Microfluidic Reprogramming and Isolation of human cells

Herland Lab, Division of Micro and Nano Systems, KTH

Master's Thesis – 30/60 hp

Internship Position (6-12 months)

Human induced pluripotent cells hold an enormous potential for clinical application particularly in the areas of precision and regenerative medicine. However, the process of reprogramming is inefficient due to the high cost, long time frame and is labour intensive, affecting the potential of this process at a larger scale. Gagliano et al. (2019) have reported that the downscaling of the process using microfluidics and microfabrication technology enhances the efficiency of the process as compared to the conventional culture system (petri dish etc.)

Qin et al. (2010) reported use of soft lithography methods allow the rapid fabrication and prototyping of well-defined structures which are usually compatible with biological applications using injection molding and photopatterning. PDMS is widely used to manufacture equivalent of a channel which can be made compatible to several types of cells by surface treatments as reported by Zheng et al. (2010). They also hold capability for potential integration of sensors for real-time monitoring and automation.

The goal of this project is to develop capability for microfluidic reprograming of human somatic cells for regenerative medicine, starting out with studying the cell proliferation and growth in microfluidic channel and potentially developing a pipeline from patient biopsy to reprogrammed cells. The work will be carried out at the Division of Micro and Nano systems at KTH, in collaboration with Falk Lab and the IPS Core Facility at KI.

Technical and Knowledge Objectives

General

- Sterile culturing techniques
- Computer aided Designing

Microfabrication

- Designing and prototyping of microfluidic systems
- Soft Lithography- PDMS
- 3-D Printing or Photopatterning (if required)

Cell Cultures

- Human primary cultures

- hiPSC Culturing

Evaluation techniques

- Immunocytochemistry (ICC)
- Flow cytometry
- RNA isolation and cDNA synthesis
- Polymerase Chain Reaction (PCR)
- Real-time-quantitative PCR (RT-qPCR)
- Imaging (Wide field, Fluorescence)

Basic Knowledge of embryonic development and reprogramming

- Signaling pathways that influence cell fate and reprogramming
- Use of induced pluripotent stem cells in research

Requirements

- Attention to details and positive disposition
- Have a relevant education background – e.g. in biomedical engineering, biotechnology, nanobiotechnology, and allied areas
- Be highly motivated and creative, independent, and open to critical feedback
- Advantageous, but not required: Prior practical experience in cell culture and/ or soft lithography and microfluidic prototyping in general or for biological experiments.

How to apply: Please send your CV (including reference contacts), academic transcript, and a personal letter (all in English) to Dimitrios Voulgaris (dvou@kth.se) and Saumey Jain (saumey@kth.se)

References

1) Gagliano, O., Luni, C., Qin, W. *et al.* Microfluidic reprogramming to pluripotency of human somatic cells. *Nat Protoc* 14, 722–737 (2019).

2) Takahashi K, Tanabe K, Ohnuki M, et al. Induction of Pluripotent Stem Cells from Adult Human Fibroblasts by Defined Factors. *Cell*. 2007;131(5):861-872.

3) Qin, D., Xia, Y. & Whitesides, G. Soft lithography for micro- and nanoscale patterning. Nat Protoc 5, 491–502 (2010).

4) W. Zheng, Z. Wang, W. Zhang and X. Jiang, Lab Chip, 2010, 10, 2906