Lab+Life SCIENTIST

GENE EDITING
ACTIVATED BY LIGHT

THE FACTS
ABOUT FACE SHIELDS

OH SUGAR!
DIABETES DRUG SECRETS REVEALED

AUG/SEP 2020
VOL.31 NO.3
PP100008671

ANALYTICAL | BIOTECH | ENVIRONMENTAL | INDUSTRIAL | LIFE SCIENCES | MEDICAL

AMT Group Australasia

1300 780 052
amtintlgroup.com.au
sales@amtintlgroup.com.au

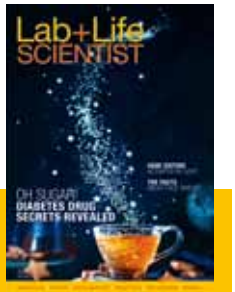
COMBINATION PCR WORKSTATION

AirClean® Systems AC600 Series PCR Workstations combine ISO 5 HEPA-filtered air with UV light irradiation for the ultimate DNA/RNA manipulation and amplification work area. Cross-contamination during amplification of DNA and RNA can lead to inaccurate results, costing the lab technician valuable time and reagents. PCR Workstations minimise this risk by keeping airborne contaminants away from samples and irradiating work surfaces and tools between amplifications. The PCR Workstation works in an efficient and timely manner for your processing protection needs by providing the highest level of safety for your biological samples.

Features Include:

- UVTect™ microprocessor controller
- No installation required
- ISO 5 vertical laminar flow air
- No ductwork required
- UV shelf with built-in pipettor holder
- Lab event timer
- Available in standard height or tall version
- Clear polycarbonate shell for 360° visibility
- Extremely quiet operation
- Sturdy trolley available

Contents



Cover image: © Stock.Adobe.com/au/Dina

Groundhog Day

Okay campers, rise and shine! And don't forget your booties, 'cause it's cold out there today!

Forgive me for opening with a quote from one of my favourite films, but sitting down to write this editor's comment certainly brought to mind the classic comedy *Groundhog Day* — where weatherman Phil Connors is forced to relive the same day, in the same small town, over and over again until he finally manages to give his life a complete overhaul. At the time of writing, Victoria is very much experiencing a second wave of COVID-19, and hotspots are starting to pop up here in NSW as well. Will it get so bad that we're all forced back into lockdown, or will we manage to break the spell by following Phil's example of putting the needs of others ahead of ourselves?

The good news is that our scientists have certainly not been tardy during this time — and in this issue of *LLS* we have an interview with the University of Oxford's Dr Harrison Steel, who has been directly involved in several significant COVID-related projects over the past few months (see page 14). Dr Steel provides some great insight into what life has been like working on the frontline of the pandemic, and his research complements that of scientists all around the world working to fight COVID-19 from all angles. Some of my personal highlights of late include:

- The development of rapid diagnostics technology, some of which can detect the virus in as little as 20 minutes
- The creation of more effective PPE, including antimicrobial face masks and sterilisable shields
- An array of promising new vaccine candidates, some of which have induced strong immune responses

There has also been progress in terms of treatment options for COVID-19, with the TGA last month granting provisional approval for the use of antiviral drug remdesivir in hospitalised patients and the National COVID-19 Clinical Evidence Taskforce recommending anti-inflammatory steroid dexamethasone for patients who are receiving oxygen or mechanical ventilation; the latter has been described as the first treatment to reduce mortality in COVID-19.

Meanwhile, the heyday of antimalarial drug (hydroxy)chloroquine appears to be over. For while a controversial study warning against the danger of the drug's use in COVID-19 patients was retracted, more recent research has shown that chloroquine only appears to inhibit SARS-CoV-2 infection in monkey kidney cells — not in human lung cells, which would be rather more useful.

But enough about COVID-19, as we have plenty of other content to cover in this issue as well. On page 33, we reveal the surprising secret behind one of the world's oldest antidiabetic drugs. We also look into the phenomenon of light-activated gene editing on page 16. And for the laboratory managers among you, we have advice for buying face shields for your staff on page 22 (important at any time but especially during a pandemic) and on the safe use of hydrogen generators on page 6.

Until next time — stay safe, stay inside and wash your hands.

Regards,
Lauren Davis
LLS@wfmedia.com.au

Lauren Davis

Quality Cells = Quality Results

Spectrophotometer cells for all applications

Fully fused construction

Window flatness better than 1µm

Certificates of conformity available

Wide choice of window materials

Customised solutions

UKAS CALIBRATION 0659

Registered No. FM 30093

UKAS 4001

Starna

'Setting the Standard'

Call: 1 800 252 284

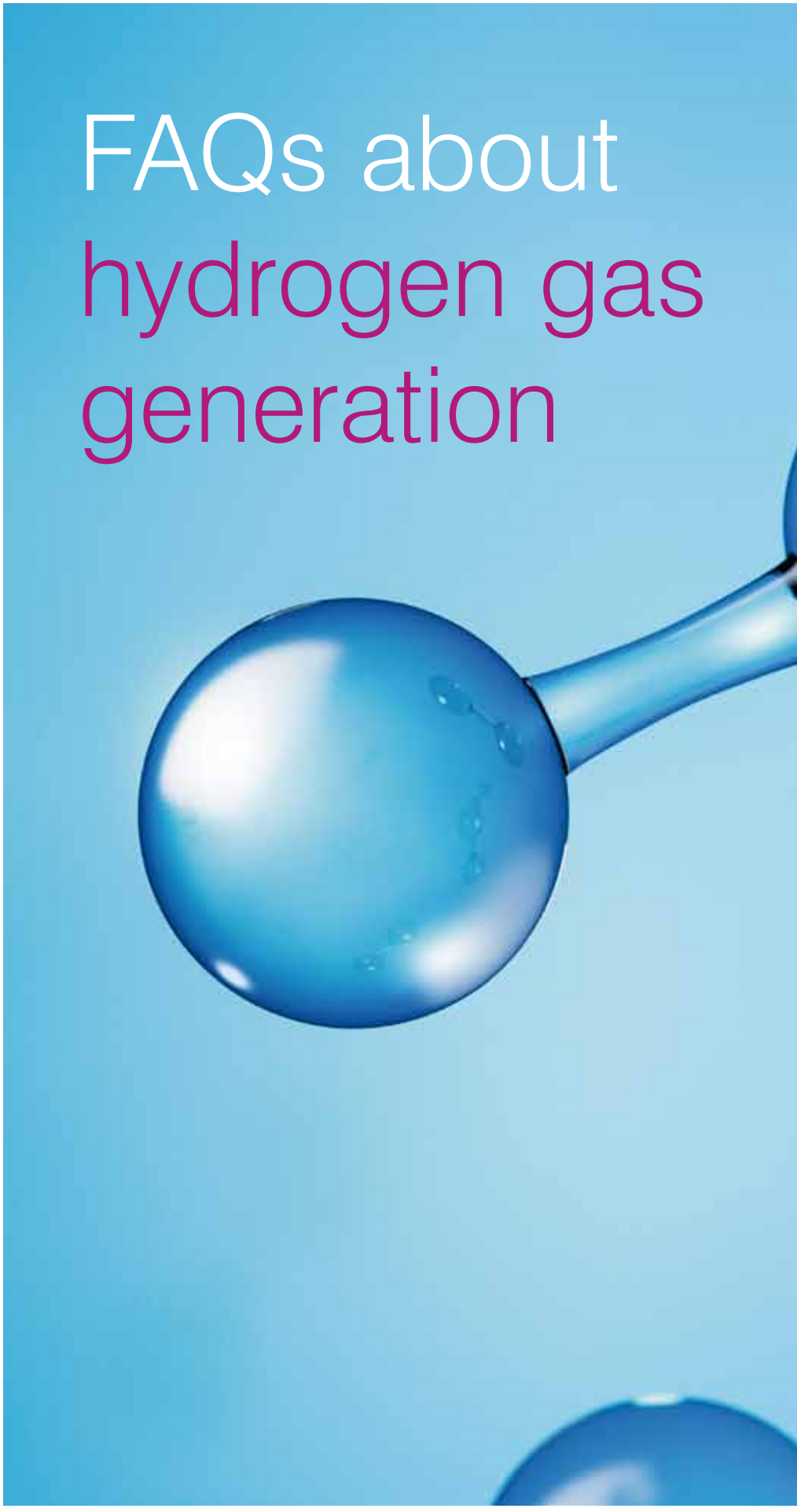
Tel: (02) 9659 8088

Email: sales@starna.com.au

www.starna.com

FAQs about hydrogen gas generation

Dr Nicole R Pendini* provides answers to several frequently asked questions collated from worldwide health, environmental, industrial, testing, medical and research laboratories regarding the safe use of hydrogen generators in the workplace.



Hydrogen is the most abundant element in the universe, although in its gaseous state it does not naturally occur on Earth and must be manufactured. In industry, $H_2(g)$ is produced on a large scale by a process called steam reforming, to separate carbon and hydrogen atoms from hydrocarbon fuels. Hydrogen is used in the laboratory for a variety of lab applications, such as gas chromatography (GC) as fuel or carrier gas; ICP-MS as a collision gas in the chemical industry to synthesise ammonia, cyclohexane and methanol; and in the food industry for hydrogenation of oils to form fats.

Significant research and development has afforded safer, efficient, greener and more cost-effective means of generating on-demand hydrogen gas for laboratories, manufacturing and industrial applications. Safety has improved so much so that hydrogen gas is now being used in some transport vehicles as a clean 'pollution-free' fuel, with the by-product of its combustion being water.

Why use a hydrogen gas generator?

Hydrogen gas generators are a safe, convenient and typically more cost-effective alternative to using high-pressure cylinders of H_2. A hydrogen generator will provide hydrogen of a consistent purity, eliminating the risk of variation in gas quality, which can impact on analytical results.

A generator also produces gas on demand around the clock, meaning that you don't need to worry about running out of gas at an inopportune moment. A hydrogen generator will free up more analytical time since you will not need to spend time ordering and changing out replacement cylinders.

A generator is an environmentally friendly alternative to cylinders, since once it is installed the generator will not need to leave the laboratory, providing gas for laboratory applications with all maintenance carried out in the laboratory. The generator also reduces your laboratory's carbon footprint, since there is no need for trucks to deliver replacement cylinders and remove empty cylinders.

How can I change from cylinders to a generator with limited downtime?

The changeover is typically seamless. If you are switching from hydrogen cylinders to a generator, existing tubing can be disconnected from the cylinder and connected to the generator, using Swagelok fittings. If you are changing from helium to hydrogen, new tubing should be always be used.

How safe is the generator?

Most hydrogen generator stores less than 300cc gas, whereas cylinders store up to 9000 L at extremely high pressure (~2000–3000 psi). A hydrogen gas generator produces gas on demand, meaning only the amount needed by the gas chromatograph (GC) is produced at regulated flow (0.5 L max) and pressure (120 psi max).

Depending on your supplier, H_2 gas generators are equipped with continuous internal and external leak checks in addition to an auto-shutdown features:

- Full diagnostic checks on start-up
- Continuous pressure-based leak check during operation
- Automatic shutdown by isolation of the H2 generation cell
- Audio and visual alarms
- Forced ventilation throughout the generator
- Low H_2 gas throughout the system (<3 L max)

Should there be an internal leak, the generator will cease gas production and alert laboratory personnel via the HMI touchscreen, which will give a warning as well as an audible alarm. If there is a leak external to the generator, or its capacity is exceeded for 20 minutes, the generator will shut down to prevent build-up of H_2 gas in the lab environment or instrument supplied. The system will also shut down if the internal pressure exceeds 120 psi.

Our safety officers are concerned about H_2 gas build-up and explosion in the lab. Is this possible with a H_2 gas generator?

Hydrogen is flammable between 4.1% and 78% in air. A laboratory measuring 5 x 4 x 2.5 m has a volume of 50,000 L. For the lower explosive level (LEL) of 4.1% hydrogen gas to be reached, we would need 2050 L of H_2 gas released into this laboratory space in one instant.

An average 'G' sized H_2 gas cylinder contains 9000 L of gas. Should a cylinder leak, it would need only to release 25% of its total volume to reach the LEL in this laboratory.

By contrast, the Peak Scientific Precision Hydrogen Trace 500cc generator produces 0.5 L/min. To reach the LEL with this gas generator, it would need to be in a completely sealed space, not be connected to the GC/application or severe leak and have complete failure of all safety features. Even in this scenario, the generator would need to operate for 67 hours (~three days) to reach the LEL.

Has any testing been conducted to evaluate the safety of hydrogen generators?

One should check that their generator carries CE, CSA and RCM (for use in Aus/NZ) approval for compliance and have been externally tested to IEC standards for laboratory use and safety requirements for the residual risk for an explosion hazard. Safety is evaluated by dilution tests and an unoperated fan, assuring the explosion LEL of 4.1% hydrogen is not reached under worst case conditions internally or externally to the generator.

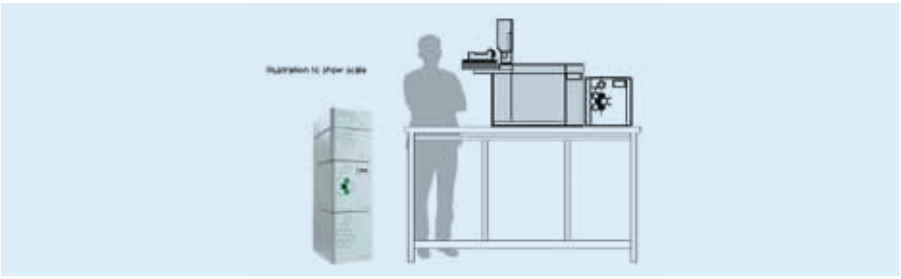
Where should I install my generator?

The generator can reside safely in the laboratory on the bench, floor or under the GC auto-sampler. The generator should be located on a flat, level surface for operation.

Can I put the generator in a cupboard?

Adequate airflow must be maintained around the generator to allow the ventilation system to perform efficiently. If the generator is stored in an enclosed space, the environment must be controlled via an air conditioner or extraction fan. The provision must be made to allow the volume of air in the room to be changed five times per hour.

The rear of the generator will become warm to the touch during operation — a minimum clearance of 15 cm from other bodies is recommended.



The vents should not be obstructed or connected to any application. Safe, forced removal of waste gases has been engineered into the generator to prevent any internal gas or pressure build-up.

Can I place the generator outside the laboratory?

This is possible as long as the recommended environmental conditions required for normal operation are met. Reducing the length of pipework will reduce costs if not already installed and the risk of any potential leaks in the pipework going undetected, improving the safety of the installation. If possible, the generator should be placed near or close (<10 m) to the GC or application.

Do my GCs need to be ventilated?

If a customer wishes to use a fume extractor or to connect tubing between the exhaust of the generator and a fume hood, this is possible. Any hydrogen exhausted from the GC will quickly diffuse in the air and presents no danger to laboratory personnel or the environment. If tubing is attached to the exhaust ports of the generator, it is essential that this is monitored frequently, since any kinks could cause a build-up of gas and cause additional health and safety issues. The majority of laboratory environment will not be completely sealed with air conditioning in place allowing air movement and cycling, and hence will not meet the LEL of hydrogen of 4.1%. If you have concerns you should have your site evaluated, perform an installation survey and request a demonstration.

Will I need hydrogen sensors in the lab or GC oven?

In the laboratory, the amount of hydrogen generated/exhausted into the laboratory is not enough to accumulate and reach the LEL of hydrogen. The risk of a significant build-up of gas in the GC oven is also extremely low, with both the external leak safety shutdown feature of the H_2 generator and the GC inlet safety shutdown feature in place.

Should your laboratory, state government or business policy require regulation, sensors or monitoring, Peak Scientific can offer both external room and in GC oven monitoring sensors for peace of mind.

How difficult are H_2 gas generators to maintain?

Maintenance is very simple and cost-effective, and many generators do not require an engineer for regular maintenance. Simply refill the deionised water reservoir weekly. Preventive maintenance (PM) is typically required biannually, requiring deioniser cartridge swap-over.

Given times of social distancing, many vendors are offering online user training, Skype, tutorials, PowerPoints, detailed user manuals, 24/7 phone technical support and video support.

How many GCs can a single hydrogen generator supply?

As a typical rule of thumb, 100cc will supply two FID detectors. Of course, the required generator will depend on flow rate, carrier gas type, column, other detectors and methods used.

Will it really be more cost-effective?

Calculating the gas, delivery charges, cylinder rental charge, staff downtime time, administration, OHS measures and training, ROI is typically within 9–15 months.

Is it difficult to install a hydrogen generator?

Not at all. Simply remove packaging, connect an external UV-protected deionised water bottle (at same height or below the generator), connect to an electrical supply (10 A) and allow to reach room temperature. Connect to your GC using 1/8″ pre-cleaned (gas purged) refrigerant-grade copper or stainless steel pipe.

What piping do I need?

Supply of hydrogen should be provided through stainless steel or analytical-grade copper tubing using Swagelok compression fittings. It is important to change the tubing that was previously used to supply helium to the GC, since over time, deposits can build up on the inside of the tubing which hydrogen will carry to the application, causing higher background signal for a longer period of time.

For any connections, Swagelok compression fittings are the recommended solution to connect copper or stainless steel tubing. No chemical bonding (such as Loctite), welding or glues should ever be used, since this can introduce volatile organic compounds (VOCs) into the gas supply, which can impact on results.

When running lines >3 m, it may be necessary to use 1/4″ piping reduced to 1/8″ to supply each GC. This increases the volume considerably and can make installation more difficult. For lines >10 m between the generator and GC, please consult with your fitting specialist.

What is Tygon tubing?

Tygon tubing is used to link an external UV preventive water bottle to a gas generator. The high-purity, plasticiser-free tubing is typically used for specialist and diagnostic equipment. This tubing has low adsorption/adsorption properties, which minimises the risk of fluid retention and leaching of the material.

What water can I use for my hydrogen generator?

The recommendation is deionised water (DI) of >1 MΩ resistivity /<1 µS conductivity purity or better. If MilliQ water is available at your facility, this is preferred.

What are the benefits of hydrogen generators over cylinders?

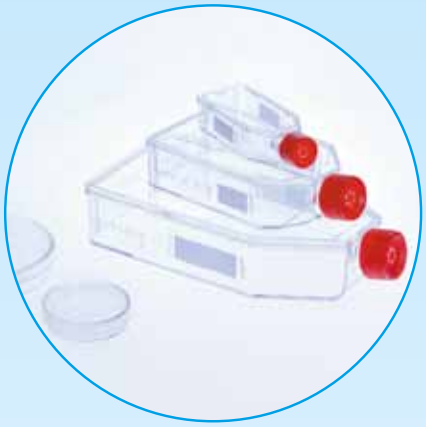
- Lower pressure = safer (1–100 psi at outlet)
- Controlled flow maintains safe hydrogen levels (up to 1000cc at outlet)
- Built-in leak sensors and automatic shutdown feature
- On-demand production = minimal storage
- Once installed there is no need to move
- All maintenance carried out in the lab
- 24/7 operation — no need to monitor supply
- Reduce costs and admin — no repeat orders of gas
- Lower carbon footprint — greener option for your lab

Dr Nicole R Pendini works for gas generation company Peak Scientific, specialising in on-site in-laboratory nitrogen, hydrogen and zero air gas generation. She also designs complete reticulated gas systems for laboratories, food and beverage and industry from single rooms to entire building sites, ensuring the right quality, quantity and pressure of gas is supplied in a sustainable, safe and environmentally conscious manner.

Peak Scientific Instruments Pty Ltd
www.peakscientific.com

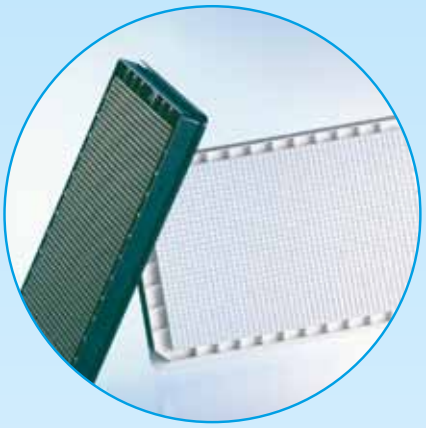
The Power of Science

Cell Culture



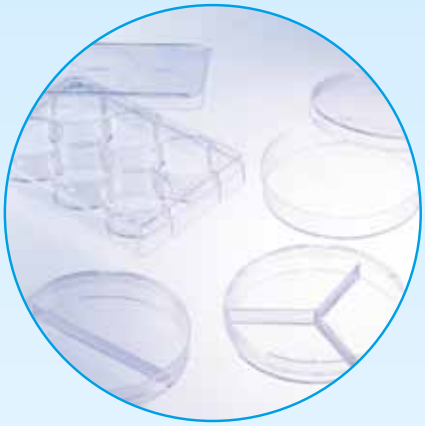
Cryo Storage

High Throughput Microplates

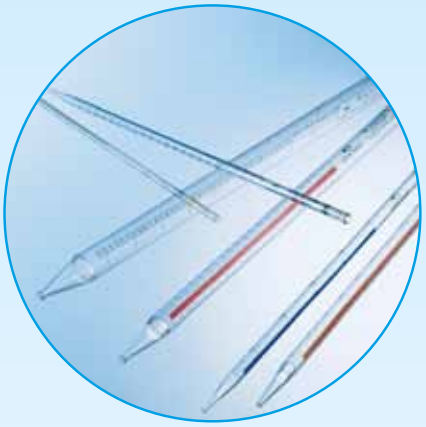


Centrifugation

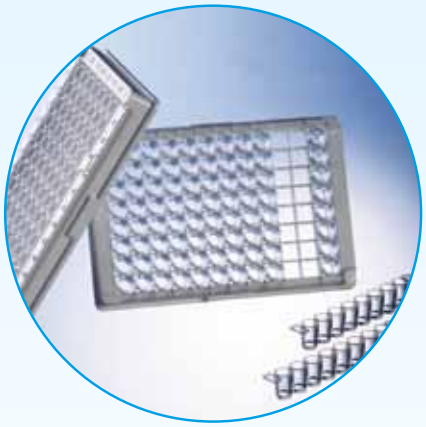
Microbiology



Liquid Handling



Immunology



Upscaled Cell Culture

Biobanking

Exclusive Australian Distributor

Interpath Services
Leading the way
ABN 79 007 196 581

A Bunzl Company

greiner BIO-ONE

Sales **03 9457 6277** Freecall **1800 626 369** Website **www.interpath.com.au**
Supplier of quality products to clinical pathology, research and life science markets

Drug found to treat vascular disorder

Researchers from Sydney's Centenary Institute have discovered a potential new therapy for cerebral cavernous malformations (CCMs), a devastating disease that often affects young people and can result in stroke and seizures. Their breakthrough has been published in the journal *PLOS Biology*.

"CCMs are vascular lesions comprising clusters of abnormally thin and leaky blood vessels," explained Professor Jennifer Gamble, senior author on the new paper. "Stroke or seizures can occur when blood from these vessels leaks into the surrounding brain tissue. We can't predict when this will happen or how frequently.

"Most often, people don't realise they have the disease until they have an event such as a seizure. Currently there is little in the way of effective medical treatment for CCMs except for surgical removal of the most dangerous lesions, which is limited by the size and depth of the lesions."

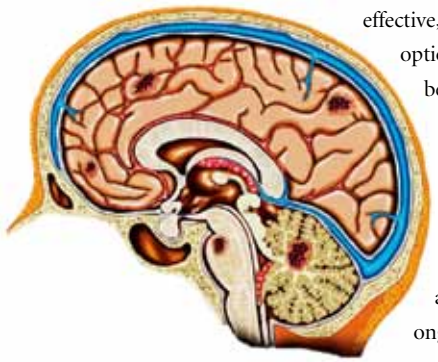
Prof Gamble and her collaborators were able to show that a protein called VE-cadherin, critical to maintaining a healthy blood vessel lining, was seen at lower levels in mice with CCM lesions. They subsequently found that the drug CD5-2 could be used to help normalise the vascular disorders, inhibiting the development and reducing the size of existing lesions.

"We … used the drug CD5-2 to elevate VE-cadherin levels, resulting in a reduction in the lesions that were present in our CCM mice," Prof Gamble said.

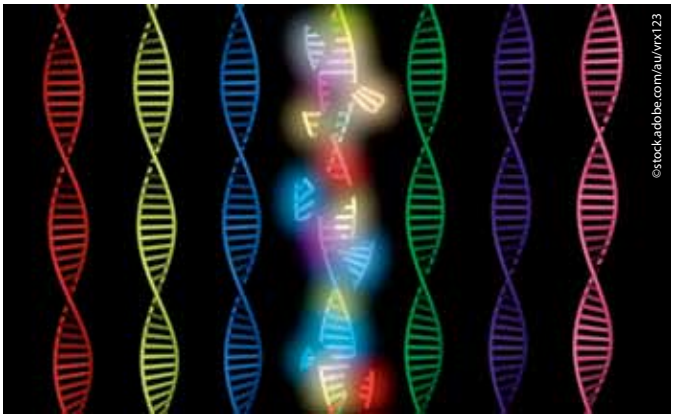
Developed by the Centenary Institute and collaborators, CD5-2 was initially designed to combat the development of solid cancers by reducing and repairing damage caused by inflammation in blood vessels. It has since been found to have other potential benefits, including as a treatment to prevent sight-loss in people with diabetes.

"CD5-2 is a drug that improves leaky blood vessels, and this is a feature of many chronic diseases," Prof Gamble said. "We have now shown that CD5-2 is a potential novel therapy for CCMs, a disease with surgery as the only option — and that's not always possible, especially if patients have multiple lesions. This discovery could lead to the first effective, non-invasive treatment option for CCMs, which would be truly heartening for sufferers."

Prof Gamble believes that CD5-2 may yield even further health benefits, with research into the drug and other disease areas still ongoing.



Cerebral cavernous malformations in the brain.



CRISPR gene editing with higher fidelity

The CRISPR system is a powerful tool for the targeted editing of genomes, with significant therapeutic potential, but runs the risk of inappropriately editing 'off-target' sites. Now a research team led by Wenzhou Medical University has shown that mutating the enzyme at the heart of the CRISPR gene editing system can improve its fidelity, which may prove therapeutically safer than the current system. Their results have been published in the journal *PLOS Biology*.

The CRISPR system employs an enzyme called Cas9 to cleave DNA. Cas9 will cut almost any DNA sequence. Its specificity comes from its interaction with a 'guide RNA' (gRNA), whose sequence allows it to bind with the target DNA through base-pair matching. Once it does, the enzyme is activated and the DNA is cut.

The CRISPR system is found in multiple bacterial species, with that of *Staphylococcus aureus* having the advantage of size — unlike some others, its gene is small enough to fit inside a versatile and harmless gene therapy vector called adeno-associated virus, making it attractive for therapeutic purposes. But a key limitation of any CRISPR system, including that of *S. aureus*, is off-target cleavage of DNA. A guide RNA may bind weakly to a site whose sequence is a close but imperfect match; depending on how close the match is and how tightly the enzyme interacts with the paired gRNA–DNA complex, the enzyme may become activated and cut the DNA wrongly, with potentially harmful consequences.

To explore whether the *S. aureus* Cas9 could be modified to cleave with higher fidelity to the intended target, researchers generated a range of novel Cas9 mutants and tested their ability to discriminate against imperfect matches while retaining high activity at the intended site. They found one such mutant, which distinguished and rejected single base-pair mismatches between gRNA and DNA, regardless of the target, increasing the fidelity up to 93-fold over the original enzyme.

They showed that the mutation affected part of the recognition domain, the region of the enzyme that coordinates contacts between the enzyme and the gRNA–DNA complex. The mutation had the likely effect of weakening those contacts, thus ensuring that only the strongest pairing — which would come from a perfect sequence match — would trigger enzyme activity.

"Avoidance of off-target cleavage is a crucial challenge for development of CRISPR for medical interventions, such as correcting genetic diseases or targeting cancer cells," said study leader Feng Gu of Wenzhou Medical University. "Our results point the way to developing potentially safer gene therapy strategies."

We bring colour into view!

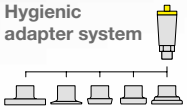
Compact pressure sensors and switches with 360° custom-colour status display

256 colours
Individually selectable:

- Measurement in progress
- Sensor switching
- Process malfunction

Compact design

Hygienic adapter system



IO-Link

Adjustment via smartphone

$547
VEGABAR 39 Clamp 1"

www.vega.com/vegabar

Looking Forward VEGA

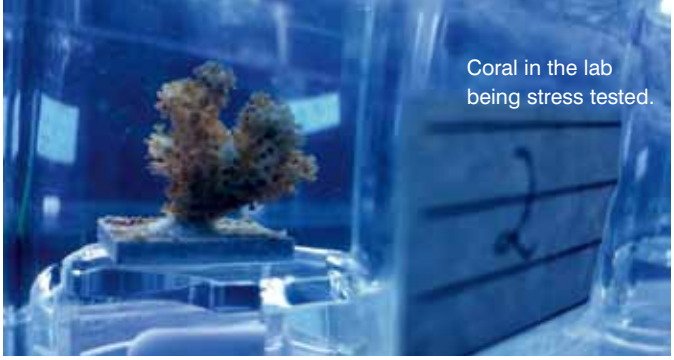

Coral in the lab being stress tested.


Image courtesy Great Barrier Reef Foundation. Photographer: Gary Cranitch, Queensland Museum.

More cells = more movement

New research from the Queensland University of Technology (QUT) has revealed that cell movement actually increases when there are more cells around, contrary to what scientists have always believed.

The motivation for the study, published in the *Journal of the Royal Society Interface*, was to test some new mathematical models the QUT team had recently developed — models which were ideally suited to explore cell biology experiments. Such experiments are commonly used as screening tools to understand potential drug treatments, or different physical treatments like different surface coatings.

The team used advanced mathematical modelling and statistical analysis on a common experiment used by biologists known as a scratch assay. Cells (in this case, prostate cancer cells) are placed in a well, and then a scratch is made to create a large vacant region that separates the cells. Scientists then observe how the cell population grows and cells move to fill up that space.

Typical experimental protocols do not vary the initial cell density, or the initial number of cells that are used. Alex Browning, a PhD student at QUT and lead author of the study, wanted to change this.

"We wanted to explore how cell density affected the dynamics of the experiment by quantifying this," Browning said. "Our mathematical and statistical methods allowed us to identify the nature of cell-to-cell interactions in the experiments that might lead to density-dependent behaviour."

Cell biologists and mathematicians have always assumed that cell movement, or motility, is independent of density and not affected by cell-to-cell interactions. As noted by QUT Professor Matthew Simpson, who supervised the project, "Scientists in the past have thought of cells like people. The more space you've got, the easier it is to move. Turns out, it is more complicated than that."

"Our results showed the opposite of what has always been assumed," Browning added. "It turns out, a higher density environment where there are more cell-to-cell interactions actually increased cell movement.

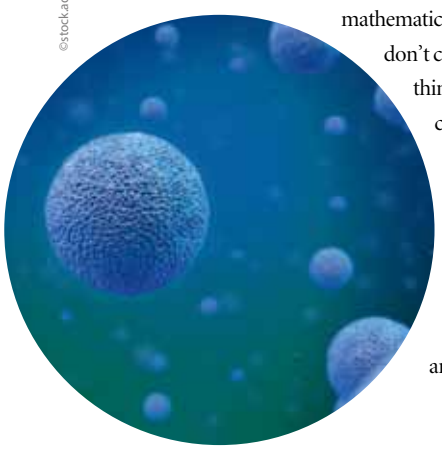
"We were quite surprised."

QUT mathematical biologist Dr Wang Jin, who co-authored the study, said the results were significant.

"Biologists do all sorts of in vitro experiments, where they grow cells in the lab, but there is no standard protocol that tells them how many cells they should put into the well to run their experiment," Dr Jin said. "Our results show that it matters how many cells they use."

Prof Simpson said the results also have implications for mathematicians, noting, "People often don't change things. The simplest thing we have done here is to change the initial number of cells.

"By changing some of the most fundamental features of these experiments, which is so basic that no-one ever questions, we actually learn an awful lot."



Probiotics boost coral survival

Researchers have proven that feeding coral a dose of good bacteria increases their overall health and tolerance to stresses related to climate change, such as rising water temperatures.

Coral reefs are critical ecosystems that are essential to the future of our planet. As noted by Anna Marsden, Managing Director of the Great Barrier Reef Foundation, "Not only are coral reefs home to 25% of the ocean's marine life but they also support the livelihoods of 1 billion people globally.

"However, we are increasingly seeing corals becoming stressed due to threats such as rising water temperatures, which is causing them to become prone to infections and less likely to survive.

"People may be surprised to find out that, just like us, corals rely on a host of good bacteria to help keep them healthy and, just like us, the balance between good and bad bacteria is often disrupted in times of stress," Marsden said.

"Probiotics have been widely and successfully used to improve both human and animal health; however, their use in marine ecosystems has been largely unexplored until now."

Now an international research team, led by Professor Raquel Peixoto from the Federal University of Rio de Janeiro, has shown in a laboratory setting that feeding corals beneficial probiotics increases their overall health and improves their chance of survival during heat stress.

"We fed the corals with beneficial microorganisms, which is like feeding them probiotic yoghurt full of good bacteria," Prof Peixoto said.

"Then we ran numerous stress tests on the corals, and time and time again the corals that had received the probiotics were in better health than those that had not.

"This finding is an exciting breakthrough in boosting the ability of coral species to survive in times of stress and help them cope with a changing climate."

Prof Peixoto's research team are currently running tests on different species of corals in the world's largest artificial ocean (the Biosphere 2) in Arizona, and in laboratories at the University of Hawaii, to refine which groups of good bacteria are the best for each species. They are also investigating new methods to scale up the application for use on coral reefs, such as delivering parcels of slow-release probiotics to targeted reefs during times of heat stress.

Marsden said pioneering science such as this provides hope for the future of the Great Barrier Reef.

Traceability is vital.

In modern laboratory testing, traceability is fundamental to ensuring the reliability of analytical processes. Whether you work in research, specialised testing services, life sciences or simply use gases in process applications – traceability is vital to reducing risk in your business.

BOC's specialised gases team can guide you on the correct type of mixture to suit your needs. If you'd like to read more about the importance of traceability, read our paper on the subject at https://bit.ly/2TIkGjK.

- Gaseous or liquefied multi-component mixtures.
- NATA or IANZ accredited.
- Individual certificates of analysis.
- Produced in accordance with ISO 17034 or ISO 17025.

boc.com.au | 1800 658 278 | scientific@boc.com

BOC
A Member of the Linde Group

The future of gases.

Want to customise your own mixture?
Visit boc.com.au/specialtymixtures

Nerves of steel

Working on the frontline of COVID-19

Oxford University scientist and John Monash Foundation scholar Dr Harrison Steel has been directly involved in two significant projects that have impacted the COVID-19 health crisis.

One of these projects has evolved into a form of rapid testing for COVID-19. The other is OxVent, a project devised to answer the demands of the current global ventilator shortage.

Tell us about your experience working on the frontline of COVID-19.

It has been a very busy time. Once the severity of the ongoing pandemic became clear, there was a worldwide realisation that fighting and eventually overcoming the virus would require a huge scientific and engineering effort. Many departments and research groups at Oxford immediately switched focus to working on this challenge, and I am glad to have been able to contribute my expertise.

What did you study at university that allowed you to be selected and involved in the medical frontline of a pandemic?

As an undergraduate I studied Mechanical Engineering and Science at the University of Sydney and worked in many industries including space science (at NASA Ames), quantum computing (at the University of Sydney) and particle physics (at DESY). I was then awarded a Monash scholarship to go to the University of Oxford, where I completed a PhD (here called a D.Phil) in Engineering, focusing on robotics and biotechnology. My work focused on developing new biotechnologies for medicine and industry, and I also founded a spin-out venture that produces open-source robotic technologies. I now hold a fellowship at the University of Oxford, where my research spans fields from synthetic biology to experimental robotics to evolution.

Were you selected from a group of other talented Oxford scientists to participate in these projects? What was this process like?

The past few months have been frantic — across the university, projects have been accelerated to address many facets of the international response to COVID-19. In many cases these projects may have started with a few academic researchers or students, who then brought colleagues with expertise in related fields, quickly building large interdisciplinary teams.

I was already working in a laboratory that specialises in developing novel 'biosensors' — their work quickly transitioned into the project on rapid COVID-19 diagnostics. My experience in building new biotechnologies led to me being contacted to help on the OxVent project. Subsequently I have been consulted on many related projects, including (for example) lending expertise to build models of virus transmission in several countries and helping related ventilator projects around the world.

The collaborative atmosphere at Oxford has enabled widespread cooperation on many of these projects. A time of crisis is not a time for overly aggressive competition — researchers have been generous to lend their time and expertise to help on many different fronts, and likewise they have been quick to consult and include colleagues that can provide other skills and expertise.

Can you tell us more about the two projects you were/are involved with?

Most of my time in the past two months has been spent working on the OxVent ventilator project.

This project was initiated by a PhD student in a biomedical engineering group here at the University of Oxford. A team quickly assembled to drive this project, for which I have been leading the electrical engineering effort. In the space of three days we rapidly produced a prototype of our ventilator technology, which we presented to the UK cabinet office as part of their Ventilator Challenge. OxVent was selected as one of the few novel ventilator designs to be funded in this competition, and we set to work on building, testing and clinically validating our system.

The government ordered more than 5000 OxVent units, with initial deliveries scheduled within the month. Meeting this deadline would require a round-the-clock effort from our team. At this point we were very fortunate to be paired up with medical device manufacturers Smith & Nephew, who provided decades of experience in product development, manufacturing and logistics. A large part of our team travelled up to their manufacturing plant in Hull and worked in partnership with their engineering and manufacturing experts to refine our system and complete the rigorous testing required for regulatory approval of the device. Seeing our technology progress rapidly was very rewarding, with a personal highlight for me being the Queen lending use of her personal helicopter to transport circuit boards I had designed across the country.

In the subsequent weeks the evolving pandemic situation in the UK thankfully did not reach the 'worst-case' predicted scenarios. This was great news for us, and the British people as a whole, as it meant that the NHS would (for the most part) be able to cope with the pandemic whilst remaining within capacity. However, this also meant that OxVent (and the majority of the other Ventilator Challenge projects) would likely not be required for the domestic fight against COVID-19; pre-existing commercial ventilators would cover this need. Upon receiving this news we immediately began reaching out to our international networks, as many countries (particularly in the developing world) have very limited access to these life-saving technologies, and are still far from reaching the peak of their domestic pandemic. We are now working on several fronts to get OxVent units deployed where they are most needed.

In addition to my direct involvement on the OxVent project, I have also found myself in the right place at the right time to contribute to several other ongoing COVID projects. This has included helping to develop easily accessible home testing procedures for COVID-19, working with teams developing mathematical models of virus transmission and spread outside of the UK, and providing advice to groups across half a dozen countries working on engineering projects similar to OxVent. At the same time I have been grateful to receive advice myself from leading experts in many areas; the past few months have been a great time for unity and collaboration in the international scientific and medical communities.

When you did start working on them, what were your day-to-day responsibilities like?

During the development of the OxVent device we worked long hours, seven days a week, to deliver a technology that could meet the clinical demands, whilst also being feasible for rapid manufacture on a large scale. This involved traditional engineering work (such as designing the system's electronics, user interface and software), management of supply chains and logistics (including working with companies in the UK and abroad to secure supply of the components in our system) and development of the final manufacturing procedures for OxVent. In parallel I was working on testing and validation of our prototypes and (eventually) final design, which included working in industrial laboratories as well as visiting hospitals to use specialised ventilator test equipment.

Did you get the opportunity to work directly with prominent figures within the UK healthcare industry?

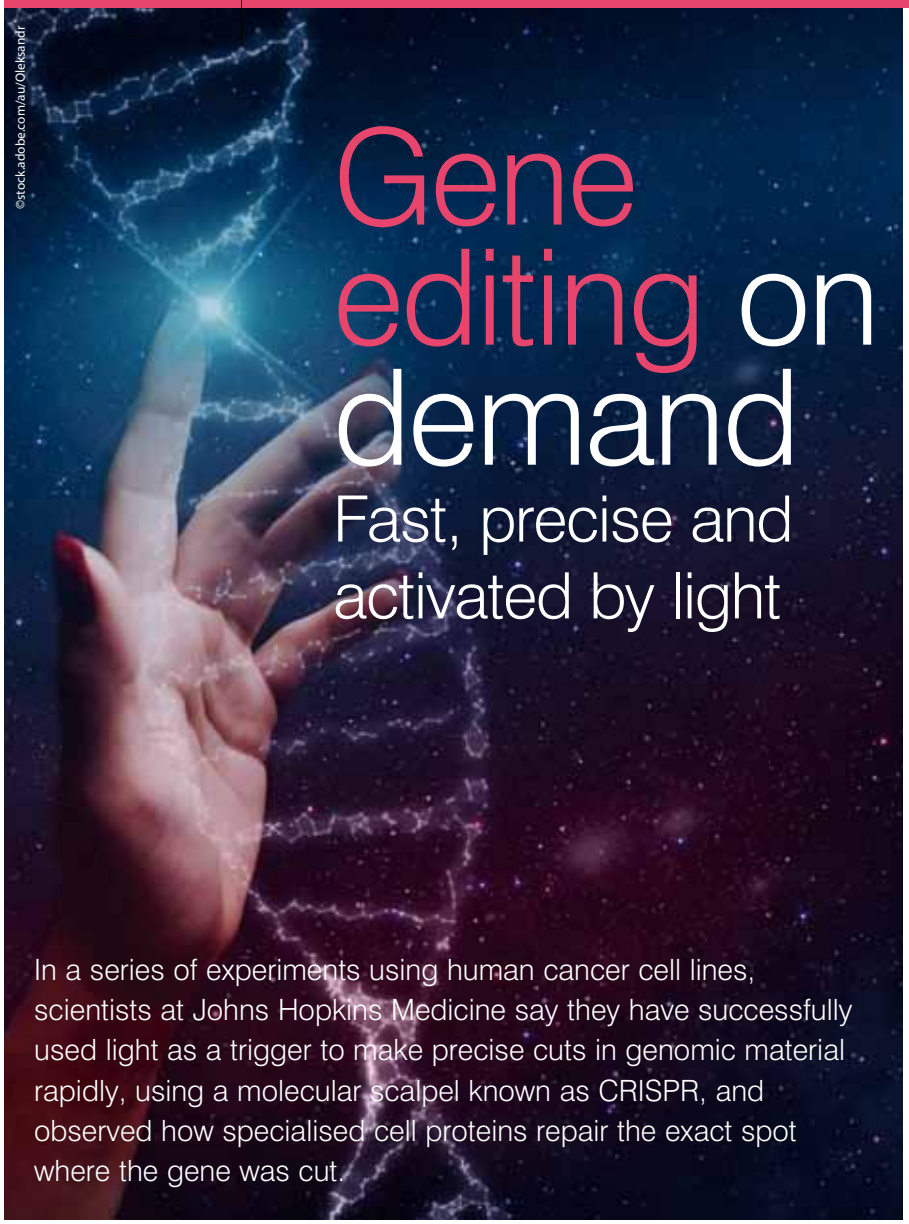
Throughout the pandemic there has been a great spirit of collaboration between scientists, engineers, clinicians and policymakers; I feel lucky to have both benefited and contributed to this effort. For example, with the OxVent team we worked with members of the UK government cabinet, senators and governors in several other countries, leading figures in the NHS and hospital trusts, experts in medical device design and regulation, and many leading engineering and manufacturing firms.

Do you have any insight or thoughts into how the UK healthcare system might come out of the crisis and what will change?

Undoubtedly major changes will occur in health care. I'd like to believe there will be a new appreciation for the services of frontline workers such as nurses and doctors. I also hope there will be a renewed focus on the funding of scientific and clinical research. In many areas of enquiry — particularly those where it is difficult to put concrete dollar amounts on a cost versus benefit of analysis — research funding has long been difficult to come by, with many in government and industry seeing such research as an 'optional' investment. Hopefully the economic impact of the current pandemic will put these (comparatively small) costs into perspective, encouraging future research spending that will help ensure the world is better prepared next time around.

Have you been following any other medical projects that you are excited to see the outcomes of in relation to COVID?

Yes, there has been a huge effort across the scientific community to fight COVID on all fronts. One project that I am particularly closely following is the Oxford Vaccine project, which is already moving forward with clinical trials. If effective, such vaccines will give society a clear path out of the crisis.



Gene editing on demand

Fast, precise and activated by light

In a series of experiments using human cancer cell lines, scientists at Johns Hopkins Medicine say they have successfully used light as a trigger to make precise cuts in genomic material rapidly, using a molecular scalpel known as CRISPR, and observed how specialised cell proteins repair the exact spot where the gene was cut.

Results of the experiments not only reveal new details about the DNA repair process, they also are likely to speed up and aid understanding of the DNA activity that typically causes ageing and many cancers. The team has since filed a provisional patent on their CRISPR technology, which has been described in the journal *Science*.

CRISPR has in recent years enabled scientists to easily edit DNA sequences and alter gene functions to speed the pace of research on gene-linked conditions. Adapted from a naturally occurring gene editing system found in bacteria, CRISPR uses small sequences of genetic material called RNA as a kind of guide that is coded to match and bind to a specific sequence of genomic DNA within a cell. The CRISPR molecule also contains an enzyme called Cas9, which acts as the scalpel to cut out the DNA sequence. The cell then uses its own enzymes and proteins to repair the sliced DNA, often adding DNA sequences that scientists slip into the cell.

According to Dr Yang Liu, a postdoctoral researcher at Johns Hopkins Medicine, studying the DNA repair process has been hampered by an inability to damage the DNA, such as by using CRISPR, in a way that's fast, precise and on demand. Johns Hopkins scientists modified the CRISPR-Cas9 complex by engineering a light-sensitive RNA molecule that allows the CRISPR complex to cut genomic DNA in living cells only when exposed to a particular wavelength of light.

"The advantage of our technique is that researchers can get the CRISPR machinery to find its target without prematurely cutting the gene, holding back its action until exposed to light," said Johns Hopkins MD-PhD candidate Roger Zou, also a member of the research team. "This allows researchers to have far more control over exactly where and when the DNA is cut."

Other research teams have experimented with both drugs and light activation to control CRISPR timing, said Professor Taekjip Ha from Johns Hopkins University. His team's experiments differ by improving the precise timing of CRISPR cuts and examining how quickly proteins repair the DNA damage.

Led by Prof Ha and Assistant Professor Bin Wu, the team delivered an electric pulse to cultures of human embryonic kidney cells and bone cancer cells, which opened pores in the cell membrane and allowed the CRISPR complex with the light-activated RNA molecule to slide into the cells. Then, the scientists waited 12 hours for the CRISPR complex to bind to a targeted spot on the genomic DNA.

When they shined a light on the cells, they tracked the amount of time it took for the CRISPR complex to make the cut. The team found that within 30 seconds of shining the light on the cells, the CRISPR complex had cut more than 50% of its targets.

"Our new system of gene editing allows for targeted DNA cutting within seconds after activation," Dr Liu said. "With previous technologies, gene editing could take much longer — even hours."

To further examine the timing of DNA repair, the scientists tracked when proteins involved in DNA repair latched on to the DNA cuts. They determined that repair proteins started their work within two minutes of the CRISPR activation, and the repair was completed as early as 15 minutes later.

"We have shown that light-activated gene cutting is very fast, and it has potentially wide applications in biomedical research," said Prof Ha. "Revealing the timing of CRISPR gene cuts allows us to see biological processes far more precisely."

Prof Ha and his team have since dubbed the technique "very fast CRISPR on demand". He also noted that light activation offers better location control than drugs that can diffuse widely in the cell.

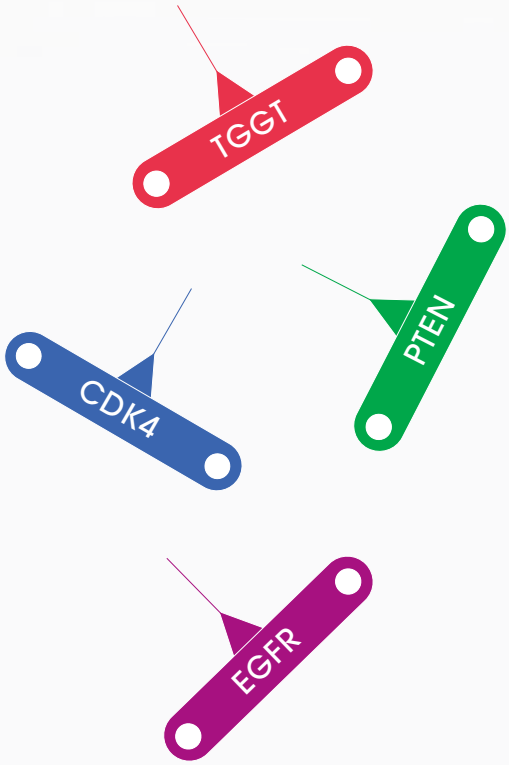
The team also used high-resolution microscopes and a focused beam of light to 'see' how repair proteins interact with the CRISPR cut site in living cells, showing that they could activate CRISPR cutting of one of two gene copies that are normally found in human cells. This capability offers opportunities for using CRISPR to study and eventually treat conditions linked to only one abnormal gene copy, such as Huntington's disease.

"There is a big research community interested in studying DNA damage and its impact," Prof Ha said. He noted that scientists typically use ionising radiation or chemicals to study DNA damage — but while those methods can also be fast, they are not specific to a certain genomic location.

"The technology we developed is well suited to study that."

Off-the-shelf, custom-made total solution to support your CRISPR cell engineering needs

With a breadth of experience working with over 1300 cell line models and over 200 distinct cell lines, we provide:



Ready-made Knockout cell lines and lysates

- Minimal preparation format, ready to culture
- Widely used, immortalized, mammalian cell lines, including HEK-293T and HELA
- Well-characterized by Sanger sequencing and western blot to confirm KO at the genomic and proteomic level
- Parental control available

Custom gene editing services

- 8-12 weeks standard project timeline from scoping to completion.
- Optional assay services, including western blot, exon sequencing, gene copy number and biomarker ID.
- FDA and IND compliant documentation to support straightforward submission

Find your KO cell lines and lysates at **abcam.com/KOcells**

Abcam Australia
Phone: 1800 960 553 Ordering: au.orders@abcam.com Technical: au.technical@abcam.com

abcam

Epithelial volt/ohm meter

The EVOM3 from World Precision Instruments (WPI) is designed to deliver improved workflow efficiency and more stable and repeatable measurements versus traditional transepithelial electrical resistance (TEER) meters.

Providing users with vital feedback during experiment measurements, the product's large screen offers a range of informational views. The graphical displays for trend analysis and measurement values help scientists deliver simple, stepwise methodology during experimental measurements. The touchscreen interface provides users with an intuitive, easy-to-use menu for configuration.

Eliminating the need to log data by hand, the EVOM3 writes the resistance or voltage information to a USB drive in CSV format for easy transfer to spreadsheets and data analysis programs. When used with the footswitch, it enables hands-free recording of measurements.

At the heart of the device is the latest processor and circuitry, providing users with quick and easy readings due to its fast stabilisation, automatic 20x sampling average and low-noise design. The auto ranging resistance feature allows for fast resistance measurements, and an over-range display feature eliminates false readings. The product has adjustable current levels in three fixed ranges, with two lower ranges for sensitive membranes and high resistance ranges up to 100 kΩ.

Coherent Scientific Pty Ltd
www.coherent.com.au

Foetal bovine serum

Foetal bovine serum contains a high content of embryonic growth-promoting factors, which makes it a commonly used growth supplement for cell culture media. CellSera's foetal bovine serum is sterile filtered using Sartorius Stedim Biotech triple 0.1 μm disposable filters.

50 mL sample bottles are available on request.

Interpath Services Pty Ltd
www.interpath.com.au

Particle measurement system

The Malvern Zetasizer Advance has been designed to offer faster, more intelligent particle size analysis. The Malvern Zetasizer range of dynamic light scattering (DLS) instruments can measure particle and molecular size from less than a nanometre to several microns. The Zetasizer Pro and Zetasizer Ultra add ease and performance to the Zetasizer Nano range, offering updated measurement features, hardware capabilities and software intelligence that empower groundbreaking research. Now, Malvern Panalytical has expanded the range to include the Zetasizer Advance.

The latest family of dynamic light scattering (DLS) instruments has been designed to build and improve on the technologies first seen in the Zetasizer Nano, making it simpler, more versatile and more powerful. Combining DLS and electrophoretic light scattering (ELS) with non-invasive backscatter (NIBS) technology, the product is able to measure particle and molecular size, molecular weight and zeta potential across a wide range of concentrations.

Recent updates introduced into the Zetasizer Pro and Ultra systems, such as multi-angle dynamic light scattering (MADLS) and adaptive correlation, have enabled higher resolution data and an approach to data acquisition that separates the sample signal from that of external noise (such as from dust or other contaminants). This enables the user to obtain reproducible particle size data quickly and with minimal sample preparation.

ZS Xplorer software offers intuitive, guided workflows that make setting up a method and performing a measurement easy and straightforward. Using an artificial intelligence (AI)-led approach to data quality assessment, it brings attention to any potential measurement issues and provides guidance on how to improve them.

Overall, the systems provide a comprehensive analysis of users' materials for a wide range of applications. Through the combination of novel measurement capabilities with advanced data analysis, users can characterise the size and surface charge of colloids and nanoparticles; screen protein formulations for colloidal stability and the presence of aggregates; and assess the shelf life and stability of complex formulations.

ATA Scientific Pty Ltd
www.atascientific.com.au

Flow meters and controllers for low flow rates of gases and liquids

Bronkhorst offers the widest range of low-flow (mass) flow meters and controllers on the market. Numerous styles of both standard and bespoke instruments are offered for applications in laboratory, machinery, industry and hazardous areas.

Bronkhorst are the leaders in mass flow / mass flow controller technology for gases and liquids, pressure controllers and evaporation systems.

Markets served: medical, research, energy, water treatment, food & beverage, pharmaceutical, oil & gas and many more.

AMS official Bronkhorst® distributor for Australia and territories

AMS

Bronkhorst®
Flow Technology

AMS INSTRUMENTATION & CALIBRATION PTY LTD
Unit 20, 51 Kalman Drive, Boronia VIC 3155 Australia
P: +61 3 9017 8225 | F: +61 9729 9604 | E: sales@ams-ic.com.au | W: www.ams-ic.com.au

Personal gel and colorimetric blot imaging system

Bio-Rad Laboratories has launched its GelDoc Go Imaging System — a personal benchtop system for the documentation of nucleic acid and protein gels, stain-free blots and gels, and colorimetric blots. The product enables users to capture high-resolution and publication-quality images at the bench, with the ability to image up to four mini-sized gels simultaneously with the system's large imaging area.

The system offers high sensitivity and performance in a compact footprint that helps conserve bench space. Its easy-to-use and intuitive software provides researchers with a way to generate images with just a few screen touches, saving time and providing results quickly. Pinch and zoom functionality helps capture and print key areas of interest, while IQ/OQ tools and software offer easy management of user accounts and permissions.

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

High-resolution mass spectrometer

Scientists working across small-molecule applications areas such as metabolomics, environmental analysis, metabolite identification, forensic toxicology and anti-doping require systems that support extensive, in-depth analysis of multiple complex samples, while simultaneously increasing output and decreasing costs. Thermo Fisher Scientific has released a high-resolution mass spectrometer that offers good measurement capabilities in a system developed for increased productivity.

The Thermo Scientific Orbitrap Exploris 120 mass spectrometer delivers qualitative and quantitative capabilities synonymous with Orbitrap high-resolution accurate-mass spectrometry (HRAM), supporting consistent data quality and decision-making. The system features fast scanning modes and rapid polarity switching that result in comprehensive sample coverage and increased productivity — delivering benefits for high-throughput screening and quantitation assays.

The product was designed specifically for laboratories to safeguard their current assays and enhance their provision of high-throughput and differentiated services, while simultaneously minimising required training and method development times. Performance is further enhanced with compatibility to Thermo Fisher's latest software updates.

With Thermo Scientific Compound Discoverer 3.2 software, small-molecule researchers are supported through extensive characterisation capabilities, access to multiple mass spectral fragmentation library and structural database sources. Access to the large Thermo Scientific mzCloud mass spectral fragmentation library enhances connectivity and characterisation for small-molecule applications to help identify compounds. Routine laboratories will meanwhile benefit from Thermo Scientific TraceFinder 5.1 software, which simplifies and optimises the high-throughput screening and quantitation of compounds with improved integration of difficult peaks and streamlined reporting.

Thermo Fisher Scientific
www.thermofisher.com.au

Laboratory water purification system

Water is the lifeblood of the life science industry, central to reproducibility, integrity and data accuracy. ELGA's three-in-one laboratory water purification system delivers water for a wide range of lab applications, offering an optimal user experience.

The PURELAB Quest's design dispenses all three types of lab water (ultrapure 18.2 MΩ-cm, pure Type II and general laboratory-grade Type III) directly from a tap water input. From only one unit, it produces water for applications from HPLC and PCR to buffer preparation and glassware washing.

The product is compact, intuitive to use, easy to install, uses reclaimed materials and offers remote monitoring through AQUAVISTA, Veolia's cloud-based digital solution. With multiple purity sensors, in-built periodic recirculation and a testing regime that covered over 150,000 dispensing cycles, it provides lab water for research labs worldwide.

The PURELAB Quest is now available from Metrohm Australia.

Metrohm Australia & New Zealand
metrohm.com.au

ESSENTIAL SMALL MOLECULES FOR **MATTER**

Air Liquide
creative oxygen

©stock.adobe.com/au/Kalim

9 key points to consider when buying face shields

Buying face shields and PPE amidst COVID-19 is a challenging task, as there are many aspects that are important to consider and can be potentially overlooked due to demands and diversity of choice.

In this article we look at key aspects to ensure you make a good choice while putting the safety of your medical staff at the front of mind.

1. User comfort

A face shield in certain applications can be required for a four-hour shift or longer, so it is essential that your user finds it comfortable for extended durations. This is a major challenge for shield designers, as they need to consider the many shapes and sizes of the human head to offer both adjustability and comfort.

2. TGA approvals

Knowing that your face shield is TGA approved will give you peace of mind that it meets federal therapeutic goods requirements for safe use in Australia. A face shield under the TGA guidelines is considered to be a visor. A visor is noted to be a transparent personal protective device intended to shield the face and eyes of a healthcare worker from unnecessary exposure from blood and other body fluid splashes while performing a clinical or laboratory procedure. Visors are suitable for use with prescription lenses and protective masks.

3. Latex-free

Make sure the shields you purchase are latex-free. Natural rubber latex allergy is a serious medical concern in health care today. Latex-sensitive patients and healthcare workers face a serious risk from any product containing latex, with exposure to latex-positive shields a particular concern. To date, there is no known cure for latex allergy except eliminating exposure to latex products. Note that some elastic straps contain latex or similar components and should be treated with caution.

4. Optical clarity

High optical clarity is an important factor when choosing a face shield. It is important the material has very high transparency and minimal distortion. Viewing through a clearer, better-quality lens allows your eyes to work longer with less fatigue and less overall strain on your body. PETG is an abbreviation for polyethylene terephthalate (with a glycol modification), which is one of the more common polymers used today that offers great clarity.

5. Face coverage

It is a good idea to ensure your shield has good face coverage. This means that you would expect the base of the shield to exceed the chin of a larger face, the top of the shield to exceed the eyebrows and the sides of the shields to go around and almost to the ears for optimal protection. Avoid smaller masks as they can be used to reduce cost at the expense of user safety.

6. Working distance

Working distance is the distance between your mouth and the inside of the shield. This is an important detail that can often be overlooked due to the depth of the N95 masks. It is a good idea to try a shield on with your larger masks, such as an N95, as they are often used together. If working distance is too small, your shield can press the mask to the face, increasing friction and discomfort.

7. Re-usable or disposable?

A disposable face shield is single-use only and will likely have foam attached to the visor, making it porous and uncleanable. Single-use shields are normally light duty and can be wasteful when raw material is in high demand. Re-usable models will most likely have a heavier and more rigid visor, with a foamless and porous-free design so every part can be submerged or wiped down prior to re-use.

8. Anti-fogging and anti-glare

Anti-fogging properties can assist with high optical clarity, especially in high-humidity atmospheres or when the user is perspiring. Anti-fogging can be achieved by incorporating properties into the raw polymer and in some cases sprayed or wiped onto the surface.

9. Origin of manufacture

Look to partner with local manufacturers in your country. Local manufacturers will understand relevant country standards and take pride in the quality, consistency and delivery of their own product. Supporting local has never been so important, and when multiple companies make this choice, jobs are supported and revenue is put into circulation.

Since 1993, Westlab has specialised in helping laboratories work effectively by supplying reliable equipment, consumables and efficient workspace designs.

Westlab Supplies

www.westlab.com.au

The S-Monovette® is the revolution in blood collection.

The S-Monovette is an innovative enclosed blood collection system that allows the user to draw blood from the patient using the syringe or vacuum method, uniting the advantages of both techniques in a single product.

When used as a syringe, the phlebotomist has full control over the speed at which the blood is drawn into the tube. This is particularly useful for patients with fragile veins, such as the very young or elderly, where the use of the aspiration technique prevents even the most fragile veins from collapsing. When the tube has been filled, the plunger is simply snapped off to leave a primary sample tube which can be centrifuged and is compatible with all major analysers.

The S-Monovette can also be used as an evacuated tube by drawing the plunger fully down and snapping it off immediately prior to blood collection. This creates a fresh vacuum and ensures a precise filling volume, ensuring a correct dilution ratio.

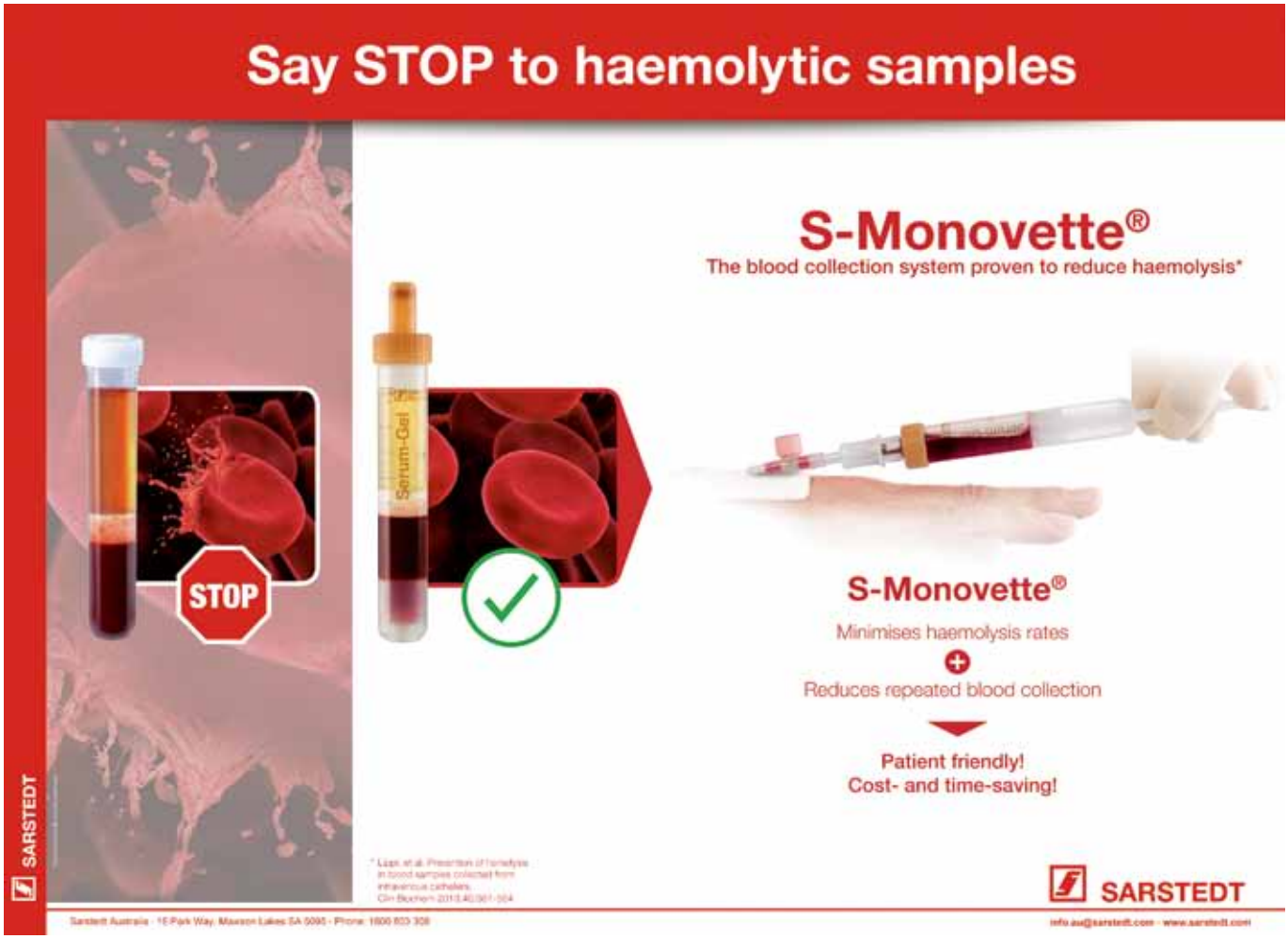
The reduced vacuum pressure in the S-Monovette drastically reduces the rate of haemolysis and vein collapse, meaning increased sample quality and reduced costs associated with repeat collections. Furthermore, unlike pre-evacuated tubes, the S-Monovette does not have to hold a vacuum for many months after manufacture, which allows the membrane stopper to be thinner and more easily penetrated by the needle sheath. This minimises the movement of the needle in the vein when attaching the tube, ensuring optimum patient comfort.

The S-Monovette needle is ready to use so that there is no need for assembly to a holder. The needle is of a compact, low profile design, which reduces the chance of haematoma by allowing for a reduced angle of puncture and eliminates the possibility of needle stick injury caused by assembly of the needle and holder. The compact design also results in approximately one sixth of the sharps volume caused by using a pre-evacuated system, giving significant cost savings.

If you would like a visit from one of our Sales Representatives to demonstrate this system, please contact us on **toll free 1800 803 308**.

SARSTEDT

Sarstedt Australia
www.sarstedt.com



SARS-CoV-2 Spike-pseudotyped lentivirus

GeneCopoeia's Lentifect SARS-CoV-2 Spike-pseudotyped lentivirus products are designed to produce a specially packaged variant of standard lentivirus that replaces VSV-G envelope glycoprotein with the Spike (S) protein.

The company's spike-pseudotyped lentivirus can be used for several applications, such as: vaccine development for the SARS-CoV-2 virus; studying the efficacy and mechanism of neutralising antibodies against the SARS-CoV-2 virus; development of antiviral therapeutic agents; and studying the mechanism of virus-receptor interaction.

In addition to lentiviral particles, GeneCopoeia also offers a SARS-CoV-2 Spike Protein Pseudotyped Lentivirus Particle Kit that includes all required reagents: Lentifect SARS-CoV-2 Spike protein-pseudotyped lentiviral particles; Lentifect Standard VSV-G lentiviral particles; and the company's ACE2-expressing HEK293T cell line.

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

Microplate handling system

The Agilent BenchCel Microplate Handler is a compact microplate storage and automated microplate handling system designed for integration with a variety of laboratory devices. The product features a high-speed robot, and its modular design provides the flexibility and scalability required to meet the needs of the most diverse laboratory applications.

The device conveniently stores and handles most microplates, lidded microplates, tipboxes and tube racks. Its 2-, 4- and 6-rack options add flexibility for a maximum of 360 standard microplates, while its scalable configuration allows integration of multiple instruments into a single benchtop system. Other features include 8 s transfer time from stack to instrument; a delidding function that removes and replaces microplate lids as necessary; and 66% more walk-away time than competitive systems, according to the company.

The product can be powered by the Agilent VWorks software or accessed through its ActiveX control for integration into any other software platform. VWorks includes a labware database capable of managing most labware, including standard microplates, filter plates, deep-well microplates, tipboxes and tube racks.

Agilent Technologies Australia Pty Ltd
www.agilent.com

Pressure transmitters

VEGA has released the VEGABAR 80 series of three pressure transmitters, with which it claims that all conceivable applications can be covered. The VEGABAR 82 with a ceramic measuring cell can cover 80% of all applications, while the VEGABAR 83 with a metallic measuring cell is suitable for high-pressure applications. The VEGABAR 81 with a chemical seal can be deployed when high temperature and chemical resistance are required.

Ceramic measuring cells have many advantages, but also some weaknesses: for example, their susceptibility to thermal shock and moisture. When sudden temperature changes occur, it can take several minutes before sensors with ceramic measuring cells begin delivering correct readings again.

VEGA's CERTEC ceramic-capacitive cell, along with temperature shock compensation, is said to reduce these problems for the VEGABAR 82. In addition to the usual temperature sensor on the backside of the CERTEC cell, there is a second sensor in the glass joint directly behind the ceramic diaphragm that is used to detect thermal shock, allowing it to be compensated by means of an algorithm.

Any two instruments from the VEGABAR 80 range can also be combined into an electronic differential pressure system. A standard VEGABAR 82, for example, can be combined with an additional sensor, selecting the 'slave' electronics version, and connect them together to form a differential pressure system. There are no oil-filled capillary tubes that need to be insulated to avoid environmental influences such as temperature changes or strong vibration and the resulting measurement errors.

VEGA Australia Pty Ltd
www.vega.com/au

Respiratory infection response

A case of mistaken identity

Scientists have identified a previously unknown immune cell that plays a crucial role presenting antigens to other immune cells during respiratory virus infections, and could explain how convalescent plasma helps to boost immune responses in virus-infected patients.

When our body faces an infection, it responds with inflammation and fever. This is a sign that the immune system is doing its job and leads to the activation of many cells, like soldiers in an army. Dendritic cells (DCs) are like the generals of that army, activating and instructing the soldiers to kill infected cells by presenting antigens derived from the 'invaders' to cells of the immune system.

There are several types of DCs that perform antigen-presenting functions in the body. Conventional DCs continuously scan the body for dangerous invaders, even when there is no infection. When there is inflammation triggered by infection, another subset of DCs emerges from inflammatory monocytes. Because monocyte-derived DCs are easily prepared in vitro from monocytes isolated from human blood, it was always assumed that these cells were very important antigen-presenting cells. Clinical trials using monocyte-derived DCs in cancer therapy have, however, been disappointing.

An international study, led by Bart Lambrecht, Martin Guilliams, Hamida Hammad and Charlotte Scott from the VIB-UGent Center for Inflammation Research, now reveals that monocyte-derived DCs are in fact poor antigen-presenting cells, and have wrongly been assumed to have these functions due to a case of mistaken identity. Their discovery, which could see a rewrite of the immunology textbooks, has been published in the journal *Immunity*.

The scientists studied mice with a viral respiratory infection with single-cell technologies; single-cell resolution allowed them to finely separate the monocyte-derived cells from other DCs during their response to the infection. They found that monocyte-derived DCs do exist, but do not present antigens. The reason for the confusion is that a lookalike DC emerges — called inflammatory type 2 conventional DC, or inf-cDC2 — that combines some of the best characteristics of monocytes, macrophages and conventional DCs to induce the best form of immunity.

"This was a big surprise for us," Lambrecht said. "We've all been taught that monocyte-derived cells are excellent antigen-presenting cells, certainly when there's inflammation. Now we show that it's actually a new hybrid DC type that's doing all the work. This really changes what we know about the immune system and is very important knowledge for understanding respiratory viral infections and other inflammatory diseases."

Guilliams added, "It took a massive team effort, but the strength of single-cell sequencing has finally cracked the complex DC code. Many contradicting findings from the last two decades now make much more sense. This also opens tremendous therapeutic opportunities, since vaccination strategies can now be designed to trigger formation of inf-cDC2s and thus generate a stronger antiviral immune response."

Scott concluded, "Through the use of single-cell technologies, we have been able to align all the findings from the past few years and identify the distinct cell types involved. Moving forward, it will be very interesting to see under what other inflammatory conditions these inf-cDC2s are generated and how they can potentially be targeted therapeutically."

The findings also have direct relevance for the current COVID-19 pandemic, caused by another respiratory virus. An emergency treatment that is currently being explored is the use of convalescent plasma, or the blood plasma of recovered patients. Study lead author Cedric Bosteels noted, "One of the unique features of the new DCs is that they express functional Fc receptors for antibodies that are found in the plasma of patients who have recovered from COVID-19."

This study is the first to show that one of the mechanisms through which convalescent plasma and the virus-specific antibodies in it work via boosting of inf-cDC2. Since boosted DCs induce a much stronger immune response, the study reveals a new target for therapeutic intervention for viral infections and other inflammatory diseases.

Air showers

Airepure (a Camfil Group company) supplies air shower enclosures that deliver concentrated high-velocity jets of HEPA filtered air, removing contaminated surface particles from personnel prior to entry or exit from a contamination-controlled area.

The company advises that its in-house engineers are experienced with the technological aspects of laminar flow air quality control and the different standards that apply to each application and can provide custom air showers with various configurations, including single- and double-door models, to suit specific needs and requirements.

Airepure air showers contain adjustable nozzles arranged on enclosure walls and ceilings that deliver pressurised filtered air at a velocity between 22 and 26 m/s, ensuring efficient scrubbing action necessary to remove particulate matter. The closed-loop circulation design directs contaminated air downward through grills and hollow walls of the air shower and back to the HEPA filter, which should remove 99.99% of all particles down to 0.3 μm.

Standard air shower features include power failure safety and emergency stop, interlocking doors, fluorescent lighting, flush-mounted windows, programmable control, touch panel and timer with LED display. Airepure's NATA certified onsite technicians can also service existing laminar flow systems and air showers through the replacement and testing of HEPA filters to meet Australian Standards and state healthcare regulations.

Airepure Australia Pty Ltd
www.airepure.com.au

Nano-volume spectrophotometer

The Analytik Jena ScanDrop^2 is a UV/Vis spectrophotometer specially designed for the analysis of microlitre samples from 0.3 μL up to 2 mL. With a selectable wavelength range between 190 and 1000 nm and in 0.5 nm increments, the unit can record a complete spectrum between 1.6 and 12.8 s depending on the adapter used.

The patented ChipCuvette adapter option can be used to measure sample volumes from 0.3 to 4 μL. The adapter cell contains 16 micro channels, each with two independent path lengths of 0.1 and 1 mm. Using both, the software can calculate the optimal path length to record the sample concentration without having the samples diluted, saving time and resources. Other adapter options include Butterfly Cuvette, for up to nine sample measurements (2 to 4 μL), and the 8-cell cuvette changer.

The unit comes optional with a 10.1″ tablet to provide a full standalone system. Alternatively, the unit can be controlled via PC/laptop as the system comes delivered with the FlashSoftPro^2 software, which contains preinstalled methods for NA and protein analysis. The product is powered by a Xenon flash lamp and has the ability to import and export data via USB drive.

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

Mass spectrometry software

With an intuitive and user-friendly design, SCIEX OS Software is intended to make mass spectrometry more accessible and straightforward for every user. The software is now available on the Echo MS System and the SCIEX Triple Quad 7500 LC-MS/MS System – QTRAP Ready.

Data analysis should become easy with shared tools, automation and reduced manual intervention. Auto-detection of sample failures results in auto-corrective action, while review by exception flags means less manual checking of results.

Results are meanwhile optimised with powerful integration algorithms. Peak modelling is designed to improve peak finding and integration, requiring less user input and therefore reducing time for data review. Automated result checking and outlier removal minimises the time it takes to establish an approved calibration range.

Finally, intuitive audit trails are designed to ensure full traceability and accountability to achieve data precision, completeness and consistency across every run, on every system.

SCIEX Australia Pty Ltd
www.sciex.com

Fume cupboards

Fume cupboards are an essential part of many Australian labs, and selecting a good one can be difficult. Apart from the obvious points such as which gas outlets, dimensions and materials to use, users also need to decide if they need constant air volume (CAV), variable air volume (VAV), manual or auto sash control, and then ensure that the installed equipment will interact with the building and HVAC system correctly.

G3Lab brings a range of fume cupboards to the Australian market with a control system developed from several years of experience and extensive client feedback, which can be as simple or as complex as the client needs. Available features include VAV airflow control, auto-closing sash, BMS outputs, specialty gas fittings, and ducting and fan systems. The product is suited to manifold or dedicated fans.

In addition, the G3Lab fume cupboard uses patented Accuvalve technology to measure actual airflow, which makes it 100% compliant to AS2243.8.

G3Lab
www.g3lab.com

Pipette tips

The Eppendorf Totally Integrated Pipetting System — epT.I.P.S. — pipette tips are designed to work in combination with the company's pipettes to deliver the precision required when working with different liquid classes and sample types.

The cone design of the epT.I.P.S. pipette tips allows users to achieve good tip fit and tightness on Eppendorf pipettes while at the same time minimising tip attachment for effortless tip ejection. Additionally, the pipette tips are universally designed for use on pipettes from other manufacturers.

When it comes to tip type, fine retracted or extended tips can help to simplify the liquid handling of small volumes, while narrow and long tips allow the bottom of any vessel to be reached so the user gets the most from their samples and reagents. Fine graduations on the tips allow users to visually check volume for precise pipetting.

The pipette tips are available in certified purity grades (Eppendorf Quality, PCR Clean, Biopur) and come individually wrapped, in resealable bags, box sets, reloads or as single-use racks for different applications. For improved sustainability, the single-use racks are now manufactured with up to 35% less plastic depending on rack size and without affecting tip quality, and have a slimline design for easy handling and safety.

Eppendorf South Pacific Pty Ltd
www.eppendorf.com.au

UV air cleaners

Grant Instruments air flow cleaners can be used to provide work environments with added protection. The UV air cleaners are compact and easy to use, and are suitable for air dis-infection in hospitals, research laboratories, veterinary clinics, schools, offices and many more spaces.

The UV air flow cleaner-recirculators consist of one or two germicidal UV lamps, a fan unit equipped with dust filters and a control unit confined in a flow-through chamber. They can be either fixed on walls (standard) or mounted on a movable tripod (optional).

Thermo Fisher Scientific
thermofisher.com

QIAcuity™

Fully integrated nanoplate-based digital PCR system for absolute quantification

- Superior partitioning in nanoplates
- Five-colour multiplexing
- Faster time to results
- Walk-away automation

Visit **www.qiagen.com/dPCR** for more information or scan the QR code below

Sample to Insight

Gas dosing control for microalgae facility

The Centre for Solar Biotechnology at The University of Queensland (UQ) was established in 2016 by Professor Ben Hankamer with the aim of accelerating the innovation and commercialisation of new solar-powered technologies and industries, many of which are based on photosynthetic green algae.

The centre operates both indoor and outdoor pilot-scale production facilities for micro- and macro-algae, which are equipped to operate high rate ponds, flat panel, tubular and airlift systems. This includes the testing of various bioreactor designs and process parameters, as well as testing and characterisation of production strains. Extensive infrastructure is already in place, including CO_2 and compressed air with associated piping and automation technologies for the operation of the bioreactors.

The existing control system for the outdoor bioreactors had been built almost 15 years ago, and the centre faced an expensive upgrade option. As a result, UQ commissioned DSI Tec to upgrade the plant with a new control system. Together they designed a new control and monitoring system for the bioreactors, which includes pH-controlled CO_2 dosing and remote sensor calibration capabilities.

DSI Tec explored a number of options and providers for mass flow meters and controllers, and other necessary equipment, but kept coming back to Bürkert. So Bürkert invited David Horton, Principal of DSI Tec, to the company's Sydney Systemhaus to discuss the project in detail.

Specific valves and instrumentation were required for the control system, and the laboratory wanted a customised design that needed to communicate with a Siemens S7-1200 platform, using a Profinet network already onsite. The control system also required futureproofing and the design needed to allow for future upgrades with additional devices.

The first requirement was to provide a transmitter for eight raw pH probes. For this task, Bürkert supplied two of the Bürkert MultiCELL Type 8691, each with Profinet and four pH modules. The pH reading, as well as other diagnostic data, is sent directly to the Profinet network for monitoring and control.

The second requirement was to provide five multifunction controllers (MFCs) to dose air, with the capacity for an additional 20 MFCs to be connected in the future. To accommodate future expansion, Bürkert supplied five of its MFCs on its Efficient Device Integration Platform (EDIP). This offers a modular design to allow the addition of devices according to application requirements. Bürkert's ME43 gateway device configured for Profinet provides an interface to the control system.

The third requirement was to provide solenoid valves for CO_2 dosing. To this end Bürkert supplied a stainless steel manifold and valve system. The manifold was built in-house by Bürkert Australia and mounted on a stainless steel top-hat, which supports easy mounting and serviceability. The five valves are controlled directly from the Siemens PLC digital outputs.

"The challenge for Bürkert was to accommodate the tight allocated installation space onsite," said Dean Bryant, National Segment Manager, Micro Fluidics & Gas Handling for Bürkert Fluid Control Systems. "We therefore provided a narrow, freestanding enclosure to accommodate all of the MFCs and valves."

Bürkert readily provides control panels and cabinets as part of its solutions for ease of setting up systems in various locations. Bryant added, "The completed system included a Siemens S7-1200 PLC/HMI combination, which contained the Profinet Master that communicated with the other devices through Bürkert's ME43 gateway device."

The close collaboration between UQ, Bürkert and DSI Tec — from the conceptual design right through to installation — ensured that the project was delivered on time and on budget.

"The automation upgrade for the indoor production facility now enables a precise and remote control of microalgae cultures to produce high-quality biomass that is then used to develop bio-inspired green medicines, foods and nanomaterials," said Dr Juliane Wolf, Research Officer and Project Manager. "Once we scale up the automation implementation further, to include our outdoor production facility, we can drive down the cost of production and expand the green developments to the production of fuels and ecosystem services."

"Our indoor and outdoor pilot plants are critical to our work, and we thank DSI Tec and Bürkert for working so professionally and constructively to provide us with the automated control systems that we require," Prof Hankamer said. "The system will take our R&D work to the next level of systems design and scale-up, so that we can provide the renewable products and jobs of the future through a solar-driven manufacturing base."

Burkert Fluid Control Systems
www.burkert.com.au

6-colour light source for microscopy

Thorlabs' Chrolis 6-Wavelength High-Power LED Source is a 6-colour light engine for fluorescence excitation applications. The configurable design combines the light from six user-chosen high-power LEDs into a single 3 mm liquid light guide. Users can select from 11 different wavelength options with outputs ranging from 365 to 780 nm, covering all known fluorophores. As experimental needs change the light engine is easily reconfigured, as the LED modules and dichroic mirrors are also available for individual purchase.

Each LED's intensity can be individually controlled via an easy-to-use graphical user interface, which also offers extensive pulse capabilities. Light pulses are generated internally. For each LED, the pulse parameters can be set separately. The pulses are optimised for fast rise/fall times and offer high-quality waveforms. Via a BNC breakout box, it is also possible to trigger the LEDs from external signals. Alternatively, the pulses generated internally can be used to trigger external devices, such as cameras.

Lastek Pty Ltd
www.lastek.com.au

Viral RNA isolation kit

The EpiQuik Viral RNA Isolation Fast Kit, from EpiGentek, is a complete set of optimised buffers and reagents suitable for quick preparation of viral RNA from cell-free liquid specimens, specifically from saliva and nasal or nasopharyngeal swabs.

The specialised buffering system allows RNA to bind to the glass fibre matrix of the spin column while contaminants pass through the column. Impurities are efficiently washed away, and pure RNA is eluted. The RNA purified with the kit can be used for a variety of routine applications, specifically for RT-PCR.

The kit offers the following advantages and features: a fast procedure that delivers high-quality total RNA in total 10 min; ready-to-use RNA for high performance in downstream applications; and consistent RNA yield from a small amount of starting material.

Sapphire Bioscience
www.sapphirebioscience.com

Biomolecular imagers

Azure Biosystems imagers cover the full spectrum of capabilities for documentation and quantitative analysis of gels, Western blots, slides, tissue samples, small animal models, plants and more. Users can choose from one of the Azure imagers for general lab imaging needs or the Sapphire Biomolecular Imager for high flexibility and performance on blots, gels, plates, microarrays, phosphor imaging, tissue and small animal models.

Azure imagers offer fast, sensitive, high-resolution, 9 MP, CCD-based detection in a small, benchtop-friendly footprint. They are multichannel, multimodal imagers, with near-infrared, visible light and UV excitation channels. They can be used to detect Cy dyes, Alexa dyes, Safe dyes, Trihalo compound based gels and more.

The basic 200 model is for streamlined gel documentation and densitometry (white light, blue light and UV). Upgrade to the 300 to add the ability to detect chemiluminescence at the same sensitivity as film. The 300 is also upgradable to the 400, which adds visible (RGB) fluorescence detection, or the 500 for Infrared laser excitation for quantitative Western lot imaging in the NIR. All of these models can be upgraded to the 600, which combines all of these detection modes — white light, blue light, UV, chemiluminescence, visible fluorescence and NIR fluorescence —in a single powerful instrument.

For labs that need high levels of imaging performance — including sensitivity (pg to fg), resolution (down to 10 μm), dynamic range (over 6-log) and field of view (25 x 25 cm scannable area) — or want an imager that can keep up with their diverse and dynamic research needs, Azure offers the Sapphire Biomolecular Imager. The instrument combines three-detector design with the background-minimising, focused excitation of a laser scanner. The result is a hybrid laser scanner–CCD imager that delivers chemi-luminescent detection, visible and NIR fluorescence detection, and phosphorimaging.

SciTech Pty Ltd
www.scitech.com.au

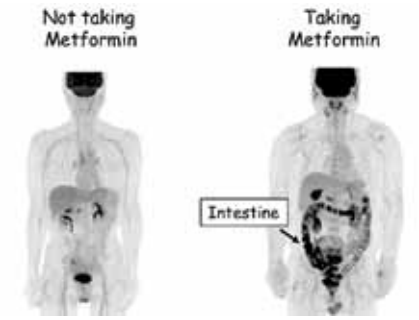
Antidiabetic drug

turns sugar into stool

Researchers from Kobe University have discovered that metformin, the most widely prescribed antidiabetic drug globally, promotes the excretion of blood sugar from the large intestine into the stool — a mechanism that had never before been realised. Their findings have been published in the journal ***Diabetes Care***.

Diabetes is characterised by the elevation of blood sugar concentration, which damages the blood vessels and in turn leads to various diseases. The good news is that a number of drugs that reduce blood sugar concentration are available for the more than 400 million people who suffer from diabetes around the world.

Metformin, recommended as a first-line drug in many countries, is the most frequently prescribed medication for diabetes, having been in use for more than 60 years. Administration of metformin lowers blood sugar levels, but the mechanism behind this effect was previously not understood. Elucidation of this mechanism would contribute to the development of new and better diabetes drugs; metformin's mode of action has thus been actively researched over the world.



Representative FDG-PET MRI images of patients taking and not taking metformin; the areas where FDG (sugar) is accumulated appear black. In patients taking metformin (right), the intestine appears black, which indicates that FDG (sugar) is accumulated in the intestine.

One such method of research has involved the use of FDG-PET (fluorodeoxyglucose-positron emission tomography) — an imaging test to study where and how much FDG (a substance similar to sugar) is accumulated in the body after the administration of this substance through the vessels. Because FDG behaves in a similar way to sugar in the human body, FDG-PET can reveal organs or tissues that consume or accumulate large amounts of sugar.

FDG-PET is generally conducted with a device that integrates both PET and CT (computed tomography) imaging, allowing for the examination of locations where FDG has accumulated. A more recent device development involves the integration of PET and MRI (magnetic resonance imaging), using a strong magnetic field to examine bodily structures that cannot be analysed by CT. Only nine PET-MRI devices have been installed in Japan, one of which was taken advantage by the Kobe research team.

The team used PET-MRI to investigate the movement of sugar in the bodies of diabetic patients, both those who were taking metformin and those who were not. The team found that sugar (ie, FDG) is heavily accumulated in the intestine of patients taking metformin. To understand exactly where in the intestine sugar accumulates, the team subsequently investigated the 'wall of the intestine' and the 'inside of the intestine' (stool and other contents) separately.

They found that, in patients taking metformin, more sugar was accumulated in the areas inside the intestine that are distal to the ileum (the anal side part of the small intestine). On the other hand, there was no difference in sugar accumulation in the wall of the intestine between patients who were taking and not taking metformin.

These results indicate that, when a patient takes metformin, sugar in the blood is released from the intestine into the stool. It was previously not known that sugar could be excreted from the intestine into the stool, nor that metformin promoted this activity.

Previous studies using PET-CT had shown that FDG accumulated in the intestines of patients taking metformin, but PET-CT could not separately show the wall and the inside the intestine. In the current study, PET-MRI allowed the research team to investigate the accumulation in the wall and the inside of the intestine (stool) separately, revealing that metformin-induced accumulation of sugar occurred exclusively inside the intestine.

Interestingly, metformin appears to share characteristics with another antidiabetic drug, known as an SGLT2 inhibitor, which lowers blood sugar concentrations by excreting sugar in the urine. Taking a SGLT2 inhibitor results in the excretion of tens of grams of sugar per day; the Kobe researchers were unable to quantitatively evaluate how many grams of sugar were excreted in stool. The significance of the discovery will, however, be further confirmed by using a new imaging method that will enable the excreted sugar in the stool to be quantified.

Single-cell whole-genome amplification kit

The TruePrime Single Cell Whole Genome Amplification Kit from 4basebio uses a novel method to achieve genome amplification from single or just a few cells. Amplification of a few cells instead of one can improve total coverage breadth if the user's experimental design allows this.

TruePrime technology is based on the combination of the recently discovered DNA primase TthPrimPol1 and the progressive and high-fidelity Phi29 DNA polymerase. TthPrimPol is a thermostable member of the recently discovered PrimPol family of enzymes. PrimPols are endowed with primase and polymerase activities. The main novelty of these enzymes is their capacity to synthesise DNA primers.

The kit uses alkaline incubation to allow cell lysis and DNA denaturation of genomic DNA with low DNA fragmentation. This results in amplified DNA with high integrity and fragment length, ensuring that most of the sequences are uniformly represented.

Suitable for next-generation sequencing, the product is insensitive to external DNA contamination and works with all types of genomes. TthPrimPol synthesises the primers for Phi29 DNA pol and there is no random extension of primer dimers. The convenient kit format enables easy handling and is said to offer reduced amplification bias in genome coverage for correct results.

BioNovus Life Sciences
www.bionovuslifesciences.com.au

Pass boxes and pass through hatches

Airepure supplies quality laminar flow hoods and clean-room air purity systems, including custom pass boxes and pass through hatches that enable the safe transfer and delivery of materials and equipment to and from a sterile area.

The company advises that its in-house engineers are fully conversant not only with the technological aspects of laminar flow air quality control but with the different standards that apply to each application. Airepure can provide custom-sized pass boxes/pass through hatches with various configurations to suit specific needs and requirements.

The pass through boxes and pass hatches feature robust, crevice-free construction in powder-coated steel with airtight durable door seals. An electrical or mechanical door interlocking system prevents cross-contamination by making it impossible to open both the front and rear doors at the same time.

The company's NATA certified onsite technicians can also service existing laminar flow systems and pass through boxes and hatches through the replacement and testing of HEPA filters to meet Australian Standards and state healthcare regulations.

Airepure Australia Pty Ltd
www.airepure.com.au

Biological safety cabinets

Air Science's Purair BIO Class II, Type A2 biological safety cabinets (BSCs) provide a primary containment work area for life science research, cell culture processing and other applications where protection of the user, the work product and the environment are needed, as is mitigation of cross-contamination on the work surface.

Biosafety in the laboratory is critical when work involves infectious diseases and toxins, as well as in cell and tissue culturing, where product contamination must be avoided. Prevention of lab-acquired infections to personnel can also be achieved by reducing potential exposure to droplets or splashes, preventing contaminants from escaping the work area.

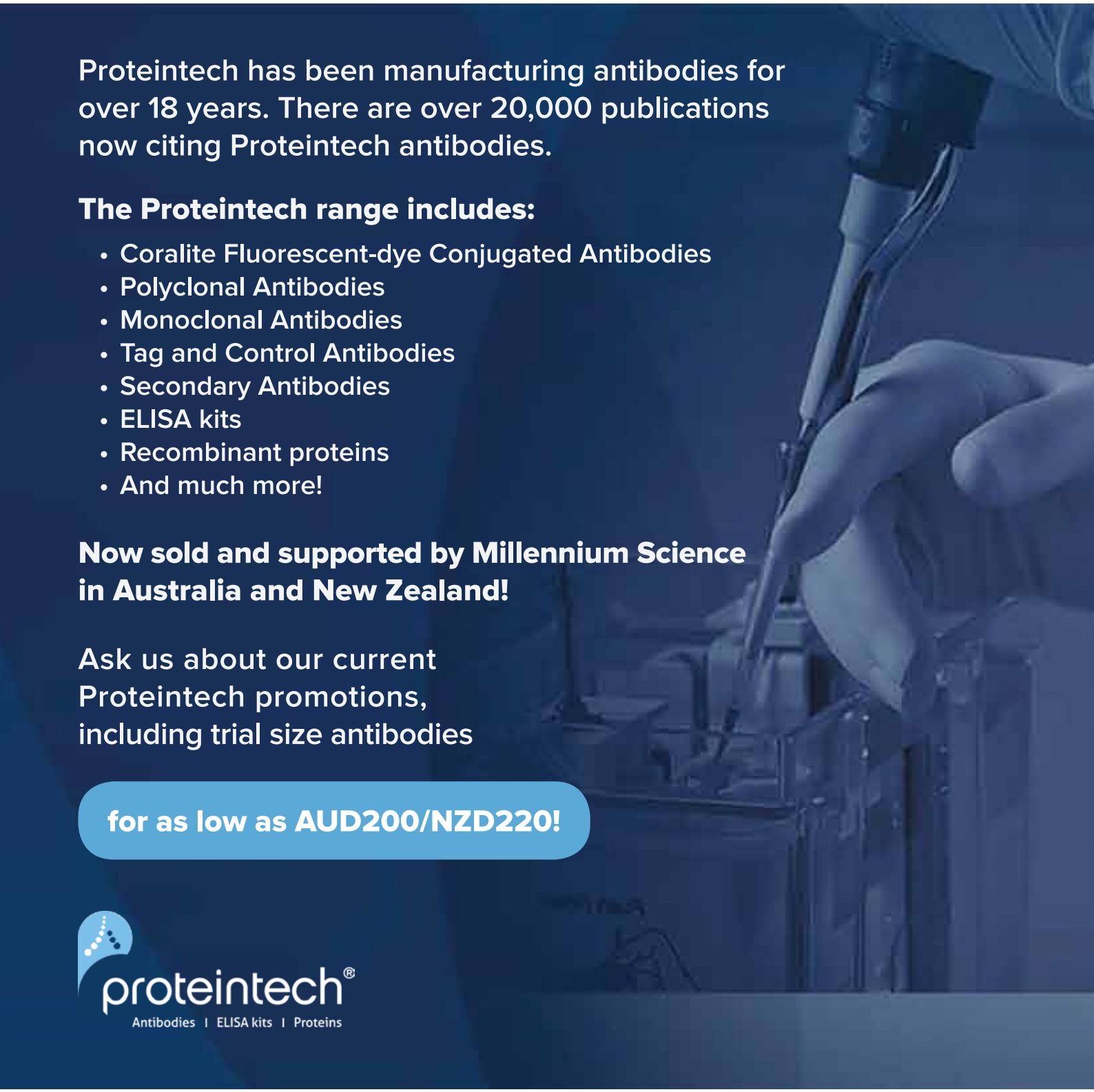
A biological safety cabinet provides a safe laboratory workspace using optimum airflow design combined with an integrated HEPA filtration system. Room air is drawn in through the intake grille on the front of the unit, then under the work surface and directed to the top of the cabinet where it passes through a HEPA filter.

Negative pressure is created inside the cabinet, resulting in a primary containment work area, while the HEPA filtration supplies clean air to the work surface in a vertical laminar flow pattern. These airflow patterns provide an optimum air curtain on the front opening, maintaining personnel and product protection. The exhaust HEPA filter traps biohazardous particles prior to the air being exhausted back into the laboratory, preserving environmental protection.

LAF Technologies Pty Ltd
www.laftech.com.au

The Benchmark In Antibodies and More!

Antibodies Manufactured and Validated In-House



Proteintech has been manufacturing antibodies for over 18 years. There are over 20,000 publications now citing Proteintech antibodies.

The Proteintech range includes:

- Coralite Fluorescent-dye Conjugated Antibodies
- Polyclonal Antibodies
- Monoclonal Antibodies
- Tag and Control Antibodies
- Secondary Antibodies
- ELISA kits
- Recombinant proteins
- And much more!

Now sold and supported by Millennium Science in Australia and New Zealand!

Ask us about our current Proteintech promotions, including trial size antibodies

for as low as AUD200/NZD220!

proteintech®
Antibodies | ELISA kits | Proteins

millennium® science
enabling next-generation research™

1800 678 242
sales@mscience.com.au
www.mscience.com.au

MRI
may enable early detection of Alzheimer's

Early identification of Alzheimer's disease gives an opportunity to halt or slow down its progression into a devastating illness that affects the daily life of patients — but diagnosis of the disease is not easy due to its overlapping signs with normal ageing.

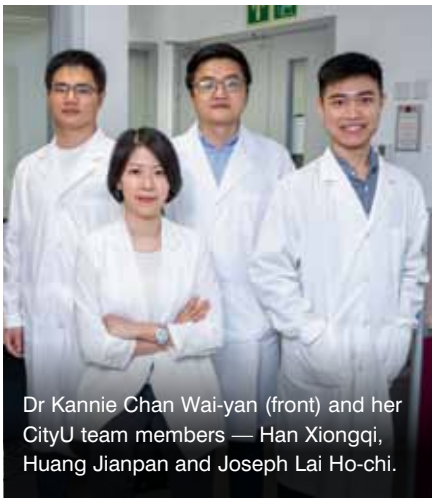
Now, an international research team led by City University of Hong Kong (CityU) has developed a non-invasive molecular imaging approach based on magnetic resonance imaging (MRI) to dynamically measure glucose level changes in the brain's lymphatic system. Published in the journal *Science Advances*, their discovery may help in identifying Alzheimer's disease at early stages so that treatment can begin as soon as possible.

"The tricky part of identifying Alzheimer's disease is that early abnormalities, such as the emergence of protein plaques, are similar to normal ageing in the human brain," said CityU's Dr Kannie Chan Wai-yan. "Patients diagnosed with symptoms, in which deposition of plaques are found in their brain hampering the cognitive function, are most likely already in the middle or late stage of the disease. Actually, pathologies in the brain happened 15 or 20 years before the symptoms appear."

Recent findings have shown that abnormal clearance of waste in the glymphatic system — the lymphatic system in the brain — is one of the hallmarks of early Alzheimer's disease. The glymphatic system is a drainage-like system for cerebrospinal fluid to flow through the brain tissue called brain parenchyma, thus facilitating

Huang Jianpan (left) holds a tube containing brain tissue sample of a mouse, while Dr Kannie Chan Wai-yan (right) looks on.

The team carries out experiments on mice using CityU's 3T MRI animal scanner, said to be the only of its kind in Hong Kong.



Dr Kannie Chan Wai-yan (front) and her CityU team members — Han Xiongqi, Huang Jianpan and Joseph Lai Ho-chi.

efficient clearance of solutes such as glucose and protein waste from the brain.

Currently, glucose uptake and metabolism can be assessed by imaging with positron emission tomography (PET) in hospitals. However, PET scans with radioactive tracers are expensive, and their invasive nature has hindered general clinical application. Moreover, patients cannot be scanned too frequently with radioactive tracers.

Seeking a more appropriate alternative, Dr Chan's team developed a new imaging approach based on chemical exchange saturation transfer MRI (CEST MRI) to assess glucose uptake and clearance in the glymphatic system of the mice's brains non-invasively. "CEST MRI has been used in the diagnosis of brain tumours," Dr Chan revealed, "[but] this is the first time that it is used in assessing the function of glymphatic system."

The team carried out the experiments using a 3T MRI animal scanner at CityU, said to be the only of its kind in Hong Kong. They injected glucose into genetically modified mice with Alzheimer's disease and healthy mice aged six months and 16 months. The dynamic response of glucose — both in the cerebrospinal fluid and brain parenchyma — was then measured using the CEST MRI.

According to the MRI results, the Alzheimer's disease mice showed significantly slower cerebrospinal fluid clearance rates than the age-matched healthy mice, which is consistent with previous neuropathological findings. "Clearance rates are reduced because of abnormalities in the brain's drainage system," Dr Chan explained.

Moreover, significantly higher glucose uptake was detected in brain parenchyma of the six-month-old mice with Alzheimer's disease compared to the healthy mice of the same age. For the 16-month-old mice with Alzheimer's disease, significantly lower glucose uptake was found in both brain parenchyma and cerebrospinal fluid compared to the age-matched healthy mice. These results echo previous research findings using other methodologies, and also serve as hallmarks to differentiate Alzheimer's disease from normal ageing.

The imaging of glucose uptake and clearance in the cerebrospinal fluid and brain parenchyma thus enables the assessment of the brain glymphatic system. Importantly, abnormalities are detected at the early stage of Alzheimer's disease when little neuropathology develops in the brain. The team believes this non-invasive assessment of the glymphatic system can serve as an imaging biomarker to reveal the early pathology in Alzheimer's disease.

"By using glucose as a 'tracer', our imaging method can sensitively detect the distinctive changes of glymphatic system function at the molecular level at an early stage of the disease, helping us to differentiate it from normal ageing," Dr Chan said. "Besides, glucose is natural, biodegradable and commonly used in hospitals, such as the glucose tolerance test. Using it as a contrast agent for MRI is non-invasive and safe."

She added that the new imaging method is compatible with the MRI machines commonly used in clinics or hospitals, which should mean low set-up cost and easy transfer into clinical application.

Having successfully identified changes in the brains of mice using a 3T MRI scanner, Dr Chan said she expects changes in the human brain to be more detectable since human brains are much larger. She anticipates that clinical trials could be conducted within three years.

High-performance liquid chromatograph

The Waters Arc HPLC System is a high-performance liquid chromatograph (HPLC) for routine testing in the pharmaceutical, food, academic and materials markets. A key target application is quality control laboratories performing batch release tests on small molecule pharmaceuticals.

The product is suitable for laboratories looking for a rugged and modern HPLC system that can run established HPLC methods regardless of the brand of liquid chromatograph on which they were originally developed, while preserving the chromatographic retention time reproducibility of those methods. The system offers ultralow analyte carryover, good injection precision and backpressure tolerance to 9500 psi at 5 mL/min.

Waters designed the product for QC laboratories, knowing how important trustworthy test results are to help ensure the uninterrupted supply of safe and effective medicines. It is suitable for users who are ready to modernise legacy instruments while preserving their specific QC methods, with the provision of a two-injection method transfer capability from any brand of HPLC instrument onto the Arc HPLC System.

Waters Australia Pty Ltd
www.waters.com

UV-C light for virus elimination

Following international approval, Osram can now supply its AirZing UV-C systems for disinfecting air and surfaces.

The company's UV-C HNS lamps work at a wavelength of 253.7 nm and are claimed to obliterate viruses and bacteria with a reliability of 99.9%, including coronavirus. The product series allows trained staff in hospitals and other public facilities to disinfect large areas.

The nucleus of microorganisms such as bacteria and viruses contains thymine, a chemical element of the DNA/RNA. This element absorbs UV-C at a specific wavelength of 253.7 nm and changes to such an extent that the cell is no longer able to multiply and survive. V-UV light (185 nm) also kills microorganisms but causes ozone that is harmful to human health; UV-C light is ozone-free and therefore safer.

UV-C light is invisible and can lead to severe burns on human skin, which is why Osram has equipped its AirZing PRO with intelligent sensors. The infrared sensor detects people in the room and immediately turns off AirZing when someone unexpectedly enters the room to avoid injuries to eyes and skin.

Osram Australia Pty Ltd
www.osram.com.au

Safety station

HEMCO's Safety Station is a multipurpose drench shower, eye/face wash and safety supply storage cabinet all in one. It is suitable for laboratories where persons may be exposed to potentially hazardous chemicals, with sanitary white polypro construction that means there is no wood or metal to rot or rust.

The station is equipped with a pull rod activated shower and push handle eye/face wash for quick rinsing of eyes, face and body. Towels and first aid supplies can be stored in the cabinet below.

Available units measure 0.61, 0.76 or 0.91 m wide, 0.61 m deep and 2.13 m high. Stations are fully assembled and ready for installation to water supply.

HEMCO Corporation
www.hemcocorp.com

Enzyme solution for surgical device cleaning

Preventing healthcare-associated infections (HAIs) has become more important than ever due to the COVID-19 pandemic, and it is well recognised by the industry that inadequately cleaned surgical equipment is a key source of HAIs. With this in mind, Novozymes has announced its Remify Everis 100 L enzyme solution for cleaning surgical instruments and devices.

The product is a phosphodiesterase (PDE) — a nuclease — that speeds up reactions and can specifically target the organic matter commonly found in medical-type soils. According to Novozymes, it has never been possible to specifically target free DNA soils with detergent ingredients before.

The company's results show that detergents, optimised by using Remify Everis 100 L, provide better cleaning performance at the right dosages, removing stuck-on soils quicker and with less effort. Under visual analysis, the optimised enzymatic detergent was said to outperform the non-enzymatic and standard detergents, leaving no visual residue in the blades tested. Fluorescent analysis confirmed this outcome.

Enzymes are gentle on delicate medical instruments and devices, and are also readily biodegradable. Other benefits are said to include improved rewash rates and decreased operational costs. Enzyme function can be optimised to ensure proper cleaning by monitoring key factors such as temperature, dose and time.

Novozymes Australia Pty Ltd
www.novozymes.com

24-well filter plates

Excessive time and risk of product loss are typical when clarifying and sterile filtering complex cell cultures for protein purification workflows. The tedious manual workflow of traditional centrifugation and filtration methods can require over 1 h to process a 24-well plate — plus risk lost samples, high hold-up volumes and process error.

Pall's AcroPrep 24-well filter plates clarify and sterile filter high-density cell cultures in one device in minutes. The filter plate's multilayer media effortlessly recovers more than 95% of extracellular proteins from whole cell cultures of up to 25 million (or more) cells/mL of varying viabilities. It is designed to save processing time, reduce consumable waste and streamline laboratory workflows.

Pall (Australia) Pty Ltd
www.pall.com

Anaerobic workstation

Don Whitley Scientific has launched its smallest anaerobic workstation: the Whitley A20 Workstation. The anaerobic chamber provides good conditions for the processing, incubation and examination of samples without exposure to atmospheric oxygen, and is gas efficient. It can accommodate 240 x 90 mm Petri dishes while retaining a generous working area, and will hold up to 400 plates for emergency anaerobic incubation.

The product serves as a first step up from using anaerobic jars to using a workstation. It has the same precise control of parameters as Don Whitley's larger workstations, ensuring appropriate anaerobic conditions are maintained. Users can check their plates as often as they like and perform tasks inside the workstation without risk to samples.

The workstation is equipped with two oval, multifunctional glove ports that act as mini airlocks, each capable of transferring 10 x 90 mm Petri dishes as the user inserts their arms. A side-loading letterbox entry system is also available, providing a straightforward way to quickly introduce individual samples into the workstation. A touch screen provides the user with an intuitive interface for easy control and operation of the workstation.

The product serves as an up-to-date replacement for the Whitley DG250 Workstation, providing modern features such as the full colour touch screen, remote access, data download (for traceability) and the opportunity to have anaerobic and catalyst conditions monitoring. It runs from two gases (anaerobic mixed gas and nitrogen) for economic running costs.

Don Whitley Scientific Australia
www.dwscientific.com.au

SARS-Cov-2 software toolkit

The Illumina SARS-CoV-2 Data Toolkit is a suite of data analysis tools and workflow functionality for researchers working with the virus using next-generation sequencing (NGS). The toolkit should make it easier for researchers to detect and identify the SARS-CoV-2 viral sequence in their samples and contribute their findings to critical public databases. Illumina is making the toolkit available at no cost to the global research community in support of efforts to combat the pandemic.

The toolkit integrates with Illumina's worldwide installed base of 15,000 sequencing systems and is designed to help the global research community and public health officials track the path of the epidemic, understand transmission routes, determine the rate of viral evolution and understand if the virus is changing in ways that impact therapeutic effectiveness. This connectivity across Illumina's global technology platform allows researchers and public health officials to easily share information.

The toolkit is releasing new and updated DRAGEN functionality, leveraging the speed of DRAGEN to accelerate infectious disease surveillance and outbreak response. It includes a DRAGEN RNA Pathogen Detection Pipeline to enable detection of infectious diseases, as well as a DRAGEN Metagenomics Pipeline for outbreak surveillance, an SRA Import App and a GISAID Sharing App.

Compatible with many Illumina workflows, including the respiratory virus target enrichment workflow, the toolkit empowers researchers to securely stream data directly from Illumina's full portfolio of sequencers into BaseSpace Sequence Hub for rapid, comprehensive analysis using the DRAGEN RNA Pathogen Detection App. Once analysis is complete, researchers can submit their data to public databases directly from BaseSpace Sequence Hub.

Illumina Australia Pty Ltd
www.illumina.com

When to go digital in PCR

What is digital PCR?

Digital PCR (dPCR) is the latest standard for absolute quantification of nucleic acids without the need for a DNA calibrator. Unparalleled accuracy and precision are achieved through the partitioning or dividing of bulk PCR reactions into a large number (up to 26,000) of discrete reactions at nanolitre volumes before undergoing PCR amplification to the endpoint.

Similar to quantitative real-time PCR (RT-qPCR/qPCR), intercalating fluorescent dyes or hydrolysis probes are used in dPCR. After amplification, reactions containing target molecule(s) fluoresce and are counted as 1s, while partitions with no target are counted as 0, giving a binary or 'digital' readout. The ratio of positively to negatively fluorescing partitions is calculated, and Poisson statistics applied to determine the absolute concentration of the target present in the initial sample.

Where does dPCR overcome challenges of qPCR?

Absolute quantification: Using standard curves to plot unknown sample fluorescence and derive a 'relative quantification' result has made qPCR one of the most popular tools in the molecular biologists' arsenal. However, this process is still affected by qPCR's key limitations, namely the reliance on assay efficiency and susceptibility to PCR inhibitors. As described above, dPCR offers true 'absolute quantification' of nucleic acids with the ability to distinguish 10% differences in DNA concentration with 95% CI. This level of accuracy is an advantage when validating reference materials, viral titers and molecular QC. Furthermore, studies in copy number variation and gene expression are greatly simplified due to the ease of doing calculations with an absolute copy number output.

Inhibitor tolerance: PCR inhibitors making their way into your samples are an unavoidable part of lab experiments. They are introduced from sample material, nucleic acid preparation and even some nucleic acid purification methods. Inhibitors disrupt PCR amplification, leading to inaccurate data interpretation, decreased sensitivity and potentially outright failure of the PCR reaction. In dPCR, sample partitioning effectively dilutes inhibitors, minimising their effect. Moreover, a yes/no endpoint PCR that does not rely on reaction kinetics helps maintain the count's accuracy. This is evident amid the COVID-19 pandemic, where dPCR has consistently overcome sample inhibition to determine positive calls, where qPCR has returned false negatives. Likewise, in environmental samples such as soil and water, pathogen detection can be done without compromise.

Increased sensitivity: Signal-to-noise ratios of rare targets increase significantly in dPCR partitions, making detection much easier than conventional qPCR, where low-abundance molecules are difficult to detect amid much higher background levels. This is especially pertinent to applications requiring increased precision, such as the detection of rare mutations in liquid biopsies and minimal residual disease monitoring, monitoring environmental samples and evaluating CAR-T transduction for downstream cell therapy. Where starting material is limited, the sensitivity of dPCR even at low copy numbers may overcome the need for pre-amplification.

Comparison of PCR techniques at a glance

	qPCR	dPCR
Reliance on standard curve	Yes; relative quantification	No; absolute quantification
Precision	Low; detects mutation rate at >1%	High; detects mutation rate at ≥0.001% Increase signal-to-noise ratio
Amplification efficiency	Variable; quantification based on the analysis of the fluorescent signal at the exponential phase, prone to inhibitors	Unaffected; partitioning and endpoint fluorescence measurement of individual partitions
Inhibitor tolerance	Lower	Higher; small partition volume contributes to resilience to a large variety of inhibitors
Reliability and reproducibility	Lower; references or controls needed	Higher; reference/calibration-free

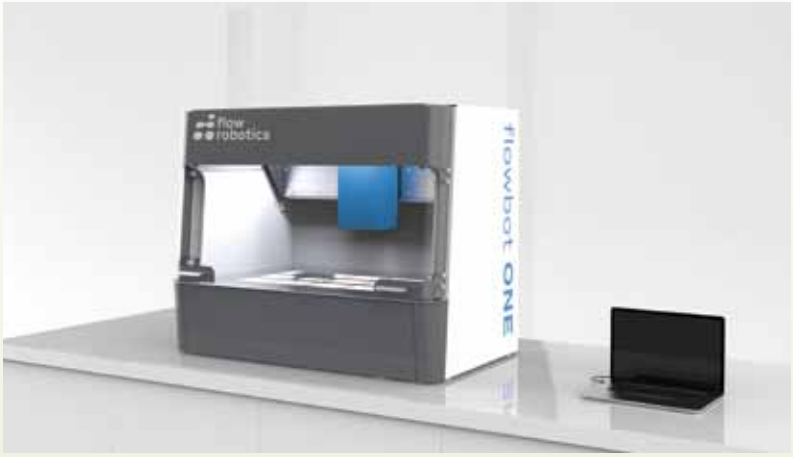
Introducing the new QIAcuity™: fully integrated nanoplate digital PCR system

Despite the clear benefits of the technology, dPCR has not been widely adopted so far. Some of the most prevalent challenges currently limiting accessibility are low-throughput instrumentation, overly complex workflows and limited multiplexing capabilities. QIAGEN®'s new dPCR system, the QIAcuity, is an integrated platform that carries out sample partitioning, thermocycling and imaging of the dPCR reactions in microfluidic nanoplates. The overall result is a system that delivers results in under 2 hours, 5-colour multiplexing capabilities and a simple workflow upstream of walkaway operation that mimics qPCR. Once completed, the easy-to-use software analyses the data and presents the final output in copies per microliter.

Find out more at **www.qiagen.com/dpcr**

QIAGEN

Pipetting robot automates COVID-19 sample prep



Since the beginning of May, Danish company Flow Robotics has been helping to optimise the intensive work of analysing coronavirus samples. The company's secret lies in a liquid-handling robot that is automating COVID-19 testing processes in hospitals around Europe, significantly reducing the time it takes for laboratories to tell patients whether they are infected with COVID-19.

The robot, called flowbot ONE, is able to automate the task of preparing samples for analysis, which is about mixing liquids and chemicals. Robot technology minimises the risk of human error and contagion in the process, and reduces the physically demanding pipetting tasks for laboratory personnel around the world.

Eight Danish hospitals are now using the product for COVID-19 testing purposes, as is a German laboratory that originally purchased the robot to test for ***Salmonella*** in food. Orders have also come from Sweden, Poland, Russia, the Netherlands and Australia, meaning thousands of tests per day are now being prepared for analysis by the sophisticated robot.

Consultant physician Jens Otto Jarløv, who works at Herlev Hospital in Denmark, is delighted to be able to automate processes in his laboratory. He said, "We are really pleased that Flow Robotics can deliver their robots so quickly. They are innovative and can automate just the things we need. We are very satisfied, and the cooperation has been very good."

Martin Friis and Thomas Sundelin from Herlev Hospital.

Molecular biologist Martin Friis, also from Herlev Hospital, now works side by side with the flowbot ONE robot. He said, "The robot pipettes the live virus, and it can pipette several samples at once, so we are now saving a lot of repetitive work and reducing the risk of accidents.

"We already keep ourselves safe, but it is still good for us to have less contact with the live virus thanks to the robot. The risk of pipetting errors is also eliminated as a result of automation because the robot follows a pattern and avoids mistakes. All in all, this lowers the stress level for us on many fronts, so we have less hassle in our work and minimise potential errors."

Flow Robotics CEO Annika Isaksson said her company is pleased to be able to make a difference for both hospital patients and staff. In line with its global expansion, Flow Robotics is now scaling up robot production.

Flow Robotics
flow-robotics.com

SPONSORED CONTENT

©stock.adobe.com/au/Alemon77

Should we put all our eggs in one basket when we develop a vaccine?

A new age of vaccine development is upon us, and biotech companies are going into RNA overdrive.

What is all the activity about? How is it different from the traditional method we have successfully used since the 1950s? Should we apply the old adage "if it ain't broke, don't fix it"?

Vaccine development is fundamentally about agility, preparedness, efficacy, distribution, cost and safety. Viral vector-based vaccines may tick the efficacy box (though is a two-shot vaccine efficacious?); however, often the most efficacious are the least safe vaccine platforms given the potential for replication and they need massive infrastructure for production (one egg — one vaccine dose). On the other end of the efficacy spectrum are the non-replicating vaccines, such as non-replicating virus vectors, virus-like particle subunit vaccines and nucleic acid vaccines.

If you explore nucleic acid vaccines, they can be categorised into three main groups: unmodified, base modified mRNA and self-amplifying mRNA (SAM). Of these, the most disruptive technology with the potential to tick all the boxes is SAM — where an alphavirus RNA is hijacked, it is produced enzymatically and structural proteins are replaced with a gene encoding for an antigenic protein. Incredibly versatile, the antibody response can be transformed with diverse antigenic genes consequentially ideal for preparedness. Safety is enhanced given the non-replicating nature of the SAM, infrastructure is minimised and distribution is simplified.

SAMs are not without their challenges though; they have to cross the cell membrane, present to the ribosome, dodge immune responses and, to fulfill the brief, they also need to be scalable, translatable and repeatable. A promising solution is the Precision Nanosystems Inc (PNI) NanoAssemblr platform that enables the rapid, reproducible and scalable manufacture of next-generation nanoparticle formulations such as lipid nanoparticles and liposomes to encapsulate a payload such as a SAM. Collaborative research across the globe has shown high encapsulation of the payload and enviable transfection resulting in encouraging efficacy, such as the findings of Dr Anna Blakney of Imperial College London (http://go.precisionnanosystems.com/m000Oh2040fQ1bncZCu0MG0).

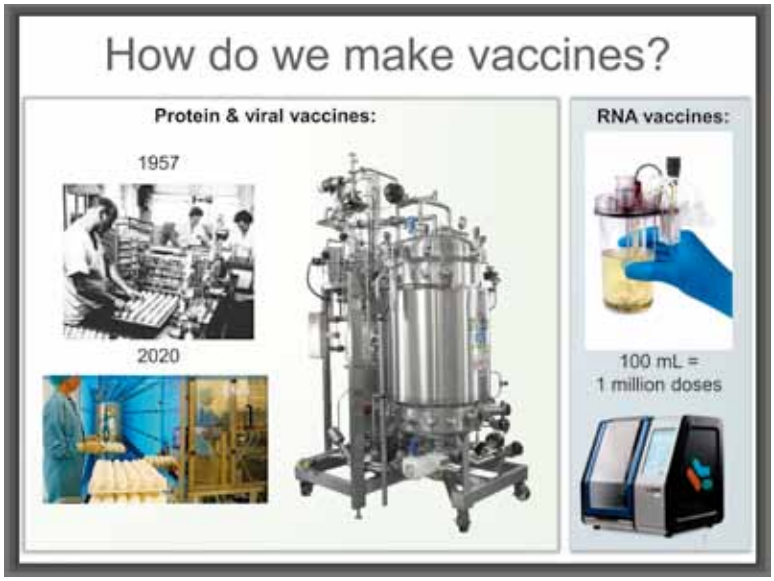


Image courtesy of Dr Anna Blakney, Imperial College London.

PNI provides instruments, reagents and services to life sciences researchers, including pharmaceutical companies, and builds strategic collaborations to revolutionise healthcare through nanotechnology unlocking a world of research. PNI Chief Scientific Officer Dr Andy Geall, renowned for RNA vaccines, delivers an enlightening webinar 'Non-Viral Delivery of Self-Amplifying mRNA Vaccines' at https://youtu.be/p-9Z0MhcCVM.

What about the cost? Often reported as a per-dose cost, it has been suggested a scaled-up SAM vaccine would be extraordinarily low — anything from 50c to around AU$1 to manufacture, depending largely on the volume produced and the amazingly low dose required to elicit the antibody response. In stark contrast to this are cultured vaccines, be it in eggs or mammalian cells. A purpose-built facility in Holly Springs, North Carolina, which cost around US$1bn to build and was recently expanded, was designed to produce up to 200 million influenza vaccine doses within six months of a declared epidemic. Interestingly, a PNI GMP installation can be dropped into existing infrastructure for a fraction of this cost.

Bringing this home to Australia and the desire to have a home-grown solution, a cultured facility on a per-capita basis may be unrealisable notwithstanding the general lack of agility. Does Australia have expertise in RNA technology? Absolutely — to cite one example, look to the exceptional research at Monash University, where Professor Colin Pouton's team has employed an mRNA vaccination approach.

Australia must continue to invest in our world-class research, understanding the financial impost of large-scale manufacture given our relatively low population, whilst considering that the alternative may be worse: relying on another nation to develop the vaccine. Would we need to compete to get it? What would the cost be? Would there be licencing fees to manufacture locally — would we need a facility to produce it?

Perhaps it is time to diversify our research efforts and invest in our future preparedness, thereby mitigating the risk of having all our eggs in one basket!

Contact ATA Scientific at enquiries@atascientific.com.au.

ATA Scientific Pty Ltd
www.atascientific.com.au

Newly discovered genetic mutations linked to autism

Scientists have identified mutations in a gene called CNOT1 that affect brain development and impair memory and learning, suggesting that drugs that help restore the gene's function may have therapeutic benefit.

The team's work also revealed that CNOT1 interacts with several known autism spectrum disorder (ASD) genes, opening new research avenues for the condition. Their study has been published in *The American Journal of Human Genetics*.

The cause of developmental disabilities, including ASD, is poorly understood. Research indicates that there may be a genetic component to these conditions, but the precise impact of the genetic variations that have been uncovered to date is unclear. Identifying the underlying cause of developmental disabilities would allow scientists to create diagnostic tests that would provide early diagnoses and potential treatments.

In the current study, scientists at Radboud University Medical Center in the Netherlands identified a commonality between 39 people with a neurological disorder: variations in the CNOT1 gene. These individuals, whose ages ranged from newborn to 22 years old, had symptoms that spanned from severe intellectual disability to nearly normal IQ and everyday functioning. The researchers hoped to determine if the variations in the CNOT1 gene were benign or the cause of the neurological symptoms — the first step to finding potential treatments.

To answer this question, the researchers at Radboud University turned to Dr Rolf Bodmer — a world-renowned genetics expert at the Sanford Burnham Prebys Medical Discovery Institute in the US. Dr Sreehari Kalvakuri, a postdoctoral researcher in the Bodmer lab, created fruit flies that contained the same CNOT1 variations seen in the patients, including DNA sequences that were 'misspelled' (missense), cut short (truncated) or otherwise altered.

This work identified nine CNOT1 variants that impaired learning and memory, as measured by several independent approaches — including a courtship assay that tested the ability of male fruit flies to remember if their female partners had paired with other males. All of these variants appeared spontaneously (de novo) in the patients, meaning they were not inherited. The scientists also discovered that these CNOT1 mutations interact with known ASD genes — revealing a genetic link to ASD that can be further explored.

"Fruit flies are a great biological model because we can complete genetic studies very quickly. This work only took a few months instead of the potential decade using a mouse model," Dr Kalvakuri said. "Additionally, the CNOT1 gene is highly conserved between fruit flies and humans, meaning it does not change much, so we are optimistic these findings can be extrapolated to people."

Next, the scientists plan to identify which molecular components interact with CNOT1, which functions as a scaffold that builds up a larger protein complex. This work might uncover additional potential drug targets for intellectual, learning or memory disorders, including ASD.

"Prior to this work, the CNOT1 gene was not on the radar of autism researchers," Dr Bodmer said. "This discovery could help us better understand the genetic mechanisms underlying ASD.

"Our work is also a first step toward exploring drugs that could augment the function of CNOT1 and might be able to help children with neurodevelopmental delays who have these specific mutations.

"Our ultimate hope is to find a treatment that could be given as early as possible to help these children stay on track developmentally."

Surprisingly, the findings also have implications for heart disease, with Bodmer noting, "A significant fraction of these patients also have cardiac defects. Conversely, children who are born with heart defects are at a higher risk of developing ASD, too. This study on CNOT1 also provides a previously unknown genetic link between heart function and ASD."

Electrostatic Spray Drying of High Oil Load Emulsions and Heat Sensitive Materials

Preservation of biological material is often achieved by removing free water and lowering water activity. In commercial settings, this is predominantly possible by using established technologies such as high-heat spray drying and low-temperature freeze drying. Both are effective; however, each technique is also limited to specific applications.

Spray drying for example operates at high temperatures and is unsuitable for drying biologically active material susceptible to thermal degradation. Living cells, microorganisms and many active ingredients often result in denaturation, product degradation and loss of quality when heated above specific temperatures. The commercially viable alternative to high-heat spray drying is sub-zero freeze drying. Although the technology is well established in the preservation of microbiological samples and other biological materials, the operating temperatures are so low that they cause damage to some materials. The underlying limitation of commercial freeze drying is generally not temperature related but rather batch processing, thereby limiting throughput.

There is a clear need for continuous, non-batch commercial-scale drying technologies that maintain a product's thermal integrity. This gap in process capability was recently filled by the PolarDry® range of electrostatic spray dryers. By delivering an electrostatic charge during the atomisation process of liquid droplets, water is evaporated at lower temperatures than possible in traditional high-heat spray drying. Electrostatic spray drying is an innovative approach combining gas-liquid atomisation and electrostatic charge. Heat transfer to the atomised droplets is based on latent heat transfer, allowing powders to be dried at temperatures as low as 30°C.

Successful applications include the drying of biological solutions such as colostrum and lactoferrin where there is no loss in biological activity. Other suitable applications include the drying of microalgae and living microorganisms. Probiotic microorganisms, agricultural bacteria and various other species associated with the human microbiome have been dried successfully using a polysaccharide carrier to obtain >50% bio-mass to dry-mass ratio. Survival post-drying is generally high with expected viable losses of approximately half a log reduction.

Unlike traditional high-heat spray drying, electrostatic spray drying takes place in an inert gas environment where oxygen is replaced by nitrogen. This expands applicability to oxygen sensitive materials and not only appeals to anaerobic microorganisms, but it is extremely well suited to spray drying of encapsulated oils. By electrostatic charging the active components base on polarity, the surface chemistry of the atomised droplets changes during the drying process and this becomes evident in resulting powders. In powders with high fat content, some of the surface fat is replaced by protein and carbohydrate. When using a carbohydrate carrier and protein stabiliser, oil retention in the powder reaches 60–80% (w/w). Interest in oil encapsulation is driven by the processing of highly volatile and unsaturated lipids, oil soluble flavour and aroma compounds, nutritional formulations and cannabinoid oils.

The future of food and nutraceutical manufacturing is driven by innovation, and high value-adding nutritional, functional and bioactive ingredients are key to sustainability. Consequently, the drive for high-quality ingredients also requires innovation in manufacturing technology necessary to support emerging markets and novel product development. PolarDry electrostatic spray dryers are developed to meet the demands and challenges associated with conventional spray- and freeze drying by providing alternative commercial solutions.

Designed and built in the US, the PolarDry commercial range of spray dryers was first launched in the US followed by Europe and Asia where sales have steadily grown in the years following market launch. Fluid Air Australia and New Zealand is excited to introduce the innovative PolarDry technology to the region with the support of a state-of-the-art, fit-for-purpose research and development ISO certified facility located in Melbourne, Australia. Equipped with advanced analytical and electrostatic spray drying capability, the facility exists to support local manufacturers with R&D requirements.

For more information visit the Fluid Air website: https://bit.ly/3jLaMbw.

FLUID AIR PolarDry
The Cooler Technology

Spraying Systems Co Pty Ltd
www.spray.com.au

Chilling incubators

Torrey Pines Scientific has announced its EchoTherm IN35 stackable and programmable chilling incubators for protein crystallography and other life science uses.

The incubators have a 27 L capacity and are Peltier based for heating and chilling. They have no compressors or CFCs and are vibration-free, making them suitable for doing protein crystallisations. Other applications include incubating marine samples below room temperature, enzyme reactions and deactivations, hybridisations, ligations, storing oocytes and general lab incubations. Three units may be stacked using two stacker accessories.

The IN35 is a fully programmable unit that can store three programs in memory and features precise temperature ramping both up and down. Temperatures are settable from 4 to 70°C controllable to ±0.1°C, and accuracy to ±0.2°C. They have an RS232 I/O port for remote control and data collection; a digital timer in hours, minutes and seconds with user-settable Auto-Off; and audible alarms. The chamber measures 30 x 25 x 36 cm and comes with two stainless steel racks with room for four.

The units are shipped with universal power supplies for use anywhere in the world off local line voltages. They are UL, CSA and CE compliant.

Edwards Group Pty Ltd
www.edwardsco.com.au

Total organic carbon generator

Peak Scientific has released its latest gas solution specifically for TOC analysers, the TOC 1000. The device is based on technology from the company's previous series of TOC generators but designed to deliver improved performance for the latest TOC analysers available on the market.

The product's gas output contains <1 ppm of CO_2, <0.05 ppm CH_4 and <0.1 ppm CO, SO_x and NO_x, delivering TOC-grade air. It is intended for use with TOC analysers being used for wastewater treatment labs, environmental monitoring labs, pharmaceutical labs, food and beverage labs, oil and gas labs, mining labs and biotechnology labs. Furthermore, Peak Scientific has had the CAT chamber independently tested and certified by the UK's National Physical Laboratory to verify the performance of the TOC generator.

Employing the latest gas generation technologies, the product has been designed with a small form factor for labs with limited space or for field use.

Peak Scientific Instruments Pty Ltd
www.peakscientific.com

Portable airborne particle counter

The MET ONE 3400+ Series Portable Airborne Particle Counter, from Beckman Coulter Life Sciences, allows users to load their routine environmental monitoring SOP sampling map and sampling configuration for each location directly into the counter, so that the SOP becomes an interactive sampling map directly on the counter screen to guide users doing daily sampling. This should help reduce training requirements and sampling data errors/omissions.

Accessed remotely via a web browser, features such as review/approve workflow, SOP version control and electronic record export are all in the counter — there's no external software needed. Secure onboard searchable/filterable Audit Trail provides fast reporting during audits, combined with Microsoft Active Directory for username and password control for log-on and electronic signatures to support 21 CFR Part 11 compliance.

Beckman Coulter Australia
www.beckman.com.au

How cancer grows resistant to treatment

The cells of the human body are constantly dividing, and each time they need to copy a three billion-letter DNA code with high precision to ensure cell survival. It turns out that the same is not true for cancers, a broad range of which — including melanoma, pancreatic cancer, sarcomas and breast cancer — generate a high number of errors when they copy their DNA when exposed to cancer treatments, leading to drug resistance.

These are the findings of an Australian research team, led by Professor David Thomas at the Garvan Institute of Medical Research. Writing in the journal *Science*, the team revealed that cancer cells can 'turn on' error-prone DNA copy pathways to adapt to cancer treatment — the same process used by bacteria to develop antibiotic resistance.

Researchers have long known that cancer cells accumulate genetic variations that make it possible for them to evade treatment. But how this happens — and whether the process could be targeted to improve cancer treatment — has been elusive.

The Australian scientists began to investigate the underlying drivers of treatment resistance by analysing biopsy samples from cancer patients, before and after they were treated with targeted cancer therapies. Targeted therapies block the growth of cancer by interfering with molecules that are needed for tumour growth, and are a common treatment for many forms of cancer.

The scientists were surprised to discover that the cancer cells from patients that had received targeted therapies showed much higher levels of DNA damage than pre-treatment samples — even when these treatments did not directly damage DNA. Further, the researchers used whole-genome sequencing to analyse how treatment resulted in accelerated evolution of the cancer genome.

"Our experiments revealed that cancer cells exposed to targeted therapies undergo a process called stress-induced mutagenesis — they generate random genetic variation at a much higher rate than cancer cells not exposed to anticancer drugs," said first author Dr Arcadi Cipponi, from the Garvan Institute and UNSW.

"This process is ancient — single-celled organisms, such as bacteria, use the same process to evolve when they encounter stress in their environment."

To pinpoint the mechanisms underlying stress-induced mutagenesis in human cancer cells, the researchers carried out a large-scale screen to silence every gene in cancer cells individually, looking to identify the specific pathways contributing to drug resistance. When they silenced the gene for MTOR — a stress sensor protein — they discovered that cancer cells stopped growing, but paradoxically accelerated evolution in the presence of a cancer treatment.

"MTOR is a sensor protein that tells normal cells to stop growing because there is a stress in the environment," Dr Cipponi said. "But we found that in the presence of a cancer treatment, MTOR signalling allowed cancer cells to change expression of genes involved in DNA repair and replication, for example shifting from high-fidelity polymerases, the enzymes that copy DNA, to production of error-prone polymerases. This resulted in more genetic variation, ultimately fuelling resistance to treatment."

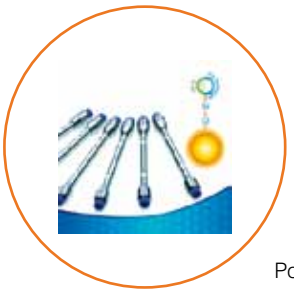
The shift to low-fidelity DNA repair and replication was temporary — once cancer cells acquired resistance to a cancer treatment, they reactivated high-fidelity pathways.

"Genomic instability can itself be harmful to cells, which is why some of our chemotherapies and therapeutic radiation work," Dr Cipponi said. "We found that once cancer cells had developed resistance to a treatment, they switched back to high-fidelity DNA polymerases to ensure the cells that had evolved resistance to treatment could survive."

Combining conventional targeted cancer therapy with drugs that target DNA repair mechanisms may lead to more effective therapeutic strategies, the researchers claim. As a proof of principle, they tested such a drug combination in a mouse model of pancreatic cancer. By combining the cancer treatment palbociclib with rucaparib, a drug which selectively targets cells with impaired DNA repair, they were able to reduce cancer growth by almost 60% over 30 days compared to palbociclib alone.

"Resistance to treatment is arguably the major issue facing patients with advanced cancers, for whom even effective treatments ultimately fail," said Prof Thomas, Garvan's Cancer Research Theme Leader and Director of The Kinghorn Cancer Centre.

"Our findings have opened up new potential strategies that either prevent stress-induced mutagenesis in cancers or are more effective in cancers that have already developed resistance."



Columns

Analysing polar compounds using liquid chromatography has historically been a challenge. Poor retention and peak shape, complex mobile phases that may not be MS-friendly, long equilibration times, low sensitivity and sample derivatisation are all complications that reduce lab efficiency and productivity.

Raptor Polar X columns from Restek are designed to retain and efficiently separate a broad range of polar analytes using a stationary phase that balances two retention mechanisms: HILIC and ion exchange. This hybrid phase is suitable for analysing acidic, basic and neutral polar compounds without time-consuming derivatisation or complex ion pairing, and it is especially compatible with mass spectrometry.

Easy changes to mobile phase conditions allow analysts to switch between modes and selectively tune retention for the compounds of interest without needing long equilibration times. The resolving power of the columns therefore helps to simplify the analysis of polar compounds.

Leco Australia Pty Ltd
www.leco.com.au

SIL proteins

A stable isotope labelled (SIL) form of an analyte protein is widely regarded as the optimal internal standard (IS) for absolute quantification of proteins using LC-MS; SIL proteins are often cited as the 'gold standard' IS.

The benefit of using a SIL protein as an internal standard is that it shares the same physiochemical behaviour as the target protein analyte. This means that the IS can be introduced at the start of the sample preparation workflow and will be processed along with the analyte protein throughout the entire analytical procedure. The addition of SIL-proteins at the start of the sample extraction can control for variations due to immunoaffinity or other isolation techniques, enzymatic digestion, other pre-analytical treatments as well as the LC and mass spectrometric ionisation. EMA guidelines recommend the use of a SIL-protein IS whenever possible for LC-MS/MS methods.

Promise Advanced Proteomics' range of SIL proteins is offered as stable isotope labelled (and unlabelled) full-length recombinant proteins that are suitable for biomarker evaluation and validation, development of certified reference materials, pharmacokinetics studies of biotherapeutics and quantification of therapeutic monoclonal antibodies.

Sapphire Bioscience
www.sapphirebioscience.com

AusBiotech + Invest 2020

October 28–30, online

Providing a new level of global insight and perspective, AusBiotech + Invest 2020 has moved online to ensure maximum flexibility and accessibility. The event will provide access to global leaders and local experts, with multiple opportunities to engage with the biotech industry. It will give attendees the chance to pitch, partner, exchange and engage with one another and propel the biotech industry forward.
https://www.ausbiotechnc.org/

Global Academic Programs (GAP) Conference
November 16–19, online
https://www.gap2020.com.au/

Linking the Galactic and Extragalactic
December 3–4, online
http://extragalactic-milkyways.org/

Eradicate Cancer 2020
December 14–16, Melbourne
https://www.eradicatecancer2020.org/

43rd COSPAR Scientific Assembly
January 28–February 4, Sydney
http://www.cospar2020.org/

Lorne Proteins 2021
February 7–11, Lorne
https://www.lorneproteins.org/

Lorne Cancer 2021
February 11–13, Lorne
https://www.lornecancer.org/

Lorne Infection & Immunity 2021
February 17–19, Lorne
https://www.lorneinfectionimmunity.org/

Science Meets Parliament 2021
March 15–17, Canberra
https://scienceandtechnologyaustralia.org.au/what-we-do/

ASID Annual Scientific Meeting 2021
March 24–26, Melbourne
https://www.asid.net.au/meetings/ASM2020

TSANZSRS 2021
April 30–May 4, Melbourne
https://www.tsanzsrs2021.com/

IAFS 2020
May 17–21, Sydney
https://iafs2020.com.au/

2021 ISFPX and ASP Annual Conference
July 5–8, Cairns
https://www.isfpx.org/

FOODCONF 2021
July 12–14, Melbourne
https://www.foodconferencesaustralia.com/

20th International Conference on Biological Inorganic Chemistry
July 18–22, Adelaide
https://www.icbic2021.org/

foodpro 2021
July 25–28, Sydney
https://foodproexh.com/

HGSA 44th Annual Scientific Meeting
August 14–17, Adelaide
https://aacb.eventsair.com/hgsa-44th-annual-scientific-meeting/

ACS 43rd Annual Scientific Meeting 2021
August 24–28, Queenstown
https://acs2020.org.au/

ASCIA 2021 Conference
September 1–3, Melbourne
https://www.ascia2021.com/

Energy Oceania 2021
September 6–8, Melbourne
https://www.energyconferenceaustralia.com/

Australasian Exploration Geoscience Conference
September 15–20, Brisbane
https://2021.aegc.com.au/

AACB 58th Annual Scientific Conference
September 28–30, Brisbane
https://aacb.eventsair.com/aacb-58th-annual-scientific-conference/

Materials Oceania 2021
October 11–14, Brisbane
https://www.materialsconferenceaustralia.com/

16th Congress of the FAOBMB
November 22–25, Christchurch
https://www.faobmb2021.org/

Tell the world about your event: email LLS@wfmedia.com.au

wfmedia
connecting industry

Westwick-Farrow Media

A.B.N. 22 152 305 336
www.wfmedia.com.au

Head Office
Unit 7, 6-8 Byfield Street,
(Locked Bag 2226)
North Ryde BC NSW 1670,
AUSTRALIA
Ph: +61 2 9168 2500

Editor
Lauren Davis
LLS@wfmedia.com.au

Publishing Director/MD
Geoff Hird

Art Director/Production Manager
Julie Wright

Art/Production
Colleen Sam, Veronica King

Circulation
Dianna Alberry, Sue Lavery
circulation@wfmedia.com.au

Copy Control
Mitchie Mullins
copy@wfmedia.com.au

Advertising Sales

Sales Manager: Kerrie Robinson
Ph:0400 886 311
krobinson@wfmedia.com.au

Nikki Edwards
Ph: 0431 107 407
nedwards@wfmedia.com.au

Tim Thompson
Ph: 0421 623 958
tthompson@wfmedia.com.au

If you have any queries regarding our privacy policy please email privacy@wfmedia.com.au

Printed and bound by
Dynamite Printing

Print Post Approved PP100008671

ISSN No. 2203-773X

FREE

to industry and business professionals

The magazine you are reading is just **one of 11** published by Westwick-Farrow Media. To receive your **free subscription** (magazine and eNewsletter), visit the link below.

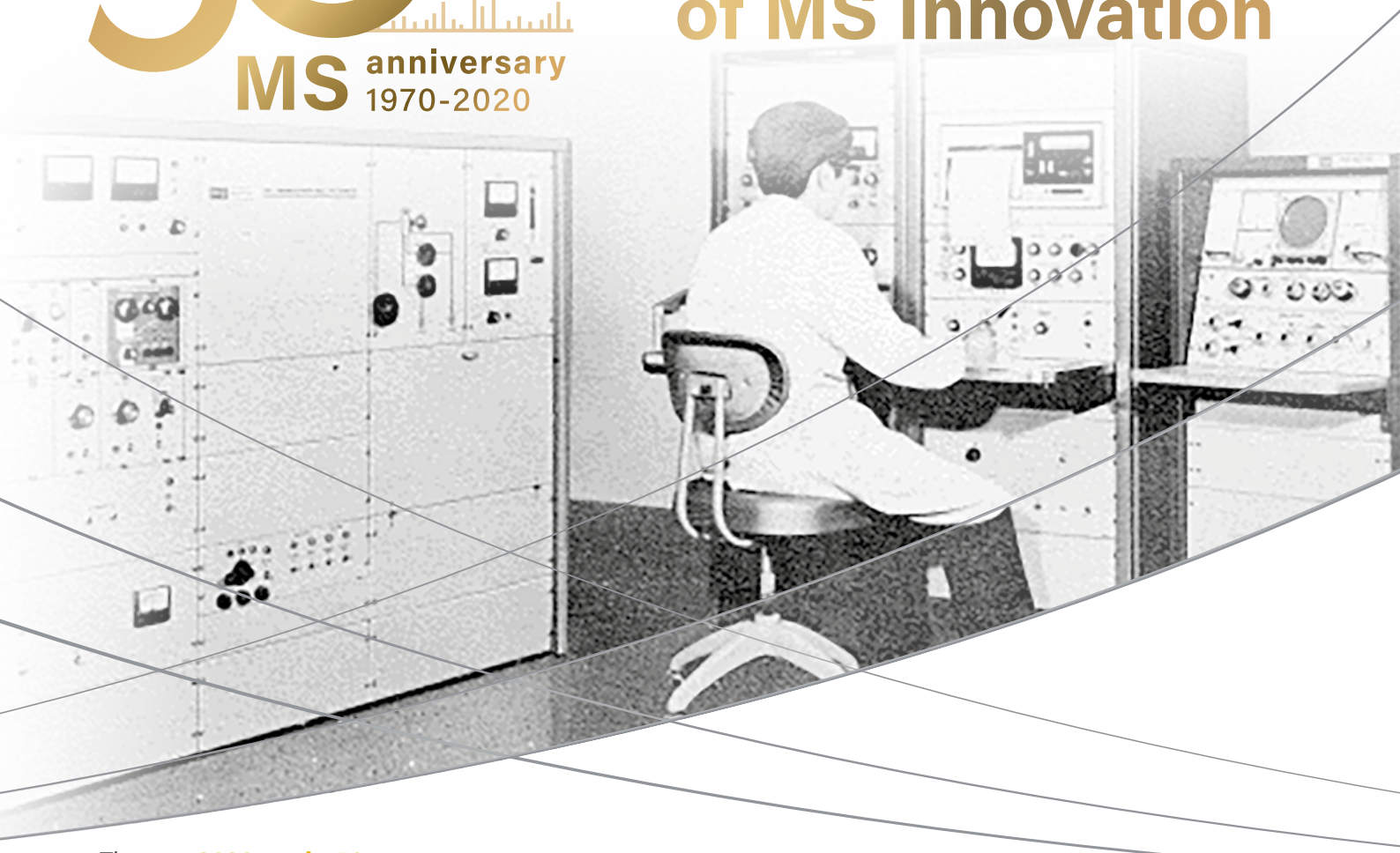
wfmedia
connecting industry

www.WFMedia.com.au/subscribe

SHIMADZU
Excellence in Science

50th MS anniversary 1970-2020

Celebrating 50 Years of MS Innovation



The year **2020 marks 50 years** since the release of Shimadzu's first mass spectrometry device, the LKB-9000 Magnetic Sector GCMS.

Our passion for innovation has led to multiple ground-breaking developments in MS technology.

AUS: 1800 800 950 NZ: 0800 127 446 info@shimadzu.com.au shimadzu.com.au