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''Ultra-compact, low-cost plasmo-photonic bimodal multiplexing sensor platforms as part of a holistic solution for food quality monitoring''

Newsletter N° 1 – March 2022

PHOTONICS PUBLIC PRIVATE PARTNERSHIP

The project is funded by Horizon 2020, the EU Framework Programme for Research and Innovation for 2014-2020 under grant agreement Nº 101007448.
The project is an initiative of the Photonics Public Private Partnership

FLEXIBLE FARM-TO-FORK SENSING - Call identifier: H2020-ICT-2020

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PHOTONICS PUBLIC PRIVATE PARTNERSHIP

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AIM:

✓ Develop an innovative sensor for faster, cost-effective, and reliable monitoring of food quality and safety in the fruit and vegetable value chains. The developed devices will be validated in various production and distribution systems.

OBJECTIVES:

✓ Develop a novel ultra-compact, cost-effective, plasmo-photonic bimodal sensor platform with on-chip light generation suitable for *farm-to-fork* applications
✓ Develop the GRACED sensing devices to cover different application requirements (reusability, multi-modality, connectivity)
✓ Detect specific chemical (Imidacloprid, Acrylamide, Ochratoxin A, Aflatoxin B2, and Deoxynivalenol) and biological contaminants (*E. coli* O157 and *Salmonella*).
✓ Develop a data analytics and sDSS platform to enable photonic-driven applications
✓ Validate the complete approach and its impact in four real-world pilots with four use cases covering different scenarios of:

- food production by small/medium-sized farms
- novel types of food production (urban farming)
- on-site food processing and vending (in-situ restaurants, on-site vending)

EXPECTED OUTCOME:

✓ A portable instrument for laboratory & field analysis of all types of samples
✓ An IoT autonomous sensing node to be deployed for unattended field measurements in water/liquid samples only, particularly useful for production systems that foresee minimum human intervention (such as vertical/urban farming)
✓ Collected data will be analyzed by a Cloud data analytics platform to assist in the decision-making process with the ultimate purpose to provide descriptive, predictive, and prescriptive analytics as a smart Decision Support System (sDSS)

News from the project

The GRACED team aims at the development of a portable device that will require 20 minutes for the simultaneous analysis of 7 samples, to detect 7 different microbiological and chemical contaminants **(Figure 1)**. Commercial or homemade produced monoclonal and/or polyclonal antibodies were selected as molecular recognition elements (MRE's) for the sensors **(Figure 2)** and will be characterized for their binding capability.

Target analytes
✓ Acrylamide
✓ Deoxynivalenol
✓ Imidacloprid
✓ Ochratoxin A
✓ Aflatoxin B2
✓ E. coli O157
✓ Salmonella

Fig. 1 GRACED target selected in the project

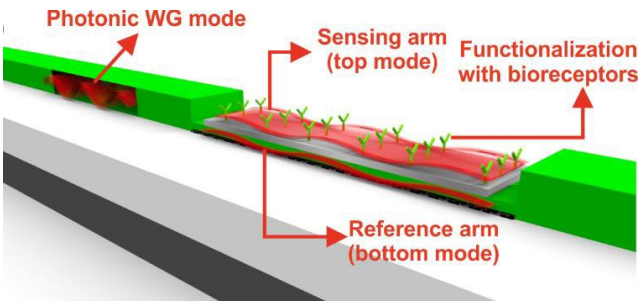


Fig. 2 Sketch of the multilayer sensor structures with attached MRE

To develop the **GRACED** device, during this period the consortium has been working on the development of the different modules. The first prototype of the sensor chip was produced **(Figure 3).** The sample holder module with microfluidics were designed and realized **(Figure 4).** The fiber optics attachment method was conceptualized **(Figure 5).**

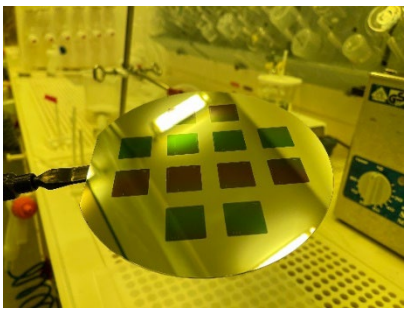


Fig. 3 Sensor chip prototype

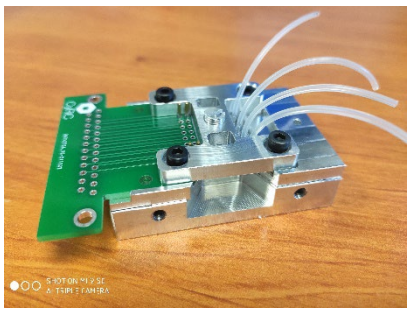


Fig. 4 Image of the sample holder

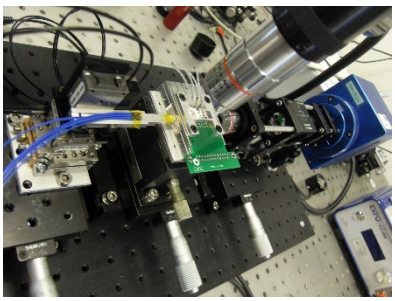


Fig. 5 Fiber optics positioning

Consortium Meetings

✓ *Kick-off meeting*

The **GRACED** kick-off meeting was organized by CyRIC on the 15th January 2021 and took place remotely due to the COVID-19 outbreak restrictions **(Figure 6)**. Administrative procedures were discussed and an overview of all work packages and scientific approaches to be followed was made. A **roadmap for the first six months** was drafted.

Fig. 6 GRACED kick-off meeting

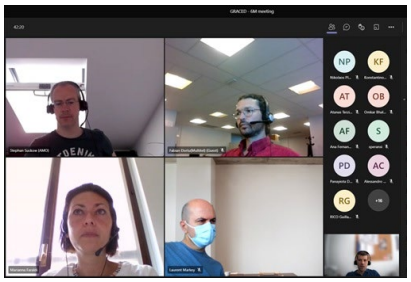


Fig. 7 GRACED 6M meeting

✓ *6M project meeting*

The **GRACED** 6M project meeting was organized by CyRIC on the 10th June 2021 and took place remotely **(Figure 7)**. The focus of the discussion was: conceptual design of the device and its system requirements. A **roadmap for the next six months** was drafted.

✓ *12M project meeting*

The **GRACED 12**M remote project meeting was organized by CyRIC on November 24th 2021 **(Figure 8)**. The focus of the discussion was: the MRE's selection, update about microfluid, optical, electronics module and subsystems, update about the sensor fabrication and on sDss system. A plan for the first integration plan was presented. A **roadmap for the next six months** was drafted **(Figure 9)**.

Fig. 8 GRACED 12M meeting

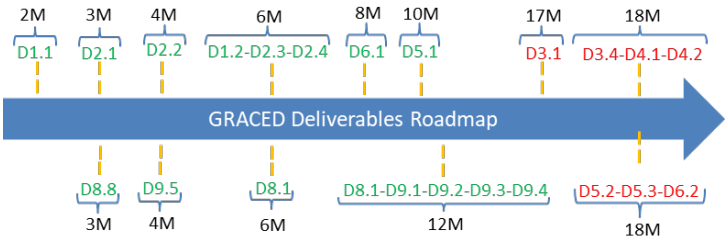


Fig. 9 GRACED Deliverables Roadmap

sous les fraises
PARIS

✓ *Planned events:*

The next GRACED Consortium Meeting (M18) is scheduled as a physical meeting for the22nd -23th June 2022, and will be hosted by **Sous Les Fraises in Paris (France).**

Dissemination Activities

✓ First GRACED press release

PRESS RELEASE Date: 19/2/2021

GRACED – Next generation sensors as part of a holistic solution for food quality monitoring

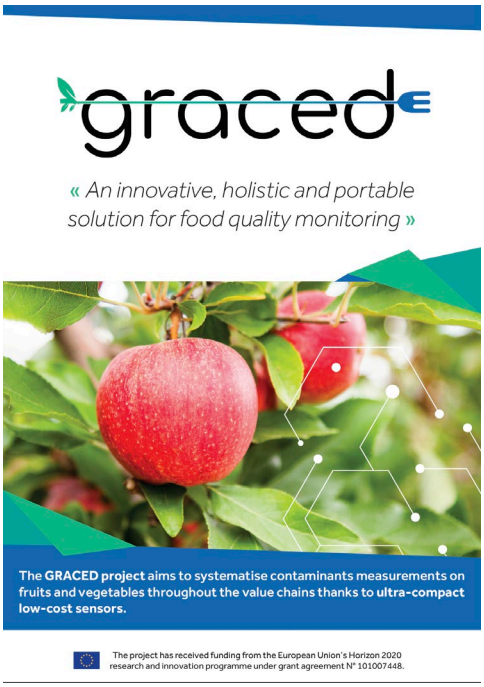
As consumer demand for fresh fruits and vegetables (F&V) continues to increase, so does the risk of microbiological and chemical contamination. Currently, inspections for F&V are carried out at the production site or the food processing facility, based also on regulatory requirements. In most cases these are inspections of random batches using laboratory techniques, which may require up to two or more days before getting results. The time and cost per analysis leads to reduced checks and thus, elevated risks, even in countries with very efficient control mechanisms.

Furthermore, such analysis cannot take place in all parts of the value chain (due to time requirements, but also due to associated cost), including supermarkets or restaurants, which are critical points since this is where the consumer will get the products from. GRACED (EU funded project, entitled "*Ultra-compact,*

✓ First GRACED paper

E. Chatzianagnostou, A. Manolis, A. Miliou, D. Tsiokos and N. Pleros, "Theory and Sensitivity Optimization of Plasmo-photonic Mach-Zehnder Interferometric Sensors," in *Journal of Lightwave Technology*, vol. 39, no. 15, pp. 5206-5217, Aug.1, 2021, doi: 10.1109/JLT.2021.3083365

✓ First GRACED Leaflet



✓ Next events

LOPEC
DRIVING THE FUTURE OF PRINTED ELECTRONICS

Exhibition: March 23–24, 2022 | ICM – Internationales Congress Center München
Conference: March 22–24, 2022 | ICM – Internationales Congress Center München

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SPIE. PHOTONICS EUROPE

ECREAM
European Cluster of Research projects for Environmental and Agri-food Monitoring

« All Events

Photonics Europe 2022

April 3 - April 7

✓ Abstract submitted to CLEO 2022

Bimodal plasmonic interferometer based on SU-8 waveguides

Omkar Bhalerao[1,2], Stephan Suckow[1], E. Chatzianagnostou[3], Konstantinos Fotiadis[3], J.-C. Weeber[4], Pratyusha Das[4], Thanasis Manolis[3], Max C. Lemme[1,2],

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Abstract: We present a first experimental demonstration of a bi-modal plasmonic interferometer with an extinction ratio (ER) of 4 dB. Theory predicts up to 17 dB ER and 6.500 nm/RIU sensitivity.

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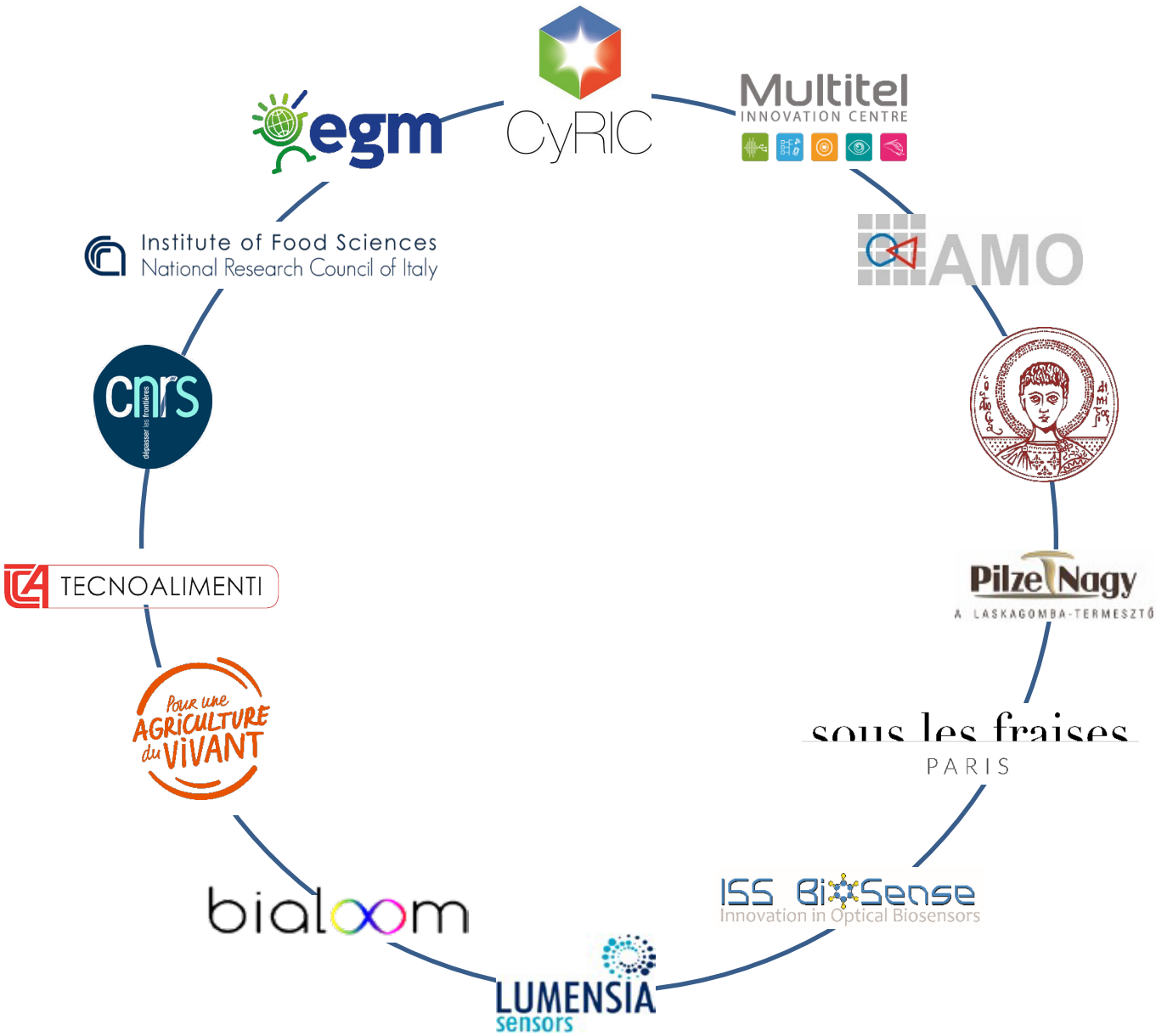
The Consortium



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A project led by **Cyric**

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