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PHOTONEX+ VACUUM TECHNOLOGIES review

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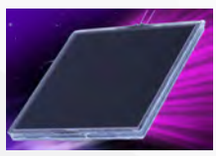

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SPIE. PHOTONEX+ VACUUM TECHNOLOGIES

Welcome to Photonex+Vacuum Technologies 2021

Kent Rochford,
CEO and Executive Director of SPIE

We are pleased to welcome you to Photonex + Vacuum Technologies 2021 in Glasgow! This is the first SPIE conference to be held in-person outside the US since this event was last held in October of 2019, and I speak on behalf of the entire SPIE staff and Board when I say it is great to be back!

Of course, there are still precautions to take, and masks are required indoors during the week. Yet, we can still engage in valuable face-to-face dialogue and meet new people to expand our networks, present research and product advancements, and maybe best of all – reconnect with old friends and colleagues.

During the past year and a half, it has become clear that despite the growing number of virtual tools available, innovation and community need face-to-face connections to thrive. SPIE has long been a leader in bringing smart people together to form connections and move optics and photonics technologies forward. We have learned just how vital that work is during the pandemic.

Our intention - and in fact, our promise - is to continue bringing like-minded people and companies together to advance our industry and improve people's lives with light and light-based technologies. We also will work to enhance these opportunities and ensure your health and safety comes first at all of our events.

Photonex has a long history of bringing the UK's photonics and vacuum communities together for a few days of bustling exhibition business and informative technical presentations. This year we will restart the tradition, and that is a welcome sign that tradeshows are back. We have an exciting program for you this week, including informative plenary presentations, interactive workshops, involvement from all four of the UK quantum hubs, a new co-located conference on European Space Systems, and much more.

I look forward to seeing you all on the floor this week and at future SPIE conferences and exhibitions!

Laurence Devereux,
SPIE Europe Photonex+Vacuum Expo Programme Development

The chances are you haven't attended an in-person get-together for the photonics and vacuum technologies since 2019! Now we are back with an extensive event, something of interest for everyone!

In-person events make productive conversations possible, enable the exchange of ideas, the opportunity to explore collaborations and partnerships. In-person events allow for quality time listening to talks, are conducive to visiting exhibitors, getting down to serious networking and progressing your work! For this reason, I encourage you to join us in Glasgow!

Glasgow was picked for this year's event due to its position in the heart of Scotland's photonics business, its easy connections with the rest of the country and importantly because it is a great place to visit!

Scotland has a significant proportion of the UK's research income in quantum technology and in photonics more widely, with commercial activity of £1.2B directly involving 5,700 people. University of Glasgow has one of the largest quantum centres in the UK. It plays a fundamental role in the UK National Quantum Technology Programme; leading QuantIC, the UK Quantum Technology Hub in Quantum Enhanced Imaging, you can meet the QuantIC team at the exhibition.

And I say it is an extraordinary event as there is so much going on under the event's new owners, SPIE. Conferences, workshops, talks and panel discussions from industry leaders. Importantly there is an extensive exhibition including an elaborate range of components, instruments and systems. Exhibitors complete the offering by giving product presentations.

SPIE brings to the event an impressive selection of conferences summarised in the following pages, focussed on high growth and enabling technologies. It's all about photonics driving the development of quantum technologies, biomedical techniques and applications for translation into clinical use, photoemission spectroscopy for materials characterization enabled by vacuum technologies, and recent progress in silicon photonics, in design, fabrication and characterisation of photonic-electronic integrated circuits (PICs).

Enjoy the event, enjoy Glasgow! Glasgow is an exciting city, a lively, bustling place, distinctive and full of character. I hope you manage to spend some time exploring the streets, parks and vibrant gastronomic scene.

Rapidly developing photonics and in-vacuum techniques landscape showcased

Amongst our extensive photonics and vacuum programmes, you are bound to find some gems that are a must hear. Your paid conference registration provides access to all technical presentations, while industry-related and workshop programmes are open to all. Here is a quick conference overview and a look at some exclusive activities and special events needing a mention.

Quantum Technologies

The conferences start with a 3-day Quantum Technology conference. Headed up by Conference Chairs Miles J. Padgett, Univ. of Glasgow; Kai Bongs, Univ. of Birmingham; Alessandro Fedrizzi, Heriot-Watt Univ.; and Alberto Politi, Univ. of Southampton, this is a forum to discuss the current state of emerging quantum technologies and the progress made towards commercialisation. Includes sessions on quantum technologies for communication, networking and advanced protocols, silicon photonics, sensors for fundamental physics and quantum technologies, and quantum technologies with photons.

Frontiers in Biophotonics and Imaging

Chairs Sumeet Mahajan, Univ. of Southampton, and Stefanie Reichelt, Human Cell Atlas, Wellcome Sanger Institute, lead a programme addressing challenges in imaging including improving resolution, speed, information, throughput and depth, which are required to improve fundamental biological understanding, diagnostic accuracy, early detection and prognostication. Sessions cover label-free microscopy; deep tissue, non-linear, and volumetric imaging; and optical manipulation and computation.

Emerging Applications in Silicon Photonics

In this conference, helmed by chairs Callum G. Littlejohns, Univ. of Southampton, and Marc Sorel, Univ. of Glasgow, design, fabrication and characterisation of photonic-electronic integrated circuits and the emerging applications and opportunities for adoption of silicon photonics technologies will be discussed in sessions on silicon photonics in quantum technologies, emerging applications, and the H2020 PICTURE project.

Photoemission Spectroscopy for Materials Analysis

Rosa Arrigo, Univ. of Salford; Robert Palgrave, Univ. College London; and Philip D. C. King, Univ. of St. Andrews are leading a conference covering photoemission spectroscopy for materials characterization, including sessions on photoemission studies of electronic structure, multitechnique surface analysis, x-ray photoelectron spectroscopy of functional materials, and 2D materials.

Simon Andrews, Executive Director, Fraunhofer UK Research Ltd, Glasgow

Professor Alistair Kean, Professor of medical nanotechnology, The Univ. of the Highlands and Islands, Inverness

Industry Programme

The Industry Stage will welcome presentations on technology updates, the business of photonics, space technology, quantum technologies, and more. Take your pick from an exceptional programme, the like of which has never been seen before in the UK.

Kicking off will be a presentation from Simon Andrews of Fraunhofer UK Research, 'The role of photonics in tackling climate change'. This talk explores the climate necessities, technical challenges and commercial opportunities open to the photonics community. From agri-tech to nuclear to offshore cable monitoring, there is important work for the laser well beyond the more obvious photonics energy solution of photovoltaics. There are two panel discussions on photonics innovation in the UK, comprising key members of the UK's innovation ecosystem and from industry who will tackle the question: 'The UK Photonics Innovation Chain: What can we do better?' Watch out for Thierry Robin's talk; he is coming across from TEMATYS in France to present 'European Photonics Industry: Overview and Analysis by Application Segment'.

Workshops

Chair of the new interactive workshop programme, 'Functional Materials Advances and Applications', Alistair Keen, Univ. of the Highlands and Islands, Inverness, has brought together a group of high-level presenters. He comments, "The field of functional materials continues to expand in both scope and importance, ongoing advances in materials research are providing access to new applications while also enhancing capabilities for existing uses".

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The high precision lines generated, with a uniformity of up to 95% on 100% of the line, have found uses in applications as diverse as rail track measurement to robotic welding alignment. With available wavelengths ranging from 450 to 830 nm and output powers from 1 to 200 mW, optional RS-232 communication via GUI interface is also offered.

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World Star Tech - Laser Diode Analyser

The Laser Diode Analyser is designed for laser parametric analysis. Generates high resolution LIV (light, current, voltage) curves in seconds, revealing diode parameters such as threshold current and slope efficiency. View the results on the modern touchscreen interface or connect the system to your computer to download and process the data. The high performance smart driver automatically detects your laser diode pinout and can drive the laser diode in auto-current or auto-power control modes.

The integrated TEC controller maintains your diode at its operating temperature ensuring accurate and repeatable measurements.

Multiple levels of laser diode protection include adjustable current limiters, automatic pinout detection, and frequent sensor range checks. Passcode-protection prevents the system from being used by unauthorised personnel. Multiple operator roles allow a manager to lock in system parameters, eliminating the risk of accidentally changing settings which could damage a diode or invalidate results. Hardware interlocks can be connected to disable the laser if desired. Included with the system is a calibrated optical power meter and a thermally controlled laser head for 5.6 mm package laser diodes.

A sliding quick-change mechanism makes it easy to exchange laser diodes between tests. 3.8 mm and 9 mm package laser diode laser heads are available upon request. Custom connectors to test butterfly laser diode packages and user designed laser heads can also be used.

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ELDIM – Micro Display Measurement

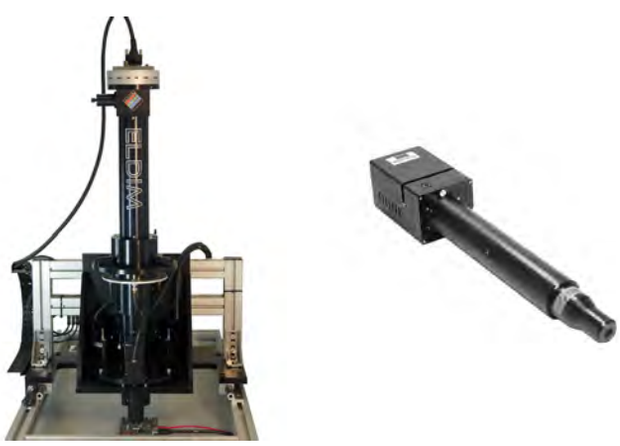
Micro Displays are increasingly used in a range of applications, from Wearable Displays to AR/VR in both consumer and military applications. Assessing the quality of these displays has proven to be a challenge in securing major markets.

Micro Displays are used in digital cameras, head mounted displays and other ultra-small and high definition display platforms. These components also have applications in military and medical technology. In these areas, they are used to support monochrome night-vision, AR displays and patientmonitoring equipment.

In order to fully characterise Micro Displays, it is important to have viewing angle, uniformity, and response time measurements. To date, no single piece of equipment has been able to provide precise and reliable measurements, however, ELDIM has designed a wide range of products to fulfil these needs.

One of these products is the XSCope series. Measurements taken with this equipment allow detailed pixel sub-structure studies.

https://alrad.com/collections/eldim



Quantum Technology

Denmark's DTU demonstrates tiny 'Fano' laser

Novel microscopic source "offers advantages over other lasers", with applications in integrated photonics and optical sensors.

Scientists from Danish research institute DTU, based in Lyngby, Copenhagen, have shown that a Fano laser, a new type of microscopic laser, has "fundamental advantages compared to other types of lasers."

The discovery can be important for many future applications, such as integrated photonics, interfacing of electronics and photonics, and optical sensors.

An increasing fraction of the global energy consumption is used for information technology, and photonics operating at very high data rates with ultra-low energy per bit has been identified as a key technology to enable sustainable growth of capacity demands.

However, existing laser designs cannot just be scaled down to reach the goals for next-generation integrated devices, and fundamental discoveries in the field of nanophotonics are therefore needed.

Joint effort

Supported by a Villum Center of Excellence, NATEC, a newly established DNRF Center of Excellence, NanoPhoton, and an ERC Advanced Grant, scientists from DTU are exploring the physics and applications of a new class of photonic devices using a phenomenon known as Fano interference. This physical effect offers an opportunity for realizing ultrafast and low-noise nanolasers (called Fano lasers), optical transistors, and quantum devices working at the level of a single photon.

Now, the DTU scientists have shown that the coherence of a Fano laser can be significantly improved compared to existing microscopic lasers. The result has been published in Nature Photonics.

"The coherence of a laser is a measure of the purity of the colour of the light generated by the laser. A higher coherence is essential to numerous applications, such as on-chip communications, programmable photonic integrated circuits, sensing, quantum technology, and neuromorphic computing.

"For example, coherent optical communication systems transmit and detect information using the phase of light pulses, leading to a tremendous information capacity," says Jesper Mørk, Professor at DTU Fotonik and Center Leader of NATEC and NanoPhoton.

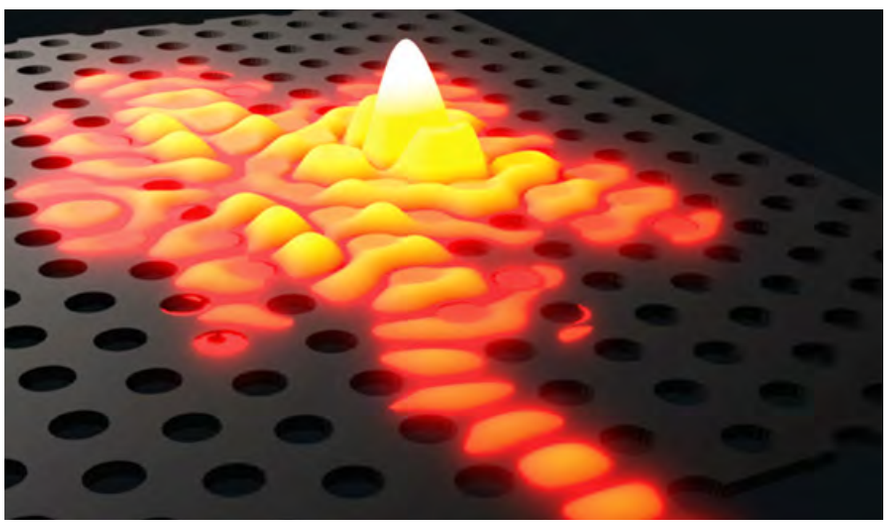
Mørk added, "The Fano laser, with a size of a few microns across, operates in an unusual optical state, a so-called bound-state-in the-continuum, induced by the Fano resonance. The existence of such a state was first identified by some of the early pioneers of quantum mechanics, but evaded experimental observation for many years. In the paper, we show that the characteristics of such a bound-state-in-the-continuum can be harnessed to improve the coherence of the laser."

"The observation is somewhat surprising," said lead author and senior researcher at DTU Fotonik, Yi Yu, "since a bound-state-in-the-continuum is much less robust than the states commonly used in lasers. We show in our paper, experimentally as well as theoretically, that the peculiarities of this new state can be used to advantage."

Buried heterostructure technology

Yi Yu continued, "To achieve the goal we have developed, in collaboration with Professor Kresten Yvind's group at DTU Fotonik, an advanced nanotechnology platform, called Buried Heterostructure Technology. This technology allows realizing small, nanometer-sized regions of active material, where the light generation takes place, while the remaining laser structure is passive.

"It is the physics of Fano resonance combined with this technology that eventually enables the suppression of quantum noise, leading to the highest measured coherence for microscopic lasers."



Source: DTU.

The Fano laser, measuring just a few microns across, operates in an unusual optical state, a so-called bound-state-in the-continuum, induced by the Fano resonance. The existence of such a state was first identified by some of the early pioneers of quantum mechanics, but evaded experimental observation for many years. In the DTU paper, the scientists show that the characteristics of such a bound-state-in-the-continuum can be harnessed to improve the coherence of the laser.

This new finding may lead to the use of Fano lasers in integrated electronic-photonic circuits, in particular in new generations of high-speed computers. In today's computers, electrical signals are used for logic operations as well as for transmitting data between different parts of the computer. However, due to ohmic losses, a lot of energy is wasted in the transmission.

The primary role of the Fano laser will be to convert the electrical data to light signals, which then are transmitted within the computer almost without loss – just as it is done in optical fibres on the internet today. The long-term perspective is to get much faster computer chips with minimal energy consumption.

The researchers from DTU Fotonik were historically the first in the world to suggest and experimentally demonstrate a Fano laser. Those results were published in Nature Photonics in 2017.

IGNITING QUESTIONS

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Quantum Technology

Xanadu and imec partner to develop photonic chips for quantum computing

To fabricate ultra-low loss silicon nitride circuits for generating "error-corrected qubits".

Xanadu, a full-stack photonic quantum computing company and nanoelectronics research center imec have announced a partnership to develop photonic qubits based on ultra-low loss silicon nitride (SiN) waveguides.

Xanadu is developing a novel type of quantum computer, one based on photonics. The photonic qubits are based on squeezed states – a special type of light generated by chip-integrated silicon photonic devices.

This approach uses photons to carry information through photonic chips. Xanadu's photonic approach offers the benefits of scalability to one million qubits via optical networking, room temperature computation, and the ability to leverage fabrication R&D centers – such as imec.

"One of the most critical challenges in building a photonic quantum computer is finding the right fabrication partner that can simultaneously deliver cutting-edge process development and volume production of high performing photonic chips," said Zachary Vernon, who heads Xanadu's Hardware team.

"Imec is one of the few semiconductor R&D centers that does advanced technology R&D as well as volume manufacturing on 200mm and 300mm lines, as well as volume manufacturing on their 200mm line. It can deliver up to a thousand wafers per year per customer on a few platforms including ultralow-loss photonic platforms. The seamless transfer offered by imec of new processes to production is especially critical for rapid scaling of our technology."

Squeezed states

Competing platforms for photonic quantum computing traditionally rely on single photon sources made from silicon waveguides, which suffer from non-deterministic operation. Using silicon nitride enables the generation of squeezed states, which replace single photons as the basic resource for synthesizing qubits.

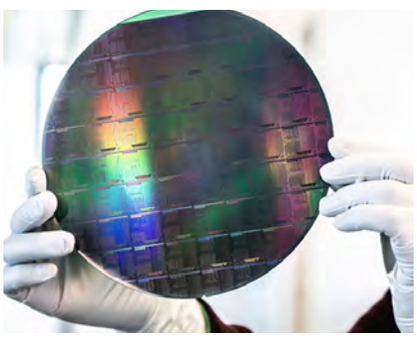

Image: imdc.

It's a sin: Silicon nitride wafer with photonics integrated circuits manufactured on imec's advanced 200mm line.

Squeezed states are deterministically generated, and can be used to distill error-resistant qubits called "GKP states". When multiplexed and implemented in Xanadu's architecture, these offer a more promising path to fault-tolerant quantum computing.

Amin Abbasi, business development manager at imec, commented, "We are pleased to see that imec's wafer-scale low loss SiN photonics platform, initially developed for communication, is finding its way towards other advanced applications, like quantum computing."

Philippe Helin, specialty components program manager at imec, added, "Xanadu's mission to build photonic quantum computers matches perfectly with our track record of and commitment to pushing the leading edge of integrated technologies."

Christian Weedbrook, Xanadu Founder and CEO, said, "Our ultimate mission is to build quantum computers that are useful and available to people everywhere. To do this we have the ambitious goal of reaching one million qubits using photonics. Working with imec will help us build the right foundation based on fault tolerance and error-correctable qubits."

Xanadu offers cloud access to both photonic quantum hardware and software solutions over its Xanadu Cloud platform. It recently announced a $100 million funding round led by Bessemer Venture Partners giving a total of $145 million raised thus far.

Quantum Technology

Hamamatsu develops 'smallest' wavelength-swept QCL

Mountable in small spaces, this laser is designed for portable volcanic gas monitoring systems.

By leveraging its expertise in micro electromechanical system (MEMS) and optical mounting technology, Hamamatsu Photonics has developed a tiny wavelength-swept quantum cascade laser (QCL) in a footprint that is just 1/150th that of its previous QCL products, the company says.

This achievement stems from the "Development of sensing technology for detecting extremely weak signals to realize an IoT society" project, supported by the New Energy and Industrial Technology Development Organization (NEDO), Japan's largest national research and development agency.

Combining the new QCL with a drive system developed by Japan's National Institute of Advanced Industrial Science and Technology (AIST) is intended to help achieve high-speed operation and simplify the peripheral circuit design, to allow the QCL to be mounted into equipment as a light source in portable analyzers. This will make the analyzers small and lightweight enough to carry anywhere, says Hamamatsu.

The development project also aims to increase analyzer sensitivity for detecting sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) as well as simplifying maintenance. Doing so, will allow its use in applications for stable long-term monitoring of volcanic gas near the craters of volcanoes. Other promising applications include detecting toxic gas leaks in chemical plants and sewers as well as making atmospheric measurements.

Volcano monitoring

Techniques for predicting volcanic eruptions usually rely on monitoring the concentration of SO_2 and H_2S in volcanic gases that tends to rise a few months before an eruption. Most research institutes therefore currently utilize gas analyzers with an electrochemical sensor that detects target gases by way of electrodes. Researchers install these gas analyzers near volcano craters to analyze those volcanic gas components in real-time.

However, since the electrodes of the electrochemical sensors are in close contact with volcanic gases, their performance deteriorates causing a short service life. These sensors therefore require constant maintenance including part replacement, which makes it difficult to perform stable long-term monitoring.

All-optical gas analyzers using a long-life light source and light detector require less maintenance and can analyze gas components with high sensitivity and high stability over a long period of time. Conventional all-optical gas analyzers are usually large because the light source takes up a lot of space, making it difficult to install those analyzers near volcano craters.

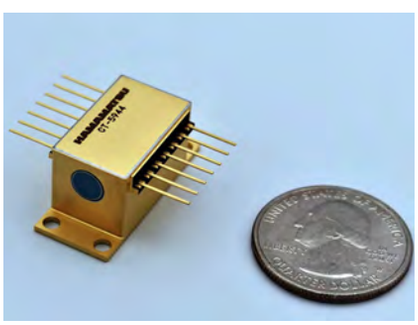

Image: Hamamatsu Photonics.

Small footprint: wavelength-swept QCL only 1/150th the size of Hamamatsu's previous QCLs.

To solve this problem, from 2020 as a part of the "Development of sensing technology for detecting extremely weak signals to realize an IoT society" project supported by NEDO, Hamamatsu and AIST have been developing a next-generation volcanic gas monitoring system.

Hamamatsu had the role of designing a miniaturized light source for gas analyzers. The new smallest wavelength-swept QCL can emit mid-infrared light, while changing its wavelength at high speed in a range from 7 µm to 8µm. Combining this new QCL with a drive system developed by AIST will help achieve high-speed operation and simplify the peripheral circuit design, allowing it to be mounted into portable analyzers as the light source.

Silicon Photonics

CompoundTek and NTU working on compact tunable laser

Precision alignment with large-scale wafers to be offered as a prototyping service later this year.

A European collaboration between silicon photonics researchers and a semiconductor equipment firm says it has successfully integrated indium phosphide (InP) lasers with silicon photonics on an industrial-scale wafer platform.

The work, led by Belgian electronics institute imec alongside Sivers Photonics (formerly CST Global) and equipment firm ASM AMICRA Microtechnologies, uses a flip-chip bonding tool for high-precision alignment.

imec reports that the team was able to bond InP distributed feedback (DFB) laser diodes onto a 300 mm diameter silicon photonics wafer with an alignment precision within 500 nanometers.

That enabled reproducible coupling of more than 10 mW of laser power into the silicon nitride waveguides on the silicon photonics wafer - something that is typically hampered by high coupling losses.

Prototyping service

imec says that it plans to offer the new technology platform as a prototyping service later this year, with the aim of accelerating the adoption of silicon photonics in cost-sensitive applications like optical interconnects, lidar, and biomedical sensing.

Following initial work with CST Global completed in March 2020, imec had originally planned to begin offering the service in the first half of this year.

After it does become available, the hybrid integration portfolio will be extended with reflective semiconductor optical amplifiers (RSOA), exploiting the etched-facet capability of Sivers' "InP100" technology, and ASM AMICRA's "NANO" flip-chip bonder tool.

"This capability will enable advanced, external cavity laser source types, as required for emerging optical interconnect and sensing applications, and will become available in early 2022," imec said.

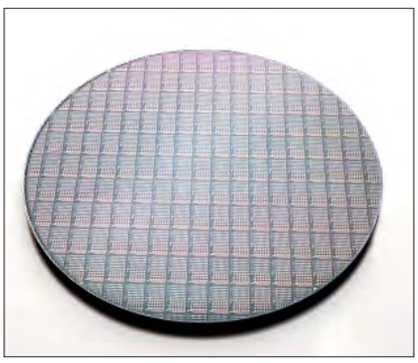

Image: imec.

imec's collaboration with Sivers Photonics and AMS AMICRA Microtechnologies will see the precision-bonded silicon photonics technology offered as a prototyping service later this year.

Prototype PICs

Joris van Campenhout, the director of imec's Optical I/O Program, said: "This additional functionality will enable our joint customers to develop and prototype advanced photonic integrated circuits (PICs) with capabilities well beyond what we can offer today, in key areas such as datacom, telecom, and sensing."

Sivers Photonics managing director Billy McLaughlin added: "The availability of InP laser sources, designed and fabricated on our InP100 manufacturing platform, will boost the adoption of silicon photonic circuits for a wide variety of commercial applications."

Johann Weinhändler, the managing director at ASM AMICRA, observed: "Our strength in high-precision placement seamlessly complements the expertise of all partners.

"With automated and ultra-precise flip-chip bonding, the way to high-volume manufacturing of these hybrid assemblies is open."

Silicon Photonics

Aurora outlines commercial roll-out for silicon photonics lidar

Updated 'Fusion' hardware for autonomous vehicles harnesses Doppler Effect to determine position and velocity of hazards.

Aurora Innovation, the autonomous driving systems company that is looking to raise $2 billion in a special purpose acquisitions company (SPAC) -powered Nasdaq listing, has outlined plans for its future commercial roll-out.

Based around 360-degree cameras, radar, and frequency-modulated continuous-wave (FMCW) lidar, the "Fusion" version of the Aurora Driver is scheduled to appear in pilot projects later this year, with incorporation

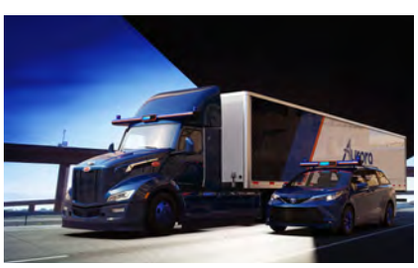

Image: Aurora Innovation.

Slated for full commercial deployment in self-driving trucks and robotaxis from 2023 onwards, Aurora Innovation's 'Fusion' sensor suite will feature silicon photonics FMCW lidar, as well as surround-view cameras and radar.

into self-driving trucks and robotaxis slated for 2023 onwards.

"With more powerful sensors condensed into a sleek, modular, automotive-grade rack and a new powerhouse computer, Aurora's hardware is feature-complete and primed to deliver a safer, more reliable Aurora Driver at a commercial scale," boasted the Silicon Valley firm, whose backers include Amazon, Uber, and Volvo, among others.

FMCW lidar

Optical technology is at the heart of the system, most notably in the form of Aurora's "FirstLight Lidar". The FMCW technology, initially developed by Blackmore Sensors and Analytics before it was acquired by Aurora in 2019, uses the Doppler Effect to determine the location, speed, and direction of other vehicles on the road.

That capability requires a much more complex optical arrangement than the conventional pulsed lidar systems that have been deployed in the vast majority of automotive lidar applications thus far. A handful of other companies, including a group at Intel, are also working on the FMCW approach.

"By leveraging FirstLight's data, the Aurora Driver can track the velocity and compute the acceleration of vehicles over 400 meters away faster than ever before, creating more time for braking and responding safely," states Aurora.

The FMCW lidar also utilizes what the company calls "OURS" silicon photonics, which it is said will enable mass-production of the lidar sensors at low cost when the Aurora Driver product is deployed in commercial volumes.

OURS is an abbreviation of Optical Universal RISC Systems (OURS) Technology, an early-stage silicon photonics startup spun out of the University of California, Berkeley, that Aurora acquired earlier this year.

Custom camera lenses

Other key elements of the Fusion hardware are cameras with a 360-degree field of view, which Aurora says combine the most advanced automotive-grade sensor technology with custom-designed lenses.

"The cameras allow the Aurora Driver to detect objects even in challenging lighting situations like facing headlight glare and sun glare, and entering and exiting tunnels," it claims.

Rounding off the sensor suite is an imaging radar system said to be more precise than traditional approaches, providing Aurora Driver with high resolution and broad coverage that complements the optical data received from its cameras and lidar.

"The improved imaging radar sensors on Aurora's hardware produce true and precise 3D images despite challenging weather conditions like rain, dense fog, and snow," states the firm.

Aurora adds that the Fusion hardware is intended to operate all of Aurora's vehicle platforms, ranging from trucks and light-duty vans, to passenger cars.

Its senior VP of hardware, Sandor Barna, said in a company announcement: "Aurora's hardware fuses the best of many generations of hardware development from Aurora and Uber ATG into a single, optimized, deeply integrated system, setting us up for the successful deployment of the Aurora Driver."

The system will be able to handle typical challenges including sun glare, bright emergency vehicle lights, dust, pedestrian detection at night, small object detection, and fast-moving objects such as speeding motorcyclists, added Aurora.

Before the autonomous trucking and ride-hailing businesses are launched, the system will first appear on board Aurora's "Class 8" [i.e. large-scale] trucks in pilot trials, as well as a test fleet of Toyota Sienna minivans that are expected on public roads by the end of this year.

Hyundai robotaxis; Waymo lidar re-think

Meanwhile, major Korean car maker Hyundai has revealed that its all-electric "IONIQ-5"

Image: Hyundai Motor Company.

Motional will deploy all-electric Hyundai IONIQ-5 as its first robotaxis in 2023. The vehicles utilize a suite of lidar, camera, and radar sensors - with lidar units from Velodyne.

cars will be used as fully driverless robotaxis, starting in a couple of years.

For partner Motional, which uses surround-view lidar sensors from Velodyne - alongside cameras and radar - in its self-driving setup, the Hyundai car will represent its first commercial vehicle.

The Boston-headquartered company plans to begin transporting public passengers from 2023, in collaboration with taxi firm Lyft.

- According to a Reuters report, autonomous vehicle pioneer Waymo will no longer sell its lidar sensors to third parties working on non-automotive applications - although it will still build lidar units for internal use.

  In 2019, the Alphabet-affiliated business said it planned to sell one of its three different in-house lidars to customers in applications such as robotics and farming, to help deliver the economies of scale needed to reduce the cost of the technology for self-driving vehicles.

  The Reuters report also states that Tim Willis, previously general manager of Waymo's short-range "Laser Bear" lidar offering, left the company earlier this year to join rival developer Aeva.

SPIE. PHOTONEX+ VACUUM TECHNOLOGIES

Exhibition
29–30 September 2021

Programme
28–30 September 2021

SEC, Glasgow, Scotland UK

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Professor Caroline Gray
Director—OpTIC Technology Center, Professor of Enterprise, Engagement and Knowledge Transfer, Wrexham Glyndwr University (United Kingdom)

Professor Gail McConnell
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Emerging Applications in Silicon Photonics II

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CONFERENCE 11883

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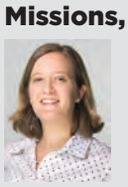
Conference Chairs: **Rosa Arrigo,** Univ. of Salford (United Kingdom); **Robert Palgrave,** Univ. College London (United Kingdom); **Philip D. C. King,** Univ. of St. Andrews (United Kingdom)

PLENARY SESSIONS

Understanding the Role of Photonics in a Changing World

Carol Monaghan
Member of the Science and Technology Select Committee, Parliamentary Office of Science and Technology (board member), Industry and Parliament Trust (board member), Chair of the All-Party Parliamentary Group on Photonics and Quantum, Vice Chair All Party Parliamentary Group on Space (United Kingdom)

Strengthening Our Superpowers: Technology, Missions, and the UK Innovation Strategy



Simone Boekelaar,
Innovate UK (United Kingdom)

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Functional Materials Advances and Applications

29 September 2021 • 9:00 AM–5:00 PM BST

Join this workshop and explore the ever-expanding field of functional materials, ranging from thin films to high-surface-area soft nanomaterials and technologies from graphene sensors to plasmonic hotspots are all part of this exciting field.

WORKSHOP

Annual EPSRC Centre for Doctoral Training in Intelligent Sensing and Measurement

30 September 2021 • 9:00 AM–5:00 PM BST

Join The University of Glasgow and The University of Edinburgh for this annual event to hear presentations by leading researchers across the sensing and measurement community.

Opening up Photonics initiative

29 September 2021 • 10:30–11:30 BST

In partnership between Photonics Scotland, Glasgow University, the Institute of Physics and KTN

OPENING UP PHOTONICS

Opening up Photonics is a platform supporting the Scottish photonics industry to discuss, challenge and address barriers faced by minority groups, with the aim of increasing accessibility, championing diversity, and ensuring a welcoming and supportive environment for all.

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Full programme details: **spie.org/pvt**

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Sponsored Editorial

IES bring their portfolio of photonics expertise to Photonex 2021

IES represent several equipment manufacturers, including EV Group (EVG) and scia Systems, providing a wide range of technologies for R&D and production.

EVG manufacture equipment for photo/UV nanoimprint lithography, resist processing, wafer/substrate bonding and alignment, mask-less exposure, hot embossing; as well as inspection and metrology equipment for many photonics applications. These include wafer level optics such as lens arrays, diffractive optical elements, lenticular lens sheets and functional optical films.

scia Systems specialise in ion beam and sputtering equipment for etching surface relief gratings, form error correction of X-ray mirrors, and dielectric/anti-reflective/diamond-like carbon coatings.

IES offer solutions in atomic layer deposition, chemical mechanical polishing, rapid thermal processing, metal deposition, magnetrons, e-beam resists, and process gas monitoring. They also offer field service equipment and process engineers for cleanrooms and fabs to optimise tool performance.

To find out more about the equipment and services IES provide, visit stand 517T, or www.ies.co.uk/equipment-partners.

Silicon Photonics

Rockley Photonics launches wearable digital health monitor

"Clinic-on-the-wrist" combining hardware, firmware, and cloud analytics, is based on spectrophotometer-on-a-chip.

Rockley Photonics, a silicon photonics technology company, has launched its complete full-stack, "clinic-on-the-wrist" digital health sensor system.

The sensor module and associated reference designs for consumer products integrate hardware and application firmware to enable wearable devices to monitor multiple biomarkers, including core body temperature, blood pressure, body hydration, alcohol level, lactate, and glucose trends, among other variables.

The wristband that contains the sensor module and communicates with custom cloud-based analytical engines via a dedicated Rockley smartphone app. The wristband will be used in a sequence of in-house human studies in the coming months, says the company.

Dr. Andrew Rickman, CEO and founder, commented, "Our full-stack sensor solution, which brings together optical and electronic hardware, firmware, algorithms, and cloud-based analytics, is an exciting milestone on our roadmap. Our reference designs will significantly aid our customers and partners with the deployment of our technology and accelerate their own scalable, high-volume product delivery.

"We believe that combining machine learning algorithms with continuous monitoring of an extended set of biomarkers from accessible wearable devices will provide new actionable insights to enhance and transform digital healthcare."

'Clinic on the wrist'

Through its "clinic-on-the-wrist" technology utilizing a miniaturized chip solution that provides continuous, non-invasive monitoring of core biomarkers, Rockley expects to be able to overcome the key challenges associated with mobile wellness monitoring.

While many of today's wearable consumer electronic devices use green LEDs to monitor heart rate, Rockley's infrared spectrophotometers can detect and monitor a much wider range of biomarkers, which could dramatically increase the functionality of wearable devices.

The central and differentiating element of the sensing system is a non-invasive sensor module based on the Rockley platform's spectroscopy technology. Unlike more common spectroscopy solutions, which use broad-spectrum light sources, Rockley's sensor module generates a large number of discrete laser outputs from a single silicon chip covering a broad optical band.

The sensor non-invasively probes beneath the skin to analyze blood, interstitial fluids, and various layers of the dermis for constituents and physical phenomena of interest. Such biomarkers have historically been measurable only by using bench-top equipment.

Moreover, Rockley's innovative architecture delivers several milliwatts of optical output power per wavelength channel, which is key to achieving the high signal-to-noise ratio required for signal analysis from a small wearable.

Rockley is initially targeting the consumer electronics market, in which significant advances in digital personal health and fitness monitoring have occurred in recent years. Rockley is also actively pursuing the application of its technologies with leading medical device companies as biomarker monitoring can advance digital health applications and improve disease prevention, detection, and management.

Photo: Rockley Photonics.

"Clinic-on-wrist" smartphone app and cloud analytics conveys health info.

Photo: Rockley Photonics.

Reverse side (skin side) of wristband. The standalone sensor module containing photonic ICs and application firmware (shown on the right).

Sponsored Editorial

Superpolished Optics for Increased System Efficiency

A laser system's efficiency faces various enemies in the form of optical losses. In particular, scatter can cause issues in high-power laser systems where loss can be significant, and UV laser systems since it tends to be greater at shorter wavelengths.

Scatter occurs due to bubbles and/or inclusions which equates to roughness in an optic's surface. It reduces the overall efficiency of laser systems, can lead to premature laser component failure and/or safety hazards (e.g. intracavity use and system alignment). It can also affect the survivability and longevity of the system's optical components, expressed in terms of laser-induced damage threshold (LIDT).

However, it is possible to combat scatter using optics with an ultra-low surface roughness. All supported by a comprehensive in-house metrology suite to verify specifications, Edmund Optics has developed a manufacturing process for superpolishing optical surfaces down to an RMS surface roughness of sub-Angstrom ≤1Å (10-10 m) for parts-per-million-level scattering. This process produces "ultra-smooth" optics with ultra-low scatter and in high-energy cases, indications of increased LIDT. Using superpolished optics thus decreases scatter whilst increasing the longevity of the laser system.

Superpolished optics are ideal for any application where a high laser power or short wavelength is required such as laser surface treatment, metrology applications, and UV medical applications.

Edmund Optics is a world-class manufacturer of high-precision optical components and an innovator in the optical manufacturing field. Each of Edmund Optics' global factories is specialised in a particular area of optical manufacturing for both off-the-shelf and custom parts.

Photonics and Imaging/Spectroscopy

Osaka University observes one million cells in single field-of-view

Technique could allow dynamic imaging of complex systems and multicellular events.

An optical imaging system designed to capture an unprecedented number of cells in a single image could help reveal the cellular dynamics underlying complex biological systems.

Developed at Osaka University's Transdimensional Life Imaging Division, the technique combines an ultra-high pixel camera and a large lens to capture what the team calls "one in a million" situations. The work was published in Scientific Reports.

Termed AMATERAS, from "a multi-scale/modal analytical tool for every rare activity in singularity," the technique is a tool for the simultaneous observation of centimeter-scale dynamics of multicellular populations, with micrometer resolution to see the functions of individual cells, according to the project.

"Conventional biological microscopes can observe at most 1,000 cells, with a field of view limited to a few millimeters," said Osaka's Taro Ichimura, who commented that the new setup uses machine vision, powered by a high-pixel camera with a macro lens.

The project's design philosophy involved tackling the factors that normally limit the number of observable cells in a microscopy field of view, including the diameter of the area in the image plane that can be observed through the eyepiece, and the pixel size of the CMOS sensors commonly used.

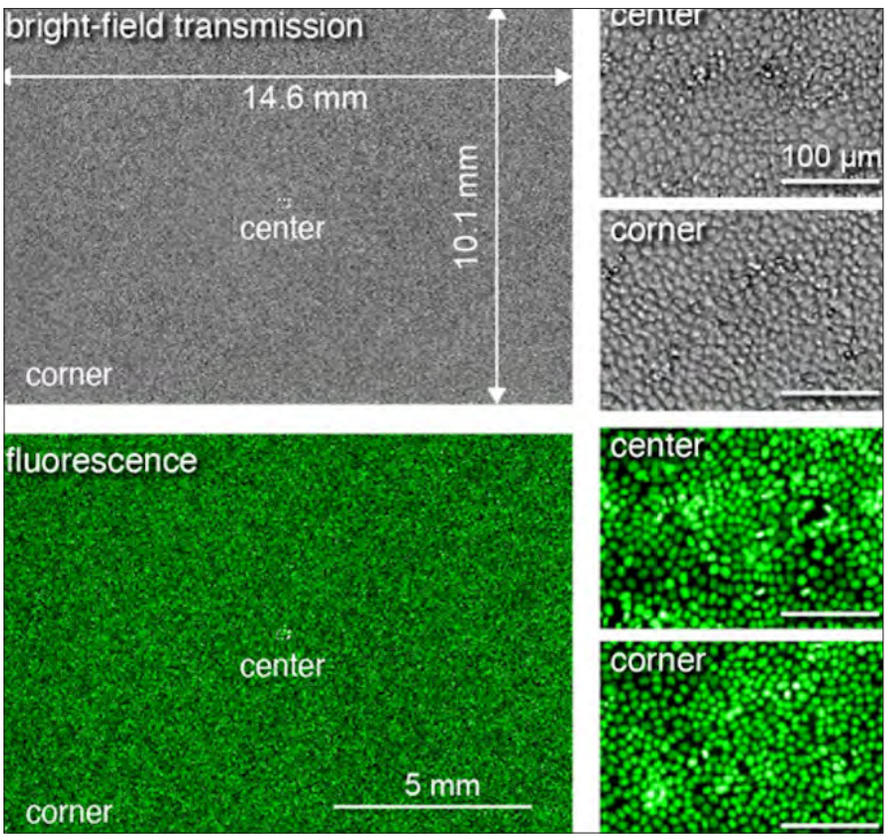
A platform in which the image sensor is larger than the observable diameter in the image plane is one route to making more cells observable, but an increase in pixel size would itself lead to a loss of resolution.

"We adopted a CMOS image sensor which has a 35 millimeter diagonal size and a pixel size of 2.2 microns, hence the number of effective pixels can reach 13,264 × 9180, which is one of the largest number of pixels among available CMOS image sensors," commented the team in its paper.

The sensor is employed alongside a telecentric low-power 2× lens designed for machine vision with a numerical aperture of 0.12, which theoretically provides an optical resolution of about 2 microns - sub-cellular spatial resolution without a high magnification lens.

This combination of a 120-megapixel camera and a telecentric macro lens provides a large field of view, up to about 1.5 x 1.0 centimeters, "wide enough to observe one million eukaryotic cells" according to the team, while still resolving individual cells and the interactions between them.

The project has termed the imaging technology "trans-scale scope," to indicate that the technology can be applied to imaging from the micrometer-scale to the centimeter-scale.



Credit: T. Ichimura/Scientific Reports.

Full FOV image and closeup images, obtained with the bright-field transmission (top three) and fluorescence (bottom three) modes.

Zoom in like a Google map

The AMATERAS platform was tested by dynamically imaging calcium ions in cultured HeLa cells, using high-brightness LEDs with four different emission colors for fluorescence excitation, and looking for a phenomena termed "spontaneous calcium ion pulsing" described in prior HeLa studies. The technique successfully detected that these anomalies were occurring in less than 0.01 percent of specimens.

Examination of mouse brain slices then demonstrated the "trans-scale" observation of a biological specimen, through multi-color imaging of centimeter-wide sections followed by enhanced magnification of areas of interest. "Any specific region can be zoomed in to see the local distribution of cells at a single-cell resolution as if it were a Google map," commented the project in its paper.

After these proof-of-principle tests, the imaging architecture could now accelerate research in a range of fields that deal with large cell populations, such as neuroscience, oncology, and immunology.

"Our trans-scale scope system AMATERAS is expected to contribute to a wide range of applications, from basic research for understanding the operating mechanism of multicellular systems, to medical applications such as the quality control of artificial cell sheets," commented Osaka University's Takeharu Nagai.

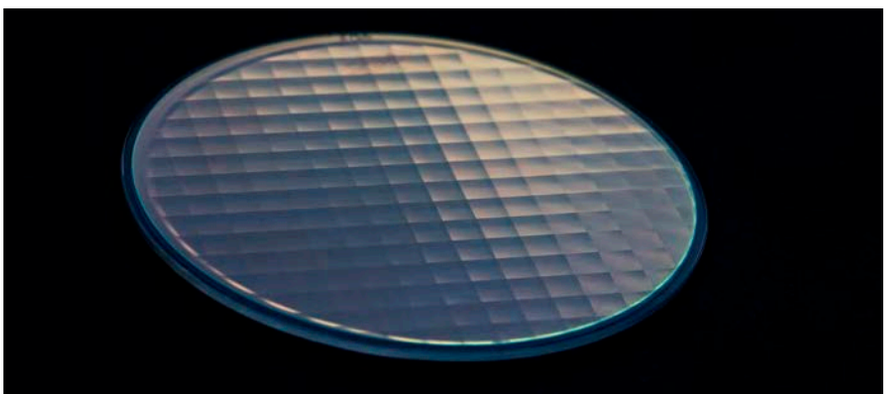
Sponsored Editorial

PowerPhotonic launch new range of beam shaping products at SPIE Photonex+Vacuum Technologies 2021

PowerPhotonic are launching a new range of beam shaping products at SPIE Photonex + Vacuum Technologies 2021. This new range of products comprises designs specifically for beam shaping in conjunction with single mode lasers for scanner based laser applications. They therefore address applications including laser additive manufacturing, remote welding and remote cutting.

In these applications, without any beam shaping, the laser spot produced on the workpiece is circular, with a Guasssain intensity profile. These spot characteristics are generally not optimum for the process; a square, flat top spot profile is generally a much more suitable characteristic.

Using traditional optics to convert a round gaussian spot into a square flat top is not straightforward and uses a number of optical components, and often significantly increases the size of the spot. However, with the unique



freeform optical design & manufacturing capabilities of PowerPhotonic, they have created a single optical element that performs this conversion efficiently (~90%) and with minimal increase in spot size (1.5x). Thus the shaped spot allows the laser process to be improved with a significant efficiency increase (and in the case of laser additive manufacturing, with greatly reduced spatter/ ejection from the melt pool)

PowerPhotonic have standard single mode laser beam shaper designs for 1070nm and 532nm single mode laser sources, and the capability to design for custom wavelengths anywhere from 300nm to 2000nm. Technical staff from PowerPhotonic will be at SPIE Photonex + Vacuum Technologies 2021 to answer customers questions.

www.powerphotonic.com

Photonics and Imaging/Spectroscopy

Blood spectroscopy test shows promise for Covid-19 triage

Rapid, low-cost blood analysis with standard FTIR equipment helps identify those patients more likely to develop severe disease.

Researchers in India and Australia say that a simple and rapid blood test using infrared spectroscopy is able to help clinicians identify hospital patients with Covid-19 who are most likely to suffer severe symptoms requiring intensive care.

In a small-scale study using a Fourier Transform infrared (FTIR) spectrometer from analytical equipment firm Agilent Technologies, the team was able to observe subtle spectral differences in samples from severe and non-severe patients.

The results from 130 samples were used to train an algorithm that was then tested "blind" on 30 patients.

Photo: Agilent Technologies.

Equipped with a diamond-attenuated total reflectance (ATR) sampling module, Agilent's "Cary 630" FTIR spectrometer features permanently aligned optics to allow a wide range of modules to be swapped in and out in seconds. Blood sample analysis now looks promising for rapid triage of Covid-19 patients.

When combined with other factors including age and existing co-morbidities like diabetes and high blood pressure, the approach identified most of the patients who went on to suffer from severe symptoms.

And although the FTIR triage did also generate a significant number of "false positive" results - patients who did not become as severely ill as the algorithm predicted - the researchers suggest the test's accuracy can be improved, and that it should help hospitals to prioritize patients, especially in developing countries.

Spectral changes

Michelle Hill, head of Queensland Institute of Medical Research (QIMR) Berghofer's Precision and Systems Biomedicine Research Group, and co-author of a paper in the journal Analytical Chemistry describing the study, explained in a release from Agilent:

"We found there were measurable differences in the infrared spectra in the patients who became severely unwell. In particular, there were differences in two infrared regions that correspond to sugar and phosphate chemical groups, as well as primary amines, which occur in specific types of proteins."

Although the precise biological reasons for those spectral changes are yet to be deduced, the relative simplicity of the approach - compared with more expensive cytokine panel tests - means that it could be particularly useful in low-resource settings.

"A simple, rapid test at the point of patient admission would transform hospital management during crises," stated the team.

Another co-author of the paper, Sanjeeva Srivastava from Mumbai's Indian Institute of Technology Bombay, added:

"We also found that having diabetes was a key predictor of becoming severely unwell in this group of patients, so we fed clinical parameters such as age, sex, diabetes mellitus, and hypertension into the algorithm."

When tested on blood samples from a separate group of 30 patients the algorithm was found to have a specificity of 69.2 per cent, and a sensitivity of 94.1 per cent when predicting which patients would become severely ill.

Srivastava points out that this means it yielded more false-positives than predictions that are based solely on the clinical risk factors of age, sex, hypertension, and diabetes.

"We hope that with more testing, we can reduce these false positives," Srivastava said.

Photonics and Imaging/Spectroscopy

Photoacoustic imaging spots inflamed plaques before heart attacks strike

Michigan State University targets types of cells most responsible for making plaques vulnerable.

Photoacoustic (PA) imaging and its ability to image blood flow and vasculature is an increasingly attractive technique to monitor and treat a number of diseases.

The method uses a non-ionizing laser pulse to briefly heat up an absorbing target for a short instant of time before allowing it to cool, causing an expansion that in turn creates an ultrasound signal.

Hemoglobin is a particularly active PA target, allowing the technique to accurately assess blood supply in tumor margins for cancer treatments, or prior to cardiac interventions, potentially imaging within the beating heart itself.

A project at Michigan State University (MSU) has now investigated ways to boost the technique's ability to image specific marker cells in those atherosclerotic plaques appearing to be most vulnerable to breakage, and so spot the plaques likely to cause strokes or heart attacks.

"The power of our new technique is in its selectivity," said Bryan Smith, director of the Translational NanoImmunoEngineering Lab at MSU's Institute for Quantitative Health Science and Engineering (IQ). "There are certainly other methods to image plaques, but what distinguishes this strategy is that it's cellular. We are specifically looking at the immune cells, macrophages and monocytes, that are most responsible for making a plaque vulnerable in the first place."

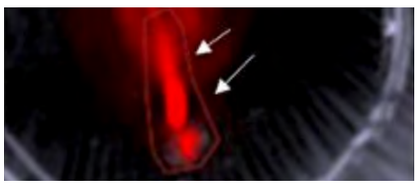
As published in Advanced Functional Materials, the new method involves the introduction of nanoparticles into the tissues of interest, which then interact strongly with the incoming laser pulse to produce a targeted PA response.

Using nanoparticles in PA-based techniques has been a focus of study throughout their transition towards clinical applications, with gold nanoparticles in particular attractive as a means to enhance the inherent contrast from tissues imaged using PA methods. Similar particles have also been used to create PA-powered microfluidic pumps for potential biomedical devices.

Diagnosis and therapy in one technique

Rather than gold, the MSU project employed carbon nanotubes, which when injected into mouse subjects naturally and specifically sought out the particular "foamy" macrophage and inflammatory monocyte cells thought to be indicative of plaque inflammation and associated with plaque vulnerability.

Subsequent PA analysis of the tissues "identified inflamed atherosclerotic plaques that display 6-fold greater signal compared to controls six hours after intravenous injection of ultra-selective carbon nanotubes, with in vivo corroboration via optical imaging," noted the project in its published paper.



Credit: Advanced Functional Materials/MSU.

Danger signs: arterial plaques.

Virtually no other cell type takes up the particular carbon nanoparticles employed, according to the MSU team, making the technique a potentially valuable route to identifying fragile plaques and those most likely to break up.

The MSU lab has also investigated whether the nanoparticles can be packed with a drug able to counteract further plaque growth, an approach which could allow a PA-based technique to both identify the problematic areas and monitor the action of a therapeutic.

There is currently no effective way to accurately locate and treat vulnerable plaques before they lead to a heart attack or stroke, commented Bryan Smith, so the current studies at MSU might change that.

"Can you connect those ideas, develop a combination of a therapy and a diagnostic? I think the answer is absolutely yes," said Smith. "There is a lot of potential in that realm. It's in the pipeline."

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SPIE. AR|VR|MR	23–25 January 2022
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SPIE. ASIA-PACIFIC REMOTE SENSING	17–19 April 2022
SPIE. ASTRONOMICAL TELESCOPES + INSTRUMENTATION	17–22 July 2022

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2021 new products and exhibitor news

In the following pages we present some recent launches and applications by companies appearing at this year's Photonex+Vacuum Technologies Exhibition.

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

Aerotech

Photonex+Vacuum Technologies 2021 provides the photonics industry in the UK with an excellent platform to present the latest research results and practical examples from industry. Aerotech is represented at this leading photonics event combined with Europe's leading conference exhibition for vacuum-enabled techniques and processes.

The manufacturer of high-performance motion control and positioning systems will place its optical alignment systems and scanning devices at the center of its presentation. In addition, the focus will be on innovative laser and motion control solutions for the optics and photonics industry. New high-precision manipulators will be shown for the first time with the latest Aerotech Automation controller.

"For us, Photonex & Vacuum Technologies in Glasgow is a unique platform for product presentation in the photonics environment as well as experience exchange and networking," commented Simon Smith, European Director Aerotech.

Aerotech's presentation focuses on high-precision, optical alignment systems and scanning devices, using the FiberMaxHP multi-axis photonic alignment system as an example. The motion system is based on the proven high-performance ANT nanopositioners.

FiberMaxHP is used in high-volume manufacturing for aligning and testing optoelectronic devices and photonics components with submicron tolerances. The precision mechanics are coupled with Aerotech's A3200 controller, a low-latency motion controller with prescribed optical alignment algorithms. This allows all automation processes to be programmed through a single control interface.

"While alignment tolerances are decreasing with new silicon photonics devices, alignment at high speed and accuracy is becoming more important," said Smith. "We are positioning ourselves with the FiberMaxHP photonics alignment platform in nanoscale applications, both in research and industrial environments."

Tadley, UK
www.aerotech.com

Alter Technology

Alter Technology is setting up a new Photonics Design Centre in Scotland, UK to accelerate commercialisation of photonic products into quantum technology and space markets.

The new Design Centre will focus on supporting the Group's development of highly integrated, miniaturised and robust photonic products to be used in the quantum enabled positioning, navigation and timing systems and photonics-based satellite optical communications. The design centre will complement the current facilities and operations of Alter Technology Group.

The Centre will be strategically set-up in the Central Belt of Scotland to tap into the strong quantum and space funding landscape within the UK and to be close to the vibrant Scottish Photonics, Quantum and Space eco-system and talent pool.

Alter Group will allocate around €6 million to in the Design Centre and its UK manufacturing site in the next 3-5 years to fund equipment, facilities, personnel and other R&D costs. The existing Livingston, UK based manufacturing site will also benefit from additional investment in associated state-of-the-art robotic based manufacturing equipment and processes for photonic products.

Stephen Duffy, CEO, said "Today's investment builds upon the significant progress already made within Alter UK on laser products

for Quantum applications and optical transceivers for intra-satellite communications and will provide the resources and expertise to fully exploit these emerging and growing markets."

Funding from the UK National Quantum Program and UKSA and the close co-operation with UK Universities and Research and Technology Organisations has been a key factor in the decision to locate this Centre in the UK. I look forward to the continued successful partnerships with our stakeholders as we advance our exciting product roadmap in the years ahead."

Livingston, UK
www.altertechnology-group.com

Oxford Instruments

Andor and Akoya Biosciences have announced they will collaborate in the "spatial omics" market. Under the partners' agreement the companies will support their mutual user base within Akoya's Imaging Innovators (I2) Network.

Andor Dragonfly high-speed confocal products combined with Akoya's Codex solution delivers "outstanding data quality for hi-plex 3D tissue imaging, deepening

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scientific insights and diagnostic potential," say the partners.

Andrew Dennis, Director of Product Management at Andor, added, "In this collaboration with Akoya our goal is to deliver high quality data and service for bio-discovery. Andor's high-speed confocal instruments are established performance leaders and, with Codex, will help to deepen our contribution to spatial proteomics. We are delighted to work with Akoya as a leader in the field."

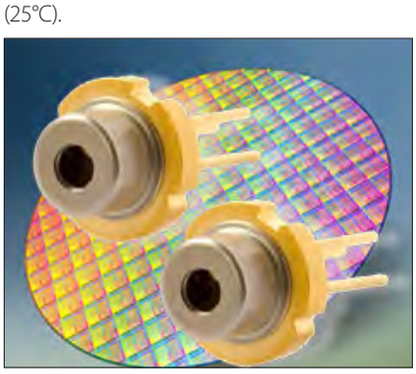
Hi-plex 3D tissue imaging enables "spatial omics", by iteratively multiplexing molecular labelling and tissue scanning technologies. Analysis of the resulting data sets provides high-resolution protein or mRNA maps at the sub-cellular level for dozens or even hundreds of target molecules.

Armed with this knowledge researchers can map gene (transcriptome) and protein (proteome) activity in a tissue sample. Due to its innovative approach and the range of expected applications, Spatial Transcriptomics was selected as "Method of the year 2020" by Nature Methods journal. Applications range from speeding up discovery in basic science to predicting disease pathology, progression, and treatment response.

Andor Technology, Belfast, UK
www.andor.oxinst.com

AP Technologies

QD Laser has introduced the QLF063x-85A0 series high power deep red laser diodes with a typical wavelength of 685nm at 100mW (25°C).



The QLF063x-85A0 series are based on QD Laser's high reliability Quantum Well structure and offer high efficiency operation with a typical drive current of 125mA (2.35V) and Slope Efficiency of 1.17W/A (5mW-100mW). Farfield beam divergence is 9° (horizontal) and 14° (vertical) FWHM with beam steer of ±3°.

These laser diodes use industry-standard TO-56 packages with a flat window and internal Monitor Photodiode and are available in Common-Anode and Common-Cathode configurations.

Sample quantities of the QLF063x-85A0 series are available for testing. For further information on QDL's full range of singlemode laser diodes please visit the webpage or contact AP Technologies.

Bath, UK
www.aptechnologies.co.uk

Carl Zeiss Microscopy

The new planetarium in Halle, Germany, will feature Zeiss projection technology. The planetarium will be equipped with projectors and Uniview Open Dome, making it "one of Europe's cutting-edge planetariums," says the firm.

Zeiss is equipping the new planetarium in Halle with leading-edge technology for visualizing celestial phenomena and delivering 360-degree video projection. The domed hall, the planetarium's centerpiece, will soon boast a 12-m diameter and will accommodate upwards of 100 visitors.

A Zeiss Skymaster ZKP 4 planetarium projector stationed in the middle of the auditorium will simulate a realistic night sky, while six Zeiss Velvet LED projectors along its perimeter will project digital images on the dome.

The True Black hybrid planetarium system combines the opto-mechanical projection power of the ZEISS ZKP 4 star projector with the high-contrast projections delivered by a variety of planetarium functions on the Zeiss Velvet projectors.

The LED projectors are special as they deliver pitch-black image backdrops – meaning the brilliance of the artificial night sky is retained even when accompanied by superimposed images, thus reinforcing the illusion of an object floating in space.

The planetarium in Halle is one of Zeiss's first customers to use Uniview Open Dome, a technology that permits any content to be projected directly from a laptop or PC onto a dome in real time. And it does this in the high resolution of up to 4,096 x 4,096 pixels.

"Uniview Open Dome is opening up a whole new age for planetariums. For the first time ever, technology imposes no limits on what can be projected onto the dome," said Martin Kraus, Head of Planetariums at Zeiss.

Oberkochen, Germany
www.zeiss.com/microscopy

Chromacity

Chromacity CEO, Shahida Imani, will participate in two panel discussions with Photonics Scotland and the UK's Photonics Leadership Group (PLG).

Photonics Scotland is hosting an Opening Up Photonics event, which is an initiative, designed to increase gender inclusivity within

the industry. Shahida will join the Opening Up Photonics panel discussion, between 10:00 – 12:00 on Wednesday 29th September, to talk about the measures taken at Chromacity to promote the importance of inclusion and diversity.

The Photonics Leadership Group will host a panel discussion on the UK Photonics Innovation Chain, between 13:30-14:30 on Wednesday 29th September. Shahida Imani will join the discussion and share an industrial

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insight into the UK photonics ecosystem to help answer the question; what can we do better?

Visit Chromacity (stand number 516) to learn how our fixed wavelength femtosecond lasers and picosecond optical parametric oscillators (OPO) are used as a powerful and efficient light source to drive advances in microscopy, spectroscopy and quantum applications.

Chromacity has announced it has completed a growth-funding round of £1.2 million. Contributors to the round include existing investors, Kelvin Capital, EOS and the Scottish Enterprise, as well as new investor ESM Investments.

The firm, which develops ultrafast fiber lasers for a wide range of scientific and industrial applications, will use the funding to expand the company's workforce, particularly within its manufacturing and R&D divisions.

Shahida Imani, CEO of Chromacity, said, "This new funding will enable us to expand our team and accelerate Chromacity's growth, both commercially and technologically.

To counteract the challenges placed on laser manufacturers by Covid-19, Chromacity has developed a remote installation capability for its optical parametric oscillators (OPOs).

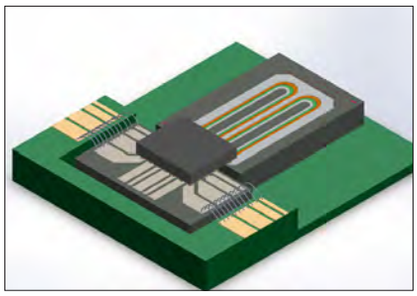
Currie, Livingston UK
www.chromacitylasers.com

Cornerstone

Cornerstone is a license free, open source Silicon Photonics rapid prototyping foundry based in the UK. Its open access and license free model differentiates the firm from other foundries.

The prototyping platform uses industry-compatible, deep-UV projection lithography meaning users can seamlessly scale up production volumes with their preferred favourite commercial foundry.

Cornerstone is a collaboration between three UK universities: University of Southampton (for wafer-scale processing); University of Glasgow (chip-level processing); and University of Surrey (ion implantation). It currently offers three different silicon-on-insulator platforms via a multi-project-wafer service.



The Cornerstone team recently announced that it has won around £1.5 million in funding from the UK Engineering and Physical Sciences Research Centre (EPSRC) to expand its capabilities.

In Cornerstone 2, the team will develop 6 new silicon-based technology platforms for researchers to design their photonic integrated circuits. The platforms extend the supported wavelength range into both the visible wavelengths and mid-infrared wavelengths, enabling a plethora of applications including LIDAR, lab-on-a-chip sensing and more.

The six new platforms comprise: flip-chip bonding of electronic circuits to photonics; pick and place of laser dies to facilitate on-chip light sources for multiple applications; high confinement silicon nitride photonics platform with thickness up to 1 µm; undercut silicon photonics platform to facilitate photonics circuits that operate at wavelengths up to 4 µm; a germanium-on-silicon platform for photonics circuits that operate at wavelengths up to 12 µm; and deep-UV projection lithography service.

Southampton, UK
www.cornerstone.sotonfab.co.uk

CS Connected

CS Connected, based in Cardiff, UK, is home to the world's first compound semiconductor community of academic institutions, prototyping facilities and global, high-volume manufacturing capabilities that collaborate across a range of research and innovation programs to bring new advanced semiconductor technologies to global market positioning Wales as a world leader in enabling new and emerging technologies. Wales is increasingly establishing its reputation as the world leader in the technologies behind electric vehicles and optical and wireless communications for 5G and beyond. The region is soon to be home to two brand new research and innovation facilities boasting around 6,000m2 of high-tech working space including advanced clean rooms and labs.

The Centre for Integrative Semiconductor Manufacturing (CISM) at Swansea University's Bay campus will focus on multiple semiconductor platforms for healthcare and a net zero future in applications such as clean energy systems and power electronic components that are driving the electric revolution.

Meanwhile, Cardiff University's Translational Research Hub (TRH) at its Maindy Campus will provide world-class facilities for advanced communications and sensing technologies based on integrated compound semiconductors.

Swansea University is currently recruiting students onto a newly launched MSc programme in Semiconductor Technology and Applications. Cardiff University already offers two MSc programmes along with PhD opportunities through its Centre for Doctoral Training (CDT).

In all programmes students will have hands on laboratory experience developing knowledge and skills in device processing, characterisation and applications of compound semiconductors, building the skilled workforce of the future for the region.

Cardiff, UK
www.csconnected.com

Edmund Optics

Edmund Optics has expanded its range of Schott products with the addition of Schott

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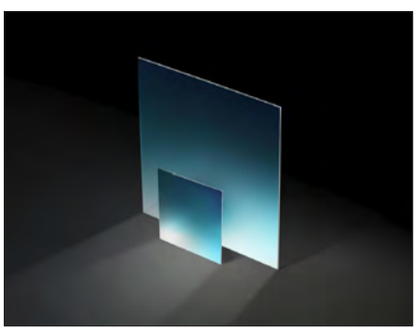
D263 T eco Windows, making it easier for customers to obtain quality optics that are environmentally sustainable. The windows are 0.4mm thick and are constructed from glass substrates manufactured with eco-friendly refining agents with excellent transmission in the visible and near-infrared spectra.



The windows feature a surface roughness of less than 1nm RMS with exceptional thickness tolerances and total thickness variation (TTV). Having high chemical resistance, durability to harsh environmental factors, and a light weight, these windows make excellent alternatives to plastic substrates for applications including resistive touch panels, capacitive touch sensors, substrates for optical filters, and other automotive or electronics applications such as mobile devices or LiDAR units.

Edmund Optics has also announced its distribution of Nonlinear Crystals, which have high laser-induced damage thresholds, and Techspec Superpolished Substrates, which have extremely low surface roughness, both of which are specified for high-power laser applications. The Nonlinear Crystals consist of β-barium borate or lithium triborate and feature anti-reflection (AR) coated surfaces with 20-10 surface quality.

The surface flatness specifications for each crystal type are λ/8 and λ/10 for BBO and LBO options, respectively. With damage thresholds up to 10 J/cm2 (@ 1064nm, 10ns 10Hz), these crystals are ideal for frequency conversion of Ti:Sapphire and Yb:doped lasers.

The low scatter of these substrates also makes them ideal substrate options for high-quality ion-beam sputtered (IBS) AR or reflective coatings. Additional applications for these superpolished windows include cavity-ring down spectroscopy, scatterometry, and UV laser eye surgery.

York, UK
www.edmundoptics.com

EPIC Innovation Centre

EPIC houses circa £2M worth of photonics and microelectronics prototyping equipment. This includes die and wire bonding solutions from Palomar, microscopy and analysis from Nikon, Jeol and Mitutoyo, device packaging from Pyramid Engineering, test from XYZTEC and EPIC's own bespoke optical alignment system.

Businesses that join EPIC will immediately gain free access to this and future technical capability, a classified cleanroom and the chance to collaborate with other specialist companies. Since opening in 2019, EPIC has welcomed 12 businesses into the centre and is now 70% occupied.

EPIC Centre Director, Wayne Loschi, is excited with how the centre has grown from a technical perspective; "EPIC has partnered with some very lucrative suppliers in the microelectronics and photonics industry to compile a compelling range of prototyping facilities for our businesses. Our range of equipment will enable current and future EPIC tenants to win more business in some of the more sensitive markets such as MedTech, Aerospace, Defence and Space."

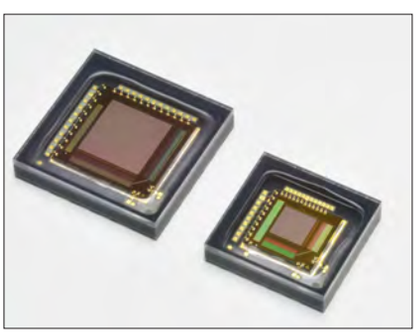
The centre now houses circa £2 million worth of innovative prototyping equipment to support the needs of an ever-growing local cluster. EPIC has recently taken delivery of a device packaging system from technology partners Pyramid Engineering. The system, which comprises a HPS 10-19 Hybrid Package Sealer, glove box, oven and associated ancillary items, is now installed in EPIC's Prototyping Suite.

The process was supported by EPIC tenant Bay Photonics, which specialises in photonics device packaging and understand the technical needs of the sector. Pyramid Engineering was keen to join companies such as Nikon, Palomar and Mitutoyo and become a technology partner at EPIC. This enables equipment suppliers to showcase their technology to EPIC tenants and the wider Hi-Tech Cluster.

Paignton, UK
www.epic-centre.co.uk

Hamamatsu Photonics

Hamamatsu Photonics manufactures and sells profile sensors for surveying equipment, but until now these profile sensors required an external controller for computing the projection data.



By re-engineering the position sensing circuit, Hamamatsu Photonics has developed a new profile sensor with an embedded computing function. This sensor, called model S15366-256, is specifically designed to calculate signals from the incident light spot within its processing chip and output incident light position information.

Since this new profile sensor can output the incident light positions as coordinate data, it needs no external controller for computing processing. Using this new profile sensor therefore will help design and manufacture surveying equipment at a reduced size, weight, and cost.

This profile sensor also has functions including high-speed readout and automatic light spot tracking that are likely to open up a wide range of applications in the field of factory automation.

The sensor is a type of CMOS image sensor with pixels arranged in two dimensions. When detecting the position of incident light,

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ordinary image sensors compute the image data they capture. Profile sensors, on the other hand, process just the projection data and so can rapidly detect the incident light position.

It uses a processing chip that contains a computing circuit for calculating the center-of-gravity of the projection data, making it possible to output the incident light position as coordinate data without having to use an external controller.

In addition, it has added functions for increasing the readout speed and tracking the maximum intensity of the light spot to allow automatic tracking of light spots moving at high speeds. It is also equipped with power-down mode that effectively reduces power consumption during standby.

Welwyn Garden City, UK
www.hamamatsu.co.uk

Hübner Photonics

Hübner Photonics offers a full range of lasers and terahertz systems including single and multi-line Cobolt lasers, tunable C-Wave lasers, C-Flex laser combiners and Terahertz imagers and spectrometers.

With its supply of innovative and reliable products, customer support, and a certified quality management system, Hübner Photonics has become a preferred supplier to major instrument manufacturers, leading research groups and public institutions working in spectroscopy, bioinstrumentation, holography, and metrology.

Helmholtz doctoral award winner

Hübner Photonics recently congratulated Dr. Valeria Perseo (pictured above) from Max Planck Institute for Plasma Physics in Greifswald for receiving the Helmholtz Doctoral Award 2020 for her doctoral thesis on "Impurity flow measurements with Coherence-Imaging Spectroscopy at Wendelstein 7-X"

With the PhD prize, the Helmholtz Association recognizes outstanding achievements during the doctoral phase. The award is intended to encourage students to pursue a scientific career path. For this purpose, financial support for a six-month research stay abroad is available in addition to the doctoral award, which is endowed with 5000 € for scientific applications.

Dr. Perseo employed the C-Wave tunable laser as a calibration source for her Coherence-Imaging Spectrometers (CIS). She wrote in an article published in Review of Scientific Instruments: "The use of the C-WAVE laser improved the flexibility, precision, and stability of our CIS diagnostic, allowing us to monitor and measure the system response with little use of simulations and opening up testing possibilities unexplored before."

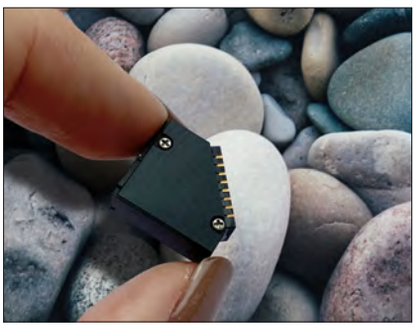
Solna, Sweden
www.hubner-photonics.com

Ibsen Photonics

Ibsen's Pebble VIS-NIR spectrometer is an addition to the Pebble platform of ultra compact spectrometers with a form factor of only 20 mm x 15 mm x 8 mm, high resolution and sensitivity, as well as environmental ruggedness.

Pebble VIS-NIR is based on the same proven diffraction grating technology used in all other Ibsen spectrometers. This ensures that it can be manufactured in high quantities with very small unit-to-unit performance variation. "I found that the Pebble was more compact and better performing than other compact spectrometers," said Kristian Nielsen, CTO of Shute Sensing Solutions.

The core of the Pebble is an effective transmission grating manufactured in-house at Ibsen. Furthermore, this spectrometer



utilizes a fast and highly sensitive CMOS detector array with 256 pixels.

When combined with a large numerical aperture of 0.22 (low f-number of f/2.2) Pebble provides amazingly high sensitivity for such a small spectrometer. A key benefit of using a transmission grating inside the device is a high resolution of 8 nm across the full 500 – 1100 nm wavelength range.

Furthermore, the pure transmission-based optics inside Pebble ensures very good thermal stability and makes it ideal for real-time measurements in the field. Pebble VIS-NIR offers a cost-effective and low-risk solution for integrators of handheld and portable multi-spectral instruments for biophotonics, medical, food, and precision agriculture applications based on fluorescence or absorbance measurements.

Farum, Denmark
www.ibsen.com

ID Quantique

ID Quantique and Poznań Supercomputing and Networking Center (PSNC) have collaborated to provide the first Quantum Key Distribution (QKD) services on an operational network in Poland and the world's first cross border QKD connection.

ID Quantique (IDQ) is a developer of quantum-safe crypto solutions, designed to protect data for the long-term future. The company provides quantum-safe network encryption, secure quantum key generation

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and quantum key distribution solutions and services to the financial industry, enterprises and government organisations globally.

As part of OPENQKD, a collaborative European project that installs and runs test beds in several European locations to showcase Quantum Key Distribution (QKD) solutions under a variety of different use cases, PSNC together with IDQ have recently completed two major implementations.

QKD – aka Quantum cryptography is a technology that uses quantum physics to secure the distribution of symmetric encryption keys in motion. This technology uses a fundamental property of quantum physics: observation causes perturbation. This means that if the encryption keys are intercepted "in motion", the sender is alerted and can decide not to use them.

PSNC together with IDQ have established a QKD infrastructure in Poznań (Poland) to provide and support various QKD use cases based on existing PSNC services, such as High Performance Computing (HPC), e-health and local administrations. The goal is to make QKD fully operational on Poznań and Pioneer networks first and to further extend to intercity links and services at a later stage.

The first international inter-city QKD link connects Cieszyn in Poland to Ostrava in Czech Republic. The implementation is the result of a cooperation between Poznań's Supercomputing and Networking Center, CESNET, IT4Innovations and the National Supercomputing Center at VSB – Technical University of Ostrava academic network.

Carouge, Switzerland
www.idquantique.com

iXblue

Integrated subsea and offshore solutions provider Unique Group has purchased an iXblue Gaps M7 USBL (Ultra Short Base Line) acoustic positioning and communication system. This addition will be placed in Unique Group's rental pool of equipment and made available to clients across the Americas.

Ajay Kottaye, Survey Business Manager, Americas, at Unique commented, "USBL positioning systems have been highly sought after by clients due to the increase in geophysical projects in the US.

"Such projects push the vertical-horizontal tracking range and accuracies to extremities, with an understanding of these requirements Unique Group has invested in the iXblue Gaps M7 USBL and added it to our rental pool so that clients can choose the best solution for their projects."

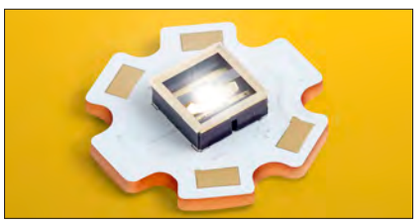
The Gaps M7 is an integrated solution that makes USBL underwater positioning extremely simple to operate from any vessel of opportunity, using a portable and truly pre-calibrated USBL head coupled with internal INS (Inertial Navigation System) and GNSS.

Offering unrivaled horizontal tracking capabilities and very high-precision geo-referenced positioning performance from extremely shallow water depths to 4,000 meters, Gaps M7 can be used for various applications such as ROV, AUV, gliders, tow fish tracking and dynamic positioning to name a few.

Easy to install and operate thanks to its compact size and lightweight, Gaps M7 can be deployed from small vessels of opportunity with a reduced crew onboard or on instrumented buoys. Embedding its own inertial navigation system, Gaps M7 does not require any on-the-field calibration, making it ready to use right away and translating into operational time savings and efficiency on the field.

Besançon, France
www.ixblue.com

Laser Components UK



Laser Components is expanding its range of c positioning lasers with two particularly compact modules. With a diameter of 9 mm, the LC-LML-635-09 line laser and the LC-LMC-635-09 cross-hair laser are just 16.5 mm long. The red laser modules (635 nm) achieve a maximum laser power of 5 mW. Their beam angle is 60°.

The LC-LMx series positioning lasers are used in many machines to mark the exact position of the workpiece, as well as to highlight drilling points and intersections.

Since they only have a supporting function, it is important that the modules can be integrated into the machine layout in the most space-saving way possible. Eye safety also plays an important role in most applications. All positioning lasers from Laser Components comply with laser class 2.

Kyocera SLD Laser (distributed by Laser Components) has expanded its range of high-lumen white light sources. To make them more attractive for use in industrial applications, the manufacturer has increased the lifetime of its 500 lumen chips to 10,000 hours.

As a second innovation, the company was successful in doubling the luminous flux of its SMD white light sources to 1,000 lumens. This offers crucial advantages for applications in which the light is transmitted via a fibre: In medical endoscopes, the extremely high luminous flux and small beam diameter mean that even thinner fibers can be used; in industrial endoscopes, light can be transmitted across longer distances than before.

Chelmsford, UK
www.lasercomponents.co.uk

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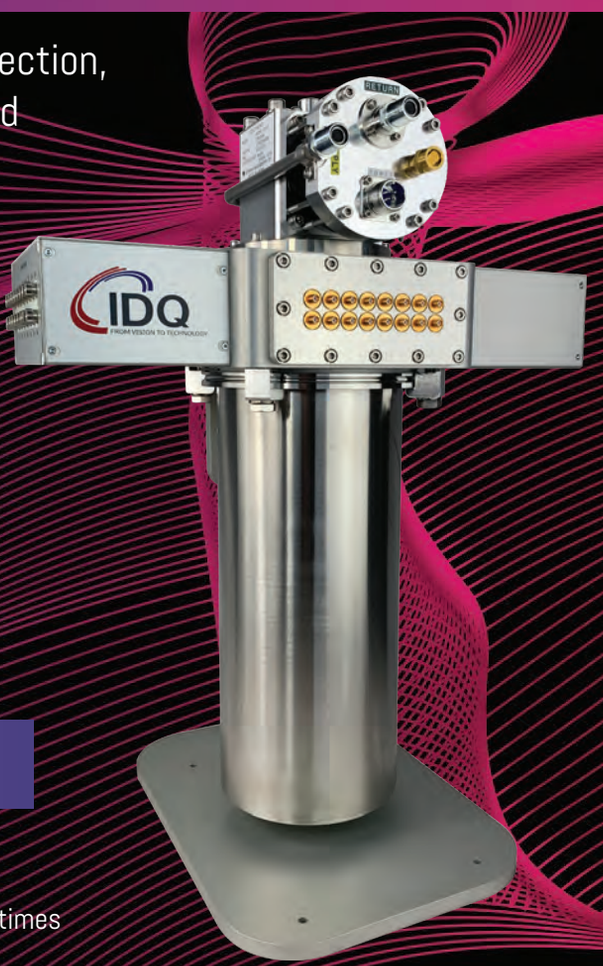

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29-30 September 2021
ID Quantique: Booth 505,
Quantum Technologies Zone

IDQ

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