

# Meet the winners of the 2024 Sony Women in Technology Award

Kiana Aran, Jiawen Li, Amanda Randles & Yating Wan

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**Technology research is the driving force of the innovations that shape the world. Sony Group Corporation (Sony) and Nature partnered together to launch the Sony Women in Technology Award to recognize three outstanding early to mid-career researchers from the field of technology. Here, we interviewed the winners of the inaugural 2024 award on the inspirations behind their outstanding research.**

**What initially inspired you to pursue a career in STEM, and how did that passion evolve over time?**

**Kiana Aran:** I never chose STEM, STEM chose me. Growing up in Iran, education was not a choice but a given, an expectation woven into the fabric of our society. In my world, pursuing higher education was as fundamental as breathing, and there was little space to question it. Coming from a family of teachers, the pursuit of knowledge felt like an arranged marriage, one that was decided for me before I had the chance to dream otherwise. And like many in my homeland, the most esteemed paths were engineering or medicine. That is why, when you look at the global landscape of science and technology, you will find so many top Iranian students excelling in these fields, migrating to the West in pursuit of opportunity. It was no different for me. My path to STEM was not one of personal selection, but of cultural design. Yet, something changed when I moved to the USA. For the first time, I saw a world of possibilities beyond the predefined routes of electrical engineering or medicine. While I had started my journey as an electrical engineer, I quickly realized that circuits and algorithms alone did not fulfil me. I craved something more, something human. My fascination with biology had always lingered beneath the surface, and through volunteer work during my undergraduate years, I discovered a deeper passion for understanding life itself. Rather than abandoning my technical

roots, I sought to fuse them with my growing love for biology. I immersed myself in bioengineering, slowly weaving together the mechanics of electronics with the complexities of human biology. With each academic step forward, I infused more biology into my research, blending disciplines that once seemed worlds apart. And in doing so, I found my true calling. Today, I stand at the intersection of biology and semiconductors, creating tools that not only advance health care but also unravel the mysteries of life itself. What started as an obligation transformed into an unshakable passion. I never actively chose STEM, but I have grown to love it in ways I never imagined. The ability to translate scientific discovery into real-world impact, to develop technologies that can diagnose disease, improve lives and push the boundaries of what is possible, has been profoundly rewarding. I cannot imagine myself doing anything else. What once felt like an arranged marriage has turned into the greatest love story of my life.

**Jiawen Li:** Since childhood, I was immersed in the world of biomedicine, influenced by my father's career as a biologist and my mother's work as a medical doctor. This environment naturally sparked my curiosity about how science and technology can advance health care. With an interest in math and physics, my passion gradually expanded beyond biology, leading me to pursue a career at the intersection of engineering and medicine. In particular, my research applies photonics and optical engineering to solve real-world medical challenges.

**Amanda Randles:** I have always been driven by an insatiable curiosity about how things work. As a child, my parents fed that curiosity with the 'Ask Me Why' book series because I was constantly asking questions about the world around me. That natural drive to understand complex systems eventually led me to STEM. In high school, I attended a math and science centre where I had my first exposure to programming. It was there that I saw firsthand how computational approaches could be used to solve real-world problems, and I became

fascinated by their potential applications. When I arrived at Duke as a freshman, I joined the Biotech Focus programme, which concentrated coursework around biotechnology. This was right on the heels of the completion of the Human Genome Project, and I was captivated by the scale and impact of interdisciplinary research. As part of the programme, I had the opportunity to visit the J. Craig Venter Institute and NIH laboratories working on sequencing the genome. Seeing large-scale projects in which computation had a pivotal role in unlocking biological insights was a turning point for me.

**Yating Wan:** I have always been a curious person, ever since I was a child. I grew up in a small town in China, where education resources were basic. But my teachers were very dedicated, and that gave me a strong foundation. At home, my mom loved books – our house was full of them. I would spend hours flipping through anything I could get my hands on, just exploring different subjects. I didn't know it at the time, but that curiosity was what eventually led me into science.

During my undergraduate studies, I was introduced to optoelectronics and lasers by Jian-Jun He. His passion for photonics was contagious, and I quickly realized that I wanted to contribute to this rapidly growing field. From there, my passion really grew during my PhD at HKUST with Kei May Lau. That PhD project<sup>1</sup> ended up being the foundation for a lot of the work I do now. That experience also taught me the importance of resilience in research. Then I moved to the USA for a postdoc at the University of California, Santa Barbara with John Bowers, and that was life changing. He really shaped how I see my own work today – science is not just about discoveries, it is about impact. It was in his laboratory that I became fully immersed in the challenge of integrating efficient light sources onto silicon chips, particularly through quantum-dot lasers.

Over time, my passion for STEM evolved beyond just curiosity – I became driven by the potential impact of my work. Seeing how research transition from the laboratory to industrial applications, particularly through

collaborations with Intel, reinforced my belief in the importance of bridging academia and industry as a faculty at KAUST. Science is tough, and it takes years of persistence, but if you love it, it is worth it. And looking back, I think that is what has kept me going – the love of learning, the excitement of discovery and the belief that what we do can have a real impact.

**Can you tell us about the moment you realized your research was/is making a breakthrough? What was the most unexpected or surprising result from your research?**

**K.A.** For me, a breakthrough is not defined by a single moment of success, but rather by the spark of curiosity that ignites the entire journey. The most exciting part of research is not when I reach the finish line, it is when I stumble upon a question so compelling that I have no choice but to pursue the answer. Those moments of raw curiosity is what drives me forward. They are the most exhilarating, more than the final outcome itself.

I remember one such moment vividly, the idea that eventually led to CRISPR–ChIP. It was an early Saturday morning, and I was standing outside a coffee shop, sipping my coffee before heading to a workout session. My mind, as always, was occupied with the wonders of biology and the potential of CRISPR. And then, a question struck me, what if I could anchor CRISPR to a transistor? I had been developing transistors for biosensing applications, but the thought of combining them with CRISPR to detect genetic material was something new, something exciting. The idea consumed me.

Throughout my entire workout class, I was mentally designing the experiment. I could barely focus on anything else for the rest of the day because I knew this was worth pursuing. By the next morning, before the sun even rose, I was already in the laboratory, setting up the foundation of what would become CRISPR–ChIP. That moment of curiosity, that need to chase an idea, was the real thrill.

Of course, seeing the technology work was incredibly fulfilling, especially when we demonstrated that it could detect mutations in unamplified genomic DNA. That breakthrough opened doors for rapid, label-free DNA detection, with profound implications for personalized medicine and CRISPR field. When the technology finally made its way into the hands of researchers, it was a different kind of joy, one rooted in impact of my work and real-world application. But nothing,

## The contributors

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**Jiawen Li** is an associate professor in the School of Electrical and Mechanical Engineering and Institute for Photonics and Advanced Sensing at the University of Adelaide, Australia. Her research work in endoscopy combines nanoscale 3D printing with optical fibres for ultrathin, flexible, multimodal fibre-optic imaging probes used in cardiology. She is actively commercializing this invention and is the Judges' Commendation Recipient prize winner.

**Amanda Randles** is an associate professor of Biomedical Sciences at Duke University, USA. Her research is focused on biomedical simulation via high-performance computing, machine learning and the personalized modelling for disease diagnostics and treatment. She is a Mid-Career prize winner.

**Yating Wan** is an assistant professor at King Abdullah University of Science and Technology, Saudi Arabia. Her research focuses on the integration of 'quantum dot' lasers onto silicon chips for more energy-efficient data communication and information processing. She is the Early-Career prize winner.

absolutely nothing, beats the rush of a question that demands to be answered. That is what keeps me going, the constant pursuit of the next 'what if'.

**J.L.** Because biomedical engineering innovations take time to be adopted by clinicians, it took me a while to realize the true impact of my research. I only recognized it as a breakthrough when clinicians – the end-users – shared overwhelmingly positive feedback, highlighting how it directly addressed a major challenge they faced in their practice.

The most unexpected result from my research so far was probably from our endeavour to combine temperature sensing and imaging, that is, the 'thermometer' and 'eye' functions, into a hair-thin device. To explore the possibility of combining sensing and imaging via a hair-thin single fibre, I applied for and got a pilot research grant together with another researcher, Erik Schartner, who was also in his early career back then. We opted to try the tellurite-glass-based method that Erik had already developed, following some quick thought experiments. This tellurite-glass-based method<sup>2</sup> worked out surprisingly well and even enabled a common-path approach to achieve optical coherence tomography, that is, a simpler setup for the imaging system compared with what we usually use. Although this kind of luck is not always guaranteed, identifying suitable and talented collaborators is crucial. Also, through collaboration with experts from different fields, I was able to see new possibilities within my old ideas.

**A.R.** There have been several key moments where I realized our research was making a breakthrough. One of the earliest was when I first visualized results from HARVEY and saw that they were producing reasonable flow patterns. I immediately ran to share them with

a co-worker – it was an exciting moment to see the models working as intended. Another milestone was successfully running the code without errors on some of the world's largest supercomputers, a feat that validated our ability to scale these complex simulations.

A pivotal moment came when we collaborated with David Frakes's laboratory to compare our computational results with experiments in 3D-printed vascular models. The strong agreement between the two gave us a lot of confidence in the accuracy of our approach. But perhaps, the most thrilling breakthrough was when we processed results from a blinded study, testing whether our virtual models could match invasive guide-wire measurements from patients across two clinical sites. Seeing a strong correlation between the computational predictions and real patient data was incredibly exciting – it demonstrated that we could non-invasively capture haemodynamic behaviour with high accuracy.

More recently, two major developments stand out. First, the Adaptive Physics Refinement (APR) method allowed us to achieve higher spatial resolution while considerably reducing computational costs. Second, the Longitudinal Hemodynamic Mapping Framework extended the time domain we could capture, moving beyond single heartbeats to weeks of patient-specific blood flow data. In both cases, it was remarkable to see these methods match ground truth results while requiring far fewer computational resources.

Given my passion for high-performance computing and pushing the limits of large-scale simulations, one of the most surprising aspects has been how feasible it is to maintain fidelity while optimizing for computational efficiency. It has been incredibly rewarding to see our work become more translatable and practical for real-world clinical applications,

demonstrating that we do not always need the biggest machines to achieve impactful results.

**Y.W.** There have been a few moments in my career where I have felt that ‘aha!’ moment, but one that really stands out was when we successfully integrated quantum-dot lasers with silicon chips. It was a project that took years of trial and error – thousands of hours, actually – and there were times when I wondered if we would ever get it right. But when we finally saw those lasers working reliably on silicon, it was such a rush. That was the moment I realized we were onto something that could really make a difference<sup>3</sup>.

What made it even more special was that soon after, Intel picked up our work and was able to replicate the process in their industrial laboratories. That was when it really hit me – this is not just a research breakthrough; it has real-world impact. Seeing something go from an academic laboratory to being validated by a major industry player was both exciting and validating. It showed that our approach was not just theoretically interesting but actually practical for large-scale applications.

As for the most unexpected result, I’d say it was how robust the quantum-dot lasers turned out to be. When we started, we knew they had potential, but we didn’t expect them to perform so well under challenging conditions. These lasers can operate at high temperatures and without isolators for long periods without degrading, which is a big deal for practical applications. That reliability was a pleasant surprise and opened up even more possibilities for where this technology could be used, like in harsh environments such as desert mining operations for autonomous vehicles.

Research is full of ups and downs, and there are plenty of days where nothing seems to work. But moments like these – where you see something function for the first time, or when your work gets recognized beyond academia – make all the challenges worth it.

## What was the most difficult challenge you encountered during your research, and what did you learn from it?

**K.A.** One of the biggest challenges I encountered during my research was bridging the gap between fundamental discovery and real-world impact. While making a scientific breakthrough is exciting, translating it into a scalable, reliable and cost-effective technology is an entirely different challenge. It requires not only technical problem-solving but also navigating regulatory landscapes, securing funding and ensuring market

adoption. Through this journey, I learned the importance of resilience, adaptability and strategic partnerships. But perhaps, the most unexpected and difficult lesson was not scientific at all, it was about leadership.

As a scientist, I was trained to formulate hypotheses, design experiments and analyse results, but I was never formally trained in leading a team, understanding team dynamics or empowering people in ways that maximize their contributions. Yet, when taking research beyond the laboratory and into commercialization, these human skills became just as crucial as scientific knowledge. I had to learn how to motivate and guide a diverse team, recognizing that each individual brought unique strengths and perspectives. It was no longer just about my technical expertise, it was about creating an environment where collaboration thrived, where people felt valued and where their skills could be harnessed effectively towards a shared vision.

Another key challenge was navigating cultural differences. The way decisions are made, risks are evaluated and communication flows can vary greatly across different cultural backgrounds. Understanding these nuances and adapting my leadership approach accordingly was a learning curve, but it became essential in ensuring that our projects moved forward smoothly. Science is universal, but the way we bring it to life is deeply influenced by human factors, and acknowledging that has been one of the most valuable lessons in my career.

Ultimately, taking a technology from the laboratory to real-world application is as much about people as it is about science. Overcoming technical and regulatory hurdles required not just scientific excellence but also an entrepreneurial mindset, emotional intelligence and the ability to build strong industry collaborations. Developing these skills has not only strengthened my ability to create impactful technologies but also made me a more effective leader, mentor and collaborator.

**J.L.** Some of the most difficult challenges I have encountered have been the extra complications I have had to manage as a researcher during my pregnancies. It is not safe for a pregnant woman to work with certain chemicals or be exposed to X-rays or UV light, as it can pose risks to the baby. However, my research requires regular use of X-ray and organic solvents and sometimes also UV light and isoflurane. This creates a significant hurdle, as it can disrupt the momentum of experimental research, particularly in hands-on, long-term projects where continuity is key.

From my experience, I learned two important lessons. First, it helps to inform the people you closely work with and ask them to keep it in confidence, so they can help you. My teammates have been extremely helpful protecting my little ones from those chemical and physical risks. With that said, I understand that in some cultures, this may be a sensitive topic and not always possible to share. This leads to the second lesson I learnt: I found that the challenge became easier to manage the second time around, as I have moved into more of a leadership role. For example, I can stay outside the operation room, observe through the lead glass that blocks most X-ray and provide guidance whenever needed, ensuring progress without direct exposure of the little one to risks.

**A.R.** There have been many difficult challenges along the way, but one that stands out is the development of the APR model. There were numerous potential failure points – instabilities in coupling, parallelization challenges and ensuring model accuracy – all of which could have derailed the project.

This effort required a dedicated, large-scale team within my laboratory. We spent considerable time scoping the problem, identifying critical ‘make-or-break’ points and developing a clear roadmap for tackling each challenge. Rather than tackling everything at once, we set up structured check-ins to ensure that no small issue became an insurmountable roadblock. Given the complexity, it was far beyond the scope of a single graduate student – it required tight coordination across the entire team.

One of the biggest takeaways from this experience was the importance of planning, collaboration and rigorous testing. Developing robust unit tests helped us catch failure points early, allowing us to iterate quickly and keep the project on track. It reinforced the value of structured problem-solving and the necessity of a team-driven approach to tackling large-scale computational challenges.

**Y.W.** The biggest challenge in integrating quantum-dot lasers with silicon chips was achieving high-performance lasers after bonding the thin epitaxial layers to silicon without degrading the other components on the chip, such as waveguides and modulators that manipulate the light. This was not something we could solve quickly – it required years of trial and error. Over 6 years, we spent thousands of hours optimizing the design, fine-tuning the bonding, etching and polishing processes and carefully controlling

temperature and pressure conditions to get everything just right.

What made this process particularly difficult was that we were combining two fundamentally different materials that were not naturally designed to work together. Silicon is an excellent platform for electronic chips, but it is not an ideal material for generating light. Quantum dots, by contrast, are highly efficient for creating tiny lasers, but integrating them into a silicon platform required meticulous adjustments to maintain their optical properties while ensuring compatibility with the silicon-based circuitry<sup>4</sup>.

Another critical challenge was ensuring reliability. Quantum-dot lasers are inherently robust – they can withstand defects and reflections and maintain performance for a long time without degradation. But we needed to make sure the entire system – lasers, silicon and all the other components – would work reliably under industry-standard conditions. Once we achieved stable performance, we partnered with Intel to test the technology in real-world industrial environments, validating that quantum-dot lasers could operate without degradation – and crucially, without the need for isolators, which simplifies system design and reduces cost.

Even after solving these technical hurdles, another major challenge remained: scalability. Demonstrating a concept in the laboratory is one thing, but making sure it can be manufactured efficiently, affordably and at scale is another. For silicon photonics to truly impact industries such as artificial intelligence (AI) computing and data centres, it needs to be mass-manufacturable while maintaining performance and reliability.

What I learned from that experience is that research is a long game. There will be failures, roadblocks and times when nothing seems to work. But those struggles are often what lead to the biggest breakthroughs. I also learned that having the right mentors and a supportive environment makes a huge difference. Science is not just about intelligence – it is about resilience, problem-solving and the ability to keep pushing forward even when progress feels slow. Now, when my students face challenges, I remind them that setbacks are not the end of the road – they are part of the journey.

**How do you see your research advancing in the future? Are there any new directions or projects you're excited to explore?**

**K.A.** I am interested in expanding the applications of bioelectronic systems for personalized

medicine. Beyond these technical advancements, I am also actively forming collaborations with experts from new fields, pushing the boundaries of interdisciplinary science. I am particularly excited about the power of modern semiconductor technologies and how their rapid evolution can be merged with biology, AI and other disciplines to create solutions that were once thought impossible. The convergence of these fields has the potential to redefine health care, making disease detection and treatment faster, more precise and more personalized than ever before.

Moreover, the continuous discovery of new biological mechanisms and advancements in synthetic biology are opening doors to scaling biological machinery in ways we never imagined. By optimizing and reengineering these biological systems such as enzymes, we can mimic nature's most advanced designs in a sustainable way. This fusion of biology with cutting-edge engineering could lead to bio-inspired semiconductor platforms, self-sustaining biosensors and programmable living materials, fundamentally changing how we approach health-care, energy and environmental challenges.

**J.L.** In the next few years, I would like to push the clinical translation of our 3D-printed micro-endoscopes<sup>5–7</sup>, allowing this technology to be widely used to help cardiologists. I plan to use the commercial package we are developing with our awarded grants to raise investment for a new medical device company, which will be created with the goal of taking our 3D-printed imaging devices to real-world health outcomes.

In the next 5–10 years, my collaborators and I aim to enable personalized cardiology by nanotechnology, including 3D nanoprinting and microfluidic chips. Although personalized oncology is being used in clinical practice to improve health outcomes, personalized cardiology is still difficult to achieve. One reason for this is the lack of personalized risk assessment tools (in addition to genomic analysis). This unmet need has resulted in ~20% recurrent heart attacks within a year. Our goal is to develop a two-stage personalized risk assessment platform technology for patients with cardiovascular disease: stage 1, micro-fluidic-based point-of-care device to screen and monitor patients via blood samples; stage 2, our novel 3D-printed intravascular imaging devices to optimize therapeutic decision-making in high-risk patients identified in stage 1.

Meanwhile, I aspire to expand the application of our 3D-printed device beyond

cardiology. Micro-endoscopes are widely needed for imaging small luminal or delicate organs (for example, brain, small airways and bile ducts) without causing trauma to the tissue. However, current fabrication methods limit their performance in terms of resolution, depth of focus and multimodal imaging capability and, thus, restrict their applications. Building on our engineering advancements in cardiology, we can now translate these innovations into applications in neurology, oncology and beyond.

**A.R.** Looking ahead, I am excited about several new directions in our research. One area we are actively exploring is using the APR method to study how cellular adhesion influences cancer cell transport over long distances. Understanding how these interactions drive metastasis at both the cellular and systemic levels could provide critical insights into cancer progression and potential therapeutic targets.

We are also ramping up studies applying LHM to investigate long-term blood flow changes across different diseases. By extending our models beyond single time points to capture weeks or months of physiological changes, we hope to uncover new biomarkers and better predict disease progression.

Perhaps what excites me most is the growing integration of wearable technology with digital twins. By coupling real-time physiological data with our predictive models, we have the potential to fundamentally change how we detect, track and treat human disease – shifting health care from reactive to truly proactive. I'm eager to see how these advancements translate into real-world clinical applications and improve patient outcomes.

**Y.W.** I see my research advancing in several exciting directions, all centred around pushing silicon photonics to new frontiers. One of the biggest challenges we've worked on – integrating efficient light sources on silicon – is now reaching a stage in which we can think beyond proof-of-concept demonstrations and move towards real-world applications. That is what excites me the most: transitioning from research breakthroughs to technologies that can make a tangible impact.

One major direction is optical computing and AI hardware acceleration. Right now, AI and machine-learning models demand massive computational power, and traditional electronic chips are struggling to keep up with that energy demand. Silicon photonics can offer a way to process data much faster and

more efficiently using light instead of electricity. My team is working on photonic neural networks, in which we use light-based circuits to accelerate AI computations. This could completely change how we build AI hardware, making it much more energy-efficient and scalable.

Another exciting project is our work on light detection and ranging (LiDAR) sensors for autonomous mining trucks. These systems need to operate in harsh environments such as deserts, where heat, dust and vibrations can be a challenge for traditional sensors. By integrating quantum-dot lasers and advanced algorithms, we are developing solid-state LiDAR systems that are compact, reliable and tailored for safe and efficient navigation in mining operations.

I'm also looking at new wavelength ranges for silicon photonics, such as mid-infrared and visible light. Most silicon photonics research has focused on telecom wavelengths, but expanding into other bands could open up applications in biomedical sensing, environmental monitoring and quantum information processing.

Of course, there are still major challenges – scalability, packaging and integration with electronics all need more work. But what makes me optimistic is the increasing collaboration between academia and industry. More companies are investing in silicon photonics, and that means the research we are doing now has a clear path to real-world impact. Silicon itself is not the best material for optics in many respects, but it is unmatched for integration. Ultimately, I see silicon photonics having a key role in shaping a more sustainable and innovative future. Whether it is improving AI, enabling quantum communication or advancing autonomous systems, the potential is enormous. And while we're still searching for that 'killer application' that will unlock the full potential of silicon photonics, I am confident that we are on the right path. It is going to take teamwork, persistence and a lot of creativity, but I'm excited to see where this journey takes us.

#### What are you planning to do with the award money?

**K.A.** We live in a fascinating time of unprecedented understanding of biological machinery. The ability to engineer biology with high precision, optimize it with AI tools and scale biomanufacturing faster than nature, while maintaining greater control, creates

extraordinary opportunities to harness these biological systems for novel applications.

The award money will be invested into advancing the next generation of bio-inspired bioelectronic tools. My goal is to leverage nature biological machineries and fuse them with modern electronics to develop transformative technologies for precision medicine, with applications ranging from infectious disease diagnostics to cancer detection and the monitoring of age-related diseases.

In addition, I see this award as an opportunity to pay it forward. A portion of the funding will be dedicated to mentoring and supporting young scientists, to empower the next generation of innovators. I want to ensure that those with the passion and vision to push boundaries have the support they need to succeed. The future of bioelectronics and precision medicine depends on bold, interdisciplinary ideas, and I am committed to fostering an environment in which these ideas can take shape and create lasting impact.

**A.R.** We plan to use the award money to advance our studies into new disease areas, particularly heart failure, while also delving deeper into the cellular components of disease progression. By expanding our research focus, we aim to better understand the underlying mechanisms driving these conditions and develop more precise computational models that can inform early detection and treatment strategies.

**Y.W.** I plan to use the award money to accelerate translational research – taking the breakthroughs we have made in the laboratory and moving them closer to real-world applications. Right now, silicon photonics is at a critical point where research innovations need to be translated into scalable, manufacturable technologies. I want to invest in pushing our quantum-dot laser integration work beyond proof-of-concept and into prototypes that could be tested in commercial settings, whether for data centres, AI hardware or LiDAR applications. Having the flexibility to support high-risk, high-reward projects that are not always easy to fund through traditional academic grants is invaluable.

Ultimately, I see this as a stepping stone towards building a company in the future. Silicon photonics has incredible potential to transform industries, and I want to be part of bringing those innovations to market. This award gives me the opportunity to start laying

that foundation – whether it is through refining device performance, exploring scalable manufacturing techniques or even forming early partnerships with industry. Research is exciting, but what truly motivates me is seeing technology make a real impact. This funding will help take our work one step closer to making that happen<sup>8,9</sup>.

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The authors declare no competing interests.

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