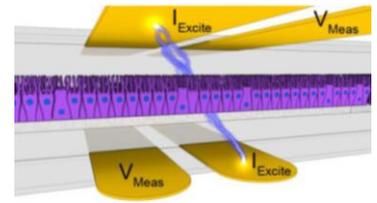


# Trans-Epithelial/-Endothelial Electrical Resistance (TEER) measurement in a cancer on chip device

MSc thesis theme



## Introduction

The barrier integrity of epithelial tissue is crucial to many physiological functions in multicellular organisms. In cancer conditions, this integrity decreases which allows for the migration of cancer cells toward the bloodstream, also called intravasation (Figure 1), a key step in the metastasis process which is a major cause of death by cancer.

Measuring the transepithelial/transendothelial electrical resistance (TEER) of cellular monolayer has been used to examine the barrier properties, such as the integrity and permeability of various type of tissues (Figure 2) [1,2]. This method can be done in a non-invasive and label-free method on a microfluidic device. This Real-time TEER measurements within a cellular environment that mimics cancer conditions can notably advance understanding of cancer metastasis and turn into a functional drug testing platform.

In this project, we will develop a novel microfluidic device which enables real-time TEER measurement using organic electrochemical transistors (OECTs) [3,4]. This device is composed of multiple layers (Figure 3) where electrodes on the top and bottom sandwich the microfluidic channels. In the middle, there are two microfluidic layers that are separated with a porous membrane. Endothelial (vascular) cells can be introduced to the bottom channel and epithelial cancer cells to top, with porous membrane providing cross-talk between two channels. This device architecture allows for manipulating the cell layers while measuring the TEER response in real-time.

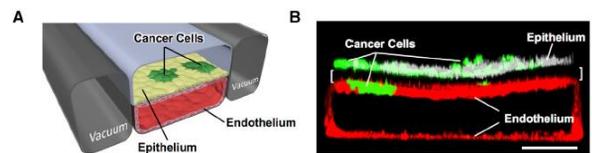
## Experiments

During project, you will get familiar with both photolithography, to fabricate the electrodes and OECT, and soft lithography to fabricate the polydimethylsiloxane (PDMS) microfluidic layers.

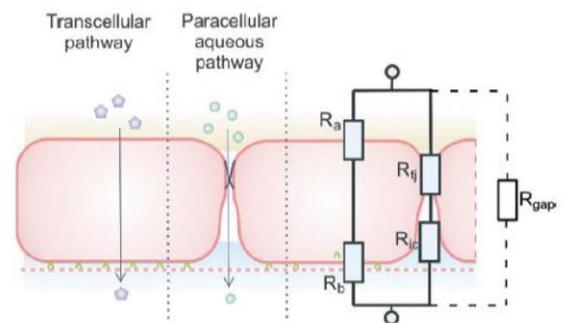
After device development and initial tests, cells can be introduced in device. You will get trainings on basic cell culture method to acquire sufficient knowledge for cellular integration into device and following permeability tests.

### References

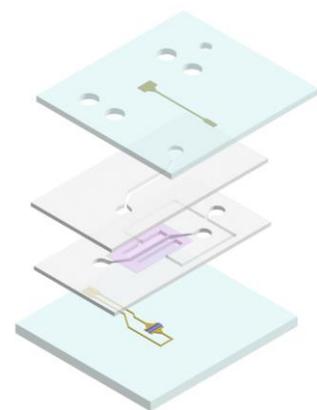
- [1] Henry et al., Lab Chip, 2017,
- [2] Hassell et al., 2017, Cell Reports 21, 508–516
- [3] Yeung et al., Sensors and Actuators A: Physical, 2019
- [4] Lieberth et al., Advanced Healthcare Materials, 2021



**Figure 1** Schematic (A) and fluorescent (B) view of cancer metastasis in device. Cancer cells (green) in top channel pass a porous membrane in between of two channels into the bottom channel (vascular cells in red), due to lower cellular integrity in cancer condition. [2]



**Figure 2** Equivalent circuit model of a cellular monolayer consisting of a transcellular route ( $R_a + R_b$ ) and paracellular route ( $R_{tj} + R_{ic}$ ) for current passing through the membrane.



**Figure3** Exploded view of the multilayer device structure, composed of electrodes in Top and bottom, and two microfluidic channels (cell channels) in between, separated by a porous membrane.