



The research commercialisation office of the University of Oxford, previously called **Isis Innovation**, has been renamed **Oxford University Innovation**

All documents and other materials will be updated accordingly.  
In the meantime the remaining content of this Isis Innovation document is still valid.

URLs beginning [www.isis-innovation.com/](http://www.isis-innovation.com/)... are automatically redirected to our new domain, [www.innovation.ox.ac.uk/](http://www.innovation.ox.ac.uk/)...

Phone numbers and email addresses for individual members of staff are unchanged

Email : [enquiries@innovation.ox.ac.uk](mailto:enquiries@innovation.ox.ac.uk)

# innovation insights

from the University of Oxford

Issue 1 November 2015

The latest innovations, collaborations  
and technology transfer

## Prenatal screening

Non-invasive, lower risk technique >>



Rapid production  
of large graphene



Measuring oxygen  
accurately *in vivo*



Enabling diagnosis  
of cognitive disorders



Chiral fluorination  
reagents



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- >> **Oxford Innovation Society feature:** Global industry leader in medical device design, Owen Mumford, discusses the healthcare changes in medication
- >> **eHealth & big data - Innovation with impact:** Isis Innovation showcased the latest projects and views from leading academics and industry innovators



## investment

- >> **Bibliotech:** A subscription service for eTextbooks
- >> **Animal Dynamics:** A company recently spun out from the Department of Zoology at Oxford University



## consultancy services

- >> **Citizen science at Oxford University Consulting (OUC):** Volunteers help scientists and researchers collect large data sets
- >> **Oxford University Consulting project:** Dr Chris Batchelor-McAuley worked with OUC on the electrochemical detection of substances on food
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- >> **Entrepreneurship training:** Oxford, Cambridge host Top 500 Innovators programme from Poland



## invention

- >> **Chiral fluorination reagents:** Technology to enable the introduction of fluorine into pharmaceuticals and agrochemicals
- >> **Measuring oxygen accurately *in vivo*:** A new chemical structure that enables the quantification of oxygen levels *in vivo*
- >> **Rotary engine seals:** Novel sealing solutions which deliver increased compliance between the rotor and its housing
- >> **Rapid production of large graphene:** A cheaper, faster CVD method for making large sheets of single crystal graphene
- >> **Enabling diagnosis of cognitive disorders:** Technology which establishes patterns in the human brain to provide a diagnosis on dementia
- >> **Mykrobe predictor software:** Ultra-fast prediction of antimicrobial susceptibility and species from whole genome sequence data
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- >> **Break-through technology for non-invasive testing of genetic disorders:** Platform technology for non-invasive prenatal screening





# Welcome to the first edition of Innovation Insights

In this issue we provide an overview of the latest innovation activities from the University of Oxford, in the context of technology commercialisation, start-up entrepreneurship, consultancy engagements undertaken by university academics and Isis Enterprise.

Features on our events and the members of the Oxford Innovation Society give further insight into Oxford's innovation community. More details can be found by following the links provided.

The last few months have seen exciting developments, with ten new companies created this year alone. We have moved into our new offices on the Botley Road, west of Oxford city centre, providing more meeting spaces, and dedicated space for the Startup Incubator and individuals preparing to launch new spin-outs. Please do come and visit us.

Articles describe a new solution for entirely non-invasive prenatal screening; new technologies from a range of disciplines; and examples of how academics from Physics, Chemistry and the Humanities have provided consultancy to external clients. We also feature how 75 innovators from Poland received training from Isis Enterprise, our innovation consultancy division.

Isis Insights, the predecessor to this publication, worked well for sharing information and news of our activities. We intend that this new publication will do the same – with the added advantage of further information being just a click away.

We hope that you like it – please let us know!

Tom Hockaday, CEO



# News

With ten new companies formed already this year, highlights of recent news items include:



## Animal Dynamics was spun out, to build bio-inspired vehicles

*The company featured in the Economist*

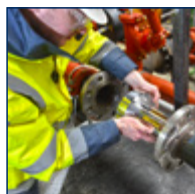
[full article >>](#)



## Isis Enterprise won a Queen's Award

*The Lord Lieutenant of Oxfordshire presented the Queen's Award for Enterprise*

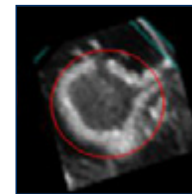
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## Oxford Sciences Innovation made its first investment

*Oxford Flow, from the Department of Engineering Science, was formed with investment from the £320m fund*

[full article >>](#)



## Chinese investment in imaging spin-out OxEML

*Offering a new class of medical images at a cost comparable to ultrasound using electromagnetic and acoustic waves*

[full article >>](#)



## Spin-out Bodle will develop low-energy high-resolution displays and glazing

*Newly formed company based on a smart material discovered in the Department of Materials*

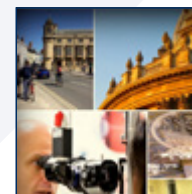
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## Spin-out OrganOx gets European regulatory approval

*A milestone as the world's first portable liver perfusion device achieves regulatory approval*

[full article >>](#)



## #StartedInOxford

*Our campaign to let the world know of the breadth and depth of companies coming from Oxford*

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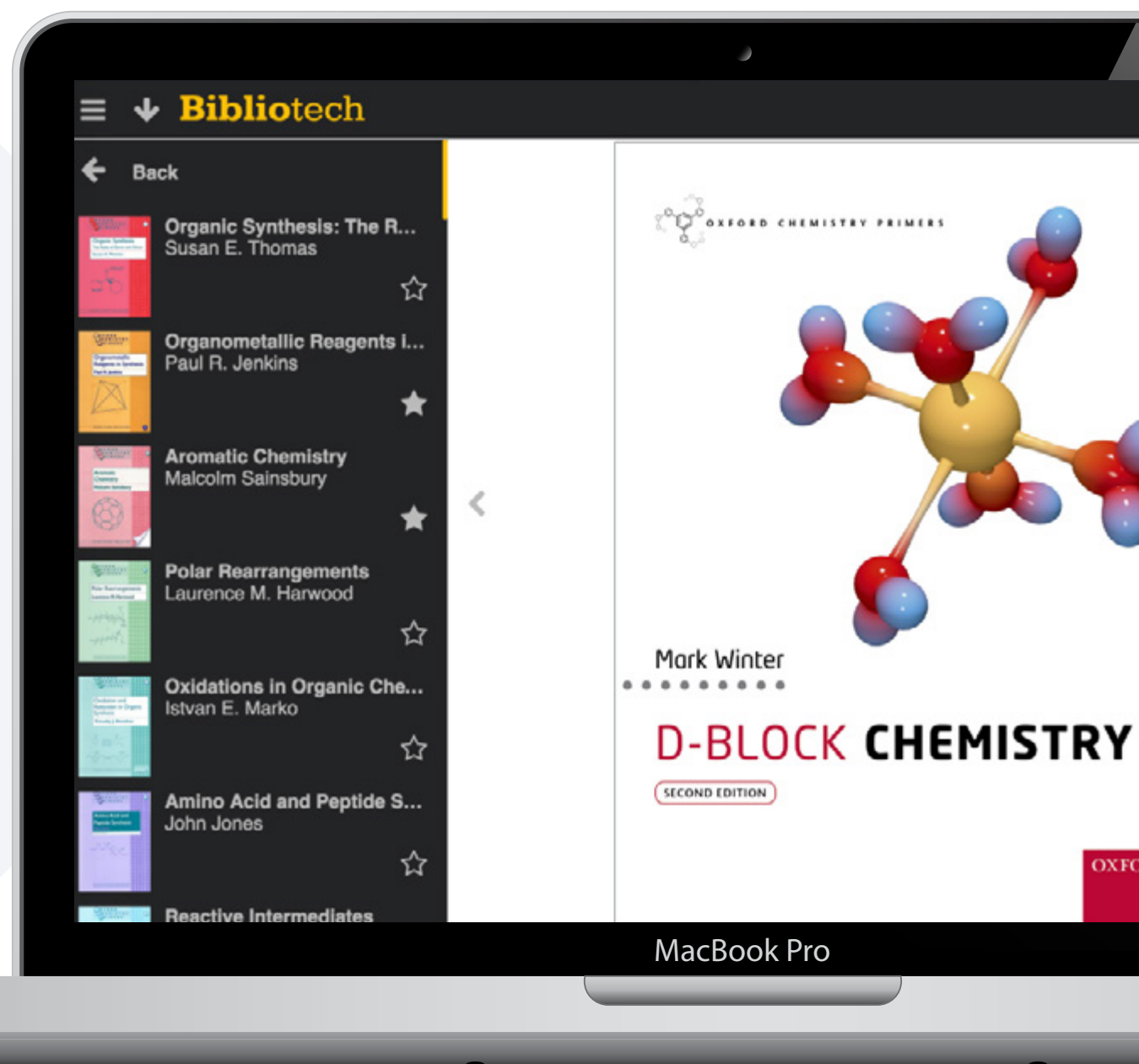


# Bibliotech is the Spotify for textbooks

A new web app is available to provide students with all the books they need, at any time on any device for a small monthly fee. The software provides the lowest price per book available today. It has an advanced search engine which navigates various fields such as extracts, definitions, diagrams and examples.

With 93% of global textbook sales accounting for physical textbooks, the market has barely been touched by the digital revolution. The software has been piloted at the University of Oxford and University College London with Oxford University Press (OUP) chemistry books. Bibliotech, currently the only subscription textbook company in the UK, are looking to scale OUP's biomedical, chemistry and politics catalogues across the UK to 109 universities.

The Company, which comes from the Isis Startup Incubator, is now open for investment.

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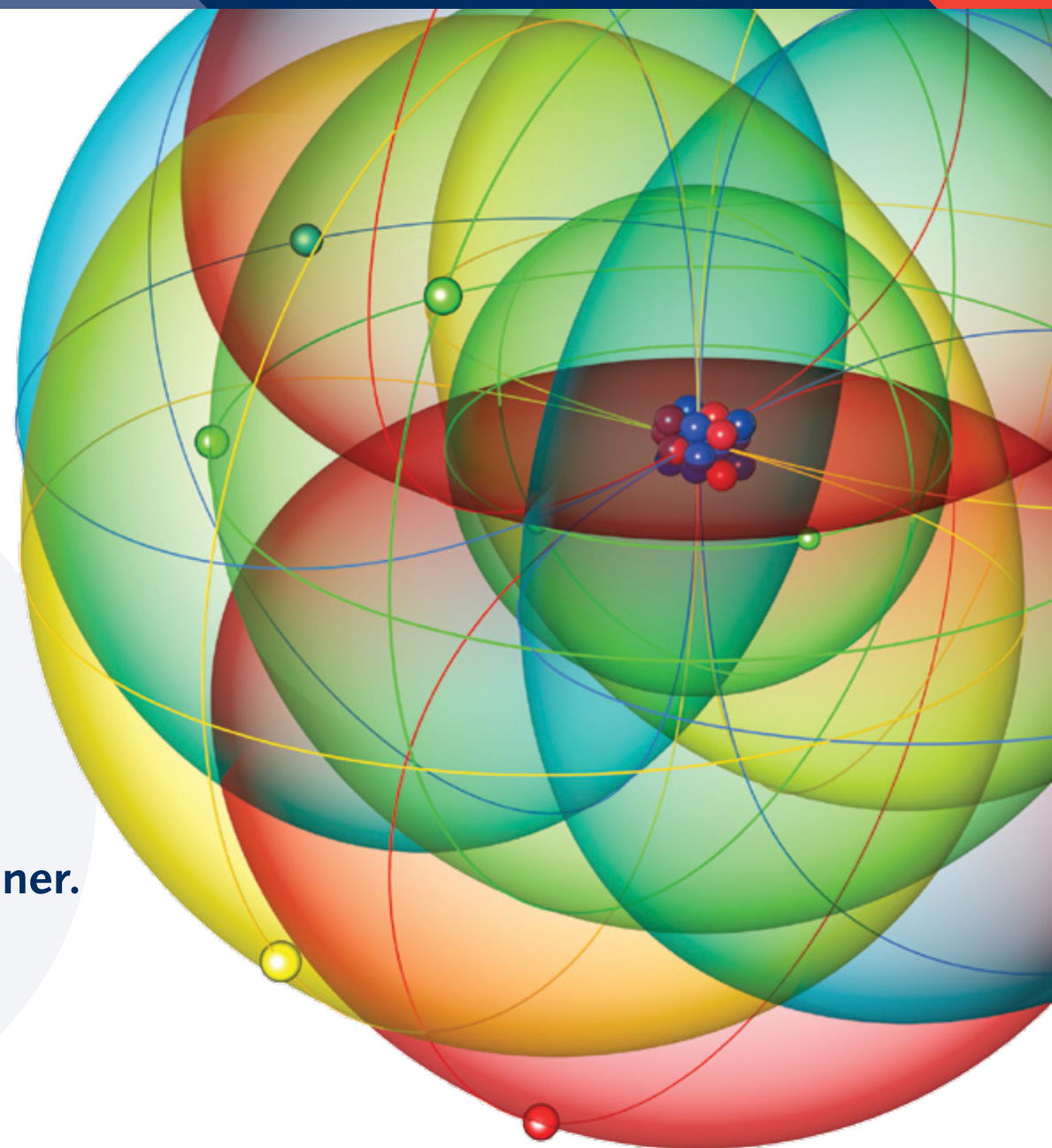
# Chiral reagents for efficient fluorination reactions

**A series of new reagents and methods have been developed in the labs of Oxford and Durham to enable introduction of fluorine into chemical compounds in an enantioselective manner.**

The reagents have much higher reactivity than existing reagents which means:

- Reactions can be carried out on a wider range of substrates
- Higher yields
- Better chiral control

The new reagents and methods would be useful in the pharmaceutical and agrochemical industries as introduction of fluorine into such compounds imparts highly desirable properties. Approximately 5-15% of the total number of launched pharmaceutical drugs in the past 50 years contains fluorine.



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# Inspired by nature

**Animal Dynamics, a spinout company from Oxford University, was formed to support the commercialisation and expertise of Adrian Thomas, Professor of Biomechanics in the Zoology department.**

With a desire to understand how things work within biological systems, Animal Dynamics are developing solutions to engineering problems which are inspired by nature, where natural systems have resulted in significant gains in performance and efficiency over existing solutions.

The company's approach is not to copy nature, but to develop designs through deep analysis of the underlying principles of natural systems, and apply these using high-performance materials and control systems. The management team is working on vehicles and propulsion technology on land, and through water and air.

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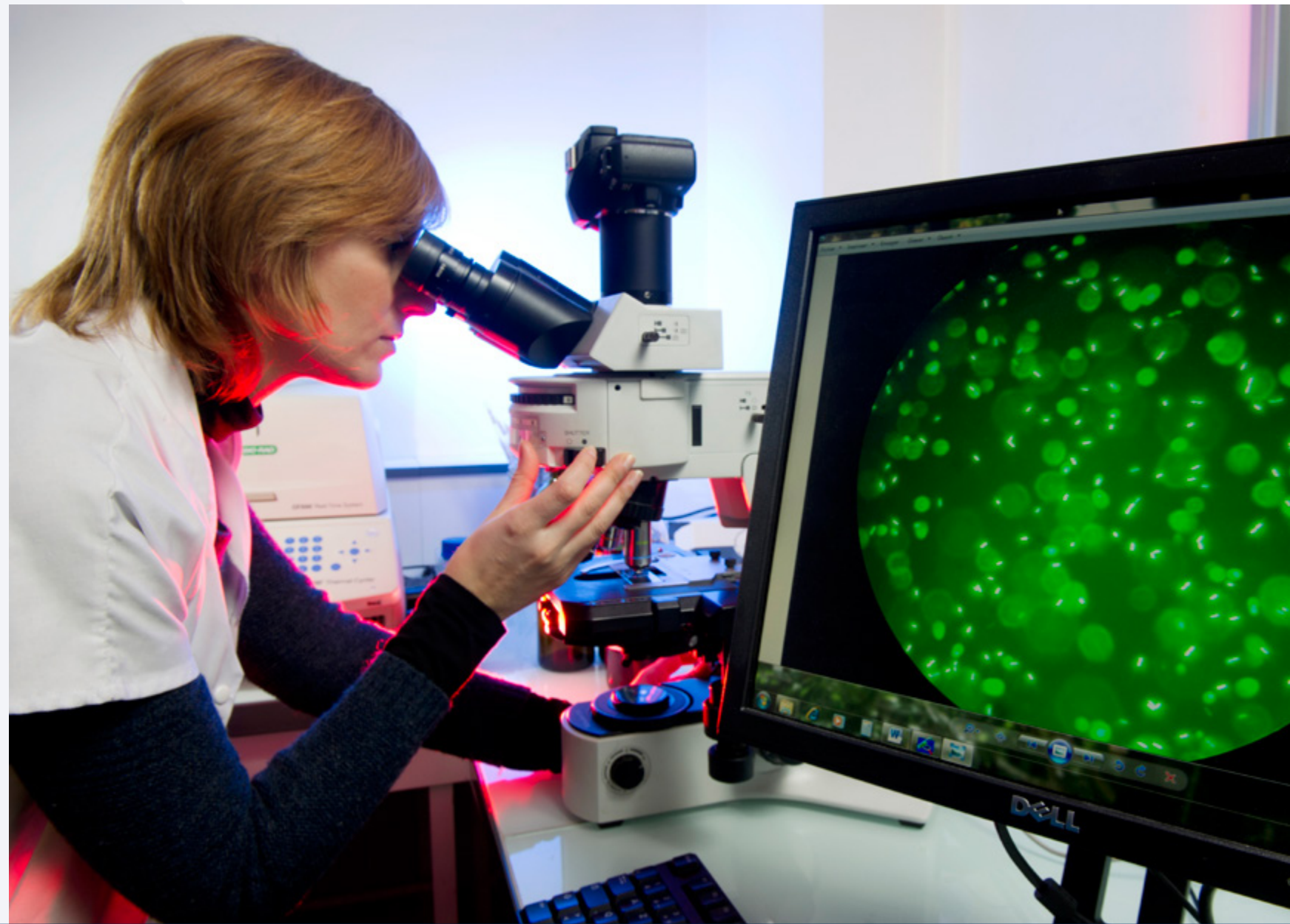


# Accurate oxygen measurement

**Measuring oxygen accurately in vivo is difficult, and this hampers understanding of key biological processes.**

A newly invented chemical probe has the ability to measure the concentration of oxygen whilst at the same time reporting the concentration of the probe itself. This enables measuring of oxygen in vivo with significantly improved accuracy.

The probe will initially be used as a reagent for measurement of oxygen in biological systems. The immediate market is the R&D community in both academic and commercial sectors. However, beyond its utility as a lab reagent, the probe will find application in other fields where accurate measurement of oxygen in complex systems is needed, such as synthesis and manufacturing in the biotech industry.



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# Citizen science for classifying data

**Data overload is one of the biggest problems facing modern science and is best illustrated by trying to classify stars in our Milky Way numbering some one hundred thousand million (i.e.  $10^{11}$ ).**

Prof Chris Lintott and his colleague came up with the idea of getting the general public involved and help in this classification. The project was eventually called Zooniverse, and Chris & the Department

of Physics, at Oxford, have since been approached by a diverse range of organisations that have large data sets requiring sorting and classification and which lend themselves to the methodology used in Zooniverse.

One such organisation is Moorfields Eye Hospital in London, a world leader in ophthalmic care, and with whom OUC has signed a consulting agreement to support in building a Zooniverse project for the Moorfields Retina on the Panopets infrastructure.

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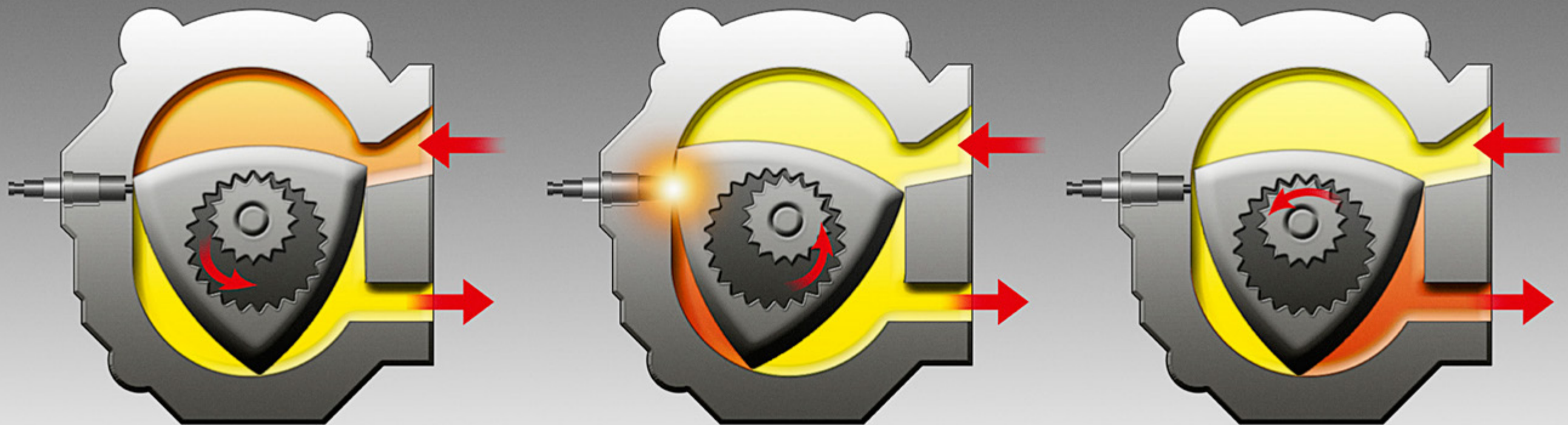
# Improved rotary engine performance

**Rotary engines are a type of internal combustion engine in which a rotor's eccentric motion is used rather than a reciprocating piston.**

While the rotary engine is widely used, it has a reputation for sealing problems. Geometric considerations mean that sealing a rotary engine is inherently more difficult than sealing a piston engine.

Researchers have designed novel solutions which improve sealing and reduce wear. This means extended service intervals; enhanced performance and reliability; and improved fuel economy. These benefits are of value to purchasers and operators in all the applications driving the uptake of the rotary engines today.

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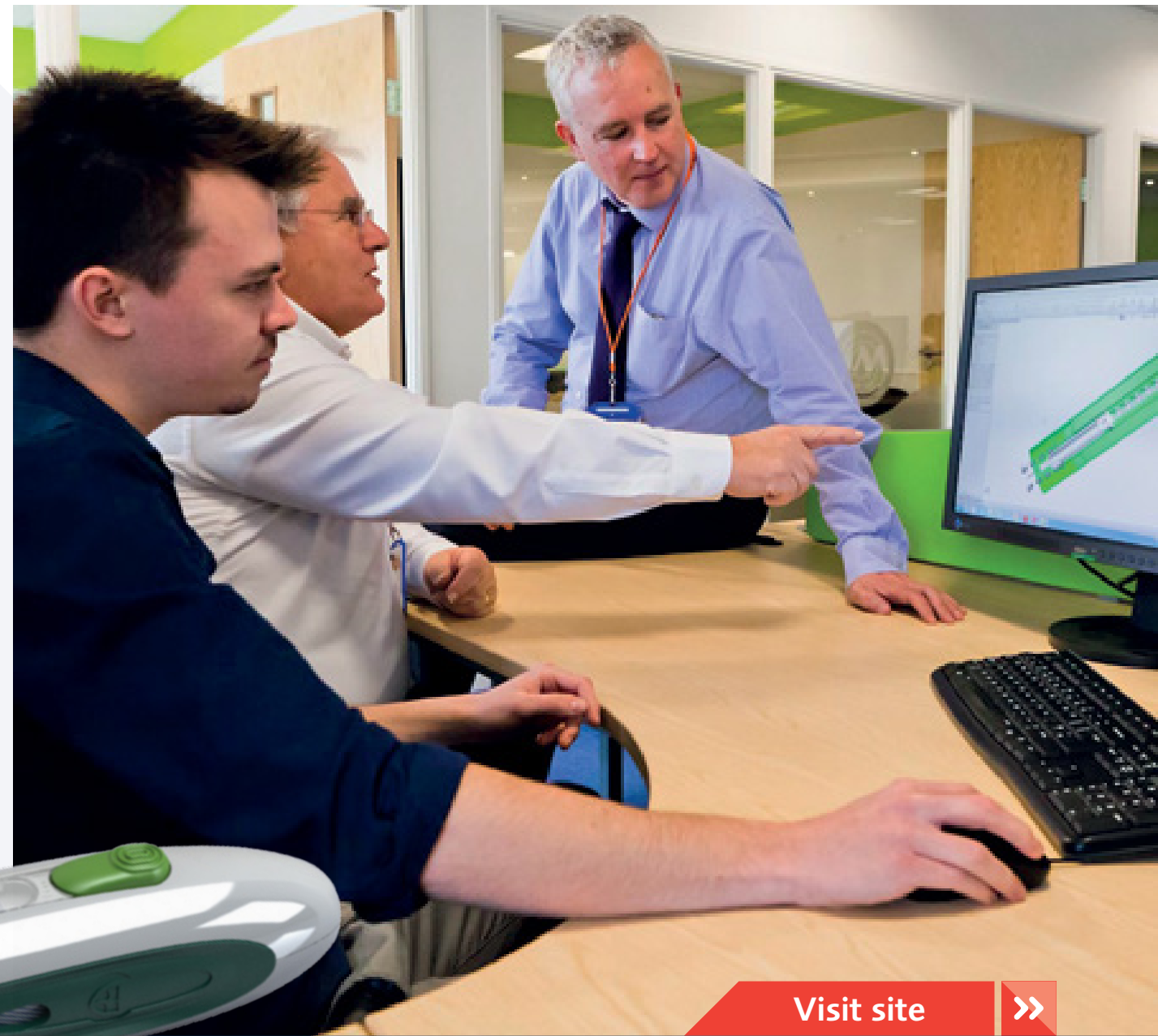
# Changes in UK medical device innovation

Oxford Innovation Society member Owen Mumford is an industry leader in medical device design and manufacturing, headquartered and with two production facilities in Oxfordshire. With a complete end to end design to manufacture service we transfer great ideas into finished products.

Healthcare is changing and increasingly medication regimes are managed by the end user rather than the healthcare professional.

To deliver effective devices, product development must start with the user requirement and incorporate Human Factors analysis to ensure the best outcomes.

The resulting devices are practical innovations which support the move towards self management and are designed to maximise adherence.



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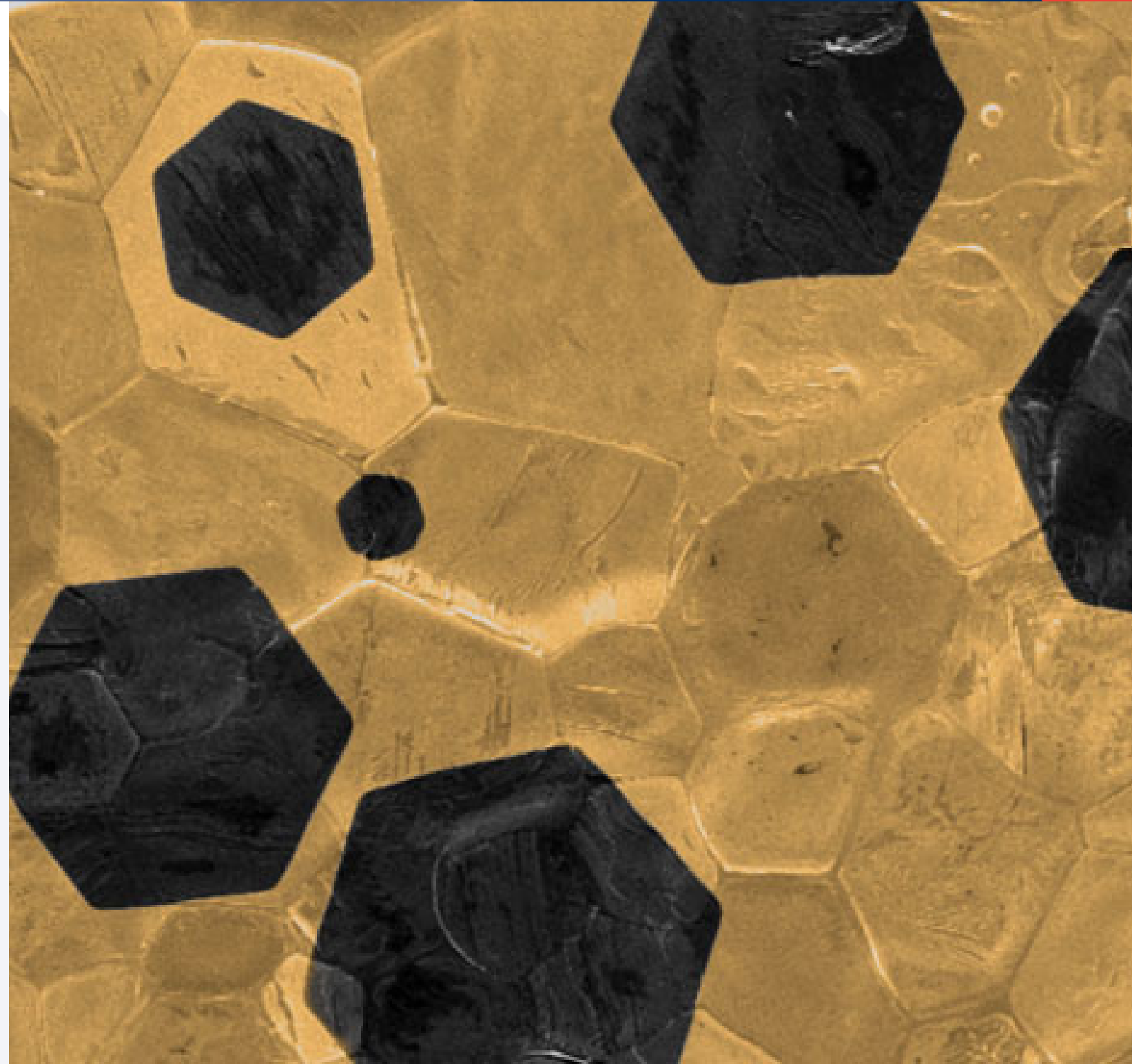
# Uniform quality graphene

**A major barrier to the adoption and development of graphene for many promising applications is the lack of graphene available in large sheets of repeatable and uniform good quality.**

This invention permits the manufacture of such commercial scale graphene sheets using a transition metal substrate combined with an intermediate silicon containing film. Large graphene flakes can be produced while expensive post-processing steps are avoided.

The invention would best be exploited by companies active in the production of novel 2D-Materials.

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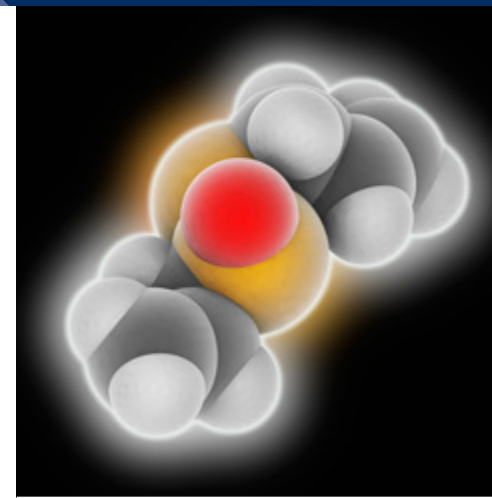
# Analysing chemical processes in food

**One of the many benefits to academic researchers engaging in consultancy work is the opportunity to apply their academic rigour and expertise to help solve problems in areas that would otherwise lie outside their normal fields of study.**

In a prime example of this, OUC recently arranged a consultancy for Dr Chris Batchelor-McAuley, a nanoelectrochemist from the Department of Chemistry to advise Beacon Foods, an independent supplier of specialist cooked ingredients to the food industry.

Dr Batchelor-McAuley, whose research focuses on the electrochemical detection of various substances, including nanoparticles, chilli and garlic, provided advice to Beacon Foods reading the chemical processes underlying 'garlic greening' and suggesting possible strategies to counteract this naturally occurring phenomenon.

Dr Batchelor-McAuley is part of an advanced research group developing novel electrochemical sensing technologies, including with applications in the food industry such as the measurement of chilli heat.



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# Diagnosing cognitive diseases

Technology developed at the University of Oxford can diagnose cognitive disorders and identify patterns in the microstructure of the human brain, which can be used to classify a range of cognitive diseases by differences from healthy subjects.

Distinguishing between healthy controls, Alzheimer's disease and cerebrovascular dementia (CVD) has been demonstrated. The method will be of huge benefit in differential diagnosis of patients who have previously had no firm diagnosis of a disease and hence have not had suitable treatment. The technology uses conventional MRI scanners and does not require contrast agent injection.



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# Humanities engagement



**Ros Ballaster, Professor of 18th Century studies in the Faculty of English and Lecturer and Tutorial Fellow at Mansfield College, was engaged in a very successful Knowledge Exchange Fellowship with the Royal and Derngate Theatre in Northampton running workshops to support script writing.**

The successful relationship was extended once the Knowledge Exchange Fellowship ended through Oxford University Consulting (OUC) putting in place a Humanities Division Services Agreement with the Theatre.

This framework agreement allows a flexible approach to engagement with

organizations, whilst providing transparency of the costs and benefits to all parties and ensuring that legal, intellectual property and confidentiality matters are all diligently covered. OUC hopes to support other Knowledge Exchange Fellows from the Humanities Division with similar arrangements in the future.



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# Determining antimicrobial susceptibility

**In patients, determining the antimicrobial resistance profiles of bacterial isolates is the most important procedure for managing infection.**

Mykrobe predictor software determines antibiotic resistance from whole genome sequence data of an isolate, with results available in 3 minutes. Results for *Staphylococcus aureus* and *Mycobacterium tuberculosis* show equivalence to standard laboratory methods. The application can identify species within mixtures, detect minor resistant populations, and identify other genomic features such as virulence elements. Mykrobe predictor can be used with any of the latest sequencing technologies and has the potential to reduce the length of current clinical microbiology workflows.

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# Capacity building and entrepreneurship

**Isis Enterprise continues to grow its capacity building activities via training programmes, internships, mentorship schemes, and joint projects for partners and clients around the world.**

The Polish Ministry of Science and Higher Education was one such recent partner: the ministry engaged Isis Enterprise (IE) to train researchers from its 'Top 500 Innovators' programme. Isis Enterprise, in partnership with Cambridge Enterprise, provided intensive training and mentorship in research commercialisation for 75 leading innovators drawn from a diversity of Poland's research institutions. This practical programme, which IE delivered during the period of July-

September 2015, focused on sharing key elements of Isis' experience of commercialising technology and transferring knowledge. IE consultants guided participants through real-life projects borne out of a variety of disciplines in order to hone practical skills,

such as evaluating and marketing technologies, forming and managing licence agreements, and creating and managing effective spin-out companies. Isis also facilitated a number of opportunities for participants to network with key members of the innovation community of Oxford as well as from further afield. Isis is delighted that its own international network has been further augmented by 75 close colleagues who are working at the forefront of the Polish innovation ecosystem.

[Entrepreneurship brochure >>](#)





# Radiopaque polyethylene for the visualisation of medical implants

Oxford researchers have created a radio-opaque ultra-high molecular weight polyethylene (UHMWPE). UHMWPE is a biocompatible and highly corrosion-resistant thermoplastic, commonly used in medical applications such as joint and ligament reconstruction and spinal and maxillofacial implants.

Surgeons often require intraoperative visibility of an implant (especially in the field of maxillofacial surgery) as well as postoperative visibility. The translucency of UHMWPE means that it is often substituted for less desirable metal implants.

This innovation does not compromise the biocompatibility or structural integrity of UHMWPE and will provide surgeons with an enhanced implant material that will not only reduce healthcare expenditure but benefit patient outcomes.

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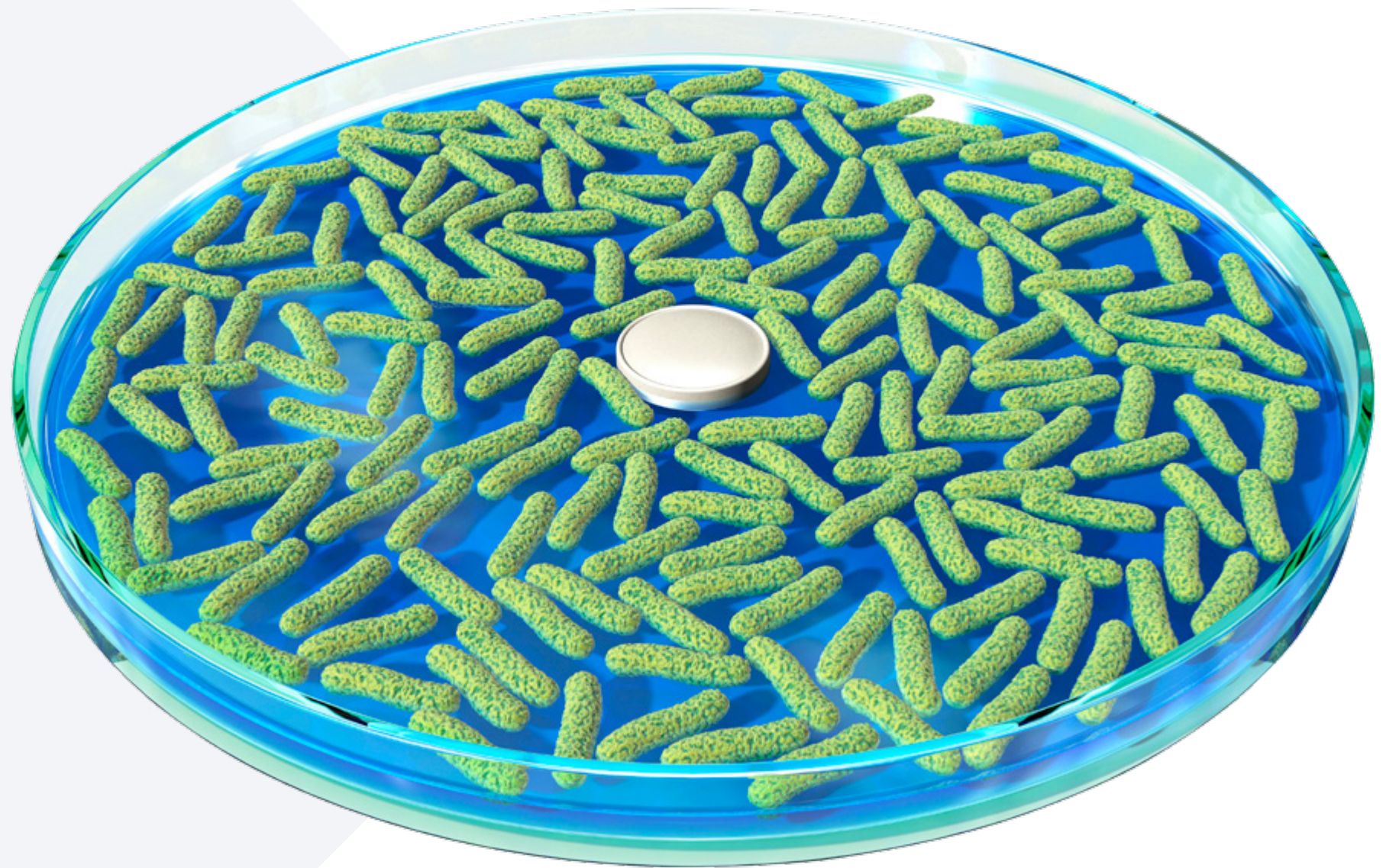




# Combating antibiotic resistance

**Metallo-beta-lactamases (MBLs)** are enzymes produced by drug-resistant bacteria that deactivate penicillin-related antibiotics.

They contribute to the growing problem of antibiotic resistance that costs an estimated \$20 billion per year in excess health care and \$35 billion in other societal costs in the US alone (Centers for Disease Control and Prevention, 2011). Scientists at Oxford University have developed an effective inhibitor for Class B MBLs, which currently have no clinically useful inhibitors available. This could be co-applied with an antibiotic to increase its efficacy and extend the lifetime of the medication.



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# eHealth & big data – Innovation with impact

**The third Isis Innovation Technology Showcase took place in June this year at the Mathematical Institute, Oxford University.**

The event highlighted the latest, most innovative technology opportunities and projects in Oxford University and the Oxford Academic Health Science Network (OAHSN), the co-hosts and partner for this year's event.

The theme was eHealth and Big Data, which included patient engagement and adoption of technologies and innovative projects into the NHS. A number of high profile key note speakers

attended the event including Dr Paul Rice, the Head of Technology Strategy in the Digital Health team in NHS England; Dame Fiona Caldicott, the National Data Guardian; Professor Alistair Fitt, Vice Chancellor of Oxford Brookes University and Andy Walker, Commercial Director for McLaren Applied Technologies.

An expert panel discussion, chaired by Professor Lionel Tarassenko, was a new feature to this year's programme.



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# The new and improved UKPDS OM2

**The new UK Prospective Diabetes Study (UKPDS) Outcome Model has significant advantages over version 1. It captures more outcomes, is based on longer follow-up data, and comprehensively captures the progression of type 2 diabetes.**

A major feature of the updated version is that it is based on data from the longest follow-up study of patients with Type 2 Diabetes, including both clinical trial and observational data in patients with a long duration of diabetes who were considerably older than usual clinical trial participants (up to age 90 years).

UKPDS Outcomes Model 2 will permit epidemiologists, health economists and trialists to carry out detailed and reliable lifetime simulations of key health outcomes in Type 2 Diabetes for the purpose of cost-effectiveness analyses of diabetes management strategies.



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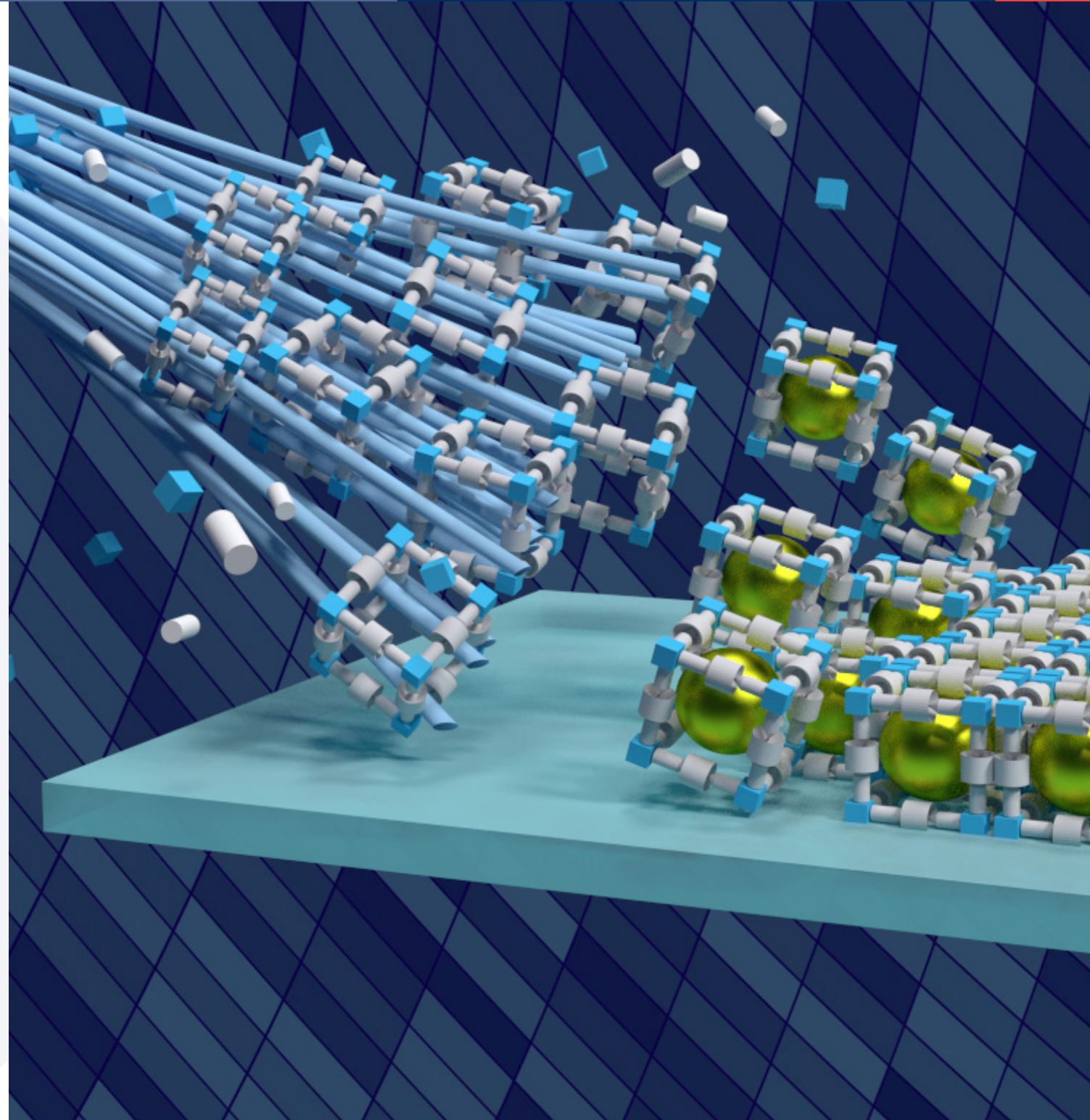
# A new class of Metal-Organic Frameworks

**Metal-organic Frameworks (MOFs) are nanoporous materials which have tunable physical and chemical properties which can have multiple functions.**

They are highly-ordered, hierarchical structures which can extend over large areas and have a very high surface area to volume ratio.

Oxford researchers have developed a process to deposit tunable thin films of MOFs at room temperature and pressure, which opens up a vast array of potential applications in electronics, optoelectronics, sensors, gas storage and delivery, phase separation and catalysis.

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# Prenatal screening

**Prenatal diagnosis is commonly used for couples where both parents are known carriers of the same genetic disorder, have a high incidence within their family, or already have a child affected by the disorder.**

In the example of sickle cell anaemia, the most common single gene disorder in the world, parents of African or Middle Eastern origin are particularly at risk. Sickle cell disease is the most common inherited disorder in the UK, affecting between 12,500 and 15,000 people. Around 250,000 people in England are carriers of the disease. The UK commenced a universal antenatal screening program in 2004 to identify couples at risk of having a child affected with sickle cell disease. For couples where both parents are sickle cell carriers, the chance of having a baby with sickle cell disease is 1 in 4. As such, the disease is the most common indication for prenatal diagnosis. *continued* ►







► Currently invasive diagnostic methods are used, such as amniocentesis and chorionic villus sampling, which carry a risk to the foetus.

Existing non-invasive screening approaches for genetic disorders use circulating cell free foetal DNA (ccffDNA). These are limited to those with particular characteristics that make diagnosis easier, for example, identification of alleles that are paternally inherited by the foetus and not present in the mother. However, many genetic disorders are recessive and current non-invasive tests cannot diagnose these conditions. This

means that pregnant women at risk of having a baby with a recessive genetic disorder have to have an invasive test, where the chance of miscarriage is 1 in 100.

### The Oxford Solution

Researchers at the Oxford Molecular Diagnostics Centre have developed an improved non-invasive prenatal technique that allows for diagnosis of recessive disorders even in cases where the cause is a single gene defect. *continued* ►





► The method only requires a blood sample from the mother, which contains both the maternal and foetal DNA. The technique involves amplifying only the small region of interest in the DNA whilst maintaining the allelic balance. Products from this amplification are then sequenced and assessed for the frequency of the mutated allele.

If the frequency of the mutant allele is higher than expected for the maternal DNA alone, the foetus is determined to have sickle cell disease.

Hence this technology provides pregnant women with key genetic information on their babies without the risks associated with invasive tests.

## Key Improvement

This platform screening method has potential applications in screening other single gene disorders characterised by single nucleotide and oligo-nucleotide base pair changes including Cystic Fibrosis, Beta Thalassemia and Tay-Sachs syndrome.

Key improvements of this new platform diagnostic test are:

- Low risk to mother and foetus
- Simple, targeted approach
- Maintains the allelic balance during amplification
- Reliable and reproducible method
- In-built controls
- Cheaper than whole genome screening
- No library preparation required

**“READI-Screen is a significant break-through technology for non-invasive testing of genetic disorders as we can now identify single nucleotide base-pair changes from circulating cell free foetal DNA. This technology allows the diagnosis of the most common genetic disorders world-wide including sickle cell disease and cystic fibrosis. READI-Screen was developed by researchers in the Oxford Molecular Diagnostics Centre (OMDC) with support from the NIHR Oxford Biomedical Research Centre and reflects the highly productive collaboration between the Oxford University Hospitals Trust (OUHFT) and the University of Oxford's world-class research departments in bringing benefits to patients.”**

– Prof. Anna Schuh

The technology comprises of a kit with primer sets and instructions for performing the method. Proof of concept experiments have been successful and clinical evaluation has now commenced. This technique has wide applications in prenatal diagnostics.

Isis Innovation would like to speak to any party who specialise in sequencing, screening and diagnosis of diseases. This is subject of a patent application and is available to license.

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## Isis Innovation Ltd

Buxton Court  
3 West Way  
Oxford  
OX2 0JB

T +44 (0)1865 280830

E [innovation@isis.ox.ac.uk](mailto:innovation@isis.ox.ac.uk)

W [isis-innovation.com](http://isis-innovation.com)



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