Impact from excellence

Tyndall
National Institute
Institiúid Náisiúnta

2022
Annual report

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Contents

Board Chair's message

The strategic role and mission of Tyndall has never been as important as it is now. The world is going through a huge point of inflection at the moment due to the disruption experienced over the past number of years, not least due to Covid.

Up until now, the primary focus of policy makers and the investment community had been on the continuing growth of the software, social media, and e-commerce giants. The fact that these companies and their technologies are dependent on hardware, Moore's Law, semiconductors, and photonics, has been forgotten somewhat.

During the pandemic, our dependence on semiconductors was highlighted in the starkest possible terms. Supply chain simplification and optimisation had made companies around the world over-reliant on a small number of territories and key suppliers. That over-reliance was further highlighted by the disruptions caused by the war in Ukraine. The result was shortages and delayed delivery in a broad spectrum of products ranging from cars to kitchen appliances.

The policy response in the US and the EU has been to introduce new legislation relating to semiconductor supply and availability – the Chips Acts. The aim is to re-energise semiconductor manufacturing and technology research in home markets and reduce dependence on lengthy and fragile supply chains.

Tyndall has a critically important role to play in that context. Not only are our researchers driving advances in semiconductors, computing, sensors, photonics and other technologies that underpin the semiconductor industry, but we are also helping to develop the next generation of talent that will be required by the technology industry here in Ireland and overseas in the years to come.

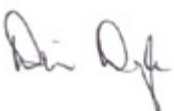
Our core aims are to create new knowledge, develop talent, and play a lead role in the creation of a science and technology ecosystem spanning start-ups, SMEs, large corporates, government, academia, and other stakeholders. By catalysing the activation of that ecosystem, Tyndall and its Board and leadership can play a pivotal role in the reshaped technology world of the next decade and beyond.

Here at home, Tyndall will continue to promote excellence in research and our planned expansion will give us the scope to develop new areas of research while building on our existing strengths.

I am pleased to say that Tyndall is performing well against all of the goals set out in our Tyndall 2025 strategy. We must now double down on that strong performance and play our part in supporting the wider objectives set by government for Ireland's technology and research ecosystem. Tyndall can do that by helping industry and the research community to make the connections which will result in new start-up enterprises, new discoveries, and new investments in Ireland.

Tyndall's success is firmly based on the quality of its people, from PhD students right the way up to the Board and the senior leadership team. I was pleased to be asked to Chair the Tyndall Board, succeeding Eoin O'Driscoll as Chair on May 1st, 2022. I want to take this opportunity to acknowledge the immense work done by Eoin during the previous eight years, including the year under review. I am proud to succeed him.

It is also an honour to serve on the Board of Tyndall which is without doubt the most impressive I've encountered in terms of the calibre of the individual members and their commitment. I would also like to pay tribute to our CEO Professor William Scanlon and all of our staff and students. Finally, I'd like to take the opportunity to acknowledge the continued support of our key stakeholders University College Cork (UCC) and the Department of Further and Higher Education, Research, Innovation and Science.



Dr Denis Doyle
Board Chair

Dr Denis Doyle
Board Chair

UCC President Professor John O'Halloran with Professor William Scanlon and Professor Gerry Wrixton

CEO's message

2022 was another year of success and progress for Tyndall National Institute. It was also a year of significant change. After two years of considerable disruptions due to Covid related public health restrictions, we were able to welcome back our staff and students to work together on-site and in person again.

This was very significant for an Institute like Tyndall. The highly creative and serendipitous nature of our work requires people to be working together in person with access to world-class equipment, tools, and facilities.

2022 was the 40th anniversary of the establishment of NMRC, the forerunner of Tyndall, and we marked that milestone with a number of events including the launch of the 'Wrixon Research Excellence and Travel Bursaries' – kindly sponsored by NMRC founder Professor Gerry Wrixon – to recognise and promote postgraduate research excellence at Tyndall. The celebrations also included the inauguration of an annual alumni event which saw Tyndall alumni across the world travelling for the occasion.

Another key highlight of the year was the appointment of Professor Paul Hurley to the Meta Industrial Chair in Semiconductor Technologies at UCC, based at Tyndall. This partnership further strengthens Ireland's strategic importance to Meta and in particular, Tyndall's research excellence in semiconductors and photonics.

It was a highly successful year for industry collaboration generally. During 2022, we worked with over 100 industry partners making it our best year ever for direct industry engagement. Also worthy of note is the large number of international industry collaborations during the year. These are helping to position Tyndall and Ireland as a global leader in research excellence.

While income received from industry increased during the year, overall income marginally reduced following many years of growth. This was largely due to the impact of the pandemic on funding programmes, which will reverse in 2023. In that regard, I am pleased to report that Tyndall is performing exceptionally well in winning funding under the new Horizon Europe research and innovation programme.

Our new ventures pipeline continued to grow with a total of 19 commercialisation projects being explored during 2022.

It was also a very successful year at an individual level with a number of Tyndall researchers achieving international recognition for their work. These included Dr Sinan Bugu who was awarded a Marie-Skłodowska-Curie Postdoctoral Fellowship; Professor Dimitra Psychogiou who received an IEEE MTT-S Award; and MCCI PhD student, Zhongzheng Wang, who won the Analog Devices (ADI) Outstanding Student IC Designer Award 2022 for the EU region.

Looking ahead, we are awaiting final planning approval to progress our long-awaited expansion plan. That expansion will enable Tyndall to move into emerging areas of research where Ireland can achieve a leading position globally.

In that context, one of the key challenges we face now and into the future is talent. Our continued growth is reliant on our ability to recruit talent nationally and internationally. I am confident that the continued and very welcome support from Government for investment in upgrading facilities and infrastructure here at Tyndall will enable us to meet that challenge.

Finally, 2022 also saw the retirement of our long time chair Eoin O'Driscoll, with whom it was a pleasure and a privilege to work on the growth and development of Tyndall over the past few years.

Eoin was succeeded early in the year by Dr Denis Doyle who is leading the Board's oversight of the future development and expansion of Tyndall as we maintain our position as Ireland's flagship research Institute.

I would like to place on record my gratitude to Eoin and Denis, their fellow Board members, and all of our staff, students and researchers for all of their efforts over the past year and look forward to working with them as we continue to make progress towards the goals and objectives set out in our Tyndall 2025 strategy.

Professor William Scanlon
CEO

Scorecard

Research excellence

Dimitra Psychogiou SFI Research Professor in Advanced RF Technologies received:

- → the inaugural Roberto Sorrentino YP Award of the European Microwave Association (EuMA)
- → IEEE MTT-S Outstanding Young Engineer Award

4 NEW SFI FRONTIERS FOR THE FUTURE & PARTNERSHIPS PROJECTS

Stefan Andersson-Engels SFI Research Professor in Biophotonics received multiple awards from the European Medical Laser Association

56 PUBLICATIONS WITH INTERNATIONAL COLLABORATORS IN TOP 10% OF JOURNALS

Impact

104 *industry partners engaged for research and facilities access, including 49 SMEs*

95 industry researchers hosted on-site

>€6M RECEIVED IN INDUSTRY FUNDING (with an additional future industry funding commitment of >€8m)

35% OF INDUSTRY FUNDING FROM OVERSEAS PARTNERS

19 PROJECTS IN OUR SPINOUT PIPELINE

International positioning

EU Programmes

€260m total project value | *€17m Tyndall grant value* | €14m to Irish Partners | *€7m to Industry based in Ireland* | 26 projects | *12 projects in digital focused topics* | 4 projects Tyndall co-ordinated

ASCENT+ contributions:

37 TA projects
The number of ASCENT+ access projects Tyndall has had so far

132
The number of researchers and students benefited

15 countries
The number of countries involved globally

3 AUTHORITATIVE CONTRIBUTIONS:

1 *'The potential and global outlook of integrated photonics for quantum technologies'*

2 *'Community Proposal for an ESA Road-Map for Cold Atoms in Space'*

3 *IEEE: International Roadmap for Devices and Systems'*

People and culture

Attained Athena SWAN Bronze Award

Trained over 300 staff/students

15,673
MIN DIRECT ENGAGEMENT WITH PUBLIC

***210 staff / students** took part in EPE events this year on behalf of the institute*

OUR EDUCATION STREAMS

→ 25 Summer Fellowships
→ 130 PhDs, 15 Masters by research
→ 20 Viva's → Launch of TARAs

Infrastructure

SUCCESSFUL IN SFI CAPITAL BID:

JOULIET — Energy for the Internet of everything (co-funded by SEAI), valued at €1.5m

285 PEOPLE
trained in the operation of process or analysis tools

111
new users to the open access labs & cleanrooms


Tyndall National Institute

Research excellence

Dimitra Psychogiou SFI Research Professor in Advanced RF Technologies received:

- **the inaugural Roberto Sorrentino YP Award of the European Microwave Association (EuMA)**
- **IEEE MTT-S Outstanding Young Engineer Award**

4 **NEW SFI FRONTIERS FOR THE FUTURE & PARTNERSHIPS PROJECTS**

Stefan Andersson-Engels SFI Research Professor in Biophotonics received multiple awards from the European Medical Laser Association

56 PUBLICATIONS WITH INTERNATIONAL COLLABORATORS IN TOP 10% OF JOURNALS

Professor Dimitra Psychogiou

Research Excellence is a key goal of the Tyndall 2025 strategy and underpins everything we do. We continue to push the frontiers of Tyndall's unique "atoms to systems" approach to deliver research with impact.

From a research excellence perspective, 2022 was a highly successful year. Science Foundation Ireland (SFI) Research Professor Dimitra Psychogiou was awarded the inaugural Roberto Sorrentino YP Award of the European Microwave Association (EuMA), presented at EuMW2021 in April 2022. She has also received the IEEE MTT-S Outstanding Young Engineer Award, for "Outstanding early career achievements and exemplary service to the Society".

SFI Research Professor Stefan Andersson-Engels received multiple awards at the European Medical Laser Association Awards in New York including Certificate of Appreciation exemplary speaker; Best Paper Award and a Lifetime Achievement Award.

Student awards included Andrea Pacheco's Student Paper of the Year for the Optica Biophotonics Congress: Biomedical Optics; Arbresha Muriqi won "Best Student Poster Award" at the 2022 AVS ALD/ALE conference; and MCCI PhD student Zhongzheng Wang won the Analog Devices Outstanding Student IC Designer Award 2022.

Major projects secured in 2022 include SFI Frontiers for the Future and Partnership Awards for Ray Duffy, Saibal Roy, Peter Parbrook/Stefan Schulz and Giorgos Fagas/Nikolay Petkov. Peter O'Brien won an SFI Centre-to-Centre award CoQREATE for quantum research in telecommunications, a collaboration between IPIC, CONNECT and the NSF Centre for Quantum Networks.

Successful early-career researchers included Xing Ouyang's IRC Laureate and Vuslat Juska's IRC/Health Research Board DOROTHY postdoctoral award.

Professor Stefan Andersson-Engels

Developing next generation materials for nano-electronic devices

2D materials are seen by many as critical to the future development of nano-electronic devices, applications, and products, ranging from transistors to sensors, as well as in broader fields such as energy, healthcare, and quantum computing. The drive to fabricate large-area semiconductor thin-film 2D Transition Metal Dichalcogenides (TMDs) at low temperatures stems from the need to solve thermal budget and integration issues related to integrated circuit technology.

Through a collaborative study with Professor Ageeth Bol's group while at Netherlands' Eindhoven University of Technology (now at the University of Michigan USA), and with the support of the ASCENT+ Access to Infrastructure programme (Horizon 2020 Grant 871130), the team were able to demonstrate a plasma-enhanced atomic layer deposition (PEALD) process, capable of depositing TMD films at temperatures as low as 100 °C. For MoS_2, the most widely studied TMD, this is the lowest temperature reported for a chemical gas-phase deposition process. The insight established in this work signifies a foundational advance in TMDs. Whilst there are still challenges to overcome, the work has been a promising development in 2D materials research.

https://pubs.acs.org/doi/10.1021/acs.chemmater.2c01154

Miika Mattinen, Farzan Gity, Emma Coleman, Joris F. A. Vonk, Marcel A. Verheijen, Ray Duffy, Wilhelmus M. M. Kessels, and Ageeth A. Bol

Atomic Layer Deposition of Large-Area Polycrystalline Transition Metal Dichalcogenides from 100 °C through Control of Plasma Chemistry

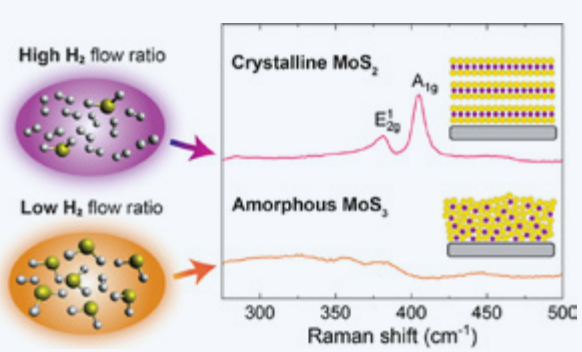
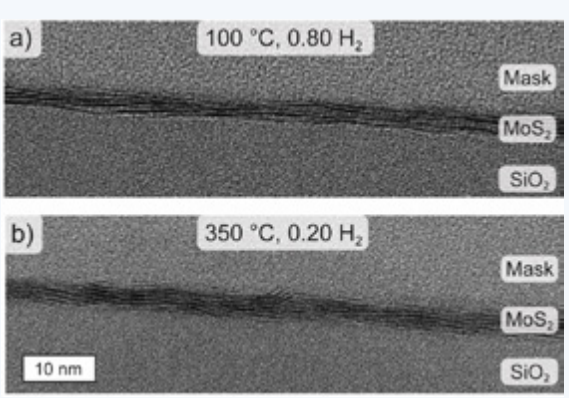


Illustration of the PEALD process and its ability to deposit crystalline, wafer-scale MoS_2 films of controlled thickness at low temperatures



Cross-sectional TEM images of MoS_2 films grown at (a) 100 °C and (b) 350 °C.

Shedding new light on quantum emitters

Semiconductor quantum dots (QDs) are bunches of crystalline semiconductor material embedded in another crystalline matrix. They are being intensively studied as they show promise to become efficient sources of quantum light, to be exploited for quantum information applications, such as quantum cryptography and quantum computation.

Tyndall researchers collaborated with Dr Miryam Arredondo-Arechavala's group at Queen's University Belfast, to better understand the structural properties of a special type of quantum dots known as site-controlled pyramidal QDs, which are deposited by metalorganic vapour phase epitaxy in recesses pre-patterned on GaAs wafers.

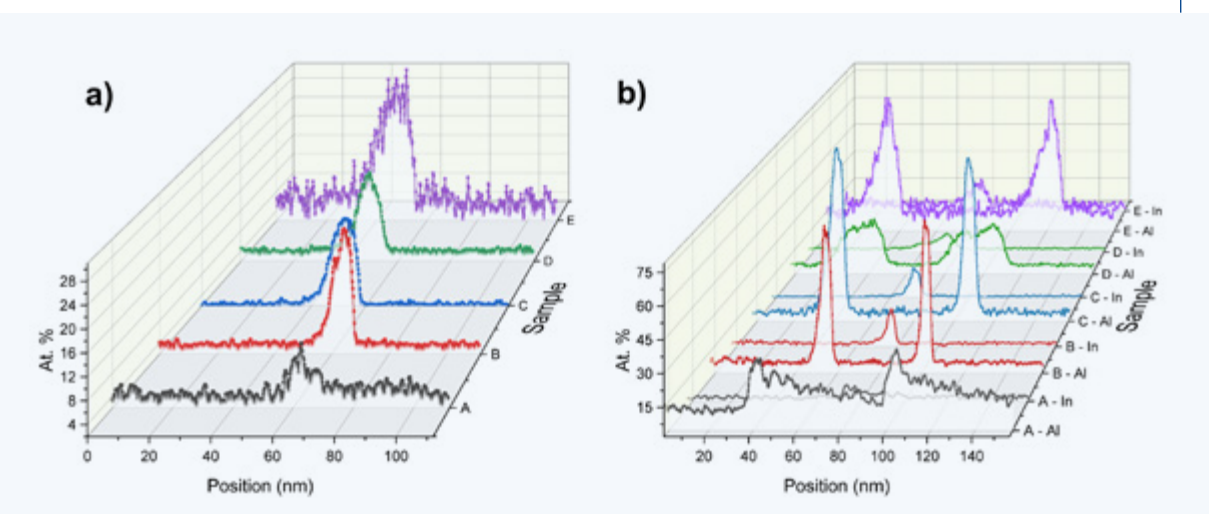
The transmission microscopy images show clearly that the InGaAs quantum dots in GaAs barriers develop an unexpected and not previously reported hexagonal symmetry, including a probable Indium segregation at the centre of the recess, that the system allows to stack multiple structures with controllable differences, and the adatom attachment dynamics is crystallographic facet selective, to the extreme that AlAs layers do not seem to wet significantly the base of the recess.

The results are shedding new light on previously unreported structural and chemical features of pyramidal QDs, of extreme relevance for further development of quantum emitters.

https://link.springer.com/article/10.1007/s10853-022-07654-2

Kristina M. Holsgrove, Tamsin I. O'Reilly, Simone Varo, Agnieszka Gocalinska, Gediminas Juska, Demie M. Kepaptsoglou, Emanuele Pelucchi & Miryam Arredondo

Atomic fractions profiles for 5 different cross-sectional samples, A to E, of single PQDs from the same bulk a) Indium content near the pyramid tip and b) Indium and Aluminium content at the quantum wire (QWR) side. For each sample the Al content is given first (bottom) and the In content follows (top).



Cleaning up sensor signals

The increased desire to sense all manner of physical phenomena in the world around us is being facilitated by advances in solid-state sensors, many of which have been developed at Tyndall. But sensors become useful only when we can process their data digitally, and that is the task of the Analogue-to-Digital Converter (ADC). To reach the goal of ubiquitous sensing, our ADCs must be as small and as power efficient as possible while representing the sensor's signal faithfully.

This work improves the state of the art for the digitisation of current signals from sensors by taking the Flipped Voltage Follower (FVF) current buffer and pairing it with a current-controlled ring oscillator (CCRO), resulting in an extremely small ADC (< 50µm x 50µm, less than the width of a human hair).

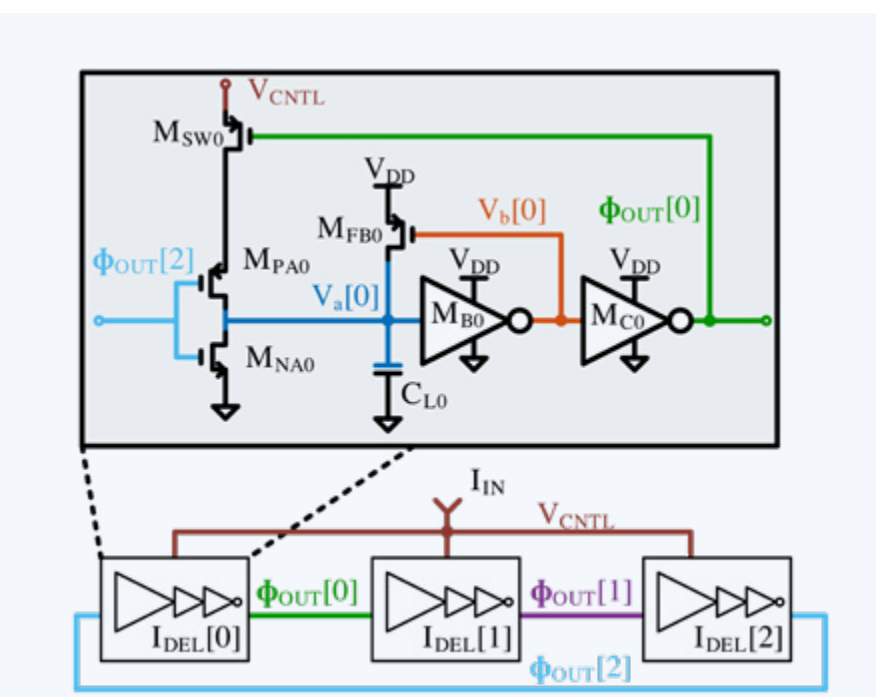
The CCRO is a notoriously non-linear circuit, causing sensor signals to be distorted at its output. The authors developed a new CCRO topology which improves its linearity by 10dB (>3x) by ensuring that the CCRO discharge time is much faster and more controlled than in previous implementations.

The ADC can measure currents from 1nA to 6µA at speeds up to 1MHz (1 million times per second) while consuming 372µW (372 millionths of a Watt).

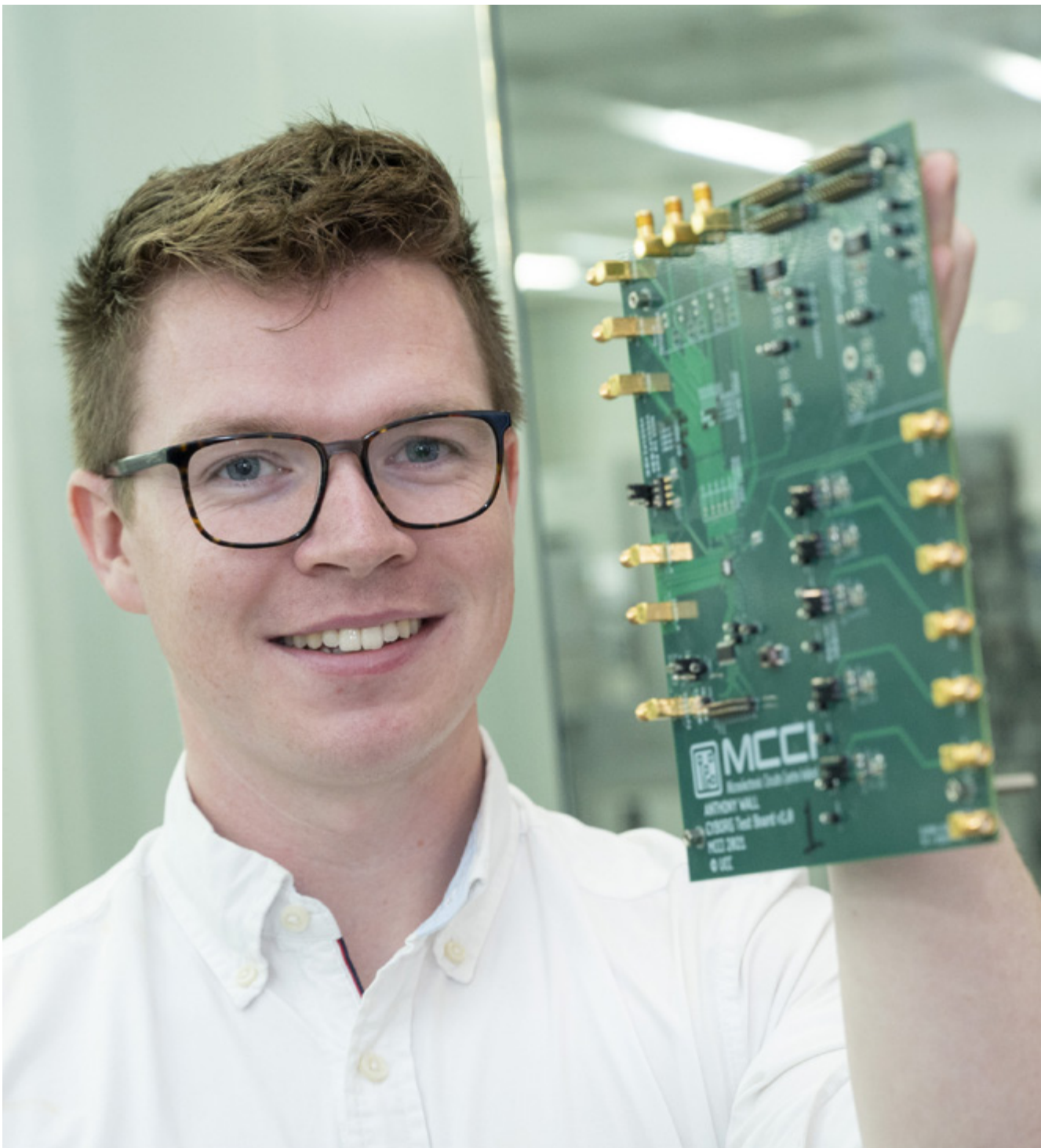
IEEE Solid-State Circuits Letters, vol. 5, pp. 202-205, (2022)

https://ieeexplore.ieee.org/document/9854922

Anthony Wall, Paul Walsh, Khosrov Sadeghipour, Ivan O'Connell and Daniel O'Hare



Schematic of the improved CCRO topology showing the added squaring inverters and positive feedback latch to improve discharge time



Anthony Wall,
PhD Student,
MCCI at Tyndall

Impact

104 *industry partners engaged for research and facilities access, including 49 SMEs*

95 industry researchers hosted on-site

>€6M **RECEIVED IN INDUSTRY FUNDING**

(with an additional future industry funding commitment of >€8m)

35% **OF INDUSTRY FUNDING FROM OVERSEAS PARTNERS**

19 PROJECTS IN OUR SPINOUT PIPELINE

Tyndall's unique research environment for industrial research, built on world-class infrastructure maintained to international industrial research standards and supported by world-class research teams delivered over 100 direct industry engagements in 2022.

Our industry partners funded more than €6m in research and services at Tyndall, 15% of Tyndall's income for the year. More than half of these engagements were with Irish SMEs. Last year also saw forward-looking industry programme funding commitments rise by 30% to its highest ever level of more than €8m, a strong indication of Tyndall's critical and expanding role in Ireland's industrial research ecosystem.

We saw strong growth in our non-domiciled industry engagements – defined as global industry partners with no research operations in Ireland who seek out Tyndall as a research partner, with 35% (€2.2m) of our industry income coming from this special category, most notably from Japan and Europe. This is a strong endorsement of our impact and growing international reputation.

Our pipeline of early stage potential spinouts increased by eight to a total of 19 projects, with three successful Enterprise Ireland Commercialisation Fund applications.

In 2022 our industry-in-residence community included 17 companies (10 SMEs) and nearly 100 industry researchers working on-site. Tyndall's highly innovative industry engagement model provides training and badged access to our state-of-the-art infrastructure and research leadership personnel.

Working with UCC Innovation we executed a total of 17 IP assignments, licences and options as well as eight new patent filings and four patent grants.

New Meta Industrial Chair in Semiconductor Technologies

In 2022 Meta agreed to a four-year programme of research led by Tyndall's Professor Paul Hurley, recently appointed as Meta's Industrial Chair in Semiconductor Technologies at UCC, based at Tyndall. This unique appointment demonstrates Meta's world-class research efforts in the core technologies underpinning the broad adoption of Augmented Reality (AR) platforms, and the strategic importance of its Irish research teams collaborating with Tyndall in Cork.

Professor Hurley will lead a multi-disciplinary research team, including the appointment of a cohort of Tyndall PhD students, to help advance the state of AR technology alongside Meta.

Speaking about this agreement, Professor Paul Hurley said, "The optoelectronic efficiency of ultra-scaled devices such as micro LEDs is dominated by surfaces and interfaces. The goal of this research engagement with Meta is to investigate heterogeneous systems and determine their impact on efficiency, further informing critical technology adoption in future products."

Professor Paul Hurley, Meta Industrial Chair in Semiconductor Technologies

Boston Scientific and Tyndall Innovation Partnership

In 2022 Tyndall's Bioelectronics cluster and Boston Scientific completed their Innovation Partnership project joint funded by Enterprise Ireland and Boston Scientific.

Tyndall researchers, Boston Scientific business partners, clinicians from Cork University Hospital and designers from Design Partners collaborated on this research project, to develop a smart implantable fiducial marker, for accurately measuring radiation at the site of a tumour during radiation therapy. This led to ground-breaking research, leading to a prototype of what is almost certainly the world's smallest Radiation Field Effect Transistor (RADFET) system, packaged within a fiducial coil, and tested in a radiation therapy clinical setting under conditions typical for prostate cancer treatment.

Impacts of the collaboration included greater engagement in Irish R & D by Boston Scientific in Digital Healthtech, aligned with Tyndall's strategic research activities, including successful EC funded collaborations.

Smart implantable fiducial marker

Enhancing animal welfare and food traceability

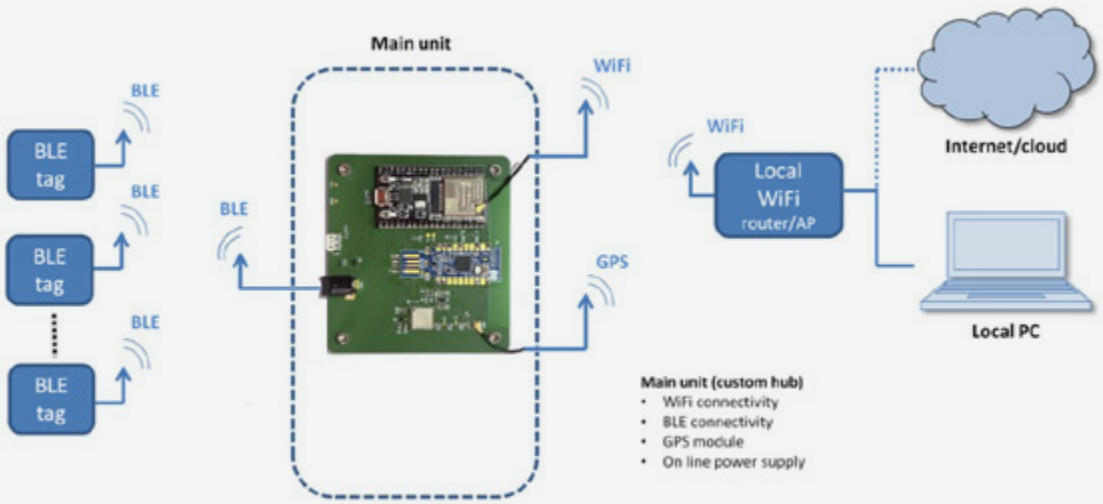
Tyndall's Life Sciences Interface Group supported a research collaboration between Irish software company Verifact and the European Space Agency (ESA) to develop and demonstrate the use of a bespoke animal tagging system which will help to improve food traceability and provide better insights into animal welfare.

This system enables information relating to individual animals to be transmitted via a hub to a cloud based secure blockchain database in a real world environment. This includes key information about the provenance of the animals and the conditions the animals are reared in. This information will be available to consumers via QR codes to enable them to verify provenance and important information around animal welfare.

Tyndall developed the bespoke tag system design according to the requirements specified by Verifact. The project is important to Verifact's current research and development programme which is targeting the growing requirement for full traceability and verification of food supply chains.

"Verifact solutions enable consumers to make better choices. Information is power and empowers the consumer to contribute to protecting the long-term future of our planet. The research with Tyndall was important as we needed a bespoke tag system to verify the use case." Frank Flemming CEO, Verifact.

Verifact prototype blockchain technology system comprising wireless ID ear tags, Tyndall developed hub and cloud based database



New ventures at Tyndall

Tyndall's new ventures pipeline continued to evolve during 2022 with a total of 19 commercialisation projects being explored. Enterprise Ireland's Commercialisation Fund funding of €1.8m was secured for three projects. Two Enterprise Ireland Feasibility Studies were also approved for funding.

A significant highlight of the year was the inaugural all-island Launching Future Disruptive Technologies Summit (LFDT), which took place in Cork in September 2022. Tyndall, along with UCC, was a founding organisation of this hugely successful deep-tech innovation event, which brought together for the first time in a single event all of the stakeholders in Ireland's deep-tech ecosystem.

Other new venture activity during the year included a number of well attended onsite events that featured Atlantic Bridge Ventures, Delta Partners and SOSV.

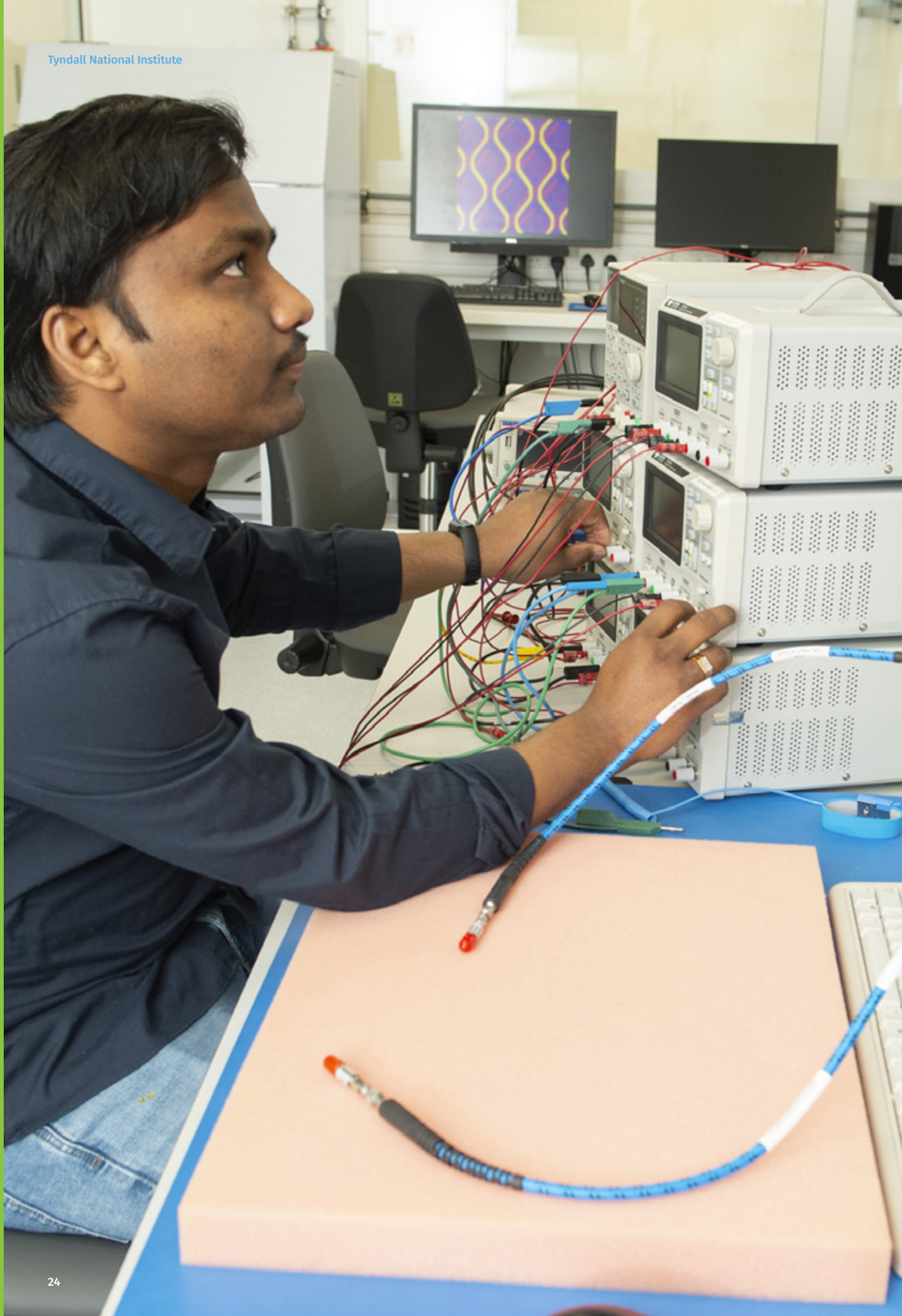
Tyndall also organised the inaugural 12-hour UCC Idea Generation Challenge for PhD candidates and researchers in October 2022.

An In-Kind Partnership Agreement was signed with Silicon Catalyst, the world's only dedicated semiconductor accelerator. This new relationship will open up a global network of companies to Tyndall and help support our deep-tech innovation ambitions.

In addition, the Explorer Pre-Accelerator Programme attracted five Tyndall projects.

Atlantic Bridge Ventures
deep-tech spin-out forum 2022

Tyndall National Institute



International positioning

EU Programmes

€260m total project value | *€17m Tyndall grant value* | €14m to Irish Partners | *€7m to Industry based in Ireland* | 26 projects | *12 projects in digital focused topics* | 4 projects Tyndall co-ordinated

ASCENT+ contributions:

37 TA projects

The number of ASCENT+ access projects Tyndall has had so far

132

The number of researchers and students benefited

15 countries

The number of countries involved globally

3 AUTHORITATIVE CONTRIBUTIONS:

1 ***'The potential and global outlook of integrated photonics for quantum technologies'***

2 ***'Community Proposal for an ESA Road-Map for Cold Atoms in Space'***

3 ***IEEE: International Roadmap for Devices and Systems'***

Dr Arindam Samanta

Tyndall is internationally recognised as a European infrastructure of scale. During 2022 significant progress was made towards the international positioning goal and objectives of the Tyndall 2025 strategy. Our thought leaders continued their important contributions to research policy and technology road mapping while our direct engagement and partnerships in EU programmes with global technology leaders have grown.

Thought leadership

Tyndall researchers have been influential in the further development of the International Roadmap of Devices and Systems (IRDS) Chapter on 'Cryoelectronics and Quantum Information Processing' with the addition of integrated quantum photonics. For the first time, Tyndall researchers provided inputs to the Quantum Industry Consortium Strategic Industry Roadmap.

We also continued to contribute to the Strategic Research and Innovation Agenda of Electronics Components and Systems (ECS-SRIA), leading the chapter on AgriFood and Natural Resources. The ECS-SRIA underpins the European Partnership on Key Digital Technologies (KDT) – to be succeeded by the Chips Joint Undertaking (JU) – and describes major challenges for the semiconductor industrial value chains in Europe.

Our researchers also made contributions to the white paper 'Open Technology Platforms for Emerging Medical Domains' as part of Health. E Lighthouse project enabling 'Moore for Medical'. In addition, several international workshops were organised including the international webinar series Enabling Digital Healthtech Innovation in collaboration with the Irish Medtech Association and Connected Health Skillnet Ireland, the 2022 EnerHarv Workshop held at North Carolina State University, and the 2022 IEEE International Workshop on Antenna Technology (iWAT).

Horizon Europe

As the first results from Horizon Europe and other EU programmes started to become available in 2022, it emerged that Tyndall enjoyed significant successes across the board with projects spanning all pillars of Horizon Europe as well as projects in the Digital Europe and Institutional Partnerships programmes.

Key successes included the Tyndall-coordinated projects ADOPTION and FreeHydroCells. ADOPTION brings on board two Irish SMEs and is exploring advanced integration of optics to enable high-efficiency cloud computing. FreeHydroCells investigates freestanding energy-to-hydrogen fuel generation by solar energy absorption. Tyndall is also leading an Irish consortium for a European Digital Innovation Hub which plans to help SMEs in the agriculture, energy and transport sectors to become more competitive by using digital technologies.

Large scale projects

Tyndall championed Irish participation in three large-scale KDT projects during 2022: AgrarSense partnering with the Irish SME Aquamonitrix, NewLife together with Boston Scientific and LoLiPoP IoT with Analog Devices, Boston Scientific and Depuy

AgrarSense and NewLife build on Tyndall's prominent engagement in the European agritech and digital healthtech ecosystems respectively. LoLiPoP IoT arose from a previous Tyndall-led project and investigates long-life power platforms for wireless sensor network modules in IoT applications.

Tyndall was also chosen as a key partner in QCI-Ireland, the Irish project implementing the European Quantum Communication Infrastructure, and CoQREATE, an international alliance led by the University of Arizona to develop technologies for the quantum internet.

Finally, we celebrated the success of Dr Sinan Bugu who has been awarded the prestigious and highly competitive Marie-Skłodowska-Curie Postdoctoral Fellowship to work on a scalable semiconductor quantum computation platform whilst acquiring new skills and knowledge at Tyndall.

Accessing key nanoelectronics infrastructure

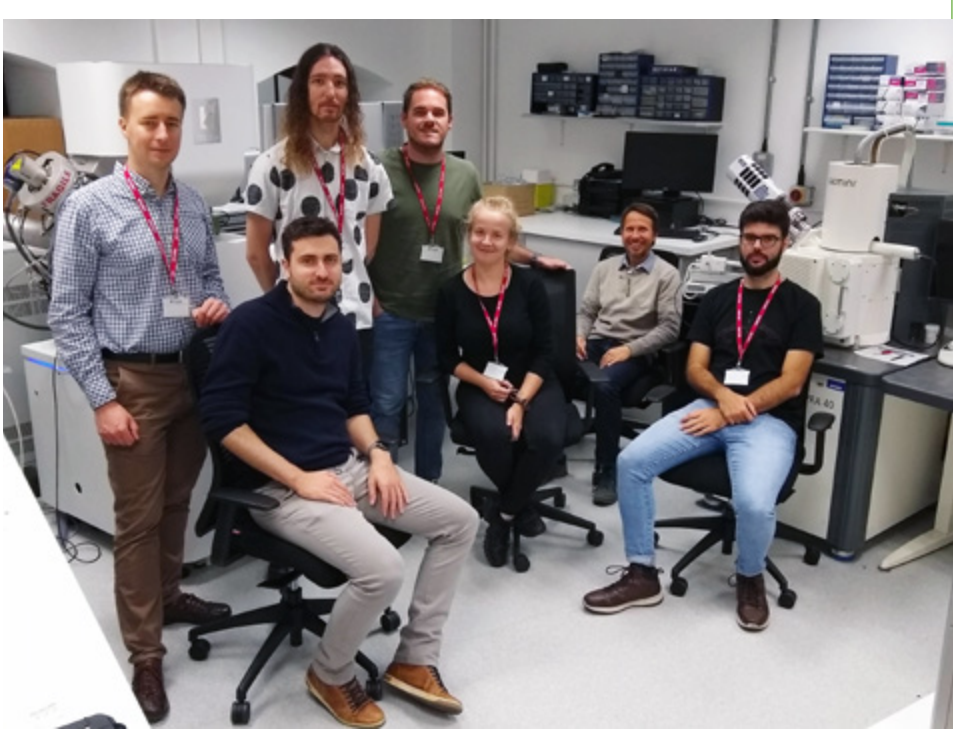
In September 2022, Tyndall ran the first Research Accelerator Programme aimed at giving early-career researchers an on-site introduction to the technology and facilities available through the ASCENT+ programme.

The EU funded ASCENT+ Programme offers open access to key research nanoelectronics infrastructure in 14 partner institutions including Tyndall, imec, CEA-leti, Fraunhofer Mikroelektronik and INL. The programme serves as a direct entry-point to unique research infrastructure in key enabling capabilities and state-of-the-art equipment in processing, characterisation and metrology, modelling and simulation data, devices and test structures. Focus areas include quantum advantage using solid-state platforms, energy-efficient computing based on disruptive devices and increased functionality through advanced integration of new materials and technologies.

The Research Accelerator Programme saw six PhD students and early-career postdoctoral researchers sponsored to visit Tyndall and get a clear insight on nanofabrication to enable them to benefit from ASCENT+ offerings and accelerate their own research.

Overall, 37 ASCENT+ projects have been made available through Tyndall. The infrastructure and expertise access has benefited over 130 researchers including 22 PhD and 7 MSc students from 15 countries around the world.

Early career researchers and PhD students, participants in the ASCENT+ Research Accelerator Programme



People and culture

Attained Athena SWAN Bronze Award

Trained over 300 staff/students

OUR EDUCATION STREAMS

→ 25 Summer Fellowships
→ 130 PhDs, 15 Masters by research
→ 20 Viva's → Launch of TARAs

15,673 MIN DIRECT ENGAGEMENT WITH PUBLIC

210 staff/students *took part in EPE events this year on behalf of the institute*

2022 marked 40 years since the establishment of Tyndall National Institute (formerly the National Microelectronics Research Centre or NMRC) and the occasion was marked with a series of celebratory events focused on Tyndall's research excellence.

Among the highlights were; the launch of the Wrixon Research Excellence and Travel bursaries; the establishment of an annual alumni event for past and present staff and students; the launch of the Tyndall Annual Recognition Awards (TARAs) and the Tyndall's Got Talent event to showcase the hidden talents, cultural diversity and skills that flourish within the Tyndall community.

The inaugural Wrixon Research Excellence Bursary winners were Dinesh Gawade, Cara-Lena Nies and Anthony Wall. All worthy recipients for their respective work in museum conservationism, computer simulations on new materials and enhanced sensor activity. In addition, two Travel Bursaries were awarded to Li Yao (Celina) Li and Lorenzo Niemitz. We look forward to learning more about their respective overseas experiences in 2023.

Ninety-eight staff and postgraduates were nominated for TARAs across a variety of categories including engineering, technical and professional support, postgraduate students, mentors, postdoctoral, and research.

Tyndall's commitment to gender equality was recognised in 2022 with the achievement of an Athena SWAN Bronze Award for gender equality in higher education. These awards celebrate good practice towards the advancement of gender equality and representation at Tyndall. We are the first research institute in an Irish university to receive the award.

Gathering face-to-face once again was another significant highlight during the year. After two years of Covid lockdowns and restrictions, it was time for everyone in the Tyndall community to reunite in person.

Our research addresses many of the most pressing sustainability challenges facing society. This focus is reflected in how we manage our internal operations. Our commitment to sustainable practices was recognised with the 2022 Award of Excellence in Energy Management from the Clean Energy Ministerial (CEM), a high-level global forum that promotes policies and programs to advance clean energy.

The appointment of Dr Denis Doyle as the new Chair of the Tyndall Board was announced early in the year. An incisive and strategically focused leader, Dr Doyle will lead the Board's oversight of the future development and expansion of Ireland's flagship research institute.

Professor Gerry Wrixon


Tyndall
40 years
of research
excellence


William Scanlon
CEO
Tyndall

Education and public engagement

During 2022, 210 staff and students from across the Institute participated in EPE activities. These activities resulted in direct engagement with over 2,000 school and undergraduate students, as well as 15,673 members of the public.

Among the highlights of the year was the launch of our SFI Discover Project 'Sensational STEM' led by senior engineer Catriona Kenny which targeted primary school audiences.

This unique and innovative project is aimed at students with an autism spectrum disorder (ASD) diagnosis who may otherwise find existing STEM programme settings distressing.

Five schools in Cork City and County took part in the project during the year and this enabled 55 students and 29 teachers to avail of ASD friendly experiments and kits for their schools. It is hoped that another five schools will avail of the opportunity in 2023.

The 2022 Tyndall and IPIC Summer Fellowship Programme ran for 12 weeks between June and August. The programme allowed 25 undergraduate students to work with renowned researchers at Tyndall, IPIC the SFI Centre for Photonics, MCCI and IERC. The programme is designed to give interns additional skills that will make them attractive candidates for future scientific careers.

SFI Discover Project
Sensational STEM

Student Awards and Prizes 2022

In addition to the inaugural Wrixon Research Excellence and Travel Bursary Awards, student awards in 2022 included the Research Student Publication of the Year, sponsored by Meta, which was awarded to Cara-Lena Nies and the runner-up awards went to Luiza Wasiewska and Marcelo Saito Nogueira. Eoghan Vaughan, Meena Baksaran, Nadeem Rather and Zhongzheng Wang all received rising star awards in recognition of their research publications.

The annual BOC Bursary Award, which recognises outstanding postgraduate students, was awarded to Arbresha Muriqi in recognition of her research on multi scale simulations of hybrid inorganic-organic films.

2022 saw the return of the annual Student Poster Competition in person, with Dinesh Gawade winning the Early Student Researcher category. In the Later Student Researcher category, first prize was awarded to Fernando Diaz, with second prize awarded to Lorenzo Niemitz, and Aritra Roy was the recipient of third prize.

The excellent achievements of our research students were also recognised at international conferences throughout 2022.

- At the 67th Annual Conference on Magnetism and Magnetic Materials, Arinandam Samanta won the magnetic sensors challenge competition.
- Ana Cláudia Rodrigues Ferreira won a student travel award from IEEE and Best PhD presentation at the VistaMilk Annual Conference.
- Debismita Dutta received Best Student Pitch at the ISAF EMAF PFM Conference. Debismita was also the winner of the IGNITE Hackathon, sponsored by Sport Ireland and winner of the 1st UCC Idea Generation Challenge for PhD students and researchers.
- Louise Colfer won a poster prize at the joint Microscopy Society of Ireland and Scottish Microscopy Society Symposium as well as a junior researcher travel grant from the SINANO Institute EID event.
- Nadeem Rather was the recipient of the Best Student Paper award at the 17th International Workshop on Antenna Technology (iWAT).
- Siddra Maryam was awarded a student travel grant from SPIE for Photonics West 2022.
- Stephen Murphy and Lorenzo Niemitz were recognised with a UCC EmployAgility Digital Badge for their work on relaunching the UCC Doctoral Student Journal “The Boolean”.
- Zhongzheng Wang received the Analog Devices Outstanding Student IC Designer award and a 2022 IEEE ISSCC student travel grant.
- Zixiao Zhang received third place in the Best Paper award at the 19th RIA/URSI Research Colloquium on Radio Science and Communications.








PhD vivas 2022

Fiona Barry
Electrochemical sensors for integration on silicon

Ardeshir Behrouzirad
Development of a bio-impedance measurement system for bladder monitoring

Darragh Cronin
Thin film magnetics for power supply on chip

Shóna Doyle
New materials via combinatorial atomic layer deposition

Michael Dunne
The atomistic simulation and analysis of novel group-IV semiconductor alloys and devices

T. Hellebore Fass
Self-assembling magnetic chains for minimally-invasive surgery

Simone Iadanza
CMOS compatible deposited materials for Optical Interconnects

Meysam Khanghah
Design of clock and data recovery circuits for energy-efficient short-reach optical transceivers

Cathal Larrigy
Laser fabrication of porous, 3D graphene-like carbon from polyimide and sustainable bioplastics

Hiatong Liang
Ultra-low and wide bandwidth vibrational energy harvesting using a statically balanced compliant mechanism

Julia Madden
Development and characterisation of macro-disc and micro-band electrodes for electrochemical sensing applications

Brian Murray
Lumped silicon photonic Mach-Zehnder modulators for high-speed optical interconnects

Cara-Lena Nies
Nitride materials and their growth for use in downscaled interconnect technology

Andrea Pacheco
Phantom and computational studies towards the clinical translation of Gas in Scattering Media Absorption Spectroscopy in neonatal care

Kankana Paul
Development of electromagnetic vibration energy harvesters as powering solution for IoT based applications

Oliver Pemble
The design, synthesis and characterisation of selected chitosan-based thin films and studies of their use as materials for antimicrobial, heavy metal adsorption, and wound dressing applications

Michael Raju
Modelling wave transport in random media for wavefront shaping applications

Eoin Russell
Technologies in the 2 µm waveband

Zeinab Shaban
Micro-transfer printing of micro-structured, ultra-thin light-emitting devices

Chandra Shetty
Design, modelling, analysis, and characterization of 3-D inductors for PwrSoC/PwrSiP DC-DC converters

Praveen Kumar
Singaravelu Miniaturized III-V/ Si Hybrid Laser with an Integrated Modulator

Justina Ugwah
SMARTProbe, a needle integrated with a portable handheld impedance analyser for real-time breast disease detection

Yuqing Wang
Novel, surface enhanced Raman spectroscopy (SERS) sensors

Luiza Wasiewska
Development of electrochemical DNA-based biosensors for the detection of Shiga toxin-producing E. coli (STEC)

Tyndall National Institute

Infrastructure

SUCCESSFUL IN SFI CAPITAL BID:
JOULIET — Energy for the Internet of everything (co-funded by SEAI), valued at €1.5m

285 PEOPLE
trained in the operation of process or analysis tools

111 **new users to the open access labs & cleanrooms**

Derry Kelleher, Facilities Manager with the 2022 Award of Excellence in Energy Management from the Clean Energy Ministerial (CEM)

Underlying the Tyndall 2025 strategy is a commitment to invest with ambition in areas of growth where quantum technologies feature prominently. These areas encompass a range of novel engineering solutions to challenging problems using the fundamentals of quantum science.

Tyndall has been pursuing a programme around novel quantum materials, devices and architectures for quantum computing. Through our Catalyst Award programme, we have supported researchers to stimulate new projects and accelerate results which build on our research infrastructure assets.

One such project focused on the foundational building blocks for silicon-based qubit devices and sensors by establishing the nanofabrication process flow and electron-beam-lithography patterning of gated silicon nanowire structures and free-standing nano-resonators.

Image 1 shows the first gate-all-around transistor structure with high-k dielectric and metal gate, conformal to the silicon nanobelt, produced as a demonstrator.

Image 2 shows a more recent design of a silicon nano-resonator that could be used as a quantum sensor.

This work has been the springboard for joint quantum technology projects with leading academic and industry groups and attracted large-scale funding through an SFI-funded partnership project between Tyndall and Munster Technological University (MTU). The work also benefited the development of early-career researchers via the award of a prestigious Marie Skłodowska-Curie Fellowship to study hole spin-qubits in germanium quantum dots and the training of PhD and MSc students.

The key pieces of new infrastructure that supported this work includes the Elionix ebeam writer, the SPTS HF vapour etcher, the MEMstar silicon vapour etcher and the Brucker Atomic Force Microscope system.

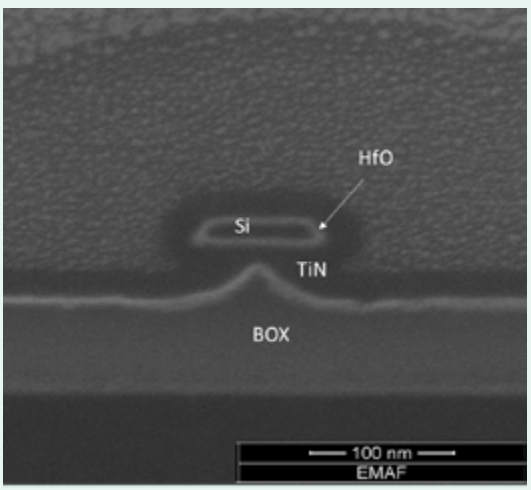


Image 1

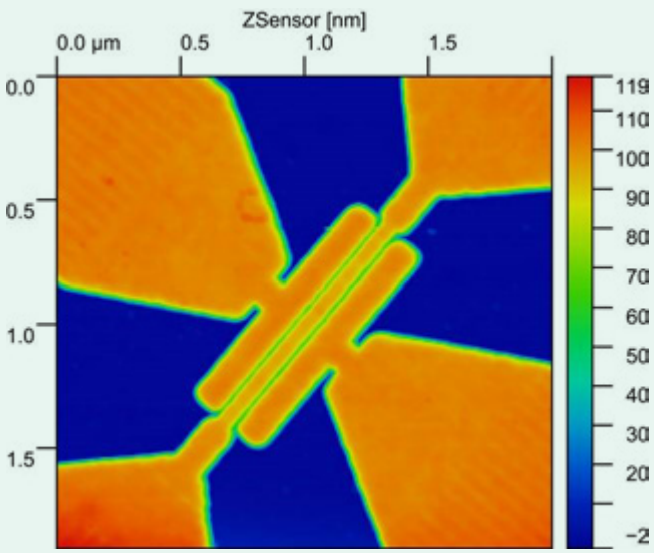


Image 2

SQUID

A SQUID (superconducting quantum interference device) is a very sensitive magnetometer used to measure extremely subtle magnetic fields, based on superconducting loops containing Josephson junctions. The Quantum Design MPMS 3 provides us with the sensitivity of a SQUID magnetometer with multiple measurement modes.

Measurements can be made from a few degrees above absolute zero up to a few hundred degrees (1.8K to 400K) with very high sensitivity (≤10-8emu).

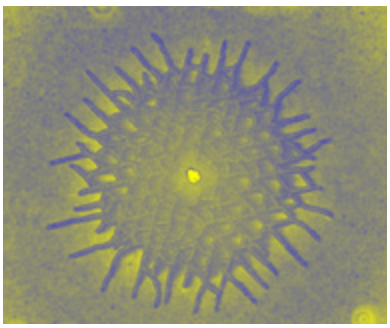
This new magnetometer is an essential tool used to support the development of new magnetic materials and devices here in Tyndall and is the only one of its type in Ireland. Substantial research interest is devoted to the development of hard and soft micro-nano-structured magnetic materials for a wide range of micro-nano-magnetic devices applications.

Additionally, Tyndall is active in the development of efficient and miniaturised high frequency induction based write-read core and integrated micro-transformers/inductors, which relies on the development of novel and improved high frequency soft to ultra-soft magnetic materials that are deposited using CMOS compatible techniques.

The system appears in our 360 degree videos of the open access facilities - https://www.tyndall.ie/virtual-lab-tours

Quantum Design MPMS 3 SQUID (superconducting quantum interference device)

Scientific image competition winners



Crystal Starburst

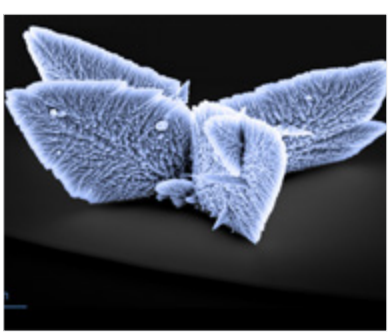
Dr Emmanouil Amargianitakis, III-V Materials and Devices Group

This image shows the central region of a circular defect which has the shape of a crisscross grown on the surface of a semiconducting crystal. The image was taken with a scanning electron microscope. The feature was created unintentionally during the high temperature (1000 degrees Celsius) growth of GaN/AlGaN materials by metal organic chemical vapor deposition. These are the materials used in Light Emitting Diodes (LEDs). This work is part of an IPIC, the SFI Research Centre for Photonics, project "Realization of ultra-violet III-nitride solid state lasers employing micro-transfer printing for their integration with waveguides" at Tyndall.

NanoButterflies

Dr Vuslat Juska, Nanosensors Group

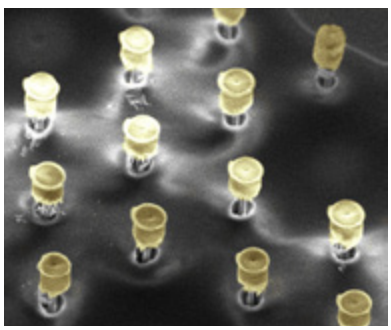
This beautiful image of butterfly-like nano-architectures on a chip represents one of the designs for immunosensor development fabricated during Dr Juska's Catalyst project at Tyndall. The project's aim is to develop an electrochemical biosensing platform based on silicon nanotechnologies. The walls of the butterfly wings are highly porous and provide increased surface areas for electrochemical applications. The aim is to transform these nano-architectures into sensing platforms to serve as diagnostic tools for neurodegenerative diseases such as multiple sclerosis.



NanoIceberg

Dr Vuslat Juska, Nanosensors Group

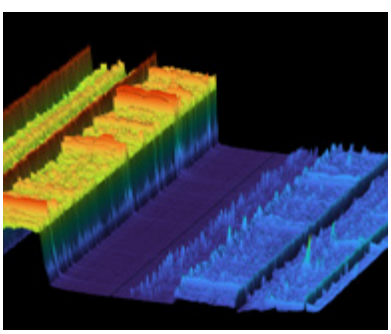
This image represents one of the nanotextured interfaces on an array that Dr Juska developed for her Catalyst project at Tyndall. The blue iceberg-like architecture is electrodeposited gold with highly porous walls. The surface morphology is key to overcoming the limitations of many electrochemical biosensing systems.



Micro-Marshmallow

Dr Simone Varo, Epitaxy and Physics of Nanostructures Group

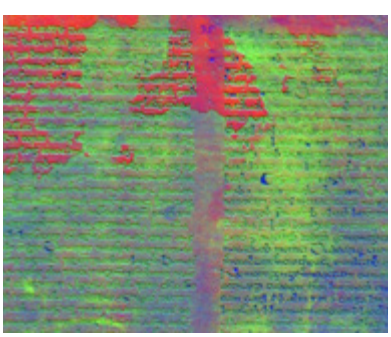
This image is part of a Catalyst award called "Coupling of non-classical light sources to compact photonic integrated packages for quantum information technologies". Photonic nanowires are one of the most promising approaches to enhance light extraction efficiency from quantum dots. In Tyndall, a novel self-aligning and wafer-scalable technique has been developed that allows the fabrication of millions of such nanowires. However, trying to invert them so that they point upwards is a tricky process. In this image, part of a Silicon Nitride protective shell was not removed, and this caused the formation of a "micro-marshmallow" on top of the photonic nanowires.



Ocean of Information

Dr Xing Ouyang, Photonics Systems Group

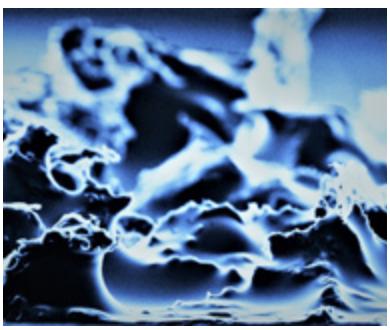
For anyone who has ever wondered what electromagnetic waves would look like if we could see them, this image depicts a wireless signal over its time and frequency dimensions. The level of the seabed indicates the strength of the signal – the higher the strength, the higher the information capacity. We can see a continental shelf, slope, Abyssal plain, ridges as well as submarine volcanos and trenches. Perhaps we, as humans, are the fish swimming in the Ocean of Information.



Gaelic Pride

Veronica Biolcati, Nanotechnology Group

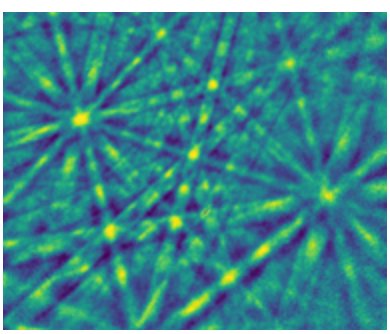
The image is from the medieval Gaelic manuscript, the Book of Uí Mhaine. It is part of a study that has been conducted under the auspices of the Irish Research Council Advanced Laureate Project – Inks & Skins. This study aims to understand the materiality of Gaelic medieval manuscripts. The image was produced using advanced image processing conducted via principle component analysis (PCA). In the case of a manuscript, PCA helps to visualise the dispersion of inks and pigments on the pages. It also detects the humidity and mould stains that affected manuscripts throughout the centuries and helps to recover faded text.



The Great Wave of LIG

Dr Cathal Larrigy, Nanotechnology Group

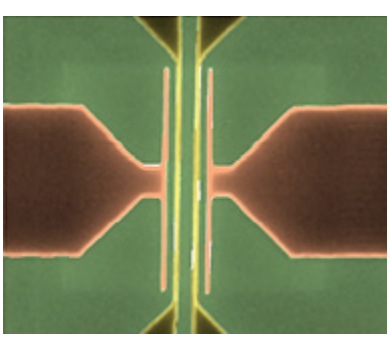
This image is a scanning electron micrograph of a cross section of laser-induced graphene (LIG) fabricated on a chitosan-based bioplastic. Chitosan is the acetylated form of chitin and is often cited as the second most abundant polysaccharide. It can be formulated into a bioplastic composite and a simple three-step laser fabrication process additively converts it into LIG. The micrograph was edited with blue hue, as it represents a striking similarity with the artist Hokusai's work, “The Great Wave off the Coast of Kanagawa”.



Mosaic in Crystals

Davinder Singh, Electron Microscopy and Analysis Facility (EMAF)

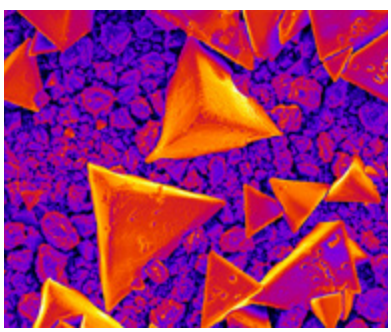
This image shows diffraction patterns of gold, also called Kikuchi patterns, after the Japanese physicist, Seishi Kikuchi, who first explained the phenomenon of electron backscattered diffraction in crystalline materials which leads to such mosaic patterns. These patterns are only observed in crystalline materials like metals, alumina, quartz, diamond as well as table salt and sugar. Electron Backscatter Diffraction (EBSD) utilises this phenomenon to analyse sample’s microstructure using a scanning electron microscope. The image has been obtained using Tyndall's newly acquired Plasma FIB-SEM which enables researchers to perform crystallographic study of samples.



Nano-Highway

Dr Nikolay Petkov, Dr Sinan Bugu, Dr Ray Duffy and Dr Giorgos Fagas, CMOS++

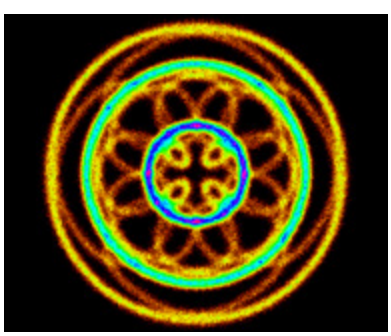
This image shows a new building block for quantum sensors based on quantum nano-mechanical resonator devices, fabricated at Tyndall.



Trigonal Pyramids

Dr Lorraine Nagle, Electrochemical Materials and Energy group

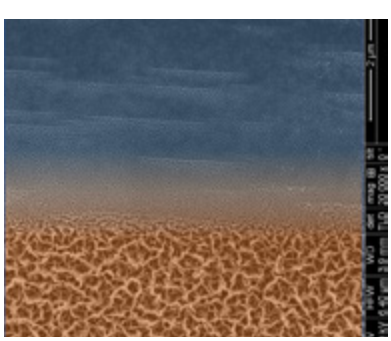
Shape control of metallic particles is important due to their unique facet-dependent electronic, magnetic, optical, and catalytic properties which have a wide range of applications including chemical and bio-sensing, catalysis, photonics, and optoelectronics. For example, the surface facet-dependent properties of copper oxide have been exploited in gas catalysis, photocatalysis, organocatalysis and sensing applications. This scanning electron microscope image of trigonal pyramidal copper oxide microcrystals was captured during their creation.

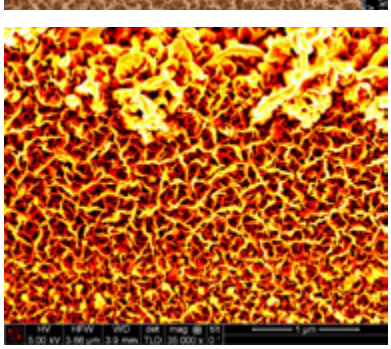


Samsara – The Wheel of Life

Dr Xing Ouyang, Photonics Systems Group

This image captures modulated radio frequency signals in the form of a two-dimension constellation diagram. These quadrature amplitude modulation signals are widely used in 5G mobile networks, Wi-Fi and fibre-optic systems for broadband communications. Each point in the picture represents four bits of information, with millions of bits contained in the image. The signal is swirling because the signal is distorted by the linear filtering effect. The result is similar to the concept of Samsara, meaning "cyclicality of all life, matter and existence".





GeSn Coral Beach and GeSn Wild Roses

Dr Nikolay Petkov, Dr Sinan Bugu, Dr Ray Duffy and Dr Giorgos Fagas, CMOS++

Both of these scanning electron microscope images are related to a collaborative SFI project at Tyndall, which aims to demonstrate the first operational GeSn (an alloy of germanium and tin) quantum devices. As shown in the images, under irradiation by a focussed ion beam, the GeSn surface morphology becomes highly textured.

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.

MaREI Energy · Climate · Marine

AMBER Advancing Materials for Impact

Insight SFI Research Centre for Data Analytics

ICHEC Irish Centre for High-End Computing

ADVANCECRT

IPIC
BRINGING PHOTONICS TO LIFE

IPIC, the SFI Research Centre for Photonics, is hosted at Tyndall and in 2022 it strengthened its position as one of Europe's leading photonics research centres while also securing its first industry projects in the space and quantum applications markets. In addition, the centre achieved a number of significant output milestones in the medical device application market, including the launch of its latest spinout, BCon Medical, in partnership with the Netherlands Cancer Institute, and Synergia Medical. The company secured nearly €13m of Series B funding to enable first-in-human clinical trials of its optoelectronic neurostimulator based on IP developed and licensed by IPIC.

2022 also saw continued interest in advanced integration technologies, driven by the market need for high density optoelectronics and simpler lower cost packaging solutions. In response, our industry partner FiconTEC installed a third tool in the Advanced Packaging Pilot-Line facility in Tyndall. IPIC also expanded its PI team to include Dr Ning Lui from the University of Limerick, whose research areas included nanophotonics, plasmonics and light emitting diodes.

Expansion of PhD training continued with the recruitment of 26 MSCA fellows through the Sparkle programme along with a further 15 PhDs being added to the Centre Of Doctoral Training, PIADS, in partnership with Queens University Belfast and Glasgow University.

Science Foundation Ireland sfi For what's next

Inspiring the next generation of women research leaders through IPIC and Tyndall's all centre Summer Fellowship Programme

CONNECT
Networks of the Future

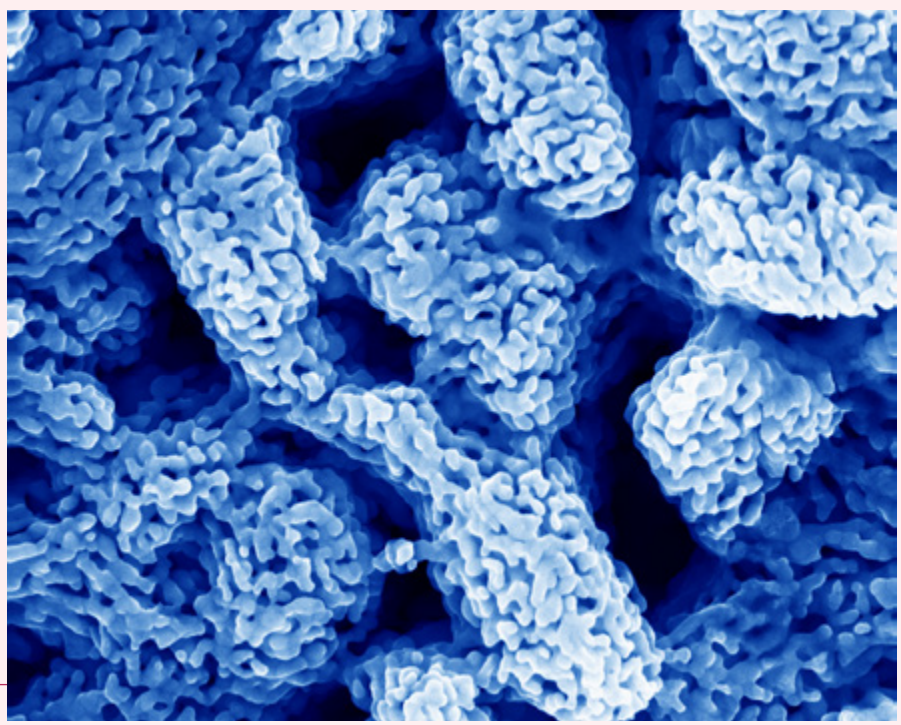
CONNECT is the SFI Research Centre for Future Networks and Communications. The Centre brings together research expertise from 10 academic institutions with a single purpose and mission to envision a future of sustainably deployed dependable networks that foster innovation in services and customer experience, empower citizens, and improve quality of life.

Tyndall researchers play leading roles within CONNECT providing leadership and major contributions to the Sustainable Internet of Things (IoT) theme and significant contributions to the centre's Dependable networks, Link Performance and Quantum themes.

In 2022, CONNECT became one of four large Research Centres in a US-Ireland R&D partnership CoQreate (Convergent Quantum Research Alliance in Telecommunications). The partnership will investigate technologies that will form the foundations of a quantum internet and investigate how it will interact and build upon current telecommunications infrastructure. Tyndall/CONNECT researchers Dr Peter O'Brien and Professor Holger Claussen lead research activities funded from the combined €3m investment allocated to CoQreate.

The award by SFI (with support of SEAI) of nearly €1.5m capital infrastructure grant in 2022 for "JOULIET – Energy for the Internet of Everything" to Tyndall, will greatly enhance the ability of the CONNECT Centre's Sustainable IoT team to further push the boundaries of its energy harvesting, storage and sustainable electronics technology research.

Science Foundation Ireland sfi For what's next



Nanoporous metal

Confirm
Smart Manufacturing

Confirm is the SFI research centre for Smart Manufacturing. In January 2022, Tyndall Confirm postdoctoral researcher Dr Matteo Menolotto was selected to represent the Irish research community along with 800 other young scientists from 38 countries to attend the 10th Global Young Scientist Summit (GYSS) 2022.

His research focus is on the creation of the next generation of collaborative robotics, developing human-centric sensing technology and human-machine interfaces to enable a safe and natural interaction between workers and robots.

As part of the SFI Centre CONFIRM Collaboration & Impact Initiative (CII), Dr Menolotto was awarded funding to continue his research in collaborative robotics. The CII initiative is a competitive award programme open to Confirm investigators that will fund new projects and deliver on excellent scientific research. The CO-OP project was funded to deliver on the creation of a research platform for the development of artificial intelligence (AI) driven collaborative robotic technology.

The rigorous selection process to attend GYSS, took into consideration the impact, level of collaboration and excellence of the research activity of the nominee. Dr Menolotto's selection as Ireland's representative on the world stage of research is not only an acknowledgement of his work, but also of the impactful nature of the research outputs of Confirm.

Science Foundation Ireland sfi For what's next

Dr Matteo Menolotto researches next generation collaborative robotics

VistaMilk

VistaMilk, the SFI Research Centre for Agri-Food and Dairy Production, was established in 2018, with the aim of enhancing the productivity and sustainability of the Irish dairy industry through innovative technologies and processes. The centre brings together a consortium of researchers from multiple disciplines, including engineering, computer science, genetics, and microbiology, to address the challenges faced by the dairy industry and improve its competitiveness.

Tyndall, as one of its partner institutions, plays a significant role in the centre's research activities. Tyndall's expertise in sensors and IoT, has contributed to developing innovative digital solutions to improve the efficiency of the dairy industry. The research is focused on developing new sensors and IoT systems for monitoring and improving various aspects of dairy production, including milk heat stability, allergen detection, and enhancing calf wellbeing and welfare amongst others.

Three additional collaborative projects were secured with multinational company partners during the year. Tyndall-VistaMilk researchers have also been active in translating their work to the marketplace with Dr Han Shao being recognised for her novel sensor technology with an Innovation Award at the 2022 National Ploughing Championships.

Dr Somayyeh Bozorgzadeh, appointed as a senior postdoctoral fellow in VistaMilk, recently won a Marie Skłodowska-Curie postdoctoral fellowship building on her on-going research activities.

2022 also saw the submission of VistaMilk's Phase 2 application to SFI. Under this proposal, covering 2024 to 2030, Tyndall activities are greatly expanded along with enlargement of core Tyndall activities. VistaMilk 2 will include a focus on energy, wireless sensing and RF devices for communications, and modelling with Professor Dimitra Psychogiou, Dr Padraig Lyons, and Dr Michael Nolan.

Science Foundation Ireland sfi For what's next

Dr Alan O'Riordan, Anna May MCHugh, National Ploughing Championships, Dr Han Shao, Dr Tarun Narayan and Dr Rowena Dwyer

IERC
International Energy Research

The focus of the International Energy Research Centre's (IERC's) energy research is efficiency in the residential and industrial sectors, renewable energy generation and storage technologies, innovative business models to enable decarbonisation, and energy policy and regulation. To support these activities IERC received funding from SEAI for CoStore which is exploring how co-located PV and energy storage can be optimally integrated. Funding from ERANet and Geothermica was awarded to GeoCoHort, a project that will enable community based geothermal energy.

In addition, to competitively awarded research work, IERC was successful in a number of tenders and is now on a framework contract to support SEAI activities in the areas of sustainable energy policy research and advice and provision of support in the electricity and wind energy sectors.

In another 2022 research highlight, the UP-STAIRS funded Home Energy Upgrade Office (HEUGO) was opened in the heart of Cork City on Grand Parade. The EU Horizon 2020 funded UP-STAIRS programme is supporting the development of energy communities through local Implementation Champions and One-Stop Shops such as the HEUGO.

IERC continued to disseminate and engage at several prestigious energy research events. Dr Padraig Lyons was a keynote speaker at the Applied Energy Symposium, co-organised by Harvard University and MIT and Professor Brian Norton presented at the International Summer School on Sustainable Materials for Renewable Energy Applications (SURE2022).

Roinn Cumarsáide, Gníomhaithe ar son na hAeráide & Comhshaoil
Department of Communications, Climate Action & Environment

Home Energy Upgrade Office (HEUGO) in Cork City

MCCI
SOLVE THE IMPOSSIBLE

The Microelectronic Circuits Centre Ireland (MCCI) is a Tyndall hosted research centre focused on advancing microelectronics technology. Its primary focus is research into analog and mixed-signal integrated circuit design and systems-on-chip (SoC) for a wide range of microelectronic applications, including wireless communications, medical/biomedical, IoT, Industry 4.0 and more.

MCCI has successfully secured its third phase of funding from Enterprise Ireland and IDA Ireland, demonstrating the centre's consistent delivery of high-quality research outcomes and world-class PhD level IC design talent to the microelectronics sector.

MCCI has produced an impressive 30 Tier 1 publications in 2022, with two individual MCCI researchers achieving first and third positions for the highest IEEE Explore downloads in Solid-State Circuits papers.

MCCI is actively partnering with both emerging and established international companies to undertake new research initiatives. The centre has emerged as a key facilitator for IDA clients seeking to establish a foothold in the Irish microelectronics sector, as evidenced by the growing number of semiconductor companies expanding their circuit design research and development (R&D) operations in Ireland over the past decade.

MCCI also plays a key role in supporting the microelectronics industry by supplying a talented pool of skilled IC design engineering professionals, and MCCI PhD student, Zhongzheng Wang, won the Analog Devices (ADI) Outstanding Student IC Designer Award 2022 for the EU region.

TECHNOLOGY CENTRE
SUPPORTED BY ENTERPRISE IRELAND

ENTERPRISE IRELAND
where innovation means business

Zhongzheng Wang pictured with Philip Quinlan ADI Design Engineering Director accepting his Outstanding IC Designer Award

esa space solutions Ireland

Established in 2016, ESA (European Space Agency) Space Solutions Ireland is made up of five consortium partners – lead partner Tyndall National Institute, MaREI, Maynooth University, Technological University of the Shannon, and University College Dublin. Local funding support is provided by Enterprise Ireland.

In 2022 five ESA Business Incubation Centre (BIC) Ireland companies were contracted (Cortex Labs, Oblivious, PlantQuest, StrongBó Agritech, Zeus Scooters), whilst the first ESA Spark Funding project was also approved (PixQuanta). ESA BIC Ireland companies also participated in three financial training workshops.

ESA Spark Funding is a new technology transfer mechanism designed to accelerate the product development and commercialisation process of a company that is integrating space technology.

A number of ESA BIC Ireland companies closed significant funding rounds during 2022, including Danu Sports, Oblivious, PlasmaBound and Zeus Scooters.

Other highlights during the year included the first ESA Space Solutions Ireland Annual Networking Event in Portlaoise, participation in the ESA Space Solutions Annual Network Meeting in Athens, Greece, and bringing three ESA BIC Ireland companies to Space Tech Expo Europe in Bremen, Germany.

Under the current four-year funding cycle of the Centre, a total of 30 Irish companies will be supported by ESA BIC Ireland, a 50 per cent increase on the first funding cycle.

ENTERPRISE IRELAND
where innovation means business

Charlie Gleeson, Founder, Zipp Mobility, and Ronan Garvey, Chief Product Officer, Zeus Scooters

Financial report

Income and expenditure summary

Income	2022 €000s	2021 €000s
Government grant	7,000	7,000
Research	33,009	36,209
Exceptional Infrastructure	0	1,733
UCC contribution	2,241	2,221
	42,250	**47,163**

Expenditure	2022 €000s	2021 €000s
Remuneration costs	27,746	26,465
Equipment and infrastructure	1,462	2,632
Consumables and related costs	12,897	9,531
Other operating and deferred costs	145	8,535
	42,250	**47,163**

Tyndall National Institute

Board members

Dr Denis Doyle
Chairperson

Prof. William Scanlon
CEO

Prof. John F. Cryan
University College Cork

Caroline Dowling
Non-executive director (various)

Prof. Bram Nauta
University Of Twente

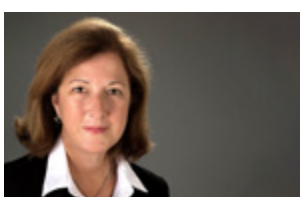
Sean O'Sullivan
SOSV

Prof. Richard Penty
University of Cambridge

Patricia Reilly
European Commission

Prof. Steven Ringel
The Ohio State University

Prof. Birgitte Bak-Jensen
Aalborg University



Susan Feindt
Analog Devices

Bob Savage
Dell Technologies

Rialtas na hÉireann
Government of Ireland

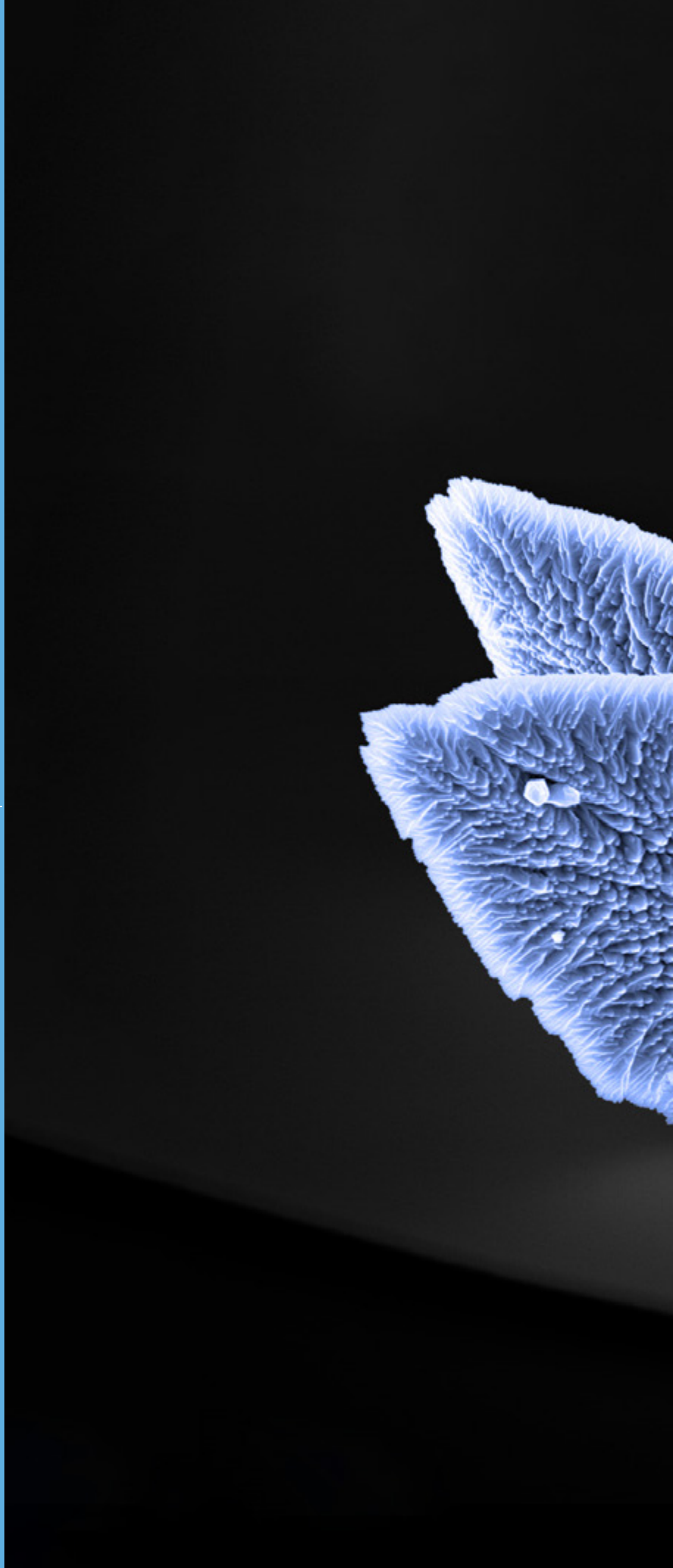
Tionscadal Éireann
Project Ireland
2040

European Union
European Regional
Development Fund

NanoIceberg

Dr Vuslat Juska, Nanosensors Group

This image represents one of the nanotextured interfaces on an array that Dr Juska developed for her Catalyst project at Tyndall. The blue iceberg-like architecture is electrodeposited gold with highly porous walls. The surface morphology is key to overcoming the limitations of many electrochemical biosensing systems



Tyndall National Institute
Lee Maltings
Dyke Parade
Cork, Ireland
T12 R5CP

info@tyndall.ie
www.tyndall.ie