Volume 20 October / November 2023

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PhotonicsViews

OPTICS • PHOTONICS • LASER TECHNOLOGY

COVER STORY

Compact design with high energy

FOCUS SECTION
Laser welding

TECHNOLOGY FEATURE
Photonics is a critical enabler of precision farming

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VDI Technologiezentrum

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To represent and serve photonics

Partnership agreement between EOS and PhotonicsViews signed

The European Optical Society EOS is gathering four thousand members, researchers, and students from academia and companies. The majority joined one of the seventeen national optical societies (NOS) to become an EOS member. Our mission is to represent and serve the diversity of photonics in Europe and encourage and facilitate cooperation. EOS and NOS work very closely to ensure they highlight the highest quality, novel research results and EU projects in different fields of optics. The German branch of EOS, the DGaO, has teamed up with PhotonicsViews in 2021, and this partnership is now extended to a European level.

Our main event at EOS is the Annual Meeting (EOSAM). It is organized every year during a week of September with one of our NOS in their country. This year, it was held in the beautiful French city of Dijon with the Société Française d'Optique (SFO), Bertrand Kibler and Guy Millot being general chairs. It included a high-quality program organized around tutorials, plenaries and topical meetings, focused and early-stage sessions settled by their chairs. An industrial program organized with EPIC fostered our relationship with the industry, and current EU projects were reported in a session organized with Photonics21. A wide range of optical technologies, from components to complete systems, were presented to meet the needs of both fundamental research and industrial applications. 510 participants enjoyed over 400 presentations, the area of 20 exhibitors for the photonics industry set up at the heart of the conference and networking during coffee breaks, lunches and a dinner.

EOS aims to keep their members always informed about the latest findings on challenging emerging technologies and outline strategic goals for optics and photonics covering both fundamental and applied topics. It is providing by high-quality communications with peer-reviewing in our own open-access journal JEOS:RP. Recently, it has been completely renewed after a publisher change and representatives of NOS are at the advisory board. Publications are indexed in the main databases to provide optimal visibility.

The new media partnership with PhotonicsViews now gives our members also immediate access to an international industry magazine, both as readers and as contributors reporting on their joint research project results or developments with immediate industry and market relevance. Looking forward to connecting with you through PhotonicsViews!

Patricia Segonds

Source: private

Patricia Segonds
president
European Optical Society
professor
Institut Néel – CNRS / Université Grenoble Alpes
France

EOS National Optical Societies (NOS)

www.twitter.com/photonicviews www.linkedin.com/company/photonicsviews

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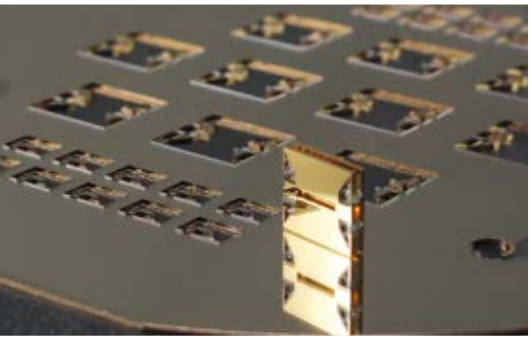

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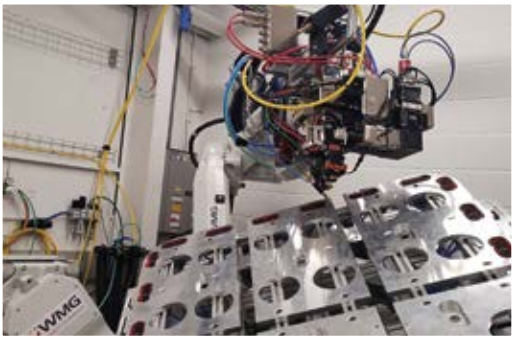

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Cover:

The new CW 3000W by Shenzhen JPT Opto-electronics is to drive performance upgrades for laser welding and cutting, combined with reductions in size and weight compared to the previous single-module laser design.

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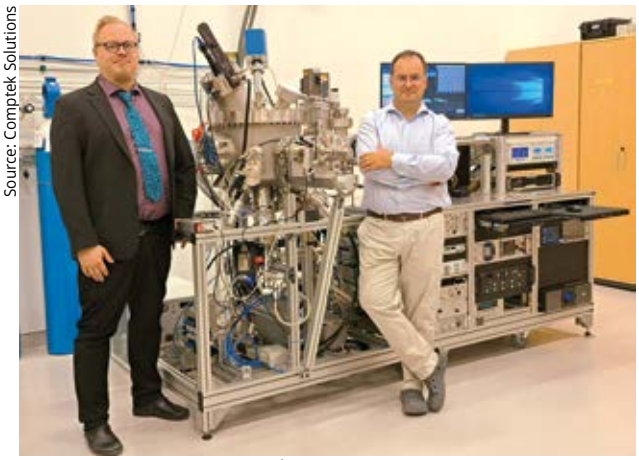
Comptek Solutions secures € 8 M investment


Source: Comptek Solutions

Company founders Jouko Lång (l) and Vicente Calvo Alonso

The series A funding for the Finnish company consists of an eight million euro equity investment with the participation of the strategic partners Horizon Europe EIC Fund and Liftt, an Italian venture capital firm. The involvement of this investor group will support Comptek in areas such as scale-up growth, advancing its technological innovation progress, and accelerating the pace of industrialization and implementation of its technology for next-generation applications in optoelectronics and power electronics.

The company, founded in 2017 by CTO Jouko Lång and CEO Vicente Calvo Alonso, was spun out of the University of Turku, Finland, where its core technology, Kontrox, was developed by Jouko together with other material scientists and semiconductor engineering researchers who constitute the company's core R&D team to date.

Pierluigi Freni, project manager of Liftt, commented, "Passivation is an essential factor of advanced optoelectronic chip manufacturing. The solution of Comptek disrupts the value chain by introducing a processing technology that enables unprecedented levels of chip efficiency and helps to reduce production costs."

According to the company, the innovation by Comptek Solutions with its Kontrox technology will be adding further growth opportunities to the market in enabling more reliable, power-efficient, and affordable devices through its integrated passivation solutions on a global scale.

www.comptek-solutions.com

Eigen Innovations and Visometry cooperate on AR software

A new partnership enables Eigen Innovations to use Visometry's VisionLib tracking library in its Image Twin and Product Twin solutions. The integration is expected to reduce model training and scaling time for Eigen's customers.

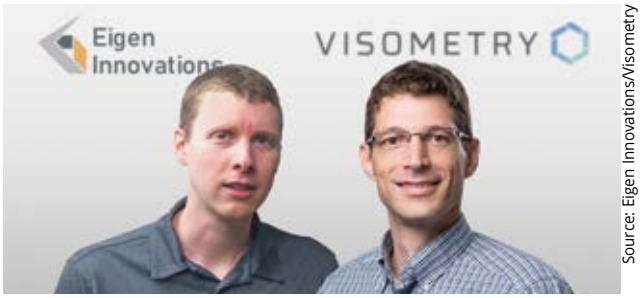
"Thanks to VisionLib and Visometry's support, we were able to speed up our development time and achieve our accuracy and processing speed goals much faster than if we had developed the object tracking all by ourselves," says Josh Pickard, director of innovations at Eigen Innovations. "We had our first prototype running within a month."

"Eigen's approach to machine vision is groundbreaking and paves the way to the smart factory of the future," said Visometry founder and CEO Harald Wuest.

By merging the images captured by the camera(s) with the CAD model of the part, Eigen Image Twin creates a digital twin that can be used to generate the same position and perspective for all parts on all machines. This eliminates unwanted variations in the image data, such as different backgrounds, positions or orientations of the part. As a result, robust machine learning models can be trained with less data and scaled on all machines inspecting the same part.

Eigen Product Twin is a turnkey vision system for inline assembly inspection. The kit consists of vision cameras with accessories such as lenses and cables, and an industrial gateway. It automatically compares the images of the part with the CAD data. If an error, such as a missing part, is detected, the system alerts personnel to make corrections. It is designed for manufacturers who want to replace manual inspection with machine vision.

https://eigen.io
www.visometry.com



Source: Eigen Innovations/Visometry

Josh Pickard, director of innovations at Eigen Innovations, and Harald Wuest, CEO of Visometry

Fisba expands its presence in Asia

Dynotech Instruments, a distributor for the world's leading manufacturers and specialist in the laser, photonics, and semiconductor industries, is now representing the St Gallen optics company.

The Swiss supplier of optical components and systems, is now building on its cooperation with Dynotech to further expand its presence in Asia. The new collaboration combines Fisba's expertise in engineering, optical design and high precision production with Dynotech's in-depth knowledge of the Indian market in life sciences, industrial applications, and aerospace and defense. Together, they will provide customized solutions that translate the individual needs of Indian customers into competitive solutions – whether they are 0.3 mm microlenses, complicated plano-optics, or high precision optical systems.

"Together, we aim to deliver optical excellence in India. We are very excited about this partnership and look forward to the opportunities the collaboration will bring," said Atsushi Itabashi, sales manager and supervisor of Dynotech. The company works as an exclusive distributor for the world's leading manufacturers.

The expansion of the distributor network is another step towards positioning Fisba in Asia. The company has already had a sales office in Shanghai since 2020, and works with distributors in Japan, South Korea and Taiwan.

www.fisba.com

Trumpf expands in south-eastern Europe

The German high-tech company Trumpf opened a new southeast european headquarters in Hungary recently. The branch was established together with a digitally networked demo factory in the business park in Gödöllő near Budapest. Trumpf's goal is to better serve the south-eastern european region as a solution provider in the future. "We expect a growing sales market in Hungary in the coming years. More than ever, the key to success lies in cross-border cooperation. This investment also strengthens our business in countries such as Romania, Bulgaria, Croatia, Serbia, Slovenia and Turkey," said Nicola Leibinger-Kammüller, CEO of Trumpf.

In the medium term, the company plans to generate total sales of more than a hundred million euros in these markets by the middle of the decade. Hungary itself has strong production sites for German automotive brands and suppliers. In addition, Trumpf lasers are used in the factories of Korean car battery manufacturers who produce in Hungary for the european market. The investment sum for the new, fully equipped building and demo factory is around 13 million euros. Trumpf currently employs around ninety people in Hungary.

Trumpf has been represented in Hungary with its own subsidiary for ten years. "In our new demo factory, we show our customers digitally networked lasers and machines that many industrial sectors use to process metal. The local site should help us achieve our sales target of more than a hundred million euros in the region in the medium term," said Tamás Major, head of Trumpf Hungary since 2013. In the course of the expansion, the company expects a moderate increase in employment. The German high-tech company employs more than 17,900 people worldwide. In the last fiscal year, sales were around 5.4 billion euros.

The two-floor building combines offices, seminar rooms, storage areas, a canteen and a demo production unit. (Source: Trumpf)

The new site is completely sustainable. Heating and cooling of the building and facilities is provided by 38 geothermal probes. A photovoltaic system was installed on the roof. There are numerous parking spaces with electric charging stations.

www.trumpf.com

Excelitas acquires Heraeus Noblelight

The industrial and medical technology manufacturer Excelitas Technologies broadens its portfolio with a set of photonic solutions across the lighting spectrum by acquiring the Heraeus Noblelight business with approximately 850 employees, including operations in Germany, United Kingdom, United States, China and Japan, along with several key application centers from the Heraeus group.

Heraeus Noblelight is an operative company within the broadly diversified German family-owned technology group. It specializes in the development and manufacture of specialty light sources and solutions, from ultraviolet to infrared, used within analytical instrumentation, industrial curing, water treatment, electronics manufacturing, medical and cosmetic therapy, battery production and many others.

"We see tremendous potential in the union of Heraeus Noblelight's technology portfolio with our own extensive offering in plasma and LED products. Leveraging our combined investments and expanded offering will drive growth and present innovative integrated solutions to our highly complementary customer and product mix across a variety of unique markets," said Michael Ersoni, Excelitas Technologies EVP commercial business.

The acquisition of Heraeus Noblelight will represent the latest in a series of strategic acquisitions by Excelitas Technologies since its establishment in 2010.

The agreement has been approved by both companies. Terms are not being disclosed and the transaction is expected to close before the end of 2023 subject to obtaining regulatory approvals.

www.excelitas.com
www.heraeus-noblelight.com

Precitec founds Indian subsidiary

The future employees of Precitec India celebrated the start of a new chapter. Precitec manager Christof Lehner welcomed everyone and emphasized the importance of this foundation for the expansion of the group. He believes that the Indian market will grow strongly in the next ten years. This will also give Precitec India a significant position within Precitec.

Also on stage were Eglon Depty, owner of Prolastec and one of the future directors of Precitec India, and Karthik Boinapally, the second director. In their speeches, they expressed their pleasure at being part of such a dedicated team.

The search is currently on for a suitable location that will not only provide sufficient space for the team, but also make room for the construction of a modern metrology laboratory and optics repair facility, as well as a logistics area and a customer center.

www.precitec.com

Source: Precitec

l–r: Karthik Boinapall, owner of Prolastec and one of the directors of Precitec India, second director Eglon Depty, and Christof Lehner, sales director subsidaries and distributor network.

Framos is building a campus in Croatia

Framos has started construction of its high-tech campus in Čakovec, Croatia. It should be completed by the end of 2024. The campus construction will provide the company's employees with the best working conditions and comprehensively expand the production capacities and the range of logistics services.

As the application areas for imaging technology continue to expand, spanning from medicine to agriculture to autonomous vehicles, smart city technology and home appliances, Framos believes the time is right to make this substantial investment.

The new building has an area of approximately 3,500 square meters and can be flexibly expanded to meet future needs. Framos will invest more than six million euros in this over the next three years. In the first phase, the new campus will provide space for 150 employees.

Source: Framos

www.framos.de

PI relocates its R&D as innovation hubs

Physik Instrumente (PI) is intensifying its cooperation with leading universities and research institutions. To do so, the specialist for piezo technology, nano positioning, and performance automation is transferring areas from research and development to so-called "innovation hubs" in close proximity to technical universities and colleges.

The iWerkx on the Hoepfner site in Karlsruhe, Germany. (Source: PI)

In September this year, PI started this by leasing around 500 square meters of office and laboratory space in the iWerkx on the Hoepfner Areal, to setup its innovation hub in Karlsruhe, south-west Germany. It is in the direct vicinity of the Karlsruhe Institute of Technology KIT, the FZI Research Center for Information Technology, and the Technologiefabrik Karlsruhe. "The proximity to these leading institutes promises a strong impetus for our future topics and helps us to consolidate and expand our technology leadership," assures Markus Spanner, CEO of the PI group. The medium-sized company already holds more than five hundred patents and invests around ten percent of turnover in research and development.

PI is also planning to establish innovation hubs as research clusters in the USA and Asia that will concentrate on future and post-future topics.

www.physikinstrumente.com

Edmund Optics expands production facility

The US optics manufacturer is investing in its laser optics production and services and, as part of this, has recently expanded its facility in Oldsmar, Forida, USA.

EO's Oldsmar, Forida, USA, facility. (Source: Edmund Optics)

The 3,100-square-foot laser optics center at Edmund Optics' Oldsmar, Florida, facility is focused on manufacturing optical components with high laser damage thresholds from the UV to the far IR.

In addition, this facility expands Edmund Optics' laser optics manufacturing capabilities in laser crystal and glass fabrication, polishing, metrology, inspection and testing, and employs around fifty people, many of whom are proven experts in laser optics.

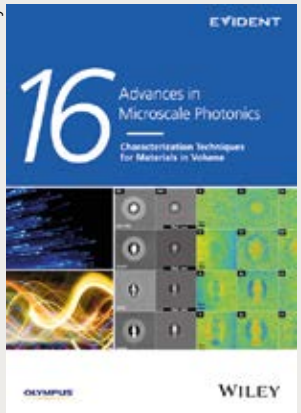
"We are excited to significantly enhance our laser optics manufacturing capabilities and capacity with the new Florida facility," said Marisa Edmund, CEO and CMSO at EO.

Dr Stefaan Vandendriessche, head of laser optics at EO, adds, "This new facility enables us to better support innovative applications through our expanded development, manufacturing, and assembly capabilities."

www.edmundoptics.com

Evident presents new e-book

Source: Wiley



◀ The cover of the new ebook

In collaboration with Wiley, Evident has launched a new e-book on the topic of characterization techniques for materials in volume.

This eBook explores various topics, including electrohydrodynamic inkjet printing for applications in mid-infrared metaoptics, the impact of zinc ion addition on steel corrosion in natural seawater, ultrafast coherent spectroscopy of a GaAs quantum dot, and the surface detection filter for transparent film OLS50-QWP.

These cutting-edge developments in microscale photonics hold great potential to revolutionize multiple industries, such as medicine, telecommunications, and sensing.

Register now to explore this and all other eBooks of the Advanced Optical Metrology series.

advancedopticalmetrology.com
www.evidentscientific.com

Supercharging Europe's photonics startups

PhotonVentures has launched a venture capital fund aimed at early-stage photonic chip startups and scale-ups. 60 million euros were raised in its first financing round with PhotonDelta as the lead investor alongside numerous private investors.

PhotonVentures plans to raise a total of 100 to 150 million euros, with its final close set for the start of 2024. It will prioritize Series A rounds, with the aim of providing investments between 1 and 2.5 million euros. PhotonVentures' investment strategy leverages on the Dutch PhotonDelta ecosystem to accelerate European startups and scale-ups.

PhotonVentures is an independent deep tech venture capital firm that has emerged from PhotonDelta, the force behind the Dutch integrated photonics ecosystem. The two organizations are strategic partners with the aim of supporting the rapid growth of Europe's photonics industry. Photonic chips are critical in a range of applications like quantum computing, robotics, sustainable agriculture, and autonomous vehicles.

The fund is planning to initially invest in fifteen European deep-tech companies that have potential to grow into international winners in their sectors. The startups should have an integrated photonics-based MVP connected to the European ecosystem.

https://photonventures.vc
www.photondelta.com

LASYS discontinued – SLT with new location in 2024

The laser industry has continued to develop strongly since the premiere of Lasys in 2008. Topics such as digitalization, automation and AI-supported production processes have also become more important. This has led to new application areas for lasers. Messe Stuttgart has now decided to use and purposefully strengthen the topic of laser material processing in an industrial environment at its own established events – for example at Quantum Effects, Nortec, AMB, Vision, TecStyle Visions, Wetec and Moulding Expo. This means that Lasys will no longer be staged as a stand-alone trade fair.

Stuttgart Laser Technology Forum (SLT) which had usually been held on the first two days of Lasys in the adjacent Messe Stuttgart congress center is being continued in a new format for SLT 2024. The traditional invited talks will be supplemented by contributed presentations; a call for papers will follow.

The organizer of the SLT, Heidi-Maria Götz of Institut für Strahlwerkzeuge (IFSW), has chosen an extremely appealing new venue in the form of the Kursaal Bad Cannstatt. Just a stone's throw away, none other than pioneer Gottlieb Daimler took the mobility of mankind to a new level.

Selected conference contributions will form a special section on laser systems and laser materials processing in the June / July issue of PhotonicsViews once again.

www.messe-stuttgart.de
www.ifsw.uni-stuttgart.de

Kursaal Stuttgart-Bad Cannstatt
(Source: IFSW, U Stuttgart)

The Nobel Prize in physics 2023 for the shortest flashes of light


OSU / MPQ / Bengt-Oberger

Pierre Agostini, Ferenc Krausz, Anne L'Huillier (l-r)

Pierre Agostini, Ferenc Krausz, and Anne L'Huillier are this year's Nobel laureates in physics, awarded "for experimental methods that generate attosecond pulses of light for the study of electron dynamics in matter" that have given humanity new tools for exploring the world of electrons inside atoms and molecules. Pierre Agostini (Ohio State University, Columbus, USA), Ferenc Krausz (MPI for Quantum Optics, Garching, and Ludwig-Maximilians-Universität München, Germany) and Anne L'Huillier (Lund University, Sweden) have found a way to create extremely short pulses of light that can be used to measure the rapid processes in which electrons move or change energy in a few tenths of an attosecond.

In 1987, Anne L'Huillier discovered that many different overtones of light arose when she transmitted infrared laser light through a noble gas. These higher harmonics are caused by the laser light interacting with atoms in the gas; it gives some electrons extra energy that is then emitted as light. L'Huillier has continued to explore this phenomenon, laying the ground for subsequent breakthroughs.

In 2001, Pierre Agostini succeeded in producing and investigating a series of consecutive light pulses, in which each pulse lasted just 250 attoseconds. At the same time, Ferenc Krausz was working with another type of experiment, one that made it possible to isolate a single light pulse that lasted 650 attoseconds. That enabled the investigation of processes that are so rapid they were previously impossible to follow.

"We can now open the door to the world of electrons. Attosecond physics gives us the opportunity to understand mechanisms that are governed by electrons. The next step will be utilizing them," says Eva Olsson, chair of the Nobel committee for physics.

There are potential applications in many different areas like electronics, material science, or medical diagnostics.

www.nobelprize.org

The Nobel Prize in chemistry 2023 – adding color to nanotechnolgy

Moungi Bawendi, Louis Brus, and Alexei Ekimov are awarded "for the discovery and synthesis of quantum dots". These smallest components of nanotechnology now spread their light from televisions and LEDs, and can also guide surgeons when they remove tumor tissue, among many other things.

The Nobel laureates in chemistry have succeeded in producing particles so small that their properties are determined by quantum phenomena – called quantum dots – which are now of great importance in nanotechnology.

"Quantum dots have many fascinating and unusual properties. Importantly, they have different colors depending on their size," says Johan Åqvist, chair of the Nobel committee for chemistry.

In the early 1980s, Alexei Ivanovich Ekimov (Nanocrystals Technology Inc, New York, USA) succeeded in creating size-dependent quantum effects in colored glass. The color came from copper chloride nanoparticles and Ekimov demonstrated that the particle size affected the color of the glass via quantum effects.


Justin-Knight_2015 / Columbia U / nexdot

Moungi G. Bawendi, Louis E. Brus, Alexei I. Ekimov (l-r)

A few years later, Louis Eugene Brus (Columbia University, New York, USA) was the first scientist in the world to prove size-dependent quantum effects in particles floating freely in a fluid.

In 1993, Moungi Gabriel Bawendi (Massachusetts Institute of Technology, Cambridge, USA) revolutionized the chemical production of quantum dots, resulting in almost perfect particles. This high quality was necessary for them to be utilized in applications.

www.nobelprize.org

Auggie Award for TriLite's ultracompact AR display

Trixel 3, the world's smallest projection display, has won the AWE Auggie Award in the category 'best interaction product'.


Augmented World Expo Auggie Awards trophies (Source: Trilite)

Held at the Augmented World Expo, the annual Auggie Awards have been the most recognized global AR and VR industry awards since 2010. Now in its 14th year, the Auggies continue to showcase the best in augmented, virtual and mixed reality.

The device's optical display engine combines TriLite's miniature and lightweight laser beam scanner (LBS), a single 2D MEMS mirror, all optical components, and the trajectory control module that shifts complexity from hardware to software. The LBS module weighs less than 1.5 g, and has a volume of less than 1 cm^3.

As well as being tiny and lightweight, the Trixel 3 is designed for mass manufacture. Its low system latency ensures AR images integrate naturally with a wearer's surroundings and spatial movements. It provides a bright display that is easy to read in direct sunlight, and its optimized optical path requires no relay optics, further saving space and weight.

www.trilite-tech.com

Mark Sobey retires from Coherent

The head of the laser department left the corporation on September 1, 2023. Dr Sobey has served as president of Coherent Corp's lasers segment since the closing of the merger between II-VI and Coherent Inc in July 2022. Prior to the merger, Dr Sobey served as Coherent Inc's chief operating officer from 2020 to 2022.

He was previously executive vice president and general manager of Coherent Inc's OEM laser sources until being promoted to COO, and before that he was executive vice president and general manager of specialty laser systems (SLS) from 2010 to 2016, and vice president and general manager of SLS from 2007 until 2010.

Source: Coherent

Dr Mark Sobey

Prior to Coherent, Dr Sobey spent over twenty years in the laser and fiber optics telecommunications industries, including senior vice president roles in product management at Cymer and in global sales at JDS Uniphase. He received his PhD in engineering and BSc in physics from the University of Strathclyde, Edinburgh.

www.coherent.com

Conextivity: Peter Fischer hands over to Sabrina Brossard

A generational transition took place just a few months before the family-owned group celebrates 70th anniversary: Sabrina Brossard is the new president of the board of directors of Conextivity, based in Saint-Prex (Vaud), Switzerland. She succeeded her father Peter Fischer, president since 1999, on June 1. With Jonathan Brossard as CEO since 2016, the third generation of the Fischer founding family takes the reins of the group whose two business activities, Fischer Connectors and Wearin', are growing rapidly.

Peter Fischer and his daughter Sabrina Brossard (Source: Conextivity)

On June 1, at the last board meeting with Peter Fischer as president, Sabrina Brossard recalled the history of the family business, whose international expansion was initiated by her father in the 1980s. The family business was founded in 1954 by Sabrina Brossard's grandfather, Walter Werner Fischer. An expert engineer in vacuum technology, he developed the world's first hermetic connector, launching a company recognized by design engineers worldwide for its products and solutions for high-performance connectivity in extreme environments.

The Conextivity group is enjoying steady double-digit annual growth, has doubled its order intake in seven years and its R&D staff in five. Beside electronic cables and connectors, Fischer has the FiberOptic series, multimode or single-mode, available with one, two, or four optical channels, or as a hybrid connector with two optical channels and two electrical contacts.

https://conextivity.com

Edmund Optics appointed new chief financial officer

Linda Fonner is the new CFO of Edmund Optics. She has more than thirty years of global management experience with companies such as Phillips & Cohen, Atotech (an FMD brand), Bristol-Myers Squibb, West Pharmaceutical and Vesuvius, a Cookson Group company.

During her career, she has led financial and operational transformations in chemical manufacturing, pharmaceutical distribution, medical device manufacturing, and high-temperature ceramic castings for the steel, foundry, and glass industries. She has expertise in setting collaborative strategy, long-term planning, mergers and acquisitions, global financial operations, and system implementations.

www.edmundoptics.com

Source: Edmund Optics

Linda Fonner

ALSO OF INTEREST

Your daily quantum of photonics news

WIN NEWS

Edmund Optics and ISP Optics enter into distribution agreement

Edmund Optics customers can now source products directly from ISP Optics

CrayoNano and AquiSense sign commercial frame contract

The contract contains sales of UV-C LED components valued at about 4 million NOK over the next 12 months.

Matrix Vision becomes Balluff

Matrix Vision and Balluff combine their competencies in the field of image processing – and continue to expand the service portfolio. The Oppenweiler location will remain.

CT to perform rapid evaluations of 3D-printed components

ORNL's machine-learning algorithm Simurgh is now licensed to be used for rapid evaluations of additively manufactured components with industrial X-ray computed tomography.

Quix Quantum completes its C-suite executives

Kathy Willing is appointed the new chief financial officer.

Edmund Optics appoints new sales director

dmund Optics has appointed Alexis Liagre as Sales Director EMEA

New CEO for the Diamond Light Source

Professor Gianluigi Botton has been appointed as the new chief executive officer for the UK's national synchrotron.

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WIN NEWS

Shimura Masayuki joins Quantum Science

The new commercialization director will oversee the company's activities to drive further growth for its quantum dot materials. Based in Japan, Mr Masayuki brings a wealth of industry experience, including more than forty years of expertise in CMOS image sensor design, camera system development, and new imaging technology research.

Before joining the business side, he held senior leadership positions at companies including Sony Semiconductor Solutions, Huawei, and SK Hynix, and has eighty publications as well as seventy patents.

Mr Masayuki's appointment follows the expansion of Quantum Science's operations in Japan last year when the business signed a distribution deal with Nishimura Chemitech, bringing its Infiq quantum dots to major semiconductor businesses.

Source: Quantum Science

Shimura Masayuki

Dr Hao Pang, CEO and founder of Quantum Science, said: "As our infrared quantum dot technology rapidly approaches consumer markets, appointing a commercialization director with the level of expertise that Mr Masayuki has underlines our commitment to providing the best in QD materials, technologies and solutions."

https://quantumscis.com

New director for Riedel Kooling

Since June 1, 2023, the former business unit manager Oliver Blume is the new director of the cooling business unit of Glen Dimplex Deutschland for Riedel Kooling in the european, middle eastern and african regions and leads the teams in sales, service and solutions, finance, marketing and communication, development and production. He also ensures synergies within the precision cooling division at the sites in Germany, USA, and China.

Blume is a qualified industrial clerk, studied business administration and languages at the universities of Paderborn and Stockholm and has twenty years of practical experience in the sanitary, heating and air conditioning industry. He was active in the marketing, product management, and sales, and also worked in various EU countries – more than 15 years of which in management positions at global companies such as Stiebel Eltron, among others. From 2018 to 2021, he headed the Glen Dimplex heating and ventilation business unit. He has worked as an independent management consultant and coach since 2021.

Source: Glen Dimplex

Oliver Blume

Riedel Kooling is an innovative manufacturer of sustainable and individual cooling solutions for a wide range of applications in the professional environment, from laser machines to magnetic resonance tomographs, and 3D printers.

https://riedel-kooling.com

Epolin welcomes head of R&D

The organic chemist Konstantyn Ziabrev joins the manufacturer of NIR absorbing dyes and thermoplastic compounds as R&D director. Ziabrev has twenty years of international academic and industrial experience. He is skilled in advanced methods of synthetic organic chemistry, multistep chemical transformations, and modern analytical methods.

He was most recently with Click Chemistry Tools and Fluoroprobes, Scottsdale, Arizona, where he developed, synthesized, and analyzed fluorescent dyes and click chemistry reagents for bioconjugation. He perfected chemical procedures and wrote standard procedures for the synthesis of compounds while performing custom synthesis of functionalized dyes.

He earned his PhD in organic chemistry with a focus in dye technology from the Institute of Organic Chemistry, Ukrainian National Academy of Sciences.

Source: Epolin

Dr Konstantyn Ziabrev

Michael Crosby, president, Epolin, said: "Konstantyn's specialized NIR dye synthesis expertise will accelerate expansion of our dye portfolio to meet the expanding light management needs of our customers." Konstantyn, in conjunction with Epolin's technical marketing group, will deliver dye solutions for light filtration within eye protection and electronic sensor applications. This addition will enhance development and synthesis capability.

Epolin, a division of Chroma Color, develops and manufactures materials that deliver premium performance in applications like laser and welding eyewear, security inks, light filters, display materials, and night vision products.

https://epolin.com

Vision Engineering: Sam Crossley takes over operational management

Source: Vision Engineering

Sam Crossley

On July 1, 2023, Sam Crossley took over as managing director of Vision Engineering. CEO Mark Curtis (64), is stepping back from the operational side of the business, now focusing on the strategic direction of the company.

Sam Crossley as a former member of the leadership team of Rotork, a manufacturer of actuators with over 3,700 employees, has in-depth market knowledge in the oil and gas, petrochemical, mining and automation sectors. His international experience includes managing the company's growth globally.

Crossley comments: "There are plenty of exciting opportunities to grow the business, and I will be focussing on these over the coming years. Vision Engineering has a well-deserved brand and reputation and I am delighted to be leading it into its next phase of global growth."

www.visioneng.de

Precise deburring with laser radiation

Manufacturer: Nanosystec
Product: High-precision manufacturing station "VersaCut" that removes burrs from mechanical processing with laser radiation.
Background: Compared to conventional techniques, the laser-based material processing shows various advantages that also help for the deburring of precision piece parts. Mechanical manufacturing processes such as drilling or milling often leave unwanted burrs, affecting the functionality of the devices. In the high-precision manufacturing station, a laser beam removes these burrs in one processing step. Neither tool wear nor deformation caused by mechanical forces occur using this non-contact method.
Features: High resolution machine vision and multicolor LED illumination

support the various process steps. Device-specific algorithms guarantee the flawless recognition of even complex structures with a precision in the micrometer regime. An XY scanner uses the data to guide the laser beam to the correct position and to handle any structures. Focus diameter and laser intensity can be adapted during the process to the respective task.
A large variety of laser sources can be integrated. In most cases, VersaCut uses robust and maintenance-free lasers with pulse durations of several ten nanoseconds and high repetition rates. Magazines, feeders, belts and robots enable full automation while exchangeable gripper units provide maximum flexibility.

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Deburring Expo, Karlsruhe, Germany, booth 708

Research-grade confocal Raman microspectroscopy goes mobile

Manufacturer: Witec, part of the Oxford Instruments group
Product: Portable research-grade confocal Raman system "alphaCART" for on-site chemical characterization with all the speed, sensitivity, and resolution of WITec's renowned stationary instruments
Background: Investigations in archaeology, the arts and cultural heritage, and geoscience are often conducted in the field or secure storage facilities. Materials science, process and civil engineering, and gas analysis experiments are regularly performed outside of conventional lab environments. The new system was developed to equip researchers working in these conditions with uncompromised analytical power.
Features: The novel instrument bundles a freely positionable, fiber-coupled Raman probe with a laser, spectrometer, and laptop computer into a robust rolling flight case. It provides high signal sensitivity as well as diffraction-limited resolution and confocality. These features enable measurements through and within transparent materials and render weak Raman scatterers visible even amidst a high background. alphaCART also offers integrated white-light illumination and a color video camera for detailed sample surveys. The system leverages the modularity of the alpha300 microscope series and shares its full range of upgrade possibilities and accessories. Excitation lasers of various outputs are available in 532 nm, 633 nm, or 785 nm, and others can be supplied upon request. Ultra-high-throughput wavelength-optimized spectrometers, microscope objectives and positioning hardware are also customer-configurable.

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Balanced photoreceivers up to 500 MHz

Manufacturer: Femto Messtechnik
Product: The low-noise balanced photoreceivers of the "HBPR" series enable the differential measurement of optical signals with wavelengths from 320 nm to 1,700 nm and bandwidths up to 500 MHz. The photoreceivers are ideally suited for highly sensitive and precise acquisition of laser pulses, even with high repetition rates and rapidly changing signal shapes, e.g. as required in quantum state tomography. The optical inputs are optionally free space or fiber-coupled to ensure maximum compatibility with common optical accessories.
Features: The photoreceivers use two photodiodes selected in pairs, which are connected in antiparallel, and a subsequent low-noise transimpedance amplifier to detect the differential signal. The series is characterized by a very low input

noise (NEP) down to 3.7 pW/√Hz and a high common mode rejection (CMRR) of up to 55 dB. Various models with Si or InGaAs photodiodes and bandwidths from 100 MHz to 500 MHz are available. The output coupling is switchable (AC/DC), the gain can be set in two stages and the bandwidth can be limited to 20 MHz. Two monitor outputs with 10 MHz bandwidth enable fast, separate acquisition of the individual input signals.
Applications: Optical spectroscopy, coherent heterodyne detection, homodyne detection of optical quantum states, optical coherence tomography (OCT), differential optical front end for oscilloscopes, spectrum analyzers, A/D converters and lock-in amplifiers.

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Multiline laser for life science applications

Manufacturer: Cobolt, a part of Hübner Photonics
Product: "Cobolt Skyra" multiline laser platform that simplifies laser use for both researchers and equipment manufacturers by offering up to four laser lines permanently aligned in a compact package and requiring no external electronics. It is designed for the next generation of bioimaging research as well as compact and easy-to-use analytical instrumentation for the life science market.
Features: The platform is manufactured using proprietary "HTCure" technology which ensures a very high level of immunity to varying environmental conditions along with exceptional reliability. With demonstrated lifetime capability and several thousand units installed in the field, the lasers of the manufacturer have proven high reliability and performance both in laboratory and industrial environments. They are offered with broad warranty terms.

Hübner Photonics manufacture high performance lasers for advanced imaging, detection and analysis. Amongst the range of lasers offered, from cw to femtosecond, diode lasers to single-frequency tunable lasers as well as laser combiners and multiline lasers, they offer solutions to suit most life science applications like the above-mentioned laser platform.

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3D-printing method to build structures with two metals

Printed bimetallic material proven to be significantly stronger than either metal alone

Taking a cue from the structural complexity of trees and bones, Washington State University engineers have created a way to 3D-print two types of steel in the same circular layer using two welding machines. The resulting bimetallic material proved to be 33 % to 42 % stronger than either metal alone, thanks in part to pressure caused between the metals as they cool together. The new method uses commonplace, relatively inexpensive tools, so manufacturers and repair shops could use it in the near term. With further development, it could potentially be used to make high-performance medical implants or even parts for space travel, said researcher Amit Bandyopadhyay.

The team borrowed the idea from nature, noting that trees and bones get their strength from the way layered rings of different materials interact with each other. To mimic this with metals, the researchers used a hybrid setup that creates parts using precise CNC computer programming and two welding heads.

The two welding heads work one right after the other on a circular layer to print two metals, each with specific advantages. A corrosion-resistant, stainless-steel core was created inside an outer casing of cheaper mild steel like that used in bridges or railroads. Since the metals shrink at different rates as they cool, internal pressure was created – essentially clamping the metals together. Tests on the result showed greater strength than either stainless steel or mild steel have on their own. Currently, 3D printing with multiple metals requires stopping and changing metal wires. The new method eliminates that pause and puts two or more metals in the same layer while the metals are still hot.

"This method deposits the metals in a circle instead of just in a line," said doctoral student Lile Squires. "This allows one material to bear hug the other material, which can't happen when printing in a straight line or in sandwiched layers." The capability to strengthen 3D-printed metal parts layer-by-layer could give automotive shops new options soon. Bimetallic, torque-resistant axle shafts or cost-effective, high-performance brake rotors could be developed. (Source: WSU)

Source: WSU

Part of the new hybrid setup that creates parts using precise computer programming and two welding heads.

Reference: *L. Squires* et al.: Radial bimetallic structures via wire arc directed energy deposition-based additive manufacturing, Nat. Commun. **14**, 3544 (2023); DOI: 10.1038/s41467-023-39230-w

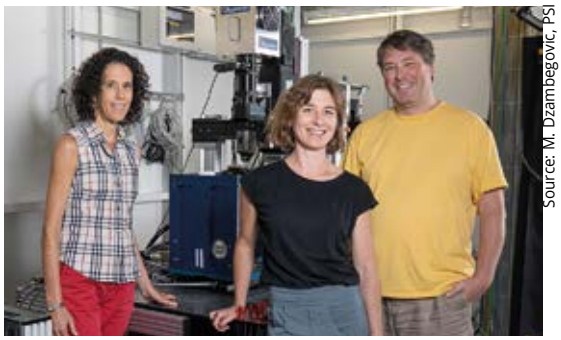
3D insights into 3D printing

3D tomograms with a speed allowing to follow the laser spot during laser-based powder bed fusion

Additively manufacturing ceramic objects with the help of a laser is a difficult challenge. Now researchers at the Paul Scherrer Institute PSI have for the first time taken tomograms revealing what happens at a microscopic level during this fabrication process. The findings will help to improve this very promising technology. Exactly what happens during the laser-based powder bed fusion (LPBF) process has already been investigated using X-rays, but these microscopic insights have only provided 2D images to date.

The researchers wanted to obtain 3D tomograms at a speed allowing the laser spot to be followed. To do so, they had to rotate their sample during the manufacturing process and track this rapid rotary movement with the laser – a major challenge. The scientists used aluminum oxide for their experiments. This ceramic material is typically used, for example, in the chemical industry for components exposed to high temperatures, in electrical engineering as an insulator, or in medicine for implants. Because this material is extremely hard and brittle, however, fabricating complex shapes with conventional technology presents huge challenges. "It would be much easier if one could print such components," says PSI physicist Steven Van Petegem. When printing aluminum oxide, however, it is still difficult to obtain a sufficiently dense material and the desired microstructure.

"Thanks to the fast GigaFRoST camera, an in-house PSI development, and a highly efficient microscope, it was possible to acquire 100 3D images each second during the printing process," explains beamline scientist Federica Marone. The shape of the melt pool surprised the researchers. When they increased the power of the laser, no depression formed on the surface, as expected. "Instead the melt pool spread out like a pancake and the surface was more or less flat," the material scientist comments. The researchers could also observe how pores and hollows formed as the material hardened, which is important for future applications. "Ideally one would like to have a smooth, attractive material with a well-defined microstructure. But a certain amount of porosity is also very desirable for specific applications," explains Makowska. (Source: PSI)



Source: M. Dzambegovic, PSI

Federica Marone, Malgorzata Makowska and Steven Van Petegem (l–r) at the SLS experimental station where the 3D images were successfully taken.

Reference: *M. G. Makowska* et al.: Operando tomographic microscopy during laser-based powder bed fusion of alumina, Commun. Mater. **4**, 73 (2023); DOI: 10.1038/s43246-023-00401-3

Civan Lasers breaks green power world record

500-W single-mode cw laser at 532 nm presented, marking a world record for such a laser type

This green laser stands apart from others on the market because of its exceptional beam quality, a feature hard to attain with current laser technology. While traditional lasers try to get high brightness by pushing power through a single crystal channel, risking damage over time, our laser employs the coherent beam combining (CBC) method. This approach combines multiple lasers into one coherent beam without endangering a single crystal, ensuring longer-lasting and dependable performance.

Coherent beam combining brings a suite of advantages: it can produce high-power cw single-mode beams, offers scalability for even greater power levels, and introduces power modulation capabilities – a significant advancement given that 532 nm lasers typically require stable crystal temperatures. With CBC, this dependency is eliminated. Furthermore, CBC provides the versatility of delivering green with IR, paving the way for diverse material processing applications.

500 watts single-mode cw laser operating at 532 nanometers. (Source: Civan Laser)

The laser was conceived and developed as part of the EurekaCBC Green project, a collaborative effort involving Fraunhofer IWS, Siemens, and Thyssenkrupp. Following its development, the laser will be sent to Fraunhofer IWS where they will spearhead the process development for Siemens and Thyssenkrupp and further explore the laser's capabilities and potential applications.

The high-power, single-mode, continuous-wave green laser shows great promise in a range of material processing applications. These include welding highly reflective materials such as copper, welding in the semiconductor domain – particularly chip-to-wafer welding, which could serve as an alternative to traditional wire bonding processes – and metal additive manufacturing (AM) of copper. While these are some of the immediate applications identified, the scope of this laser technology is vast. Its potential stretches beyond what is currently known, suggesting that there are still uncharted territories and innovative applications awaiting discovery.

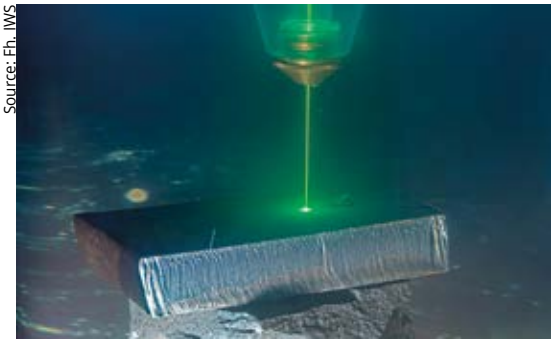
The trajectory of development for the green laser product is ongoing. Civan Lasers intends to advance the prototype by cutting its size by half, dramatically lowering its cost, amplifying its power capabilities, and introducing a dynamic beam within the green laser.

www.civanlasers.com

Underwater laser cutting

A technological approach to use lasers as particularly efficient, environmentally friendly, and energy-saving cutting tools in water

Source: Fh. IWS



A green laser is used to cut steel and metals in the sea.

Given the increasing demand for renewable energy sources, the need for modern dismantling technologies for underwater use is also growing. For example, to bring a wind power plant in the sea up to more power, old steel frames must first be dismantled below sea level to rebuild them later in a larger size.

The Frauenhofer researchers use particularly short wavelength green lasers to cut steel and other metals below the water surface. At the same time, the water serves as a tool to expel the resulting melt from the kerf with pressure. This eliminates power losses, extra gas lines, and other disadvantages.

Green lasers in the class over one kilowatt class have become available to achieve the necessary cutting power. In the future, shorter-wavelength versions with blue lasers are conceivable. Such short-wave lasers penetrate even water without significant losses.

Compared to today's common cutting methods with saws, automatic saw wires, and plasma cutters, underwater laser cutting is expected to achieve several advantages: "The process requires comparatively little energy, and the power transmission is more efficient," emphasizes project leader Dr Patrick Herwig, who heads the laser cutting group at the IWS. He adds that this approach also allows the construction of particularly compact underwater robots with laser attachments. Previously difficult to reach areas of underwater structures could be accessed by small robots more easily and efficiently than the sawing machines used today.

Professor Christoph Leyens, director of Fraunhofer IWS, describes the economic and social relevance of the innovative technology: "Seventy percent of the earth consists of water. In the future, humanity must increasingly use these offshore reserves to develop and expand environmentally friendly energy sources. We need new underwater manufacturing technologies like our laser cutting solutions. Until now, water has been seen as the 'enemy'. We are reversing that and understanding it as a 'friend'." In the next step, the researchers want to further develop their lab-scale proven concept into practically applicable systems.

www.iws.fraunhofer.de

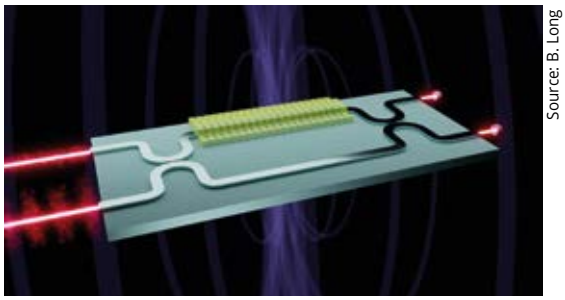
Quantum-scale technologies for better sensors

UC Santa Barbara joins the NSF's Quantum Sensing Challenges program

The main advantage to be gained from the realm of quantum sensing is its extreme sensitivity and accuracy, able to capture the faintest of signals and measure at the smallest of scales. Now, several UC Santa Barbara researchers are poised to deploy their expertise in quantum science as part of the US National Science Foundation's (NSF) program Quantum Sensing Challenges for Transformational Advances in Quantum Systems (QuSeC-TAQS). They join a cohort of eighteen research teams at universities across the US backed by a 29 million dollar investment from NSF to explore ways to harness the infinitesimal and sometimes counterintuitive quantum-scale properties of nature to create opportunities at the human scale.

The teams will each receive one to two million dollars over four years to conduct a broad range of exploratory research activities. The potential impacts are diverse, from the ability to sense gravitational waves as they ripple across space, to a means for witnessing the inner functions of living cells. NSF director Sethuraman Panchanathan said: "We are now taking the next step in quantum research through these projects and others, which combine fundamental research with potential applications that can positively impact our lives, our economic prosperity and our competitiveness as a nation."

A magnetometer measures a magnetic field, and in doing so provides important information about targets in relationship to that field. Scientists continue to leverage the elegant power of that technology in a growing list of applications, from archaeology to space exploration. Galan Moody and Paolo Pintus aim to bring the high precision of quantum sensing to magnetometry, and build it all onto a chip. Their proposed photonic integrated magneto-optic interferometer would be unprecedented in its sensitivity – a ten-time enhancement beyond the standard quantum limit – built into a compact, energy efficient device that can be used to detect minute magnetic fields with applications for navigation, geosciences and biomedicine, as well as space exploration. Key to this novel, low-SWaP (size, weight and power) device is the use of quantum light. "We can build on decades of research and development to make magneto-optical sensors that do not require any other bulky instrumentation, making them compact and portable," said Moody, whose expertise lies in quantum photonics. "Usually, these sensors are powered by lasers, but there is a limit to their sensitivity. Instead, by using squeezed light we can go beyond this limit." (Source: UCB)



Source: B. Long

Illustration of a quantum magnetometer on a chip.

Paving the way for advanced quantum sensors

New study explores finite-range interactions for creating entanglement

Metrological institutions around the world administer our time using atomic clocks based on the natural oscillations of atoms. These clocks, pivotal for applications like satellite navigation or data transfer, have recently been improved by using ever higher oscillation frequencies in optical atomic clocks. Now, scientists at the University of Innsbruck and the Institute of Quantum Optics and Quantum Information (IQOQI) of the Austrian Academy of Sciences led by Christian Roos show how a particular way of creating entanglement can be used to further improve the accuracy of measurements integral to an optical atomic clock's function.

With the support of theorist Ana Maria Rey from JILA in Boulder, the Innsbruck physicists tested the measurement accuracy on an entangled ensemble of particles in the laboratory. The researchers used lasers to tune the interaction of ions lined up in a vacuum chamber and entangled them. "The interaction between neighboring particles decreases with the distance between the particles. Therefore, we used spin-exchange interactions to allow the system to behave more collectively," explains Raphael Kaubrügger from University of Innsbruck.

All 51 particles in the chain were entangled with each other and produced a squeezed quantum state in which measurement errors can be roughly halved in relation to individual particles. Previously, entanglement-enhanced sensing mainly relied on infinite interactions, limiting its applicability to only certain quantum platforms. With their experiments, the quantum physicists were able to show that quantum entanglement makes sensors even more sensitive.

"We used an optical transition in our experiments that is also employed in atomic clocks," says Roos. This technology could improve areas where atomic clocks are currently used, such as satellite-based navigation or data transfer. Moreover, these advanced clocks could open new possibilities in pursuits like the search for dark matter or the determination of time-variations of fundamental constants. Christian Roos and his team now want to test the new method in two-dimensional ion ensembles.

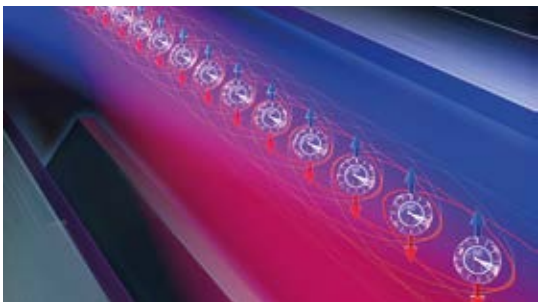


Illustration: Innsbruck physicists entangled all particles in the chain with each other and produced a squeezed quantum state. (Source: S. Burrows et al., JILA)

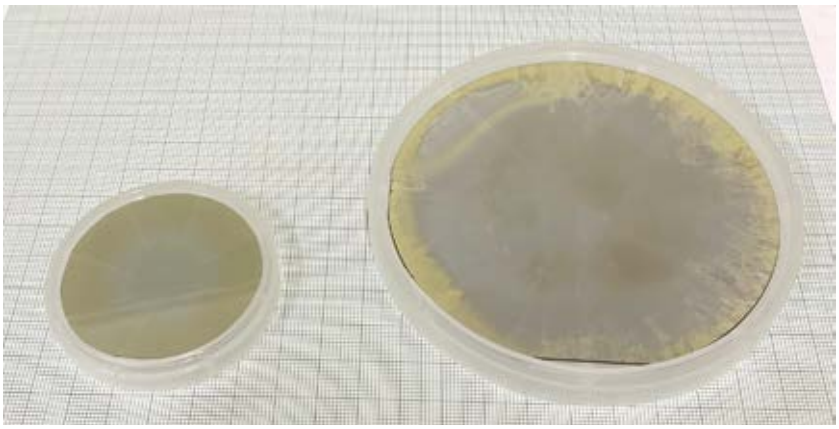
Reference: *J. Franke* et al.: Quantum-enhanced sensing on optical transitions through finite-range interactions, Nature, online 30 August 2023; DOI: 10.1038/s41586-023-06472-z

Crystal IS and Asahi Kasei produce first four-inch aluminum nitride substrate

Scalability of Crystal IS processes for growing AlN bulk single-crystals demonstrated

Aluminum nitride substrates have low defect densities, high UV transparency, and low concentrations of impurities. AlN is attractive for a variety of industries, such as UVC LEDs and power devices, due to its ultra-wide bandgap and very high thermal conductivity. The four-inch substrate produced shows a usable area of over 80 percent based on current requirements for UVC LEDs.

Founded in 1997 to develop native aluminum nitride substrates, Crystal IS manufactures UVC LEDs on its commercial process for two-inch diameter substrates. These LEDs enable industry-leading reliability and performance at the ideal germicidal wavelengths from 260 nm – 270 nm. The current capacity of the facility can meet the volume requirements for consumer devices using UVC LEDs based on the existing two-inch production line.



Source:Asahi Kasei

Crystal IS four-inch diameter bulk aluminum nitride substrate comparison

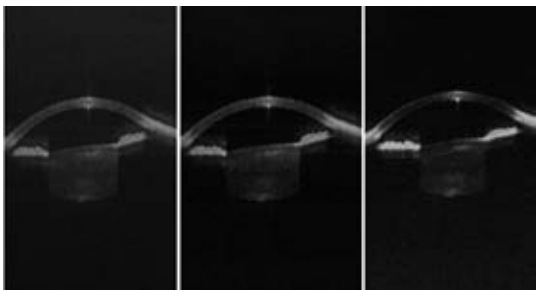
Crystal IS currently produces thousands of two-inch substrates annually to support the production of its Klaran and Optan product lines.

https://cisuvc.com
www.asahi-kasei.eu

Low-cost technology for easier eye imaging

Inexpensive laser could increase access to optical coherence tomography imaging

Austrian researchers have shown that a vertical cavity surface emitting laser (VCSEL) diode could offer a less expensive light source for swept-source optical coherence tomography (OCT). This advance could lead to ophthalmologic OCT systems that are practical for use outside the ophthalmology clinic, even at home. "OCT has become a standard imaging tool in ophthalmology for the diagnosis and monitoring of diseases like glaucoma, macular degeneration and diabetes-related retinopathy," said Milana Kendrisic from the Medical University of Vienna. "However, the price of laser sources and the complexity of OCT systems hinder its accessibility outside of clinics and hospitals, in particular for home care or point-of-care use."



Source: Optica

VCSELs could offer a less expensive light source for swept-source optical coherence tomography (OCT).

Although single-mode VSCELs usually operate using a constant current, the researchers varied the current to achieve the changes in the wavelength, or color, needed for swept-source OCT. The researchers used their setup, that incorporates a VCSEL and advanced post-processing algorithms, to obtain full-eye scans on a healthy volunteer. "We want to develop a low-cost OCT device that could be used in a general practitioner's office, a pharmacy or even a supermarket to allow eye checkups without going to the ophthalmologist," said Kendrisic. "It could also allow home-based treatment monitoring for patients with age-related macular degeneration or eye health in diabetes patients to monitor treatment or catch abnormal changes early, avoiding loss of vision and ultimately preserving quality of life. This might be done by renting an easy-to-use device from your health insurance provider, for example."

Swept-source OCT is a relatively new approach that became clinically available for eye imaging in 2010. It uses a laser that changes wavelengths over time to enable high-quality visualization of multiple parts of the eye. Although this new approach reveals details that are being used to better understand and diagnose eye disorders, swept-source lasers usually cost tens of thousands of dollars. In the new work, the researchers set out to see if a much cheaper VCSEL diode could be used in place of the expensive swept-source laser. While VCSEL diodes typically produce a laser output beam at a certain well-defined wavelength, if the diode's operating temperature changes, the output wavelength will also change.

After figuring out the best way to increase current to the VCSEL without damaging the laser while also ensuring the best possible resolution for imaging, the researchers incorporated it into an optical setup for performing ophthalmic OCT imaging. (Source: Optica)

Reference: *M. Kendrisic* et al.: Thermally tuned VCSEL at 850 nm as a low-cost alternative source for full-eye SS-OCT, Opt. Lett. **48**, 3079 (2023); DOI: 10.1364/OL.489050

www.cdg.ac.at

Tiny endomicroscope for deep-brain observations

New device could help to understand neuronal communication better

Minimally invasive technologies providing images from delicate deep-brain tissues are required in order to investigate the activity of neuronal structures as well as the interaction of nerve cells. A new hair-thin endomicroscope, developed by an international team with the participation of Leibniz Institute of Photonic Technology (IPHT) in Jena, Germany, promises extremely gentle in-depth observations. It offers the potential to investigate areas of the brain in great detail and to study the onset and progression of severe neuronal diseases. The instrument is expected to help neuroscientists in defining new strategies to combat these debilitating conditions.

With a diameter of only 110 µm, the new endoscope is enabling the acquisition of images at an unprecedented tissue depth and at the subcellular level. This not only allows research into deep-residing brain structures, which were previously difficult to access, but also to precisely study the neuronal connectivity and signaling activity of individual neurons in the brain. "At the heart of the endoscopic system is an ultrathin optical glass fiber that serves as a probe. Using digital holography, we can use it to image and visualize individual cells and blood vessels with high resolution, distortion-free and with high contrast," explains Tomáš Čižmár, fiber research and technology department head at the IPHT.

The researchers have also exploited a new type of fiber probe, a side-view probe, which allows observation of the tissue perpendicular to the fiber axis. In this way, the tissue being imaged is much less stressed and damaged by the insertion of the endoscope into the tissue than by using conventional bare-terminated probes. (Source: Leibniz IPHT)

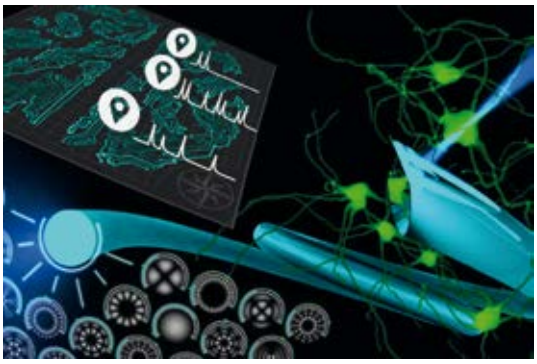


Illustration of the new fiber endoscopic concept of the researchers from Brno and Jena that will advance neuroscience. (Source: T. Čižmár)

Reference: *M. Stiburek* et al.: 110 µm thin endo-microscope for deep-brain in vivo observations of neuronal connectivity, activity and blood flow dynamics, Nat. Commun. **14**, 1897 (2023); DOI: 10.1038/s41467-023-36889-z

Shrinking endoscopes with metaoptical fibers

New device captures real-time full color scenes with a one millimeter diameter coherent fiber bundle

Ultracompact, agile endoscopes with a large field of view (FoV), long depth of field (DoF), and short rigid tip length are essential for developing minimally invasive operations and new experimental surgeries. As these fields develop, the requirement for miniaturization and increased precision becomes progressively demanding. In existing endoscopes, the rigid tip length is a fundamental limitation of the device's agility within small tortuous ducts, such as an artery. It is primarily constrained by the size of the optical elements required for imaging, so alternative solutions are urgently needed to reduce the tip length. A team of scientists led by Johannes Fröch and Arka Majumdar from the University of Washington (UW) have developed a novel technique for reducing the rigid tip length.

Existing solutions include lensless and computational imaging with single fibers or coherent fiber bundles. However, these are typically limited to a short working distance and often extremely sensitive to bending and twisting of the optical fiber, affecting or even precluding accurate computational reconstruction. Flat metaoptics are an emerging and versatile idea in the photonics community to create miniaturized optical elements. These are subwavelength diffractive optical elements composed of nanoscale scatterer arrays.

Flat metaoptics are compatible with high-volume semiconductor manufacturing technology and can create disposable optics. These properties have already inspired researchers to explore the potential of meta-optics for endoscopy, including fiber-integrated endoscopy, side-viewing single fiber scanning endoscopy, and scanning fiber forward-viewing endoscopy. Unfortunately, metaoptics traditionally suffer from strong aberrations, making a large FoV and full-color imaging challenging. So far, these limitations have restricted most metaoptics endoscopes to single wavelength operation, although a metaoptic doublet was recently a metaoptic doublet was demonstrated in conjunction with a coherent fiber bundle for polychromatic imaging. Such polychromatic imaging is unsuitable for broad-band illumination, which is often the case for clinical endoscopy.

The UW team have now demonstrated an inverse-designed metaoptic optimized to capture real-time full color scenes with a 1 mm diameter coherent fiber bundle. The metaoptic enables operations at an FoV of 22.5°, a DoF of >30 mm and a minimum rigid tip length of only ~2.5 mm. This is a 33 % tip length reduction compared to a traditional commercial gradient-index (GRIN) lens integrated fiber bundle endoscope. This is due to the shorter focal length and the ultrathin nature of the metaoptic.

At the same time, comparable imaging performance and working distance are maintained. By ensuring that the meta-optic has a modulation transfer function (MTF) within the limitations of the fiber bundle, the research team achieved full-color operation without requiring a computational reconstruction step, thus facilitating real-time operation. (Source: LPC / CAS)

Reference: *J. E. Fröch* et al.: Real time full-color imaging in a Meta-optical fiber endoscope, eLight **3**, 13 (2023); DOI: 10.1186/s43593-023-00044-4

https://labs.ece.uw.edu/amlab

DGaO Deutsche Gesellschaft für angewandte Optik
The German Branch of the European Optical Society

RWTH AACHEN UNIVERSITY

INVITATION AND PROGRAM CALL

The German Society for Applied Optics (DGaO) invites you to the

125TH ANNUAL MEETING OF THE DGaO

21 – 25 May 2024 in Aachen, Germany
at the RWTH Aachen University

The following main topics from applied optics will be in focus:

- **Optical metrology and measurement systems**
- **Optical design**
- **Optical systems for digital photonic production**
- **Laser and high power optics**
- **Optomechanics**
- **Systems and applications for EUV and high energy photons**

Source: RWTH Aachen

Call for abstracts

We invite you to submit oral presentations (12 minutes) and posters from the list of topics above or from the general field of applied optics. Please use the online system at https://www.dgao.de. The abstracts should not exceed 1,200 characters (including blank characters). The conference language is German, but English contributions are also welcome.

DGaO Young Scientists Award

The DGaO will once again award the DGaO Young Scientists Award in 2024 for the best dissertation and for the best master's thesis of 2023 in the field of applied optics. Detailed information is available on the DGaO website. Nominations for the DGaO Young Scientists Award can be submitted until January 31st 2024 to the DGaO office (dgao-sekretariat@dgao.de).

Program Committee

Prof Dr Christian Faber, Hochschule Landshut (Chair); Prof Dr Carlo Holly, RWTH Aachen University (Conference Manager); Dr Alexander Bielke, ASML Berlin; Dr Robert Brüning, Fraunhofer IOF Jena; Dr Ulrike Böhm, Carl Zeiss AG Oberkochen; Adrian Grewe, Carl Zeiss AG Jena; Marco Hanft, Carl Zeiss AG Jena; Dr-Ing Christian Hinke, RTWH Aachen University LLT; Dr-Ing Oskar Hofmann, RWTH Aachen University TOS; Dr Meike Hofmann, TU Ilmenau; Christof Pruß, ITO Universität Stuttgart; Dr Henning Rehn, Fisba AG St. Gallen; Christian Schober, ITO Universität Stuttgart; Dr Christian Sinn, Köln Optik; Dr-Ing Martin Traub, Fraunhofer ILT

Deadlines

Submission of abstracts:	**by January 9th 2024, (receipt)**
Notification of acceptance:	**10th February 2024**
Program mailing and publication:	**31st March 2024**
Binding registration:	**from the beginning of March 2024**
End early-bird registration:	**by April 14th 2024**

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EOSAM brought together photonics experts in Dijon

Review: European Optical Society Annual Meeting, 11 – 15 September 2023, Dijon, France

EOSAM 2023 was held in the Palais des Congrès de Dijon, organized this year with the French Optical Society (SFO), one of the seventeen national optical societies of the European Optical Society (EOS), which celebrated their 40-year anniversary, bringing together founders of the SFO, the presidents, and secretary generals throughout the years.

Nine topical optical meetings, four focused sessions on selected hot topics deemed to be of special interest to conference attendees. EU project sessions, early stage researcher sessions, and sessions on the industrial mastering of optical technologies and systems were scheduled in parallel in large rooms or the big auditorium to accommodate more than 500 attendees.

The exhibition and industrial program fostered relations between science and industry. Many PhD level students attended the conference; master-level students were also given a chance to come and join the tutorials on Monday. Ten tutorial speakers took the stage before the official opening of the conference on Tuesday: Sébastien Bidault, Julien Charton, Sara Ducci, John Dudley, Oliver Fähnle, Philippe Grelu, Sandrine Lévêque-Fort, Rüdiger Paschotta, Roozbeh Shokri, and Antoine Dubrouil.

The exhibition involved twenty companies, exhibiting from Tuesday to Thursday. Common for all coffee and lunch breaks was a nice buzzing sound of people excitedly exchanging ideas, information and contacts. Around ninety posters were presented on Wednesday and Thursday, with the posters kept on poster boards both days to allow sufficient time for discussions.

EOSAM included a high-level program, with six exceptional plenary speakers and two plenary award speakers: Thomas Ebbesen, Ursula Keller, Fabio Sciarrino, Valentina Emiliani, Laura Na Liu, and Jean-Pierre Wolf.

The EOS Prize was awarded to the best paper published in the Journal of the European Optical Society, JEOS-RP, with the title of "Optical diagnosis of gastric tissue biopsies with Mueller microscopy and statistical analysis", authored by Myeongseop Kim, Hee Ryung Lee, Razvigor Ossikovski, Aude Malfait-Jobart, Dominique Lamarque, and Tatiana Novikova.

Joint industrial optics podium session by EPIC and EOS (Source: Wiley)

The ICO 2021 Award was handed to Bo Zhen "for his pioneering research on optical bound states in the continuum, exceptional points, and other topological states in photonics."

The awards for the best student presentations at EOSAM, this year sponsored by Bühler, Evatec and Rhysearch, went to Thibault Wildi, Deutsches Elektronen-Synchotron DESY, Germany, Hritwick Banerjee, École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, and Maxime Romanet, Femto-ST Institute, France.

EOS elects fellows each year from the nominated members of the society to highlight and celebrate people who have contributed to the optics and photonics community. In 2023, the new fellows are: Francesco Baldini, Christophe Moser, and Sébastien Tanzilli. Goery Genty also received his 2022 fellow diploma in Dijon.

An honorary member title was given for an exceptional service to the community for the first time.As elected by the membership in 2022, Hervé Lefèvre received his honorary member trophy at the honorary member ceremony.

The EU project sessions, now organized for the seventh time, included 13 projects. The sessions were chaired by Lydia Sanmartí-Vila, ICFO and Richard Pitwon, Resolute Photonics. This year EOS collaborated with Photonics21 for the program, with the support of Michael Wale and his team.

For the first time, EOSAM included focused sessions on selected hot topics deemed to be of special interest to conference attedendees. The sessions highlight several specific areas that reflect the emerging trends in optics and photonics, this year including specialty optical fibers, structured light, chiroptical phenomena, and machine learning for optics and photonic computing for AI.

The industrial program started with relevant tutorials and was continued with the well-attended sessions on industrial mastering of optical technologies and systems ("IMOTS"), chaired by Oliver Fähnle, EOS industrial committee chair, and Marco Hanft from Carl Zeiss.

The industrial optics podium session focused on successful know-how transfer from R&D to industry. EOS organized the podium together with the European Photonics Industry Consortium, EPIC. The podium was chaired by Oliver Fähnle and Jérémy Picot-Clémente, technology manager at EPIC. The podium included Gauthier Brière from Applied Materials, Aspericon's Sven Kiontke, Samuel Bucourt of Imagine Optic, Pierre Brochard from Sylentsys, and Tematys' Jacques Cochard.

www.europeanoptics.org

EOS teams up with PhotonicsViews

The fruitful parnership with the DGaO, the German branch of the European Optical Society, was elevated to an international level. By approval of the EOS' executive committee (pictured with Oliver Dreissigacker of PhotonicsViews, center), the media partnership now extends to all corporate and individual members of the EOS and any of its National Optical Societies throughout Europe, granting access to all printed issues in addition to the open online content.

www.wileyindustrynews.com/en/photonicsviews

Bernhard Ohnesorge is the new Spectaris chairman

Mirjam Rösch becomes deputy, Amily Guo to head the Hamburg/Schleswig-Holstein regional group

Source: Spectaris

Amily Guo, Dr Bernhard Ohnesorge and Mirjam Rösch (l – r)

Dr Bernhard Ohnesorge, managing director of Carl Zeiss Jena, was elected as the new chairman with over ninety percent of the votes at the general meeting on September 12 in Berlin. Ohnesorge succeeds Ulrich Krauss.

Ohnesorge summarized his priorities for the future work of the association: "We need better political conditions, and to this end we must continue to expand our lobbying work in times of excessive regulation. Our member companies need to be supported above all in recruiting skilled workers and in doing business globally under geopolitical risks." The network across the four Spectaris industries is also to be further strengthened. For the past four years, Ohnesorge has been head of photonics at Spectaris. He would now like to relinquish this office promptly in order to devote himself fully to his new role as chairman.

His previous position as vice chairman had already been filled at the general meeting. Mirjam Roesch, commercial director DACH and managing director at Hoya Lens Germany and chair of consumer optics (ophthalmic optics) at Spectaris, was elected as his successor. In addition, the members elected Amily Guo (Drägerwerk) as the new chairwoman of the Hamburg/Schleswig-Holstein regional group. She succeeds Inga Kuhls (also Dräger).

For the first time, the association bundled its annual industry days, the evening annual reception and the general meeting into a Spectaris future festival. Through three parallel program tracks with renowned speakers, the guests received important suggestions and insights for the current challenges.

www.spectaris.de

Laserlab-Europe AISBL elects new executive director

John Collier of CLF succeeds Jens Biegert of ICFO who has headed the organization since 2021.

(Source: Laserlab-Europe)

Jens Biegert (r) congratulates his successor as Laserlab-Europe director, John Collier

The General Assembly of Laserlab-Europe AISBL, the international not-for-profit association representing 47 leading laser research infrastructures in 22 European countries, has elected John Collier, director of the Central Laser Facility (CLF), an institution of the Science and Technology Facilities Council, UK, as its new executive director.

Prior to assuming the role of executive director, Collier was the vice-chair of the general assembly of Laserlab-Europe AISBL since March 2022 and has been actively involved in the association for many years. Besides his work for Laserlab-Europe, he has led the CLF for over a decade, building it into one of the world's leading research centers using lasers, and establishing the CLF at the heart of major international programmes.

"I am delighted to have been elected the new executive director. I look forward to working with colleagues across Europe to further strengthen and develop laser and photonic-based science throughout the continent.", stated John Collier.

Outgoing executive director Jens Biegert said: "It has been a tremendous honor serving the association. I am proud of our progress and how closely we work together as a European laser community. I am confident that John Collier will provide the leadership and foresight to steer Laserlab-Europe into a promising future. I wish him all the best."

The members of the general assembly congratulate John Collier and thank Jens Biegert for his achievements and commitment in leading the Laserlab-Europe association.

The Laserlab-Europe AISBL provides leadership in laser-based and photonics research and in related technologies through a wide range of world-leading investigative capabilities, user training, and services. The association considers itself to be the home for laser-based research in Europe, formulating and promoting new developments in laser-based research that are pursued in a flexible and coordinated fashion beyond the potential of a national scale.

www.laserlab-europe.eu

Second photonics industry summit in Washington, DC

The day-long SPIE event focuses on optics and photonics as a key enabler of emerging technologies

On 27 September, in Washington, DC, the international society for optics and photonics SPIE will host its second Photonics Industry Summit. The one-day event will bring together leaders from the optics and photonics community, executives within related industries, US government agency representatives, and elected officials. Collectively, they will be sharing their plans and expectations for optics and photonics-related programs in key technology areas, including focused panel discussions on the semiconductor industry, STEM workforce development, and the latest innovations in quantum.

Source: SPIE

Conference at the SPIE Photonics Industry Summit in the US capital

"Building on last year's overwhelming success, I think we have outdone ourselves with the breadth and quality of this year's program," notes Jennifer O'Bryan, SPIE director of government affairs. "If you want a jump-start on positioning your company or institution to work with the US government, you will want to be at this year's Industry Summit."

The event is sponsored by AmeriCom, Edmund Optics, Google, Hamamatsu, Jenoptik, LaCroix Precision Optics, Leonardo Electronics, Optimax, Quartus Engineering, Sydor Optics, Teledyne, Thorlabs, and Toptica Photonics.

https://spie.org

Julie Bentley elected into SPIE presidential chain

The Society's next vice president is a Rochester professor and president of Bentley Optical Design

University of Rochester's **Julie Bentley** has been elected to serve as the 2024 vice president of SPIE, the international society for optics and photonics. With her election, Bentley joins the SPIE presidential chain. She will serve as president-elect in 2025, and as the society's president in 2026.

The 2023 president Bernard Kress, director of XR hardware at Google, made the announcement along with other SPIE election results at this year's Annual General Meeting of the Society on 22 August, during SPIE Optics + Photonics. Terms begin on 1 January 2024.

Bentley, a professor at the University of Rochester's Institute of Optics, who began her academic career in optics as a student at the university, is a recognized expert in designing lenses and optical systems, as well as a much-lauded instructor. She is also a private consultant and holds four patents in optical design and engineering.

An SPIE fellow member since 2012, Bentley has had extensive involvement with the Society. Aside from her popular SPIE courses, she served on the SPIE board of directors 2014 – 17, has served on the Scholarship, IT, Education, Awards, and Publications Committees, has chaired the Joseph W. Goodman Book Writing Award, and has co-authored two books for SPIE Press. In 2022, Bentley received the SPIE Directors' Award, one of the Society's highest honors.

Alongside Bentley, Jennifer Barton, director of the BIO5 Institute at the University of Arizona, will serve as the 2024 SPIE president while Zygo's Peter De Groot will serve as president-elect.

Jim McNally, CEO of StratTHNK Associates, was elected to serve as the 2024 SPIE secretary/treasurer.

The following newly elected society directors will serve three-year terms from 2024 – 2026: **Samuel Achilefu**, professor and chair of the University of Texas Southwestern Medical Center's department of biomedical engineering, **Agnes Huebscher**, Edmund Optics' senior director of global strategic marketing, **Daewook Kim**, associate professor at the University of Arizona's Wyant College of Optical Sciences, and **Michelle Stock**, TracInnovations' director of business development and sales, North America.

Top row, l – r: Julie Bentley, Jim McNally, Samuel Achilefu; bottom row, l – r: Agnes Huebscher, Daewook Kim, Michelle Stock (Source: SPIE)

The SPIE nominating committee accepts recommendations for the election slate on an ongoing basis. Directors, who serve a three-year term, are expected to attend and participate in three board meetings each year.

https://spie.org

Light in space and on Earth

EPIC members discuss how photonics is a game-changer in the fields of defense, aerospace, and life sciences

By replacing or enhancing conventional electrical solutions, photonics technologies are set to revolutionize critical areas such as digital and radio frequency (RF) telecom payloads, sensors, micro lidars, and spectrometers. The impact? Reduced size, weight, power consumption, and improved overall system performance. We discussed it in detail during the Technology Meeting on Photonics for Space at Exail's facilities in Paris, France. One of the most promising breakthroughs in this field is the advent of photonic integrated circuits (PICs). These tiny powerhouses offer chip-scale integration of multiple optical elements, enabling complex functions. With this development, PICs are set to be at the heart of future photonics applications in space.

EPIC members visiting Vigo Photonics, during the EPIC Meeting on Photonics for Defense, held in Poland on 6 and 7 September. (Source: EPIC)

Several key developments were highlighted at the recent EPIC meeting on Photonics for Defense in Poland. High-resolution imaging sensors with enhanced low-light capabilities are now indispensable for critical operations. Meanwhile, directed energy weapons (DEWs) employing advanced solid-state lasers have moved from concepts to being a tangible reality. Notably, secure communications emerged as a prime defense against cyber threats, highlighting the need for innovative encryption techniques.

This September we also held the EPIC Meeting on Photonics for Bio and Life Science Applications at Park Innovaare in Baden, Switzerland. The event provided a dynamic glimpse into the role of photonics innovations in medtech and bioprinting. From high-resolution imaging to cutting-edge bioimaging advancements and advanced spectroscopy, there is no doubt that the future of healthcare and biological sciences is being reshaped by photonics technology.

On the talent front, the HR working group met to develop strategies to attract and retain the best professionals in the photonics sector. A collaborative approach emerged as a potential solution, recognizing that the competition for talent extends beyond the photonics sector. Drawing from a global pool of candidates, photonics companies could work together to attract and retain the best and brightest. One achievement has been the establishment of a career booth at ECOC where exhibitors have been able to advertise their vacancies and interact with potential candidates. For those eager to engage further, mark your calendars for the next meeting on December 15.

Check our calendar of upcoming events and remember to mark the 21st of October on your calendar, the celebration of the Day of Photonics!

www.epic-assoc.com

Upcoming EPIC events:

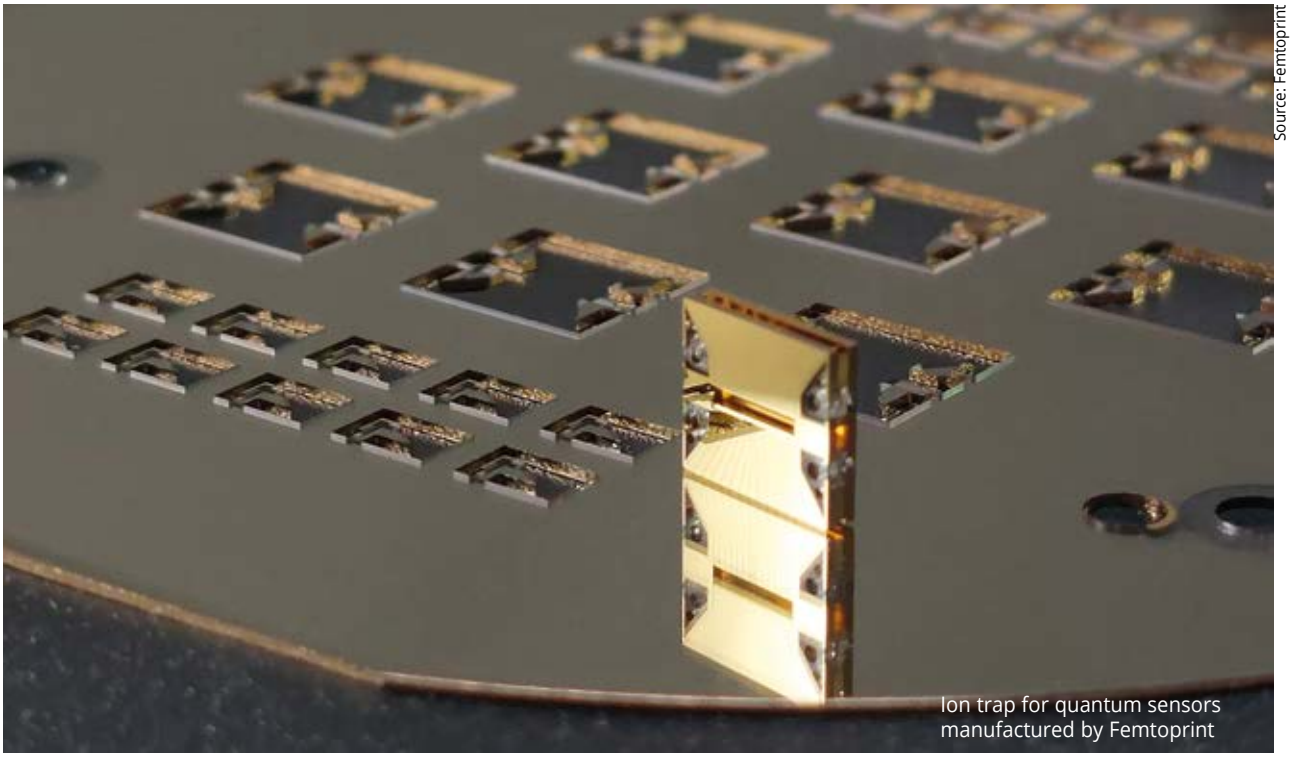
- 21 October 2023
  Day of Photonics
- 23 October 2023
  EPIC Online Technology Meeting on LIDARs on Chips
- 24 – 25 October 2023
  EPIC Meeting on Laser Applications along the Battery Manufacturing Process at Arena2036, Stuttgart, Germany
- 6 November 2023 Online Event
  EPIC Online Technology Meeting on Optical Design and Simulations: Tools and Use Cases
- 7– 8 November 2023
  EPIC Members Investors Meeting in Eindhoven, The Netherlands
- 13 – 14 November 2023
  EPIC Technology Meeting on Microelectronics & Photonics – Two Sides of One Coin, in Munich, Germany
- 15 November 2023
  EPIC TechWatch on Laser and Photonics Application at Compamed High-Tech Forum by IVAM at Medica, Dusseldorf, Germany
- 20 November 2023 Online Event
  EPIC Online Technology Meeting on New Mid-IR Developments for Novel Industrial Manufacturing
- 29 – 30 November 2023
  EPIC Meeting on Photonics-Assisted Cancer Pathology and Surgery at University Hospital Antwerp, Belgium
  EPIC activities at W3+Fair, Jena, Germany
- 30 November 2023
  EPIC TechWatch at W3+Fair
  EPIC VIP Breakfast at W3+Fair
- 15 December
  EPIC HR Workgroup online meeting

For the list of all events, visit:
www.epic-assoc.com/epic-events

Quantum sensors making waves across europe

Quantum sensing: a new frontier for innovation and impact in Europe

Ivan Nikitskiy



Source: Femtoprint

Ion trap for quantum sensors manufactured by Femtoprint

Europe has witnessed remarkable developments in quantum sensing technology in recent years. Various companies have entered the field from different perspectives and made significant strides in harnessing the power of quantum phenomena to create highly sensitive and precise sensors. These sensors have the potential to revolutionize a wide range of industries, including healthcare, telecommunications, navigation, and more.

Advanced sensors will grant us the ability to understand brain signals, communicate with ultimate security, and navigate with unprecedented precision. To realize this vision, three crucial factors will be essential: visionary thinking, agile and persistent action, and excellence in both market strategy and technological development.

Femtoprint

A Swiss company, Femtoprint is a global leader in high-precision 3D microfabrication in glass [1]. Leveraging ultrafast laser technology, Femtoprint offers a range of capabilities, including freeform manufacturing with micrometric precision, the in-volume inscription of waveguides and optical devices, and the ability to weld different materials, predominantly glass but also glass with silicone. They are also proficient in drilling, dicing, and surface treatments for freeform optics and metal coatings to create 3D electrode arrays.

Its primary focus in the quantum field lies in the development of 3D glass ion traps. These traps find applications in quantum computing, precision measurements, and frequency standards for atomic clocks and spectroscopy. Femtoprint combines expertise in ion-trapping, optics, and photonics to enable monolithic multifunctional devices and offers a comprehensive solution for the development of those devices, from glass fabrication to trench design, metal coating, testing, and assembly. Moreover, with their range of services, spanning from feasibility and fast prototyping to pilot and volume production, they ensure full control over fabrication processes and production systems.

Bosch Quantum Sensing

Ten years ago, Bosch's corporate research embarked on a groundbreaking endeavor, initiating extensive scouting and studies. Over the years, several technical prototypes have been developed, achieving an ever higher level of matu-

The laboratory for quantum magnetometers on nitrogen vacancy centers in diamond. (Source: Bosch Quantum Sensing)

rity up to an exceptionally sensitive sensor demonstrator capable of measuring magnetic fields a thousand times more precisely than today's standard sensors. At the beginning of 2022, Bosch founded the internal start-up Bosch Quantum Sensing where the research results of the past years are bundled and transformed into innovative products and solutions that improve the quality of life for all people worldwide. The quantum magnetometer which is now being further developed by the start-up team employs nitrogen vacancy (NV-) centers in diamond to detect the tiny magnetic fields generated by physiological processes. These quantum sensors are not only highly sensitive but also remarkably compact, offering a significantly higher spatial resolution and an extensive measuring range. Moreover, they possess the invaluable ability to provide supplementary information, exhibiting robustness and calibration-free operation. This remarkable advancement marks the birth of the new generation of quantum sensors, ultimately prompting Bosch's decision to venture into commercializing these revolutionary products and solutions.

In their quest for the right applications, Bosch Quantum Sensing diligently scrutinized customer pain points and assessed the genuine value that quantum sensors could add to various industries. Recognizing the wide range of possibilities in quantum sensing, they adopted a systematic funnel management approach, meticulously evaluating and selecting the most promising business cases. Among the identified applications to date, the medical sector emerged as a significant contender, encompassing mobile magnetocardiogram technology and prosthesis control. Consumer goods also present a remarkable avenue, for example with heart monitoring devices for drivers. Furthermore, the domains of exploration and navigation demonstrate immense potential, including the exploration of mineral resources and advancements in airplane navigation.

Lastly, quantum sensors show promise in optimizing industrial processes, enabling nondestructive material testing and enhanced battery control. Looking towards the future, Bosch Quantum Sensing envisions brain-computer interface (BCI) applications to unleash a vast and lucrative market, further fueling their commitment to this transformative technology. The disruptive potential of BCI applications is huge, quantum sensors will for example allow medical prostheses to be moved only by thought and will also enable control purely by thought in virtual realities.

With visionary thinking propelling their endeavors, Bosch's unwavering dedication to agile and persistent action, coupled with its excellence in market strategy and technology underpins its innovation leadership and paves the way for a future where quantum sensors seamlessly integrate with our cognitive abilities. By unlocking the potential of these cutting-edge devices, we inch ever closer to a world where mind and machine converge, forever reshaping the limits of human potential.

Exail

The pioneering French company Exail, has established itself as a leader in the fields of high-precision measurements, quantum sensing, and metrology. With a specialized focus on sensors utilizing cold atoms, Exail has been at the forefront of this cutting-edge technology for the past decade. Today, their systems are operational across the globe, delivering exceptional performance and reliability.

The company's impressive product portfolio encompasses a range of advanced solutions. Their offerings include cold atom gravity meters, which enable highly accurate measurements of gravitational forces. Exail has also developed atomic clocks renowned for their precision and stability and which can be used in various industries where precise timekeeping is essential. In addition, Exail produces high-precision optical frequency transfer devices that ensure the accurate transmission of optical frequencies for critical applications.

Organization

EPIC – European Photonics Industry Consortium

EPIC is the world-leading photonics industry association representing more than 800 members across 35 countries. EPIC promotes the sustainable development of organizations working in the field of photonics, EPIC fosters a vibrant photonics ecosystem by maintaining a strong network and acting as a catalyst and facilitator for technological and commercial advancement. EPIC publishes market and technology reports, organizes technical workshops and B2B roundtables, supports EU funding proposals, advocacy and lobbying, education and training activities, standards and roadmaps, pavilions at exhibitions.

www.epic-assoc.com

An absolute quantum gravimeter on Mount Etna (Source: Exail)

Finally, Exail provides a full range of frequency-stabilized turnkey laser systems for a variety of applications in the field of quantum technologies.

What sets Exail apart is its vertical integration model, which grants them complete control over the manufacturing process. From components to full instruments, Exail has the capability to build every element of its systems in-house. This level of control allows them to ensure the precise specifications of each component, guaranteeing optimal performance and reliability of the final product. This comprehensive approach sets Exail apart as a provider of unrivaled quality in the industry.

To further push the boundaries of quantum technologies, Exail actively collaborates with space agencies. Their ongoing partnership involves qualifying their lasers for space quantum systems, such as quantum accelerometers. By meeting the stringent requirements for space applications, Exail solidifies its position as a trusted partner for the most demanding and critical missions. The company is also engaged in the development of onboard quantum sensors tailored specifically for ships. These sensors aim to enhance maritime operations by providing accurate and real-time data on gravity mapping, contributing to improved navigation and safety.

Continuing its commitment to innovation, Exail is actively researching and developing new optical components and architectures for quantum technologies. These advancements pave the way for future breakthroughs in quantum sensing and metrology, unlocking unprecedented levels of precision and sensitivity. Dedication to excellence, coupled with their expertise in cold atom technology and their vertical integration capabilities, positions them as a key player in the advancement of quantum sensing and metrology. With their ongoing collaborations and innovative projects, Exail is shaping the future of high-precision measurements and quantum technologies.

Qant

As part of the Germany-based Trumpf group, Qant is at the forefront of quantum technology development and spearheading quantum computing [2] as well as quantum sensing, with a focus on four key product lines that showcase their innovative capabilities.

Firstly, Qant is pioneering advancements in particle metrology. They have developed highly sophisticated sensors capable of analyzing the finest particles in gases, liquids, and powders. This particle sensor was the first industrialized quantum sensor at all, presented to a broad audience at Hanover Fair 2022. These sensors find applications in various industries such as chemicals, pharmaceuticals, and food processing. Furthermore, Qant's particle metrology solutions enable precise algae and bacteria analysis as well as material characterization, opening up new opportunities for research and development in these fields.

In the realm of atomic gyroscopes, Qant's sensors offer exceptional stabilization and localization capabilities for systems. These gyroscopes find practical use in satellite leveling, where accurate positioning is crucial for optimal satellite performance. Additionally, these atomic gyroscopes enable precise indoor automated guided vehicle localization, enhancing the efficiency and effectiveness of automated navigation systems in various industries.

Qant's expertise extends to magnetic sensing, where their sensors excel in measuring the finest signals within magnetic fields. This technology holds immense potential for applications such as prosthesis control through neuronal signals, enabling individuals to regain control and mobility with artificial limbs. Furthermore, the company's magnetic sensing solutions find applications in outdoor automated robotic localization and human-machine interfaces, enabling seamless interaction and integration between humans and machines.

Last but not least, Qant is actively involved in the development of photonic computing. Leveraging photonic chips and computing, Qant tackles complex algorithms for quantum computing, complex optimization problems, and neuromorphic computing. These advancements pave the way for faster

and more efficient computational processes, propelling the boundaries of technology and innovation.

Qant's dedication to pushing the boundaries of quantum technology across these four product lines demonstrates its commitment to driving progress in various industries. By leveraging its expertise and innovative capabilities, Qant is positioned as a key player in the ongoing development and commercialization of quantum technologies.

Qnami

Nestled in Basel, Switzerland, Qnami has been developing quantum sensors since 2017. Their pioneering technology harnesses the power of nitrogen vacancy (NV) centers in diamond, enabling the fabrication of scalable quantum sensors. In the realm of high-resolution magnetic imaging, Qnami's scanning NV microscopy stands as a groundbreaking advancement. This innovative technique combines optically-detected magnetic resonance (ODMR) spectroscopy with noncontact scanning probe microscopy, providing a noninvasive means to measure incredibly faint magnetic features. By utilizing NV spectroscopy as a quantum sensor, Qnami achieves exceptional sensitivity and resolution at room temperature. Qnami's quantum sensors have successfully transitioned from the confines of the laboratory to become turn-key instruments that extend the boundaries of current measurement capabilities.

In the realm of memory devices, Qnami's technology has introduced new tools for process metrology. The remarkable sensitivity and resolution achieved at room temperature allow for non-invasive measurements of individual bits, revolutionizing the ability to correlate defects with critical process steps. This integration of quantum sensors into the manufacturing process has significantly enhanced process control and quality assurance, providing invaluable insights into the performance and reliability of memory devices.

Qnami's dedication to advancing quantum sensing technology has propelled their instruments beyond theoretical concepts and into practical commercial applications. The availability of turn-key instruments demonstrates the maturity of their technology and its seamless integration into real-world scenarios. By pushing the boundaries of sensitivity, resolution, and reproducibility, Qnami has ushered in a new era of quantum sensors that enable groundbreaking research, manufacturing process optimization, and enhanced memory device performance.

A particle quantum sensor in use (Source: Qant)

GLOphotonics (or 'GLO')

The French deep-tech company GLOphotonics (or 'GLO'), a pioneering market player in the fabrication and commercialization of its proprietary hollow-core photonic crystal fiber (HCPCF) [3]. GLO operates in a diverse range of markets, and to which it develops, manufactures, and commercializes key enabling photonic components, subsystems, and systems.

In the rising quantum technology market, GLO proposes replacing complex vacuum setups of quantum technology laboratories with HCPCFs filled with atomic vapors as the central core of the HCPCF is simultaneously a microcontainer of atomic/molecular vapors and an optical waveguide with controllable modal content. This system can be hermetically sealed to create a highly versatile atomic and photonic component – a photonic microcell – which is both an optical fiber and an atomic system allowing unprecedented atom-light interactions. By confining the atoms together with light over modal areas of as small as a few microns, whilst keeping them in interaction over length scales a million times longer than the Rayleigh range, the best of two worlds can be achieved: friendly compactness coupled with an unprecedented atom-light interaction efficiency, opening the doors to portable, precise quantum sensors fitting in the palm of one's hand.

For a long time considered a difficult technology, thanks to the work of GLO


Fig. 4 Engineer with a quantum magnetometer (Source: Qant)

it is now sufficiently 'mature' to allow merging the domains of HCPCF with atom-based quantum technologies. The line of bespoke prototype solutions can form the basis of high-scale manufacturing and supply for the quantum domain with far-ranging applications to atomic clocks, quantum sensing, and entangled photons sources.

PMC Atomic Clocks are GLO's portable atomic clocks characterized by ultralow power consumption (<100 mW), a compact and shapeable footprint, and an ultralightweight design (<50 g). Twinlas is GLO's entangled photon source capable of creating entanglement between photons of different wavelengths , combining the advantages of transmission over long distances capable in the telecom wavelengths with the ability to incorporate quantum memories and repeaters only available in the visible spectrum. This technology holds great promise for quantum communication over long distances and quantum interconnects, eventually opening the door to a quantum internet of things. In quantum sensing and particularly quantum magnetometry, GLO seeks the development of a novel, compact, room-temperature quantum sensing platform capable of providing an entirely novel, non-invasive medical imaging technology allowing a tissue-specific imaging technique using magnetic fields. This breakthrough technology has the potential to greatly impact healthcare practices by improving the accessibility and affordability of medical imaging for a wide range of conditions.

EPIC

All the companies mentioned above are members of EPIC – the European Photonics Industry Consortium – and pursue innovation in their respective domains, pushing the boundaries of technology and shaping the future of the quantum industry in Europe. Through their pioneering efforts, they pave the way for advancements in a wide range of industries, from telecommunications to healthcare, and contribute to the ongoing development of quantum technologies. The landscape of quantum technology is evolving rapidly, with numerous companies at the forefront of groundbreaking advancements. Collectively they represent the European vanguard of the quantum revolution with the future breakthroughs that will reshape industries and revolutionize the way we perceive and interact with the world around us.

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"We aim to provide quantum-centric supercomputing"

During "World of Quantum", Heike Riel of IBM Research revealed details of the company's quantum development roadmap

Source: all images: Weber & Schandwick

In the southwest of the Stuttgart region in the state of Baden-Wuerttemberg, the Quantum Village Ehningen has grown a lot over the past two years – this will continue in the future, with the development of completely new potential for industry, science, and society. On April 18, 2023, the Quantum AI Experience & Innovation Center "Q.AX" opened its doors during a ceremony at the former IBM site in Ehningen, attended by minister-president Winfried Kretschmann.

Can you tell us about the new quantum computing campus in Ehningen and its significance for advancing quantum technologies?

Riel: We are building the IBM Quantum Europe data center to facilitate access for companies, research institutions and government agencies to cutting-edge quantum systems. It will house multiple IBM quantum systems, each with powerful quantum processors of more than 100 qubits. Users will benefit from the site's proximity to the Frankfurt IBM cloud region and the strong development and customer enablement teams at IBM Germany.

IBM Quantum puts a strong emphasis on accelerating adoption of quantum computing and growth of the related skills. The IBM Quantum Europe datacenter continues our strategy of making it easier for European developers and researchers to have access to leading-edge quantum computing infrastructure. This enables the development of use cases, supports industrial clients, pushes education and grows the ecosystem.

How does Ehningen foster collaboration among quantum researchers, both within IBM and with external partners?

Riel: Operational efficiencies increase with a data center. Users benefit from improved availability as soon as there is more than one system. Building the IBM Quantum Europe datacenters today is also in support of our future strategy to provide quantum-centric supercomputing, which will require multiple quantum systems in proximity to classical computer resources and other cloud services.

▲ Heike Riel, IBM fellow, department head science and technology, and Oliver Dreissigacker, editor-in-chief PhotonicViews, at World of Quantum.

In just a few years, with the ongoing development of Ozean Group's "Quantum Gardens Ehningen" district as a future-oriented living-tech campus at what is now the IBM site, many people will be researching future technologies

Heike Riel and Oliver Dreissigacker in lively conversation at the booth of IBM at the "World of Quantum".

such as quantum computing, AI and the like, as well as working and even living on-site.

In the context of optical communication, what recent advancements have been made in using photons for data transfer in quantum computing systems?
Heike Riel: IBM's focus is on the development of quantum processors based on a superconducting qubit architecture. We have laid out plans as part of our quantum development roadmap to develop a 100,000-qubit quantum computer by 2033 through a collaboration with the University of Tokyo, the University of Chicago, and others.

How does the use of photons in chip-to-chip communication impact the scalability and practicality of quantum computing systems?
Riel: The plans for this quantum-centric supercomputer are expected to involve innovations at all levels of the computing stack, and encompass the convergence of the fields of quantum computing and quantum communication, as well as the seamless integration of quantum and classical workflows via the hybrid cloud.

And over the next decade we will work with our global quantum ecosystem to evolve how our quantum processors can be connected via quantum interconnects. This work will aim to enable high-efficiency, high-fidelity, inter-processor quantum operations in order to scale up to 100,000 qubits.

Are there any specific applications or industries that would benefit from advancements in optical communication and chip-to-chip communication within the context of quantum computing?
Riel: IBM scientists are already laying the groundwork to build this quantum-centric supercomputer by 2033. By the end of 2023, IBM intends to debut three cornerstones of the necessary architecture: One is the new 133-qubit 'IBM Heron' processor. This processor is a complete redesign of IBM's previous generations of quantum processors, with a new two-qubit gate to allow higher performance. It will also be compatible with future extensions to enable modular connected processors to grow the size of the computer. The second is the introduction of IBM Quantum System Two. The new flagship system is designed to be modular and flexible to introduce elements of scaling in its underlying components, including classical control electronics and a high-density cryogenic wiring infrastructure. This system is targeted to be online by the end of this year.

The third is the introduction of middleware for quantum, a set of tools to run workloads on both classical and quantum processors. This includes tools for decomposing, parallel execution, and reconstructing workloads to enable efficient solutions at scale.

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“We have to road-map the future”

Interview with Coherent’s Dr Robert Kuba and Jarno Kangastupa

Source: all images: Wiley-VCH

At Laser World of Photonics, Coherent presented new products for the automotive sector: an adjustable ring-mode laser to effectively weld materials with a propensity for cracking or spatter, dissimilar materials, and even copper, and a tactile seam-tracking process head for brazing and wire welding. PhotonicsViews spoke with the directors from Tampere, Finland, and Kleinmachnow, Germany.

▲ From left to right: Oliver Dreissigacker, editor-in-chief of PhotonicViews with his interview partners Robert Kuba and Jarno Kangastupa at Coherent’s booth at this year’s Laser World of Photonics in Munich, Germany.

Mr Kangastupa – what is your responsibility?

Kangastupa: I manage the Coherent Tampere Finland site, where we develop special fiber lasers for challenging tasks. Our new product is not a regular fiber laser, it is an adjustable ring-mode laser called ARM laser where we have two beams coming out of one fiber cable. The center beam looks like a conventional laser beam, and it is surrounded by an annular beam, the ring beam, so we can power both beams independently to alter the welding characteristics, reduce spattering, or keep the melt pool open longer than with a conventional laser. All the gases that form have time to move out of the melt pool.

Kuba: There are already solutions that can send light through the core and the cladding, but our laser is unique because we can completely independently control both the power in the ring and in the core. Some other companies may have similar solutions, but we can see that the effect really is spatterless welding. We still see some sparks, but no more spatter. This is very important because there are no defects in the weld. Spatter-free welding is most important for e-mobility and in particular for batteries where we need a totally helium leak test-conformant weld with no core porosity.

So, the main welding application is battery production and not so much car body production?

Kuba: We have solutions for thin foil welding, battery production, and also body welding. This latter has changed considerably for electric vehicles and there are a lot of laser applications now. In addition, the very solid existing markets with aluminum alloys and high-strength steels for body-in-white and hang-on parts are still in development and therefore highly interesting.

With regard to the market, most batteries are produced in China. How many lasers will you sell to China?

Kuba: China is a huge and currently highly dynamic market, but there are

Robert Kuba (l) describes the advantages of the new HIGHmotion 2D laser processing head which features smaller spot sizes.

additionally large OEM manufacturers producing outside China, so it is a global market, and not ending soon.

Kangastupa: The US introduced the Inflation Reduction Act of 2022 that made 400 billion dollars available to pull in investments into North America. It is self-evident that not all batteries will be made in China; they will be made in North America and we have to also manufacture them in Europe too because it is such an important technology, otherwise we will be dependent on someone else.

Yes, most of the volume is still in China at the moment. We just had the news recently that Volkswagen has had to reduce its production of electric vehicles because government funding for buyers is running out and the sales numbers are going down.

Kangastupa: This is of course true, but we can see electric vehicle prices reducing and thus supporting the electrification trend. We have a great product roadmap and capacity plans in Europe and North America to follow this trend.

Kuba: The market will be super dynamic so we will not be able to direct the market, but maybe can help to influence it through the superior technology we are offering right now.

Are fuel cells a topic?

Kuba: Yes, of course, the fuel cells have an almost unlimited demand for laser welding on their own, and beyond that the 'FCEV' is equipped with a battery drive. Depending on when the technology becomes widely adopted, there may be a further boost in demand based on this.

Kangastupa: The current battery technology requires a few hundred electrode foils in each cell, typically around ten microns thick and made of copper or aluminum. The fuel cell bipolar plates are also thin and require lots of welding on a wide range of materials. We are working on the technology too.

Kuba: The welding of the cap on the battery housing – whichever form it has – must be perfectly sealed, and you can see in high-speed videos of the process that the melt-pool is very stable. Of course there are some sparks, but it is spatterless, and this is important because the unit would otherwise no longer conform to the helium leak test requirements. The spatter also lands somewhere where it shouldn't be and could cause faults in other components.

We control the welding process using the two independently adjustable beams, changing the power in both, and also have a large variety of pre-programmed settings covering the full range of parameters. Of course, the beam must be precisely positioned and that is done by our HIGHmotion scanner solution, which has the HIGHvision system to capture the object to be welded. The positioning accuracy needs to be micron-precise, so the image tells the welder exactly where to start within milliseconds. The welding then takes place at a double-digit meters per minute speed, which is probably a world record speed at the moment.

Kangastupa: We also weld the battery components such as the contacts, the pressure vents, and current interrupt devices in the prismatic battery cells. We weld the contact to all the foils, so our system welds not only the internal but also the external parts of the battery.

Kuba: There is a lot of copper in the batteries. With regard to the foils, the larger the battery, the more contacts you have to the busbar, which itself has to be bigger to handle the current. There are physical limits to how deep the penetration of the weld contact can be due to the material properties of copper. We have developed a solution for this problem using a single-mode laser variant of the ARM laser, together with our HIGHmotion scanner which has a 1.5× magnification. This delivers a very good beam quality into a very small spot, while maintaining a large field size, and enables us to penetrate up to 6 mm into a copper busbar with an IR laser. The

Company

Coherent

Coherent empowers market innovators to define the future through breakthrough technologies, from materials to systems. We deliver innovations that resonate with our customers in diversified applications for the industrial, communications, electronics, and instrumentation markets. Headquartered in Saxonburg, Pennsylvania, Coherent has research and development, manufacturing, sales, service, and distribution facilities worldwide.

www.coherent.com

Jarno Kangastupa explains the HighLight FL-ARM fiber laser.

usual method of welding copper is to use either green or blue lasers because of the better absorption. However, the properties of copper and its absorption change once the melt pool is established, and blue and green lasers have limited penetration. So we have a very good solution for welding copper busbars, and currently a state-of-the-art penetration.

Do you also use that for welding the copper hairpins in the stator of the motor?

Kuba: Yes, we use it for the hairpins. Our rapid object detection and vision system makes the welding very precise. So welding hairpins at high speed is similar to welding the busbars.

Kangastupa: When welding copper, our thermal simulations showed how the energy would spread through the material, and then we verified the theories with an x-ray video. We had a cooperation project with the European Synchrotron Radiation Facility and the resulting video showed how the beam behaves differently if you have a regular beam or just a ring-mode beam, or a combination of center and ring beams. It was quite encouraging to see how the theories and simulations matched the real result and proved that our thinking was correct.

Kuba: Here we have an ARM laser, the scanning and vision system – the illumination and the camera system – with many options for process quality monitoring. This HIGHmotion version of the scanning head has different magnification options, usually 1.5× or 1.3×. This gives our system a very wide field of view for the thick copper welding. For the battery can to cap, we can easily go with a magnification of 2.25×. The task is to have good lighting for super-fast detection, positioning, and weld processing. This is millisecond detection and micrometer precision combined within the product.

Kangastupa: Just a word about the ARM laser and its beam modes: we have two beams and can change the power in each one individually. We can adjust the mode within thirty microseconds. There are already some optomechanical systems on the market that can change modes within tens of milliseconds, but we can change the beam mode more than one thousand times faster than anything else available right now. The system has a closed loop control so we can measure how much power is coming through the center and ring beams, whereby the controller compares the output value to the set value. The system will automatically make any correction if there is a deviation, both when we are pulsing the laser and if we are configuring the system for a 'power ramp' or a continuous wave. The system makes these adjustments automatically also when welding highly reflective copper material, avoiding any problem. The laser has a high tolerance to back reflection. Some manufacturers have to tilt the beam so that the reflection does not come back through the optics. In our case, we can weld at a 90° angle, which is unique in the market at the moment.

Kuba: That is what the industry calls a subsystem, or even a system, which may include process monitoring. For the latter, we offer SmartSense+, which is deeply integrated into our optical system and enables yield evaluation and improvement. As everyone knows, Coherent is very strong in such welding applications. We do a lot of testing before the components end up at the customer. We offer to the EV market a full welding solution with embedded process monitoring.

Last but not least, the body-in-white is changing with electromobility because obviously you don't have a big motor in the front. You still have a lot of weight in the car and in the base – let's call it the basement of the car – so the basement is changing but also the structure is changing, for example in the B-pillar. This needs to be much stronger in case the car turns over and lies on its roof. The weight of the battery needs to be supported somehow so the B-pillar has to be made much stronger, which brings a lot of applications for lasers, for tailor-welded parts. High-strength steel can only be cut by a laser and is best welded by laser. That is one example.

Here we have tactile-guided optics called HIGHtactile with wire feeding, and that is largely being used to weld the basement of the car. There are different designs: there is aluminum; there are steel designs; but there is a huge amount of welding necessary. In order to be fast, it is recommended to add the wire. So that part and other parts are changing in the EV with a lot of opportunities for lasers, and the kind of optics with wire feeding has a wide application in the EV.

Kangastupa: When the steel companies develop new high strength steels, they typically have great characteristics. The welding of them however can be challenging. There are some material combinations that are easy to crack. With the ARM laser, we can weld high-strength steel so that there are no cracks or craters in the weld seam. We can gradually taper out both the depth and the width of the weld seam by adjusting the center and ring power. This is quite important when introducing new materials to the market.

*

The interview was conducted by Oliver Dreissigacker, editor-in-chief, PhotonicsViews.

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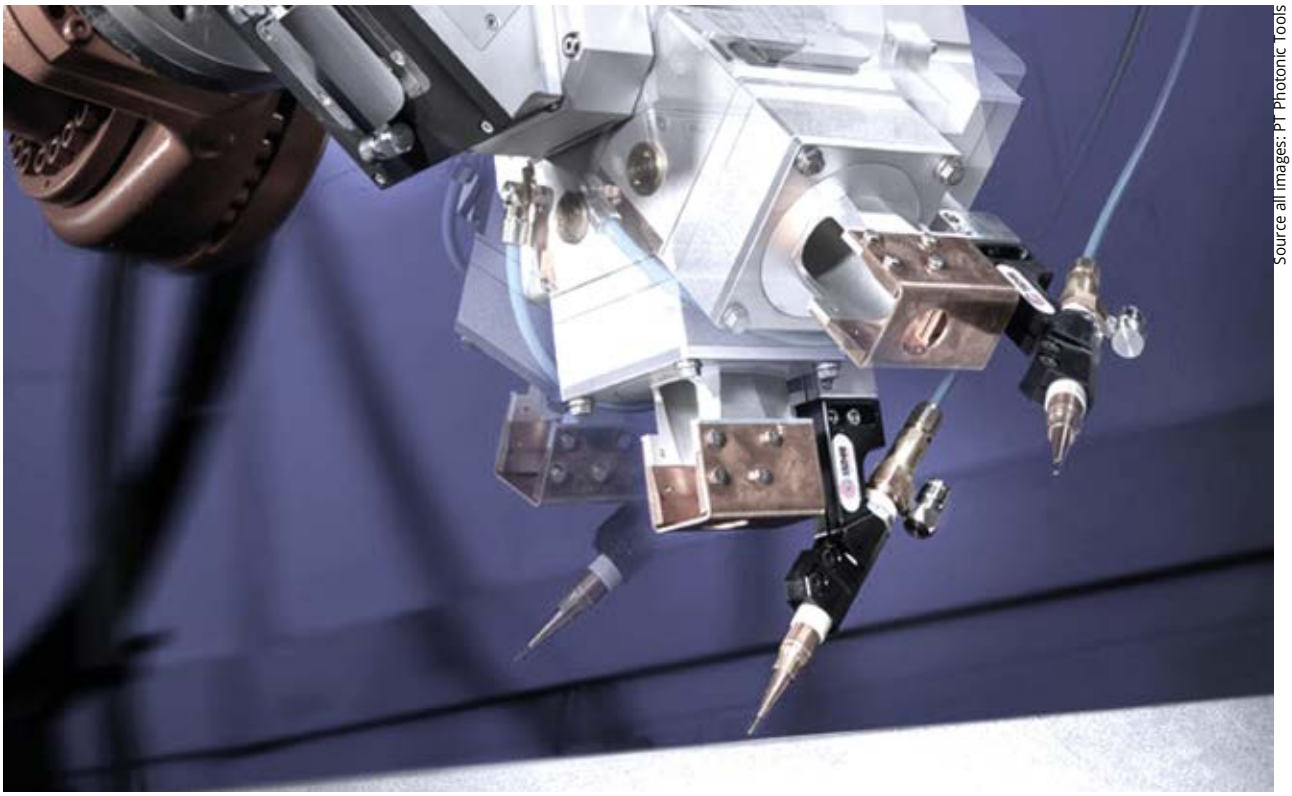
The next generation of tactile laser processing heads

A new generation of laser processing heads makes laser joining easier, established processes more efficient, and enables new applications

Björn Wedel



Source all images: PT Photonic Tools

For more than twenty years, tactile laser processing has been the state of the art for laser brazing and filler wire-assisted laser welding. The expectations of process efficiency, uptime and machine integration have been growing during this time. A new generation of processing heads is responding to that with a simplified optomechanical design and a monitoring system that continuously shows the status of all critical components.

Laser joining has become the method of choice for automotive manufacturing. First it was applied at the body-in-white stage, now it has come to battery welding too. Even Tesla develops laser processes for such purposes.

Laser brazing, for example, has been used for roof joints or other longer welds on the outer skin of the car where superior weld quality leads to high stiffness and good optics. Most often, such processes are accomplished with tactile laser processing, which means the filler wire is used to guide the laser head along the welding contour. It can follow a 3D shape and compensate for small deviations in the shape of the parts being joined. Filler wires can be made of specific alloy compositions, facilitating controlled alloying during the welding process. This enables the formation of joints with specific properties tailored to diverse applications.

Tactile laser heads have been workhorses in many production lines for some decades now, and they have become a common and important part of the investment in a laser processing cell. In the meantime, several trends have led to increasing demands on the laser heads: process efficiency and uptime should be maximized to save costs and increase profitability. With newer trends such as IoT or Industry 4.0, constant monitoring of all critical components became mandatory.

Design concept

The team from the German company Photonic Tools together with its cooperation partner Abicor Binzel has embraced these trends and developed a new tactile laser head that fits into the dimensions of established systems while bringing a set of new ideas. Their

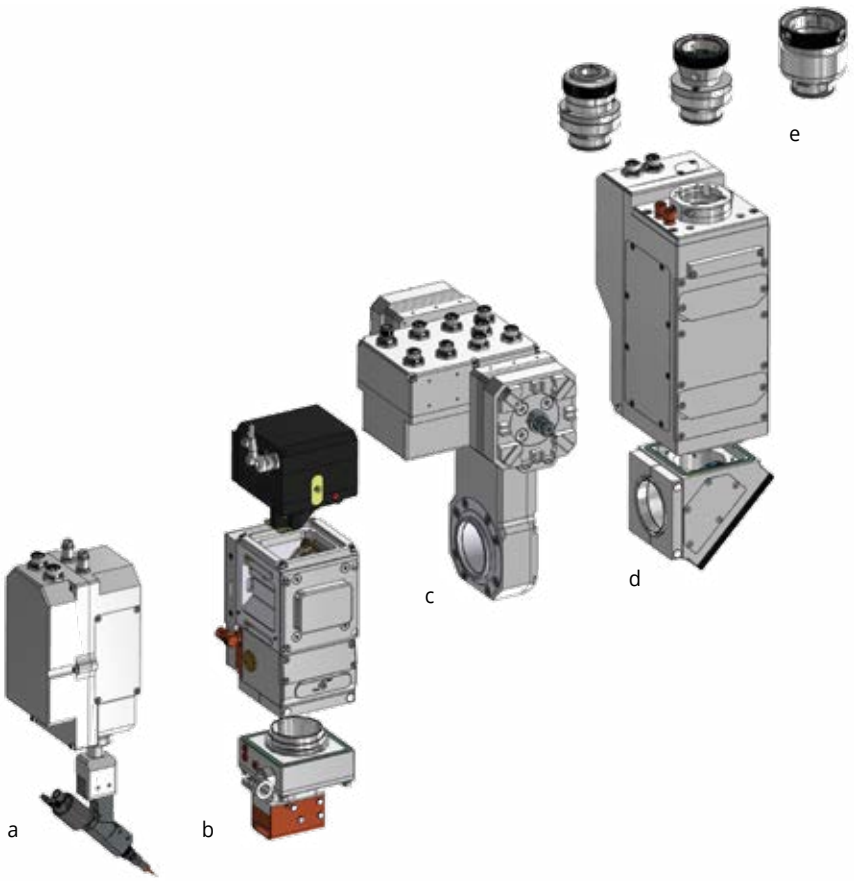


Fig. 1 Modules within the laser head: (a) motorized tactile sensor arm with force measurement, (b) camera viewing (top), focusing module (mid), crossjet (bottom), (c) rotary drive unit with central control access, (d) motorized collimation module, (e) a choice of fiber connectors

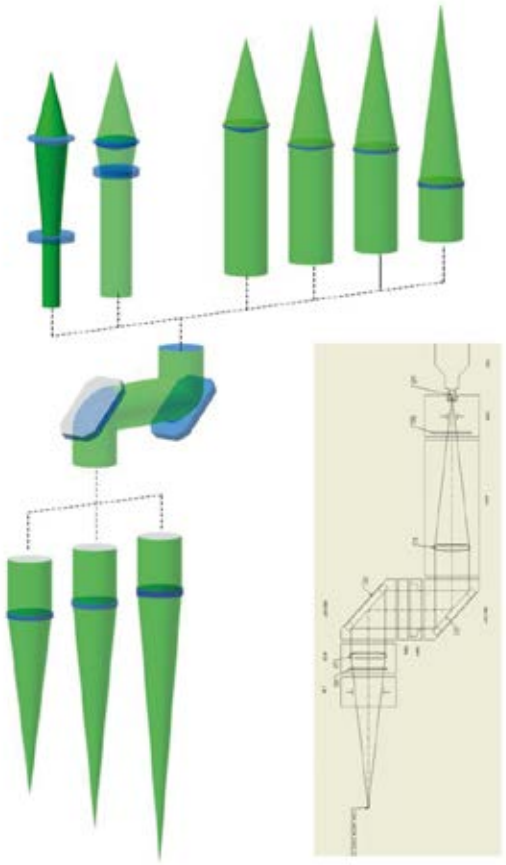


Fig. 2 The design approach reduced the number of lenses to a minimum. Shown here are options for the collimation systems (top) and the focusing lenses (bottom).

main focus was on a modular, simplified design of the laser head (Fig. 1).

The requirements from the application side were:

- Suitable for welding and brazing
- Suitable for lasers in excess of 10 kW power
- Accepting light from fiber and diode lasers, i.e. with up to 240 mrad divergence
- Addressing 'green' and 'blue' laser systems to process reflective materials
- Optional focus forming

The first requirement is obvious; the second one led to several innovations in the design of the head. One idea was to reduce the number of optical elements to a minimum, which leads to less absorption and simpler cooling requirements. Photonic Tools solved the challenge with a design that relies on a maximum amount of three optical elements using a toolbox of different collimation and focusing optics. The collimation optics transforms the beam from the laser light cable into a parallel beam, and the focusing lenses create the focal spot on the workpiece (Fig. 2). Available lenses include collimation lenses for both fiber lasers (typically 125 mrad) and diode lasers (up to 240 mrad).

A zoom module offers a magnification range from 2.7 – 5 with only two lenses. All lenses are designed for infrared lasers. With appropriate coatings on the optics, blue or green lasers can also be used. The modules are standardized, which allows for quick and simple custom configuration of the lenses, including the focus-forming optics.

A second consideration for a high laser power and high duty applications was related to cooling. All critical elements are cooled, including the collimation and focusing lens modules, the beam bending mirrors and the cover slide holders. The mechanical design still allows the modules or optics to be easily replaced for maintenance or service.

Control and monitoring

The demand for more productivity implies a high uptime, and an accordingly stringent control and monitoring method is needed. All main modules in the new tactile laser head are controlled by an EtherCAT master PC. Forces and angles on the tactile sensor (i.e. the filler wire feeder) are continuously monitored, as are the real time and direct temperatures of the lenses, mirrors or cover slides. Stray light is sensed on all optical elements to quickly detect any optical defect. This is substantial progress compared to previous laser heads where the status of the optical

Company

PT Photonic Tools

PT Photonic Tools GmbH was founded in fall 2013 to deliver system components and application solutions for industrial laser applications. Photonic Tools set a first milestone with the first industrial fiber beam guidance for ultrashort-pulse lasers. Today, Photonic Tools develops and produces modular laser processing heads and fiber-based beam guidance systems for a number of industrial applications in macro and microprocessing.

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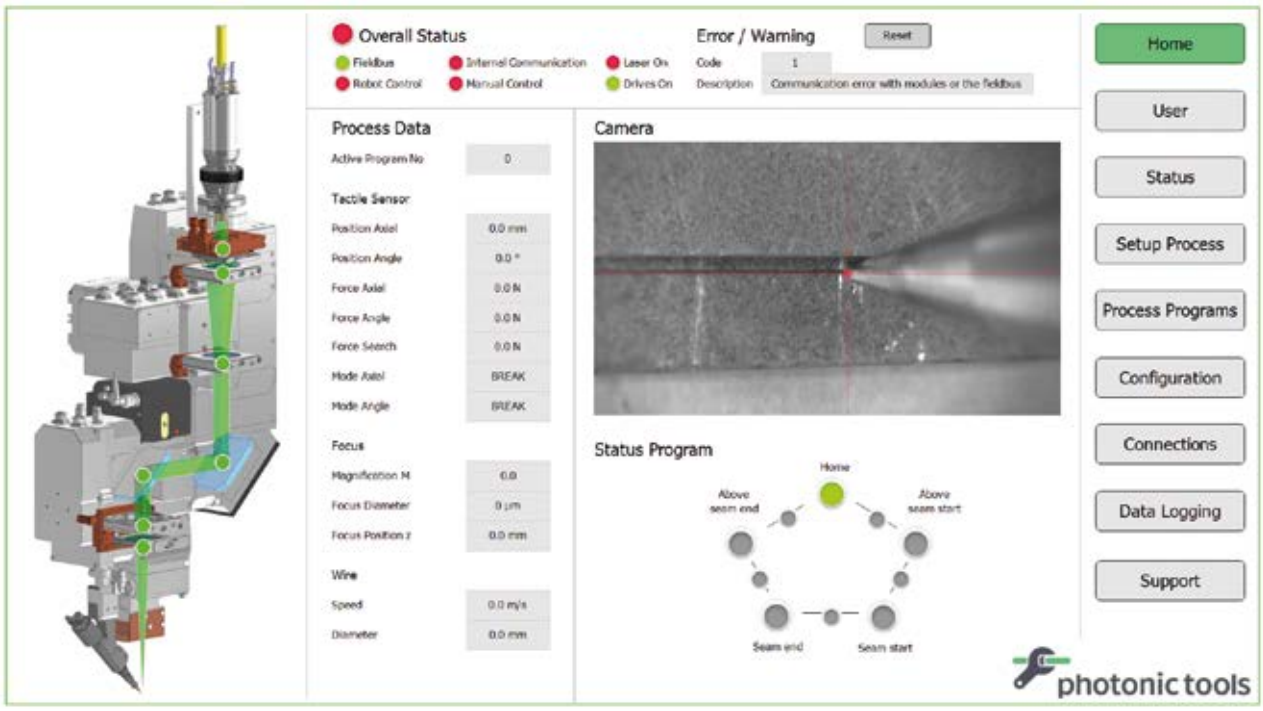

Fig. 3 Home screen of the control system

components in the system was mostly unknown.

The user can configure thresholds for warnings or system errors by using these signals, or alternatively they can be recorded and used for other purposes such as quality control or maintenance prediction.

Maintenance and service

The whole system is optimized for maximum uptime, so the safety of the modules and components in the beam path has been taken very seriously. If any defect in the optics is detected, the modularity of the system makes service much easier and allows the replacement of optical components without recalibration and without interruption of the cooling circuit.

Consumable cover slides can be replaced very easily. All optical components such as lens modules can be exchanged in a simple process using a special exchange holder that is also used for storage and transport. In this way, contamination is minimized and, after a short training session from the manufacturer, the exchange procedure can even be executed in the field.

The sensor information from the tactile laser head adds to the available process data and facilitates continuous process optimization and quality assurance. By monitoring real-time data, engineers can identify process inconsistencies and make immediate adjustments, ensuring consistent and reliable results.

Conclusion: A great future for tactile laser heads

A newly designed tactile laser head delivers an important contribution to ambitious goals such as cost savings and productivity improvement in an automated production line. A simplified optomechanical design leads to higher uptimes and simpler maintenance. Continuous function monitoring allows the status of all critical components in the laser processing head to be seen, including all the optical elements.

Tactile laser heads have delivered excellent seam quality in automotive applications to create strong, durable welds for components such as chassis and body structures. They are used to weld or braze various materials from aluminum to zinc coated steel. After having become a standard tool in the automotive industry, they are now of interest for other fields of production such as transportation (trains) or aerospace. The new generation of tactile laser heads is ready to accept the challenge.

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Source: Abicor Binzel

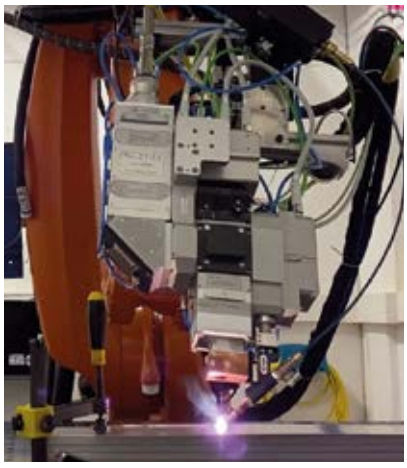

Fig. 4 Tactile laser heads are used in the automotive industry for their excellent weld seam quality. This image was taken at the facilities of cooperation partner Abicor Binzel.

Author

Björn Wedel is the founder and CEO of PT Photonic Tools. Together with Bernhard Lummer, he not only founded Photonic Tools but has also built-up and, together with his earlier foundation HighYAG Laser Technology, achieved the position of international leader in system components for industrial high-powered lasers. They have made a decisive contribution to establishing high-powered lasers in industrial production.

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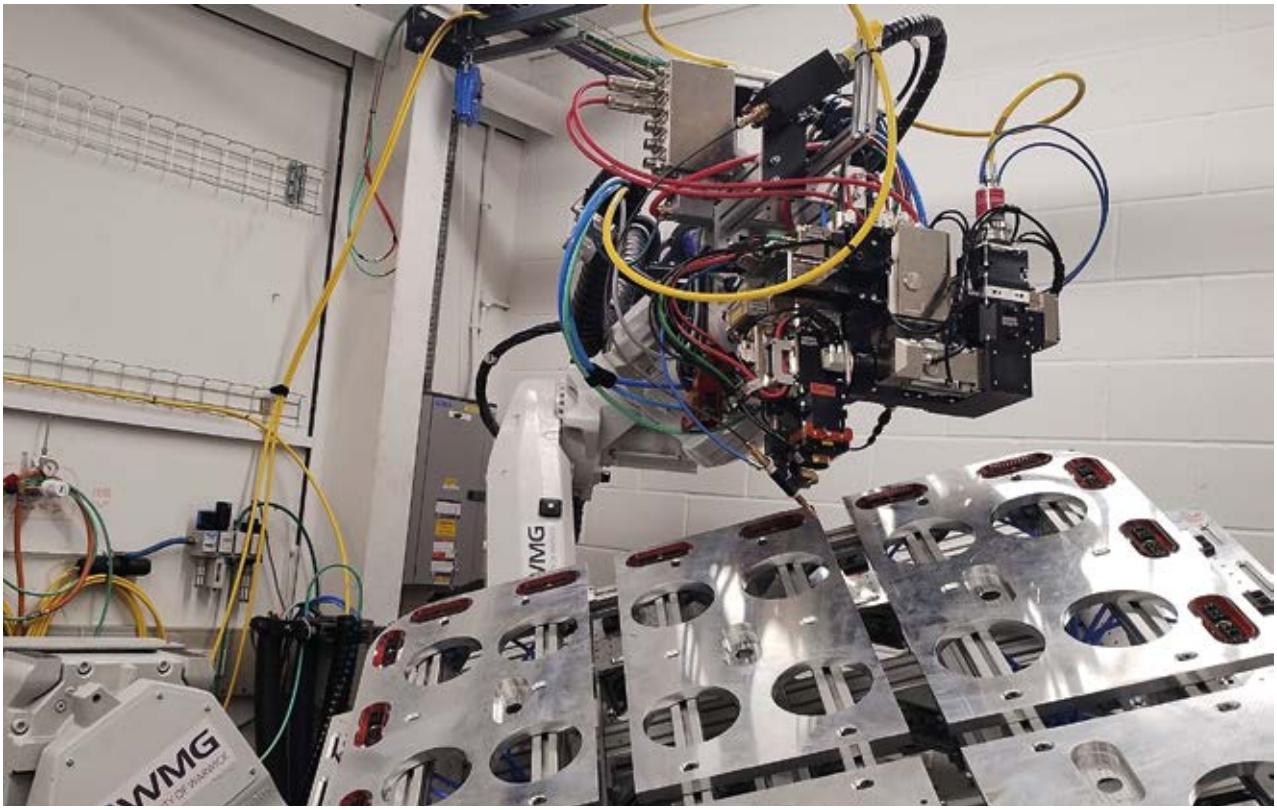
In search of the perfect process

Laser welding of electric vehicle battery cases

Axel Luft, Pasquale Franciosa, and Philip Marben



Battery cases in modern electric vehicles must meet very demanding functional requirements. WMG – an independent research and development Institute at the University of Warwick – tested laser welding processes for optimizing aluminum battery cases on behalf of major automotive manufacturers. In extensive laboratory tests, WMG studied which production technology could produce the best results.

The automotive industry is currently undergoing its largest transformation in recent decades. The changeover to battery-driven electric vehicles is fully underway. Many large manufacturers have already set their phase-out date for conventional internal combustion engine technology. There are still several hurdles to be overcome however. One of these is the production of batteries, and particularly their housings, since these must meet very demanding functional requirements.

Batteries as a key component for electric vehicles

One of the decisive factors is battery range, which largely depends upon the electric vehicle's weight. The battery in an electric vehicle is significantly heavier than the gas tank in an internal combustion vehicle and, depending upon the vehicle and its range, can weigh over 500 kilograms. The battery's location within the vehicle is therefore relevant for vehicle dynamics and the installation space must be used as efficiently as possible. In most models, battery cases are installed flat in the floor.

The battery's large mass is due not least to the thick case material, which can measure 2.5 – 4 mm. Such thicknesses are necessary to ensure the required crash safety – another important requirement – because lithium-ion batteries pose a significant fire risk, and particularly in accidents.

▲ WMG hasdeveloped an innovative and production-ready method to laser-weld aluminum battery cases. The WMG team selected the ALO4-O processing optics from Berlin-based Scansonic for the purpose. (Source: WMG, U Warwick)

The cases in which batteries are installed in the vehicle must therefore fulfill a number of criteria. To save weight, battery case manufacturers frequently rely on high-strength 6xxx aluminum alloys. They also use complex geometries to prevent batteries from incurring damage during a collision. Battery cases must be completely gas and watertight during operation. Batteries are also liquid-cooled, at least in newer models, to optimize the charging

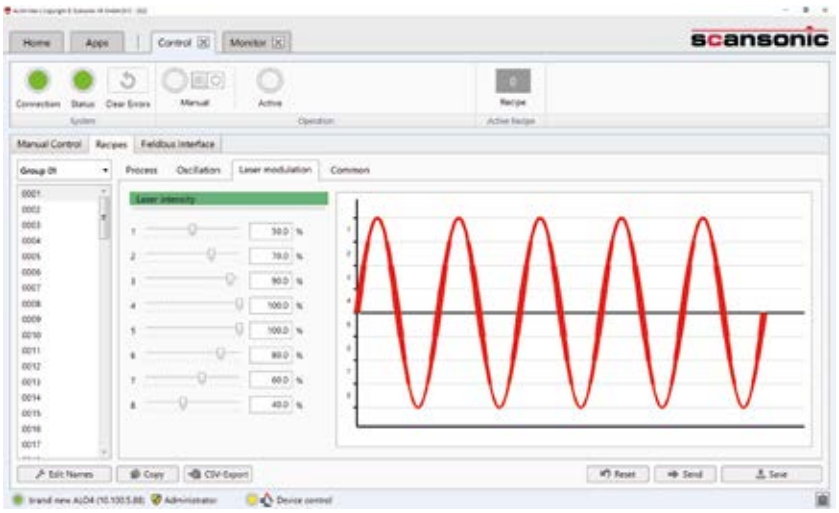


Fig. 1 The ALO4-O enables the laser power modulation parameters to be adjusted in eight segments. (Source: Scansonic)

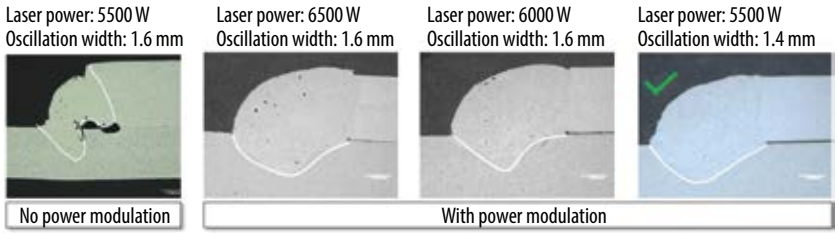


Fig. 2 The best results were achieved when the oscillation width corresponded to approximately 80 – 90 % of the top material thickness. The weld seam was further improved when the laser power was simultaneously modulated. (Source: WMG, U Warwick)

process whereby the cooling structures are also part of the battery case.

The challenge of the joining process

The conditions described above present enormous challenges for the production process. For example, the specific properties of 6xxx aluminum make it particularly susceptible to crack formation. Such cracking results from high thermal tensions during solidification, which is exacerbated by the material's high thermal conductivity.

The joints are also difficult to access due to the geometry of the cross members within the battery case. The joining process must ensure that the seams are gas tight, and any warping of parts during the joining process must be avoided or at least kept to a minimum. Thermal energy input must also be limited to the smallest extent possible.

Electromobility with electric battery vehicles should become the norm, at least for passenger cars. The automotive industry therefore needs methods that enable the production of the quantities required, deliver the necessary quality, and of course keep costs for a production-ready process as low as possible.

Laser welding meets these requirements in all areas. Using robots, it is possible to achieve high-speed automation and to easily produce product variants, while optimized welding procedures can minimize the energy input into the workpiece. All these factors make laser welding superior to traditional arc welding for example, or hybrid welding which combines lasers and arcs. The greater heat generated in an arc welding process results in significantly higher part distortion. Even the friction stir welding process in which a rotating tool performs the welding process and which has been used for some years cannot offer all the benefits of laser welding. Although the thermal energy input in this process is low, it requires high contact forces that in turn can lead to deformations.

Experiments at Warwick University

So what does a definitive laser welding process look like? Working on behalf of major automotive manufacturers, WMG at the University of Warwick in the United Kingdom have developed a new, production-ready process for the laser welding of battery cases. The goal of the test series was to develop a stable

Institute

Warwick Manufacturing Group

The organization, originally founded as the Warwick Manufacturing Group, offers technology transfer for small and midsize enterprises as well as large industrial firms. For more than twenty years, the institute has worked with a team of experts to produce innovative technical infrastructure and technology in electromobility, and advanced manufacturing technology such as laser beam welding.

https://warwick.ac.uk/fac/sci/wmg/research/materials/lbw/

Company

Scansonic

Scansonic offers comprehensive solutions for laser welding, laser brazing, laser cutting, laser coating, and laser hardening, as well as optical sensors and process monitoring systems. The company's Laser Application Center (LAC), with more than 700 m² of space and ten laser laboratories, is one of the largest and best-equipped facilities in the industry. Here, developers are studying the influence of various process parameters on the entire process in order to develop optimized solutions for the respective applications. Scansonic also regularly collaborates with technical colleges and universities in studies involving bachelor's and master's theses.

www.scansonic.de

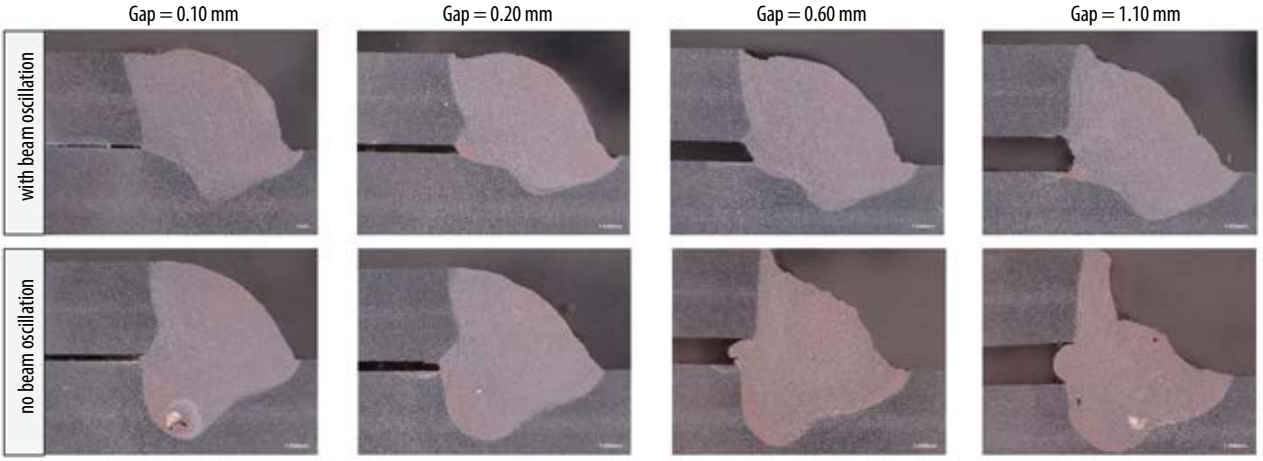


Fig. 3 The tests by WMG show significant improvements in seam bridging with an oscillating laser beam (top) compared to welding without oscillation. (Source: WMG, U Warwick)

process that balances part tolerances and facilitates reliable gap bridging. Another goal was to achieve the maximum process speed while simultaneously minimizing laser output, i.e., having a small spot size in order to save energy and reduce part distortion.

Foundation for laser processing optics

At the outset of the tests, the goal was to find suitable laser processing optics, since they play a decisive role in manufacturing. The optics must ensure that the laser beam arrives at the right location with the appropriate focus.

Many automotive manufacturers already use a processing optics from Scansonic that has been proven in vehicle bodywork manufacture over many years to laser weld battery cases. This optics is the ALO4 with tactile seam tracking, i.e. it uses a filler wire that is melted onto the workpiece during the process. Producing wide seams and cross-sections in larger material thicknesses, such as those used for battery cases, requires a comparatively large laser spot with a diameter of approx. 1 – 2 mm, as well as very high laser power to achieve the power density needed for aluminum. Using this process, even with a material thickness of 3 mm, a part-to-part gap of 33 % of the top material can be bridged at a speed of 3 m/min and power of 7.5 kW.

Given the project targets, the experts at WMG decided to use the new ALO4-O processing optics, which was specially designed for use in battery case production. The laser processing head combines tactile seam tracking using filler wire with the beam oscillation of a scanner optics. Wire alloying and oscillation make crack-free weld seams possible, even with larger part-to-part gaps (Infobox).

The ALO4-O won the search for the best optics for the research project due to its range of capabilities. It combines near-field scanning optics, tactile seam tracking, and fast modulation of the laser power along with beam oscillation. This allowed the team to control the thermal energy input to tailor the structure of the seam, and ultimately to eliminate weld cracks while maximizing the processing speed.

The test setting

Extensive laboratory tests examined a number of parameters that could influence the welding process results, such as the laser power, the oscillation width, the welding speed, the spot diameter, and the part-to-part gap.

When varying the laser power, the researchers found that one of the strengths of the ALO4-O is that it allows modulation of the laser power across eight segments of the oscillation shape (Fig. 1). Thanks to this capability, different thermal energy input can be achieved at various points in the welding process. The focus on the workpiece is naturally longer in the vicinity of the reversal points during beam oscillation. The optics can reduce the laser's power at this point to ensure that power remains even across the weld seam's cross-section.

During the tests, the ALO4-O's integrated SCeye process monitoring system documented the weld seams, while simultaneously storing the process videos, the optics' settings and applied parameters, and external signals such as the wire feed speed or laser power. The quality was subsequently checked using photomicrographs.

The tests in the laser laboratory at Warwick utilized a Coherent fiber laser with a maximum power of 10 kW. The power of the core and the ring beam of this ARM (adjustable ring mode) laser can be adjusted independently of one another. The prototype battery case consisted of 6xxx aluminum alloy. For a geometric structure, a fillet seam with overlapping material was welded in the test series.

Test results

Oscillation width and modulation of laser power

Various different values were selected during the tests for the oscillation

Infobox

Benefits of the ALO4-O in battery case production

- Designed for laser wavelengths of 1,030 – 1,080 nm with up to 8 kW (Fig. 4)
- Tactile seam tracking with a filler wire to balance part tolerances and achieve stable process management with the highest seam quality
- Also: 2D laser beam oscillation. Focus movement through two synchronized galvanic scanners by ±3 mm at up to 1,000 Hz
- Implementation of both right and left applications. Enables processing of different parts in one laser cell
- All process parameters can be set in an intuitive user interface
- SCeye process monitoring possible

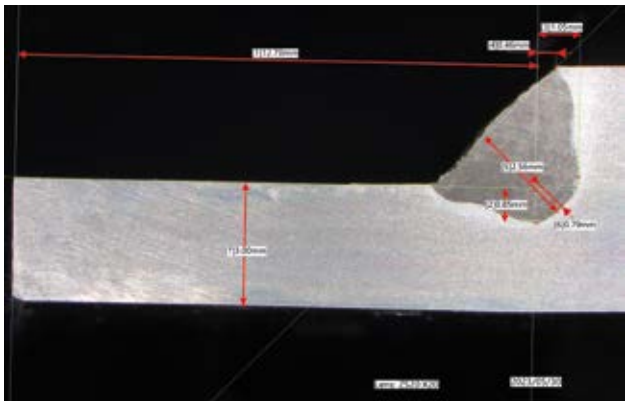


Fig. 4 In a research project conducted at the Scansonic laser laboratory, different parameters are varied in order to develop an optimal welding method. This project showed that results could be achieved with a disk laser that were comparable to those achieved at WMG with a ring spot laser. In this example: 3 mm material thickness, AL6082 aluminum, and 5 m/min process speed at 7.5 kW, oscillation 180 Hz, amplitude 0.8 mm, and spot diameter = 0.7 mm. (Source: Scansonic)

width at a frequency of 120 Hz and for the modulation of the laser power. The best results were achieved when the oscillation width corresponded to approximately 80 – 90 % of the top material thickness. The weld seam was further improved when the laser power was simultaneously modulated (Fig. 2).

Oscillation and gap bridging

One challenge for seam tightness is the gap between the welded materials. There is never a 100 % fit between parts because of production tolerances, so the WMG team also conducted tests on this aspect. The fundamental idea for bridging gaps between parts was to melt additional top part material in order to create a stable weld seam together with the filler wire. Once again, beam oscillation clearly showed a positive effect on the seam and gaps corresponding to up to 45 % of the top part's thickness could be safely bridged. In the tests, these gaps measured up to 1.10 mm. This result is even comparable to a purely remote laser welding solution, and the photomicrographs of the tests clearly demonstrate the quality of the weld seam and provide a direct comparison to welding without oscillation (Fig. 3).

Oscillation and speed

In another series of tests, the researchers studied the effects of beam oscillation on the stability of the welded joint. No effect was observed at low welding speeds of 2.7 m/min. However, at a welding speed of 4.8 m/min (a goal for series production), beam oscillation produces up to 70 % greater shear strength. This allows input power to be reduced while achieving the same stability, which directly produces less thermal deformation and also saves energy.

Good weld seams even with simple lasers

A ring spot laser is not absolutely necessary for a perfect weld seam, as shown by tests currently being performed at Scansonic's laser laboratories in Berlin (see Company) as part of a student research project (Fig. 4) using a traditional disk laser and AlSi12 filler wire. The initial results demonstrate that a stable process can also be achieved through a combination of the tactile process with beam oscillation and power modulation. As already proven by WMG, these tests in Scansonic's own laboratory show that beam oscillation allows higher welding speeds with a lower energy input into the part, as well as improved gap bridging.

The tests clearly support the proposition that the aluminum seam welding process can be significantly improved by combining tactile laser welding with filler wire and beam oscillation, if necessary together with power modulation. The team from Warwick has since developed prototypes based upon its results, and these are currently being tested by OEMs. This application, which is still new for the automotive industry, is now making reliable processes available for series production.

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Pasquale Franciosa is a reader (associate professor) at WMG, the University of Warwick. In his role he is responsible for the strategic introduction and development of novel laser beam welding technologies. He heads up the laser beam welding lab and works closely with many companies in the automotive, aerospace and micromobility supply chain.

Philip Marben is the product owner for the tactile laser processing optics of the ALO4 product family at Scansonic MI. He received his MSc degree as an industrial engineer from the Otto von Guericke University, Magdeburg, Germany. He started at Scansonic in the in-house laser laboratory where he gained in-depth knowledge and understanding of laser processing challenges.

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Compact design with high energy

The new CW 3000W by JPT is to drive performance upgrades for laser welding and cutting

Source all images: Shenzhen JPT Opto-electronics

In recent years, kilowatt lasers have become standard products in the industrial laser market. The popularity of kilowatt lasers has greatly improved the efficiency and capabilities of industrial processing. Despite the performance improvements, the large size of these lasers has posed significant challenges in transportation and assembly. As a result, laser manufacturers have contemplated ways to reduce the overall size of these laser systems.

Guided by the pursuit of a smaller form factor, JPT, a leading supplier of fiber lasers, has conceived a brand-new design and introduced a new generation of high-power 3 kW continuous-wave fiber lasers. Compared to the previous single-module laser design, this new generation laser achieves a 56 percent reduction in volume and a 50 percent weight reduction.

Based on the standard model, the laser source of the new CW 3000W has multiple upgrades as given in the table. The new version of the laser adopts network communication, which has a long transmission distance and strong anti-interference ability, making it more convenient for system integration. At the same time, the key switch has been given a more concise appearance and a QBH spring protection ring protects the laser output head.

There are many performance advantages for the new CW 3000W, the first of which is power linearity: with the help of multistage power correction, the laser power output is more linear. The offset is less than three percent; the product consistency is higher, which is more obvious in high-end applications.

		New model	Standard model
Compact design Large energy	Dimension	**Compact**	
	Power buffer	**10 – 15 %**	<10 % (2,000 W) <5 % (3,000 W)
Higher performance	Power linearity	**<3 %**	<3 % (Premium version) N/A (standard version)
	Signal delay for analogy output	**<50 µs**	<50 µs (Premium version) ~ms (standard version)
	Network port function	**Yes**	Yes (Premium version) N/A (standard version)
More comprehensive functions	Power compensation	**Yes**	Yes (Premium version) N/A (standard version)
	Power feedback	**Yes**	Yes (Premium version) N/A (standard version)
	Adjustable power range	**1 – 100 %**	10 – 100 %
	Power increase and decrease slowly	**Yes**	N/A
	Laser use time	**Yes**	N/A

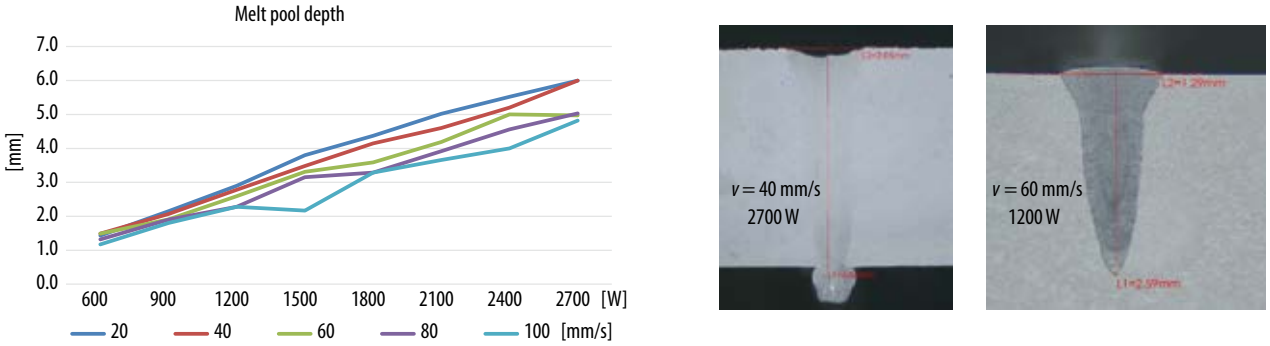

Fig. 1 Welding test on a 6 mm piece of aluminum: relation of power increase and melt pool depth with speed (left). The metallographic shows that the new machine has concentrative energy, and its molten pool is uniform.

Second is the response time for the laser to emit a signal. The analog signal response time of the standard machine is over 500 µs, and the analog quantity response time of the new version is less than 50 µs. The response time of PWM and enable is less than 10 µs, which provides higher adaptability in special application scenarios such as high speeds and high frequencies.

Third, power compensation is worth mentioning: the new version of the laser has a 10 – 15 % power buffer. The software sets the expected power value internally. When an irreversible power decay occurs, it can automatically adjust the laser current in real time to maintain the long-term stable and efficient energy output of the laser. It is possible to set a power PD to monitor the laser intensity: When the power decays and cannot reach the setting value, the current will be increased so that the laser intensity reaches the desired value.

Fourth, power can feedback in real time in the following two ways:

- Analog output power can be measured by the external analog voltage output (0 – 4 V).
- Network output can read the feedback power directly through the suffix.

Fifth, the new machine can adjust its output power from 1 – 100 %. It can work even when the power setting is less than 10 %. The greater the controllable range of energy, the wider the application range. Here please note that the linearity within 3 % is not guaranteed when the output power is less than 10 %. The real laser output power may have some deviation, compared to the power setting.

Sixth, there are new functions in the software. Power increase and decrease slowly: the first and last energy can increase or be increased slowly by the monitoring software, which meets more application scenarios. So far, the settable time range is 3 – 500 ms. Laser user time: the laser monitors and displays the actual laser output time so that it can calculate the actual running time.

Seventh, welding performance possesses notable characteristics (see Fig. 1):

- When welding a 6 mm piece of aluminum, the depth and the width of the melt pool increase at higher powers. At higher speed, the melt pool depth and width decrease.
- When testing at a low speed and 2.7 kW, the laser can be used to weld through 6 mm aluminum.

Lastly, there are some advantages for modulated frequency and power stability. In a welding cable test at different frequency from 1 kHz to 20 kHz under low pulse width, the results show that higher frequencies produce a more uniform and denser light spot.

In summary for power stability:

- Under the same parameters, the larger the pulse width is, the larger the size of the point is. Increasing peak power also increases the size of the point.
- In a 6 × 6 array point testing, it has stable and focused energy, uniform welding point, stable light output, all of which can meet the needs of precision welding.

The new CW 3000W has a much smaller volume, making the entire machine smaller. Based on this, the power linearity is also improved; the machine retains a power buffer of 10 – 15 % to ensure its service life. The new version of the laser also has an improved response speed of analog signals and has a large degree of compression for light output delay. In high configuration models, new functions are available in the software control, making control operations more intelligent and more adaptable to different application scenarios. It is suitable for cutting, welding and other application scenarios to meet the application needs of different customers.

JPT's new CW 3000W has greatly improved the efficiency of going from raw materials to finished products, as well as significantly enhancing the user experience. It meets the users' demands for convenience, cost-effective transportation, and space-saving installation.

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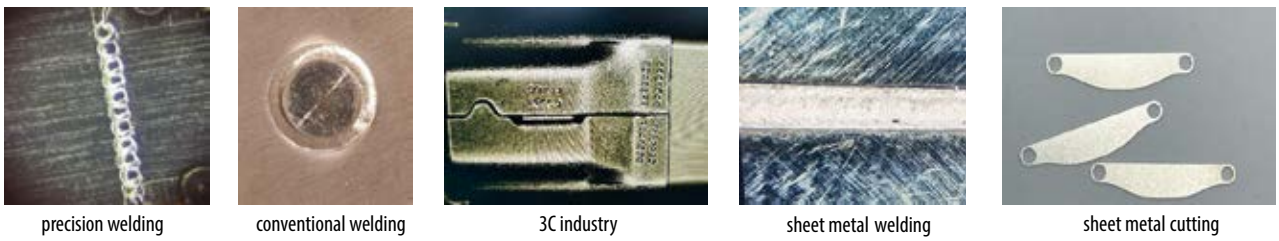

Fig. 2 Industrial laser applications for which JPT's new CW 3000W is well suited

Single frequency lasers

Hübner Photonics single frequency lasers – enabling many future applications

C-WAVE tunable single frequency laser
(Source all images: Hübner Photonics)

Hübner Photonics, a manufacturer of high performance lasers for advanced imaging, detection, and analysis, have one of the widest ranges of single frequency lasers in the industry for many interferometric techniques, including holography, Doppler velocimetry, laser ultrasonics, and dynamic light scattering. All of the Cobolt 04-01 and 05-01 Series lasers, along with the C-WAVE Series of widely tunable lasers are single frequency lasers with linewidths <1 MHz and coherence lengths >10 m, and thereby very suitable for almost any interferometric-based application. The wide wavelength coverage of 355 nm – 1,064 nm (and even further into the NIR), offers full flexibility to select the optimum wavelength for the specific interferometric-based technique.

Being manufactured using a proprietary HTCure technique provides a very high level of immunity to varying environmental conditions, and thereby ensures exceptional performance and reliability of all Hübner Photonics Cobolt lasers.

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Cobolt single frequency lasers – a footprint and wavelength for every interferometric-based application.

Thermal management as a process guarantor

Why precise temperature control in laser procedures is decisive for safety and the quality of results

Source all images: Technotrans

Although effective thermal management is essential for temperature-intensive laser applications, it is far more than a necessary evil, because it makes a decisive contribution to safety, the quality of results and reproducibility. In view of innovative (further) developments in the laser sector, the importance of precise temperature control is growing. Users are demanding highly flexible cooling systems in the form of customized solutions, maximum precision and high reliability.

In recent years, the laser industry has experienced strong growth, driven by the increasing demand from various industries for precise material processing and advanced technology. Perhaps one of the most exciting trends is the increasing use of solid-state lasers in industry, especially fiber lasers, which have successively replaced CO_2 lasers in various fields of application. CO_2 lasers are more powerful due to their higher wavelength and are often better suited to processing non-metallic materials such as wood, acrylic, paper, plastics, leather and textiles. However, in direct comparison, they require more space and cause higher acquisition and operating costs. Fiber lasers, on the other hand, are more compact and economical. They are also becoming increasingly powerful and can now cut, melt or engrave even stronger metals, quickly and precisely.

Fiber lasers are most commonly applied in the automotive sector's sheet metal processing area where sheets with a material thickness of up to one millimeter are cut, welded or soldered. In this application, the extremely low tolerances not only guarantee the flawless appearance of the body of the finished vehicle but also provide the joint with the necessary strength. The implementation of fine machining operations such as the controlled and process-reliable fusion of metals requires a very high level of precision. This is where temperature comes into play, as this level of precision is only possible with optimal laser cooling. "Precisely controlled parameters, which include the laser power and temperature, are crucial in metal processing to achieve

▲ The piko active cooling system is ideal for applications requiring very accurate temperature stability. The slide-in piko cooler can be integrated into a variety of systems.

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The pure.line is a cost-optimized and compact version of the modular Technotrans chillers that can be configured via an easy-to-use microprocessor control console.

the desired results," says Ingo Gdanitz, business development manager at Technotrans.

Precise temperature control as a key technology

The thermal management specialist has many years of expertise in this field: Technotrans solutions cool the laser and the peripherals such as the laser head or integrated motors. Temperature control ensures safety in the melting and cooling process, where a constant temperature at the laser source and the beam-emitting components is crucial as otherwise the laser could introduce a fluctuating amount of energy – which in turn leads to inconsistent burn-in depth. "There are basically two areas in which we can indirectly influence the demanding metallurgical process: on the one hand, we support the laser's stable performance by maintaining a constant temperature level; on the other hand, our solutions prevent thermal distortion or thermal expansion in geometry," explains Gdanitz.

Looking at cooling systems as a whole, having a compact size is very important. Technotrans is focusing on the construction of slim, columnar cooling solutions because users demand the smallest possible footprint in their production facilities, and because a certain surface area is necessary for heat equalization. This is because the cooling systems are equipped with air-water heat exchangers that require sufficient air flow. Despite their compact design, the systems have a high power density and energy efficiency thanks to an intelligent machine design. Their modular design also allows simple adaptation to the individual requirements of the respective process.

Ultraquiet performers

Smooth operation and low noise emissions in cooling systems are definitely an important requirement in metalworking. However, both are absolutely decisive when it comes to other applications, such as those for the medical technology segment where lasers are mostly used in minimally invasive procedures. "Laser powers in medical technology are significantly lower than in metalworking, but our cooling solutions are used in close proximity to people who need to concentrate on their work," says Gdanitz. In addition, it is not uncommon for the coolers to be located in cleanrooms – for example in aseptic operating theaters or laboratories. In these environments, it is important to avoid air movement caused by the integrated fans of a cooler to the greatest possible extent.

To achieve this, Technotrans uses solutions based on Peltier technology in which refrigeration is created with Peltier elements and with the aid of plate-shaped semiconductors. Voltage is applied to these elements and one side of the plate stays cold, the other one hot. As the Technotrans Peltier devices do not contain any moving parts, they do not create any vibrations, nor do they emit any sound. In addition, the semiconductor plates have fast response characteristics and they immediately adapt the cooling level when the voltage changes. This

Company

technotrans

The core competence of the global technology and service group technotrans SE are application-specific thermal management solutions. With 17 sites, the group has a presence in all of the major markets worldwide. The technology provider also develops highly specific cooling and filtration solutions for the laser and machine tools sector. The group has five production sites in Germany and one production site each in China and the USA and has a global workforce of 1,500 employees. In the 2022 financial year, the group achieved a turnover of 238.2 million euros.

www.technotrans.de

Meet us at Blechexpo: Hall 8 / Booth 8309

The ECOtec.chiller xtend is a highly versatile option for the modular cooling system and provides thermal management with high energy efficiency and adaptability.

The Mini Tower version of the pe004 Peltier cooler with a cooling capacity of 200 – 400 W features a very compact construction, particularly energy-efficient operation and a high-quality design.

enables fast and precise control of the feed flow temperature.

Dynamic control technology for energy-efficient cooling

Whether in metalworking or medical technology, very few laser processes work with continuously activated laser radiation. Instead, the laser is often switched on and off in extremely rapid cycles, for example in perforation where laser beams create microscopically small holes at short intervals. This poses a challenge for the cooling process as the varying heat load introduced into the system can cause a periodic fluctuation in the cooling water temperature – so-called pulsing. If this is not controlled and pulsing occurs too quickly, an uneven temperature profile will be the result in the cooling water system.

The possible consequences: inadequate process quality, poor reproducibility and damage to the components. Technotrans meets this challenge with dynamic control technology and the use of speed-controlled compressors that regulate the required cooling capacity at high speed. "As a result, our extremely energy-efficient cooling solutions ensure constant process conditions. We only ever call up the cooling capacity actually needed at that very moment. Depending on the application, this facilitates energy savings of up to thirty percent compared to conventional technology," says Gdanitz.

Networking increases control and optimization potential

Looking to the future of laser applications, one thing is already clear today: the complexity of the technology continues to increase, and with it the individual requirements for thermal management. Gdanitz: "The demand for customized solutions already outweighs standard variants – and is steadily increasing." One continuing trend is system integration where users often want more than just a physical adaptation of their cooling system through the configuration of cooling circuits and additional functions. Instead, it is more about the communication and data exchange between several devices in the process, which Technotrans achieves by data networking its devices with the overall system. By equipping the cooling systems with modern control units, all cooling process data can be seen and adjusted either on the device itself or remotely at any time; for example the supply and return temperature or volume flow. This is particularly helpful when it comes to error analysis, optimization and documentation.

In addition, future technology such as special high-tech lasers in semiconductor production will soon take on a greater role. This is where Technotrans supports innovative applications that use lithographic processes to increase the production speed of chips or the processed semiconductor starting material (wafers). Temperature control solutions specially developed and precisely matched to the application are also a fundamental requirement in these processes.

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The best of two worlds

3D laser manufacturing of custom components in the micrometer and submicrometer range

Source all images: Femtika

Founded in 2013, Femtika is a spinoff company of the Laser Research Center of Vilnius University, Lithuania. The experts there have many years of experience in the research and development of 3D laser precision micromachining, and they specialize in hybrid micromachining technology.

Femtika has been using Aerotech's linear stages and galvo scanners since the company's foundation in 2013 to produce universal tools with femtosecond lasers suitable for multiphoton polymerization, laser ablation and selective laser etching technologies. The heart of a laser nanofactory workstation always consists of a femtosecond laser in combination with a nanopositioning system from Aerotech. These enable fast and highly precise 3D manufacturing across the entire workspace. However, the first contacts occurred much earlier as the University of Vilnius had been using Aerotech equipment since 2005. Femtika's founders used Aerotech equipment intensively for research projects and other academic work.

Dr Vytautas Purlys, CTO at Femtika, looks back fondly at the company's early days: "Before we were introduced to the Aerotech positioning stages, we assumed that nanometer precision could only be achieved with piezo stages." The most common solution at the time was to mount the piezo stage on a larger, less precise mechanical stage. "This approach was sufficient for small structures, but for larger structures we always had problems with stitching and extremely long manufacturing times," continues Purlys. "We then tried Aerotech's high-precision linear stages, which immediately improved the quality for larger microstructures and also allowed them to be manufactured faster – by at least a factor of ten." Soon after, it became clear that the speed could be increased by a further factor of ten if they incorporated Aerotech's AGV galvo scanner. "I remember one project where we produced thousands of high-quality structures overnight, while our older piezo system only managed ten in the same time," he enthuses.

▲ The experts at Femtika have many years of experience in 3D laser precision micromachining R&D.

3D printing with multiphoton polymerization

One of Femtika's most commonly used processes is multiphoton polymerization, one of the highest resolution 3D printing technologies. This process is

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based on photopolymerization reactions that are triggered only in a focal volume of the sharply focused femtosecond laser focal point. The microstructures are printed by scanning the laser beam over the volume of the photopolymer.

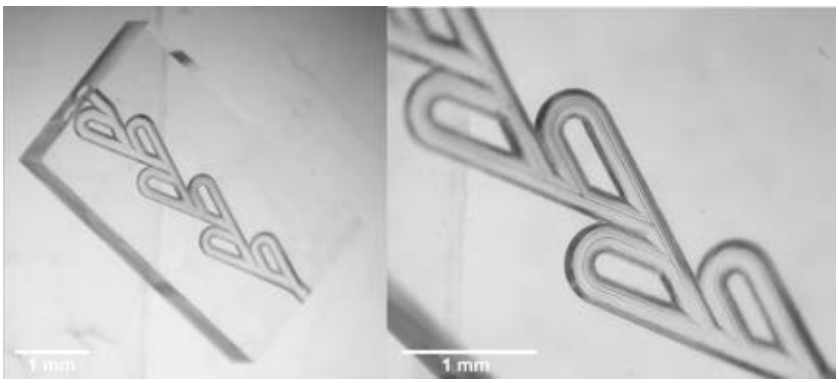
"A key advantage of this process is the ability to print very high resolution structure sizes down to 150 nm," explains Purlys. "In addition, there is an exceptionally high surface quality and the ability to create 3D micro-objects of any shape without the need for supports."

Examples of applications for multiphoton polymerization are micro-optical and photonic elements, which are not only printed on planar surfaces but also directly on fiber tips, photodiodes, semiconductor ICs, etc. The process is also frequently used for biomedical applications such as the production of 3D scaffolds, which are support structures for cell growth that can be used for drug testing.

One machine for a variety of high-precision processes

Femtika's laser nanofactory machines are not just very high resolution 3D printers: they also offer many other microfabrication techniques made possible by femtosecond lasers. This means that the same machine can perform a variety of processes that would not be possible in the traditional 3D printing world.

"Our workstations are often used for selective laser etching of glass, for example," says Purlys, citing a common practice. "Unlike 3D printing, this is a subtractive process where the laser is used to modify the intermolecular glass structure. The laser-modified glass areas are then chemically etched away, leaving only unmodified areas." This is not only applied in medical technology (in microfluidic devices or micromechanical particles, for example) but also in micro-robotics and the watch industry.



Microfluidics is a popular application for selective glass etching, providing low surface roughness (ca. 200 nm RMS). It is more versatile than ablation and enables 3D freeform structures, such as channels with integrated functional elements or 3D channel systems embedded in the glass volume.

"In general, lasers are unique tools because of their ability to modify the volume of transparent materials without touching their surface," continues Purlys. By modifying the volume of materials, different waveguides, diffractive optical elements or Bragg gratings can be realized. Surfaces can also be modified with femtosecond lasers. For example, micro-ablation is used when tiny grooves or holes are needed on the surface, while surface structuring enables the production of hydrophilic or hydrophobic surfaces.

Building small features over a large area

Each laser process places its own unique demands on the positioning system. Some processes require precision and resolution, others speed, still others a working range, and all this together results in quite a demanding list of requirements. "Since all of our processes are based on functional material changes, the specifications of the positioning system directly contribute to the quality of the manufactured structures," emphasizes Purlys.

Stitching together small areas to create a larger part is one of the most essential aspects in the world of sub-micrometer printing. This is not only threatened by inaccuracies of the positioning system, but also by the material's behavior. The Femtika CTO illustrates the problem with a pictorial example: "Imagine you are on the beach. While you are lying comfortably in the sand,

Company

Femtika

Femtika is a spinoff company of the Vilnius University Laser Research Center. Founded in 2013 by a team of experts with many years of experience in the research and development of 3D laser precision micromachining, the company specializes in hybrid microfabrication technologies including multiphoton polymerization, laser ablation and selective laser etching. Femtika also offers research services in this field. The company aims to meet the growing global demand for available tools and technology that enable true 3D laser manufacturing of custom components at micro and sub-micro scales. The microstructures supplied by Femtika are used in the development of future products in the semiconductor, photonics, medical, automotive, and aerospace industries.

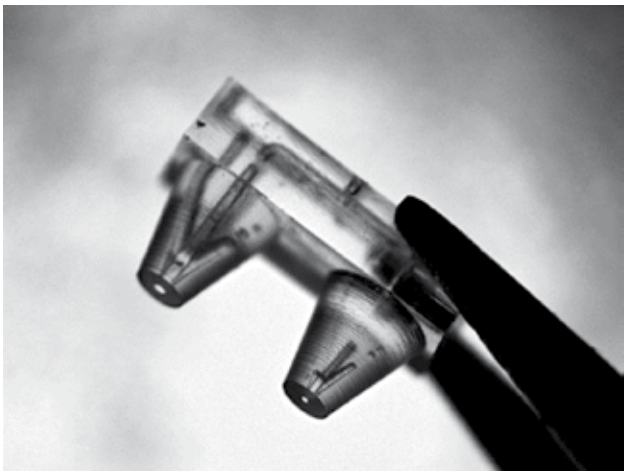
https://femtika.com

Company

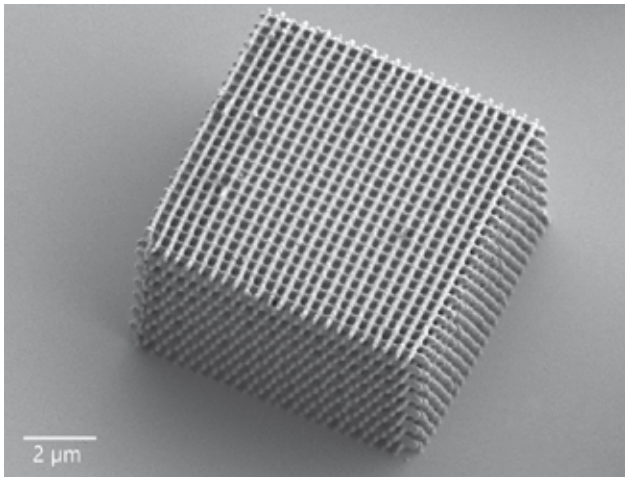
Aerotech

Headquartered in Pittsburgh, USA, Aerotech Inc. is a mid-sized, employee-owned company. In Germany, the company is represented by its own subsidiary, Aerotech GmbH, based in Fürth, Franconia. In addition to sales and service departments, the customized assembly of positioning systems for the European market takes place in Fürth. The motion solutions are used in medical technology and life science applications, semiconductor and flat screen production, photonics, automotive, data storage, laser processing, aerospace, electronics manufacturing, as well as in inspection and testing through to assembly. Aerotech has further full-service offices in the United Kingdom (Ramsdell), China (Shanghai City) and Taiwan (Taipei City) and currently employs approximately 500 people worldwide.

https://uk.aerotech.com



Micronozzles produced by selective glass etching



Photonic crystals are one of the applications for the multiphoton polymerization technique, which can be used to produce almost any geometric 3D structure.

you try to draw a circle with your finger. Between the place where you started the circle and the place where you finished it, you will notice a defect – a small pile of sand. No matter how steady and precise your hand is, the pile will be there. Now try to draw a larger pattern with small, 'gridded' squares – imitating the effect of the galvo scanner. You will find that your artwork is full of such heaps or 'stitches' between the squares."

Similar problems occur in the micro world, caused by the way the materials react to the laser pulses. Often the galvo scanners are used to raster the laser spot over small square areas, which are then joined by repositioning them in steps, leading to errors in the joining process. This approach can significantly affect the quality of the manufactured structures. For example, microlenses manufactured in this way show considerable scattering, micro parts can contain fractures, and parts for the watch industry lose their aesthetic appeal.

"To minimize the number of stitching errors, we actively use infinite-field-of-view technology where the movement is automatically divided into a fast and a slow movement and executed simultaneously with Aerotech's galvo scanners and linear tables respectively," explains Purlys. "In this way, the stitching is eliminated and the structures produced become more uniform."

Femtika's Laser Nanofactory workstation for multiphoton polymerization, laser ablation and selective laser etching technology.

Control is the key

The system's overall precision is thereby limited by the least precise component, so the performance of the stages and galvos must be precisely matched. However, this is not the only important factor. The control system is an often overlooked component that performs a very important, almost invisible task.

With direct laser writing techniques, the structures are written while the table/galvo scanner is moving. When the positioning system is accelerating or decelerating, the number of laser pulses hitting the material increases. This can lead to various errors or even material damage in these areas. These problems can be solved by firing the laser pulses at constant distances from each other. If both galvo scanners and mechanical tables are used, this poses a challenge for the control system as the positions of both devices have to be taken into account.

"As longtime users of Aerotech's A3200 controller, we were excited to be able to test the new Automation1 control platform as well," explains Purlys, before offering his opinion: "Apart from the significant improvements to the user interface, we also discovered many new useful features. For example, the way the movement is defined is now much more user-friendly, the control parameters are easier to find and their meaning is now also easier to understand. From the integrator's point of view, we like the new control API that makes the implementation of various control functions much easier."

During the software migration, Femtika's experts noticed some functions that previously required fifty lines now can be implemented in just a few lines of code. "Many other small improvements helped us save implementation time and increased the overall quality of our products," concludes Purlys.

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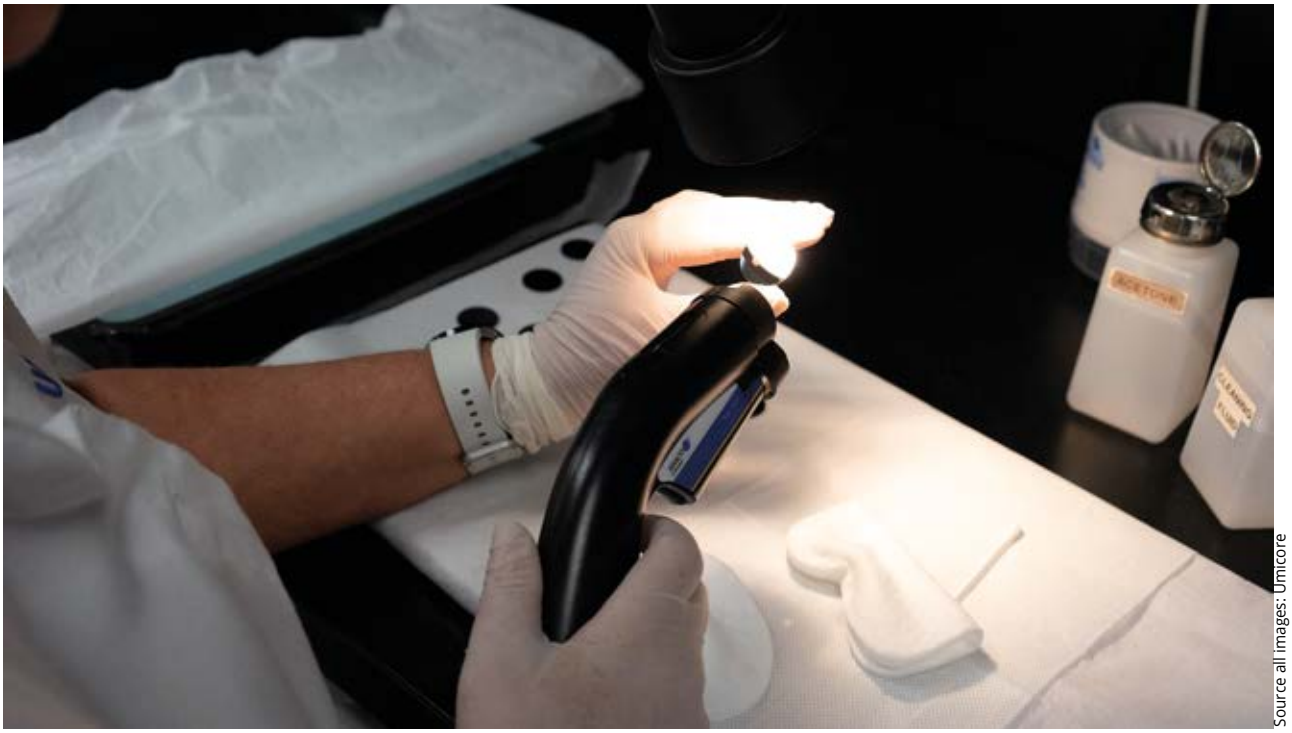
Unravelling the mystery of rising methane emissions

Laser absorption spectroscopy can pull our climate back from the brink

Mark Naples



Source all images: Umicore

The global picture of emissions is more complex than it might appear – here is how laser absorption spectroscopy can untangle the many mysteries surrounding methane emissions.

Emissions management is a journey. But the path to lowering emissions is fraught with complexities and new challenges requiring new skills and a measured approach, but it is a journey vital for future viability.

Even though methane only makes up 0.00017 % (1.7 parts per million by volume) of the atmosphere, it traps a significant amount of heat. It is one of the greenhouse gases contributing the most to global warming, responsible for up to 20 % of global heating alone. Its power is even greater: this gas traps eighty times more heat than CO_2 in equal quantities over twenty years. Its concentration is constantly rising.

According to the Energy Institute's recent report [1], carbon emissions from energy use, industrial processes, flaring, and methane (in CO_2 equivalent terms) increased by 0.8 % in 2022, reaching a new high of 39.3 gigatons of CO_2 equivalent ($GtCO_2e$). The earth's atmospheric methane concentration has increased by about 160 % since 1750 – with the overwhelming percentage caused by human activity, accounting for 20 % of the total radiative forcing from all the long-lived and globally mixed greenhouse gases, according to the 2021 Intergovernmental Panel on Climate Change report [2].

Global fossil fuel industry emissions of methane increased to a near-record in 2022, prompting a call from the International Energy Agency (IEA) for oil and gas companies to use 'windfall' profits to clean up leaks of the potent global warming gas. The IEA says spending 75 billion US dollars, or 2 % of oil and gas companies' combined annual earnings, on lowering methane emissions would cut direct greenhouse gas emissions by 15 %.

▲ Controlling and limiting the reflective properties of filter lenses is crucial to sensor performance.

Methane emissions are driving the climate to change in unprecedented ways, but there are still many options to alleviate the impacts through mitigation and adaptation.

Methane matters

While methane is significantly more potent than CO_2, it remains in our atmosphere for a much shorter time; around ten years, compared to around a century for CO_2. So, while methane emissions can rapidly accelerate humanity's movement towards the climate tipping

Widely used to detect the presence of noxious or flammable gases in the atmosphere, IR filters are a key component of preventative maintenance safety systems critical to the oil, gas, and energy sector.

point, cutting emissions can pull us away from the cliff edge just as quickly. Identifying these emissions, whether from leaks, flaring, oil and gas exploration, livestock, or other sources, is therefore a time-sensitive issue.

Roughly 40 % of all methane emissions come from natural (biogenic) sources, but our actions influence the biogenic production of methane that occurs across the world, largely as a result of biomass being broken down by methane-producing microbes in wetlands.

As the climate continues to warm and icy regions continue to thaw, more of these wetlands are created in the form of thermokarst – areas of marshland that are gouged into the earth when permafrost thaws too quickly. These wetlands, coupled with generally higher temperatures, create environments for microbes to thrive, producing more emissions and presenting the risk of a 'doom loop' emerging where the planet itself drives a vicious cycle of higher emissions and higher temperatures.

Complicating matters is the complex interplay between the many unseen natural processes that take place in the natural world. Put simply, nothing in our atmosphere happens in a vacuum.

Atmospheric methane can be broken down by hydroxyl radical molecules, separating it into carbon dioxide and water. While precise data on hydroxyl radicals is limited due to their short lifetime (they remain active for less than a second), they are one of many byproducts created when fossil fuels are burned. Counter-intuitively, cutting fossil fuel consumption – as much of the world did suddenly, due to Covid-related lockdowns throughout 2020 – could be driving short-term, methane-related warming. An increase in wildfires [3] is also thought to be driving a shortage of the 'atmospheric detergent' hydroxyl radicals, as these cleansing molecules also react with carbon monoxide, meaning they can be depleted by the gases and particulate matter spewed into the atmosphere by fires.

The global situation is immensely complex, and we cannot even begin to comprehend it without access to high-quality, real-time data from across the world. Every decision, from a business looking to improve air quality on its site to a global agreement like the Paris Climate Accords, has an impact on our climate at some level. Without a thorough analysis of the measurable impact of these decisions, how can we be sure they are right?

Yet data on methane already exists – all businesses need to do is use the tools to collect it. This is the power data gives us – it empowers decision-making by allowing us to quantify the effectiveness of our actions. As the lines between human-caused emissions and natural emissions become increasingly blurred, understanding the delicate interplay between humanity and the planet we live on becomes crucial.

The big picture has to be complete because lacking crucial data on hydroxyl radical concentrations, for example, could lead to wrong turns in the fight against methane emissions as the climate cliff edge inches closer. Laser absorption spectroscopy is the tool that will paint this big picture for us.

Spectroscopic solutions

As a powerful tool for detecting trace gases, laser absorption spectroscopy has been widely used to monitor atmospheric greenhouse gases, pollution, and respiration processes, and also for human breath analysis. The detection is based on the light absorption when it propagates through a medium, and as interest in air quality has dramatically increased in recent years, both well-established and new sensor manufacturers are looking for high-performance filters at competitive prices.

Thanks to recent technological advances, the oil and gas industry, scientists, and authorities can tap into a growing set of tools to help them detect and quantify emissions. From specialized handheld cameras that help technicians to pinpoint leaks, to space-borne instruments that can quantify regional emissions, these tools are changing our understanding of emissions and expanding the methods available for target setting, monitoring, and compliance.

To detect the level of light absorption through a medium, emitters within a sensor generate pulses of IR light, passing through a sampling chamber containing a filter. The filter blocks out light of a certain wavelength so that only the required wavelengths make it past the filter to reach the detector. This measures the IR light's intensity (or attenuation), which can determine the precise concentration of gas that may be present. Different filters allow different wavelengths of light to reach the detector, which can in turn be used to detect other gases and distinct particles.

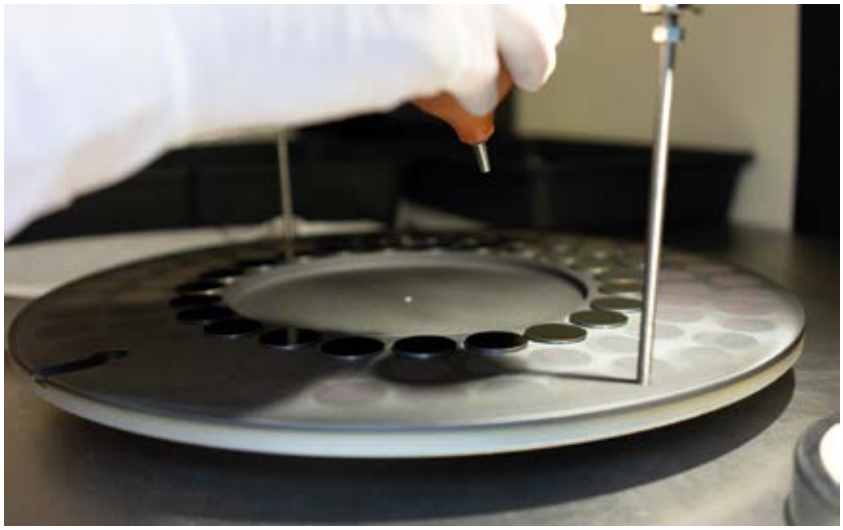
This kind of sensing technology offers near-limitless scope because it works using the unique properties of light. It can analyze the particulate matter in human

Company

Umicore Coating Services

A subsidiary of the € 3.9 B, Belgian-owned material and technology company, Umicore Coating Services has amassed over thirty years' experience in the provision of ultralow absorption laser coatings, as well as other types of coatings and filters for infrared systems. With more than 2,500 proven coating processes, its state-of-the-art facility in Dundee can repeatedly manufacture optical coatings with exceptional spectral and environmental performance.

https://eom.umicore.com



Modern sensing technology is highly scalable and available in increasingly small form-factor devices thanks to advances in laser absorption spectroscopy.

breath, providing a detailed breakdown of the particles that enter and leave our lungs with every breath. At the other end of the scale, it can be installed in satellites and sent into orbit to look for significant global gas leaks. While both applications require very different systems in size and scope, the principle behind the technology is the same.

Newer gas analysis instruments use a laser diode mounted on a thermo-electric cooler to tune a laser's wavelength to the specific absorption wavelength of a particular molecule. They exploit their high-frequency resolution, which results in enhanced sensitivity – more significant levels of interaction between gas molecules and light in the order of parts per billion – and discrimination, as they are tuned to specific gas compounds. This eliminates the potential for false alarms, a common headache with other commonly used gas detection technologies. And by incorporating different filters into a system that allow different wavelengths of light to reach the detector, it is possible to check for multiple other gases using the same compact design. This enables the monitoring of almost any harmful gas, from methane to carbon dioxide.

A problem that has to be seen to be believed

Despite the many precautionary measures taken, leaks are a fairly common occurrence and a significant contributor to the overall industrial greenhouse gas (GHG) emissions. According to one report, the leaks from bolted joints contribute 170 million metric tons of fugitive GHG annually [4].

For decades, the industry has accepted these leaks, and by extension their emissions, as an unavoidable cost of doing business. Quickly detecting leaks has become an industry-wide priority to keep emissions as low as possible. Driven by the rise of key enabling technologies like miniaturized electronics, advanced algorithms, and low-cost access to space, and fueled by increased international awareness, these novel solutions have the potential to greatly improve our ability to identify and address pollution sources.

With increasing global regulation of methane emissions and reporting, innovative technology supercharged with CH_4 narrow bandpass filters can help to measure methane leaks at a distance by using a laser and camera system to provide a highly capable solution for various gas detection challenges within emission monitoring.

Umicore has extensive experience in designing new infrared filters to meet precise technical specifications. Our IR bandpass filters that isolate a narrow region of the infrared spectrum continue to prove a highly effective choice for the early detection of noxious, harmful, and corrosive gasses in the atmosphere in parts per billion.

They are critical to ensuring the health and well-being of the workforce, and are integral to a robust preventive maintenance system to ensure that a site runs at optimal performance whilst complying with all health and safety policies.

Losing just 1 m^3 of methane per hour will result in a financial loss of around 5,000 GBP per year. There are the environmental and human costs to consider too. According to the UN Environment Program, reducing methane emissions is the most powerful lever to mitigate climate change. By reducing fugitive emissions, organizations can do the right thing by proactively – and transparently – responding to the climate change crisis with tangible steps that lead to measurable results for both the environment and the business.

Reducing methane emissions is crucial to address climate change and add economic value to gas operations. We may see a difference in this space as there have already been diplomatic efforts ahead of the COP28 to be hosted in the UAE later this year. Still, until then, we must continue to strive to improve leak detection and quantification technologies.

DOI: 10.1002/phvs.202300028

[1] Energy Institute: 72nd Statistical Review of World Energy, 2023, ISSN 2976-7857 / ISBN 978 1 78725 379 7

[2] Intergovernmental Panel on Climate Change report 2021, ISBN 978-92-9169-158-6

[3] *C.-H. Cheng & S. A. T. Redfern:* Impact of interannual and multidecadal trends on methane-climate feedbacks and sensitivity, Nat. Commun. (2022) 13:3592; DOI: 10.1038/s41467-022-31345-w

[4] 2021 Case Study by GEC

Author

Mark Naples, general manager at Umicore Coating Services and previously commercial manager, has almost two decades of experience working across the optics, sensing, and imaging industries. Well versed in planning and execution to bring disruptive technologies to market, Naples possesses significant business development experience in building robust supply chains and solution implementation at global brand companies.

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Photonics technologies for agriculture

Precision farming harnesses the wonders of nature to feed the human population

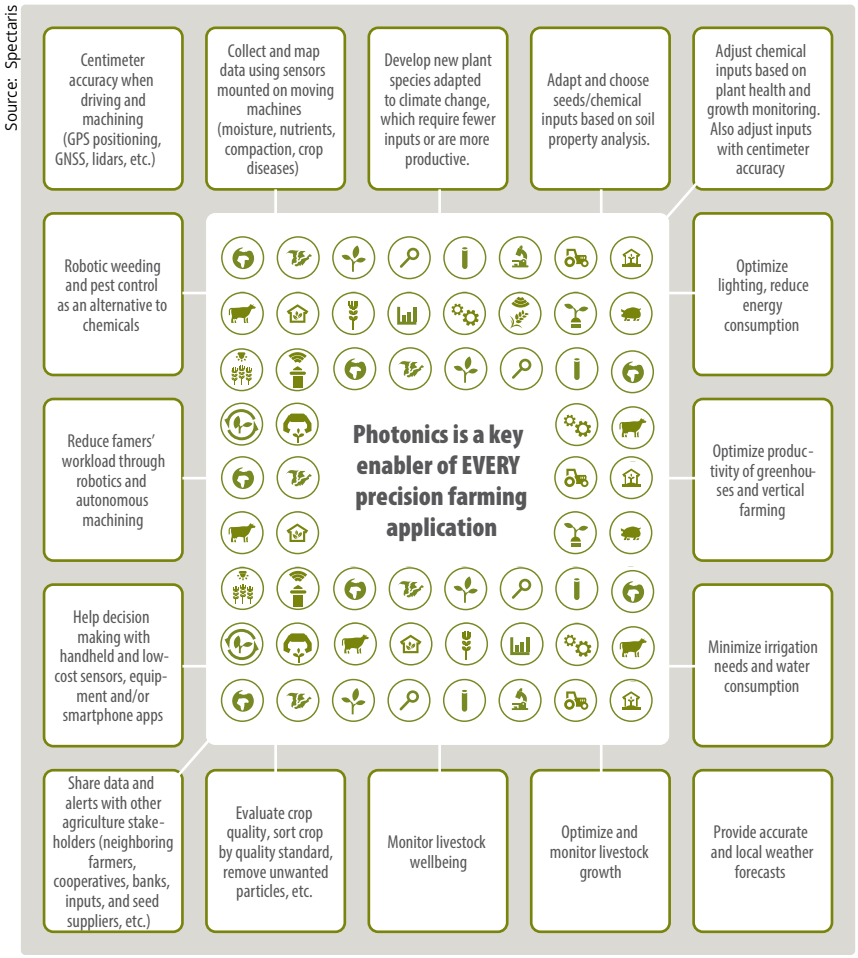
Source: Worawut / Adobe Stock

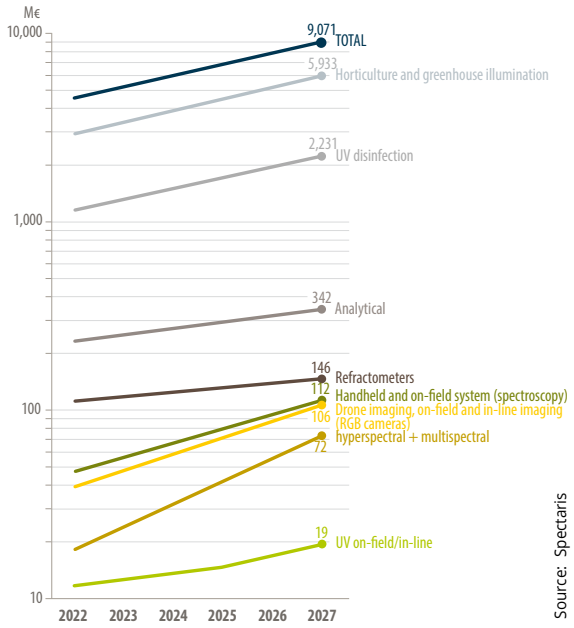
For a long time, agriculture was able to feed the world by cultivating more land and increasing input, fertilizer, and the use of pesticides. But it began to reach its limits in the 1980s. Since the 1990s, the only way to improve is to make use of precision farming. A joint study by Tematys, Spectaris and Messe München lays out the details.

Eleven percent of humanity was undernourished in 2021, and three billion people could not afford a healthy diet in 2019. The world's population is expected to grow from eight billion people in 2022 to eleven billion in 2100. That represents a forty percent increase. Agriculture will not be able to expand the area under cultivation at the same rate in order to provide everyone with sufficient food of the highest possible quality.

Agricultural land already accounts for about 37 % of total land area. Around 33 % of the world's soils are moderately to severely degraded. Soil erosion carries away 20 to 37 billion metric tons of topsoil annually, reducing crop yields and the soil's ability to store and distribute carbon, nutrients, and water. The rapid expansion of cities into less populated areas further narrows the available space. Deforestation is equally harmful as it threatens biodiversity and increases greenhouse gas concentration in the atmosphere. The supply of more and more inputs, such as fertilizers, pesticides, or animal feed, is becoming less and less efficient, and the resulting pollution of the soil by excess input is becoming less and less acceptable to society. In addition, agriculture must not only dramatically increase yields, but also improve practices to stop soil degradation, reduce pesticides, maintain biodiversity, reduce greenhouse gas emissions, and adapt to the effects of global warming.

The agriculture of the future will therefore have to rely on science, technology and the resulting new, innovative agricultural approaches such as precision farming. Precision agriculture is an agricultural management concept based on observing, measuring, and responding to variations between and within fields. The goal of precision agriculture is to develop technical solutions to optimize yields from inputs while conserving resources. Precision agriculture also encompasses new agricultural concepts such as vertical or urban agriculture, which are also based on scientific optimization of growth processes and disease and pest control.





▲ Global market forecast for photonic applications in precision farming – lighting and UV disinfection still account for the largest share

◀ Every step of the agriculture value chain can be improved by a precision farming approach – photonic technologies are able to measure complex data at any scale

According to Roland Berger, precision agriculture is based on the four main technology families

- Robotics and automation technology: Autonomous work is enabled by automated steering technology and high-precision positioning systems. Robots require photonic sensors (cameras, lidar, etc.) to move autonomously and explore their environment.
- Image processing and sensors: Data for assessing soil and crop health, etc. are collected via sensors, remote sensing systems, and geomapping. Photonics is the only way to perform advanced analysis without contact.
- Digitization and big data analytics: Fiber optics are the backbone of telecom networks. Transceivers, those components that convert light into electricity and vice versa, are critical to the performance of data centers.
- Bioengineering: Seed development to improve resistance to specific agricultural and/or climatic conditions relies heavily on microscopy techniques. Genetics would not be possible without PCR analysis read by photonic technologies. Phenotyping is based on advanced imaging.

The global market for photonics for precision agriculture is currently worth around € 4.6 B and is expected to virtually double by 2027 to a value of € 9.1 B. This corresponds to annual growth of around 15 %. Lighting and UV disinfection still account for the largest share, but many other emerging technologies and fields of application have enormous potential. Lighting includes greenhouse lighting and new types of agriculture such as vertical or urban farming. With the advent of LEDs, lighting a greenhouse is not only more energy efficient, it is now also possible to adjust the wavelength of the lighting to provide exactly the light that the plants need and promote their growth. UV disinfection is currently the second largest market. Disinfected water is needed in agriculture, breeding, dairy production, nurseries, soil-less production, hydroponics/aeroponics, the disinfection of drain backwaters, and reprocessing of nutrient solutions, or simply for irrigation.

But UV can do even more: recent studies have shown that irradiating crops with UV-C boosts plant immunity and significantly reduces the need for chemicals to control pests and diseases. This is still a very young but promising market. Other opportunities for photonics in agriculture include imaging systems – either permanently installed or built into drones or robots – that can monitor crop growth, animal welfare and disease detection. A more traditional but still important market is all the instrumentation for monitoring, disease diagnosis, quality assessment and control, and sanitation testing. Equipment that was once only used in labs is becoming more miniaturized and can now be handheld or attached to tractors and machinery for precision agriculture in the field.

Reference: *Benoît d'Humières* et al.: Photonic Technologies for Agriculture, Spectaris, 1st ed. Berlin / Munich, February 2023, www.surveymonkey.de/r/L3F68C6

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Photonics is a critical enabler of precision farming

Optical measurement technologies in soil quality evaluation, plant growth monitoring, and optical sensors for real-time testing during harvest

Source: Monopoly919 / adobe stock

Innovative ideas and solutions emerge within the Nynomic group from the interaction of its various specialized companies, which range from component development and system integration to highly application-oriented implementation. Intensive cooperation with numerous external partners in the field is also extremely valuable.

Optical methods are already very well established and widely used in agriculture, from breeding and seed production to sowing, growing and finally during harvesting. For example, 'agrophotonics' are used for the quality assessment of fruits and soil and they have become a standard for plant ratings and the monitoring of yield. In soil analysis, they assist in determining nutrient requirements or serve to monitor legally stipulated threshold values for the total nitrogen content. And more recent developments using optical methods for more targeted and therefore more sustainable application of herbicides or fertilizers are very exciting.

Optical sensing in soil quality evaluation

Soil quality by its very nature provides a substantial contribution to the successful cultivation of crops and hence to the highest possible yield. Optimal results are obtained by regularly analyzing both the chemical composition and the nutrient content. Optical sensors for simple and fast measurements in the field are available, eliminating the need for time-consuming and rather costly sampling for wet chemical analysis. At their most basic, handheld sensors for field use provide full analytical data in a matter of seconds. Vehicle or drone-based sensors are also capable of fully covering agricultural plots, delivering spatially resolved maps of soil quality.

In contrast to sampling-based methods, it is only through the use of optical methods that significantly more effective and efficient field management becomes possible. The approach for optical sensors is pretty much always the same: light reflected from the ground – either natural light from the sun or from artificial light sources – is collected by sensors in the ultraviolet, visible, or near-infrared range and analyzed in spectral terms. From these measurements, one can determine the chemical composition of the soil. This in turn is a prerequisite for the subsequent soil

cultivation or preparation of the soil. For example, the application of fertilizer has to be precisely controlled, which also happens by means of optical sensor technology. However, the amount of fertilizer applied is not only decisive for optimized plant growth; environmental aspects also make it necessary to avoid soil overload by spreading too much fertilizer and to comply with legally stipulated limits (total nitrogen). Modern fertilizer vehicles are therefore often fitted with optical sensors that analyze the usually quite inhomogeneous liquid or dry fertilizers for their relevant ingredients. The measured data is used to adjust the spread rate automatically via control valves to ensure that the correct amount of nutrients is always applied to that particular area.

Plant growth assessment

Photonic measurement techniques are ideal for monitoring plant growth as they are completely non-destructive and make many parameters that are important for evaluating the respective condition of individual plants accessible by measuring their optical properties. This procedure takes advantage of the fact that the plant components and ingredients each absorb very different proportions of light. In typical measurement setups, light is reflected from the plant and detected and analyzed by a measuring device in the visible UV or IR range. These data can then be used to calculate concentrations of chemical constituents, based on which a reliable and comprehensive phenotypic assessment can be made. Scanning or direct imaging measurement cameras can even be used to visualize distributions within plants.

Phenotyping is the quantitative recording of plant appearance. Environmental influences or the effects of plant diseases are identified using optical methods. For this purpose, leaf discs are grown in multiwell plates and analyzed using dedicated camera systems. (Source: Nynomic group)

Applications of this technique include plant growers who need to evaluate new varieties for their germination characteristics, or root or shoot growth in the different growth phases according to the respective breeding objectives. The characterization of the many thousands of new experimental plants each year is hardly imaginable without the possibilities of modern, high-throughput sensor technology. Regular monitoring of plant growth is now also generally established in agriculture. Optical sensors mounted on vehicles or drones can be used to record entire inventories, which can be used, for example, to determine nutrient requirements with spatial resolution. In addition, plant diseases or a possible pest infestation can be detected in good time. Based on the sensor data, appropriate measures can then be taken on a localized basis, resulting in more targeted action on the one hand and less use of chemical pesticides on the other, aspects that are essential both in terms of business management and environmental protection. Equally important in addition to monitoring crop health is the detection and localization of weeds in the crop area. The targeted application of herbicides according to need in modern field management only becomes possible through the use of optical sensor systems.

Harvesting machines – high demands for agrophotonics

Monitoring and documentation of both yield and harvest quality is the most essential factor for success in agricultural applications. In addition to the retrospective evaluation of the measures

A semi-automated phenotyping system for laboratory samples that enables measurements with a range of optical sensors, including hyperspectral cameras, chlorophyll fluorescence cameras, RGB cameras or laser scanners. (Source: Nynomic group)

Company

Nynomic

Nynomic AG is an internationally leading manufacturer of products for permanent, non-contact and non-destructive optical measurement technology. Its products and services are based on a wide range of intelligent sensors for measuring optical radiation and smart technologies for data acquisition, processing, and evaluation.

Photonics can be found in many different industries, but they are especially well established in the field of agriculture. The application of optical sensor systems can play a decisive role in improving modern field management.

The right partners for the specialist topics of soil analysis, harvesting and plant growth can be found in the Nynomic group at tec5, m-u-t and LemnaTec.

www.nynomic.com

An NIR sensor directly mounted on an agricultural machine is shown in operation. The use of this technology allows not only dry matter, but also starch, sugar, or many other quality parameters to be determined, depending on the crop. (Source: Nynomic group)

taken, it is the basis for optimizing subsequent processes. The optical sensors are directly mounted on a harvesting machine such as a grain forage harvester or a beet harvester for this purpose. The crop material passes the sensor and is analyzed while in operation. Material-specific absorption bands, usually in the near-infrared range, are used as a basis and are recorded spectrally. From these measurement data the sensor is able to calculate the concentration of the relevant ingredients and thus determine the changing chemical composition of the crop flow in real time.

As an example, dry matter can be directly analyzed for its water or moisture content. Combining these measurement data with the respective GPS position of the harvester leads to maps of the respective crop areas ('geotagging'), in which the yield is shown with precision down to the meter and with spatial resolution.

Besides dry matter, many other crop quality parameters can also be recorded, such as protein, starch, or sugar content. Since the acceptance, utilization, and in particular the payment for agricultural products are often defined by their quality, sensor-based classification and sorting of the harvested goods directly in the field is a highly efficient solution.

Determination of quality parameters also has an important role to play in plant breeding as they are linked to key breeding objectives, such as optimizing the protein content of energy maize. In field trials, new varieties are fully analyzed with optical sensors after test cultivation while they are still being harvested and directly on the machine. Sampling and further processing in analytical laboratories, for example, can therefore be waived completely.

Using optical sensors on harvesting machines puts tough demands on the manufacturers of measuring equipment: in addition to the harsh environmental conditions such as dirt, moisture, and vibrations, etc., the systems have to operate extremely reliably and be highly available. The time slots for harvests are quite short and not repeatable; a system failure cannot be tolerated. It is therefore imperative that users can fully rely on those devices, which are essential for their crop management.

Emphasis is also placed on user-friendliness: the sensor systems are designed in such a way as to carry out automated measuring routines without any major user interaction and, if necessary, to transmit the analysis results to the harvesters' onboard system in real time. This data can then be used to generate further commands for machine control and to create consistent documentation.

In this application an NIR sensor is directly mounted on the slurry tank, measuring the nutrient concentrations of organic fertilizer. (Source: Nynomic group)

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Full article in PhotonicsViews issue 6/2023

Spectral imaging made easy

Researchers developed a fully standalone spectral imaging system for fresh produce analysis

Hyperspectral imaging has been used for quite a while in scientific and industrial applications. It has proven to be a powerful technology for advanced classification and material analysis in numerous use cases. Compared to conventional imaging systems, hyperspectral imaging extends beyond the visible spectrum, making it capable of detecting information that is invisible to the human eye. It offers unparalleled capabilities in numerous fields where precise characterization and identification are essential.

While hyperspectral imaging has demonstrated significant advantages and potential in various industries and research fields, the complexity of data acquisition and analysis has hindered its widespread adoption – up until now:

Based on hyperspectral cameras from the Finnish manufacturer Specim, researchers have developed a smart all-in-one spectral imaging laboratory system for standardized automated data acquisition and real-time spectral model deployment. A fully standalone system integrated with two different hyperspectral cameras working in complementary spectral ranges has proven its capability for reliable fresh produce analysis.

All-in-one spectral imaging (ASI) laboratory system for analyzing the properties of several fruits. (Source: WUR)

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Full article in PhotonicsViews issue 1/2024

Photonic blood glucose measurement with infrared quantum cascade lasers

A novel non-invasive and pain-free glucometer for diabetes patients

Diamontech has developed a photonic technique based on quantum cascade lasers (QCL) and photothermal detection. Mid-IR light pulses from a QCL in the spectral range of 8 – 11 µm are directed onto skin and selectively excite vibrational modes of glucose in the skin. Upon relaxation, a small amount of heat is generated in the skin that is detected by a proprietary photothermal technique. The glucose concentration is calculated from the thermal response on the skin surface.

Clinical tests of a CE-certified tabletop device ("D-Base") have revealed an accuracy that corresponds to that of minimally invasive glucometers. Further miniaturization has led to a portable device about the size of a smartphone ("D-Pocket") that is presently being finalized. It will be a companion for the diabetes patient and will allow a frequent reagent and pain-free blood glucose control.

Mid-IR light pulses from a quantum cascade laser 8 – 11 µm are directed onto the tip of the index finger and selectively excite vibrational modes of glucose in the skin. (Source: Diamontech)

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Thorsten Lubinski, CEO
Boxhagener Straße 82A
10245 Berlin
Germany
e-mail: info@diamontech.de
Web: www.diamontech.de

Source:: CIOE

Source: Messe München

November 7 – 10, 2023

Blechexpo / Schweisstec

Stuttgart, Germany

www.blechexpo-messe.de
www.schweisstec-messe.de

November 7 – 10, 2023

formnext

Frankfurt, Germany
https://formnext.mesago.com

November 13 – 16, 2023

Compamed / MEDICA

Düsseldorf, Germany

www.compamed-tradefair.com
www.medica-tradefair.com

November 14 – 17, 2023

productronica

Munich, Germany

https://productronica.com

November 29 – 30, 2023

W3+ Fair

Jena, Germany

https://w3-fair.com/en/jena/

November 30 – December 1, 2023

Laser Symposium & ISAM 2023

Dresden, Germany, and online

www.lasersymposium.de

January 27 – February 01, 2024

SPIE Photonics West

Francisco, CA, USA

https://spie.org

February 21 – 23, 2024

PHOTOPTICS

Rome, Italy

https://photoptics.scitevents.org

March 06 – 08, 2024

Asia Photonics Show (APE)

Marina Bay Sands, Singapore

www.asiaphotonicsexpo.com

March 13 – 14, 2024

W3+ Fair

Wetzlar, Germany

https://w3-fair.com

March 20 – 33, 2024

LASER World of PHOTONICS CHINA

Shanghai, China

www.world-of-photonics-china.com.cn

April 07 – 11, 2024

SPIE Photonics Europe

Strasbourg, France

https://spie.org

April 17 – 19, 2024

AKL'24

Aachen, Germany

www.lasercongress.org

April 23 – 26, 2024

Control

Stuttgart, Germany

www.control-messe.de

Read event previews and reviews on www.wileyindustrynews.com/en/events

Bringing the global optoelectronic community together

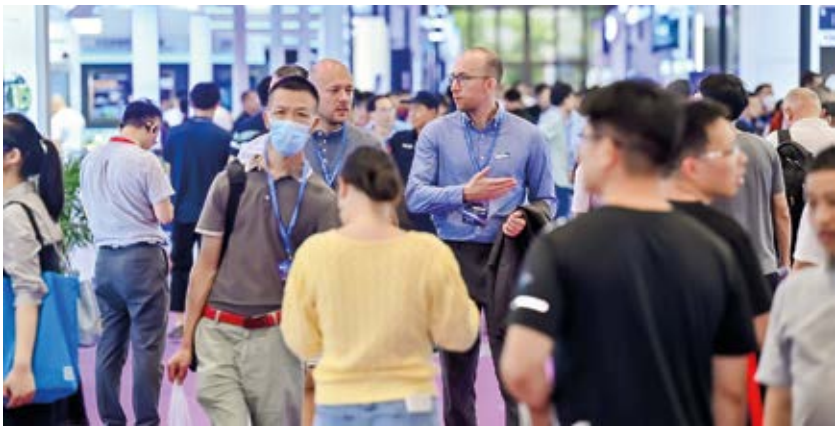
Review: China International Optoelectronic Exposition, 6 – 8 September 2023, Shenzhen, China

The world's leading optoelectronic exhibition, CIOE 2023, took place at the Shenzhen World Exhibition and Convention Center with 3,625 exhibitors from all over the world who gathered together to showcase their state-of-the-art products and technologies.

With a record high show area of 240,000 square meters, CIOE 2023 presented the entire optoelectronic ecosystem with seven concurrent subexpos including Information and Communication Expo, Precision Optics Expo & Camera Expo, Laser Technology & Intelligent Manufacturing Expo, Infrared Application Expo, Intelligent Sensing Expo, Photonics innovation Expo and Display Technology Expo.

Aiming at the hot topics and market demand of the industry, CIOE 2023 brought together more than three thousand leading industry players to showcase the cutting-edge technologies and innovative products for the optoelectronic industry, such as optical chips, optical modules, semiconductor materials and equipment, lens and camera modules, AR/VR, lasers, laser equipment, infrared thermal imaging, 3D imaging sensors, lidar, and display manufacturing equipment.

This year, with China's re-opening, global business exchanges have returned to the right track, and a large number of international optoelectronic brands have laid out a new international track through CIOE. The event brought together international brands from the United States, Canada, Germany, France, Denmark, Sweden, Italy, Poland, Japan, South Korea, Singapore, Malaysia, Switzerland, Israel, and others, to showcase innovative optoelectronic technologies and solutions, providing more new ideas for the technological development of industrial and downstream applications. During the three days, CIOE 2023 attracted a total of 108,063 visitors, including 3,013 international visitors. Compared with 2021, this was an overall increase of twenty percent.



Source: CIOE

Building upon the success of CIOE and adhering to the spirit of opening up leads to development, the organizers have built a brand-new platform for leading Chinese enterprises to go global. "Next March we will hold a new expo – Asia Photonics Expo (APE 2024) in Singapore, to help Chinese enterprises explore overseas markets and develop our optoelectronic industry. APE will be a high-quality communication, exchange and learning platform for global industry players that can promote the in-depth communication and business collaboration between the photonics upstream and downstream professionals," Eric Yang, vice chairman and secretary general of CIOE shared.

www.cioe.cn

Back on the international trade fair stage

Review: Schweissen & Schneiden, 11 – 15 September 2023, Essen, Germany

With 826 exhibitors and 40,000 trade visitors from 124 nations, Schweissen & Schneiden confirmed its position as the world's leading trade fair for joining, cutting and surfacing technology. 83 % of all trade visitors accompany purchasing decisions in their companies. A large number of experts from the steel, mechanical engineering and vehicle construction sectors, but also from wholesale, the service sector and the energy industry, came to find out about new solutions and to place orders on site. A third of all visitors used the trade fair to make or prepare investments, and the average order volume increased significantly compared to the previous event. Digitalization and networking play a decisive role in the future orientation of the cutting and surfacing technology. Smart robot systems that work hand-in-hand and together carry out the most diverse process steps efficiently were on display, as were systems that create digital twins and enable optimizations thanks to their real-time data.

Overall, 66 % of the exhibiting companies came from abroad. Numerous nations were represented under their respective national flags, including China, France, Japan, South Korea, Taiwan and the USA.

The accompanying DVS Congress from Monday to Thursday attracted almost 450 participants. It was a combination of the Large Welding Conference, the DVS Campus, and the Underwater Technology Conference.

Source: Messe Essen

The next Schweissen & Schneiden will be held from 15 – 19 September 2025 at Messe Essen, Germany.

www.schweissen-schneiden.com

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www.materion.com/balzersoptics

Free-form optics

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info.mbo@materion.com
www.materion.com/balzersoptics

Windows, optical

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14 November 2023 Editorial deadline

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- Laser Sources
- Optical Components

SPIE. PHOTONICS WEST

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- Photonics for Quantum Technology
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03 June 2024 Publishing date
19 April 2024 Advertising deadline
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Focus: Stuttgart Laser Technology Forum (SLT)

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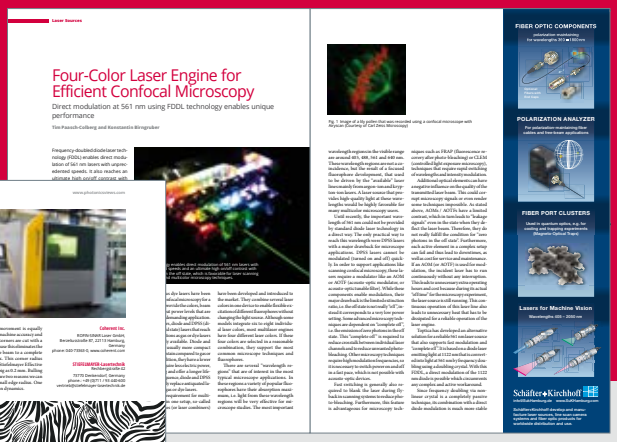
- Medical Applications
- Laser Marking and Engraving



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Company Index

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