New X-ray vision

CATH O’DRISCOLL

Researchers have developed a new type of X-ray detector that does not require an external power source, and which is claimed to be 100 times more sensitive than conventional silicon-based detectors. Its high sensitivity and increased resolution could lead to lower exposure to X-rays for patients and imaging staff at hospitals and dentist surgeries.

Conventional X-ray detectors are widely used in medicine, security applications and in research, for example, at synchrotron facilities. They operate at very high voltage and rely on high-purity semiconducting single crystals such as silicon, which need to be fairly thick to allow efficient X-ray absorption and are therefore expensive to manufacture.

The scientists at Los Alamos National Laboratory and Argonne National Laboratory collaborated to produce the new detector based on thin films of cheap and readily available hybrid perovskites – materials that have a similar crystal structure to the mineral perovskite (CaTiO₃).

‘The perovskite material at the heart of our detector prototype can be produced with low cost fabrication techniques,’ says Hsinhan Tsai, an Oppenheimer distinguished postdoctoral fellow at Los Alamos. ‘The result is a cost-effective, highly sensitive, and self-powered detector that could radically improve existing X-ray detectors, and potentially lead to a host of unforeseen applications.’

Hybrid perovskite films can be deposited on surfaces by spraying solutions that cure and leave behind thin layers of the material. ‘One critical requirement is the inclusion of heavy elements and [the] material needs to be dense,’ says Tsai. ‘If the [effective atomic] Z number of the material is small, like 14 for silicon, [you] need to increase the thickness in order to generate enough signal. On the other hand, perovskites have much higher Z numbers – around 65 – and can absorb X-rays more efficiently. This also allows us to reduce the thickness needed in perovskite detectors to generate high X-ray induced signal.’

In the present work (Sci. Adv. 2020; 6, eaay0815), a perovskite of formula (BA)₂(FA)₇I₄ (where BA is butylammonium and MA is methylammonium) is sandwiched between p- and n-type semiconductors to form a p-i-n diode. Heavy atoms lead and iodine facilitate the absorption and detection of the X-rays.

The team demonstrated that thicker perovskite layers are also able to detect X-rays, but in this case, they require a small voltage source to improve the signal collection. The researchers suggest that the useful energy range of a detector with thicker perovskite layers could be extended beyond X-rays to low energy γ-rays.

‘The current barrier for commercialisation of our detector is that we need to demonstrate a large area detector to meet the market needs for imaging, however, it’s an engineering problem,’ says Tsai. ‘Potentially, we could use inkjet or roll-to-roll types of systems to print large scale detectors. This would allow us to replace half-million-dollar silicon detector arrays with inexpensive, higher resolution perovskite alternatives.’

‘The use of perovskites by the authors underlines the fantastic potential of this material for many applications, including the proposed self-powered version of detector,’ comments professor Ravi Silva, Director of the Advanced Technology Institute at the University of Surrey. ‘The higher sensitivity will allow for lower doses, which is critical for patients or applications that need multiple exposures as well as higher resolution from the digital image’.

The solution processability makes the fabrication of large area low cost detectors a real possibility, with applications in medical, non-destructive testing, border security, food and pharma inspection. By manipulating the synthesis, the authors claim the X-ray attenuation too can be tuned for different energy ranges, which could even move this to X-ray therapeutics.’

OCT Covid-19 test

ANTHONY KING

A smartphone test for Covid-19 is being developed by pharma company Sanofi. The test aims to allow individuals to self-test and find out whether or not they are infected within a few minutes. It could be available as an over-the-counter test kit to use with a smartphone before the end of 2020. This follows an agreement signed by Sanofi with a Californian startup, Luminostics. This company will bring the tech for consumer diagnostics, while Sanofi brings to the table its clinical research testing capabilities.

It has become clear during the pandemic that rapid, reliable mass testing is one of the key strategies for successful containment of a pandemic outbreak.

The objective for Sanofi is to develop a consumer-based test that can detect the Covid-19 virus with high sensitivity and specificity from respiratory samples. The time from specimen collection to results is, according to Sanofi, expected to be in the range of 30 minutes or less.

In a statement, the French-headquartered company said that the test is based on Luminostics’ unique technology that uses a consumer smartphone’s camera, controlled by an iOS/Android app paired with an inexpensive adapter, in combination with ‘glow-in-the-dark’ nanochemistry and signal processing artificial intelligence.

The diagnostic platform consists of an app that will tell a user how to run the test, capture and process data to display test results, and then to connect users with a telehealth service based on the results. The adapter will be reusable and compatible with most types of smartphones. Also included will be consumables for specific collection, preparation and processing.

‘While point-of-care tests were made available relatively quickly – although not in a sufficient quantity – no over-the-counter (OTC) self-testing solution is currently available,’ noted Sanofi in a statement. It listed advantages of its test solution: thousands of points of sale, including online purchases; no interpersonal contact required to conduct the test; and immediate availability of results.

Luminostics is a startup which aims to raise healthcare accessibility by designing and delivering products that allow for affordable and widespread health tests with immediate follow-up.

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Improving perovskite solar cells

MARIA BURKE

A way to detect imperfections in next generation solar cells has been reported by researchers in Australia. The method, based on light modulation, promises improved quality control for commercial production to compete with silicon-based devices.

Next generation solar cells are likely to be based on perovskites, related to the naturally occurring Ca, Ti oxide mineral. On a small scale, they are almost as efficient as silicon ones and they are cheap to source. However, performance falls when they are made on larger scales because of nanoscale-size flaws that form on the surface during manufacture. The future of perovskite solar cells hinges on whether they can be fabricated into high efficiency large area devices, and this requires methods for rapidly and reliably identifying imperfections that limit their performance.

The Australian technique is based on photoluminescence. It involves shining blue light onto the cells and recording the IR light that bounces back. Imperfections on the surface change the amount of IR produced. The team analysed how the cell emits light under different operating conditions and then mapped the results at a high spatial resolution (Nano Energy, 2020, 73, 104755).

The researchers say the technique allows them to quickly spot defects and quantify their impact. They characterised an entire batch of perovskite solar cells and then successfully compared their results with established electrical analysis methods.

‘Using this technique, we can rapidly identify a whole range of imperfections,’ says Kevin Rietwyk from Australia’s ARC Centre of Excellence in Exciton Science at Monash University. ‘We can then figure out if there are enough of them to cause a problem and, if so, adjust the manufacturing process to fix it. It makes for a very effective quality control method.’

Achilles’ heel poked

ANTHONY KING

An antibody from a SARS patient back in 2003 is shedding light on how antibodies might bind to Covid-19. A group in California showed precisely where the antibody – CR3022 – attached to SARS-CoV-2, highlighting a possible vulnerability.

The antibody bound to the spike protein, protrusions from the surface of the virus that give coronaviruses their crown-like appearance. The spike protein first touches a target cell when it locks onto an ACE2 enzyme on the cell surface.

“We were interested in finding out where antibodies bind the spike protein, particularly neutralising antibodies,” says Ian Wilson, structural biologist at the Scripps Research Institute in California. “This can give us indications as to how we might better design vaccines and therapeutics, so a sort of Achilles’ heel.”

The research revealed the antibody stuck onto an area of the spike protein away from the attachment site. Surprisingly, it bound to a spot that is usually hidden, except for when the virus undergoes a shapeshifting manoeuvre to enter our cells.

Virologist Tom Gallagher at the Loyola University of Chicago compares the virus spike to a flower. “It is only after one or two of the petals of the flower open that the antibody binds and inactivates it,” he explains. It could be that the virus is hypersensitive to antibody neutralisation while undergoing these dynamic changes.

The antibody studied was 100-times less effective at binding to the new virus than the original SARS virus. Still, the group at Scripps note there have been examples of antibodies that did not neutralise viruses in vitro, yet proved effective in lab animals.

“There are other mechanisms of clearing viruses other than direct neutralisation. Binding can be sufficient to get clearance,” says Wilson. If this approach of binding to the hidden site on SARS-CoV-2 was potent enough, such an antibody could be used by itself or in combination with other antibodies.

“We now have colleagues here at Scripps extracting antibodies from convalescent patients to see what antibodies are produced against SARS-CoV-2,” Wilson explains. Such antibodies also give clues about what a good immune response looks like in terms of what makes an effective vaccine.

“If we know where exceptionally potent neutralising antibodies bind we can try to shepherd the immune system towards targeting those specific areas,” adds Wilson. At the moment, it seems that the virus is not mutating much, which makes the task of developing a vaccine “an awful lot easier,” says Wilson. He expects to see lots of studies on antibodies from patients that target the novel coronavirus very soon.
Sepsis antibody therapy

XIAOZHI LIM

Sepsis is a lethal illness responsible for 20% of deaths worldwide in 2017.

In 1999, Haichao Wang and his colleagues at the US Feinstein Institute for Medical Research identified the high-mobility group box-1 protein (HMGB1) as a mediator of late-stage sepsis and a therapeutic target (Science, doi: 10.1126/science.285.5425.248).

Now, the researchers have discovered that HMGB1 acts with a partner-in-crime – another protein called tetranectin – to cause immunosuppression by killing white blood cells called macrophages (Sci. Transl. Med., doi: 10.1126/scitranslmed.aaz3833).

An antibody that prevented HMGB1 and tetranectin from interacting with each other rescued septic mice even when administered 24 hours after the onset of sepsis.

Wang and his colleagues began by comparing blood samples from healthy patients and septic patients. They observed that a 20kDa protein – tetranectin – was low in septic patients with elevated levels of HMGB1. Compared with healthy patients, septic patients had some 62 to 67% lower plasma tetranectin concentrations, and one patient who died of septic shock within 24 hours of blood sampling had almost none.

To confirm that tetranectin plays a role in sepsis, the researchers deleted a gene that produces tetranectin in mice and found it exacerbated mortality rates. Then, they administered tetranectin to septic mice and found physiological doses aided survival. But when they prepared a set of polyclonal antibodies to act against tetranectin, surprisingly, two of them protected the mice from sepsis.

‘This was totally unexpected, so we repeated the experiment,’ Wang said. The protective effect remained even when the antibodies were administered 22 hours after the onset of sepsis.

To figure out why, the researchers screened the two polyclonal antibodies against peptides found on different regions of tetranectin. It turned out both antibodies recognised a peptide that the researchers labeled P5. Wang’s team then generated a set of monoclonal antibodies in mice that bond to P5. An antibody called mAb8 greatly improved survival in septic mice, with less tetranectin depletion, lowered sepsis-induced lung and liver injury and reduced levels of bacteria in blood even when administered 24 hours after septic insult.

‘This has marked translational potential,’ writes Craig Coopersmith, a leading sepsis expert at Emory University, in a accompanying paper commentary. In most studies of new therapeutic agents, treatment begins very shortly after sepsis insult, which is not the case in the real world. ‘It is nearly impossible to treat patients in the earliest stages of disease.’

The antibody prevents tetranectin and HMGB1 from interacting, Wang explains. Tetranectin and HMGB1 bind strongly to form a complex that can enter and kill immune cells like macrophages, exacerbating sepsis. The antibody effectively competes with HMGB1 for binding with tetranectin, keeping it in blood plasma and outside of immune cells.

RESEARCHERS at the Graduate Schools of Engineering and Science at the University of Tokyo, Japan, have developed a new fluorinated cyclic phosphate solvent (TFEP) electrolyte as a safer alternative for the ethylene carbonate (EC) currently used in Li-ion batteries. EC is flammable and unstable above 4.3V, whereas TFEP is said to be non-flammable and can tolerate greater voltages up to 4.9V. This higher voltage in a battery whose size is unchanged can give greater battery life between charges, offering greater ranges for electric vehicles (Nature Energy. doi: 10.1038/s41560-020-05667-z).

A CONSORTIUM of scientists from the University of Exeter, UK, have identified new mono-alkyl chain lipophilic cations (MALCs) that inhibit the activity of fungal mitochondria to protect crops against Septoria tritici blotch in wheat and rice blast disease. The most effective MALC, C18-SMe2+, when applied to crops is believed to generate aggressive molecules inside the fungal mitochondria, which initiates a ‘self-destruct’ mechanism. It also ‘alerts’ the plant’s defence system (Nature Comm., 2020, 11, 1608).

SCIENTISTS at the University of York, Toronto, Canada, have developed organic electrode materials to replace cobalt for Li-ion batteries that are said to be more environmentally friendly, but with the same performance characteristics. The phosphaviologen-based pyrene-carbon nanotube composites are designed to make large-scale manufacturing, recycling and disposal of electrodes more environmentally sustainable (Batteries & Supercrops, doi: 10.1002/batt.202000031).

A CONSORTIUM of scientists from Hokkaido University and Kao Corp, Japan, has revealed why natural drying makes cotton towels stiff when fabric softener is not used - it is all about crosslinking. Using atomic force microscopy (AFM) and AFM-based IR spectroscopy, the investigators looked at bound water on cotton surfaces at the molecular level. The bound water causes cross-linking between single fibres through capillary adhesion. The research could benefit the development of fabric softeners and better cleaning technologies (Journal of Physical Chemistry C, doi: 10.1021/acs.jpcc.0c00423).
**US Particulates Ruling**

**MARIA BURKE**

The US Environmental Protection Agency (EPA) has announced it will not strengthen standards for particulate matter pollution, against the recommendations of independent experts and EPA’s own scientists. The decision was welcomed by many industry groups, but environmentalists and opposition politicians have accused the administration of putting politics above public health.

The EPA is required to review the National Ambient Air Quality Standards regulation, which sets limits on the concentrations of pollutants in the air, every five years. In the past, these reviews have usually resulted in stricter standards. Regions that exceed the standard face limits on new industrial development until air quality improves.

However, EPA Administrator Andrew Wheeler believes the current standard does not need to be changed. Set in 2012, it allows for 12 millionths of a gram per cubic meter (mg/m³) of air. EPA staff had recommended a reduction to 8 millionths of a gram per cubic meter after research showed respiratory damage could occur at current standards.

The decision follows a non-peer-reviewed study by Harvard University that found more Covid-19 patients die in parts of the country with increased levels of fine particulate pollution. ‘This decision comes as no surprise, but it’s appalling nonetheless,’ comments Gretchen Goldman, Research Director for the Center for Science and Democracy at the Union of Concerned Scientists. ‘It’s especially egregious that EPA is making this announcement in the thick of the Covid-19 pandemic – a public health crisis that evidence increasingly suggests is dangerous to people living in areas with higher air pollution levels.’

However, Frank Macchiarola, senior Vice President of policy, economics and regulatory affairs at the American Petroleum Institute says: ‘Many industry groups across America – including ours – agree that EPA’s proposed rule is a smart balance that will further reduce emissions and help protect public health while meeting America’s energy needs. The US has made significant progress in this area as it has reduced PM2.5 annual concentrations by 39% since 2000.’

**Bacteria and nanowires convert carbon dioxide**

**MARIA BURKE**

Chemists have created a hybrid system of bacteria and nanowires that captures energy from sunlight to convert carbon dioxide and water into organic molecules and oxygen. Such a biohybrid offers potential as a way to remove carbon dioxide from the atmosphere, and as a raw material to manufacture oxygen and organic compounds on deep space missions.

Five years ago, the team from University of California, Berkeley, and Lawrence Berkeley National Laboratory described how the bacteria Sporomusa ovata packed into a ‘forest’ of silicon nanowires could convert solar energy into acetate in a similar process to photosynthesis. Now they have managed to improve conversion efficiency from 0.4% to almost 4% (Joule, doi: 10.1016/j.joule.2020.03.001). Most plants convert less than 0.5% of solar energy in photosynthesis, apart from sugar cane, which is 4-5% efficient. ‘These silicon nanowires are essentially like an antenna,’ says project leader Peidong Yang, professor of chemistry at UC Berkeley. ‘They capture the solar photon just like a solar panel. Within these silicon nanowires, they will generate electrons and feed them to the bacteria. Then the bacteria absorb CO₂ do the chemistry and spit out acetate. The oxygen is a side-benefit.’

The team found a way to counteract the effect of rising pH and this allowed them to pack many more bacteria into the nanowire forest. They were able to operate the bioreactor for a week without the bacteria detaching.

As the biohybrid takes CO₂ from the air, it could help address climate change. Yang also believes the system has potential for use on deep space missions, for example, to Mars, where the atmosphere is mainly CO₂. Biological systems are light for rockets to carry and they reproduce themselves. They could be used to generate oxygen, and acetate molecules can serve as building blocks for a range of organic molecules. Many other organic products could be made from acetate inside genetically engineered organisms, such as bacteria or yeast.

Currently, Yang’s team is investigating how to embed quantum dots in the membranes of bacteria; the dots would act as solar panels and mean silicon nanowires would be unnecessary. They are also exploring techniques for genetically engineering the bacteria to make them capable of producing organic compounds, such as acetic acid.
In tests, the plate nanolattice design was found to be up to 639% stronger and 522% more rigid than the average performance of nanostructure constituents. Now, researchers from the University of California, Irvine (UCI), US, have designed and produced a new nanometre-sized carbon material that – as a ratio of strength to density – is stronger than diamond (Nature Commun. doi.org/10.1038/s41467-020-15434-2).

Lattices based on intersecting beams have been known for decades and are used in aerospace applications and for impact protection, such as in helmets. The new material uses so-called closed-cell plates instead of the cylindrical trusses found in beam nanolattices, however, which makes the lattice even stronger.

‘Take three beams intersecting perpendicularly to make a node. Pushing down on one of the beams only puts pressure on that beam, the other two can’t take on any of the pressure’, says UCI’s Jens Bauer. ‘Plates can be more supportive of one another. Imagine three plates intersecting to form a corner. If you push down in one direction, two plates bear the load. In the beam-based design, one-third of the material is doing the work while in the plate-based design two-thirds of the material is.’

In tests, the plate nanolattice was found to be up to 639% stronger and 522% more rigid than the average performance of beam-based architectures.

Previous beam-based designs, while interesting, lacked efficient mechanical properties. ‘This new class of plate-nanolattices that we’ve created is dramatically stronger and stiffer than the best beam-nanolattices,’ says Bauer.

The material was prepared using a 3D laser printing technique called two photon polymerisation-direct laser writing (TPP-DLW). An optical microscope focuses a laser beam into a droplet of UV sensitive liquid resin. The resin absorbs the laser light and causes polymerisation when molecules are simultaneously hit by two photons. The structure of the polymeric lattice produced can be varied by scanning the laser or moving the stage in three dimensions. Excess precursor resin is removed through tiny holes in the plates before the polymeric lattices are transformed to carbon by vacuum heat treatment at 900°C.

At present, the TPP-DLW approach can only make small quantities of plate nanolattices, with realistic material volumes of around 1mm³. However, Bauer is optimistic the process may be scaled up to provide commercial quantities. ‘There is a continuous effort to increase the TPP-DLW output volume. It is a young technique and over the last decade, output has already increased by several orders of magnitude. We need to find ways to scale-up the volume of material that can be produced through further evolution of additive manufacturing processes or the adoption of self-assembly techniques.’

He envisages that – subject to successful scale-up – the new plate nanolattices could find application in the aerospace industry, micro-electromechanical devices like smartphone sensors, small scale biomedical devices and micro-satellites.

New highly porous materials can store significantly more hydrogen and methane than conventional adsorbent materials at safer pressures and lower costs, claim US researchers. They show potential for use on board clean energy vehicles and to store compressed gases for industrial applications. Vehicles powered by hydrogen and methane need to be under high pressure to operate – the pressure of a hydrogen tank is 300 times greater than the pressure in car tyres. But compression is expensive and can be unsafe. For the next generation of green vehicles, researchers are developing new adsorbent materials that can store hydrogen and methane gas at much lower pressures.

A research team led by Omar Farha at Northwestern University, Illinois, report that their new materials get around this challenge. Based on metal-organic frameworks (MOFs), they consist of organic molecules and metal clusters that self-assemble to form multi-dimensional, highly crystalline, porous frameworks. Their MOFs, NU-150, contain tri-aluminium nodes and a large hexadentate aromatic linker. The team says a 1g sample of the material has a surface area that would cover 1.3 football fields and the volume of six M&Ms.

The study, combining experiment and molecular simulation, shows the material with its high porosity and surface area outperforms ‘one of the best deliverable’ hydrogen capacities – 14% by weight. ‘We can store tremendous amounts of hydrogen and methane within the pores of the MOFs and deliver them to the engine of the vehicle at lower pressures than needed for current fuel cell vehicles,’ says Farha.

Chris Wilmer, assistant professor of chemical engineering at the University of Pittsburgh, comments: ‘It’s very impressive how far Farha and his team have pushed the envelope in terms of storing gases in MOFs. It’s also remarkable to take a step back and reflect on how much MOFs have improved in a decade; everything from chemical stability, reproducibility, cost of synthesis, and of course gas storage, has improved dramatically.’
Sticky batteries

While technology improvements are rendering wearable electronic devices ever lighter and smaller, there is an urgent need for innovative new power sources that can stretch and bend with the body, while being safe and durable. Thin-film lithium microbatteries are commercially available yet suffer from short life cycles, abrupt failures and safety concerns associated with lithium.

Now, researchers from several Korean academic institutions have joined forces to produce a new type of re-attachable, ‘sticker-type’ microsupercapacitor (MSC) power source they hope will see widespread use in flexible and wearable devices (Chem. Eng. J., doi: 10.1016/j.cej.2019.123972).

“Our sticker-type flexible MSCs are easily re-attached to next-generation wearable devices and IoT [Internet-of-Things] gadgets and [are] eco-friendly,” says Hana Yoon of Korea Institute of Energy Research, who led the work. “They are expected to solve many obstacles of lithium-based energy storage technologies.”

An optimised version of the MSC demonstrated superior volumetric energy density of 1.08 mWh/cm$^3$ and 13 times higher volumetric power density of 83.5 mW/cm$^3$, compared with conventional lithium thin-film batteries. To produce their MSCs, the team fabricated a 3D network of highly swollen graphene oxide electrodes, impregnated with durable adhesive polymer composites.

“The patterning technology developed from this study generated unique swollen graphene with [an] ultra-short pulse laser in a relatively short period of time, while minimising loss of materials,” says co-researcher Young-jin Kim of Korea Advanced Institute of Science and Technology. “This technology has a potential to promote industrial applications of laser-induced-graphene to various sectors.’

An prototype of an MSC array was attached to safety goggles and successfully powered a micro-LED. The total capacitance of the array was maintained at ~97% of its original value after 200 repetitive attachments and detachments, showing good durability. In addition, the sticker-type MSC array had stable performance after repeated deformation, and retained up to 99% of capacitance after 200 bending cycles.

A Covid-19 vaccine trial under way at the University of Oxford will recruit 510 volunteers, who will receive the new vaccine or a control vaccine for comparison. Healthy individuals aged between 18 and 55 are now receiving the vaccine jab in initial Phase 1 trials.

A total of 1,112 volunteers will eventually be enrolled in Phase 1 and Phase 2 trials, led by vaccinologist Sarah Gilbert. She believes there is an 80% chance of having a working Covid-19 vaccine by September 2020.

The group previously made a vaccine in a chimp adenovirus against MERS, which is caused by a cousin of SARS-CoV-2. The Gilbert lab had also previously worked on a vaccine for the Ebola outbreak in West Africa in 2014.

The Covid-19 vaccine consists of a genetic sequence for the spike protein of the pandemic coronavirus placed inside a harmless adenovirus from chimpanzees.

Adenovirus proteins are generated along with the Covid-19 virus spike protein, says Colin Butter, a veterinary immunologist at the University of Lincoln, who has collaborated with the Oxford group on other vaccines. “The immune system sees those proteins. Those antigens are then taken up, transported usually to lymph nodes and presented on antigen presenting cells. That will trigger a de novo immune response.”

Antigens, which flag foreign entities to our immune system, are generated by breakdown of the vaccine virus inside of cells. This will provoke an antibody response that can bind to and neutralise the virus, but also stimulate a T-cell response. T-cells carry out immune surveillance. If they discover virus-infected cells, they kill them. ‘The great thing about this vaccine is that it will produce both [an antibody and a T-cell response],’ Butter explains.

Most trial participants will receive a single dose of vaccine. However, a small number will also receive a booster shot of the same vaccine four weeks later. Participants will be asked to record any symptoms experienced for seven days and will attend follow-up visits. Blood samples will reveal the immune response to the vaccine.

Gilbert expressed hope during a BBC interview that her vaccine might induce immunity that lasts longer than that induced by a natural SARS-CoV-2 infection. Coronaviruses often do not leave behind a strong immune memory.

Oxford has a pilot plant to make a small number of doses. Oxford will partner with AstraZeneca to develop and manufacture the vaccine, with the aim of producing 100 million doses by the end of 2020, while prioritising supply to the UK.

Another phase of vaccine tests will need to be carried out on adults older than 55. Older people generally are harder to vaccinate, as their immune response can be more subdued. ‘This doesn’t mean the vaccine won’t be efficacious in older people. I’m afraid it is a suck it and see,’ says Butter.

Making limited vaccine available by the end of this year, with more in early 2021, says Butter, ‘would be a heroic effort. Extraordinary, but not impossible.’
Vulnerable organs

Initial reports of infection with the Covid-19 virus (SARS-CoV-2) focused on the lungs and pneumonia caused by severe infection. But increasingly there are reports that other organs, such as the heart and kidneys, are also affected.

The virus latches onto an enzyme – ACE2 – that is abundant on the surface of lung cells. Findings suggest this entrance point is also highly expressed in the nose, mouth and airways, offering quick access to the body. ACE2 is involved in regulating blood pressure.

A recent preprint by Chinese scientists on bioRxiv (biorxiv.org/content/10.1101/2020.04.16.045690v1) reported sequencing RNA from single cells in different tissues to find expression levels of ACE2. They identified the brain, gall bladder and fallopian tubes as high in this enzyme and therefore vulnerable to Covid-19 infection. They also, along with others, identified the heart, small intestine, oesophagus, testis and kidney as high-risk organs, with high expressions of ACE2.

However, Jia Hongpeng at Johns Hopkins University warns that ‘high gene expression levels of ACE2 doesn’t mean that the cell is highly susceptible to SARS-CoV-2’ and RNA sequencing only identifies gene expression levels in certain types of cells. Virologist Tom Gallagher at Loyola University of Chicago agrees that, although ACE2 is important, ‘many other susceptibility components have to be in place to allow infection.’

Alan Kliger, kidney expert at Yale University and co-chairman of a Covid-19 response team for the American Society of Nephrology, credits some of the early Chinese ACE2 publications for alerting doctors to possible kidney complications from Covid-19. This was confirmed in European and US hospitals. ‘Up to 40% of patients and up to 50% in one institution, here in the US not only had renal insufficiency, but actually had acute renal failure and required renal replacement therapy,’ says Kliger. In New York, Covid-19 patients in intensive care, placed significant extra demand on dialysis machines.

‘Blood pressure is a really complicated phenomenon and involves lots of feedback loops. As a result of it being a widespread system throughout the body, a lot of cells have ACE2 receptors,’ explains David Bott at SCI, who wrote a recent explainer on the chemistry of the virus (soci.org/action-against-covid-19/chemistry-and-covid-19).

ACE2 is highly expressed in the heart. During the original SARS outbreak in Toronto in 2003, SARS virus RNA was detected in over one-third of the heart samples of patients who died from SARS.
**Business digest**

US-headquartered gene therapy company Asklepios BioPharmaceutical has acquired Paris-based gene therapy company BrainVectis, a spin out from the French National Institute for Health and Medical Research. The acquisition will expand AskBio’s therapeutics for neurodegenerative disorders. BrainVectis will operate as a wholly owned subsidiary of AskBio and maintain its office in Paris, France.

UK immune-oncology company Avacta in collaboration with US global life sciences company Cytiva, formerly GE Healthcare Life Sciences, has successfully generated specific affimer reagents for a Covid-19 antigen rapid test ahead of schedule.

Chemicals major BASF and Australian digital technology solutions provider Security Matters will together develop solutions for plastics traceability and circularity. Security Matters will contribute its technology to enable physical and digital tracking of closed loop recycling, to authenticate sustainability claims and to improve sorting of plastic waste. BASF will provide experience in plastic additives, regulatory know-how and understanding of the plastics value chain. Both companies will combine their R&D capabilities and required resources.

German pharma major Boehringer Ingelheim is collaborating with US artificial intelligence specialist Insilico Medicine to identify new drug targets through its internal Research Beyond Borders initiative, which is tasked with forming new collaborations outside of the company’s traditional therapeutic areas and geography. In addition, Boehringer is investing €3m in a second digital lab Bi X, in Shanghai, China, which is expected to open later in 2020.

German chemical distribution company Brenntag, headquartered in Essen, has achieved gold status in EcoVadis’s sustainability assessment. EcoVadis is a collaborative platform providing sustainability ratings and performance improvement tools for global supply chains.

The Competition Appeal Tribunal (CAT) has upheld the judgement of the CMA to block the merger of Ecolab and Holchem, two of the largest suppliers of cleaning chemicals to food and drink manufacturers in the UK. The CMA concluded that the only effective way of addressing the significant loss of competition as a result of the merger was to block it by requiring Ecolab to sell off Holchem. The judgment means that Ecolab must now sell Holchem Laboratories to a purchaser approved by the CMA without delay.

Glasgow-based scientific software company DeepMatter, which focuses on digitising chemistry, has signed a contract with the Cancer Research UK Beatson Institute and Cancer Research Technology, the commercialisation and development arm of Cancer Research UK, for its DigitalGlassware platform. The use of this technology will allow the drug discovery unit to share its chemistry across locations, so that new discoveries might be made faster.

The pharmacovigilance division, Diamond PV Services, of the UK-headquartered technical services and regulatory affairs consulting group Diamond Pharma Services has acquired PharmaCentral, a pharmacovigilance services and medical affairs business based in Dublin, Ireland. The acquisition will expand Diamond’s presence in Europe and enhance the senior-level expertise within its pharmacovigilance team.

US pharma major Eli Lilly is moving its UK research centre from its current base in Erl Wood in Surrey to Bracknell, Berkshire. The UK centre is expected to focus on non-lab R&D, with neuroscience research being transferred to Lilly’s US R&D hub in Cambridge, MA.

German headquarted drug discovery and development company Evotec and Japanese pharma major Takeda have entered a multi-year gene therapy research alliance. Evotec will support multiple Takeda programmes targeting conditions aligned with Takeda’s four core therapeutic areas: oncology, rare diseases, neuroscience and gastroenterology. The alliance will use Evotec’s gene therapy capabilities as well as its broader drug discovery platform. No financial details were disclosed.

The Netherlands-headquartered global medical technology company Factory-CRO...
Group, which was formed from a merger of BBA, Factory-CRO, Five Corners, and MileStone Research Organization, has rebranded as Avania. The CRO’s team provides early strategic consulting, through product feasibility studies to post-marketing guidance.

Pharmaceutical research company Galapagos, headquartered in Belgium, is to collaborate with Poland-based biopharmaceutical company Ryvu Therapeutics to develop small molecule drugs for use in inflammation. Ryvu will be responsible for early drug discovery. Galapagos will have an exclusive option to license IP developed by Ryvu and to continue to develop this during the collaboration. In exchange for global development and commercialisation rights, Ryvu will receive an upfront payment and will be eligible for further option, milestone and royalty payments.

US biopharmaceutical company Gilead has entered a three-year cancer immunotherapy research collaboration between its oncology-focused subsidiary Kite and Australian biotechnology company oNKo-innate. The collaboration will develop cell therapies focused on natural killer (NK) cells. The Australian company will identify and validate targets for Gilead to seed discovery programmes and will evaluate NK constructs for Kite’s development of cell therapies. In return, oNKo-innate will receive an upfront payment and additional payments based on achieving certain clinical, regulatory and commercial milestones, as well as sales royalties.

UK multinational chemicals company Ineos and UK headquartered recycling firm Plastic Energy are building a recycling plant that will convert plastic waste into the raw materials for making new polymers. The plant will use Plastic Energy’s proprietary technology to convert the waste from Ineos sites into virgin plastic for use in medical products, food packaging and lightweight car parts.

The Lighthouse Laboratory in Glasgow, Scotland – a Covid-19 testing facility – is now operational. The lab, which is hosted by the University of Glasgow at their Queen Elizabeth University Hospital Campus, is part of a network of diagnostic testing facilities in the UK, alongside other Lighthouse Lab sites in Milton Keynes and Alderley Park, which are funded by the UK government.

Merck has acquired the OLED patent portfolio for display applications from global technology company Konica Minolta, comprising over 700 patent families. Financial terms were not disclosed.

The proposed merger between Mylan and Pfizer’s Upjohn, although facing a delay due to the Covid-19 pandemic, has won antitrust clearance from the European Commission—but with conditions. EU regulators will allow the transaction after the two companies agreed to sell some Mylan generic drugs across 20 countries in the European Economic Area and the UK.

Researchers from North Carolina State University, US and Collaborations Pharmaceuticals have created a free-to-use database of 14,000 known macrolactones. The database, MacrolactoneDB, contains information about the molecular characteristics, chemical diversity and biological activities of these large molecules, which bind to protein targets, making them suitable for antiviral, antibiotic, antifungal and antiparasitic drugs.

Dutch chemicals company Stahl, headquartered in Waalwijk, Noord-Brabant, which specialises in coatings, processing and treatments for a range of materials, has joined the Roundtable on Sustainable Biomaterials (RSB). The RSB is a multi-stakeholder organisation committed to ensuring best practice in sustainable biomaterials.

Dutch biopharmaceutical R&D company Synthon Biopharmaceuticals, which develops precision medicines for patients with relentless cancers and autoimmune diseases, has relaunched as Byondis.

BASF’s Chimassorb light stabilisers have been used by polyethylene producer M/s Megaplast India to produce non-woven HDPE geotextile for use in road construction. The additives stabilise the production process and extend the lifespan of the material. Geotextiles maintain the separation between layers of different sized soil particles, restricting the flow of water and finer soil particles into the gravel base and thereby reducing repair costs.

German thermoplastics producer Kraiburg TPE has developed new thermoplastics elastomer (TPE) technology that uses 3M Glass Bubbles to produce extremely lightweight thin-walled mouldings with excellent surfaces and able to withstand mechanical loads. The microscopically small hollow borosilicate glass bubbles are insoluble in water and spread evenly through the TPE matrix helping to increase dimensional stability. Production waste can be recycled. The three Thermoplastic K grades are suitable for exterior vehicle components, power tools and sealing applications.

Global, producer of high performance thermoplastic technical textiles, has launched a range of so-called intelligent textiles that can integrate functions into a fibre, such as the illumination of certain zones, temperature measurement or detection of a remote presence. With luminous textiles, certain zones in the fabric illuminate so shapes can appear without the use of cables or light bulbs. For the construction sector, floor slabs could integrate signage information that could be modified remotely. Safety vests could be made more visible, while in the aviation and automotive sectors, interior cabin design can be changed and the amount of cabling and electronics reduced.

BASF and Hengst Filtration in Germany have developed what is claimed to be the world’s first reusable spin-on oil filter module, the Blue.on, for cars. It is designed to reduce the number of oil filters replaced and thrown away – around 2bn/year. Made from long glass fibre reinforced Ultramid Structure A3W12 LF1, the use of this material also offers a 23% weight reduction for the module, compared with its conventional metal counterpart.