UNIVERSITY OF CAMBRIDGE

Department of Chemical Engineering and Biotechnology | Lent 2021 | Issue 32

CEB *Focus*

Resilience in the face of global challenge

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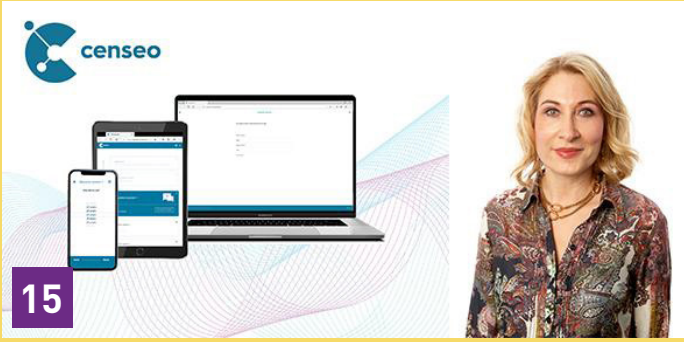

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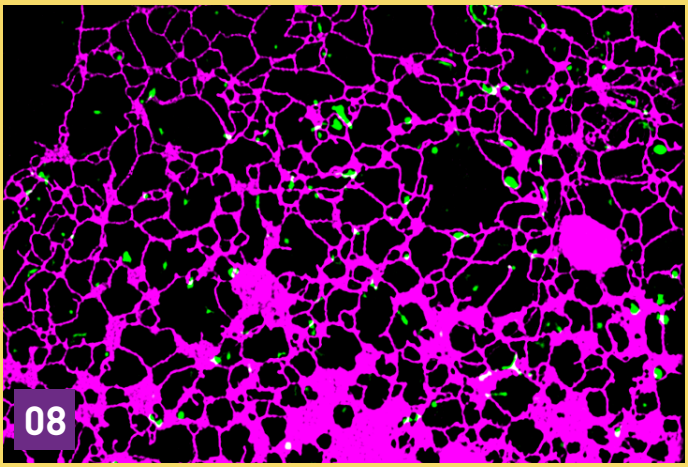

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High speed super-resolution microscopy records driving force of behind a cellular process linked to neurodegenerative disorders.

From left to right: Adarsh Arun, Bowen Huang and Sina Schack (former Editorial Team members), Madhuri Manohar, Elena Gonzalez, Sarah Barron, Yong Ren Tan, Cristina Lopez and Niki Kotecha (not featured).

A very happy New Year to all our readers! We have left behind a year marked by the arrival of COVID-19 and we have kick-started 2021 with renewed hope as the vaccine roll-out is likely to finally bring some sense of normality back into our lives. Despite the challenges faced, CEB has continued adapting its teaching and research activities, remaining committed to delivering the best education to all its students and the best research outputs for a healthier and more sustainable world.

In the last issue, our new HoD, Professor Clemens Kaminski, presented his strategic vision for the department and, in this issue, he reflects on the resilience of our research efforts in the face of global challenges, and shares his aspirations to further strengthen our ethos of inclusive innovation to meet the pressing needs of the modern world.

'Teaching Matters' includes an update from our new Director of Teaching, Dr Andy Sederman, who reviews virtual teaching and shares highlights of Lent term, as well as an account of first year undergraduates transitioning from Engineering and Natural Sciences into the Chemical Engineering Tripos.

The 'Research Highlights' section reviews our latest research breakthroughs: we have Dr Beth Tennyson on the crucial role of 'recycled' light in solar panels and LEDs, Dr Jenny Molloy on 'open enzymes', David Brossault on his new method for producing magnetic photocatalysts for water treatment, and Dr Meng Lu and Professor Clemens Kaminski on insights into cellular machinery.

'Biotech Matters' features Dr Ljiljana Fruk on regenerative agriculture and her new textbook: 'Biotechnology: Concepts and Applications', as well as MBE student Aadit Shah on leading the network of student-led biotechnology incubators, Sling Health.

'Industry Business' is packed with student initiatives to engage with industry, Professor Sabine Bahn's venture, Psyomics, securing £1.5m funding to transform mental health diagnosis in the UK, and Professor Alexei Lapkin's Innovation Centre in Digital Molecular Technologies, a new project linking SMEs with academia and bigger companies.

Amongst some of the 'Achievements' worth noting: Anthie Moysidou is highly commended by the Outstanding Student Contribution to Education Awards for her contribution to access and outreach activities within the University, Dr Leander Crocker receives the inaugural Robin Paul Prize and Dr Jenny Molloy is named Fellow of the World Economic Forum's Global Future Council on Synthetic Biology.

'Alumni Corner' remembers the late Professor Jim Wilkes, department alumnus, former faculty member, and active CEB supporter. It also features Dr Ipshita Mandal-Johnson on the global bioeconomy and bioinnovation, as well as reflections from recent graduates of the Cambridge-CARES Studentship Scheme.

We have continued delivering our outreach event offering online and are delighted to confirm that CEB will be contributing to the very first virtual Cambridge Festival in March with an exciting and diverse programme of events.

Finally, 'Teatime Teaser' brings you a 'mindfulness' surprise with images of CEB science for you to colour in and bring to life!

With best wishes,

Elena Gonzalez

Chief Editor

Message from our HoD

Head of Department, Professor C. Kaminski, in front of CEB research buildings © University of Cambridge. Photo by Phil Mynott.

Dear all,

Welcome to this first issue of CEB Focus in 2021.

It grows tired with the repetition, but we find ourselves in unprecedented times, as a Department, as a University community, and as a global society. Teaching is once again taking place online, and our recording studio, headed by Robin Ansell, has been in operation almost around the clock to ensure we can continue to provide high quality content to our students. Whilst Covid goes on, the political landscape is changing too with Brexit.

There is a lot to adapt to and it is crucial we don't lose heart and look forward with optimism. Excellence in science and research has risen to the challenge of 2020, and looks set to triumph in the year ahead. Research in our department has been flourishing throughout the pandemic, and I am impressed how members of CEB have managed to adapt so quickly and efficiently to a new way of life and work. But short-term achievements must translate into long-term, sustainable recovery, and much of my work in 2021 will be on supporting Chemical Engineering and Biotechnology to realise that vision.

I hope you enjoy reading in this issue about the work we have undertaken, and please do get keep in touch with us to find out more.

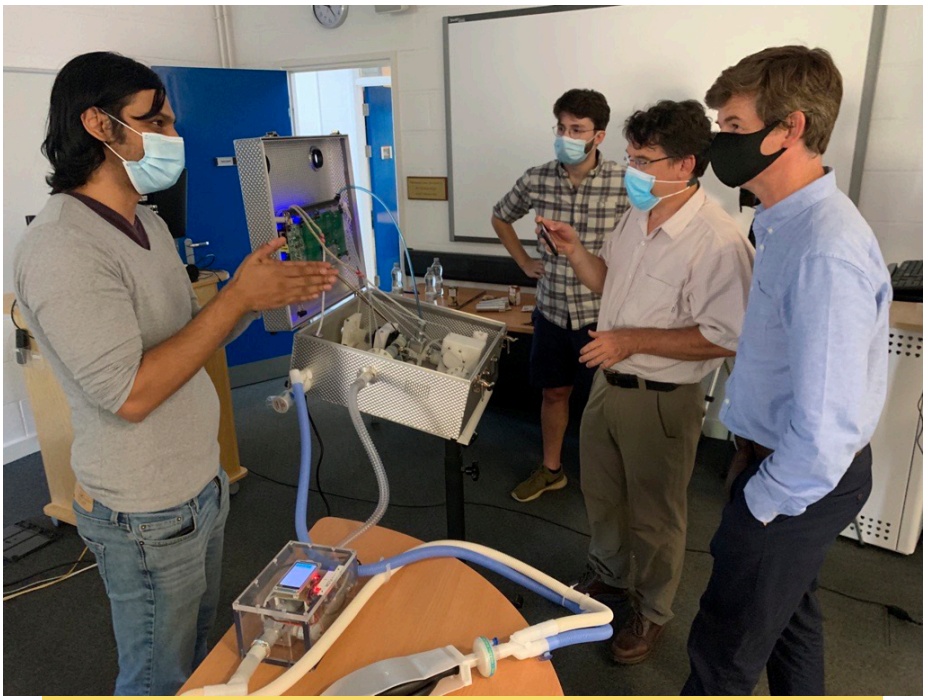
Best wishes for a successful and positive 2021!

Clemens

Resilience in the face of global challenge

Professor Clemens Kaminski, Head of Department

Cross-disciplinary and cross-border collaboration has always been at the core of CEB research, but the latest pandemic has shown us its extraordinary value and given our researchers an appetite to further embrace these ways of working. CEB's research response to the COVID-19 pandemic shows our department's innate ability to tackle global challenges.



Open Ventilator System Initiative is an affordable, high-quality, context-appropriate ventilator system, manufacturable in low-income countries. © OVSI.

"Responsible research and science without borders are key motivators for our work

As I am writing this, we are still in the midst of a global pandemic, posing enormous challenges to society. Healthcare systems are overburdened, economies are dwindling, and families everywhere continue to experience tragic losses.

To take us out of this crisis requires radically new ways of thinking, managing, and conducting science and our discipline has never been more relevant.

Biotechnology is at the heart of the methods used in mass testing and is driving the rapid development of COVID-19 vaccines. Producing vaccines at scale to immunise the global population is a problem that chemical engineers have the tools to solve. The hopes of a generation are pinned on science that is critically enabled by chemical engineers and biotechnologists.

Despite the pandemic and the difficulties posed by social distancing rules and lockdown, the research going on in our department remains vibrant. As the first wave of the pandemic hit, our researchers were immediately directing their skills and energy into COVID-19-related projects. All of these projects are examples of ethical research practice and inclusive innovation.

In the Easter 2020 issue of CEB Focus, we covered the Open Ventilator System Initiative (OVSI)[1], a collaboration between research groups, institutes and companies to develop a low-cost ventilator system to address the acute shortage of medical ventilators. Our researchers continue to work on the associated oxygen supply, critical to effective care for Covid and many other respiratory conditions in countries across the world. Professor Axel Zeitler has been leading the OVSI project in conjunction with the University's Whittle Laboratory and many of our researchers have played key roles, including Professor Geoff Moggridge, whose injection moulding processes enable the design of ventilator parts, and Drs Ewa Marek and David Fairen-Jimenez who are designing low-cost oxygen concentrator technology to complement the ventilation unit.

The success of this initiative – which has produced an open-source ventilator system for a fraction of traditional costs – was critically enabled by connections founded through our EPSRC Centre for Doctoral Training in Sensor Technologies for a Healthy and Sustainable Future (Sensor CDT), and our affiliated NGO partner, the Cambridge Centre for Global Equality (CGE), headed by Dr Lara Allen.

We also highlighted contributions from some of our biotechnology groups. As part of a wider push to make biotechnology more accessible, the Open Bioeconomy Lab[2], led by Dr Jenny

Researchers from the Cameroon team of the Open Bioeconomy Lab © Open Bioeconomy Lab.

Molloy, has been producing open-source enzymatic toolkits that enable the production of essential enzymes required for COVID-19 research, addressing many of the supply chain bottlenecks encountered by low- and middle-income countries. And working with Professor Lisa Hall's Analytical Biotechnology group, these enzymes are being used to develop inexpensive diagnostic kits for distribution in Ghana, Cameroon, and Ethiopia.

Our close links with industry have enabled Dr Graham Christie's Molecular Microbiology Group and Dr Ljiljana Fruk's BioNano Engineering Group to set up anti-viral materials testing in their laboratories, working with several companies to develop surfaces and fabrics (particularly for face masks) that can deactivate and destroy coronaviruses. Dr Fruk's group are also working with biotech company Colorifix, to develop antiviral dyes that can be sustainably produced by microorganisms.

And our Bioelectronic Systems Technology Group, led by Professor Róisín Owens, are investigating a new approach for screening antiviral drugs, using their 'membrane on a chip' technology. The method mimics how viruses interact with our cells providing a safe and reliable electrical readout to test for therapeutic efficacy.

These projects[3] are built on technologies that are sustainable, minimise resources, and that are replicable by others at low cost. Responsible research and science without borders are key motivators for our work, and, crucially, were so before the COVID-19 pandemic developed.

This existing ethos, the incredible diversity of research housed in our department, and our strong links with other institutes, NGOs and industry, place us in a remarkable position to respond to the most urgent of global challenges. We could tell a similar story for our research focused on mitigating climate change. Novel energy solutions, air pollution monitoring, cleaning up chemical processes with AI and machine learning... these are just some of the areas to which our researchers are applying their collaborative approach.

These are brilliant efforts, and my ambition for the department is to provide the optimal infrastructure and resources for such work to flourish. We embrace an ethos of co-creation, an approach to science that involves citizens and partners in end-user communities.

The Sensor CDT is one such example, where responsible research and entrepreneurship are embedded throughout the programme, and modern tools such as rapid prototyping, design with open hardware, and ethical research practice are formally taught. We are in the process of revamping our undergraduate Tripos into a four-year course, in which such skills will be taught in the future.

To enable this, we are developing a MakerSpace laboratory in our department, which will include state-of-the-art facilities for additive manufacturing, electronic prototyping, and CAD design.

The MakerSpace will be critical for the delivery of practical components in our future Tripos. Knowledge gained through delivery of our Masters programmes (Biotechnology MPhil, MPhil in Advanced Chemical Engineering Practice, Masters in Bioscience Enterprise, Automated Chemical Synthesis CDT) and our connection with the CGE provides us with outstanding opportunities to train future champions in the discipline, able to respond to global research challenges intelligently, rapidly, and effectively.

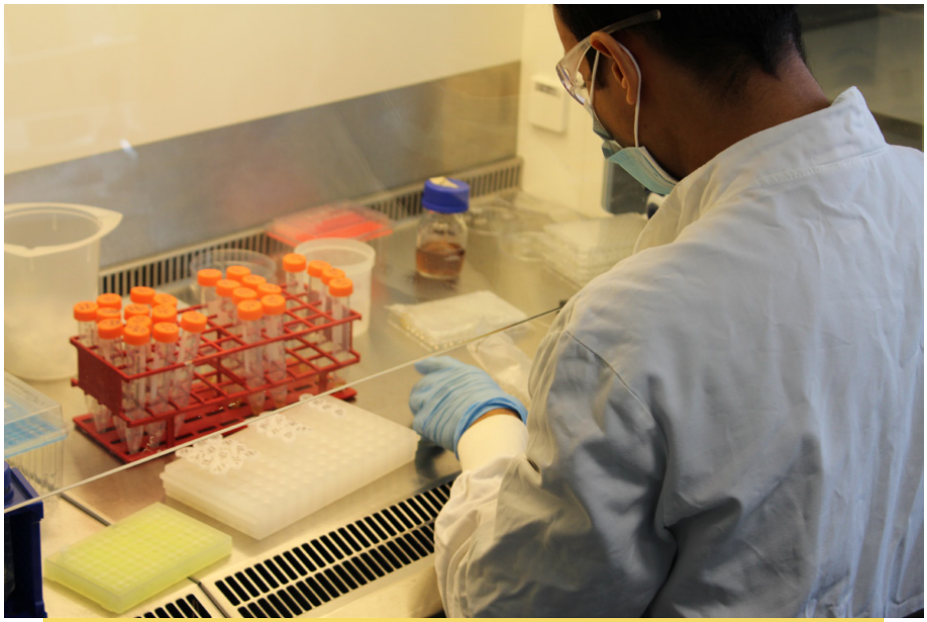
We cannot address such global challenges without visionary supporters. Involving our wider community in our mission to tackle global challenges, either through collaborative research, teaching or philanthropic funding is vital to our success. If you would like to become associated with the department's efforts and hear more about the various projects in our department, please get in touch with our team at the Cambridge University Development and Alumni Relations office: www.philanthropy.cam.ac.uk/give-to-cambridge/chemical-engineering-and-biotechnology

References:

[1] OVSI Ventilator initiative www.ovsi.org

[2] Open Bioeconomy Lab www.openbioeconomy.org

[3] See our COVID-19 research related stories on www.ceb.cam.ac.uk/covid-research



Researcher Suraj Mital from the Molecular Microbiology group testing anti-viral properties of materials © University of Cambridge/ Robin Ansell.

Part I's transition to CEB

Andrew Te Water Naude, Part I Student and Year Group representative of the Cambridge University Chemical Engineering Society

Part I's during their weekly virtual teatime.

In a normal year, the change to chemical engineering is one that seems almost unique: being welcomed by a new department, and the accompanying inductions, is an experience that seems like it belongs in an undergraduate's first year. In reality though, it's second year, so while the department and specific course content are new, the overall experience builds on that of first year. This building on first year is achieved by increasing difficulty of content and introducing changes in the workload: Michaelmas term promises a challenging, but fulfilling, adaption to a new course. There are varying numbers of labs and lectures, and problem sheets are on new topics as the CET exercise makes its exciting debut.

However, this is not a normal year by any means. The CET I cohort arrived, remotely, in October with a third of our prior time in Cambridge being unexpectedly changed as a result of the COVID-19 pandemic. The department we have been enthusiastically welcomed into exists almost solely through Moodle and Panopto, with only a brief window of in-person labs. Primarily online tuition carries with it a range of benefits and challenges: live lectures can be attended within minutes of waking up, recorded lectures can be viewed whenever convenient, but practical exposure to what we're learning is limited. Without the opportunity to use labs to observe theory in action and understand what the numbers we run mean, motivation can be hard to find.

Our only Easter term so far encountered these issues, so we are practised in the self-discipline needed to keep up to date with lectures of this style. In this format of teaching, supervisions become more important than before, providing deadlines to have covered lecture material. Without being in the department daily for lectures, some in-person supervisions present an opportunity: they are held in colleges other than our own instead of in the department as usual.

These limited in-person supervisions are also a chance to meet other members of the year group, in cases where supervision groups include students from different colleges. In lieu of in-person opportunities to meet everyone, online events have stepped up, with CUCES providing an introductory social and regular calls to chat. Despite this, many of the cohort feel they haven't been able to meet many others outside their college and supervisions.

Overall, the transition into CET I is a difficult one, but the year group is settling into the new course and, along with the department as a whole, continuing to make the best of the circumstances.

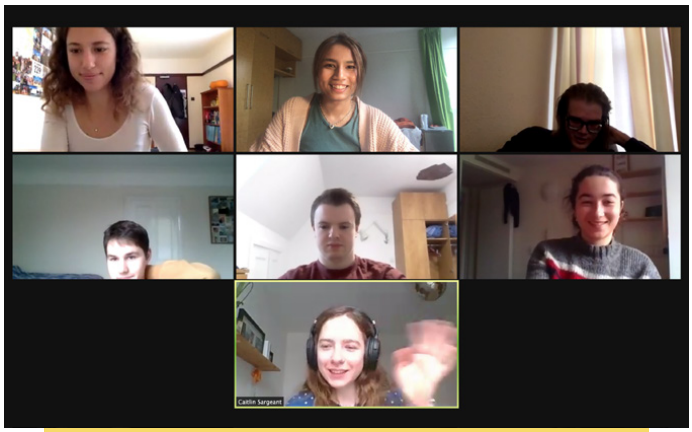
Virtual Teatime with CUCES

Thuza Naing, Part IIB Student and President of the Cambridge University Chemical Engineering Society

Virtual teatime with Part IIB's.

Much to our disappointment, teatime at CEB is not happening as usual this year for obvious reasons. Some of us have yet to even step foot into the building this term! But in an attempt to maintain the tradition and to keep our relatively small circle of chemical engineering undergraduates feel somewhat connected, CUCES have started hosting weekly virtual tea breaks.

The intention of the virtual tea breaks is to give us a chance to catch up with our course mates that we would rarely get to see otherwise. Additionally, they serve as a space to informally discuss some chemical engineering work since now we neither have a library nor a computer suite to study together! All in all, the majority of us really miss our tea breaks and would love to return to the department when social distancing measures are no longer required. But for now, virtual tea breaks are at 11am every week with one day of the week for each year group: Wednesdays for Part I, Thursdays for Part IIB and Fridays for Part IIA. A tea break would last around 45 minutes and people tend to drop by or leave at different points, so it's very casual. If you have some spare time or just simply want a reason to take a break from work, do drop by! We hope to see you there!



Virtual teatime with Part IIA's.

Undergraduate update: our new Director of Teaching, Dr Andy Sederman, reviews the virtual start to the academic year and Lent term upcoming highlights

Dr Andy Sederman

Our new Director of Teaching, Dr Andy Sederman © Andy Sederman

We have kicked off 2021 with a change of Director of Undergraduate Teaching in CEB. Geoff Moggridge, who has held the position for the past two years, is taking a sabbatical for 2021. Whilst Geoff is away, I will be stepping into his role and will be acting Director of Undergraduate Teaching for the year. In this role, I will be overseeing the undergraduate course – arranging teaching and course modifications throughout the year. I am a chemical engineer by training and did my undergraduate degree in the Chemical Engineering department here in Cambridge back in the 1990s.

When Geoff planned to go on sabbatical and I agreed to become Director of Undergraduate Teaching, the world – and undergraduate life in Cambridge – looked very different! Since last March, and especially this term, we have all had to become used to a large fraction of the teaching being delivered remotely. Although this has been forced upon us (staff and students), it has also made us assess how we might adjust our teaching methods in the future. Whilst none of us want the course to be delivered exclusively online in the future, there may be aspects of the course that are best delivered online. There has been lots of good feedback about the quality of the lectures recorded in the new CEB recording studio which provides professional quality recording facilities – a special thanks must go to Professor Axel Zeitler and especially Computer Associate Robin Ansell for setting up the facility and recording/editing so many hours of lectures in such difficult circumstances.

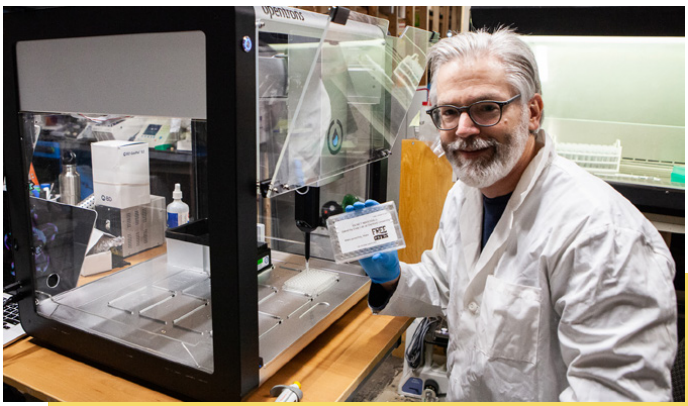
With the success of several vaccines, we can now look towards a future without the current social distancing constraints and a return to 'normal', however that is still a few months away. This term, all undergraduate lectures will continue online, as they were last term, but we hope that we will be able to re-start some of the labs that had to be moved online last term. Many supervisions are likely to continue online at the beginning of Lent term, but, with the prospect of warmer weather (and even a population protected by the vaccine) as the term and year progress, more in-person supervisions may return.

The hope is that the Easter term exams, where distancing is required anyway, will be done in-person in the department, though, this will be dependent on suitable safety measures being in place and on the situation at the time of the exams – there will be further updates closer to the time.

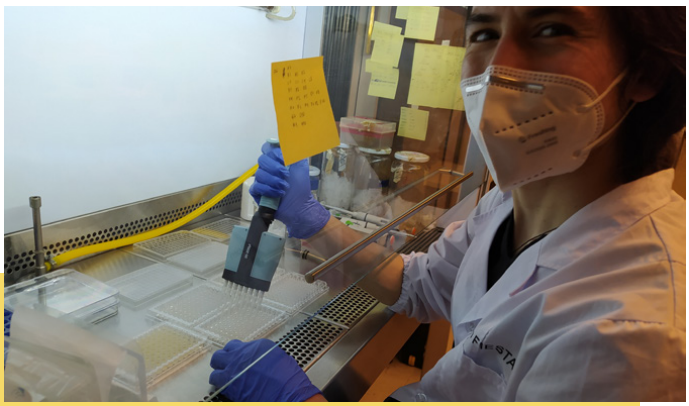
See Dr Sederman's profile www.ceb.cam.ac.uk/directory/andy-sederman

Open-source enzyme toolkit helps developing countries meet rising demands for SARS-CoV-2 research and diagnostics

Researchers at CEB, Pontificia Universidad Católica de Chile and Stanford University, with support from Ginkgo Bioworks and the BioBricks Foundation, have developed a free, open-source toolkit that allows laboratories to produce their own tools for SARS-CoV-2 research and diagnostics, without relying on an increasingly fractured global supply chain.



Scott Pownall in the Open Science Network community biolab in Vancouver, Canada. He is using the collection to develop open and low-cost protocols for optimisation of enzyme expression and purification for use in SARS-CoV-2 diagnostics, a project funded by Paris-based Just One Giant Lab's (JOGL) Open COVID-19 Initiative © Scott Pownall



Isaac Nuñez, and collaborators at iBio and Pontificia Universidad Católica de Chile, will use the collection to streamline the setup of a local manufacturing node for enzymes used in diagnostics, environmental monitoring and education. Like many other countries, Chile relies on external supply for diagnostic reagents to fight SARS-CoV-2. © Isaac Nuñez

High demand for millions of COVID-19 tests per day combined with a disrupted global supply chain has left many countries facing diagnostic shortages. In a recent Nature commentary, John Nkengasong, Director of the Africa Centres for Disease Control and Prevention, stated: "the collapse of global cooperation [has] shoved Africa out of the diagnostics market... African countries have funds to pay for reagents but cannot buy them."

Scientists across the world are therefore developing new tests that are faster, cheaper, adapted to needs of local health systems and easy to manufacture in order to overcome this challenge.

To enable those scientists to access critical research tools that they need for their work, researchers from the Open Bioeconomy Lab at the University of Cambridge, the Lab de Tecnología Libre at iBio/PUC Chile and the FreeGenes Project at Stanford University teamed up with synthetic biology company, Ginkgo Bioworks, to design an open-source toolkit that enables researchers to produce 16 of the most useful enzymes for several diagnostic techniques used to detect the SARS-CoV-2 virus.

"Designing the collections was a great collaborative effort between researchers with diverse expertise and different local needs for fighting the pandemic," said Dr Chiara Gandini, a post-doctoral researcher at CEB. "We designed it with other biologists in mind, making it as easy as possible for them to reconfigure the toolkit for their requirements."

The 'Molecular Diagnostic Toolkit' comprises ready-to-use DNA to produce enzymes including DNA polymerases and reverse transcriptases – the enzymes used in gold standard RT-qPCR tests. These enzymes are also useful for tests like LAMP, which is faster and simpler than RT-qPCR and is rapidly being adopted in more labs. Control DNA is also included in the toolkit, to validate that tests will specifically detect SARS-CoV-2, but not closely related viruses.

The Molecular Diagnostic Toolkit is designed to use standard laboratory techniques to produce and purify the enzymes but many researchers in the Global South work under challenging resource constraints and may need to adapt their work to the local availability of materials. They can therefore make use of the 'E. coli Protein Expression Toolkit': a collection of over 100 DNA parts that can be assembled in thousands of combinations to tailor the whole production process. For example, modules are included to bind enzymes to cellulose to develop paper-based tests or to activate enzyme production in cells using light from LEDs instead of expensive chemicals.

The toolkit has been pre-ordered by over 34 labs from 16 countries, including Brazil, Chile, Peru, Colombia, Costa Rica, Mexico, Cameroon, Ethiopia, India and Vietnam.

Tamara Matute and Isaac Núñez, researchers from the Pontificia Universidad Católica de Chile and iBio, who participated in the design of the collection, explain that "having access to this palette of molecular tools is crucial for our region to fight any reagent supply shortages in the short-term, and to leverage technological autonomy in diagnostics and viral monitoring in the long term." They add that mechanisms like the open online community, Reclone Network, are also needed to enhance the usefulness of the collection through peer support including fostering "a collaborative community, crowd-sourced protocols and openly-shared resources".

While the initial focus of the toolkit is to support research and development, the very same DNA could be used to manufacture diagnostic kits with the correct processes and regulatory approvals in place. As it is open-source, any company or institution can produce and commercialise enzymes from the toolkit. For example, LAMP enzymes will be manufactured at the Ethiopian Biotechnology Institute in a collaboration with the University of Cambridge supported by the Cambridge-Africa Alborada Fund. Dr Brook Esseye of the EBTi LAMP Initiative said, "this initiative will enhance local capacity for bio-manufacturing and strengthen partnerships among researchers in various countries so we can join hands to fight this global pandemic."

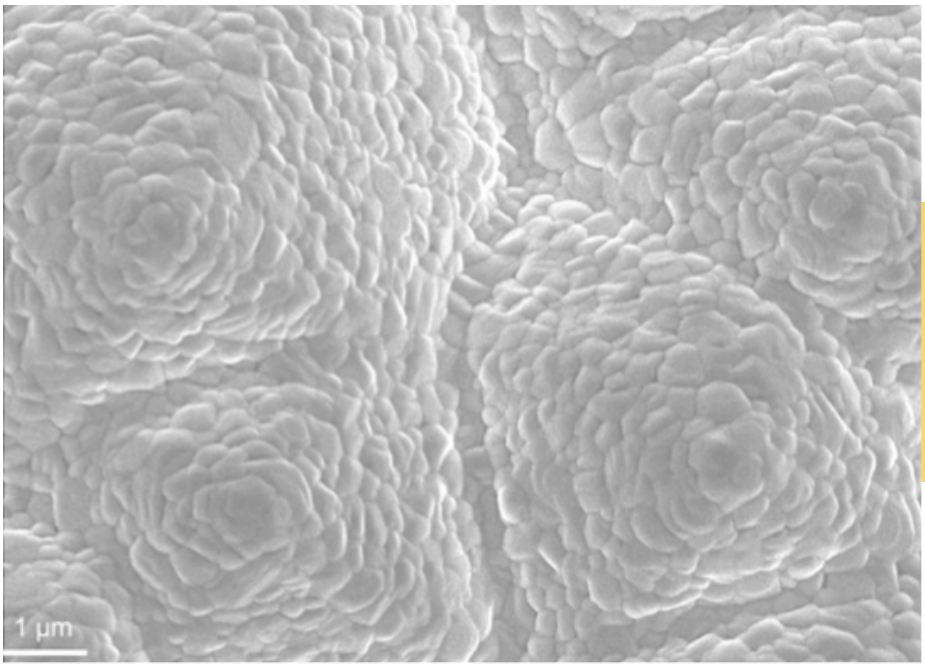
"A resilient local supply chain for diagnostics is vital to future health security and pandemic preparedness," said Dr Jenny Molloy, Shuttleworth Fellow at the University of Cambridge Department of Chemical Engineering and Biotechnology.

"Fortunately, the same enzymes used to detect COVID-19 can also detect malaria, typhoid and many other diseases. This powerful flexibility is why it is so important that key enabling tools for biotechnology are accessible, used and useful for all researchers around the world."

The toolkit has been made freely available under the Open Material Transfer Agreement (OpenMTA), which gives explicit permission for recipients to distribute to other labs and to use the toolkit for commercial purposes, and can be ordered online via Stanford University's Free Genes project.

Researchers and users of the toolkit are invited to share protocols, resources and advice via the Reclone Forum.

See news item on www.ceb.cam.ac.uk/free-genes. More general or press enquiries can be directed to info@reclone.org



Top-down view scanning electron microscopy image of perovskite grains conformally coating the micron-sized silicon pyramids that lie underneath © Stranks Lab

Novel analysis illuminates the crucial role of 'recycled' light in high-efficiency solar cells

Postdoctoral researcher and Marie Skłodowska-Curie Fellow, Dr Elizabeth Tennyson, is investigating how the front-surface texturing of multi-junction photovoltaics (PVs) can alter or tune the performance of perovskite/Si solar cells.

To reduce the price of electricity from solar PV and increase solar energy adoption, researchers are striving to hit the fundamental limits of our energy-harvesting capabilities. Currently, conventional silicon (Si) devices hold ~90% of the PV market and have a record power-conversion efficiency (η) of 26.7%. Competing against Si solar cells is unlikely, yet introducing higher η PV technologies may be the key for launching new types of solar cell materials commercially. Combining metal halide perovskite semiconductors (i.e. perovskites) with Si solar cells enables solar energy harvesting to go beyond the bounds of a single-junction Si device, towards a practical η threshold of 32%, and the current record is already at 28% for these devices. To reach the highly coveted 30%, light management, that is, how light travels within the solar cell materials, will play a role.

Briefly, perovskites are of great interest to the PV research community because this material class has tunable chemical, electrical and physical properties and is compatible with flexible substrates. Perovskites are of the chemical formula: ABX_3 and often contain an organic/inorganic cation in the A-site (methylammonium ($MA=CH_3NH_3$), formamidinium ($FA=HC(NH_2)_2$), or Cs), a metal cation in the B-site, and halide anion atoms in the X-site (e.g. iodine or bromine). Moreover, at the microscopic level, this material is composed of grains and grain interfaces, where the grain size is typically on the order of hundreds of nanometres, indicating their polycrystalline nature – see image above.

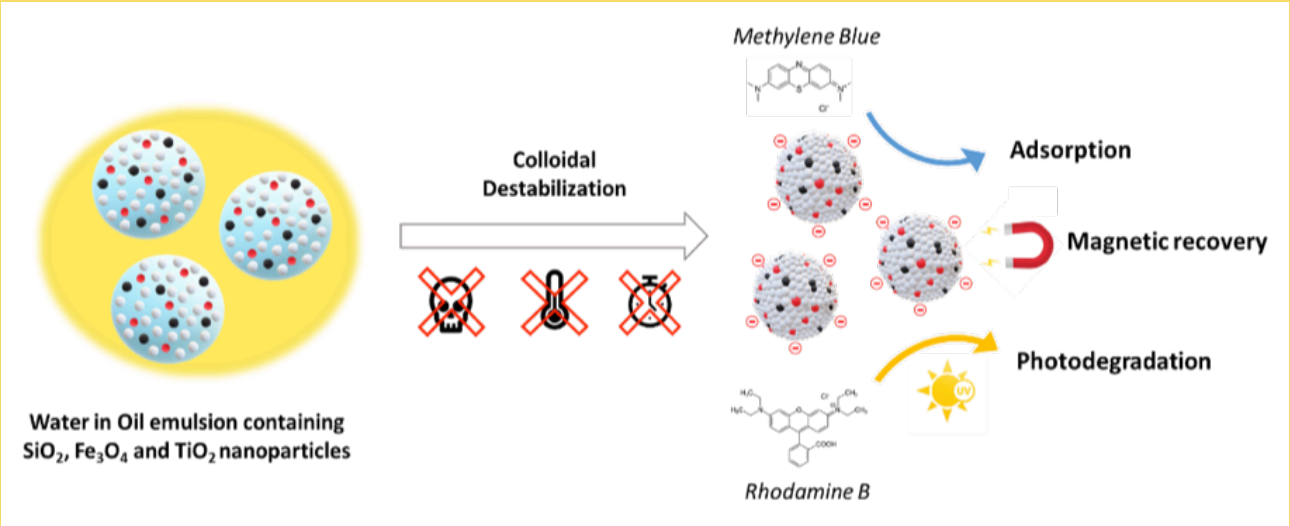
By leveraging the unique versatility of perovskites and including them as a top layer in tandem perovskite/c-Si PV devices, the η goes beyond that of single-junction Si solar cell. To date, the best Si solar cells consist of a square-based pyramidal architecture (~5 µm base width) designed to boost light absorption and minimise reflection. To uphold the excellent light management in the tandem perovskite/c-Si stack, the c-Si is conformally coated with the perovskite material (see image). However, existing light-management/texturing processes are optimised solely for c-Si. New texturing schemes in which photon management within perovskite and Si light-absorbing layers are holistically designed will lead to further device improvements by capturing or recycling emitted photons.

To understand how the texturing influences performance, we perform high spatial resolution microscopy techniques that collect the radiation from the perovskite layer when excited by an incident laser. The emitted light tells us about the local performance, and we find that the radiation is reliant on the local texturing, i.e. different radiation occurs at the valley than at the peaks of the pyramids. Ideally, a uniform radiation pattern is desired, therefore, to homogeneous the response, a new texturing design is likely required.

In my research, we are seeking to understand how texturing and performance are related to fabricating better solar cells.

More information on www.ceb.cam.ac.uk/news/novel-analysis-illuminates-crucial-role-recycled-light-solar-panels-and-leds

> *In my research, we are seeking to understand how texturing and performance are related to fabricate better solar cells.*



New method for the production of micron-sized magnetic photocatalysts from commercial nanoparticles © David Brossault

From commercial nanoparticles to multifunctional microparticles: a sustainable approach to produce magnetic photocatalysts

David F.F. Brossault, fourth year PhD student in the Colloidal Dispersions group of Professor A.F. Routh

Researchers from our Colloidal Dispersions group developed a new method for the production of magnetic photocatalysts, which would provide a green and feasible alternative for the production of structured functional materials.

Magnetic photocatalysts are composite systems comprising a semiconductor and a magnetic material. This dual nature has rendered such systems as effective candidates for degradation of organic pollutants from wastewater. These systems are traditionally prepared using sol-gel or solvothermal approaches where successive layers of chemical compounds are coated on a magnetic core. Such preparation methods present three major limitations: they are often time-consuming, they require high temperatures and toxic chemicals, and the need for sequential synthesis steps and heat treatment makes their implementation challenging.

Salt addition resulted in a decrease of the electrostatic repulsion between nanoparticles ($TiO_2/Fe_3O_4/SiO_2$), which organised into spherical microparticles. The use of nanoparticles as building blocks enabled the nanoparticles to easily combine magnetic, catalytic and adsorption properties in a single structure. The potential of such a system for water treatment was investigated with two model synthetic dyes, Rhodamine B and Methylene Blue. Photodegradation experiments carried out under UV-light irradiation confirmed that both dyes could be removed from solution in the presence of our beads, with Rhodamine B being photodegraded and Methylene Blue being mostly adsorbed. Furthermore, the microparticles could easily be recovered with a magnet and be reused for further treatments. Therefore, this method appears as a fast and cheap alternative for producing micron-sized magnetic photocatalysts from commercial nanoparticles without expensive equipment, toxic chemicals or high temperatures as usually reported.

Our research investigated the production of magnetic photocatalysts via a direct assembly of nanoparticles in aqueous droplets.

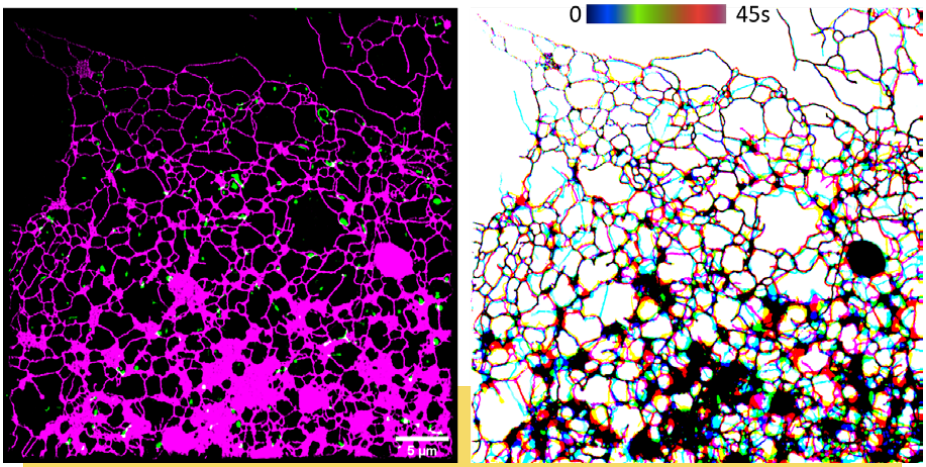
Check our David Brossault's work in the Colloidal Dispersions group on www.ceb.cam.ac.uk/directory/david-brossault

Source:

D.F.F. Brossault et al., J. Colloid Interface Sci., 2021, DOI: 10.1016/j.jcis.2020.10.001

High-speed super-resolution microscopy records the driving force of cellular protein factories

Researchers from CEB have identified the driving force behind a cellular process linked to neurodegenerative disorders such as Parkinson's and motor neurone disease.



Left: A representative image of ER network (magenta) and its close contact with lysosomes (green).

Right: Temporal colour coded image demonstrates the restructuring of ER network in the time window of super-resolution imaging; each colour indicates one frame.

In a study published last month in *Science Advances*, researchers from the Cambridge Department of Chemical Engineering and Biotechnology, show that tiny components within the cell are the biological engines behind effective protein production.

The endoplasmic reticulum (ER) is the cell's protein factory, producing and modifying the proteins needed to ensure healthy cell function. It is the cell's biggest organelle and exists in a web-like structure of tubes and sheets. The ER moves rapidly and constantly changes shape, extending across the cell to wherever it is needed at any given moment.

Using so-called super-resolution microscopy techniques, researchers from our Laser Analytics Group have discovered the driving force behind these movements – a breakthrough with significant impact in the study of neurodegenerative diseases.

"It has been known that the endoplasmic reticulum has a very dynamic structure – constantly stretching and extending its shape inside the cell," explains Dr Meng Lu, a research associate in the Laser Analytics Group, led by Professor Clemens Kaminski.

"The ER needs to be able to reach all places efficiently and quickly to perform essential housekeeping functions within the cell, whenever and wherever the need arises. Impairment of this capability is linked to diseases including Parkinson's, Alzheimer's, Huntington's and ALS. So far there has been limited understanding of how the ER achieves these rapid and fascinating changes in shape and how it responds to cellular stimuli."

Lu and colleagues discovered that another cell component holds the key – small structures, that look like tiny droplets contained in membranes, called lysosomes. Lysosomes can be thought of as the cell's recycling centres: they capture damaged proteins, breaking them down into their original building blocks so that they can be reused in the production of new proteins. Lysosomes also act as sensing centres – picking up on environmental cues and communicating these to other parts of the cell, which adapt accordingly. There can be up to 1,000 or so lysosomes zipping around the cell at any one time and with them, the ER appears to change its shape and location, in an apparently orchestrated fashion.

What astonished the Cambridge scientists was their discovery of a causal link between the movement of the tiny lysosomes within the cell and the reshaping process of the large ER network. "We could show that it is the movement of the lysosomes themselves that forces the ER to reshape in response to cellular stimuli," explains Lu.

From a biological point of view, this makes sense: The lysosomes act as a sensor inside the cell, and the ER as a response unit; co-ordinating their synchronous function is critical to cellular health.

To discover this surprising bond between two very different organelles, Kaminski's research team made use of new imaging technologies and machine learning algorithms, which gave them unprecedented insights into the inner workings of the cell.

'It is fascinating that we are now able to look inside living cells and see the marvellous speed and dynamics of the cellular machinery at such detail and in real-time," says Professor Clemens Kaminski. "Only a few years ago, watching organelles going about their business inside the cell would have been unthinkable."

The research group used illumination patterns projected onto living cells at high speed, and advanced computer algorithms to recover information on a scale more than one hundred times smaller than the width of a human hair. To capture such information at video rates has only recently become possible.

The authors also used machine learning algorithms to extract the structure and movement of the ER networks and lysosomes in an automated fashion from thousands of datasets.

The team extended their research to look at neurons or nerve cells – highly specialised cells with long protrusions called axons along which signals are transmitted. Axons are extremely thin tubular structures and it was not known how the movement of the very large ER network is orchestrated inside these structures.

The work by Lu and team explains how: lysosomes travel easily along the axons and pull the ER along behind them. The researchers also show how impairing this process is detrimental to the development of growing neurons.

Fascinatingly, the researchers frequently saw events in their images where the lysosomes act as repair engines for disconnected or broken pieces of ER structure, merging and fusing them into an intact network again. The work is thus highly relevant for an understanding of disorders of the nervous system and its repair.

The team also studied the biological significance of this coupled movement, providing a stimulus – in this case, nutrients – for the lysosomes to sense. The lysosomes were seen to move towards this signal, pulling the ER network behind so that the cell can elicit a suitable response.

"So far, little was known on the regulation of ER structure in response to metabolic signals," says Lu. "Our research provides a link between lysosomes as sensors units that actively steer the local ER response."

The team hopes that their insights will prove invaluable to those studying links between disease and cellular response, and their own next steps are focused on studying ER function and dysfunction in diseases such as Parkinson's and Alzheimer's. Neurodegenerative disorders are associated with aggregation of damaged and misfolded proteins, so understanding the underlying mechanisms of ER function is critical to research into their treatment and prevention.

"The discoveries of the ER and lysosomes were awarded the Nobel Prize many years ago – they are key organelles essential for healthy cellular function," says Kaminski. "It is fascinating to think that there is still so much to learn about this system, which is incredibly important to fundamental biomedical science looking to find the cause and cures of these devastating diseases."

More on www.ceb.cam.ac.uk/news/superresolution-microscopy-driving-force-protein-factories. You can also read the full paper, published in *Science Advances*: Meng Lu et al. 'The structure and global distribution ofthe endoplasmic reticulum network is actively regulated by lysosomes.' Science Advances (2020). DOI: 10.1126/sciadv.abc7209

Regenerative agriculture: can we get there soon please?

Dr Ljiljana Fruk, Lecturer and Bionano Engineering Group PI

Dr Fruk in her family's vineyard during last season's grape picking. © Ljiljana Fruk

Increasing population and consumption are placing unprecedented demands on natural resources, and the key challenge that needs to be immediately addressed is how to feed everyone whilst maintaining a healthy ecosystem. This challenge can be resolved by coordinated management of soil, water and vegetation, and an introduction of innovative technologies and scientifically backed-up strategies to current agricultural practices and food processing.

Redefining agriculture does not only mean changing the agricultural practices and debunking myths, but also making sure that we apply the 'reuse and manage' policies to agricultural waste and create climate-friendly food production systems and factories, whilst removing the need for soil enhancement and preserving environmental integrity.

Agricultural practices account for just under 25% of all greenhouse gas emissions from human activities, and they continue to have a huge impact on biodiversity, water usage and general pollution. Just think about all the reports you have heard of rainforests being cut down to create more space for farming and growing monocultures of soya or palm trees. However, we do not need to go far from home to find the things that are not going that well; even in Europe, where the preservation of biodiversity is more highly regulated, we encounter unsustainable farming practices.

So, what exactly is regenerative agriculture? Although there is still some discussion on its real definition[1], the best description would be that regenerative agriculture is a system of farming principles that increases biodiversity, enriches soil, improves watershed and enhances ecosystem health, all while being climate-friendly. Rather than inventing something radically different, regenerative agriculture looks at the problem holistically and makes use of science and technology to improve farming practices.

In fact, it is a science-based concept that uses the knowledge we have accumulated over the decades. For example, conservation tillage is encouraged to avoid degradation and damage of soil caused by conventional ploughing and tillage. To promote the benefits of such practices, the research of the root biome and the importance of the microorganisms living in synergy with crops will play a significant role in the years to come. Some farmers are also introducing diversity to their crops and having more crop cycles to enrich the fields without adding a large amount of artificial fertilisers.

Such increased crop diversity has already been shown to prevent diseases and pest issues. The use of fertilisers and chemical treatments of the crops and animals has significantly decreased without neglecting the science. Rather than refusing innovation, regenerative agriculture embraces it, and it weaves the science into its core. And this is one of the main reasons why it is being supported by different stakeholders, not only the farmers, and why I believe it is here to stay, and further efforts need to be made to promote it at all levels.

The idea of regenerative agriculture links well with international efforts to create climate-friendly agricultural practices, enabling growth whilst avoiding damaging environmental side-effects. It has already been embraced by the EU: for example, the latest efforts are aimed at promoting research and practices that can improve soil health[2]. In addition, the Engineering and Physical Sciences Research Council (EPSRC) has recently initiated a survey aimed at canvassing the research and innovation space for net zero agriculture.

These initiatives, together with numerous platforms concerning food production and consumption and the recent pandemic-driven challenges of food security and waste, clearly indicate the timeliness and importance of the wider action, which would also benefit from CEB engagement.

CEB has recently submitted an outline proposal for redefining agriculture to the University's Cambridge Zero initiative, which I am planning to refine further, and build up a critical mass of scientists from a wider range of backgrounds to help tackle the issues of sustainable agriculture practices. Join me in the discussion and stay tuned for more to come. To learn more about some of the current EU projects on regenerative agriculture see

www.cordis.europa.eu/article/id/117838-regenerative-agriculture-in-the-interests-of-more-fertile-pastures-offering-greater-plant-bio/es

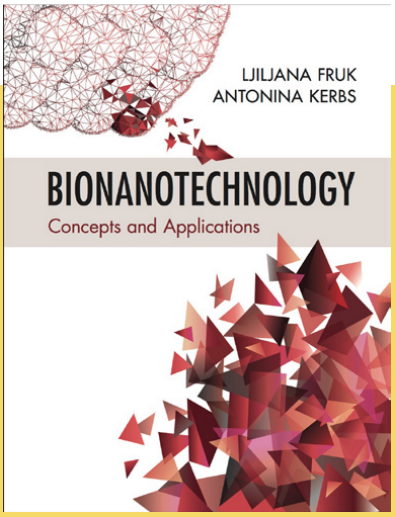
References:

[1] Newton, P., Civita, N., Frankel-Goldwater, L., Bartel, K. and Johns, C. (2020). What is Regenerative Agriculture? A Review of Scholar and Practitioner Definitions Based on Processes and Outcomes. Frontiers in Sustainable Food Systems 4, articles 577723 (www.frontiersin.org/articles/10.3389/fsufs.2020.577723/full)

[2] www.ec.europa.eu/info/news/healthy-agricultural-soils-24-eu-countries-coordinate-unprecedented-research-programme-2020-feb-26_en

A textbook for inquisitive, interdisciplinary minds: Dr Ljiljana Fruk publishes new bionanotechnology tome

Book authors Dr Ljiljana Fruk (centre) and former postdoctoral researcher Dr Tonya Kerbs (right) with illustrator Dr Nan Li (left). Photo taken pre-COVID-19 © Ljiljana Fruk



Textbook front cover © Cambridge University Press

We are pleased to announce the publication of a textbook authored by Dr Ljiljana Fruk, head of our BioNano Engineering group, and our former postdoctoral researcher, Dr Tonya Kerbs, now a research scientist at Milteny Biotec. The book 'Bionanotechnology: Concepts and Applications' includes over 200 detailed, full colour illustrations designed with the help of another former CEB postdoc, Dr Nan Li, who has been working with Ljiljana to develop the original figures and has been crucial in guiding the 'graphical look' of the book. The book has already been described as the 'first ever textbook to equip students with a comprehensive knowledge of the key concepts in bionanotechnology'. Published by Cambridge University Press (CUP), the book is hitting online stores and physical bookshops this January.

The textbook is a timely edition, coming out at a moment when Pfizer and BioNTech have already announced the production of an efficient vaccine designed with the help of lipid structures. Liposomes, nanoparticles made of cell-membrane components, similar to the lipid particles, have been around for more than 20 years and have already found applications as nanocarriers for chemotherapeutics. The book describes these nanostructures, as well as other types of nanomaterials, covering diverse aspects of bionanotechnology, such as DNA nanostructuring and nanomaterial biofunctionalisation, as well as bioinspired nanotechnology and the design of nanosensors. It is written in such a way to be accessible to students from a wide variety of backgrounds, with features such as 'Back to Basics' and 'Research Report' boxes to enable readers to build a strong theoretical knowledge and revise the basic concepts whilst applying them directly to current research.

"I have been thinking about writing this book for several years, prompted by the interest of students from various backgrounds and researchers working in the field, which is very interdisciplinary, and it is easy to lose the track of all of the concepts," said Dr Fruk.

"After several years teaching I have finally decided to jump into it. Good that I did, as I did not know what it entails to write a textbook! I had moments during the writing process when I thought the book will never be finished. I also had moments when, after writing a whole chapter, I'd just realise a few days later that the way I had structured it would just not work, and I'd have to start writing it again. Tonya was getting crazy with constant requests to check yet another publication.

"After three years of planning and one and a half years of intense writing, I can say that I have totally enjoyed the process, particularly working with Tonya and Nan. We had some Saturday late-night sessions tweaking the tiny details of the figures just to get them right, and I feel it was worth it. I am also very happy that we insisted on working on the cover page until it really looked the way we thought it should. Writing this book was definitely an exercise in perseverance, but it was also a very creative and fulfilling process fully supported by Cambridge University Press (CUP) team and our editor Katrina Halliday. I definitely recommend putting a book together but would suggest finding a good team to support you when you get stuck. I absolutely had that."

A series of video blogs covering different aspects of the book are also being produced along with bionano chocolate to 'sweeten' the book reading. More info on the book and ordering via CUP on

www.cambridge.org/highereducation/books/bionanotechnology/5598FC43FBA3B70DDF1602DEDAF03E02 as well as other online book sellers and independent bookstores www.bookshop.org

'Sling Health' biotechnology incubator: a Cambridge chapter

Aadit Shah, Master in Bioscience Enterprise (MBE) 2020-2021 student and leader of Sling Health®

Sling Health® is "a national network of medical technology incubators providing experiential training for the next generation of medical entrepreneurs and enabling the creation of innovative technologies for pressing clinical needs".

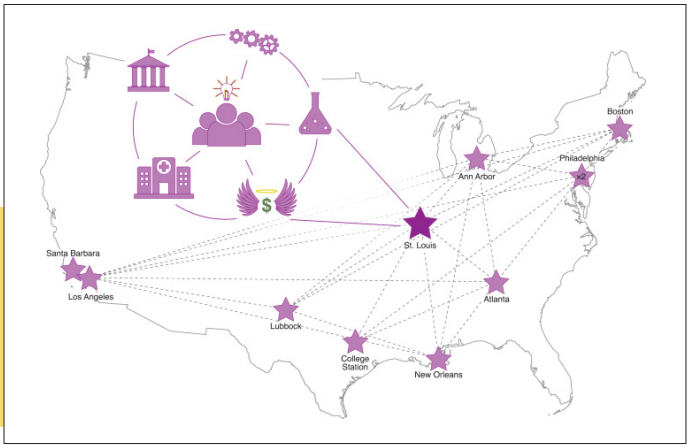


Figure1. Map: Sling Health helps to coalesce medical, engineering, scientific, legal, and entrepreneurial or business resources available at universities into a medical entrepreneurial community to support student innovation. Sling Health further connects these separate communities at different institutions across the country into a cohesive network. There are currently 11 chapters involving 15 universities in the United States. Active chapter sites include St. Louis, Boston, Philadelphia, and Los Angeles. © Sling Health

Trainees at universities often have big ideas, motivation, and the time needed to improve healthcare in meaningful ways. While there are a plethora of medical problems needing better solutions and trainees eager to engage, the lack of funding, mentorship, and experience are considerable barriers to entry for student-innovators. Furthermore, the experiential, multidisciplinary, and fluid nature of medical innovation is not conducive to the faculty-driven, classwork-based structure of traditional academic courses.

In 2013, Sling Health, formerly known as IDEA Labs, started in St. Louis as a student-led medical technology incubator to overcome these challenges and enable trainees to go beyond learning the current state of healthcare and, instead, start advancing the field.[1]

In a recent publication in Nature Biotechnology, the multi-university, chapter-based structure and national impact of Sling Health over its first seven years is described.

I currently lead Sling Health which supports more than 250 students across 11 cities and 15 institutions in the US annually. In partnership with the American Medical Association, the organisation has incubated more than 120 student teams, generated more than$18 million in follow-on funding, and produced technologies that have interfaced with over 80,000 patients in clinical trials.

A crux of the program is a collaboration amongst students from diverse technical backgrounds, including engineering, medicine, business, and design. Paired with a rich biotechnology ecosystem, such an environment of interdisciplinary engagement across the boundaries of academia and industry has led to the most successful Sling Health chapters. As such, the University of Cambridge is incredibly well-suited as the next site for Sling Health.

If you are interested in learning more about Sling Health[2] or supporting the efforts of founding Cambridge's chapter, reach out to me on aadit@slinghealth.org

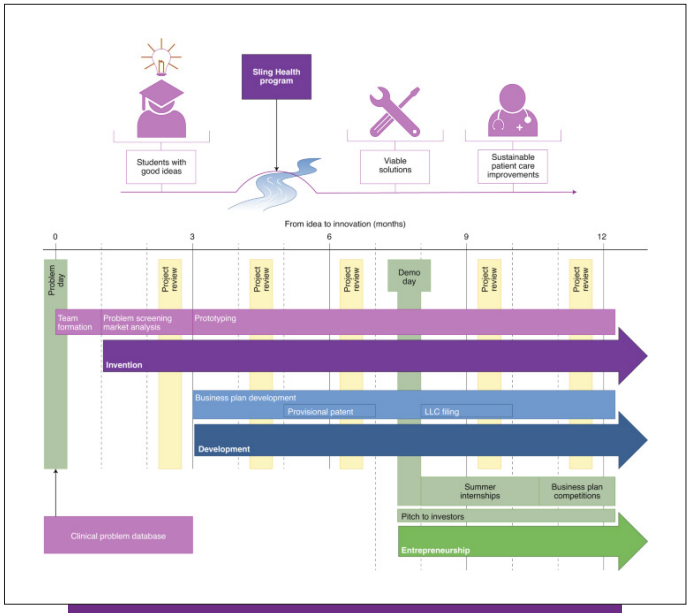


Figure 2. Timeline: Teams follow an entrepreneurial curriculum within the Sling Health programme, leading teams from problem identification through to launching a start-up or company. © Sling Health

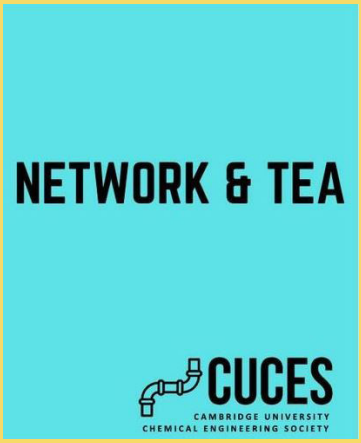
References:

[1] Linderman, S.W., Appukutty, A.J., Russo, M.V., Shah, A.P., & Javaherian, K. Advancing healthcare technology education and innovation in academia. Nat Biotechnol 38, 1213–1217 (2020). https://doi.org/10.1038/s41587-020-0689-7

[2] Sling Health www.slinghealth.org

'Network and Tea' sessions organised by CUCES

Arwa Omran, Cambridge University Chemical Engineering Society (CUCES) Careers Officer



'Network and Tea' sessions are being organised by CUCES to link CEB students with company representatives © CUCES

Since many summer internships were cancelled due to the coronavirus pandemic, the rest of the CUCES committee and I decided to create a new initiative over the summer, which would allow students to informally interact with company representatives.

Consequently, we organised weekly 'Network & Tea' virtual sessions. This enabled students to form professional connections and mentorships with representatives from a wide range of companies, such as BP, GSK and P&G. Most of these representatives were ex-Cambridge Chemical Engineering students, so were very helpful in tailoring their advice to current students.

In the one-hour video call, students gained insight from these industry experts by asking questions about the typical day-to-day work, application processes, as well as having a general chat about career aspirations. Students were then given the opportunity to maintain contact with the presenter on LinkedIn or via email if they wished to do so. In order to attract as many students as possible to attend, we ensured that the seven companies that we hosted ranged from start-ups to well-established firms, as well as from consulting to pharmaceuticals. We aim to continue this initiative every summer to give students a clearer idea on what companies they're interested in, and allow them to network with ex-Cambridge Chemical Engineering students.

Any company reps interested in taking part in these please contact CUCES on chengsoc@hermes.cam.ac.uk

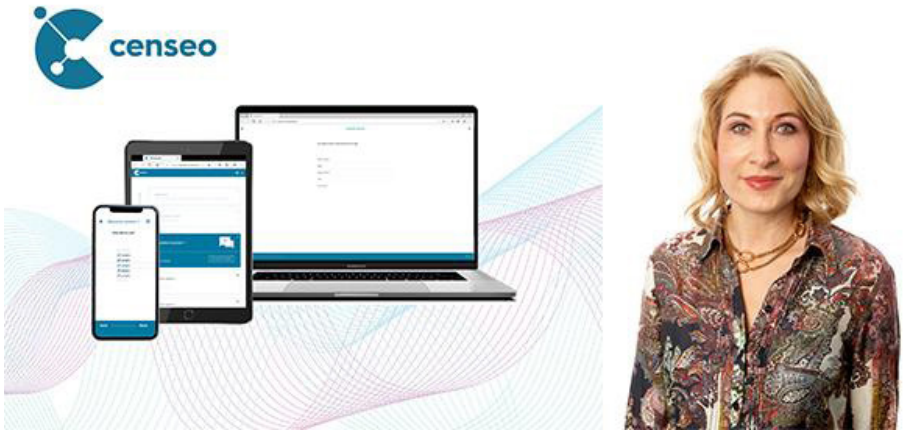
Psyomics secures £1.5m funding to transform mental health diagnosis in the UK

Psyomics Ltd, a UK-based healthtech and University of Cambridge spin-out, has closed a £1.5 million funding round from existing and new investors to bring its mental health assessment and diagnosis platform, Censeo, to market in the UK. University spinout specialists Parkwalk, led the round, joined by fellow existing investors Jonathan Milner, Martlet, and Cambridge Enterprise.

Psyomics was co-founded by CEB's Professor Sabine Bahn, and Daniel Cowell, former COO of Horizon Discovery.

Drawing on twenty years of deep psychiatric and psychological expertise, as well as a significant clinical trial, Psyomics' digital diagnostic platform, Censeo, mirrors the rich process of a face-to-face psychiatric assessment, guiding a user through a series of adaptive questions. Smart algorithms perform a detailed and bespoke analysis, creating a 'map' of an individual's mental health, providing diagnosis where appropriate and enabling a clear treatment pathway. Censeo supports GPs and clinicians in getting patients to the right level of support at the outset and provides patients with a stigma-free way to start addressing their mental health concerns.

"Diagnosing mental health issues correctly in primary care can be difficult, due to time constraints and the fact that mental health conditions can be masked by physical symptoms," says Psyomics' Chief Medical Officer, Professor Sabine Bahn. "Delays in diagnosing – or misdiagnosis – mean that it can take several years for an individual with depression to be correctly diagnosed. For bi-polar disorder the average delay is six to eight years. The consequence of this is that many people suffer unnecessarily from debilitating symptoms that could be successfully treated. It is clear that faster and earlier diagnosis, followed by the most appropriate treatment, will improve the quality of life of affected individuals, while at the same time relieving pressure on the healthcare system".



Psyomics Ltd, a UK-based healthtech and University of Cambridge spin-out, co-founded by CEB's Professor Sabine Bahn, has closed a £1.5 million funding round from existing and new investors to bring its mental health assessment and diagnosis platform, Censeo, to market in the UK. © Psyomics

"This funding will enable Psyomics to support the UK's plans to improve mental health provisions for the nation," adds Psyomics CEO, Dan Cowell. "Through giving patients, clinicians, and caregivers an earlier and clearer understanding of individual mental health needs, we believe we can make significant improvements in patient experience and clinical capacity, with positive impacts throughout the entire healthcare system. Our investors share our belief in the opportunity to make a genuine impact with Censeo."

Martin Glen, Investment Director at Parkwalk, says: "Covid-19 has accelerated adoption of digital tools for a wide range of applications, and Psyomics' clinical and tech-led diagnostic tool can transform mental health diagnosis. We have always felt that what sets Psyomics apart is its deep clinical roots/knowledge. We are pleased to be a part of this next funding round and look forward to seeing Psyomics continue to grow with its market-ready product".

Multi-million pound research centre in AI to spark digital revolution in chemical industry

The Innovation Centre in Digital Molecular Technologies (iDMT) is a newly planned multimillion-pound research centre that aims to accelerate access to pharmaceuticals, agrochemicals, functional molecules and molecular materials through machine learning and robotics-based synthesis.

Professor Alexei Lapkin who leads the Sustainable Reaction Engineering (SRE) group here at CEB will be Director of the iDMT, which is also part-funded by the European Regional Development Fund and will be housed in University of Cambridge Department of Chemistry.

In partnership with pharmaceutical companies AstraZeneca and Shionogi, the iDMT will set up a new experimental research facility, integrating high-throughput synthesis, analytics, chemical informatics, machine learning, robotics and reaction engineering.

"Access to novel functional molecules and materials continues to be a major bottleneck in many chemistry-using industries, such as medicine, food, electronics and energy," says Professor Alexei Lapkin. Professor Matthew Gaunt, co-director of iDMT and Director of the EPSRC SynTech centre for doctoral training further adds, "despite tremendous advances in chemistry, we still cannot always make all of the molecules we need on demand, especially when set against increasingly competitive business-driven timelines, and this means that we often miss out on many potential opportunities to, for example, develop new medicines."

Professor Alexei Lapkin, Director of iDMT © Alexei Lapkin

The Innovation Centre in Digital Molecular Technologies (iDMT) © I-DMT

iDMT Innovation Centre in Digital Molecular Technologies

Digitalisation of discovery research, development and manufacturing of molecules and materials offers a much-needed step-change towards a new model of industry, where access to molecules will be faster, less resource intensive and without negative consequences for the environment.

However, one of the barriers to digitalisation of the chemical industry is the absence of a central location with the research infrastructure and multi-disciplinary intellectual capital to support providers to develop the necessary commercial, technical and software solutions. To this end, the iDMT will support collaborative research projects with small and medium enterprises (SMEs) from across the UK, aiming to develop a technology base to support the emerging digital economy in the 3rd largest manufacturing sector in the UK. It will support SMEs in developing their understanding of new digital tools and processes in making molecules, and enable them to develop solutions to some of the key challenges facing larger, end-user companies in the pharmaceutical and wider chemical manufacturing sectors.

Notably, the iDMT will support collaborative research projects involving academic and industrial researchers in three key areas:

- Acceleration of synthesis through AI and automation
- Equipment for robotic experiments
- Algorithms and tools for digital process development

Construction of the facility is due to begin shortly, but the centre is already open for projects.

Interested companies should contact Professor Alexei Lapkin for further information: www.ceb.cam.ac.uk/directory/alexei-lapkin

Chrysanthi-Maria (Anthie) Moysidou, postdoctoral research associate in the Bioelectronics Systems Group © Chrysanthi-Maria Moysidou

Dr Jenny Molloy, Shuttleworth Fellow and Director of the Open Bioeconomy Lab © Jenny Molloy

Anthie Moysidou 'highly commended' in Outstanding Student Contribution to Education Awards (OSCEA) 2020

Chrysanthi-Maria Moysidou, known as Anthie amongst her peers, is a postdoctoral research associate in the Bioelectronics Systems Group and an avid yoga instructor in the Department of Chemical Engineering and Biotechnology. During her tenure as a PhD student in CEB and a graduate member of Newnham College, she was, and continues to be a tremendous asset to the department, primarily for outreach and peer support during lockdown.

In 2020, Anthie was 'Highly Commended' in the 'Access and Outreach' category of the Outstanding Student Contribution to Education Awards (OSCEA), instituted by the Cambridge Centre for Teaching and Learning. These annual awards are bestowed to recognize the voluntary efforts of students who have made a significant positive impact on the educational experience at Cambridge.

Anthie is a regular contributor to the Cambridge Science Festival, with presentations and activities for children and she has been instrumental in organising events for World Microbiome Day for the past two years. In 2020, the event for the 3rd World Microbiome Day was organised virtually with a stellar line-up of speakers such as scientists Dr Giles Yeo and Dr Anne Neville, and culinary and fermentation pioneers David Zilber and Tvrtko Šakota.

Going beyond the realms of outreach within the department, Anthie has been active in going to schools around the UK with the Newnham Schools Liaison Officer. In the last year she has delivered taster academic sessions to students of various ages from visiting schools, given a lecture for Year 12 residential students and visited schools to talk about her research and her experiences as a PhD student. According to the Principal of Newnham College, Alison Rose, "Anthie is always keen to be involved and very reliable, so we're really grateful to have her help with Newnham's outreach projects".

Source:

www.cctl.cam.ac.uk/oscea/winners-2020/anthie-moysidou

Dr Jenny Molloy named Fellow of the World Economic Forum's Global Future Council on Synthetic Biology

Dr Jenny Molloy is the founding director of the Open Bioeconomy Lab. She is also a Shuttleworth Foundation Research Fellow in our department. Her research focuses on understanding the barriers to access of biological tools in low-resource environments, developing new technologies for local enzyme production and building capacity for biological research through open-source tools. She is also the founder of several non-profit organisations, including the Global Open Science Hardware Community (GOSH), Beneficial Bio Ltd. and the Cambridge Biomakespace.

Molloy was appointed as a fellow member to the Global Future Council on Synthetic Biology, among 23 others for next year. Established by the World Economic Forum (WEF), the Global Future Councils (GFC) are an interdisciplinary network of leaders from academia, government, international organisations, business and civil societies.

Grouped into thematic councils, their aims include identifying the latest trends in research, contributing expert knowledge to advise decision makers, WEF initiatives and deepening our understanding of how emerging technologies can be leveraged to address global, regional and industry issues. GFC Fellows are scholars at leading universities who play a crucial role in councils by being responsible for capturing, synthesising and disseminating knowledge and insights from the councils' deliberations. The long-term goal of the council is to "develop a narrative of the ideal future states of synthetic biology and a roadmap to ethically realising those visions".

"This is a great opportunity to engage with a diverse, multisectoral group of thought leaders to address the huge barriers to equitable, global participation in a bioeconomy underpinned by synthetic biology", says Molloy. "I hope the Global Future Council will be a venue for deep and critical thinking on how to transition to a more inclusive future where synthetic biology generates public good". Molloy also added that some of the emerging themes for the upcoming year include building a new narrative and vision for the future of synthetic biology, centering equity, sustainability, solidarity and humility.

For more information on the Global Future Council on Synthetic Biology, visit www.weforum.org/communities/gfc-on-synthetic-biology

Source: www.ceb.cam.ac.uk/news/dr-jenny-molloy-named-fellow-world-economic-forums-global-future-council-synthetic-biology

CEB entrepreneur Lorena Gordillo-Dagallier shines at climate tech competition with air pollution sensor network

Lorena, a third year PhD student of the Sensor CDT programme © Lorena Gordillo-Dagallier

Lorena Gordillo-Dagallier is a third year PhD student with our Centre for Doctoral Training in Sensor Technologies (Sensor CDT) in the laboratory of Professor Lisa Hall, and her research focuses on improving paper diagnostic technologies using printed biosensors with paper-binding enzymes. She is one of three winners of the Women4Climate Tech Challenge, awarded last year. As a winner, she has the opportunity to pilot community-driven air quality monitoring project, open-seneca, in Lisbon and Stockholm, with full support and funding.

Open-seneca is an initiative working to highlight and install mobile air quality sensor networks throughout cities. The project evolved from the team challenge of Gordillo-Dagallier's Sensor CDT cohort, and is run by a team of six students who work on the project in their spare time, around their PhDs. The other team members are Peter Pedersen, Christoph Franck, Charles Christensen, Sebastian Horstmann and Raphaël Jacquat. The mobile sensor network takes a unique approach in involving 'citizen scientists' to capture and record air pollution data across the city. With small sensors that can be attached to pedal bikes, motorbikes and scooters, as well as cars, the volunteers are able to easily track pollution levels as they go about their day-to-day lives. The aim of the initiative is to raise awareness within communities about personal exposure to particulate pollution while creating pollution maps that can be used to inform policy and urban development. In addition to providing sensors, the initiative also aims to educate communities through a series of practical workshops in the hope to drive behavioural change and change attitudes.

"We all hear every day about the problems of air pollution and climate change", says Gordillo-Dagallier. "However, most people do not see it as a personal issue and there is a lack of motivation for change. I used to be one of them. But now I am aware, and I want to raise awareness around me". Open-seneca has already established pilot projects in Nairobi, Kenya, and Buenos Aires, Argentina, with the help of local and government bodies. The project is particularly powerful in places where there is currently no air quality mapping infrastructure.

As the sensor networks have been active throughout 2020, the project has also been able to monitor the impact of city lockdowns, introduced to control the spread of COVID-19, on air pollution. "It's interesting because we can see how the changes in lockdown measures in the city and on transport have improved air pollution in certain areas", says Gordillo-Dagallier. The data from the projects has the potential to inform so-called 'green recovery' policies looking to ensure any environmental benefits caused by COVID-19 lockdowns can continue as restrictions are lifted.

The Women4Climate Tech Challenge is a joint initiative from the VELUX Group and C40, alongside four C40 host cities: Lisbon, Los Angeles, Stockholm and Tel Aviv-Yafo. Its main aim is to support and promote diversity and inclusion in technology, innovation and the built environment sectors. Following pitches from the ten finalists, each of the four cities could choose a project to support and pilot. Both Lisbon and Stockholm chose to work with Gordillo-Dagallier. Gordillo-Dagallier and the other successful entrepreneurs will now see their innovations brought to life in their host cities, with $50,000 in funding to be split amongst the winning projects and used to support their experimental phase in each city.

"It was a very rewarding experience to get to work with other finalists in preparation for the final pitch and see everyone deliver such inspiring pitches", said Gordillo-Dagallier. "I thank the C40 Women4Climate team for bringing us together and all the support we've received over these past months. Having open-seneca as one of the winning projects of the C40 W4C Tech Challenge 2020 has only been possible thanks to our very passionate team and all the support received from the university, especially the Sensor CDT, the Centre for Global Equality, and our partners all over the world. Thank you to you all".

For more information about the project, visit open-seneca.org

Source: www.ceb.cam.ac.uk/women-4-climate-tech-challenge

Lorena Gordillo-Dagallier (third from left) with members of the Nairobi Makerspace open-seneca team in July 2019 (pre-COVID-19) © open-seneca

Helen Schofield, a recent Chemical Engineering graduate © Helen Schofield

CEB student Helen Schofield receives Salters' Institute Graduate Award 2020

Student Helen Schofield, who graduated from our Chemical Engineering degree last summer, has been awarded the Salters' Institute Graduate Award for 2020. Awarded annually, the prizes are based on an "assessment of the potential of candidates ultimately to occupy leading positions in public life, either by employment in the chemical or related industries, or more generally in employment that supports the industrial life of the UK". Helen is one of five winners in 2020 from across the UK.

"It was a privilege to be nominated for the Salters' Graduate Award by CEB and I am thrilled to have been selected as a recipient", says Helen. "My time as an undergraduate at CEB challenged me greatly, however the diversity of the course has given me a good understanding in many key areas, whilst notably improving my ability to problem solve. Undoubtedly, this will be pivotal as I begin my career in industry as a Contact Engineer in the Chemicals division at ExxonMobil. I would like to take this opportunity to thank those who nominated me, and my supervisors and peers who supported me throughout my degree".

Source:

www.ceb.cam.ac.uk/news/helen-schofield-awarded-salters-institute-graduate-prize

Postdoctoral Research Associate Leander Crocker wins prestigious Robin Paul Research Prize

Leander Crocker, Postdoctoral Research Associate in the BioNano Engineering research group, has been awarded the prestigious Robin Paul Research Prize for his work on developing enzyme-inspired sustainable catalysts such as flavin compounds. The research prize was recently launched to honour the late Dr Robin Paul, Chemical Engineering alumnus and good friend of the Department, whose efforts kick-started fundraising for the new CEB building in West Cambridge. The prize aims to recognise research papers that demonstrate scientific excellence, and significant advancement in scientific understanding, amongst other factors.

Leander's research adopts a novel approach in improving the long-term photostability of flavin compounds whilst maintaining biocompatibility by embedding them within a nanostructured polymer system. This is especially promising given that flavin compounds are industrially relevant sustainable catalysts that are easily synthesisable, non-toxic and able to utilise a limitless power source – light. Leander adds, "Our approach therefore extends the current strategies of flavin catalysis and could be more widely applied to the synthetic photocatalysis community to improve the stability and activity of other photocatalysts".

On receiving the award, Leander said, "I was very honoured to receive the award and felt proud that our work is worthy of such recognition. I am truly grateful for such a supportive mentor and team around me. The prize has further encouraged the lab and me to continue developing this work in order to provide more impactful contributions to sustainable chemistry".

Source: www.ceb.cam.ac.uk/news/news-list/robin-paul-research-prize-2020

www.ceb.cam.ac.uk/directory/leander-crocker

Leander Crocker, a postdoctoral research associate at CEB © Leander Crocker

Dr Ipshita Mandal-Johnson's journey in global bioinnovation

Dr Ipshita Mandal-Johnson works at the intersection of biotechnology, innovation and impact, seeking to support the planet and people before profit through the Global Bio Fund.

Mandal-Johnson has worked in seven countries over the last 15 years, working with research institutions, startups and established companies in biotechnology, pharmaceuticals, technology and financial services. She has been featured in Nasdaq, Nature Careers and The Economist Intelligence Unit and spoken at events for Foreign Policy, the Global BioEconomy Summit, BioBeat and SynBioBeta, amongst others.

Mandal-Johnson currently sits on the boards of Global Engineering Futures and Chiasma NZ and is a visiting lecturer at the Harvard School of Public Health. She has received multiple awards including the McKinsey Founders Award and St Gallen Leader of Tomorrow, and has been listed in the 50 Movers and Shakers in Bio Business three times, as well as an inaugural '40 under 40' for the University of Auckland. She completed her PhD at CEB with Professor Nigel Slater. Below, Mandal-Johnson shares her thoughts and experiences on working in global bioinnovation.

My PhD was fully-funded with scholarships from the Engineering and Physical Sciences Research Council and the Prince of Wales Cambridge Commonwealth Trust. My research involved developing microcapillary film membranes for high throughput purification of biomolecules for applications in biomanufacturing and wastewater treatment. With my research colleagues, I also participated in i-Teams, a Cambridge programme that combines multi-disciplinary teams of students with industry mentors and real University inventions to assess the commercial viability of new technologies and product designs. We were one of the winning teams in the Cambridge University Entrepreneurs category with Purit Technologies. During my time at CEB I was also an active member of the CEB Focus Editorial Team and represented the department at the University Graduate Council.

Along with my PhD I co-founded Global Biotech Revolution C.I.C with my lab colleague, Christian Guyader. Its flagship event, the GapSummit, is the world's first inter-generational platform in the bio-economy (healthcare, agriculture, food, energy and industrial biotechnology). Over the years the annual GapSummits have brought together 600 competitively selected 'Leaders of Tomorrow' from 72 countries to debate with over 300 'Leaders of Today' from industry, academia, and governments. To date, over 120 venture ideas have launched from the 'Voices of Tomorrow' competition and 18 of our alumni have started companies. The initiative has been supported by more than 70 organisations including the WHO, UN, Nature, the BBC, BIO, Facebook and Johnson and Johnson.

The experience from my PhD and co-founding Global Biotech Revolution supported me joining Bactevo (later renamed as Nanna Therapeutics) at an early stage as its 3rd employee. There, I built its market strategy, built relationships with tech investors and commercial partners, and managed R&D programmes with Innovate UK and pharmaceutical companies. In 2020, Nanna Therapeutics was acquired by the Japanese pharmaceutical company, Astellas, with payments overtime up to £80 million. Working in the private sector, I also worked with multiple technology and pharmaceutical clients with the strategy consulting firm, McKinsey and Company. Some of the highlights of my work included working with the government of India, co-managing 'Digital India 2.0' project with senior government leaders in six ministries. Another highlight was coordinating a merger and acquisition of one the leading pharmaceutical companies to deliver multi-billion synergy benefits.

CEB alumna Dr Ipshita Mandal-Johnson speaking at the Judge Business School Startup Finance Academy © Ipshita Mandal-Johnson

In 2020, I co-founded Global Bio Fund with the mission of solving sustainability and development challenges through bioinnovation. The organisation conducts research, advises growth stage companies and builds ventures focused on diverse teams with underrepresented founders, addressing global challenges in healthcare, food sustainability and climate change. Our partnership team and advisors network has over 300 years of combined experience, and we are working with the Global Fund, Draper Esprit, Harvard University, USAID amongst others.

Source: [1] www.globalbiofund.org

Five years of cross-cultural collaboration for CARES students: graduates from the Cambridge Centre for Advanced Research and Education in Singapore share their experiences

Louise Renwick, CARES Communications Executive

The Cambridge Centre for Advanced Research and Education in Singapore is funded by the National Research Foundation, Prime Minister's Office, Singapore, under its Campus for Research Excellence and Technological Enterprise (CREATE) programme.

Since 2015, PhD students at the Department of Chemical Engineering and Biotechnology have been taking advantage of global teaching and research expertise through the Cambridge-CARES studentship scheme.

This programme was set up to support international collaboration in the area of decarbonisation research and allows students to spend a year in Cambridge before continuing their study at the Cambridge Centre for Advanced Research and Education in Singapore (CARES).

The programme has come a long way since the very first students arrived in Singapore, with several having now graduated and a new cohort due to start their time in Singapore as soon as travel restrictions ease. Here, three 2020 graduates share their experiences of the Cambridge-CARES studentship scheme.

Astrid Boje © Astrid Boje

Astrid Boje

My PhD was about developing computational methods to model the formation of nanoparticles in flames. The process I studied was the synthesis of pigmentary titanium dioxide, an important commodity chemical that is responsible for the white colour in paints among other applications.

Spending time with the Cambridge Computational Modelling group and the CARES team in Singapore provided access to two research groups and facilities including high performance computing resources and libraries. Other highlights from my time in Singapore were exposure to life in a new city and the opportunity to travel in southeast Asia, the delicious and varied food and the warm weather!

Working with an industrial partner provided valuable insight into the process and challenges posed under the industrially relevant conditions. I also benefitted from ideas from visiting scientists at CARES when developing a new approach to overcome numerical challenges in my simulations.

I am now a postdoc in chemical physics at Chalmers University of Technology in Gothenburg, Sweden. I am studying reaction kinetics in heterogeneous catalysis with applications including CO oxidation and sustainable alternatives to fossil-derived organic molecules.

Manoel Manuputty

My PhD focused on understanding how titanium dioxide nanoparticles form and grow in a flame synthesis process. One obvious benefit of spending time in both Cambridge and Singapore was being able to interact with researchers from diverse backgrounds and to have access to excellent research facilities in both of these places. Other than that, I personally enjoyed being able to experience the very different environments in Cambridge and Singapore. I also managed to squeeze in some travel around Europe and Southeast Asia during my PhD.

One of the highlights of my time in Singapore was helping to set up some new experimental work in the CARES labs. One example is when we built an entirely new burner system for material synthesis, which gave me a few new skills that have come in handy in my research work.

I am now working as a Research Fellow, continuing my research on flame synthesis in CARES. I am also pursuing some collaborations with researchers from the local universities to explore other potential applications of the materials prepared from the flame synthesis.

Manoel Manuputty © Manoel Manuputty

Casper Lindberg © Casper Lindberg

Casper Lindberg

My research focused on investigating the flame synthesis of titanium dioxide nanoparticles using detailed population balance models. I developed a particle model that captures detailed morphological information and the crystal phase of aggregate particles.

The Cambridge-CARES programme gave me the opportunity to meet and collaborate with people from all ends of the world. Working in Singapore provided an opportunity to see and experience somewhere different as my higher education has been at Cambridge since undergraduate level. One highlight of my time in Singapore was the delicious food and wonderful places to visit around South East Asia. I was also able to collaborate with people I wouldn't have met in Cambridge, like a visiting PhD student from Tsinghua University. The collaboration led to a number of papers and has continued after the student's return to Beijing.

I am now a Research Fellow at CARES and working on the J-Park Simulator.

These researchers were supported by industrial partners Venator (Astrid and Casper) and CMCL Innovations (Manoel). To join the Cambridge-CARES studentship scheme, students must be supervised by an existing CARES PI and be approved by the Degree Committee for Leave to Work Away after their first year in Cambridge. Please contact Élana McNaught (elana.mcnaught@admin.cam.ac.uk) if you have any queries. See www.cares.cam.ac.uk

In memory of Professor James 'Jim' Wilkes (24 January 1932 – 6 December 2020)

We are saddened to report the death of alumnus and former faculty member Professor Jim Wilkes, who passed away in Michigan on Sunday 6 December 2020 from complications following heart surgery.

Professor Jim Wilkes (far left) with Elena Gonzalez (middle) and the late Professor John Davidson (far right) dining at Emmanuel College in October 2018. © Elena Gonzalez

James ("Jim") Oscroft Wilkes was born on January 24, 1932 in Southampton, England. He obtained his bachelor's degree in chemical engineering from Emmanuel College, Cambridge, in 1955. Jim was also a faculty member in our Department from 1956 to 1960 before moving permanently to the University of Michigan in 1960. He was an Arthur F. Thurnau Professor from 1989-1992, and Assistant Dean for Admissions in the College of Engineering from 1990-1994. Also a former chairman of the department, he retired from the University of Michigan in 2000 and a significant undergraduate scholarship fund was established there in his honour.

You can read the full obituary on www.ceb.cam.ac.uk/news/memory-professor-james-jim-wilkes-24-january-1932-6-december-2020

Below, another former CEB faculty member, Sir David Harrison, shares his personal memories of Jim:

"I first met Jim in October 1956 when we arrived together as the most junior members of staff of the Cambridge Chemical Engineering Department which had opened just six years earlier. Jim had arrived by way of the Chemical Engineering Tripos, which he completed in 1955 and followed by a Master's program at the University of Michigan and marriage to Mary Ann; while I had spent 1953-56 as a research student in the nearby Physical Chemistry Department. Chemical Engineering was then housed in temporary (war-time) huts in Tennis Court Road behind Peterhouse. Jim 'discovered' chemical engineering in his second year at Emmanuel College and had obtained, with the kind assistance of the remarkable Departmental Secretary, Margaret Sansom, a tour of the department by the first Shell Professor Terence Fox. Jim was for ever grateful for that introduction which determined the course of his academic work and indeed of his life.

Staff rooms were in short supply in 1956 and Jim and I shared an office for the three years before the Department moved, in 1959, to purpose-built accommodation in Pembroke Street. I learned a great deal of chemical engineering from Jim because he had been immersed in the subject for the previous three years while I was working in the chemistry department. Lectures were given in a free-standing hut and when a very young-looking Jim arrived to give his first lecture he found some of the class outside in the sunshine. He said "perhaps we ought to go in now", to which they replied "he (the lecturer) has not yet arrived". Jim said "I am he".

Jim was a very scholarly university teacher as his fine books on numerical methods, polymer processing and computational fluid mechanics testify. His distinguished academic career, although based at the University of Michigan, also extended to graduate courses in Bangkok. His academic range was remarkably wide, notably his edition in 2015 of his grandfather's material on 'Place Names in Hampshire and the Isle of Wight', which runs with many fine illustrations to 600 pages. This work of scholarship attracted praise from authorities like Professor Oliver Padel, President of the English Place Names Society. He was also an accomplished organist to the extent of having an instrument installed at home.

Jim and Mary Ann kept their friendships in good repair to a remarkable extent. John Davidson and I visited their home in Ann Arbor following a conference in Chicago, and Jim suggested that we travel to Ann Arbor by train, which worked well. There was however a slight problem that our Chicago hosts seemed not too sure where the railroad station was (they would of course have had no trouble taking us to O'Hare airport). How odd the British are.

Jim returned to Cambridge every year, staying in Emmanuel. His last visit was in October 2019 and it followed a well-trodden path. He kindly entertained John Davidson and I to dinner in Emmanuel, then later in the week he dined in Trinity and had lunch in Selwyn. He will be greatly missed".

Celebrating Black History Month

To celebrate Black History Month, CEB displayed the Africans in STEM-curated 'Black Legacies in STEM' exhibition, to celebrate notable black scientists around the world and raise awareness of some of the challenges faced by black students in STEM.

Tonny Okedi, CEB researcher in the Electrochemical and Microengineering group and this year's coordinator of the Africans in STEM Black History Month exhibition.

"The exhibition profiled influential black scientists from the past and present from around the world. Their collective achievements are vast, covering life changing medical discoveries and inventions to awe-inspiring environmentalism, Nobel Peace Prizes and successful business ventures launched on the backs of their scientific discoveries

What was your personal motivation for getting involved with the organisation of this event?

"The exhibition is the brainchild of Sandile Mtetwa (PhD student, department of Chemistry) and Cynthia Okoye (PhD student, department of Pharmacology) – my personal motivation to participate was to be a relatable face for budding young black scientists looking to enter STEM research at leading universities".

Can you tell us a little about the exhibition and the people featured?

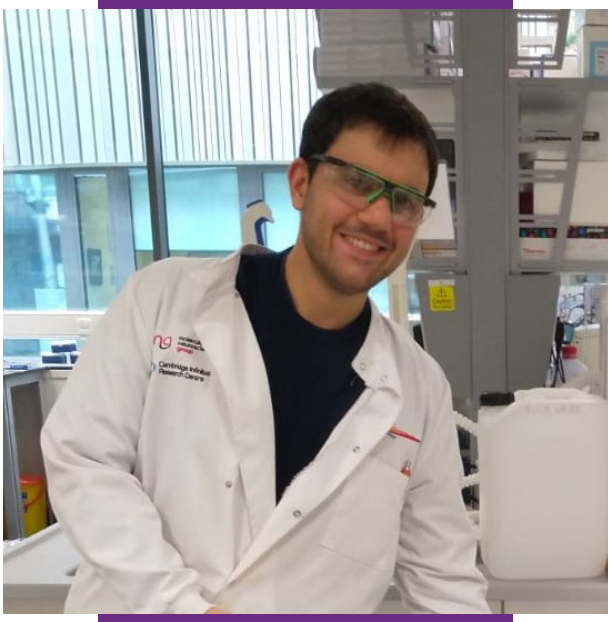
"The exhibition profiled influential black scientists from the past and present from around the world, as well as early career black scientists in Cambridge. Their collective achievements are vast, covering life changing medical discoveries and inventions to awe-inspiring environmentalism, Nobel Peace Prizes and successful business ventures launched on the backs of their scientific discoveries".

What are your aspirations for the representation of black people in STEM?

"For Africa specifically, I would like to see STEM research expand and diversify to areas outside of health to include other critical areas in the 21st century, particularly technologies for fighting and adapting to climate change and artificial intelligence. More generally, I would like to see a greater pipeline of black academic leaders in STEM – by this I mean retaining black PhDs to postdoc level and offering the right support to really see them progress to and thrive at PI level".

For more information visit: www.africansinstem.co.uk

Luca Mascheroni is one of the joint AstraZeneca- Sensor CDT students within the department, who gave a talk on his research at the symposium



AstraZeneca and University of Cambridge virtual symposium

The first ever joint science symposium between AstraZeneca and the University of Cambridge was held this November. The symposium was supported by Sir Mene Pangalos (Executive Vice-President, BioPharmaceuticals R&D, Astra Zeneca) and Professor Andy Neely (Pro-Vice-Chancellor for Enterprise and Business Relations, University of Cambridge) and showcased first-class science from this collaboration including disease models, pre-clinical and clinical research, data science and the use of AI in medicine. A collection of PhD students from the joint AstraZeneca-sensor CDT programme at CEB presented their research at this symposium, including PhD student Luca Mascheroni. Luca is part of the Laser Analytics group and his work involves the study of super-resolution imaging to study live attenuated influenza vaccine efficacy. He gives his insights into the experience below.

'It was a constructive experience in many ways. It was challenging to come up with a presentation that could be interesting for scientists that are working on extremely diverse topics, especially when you only have ten minutes. But it was a very nice way to get meet other AZ-funded PhD students. Finally, it was very interesting to witness how such an event is organised in an industrial setting: we had two rehearsals before the actual talks, everything had to work perfectly!'

For more information visit: www.c2d3.cam.ac.uk/events/astrazeneca-and-university-cambridge-virtual-symposium

Cambridge Science Festival 2021

We have been working hard behind the scenes to put together an exciting contribution to the Cambridge Festival that will take place in March 2021. The new format combines the University's two annual festivals – the Festival of Ideas and the Science Festival – into one interdisciplinary celebration of research at Cambridge.

This year, our events will cover a wide range of topics for all ages including the secrets of digestion, how scientist build organs in the lab, how scientists are searching for eco-friendly fuel and how you can build a sensor! All the talks will be held online, and available to watch live or on demand.

Keep an eye out for the launch of programmes and activities to be revealed on www.cam.ac.uk/public-engagement/public-events

Snapshot from our interactive science festival contribution from three years ago

Redefining the world of brewery

Dr Katherine Smart, Global Technical Director at Diageo © Diageo

Dr Katherine Smart, Global Technical Director at Diageo, one of the world's largest producers of spirits and beers, leads Diageo's global drinks portfolio, with responsibility for innovation, research and liquid development, packaging and governance. She holds a PhD in Fermentation and Brewing Science, a DSc by publication in Brewing and Distilling Sciences, an honorary LLD and is a Fellow of three learned societies. She is also a Lecturer in Brewing and Distilling at the University of Cambridge, Professor of the University of Nottingham, Rectifier of the Gin Guild and is a Liveryman Distiller of the Worshipful Company of Distillers. Katherine also served as President of the Institute of Brewing and Distilling from 2016 - 2018, only the second woman to hold the role.

The Editorial Team caught up with Katherine following her appointment as Renter Warden of the Worshipful Company of Brewers:

CEB Focus: Congratulations on making history as the first woman to be appointed as the Renter Warden of the Worshipful Company of Brewers! What does your latest achievement mean to you?

KS: Thank you so much. First of all, the Worshipful Company of Brewers is one of the oldest liveries, founded in 1438 for the purpose of creating a community of brewers and brewing companies. The Company supports a few education charities and the National Brewing Library, which I helped to found. It is a privilege to be able to contribute. It is an honour to be the first woman to be a member of the court and a Renter Warden. My role involves supporting the charitable work of the company and I am already finding this hugely rewarding.

CEB Focus: You are one of only a few female brewing experts around the world, and have founded your own family distillery, the Surrey Cooper Distillery. Where does your passion for brewing come from?

KS: I was awarded a PhD Scholarship by Bass Brewing Company, at the time the UK's largest brewing company, and was so fortunate to have been guided and encouraged in my early career by some talented scientists who were also brewers. I was particularly fascinated by brewing yeast and the fermentation process. My research areas of brewing and distilling expanded into fermentation for biofuels and biorefining. Brewing science has been more influential than many people realise. When Antonie van Leeuwenhoek first used his lenses to see microbes it was yeast in his beer that he viewed. Pasteurisation, refrigeration, pH and the students T test – all were developed by scientists working on a problem in brewing. I have always found this inspirational and brewing science is still fascinating to me now.

CEB Focus: You are incredibly busy teaching in the department, helping to run our MPhil in Bioscience Enterprise (MBE) course and working in your senior role in Diageo, apart from holding many fellowships and key external positions. How do you manage to juggle all of these different roles?

KS: I think the key is to be very organised and to have very strong time management skills. It can be challenging but it is also refreshing to be able to work in different sectors with different perspectives. As academics, we all hold multiple roles from teaching to research to administration, and many of us have editorial roles for journals or are in leadership roles in societies as well. The difference is my work for Diageo. I am the Global Technical Director with a team of more than 300 people based in the UK, Ireland, Singapore, Australia, South Africa, Ghana, Mexico and Panama. My role is to lead this multinational team in solving business challenges and creating innovative opportunities. All my roles have science at their core, and this, of course, is my passion, but in Diageo I also have to be an effective businesswoman.

CEB Focus: We have heard you are an active advocate of women in brewing. Tell us what initiatives you are leading in support of women in brewing.

KS: I am committed to helping women develop careers in brewing and distilling and indeed in science. Diageo supports scholarships for women in many disciplines where there is under-representation. I am very proud of our work in this. We also support STEM in schools in many countries. Many of my PhD students have developed careers in academia and industry and I am so proud of them.

CEB Focus: As a Lecturer in Brewing and Distilling, what is your teaching role in the department?

KS: I am the academic lead for the MBE and this involves coaching students through their programme and developing the curriculum for the future. I find all my time with students very rewarding, from applicant interview to final project presentation marking. Developing individuals to meet their real potential is at the heart of everything I do.

CEB Focus: How do you use your brewing experience in your day-to-day role in Diageo?

KS: In a typical Diageo day, I am making significant business decisions. We are the largest distilling company in the world. Our products include Johnnie Walker, Tanqueray, Don Julio Tequila, Gordons and multiple single malt whiskies. We also make amazing beers such as Guinness and Hop House 13. Custodianship of these brands is one of my roles. I also have a role in strategy and change management. This sees me reconfiguring our manufacturing to make hand sanitiser instead of distilled products, as we did when COVID-19 first started, to make sure our NHS had sufficient hand sanitiser when this was in very short supply. My team and I create new products and are developing the technical sustainability strategy for our company. No two hours are the same, which is stimulating, and I never stop learning.

CEB Focus: Finally, what words of encouragement would you send to women contemplating entering the traditionally male-dominated world of brewing?

KS: I don't think of brewing as male-dominated; it was when I first started my career, but now, I have many talented women colleagues in the industry and that is to be celebrated. I would encourage the reader to reflect on our collective opportunity. At Cambridge, we have the most incredible environment in which to learn, discover, share and celebrate science. Some of us will elect to stay within academia to develop ourselves and others, and to progress science and engineering research. Industry also needs and values talented individuals who have a passion for science and the ability to apply that to business settings to build and shape the future. Some of us will opt for a career in the commercial world and ultimately this enables reinvestment in the university sector. Academia and industry work brilliantly together across multiple sectors and, in my experience, transitioning a career between the two is exciting, stimulating and a privilege. Create a career that allows you to follow your passions and enables you to be authentic in the workplace.

Cambridge University Womxn in Engineering Society

Imogen Richards
CUWES President and Co-Founder

A new, small but important society has just appeared in the list of Cambridge societies you can join. It is not the easiest thing (nor necessarily the best idea) to establish a society in the middle of a global pandemic. The words 'isolation' and 'society' do not really sit together. But starting a new society is what a group of undaunted Cambridge womxn have done. The Cambridge University Womxn in Engineering Society (CUWES) is now up and running and looking for recruits, and you will be hearing a lot from them in the future.

The world, and Cambridge in particular, still has significant room for improvement when it comes to celebrating and encouraging women into STEM, and into engineering in particular. With less than 25% women engineers at undergraduate level (which, we have to say, is higher than the national average) and significantly less at postgraduate and higher levels, there is work to be done here on gender equality. The aim of the new society is to promote the cause of womxn in all branches of engineering and to provide a supportive, friendly environment to encourage them on their journey towards becoming successful engineers.

In the society's first term, there have been virtual events ranging from talks from CEOs to escape rooms and even advice on how to survive a Week 5 at Cambridge. There has been an event giving guidance and support on applying for internships, and access work is planned that involves helping sixth formers prepare for Cambridge interviews. There is currently a collaboration with the Cambridge University Robotics Society to organise an event promoting STEM for girls in schools. This is all useful stuff if you are a womxn engineer trying to fit in to the male-dominated world of Cambridge science and engineering, and the society is looking forward to you joining them.

Of course, we all hope the world will return to normal soon, so that there can be in-person events. In the meantime, there is no doubt that CUWES will continue to help and inspire our new generation of womxn engineers in every way it can.

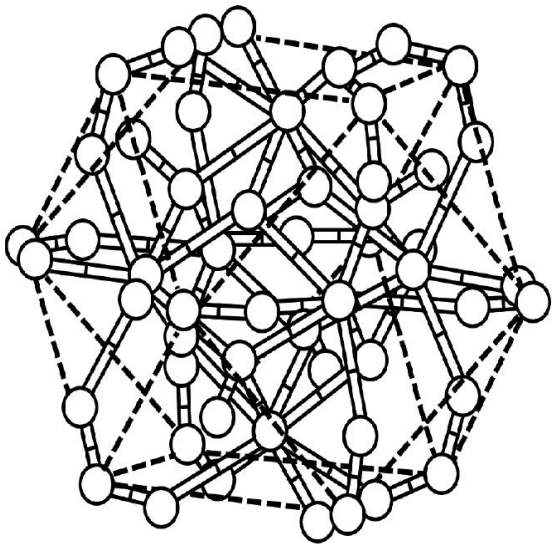
If you'd like to get involved, then like our page on Facebook (CU Womxn in Engineering Society) or Instagram (@cuwengsoc) to keep updated on our events or email us at cuwes-committee@srcf.net for more information.

Cambridge University Womxn in Engineering Society's logo © CUWES

"The aim of the new society is to promote the cause of womxn in all branches of engineering and to provide a supportive, friendly environment to encourage them on their journey towards becoming successful engineers.

Mindfulness colouring with CEB science

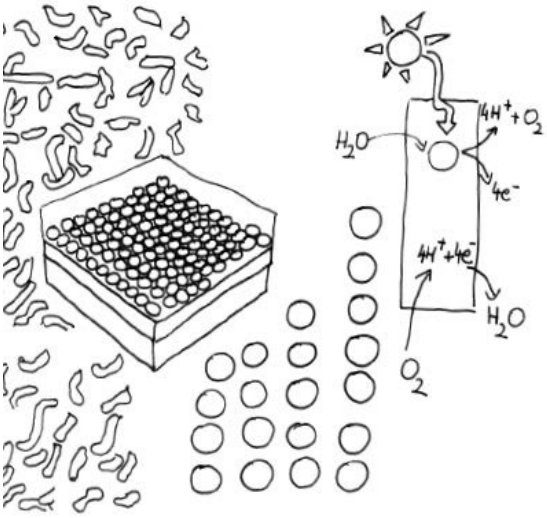
Immerse yourselves in the exciting world of CEB science: sit back, colour in real images from our researchers' work in the labs and relax your mind in the process. The images are visual representations of key science concepts underpinning our scientists' and engineers' battles to help tackle the greatest challenges in energy and the environment, sustainability and healthcare. See our full catalogue of cool science images featured in our science colouring book on Issuu digital publishing platform www.issuu.com/cebcambridge



Less toxic chemotherapy

Metal Organic Frameworks (MOFs) can adsorb drugs and take them only to the cells that need them. They could be used to make chemotherapy less toxic.

David Fairen Jimenez, Chun Man Chow, Adsorption and Advanced Materials Group



Green energy

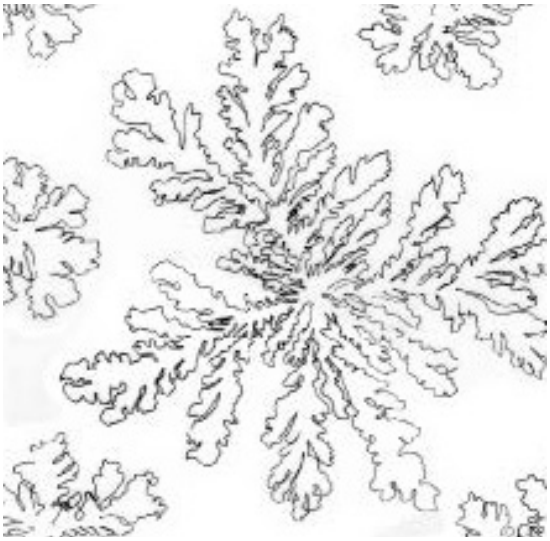
Solar cells made using algae or bacteria, which help convert sunlight into electricity.

Adrian Fischer, Aazraa Oumayyah Pankan, Electrochemical and Micro Engineering Group

P450- detoxer

The biological detox machine in our liver. This protein degrades dangerous stuff so that it can be removed from our body or recycled.

Ljiljana Fruk, Leander Crocker, Christoph Franck, BioNano Engineering Group



Golden DNA

These nanoflowers grow when gold solution is added to DNA and irradiated with light. They make up a cool material which conducts electricity and can be used to store simple information (write-once-read-many times devices, or WORM).

Ljiljana Fruk, Yu-Chueh Hung, BioNano Engineering Group

CEB Teaching Consortium of companies

For more information on the CEB Teaching Consortium visit
www.ceb.cam.ac.uk/undergraduates/teaching-consortium

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