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review

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Glasgow, United Kingdom

Technical programme: 24 - 26 October 2023

Exhibition: 25 - 26 October 2023

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Welcome to Photonex 2023

SPIE Photonex, the #1 conference and exhibition in the UK photonics calendar, returns to the SEC in Glasgow between 25 - 26 October. Following is a preview some of the key conferences and hot topics.

This year's event offers a great opportunity to hear the latest developments in research covering photonics, quantum technologies, functional materials and more; to see first hand the latest solutions, components, instruments, and systems; and to network with the movers and shakers from across the industry.

SPIE Photonex brings the whole supply chain together, including supplier companies, consultants, industrial users, researchers, science groups, and innovative start-ups. And besides a chance to meet the industry figures, late news is that organizer SPIE confirmed that HRH The Princess Royal will grace this year's gathering, on Wednesday, October 25th.

A key pillar of SPIE Photonex is its Industry Programme, which this year offers three distinct tracks – silicon photonics, quantum technologies, and functional materials.

Programme Chairs are: Simon Andrews, Executive Director, Fraunhofer UK Research Ltd (who is also non-exec director of both Technology Scotland and Photonics Leadership); and Dr. Najwa Sidqi, Knowledge Transfer Manager, Innovate UK KTN (see below).

Andrews introduced some of the event highlights. "Photonex has a fantastic conference side to it with deep dives into many important topics," he said. "We're fortunate that there are so many new materials and components coming through



Credit: Courtesy of Terry Murden, Daily Business Magazine.

Simon Andrews, Photonex Programme Co-Chair; he is also Executive Director, Fraunhofer UK Research Ltd.

at the moment so that organizations like ours can envisage many practical applications and different new systems they enable."

He continued, "We have a good presence from Scotland, around the UK and further afield, and SPIE Photonex as a conference

continued page 4



Credit: SPIE.

SPIE Photonex 2023: Bringing the whole supply chain together.

continued from page 3

is becoming increasingly international. A couple of presentation topics that have caught my eye include gas sensing and hydrogen detection in particular. There's an increasing role for the photonics sector to make sure that these developments are done safely, as we move towards a hydrogen economy, for example."

Photonics initiatives

The conference session on October 25th chaired by Andrews is entitled Photonics and Government Initiatives: Policies, Collaborations, and Impact. He explained, "I gave it such a broad sweeping title some months ago, in order to try to cover everything. The landscape is changing very quickly, and I think for many companies and researchers, who are busy with the day job, they don't always get the opportunity to look around the landscape. This conference will meet their needs."

John Lincoln (head of the UK's Photonics Leadership Group) is kicking off this session with an overview of the UK photonics industry. He says that the UK photonics industry has now grown to a value £15.2 billion, employing 80,000 people in over 1,200 firms. The latest data on UK photonics will be reviewed, the prospects for further growth highlighted, covering photonics' characteristics and drawing comparisons with other key manufacturing sectors in the UK and globally.

Alison MacLeod will give the local Photonics Scotland perspective, then Chris Jones from innovate UK will update the conference on the UK's Quantum Strategy and what is coming next. Jones will say that ten years on from the launch of the UK's pioneering National Quantum Technologies Programme, this initial blueprint for science and technology translation has grown significantly, spawning an internationally-influential national strategy with significant industrial, economic, and international implications.

Then Najwa Sidqi from the Innovate UK's KTN of innovate UK all be looking at collaborations and getting people together; her presentation is entitled Catalyzing progress in quantum: the role of knowledge transfer in quantum technologies implementation.



Credit: Innovate UK/KTN

Quantum Conference Chair: Dr. Najwa Sidqi, Knowledge Transfer Manager, Innovate UK KTN.

The final speaker in this session is Iain Mauchline who is going to talk about UK semiconductor strategy. The recently-published UK semiconductor strategy has the stated vision for the UK to secure areas of world leading presence with national strengths of R&D, design and IP and compound semiconductors. Photonics is of major importance in all these areas, hence this is a prime area of interest for the UK economy.

Quantum technologies

As with recent editions of SPIE Photonex, this year's event features a whole conference strand covering quantum technologies, also on October 25th, chaired by the aforementioned Najwa Sidqi.

The quantum strand includes market-focused presentations such as "Bridging the gap in product-market fit for quantum positioning and navigation" (Lia Li, of Zero Point Motion); "New holdover atomic clocks for PNT applications" (Mohsin Haji, of the UK's National Physical Laboratory); "Scalable quantum computing based on award-winning photonics" (Henk Snijders, of QuiX Quantum); and "Integrated optics for quantum information processing" (Lloyd McKnight, of Glasgow's Fraunhofer Centre for Applied Photonics).

Of the great potential of quantum

developments, Andrews said, "There's an interesting point for us all in the industry to be clear on the intersection of quantum and photonics; while there is now a vast amount of commercial reality in photonics worldwide, quantum as a market is still at a relatively early stage of development."

He added, "Whilst photonics is incredibly important for quantum, the media attention that quantum has received has been so high, but we mustn't forget just how much research, development and manufacturing is going on in regular traditional pre-quantum photonics, which is still very significant. But the excitement over quantum certainly deserves its place."

Andrews concluded, "For me this year's SPIE Photonex meeting is a fantastic opportunity for different groups to get together. The big Venn diagram of photonics, quantum, and semiconductor technologies is incredibly important today. You can add on your other favorite layers to that diagram, whether it's space or optical communications or materials. Nowadays it's difficult to do things in silos. So I hope the event it will be a mix of introductions to new ideas and a comprehensive recap for everyone in the industry."

Author:

Matthew Peach, Editor in Chief, optics.org

Functional materials are set to make impact in clinics

The ability to control surface structures at the nanoscale brings new opportunities for imaging and sensing.

The latest developments in functional materials will be discussed at SPIE Photonex in a conference session devoted to advances and applications in the field.

Co-chaired by Alistair Kean from the University of the Highlands and Islands, and Nikhil Bhalla from the University of Ulster, the conference includes sessions focusing on current research and real-world uses of functional materials, including clinical applications where their impact could be dramatic.

Functional materials rely in essence on surface modifications - deliberate changes to a surface at the nanoscale which in turn influence its behavior when molecules or photons interact with it. This concept is not new, with industrial catalysts a familiar example of modified metallic surfaces providing a lower energy route to a chemical reaction than would normally be available. And nature has employed nanostructured surfaces for much longer than that, as the colorful wings of butterflies and their response to incident sunlight demonstrate.

But modern manufacturing technology can produce increasingly sophisticated and controlled modifications. These bring about significant changes in the material's fundamental behavior, as for example when some nanotextured surfaces show inherently improved antiviral or antibacterial properties. And the optical behavior can be altered too, with new manufacturing methods allowing researchers to exploit optical phenomena that do not arise on conventional macroscale surfaces.

"A functional surface might have modified mechanical or chemical behavior, and a conference on functional materials could discuss catalysis operations, or tribology, or energy generation among other aspects," commented Alistair Kean.

"But interactions between photons and the surfaces they encounter is a critical aspect of applications in science and engineering, as well as being a fundamental part of the living world, and functional materials offer the opportunity to control the behavior of those photons. Functional materials in photonics are a route to exploiting optical phenomena such as metamaterials and

plasmonics, and that is the motivation for discussing them at a photonics conference like SPIE Photonex."

Both metamaterials and plasmonics are already making their way into real world applications. Metamaterials could allow cloaking and camouflage of military equipment or aircraft, and the connected networks of devices termed the Internet Of Things is being enabled by nanoscale receivers and transmitters exploiting plasmonic effects.

"However, our interest now is in using this technology to make new things," said Kean. "For example investigating whether metamaterials could be used in both the lenses and sensor pixels of an endoscope for bioimaging. Functional materials would then be manipulating both outgoing and incoming light in an optical biopsy procedure, steering the light in ways that conventional endoscope optics cannot do."

A healthy UK sector

Kean is a co-founder of Nikalyte, created in 2019 to develop nanoparticle coating equipment and services for research and commercial use. As an example of functional materials utilized in optical applications, Kean points to nanostructured sensors made by Nikalyte and used in surface enhanced Raman spectroscopy (SERS), where enhanced sensitivity allows identification of trace chemical signatures from explosives or street drugs at the parts-per-trillion level.

"Making these functional surfaces through physics gives us unprecedented control over their manufacture and the novel capabilities we can design into them; more control than chemical approaches could bring," said Kean. "Nikalyte is one example of how strong the UK functional materials sector now is."

The challenges of translation and commercialization are always present, however, making the choice of marketplace for particular functional materials a key concern. Kean believes that medicine and healthcare is a sector where the impact could be dramatic, and as an example foresees sensors whose sensitivity and specificity lets them detect signs of disease not just before other techniques,

but before significant symptoms develop.

"Detection and diagnosis of kidney disease normally involves biopsy and surgical procedures after symptoms manifest themselves, but I want to create sensors that let you tell if kidney disease is present five or even ten years before then," said Kean. "This will need a combination of sensors made using functional materials plus AI-driven algorithms to process the data, with ultimately quantum computers being applied to the task also. Processing the raw data will need these computational advances, but the result would be a remarkable advance for treatment of diseases such as Parkinson's or cancer."

Benefits for patients, reduced load on healthcare

The Photonex conference on functional materials will focus primarily on these themes of sensing, plasmonics and metamaterials. It will feature a keynote presentation from Ahu Gumrah Dumanli and a University of Manchester project studying how a natural nanosurface that already has optical properties can be modified further with synthetic nanomaterials.

The Manchester team has isolated a porous chitin matrix with a helicoidal microstructure from prawn shells that has strong circular polarization in the visible range, and deposited plasmonic materials onto it using reduction of gold nanoparticles at room temperature.

According to the team's presentation, optical analysis of the resulting films showed that surface lattice resonances of the gold nanoparticles became optically active and produced a distinctive macroscopic combination of optical effects. This suggests one easy and cost-effective fabrication method for the production of metasurfaces, that could also be scaled-up for larger scale manufacture.

This is the kind of evolution that the functional materials sector will be discussing at SPIE Photonex as the route to applying functional materials across multiple applications.

"Disease prevention is my goal," commented Alistair Kean. "We want to be able to interact gently with the body and tell a great deal about the biochemistry we see. A route to potentially detecting cancer or Parkinson's disease sooner would be a huge benefit for patients and reduce the load on healthcare systems, and we are approaching a threshold now where functional materials can help to bring this about. This marriage of photonics and functional materials is a good one for creating new technologies."

Author:

Tim Hayes, Contributing Editor, optics.org

Raytheon UK to integrate laser weapon on patrol vehicle

15 kW laser, said to be ready for operations, is designed to counter aerial threats such as hostile drones.

Raytheon's UK subsidiary said in September it is about to receive the first laser weapon in the country, and will integrate it onto a patrol vehicle next month.

Announced during the "DSEI 2023" defense industry event held in ExCeL, London, the development is said to mark a significant advancement in the understanding of how directed energy systems can be fielded.

Now known as "RTX", Raytheon has been closely involved in the development of weapons based on fiber laser sources for several years. It says that the 15 kW system heading to the UK is "operationally ready", and that it will be integrated onto one of the British Army's "Wolfhound" patrol vehicles during October as part of a contract agreed in 2021.

The weapon is intended to counter aerial threats, notably those presented by drones, and its fielding represents the latest development in the UK Ministry of Defence's (MoD's) Land Demonstrator program.

The development also coincides with the official opening of Raytheon UK's new laser integration center in Livingston, Scotland, which the firm announced just over a year ago.

The center will host testing, fielding, and maintenance of Raytheon's laser weapons, acting as a regional hub established to ensure that laser weapons can be quickly fielded, maintained, and repaired.

Milestone

Julie Finlayson-Odell, managing director of weapons and sensors at Raytheon UK, said in a company release:

"The arrival of this transformative technology is an important milestone in our collaboration with the MoD on using directed energy to address a variety of threats, from drones and UAVs to more complex missile systems.

"This system is a culmination of decades of investment, research and innovation and its arrival reflects our continued commitment to help fulfil a key strategic objective of

weather conditions such as extreme heat, cold, rain, sleet and snow.

During four days of live-fire exercises that took place in the US earlier this year, it is said to have successfully acquired, tracked, targeted and destroyed dozens of drone targets in short-range attack, swarm attack, and long-range threat scenarios.

Portable system

While much higher-power laser weapons



Photo: Raytheon UK/RTX.

At 15 kW, the laser weapon being delivered to Raytheon UK is a lot less powerful than some of the directed energy systems currently under development in the US and elsewhere. However, its relative portability and affordability is expected to prove advantageous as a new way to counter threats posed by drones.

the UK's Integrated Review, which is to understand how directed energy weapons can safely and effectively operate alongside other elements of the UK's armed forces."

According to the firm, the high-energy laser weapon system has performed as intended in multiple field tests, including in difficult

are in advanced development, the 15 kW system is compact and portable, can be installed on a variety of platforms, and connects to other air defense systems easily, says Raytheon UK.

"With [a] deep, rechargeable magazine and minimal logistics, this laser weapon is an affordable and viable option to protect military and critical infrastructure, and rapidly defeat threats," reports the firm.

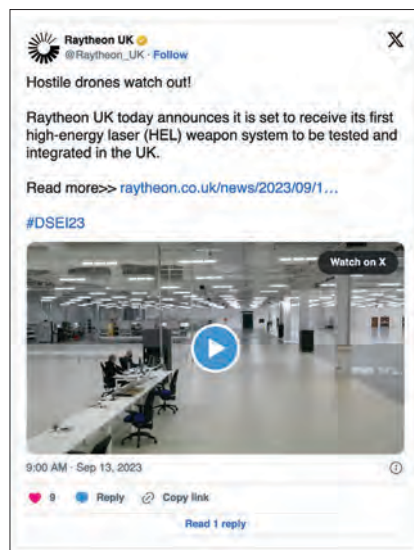
"The system offers a nearly infinite number of shots and precision accuracy with very low collateral damage, making it an affordable alternative to traditional munitions."

In the US, eight of the laser weapons have been delivered for military use, and are said to have defeated more than 400 targets over 25,000 operational hours.

In June, RTX said that it had delivered a 10 kW laser weapon small enough to fit in the bed of a pick-up truck to the US Air Force, also to combat drone attacks.

Author:

Mike Hatcher, Business Editor, optics.org



MicroLED maker Kubos awarded £700,000 funding from Innovate UK

Cambridge-based materials technology company also announces first patents, export plans, and customer win.

Kubos Semiconductors, based in Cambridge, UK, a microLED material technology company, has been awarded a £700,000 (\$890,000) Future Economy Investor Partnerships (FEIP) grant from Innovate UK, the UK government's innovation agency.

Kubos has also been granted its first process technology patents and has received its first customer order.

The funding, which is subject to completing aligned investment led by the Development Bank of Wales, is for a 24-month project to achieve 5% efficiency for red microLEDs by deploying the company's proprietary cubic Gallium Nitride (GaN) process, called KubosLED.

Kubos says achieving the project's goal will make microLEDs viable in AR/VR applications by approximately doubling the efficiency achieved with other process technologies. The company stated, "Poor red microLED efficiency is currently one of the main factors constraining the AR/VR market."

Carl Griffiths, Technology Seed Fund Manager

for DBW said, "We've only recently joined the FEIP and Kubos is the first company we have supported, and they have been awarded this grant. Kubos has demonstrated it has the right focus on deep tech, the right profile and momentum to secure the funding. Their exciting new technology has a clear purpose, and the market opportunity is vast."

Welsh cooperation

Following successful completion of the funding round in the autumn, Kubos as a fabless semiconductor company, will open a development office in Wales. This will enable it to continue to benefit from years of collaboration with the South Wales Compound Semiconductor cluster, specifically the Compound Semiconductor Centre (CSC).

The CSC is a partnership between Cardiff University and international compound semiconductor fabrication company, IQE Plc) and the Institute of Compound Semiconductors at Cardiff University, where the Kubos LEDs are processed and tested.



Kubos boss: Caroline O'Brien.

Kubos's core cubic GaN process and product technology patents have now been granted in China, Japan, Singapore, and the US. Its patent portfolio has also been extended to include granted patents for silicon carbide epitaxy, which is used by Kubos as a growth substrate.

The company has also won its first customer for its KubosLED material in red microLEDs. Kubos CEO, Caroline O'Brien, commented, "We see huge demand for our technology every time we engage with potential customers and are delighted to have won our first major customer and secured further funding to ensure we reach our technology goals."

"These achievements underline the fact that KubosLED material technology is the leading contender to clear a major bottleneck that's been holding back AR/VR adoption."

Author:

Mike Hatcher, Business Editor, optics.org



Kudos for Kubos: A 150-mm wafer of GaN LEDs under test via wafer probing.

Source: Kubos Semiconductors.

Photonics news from around the UK

G&H acquires Artemis Optical for £8.9 million

Deal enhances group's portfolio and creates new opportunities for vertical integration and cross-selling.

G&H, a developer of precision optics and photonics solutions, in July announced the acquisition of Artemis Optical, a Plymouth, UK-based manufacturer of thin-film coatings.

G&H stated that the deal, valued at £8.9 million (\$11.5 million), "enhances its product portfolio and creates new opportunities for vertical integration and the cross selling of enhanced combined capabilities."

Under the new company name, "G&H | Artemis", the partnership marks a significant milestone in the journey of both companies. With origins dating back almost 200 years to a pioneering optician in Victorian London's Wigmore Street, the Plymouth-based Artemis Optical currently employs 40 staff. G&H is planning for the newly-acquired site to become a Center of Excellence for coatings within the Group.

Terms of the acquisition

The terms of the acquisition were published on the London Stock Exchange website:

"The total consideration payable for Artemis by G&H is up to £8.9 million. This comprises an initial cash consideration of £4.5 million, funded from existing resources, together with £2.4 million of new G&H ordinary shares to be satisfied by the issue of 412,088 new G&H ordinary shares.

"There is a deferred contingent cash consideration of up to £2.0 million, payable based upon Artemis' performance in the two years ending 31 July 2025. The acquisition was expected to complete on 21 July 2023.

"In its financial year ended 31 March 2023 Artemis' revenue was circa £4.3 million and adjusted EBITDA was circa £0.7 million. As at the end of June 2023 Artemis had gross assets of circa £3 million. This acquisition is expected to be marginally earnings enhancing in the first full financial year of G&H's ownership."

G&H commented that it had selected Artemis due to its "state-of-the-art facilities and highly skilled team". This investment also complements G&H's June 2023 acquisition of GS Optics, further developing the group's position in the aerospace, defence and life sciences sectors at the same time as fostering greater innovation within the organization.

well-positioned to accelerate our customer focused innovation plans and create a better world with photonics."

Artemis will continue to maintain its dedicated focus on serving markets such as aerospace, military and defence, life sciences, and various other technology applications.

Jamie Pindard, General Manager of Artemis



Photo: Artemis Optical.

Artemis manufactures optical thin-film coatings for challenging applications. It specializes in periscopes and sighting systems, head-up and helmet-mounted displays, laser protection, and narrow band analytical filters.

Charlie Peppiatt, CEO of G&H, commented, "The addition of Artemis Optical to G&H is an exciting new chapter of accretive growth for the company and innovation for our combined customers."

He added, "Artemis' renowned excellence in thin-film coatings complements our existing capabilities to enable us to deliver advanced photonics technology and unparalleled value for our customers. Together, we are

Optical, said, "The acquisition of Artemis by G&H is an exciting milestone for both of our journeys. I am confident that existing customers of both companies will benefit from the combined expertise, resources and global reach that we can now bring to the market."

Author:

Mike Hatcher, Business Editor, optics.org

Webb spots methane and carbon dioxide in K2-18b exoplanet atmosphere

Results from optical instruments suggest exoplanet may have a water ocean.

A new investigation by NASA's James Webb Space Telescope (JWST) into the exoplanet named K2-18b has revealed the presence of carbon-bearing molecules including methane and carbon dioxide in its atmosphere.

The detection of these molecules, along with a shortage of ammonia, is consistent with the presence of an ocean underneath a hydrogen-rich atmosphere, which would make K2-18b the kind of exoplanet termed a Hycean world. Some astronomers believe that these are promising environments to search for evidence of life on exoplanets.

"Our findings underscore the importance of considering diverse habitable environments in the search for life elsewhere," commented Nikku Madhusudhan from the University of Cambridge, lead author of a paper submitted to *Astrophysical Journal Letters* about the findings.

"Traditionally, the search for life on exoplanets has focused primarily on smaller rocky planets, but the larger Hycean worlds are significantly more conducive to atmospheric observations."

JWST's science payload includes a suite of

four integrated optical instruments designed to allow imaging and spectroscopy over a range of 0.6 to 28.3 microns, from visible to mid-infrared wavelengths.

The telescope's Near Infrared Camera (NIRCam) acts as its primary imager, employing ten mercury-cadmium-telluride detector arrays. NIRCam also acts as a wavefront sensor for JWST's Optical Telescope Element, based around the telescope's 6.5-meter primary mirror.

The other instruments are the Near-Infrared Spectrograph (NIRSpec) gathering spectra in a 9-square-arcminute field of view; the cryogenically cooled Mid-Infrared Instrument (MIRI) for broadband imagery and spectroscopy; and the Fine Guidance Sensor/Near Infrared Imager and Slitless Spectrograph (FGS/NIRISS) used in particular for exoplanet detection and characterization, and exoplanet transit spectroscopy.

One JWST observation comparable to eight with Hubble

Described as a "technical and scientific triumph" at the SPIE Astro conference shortly after it delivered the first NIRCam deep-

field images of distant galaxies in 2022, JWST should now assist astronomers in characterizing the atmospheres of exoplanets like K2-18b, previously a tricky proposition.

In this case researchers analyzed light from K2-18b's parent star as it passed through the exoplanet's atmosphere during a transit of the planet, allowing them to detect the presence of gases in that atmosphere and identify its constituents.

"This result was only possible because of the extended wavelength range and unprecedented sensitivity of Webb, which enabled robust detection of spectral features with just two transits," said Madhusudhan. "For comparison, one transit observation with Webb provided comparable precision to eight observations with Hubble conducted over a few years and in a relatively narrow wavelength range."

Next steps will include using the telescope's MIRI spectrograph to validate the findings and investigate the environmental conditions on K2-18b. The ultimate goal, of course, is to see if life can be identified on a habitable exoplanet, a quest in which the JWST's optical instruments will be key.

"These results are the product of just two observations of K2-18b, with many more on the way," said team member Savvas Constantinou from the University of Cambridge. "This means our work here is but an early demonstration of what Webb can observe in habitable-zone exoplanets."

Author:

Tim Hayes, Contributing Editor, optics.org



Artist's concept showing what exoplanet K2-18b could look like based on science data. JWST has revealed the presence of carbon-bearing molecules including methane and carbon dioxide.

Photonics news from around the UK

IQE, Mojo Vision advance RGB and blue micro-LED development

Epiwafer foundry releases RGB multi-wavelength platform; Mojo lights up 300 mm GaN-on-silicon wafer for blue emitters.

Two developers of novel micro-LEDs are claiming separate manufacturing breakthroughs for display applications, with the potential to advance mass production of the emerging technology.

IQE, the UK-based epiwafer foundry company, has launched a new portfolio of 200 mm-diameter wafers capable of red-green-blue (RGB) emission. It has recently been working with University of Cambridge spin-out Porotech, to produce novel light emitters based on porous GaN that can be engineered to produce light at wavelengths across the visible spectrum.

Meanwhile Mojo Vision, the Silicon Valley firm that recently raised more than \$22 million in support of its quantum-dot emitter structures, says it has produced a 300 mm-diameter GaN-on-silicon wafer hosting an array of blue micro-LEDs.

Although not yet widely deployed, micro-LEDs are being touted by some as a potentially disruptive technology in the displays and augmented reality (AR) sectors, bringing key advantages in terms of brightness, contrast, viewing angle, and aperture ratio.

According to analysts at the consultancy

company Yole Intelligence, the main stumbling block is cost, with at least an order-of-magnitude reduction thought to be required before micro-LEDs can compete in consumer applications.

Yole sees micro-LEDs as the only display technology capable of providing the right combination of cost, brightness, efficiency, and size for AR applications - and said earlier this year that realizing full-color RGB microdisplays on the same epiwafer remained a key challenge.

Mass production goal

The latest claims from IQE and Mojo Vision suggest that progress is being made towards mass production of the devices, with the accompanying promise of massive cost reduction.

IQE says that its GaN and GaAs epitaxy will be critical to enabling faster adoption of micro-LEDs, because its high-volume manufacturing platforms and scale ought to yield a commercial advantage.

"The launch of IQE's differentiated micro-LED wafer products will provide its customers with faster-time-to-market options for display-level qualification," stated the

company, which already produces more conventional epiwafers used widely in the mass production of radio-frequency chips and semiconductor lasers.

"With multi-wavelength solutions available at wafer diameters including new options at 200 mm, IQE is delivering qualified foundry capacity from its multi-continent operations, which is a significant point of difference as it provides customers with epitaxy supply chain diversification," added the foundry.

Mark Furlong, its executive VP of business development, said: "We are pleased to offer our customers the industry's broadest range of materials technology platforms for micro-LED display qualification.

"We recognise that IQE can play a critical role in accelerating the deployment of micro-LEDs across many end applications and the launch of this new portfolio is in line with our strategy to diversify into GaN technologies, in the high-growth display market."

IQE is also looking to scale up to 300 mm-diameter wafers - and further cost reduction - in the future.

300 mm wafers

Mojo claims to have already achieved that wafer size milestone, producing what is said to be the "first ever" 300 mm GaN-on-silicon wafer hosting blue micro-LEDs.

"This accomplishment marks important progress towards maturing micro-LED manufacturing at state-of-the-art 300 mm CMOS fabs," said the Saratoga startup, which has previously focused on developing compact dynamic displays with extremely high emitter density and image resolution.

"Micro-LEDs provide critical performance, efficiency and form-factor advantages essential to applications in extended reality (XR), wearables, automotive, consumer electronics, and high speed communication.

"Mojo Vision overcame extensive supply chain and wafer qualification issues, such as wafer bow and contamination concerns, to get GaN-on-silicon wafers allowed into the 300 mm facility."

Mojo's CEO Nikhil Balram added: "Achieving cost-effective, large-scale manufacturing is the gap we are working to bridge with this breakthrough."

Rajeeva Lahri, a semiconductor industry veteran who advises Mojo, suggested that the latest result would help to establish a roadmap for commercial scaling of micro-LED technology using processes compatible with industry-standard 300 mm fabrication facilities.

Author:

Mike Hatcher, Business Editor, optics.org

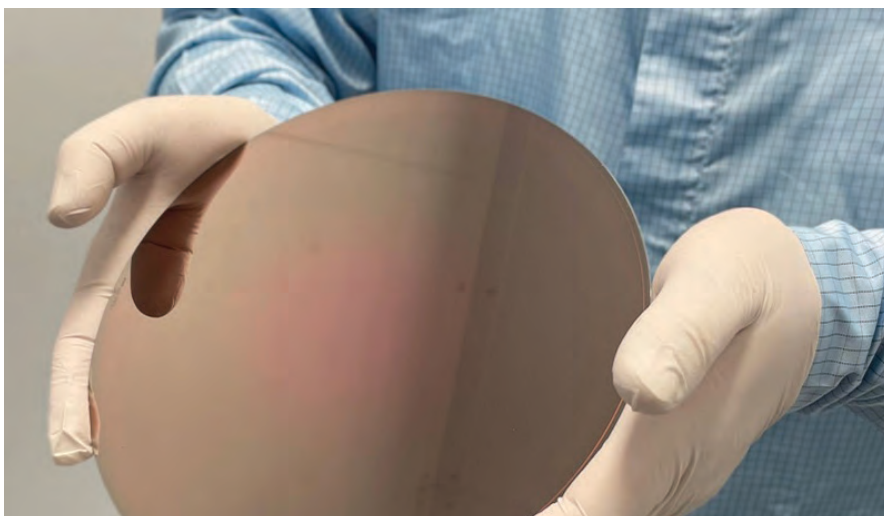


Photo: IQE.

IQE's 200 mm-diameter RGB micro-LED epiwafer (shown here) promises to represent a key step towards mass production of the devices, which are tipped for success in AR/VR display applications - provided that costs can be reduced significantly. Production on 200 mm and 300 mm silicon wafers would be one of the key ways to reduce manufacturing costs. Startup Mojo Vision has now produced a 300 mm-diameter wafer hosting an array of blue micro-LEDs.

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Toshiba, Orange say quantum encryption compatible with existing data networks

Multiplexing approach allows quantum key distribution signals to co-exist with classical signals at distances up to 70 km.

New research by Toshiba Europe and telecoms giant Orange suggesting that quantum key distribution (QKD) can be deployed on existing optical networks is being hailed by the two firms as a "huge step forward" for quantum-secure communications.

Revealed in a newly published paper based around a presentation made at this year's Optical Fiber Communication (OFC) conference, the work relates to a QKD system operating at 1310 nm, coupled with 1550 nm data channels transmitted over 50 kilometers of standard single mode fiber.

Co-propagation

UK-based Toshiba Europe, which is an acknowledged leader in the development of QKD, says the results of work at Orange Labs in Lannion, France, show how the technology can be deployed on a provider's existing fiber network, alongside current data services.

"These findings could help network operators reduce the cost of implementing QKD by removing the need to invest in dedicated quantum fiber infrastructure," points out the firm.

Until now, the deployment of QKD has required operators to invest in so-called "dark fiber" across their networks specifically for sending quantum information, increasing the cost and time to adoption.

Previous studies have indicated issues compromising the viability of such deployments, including the possible number and optical power of the data channels used and the effective network distance, as well as the speed of the QKD element.

But Toshiba Europe now says that wavelength division multiplexing (WDM) should enable QKD to operate on existing optical fibers thanks to spectral separation.

"Through the tests, researchers from Toshiba and Orange demonstrated the effective co-propagation of the classical and quantum signals with high secret bit rates, allowing them to co-exist while still being capable

However, the same characteristics mean that - so far - dedicated fiber and highly sensitive, expensive photonic components have been required for QKD deployment.

Paulette Gavignet from Orange Innovation commented: "This work shows that we can have co-propagation of the quantum channel with WDM data channels in the same fiber, without changing the engineering rules of the operational WDM links.



Photo: Toshiba Europe.

Toshiba's European quantum technology division is at the forefront of QKD system development. Such systems, used to secure highly sensitive messages through single-photon physical characteristics, have typically required dedicated networks. Toshiba and Orange now say that the secure links can be co-propagated within commercial data networks - depending on the total optical power used and the length of the network.

of effectively delivering keys at distances of up to 70 km, showing great promise for deployments in metro networks in built-up areas," the two firms reported.

High secret key rate

While quantum computers capable of cracking public key encryption used to protect sensitive data are yet to appear, there is a widespread fear that the current approach could be rendered insecure in the future.

QKD presents one way to protect such data, because it relies on the physical properties such as the polarization of an individual photon - meaning that any attempt to intercept the key would immediately be detected.

"The high secret key rate obtained in this configuration is very promising for the introduction of QKD in operator's networks."

Orange group CTO Laurent Leboucher added: "Together with Toshiba, we showed that it is possible to introduce new security functions in the operators' networks without requiring the use of dedicated fibers. With this cost-effective approach, we pave the way towards a digital fortress, guaranteeing the security of our customers' most valuable data."

Andrew Shields, a QKD pioneer who heads up Toshiba's Quantum Technology Division in Cambridge, said: "Validating the ability of our QKD technology to protect transmissions while using existing fiber networks is a huge

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Toshiba, Orange say quantum encryption compatible with existing data networks

step forward in making quantum-secure communications accessible for today's organisations."

New metric

The work detailed in the paper includes evaluation of a 1310 nm quantum channel multiplexed with up to 60 data channels, each carrying a 100 Gb/s bit rate in the telecommunication "C band" across a commercially available Toshiba QKD system.

"The ability to multiplex classical data while retaining excellent QKD performance was enabled by the system's novel design, which included high-extinction spectral filters and time-domain gating used to help isolate the quantum signal and reduce noise introduced from the classical channels," explains the Toshiba-Orange team.

Tests were run with both 30 and 60

multiplexed channels over 20 km, 50 km and 70 km fiber lengths, with the secure bit rate measured over each distance.

Results showed that the high number of WDM channels had little impact on the secure bit rate, which was more influenced by the optical launch power of the aggregated data channels used in the system.

That finding has enabled Orange and Toshiba to propose a new metric - which they call the "co-propagation Efficiency (CE)" - to estimate the performance of the QKD system in such a deployment while considering the total power of the data channels and transmission distance.

"These findings have two key implications for the viability of using QKD to secure communications against attack by quantum computers at a commercial level," says Toshiba.

"Firstly, it shows that the commercially available equipment evaluated by Toshiba and Orange is successful at allowing QKD to be more effectively deployed on current fiber networks.

"Secondly, the new metric developed by the researchers, which acknowledges that power - and not the number of channels -

has the most impact on efficiency, may aid operators in network and service planning."

In their research paper, the team concludes: "These results show the possibility to deploy commercial QKD system[s] on currently existing fully filled WDM links with 100 Gb/s and 400 Gb/s channels in data center interconnection (DCI) applications."

ID Quantique joins space-QKD effort

In related news the Swiss firm ID Quantique - another developer of QKD systems - says that it is now participating in the "EAGLE-1" initiative to deploy space-based quantum encryption.

First revealed last year, the project is funded via Horizon Europe and the European Space Agency and is aiming to launch a satellite into low-Earth orbit as soon as next year.

Germany's TESAT is due to manufacture a QKD payload to establish a secure optical link from space to the ground, as well as the QKD module of the satellite, and has selected ID Quantique to provide its quantum random number generator (QRNG) and chipset technology.

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Researchers develop 'quantum' method to detect infrared light at room temperature

Universities of Birmingham and Cambridge claim "breakthrough" in understanding of chemical, biological molecule processes.

Scientists from the University of Birmingham and the University of Cambridge, both in the UK, have developed a new method for detecting mid-infrared (MIR) light at room temperature using quantum systems.

The research, published in *Nature Photonics*, was conducted at the Cavendish Laboratory at the University of Cambridge and is said to "mark a significant breakthrough in the ability for scientists to gain insight into the working of chemical and biological molecules."

In the new method using quantum systems, the team converted low-energy MIR photons into high-energy visible photons using molecular emitters. The innovation has the capability to help scientists detect MIR radiation and perform spectroscopy at a single-molecule level, at room temperature.

Dr Rohit Chikkaraddy, an Assistant Professor at the University of Birmingham, and lead author, explained, "The bonds that maintain the distance between atoms in molecules

can vibrate like springs, and these vibrations resonate at very high frequencies.

"Modern detectors rely on cooled semiconductor devices that are energy-intensive and bulky, but our research presents a new and exciting way to detect this light at room temperature," he added.

Interactive states

The new approach is called MIR Vibrationally-Assisted Luminescence (MIRVAL), and uses molecules that have the capability of being both MIR and visible light. The team was able to assemble the molecular emitters into a very small plasmonic cavity which was resonant in both the MIR and visible ranges.

They further engineered it so that the molecular vibrational states and electronic states were able to interact, resulting in an efficient transduction of MIR light into enhanced visible luminescence.

Dr Chikkaraddy continued: "The most challenging aspect was to bring together three widely different length scales – the visible wavelength which are hundreds of nanometers, molecular vibrations which are less than a nanometer, and the mid-infrared wavelengths which are ten thousand nanometers – into a single platform and combine them effectively."

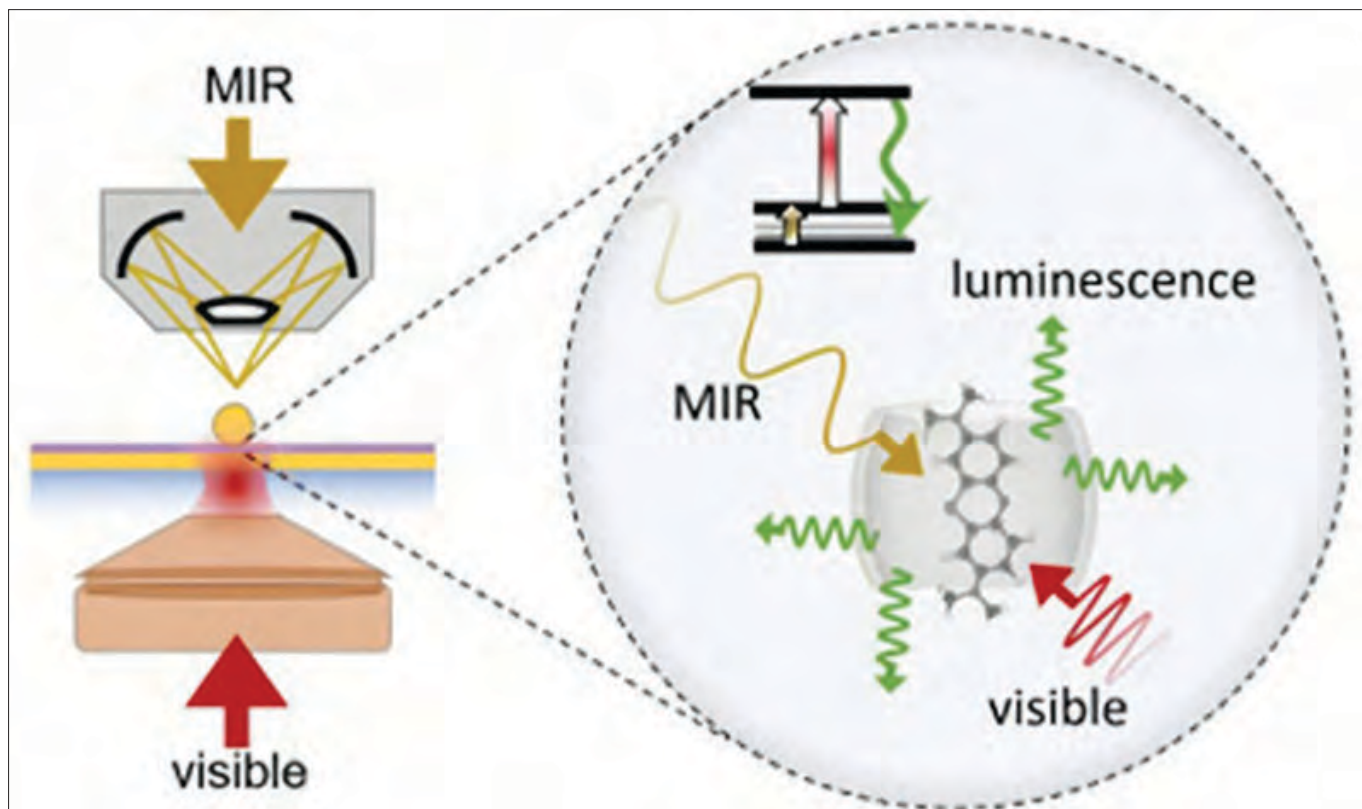
Through the creation of picocavities, incredibly small cavities that trap light and are formed by single-atom defects on the metallic facets, the researchers were able to achieve extreme light confinement volume below one cubic nanometer. This meant the team could confine MIR light all the way down to the scale of a single molecule.

This breakthrough has the ability to deepen understanding of complex systems, and opens the gateway to infrared-active molecular vibrations, which are typically inaccessible at the single-molecule level. But MIRVAL could prove beneficial in a number of fields, beyond pure scientific research.

He concluded, "MIRVAL could have a number of uses such as real-time gas sensing, medical diagnostics, astronomical surveys and quantum communication, as we can now see the vibrational fingerprint of individual molecules at MIR frequencies."

Author:

Matthew Peach, Editor in Chief, *optics.org*



Principle of MIR Vibrationally-Assisted Luminescence (MIRVAL).



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beyond borders

Quantum sensors progress beyond the lab

Gravity measurements at sea and new brain scanners among the applications targeted by UK quantum startups Delta-g and Cerca Magnetics.

Next year will mark a full decade since the UK's Engineering and Physical Sciences Research Council (EPSRC) identified four university "hubs" charged with turning quantum technologies from laboratory curiosities into commercial products serving real-world applications.

Given the generous funding received since then, and the establishment of nearly 50 UK-based startups, that anniversary will likely prompt an assessment of what has been achieved so far. Photonex 2023 attendees are set to get something of a preview, with several research groups and spin-outs supported by the EPSRC funding scheme presenting in Glasgow this week.

The "Quantum Technology: Driving Commercialisation of an Enabling Science" conference stream largely reflects the themes of the four UK hubs, with sessions dedicated to imaging, sensing, encrypted communications, and components.

In a recent podcast produced by the Inside Quantum Technology web site, the more immediate commercial potential of quantum technologies outside the high-profile area of computing was highlighted by Stuart Woods from the venture fund Quantum

Exponential. "We hear a lot of press around quantum computing, but what we see around quantum sensing is a lot more 'real' and a lot more 'near,'" he said, explaining that sensing applications can be roughly divided into four vertical markets: medicine; smart cities and infrastructure; defence; and timing and navigation.

The same podcast highlighted the recent achievements of the UK quantum startup firms Cerca Magnetics and Delta-g, spin-outs from the universities of Nottingham and Birmingham respectively.

At-sea atom interferometry

The past few months have seen significant developments at Delta-g, with the firm raising £1.5 million in "pre-seed" funding in the summer, and hiring CEO Pete Stirling. That was followed by a successful trial of its atom interferometer sensor on board a research vessel in the North Sea.

Trial lead Andrew Hinton, a research fellow at Birmingham's quantum sensing hub, said in a release detailing the work: "The system was able to perform atom interferometry in variable weather conditions, including direct sunlight, and being placed under a tarpaulin

for sudden downpours of rain. This sea trial was a huge accomplishment in proving that our quantum sensors have reached a technological maturity where they can be reliably operated in harsh conditions."

Gareth Brown, a senior principal quantum scientist at the UK's Defence Science and Technology Laboratory (DSTL), added: "The successful operation of a cold atom gravity gradiometer in strap-down configuration on a maritime vessel is a world first and an important step forward for the technology."

During the Inside Quantum Technology podcast, CEO Stirling emphasised how Delta-g is now working to scale the technology to a size practical for field deployment. "The [pre-seed] funding is for size, weight, power, and cost reduction," he said. "[It's an] amazing instrument and we have an exciting program to take it forward, with lots of in-bound interest."

Delta-g's roadmap should see the gravity gradiometer reduced from roughly the size of an industrial fridge to that of a large microwave, with a pre-production demonstrator expected to be ready by spring 2024, for field experiments in the summer. "[We have] a clear roadmap and the resources and capital to deliver that," Stirling said.

Such a product would have huge commercial potential. As Professor Sir Peter Knight - long-time chair of the UK National Quantum Technologies Programme - told a House of Commons Science and Technology Committee in September: "One of the

continued page 19



Photo: University of Birmingham/Delta-g.

The team responsible for what is thought to be the first successful at-sea trial of a cold-atom gravity gradiometer. Birmingham spin-out Delta-g will use recent funding to shrink the quantum sensor (shown behind the team) to roughly the size of microwave oven.

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Quantum sensors progress beyond the lab

applications is: what is under your feet? Half the holes dug up in London are in the wrong place. We do not know where the pipework is. If we can improve the sensitivity of gravity sensors by a factor of two we can save billions."

Photonex attendees will get a chance to hear about the latest developments, with Delta-g scheduled to deliver an invited presentation detailing the path to commercialization that will open the quantum sensing session on Wednesday afternoon.

Next-gen MRI

Also taking part in the podcast was Cerca co-founder Niall Holmes. The brain-scanning technology developed by the Nottingham spin-out is based around optically pumped magnetometers (OPMs), which enable magnetoencephalography (MEG) scanning - monitoring the electrical activity of neurons - without the need for cryogenic cooling.

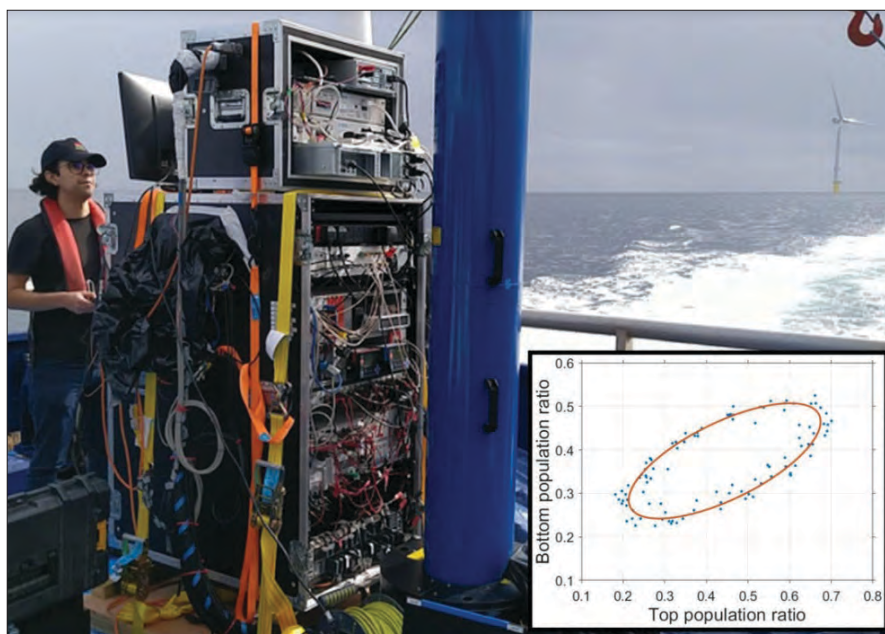
As Holmes explained, the University of Nottingham has a celebrated history in medical imaging physics, notably some Nobel-winning research by Professor Sir Peter Mansfield.

MEG is fundamentally different to MRI, and involves measuring the tiny magnetic fields generated when a neuron is firing. "It's not a well known technique, and [normally] requires liquid helium cooling," Holmes said. "[But the] miniaturisation of OPMs solves that problem, and removes the stillness requirement."

It means that instead of bracing themselves inside a scanner for several minutes, patients simply wear a 3D-printed helmet attached to the sensors, with the technique able to generate a unique combination of high spatial and temporal resolution imagery.

Cerca's technology remains at the pre-clinical stage for now, and restricted to research use. The next big step for the company is to build a prototype suitable for clinical use, with the aim of studying conditions such as epilepsy and autism, as well as monitoring brain activity during social interactions.

Woods observed that both Cerca and Delta-g are now at the "very solid prototype" stage with their quantum sensing technologies. "The ability to have an impact within the next few years is a lot sooner than what we're likely to see with quantum computing," he noted. And highlighting Cerca's progress during the



Team member Adam Seedat operating the Delta-g sensor on the open deck of the RV Princess Royal, as it was used during the trial. The inset graph shows example sensor output data - the ellipse is formed by combining the outputs of two atom interferometers to extract gravity gradient information.

House of Commons session, Knight said: "It is a major success story. It is one of the few startups - and it is an early startup - that is making money." He added that healthcare applications of quantum technologies may be the "transformative quick win" for the UK over the next few years.

Looking ahead, Woods suggested that the ability to intersect large clinical datasets with new information from quantum sensors looked particularly exciting.

"We've all been touched by people with addiction or depression," he told the podcast. "The ability to view chemical changes or imbalances appearing in the brain would add another data point to allow us to help people."

Applications in focus

Similarly, a quantum gravity sensor would enable us to interrogate our planet in a fundamentally different way - perhaps offering the ability to identify sinkholes before they even appear.

"Climate change is causing some parts of the world to dry rapidly, and other places to become wet," Woods said. "Jakarta is sinking at a rate of 30 centimetres per year, and the ability to monitor and understand those changes is what I think the quantum sensors can begin to offer."

Another sign that quantum technology could truly be emerging from the laboratory is the relocation of November's National Quantum Technologies Showcase. Having swiftly outgrown its original location at the Royal Society, in recent years it has taken place at

the Queen Elizabeth II Conference Centre in Westminster - but 2023 sees the event move to the larger Business Design Centre in Islington.

The nature of Innovate UK grants is also shifting towards applications, with both Delta-g and Cerca among the initial 30 recipients of a total £15M in Quantum Catalyst Fund awards announced in September. Other projects will look at potential applications ranging "from quantum corrosion monitoring" to optimising energy grids.

Intended to accelerate the adoption of quantum solutions by the public sector, the "Phase 1" funding is intended to cover just three months, after which the most promising concepts will be awarded a "Phase 2" contract to develop a prototype.

Here at Photonex, aside from the dedicated conference sessions there will be a chance to discuss recent developments with representatives from exhibitors including Glasgow's "Quantic" quantum imaging hub, as well as the National Physical Laboratory (NPL) and Toptica, a key supplier of lasers for quantum applications. The exhibition floor will also host a session devoted to "Quantum Devices and Applications" organised by Innovate UK's Najwa Sidqi, with presentations from NPL atomic clock specialist Mohsin Haji and Lia Li, CEO and founder of the quantum navigation startup Zero Point Motion, among others.

Author:

Mike Hatcher, Business Editor, optics.org.

Photo: University of Birmingham/Delta-g.

Quantum gas lidar monitors continuous methane emissions

UK based QLM says its detector offers 360° view of equipment up to 200m away – and associated gas emissions.

QLM Technology, a Bristol, UK-based developer of a novel emissions measurement and quantification technology, has announced the commercial launch of both its Quantum Gas Lidar and the QLM Cloud, an analytics platform for analyzing and managing associated emissions data.

QLM's patented Quantum Gas Lidar combines quantum photonics detection technology, telecom tunable lasers and a lidar to achieve detailed, 360 degree images of [chemical plant] equipment up to 200m away and any associated methane emissions, with "exceptional accuracy".

The resulting gas lidar images are analyzed and stored, and significant emissions events and related analysis are reported through the QLM Cloud. The combined

solution of QGL hardware and QLM Cloud are offered as a Software-as-a-Service, within which users can customize alerts and reports of emissions exceeding select thresholds.

'Quantum technology architecture'

QLM's Quantum Gas Lidar is also available through SLB, QLM's partner for the oil and gas industry, as a part of their Methane Digital Platform offering from SEES (SLB End-to-end Emissions Solutions).

The new lidar incorporates QLM's latest enhancements in quantification analytics and metrology. The system has been certified for deployment around the world: both US and UK patents have been granted around its core quantum technology architecture.

QLM's continuous monitoring solution detects emission sources and accurately quantifies their flow rates, locating them in 3D, so that the most consequential emitters can be prioritized and addressed.

The system provides a comprehensive, scalable, cost-effective continuous emissions management and reporting solution enabling customers to show achievement of ESG goals and compliance with OGMP 2.0 level 4/5, US EPA, PHMSA and other emerging regulatory reporting requirements.

QLM is a UK-based photonics technology and analytics company with operations in England, Wales and California. QLM developed a patented Quantum Gas Lidar that detects, visualizes, locates and accurately quantifies emission rates of greenhouse gases, enabling customers to identify and cost-effectively remediate their largest emitters. Its lidar technology is scalable to low cost at high volume, enabling wide deployment, the company states.

Author:

Mike Hatcher, Business Editor, optics.org



QLM Cloud analytics portal showing lidar viewfinder, emissions map and emissions event trending and reporting (left). QLM Quantum Gas Lidar system hardware (right).



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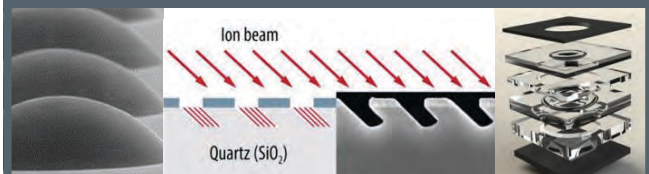
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SiPhox Health lands \$27M for silicon photonics test kits

MIT spin-out wins backing from Intel Capital and Khosla Ventures as it seeks FDA clearance for biomarker test platform.

SiPhox Health, a silicon photonics startup targeting healthcare applications, says it has now attracted \$27 million in funding, following a recent series A round worth \$17 million.

It adds that the series A round was led by Intel Capital, while Khosla Ventures and the renowned startup accelerator Y Combinator headed up the seed funding.

The Burlington, Massachusetts, firm already sells a mail-in blood collection kit providing measurement of the concentrations of 17 different biomarkers, with results that can be combined with physiological data from wearable devices like Fitbits.

Among those biomarkers are the stress response hormone cortisol, along with hemoglobin, Vitamin D, insulin, testosterone, cholesterol, and others.

The Massachusetts Institute of Technology (MIT) spin-out now wants to use its investment to help work towards US Food & Drug Administration (FDA) approval for its "SiPhox Home" platform, saying that the silicon photonics technology could help

to prevent and manage chronic diseases affecting millions of people globally.

"[SiPhox Home] will offer a broad menu of proteins and hormone tests from a finger-prick blood sample, with results in five minutes or less," said the firm, whose chip-based approach is said to incorporate state-of-the-art integrated photonics, electronics and microfluidics.

AIM Photonics development

According to SiPhox its co-founders Diedrik Vermeulen and Michael Dubrovsky had a vision of using silicon photonics, thus far deployed almost entirely in optical communications, to put a laboratory-grade health testing device in every home to help monitor chronic diseases.

"Access to low-cost, convenient health testing can help prevent and manage these conditions, improving the lives of patients and enabling many healthcare innovations that are bottlenecked by existing testing approaches," states the company.

CEO Vermuelen added: "At SiPhox Health, we are leveraging the trillions of dollars invested in the semiconductor industry to enable lab-quality results in a consumer-ready, user-friendly device."

The firm currently offers a mail-in test service under a range of different subscription models, selling a single one-off test for \$245, or an unlimited "membership" option at \$95 per test.

Developed initially via the AIM Photonics initiative, the platform uses "basic biochemistry in conjunction with silicon photonics" to enable ubiquitous, low-cost measurement of biomarkers linked with inflammation, hormones, and metabolic or cardiovascular health.

Massive scaling

Dubrovsky, now the company's "chief product officer", said in a statement announcing the venture funding: "SiPhox's goal is to create category-defining health tracking products starting with the SiPhox Home, which is a 100-fold improvement over existing blood diagnostics.

"Eventually, our technology will enable the ultimate wearable device for measuring proteins, hormones, and small molecules continuously.

"Every cell in the human body is a much more advanced sensor than anything on the market today, showing we are nowhere near the physical limits for performance and miniaturization in diagnostics."

Intel Capital's managing director Srinu Ananth added: "The rapid growth in telehealth and home health sectors necessitates a new paradigm in diagnostics. SiPhox Health's fast and accurate at-home testing is poised to change the patient journey for employers, pharma, insurers and health systems.

"Investments in silicon photonics over the past two decades for the datacom and telecom industry have enabled the massive scaling of the internet and cloud computing.

"This has set the stage for startups like SiPhox to apply silicon photonics technology to new frontiers. We are highly impressed with their technology and approach to tackling this opportunity."

www.siphoxhealth.com

Author:

Mike Hatcher, Business Editor, optics.org

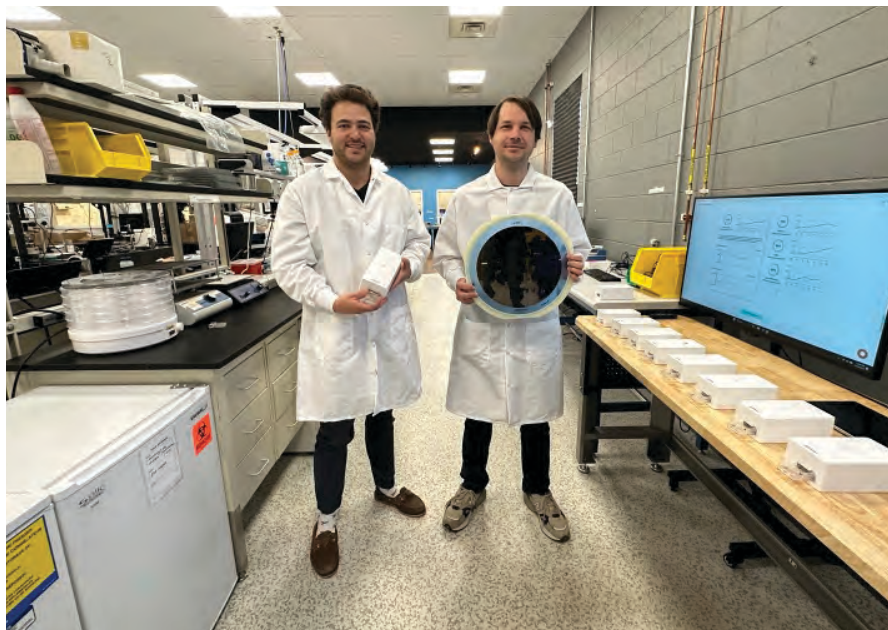


Photo: Business Wire/SiPhox Health

SiPhox Health co-founders Michael Dubrovsky (left) and Diedrik Vermeulen, standing in the SiPhox Health biochip pilot line and laboratory space. CEO Vermeulen is holding a 12-inch diameter silicon photonics wafer featuring SiPhox's sensor chips, while chief product officer Dubrovsky is holding the "SiPhox Home" biomarker testing kit.

Indie Semiconductor grows automotive offering with Exalos buyout

Swiss firm sells a range of superluminescent LEDs and semiconductor optical amplifiers made using proprietary processes.

Automotive technology firm Indie Semiconductor says it has acquired Exalos, the Swiss designer of superluminescent LEDs (SLEDs) and semiconductor optical amplifiers (SOAs).

California-based Indie says that the deal, which could end up costing \$65 million, will give it access to some proprietary photonics technology well suited to applications including head-up displays (HUDs) and lidar sensors.

In particular, adds Indie, Exalos' field-proven devices complement its own laser and silicon photonics products.

The firm has paid an initial \$45 million - in the form of 6.6 million Indie shares - to complete the acquisition, with up to a further \$20 million payable in either cash or more shares, depending on sales performance over the next two years.

Like Indie, Exalos has pursued a fabless business model, outsourcing manufacturing to commercial foundries so that it can concentrate on epitaxial wafer design.

That approach has resulted in the firm's development of low-speckle SLEDs emitting in the red, green, and blue that are well suited to applications in HUDs and extended reality headsets.

FMCW lidar boost

Donald McClymont, Indie's co-founder and CEO, said in a release announcing the agreement that Exalos' suite of photonic components would immediately expand Indie's advanced driver assistance systems (ADAS) and "user experience" product offering to top-tier vehicle makers.

"Specifically, Indie can now leverage Exalos' core SLED and SOA technologies to enable HUD, high-brightness visible lighting and inertial measurement unit (IMU)-based navigational applications"

McClymont also pointed out that the technology would enable Indie to extend its portfolio of frequency-modulated continuous-wave (FMCW) lidar sensors, a chip-scale version of lidar technology that is able to determine

both the position and velocity of other road users.

"We are gaining a well-established team of 17 world class engineers, including the industry's leading expertise in bright light sources based on a proprietary gallium nitride process," he said.

Founded 20 years ago in Zurich, Exalos says it has since shipped more than 700,000 SLEDs, for applications across medical and industrial imaging, navigation, optical sensing, metrology, and scientific research.

As well as SLEDs and SOAs, the company has expertise in "swept source" external-cavity tunable lasers, which have been used in the development of ultra-compact optical coherence tomography (OCT) scanners.

Exalos' CEO and co-founder Christian Velez commented: "Given Indie's global sales channels and demonstrated scalability, I am confident that together we can take our business to the next level, capitalizing on clear product synergies between us and extending our customer reach while preserving the Exalos innovation engine."

Steep sales growth

For Indie, the Exalos deal should complement its 2021 acquisition of Canadian photonics startup TeraXion, whose developments included a high-linearity distributed feedback (DFB) laser diode specifically aimed at FMCW lidar applications.

That deal was made possible by Indie's \$350 million listing on the Nasdaq via a special-purpose acquisitions company (SPAC) arrangement completed in June 2021.

As well as TeraXion and Exalos, the firm has since acquired Analog Devices' Symeo Radar division, video processor company GEO Semiconductor, and Germany's Silicon Radar. It has also signed a strategic partnership with FMCW lidar specialist SiLC Technologies.

Last month Indie reported that its quarterly sales had more than doubled year-on-year, to \$52 million, although that was accompanied by an operating loss of nearly \$41 million.

Namechecking the likes of Bosch and Toyota as users of its technology, CEO McClymont told investors:

"Our steep growth trajectory reflects design win momentum across ADAS, user experience and electric vehicle applications. Indie is increasingly well positioned to capitalize on these triple megatrends and the resulting \$48 billion autotech market opportunity."

Author:

Mike Hatcher, Business Editor, optics.org

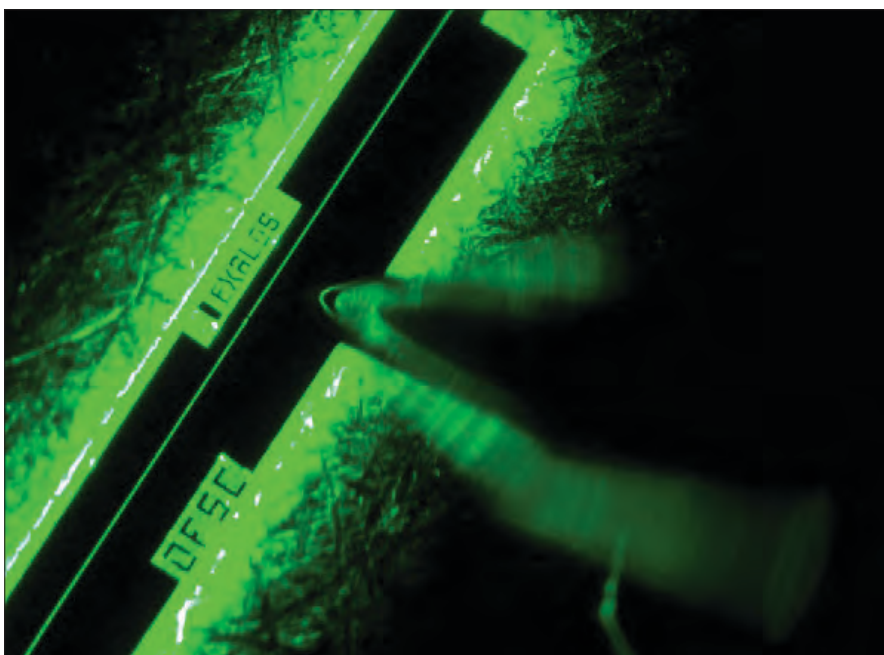


Image: Exalos.

Innovation engine: Exalos' research team recently published details of a new technology for green superluminescent light emitting diodes (SLEDs), based around novel InAlN n-type claddings. "The performance of these devices, including electro-optical characteristics, optical confinement, and substrate leakage, has significantly improved when compared to traditional devices based on AlGaIn claddings," it reported earlier this year.

Hamamatsu backs Raman drug monitoring startup Axithra

Spin-out combining expertise from imec and Ghent University raises €10M in seed funding round.

Axithra, a startup company based in Belgium developing chip-based Raman spectroscopy technology to monitor drug concentrations in patients' blood, has raised €10 million in seed funding.

The spin-out from imec and Ghent University says that its platform could pave the way towards faster and more personalized care, for example ensuring that patients receive the correct doses of antibiotics to treat infections, and spend less time in intensive care as a result.

The seed funding, which includes support from Japan's Hamamatsu Photonics, is expected to secure two years of research and development work into therapeutic drug monitoring (TDM) applications.

imec's own venture unit co-led the funding with healthcare-focused Kurma Partners, alongside support from Qbic, Noshag, White Fund, Wallonie Entreprendre, and Spain-headquartered testing giant Werfen Diagnostics.

Raman 'game-changer'

Axithra's approach is said to combine imec's world-leading semiconductor process knowledge with some unique on-chip Raman expertise provided by photonics research from its partners in Ghent.

Its CEO, Leander Van Neste - previously a visiting professor at Ghent, with a background in cancer genetics - said: "I am convinced that together we can build out our TDM platform to be a true game-changer.

"Due to the simplicity and speed of our platform, we can customize medication for each individual patient, even with rapidly changing conditions, and in all sorts of environments, including outside the traditional hospital lab."

Roel Baets, a professor in silicon photonics at Ghent, added: "Our Raman-on-chip technology is the basis of Axithra's solution. Integration on a photonics chip makes this technique much more sensitive."

Axithra explains that, for many drugs, the



Credit: Maiftech.

Thanks to the seed funding from Hamamatsu and others, the Axithra team led by CEO Leander Van Neste will be able to carry out two years of R&D work on its chip-based Raman technology for therapeutic drug monitoring.

correct dosage is crucial to ensure the maximum benefit to patients.

"It is a constant focus in hospital units with seriously ill or debilitated patients, who often exhibit physiological changes over time, such as those in the intensive care or oncology unit," says the startup.

"When administering insufficient doses, a drug loses effectiveness, while excessive doses may cause toxic, potentially fatal, side effects."

Axithra's Raman platform will aim to provide fast, accurate measurement of drug concentrations in blood, enabling timely adjustments of dosages as required.

Antibiotics optimized

The first application for the company will be to measure the concentration of beta-lactam antibiotics in a patient's blood, so that doses can be personalized.

"This class of antibiotics is by far the most commonly used to treat or prevent bacterial infections and is administered to millions of intensive care patients each year," it explained.

"Axithra's platform will ensure that treatments

can be optimally tailored to the individual patient. Over time, other drug classes will be incorporated in the pipeline."

Jan De Waele, a professor at Ghent University Hospital - and also President-elect of the European Society of Intensive Care Medicine - said in imec's announcement of the funding round:

"Given the large variation between patients in intensive care, this development will enable

us to better treat our patients with severe infections, and protect them from possible harm.

"Because current solutions have long turnaround times, Axithra's platform will help us to intervene more quickly, improving outcomes of severe infections and reducing the length of stay of patients in the intensive care unit, [thereby] decreasing costs."

imec says that Axithra is a "perfect example" of how processes developed for the semiconductor industry are now being exploited for applications in life sciences.

Frank Bulens, a partner at the institute's "imec.xpand" venture unit, observed: "Great to see such a broad investor support for this new spin-off from imec and UGent.

"This substantial seed round will allow the startup to achieve its prototype proof-of-concept milestone, a good basis for raising further financing to advance its product to the market."

www.hamamatsu.com

www.axithra.com

Author:

Mike Hatcher, Business Editor, optics.org



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Lockheed Martin aiming to scale laser weapon to 500kW

Under second phase of HELSI program; powering up from previous 300kW capability.

Military and aerospace systems developer Lockheed Martin says it will “scale its laser technology to a new benchmark” with the planned launch of a 500 kW-class laser, the most powerful laser Lockheed Martin has produced.

This eclipses its previous 300 kW-class laser power level developed under a contract from the U.S. Department of Defense’s Office of the Under Secretary of Defense for Research & Engineering, OUSD (R&E), which was launched in September, 2022.

The new 500 kW-class laser, developed under a new contract just awarded by OUSD (R&E), is the second phase of the High Energy Laser Scaling Initiative (HELSI). This phase of HELSI aims to increase the laser’s power level while achieving excellent beam quality and optimizing efficiency, size, weight, and volume for the continuous-wave high energy laser sources.

Proving this capability will reduce risk for the Department of Defense acquisition and fielding of high-powered laser weapon systems for all six military branches.

Rick Cordaro, VP Mission Systems & Weapons, commented, “OUSD has invested to mature high energy lasers in support of America’s warfighters. At the same

time, Lockheed Martin has invested in our production infrastructure in anticipation of the Department of Defense’s demand for laser weapons that have additional layers of protection with deep magazines, low cost per engagement, high speed of light delivery and high precision response reducing logistics requirements.



Lockheed Martin’s 500 kW-class laser (rendering) for the OUSD’s High Energy Laser Scaling Initiative (HELSI). The laser will be tactically configured and ready to support military platforms.



U.S. Army’s Indirect Fires Protection Capability-High Energy Laser (IFPC-HEL) demonstrator laser weapon system.

“The new 500-kW laser will incorporate our successes from the 300-kW system and lessons learned from legacy programs to further prove the capability to defend against a range of threats,” said Cordaro.

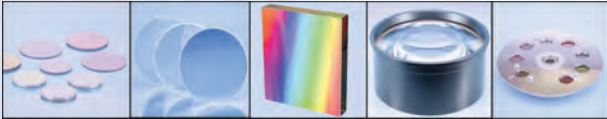
Development experience

An established weapon system integrator, Lockheed Martin has invested in demonstrating the maturity of its directed energy technology and increasing its production capacity to build laser weapon systems at scale. The company stated that the HELSI progress reflects the firm’s commitment to developing advanced technologies “offering speed and agility to Joint All-Domain Operations”.

The 500 kW-class laser will be tactically configured, utilize Lockheed Martin’s proven spectral beam combined architecture to support military platforms, and incorporate Department of Defense Modular Open System Approach standards to ensure the systems interoperability and multi-mission integration.

Lockheed Martin’s 500 kW-class laser conceptual rendering for the OUSD’s High Energy Laser Scaling Initiative (HELSI). The laser will be tactically configured and ready to support military platforms. Image courtesy Lockheed Martin. U.S. Army’s Indirect Fires Protection Capability-High Energy Laser (IFPC-HEL) demonstrator laser weapon system. Image courtesy Lockheed Martin.

Author:
Matthew Peach, Editor in Chief, optics.org



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