University of Basel
Department of
Biomedical Engineering

University of Basel, department of Biomedical Engineering, Hegenheimermattweg 167c, 4123 Allschwil

Master of Science – Biomedical Engineering
Thesis Proposal:

Electrochemical biosensing of inflammation in engineered cartilage tissue and integration into a cartilage-on-chip platform

Early osteoarthritis involves metabolic alterations, local pH shifts, LDH release, and matrix degradation. Electrochemical sensors provide a real-time, non-destructive way to monitor these changes. Combining these sensors with engineered cartilage tissue generated from human primary nchondrocytes allows a physiologically relevant environment for inflammation detection. Using IL-1β to induce inflammation and comparing multiple human donors enhances the biological relevance. Incorporating multiple sensing modalities (pH, LDH, potentially additional markers) into an organ-on-chip platform could enable dynamic monitoring of tissue state and degeneration mechanisms.

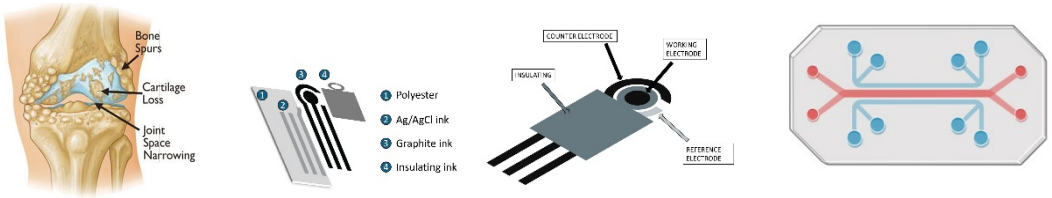

Figure 1. An osteoarthritic knee, showing signs of tissue degeneration, a printed electrochemical sensor with integrated electrodes and a PDMS microfluidic chip design showing channels for tissue culture.

The objective of this thesis is to fabricate engineered cartilage constructs, evaluate electrochemical sensors in these tissues, and determine whether sensor readouts can distinguish healthy from inflamed states. The student will culture primary cells, produce tissue constructs, apply IL-1β stimulation, and test the sensors for stability, sensitivity and responsiveness. The project includes several specific objectives: **(1)** fabrication of gelatin-cellulose cartilage constructs seeded with primary human chondrocytes, **(2)** establishment of healthy and IL-1β inflamed culture conditions across donors, **(3)** evaluation of electrochemical sensors including pH, LDH and potentially additional analytes for stability, reproducibility and sensitivity within 2D and 3D environments, **(4)** correlation of sensor outputs with biological assays to validate readout accuracy, and **(5)** integration of selected sensors into a cartilage-on-chip platform for real-time monitoring under controlled conditions.

Nature of thesis
Experimental: 80%
Documentation: 20%

Specific requirements
Experience with basic cell culture is useful but not essential. Interest in biosensing, electrochemistry, and microphysiological systems is an advantage.

Group leader
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