INNOVATION insights

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

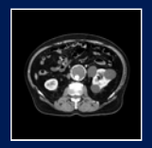
ISSUE 14 APRIL 2020

TECHNOLOGY TRANSFER MARKETING

Is it a waste of time?

Tuneable optical coatings ▶

Bespoke reference electrode for electrochemical sensors ▶



Growth prediction of abdominal aortic aneurysms ▶

Soil-structure interaction sensor ▶

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INNOVATION insights

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Changing the world for the better

Creating impact from Oxford University research

During these uncertain times as everyone adjusts to the coronavirus pandemic, we hope that you, your colleagues and families are safe and well.

OUI is still available, adapting to new working practices without face to face interaction, seeking to ensure that world-leading research from Oxford benefits wider society.

We are working closely with University researchers to support and facilitate projects related to COVID-19. These include a widely publicised vaccine programme from Professor Sarah Gilbert's lab, a new rapid diagnostic test for COVID-19 co-developed in Oxford and our research centre in China, and introduction of a new remote blood pressure monitoring tool for pregnant women allowing them to avoid unnecessary potential exposure to coronavirus.

More details of the University's coronavirus-related research programmes can be found at https://www.research.ox.ac.uk/Area/coronavirus-research.

Whilst the response to COVID-19 is now our highest priority, this edition of Innovation Insights highlights the staggering breadth of research outputs from Oxford – including improved nanoscale lithography, several diagnostic and therapeutic innovations and software to analyse genealogical histories from large samples.

We hope that you find these interesting and useful, and welcome any feedback on them.

News

Oxford spinout wants to take on Amazon's online research market

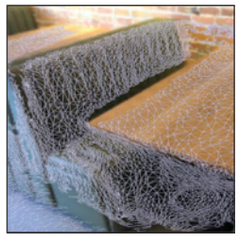
Oxford's innovation output and the surrounding Oxford Cluster take centre stage in the Wall Street Journal feature on European university innovation.

FULL ARTICLE ▶

Using VR for medical training

Oxford research group has developed a new virtual reality medical training app that allows healthcare workers to enter a realistic 3D virtual hospital on their own smartphones or using a virtual reality headset.

FULL ARTICLE ▶



Niantic Labs acquires Oxford spinout

Augmented reality spinout 6D.ai has been acquired by Pokemon Go developer Niantic Labs, giving the gaming company next-generation AR tech.

FULL ARTICLE ▶

Oxford angel networks join forces

Oxford Investment Opportunity Network and Oxford Angel Network have merged to form a strong and cohesive Oxford-based angel network.

FULL ARTICLE ▶

Biotech company collaborates with Oxford spinout

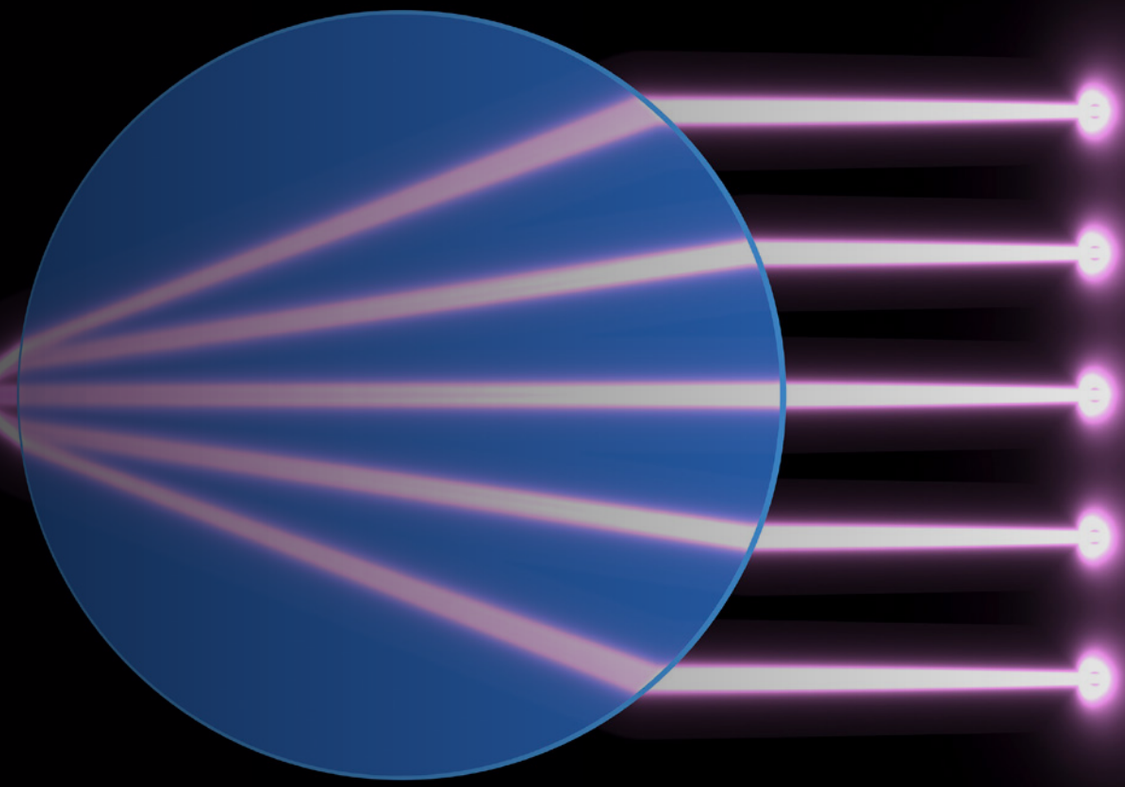
Oxford spinout EvOx Therapeutics has agreed a $44m licensing deal with Japanese pharma giant Takeda.

FULL ARTICLE ▶

Multifunctional device for focusing light through an optical component

Graded Index (GRIN) lenses are affordable, flat, rigid lenses, commonly used for compact imaging systems. GRIN lenses have the inherent property of radically changing birefringence, a property undesired for most applications.

Oxford researchers have taken advantage of undesirable birefringence properties of GRIN lenses, by combining them in cascade with other widely sold optical components. This enables extra functionality and applicability of commonplace GRIN lens systems, in areas such as microscopy, quantum optics communication and cancer detection.



FULL WEB PROFILE ▶

Tuneable optical coatings

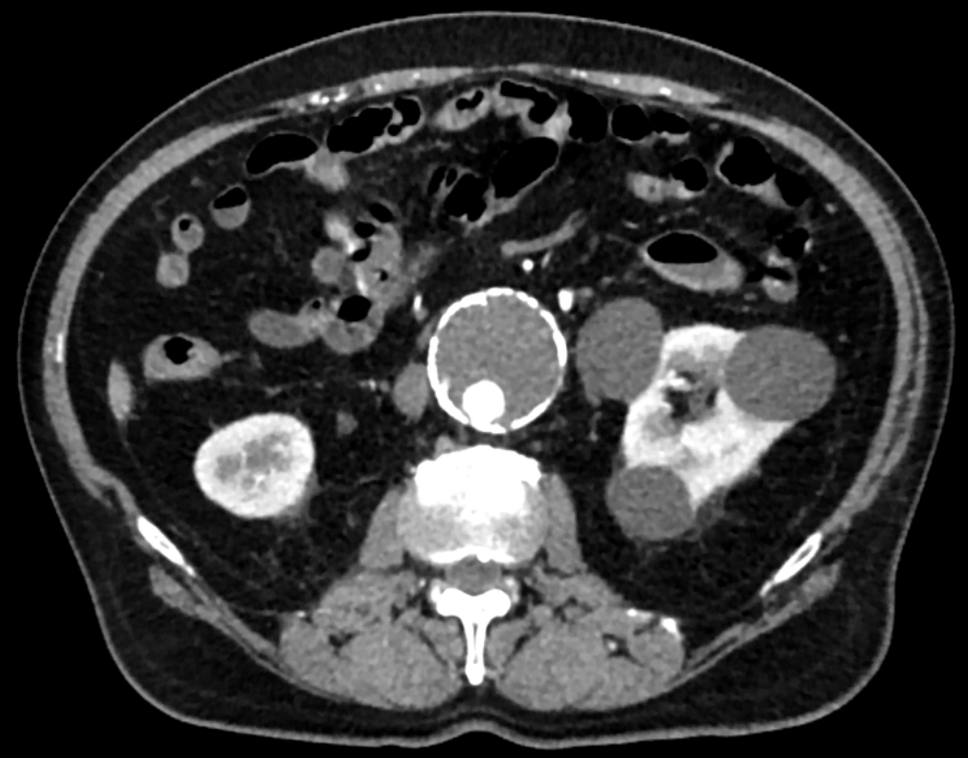
Researchers at the University of Oxford have identified and used a new class of chalcogenide glass materials in optical coatings which have potential applications across a broad range of optical components.

These new optical coatings provide a continuously tuneable refractive index and incredibly low losses. Further, the stack arrangement required to use this new class of chalcogenide glass materials is significantly less complex than the arrangement required for use with phase change materials.

FULL WEB PROFILE ▶

Growth prediction of abdominal aortic aneurysms

Scientists at the University of Oxford have developed a method to determine the future progression rate of abdominal aortic aneurysms (AAA) by using flow mediated dilatation, a physiological marker of systemic endothelial function, and circulating biomarkers for the prediction of AAA growth.



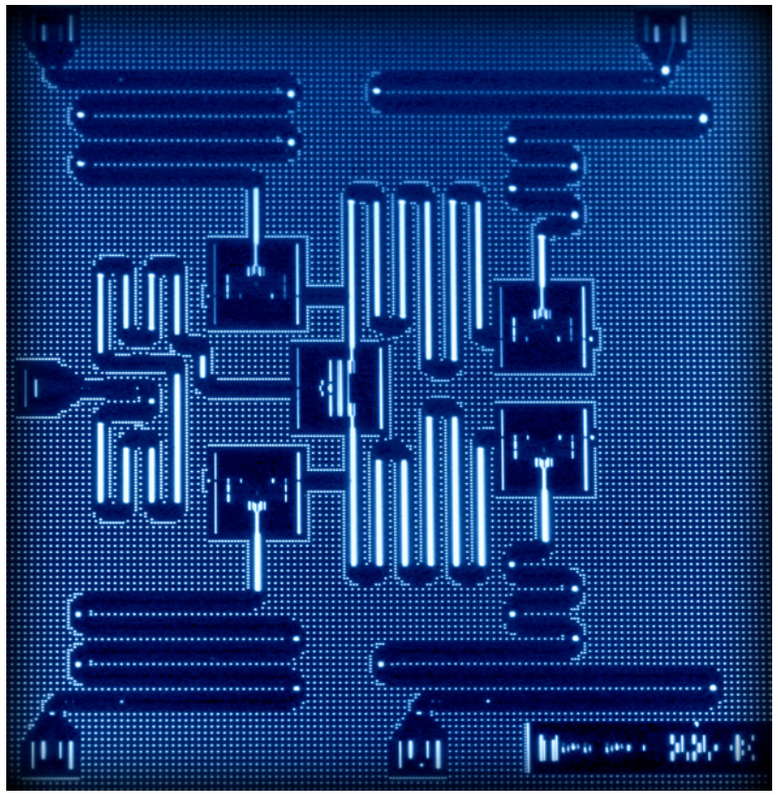
This is the first time a method has shown predictive AAA growth with high accuracy. Predicting the future rate of AAA growth is a useful tool for guiding the management of slow growing aneurysms which receive less frequent monitoring, whereas fast growing aneurysms may benefit from early intervention. Currently the threshold for AAA repair is defined by the size of the aneurysm and not the biological behaviour of the aneurysm within the affected individual.

The ability to predict the rate at which an aneurysm will progress will enable stratification of clinical need in terms of monitoring and intervention.

FULL WEB PROFILE ▶

Highly efficient frequency up-converter based on quantum light

A frequency up-converter is a device that converts low-frequency input signal to a high-frequency output signal. Generation of signals at high frequency, with cleanly defined spectral components, high output power and low noise is important for many applications including telecommunications and signal processing. For example, such signals may be useful as a local oscillator in heterodyne receivers, for frequencies from radio waves to THz.



Based on the similar working principles of a Travelling Wave Parametric Amplifier (TWPA), Researchers at Oxford have developed a broadband high efficiency frequency up converter based on the nonlinear wave mixing mechanism in a travelling wave parametric device. The up-converter exhibits quantum-limit noise performance, high conversion efficiency and cleanly defined spectral components. Key application areas include quantum-computing, astronomical experimentation and cryogenic readout applications.

FULL WEB PROFILE ▶

Silver electrode for electrochemical production of hydrogen

Despite the world's reliance on fossil fuels, their polluting and finite nature necessitates the development of clean and renewable energy sources to sustain humanity in the future. One alternative fuel source is hydrogen, the combustion of which yields nothing but water and energy. However, current systems developed to produce hydrogen are generally inefficient, limiting large industrial scale use. Proton membrane exchanger (PEM) electrolysis electrochemically splits water to yield hydrogen gas but has poor efficiency and is limited by relatively low rate of hydrogen production and expensive platinum electrodes.

To overcome these drawbacks, Oxford University researchers have developed morphologically controlled silver nanoparticles as a replacement for platinum in PEM electrolysers, resulting in higher rates of hydrogen production. This development will significantly decrease the cost of PEM electrolyser electrodes and support the use of such systems in a large-scale industrial environment.

FULL WEB PROFILE ▶

Bright Sparks lights fuse on Oxford's startups

What happened when we paired Oxford University's most original startups with Vodafone's business leader talent?

The entrepreneur's journey is a perilous one, especially when they are first starting out. Be it a newcomer to the scene or a seasoned veteran, entrepreneurship is a profession of dizzying heights and crushing lows. Startups and spinouts can be made on a chance encounter and succeed despite the odds, while the best laid plans can still crash and burn in unforeseen pitfalls.

One of the ways Oxford University stacks the deck for our companies is mentorship. By pairing our companies with an experienced pair of hands, we can help our newer firms spot obstacles and opportunities they may have missed and guide them in making the best of both.

FURTHER INFORMATION ▶

Bespoke reference electrode for electrochemical sensors

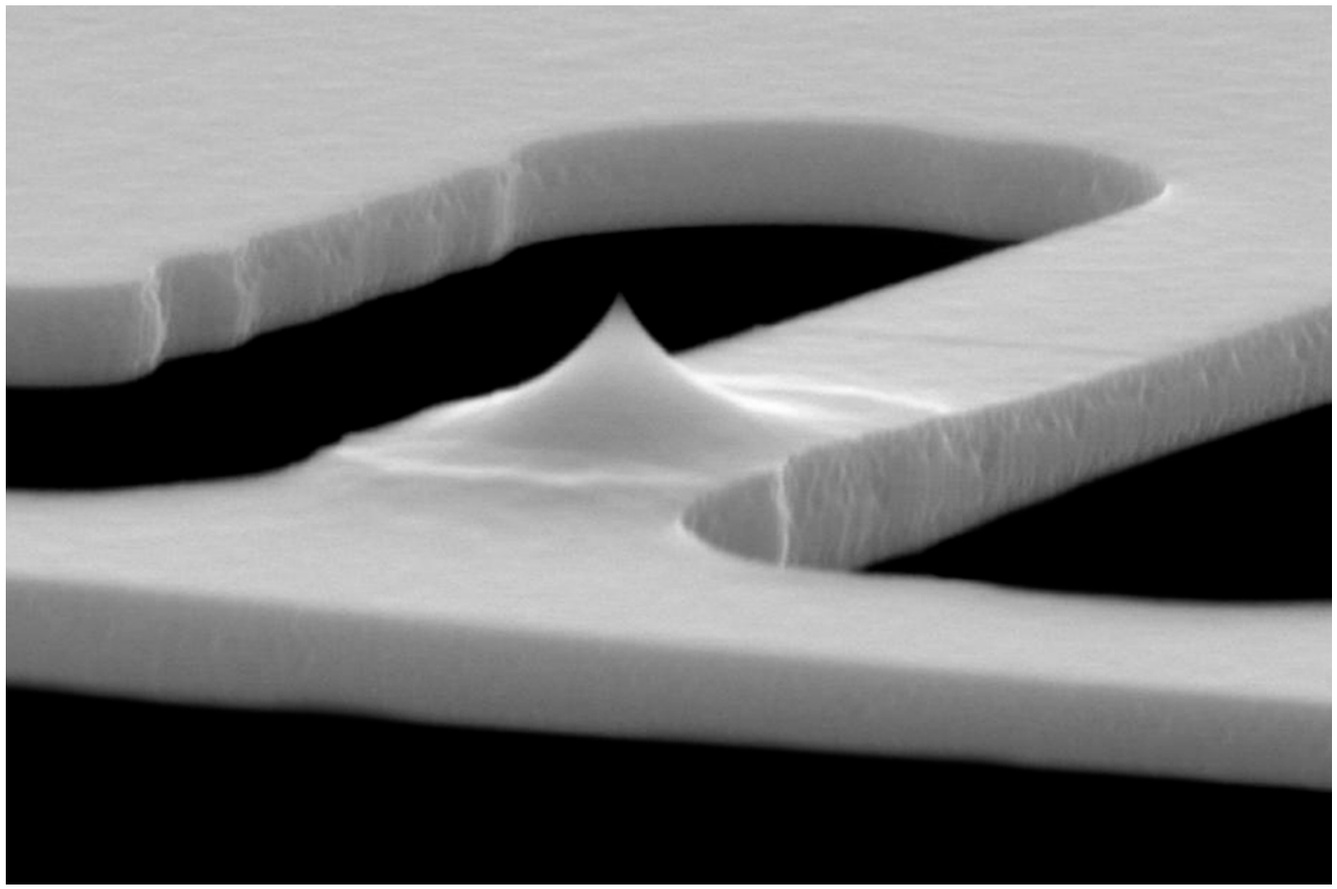
FULL WEB PROFILE ▶

Reference electrodes are fundamental to electrochemical sensors of all kinds. The most popular reference electrode is the silver/silver chloride electrode, widely used in pH meters and disposable sensor strips. They suffer from lifetime issues, leakage driven contaminations, unstable potential and fragility.

Oxford researchers have applied their expertise and developed a novel solid-state electrolyte-free reference electrode. Among the numerous advantages, the new technology makes the miniaturisation of the electrode feasible, opening several opportunities in the field of chemical sensing and analytical devices including the micro and nanoscales.

Variable linewidth nanolithography

Scanning probe lithography is often used to form 'mask-less' patterns on a surface using a purpose-built 'probe'. In the case of nanolithography, such probes can be configured with a sufficiently sharp tip to enable the creation of nanoscale features.



Conventionally, an array of probes, each with a different tip sharpness, is used to achieve varying levels of precision. Researchers at the University of Oxford have developed a new technique using nanolithography methods to form patterns using a single probe with tunable precision. A patent application directed to the new technology has been filed and OUI are seeking commercial partners to take the new scanning probes to market. This eliminates the need for recalibration when multiple probes are used, and allows features to be created in a single pass.

FULL WEB PROFILE ▶

Estimating genome wide genealogies for thousands of whole-genome sequences

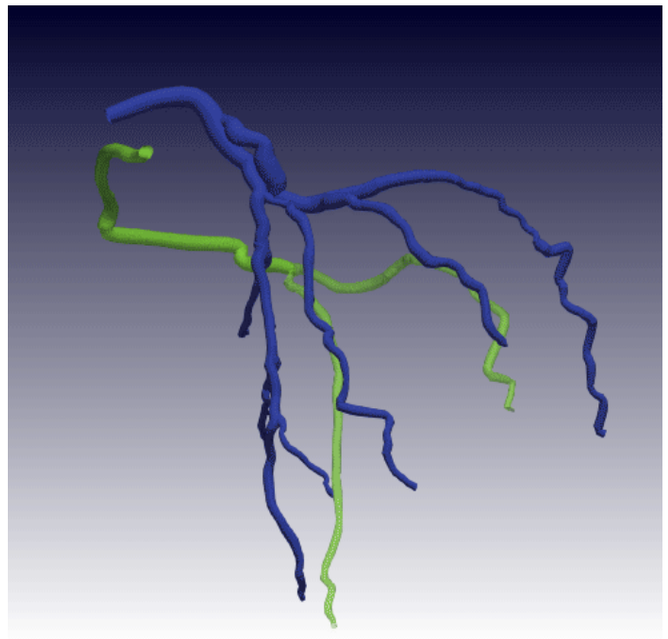
Genealogies describe how DNA samples are related through most recent common ancestors back in time. In principle, they are the best attainable record of the genetic past of a sample of DNA sequences and therefore, if known, simplify and substantially enhance any inferences we make about our shared genetic past.

RELATE is new software from the University of Oxford that makes inference of genealogical histories for large sample sizes possible, a problem that despite its importance had previously been impossible for all but the smallest datasets. RELATE scales to >10,000 sequences and improves accuracy in scenarios with realistic levels of errors.

FULL WEB PROFILE ▶

A new method for automated 3D blood vessel reconstruction

Cardiovascular disease is one of the leading causes of death worldwide. Angiography is the gold standard technique for the early detection of cardiovascular diseases, as well as for the assessment of narrowing in coronary arteries. However, determining the risk of the patient suffering future cardiac complications using only angiographic images is difficult, and often other scans are required, delaying treatment decisions. The main challenge is that the angiograms are two-dimensional images and often the physicians' experience is not enough to determine the exact location and the severity of a coronary stenosis.



Driven by this need, Oxford researchers have developed a new method for generation of 3D coronary arterial trees from retrospective angiographic projections. This new algorithm can solve the motion artefacts during image acquisition and provides additional information allowing physicians to take decisions on treatment and cardiovascular risk assessment.

CLICK HERE FOR 3D ANIMATION ▶ FULL WEB PROFILE ▶

Technology Transfer marketing – is it a waste of time?

Like many other research-intensive universities, Oxford yields hundreds of new inventions every year. This provides the substrate for one of the key aspects of our activity at OUI – the management and commercialisation of IP arising from research. While we don't take forward every new idea that crosses our threshold – and there are various reasons why we might decide that a project is not supportable – we proceed each year to file in excess of 100 new patent applications, and support plenty of non-patentable IP such as copyright in software source code and health outcomes questionnaires.

The result is many new commercialisation projects each year, spanning everything from quantum computing to vaccines to autonomous vehicles to energy storage to speech recognition and so on. And plenty of AI of course. Some of these projects might have "spinout" written all over them from the outset, where they clearly have the potential to sustain a new venture, and indeed we create 20+ each year.

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Others might only ever be destined for repeat non-exclusive licensing to existing companies, for example the software research tools we licence via our online Software Store. Or some may have an obvious home in a company with which the academic inventor already has a connection or collaboration.

There will also, every year, be a significant number of projects that don't fit neatly in any of the above categories. On the face of it they are deserving of support; they appear to provide an economically and technically tractable solution to a meaningful problem; they have IP that we can protect or manage in a manner that should be conducive to finding a partner; and our preliminary market research has identified some target companies operating in the relevant business area.

Cue action from colleagues to generate non-confidential marketing profiles, identify and contact target companies and find one to which we can licence the IP and which will develop and market a product based on the Oxford invention. And this is where things get sticky. Many – if not most – of our projects are quite specialised and, although we endeavour to deploy proof of concept funding to advance them to a more mature Technology Readiness Level, many are still in need of significant development before a product or service can be sold. This immediately turns off a slew of companies which are interested only in finished products or those in late stage development.

Then we have the challenge of finding amongst the global panoply of potential licensees those for which:

- the strategic fit is right
- the technical fit is right
- the risk profile is acceptable
- the timing is right
- sufficient financial resources are available to invest
- the right person can be found to champion the deal

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Finally, add in the sheer breadth of sectors that we cover and, even with a relatively large team, finding the needle in the haystack – aligning TTO "push" with company "pull" - can be a Herculean task.

What do our results tell us about the effectiveness of this marketing approach? OUI alum Richard Holliday recently posted an excellent LinkedIn article (https://www.linkedin.com/pulse/doing-deal-richard-holliday/) citing an analysis he led here a few years ago that looked at a cohort of 100 licence deals and identified the source of the partner for each. His results showed that about 25% of deals came from pre-existing academic contacts. However, a more recent analysis by my colleague Serena de Nahlik shows that this source of partners has grown year on year since the original study to nearly 50% in the period 2017-19. The same study indicates an increasing proportion of licensing deals to our spinout portfolio and a dwindling proportion of deals from our efforts to scour the market for potential partners.

How about marketing platforms? There are many such offerings, with the likes of InPart and TechConnect having garnered significant market share in recent times. While we endeavour to keep an open mind, it is fair to say that we have enjoyed very little success in terms of actual transactions being traced back to contacts made via such platforms, although there may be indirect benefits both from exposure of our IP and also in identifying organisations with an interest in the research which gave rise to the licensing opportunity. Ultimately there remains a reticence amongst the kind of large corporates that browse such platforms to take on the early stage opportunities we typically offer, no matter how loudly they trumpet their open innovation credentials.

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So what is the solution to this challenge of getting our IP into the hands of partners who can take it to market and ultimately achieve impact? Magic bullets are unlikely to exist but one experiment that we piloted earlier this summer in Oxford might represent a glimmer of hope for a fundamentally different approach.

In collaboration with The Foundry (Oxford's student entrepreneurship centre) and Oxford Sciences Innovation plc (which manages a £600M venture fund focused on Oxford University), OUI launched StEP – our Student Entrepreneurship Programme. This programme brought together interested Oxford University students who self-assembled into multi-disciplinary teams around projects chosen from a pool of 30 from OUI's portfolio. None of these projects were already being pursued as spinouts and many were in the "hard to shift" category. The teams then worked intensively during a 4 week period, supported by a stipend, to work up new venture proposals, supported by various mentors and with the chance of winning £25K at the end of it, courtesy of OSI. For any new venture arising, the students receive 90% of the founding equity, with the remaining 10% shared between the University and the academic originator of the IP (whose consent was required to make available the project in the first place).

We imagined the primary benefit of the programme would be giving the students entrepreneurial experience. However, the quality of new venture proposals from minds unencumbered by dogma or received wisdom was fantastic, and far surpassed our expectations. Not only is the winning project making great progress but others have gained new momentum and focus. The scheme was so successful that we are repeating it in 2021 – see https://unistep.org/ .

It also shows the power of simply building a pool of local entrepreneurial demand in which the entrepreneurs are, within reason, agnostic as to the nature of a given project, provided that they can see a genuine commercial opportunity. Arguably this is precisely the approach that has led to the pre-eminent innovation ecosystems built around MIT and Stanford, where the cadre of entrepreneurs and investors provides the main "pull" for technologies, and the TTOs have historically provided little support beyond the licensing transactions.

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INNOVATION insights

One of Oxford's great strengths is its intellectual capital and, while it may not quite have the number of entrepreneurs that Boston offers, we have an increasingly entrepreneurial student and research community, one of the world's top business schools generating MBAs and Exec MBAs, and huge growth in the number of companies around the city. We also have a diverse alumni network, many of whom are accomplished entrepreneurs, and to this end there is a strong imperative for us to foster stronger links with Oxford's colleges.

The colleges are rightly sensitive about their own alumni relationship management but are also starting to embrace entrepreneurial support as a means of enhancing both alumni engagement and student experience.

The StEP model may not be the panacea for all TTO marketing woes but it represents a concept that has shown initial promise and which could have the potential to fundamentally alter how we connect IP to commercialisation partners. For instance, we are looking at how we could make available a wider range of projects and connect them to established and more experienced entrepreneurial networks. The StEP model could also lend itself to collaborative approaches between universities, especially smaller institutions that would otherwise struggle to achieve critical mass. With the first iteration of the Knowledge Exchange Framework (KEF) - intended to increase efficiency and effectiveness in all aspects of knowledge exchange - looming, it is perhaps a timely innovation.

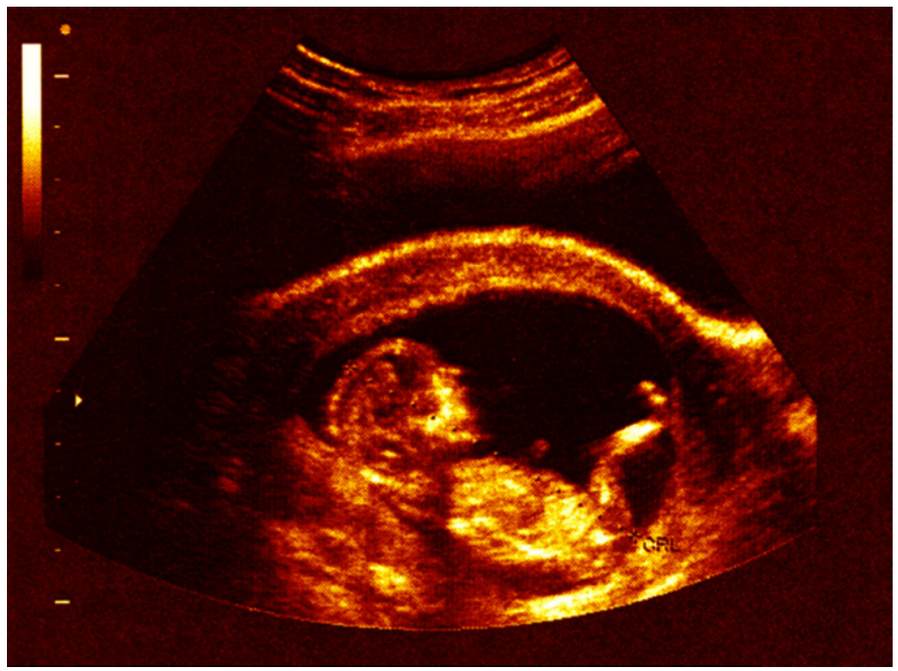
We would love to hear from other institutions that have had experience with similar models, or indeed completely different approaches that have yielded success.

Adam Stoten PhD RTTP, Chief Operating Officer, Oxford University Innovation Ltd

FURTHER INFORMATION ▶

Rapid method for the measurement of foetal scalp blood pH

Foetal capillary blood pH (foetal blood sampling) is a key diagnostic used during labour and is often used to determine if expedited delivery is required. Failure to deliver a baby in a timely manner could lead to neonatal brain damage. Currently, foetal health in utero is measured using a combination of foetal heart monitoring and, if found to be abnormal, a foetal scalp blood pH measurement. The acquisition of foetal scalp blood for pH measurement is technically difficult and takes time to perform (around 15 minutes), a significant issue if the baby is believed to be compromised.



Scientists at Oxford have developed a novel sensor suitable for making in-vivo foetal scalp pH measurements with many advantages over the current technologies. This bespoke sensor would make the process of obtaining foetal scalp blood easier, it can be performed at smaller cervical dilation, by midwives or doctors and give a much faster result.

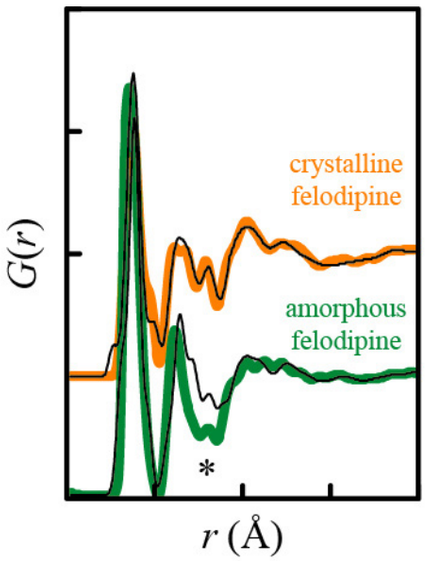
FURTHER INFORMATION ▶

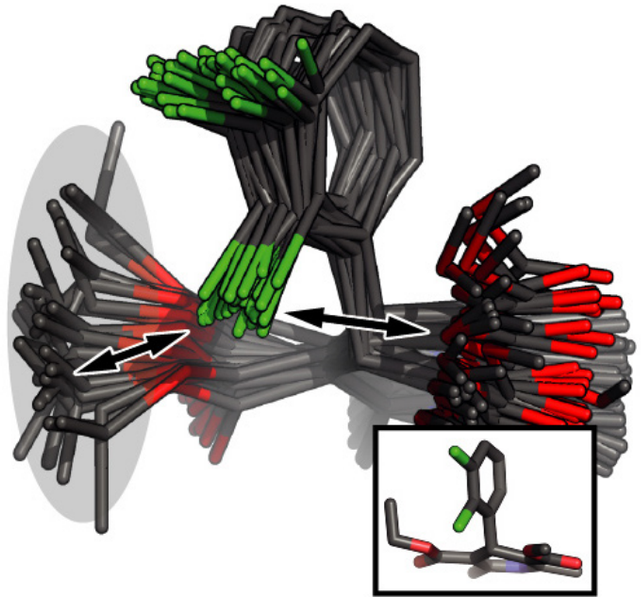
A method for the characterisation of amorphous complex mixtures

The analysis of mixtures is critical for the pharmaceutical industry as it is a requirement for quality controls. More specifically, amorphous solid dispersions (ASD) are key in the development of new drugs as they have shown to improve their solubility and bioavailability.

As the amorphous substance is often the active pharmaceutical ingredient (API) of the drug, the availability of methods for the analysis of amorphous components is essential. Current methods include mass spectroscopy, nuclear magnetic resonance and infrared spectroscopy; however, the quantification of ASDs for formulation purposes remains a challenge and no methods are currently available to measure the level of crystallinity of an API.

Researchers at Oxford have created a new and robust method that enables not only the characterisation of the single components of a complex mixture but also the level of crystallinity of the sample. Among the numerous advantages, the method is also applicable to alternative experimental datasets such as NMR, thus increasing the versatility of the method in the analysis of amorphous samples.



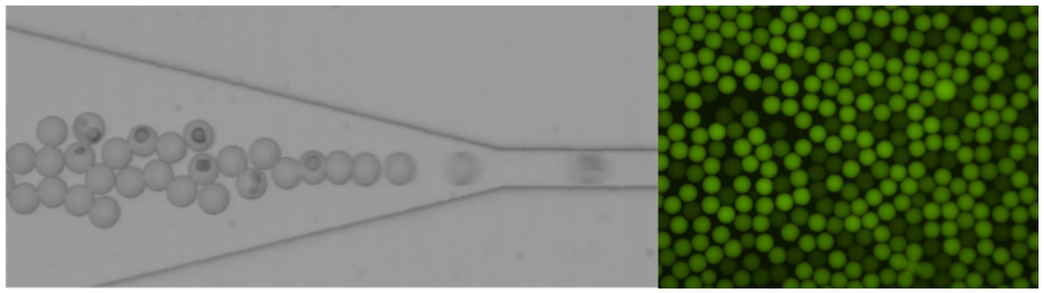


FULL WEB PROFILE ▶

Single-cell analysis of HIV cure strategies

With at least 36.9 million people living with HIV, it is one of the foremost global challenges. Despite the success of antiretroviral therapy, reducing the viral load of infected individuals to undetectable levels, it is not a cure. A fundamental barrier to complete HIV eradication is the lack of an assay that can identify, sort, quantify and characterise the latently infected cells that comprise the persistent reservoir of infection.

In response, researchers at Oxford University have developed a revolutionary microfluidics-based method for isolating and targeting this very rare cell population, with the capability of retaining RNA, DNA and proteins for downstream analysis. The facility to isolate individual latently infected cells,



enables proviral and integration site sequencing from single cells to assess viral replication competency. As well as providing a tool to quantify the HIV reservoir, this novel technique will also allow characterisation of host factors that impact latency and enhance target discovery.

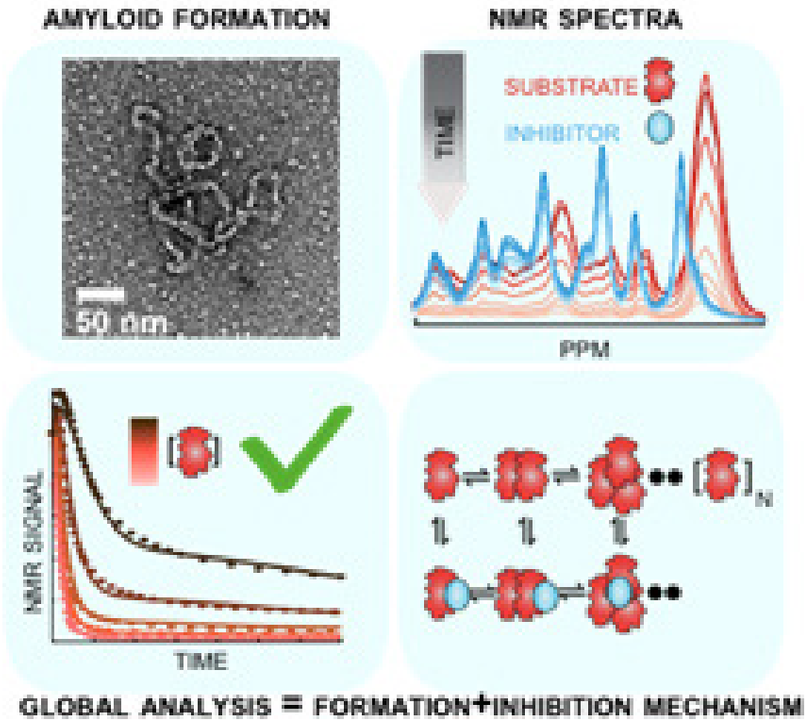
FULL WEB PROFILE ▶

FIRM: Amyloid Formation and Inhibition Mechanism

Protein aggregation is associated with neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease. Understanding this phenomenon is expected to provide insights into the pathology of these diseases.

Oxford researchers have created an efficient software platform for the analysis of chemical kinetics of protein aggregation and chaperone mechanisms that makes use of nuclear magnetic resonance (NMR) data. This software enables accurate prediction of rate equation models, including determination of the rate and dissociation constants. The software has been tested with various datasets and a graphical user interface is being developed.

FULL WEB PROFILE ▶



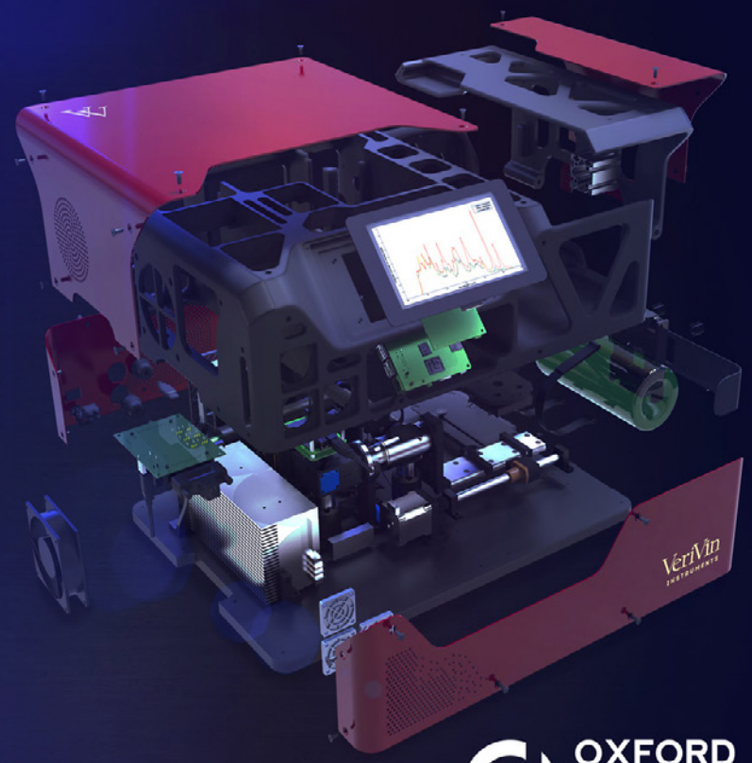
Prototyping a pioneering through-barrier Raman spectrometer

VeriVin, a graduate of the Oxford University Innovation Incubator, approached product design consultancy, Oxford Product Design (OPD), with the task of integrating their unique through-barrier Raman spectrometer into a working instrument. This pioneering technology conducts through-barrier analysis of complex liquids in sealed containers.

The OPD team worked on site with VeriVin, designing responsively as their technology evolved, and taking a highly integrated and lean-agile approach to the project.

The product's chassis was created using the latest in Stereolithography (SLA) 3D printing technologies, with an aluminium base upon which optics and other components could be mounted. This approach reduced design constraints, enabling the team to translate the complex scientific requirements of the product into a fully working prototype in just four weeks.

VeriVin recently won an Institute of Physics Business Award. Together with OPD, a member of the Oxford Innovation Society, the team will shortly begin work on a beta version of the product.



FURTHER INFORMATION ▶

OXFORD PRODUCT DESIGN

Soil-structure interaction sensor

Underground structures built beneath the earth's surface can often suffer from contact stresses that develop between the structure and the surrounding soil. Measurement of these contact stresses can be used to inform design and construction processes, as well as providing information on long-term performance. Existing sensors for measuring soil-structure interaction is typically complex, expensive, susceptible to damage in construction applications and unable to provide all the measurements required.

To overcome the limitations of existing sensors, Oxford University researchers have developed an innovative new soil-structure interaction sensor. The design employs a new sensor structure with a machine learning approach to allow measurement of all soil-structure contact stresses and pore water pressure using a single sensor. New strain sensing technology is used to reduce the risk of sensor failure in construction monitoring. The resulting design is more robust, simpler to manufacture and more cost effective than existing sensor technologies.

A cancer treatment to improve the efficiency of radiotherapeutic methods

Scientists at the University of Oxford have developed a new method for improving the efficacy of cancer treatment by simultaneously introducing embolisation particles and for use in the treatment of cancer in combination with X-ray radiation or proton beam radiation.

The invention provides a method of treating cancer whereby the patient can be administered a dose of the embolisation particle and then directing X-ray radiation, or proton beam radiation, at a locus or site of the cancer or tumour tissue.

Typically, the step of directing X-ray or proton beam radiation to a locus or site of the cancer or tumour tissue is performed directly after administering the particles to a subject by injection. An important feature of the device is that it is multimodal i.e. you have the physical restriction of blood and nutrients to the tumour coupled with a chemo or radio sensitisation.

FULL WEB PROFILE ▶

INNOVATION insights

IMPORTANT NEWS
FOR OUR OIS MEMBERS

Considering the Coronavirus outbreak and the current UK Government advice, Oxford Innovation Society (OIS) meetings are currently on hold.

We are preparing alternative means of engagement and will communicate details to members once arrangements have been made.

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Oxford University Innovation Ltd
Buxton Court
3 West Way
Oxford
OX2 0JB

T +44 (0)1865 280830
E enquiries@innovation.ox.ac.uk
W innovation.ox.ac.uk

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