Engineering Tripos Part IIA Project, GG1: Microfluidics, 2021-22

Leader

Dr T Savin [1]

Timing and Structure

Fridays 9-11am plus afternoons, and Tuesdays 11-1pm

Prerequisites

3G2 Useful

Aims

The aims of the course are to:

- To introduce the basic principles of microfluidic devices.
- To provide practical experience with soft-lithography and microfabrication.
- To design and study the behaviour of simple devices that highlight the key aspects of microfluidics

Content

Microfluidic devices are designed to perform high throughput chemical, physical and biological analysis on small volumes of fluids. This technology is particularly important for biological and biomedical applications where compounds to analyse are often only available in minute quantities, and where there is a need for large scale automation of sequential processes. Typical applications in life sciences are flow cytometry, DNA analysis, cell manipulation and separation, with an increasing use for clinical diagnostics.

These devices typically involve a large array of micron size channels, mixers, sensors and switches that can be integrated in fluidic circuits, often called "lab-on-a-chip" . The development of such devices is highly multi-disciplinary, with a strong engineering component.

During this project, the students will design a device that mixes fluids and study their reactions inside micro-droplets acting as small reactors that can be physically sorted as a function of their chemical content.

FORMAT

This project will be taken by a group of four students. During the first two weeks, students will learn the necessary techniques and plan their progress for the weeks 3 and 4, which will require a larger work load. Students will work in pairs during week 3, each developing a specific modules of the final device.

Week 1: Soft lithography

All participants will learn how to create microfluidic channels using microfabrication and soft-lithography. This involves creating a mask using a vector graphics software, using a photo-resist to generate a mold, and finally imprinting the circuit on a soft and transparent elastomer matrix.

Week 2: Connections, input/outputs

During week 2, techniques to create input and output connections will be introduced, and a simple device will be built to merge several channels and study mixing issues in microfluidic devices.

Week 3:

In week three, students will work in groups of two, each developing a specific module of the project. One group will design and test a fluid mixer, while the other will develop a droplet generator.

Week 4:

During week four, the two groups will integrate their work into a single device in order to study the dynamics of a reaction in the droplets.

Coursework

Coursework	Due date	Marks
Development: Project skills, technical skills and initiative		20 Individual)
Individual report	4pm Thursday 26 May 2022	30
Team report	4pm Friday 10 June 2022	30

Examination Guidelines

Please refer to Form & conduct of the examinations [2].

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Links
[1] mailto:ts573@cam.ac.uk
[2] https://teaching21-22.eng.cam.ac.uk/content/form-conduct-examinations