

First step towards a “template cell-free” surface imprinted polymer-based biosensor for the detection of bacteria

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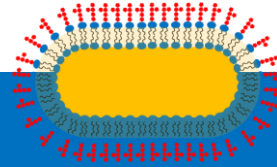
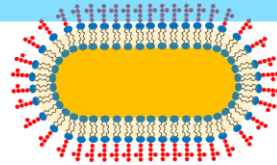
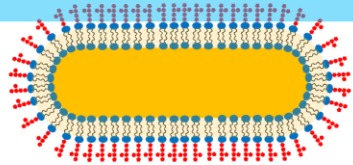
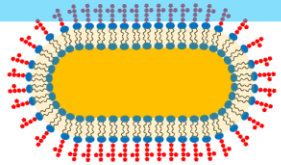
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Presentation flow

- State-of-the-art & Motivation
- Proposed concept
- Design & Fabrication & Methodology
- Results
 - Microscopy
 - EIS
- Conclusion & Future work

Stamp with bacteria



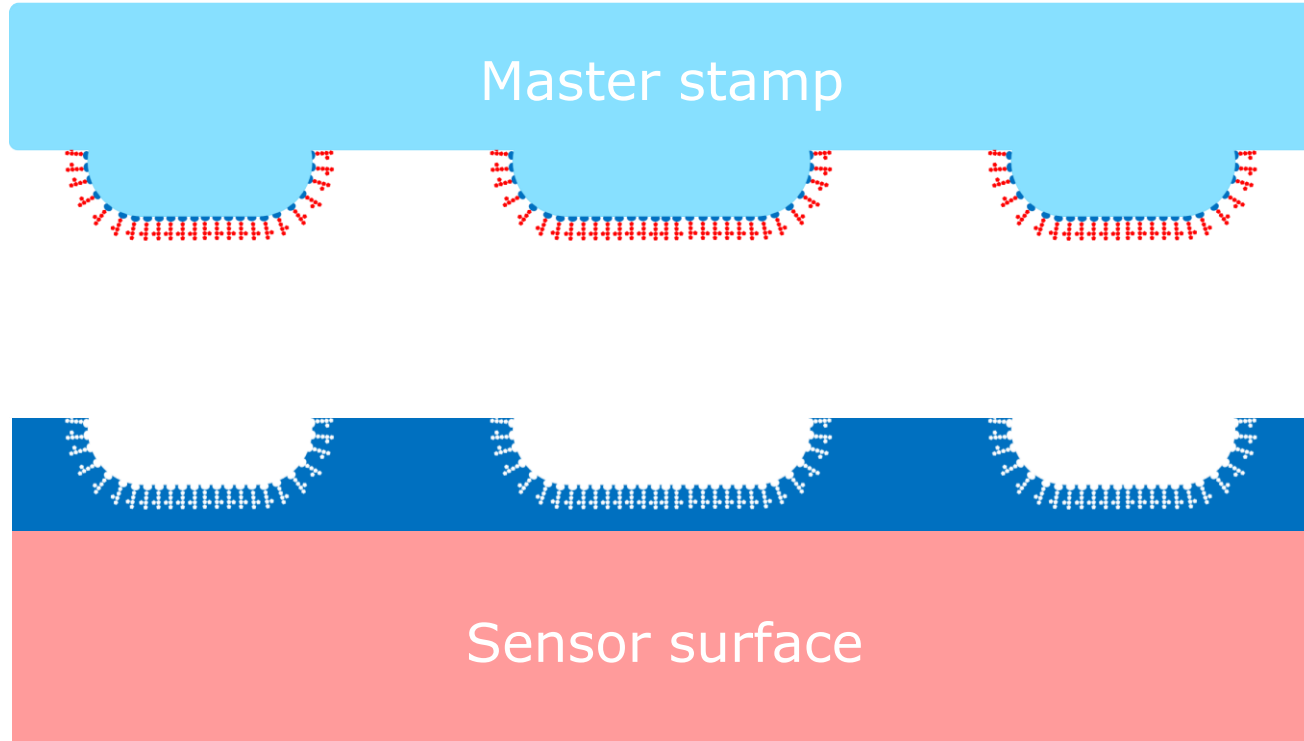
Sensor surface



- Template cell-free?
- Potential risks?
- Consistent & automated fabrication?

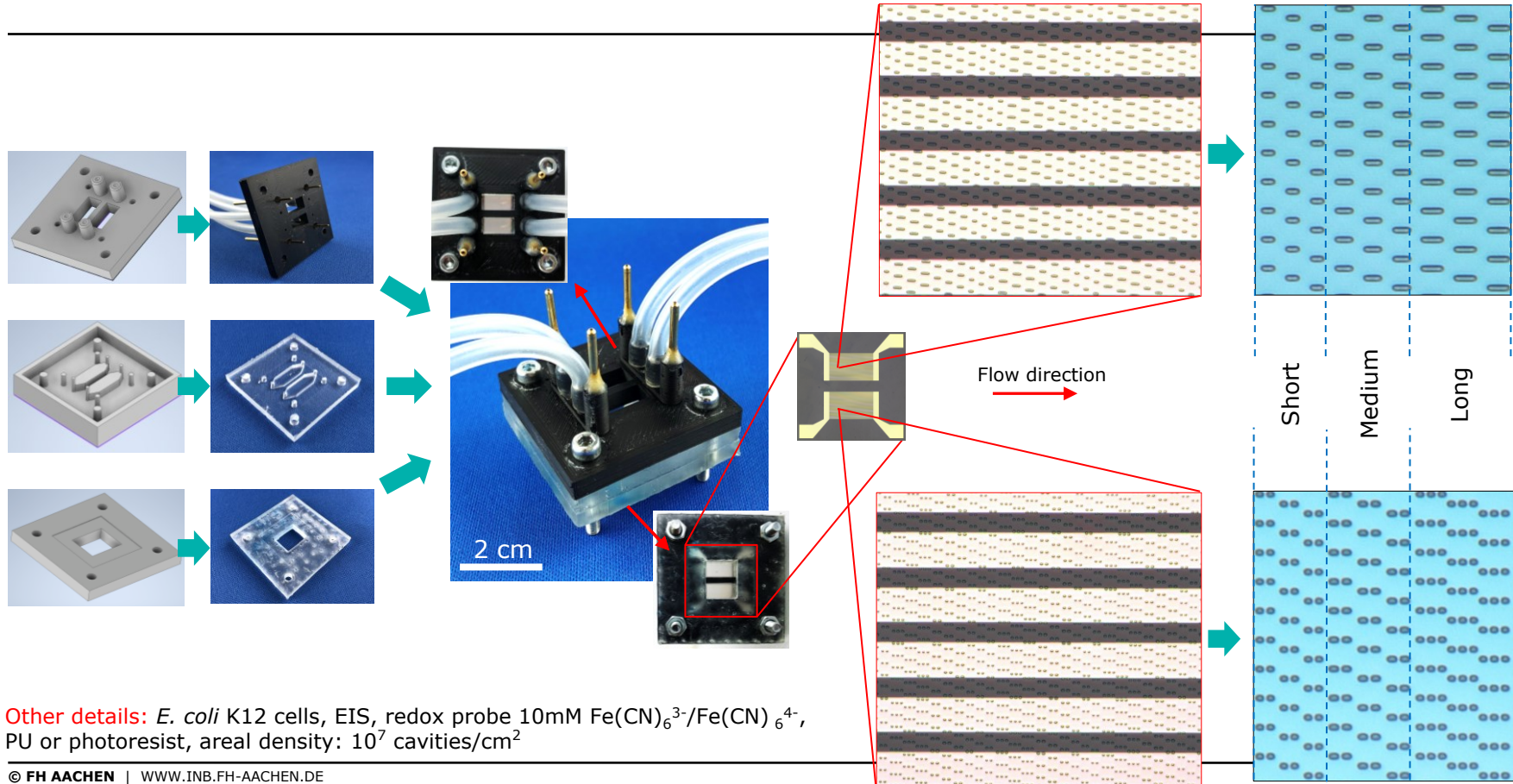
Proposed concept

3D photolithography → Master stamp → Imprinting



- ✓ No need for template bacteria.
- ✓ Safe.
- ✓ Suitable for automation.

Design & Fabrication & Methodology



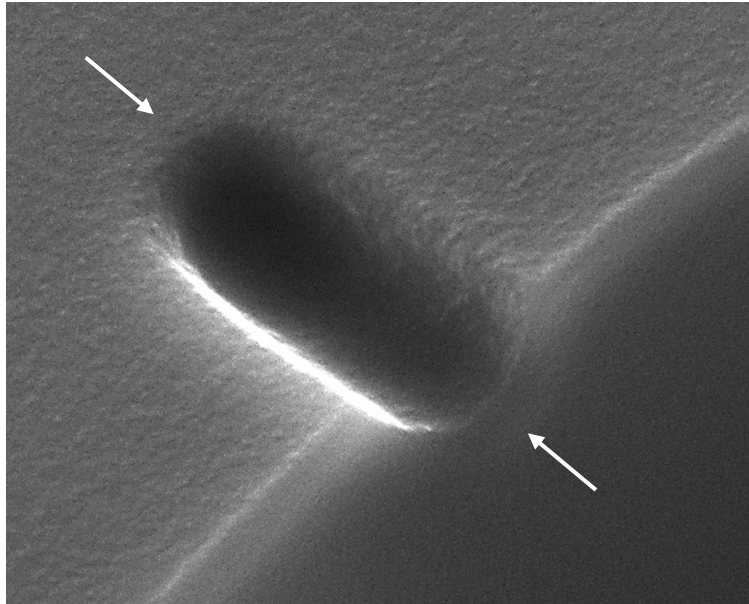
Other details: *E. coli* K12 cells, EIS, redox probe 10mM $\text{Fe}(\text{CN})_6^{3-}/\text{Fe}(\text{CN})_6^{4-}$, PU or photoresist, areal density: 10^7 cavities/cm²

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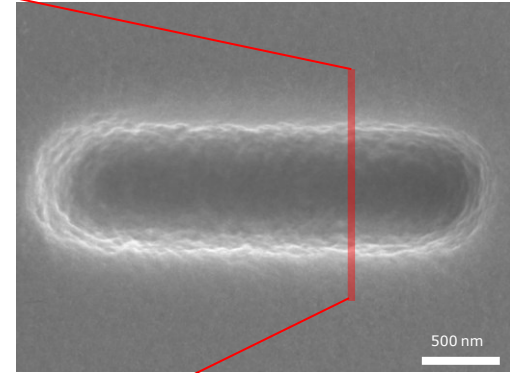
Results - Characterizations

SEM images of there main structures for SIP development



The arrows indicate achieved curvative geometry not on the tails but also on the bottom of the cavity.

A cavity on IDE-based **sensor chip**.

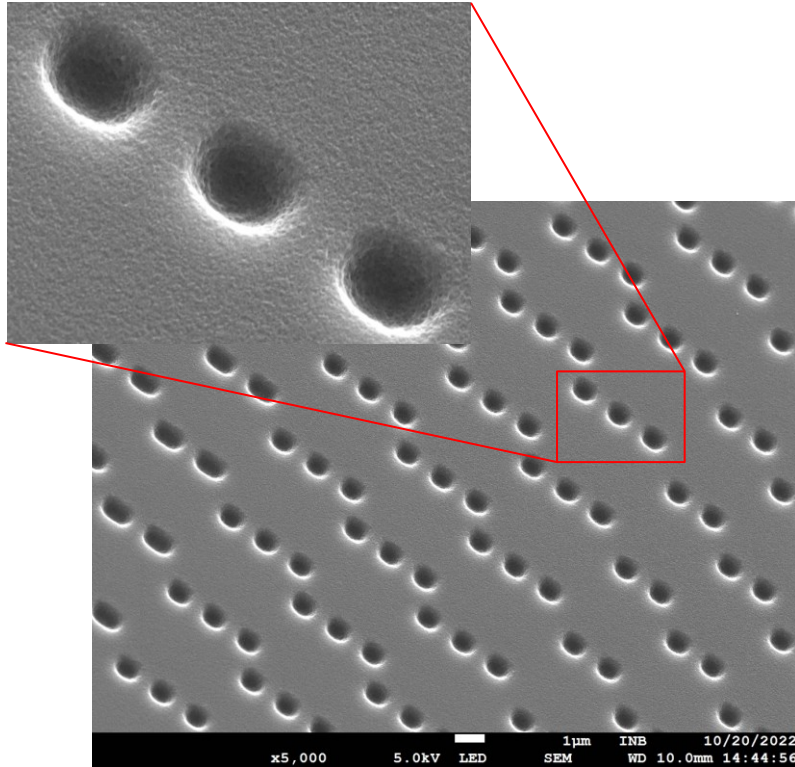


PU, Polyurethane.

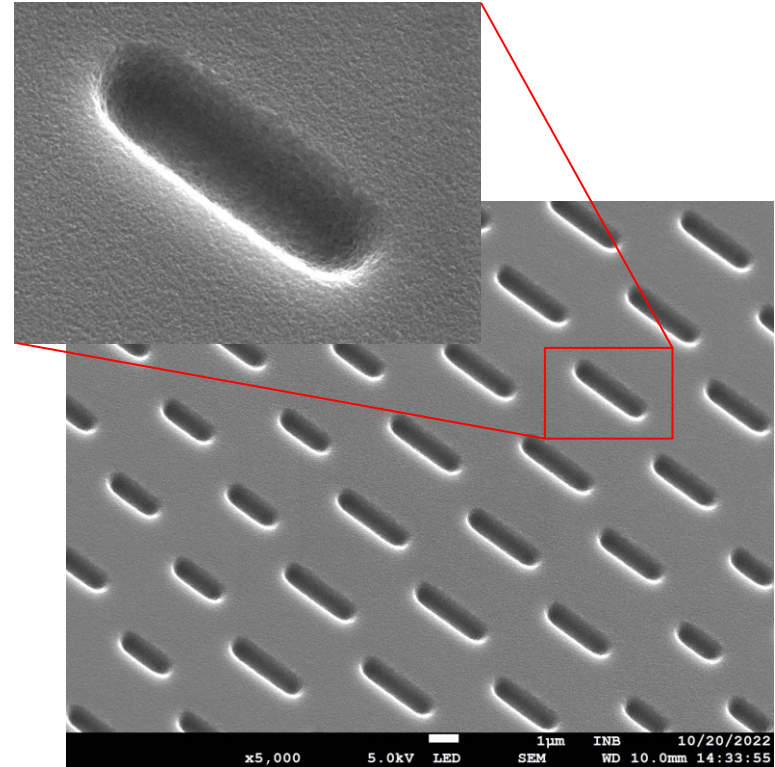
Results - Characterizations

SEM images of the different cavities

Control cavities



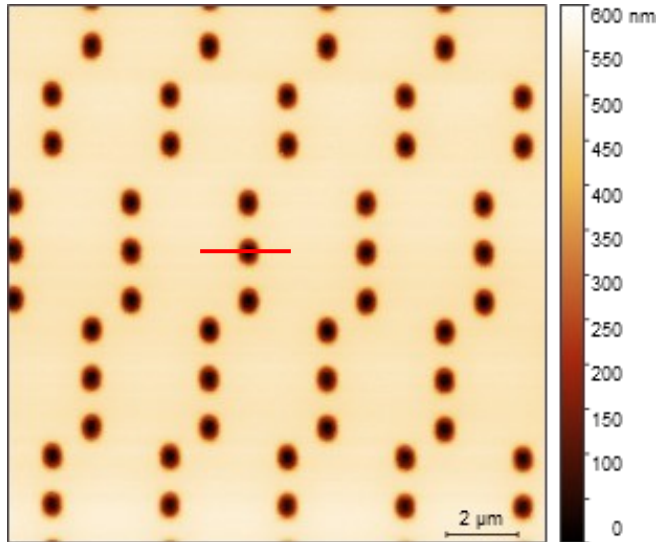
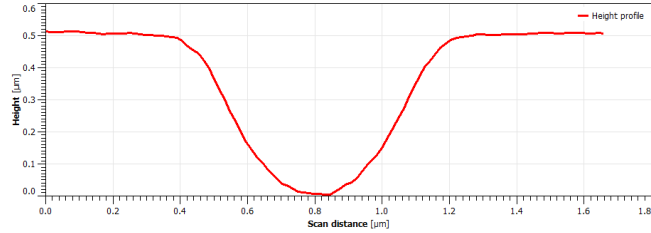
***E. coli* cavities**



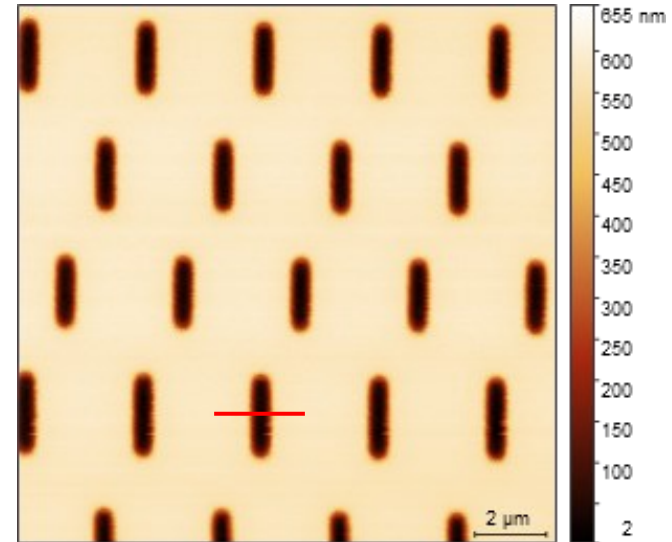
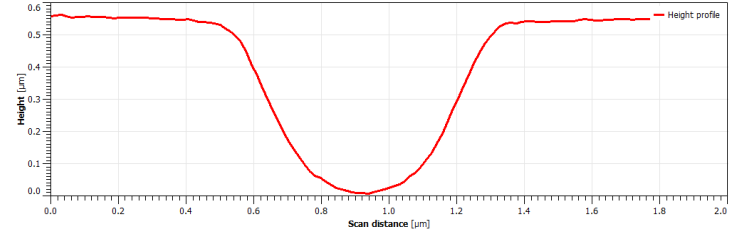
Results - Characterizations

AFM images showing cavities of both **control** and *E. coli*

Control cavities



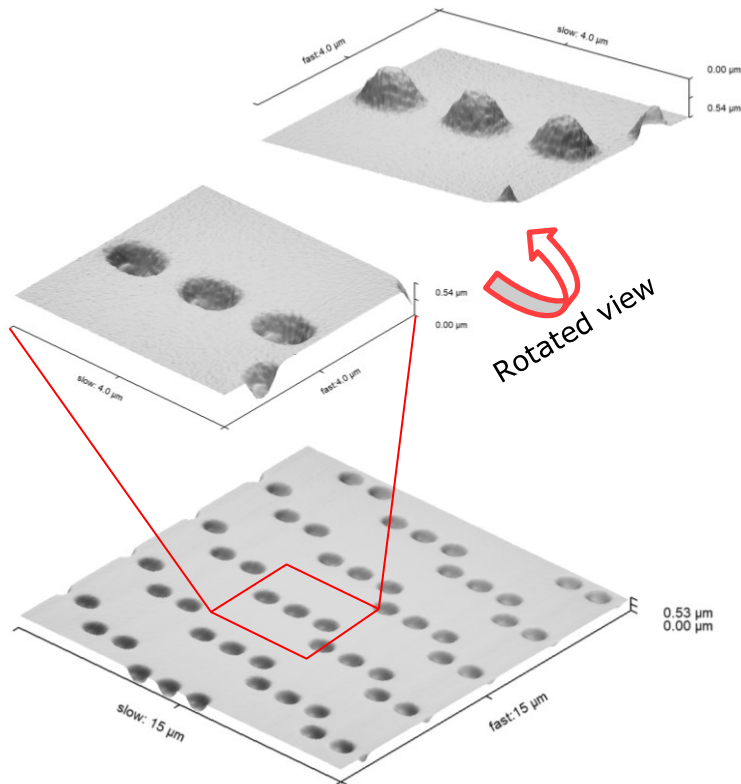
E. coli cavities



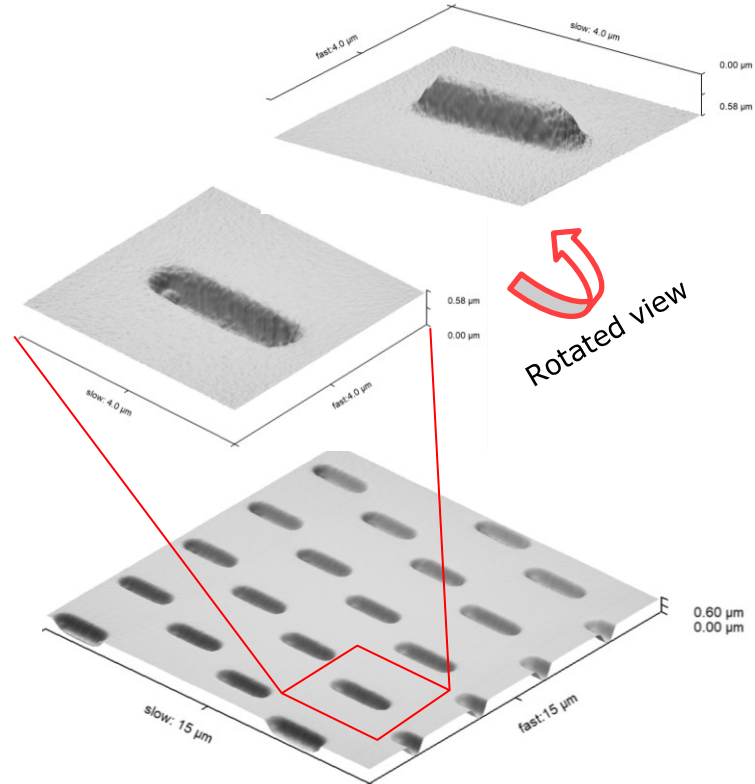
Results - Characterizations

3D-AFM images showing cavities of both **control** and *E. coli*

Control cavities



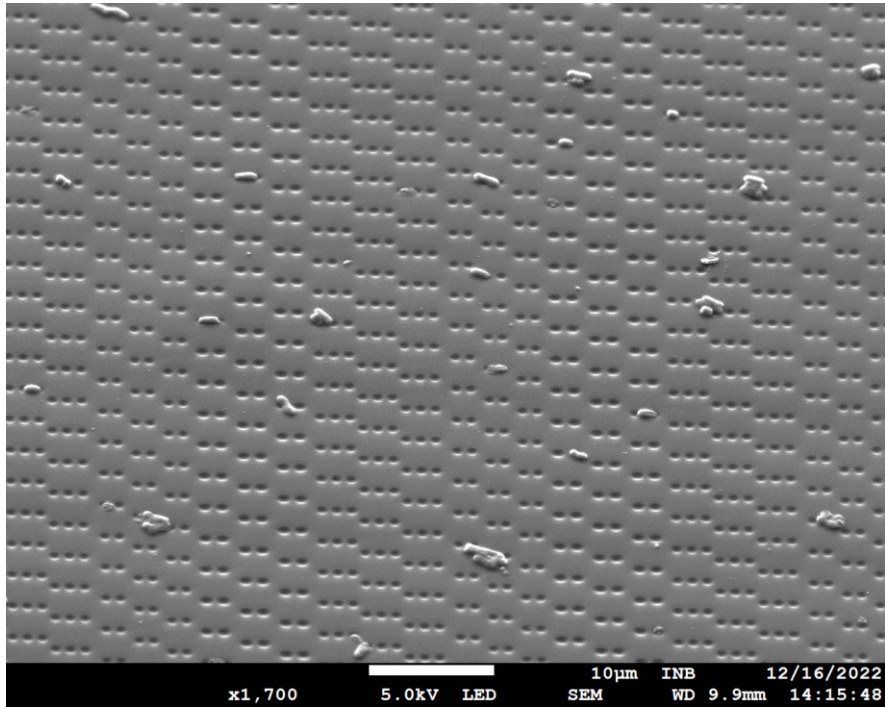
***E. coli* cavities**



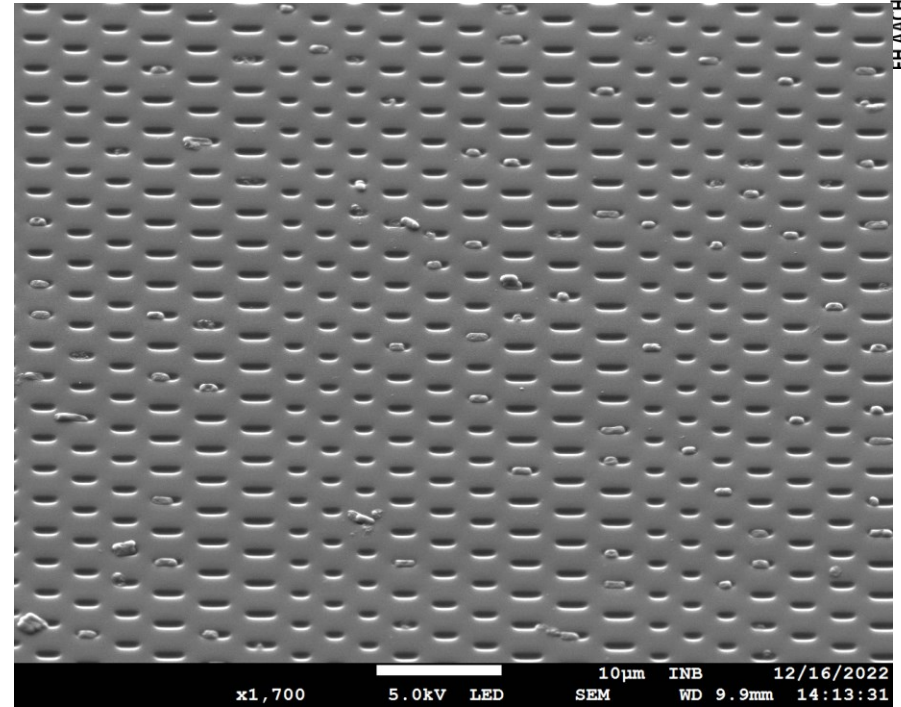
Results - Measurements

Representative AFM/SEM images showing capture of *E. coli* cells on the sensor surface

Control cavities



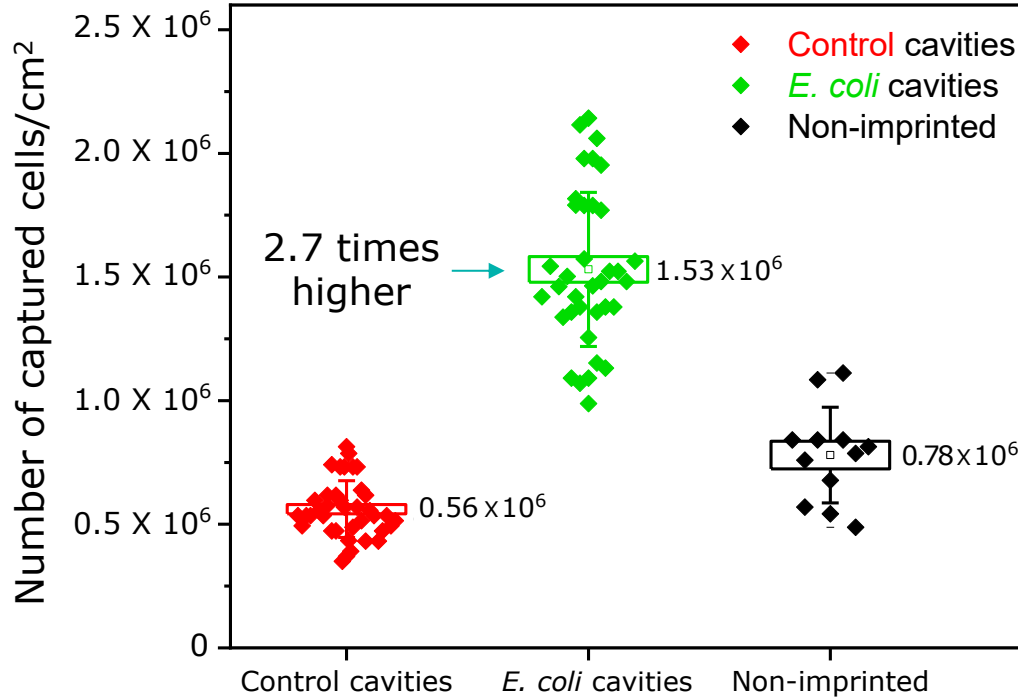
E. coli cavities



10^8 cells/mL were applied to the channels of the flow-cell and waited for **10 min** (no flow) before fixation and measurements.

Results - Measurements

Number of captured *E. coli* cells on the sensor surface



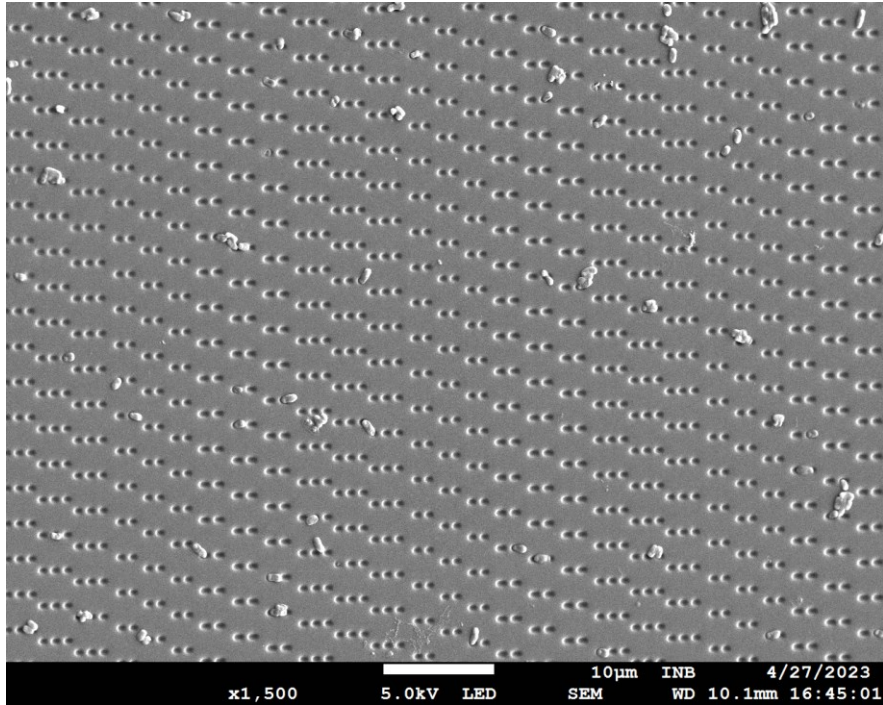
n=3, dots represent the number of cells for each counted-SEM images.

10⁸ cells/mL were applied to the channels of the flow-cell and waited for **10 min** (no flow) before fixation and measurements.

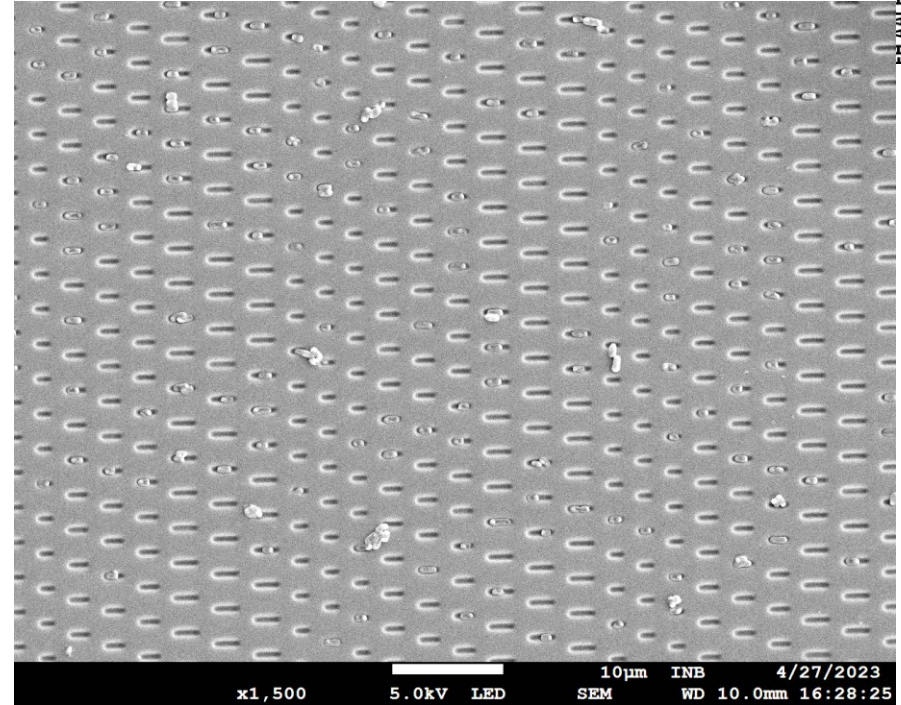
Results - Measurements

Representative SEM images showing capture of *E. coli* cells– 20 min incubation

Control cavities



E. coli cavities

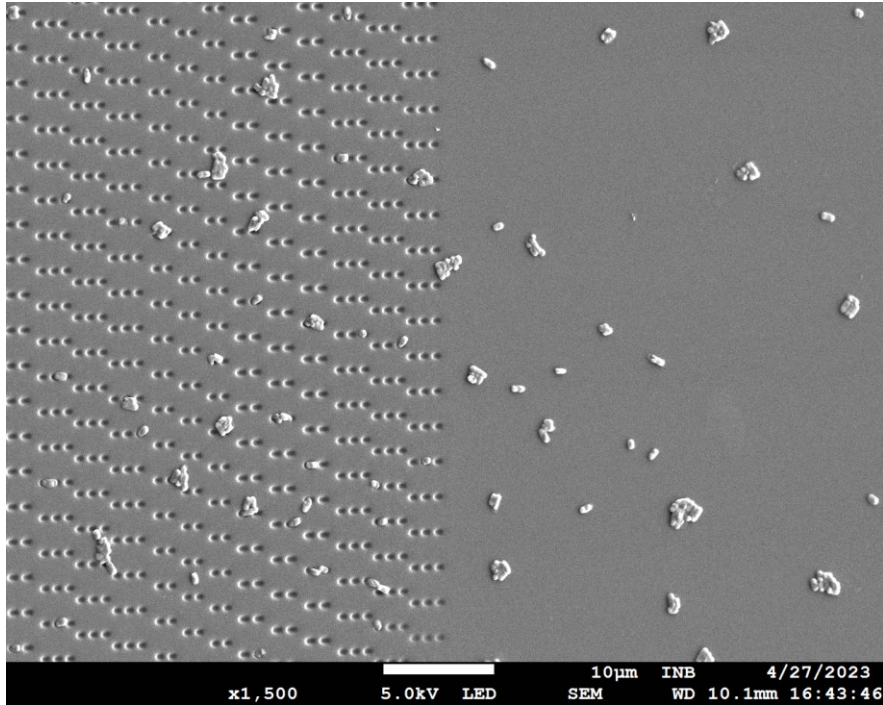


10^8 cells/mL were applied to the channels of the flow-cell and waited for **20 min** (no flow) before fixation and measurements.

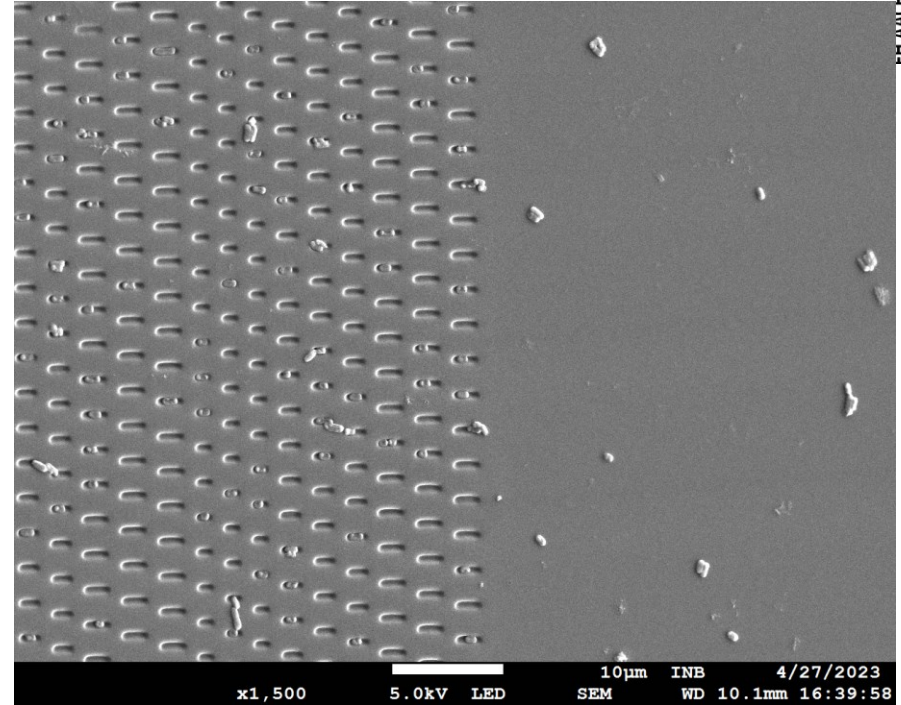
Results - Measurements

On border: Control-SIP vs SIP vs NIP

Control cavities



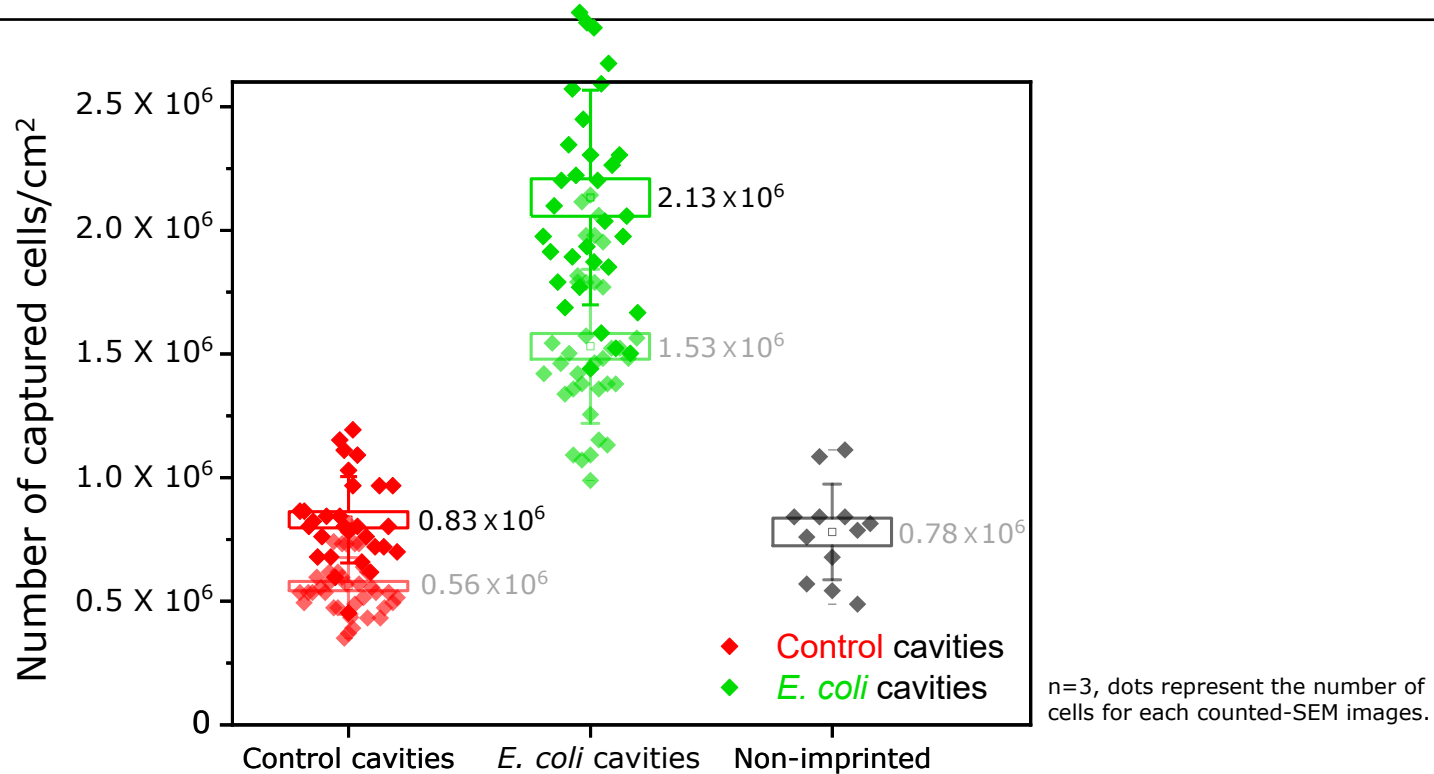
E. coli cavities



10⁸ cells/mL were applied to the channels of the flow-cell and waited for **20 min** (no flow) before fixation and measurements.

Results - Measurements

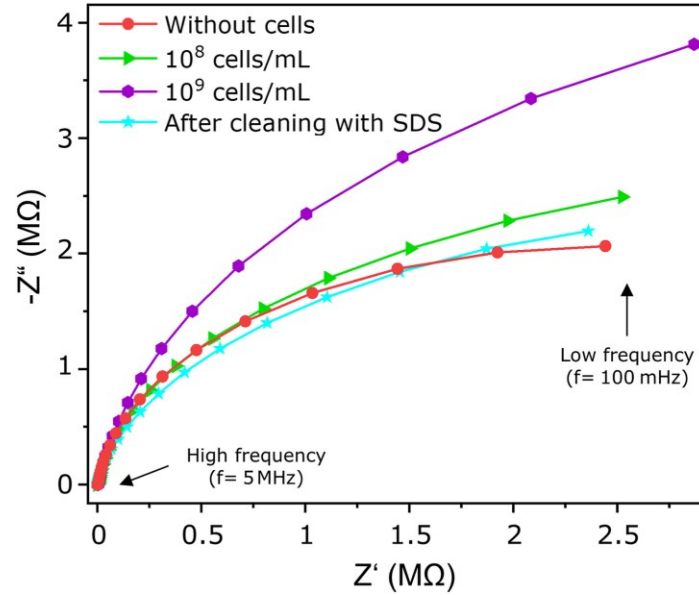
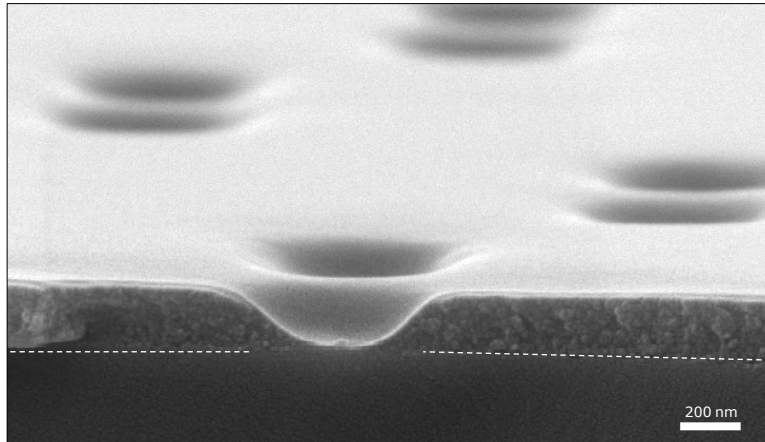
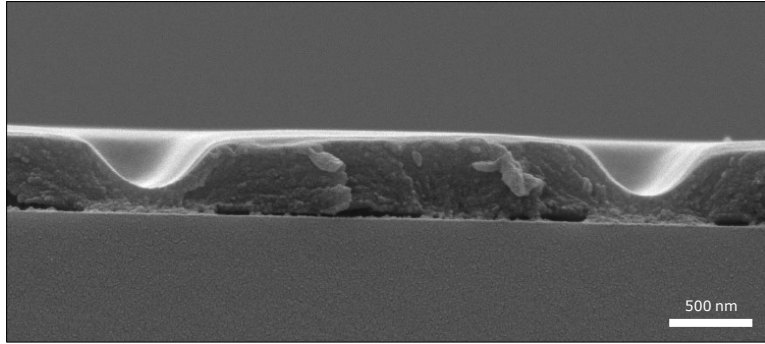
Number of captured *E. coli* cells on the sensor surface – **20 min incubation**



10⁸ cells/mL were applied to the channels of the flow-cell and waited for **20 min** (no flow) before fixation and measurements.

Results - Measurements

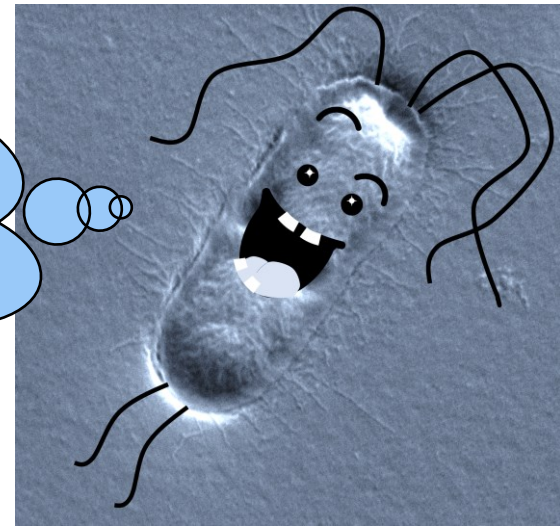
Signal measurement



- ✓ The contribution of "geometry matching" has been demonstrated.
- ✓ **Imprinting factor** (ratio of SIP versus control-SIP) was found to be around **2.7**.
- ✓ Possibility of **electrochemical signal measurement** has been shown.
- ✓ **Future work** includes **functionalization of the master stamp surface**.

Many thanks

I loved this cavity :)



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