



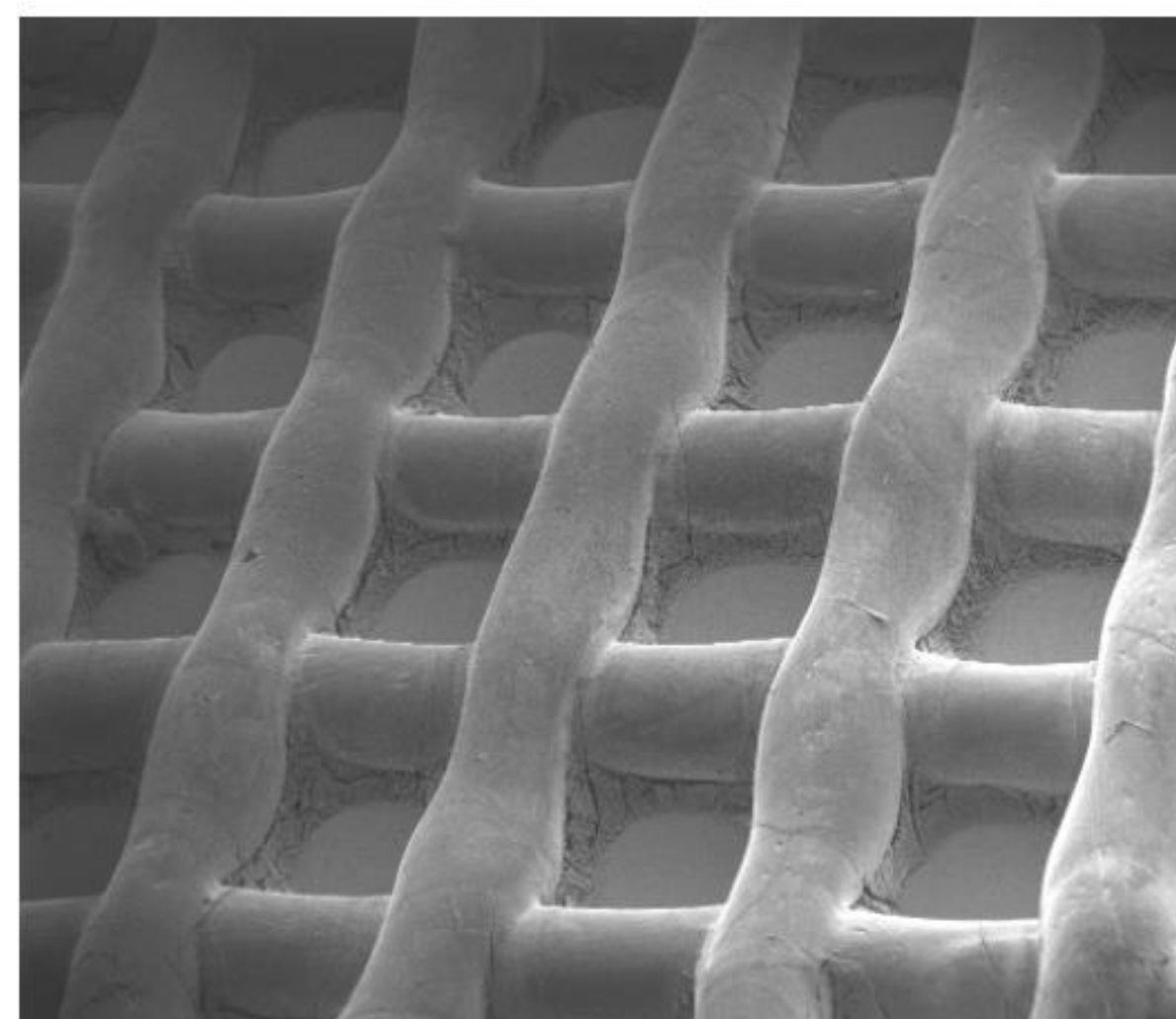
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UNIVERSITY
EXCELLENCE INITIATIVE
Ministry of Science
and Higher Education

3D PRINTING FOR BIOMEDICAL APPLICATIONS

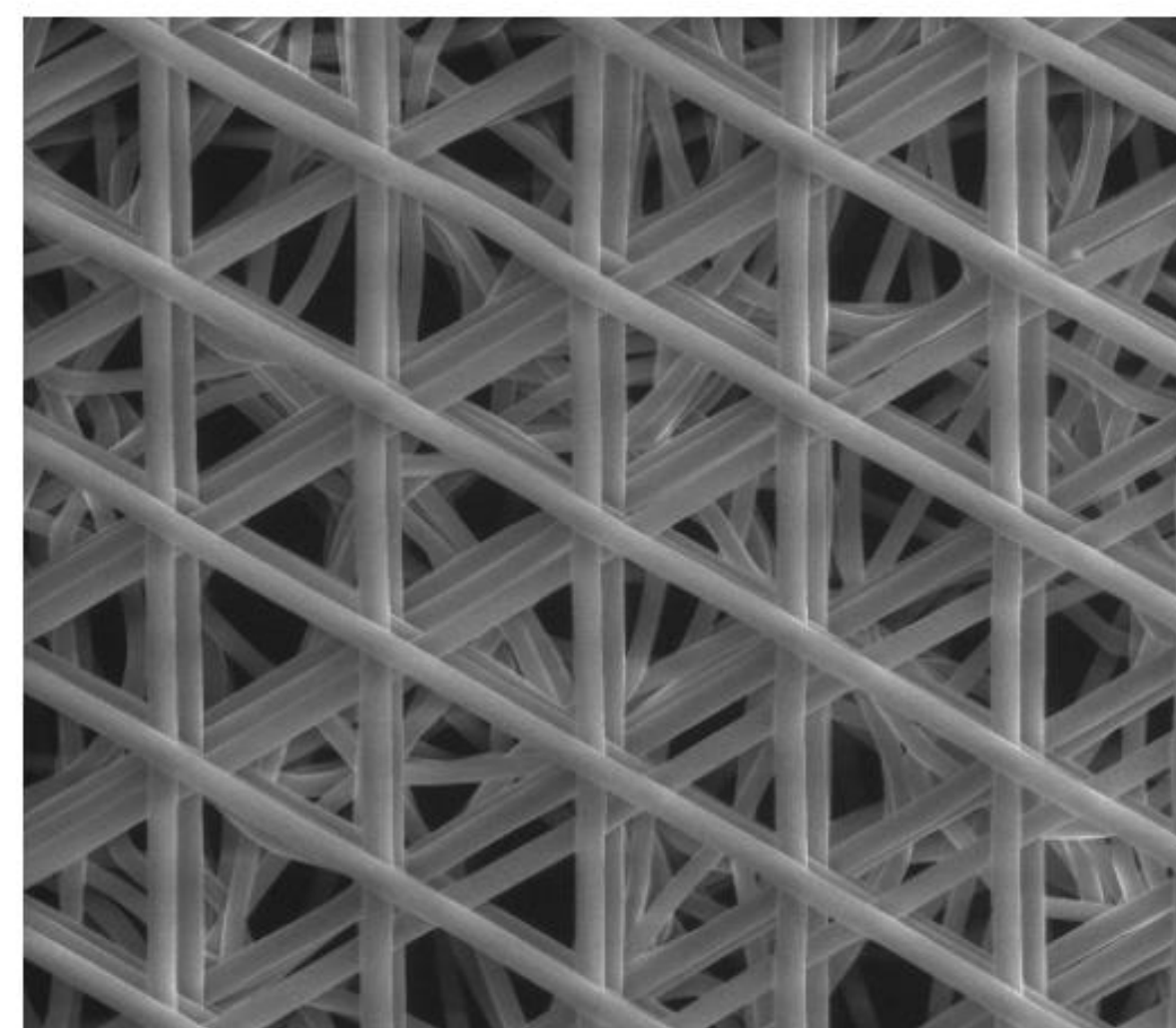
Gosia (Malgorzata) Wlodarczyk-Biegun



3D BIOPRINTING



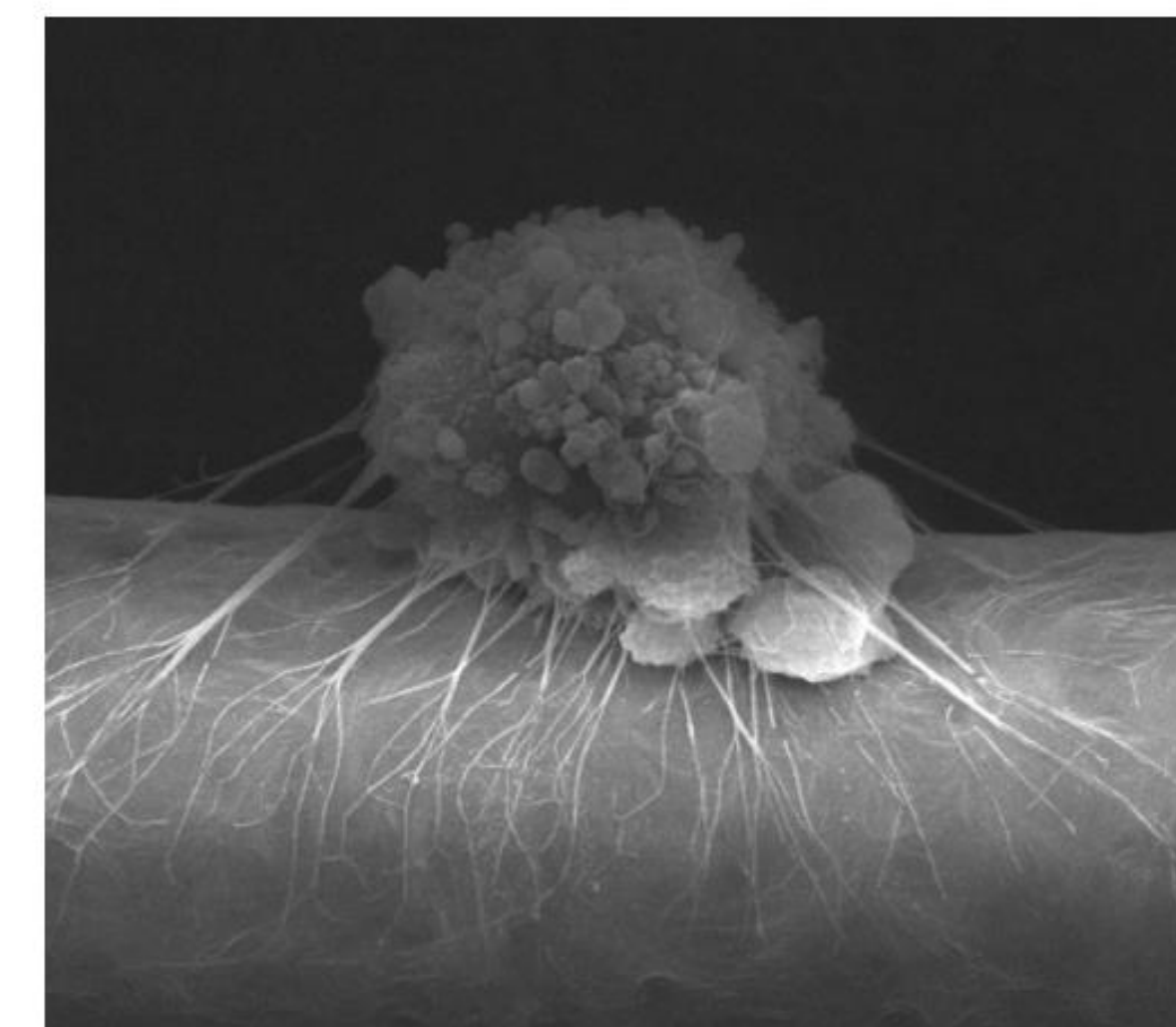
We develop new printable materials



MELT ELECTROWRITING



We study cell-material interactions



BIO-INSTRUCTIVE MATERIALS



We work on *in vitro* models
Customized implants

Focus on hierarchical and gradient tissues

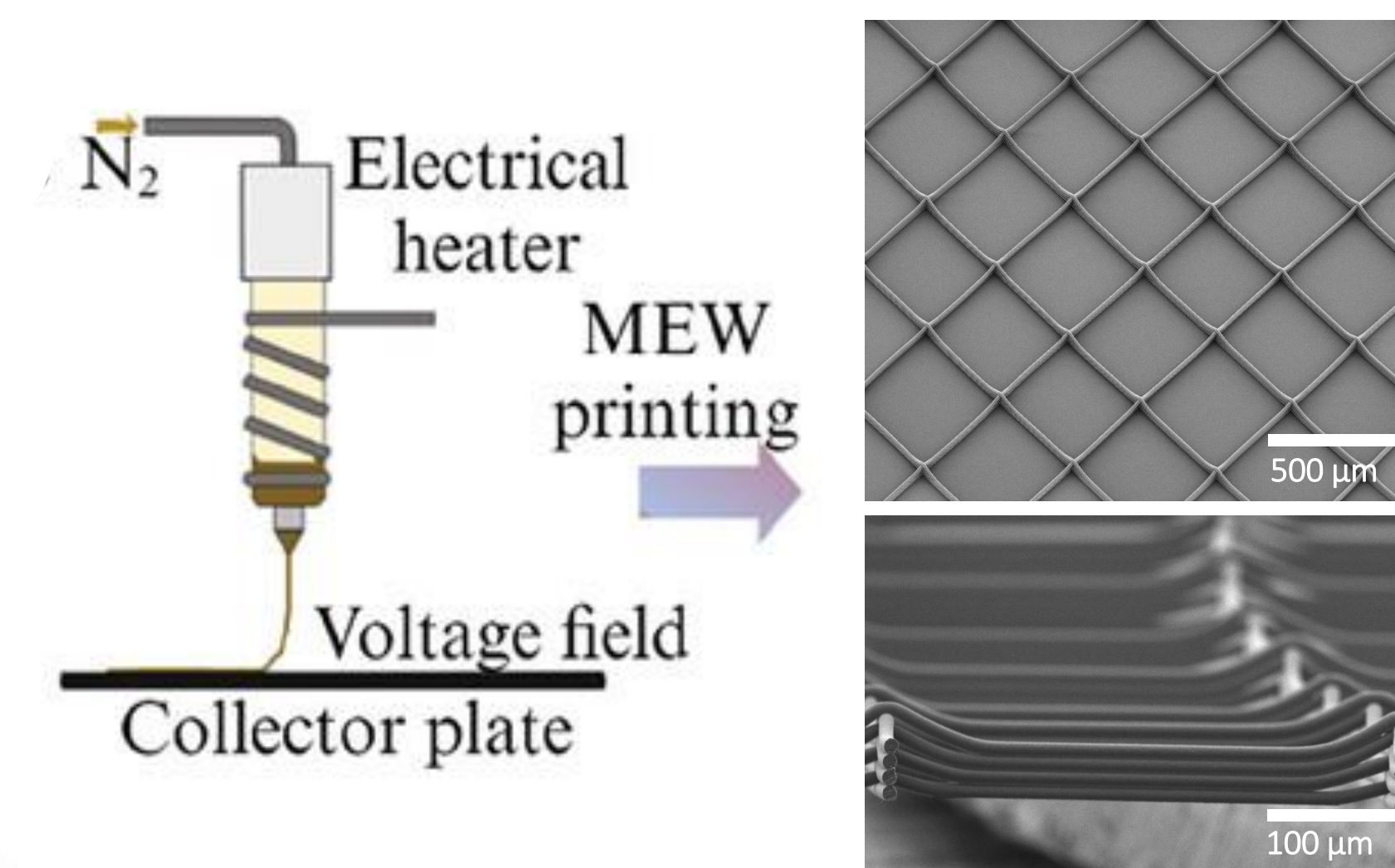
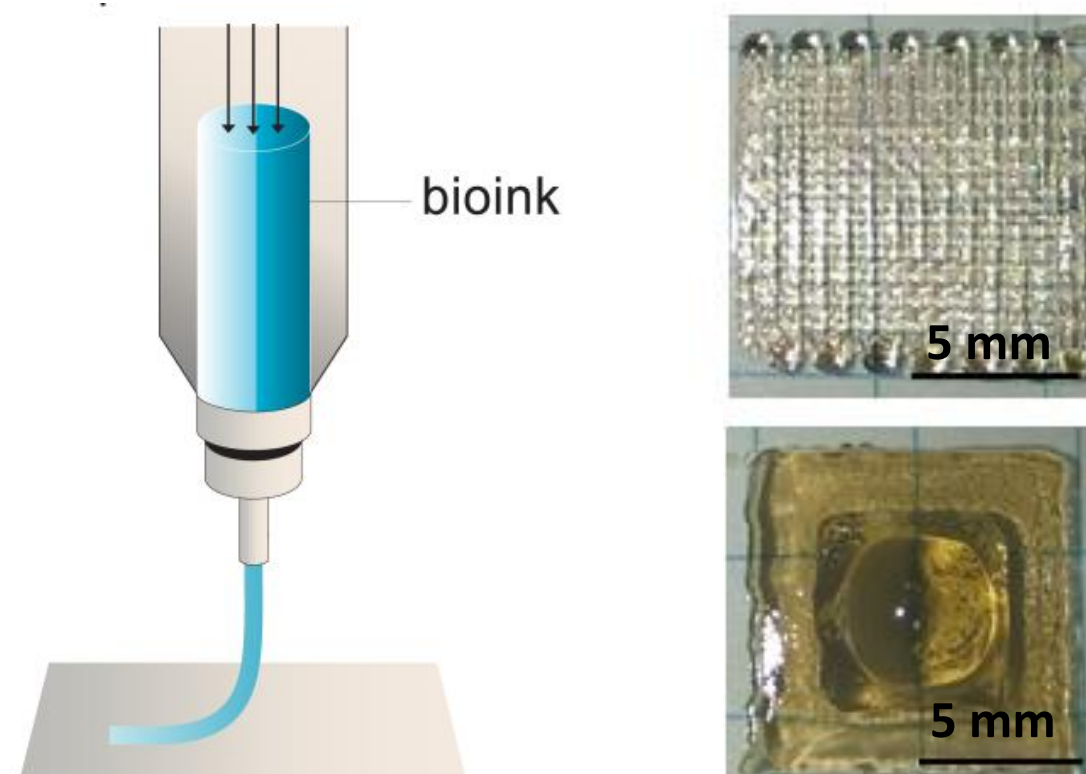
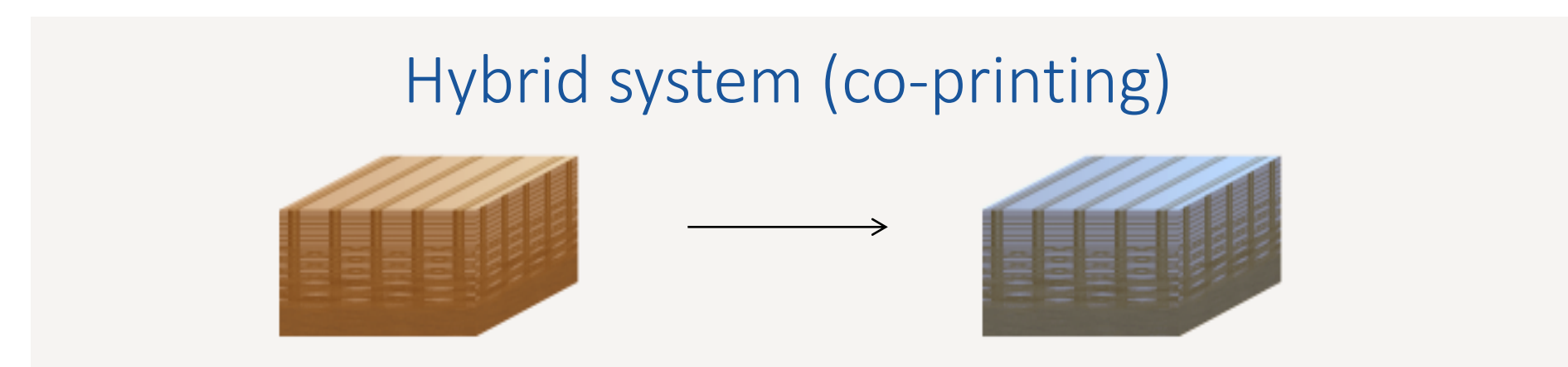


ADVANCED PRINTABLE SYSTEMS: HYBRID MATERIALS



Biofabrication
and bio-instructive
materials

Addressed challenge: complexity of natural structures



BIOFABRICATION AND BIO-INSTRUCTIVE MATERIALS GROUP



Biofabrication
and bio-instructive
materials



We work jointly with the University of Groningen

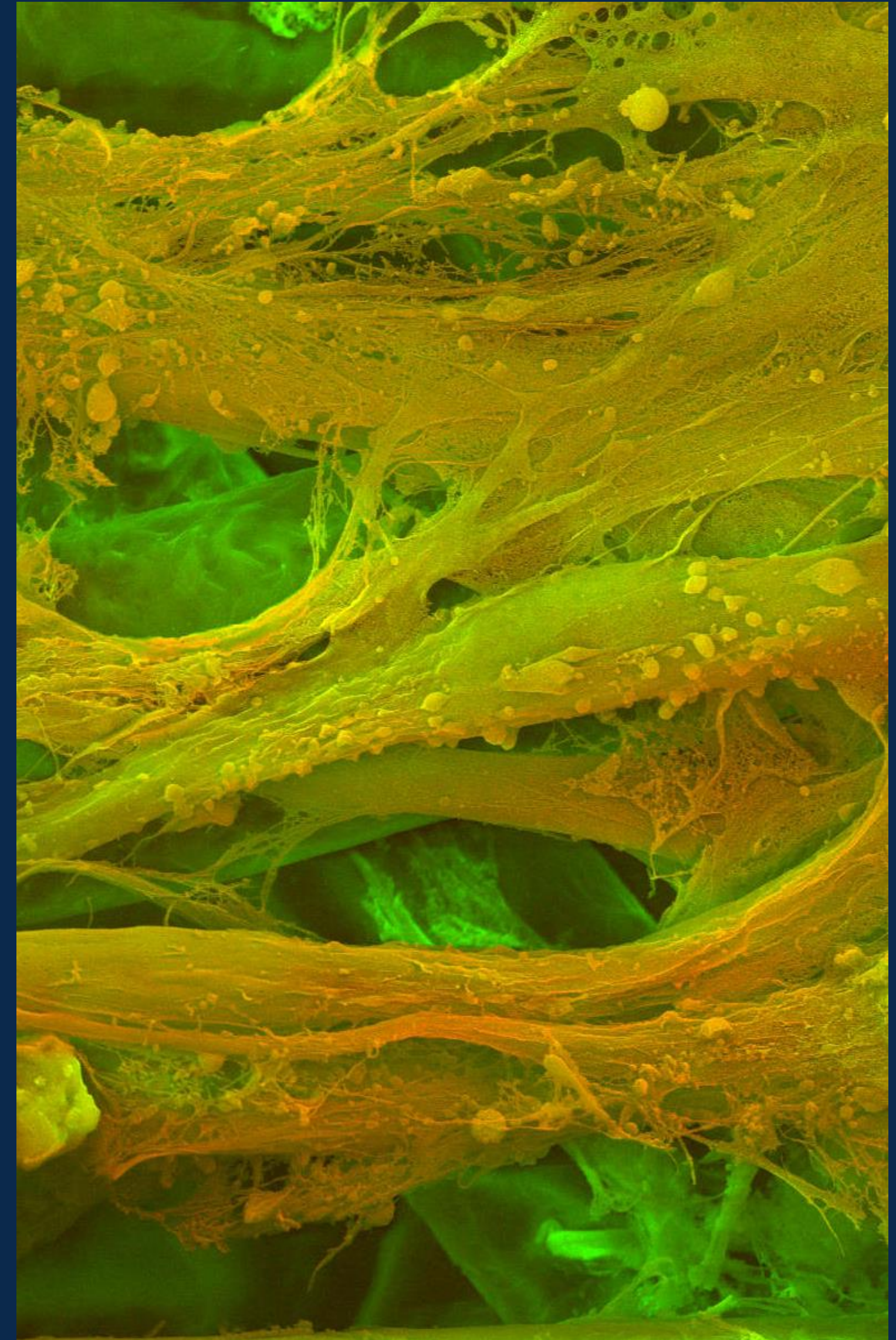


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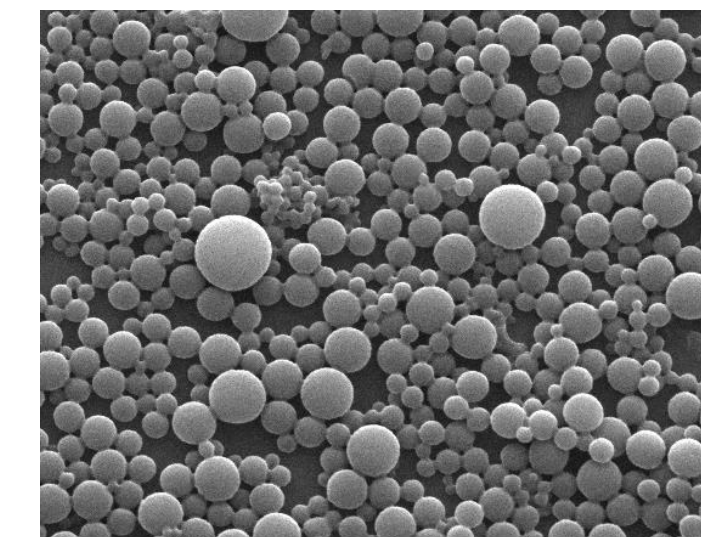
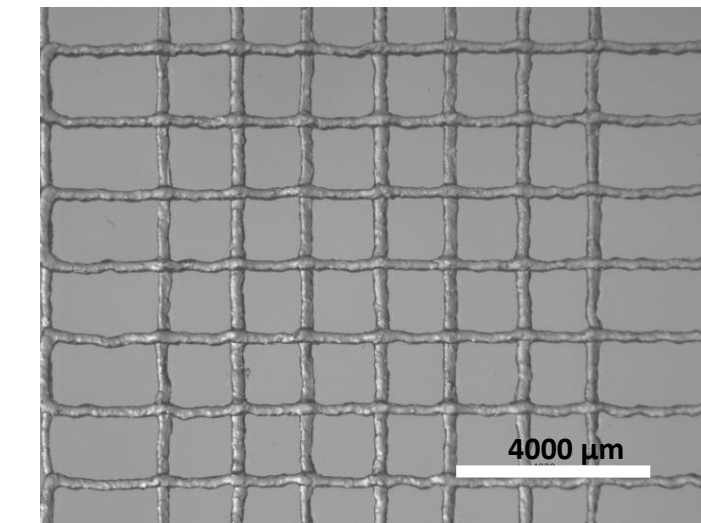
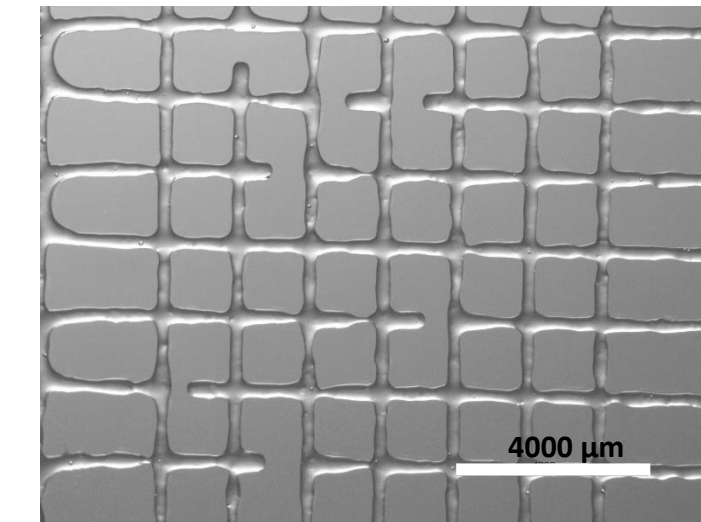
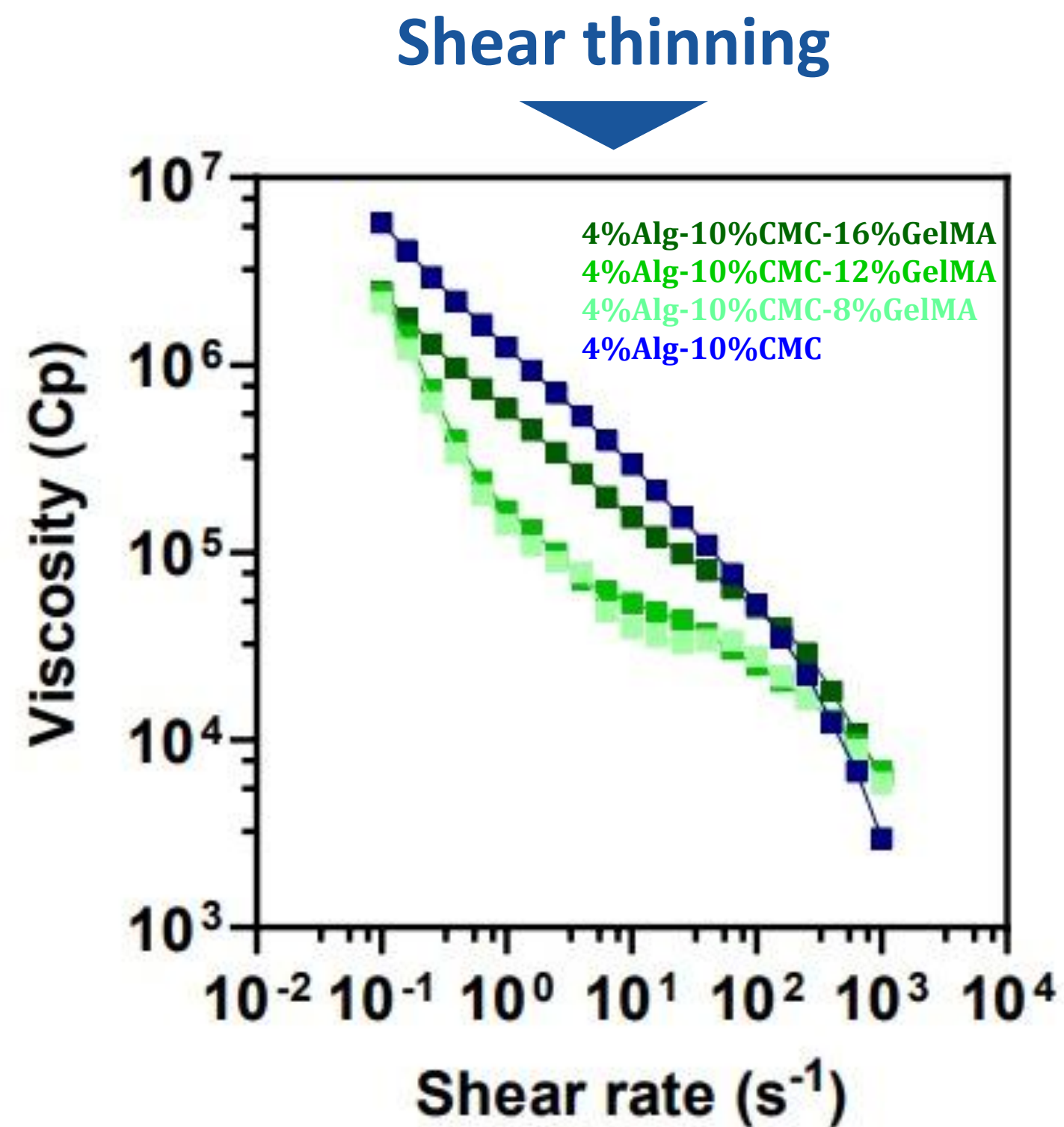
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EXAMPLES of PROJECTS: NEW MATERIALS



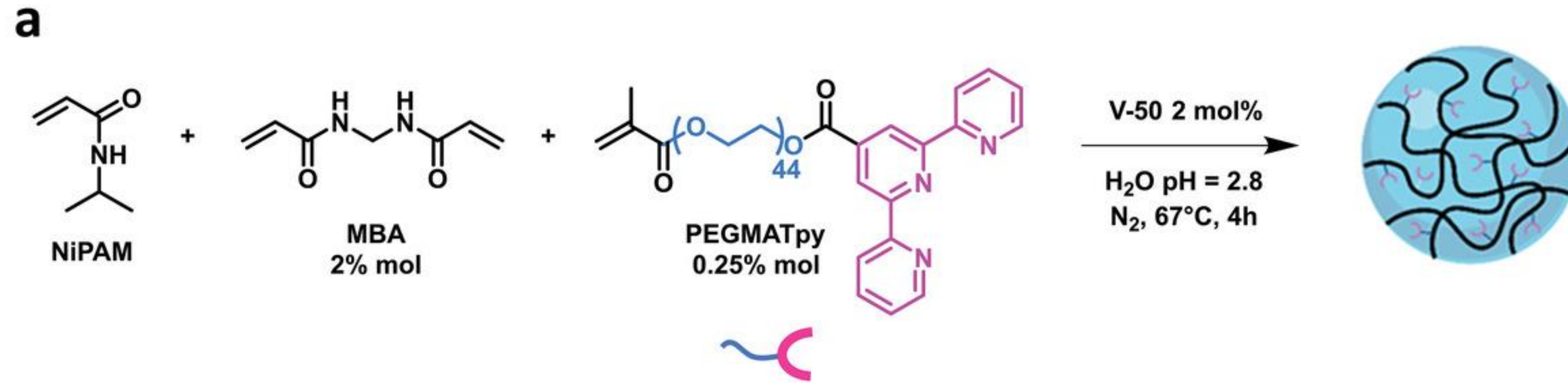
PRINTABLE BIOINKS FOR GRADIENT DESIGNS

Development and characterization of bio(inks)
Alginate/ Carboxymethylcellulose/ GelMA
Alginate/GelMA/PLGA

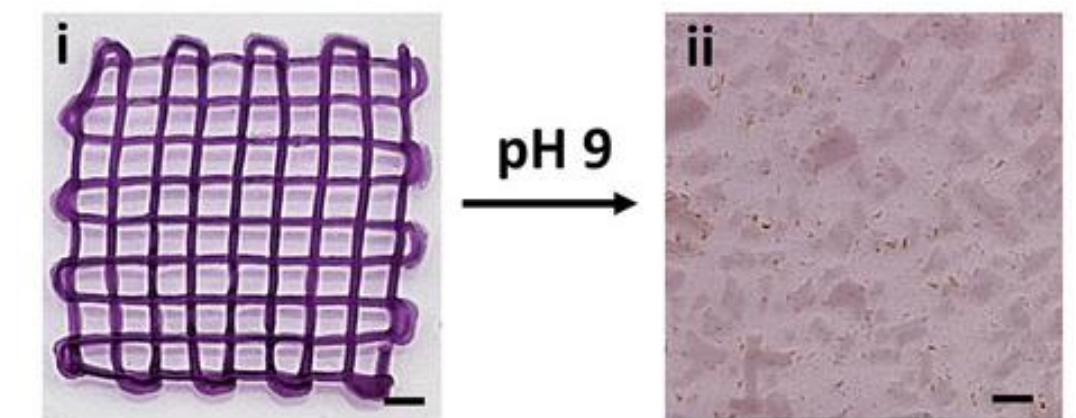
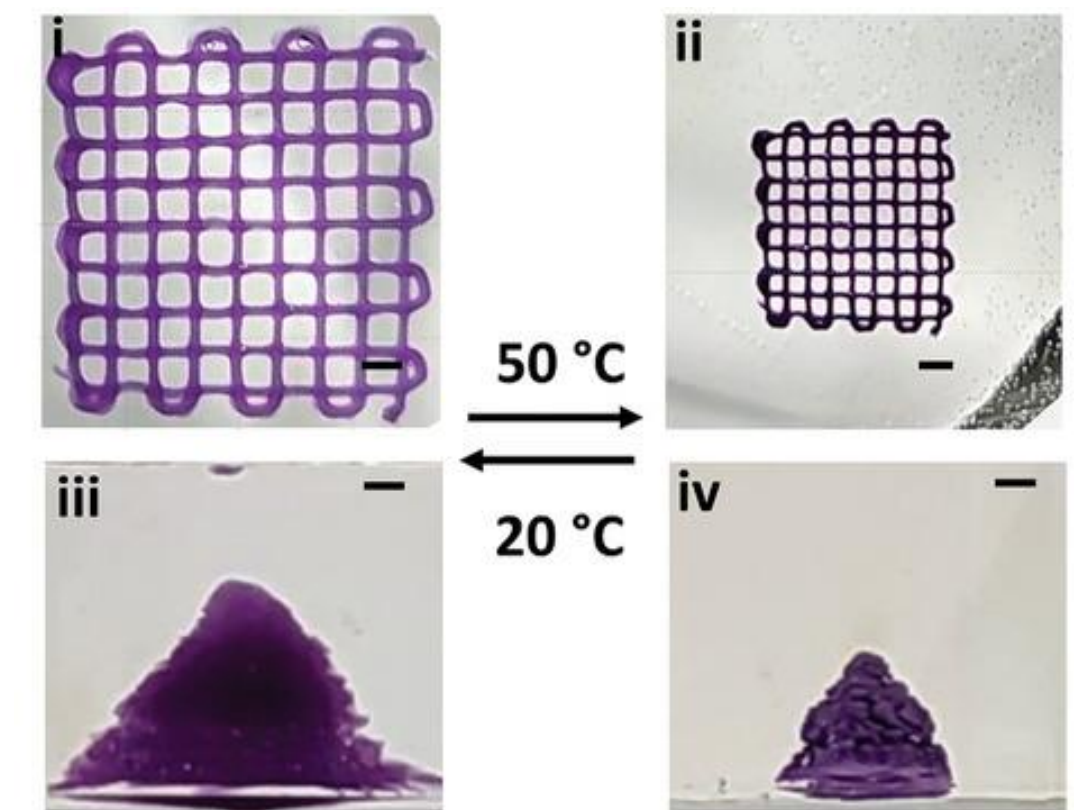


Collaboration with Daniele Parisi, RUG

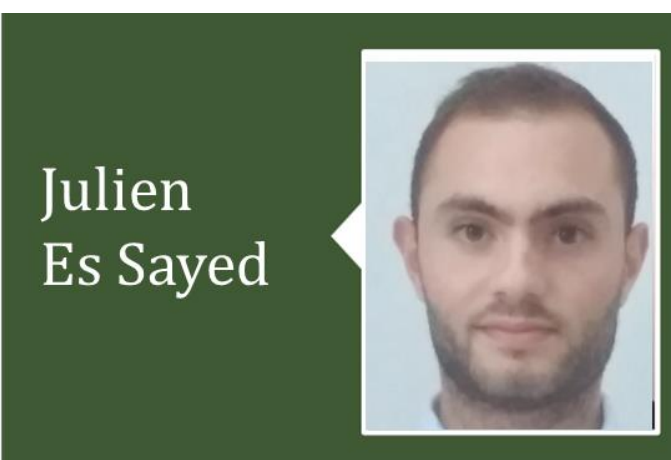
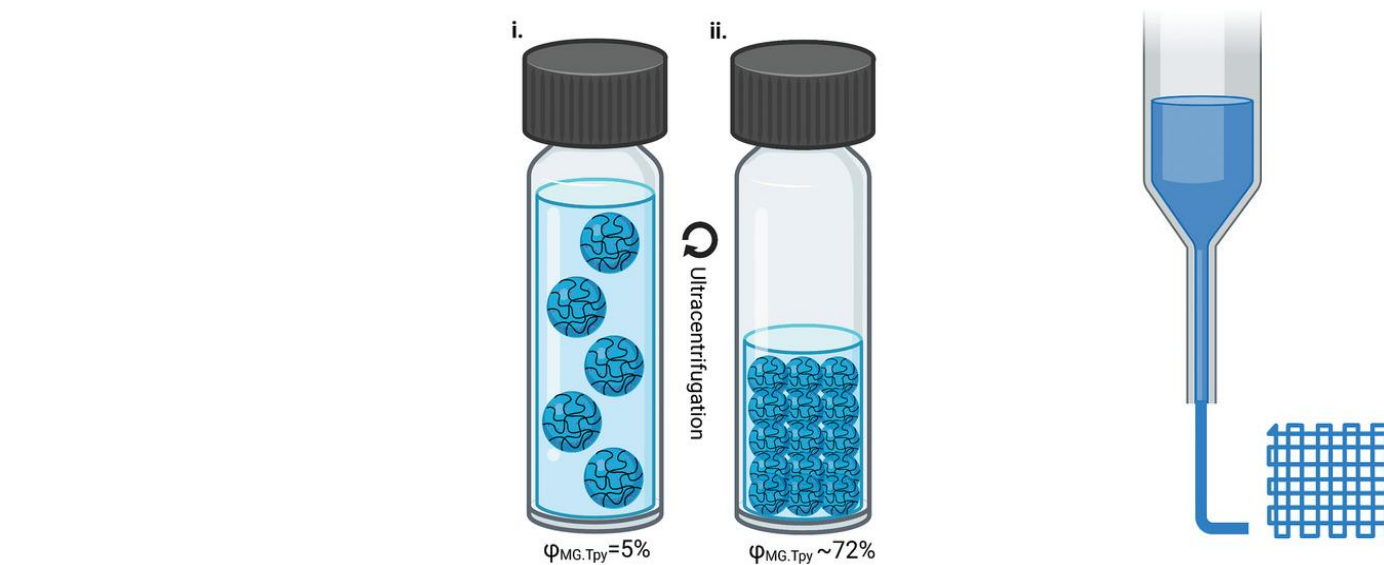
MICROGEL-BASED SYSTEM WITH THERMO RESPONSIVENESS



Reversible change of size

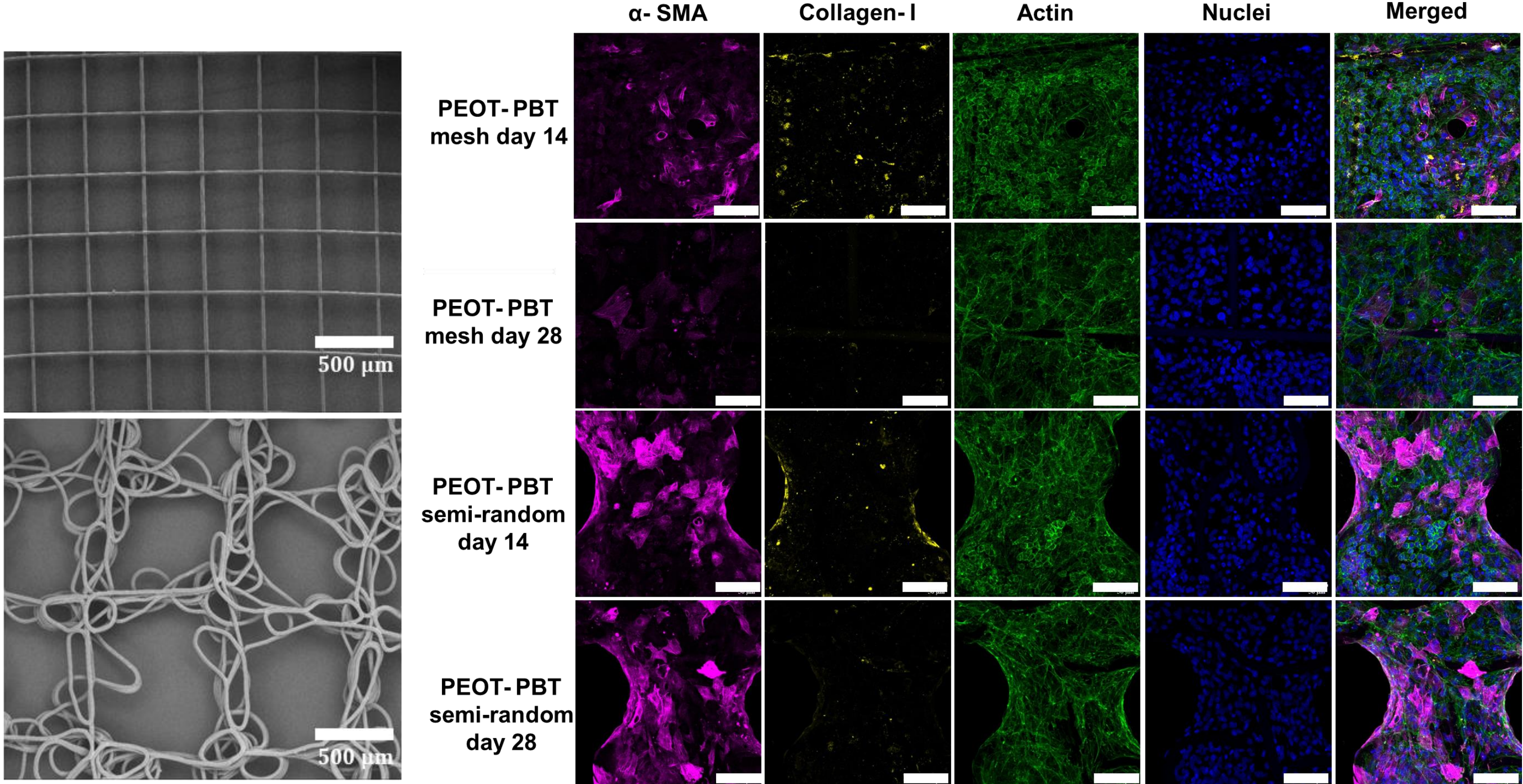
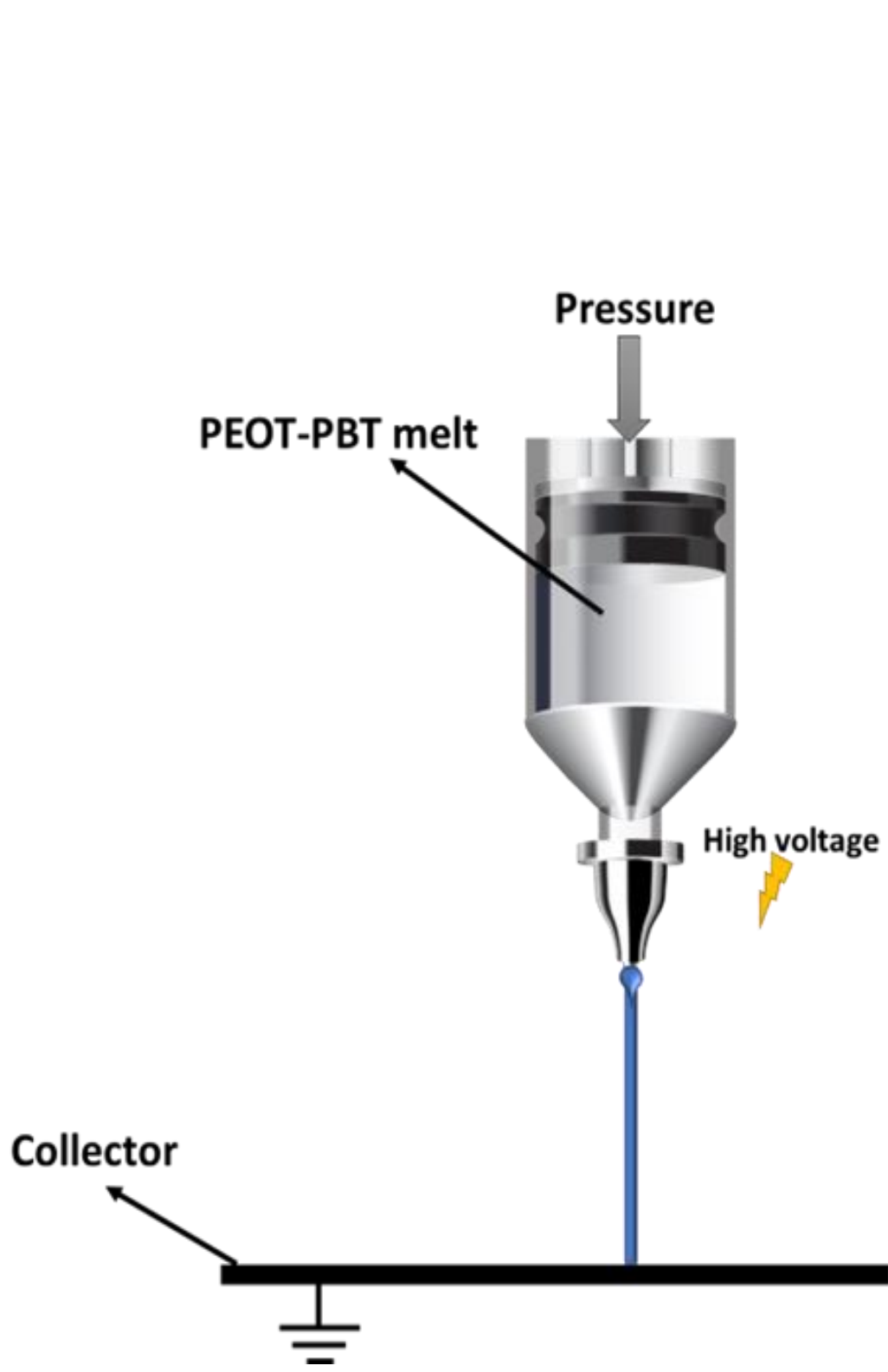


Irreversible dissolution



Es Sayed, Wlodarczyk-Biegun et al., Adv. Func. Mater. 2023

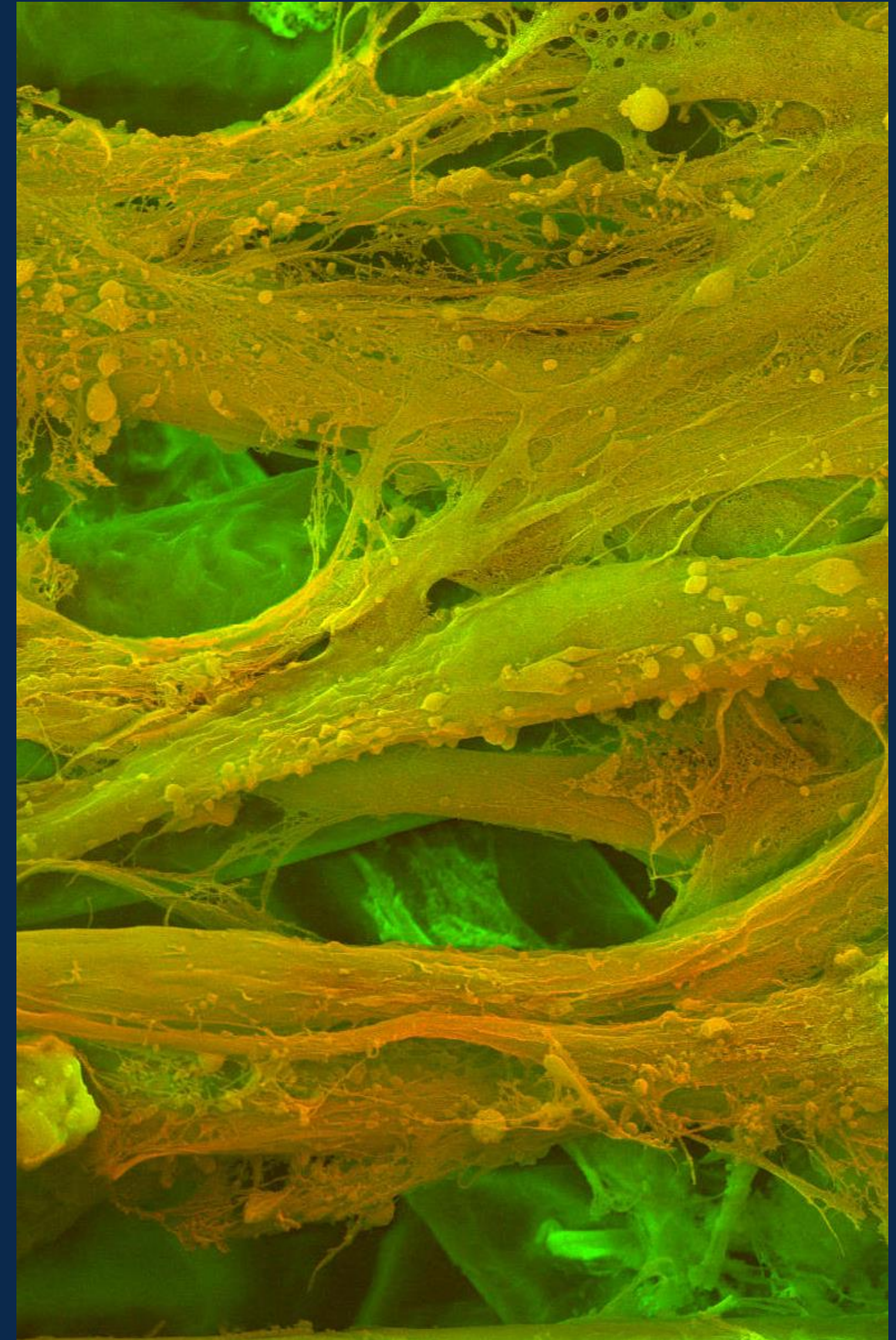
NEW MATERIAL FOR MELT ELECTROWRITING: PEOT-PBT



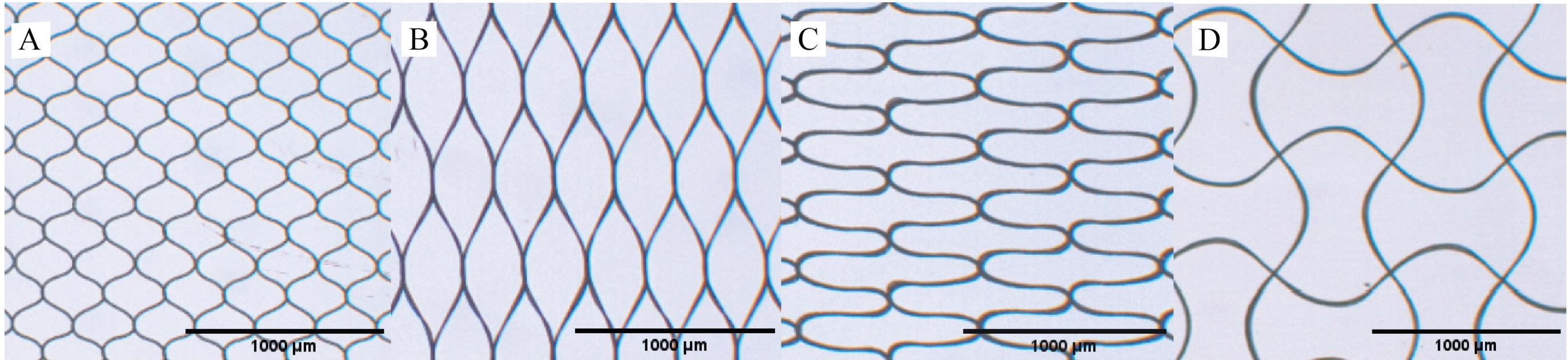
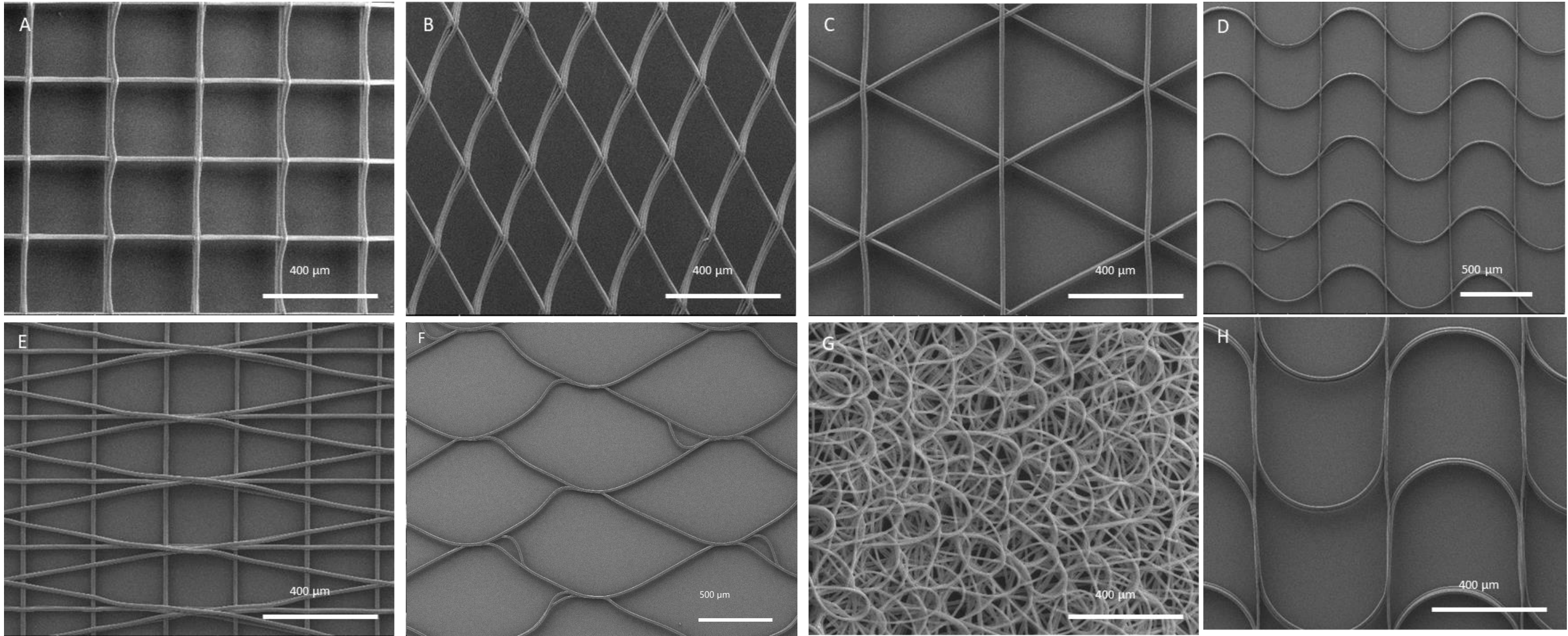
Elastomeric scaffolds printed with PEOT-PBT (Polyvation, NL) with different designs supporting the growth of fibroblasts.

A Amirsadeghi, Pavan Gudeti, Wlodarczyk-Biegun et al., Adv. Healthcare. Mater. 2024

EXAMPLES of PROJECTS: NEW DESIGNS



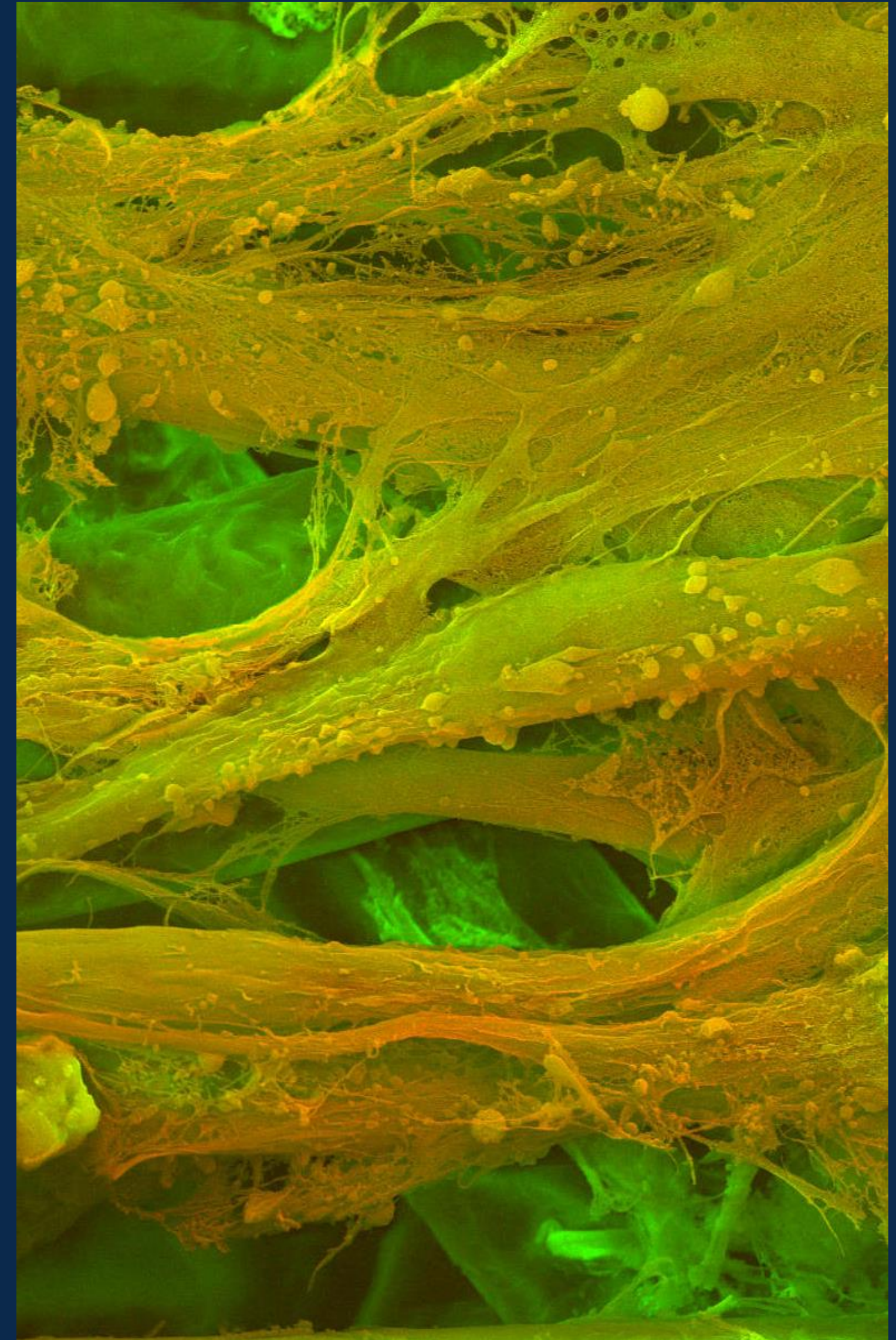
PRINTED STRUCTURES: VARIABILITY



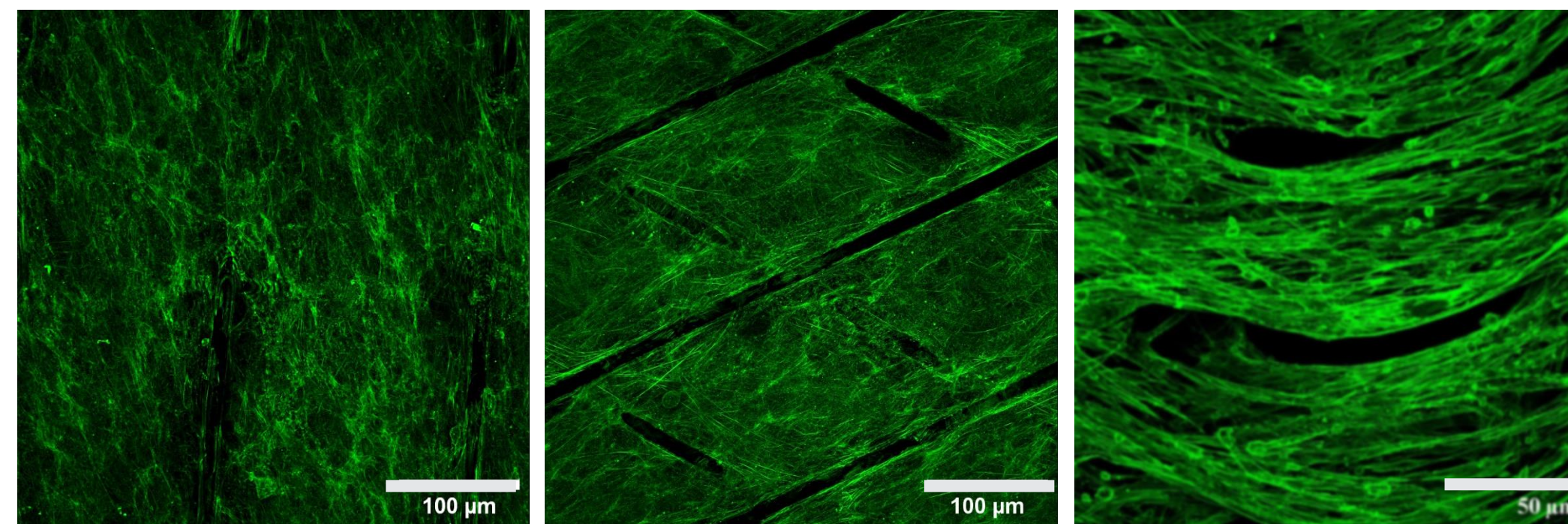
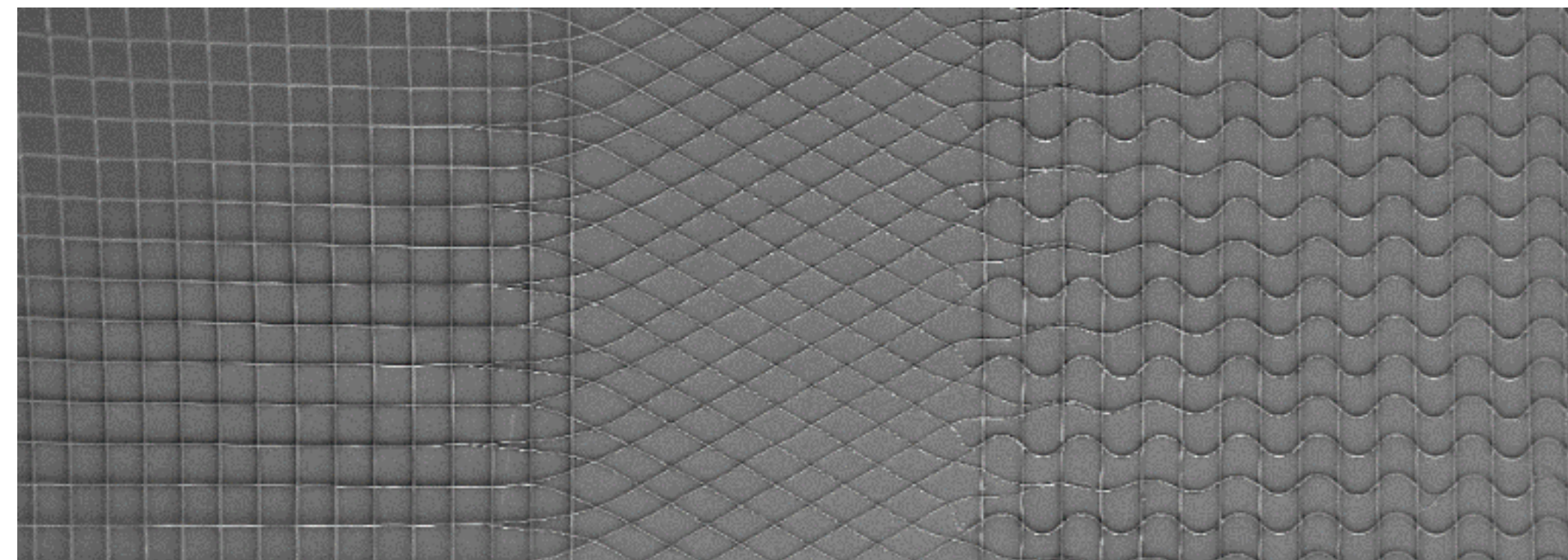
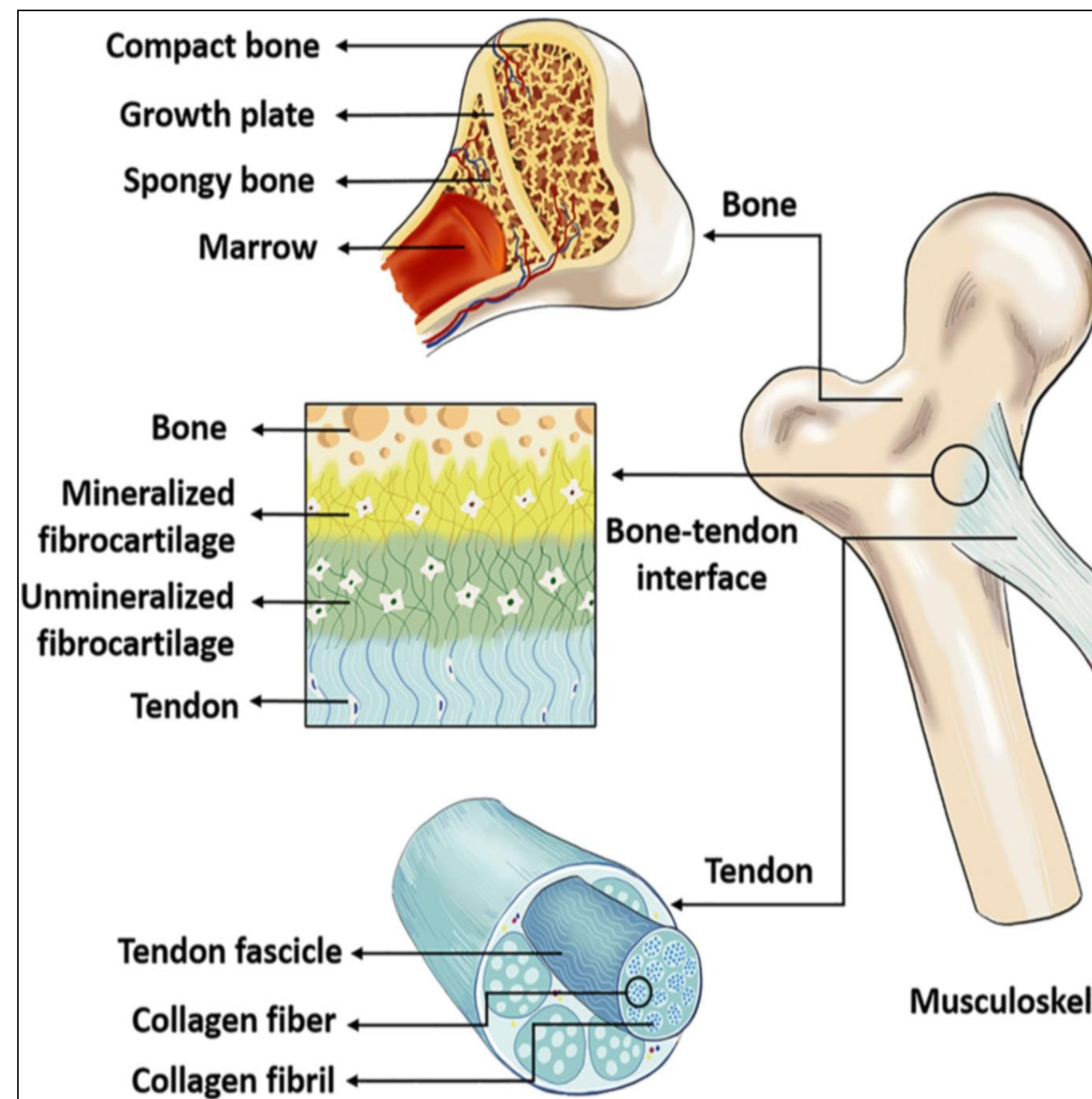
We analyze material biological and mechanical properties.



EXAMPLES of PROJECTS ENGINEERED TISSUES



GRADIENTS FOR BONE-TENDON CONNECTION



D. Wang et al. Biomaterials 272 (2021) 120789

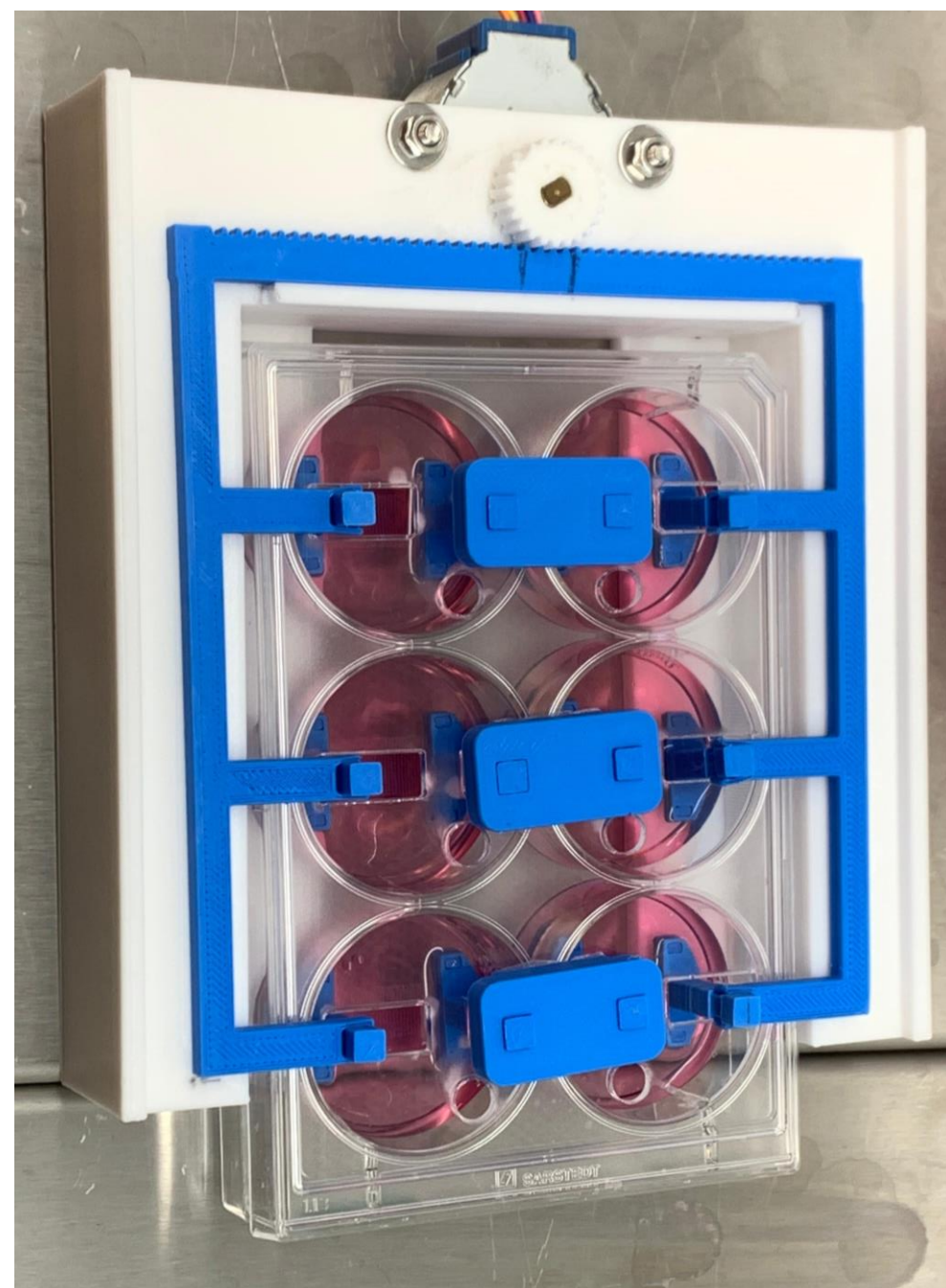
Scaffold architecture directs cell performance to mimic the organization of the native hard-soft tissue interface.



STRETCHING DEVICE



Biofabrication
and bio-instructive
materials



Static
conditions

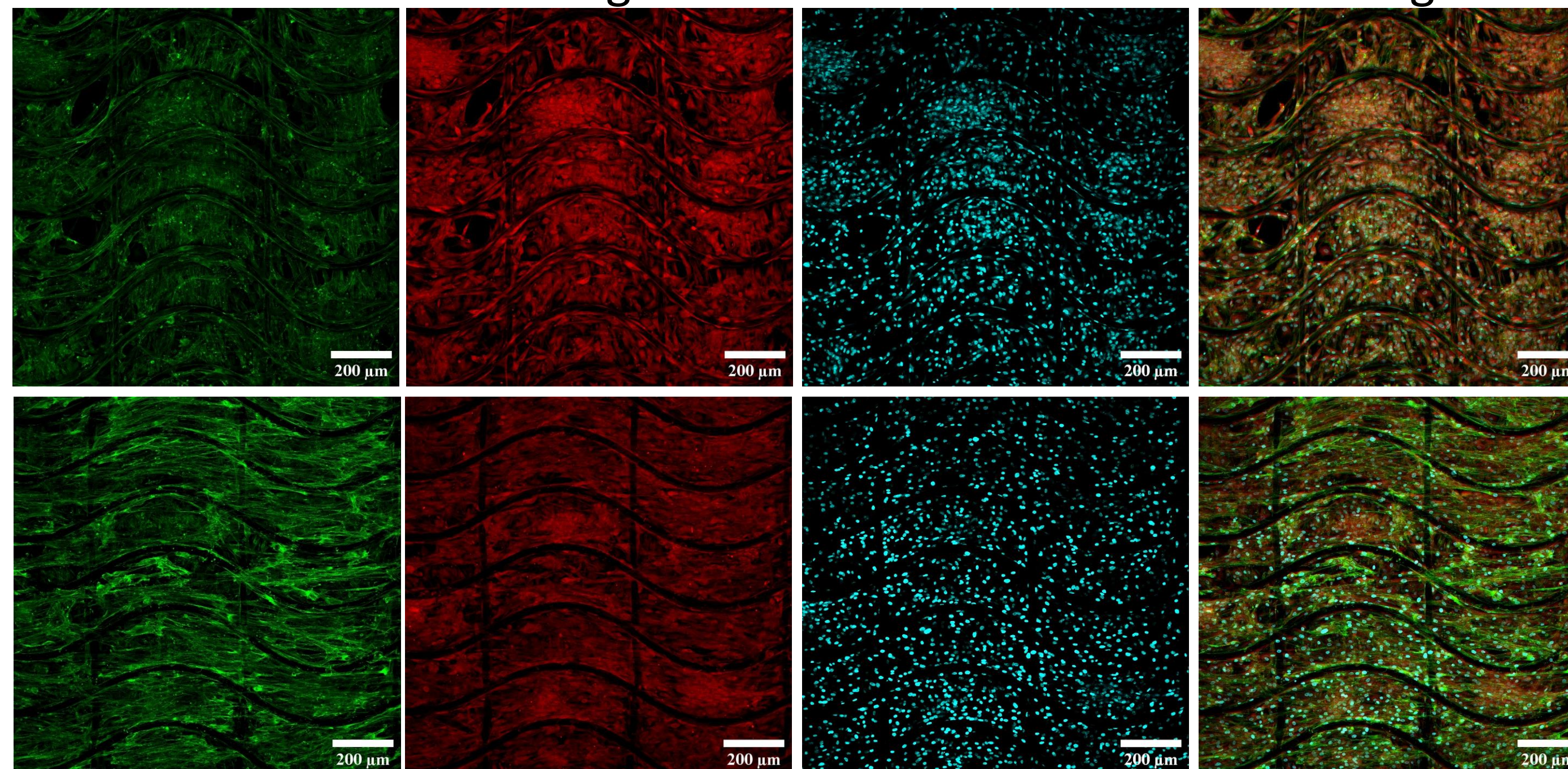
Dynamic
conditions

Actin

Collagen I

Nuclei

Merged



Piotr
Zieliński



Pavan
Gudeti



Tenocytes growing (day 31) on the printed wavy structures under static and dynamic conditions (oscillatory stretching with our lab-made device).

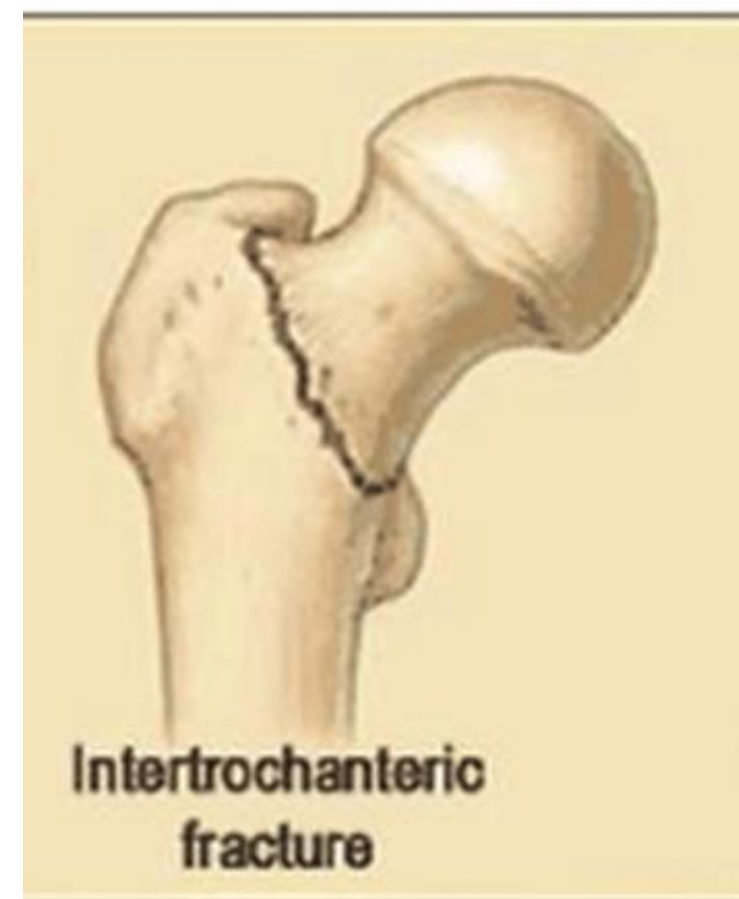
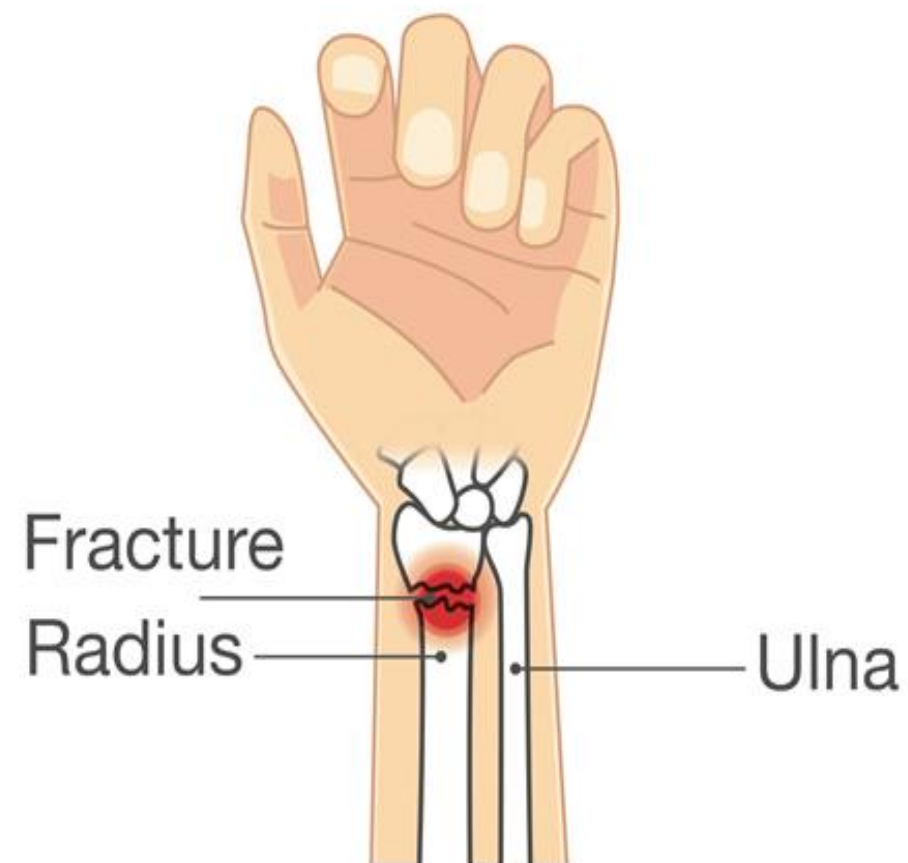
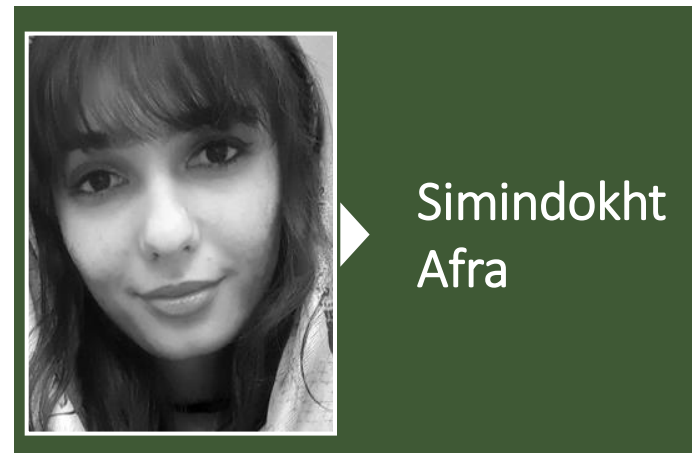


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PRINTING FOR BONE REGENERATION



Chitozan

- Promotes osteoblast proliferation
- Increases Osteopontin and Collagen I expression
- Antibacterial activity

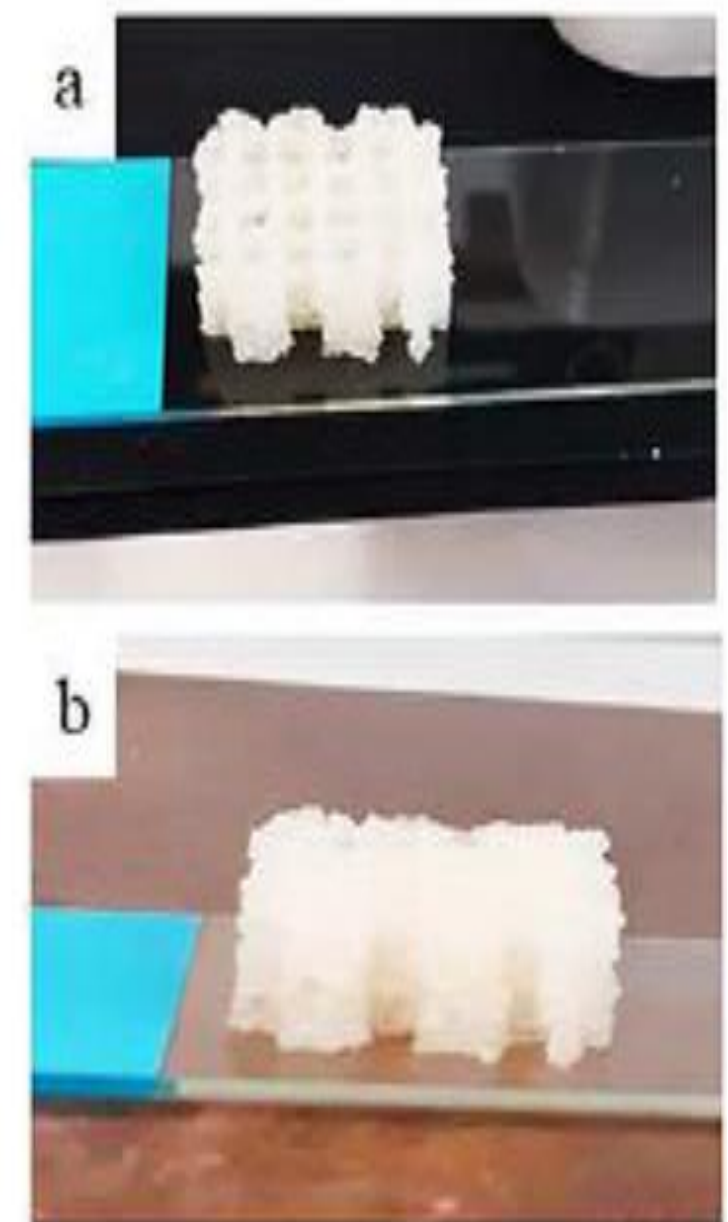
Nano hydroxyapatite

- 65% Inorganic mass of ECM
- crystals are very similar to bone apatite
- Osteoinductive

Alendronate

- As the first-line treatment of osteoporosis

Printable bioink for bone regeneration and osteoporotic treatment.



MAIN CONTRIBUTORS



Biotechnology Center

- Małgorzata Włodarczyk-Biegun
- Hatice Ercan Polat
- Joanna Żur Pińska
- Onyedikachi Cecil Azuama
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- Taha Cagri Senocak
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INM

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THANK YOU!

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