EPFL

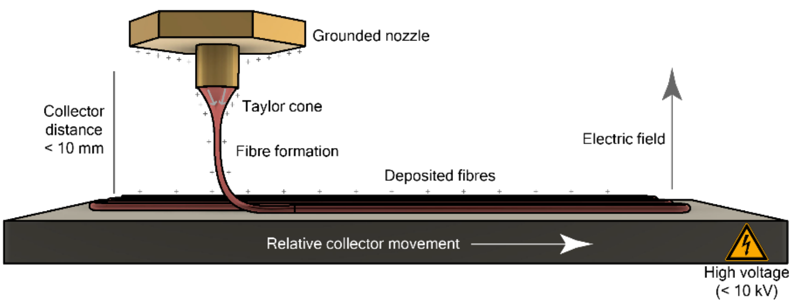
Investigation of simple parameters on the fibre diameter in melt electrowriting (MEW)

Semester project

(Section: Microengineering –Materials Science – Electric Engineering – 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 fabricate unique patient-specific designs as well as fabricate structures from a wide range of biomaterials.[1] For biomedical applications, high resolution 3D printing techniques, such as melt electrowriting (MEW) have been favoured 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 the LMIS1, we are currently investigating a novel filament-based extrusion system, which has many advantages over the current standard due to the possibilities in processing a wider variety of polymers.[3] A current gap is in the understanding of the jet and the influence of different parameters such as the nozzle diameter and extrusion rate on it and the resulting fibres. This student project will contribute to the understanding of how these different parameters interact and result in a printed fibre. This can allow for more control over the jet and the resulting structures for future applications.
The topic is highly multidisciplinary, involving aspects of engineering, computer and materials science: the focus can be adjusted depending on the student's preferential interests, best knowledge, previous experience and motivation.



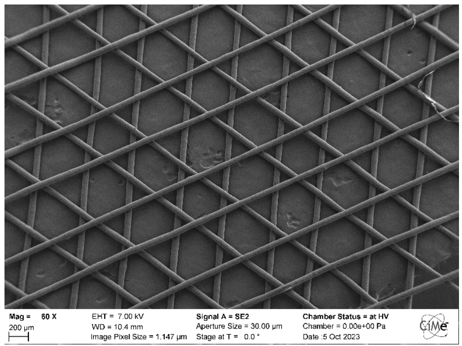


Figure 1 : *(left) schematic showing the principles behind melt electrowriting (MEW), (right) scaffold printed with MEW.*

Possible tasks:

- Analysis of the influence of the nozzle diameter (150 – 400 µm) on the fibre diameter.
- Design of experiments to be performed on our five printers to
    a. verify their extrusion rates,
    b. evaluate the reproducibility of experiments,
    c. assess the validity of theoretical predictions on different polymers (no chemical knowledge required!).
- SEM characterisation of finalised scaffolds on modern instruments.

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[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.

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