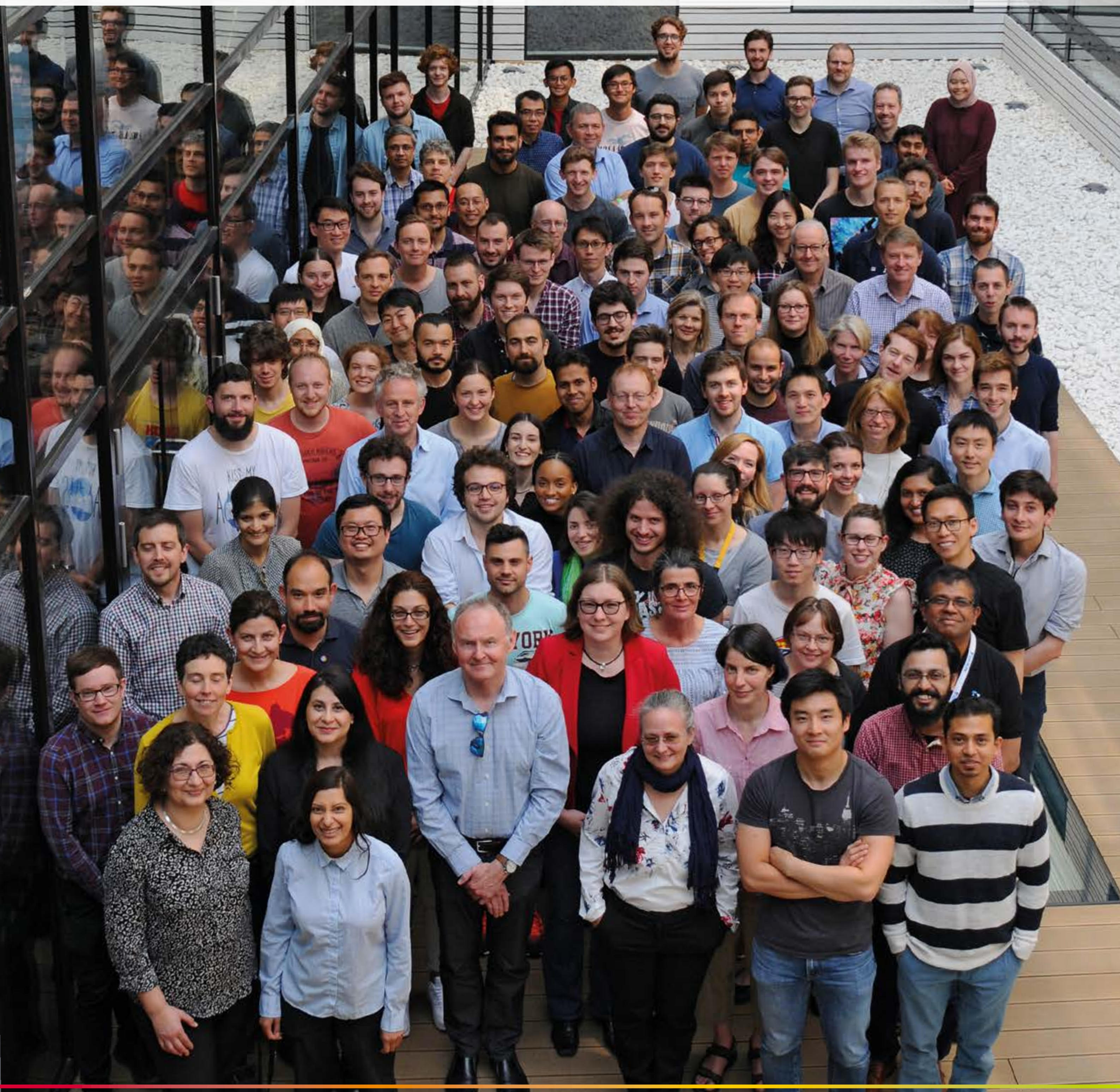
Maxwell Centre Report

2018/19

UNIVERSITY OF CAMBRIDGE

"The Maxwell Centre acts as a super-connector for the University ecosystem. Its programme provides access to expertise across disciplines, building partnerships and facilitating industry collaborations with the University of Cambridge world-leading researchers. The unique combination of discovery science, solution engineering and business insight enables the Maxwell Centre community to tackle global challenges."

Professor Andy Neely, Pro-Vice Chancellor for Enterprise and Business Relations



From the Director

Prof Sir Mark Welland
FRS FREng FIET FInstP
Director, Maxwell Centre

As the Maxwell Centre Director since the beginning on 2019 I would like to start by paying testament to my predecessor, Professor Sir Richard Friend. Populating a new building with such a diverse, effective and connected community is no mean feat and it is clear to me that it is Richard's vision, supported by Dr Aga Iwasiewicz-Wabnig and the Maxwell team, that has made Maxwell what it is today.

My task in the next couple of years will be to ensure that Maxwell Centre becomes an established and integrated activity that offers a creative space for the best of Cambridge research to interact with the commercial world, nurturing new ideas so that they can grow into long term University-industry collaborations across Cambridge. To this end we are currently developing a long term strategic plan that will build on the excellence that is Maxwell today ensuring that it can best meet the needs of all stakeholders into the future.

Programmes currently hosted at the Maxwell Centre:

- Maxwell Programme and knowledge exchange support
- Maxwell Centre Industrial hot-desking scheme
- Impulse for Tech Innovators
- Maxwell-OTR partnership to support Translational Technologies
- Winton Programme for the Physics of Sustainability
- Henry Royce Institute: Materials for Energy Efficient ICT
- Centre for Advanced Materials for Integrated Energy Systems
- Faraday Institution: Extending Battery Life
- Gianna Angelopoulos Programme for Science, Technology and Innovation
- Resident companies: ARM, Magna International, Ovako and Talga
- National Physical Laboratory's East of England Hub
- Centre for Digital Built Britain
- Energy@Cambridge Interdisciplinary Research Centre
- Cambridge Big Data Strategic Research Initiative
- Cambridge Global Challenges Strategic Research Initiative
- EPSRC CDT in Nanotechnology (NanoDTC)
- EPSRC CDT in Computational Methods for Materials Science
- MPhil in Scientific Computing
- Several research groups from participating departments
- and more …

Third year at the Maxwell Centre

Dr Aga Iwasiewicz-Wabnig
Maxwell Centre
Director of Partnership Development

Mónica Lucena
Maxwell Centre
Engagement Coordinator

Access electronic versions of the Maxwell Centre Reports here: www.maxwell.cam.ac.uk/programmes

2019 is a year of change for the Maxwell Centre. Prof Sir Mark Welland has taken over as the Director, following Professor Sir Richard Friend, the Founding Director, under whom the Centre flourished since 2016. The academic and industry landscapes are evolving, and the world is facing many significant challenges. This is the time when new thinking and joint research are needed more than ever, and close collaborations with industry are key for successful translation of ideas to solutions. Prof Welland and Dr Aga Iwasiewicz-Wabnig (appointed as the Director of Partnership Development last autumn), are reviewing current needs and opportunities, and formulating a new strategy for the Maxwell Centre, with the view to implement it from the coming academic year.

The Maxwell Centre has been steadily expanding its programmes and activities to bring academia and industry closer together around physical science and technology research. The Centre is growing in reach, and once more we are proud to present the Maxwell Centre Report 2018/19, which you now have in front of you. We feature selected highlights of research, training and facilitation; two of our resident companies; a successful trial to aid translation of technologies into clinics; and news from the Impulse for tech innovators, our practitioners-led entrepreneurial training programme. This, and previous reports are available in electronic format from our website, should you like to look back at our history to date.

The Centre acts as a hub for academia-industry interactions at the West Cambridge campus, where researchers from several departments and industry interact each day, through planned events, but also by serendipitous corridor chats, or over a coffee. Each conversation furthers our mutual understanding, and many open up new collaboration opportunities that we could have otherwise missed out on.

The Maxwell Centre building occupancy exceeded 260 people on a full-time basis, with many more part-time visitors. We also welcome several hundreds of participants to events hosted at the Maxwell Centre each year. On a typical day you will find here industrial residents and hot-desking visitors, physicists, chemists, engineers and material scientists; technologists, tenured academics, postdocs, doctoral students, facilitators, innovators and entrepreneurs – many of whom wear several of these hats. We now host 52 individuals from 14 companies. State-of-the-art laboratories, including advanced materials characterisation, Cambridge hubs of the Henry Royce Institute (officially opened in October) and the Faraday Institution, welcome internal and external users.

The Maxwell Centre vision and community extends beyond one building alone, acting as a gateway to Physical Sciences and Technology in Cambridge. We are continuously working on identifying and lowering any barriers to entry for industrial research collaborations, through signposting, introductions, knowledge brokering and facilitation. We build on best practice from within the University, enhanced by creative thinking and developing new model agreements, to enable and streamline access to facilities and know-how across West Cambridge. As such, the Maxwell Centre is ideally positioned to identify stakeholders' needs, both common and distinct, and propose solutions that can work for many departments, leading towards collaborative research without borders. Looking a few years ahead, the Cavendish Laboratory will re-open its doors as a national facility, the Ray Dolby Centre, construction of which is under way just across the road. We are currently working with the Department of Physics' leadership to consolidate and de-risk facility access models based on the Maxwell Centre experience.

Several events and highlights of the last year deserve a mention. In January, we have represented the University of Cambridge at the 30th North American International Auto Show 2019, in Detroit, USA. Magna International, Maxwell Centre's industrial residents, invited us as the first of the UK universities to ever take part in the AutoMobili-D event. We collaborated with Cambridge Enterprise to collate and present a selection of automotive and connected world projects from Cambridge, which we have listed on our website, under Programmes.

Representing the University of Cambridge at the 30th North American International Auto Show 2019, in Detroit, USA.

On the 8th of March 2019 the Vice-Chancellor, Professor Stephen Toope OC, launched the Gianna Angelopoulos Programme for Science, Technology and Innovation. The GAPSTI programme will be directed by Dr Nikolaos Nikiforakis, whose research we featured in last year's report. The programme will focus on computational multiphysics, energy materials and devices research, and is enabled by a donation by Gianna Angelopoulos-Daskalaki, a Greek businesswoman, parliamentarian and President of the 2004 Athens Olympics, who also visited and spoke at the GAPSTI launch ceremony.

Our already well established partnership with the Cambridge Network to deliver termly "From discovery science to industrial applications" seminar series continues to provide a glimpse into cutting-edge University research to industrial audiences. These events offer a front row seat for companies wishing to learn about current research that is relevant and interesting to them, yet at a stage that would not normally be easily accessible outside of the academic community. The talk is always followed by discussion and networking. This year, we featured Dr Yan Yan Shery Huang, from the Department of Engineering, who discussed "Biomicrofabrication of Cellular Interfaces", Dr Akshay Rao, from the Department of Physics, who shared his thoughts on "Commercialising novel semiconductor materials", and Professor Tuomas Knowles, of the Department of Chemistry, the Cavendish Laboratory and Fluidic Analytics, who spoke about how to "Understand the machinery of life, and get there faster: Probing proteins in small volumes".

The monthly Innovation Seminar series also continues, in collaboration with the NanoDTC and the Impulse programme. These events are open to all, and we had a pleasure to hear another set of exciting talks – including Stuart Biles from ARM (introducing ARM collaborative research programmes), Dr Mario de Miguel Ramos and Dr Teona Mirea from Sorex Sensors (on the journey of an international university spin-out), Simon Tilley from SAS (about industrialising analytics and AI), Professor Henning Sirringhaus (on plastic electronics, from lab to fab), and more.

Further details of abovementioned, as well as other Maxwell events can be found on www.maxwell.cam.ac.uk/past-events . To be kept in the loop about our upcoming events and opportunities please contact our Engagement Coordinator, Mónica Lucena, who is responsible for the Maxwell Centre monthly newsletter and will be delighted to keep you posted.

This report is launched in conjunction with a celebration of the excellent research and industrial collaborations that draws audiences of both academic and external affiliations. As we are writing this, the preparations are in full steam for our third Maxwell Centre Annual Research Showcase, taking place on the 12th of June 2019. We will hear keynote addresses from Dr Emily Shuckburgh, Director of the Cambridge Carbon Neutral Futures Initiative, and Mansoor Hanif, Chief Technology Officer at Ofcom. Also, back by popular demand, there will be a series of 30 short talks by researchers from across the Physical Sciences and Technology departments – the best way to spend an hour getting an overview of the ongoing cutting-edge research in Cambridge. This year we introduce an industrial panel discussion session, which will focus on challenges and opportunities of the modern day connected world.

If you are interested in joining the Maxwell community please get in touch. We help industry collaborations with Cambridge to develop and mature, and as they graduate and move on, we welcome new residents and remote partners.

- www.maxwell.cam.ac.uk/programmes
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Magna International

Ian Simmons
Vice President,
Innovation Development

David Paul
Director,
Innovation Development

As a mobility technology company and leading supplier in the automotive industry, Magna continues to deliver on what's needed today while creating innovations that society doesn't even know they need yet. And more important, we are solving problems that haven't yet surfaced. We know how to auto-qualify technology from other industries, and we are constantly improving our own processes and products, keeping us ahead of the curve.

Suppliers and automakers are pushing the pace of technology like never before. In the last five years, thousands of disruptive companies have brought forward new technologies that could apply to the automotive industry. Millions of students are learning about robotics, user experience design, machine learning, computer science and dozens of other fields that will impact mobility.

With brilliant and disruptive thinking everywhere, the question isn't about when driverless cars are coming or when all vehicles will be fully electric. The question is about who is ready for these transformative shifts.

It makes you realize that with all this talent and expertise, answers are everywhere. It's up to us to define the right questions. At Magna we cultivate innovation – in our company, in our industry, and beyond. We turn disruptive thinking into disruptive technology. Then we bring it to market.

Our more than 169,000 entrepreneurial-minded employees – combined with our ability to rapidly auto-qualify and commercialize technology – uniquely position us to accelerate developments in far less time.

And knowing that great ideas come from a wide variety of sources, we actively work with universities, entrepreneurs and startups around the world to help bring their innovations to market.

The first year in the Maxwell Centre has been a great success, which supports the reasoning for co-locating. Being at the heart of the University West Campus, we are close to the Engineering and Science Departments, Cambridge Enterprise, Cambridge Network, Cambridge Innovation Capital and Ideas Space. There is a strong sense of community spirit across the whole campus and ecosystem, which has resulted in technologies being discovered and research projects started that otherwise would never have occurred.

The ability to connect was clearly demonstrated in our recent Innovation Day at the Maxwell Centre, with a whole day of networking and face-to-face meetings with academics and startups across the Cambridge ecosystem. Magna is also proud sponsor of three entrants in the 2019 Impulse Program.

Magna makes the impossible possible by solving some of the automotive industry's most complex problems, and we remain on the forefront by working closely with innovative institutions such as the Maxwell Centre.

"Our entrepreneurial culture helps keep us at the forefront of possibilities. This is something our employees and leadership live by. Our agility, complete systems expertise, global reach and disruptive thinking allow us to bring the best technology to market and lead the industry into the future."

Swamy Kotagiri, Magna
Chief Technology Officer

Sorex Sensors

Prof Andrew Flewitt
Chairman of the Board and Co-founder

Michael LeGoff
Chief Executive Officer

Dr Mario De Miguel Ramos
Chief Technology Officer and Co-founder

Sorex Sensors is poised to transform a range of industries with its innovative sensor technology having spun out from the University of Cambridge, University of Warwick and the Universidad Politécnica de Madrid. The company raised £1.2 million seed funding in 2018 from Cambridge Enterprise, the Cambridge Angels and Cambridge Capital Group.

In early 2019, Michael LeGoff was appointed chief executive officer (CEO) to lead Sorex Sensors during its next phase of growth. He is the former founder and CEO of the relaunched electronics pioneer Plessey Semiconductors and has more than 25 years of industry experience focused on commercialising technology. Dr Mario De Miguel Ramos is the chief technology officer (CTO) and co-founder of Sorex Sensors; his PhD focused on film bulk acoustic resonator (FBAR) technology and he has been working in the field for more than seven years. Professor Andrew Flewitt is the chairman of the board and co-founder of the spin-out. He is head of the electrical engineering division of Cambridge University and a renowned scientist and researcher in the use of FBAR technologies.

Sorex Sensors has developed a novel MEMS mass sensor based on FBAR technology. Fabricated on a silicon wafer, the sensor comprises a thin film of piezoelectric material that is made to resonate. Attachment of mass to the surface changes the resonant frequency and provides an extremely accurate measurement of the amount of mass on the sensing area.

The sensor is extremely small – as thin as a human hair – and can be arranged into arrays on the same chip to measure different targets simultaneously. It has high mass sensitivity, down to one femtogram – the weight of the average virus particle.

Initial applications include monitoring vehicle emissions; measuring industrial air quality; the detection of various biomolecular structures in the body; and improving the performance and accuracy of atomic layer deposition tools, which is a key part of the fabrication of semiconductor devices. The sensor can be operated from a coin cell battery, a mobile phone or even from energy harvesting devices.

"The Maxwell Centre is a perfect base for us – providing all the facilities we need so that we can concentrate on our product launch and focus on the key industrial applications where the technology will have an immediate and tangible impact."

Michael LeGoff, CEO, Sorex Sensors.

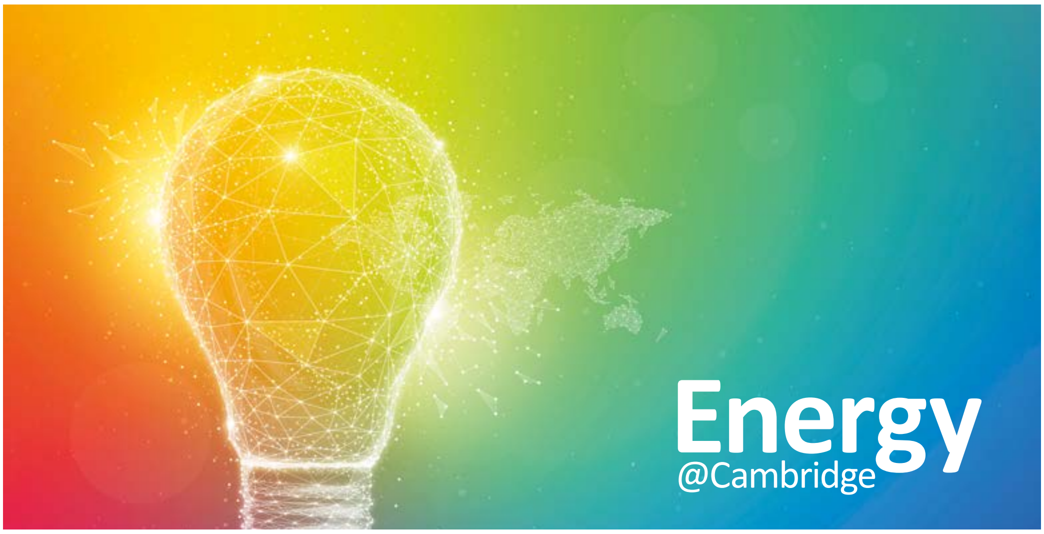
In addition to its team at the Maxwell Centre, Sorex Sensors has researchers at the Universidad Politécnica de Madrid and the University of Warwick.

Energy@Cambridge Interdisciplinary Research Centre (IRC)

Dr Isabelle de Wouters
Director of Scientific Development

Raheela Rehman
Project Officer

Dr Shafiq Ahmed
Coordinator



The Maxwell Centre hosts the Energy@Cambridge IRC, which was established to help external organisation to navigate and access energy research at the University of Cambridge, and to support the development of cross-School programmes and activities.

Spanning activities across from Arts and Humanities through to Technology, Energy@Cambridge works with teams of academics to develop new research programmes, a number of which are now hosted and supported by the Maxwell Centre.

In this report we describe the new activities of the Cambridge Henry Royce and EPSRC Centre of Advanced Materials for Integrated Energy Systems (CAM-IES), which emerged from the Energy@ Cambridge Materials for Energy Efficient ICT theme; and the Faraday Batteries Degradation Programme established with the support of Energy@Cambridge. In January 2019, we launched the Cambridge Creative Circular Plastics Centre (CirPlas) a UKRI funded programme which uses multi-disciplinary approaches to tackle plastic waste.

This new Centre builds on Energy@Cambridge activities focused on sustainability and circular economy approaches that address issues of energy and waste.

www.energy.cam.ac.uk
energy@admin.cam.ac.uk

Maxwell Centre

Energy @Cambridge

Prof Erwin Reisner
PI of CirPlas

Cambridge Creative Circular Plastics Centre (CirPlas)

The Cambridge Creative Circular Plastics Centre (CirPlas) is a UKRI funded programme. The Centre acts as a nucleus for a global network of partners and coordinates a range of research projects, workshops and a forum to tackle contemporary challenges from the manufacturing of more sustainable materials to driving innovations in plastic recycling.

The activities of CirPlas are managed by the Energy@Cambridge IRC, which hosted the launch of CirPlas at the Maxwell Centre on the 14th of February 2019.

Between January 2019 and July 2020, the Centre will support a series of research projects and workshops to support multi-disciplinary engagement on the following themes:

Sustainable feedstocks and materials

- Lignocellulose-derived alternatives to plastics: Paul Dupree (Biochemistry)
- Mechanical testing and Raman spectroscopy of cellulose fibres and films: James Elliott (Materials Science)

Manufacturing and Recycling Processes

- Solar-driven conversion of plastics into fuel and bulk chemicals: Erwin Reisner (Chemistry)
- Breakdown of plastics to produce electricity in microbial fuel cells: Adrian Fisher (Chemical Engineering)
- 3D printing with plastic waste: Jeremy Baumberg (Physics)

Tracking plastics material flows

- UK Plastics flow and stock model: Jonathan Cullen (Engineering)
- Feasibility studies to track and recover plastics: Ronan Daly (Engineering)
- New tools for testing and characterising micro-plastic pollution: David Aldridge (Zoology)

Waste and Management

- Household waste and domestic and community practices: Brigitte Steger (Asian and Middle Eastern Studies)
- Business models for waste management: Khaled Soufani (Judge Business School)

The activities of CirPlas are supported by the: British Antarctic Survey, Cambridge Cleantech, RECAP Waste Management; Centre for Global Equality, University of Cambridge Centre for Science and Policy (CSaP), and Cambridge Institute for Sustainability Leadership.

Henry Royce Institute

Prof Sir Richard Friend FRS FREng
Royce Academic Champion

Dr Lata Sahonta
Programme Manager,
Cambridge Royce & CAM-IES

Since the arrival of cutting-edge research equipment provided by the Henry Royce Institute in 2018, the Maxwell Centre has been the nucleus of a growing community of researchers from UK universities, and industry researchers, from global tech companies to recent spin-outs. Maxwell visitors have taken advantage of excellent shared experimental facilities, and access to expert technical advice, available through the Cambridge Royce equipment.

The Cambridge Royce facilities were officially opened in late 2018 by Professor Dame Julia King, chair of the Henry Royce Institute Governing Body, with an opening address from the Vice-Chancellor Stephen Toope, and featured short talks from early career researchers and industry users of the facilities.

Cambridge Royce acts as a national centre for providing equipment, technical support, and collaboration opportunities within the energy materials research space, enabling users to access key facilities for fabrication, testing and packaging of energy-efficient device materials and systems. The Cambridge Royce facilities focus on supporting research in "Materials for Energy-Efficient ICT", including battery technologies, solar cells, fuel cells, energy harvesters, and energy-efficient data storage and communications.

This year Cambridge Royce has also supported five places on the "Impulse 2019" programme at the Maxwell Centre, providing a pathway for entrepreneurs working in the energy materials field to take their ideas from fundamental research to commercialisation.

www.maxwell.cam.ac.uk/programmes/henry-royce-institute
royce@maxwell.cam.ac.uk

The Cambridge Royce facilities were officially opened in late 2018 by Professor Dame Julia King, chair of the Henry Royce Institute Governing Body

CAM-IES

Prof Clare Grey FRS
Cambridge Faraday Institution
and CAM-IES Director

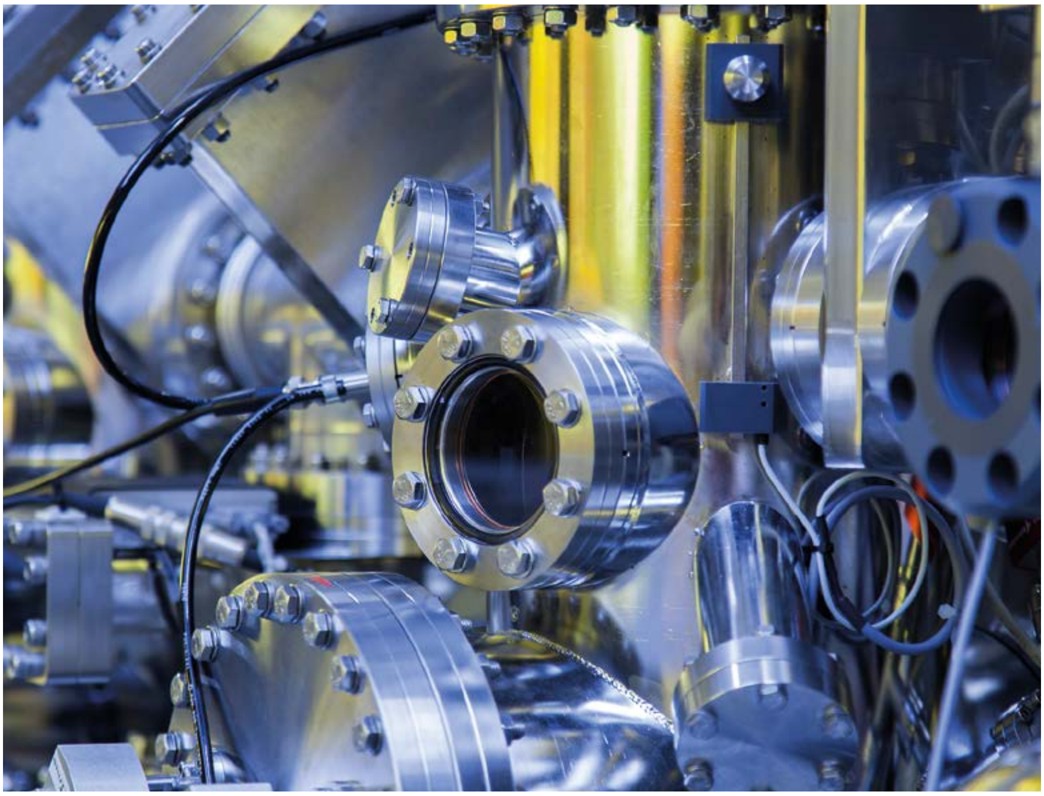
Dr Lata Sahonta
Programme Manager,
Cambridge Royce & CAM-IES

2019 has been a busy year for the Centre of Advanced Materials for Integrated Energy Systems (CAM-IES), a cross-disciplinary research partnership between University of Cambridge, Newcastle University, UCL and Queen Mary University of London, based at the Maxwell Centre. Throughout the year CAM-IES has run a number of funding calls to provide access to Cambridge Royce equipment, and has hosted workshops and seminars on a range of energy materials topics such as IoT, novel imaging techniques for energy materials, redox flow batteries, materials modelling, and advanced oxide materials for fuel cell applications.

CAM-IES is supported by a number of industry partners, including Tata Steel, Arm, Shell, Johnson Matthey, Siemens, CDT and Dyson, and aims to create a multi-disciplinary research community in energy materials, where researchers from the solar, battery, fuel cell, large-area electronics, and device materials communities can engage in cross-cutting collaborations. CAM-IES events at the Maxwell Centre are free and accessible to all research communities, and have proven to be extremely popular.

For more information about CAM-IES and how to collaborate, please contact Lata Sahonta, the Programme Manager.

- www.energy.cam.ac.uk/cam-ies
  sls55@cam.ac.uk



The Cambridge Centre for Data-Driven Discovery: C2D3

Prof Anna Vignoles
Co-chair of the Cambridge Centre for Data-Driven Discovery

A new research centre will bring together expertise from across academic departments and industry to drive research into the analysis, understanding and use of big data.

The Cambridge Big Data Strategic Research Initiative has been resident in the Maxwell Centre since 2016 and featured in our first report. This year, we are delighted to announce a new exciting development in this field. The Cambridge Centre for Data-Driven Discovery (C2D3) will harness the knowledge of academics in data science, ethics, and from a wide range of disciplines, to research all aspects of this complex and expanding area. The Centre will be truly interdisciplinary, allowing experts in technical, mathematical and topic knowledge to work together on tackling the methodological and practical challenges presented by handling big data.

The Centre is to be funded by a series of collaborations with partners in business and industry which have an interest in using big data for the benefit of their customers and their organisations.

The first founding partner is to be Aviva, Britain's biggest insurer. Aviva will sponsor a research fellowship and support PhD students to help investigate some of the ethical, political and operational questions surrounding the use of big data.

"The University is constantly looking for innovative ways for our research to make a difference to the wider world, as well as opportunities for our students to gain valuable experience of industry. Working with Aviva will give our researchers the opportunity to solve some 'real world' challenges, ranging from how to securely, ethically, efficiently and effectively store and use their customers' data and to identify what health interventions are most likely to help their customers live a longer and healthier life."

Professor Anna Vignoles, co-chair of the Cambridge Centre for Data-Driven Discovery

The relationship will combine world-class research with frontline practice. It will help Aviva develop new ethical approaches to advising customers through evidence-based science. It will enable University researchers to develop methods and tools to address real-world problems and to influence the wider debate about how organisations address the difficult methodological, practical and ethical challenges of big data.

"Aviva is on a mission to create a world-class data science capability – and this ground-breaking partnership with the University of Cambridge will equip us with unparalleled access to knowledge and research in this area."

Owen Morris, Managing Director of Aviva Quantum, Aviva's Global Data Science Practice

It is expected that ten organisations, including Aviva, will form a C2D3's Industry Club, which will underwrite the cost of research and provide companies with:

- Access to existing research
- The opportunity to commission new areas of research
- Practical guidance, tools and techniques to use data in the commercial world.

www.bigdata.cam.ac.uk
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Trust & Technology Initiative

Prof Simon Moore
Co-Chair

Dr Jat Singh
Co-Chair

Dr Jennifer Cobbe
Coordinator

Exploring the dynamics of trust and distrust around internet technologies, society and power

The Trust & Technology Initiative brings together and drives forward interdisciplinary research from Cambridge and beyond to:

- Better inform trustworthy design and governance of next generation tech at the research and development stage
- Promote informed, critical, and engaging voices supporting individuals, communities and institutions in light of technology's increasing pervasiveness in societies.

The Initiative is unique in considering the interplays and feedback loops between technology fundamentals, societal impact and governance of next generation systems at the research and development stage. Our particular ability to connect cutting edge deep technology with social science and humanities expertise enables dynamic exploration of emergent use cases, and for us to envisage and experiment with realistic future scenarios.

A network around trust, technology, society and power

As a network, the Initiative is a 'big tent,' bringing people together, facilitating collaboration, and engaging industry, civil society, government, and the public, in Cambridge and beyond, across:

- Relationships and interplays between technology and society; the legal, ethical and political frameworks impacting both trust and technology, and innovative governance, in areas such as transport, critical infrastructure, identity, manufacturing, healthcare, financial systems and networks, communications systems, internet of things
- The nature of trust and distrust; trust in technology, and trust through technology; the many dimensions of trust at individual, organisational and societal levels
- Rigorous technical foundations, for resilient, secure and safe computer systems, including data and communications platforms, artificial intelligence, and robotics

Get in touch

Our team would be delighted to have a chat over coffee, or a call, to discuss how we could help you and opportunities to work together.

Sign up for our newsletter: bit.ly/CamTrustTechList

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The Winton Programme for the Physics of Sustainability

Dr Nalin Patel
Winton Programme Manager

Dr Giuliana Di Martino
Winton Advanced Research Fellow

Dr Bartomeu Monserrat
Winton Advanced Research Fellow

Dr Chiara Ciccarelli
Winton Advanced Research Fellow

The Maxwell Centre has been an ideal home for the Winton Programme for the Physics of Sustainability, which was set up through a donation of £20M by David Harding, alumnus of the Cavendish Laboratory. Researchers working in close proximity across a range of disciplines has led to the cross fertilisation and development of ideas needed to tackle the growing demand for natural resources whilst managing climate change.

A key component of the Programme are the Winton Advanced Research Fellows who are given the freedom to establish their own research groups and take research into new and ambitious directions. In the last round, two appointments were made; both have started their research and are based in the Maxwell Centre.

Dr Giuliana Di Martino is working with light trapped inside plasmonic cavities to produce new innovative methodologies for studying real-time processes in materials. The ability to confine light to gaps between nanoparticles enables the probing of individual atoms that is required to understand and develop the next generation of nano-devices. A particular area of interest is memrestive memories that have the potential to significantly reduce power consumption[1]. Understanding the nanoscale kinetics of the switching mechanisms is needed to enable high-endurance devices to be produced that can be incorporated into the low-energy computers of the future.

Dr Bartomeu Monserrat develops quantum mechanical methods to theoretically study material properties. His research interests are in sustainable energy sources and energy management through the design of novel materials that have applications ranging from low-power electronics to solar cells and superconductors. The combination of quantum mechanics with powerful supercomputers allows his group to design these materials at the atomic level in a virtual laboratory, reducing the costs and accelerating the discovery process. Some of his recent work has involved collaborating with Winton Fellow Dr Felix Deschler and Winton Scholar Johannes Richter to understand charge process in perovskite systems for photovoltaic and light-emitting diode operations[2].

Another Winton Fellow, **Dr Chiara Ciccarelli**, in collaboration with Dr Hannah Joyce from the Department of Engineering, has set up a THz Time-Domain. Ciccarelli group will use the new facilities to evaluate spin physics in ferromagnetic and antiferromagnetic systems in search of low energy devices. The new capabilities in the Maxwell will enable studies of these systems in the picosecond timescale for ultrafast computing applications.

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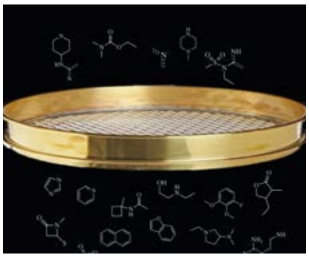
1 Di Martino G. and Tappertzhofen S., Nanophotonics, 2019 (https://doi.org/10.1515/nanoph-2019-0063)
2 Richer J.M. et al, Adv. Mater. 30, 1803379, 2018, (https://doi.org/10.1002/adma.201803379)

Dr Alpha Lee
Winton Advanced Research Fellow



Designing molecules and materials using machine learning: From Data to Insights

My group combines physics with machine learning to accelerate drug discovery and materials discovery. Drug discovery is like trying to find a needle in a haystack. There are over 1060 theoretically stable drug-like organic molecules (more than the total number of atoms on Earth), and only a few of them, if any, can treat a particular disease. This problem is even more acute for materials discovery as the number of theoretically stable inorganic materials is almost boundless. To accelerate drug discovery and materials discovery, we need to solve three challenges – design, make and test.

First, we need to design molecules that are predicted to have a high figure of merit. A key problem in drug discovery is finding a molecule that will activate a particular physiological process. It is possible to build a statistical model by searching for chemical patterns shared among molecules known to activate that process, but the data to build these models is limited because experiments are costly. We derived machine learning methods using methods in theoretical physics that accurately predicts the biological activity of molecules given only a small amount of data. Our method acts as a sieve, filtering out pharmacologically irrelevant chemical patterns from the data and identifying pharmacologically important ones. Working with Pfizer, we discovered 4 new molecules that activate the CHRM1 receptor, a protein that may be relevant for Alzheimer's disease and schizophrenia. The accuracy of our method doubles that of the state-of-the-art. Our current effort is directed at applying this methodology to materials discovery, focusing on thermoelectrics, superconductors and optoelectronic materials.

Second, we need to synthesize in the lab the molecules that we have computationally designed. This is a significant challenge in organic chemistry – the synthesis of complex molecules is often an art realised by chemical heuristics combined with extensive experimentation. We developed a machine learning method that predicts the outcomes of chemical reactions with 90% accuracy – 10% more accurate than expert chemists – given reactants and reagents. The method infers the "rules" of chemistry from scratch using reactions reported in the patents. This method is currently being extended to solve the reverse problem of generating synthetic schemes for complex molecules, as well as tackling the more challenging problem of materials synthesis.

Third, molecules that are designed computationally and synthesised in the lab need to be experimentally tested to confirm whether they indeed have a high figure of merit. Experiments are generally expensive thus experiments should be planned such that maximum amount of information is generated with minimal number of experiments. Using techniques in statistical physics, we developed models that adaptively design experiments. The model suggests which molecules one should test, and experimental results are fed back into the model, forming a closed-loop optimisation workflow.

Extracting patterns and trends from data has always been a cornerstone of Natural Sciences. We develop statistically principled methodologies, grounded in physics, that automate this process. Those methodologies allow us to tackle the design-make-test challenges in molecular and materials discovery. As the accuracy of those methods matches domain experts, we can start systematically interrogating what patterns have those methods detected, arriving at new physical insights about molecules and materials.

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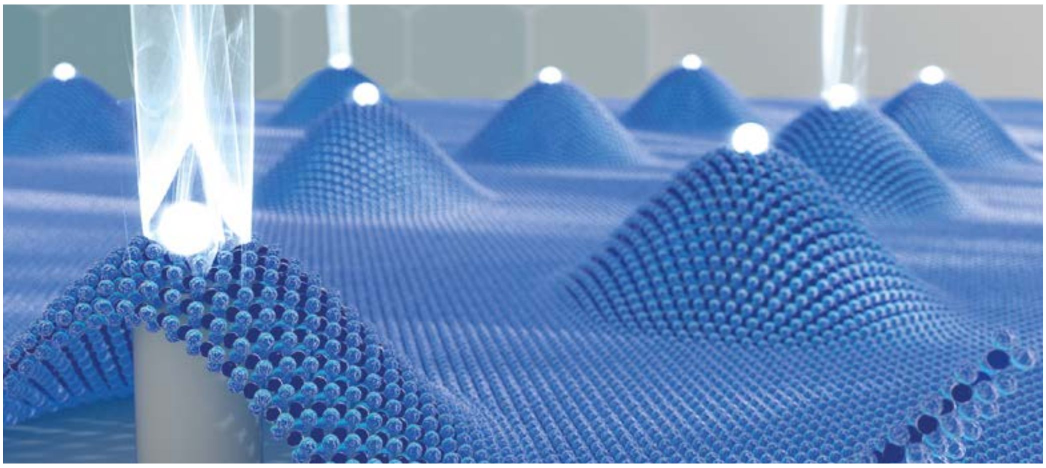
aal44@cam.ac.uk

Quantum optical materials and systems

Prof Mete Atatüre
Department of Physics



My group exploits the laws of quantum physics and optics, looking for new science that can lead to computing, sensing or communication applications.

The recent highlight of our research was a demonstration of collective controlled quantum behaviour of nuclei within charged semiconductor quantum dots, enabling them to operate as a quantum memory device. A quantum dot is a solid clump of thousands of atoms in which an electron – capable of a quantum bit (qubit) behaviour – can be trapped. We realised that, contrary to previous consensus, the inevitable magnetic interaction between the trapped electron and nuclei can in fact play a useful role in a device. It has been known that nuclear spins interfere with the electron's spin, and can cause decoherence, an effect that is limiting its performance as a qubit. We demonstrated that under close optical control, however, the very same magnetic coupling between the electron and an ensemble of nuclei can be harnessed to mediate exchange of information, with a quantum spin memory bit formed by the group of nuclei acting in unison. We exploited this effect using laser light irradiation of semiconductor quantum dots, to laser-cool the sea of nuclei to below 1mK, a thousandth of a degree above absolute zero temperature, and collectively manipulate their behaviour, demonstrating a quantum-coherent spin wave. This work established a deterministic and coherent interface between a spin qubit and its nuclear environment, and paves a way towards realisation of a solid-state memory for quantum information storage. A more detail account of our findings has been published in Science, in April 2019.

In parallel, we investigate diamond as a material for quantum applications. In the Nanoscale Quantum Sensing and Imaging Suite, which I lead within the Cambridge Henry Royce Institute, we use atomic defects in diamond nanoparticles to understand the performance of ultradense nanoelectronics and nanospintronic devices for the future. We are able to probe local temperature and magnetic field noise with a spatial resolution of around 10 nm in order to understand the origins of systems failure and device interferences. We collaborated with Asylum Research on developing this new modality for atomic force microscopes, where a tip with a spin-active impurity in diamond acts as a scanning nano-MRI sensor. This new microscopy enables, for instance, direct high resolution imaging of the environment inside of a living cells, non-invasive mapping of sensitive magnetic features, and probing of caloric effects in thin film devices.

Lastly, I also want to briefly mention a new collaboration with Dr Carmen Palacios Berraquero, a postdoc from my group, and alumna of the Maxwell Centre's Impulse programme, who went on to become the CEO of Nu Quantum. Her start-up company develops a system for quantum-secure communications via satellite based on the patents she filed during her PhD in Cambridge, and we will collaborate on the development and testing of quantum light source arrays through our recent Innovate UK joint funding. Nu Quantum research team begins hot-desking from the Maxwell Centre this month, which will enable us to work closely together in the foreseeable future.

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Maxwell Centre

Extending Battery Life: The Faraday Institution Degradation Project

Prof Clare Grey FRS
Department of Chemistry

One focus of the work of my group and the Faraday Institution Degradation Project aims to relate external stimuli and stresses (high temperature, charging rates) to physical and chemical processes that cause degradation of performance inside the battery, and to develop solutions to this through materials and systems design.

The lithium-ion battery, developed more than 25 years ago has revolutionized the portable electronics industry, changing the way that both humans and machines communicate. Over the last 25 years, the battery has increased in energy density by a more than a factor three, has dropped in price by more than tenfold and lasts noticeably longer. But it is still too expensive to allow for the widespread adoption of electric vehicles (EV). One "simple" solution is to a design a battery that lasts much longer and that may have a second life – as back-up for electricity on the grid for example.

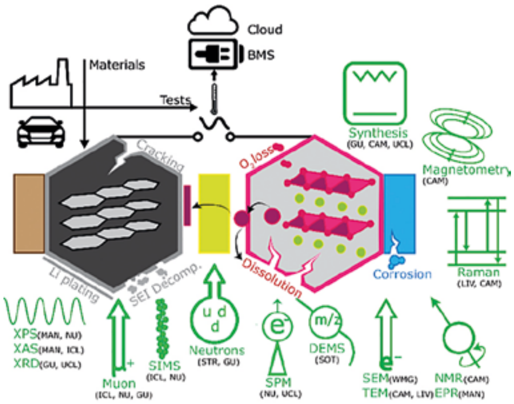
The Faraday Institution, was founded as an independent, national, virtual laboratory for energy storage research in the UK in October 2017. It is a partnership between universities (Cambridge, Sheffield, Imperial College, Liverpool, Manchester, Newcastle, Southampton, University College, Nottingham and Warwick) and 10 industry partners. Its goal is to address electric vehicle (EV) challenges and promote EV production and all of the EV value chain in the UK via performing cutting edge research.

I lead the £12M "Degradation project", aiming to attack the critical problem of battery life. The project involves approximately 30 academics from across the UK, including 9 other Cambridge investigators and affiliated partners (S. Dutton, A. Lee, J. Baumberg, A. Ferrari, C. Ducati, D. Wright, M. de Volder, H. Bronstein, and N. Fleck). The project focusses on batteries that are just entering the newest EVs, with challenges arising from the use of cathode materials with increasingly higher nickel contents (arising from the move away from the more expensive metal cobalt) and the use of anode materials with higher natural graphite contents.

We want to identify the stress-induced degradation processes that are instigated or accelerated when cells are operated outside of the recommended operational range of voltage, temperature, cycling rates, etc. The project aims to determine how synergistic effects in full cells, resulting from the specific combination of anode, cathode and electrolyte materials used in the battery contribute to degradation. The results from different characterization techniques will be combined with electrochemistry and AI/machine learning approaches to obtain correlative signatures for the observed degradation mechanisms. Ultimately these signatures can be used to identify when specific degradation mechanism become active in battery packs and to suggest practical (i.e., cycling regimes) and materials solutions to prevent degradation.

In one scientific highlight, performed by my team at the Department of Chemistry[1], a combination of NMR spectroscopy and in situ powder diffraction of NMC-811 (LiNi0.8Mn0.1Co0.1O2) was used to identify the optimum regime in which to cycle NMC-811 at high rates.

The Faraday Institution funded additional equipment for batteries research, including an upgrade to the pulse-laser deposition (PLD) within to the Royce cluster tool at the Maxwell Centre, to allow sputtering and evaporation of metals (such as Li).



Methods used to investigate battery degradation by the Faraday Institution project.

1 Katharina Märker, Philip J. Reeves, Chao Xu, Kent J. Griffith and Clare P. Grey, Chem. Mater. 31, 2545 (2019)

Nanowire-enabled electronics

Dr Hannah Joyce
Department of Engineering

Semiconductor nanowires are filamentary crystals with diameters 1000 times smaller than the diameter of a human hair. Their wire-like shape imparts nanowires with compelling advantages over the conventional "bulk" semiconductors that underpin modern electronics. The advantages of nanowires include their considerable mechanical flexibility and elasticity, enhanced light absorption and emission, waveguiding properties, and more efficient charge injection and collection.

We aim to harness the unique properties of nanowires, and thereby achieve electronic devices with entirely new functionality and with performance that surpasses the current state-of-the-art. For example, using films of aligned GaAs nanowires we are engineering terahertz-band modulators for ultrafast wireless communications. These modulators control both the polarisation and intensity of terahertz signals and can be switched at speeds over 200GHz. We are pursuing highly efficient flexible and stretchable solar cells based on semiconductor nanowires. These solar cells exploit the mechanical flexibility of nanowires and their optimal absorption of solar radiation. As another example, nanowires are particularly promising as the light-absorbing and charge-separating electrodes in solar photoelectrochemical cells for renewable hydrogen generation. Due to the nanowires' excellent solar absorption and high surface area-to-volume ratio, a nanowire-based solar water splitting scheme requires approximately 10000 times less material than one based on bulk semiconductors, which represents a significant saving.

Our group focuses on three interlinked aspects of nanowire-enabled electronics, namely (i) the growth of nanowires, (ii) the characterisation of the electrical and optical properties of the nanowires and ultimately (iii) the engineering of devices. To "grow" the nanowires, we employ metalorganic chemical vapour deposition, which offers atomically-precise control over the nanowire crystal structure and is readily scalable for industrial mass fabrication.

Measuring the electrical properties of these tiny nanowires is a particular challenge. Conventional techniques for electrical characterisation, which require metallic contacts to the material under study, and are not well-suited for measuring nanowires. To overcome this challenge, our group probes the nanowires with an unconventional method of electrical characterisation known as optical pump–terahertz probe (OPTP) spectroscopy. This technique measures the transmission of an electromagnetic pulse consisting of terahertz frequencies; the transmission of the pulse is directly related to the electrical conductivity of the nanowires. Using OPTP spectroscopy, we are able to measure the device-relevant electrical properties (charge carrier mobilities, lifetimes, surface recombination velocity, doping levels, charge separation rates) of nanowires with considerably higher accuracy and throughput than possible with conventional techniques. This OPTP system is housed in the Maxwell Centre's new Terahertz Lab, which is shared with Dr Chiara Ciccarelli and largely funded through the Winton Programme for the Physics of Sustainability. This system is showing tremendous value in the targeted development of nanowires. It is greatly accelerating the development of nanowire-enabled devices, that in turn are expected to revolutionise information & communication technologies (ICT), healthcare, energy conversion and energy storage.

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Maxwell Centre

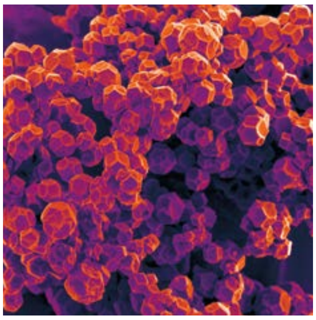
Using machine learning to find new materials for gas storage and drug delivery

Dr David Fairen-Jimenez
Department of Chemical Engineering and Biotechnology

My group's research concerns the study of the molecular mechanisms that control adsorption processes in porous materials. We are particularly interested in drug delivery systems, where nanotechnology has the potential to revolutionise cancer diagnosis and therapy. We are also interested in the use of novel porous materials for the necessary shift from today's fossil-fuel-focused energy economy to more sustainable energy production. Our research in this area is focused on hydrogen and renewable energy sources, as well as carbon capture to mitigate the effects of global warming.

We aim to develop new ways to study adsorption processes, design new porous materials, such as metal-organic frameworks (MOFs), and develop new methods to predict their performance and properties. Our research covers the whole process of material development, with the team roughly divided into three main themes: data mining for performance prediction, engineering of systems for gas storage or separation, and synthesis of nanomaterials for drug delivery.

Recent major advances in computational power allow us to use computational simulation, such as grand canonical Monte Carlo and molecular dynamics, as well as machine learning, to better focus our design of new materials. We have developed a high-throughput screening model that can be used with databases of thousands of materials to find those optimal for specific applications. Using big data analysis we can understand how a material's properties affect its final performance, while machine learning enables us to recognise relationships, discover hidden insights and extrapolate this behaviour to look at designing new optimal systems. Once an optimal material is identified, we experimentally engineer and adapt it to suit its final applications.



MOFs are self-assembling 3D compounds made of metallic and organic atoms connected together

With funding from the Royal Society and the European Research Council, we have developed an algorithm that can predict the properties of more than 3000 existing MOFs, as well as MOFs which are yet to be synthesised in the laboratory.

MOFs are self-assembling 3D compounds made of metallic and organic atoms connected together. Like plastics, they are highly versatile and can be customised into millions of different combinations. Unlike plastics, which are based on long chains of polymers that grow in only one direction, MOFs have orderly crystalline structures that grow in all directions.They are relatively straightforward to synthesise, and their crystalline structure means that they can be made like building blocks, so that individual atoms or molecules can be switched in or out of the structure, a level of precision that is impossible to achieve with plastics.

The structures are highly porous with massive surface area: a MOF the size of a sugar cube laid flat would cover an area the size of six football fields. Due to their porosity, MOFs are effective storage devices. The pores in any given MOF can be customised to form a perfectly-shaped storage pocket for different molecules, just by changing the building blocks.

MOFs are synthesised in powder form, but in order to be of any practical use, they need to be put under pressure and formed into larger, shaped pellets. However, due to the open nature of their structures, many MOFs are crushed in this process, wasting both time and money. By predicting the mechanical properties of MOFs before we make them, we can ensure we focus only on those with the necessary mechanical stability or particular properties we're trying to design. We have also launched a number of interactive websites where scientists can use the algorithm to design their own MOFs, helping to close the gap between experimentalists and computationalists working in this area.

Some of the MOFs we have developed have unrivalled capacity for storing gases such as methane for use as biogas, and can also be fine-tuned to separate gas mixtures. In 2015, we founded spin-out company, Immaterial, which can design and manufacture MOFs for different purposes. The company has raised a quarter of a million pounds in investment and has received £3 million in grants and awards from funders such as the EPRSC, InnovateUK and Cambridge Enterprise. We are looking to work with other industrial and academic collaborators to develop new MOFs for gas storage and separation and to scale up manufacturing of these materials.

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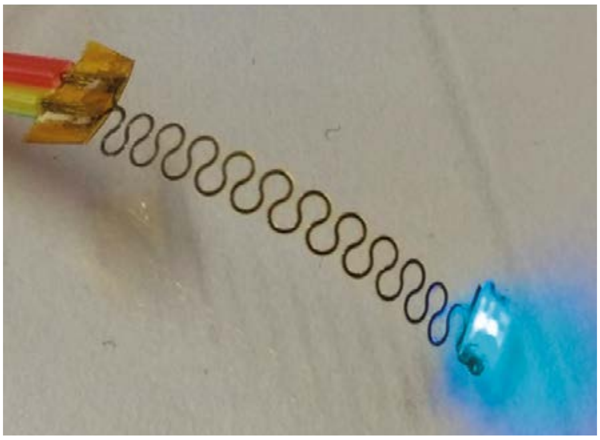
Soft electronic platforms for energy and sensing

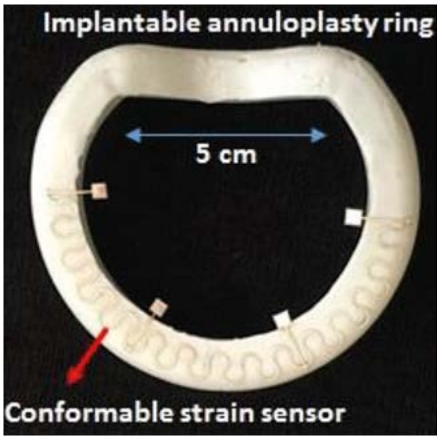
Dr Sohini Kar-Narayan
Department of Materials Science and Metallurgy

Digital healthcare devices and point-of-care diagnostics have been identified as one of the best solutions to provide affordable healthcare worldwide in the 21st Century. Wearable sensors, based on skin-like electronics, that can continuously monitor and communicate vital health data, such as temperature, heart rate, biomarkers in sweat, and blood pressure, to name a few, could help prevent diseases and monitor chronic conditions reducing healthcare cost.

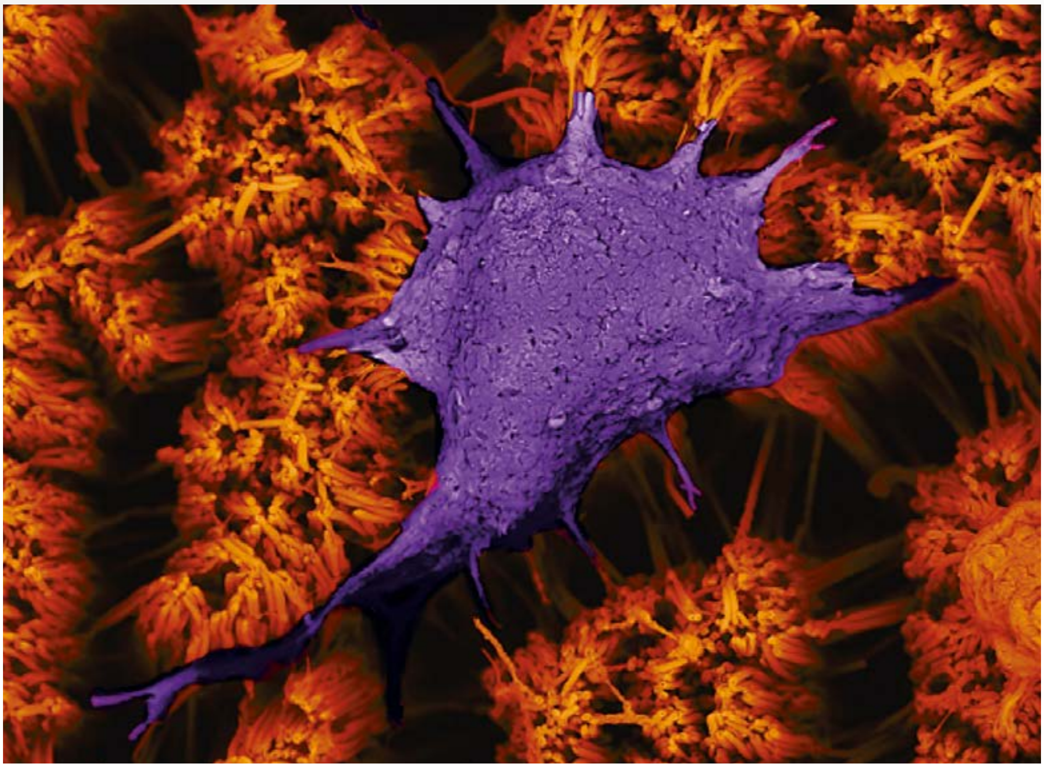
Furthermore, these sensors would be able to provide large amounts of physiological data to enable "personalised healthcare", and to accelerate clinical trials and scientific research. In this context, flexible, stretchable and conformal electronics with increased contact area would greatly enhance the quality of signals acquired from/through the skin or other biological tissue. However, current silicon-based electronics is rigid, as are batteries that are typically required to power sensors, and as such do not integrate well with human skin or tissue. The challenge is therefore to develop "soft electronics" for sensors that seamlessly integrate with the human body without compromising on comfort and safety. This poses a significant manufacturing research challenge, requiring the incorporation of novel functional materials with advanced sensing capabilities into next-generation soft electronic components, aimed at the global healthcare market.

In our group, we use novel microscale additive manufacturing routes, such as aerosol jet printing, that simultaneously enable the discovery, design and development of new conformable devices, taking into account the need for rapid prototyping as well as scalability of the technology. This includes the development of printed conformable devices for physiological sensing, as well as flexible and stretchable energy harvesters to ensure smooth, autonomous operation. Research in our group is broadly aimed at applications in sensor-assisted diagnosis, surgery, as well as personalised treatment management.





Examples of flexible, stretchable and conformable functional devices



A cell interacting with a piezoelectric structured substrate

At the same time, we develop devices for sensing and actuation at even smaller length scales, i.e. at the cellular level. This is of particular interest in biological systems which are responsive not only to chemical changes, but also changes in their mechanical environment. This 'mechanobiology' is believed to regulate some important cell functions, such as the how stem cells differentiate and the direction in which brain cells can grow. The influence of mechanical and electrical stimulation on bone, muscle and nerve cells is significant and well documented, however the mechanisms involved are not thoroughly understood. The forces that occur between cells do so over very short length scales and are exceptionally small. In order to mechanically interface with these cellular systems, it is necessary to create a soft and interactive platform that is equally small and sensitive. Responsive nanomaterials, such as piezoelectric polymers with enhanced functionality, can therefore provide a convenient route towards achieving a bio-electromechanical interfacing platform with advanced functionality. By allowing a culture of cells to act on and deform a piezoelectric structure, the resulting polarisations could be detected using an array of electrodes and used to image the interactions occurring. Furthermore, the same imaging platform could also be used to stimulate or control the growing cells. As the piezoelectric effect also works in reverse, applying an electric field will induce a deformation of the material. An array of microscopic pre-patterned electrodes can therefore allow precise spatial control of this deformation.

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The University hosts a number of themed Centres for Doctoral Training (CDTs), including EPSRC-funded centres listed here: www.epsrc.group.cam.ac.uk

Spotlight: EPSRC CDT in Sensor Technologies and Applications for a Healthy and Sustainable Future

Prof Clemens Kaminski
Director

Dr Róisín M. Owens
Co-Director

Prof Axel Zeitler
Co-Director

The EPSRC CDT in Sensor Technologies and Applications for a Healthy and Sustainable Future (Sensor CDT) provides doctoral training to students across twenty participating departments. We sit at the heart of an extensive network of academics and industrial partners interested in all aspects of sensing from fundamental technology to applications. We are currently training 50 students and will recruit and train an additional 50 students by 2027.

Starting this year, we will increase our focus on addressing the sustainable development goals and training in responsible leadership and entrepreneurship. The CDT learning experience is strongly team-focused and the course includes a dedicated MRes (Masters of Research), with continued support provided through the entire PhD phase.

A large number of companies from all sectors of the UK economy participate in the programme with start-ups and SMEs in particular benefitting from a staged engagement programme, which permits the exploration of ideas in mini-research projects, a leveraged studentship funding model, and access to excellent students, academics, and infrastructure.

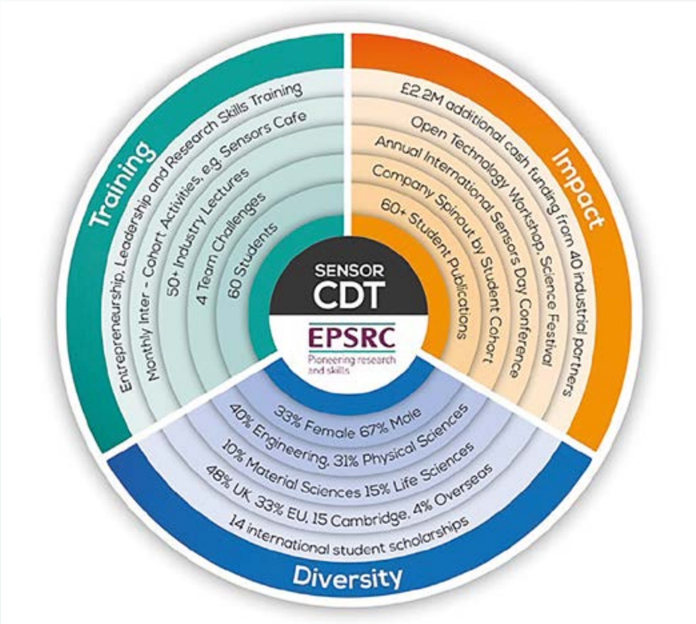
A core teaching component of the MRes is the Team Challenge, during which is led by the students working as a team. The most recent Team Challenge showcases the ideas we have for responsible innovation. Students engaged the public in the CamBike Sensor project to develop a citizen enabled air quality monitoring network. The students won a prize from the Global Challenges Research Fund and are currently taking their technology to citizens in Argentina and Africa.

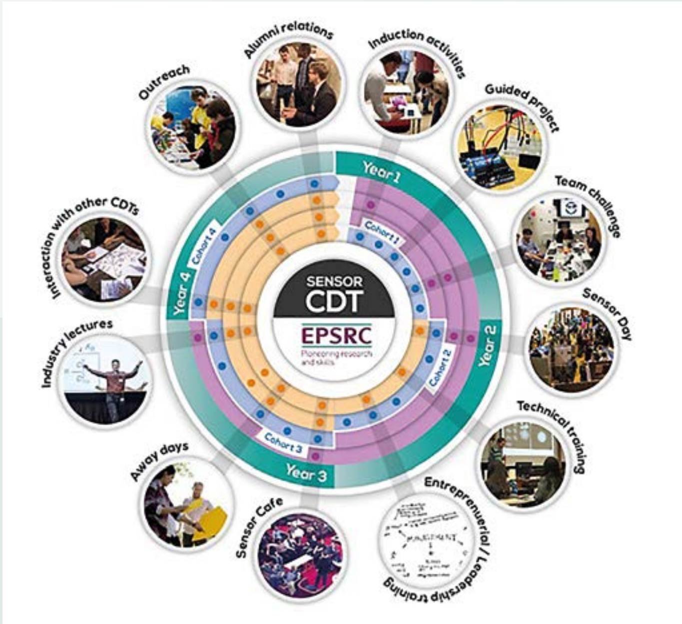
"Sensor innovation is a powerful enabler to understanding how our environment is changing, and how we can adapt to this change. It underpins the delivery of the Sustainable Development Goals. I look forward to the vibrant contributions the students will make to address global challenges through sensing."

Dr Beatrix Schlarb-Ridley, Director of Innovation and Impact at the British Antarctic Survey

The academic leads on the programme are Dr Róisín Owens, Professor Axel Zeitler, and Professor Clemens Kaminski. The management team includes Philip Mair (teaching) and Karen Scrivener (operations). Industrial partners include MedImmune Ltd, Fluidic Analytics Ltd, Alphasense Ltd, British Antarctic Survey, ioLight, Nokia Bell Labs, Zimmer & Peacock Ltd, Panaxium SAS, Anglian Water, TeraView Ltd, Centre for Digital Built Britain, Cambridge Enterprise Ltd, Cambridge Display Technology Ltd, Smart Cambridge, Arm Ltd, National Physical Laboratory, Cartezia, Synoptics Ltd, Silicon Microgravity Ltd, Galvani Bioelectronics, Victoria & Albert Museum, Marks & Clerk LLP, Magna International Inc, Kirkstall Ltd, Iconal Technology Ltd, Blue Bear Systems Research, and the Hitachi Cambridge Laboratory.

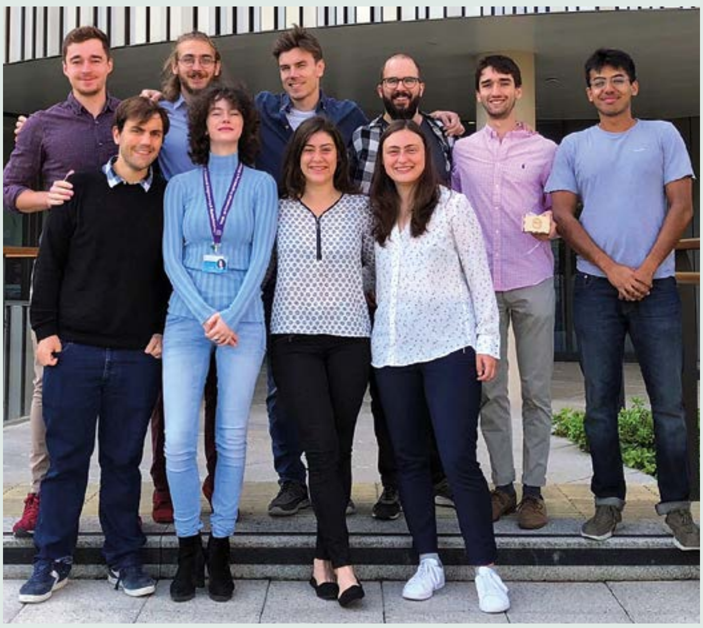
cdt.sensors.cam.ac.uk





Sensor CDT activities

The hub on a bike



Sensor CDT 2017 Cohort – The CamBike Sensor Team

CamBike Sensor in the Alps

Impulse Programme for tech innovators

Yupar Myint
Head of Programme

Dr Alexandra Huener
Coordinator

Participant Profile (2017 - 2019)

Level of Education

- Postdoc 60%
- PhD 26%
- Master's, Bachelor's & others 14%

Fields of Research

- Artificial Intelligence
- Biotechnology
- Clean Energy
- Diagnostic Testing
- Graphene
- Healthcare
- Machine Learning
- Quantum Technologies
- Sensors
- Software
- Water Tech

An intensive and steep learning curve experience

Impulse serves as a catalyst for entrepreneurship in individuals and organisations. It engages 80+ experienced innovators from Cambridge who act as role models and provide guidance to aspiring entrepreneurs towards the development of their science and technology ideas and turning them into successful commercial ventures.

"I believe we need to encourage the brightest people with the big ideas and create a truly inspirational environment and provide the correct support. I fully support Impulse which will allow researchers and innovators to test their clever ideas and execute them successfully."

Dr Hermann Hauser, Impulse board member

Our advisory board members include:

- Prof Chris Abell
- Matthew Bullock
- Dr David Cleevely
- Prof Sir Richard Friend
- Dr Debbie Harland
- Dr Hermann Hauser
- Prof Andy Hopper
- Dr Elaine Loukes
- Prof Chris Lowe
- Prof Florin Udrea

Programme overview:

Chance encounters make amazing ideas possible.

The programme is comprised of two intensive residential modules with individual assignments in between, over 2-3 months. Its nature allows considerable flexibility in defining aims and workflow. Our 4th annual Impulse Programme will take place from April- July 2020.

The programme is aimed at:

- PhD students, Post-docs and researchers across the different fields of Physical Sciences and Technology
- Early-stage entrepreneurs
- Researchers/Engineers/Managers from large corporates with innovative ideas

"I was impressed by the high profiles and vast experiences of the speakers and mentors. I was inspired by my mentor Jamie, whose questions triggered a chain of positive changes for me. All of this would not have been possible without Impulse. It is true that chance encounters make amazing new things happen."

Dr Jialin Dou, ARM, Impulse alumnus

Further information about the programme timetable, mentors, speakers and other contributors, and application procedure can be found on our website.

www.maxwell.cam.ac.uk/programmes/impulse
impulse@maxwell.cam.ac.uk

New Maxwell initiative:
Linking the Schools of Physical Sciences, Technology and Clinical Medicine

Dr Alex Samoshkin
Translational Technology Manager

Dr Aga Iwasiewicz-Wabnig
Maxwell Centre
Director of Partnership Development

Dr Anita Marguerie de Rotrou
Head of the Office for Translational Research

In today's fast-paced technology driven world, unlocking the power of technological advances requires the convergence of multiple disciplines to co-create the transformative therapies of the future. The challenge is to bridge physics, technology, engineering, biology and medicine to be able to translate the findings on new methods/technologies/materials into the clinic, but also to bring clinical questions and challenges back to engineers and researchers who are able to solve them.

To push this further, the University of Cambridge facilitates an ecosystem that provides dynamic, well-connected interdisciplinary research, active knowledge exchange, entrepreneurship, acceleration and incubation of new ideas across scientific departments.

To link West Cambridge with the Biomedical Campus, the University of Cambridge created a Translational Technology Facilitator position. In June 2018, the Maxwell Centre and the Office for Translational Research (OTR, School of Clinical Medicine) jointly appointed Dr Alex Samoshkin, whose role aims to connect science and engineering researchers, academics, engineers and clinicians at the Biomedical Campus, as well as potential industry partners.

Alex meets with researchers from both sites, in order to identify transferrable expertise and techniques that can tackle specific unmet needs in biomedical research and applications. Sharing his time between the West Cambridge and Biomedical campuses, Alex has the opportunity to interact frequently with both academic researchers and busy clinicians in their own work environments. Face-to-face meetings result in awareness of their biggest research achievements, questions, potentials. A second goal is to create research partnerships by introducing and connecting the right people and groups with each other. Once such bridge is established, Alex facilitates opportunities to develop joint funding bids to enable conversion of blue-sky research into benefit for patients.

So far, this new direct link has resulted in a stronger connection between the two sites' research networks. It has increased the visibility of biomedical challenges amongst scientists and engineers at West Cambridge, as well as the awareness of early emerging techniques and methodologies amongst the Biomedical Campus researchers and clinicians. The early engagement and feedback from both clinical and technology sides has provided essential de-risking of projects, underpinning translation to applications, and fruitful industrial collaborations.

In just one year, Dr Samoshkin has connected researchers from 27 academic groups (13 from Physical Sciences/Technology Schools, and 14 from the Biomedical Campus). Additionally, 9 SMEs and 7 large industry partners have been linked with relevant academic groups, leading to joint funding bids. Alex has provided instrumental support towards 18 bids to date, including help with identification of the appropriate funding sources, consortia building and proposal writing. Seven proposals have been funded so far, securing over £1.2M towards collaborative interdisciplinary research and translation, with more still under consideration. The research will involve departments of Physics, Engineering, Chemical Engineering and Biotechnology, Applied Mathematics and Theoretical Physics, Radiology, Medicine, Paediatrics and the Addenbrooke`s Hospital.

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Industry collaboration

Industry interactions fostered by the Maxwell Programme range from joint research projects, partnerships with the Centres for Doctoral Training, collaborations between individuals, research groups, and networks, through to established industrial presence in the Maxwell Centre. Members of over 200 companies visited us in the past year, and the Maxwell academic community maintains industrial interactions that are now too many to name.

Companies that interacted directly with the Maxwell Centre programme within the last year by taking residence in our building, hot-desking, visits and hosted collaborations include:

… and more

"The Strategic Partnerships Office and the Maxwell Centre share a common vision – to enable productive and meaningful partnerships between the University of Cambridge and industrial partners and other partners. Our teams work closely together to foster those relations across the Physical Sciences and Technology."

Dr Karen Kennedy, Director, Strategic Partnerships Office

Maxwell Centre

Structure and Governance

Maxwell Centre Steering Committee

Prof Lindsay Greer, Head of the School of Physical Sciences, **Chair**

Prof Sir Mark Welland FRS FREng FIET FInstP, **Director**, Maxwell Centre

Dr Aga Iwasiewicz-Wabnig, Maxwell Centre Director of Partnership Development

Prof Andy Neely, Pro-Vice Chancellor for Enterprise and Business Relations

Prof Chris Abell FRS FRSC FMedSci, Pro-Vice Chancellor for Research

Prof John Dennis FIChemE, Head of School of Technology

Prof Lisa Hall, Head of Department of Chemical Engineering and Biotechnology

Dr James Keeler, Head of Department of Chemistry

Prof Richard Prager, Head of Department of Engineering

Prof Paul Midgley FRS, Head of Department of Materials Science and Metallurgy

Prof Andy Parker FInstP, Head of Department of Physics

Prof Neil Greenham, Deputy Head of Department of Physics, Resources

Prof Tim Minshall, Head of the Institute for Manufacturing

Dr Peter Hedges, Head of University Research Office

Dr Malcolm Grimshaw, Head of Physical Sciences, Cambridge Enterprise

"The Maxwell Centre acts as a valuable and important hub on the West Cambridge site to facilitate interaction between industrial partners and academics. The Materials Department has been delighted to collaborate with the Maxwell Centre since its inception, to help us build ever stronger links with industry and the wider community."

Prof Paul Midgley FRS, Head of Department of Materials Science and Metallurgy

"Talga is excited to be part of the growing industry community at the Maxwell Centre. We value highly the opportunity to collaborate with the academic and industry partners at Maxwell and the ability to access the state-of-the-art shared facilities. The support from the Maxwell team has made us feel very welcome while establishing a site office and two battery material research labs at the Centre."

Dr Anna Motta, Global R&D Manager, Talga Technologies

"What makes the Maxwell Centre unique are not just the high-quality laboratories and meeting spaces, but the fact that it brings together a wide range of researchers and experimental techniques. The resulting highly-collaborative atmosphere is particularly important for interdisciplinary research groups such as ours. From lab-floor to the coffee areas, the building design encourages informal meetings, which has already led to several new collaborations."

Dr Tijmen Euser, University Lecturer, Department of Physics

"The Centre for Digital Built Britain is a partnership between the Department of Business, Energy & Industrial Strategy and the University of Cambridge aimed to deliver a smart digital economy for infrastructure and construction for the future. We work with academics, industry and government, and the Maxwell Centre has proven to be an ideal operational base for CDBB."

Alexandra Bolton, Executive Director, Centre for Digital Built Britain

Get in touch

We welcome more ways of engaging with external partners and industry – the Maxwell Centre is set up to facilitate and foster these interactions. We look forward to new collaborations that involve innovative and ambitious research approaches to solving real world challenges.

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@Maxwell_Centre

UNIVERSITY OF CAMBRIDGE

Maxwell Centre