

Multi-modal, configurable optical lab-on-chip platform for low-cost multipurpose diagnostics & monitoring



Co-funded by
the European Union

Project funded by



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
State Secretariat for Education,
Research and Innovation SERI

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No101135435. The content of this publication reflects only the author's view, and the European Union is not responsible for any use that may be made of the information it contains. This work has received funding from the Swiss State Secretariat for Education, Research and Innovation (SERI)

Project overview

Challenge

Developing a miniaturized sensing platform that integrates different detection techniques for various applications, balancing contradictory specifications.

Solution

MultiLab addresses this challenge, by developing a modular multi-sensing platform compatible with wafer scale manufacturing that will integrate multiple sensing modalities to simultaneously detect biological and chemical targets for medical diagnostics and environmental monitoring



Objectives

Sensing modalities

- **Develop ECL bio-sensors for Biomarker Detection**

Fabricate enzyme-based ElectroChemiluminescence (ECL) sensors on low-cost, all-graphite inkjet-printed 3-electrode cells for detecting biomarkers like lactate, uric acids, O_2 and H_2S .

- **Develop PA-AWG sensor**

Integrate an Al plasmonic waveguide in a Plasmonic augmented Arrayed Waveguide Grating (PA-AWG) module to enable simultaneous detection of proteins, miRNA and microorganisms with high scalability and cost-efficiency.

- **Develop mid-IR Photothermal Spectroscopy (PTS)**

Develop PTS sensors for label-free multi-component analysis in the mid-IR range, initially using Mach-Zender Interferometers (MZI) and exploring AWG integration for enhanced performance.

Integrate and validate multi-modality optical sensing platform

Create modular PICs with CMOS-compatible Si_3N_4 photonics and interchangeable bio-sensing modules, combining them with customized microfluidics to improve sensitivity and reduce measurement time.

Develop Machine Learning approaches

Use ML to analyze multiplexed sensor data, implementing advanced techniques.

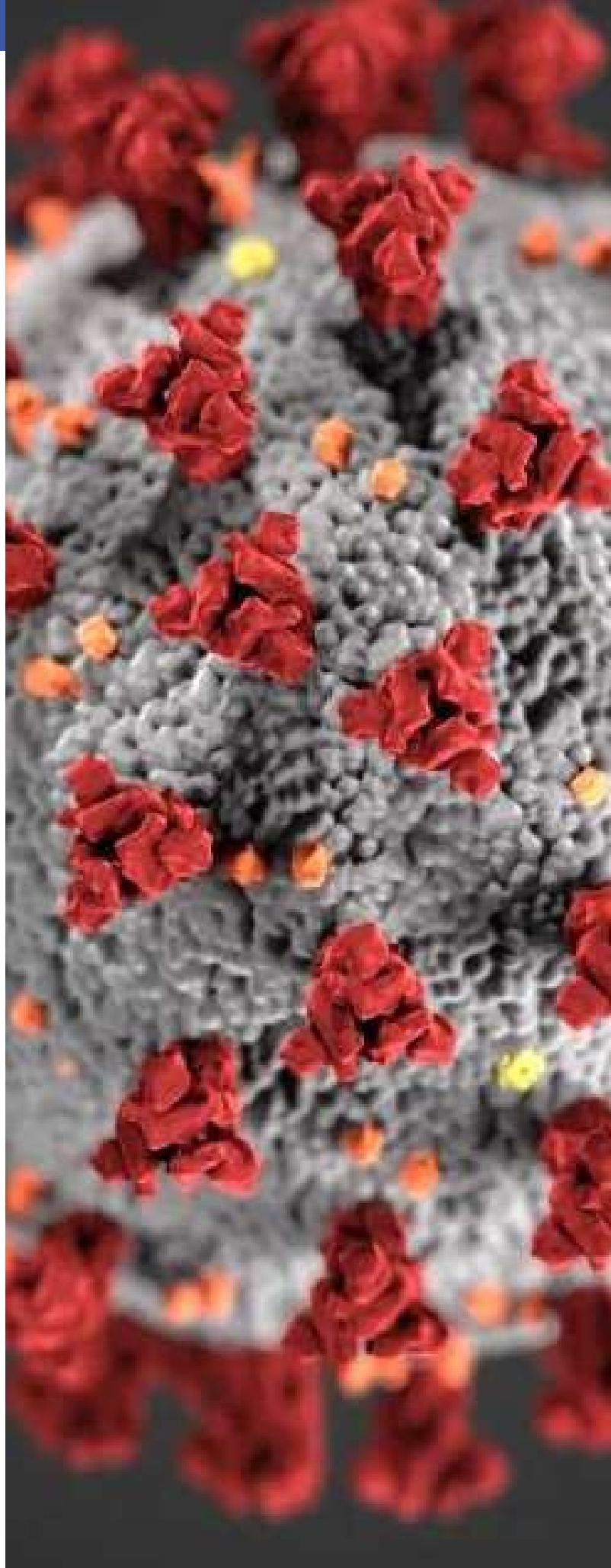


Healthcare case study

Fever is a common symptom, but accurately distinguishing between viral and bacterial infection is challenging. Conventional methods are time-consuming and unsuitable for rapid point-of-care diagnosis, potentially leading to unnecessary antibiotic use and antibiotic resistance.

MultiLab using the PA-AWG module simultaneously detects host and pathogen biomarkers, including protein markers, RNA transcripts, severity biomarkers and specific pathogens. Additionally the ECL module detects lactic and uric acid, key indicators of acute infection.

This innovative approach promises to enhance diagnostic accuracy, reduce inappropriate antibiotic use, and lower healthcare costs. With validation using clinical samples, MultiLab aims to transform the management of febrile patients and combat antibiotic resistance.





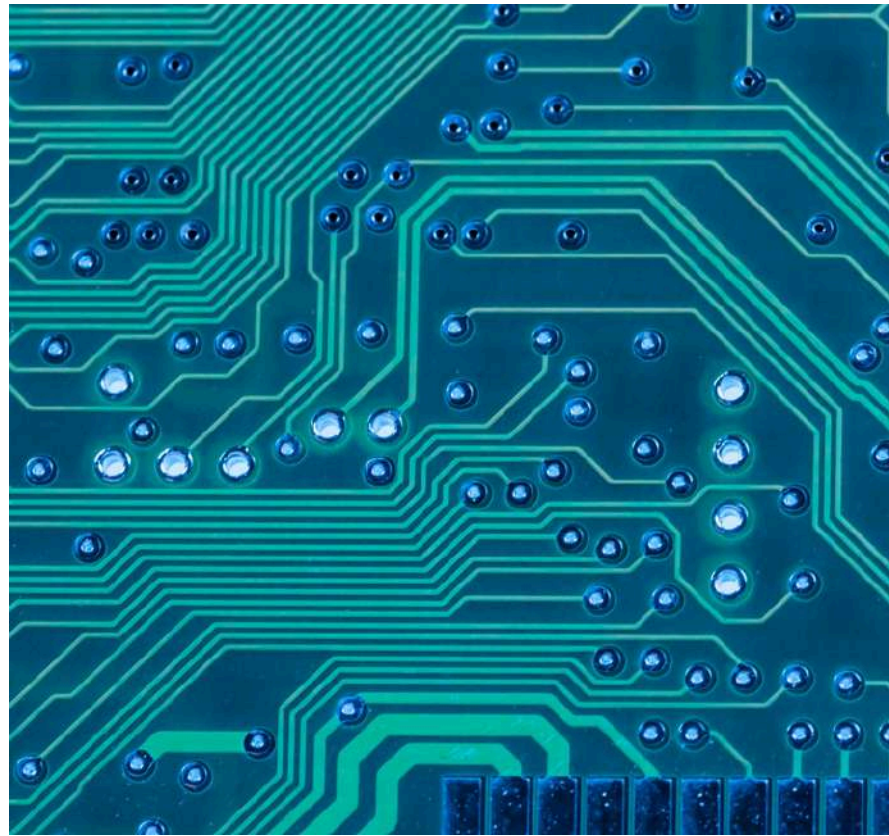
Environmental case study

Surface water eutrophication can lead to Harmful Algal Blooms (HABs), affecting water quality and posing risks to human health and aquatic life. Conventional monitoring methods are often slow and unable to provide early warnings, leaving a significant gap in protecting water resources.

MultiLab steps in to bridge the gap with groundbreaking innovation offering an IoT-enabled, affordable and reliable monitoring tool for early HAB detection. By analyzing water samples for nutrients (Nitrate, Ammonium, Phosphate), dissolved oxygen and hydrogen sulphide, MultiLab enables predictive models for confident early warnings, crucial for safeguarding drinking water sources.

By quantifying nutrients with precision and validating against standard methods, aims to enhance current monitoring practices and advance understanding of nutrient-bloom relationships.





Technical updates up to M12

- **Case Studies & System Design:** Detailed case studies, system requirements, and conceptual designs have been defined.
- **Optical Biosensors:** Enhanced sensor designs and optimized spectroscopy modules boost detection capabilities.
- **PIC Platform Integration:** Optimized waveguide designs and scalable microfluidic solutions are advancing integration efforts.
- **Instrumentation & Data Analysis:** System integration combines optical setups with machine learning; initial data models are under testing.
- **Chip Configuration:** Layout configuration is progressing effectively.

12M Consortium Meeting

On November 27-28, the 12M Consortium Meeting took place in Vienna, Austria, hosted by our valued partner, TUW.

This two-day meeting brought together all consortium members to:

- ✓ Review the project's progress over the past 12 months.
- ✓ Share updates
- ✓ Address technical challenges and solutions.
- ✓ Set clear action plans for the next six months.





ECREAM cluster

MultiLab has joined **ECREAM**, the European Cluster of Research Projects for Environmental and Agri-food Monitoring. ECREAM connects research projects, primarily photonics-based, funded under Horizon 2020 and Horizon Europe. By facilitating knowledge sharing and coordinating joint communication and dissemination efforts, ECREAM helps drive innovation and impact in the field!

European Researcher's Night 2024 in Cyprus

CyRIC presented **MultiLab** at the European Researchers' Night in Cyprus, highlighting its innovative biosensing and optical technologies, and how the project could impact diagnostics and environmental monitoring



Contact

Wrapping up our second newsletter edition, we're thrilled by the progress within our MultiLab project.

With gratitude to our partners, we stride into the future, eager to pioneer advancements in medical diagnostics and environmental monitoring.

Stay tuned for updates as we revolutionize the field through technology and commitment.

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