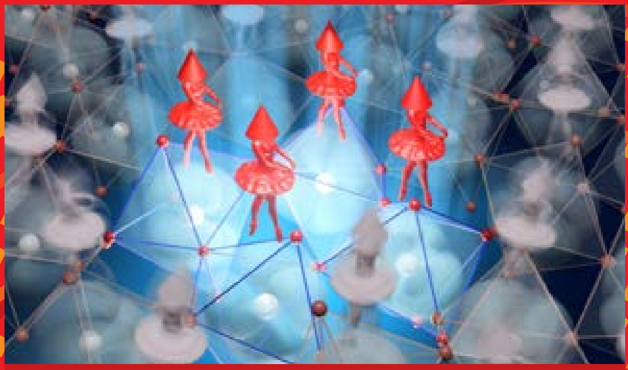
TUESDAY
EDITION

SPIE. | optics.org | TUESDAY, JANUARY 20, 2026

PHOTONICS WEST SHOW DAILY



Digital twins for quantum p. 09

SPIE and UNC Charlotte announce $1 million fund

The SPIE Emerging Innovators in Optical Science and Engineering Scholarship will support doctoral students.

At Monday's OPTO plenary session, SPIE, the international society for optics and photonics, and the University of North Carolina at Charlotte (UNC Charlotte) announced the establishment of the SPIE Emerging Innovators in Optical Science and Engineering Scholarship. The $500,000 gift from SPIE has been matched by an equivalent contribution from the UNC Charlotte Foundation, forming the $1 million endowed fund.

Part of the SPIE Endowment Matching Program, the new fund will support two students pursuing doctoral work in the university's Optical Science and Engineering program, which has a particular focus on rapidly growing fields such as

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Check is delivered: UNC Charlotte's Menelaos Poutous (left) and Bernadette Donovan-Merkert (center) accept the $500k check from SPIE Incoming President Cather Simpson (right). Credit: Joey Cobbs.

The realities of building hardware for AR/VR/MR

Bernard Kress discusses the continuing evolution of the industry and the AR|VR|MR conference and expo.

Bernard Kress takes the stage at the AR|VR|MR conference. Credit: Joey Cobbs.

This year's AR|VR|MR conference at SPIE Photonics West will occupy mainly two floors of the Moscone West convention center—one for the technical discussions and plenary stage, and one for the exhibition.

"It's huge," remarks Symposium Chair Bernard Kress, who notes that the beginnings of AR|VR|MR stretch back only to 2018, with just a few sessions, to today's program that spans four days with a solid mix of technical presentations from the research community and the latest hardware on display and up for discussion by industry players. There will be new product presentations, he says, and, for students, the Optical Design Challenge, where they will have the chance to "pick up a big check and get recognition from industry."

For history buffs and technophiles, there is a museum with about 300 headsets spanning the industry's history. Every year, Kress

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DON'T MISS THESE EVENTS.

QUANTUM WEST BUSINESS SUMMIT
9:30 AM – 6:30 PM Room 160
(Moscone South, Upper Mezzanine)

PHOTONICS WEST EXHIBITION
10 AM – 5 PM
(Moscone North/South Exhibition Halls)

AR|VR|MR AND VISION TECH EXPOS
10 AM – 5 PM
(Moscone West, Level 1)

JOB FAIR
12 PM – 7 PM
(Moscone West, Level 2 Lobby)

VISION TECH AGRICULTURE SESSION
1:30 PM – 4:50 PM West Expo Stage 1 (Moscone West, Exhibit Level)

STARTUP CHALLENGE FINAL PITCH COMPETITION
2:30 PM – 4 PM Expo Stage
(Moscone South, Exhibit Level)

AR|VR|MR OPTICAL DESIGN CHALLENGE
6 PM – 7 PM Career Hub Stage
(Moscone West, Level 2)

LASE POSTER SESSION - TUESDAY
6 PM - 8 PM Poster Hall
(Moscone West, Level 2)

For the full schedule and most up-to-date info, download the SPIE Conferences app. Some events require a paid technical registration.

IN THIS ISSUE.

Industry panel considers generative AI for optical systems design

ASML's Sergey Nikitin (Far L) moderates the discussion with distinguished panelists (L-R) Simon Verghese (Waymo), Jie Li (Meta), Sanjay Gangadhara (Ansys). Credit: William G. Schulz.

A panel discussion at the Photonics West Industry Stage on Saturday tackled the hot topic of generative AI for optical system design. The aim was to explore how these new tools can support system design and verification, and system performance validation under real-world conditions.

Session moderator Sergey Nikitin of ASML introduced the panelists: Simon Verghese of Waymo, Jie Li, Meta Platforms, and Sanjay Gangadhara of Ansys. Nikitin said the idea for the panel was to have open discussion, and maybe some open-minded fun. "We're trying to see how all these LLM tools can help us—what's working, what's not working, what's fun, what's not fun."

Verghese noted that possibilities surrounding the use of generative AI come at a time when his company has started scaling its fleets rapidly to other cities around the US. "We're seeing more rare events, extreme rainstorms or fog, or in some cases snow and realizing how important it is that our sensing modalities are somewhat orthogonal—if cameras are really paired with radar to do the job." He says other parts of the work include estimating how far various sensors can see for a given weather condition.

Li noted that Meta uses an internal simulator for its optimization pipeline, along with some research using machine learning to assist the company's design activities.

Nikitin asked the panelists about the most common use cases of AI in academia and large companies in optics today.

Verghese noted that Waymo has a version of Gemini that can go through all of the company's internal documents. With several thousand people working on one project, he says, "I have found these LLMs running on our internal documents are incredibly efficient for me to get the lay of the land, to understand what's going on, to break things down. In general, it's a really good graduate student research assistant."

Gangadhara cited similar experience with LLMs: "These tools are valuable for data consolidation. When you're trying to gather data and information from various sources—how do you summarize and synthesize that effectively? These LLM based tools are very effective. It gives you the opportunity to validate and verify."

"Basically, I don't do [internet] search anymore," said Li. "I always use our internal operators to do the search into our code base, our knowledge base."

Nikitin asked the panelists about their vision for future teams that include both humans and AI agents working collaboratively on optical system design. For Gangadhara, it's that AI enables the human engineer to get more insight into the types of designs that will meet the requirements. "Like if I have a lidar system that has to fit in this box, with this mechanical constraint or this thermal constraint and then trying to translate that for whatever [software] design tools... AI can just more efficiently bridge that gap. It's a more natural integration and that's, I think, very powerful."

With three different sensing modalities on autonomous vehicles, Verghese said, AI makes it possible to tease apart what they should really care about—or not—with a given system. "My suspicion is that we could use less resolution in our lidars, for example, because the cameras are so capable, but then showing that all the way through the simulator so we can see rare events and then connect that back to our capability channels."

Asked if any of the current LLM tools could guide optical engineers or even give full optical design, the panelists expressed skepticism. Li said they can be used to quickly onboard new projects, but "In terms of supporting real optical system design, I think it depends."

"The whole flow has to be in a loop with humans right now," said Gangadhara. "I don't think it can finish the end-to-end design. We're certainly seeing that these things are useful for providing insights that you might not have necessarily gained, otherwise."

Verghese said he's been impressed with what an LLM can come up with in terms of optical design ideas, "but it runs out of useful info. I am skeptical it will help experts be more expert."

Indeed, at most large companies, Gangadhara said, "it's design optimization that's getting a lot of play." He can see a future when AI agents might be doing a lot of the heavy lifting, but with humans guiding the process.

"It's reasonable to predict that AI and humans will work together," said Li. But human engineers will not be replaced.

WILLIAM G. SCHULZ

PHOTONICS WEST. SHOW DAILY

PUBLISHED BY
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spie.org

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says, someone from industry will say, "Hey, Bernard, we couldn't find our headset in the museum. Here is one. We did it in the '80s or the '90s or the 2000s.... We don't want this to fall into oblivion, so please take it, put it in the museum, so we can tell our story also."

For some, he says, the approximately 100 exhibitors are "the real bread and butter" of the conference, "because then you can actually talk with the companies, get these devices in hand, try it on, if it's a headset, and have an experience."

There will be panel discussions on light engines, waveguides, materials, and manufacturing, as well as plenary sessions that include Meta's Jason Hartlove, David Hayes of Plessey Semiconductor, and University of California, Berkeley's Emily Cooper.

Kress says technical sessions will "dig deep" and feature research from academia and industry. The sessions will focus on work to advance AR/VR/MR technologies, as well as the sharing of ideas about new architectures and technologies, new processes, and so on.

In arm's reach: the AR|VR|MR expo gives attendees the opportunity to try headsets on. Credit: Joey Cobbs.

Asked about industry trends and how they are reflected in the AR|VR|MR programming, Kress mentions display and sensing technologies and how they need to become linked. "The sensor fusion needs to happen with the display specs, and this can only happen with miniaturized components," he says. "That's why industry is very excited about microLEDs, but also about devices that don't use much power—that aren't power hungry." He says people are also getting excited about laser beam scanners, for example, "because they're way more efficient than microLEDs. There's no clear winner, and we actually have a panel to discuss this."

Kress predicts that as the industry continues to innovate, there will be different combinations of light engines and waveguides that are best suited for one or another product category. "You know, is it monocular? Is it binocular? Is it single color? Is it small field of view? Is it large field of view? And they will all define a suitable combination of light engine and waveguide. So, hey, there's place for everyone."

Asked how SPIE and AR|VR|MR fit within the universe of conferences for the industry, Kress says it fits between those that focus on user experience and consumer electronics shows. "SPIE is about hardware, so it's between the final product and the experience. Steve Jobs said, 'Hey, forget the hardware. It's not important. It's the user experience that is important.' But the user experience has to be brought to the consumer with hardware, and that hardware needs to be carefully adapted. And so this is really what we do. It's the hardware."

WILLIAM G. SCHULZ

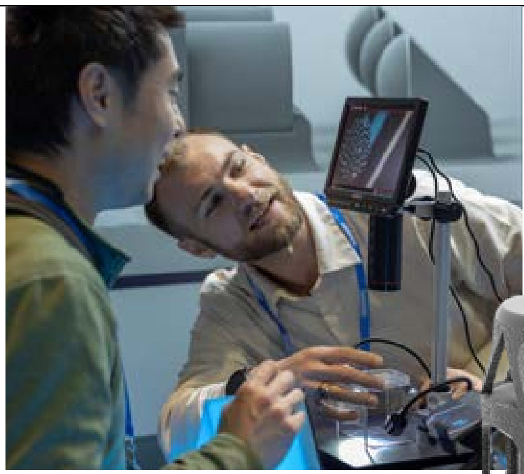
Nanoscribe remote-prints 3D micro-optics from BiOS booth

Representatives from Nanoscribe, the developer of high-precision additive manufacturing systems, used the weekend's BiOS Expo to demonstrate how they can quickly fabricate optical components from a remote location.

Using a Quantum X Align tool located at the firm's Germany headquarters, but controlled live from Nanoscribe's BiOS booth, sales managers Taylor Stark and Arwin Shrestha printed periscope and collimating lenses at the tip of an optical fiber that might be used in a variety of applications, for example projection displays. The printing technique is a form of two-photon polymerization (2PP) known as aligned two-photon grayscale lithography (2GL), which Nanoscribe claims to be the fastest commercially available approach to 2PP-based 3D microfabrication. It is based on dynamic modulation of laser power coupled with high-speed scanning.

The company explains that the system prints freeform micro-optics directly in place with nanometer-scale positioning accuracy, meaning that the optical components are aligned precisely to optical axes. Nanoscribe believes it will open up new possibilities for endoscopy, biomedical sensing, imaging, and lab-on-a-chip applications.

The Karlsruhe-based company has also opened a demonstration lab in Shanghai that hosts a Quantum X Align tool. CEO and co-founder Martin Hermatschweiler commented: "The Shanghai Quantum X demolab is more than a local facility—it represents a milestone in our long-term commitment to the Chinese market. By providing access to high-throughput two-photon lithography instrumentation, we enable our customers to accelerate development cycles and bridge the gap from academic proof of concept to industrial-scale production. This is how we actively support the transition from lab to fab."



Nanoscribe's Taylor Stark at the weekend's BiOS Expo, where he demonstrated remote 3D printing of high-specification optics via a link to one of the firm's Quantum X Align tools. Credit: Joey Cobbs.

Having recently hit the milestone of selling its 400th system, Nanoscribe said it was seeing a "marked increase" in demand from industrial customers for the broader Quantum X family of 2PP systems.

"We are seeing strong and growing interest from both application-oriented research and industry," Hermatschweiler added. "This underscores a clear market pull for our products, especially in optics manufacturing and photonics packaging. With our turnkey process-line solutions, we are enabling customers to move from a few prototypes to scalable production."

Key applications driving that industrial uptake are said to include aligned 3D microprinting for photonics packaging, such as optical coupler interfaces on chips, chip edges, fibers, fiber arrays, and wafers.

MIKE HATCHER

Indie's new narrow-linewidth DFB laser diodes, made by its Exalos subsidiary and aimed at quantum computing applications, were displayed at the company's BiOS Expo booth. Credit: Joey Cobbs.

Indie's photonics portfolio hits three shows

Indie Semiconductor has a greater presence at this year's event, with the California-headquartered chip maker's photonics-focused business unit appearing at each of the BiOS Expo, Quantum West (booth #510), and main Photonics West (booth #4719) technology exhibitions. Among the firm's latest offerings is a new family of narrow-linewidth distributed feedback (DFB) lasers aimed squarely at the emerging market for quantum computing.

Produced by Indie's Exalos subsidiary in Switzerland, the gallium nitride (GaN) laser diodes enable narrow-linewidth, single-frequency emission across the 400-520 nm range, providing more compact and efficient sources of light than is typically the case for external-cavity laser systems used in quantum computing development.

The devices employ monolithic gratings integrated into single-transverse-mode ridge-waveguide structures to ensure wavelength stability, achieving high side-mode suppression ratios and stable operation over a wide current range.

Other highlights from Indie's photonics unit, comprising Exalos and TeraXion, include a new miniaturized full-color RGB light module based around superluminescent diodes (SLEDs) and ceramic packaging that promises to massively reduce average power consumption for near-to-eye displays.

"This module is essential for augmented reality (AR) systems, where compact and lightweight optical modules are critical for improving visual clarity and reducing noise artifacts," stated the company. "It enhances the viewing experience in head-up displays (HUDs) for automotive and aviation applications by providing sharp and reliable projections."

The SLED emitters are said to generate optical peak power levels of 350 mW per color with short electrical current pulses at short duty cycles, thereby reducing power requirements.

MIKE HATCHER

Phlux targets lidar and marksmen with 1550 nm APDs

UK startup Phlux Technology is showcasing its "Aura" family of noiseless avalanche photodiodes (APDs) at this week's exhibition with two booth demonstrations: one for 1550 nm lidar sensing, and another for optical time domain reflectometers (OTDRs) used in fiber-optic test equipment.

Based on indium gallium arsenide (InGaAs) material, the high-performance sensors—shortlisted for a 2026 Prism Award—are said to boost range and improve fault-detection accuracy, with Phlux calling them "the world's highest-performance 1550 nm sensor APDs."

Prism-nominated "Aura" APDs from Phlux Technology feature in two booth demonstrations by the company: lidar sensing and optical time domain reflectometry. Credit: Phlux Technology.

Available in 30 μm, 80 μm, and 200 μm versions, the devices from the University of Sheffield spin-out are claimed to be 12x more sensitive than traditional InGaAs APDs.

Alternatively, for a given range, significantly lower laser power is needed, which reduces system costs by up to 40% and size and weight by up to 30%, partly thanks to simplified thermal management.

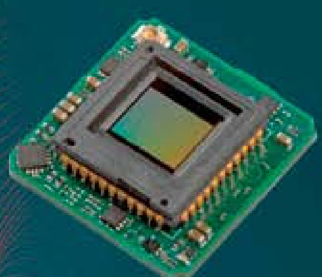
As well as targeting professional laser rangefinders, OTDRs, long-distance lidar, and free-space optical communications working at 1550 nm, Phlux says that other versions of the APDs are now being evaluated for use in premium hunting and professional shooting optics.

Because it is designated as eye-safe, the 1550 nm wavelength enables system designers to use much higher laser powers compared with more traditional 905 nm devices. For hunting applications, that translates to longer ranging distances and better performance with difficult, low-reflectivity targets.

"Professional hunters and precision shooters are pushing their equipment harder than ever for smaller targets, more marginal light, tougher weather, and more complex backgrounds," said Phlux sales chief Stuart Sendall. "They are telling us the same thing we hear from telecoms and defense customers: they need better range and more detail and accuracy in detecting infrared signals. Our sensors are designed to unlock that extra margin of performance."

Founded in 2020 by CEO Ben White and fellow Sheffield compound semiconductor experts Jo Shien Ng and Chee Hing Tan, Phlux Technology is exhibiting this week at booth #5528.

MIKE HATCHER



SPIE Photonics West 2026: Expands beyond boundaries

As we come out of the holiday season, which many of us spent with loved ones not familiar with our industry, it's fun to think about how we explain photonics to those not in the know. When someone asks what we do, saying "I work in photonics" doesn't really answer the question. Photonics isn't just one field. It's the thread that runs through so many areas: healthcare, manufacturing, telecom, defense, AI, AR/VR, quantum, astronomy, and the list goes on. That's what makes our field and this event so special. It's interdisciplinary. It's collaborative. And it's full of opportunities to learn, connect, and create.

This interdisciplinary nature is reflected in Photonics West, which spans six major application areas: BiOS, LASE, OPTO, Quantum West, AR|VR|MR, and the new Vision Tech program. Each area offers deep technical content while highlighting real-world applications, ensuring you'll leave with both knowledge and inspiration. And while we try to put this application-focused structure around the program, what makes photonics so powerful is its ability to work across these lines. Advancements in silicon photonics or OLEDs will be presented in OPTO, but are also directly applied to applications discussed in the AR|VR|MR, BiOS, and Vision Tech sessions, and that's just one example of the breadth of our enabling technology.

Kent Rochford is CEO and Executive Director of SPIE. Credit: SPIE.

Photonics West is not just about research and science—it's about turning breakthroughs into business opportunities.

Looking through the technical program, it's easy to see how diverse the applications of light are. It's also easy to get caught up in the amazing ingenuity of the attendees here this week and the fascinating research being presented. There are talks on everything from using machine learning to improve and enable early cancer detection, using hyperspectral imaging to detect pits in cherries, building a fluid lens to correct the vision of prescription-glass wearers while using VR goggles, and improving optical ion clocks. There is even a presentation on the optical and electrochemical characteristics of pigments extracted from mushrooms. Truly something for everyone.

Of course, Photonics West is not just about research and science—it's about turning breakthroughs into business opportunities. This week's robust Industry Program provides a strategic lens on market trends, government policy updates, investment opportunities, and commercialization pathways. With more than 50 industry sessions, this program is designed for executives, entrepreneurs, and decision-makers who want to stay ahead in a rapidly evolving marketplace and gain insights beyond the buzzwords.

Speaking of buzzwords, quantum technologies are entering the marketplace, and it's becoming a business. At the Quantum West Business Summit, you'll hear from leaders who are building the future of quantum computing, sensing, and secure communications. These sessions are not to be missed if you want to be part of moving quantum forward into a viable and valuable industry. Keynotes and panels will address critical topics, including lasers for quantum computing, photonics-integrated circuits (PICs) for scalable quantum systems, and packaging capabilities for quantum devices. Over 40 industry leaders from companies like IonQ, TOPTICA, Quantinuum, and Infleqtion will share insights on building a robust quantum supply chain and overcoming barriers to adoption.

Making its debut this year, the Vision Tech Forum is a testament to the rapid evolution of imaging and sensing technologies. Over two days, this forum will explore how photonics powers intelligent vision systems, enabling advancements in machine vision for robotics, AI-powered drones for public safety, and advanced sensors that can see what the human eye can't. It's a fascinating mix of hardware and AI, and it's changing everything from agriculture to autonomous vehicles.

The Vision Tech Expo complements these sessions with hands-on demonstrations of hyperspectral imaging, 3D sensing, and embedded vision platforms. Whether you're a researcher, engineer, or business leader, Vision Tech offers insights into technologies that bridge hardware and AI, creating smarter, safer, and more efficient systems for the future.

This is just a sampling of what you'll find this week. Make sure to download the conference app and build your custom schedule with the presentations and companies that will help move your work forward. But I strongly advise leaving some space for randomness and the serendipity that can only happen at an event like Photonics West.

As you navigate the week, make use of the networking opportunities, talk to the company reps, and engage with the thought leaders shaping the future of light-based technologies. Whether you're here to learn, connect, or innovate, Photonics West offers the resources and relationships to help you succeed.

This year, we've packed the program with content that reflects just how far photonics reaches into our lives, and how much further it's going. From healthcare to quantum computing, from AI-driven vision systems to industrial manufacturing, photonics is the backbone of innovation. And at Photonics West, you'll see it all.

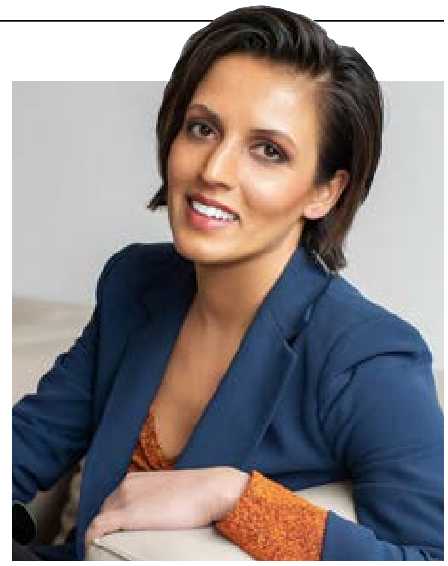
So take your time. Explore the sessions. Walk the exhibit halls. Strike up conversations. You never know where the next big idea or partnership will come from.

Welcome to Photonics West 2026. Let's make this an unforgettable week.

KENT ROCHFORD

Twin tickets to the quantum revolution

Quantum West Plenary speaker Prineha Narang argues that the quantum revolution is not far off and could be accelerated by combining digital twins and AI in quantum device design.



Prineha Narang is Professor in Physical Sciences, and in Electrical and Computer Engineering at the University of California, Los Angeles. Credit: UCLA.

We have all heard the promise of quantum computing. It will be so fast and powerful that it will solve problems far beyond the capabilities of regular supercomputers, bringing transformative change to almost every sector, from optimizing the fertilizers that sustain our food supply to discovering drugs to cure all disease, or from designing better batteries for electric cars, to finally harnessing fusion power to give us clean electricity.

For most people, these revolutionary benefits still seem a long way off. Even Jensen Huang, the boss of world-leading AI chipmaker NVIDIA, has said that quantum computers are 15 to 30 years away from being "very useful." But is that really true?

One person aiming to prove Huang wrong is quantum scientist and technologist Prineha Narang. Narang is Professor in Physical Sciences, and in Electrical and Computer Engineering at the University of California, Los Angeles (UCLA), and Visiting Professor of Physics at the Niels Bohr Institute and the Novo Nordisk Foundation Quantum Computing Program (NQCP) in Copenhagen, Denmark.

Narang is also an operating partner at deep technology fund DCVC (with investments in quantum), founder and board member at Aliro—a company that develops quantum computing and networking systems designed to emulate, pilot, and deploy entanglement-based quantum networks—and was even the first US Science Envoy to be appointed in the field of quantum science and technology in 2023.

Given these various high-level roles, Narang has her finger on the pulse in the quantum technologies sphere. Her Quantum West Plenary, *Digital twins in scalable manufacturing of quantum devices* on Monday detailed an important tool in accelerating the development and scaling of quantum technologies, and thereby shortening the runway to "very useful" quantum computers—using digital twins and AI to design optimal quantum devices. In her own words: "When I give my talk at Photonics West, I will be highlighting what is actually important to unlock the full promise of quantum technology, and why I think digital twins are an important and underexplored ingredient of this journey."

Digital twins

"If you think about your favorite photonic quantum device, there are many material, device, subsystem, system, and architecture level questions you want to answer," she continues. "This is a many-parameter problem, where each of these choices is interdependent; you wouldn't want to make them willy-nilly."

To simplify the decision-making process, Narang and colleagues built an in-silico version of each important step that amounted to a basic digital twin. The team then applied AI. The combination was devastatingly effective: removing the cost and time bottlenecks that come with prototyping, simulating, and predicting device behavior accurately, and identifying optimal, sometimes unexpected, parameters swiftly.

Specifically for photonic quantum devices, the challenge is often rooted in complex material science. The performance of these devices—their ability to generate, guide, and manipulate single photons with high fidelity—is intrinsically tied to the imperfections and characteristics of the underlying semiconductor and waveguide materials.

The sheer number of material compositions, fabrication methods, and geometric parameters is too vast for humans or regular simulations to navigate effectively. This is where the power of AI-driven digital twins comes to the fore.

The digital twin captures the intricate relationships between these various parameters and how they affect functionality. AI then acts as an intelligent guide, exploring this vast parameter space to identify previously overlooked sweet spots. This design methodology promises not just incremental improvements, but potentially the discovery of entirely new material and device platforms that can overcome fundamental issues. As Narang confirms: "There are many, many more design subspaces or parts of this larger parameter space that become available when you bring the full power of AI to this problem."

What's more, the AI-driven digital twin methodology creates a feedback loop where experimental results continuously refine the virtual models, which in turn guide the next generation of experiments and devices, ultimately accelerating the path from laboratory demonstrations to optimized, scalable quantum devices.

Now collaborating with NVIDIA on applying these AI-driven digital twins to quantum device design, Narang and colleagues are focusing their efforts on three different fronts. "One is just a brute-force error-rate problem—a 'make it better now' problem," says Narang. In regard to photonic quantum devices, this refers to the high frequency of errors that occur during quantum computation, largely caused by the inherent challenges in generating, manipulating, and detecting single photons. If errors are too frequent, they accumulate faster than they can be corrected, corrupting the final result.

The second front is exploring new architectures that could hold more promise than those currently on offer. This area

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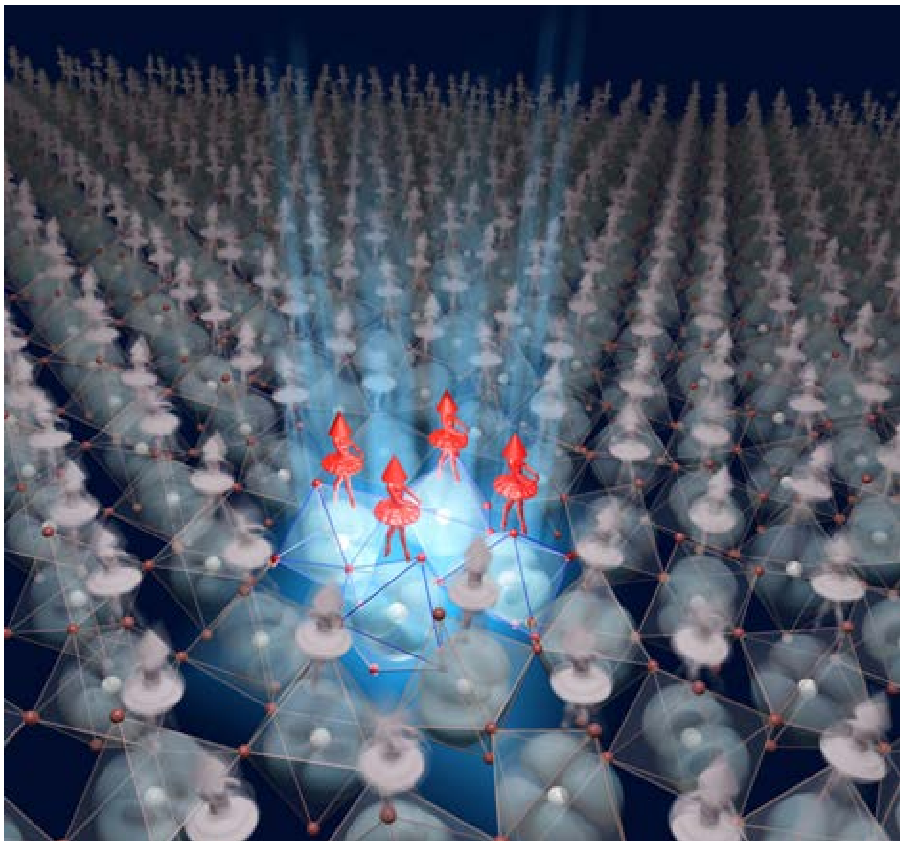
Digital twins continued from page 09

is important because photonic quantum devices suffer from two key weaknesses: photon loss and the probabilistic nature of all-photonic gates, both of which lead to high error rates. As AI explores a far larger parameter space, the likelihood of discovering novel device architectures that address these weaknesses to achieve fault-tolerant, scalable operations increases significantly.

"The final front—which we haven't yet focused on, but will in the future—asks: what does it mean to have abstracted the sensitive and expensive physical quantum hardware.

Why do we need to take this AI-driven digital twin approach to quantum device design now? Because we are already on the cusp of the quantum revolution.

In October 2025, Narang co-authored an opinion piece, "America's Quantum Manufacturing Moment," in which she mapped out a plan to secure US quantum competitiveness. As part of this, she outlined some of the real-world uses of quantum technologies that have emerged in the past year.



Digital twinning is helping UCLA's Prineha Narang to better understand how to control the detrimental "quantum dance" of electrons in molecules, which could lead to significant advances in photonic quantum computing. Credit: Prineha Narang.

twins for error detection, quantum control, and error correction schemes?" says Narang. Such digital twins could predict when and where errors are most likely to occur to help with testing and optimization, or they could provide high-fidelity insights to allow real-time adjustments in quantum systems, all without risking

She cited, for example, Australian company Q-CTRL, whose quantum navigation system (admittedly quantum sensing, not quantum computing) proved so accurate that the startup secured a US Defense Innovation Unit contract to develop the technology for military purposes.

Narang also highlighted multinational bank JPMorganChase, whose collaboration with Amazon and CalTech led to the development of a technique to allow portfolio optimization problems—selecting and combining different assets to achieve the best possible outcome in terms of risk and reward—to be solved by near-term quantum computers with a limited number of qubits.

Recent achievements

There have also been significant recent achievements in quantum chip design and computation too. In March 2024, Quantinuum announced they had solved the quantum scaling challenge for their trapped-ion quantum computing architecture, proving its potential for future growth. Later that year, Google demonstrated Willow, a 105-qubit superconducting quantum computing chip. Willow performed a computation in under five minutes that would take one of today's fastest supercomputers 1025 or 10 septillion years. More recently in February 2025, Microsoft unveiled Majorana 1, what the company claims is the world's first quantum processor powered by topological qubits, which should be less prone to errors.

Photonic quantum chipmakers are not far behind. Quandela and attocube systems GmbH successfully delivered a 12-qubit photonic quantum computer—the most powerful photonic system ever made—to CEA in France, in November 2025. And PsiQuantum recently raised $1 billion and committed to building a fault-tolerant quantum computer with roughly a million qubits by 2027.

Taking these early applications and significant achievements in quantum chip design and computation into consideration, the quantum revolution seems less like a distant dream and more like a reality slowly resolving into view. This is why Narang is so keen for the US and its allies to grasp the nettle in all aspects of quantum to secure their place at the forefront of technological innovation now, at the start of what she and many other technologists see as the next industrial revolution. "It's a technology where you wouldn't want to be second and it's very important that the

> "Quantum has come of age, and the idea that we need digital twins for foundries, fabs, manufacturing is indicative of how the technology has matured. And that's a good thing, not only from the technology standpoint, but actually this is a great opportunity for people to enter this field."

manufacturing, the devices, the IP that the technology sits on, all be retained in the US and with like-minded allies," she warns. "For any technology that we consider mission critical, it's important we don't rely on adversaries for it."

But beyond it being a necessity for future national security and prosperity, Narang argues that leading the way in quantum provides opportunities to have a seat at the table as history is written. "Quantum has come of age, and the idea that we need digital twins for foundries, fabs, manufacturing is indicative of how the technology has matured," says Narang. "And that's a good thing, not only from the technology standpoint, but actually this is a great opportunity for people to enter this field."

"If you ever wanted to be a technologist, to be a scientist, the time is now," she concludes. "Everything is moving so fast and is so exciting, we can work across fields and do so much. There is really no other path that I would encourage someone to take today."

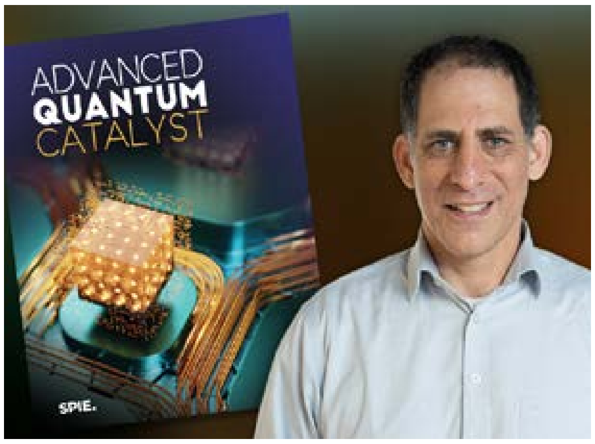
BEN SKUSE

Applied quantum technology and research focus of new SPIE journal

The 16th journal to join the SPIE fold will be led by Editor-in-Chief Uriel Levy.

In November, SPIE announced the launch of its 16th journal, *Advanced Quantum Catalyst* (AQC). The announcement was made during the inaugural SPIE Quantum Catalyst event in Boulder, Colorado. And on 1 December, Hebrew University of Jerusalem Professor Uriel Levy became *Advanced Quantum Catalyst*'s first editor-in-chief.

With an editorial board representing diverse expertise across quantum sensing, biology, photonics, and engineering, *Advanced Quantum Catalyst* fills a critical gap in the quantum research publishing landscape. The journal will cover applied quantum technology and will serve as the premier venue for engineers, industry practitioners, and cross-disciplinary researchers working on real-world quantum applications, with particular areas of focus to include quantum sensing, quantum-enabled imaging, chip-level integration, and quantum-adjacent technologies. The journal will also emphasize implementation, integration, real-world systems, experimental work, engineering methods, and cross-disciplinary applications in sensing, imaging, biology, and computing.



Uriel Levy is the inaugural editor-in-chief of the newest SPIE journal, *Advanced Quantum Catalyst.* Credit: SPIE.

"*Advanced Quantum Catalyst* is a very welcome—as well as very timely—addition to SPIE's portfolio of journals," said Chair of the SPIE Publications Committee Cather Simpson at the time of the journal's launch. "As we know, the quantum research community is rapidly evolving, with increasing emphasis on practical implementation and real-world deployment. Launching *Advanced Quantum Catalyst* meets this transformative moment of quantum technology underpinning economic growth, and will enable advances in this critical area."

Levy, who will be presenting two invited papers at 2026 SPIE Photonics West, one on 19 January, *Chip scale atomic vapors: from fundamental physics to large scale manufacturing and applications,* and one on 20 January, *Dielectric metasurfaces: from new materials and geometries to imaging and tunability,* is a professor at the Applied Physics Institute and the Center for Nanoscience and Nanotechnology at the Hebrew University of Jerusalem. He leads the university's Nano-Opto Group and is also the co-founder and the CTO of TriEye, developing CMOS-based, cost-effective shortwave infrared (SWIR) sensing solutions for the automotive industry and beyond.

Levy's research spans a wide range of aspects of nanophotonics and light-matter interactions, with a focus on device-oriented research. Over the years, he has pioneered several key concepts in nanophotonics, including silicon-based photodetection in the shortwave infrared, nanoscale polarization optics, metasurfaces, and chip-scale atomic vapor technology. His research covers both fundamentals of light-matter interactions and diverse applications in imaging, communications, sensing and metrology, energy harvesting, memories, displays, and other chip-scale optoelectronic devices. He holds dozens of groundbreaking patents, has published more than 200 journal papers, and has shared his research results at hundreds of scientific professional forums and events.

Levy is the recipient of multiple recognitions and honors, including the Kaye Innovation Award—presented by the Hebrew University of Jerusalem for academic research that drives societal benefit and commercial progress—a European Research Council Consolidator Grant, the President's Young Investigator Award of the Hebrew University, and the Rothschild Post-Doctoral Fellowship. In 2024, Levy was named a Fellow Member of SPIE.

He holds a BSc in Physics and Materials Science from Technion, the Israel Institute of Technology, and a PhD in Electro Optics from Tel Aviv University. Prior to joining the Hebrew University, he spent nearly four years as a researcher at the University of California, San Diego.

"I am thrilled to start my role as the inaugural editor-in-chief of *Advanced Quantum Catalyst*," says Levy. "The launch of the journal marks an exciting moment for the quantum science and engineering community. Together, our mission is to accelerate the translation of fundamental quantum discoveries into real-world technologies. The journal will be the home for the community at large, including both academia and industry. By uniting physicists, chemists, engineers, and industry innovators on a single platform, this journal will serve as a catalyst for the next generation of quantum-enabled breakthroughs. We are committed to the highest standards of scientific rigor, openness, and impact."

"I am delighted to welcome Professor Uriel Levy as editor-in-chief," says SPIE Director of Publishing Operations Gwen Weerts. "He brings decades of groundbreaking research, including applied quantum science, and extensive experience in journal editorial leadership. His vision and expertise will be instrumental in shaping the future of this exciting new publication. We look forward to working together to advance the field of applied quantum technology and provide a premier platform for transformative discoveries."

The journal will begin accepting submissions in early 2026, operating as an open access journal for at least the first two years, with article processing charges waived during that time. The first issue will be published in the SPIE Digital Library in January 2027, with early accepted papers published in advance.

DANEET STEFFENS

Transparent discovery

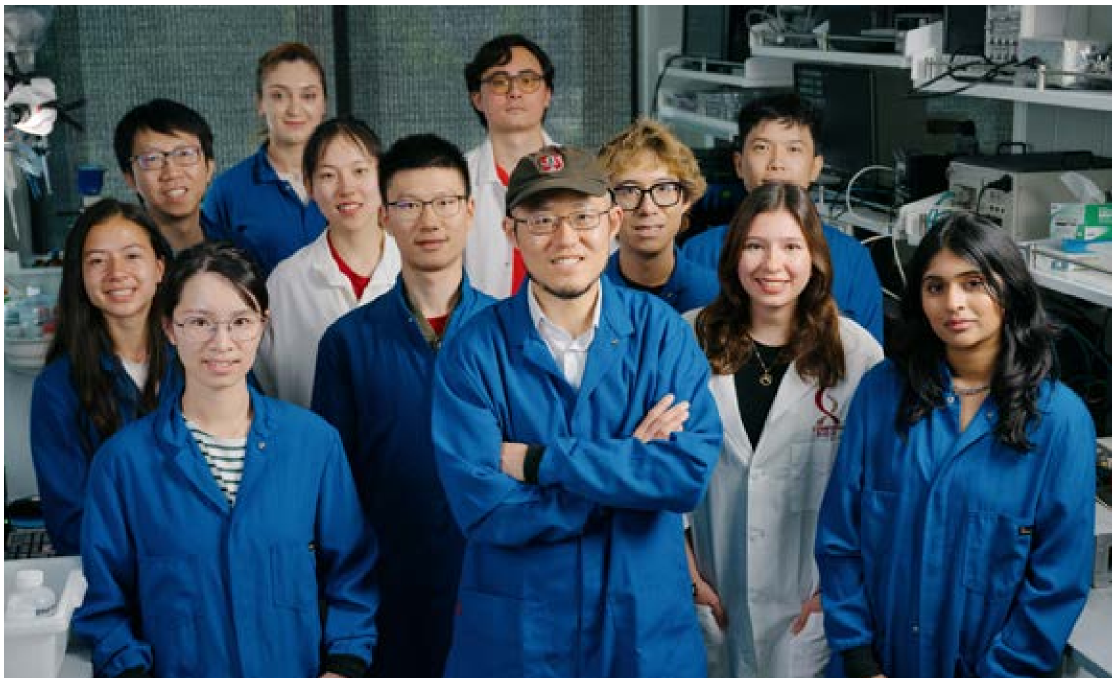
Stanford University's Guosong Hong announced as inaugural recipient of SPIE's *Biophotonics Discovery*'s Impact of the Year Award.

This week, SPIE, the international society for optics and photonics, is celebrating the inaugural *Biophotonics Discovery*'s Impact of the Year Award as well as its first recipient, Stanford University Associate Professor of materials science and engineering Guosong Hong. Hong was officially honored at the Biophotonics Focus plenary on Sunday evening.

The award is administered and presented by the SPIE journal *Biophotonics Discovery*. It was created to recognize outstanding contributions that have significantly advanced the field of biophotonics through one or more of the following areas: technology developments; clinical or translational breakthroughs; and regulatory or agency-level impacts. Nominees may include up to three individuals—the award's acknowledgement of the importance of collaborative efforts—who must be identifiable leaders of the work being recognized. A specific event tied to the nominees and their work, such as a journal article, presentation, or agency-level action, must be associated with SPIE journals or conferences. These could include manuscripts, conference presentations, special sections, or overall impact on the SPIE community such as shaping policy that would affect SPIE researchers or programs.

With this inaugural recognition, Hong is being honored in the technology development category for "significantly advancing the field of biophotonics" based on research that he presented at the SPIE Photonics West's BiOS conference in 2025. His presentation, *Achieving optical transparency in live animals via the Kramers-Kronig relations,* demonstrated his team's success in achieving optical transparency in live animals by utilizing the light-absorbing and light-directing properties of food-safe dyes.

"I'm incredibly excited about the new award," says *Biophotonics Discovery* Editor-in-Chief Darren Roblyer, a Boston University professor in the Biomedical Engineering and Electrical and Computer Engineering departments. "It's different from other awards in our community and recognizes a contribution made within the last three years, highlighting how the award as well as the journal are capturing cutting-edge discoveries and advancements in our field. The award criteria are broad, and the recipients need not be focused solely on scientific discoveries or translational events; the award can also recognize contributions from funding and regulatory agencies, companies, and nonprofits. Guosong Hong is the perfect recipient of our inaugural award. His discovery in tissue clearing is making a big splash, and we want to recognize his important contribution."



Impactful research team: Stanford University's Guosong Hong (center) with students from his lab in this picture from 2004. Hong is the inaugural winner of the SPIE Biophotonics Discovery's Impact of the Year Award. Credit: Hong.

Hong and his team have developed a way to see organs within a body by making the overlying tissues transparent to visible light. Optical scattering—when light interacts with particles or irregularities making it deviate from its original path—is one of the main challenges in biomedical optics, so a method to eliminate its effect by reducing light-scattering and offering a more uniform light-directing approach, will have a deep and significant impact on biophotonics research and clinical translation. Hong's demonstrated process, which included a topical application of food-safe dye—specifically tartrazine, the food dye more commonly known as FD & C Yellow 5—could ultimately apply to a wide range of medical diagnostics and clinical applications, from locating injuries to monitoring digestive disorders and identifying cancers.

The award-winning research drew from two Hong-supervised projects: one of his graduate students, Nick Rommelfanger, was exploring how microwaves interact with biological tissue. Rommelfanger was also working with another member in the Hong Lab, postdoc researcher Zihao Ou, who was screening a range of absorbing molecules, trying to understand how strong absorption could change the scattering property of materials such as silica beads in an aqueous medium.

Hong, Rommelfanger, and Ou realized that it is possible to apply Kramers-Kronig relations to the optical regimes by using the resonantly absorbing molecules for homogenizing refractive indices across different tissue components. "The next day," says Hong, "at a campus café, I ran into one of my colleagues, [SPIE Fellow Member] Mark Brongersma, an expert in nanophotonics. I brought up this idea to him, and he said, 'Wow, this is really interesting! This is something worth exploring together.'" Then and there, "Mark wrote down his ideas of what experiments we should do to validate this idea on a napkin."

Many discussions followed, but, says Hong, "we knew this would work, it was just a matter of time to do the experiments. Zihao had already accumulated substantial knowledge of the dyes he studied for the other project; however, none of them worked for this idea on transparency, because although these dyes were very strongly absorbing, they had a tail absorption that would block any transparency. He would get refactor index modulation, he would get the homogenization of refractive indices, but it just wouldn't get the transparency, because absorption was too strong. Tartrazine was really unique because it has a very intense absorption, but the tail drops very quickly."

Their research has been rapidly adopted and built upon by many laboratories around the world. Two recent studies from Cynthia Toth's lab and Adam Wax's lab, both at Duke University, demonstrate that other dye molecules, such as fluorescein and indocyanine green, two FDA-approved fluorophores, can also be repurposed as clearing agents in biological tissues by following Hong's theoretical framework: "Basically, this is such a general principle that the success of this theory does not really depend on the identification of a single dye. It's really widely applicable for many, many dyes."

Hong, who received his BSci in Chemistry from Peking University and his PhD in the same subject from Stanford in 2014, joined Stanford Materials Science and Engineering and Neurosciences Institute as an assistant professor in 2018. He is the recipient of many other recognitions including the Materials Research Prize for Young Investigators from ETH Zürich; the Vilcek Prize for Creative Promise in Biomedical Science; the Presidential Early Career Award for Scientists and Engineers; the Biomedical Engineering Society's Rising Star Award; the Camille Dreyfus Teacher-Scholar Award; the NIH Pathway to Independence (K99/R00) Award; the MIT Technology Review '35 Innovators Under 35' Award; the Science & PINS Prize for Neuromodulation; the National Science Foundation CAREER Award; the Walter J. Gores Award for Excellence in Teaching; and the Rita Allen Foundation Scholars Award.

"This particular award means a lot to me," says Hong, who is excited by the myriad possible applications of the research, from noninvasive diagnostic imaging of deep-seated skin cancers and more accessible venipuncture, to replacing the need for corneal transplants. "I originally trained as a chemist, and I've worked a lot on nanomaterials and their physical and chemical properties rather than in biophotonics. But I'm so glad that last year Shy Shoham invited me to give a talk on this topic at SPIE Photonics West. From the research, from my presentation, I received this award, and I'm very honored. It says that our research, although it originated from a different insight, from the electromagnetic-tissue interaction, has had an impact beyond what we originally set out to achieve, reaching a broader community and benefitting more research directions."

DANEET STEFFENS

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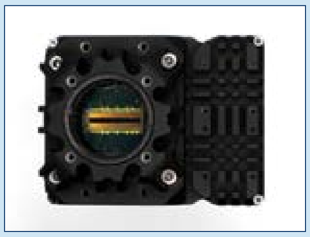

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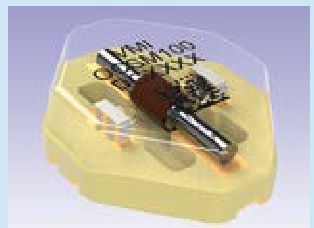

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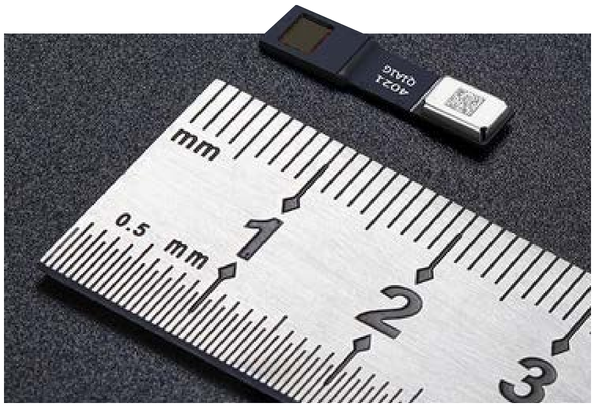
2026: A make-or-break year for microLEDs?

Yole Group analysts explain why the emerging market for microLED displays is at a critical moment, and progressing down two distinct technological paths.

Garmin's new Fenix 8 watch is available in a range of different sizes and technology formats, with a microLED-on-TFT display used to illuminate the largest, 51mm-diameter version to provide state-of-the-art brightness for improved daylight visibility. However, that upgrade comes at a significant cost, with Garmin pricing the microLED version at $2,000 initially, $800 more than the OLED-based equivalent. Credit: Garmin.

In February 2024, Apple sent shockwaves through the displays industry when it cancelled its planned use of microLED displays in future smartwatches, with key supplier ams Osram forced to shutter the state-of-the-art facility in Malaysia that would have been dedicated to that supply agreement.

But interest in microLEDs has not disappeared, and 2025 saw new venture funding for the UK's Plessey Semiconductor and California-based Mojo Vision, amid optimism that microLED display shipments could soon take off, initially in extended reality displays.



China's Jade Bird Display (JBD) is currently the key supplier of microLED-on-silicon displays for AR glasses, and recently teamed up with RayNeo and Applied Materials to develop full-color waveguide AR glasses with improved brightness, color, and image uniformity. Credit: JBD.

Then, in September 2025, Garmin revealed a new version of its high-end Fenix 8 smartwatch featuring a microLED display. Retailing at just a penny under $2,000 as of Black Friday, it features no fewer than 400,000 individual LEDs, and is being hailed by Garmin as "the brightest smart watch ever built."

So are microLED displays destined for a bright future or not? *Show Daily* asked analysts Raphaël Mermet-Lyaudoz and Eric Virey from the market research firm Yole Group about the latest developments in a sector they have characterized as being at a "make-or-break" point in its evolution.

Show Daily: *Yole Group has characterized the current scenario as "make-or-break" for microLEDs: what is the current state of play?*

Yole Group: Since Apple unplugged its smartwatch project (using the microLED-on-TFT technology platform) with ams Osram, the center of gravity of the microLED industry has shifted more toward Asia. In terms of applications, the focus is now more around augmented reality (AR), using microLED-on-silicon technology. Those two platforms—microLED-on-TFT for medium to large-sized panels such as watches, televisions, and automotive, and microLED-on-silicon for AR—are two very different beasts that are now following different paths increasingly. One could succeed while the other does not.

We are at a make-or-break moment: the first commercial products for both platforms are being released, and it is time for consumers to choose whether to adopt it or not. While microLED-on-TFT products are currently limited to a watch, an exterior automotive display (both of which are manufactured by Taiwan's AUO Corporation), and a TV project at Samsung whose future is uncertain, microLED-on-silicon has now been adopted in more than 40 different pair of AR glasses—mostly monochromatic, and mostly in China.

How significant is Garmin's launch of a high-end smartwatch with a microLED display?

Embedding microLEDs in smartwatches was Apple's intention when it first brought the technology under the spotlight in 2014 though the acquisition of Luxvue. Garmin is making the jump in 2025 using an AUO panel. The Fenix 8 microLED watch is priced at $2,000, $800 more than its premium OLED sibling, but has a significantly low battery life—a metric that Garmin users are very attached to. The microLED version however offers significantly higher brightness and wider viewing angles. The idea is to enable more convenient viewing in bright daylight, but many users seem to find that the OLED is already bright enough. The viewing angle gives a more premium look, but it remains to be seen just how much users value this feature. Garmin is aware of those shortcomings, but appears to remain committed to microLED. This is just the first iteration. There are innovations such as high-voltage microLEDs that could rapidly and significantly reduce power consumption, and these will be needed prior to releasing any new generations.

What level of commercial deployment of microLEDs do you expect to see in AR displays in 2026?

To answer this question, it is necessary to make the distinction between the US and Chinese markets, which are following different paths. The US market is led by big players like Meta and Google. Meta released its first commercial products in September 2025, and Google should follow in 2026. Both are using LCoS [liquid crystal on silicon] in their first generation of products, as it remains more mature than microLED. But in China most of the products are already based on microLEDs, for example Rokid's monochromatic glasses, and TCL Electronics subsidiary RayNeo's polychromatic version. It seems that the Chinese market is leapfrogging towards microLED—even if the technology is still imperfect—while the US market is waiting for greater maturity before adoption happens.

In short, microLEDs won't be adopted in volume in consumer products in the US next year, but rather in 2027. In China, the microLED-on-silicon market will intensify in 2026 amid global AR marketing efforts and hype.

Cost is not a primary barrier prior to this technology adoption, and for the initial product generation OEMs will sell them below cost. What matters the most to them is the readiness in terms of performance, meaning better brightness and power consumption, and the capability of the supply chain to deliver millions of units per year.

Aside from AUO, who are the key players in microLED production right now?

This depends on which platform we are talking about. For microLED-on-TFT, AUO is the frontrunner but let's not forget about Samsung, TCL CSOT, BOE, and Tianma. All are making progress—as seen through the prototypes exhibited at trade shows. For microLED-on-silicon, Jade Bird Display is currently the one and only player supplying in volume, but it should be joined in the coming years by competitors like Raxium (acquired in 2020 by Google), Hongshi, Innovision, Saphlux, Raysolve and others. All the microLED-on-silicon for AR players are investigating different architectures to deliver monolithic, single panel RGB solutions.

Some players could address both TFT and silicon platforms, for example PlayNitride, which is the current market leader in terms of die supply. Porotech has a disruptive approach for color-tunable die (one die can emit any wavelength in visible range), and Aledia is developing a nanowire-based LED whose efficiency is independent of die size. This suggests that they can achieve record efficiency with very small LEDs, which has been a major issue in the industry. They also leverage photonic crystal effects, which allows better control of the angular emission profile and also improves optical coupling efficiency into AR glasses.

continued on page 19

Claiming to be the world's lightest AR glasses, Rokid's latest designs weigh just 49 grams but manage to incorporate a 12 megapixel first-person camera, microLED waveguide displays, and integrated audio. Credit: Rokid.

microLEDs continued from page 18

Startups Plessey, Mojo Vision, and Avicena have recently gained investment: what could they bring to the industry?
Officially, Haylo Ventures acquired Plessey Semiconductor, but this move is mostly part of Goertek's verticalization strategy. The AR supply chain will mature and may look increasingly like the automotive sector, where Tier 1 companies are key players. Goertek intends to become a Tier 1 player in AR with this acquisition, plus the recent addition of two Sunny Optical subsidiaries to manufacture optical metasurfaces for diffractive waveguides, another key element of the glasses.

Startups that are investigating different LED die technologies or stack architectures, mostly in the field of microLED-on-silicon, need cash to survive until the market takes off. Mojo Vision initially developed AR contact lenses but has pivoted to focus on just the microLED-on-silicon display. The more recent round of funding was also probably helped by the emerging potential for microLED-on-silicon to be used in optical interconnects for AI data centers. This is a field that is gaining some momentum—as shown by Avicena's series B round, and Credo's acquisition of Hyperlume only six months after they emerged from stealth mode.

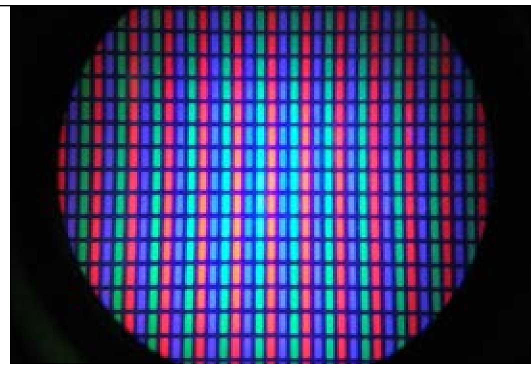
Aside from AR displays and smartwatches, what other applications represent realistic markets for microLED technology?
At Yole Group we've identified two distinct supply chains (those of Nichia and ams Osram) for automotive headlamps, and conducted a reverse cost analysis of both those modules. The automotive market represents more than 80 million vehicles annually but is very price sensitive. MicroLED-based adaptive beam headlamp technology may trickle down from the current luxury car segment to more affordable models, although this could take some time, and strong differentiation and cost are key considerations.

There's currently a lot of hype around AI data center applications, and microLED-based optical transceivers have been demonstrated by Avicena and Hyperlume. Cutting power consumption linked to the interconnects within racks is one of the top priorities in designing next-generation data centers, but there are kingmakers in this field—the likes of NVIDIA, Broadcom, and major hyperscalers—and lasers are now considered to be the emerging standard. Lasers emit coherent light, and these devices rely on wavelength multiplexing, while for microLED links multiplexing is achieved spatially with arrays of microLEDs and photodiode arrays. It is therefore a different story in terms of protocol and integration modalities—the final decision will be taken at the architecture level.

Raphaël Mermet-Lyaudoz, PhD, is Technology & Market Analyst for Display at Yole Group.

Eric Virey, PhD, is Principal Analyst for Display at Yole Group.

MIKE HATCHER



Saphlux, which claims to be the first company to mass-produce quantum-dot (QD) microLED displays, is working on AR glasses applications with Vuzix featuring its mono-green microdisplay. This image shows Saphlux's "RGB in One" chip wafer, which uses QD conversion of blue light and simplifies chip transfer and die bonding processes. Credit: Saphlux.

Sergio Leon-Saval: Astrophotonics and the development of the photonic lantern

The OPTO Plenary speaker looks to the photonics community for innovations to aid the next generation of astronomy.

Sergio Leon-Saval is Director of the Sydney Astrophotonic Instrumentation Laboratory at the University of Sydney, Australia. Credit: Leon-Saval.

Astrophotonics is part of the changing technology for astronomical observation, says Sergio Leon-Saval of the University of Sydney, Australia. But what is it exactly? In the most basic sense, he says, with astrophotonics, "we wanted to actually exploit [photonics] technologies in astronomy and change and create new technologies based on those applications to astronomical science. That's what we call astrophotonics."

For most of the modern history of photonics, telecommunications has been the driver for innovation, says Leon-Saval who is director of the Sydney Astrophotonic Instrumentation Laboratory (SAIL) as well as the university's Institute of Photonics and Optical Science (IPOS).

Now, he continues, "people are realizing that photonics is not only about telecommunications. It's not only about lasers. In astronomy, they realize that it has technological capabilities that they can use for doing science."

Still, astronomers are a conservative lot when it comes to adopting new technologies, Leon-Saval says. And it's easy to understand why. A night at a big telescope can cost upwards of $100,000. The prospect of just 1dB or 10% loss of light, for any reason, "is like a nightmare." He says his message about astrophotonics is that it can give back some of those lost photons.

One astrophotonics capability Leon-Saval developed is called the photonic lantern, a device that converts light from a multimode to a single-mode and/or few-mode system and vice versa with low loss. He talked about the device and his work in astrophotonics on Monday during his OPTO Plenary presentation.

"Despite the name, the photonic lantern is not emitting anything," Leon-Saval says. He says it's essentially a waveguide converter that can transform light from a multimode system to an array of single-mode waveguides. "The basic principle is that you need to conserve the number of modes in the system, so you conserve the entropy, and then you can get low losses. The way that you make them, the way that you do them, is by creating a composite waveguide."

Leon-Saval says development of the photonic lantern began some 20 years ago while doing his PhD work at the University of Bath with Tim Birks and Philip Russell on photonic crystal fibers and device transitions. He says astronomers had a very interesting problem to tackle, which was how to filter extremely narrow spectral lines for hydroxyl (OH). "That's a huge thing for astronomers because basically it shines to the detectors and makes them blind." Filtering with photonic fiber would allow the astronomers to see galaxies and stars farther out in the universe.

But Leon-Saval knew coupling efficiency for a fiber into a telescope was bad. "You've got aberrations. You've got an extremely large telescope, big focal plane—it didn't work. The coupling efficiencies were 1% or less."

> "People are realizing that photonics is not only about telecommunications. It's not only about lasers. In astronomy, they realize that it has technological capabilities that they can use for doing science."

He says the question became how can we make those filters inside the fiber—a fiber device that we can couple to the telescope? "So that's how, during my PhD, because I was working in fiber device transitions, we envisaged the way in which we get the multiple light from a multiple fiber, and then we divide them into single fibers; we filter them and combine them again to the spectrum. And that's how the lantern was envisaged."

Today, the photonic lantern is an essential device for astrophotonics, for example, its use in wavefront sensing. Placed at the telescope image plane it allows adaptive optics (AO) correction to be performed using the actual instrument point-spread function (PSF), rather than a separate pupil-plane wavefront sensor such as a pyramid or Shack-Hartmann device.

This has a number of advantages, Leon-Saval says, including the elimination of aberrations between the pupil plane and image plane caused by phase shears arising from thermal effects of telescope secondary-mirror supports or imperfectly phased mirror segments. Those are among the most challenging limitations in current high-contrast imaging and will be especially important for the coming generation of extremely large telescopes.

Neural network-based wavefront reconstruction can be done by training a model on a set of training data, consisting of known probe wavefronts injected into the photonic lantern using a deformable mirror or spatial light modulator, Leon Saval says. This can be *in-situ* in an AO system, he adds.

The photonic lantern can also contribute to novel science measurements. For example, Leon-Saval points out that a central challenge in high-contrast imaging, such as the search for exoplanets, is contamination of the science signal by diffracted starlight. Because the star can be orders of magnitude brighter than the science target, the photon noise from the star completely dominates the science signal beyond the possibility for post-processing repair. He says at some point it becomes difficult for coronagraphs to decrease their inner working angle to reveal objects, and that "nulling" is one alternative. It uses destructive interference to remove contaminating starlight. While usually implemented using bulk optics or in photonic chips, he says the same principle has been achieved using a single mode fiber and a pupil plane mask.

But a similar process can be performed using a mode-selective photonic lantern that, rather than having the input modes and output SMF amplitudes related by mixing as per some transfer matrix, maps a specific input mode to a specific output SMF. This allows creation of a photonic lantern nuller. An off-axis object such as a planet will preferentially couple into these modes, and thus the measurement of the leakage of light into these modes can give a high SNR measurement of the off-axis science target.

A major goal with the photonic lantern, Leon-Saval says, is to enable full-imaging capability beyond the diffraction limit. By completely measuring the complex PSF, the device will be able to distinguish between real structure and artifacts from seeing and undo the effects of seeing to produce an uncorrupted image. But getting there will require innovation beyond current systems, including developing sufficient degrees of freedom to unambiguously measure phase and amplitude, the ability to also measure spatial coherence, sufficient spatial elements to image desired field of view, and innovative data analysis and image reconstruction algorithms.

Eight or nine research groups around the world are engaged in astrophotonics research, and it is in the plans of both US and Australian astronomers, Leon-Saval says. "We want to exploit these technologies in astronomy and change and create new technologies."

For applications beyond astronomy, Leon-Saval says, "we're working on the whole concept of waveform sensing, imaging, and also laser coherent addition." In the same way a photonic lantern can measure a complex image at the focal plane of a telescope, "you can now distinguish between two sources that are below the diffraction limit. You can reconstruct that image because you can get that information."

The technology is also applicable to laser communications, he says, "and we're now working with the US Air Force. We can shape that beam to propagate in the atmosphere—but it's all related to the capability of these devices that were invented merely as a way of dividing the light into single-mode waveguides. Now we've transformed that technology into something more."

WILLIAM G. SCHULZ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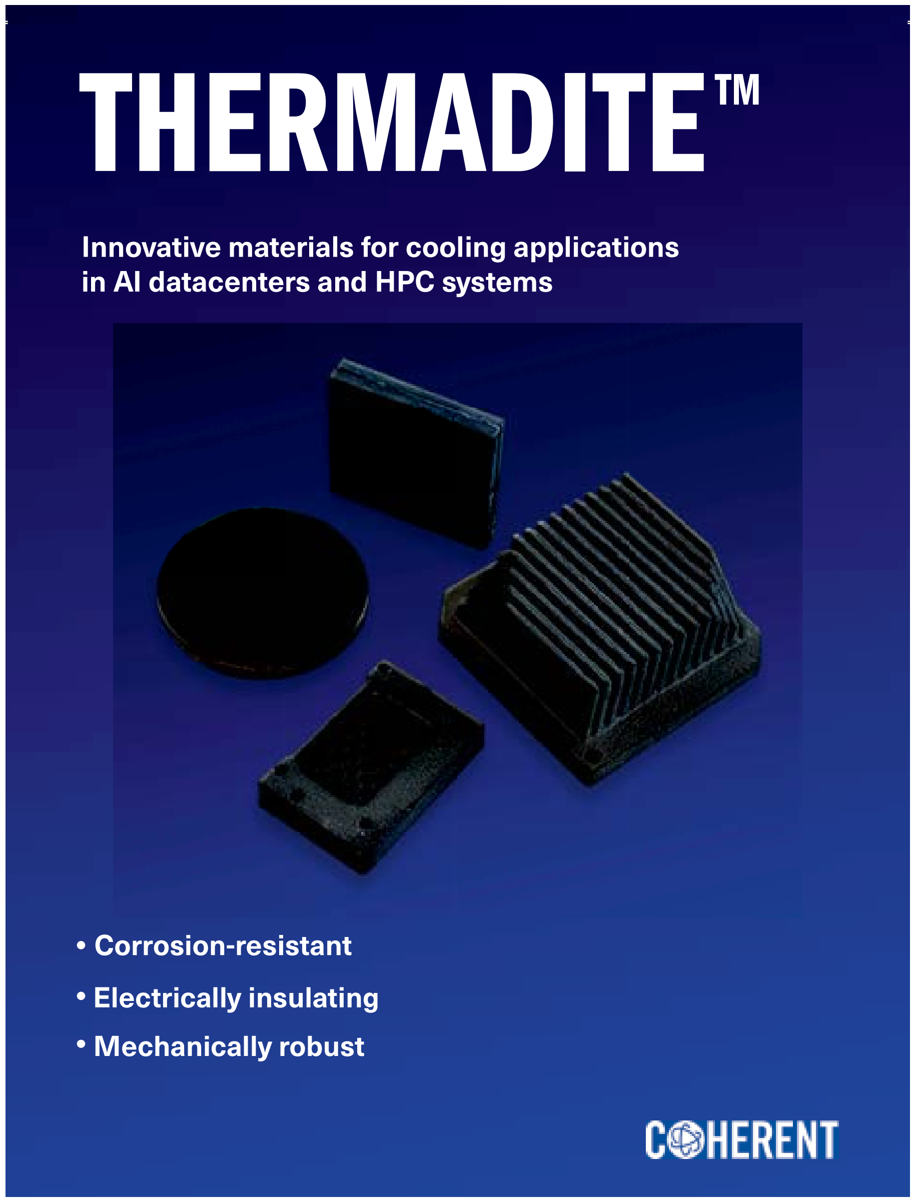
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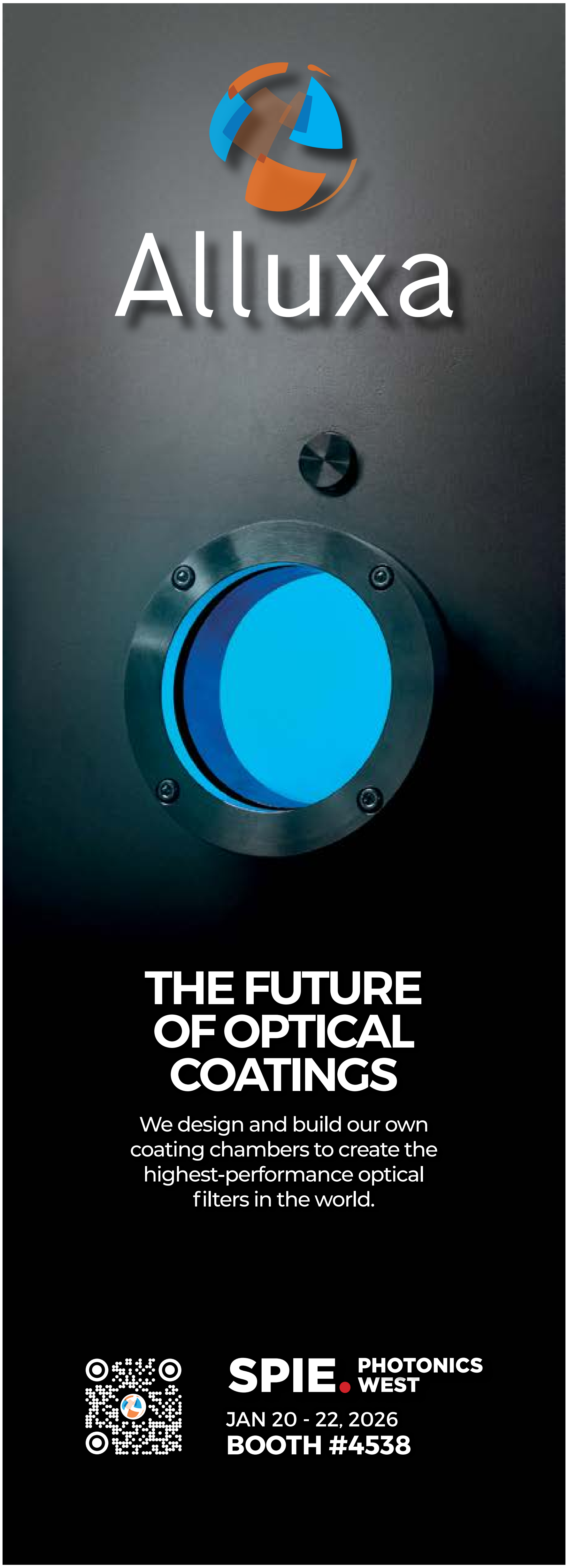
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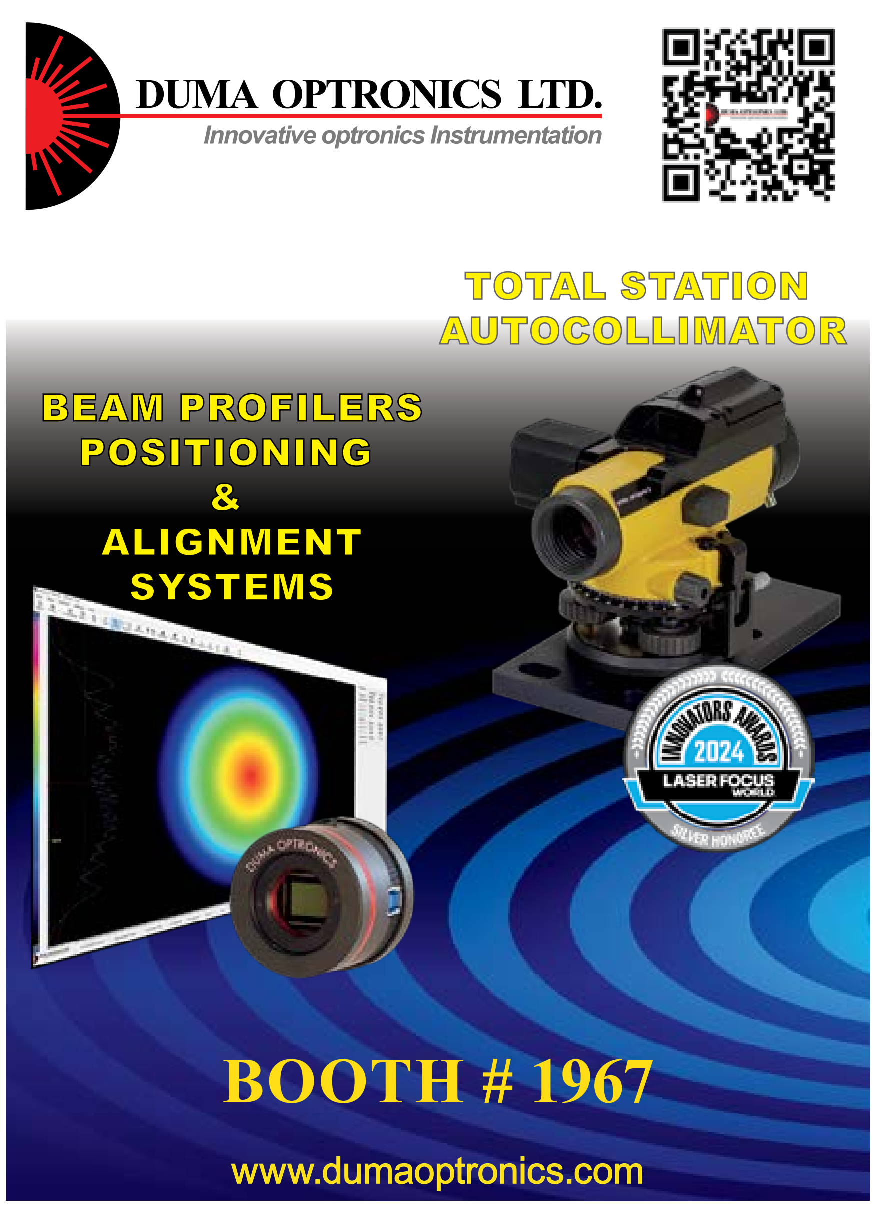
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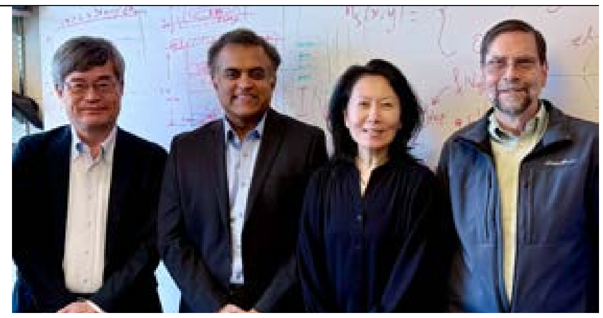
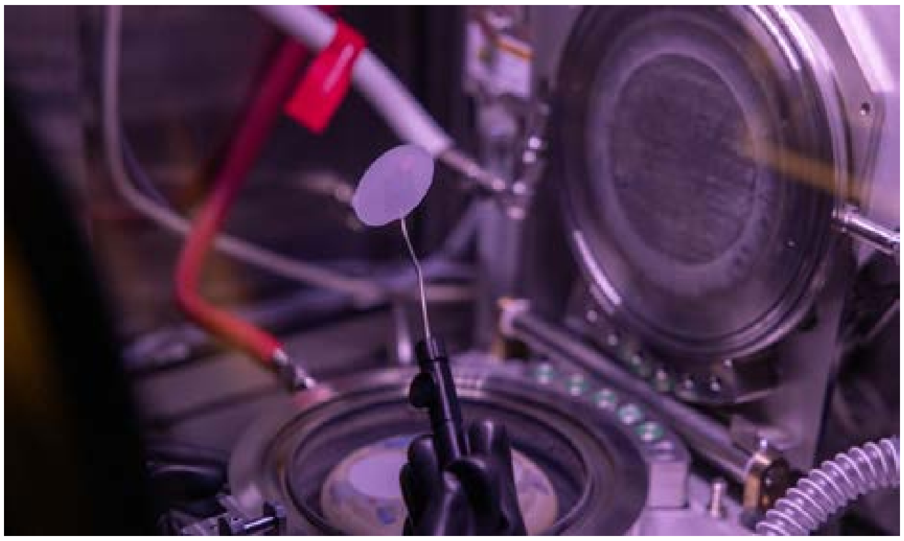
The long road to deep-UV light

More than two decades of wide bandgap engineering delivered the all-but-impossible deep-UV laser. So will far-UVC be next?



Driving deep-UV forward: Debdeep Jena (2nd left) with colleagues (left to right) Hiroshi Amano, Huili (Grace) Xing and Leo Schowalter. Credit: Debdeep Jena.

As a grad student at the University of California, Santa Barbara (UCSB), in the early 2000s, Debdeep Jena didn't believe a deep-ultraviolet semiconductor laser would ever be realized in practice. His early experiments on III-V nitride semiconductors showed that these electrically insulating, wide bandgap materials could be combined and manipulated to conduct electrons, indicating they could be exploited in high-power radio frequency electronics. However, this result also raised the tantalizing prospect that electron opposites—holes—could be created in these materials, which could combine with electrons and emit ultraviolet light.



Custom-MOCVD, recently installed at the Duffield Hall Lab, Cornell: Debdeep Jena can make GaN- and AlN-based devices using either MOCVD or MBE. Credit: Cornell.

By that time, Professors Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura, had coaxed blue light from GaN by doping the material with silicon and magnesium—work that earned them the 2014 Nobel Prize in Physics for blue LEDs. So Jena found himself wondering: could shorter-wavelength ultraviolet be generated too?

"To be frank, we honestly thought this is never going to happen—it had taken half a century to discover how to make holes in gallium nitride before the blue LED [was realized] and we knew the same doping method would not carry over to ultraviolet light," he says. "But having created electrons meant there could be light at the end of this tunnel."

Jena's OPTO plenary, *Deep-UV photonic devices enabled by distributed polarization doping*, on Monday morning was living-proof that there was very bright light at the end of the deep-UV tunnel. So how did he and colleagues create it?

Toward UV

During the 2000s, researchers had discovered that stacking two distinct wide bandgap materials, such as GaN and AlN, on top of each other, induced electrons at the interface due to the mismatch in polarization of the different semiconductors. This polarization discontinuity—in effect a break in the electronic symmetry of the AlN/GaN heterostructure—created an electric field and the ensuing electron layer, also known as a 2D electron gas.

Jena and UCSB colleagues were keen to exploit this broken symmetry effect and pioneered distributed polarization doping (DPD) in which the composition of semiconductors, such as AlGaN or AlN/GaN, would be gradually graded to impart a continuous change in polarization across the material. This spatial gradient in polarization would create an internal electric field that ionizes the charges within the semiconductors to create holes or electrons. These charge carriers would then be swept across the spatial gradient—all without adding chemical dopants. "This key advance has led to the development of vertical devices in ultrawide bandgap AlGaN semiconductors," highlights Jena.

With their DPD approach in tow, Jena and colleagues went on to develop GaN- and AlN-based heterostructures with large built-in electric fields and high charge carrier densities. Polarization-doped field effect transistors swiftly followed, and, in 2009, the researchers reported how they had succeeded in creating holes for the first time using DPD in magnesium-doped AlGaN heterostructures, in *Science*. Crucially, they also demonstrated the first use of DPD in ultraviolet LED structures.

Development continued apace, and a decade later, Jena and Cornell colleagues, including Professor Huili (Grace) Xing, were able to use polarization doping to create, for the first time, a 2D hole gas in epitaxially-grown GaN on AlN—with no actual dopants at all. "We published these results in *Science* in 2019—which I'm personally very proud of," says Jena. "As a graduate student I had wondered if this would ever be possible—the physics was very clear in 2003, but it took nearly 20 years to practically realize it."

A cleaner crystal

Just after Jena's dopant-free 2D hole gas breakthrough, Nagoya University Professors, Hiroshi Amano, now a Nobel laureate, and Leo Schowalter—also chief technology officer of Asahi Kasei-owned Crystal IS—used the DPD approach to deliver the first electrically-pumped deep-UV lasers. As Jena highlights, their promising results were also due to their ability to grow good quality AlN crystals. Epitaxially growing layers of AlN on native substrates had always been hampered by difficult-to-remove impurities on the wafers that led to polarity inversion and defect formation during materials growth. To take crystal purity further, Jena, Xing, and Schowalter joined forces to pioneer aluminium-assisted cleaning, widely used today to grow very high quality AlN on native crystals.

The method comprises Al deposition followed by desorption at high temperatures to remove impurities from large-area substrates. As part of the process, Al is sprayed onto the AlN substrate during epitaxy to react with substrate impurities and form a volatile

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Astronomy and meteorites offer solution to space-laser challenges

Zoran Sodnik describes a way around atmospheric turbulence and clouds that disrupt optical communications.

Ask Zoran Sodnik to describe the challenges that remain in using optical rather than radio frequency technology to communicate with space satellites, and he will deliver an ironic take on the famous Star Trek phrase.

"The final frontier is not deep space, it is not Alpha Centauri, it is not another galaxy," says Sodnik, an optical communications expert who consults for the European Space Agency. "The final frontier is going reliably through the Earth's atmosphere."

To put it another way: reliable optical communications between satellites orbiting above Earth's atmosphere is, relatively speaking, easy. There is little interference that blocks the transmission of optical signals from one satellite to another.

But want to use optical technology to transmit between any of those satellites and a ground station on Earth? It's a great idea, given that radio waves, used in today's broadcast, internet, and other satellite-to-Earth applications, are reaching their capacity limits. Using optics would open up all sorts of bandwidth.

This 589nm sodium laser beam at the European Space Agency's optical ground station in Tenerife is creating an artificial star to help reveal and correct distortions in communication signals. The technology is still in the research stage. It is inspired by the proven sodium guide star technology that astronomers use to correct distortions in images caused by atmospheric turbulence. Credit: European Space Agency.

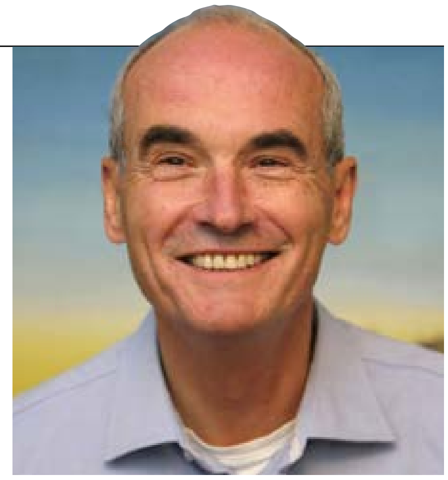
The thing is—for reasons that are close to Earth involving things like clouds and atmospheric turbulence—it cannot be done reliably. Not yet anyway.

Never fear. As Sodnik explained on Monday in his LASE plenary talk, *Optical communication in space and its final frontier,* there are several tools that could eventually crack this problem. Perhaps the most intriguing of them is the use of a laser operating at the sodium wavelength of 589nm—not as a communication channel per se, but as a measurement device to address one of the main issues currently bedevilling Earth-to-satellite optical communications: atmospheric turbulence.

As a quick review, atmospheric turbulence is the disturbance caused by the sun's uneven heating of the Earth's surface; the heated air rises and dissipates into eddies, each of which refract light differently and at varying speeds. It's what causes stars to twinkle, and it wreaks havoc on any attempt to reliably transmit optical signals through the atmosphere.

"It will give you data errors due to outages, fades, and surges," says Sodnik. "It makes the light you receive strongly change in irradiance" (meaning that the power of the signal can fluctuate wildly).

As there is no stopping atmospheric turbulence, the next best thing would be to correct for it using adaptive optics.



Zoran Sodnik. Credit: European Space Agency.

And that is what Sodnik is working on, with different solutions for uplink and downlink transmissions. Neither will be easy, especially the uplink side, which is where the 589nm laser comes in to play.

Answer is in the stars

The good news regarding 589nm lasers is that astronomers already successfully use them and their orange/yellow light in a manner that Sodnik and other space optics experts want to replicate for satellite communications.

Astronomers shoot 589nm light into the edge of the atmosphere known as the mesosphere, roughly 80-to-100 kilometers above Earth; it's where meteorites deposit sodium gas. The laser light makes the sodium gas glow (similar to conventional sodium streetlights, in which electricity excites sodium gas into its orange/yellow color), creating an artificial star which is also known as a sodium star, a sodium guide star, or a laser guide star.

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Deep-UV light continued from page 23

oxide that evaporates on heating. Jena, Xing, and colleagues, including Yongjin Cho, now at Paul Drude Institute for Solid State Electronics, Berlin, but then at Cornell, discovered that repeating this deposition-desorption cycle just once removed 20% of the impurities. What's more, cycling through the process tens and tens of times, they could eventually remove all impurities from the substrate. The impact on materials and device development has been profound.

"Aluminium-assisted cleaning enabled us to employ distributed polarization doping in many, many more ways than we could before," highlights Jena. "We had already created [charge carriers] in our materials using distributed polarization doping, but for example, the 2D hole gases that we create using aluminium-assisted cleaning as well have much better transport properties as the crystal quality is so much better."

With distributed polarization doping and aluminium-assisted cleaning established, the development of GaN- and AlN-based wide bandgap semiconductors has proceeded rapidly. Using molecular beam epitaxy at Cornell, Jena and colleagues have fabricated myriad high power electronics devices, including resonant tunnelling diodes and p-n diodes. However, as Jena emphasizes: "There is no reason we can't make devices with other epitaxy techniques such as MOCVD (metal-organic chemical vapor deposition), which in some cases may be more practical for mass production." Indeed, Cornell recently installed a custom-MOCVD system, designed with AIXTRON, to develop epitaxy growth processes for LEDs, power, and RF devices that can be translated to industry.

Jena and colleagues also recently exploited the broken symmetry of GaN-based semiconductors to forge a new field called 'dualtronics' and develop dual-sided chips. Here, both faces of the semiconductor wafer are used to fabricate functional devices—HEMTs on one side and LEDs on the other.

And with a view to driving ultraviolet light ever further forward, Jena has also teamed up with researchers from ultrawide bandgap and far-UVC device firm, Visium UltraLabs, where Schowalter is now CTO. Visium and other industry players are already manufacturing short-wavelength, UV-C devices that typically emit light at around 254 nm and lower to disinfect water and surfaces. However, the researchers are also keenly eyeing far-UVC light, with wavelengths around 222 nm—now known to inactivate pathogens, such as the superbug MRSA and coronaviruses, without harming people.

"There are some very big issues with far-UVC LEDs and lasers, including the fact that they degrade over time—efficiency isn't that high to start with but after running the device for a few hours, it drops to near-unusable values," says Jena. "So we're investigating the science behind this and are looking at new ways of doping the AlN crystal beyond distributed polarization doping."

According to the researcher, to date, far-UVC devices have been fabricated at relatively high temperatures using MOCVD, which can create large numbers of defects. However, MBE offers a lower temperature growth route that might reduce defect numbers and improve device lifetime. "We're also looking at new heterostructures, so there's a real mix of approaches here," he adds.

Given their far-UVC focus, is Jena hopeful that a practical device could be realized soon? In short, yes. "I tend to be optimistic but if I was to predict this, I'd say it's not going to take more than five or six years from now," he says. "The development of UV semiconductor LEDs and lasers is a really good example of persistence and collaboration from around the world. Far-UVC devices are now the final frontier for photonic devices."

REBECCA POOL

Dragonfly-inspired: How neuromorphic sensors are transforming space imaging

Gregory Cohen of Western Sydney University explains why mimicking nature could solve space's toughest imaging challenges.

"Animals are capable of completing far more complicated visual tasks than even our most sophisticated systems, and they do so using a fraction of the power that machines use," says Gregory Cohen, professor of neuromorphic systems and director of the International Centre for Neuromorphic Systems (ICNS) at Western Sydney University.

"Our favorite example is probably the dragonfly, as they are incredibly accurate and effective hunters. They prey mostly on mosquitoes and are ruthlessly efficient at catching them. The interesting thing is that they don't go to where the mosquitos are but rather intercept them by predicting where they are going to be. This is an incredibly difficult visual task, and something that we struggle to do with modern imaging systems and high-end CPUs and GPUs. However, the dragonfly seemingly can do this with a tiny brain, a terrible vision system (relative to ours), and using almost no power. Clearly, the dragonfly is doing it the easy way, and we're doing it the hard way."

Gregory Cohen of Western Sydney University in front of the Astrosite—a mobile neuromorphic telescope observatory used to track satellites and space junk. Credit: Western Sydney University.

Cohen and his team at ICNS use neuromorphic systems for monitoring satellites and space junk, looking for atmospheric phenomena, and high-speed tracking and detection. On Wednesday, Cohen will present *Biology-inspired sensors for space—why a biological approach makes sense,* highlighting how neuromorphic sensing can be used to solve real-world problems in space imaging.

Why mimicking nature works

"We are not trying to recreate biology," Cohen explains. "We don't want to build a dragonfly but rather understand how its vision system is perceiving the world and how its brain is computing that information."

ICNS's work with neuromorphic engineering involves figuring out how to build systems that match the robustness, reliability, and power efficiency of biological systems. They then build real-world systems that use those principles to tackle problems like tracking satellites, tracking wildlife, and even detecting objects passively underwater.

"The most exciting part of my work is discovering new applications and uses for neuromorphic sensors," says Cohen. "We often go out and record anything that we can, and often we discover things that we never expected. For example, we once recorded lightning, more for fun than anything else, only to discover that neuromorphic sensors are absolutely perfect for lightning imaging and can even outperform the most expensive high-speed cameras."

The trick is that most sensors are not specialized for a task, which means that they capture far more data than is often necessary. This means more data to process, to store, and to transmit. This often consumes an enormous amount of energy and slows down the entire system. Neuromorphic vision sensors, for example, can offer all the benefits of a high-speed camera in some applications, without all the costs in terms of data bandwidth and power consumption.

"An issue with neuromorphic engineering is that the term has become quite broad, which makes it often difficult to

continued on page 27

Sodnik continued from page 24

Atmospheric turbulence distorts the sodium star's light as it travels to Earth, where it is received. Astronomers use adaptive optics to compensate for those distortions in Earth-based telescopes in order to correct what would otherwise be distorted images from space.

Sodnik is doing the same thing. But rather than correcting images from space—as astronomers have been doing for about 40 years—he is correcting optical communication signals going into space.

The idea is to operate adaptive optics in reverse, a process is known as "predistortion." By knowing the optical distortions from the sodium guide star, engineers pre-distort the optical signal from ground in a reverse manner such that the same atmospheric turbulence that roughed-up the 589nm laser light will pummel the optical signal back into the correct shape on its way up to the satellite.

The speed of the adaptive optics and computer technology is much faster than any changes in atmospheric turbulence, assuring that the predistortions will still be valid, Sodnik notes. Whereas corrections happen in a multiple kilohertz timeframe—thousands of times per second—atmospheric distortions occur at up to 200-to-300 times per second—a comparative snail's pace.

Sodnik and others have done this experimentally at various observatories around the world. Sodnik is currently working on it through an ESA funded project at three different observatories in Greece. Plenty of challenges remain before the technology can be proven to work well in optical communications, especially at the 99.9% reliability rate that Sodnik notes should be the standard for telecommunication applications such as broadcast and internet services.

"There's a lot to be done," says Sodnik, who now consults for ESA after retiring in 2024, following a long career there as an optical communications engineer.

Daylight robbery

One big problem is that artificial stars, for all their effectiveness in nighttime astronomy, are hard to see in daytime as required for satellite communication purposes.

"Artificial stars are quite dim," notes Sodnik. "How do you observe an artificial star in daylight? If you cannot work in daylight, you will have difficulty reaching 99.9% availability."

While the uplink method involving the use of sodium stars is unproven, the downlink side of the solution is already much more reliable, according to Sodnik.

Optical communication signals traveling from satellites down to ground stations are strong and because atmospheric distortions happen close to the receiver they are easier to correct. A wavefront sensor measures the distortion of an arriving signal and a combination of deformable mirror, computer, and actuators (the components of adaptive optics) then apply the opposite deformation, which reshapes the optical wave back into its correct form.

The technology "can instantly correct and apply the opposite distortion that the atmosphere has on the beam, and smooth out the beam," Sodnik explains.

Unfortunately, the same method does not work for uplinks because the "point ahead" angle required to transmit from a ground station to a faster moving satellite invalidates using the downlink information for uplink corrections.

This is where the sodium laser comes into play. Its beam is transmitted with the point-ahead-angle applied such that the light coming back from the sodium star contains the correct information on the pre-distortions required for the uplink signal.

"On the downlink we know how to solve the issue," says Sodnik. "On the uplink, we think we do, but we have not proven its effectiveness and reliability yet. The uplink is much more difficult, because the distortions happen at its source, and when it reaches the satellite you cannot correct."

Short of atmospheric turbulence, what are some other challenges?

"Clouds are a no-no," says Sodnik. "Clouds completely prevent you from transmitting optics." Here, though, there is a convenient solution: in any constellation of communication satellites, there will almost always be one that has a clear view down to an Earth station. If clouds block one satellite, then simply use optical signals to transmit to another with a cloud-free path to an Earth station.

That infrastructure does not yet exist, but is certainly achievable. "If we only had clouds to worry about, we'd all be happy," says Sodnik. "But we have to tackle another problem—atmospheric turbulence."

He thinks it could take another ten years. But once it's solved, then optical satellite communications can reliably go where no optical satellite communications has ever reliably gone before: to Earth.

MARK HALPER

Dragonfly continued from page 26

understand what we mean by neuromorphic engineering," says Cohen.

One of the biggest challenges Cohen and his team face is that the neuromorphic approach often requires a fundamentally different way of thinking about and approaching the problem. This is often perceived as risk, and ICNS often has to work with collaborators to showcase and demonstrate the value that their technology can bring. However, they have an impressive 12-year track record which makes it easier to get the attention of industry and government, and the technical knowhow and expertise to build and demonstrate proof-of-concept systems to help people understand this technology.

ICNS on the ISS

ICNS's Falcon Neuro and Falcon ODIN, the first operational neuromorphic sensors in orbit, are currently deployed on the International Space Station (ISS). Developed in equal partnership with the United States Air Force Academy, these sensors are designed to explore atmospheric phenomena like lightning and sprites. So far, they've discovered much more and have led to several exciting space-based applications of neuromorphic sensors.

"The neuromorphic instruments on the ISS have shown that they can do things that conventional sensors simply cannot do," says Cohen. "We have shown that our sensors can be used to track satellites and space-junk from orbit, used for high-speed Earth imaging, and even used for satellite inspection and rendezvous operations."

Neuromorphic sensors offer high-speed imaging, low data rates, and high-dynamic range, which are the holy grail for space-based systems. They work while in motion, whereas most sensors require stability, which is a huge benefit as everything is always moving relative to one another in space. Their ability to image at low data rates makes them perfect for use in distant and extreme environments, where reliability and on-board decision-making are critical.

Cohen is credited with creating the field of neuromorphic space imaging, which has made up the bulk of his research career. "I'd love to say that imaging space was one of the first thing that I tried with neuromorphic sensors, but it was about the 20th idea," Cohen explains. After completing his PhD in France, he left a lab filled with mathematicians who were exploring fundamental computer vision algorithms with neuromorphic imaging sensors and returned home to Australia, where he was the only vision researcher in his group. It was then that he started looking for applications for neuromorphic sensors. After trying everything from mining applications to sleep and health tracking, he put the sensors on a telescope. "We were blown away with what we were able to see and to do," says Cohen.

Cohen jokes that he was not burdened with knowledge or expertise when it came to applying neuromorphic engineering to space imaging. He had never really worked with telescopes before trying out his sensors on one. This may have helped the situation as neuromorphic engineering often works best in situations where conventional cameras struggle or fail. "For space imaging, I moved the camera to see things whereas everyone else was working as hard as possible to remove every bit of motion or vibration," says Cohen.

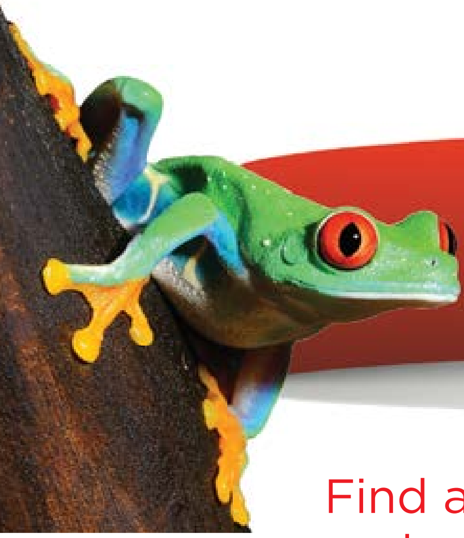
The neuromorphic approach

When explaining neuromorphic sensing, Cohen puts it like this: "If you are trying to do a task with a camera, then you are probably using the wrong sensor, and you should look to use a neuromorphic approach. If you are trying to take a picture because you don't know what data you need, then don't use a neuromorphic sensor, use a camera."

While Cohen would like to see more researchers using neuromorphic sensors and neuromorphic approaches, he notes that the ease with which one can get a neuromorphic sensor often leads to people capturing some data and then using conventional techniques to process it. "This never really works and leads people to conclude that the sensors don't work," says Cohen. "Often, the sensors *are* working, the problem is understanding the data and how to work with it. That's what we have specialized in over the past 12 years, and something that I would like to disseminate throughout the research community."

At Photonics West, Cohen will share with attendees the potential and successes of neuromorphic engineering. "I would like them to know that there is an entire community that wants to see this research succeed and that is more than happy to help and work with people to solve problems. We are a community with great ideas and novel solutions looking for interesting problems to solve."

KAREN THOMAS



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18 January 2026 • 8:00 AM - 9:00 AM

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Panel: Women in Emerging Tech
19 January 2026 • 9:45 AM - 10:25 AM

Lightning Talk: Career transitions: from early career researcher to leading a lab
19 January 2026 • 10:45 AM - 11:15 AM

Women in Optics Panel: Lessons Learned
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BiOS Student 3-Minute Poster Presentations, sponsored by JBO, BIOS, and Neurophotonics
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Vision Tech Morning Market Session: Growing your Vision Tech Business in 2026 and Beyond
20 January 2026 • 8:45 AM - 9:45 AM

Vision Markets (Germany)

African Photonics Hour
20 January 2026 • 10:00 AM - 11:00 AM

Lunch & Learn - Leadership
20 January 2026 • 12:00 PM - 1:00 PM

Green Cards for Scientific Researchers
20 January 2026 • 2:45 PM - 4:00 PM

Career Sparks: Rapid-Fire Talks for Professional Growth - Tuesday
20 January 2026 • 1:30 PM - 2:30 PM

Green Cards for Scientific Researchers
20 January 2026 • 2:45 PM - 4:00 PM

AR|VR|MR Optical Design Challenge
20 January 2026 • 6:00 PM - 7:00 PM

GenAI's New Role in Scientific Discovery and Dissemination
21 January 2026 • 10:15 AM - 11:45 AM

Lunch & Learn - Skill-building and Workforce Development
21 January 2026 • 12:00 PM - 1:00 PM

Career Sparks: Rapid-Fire Talks for Professional Growth - Wednesday
21 January 2026 • 2:00 PM - 3:00 PM

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Jen Wilson, Jen Wilson International, LLC
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Monday 19 January 2026 . . . . .12:00 PM - 4:45 PM
Tuesday 20 January 2026 . . . 10:00 AM - 4:45 PM
Wednesday 21 January 2026. 10:00 AM - 4:45 PM

SPIE Job Board Station
Looking for a change, or just want to see what's out there?
Peruse available jobs on the online SPIE Job Board.

Sunday 18 January–Wednesday 21 January
10:00 AM - 5:00 PM

Mock Interview Station Office Hours
Room 2000 (Moscone West, Level 2)

Meet one-on-one with an expert to talk strategy to stand above the rest at your next interview.

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Tuesday 20 January 2026 . . .10:30 AM - 12:00 PM

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Come peruse career-building books at our Little Library!
Feel free to hang out, read, and get inspired by our collection.

Sunday 18 January–Wednesday 21 January 2026
10:00 AM - 5:00 PM

Resume Review Stations
Liz Helton and Julia Holian, resume writers and career strategists for Career Transformation Partners, are offering free, first-come, first-served resume reviews.

Monday 19 January 2026 . . . . 10:00 AM - 4:45 PM
Tuesday 20 January 2026 . . . 10:00 AM - 4:45 PM

Free Professional Headshots
Come get a professional portrait taken to update your SPIE profile, social media pics, or your resume.

Monday 19 January 2026 . . . . .12:00 PM - 4:30 PM
Tuesday 20 January 2026 . . . 10:00 AM - 4:30 PM
Wednesday 21 January 2026. 10:00 AM - 4:30 PM

Career Speed Mentoring
19 January 2026 • 2:30 PM - 3:30 PM

Immigration Lawyer Station
Marco Pignone, Immigration Lawyer at Getson & Schatz, P.C.
Tuesday 20 January 2026 . . . 10:00 AM - 4:45 PM
Wednesday 21 January 2026. 10:00 AM - 4:45 PM

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Gold for Giger

Medical imaging pioneer Maryellen Giger is the recipient of the prestigious 2026 SPIE Gold Medal.


Maryellen Giger (far right) with labmates at the University of Chicago. Credit: Maryellen Giger.

One of five children—and the only girl—Maryellen Giger, the 2026 recipient of the SPIE Gold Medal, had an early love for problem-solving. "As the only girl, I did everything," says Giger. "I did math and science. I did baton-twirling and ballet. I did Girl Scouts and 4-H. But I was always math and physics minded, and I worked on many brain teasers—gifts from my parents."

During college at Illinois Benedictine College, Giger discovered medical physics through an early mentor, Rose Carney, and from working at Fermilab for three summers. A master's degree at the University of Exeter in England followed, where Giger pursued a project focusing on the digital analysis of electrocardiograms for SIDS (sudden infant death syndrome). She then did her doctoral work at the University of Chicago in medical physics. It was, she says, "a perfect fit: I really like trying to figure out the problem, and medical physics was a physics area where I could see my efforts hopefully impact humanity while I was alive, as opposed to, for example, astrophysics or particle physics."

Imaging, Giger found, was very mathematical and during her PhD studies—with advisors/mentors Kunio Doi and Charles Metz—in the early-mid 1980s, film was starting to go digital, a paradigm shift embraced rapidly by the imaging community. "How does that affect humans detecting disease when we go from film to digital image?" Giger asks rhetorically. "We were looking at resolution, at noise, and at signal to noise ratio." In fact, medical imaging continued to lead in a range of optics-related technologies that are now applied widely.

Then as a post-grad student and faculty member, Giger was part of the Univ. of Chicago leadership group developing computer-aided diagnosis—"basically AI as an aid to radiologists"—leading to computer-aided detection (CADe) methods that were later licensed to R2 Technology, Inc, becoming the first FDA approved computer-aided detection system.

In addition, Giger was a cofounder, equity holder, and scientific advisor of Quantitative Insights, Inc. (QI), which started through the Univ. of Chicago's 2009-2010 New Venture Challenge, building on research from the Giger lab. QI produced QuantX, which, in 2017, through the de novo process, became the first FDA-cleared, machine-learning-driven system to aid in cancer diagnosis (CADx). In 2019, QuantX was named one of *TIME* magazine's inventions of the year.

Integral to that pioneering work, Giger, now the A.N. Pritzker Distinguished Service Professor of Radiology, Committee on Medical Physics, and the College at the Univ. of Chicago, is highly regarded as a leader in the fields of computer-aided diagnosis, quantitative imaging, radiomics, deep learning, and radiogenomics. Her research focused on developing AI methods now known as radiomics, deep learning CNNs, and transfer learning embeddings; many years before those terms were coined. She is one of a handful of scientists who shaped the field of computer-aided diagnostics in medical imaging in the mid-1980s through present day: The work of those Univ. of Chicago scientists has grown into a multi-billion-dollar AI industry.

Giger is also the contact principal investigator of the National Institute of Biomedical and Bioengineering's Medical Imaging and Data Resource Center (MIDRC), a recent effort bringing together the latest medical-imaging professional organizations—including the Radiological Society of North America, the American Association of Physicists in Medicine, and the American College of Radiology—in order to harness the powers of AI and medical imaging, a project which received a 2023 DataWorks! Prize Distinguished Achievement Award. MIDRC (midrc.org) has already ingested over half a million imaging studies from medical institutions across the US, making these diverse and curated imaging data as well as various algorithms and resources open to all investigators.

An SPIE member since 1982 and SPIE Fellow since 2014, Giger—who began attending SPIE Medical Imaging conferences as a student in the 1980s—was one of the founding chairs of the Computer-Aided Diagnosis Conference at SPIE Medical Imaging and the inaugural editor-in-chief of the *Journal of Medical Imaging*. She has served on multiple SPIE committees and was a member of the SPIE Board of Directors from 2012-2014. In 2018, Giger held the role of SPIE President. In 2021, Giger received the SPIE Directors' Award, and in 2022 she was the recipient of the SPIE Harrison H. Barrett Award in Medical Imaging.

Across a career of numerous accolades, other recognitions for Giger include her election into the National Academy of Engineering in 2010; receiving the American Association of Physicists in Medicine's William D. Coolidge Gold Medal in 2015; and a Univ. of Chicago Biological Sciences Division Distinguished Faculty Award in 2021. Giger also remains proud of her pioneering role in AI and medical imaging, its development, translation, and implementation, as well as the work she did lecturing on the topic, "discussing issues of development and bias and where it can go wrong, where one wants to be aware, as well as imparting that knowledge to students," says Giger. "Sharing what we've learned with students is so important!" An avid mentor to others, Giger typically takes five or six undergrads or high-school students into her lab each summer.

When she started attending SPIE Medical Imaging as a student herself, Giger would get quite nervous before presenting, "because you had all these brilliant people in the audience and you're giving a talk—to them!" Actually, she says, the talk part was easy; it was the Q&A part that was stressful: "All those giants would ask questions, but I survived and kept going."

It's innovativeness and a kind of resilient work ethic that continues to drive Giger—that, and a couple of sound life philosophies. "I also give two other types of talks beyond the usual scientific ones," she says. "One is on balancing life and work. I mean, I have four kids and five grandkids. The other is on how to build a lab: I think people don't think of the big picture enough. Me, I stick with the *All I Really Need to Know I Learned in Kindergarten* credo: Don't hit. Be kind. Share. Even when it comes to grants, you've got to share; you've got to play nice in the sandbox." After all, as Giger points out: "The more you share, the more you get."

DANEET STEFFENS

Endowed fund continued from page 01

nanophotonics, quantum optics, biomedical imaging, and advanced optical materials. This endowed fund marks the first of its kind for the UNC Charlotte Optical Science and Engineering program.

"Recipients of the SPIE Emerging Innovators in Optical Science and Engineering Scholarship will have an important impact on the future of optics and photonics," said SPIE CEO Kent Rochford. "These students, pursuing their doctorates in optical science and engineering, will help contribute innovation in the field across industry, academia, and government. We are delighted to work with UNC Charlotte to create these transformative opportunities for their students."

"This endowment is a powerful catalyst for our growing Klein College of Science," said Bernadette Donovan-Merkert, founding dean of the UNC Charlotte Klein College of Science. "Supporting additional doctoral students fuels the talent that will drive advances across nanophotonics, precision metrology, biomedical imaging, and quantum technologies. The investment from SPIE strengthens our momentum, expands our capacity and energizes our entire Optical Science and Engineering program. We are thrilled for what this investment sets in motion."

This agreement marks the 14th major SPIE gift to universities and institutes as part of the Society's ongoing program to support the international expansion of optics and photonics through increased educational capacity, funding of research, and the development of talent pipelines for industry.

The SPIE Endowment Matching Program was established in 2019 to increase international capacity in the teaching and research of optics and photonics. With this latest gift, SPIE has provided over $5.5 million in matching gifts as part of the program, resulting in more than $14 million in dedicated funds. The SPIE Endowment Matching Program supports optics and photonics education and the future of the industry by contributing a match of up to $500,000 per award. Proposals for the next round of consideration are currently being accepted and are due 30 April.

DANEET STEFFENS

Reshaping globalization

Show Daily interviews Samuel Sadoulet, CEO of Alio Labs.

Alio Labs is an advanced photonics manufacturer focused on high performance thin-film optics and fully automated production. The company combines its proprietary Quadrode™ thin-film deposition technology with advanced automation and metrology in Santa Rosa, CA, to enable scalable volume manufacturing. The company says its broader mission is "to help shape the next generation of globalization by unlocking the photonics industry's potential through a collaborative ecosystem where thin-film enabled technologies from industry and research institutions are scaled into real world solutions."

Show Daily: *What is the headline news from Alio Labs?*

Samuel Sadoulet: In 2025, Alio Labs moved into a new 2800 m^2 (30,000 sq ft) facility to support volume production with proprietary coating systems that extend well beyond current deposition technology. The company is part of a collaborative ecosystem serving customers worldwide in medical and life sciences, semiconductors, communications, and laser and metrology systems. We also recently announced the addition of KineoLabs, which brings complementary strengths in optical devices and early disease detection technologies. Alio Labs also welcomed UltraFast Innovations into the ecosystem, expanding capabilities in ultrafast laser instrumentation and dispersive optics.

We believe that the photonics industry will benefit from a new model of collaboration. The field remains highly fragmented, with many companies working in isolation on increasingly complex problems. Our approach is to create an ecosystem where manufacturing innovation, shared expertise, and coordinated development allow teams to solve challenges that no single organization can address alone.

Samuel Sadoulet (left) alongside Nobel laureate Ferenc Krausz. Credit: Alio Labs.

What are your future development plans for Alio Labs?

We are developing a fully automated thin-film optics fab built around our proprietary Quadrode™ plasma deposition technology. Our factory in Santa Rosa integrates mobile and fixed robotic systems that support every stage of thin-film manufacturing including deposition, cleaning, substrate handling, inspection, metrology, and downstream optical processing. This level of automation is designed to improve performance and quality while reducing costs and increasing reliability.

Alio Labs' Quadrode™ plasma deposition platform is built in-house using large custom stainless steel vacuum vessels and novel source concepts that allow the production of precise amorphous and low defect films. The platform supports substrate sizes up to 0.5 m in size and a wide range of oxide, nitride, and metal materials. These capabilities position Alio Labs to deliver both low-volume high-mix and high-volume low-mix thin-film structures.

We are offering a suite of products that includes custom dielectric thin-film structures, anti-reflective coatings, wideband mirrors, linear variable filters, hot and cold mirrors, and conductive coatings. The roadmap includes ultranarrow band filters, notch filters, multi-chroic optics with very low wave distortion, short pass and bandpass filters with high optical density, plate polarizers, low stress ultra flat coatings, and large format coatings up to 500 mm in size.

We are a globally oriented organization. We plan to establish a European site in the near future to support our customers and to collaborate more closely with European partners. We also see strong potential for expansion in Asia. Our view is that the next phase of globalization will depend on private sector leadership and creative manufacturing models that ensure customers continue to have access to the best photonics technologies.

What markets are you addressing?

Alio Labs' customers operate across medical and life sciences, semiconductors, communications, advanced laser systems, precision metrology, and research. Many of them require scalable performance that is difficult to achieve in traditional thin-film fabs, and our automated approach is designed to address that challenge directly.

We are continuing to grow within a broader ecosystem that includes KineoLabs and UltraFast Innovations. This structure creates a platform for coordinated development, joint customer programs, and complementary product offerings. The company is expanding its team in engineering, operations, and customer support as programs advance toward higher production volume.

What about the importance of research and academic inputs into the company?

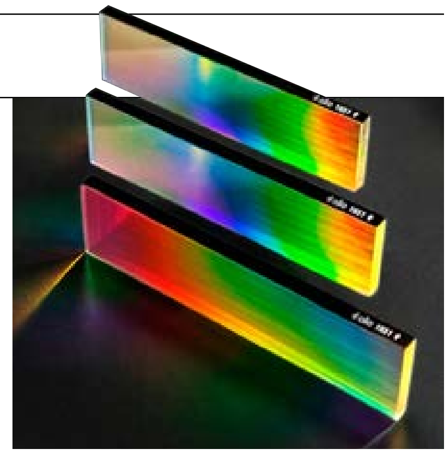
The industry has long struggled to connect academic discovery with private sector execution, and we believe that stronger integration between the two is necessary for meaningful progress. One of the advantages of our ecosystem model is that it naturally brings these worlds together. UltraFast Innovations in Munich, founded out of the Max Planck Institute of Quantum Optics and Ludwig Maximilian University, provides Alio Labs with direct access to leading research institutes, emerging technologies, and a pipeline of exceptional students. We are proud to support and be supported by Ferenc Krausz, the Nobel Prize winner in Physics, whose scientific leadership continues to shape the field.

We see a similar opportunity in Northern California and in the greater Boston region, where world-class universities and strong research communities create fertile ground for collaboration. As we expand our presence, we expect these relationships to deepen.

What do you believe Photonics West offers the company?

Photonics West 2026 marks the public unveiling of Alio Labs. Although our leadership team includes many seasoned industry executives, this will be our first year exhibiting as a company. Our message is centered on manufacturing innovation, scalable thin-film performance, and the introduction of an ecosystem model designed to address the fragmentation that has long characterized the photonics industry. We want to show customers and partners what becomes possible when deposition science, automation, metrology, and downstream optical engineering are developed together in a coordinated way.

Our booth (#1549) will feature new products based on our proprietary Quadrode™ plasma deposition platform, including custom dielectric thin-film structures, wideband mirrors, linear variable filters, and advanced coatings for medical and life sciences, semiconductor instrumentation, communications, and next generation laser systems. We will also preview ultranarrow band filters, high optical density filters, large format coatings, and ultra flat low stress films that will be released as our production capacity ramps.



A high-performance variable filter powering the next generation of spectroscopy. Credit: Alio Labs.

To demonstrate the power of collaboration, our presence at Photonics West will also include KineoLabs and UltraFast Innovations. KineoLabs will highlight its work in optical devices for early disease detection, and UltraFast Innovations will demonstrate capabilities in attosecond optics, dispersive components, and ultrafast instrumentation. Together, the three companies showcase what an integrated photonics ecosystem can deliver.

What is your expectation of the development of the photonics market for 2026?

The photonics industry has enormous untapped potential, yet it remains highly fragmented, with many companies advancing narrow portions of the technology stack in isolation. We believe that meaningful progress will come from connecting those pieces.

We see strong acceleration in the adoption of photonics across nearly every sector we serve. Thin-film enabled devices are becoming central to many of these advancements, both in fundamental research and in applied systems for medical diagnostics, energy, communications, and advanced sensing.

A defining trend for 2026 is the transition from traditional thin-film optics processing to highly automated manufacturing. Automation supports higher performance and greater consistency, and it also enables distributed manufacturing where identical capability can be established in multiple regions. This will become increasingly valuable as companies navigate supply chain pressure and the need for reliable access to critical optical components. We believe that the global photonics market will increasingly rely on private sector innovation to ensure that customers everywhere remain connected to the best technologies.

Overall, the market is moving toward more integrated optical systems, higher performance requirements, and a greater need for coordinated development across the photonics value chain. These trends align directly with our focus on manufacturing innovation and on building a collaborative ecosystem.

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