PASSIVATED POROUS SILICON MEMBRANES FOR THE OPTICAL DETECTION OF BACTERIAL LYSATE

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Introduction

Because of their increasing resistance to antibiotics, bacteria have become one of the top ten threats to global health according to the World Health Organisation [1]. Biosensors can allow the rapid detection of such pathogens. Porous silicon (PSi) is a promising and widely used transducer, especially for sensors that rely on optical measurements [2]. In this research, optical biosensors based on self-supported PSi membranes were fabricated and passivated using atomic layer deposition (ALD). Their performance was assessed via the detection of *Bacillus cereus* after their selective lysis by the phage-coded endolysin PlyB221 [3].

ALD Passivation of PSi Membranes

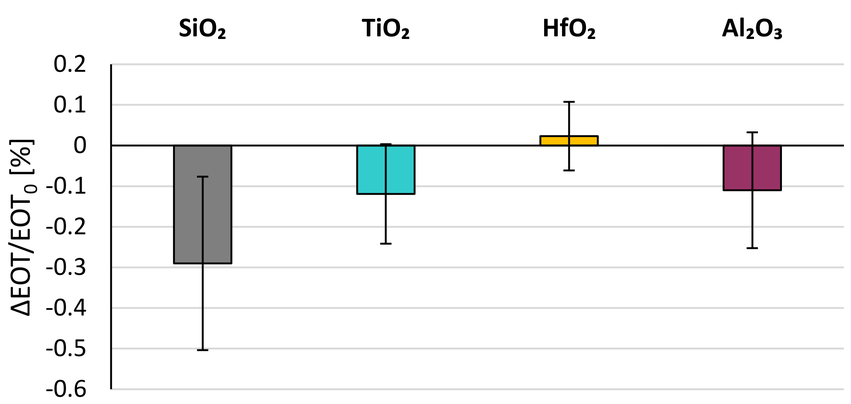

Figure 1: Average EOT shift in PBS after 3 h (after 30 min of pre-wetting in PBS).

- **Design:** self-supported, double-layered PSi membranes;
- **Fabrication:** p++ wafer, standard microfabrication techniques & anodisation;
- **Detection:** Reflective Interferometric Fourier Transform Spectroscopy (RIFTS);
- **Passivation:** ≈ 5 nm of atomic layer deposited Al_2O_3, HfO_2 or TiO_2.

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↗ **stability (Fig. 1) and** ↗ **reflectivity**

⇓

Improved optical sensor

Biosensing of *B. cereus* lysate

The perfomance of all three passivation types for the biosensing of *B. cereus* was studied as well. The detection protocol is detailed in Figure 2. **PlyB221** is a protein coded by the Deep-blue phage that targets *B. cereus* and attacks the bacterial cell wall.

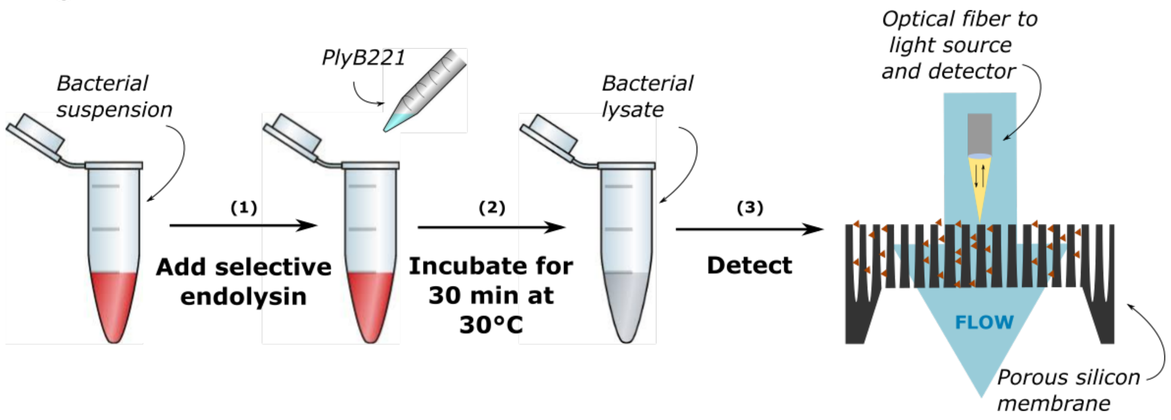

Figure 2: Biosensing protocol (Reproduced from [4])

The relative EOT shift measured after 1h of *B. cereus* lysate filtration (10^6 CFU/ml) was compared to two negative controls: in PBS and with endolysins only. For all sensors, the EOT shift for bacterial detection is significant, but **the shift is the most significant for TiO_2 passivated sensors** (Fig. 3).

TiO_2 biosensors were able to significantly (p-value < 0.01) detect concentration of *B. cereus* lysate **as low as 10^3 CFU/ml in only 1h** (Fig. 4). The selectivity of the detection has been demonstrated in previous works [3, 4]).

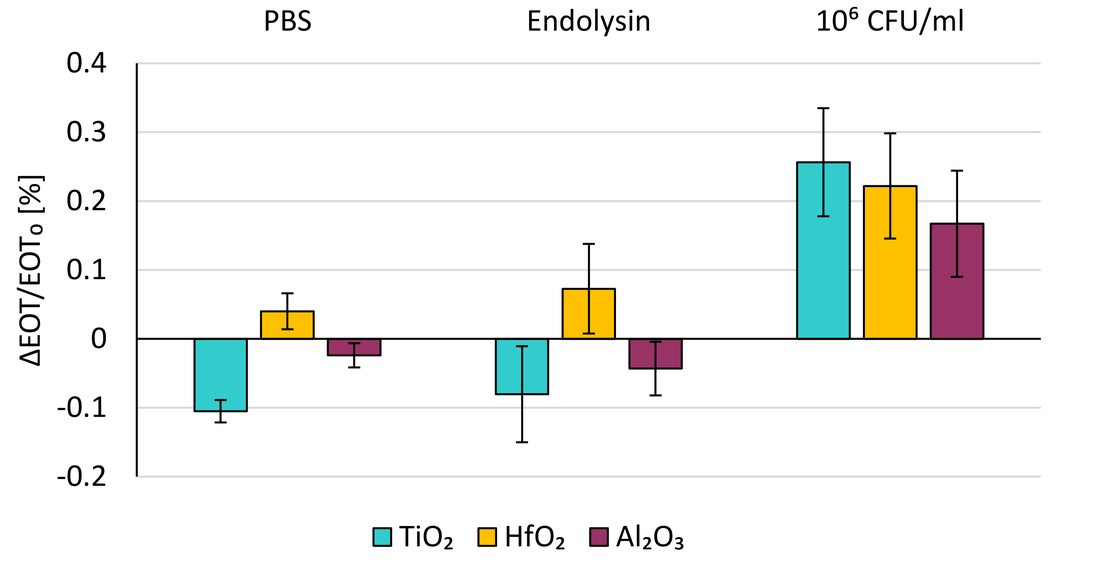

Figure 3: Comparison of sensing performance for all 3 types of ALD passivation.

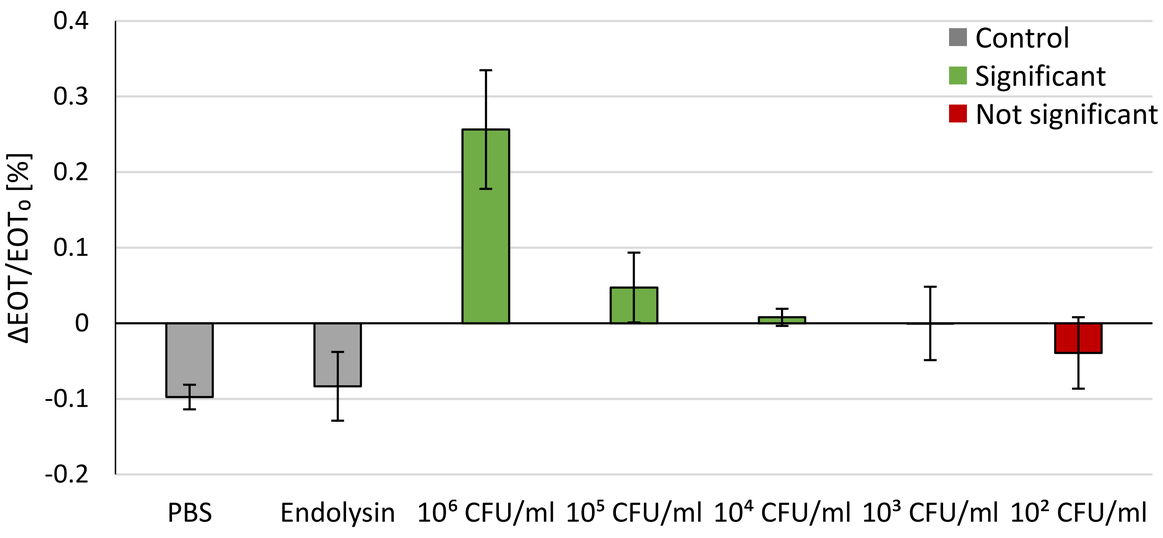

Figure 4: Shift of EOT after 1h with decreasing concentration of *B. cereus* lysate

Conclusion

ALD-passivated PSi membranes make **selective, sensitive and versatile biosensors** that can detect **10^3 CFU/ml of bacteria in only 1h**.

Aknowledgments

R. Vercauteren was funded by a FRIA fellowship (F.R.S.-FNRS).
More information on this research can be found here:

References

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