Master Project at the Laboratory of Life Sciences Electronics

Investigation of a High Sensitivity Single Cell Sensors and Electrical Parameter Extraction of Cells via Electrorotation

The goal of this master project is to investigate in label-free the physical properties of single cells using the highly sensitive method of electrorotation within three dimensional electrodes. When cells are placed in a rotating electrical field they start to rotate with a speed that correlates to the frequency of the rotating electric field and which reflects intrinsic electrical properties of cells. Electrorotation is a recognized method which is capable to extract inherent electrical properties, like membrane permittivity and cytoplasm conductivity of cells. The investigation of these properties can be employed to recognize different cells or to highlight cell states (e.g: healthy vs diseased cells). The high sensitivity of this technique and the possibility of single cell detection make this technology a potential candidate for non-invasive real-time observation of the cell state.

To increase the efficacy of the device we developed a process to produce 3D electrodes within a microfluidic channel. With these electrodes we can achieve a homogenous electrical field over the complete channel width. Through this homogenous electrical field we can achieve higher rotation speeds at lower voltages and therefore a significant higher sensitivity.

The student will start with a literature survey of the technique of electrorotation and the 3D integration of the electrodes to understand the technique and the extraction of the electrical parameters of the cell from the electrorotation spectrum.

This task will be followed by electrorotation measurements of different cell types, data analysis and extraction of the cell parameters.

At a later stage of the project the LabView code used for the experiment might be improved to achieve a faster and more automated acquiring of data, in addition the layout of the microfluidics would have to be optimized in order to have a more effective cell trapping.

Advisor: Prof. Carlotta Guiducci
Supervisor: Kevin Keim (kevin.keim@epfl.ch)

Type of work: 10% literature study, 40% experimental measurements, 20% data analysis, 25% coding, 5% cell culturing

Required background: physics, electrical-engineering, bio-engineering, micro-engineering or similar

If you are interested in this master project, please send an email including CV and transcript of records to kevin.keim@epfl.ch.