

THE JOURNAL FOR SCIENCE, ENGINEERING AND TECHNOLOGY

# advances

WALES

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How tiny microbes are eating away beneath the world's glaciers



**10** Taking the sting out of extracting collagen



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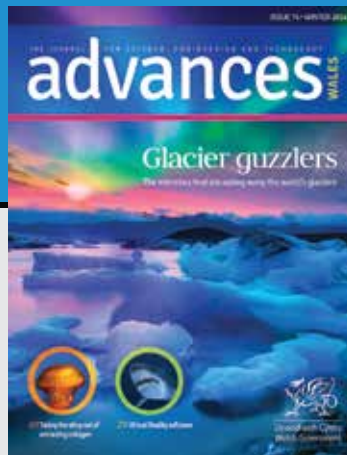


Llywodraeth Cymru  
Welsh Government

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**26**  
**Sea-ing is believing:**  
Underwater-world software developed for launch of new Samsung Gear VR mobile device



As Tim Berners-Lee, creator of the World Wide Web says,  
**“We need diversity of thought in the world to face the new challenge.”**

Without doubt, Wales is home to many innovative, successful companies with a wide range of groundbreaking research and technology and an impressive showcase which belies its size.

Diversity is key and with developments as far ranging as a new prototype for renewable energy (page 22) to an all-weather solid flammable biofuel (page 21) and the extraction of collagen from jellyfish (page 10), Wales is ensuring that it remains ahead of the game.

Great research needs to be recognised and celebrated. Our Welsh universities are at the forefront of many revolutionary discoveries and research, such as that led by Dr Arwyn Edwards, investigating how microbes behave in the dark beneath glaciers- the full article can be found on page 18. It is also fantastic to see research progressing to development, for example from Dr Llyr ap Cenydd, of Bangor University, whose expertise leads us to a virtual underwater world (page 26).

Our news section looks at collaborations, investments and success stories for Wales. One of these highlights the launch of Schoop UK's smartphone technology worldwide (page 7) and another celebrates how View Holographics took on the giants of Hollywood and won (page 4).

I hope you enjoy reading this varied and packed issue which highlights the diverse range of research and development, as well as the breadth of expertise we have here in Wales.

**Lucinda Scott-Morgan** (née Dargavel)  
Editor

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Advances Wales is a high-quality, quarterly 'transfer of technology' journal produced by Welsh Government to showcase new developments in science, engineering and technology from Wales. Devoted to concise reports and commentary, it provides a broad overview of the current technology research and development scene in Wales.

Advances raises the profile of the technologies and expertise available from Wales in order to facilitate collaborative relationships between organisations and individuals interested in new technologies and innovation.

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Advances Wales is designed and published on behalf of Welsh Government by Teamworks Design, 7 Schooner Way, Atlantic Wharf Cardiff CF10 4DZ. Opinions expressed in this magazine are not necessarily those of Welsh Government or its employees. Welsh Government is not responsible for third-party sources cited such as web sites or reports. ISSN 0968-7920. Printed in Wales by Harlequin Printing & Packaging, Pontyclun. Crown Copyright.



## Potential Welsh spaceport plans welcomed

**Space scientists at Aberystwyth University have welcomed news that an airfield in North Wales could become the UK's first launch pad for orbital leisure flights.**

The Department for Transport announced last week that the Llanbedr Airfield near Harlech is one of eight sites being considered for the first civilian flights into space. The site will be used for both space tourism and for launching UK-built satellites and Prof Barnes, Head of Space Robotics at Aberystwyth University, commented, "Space planes will be launched from this spaceport,

and they will carry humans and equipment into space."

The government says it wants to have the UK spaceport operational by 2018 and as well as Llanbedr there are also six locations in Scotland and one at Newquay, Cornwall on the shortlist. If successful, this opportunity would provide massive economic benefits to Wales, and being only 50 or so miles from Aberystwyth would offer many opportunities for the university.

Aberystwyth University is a key member of the Welsh Government co-ordinated WASP - Wales Academic Space Partnership - which seeks to support Welsh Government in winning the bid to locate the spaceport at Llanbedr.

The inaugural meeting of WASP was held at Aberystwyth University in May of this year, and a 10-year strategic plan for a pan-Wales, industry-facing, WASP Centre of Excellence is being generated. This plan seeks to strengthen the 'space' in 'aerospace' for Wales.



## Global digital health experts attend UK innovation conference

**Internationally renowned digital health experts are set to attend a three day open innovation conference in the UK.**

Digital Health Assembly: Open Innovation will take place from 10-12 February at the SWALEC Stadium in Cardiff and is expected to welcome delegates from the digital health community worldwide.

Focusing on the key themes of Big Data, Empowering Patients and Staff and Innovative Business Models, this event will bring together leading individuals from the rapidly developing digital health sector to highlight the opportunities available to create sustainable healthcare if open innovation is embraced.

Jointly organised by eHealth Industries Innovation (ehi<sup>2</sup>) Centre, College of Medicine, Swansea University and the Medical Research Council funded The Farr Institute



of Health Informatics Research, the three day conference will focus on the topics of Big Data, Empowering Patients and Staff and Innovative Business Models through a series of presentations, panel debates, roundtable discussions, Open Innovation master classes and innovate sessions.



[www.digitalhealthassembly.com](http://www.digitalhealthassembly.com)

Speaking ahead of the conference, Professor of Health Informatics at Swansea University and Conference Chair, Professor David Ford, said, "Digital Health Assembly: Open innovation will bring together a diverse collective of innovative minds from the healthcare and technology sectors worldwide, with a view to establishing new cross-sector partnerships and opportunities."

## North Wales hologram company wins shining award

**View Holographics based at Glyndŵr University's OpTIC Centre in St Asaph, North Wales, is now mixing with the biggest names in the industry after winning an illustrious international prize in the movie capital of the world.**

While in Los Angeles to successfully compete against Disney, Panasonic and Sony for the Lumiere Technology Award for Advanced Imaging, the firm attracted the attention of the heavyweights of the silver screen which could see their hologram technology used at cinemas around the world to promote the latest 3D films.

Creative Director Simon Cotton and Sales and Marketing Director Kate McDonald journeyed to the US to collect the prize and met with 20th Century Fox, Paramount Pictures, DreamWorks Animation, Warner Bros, Walt Disney Studios and others, to discuss possible partnerships.

"We are very proud to receive this award, which gives international recognition to the groundbreaking technology we have developed over the past six years, with the support of Glyndŵr University."

**Geoff Andrews CEO,  
OpTIC Centre, Glandwr University**

"We managed to present and showcase this Welsh technology in front of the biggest studio names in Hollywood, who have all responded extremely well and can see how our innovation can benefit the entertainment industry," said Kate.

The company has already received requests to do test samples for some of the biggest blockbuster movies for next year and Kate explained, "At the moment, the 3D experience

only starts once people are in the cinema watching the film. For years, film companies have wanted to find a better way to market these films and we could be the answer to their prayers. This could be used to create 3D posters and even holograms on stands or on the floor in cinemas which people could walk around."

The Lumiere award, which has been presented to silver screen legends Ang Lee, Martin Scorsese and James Cameron, is the highest honour bestowed by the membership of the Society.

Glyndŵr University Vice Chancellor, Professor Michael Scott, added, "Congratulations to View Holographics - what an incredible achievement. They took on the giants of Hollywood and won."



[www.viewholographics.co.uk](http://www.viewholographics.co.uk)

## Welsh research project seeks to substantially cut cyclist deaths

**A pioneering collaborative project, led by Cardiff University colleagues Dr Peter Theobald and Dr Philip Martin, is examining how 3D printed materials can be used to manufacture ultra-lightweight customised bicycle helmets to improve their safety performance during impacts.**

Between 2005 and 2013, over 26,000 cyclists were either killed or seriously injured on the roads of Great Britain and this project seeks to reduce these numbers in the future. The project also seeks to improve current safety guidelines for bicycle helmet designs in the UK and beyond, as existing guidelines consider only the impact performance of bicycle helmets. The researchers are examining the requirement to develop regulatory guidelines for evaluating bicycle helmet performance during impacts where 'rotational' injuries also occur - which is where the brain rotates inside the skull following the collision.



Backed by High Performance Computing (HPC) Wales' Research and Innovation fund, these researchers are using supercomputers to develop 3D printed helmets to improve a safety helmet's structure to stop the deformation of the helmet and transfer of energy to the head. It is this impact and relative rotation of the brain inside the skull that causes most traumatic brain injuries. Allowing the brain and the skull to keep moving, and being slowed down in tandem, is believed to reduce the risk of brain injuries after collisions.

Dr Philip Martin, Research Associate at Cardiff University, said, "It is scary how similar

traditional bicycle safety helmets on the market actually are. If you went into a helmet shop with an unlimited sum of money, you would come out with essentially the same thing, in regards to safety, as there is no superior product. The only real differences are in shape, colour and design - merely aesthetics. Everything is made out of polystyrene, which fails to offer adequate protection during 'oblique' impacts.

"The use of advanced supercomputing technology has helped us speed up our research to produce results much faster than any system I have worked with before."



[www.cardiff.ac.uk](http://www.cardiff.ac.uk)

## New device for early diagnosis of Human Cytomegalovirus (HCMV)

**Researchers from Swansea and Cardiff Universities have been awarded a grant of more than £323k to develop a new, non-invasive, low-cost, and easy to use point of care device to diagnose Human Cytomegalovirus (HCMV) in urine or saliva.**

HCMV, a member of the herpes family of viruses, can have serious health consequences for those with weak immune systems, and a “devastating impact” on pregnant women and their babies if infected.

The grant is a prestigious Product Development Award, which will support a three-year project, under the National Institute for Health Research Invention for Innovation (NIHR i4i) scheme to Dr Vincent Teng of Swansea University's College of Engineering, Dr Richard Stanton of the Institute of Infection

and Immunity at Cardiff University's School of Medicine, and the Wales Specialist Virology Centre.

HCMV is spread through bodily fluids including saliva, blood, breast milk, semen and urine and the early detection of HCMV is critical to allow intervention as soon as possible, in order to minimise the long-term impact of these problems.

Dr Teng, Associate Professor and Head of the Nanoelectronics Research Group at Swansea University, said, “We are very pleased with this prestigious award, as it allows us to develop an innovative invention that offers low-cost, easy-to-use, rapid detection of pathogens using nanotechnology which is suitable for large-scale screening of viral infections with excellent sensitivity and specificity without the need to send the sample to laboratory.”

The device can be manufactured using a printing technique, which offers low-cost high-volume production of the technology, to ensure

commercial viability of the invention. This is in collaboration with co-investigator Dr Davide Deganello, from the Welsh Centre for Printing and Coating (WCPC) at Swansea University.

“Up to 1,000 babies are born every year in the UK with permanent disabilities as a result of HCMV infection. This project is a fantastic opportunity to combine expertise in virus infection at Cardiff University, viral diagnosis at the Wales Specialist Virology Centre, nanotechnology at Swansea University and printing at the WCPC to make a real difference to their quality of life.”

**Dr Richard Stanton**  
Institute of Infection and Immunity,  
Cardiff University School of Medicine

## Welsh finalist in UK's largest search for new 'green' innovation

**SolaVeil®, a globally patented day-lighting technology developed in Wales, has been selected as a finalist in the Innovation Gateway – a major international search for new ways of reducing energy, water and waste.**

Launched earlier this year, the RBS Innovation Gateway attracted more than 140 submissions in just 40 days, from brand new concepts through to market-ready products and services. The ideas came from innovators and small businesses (SMEs) around Britain and the world, from Perth in Scotland to Perth in Western

Australia. The best ideas submitted will be tested on the RBS estate of 2,500 buildings and branches in the UK.

SolaVeil-treated glazing creates ‘Solar Illumination’ for a building in the form of super cooled daylight, significantly reducing the energy requirements for both artificial lighting and air conditioning, whilst enhancing the potential for natural ventilation. The day-lighting technologies are digitally constructed 3D microstructures which reduce solar heat gain by blocking short wave infra-red and controlling the transmission and diffusion of the visible daylight spectrum through the glass façade.

Its inventor Brian Hughes, technical director at Cardiff-based Daylight Business Solutions has developed SolaVeil over the past five years with support from Cardiff University. He said, “We are delighted to have been shortlisted in this competition and that RBS's expert panel has recognised the unique innovative properties of SolaVeil which is delivering tangible energy saving results at properties where it has been installed in Wales, England and overseas.”

The RBS Innovation Gateway opens up new opportunities to promote SolaVeil internationally

and, if selected, will help cut energy bills and reduce carbon emissions on RBS's estate.”

As a finalist SolaVeil is now just one step away from seeing its innovation installed by RBS. The final round will take place with a final pitch in London in front of a Dragon's Den style panel.

SolaVeil technology has benefited from advice and support in a number of areas from Welsh Government innovation specialists.

“SolaVeil's energy reducing technology supports our aim to cut energy costs and reduce carbon emissions and is a made in Wales success story. I am delighted to hear it has been selected as a finalist in this international competition which has the potential to open up new business opportunities.”

**Edwina Hart**  
Welsh Government Economy Minister



[www.solaveil.co.uk](http://www.solaveil.co.uk)



## Over 10,000 young pupils in Wales already coding thanks to Technocamps

**School children in Wales already have a taste for coding thanks to an inspiring outreach programme called Technocamps. The programme started in 2003 and is led by Swansea University in partnership with the Universities of Aberystwyth, Bangor and the newly formed University of South Wales.**

Technocamps has brought computer science to life and in just over three years has taught fundamental computing skills to over 10,000 young people throughout Wales.



"It is great to hear that England have taken the initiative and introduced Computing on the curriculum at such an early age. In Wales, Technocamps has driven Computing Education in Secondary Schools, as well as engaged fully with primary schools, to allow pupils to have the head start that their equals in England are now getting. This will ensure that young people in Wales will not get left behind in what will inevitably be a demanding future for them. These fundamental skills will ensure that they will be equipped and ready to take on the digital world that is now encompassing our everyday lives."

**Professor Faron Moller  
Director of Technocamps**

Professor Moller said, "Currently there are no similar plans to introduce computing into the curriculum in Wales. Technocamps, however, is already geared up to support Welsh Government on this, should they need it, with resources already available for pupils and CPD training ready for teachers through its Technoteach."

One of the other programmes, 'Playground Computing' has over the past year

introduced the concept of computing to Primary Schools in Wales through fun activities which the young people find easy to engage with and TechnoTeach has trained nearly 100 teachers from both primary and secondary schools from across South Wales.

TechnoTeach provides training which supports and enhances the ICT and the new Computing curricula taught in schools, colleges and educational establishments. The programme is free and it gives teachers and educators the chance to up-skill in Computer Science, which will be essential if and when Wales follows England's lead in introducing the new Computing curriculum.

Through these various projects, Technocamps has witnessed a surge of pupils and teachers across Wales now eager to take this a step further and learn more about coding and with an increasing number of schools in Wales introducing digital technologies such as iPads into the classrooms, this is the next step on the journey to get young people to understand coding principles.



[www.technocamps.com](http://www.technocamps.com)

## Proposed new mechanism for building quantum computers

**A new mechanism for building quantum computers has been proposed by an international team of scientists led by Dr Daniel Klaus Burgarth at Aberystwyth University.**

Writing in the scientific journal Nature Communications, Dr Burgarth describes how the frequent observation of a basic building block of a quantum system, known as a qubit, could lead to the creation of far more powerful computers.

The paper, entitled 'exponential rise of dynamic complexity in quantum computing through projections', explains that while the possibility of using quantum effects to develop a new type of computer has been known for over 30 years, only small "quantum computers" have been built until now.

Scientists are now engaged in a worldwide effort to build large quantum computers which will be able to perform some very complex computations in a very short time; tasks that would take the most powerful computers currently in use many thousands of years.

Dr Burgarth said, "Essentially our result is in the realm of theoretical physics, more specifically quantum computing. What we show is that the act of measuring a quantum system can change its dynamics substantially, to the extent that the not-measured system is very simple while the measured one is a quantum computer."

Besides potential practical applications, the result sheds new light on the role of measurements in quantum mechanics. Dr Burgarth demonstrates that while in our day-to-day life things appear independent of our observations, it is a perplexing but long known fact that this is no longer the case in the quantum world.



[www.aber.ac.uk](http://www.aber.ac.uk)

## European link-up to attract more research funds to Wales

**A link-up with one of Europe's leading universities will help attract more European research funding to Wales according to Cardiff University's Vice-Chancellor, Professor Colin Riordan.**

Professor Riordan's comments follow the signing of a Cooperation Agreement between Cardiff University and the University of Leuven (KU Leuven) in Belgium. The Agreement is the first of two planned by the University to enhance Cardiff's reputation as a global university and put Wales on the international stage for its world-leading research.

Consistently ranked as one of the world's top 100 research intensive universities and amongst the best in Europe, the University of Leuven is Belgium's oldest and largest university.

"International alliances in higher education are becoming more important than ever. With ever increasing international competition for research income and attracting the best academics and students, working in isolation is simply not an option," said Professor Riordan.

"Cardiff and Leuven already enjoy a long-standing academic relationship. Academic collaborations have resulted in significant European funding and key research activities.

This agreement represents the coming together of two world-leading European universities and an ideal opportunity to formalise our links," he adds.

With an initial focus on maximising European Funding opportunities, the agreement provides an opportunity to bring together the extensive international ties of each University, enhancing the international brand and the reputation of both institutions.



## Global coverage for Cardiff app developer

Cardiff mobile app developer, Schoop UK, has signed a €300,000 (£240,000) partnership deal with a German company which will lead to its smartphone technology being launched in 120 countries across the world.

Formed after winning backing from Finance Wales, the company has developed an app for public bodies, such as schools, which provides updates, reminders and messages for groups and organisations.

Mobile services provider GMPS Group has invested the capital to develop the app to include electronic fundraising, electronic wallets and global payment services, with a further seven-figure investment available over the next six months to roll it out globally.

"We are incredibly excited about working with GMPS and integrating e-fundraising and e-wallet payment solutions into the app. Following its global launch we have plans to expand our Cardiff headquarters and recruit 50 new staff before the end of 2014."

**Paul Smith**  
Founder of Schoop

Rhiannon Wilkinson, senior investment executive at Finance Wales, said, "Paul and the team at Schoop UK have made impressive progress in six months, which demonstrates that when innovative, commercially viable ideas receive the right backing early on, they can quickly take off and attract high profile investors."

 [www.schoop.co.uk](http://www.schoop.co.uk)

# Cutting-edge £300m 'innovation' centre for Cardiff University

**Cardiff University is unveiling £300m plans for four new research centres in the capital city focused on innovation and building the Welsh economy.**

The proposals for a former industrial site in the Cathays area include a social science research park and an entrepreneurship centre while the other buildings will host research on semiconductor technology and turning academic work to practical uses.

A member of the Russell Group of UK universities, and in the top 125 of world universities, Cardiff University has said that it aims to put innovation and entrepreneurship at the heart of its strategy to be an "engine

for future prosperity, health and growth in Wales, the UK and the wider world".

The innovation centre will offer advice to local firms as well as business "spin-outs" from the university itself, while the semiconductor research institute will test the technology "in realistic environments", college officials added.

According to the university's leaders, this social science research park will be the first in the world and will provide an environment for "creating, sharing and applying new knowledge." Practical "real-world applications" for society, healthcare, culture and the economy will be the focus of a research facility focusing on academic research.

"What we're going to do is come up with a new way of doing innovation. We want to orientate the university and all of its capacity towards innovation in a way that I don't think has been done before."

**Professor Riordan**  
Cardiff University



[www.cardiff.ac.uk](http://www.cardiff.ac.uk)

## IN BRIEF

### Hydro secures UAE contract

Based in Llangennech, South Wales, Hydro Industries has secured a multimillion-pound contract to provide its water purification technology to the United Arab Emirates (UAE).

The £20m deal is part of a joint-venture with Abu Dhabi-headquartered group M Partners. Hydro will provide its electro based technology to assist UAE in achieving more effective water treatment processes.

Chief Executive Wayne Preece said, "This deal has been the culmination of more than a year's work in the Emirates to position Hydro with the best possible organisation to build its business and brand."

### Markes named "Best of Best" at Canmol: Wales Marketing Awards

Scientific instrument manufacturer, Markes International, proved its talent as a marketer as well as a manufacturer of innovative products when the company was presented with two awards at the Chartered Institute of Marketing's (CIM) Canmol: Wales Marketing Awards. Markes won the Technology and Energy category and was also awarded the "Best of Best" trophy for the new product introduction of Select-eV (as featured on page20).

### Exceeding targets

Finance Wales exceeded its investment target for the first half of 2014-15, investing £19.8 million in Wales and attracting £15.9 million additional investment to provide Welsh SMEs with a £35.7 million growth capital injection.

Chairman Ian Johnson said, "The last financial year was a record year for the Finance Wales Group and I'm pleased Finance Wales' investments in Wales are ahead of target this year. Finance Wales can now offer a broader range of tailored funding options thanks to Welsh Government funds."

### CE marking for Microvisk

Medical device innovator Microvisk Ltd, based in North Wales, has achieved CE marking for healthcare professional use of the world's first disposable medical diagnostic strip based on a Micro-Electro-Mechanical System (MEMS).

A major step forward in blood testing technology, this patented, microcantilever sensor technology determines blood clotting speed from a finger prick sample, with results displayed on its compact CoagMax® handheld reader.

### Caerphilly start-up is first company backed by £7.5m Wales Technology Seed Fund

Personalised online health and well-being technology firm Nudjed Ltd has received a £125k equity investment from the Wales Technology Seed Fund which is managed by Finance Wales on behalf of Welsh Government.

This start-up is providing a personalised online health and wellbeing platform aimed at busy executives and combines bespoke motivational training with a digital health advice service.



# Swansea University geography researcher awarded prestigious Royal Society Research Fellowship

**Dr Jacqueline Rosette, Geography researcher at Swansea University, has been rewarded by the Royal Society with a University Research Fellowship.**

Jacqueline recently worked at NASA on carbon assessment in the USA and seasonal effects in the Amazon, and at Forest Research Northern Research Station on methods to improve our ability to monitor the UK's public forests.

Her research involves the assessment of forest ecosystems using satellite and airborne remote sensing and in particular she uses lidar, a technology which captures a vertical profile of the forest canopy. This can be related to important parameters such as the amount of carbon stored and can help to answer questions

regarding changes to our forests in response to climate change, human or natural disturbance. Using the application of a computer simulation model, developed by Professor Peter North at Swansea University, she investigated a question which has long been puzzling scientists regarding an apparent 'greening' of the Amazon during its annual dry season. The analysis demonstrated that this can be explained by the effects of shadowing within the forest canopy and the relative positions of the sun and satellite sensor, rather than a greening of the forest itself.

Published in the scientific journal Nature, these findings will help scientists to develop a more accurate picture of changes in the Amazon, which is more important now than ever, given the enormous role that the Amazon plays in regulating carbon dioxide, and influencing climate change.

"It is a great honour to receive this research Fellowship from the Royal Society. I am privileged to collaborate with expert scientists at Swansea University, NASA and Forest Research. The University Research Fellowship provides an invaluable opportunity to help to address some of the important questions which remain about our planet's forest ecosystems."

**Dr Jacqueline Rosette**  
Geography Researcher, Swansea University



[www.swansea.ac.uk](http://www.swansea.ac.uk)

## Medica launch for EKF

EKF Diagnostics, headquartered in Cardiff, introduced two new diagnostic tests at Medica 2014

Visitors to the trade fair saw EKF's novel assay for early sepsis detection, as well as its new hand-held point of care hemoglobin analyser. Alongside these new products, EKF also showcased a new version of its Hemo Control hemoglobin analyser, the industry-leading Biosen glucose and lactate analyser, as well as previewing SensPoint, a new lactate analyser designed for use in professional medical settings.

## Bangor University's specialist equipment helping molecular level research

The new £1m Time of Flight Secondary Ion Mass Spectrometer system (ToF-SIMS) being used by Bangor University's CLARET project is one of only a handful available for commercial use across the UK and is assisting companies in examining products at a molecular level.

The CLARET project provides lifetime and reliability testing facilities and tailored academic expertise to support companies involved in the design, manufacture or integration of opto-electronic and material technologies.

## BioWales 2015- Conference, Exhibition & Partnering Wales Millennium Centre, Cardiff, 4th & 5th March

Now in its 13th year, BioWales is set to attract over 600 delegates from the Life Sciences Sector in Wales, UK and beyond. Registration for BioWales 2015 is already open and Early Bird registration closes on 22 December. There are opportunities to participate at a number of levels: as delegates, exhibitors, sponsors and in 1-to-1 partnering sessions.

An international line-up of speakers and industry experts will deliver keynote addresses and lead the showcase presentations and discussions around supply chain opportunities and development. These include Paul van Arkel, Head of Corporate Strategy & Health Care Systems, Novartis International AG, Professor Valerie Edwards-Jones, Clinical Director, MelBec Microbiology Ltd and Bill Mitchell, President and CEO, Packaging Coordinators Inc.

Pharma and Regenerative Medicine supply chain showcases will offer an opportunity to hear from some of the key players in the industry and meet the buyer workshops will focus on routes to market within the NHS and international markets offering an insight and advice on barriers and opportunities.

BioWales 2015 will provide extensive opportunities to network with key figures from the ecosystem, innovators, investors, companies and academics and following last year's success, the Dragon's Den style pitches will return in 2015 providing the opportunity to pitch your company or idea to a line-up of investors and venture capitalists.

**For further details visit: [www.BioWales.com](http://www.BioWales.com)**

# Taking the sting out of extracting collagen

## Collagen extraction from jellyfish

**U**sing its innovative extraction process **Jellagen Pty Ltd**, in Pembrokeshire, West Wales, produces medical grade collagen sourced from jellyfish, a sustainable and novel source of biomaterials. **Jellagen hopes to transform the process for extracting jellyfish collagen with an enzyme-based extraction process for jellyfish.**

Pharmaceutical and medical health companies are actively seeking alternative collagen products as their customers seek to move away from mammalian derived sources. Nearly all collagen products presently available are derived from bovine, porcine and other mammalian sources. Jellagen's collagen, derived from barrel jellyfish, overcomes many of the problems facing these sources as it has no known disease transfer risk, is from a BSE free source and provides superior biocompatibility with a preserved structure and function. In addition, it is sustainably sourced from a renewable supply.

Jellagen supplies collagen to the medical device, regenerative medicine, cell culture reagent and in vitro diagnostic markets. Collagen is a fibrous protein containing telopeptides at both the C and N-terminus of the molecule. It is these telopeptide molecules which confer most of the antigenicity of collagen. The company produces this telo collagen via an acid based extraction process from the same jellyfish biomass material. This is more suited to uses where biocompatibility issues are not detrimental to a host or the product efficiency, such as in tissue culture and cell reagent scenarios.

Collagen is used in the manufacture of biomaterials due to its fibres being able to form strong bonds and it is used in gels, scaffolds and membranes for a number of medical applications ranging from wound care and cartilage repair through to bone grafts. It is the most abundant protein in mammals, making up 25-35% of the total protein content within the body and has a wide range of biomedical applications as a

biomaterial, including for use as; tablets, bone substitutes, sponges, meshes and in a wide array of surgical repairs.

Fibrillar collagens such as Type II, III and V, exist as a triple helix, with each polypeptide chain bound together by hydrogen and covalent bonds. These features form strong fibres which can be made in to structures with low antigenicity, excellent biocompatibility and biodegradability. As a result collagen is regarded as one of the most useful and widely utilised biomaterials.

Jellagen's collagen is produced in GMP certified laboratories under ISO 13485 Quality Management System and is available as medical grade with purification processes being refined to allow for GMP certification. With funding led by Finance Wales and supported by Welsh Government, Jellagen is looking to develop further innovative techniques for enzyme-based extraction of collagen, which remove the telopeptides and result in atelo collagen. Atelo collagen has a significant advantage over telo collagen in that it is less antigenic, which makes it more biocompatible offering less risk of rejection by the host. This will make Jellagen's atelo collagen preferable for use in medical devices and other in vivo applications.

The company is constantly striving to improve and refine its processing and extraction techniques in order to provide the best quality product to market that is 'fit for purpose' and easy to work with. Jellagen is actively collaborating with companies and universities to support further development of its medical grade jellyfish collagen into a range of med-tech products, which will see the development



Jellagen aims to be Europe's first provider of medical grade Type II and Type V jellyfish collagen as a raw material, and one of only a few providers globally.



of a range of innovative products utilising jellyfish collagen at the nano-level.

Jellagen is working towards using electrospinning technology and processes to develop a new range of products from its jellyfish collagen. These meshes and scaffolds will be used for the development of new and novel medical devices. These devices, or constructs, will have superior structure,

function and biocompatibility than bovine and porcine based collagen devices which are currently on the market.

Jellagen's co-founder & CTO Alex Mühlhölzl added, "Through the development of strong relationships and collaborations with several universities and companies, we are developing

these new products which will have further reaching applications in the treatment of pressure ulcers and bed sores. We are also investigating the feasibility of new jellyfish collagen micro carriers with embedded functionalisation and corneal therapies from jellyfish collagen."

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"Jellyfish derived collagen provides the market with an innovative approach for the development of new medical technologies with improved functional properties. The company seeks to utilise this technology platform for the development of products applicable in multi US\$Bn markets such as novel cell culture reagents as well as development of functional wound healing products for the treatment of Diabetic Foot Ulcer which is still a major unmet clinical need."

**Andrew Mearns Spragg**  
Jellagen CEO

#### Profile

##### Product

Type II and V medical grade collagen in solution or powder

##### Applications

Biomaterial in biomedical applications

##### Contact

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# Crabs to cash

Crustacean shell key to extraction of chitin, a broadly used bio-stimulant

**A**n innovative, commercially-led collaborative research project with BEACON: The Welsh Biorefining Centre of Excellence, based at the Institute of Biological and Environmental Rural Science's (IBERS) in the University of Aberystwyth, Mid Wales, has begun to extend the capabilities of bio-refinery technology into the valorisation of food manufacturing by-products with a focus on crustacean shell to produce chitin.

The project, called iCRAB (Integrated Chitin & Ryegrass Acid Biorefinery) is a multi-disciplinary collaboration led by Pennog Ltd.'s industrial biotechnology venture, Pennotec integrating food processing by-products which would otherwise be disposed of, into a green bio-refinery process.

The iCRAB biorefinery process involves co-fermenting a readily available, agricultural biomass (high sugar forage grass), with food processing by-products to manufacture a combination of platform chemicals, such as those used in the production of bio-plastics, and high value biological actives. The challenge facing green biotechnology in the 21st century is to develop economically viable extraction systems to recover and purify often difficult to extract high value biological actives from waste biomass whilst avoiding the use of non-sustainable chemical reagents.

iCRAB's biorefining innovation not only comes from using agricultural biomass as a raw material to generate an organic acid as a key commercial product, but also from using the natural fermentation process for its production to facilitate the extraction of high value compounds from a food processing by-product stream. This food processing by-product material in turn provides essential nutrients and auxiliary chemicals to the organic acid fermentation process which help to increase productivity and yield. By combining the two very different biomass

streams in a single process the sustainability equation becomes balanced.

The project is an innovative pairing of the green biorefining concept with the needs of the crab processors to both reduce waste and improve incomes through the extraction of higher value compounds. While biorefining research at IBERS is not limited to any one feedstock and includes both food and non-food crops together with energy crops, macro algae and waste streams, the core research at the heart of the BEACON project has been almost eight years of continuous applied biorefining expertise on high sugar perennial rye grass varieties developed by the grass breeders at IGER/IBERS over a thirty year period.

Biorefining research using high sugar rye grass juice at IBERS has produced lactic acid concentrations of up to 12% weight/volume in such controlled fermentations. In much the same way, it is possible to utilise the natural acid-neutralising properties of crustacean shell material to help control the pH in combined grass juice fermentation. As the shell material neutralises the organic acid it degrades, providing a slow-release of nutrients into the fermentation process and releasing higher value products for recovery and sale.

Crustacean shell, the major by-product from scampi, prawn and crab meat processing contains 20-30% chitin. Chemically extracted chitin is sold as a horticultural bio-stimulant and is the main source for glucosamine used to combat arthritis, while chitosan, which is also derived from chitin, has a broad commercial market including within the agricultural, water treatment, medical and personal care sectors. Chitin and other potential high value components within shells such as proteins, flavouring compounds and astaxanthin, can be degraded when chitin is extracted chemically.

Lactic acid has been identified as a more benign approach to chitin extraction. However, no commercial process operates yet in Europe due to the cost of lactic acid production. Perennial ryegrass, which produces high yields of fermentable sugars, fibre, protein and pigments, has been identified as a potential economic feedstock for a commercial lactic acid biorefinery.

The innovative iCRAB project is looking to improve the economics of both chitin extraction and lactic acid production by combining the two in a single biorefinery process. Lactic acid dissolves

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“iCRAB could significantly reduce the minimum economic scale of operation of a grass sugar biorefinery. The development of small scale bio-refinery processes to extract value from agricultural and food processing waste offers the possibility of creating high value and high skilled jobs in rural locations.

The challenge facing green biotechnology in the 21st century is to develop economically viable extraction systems to recover and purify often difficult to extract high value biological actives from waste biomass whilst avoiding the use of non-sustainable chemical reagents.”

**Dr Jonathan Hughes**  
Managing Director  
Pennotec



calcium carbonate in the shell, which buffers the fermentation, increasing lactic acid yield. Other synergistic benefits of adding shell to the biorefinery are economic – shell-derived products including chitin provide a high value product stream, and environmental – perennial ryegrass can grow on reclaimed land and shell is diverted from landfill.

This year Pennotec, in collaboration with Aberystwyth University (led by Dr Joe Gallagher,

Bioconversion and Biorefining Group Leader (IBERS) and BEACON Projects Leader) will seek to demonstrate on a pilot scale that it is feasible to combine processes to produce organic acid reagents from replenishable resources with waste valorisation processes.

In the future, Pennotec hopes to market the waste valorisation expertise to other bio-waste producers through an expansion of the biorefinery technology developed during the

iCRAB project to include the production of produce of other organic solvents. The iCRAB process could potentially act as a pre-digestion and extraction step for the recovery of high value actives prior to conventional biogas production.



#### Profile

**Product**

Biorefinery technology

**Applications**

Valorisation of manufacturing waste

**Contact**

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# Quest for complete extraction using molecule filtration

## Applying pharma processing to compound extraction

**B**ased in Aberystwyth, Mid Wales, PhytoQuest has developed a new extraction and filtration method for low molecular weight bioactive sugar-like molecules (for example iminosugars - analogues of sugars in which the oxygen is replaced by a nitrogen atom).

The major bio-active extractable components of plants are usually water-soluble but most research has been done on the more minor non-water soluble components because they are easier to work with.

PhytoQuest has developed a niche expertise in low molecular weight bioactive sugar-like molecules which are present in most plants but are rarely found in commercial extracts from around the world. The company has worked with BEACON- The Welsh Biorefining Centre of Excellence- at Aberystwyth and the College of Engineering at Swansea University to experiment with and develop new filtration systems which are able to concentrate the target molecules without using chemicals or solvents.

These innovative filtration systems are just one way of getting the extracts needed by using a more environmentally friendly method. Dr Darren Oatley-Radcliffe at the College of Engineering used to work at GlaxoSmithKline and is now applying his expertise in pharmaceutical process development to this new extract production which involves concentrating high value iminosugars from potato waste streams via a combination of carefully selected reverse osmosis and nano-filtration filters.





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“Most herbal medicines were taken as teas/beverages in the past and so this gives a clue as the best solvents to use to find the active chemicals. It's no wonder the active components of most plants are not identified yet!”

**Robert Nash**  
Founder, Phytoquest

The filters allow for the removal of high molecular weight components from the smaller iminosugars whilst also giving resolution of the smaller molecules. As a result, the bioactive iminosugars increase in concentration significantly in the end product; the by-products such as proteins, starch and common amino acids may have added value.

PhytoQuest has a strong IP portfolio on the bioactive compounds found in natural ingredients allowing innovation in the healthy-living products market emerging from the convergence of pharmaceuticals, foods and cosmetics. The expertise at PhytoQuest is unique and generates many patents and publications and the company is developing novel immune modulators and anti-diabetic compounds which have been isolated and identified in Aberystwyth. Ingredients are also being produced which are extracts containing identified novel active compounds at carefully controlled

concentrations. With anti-oxidants not living up to expectations as clinically beneficial food and cosmetic ingredients, PhytoQuest is looking to develop markets around the real active compounds in many traditional healthy foods and medicines.



**Reverse Osmosis** is a process in which dissolved inorganic solids (such as salts) are removed from a solution (such as water) and this is accomplished by household water pressure pushing the tap water through a semi permeable membrane.

**Nanofiltration** is a membrane filtration based method which uses nanometer sized cylindrical through-pores that pass through the membrane at an angle of 90°. Nanofiltration membranes have pore sizes from 1-10 Angstrom this is smaller than that used in microfiltration and ultrafiltration, but just larger than those used in reverse osmosis.

#### Profile

##### Product

Extraction and filtration method

##### Applications

Extraction of iminosugars

##### Contact

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# Wattwave keeps you connected

## New secure communications development for the Smart Building

**E**nModus, based in Chepstow, South Wales, is a Smart Building technology company which has developed Wattwave - a unique powerline communications protocol designed to be the robust, efficient and secure communications backbone for Smart Buildings.

Unlike most competing wireless and wired technologies, Wattwave offers building managers and installers a long-range, robust, and easy-to-embed technology for lighting, HVAC (heating, ventilation and air conditioning) and individual point load control. As a powerline-based technology, Wattwave is far less susceptible to signal interference and propagation issues in buildings, and it was designed from the ground up to offer unparalleled range. Developed to provide a secure and efficient communications backbone for low bitrate applications in industrial and commercial buildings, Wattwave is fully compliant with all applicable regulations and co-exists without issues with other powerline-based communications technologies.

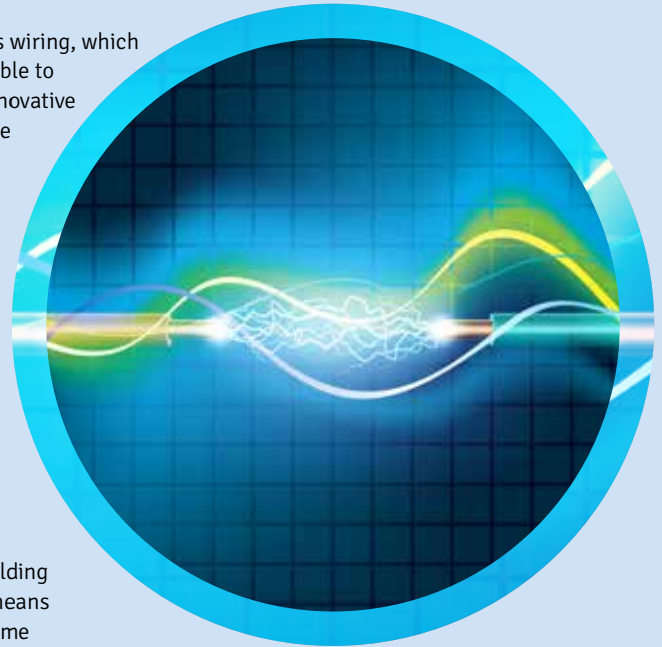
In addition to these advantages in range and robustness, Wattwave is also much less expensive to embed than competing technologies which makes it a very attractive proposition for Original Equipment Manufacturers (OEMs) who are looking to develop connected Smart Building devices and in particular lower cost devices such as LED lighting or smartplugs.

The Wattwave system consists of a hub (gateway) and up to 255 nodes, and offers full duplex communication under the control of the Wattwave cloud-based platform-allowing customers to develop their own branded user interfaces.

Wattwave operates on mains wiring, which means that it is not susceptible to radio interference and its innovative techniques efficiently handle powerline noise, ensuring robust communications. As the system has been designed specifically for low bitrate control and monitoring of mains-powered devices, Wattwave does not carry the cost overheads which comes with high bandwidth networking, meshing, various power modes, etc.

The system uses the copper electricity wiring in your building for communication, which means that it does not suffer the same signal propagation issues as wireless technologies. Wattwave's full duplex two-way communications enables electrical equipment to continually send back diagnostics information, which can be used to prevent breakdowns as well as to improve efficiency and service scheduling. Facilities managers are able to monitor energy consumption from each node, and to turn plant equipment and lighting on and off accordingly.

In most parts of the world, heating, cooling and ventilation accounts for the bulk of a building's energy consumption. As a result, it is a key focus area for Smart Building technology - more efficient monitoring and control can lead to significant cost savings and reductions in carbon emissions! Wattwave communications embedded in thermostats, boiler controls, air conditioning units, lighting systems and other mains-connected devices enables these to be monitored and controlled as part of an integrated energy management system. While Wattwave is not suitable for embedding in wireless sensors and other battery operated devices, it can be used in small mains-powered devices that receive the short-range signals from such sensors and transmit them over the powerline - a low-cost, reliable and pragmatic way to incorporate sensor information in the overall climate control system in any building.



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“From day one at enModus, our vision was to develop the ideal technology for embedding in all mains powered building infrastructure. I'm delighted to say that we can now offer our customers a next generation communications technology that precisely meets this need. In addition, with our cloud-based platform, we can offer users an end-to-end solution for easy adoption, and a faster way to make their building Smarter.”

**Andy Heaton**  
CEO, enModus Ltd

### Profile

**Product**  
Wattwave  
**Applications**  
Powerline communications

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# Lithium iON/OFF

## Clean power energy systems on the go

**L**ampeter-based Perpetual V2G Systems which develops clean power solutions for numerous applications and has created a new lithium system for high consumption equipment on-board vehicles.

Founded in early 2012, the company has undertaken a number of Research & Development projects with positive results in applications ranging from carbon reduction systems for use in supermarket delivery vans, through to critical on-board power supplies in emergency vehicles.

The company's complete lithium systems mean that space can be saved, weight can be reduced, and more efficient energy for DC and 230VAC high-consumption equipment onboard can be achieved using lithium ion batteries. These batteries weigh a fraction of traditional AGM lead batteries but provide double the amount of energy for consumption and last on average more than six times longer. Their charging times are very short, and lithium technology provides perfectly reliable mobile power solutions which can function

as both main and backup power systems for various types of equipment. When using the lithium system, the system is charged while driving.

Where the lithium ion battery technology makes 90% of the rated capacity available, lead-acid technology only makes 30%-50% available. This means that you would need twice the rated capacity of lead-acid to match the available capacity of lithium and when comparing CO2 emissions of the lithium ion battery and idle running solution over the system lifetime, a CO2 saving of approximately 8 tons is achieved.

Each lithium battery has an extended interface which allows it to control the power distribution for different consuming appliances. This interface can control alternative chargers, solar panels, gen-sets, and other charging devices and the control of external devices is ensured via several communications, wake-ups and input and output pins. These output pins can be configured via PC software and triggered in the occurrence of different events caused by cell voltage, cell temperature, current and/or SoC (State of Charge) levels.

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“Interest in our business is increasing everyday, including large global refrigeration manufactures, leading multinational corporations, and university research projects.”

**Andy Ling,**  
Managing Director

When the lithium battery is not in use, this Battery Management System (BMS) enters a low power state keeping power consumption at an ultra-low level to avoid any further discharge of the lithium cells. The BMS can be re-activated through several wake-up high/low input pins and charge currents plugged into the battery.

The advanced SoC calculation within the interface ensures that all cells are kept in a balanced condition at all times. The BMS has a high cell-balance current which reduces the need for active cell balancing and restores the cells to a balanced condition faster and it provides cell balancing of each single cell in charge, discharge and idle mode. The advantage of its internal MOSFET (Metal Oxide Semiconductor Field Effect Transistor) safety breaker is its capability to disconnect high currents without damaging the main switch and the BMS can use the MOSFET safety breaker for overload protection without damaging the cells.



### Profile

#### Product

Cleantech power supplies, off-grid mobile power

#### Applications

Refrigerated commercial, emergency service and utility vehicles

#### Contact

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# Glacier guzzlers

How tiny microbes are eating away beneath the world's glaciers

**D**r Edwards and his colleagues at Aberystwyth University, in Mid Wales, have discovered that the fate of Earth's biggest stores of freshwater - glaciers and ice sheets - is closely linked to the lives of the smallest life-forms, the microbes, living within them.

In their paper, recently published in the journal *Wiley Interdisciplinary Reviews*, Dr Edwards argues that the study of microbial processes in glacier environments will be important to understand how glaciers and ice sheets respond to climate change. "Very crudely, we can think of glaciers as having a "bank account", with credit being supplied as fresh snowfall, which is then condensed into glacier ice, and debit being paid as ice melts at lower elevations. We have compiled an evidence base that microbes are important creditors and debtors to this glacial bank account."

The "credit" is accumulated in the same way as microbial proteins in clouds help catalyse the formation of snowflakes, and these microbes live in snowpacks. "Debit" is taken from these glaciers as microbial ecosystems darken the ice surface, increasing the amount of the sun's energy absorbed by the ice, a so-called "biological albedo feedback" (climate feedback) for glaciers.

The balance between snow input and loss of ice is known as a "mass balance" and the factors affecting mass balance have been thought to be purely physical: crudely- snowfall and then the melting of ice in warmer temperatures. However, this explanation overlooks the role of microbes as certain proteins (called ice nucleating proteins) on the surfaces of bacteria in the atmosphere catalyse the formation of ice crystals. The activity of these proteins is important in forming snow in the atmosphere and hence nourishing the "credit" of a glacier by providing the key ingredient to make glacier ice.

Dr Edwards added, "We have taken to describing these microbial influences as a "germ theory" for glaciers because of the implications for how glaciers work".

Glaciologist, Dr Tristram Irvine-Fynn, said, "Using sophisticated techniques in flow cytometry, we calculated the number of microbes living in the surface of glaciers worldwide. We were shocked to find numbers comparable to well-known habitats such as rainforest soils or the surface of the oceans".

"These microbes may be tiny, but they are important. We need to understand this accumulation of microbes in more detail to see how this albedo effect multiplies the impact of climate change on melting glaciers," Dr Irvine-Fynn added.

The association between microbes and ice runs deep as this also includes those microbes which are buried underneath glaciers. Microbial geochemist, Dr Andrew Mitchell, who was involved in the research,

was co-principal investigator of the US National Science Foundation's successful project to drill into Antarctica's sub glacial Lake Willans.

Dr Mitchell said, "Glacial ice covers 11% of Earth. We didn't know until a decade ago that life could survive underneath the ice, but as a result of our work we know how microbes "eat" rocks to survive under the ice, and produce methane, a powerful greenhouse gas".

This sub glacial lake in Antarctica is home to roughly 2500 species of bacteria despite being isolated by 800m of ice for at least 120,000 years and scientists have discovered microbes that "breathe" rocks to generate energy. For example, iron and sulphur, such as that found in the mineral which makes fool's gold (iron pyrite), can be used to power microbial communities in these harsh environments. The consequence of this is twofold because firstly, microbes break down the rocks to reach these energy sources, thus contributing at a microscopic scale to the formation of the impressive landscapes made by glaciers and secondly, a particular group of microbe, the methanogenic Archaea, responds by making methane. Methane is a relatively short-lived but very powerful greenhouse gas and recent estimates suggest that hundreds of billions of tons of methane are formed underneath Antarctica's ice sheets in this way. While these ice sheets are stable, this methane is secure, but recession of the ice sheet has the potential to release important quantities of methane.

The team is set to investigate further the links between ice and life as it is setting out to map the biology of glacial ice across the Arctic and Alps, with fieldwork in Svalbard, Greenland, the Canadian and Swedish Arctic and Austrian Alps. This work is funded by the Royal Society, Natural Environment Research Council, European Union and Climate Change Consortium of Wales.

They will then work with BSc students in Biological Sciences and MSc Glaciology students, linking this cutting-edge research with teaching at Aberystwyth University. "Hopefully our fieldwork will help provide a snapshot of how microbial life in glaciers responds to and magnifies the change in glaciers and ice-sheets at a key point as our climate warms," said Dr Edwards.

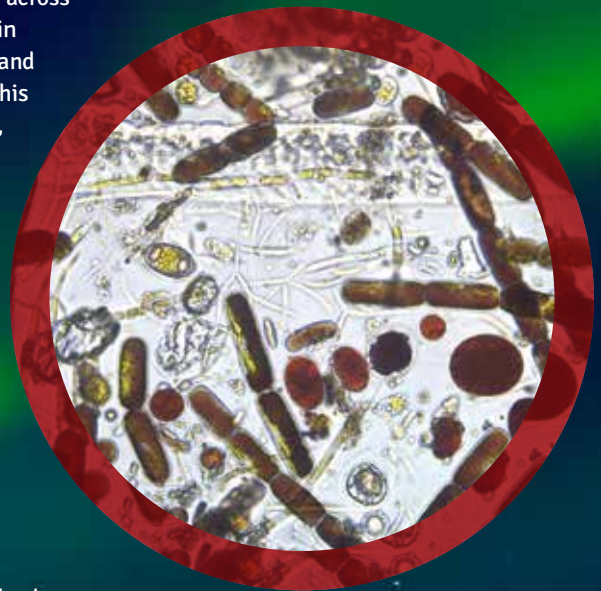


PHOTO CREDIT: DR ARWYN EDWARDS

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"Much attention is focused on the future of glaciers and ice sheets because of their sensitivity to warming climates. Melting glaciers and ice sheets will affect the livelihoods, food and water security of hundreds of millions of people. Greenland may feel like a world away from us in the UK, but its ice sheet holds the equivalent of 7.5 metres of sea-level rise and as this melts it risks catastrophic effects on coastal erosion and sea defences here."

**Dr Edwards**  
**Aberystwyth University**

#### Profile

**Product**  
Microbes

**Applications**  
Effect of glacial microbes

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# Making its Marke

## Technology firm sparks a revolution in chemical analysis

**M**arkes International, headquartered in South Wales, has developed a new technology which makes it easier for scientists to identify chemicals in everything from crude oil to the air we breathe.

Previously featured in Advances issue 42, Markes is an analytical instrument firm and its team of scientists have taken a well-used mass spectrometry (MS) technique and modified the way that the instrument works internally so that the chemist can simply switch from 'hard' to 'soft' ionisation, all at the click of a mouse.

MS is usually deployed alongside a separation technique called gas chromatography (GC), which separates out individual components of a complex mixture, in much the same way as ink on blotting paper and the combined technique of GC-MS is widely used by analytical chemists to identify volatile chemicals in a wide range of situations – from the air we breathe, to the wine we drink, and the carpets we walk on.

The trouble with most existing MS techniques is that they break up the chemicals into lots of fragments – this is known as 'hard ionisation' – and makes it difficult for the chemist to tell the difference between very similar chemicals. Although there are some less drastic, 'soft'



Mass spectrometry (MS), is an analytical technique which helps identify a substance by breaking up its molecules into fragments – producing a spectral 'fingerprint' which can be matched against an existing library of spectra.

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“This Select-eV technology, which we launched in January this year, makes it much easier for chemists to tell the difference between very similar chemicals.

This is important because similar chemicals can have very different properties – so for example, one might be toxic and another harmless. Analysts need to be able to confidently differentiate between such chemicals, which are usually present in only tiny amounts, and now with Select-eV at their disposal they have got a tool which makes it much easier to do that.”

**Dr Gavin Davies, FCIM**  
Marketing Manager, Markes



methods, these are a hassle to operate and so they are rarely used for GC-MS analysis of volatile chemicals.

Select-eV also comes with a number of additional advantages, mainly deriving from the fact that the chemicals are broken into fewer pieces. Key amongst these is the enhanced ability to detect very small amounts of chemicals – otherwise known as 'sensitivity'. Analysts are continually demanding greater sensitivity, because very small amounts of chemicals, whether man-made or naturally occurring, can sometimes have a big effect for example, allergens in cosmetics or bacterial toxins in foods. The new Select-eV technology is available incorporated into Markes' BenchTOF-Select mass spectrometer, or as an upgrade to existing instruments.

Markes made a splash as soon as they launched Select-eV, by getting an 'Honourable Mention' at the prestigious

Pittcon tradeshow in March this year. Dr Davies concludes, “We're really proud of the success of Select-eV and the commendations we have received, because it exemplifies our approach to our entire business – developing solutions from the ground up that directly meet the challenges faced every day by scientists”.

### Profile

**Product**  
Select-eV®

**Applications**  
Varied- environmental, forensic, petrochemical and food

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# Power of the dragon

## Dual-use flammable biofuel ignites interest

**The production of an all-weather solid flammable biofuel for military rations cookers, which can double as a waterless hand sanitiser has been launched by the UK military company, BCB International Ltd in South Wales.**

Many NATO forces currently issue hexamine fuel to their troops for cooking in the field and are looking to move to a replacement fuel due to the dangers which hexamine presents to the health of soldiers. Hexamine is a potentially dangerous and outdated substance; burning it gives off cyanide. Headquartered in Cardiff, BCB International Ltd, believe that their alcohol-based alternative fuel, 'FireDragon', will prove popular with soldiers on patrol who need to heat up their rations quickly without producing and inhaling toxic fumes.

Designed by BCB in partnership with Prof. D. Knight & Dr. I. Morgan of Cardiff University, FireDragon is non-toxic, non-drip and is made

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“Over the last five years, we have been developing a green and clean solid biofuel made from ethanol called 'FireDragon'. I am happy to announce that after extensive research and pre-production trials, the eagerly awaited fuel is now in production. The launch of the fuel is good news for our troops. It will enable soldiers to cook their meals and make their brews with a safer and cleaner fuel than traditional military rations fuel blocks like hexamine.”

**Andrew Howell**  
BCB Managing Director

from 100% natural ingredients, including ethanol sourced from UK grown grain stocks. The FireDragon fuel can be packed with rations and also doubles as a waterless hand sanitiser which helps Militaries to reduce both their logistics and their medical costs.

This revolutionary fuel is more than a match for similar alternative fuels. One tablet of



FireDragon fuel (27 grams) can boil 500 ml of water in 5-6 minutes which is at least two minutes faster than competitors' products and it can even be ignited whilst wet; this is a unique property of FireDragon.

Mr. Howell concludes, "Wherever they operate, whether in driving rain, the freezing arctic or searing heat, the fuel will enable soldiers to heat their rations right where they need them."



FireDragon is also suitable for the general public for outdoor pursuits, barbecues, mountain stoves etc.



### Profile

**Product**  
FireDragon biofuel

**Applications**  
Outdoor pursuits, barbecues, military

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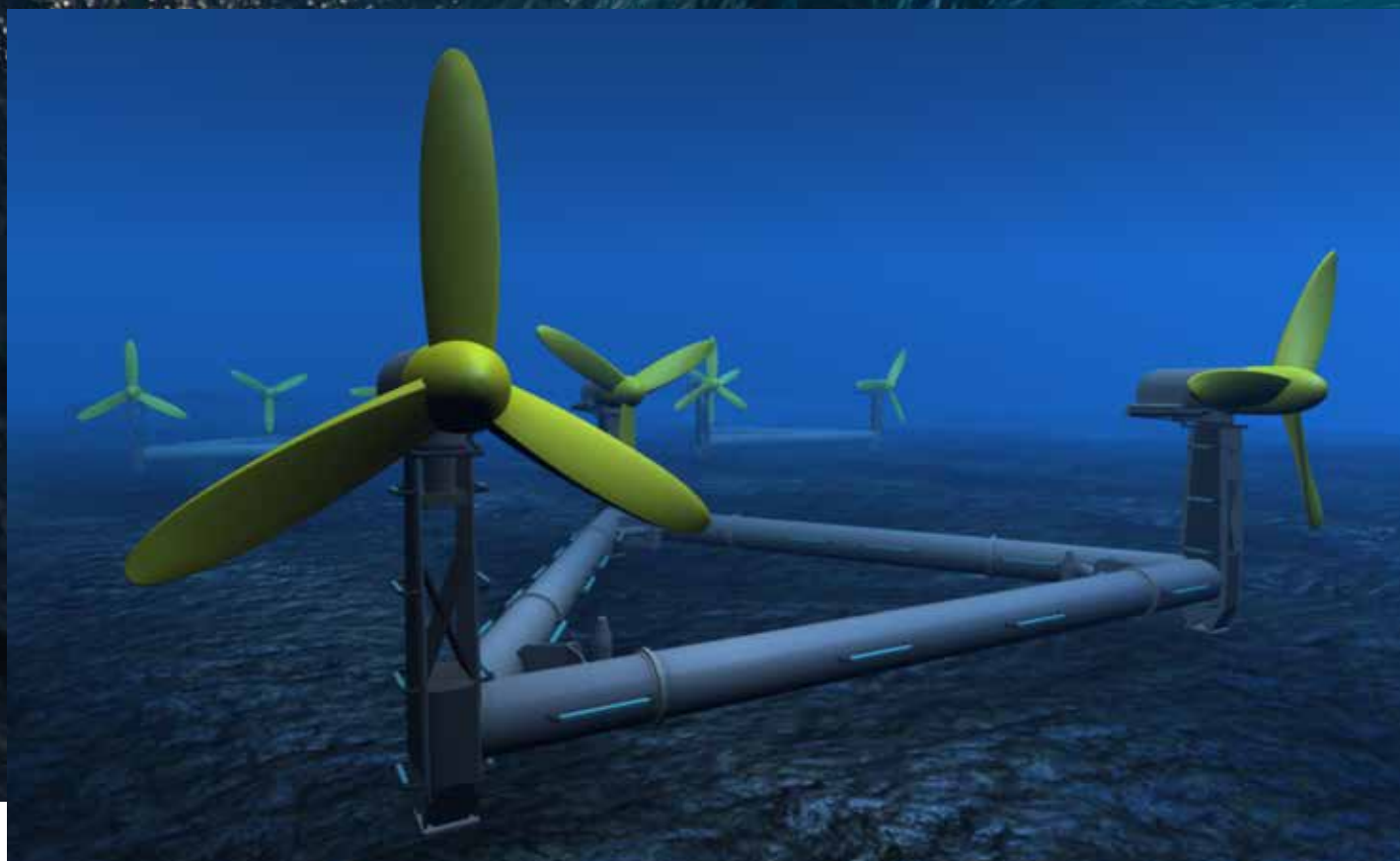
# Streaming the power of the sea

New prototype developed to provide source of renewable energy

**W**ith offices in Cardiff and Pembroke, South Wales, Tidal Energy Ltd (TEL) has developed a revolutionary DeltaStream prototype to harness tidal energy and provide a secure and sustainable source of renewable electricity efficiently, with minimal impact on the environment.

This prototype involves installing and testing at sea a full-scale tidal stream energy-generating device which will be deployed at Wales' first consented test site in Ramsey Sound, Pembrokeshire. The Company's technology will use the power of the sea's tides to provide a secure and sustainable source of renewable electricity with ease, efficiency and minimal impact on the environment.

TEL's mission is for DeltaStream to be the technology of choice for tidal energy development projects around the world.





Generating electricity from tidal stream technology presents a number of unique engineering challenges because a commercially competitive project must be able to generate power over the widest possible variation of tidal water flows.

One of the benefits of DeltaStream, making it competitive in the market, is that installation costs will be kept low despite the fact that traditional methods of installing marine energy technology, for example using piling, have proven to be time consuming, costly and require complex and expensive maintenance.

Locations with the greatest potential to generate electricity from tidal power are by their nature the most turbulent and the strength of tidal currents means that the technology and its associated infrastructure must be sufficiently robust to withstand these currents. To combat this problem, the DeltaStream unit has a triangular steel main base frame with 'Rock Feet' which secures the device to the seabed. By providing a gravity foundation for three nacelles (housings), this system reduces the high installation and maintenance costs traditionally associated with marine renewable technology. The frame's design also ensures that there is no damage caused to local ecosystems including sea mammals and fish, seabirds, the seabed benthic community, the underwater flora and fauna.

There is an independent horizontal axis water turbine generator in each nacelle supported on a tower at the apexes of the triangular main base. Each nacelle has an automated hydraulic yaw mechanism which

controls the orientation of the water turbine generators in relation to the direction of the tidal flow; this technology is deployable in a large scale array format.

The DeltaStream technology is connected to the shore using an export submarine power cable, with power conditioning equipment for grid connection located onshore.

An impressive 188 suppliers and contractors have been involved with the DeltaStream project so far, with 67 Welsh companies amongst them, including Cardiff-based Hyder Consulting, Mustang Marine in Pembroke Dock and Raymond Brown Construction of Bridgend.

TEL is working in partnership with Milford Haven Port Authority to develop an operating base for the forthcoming sea trials, and commissioned Mustang Marine to fabricate and assemble the DeltaStream device at its facilities in Pembroke Port. These partnerships provide a unique opportunity for the long-term development of the marine renewables industry in Wales and will help put Wales at the forefront of marine energy development.

### Profile

#### Product

DeltaStream Tidal Turbine

#### Applications

Tidal stream energy generation

#### Contact

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# Momentum builds for testing technology

## Rapid universal testing technology for infection

**B**ased in Cardiff, South Wales, Momentum develops rapid tests for critically-important clinical specimens within the hospital microbiology laboratory and has created a new unique ETGA technology which universally detects viable organisms in clinical samples.

The company creates products to provide an integrated solution for rapid universal detection and exclusion of micro-organisms from a variety of sample types. As part of a planned suite of products, Momentum has developed ETGA Minus which delivers confirmation of a negative blood culture on the following day after the specimen reaches the laboratory, compared with five days currently, allowing clinicians to reduce unnecessary antibiotic use or seek other causes for a patient's symptoms. Clinical testing has demonstrated a negative predictive value of 99.5%.

Further products under development include same day detection of positive samples, with organism differentiation, as well as those with the potential to deliver a phenotypic next day antimicrobial susceptibility test. Traditional culture takes days to give results and faster methods have been developed using technologies based on organism identification direct from blood such as nucleic acid testing (NAT). However, there are limitations inherent in these technologies as none of these newer methods provide true universal bacterial or fungal detection and they are restricted to a defined number of pathogens.

Although NAT provides organism identification, the presence of DNA does not guarantee the presence of viable organisms. Organism DNA can be found in samples well after the organisms have been successfully destroyed by antibiotic treatment. Momentum's Enzymatic Template Generation & Amplification (ETGA) technology addresses these limitations by universally detecting bacteria and fungi and only detecting viable organisms.



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“We have developed an innovative technology in ETGA that we believe will address some of the important current unmet needs in the diagnosis of infection in critical clinical areas, contributing, in the future, to the better management of antibiotic and improved patient outcomes.”

**James Collier**  
Commercial Director, Momentum

ETGA detects micro-organisms by measuring nucleic acid-modifying enzymes within these organisms which are then sensitively detected by an established DNA amplification method, PCR (polymerase chain reaction).

ETGA involves the processing of clinical samples to remove background material and the concentration of the micro-organisms. The micro-organisms are then lysed to release the target enzymes and mixed with a DNA substrate and PCR reagents.

When the enzyme from the micro-organism reacts with the DNA substrate it creates a DNA target which is detected by quantitative PCR (qPCR). This is then read using the PCR instrument and is a procedure which involves amplifying small quantities of DNA and detecting the result. PCR instruments are widely used in clinical microbiology laboratories. When bacterial or fungal cells die or lyse, the target enzymes rapidly break down giving ETGA its unique ability to only detect viable organisms.

Products based on ETGA technology are in vitro diagnostic (IVD) kits used in hospital microbiology laboratories for the screening and diagnosis of infectious disease. Physically the products comprise bottles of reagents together with appropriate Instructions For Use (IFU). These are used with off-the-shelf PCR instrumentation common in most laboratories. Culture can, in principle, detect any growing pathogen, but many infections require 1-5 days to detect. Culture-based

testing is a mainstay in clinical microbiology, used on all kinds of specimens but cerebrospinal fluid and blood are among the most critical. Rapid testing is also valuable in some joint fluids and certain other specimens such as ascites (fluid in the abdominal cavity) and pleural fluids (fluids near the lung).

Momentum is developing a number of applications for the use of ETGA technology. The initial development focus is on areas of testing where the speed, sensitivity, the universal and viable detection characteristics of the technology will deliver the greatest benefit.

### Profile

**Product**  
ETGA Minus  
**Applications**  
Rapid detection of infection  
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# Biosensor detects cancer biomarkers

## Graphene biosensor aids in fight against the disease

**A team of researchers from Swansea University, in South Wales, has developed a highly sensitive graphene biosensor with the capability to detect molecules which show signs of increased cancer risk.**

The newly developed graphene biosensor could ultimately help to provide a rapid diagnosis at the point of care. In comparison with other bioassay tests, this sensor is over five times more sensitive.

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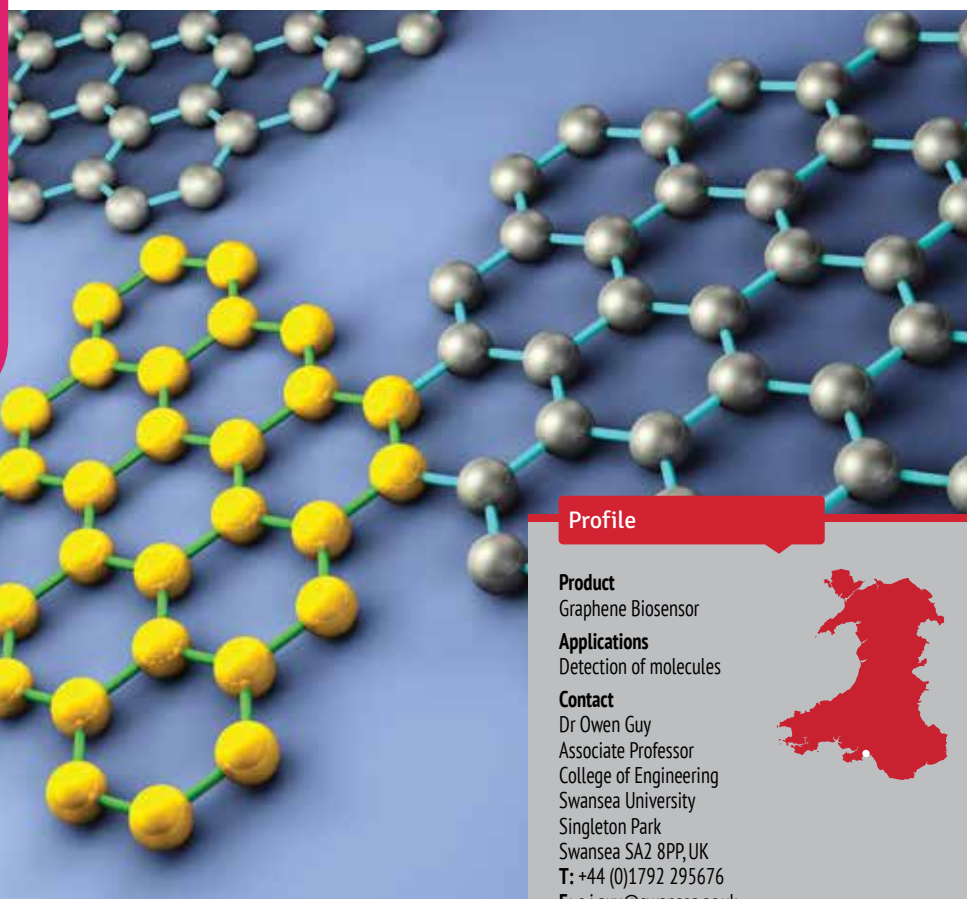
“Graphene has superb electronic transport properties and has an intrinsically high surface-to-volume ratio, which makes it an ideal material for fabricating biosensors. Now that we’ve created the first proof-of-concept biosensor using epitaxial graphene, we will look to investigate a range of different biomarkers associated with different diseases and conditions, as well as detecting a number of different biomarkers on the same chip.”

Dr Owen Guy, Study Co-author,  
Swansea University’s Centre for NanoHealth

Conventionally, graphene is produced using an exfoliation technique in which layers of graphene are stripped from graphite. However for a biosensor, a large substrate area is required in order to produce patterned graphene devices.

The researchers used conditions of low pressure and very high temperatures in order to grow graphene on a substrate of silicon carbide. The graphene devices were then patterned, by using methods similar to those used when processing semiconductors, and the team then attached antibody bioreceptor molecules which could bind to specific target molecules in urine, saliva or blood.

In order to verify if the bioreceptor molecules were bound to the graphene biosensor, the researchers used Raman spectroscopy and x-ray photoelectron spectroscopy. The biosensor was then exposed to various concentrations of the molecule 8-hydroxydeoxyguanosine (8-OHdG) which is produced when high amounts of DNA damage occur and this is connected to a high risk of cancer development. Traditional detection tests, such as enzyme-linked immunosorbent assays (ELISAs), are not capable of detecting the low concentrations of 8-OHdG present in urine but this new graphene sensor has the capability to detect low concentrations of 8-OHdG and at a comparatively faster rate.



### Profile

#### Product

Graphene Biosensor

#### Applications

Detection of molecules

#### Contact

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The paper has been published in 2D Materials, a journal of IOP Publishing and can be downloaded from <http://iopscience.iop.org/2053-1583/1/2/025004/article>



# Sea-ing is believing

Underwater-world software developed for launch of new Samsung Gear VR mobile device

**D**r Llyr Ap Cenydd from Bangor University's School of Computer Science, in North Wales, has worked on a project with Samsung and Oculus to develop an app called "Ocean Rift" which is a Virtual Reality (VR) experience.

Expected to launch alongside Samsung's new Gear VR mobile device, Ocean Rift immerses the user in a vivid underwater world and gives the user the experience of swimming with various aquatic creatures including dolphins, turtles, sea snakes, rays, sharks, whales, and even extinct

prehistoric reptiles. The app lets users select from a series of habitats using a touch panel on the side of the device and they are then teleported to a range of destinations from a coral reef or a shipwreck to a lagoon, the deep sea and even Atlantis. Once there, they can interact with creatures which are animated by an innovative state-of-the-art artificial intelligence system which has been developed specifically for the project.





Traditionally the motions of virtual characters are calculated using pre-created data, sourced from a library of motions created beforehand by animators or by using motion capture technology. However, the animals in Ocean Rift are animated live using a technique called procedural animation, where a creature's virtual muscles are controlled by algorithms with the aim of synthesising more life-like animation and behaviour automatically. Algorithms control every part of the creature's motion, including how it moves through the water, adjusts its flippers and how its eyes blink and track the player. When combined with VR technology, Llyr believes that advanced animation systems like this one can help to immerse the player in the virtual world by making them feel as though they are interacting with living things.



The lecturer was invited to develop for the device having previously released several game and tech demos on a similar device called the Oculus Rift. Dr Llyr ap Cenydd, who has spent a year developing the app said, "This project was undertaken in my spare time but it's related to my research in animation and virtual reality."

The app will run on the Gear VR which is a virtual reality headset powered by the Note 4 smartphone. Wearing the headset means that the user becomes completely immersed in the virtual world. The device, which looks like a pair of ski-goggles, magnifies the smartphone screen so that it fills the user's visual field and by showing a different image to each eye and tracking where the user is looking, it gives the effect of being transported to a new reality.



This new development in gaming technology is not on general release yet, but will arrive on the open market in the US this month.

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"Ocean Rift started as an experiment to see how far I could take emerging virtual reality technology to make someone feel like they are underwater. The Gear VR version takes things much further – you can swim with a pod of dolphins, stand in a cage surrounded by Great White Sharks and even swim with creatures that are long extinct. It's been an amazing experience working with this cutting edge technology and I can't wait for people to try it."

**Dr Llyr Ap Cenydd**  
Bangor University, School of Computer Science

#### Profile

##### Product

Ocean Rift

##### Applications

Virtual Reality

##### Contact

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