Development of 3D printed engineered living materials for growth-decoupled biochemicals production

Summary

The aim of the project is to develop 3D-printing enabled engineered living materials for biochemicals production. This project envisions development of a portable, reusable, on-demand technology platform for biochemicals production. The scaled-up flow-biochemistry platform could be deployed for additive manufacturing in biotechnology industry.

Research field:	Chemistry and Biotechnology
Supervisors:	Petri-Jaan Lahtvee Rahul Kumar
Availability:	This position is available.
Offered by:	School of Science Department of Chemistry and Biotechnology
Application deadline:	Applications are accepted between September 01, 2021 00:00 and September 30, 2021 23:59 (Europe/Zurich)

Description

The current biochemicals production processes are primarily based on the use of fermentation bioreactors in batch and fed-batch mode, where yields and productivities have peaked, requiring technological innovations to uplift this cap on productivities. Conventional cell immobilization (e.g. Ca^{2+} alginate- or polysaccharide-based gels), for biochemicals production, have limited success due to the fragility of the encapsulating material and limited cell retention. However, recent advances in additive manufacturing (3D printing) provide an opportunity to move beyond the traditional biotechnology paradigm by engineering living materials with novel bio-catalysis capabilities. The 3D printing of engineered living materials allows immobilization of biological and synthetic catalysts, providing numerous advantages: (i) printing of co-cultures without the risk of strains out-competing each other; (ii) significantly extended cell-retention due to material stability; (iii) functionalization of the polymeric materials; (iv) increased substrate-to-product yield; (v) co-printing of cells and enzymes in functional hydrogels.

The successful PhD candidate for this project requires a background in one of the following fields: materials science, organic chemistry, polymer synthesis, biotechnology, bioengineering, robotics or chemical engineering. This international collaborative project will allow training and skills development in the areas of 3D printing, engineered living materials, bioprocess development and synthetic materials biotechnology, leading to high impact scientific publications.

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