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Photonics21 Press Release

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New sensor spots killer fruit & veg with photonics

Pesticides in fruit and vegetables kill 11,000 people every year and unintentionally poison 385 million worldwide. Monitoring these foods for microscopic chemicals and harmful bacteria can take days of sending small batches off to laboratories for testing and analysis. But now, a new detector is being developed to spot minute traces of these poisonous elements with photonics to give a result in minutes.

This new ultrasensitive detector harnesses light particles to spot the tiniest traces of pesticide or bacteria in minutes – 50 to 100 times quicker than existing technologies.

Currently being developed by an EU-funded consortium, the new system will allow workers to check for pesticides or bacteria by monitoring dozens more samples of fruits and vegetables than are currently performed. From preparing a sample to detection, the new system can deliver a result in less than 30 minutes – a fraction of the time at present.

The team use an incredibly sensitive system that uses laser light to detect chemical or biological analytes. Called a plasmophotonic bimodal multiplexing sensor, the system can spot bacteria or pesticides label-free, without having to use chemicals or dyes as a marker.

Given that food can degrade quickly and with lengthy safety checks at present, factories make fewer checks meaning consumers face a greater risk of exposure to poisons and bacteria – even in countries with very efficient monitoring techniques.

Typically, safety checks on fruit and vegetables are made in random batches then sent to a laboratory, a process that can take 2-3 days to get a result. Due to time and costs, these checks cannot be performed in critical parts of the value chain like supermarkets and restaurants.

Each year, 385 million people are unintentionally poisoned by eating fruit or vegetables that contain pesticides; [11,000 of these tragically lose their lives as a result](#). These pesticide residues consumed via food and water can also cause a whole host of deadly long-term conditions, including birth defects, cancers, genetic defects, blood disorders, and neurotoxicity.



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Project coordinator Alessandro Giusti said: "With thousands of deaths worldwide, we are in urgent need of a rapid new monitoring device that is accurate, highly sensitive, and cheap to produce".

The project, called GRACED, is currently being coordinated by CyRIC - Cyprus research and innovation Centre, Cyprus and includes a consortium of experts from all across Europe. The developers took their inspiration from one of their existing sensors that examines water to detect microbiological or chemical contamination with a small number of pesticides.

"We developed the project as a 'hard fork' extension of a previous EU project we ran called WATERSPY. In a sense, the two projects are related: bio photonics-based technology to determine contamination in specific matrixes – in WATERSPY, it was drinking water; in GRACED, it can be anything – water used for feeding the plants, or the actual fruits and vegetables themselves. The core technologies, however, are entirely different.

"Everything is done on a single chip – we are working to detect seven different analytes simultaneously in less than 30 minutes (including sample preparation time)."

Interferometric Sensing

To produce an unequivocal bacteria or pesticide detection, the system works by looking at the 'binding' of the contaminant to the sensor surface - producing a new unique signal when a harmful constituent is present.

With their plasmo-photonics bimodal multiplexing sensor, the GRACED team uses one of the most sensitive detection technologies available to identify at the molecular level.

Since the receptors on the sensor surface are specifically 'tuned' to a particular bacteria or chemical, only the analytes of interest are captured along the sensor.

Light travelling in the sensor generates a fully exposed evanescent field over the sensor surface. Here, receptors can recognise the contaminants when a sample passes through.

This recognition event changes the speed of the laser light and therefore the interference pattern at the output.

This change can be measured and determined precisely against a set of existing values – and could give an instant diagnosis for a contaminant expected at the picomolar to attomolar (pM–aM) range without any need for amplification.



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The sensor is part of a holistic, modular solution that exploits unique engineering designs, IoT concepts, and advanced data analytics to detect contaminations in fruit and vegetable value chains.

Vertical and Urban Farming

The GRACED team sees the applications as being extremely useful to several next-generation food production alternatives: "Vertical or urban farms are like a bit like a laboratory where everything is conducted in controlled rooms. Controlling the water quality is very important to the success of these types of farms, and if this process is automated, it is even better.

"Some urban farms are using 'grey water' – sink water used for irrigation – where the risk of contamination is possible. So, a solution like ours will be highly complementary to futuristic food production," Giusti said.

Concluding in 2024, the GRACED project will conduct future trials in France, Italy, and Hungary, covering different types of production systems (conventional open-air farming, novel urban farming, short agroecological value chain, semi-automatic farming). The three-and-a-half-year project received a grant of € 4,989,480 from Horizon 2020 under the Research and Innovation action funding scheme.

GRACED is coordinated out of the Cyprus Research And Innovation Center Ltd (CYRIC) and includes a mix of technical Partners From: Italy - Consiglio Nazionale Delle Ricerche, Tecnoalimenti S.C.P.A., Iss Biosense Srl; France - Easy Global Market Sas, Centre National De La Recherche Scientifique Cnrs, Sous Les Fraises, Pour Une Agriculture Du Vivant; Cyprus - Bialoom Ltd; Belgium – Multitel; Greece - Aristotelio Panepistimio Thessalonikis; Germany - Gesellschaft Fur Angewandte Mikro Und Optoelektronik Mit Beschränkterhaftung Amo Gmbh; Hungary - Pilze-Nagy Kereskedelmi Es Szolgaltato Kft; Spain - Lumensia Sensors Sl.

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About GRACED

<https://www.cyric.eu/>

About Photonics21



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Photonics²¹ is the European Technology Platform (ETP) for photonics, a technology encompassing all products and processes around the emission, manipulation and detection of light. Photonics technologies are integral to many industries, including medical, healthcare, transport, manufacturing, and telecommunications.

"Photonics²¹" was set up in December 2005 to bring the community of photonics researchers and industries together. The European Commission defined photonics as one of five European Key Enabling Technologies (KET's) in September 2009. Shortly after, the European Research & Innovation Program "Horizon 2020" invited Photonics²¹ to become a "Public-Private Partnership" (PPP). The "Photonics 21 Association", a legal entity under Belgium law, became the private contract partner in November 2013 in a Public-Private Partnership (PPP) in conjunction with the EU Commission and will become a Photonics partnership during the current framework programme Horizon Europe.

Today Photonics²¹ represents more than 3,000 personal members from across Europe and abroad. Our members and stakeholders are experts in the photonics industry, research and innovation organisations, universities, and value chain partners who actively engage with us to develop a joint photonics strategy for future research and innovation in Europe.

With the global photonics market growing from €499 in 2015 to €654 in 2019, light technologies represent an industry with long-term growth potential. Valued at €103 billion in 2019, the European photonics industry has grown at a solid CAGR of 7 % since 2015 and currently employs around 390,000 people directly.

With optimistic growth forecasts, current industry trends like digitalisation, resource efficiency, individual and zero failure production will further drive the photonics industry.

Photonics plays a significant role in Europe's Digitisation and Technological Sovereignty. It has the enormous potential for solving Europe's societal challenges, such as the instant diagnosis of major diseases, quality food from farm to fork, accident and congestion-free transport, and a truly circular economy.

As a breakthrough key enabling technology that is increasing the competitiveness of European industry, photonics can make a significant contribution to the over-arching European Union objectives, such as the digital transformation of European industry, achieving the European Green deal and a sustainable EU future, and the establishment of a future sovereign and resilient European digital infrastructure.

Contact



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W: <http://www.photonics21.org>

E: secretariat@photonics21.org

T: <https://twitter.com/Photonics21>

L: www.linkedin.com/company/photonics21