Tyndall

Connecting ideas. Delivering impact.

2025

Annual report

Rialtas na hÉireann
Government of Ireland

UCC
Coláiste na hOllscoile Corcaigh
University College Cork, Ireland

Contents

Board chair's message

Dr Denis Doyle, Board Chair, Tyndall, Professor William Scanlon, CEO, Tyndall, James Lawless TD, Minister for Further and Higher Education, Research, Innovation and Science and Professor John O'Halloran, President, University College Cork.

When we look back on 2025 in the years ahead, it will be seen as a pivotal moment in Tyndall's history. The institute was chosen to host the launch of Silicon Island: Ireland's National Semiconductor Strategy by Minister for Enterprise, Tourism and Employment Peter Burke, TD, in May 2025.

This landmark strategy, Ireland's response to the European Chips Act, sets out a clear ambition to strengthen the country's position in the global semiconductor industry through high-value job creation, increased investment, and innovation in advanced manufacturing, chip design, and research.

Crucially, the Strategy provides a framework to bring together all participants in Ireland's semiconductor ecosystem and define their respective roles. Tyndall is proud to have contributed to its development, and its selection as the launch venue reflects the institute's central importance to both the Strategy's implementation and the broader ecosystem. Tyndall sits at the heart of this network, connecting government, industry, and research to enable collaboration and impact.

In June 2025, we were pleased to welcome Minister for Further and Higher Education, Research, Innovation and Science James Lawless, TD, to Tyndall. The support of the Department is essential to the delivery of our mission, and it is encouraging that alignment and engagement with the Department have never been stronger. During his visit, the Minister highlighted Tyndall's success in being selected to host three of the five Chips Joint Undertaking pilot lines under the European Chips Act, an achievement of major significance for Ireland's semiconductor research system.

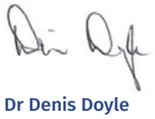
These pilot lines form an important part of Europe's collective response to semiconductor challenges, with collaboration at their core. They provide indigenous Irish companies and international partners with access to Tyndall's advanced research capabilities and infrastructure, as well as to wider European networks.

Operationally, 2025 was a highly successful year across all aspects of Tyndall's activities. Researchers received prestigious awards, research funding reached record levels, and engagement with both international and Irish industry partners strengthened further. Continued investment in infrastructure and equipment ensured the institute remains at the forefront of scientific excellence.

A major focus for the Board was the development of a new five-year strategy, as the previous plan reached its conclusion. This new strategy aligns with the Silicon Island initiative, the European Chips Act, and the priorities of Government, University College Cork, IDA Ireland, Enterprise Ireland, and other stakeholders. Its central aim is to reinforce Tyndall's role as a core pillar of Ireland's semiconductor capability.

The strategy was developed through a highly collaborative and iterative process, involving extensive consultation with partners across academia, industry, and government, as well as internal engagement within the institute. This work was successfully completed in early 2026, culminating in the publication of the Tyndall 2030 strategy.

I would like to thank the Board for their dedication in delivering this important work, alongside their ongoing responsibilities. I also extend my thanks to CEO William Scanlon and to all staff and students, whose contributions have made 2025 an outstanding year for Tyndall. Finally, I acknowledge the continued support of the Department of Further and Higher Education, Research, Innovation and Science and University College Cork, which is vital to fulfilling our mission of positioning Ireland at the forefront of global semiconductor innovation for economic and societal benefit.



Dr Denis Doyle
Board Chair

CEO's message

2025 was another year of outstanding achievement for Tyndall, with strong progress across all key metrics and targets within the five pillars of the Tyndall 2025 strategy – research excellence, impact, international positioning, people and culture, and infrastructure.

The global context has evolved significantly since the strategy was first developed. Its early implementation coincided with the COVID-19 pandemic, which highlighted society's reliance on technology and, in particular, semiconductors. This underscored Tyndall's pivotal role within Ireland's and Europe's semiconductor ecosystems and sharpened our strategic focus on positioning Ireland at the forefront of global semiconductor innovation, a goal that continues to guide all our activities.

In 2025, Tyndall recorded its strongest-ever year for project income, both in overall value and in the balanced mix of funding across frontier research, collaborative programmes, and industry partnerships. This reflects both the strength of our research base and the growing relevance of our work to industry and society.

The year also marked our most successful period for spinout activity, with three new semiconductor-focused companies established. Notably, all three were selected for the inaugural ChipStart EU programme, with only 12 companies chosen from across Europe. This recognition further reinforces Tyndall's position as a leading driver of semiconductor innovation at the European level.

Tyndall also secured two Disruptive Technologies Innovation Fund (DTIF) projects, funded by Enterprise Ireland, highlighting the impact of our research in supporting innovation among indigenous Irish companies. A further significant development was the establishment of Ireland's Chips Competence Centre (I-C3), led by Tyndall in partnership with MIDAS Ireland, MCCI, and UCD/NovaUCD. Supported by Enterprise Ireland and the EU, I-C3 is delivering services to strengthen and support the Irish semiconductor ecosystem.

Individual achievements were also notable. Researchers Dr Rehka Gautam, Dr Shree Krishnamoorthy, Dr Sabir Hussain, and Dr Samuel Delgado were awarded Research Ireland Pathway Awards, supporting the next generation of scientific leaders. Tyndall also continued to meet or exceed its targets in talent development while making steady progress towards gender diversity goals. In addition, Professor Holger Claussen was elected to the Royal Irish Academy, recognising his outstanding contribution to research.

These successes are rooted in the excellence of Tyndall's people, staff and students alike, and are supported by sustained investment in world-class infrastructure. Continued funding from Research Ireland has been critical in ensuring access to the advanced equipment required to deliver cutting-edge science.

Progress also continued on Tyndall's new building, which will double the institute's physical footprint. Contracts proceeded to tender in 2025, with completion anticipated before the end of 2028.

A defining moment of the year was the launch of the Silicon Island strategy at Tyndall by Minister for Enterprise, Tourism and Employment Peter Burke, TD, in May 2025, reaffirming the institute's central role in Ireland's semiconductor future.

The future for Tyndall is an exciting one replete with opportunities. The institute is now recognised as a cornerstone of Ireland's semiconductor ecosystem and, with the continuing support of our excellent staff and Board as well as the Department of Further and Higher Education, Research, Innovation and Science and University College Cork, I am confident that we will continue to fulfil our purpose of making Ireland a global leader in sustainable semiconductor innovation.

Professor William Scanlon
CEO

Scorecard

RESEARCH EXCELLENCE

333 publications

97% in top 10% of all journals

4 Research Ireland Pathway Awards

2 Government of Ireland PhD/PD awards

Samuel Delgado received the Microelectronic Engineering Journal Lectureship Award

Sanathana Konugolu elected as a Fellow Member of Optica

Holger Claussen elected to the Royal Irish Academy

IMPACT

98 unique industry partners engaged for research and facilities access

48% of industry funding partners were small and medium-sized enterprises (SMEs)

€8.5M received in industry funding

76 industry researchers hosted on-site

3 spinout companies launched

12 industry partners-in-residence

INTERNATIONAL POSITIONING

EU PROGRAMMES

€686m total project value | €125m Tyndall grant value
>€26m to Irish Partners | >€11m to Industry based in Ireland
84 projects | 18 Tyndall co-ordinated projects

INFRACHIP

121 Number of Transnational Access projects granted

42 Number of countries acquiring access

668 Number of researchers benefitting

MARIE SKŁODOWSKA-CURIE ACTIONS

6 Fellowship projects

4 Doctoral Network projects

1 Staff exchange project

1 Co-fund project

PEOPLE AND CULTURE

172 Postgraduate students

(**159** PhDs & **13** Masters)

581 staff/students

51 nationalities

OUTREACH

Engaged with over **1,482** students directly

over **705** primary school students

600 second-level school students

177 undergraduates

Engaged with **5,082** members of the public directly

58 staff/students participated in public events

162 staff/students participated in schools events

28 interns participated in the Summer Fellowship 2025 Programme

114 Transition Year (TY) students participated in TY programmes at Tyndall

INFRASTRUCTURE

Achieved Scope 1 emissions reduction target under the Climate Action Mandate 4 years ahead of schedule.

The Life Sciences Interface Laboratory received My Green Lab Certification through the Research Ireland-supported programme

127 New Users

405 Users trained on tools

Tyndall National Institute

Research excellence

333 publications

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Samuel Delgado received the Microelectronic Engineering Journal Lectureship Award

Sanathana Konugolu elected as a Fellow Member of Optica

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RESEARCH EXCELLENCE

Research excellence is at the very core of Tyndall and 2025 was another highly successful year in this regard.

Tyndall researchers continued to receive national and international recognition for their research excellence during the year. Professor Holger Claussen was elected to the Royal Irish Academy; Dr Sanathana Konugolu, who holds a European Research Council Starting Grant, was elected as a Fellow Member of Optica; and Dr Samuel Delgado received the Microelectronic Engineering Journal Young Investigator Award and Lectureship.

Major research funding awards included four Research Ireland Pathway Awards from the 2025 call to Dr Rekha Gautam, Dr Shree Krishnamoorthy, Dr Sabir Hussain, and Dr Samuel Delgado, enabling Tyndall to support and develop early career talent. Further prestigious research awards included Research Ireland Frontiers for the Future Programme awards to Brian Corbett, Dr Lida Ansari and Dr Farzan Gity, and a Marie Skłodowska-Curie Actions (MSCA) Doctoral Network award to Dr Daniela Iacopino as coordinator. Prof. Holger Claussen and John Morrissey are leading Tyndall's participation in two Disruptive Technologies Innovation Fund (DTIF) Awards. The Semiconductor Photonics Education and Research (SPEAR) project was successful under the PEACEPLUS Programme.

Coverage of major research advances included wireless sensors for invasive species monitoring on RTÉ News and the detection of per- and polyfluoroalkyl substances (PFAS) 'forever chemicals' in the Irish Times.

PhD candidate Sana Muzaffar, Dr Richard Murray, and Dr Alan O'Riordan

Exploring mid-infrared silicon photonics integrated circuits

Low-cost integrated spectroscopy using light in the 2–3 micron wavelength range will enable the ubiquitous sensing of greenhouse gases, such as carbon dioxide and methane, while also transforming the personal monitoring of important human biomarkers such as glucose and lactate. Achieving this requires chip scale heterogeneous integration of lasers and detectors with optical waveguides to form photonic integrated circuits made in a mass-producible manner.

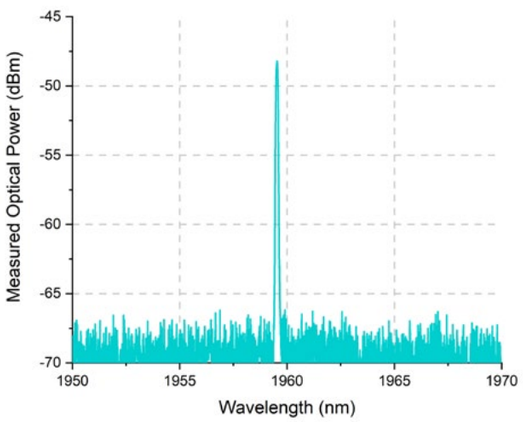
In collaboration with the Tampere University in Finland, Tyndall researchers have demonstrated a key step on this journey by realising a single frequency external cavity laser operating at 1,960 nanometres on a silicon waveguide platform. The integration technology uses micro-transfer printing, which Tyndall has pioneered, where arrays of gallium antimonide (GaSb)-based lasers were formed into suspended coupons, with each laser only 4 microns thick. The devices were then transferred and the light coupled to a mirror etched in a 3-micron thick silicon on insulator waveguide platform.

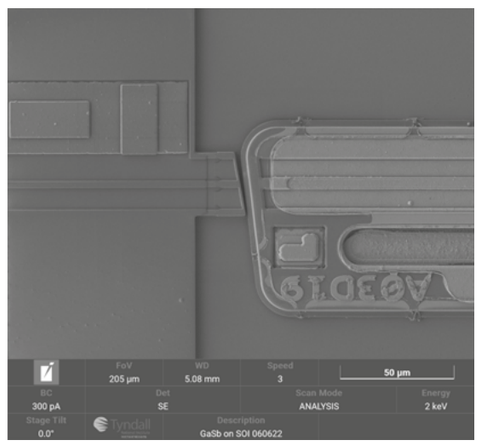
The operation of GaSb lasers can be extended to wavelengths beyond 2.5 microns, and the silicon photonics circuits can be augmented with additional functionality by the inclusion of detectors as previously demonstrated by the Tyndall team.

Tuorila H, Viheriala J, Arafat Y, Hilska J, Atar FB, Gunning F, Corbett B and Guina M

"Micro-Transfer Printing of GaSb Optoelectronics Chips for Mid-Infrared Silicon Photonics Integrated Circuits." Advanced Materials Technologies, 2025, 10(10): 2401791.

Available from: https://doi.org/10.1002/admt.202401791





Electrochemical synthesis of nitrogen-doped carbon dot inks and evaluation of their use for anticounterfeiting applications

The production and distribution of counterfeit high-value items, including banknotes, legal documents, pharmaceuticals, jewellery and fashion products, represents a major societal and economic challenge, generating an estimated US$461b in illegal sales. In the European Union (EU) alone, counterfeit products account for 5% of total imports, highlighting the urgent need for new, robust anticounterfeiting technologies.

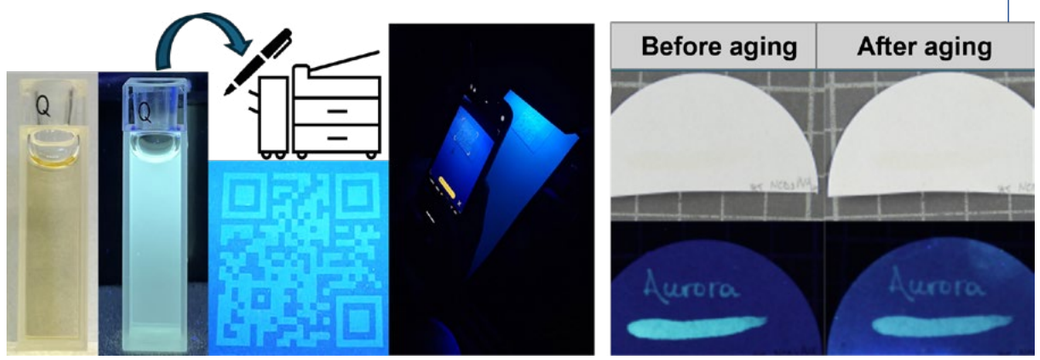
In this work, we synthesised nitrogen-doped carbon dots (N-CDs) to develop highly fluorescent, durable security inks for future anticounterfeiting marking. The N-CDs were produced through fast, novel and environmentally friendly electrochemical synthesis, using readily available, chemically friendly precursors in aqueous media and mild operating conditions. The resulting nanomaterials exhibit strong excitation-dependent fluorescence, with a tuneable emission spanning from blue to green and a quantum yield higher than comparable electrochemical approaches. Importantly, the N-CDs show excellent stability across a broad range of realistic conditions, maintaining their optical performance under varying temperatures (4–40 °C) and pH values (2–9). Optimised N-CD-based ink formulations were successfully applied through both pen-writing and inkjet printing, producing security patterns invisible under ambient light but clearly detectable under ultraviolet illumination. Accelerated ageing tests confirmed strong resistance to environmental degradation, supporting their suitability for real-world applications. This research reflects how Tyndall actively addresses societal challenges by developing novel, robust, sustainable nanotechnologies to combat fraud and protect consumers.

Martina Piletti, Themis Krasoudaki, Andrea Matulac, Labrini Sygellou, Dario Angelone, Sanathana Konugolu Venkata Sekar, Rodorico Giorgi, Aidan J. Quinn, Daniela Iacopino

"Electrochemical synthesis of nitrogen-doped carbon dot inks and evaluation of their use for anticounterfeiting applications." Journal of Materials Chemistry C 2025.

Available from: https://doi.org/10.1039/D5TC00939A

Electrochemically synthesized N-CDs for a rapid, low-cost route to pen-written and inkjet-printed fluorescent security markers, remaining invisible under ambient light while emitting bright fluorescence under UV illumination



Why ‘Zn diffusion’ is not always diffusion

Metal–organic-vapour-phase-epitaxy (MOVPE) is a well-established technique for growing III-V materials and underpins many modern photonic devices.

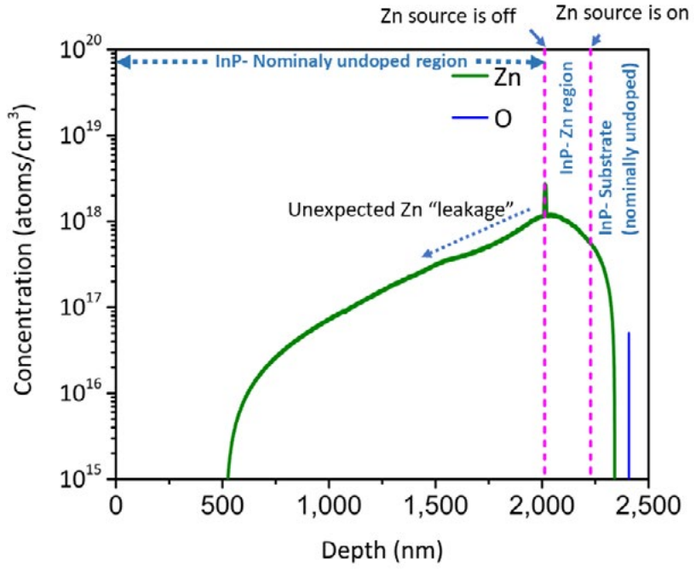
Despite its widespread use, many unresolved issues continue to hinder the further development of novel III-V devices. One such issue is the so-called ‘long-range’ diffusion of zinc (Zn), a typical p-type dopant historically famous for its high diffusivity. To mitigate this problem, most III-V-based photonic devices, including lasers and modulators, are fabricated with an n-i-p design, placing the p-type doping at the top of the structure. While this reduces the time available for Zn to diffuse, it also restricts the design flexibility.

This work re-evaluated the Zn doping issues with surprising findings on Zn dopant behaviour. Secondary ion mass spectrometry (SIMS) experiments show that Zn (or its precursors) can act as a surfactant, accumulating on the sample surface during the growth of intentional doping layers and gradually incorporating into nominally undoped layers even after the Zn source is closed. These observations are supported by semi-quantitative modelling combining surfactant and diffusion behaviour. Importantly, we demonstrated that this phenomenology can be suppressed through growth interruptions or, more effectively, by introducing a competing surfactant species such as antimony. These results highlight the importance of a multifaceted surface process in MOVPE and support robust solutions for advanced III-V designs, enabling next-generation integrated applications.

Ayse Ozcan-Atar, Agnieszka Gocalinska, Paweł P. Michałowski, Mack Johnson, John O’Hara, Brian Corbett, Adrianna Rejmer, Frank Peters, Dimitri D. Vvedensky, Andrew Zangwill, Gediminas Juska, Emanuele Pelucchi

“Why ‘Zn diffusion’ is not always diffusion: Surface physics and a 40-year-old epitaxy problem.” Applied Surface Science 2025.

Available from: https://doi.org/10.1016/j.apsusc.2025.162360



Revolutionising non-reciprocal filtering networks with reconfigurable and flexible signal routing via spatiotemporal modulation-based switching

Modern wireless transceivers require compact, reconfigurable and non-reciprocal radio frequency (RF) front ends capable of supporting flexible signal routing, filtering, and isolation within stringent size and power constraints. Conventional solutions rely on cascaded components and magnetic-based non-reciprocal devices, leading to increased loss and footprint as well as system complexity.

Researchers at Tyndall have developed a new magnet-free approach to enable RF switching and non-reciprocal bandpass filtering based on spatiotemporally modulated (STM) resonator arrays. By applying low-frequency phase-shifted modulation signals to coupled resonators, this technique enables unilateral signal transmission while embedding intrinsic switching and filtering within a single circuit. Crucially, signal paths are dynamically configured without additional RF switches.

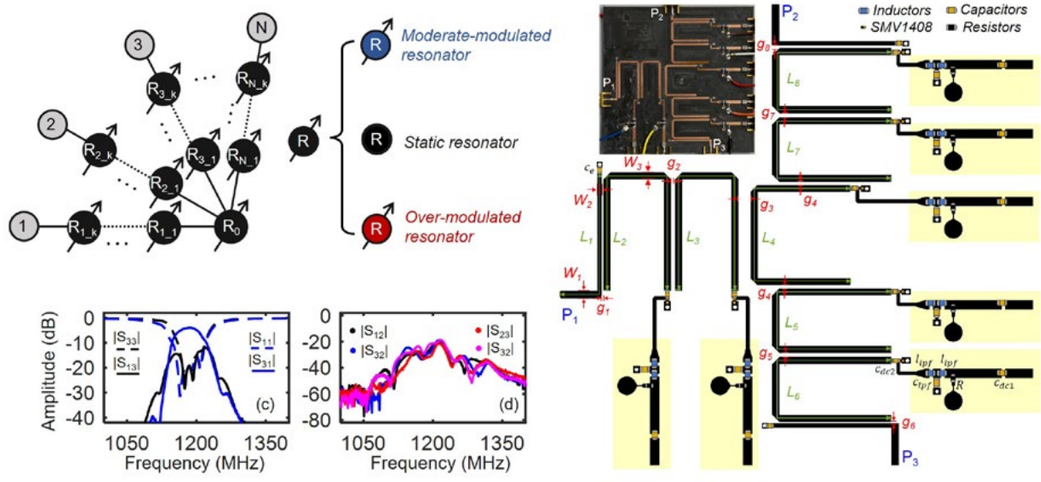
STM has recently emerged as a promising approach for realising magnet-free, Integrated Circuit-compatible and energy-efficient non-reciprocal devices. However, previous STM-based devices overlooked the intrinsic switching off capability of STM resonators. In this research, switching off is achieved using over-modulation, which suppresses signal transmission by redistributing RF power into higher-order intermodulation products. A three-port prototype operating at L-band validated the concept, achieving over 20-decibel isolation and third-order bandpass filtering performance across all reconfigurable states.

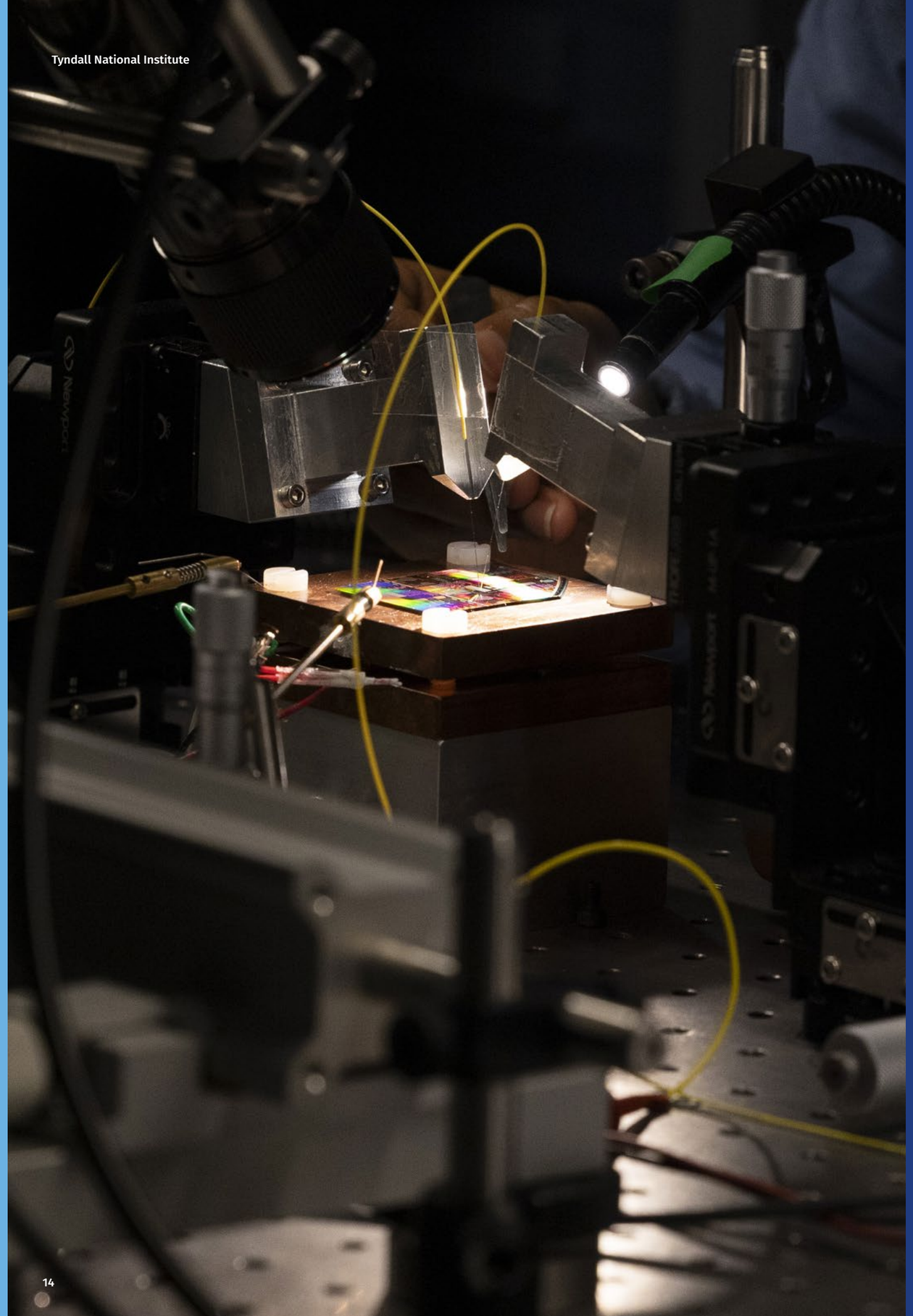
Building upon this foundation, the same STM-based switching principle has been extended to scalable multi-port and multifunctional RF signal-routing networks, further enabling concurrent dual-channel routing, power division, and circulation. By solely controlling modulation states, these networks provide a compact, flexible and scalable solution for future full-duplex and multi-antenna wireless systems.

Zixiao Zhang, Dimitra Psychogiou

“Unilateral Single-Pole MultiThrow Filtering Switch Using Spatiotemporally Modulated Resonator Arrays.” IEEE/MTT-S International Microwave Symposium Digest 2025.

Available from: https://doi.org/10.1109/IMS40360.2025.11103769





Impact

98 unique industry partners engaged for research and facilities access

48% of industry funding partners were small and medium-sized enterprises (SMEs)

€8.5M **received in industry funding**

76 industry researchers hosted on-site

3 spinout companies launched

12 industry partners-in-residence

Tyndall's impact goals align with the ambitions of Silicon Island: Ireland's National Semiconductor Strategy, and specifically the aims to grow Ireland's semiconductor ecosystem, create a strong talent pipeline, and foster an open ecosystem based on collaboration.

Measures of our 2025 impact include:

- Direct engagement with 98 companies (48% small and medium-sized enterprises)
- Securing €8.5 million in industry funding (29% from overseas)
- 71 industry researchers (24% from small and medium-sized enterprises) utilised our fabrication and laboratory facilities.

Further outputs that have directly contributed to the growth of the sector included the creation of three spinout companies, the establishment of Ireland's Chips Competence Centre (I-C3) to support indigenous companies to scale, and the mapping of the indigenous semiconductor sector. This final activity identified 78 companies employing more than 3,400 people and will be updated annually in order to quantify the growth of the sector, both in terms of the number of companies and the total number of people employed.

The establishment of I-C3, led by Tyndall with consortium partners MIDAS Ireland, Microelectronic Circuits Centre Ireland (MCCI), and University College Dublin (UCD)/NovaUCD represented a key milestone. I-C3 is developing tailored supports in funding, training and mentoring, advisory services, market access, and industry networking with the objective of assisting companies to scale their businesses.

Dr Patrick Morrissey, Elisabeth Wintersteller, John Blake and Dr David McGovern

Spinout companies

Tyndall generated three new spinout companies in 2025.

In March, Vivid Photonics spun out of Tyndall's Photonics Centre/Irish Photonic Integration Centre (IPIC) to commercialise Brian Corbett's patented surface-emitting Superluminescent Diode (SLD) technology for applications in advanced medical imaging, optical coherence tomography, fibre sensing, and high-precision industrial measurement systems.

In September, PulpoSemi was established as a spinout. This company emerged from MCCI and is led by Séamus O'Driscoll. PulpoSemi's ambition is to address the specific market need for disruptive power electronics voltage regulator chiplet solutions for integration in artificial intelligence (AI) SoCs.

The final spinout of the year was Endurance Semiconductors, which spun out in November. This venture is based on commercialisation activity led by Alan Blake in Tyndall's Speciality Products and Services. Ger O'Keeffe is leading the new company, whose silicon carbide devices aim to cut power losses by up to 50%, reducing heat, cost, and carbon across the world's most demanding systems: from AI data centres to electric-mobility and renewable-energy platforms.

All three spinouts were selected to participate in the inaugural ChipStart EU Programme, an incredible achievement considering that only 12 companies were selected in total from across Europe for this initiative.

Launched in Malta, ChipStart EU is Europe's first incubator focused specifically on accelerating semiconductor start ups from concept to commercial impact. The highly competitive programme is designed to address some of the most challenging barriers faced by chip start ups: access to expertise and industrial partnerships, and costly design and fabrication resources.

Three Tyndall companies being accepted into the inaugural programme highlights the quality of innovation emerging from Tyndall and the strength of its start up support environment. Each company will benefit from tailored technical mentoring, access to world class semiconductor partners and business development support, and connections into global supply chains – all critical assets for scaling in Europe's rapidly evolving chip landscape.

This success also supports Europe's ambitions under the European Chips Act, which aims to strengthen its semiconductor autonomy and resilience. By helping early-stage companies bridge the gap between research excellence and market-ready technology, ChipStart EU plays a vital role in translating innovation into economic impact.

Chris Gorman, CEO, Vivid Photonics

Working with industry to support future talent needs

Tyndall hosted Building a Future with Chips: Career Opportunities in the Irish Semiconductor Sector, a 1-day event that brought together 80 undergraduate science, technology, engineering, and mathematics (STEM) students from across Ireland and representatives from 12 leading organisations in the semiconductor space.

Jointly organised by IPIC and MIDAS Ireland, the event aimed to showcase the career paths available in Ireland's growing semiconductor sector. With more than 20,000 professionals already employed in semiconductor-related roles and that number set to grow, the event was an opportunity for students to explore career pathways in this high-growth sector. Industry leaders such as AMD, Analog Devices, Cadence Design Systems, Infineon Technologies, Qualcomm, and Qorvo joined forces with Irish innovators and research centres including Equal1, Orbital Innovations, the International Energy Research Centre (IERC), IPIC, MCCI, and Tyndall. Together, they engaged students through interactive sessions, expert panels and networking opportunities.

Furthermore, in order to support the development of entrepreneurial thinking and catalyse new spinout opportunities, the fifth edition of the IPIC Explorer pre-commercialisation programme was also delivered during 2025. The programme took seven teams on an accelerated journey through product definition, market sizing and customer engagement, which cumulated in them presenting to a panel from ams OSRAM (sponsors), Atlantic Bridge, Enterprise Ireland and MIDAS Ireland.

Building a Future with Chips: Career Opportunities in the Irish Semiconductor Sector event at Tyndall

Emerging spinouts

Two new Enterprise Ireland Commercialisation Fund projects were approved for the Life Sciences Interface Group and Tyndall's Photonics Centre/IPIC.

Another two projects secured funding from the new Accelerating Research to Commercialisation (ARC) Hub for HealthTech. These projects will be developed by Dr Conor O'Mahony in the Life Sciences Interface Research Group and by Dr Salvatore Tedesco in the Wireless Sensor Systems Research Group. Conor's project involves the development of an emerging smart wound care device, which involves the merger of sensors and information and communication technologies with conventional dressings. Salvatore's project is focused on the development of a wearable medical device that monitors patients with Parkinson's disease.

Two Enterprise Ireland-funded Feasibility Studies were completed during 2025, and an additional Feasibility Study was approved for funding by year-end.

The establishment of I-C3 during 2025 will ensure that new supports will be available to spinout companies emerging from Tyndall until 2029. This initiative will positively impact on Tyndall's new ventures agenda, including the provision of dedicated support for participant companies that are conducting fundraising.

International positioning

EU PROGRAMMES

€686m total project value | €125m Tyndall grant value
>€26m to Irish Partners | >€11m to Industry based in Ireland
84 projects | 18 Tyndall co-ordinated projects

INFRACHIP

121 Number of Transnational Access projects granted

42 Number of countries acquiring access

668 Number of researchers benefitting

MARIE SKŁODOWSKA-CURIE ACTIONS

6 Fellowship projects

4 Doctoral Network projects

1 Staff exchange project

1 Co-fund project

INTERNATIONAL POSITIONING

Tyndall significantly advanced its strategic influence and international standing throughout 2025, cementing its role as a central pillar in Ireland's semiconductor ecosystem. Tyndall's activities spanned high-level policy contributions as well as leadership in European roadmaps. Tyndall also secured significant funding and other strategic wins in 2025, reinforcing its position as a leader in European semiconductor research and innovation. These successes span critical infrastructure, international cooperation, and advanced training networks.

Thought leadership

A defining moment for Tyndall in 2025 was hosting the launch of Silicon Island: Ireland's National Semiconductor Strategy. Tyndall was instrumental in shaping and advancing this Government-endorsed strategy, notably through its influential position paper, "Ireland's Role in the Global Semiconductor Industry". Supported by the Department of Enterprise, Trade and Employment (now the Department of Enterprise, Tourism and Employment), Silicon Island positions Ireland to capture new opportunities within the global semiconductor supply chain, aligning with the European Chips Act. Tyndall's pivotal role was further formalised by becoming a signatory to the Declaration of the Semicon Coalition, underscoring its commitment to European technological sovereignty. Beyond this flagship launch, Tyndall researchers actively shaped policy by contributing to five position and white papers in 2025, providing expert guidance on critical technology sectors.

Tyndall continues to hold key leadership positions in major European industry associations, with representation on the board of the European Association on Smart Systems Integration (EpoSS), as well as on the Board of the Chips Joint Undertaking (Chips JU). These appointments ensure that Irish research priorities are represented at the highest levels of European decision-making.

Tyndall also demonstrated thought leadership in defining future research directions. Tyndall researchers co-led two critical chapters in the 2026 Electronic Components and Systems Strategic Research and Innovation Agenda (ECS SRIA): "Agrifood and Natural Resources" and "Long Term Vision". Additionally, Tyndall holds the Chair of the International Focus Team for 'More than Moore' within the International Roadmap for Devices and Systems, a prestigious role that influences global semiconductor development beyond standard scaling.

Prof. Cian O Mathúna

Partnerships

Tyndall significantly expanded its global reach and industrial partnerships in 2025 through high-profile international engagements and strategic project wins.

Tyndalls strengthened ties with Asian markets through a strategic mission to Korea and Japan. Following attendance at PwrSoC in Korea, Tyndall researchers joined an IDA Ireland-supported trade mission, conducting numerous high-level meetings with key industry partners. This commitment to international business development continued in the United States, where Tyndall co-organised the Ireland pavilion at SEMICON West in collaboration with IDA Ireland, showcasing Irish semiconductor capability to a global audience.

Furthermore, Tyndall maintained a strong presence at SPIE Photonics West 2025, the world's premier photonics forum. The delegation delivered seven presentations and supported the launch of the new spinout company, Vivid Photonics, underscoring Tyndall's role in translating research into commercial reality.

Dr Padraic Morrissey

Large-scale projects

Tyndall secured significant funding and strategic wins in 2025, reinforcing its position as a leader in European deep tech research and semiconductor innovation. These successes span critical infrastructure, international cooperation, and advanced training networks.

Strengthening ties between Europe and global semiconductor leaders, Tyndall successfully coordinated the Japan and EU Semiconductors: Mutual Innovation & Excellence (JASMINE) project, which kicked off in early 2026. Funded under a specific call to boost research and innovation cooperation between the EU and Japan, this project underscores Tyndall's role in bridging European and Asian semiconductor ecosystems.

In the prestigious MSCA Doctoral Network programme, Tyndall achieved 2 notable successes out of 153 funded projects across the EU. This includes the FERNS network, coordinated by Tyndall, which will train the next generation of researchers in sustainable electronics.

International Cooperation on Semiconductors – ICOS

The International Cooperation on Semiconductors (ICOS) initiative, funded under Horizon Europe, is a strategic Coordination and Support Action designed to strengthen Europe's position in the global semiconductor value chain through targeted international research collaboration.

The project, running from January 2023 through to early 2026, has delivered a comprehensive analysis of global semiconductor ecosystems, identifying technological priorities, capability gaps, and opportunities for cooperation with leading regions including the United States, Japan, South Korea, Taiwan, and India. Key outputs include in-depth value chain assessments, strategic gap analyses, international workshops, and policy-oriented recommendations that informed European Commission actions and future research programmes in alignment with the EU Chips Act.

Over its three-year duration, ICOS has successfully fostered partnerships, shaped collaboration frameworks, and provided actionable guidance to translate Europe's research excellence into industrial competitiveness. Tyndall has played a leading role within the consortium, acting as Work Package leader for Horizon Scanning and Technology.

Europractice 2.0

Tyndall secured funding for EUROPRACTICE 2.0, ensuring the continued provision of essential design tools and fabrication services to academia and industry across Europe.

EUROPRACTICE 2.0 is the latest phase of Europe's semiconductor prototyping and design infrastructure, funded through the Chips JU to strengthen European microelectronics capability and semiconductor sovereignty. Building on more than 30 years of EUROPRACTICE activity, the programme expands access to advanced design tools, Multi-Project Wafer (MPW) fabrication, heterogeneous integration, chiplet technologies, and advanced packaging services for universities, research institutes, and early-stage innovators across Europe. Its aim is to lower barriers to semiconductor innovation while supporting the path from research and education to system-level prototyping.

Tyndall plays a central role within EUROPRACTICE 2.0 through its expertise in advanced packaging and system integration. Tyndall supports the programme's move beyond stand-alone chip fabrication towards integrated electronic and photonic systems, contributing capabilities in photonics packaging, module integration, and silicon interposer technologies. These services help bridge the gap between fabricated dies and deployable demonstrator hardware.

A major focus of EUROPRACTICE 2.0 is heterogeneous integration and advanced packaging. The programme now supports technologies including 2.5-dimensional and three-dimensional (3D) integration, flip-chip assembly, wafer-level fan-out, and silicon interposers. Tyndall's custom silicon interposer platform enables compact multi-die integration and chiplet-based system development for next-generation electronic and photonic applications.

Through EUROPRACTICE 2.0, Tyndall also offers expert-led training in advanced areas such as photonics packaging, micro-transfer printing, and compound semiconductor laser fabrication. These hands-on courses provide practical experience with the state-of-the-art facilities and processes essential for the manufacture and integration of next-generation photonic devices.

Sparkle

Funded by Research Ireland and the European Commission, the MSCA COFUND SPARKLE is an advanced training and research programme operated by IPIC that was delivered from June 2019 to December 2025.

Following a competitive application process, 25 experienced international researchers were selected for fellowship positions. They relocated from 12 countries to Europe for a 2-year fellowship in photonics and semiconductor technologies.

The fellows published 13 peer-reviewed papers and participated in 68 outreach and engagement activities, including MSCA Researchers' Night and the IPIC podcast A Little Light Listening, helping to raise public awareness of advanced photonics and semiconductor research. By supporting career development and attracting global talent, SPARKLE contributed to strengthening Europe's photonics and semiconductor ecosystem. Programme alumni are taking up senior roles in academia and industry, demonstrating the lasting impact of SPARKLE on research excellence and innovation capacity.

Participants of training event: A guide to proposal writing, held on 4th and 5th March 2025 at Tyndall National Institute, co-organised by MSCA COFUND SPARKLE and the Tyndall TEC-Net.

People and culture

172
Postgraduate students
(**159** PhDs & **13** Masters)

581
staff/students
51 nationalities

OUTREACH
Engaged with over **1,482** students directly

over **705** primary school students

600 second-level school students

177 undergraduates

Engaged with **5,082** members of the public directly

58 staff/students participated in public events

162 staff/students participated in schools events

28 interns participated in the Summer Fellowship 2025 Programme

114 Transition Year (TY) students participated in TY programmes at Tyndall

Tyndall's Annual Cultural Celebration

PEOPLE AND CULTURE

2025 was a year of progress across People and Culture as we continued to strengthen our commitment to supporting our people, developing talent, and fostering an inclusive and positive culture at Tyndall. By year-end, Tyndall had 581 research and professional services staff, including 172 PhD and MSc postgraduate students, representing more than 50 nationalities, reflecting the global nature of our community.

Our focus on equality, diversity and inclusion remained strong throughout the year. We continued to advance actions under the Athena Swan Action Plan, introduced gender-decoded job descriptions in order to support fair and inclusive recruitment, and further promoted the visibility and progression of women in STEM. Positive workplace behaviour remained a priority, with ongoing delivery of bystander intervention training and strong promotion of the duty of care and right to dignity policies.

In 2025, we strengthened support for staff through enhanced maternity supports and the introduction of human resources clinics every 2 weeks, offering accessible, practical advice for all staff. The Leadership Forum continued to grow, building capability and consistency across Tyndall's leadership community, while the new LIFT Programme was launched in order to support leadership development and values-based behaviours, with full rollout continuing into 2026.

Policy development continued during the year with the introduction and implementation of the UCC Work Life Balance Policies, which include provisions for remote working and flexible working for caring purposes. Staff have already made use of these supports, demonstrating strong engagement with flexible working options.

Engagement and communication continued to be strengthened through the ongoing success of the Good to Know campaign, helping staff and students easily access important information on policies, supports and benefits. The Tyndall Annual Recognition Awards (TARAs) continued to grow, with 18 award winners and the introduction of 2 new engineer awards, further broadening the scope of recognition across Tyndall.

2025 reflected Tyndall's continued commitment to supporting people, nurturing development, attracting top talent, and building a culture grounded in inclusivity, respect and collaboration.

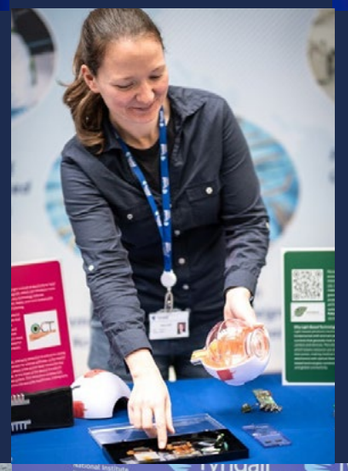
Tyndall's Annual Recognition Awards (TARAs)














Education and public engagement

In 2025, 283 staff and students from across the institute participated in education and public engagement (EPE) activities. These efforts allowed us to directly engage with more than 1,400 school and undergraduate students, as well as 5,082 members of the public.

A highlight of 2025 was Science Week, when IPIC and Tyndall collaborated with the Future Humanities Institute at UCC to deliver “Light Laboratory: Optical Science Past, Present, Future”. Funded by Research Ireland under the Discover Science Week Programme. This in-person experience brought together art and STEM in order to illuminate the history and future of light. Over 2 days, we engaged with 80 secondary school students as well as youth and community groups.

At the TARAs, Rupa Ranjani Palanisamy was recognised as the EPE/Outreach Person of the Year for her outstanding contribution and commitment to EPE activities and events throughout the year.

At third level, 28 undergraduate students were awarded places in the 2025 Tyndall and IPIC Summer Fellowship Programme, which ran for 12 weeks from June to August and was coordinated by Dr Caitriona Tyndall.

Tyndall's TY Programme

PhD Vivas 2025

Michael Amissah
Investigation of diffuse reflectance spectroscopy and acousto-optics for deep tissue imaging and diagnostics

Dario Angelone
Novel tools for in vivo fluorescence lifetime imaging using miniaturised SPAD arrays

Andrea Bocchino
Wearable microsystems for transdermal delivery and diagnostics

Finbarr Buckley
Design and application of molecularly imprinted polymers for the detection of BPA, PFOA, and caffeine

Subash Chevella
High-performance building blocks for analogue-to-digital converters

Luca Colavecchi
Processing techniques, structural configurations, and electric field influence in Pyramidal Quantum Dots: an experimental and simulative investigation

Ehren Dixon
Electrochemical materials and microfabrication for sensor devices

Gokhan Dumlupinar
Near-infrared to near-infrared upconverting nanoparticle optical nanoprobe on bio-imaging applications

Ana Cláudia Rodrigues Ferreira
Development of a smart bolus system for multi-parameter monitoring of bovine welfare

Robert Finn
Electronic and optical properties of A1GaN-based heterostructures

Eva Flynn
Bioimpedance sensing for distinguishing tissue types in excised breast tissue

Annamaria Fordymacka
Bridge to digital converters for environmental monitoring in edge IoT devices

Rachel Georgel
Electronic interfaces for biophotonics data capture

Parnika Gupta
Study of glass interposers for co-packaging electronic and photonic chips

Jahidul Islam
Sustainable laser-induced graphene (LIG) for electrochemical sensing, energy storage and harvesting

Giulia Malvicini
Advancements in Fabry-Pérot cavity fabrication and its applications in photothermal spectroscopy for trace gas sensing

Siddra Maryam
Optical diagnostics for oral and gastrointestinal tract pathologies

Francesco Mattana
Generation of multi-photon quantum states from quantum dots

Peter Milner
Design, fabrication and characterisation of ultraviolet light-emitting diodes for biomedical applications

Cónal Murphy
Predictive atomistic simulation and in silico design of quantum dots for classical and quantum light emitters

Stephen Murphy
Artificial intelligence based techniques for optical networks

Mohammed Nasser
New design techniques and architectures for highly-reconfigurable and continuously-tunable RF filters using acoustic-wave and planar-microwave resonators

Brendan O'Sullivan
Gate driver systems using heterogeneously integrated transformers for isolated signal and power transfer

Alida Russo
Direct writing of functional materials for milk quality point-of-care tests

Kevin Sewell
Unveiling transport, optical and spin-scattering mechanisms in GESN alloys through first-principles calculations

Manish Srivastava
On-chip magnetic sensor and readout design for 3D position tracking in image-guided interventions

Madhan Venkatesh
Low-power SAR ADC for biomedical portable devices

Anthony Wall
CMOS techniques for direct digitisation of current signals

Jack Wall
Mode-locked silicon nitride photonic integrated circuit based hybrid external cavity lasers

Zhongzheng Wang
The design of sensor interface circuits for electrochemical impedance spectroscopy

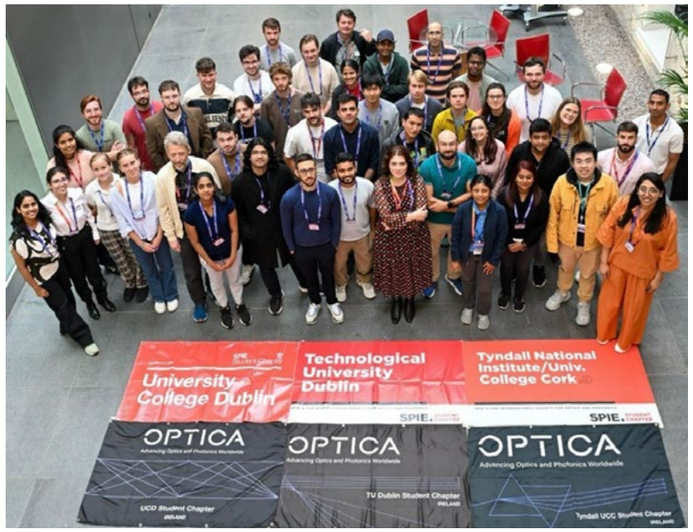
Zidi Zhang
Generation and detection of photo-thermal and photo-acoustic waves in solids for advanced near-field IR imaging

PIADS

2025 marks another successful year for our PhD students in the Centre for Doctoral Training in Photonic Integration and Advanced Data Storage (PIADS). Having started in 2019, PIADS saw its first PhD students successfully completing their viva in 2024 and 2025.

To date, IPIC accounts for five PIADS alumni in the Centre for Doctoral Training. From successfully applying for their own research funding with Research Ireland, to taking up careers in companies like GlobalFoundries, Intel, Meta, or Xanadu, our PhD students are equipped with the best skills to take up advanced roles.

Cohort-based training plays a big part of their student life. From annual winter schools to career days and our Conclave research showcase, there are plenty of training opportunities for our students to grow a skill set that is tailored to their future career ambitions.



A highlight of 2025 was the student conference, which was co-organised by the Irish Optica and SPIE student chapters, and PIADS. It welcomed 80 postgraduate students to Cork for an engaging 2-day event. The conference delivered a vibrant programme of keynote talks, workshops for skills development on presentation skills and AI in photonics, as well as a career panel discussion, industry visits, networking opportunities and social events.

Student awards

2025 Postgraduate Publication of the Year

Sponsored by Qualcomm

Winner:

Alida Russo

Pen direct writing of SERRS-based lateral flow assays for detection of penicillin G in milk

Runners-up:

Peter Milner

Temperature-dependent investigation of polarisation doping in 330 nm ultraviolet light-emitting diodes

Owen Moynihan

Micro-transfer printed high-speed inp-based electro-absorption modulator on silicon-on-insulator

Saif Wakeel

Etching-free fabrication and integration of 45° micro-mirror for surface-compatible photonic packaging

Zixiao Zhang

Multi-functional single/multi-band bandpass filters with co-integrated RF isolator, variable phase shifter or variable attenuator functionalities

Rising star:

Karan Roy

Tuning non-linearity in cascaded tapered spring topologies of electromagnetic-vibrational energy harvesters with enhanced figure of merit

Wrixon Research Excellence Bursaries

Zixiao Zhang

Zixiao's research is paving the way for future wireless communication systems by developing compact, energy-efficient RF filters using special resonator arrays that can be 'modulated' in space and time. These multifunctional components combine filtering, phase shifting, and signal routing in a single device, reducing size and cost while enabling adaptable RF front ends for 6G networks.

Debismita Dutta

Debismita is tackling the energy restrictions in modern computing by engineering ferroelectric materials for ultra-low-power memory and neuromorphic systems. Her work introduces spiral defect structures to reorient polarisation and reduce switching energy fourfold, alongside a novel 3D X-ray analysis method to map complex defects, advancing scalable, energy-efficient devices.

Tommy Murphy

Tommy's research enhances integrated photonics through improved quantum nanostructures such as quantum dots and wells. He developed QUDOS, an open-source simulator for predicting optical properties, and solved a decades-old puzzle in quantum well intermixing. These breakthroughs enable smarter design of high-speed photonic components for data communication.

Cian O'Donnell

Cian is developing millimetre-scale wireless implants for real-time tumour tracking, using miniature inductive power transfer and low-power sensing. This innovation promises to improve surgical precision and patient outcomes by enabling accurate, continuous monitoring during procedures.

Dario Angelone

Dario's project introduces EndoCam, a tiny SPAD-based fluorescence lifetime imaging (FLIm) camera that fits into endoscopes for real-time imaging inside the body. His work demonstrates FLIm for tumour tissue analysis and creates the first chip-on-tip FLIm micro-camera for clinical use, paving the way for advanced diagnostic tools.

BOC Gases Postgraduate Bursary

Rajvinder Kaur

Micro-thermoelectric cooler for thermal management of integrated photonic devices

Wrixon Travel Bursaries

Rajan Bharti

Rajan's project seeks to improve the efficiency of tiny InGaP micro-light-emitting diodes (LEDs) by tackling defects that waste energy instead of producing light. These losses occur at the interface with Al_2O_3, likely due to missing phosphorus atoms. Current research has identified the electrical signature of these defects, but their full behaviour remains unclear. A planned study will use advanced spectroscopy techniques in order to map these defects in detail, revealing their energy levels and how they interact with light. The findings will guide methods to suppress these defects, boosting LED performance and enabling more efficient, miniaturised optoelectronic devices for future technologies. Rajan will travel to Ohio State University, where he will be working in the Electronic Materials and Devices Laboratory.

Simone Innocente

Simone is applying advanced machine learning to interpret complex optical spectroscopy data, improving diagnostic accuracy in pathology. By developing standardised data processing tools and combining features from multiple techniques, his work enhances both the quality and precision of disease detection. Simone will travel to Florida International University in Miami, where he will be working in the Medical Photonics Laboratory.

Notable Student Awards

Ajay Mothe, Steven Cheng & Zehan Guo

- First prize in the Student Design Competition at European Microwave Week, Utrecht, Netherlands

Amna Javed Tiwana

- Best poster award at the Photonics Ireland Conference 2025

Tiwana AJ, Townsend P, Claussen H & Ouyang X,

- A computationally efficient 2D-root MUSIC parameter estimation for OCDM-based RadCom
- TEC-NET Scientific writing competition for early career researchers in Tyndall – 2025

Berkay Dogan

- IEEE Microwave Theory & Technology Society Pre-graduate Scholarship 2025 (Cycle 1): Dogan B and Psychogiou D, Highly-Miniaturized 3D RF Filtering Technologies Enabled by Monolithically-Integrated Resonator Arrays
- European Microwave Week 2025 Student Travel Grant Honour: Dogan B, Patil DD and Psychogiou D, Ultra-Compact Inkjet-Printed Folded Waveguide Resonator-Based Bandpass Filters
- The 20th Royal Irish Academy (RIA)/ International Union of Radio Science (URSI) Research Colloquium on Radio Science and Communications Best Student Paper: Dogan B and Psychogiou D, Monolithically-Integrated Nested Ridge Waveguide Dual-Channel Filters
- First place in Best Pitch Prize Awards, Tyndall Deep-Tech Ideation Challenge

Changhao Li

- UKNC Travel Bursary (awarded by the UK Nitrides Consortium)

Cian O'Donnell

- Analog Devices Outstanding Student IC Designer Award 2025

Jordan Darran Emmett Walsh

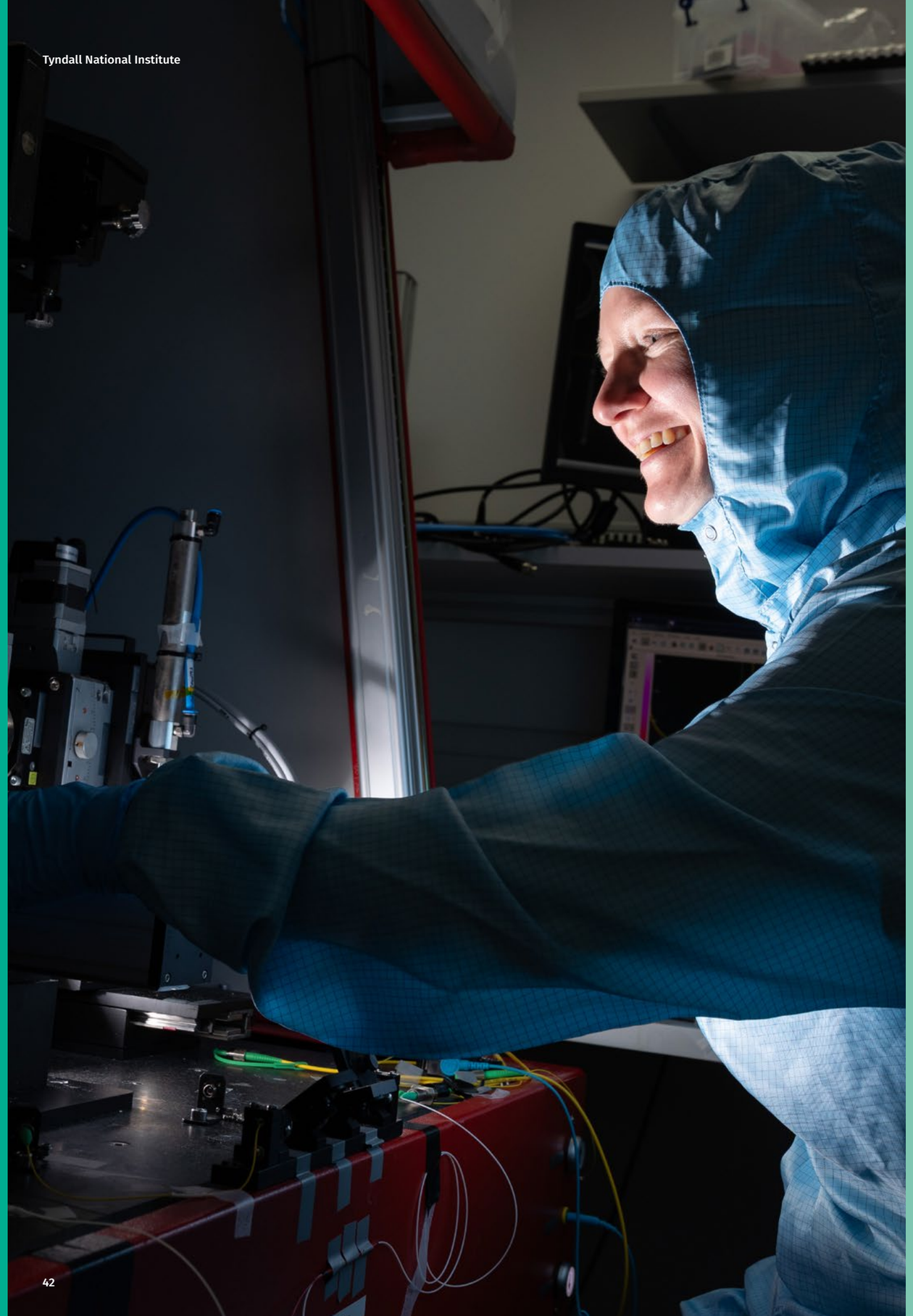
- Best Poster Award, Photonics Ireland Conference 2025: Walsh JDE, Broderick CA and Peters FH, Inverse design of semiconductor quantum wells for integrated photonics
- Student Poster Award runner-up, Tyndall Internal Conference 2025

Rupa Ranjani Palanisamy

- Education and Public Engagement/ Outreach Person of the Year Award at the 2025 TARAs
- Honorable mention in the nanoartography image competition for a scientific image at the intersection of nanoscience and art. Awarding body: Purdue University, USA.

Somali Dhal

- Best Paper Award Honourable Mention, Biophotonics Summer School 2025, SPIE: Dhal S, Fernandez MV, Humbert G, Andersson-Engel S, Komolibus K, Dean K and Gautam R, Saliva Filtering for Diagnostics: A Pitfall?
- SPIE Optics and Photonics Scholarship 2025, Funding Body: SPIE Steven Cheng
- First place in Tyndall Deep-Tech Ideation Challenge, Best Market Opportunity and Overall Winner Award (Steven Cheng, Pavel Kirilenko, Jose Cortes and Yineng Wang)



Infrastructure

Achieved Scope 1 emissions reduction target under the Climate Action Mandate 4 years ahead of schedule.

The Life Sciences Interface Laboratory received My Green Lab Certification through the Research Ireland-supported programme

127 New Users

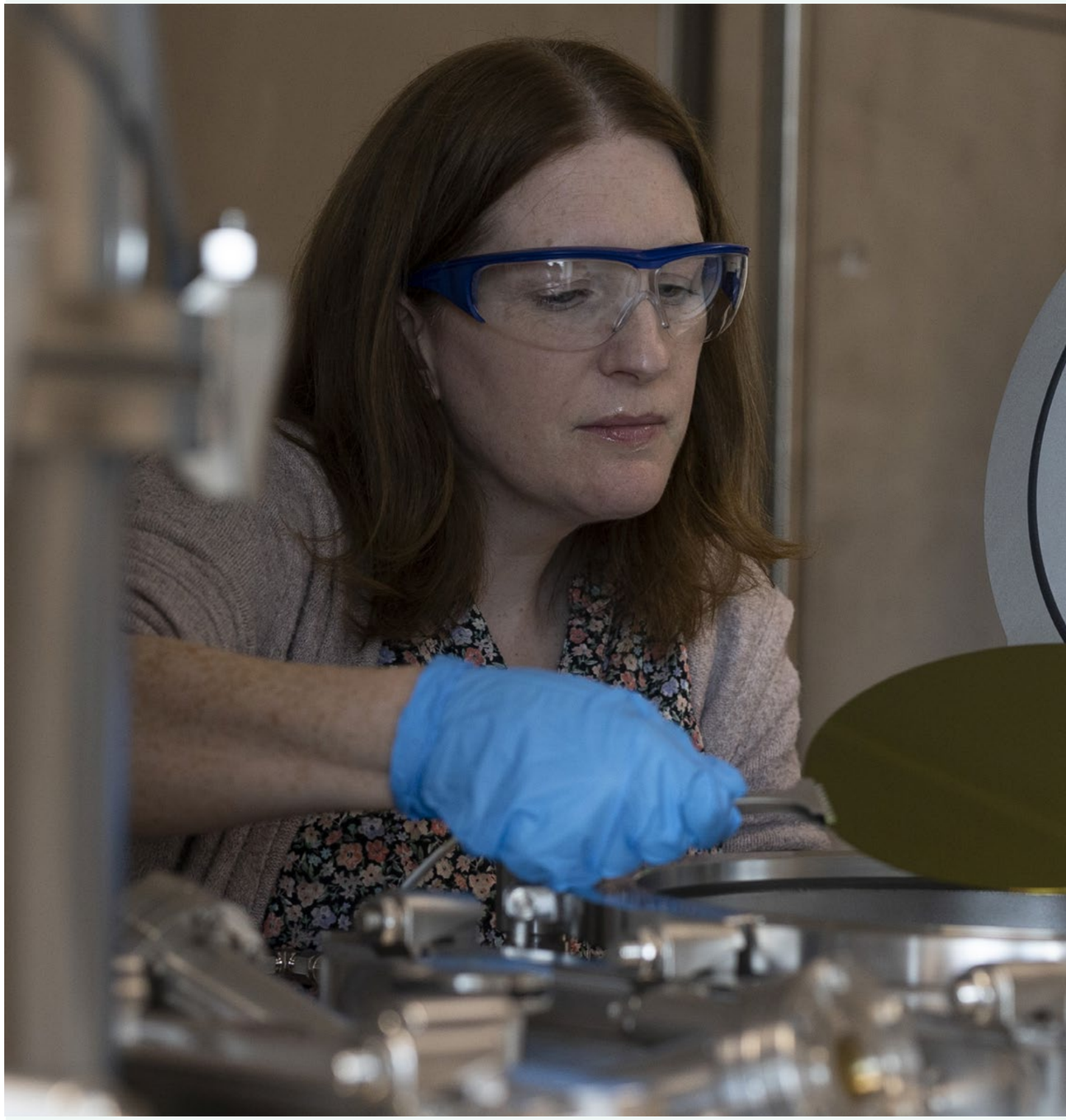
405 Users trained on tools

Advanced Semiconductor Processing and characterisation facility for multifunctional thin-film matErials (ASPIRE)

Dr Lynette Keeney
€4.675 million

Transforming advanced materials into real-world semiconductor technologies requires reliable ways to grow and characterise ultra-thin layers in device structures. These thin films must be made with incredible precision, down to the atomic level, in order to tune their performance for next-generation devices. Modern materials growth techniques allow consistent production of these films at scale, moving cutting-edge discoveries from the lab towards real-world applications.

Structural characterisation allows for accurate identification of materials and assessment of how processing parameters influence their properties, which are crucial steps in optimising both materials and devices. When combined with state-of-the-art material processing, electromechanical, electrical and magnetoelectric characterisation, this facility will enable comprehensive correlation between the physical and functional properties of novel materials and devices. Unparalleled insights into materials performance, from synthesis to device integration, will provide a uniquely integrated approach to prototyping novel materials and semiconductor devices, accelerating innovation in computing, biomedical, and low-power electronic technologies.

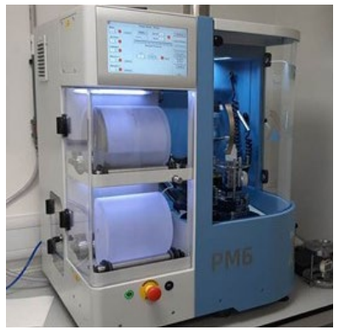


The following new tool updates were implemented in 2025

Tyndall's commitment to research excellence is deeply entrenched in its forward-looking approach to creating and maintaining state-of-the-art research infrastructure. Our latest investments in infrastructure not only epitomise our dedication to pioneering advanced technologies, but also substantially contribute to positioning Tyndall as a hub for international scientific talent.

YES asher

The YES asher accommodates up to 300-millimetre wafer size. It is essential for organic polymer ashing and surface modification prior to processes such as transfer printing for heterogeneous integration.

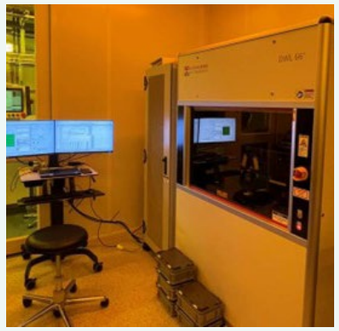


Logitec PM6 Precision Lapping and Polishing System

The Logitec PM6 Precision Lapping and Polishing System is a high-precision, semi-automated platform used for the controlled thinning, lapping and polishing of semiconductor wafers and advanced materials. The system supports a wide range of substrate types and thicknesses, enabling highly uniform material removal with excellent surface flatness and low damage. At Tyndall, the PM6 is a critical enabling tool for device fabrication, packaging, and advanced materials research, supporting activities such as backside wafer preparation, substrate planarisation, and preparation for high-resolution metrology and bonding processes. Its flexibility and process control make it particularly valuable for compound semiconductors, microelectromechanical systems, and photonics applications, where precise thickness control and surface quality are essential.

Angstrom physical vapour deposition tool

This is used for the sputter deposition of metals and dielectrics, and is capable of accommodating up to 8-inch wafers.



Heidelberg Instruments Maskless Aligner DWL 66+

The Heidelberg Instruments DWL 66+ maskless laser lithography system is a high-resolution, direct-write patterning platform that enables rapid and flexible micro- and nano-scale device fabrication without the need for physical photomasks. Using precision laser exposure and advanced stage control, the system delivers excellent overlay accuracy and feature definition, making it ideally suited to rapid prototyping, process development and low-volume pilot fabrication. At Tyndall, the DWL 66+ is a core enabler for semiconductor, photonics, microelectromechanical systems, and advanced materials research, significantly reducing design-to-fabrication cycle times and supporting iterative device optimisation. Its maskless operation lowers cost and risk for early-stage innovation while providing a critical bridge between exploratory research and scalable manufacturing processes, strengthening Tyndall's capability to support both EU-funded research programmes and industry-focused technology development.

Tyndall's Graduate Engineering Programme

Tyndall has commenced a Graduate Engineering programme, which is a structured 2-year rotation across two coupled engineering disciplines: process engineering and maintenance engineering.

Those taking part have the support of dedicated managers and mentors to help grow their experience across these disciplines. Graduates will have the opportunity to gain hands-on experience in the different elements of engineering at Tyndall. The Graduate Engineering Programme is designed to meet the demands of the working world as would be experienced by graduates in the semiconductor industry. Additionally, there is a dedicated Master's programme operated through Munster Technological University (MTU) www.mtu.ie/courses/crsnfpi9/ that has been designed to complement the hands-on programme offered at Tyndall.

Alex Galligan and Raquel Sanchez

Our decarbonisation story

Tyndall is a large energy user, consuming 9.5 gigawatt hours of electricity and 3 gigawatt hours of natural gas in 2024, resulting in 3,800 tonnes of carbon dioxide emissions. With the construction of the new Tyndall campus expansion set to double our footprint, the challenge was clear: grow our capacity while halving emissions in line with the National Climate Action Plan, which requires a 51% reduction in greenhouse gas emissions by 2030 against a 2016–2018 average baseline.

A strong foundation

Our journey builds on a long-standing commitment to energy management. Certified to the ISO 50001 standard since 2011, Tyndall has continuously improved energy performance over many years.

Between 2019 and 2023, targeted infrastructure upgrades delivered 2.6 megawatt hours of energy savings and a reduction of 625 tonnes of carbon dioxide, despite increased energy demand from new laboratories and cleanroom space.

A strategic shift

In 2023, we launched a comprehensive decarbonisation programme with a clear objective: eliminate fossil fuels from on-site heating.

Working with the Sustainable Energy Authority of Ireland, we applied the Excellence in Energy Efficient Design (EXEED) methodology, prioritising demand reduction before introducing low-carbon technologies.

Delivering decarbonisation

With demand reduced, we transitioned to low-carbon technology through the following actions:

- Installation of high-efficiency four-pipe heat pump systems
- Removal of gas boilers and air-cooled chillers
- Full electrification of heating systems
- Replacement of canteen gas hobs and fryers with electric versions.

In March 2025, we reached a major milestone: Tyndall's heating demand was being fully met by heat pumps with minimal increase in campus electrical use. The gas boilers were turned off, ending on-site fossil fuel combustion for heating.

Optimising before electrifying

A detailed review of campus energy systems identified the following key opportunities to reduce demand:

- Smarter building management system controls
- Improved air handling and system balancing
- Pumping and hydraulic optimisation
- Enhanced heat recovery
- System-wide operational improvements.

These actions were implemented in three phases:

1. Operational improvements
2. Low-cost efficiency measures
3. Capital investment in decarbonisation.

This approach reduced overall energy demand – and, crucially, reduced the size, cost, and footprint of new plant infrastructure.

Investment and impact

- Total investment: €3 million
- Sustainable Energy Authority of Ireland grant support: €560,000

This project not only reduces emissions but also future-proofs the campus for expansion while aligning with national climate goals.

Verified results

This project has resulted in an almost 20% reduction in on-site energy use.

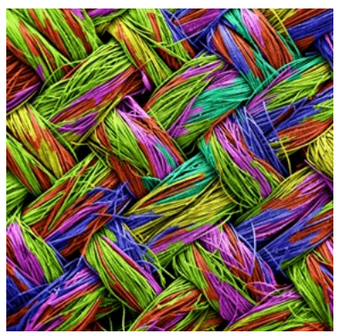
The project has achieved EXEED certification, independently certified by the National Standards Authority of Ireland. This certification confirms measurable energy performance improvements, successful application of energy-efficient design principles, and delivery of real, verified decarbonisation outcomes.

The outcome

Tyndall has demonstrated that deep decarbonisation is achievable alongside growth by combining structured energy management, engineering excellence, and a 'reduce-first' philosophy.

From optimisation to electrification, the transition from fossil fuels to a low-carbon future has been delivered and independently verified.

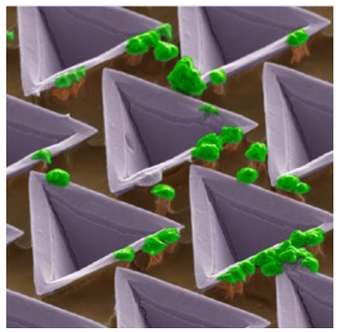
Scientific image competition winners



Carbon Network

Rupa Ranjani Palanisamy, Advanced Energy Materials Group and Material Chemistry and Analysis Group

This image highlights the development of $NiSe_2$-$CoSe_2$ (NCS) nanowires grown on activated carbon cloth (ACC), a substrate that enhances both electrochemical and thermoelectric performance due to its high conductivity and flexibility, and large surface area. The NCS/ACC electrode outperforms monometallic selenides, achieving a charge storage capacity of 112 mA h g^{-1} and a Seebeck coefficient of −3.4 mV K^{-1}. This dual-functional system demonstrates efficient heat-to-electricity conversion and storage, making carbon network-based architectures promising for next-generation thermo-electrochemical energy devices.



Inorganic architecture

Luca Colavecchi and Salvador Medina, Epitaxy and Physics of Nanostructures Group

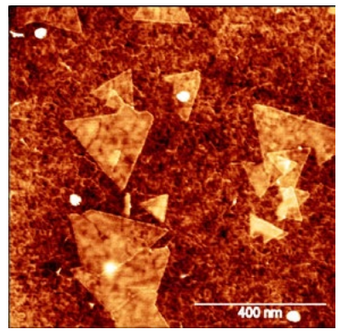
The image shows a dry-etched gallium arsenide (GaAs) structure with distinct triangular profiles formed due to the growth at a specific crystal orientation - in this case <111>, and the sample shows the aluminium arsenide (AlAs) barrier layers.

These barriers slow or stop the etch process, resulting in anisotropic etching that creates sharp, angular shapes as the surrounding GaAs is removed. The triangular geometry reflects the selective etch dynamics between the two materials. Along the etched surfaces, tree-like patterns are visible, caused by impurities or defects within the sample. These impurities interfere with the etch uniformity, producing irregular, branch-like features; these impurities are in green in the image, and they cast a shadow on the sample that appears as the trunks of the trees. The image highlights the interplay between material composition, etch chemistry, and defect-driven patterning in semiconductor fabrication.

Night in Maxwell Prison

Berkay Dogan, Advanced RF Technologies Group

This scientific image depicts a monolithically integrated 3D-printed nested waveguide filter, a key component in advanced RF satellite systems. The carefully designed holes and slots facilitate the copper plating process, enhancing electrical conductivity and ensuring high-performance signal filtering. A prison for interference, a palace for essential signals.



WS2 Nachos in a salsa spread

Aashi Gupta, Pavlina Metaxa, Brendan Sheehan and Ray Duffy, Quantum Electronic Devices Group

This scientific image is an atomic force microscopy (AFM) image of metal–organic chemical vapor deposition (MOCVD)-grown ~1.2 monolayers of tungsten disulphide (WS2).

The ‘salsa dip’ represents the monolayer of WS2 with uniform grain sizes, whereas the triangles (‘nachos’) are the WS2 grains that coalesce to form bigger grains due to the high thermal budget. This image was taken using the Bruker Dimension Icon AFM tool at the Open Access Characterisation Facility laboratory using a high-resolution tip. This image demonstrates the capability of the tool to take high-resolution images even for very small scan sizes of around 400 nanometres. This image can further be used to calculate the grain sizes of WS2, which is a crucial parameter for determining device performance.

Scientific image competition winners

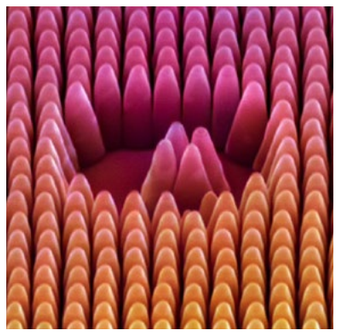
Fairy Forest

Atieh Mousavi and Alida Russo, Life Science Interface Group

This fluorescence image of antibodies on the surface of a polymer-modified electrode resembles Irish fairies in a forest.

In this project, the aim is to develop a disruptive multiplexed near-patient diagnostic solution to enable the early detection of stage I and II ovarian cancer using different biomarkers by designing, fabricating, and characterising sensors to be used as detection tools. This image was taken after the functionalisation of homemade electrodes with polymers and antibodies.

This innovative approach focuses on creating highly sensitive and specific sensors that can detect multiple biomarkers simultaneously. The unique fibrous structures of the polymer layer, influenced by the conditions of polymerisation, contribute to the improved conductivity and surface area of the electrodes. This allows for better immobilisation of antibodies and more effective electrochemical sensing, ultimately aiming to improve patient outcomes through earlier diagnosis and treatment.



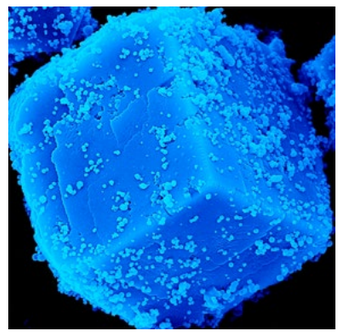
Dancing Crayons

Christian Corcoran and Chandrashekar Lakshmi Narayana, Nanophotonics Group and Quantum Electronic Devices Group

In this scientific image, a cluster of silicon metasurfaces appear to be dancing among a crowd.

These pillars are revealed from their silicon substrate through a wet-etch process.

These metasurfaces can be employed to achieve low parts-per-billion concentrations for photothermal spectroscopy. The near-field enhancement effect is beneficial for mid-infrared sensing, especially when working with low sample volumes.

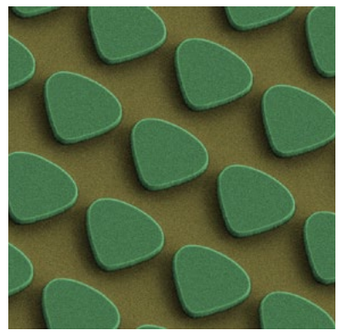


Fluorescent Ice Cube

Rupa Ranjani Palanisamy, Advanced Energy Materials Group and MCAG

This image, titled Fluorescent Ice Cube, captures $ZnCo_2S_4$ material synthesized by the hydrothermal method. Under the scanning electron microscope, the particle looks like a glowing block of ice. The colouring makes the cube glow, turning it into a vivid display of light and structure.

Beneath this artistic surface lies a scientific story. This is not a block of ice, but an electrode material from the TRANSLATE project (https://translate-energy.eu/), designed to electrochemically convert heat into electricity. The cube's surface features tiny particles that act as active sites, improving the electrochemical performance. The image reveals how complex science connects to everyday life, opening a window into the microscopic world. It is a reminder that even the smallest structures can hold the power to shape the energy technologies of the future.

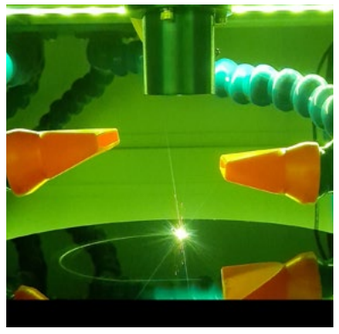


Dragon Meta-Scales

Giovanni Piscopo, Artem Vorobev and Tomasz Piwonski, Centre for Advanced Photonics and Process Analysis

A triangular pillar-based metasurface was fabricated in Tyndall National Institute on a silicon-on-silicon-dioxide platform. The nanostructures were designed and optimised for compatibility with stepper lithography fabrication processes. The strongly asymmetric shape was engineered to support bound states in the continuum, enabling strong resonant behaviour and near-field enhancement for spectroscopy applications. The fabricated metasurface will be used for improving existing photothermal spectroscopy techniques aiming to facilitate the detection of poisonous gases and volatile organic compounds in fields relevant to medicine and industry.

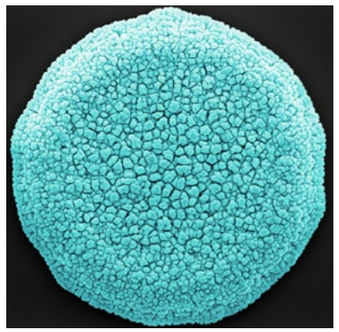
Scientific image competition winners



Blazing a Trail

Richard Murphy, Speciality Products & Systems Group

This image shows laser dicing of an 8-inch silicon wafer using Tyndall's LASEROD LPS-300 system. This precision process enables clean, high-quality cuts that are essential for advanced semiconductor device fabrication. The LPS-300 offers sub-micron accuracy, making it ideal for research and industrial applications where reliability and minimal damage are critical.



Cobalt Sugar Gummy

Ehren Dixon, Electrochemical Materials & Energy Group

In electroplating, you have the ability to deposit a wide variety of metals and alloys, but it sometimes doesn't plate the way you want!

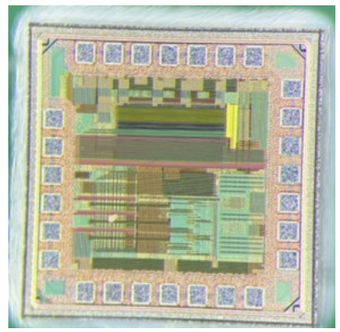
In plating alloys, you have to take into consideration that the plating parameters may be widely different to that of any of the individual metals, leading to some trial and error where you can get some very interesting formations!

This sugar-coated gummy (jelly sweet) is actually a test plate of a cobalt alloy that has gone a bit awry, but nonetheless looks very appetising!

Spiral Starfighter

Andres Fontana and Berkay Dogan, Advanced RF Technologies Group

At first glance, this looks like a tiny starship etched in gold; however, it is a fractal spiral inductor built on a gallium nitride (GaN) platform. Its folded spiral geometry compresses a long current path into an ultra-compact footprint, achieving high inductance with remarkably low loss, a key element for efficient, high-frequency circuits. The GaN technology beneath further boosts performance with a high Q-factor and low parasitics, making it ideal for next-generation RF and power systems, where maintaining a low noise floor and high spectral purity is essential. Beyond function, its silhouette evokes the TIE fighters of science fiction, turning a humble inductor into a modern hieroglyph, a symbol of how imagination and engineering merge to reach for the stars.



Goldfish Chip

Ahmed Hashem, Jaekyum Lee, and Dr Daniel O'Hare, MCCI

This microscope image shows a silicon chip that measures only one square millimetre, making it one of the smallest chips developed for controlling pixels in advanced imaging systems. The chip contains the control circuitry of a 3D complementary metal oxide semiconductor (CMOS) image sensor, where different stacked layers are used to manage sensing, processing, and control separately. It also contains some of the smallest analog-to-digital converters (ADCs), parametric measurement units (PMUs) and reuse distance vectors (RDVs) ever developed. This work is part of ongoing research at Tyndall National Institute, focused on developing ultra-miniaturised image sensors for biomedical endoscopy applications. By shrinking the control circuitry while preserving the operation, the research supports higher pixel densities, lower power consumption, and improved image quality, all within the extremely tight size constraints required.

Agency-funded centres

Collaboration with national centres

In addition to the major agency-funded centre activities highlighted in this section, Tyndall has fostered deep collaborations with a number of other national research centres, which have led to many fruitful partnerships and projects. These valuable relationships offer productive interactions and collaborations for researchers and experts in various fields, with access to collective resources such as equipment, technology, and talent. Tyndall has played a significant role in project leadership and activity with the institutions listed and we would like to acknowledge these important relationships.

AGENCY-FUNDED CENTRES

IPIC
BRINGING PHOTONICS TO LIFE

The Irish Photonic Integration Centre (IPIC) transitioned from Science Foundation Ireland to become the Research Ireland Centre for photonics in 2024, following the establishment of the new national research and innovation funding agency. IPIC remains Ireland's centre of excellence for research, innovation and PhD training in photonics, and 2025 saw continued progress towards market deployment for its breakthrough research programme.

In 2025, the percentage of IPIC PhDs who have transitioned to industry exceeded 70% for the first time, and this success has continued. This reflects high demand for IPIC PhDs, with students and previous departees joining Xanadu Quantum Technologies, ASML, Analog Devices, and Meta in 2025.

The Photonics Ireland Conference 2025 was held in Cork from 3–5 September 2025, welcoming 208 participants from academia and industry. The event fostered collaboration, knowledge exchange, and new partnerships across the photonics community. The programme included keynote lectures, parallel sessions, a panel discussion, an industry session, and poster presentations highlighting cutting-edge research and innovation. Keynote speakers were Kei May Lau (Hong Kong University of Science and Technology), Brian W Pogue (Dartmouth College and University of Wisconsin–Madison), and Aaron Lowe (Meta), addressing advances in photonic integration, medical optical devices, and micro-LEDs for augmented reality. Poster and short talk awards recognised outstanding contributions from emerging researchers across Ireland's leading institutions.

Vivid Photonics, a spinout company from Tyndall and IPIC, was launched at the Irish Consulate in San Francisco during SPIE Photonics West 2025, where CEO Chris Gorman competed in the SPIE Startup Challenge. The company has developed a groundbreaking horizontal cavity surface-emitting Superluminescent Diode (SLD) technology – the first of its kind globally – that is set to revolutionise image quality in augmented and virtual reality. This light source technology is designed to deliver superior image quality in compact, ultra-low-power, lightweight augmented reality devices such as smart glasses, enabling seamless integration into everyday experiences.

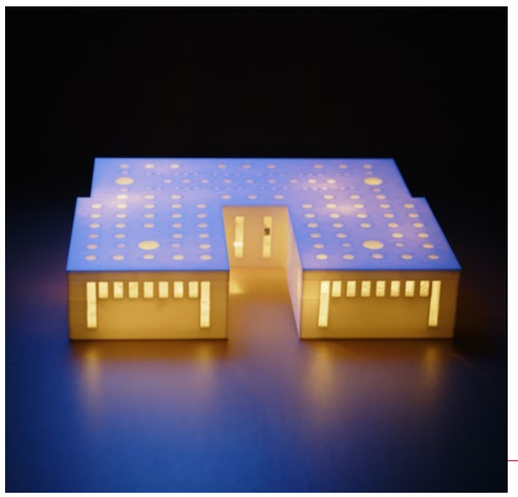
Taighde Éireann
Research Ireland

Photonics Ireland Conference 2025

CONNECT is the Research Ireland Centre for Future Networks and Communications. CONNECT brings together research expertise from 10 academic institutions with a unified purpose and mission: "We envision a future of sustainably deployed dependable networks that foster innovation in services and customer experience, empower citizens, and improve quality of life." The centre has been operating for 12 years.

One example of research at the centre is the following: Emerging 5G–6G wireless networks drive the need for high-performance RF components within a single RF transceiver to support a myriad of Internet of Things applications. However, the use of conventional RF front end (RFFE) design and multi-part integration techniques results in bulky and heavy subsystems while limiting advanced design topologies. In order to address these challenges, monolithic 3D dual-channel waveguide filters based on a novel nested waveguide resonator approach are proposed and realised by exploiting the free-form capabilities of additive manufacturing (AM) technologies. The proposed solution achieves a more than 50% reduction in overall RFFE size and enables independently reconfigurable filtering channels for multiplexing scenarios in a single, ultra lightweight (<80 grams) RF architecture while achieving superior interchannel isolation (>110 decibels). This research, performed by PhD student Berkay Dogan and PI Dimitra Psychogiou, led to two key IEEE publications (one article in IEEE Transactions on Microwave Theory and Techniques (doi: 10.1109/TMTT.2025.3601503) and one European Microwave Conference paper (doi: 10.23919/EuMC65286.2025.11235292)). It also led to the following key research awards: an IEEE Microwave Theory & Technology Society Pre-graduate Scholarship (for PhD student B Dogan), a Student Travel Grant from European Microwave Week 2025 (for PhD student B Dogan), and the Best Student Paper at the 20th Royal Irish Academy (RIA)/International Union of Radio Science (URSI) Research Colloquium on Radio Science and Communications.

Another example of research within the centre was the development of a low-cost, flexible, wearable sensing technology for monitoring urine biomarkers in infants, addressing an important need in early health assessment. Using laser-induced graphene patterned with a visible laser, pH and uric acid sensors were fabricated on flexible polymer substrates and seamlessly integrated into disposable diapers. The sensors deliver rapid, reliable measurements with high stability and selectivity, maintaining performance in urine-like conditions. Successful demonstrations in baby diapers using portable electronics show the potential for real-time, non-invasive health monitoring. This work highlights a scalable pathway towards smart infant care products that combine advanced sensing with simplicity, comfort, and practical deployment. The research was performed by Md Rasel, Jahidul Islam, Hassan Hamidi, Aidan Quinn and Daniela Iacopino.



Monolithically Integrated Dual-Channel Filters Using Nested Waveguide Resonator Arrays

VistaMilk Research Ireland Centre is focused on digitalising the dairy industry, and it operates in collaboration with leading Irish and multinational food and information and communication technology companies. Funded by both Research Ireland and the Department of Agriculture, Food and the Marine, VistaMilk's Phase II research programme aims to revolutionise the dairy industry through increased innovation and sustainability across the entire dairy production chain.

Key areas of research at VistaMilk include:

- Pasture and soil management: Investigating sustainable pasture practices, soil nutrient dynamics, and breeding programmes in order to enhance dairy production
- Animal health and nutrition: Focusing on animal fertility, health diagnostics, and breeding programmes
- Next-generation dairy products: Exploring advanced dairy processes, digestive characteristics of dairy products, and their health benefits for humans
- Agri-tech: Leveraging advanced sensors, data analytics, and systems integration in order to maximise efficiency throughout the dairy production chain.

Tyndall's contribution during Phase I of the VistaMilk research programme centred on the development of novel chemical and biochemical sensors and wearables in collaboration with other researchers and industry. Significant intellectual property has been developed, resulting in multiple invention disclosure forms and patents being submitted, and more than 60% of the associated scientific papers were published in the top 10% of all journals. Follow-on projects are currently under way with industry partners in order to translate the research output to products.

In Phase II of the VistaMilk research programme (2024–2030), Tyndall has expanded its focus to include energy management and theoretical modelling. VistaMilk's mission extends beyond technological advancements. It aims to develop innovative new technologies and positively impact on the environment, addressing key societal challenges by developing technology to reduce greenhouse gases (such as methane), increase cheese safety and minimise food wastage, improve animal well-being, and enhance consumer health. By bridging the gap between agri-food and information and communication technology, VistaMilk is at the forefront of precision-based dairy production and processing, thus ensuring a sustainable and efficient future for the dairy industry.

Dr Alan O'Riordan

MCCI
MICROELECTRONIC CIRCUITS CENTRE IRELAND

Microelectronic Circuits Centre Ireland (MCCI) is a national centre of excellence dedicated to advancing semiconductor and microelectronics research. MCCI provides deep expertise across RF technologies, power management, multi-sensor systems, high-performance data converters, and cryogenic CMOS, enabling next-generation electronic systems for a broad range of applications.

MCCI plays a critical role in developing the advanced circuit-level technologies that underpin innovation in intelligent devices, high-reliability systems and emerging digital infrastructures. MCCI's research model is application driven and shaped by real industry needs. Close engagement with industrial partners ensures that the centre's work directly supports technological and commercial challenges across key sectors, including smart manufacturing, telecommunications, healthcare, aerospace, edge artificial intelligence (AI) and quantum computing. Through collaborative projects, MCCI delivers practical, high-impact semiconductor solutions that contribute to Ireland's leadership in microelectronics innovation and strengthen the competitive position of its industry partners.

A significant milestone in 2025 was the creation of MCCI's first spinout company, PulpoSemi, founded by Seamus O'Driscoll. This marks an important step in translating MCCI's research and expertise into commercial impact. The establishment of PulpoSemi highlights the centre's important role in creating and supporting innovation and entrepreneurship for Ireland's indigenous semiconductor ecosystem.

MCCI marked an important achievement during the year, with PhD researcher Cian O'Donnell receiving the 2025 Analog Devices Outstanding Student IC Designer Award. This prestigious honour recognises exceptional technical ability and research excellence, highlighting the strong pipeline of emerging talent within MCCI's postgraduate community. The award reflects both Cian's contributions in advanced microelectronics research and the high-quality mentorship and training environment fostered by the centre. Achievements such as this reinforce MCCI's commitment to developing future leaders who are capable of driving innovation in Ireland's semiconductor sector.

MCCI was selected as a research partner in the national €11.1 million Disruptive Technologies Innovation Fund (DTIF)-funded SensABLATE project, led by Endowave. This major collaborative initiative focuses on developing next-generation ablation and sensing technologies for the treatment of lung cancer, bringing together industry and research expertise in order to advance high-impact medical and electronic systems. MCCI's involvement underscores its growing strategic importance in national innovation programmes and its capacity to contribute advanced circuit-level solutions to large-scale multidisciplinary projects. Participation in SensABLATE strengthens MCCI's role in supporting Ireland's competitiveness in emerging technology domains.

Enterprise Ireland

Ian O' Donnell, MCCI accepts the 2025 Analog Devices Outstanding Student Award from Gerard Mora, Director of Technology in Precision Signal Chains, Analog Devices

esa
space solutions
Ireland

In 2025, ESA Space Solutions Centre Ireland (SSCI), of which Tyndall is the lead consortium partner, had its most successful year since its inception in 2016, with a record 15 ESA Business Incubation Centre (BIC) Ireland incubation contracts executed during the year. This brought the total number of ESA BIC contracts signed during the current funding cycle (2022–2025) to 30.

ESA Spark Funding, a technology transfer initiative managed by ESA SSCI, is designed to accelerate product development in companies that are integrating space technology in order to develop new market applications. One ESA Spark Funding contract was executed during the reporting year, bringing the total number of ESA Spark Funding projects contracted to eight.

2025 also saw an expansion of the ESA SSCI Consortium Partnership with the addition of Atlantic Technological University and MTU, bringing the total number of ESA BIC incubation locations available to host active start-ups across the country to 11.

ESA BIC Ireland is part of a growing network of 36 ESA BICs operating across 23 ESA member states, which were established to empower entrepreneurship and to allow local economies to benefit from space data, technologies and assets. This constitutes the largest space innovation network in the world.

Enterprise Ireland

Conor Sheehan, deputy Head of National Delegation to ESA, Dr Orla Flynn, President of ATU, George McCourt, Head of Innovation and Enterprise at ATU, Finola Howe Head of Enterprise & Engagement ATU and Peter Finnegan, manager ESA Space Solutions Centre Ireland

Financial report

INCOME & EXPENDITURE SUMMARY 2025

Income and expenditure summary

Income	2025 €'m	2024 €'m
Government grant	10.0	10.0
Research	48.5	41.7
UCC contribution	2.2	2.4
	60.7	**54.1**

Expenditure	2025 €'m	2024 €'m
Remuneration costs	34.3	31.7
Equipment and infrastructure	3.7	2.8
Consumables and related costs	16.6	15.0
Other operating and deferred costs	6.1	4.6
	60.7	**54.1**

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Board members

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University College Cork

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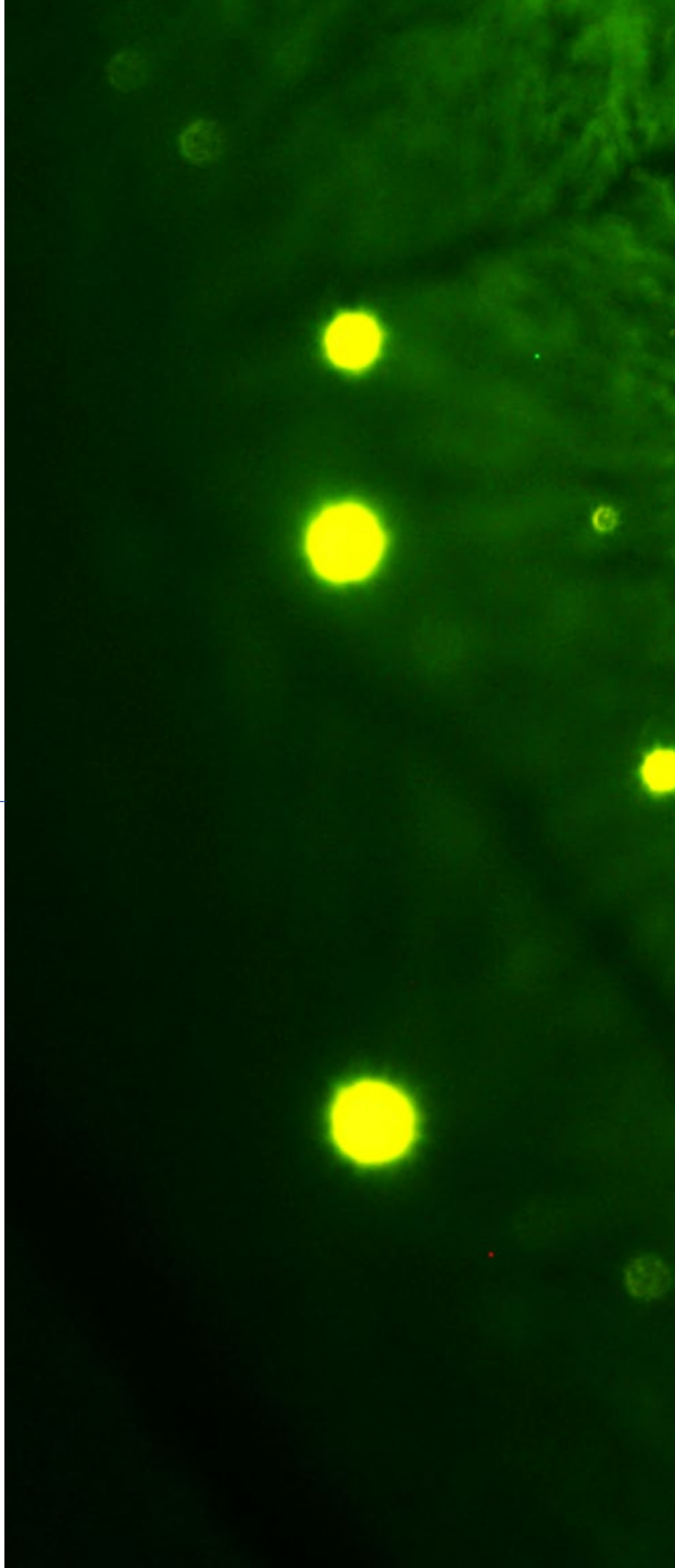
Bob Savage
3Sixty Consulting

Ann-Marie Holmes
Non-executive director (various)

Rialtas na hÉireann
Government of Ireland

Tionscadal Éireann
Project Ireland 2040

European Union
European Regional Development Fund



Fairy Forest

Atieh Mousavi and Alida Russo,
Life Science Interface Group

Fluorescence image of antibodies on a polymer-modified electrode, taken after functionalizing homemade sensors. This project aims to develop a multiplexed near-patient diagnostic tool for early detection of Stage I and II ovarian cancer using multiple biomarkers. The polymer's fibrous structure enhances conductivity and surface area, improving antibody immobilisation and electrochemical sensing, ultimately supporting earlier diagnosis and better patient outcomes.

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