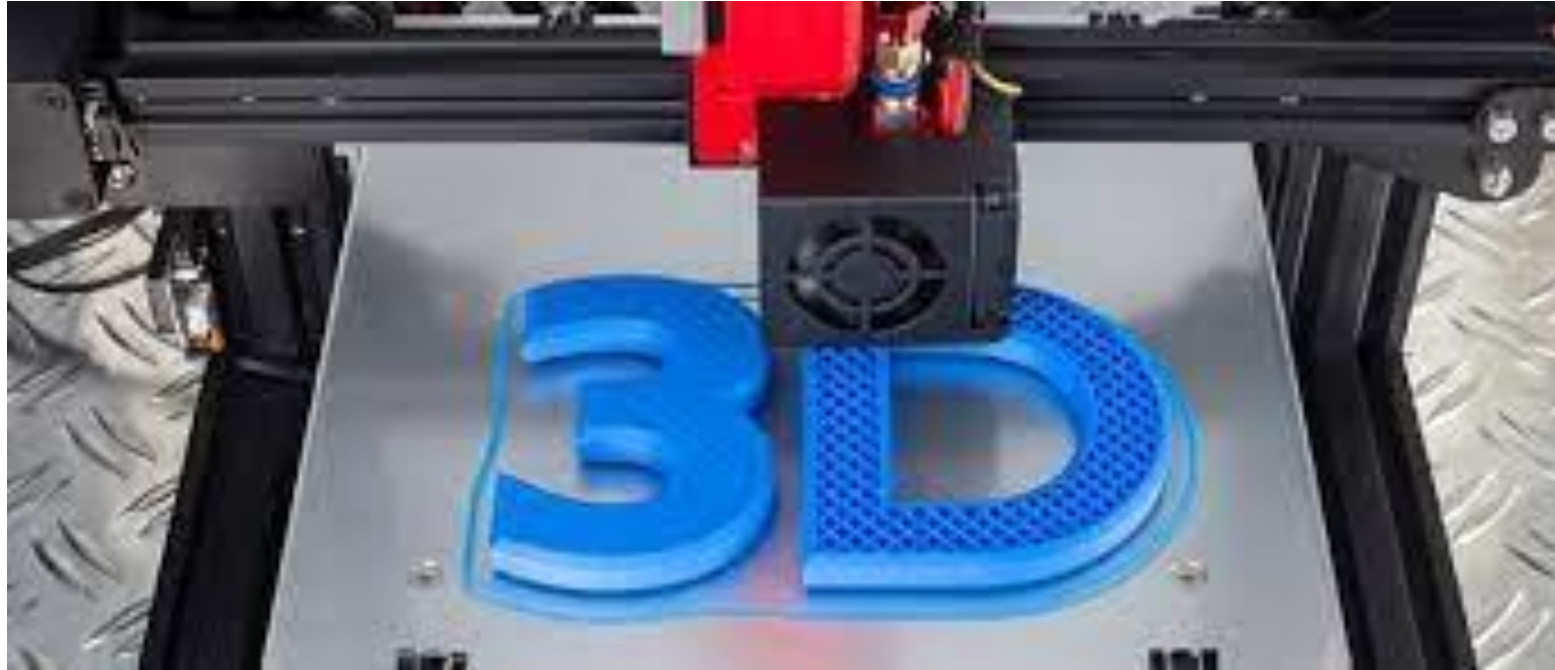




An overview of 3D printing techniques



Who I am

PhD. Daniel Rojas

- BSc in Chemistry (2011-2015)
(UAH, Spain)
 Universidad de Alcalá
- MSc in Electrochemistry (2015-2016)
(UAM, Spain)
 UAM
- PhD. in Chemistry and food Science (2017-2020)
(UAH, Spain and UNITE, Italy)



- Postdoctoral fellow (2020-2021)
(CEITEC, Czech Republic)



- Postdoctoral fellow (Dec 2021 – Present)
(UAH, Spain)



- 1. What is 3D printing?**
- 2. 3D printing techniques**
- 3. Applications in science and technology**

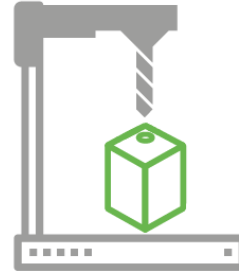
I. What is 3D printing?



Additive vs subtractive manufacturing



Material



Subtractive
Manufacturing



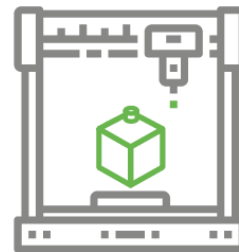
Manufactured
Part



Waste



Material



Additive
Manufacturing

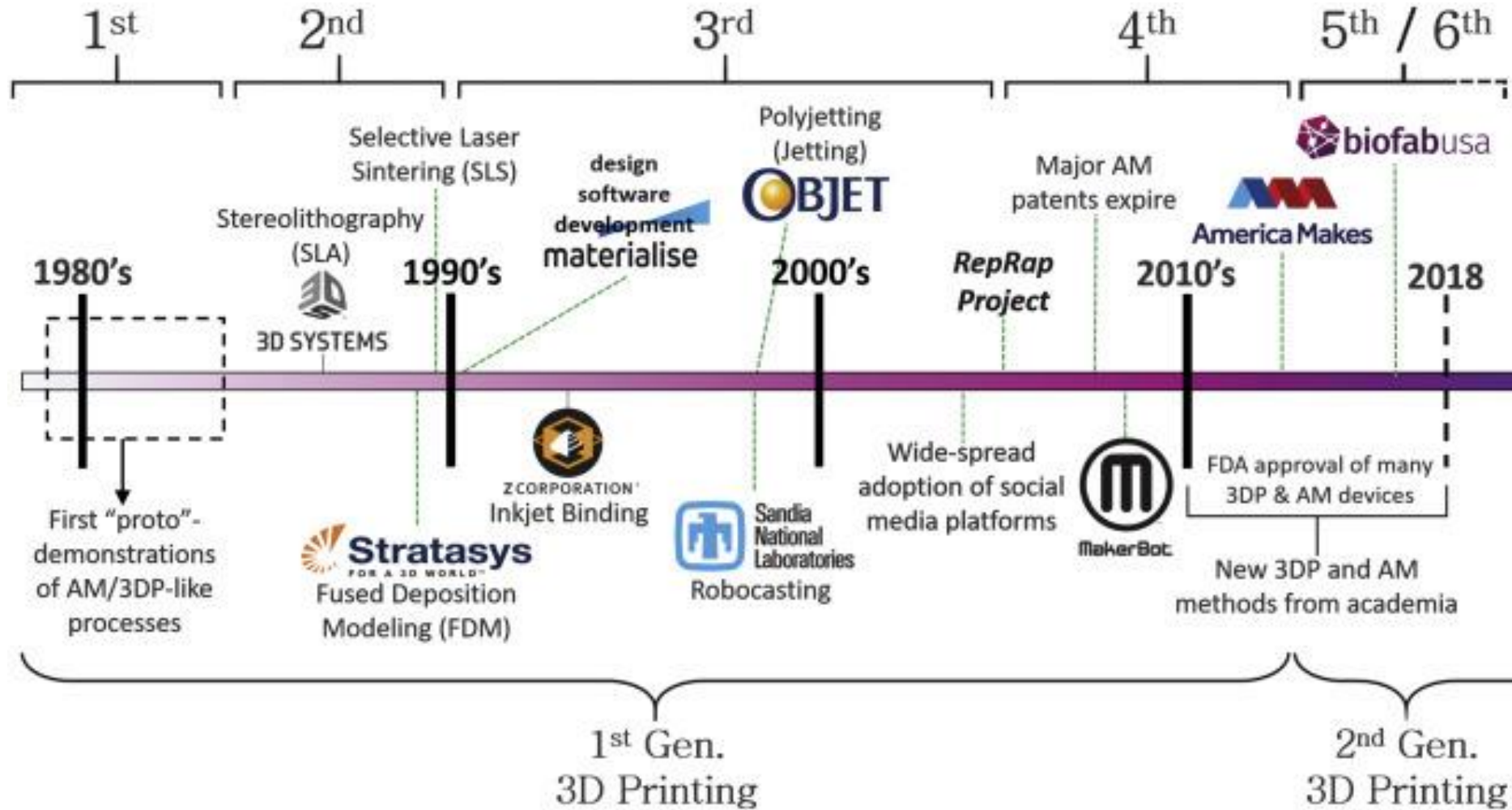


Manufactured
Part



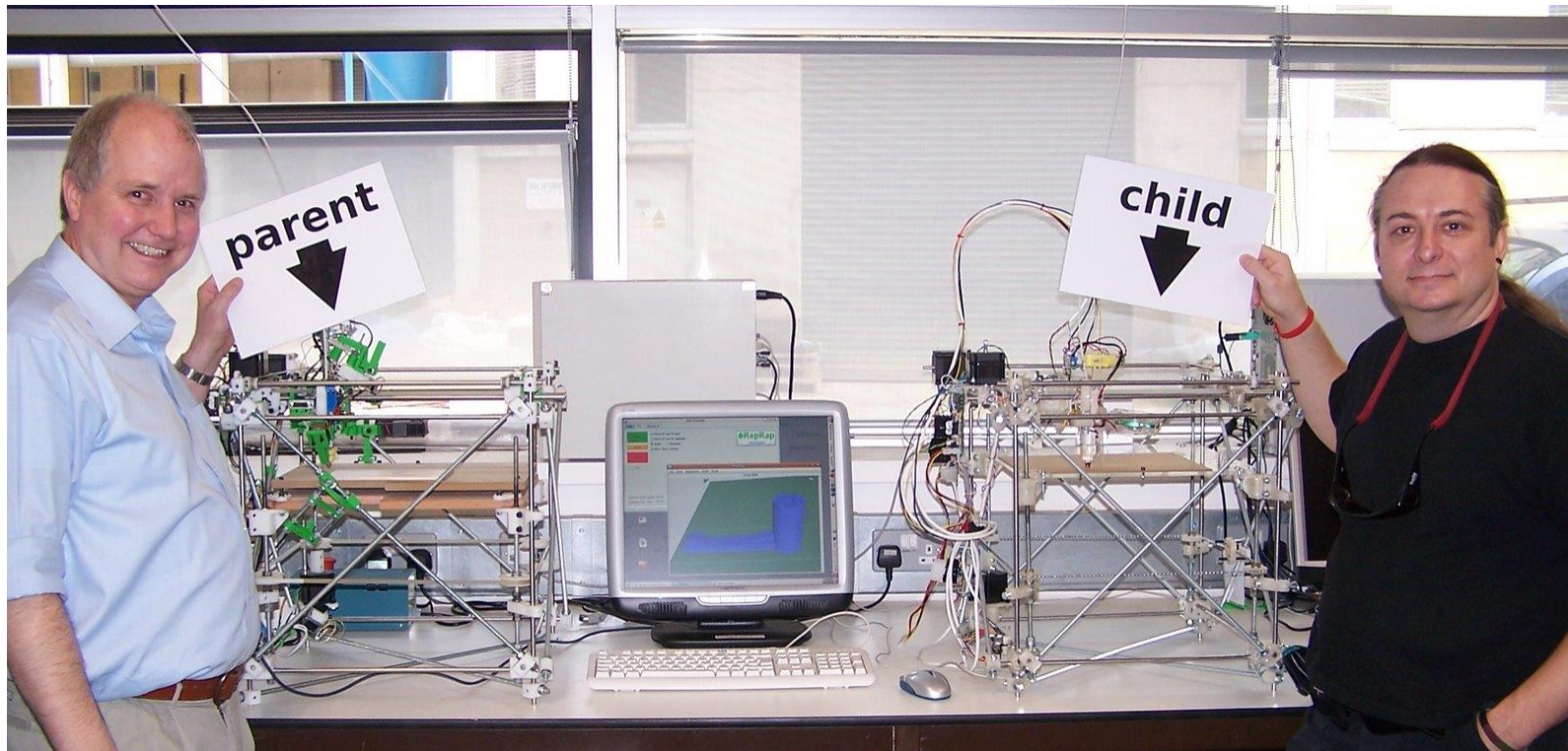
Waste

3D printing history



RepRap (replicating rapid prototyper) project

Rep-Rap Project is an initiative created at Bath University (UK) with the aim of creating a printer with self-replicating capabilities.



<https://reprap.org/wiki/RepRap>

<https://www.youtube.com/watch?v=XxJgZnhq714>

3D printing farms



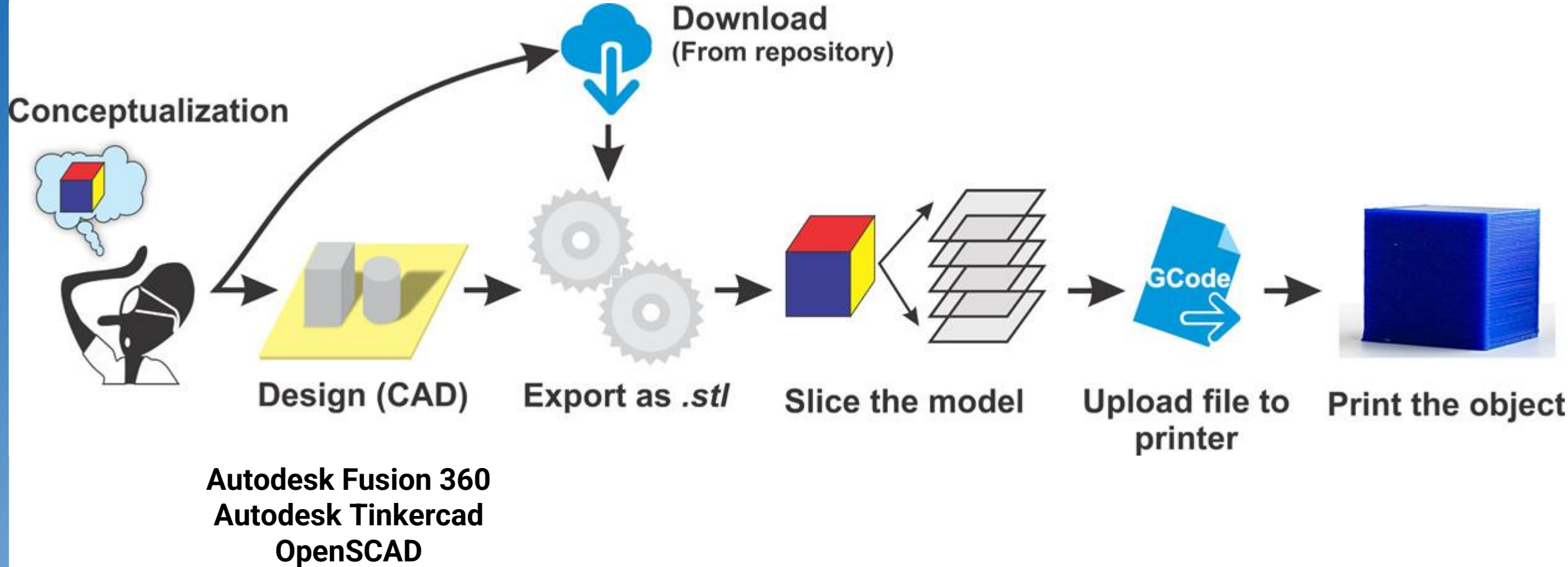
3D printed farms



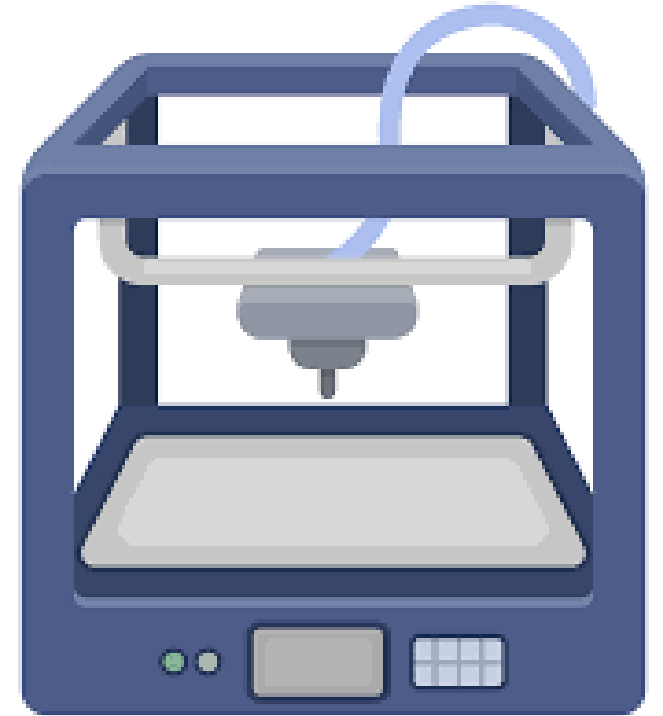
How is the 3D printing workflow?



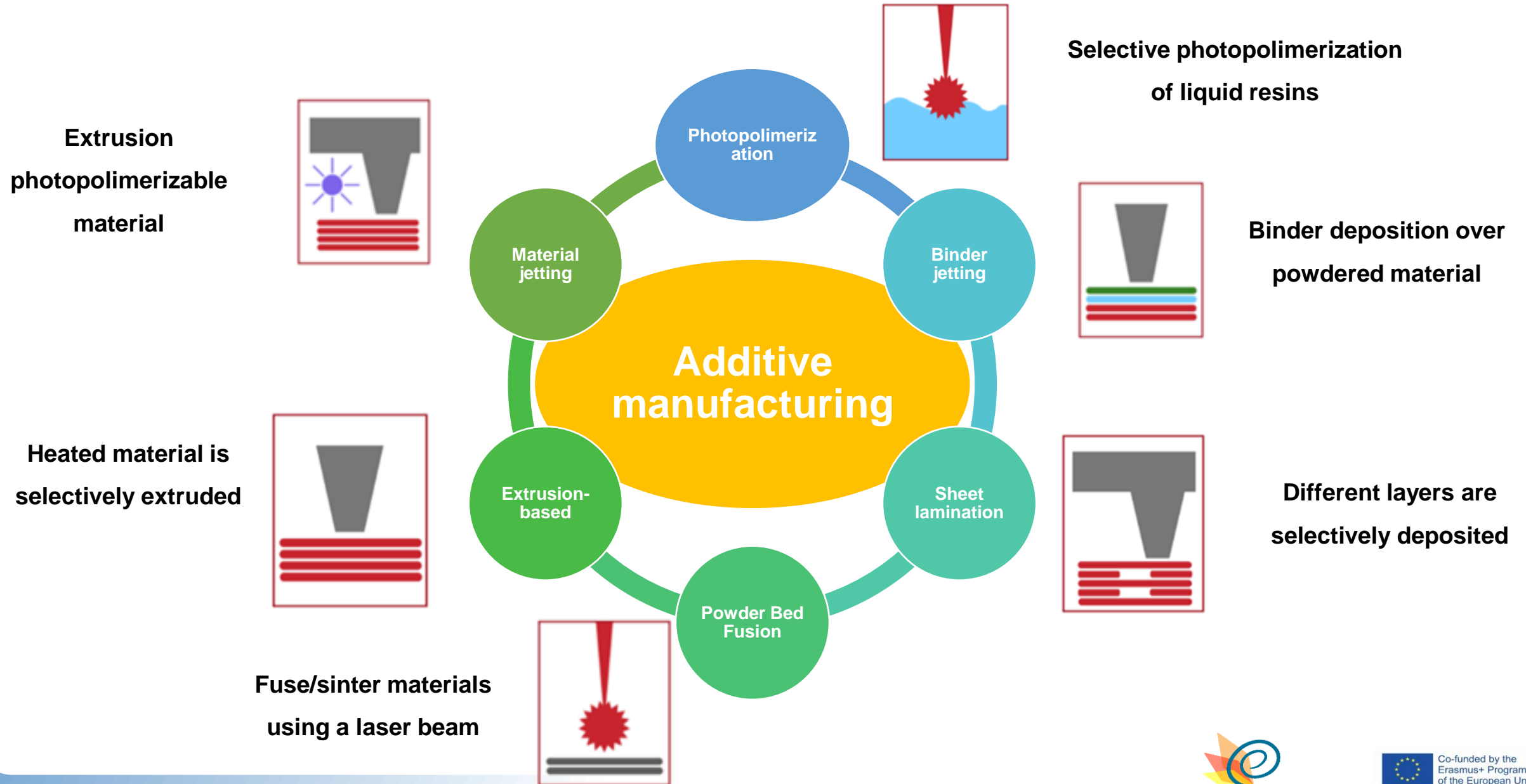
3D printing workflow



2. 3D printing techniques classification



3D printing techniques

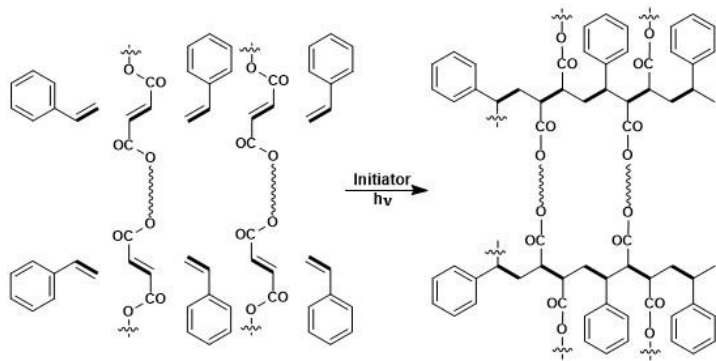


Photopolymerization techniques

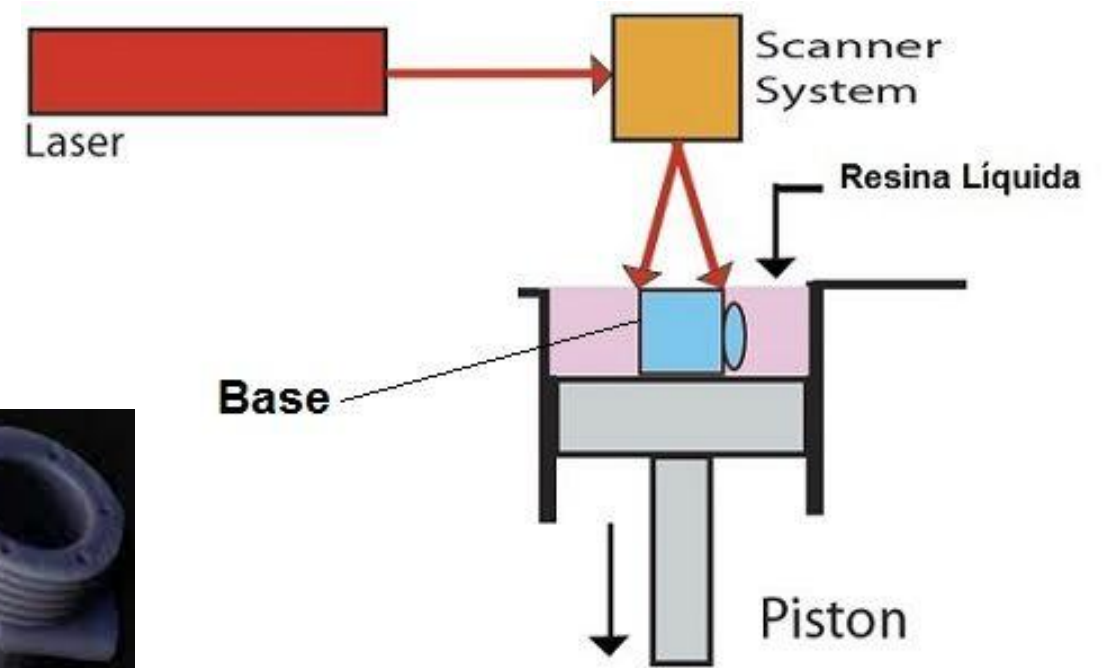
Técnicas de fotopolimerización

Consist in the creation of a 3D object by the layer by layer solidification of photosensible polymers able to polymerize in the presence of light. It starts with a vat containing the liquid resin.

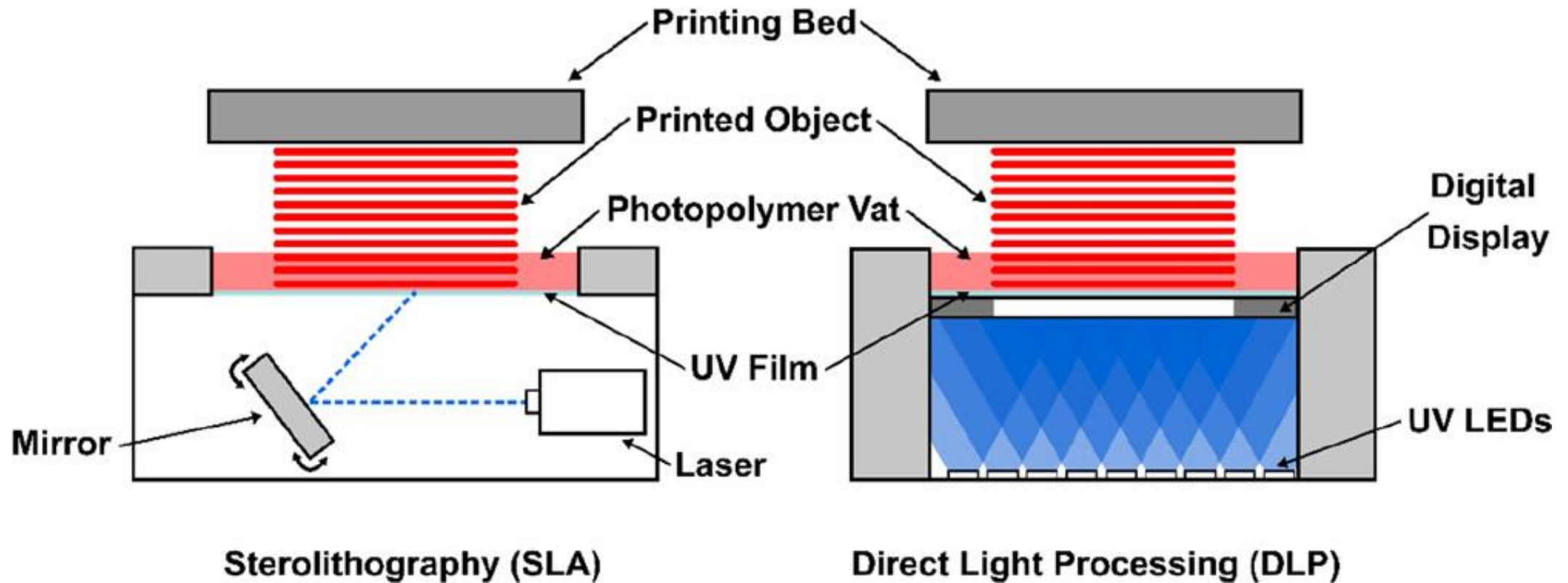
- Cheap
- Easy to use
- Smooth Surface
- Tighter unions (covalent bonding)
- Postprocessing steps
- Benchtop instrumentation
- Limited materials



Monomeric styrene and oligomeric acrylates can be used to produce crosslinked polymeric structures through photopolymerization



Photopolymerization techniques



Digital light processing (DLP)



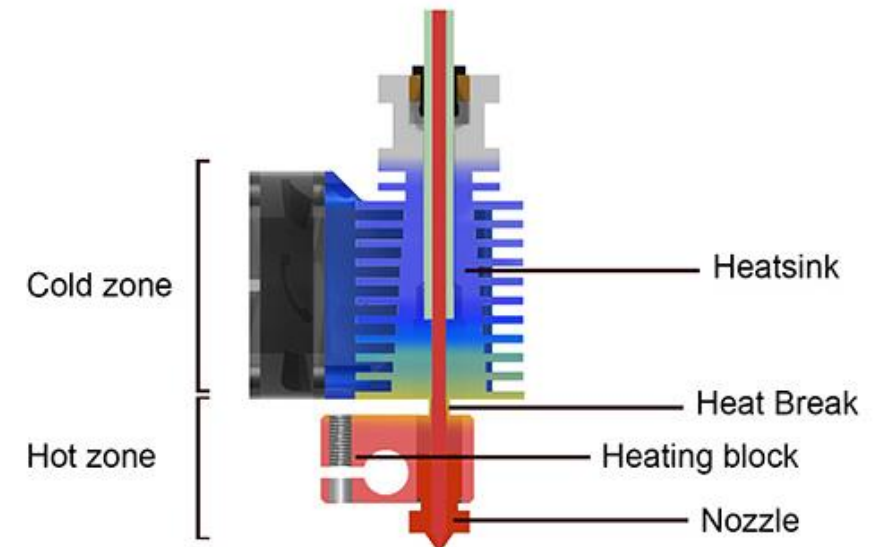
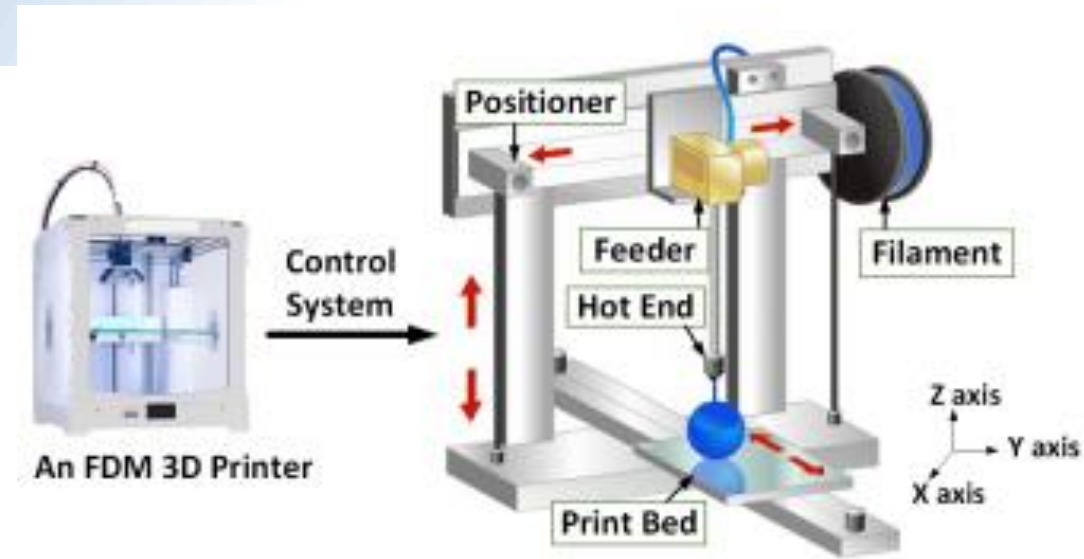
Extrusion techniques

Extrusion techniques

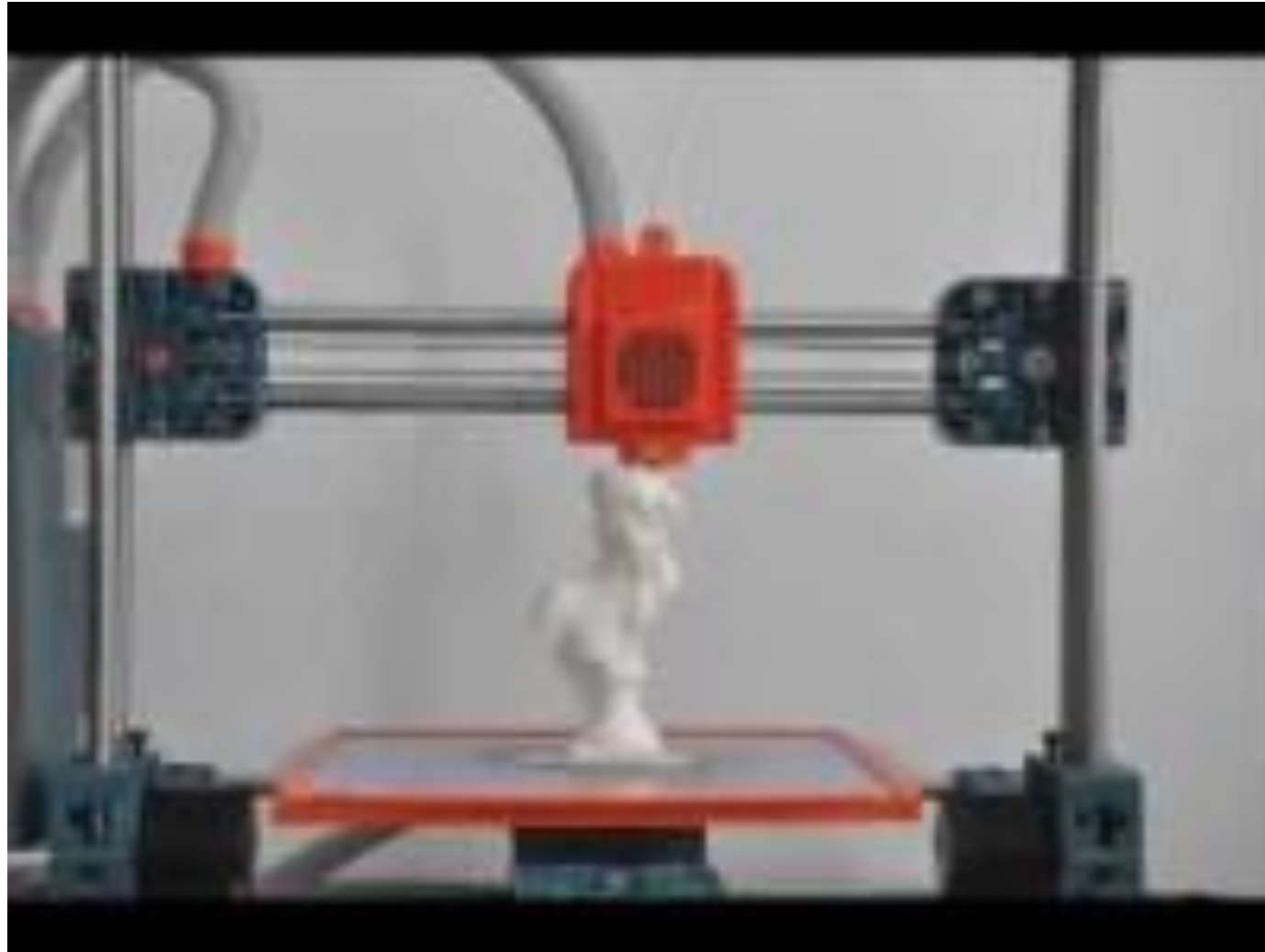
Fused Deposition Modelling (FDM)

Thermoplastic material is fused and selectively deposited layer by layer to create a solid 3D object.

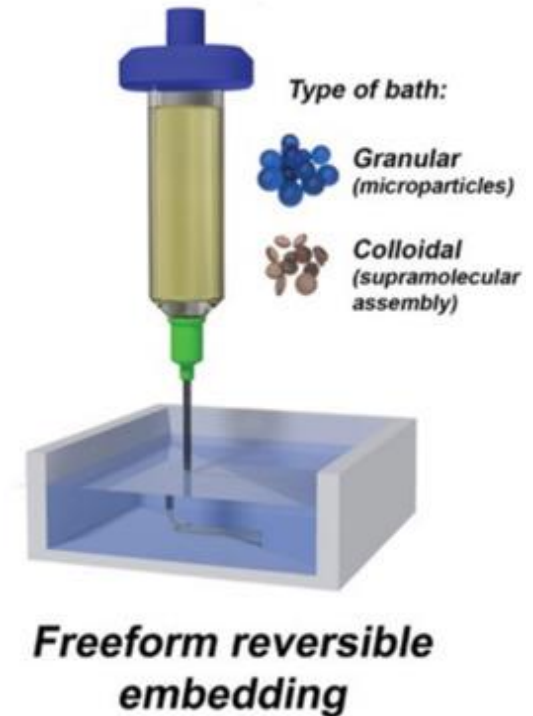
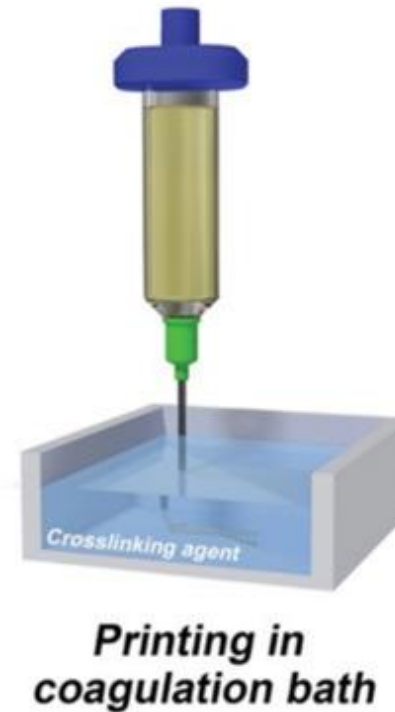
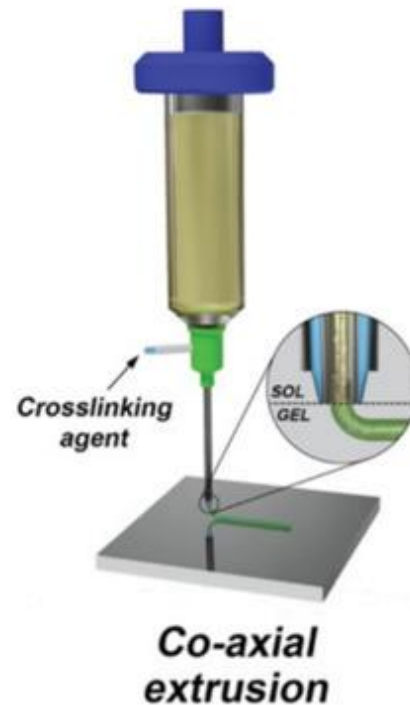
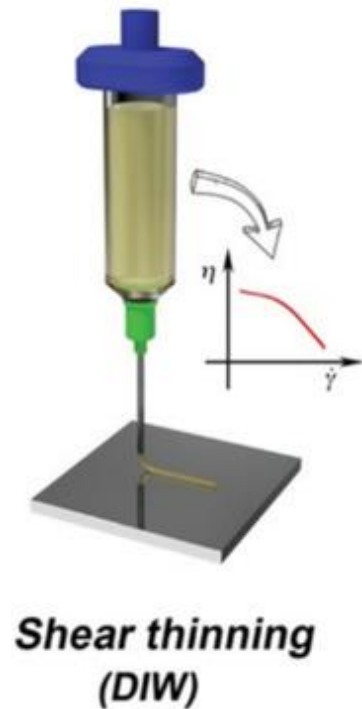
- Most widespread technique
- Cheap
- Easy to use
- Wide range of materials and composites
- Benchtop instrumentation



Fused Deposition Modelling (FDM)



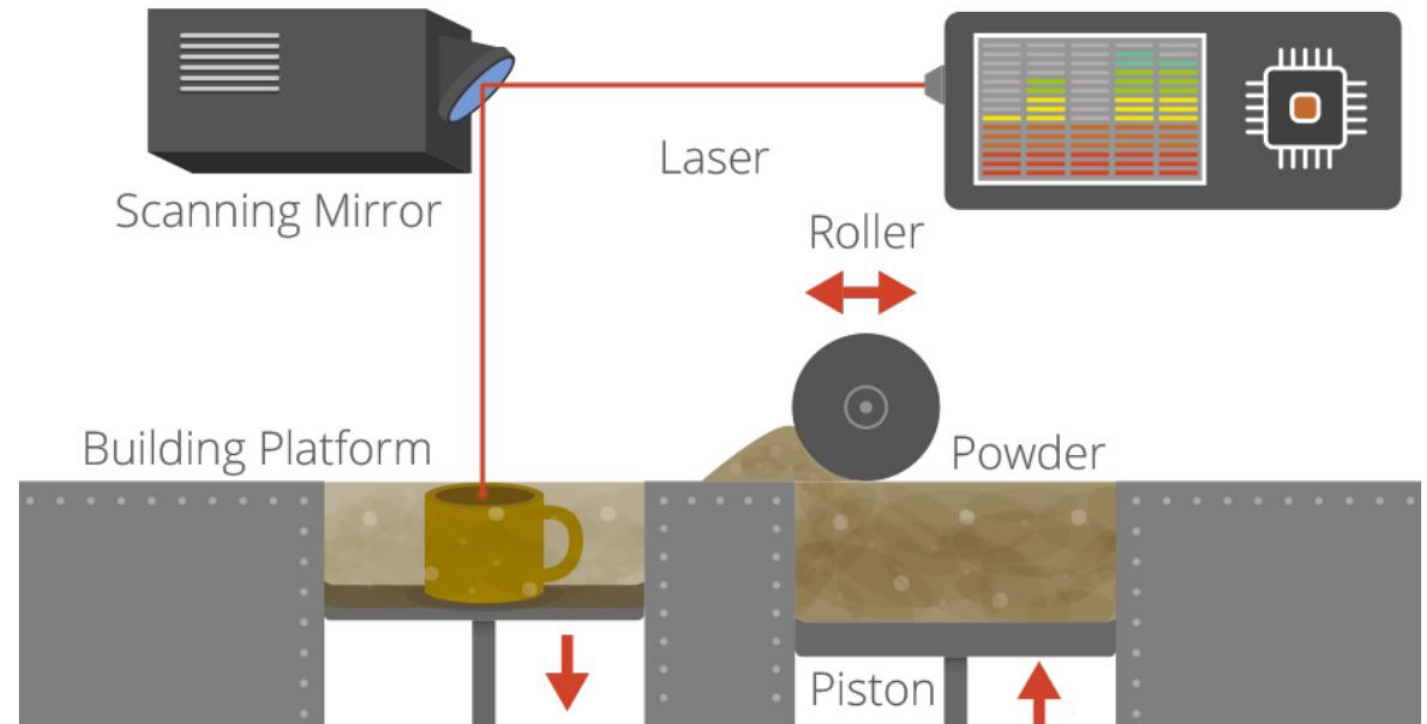
Extrusion-based bioprinting



Laser Sintering / Laser Melting

Selective Laser Sintering (SLS) : laser sintering of metallic and thermoplastic materials.

- Great mechanical resistance
- Pure metallic parts
- Good surface finish
- Postprocessing
- Bulky instrumentation



Metal 3D printing



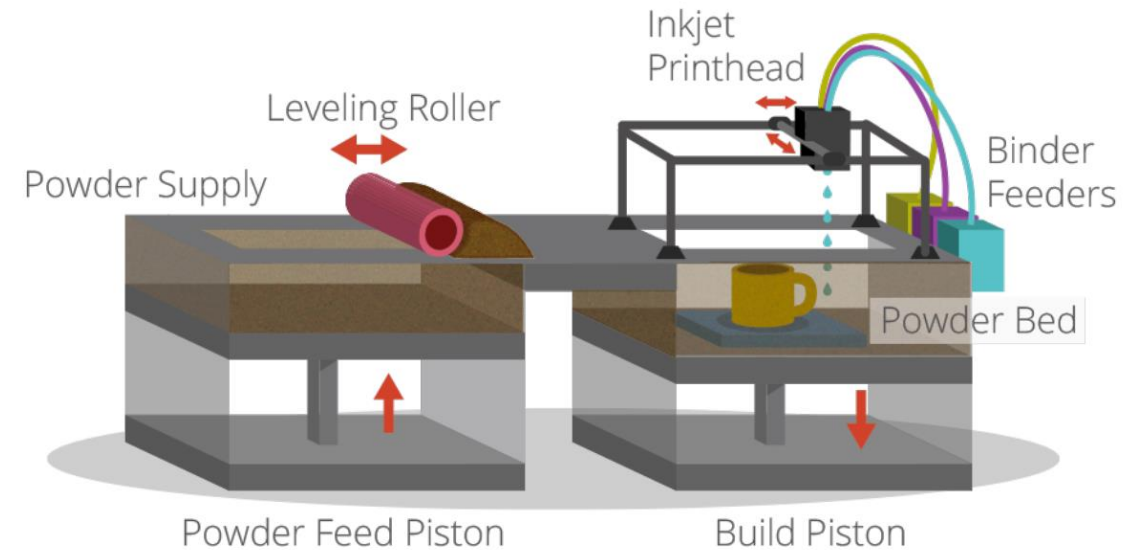
Binder Jetting

Binder Jetting

Binder Jetting print a binder over a powder bed enabling bind powder particles. Mainly used to create casting molds and metallic parts

Ventajas:

- No need for printing supports
- Bulky instrumentation
- Brittle parts
- Postprocessing steps

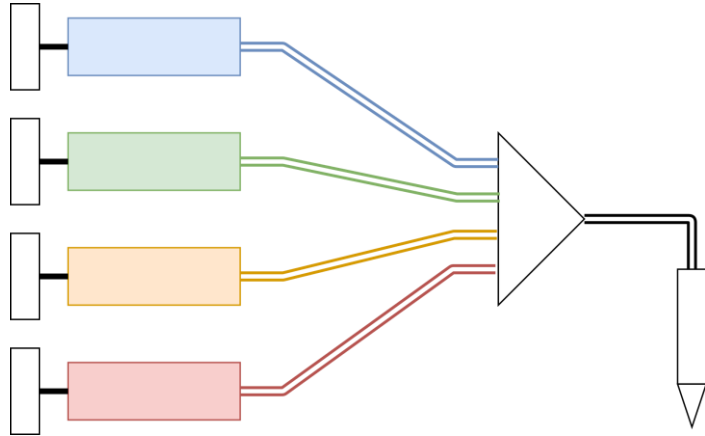


Binder Jetting

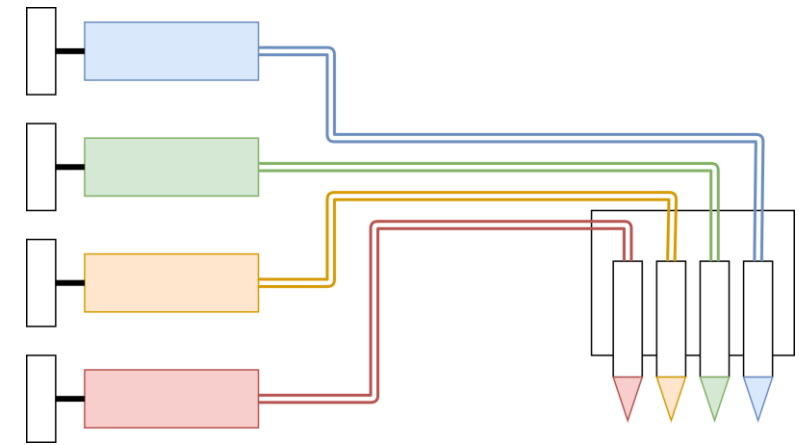
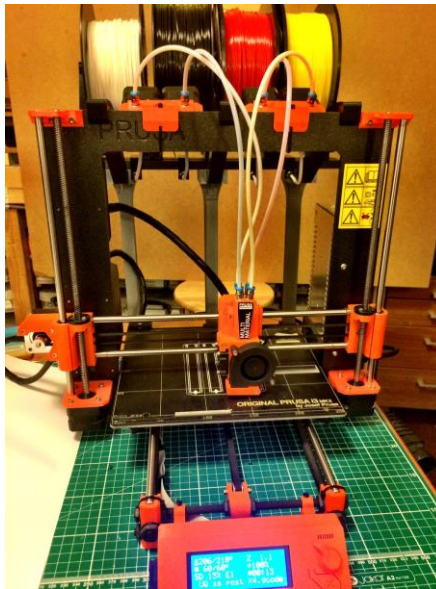


Multimaterial printing

FDM Multimaterial



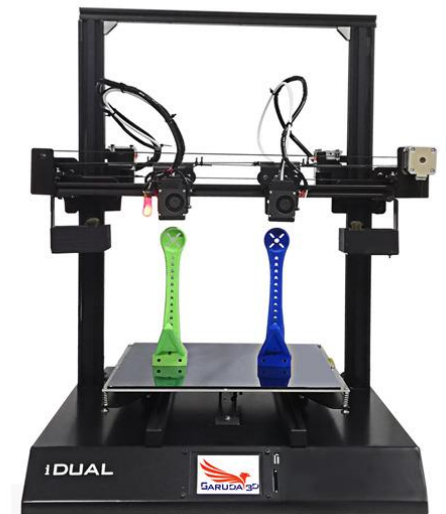
Extrusor individual



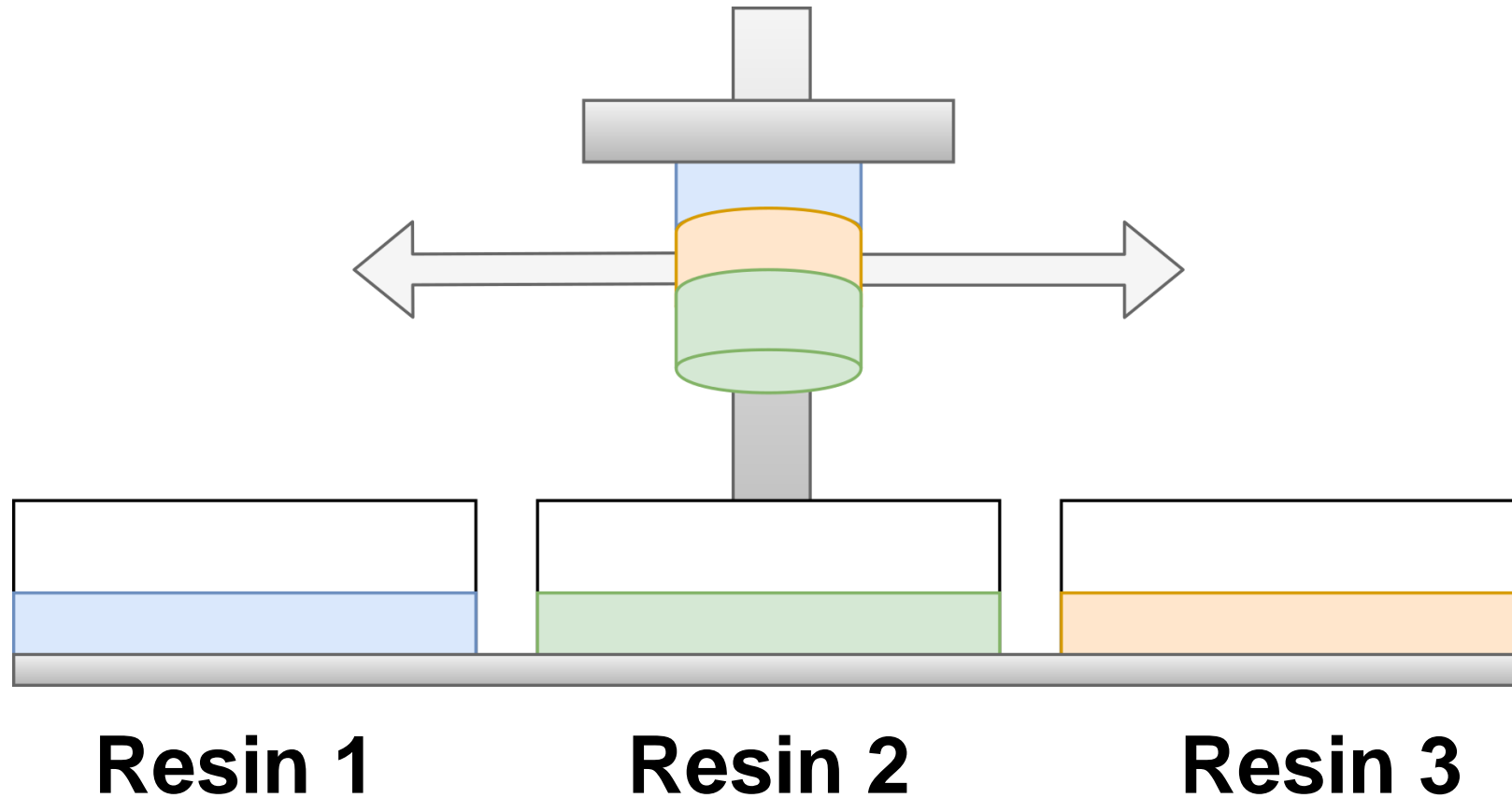
Doble extrusor



Doble extrusor independiente



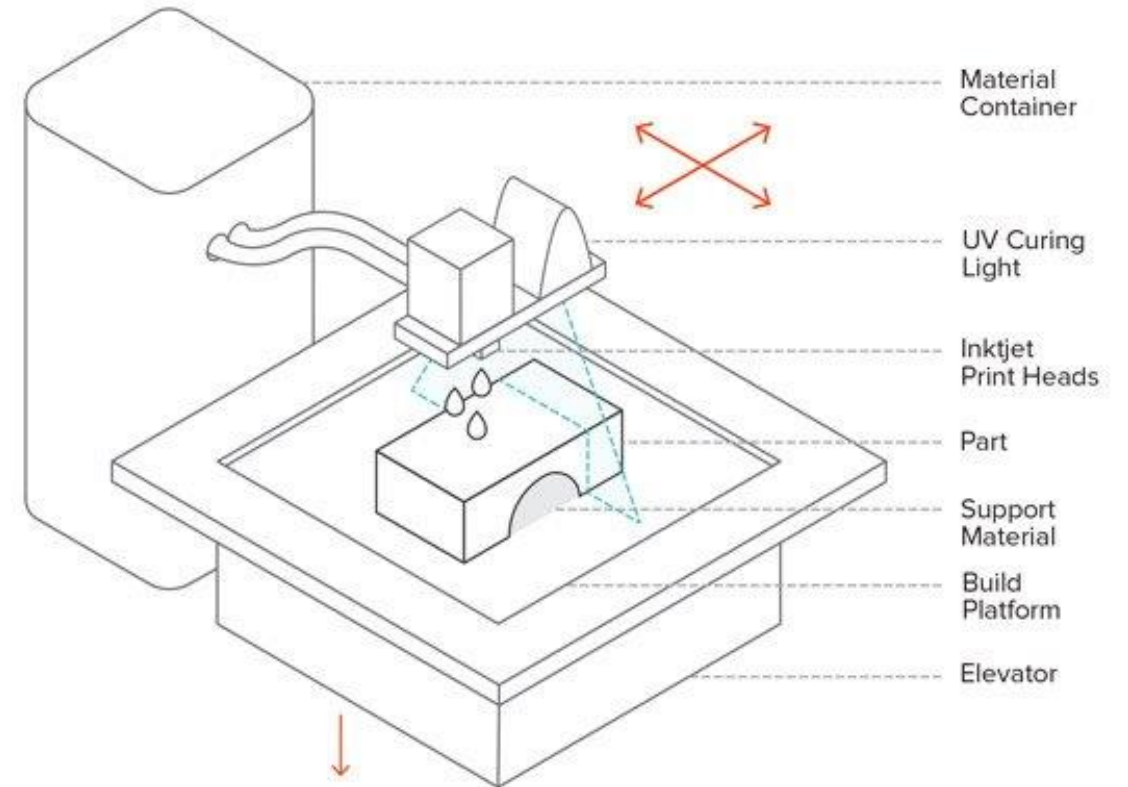
SLA Multimaterial



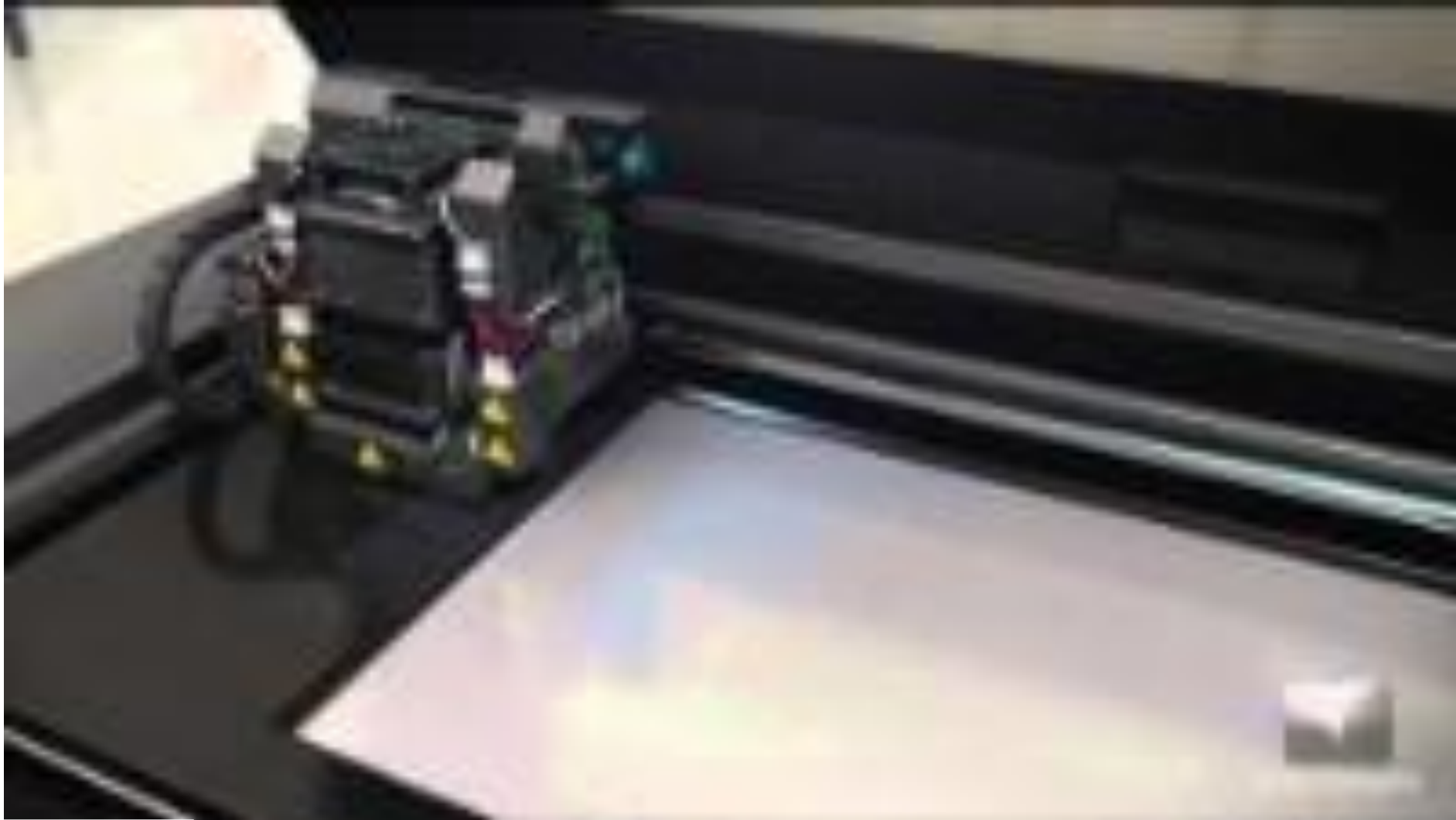
Material Jetting (*Polyjet*)

Material is jet through a nozzle and is photopolymerized (mix between FDM and photolithography)

- Simple multimaterial solution
- Very good surface finish
- Postprocessing steps
- Pieces are very light sensitive



Material Jetting



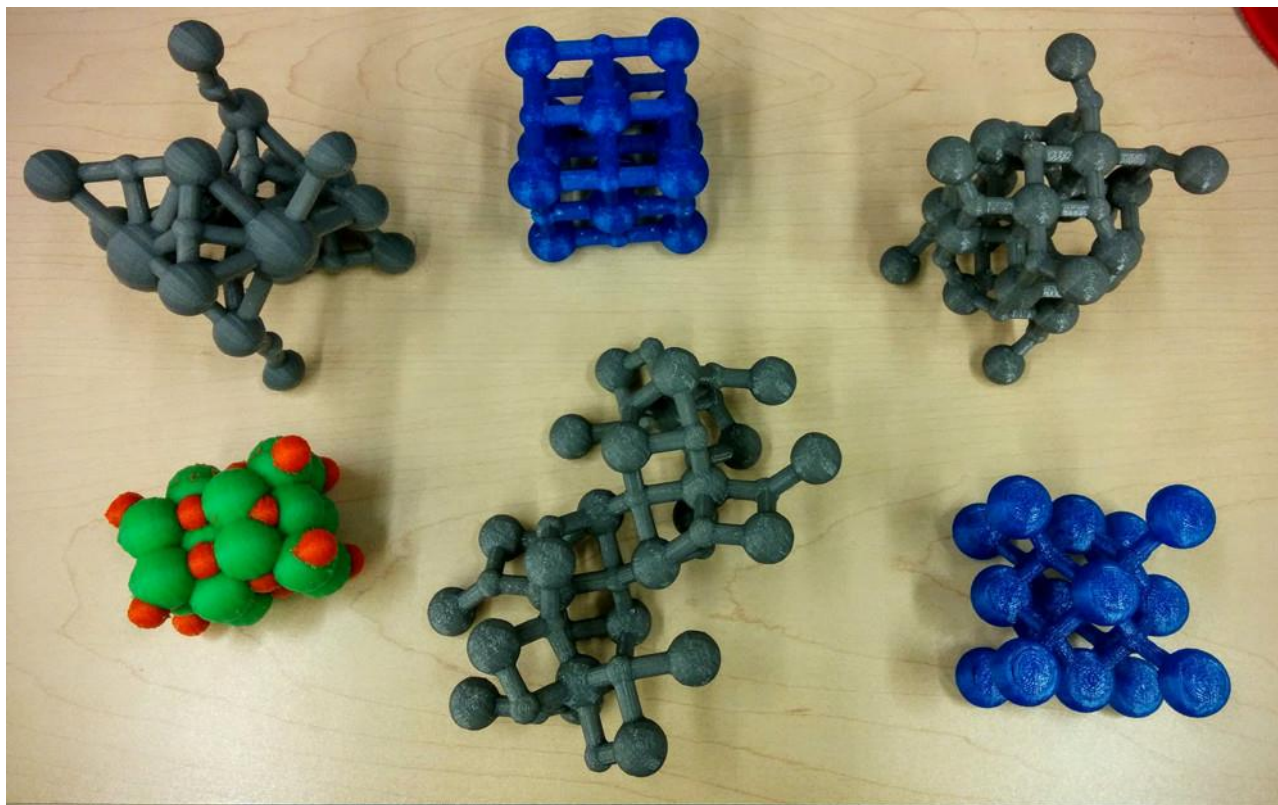
Material Jetting (*Polyjet*)



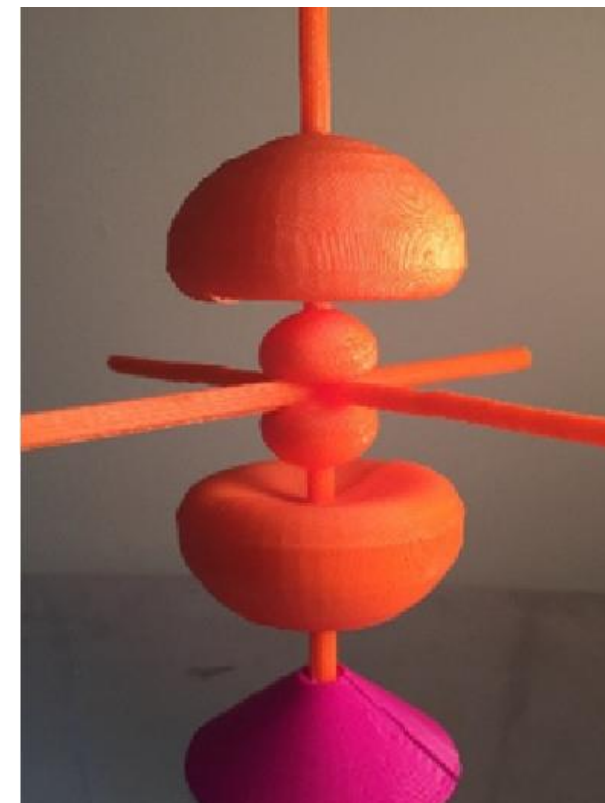
3. Applications in Science and Technology

Powerful tool in chemistry teaching

Crystal unit cells

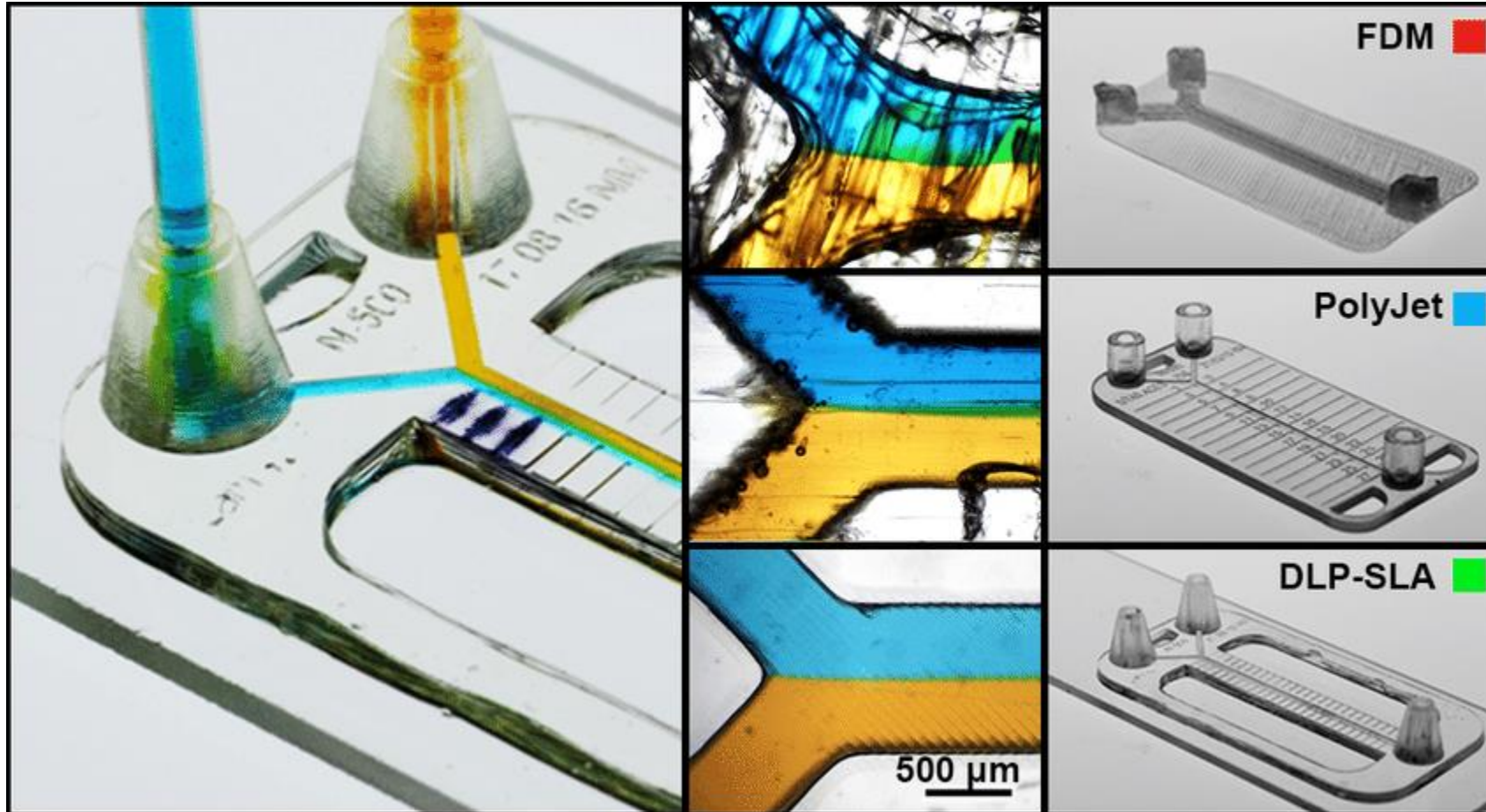


J. Chem. Educ. 2015, 92, 11, 1960-1962



J. Chem. Educ. 2016, 93, 9, 1586-1590

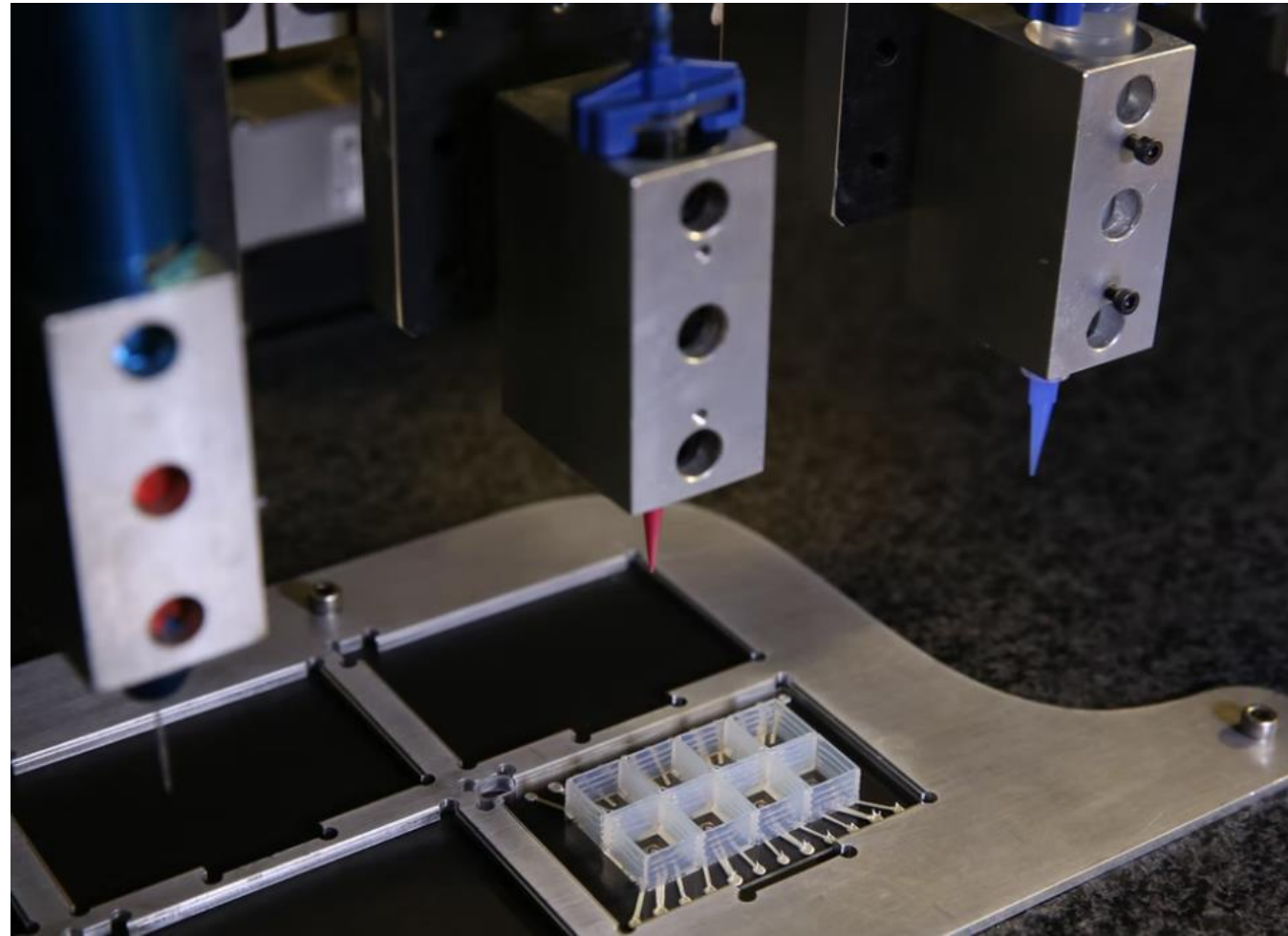
3D printed microfluidics. A comparison of techniques



Bioprinting

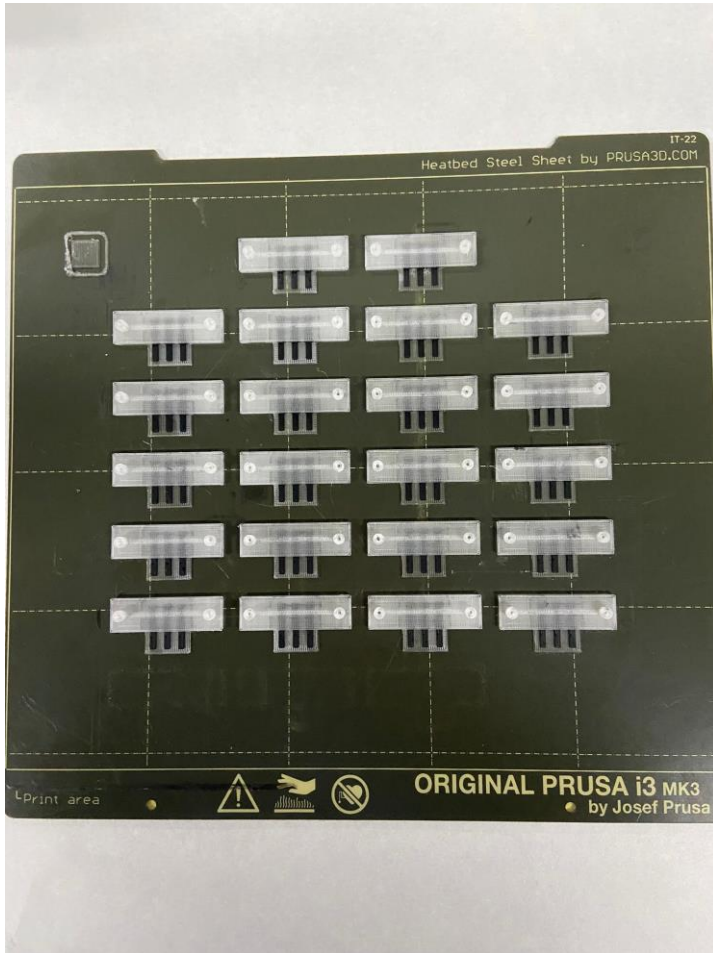


Bioprinting



<https://wyss.harvard.edu/news/first-entirely-3d-printed-organ-on-a-chip-with-integrated-sensors/>

Our work in MINYNANOTECH



Real device

