

Organ-on-chip devices

PhD Report – 3rd semester

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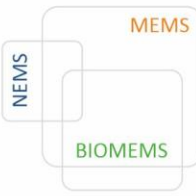
www.ek-cer.hu | www.mems.hu | www.biomems.hu



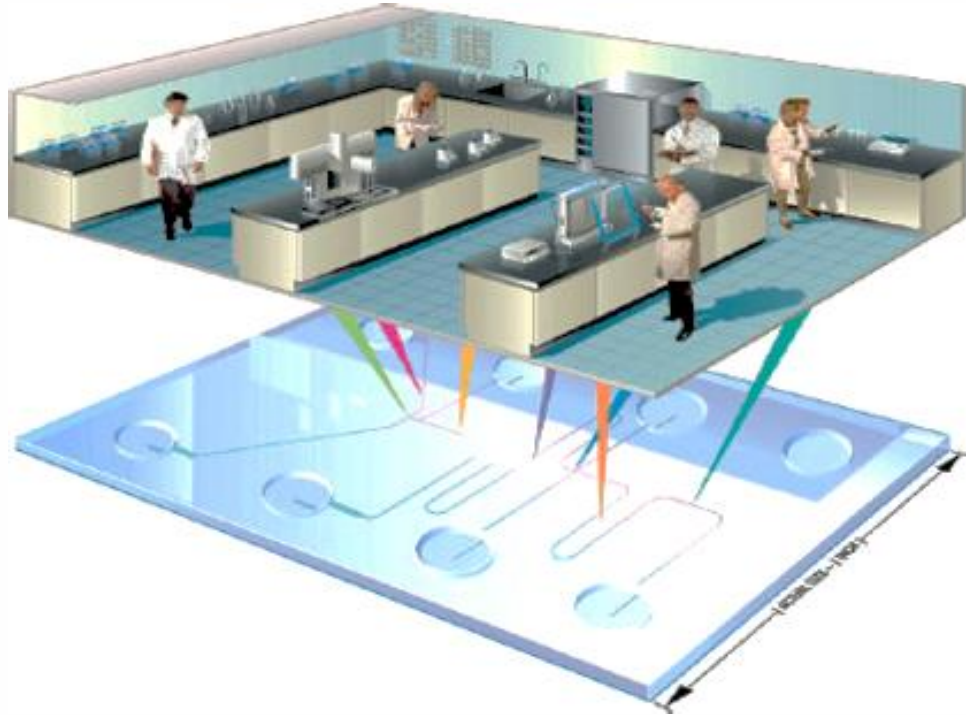
Introduction

- Microfluidics: precise control and manipulation of fluids on a micrometer scale
- Small Reynolds number: viscous forces, laminar flow
- Capillary flow, autonomous flow
- Advantages of size: portability, low consumption (sample, reagents)
- Lab-on-a-chip: miniature version of a complete laboratory
- Organ-on-a-chip: cell cultures, tissues on a microchip
- Generating chemical gradients
- Cell-trapping and behaviour monitoring
- Measurements with bacteria and antibiotics

Goal: chemical gradient generation, cell-trapping, electrode integration, impedance spectroscopy based measurements, rapid antibiotic resistance measurements



Lab-on-a-chip

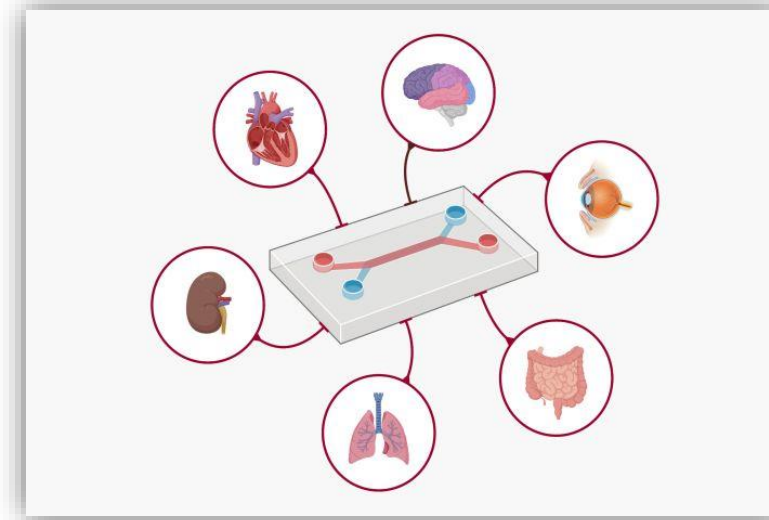


Polimer alapú mikrofluidikai eszközök technológiája, Holczer Eszter

Advantages:

- Low consumption, reduced waste
- Point-of-care
- Fast, precise, controllable
- Low cost, disposable

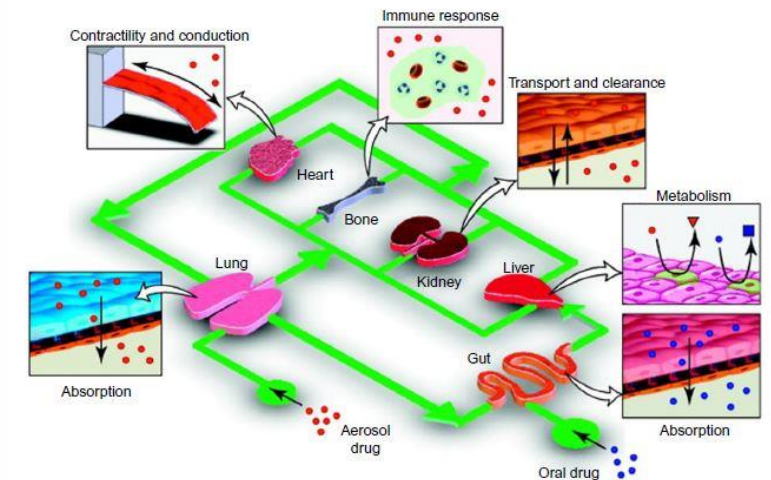
Organ-on-a-chip



<https://www.ufluidix.com/microfluidics-applications/organ-on-a-chip/>

Advantages:

- Reduce or replace animal testing
- Drug development and tests
- Cancer research

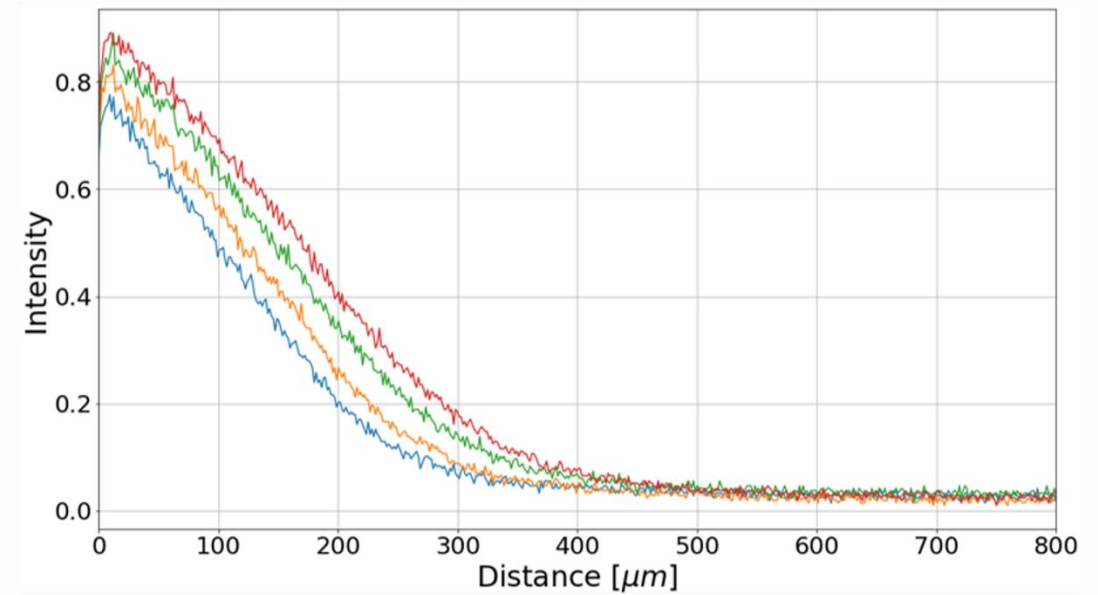
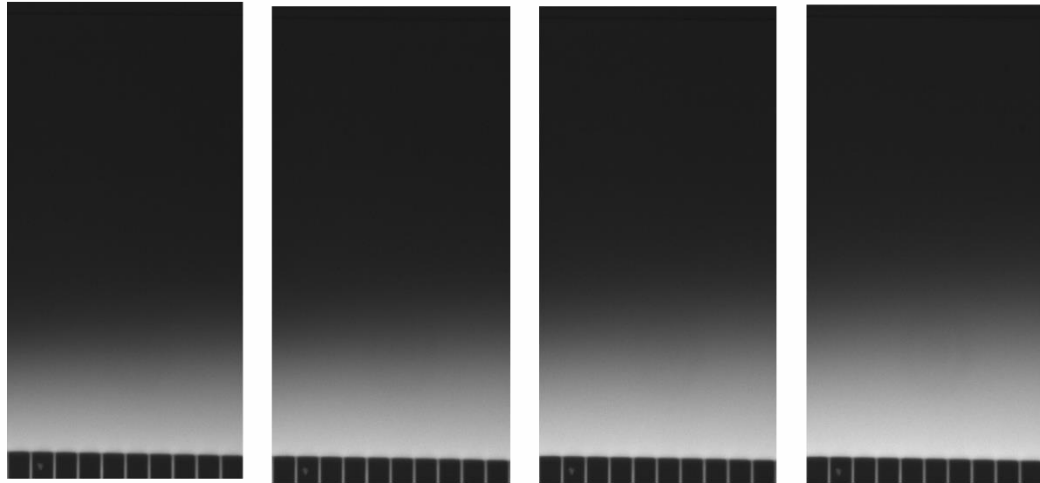


Lab-on-a-chip technology and microfluidics: Antonio Francesko, Vanessa F. Cardoso, Senentxu Lanceros Mendez, 2019

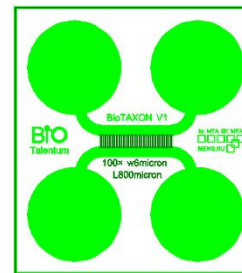
Results in previous semesters

Protein Diffusion: BSA, IgG, Rh B

- Publication: Manuscript waiting for revision
- Python evaluation program, error function fitting



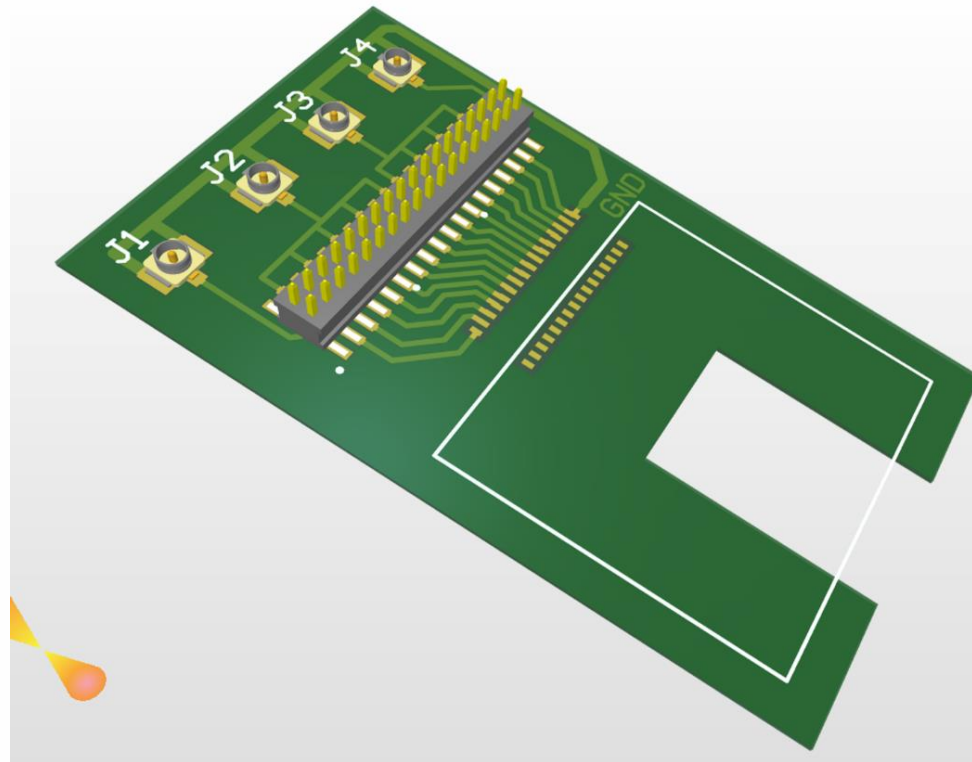
Material	D of measurement [$\mu\text{m}^2/\text{s}$]	D in literature [$\mu\text{m}^2/\text{s}$]
BSA	64.24 ± 0.63	60.7, 63.8, 72
IgG	38.95 ± 0.29	38, 40
Rh B	372.74 ± 3.32	360, 420, 427



Results in current semesters

Device assembly

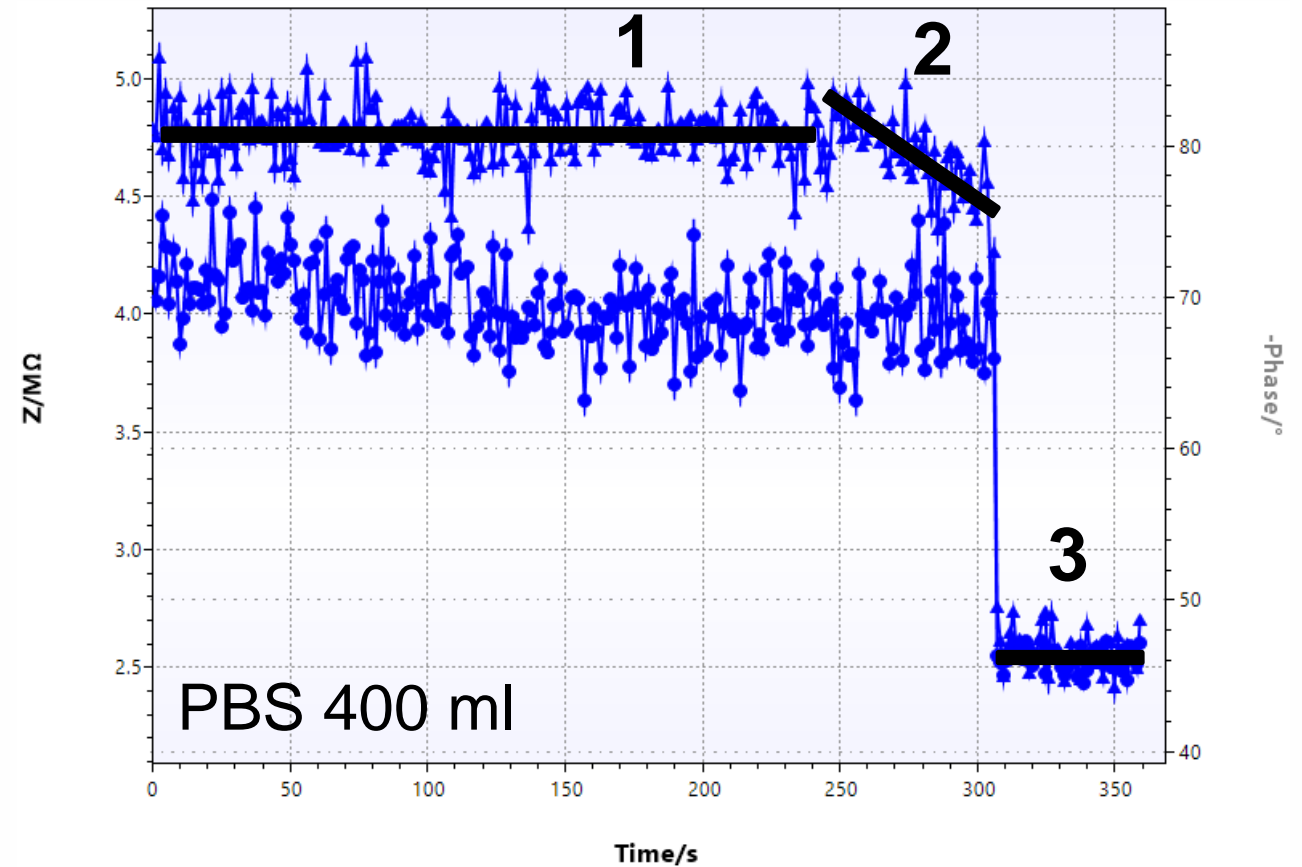
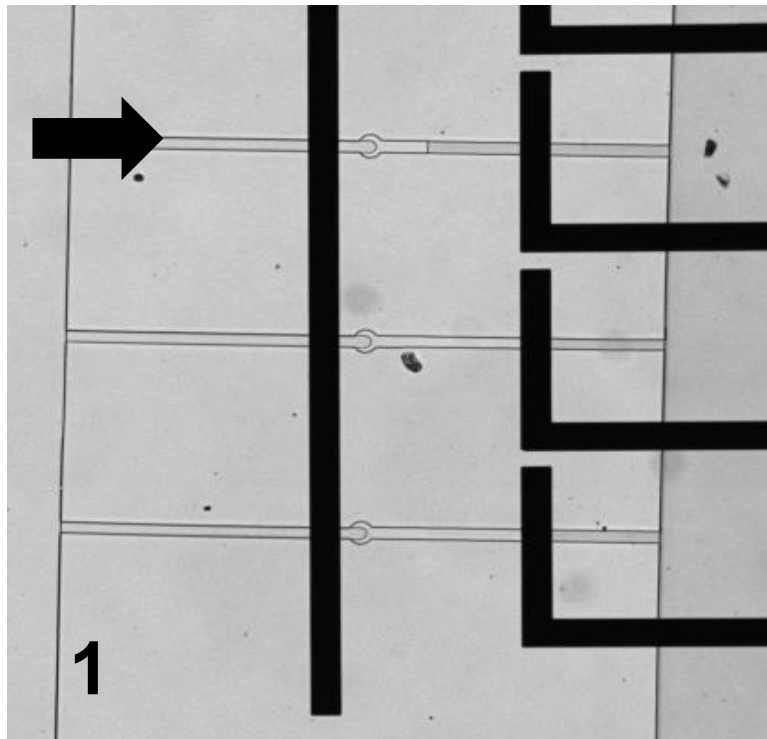
- PCB fabrication
- Au and Pt electrodes
- 4 channels measurement
- Connection with PalmSense4



Results in current semesters

Measurements

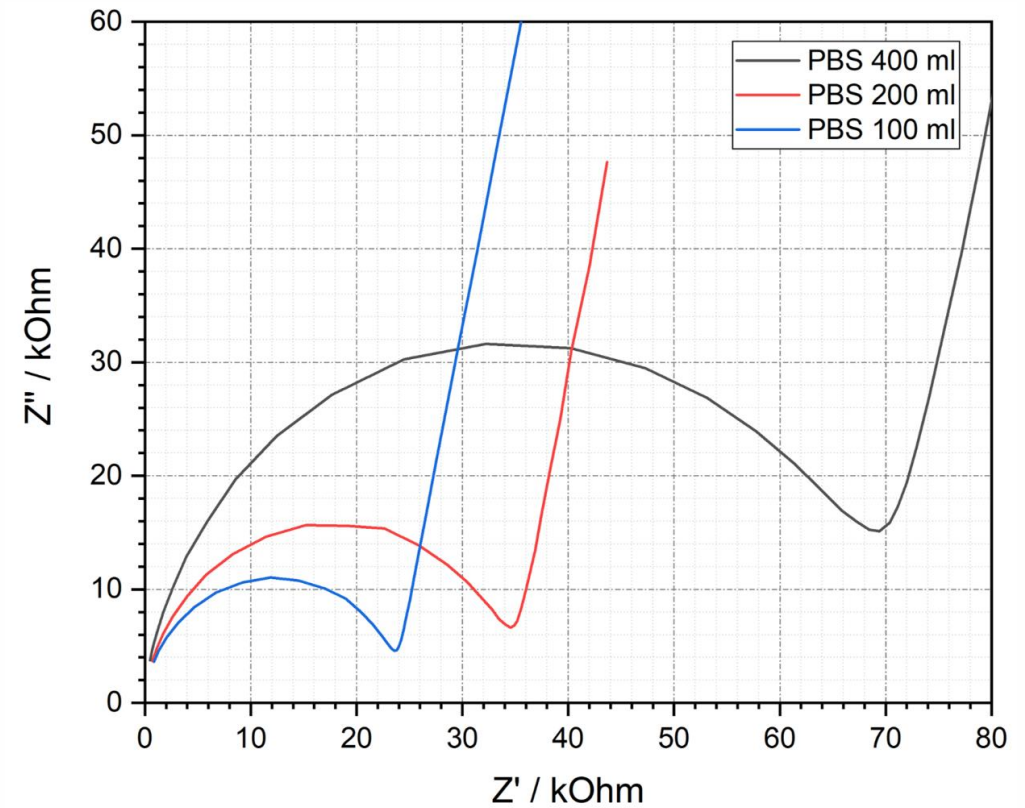
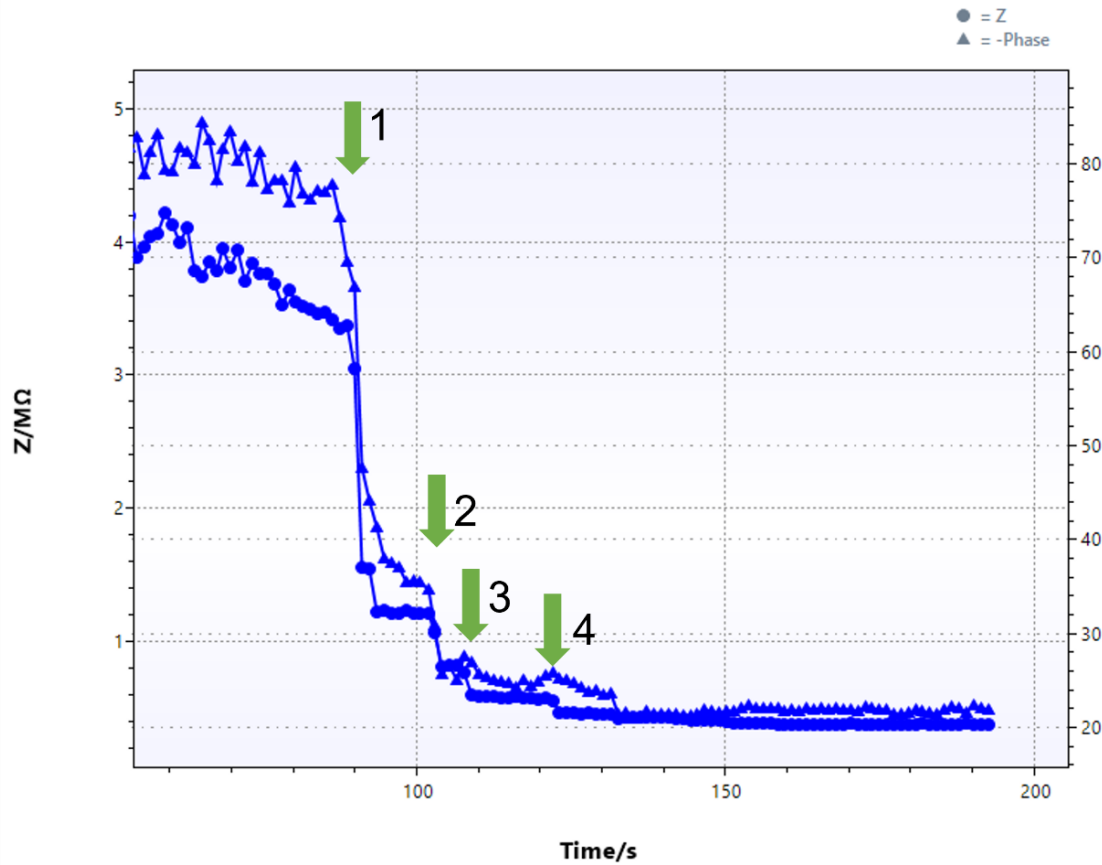
- Filling tests → steps
- PBS concentration measurements



Results in current semesters

Measurements

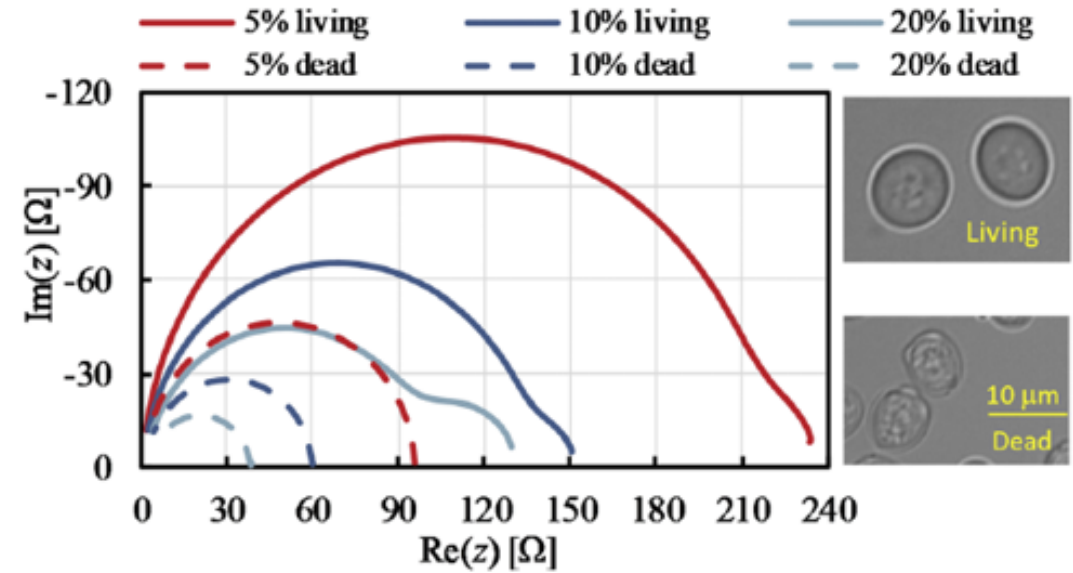
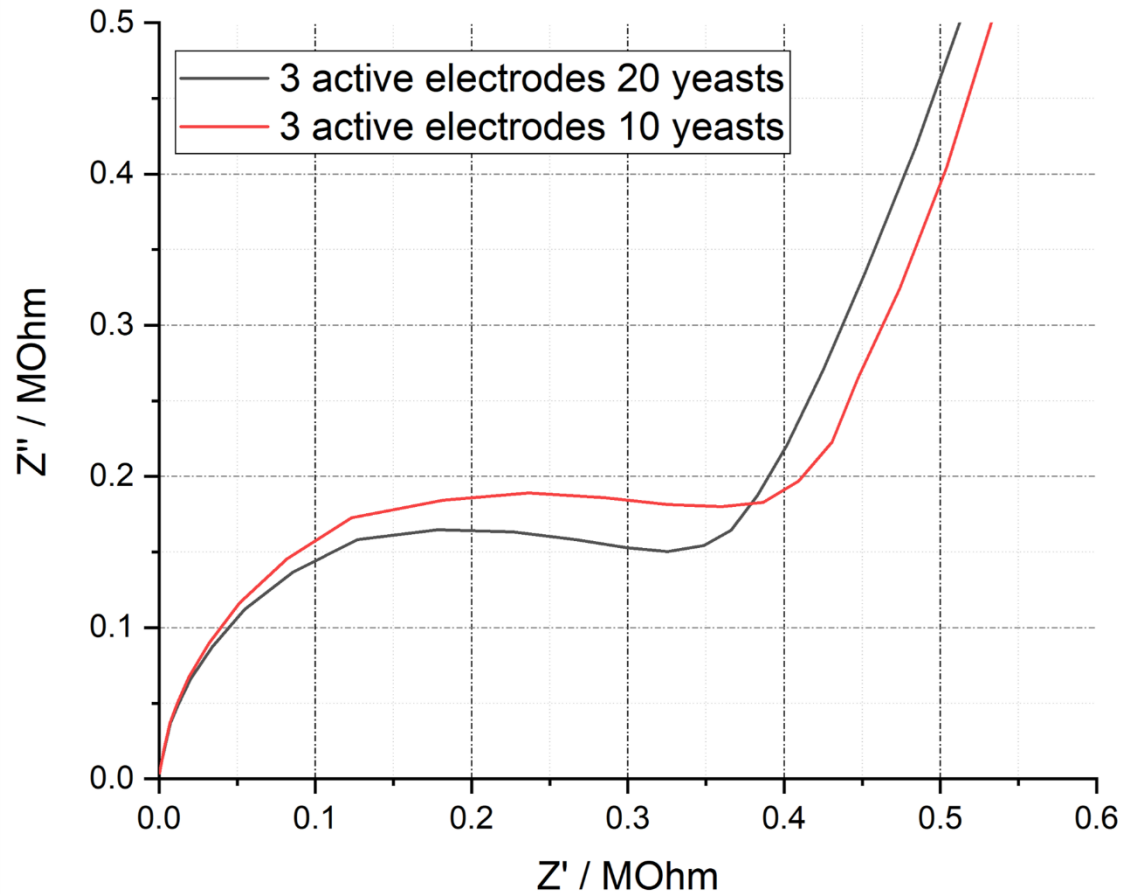
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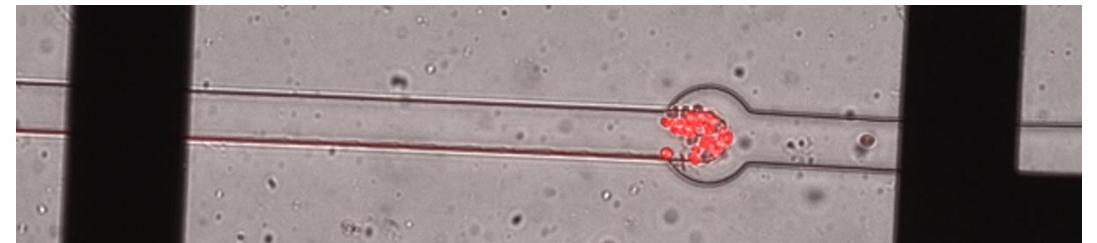
Results in current semesters

Measurements

- 0.05 mg/ml yeast solution in PBS with 10 mg/ml Glucose and PI staining
- Measurements with Au and Pt electrodes



Li Wang et al. A hybrid Genetic Algorithm and Levenberg–Marquardt (GA–LM) method for cell suspension measurement with electrical impedance spectroscopy



Publications

- Manuscript of protein diffusion coefficient measurements
- Under evaluation – Hungarian Article:
 - *Bányai Anita; Bató Lilia; Leelőssyné Tóth Eszter; Varga Máté, Fürjes Péter, **Áramlástan jelenségek mikroszkopikus mérettartományban – mikrofluidikai rendszerek és alkalmazásaik**, Fizikai Szemle – Magyar Fizikai Folyóirat*

Previous conferences

- Mátrafüred 2022 – International Meeting on Chemical Sensors – Poster (June 12-17)
 - *Lilia Bató , Péter Fürjes, **Individual cell trapping and viability testing in microfluidic device**, Mátrafüred 2022 – International Meeting on Chemical Sensors, Visegrád, Hungary, 2022*
- Rotterdam – Lab-on-a-Chip Microfluidics Europe – Poster (June 21-22)
 - *Lilia Bató, Péter Fürjes, **A fluorescent detection method to measure the diffusion coefficients of proteins in a free-diffusion based microfluidic system**, Lab-on-a-Chip Microfluidics Europe 2022 Conference, Rotterdam, The Netherlands, 2022*

Courses completed:

- Selected chapters of material testing methods I.: FTIR, SEM, STM, AFM
- Chemical sensors: methods and applications

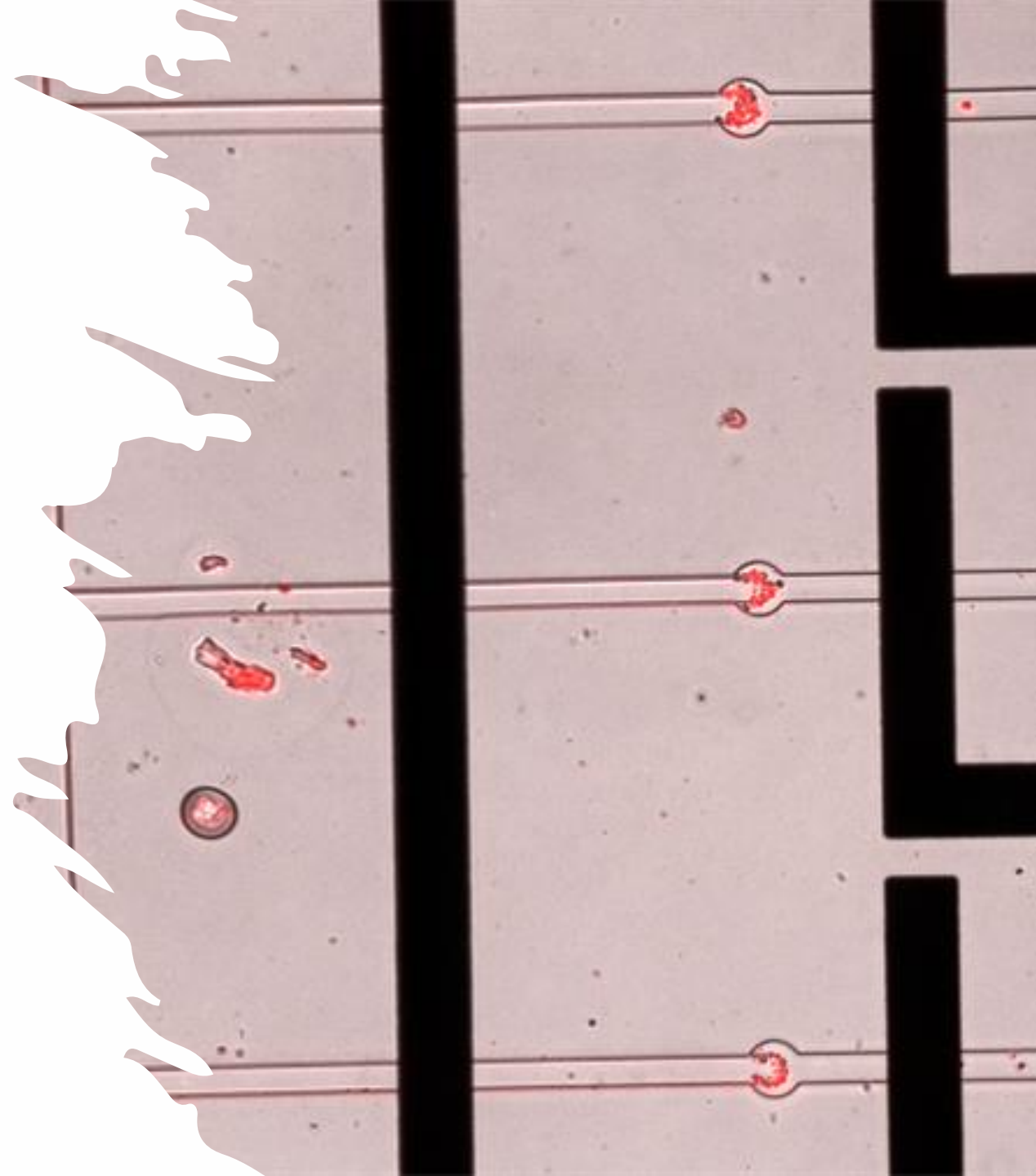
Future plans

Research

- Impedance spectroscopy measurements on trapped yeast cells
- Measurements with Pt electrodes
- Rapid antibiotic resistance measurements (E. Coli)
- New structure with closer electrodes in SU-8

Publication

- Protein diffusion article



Thank you for your attention!