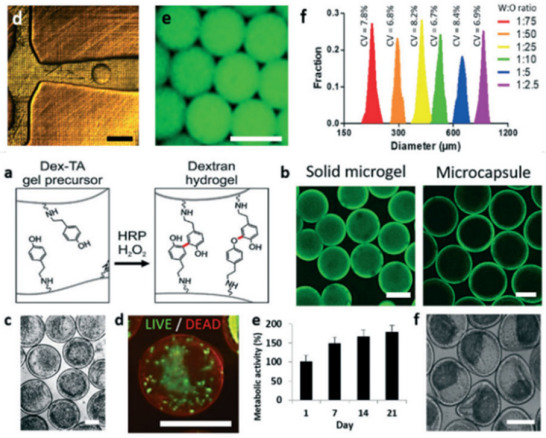
Advanced 3D-printing of microfluidic devices to create living micro-building blocks

Objective: to design and optimize the fabrication of a microfluidic droplet generator using next-gen 3D-printing technology. The microfluidic device will be used to encapsulate cells within microgels, thus paving the way to use the encapsulated cells in organoid production and other tissue engineering applications.

Introduction: cell encapsulation within hydrogel microdroplets (microgels) is an emerging approach that has multiple applications, notably in the fields of biofabrication and tissue engineering. The microgels support cell adhesion and proliferation by acting as a 3D extracellular matrix mimic (e.g., mimicking a pericellular niche), and can have a high impact in cell fate (e.g., controlling cell differentiation). Microencapsulated cells can then be used to form organoids and assemble into large-scale engineered tissues with controlled micro-architecture. In order to encapsulate cells, microfluidic devices known as microdroplet generators are required. However, the fabrication of those devices requires extensive work and the use of specialized facilities (i.e., clean rooms). Furthermore, the rate at which the microdroplets are generated is currently limited by the fabrication techniques thus preventing the scalable production and application of encapsulated cells in tissue engineering applications.

In this project, the student will use an highly innovative 3D-printing technique to speed-up the manufacture of microdroplet generators. The student will test the microfluidic device for cell encapsulation and optimize parameters to control microgel size and cell viability. The results of this project will improve the rate at which we can produce encapsulated cells for tissue engineering applications.



Techniques: the student will learn and master techniques such as 3D-printing, droplet microfluidics, cell culture, cell encapsulation, confocal and brightfield imaging, and polymer modification and characterization.

Relevant literature: https://onlinelibrary.wiley.com/doi/full/10.1002/adma.202102660; https://pubs.rsc.org/en/content/articlelanding/2020/LC/C9LC00980A

Daily supervisors: Dr. Alexis Wolfel Sanchez - https://people.utwente.nl/a.wolfelsanchez; PhD candidate Cécile Bosmans https://people.utwente.nl/c.m.y.m.bosmans

Principal investigator: Dr. Jeroen Leijten - https://www.utwente.nl/en/research/researchers/featured-scientists/leijten/