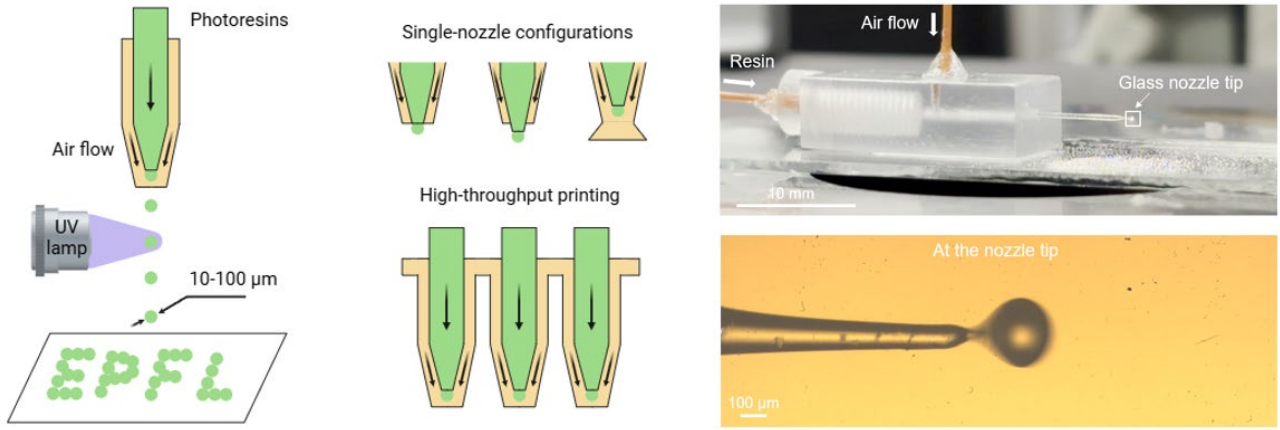
Call for 2025 Fall Semester Project / Master Thesis Students

In-Air Droplet Generation & Solidification via Microfluidics

Fields: Additive Manufacturing | Microengineering | Materials Science

Project Overview

Join us in pioneering a novel 3D printing approach that leverages in-air droplet microfluidics to fabricate microscale polymer beads for voxel-by-voxel assembly of 3D structures. Traditional water-oil microfluidics pose challenges for direct printing. This project explores air-assisted droplet generation as an innovative solution. We investigate how polymerizable resin droplets can be formed mid-air using co-axial nozzles and immediately solidified via UV light before substrate deposition. Foreseeable challenges include optimizing nozzle geometry, droplet trajectory, and scaling up via multi-nozzle systems.



(**Left**): Illustration of a voxel-based 3D printing process. Resin droplets, formed through focused air flow at a co-axial glass nozzle, undergo UV-induced polymerization mid-air before reaching the substrate. (**Middle**): Various nozzle configurations are investigated to improve droplet formation consistency and increase printing throughput. (**Right**): Top: A printed structure composed of large resin droplets generated using a single-nozzle setup. Bottom: High-resolution capture of a resin droplet detaching from the nozzle during the printing process.

What You'll Work On

Tasks will be tailored to your background and interests and may include:

- Designing 3D-printed units for assembling co-axial glass capillary nozzles
- Generating resin droplets using air flow in microfluidic devices
- Characterizing droplet size, frequency, and dispersity as functions of flow parameters
- Exploring in-air UV polymerization for real-time droplet solidification
- Developing multi-nozzle setups for high-throughput 3D printing

Why Join?

- Cutting-edge research team in advanced manufacturing
- Hands-on microfluidic experimentation

Interested? Reach out now to learn more or apply. **Contact:** Tao Zhang (tao.zhang@epfl.ch), Dr. Arnaud Bertsch (arnaud.bertsch@epfl.ch), Prof. Juergen Brugger (juergen.brugger@epfl.ch)

[1] Zhang, *et al. Trends in Biotechnology* (2023). [2] Takagi, *et al. Microfluidics and Nanofluidics* 25.9 (2021). [3] Yang, *et al. International Journal of Bioprinting* 10.1 (2024).

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