



World's fastest gas detector to prevent global warming

Using the latest photonics technology a group of European scientists are developing a multi-gas detector that can spot dozens of harmful emissions with a single sensor in milliseconds, delivering a breakthrough for the prevention of climate change.

The Intergovernmental Panel on Climate Change (IPCC) estimates that concentrations of Methane (CH₄) in the atmosphere are roughly two and a half times those of pre-industrial times. The primary component of natural gas, Methane is over 20 times more effective at trapping heat than carbon dioxide and can remain in the atmosphere for more than a decade.

With natural gas and petroleum systems being the largest source of CH₄ emissions from industry, and with the USA pledging a 40-45% reduction in methane emissions from 2012 levels by 2025, it has never been more important to have effective monitoring equipment.

Exploiting new photonics technology, the H2020 project MIREGAS ('Mid-IR source for Gas Sensing') has come up with their solution: a novel, low cost sensor that has the potential to be programmed to detect an unlimited number of gases.

The first of its kind, MIREGAS aims to deliver a single, multi-band gas sensor that can be easily deployed in strategic points of methane emissions, such as on oil rigs or in industrial areas, and monitor dozens of Greenhouse gasses all at once.

While current technology can take up to 10 seconds to produce a positive ID, the device can detect dozens of harmful emissions in milliseconds, making it several thousand times faster state of the art gas sensors, and, effectively a real-time instrument.

The size of a mobile phone, the gadget can pick out poisonous gases from a mixture of emissions, including methane, ethane, butane, propane, CO₂, carbon monoxide, hydrogen sulphide and benzene, all from one compact filter.

Combining the principles seen in fibre optic communications, the MIREGAS gadget exploits multiplexing-to-demultiplexing filters, modulating and wavelength tuning, with Mid-IR spectroscopic sensing technologies, a process never seen before.

Professor Pentti Karioja from the VTT Technical Research Centre of Finland Ltd, explains:

“Because the MIREGAS device is adjustable, it is possible to use only one light source instead of several lasers. This means that we can make multiple readings and monitor several harmful gases simultaneously through one sensor.”

While Mid IR spectroscopic equipment exists, current sensors are based on the use of filters, spectrometers or tuneable lasers, meaning a several lasers would be needed for corresponding gases.

“The possibility to tailor a spectral response to match any wanted set of absorption lines with any desired bandwidth is a major advantage of our filtering approach when compared to the single narrow line of a tuneable laser”, said Karioja.

Initially the MIREGAS device is expected to be deployed in several industrial fields such as building ventilation, process control and safety, gas leakage monitoring, personal, pipeline and explosion safety. However the capabilities for observing dangerous greenhouse gasses in our atmosphere will provide practical tools for tackling climate change.

Pawel Kluczynski of Airoptic, a key partner in the MIREGAS consortium, says:

"Excessive methane emissions are dangerous, and can have a considerably greater warming effect than carbon dioxide. The widespread application of methane emission detection, as well as all of the hydrocarbons from C1 to C5 is a key area for the MIREGAS technology.”

“Not only are our measuring costs ten times cheaper than methods used today but our spectral resolution is 10 times better compared to conventional MOEMS filters used currently in gas sensors. It offers 24/7 protection, there is no need for recalibration and you don't need a Ph.D to operate it.”

At the foreseen manufacturing cost of below €300 per unit, the proposed approach is extremely competitive against conventional gas sensors which can cost in excess of €75,000. “These devices currently in the market are either expensive complicated and heavy instruments, or the applied measurement principles are inadequate in terms of stability and selectivity” said Kluczynski

Coordinated in Finland by VTT, the MIREGAS project has received a grant of €3,588,262 from H2020 via the Photonics Public Private Partnership. MIREGAS is comprised of a consortium of members from Finland, Poland and Norway, including Tampere University of Technology, Vaisala OYJ, the Instytut Technologii Materialow Elektronicznych, Airoptic Spolka z Ograniczona Odpowiedzialnoscia, Vigo System S.A. and Gassecur AS

About MIREGAS

Cost effective multi-wavelength light sources are key enablers for wide-scale penetration of gas sensors at Mid-IR wavelength range. Utilizing a novel Mid-IR Si-based photonic integrated circuit filter and wide-band Mid-IR SLEDs, we aim at demonstrating an innovative light source that covers 2.7...3.5 μm wavelength range with a resolution < 1nm. The spectral bands are switchable and tuneable and they can be modulated.

The source allows for the fabrication of an affordable multi-band gas sensor with good selectivity and sensitivity. The unit price can be lowered in high-volumes by utilizing tailored molded IR lens technology and automated packaging and assembling technologies. In safety and security applications, the Mid-IR wavelength range covered by the source allows for the detection of several harmful gas components with a single sensor.

The project is filling a gap: affordable sources are not available. The market impact is expected to be disruptive, since the devices currently in the market are either complicated, expensive and heavy instruments or the applied measurement principles are inadequate in terms of stability and selectivity. At the foreseen price level, the proposed approach is extremely competitive against conventional gas sensors. The source will be validated in several key applications including building ventilation, high voltage asset monitoring, emission monitoring, gas leakage monitoring as well as process control and safety.

The consortium is composed of one large European company, three SMEs, and three world-class research organisations from three European countries representing the complete value chain from devices and components to gas sensor manufacturers. The position of these organizations in their respective markets guarantees that the project results will be widely exploited providing the companies with a technological advantage over their worldwide competitors thus creating new high-tech jobs and technology leadership in Europe.

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. It is integral to a wide range of industries that include the medical, healthcare, transport, manufacturing, and telecommunications sectors. In December 2005 "Photonics21" was set up to bring the community of photonics professionals and industries together.

In September 2009, the European Commission defined photonics as one of five European Key Enabling Technologies (KET's) and shortly after the European Research & Innovation Program "Horizon 2020" invited Photonics21 to become a "Public Private Partnership" (PPP). In November 2013 the "Photonics 21 Association", a legal entity under Belgium law, became the private contract partner in a Public Private Partnership (PPP) in conjunction with the EU Commission.

Today Photonics21 represents more than 2600 personal members from all over Europe. 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 at twice the world economic growth rate, from 350 Billion Euros in 2011 to 615 Euros in 2020, Photonics21 stands in a secure global market position. The production of European photonics alone accounts for 60 billion Euros and employs over 350,000 people directly.

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

For more information about Photonics21 please go to

<http://www.photonics21.org/index.php>