Lab+Life SCIENTIST

THE EYES HAVE IT

NEW GENERATION BIO-IMAGING
GENE THERAPY FOR EYE DISEASE

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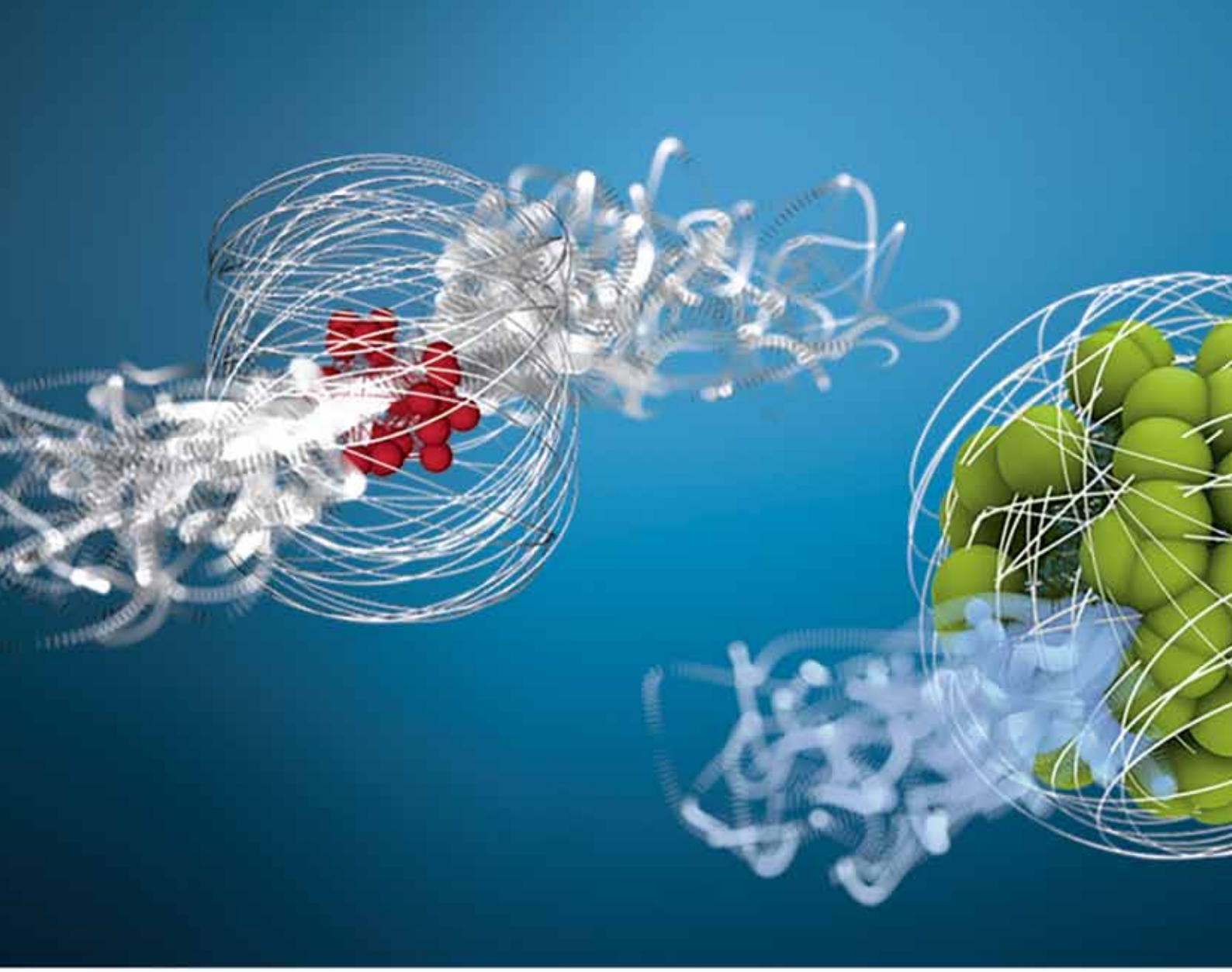

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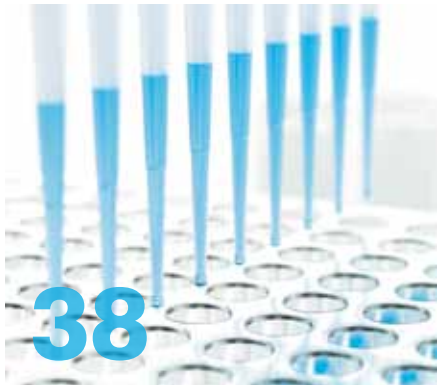

Welcome to the February/March issue of *Lab+Life Scientist*. The Lorne series of conferences had another highly successful year attracting more than 1400 delegates. The conferences brought together local and international experts in the fields of genomics, proteomics, cancer, infection and immunity, protein structure and function.

This issue features renowned Australian proteomics researcher Dr Valerie Wasinger, who presented at the 23rd Annual Lorne Proteomics Symposium. Dr Wasinger has conducted proteomics research for over two decades and her recent work has led to a patent regarding the enrichment of low mass proteins for inflammatory bowel disease (IBD) diagnosis and monitoring. To read more about her work, projects and thoughts on the recent developments in the industry, go to page 6.

This issue's liquid handling feature is on Massachusetts Institute of Technology's lab-on-a-chip technology that uses electric fields to move droplets of biological solutions around a surface, mixing them in ways that could be used to test thousands of reactions in parallel. The technology is based on a physical principle called electrowetting, whereby electric fields are used to move, merge, stir and analyse tiny biological samples.

Technological advancements are transforming the world of science and research. This issue features a number of exciting scientific developments, for example, how virtual reality is now allowing scientists to 'walk' cancer cells; a new microscopy technology that allows us to track a single molecule inside a living cell; and ingestible capsules that measure gut gases.

The microscopy technology mentioned above was developed by researchers at the University of Technology Sydney's new Institute for Biomedical Materials and Devices (IBMD). The institute, launched by Nobel laureate and Obama administration energy secretary Steven Chu in February, aims to develop next-gen, inexpensive, easy-to-use biomedical devices. IBMD is transforming advances in photonics and materials into revolutionary biomedical technologies, according to the UTS.

IBMD will be headed by Professor Dayong Jin, one of the winners of a Prime Minister's Prizes for Science in 2017. Jin will spearhead an international effort to transform diagnostic medicine: integrating technologies to develop small, stable, inexpensive devices for disease diagnosis that are as easy to use as smartphones are today. The institute is working closely with the research and development partners around the globe to deliver interdisciplinary research in nanophotonics, nanomaterials, biomaterials engineering, point of care diagnostics technologies and super resolution bio-imaging.

This issue also features an article on how CSIRO's patented gene silencing technology RNA interface (RNAi) is allowing researchers to protect plants and animals from diseases and to develop new plant varieties with beneficial attributes. As always, we've got some great new products. Happy reading!

Regards,
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Adam Florance

The power of proteomics

Renowned researcher Dr Valerie Wasinger has been at the forefront of proteomics research since the inception of the field in 1995. Her recent work has led to a patent regarding the enrichment of low mass proteins for inflammatory bowel disease (IBD) diagnosis and monitoring. The application of these ideas for better management and treatment of IBD was the focus of her presentation at the 23rd Annual Lorne Proteomics Symposium.

The etiology and cure for IBD are uncertain, said Wasinger, who is currently based at the Bioanalytical Mass Spectrometry Facility (BMSF) at the University of New South Wales' Mark Wainwright Analytical Centre.

"Measures relating to disease activity, permeability and inflammation are available but are limited in their ability to measure 'clinical remission', a newly accepted gold standard for treatment of this condition. Scientists and clinicians are embracing the concept of intestinal epithelial barrier integrity and its role in the pathogenesis and natural history of IBD."

IBD, proteomics and collaborative research

"Peptide biomarkers from the low-mass-plasma proteomes have been identified as significant players in the diagnosis of IBD, the differentiation of active disease and remission, and remission in healthy individuals. These markers have been quantitated using MRM. Binding partner studies show a novel relationship to endocytic signalling, lipid metabolism and actin nucleation, and additionally correlate to the 'tissue integrity' of leaky-gut IBD patients.

"Modulated proteins in patients with ongoing intestinal damage may be able to predict for relapse and the need to escalate treatment. Markers which can be translated into treatment management able to measure repair of leak, restitution and epithelial cell healing are being sought to manage IBD.

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Analytical facilities are the correct path forward and often intellectual collaboration provides so much more than a single isolated research lab can generate.

"Currently, I'm working on the proteomics of endothelial tissue integrity and barrier function in the context of IBD in conjunction with my collaborators at Concord Hospital, including Professor Rupert Leong. We have had success identifying biomarkers of IBD that hold true for diagnosing those that are also in disease remission. Now we are expanding this study in the ever-shifting IBD landscape to understand the role of these markers in the context of gut tissue integrity. Dysfunction of the endothelial single cell layer, paracellular leak and cell loss is a prominent focus of many illnesses including IBD. Managing this dysfunction is now the main goal of treatment in IBD with evidence showing that clinical remission can be achieved.

"Having expertise across diverse disciplines (clinicians and researchers) makes this project absolutely relevant. I think that the drive to translate basic proteomic research into clinical outcomes has been overlooked. It requires more than having a hypothesis and proving a point. There has been a huge gap between basic research outcomes and the point where industry wants to partner in your research.

"It's the place that's difficult to fund because it has lost its novelty — if you have published. And it requires you to move outside your comfort zone (new technologies and regulatory expertise). There is risk involved, perhaps sufficient to deter individual groups from proceeding. The perfect scenario for the valuable transfer of knowledge from bench to clinic involves a marriage of different disciplines including practical patient care and laboratory research. A facility such as BMSF is the perfect environment to foster these long-term research relationships."

From bench to clinic

The path from the laboratory to a clinical outcome is long and hard. Wasinger acknowledges that funding, as with all research, remains an ongoing issue. "Global cuts in the research dollar, changing legislation and the high cost of infrastructure and maintenance of that infrastructure are especially challenging to the field of proteomics as researchers realign themselves and establish new funding opportunities for discovery research. From a facilities perspective, the scientific landscape needs to foster long-term projects with a need to recognise the risk inherent for translatable research. The current environment is one fostering research with as little risk as possible.

"Access to expertise and infrastructure is also increasingly in demand as a consequence. This is why many universities are supporting facilities such as BMSF, which become a hub of expansive research experience across all disciplines and proteomic technologies. In association with academics, researchers and industry, these hubs are generating IP, innovation for the next proteomic generation. The fostering of facilities, infrastructure and know-how is a model adopted by many universities."

Analytical facilities are the correct path forward and often intellectual collaboration provides so much more than a single isolated research lab can generate, suggested Wasinger.

"The space between basic science and patient treatment is in need of transformation. It is complex and there is a huge discrepancy between the initial outlay in resources and effort versus the success of markers in clinical practice. Proteomics is not directly transferable to clinical practice. The reason for this is that basic research is vastly different to the regulatory diagnostic requirements for clinical assay or assays used to monitor disease progression and inform on treatment. Proteomics is becoming more robust in that quality research is recognised for precision and specificity, and as labs routinely

monitor and implement quality control and recognise clinical requirements this will aid in reproducibility as well as begin to bridge the gap between bench and clinic.

Personalised medicine

In time, this will allow the full power of proteomics to be utilised in the field of personalised medicine, said Wasinger. The promise of personalised medicine has received much attention in recent years and many presume that new fields of research like proteomics will have a major impact on this arena.

"Personalised medicine is just a fancy label denoting that we don't understand enough about a system. The goal of personalised medicine is far more noble; to have in place a road map of all genes, proteins and metabolites to predict every possible disease or treatment scenario, and to use this to inform on treatment and care at a group or individual level rather than a population level. This would allow for the stratification of patients based on evidence. But that noble goal requires a huge investment of money and time.

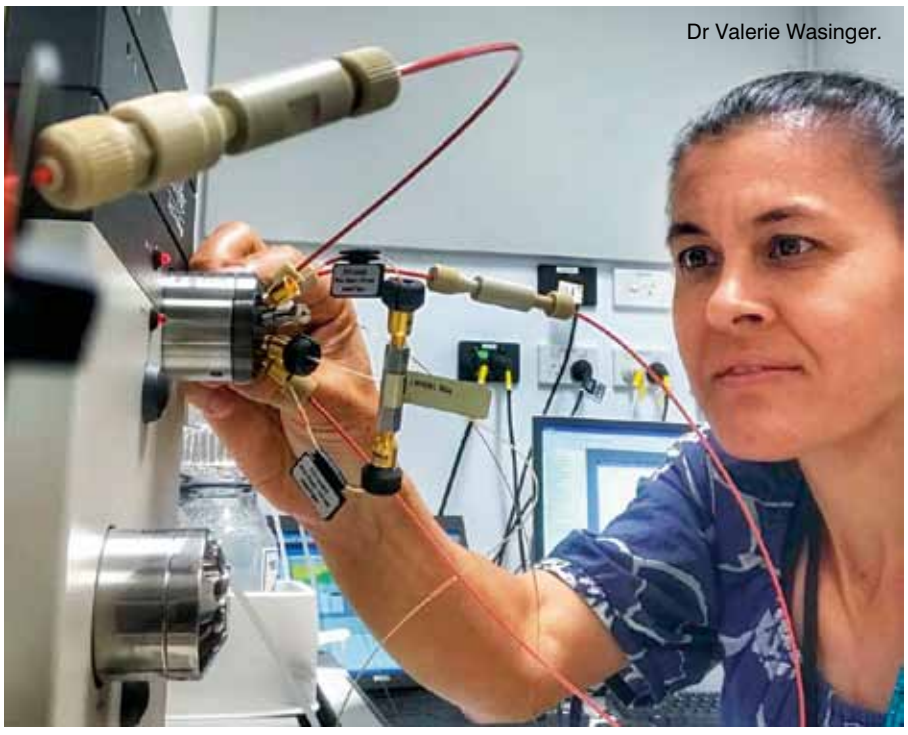
Technological advances

"The tools used in proteomics are a powerful way to observe all players at the protein level contributing to disease pathways. Hence its emergence and acceptance into translatable clinical settings will drive the proteomic market into the future. Technology-enabled proteomic products are finding applications in diagnostics, health monitoring and therapeutic/drug discovery. This is mainly propelled by advances in mass spectrometry, but also in bioinformatics and the downstream technologies and increasing uptake of micro-array technologies in an already proven bench to clinic pipeline. An increase in the acceptance of user-friendly and cost-effective devices that enable diagnostic assay and measurements at the clinical level is allowing the life sciences to expand into the proteomic domain in addition to the genomic arena."

Technology-enabled proteomic products are finding applications in diagnostics, health monitoring and therapeutic/drug discovery.

Dr Wasinger's career progression has been atypical but highly rewarding.

"I'm not your typical academic. I am part of the UNSW Analytical Facility. A facility that develops the methods, maintains the high-end tools and are applications specialists. I love my work — I have the best job in the world. This role allows me to work on topics as diverse as IBD biomarkers to sexing ancient human remains and everything in between."



Dr Valerie Wasinger.

Curious about the world

Growing up, Dr Wasinger was a fan of science-oriented TV shows like *The World Around Us*, *The Curiosity Show* and especially, David Attenborough. "It was the tenacity of life, the unassuming simplicity of 'being' and the satisfaction of discovering the meaningful connection in a background of seemingly unrelated things that drew me to studying science and biochemistry and microbiology at Sydney University. But it took a revolution in genomics and a parisitologist with a lot of soul to cement the love of research. The forecast of a lifelong structural study of a single molecule had changed to the possibility of understanding all the connections, all the (proteins) players at the one time. That seemed like a panacea to me. I was in."

Dr Wasinger is recognised in the field of proteomics in Australia and internationally. In the early 1990s, she became involved in groundbreaking research into the new field of proteomics, co-authoring the paper in which Marc Wilkins first coined the term.

"I was in the right place at the right time — at the cusp of the genomic sequencing revolution in the early 1990s, and the release of entire genome data into public databases. Wolfgang Paul had just won the Nobel prize for the ion trap technique (1989) and Fenn, Tanaka, Karas and Hillencamp were about to revolutionise the very tools that so much define the field today. Our group at Sydney University was working with Macquarie University and UNSW on the techniques (such as 2D-gel electrophoresis, mass spectrometry and amino acid analysis and database search algorithms/tools) as well as the fundamental concepts that defined and created an entirely new field of research — proteomics. Notably, researchers from a number of Australian universities contributed to its creation."

Proteomics continues to be a field driven by Australian scientists and the Annual Lorne Proteomics Symposium has become one of the largest internationally recognised events in Australia in this field.

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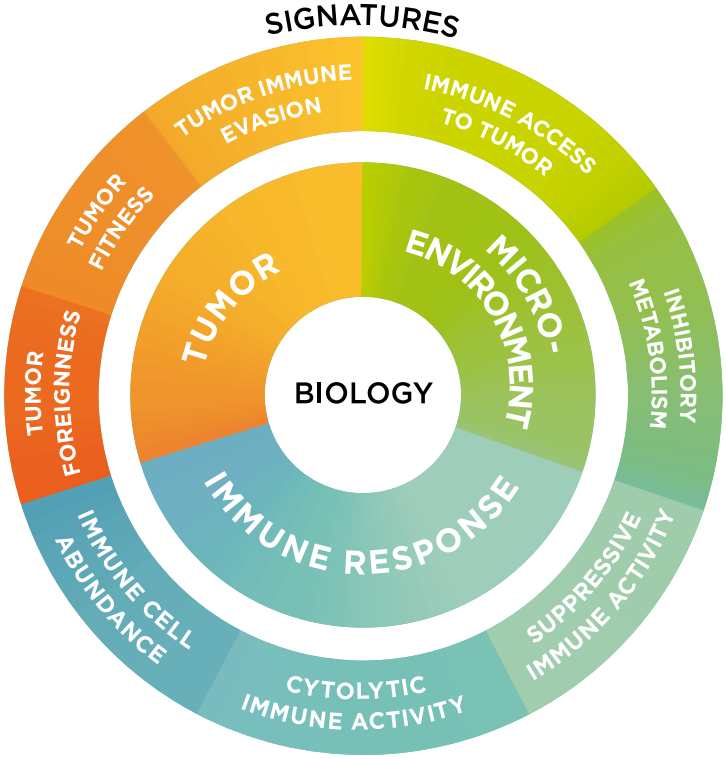

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Anton Paar sets up offices in Australia, NZ

Anton Paar, a manufacturer of high-quality measuring and analysis instruments for research and industry, has set up new offices in Sydney and Auckland.

The local subsidiaries were launched on 1 January 2018 in order to meet the growing demand for high-quality instrumentation and an ever-expanding network of customers in Australasia. Led by the new Managing Director, Jutta Rieger, both offices feature fully equipped laboratories and collaborative spaces to demonstrate new applications and host educational workshops to improve the end-user experience.

"For almost two decades Anton Paar's products and services have been represented very successfully in Australia and New Zealand by MEP Instruments, a joint venture company owned by Anton Paar of Austria and Metrohm of Switzerland. Over the years the business volume has grown significantly, which led to the decision to dissolve the joint venture and set up separate legal entities for Anton Paar and Metrohm in Australia and New Zealand," Anton Paar Australia and Anton Paar New Zealand Managing Director Jutta Rieger said.

"Opening new subsidiaries in the Asia Pacific region is part of Anton Paar's global growth strategy, which also includes acquisitions to further enrich the portfolio for the benefit of our customers."

Anton Paar Australia and Anton Paar New Zealand are now in a position to focus on all 13 product lines within the wide portfolio of high-quality laboratory devices and solutions, said Rieger.

Founded in 1922 in Austria, the company is the market leader in measuring density, viscosity and carbon dioxide. The company offers accurate devices for the examination of surfaces, particles or diluted gases like oxygen, and develops tailor-made analytical solutions that can be integrated into existing or new processes. The company's solutions are employed in a range of industries, including food and beverages, cosmetics, petrol-based products, pharmaceuticals and many others.

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Jutta Reiger, Managing Director, Anton Paar Australia and Anton Paar New Zealand inaugurating the Australian office with the global CEO Friedrich Santner Image courtesy of Anton Paar.

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Computer algorithms identify cancer from tissue images

Artificially intelligent computer algorithms have been found to equal human pathologists in detecting metastases of breast cancer in lymph nodes, as demonstrated during Radboud University Medical Center's CAMELYON16 challenge.

The CAMELYON16 challenge, held between November 2015 and November 2016, gave machine learning researchers the opportunity to create a computer algorithm that can independently make a diagnosis based on pathology images — specifically, the detection of metastases of breast cancer in lymph nodes. The challenge was accepted by 23 research groups from around the world, with the results published in the journal *JAMA*.

Participants were given 270 digital images of tissue preparations, of which it was already known whether, and where, metastases could be found. Using these images, the participants developed algorithms which had to distinguish between images with and without metastases, and then locate the exact position of the metastases. They then received 129 new images, which they used to test the algorithms. The 129 test images were also assessed by 11 experienced pathologists, who analysed them under conditions that were similar to a realistic hospital situation. In addition, one pathologist was allowed to take as much time as she wanted to diagnose the images.

The 23 participating research groups submitted a total of 32 computer algorithms, the most successful of which used 'deep learning', in which the computer learns to recognise patterns based on a large number of examples. The top algorithms performed significantly better than the pathologists who assessed the images in the realistic hospital work situation.

The winning algorithm, meanwhile, detected metastases as effectively as the pathologist who worked without time pressure. On average, this algorithm generated a false positive (a metastasis that actually did not exist) only 1.25 times per 100 images.

"For the first time we have seen that a computer can make this diagnosis as effectively as a pathologist," said Jeroen van der Laak, who coordinated the challenge. "A pathologist with this algorithm is therefore better off than a pathologist without. The patient receives the result of the biopsy sooner and the algorithm helps pathologists make better diagnoses, even under time pressure."

The researchers expect that the technique will be suitable for use in patient care within a few years, and that the computer algorithm will increasingly be capable of diagnoses.

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VR allows scientists to 'walk' together through cancer cells

Virtual reality (VR) technology designed by the ARC Centre of Excellence in Convergent Bio-Nano Science & Technology (CBNS) is allowing multiple scientists to see inside a human cell at the same time, giving researchers a 3D tool to improve doctor interaction and help analyse how cancer drugs work.

The technology is the result of a major initiative called Journey to the Centre of the Cell, which combines scientific data, microscopy images and animation to create a virtual world of cells and blood vessels that can be seen through headsets. Professor John McGhee and Professor Maria Kavallaris, both investigators at CBNS, are collaborating on the project.

"I saw we could do so much more with VR than selling products and superheroes," explained Professor McGhee. "We have amazing gaming technology and we can use it to benefit patients and specialists. The inner workings of the body can often get lost in specialist data and this makes the process democratic."

Until now, Professor McGhee's work involved single VR headsets, with one person moving around in the data. But new technology means multiple users from different parts of the world can walk inside the 'landscape' of the cell at the same time.

Professor Maria Kavallaris and Associate Professor John McGhee using virtual reality headsets. Photo: Quentin Jones.

"We can have multiple scientists logging in at once with users able to view the same data," he said. "This could help researchers ask questions they've never thought of."

Professors McGhee and Kavallaris are focusing on educating researchers on how cells function and the way drugs are internalised by cancer cells. According to Professor McGhee, "Our goal is to be able to see a drug enter into the tumour, so we can highlight the target for chemotherapy or radiotherapy and deploy a drug more accurately."

Professor Kavallaris, a leading cancer biology researcher and nanomedicine expert, said tracking 3D cells in tumours can show scientists what happens when cells move in real time — information that can be used when looking at the spread of cancer.

"We have never had access to something like this before," she said. "We hope it will help scientists better understand how and what happens if you interfere with a genetic process and add certain drugs. Eventually it could be a tool to explain to patients and their parents about types of cancer and strategies for treatment."

The technology is already being trialled on Monash University pharmaceutical science students learning about cancer drug delivery to see if it improves their understanding. The results of the trial, published in the journal *Traffic*, are looking particularly promising.

Discovery allows the human eye to track a single molecule inside a living cell

Researchers at the University of Technology Sydney have developed a new microscopy technology that allows the human eye to track a single molecule and inspect its behaviour inside a living cell.

Using a new class of nanoparticle sensors — upconversion Super Dots — that convert low-energy near-infrared photons into high-energy visible emissions, scientists have defined how many single photons are needed for the human eye to track a colour-tagged single molecule inside a living cell. The answer is 4000 photons per 100 milliseconds under a simple microscope set-up.

The research, published in the Nature journal *Light: Science & Applications*, means problems with imaging resolution and sensitivity can be overcome using relatively inexpensive, standard microscopes.

"Subcellular research is the new frontier in biomedical science and nanoparticles are the new tools for super resolution imaging and drug delivery," said lead author Dr Fan Wang, a senior research fellow at UTS Institute for Biomedical Materials and Devices (IBMD).

"Medicine has progressed from looking at symptoms from the outside of a person, to assess their health conditions, to looking inside using endoscopes and scans. Now we are developing new tools to enable the inspection of the individual cells in real time. At that intracellular level you get a fundamental understanding about how cancer spreads or how a particular treatment might work," Dr Wang said.

"Our new generation of Super Dots sensors are stable, non-toxic, background-free and very uniform, making them ideal for bio-imaging," Dr Wang said.

The research complements the volumetric imaging platform IBMD is developing to decode the traffic conditions and environment to build a 3D 'street view' inside living cells.

IBMD Director Professor Dayong Jin said, "This new imaging technique is capable of monitoring, or tracking, a single optical sensor with high temporal, spectral and spatial resolution through cellular compartments."

The new technique provides a fifth dimension for our eyes to simultaneously discriminate between multiple sets of single nanoparticles sensors, and gives colour-blind observers the ability to use fluorescence microscopes, Dr Wang said.

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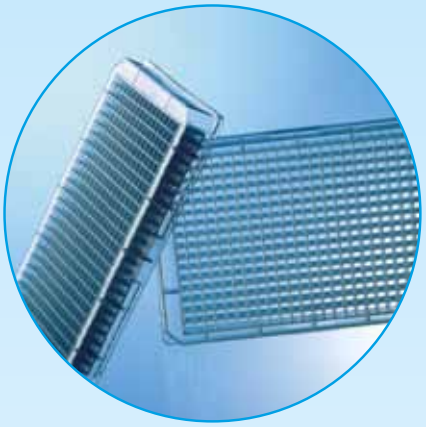

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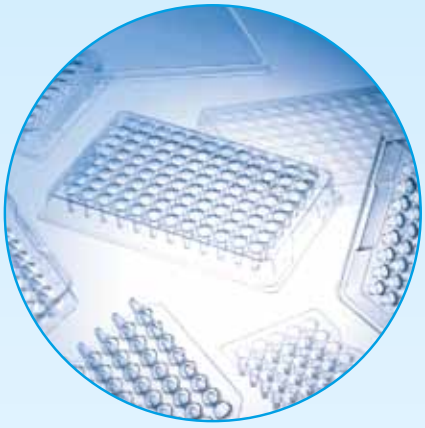

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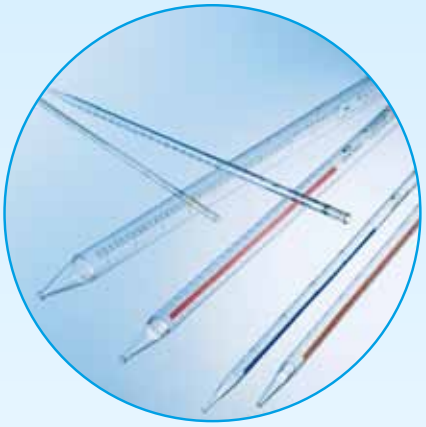

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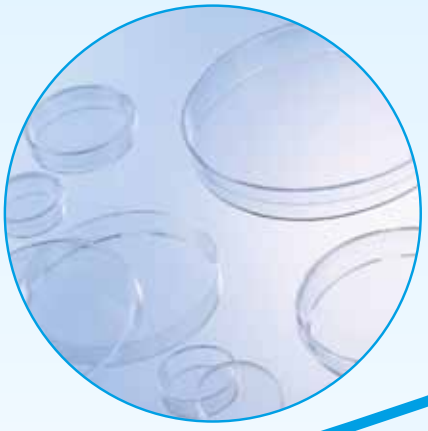

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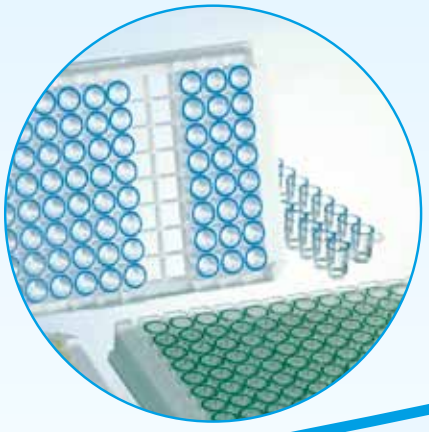

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Computer simulations reveal roots of antibiotic resistance

Supercomputer simulations conducted at Los Alamos National Laboratory have revealed the role of transport proteins called efflux pumps in creating drug resistance in bacteria — a breakthrough that could help improve drugs' effectiveness against life-threatening diseases and restore the efficacy of defunct antibiotics.

Some infections do not respond to antibiotics because the efflux pumps inside Gram-negative bacteria flush out antibiotics before the drugs can work. Researchers at the Los Alamos lab chose to focus on the pumps located inside the bacteria *Pseudomonas aeruginosa*, which can cause serious illnesses such as pneumonia and sepsis.

In *P. aeruginosa*, the major pump type is called MexAB-OprM and is composed of three proteins: MexA, MexB and OprM. Only ever studied in parts, the pump encompasses both inner and outer membranes found in Gram-negative bacteria and connects the cell's interior and periplasm (the compartment between both membranes) to the cell's exterior. That connection creates a path for drug molecules to exit the cell.

"This is a really, really large system — approximately a million and a half atoms," said Los Alamos theoretical biologist Cesar A López. It was therefore a significant moment when the laboratory's supercomputers successfully performed the first atomistic simulations of the entire MexAB-OprM pump embedded within a double membrane system on a microsecond time scale.

The researchers used the simulations to investigate the dynamics of the assembled pump and to understand how pump functionality arises from these dynamics. The amino acid interactions that stabilise the complex between MexA and OprM were also independently cross-validated using a computational technique called sequence covariation analysis by Los Alamos theoretical biologist Timothy Travers.

"This is the first time such a sequence-based technique has been applied for cross-validating the interface of a protein complex built using simulations and cryo-electron microscopy," said Travers.

Application of these computational techniques to the multitude of efflux pumps found in different Gram-negative pathogens should allow scientists to elucidate if general mechanisms are shared among different pumps or are pump-specific. For example, perhaps the amino acid interactions that stabilise the pump structure could be targeted by drug development efforts to block pump assembly or function, thereby rendering currently defunct antibiotics effective once more.

"By understanding how the pump moves and dynamically behaves, we can potentially find a way to deactivate the pump — and antibiotics that haven't worked in a long time may be useful again," said Los Alamos biophysicist Gnana Gnanakaran.

The findings have been published in the journal *Scientific Reports*.

Ingestible capsule measures gut gases

Researchers at RMIT University in Melbourne have developed an ingestible capsule that detects and measures gut gases — hydrogen, carbon dioxides and oxygen — in real time.

The first human trials of the gas-sensing, swallowable capsule showed that the human stomach uses an oxidiser to fight foreign bodies in the gut. The technology could revolutionise the way that gut disorders and diseases are prevented and diagnosed.

"We found that the stomach releases oxidising chemicals to break down and beat foreign compounds that are staying in the stomach for longer than usual," said study lead and capsule co-investor Professor Kourosh Kalantar-zadeh.

"This could represent a gastric protection system against foreign bodies. Such an immune mechanism has never been reported before."

Another never-before-seen observation from the trial was that the colon may contain oxygen.

"Trials showed the presence of high concentrations of oxygen in the colon under an extremely high-fibre diet," Kalantar-zadeh said. "This contradicts the old belief that the colon is always oxygen-free.

"This new information could help us better understand how debilitating diseases like colon cancer occur."

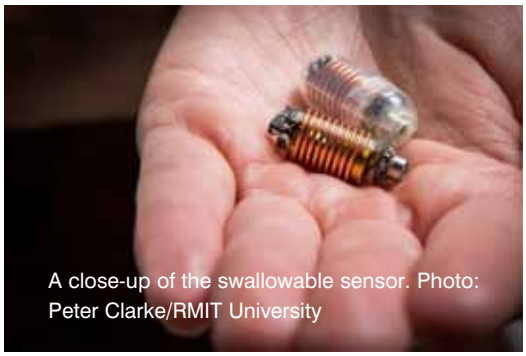
Results showed that the capsule accurately shows the onset of food fermentation, highlighting its potential to clinically monitor digestion and normal gut health.

The trials also demonstrated that the capsule could offer a much more effective way of measuring microbiome activities in the stomach, a critical way of determining gut health.

"Previously, we have had to rely on faecal samples or surgery to sample and analyse microbes in the gut," Kalantar-zadeh said.

"But this meant measuring them when they are not a true reflection of the gut microbiota at that time. Our capsule will offer a non-invasive method to measure microbiome activity."

Now that the capsule has successfully passed human trials, the research team is seeking to commercialise the technology.



A close-up of the swallowable sensor. Photo: Peter Clarke/RMIT University

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RNA interference (RNAi), CSIRO's patented gene silencing technology, is enabling researchers around the world to protect plants and animals from diseases, and to develop new plant varieties with beneficial attributes.

CSIRO has provided research materials to 3700 laboratories around the world and has issued more than 30 research and commercial licences for RNAi to date.

Global forestry company FuturaGene is the latest of public and privately funded organisations worldwide to license the technology which enables scientists to reduce or switch off the activity of single genes, with enormous benefits, especially in agriculture. FuturaGene will use RNAi technology to develop more resilient forestry crop varieties, primarily eucalyptus and poplar.

Technologies for preserving and enhancing yield in renewable plantations are an imperative for meeting growing wood demand in the face of climate change and increasing pest and disease threats, while preserving natural forests.

Other uses of RNAi technology include developing potatoes that don't go brown, animal feed that's easier to digest and an improved industrial oil.

Senior Research Scientist with CSIRO Agriculture and Food Ming-Bo Wang was one of the scientists involved in RNAi's development in the mid-1990s, and together with colleague Peter Waterhouse, received the 2007 Prime Minister's Prize for Science for the work.

"One of the projects we were working on at the time was with the potato chip industry; we were trying to develop a virus-resistant potato," Dr Wang said.

"We discovered that when plants are attacked by viruses they use double-stranded RNA to mount a counterattack.

"We realised we could make use of this 'virus immune' response to develop a mechanism that would stop individual genes from passing on information.

"At first we didn't think much of it but when we realised we'd uncovered a fundamental mechanism for silencing genes, we knew there would be widespread applications."

The RNAi mechanism was used by US company Simplot to develop the 'Innate' potatoes that bruise less than other potato varieties. The potatoes also produce less acrylamide, a chemical which can accumulate in starchy foods such as potatoes when they are cooked at high temperatures.

Forage Genetics has licensed RNAi to develop an animal feed that is more easily digested. Alfalfa (or lucerne) is an important source of cattle feed in many countries. One major challenge for farmers is that if harvested late, alfalfa can contain high levels of lignin, the fibrous material that is important for binding cells, fibres and vessels in plants. Animals are unable to digest lignin.

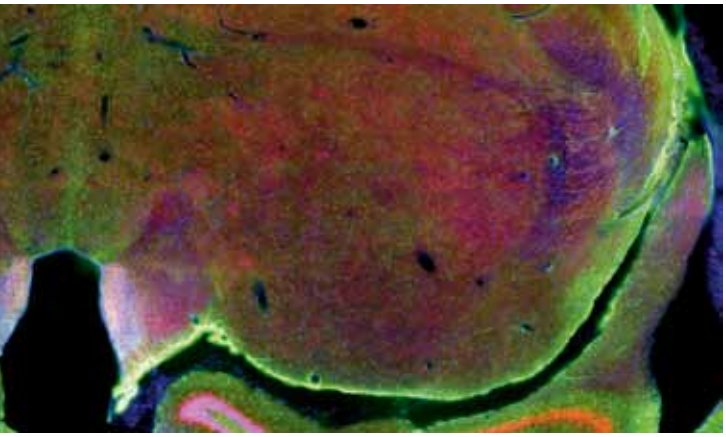
HarvXtra alfalfa has up to 20% less lignin, making it much more digestible for cattle. It can also be harvested seven to 10 days late without sacrificing quality.

CSIRO itself has made use of RNAi to develop safflower seed oil that contains over 93% oleic acid, a valuable component in industrial chemicals and lubricants. Super high oleic oil safflower is being commercialised by GO Resources.

Dr Wang said that while there are more recent gene editing tools, RNAi will have a major role to play for many years to come because of its ability to silence multiple genes at the same time and tone down the expression of essential genes without killing a plant. He said that CSIRO was continually developing new tools, technologies and techniques to improve RNAi delivery, potency and ease of use.

Image courtesy of CSIRO.

Using gene silencing technology, CSIRO developed a safflower seed oil that contains over 93% oleic acid, a valuable component in industrial chemicals and lubricants.



Ultrafast laser system for multiphoton microscopy

The Spark 1040 Laser System from Chromacity Lasers is an air-cooled, compact, ultrafast ytterbium fibre-based laser providing high performance with turnkey operation. It is available in two versions, delivering either 500 mW or up to 2.5 W, with picosecond or femtosecond pulse-widths and operating at a wavelength of 1040 nm.

Applications include multiphoton microscopy, light-sheet microscopy, optogenetics imaging experiments, fluorescence measurement of dyes/quantum dots and time-resolved experiments (TCSPC/FLIM).

In multiphoton optogenetics experiments, the product has three key benefits. Inherent 3D resolution allows cells/groups of cells to be imaged at typically micron resolution in the z-axis and a few hundred nm in the XY plane; using a pulse laser source also allows time resolved measurements to be taken. Images can be captured at greater sample depths by the use of 2x or 3x longer wavelengths resulting in a 16x or 81x reduction in scatter as well as an increase in image depth. Photobleaching and photothermal degradation is reduced, allowing in vivo experiments to be more readily accessible.

SciTech Pty Ltd
www.scitech.com.au

Sequencing workflow

The NovaSeq Xp workflow, for use with the NovaSeq 6000 sequencing system, enables sequencing of different library pools in each lane of the flow cell. Made up of the NovaSeq Xp 2-Lane and 4-Lane Kits, and the Xp Flow Cell Dock, the workflow allows users to easily load libraries directly into each lane of the NovaSeq flow cell — providing flexibility to the user's run configuration.

Users can separate projects and sequencing methods by lane, multiplex within lanes to increase the total number of samples per flow cell and decrease DNA input compared to the standard workflow. The optional workflow is compatible with both manual loading and automated loading using liquid handling robots.

Illumina Australia Pty Ltd
www.illumina.com

Multimode reader with integrated microplate stacker

Tecan's Spark multimode reader can now provide walkaway processing of up to 50 assay plates per run with the addition of the Spark-Stack integrated microplate stacker. The versatile and field-upgradeable module is designed to automate plate loading, unloading and restacking for non-lidded SLAS-format microplates from six to 1536 wells.

Suitable for assays requiring room temperature pre-incubation steps, the Spark-Stack is equipped with removable dark covers to protect light-sensitive assay, such as AlphaLISA, AlphaScreen, AlphaPlex and GFP-transfected cells. Software updates to both SparkControl and SparkControl Magellan provide seamless operation of the Spark-Stack module, helping to streamline laboratory workflows and allowing overnight running for greater productivity.

Tecan Australia
www.tecan.com.au

GC-MS systems

Updated with capabilities in high-resolution accurate mass (HRAM) GC-MS, the Thermo Scientific Orbitrap GC-MS systems are suitable for metabolomics, food safety, environmental, pharma and toxicology applications. The systems are designed to provide sensitive and selective compound identification of complex samples for both research and routine laboratories performing gas chromatography mass spectrometry (GC-MS).

The addition of Variable electron Voltage (VeV) technology enables low electron voltage settings to be used during electron ionisation (EI) protocols, promoting high mass signals and providing high sensitivity for compounds prone to extensive fragmentation.

Due to the Orbitrap GC-MS HRAM Metabolomics Library for electron ionisation (EI), metabolite identification is efficiently streamlined. The library includes more than 800 metabolites and the spectra is refined and curated with the elemental composition of each EI fragment verified.

TraceFinder Automated Compound Identification software features a specialised spectral deconvolution library and automated compound identification to enable identification of challenging compounds.

Thermo Fisher Scientific
www.thermofisher.com.au

2D image analysis software

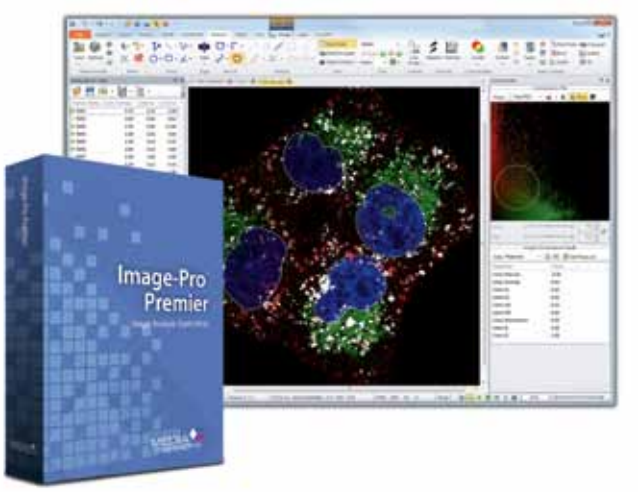


Image-Pro Premier, by Media Cybernetics, is a 2D image analysis software package that offers intuitive tools that make it easy to capture, process, count, measure, analyse and share images and valuable data. Image-Pro Premier v9.3 offers 64-bit support, a user-friendly interface and a suite of 2D measurement solutions.

Image-Pro Premier's technique for performing automatic measurements is a suitable solution for gathering data from images by segmentation systems. Image-Pro Premier v9.3 is packed with improved tools that give the user more power to process and analyse images, such as: creating, downloading and sharing custom apps; capturing single images and movies; processing and enhancing; measuring distances and areas; tracking objects and measuring intensity; automatically counting and classifying objects; automating tasks; and sharing work.

The software is used worldwide by thousands of researchers and imaging professionals in a wide range of applications, including life science research, pathology, fluorescence imaging, ring analysis and ageing, cell biology, industrial inspection, quality control, particle analysis, forensics, etc.

Scitech's multidisciplined imaging and applications team offers in-depth knowledge, advice, training and technical support for all imaging requirements.

SciTech Pty Ltd
www.scitech.com.au

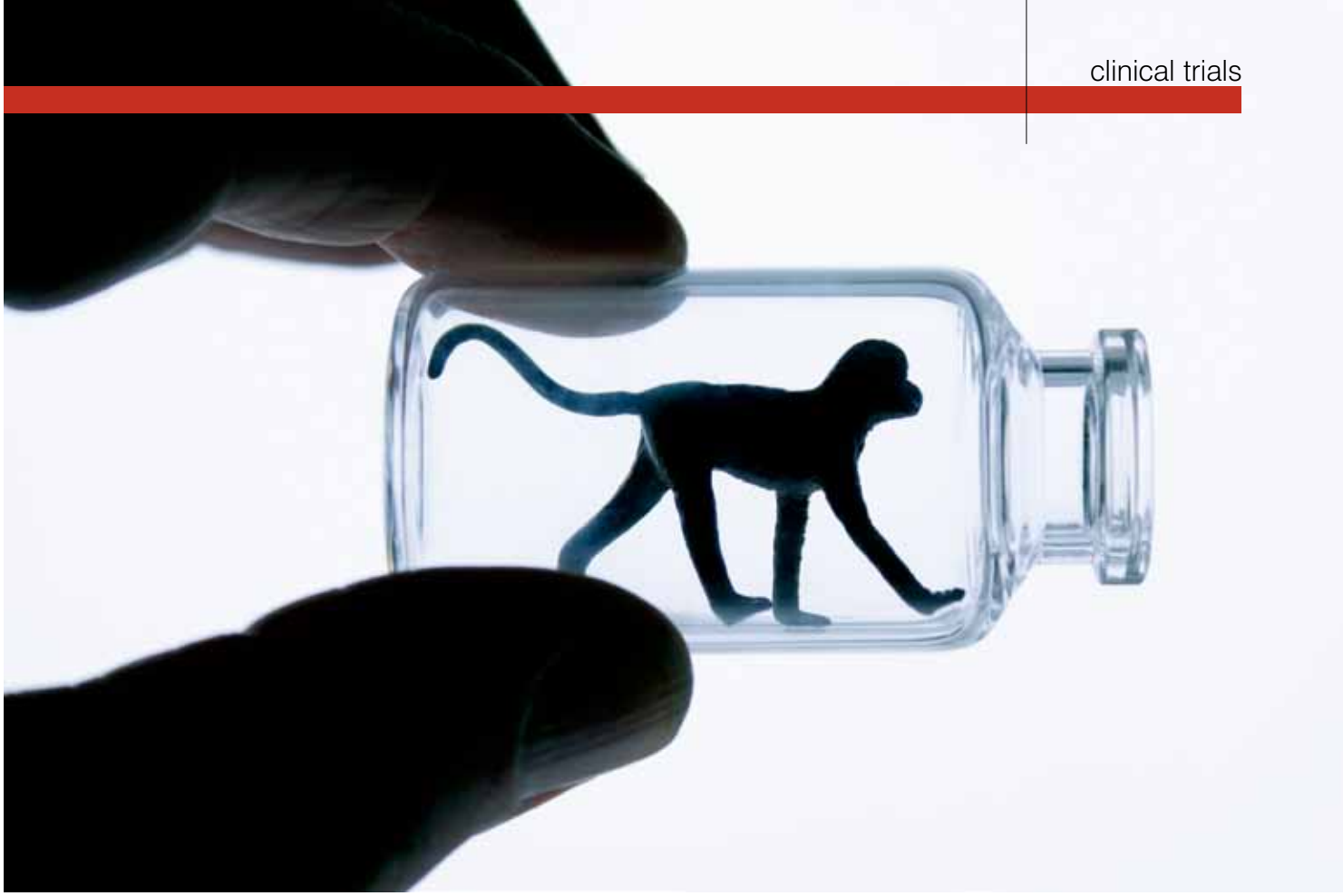
Fragment analysis kits for cfDNA quality control

Sequencing cell-free DNA (cfDNA) fragments, a biomarker used to detect and treat cancer via a liquid biopsy needs an optimal DNA concentration during flow-cell loading. Advanced Analytical Technology's line of High Sensitivity Fragment Analysis Kits for its Fragment Analyzer Automated Capillary Electrophoresis System can measure the size and concentration of the three common cfDNA fragments — the ~165 bp mono-nucleosome, the ~350 bp di-nucleosome and the ~565 bp tri-nucleosome — using only 2 mL of sample.

The kits use internal standards, which enables DNA quantification within 25%. The sizing accuracy for the small fragment and NGS kits is within 5%, while the accuracy of the large fragment kit is around 15%. Runs are completed in less than an hour.

The kits contain everything required for an optimised capillary electrophoresis experiment on cfDNA.

Millennium Science Pty Ltd
www.mscience.com.au



Study raises concerns over animal trials

An investigation into testing of a new tuberculosis vaccine has suggested the researchers misrepresented the results of animal studies to gain funding and approval for further trials.

The vaccine, developed by researchers at Oxford University, was reported to be effective in animal studies but did not show a benefit in human trials. An investigation by *The BMJ* found that weak results from a monkey study were not included in submissions for funding and approval for human trials, raising concerns about systematic failures in preclinical animal studies, the precursors to human clinical trials.

Led by *The BMJ*'s Associate Editor, Dr Deborah Cohen, the investigation and linked expert commentaries highlight the "pick and mix" approach to animal research and raise wider questions about lack of oversight and transparency, unaccountable regulatory decision making, and lack of clarity about what data are required when deciding to move from animal (preclinical) studies to human (clinical) trials.

Whereas in clinical medicine, clinical trial registries help prevent selective presentation of evidence, there is no comparable mechanism for preclinical evidence.

As such, experts warn that this investigation is just one example of "a systematic failure" afflicting preclinical research and call for urgent action "to make animal research more fit for purpose as a valuable and reliable forerunner to clinical research in humans".

The investigation focuses on MVA85A, a vaccine developed by researchers at Oxford University to boost the effectiveness of the BCG vaccine and provide extra protection against tuberculosis, which kills over a million people a year.

It was reported to have been shown to be effective in animal studies, but failed to show benefit when tested in a large clinical trial in South African infants in 2009.

The *BMJ* has been told that this apparent disparity between the animal and human results has led major funders of TB research to rethink their funding priorities, with allegations that this has slowed progress in the entire field.

But an independent systematic review in 2015 concluded that the results of the animal studies had been overstated.

And it appears that while the clinical trial was in the late stages of preparation, a study in monkeys should have raised doubts about the effectiveness of MVA85A. Although the monkey study was too small to draw firm conclusions, the results sparked concerns in academic circles.

Yet several months after the monkey study ended, it appears that these results were not included in information submitted to regulators for approval and funding of human trials of MVA85A.

While publicly relying on claims that the vaccine had been shown to be safe and effective in animal studies, the Oxford researchers played down their significance when speaking privately.

The *BMJ* investigation also shows the difficulties in obtaining basic information, such as the study protocol and the application for ethical approval to conduct the study, leaving questions about the exact purpose of the monkey study unanswered.

Jonathan Kimmelman, Associate Professor in the Biomedical Ethics Unit at McGill University in Canada, said that this is not an isolated case. "It's widely recognised that animal studies intended to support drug development are often riddled with flaws in design and reporting. But it sometimes feels as if regulators and ethics committees missed the memo. Unfortunately, there are other cases where new treatments were put into human testing on animal evidence that was foreseeably flawed, incomplete or even negative," he said.

The story of MVA85A also raises questions about how researchers and institutions respond to criticism.

In a linked editorial, Malcolm Macleod, Professor of Neurology and Translational Neuroscience at the University of Edinburgh, said, "We need to develop better and more systematic ways to establish when a drug is ready for clinical trials in humans — and importantly, when it is not."

The story of MVA85A also raises questions about how researchers and institutions respond to criticism, he added.

"Until our institutions recognise that their core purpose is to produce research of value to society they risk a slow decline in their reputation, and possibly a faster and more serious erosion of public trust in science. In these troubled times that public trust is more important than ever."

Finally, Merel Ritskes-Hoitinga and Kim Wever at the Department for Health Evidence in The Netherlands have said improvements in the design, registration, reporting, appraisal and transparency of animal studies are urgently needed. They call on funders, journals, regulators, academia and ethics committees to lead "a culture change" to realise the potential of animal studies to transform human health.

what's new

Liquid chromatograph mass spectrometer system

Shimadzu Corporation has released the Nexera Mikros, a micro flow rate-compatible liquid chromatograph mass spectrometer system. The Nexera Mikros maintains the durability and operability of liquid chromatograph mass spectrometer (LC-MS) systems to date while providing greater than 10 times the sensitivity, according to the company.

In recent years, in the field of pharmaceutical development, analysis is sometimes performed on trace amounts of components in blood. Examples include studies of the pharmacokinetics of new administered drugs, and hormones within living organisms. In such cases, LC-MS systems compatible with nano flow rates have been utilised, in order to improve the efficiency of the intake of target components to the mass spectrometer. However, nano flow rate-compatible LC-MS systems had room for improvement in terms of instrument operability and processing speed, such as a tendency for pipes to clog, difficulty discovering liquid leaks and the hours required for the analysis of a single sample.

The Nexera Mikros can accommodate a wide range of flow rates, from the semi-micro flow rates (100 to 500 μL/min), which are often used for analysis in existing systems, to micro flow rates (1 to 10 μL/min). This system establishes both durability and operability while enabling analysis with greater than 10 times the existing sensitivity. Through this product, Shimadzu is contributing to improving the productivity at pharmaceutical companies and clinical consignee research organisations.

Shimadzu Scientific Instruments (Oceania) Pty Ltd
www.shimadzu.com.au

Gene expression panel

The PanCancer IO 360 Gene Expression Panel enables the rapid discovery and development of potentially predictive signatures.

The 770-gene expression panel interrogates vital components in the complex interplay between the tumour, microenvironment and immune response in cancer for a multifaceted characterisation of disease biology and interrogation of mechanisms of immune evasion.

Developed specifically for translational research, the powerful panel incorporates 15+ potentially predictive research use only (RUO) biological signatures, including the 18-gene Tumor Inflammation Signature.

Bio-Strategy Pty Ltd
www.bio-strategy.com

Aggresome detection kit

Enzo Life Sciences' PROTEOSTAT Aggresome Detection Kit provides a rapid, specific and quantitative approach to identifying inhibitors relevant to neurodegenerative disease in a cellular context. The kit is suitable for screening compounds of potential therapeutic value, and optimised for antibody co-localisation studies to identify interactions between aggregated protein cargo and the various proteins implicated in autophagy and aggresome formation.

The kit includes a simple assay that does not require non-physiological protein mutations or genetically engineered cell lines. It easily quantifies aggresome and related inclusion bodies by flow cytometry.

The product has been validated under a wide range of conditions and with small molecule modulators. It is particularly useful for the study of neurodegenerative diseases, liver disease, toxicology studies and more.

Sapphire Bioscience
www.sapphirebioscience.com

Insights into Australia's clinical trial activity

A report by the Australian New Zealand Clinical Trial Registry, housed in NHMRC Clinical Trials Centre at the University of Sydney, reveals favourable insights into clinical trials in Australia — an area that receives more than $1 billion of investment each year.

The report represents one of the most comprehensive assessments of clinical trial activity in Australia ever undertaken, according to the researchers. It draws on data from 10,549 Australian clinical trials registered between 2006 and 2015, highlighting important national trends in Australian clinical trial activity.

"Clinical trials are an essential part of an effective and efficient healthcare sector, and a vital strategy in ensuring better health for all Australians," said Associate Professor Lisa Askie, director of Systematic Reviews and Health Technology Assessment at the NHMRC Clinical Trials Centre.

"They ensure that the best treatments, to both prevent and treat illness, are assessed rigorously before being implemented into routine care.

"As such, it is vital to ensure that the clinical trials we are doing in Australia meet the needs of our citizens, and that the clinical trials sector remains robust and competitive by international standards."

The report found that a total of 5.2 million people have participated in Australian clinical trials registered from 2006 to 2015. Just under half (45%) of these trials had some kind of industry involvement, either as a funding source, primary sponsor, secondary sponsor or other collaborator.

Cancer has been the most frequently studied health issue in recent Australian clinical trials at 18%, followed by mental health (10%) and cardiovascular conditions (12%). Trial activity in mental health has grown particularly steadily since 2006, and trials registered each year in this area have outnumbered trials for all other health conditions, except cancer, since 2010.

Measured against the relative 'burden of disease' represented by the top National Health Priority Area conditions, cardiovascular disease has seen fewer trials than would be expected but significantly more participants. For mental health, the number of trials is close to what would be expected, but the total number of trial participants is lower. Meanwhile, some areas of high disease burden, such as dementia and obesity, remain under-represented.

Clinical trials in Australia assess multiple types of interventions, including drug treatments (47%), surgery (4%), medical devices (10%), behavioural therapies (10%) and prevention strategies (11%). The range of activity includes large, multicentre, phase 3 trials likely to have an impact on clinical practice directly, as well as early-phase trials testing novel therapies or interventions that may become the new best treatments of tomorrow. Australia ranks towards the middle of comparable nations in terms of clinical trial activity on a per capita basis, above Canada and Ireland, for example, and below Sweden and New Zealand.

More than $1 billion is invested in Australian clinical trials each year by both government and industry — an investment that is said to represent great value for money. For example, a recent joint report by the Australian Clinical Trials Alliance and the Australian Commission on Safety and Quality in Health Care showed that in investigator-initiated trials conducted within trial networks, for every $1 invested there was a greater than $5 return on investment. Several other studies have demonstrated significant return on investment and improved health outcomes in systems with high clinical trial research participation.

"The information contained within this report will help consumers, clinicians, industry, universities and those in the healthcare sector to better prioritise, plan and perform clinical trials," said Professor Askie.

"This will lead to innovation and efficiency, and will help improve the health of all Australians."

Professor Askie suggested that prioritisation of trials in future "should be based on factors such as disease burden or gaps in health outcomes between different populations, and include those areas with the potential to have a greater impact and return on investment".

"For example, clinical trials targeting interventions in the perinatal or early childhood period could be important in terms of lifetime benefits."

Falcon III

Next Generation EMCCD

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The Falcon III EMCCD camera is based on e2v's next generation CCD-351 back-thinned 1" sensor. It combines high sensitivity, speed and resolution with QE up to 95%.

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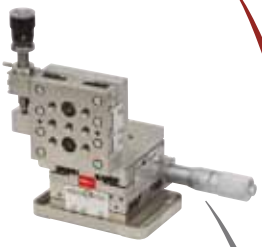

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Laboratory refrigerators with Profi controller

The LIEBHERR Laboratory Refrigerators with Profi controller are German engineered and equipped with features and functions to securely store the user's valuable samples and reagents safely at precise, temperature-controlled conditions.

The LIEBHERR Laboratory Refrigerators come with the high-tech Profi electronic controller (with digital display) which allows temperatures to be set between 0 to +16°C, with 1/10°C accuracy and controlled using the in-built 3-point calibration function when an external temperature sensor is used. Temperature stability and consistency is maintained by the dynamic (forced-air) cooling system working in conjunction with the highly efficient compressor and eco-friendly, energy-efficient refrigerant (R 290).

The laboratory refrigerators are said to defrost less often and faster (in just 8 min) using a hot gas defrost system. They are fitted with locks, equipped with integrated visual and audible alarms to warn users of undesirable temperature deviations and have an integrated data memory to record the last 30 alarm events and one week's worth of temperature profiles. Temperature data can also be transferred to a building management system via RS485 interface and alarms can be forwarded to an email, phone, etc via volt-free contact.

Andi-Co Australia
liebherrprofessional.com.au

Fraction collector

Bio-Rad Laboratories' NGC Fraction Collector allows researchers to choose how to collect and when to access their fractions.

When used with the NGC Chromatography System, the NGC Fraction Collector provides the flexibility and collection capacity needed for any application, from discovery to scale-up.

The system can be triggered to collect based on slope, per cent of buffer from pump B, pH and detector signals. Front-to-back dispensing provides easy access to fractions before method completion for faster downstream analysis. Researchers can also choose the type of collection vessel they prefer for each phase in a method, including deep-well plates, tubes, bottles and carboys (with prep-rack adaptors for large-scale purification). Adding two new fraction collectors to each NGC system can further expand capacity.

An efficient benchtop Peltier cooling module saves lab space and preserves the integrity of temperature-sensitive biomolecules. An optional enclosure protects samples from environmental conditions while allowing full access during a run. Because the enclosure is optional, the same fraction collector can also be used for reverse-phase chromatography applications.

The fraction collector runs on ChromLab 5.0 Software, to which users can upgrade for free, no matter what edition they currently use.

Bio-Rad Laboratories Pty Ltd
www.bio-rad.com

Risk management module

LTech's latest standalone module, Lims1 Risk Management, is specifically designed to help laboratories better manage risk and compliance.

Aligned with the ISO 31000 risk management standard, Lims1 Risk Management enables users to quickly and easily assess their laboratory risks, generate reports and store a history of risk information.

With Lims1 Risk Management, compliance obligations can be allocated and scheduled, requiring signoff when due. Alert features remind the user when tasks are due and escalate them to a manager when tasks are overdue. The Incident module allows users to publish forms and report incidents, complaints, breeches, feedback or any other issues. The forms can be published on the company home page or on company's intranet for staff use.

LTech's aim is to provide an intuitive and easy-to-use product. The Lims1 Risk Management Software as a Service (SaaS) delivery model means instant deployment, so no hardware requirements or software installs are necessary. All the user needs is an up-to-date browser.

LTech Australia Pty Ltd
www.lims1.com

Kit for clarification and filtration of mammalian cell culture

The convenient, ready-to-use Sartoclear Dynamics Lab P15 kit combines a syringe pre-filled with a filter aid for clarification and an integrated 0.2 μm polyethersulfone filter for sterile filtration.

The kit has been designed for harvesting small volumes of up to 15 mL of mammalian cell cultures in the lab. It performs the clarification and sterile filtration in one step quickly, effortlessly and without any prior centrifugation step.

The two-in-one, single-use system is designed for all cell densities — up to 20 x 10^6 cells/mL and even higher.

Sartorius Australia Pty Ltd
www.sartorius.com

S. aureus CRISPR/Cas 9 monoclonal antibody

EpiGentek has released a monoclonal antibody that is specific to ***Staphylococcus aureus*** Cas9 (SaCas9) and enables easy and specific monitoring of gene editing processes.

The CRISPR/Cas9 system allows for sequence-specific cleavage of a targeted genomic locus by delivering the RNA-guided Cas9 nuclease and appropriate guide RNAs into a cell. In addition, the protospacer adjacent motif (PAM) sequence immediately following the specificity sequence is necessary for successful binding of the Cas9 nuclease.

It is important to monitor the level of Cas9 editing protein or track the Cas9 editing protein in transfected cells, as it will show transfection efficiency and optimise the editing process in the total cell population. SaCas9-mediated genome editing has been reported in human cells and Arabidopsis. Because SaCas9 (1053 a.a.) is smaller than ***Streptococcus pyogenes*** Cas9 (SpCas9) (1368 a.a.), SaCas9 could have advantages for delivering and expressing Cas9 protein, especially using virus vectors.

Sapphire Bioscience
www.sapphirebioscience.com

Lauren Davis

‘Programmable droplets’ could replace pipettes

Pipettes have been a staple of biology labs for decades, providing a hygienic and accurate alternative to the less-than-ideal practice of ‘mouth pipetting’.

Above: Two droplets before merging. Image courtesy of Udayan Umapathi/MIT Media Lab under CC-BY-NC-ND 4.0

Now, researchers from the Massachusetts Institute of Technology (MIT) are replacing the humble pipette with lab-on-a-chip technology that uses electric fields to move droplets of biological solutions around a surface, mixing them in ways that could be used to test thousands of reactions in parallel.

“Biologists in a lab spend on average 30–50% of their time manually moving fluids, and this task is not only tedious, but is also error-prone,” said Udayan Umapathi, a researcher at the MIT Media Lab. “On top of that, each of these labs produce massive amounts of hazardous trash in the form of pipette tips.

“Of course you can replace the human with a pipetting robot, but each of these machines have their own definition for what a protocol is and there are multiple research laboratories developing their own standard.”

Furthermore, Umapathi said, pipetting robots do not solve the problem of pipette waste, with pharmaceutical companies in particular guilty of employing robots equipped with dozens or even hundreds of pipettes.

“If you look at drug discovery companies, one pipetting robot uses a million pipette tips in one week,” he said. “That is part of what is driving the cost of creating new drugs.”

Another alternative to pipetting is microfluidic devices, in which biological solutions are pumped through microscopic channels connected by mechanical valves. Umapathi noted that traditional microfluidic systems that use tubes, valves and pumps are mechanical — which means they have a tendency to break down.

“I noticed this problem three years ago, when I was at a synthetic biology company where I built some of these microfluidic systems and mechanical machines that interact with them. I had to babysit these machines to make sure they didn’t explode.

“Biology is moving toward more and more complex processes, and we need technologies to manipulate smaller and smaller volume droplets,” Umapathi continued. “Pumps, valves and tubes quickly become complicated. In the machine that I built, it took me a week to assemble 100 connections. Let’s say you go from a scale of 100 connections to a machine with a million connections. You’re not going to be able to manually assemble that.”

Seeking a solution to this problem, Umapathi and his team have been developing lab-on-a-chip technology based on a physical principle called

electrowetting, whereby electric fields are used to move, merge, stir and analyse tiny biological samples. Their research has been described in the journal *MRS Advances*.

"So fundamentally what we are doing in our chip is to charge and discharge tiny metal plates," Umapathi explained. "This charging and discharging of these metal plates attracts and repels tiny droplets. And by sequentially turning on and off these metal electrodes, you can gently shuttle a drop from one location to another. We developed a new surface coating that prevents droplets from leaving a trail behind and thus preventing contamination between droplets which could cross each other."

Thousands of droplets could be deposited on the surface of Umapathi's device, automatically moving around in computationally prescribed patterns in order to carry out experiments efficiently, cost-effectively and at large scales. The system includes software that allows users to describe the experiments they wish to conduct, before automatically calculating droplets' paths across the surface and coordinating the timing of successive operations.

"The operator specifies the requirements for the experiment — for example, reagent A and reagent B need to be mixed in these volumes and incubated for this amount of time, and then mixed with reagent C," Umapathi said. "The operator doesn't specify how the droplets flow or where they mix. It is all precomputed by the software."

The MIT group is not the first to venture into the field of 'digital microfluidics', with various research groups experimenting with the electrical manipulation of droplets over the past 10 years. However, previous chips have been manufactured using high-end etching techniques that require controlled environments known as clean rooms.

Umapathi and his colleagues have instead focused on getting costs down, with their prototype making use of a printed circuit board (PCB) — a plastic board with copper wiring deposited on top of it — patterned with an array of electrodes. Their chief technical challenge was to design a coating for the surface of the PCB that would a) reduce friction, enabling droplets to slide across it, and b) prevent biological or chemical molecules from sticking to it, so they won't contaminate future experiments.

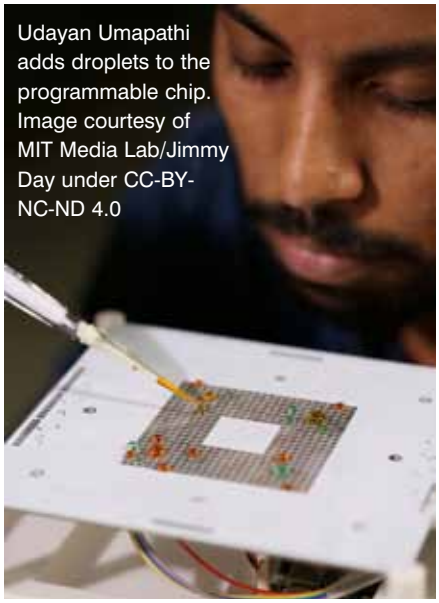
In the prototype, the researchers coated the board with a dense array of tiny spheres, only a micrometre high, made from a water-repellent material that causes droplets to skate across the tops of the spheres. The researchers are also experimenting with structures other than spheres, which may work better with particular biological materials.

Because the board's surface is hydrophobic, droplets deposited atop it naturally try to assume a spherical shape. Charging an electrode pulls the droplet downward, flattening it out. If the electrode below a flattened droplet is gradually turned off, while the electrode next to it is gradually turned on, the hydrophobic material will drive the droplet towards the charged electrode.

Three hundred times a second, a charged electrode in the researchers' device alternates between a high-voltage, low-frequency (1 kHz) signal and a 3.3 V high-frequency (200 kHz) signal. The high-frequency signal enables the system to determine a droplet's location, using essentially the same technology as touch-screen phones. If the droplet isn't moving rapidly enough, the system will automatically boost the voltage of the low-frequency signal. The sensor signal additionally enables the system to estimate a droplet's volume, which, together with location information, allows it to track a reaction's progress.

Umapathi believes that digital microfluidics could drastically cut the cost of experimental procedures common in industrial biology, removing the need for specialty machines and the use of disposables such as pipette tips. He and his colleagues have been running various experiments on their chip to reduce their dependency on pipettes by over 10-fold, and they are even working on liquid assays that could reduce pipetting operations 100-fold.

The team's work has also been noticed by BioBright, a company that develops information systems to manage the wealth of data generated by high-volume biological experiments. BioBright founder and CEO Charles Fracchia described Umapathi's digital microfluidics system as "effectively a cheaper version" of the smaller-volume systems employed by pharmaceutical industry over the past 15–20 years.

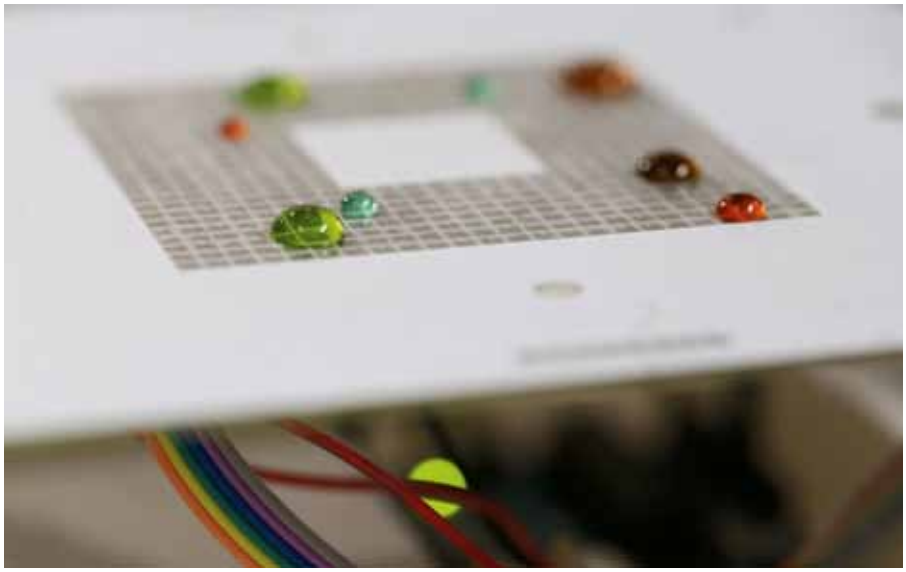


Udayan Umapathi adds droplets to the programmable chip. Image courtesy of MIT Media Lab/Jimmy Day under CC-BY-NC-ND 4.0

"I don't want to call it DIY bio, but it's lower cost, simpler instrumentation, easier access," said Fracchia. "It's exciting that he's managed to do it with lower voltage, and it's exciting that he can do it with a single electrode."

Ultimately, Umapathi hopes his technology will enable existing machines to manipulate over a million samples on a single chip, thus leading to the discovery of new drugs and markers for disease.

"Modern healthcare testing facilities around the world do not scale economically to provide affordable health care," he said. "My hope is that we can bring affordable health care through lab-on-chip technologies to billions of people around the world."



A side view of the programmable chip shows the wiring that supports the actuation and sensing of droplets, allowing for movement and combination of droplets. Image courtesy of MIT Media Lab/Jimmy Day under CC-BY-NC-ND 4.0

Automated force tensiometer

The Attension Sigma 700/701 is a fully automated force tensiometer used to study material properties such as wettability, adsorption, adhesion and more. It provides measurements of surface/interfacial tension, critical micelle concentration (CMC), dynamic contact angle, surface free energy (SFE), powder wettability (washburn), adhesion force, sedimentation and density.

The Attension Sigma Force tensiometer is a versatile tool that can be used in research, development and quality control in a variety of industries such as chemicals, pharmaceuticals, electronics, foods, energy, paper and packaging. The precision of each measurement is ensured by an ultrasensitive microbalance and good sample stage movement. This precision is particularly useful when studying the wettability of powders (eg, lactose) — a property which can significant influence the dissolution rates and interactions with other particles.

The ergonomic and open design offers users easy access to the different parts of the instrument while the easy-to-use user interface ensures that the instrument is quick to learn and easy to operate. OneAttension software combines an intuitive user interface with a high level of functionality including easy measurement set-up, live results, data analysis and reporting tools.

The Attension Sigma can be complemented with a range of accessories to accommodate a number of applications including various probes, temperature control vessels, CMC dispensers, active vibration isolation system and cabinet, and more.

ATA Scientific Pty Ltd
www.atascientific.com.au

Conjugation test kits

The Innova Biosciences Check&Go! Conjugation Test Kits allow scientists to confirm the success of their antibody conjugation in one easy step. The key component of the kit is a nitrocellulose membrane containing a 'test line' of immobilised Protein A and Protein G called a 'half strip'.

Both Protein A and Protein G have a high affinity for the Fc region of a variety of IgG molecules. The half strips also contain an absorbent pad to promote and control the flow of sample through the nitrocellulose. This simple qualitative lateral flow assay does not require any specialised equipment.

Three versions of the kits are available: Conjugate Check&Go!, to confirm the successful conjugation of a coloured label to an antibody; Biotin Check&Go!, to confirm the successful biotinylation of an antibody; and HRP Check&Go!, to confirm the successful conjugation of horseradish peroxidase (HRP) to an antibody.

The test kits are easy to use, enabling users to check the success of their conjugation in only minutes. Each test requires only small volumes to run — 20 to 40 μL of diluted conjugate. There are 30 tests per kit and all components to run the tests are provided.

BioNovus Life Sciences
www.bionovuslifesciences.com.au

Electronic pipettor

The LabCo electronic pipettor is a versatile, motor-driven pipetting instrument designed to deliver precise performance in liquid handling. Its design and operation are based on the principle of air displacement and use disposable pipette tips.

The product has been calibrated and tested according to ISO8655 quality management standards. In compliance with the quality control requirements of ISO8655-6/DIN 12650, each pipette has been tested for gravity with distilled water (DIN/ISO3696, grade 3) at 22°C.

The pipettor comes with a comprehensive range of liquid handling protocols with easy programming. The motor drive with built-in error control improves pipetting precision.

The pipettor includes three speeds for aspiration and dispensing and the efficient lithium-ion battery offers long runtime on each charge. It can be charged through a charging stand or directly through the charging cable. The lower part of the device is autoclavable.

Labtek
www.labtek.com.au

National Research Foundation

Redefining the kilogram

In Sèvres, a small commune on the outskirts of Paris, lies a gleaming lump of metal the size of a palm. Le Grand K, or Big K as they call the platinum and iridium alloy, sits underground in a high-security vault. It is held under three glass bell jars and can only be retrieved using three separate keys, each held by different individuals.

Contrary to appearances, tampering and theft isn't the utmost concern for those who guard Big K. Instead, the artefact's custodians have spent recent years worrying that the alloy isn't quite living up to the reputation that it's held for the past century — that it's no longer exactly one kilogram in mass, but micrograms lighter.

Being off by roughly the weight of a grain of sand might seem trivial, but Big K is the International Prototype of the Kilogram. In other words, it's the gold standard against which all other kilograms in the world are measured. The tiniest discrepancy in Big K's accuracy impacts fields such as medicine, electronics and engineering, sectors where precise measurements are paramount.

But a fluctuating kilogram also has rippling effects on other phenomena — such as force, energy and luminous intensity — that use it as the building block for measurements. Because of the wide-reaching consequences an imprecise Big K holds, scientists are now searching for a more reliable and stable standard for the kilogram — one that doesn't centre on a single piece of metal. Their aim: to redefine the kilogram using a new physical standard by the end of 2018.

"We are about to witness a revolutionary change in the way the kilogram is defined," said physicist Klaus von Klitzing while speaking at CERN last October. Von Klitzing, who won the 1985 Nobel Prize in Physics, is one of the scientists involved in the kilogram's makeover.

The change, many argue, is long overdue. The kilogram is one of seven base units that comprise the International System of Units (SI), the most widely used measurement system in the world today. Originally, both the kilogram and the metre were defined by prototypes and the time was fixed by the earth rotation; however, in the meantime, more and more base units are connected to physical quantities of nature that remain the same regardless of time or location.

One second, for example, is defined as the time it takes for the cesium-133 atom to complete 9,192,631,770 periods of radiation for a specified transition. One metre used to be represented by a metal bar stored alongside Big K in France, but is now defined by how far light travels in a vacuum during 1/299,792,458 of a second.

The kilogram remains the only SI unit represented by an unstable artefact. So in 2014, members of the General Conference on Weights and Measures, the international body which oversees the SI system, voted to redefine the kilogram in terms of Planck's constant, a fundamental constant of quantum mechanics.

The redefinition is a big deal, said John Pratt of the National Institute of Standards and Technology (NIST), the body responsible for the standardisation of weights and measures in the United States. The new definition means we can switch from "a 19th century definition of mass to a more 21st- or 22nd-century definition of mass", Pratt said. "We could get it based on an idea more than an object."

When the gold standard is unstable, as Big K has proved, it's a "huge inconvenience", said Pratt. Big K's unaccounted weight loss means its sister cylinders — cast from Big K and shipped around the world for calibration — are no longer identical to the gold standard. NIST's copies, for example, differ from Big K by roughly 45 micrograms, the weight of an eyelash. That wreaked havoc several years ago, leading to NIST re-issuing certificates for its kilograms and companies producing weights based on NIST's standards having to manufacture new ones.

Redefining the kilogram according to Planck's constant will help avoid such problems altogether. However, physicists need to first get a good enough measure of Planck's constant, the quantum-mechanical number that relates how a particle's energy is related to its frequency and, through $E=mc^2$, to its mass. Once scientists assign an exact fixed value to Planck's constant, they'll be able to derive a new definition for the kilogram.

Two types of experiments are currently underway, both seeking to measure Planck's constant with extraordinary precision. The first is the Avogadro Project, led by an international team of scientists. It involves counting the number of atoms in two spheres of silicon that each weigh the same as Big K. With this number — the precise number of atoms comprising a particular substance — researchers can calculate Avogadro's constant, convert it into a value for Planck's constant and thus relate the kilogram to atomic mass.

The second method uses a device called a watt, or Kibble, balance. It's a scale of sorts that produces a value for Planck's constant by measuring a one-kilogram test mass, calibrated using Big K, against an electromagnetic force. Planck's constant is proportional to the amount of electromagnetic energy required to balance the mass.

In order to calculate the current and voltage that make up the electromagnetic force, physicists at NIST, who are leading the project, use two different universal constants. One is the Josephson constant, while the other is the von Klitzing constant. It was the discovery of the latter, part of the Quantum Hall Effect, that earned von Klitzing the 1985 Nobel Prize in Physics.

Five years earlier, von Klitzing, from the Max Planck Institute for Solid State Research in Germany, conducted experiments to observe the effect of magnetic fields applied to semiconductors that had been cooled to extremely low temperatures. He discovered that in his experiments the electrical resistance rose in a stepwise manner — an integer fraction of a specific number, 25,812.807 ohms, which is now called the von Klitzing constant.

The Quantum Hall Effect, as the phenomenon is called, is now used globally to calibrate electrical resistances. Scientists can use the von Klitzing constant to measure current in a watt balance.

"With the help of fundamental constants, we have the possibility of establishing units that necessarily retain their significance for all cultures, even unearthly and human ones," was a visionary statement of Max Planck more than 100 years ago and today we have the chance to realise this vision. The Quantum Hall Effect triggered this realisation.

Von Klitzing was in Singapore to participate in the annual Global Young Scientists Summit. The five-day event, organised by the National Research Foundation Singapore, facilitated interactions of bright, young international researchers with eminent scientists to discuss key areas of science and research, technology innovation and society, and solutions to global challenges. Among the topics up for discussion was the kilogram's makeover. In November, members of the General Conference on Weights and Measures will gather in Versailles, France, to vote on the new definition for the kilogram, alongside that of the ampere, kelvin and mole. If approved, the updated and fixed values will come into effect from 20 May 2019, on World Metrology Day.

Professor Klaus Von Klitzing, Nobel Prize In Physics (1985). Image credit: NRF Singapore.

Adeno-associated virus (AAV) particles

GeneCopoeia's AAVPrime adeno-associated virus (AAV) products are useful tools for inserting genes into a broad range of cell types with high efficiency and enhanced safety. GeneCopoeia's optimised helper-free human AAV system allows viral packaging without potentially pathogenic helper adenovirus. Many pre-made particles are available in 12 different serotypes, such as fluorescent reporters. Users can also request custom AAV particles for genes up to 3 kb in length.

Key advantages include: high titers — a titer of purified particles can be up to 10^{14} GC/mL; high adaptability — all serotypes are available; versatility, making the product usable in a broad range of host cell types; low toxicity, as the product does not integrate into the host genome; low immunogenicity, with minimal host immune response; and safety, as the product is not associated with any human disease.

AAVPrime uses a helper virus-free system for the safe preparation of high-titer AAV particles. HEK293T cells are co-transfected with three plasmids encoding the factors necessary for recombinant AAV packaging and purified AAV particles are either membrane purified or purified by two-phase partitioning for high-titer AAV ready for in vivo animal use.

The destination vector carries the user's gene of interest (GOI) and two ITRs. Users can choose from a variety of destination vectors carrying promoters including CMV, EF1a, CAG, CBh and tissue-specific promoters, and reporter gene GFP for optimal gene expression and detection. The plasmid that carries the Rep and Cap genes from wild type AAV and the plasmid that carries adenovirus VA, E4 and E2A genes required for efficient AAV production are co-transfected with the destination vector for AAV packaging.

United Bioresearch Products Pty Ltd
www.unitedbioresearch.com.au

Viscometer/rheometer

The Rheosys Merlin VR is a versatile instrument that can easily generate precise data in terms of viscosity, flow curves and yield stress. It is suitable for investigating the mixing, stirring and pumping behaviour of coatings, emulsions and dispersions, as well as for performing conventional flow and viscosity profile experiments.

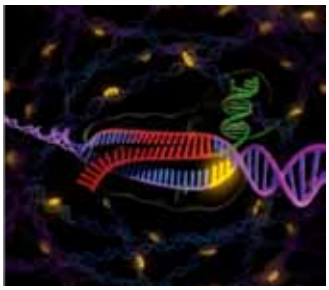
The device features a built-in thermoelectric temperature control system and the ability to conduct temperature isothermal and ramp experiments. It comes complete with co-axial cylinders, and cone and plate and parallel plate measuring systems, enabling the unit to routinely measure a wide range of materials under varied conditions.

The product offers continuous display of viscosity, measured temperature, temperature setpoint, shear rate, shear stress, angular velocity, torque (uNm), % torque and measuring system status on the instrument LCD display or in the Windows software. Research software 'micra' lets users build their own rheological tests — from quick single-point measurements to complete viscosity profiles and yield stress determinations — without the need for complicated test method set-ups.

The innovative design incorporates a thermoelectric temperature control system (-10 to +120°C) that allows isothermal, step and/or ramp temperature profiles. The DIN standard sample measuring systems of cone and plate, parallel plate, and bob and cup, coupled with a wide shear rate and torque range, provide a measurable viscosity range from 1 to 1E08 cP.

Scientex Pty Ltd
www.scientex.com.au

CRISPR products and services



GeneCopoeia's Genome-CRISP CRISPR-Cas9 products and services are designed to provide a complete, powerful solution for precision RNA-guided genome editing.

The company provides over 45,000 human, mouse and rat genes to knock out using CRISPR. It also offers HDR donor cloning vectors and custom HDR donor construction, for CRISPR genome editing applications in which homolgous recombination will be used.

Premade Cas9-expressing stable cell lines are suitable for sgRNA library screening and other high-throughput CRISPR-Cas9 applications. Users can meanwhile easily create knock-ins of virtually any DNA fragment using the company's Safe Harbor knock-in kits for human AAVS1 and mouse ROSA26.

The IndelCheck insertion/deletion detection system is a complete system for pre-validation of sgRNAs and screening for genome modifications. It includes a T7 Endonuclease I assay kit and a target site PCR kit. Target site-specific PCR primers are optional.

Users can choose from seven pre-made, pathway-specific, lentiviral-based sgRNA libraries in a variety of formats. Custom libraries are also available on request.

Finally, VividFISH chromosome probes for fluorescence in situ hybridisation (FISH) will help users with their genome editing workflow in cultured mammalian cell lines.

United Bioresearch Products Pty Ltd
www.unitedbioresearch.com.au

Acid storage cabinet

HEMCO's Acid Storage Cabinet is specifically designed for the storage of corrosive chemicals and is available in 12, 18, 24, 30, 36, 42 and 48″ widths. The standard size is 35″ high and 22″ deep.

The moulded one-piece fibreglass liner inserts directly in the cabinet and is sealed on all edges for ease of cleaning. The interior features a containment lip on the front bottom edge to hold spills.

The front access doors have air inlet vents and are lined, and the edges are sealed. No metal is exposed to corrosive vapours.

The shelf is removable for smaller container storage.

HEMCO Corporation
www.hemcocorp.com

Expression and manufacturing platform

Lonza has announced the launch of its XS *Pichia* 2.0 Expression and Manufacturing Platform for the development of therapeutics.

Pichia pastoris was designed as a valuable alternative to *E. coli* and CHO cells for the production of novel protein formats such as multispecific antibody mimetics. But scaling up of traditional *Pichia* fermentation processes can be challenging due to use of methanol and complex feed regimes. In addition, the fermentation times of traditional *Pichia* processes require guaranteed sterility of the vessel and medium.

To address these challenges, Lonza has developed an expression and manufacturing system that provides high product titres (up to 6 g/L) for these novel compounds along with a fast, robust and scalable manufacturing process suitable for commercial production. The XS *Pichia* 2.0 system is said to deliver high cell viability for improved product quality; reduced fermentation times that approximate *E. coli* processes; and ease of implementation in large-scale plants.

A model-based process development approach enables a product-specific set-up based on the specifications of the full production process and the requirements of the production plant. In addition, the system is complemented by effective high-throughput screening, which enables identification of high-performing clones under fed-batch conditions.

Lonza Australia Pty Ltd
www.lonza.com

Batch quantification system for proteomics and genomics

Lunatic from Unchained Labs makes batch quantification of protein, DNA and RNA simple. It is said to be the easiest-to-use system on the market that can batch measure biologics and genomics from low to high concentrations due to its dynamic range of 0.03–200 OD.

Lunatic is said to get biologics and genomics UV/Vis quantification correct every time. Just drop, load and read — there is no sample prep, no standard curves, no cleaning and no cross-contamination.

Using a proprietary microfluidic chip, the user's 2 μL sample will remain stable for up to 2 h. When the user is ready, Little Lunatic will measure 16 samples on a single chip in 2 min. For higher throughput applications, Big Lunatic is said to be the only microvolume spectrophotometer that can measure in a 96-well format in as little as 5 min.

Lunatic's Unmix applications automatically identify impurities in the user's sample so they learn the true concentration — not just the A260/A280 — as well as exactly what might be messing up their samples.

A host of 21 CFR Part 11 compliant features makes Big Lunatic fully compliant for GLP labs. Its ability to communicate with robots also enables it to be fully integrated into automated workflows.

AXT Pty Ltd
www.axt.com.au

Surface science software

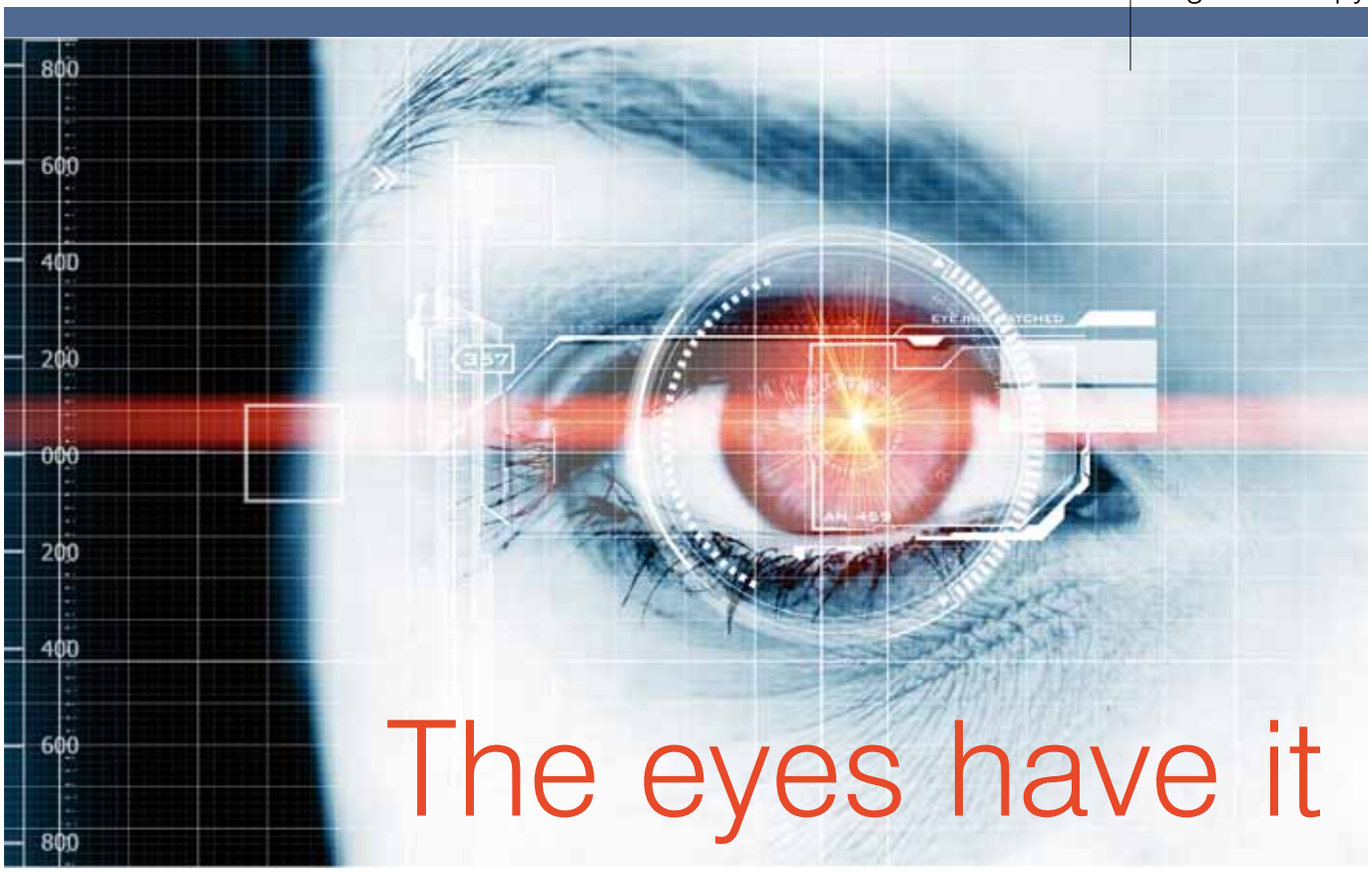
ADVANCE software is designed to be a universal platform for all KRÜSS measuring instruments and now also supports the high-end K100 tensiometer. The software displays the logical workflow of scientific measurements on an intuitive user interface.

The broad scope of methods offered by the K100 include, in addition to standard methods for surface and interfacial tension of liquids, completely automated CMC measurement and processes for characterisation of the wettability of solids and powders right up to the determination of their surface free energy. In parallel with the software release, the measuring instrument also offers technical upgrades, such as a sensor that registers the closing of the sample chamber doors.

The software controls measurement sequences with the aid of ready-made automation programs, reducing manual steps to the absolute minimum. Measurements can therefore start immediately without any further adjustments. Procedures can also be intuitively modified or even created for completely different sequences without any programming knowledge.

The automation programs work hand in hand with the numerous software-controlled K100 components and sensors. Also, the integrated stirrer can switch itself on and off during the procedure in order to homogenise the sample before measurement. During a critical micelle concentration (CMC) measurement, special micro dispensers are integrated in a fully automated procedure which includes creating a concentration series and evaluating the measurement curve.

Scientex Pty Ltd
www.scientex.com.au



The eyes have it

Elizabeth Rakoczy wins Florey Medal for wet AMD gene therapy

Molecular ophthalmologist Professor Elizabeth Rakoczy has been awarded the 2017 CSL Florey Medal for the creation of a new gene therapy for wet age-related macular degeneration (wet AMD) — the most common cause of blindness in the developed world.

Established by the Australian Institute of Policy and Science (AIPS) in 1998, the Florey Medal recognises significant lifetime achievement in biomedical science and/or human health advancement. Supported by CSL since 2007, the medal carries a $50,000 prize and has in the past been awarded to such esteemed names as Graeme Clark, Ian Frazer and Nobel Laureates Barry Marshall and Robin Warren.

The 2017 award recognises Professor Rakoczy — the founding director of the Department of Molecular Ophthalmology at Lions Eye Institute (LEI), University of Western Australia (UWA) — for her contribution to the development of a new gene therapy for wet AMD. The disease causes central vision loss in more than 112,000 Australians and up to 8000 more commence treatment each year in the form of invasive eye injections. Each injection costs about $2000 and patients have six to eight per year.

The new gene therapy, which is proving to be safe and well tolerated in human trials, promises to replace monthly injections with a one-off treatment in which modified viruses take genes directly into cells. Professor Rakoczy first showed that they could carry a healthy replacement for a mutated gene that causes degeneration of the eye's retina. She then showed they can deliver instructions for eye cells to produce their own treatment for wet AMD.

"It is our hope that in the next few years, millions of people suffering from wet AMD will be able to have single-injection therapy to control their condition," Professor Rakoczy said.

The science behind the new treatment began more than 20 years ago when Professor Rakoczy was initially recruited to UWA and the LEI. It was the first research in Australia using gene therapy in ophthalmology or any other medical field and was named by the National Health and Medical Research Council in its 10 of the best national research projects in 2005.

Professor Rakoczy said her research demonstrates how a scientific discovery could make a fundamental difference, noting, "I have been fortunate to be around when recombinant gene technology became available so we could turn infectious viruses into useful delivery vehicles to develop localised 'biofactories' of a desired medication — in this case, in the back of the eye in the retina."

Professor Rakoczy paid tribute to the more than 50 scientists, cell and molecular biologists, physicists, statisticians, virologists, veterinary scientists, ophthalmologists and students who worked together to bring the treatment to fruition. She additionally hopes to adapt her biofactory idea to other diseases to alleviate suffering.

"Professor Rakoczy is a quiet achiever, a world leader in gene therapy and a key contributor to advancing international eye research," said CSL Chief Scientist Dr Andrew Cuthbertson. "CSL is proud to support this award, which recognises excellence in research as well as creating role models for the next generation of medical researchers. Gene and cell therapies hold the potential to significantly reduce vision loss over a patient's lifetime, which is why work in this field is so important."

High-throughput screening 10 times faster

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Scientists have created a faster high-throughput screening process by combining desorption electrospray ionisation (DESI) mass spectrometry with robotic sampling technologies.

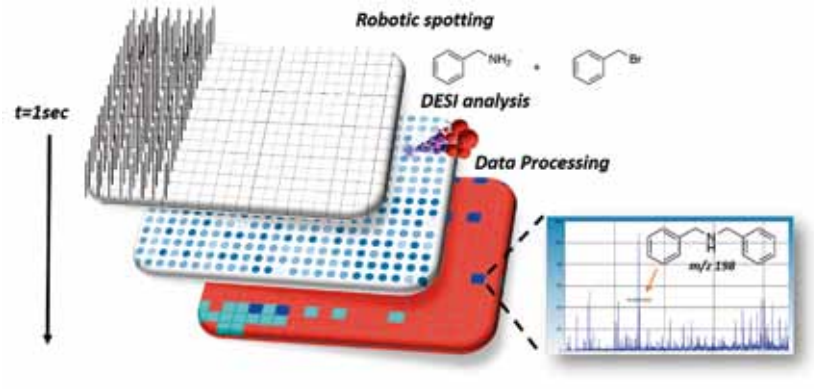
High-throughput screening uses robotics, data processing software, liquid handling devices and sensitive detectors to quickly conduct millions of chemical, genetic and pharmacological tests. It allows researchers to identify active compounds, antibodies or genes that modulate a particular biomolecular pathway, which is especially useful for drug discovery.

"The area of high-throughput library screening reached a plateau, where the fastest screens took about eight seconds per target," said Graham Cooks, the Henry B. Hass Distinguished Professor of Analytical Chemistry at Purdue University, who led the research.

"If you can reduce that time by a factor of 10, which is what we're reporting, then you can potentially do library screens that might have taken months in days," said Cooks.

"Current estimates suggest that there are more than 10^{60} drug-like molecules of pharmaceutical interest and over 10^{7} possible reaction conditions for a single metal-catalysed reaction used to build a drug scaffold. This reality underscores the need for rapid reaction screening and optimisation, particularly with the introduction of automated synthesis techniques and the use of combinatorial methods to generate large numbers of closely related compounds," the researchers wrote in a paper published in The Royal Society of Chemistry's journal *Chemical Science*.

DESI, which was originally developed for biological tissue imaging, sprays electrically charged droplets at a sample, from which ions are



Graphic abstract showing high throughput analysis of reaction mixture arrays using methods that were originally developed for biological tissue imaging. Image courtesy of Purdue University.

generated and then collected and analysed in a standard mass spectrometer. The technique was developed by Professor Zoltan Takáts and others in 2004 in Cook's lab.

"We are spraying a solvent onto a mixture and creating a new product, which we're seeing in a splashed droplet," Cooks said.

This technique allows researchers to perform a reaction and analyse the product in one step, in one second. That's the power of it, Cooks said.

The research was supported by the Defense Advanced Research Project Agency's Make-It! program, which aims to develop technology to create any particular chemical from cheap raw materials. Five research institutions are involved in the program, and Purdue's task is to develop methods to rapidly analyse the results of reagents being mixed together under particular conditions.

The project's objective is essentially to rationalise organic synthesis.

"How do you do that? You have to create some accessible knowledge base, which says that if you combine sample A with sample B you will get sample C," said Cooks. There's an algorithmic knowledge base that needs to be constructed, and then there's the conditions under which particular reagents are examined. So it's not only the reagents, it's also the solvents, the catalysts, the physical conditions that we're looking at."

The current methods for designing and producing new synthetic molecules can take years between initial design and final production. Increasing the rate of discovery and production of molecules could lead to advances in several areas crucial to national security, according to DARPA.

Mobile hyperspectral camera

SPECIM IQ is a mobile hyperspectral camera that allows users to analyse material samples anywhere, in seconds. It is said to meet the real-time monitoring needs of industries ranging from food and health to forensic investigation, recycling, art and agriculture, providing information in an instant for critical decision-making and response.

Hyperspectral imaging, which combines spectroscopy and digital imaging, is useful for demanding measurement applications. By enabling spectral analysis down to the pixel level, it provides the capabilities for analysing the physical and chemical make-up of both large and small samples. Until now, the complexity and bulky size of the equipment and lack of real-time information have limited its use in industrial applications.

Now, SPECIM IQ enables users to concentrate on problem-solving rather than complex data acquisition and processing. The graphical user interface is simple to use, and it provides instant measurement results and insights into the problem without requiring complex mathematics or signal processing skills. This makes the product suitable for medical, cosmetics and other industries.

In the field of agriculture, farmers will be able to screen their crops for infestation and see the results immediately, in many cases a week before any problems are visible to the human eye. Rather than routinely treating crops, they will be able to treat them just where needed. Forensic investigators will meanwhile be able to screen a crime scene for evidence in seconds, rather than collecting samples, sending them to the lab and waiting for days or weeks for the results.

The product also enables members of the OEM industry to build their own applications for their own clientele, made easy by Specim's Application Development Tool.

Adept Turnkey Solutions
www.adept.net.au

New drug could halt MS in its tracks

Monash University researchers are about to conduct a study into a drug that may thwart the progression of multiple sclerosis (MS), following a $70,000 grant from MS Research Australia.

The preclinical study marks the culmination of six years of research by Dr Steven Petratos, who was aided by his team at Monash's Department of Neuroscience. If deemed successful, clinical trials will follow.

Diseases such as MS occur when the protective covering provided to the nerve fibres by the supporting brain cells is damaged or missing. MS affects more than 23,000 Australians, causing symptoms that include muscular spasms and problems with coordination, weakness, balance and functioning of the limbs.

The novel drug, a small molecule called DITPA (Diiodothyropropionic acid), could potentially help patients with secondary progressive MS — the stage that follows relapse and remission, when the disease steadily worsens. Specifically, it may offer protection to nerve fibres damaged by the disease in the brain, spinal cord and optic nerves, as well as enhancing their repair.

The drug's effects, and the mechanism that allows it to work, were found serendipitously by Dr Petratos's team during research into a group of molecules affecting the development of human brain cells called oligodendrocytes, which play an important role in interacting with, supporting and protecting nerve fibres. As explained by Dr Petratos, the molecule has the advantage of being able to cross the blood–brain barrier to target affected cells in the brain — a limitation of existing treatment.

"The drug that we've identified may have a significant benefit in changing the course of MS progression primarily from the aspect of protection of the central nervous system as well as enhancing repair," he said.

Dr Petratos said that while a range of existing drugs moderate MS and treat the inflammation associated with it, they do not address the degenerative aspect. He said the new drug is thus "a potential game changer for MS patients in the future".

DITPA has already been approved by the US FDA for use in clinical trials to treat a rare disorder called Allan-Herndon-Dudley syndrome (AHDS), which severely affects movement, and has been used in larger trials for cardiac problems. Dr Matthew Miles, CEO of MS Research Australia, said, "Repurposing an existing human drug to protect nerve fibres from degradation is different to the standard approach and we're excited to see the results."

Dr Petratos's lab will now test for possible side effects of the drug and any toxic outcomes. He noted that the drug will need to be tested in the long term, as repair to nerve fibres would take years.

The molecule has been patented and the researchers are negotiating with a potential commercial partner to further develop and test the drug in clinical trials.

Commercialising life science research
April 17-18, Brisbane

TTS and AusBiotech are holding TTS Australia, a two-day global meeting of technology transfer, at University of Queensland's Customs House in Brisbane.
The conference will seek to deliver direct interaction with innovators representing international leading universities, research institutions and science parks, as well as biotech CEOs and local biotech sector leaders and is an excellent opportunity for accessing world-class science.

11th International Symposium on Pneumococci and Pneumococcal Diseases 2018
April 15–19, Melbourne
http://isppd.kenes.com/2018/Pages/default.aspx

TTS Australia 2018 — Commercialising life science research
April 17–18, Brisbane
https://www.ttsglobalinitiative.com.au/

AusMedtech 2018
May 1–2, Adelaide
https://www.ausmedtech.com.au/

Australasian Society For Infectious Diseases Annual Scientific Meeting 2018
May 10–12, Gold Coast
https://www.asid.net.au/meetings/asid-annual-scientific-meeting-2018

5th Asian and Oceanic Congress on Radiation Protection
May 20–23, Melbourne
http://www.aocrp-5.org

64th Annual Scientific Meeting for the Australian Mammal Society
July 1–5, Brisbane
http://australianmammals.org.au/events/20_64th_annual_scientific_meeting

Australian Society for Microbiology 2018 Meeting
July 1–5, Brisbane
http://asmmeeting.theasm.org.au/

MACRO2018
July 1–5, Cairns
http:// www.macro18.org/

1st World Congress on Nutrition & Food Sciences
July 9–10, Sydney
http://www.nutritionalconference.com/

8th World Congress on Plant Science & Genomics
July 9–10, Sydney
http://plantgenomics.plantscienceconferences.com/

International Conference on Chemistry Education 2018
July 10–14, Sydney
http://www.icce2018.org/

15th Asia-Pacific Pharma Congress
July 16–18, Sydney
http://asiapacificpharmaconference.blogspot.com.au/

International Symposium on Relations between Homogeneous and Heterogeneous Catalysis
July 22–25, Sydney
http://www.ishhc18.com/

9th Vacuum and Surface Science Conference of Asia and Australia
August 13–16, Sydney
http://www.ansto.gov.au/Events/9thVacuumandSurfaceScienceConferenceofAsiaandAustralia/index.htm

International Society for Clinical Biostatistics and Australian Statistical Conference 2018
August 26–30, Melbourne
http://iscbasc2018.com/

AusAg & Foodtech Summit 2018
September 3–4, Melbourne
http://agfoodtech.com.au/

Melbourne International Joint Breast Congress (MIBC)
October 11–13, Melbourne
http://melbournebreast2018.org/

AusBiotech 2018
October 31–November 2, Brisbane
https://www.ausbiotech.org/events/event/AusBiotech-2018

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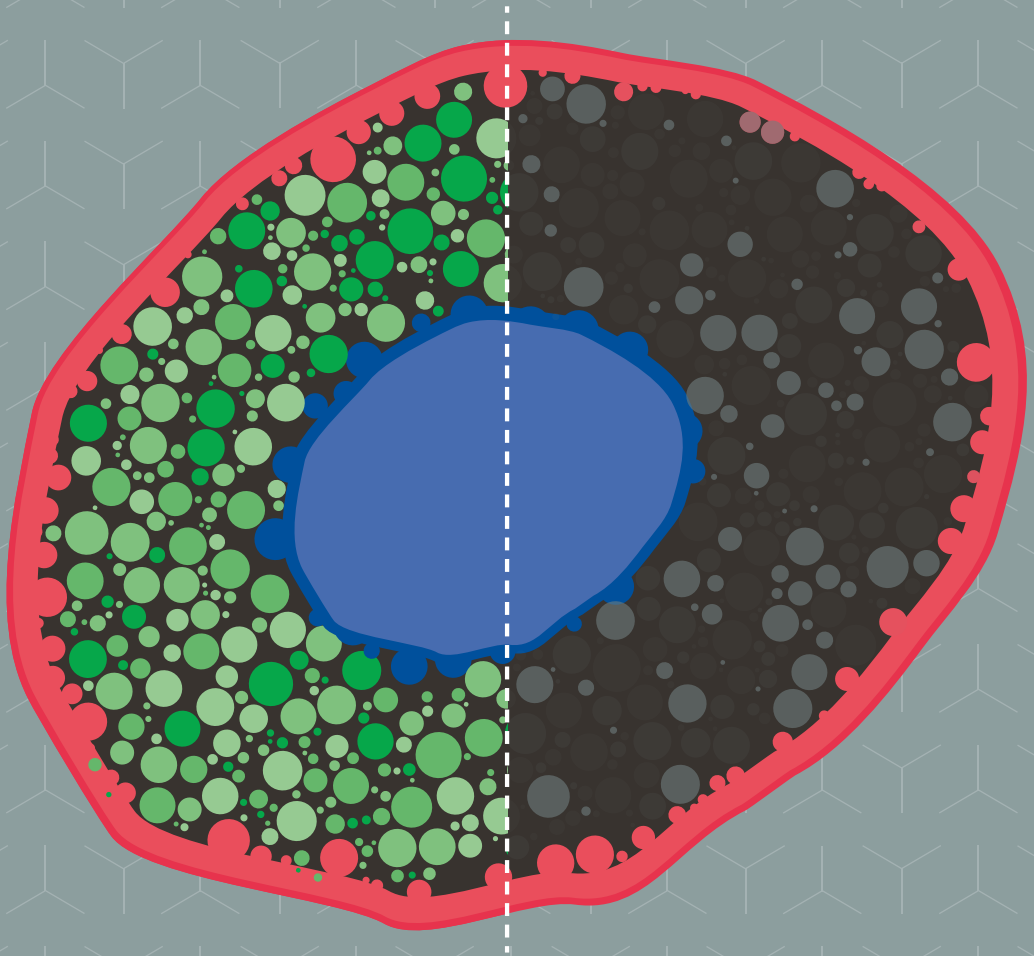

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1. Bradbury, A. and Plückthorn, A. 2015. Reproducibility: Standardize antibodies used in research. Nature. 518(7537), pp.27-29.

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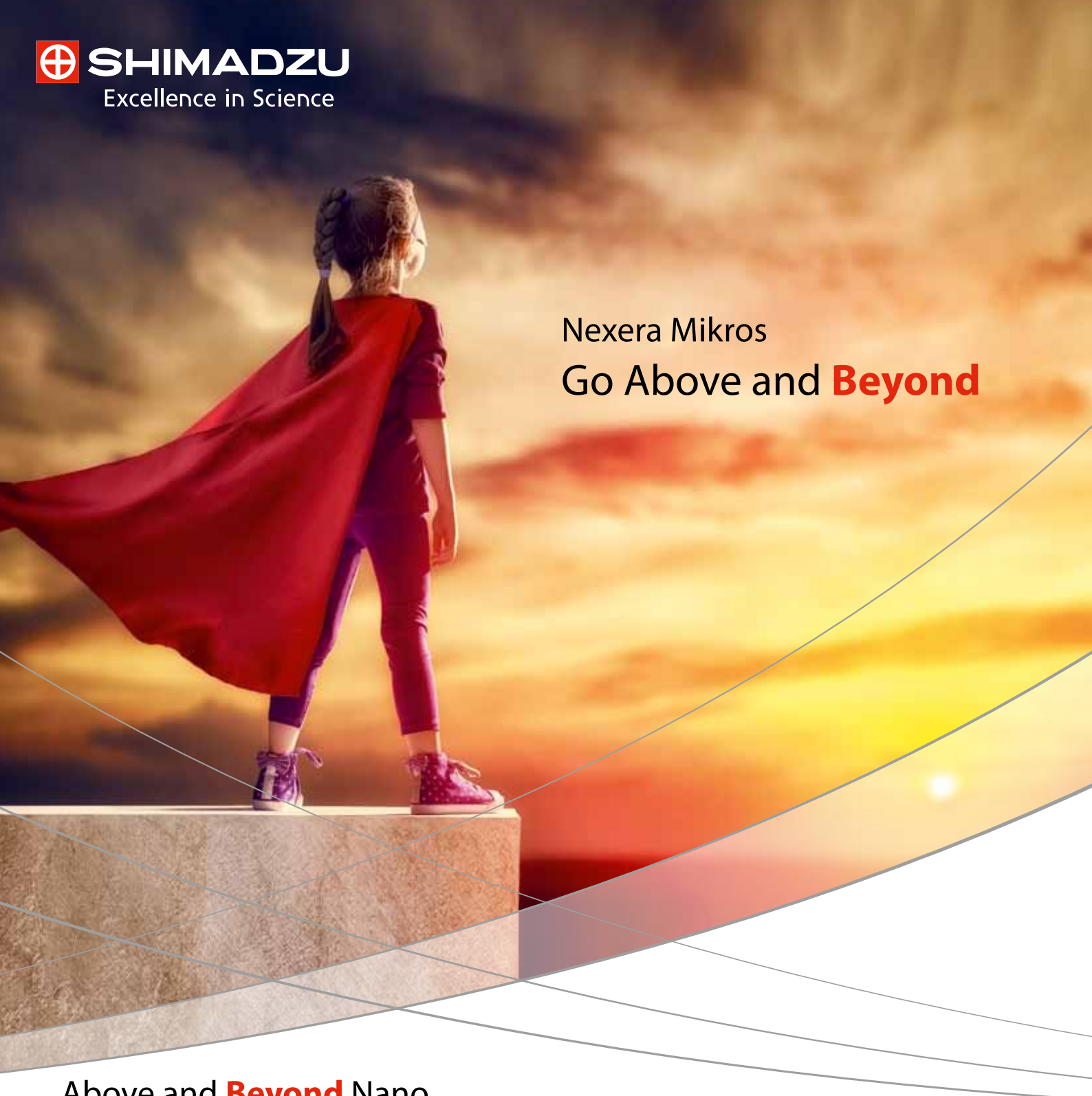

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