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PHOTONICS FRONTIERS AWARD 2025

12 Check out the shortlist for the 2025 Photonics Frontiers Award

Groundbreaking projects that harness the power of light to address real-world challenges

Read more on page 12

Read more online at electrooptics.com

Photonics in peril: US research faces long-term decline amid funding cuts and trade turmoil

Federal funding cuts, combined with the rising costs of post-tariff components, are pushing US photonics research towards a crisis of innovation and talent

The US photonics sector, which underpins advances in telecommunications, medicine, defence and computing, is facing a perfect storm. Federal funding reductions, escalating tariffs and shifting global trade dynamics are converging to stall innovation, disrupt supply chains and drive the country's best talent out of academia – and increasingly out of the country.

Without strategic intervention, the decline in innovation could stretch far beyond the next federal budget cycle, reverberating across American industry and the country's global competitiveness for decades.

The collapse of the research backbone

Photonics innovation is rooted in university labs that rely heavily on federal agencies such as the National Institutes of Health (NIH), the National Science Foundation (NSF) and the Department of Energy. These labs are where foundational research happens: developing high-efficiency lasers, biosensors and quantum-grade optical systems. But those pipelines have started to dry up.

In February, the Trump administration signed an executive order slashing funds from the NIH, including $79m cut from existing research grants in the State University of New York (SUNY) system alone. Meanwhile, Florida State University has already halted 11 NIH-funded projects and other universities have seen their proposals ignored or indefinitely delayed as NIH has reportedly stopped reviewing thousands of new grant applications.

This is not just a problem for health research. It affects the entire ecosystem of scientific discovery, including photonics.

"People will die," said Fred Kowal, President of United University Professions, bluntly summing up the long-term fallout from lost research in areas such as Alzheimer's, heart disease and muscular dystrophy. The same applies to photonics applications including early cancer detection or optical imaging in surgery.

For researchers such as Clarissa Henry at the University of Maine – whose NIH-funded lab explores muscle regeneration through electrical stimulation – the loss of funding has forced imminent closures. "I've talked to four other muscle biologists this week and they're all shutting down their labs," she said.

Tariffs add financial squeeze

Meanwhile, photonics labs and companies are contending with another layer of difficulty: escalating import tariffs. Many high-precision optical components, from rare earth crystals to precision lenses and photodetectors, are sourced internationally. In particular, US tariff rises on Chinese imports have caused the cost of these components to spike, with analysis from Yale suggesting there's been a 20% rise in the cost of optical components post-tariff.

Consequently, universities will soon either need to delay or downsize projects, and SMEs in the photonics supply chain could face existential threats, being unable to pass rising costs onto a shrinking customer base, with only the larger global companies able to act quickly enough to weather the storm.

"While our direct exposure is limited," said Donald McClymont, CEO of Indie Semiconductor, a US company with a globally diverse supply chain, on the company's Q1 earnings, "tariffs are impacting overall market sentiment and creating uncertainty across the automotive industry. Multiple OEMs have recently announced a reduction in vehicle production, temporary layoffs or paused shipments to the US. We expect other OEMs to follow. Consequently, we anticipate vehicle prices for US consumers may increase by several thousand dollars, which could ultimately lead to a drop in end-vehicle demand."

Truce offers some respite

After imposing tariffs on Chinese imports at a rate that quickly rocketed to 145%, the US and China have since arranged a 90-day truce, reducing US/China and China/US tariffs to 30% and 10% respectively. As a result, the markets in both countries responded positively, but Reuters analysts commented that "a more permanent trade deal needs to be struck".

The UK, meanwhile, has led the way in doing just that, being among the first countries to strike up a new trade deal with the US. The news came as "a welcome headline" to Andrei Danescu, CEO of robotics firm Dexory. "It's a step forward for transatlantic trade," he said, "but sadly, headlines don't build resilience! Even positive shifts in trade policy can create ripple effects across supply chains. This is yet another reminder that reliance and agility isn't optional – it's the foundation for long-term competitiveness in an increasingly unpredictable world. What's needed now is not a patch, but a full rethinking of how supply chains are designed."

With that in mind, the announcement of a new trade deal with India will help UK businesses quietly turn their attention elsewhere, offering the opportunity to solidify their supply chains in the East. The strategy was shared by Lumentum CEO Michael Hurlston at a recent JP Morgan conference, who stated that the reverse tariff from the US to China has hit the US company hard, but that with "manufacturing footprints in China and Thailand, we think we can steer around tariff impacts [by] using that supply chain flexibly."

However, as non-US companies find more stable demand and pricing environments in Europe and Asia, they could also choose to steer away from the American market, removing US researchers' access to a global supply of innovation and technology as a result.

Private sector can't fill the research gap

As the kind of research performed in photonics labs to better understand light-matter interactions or develop better photonic circuits offers no immediate payoff, private companies may not

The White House

US President Trump at the Conservative Political Action Conference (CPAC) 2025

step in to make up the funding shortfall. Global University Venturing (GUV) suggests that, with 10-to-20 years before many research breakthroughs become commercially viable, that business model is not of interest to venture capitalists or corporate R&D departments.

"Drug companies aren't doing this because they can't afford to spend 20 years on it," said Josh Kelley, a Professor of Molecular & Biomedical sciences performing photonic biosensing research at the University of Maine.

Even in AI, where industry funding is massive, researchers such as Scott Niekum of UMass Amherst, whose research focuses on AI safety, rely on federal grants. "There's not much money in AI safety," said Niekum. "There's probably one safety researcher for every 100 building new capabilities."

The impact on photonics spin-outs and tech transfer

In an attempt to adapt, US universities are doubling down on commercialisation, with internal venture funds launched to spin out technologies from campus labs, such as the one supporting AI at UC Berkeley. This may help specific projects make it to market, but it won't scale.

Tech transfer offices are themselves supported by the same federal indirect funds that are now being capped or cut. According to GUV, their pipeline – measured by patent filings and invention disclosures – is thinning. As federal grants decline, fewer researchers are positioned to develop IP, submit patents or start companies.

This drop-off has long-term consequences. "In 10 years from now, the number of new drugs on the market might actually go down," says Stephen Susalka, CEO of the Association of University Technology Managers (AUTM). And the same logic applies to photonics technologies: fewer funded labs today means fewer diagnostic tools, lasers and photonic chips tomorrow.

A bleak outlook for future talent

Graduate students are the engine of research and the next generation of innovation leaders. Now, according to the NEA, many US universities are pausing new graduate admissions in STEM fields, as they can no longer guarantee funding.

"We have three PhD students," says Brian Weil, a cardiac researching physiologist at the University of Buffalo. "The idea is they take all this knowledge and multiply it – set up their own labs, make their own discoveries. That's the future we're losing."

The ripple effect is already visible. Postdocs and faculty are relocating to countries with more stable funding and research incentives. Europe and Asia are seeing increased interest from American scientists in relocating or collaborating. It's a slow-moving brain drain, but one that may be impossible to reverse if sustained.

Economic and strategic costs

From a macroeconomic perspective, the numbers are sobering. A study from researchers at American University projects that even a 25% cut in federal R&D could shrink US GDP by more than 3.8% – a loss on par with the Great Recession.

With cuts at 50%, the economic hit grows to 7.6% and at 75%, it exceeds 11%.

Photonics is a strategic technology that intersects with defence, data security and manufacturing competitiveness, so allowing the sector to atrophy could also undermine US national security and economic independence.

"A lot of innovation isn't very profitable at first," noted Weil. "If the federal government doesn't fund it, it doesn't happen."

The crisis in US photonics is not hypothetical. It is here, and it is expanding. Funding cuts have already halted projects. Tariffs are actively inflating costs. Labs are shutting. Talent is leaving. And the country is losing ground in a field critical to its economic and technological leadership.

If policymakers do not act – by restoring federal investment and reassessing trade policy – the damage will stretch well beyond this administration, suggests the NEA, which claims it will cost the US its role as a global leader in photonics and innovation more broadly. And it may take more than a decade to rebuild what has been lost. **EO**

James Wormald

Quantum tech moves from lab to market with real-world breakthroughs

From scalable computing chips to non-invasive and autonomous inspection, quantum tech is now solving real business needs

Just a few years ago, quantum technology was still largely the domain of theorists and lab-bound physicists. But if the recent Commercialising Quantum 2025 event in London made anything clear (as if the topic of quantum technology ever is), it's that quantum is moving out of the lab and into the real world – fast.

The event spotlighted how this next wave of computing and sensing is no longer speculative. Commercial deployments, strategic advantages and enterprise-grade solutions are taking shape across multiple sectors.

The key? A maturing ecosystem of quantum research and commercialisation that includes multiple technical modalities – superconducting, trapped ion, and photonics-based quantum systems – each vying to become the backbone of next-generation infrastructure. As new architectures, hybrid approaches and custom quantum-as-a-service approaches emerge, developers are no longer asking 'if' quantum will scale, but 'when'.

A modality mosaic: the diversity of the quantum landscape

Quantum computing is not a one-size-fits-all game. Different technologies offer different strengths. Superconducting qubits, the workhorse of early-stage quantum machines, are fast, but prone to noise and require cryogenic environments. Trapped ion systems promise high-fidelity operations, using individual atoms suspended in electromagnetic fields, but are typically slower and complex to scale.

Photonic qubits that use particles of light, meanwhile, offer advantages such as room-temperature operation and ease of networking, but are lagging behind on their development journey. Recognising the strengths and weaknesses of each, some of the most ambitious players in the field are now exploring hybrid approaches – none more notable than Microsoft.

Microsoft's Majorana 1: a million-qubit machine in the making

At the forefront of scalable quantum computing, Microsoft recently unveiled its Majorana 1 chip, the first powered by what it calls a "topological core". This architecture uniquely combines superconducting and photonic components to produce topological qubits – more stable, more fault-tolerant and more compact than their predecessors.

Microsoft Quantum

"Built with a breakthrough class of materials called a topoconductor, Majorana 1 marks a transformative leap toward practical quantum computing" – Chetan Nayak, Technical Fellow and Corporate Vice-President of Quantum Hardware, Microsoft Quantum

"We took a step back and said 'okay, let's invent the transistor for the quantum age. What properties does it need to have?'" said Chetan Nayak, Microsoft Technical Fellow. "That's how we got here – it's the particular combination, the quality and the important details in our new materials stack that have enabled a new kind of qubit and, ultimately, our entire architecture."

The Majorana 1 chip is designed to eventually scale to a million qubits, a critical milestone for delivering commercially relevant quantum computing power. According to Microsoft, this scale would allow quantum systems to tackle complex challenges such as chemical degradation, material corrosion, microplastic pollution and the design of self-healing materials.

"Whatever you're doing in the quantum space needs to have a path to a million qubits," said Nayak. "If it doesn't, you're going to hit a wall before you get to the scale at which you can solve the really important problems that motivate us."

Microsoft's architecture uses indium arsenide and aluminium nanowires, materials arranged atom-by-atom to support the formation of Majorana particles. "Those materials have to line up perfectly," said Krysta Svore, Microsoft Technical Fellow. "If there are too many defects in the material stack, it just kills your qubit."

These topological qubits benefit from inherent error resistance, enabling digital control through voltage pulses, which significantly simplifies scaling compared with analogue-based systems.

"The measurement can be turned on and off like flicking a light switch," said Svore. "That means we can scale the architecture far more efficiently [because] you're not spending half your time tuning knobs."

The approach is already showing results. Microsoft has fabricated a chip that includes eight topological qubits and a surrounding control system compact enough to fit in the palm of a hand. The technology fits neatly into Azure data centres and supports Microsoft's long-term vision of delivering utility-scale, fault-tolerant quantum systems.

The company's goals have drawn the attention of the US Defense Advanced Research Projects Agency (DARPA), which included Microsoft in its US2QC programme to explore accelerated paths to scalable quantum computing.

"From the start, we wanted to make a quantum computer for commercial impact, not just thought leadership," said Microsoft Technical Fellow Matthias Troyer. "We knew we needed a new qubit. We knew we had to scale."

One of the most transformative potentials of future quantum systems lies in their ability to partner with artificial intelligence, as "any company that makes anything could just design it perfectly the first time out," said Troyer. "It would just give you the answer. The quantum computer teaches the AI the language of nature so the AI can just tell you the recipe for what you want to make."

Topological qubits are also physically compact, avoiding the bulkiness that plagues other quantum designs. "There's a Goldilocks zone," said Troyer. "Too small and it's hard to run control lines; too big and you need a system the size of an airplane hangar."

Microsoft's full-stack quantum system includes not just hardware, but software and environmental controls built in-house, including a dilution refrigerator operating at temperatures colder than outer space.

The Economist Impact Commercialising Quantum Global event took place in London

EdenBase and the rise of quantum application hubs

But scaling hardware is only half the equation. The other is building the ecosystem to turn quantum hardware into useful applications. That's the goal of the EdenBase Quantum Hub, a recent initiative launched in London.

Backed by partners involved across all quantum modalities, EdenBase serves as both incubator and accelerator for quantum start-ups and enterprise adopters. The hub provides access to quantum computing infrastructure, mentorship and funding – enabling researchers and founders to turn theory into applied solutions.

By lowering barriers to entry, EdenBase aims to make quantum innovation more democratic and collaborative. Its location in London reflects a broader UK Government push to become a global leader in the commercialisation of quantum, with national programmes investing heavily in industry-academic partnerships and infrastructure.

Real-world quantum photonics applications

A growing cohort of quantum photonics companies are already proving the technology can solve real-world problems today, harnessing the power of light and combining it with quantum principles to create tangible solutions in healthcare, security and energy – each with commercial deployments or products in advanced stages.

Bristol-based Siloton, for example, is revolutionising ophthalmic care with its breakthrough photonic chip technology. The company said it became the first commercial organisation to capture a sub-surface image of a human retina using a photonic integrated circuit – a milestone that could reshape how vision-threatening conditions are diagnosed and managed.

Siloton's chip, Akepa, miniaturises the bulky optical coherence tomography (OCT) machines found in hospitals into a device smaller than a £1 coin. This allows for high-resolution, non-invasive eye scans outside of clinical settings – making home-based or remote monitoring feasible for millions.

"OCT scans are critical to providing the sight-saving eye care that almost everyone will eventually need," said Dr Alasdair Price, CEO of Siloton. "The Siloton team has shown that we can use affordable and scalable technology to expand the reach of OCT systems, reducing preventable blindness, alleviating pressure on eye clinics and potentially saving healthcare providers such as the NHS billions each year." With support from the NHS, Moorfields Eye Hospital and the European Space Agency, Siloton is positioned to address one of healthcare's most pressing issues: the growing burden of retinal disease.

Aegiq is a University of Sheffield spin-out that focuses solely on quantum photonics, developing scalable, chip-based quantum systems. Its flagship prototype, the Artemis quantum computer, integrates multiple photonic chips to form a small-scale quantum network. Built using compound semiconductors, Artemis offers robust functionality in a compact form and is already being deployed at the UK's National Quantum Computing Centre.

The company, founded by Ukrainian Max Sich with Andrii Iamshanov and Photonics100 honoree Scott Dufferwiel, is looking to commercialise secure quantum communication technologies, including network monitoring systems that use quantum effects to detect tampering or degradation – particularly valuable for sensitive infrastructure such as submarine fibre optic cables.

Unlike many early-stage efforts, Aegiq has invested in full in-house manufacturing and has products approaching market readiness in both quantum computing and telecommunications. Their technology is fault-tolerant by design and requires minimal oversight – paving the way for truly autonomous quantum systems in the near future.

In the energy sector, meanwhile, QLM Technology is using applied quantum principles to tackle one of the most urgent environmental challenges facing the planet: methane emissions. In partnership with SLB and Repsol Sinopec, QLM deployed a quantum gas lidar camera to the Flotta Oil Terminal off the coast of Scotland to look for leaks. Using tunable diode laser imaging, the system successfully identified small, previously undetectable leaks across the facility.

"The trial provided QLM and SLB with valuable information," said Catherine Sherwin, Technology Lead at Repsol Sinopec. "The results gained provided us with detail on top-down methane emissions."

Demonstrating not only pin-point detection, but also the ability to continuously monitor large industrial sites, these quantum lidar sensors could become a staple in global emissions monitoring strategies. Together, Silicon, Aegiq and QLM, as well as Microsoft and EdenBase are exemplifying how quantum photonics is no longer theoretical – it's already here. **EO**

James Wormald

News highlights

Read more news stories online at electrooptics.com

Coherent posts record $1.5bn sales, citing supply-chain strength and tariff readiness

The Business Journals

Coherent will use the CHIPS Act funding to accelerate the commercialisation of next-generation wide- and ultrawide-bandgap

Coherent has reported record quarterly sales of nearly $1.5bn, up 24% year-on-year, as the company continues to benefit from surging demand from AI-related data centres and telecoms applications.

The results, posted for the quarter ending March 31, come amid what CEO Jim Anderson called a "high level of macroeconomic uncertainty" tied to new US import tariffs.

Despite those headwinds, Anderson emphasised to investors Coherent's ability to remain agile: "Our geographically diverse supply chain, combined with the internal production of many of our most critical technologies, provides adaptability and optionality that benefits our customers."

With 60 production facilities across 14 countries – half of them in the US – Coherent's global reach is seen as a buffer against supply chain disruption.

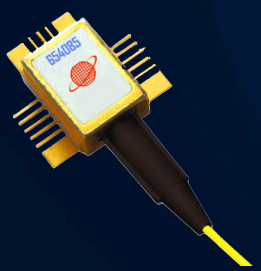
"We delivered strong growth and profitability in the March quarter with record revenue driven by another quarter of strong AI-related data centre demand," he said. "We also introduced many new industry-leading optical networking products and technologies during the past quarter, which position us well for long-term growth."

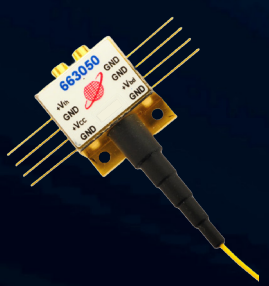
Coherent's growth was mainly put down to the company's networking segment, which includes optical transceivers that are essential for high-speed data transmission, reporting $897m in revenue – a 45% year-on-year increase. New 1.6Tb/s optical transceivers that incorporate EMLs, VCSELs and silicon photonics were all unveiled at the recent OFC (Optical Fiber Communications) conference in San Francisco, for example, alongside a roadmap towards 3.2Tb/s systems.

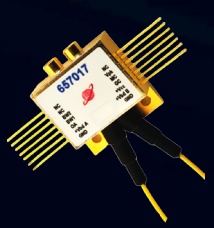
Reporting a $9.9m pre-tax profit, the company reversed a $31.9m loss for the same quarter last year. CFO Sherri Luther said: "We also paid down $136m of our outstanding debt, [as] cash and capital allocation remain priorities as we further improve operating leverage and efficiency."

Looking ahead, Coherent expects flat sequential sales for the June quarter, and although investment sentiment remains positive – with share prices rising 5% in pre-market trading – the stock remains more than 25% down since the start of the year.

WIDE BANDWIDTH OPTICAL RECEIVERS FOR MAXIMUM NETWORK FLEXIBILITY







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IPG Photonics

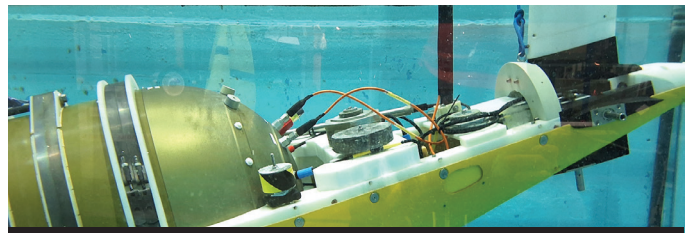
IPG Photonics' UK base in Coventry

IPG Photonics forecasts tariffs to impact Q2 revenue

IPG Photonics has announced its second-quarter revenue for 2025 is expected to be between $210m and $240m. The figures, which are $15m lower than previously expected, are due to tariff-related potential shipping delays, said the company. Despite these near-term headwinds, however, IPG's Q1 results were above the midpoint guidance, and show growth in strategic areas such as advanced laser applications.

Posting first-quarter revenue of $228m – down 10% year-on-year from 2024 – the company suggested the decline was primarily driven by a 14% drop in materials processing sales, particularly in welding and cutting applications, but was partially offset by gains in micromachining, cleaning, additive manufacturing and non-industrial sectors.

Despite these sharp falls, CEO Dr Mark Gitin highlighted progress in IPG's targeted growth areas. "We're gaining early traction in key areas central to our strategy, including medical, micromachining and advanced applications," he said.



NOC

Aquark Technologies' AQuest System was tested on Boaty McBoatface at the National Oceanography Centre

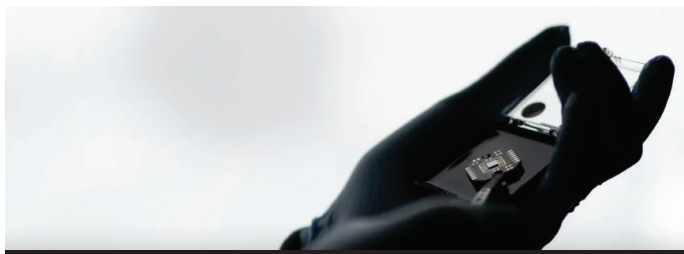
Boaty McBoatface in quantum sensing first

Laser-cooled atom trapping has successfully been demonstrated beneath the water's surface, as the autonomous submersible vehicle called Autosub Long Range (ALR) – better known as Boaty McBoatface – has shown a first for quantum sensing and underwater research.

The test, led by the National Oceanography Centre in collaboration with Aquark Technologies involved deploying Aquark's AQuest cold atom platform in NOC's large-scale indoor test tank. According to NOC, it is the first instance of cold atoms being continuously trapped in dynamic underwater conditions.

This is especially significant as laser cooling and atom trapping – technologies central to many quantum sensors – are extremely sensitive to environmental disturbances.

"Laser cooling atoms is only possible when a system is completely isolated from most external disturbances," explained Aquark Technologies. "Forming ultra-cold atom clouds poses a big engineering challenge, even on dry land."



Sparrow Quantum

Sparrow Quantum has raised $25m to scale the production of its photonic quantum chips

Photonics start-ups raise $100m+

More than $100m in funding has been secured across a wave of photonics-focused start-ups aiming to address bottlenecks in quantum computing, AI processing and data centre infrastructure. Sparrow Quantum, nEye Systems, InfiniLink and Lumai – are developing advanced optical and photonic chip technologies designed to reduce power consumption, scale processing capabilities and meet increasing demand from AI and quantum applications.

Copenhagen-based Sparrow Quantum has raised $25m to scale the production of its photonic quantum chips.

In the US, nEye Systems – founded at UC Berkeley – has announced $58m in funding, bringing the company's total figure raised to $72.5m, to develop a wafer-scale optical circuit switch (OCS) aimed at reducing communication bottlenecks in high-performance AI/ML computing clusters.

Cairo-headquartered InfiniLink recently announced the closure of a $10m funding round to aid the the development of its silicon photonics-based integrated optical transceiver chiplets (iOTC).

Finally, Oxford University spin-out Lumai has secured more than $10m to develop an optical AI accelerator technology to cut the cost and boost the performance of AI data centres.

EU Commissioner Henna Virkkunen at Photonics21's anniversary event

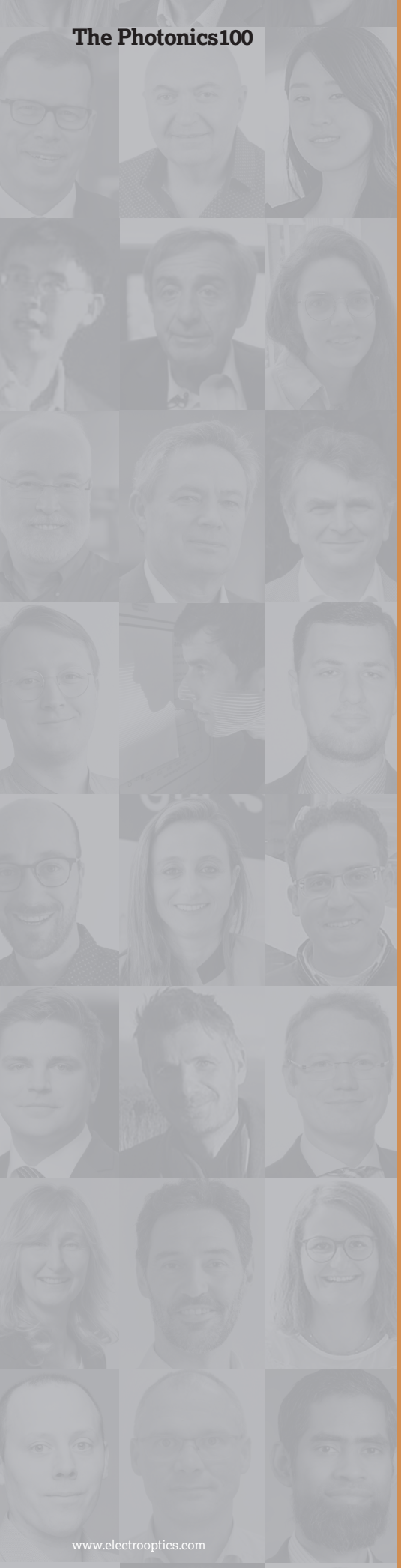
EU Tech Commissioner says photonics a 'strategic asset'

At the 20th anniversary of Photonics21 in Brussels, EU Commissioner for Innovation Henna Virkkunen identified photonics as "not only a field of scientific inquiry but a strategic asset for the European Union," calling for the technology to remain central to Europe's industrial and research priorities in the next funding cycle.

The two-day annual meeting brought together experts from industry, research and policy to assess the progress of the Photonics21 platform since its founding in 2005. The event also marked the start of shaping priorities for Framework Programme 10 (FP10).

"Photonics is the backbone of Europe's digital and green transitions," said Dr Lutz Aschke, President of Photonics21. "Commissioner Virkkunen's message reinforces what we've always known: that light-based technologies are essential infrastructure for Europe's sovereignty, competitiveness and sustainability."

Since 2005, Photonics21 has played a coordinating role in advancing European photonics through the Photonics Public Private Partnership (PPP), which has channelled more than €1bn into research and innovation projects.



Celebrating innovation in light: nominate now for the 2026 Photonics100!

Now in its fourth year, The Photonics100 returns to celebrate the scientists, engineers and innovators making the biggest impact in photonics today

The 2026 Photonics100 list will shine a light on 100 individuals whose work is shaping the future of our industry – from fundamental research to cutting-edge product development.

Thanks to your involvement, The Photonics100 has become a powerful platform for recognising excellence in photonics. Previous editions have sparked global engagement, with inspiring nominations from industry and academia alike. We've seen the community come together to highlight both high-profile leaders and unsung heroes making a real difference in the field.

In the past year, we have held events for alumni in Manchester, England, and at Photonics West in San Francisco. Plans are already in development for a further event at the forthcoming Laser World of Photonics in Munich, Germany, this June. The team will be there – come along and say hello. We are at Stand 250 in Hall B3.

So, who will make the 2026 list?

We're looking once again for R&D powerhouses, rising stars and visionary leaders – those who have driven forward photonics innovation in the past 12 months and helped their organisations stay at the forefront of progress. These are the people solving real-world problems with light-based technologies, from quantum and sensing to optical communications, imaging and beyond.

How to nominate

It couldn't be simpler. Just go to electrooptics.com/thephotonics100 and click the big orange button (see alongside). But remember to complete the nomination form before 30 June, 2025, explaining who you'd like to nominate and why.

You can nominate colleagues, clients, collaborators – or even yourself. There's no limit to the number of entries you can submit, provided each one is completed separately.

Categories for 2026

- **Photonics vendors:** Suppliers and integrators of optics, lasers, sensors and imaging technologies
- **OEMs using photonics:** Companies applying photonics in verticals such as healthcare, defence, automotive and more
- **Start-ups:** Innovative young companies (less than five years old) driving photonics forward
- **Academia/research:** Scientists advancing photonics technologies or using photonics to power new research directions

The Photonics100 is focused on those working on the technical side of innovation – the thinkers, makers and doers bringing photonics breakthroughs to life. We plan to publish the 2026 list later in the autumn with the support of our principal partner, Chroma Technology, and supporting partner, Edmund Optics.

We need your help to find them. Get involved and help us spotlight the people redefining the possibilities of light. **EO**

How to nominate someone for the Photonics100

1. Go to **electrooptics.com/thephotonics100**
2. Click The PHOTONICS 100 Click here to nominate now!
3. That's it (but remember the closing date is **30 June, 2025**).

Lighting the way: the 2025 Photonics Frontiers Award shortlist

Groundbreaking projects that harness the power of light to address real-world challenges

The highly anticipated shortlist for the 2025 Photonics Frontiers Award has been unveiled, following evaluation of dozens of entries by an independent panel of judges drawn from academia and industry. The shortlist below represents their choice of the most innovative and impactful applications of photonics in areas ranging from environmental monitoring and healthcare to advanced manufacturing and communication technologies.

Imaging technologies

- Brake Disc Production Quality Assessment And Photonics Field Application, submitted by (SB) Marco Pistilli of the R&D Machine Vision Department at I.D.E.A.
- Advanced Lost Cargo Detection for Safer Autonomous Driving, (SB) David Cheskis, Vice-President, Industrial Business Unit, TriEye.
- Short Wavelength Infrared (SWIR) 3D Laser Line Profile Sensors for Outdoor Applications in the Agricultural, Transportation, Logistics and Construction Markets, (SB) Ian Blasch, Senior Director, Jabil.

Biophotonics and healthcare applications

- Simultaneous Eye-safe Spectroscopy and Fundus Imaging Technology for Point-of-Care Detection of Traumatic Brain Injury – 'EyeTBI', (SB) Pola Goldberg Oppenheimer, Professor in Microengineering and Bionanotechnology at the Institute of Healthcare Technologies and School of Chemical Engineering / University of Birmingham.
- Villuminator: Uniform Illumination for Enhanced Microscopy Imaging, (SB) Lihao Tan, Principal Optical Systems Engineer at V-BMB.
- Laser Ultrasound for Carotid Imaging and Diagnosis (LUCID), (SB) Francis Kalloor Joseph, Assistant Professor in the Biomedical Engineering group at the Erasmus Medical Centre, Rotterdam.

Environmental monitoring and sustainability

- Multi-Spectral Sensing For Minimising Global Food Loss And Waste By Detecting The Ideal Harvesting Time, (SB) Abdel Karim Ruvalcaba-Perez on behalf of Friedrich Schiller University Jena, ams-OSRAM Group, and Fraunhofer IOF.

Laser technologies and applications

- Beam Shaping for Enhancing Electric Vehicle Welding Applications, (SB) Dr Alex Griffiths, Lead Engineer, PowerPhotonic
- Compact High-Energy Laser For Space Rocket Engine Ignition, (SB) Dmitry Tabakaev, Senior Scientist, Silicon Austria Labs
- Laser Quality Control for Sustainable Electronics Manufacturing, Mariia Zhuldybina, CEO, TRAQC

Optical communications and networking

- Solder-Reflow Resistant Injection Molded Thermoplastic Micro-Lens Array For Optical Coupling, (SB) Jos van Gisbergen, Chief Scientist Application Technology, SABIC
- Photonic Layer Security Post Quantum Transmission System, (SB) Dan Sadot, CEO, CyberRidge
- Robust Optical Ground Stations for LEO Laser Communications, (SB) Jean-François Morizur, CEO, Cailabsa

Photonic and optical sensors

- Silicon Photonics Optical Gyroscope, (SB) Mario Paniccia, CEO, ANELLO Photonics
- Holographic eXtended Reality (HXR) platform, (SB) Mike Noonen, CEO, Swave Photonics
- Ultra Compact Digital Nano Spectrometer-on-a-Chip for Wearable, Mobile and IoT, (SB) Bill Choi, CEO, nanoLambda

Spectroscopy and analytical techniques

- White Light Transmission Spectroscopy for Rapid Quality Control in Nanoimprinted Sensors, (SB) Mike Hardy, Research Fellow, Smart Nano NI, Centre for Quantum Materials and Technologies, School of Maths and Physics, Queen's University Belfast
- Diamond-Enhanced ATR Fiber Probes for Robust Industrial Spectroscopy, (SB) Dr Viacheslav Artyushenko, Founder & Senior Adviser, art photonics.

You can read individual submissions from each entrant at electrooptics.com/frontiers and we are also organising a series of webcasts showcasing the entries. You can watch these on demand at electrooptics.com/webcasts.

The winner of the Photonics Frontiers Award 2025 will be announced at a ceremony held on **Wednesday, June 25, 2025**, during the Laser World of Photonics exhibition. This event will bring together leaders and innovators from across the global photonics community to celebrate these remarkable achievements.

About the Photonics Frontiers Award

The Photonics Frontiers Award celebrates innovative projects where photonics plays a pivotal role in solving real-world challenges. Unlike awards that recognise individual achievements, this award amplifies groundbreaking applications from integrators, OEMs, academic institutions, and end-users. Supported by our principal sponsors Chroma Technology, Lumencor and Hamamatsu, and commercial partners Edmund Optics and Omega Optical, the award aims to connect breakthrough photonics technologies with the audiences that need them most, fostering collaboration and driving further innovation in the field.

Thank you again to all who entered. You can pick up a print edition of the Photonics Frontiers Award showcase at our stand at Laser World of Photonics in Munich (Hall B3; Stand 250)

"We are thrilled by the exceptional quality and breadth of applications received for the 2025 Photonics Frontiers Award," said Warren Clark, CEO of Europa Science, the parent company of *Electro Optics.* "The shortlisted projects truly exemplify the power of photonics to address some of the world's most pressing challenges and drive innovation across numerous sectors."

The independent judging panel included Antonio Castelo, Technology Manager at EPIC; Alison McLeod, Director of Photonics Scotland; Chris Yates, President, EMVA; John Girkin, Professor of Biophysics at the University of Durham; John Lincoln, Chief Executive of the Photonics Leadership Group; and Miles Padgett, Royal Society Research Professor at the University of Glasgow.

The panel said the shortlisted projects were recognised for their combination of:

- Innovative use of photonics: Novel applications of light-based technologies to solve specific problems.
- Tangible impact: Exhibiting measurable improvements and benefits for end-users or processes.
- Growth potential: The capability to unlock new markets and opportunities for photonics.
- High-quality submissions: Presenting clear, detailed, and well-articulated entries. **EO**

Record numbers set to attend Laser World of Photonics 2025

Alongside a record-breaking 1,350 exhibitors at Laser World of Photonics, a total of 38 award finalists will be celebrated in Munich, across both the Innovation Award and Electro Optics' inaugural Photonics Frontiers Award

Laser World of Photonics, the global trade fair for photonics technologies, will return to Munich from June 24-27 with a record-breaking 1,350 companies from 43 countries scheduled to exhibit.

Held alongside the automatica and World of Quantum trade shows, the event will feature a robust programme of technical forums, special exhibitions, guided tours and career events.

An expanded 2025 programme underscores the event's growing industry relevance, and with exhibitor numbers exceeding previous records. Exhibition Director Anke Odouli (she is interviewed on page 42) says the event is "a complete success" in both scale and scope.

In addition to showcasing industrial products and research-driven innovation, the fair will offer four dedicated forums exploring major application areas, including:

Instrument Systems
KONICA MINOLTA Group

Instrument Systems
Hall A3, Booth 100

Precision is the foundation of our innovation. Since 1986, Instrument Systems has developed premium measurement systems made in Germany, trusted by industry leaders in R&D and production worldwide.

At this year's Laser World of Photonics, we present solutions for µLED, wafer-level testing, VCSEL, laser and lighting applications, covering the full spectrum from UV to IR. Our systems combine spectroradiometers, imaging colorimeters and precision optics to deliver fast, accurate and traceable results from lab to fab.

Whether testing µLEDs on wafers and displays with our LumiTop Colorimeter, analysing polarised VCSELs with VTC camera, or measuring UV to IR emitters using the CAS 140D spectroradiometer, we ensure reliable performance and comparability. All results are traceable to national standards and comply with international norms.

We're here to solve your metrology challenges – let's connect! **www.instrumentsystems.com**

coher sense

Coher Sense
Hall A3, Booth 531

Measuring lasers accurately is just as complicated and complex as it sounds – this will change with LASER 2025!

In Munich, Coher Sense launches the KISA, a miniaturised polarimetric optical interferometer that characterises power, wavelength and bandwidth – simultaneously, on one screen, in one tiny device. Our patented KISA technology makes laser measurement uncomplicated and accessible.

Existing solutions are bulky, slow and expensive. KISAs provide power, wavelength and bandwidth at 10+ kHz data rate, all from the palm of your hand. KISAs are easy to use and built for both lab environments and integration into larger systems. We enable new markets and applications where traditional solutions are too complex, too large, too power-hungry or too costly. Performance, efficiency and accessibility enable the success of our OEM partners, researchers and industrial users.

A customer called it "the Multimeter for Lasers" and we embrace that vision. Curious? Swing by hall A3, booth 531. **cohersense.de**

Electro Optics at LWoP

The EO team will be at **Hall B3 Stand 250,** where we have multiple opportunities for you to engage with us at the show!

Nominate your colleagues for 2026's Photonics100!
Attendees will have the opportunity to come to our stand to submit their nominations for The Photonics100, which is now in its fourth year. Or go to **electrooptics.com/ThePhotonics100**.

Innovation Awards 2025
Make sure to also mark your calendars for the opening night of the show, when the ceremony of this year's Innovation Awards is set to take place. For more information and a list of this year's Innovation Awards finalists, see page 16.

The Photonics Frontiers Award
The winner of Electro Optics' Photonics Frontiers Award will be announced at the show on Wednesday, 25 June. Head to **Hall B3 Stand 250** for more. See you there!

- **Integrated Photonics Application Forum (A2):** examining how integrated photonics contributes to sectors such as telecommunications and artificial intelligence.
- **Biophotonics and Medical Applications Forum (B2):** including topics such as medical diagnostics and therapeutic systems using photonic technologies, as well as the overlap between biophotonics and biotechnology.
- **Laser Materials Processing Forum (B3):** exploring additive manufacturing and photonics applications in electric mobility.
- **Lasers & Optics Forum (A2):** focussing on high-energy laser sources for both industrial and scientific use.

Alongside the forums, attendees will also have access to three major special shows and technology demonstrations including:
- **Photons in Production (B3.441):** 400 sqm space hosting live demonstrations including laser use in zero gravity and the surface cleaning of battery electrode rollers.
- **Connected Machines (B5.224):** illustrating how industrial systems from different manufacturers can connect, with real-time demonstrations accessible by smartphone.
- **Photons Meets Robotics (A3.433):** highlighting the integration of photonics with automation technologies, with a focus on AI-driven solutions. EO

excelitas

Excelitas
Hall B1, Booth 110

Excelitas is the leading provider of advanced, life-enriching technologies that make a difference, serving global market leaders in the life sciences, advanced industrial, next-generation semiconductor and avionics end markets.

Headquartered in Pittsburgh, USA, Excelitas is an essential partner in the design, development and manufacture of photonic technologies, offering leading-edge innovation in sensing, detection, imaging, optics and specialty illumination for customers worldwide.

Our award-winning LINOS® d.fine HR-M lens series is the culmination of a legacy of German craftsmanship and innovation.

Engineered for modern 2-3 µm pixel structures, it delivers uncompromising clarity and wide field coverage, resulting in maximum throughput for critical inspection applications.

A perfect match for full-frame and 16K line scan sensors.
www.excelitas.com/

MÖLLER-WEDEL OPTICAL

Instruments You Can Trust

Moeller-Wedel Optical
Hall A3, Booth 111

Möller-Wedel Optical designs and manufactures optical measurement technology. Our instruments are reliable, durable and support our customers in their daily work. With in-depth expertise, flexible solutions and personal consultation, we help our customers tackle their measurement tasks with confidence and precision. Our focus is on technology that delivers – in every detail. We place our customers' needs at the centre of everything we do, believing in solutions that are created through partnership and built to last.
moeller-wedel-optical.com/en/

Innovation Award: the 2025 shortlist

The Innovation Award returns to Munich this year, with 20 finalists selected from more than 70 entries

A judging panel of industry experts has shortlisted entries across seven categories. The overall Innovation Award winner will be announced on June 24. Alongside industry recognition, the overall €5,000 Innovation prize, sponsored by Europa Science, publisher of *Electro Optics*, awaits the winner.

"This year's Innovation Award shortlist showcases the extraordinary depth of creativity and technological advancement in the photonics industry. From quantum technologies to medical engineering, these 20 finalists represent the cutting edge of innovation, demonstrating why photonics continues to be one of the most dynamic and transformative fields of our time," said Warren Clark, Europa Science CEO and Innovation Award judging panel moderator.

"The Innovation Award, alongside Electro Optics' Photonics100 and Photonics Frontiers Award and Imaging & Machine Vision Europe's Visionaries campaign, is now firmly part of the annual recognition for innovators in our amazing industry."

JUDGING PANEL

Tom Hausken, Optica (formerly OSA)
Agnes Hübscher, Edmund Optics
Chris Yates, Vision Ventures Germany
Wilhelm Kaenders, TOPTICA Photonics
Prof Peter Loosen, Fraunhofer-Institut für Lasertechnik ILT
Prof Jürgen Popp, Leibniz-Institut für Photonische Technologien Jena
Peter Soldan, VDI Technologiezentrum
Prof Ronald Sroka, LIFE-Center, University Hospital Munich
Dr Wenko Süptitz, SPECTARIS

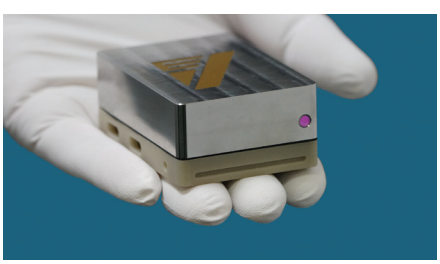
LASER AND OPTOELECTRONICS / ILLUMINATION AND ENERGY

Edmund Optics – PeakPower High LDT Low GDD Ultrafast Mirrors
While laser damage threshold (LDT) generally needs to be sacrificed to reach both high reflectivity and low GDD, Edmund Optics' ultrafast mirrors have both, reaching >99.5% reflectivity and near-0 GDD alongside more than 0.75cm2 for 25fs pulse durations at 920nm by optimising the coating process with combinations of layered materials.

TRUMPF Laser- und Systemtechnik – TruMicro 9010
A high-power industrial ultra-short pulse laser that combines a slab laser module with a multi-pass cell to deliver 10GW peak power at a 100KHz repetition rate and 1kW average power, TRUMPF says its TruMicro 9010 laser delivers flexibility and precision suitable for efficiently scaling existing applications and building new industrial use cases.

BIOPHOTONICS AND MEDICAL ENGINEERING

Futonics Laser – Thulium Fibre Laser 1000W QCW / 200W CW
Incorporating a patented coupling system, Futonics' 2µm thulium fibre laser features advanced performance and long-term stability, delivering 1000A QCW / 200W CW to enable precise and minimally invasive lithotripsy for laser-based medical procedures.



LaserAtWork – Hummingbird
Hummingbird is a pocket-sized 1030nm femtosecond laser oscillator with >1W average power and <200fs pulses at 50MHz. With an ultra-compact footprint of 70 x 49 x 28mm3 – including cooling and electronics – the product can be integrated into portable and space-limited set-ups for biomedical applications such as optogenetics, two-photon imaging, advanced research and as a robust seed source for amplifiers.

TOPTICA Photonics – FemtoFiber ultra FD 780/920/1050nm
The FemtoFiber ultra FD delivers femtosecond laser pulses to two-photon microscopes via optical fibre, eliminating free-space paths, mirror alignment and power meters. While boosting safety and simplifying set-up, possibilities for more compact microscope designs open up.

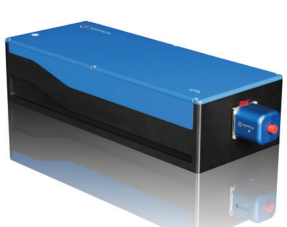
QUANTUM TECHNOLOGIES

Attocube systems – attoCMC
Providing easy access to the cryogenic temperatures required for quantum photonics, the compact, automated design of attocube's plug-and-play attoCMC system eliminates complex lab infrastructure, cuts operational costs

Europa Science CEO Warren Clark, second from left, with the 2023 Innovation Award winners, Civan Lasers

and lowers energy consumption. With no need for external cooling, the low-power system is ideal for datacentre applications, helping accelerate quantum innovation by implementing real-world solutions.

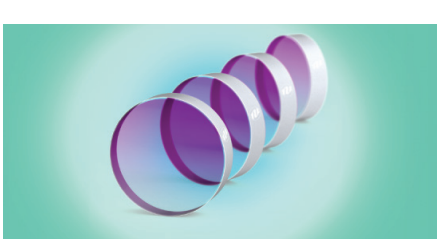
Menhir Photonics – MENHIR-1030 at 1GHz
An industrial-grade 1GHz femtosecond laser, Menhir's MENHIR-1030 offers ultra-low noise, extreme stability and 24/7 maintenance-free operation. The laser is designed for high-precision tasks from generating high-flux single and entangled photons in quantum technologies, to achieving ultra-high peak power with coherent combining and enabling GHz burst in material processing.



TOPTICA Photonics – CTL 780
CTL 780 is a laser that offers mode-hop-free tuning from 750 to 790nm. Designed for pumping and probing micro-cavities and Rb/K atoms or characterising photonic devices, the CTL series can be used to perform the resonant excitation of tiny structures such as quantum dots and micro-cavities, as well as molecular spectroscopy and component testing.

OPTICS / MANUFACTURING TECHNOLOGY FOR OPTICS

Midel Photonics – All-reflective beam shaping
Although many laser applications face increased costs and limited quality due to unsuitable energy distribution, Midel Photonics' use of microstructured mirrors sets out to solve the issue by enabling more precise beam shaping, splitting and focusing. The result is better optimised energy distribution, combining enhanced performance with reduced energy loss.



Optoman – non-degrading UV optics
Proud to see its non-degrading optics recognised at the Laser World of Photonics' Innovation Awards, Optoman commented "innovation means building performance that lasts, not just impresses at first. It's rewarding to push the limits of optical durability, developing components that maintain consistent performance, even under prolonged pressure."

SENSORS, TEST AND MEASUREMENT / IMAGING

ficonTEC Service – double-sided electro-optical PIC wafer tester
Targeting volume electrooptical testers of wafer-level silicon photonics PICs – destined for co-packaged optics chiplet applications – the wafer tester integrates with standard semiconductor automated test equipment (ATE), providing both DC and high-data-rate testing as well as six-axis actively aligned optical probing. >

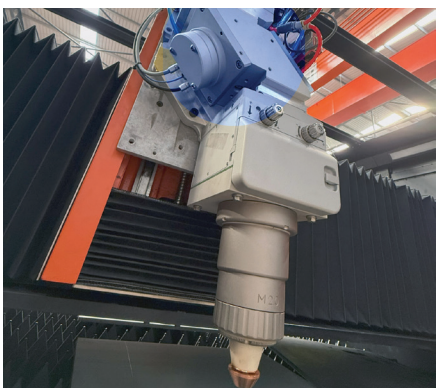
> **Hamamatsu Photonics – Fingertip-sized UV mini-spectrometer C)16767MA**
The fingertip-sized C16767MA is a highly sensitive UV spectrometer. Using proprietary MEMS technology, it splits UV light in the 190 to 440nm range into individual wavelengths, then measures the light intensity at each one with high resolution. A compact design also allows the mini-spectrometer to be integrated into environmental measuring devices easily.

Pi Imaging Technology – SPAD Alpha
A megapixel single-photon camera, available in monochrome or colour, the SPAD Alpha offers zero readout noise, a dark count rate <100cps and a global shutter speed for nanosecond exposures. Supporting full-resolution photon counting – up to 73,000fps – and tunable resolution reaching over a million fps, Alpha reaches over 100dB SNR and enables time-resolved imaging with six-ns gating and 17-ps shift resolution, making it suitable for low-light and 3D imaging applications.

LASER SYSTEMS FOR INDUSTRIAL PRODUCTION ENGINEERING

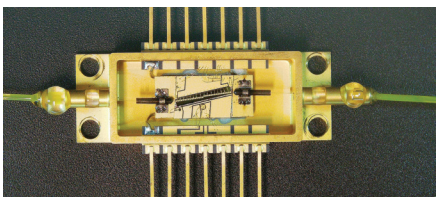
Ekspla – FemtoLux
FemtoLux is a 50W femtosecond laser with a direct refrigerant cooling (DRC) system that's been proven for military use with 90,000hrs MTBF. With a reduced need for servicing, the laser is compact, offers 24/7/365 operation, <0.5% power stability and advanced options like harmonics (515nm, 343nm), pulse-on-demand and GHz burst.

K2 Photonics – K2-ASOPS
K2-ASOPS is a compact 60MHz femtosecond laser that produces two output beams using nearly the same components as a single laser, with one key difference: each beam runs at nearly identical repetition rates, but with a controllable and stable difference. K2 says the technology has the ability to revolutionise laser measurement applications such as semiconductor wafer inspection, layer thickness analysis, adhesion inspection and other advanced material characterisation.



Robust AO – Zwobbel-IR-HP
Using a deformable mirror that oscillates at up to 3500Hz, Robust AO's Zwobbel-IR-HP enables real-time axial beam shaping in high-power lasers up to 20kW. Controlling energy density with the adjustment of Rayleigh length, spot size and intensity profile, the system is light and easy to integrate, and can boost speed (up 90%) and quality with enhanced 3D laser processing and more efficient cutting, welding and structuring.

OPTICAL INFORMATION AND COMMUNICATION / SECURITY



Innolume O-Band QD SOA
For platforms such as datacom, AI connectivity, terrestrial free-space optical (FSO) links, FMCW lidar and optical switching, the O-Band quantum dot semiconductor optical amplifier (QD SOA) from Innolume offers EDFA-like performance in an electrically-pumped semiconductor device, providing either the simultaneous amplification of multiple modulated laser lines with minimal BER degradation, or very high output power at a single wavelength.

Piezosystem Jena – PSH 20/2 and PSH 35/2
The PSH 20/2 and PSH 35/2 two-axis tilting stages are piezo-driven and deliver up to ±22 mrad tilt, 1.0 µrad resolution (closed loop) and up to 2kHz resonance. Originally developed for space as fast steering mirrors, they are built for extreme conditions, offering speed, precision and low power use with PSH 35/2 adding stroke and thermal stability and PSH 20/2 specialising in high-frequency operations.

Zerothird – eQKD system
Polarisation-entangled photon pairs and superconducting nanowire detectors are used by Zerothird's eQKD system for secure quantum key distribution. A photonic layer eliminates optical realignment to improve both stability and reliability in real-world environments and the system itself supports both long- and short-distance links (up to 350km) and star-topology networks. EO

excelitas®

The Future is Bright.
We've Got a New Look to Match.

At Excelitas, we're reimagining our brand to reflect our vision for the future, but our mission remains the same: enabling success for our customers through close partnerships and cutting-edge innovation.

We're expanding our technology portfolio and production capabilities to address more applications and fulfill tomorrow's critical infrastructure. Our customers benefit from the depth of our engagement and the unwavering reliability of our solutions. From breakthrough advancements to streamlined efficiencies, we're pushing boundaries to ensure our customers stay ahead of their next challenge.

The future isn't waiting. We're building it now, alongside the boldest innovators on the planet . . . our customers.

LASER WORLD OF PHOTONICS
Hall B1, Booth 110

Enabling **the future**

Watch Our Video

Product round-up

A look at some of the products and components that will be on show from the record-breaking 1,350 exhibitors at this year's Laser World of Photonics in Munich.

For more product news, please visit electrooptics.com

Booth A3.311

Hamamatsu Photonics
LCOS-SLM optical phase modulator

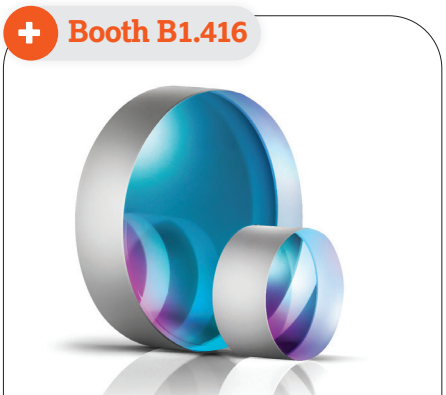
Hamamatsu Photonics LCOS-SLM is an optical phase modulator designed to control the phase of the laser beam by sandwiching liquid crystals between a CMOS chip and a transparent electrode deposited on a glass substrate. Digital images output from PCs are converted into analogue signals by a dedicated drive circuit before voltage is applied to pixel electrodes on the CMOS chip. The liquid crystals' refractive index is then changed by tilting their molecules with the voltage.

Booth B1.539

Indie
VINCI-1064 femtosecond fibre laser

Designed to be both simple and robust, Indie's VINCI-1064 femtosecond fibre laser features SESAM-free oscillator architecture, enhanced reliability and reduced cost. Built for applications such as terahertz signal generation and two-photon microscopy, the fibre laser operates at a central emission wavelength of 1064nm and delivers a combination of performance characteristics including an ultra-short pulse duration of 50fs and power levels nearing one megawatt.

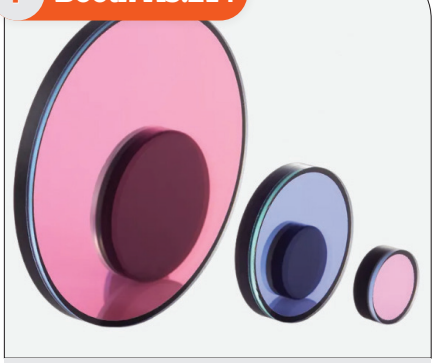
Booth B1.416



Edmund Optics
TECHSPEC® low GDD dielectric ultrafast laser mirrors

Designed to offer excellent performance at an accessible price point, Edmund Optics' TECHSPEC® low GDD (group delay dispersion) dielectric ultrafast laser mirrors are engineered to maintain the temporal characteristics of ultrashort pulses, while also ensuring the system's consistency and optimal pulse intensity. With a multilayer dielectric coating on fused silicon substrates, the mirrors reach more than 99.9% reflectivity and a low coefficient of thermal expansion for ultrafast beam transport applications.

Booth A3.214

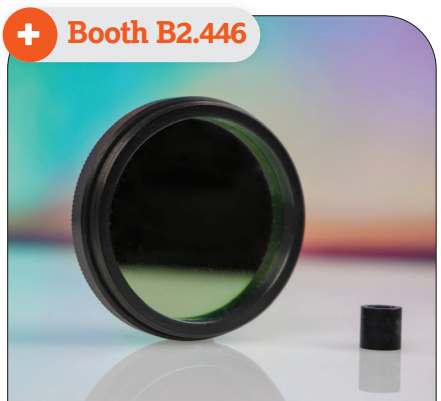


Pro-Lite Technology
Optical filters from UV to far-IR

Designed to provide durability and environmental stability, Pro-Lite Technology's range of optical filters covers a wide spectral range from ultraviolet (UV) to far-infrared (IR), specifically 193nm to 14µm. Including a variety of optical filters such as bandpass filters and neutral density (ND) filters, the range features precise wavelength selection through advanced thin-film coating techniques and a vertically integrated manufacturing process.

Booth name: (SphereOptics)

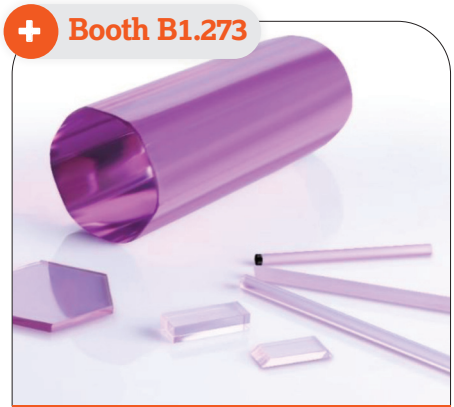
Booth B2.446



Chroma Technology
SWIR optical filters

Supporting imaging and sensing from 900 to 2500nm with high transmission, deep blocking and angular stability, Chroma Technology's SWIR optical filters are designed for performance applications where visible or NIR methods fail, from surgery to remote sensing. Available in bandpass, longpass, notch and custom types, they integrate with SWIR detectors in OEM and research systems and are made in the USA with durable thin-film coatings.

Booth B1.273



Cryslaser
Nd:YAG

Cryslaser's high-quality Nd:YAG crystals use the Czochralski method, tailored for industrial, medical and scientific laser applications. Offered as rods, slabs, wafers or raw blanks, the crystals feature high gain, low threshold and strong thermal and mechanical properties. Compatible with lamp- and diode-pumped systems, Cryslaser's Nd:YAG products support CW, pulsed, Q-switched and mode-locked operations, with custom shapes including flat, wedged, Brewster and grooved rods.

Booth A2.257

Nanoscribe
IPX-Clear

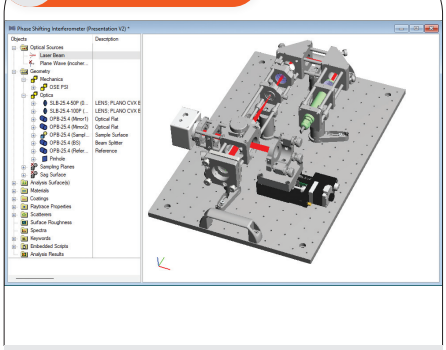
Nanoscribe's IPX-Clear is a photoresin designed for 3D microfabrication of transparent microoptical components. With high transmission across the visible spectrum, low surface roughness (<10nm) and precise shape accuracy (<200nm), the photoresin is specialised for microoptics, integrated photonics and micromechanics, supporting micron to millimetre-scale parts.

Booth B2.600

Frankfurt Laser Company
UV laser series

Designed for microscopy, spectroscopy, cell sorting and semiconductor inspection, the UV laser series from Frankfurt Laser Company includes lasers for industrial, biomedical and scientific use ranging from 261 to 400nm. Models include fibre-coupled, compact diodes and solid-state versions, with features such as <3% power stability, TTL/analogue modulation and a 10,000+ hour lifespan.

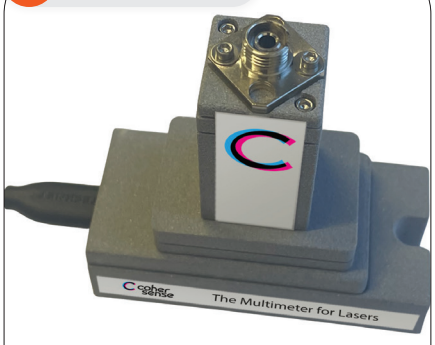
Booth B1.165



Photon Engineering
FRED Optical Engineering Software

Photon Engineering provides advanced optical engineering software and services, with a focus on stray light analysis, illumination design and system modelling. Its flagship product, FRED Optical Engineering Software, offers powerful ray-tracing with support for coherent/incoherent sources, polarisation, scattering and thermal effects. Used across aerospace, defence, automotive and biomedical fields.

Booth A3.531



Coher Sense
KISA sensor

The KISA sensor by Coher Sense is a compact fibre-optic device for real-time laser characterisation, measuring wavelength, power and bandwidth simultaneously. Using a patented polarimetric interferometer, it delivers sub-picometre precision at more than 10kHz data rates. Designed for photonics R&D, manufacturing and quantum applications, KISA is intended to replace multiple instruments with one unit.

Booth B2.303

G&H
AODF-UV Series: UV acousto-optic deflectors

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Approaching customised steel processing systems with caution and laser precision

Federico Bonaldo, Physicist in the Research and Innovation department of Castellini Solution, discusses how the company integrates high-powered fibre lasers into bespoke systems for laser welding, cutting and scribing

Physicist in the Research and Innovation department of Castellini Solution

Castellini Solution

Electro Optics: Tell me about Castellini, it builds machinery that uses laser components, is that right? What types of equipment does it manufacture? And how is it used?

Federico Bonaldo: That's right, Castellini has a very long history in the steel industry. We're divided into two business units; the first provides machining, milling and turning equipment for the steel industries. But the division I belong to is Castellini Solution. We provide customers with complete solutions using turnkey equipment for highly technological processes based on laser technology.

We work on everything from a system's design to testing and implementation in customer facilities. We mainly work in the steel industry so we're focused on the laser material processing of steel, and we usually provide very highly customised machines to satisfy customer requirements.

We sell machines for the coil processing industry, for laser welding, laser cutting, coil-to-coil machines and laser scribing for grain-oriented electrical steel coil production, for example.

For steel plates, we also provide laser cutting, laser welding, laser cleaning and marking, and we can mix them together. So we provide a large variety of laser applications.

EO: So it's quite a bespoke solution you provide from that division. What are the different types of lasers you integrate into these customised solutions?

FB: We mainly use fibre lasers due to their wide range of suitable applications. They have a range of powers and include a lot of the features we search for.

In the majority of our applications, we use continuous wave (CW) fibre lasers, ranging from something like 2kW to 20kW, but have higher-powered ones in our laboratory facility where we'll use up to 50kW CW lasers sometimes.

EO: What are some of the ways your customers use these laser-based solutions to improve product quality?

FB: The first example that comes to mind is about laser scribing of grain-oriented electrical steel. Laser scribing is a process that enables the user to reduce the treated material's magnetic core loss. It's then used inside high-power transformers, bringing better efficiencies for energy distribution.

That means the final product can be of far higher quality, and can be sold for a higher price. Even though the product is being produced in the same way, once it's treated with the laser system, the quality is improved.

Another example is in laser welding. You can increase productivity of the welding process due to the automation and the high penetration laser applications are capable of. Basically, you can weld more products in less time, while keeping the weld quality very homogenous. And that's important because it makes it far easier to abide by any welding standards, without the need for any post-processing, for example. It's a very robust, very repeatable technique, and always provides the same outcome in terms of quality.

EO: What are the performance characteristics you commonly look for in laser systems? Or does it always differ dependent on the project and the clients' needs?

FB: We do have some general, overall rules, but yes, for every case there are specific features we seek. If I think about laser sources, the first thing I look for is beam quality. We measure beams in terms of BPP (beam parameter product) or divergence, but also homogeneity and intensity distribution.

For some applications there are quite strict requirements for spot size (for scribing, for example, we need to have a very narrow spot size) and that means we have demanding requirements on things such as beam quality, fibre diameter and also optical configuration, so we always work with high-quality lenses and mirrors from high-quality vendors. That's also to make sure the beam propagation is done to the highest efficiency and to ensure thermal deformation-induced effects are avoided.

"Creativity is the most important aspect when it comes to innovation. Mixing different viewpoints can lead to innovative experimental design methods"

EO: What challenges do you tend to face when sourcing these components? How could vendors make the process easier for you, do you think?

FB: Our biggest concern when we design and build new laser-based machines is with the alignment of the processing head or the delivery of laser regulation together with the process monitoring system. There are many different ways to perform this alignment. One method is to use the process monitoring system for calibration and configuration purposes, but usually we just use a very small amount of laser power to check the position direction of incidence, spot dimension and the uniformity of rigidity.

This can be done with just a very small amount of power, but if we were to use a very high-powered laser, up to around 50kW, the usable power is still usually limited to around 10%. We're talking about 5kW, which is quite high for a minimum. That's a challenge because we have cameras that measure the spot size, and they're not able to sustain that level of power.

Other problems are that we often search for clear and detailed specifications of laser systems, but can't find them in the market, and it would also be good to get more troubleshooting details and better availability of information through exchanges with our built-in HMI software.

EO: So you'd like lasers that allow you to use less than 10% of their total power?

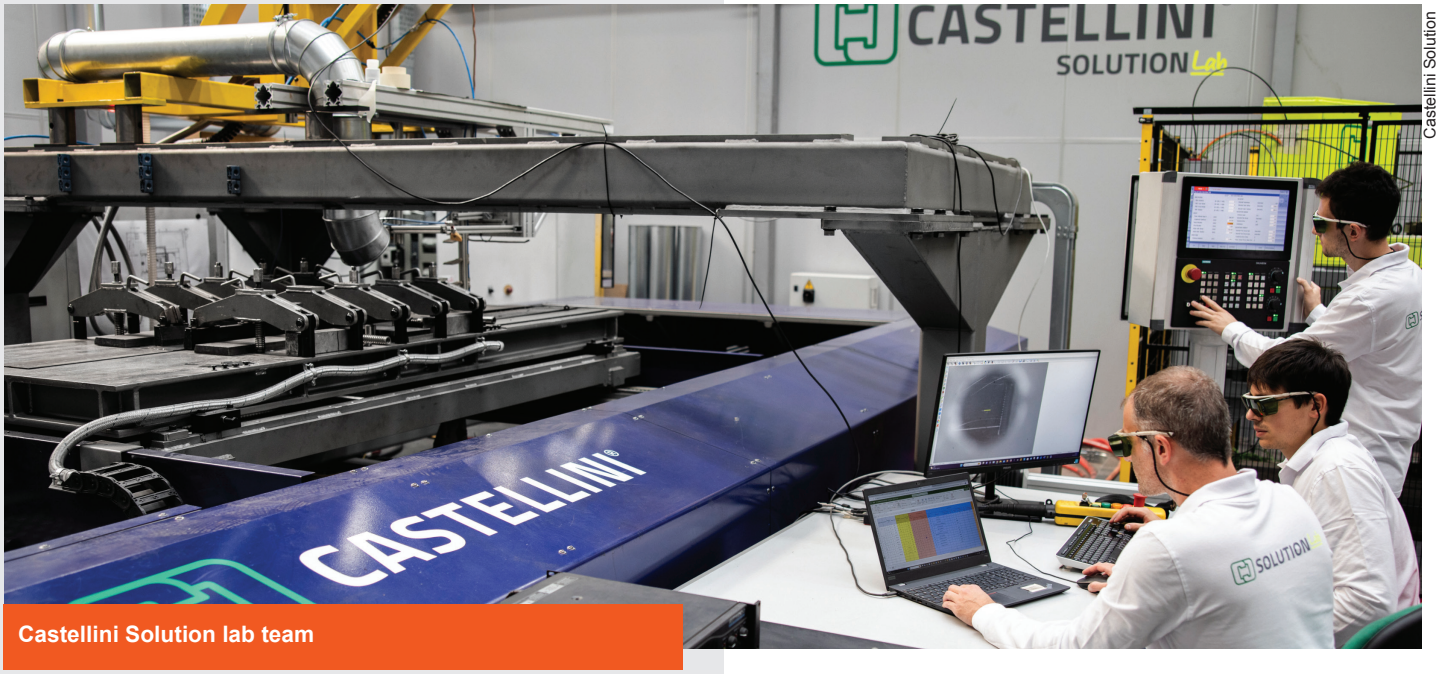
FB: Yes, that could be the case when we use a very high-powered laser. When we do laser alignment inside the centre of the nozzle, for example, if the minimum power is 5kW, we will probably have difficulty with a single shot, but that's a very practical example that doesn't often apply because very high-powered systems, except for laser cutting, are not yet standard.

EO: Away from technical product specifications, you mentioned technical support was something you put a lot of value in. What else do you think is of high value when choosing which vendor to go with?

FB: Since we build and sell machines, from our company point of view, the first thing we want is reliability and robustness in a system. We want it to always operate in the same way, so that it always reaches the same output performance over time.

Equally, however, I think given that I belong to the research and innovation department, we also look out for innovative features because we want to test and implement new technologies and new features in already existing processes. That's with a view to optimising them, but also to find new processes and cutting-edge applications for laser technologies.

To give you an example, beam shaping is very much a trend these >



Castellini Solution

Castellini Solution lab team

Castellini Solution

3D laser cutting

Castellini Solution

Laser marking

days, as it makes for a versatile possibility to deliver the laser beam on the material we want to process.

We are already taking advantage of beam shaping in our laboratory, and that's something we value very much.

EO: How does not being able to get your hands on the right components because of expanded lead times affect your business and your innovation?

FB: I agree, I think lead times have increased over the past year. It's very difficult to give a quantitative number on by how much because it depends on the type of equipment. If it's highly customised laser-related items, that adds a major boost to lead times.

To face it, we usually just plan ahead a little further and use a larger time window for the component supply. As a complementary strategy, in order to avoid project delays, we try to divide our tasks to carry them out in parallel with each other. This way, if one component is missing we can move to another one while we wait for the delay, or whatever it is, to be resolved.

If we're talking about machines we're selling to customers, [lead time changes] can have a huge impact, but if we're talking about research projects, they will go on for a longer amount of time, so the change in lead times affects them less.

EO: And how important is creative thinking? How key is it to creating bespoke, customised systems that maybe use a different angle to solve a problem?

FB: Creativity is maybe the most important aspect when it comes to innovation. I think of scientific and technological innovation as having three main steps. The first is state-of-the-art research, and we can include scientific research as well as market exploration and compression, to see where the opportunities for technological advancement are. The second step is networking and the sharing of ideas. Again, this is in both the scientific community and the industrial environment. And the third step is building scientific knowhow by treasuring the information collected in steps one and two.

Mixing different viewpoints can lead to innovative experimental design methods. There's a big benefit to talking about your topic, your projects and your problems with people with very different backgrounds because it helps to be open-minded when discussing them. More often than not, this leads to innovation.

EO: …and this is the business case for how important diversity is in the workplace.

FB: Yes, absolutely. If you want to achieve something that is very

innovative, it is very difficult for one person to do it. We need to discuss, we need to test, but the exchange of information and exchange of ideas is fundamental.

EO: Safety is a huge issue when working with laser systems. How do you ensure users' safety when using high-powered lasers in a production environment?

FB: Laser safety is a major concern. From the design of a machine right up to the build stage and implementing it in the customer premises, we take safety into consideration at every step. For automation system machines, we use the highest safety standards possible in the industrial environment, then add specific laser safety measures on top. We have all sorts of safety interlocks for doors and zones, for example, and we have special windows certified for laser protection at the specific wavelengths we use, in case the process needs to be monitored.

Usually, machines are enclosed in a mechanical barrier which is like a separate room you can look into through this protective window, but where there are moving parts we also use optical sensors that ensure everything stops if someone enters a specific zone.

We also include many procedures in our manuals that ensure everyone's working in safe conditions around these machines.

EO: Do you get any feedback from customers that you then build into your processes?

FB: To date, there haven't been any incidents so we haven't had any feedback from customers. But we do ask third parties to evaluate the residual harmfulness of a machine or system through a risk analysis, if the safety situation is not completely clear. Of course, we are very open to any customer feedback, not limited to safety, anywhere from design to utility usage.

EO: Are you involved in the R&D of any new laser technologies that you're particularly excited about utilising for manufacturing purposes?

FB: We have a lot of research projects going on right now that we're very excited about. We're testing pure laser welding on very thick steel plates, for example, up to 40mm thick. We're using a double pass configuration – so two laser passes occur one after the other, one from one side (top), then one from the other (bottom) – to reach the desired plate thickness [in terms of laser penetration].

It's very challenging because it needs a very narrow, very high-powered and very high-quality laser beam to achieve that level of penetration. Nevertheless, we think we have one possible system that's suitable. We're currently testing it and getting some promising results. We're also testing different beam shape characteristics and how they affect the welding of different materials (e.g. aluminium) and we're planning on some experiments with laser scribing as well.

One of the most thrilling technologies we're looking into, is laser surface cleaning.

We designed and developed a completely customised optical set-up to deliver a suitable laser in terms of wavelength, power and interaction time with the material.

From the perspective of the geometrical characteristics and the dynamic properties, the application is very complex because it involves theoretical concepts related to laser material interaction and laser ablation concepts.

But, we're very excited about it, and we feel engaged and determined to tackle the innovative process technology and bring it to an advanced stage that's required for further development. **EO**

Federico Bonaldo joined us for an online panel discussion on laser safety. To watch the full discussion on-demand, register for free at www.electrooptics.com/webcasts

How to minimise laser risk across industries

As power levels grow and devices shrink, the need for laser safety has never been greater. At a recent online panel discussion, we asked industry leaders for their opinions on the current state of laser safety and how it can be optimised

“The most hazardous people on the planet are the ones in the labs, because they’re used to it, and they’re complacent”

Scott Wohlstein, The Photonics Group

As lasers become faster and more powerful across industries, the need for comprehensive safety protocols has never been more critical. From healthcare and academia to manufacturing and advanced imaging, laser users and team leaders must prioritise risk management while maintaining operational efficiency.

Electro Optics held an online panel discussion recently, asking safety providers, integrators and laser manufacturers their opinions on the current state of laser safety and how they think it can be optimised.

Changing landscape of laser safety

“The biggest single challenge we’ve had in the past 18 months to two years, is handheld laser application, particularly welding cleaning,” said David Lawton, Market Development Manager for EMEA, LATAM and APAC at Kentek Corporation, a global manufacturer of laser safety solutions.

“This has been out there for quite some time, but handheld laser welding has just simply exploded, and there’s no real way of containing the radiation.”

The rapid evolution of technology is outpacing safety standards, particularly with higher-power systems. “Handheld laser welders might have been one or two watts. Now we’re talking about 1-2kW,” Lawton explained. “At a trade show I attended last month, there was a 6kW unit. That then changes the ballpark in terms of how to advise on laser safety.”

This power escalation creates significant challenges for safety professionals.

Scott Wohlstein, President of The Photonics Group, noted: “From stem to stern – and I hate to say this, because as an entrepreneur, as a capitalist, I want people to build things and create wealth – there are certain times where perhaps we should put a pause on things and make sure that everything is safe and compliant before we bring it in.”

Industrial applications and containment strategies

Federico Bonaldo, physicist for the R&I department at Castellini, describes its approach to laser safety in steel manufacturing applications: “Our laser scribing machine employs two high-power fibre laser sources, which are classified as

Class 4 in the laser safety classification. So what we do to ensure to be safety-compliant is that we completely seal off the machine."

This approach prioritises complete containment. "This safety measure, together with laser protective windows, physical barriers, doors, and interlock system guarantees that neither direct, reflected or diffused light can slip through the enclosed volume, allowing us to stay safety-compliant," Bonaldo added.

Compliance challenges

Experts identify several critical issues facing the laser safety community:

Standards lagging behind technology

"The current international standards are not keeping up with the technology. The technology is moving faster than the standards," said Lawton. "For instance, there is a worldwide standard for welding, but it specifically excludes lasers. There is a worldwide standard for laser protective eyewear, but it specifically only covers eyes. It doesn't cover face protection. And that's where we've got this gap.

"At the moment, for instance, a welding helmet needs to meet the welding standards. But if it's got a big vision panel on the front, it can't match the laser protective eyewear because it also is a face protection, so the only way to comply with the standard at the moment, is to have laser protective eyewear underneath a welding helmet. Even though there are welding helmets that do laser and welding – and we have one, don't get me wrong – but technically, we can't declare CE compliance, because the standards don't cover it."

Non-compliant products

Wohlstein expressed agreement with Lawton's points and added: "That's from a workplace user perspective. We're hoping that these products are compliant to the federal code in the United States, to 60825. But some of these things are… integrated. When you consider the Asian builders of laser diode packs, the fibre packs, all that stuff is built in different countries, then it's sent to somebody that integrates it. They're typically not compliant. The integrator is not typically compliant. It comes to the United States, and it's an absolute mess in terms of compliance. Things don't work properly, and they don't meet any of the standards."

Beyond radiation: additional hazards

Bonaldo raised another often overlooked safety issue: "Another topic that comes to my mind about laser welding risks, is the fumes and dust and their disposal; sometimes this is understated. It's a very pivotal topic."

Lawton added: "The new version of ISO, 11553-2, for laser processing machines is actually, for the first time, taking into account fume hazards. Although it's not a laser-related safety problem, it's created by the laser, and they've added that."

Regional approaches to regulation

The panel identified varying approaches to laser safety across regions:

In the UK, Lawton describes a dual approach: "It's coming from both the corporate [side] being very risk-averse, but also from what I affectionately call the laser police, or the Health and Safety Executive (HSE)."

They advocate for complete containment wherever possible – the "put it in a box" school of laser safety.

In Europe, practices are evolving: "For instance – and I'm broad brushing and generalising the German laser application – particularly in university, they're usually quite happy with a curtain, so they pull a laser-blocking curtain around their application, and that's okay. And they're now starting to look at possibly using the curtains as a secondary barrier."

In the US, Wohlstein points to regulatory challenges: "The Center for Devices and Radiological Health (CDRH)... [is] under water because of the flood of non-compliant devices." To address this, his organisation developed a "Suspicious Laser Product Protocol (SLaPP)" form to help laser safety officers identify potentially non-compliant systems. >

> "The only way to comply with the standard at the moment, is to have laser protective eyewear underneath a welding helmet"
>
> **David Lawton, Kentek Corporation**

Best practices for laser safety professionals

1. Verify compliance and documentation

Bonaldo recommends: "What we do is always look for the trustworthy suppliers, and we always check for all of the safety documentation." When necessary, they engage third-party consultants to assess conformity.

2. Implement engineering controls

Full enclosure remains the safest approach. Bonaldo explains their system: "We completely seal off the machine with the full enclosure, in what we call a laser room... this safety measure, together with laser protective windows, physical barriers, doors and interlock system, guarantees that neither direct, reflected or diffused light can slip through."

3. Create comprehensive training programmes

Training is essential for creating a safety culture. Bonaldo explained: "What we offer to the customers is user manuals and conformity declaration for all of the apparatus. And on top of that, what we do is provide adequate safety training for laser and non-laser-related hazards, as well as the standard operating procedure for machine usage."

4. Account for direct and indirect hazards

Laser-generated fumes and other indirect hazards require attention. As regulations begin to address these concerns, safety professionals should implement appropriate ventilation and filtration systems.

"Since the use of lasers is so widespread around the world, laser safety needs to be just as widespread as well"

Federico Bonaldo, Castellini

5. Be conservative in safety calculations

Bonaldo advised: "We are very conservative in our laser calculations. We do put some multiplying factors when we do laser calculations to be on the safe side. And when we are not sure of something, of course, we ask people who have more expertise than we have in that topic."

Common misconceptions and mistakes

One persistent issue is misunderstanding laser classifications. Lawton explained: "This is one of my pet hates – the classifications were set dependent on the damage that a laser can do to the human body. That's where break points were set."

He clarified a critical distinction: "If we have a DVD player or a BlueRay player at home, inside those products, you've got a dangerous laser. But because it's interlocked inside, that is a Class One laser device."

The key test is whether "you could give that to a five-year-old child and ask them to find the laser, and they're unable to do without a tool".

Unfortunately, some manufacturers misrepresent their products: "There are a lot of companies that call the product Class One, when, in actual fact, you could climb over the barrier and get into it and get access to the radiation."

Complacency also presents a significant risk, suggested Wohlstein: "The most hazardous people on the planet are the ones in the labs, because they're used to it, and they're complacent."

Balancing safety and practicality

While implementing comprehensive safety measures may seem expensive, Lawton put this in perspective: "If somebody was to get hurt, the level of litigation, responsibility and compensation would far outweigh the costs of doing it in the first place. So technically, it's money well spent."

He also highlighted alternative approaches: "I watched a presentation recently for a set-up of a very, very powerful laser. It was a petawatt laser with multiple beam lines, and they had to replace it. The guy in charge set his team the challenge of doing the entire change-out without using eyewear in any way, shape or form." While this approach took longer initially, "the learning experience made from that has actually given them the skill set to do it again tomorrow. Financially, it was actually less money than they would have spent, had they had to use eyewear."

Innovative approaches can also improve safety while enhancing processes: "Going back to laser cleaning, there's a company that is actually playing about with a longer wavelength for laser cleaning, which is beyond the retina hazard region. The maximum permissible exposure (MPE) levels are much, much higher, and so by using a longer wavelength, the requirement for eyewear reduces."

The future of laser safety

The experts see several emerging trends in laser safety:

Artificial intelligence integration

Wohlstein described promising developments: "I'm working on a research project with Johns Hopkins University called the Verisa programme, and it virtualises safety. Before you get presented with the hazards and you even spend a dollar, there's an input deck where you load in your CAD drawings, and you can actually move virtually and see what standards, classification and hazards you're going to encounter."

AI seems particularly well suited to standards-based safety: "Anything that's driven or bound by standards is a perfect target for AI. There's no ambiguity."

Visualisation and simulation tools

Bonaldo suggested: "I was also thinking about simulation, and perhaps also virtual reality as a kind of visualisation of the safety areas and the hazard area. This could also show different levels of coherence."

Broader awareness and education

As laser use expands, so must safety education. Bonaldo emphasised: "From my point of view, what we lack since the use of lasers is so widespread around the world, laser safety needs to be just as widespread as well."

The laser industry continues to expand, with Wohlstein noting: "Photonics is projected to be a trillion-dollar industry in two years." With this growth comes increased responsibility to ensure proper safety protocols are implemented.

As Bonaldo concluded: "In my opinion, most of the mistakes are human errors. So that's what we need to address, even in the future, if we have all the AI and digital simulation tools in place."

The summary presented here is for general informational purposes only. Before taking any actions based upon such information, we encourage you to consult with the appropriate laser safety professionals. EO

This is an edited summary. You can watch the full discussion on-demand at www.electrooptics.com/webcasts

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From battle tanks to cars (via poaching): IR-absorbing dyes and laser safety challenges

Donald Tibbitt, Global Business Director for laser-safe dye developer Epolin, explains how the extrusion of laser-absorbing thermoplastics is about more than just safety goggles

Electro Optics: Tell me about Epolin. What do you produce and how does it relate to laser manufacturing?

Donald Tibbitt: Epolin started about 40 years ago, but the initial technology was an expanding monomer, which had absolutely nothing to do with absorbing light. It was used for aircraft coatings because it was incredibly robust, it adhered really well and the company was widely successful.

The problem was that it was so hard to remove the coating that aircraft companies couldn't use it any more because, when a plane was sold to a different airline, they wanted to put their own graphics on there and they weren't able to. Also, Sun Chemical brought out a similar paint that was half the price around the same time, so all the money Epolin had from going public quickly evaporated.

It was down to a chemist and a bookkeeper, when a company called American Optical called and said: "We don't know anything about expanding monomers or polymers at all, but we have an issue [we think you can help with]". They had a tank rangefinder being used in the Gulf War that was blinding people because the beam was hitting them in the eye. So American Optical wanted to develop glasses that would protect people from the laser.

They dug out some old patents and sent them over to us. We took a look and said "yeah, we can do this".

And that was how we got into laser protective eyewear. Since then, we've taken the technology and applied it to welding and to inks, just using the dye.

But then we realised that people don't want to work with dye at all. It gets all over the place. They want it in an easy-to-use format instead, so we took the dyes and compound extruded them into polycarbonate pellets that had the dye in them. The beauty of these pellets is that you can send them to an injection moulder and they can mould any shape, any format, such as different lenses or small filters and things like that.

That was just one of the formats we used to expand the business. From there, we got into other automotive applications. On the dashboard of a car, for example, you have these little silicon detector domes with a sensor underneath that detects sunlight. When it gets dark outside, you want your headlights to come on, so an electronic signal tells the car to turn the headlights on automatically, and that's where automatic headlights came from.

But if there's too much infrared signal, the lights don't come on at all. So we put an infrared absorber in there, to eliminate the infrared effects of sunlight, and a UV absorber to eliminate the UV effects, and it would only take in the visible effects.

EO: So you manufacture materials that absorb near-infrared light, and also protect from it?

DT: Yes, the dyes we synthesise can be put into a polymer-like polycarbonate, such as lenses in glasses. Those dyes will absorb a certain power of laser, but they're used in all different kinds of applications, too. The same dyes can be used for TIG (Tungsten Inert Gas) welding, for example, where metal can be welded together. Then there's laser welding, which uses an actual laser instead of the TIG to join pieces of metal together.

There's a different type of dye for that, but it also absorbs infrared. We combine the two dyes together into one pair of eyewear so that it protects you from welding and if there's a reflection of the laser that hits you, that's blocked as well. So it's laser protective safety and welding protective safety in one.

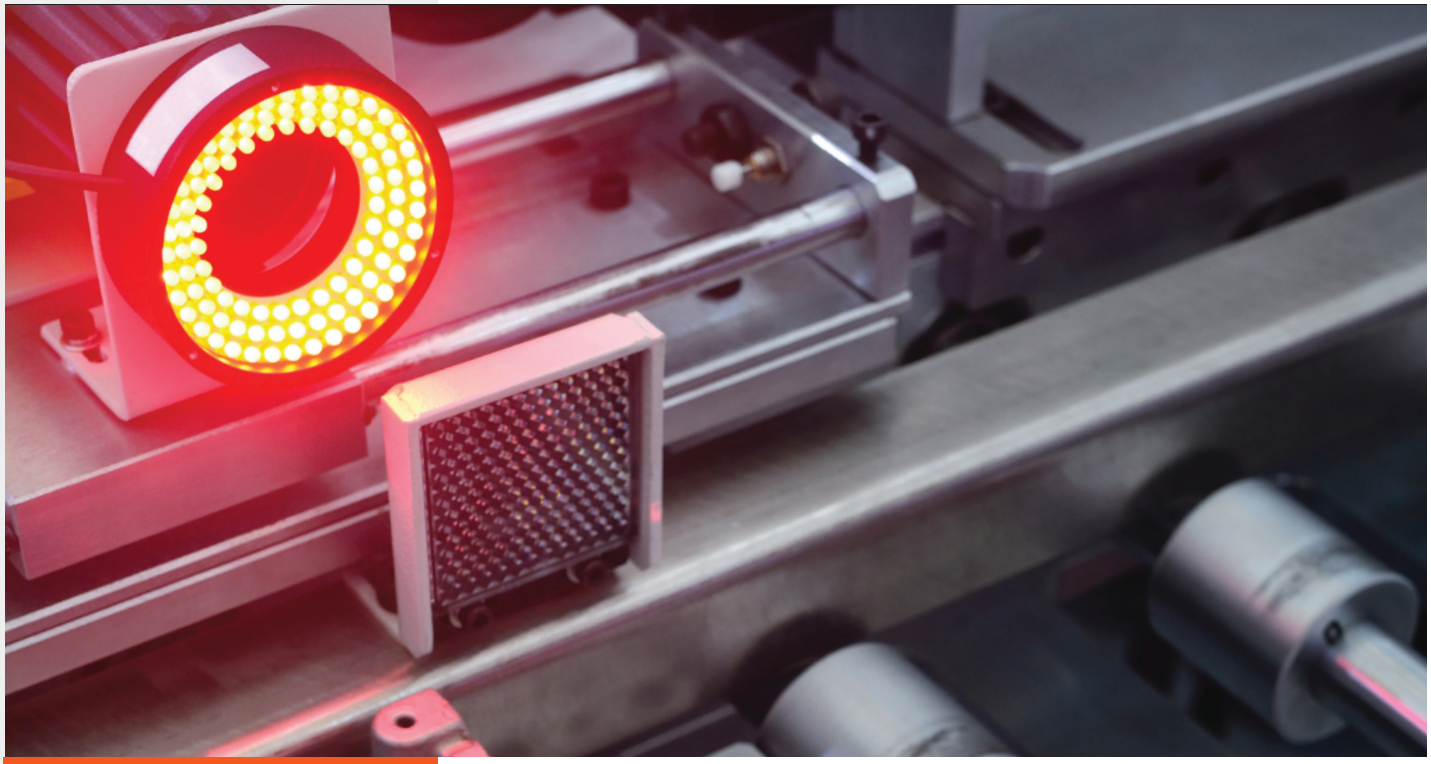
EO: So do you produce the dyes (as pellets) as well as components like glasses that have dyes applied to them?

DT: We don't manufacture items such as lenses. When it comes to certain shapes and sizes – if someone wants a film that they can cut a tiny sensor out of, for example, we'll send them our dye-loaded pellets and they'll take those pellets and extrude them into a thin film. They'll then send us a roll of the film and we'll cut it up and sell it directly to our customers. There are other opportunities and formats that we could sell the technology for, but at present we are mainly selling either the dye pellets, whether it's polycarbonate or acrylic, or the dyes themselves.

One of the things we're going to start doing is putting dyes into different materials such as epoxy. These small silicon detectors either have big moulded parts or dispersed epoxy right over the top, so it's like a filter on top of a chip.

EO: You say you started out in defence applications. I imagine that's still a big part of the business, but your plastics and dyes are also used for protective eyewear for industrial use. What are the design considerations for materials going into different markets?

DT: Yes, a lot of times clients – especially those in defence – won't be able to tell you what they are actually needed for. You have to come up with a proposal and it will either be accepted or not. A lot of our commercial industrial and medical customers, however, will come to us and tell us exactly what they need because we'll ask them questions such as: "What



Assembly line inspection

wavelengths do you need blocked?" "What wavelengths do you need transmitted?" "What optical densities do you require?" Or else we'll ask for a laser damage value.

Even just over a video call I can bring up spectral curves and show clients exactly what the eyewear will look like. Let's say we have an optical density of five and it's giving us 50% visible light transmission. Visible light transmission is important because you have to be able to see through it, so the customer says "do you have another option that isn't green?" In that case we could switch things around and give the same optical density of five at the given wavelength, but maybe transmit 60% visible light transmission.

We can build that curve, right in front of the customer. It's not just "come to us and we'll give you a wavelength and we'll give you a dye", we work with customers from the beginning, all the way to the end. Some customers will even send us a piece of a lens, which we'll analyse to make sure it will meet specifications once it's injection-moulded. We do that as a service.

EO: So, it's a really bespoke, project-by-project offering?

DT: Yes, it's very customisable. If you want an optical density of 5.2 instead of 5, for example, we can do that for you. We like to call that concierge chemistry. You just tell us what you want and we'll build it for you. We'll show you a theoretical curve. If you're happy with it, we'll build an actual sample, then you can take a look at the sample and say: "I really like this, I want to get this moulded into lenses." Then, at that point, we can build another quantity of material pellets and send them to the customer's moulder to mould into a lens. We'll then test it for them, but the customer has to use a third party to get it CE certified.

EO: As well as eyewear, what are some other, perhaps larger scale, laser safety products the dyed materials can be applied to?

DT: One thing the material can be used for is as an acrylic window. You take the near-infrared dye we produce and send it to a cast acrylic house, and they'll process the dye and build an 8 x 4ft cast sheet. The good thing about cast acrylic is that you can make one sheet if you only need one.

EO: How complex is it to create polymers that block specific wavelengths, while still maintaining clarity, flexibility and durability in the material?

DT: The biggest challenge to that is working in dyes. Dyes work like hills when they absorb, as opposed to vapour deposition or dielectric stack technologies where they're more like right angles or square waveforms. Let's say you wanted something that would be completely black >

"A lot of times clients – especially those in defence – won't be able to tell you what they (our products) are actually needed for"

Near infrared dyes can enhance laser welding accuracy

> in the visible up to 900nm, then you want an opening from 900 to 1000nm and then to block 1000 to 1100nm, you could do the lower wavelength part with a dye, no problem, but on the other end the dye slopes so you don't get a good window.

If you were going to do something like that you could consider a hybrid, where one side has the dye that blocks all the visible light up to 900nm, and on the other side you would have 1000 to 1100nm vapour deposition or dielectric stack.

EO: There's been a lot of sustainable material innovation in the packaging sector over the past decade or so. What role do NIR-absorbing dyes have in the manufacture of more recyclable packaging?

DT: There are a number of materials used for packaging that are near-infrared absorbing. Polyester bottles are a good example. If you put an infrared absorber in a polyester bottle, you can put it through a detection device and sort out polyester from polycarbonate, polyethylene or polypropylene materials.

Epolin is a subsidiary of Chroma Colors, and Chroma Colors has additives they use specifically for making packaging easier to recycle by being able to separate polyesters from polycarbonates from polyethylene, etc., and you can get a much better rate of recycling.

EO: Are there any recent projects or specific use cases you can share where Epolin tackled a unique NIR-absorption challenge?

DT: Around 20 years ago we got a call from the National Forest Agency in the US. They were having a lot of problems because they were putting trail cams in the forest to catch poachers, that would use infrared light to illuminate the area when it was dark. In very low light conditions, humans can actually pick up infrared light. And that meant the poachers could see the cameras – and smash them – before they were recorded.

We had to find a solution, so we had these visibly opaque materials that would block out all visible light, but found we had to stretch it further and further into the infrared.

Twenty years ago, we didn't have the technology, so the application didn't work out. More recently, however, we were approached by an automotive company with the same issue.

Advanced driver-assistance systems (ADAS) use infrared sensors to detect drivers and make sure they're holding the steering wheel or paying attention to the road, then beep if it can see you're not, or disabling a passenger air-bag if it detects a baby in a car seat, for example.

Because these are infrared sensors, it means if you're driving at night there's a distracting red glow coming from the car dashboard. It's the same red glow that they were seeing from trail cams 20 years ago. Except now we have the technology to block it further into the infrared.

Now we can block it out right to the edge of where you need the signal, so you don't see the red glow, but the sensor is still operating.

EO: What are some of the future trends you believe will dominate the market over the next five years?

DT: There are some welding standards that have come out recently. The new one is ISO 16321. It's a standard that requires dyes to absorb further out into the infrared. Typical welding standards [used to] go from 780 to 2000nm. Now they go all the way out to 3000nm (or three microns). So to address those new standards, we've built a new series of dyes. We're still in the early testing phase but it looks like that could be a really good market for us in the future.

We also need to produce dyes that are compatible with epoxy and silicone on a molecular level so that they dissolve in – such as a dye does. But the biggest challenge is that we have to be absolutely sure that the dye won't bleed out of the material over time.

EO: And what do those new standards mean for emerging application areas?

DT: A lot of it is for on-chip filters, where you need a specific amount of absorbance from a dye for a silicon detector. That's an area that's going to be big for us in the future, for sure. **EO**

"Humans can pick up infrared light in low-light conditions. That meant poachers could see the cameras, and smash them before they were recorded"

Precision healing: How lasers are transforming biotech and medicine

A recent online panel discussion explored how laser-based applications can best be optimised for biotechnology and medicine use cases

"You not only have to put a laser into a medical device, but you have to make that medical device work – in a business sense"

Brian King, Principal Optical Systems Engineer, StarFish Medical

Laser sources are helping to optimise a range of applications across biotechnology and medicine, from laser-based imaging and tissue ablation to advanced genetic research tools. With diagnostics becoming more precise and treatments getting less invasive, the benefits of laser technology are clear to see and show no signs of slowing down.

A recent online panel discussion hosted by *Electro Optics* explored the latest developments and trends in laser applications for biotech and medicine, the challenges to overcome and the innovative ways in which laser sources are optimising these sectors.

Experts from Politecnico di Milano and StarFish Medical provided their insights.

Key challenges and evolutions

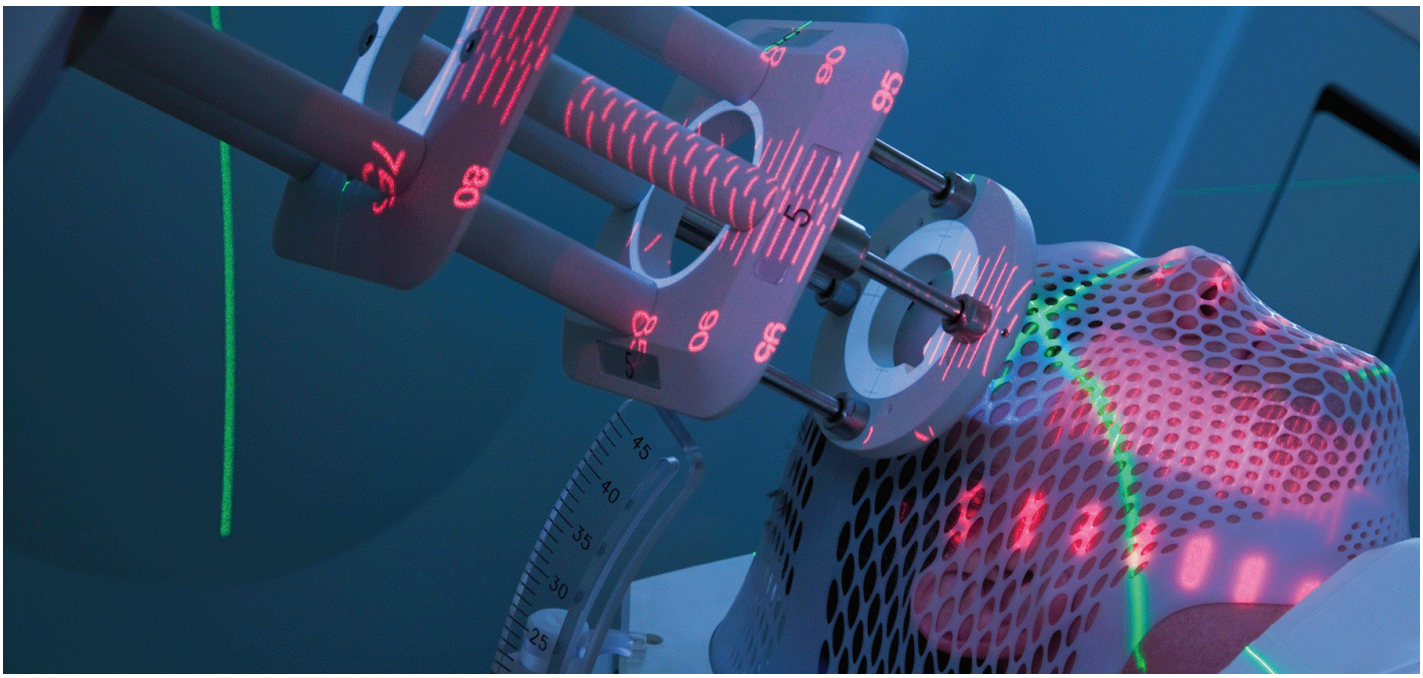
The discussion began with exploring the biggest challenges experts face when overseeing biotech and medical laser applications and getting the best out of these light sources.

Giulio Cerullo, Professor of Physics at Politecnico di Milano and co-founder of Cambridge Raman Imaging, said: "There is a realisation that lasers emit very peculiar radiation. They are monochromatic and they emit specific wavelengths, as well as having a spatial coherence so they can be focused down to very small spots, reaching very high light intensities."

He explains that the first applications exploited this property, using lasers to ablate or photocoagulate tissue. "They were not very successful, because people didn't understand which wavelength you need, and which regime of light matter interaction you need. I think, nowadays, people have understood very well that you need some specific laser wavelength to interact properly with tissues."

For precise tissue ablation in laser surgery, wavelengths with high water absorption are crucial since human tissue is 90% water. This has led to infrared lasers such as thulium (~2,000nm) or erbium (~3,000nm) being particularly effective.

"Another important constraint is the availability of optical fibres," Cerullo continued. "For many applications such as endoscopic surgery, you don't want to cut



the patient. You want to bring the light via an optical fibre."

While good optical fibres often aren't available at 3,000nm without toxicity concerns, 2,000nm fibres are readily available, enabling applications such as prostate reduction surgery for treating prostatic hypertrophy in aging males.

Another classic example is myopia correction. "You want to reshape the retina, to correct for the excessive curvature that results in myopia, and this nowadays can be done with lasers, in particular with the UV laser," said Cerullo. The excimer laser allows precise ablation of the cornea to achieve the correct curvature.

The evolution of femtosecond lasers has been particularly striking. "I've been working with lasers for more than 30 years, and these very short pulse lasers, so-called femtosecond lasers, initially were very complex laser systems that could only be used in sophisticated labs. Nowadays, they have become very robust and they can even be found in clinical applications."

In LASIK procedures for myopia correction, femtosecond lasers now cut the corneal flap before excimer laser processing – a task previously performed manually with a knife. This guarantees extremely high precision in a procedure undergone by millions worldwide annually.

Brian King, Principal Optical Systems Engineer at StarFish Medical, highlighted additional challenges in the medical space: "[At a lot of wavelengths], tissue isn't particularly absorptive, but it's very, very highly scattering. That's why, historically, we've seen a lot of application of laser radiation to ophthalmology, where the eye is transparent to many different wavelengths of light."

One of the earliest applications was diabetic retinopathy treatment, using laser thermal power to seal and photocoagulate bleeding blood vessels in the retina. However, King noted that many other applications tend to be superficial, such as tattoo removal or laser scalpel work, unless endoscopes are used – which again raises issues of matching laser wavelengths to available fibres.

Beyond technical challenges, King pointed to business considerations: "The fundamental cost of many laser systems works for some applications, but can be cost-prohibitive for others. You not only have to put a laser into a medical device, but you have to make that medical device work – in a business sense."

Regulatory burdens present another challenge unique to medical devices. "You have to balance risks with potential benefits," King explained, "not only in terms of getting the medical device cleared or certified, but also in terms of proper market certification, understanding the work instructions in the clinic, and safety applications for both patients and clinicians."

Perceptions around non-invasive laser methods

When discussing changing perceptions around the safety of various laser types and non-invasive methods for medical use cases, Cerullo acknowledged safety concerns, but emphasised solutions: "The laser can be dangerous, especially for the eye. But, of course, there are two possibilities. Either you have to use appropriate safety goggles when you use a laser and be protected; and then you can make Class 4 lasers where essentially you can never reach the beam as a user, and there is an interlock that blocks the laser if you try to access the beam."

The greater challenge, he suggested, is making lasers accessible to medical professionals: "The medical doctor is not an expert in optics. They don't know the physics of the laser. Maybe it's right that they focus on different problems, so they want to see the result. So, we need to make the laser different from a laser that we use in our own labs. We need to make it very user-friendly and simple."

King concurred: "The doctor needs to spend their cognitive load thinking about the operation, about diagnoses, the interaction with the patient. In my old lab, you'd go in at 8 or 9 in the morning and nurse the lasers until they were happy at maybe 4 or 5 o'clock in the afternoon; and then take some data. That just doesn't cut it for a medical device; time is important in the operating theatre and in the clinic."

Partnerships between academia and business

Academic-industry partnerships prove essential for advancing medical laser applications. Cerullo, discussing collaboration between Politecnico di Milano and laser provider Coherent, noted: "This cooperation between industry and academia is essential for both sides, because sometimes the academia side does research which is maybe more detached from the application, and the industry also needs the specific expertise of the academia."

These partnerships extend beyond surgical applications to diagnostic imaging. "You can use light to make images or to make diagnostics in a non-invasive and non-destructive way," Cerullo explained. "If you compare optical microscopy with other imaging techniques, such as magnetic resonant imaging, the optical technique has a much higher spatial resolution. And if you compare it with electron microscopy, electron microscopy can have a much higher spatial resolution – but it is destructive. So the optical approach is >

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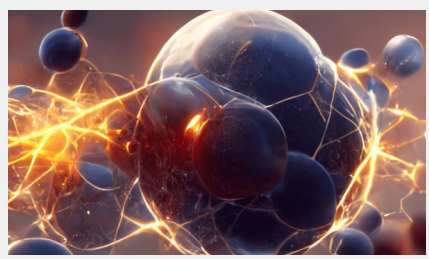

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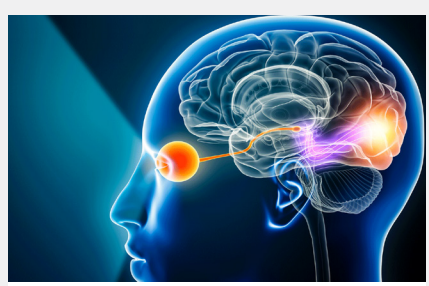

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non-destructive and with high spatial resolution."

Academia contributes by developing sophisticated microscopy techniques with two main application classes: studying fundamental biological processes at cellular level and diagnostics. Cerullo pointed to optical coherence tomography (OCT) as perhaps the most successful application: "OCT is a technique that was developed in the 1980s by Jim Fujimoto at MIT, and nowadays it has become a must-have for every ophthalmologist because, especially for aging people, you can monitor a lot of diseases of the retina like retinal maculopathy."

As a design consultancy, StarFish Medical approaches partnerships differently. King explained: "People would come to us with an idea for a medical device or a problem that they want to solve and ask our team of engineers about mechanical, regulatory safety, human factors and optics, to help build that device."

The value they bring to academic partnerships combines business understanding with product expertise.

He said: "Getting a laser system to work in the lab is not the same thing as packaging it up; making a hundred of them that are identical to each other; shipping them across the continent or across the ocean; and then having them work in a robust way."

King emphasised the complementary nature of these relationships: "There's that synergy between the ideas and the fundamental knowledge that one finds in academia, and the creativity of thinking of new applications and wanting to ask, 'what else can I do? What else can I see with this?', and then marrying that with the discipline and the constraints of product engineering."

This balance is vital for commercial success: "When I transitioned from academia to industry, one of the things I had to learn was that your technology is not a product. Your product is technology that works in a robust, repeatable, manufacturing, manufacturable, cost-effective way and that people will buy."

"The medical doctor is not an expert in optics… so we need to make [the laser] very user-friendly and simple"

Giulio Cerullo, Professor of Physics at Politecnico di Milano and co-founder of Cambridge Raman Imaging

Timelines and design considerations for medical lasers

The development of medical laser applications differs significantly from other sectors. Cerullo noted: "If you want to have a laser for surgery, you need to have to go through a lot of pre-clinical trials and get the product approved. This may take years and years, and for good reason, because in the end, you have to go to a patient."

These extended timelines impact investment strategies: "You must be ready to invest a lot of time until you have a product, so the development phase is much longer. This also may be a problem potentially for some investors, because this will require you to wait a bit more to generate revenues on a specific medical product."

King highlighted another unique aspect of medical device development: "The overriding integration of risk analysis into the design effort, where you're always trying to balance the benefits with the risks. You're often folding that into the design process and trying to understand the largest amount of power that you can get away with, and still maintain classification."

The unpredictability of the human body adds complexity: "After your beautiful optics, you shape your laser beam and make it exactly right, and bring it to the right location before going through your final lens, which is the human body. In ophthalmology, [you must consider] the physiological variation in your patient population. If you're going into the skin, you have to think about the scattering, and also about the difference in scattering and absorption for people from different genetic backgrounds."

Best practices for future development

For those looking to enter the field, the experts offered several recommendations. King advised: "Understand where your product fits in the market, and what the commercial success is likely to be."

This includes considering reimbursement structures, particularly in markets such as North America, where Medicare rates often dictate product adoption.

Understanding regulatory pathways early is critical: "Certifying bodies will look favourably upon FDA certification, and I think the converse is also true. In the end, all of these certifying bodies or approving bodies are looking for that sort of risk analysis and understanding the benefits and risks, as well as how you are managing the risks."

From an academic perspective, Cerullo encouraged mastering the fundamentals: "It's important to learn the basics of laser physics and optics. I find that this is something that not many people understand very well, so if you become a real expert in lasers and optics, you will never be out of a job."

Interdisciplinary knowledge is equally important: "If you want to go into medical applications, [consider] also a bit of the bio part. So you need to know a little bit of biology. Of course you don't necessarily need to become a medical doctor, or a biologist, but you need to be able to talk to them."

King added a technical reminder about laser properties: "Lasers are very bright… radically different from any other light source in the solar system. But the other thing is the coherence, the monochromaticity, and the regular phase relationship between different photons in a laser beam can be very powerful."

In vivo imaging, femtosecond lasers and future trends

Looking ahead, both experts anticipate continued innovation. Cerullo predicts more sophisticated imaging techniques: "In vivo imaging, for which you don't need to take a biopsy, can be used to improve diagnosis, but also maybe perform a diagnosis during treatment."

Femtosecond lasers, once rare, will enable new therapies, particularly in surgery. Cerullo also highlighted nanomedicine: "Using some nanoparticles, to carry, for example, a drug, and to let it arrive at the cell, either to destroy a tumour cell, or maybe to heal and perform some other kind of treatment. You can use the light to activate the drug release."

As laser technology continues to evolve alongside biological understanding, the possibilities for improving diagnostics, treatments, and research tools will only expand, ensuring that the intersection of lasers with biotechnology and medicine remains an exciting frontier of innovation. EO

This is an edited extract. To view the full online panel discussion on-demand, go to www.electrooptics.com/webcasts.

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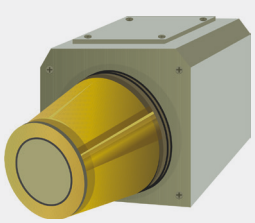

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Fluence Technology – on building reliable, high-performance femtosecond lasers

Fluence Technology R&D Director of Laser Microprocessing, **Bogusz Stępak**, explains how it combines reliability with precision on ultrafast lasers

Electro Optics: Fluence Technology is reasonably new to the ultrafast laser scene, what technology gaps were you looking to fill?

Bogusz Stępak: The company was founded in 2016 by four passionate scientists who had more than a decade of experience working with femtosecond lasers in advanced research laboratories. Notably, the initial high-power femtosecond laser prototype developed by the founders in 2013 remains operational and continues to be utilised as a valuable tool within the scientific community.

We realised there were not many lasers on the market that were robust and reliable across industrial environments and were easy to use. We started with the goal to create lasers that demanded no specialised knowledge – just start instantly and work every time, without any adjustments. Around the same time, we saw the growing potential of femtosecond laser technology.

Backed by a skilled technical team already leading research in fibre-based femtosecond laser design, these factors came together to inspire us to found Fluence Technology. Since we began, we've been refining industrial-grade femtosecond lasers for materials processing and, today, we serve both industrial and academic sectors with products that are used across six continents.

EO: Can you elaborate on your fibre-based femtosecond laser technology – how does it differ from typical ultrafast lasers?

BS: Most femtosecond lasers available today are based on free-space optics, where the laser beam travels through open space between mirrors and other optical components. These lasers are complex optical systems consisting of laser amplifiers, a laser resonator (oscillator) that generates femtosecond pulses and dispersive elements that stretch and compress the pulses in time. The stability of the lasers' output parameters is directly influenced by the way the mirrors are mounted and positioned.

Free-space designs introduce hundreds of degrees of freedom, as each optical component can shift or drift, due to environmental factors or material behaviour. Even minor changes can significantly impact the characteristics of the emitted laser radiation so constructing such systems requires extreme precision, with complexity often leading to manufacturing errors.

Fibre lasers address these concerns by guiding laser light all the way through the optical fibre from generation to final amplification. Because the all-fibre oscillators don't use degradable components such as a saturable absorber mirror, light remains confined within the fibre, unaffected by physical movement. Fibre segments and components are connected using specialised splicers in a semi-automated process, significantly reducing the risk of manufacturing defects.

Besides high beam quality and pointing stability, fibre amplifiers offer greater flexibility in achieving higher pulse repetition rates (tunable up to 20MHz in our case) and longer pulse bursts, enhancing material processing efficiency.

EO: What are some of the development challenges you faced when attempting to build environmentally stable and maintenance-free lasers?

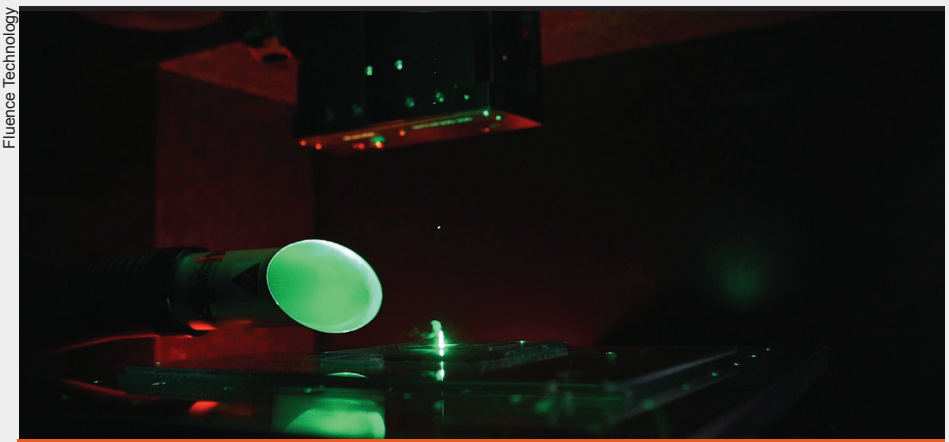
BS: The main technological difficulty lies in combining the high peak powers of femtosecond pulses with the fibre-optic medium that guides them.

Due to the optical properties of the glass medium, developing a fully fibre-based laser capable of delivering industrially relevant energy levels and peak power has been one of the most significant challenges.

Over the past decade, Fluence engineers have mastered guiding high-peak powers in fibres, achieving excellent pulse characteristics with duration of <270fs and energy of >200µJ.

Ongoing progress in this area depends heavily on innovations in fibre components and the development of new active fibres. Despite the challenges, the field is advancing steadily, and fibre-based femtosecond lasers hold strong promise for the future.

Fluence Technology



Processing of glass sample in Ultrafast Laser Application Laboratory at Fluence using second harmonic (515nm) of Jasper X0 laser

EO: What about materials processing? What kind of advantages do femtosecond lasers have for applications such as cutting, drilling and marking, for example?

BS: Femtosecond laser processing is a fascinating field with transformative impact across various manufacturing industries. It opens entirely new possibilities thanks to the unique interaction of ultrafast laser pulses with matter. Unlike nanosecond or continuous-wave (CW) lasers, femtosecond lasers deposit energy with exceptional precision – both in time and space.

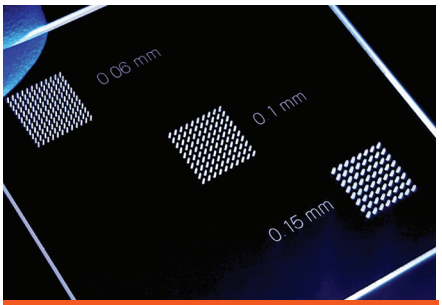
Did you know, for example, that a femtosecond laser actually emits no light for the vast majority of its operational life? Its duty cycle is often below 0.000001%. Yet, it's precisely this transient nature that makes it so powerful. A femtosecond pulse is so brief that atomic motion is essentially frozen during energy deposition. This leads to extraordinary precision, minimal heat-affected zones (HAZs) and pristine material quality. Quality can be further improved by an advanced pulse-on-demand feature which provides extremely accurate pulse triggering that converts to superior spatial positioning accuracy and enhanced corner processing.

This changes when pulse durations exceed the time required for thermalisation of energy absorbed by electrons – typically beyond one picosecond. As a result, picosecond pulses tend to cause more heat accumulation, which we observe especially in heat-sensitive materials such as polymers, composites and multilayer substrates. These can often be processed faster and with higher quality using femtosecond pulses.

Shorter pulse durations also mean higher peak intensity, which, in turn, can alter the materials' optical properties during the interaction. In femtosecond laser processing, it's the light – not the material – that governs the interaction. This opens new frontiers in processing, such as enabling deeper energy penetration, and results in significantly improved ablation efficiency. When comparing 7ps pulses with 250fs pulses, for example, removal rates for materials like stainless steel or titanium can nearly double, and with less energy wasted as HAZs are drastically reduced.

Femtosecond pulses are also highly advantageous for precision drilling. Their high peak intensity comes primarily from short pulse durations and pulse energy. Beam quality also matters greatly, because improving the beam from $M^2 = 1.3$ to $M^2 = 1.1$ can boost peak intensity by 33%.

Fluence Technology



Through-glass vias drilled by Jasper X0 in 1.1mm-thick borosilicate glass

In our experiments at Fluence's Ultrafast Laser Application Laboratory, we observed a 1.7× increase in hole depth in glass when using >200µJ, 250fs pulses versus picosecond pulses. Thanks to high beam and pulse quality as well as high pulse energy, we demonstrated 900µm – deep holes in glass using repetitive single pulses – very promising for through-glass via (TGV) fabrication.

Moreover, with 200µJfs pulses we can drill holes in 1.5mm-thick stainless steel without moving the beam. In general, the higher peak intensities of femtosecond lasers help achieve greater aspect ratios in material processing, allowing for faster >

> cutting and deeper drilling – much like using a sharper knife.

EO: You say your lasers feature 'environmental resilience'. What exactly does this mean and what practical benefits does this bring to your clients?

BS: When we talk about environmental resilience, we primarily mean that our lasers are designed for long-term stability and maintenance-free operation in real-world conditions where ambient humidity and temperature fluctuate.

At the core of every Fluence laser is an all-fibre oscillator. It's a unique, alignment-free design that contains no degradable components such as saturable absorbers and no free-space optics. The amplification of pulses takes place in fibres as well.

This architecture eliminates many of the common failure points found in traditional ultrafast lasers, dramatically reducing maintenance requirements and ensuring consistent performance over time.

EO: What are the quality control measures you put in place to test femtosecond lasers?

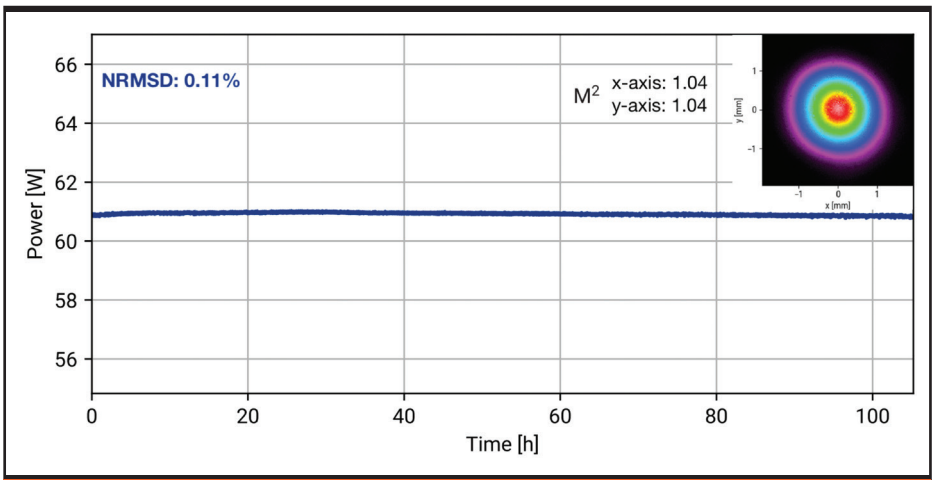
BS: Rigorous quality control is the foundation of laser production, so we ensure the tightest parameter tolerances under fluctuating temperatures and long-term logs.

Our laser products undergo a comprehensive set of standardised tests across diverse environmental scenarios. Starting with the core component – the oscillator – we assess parameter stability using a vibration platform and test chambers that expose the system to temperature and humidity cycles. In addition to evaluating start-up time, we conduct thorough assessments of power stability, repetition frequency stability and other performance metrics.

For complete laser systems, such as the Jasper X0, we conduct extensive testing through repeated temperature cycling and prolonged full-power operation logs, extending up to 110 hours. This ensures the laser's power stability and beam pointing precision consistently meet or exceed industry standards.

Each laser unit is tracked throughout its production, with detailed manufacturing logs that include alignment reports, component batch and serial number tracking (in accordance with the ISO 9001), environmental test results and final performance verification. This guarantees full traceability and rigorous quality assurance at every step of the process.

"The higher peak intensities of femtosecond lasers help achieve greater aspect ratios in material processing, allowing for faster cutting and deeper drilling – much like using a sharper knife"



Fluence Technology

105h power stability measurement of Jasper X0 femtosecond laser. Insert: beam profile of the same laser unit at 1m distance from its output aperture

EO: What kind of support do you provide to clients integrating your laser systems?

BS: We support clients throughout the entire integration journey – from initial discussions and feasibility studies to full implementation and long-term operation. Our approach combines deep application knowledge with a strong focus on collaboration, responsiveness and long-term reliability.

We begin with feasibility studies, live demonstrations and detailed consultations to ensure the laser source is perfectly matched to the client's process requirements. Our Ultrafast Laser Application Laboratory plays a key role here, allowing us to simulate real-use cases and identify optimal laser parameters and optical set-ups before integration begins.

We work closely with machine builders and system integrators, providing technical guidance, application insights and configuration recommendations to ensure a seamless integration process, and the modular design of our systems enables quick serviceability. After commissioning, we offer thorough after-sales support, including training, remote diagnostics and fast-response technical assistance.

During five years of hands-on experience in our application laboratory, we've gained extensive experience through collaborations with leading industrial partners in laser micromachining. These insights have helped us refine our products from the end-user perspective, allowing us to respond quickly and effectively with optimal solutions.

To conclude, we don't just deliver a laser – we help our clients move from concept to reality faster, with expert guidance, robust technology and comprehensive support.

EO: Tell me about some of the future trends you're expecting to see in laser research or commercial use, and how is the company positioning itself for them?

BS: For industrial research, high-power ultrafast lasers are gaining increasing attention, as emerging industrial applications are set to demand kilowatt-level sources to reach desired productivity. Over the past two decades, CW fibre lasers have achieved remarkable success in industry, with power scaling rapidly from hundreds of watts to tens of kilowatts. This rapid advancement highlights fibre technology's inherent suitability for power scaling.

Now, femtosecond fibre lasers are poised to follow a similar trajectory. Nevertheless, in our laboratories, we are exploring several alternative amplification schemes that combine different approaches to meet the demand. EO

Winning formula of Laser World of Photonics

Carlos Lee, EPIC Director General, meets **Anke Odouli** (right), Exhibition Director of Laser World of Photonics and World of Quantum at Messe München, to help us understand how this landmark show has come to dominate the European industry

Carlos Lee: What's the background to your appointment as Exhibition Director of Laser World of Photonics and World of Quantum?

Anke Odouli: In 2004, after completing an MA in Communications Science at the University of Mainz, Germany, I started my career as a project manager at the German-American Chamber of Commerce. Then, in 2007, I moved to Messe München's New Technologies Unit. There, I became Project Manager of electronica, the world's leading trade fair and conference for electronics, and, in 2013, Exhibition Director.

After a stopover at [electronics trade show] productronica, I became Exhibition Director of Laser World of Photonics and the World of Photonics Congress in 2019.

I was delighted to have the opportunity to continue working with new technologies, which is an area I had become enthusiastic about and that I saw as very important for driving Messe München's future.

In early 2020, the quantum community began calling for an international trade fair platform. In response, we launched the first World of Quantum alongside Laser World of Photonics in 2022. Concurrently, I became Global Industry Lead for the shows abroad with responsibility for Laser World of Photonics India and China.

CL: Could you give a brief overview of the development of Messe München and its trade fairs?

AO: Messe München (Munich Fair) was founded in 1964 by the Free State of Bavaria, the City of Munich, and the Munich and Upper Bavaria Chamber of Industry and Commerce, who are still the main shareholders of the company.

The original aim was to provide a dedicated trade fair and exhibition to support Bavaria's growing economy and industry, but, over the years, it has expanded to become one of the world's leading trade fair organisers. We now have about 1,000 employees worldwide, and we host global events in industries such as construction, environmental solutions and new technologies.

In 2024, Messe München organised 16 events in Munich, attracting more than 32,000 exhibitors and generating a turnover of around €330m. In the same year, we held 47 events abroad – including countries such as China, India, Brazil, Turkey, Kenya, Vietnam and Singapore – that attracted more than 22,500 exhibitors and a revenue of about €200m.

CL: Can you say more about your new technology trade fairs?

AO: The longest running of these is electronica, which first took place in 1964. Since then, it has been held every two years and has become the world's leading trade fair and conference for electronics. In terms of the number of exhibitors, it's one of our most successful shows – having attracted 3,480 exhibitors in 2024.

In 1975, as a spin-off from electronica, we launched productronica – the world's leading trade fair for electronics development and production – to alternate every two years with electronica.

analytica, a leading trade fair for laboratory technology, analysis and biotechnology, was first held in 1968, and 2009 saw the launch of LOPEC (Large-area, Organic & Printed Electronics Convention), the world's leading trade fair and conference for flexible, organic and printed electronics.

The first Laser World of Photonics, together with the World of Photonics Congress, took place in 1973 with around 100 exhibitors. Since then, the show has been held every two years and soon became the leading international platform for cutting-edge laser and photonics technologies. The 2023 edition attracted more than 1,300 exhibitors and 40,000 visitors from 70 countries.

In 2004, we launched automatica – a leading exhibition for smart automation and robotics. Our most recent show is World of Quantum, which had its first edition alongside Laser World of Photonics in 2022 with 70 exhibitors. We followed the same format for the 2023 event, which attracted 86 exhibitors from 17 countries and 17,000 visitors.

CL: How are the programmes for the 2025 editions shaping up?

AO: The next editions of Laser World of Photonics, World of Quantum and automatica will, of course, be in Munich from June 24 to 27, 2025. As in 2023, these shows will be held at the same time and under the same roof, i.e., visitors will have access to three world-leading trade fairs with one ticket.

We have organised it this way because the exhibition spectrums complement each other perfectly: many quantum solutions originate from photonics and automation and robotics are becoming increasingly important for laser and photonics companies to remain competitive in the market.

However, it's important for us that each trade fair preserves its own character. First, although there are many synergies between the technologies, they are not relevant to every single visitor, and second, because the photonics, quantum and robotics industries are at different stages of development.

This year, the supporting programme of the Laser World of Photonics includes forums on biophotonics and medical

Laser World of Photonics and World of Quantum, Messe München

Crowds line up for the opening at the most recent Laser World of Photonics

applications, materials processing, lasers and optics, and integrated photonics applications, chaired by EPIC and Photon Delta. At World of Quantum, the four exhibition sectors are quantum technologies, quantum sensors and quantum metrology, quantum communication and quantum computing.

I have to say that we're very pleased with the numbers, so far. For the quantum show, we already had 125 exhibitors registered by early April and it is an important milestone for us to reach three figures. I don't know of any other quantum show that has anywhere near as many exhibitors.

At this point, I would like to thank the core team for the work it has put in to make the 2025 edition a success, namely: Simone Bingel, Alexandra Ehrhart, Ilana Faustmann, Carolin Fischer, Katrin Hirl and Andrea Keil, as well as the big Messe München team. Trade shows are teamwork!

CL: What's the background to Laser World of Photonics China and India?

AO: Laser World Photonics China first took place in Shanghai in 2006 with 163 exhibitors. The aim was not to create an international trade fair, but to bring international brands and knowledge to the local Chinese market and surrounding area. Since then, Laser World Photonics China has been held on a yearly basis. This year, we celebrated its 20th anniversary and, for the first time, it was a standalone show with nine halls covering 100,000 m², and 1,404 exhibitors, mainly Chinese, but with some international brands from outside the country.

The first edition of Laser World of Photonics India was held in Mumbai in 2012. Since then, the show has taken place each year, alternating venues between Bangalore, Mumbai and New Delhi. The 2024 edition attracted 117 exhibitors and 4,361 visitors over the three-day event.

CL: Do you recommend European photonics companies to exhibit at these shows?

AO: Absolutely. For the 2024 edition of Laser World of Photonics China, 13% of the exhibitors came from countries including the United States, Germany, Japan, Switzerland, Spain, France and the UK. Similarly, companies from Switzerland, Germany, the UK, Lithuania, Spain and Finland were present at the 2024 Laser World of Photonics India.

The advantages for European companies are not only the opportunity to showcase innovations directly to local manufacturers, distributors and potential partners, but also that the events are organised according to European standards and mindset, which makes it much easier for them to engage with these types of shows.

CL: What are the main factors of your success?

AO: First, all of our shows are held in major business and innovation hubs in large state-of-the-art exhibition centres. Second, we have a customer-centric approach delivering high-value experiences for exhibitors and visitors. Third, we have strong and stable financial backing from the Bavarian state and local government. But, most importantly, over the past 60 years, we have developed strong partnerships and collaborations with companies, international trade associations, government bodies and the media to create an ecosystem capable of successfully showcasing what each industry is doing in specific countries. EO

"I was delighted to have the opportunity to continue working with new technologies, which is an area I had become enthusiastic about"

Anke Odouli, Exhibition Director of Laser World of Photonics and World of Quantum at Messe München

EPIC bridges the gap: connecting members with global distributors

By Carlos Lee, Director General

One of the added values of EPIC membership is the facilitation of strategic connections between companies and distributors, with the primary goal of increasing members' global market presence. By fostering these relationships, our members can unlock additional opportunities for growth, generating additional and diverse revenue streams, gaining a deeper understanding of global market demands and increasing their overall resilience in an ever-evolving industry landscape.

Furthermore, this initiative ensures that companies remain closely aligned with the requirements of the global photonics industry, a sector inherently defined by its interconnectedness. The global photonics manufacturing value chain underscores the reality that no company operates in isolation, and that success is driven by collaborating with the most relatable players, independent of their geographical location. Through this membership benefit, EPIC member companies are better positioned to thrive in a competitive global environment to achieve long-term success and sustainability.

Unless you are already familiar with the local market, it can be challenging to identify the right partners who can effectively help you sell your products and provide after-sales services if required. This is where EPIC steps in. It offers support by bridging this gap and facilitating connections with distributors in key regions across the United States and Canada, as well as China, Taiwan, Japan, Korea, Singapore and India.

Each of these markets presents unique opportunities and challenges. Having a reliable local partner can make all the difference in ensuring a successful market entry and sustained growth. By leveraging EPIC's expertise and network, members can save time and reduce risks. EPIC's unique initiative in this area underscores its commitment to empower its members to thrive in the competitive and interconnected landscape of today's global economy.

For smaller – yet rapidly growing – markets such as Thailand, Vietnam, Indonesia and the Philippines, the Asia Photonics Expo (APE), held in Singapore, serves as a strong platform for this purpose, offering a strategic gateway to these emerging markets.

Singapore's central location and its role as a stable hub for innovation and trade make it a natural focal point for connecting European photonics companies with opportunities across Southeast Asia. To maximise this potential, EPIC organises a dedicated European pavilion, providing member companies with a collective, more impactful presence. **EO**

Here I am with EPIC at OPIE in Yokohama, Japan, on the pavilion organised by Berlin Partner für Wirtschaft und Technologie

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