Investigation of melt electrowritten scaffold design on drug delivery

Master's thesis/Semester project

(Section: Biomedical Eng. – Materials Science – Electrical Eng. – 3D Printing)

Over the last two decades, additive manufacturing (3D printing) has been gaining significant attention in tissue engineering and biofabrication research as a versatile class of manufacturing technologies. This primarily stems from its ability to manufacture unique patient-specific designs and structures from a wide range of biomaterials.[1] For biomedical applications, high resolution 3D printing techniques, such as melt electrowriting (MEW) have been used for their exceptional ability to replicate the fine features and complex microarchitecture of native tissues to mimic both their structure and function.[2] To date, MEW research often utilises pressure-driven extrusion methods on custom devices built by individual research groups, processing the most common polymer in MEW poly(caprolactone) (PCL).

At LMIS1, we are currently investigating a novel filament-based extrusion system which has many advantages over the current standard due to the possibilities of processing a wider variety of polymers.[3] A current gap is in the understanding of the influence of the printing geometry on drug uptake and release in aqueous media. This student project will contribute to the understanding of this by printing structures, loading them with (model) drugs and studying their release via spectroscopic methods.
The topic is highly multidisciplinary, involving aspects of engineering, pharmacy, and materials science: the focus can be adjusted depending on the student's preferential interests, best knowledge, previous experience and motivation.

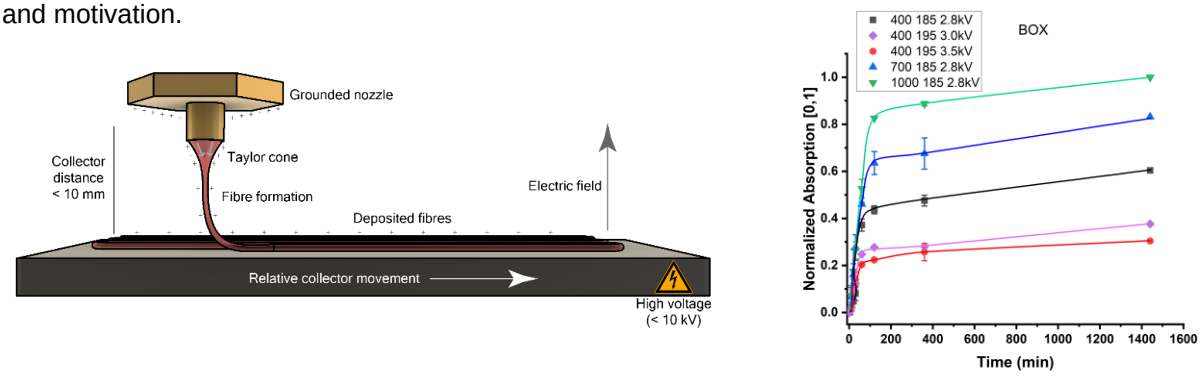

Figure 1 : *(left) schematic showing the principles behind melt electrowriting (MEW), (right) release pattern from preliminary studies.*

Possible tasks:

- Analysis of the influence of geometry and printing design onto the drug release via
    a. Manufacturing of scaffold with different geometries
    b. Loading of scaffolds with (model) drugs (preliminary work already done)
    c. Drug release studies in aqueous solution
    d. Effect of design and drug loading on mechanical properties
- SEM characterisation of finalised scaffolds.

Contact: Sönke Menke *(soenke.menke@epfl.ch)*
Biranche Tandon (*biranche.tandon@epfl.ch*)

[1] B.P. Chan, K.W. Leong, *Eur Spine J*, **2008**, *17*, 467-479;
[2] J.C. Kade, P.D. Dalton, *Adv Healthcare Mater*, **2021**, *10*, 2001232;
[3] A. Reizabal, *et al.*, *Addit Manuf*, **2023**, *71*, 103604.

École polytechnique fédérale de Lausanne

Microsystems Laboratory 1 (Prof. J. Brugger)
EPFL STI IMT LMIS1 (Batiment BM) Station 17 CH - 1015 Lausanne

Phone : +41 21 693 63 18
E-mail : soenke.menke@epfl.ch
Office : BM 3.112