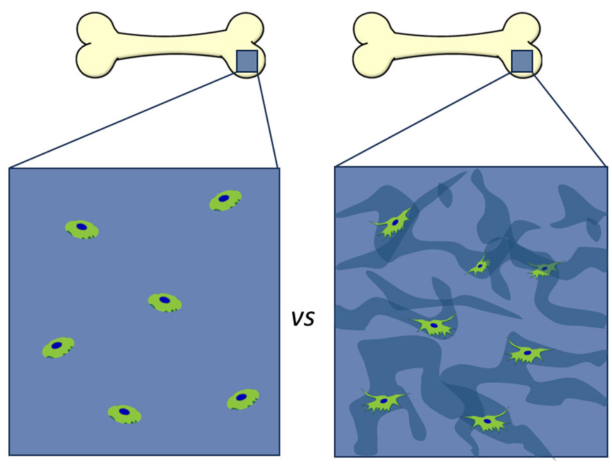
Advanced bioprinting of macroporous living tissues

Macroporous hydrogels offer large-pore sizes (above 1 µm) as compared to regular hydrogels (5 – 50 nm). This macroporosity facilitates solute transport (e.g., nutrients and oxygen), cell migration, and cell-cell communication, improving the performance of 3D tissue models. Although novel 3D-printing technologies have increased speed and resolution of cell-laden hydrogel printing, current formulations do not allow to create extended and interconnected macroporous structures to ensure cell survival.

In this project, we propose to apply an innovative in-house structuration technology to create novel bioinks for advanced 3D-bioprinting. The elaborated bioinks will enable to 3D-bioprint cell-laden hydrogels at a high speed while introducing macroporosity to improve cell viability and the overall performance of the 3D engineered construct.

To achieve these goals, the student will first test different conditions and methodologies to prepare structured bio-inks to form macroporous hydrogels. The selected formulations will be used for 3D printing. The effects of structured bio-inks on 3D-printing will be studied and formulations will be optimized accordingly. Following, the student will 3D-bioprint cell-laden macroporous hydrogels and evaluate the effect of phase separation and macroporosity on cell behavior.

Ultra-fast 3D-bioprinting



Nanoporous hydrogel   Macroporous hydrogel

Techniques: the student will be trained (hands-on-training) on techniques such as polymer modification and characterization, UV-Visible spectroscopy, brightfield and confocal microscopy, 3D-bioprinting, cell culture, and bioimaging.

References: https://onlinelibrary.wiley.com/doi/full/10.1002/advs.202204609; https://onlinelibrary.wiley.com/doi/full/10.1002/adfm.201906330

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