Fabrication of 3D Cell Scaffolds & Analysis of Cell Infiltration and Migration

Master Project/Thesis

Motivation
Human tissues are highly complex structures, which we want to mimic in vitro to study the effect of new treatments.
Currently, this is mostly done on 2D cell culture, which lack to represent the natural structures of tissues, including cell-cell and cell-extracellular environment interactions. Therefore, new technologies have evolved to realize 3D culture systems. However, these technologies are often time-consuming, require long-term cultures, lack vascularization, reproducibility, and high consistency. With the novel technology developed at sallea (ETH Zürich), we are trying to change this by using an indirect 3D printing method to produce so-called 3D cell scaffolds (see Figure 1 and [1]).
We obtain highly reproducible scaffolds with tuneable pore sizes for almost any material (from gels over bioplastics to metals). To assess the biological relevance of these scaffolds, cell experiments will be conducted and compared to current systems. This project/thesis is a collaboration between the group of Prof. Lehmann at ZHAW Wädenswil, and sallea a start-up at the Complex Materials group of Prof. Studart (ETH).

Project Aim
The aim of the master project/thesis is to prepare scaffolds from biologically relevant materials (e.g. cellulose, hydrogels, collagen, …) and study the cells' growth, morphology and behaviour. Further, the effect of pore size and scaffolds materials on the infiltration, and cell migration, will be evaluated.
The preparation of the scaffolds will take place at sallea (ETH Hönggerberg) where the focus will be on how to infiltrate the scaffold material into the salt template (with vacuum, hydraulic press, injection moulding or casting). The cell studies will be conducted at ZHAW Wädenswil.

The tasks may change due to changes in the project progression and/ or because of varying interests of the student. Ideas/ Interests etc from the student are highly appreciated.

Methods you will learn/use
Scaffold preparation
- 3D printing of NaCl (stereolithography)
- ev. CAD drawing
- vacuum infiltration, casting, injection moulding (depends on material)
- optical microscope
- SEM
- more upon desire/ course of project

Cell studies
- Immuno- and cell staining with cell lines or primary cells
- Fluorescence microscopy and live imaging
- 2-Photon microscopy via SHG
- SEM

Contact
Do not hesitate to contact us for more details or questions about the project, we are happy to have a chat!
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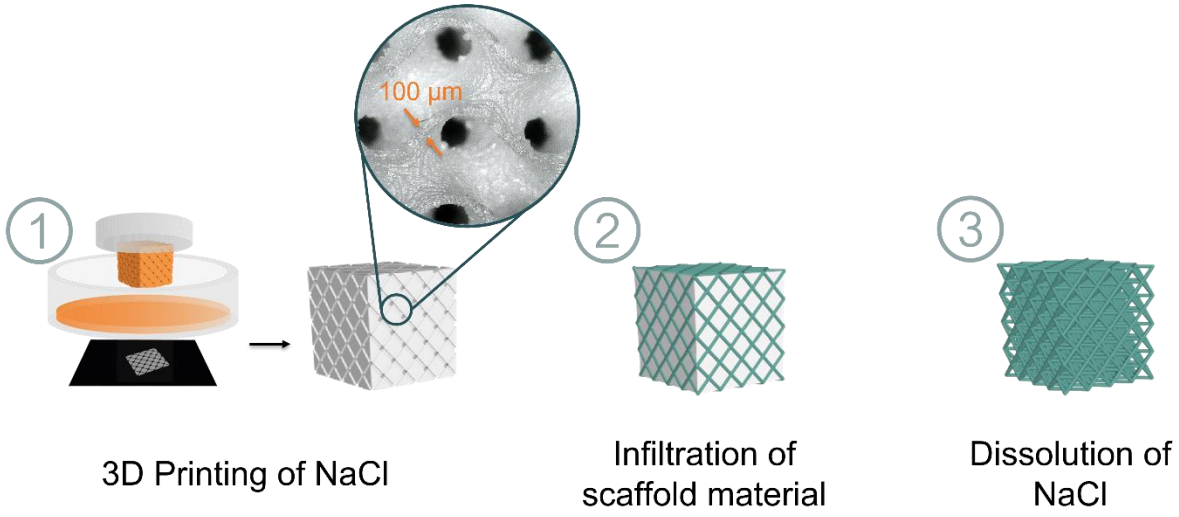

Figure 1 sallea's process to manufacture 3D cell scaffolds.

Literature

1. Kleger, N., Fehlmann, S., Lee, S. S., Dénéréaz, C., Cihova, M., Paunović, N., Bao, Y., Leroux, J.-C., Ferguson, S. J., Masania, K., Studart, A. R., Light-Based Printing of Leachable Salt Molds for Facile Shaping of Complex Structures. *Adv. Mater.* 2022, 34, 2203878.

2. Wolf, K. *et al.* Collagen-based cell migration models in vitro and in vivo. *Semin. Cell Dev. Biol.* **20**, 931–941 (2009).