

Thrust Area 2: *Nanomechanics (Scaffolds)*

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Nanosystems Engineering Research Center for Directed Multiscale
Assembly of Cellular Metamaterials with Nanoscale Precision

National Science Foundation: EEC-1647837

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Projects 1,2,5

Mechanical Engineering PhD candidate



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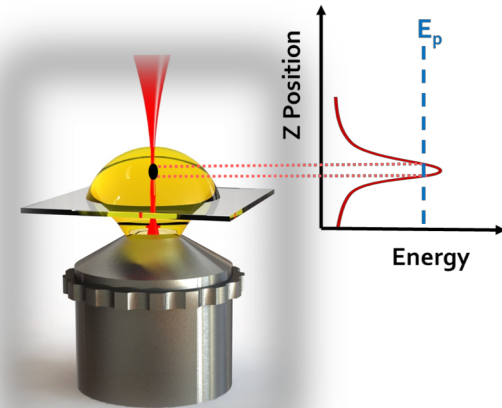


- 3D printing introduction
- What is direct laser writing?
- Direct laser writing challenges
- Applications in CELL-MET



- Types of 3D printing
 - Extrusion printing
 - Nozzle that extrudes material one layer at a time
 - Stereolithography
 - Liquid photoresist (light-sensitive material) is selectively exposed to a laser
 - Exposed photoresist solidifies, more photoresist is added, next layer is exposed.

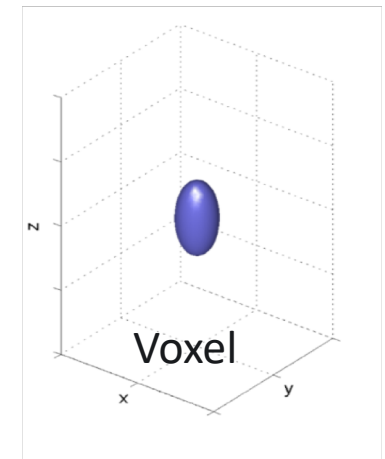
- Direct Laser Writing (DLW)
 - Microscopic 3D printing
 - Resolution down to 200 nm (x-y) and 600 nm (z)



Microscope Objective lens

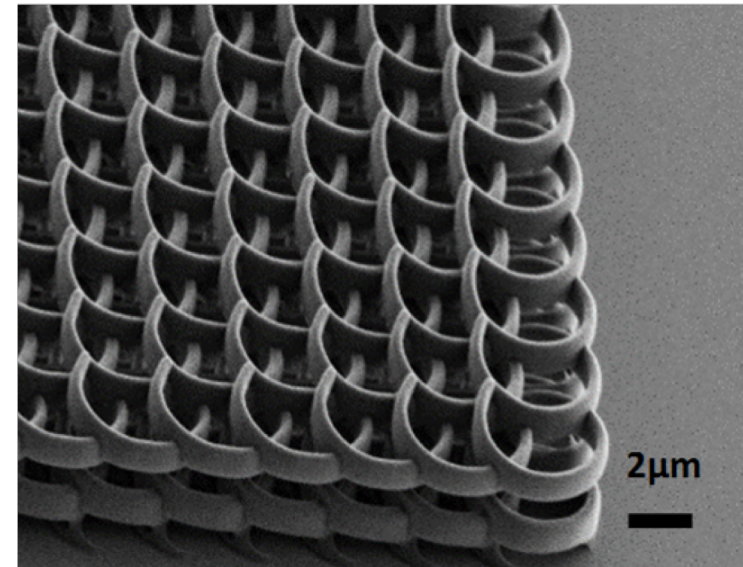
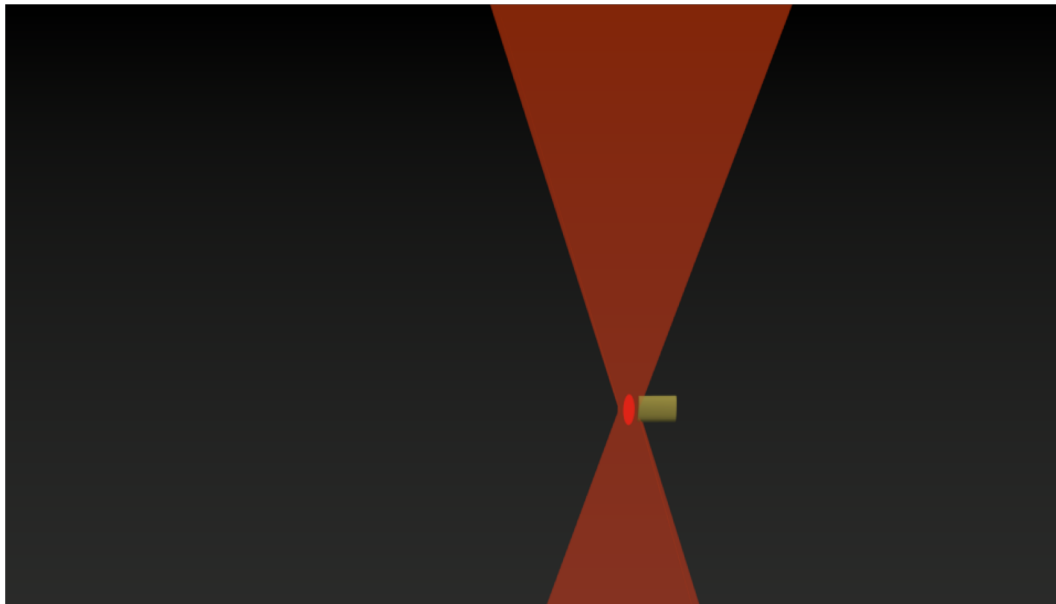
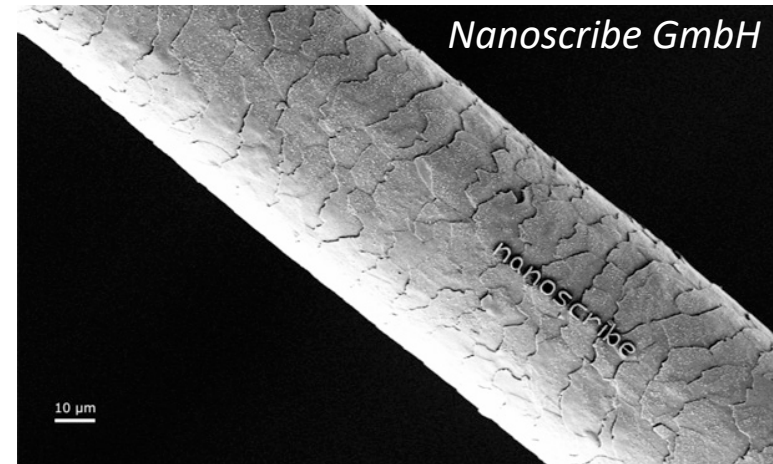
Microscope Objective lens

Inverted Microscope



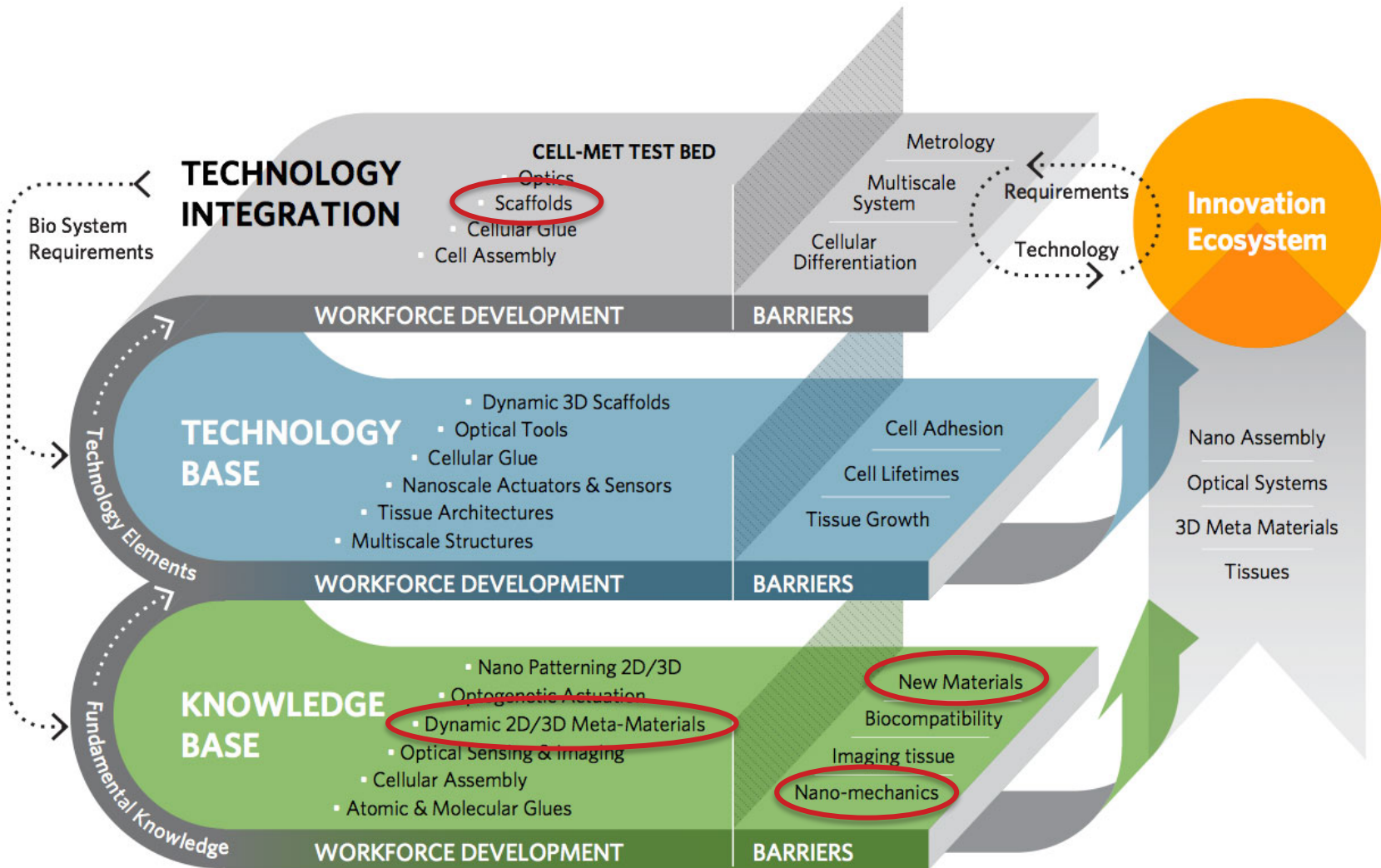


- Direct Laser Writing
 - Microscopic 3D printing

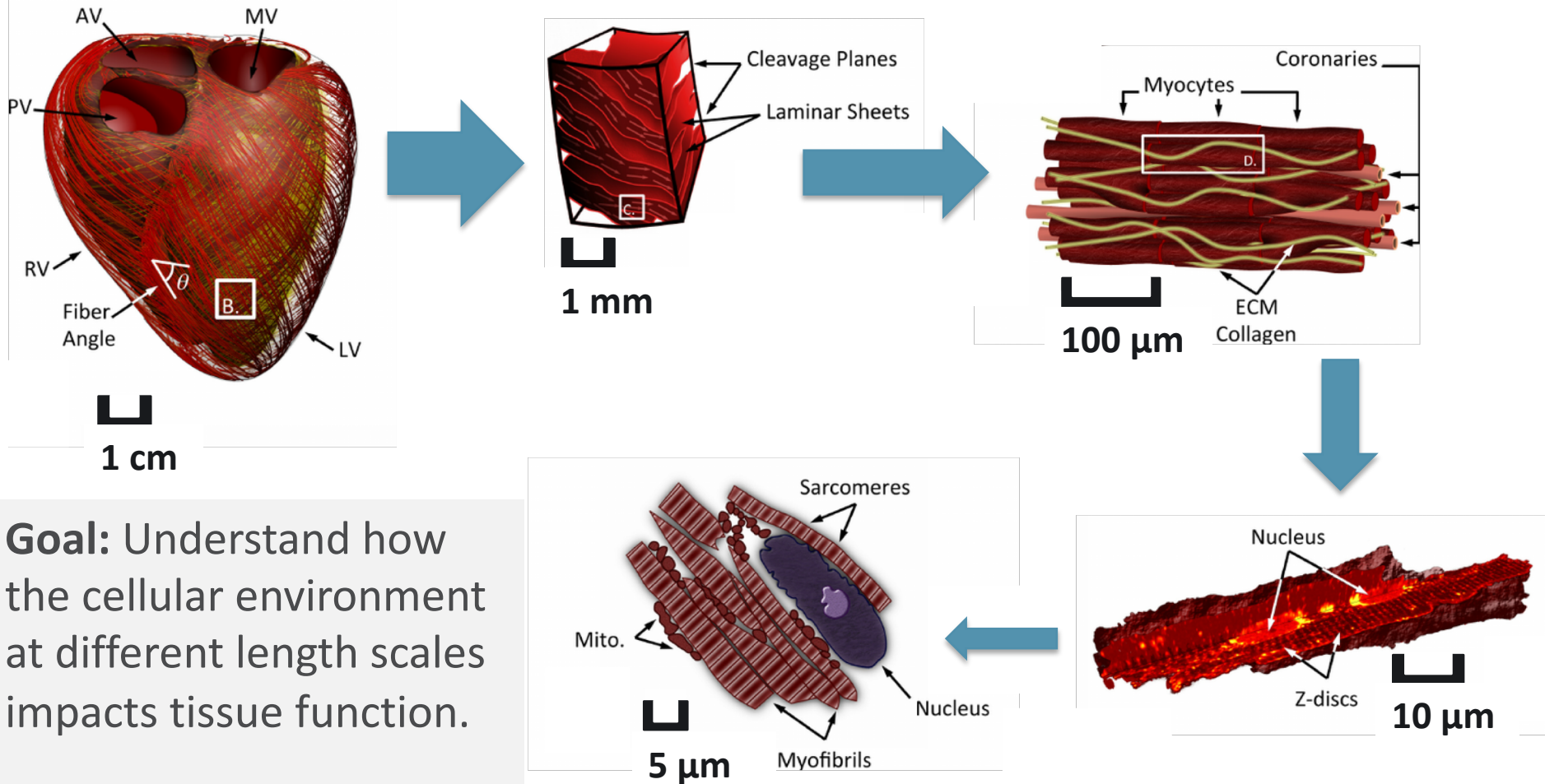




- Developing materials that can be used with DLW
- Determining material properties of what you print
- Scaling up the fabrication process
- Finding/handling the structures!



Application - Scaffolds

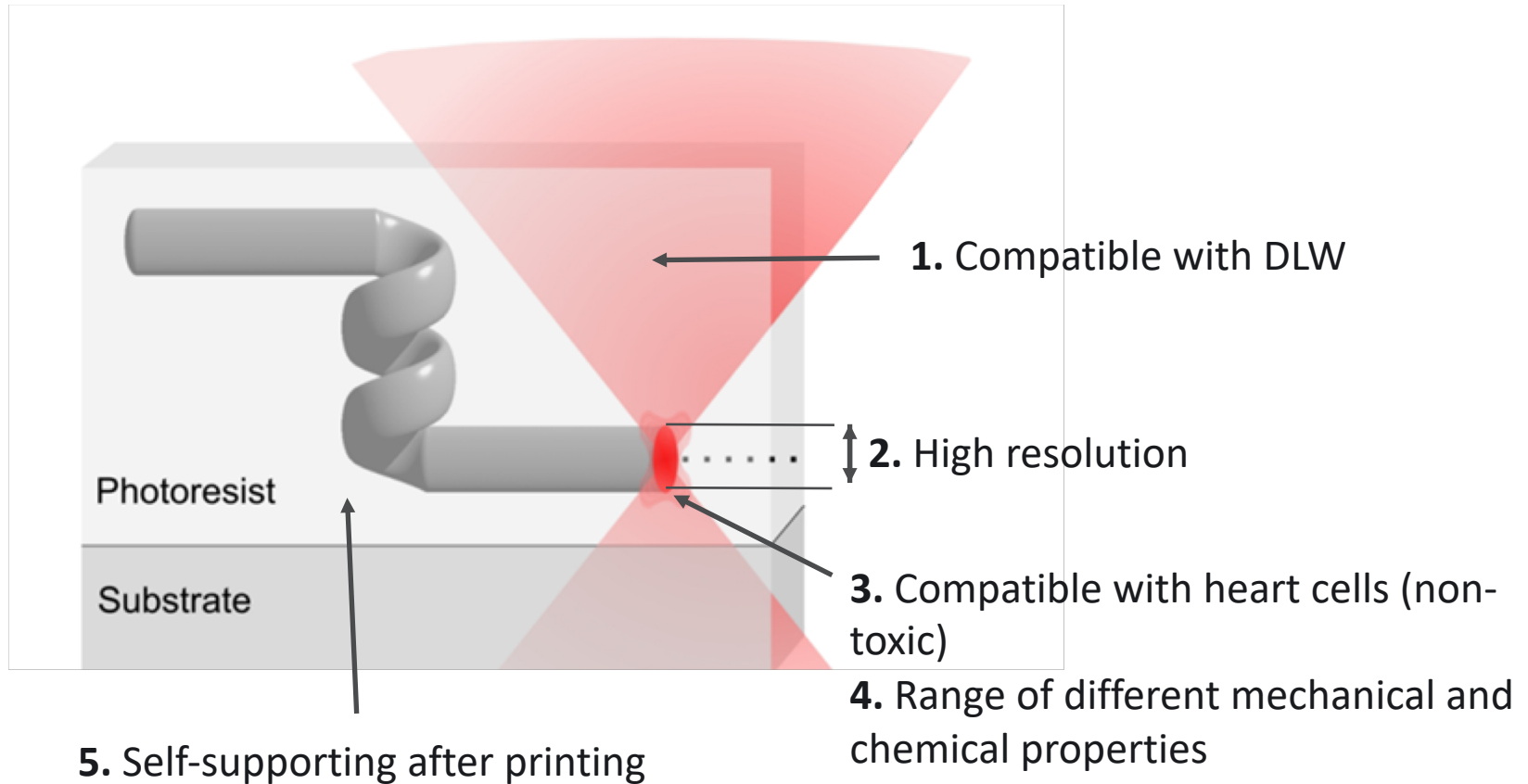


Goal: Understand how the cellular environment at different length scales impacts tissue function.

R. Chabiniok, et al., *Interface Focus* 2016, 6, DOI 10.1098/rsfs.2015.0083.

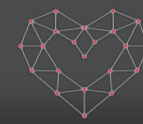


What do we want in a scaffold material?

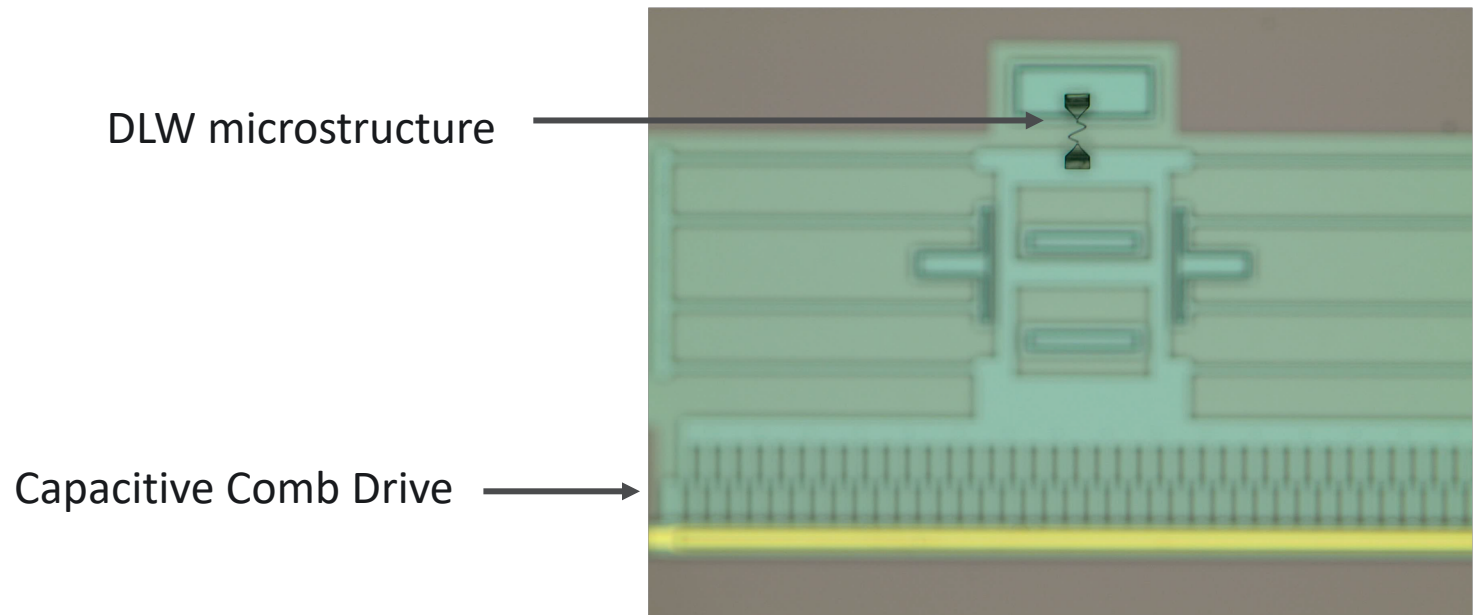


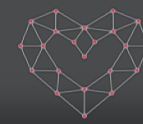


- How do you move something you can't even see?
 - MEMS (micro-electromechanical systems)
 - Magnetics
 - Microfluidics
 - Nanoindentation

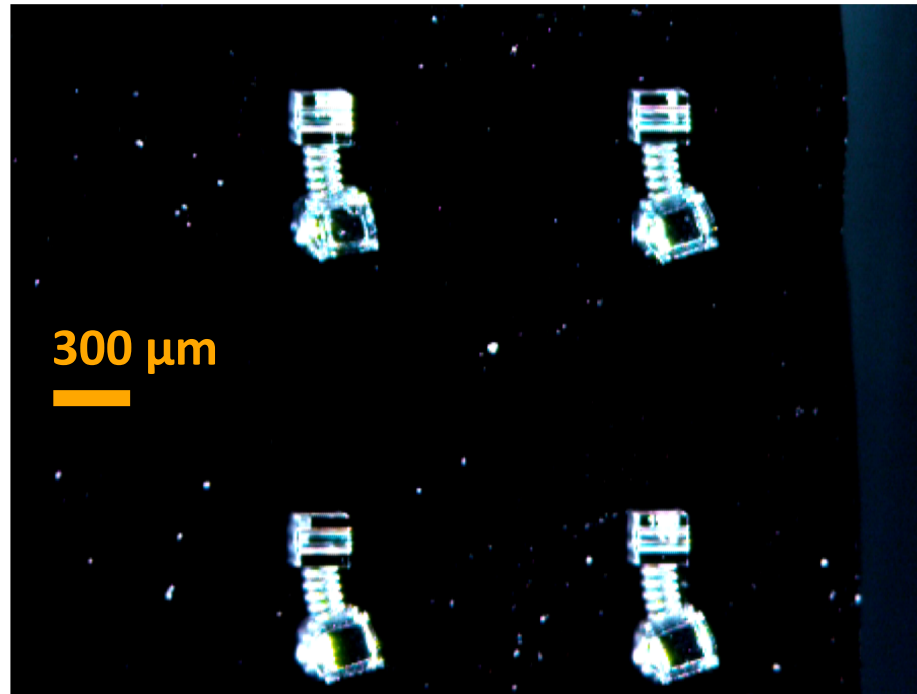


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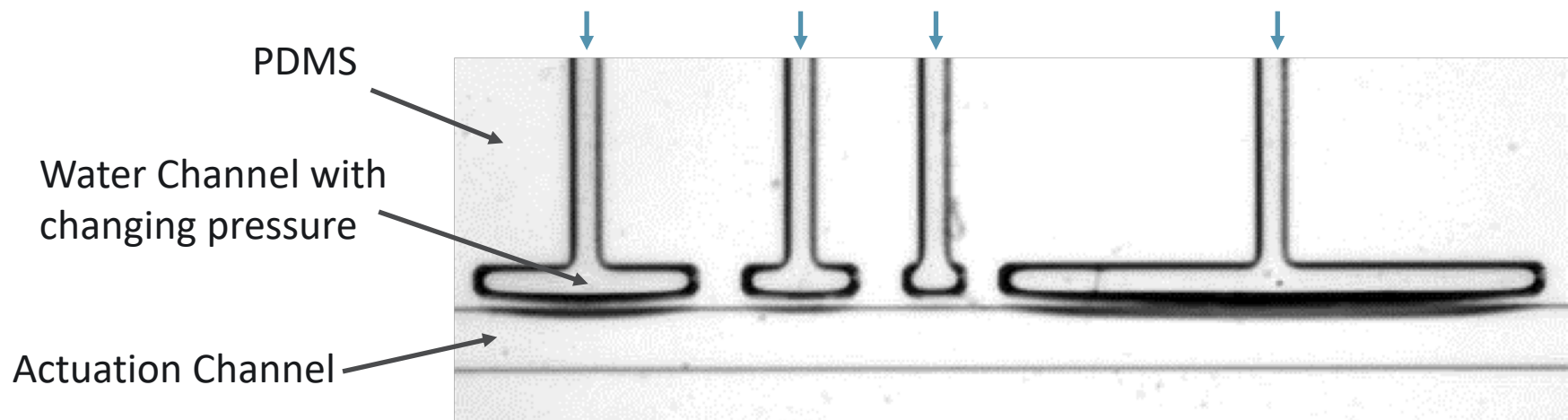


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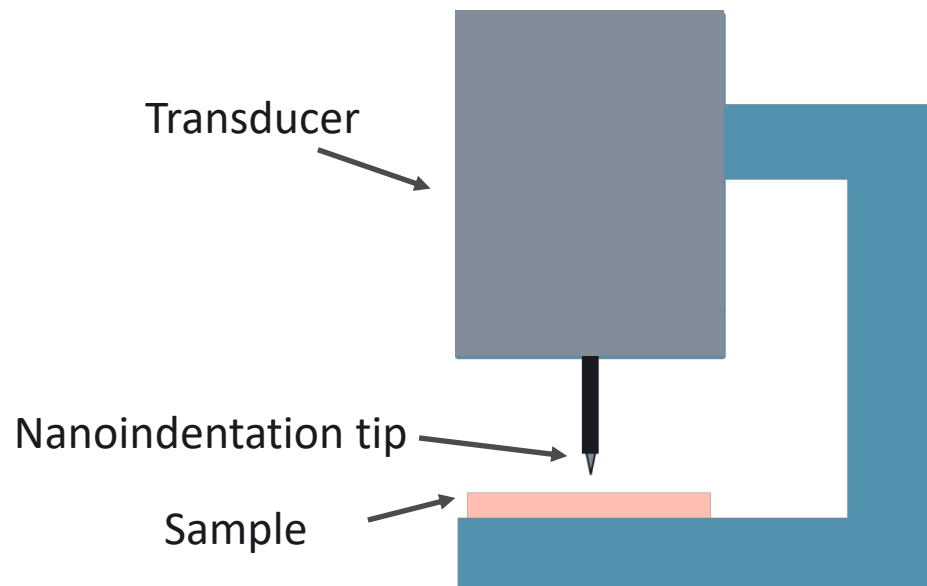


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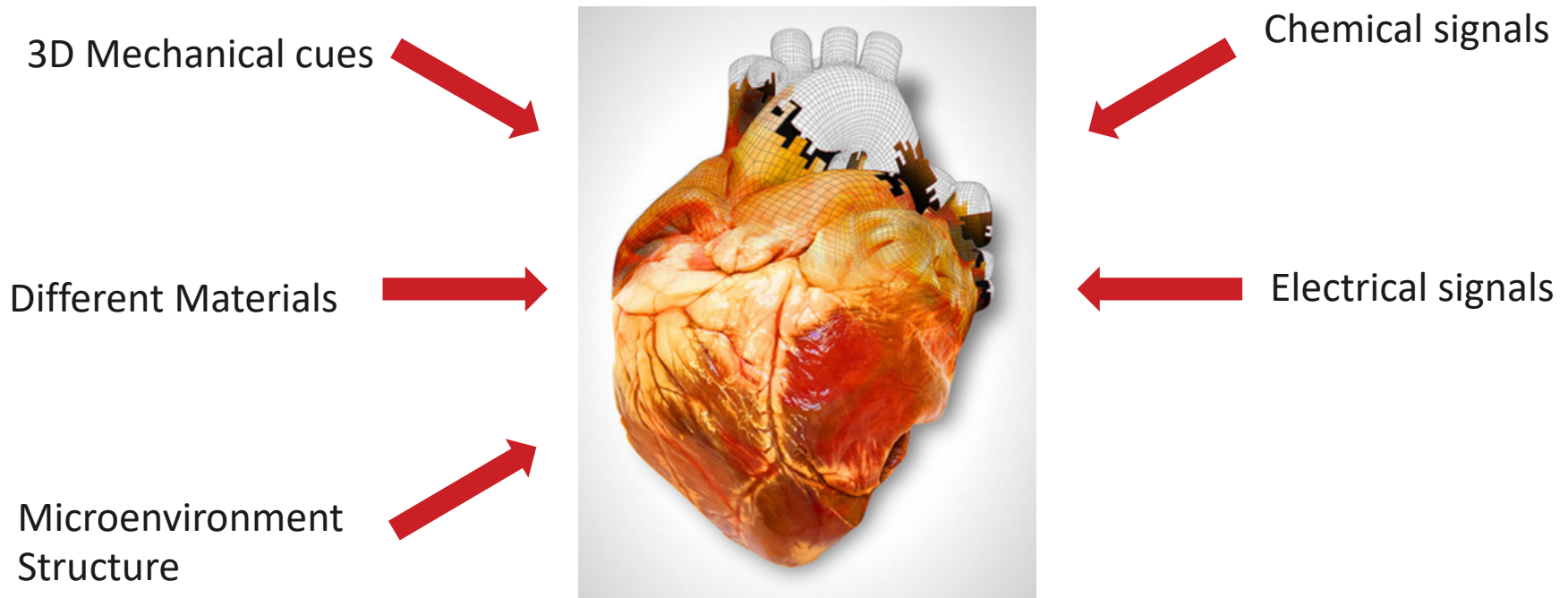


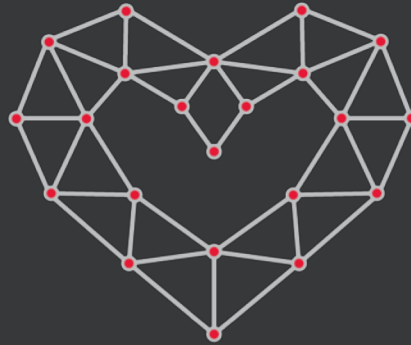
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- DLW will be a prototyping tool to help us understand what physical and mechanical cues are important for controlling how heart tissue behaves.

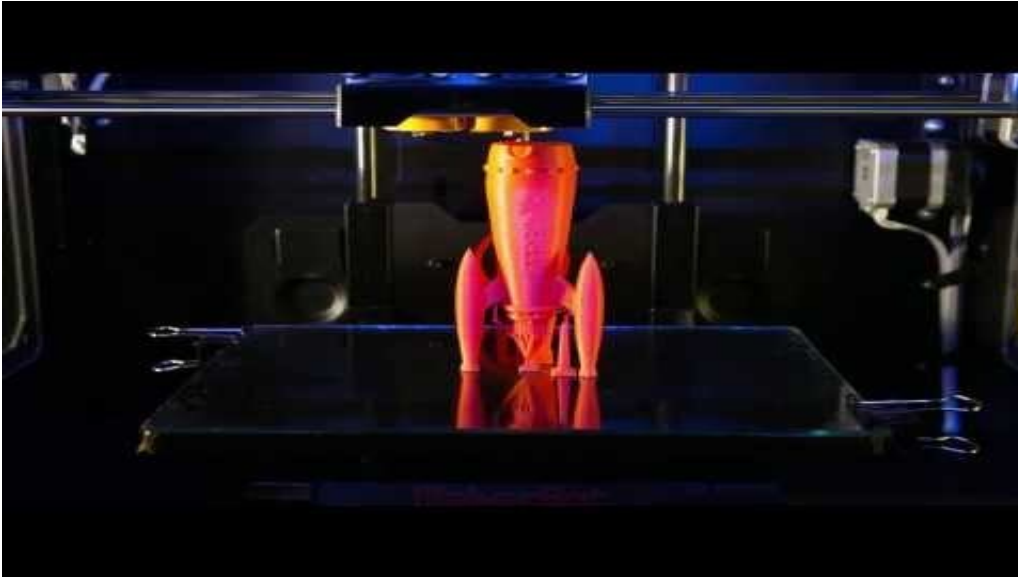




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Extrusion

MakerBot 3D Printer



Stereolithography

Carbon 3D Printer

