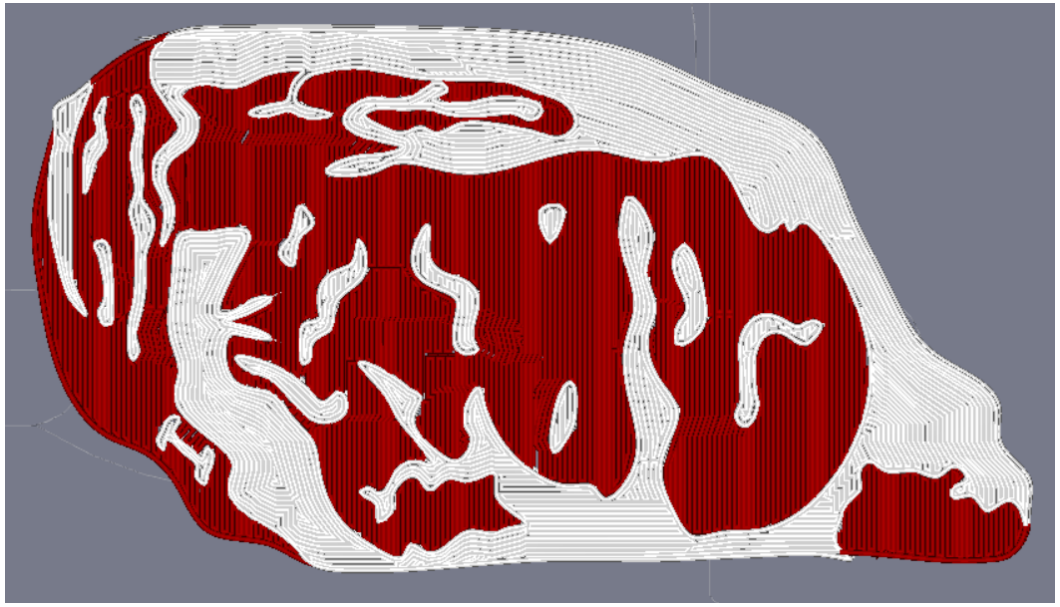
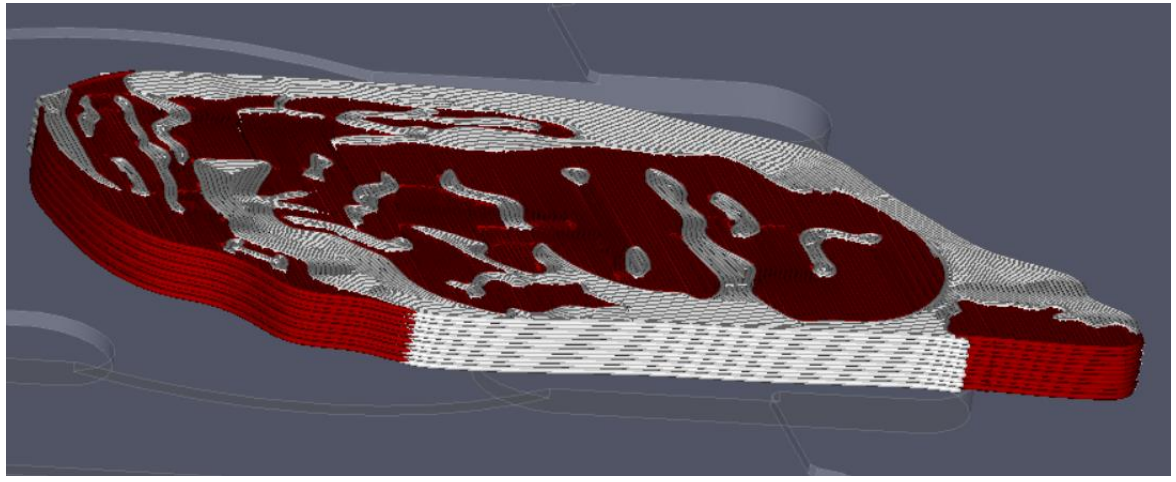
The auricle-scaffolds



STEAK 3D-PRINTING DESIGN

RIBEYE STEAK





BIO- PRINTED STEAK