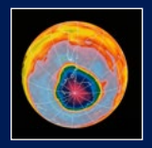
INNOVATION insights

THE LATEST INNOVATIONS, COLLABORATIONS AND TECHNOLOGY TRANSFER
FROM THE UNIVERSITY OF OXFORD

ISSUE 10 SEPT 2018

THE SOCIAL ENTERPRISE OPTION

Oxford University Innovation's social and environmental proposition



Quantum sensitive sensors ▶

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OXFORD UNIVERSITY INNOVATION

UNIVERSITY OF OXFORD

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INNOVATION insights

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It's not just technology

...innovation is found in all the disciplines at Oxford University

There is constant debate about how universities and their research commercialisation offices such as OUI should support their academic communities to create impact in wider society.

Traditionally the focus of such activities has been commercially driven, where the 'product' is a discovery or invention that can be protected and valued, and then licensed, sometimes to newly-created spinouts.

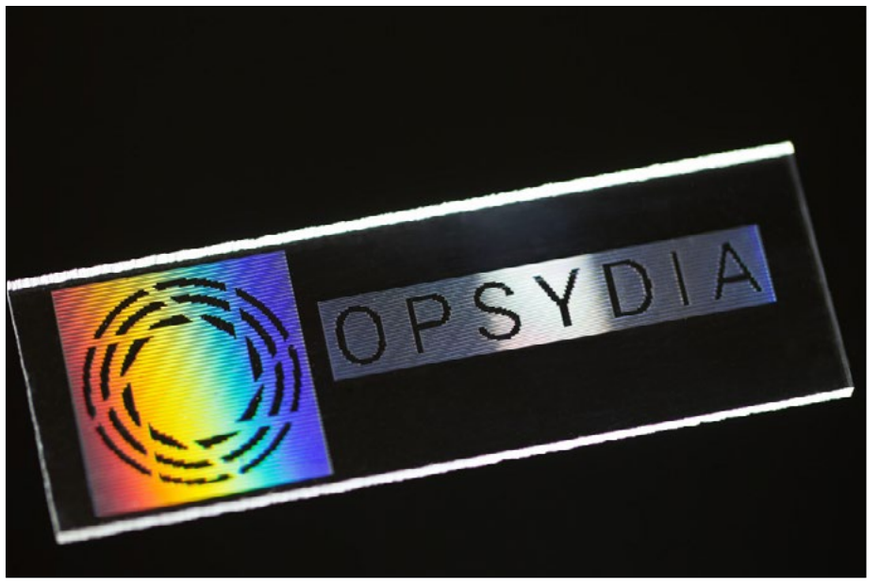
Whilst scientific discoveries tend to fit well into this model, the brilliant minds in universities such as Oxford create impact in many more ways. A new video on the OUI website features researchers from disciplines in the Humanities and Social Science Divisions creating impact through academic consultancy. And in this edition we highlight a new initiative supporting social enterprise – ventures created with all the rigour of conventional businesses, but with returns reinvested or channelled to causes for social or environmental good.

OUI supports all these initiatives, as we continue to build a world-leading innovation ecosystem with Oxford University at its heart.

We hope that you enjoy reading news of the latest innovations from Oxford in this edition of Innovation Insights.

Matt Perkins, CEO

News

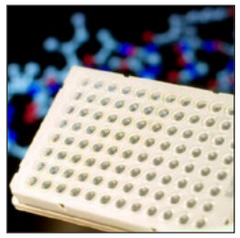


Opsydia provides diamond security
Secure laser marking technology company, Opsydia, have announced a gemstone security partnership with jewellery company De Beers.

FULL ARTICLE ▶

Electrochemical chilli sensor
Professor Richard Compton and his team have developed portable devices which can detect the levels of garlic, ginger and turmeric in foodstuffs.

FULL ARTICLE ▶



Oxford spinout extends test for Alzheimer's disease
Cytox, a precision medicine testing company, has developed an innovative Alzheimer's disease risk assessment using a blood or saliva sample.

FULL ARTICLE ▶

New wireless charging technology
Wireless energy firm Metaboards raised $5m to go towards development of their wireless charging prototypes. Oxford Sciences Innovation led the deal.

FULL ARTICLE ▶

Oxford gene therapy company signs a deal with an American start-up
Oxford Biomedica has signed a deal worth a potential $842.5m with US-based Axovant Sciences for a Parkinson's Disease treatment.

FULL ARTICLE ▶

Staphylococcus aureus vaccine

S. aureus asymptomatically colonises around 30% of the human population, however, occasionally it can cause disease. Of particular importance is the rise in the number of hospital related infections caused by drug resistant strains of *S. aureus*. For example, treatment of Methicillin resistant *Staphylococcus aureus* (MRSA), relies on the last line of effective antibiotics, and strains of *S.aureus* that are resistant to all current treatments have been reported.

A continuation of this trend will mean an alternative approach is required to combat the spread of these infections. Vaccines against *S. aureus* infections offer an attractive preventative measure, which could neutralise the threat posed by drug resistant strains. Researchers at the University of Oxford have identified two key proteins that could offer a route to such a vaccine.

FULL WEB PROFILE ▶

Oxford University Statistical Consulting

Oxford University Statistical Consulting (OUSC) provides comprehensive statistical consultancy services to external businesses. Clients tell us they do better when they work with us. They make better decisions.

It's because OUSC gives its clients access to specialist tools and methodologies – the results of research at Oxford that's world leading. Specialisms encompass machine learning, trial design, data management, modelling, analysis and prediction. OUSC's clients come from every walk of business life. Their shared advantage is a dramatically more sophisticated understanding and use of data. Oxford University Innovation's Consulting Services team works with OUSC to provide contractual and administrative support.

UNIVERSITY OF OXFORD DEPARTMENT OF STATISTICS

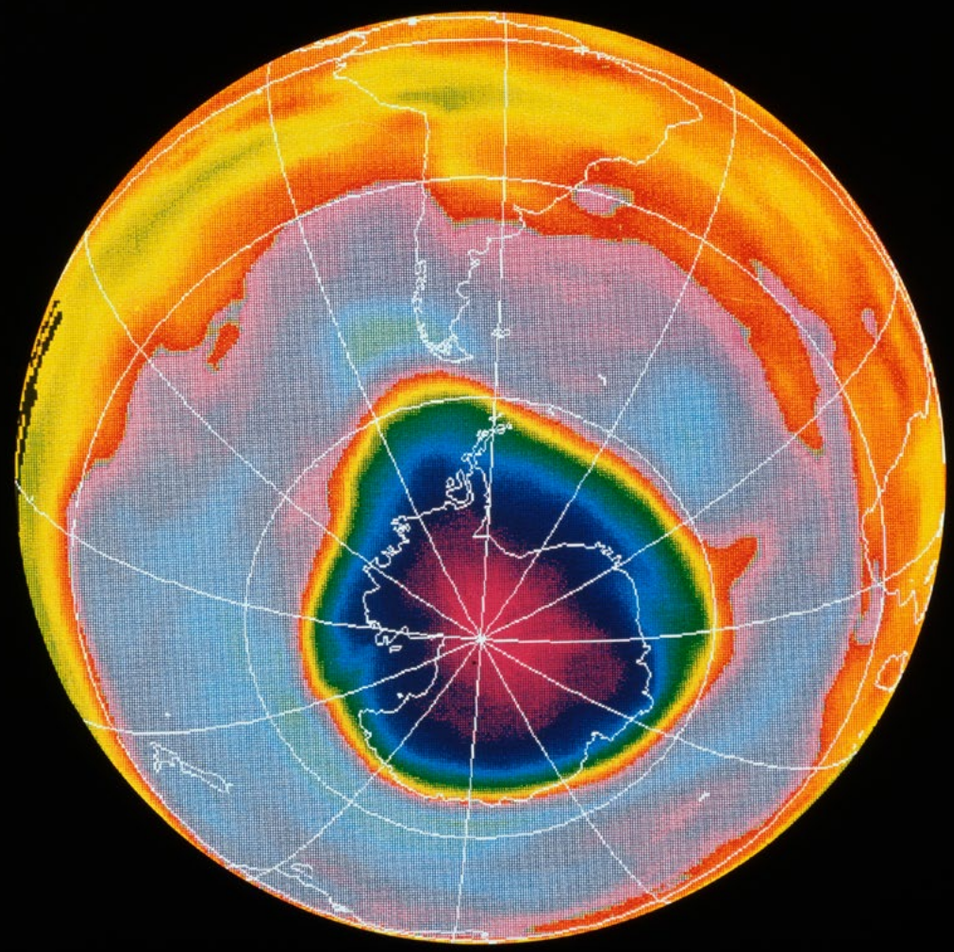
OUSC OXFORD UNIVERSITY STATISTICAL CONSULTING

FURTHER INFORMATION ▶

Quantum sensitive sensors

The detection of very low amounts of an object is a major challenge faced in many different fields, including medical biology, environment, security, or aerospace. Current techniques get around this by labelling the substance with a marker to amplify the signal, but this is prone to experimental errors and can be costly. There is a considerable need for sensing technologies able to detect measureands and analytes at the mesoscopic level.

Oxford Scientists have developed a highly sensitive, label-free density-of-states (DOS) based sensing technology operating at the mesoscopic or nanoscale level. This technology can be applied to a wide range of potential applications, including specific detection of biological molecules. It can also be used in other areas such as environmental sensing and substance detection and has the potential to be deployed in space technologies.



FULL WEB PROFILE ▶

The development and impact of quantum technology

Quantum computers are powerful machines that take a new approach to solving complex processes. Built on the general quantum state of a qubit, which can exist in two states and stores more information than a 1 or 0, it can perform operations far quicker than traditional computers.

The world leading quantum research group, IBM Q, sponsored this summer's Oxford Innovation Society (OIS) Meeting & Dinner held at Pembroke College, University of Oxford. The evening included talks from Professor Ian Walmsley, Pro Vice Chancellor (Research & Innovation) on the latest quantum computing developments from University of Oxford. Dr Anthony Annunziata, Associate Director, IBM Q Network shared his views on the new quantum developments. A lively panel discussion of experts and industry leaders rounded off the evening.

FURTHER INFORMATION ABOUT THE OIS ▶

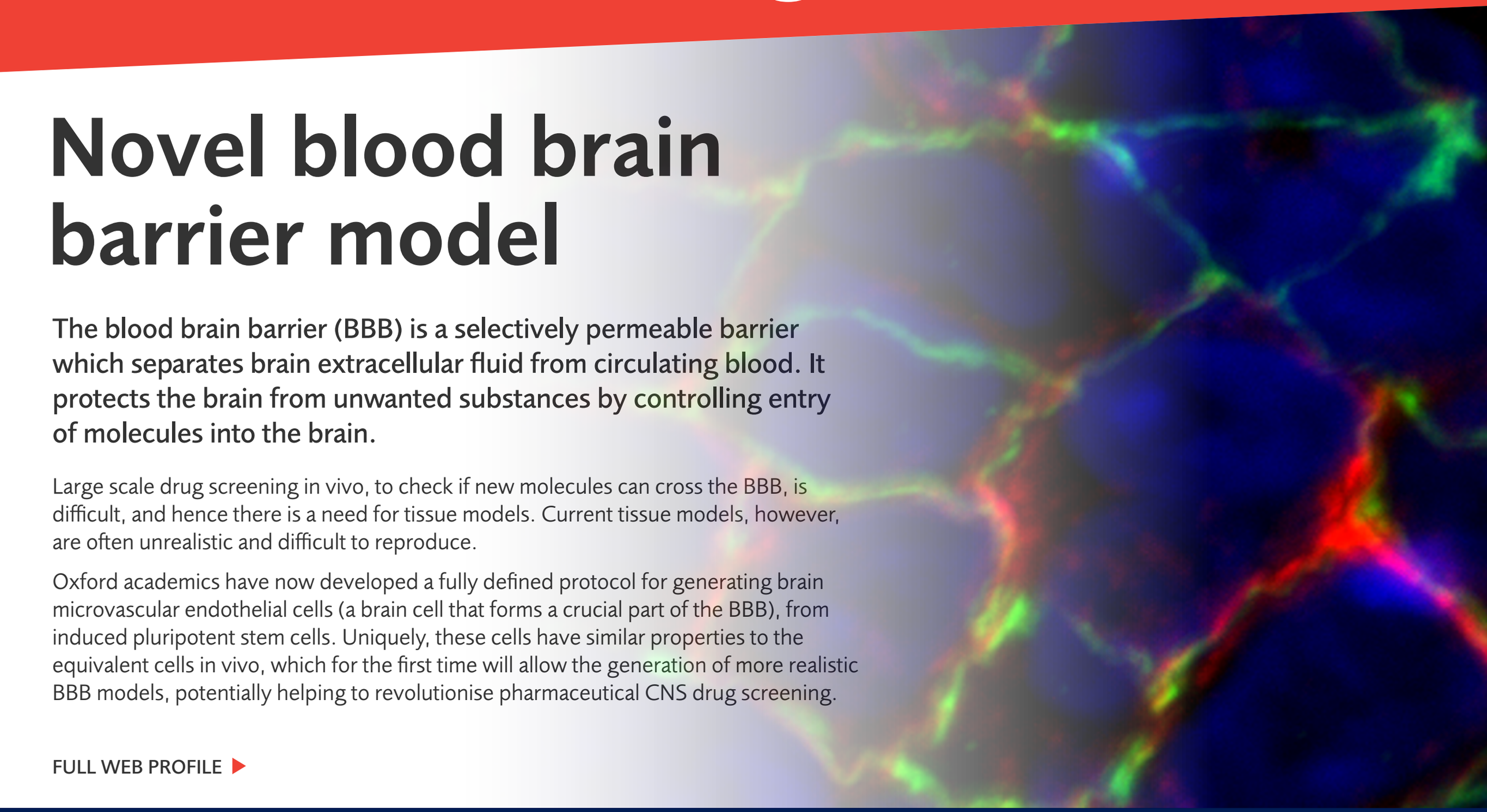
Antiviral drug increases quality in herbaceous plants

Agroinfiltration allows scientists to transiently express genes in plants such as Nicotiana benthamiana so that humanised recombinant proteins such as vaccines and antibodies can be produced at scale. Agroinfiltration offers an alternative to animal models, and various organisations are therefore interested in making this process more efficient.

Researchers at the University of Oxford have discovered three new protease inhibitors that aid agroinfiltration by preventing endogenous plant proteases from degrading recombinant proteins. These protease inhibitors support producing increased yields and the quality of proteins of interest.

FULL WEB PROFILE ▶

Novel blood brain barrier model



The blood brain barrier (BBB) is a selectively permeable barrier which separates brain extracellular fluid from circulating blood. It protects the brain from unwanted substances by controlling entry of molecules into the brain.

Large scale drug screening in vivo, to check if new molecules can cross the BBB, is difficult, and hence there is a need for tissue models. Current tissue models, however, are often unrealistic and difficult to reproduce.

Oxford academics have now developed a fully defined protocol for generating brain microvascular endothelial cells (a brain cell that forms a crucial part of the BBB), from induced pluripotent stem cells. Uniquely, these cells have similar properties to the equivalent cells in vivo, which for the first time will allow the generation of more realistic BBB models, potentially helping to revolutionise pharmaceutical CNS drug screening.

FULL WEB PROFILE ▶

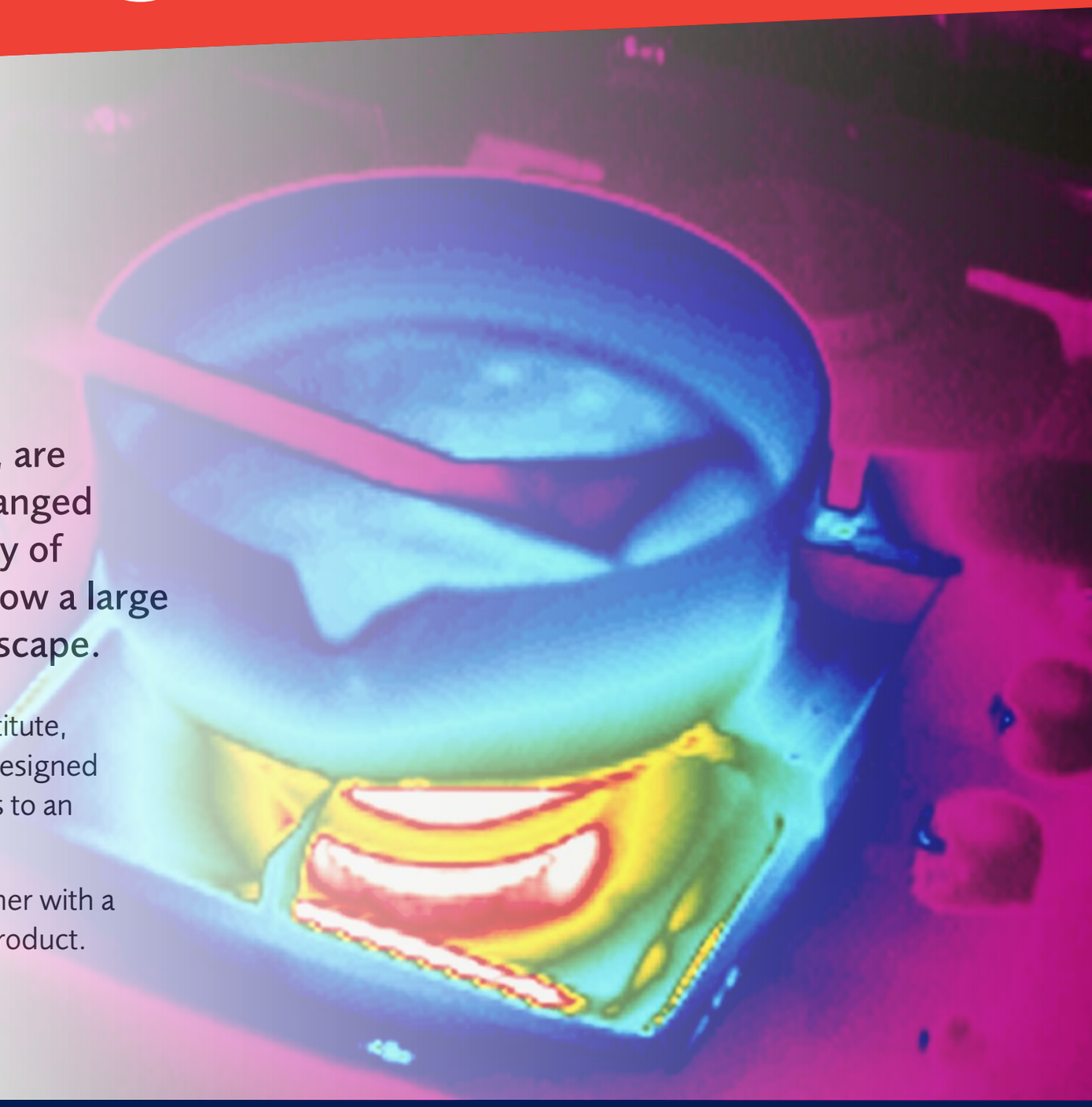
Research in rare diseases

To address the issue of lack of information about disease history and long-term conditions of patients, Oxford researchers have developed a reliable internet-based platform with online registration. This includes initial verbal consent, online capture of responsive to spatient-reported outcome measures and events within a dynamic consent framework.

The online Rare UK Diseases Study (RUDY) platform has been implemented for patients with rare diseases and has successfully recruited 615 patients with a high degree of engagement. This platform cuts down the administrative cost for patient data management and encourages collaboration between patients, doctors and researchers.

FULL WEB PROFILE ▶

Fuel-efficient pan design



Cooking pans, as used in kitchens around the world, are generally simple vessels whose designs have not changed much over many years. Researchers at the University of Oxford have recognised however, that such pans allow a large proportion of heat energy from the heat source to escape.

Developed in the internationally-renowned Oxford Thermofluids Institute, Oxford's groundbreaking cooking pan technology utilises uniquely designed vertical fins to capture and absorb heat energy. This technology leads to an efficient, fast and even cooking process.

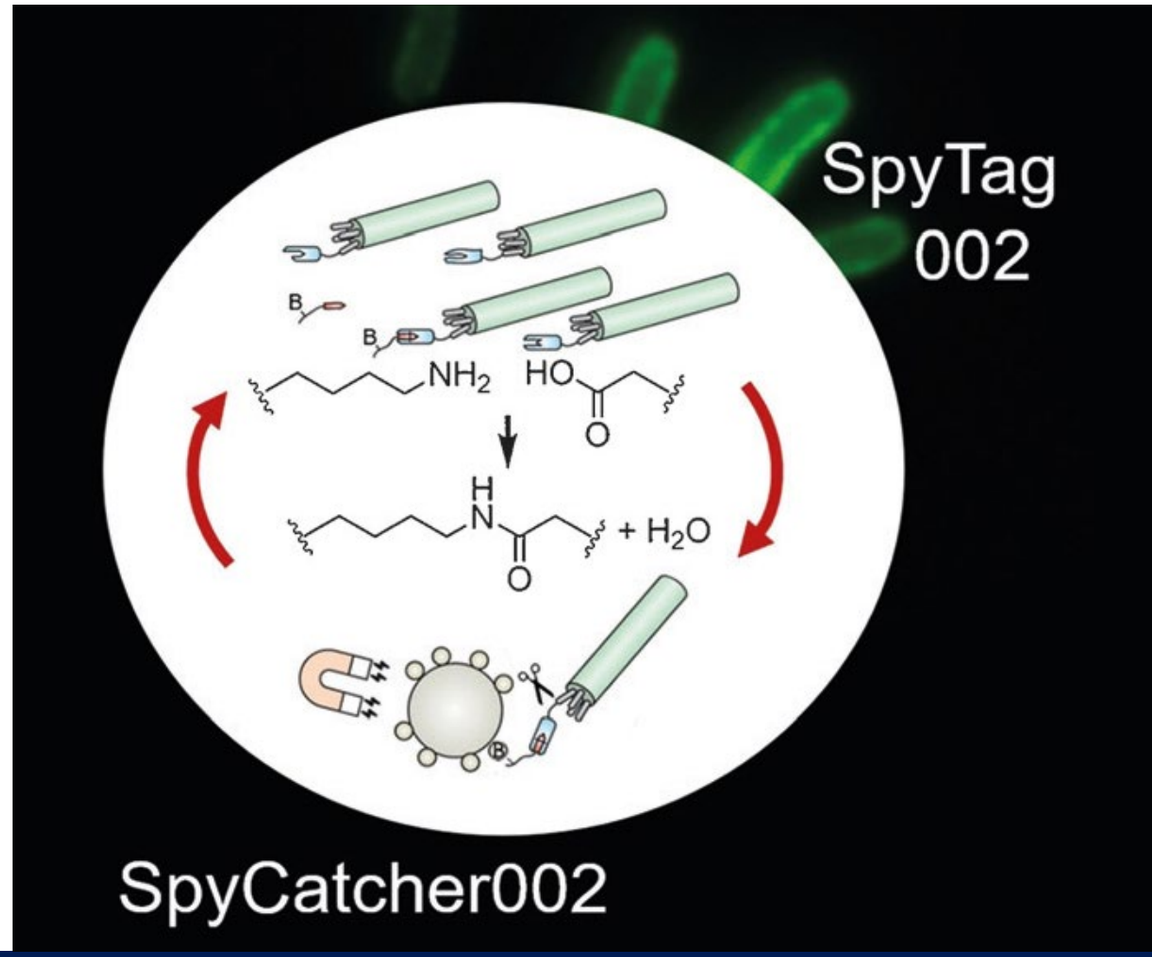
With proven improved cooking times and reduced energy use together with a striking visual impact, this is an opportunity for a highly marketable product.

FULL WEB PROFILE ▶

SpyTag and SpyCatcher version 2.0

Bioconjugation, a strategy to form covalent links between biomolecules, is useful for the study and manipulation of protein properties. Peptide interaction can be exploited to form powerful tools for bioconjugation.

By taking advantage of the characteristics of bacterial pilins and adhesins, Oxford researchers have developed SpyTag and SpyCatcher, which are a peptide/protein pair that act as a 'superglue' for proteins. SpyTag and SpyCatcher spontaneously form an irreversible covalent link across a wide range of experimental conditions. They have been used extensively in academic and industrial settings for diverse purposes, such as enzyme stabilisation, vaccine optimisation and formation of novel biomaterials.



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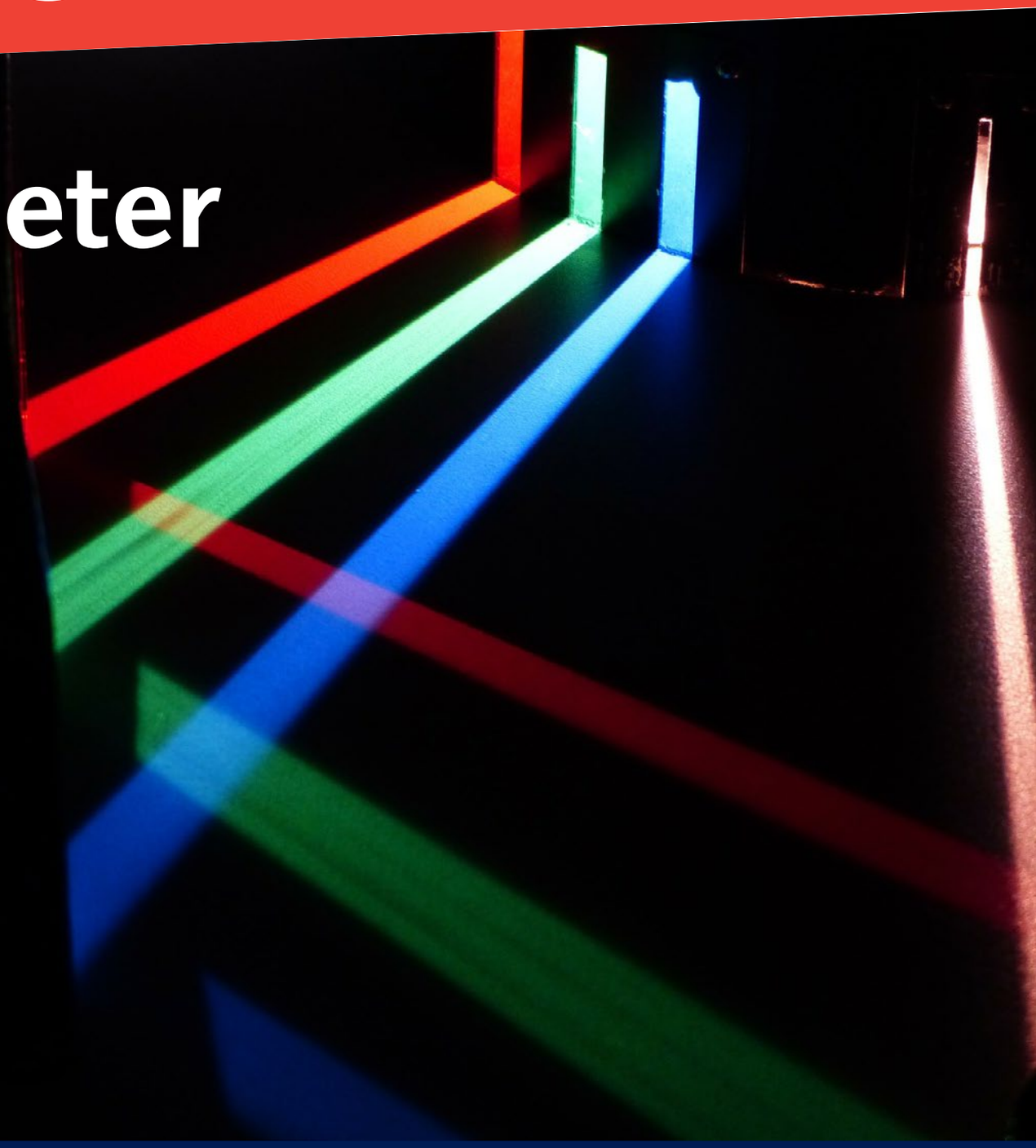
3D laser spectrometer

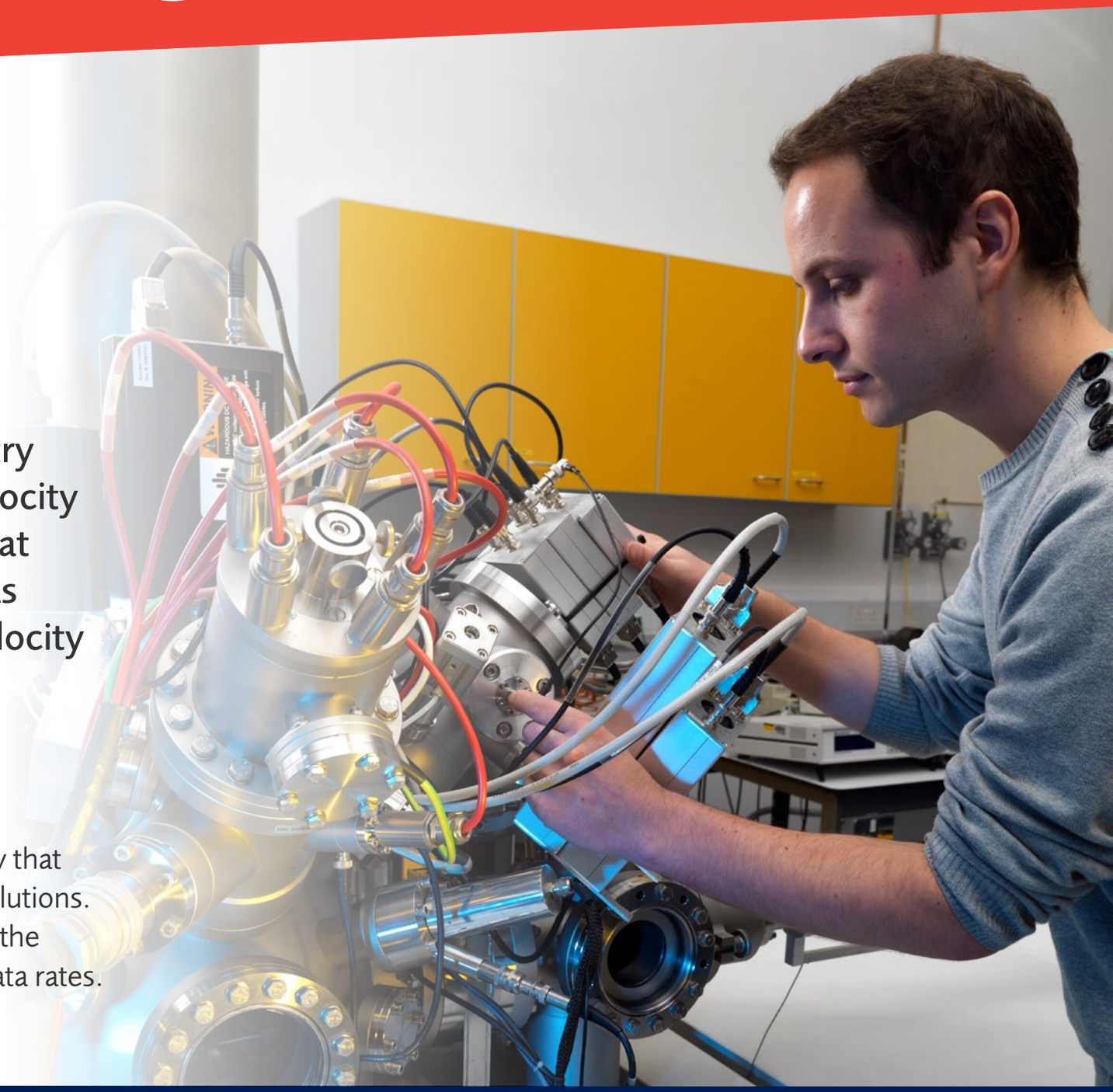


Current spectrometers are limited to receiving signals in low light conditions due to different spectra throughput from various positions from a material. The narrow slits at the entrance of spectrometers limit the number of photons entering the spectrometer and the spectral resolution is reduced. If wider slits in a spectrometer are used, it will increase the light throughput, and reduce the spectral resolution.

Researchers at Oxford University have developed a novel technology using spectroscopy to capture multiple two-dimensional spectral images from a single capture with higher light throughput. The 3D laser spectrometer design is built upon the concept from an emerging field of compressed sensing to make it possible to retrieve 3D spectral information from a screen/camera.

FULL WEB PROFILE ▶

Charged particle imaging



A new variation on time-of-flight mass spectrometry enables mass-selective images of the spatial or velocity distribution of an ion's mass-to-charge point ratio at the point of formation. Spatial map ion imaging has applications in surface imaging techniques and velocity map imaging, which has been used successfully in the field of reaction dynamics to study molecular photofragmentation events and other processes.

Oxford researchers have developed the Oxford sensor technology that allows particle events to be imaged with high spatial and time resolutions. Large numbers of images may be recorded and stored on-chip on the nanosecond to microsecond timescale before readout at slower data rates.

FULL WEB PROFILE ▶

Enhancing crop yields and stress resilience

Plastids are organelles that are found in plant cells where chemical pathways are performed and compounds are stored. Transition and interconversion between different types of plastids is an important mechanism for development and adaption in plants. A recently characterised pathway, known as TIC/TOC, regulates the uptake of proteins that are essential for the transition and interconversion of plastids.

Researchers based at the University of Oxford have identified two key novel components of this pathway and they envision using these to regulate critical traits such as promoting improved yields, stress tolerance, delaying leaf senescence to induce a "stray green" phenotype and altering fruit ripening.

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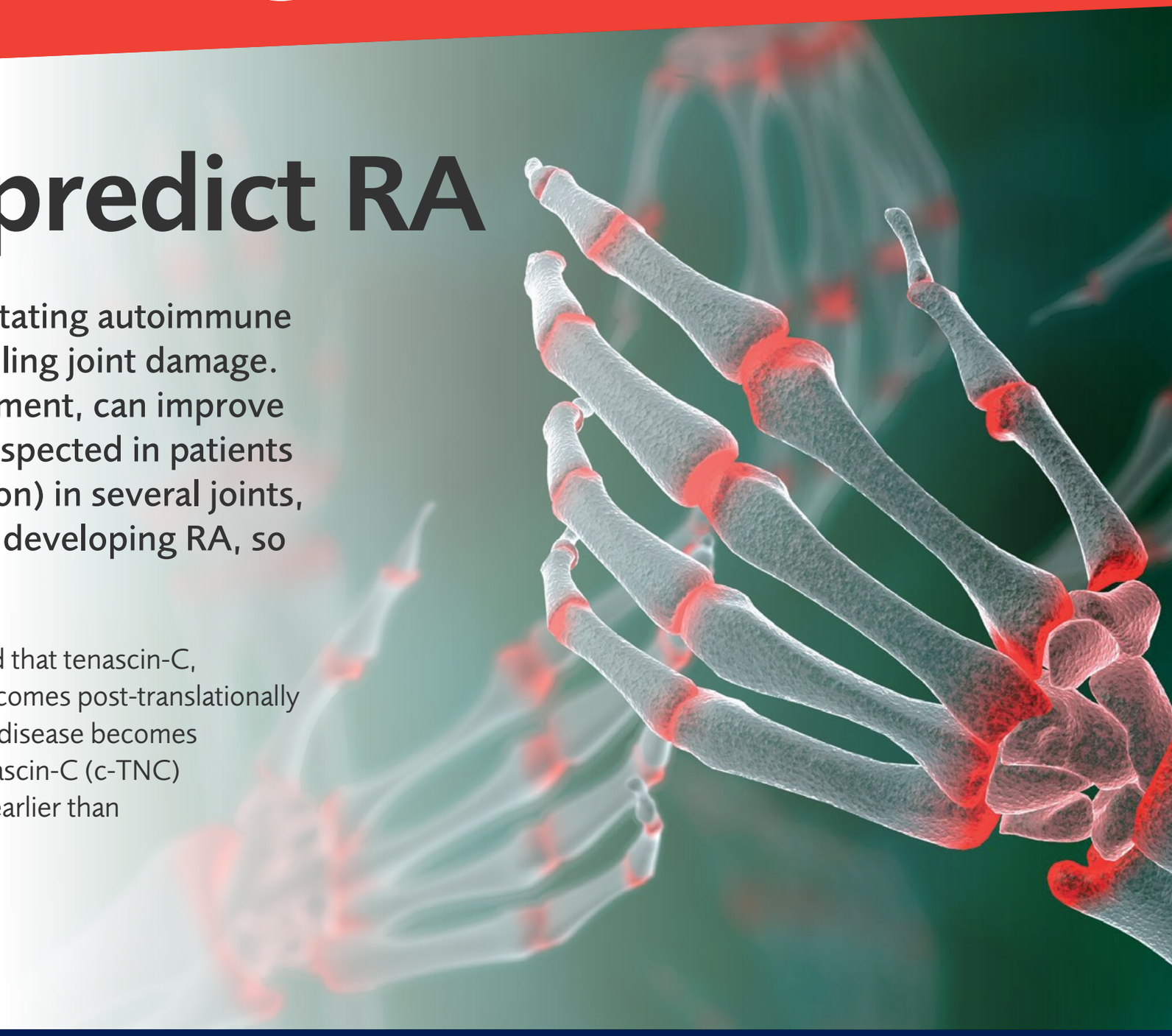
Biomarker to predict RA



Rheumatoid arthritis (RA) is a highly debilitating autoimmune disorder which can result in pain and crippling joint damage. Early diagnosis, and therefore earlier treatment, can improve patient outcomes. Although RA is often suspected in patients presenting with synovitis (joint inflammation) in several joints, not all patients with early synovitis end up developing RA, so treatment is not standard at this stage.

Researchers at the University of Oxford have discovered that tenascin-C, a pro-inflammatory extracellular matrix glycoprotein, becomes post-translationally modified by citrullination in patients with RA before the disease becomes apparent. Therefore, a test that detects citrullinated tenascin-C (c-TNC) in the serum may identify patients that will develop RA earlier than previously possible.

FULL WEB PROFILE ▶

Contamination-free microcentrifuge tube holder system

Researchers often use microcentrifuge tubes in laboratory centrifuges to separate liquid substances at high speeds, including hazardous material. These tubes are handled by researchers' hands, which results in increased exposure of the hand to radiation if the contents are radioactive. Subsequently, the radiation can spread onto any surface the researcher touches, resulting in cross contamination.

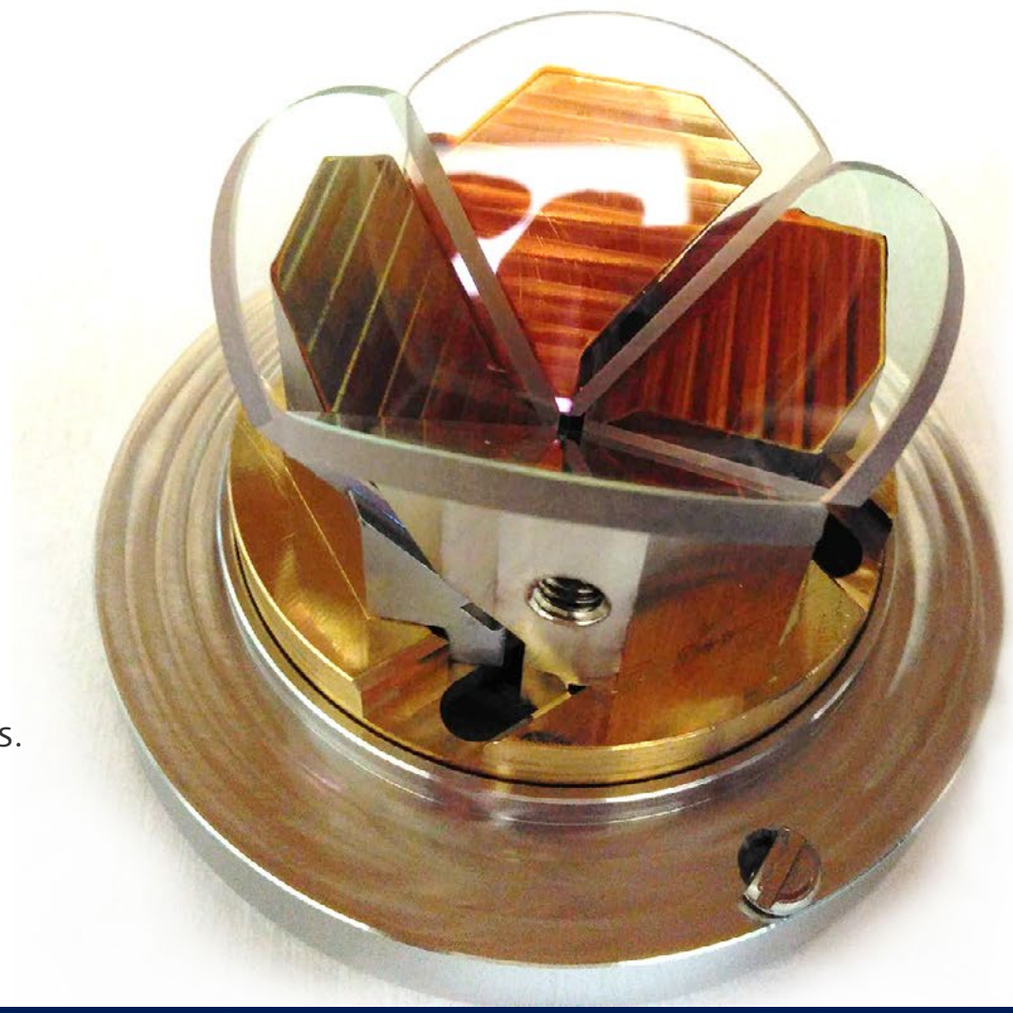
Researchers at Oxford have developed an Eppendorf tube holder to reduce contamination by mounting the tube away from the researcher's hand.

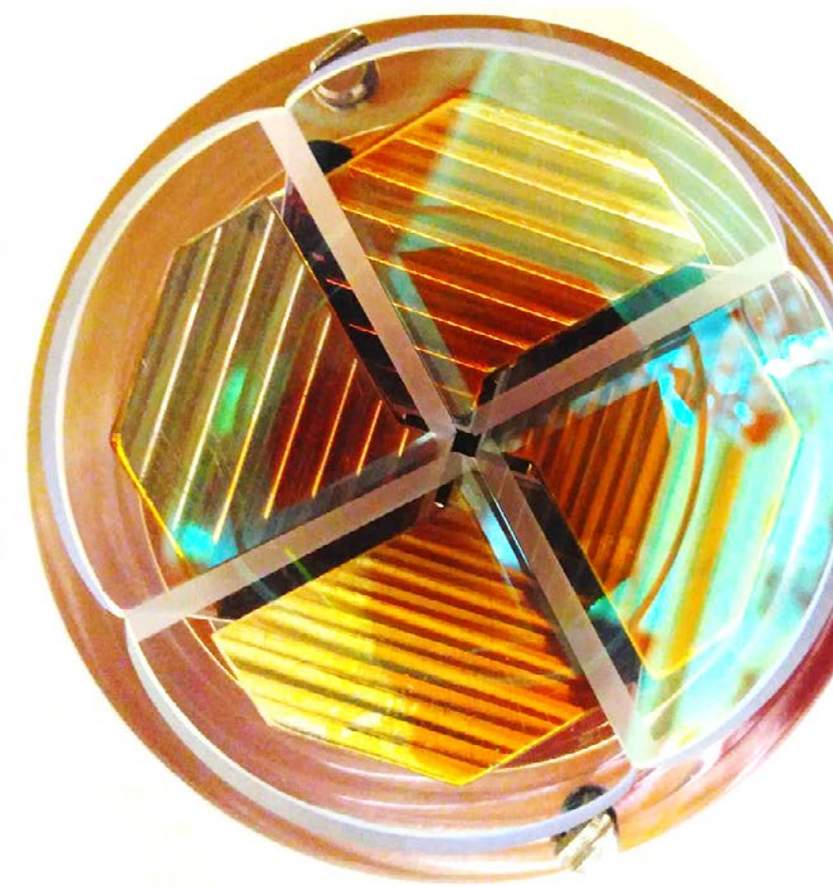
FULL WEB PROFILE ▶

Pyramidal magneto optical trap

Oxford researchers have designed a compact magneto optical trap with identical mirrors and mounts, making it easier to manufacture and fit inside a standard size vacuum tube.

Unlike previous devices, the size of the hole through which the atoms emerge is adjustable, this adds the ability to change the divergence of the beam of cold atoms to meet the requirements of different applications.





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A novel sequencing solution

DNA sequencing has had a huge impact on diagnostics, genomics and functional analysis. Although many single-molecule sequencing methods exist, there is currently no effective way to connect the functional properties of a single DNA molecule with its sequence.

Researchers at the University of Oxford have developed a single-molecule sequencing method capable of connecting the functionality (reactions or interactions) of a single molecule with its sequence. This novel method is expected to support screening libraries of candidate therapeutic or agrichemical targets.

FULL WEB PROFILE ▶

Programmable and versatile gene regulation and editing

Oxford researchers have engineered a family of Cas9-based programmable transmembrane receptors that allows for conditional transcriptional regulation, conditional gene editing and rewiring of endogenous cellular pathways.

This was previously not suitable for user modulation of endogenous gene expression. However, this system can be regulated using a broad range of different inducers – from small molecules to cell-cell interactions, depending on the choice of the variable extracellular domain. Furthermore, it allows for dose-dependent control of gene expression and control over multiple gene functions. Using this system allows control over when and where to regulate (activate or repress) the gene of interest to achieve customisable sensing and response genetic engineering.

This technology has been validated using mammalian cells and will have applications in both basic research and therapeutic applications.

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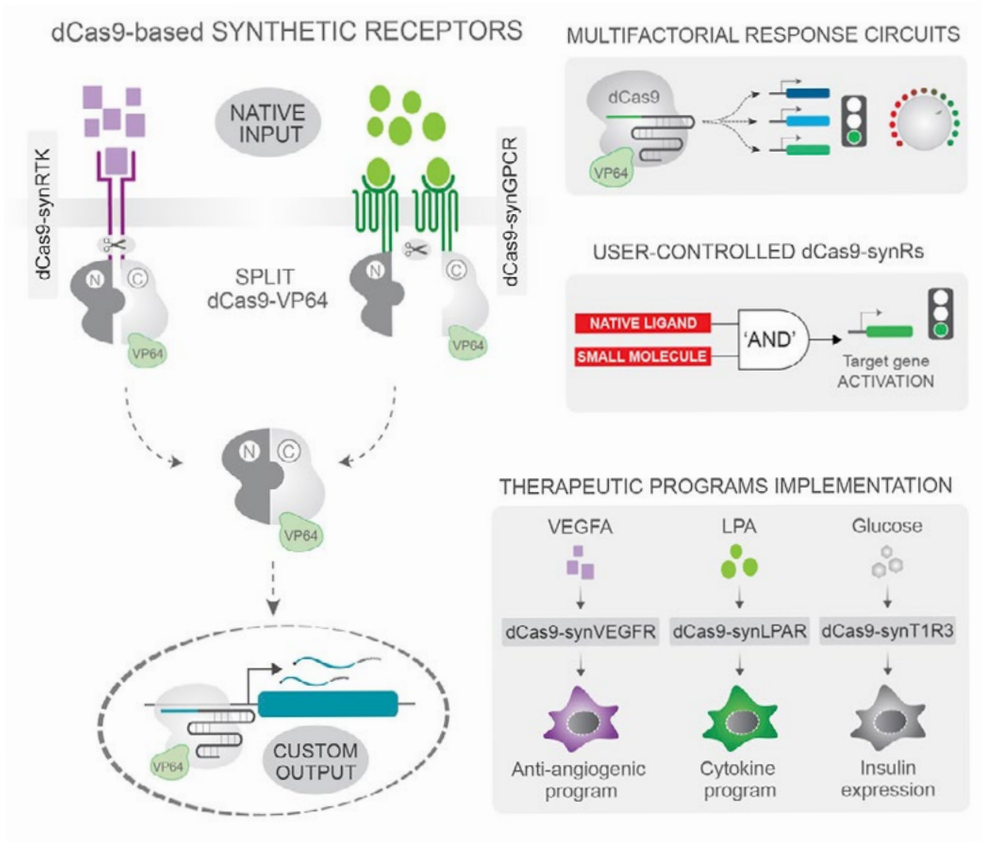
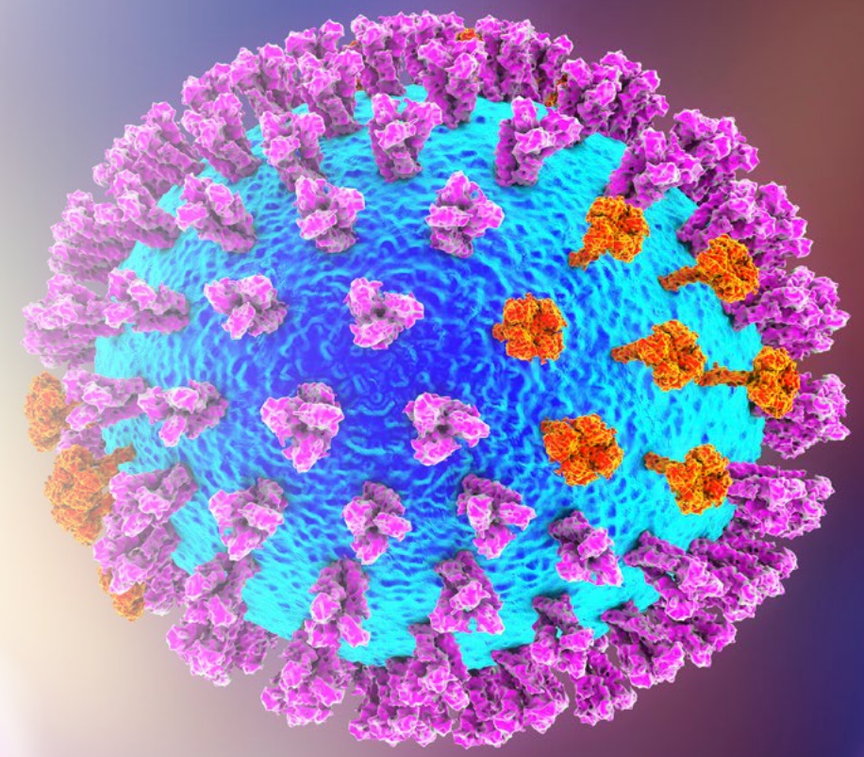


A universal influenza vaccine

Influenza is a highly contagious virus that causes severe illness and death each year. Vaccinations are available to those most at risk however, due to the seasonal variation of the virus, a vaccine that is effective one year, may be ineffective the next year. For this reason, the vaccine must be continuously updated to account for this variability.



Oxford researchers have made significant process in addressing this issue by analysing influenza viruses for areas of limited variability that could be targeted by a new vaccine. A vaccine has been developed that targets an epitope on the surface of the H1 haemagglutinin that is both highly immunogenic and has limited variability. This vaccine would be capable of conferring immunity to past and future strains of H1N1 influenza viruses through two to three vaccinations instead of the currently required yearly vaccinations.

FULL WEB PROFILE ▶

The Social Enterprise option

When I opened my email on my first day back at work in 2016, I found a request from my line manager asking me to explore what OUI could do to help the Humanities & Social Science divisions of the University with commercialisation. In those first few months, working alongside Susan Clark from Consulting Services, it wasn't difficult to identify projects, one of which became our first Humanities spinout, Inkpath.

But it was very clear in spinout terms, at least, the mainstream investment model wouldn't fit all the great ideas we were coming across. A lot of research in these divisions is internationally focussed, with research going into topics such as poverty, climate change, water management, human rights, war and peace – much of which is still focussed on developing nations.

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INNOVATION insights

FEATURED ARTICLE

You may have already read about the great work Sarah Deakin, Pippa Christoforou, Serena de Nahlik and Zoe Reich did in helping to set up and run our crowdfunding platform, OxReach at about the same time. Again, with healthcare interventions focussed on sub-Saharan Africa from Tropical Medicine and tackling the homeless crisis in Oxford, pilot projects have been put together and demonstrated to work which have been demonstrated to solve the problems they address.

But what next? How can the answers to these problems-local, national or international-be developed to maintain sustainable impact and continue to do their bit to make the world a better place?

Commercial endeavour can be seen to be on a spectrum, with ruthless "profit at all costs" companies at one end of the spectrum. OUI and the University do not get involved in this space anyway which is why we explicitly state we won't work with tobacco companies and arms dealers, for example. At the other end of the spectrum there are charities. Good work is done for the purpose of the charity and they largely rely on donations to remain active. In the middle sits social enterprise – businesses which have a social or environmental purpose written into their articles of association, thereby embedding that mission in the DNA of the company.

Yes, profits are made, but these are then recycled by the company to expand and make more impact. We have identified that social enterprise is a viable vehicle to take forward many of the projects in departments like Tropical Medicine, International Development, Geography, Theology, The Oxford Internet Institute, and Anthropology. Without having advertised we are going to do this,we already have 25 projects in the pipeline.

Keith Barnes Photography

CONTINUED ▶

In June, the OUI Board formally gave its approval to offer social enterprise as part of our service to the University, so what does that mean?

With social enterprise sitting at that boundary between mainstream business and charity, the legal waters are a bit muddy. There are two basic legal frameworks: Companies Limited by Shares (CLSs) and Companies Limited by Guarantee (CLGs). CLSs will better suit the more science-based companies which need to raise investment to build up a technology (e.g. cleantech, software) whereas service-based companies are more likely to be CLGs; but we're not being prescriptive – the tail should not wag the dog. We've created a standard set of documents for both, so if the company doesn't have or doesn't need financing to start, these template documents are there to enable a team to get going and start making impact. OUI pays for the legal and accountancy costs, and these are paid back gradually when the company starts to generate income. Most importantly, the social or environmental purpose is written into the articles of association for the company and is protected by a University veto. Furthermore, if the company is raising finance from the beginning, we can then help create a Community Interest Company (CIC). This enables the company to raise funds through Social Investment Tax Relief (SITR), create an asset lock which further protects the social or environmental purpose of the company with the additional (but not onerous) oversight that this brings.

CONTINUED ▶

INNOVATION insights

FEATURED ARTICLE

So what of finance? We realise that just like mainstream business and to quote Andrea Alunni, social enterprise needs its "innovation trajectory as well." Therefore, we are pleased to announce that we have received funding from EPSRC and GCRF to cover the innovation gap between research and a viable product with a new translational funding pot totalling £550,000, with first applications encouraged for the Michaelmas term. For the next stage, impact investment and finance is significantly growing in popularity, but is admittedly still in its infancy. We continue to make connections with the investment community and hope to have further news soon.

The first of OUI's social enterprise spinouts, sOPHIa Oxford, came in July from the Department for International Development in the Social Science Division. The team in the Oxford Poverty and Human Development Initiative led by Sabina Alkire have developed a multi-dimensional poverty index, which both measures poverty and provides workable solutions to eliminate it. The company will be providing an accreditation service to businesses, starting in Central America, but rolling out across the world. Its first deal is with ANDI, the biggest association of businesses in Colombia.

This is the first of many, we expect many more to be added to the pipeline in the coming months and we're looking forward to helping Oxford maximise its positive impact by rolling out great ideas for solving social and environmental problems across the world. If you'd like to help too, don't hesitate to get in touch.

FURTHER INFORMATION ON THE SOCIAL ENTERPRISE LAUNCH ▶

Interested to develop research collaborations?

The Mathematical, Physical and Life Sciences division is home to a world class community of researchers who bridge cutting edge discovery with commercial application.

Our interdisciplinary community pursues research today to solve the challenges of tomorrow across themes including sustainable energy, future cities, biomedical engineering, evolution and ecology, artificial intelligence and data science, to name a few.

For partnership and engagement support:
www.mpls.ox.ac.uk/our-team/industry-links

Find out more: **www.mpls.ox.ac.uk**

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OXFORD INNOVATION SOCIETY 2018/19

The Oxford Innovation Society (OIS) is an open innovation network for industry, academia, and investors. Upcoming meetings will be held on:

- Thursday 27th September
- Thursday 21 March

Meetings are held in Oxford for OIS members and invited guests, and are followed by a formal reception and dinner.

Details on www.innovation.ox.ac.uk/ois

INNOVATION insights

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