Photonics21 Press Release

Scientists use photonics to make wastewater eco-friendly

Wastewater will soon become cleaner and less harmful to plants and animals thanks to a new, ultra-sensitive water sensor being developed by European scientists to detect tiny amounts of toxic substances with light.

A new laser system to detect minute traces of toxic substances in wastewater is currently in development by a consortium of European scientists.

Wastewater – water used in a commercial, domestic, or industrial setting and contaminated by human use - is very dangerous to wildlife and food chains if residual toxic compounds remain.

With the need to be purified to international standards, scientists strive to make wastewater free from hazardous substances like particles of oil and hard material like rocks.

But now, researchers from Swiss engineering firm, Alpes Lasers have teamed up with a group of oil industry partners and academic institutes to create an ultrafast sensor that will make toxic wastewater harmless by detecting the tiniest concentrations of oil and suspended solids in water.

Improving its detection rate using AI and machine learning, this new laser system will continuously monitor water in a live setting, with no need for sampling or preparation.

Using hyperspectral imaging – a technique to photograph a mixture of infrared and other light wavelengths – the sensor will detect microscopic pathogens that are indistinguishable to the human eye or conventional imaging methods.

Oil Processing

Harmful 'wastewater' by-products are created particularly when naturally-occurring 'crude oil' is, processed, distilled and refined to make new, useful fuels like diesel, kerosene, and liquefied petroleum.

Producing cooling water, process water, stormwater, and sanitary sewage waters, oil refineries have sought to reduce the number of dangerous by-products by monitoring the wastewaters at critical stages in their refining processes.

But this new light-based analyser looks to place fewer pollutants into the environment during oil refining while simultaneously optimising core processes in water extraction from crude oil by 10%.

Although sophisticated techniques at present use acoustics to identify all the constituents in crude oil, some dangerous elements may still be present in wastewater.

Frequency Combs

Aiming to give Europe a global competitive lead in oil refining, the European consortium 'HYDROPTICS' is developing the most sensitive and one of the first water analysers to use Quantum Cascade Laser Frequency Combs.

Quantum Cascade Lasers Frequency Combs are novel laser sources that provide equidistant coherently linked optical modes in the mid-IR range, currently deployed in spectroscopy applications precisely due to their unique properties.

Project coordinator, Dr Antoine Muller said: "The HYDROPTICS project is creating a highly accurate oil-in-water analyser based on cutting edge mid-IR light sources and spectroscopy techniques.

"Our highly sensitive analyser will optimise several critical stages in oil production as well as control downstream processing routines for final mineral oil product development.

"Frequency Comb Quantum Cascade Laser source will enable scientists to rapidly measure the area of the absorption peak related to deformation vibration of the methyl groups."

Rapid Processing

At present, Quantum Cascade Lasers can be used to measure the oil content in water. However, this requires a reference sample that can take several hours to prepare and deliver a result.

But, this new HYDROPTICS device can deliver measurements in minutes. Project Coordinator, Dr Sargis Hakobyan said: "Our scientists at HYDROPTICS are using two lasers to continuously monitor the oil-in-water content for long periods, which is not possible with current techniques that use a single laser.

"We are also developing machine learning techniques to collect and analyse data to refine the extraction process.

The EU is the second-largest producer of petroleum products in the world after the United States, with a crude refining capacity of about 15 million barrels per day, representing 16% of total global capacity.

"Our novel, ultrasensitive oil-in-water on-line analyser will mean Europe will gain a significant industrial lead.

"Essentially, HYDROPTICS will enable Europe's oil industry to have a better yield with less waste, to have a by-product we can re-use while having a positive environmental impact.

“The positive innovation and environmental implications of our technology mean we can help address a significant Societal Challenge in smart, green technology,” said Dr Hakobyan.

Fluid Analysis

The consortium sees the long term implications of HYDROPTICS being tailored to any industry that needs to perform molecular detection in liquids or gases.

Dr Hakobyan said: "We expect industries that are looking to perform highly sensitive analyses of liquids or gases to benefit from HYDROPTICS: surface water monitoring for phosphate/nitrate contamination; milk analysis for protein/fat concentration and early-warning systems for accidental or deliberate contaminations".

The consortium expects to have a prototype ready by 2023. Dr Muller said: “We expect to test a working prototype that will be installed in an oil refinery business with our two partners in Austria and Turkey in a love setting. All parts of the prototype will be verified by each corresponding partners labs.”

HYDROPTICS is coordinated in Switzerland by the company **Alpes Lasers** (Neuchâtel, Switzerland) and is comprised of 10 partners, including Quantared Technologies (AT), IRsweep (CH), DBC Europe (BE), OMV Exploration & Production GmbH (AT), Turkiye Petrol Rafinerileri Anonim Sirketi (TR); Technische Universitaet Wien (AT), Interuniversity Microelectronics Centre (BE), Silicon-Austria Labs (AT), and National Technical University of Athens – NTUA (EL).

About Photonics21

Photonics21 is the European Technology Platform (ETP) for photonics, a technology encompassing all of the products and processes around the emission, manipulation and detection of light. Photonics is integral to a wide range of industries that include the medical, healthcare, transport, manufacturing, and telecommunications sectors.

"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.

Today Photonics21 represents more than 3000 personal members from across Europe and abroad. Our members are experts in the photonics industry, research organisations and

universities 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 €350 Billion in 2011 to €447 Billion in 2015, Photonics remains a strong industry. The European photonics industry, estimated to be worth €70 billion, has considerable global leadership positions and employs over 300,000 people directly.

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

Contact

W: http://www.photonics21.org

E: secretariat@photonics21.org

T: https://twitter.com/Photonics21

L: www.linkedin.com/company/photonics21