

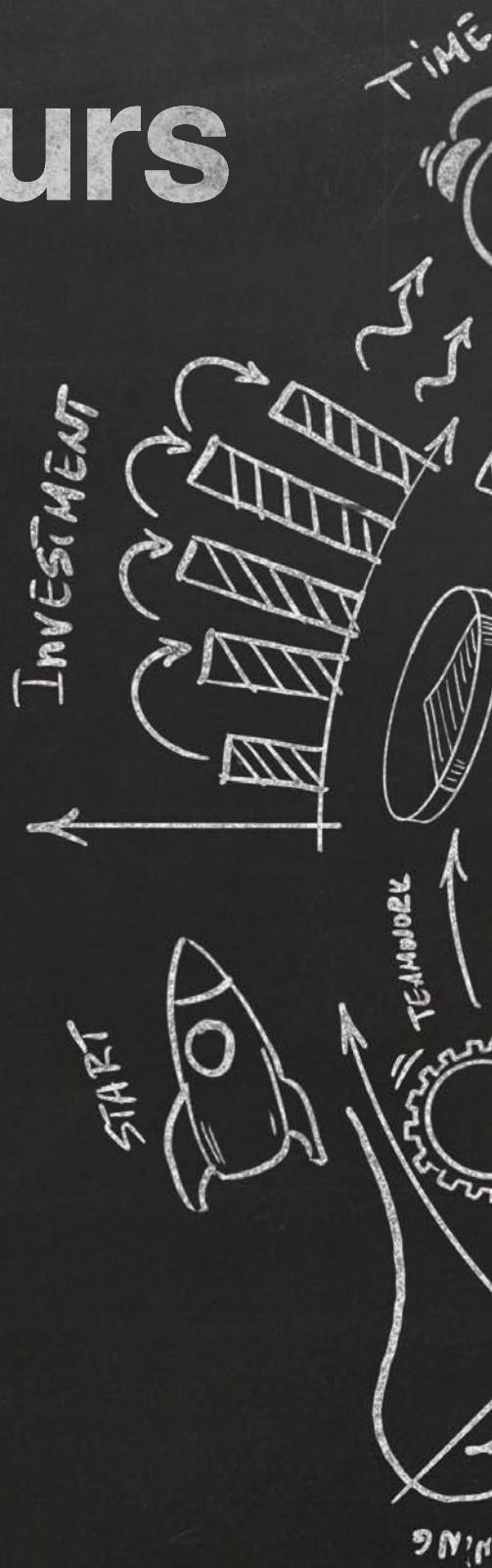
Entrepreneurs to Watch

In a biennial feature, OPN throws the spotlight on a selection of creative scientists and engineers—and the enterprises they're building.

In this issue, *Optics & Photonics News* again talks with a number of entrepreneurs who are building intriguing new businesses on a foundation of optics and photonics.

The companies founded or cofounded by the 10 scientists and engineers profiled in the following pages range from clean energy to quantum tech, from integrated lasers to 360-degree imaging, from wound care to space traffic management. And while each profile focuses on a single individual, the stories also highlight that every entrepreneurial venture is an ecosystem in itself, involving cofounders, mentors, funding partners and many others.

In the coming weeks, we'll be posting longer Q&As with the featured entrepreneurs online. Look for them at optica-opn.org/link/entrepreneurs-2023.







Courtesy of Antora Energy

Andrew Ponec

Andrew Ponec, cofounder of Antora Energy, sums up its mission succinctly: “At the core, we’re a company working to help stop climate change.” It’s a problem he’s been interested in since first learning about the threat in middle school. “It was definitely one of these light-bulb moments,” he recalls, “where it’s like, ‘I can’t believe we’re not all talking about this!’ ”

That early interest drew Ponec, as a Stanford University undergrad, to labs working on new photovoltaics and power-conversion technologies; he even took time off from study to found an earlier company, Dragonfly Systems, which was snapped up by SunPower Corp. On returning to Stanford, Ponec started talking with fellow student Justin Briggs—later (along with David Bierman) an Antora cofounder—about what they could do to really make an impact.

They settled on decarbonizing one of the biggest sources of carbon emissions: industrial heat and power. “About 30% of all global emissions are industrial emissions; it’s the single largest sector,” Ponec notes. “And you actually use about twice as much heat energy as you do electrical energy in industry.”

Antora’s system draws cheap, clean solar- and wind-generated electricity to heat up carbon blocks the size of a small shipping container to incandescent temperatures above 2000 °C. The hot blocks, part of a “thermal battery” system situated next to an industrial site, store the energy for times solar and wind power aren’t available. And the heat energy, harvested as light (thermal radiation), is piped into the industrial plant both to power its high-heat requirements directly and to be converted into industrial electricity, using thermophotovoltaic cells Antora is also pioneering.

When OPN spoke with Ponec, Antora was commissioning its first pilot unit installed on an industrial site. He expects many more to follow. “Our vision is that any time you come across an industrial facility, you see a thermal-energy storage system next to it, converting renewable electricity into the power and heat it needs 24/7,” Ponec says. “The market is absolutely enormous.”

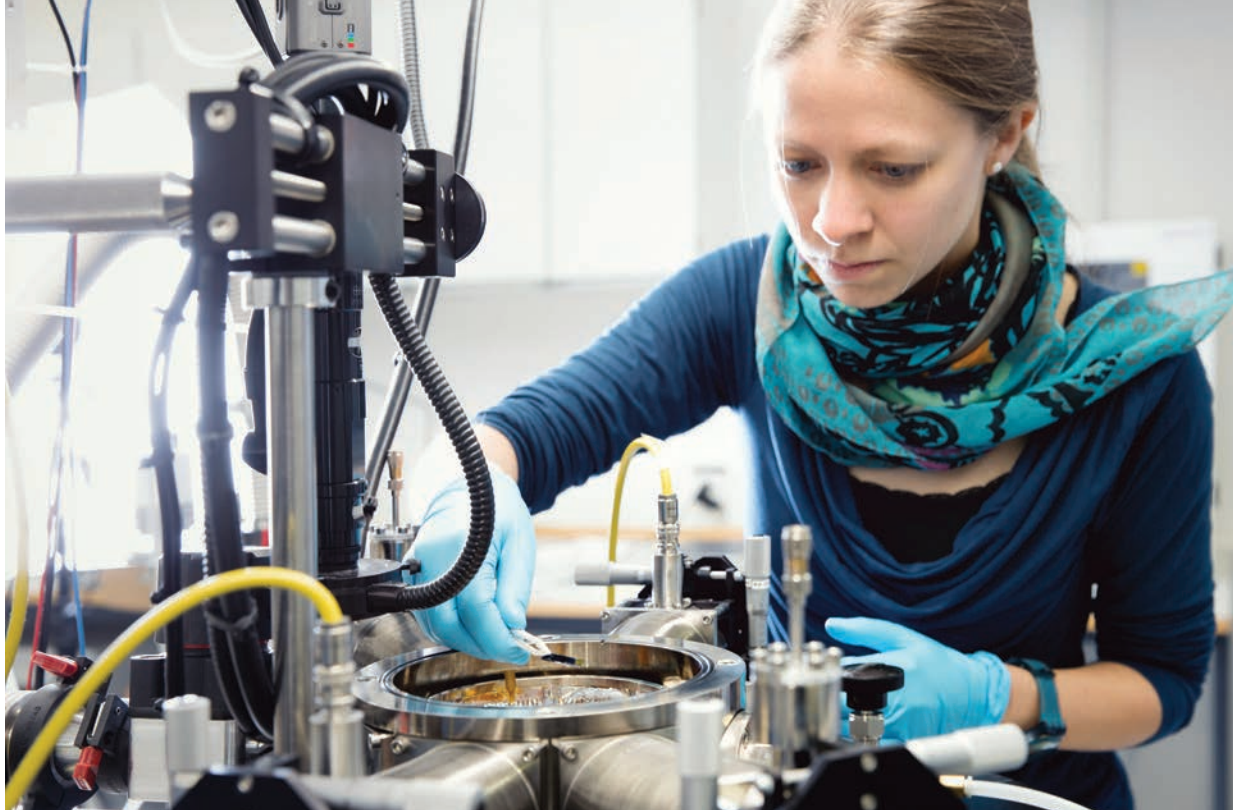
COMPANY

Antora Energy

FOCUS

Decarbonizing heavy industry

antoraenergy.com



Courtesy of Polariton

Claudia Hössbacher

Becoming a CEO was not a part of Claudia Hössbacher's life plan. But toward the end of her Ph.D. training in the ETH Zurich lab of Juerg Leuthold, she wondered: What comes after good scientific results? The answer, it turned out, was to cofound Polariton Technologies in February 2019.

Polariton focuses on adding plasmonics to the integrated-photonics platform, thereby shrinking the device size and speeding up operation frequency to the terahertz regime. The company currently sells what it says are "the world's fastest and smallest electro-optic modulators" to help break the bottleneck between electrical circuits and optical fibers. Hössbacher adds that such modulators—a crucial component of optical communications—are also a great "minimum viable product" for a startup.

To get the company off the ground, the first thing Hössbacher and Polariton cofounders Benedikt Bäuerle and Wolfgang Heni did was to write a business plan. Then they attended startup competitions that Hössbacher says iteratively improved the plan. An ETH Pioneer Fellowship especially helped, connecting Hössbacher to other startup founders for sharing information, tips and resources.

Right now, in addition to modulators, Polariton offers complementary services such as consulting, design and packaging to generate revenue. These offerings also help the company get a foot in the door with clients, which leads to long-term relationships.

Hössbacher emphasizes that one of Polariton's most important values is teamwork. That cooperative spirit extends beyond the company into external partnerships. In December 2022, for instance, Polariton and Colorado-based Lightwave Logic shared the result of a joint effort:

plasmonic polymer optical modulators with a performance reportedly 10 times better than those in the market today. "One could see Lightwave as a customer, but we can also see each other as partners and help each other succeed," Hössbacher says. "No one can do it alone. There is no single hero. We are all a team working together."

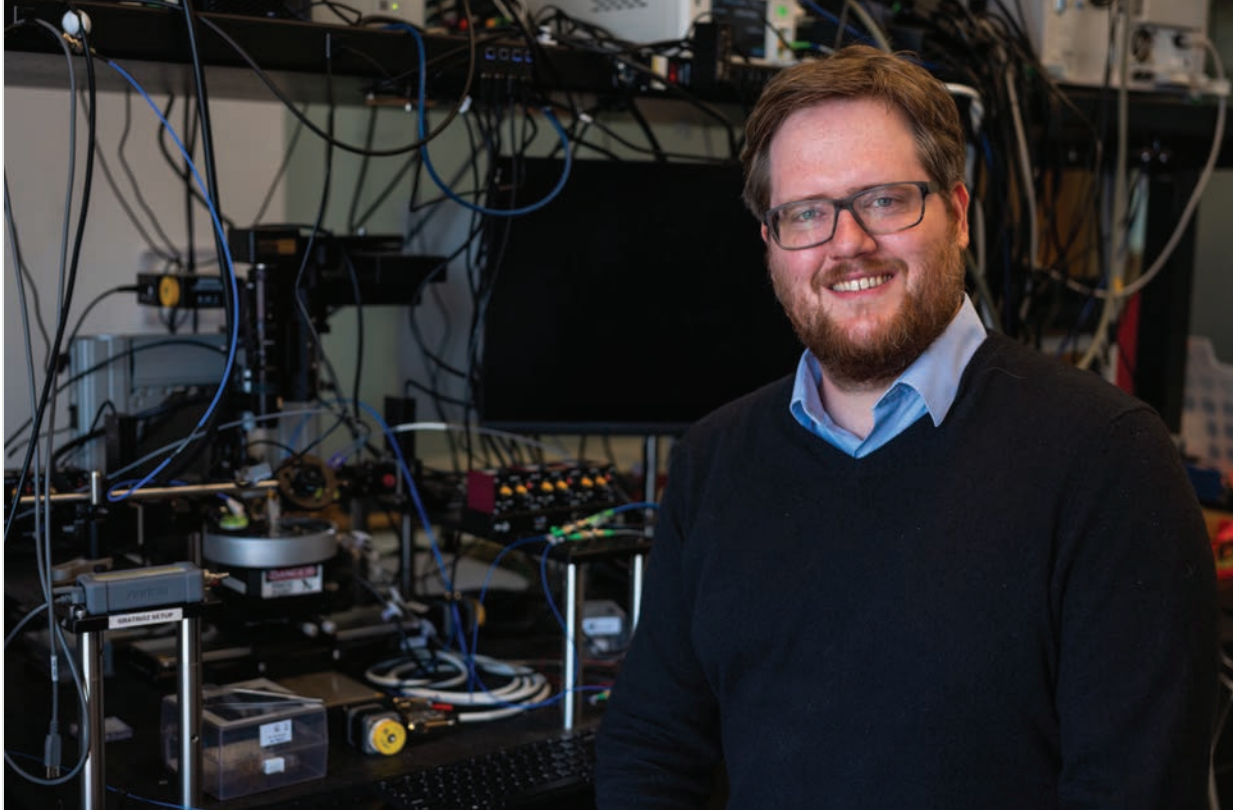
COMPANY

Polariton
Technologies

FOCUS

Plasmonic-enabled
integrated photonics

polariton.ch



Courtesy of C. Reimer

Christian Reimer

Spun out of the Harvard University, USA, lab of Marko Lončar in 2018, HyperLight has ambitious goals. “What drives us,” says cofounder Christian Reimer, “is that we want to maximize the potential of integrated photonics,” and give it a social and economic impact comparable to that of electronics. The company’s vehicle for achieving that goal is thin-film lithium niobate (TFLN).

Reimer actually came to HyperLight “just in time to join the party,” when he arrived at Lončar’s lab as a postdoc under an EU Marie Curie Fellowship. On his first day there, another member of the lab, Mian Zhang, who became cofounder and CEO of HyperLight, introduced him to TFLN. Reimer “immediately fell in love with the material,” seeing its immense potential for integrated photonics. He declined his fellowship and jumped on the HyperLight train as a cofounder—“the best professional decision of my life,” he says.

HyperLight’s story highlights the teamwork behind entrepreneurship. Reimer calls Zhang, who became the company’s CEO, “the main driver of HyperLight and TFLN technology as a whole.” Another cofounder, Kevin Luke, advances technology development. And Reimer works with customers to “identify their needs, build deep collaborations, and ... develop chips that work for them.” He adds that HyperLight is “focusing on delivering the best photonic-chip solutions to our customers.”

After the company’s spinout and funding from several VC operations in the Cambridge, MA, area, HyperLight, like others, faced a lean year at the start of the pandemic. Since 2021, however, it has started to “hire more aggressively and scale up.” While it has logged some impressive speed and bandwidth records for its TFLN modulators, Reimer argues that the real success story lies in figuring out mass production for the platform.

“We can now produce TFLN in an ISO-qualified, fully scalable, high-volume production line,” he says. “That is really, really important ... It’s not as colorful or flashy as us breaking a world record, but it’s the backbone that will enable TFLN to make a real impact.”

COMPANY

HyperLight

FOCUS

Thin-film lithium niobate
integrated photonics

hyperlightcorp.com



Courtesy of Circle Optics

Zak Niazi

While taking lens design in college, Zak Niazi, the future founder and CEO of Circle Optics, wondered: if Google's car-mounted cameras could map the planet, why couldn't he strap on a headset and create panoramas of Venice, Italy? The answer, he learned, was parallax, which made computationally stitching photos together to create a 360-degree image a costly process—up to US\$3,000 per minute of footage, according to Niazi.

Circle Optics, he says, has a solution. Instead of combining overlapping circular fields of view computationally after image capture, the company's technology uses abutting polygonal lenses—so it's "stitchless" from the get-go. Where the lenses touch, the fields of view conjoin, allowing images to be snapped together seamlessly. Co-locating the centers of perspective of multiple lenses creates a combined, parallax-free panoramic image.

Circle's products, according to Niazi, aim at enhancing safety and "democratizing" immersive experiences. Pegasus is a miniaturized drone camera with defense and air-safety applications. It has a wider field of view than other products on the market, Niazi says, and the ability to see about twice as far. Another product line, the Hydra II camera system, could assist creation of affordable virtual-reality content for media and entertainment, as well as military training.

In 2019, Circle participated in the Luminate accelerator, kicking off an increase in outside financing. The US government has been an important early funder, and Niazi points to the Small Business Innovation Research and Small Business Technology Transfer programs as key support for building prototypes. Circle also used Wefunder to crowdfund more than

US\$200,000, which Niazi says was a chance to build community as well as dollars.

Circle plans to launch its first two products later this year, with Hydra II debuting in July and flight testing for Pegasus beginning in late 2023. "What we're trying to do is make experiences as accessible as information is today with the internet," says Niazi.

COMPANY

Circle Optics

FOCUS

Stitch-free 360-degree multi-camera system

circleoptics.com



Courtesy of Photonic Inc.

Stephanie Simmons

To achieve the “holy grail” of quantum error correction and trustworthy quantum computing, says Stephanie Simmons, “you’re going to need buckets of qubits—just buckets of them.” And, she believes, the best platform for achieving that is silicon, which is comfortable in both the computing and communications worlds. The vision that “silicon always wins” animates Photonic Inc., the company Simmons founded in 2016—which has developed ways to put a million qubits on a single silicon chip.

Simmons says she came across the concept of quantum computing at age 16, and has been “head down on quantum computing” ever since. “For me, the first love ended up being the real one.” In postdoctoral research at the University of New South Wales, Australia, and Oxford University, UK, and since 2015 in her lab at Simon Fraser University, Canada, she and her colleagues have relentlessly advanced the technology of spin-photon interfaces in silicon.

One reason she’s so bullish on silicon as a quantum platform is industry’s long history perfecting the technology. “Silicon is just really clean,” she says. “We know how to make it cleaner than any other solid material.” Also, as Simmons’s team showed in a *Nature* paper last year, it’s possible to “talk to” spin qubits in silicon optically, at telecom wavelengths—thereby taking advantage of another superb carrier of quantum information, the photon. “We believe that quantum computers and quantum networks will ultimately be the same technology,” she says.

Photonic Inc. currently operates in stealth mode. Simmons began the enterprise, with angel-investor funding, to collect IP surrounding spin qubits in silicon while the technology was being developed. “Once we found what we were looking for, we hit the go button” in 2021, she says, garnering additional funding and ramping up staff to more than 100. Simmons—whose title at the firm is “chief quantum officer”—calls Photonic “the biggest quantum-computing company you’ve never heard of.”

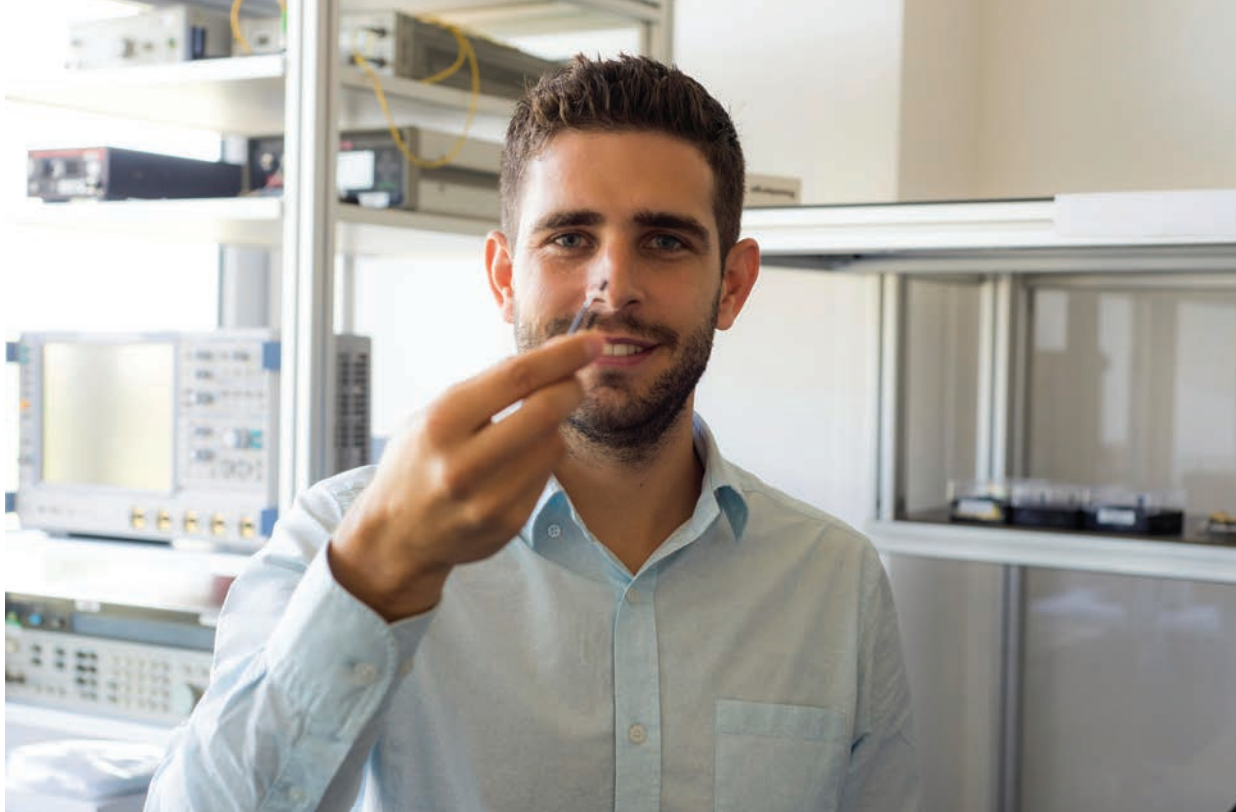
COMPANY

Photonic Inc.

FOCUS

Silicon-based quantum technology

photonic.com



Courtesy of C. Abellan

Carlos Abellan

T rue randomness, according to Quside cofounder and CEO Carlos Abellan, is essential for both cybersecurity and high-performance computation. And he believes quantum physics holds the key to meeting the growing need for truly random numbers, while also allowing monitoring of their quality. To this end, Quside offers two types of product: integrated photonic chips that produce quantum random numbers for cryptography and high-performance computation, and a “randomness processing unit” that acts as a hardware accelerator for randomness-based computing workloads.

Abellan started work on randomness while doing his Ph.D. at the Institute of Photonic Sciences–ICFO, Spain. ICFO has a Knowledge and Technology Transfer (KTT) team that links researchers with industry partners, fostering entrepreneurship for promising tech. Abellan says the KTT framework, his

desire to “build things people can use” and ICFO’s enabling of state-of-the-art research created “the perfect storm” for a successful spinoff.

Quside’s tech generates randomness by measuring innately unpredictable quantum processes through phase diffusion in semiconductor lasers. The laser is gain-switched to produce a stream of phase-randomized optical pulses, and an interferometer then converts the random phase to random amplitude. Finally, a fast photodiode moves the photonic signal into the electronic domain, and standard electronics convert the analog signal into digital. Abellan says this method turns microscopic quantum observables into macroscopic dynamics, providing a very fast output and a strong, easily measured and inspected quantum signal.

In late 2022, Quside secured Series A funding with lead investors Trumpf Ventures and Spanish deep-tech funder Bullnet Capital. The company’s goals are now twofold: support existing customers, and reduce

the products’ cost to make them more attractive to the consumer market. Abellan’s ultimate vision is to make the technology available for everyone. “We have a very strong pipeline of innovation, but it’s always driven toward the customer,” Abellan says. “So it’s not crazy, moonshot research—it’s real life.”

COMPANY
Quside

FOCUS
Quantum random
number generation
quside.com



Courtesy of Metalenz, Inc.

Rob Devlin

Rob Devlin first became interested in engineering as a kid, when he and his grandfather, a World War II veteran, worked on building shortwave radios in his grandfather's basement. "You could take these components, slap them together and all of a sudden you were hearing someone half-way around the world," he recalls. "It was a very cool realization."

Years later, he experienced a similar feeling as a grad student in the Harvard University, USA, lab of Federico Capasso, where Devlin worked on boosting the efficiency and manufacturability of the optical metasurfaces the lab was pioneering. The work led to a landmark 2016 *Science* paper—and, shortly thereafter, to Devlin's cofounding of Metalenz, Inc.

Since then, Devlin and his team have pushed metasurfaces—intricately engineered 2D components that can radically simplify and shrink functions typically requiring bulk optics—to market adoption. Metalenz has focused initially on 3D-sensing applications, gaining particular traction last year when it began shipping its flat lenses in millions of time-of-flight sensors produced by STMicroelectronics.

The company also closed a US\$30 million Series B funding round in October 2022, which has enabled it to ramp up production and to boost its staff capabilities in machine and computer vision. Those capabilities will come in handy in developing markets for its newest technology, PolarEyes—a metasurface module that enables complete polarization imaging "at a form factor and price point where you can put this in any device out there."

One key to Metalenz's success thus far, according to Devlin, has been focusing on "the mass-production side of things" from the outset. Especially memorable, he says, was when the team received the first 300-mm wafer with 10,000 Metalenz devices on it. "That was just a really cool moment," he says. "Because now it was, OK, this is not just exciting and interesting—it's real, and you can make it."

COMPANY

Metalenz, Inc.

FOCUS

Metasurfaces for sensing and beyond

metalenz.com



Courtesy of G. Radhakrishnan

Geethanjali Radhakrishnan

In Latin, “adiuvo” means “to help,” and that speaks to the core of Adiuvo Diagnostics’ mission. Founder Geethanjali Radhakrishnan grew up in an area of India where obtaining health care required traveling 100 km to a tertiary hospital, making early diagnosis difficult and often worsening patient outcomes. She gives the example of a farmer with a fungal-infected wound who was mistakenly treated with expensive antibiotics. By the time he was seen at a hospital and the correct cause was identified, the infection was very advanced and the limb had to be amputated.

After getting her degree in bioengineering, Radhakrishnan was inspired to help improve point-of-care diagnostics in low-resource settings, so she developed Illuminate—a handheld device that screens for bacteria and fungi in wounds. Adiuvo has identified the unique biomarkers of different bacteria and fungi, so the device can use label-free multispectral imaging to noninvasively detect their natural autofluorescence.

The system then implements an artificial-intelligence model to compensate for background noise and skin-color variation—a machine-learning process that continues as more patients are treated with Illuminate. Results are provided within two minutes without the need to take cultures or send samples to a lab.

Radhakrishnan is a single founder, so early funding and mentorship have been particularly important to her growth as an entrepreneur. She received a grant from India’s Biotechnology Industry Research Assistance

Council under its Biotechnology Ignition Grant scheme (BIRAC BIG), which helped her get the technology to the proof-of-concept stage. Participation with social incubators Villgro and Venture Center, Pune, provided access to mentors who taught her about efficient innovation and starting a business.

Although never losing sight of its identity as a “techno-social enterprise” with a focus on low-resource settings, Adiuvo also has global aspirations. The next goal is breaking into the US market, with FDA approvals currently in process. As Radhakrishnan notes, “this solution is bound to work anywhere.”

COMPANY

Adiuvo Diagnostics

FOCUS

Optoelectronics for wound care in low-resource settings

adiuvodiagnostics.com



Courtesy of H. Zia

Haider Zia

Haider Zia's interest in science started in childhood, when he and his businessman father would together read publications such as *Scientific American*. That upbringing led him to pursue engineering physics for his bachelor's degree—and to a laser-physics course that spurred an “instant, magnetic interest.” After finishing a Ph.D. focusing on fiber lasers, Zia wondered, “what's the next coolest thing?” The answer, to him, was photonic chips. So he signed up for a postdoc at the University of Twente, Netherlands, with a research focus on supercontinuum-light generation in such chips.

As he continued his academic journey, Zia eventually saw the hazard of, as he puts it, becoming like “a horse wearing a blinder on a race track.” By focusing solely on research, he thought, one could miss opportunities to connect with other fields and offer something meaningful to society. So in November 2022, he started a company to turn the deep-tech research he was doing in the lab into a product that could benefit others.

That company, Superlight Photonics, capitalizes on Zia's postdoctoral research on low-power supercontinuum lasers. The tech rests on a neat trick—so-called sign-alternating-dispersion waveguides. Zia's research showed that such a waveguide, with segments alternating between the normal- and anomalous-dispersion regimes, enables broadband supercontinuum light to be generated with up to thousands of times less power relative to other schemes published in the last five years.

When OPN spoke with Zia, Superlight Photonics was about to close its seed funding round. The company now offers supercontinuum lasers as a product, packaged on a chip with a fiber feedthrough. The company is also discussing which potential markets to target and how quickly its product can scale.

In getting Superlight off the ground, Zia says a Twente-affiliated startup incubator, Novel-T, was especially useful, guiding him through the process. And Zia's father—whom he calls his “close advisor”—has also been there for every step. “I definitely got closer to my father along the process,” Zia says.

COMPANY

Superlight
Photonics

FOCUS

Integrated super-
continuum lasers

superlightphotonics.com



Courtesy of Luminate NY

Eric Ingram

Space is getting crowded, with new satellite fleets jostling for position in low Earth orbit. For Eric Ingram, that's both a problem and an opportunity—one that led to his 2019 cofounding, with fellow engineer Sergio Gallucci, of SCOUT Space. "Space is a super-important ecosystem," Ingram says. "I saw an increase in people using space ... but no real increase in infrastructure to support that."

SCOUT's answer is making satellites themselves smarter about what's going on around them—through machine-vision hardware and machine-learning software that enable satellite autonomy. The company is rolling out a compact vision system, called Owl, that can be installed onboard other satellites. It's also working on its own fleet of stand-alone traffic-management spacecraft, OVER-Sat, to come online in the next few years.

Ingram—who previously worked on both the engineering and the regulatory side of space—funded SCOUT himself for its first year and a half, and notes that it encountered early headwinds from the pandemic. "It was very poor timing to start a company," he admits.

But SCOUT eventually attracted VC funding and started seeing traction with commercial and government customers in early 2022. "We have more inbound demand than we can really handle right now, which is a good problem to have," Ingram says. SCOUT has also participated in several technology accelerators, such as the TechStars Space Accelerator and the Luminate optics, photonics and imaging accelerator, to tap expertise and connections in specific sectors.

While Ingram has had a physical disability since birth, he has not let it blunt his ambitions in space. Indeed, he is on the leadership team and one of the earliest members of Astro Access, a charitable organization working to ensure that disability is not a bar toward experiencing and working in space. He even thinks his own situation may have helped his entrepreneurial venture. "Having a disability, I have to creatively problem-solve every day," he notes. That sort of mindset, according to Ingram, "is extremely useful in starting a business."

COMPANY
SCOUT Space

FOCUS
Satellite autonomy to
preserve the space
ecosystem

scout.space