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Detection of Aflatoxin M1 in milk with a Mach–Zehnder Interferometric immunosensor

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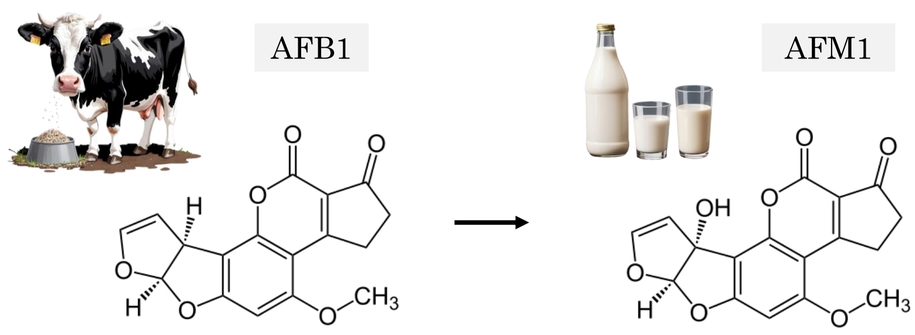
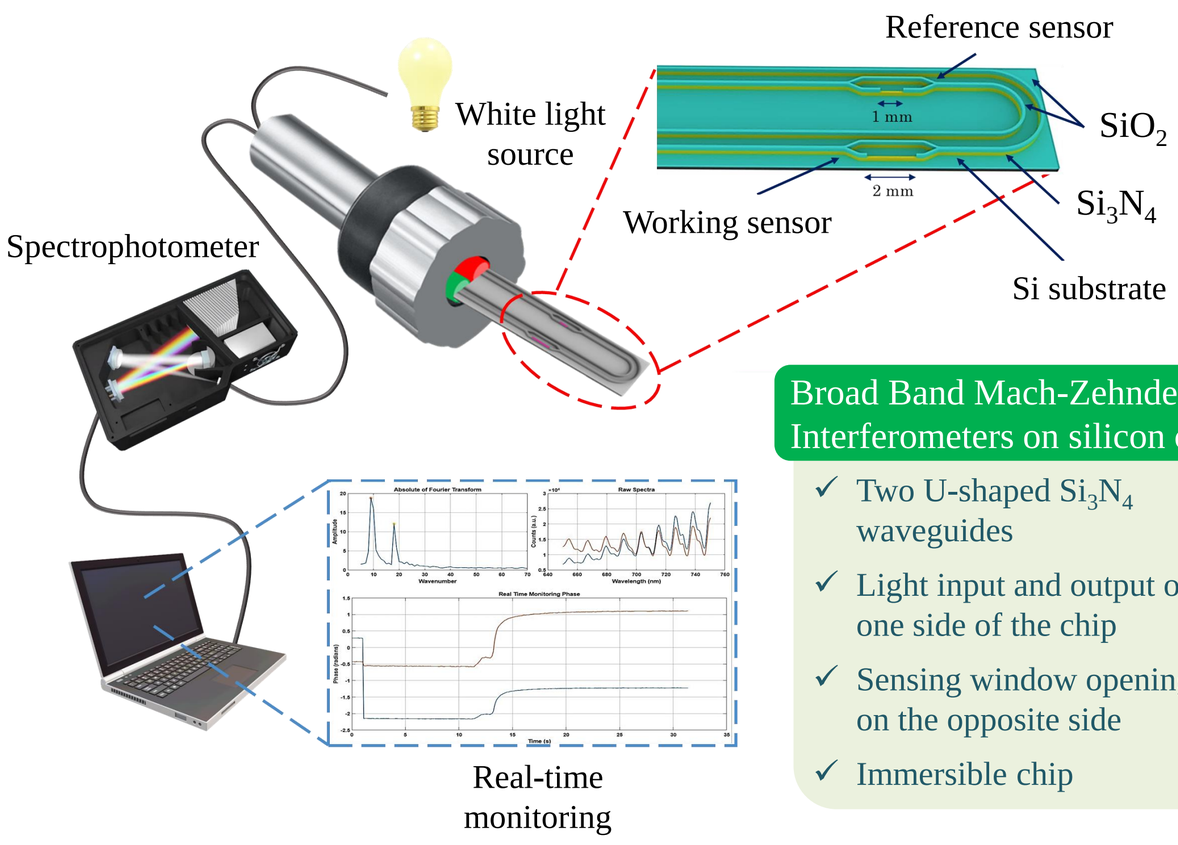
Introduction

Aflatoxin M1 (AFM1) is the hydroxylated metabolite of Aflatoxin B1 (AFB1) and is detected in the milk of animals that have consumed contaminated feedstuffs with AFB1. AFM1 has been categorized as a Group 2B carcinogen by the International Agency for Research on Cancer (IARC), indicating that it is carcinogenic to humans [1]. Consequently, the European Commission has established maximum allowable levels of AFM1 in milk consumed by infants and adults, at 25 and 50 pg/mL, respectively [2]. Here, a rapid and sensitive immersible photonic Mach-Zehnder immunosensor for detecting AFM1 in cow milk is presented.

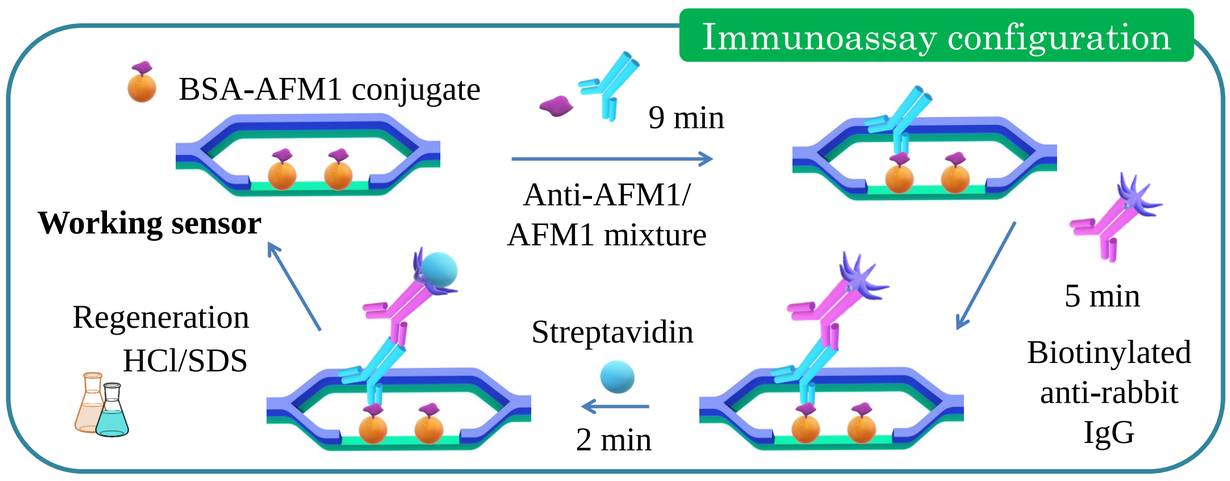


Methods



Broad Band Mach-Zehnder Interferometers on silicon chip

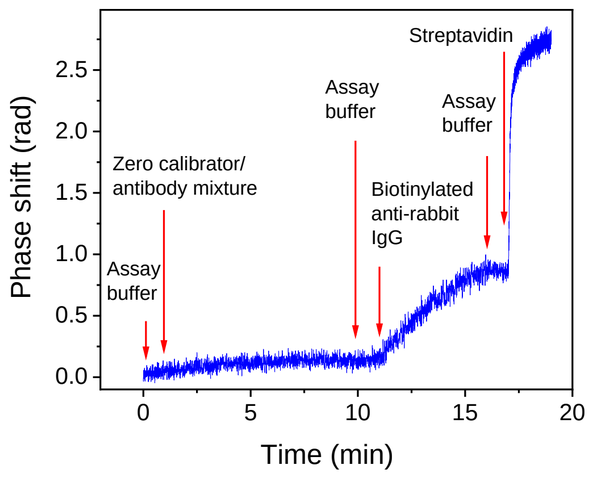
- ✓ Two U-shaped Si_3N_4 waveguides
- ✓ Light input and output on one side of the chip
- ✓ Sensing window openings on the opposite side
- ✓ Immersible chip



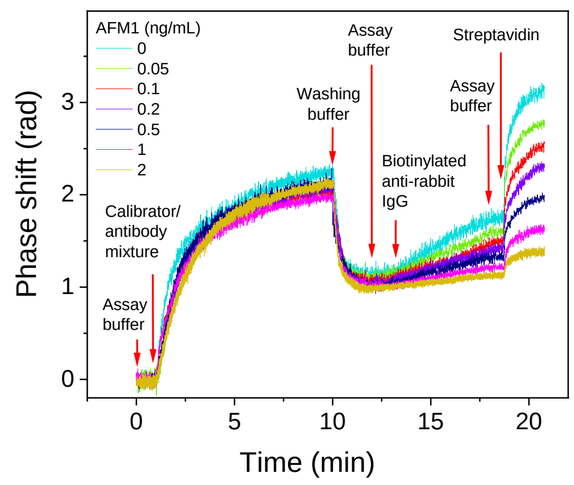
References
[1] S. Marchese, A. Polo, A. Ariano, S. Velotto, S. Costantini, L. Severino, Toxins (Basel) 2018, 10
[2] Commission regulation (EU) No 1881/2006 of 19 Dec., Off. J. Eur. Union L. 59 (2006) 8.

Results

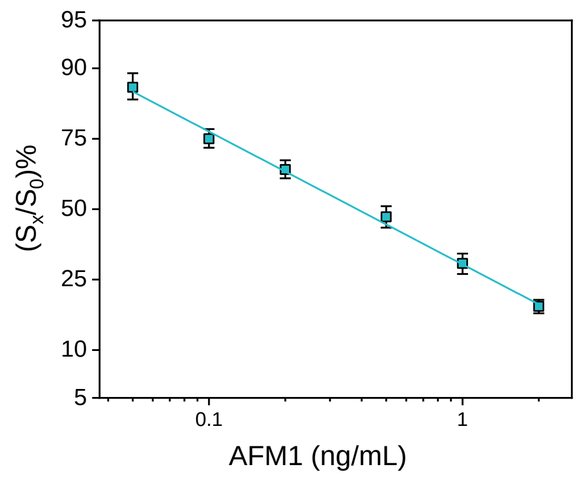
Real-time signal response of zero calibrator in assay buffer



Real-time signal responses of calibrators containing 0 – 2 ng/mL in undiluted milk



Typical calibration curve of AFM1 in milk



The **analytical signal** in all cases is that received during the reaction with streptavidin.

Analytical characteristics

Limit of detection	0.02 ng/mL
Dynamic range	0.05-2 ng/mL
Intra-assay CV	5.4%
Inter-assay CV	7.6%
Recovery	89-112%
Assay duration	20 min

Conclusion

- ✓ An immersible photonic immunosensor that does not require external pumps and microfluidics, simplifying the instrumentation and the assay procedure is demonstrated.
- ✓ The 3-step assay format was sensitive and fast with a LOD of 0.02 ng/mL, which extended up to 2 ng/mL.
- ✓ The analytical performance of the assay along with real-time monitoring and quick processing renders it ideal for on-site detection of AFM1 in milk.

Acknowledgments
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