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NEWSLETTER 064 DECEMBER 2022

TAKING STOCK OF 2022: a prolific year to start OSCAR's Year Five with

OSCAR RESEARCHERS develop a new bioreactor that improves culturing process

CONTENTS

Taking stock of 2022: a prolific year to start OSCAR's Year Five with

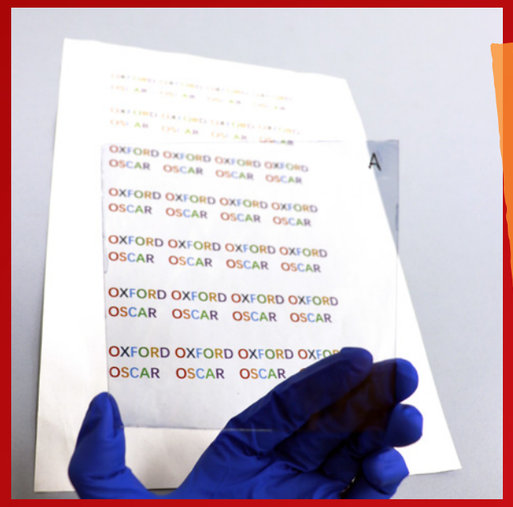
Despite the ever-lurking threat of Covid-19, 2022 has been a prolific year for OSCAR. Two local outbreaks hit Suzhou in February and April, disrupting the day-to-day running of OSCAR, and perpetual reports of cases across China for the better part of the year cast a shadow on in-person interactions. The pandemic seemed obstinate, and the restrictions constant. At one point, authorities were putting strict control over building occupancy levels to contain rapidly growing infections. OSCAR's emergency response prioritized lab-based research, adopting dynamic work schedules to keep research projects moving. Special building maintenance arrangements and EHS protocols were implemented to ensure it was safe and efficient to work inside the building.

OSCAR demonstrated science-informed decision-making, adaptiveness and resilience in the pandemic years. These qualities will help carry OSCAR through the process of returning to normality, following China's announcement of the downgrading of Covid-19 controls on 26 December.

Before we look ahead to the coming year and a string of new activities as things emerge from hibernation, let's take stock of how OSCAR rose above yet another challenging year and made progress across the board.

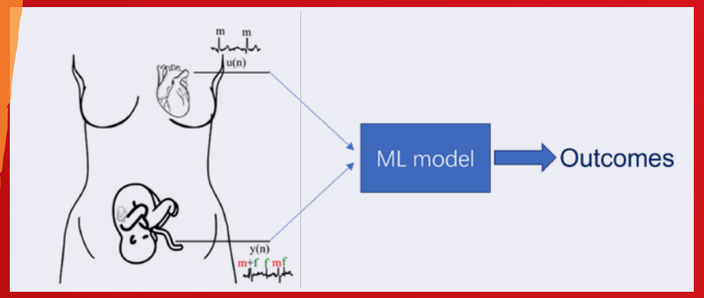
OSCAR continues to empower the world with close-to-market innovation

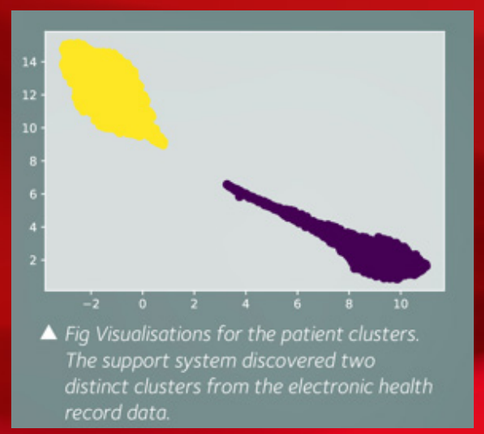
OSCAR produced ***11*** patents , ***two*** book chapers, and ***12*** research papers in the past 12 months, capturing our imagination for future technologies with innovative research. Here are some of the highlights.



Scientists from OSCAR's Optoelectronic Technology Lab developed a low-cost process to fabricate PEDOT transparent conducting films. The material is of enormous importance in the manufacture of optoelectronic devices, sensors, touch screens and sensing devices.

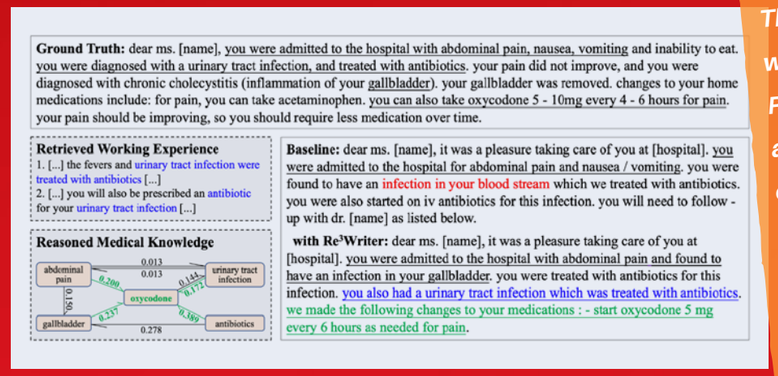
OSCAR's Digital Health research team presented an algorithm to assess fetal electrocardiogram recordings for prenatal diagnosis and monitoring. The approach is expected to improve the reliability of fetal monitoring and contribute to healthier births.





▲ *Fig Visualisations for the patient clusters. The support system discovered two distinct clusters from the electronic health record data.*

The Digital Health team is also behind a clinical-decision-support system for identifying and classifying patients with heart, respiratory, or kidney failure using electronic health records.


Ground Truth: dear ms. [name], you were admitted to the hospital with abdominal pain, nausea, vomiting and inability to eat. you were diagnosed with a urinary tract infection, and treated with antibiotics. your pain did not improve, and you were diagnosed with chronic cholecystitis (inflammation of your gallbladder). your gallbladder was removed. changes to your home medications include: for pain, you can take acetaminophen. you can also take oxycodone 5 - 10mg every 4 - 6 hours for pain. your pain should be improving, so you should require less medication over time.

Retrieved Working Experience
1. [...] the fevers and urinary tract infection were treated with antibiotics [...]
2. [...] you will also be prescribed an antibiotic for your urinary tract infection [...]

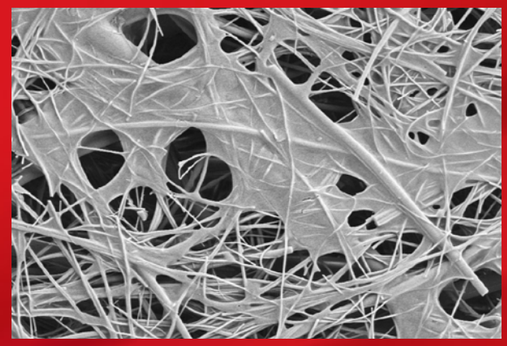
Reasoned Medical Knowledge
abdominal pain — 0.013 / 0.013 — urinary tract infection
abdominal pain — 0.200 — oxycodone — 0.144 / 0.172 — urinary tract infection
abdominal pain — 0.150 — gallbladder — 0.237 — oxycodone — 0.369 — antibiotics
0.278

Baseline: dear ms. [name], it was a pleasure taking care of you at [hospital]. you were admitted to the hospital for abdominal pain and nausea / vomiting. you were found to have an infection in your blood stream which we treated with antibiotics. you were also started on iv antibiotics for this infection. you will need to follow - up with dr. [name] as listed below.

with Re³Writer: dear ms. [name], it was a pleasure taking care of you at [hospital]. you were admitted to the hospital with abdominal pain and found to have an infection in your gallbladder. you were treated with antibiotics for this infection. you also had a urinary tract infection which was treated with antibiotics. we made the following changes to your medications : - start oxycodone 5 mg every 6 hours as needed for pain.

The team's collaborative research work with the University of Oxford, Peking University, Yale University, and Tencent JARVIS Lab, among others, was accepted by NeurIPS 2022. Researchers developed a novel method for generating accurate and fluent patient instructions in textual form, deriving from the patient's health records during hospitalisation.

Researchers from OSCAR's Functional Materials group deployed a new bis-carbene-enabled surface modification technology on glass fibre membranes to achieve new surface properties. The technology also proved applicable to enzyme immobilization.



Research teams at Oxford University and OSCAR reported a new approach to accelerate enzyme evolution for targeted, selective C–H oxidation of cyclic amines and potentially many other substrates, delivering high-value alcohol products for drug discovery and synthetic applications. Their work was featured on the cover of the Nature Synthesis December 2022 issue.

OSCAR's research article on RT-LAMP for rapid diagnosis of coronavirus SARS-CoV-2 was Microbial Biotechnology's most cited articles in 2020 and 2021. This paper is also among the top 1% cited paper in the academic field of microbiology based on a highly cited threshold and publication year, according to the Web of Science.

OSCAR continues to attract research talent to push the boundaries of modern biotechnology, advanced materials, computational approaches and manufacturing techniques.

Nine new researchers joined OSCAR's thriving research community in 2022.

Xiaoning Zhang
Research Assistant in Prof. Jeremy Robertson's group

Dr. Xinxin Zhang
Research Scientist in Prof. Jeremy Robertson's group

Dr. Peng Tang
Research Scientist in Prof. Mauro Pasta's group

Yixuan Guo
Research Assistant in Prof. Mauro Pasta's group

Dewan Wang
Senior Research Technician in Prof. Paul Stavrinou's group

Haiyan Song
Research Technician in Prof. Ian Thompson's group

Wei Li
Research Scientist in OSCAR-Prenetics ITC for Advanced Molecular Diagnostics

Dr. Lin Li
Research Scientist in OSCAR-Prenetics ITC for Advanced Molecular Diagnostics

Dr. Alexander Vasilyev
Research Scientist in Prof. David Clifton's group

OSCAR achieves a new milestone in research infrastructure and academia-industry collaboration

The OSCAR Innovation Hub was opened in November as OSCAR celebrated its fourth anniversary. The Hub is **1,000** m^2 of lab space on the seventh floor of the OSCAR building, constructed to house Innovation Technology Centres (ITC), in-house facilities focussed on accelerating the translation of highly promising technologies from the lab to the market.

Division of functions and area of the OSCAR Innovation Hub

Location	Lab function	Area (m^2)
7G-01 to 7G -29 area, 7B-01 to 7B-12 area	Biotherapeutics GMP (Cell/Tissue, Biomaterials)	580
7E-01 to 7E-06	Medical Device (Molecular Diagnostics)	140
7B-13	Biomanufacture	96
7L-01 to 7L-07, 7D-01 to 7D-05	Analytical Laboratories and Quality Control	200

OSCAR launched its **second** industry-sponsored Innovation Technology Centre following a six million RMB collaboration with Shangqiu Hongda Optoelectronics. The ITC is committed to advancing the commercial application of perovskite technology in the spheres of solar cells, light-emitting devices, microcavity organic emitters and imaging.

We applaud both individual and collective efforts put in to win distinctions for OSCAR

OSCAR's Energy Storage and Conversion Lab won first place in the "Maker in China' Jiangsu SME Innovation and Entrepreneurship Contest 2022. Using single atom/nanocluster catalysts, the team demonstrated marked savings in the costs of industrial hydrogen production.

OSCAR was named the overall winner of the '2022 Greater Suzhou Best Employer Awards', a recognition of OSCAR as an employer deserving to be aspired to.

IP Manager Yechen Gui and Research Scientist Dr. Kamran Khan were both honoured with an SIP Educators of the Year Award for making a commendable contribution to scientific research, social services and technology transfer and commercialization.

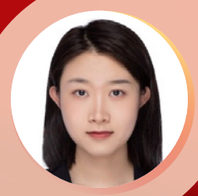
Sixteen OSCAR scientists and professional services staff were awarded diverse talent programmes.








- *High-level Foreign Expert Programme*
- *Jiangsu Innovation and Enterprise DPhil Programme*
- *Suzhou High-level Talent Programme*
- *SIP Talent Programme*
- *SEID International Disciplinary Leading Talent*
- *SEID Science and Education Key Talent*








OSCAR keeps exchanges with academia, industry and the public alive through Academic Seminars, Open Days and alumni events.

In 2022, OSCAR held ***four*** *Academic Seminar Sessions.* ***Nine*** *speakers shared topics ranging from nanotechnology and mathematical modelling to biomedical engineering and environmental biotechnology.*









OSCAR welcomed Oxford and Cambridge Universities alumni and local young talents to a science and technology focussed innovation forum, inviting insights into the development of innovative technologies, and their social and economic impact.

OSCAR invited people from venture capitals, government agencies and enterprises to the Sino-UK Innovative Technology Roadshow-OSCAR Day, connecting Chinese and British innovators and promoting collaboration to advance promising technologies.

Out with the old challenges overcome and deliverables checked off in 2022, in with the new opportunities and ambitions of 2023. OSCAR is ready for Year Five of continuing 'innovation, incubation and impact'.

OSCAR researchers develop a new bioreactor that improves culturing process

OSCAR's Regenerative Medical Engineering Centre, led by Professor Zhanfeng Cui and Professor Cathy Ye, has developed a new type of bioreactor that provides a markedly improved environment for cell growth. The new bioreactor achieves steadier culturing levels and lower contamination levels compared to the flask-based method which mostly causes waste pile-up due to complex manual operations.

Flasks are often used as culture devices for the production of cells or their target metabolites such as extracellular vesicles (EV). Flask-based culture devices are voluminous. They generate culture solutions with very low concentrations of the produced cells or their target metabolites, which requires complex downstream processing to elevate concentration levels. Further adding to the disadvantages of these devices is the difficulty in guaranteeing consistency between batches of products.

The new bioreactor developed by OSCAR researchers adopts on a filter membrane composed of hollow fibres, enabling multiple improvements in the culturing process.
First, the culture is allowed to adhere to the hollow fibre membrane and grow on both the intraluminal and extraluminal space of the cartridge (see Figure 1), thereby maximizing the utilization of space in the bioreactor and allowing efficient production of target substances.

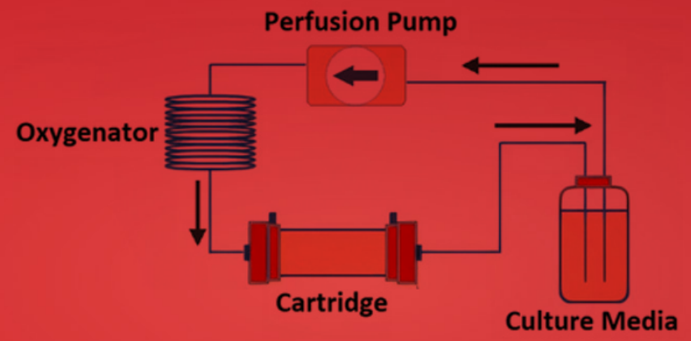


Figure 1 A brief diagram of the culturing process in the new bioreactor

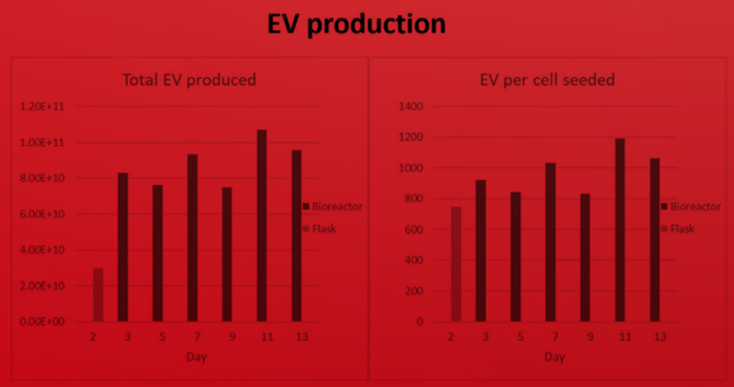


Figure 2 Extracellular vesicles (EV) produced by the new bio-reactor compare to the flask-based method

Secondly, in the new bioreactor, cells are perfused directly by medium, providing ample nutrients and a highly oxygenated medium stream directly over the cells. Meanwhile, the use of a filter membrane permits sufficient oxygen transfer for the cells to grow.

Thirdly, the new system comes with two independent sets of culture solution-supplying devices for both the inner and outer area of the filter membrane.

The ingenuity of the bioreactor also includes automatic adjustment of the membrane based on the state of the culturing process in the growth zone to maintain optimal conditions.

The bioreactor obtains target substances with higher growth rates and higher yields (see Figure 2).

A patent application derived from this research has been filed.

Recent OSCAR publication

Joint research article by OSCAR and Jilin University published in Advanced Functional Materials

OSCAR's Optoelectronic Technology Laboratory (OeTL) and Professor Fenghong Li's research group at Jilin University reported a new cathode interlayer modified aluminium (Al) to achieve efficient and stable inverted perovskite solar cells (PVSCs) with a power conversion efficiency (PCE) of 20.64%. This collaborative work was published online in *Advanced Functional Materials* on 29th December 2022.

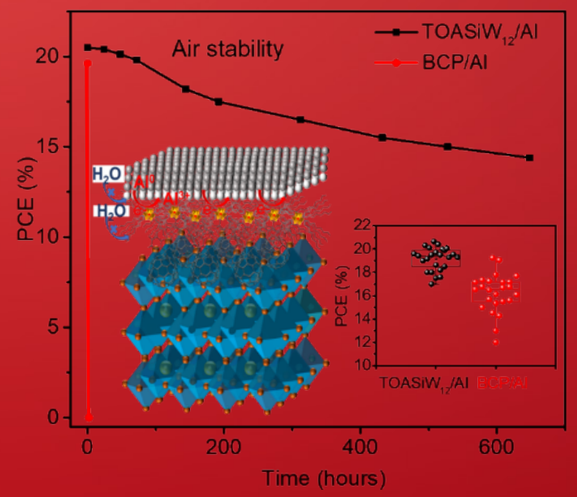


Figure 1 Efficient and stable inverted perovskite solar cells

Dr. Jingsong Huang, Co-PI of OeTL and Head of OSCAR-Hongda ITC for Perovskite Technology, and Professor Fenghong Li from the State Key Laboratory of Supramolecular Structure and Materials, Jilin University, are the corresponding authors of the research paper. Dr. Chengzhuo Yu, a visiting PhD student from Jilin University, is the first author. Dr.Yun Hu, Research Scientist in OeTL also contributed to this work as the co-author.

RESEARCH ARTICLE

ADVANCED FUNCTIONAL MATERIALS
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Efficient and Stable Inverted Perovskite Solar Cells with $TOASiW_{12}$-Modified Al as a Cathode

Chengzhuo Yu, Yun Hu, Jialin Yang, Jingsong Huang, Bao Li, Lixin Wu, and Fenghong Li**

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Inverted planar perovskite solar cells (PVSCs) have received great attention due to their easy fabrication at low temperatures, suitability for flexible substrates, and compatibility with multijunction solar cells. So far, the power conversion efficiency (PCE) of single-junction inverted PVSCs can reach over 25%, showing great prospects for commercialization. However, the use of precious metals such as gold or silver as electrodes limits the further development of PVSCs. The inexpensive metal Aluminium (Al) is scarcely utilized as the cathode in PVSCs owning to its violent reaction with the perovskite active layer, which results in poor device stability in air. These challenges have made it imperative to improve the efficiency and stability of PVSCs with Al as the cathode for the mass production of low-cost PVSCs.

In this context, researchers proposed surfactant-encapsulated polyoxometalate complex $[(C_8H_{17})_4N]_4[SiW_{12}O_{40}]$ ($TOASiW_{12}$), a novel solution-processed cathode interlayer (CIL) material, to replace the CIL of bathocuproine (BCP) commonly applied in PVSCs.

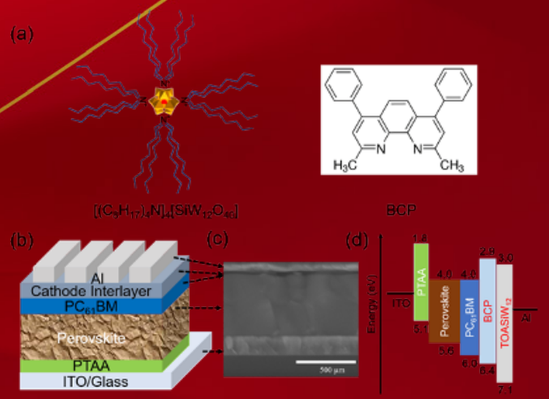

Figure 2 Molecular structures of CILs, device structure of the PVSCs and energy level diagram

$TOASiW_{12}$ is a supramolecular compound in which the organic part (TOA) and inorganic part (SiW_{12}) are bound together by electrostatic interaction. $TOASiW_{12}$ presents many advantages, including one-step synthesis by ion exchange reaction and the characteristics of hydrophobicity, high yield, low cost, and environmentally friendliness.

In this work, $TOASiW_{12}$ served as a physical buffer layer that avoids direct contact between the perovskite and Al in the devices. $TOASiW_{12}$ was also able to block moisture from entering the perovskite thanks to 16 hydrophobic octyl chains to prolong the device's air stability.

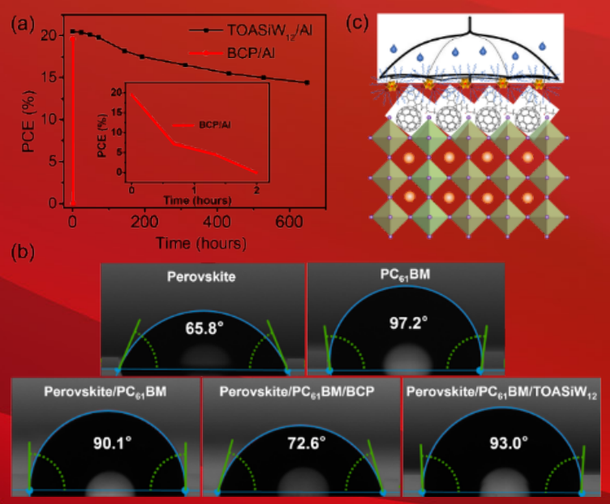

Figure 3 The unencapsulated devices retained more than 80% of the initial PCE after 350 hours of storage in the ambient atmosphere, while the PCE of the devices with BCP/Al rapidly dropped to below 2% of the initial values after the devices were exposed to the air for 2 hours.

Researchers discovered that a thin $TOASiW_{12}$ layer could effectively obstruct the chemical reaction between Al and the perovskite layer, and significantly enhance the device stability. Achieving a power conversion efficiency (PCE) of 20.64%, $TOASiW_{12}$-modified Al proved to be an excellent cathode interlayer material for efficient and stable inverted PVSCs.

This breakthrough in perovskite solar cells is expected to speed up the development of new interface materials applied in the efficient, stable and low-cost Al-based PVSCs.

Meet OSCAR's new Research Scientist

Dr. Peng Tang
Research Scientist in Prof. Mauro Pasta's group

Dr. Peng Tang joined the OSCAR family in December 2022 as a research scientist in Prof. Mauro Pasta's group.

Before joining OSCAR as an employee, Peng was a visiting Dphil student at OSCAR in 2020. He was a member of the research team behind OSCAR's awarding winning project in August this year that involved the development of an innovative cost-saving catalyst in industrial hydrogen production.

Peng defended his doctoral degree at the University of Oxford in November 2022 under the supervision of Prof. Mauro Pasta. His DPhil project at the Department of Materials in Oxford investigates the structure-property relationship of Pt single-site electrocatalysts for the hydrogen evolution reaction.

Peng's project at OSCAR will focus on developing low-loading Pt/Ir electrocatalysts for green hydrogen production by water splitting, especially the study of the synthesis and characterisation of Ir nanoparticles and single sites and their catalytic properties for the oxygen evolution reaction.

Peng says 'It is great to join the OSCAR family again as a research scientist. OSCAR is an attractive place to smoothly carry on the research projects I was doing at Oxford because the way to conduct research here is the same as that at Oxford. Fortunately, I am familiar with OSCAR from two years ago when I did an exchange project during the pandemic. Therefore, it is easy to straightforwardly start my work with the help of the OSCAR team. The pleasant atmosphere, friendly colleagues, and professional supporting team will make the journey successful.'

Meet OSCAR's Visiting Student

Dr. Yuan Zhang

Dr. Yuan Zhang is a Dphil student from the Department of Chemistry, University of Oxford, and a visiting student in Professor Luet Wong's research group at OSCAR for three months. Yuan received his PhD degree in Inorganic Chemistry in August. His doctoral research focused on the development of a computational-analysis-based enzyme engineering approach for the selective production of high-value compounds and clinical drugs.

Yuan's main interest lies in the improvement of the production scale and selectivity of important chemical compounds using the computational enzyme engineering approach.

High-value chemical compounds, such as cosmetics, medicines, agricultural chemicals, fragrances and flavours, are vital to the healthcare and quality of life of the human race. Up to now, the industrial-scale production of these important chemicals relies heavily on traditional organic synthetic approaches, which are, most of the time, not environmental-friendly. With the fast development of synthetic biology, scientists are now making efforts to produce these vital chemicals using biological approaches.

The key to biological production is the various enzymes that catalyse different types of chemical reactions. Enzyme engineering has played an important role in the development of biological pathways to high-value chemicals as it can 'boost' enzymes by improving their stability, activity, and selectivity.

However, the application of enzyme engineering is highly time- and effort-consuming and requires a lot of random screening tests, as it's impossible to understand how exactly enzymes and their substrates interact.

OXFORD SUZHOU CENTRE FOR ADVANCED RESEARCH

'Now, with the explosive growth of computation power and simulation software, we have been developing a computational enzyme engineering approach, which can facilitate efficient enzyme engineering and produce highly active enzymes for the construction of biological synthesis routes of important chemicals.' Yuan explained.

'During my visit at OSCAR, I have been focusing on further developing this computational approach, together with my colleagues here. Our aim is to establish a routine process that works for different enzyme mutants and substrates. We have successfully employed this approach to achieve the selective synthesis of various drug intermediates. In some cases, we manage to improve the activity of enzymes by 5-fold with just one round of computational guided enzyme engineering. As a comparison, this level of improvement usually requires thousands of mutants to be generated by traditional enzyme engineering approaches.'

Dr. Yuan Zhang (L1) and his fellow researchers from Prof. Luet Wong and Prof. Jeremy Robertson's teams at OSCAR.

With the completion of his DPhil study, Yuan decided to pursue his career in the science and technology sector.

'I plan to do post-doctoral research around the world and then hopefully find an academic job eventually. I also want to establish institutional collaborations between OSCAR and other research institutes within China and across the globe.' Yuan said.

'I've had a lovely and memorable three-month visit at OSCAR, which really helped a lot with the progress of my project. The state-of-the-art equipment and facilities facilitate an efficient workflow for scientific research, and the friendly environment created by the administration team and colleagues make for a perfect work-life balance. The interdisciplinary collaborations and science-industry communications at OSCAR are also efficient and of good quality. All these make OSCAR a perfect institute for researchers who really want to produce scientific achievements that change our lives.'

The OSCAR Big Family wishes everyone a happy New Year of the Rabbit

All OeTLers sincerely wishing everyone a most happy and prosperous New Year.

The OSCAR administration team wishes everyone a 'bouncy' Year of the Rabbit.

The Regenerative Medial Engineering team on the 6th floor wants to wish everybody a happy Chinese Lunar New Year. The Rabbit is a symbol of good fortune in Chinese culture. May the New Year bring everyone good luck, perfect health, boundless happiness, and abundant prosperity!

The Digital Health team wishes a happy Chinese New Year Tu ('兔') you!

"The chemistry and biotechnology groups, and the ITC for Molecular Diagnostics wish you the best of luck in the year to come. Take your passion and make it come true."

"The Energy Storage and Conversion team wishes you a happy Chinese New Year."

"Happy Chinese New Year! The OSCAR chemistry team wish you a happy, healthy, and amazing year!"