



Creating Growth,  
Enhancing Lives

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# ANNUAL REPORT

April 2022 - March 2023

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## OUR MISSION

The Agency for Science, Technology and Research (A\*STAR) drives mission-oriented research that advances scientific discovery and technological innovation. We play a key role in nurturing and developing talent and leaders for our research institutes, the wider research community, and industry.

Our research creates economic growth and jobs for Singapore. As a Science and Technology Organisation, we bridge the gap between academia and industry in terms of research and development. In these endeavours, we seek to integrate the relevant capabilities of our research institutes and collaborate with the wider research community as well as other public sector agencies towards meaningful and impactful outcomes.

Together with the other public sector agencies, we develop industry sectors by: integrating our capabilities to create impact with multi-national corporations and globally competitive companies; partnering local enterprises for productivity and gearing them for growth; and nurturing R&D-driven startups by seeding for surprises and shaping for success.

Our research, in addition, also contributes to societal benefits such as improving outcomes in healthcare, urban living, and sustainability. These serve to enhance lives in Singapore and beyond.

## OUR VISION

A global leader in science, technology and open innovation.

A\*STAR is a catalyst, enabler and convenor of significant research initiatives among the research community in Singapore and beyond. Through open innovation, we collaborate with our partners in both the public and private sectors, and bring science and technology to benefit the economy and society.

## MESSAGE FROM THE CHAIRMAN AND CEO

As we approach the halfway mark of the RIE2025 tranche, A\*STAR is steadily transforming ourselves into a strategic innovation engine for Singapore. We continue to advance great science, address national and societal challenges, and create good opportunities for economic growth.

Sustainability remains a key focus for A\*STAR, especially in developing innovations that promote energy efficiency. Underwater turbines designed by A\*STAR's Institute of High Performance Computing (IHPC) and local SME Bluenergy Solutions contribute to supporting Singapore's net zero aspirations by 2050. The turbines will be used in a trial to convert the tidal movement off Pulau Satumu into electricity for Raffles Lighthouse.

To improve health outcomes, A\*STAR's Bioprocessing Technology Institute (BTI), Institute for Molecular and Cell Biology (IMCB), and Experimental Drug Development Centre (EDDC) worked with the National Cancer Centre Singapore to develop EBC-129, the first made-in-Singapore antibody-drug conjugate (ADC). It has since been approved to enter clinical trials by the United States Food and Drug Administration (US FDA). The ADC could be a more effective and targeted alternative to chemotherapy with its ability to selectively target cancer cells.

Strong partnerships with public and private agencies continue to be key enablers in translating our science into impact. For instance, CRISP Meats, a multi-institutional research programme by A\*STAR, the Singapore Institute of Technology (SIT) and the National University of Singapore (NUS), was launched to address the challenges businesses encounter in accelerating the development and production of cultivated meat and seafood.

We also partner with other public agencies to support startups as they bring technologies to market. Lucence, an A\*STAR spin-off and Singapore-based biotech startup, secured approval from Medicare, a US government-funded healthcare insurance programme, for one of its cancer tests.

A\*STAR continues to focus its research in areas that will be crucial in shaping the future. We worked with the Centre for Quantum Technologies (CQT) at NUS and the National Supercomputing Centre Singapore (NSCC) to launch two platforms to elevate our local quantum technology ecosystem. One of the platforms, the National Quantum Fabless Foundry, is being hosted at A\*STAR's Institute of Materials Research and Engineering (IMRE) to support micro and nanofabrication of quantum devices under Singapore's Quantum Engineering Programme.

Our people are at the heart of our push towards research excellence and innovation. They are dedicated to new discoveries and advancing technologies for sustainable economic and societal impact. A\*STAR remains fully committed to nurturing talent for Singapore by providing them with the resources and opportunities to excel.

Looking forward, A\*STAR remains well-positioned to continue impacting Singapore, Singaporeans and Science.



**Ms Chan Lai Fung**  
*Chairman*

**Mr Frederick Chew**  
*Chief Executive Officer*

## BOARD MEMBERS (AS OF 31 MARCH 2023)



### CHAIRMAN

- 01 Ms Chan Lai Fung**  
 Chairman, A\*STAR  
 Permanent Secretary (National Research & Development), National Research Foundation (NRF)

### MEMBERS

- 02 Mr Frederick Chew**  
 Chief Executive Officer, A\*STAR  
 Chief (Public Sector Science & Technology Policy & Plans Office), Prime Minister's Office
- 03 Professor Barry Halliwell**  
 Chairman, Biomedical Advisory Council, A\*STAR  
 Senior Advisor, Academic Appointments and Research Excellence, Office of the Senior Deputy President and Provost, Tan Chin Tuan Centennial Professor, National University of Singapore
- 04 Professor Sir John O'Reilly**  
 Chairman, Science and Engineering Advisory Council, A\*STAR  
 Chairman, NICC (Standards) Ltd
- 05 Professor Isaac Ben-Israel**  
 Director of The Blavatnik Interdisciplinary Cyber Research Center and the Yuval Ne'eman Workshop for Science Technology and Security, Tel Aviv University
- 06 Mr Ashok Belani**  
 Executive Vice President, New Energy Schlumberger
- 07 Professor Stefan Catsicas**  
 Managing Partner, Skyviews Life Science SA
- 08 Mr Chia Song Hwee**  
 Deputy Chief Executive Officer, Temasek International Pte Ltd
- 09 Professor William Chin**  
 Bertarelli Professor of Translational Medical Science and Medicine Emeritus, Harvard Medical School
- 10 Professor Jackie Hunter**  
 Board Director, BenevolentAI Ltd
- 11 Dr Benjamin Koh Khay Wee**  
 Deputy Secretary (Development), Ministry of Health (MOH)
- 12 Dr Josephine Kwa**  
 Director, Barghest Building Performance Pte Ltd
- 13 Mr Arunjai Mittal**  
 Independent Director
- 14 Ms Jacqueline Poh**  
 Managing Director, Economic Development Board
- 15 Mr Quek Gim Pew**  
 Senior R&D Consultant, Ministry of Defence
- 16 Mr Ravinder Singh**  
 Group Chief Operating Officer, Technology & Innovation President, Defence & Public Security, ST Engineering Pte Ltd
- 17 Mr Soh Gim Teik**  
 Partner, Finix Corporate Advisory LLP
- 18 Professor Tan Eng Chye**  
 President, National University of Singapore



## A\*STAR EXECUTIVE MANAGEMENT (AS OF 31 MARCH 2023)



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### SENIOR MANAGEMENT

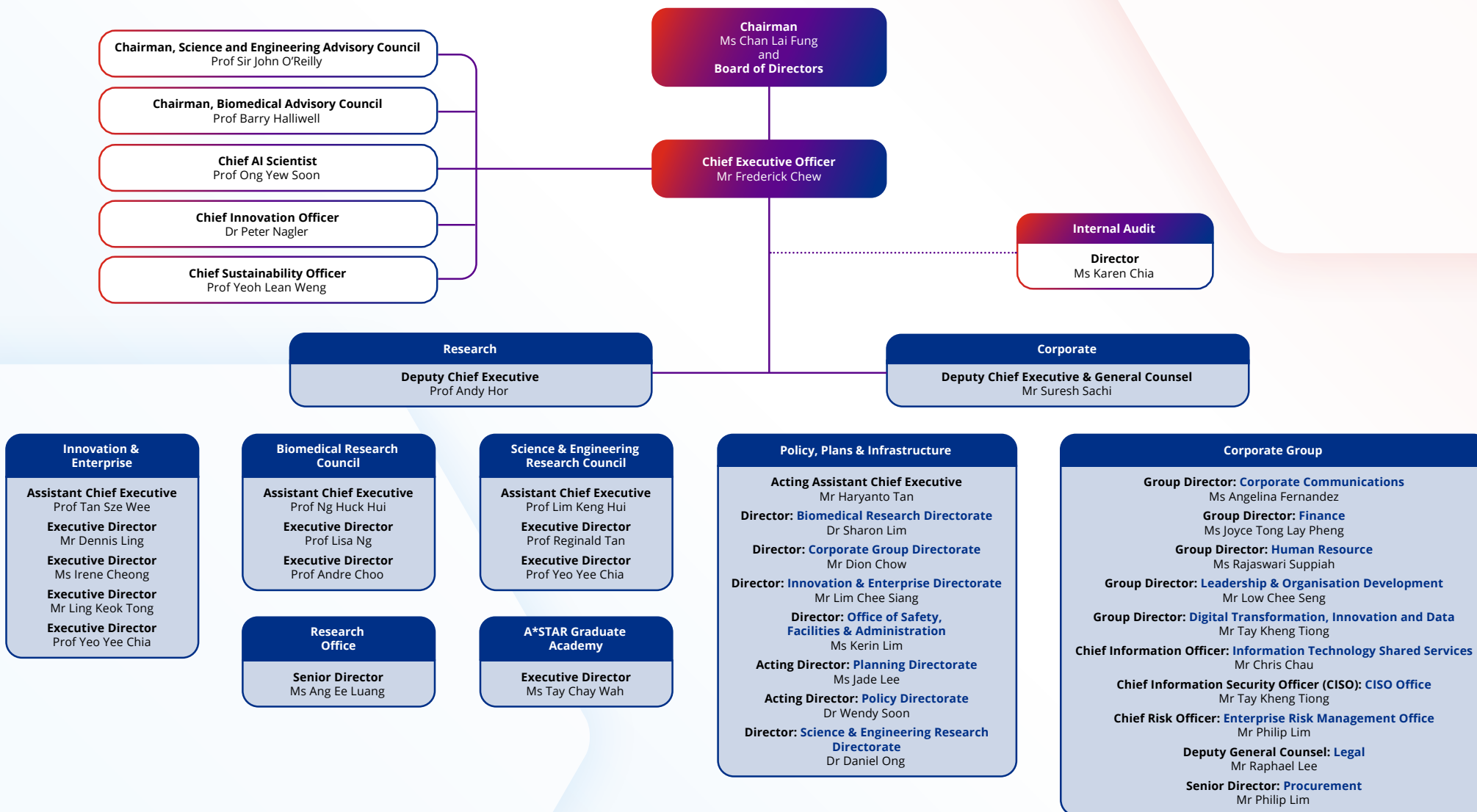
- 01 Mr Frederick Chew**  
*Chief Executive Officer, A\*STAR*  
*Chief (Public Sector Science & Technology Policy & Plans Office), Prime Minister's Office*
- 02 Mr Suresh Sachi**  
*Deputy Chief Executive (Corporate)*  
*General Counsel, A\*STAR*
- 03 Professor Andy Hor**  
*Deputy Chief Executive (Research), A\*STAR*
- 04 Professor Ng Huck Hui**  
*Assistant Chief Executive, Biomedical Research Council, A\*STAR*

- 05 Professor Lim Keng Hui**  
*Assistant Chief Executive, Science & Engineering Research Council, A\*STAR*
- 06 Professor Tan Sze Wee**  
*Assistant Chief Executive, Innovation & Enterprise, A\*STAR*
- 07 Mr Haryanto Tan**  
*Acting Assistant Chief Executive, Policy Plans & Infrastructure*

### SENIOR SCIENTIFIC ADVISORS

- 08 Professor Barry Halliwell**  
*Chairman, Biomedical Advisory Council (BMAC), A\*STAR*  
*Senior Advisor, Academic Appointments and Research Excellence, Office of the Senior Deputy President and Provost, Distinguished Professor, Department of Biochemistry, National University of Singapore*
- 09 Professor Sir John O'Reilly**  
*Chairman, Science and Engineering Advisory Council (SEAC)*  
*Chairman, NICC (Standards) Ltd*
- 10 Professor Ong Yew Soon**  
*Chief Artificial Intelligence Scientist, A\*STAR*  
*President's Chair Professor of Computer Science, NTU*
- 11 Dr Peter Nagler**  
*Chief Innovation Officer, A\*STAR*  
*Advisor Institute of Sustainability for Chemicals, Energy and Environment (ISCE<sup>2</sup>)*
- 12 Professor Lam Ping Koy**  
*Chief Quantum Scientist, A\*STAR*
- 13 Professor Yeoh Lean Weng**  
*Chief Sustainability Officer, A\*STAR*  
*Executive Committee Member, Institute of Sustainability for Chemicals, Energy and Environment (ISCE<sup>2</sup>)*

# ORGANISATION CHART (AS OF 31 MARCH 2023)



## SUBSIDIARY COMPANY

### Name of subsidiary company

Accelerate Technologies Pte Ltd (A\*cceletrate)

### % of shareholdings A\*STAR has in company

100%

A\*cceletrate was established to commercialise the Intellectual Property portfolio of the Agency for Science, Technology and Research (A\*STAR) as well as to hold and manage its spin-off activities.

As of January 2021, the functions and staff of A\*cceletrate were incorporated into A\*STAR's Innovation & Enterprise Group (I&E). I&E supports A\*STAR in transforming the economy by driving innovation and commercialising A\*STAR's research outcomes. Together with the public sector, industry partners and the research community, I&E leverages innovation to help Singapore companies grow and be more competitive, facilitates the growth of deep tech startups in Singapore and supports national platforms to drive the productisation efforts of enterprises.

A\*cceletrate continues to hold license agreements and equity in spin-off companies. A\*cceletrate has a wholly-owned subsidiary, Accelerate Venture Creation Pte Ltd (A\*VC), an investment holding company with legacy shareholdings in two spin-off companies. Collectively, A\*cceletrate and A\*VC hold equity stakes in over 40 spin-off companies in the biomedical and physical sciences.

### A\*cceletrate subsidiaries

- A\*cceletrate Venture Creation Pte Ltd
- A\*STAR (Suzhou) Co. Ltd

For more information, visit

<https://www.a-star.edu.sg/enterprise>

## OUR INSTITUTIONS AND PLATFORMS

The A\*STAR community spans a broad range of research areas from the biomedical sciences to the physical sciences and engineering. The community of scientists and researchers, technical and non-technical staff, and industry development, commercialisation and corporate staff were more than 5,800 strong as of 31 March 2022.

### Biomedical Research Entities

- A\*STAR Infectious Disease Labs (ID Labs)
- A\*STAR Skin Research Labs (A\*SRL)
- Bioinformatics Institute (BII)
- Bioprocessing Technology Institute (BTI)
- Genome Institute of Singapore (GIS)
- Institute of Bioengineering and Bioprocessing (IBB)
- Institute of Molecular and Cell Biology (IMCB)
- Singapore Immunology Network (SIgN)
- Singapore Institute for Clinical Sciences (SICS)
- Singapore Institute of Food and Biotechnology Innovation (SIFBI)

### Science and Engineering Research Entities

- Advanced Remanufacturing and Technology Centre (ARTC)
- Institute of Sustainability for Chemicals, Energy and Environment (ISCE<sup>2</sup>)
- Institute of High Performance Computing (IHPC)
- Institute for Infocomm Research (I<sup>2</sup>R)
- Institute of Materials Research and Engineering (IMRE)
- Institute of Microelectronics (IME)
- National Metrology Centre (NMC)
- Singapore Institute of Manufacturing Technology (SIMTech)

### Horizontal Technology Coordinating Offices

- Agritech and Aquaculture
- Artificial Intelligence, Analytics and Informatics
- Health and Medical Technologies
- Infectious Diseases
- Robotics
- Social Sciences and Technology
- Urban and Green Technology

### National Platforms

*Platforms managed by A\*STAR but funded nationally.*

- Advanced Manufacturing Training Academy (AMTA)
- Biomedical Sciences Industry Partnership Office (BMS IPO)
- Consortium Management Office (CMO)
- Diagnostics Development (DxD) Hub
- Experimental Drug Development Centre (EDDC)
- InVivos
- Low Carbon Energy Research Coordinating Office (LCER CO)
- National Additive Manufacturing Innovation Cluster (NAMIC)
- National Quantum Office (NQO)
- National Robotics Programme (NRP)
- National Supercomputing Centre (NSCC)
- Singapore Biodesign (SB)
- Technology Centre for Offshore and Marine, Singapore (TCOMS)
- Urban Solutions and Sustainability Innovation & Enterprise (USS I&E)



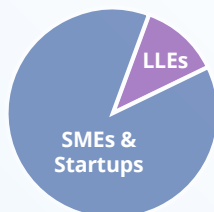
## FY2022 AT A GLANCE

**1,806** projects undertaken with companies (industry projects)

**\$227.2M** Industry R&D Spending

### Supporting Local Enterprises' Productivity and Growth

**88%**  
projects with SMEs and Startups



**12%**  
projects with LLEs

**42** Research Scientists and Engineers seconded to industry

### Strengthening Innovation and Enterprise

#### PRODUCTISATION & SPIN-OFFS

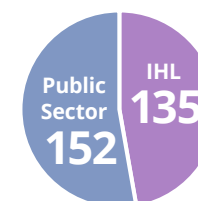
**9** successful A\*STAR Spin-offs

Attracted **\$131.9M** of follow-on funding



### Contributing to Public Sector Transformation

**287** projects undertaken with public sector agencies and Institutes of Higher Learning (IHLs)



### Advancing Quality Science

**1.7**

A\*STAR publications' average Field-Weighted Citation Impact in Research, Innovation and Enterprise (RIE) 2025\*

\*60% more cited than expected according to the global average

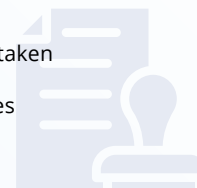
**25%**

of our publications were amongst the top 10% of the world's most highly cited



#### LICENSING

**56** licenses taken up by 49 companies



**45%** to SMEs and spin-offs

### Attracting and Building Pipeline of STEM Talent

As at end FY2022, A\*STAR has built a pipeline of

**1,776**

R&D talent through a suite of scholarships since 2001

**127**

A\*STAR scholarships awarded since the start of RIE2025, as at the end of FY22



# KEY ACHIEVEMENTS

- 11** Strengthening Singapore's Economy
- 18** Addressing National Challenges with Multi-Disciplinary R&D Capabilities
- 35** Deepening Use-inspired Basic Research
- 42** Nurturing Top Talent for the Local R&D Ecosystem







## KEY ACHIEVEMENTS

# STRENGTHENING SINGAPORE'S ECONOMY

As Singapore's lead public sector agency at the forefront of research, A\*STAR's continuous contributions to the research community enable local companies to build up their capabilities. Additionally, our close collaboration with other institutes from abroad allows us to expand our reach and engage in mutual learning. Through extensive research in various domains, we propel economic growth and progress.



## ACCELERATING THE GROWTH OF LOCAL COMPANIES

### Uplifting Small and Medium-sized Enterprises

The [Technology for Enterprise Capability Upgrading \(T-Up\) programme](#) was made available for Trade Associations and Chambers (TACs) to tap on from 1 January 2023. A\*STAR intends to second researchers to five TACs in 2023. The researchers will share their expertise in research and development (R&D) and innovation projects with professionals from small and medium-sized enterprises (SMEs) to help them establish competitiveness in a tumultuous economy.



▲ T-Up Excellence awards winners, from left to right: Frederick Chew, CEO, A\*STAR; Dr Lee Sook Yee, Science Team Lead of Alchemy Foodtech; Verleen Goh, Co-founder of Alchemy Foodtech; Peter Ong, Chairman of EnterpriseSG; Dr Tong Cheuk Ka, Strategy and Programme Manager of Tessa Therapeutics; Chan Lai Fung, Permanent Secretary of National Research and Development and Chairman of A\*STAR; Dr Xavier Lim, Solutions Director of Xnergy Autonomous Power Technologies; Mr Vincent Chuang, Senior Research Engineer from A\*STAR

*"I hope our initiatives will give local companies a boost in their innovation capacity to create new products and services and meet the global demand for sustainable solutions."*



▲ Frederick Chew, CEO A\*STAR presenting at SME Tech Day

### Equipping Local Firms for Entry into the Chinese Market

The A\*STAR Partners' Centre (A\*PC) joined the Global Innovation Alliance, a joint initiative between the Ministry of Education, the Singapore Economic Development Board and Enterprise Singapore. A\*PC has supported 22 Singapore companies in developing their business in China, since its inception in November 2020. By joining the Global Innovation Alliance, A\*PC will be better positioned to help more local firms penetrate the Chinese market.



▼ Facilities in A\*PC

▲ Launched in November 2020, A\*PC aims to help local firms enter the Chinese market



## ACCELERATING THE GROWTH OF LOCAL COMPANIES

### Enabling Local Technologies to Go Global

A\*STAR spin-off Lucence, a Singapore-based biotech startup, has obtained a coverage decision from Medicare, a US government-funded healthcare insurance programme, for its LiquidHALLMARK® liquid biopsy test. As the first Asian-headquartered healthcare services company to secure US national insurance approval, Lucence is developing innovative biomedical technologies to benefit patients worldwide.

### Commercialising Low-calorie Noodles Rich in Dietary Fibre

A\*STAR and Hafnium Ventures signed an exclusive license agreement to commercialise a [low-calorie noodle formulation](#) made with plant-based ingredients by NOBA, a spin-off from A\*STAR's Singapore Institute of Food and Biotechnology Innovation (SIFBI). This innovative low-calorie noodle is made with plant-based ingredients and is high in dietary fibre while preserving a similar taste and texture to the yellow noodles commonly consumed in Asian dishes.



### Accelerating the Transition from Lab to Market



A\*STAR, Nanyang Technological University Singapore (NTU) and the National Healthcare Group (NHG) have launched [co11ab Novena](#), a biomedical technology (BioMedtech) incubator on 9 September 2022. The incubator will bring together research, clinical and venture creation activities, supporting BioMedtech startups from research to commercialisation.

◀ From left to right: Professor Andy Hor, Deputy Chief Executive (Research), A\*STAR; Mr Soh Leng Wan, Assistant Chief Executive, Enterprise SG; Professor Lam Khin Yong, Senior Vice-president (Research), NTU; Professor Benjamin Seet, Deputy Group CEO (Education and Research), NHG

“Platforms like co11ab are important to bring together the research ecosystem's collective strengths and capabilities in support of R&D (research and development) translation, spin-off creations and incubations to bring health technologies to the clinic and the market.”

**Professor Tan Sze Wee**  
Assistant Chief Executive of Innovation and Enterprise, A\*STAR

### Microemulsion Technology Employed in Developing Steroid Cream



Tapping on the microemulsion platform technology of A\*STAR's Institute of Sustainability for Chemicals, Energy and Environment (ISCE<sup>2</sup>), Hyphens developed a formulation incorporating lipids and other key ingredients in its new steroid cream: [Meradan®](#). While most steroid creams are known to cause skin thinning, Meradan® is formulated with skin barrier repair properties and is suitable for alleviating skin diseases and conditions.

◀ Hyphens develops steroid cream, Meradan®, with the help of ISCE<sup>2</sup>



## ACCELERATING THE GROWTH OF LOCAL COMPANIES

### Driving Clinical Translation of Immune Cell-based Therapy

A\*STAR's Institute of Molecular and Cell Biology (IMCB) collaborated with leading biotechnology company SCG Cell Therapy Pte Ltd (SCG) to accelerate the clinical translation of the latter's cell-based immunotherapy pipeline. SCG is providing its proprietary technologies to the therapeutic development of immune cell-based therapy candidates such as CAR-T, TCR-T therapies, antibodies and vaccines. Meanwhile, IMCB is lending its capabilities on in-vivo drug testing and development platforms based on humanised preclinical test platform technologies.



### Developing Singapore's Competitiveness in Robotics

The National Robotics Programme (NRP), a national platform hosted by A\*STAR, celebrated its sixth anniversary with the NRP6 Festival, featuring various robots. This included the ISERO, developed by I<sup>2</sup>R, and the Multi-purpose All-Terrain Autonomous Robot (M.A.T.A.R), developed by A\*STAR, Home Team Science and Technology Agency (HTX), and the Singapore Police Force (SPF). NRP has worked with industry partners to build robots that have been commercialised and successfully deployed in Singapore and beyond, for its capabilities to augment our workforce and empower individuals.

### Innovating Air Sanitisers with Greater Killing Prowess

#### Safe Air Dome Technology

which has been incorporated into air sanitisers, is a product of A\*STAR and spin-off Plasma Science's collaboration. To eliminate bacteria and viruses, the technology taps on the science of cold plasma ions, advanced graphene electrostatic plates and built-in ultraviolet-C to boost sterilisation, hence addressing the key limitations of conventional air purifiers in the market.

▶ *The Safe Air Dome Technology, developed by A\*STAR's IMRE and Plasma Science, captures and destroys volatile organic compounds, allergens, odour, aerosol and dust, whereas typical air purifiers in the market are designed to remove dust and allergens only*

**Revolutionary System That is Proven To Help You Breathe Safer & Better**

**TRIDENT**

TRIDENT PLUS

Up to 138sqm  
Wi-Fi App Control  
Speed: 1, 2, 3, 4, AUTO  
TVOC & PM2.5 Indicators

TRIDENT MINI

Up to 74sqm  
Wi-Fi App Control  
Speed: 1, 2, 3, 4, AUTO  
Child-lock function  
TVOC & PM2.5 Indicators

**INTRODUCING TRIDENT**  
ULTIMATE AIR & SURFACE SANITISER

Technology developed in Singapore by Plasma Science in collaboration with the Agency for Science, Technology and Research (A\*STAR) Institute of Materials Research and Engineering, and other partners.  
WWW.TRIDENTAIR.SG

**THE NEW WAY TO BREATHE BETTER HAS ARRIVED**  
The first and only line-up of air purifiers in Singapore that creates a 'Safe Air Dome' around users by eliminating viruses (including the coronavirus), allergens, odour, aerosols, and dust by up to 99.99% unlike other purifiers in the market which are mainly designed to remove dust and allergens.



## FOSTERING STRONG INTERNATIONAL PARTNERSHIPS

### Stimulating Innovation in the Eye Health Community

A\*STAR and Johnson & Johnson Vision will establish an [Eye Health Digital Innovation Consortium](#) to forge public-private partnerships that address eye health needs in Singapore and beyond. The two organisations will jointly invest S\$15 million over three years. The consortium, hosted at A\*STAR's IHPC, taps on its expertise in blockchain and trust technologies, computational behavioural modelling and artificial intelligence to create new value in translating eye health research technologies into digital solutions for patients.



▲ A\*STAR's IHPC and Johnson & Johnson Vision sign MoU for Eye Health Digital Innovation Consortium

### Developing High-quality 200mm Silicon Carbide and Specialty Epitaxy Processes

LPE and A\*STAR's IME announced a research collaboration to [develop high-quality 200mm SiC](#) and specialty epitaxy processes including enhanced growth rates with improved uniformity. To achieve their aim, the parties will carry out experimental activities supported by simulation studies. IME will establish the 200mm SiC pilot line to validate 200mm manufacturing processes and tools on a pilot scale before progressing to 200mm high-volume manufacturing.

**“The success of this collaboration will benefit the SiC manufacturing ecosystem and accelerate the adoption of high-performance SiC power modules across various applications such as electric vehicles and charging points.”**

**Mr Terence Gan**  
Executive Director, A\*STAR's IME

### Supporting Startups in Adopting Precision Fermentation

A\*STAR's SIFBI entered a multi-year partnership with ScaleUp Bio to [set up a joint lab](#) focused on precision fermentation. Situated within the Food Tech Innovation Centre (FTIC) at Biopolis, the lab provides startups with large-scale fermenters, processing units, testing, and analysis tools to optimise their operations and product development. Such developments will support the growing needs of local and regional consumers.

## FOSTERING STRONG INTERNATIONAL PARTNERSHIPS

### Forging Bilateral Partnerships to Cultivate Machine Learning and Artificial Intelligence

A\*STAR's IHPC and Japanese research institute RIKEN Center for Advanced Intelligence Project (AIP) signed an [MoU](#) to promote multinational collaboration in education and research relating to Artificial Intelligence (AI). Besides conducting joint research to advance machine learning and AI algorithms, the two entities will exchange researchers and engineers, publish high-quality publications in renowned conferences and journals, and organise Singaporean and Japanese workshops about machine learning and AI.

### Collaboration to Develop Practical Adhesive Material Applications

Toray Industries and A\*STAR's Institute of Microelectronics (IME) are jointly researching on [practical applications for high heat-dissipating adhesive sheets](#) for silicon carbide (SiC) power semiconductors. These offer significant energy efficiency and carbon neutrality benefits, particularly in automotive applications, because of their superior heat resistance to conventional silicone.

### Advancing Flow Cytometry Analysis for Immunology Research

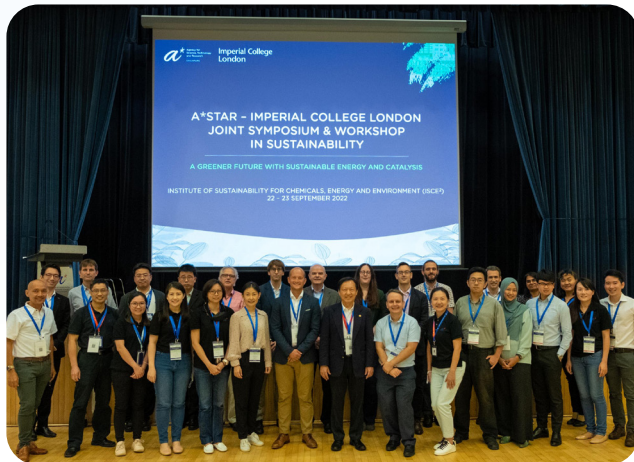


A global leader in life science technologies, Becton Dickinson (BD) Holdings, and A\*STAR signed a partnership that will hone in on [deep immunophenotyping](#) of human tissues using spectral flow cytometry panels to yield findings that manifest positive healthcare outcomes. The panels will pave a path for constructing other related flow panels, shorten the time needed to develop new high-dimensional spectral panels and improve the consistency and reproducibility of the flow cytometry data in the research ecosystem.

## FOSTERING STRONG INTERNATIONAL PARTNERSHIPS

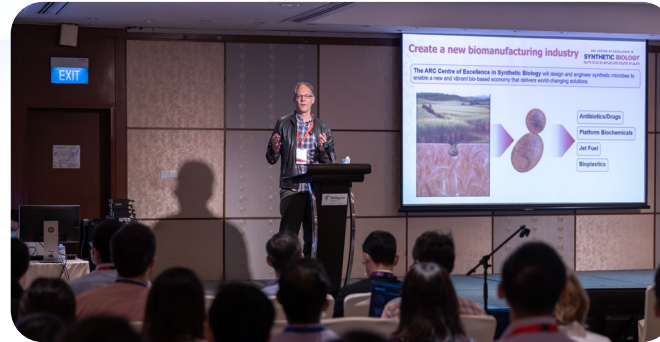
### A\*STAR-Imperial College London Joint Symposium and Workshop

A\*STAR orchestrated a symposium in collaboration with delegates from the Imperial College London (ICL). Speakers from the local and international research community came together to discuss their endeavours to tackle a wide range of issues on sustainability. The symposium covered topics such as carbon upcycling, small molecule activation, high-throughput chemistry and environmentally friendly catalysis. The event also featured a segment dedicated to engaging talented individuals in these crucial areas. At the event, A\*STAR and ICL signed an MoU aimed at promoting research and development collaboration activities in the field of sustainable energy and catalysis.



▲ Group photo of Imperial College London delegates, Symposium Speakers and A\*STAR organising committee

### A\*STAR Mini Symposium on Engineering Biology



▲ Keynote speaker, Distinguished Professor Ian Paulsen from Macquarie University, Sydney: speaking at the A\*STAR Mini Symposium on Engineering Biology

A\*STAR organised a symposium and invited leaders from academia and industry to discuss cutting-edge advancements in engineering biology. Distinguished international and local speakers from academia and industry presented their achievements in foundational technologies, therapeutics, nutrition, green chemistry, and the translation of these technologies into practical applications. Participants also explored how synthetic biology is poised to impact our lives soon. The unprecedented ease and accuracy of genetic manipulation in engineering biology offers promising solutions to pressing environmental and societal issues.

### A\*STAR Mini Symposium on Quantum Science and Technology

To further research collaborations in the field of quantum science and technology, A\*STAR gathered researchers in active discussions on issues pertaining to quantum research through an organised symposium. Distinguished speakers from Australia and Singapore shared their expertise in quantum photonics, quantum computing hardware and quantum sensing technologies.



▲ Keynote speaker, together with invited Speakers and A\*STAR Symposium organising committee





## KEY ACHIEVEMENTS

# ADDRESSING NATIONAL CHALLENGES WITH MULTI-DISCIPLINARY R&D CAPABILITIES

A\*STAR strives to derive better societal, health and sustainability outcomes for Singaporeans. As such, we work closely with the public sector and industry to develop innovative solutions that improve lives.

## BUILDING COLLABORATIONS FOR BETTER SOCIETAL OUTCOMES

### Reshaping the Classrooms of Tomorrow

A\*STAR, NTU and the National Institute of Education (NIE) will jointly work on cooperative research initiatives in education that focus on [reshaping research into pedagogy design and intelligent tools](#) for future classes. The collaboration aims to spotlight the science of learning in education, AI, machine learning and human-artificial cognition. By amalgamating AI technologies with social and behavioural sciences, the collaboration can alleviate issues found in current teaching and learning systems.



▲ Professor Louis Phee, Dean, College of Engineering, NTU; Professor Christine Goh, Director, NIE NTU, Professor Lim Keng Hui, Assistant Chief Executive, SERC, A\*STAR

### Investigating Screen Time and its Effects on Cognitive Functions

A\*STAR's Singapore Institute for Clinical Sciences (SICS), together with the National University of Singapore (NUS), the National Institute of Education (NIE), KK Women's and Children's Hospital, McGill University and Harvard Medical University, conducted a [study](#) that ascertained a positive relationship between excessive screen time during infancy and the demonstration of adverse outcomes in cognitive functions. Specifically, excessive screen time could impede executive function development and correlates to children struggling to control emotions or impulses, sustain attention, follow multi-step instructions and persist in difficult tasks.



▲ Increased screen time is associated with more altered brain activity and cognitive deficits in children

“With these results, we are one step closer towards better understanding how environmental influence can affect the health and development of children. This would allow us to make more informed decisions in improving the health and potential of every Singaporean.”

**Professor Chong Yap Seng**  
Dean of NUS Medicine and Chief Clinical Officer, SICS



## BUILDING COLLABORATIONS FOR BETTER SOCIETAL OUTCOMES

### Home-based Training Programme to Target Child Inattentiveness

A\*STAR spin-off Neeuro, together with the Institute of Mental Health (IMH), launched [Cogo](#), a complementary home-based attention training programme. The solution, a 24-session guided game paired with Neeuro's EEG headband "SenzeBand 2", targets attentiveness issues in children aged 6 to 12. Cogo provides parents with a tool that alleviates their children's inattentiveness in the comfort of their own homes.

▲ *Cogo is a non-invasive ADHD intervention programme that assists parents in curbing their children's attention challenges*



### Teaching Self-regulation to Caretakers and Preschool Children

To help preschool teachers promote eating self-regulation skills for children and caregivers, A\*STAR's Singapore Institute for Clinical Sciences (SICS) has developed a programme known as the [Appetite Tool](#). With the aim to prevent childhood obesity early on, the programme advocates the importance of eating according to internal cues of hunger and fullness instead of external cues in the environment. It includes evidence-informed story books, developmentally appropriate activities and recommended practices to raise appetite awareness among children and their caregivers.



▲ *The Appetite Toolbox aids preschool teachers in cultivating better eating self-regulation among children*



▲ *A child's development of a sleep-wake cycle starts in the womb*

### Examining How Sleep Affects Mother and Fetus

As part of Singapore's GUSTO cohort study which looks into understanding the various conditions that influence the health and development of women and children, A\*STAR's SICS conducted a [study](#) investigating how sleep comes into play. The study found that an expectant mother's sleep quality correlates with her physical and mental well-being; additionally, it can influence her infant's daily pattern of wakefulness and sleep during the first year of birth.



## CONTRIBUTING TO BETTER HEALTH OUTCOMES

### Advancing Patient Care through Digital and Wearable Therapeutics

Digital therapeutics startup Respiree, an A\*STAR spin-off, has secured the 510(k) clearance from the US Food and Drug Administration (FDA) for its chest wearable, [RS001](#). The device directly measures respiration and is intended for patients with cardio-pulmonary diseases such as congestive heart failure and chronic obstructive pulmonary disease (COPD). With RS001, physicians can identify COPD exacerbations much earlier and provide patients with preventive care in advance, subsequently improving morbidity and mortality rates. Respiree aims to improve patient outcomes and medicine by offering targeted predictions and diagnoses of cardio-respiratory diseases through an amalgamation of advanced breath-cardio sensors and artificial intelligence (AI).



◀ Illustrative Image of Respiree™'s RS001 Cardio-respiratory Wearable

### Conducting Optoacoustic Imaging to Verify Complete Tumour Excision

A\*STAR's Institute of Bioengineering & Bioimaging (IBB) and the National University Hospital (NUH) used [optoacoustic imaging to augment current methods](#) of ascertaining that cancerous breast lesions are completely removed during breast-conserving surgeries. Optoacoustic imaging is a hybrid technology which uses both laser and ultrasound imaging and could potentially assist in reducing reoperation and preventing further psychological stress for patients.

### Studying Asian Skin and Evaluating Skin Disorders

Under the Asian Skin Microbiome Programme (ASMP), A\*STAR Skin Research Labs (A\*SRL) is [investigating the distinction between Asian and Caucasian skin](#). The institute studies skin microbiome and actively contributes to the Skin Research Institute of Singapore (SRIS), a collaboration between A\*STAR, NHG and NTU. The programme has developed a unified skin microbiome database comprising skin metagenomics, metabolomics and lipidomics across a range of diverse Asian ethnicities and age groups. This will then be paired with extensive questionnaire information and skin phenotyping data to form a holistic view of the skin microbiome within the Asian population.

### Integrating Social Sciences with Digital Technologies to Address National Priorities

The SMU-A\*STAR Joint Lab in Social and Human-Centred Computing was launched and covers two multidisciplinary research pillars in Computational Social Science and Human-AI Synergy. Through joint projects that dive into areas such as adaptability, resilience and successful ageing, and with industry collaborators from Dementia Singapore and Sengkang General Hospital, this symbiotic partnership aims to generate impactful outcomes to address the needs of our population, especially for our seniors.

## CONTRIBUTING TO BETTER HEALTH OUTCOMES

### Tapping on AI to Detect Cancer Mutations

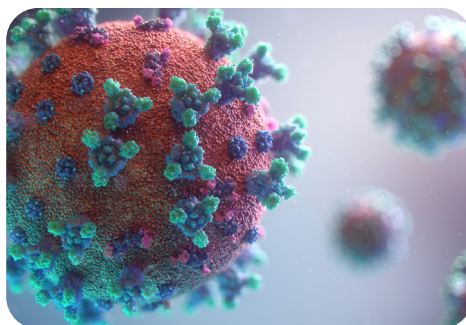


▲ Using AI can speed up and make the sequencing of large amounts of patient data much more efficient

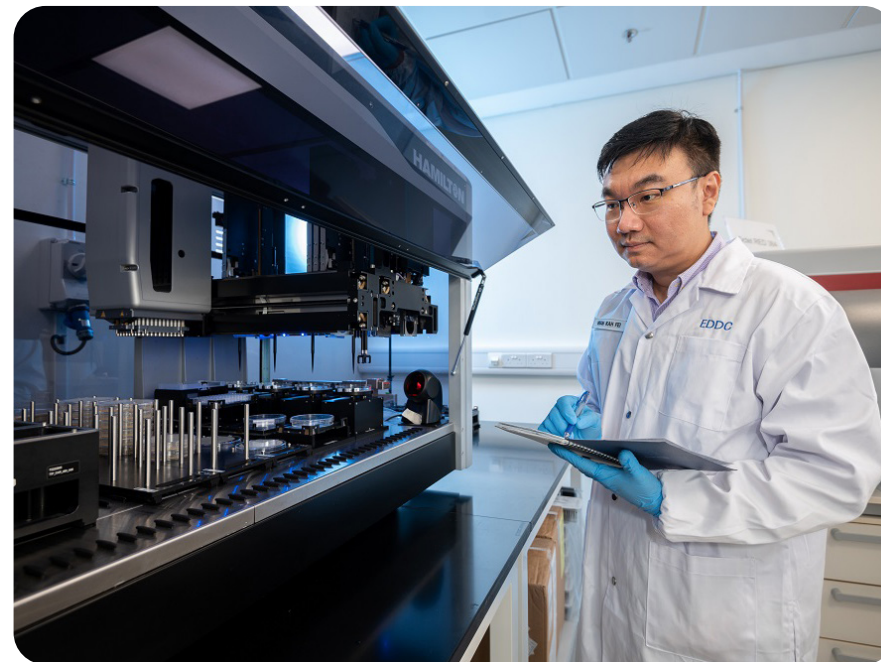
A\*STAR's Genome Institute of Singapore (GIS) developed [VarNet](#), an AI-based mutation caller, which goes through raw deoxyribonucleic acid (DNA) sequencing data and detects mutations using deep learning models. By analysing labelled tumour data and DNA sequencing data, VarNet can pick up on mutations in sequence data that it encounters. It detects mutations in real and synthetic tumour data with higher accuracy than existing mutation callers and could alleviate the need for human experts to validate and check the output of the callers in the future.

### Mixing mRNA vaccine boosters for Stronger Antibody Responses

A study that A\*STAR's Infectious Diseases Labs (ID Labs) conducted found that [mixed mRNA booster vaccination](#) provides higher and more sustained antibody levels against the Omicron XBB strain. Study participants who had a Moderna monovalent booster after two Pfizer vaccinations exhibited higher and more consistent antibody levels compared to those who received a Pfizer monovalent booster.



### Optimised Antibodies for Safer Treatments



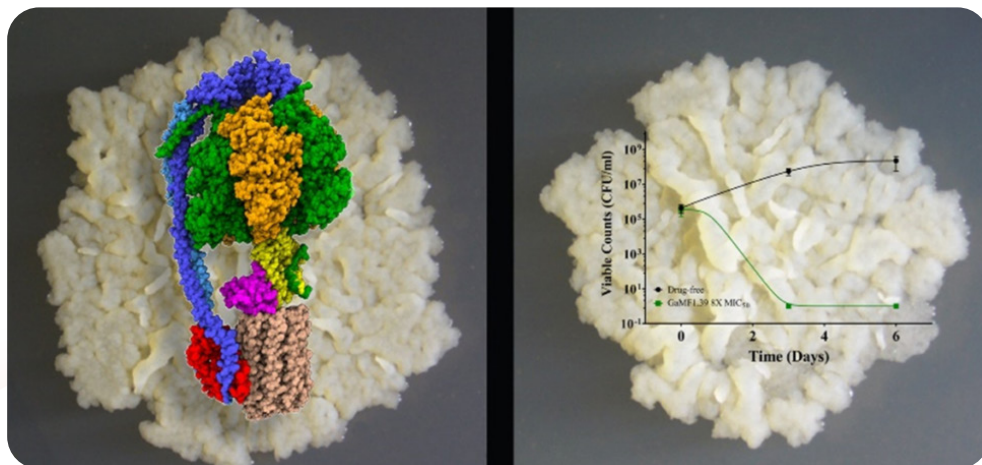
▲ A researcher from EDDC, an A\*STAR-hosted development platform, planning the automation of an antibody engineering process

Pharmaceutical company Boehringer Ingelheim has entered a [global licensing agreement](#) to develop and commercialise unique antibodies, developed by A\*STAR's research institutes, for targeted cancer therapies. The Experimental Drug Development Centre (EDDC), an A\*STAR-hosted development platform, optimised the antibodies and confirmed they could be applied to various solid cancers, which paves the way for safer and more effective therapies for patients.



## CONTRIBUTING TO BETTER HEALTH OUTCOMES

### Developing New Drugs to Thwart Tuberculosis



▲ The mycobacterial F-ATP synthase (left) is the target of the new chemical compound, which is shown to be potent in killing the bacterium (right)

To kill multidrug-resistant tuberculosis (TB), A\*STAR's Experimental Drug Development Centre (EDDC) [developed a series of chemical compounds](#) with NTU. US-based company Neuro-Horizon Pharma has licensed the compounds and will use them to create new drugs that tackle TB, the second leading infectious disease killer, which is growing resistant to existing medications.

### Furthering Cancer Treatment and Research

[m6Anet](#) is a software that accurately predicts m6A modifications from genomic data. A joint collaboration between A\*STAR's GIS and NUS, the tool can accurately predict RNA modifications such as m6A to help scientists more quickly discern diseases associated with m6A. This will advance the development of cancer treatments in the future.

### New Antibody-Drug Conjugate Approved to Enter Clinical Trials



▲ A\*STAR's EDDC staff working on validation studies for EBC-129 patient selection assay



▲ A\*STAR's EDDC, BTI and IMCB worked with the NCCS to develop EBC-129, the first made-in-Singapore antibody-drug conjugate (ADC)

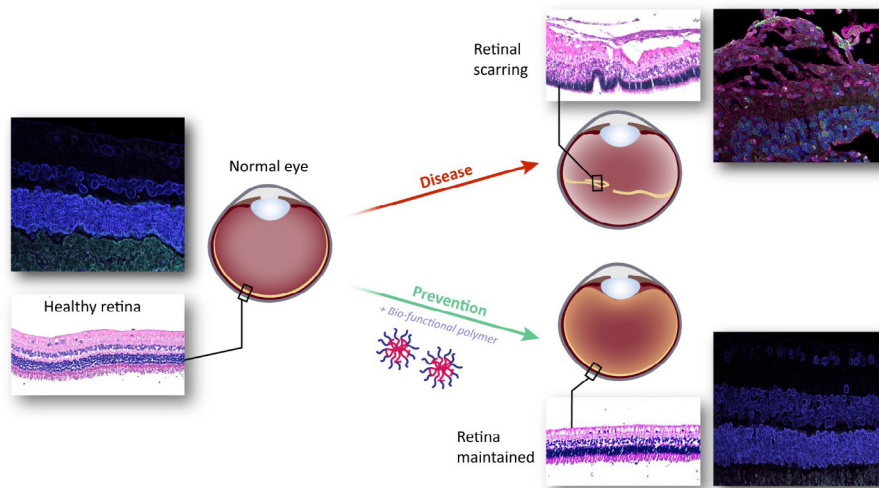
A\*STAR's EDDC, BTI and IMCB worked with the NCCS to develop EBC-129, the [first made-in-Singapore antibody-drug conjugate \(ADC\)](#) that is entering clinical development. The United States Food and Drug Administration (US FDA) approved the advancement into first-in-human studies involving Singaporean patients. In determining the ADC's safety and tolerability, the ADC could prove a more effective and targeted alternative to chemotherapy.



## CONTRIBUTING TO BETTER HEALTH OUTCOMES

### Preventing Retinal Scarring with Unique Thermogel

A\*STAR's Institute of Molecular and Cell Biology (IMCB) and Institute of Materials Research and Engineering (IMRE) worked together with NUS and the Singapore Eye Research Institute (SERI) to [develop a bio-functional thermogel](#), a kind of synthetic polymer, that prevents retinal scarring caused by failed retinal detachment repair surgery. The collaboration aims to design the next generation of polymers with targeted chemical modifications to induce specific cellular behaviours and derive other applications of the thermogel aside from ophthalmology.



▲ Applying a bio-functional thermogel can prevent retinal detachment and maintain the retina without scarring

### Cell-based Research to Innovate Diabetes Treatments

Local biotech startup BetaLife acquired the rights to human induced Pluripotent Stem Cell (iPSC) technology from A\*STAR. [Through collaborative efforts](#), the technology will aid in developing regenerative medicine. iPSC cells exist in an embryonic state, providing a renewable and sustainable source of mature human cells of various types. To further develop human iPSC-based therapy, the partnership aims to create a carefully selected human iPSC bank. To enhance research efforts, the bank will encapsulate the genetic diversity of Asian ethnicities and develop pancreatic islet cells, supporting new forms of iPSC-based therapies.

### Fostering Innovation in Dentistry



In pursuit of advanced regenerative technologies for dental use, A\*STAR, the National Dental Centre Singapore (NDCS) and Osteopore (OSX.AX) collaborated to [develop a new generation of jaw implants](#). The research findings will stimulate faster bone growth and reduce the need for complex bone harvesting processes, thereby streamlining dental procedures and applications in the future.

◀ A\*STAR, the National Dental Centre Singapore (NDCS) and Osteopore collaborated to develop a new generation of jaw implants

## SHAPING A SUSTAINABLE FUTURE

### Developing Cultivated Meats and Local Prowess in Biomanufacturing and Biotechnology

A\*STAR's BTI and Corning launched a joint lab in March 2023 to advance bioprocessing capabilities in the flourishing local and regional biomanufacturing and life-sciences research markets. The lab taps on Corning cell culture technologies as well as A\*STAR's expertise in cell culture and media development. It aims to develop platform solutions to enable resource-efficient and cost-efficient production of cultivated meat. The findings can apply to cell and gene therapy and biologics development, and propel Singapore's growth as a major global hub for R&D in biomanufacturing and biotechnology.

► Opening day of the Asia Accelerator Lab



“ This is a significant step forward in Singapore's growth as a key global hub for research and development in the biomanufacturing and biotechnology sectors.”

Dr Koh Boon Tong  
Executive Director at A\*STAR's BTI



### Charting a Sustainable Course

At the 27<sup>th</sup> United Nations Climate Change Conference (COP27), A\*STAR participated in the panel “Decarbonising Logistics” to discuss the key challenges and opportunities in decarbonising supply chains, and also shared our [end-to-end capabilities for carbon management](#).

► A\*STAR attended COP27 and shared its end-to-end capabilities for carbon management



► Dr Yeo Zhiquan from A\*STAR's SIMTech, spoke about A\*STAR's end-to-end capabilities for carbon management





## SHAPING A SUSTAINABLE FUTURE

### Anchoring Sustainability among Local Businesses



▲ Signatories at the Green Compass MoU signing ceremony.

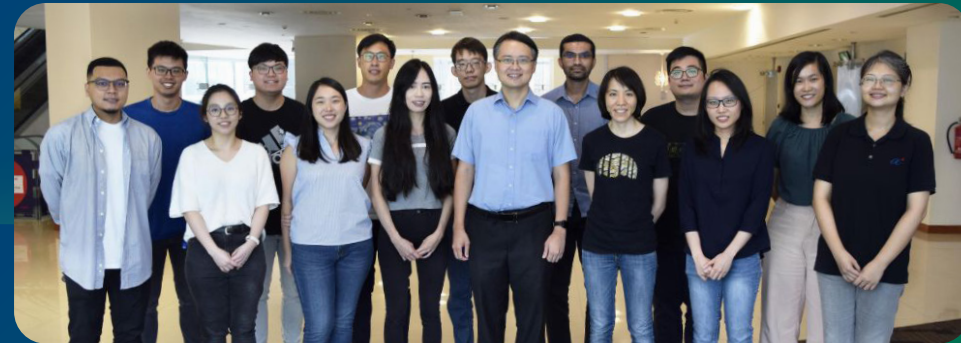
A\*STAR signed a memorandum of understanding (MoU) with six parties from the public and private sectors for Green Compass at the Industrial Transformation Asia-Pacific (ITAP) 2022 event. Together, the members will reinforce the Green Compass environmental sustainability assessment and roadmapping tool and introduce it to more local companies. Developed by A\*STAR, JTC and TÜV SÜD, the tool empowers businesses to better comprehend and catalyse their environmental sustainability progress and improve resource efficiency.



▲ Green Compass™ Learn-Assess-Prioritise-Plan model

### Bringing Cultivated Meat and Seafood to the General Population

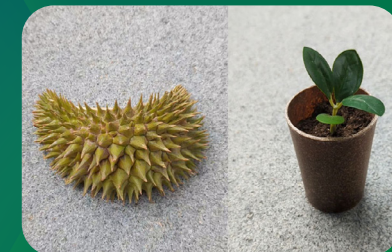
A\*STAR and its partners' multi-institutional research programme, the CentRe of Innovation for Sustainable banking and Production of Cultivated Meats (CRISP Meats), address the issues that businesses encounter in stimulating the development and production of **cultivated meat and seafood** through public-private partnerships. The programme involves labs from A\*STAR, SIT and NUS and aims to develop integrated platform technologies across the value chain to support the development and production of cultivated meat products. This is in line with the "30 by 30" food security national agenda, which aims to produce 30% of Singapore's nutritional needs by 2030 locally.



▲ Dr Ng Say Kong, Principal Scientist, A\*STAR's BTI and Co-Director of CRISP Meats (centre front), and the Animal Cell Processing team at A\*STAR's BTI

### Upcycling Durian Shells into Gardening Paraphernalia

Organic, inedible fruit waste such as **durian husks can be transformed into eco-friendly plant pots** with technology that A\*STAR's IMRE developed. Moving forward, such developments can spell less waste generation incurred in agricultural processes. They can also propel the urban farming movement in Singapore to enable a more food-resilient future.



▲ Using A\*STAR IMRE's technology, waste durian husks can be repurposed to create plant pots



## SHAPING A SUSTAINABLE FUTURE

### Tamping Down on Food Waste

To combat food waste, A\*STAR's SIFBI combines research capabilities in food nutrition, public health, biotechnology, manufacturing and agri-food technology to uncover innovation opportunities across the food value chain. With expertise in the discovery and engineering of microbial strains, SIFBI collaborated with [ID Capital Pte Ltd, Bühler Group & Dole Sunshine Company to produce a White Paper](#), developing solutions that address Singapore's food waste challenges.

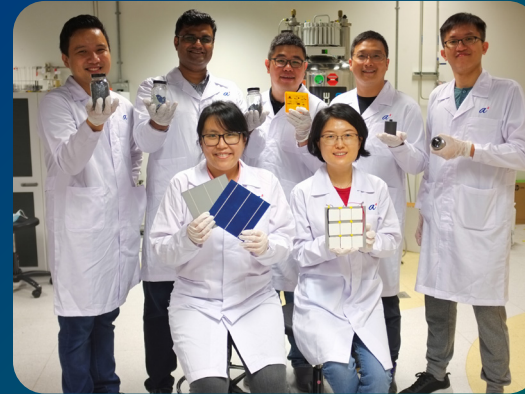
### Improving Recycling Efforts Using BINgo

[BINgo](#), a smart waste sorting bin, uses AI, the Internet-of-Things and smart sensors to alleviate poor recycling practices and rates in Singapore. Its pilot was launched by FairPrice Group (FPG) and A\*STAR, and integrates engaging and educational elements so shoppers can distinguish recyclables from non-recyclables, allowing them to recycle more items with higher accuracy.



▲ *BINgo uses AI and smart sensors to discern recyclables from non-recyclables and identify problematic contamination*

### Repurposing Silicon to Harvest Energy



A joint study by A\*STAR's IMRE, IHPC and NTU resulted in the development of new technology that can [transform old solar panels into new high-performance energy-harvesting thermoelectric material](#). The technology converts heat to electricity and benefits from incorporating impurities and defects. The research team plans to apply it to large-scale upcycling of waste silicon with high-temperature energy harvesting applications.

◀ *The team developed technology that can transform old solar panels into high-performance energy-harvesting thermoelectric material*

### Transforming Plastic Waste to Sustainably Produce Batteries

A\*STAR's IMRE has found a way to [upcycle waste PET plastic into polymer electrolytes](#), which are key components for safer lithium-ion batteries. This could enable a future powered by more sustainable energy, building a more circular economy while also alleviating growing problems relating to problem waste.

▶ *The A\*STAR IMRE team's technology gives commonly discarded bottles a new life as key components for lithium-ion batteries*





## SHAPING A SUSTAINABLE FUTURE

### Making Waves in the Tidal Energy Market



▲ The project aims to replace generators which use planet-warming diesel with clean tidal energy

Local SME Bluenergy Solutions and the Maritime and Port Authority of Singapore (MPA) announced a project to **convert tidal movement off Pulau Satumu into electricity** for Raffles Lighthouse, one of Singapore's offshore islands. This is done through the deployment of a "plug and play" solution that optimises the hydrodynamic features of four tidal energy turbines to generate electricity for facilities, jointly developed by Bluenergy Solutions and A\*STAR's IHPC. This project will lead to carbon emission savings, paving the way for a cleaner and greener future for the maritime sector.



▲ MPA will purchase energy generated from Bluenergy's tidal turbines, which were jointly developed with A\*STAR's IHPC

### Self-calibrating Temperature Sensors that Monitor Energy Efficiency

A\*STAR's National Metrology Centre (NMC) developed a **self-calibrating temperature sensor prototype** that can monitor energy efficiency in chiller plants, resulting in more sustainable practices. Typical temperature sensors experience sensor drift and inaccurate readings, leading to accumulated energy and efficiency loss over time. NMC's prototype self-calibrates at 16°C. It offers users up to 80% in cost savings without the need for annual lab calibration.

### Pushing for Sustainability in Singapore's Transport Industries

A\*STAR is part of the **Low-Carbon Energy Research (LCER) Funding Initiative (FI)**, which aims to develop low-carbon energy technologies in the domains of hydrogen and carbon capture, utilisation, and storage (CCUS), to support the decarbonisation of the power and industry sectors. A multi-agency initiative involving the Economic Development Board (EDB), the Energy Market Authority (EMA), the National Climate Change Secretariat (NCCS) and the National Research Foundation (NRF). The initiative also pushes for the use of hydrogen as an alternative to fossil fuels in the maritime and aviation sectors.





## BOOSTING ADVANCED MANUFACTURING AND TRADE & CONNECTIVITY FOR SINGAPORE

### Supporting AI Research to Advance the Maritime Industry



▲ Under the Maritime AI Research Programme, A\*STAR's IHPC will lead the development of Maritime AI

Singapore Maritime Institute awarded S\$4.78 million to A\*STAR's IHPC to spearhead the development of Maritime AI. With a focus on research programmes and implementing AI applications in the maritime industry, the programme aims to coordinate efforts for Maritime AI research, develop capabilities and facilitate industry-wide adoption of AI and related technologies. In collaboration with relevant agencies in the industry and institutes of higher learning, IHPC will use the funding to launch the first phase which will focus on maritime data and AI modelling excellence, making data processing and AI model toolkits available for evaluation. The toolkits address use cases such as traffic safety management, predictive maintenance and emission monitoring.

### Collaborating to Develop Robotics and Automation Standards Globally

Japanese electronics company Omron and A\*STAR's ARTC signed a memorandum of understanding to develop common standards for robotics and automation that can be applied globally, leveraging Omron's custom mobile robot solutions. ARTC manages the ROS-I Consortium Asia Pacific to support the development of the robotics middleware framework (RMF) and its application beyond the healthcare industry and across other sectors. The collaboration between Omron and ARTC will address vital issues facing the industry such as labour scarcity, limited space, supply chain disruptions and balancing sustainability with productivity.



▲ The beginning of the new partnership with OMRON through the ROS-Industrial Consortium Asia Pacific looks forward to leading the Robotics Middleware Framework (RMF) in the logistics industry while encouraging implementation at scale for the industry and other cross-sectorial applications



## BOOSTING ADVANCED MANUFACTURING AND TRADE & CONNECTIVITY FOR SINGAPORE

### Innovating Aviation Solutions Using AI and Robotics

The Smart Automated Aircraft Visual Inspection System (SAAVIS) programme, led by A\*STAR's Institute for Infocomm Research (I<sup>2</sup>R) and involving IHPC, combines expertise in robotics, computer vision, AI and path planning capabilities to improve the accuracy and speed of defect detection in airframe surfaces. The enhanced technology uses high-resolution cameras and autonomous ground robots to analyse the aircraft's state, before tapping on AI technology to automatically detect defects of concern. By detecting defects early, aircraft maintenance, repair and overhaul companies can plan and arrange for aircraft servicing in a more efficient and timely manner.

### Reinforcing Collaborations and Partnerships through Global Summits

The National Additive Manufacturing Innovation Cluster (NAMIC), supported by A\*STAR, brought back its flagship event: the Global Additive Manufacturing Summit (GAMS). Over 5,000 delegates hailing from 13 countries attended the summit held from 19 to 20 October 2022. Themed around "Embracing Sustainability and Supply Chain Resilience with 3D Printing", GAMS invited 14 international thought leaders to speak on decarbonisation and supply chain resilience through additive manufacturing. It also provided learning and networking opportunities for students, industry professionals and innovators interested in additive manufacturing.

### Accelerating Administration of Advanced Manufacturing Solutions

MiRXes, an A\*STAR spin-off and Singapore-based biotechnology startup has signed an MoU with A\*STAR's Advanced Remanufacturing and Technology Centre (ARTC) to expedite the implementation of advanced manufacturing solutions and facilitate manufacturing at scale. In particular, they will assess research and development activities in automation, digitalisation, disruption analysis and prevention, and sustainability to build innovative solutions for in-vitro diagnostics and research use.



▲ MoU signing ceremony representatives from A\*STAR and MiRXES



## BUILDING COLLABORATIONS TO TACKLE NATIONAL CHALLENGES

### Tapping on Sustainable Resources with Singapore's First Ocean Basin Facility

Singapore's [first ocean basin facility](#) officially opened on 26 July 2022 at the Technology Centre for Offshore and Marine, Singapore (TCOMS), an R&D centre formed by A\*STAR and NUS. Designed to imitate real-world ocean operating environments, the facility will enable the evaluation of emerging technologies that aim to leverage the ocean as a sustainable resource.



▲ The ocean basin facility will allow Singapore to tap on the ocean as a sustainable resource



▲ From left to right: Prof Chan Eng Soon, Chief Executive Officer, TCOMS; Mr Quek Gim Pew, Senior R&D Consultant, MINDEF; Ms Quah Ley Hoon, Chief Executive Officer, MPA; Prof Tan Eng Chye, President, NUS; Ms Chan Lai Fung, Chairman, A\*STAR; Prof Low Teck Seng, Chief Executive Officer; Professor Ho Teck Hua, Provost of NUS; Prof Andy Hor, Deputy Chief Executive (Research), A\*STAR, launched the TCOMS Ocean Basin Facility

## BUILDING COLLABORATIONS TO TACKLE NATIONAL CHALLENGES

### New Centre to Boost ASEAN's Pandemic Preparedness

A\*STAR's Bioinformatics Institute (BII) has partnered with Duke-NUS (National University of Singapore) to launch the [Centre for Outbreak Preparedness \(COP\)](#) along with other Singapore government agencies and key partners. By leveraging the research, collaborations and commercialisation successes that contributed to Singapore's fight against the COVID-19 pandemic, the COP aims to enhance regional research capacity, cooperation and preparedness against future pandemics and public health threats.



▲ The COP will work closely with Singapore government agencies and key partners to aid Singapore in battling the COVID-19 pandemic

### Gaining a Competitive Edge in the Global Semiconductor Industry

A\*STAR's IME, DSO National Laboratories and NTU have established the [National Gallium Nitride Technology Centre](#). As a shared resource and translation centre, it aims to elevate Singapore's global competitiveness in the mmWave RF semiconductor industry, thereby ensuring local market capture and leadership.

“One emerging material for chips is Gallium Nitride, which can perform better and more reliably at high power, especially in emerging areas such as 6G communications. This is potentially a high-growth segment.

To ride on this new wave, Singapore will be setting up the National Gallium Nitride Technology Centre, with an initial investment of around US\$85 million over the next five years.”

**Mr Heng Swee Keat**  
Deputy Prime Minister of Singapore

### Introducing Flexibility to Regional Networks for Combatting Dengue

A\*STAR's BII is engaged in a three-year research collaboration with NEA to enhance the UNited In Tackling Epidemic Dengue (UNITEDengue) web portal that was previously developed with BII. Subsequently, users will be able to upload data independently and the institute can exercise flexibility in incorporating databases and analytical tools to keep up with the network's growing needs. In particular, the collaboration will facilitate the cross-border sharing of surveillance information and knowledge on dengue control.



## BUILDING COLLABORATIONS TO TACKLE NATIONAL CHALLENGES

### Ameliorating Safety Concerns on Local Consumption of Cultured Meat



A\*STAR, in collaboration with NUS and Singapore Food Agency (SFA), has signed an agreement to develop regulatory guidelines on the safety assessment of cultured meat and address safety concerns regarding the local consumption of cultured meat. Additionally, in a separate agreement, the three partners will work together to evaluate the food safety status of novel alternative proteins.

### Enhancing Singapore's Future with High-performance Computing Resources

The National Supercomputing Centre (NSCC) Singapore, a national platform hosted by A\*STAR, signed a series of MoUs at the annual international SupercomputingAsia (SCA) 2023 conference. These collaborations promote the use of high-performing computing (HPC) resources in bioinformatics, education and human capital development to improve industry capabilities and better equip a future workforce.



▲ ASPIRE2A's core computing capabilities deliver a level of performance and flexibility needed to support a multifaceted array of HPC applications

## MAKING WAVES IN QUANTUM TECHNOLOGIES

### Building Quantum Research Ties with Finland

To spur research and development collaboration in the quantum technology field, The National Quantum Office (NQO) has signed an [MoU](#) with VTT Technical Research Centre of Finland, IQM Quantum Computers, and CSC - IT Center for Science (Finland). Under the MoU, the parties hope to accelerate the development of quantum technology hardware components, algorithms and applications and collaborate on quantum-accelerated high-performance computing and both terrestrial and satellite quantum communications. The MoU lays the foundation for knowledge exchange on national strategic roadmaps for quantum technologies.



▲ From left to right: Mr Kimmo Koski, Managing Director, CSC - IT Center for Science; Ms Erja Turunen, Executive Vice President, Digital Technologies, VTT Technical Research Centre of Finland; Mr Ling Keok Tong, Executive Director, National Quantum Office, Singapore; and Dr Juha Vartiainen, Chief Operations Officer and Co-founder, IQM Quantum Computers signed the Memorandum of Understanding

### New Platforms to Elevate Local Quantum Ecosystem



A\*STAR's IHPC, the Centre for Quantum Technologies (CQT) at NUS and the National Supercomputing Centre (NSCC) Singapore have joined hands to launch the [National Quantum Computing Hub](#), the [National Quantum Fabless Foundry \(NQFF\)](#) and the [National Quantum-Safe Network](#). NQFF, hosted at A\*STAR's Institute of Materials Research and Engineering (IMRE), will support micro and nanofabrication of quantum devices in the three pillars of quantum computation, communication and sensing under Singapore's Quantum Engineering Programme (QEP). By coordinating activities across research organisations and building public-private collaborations, the platforms will develop local capabilities in quantum computing, quantum-safe communication and the manufacturing of quantum devices.

“Quantum technologies are attracting global interest thanks to their potential impacts across industries. The creation of three national quantum platforms in Singapore allows us to act as a bigger player in the key areas of computing, communication and manufacturing. The Quantum Engineering Programme supports these initiatives and other efforts to reap the benefits of Singapore's strong heritage in quantum research.”

Dr Alexander Ling, Director, QEP





## KEY ACHIEVEMENTS

# DEEPENING USE-INSPIRED BASIC RESEARCH

A\*STAR leverages use-inspired basic science to build robust innovation pipelines where research can be translated into impactful outcomes for Singapore and beyond.

Through the years, A\*STAR has stood at the forefront of science and technology innovation. A\*STAR's publications continue to be highly cited in the scholarly world. A Field-Weighted Citation Impact (FWCI) score of 1.68 shows that our publications are 68% more cited than expected according to the global average and 25% of our total publications were also amongst the top 10% of the world's most highly cited research outputs.

Our multidisciplinary R&D capabilities also allow us to develop solutions for the industry and society as we tackle global challenges such as sustainability and climate change. Here are some impactful projects from the past year.

## BIOMEDICAL SCIENCE

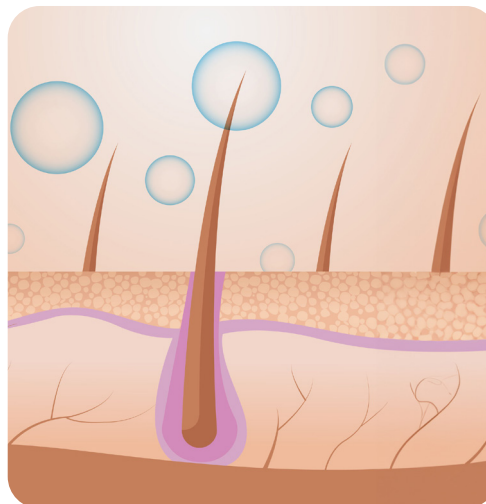
### Analysing Skin Microbiome for Subtypes of Skin Disorders

A\*STAR researchers conducted a study on the differences in skin microbiota in ichthyosis patients, which is currently an understudied topic. Their findings revealed a common skin microbiome signature across congenital ichthyoses, a group of rare skin disorders present at birth. The data suggest that targeting the imbalance of microbes, along with further studies on the relationships between skin microbes, lipids and genes, may lead to new therapeutic interventions for ichthyosis.

**Tham Khek-Chian** and **John Common\***, *A\*SRL*

[Distinct skin microbiome community structures in congenital ichthyosis](#)

The British Journal of Dermatology



### Web Server to Predict Protein Allergenicity Potential

A\*STAR researchers developed [AllerCatPro 2.0](#), a web server using advanced bioinformatic tools and extensive datasets to predict the likelihood of allergenic proteins in food and personal care products. This user-friendly platform is freely accessible at <https://allercatpro.bii.a-star.edu.sg>.

**Minh N Nguyen** and **Sebastian Maurer-Stroh\***, *BII*

[AllerCatPro 2.0: a web server for predicting protein allergenicity potential](#)  
Nucleic Acids Research

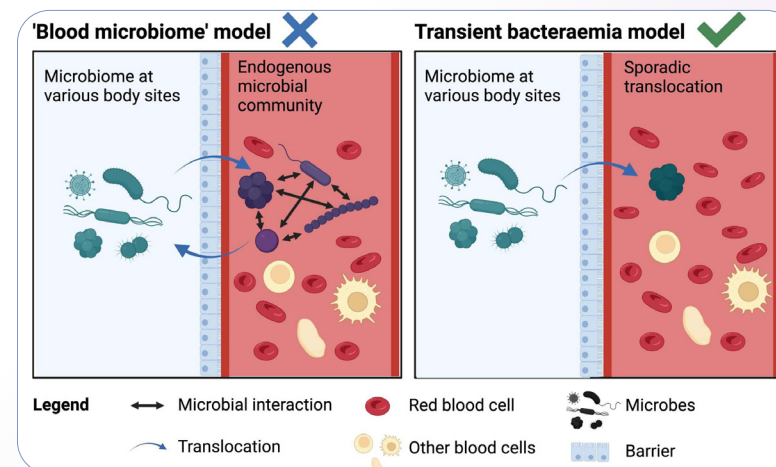
### Seeking a Common Microbiome in Human Blood

Human blood is conventionally considered sterile, with recent studies challenging this assertion by suggesting the presence of a blood microbiome. In response, A\*STAR researchers conducted a large-scale population study. Their findings do not support the hypothesis of a consistent core microbiome endogenous to human blood. They also showed how microbes from other parts of the body can sporadically enter the bloodstream.

**Cedric Tan\*** and **Niranjan Nagarajan\***, *GIS*

[No evidence for a common blood microbiome based on a population study of 9,770 healthy humans](#)

Nature Microbiology



◀ A transient bacteraemia model is better supported by evidence from a population study of healthy individuals



## BIOMEDICAL SCIENCE

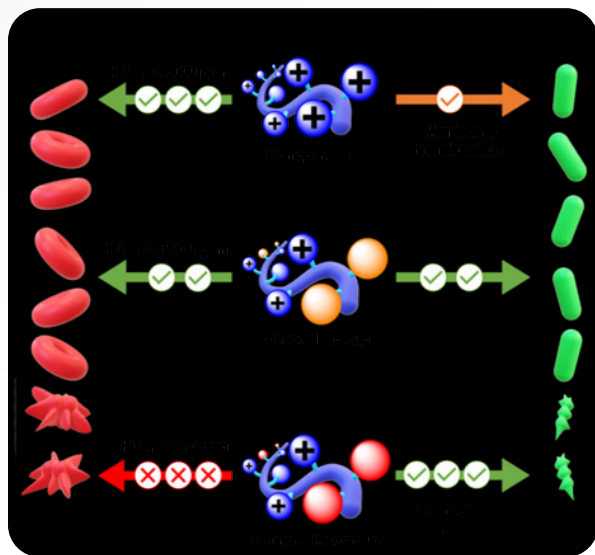
### Investigating how polymer design affects its antimicrobial mechanism

A\*STAR researchers created different polymers with varying hydrophobic side chains to study their antimicrobial properties. Their findings showed that more hydrophobic polymers were more efficient in killing bacteria, but also caused damage to healthy cells at higher concentrations. The study provides key insights into the design of improved antimicrobial polymers by taking the effects of hydrophobic side chains into consideration.

Yi Yan Yang\* and Jason Tan, *IBB*

[Effects of Hydrophobicity on Antimicrobial Activity, Selectivity, and Functional Mechanism of Guanidinium-Functionalised Polymers](#)

Advanced Healthcare Materials



◀ A series of biodegradable guanidinium-functionalized random polycarbonates, with varying hydrophobic side chains, are synthesized by organocatalytic ring-opening polymerization. Despite being more efficient in eliminating bacteria, the more hydrophobic polymers suffer from poor selectivity due to high hemolytic activity. The increment in hydrophobicity has also changed the killing mechanism of the polymers to predominantly membrane disruption.

### MSC Exosomes May Ease Immune Dysregulation in Acute Respiratory Failures

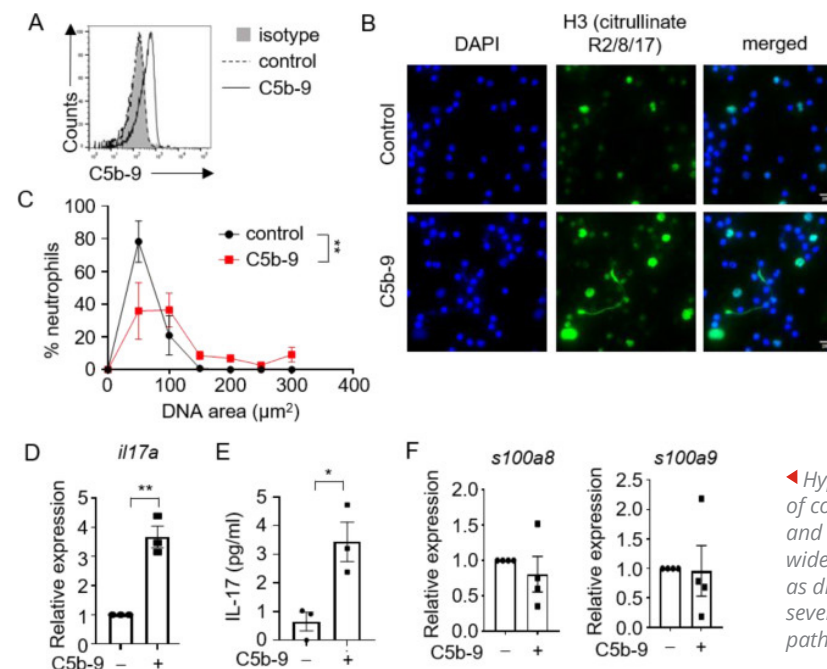
A\*STAR researchers discovered that MSC-derived exosomes could inhibit the activation of complements and neutrophils via a CD59-dependent mechanism. This could potentially alleviate the immune dysregulation often seen in acute respiratory failures.

Loh Jia Tong and Lam Kong Peng\*, *SigN*

Lim Sai Kiang\*, *IMCB*

[Mechanism for the attenuation of neutrophil and complement hyperactivity by MSC exosomes](#)

Cytherapy



◀ Hyperactivation of complements and neutrophils are widely implicated as drivers of severe COVID-19 pathogenesis

## BIOMEDICAL SCIENCE

### Investigating How Cells and Cytokines in Infected Tissues Interact

A\*STAR researchers have developed a highly-sensitive proteomic multiplexing technique named iSPOT, to examine how SARS-CoV-2 infection affects various organs in acute infections. The study provided important insights into the body's immune response and tissue damage in COVID-19 infections. Findings demonstrate the role of multiple cytokines in mediating the pathologies, and the use of combinational cytokine therapies in potentially mitigating fatal complications in severe COVID-19 cases.

**Akhila Balachander**, *SigN*  
**Lisa Ng\*** and **Laurent Rénia\***, *ID Labs*

[Organ-specific immune response in lethal SARS-CoV-2 infection by deep spatial phenotyping](#)  
 Clinical & Translational Immunology

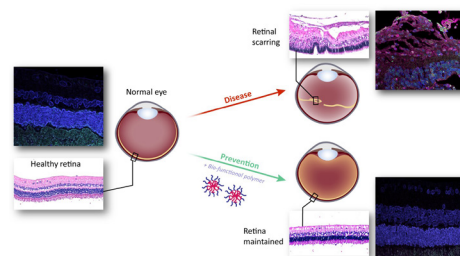
### Using a Bio-functional Polymer to Prevent Retinal Scarring

A\*STAR researchers developed a [synthetic polymer](#) using a mixture of biomaterials typically used as drug carriers. This new thermosensitive material, called poly(CEP), has a gel-like consistency and gradually degrades once injected into the eye, where it slowly releases anti-inflammatory polymer molecules.

**Bhav Harshad Parikh**, **Liu Zengping**, **Su Xinyi\***, *IMCB*  
**Loh Xian Jun\***, *IMRE*

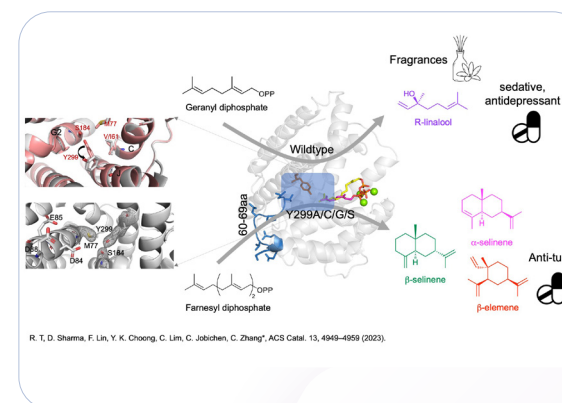
[A bio-functional polymer that prevents retinal scarring through modulation of NRF2 signalling pathway](#)

Nature Communications



▲ A healthy retina contains organised light-sensitive layers of neurons at the back of the eye. Upon retinal scarring, it can result in retinal detachment with loss of these organised layers and visual impairment. Application of a bio-functional thermogel prevents this detachment and maintains the retina. Image credit: Kim Chi Tran, A\*STAR's IMCB

### Examining How Fungal Enzymes Produce Terpenes



◀ Our study provides insights into factors that govern chain length (C10 or C15), water incorporation, and cyclization (cyclic vs acyclic) of terpenoid biosynthesis and the enzyme we studied can be used for bioproduction of fragrance and antidepressant, antitumor drug molecules.

Terpene synthases are the key enzymes responsible for the production of terpenoid compounds. Terpenoids have multiple applications in pharmaceuticals, food, flavours and fragrances, and agriculture. A\*STAR researchers identified key regions and mutations that influence the specificity and product type, discovering insights into engineering improved enzyme variants with desired properties for various applications.

A\*STAR researchers provided insights into factors governing chain length, water incorporation and cyclisation of terpenoid biosynthesis. The enzyme studied can be used in a variety of applications such as the bioproduction of fragrances, anti-depressants and anti-tumour drug molecules.

**Rehka T.** and **Zhang Congqiang\***, *SIFBI*

[Structural Understanding of Fungal Terpene Synthases for the Formation of Linear or Cyclic Terpene Products](#)  
 ACS Catalysis



# PHYSICAL SCIENCE AND ENGINEERING

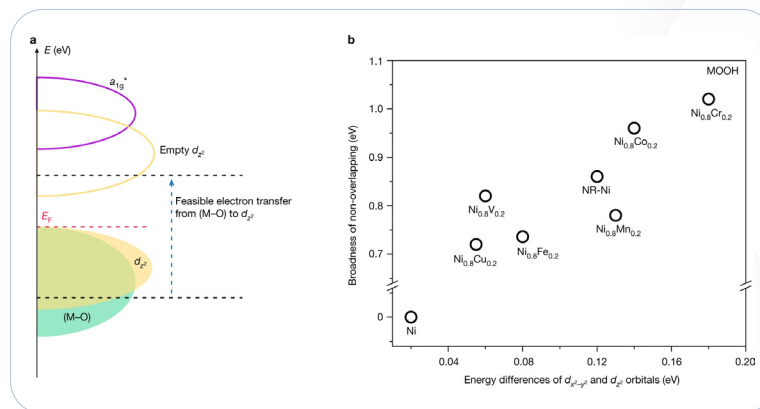
## Optimising Electron Transfer Processes in Oxygen Evolution

Utilised for fuel cells, metal-air batteries and carbon dioxide reduction, electrocatalysts have many applications, and is vital for the development of electrochemical water splitting technology.

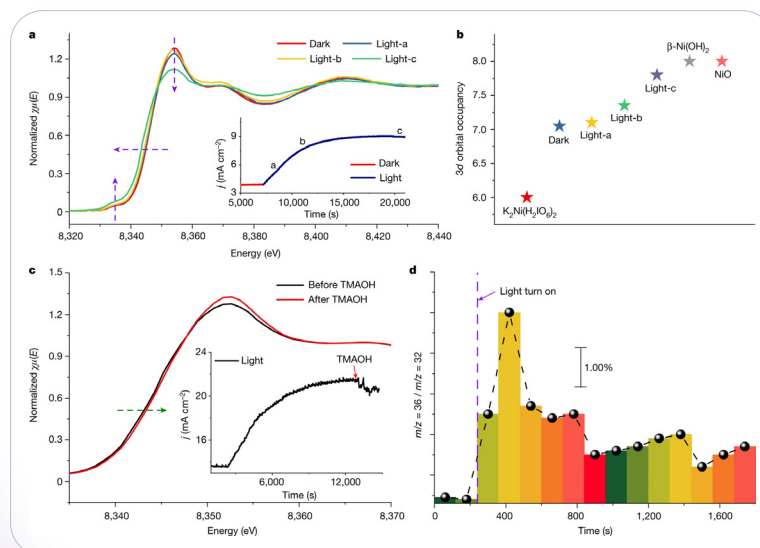
In this study, A\*STAR researchers investigated a light-triggered electron transfer mechanism. In comparison with traditional methods, this transfer mechanism can bypass potential limits, leading to the production of high-performing and robust electrocatalysts for the achievement of efficient and durable oxygen evolution reaction (OER) electrocatalysts.

Xi Shibo, *ISCE<sup>2</sup>*  
Yu Zhigen, *IHPC*

[Pivotal role of reversible NiO<sub>6</sub> geometric conversion in oxygen evolution](#)  
Nature



▲ Fig.1 The origins of the team's proposed coupled evolution mechanism



▲ Fig.2 Identification of redox activities for NR-NiOOH subjected to light irradiation

## A miniature CO<sub>2</sub> gas sensor for air quality monitoring

A\*STAR researchers have miniaturised and enhanced the performance of CO<sub>2</sub> gas sensors. These improvements will pave the way for future developments of compact and cost-effective optical-based CO<sub>2</sub> gas sensors which can be integrated into consumer electronics to monitor air quality in real time.

Doris Ng, *IME*

[Miniaturised CO<sub>2</sub> Gas Sensor Using 20% ScAlN-Based Pyroelectric Detector](#)  
ACS Sensors



▲ Miniaturised NDIR CO<sub>2</sub> gas sensor (4 cm long, 0.1 cm diameter) based on 20% ScAlN pyroelectric detector

# PHYSICAL SCIENCE AND ENGINEERING

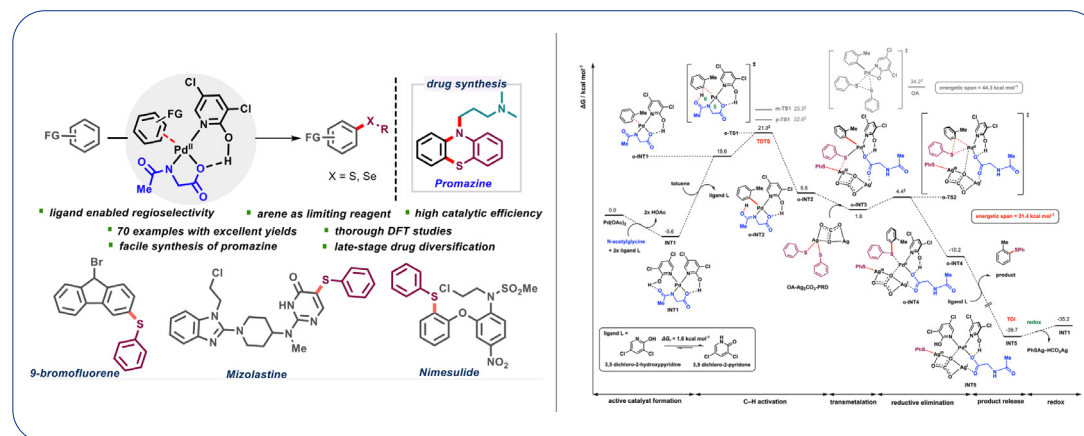
## Tapping on Catalysts to Construct Chalcogen Motifs

A\*STAR researchers have developed a new catalytic system based on palladium that adopts a dual-ligand approach to build molecular chalcogenide motifs for natural products and complex molecules. This eliminates inefficiency as well as the need for excessive chemicals. Such computational mechanistic studies help unravel complex mechanisms while highlighting the essential roles of ligands in achieving effective catalysis.

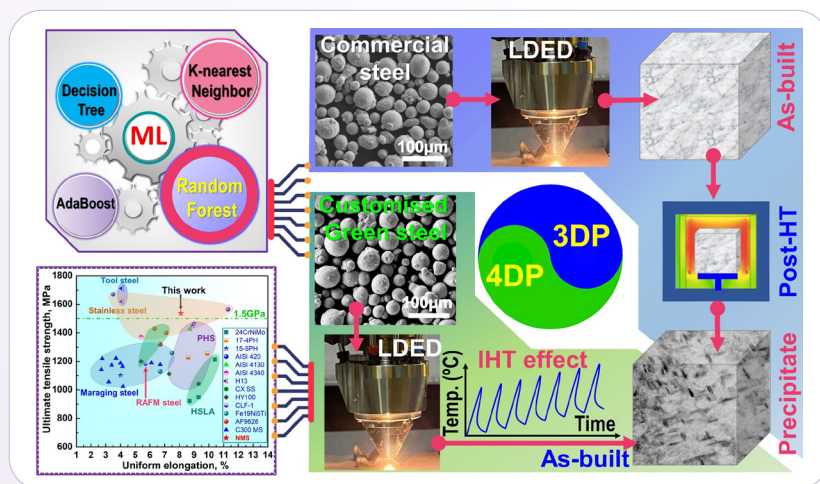
Zhang Xinglong, IHPC

[Dual Ligand Enabled Nondirected C-H Chalcogenation of Arenes and Heteroarenes](#)

Journal of the American Chemical Society



▲ Palladium-catalysed chalcogenation of arenes for complex molecule syntheses and its theoretical mechanistic studies



## Green Metals for 4D Printing Customised by Machine Learning

Existing commercial materials used in traditional manufacturing typically require energy-consuming post heat treatments. A\*STAR researchers leveraged laser additive manufacturing (LAM) and machine learning technology to customise a “green metal” that eliminates the need for post heat treatments. 4D printing was also achieved through synchronous integration of time-dependent precipitation hardening with 3D geometry shaping. This breakthrough could revolutionise the efficiency and quality of 3D printing while reducing energy consumption and advancing the development of novel materials.

Tan Chaolin and Chew Youxiang, SIMTech

[Machine Learning Customised Novel Material for Energy-Efficient 4D Printing](#)

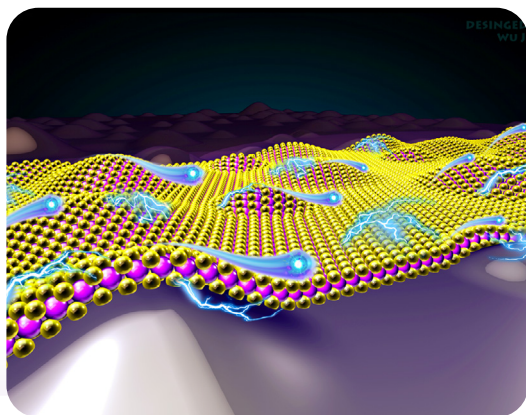
Advanced Science

◀ This work customised a “green metal” by machine learning, highlighting the 4D printing via synchronous integration of time-dependent precipitation hardening with 3D geometry shaping to eliminate post heat treatment



## PHYSICAL SCIENCE AND ENGINEERING

### New Strategy to Revamping 2D Electronics Performance



A\*STAR researchers proposed a novel strategy that overcomes the phonon-limitation by tailoring lattice symmetry using 2D semiconductors. This approach developed a high-mobility solution to meet the growing demand for high-impact and energy-efficient electronic devices and systems.

Wu Jing, Ng Hong Kuan, Ady Suwardi, *IMRE*

[Improving carrier mobility in two-dimensional semiconductors with rippled materials](#)

Nature Electronics

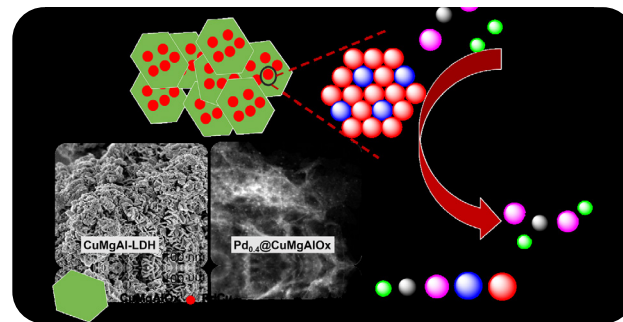
### Boosting Formate Production Through Rational Catalyst Design

Through the carbon capture system, carbon dioxide can be converted to formate, addressing climate change issues. The formate can also be used as a fuel additive, helping to mitigate the energy crisis. A\*STAR researchers developed a bimetallic catalyst with electron-rich Palladium-Copper (PdCu) nanoparticles. PdCu nanoparticles allowed for superior performance, resulting in a stable and high rate of formate formation.

Liu Yan, *ISCE<sup>2</sup>*

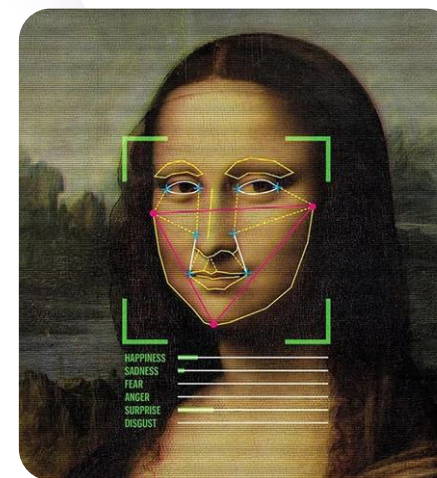
[Experimental and in situ DRIFTS studies on confined metallic copper stabilized Pd species for enhanced CO<sub>2</sub> reduction to formate](#)

Applied Catalysis B: Environmental



▲ Strong synergetic effects between Pd and confined Cu species in MgAlO<sub>x</sub> matrix were moderated for delivering the enhanced CO<sub>2</sub> reduction performance to formate

### Integrating Multiple Domains for Facial Expression Recognition



◀ Researchers at A\*STAR developed a novel framework for facial expression recognition, which has wide applications in areas such as mental health monitoring and human-computer interaction

A\*STAR researchers proposed a novel approach to address phonon-limitation facial expression recognition (FER) by tailoring lattice symmetry using 23 semiconductors. The approach developed a high-mobility solution to meet the growing demand for high-impact and energy-efficient electronic devices and systems.

Wu Min, *I<sup>2</sup>R*

[SSA-ICL: Multi-domain adaptive attention with intra-dataset continual learning for Facial Expression Recognition](#)

Neural Networks



## KEY ACHIEVEMENTS

### **NURTURING TOP TALENT FOR THE R&D ECOSYSTEM**

At A\*STAR, we are committed to ensuring a pipeline of ready scientific talent for our local R&D ecosystem. We believe that this is an essential part of maintaining Singapore's status as one of the world's foremost innovative economies.





**Professor Wang Yue**  
(Senior Principal Investigator, ID Labs)  
elected into the **American Academy of Microbiology**



**Professor Laurent Rénia**  
(Professor, NTU and Senior Fellow, ID Labs)  
conferred the **French National Order of Merit**



**Professor Nicholas Barker** (Research Director, IMCB) elected as an **European Molecular Biology Organization (EMBO) Associate Member**

## Singapore National Academy of Science (SNAS) Fellowship



**Professor Hong Wanjin**  
Executive Director,  
IMCB



**Professor Lisa Ng**  
Executive Director,  
BMRC and ID Labs



**Professor Chen Xiaodong**  
Professor, NTU  
Scientific Director, IMRE



**Professor Liu Xiaogang**  
Professor, NUS  
Principal Scientist, IMRE



**Professor John Wang**  
Professor, NUS  
Principal Scientist, IMRE

## President's Science and Technology Award (PSTA) - Young Scientist Awards 2022



**Dr Bi Renzhe**  
Senior Scientist, IMRE

## President's Science and Technology Medal (PSTM) 2022 recipient



**Professor Hong Wanjin**  
Executive Director, IMCB

## Fellowship of the Royal Society

The Fellowship of the Royal Society is an independent scientific community in the United Kingdom, committed to promoting excellence in science for humanity. Individuals are selected for their substantial contribution to the advancement of science.



**Professor Gao Huajian** (Scientific Director, IHPC and Distinguished University Professor, School of Mechanical & Aerospace Engineering, NTU) was elected as a Fellow of the Royal Society

## MIT Technology Review “Innovators under 35”

The list recognises the 35 best young talents in the Asia-Pacific region who have demonstrated expanding influence in their field of research and pioneered cutting-edge achievements.



**Dr Lum Yanwei**  
Assistant Professor, NUS  
Scientist, IMRE



**Dr Liu Yuxin**  
Assistant Professor, NUS  
Scientist, IMRE

## National Research Foundation (NRF) Fellowship 2023

The NRF Fellowship provides support for outstanding early career researchers from all over the world to lead impactful research in Singapore.



**Dr Jason Lim Yuan Chong** (Scientist, IMRE) was awarded for the research titled “ECO-Cycling: Environmentally-friendly Catalytic Oxidations for Upcycling Waste Polyethylenes into Chemical Commodities”.



**Dr Yang Le** (Scientist, IMRE) was awarded for the research titled “Spinning Towards a ‘Bright’ Future: Energy-Harvesting with Spin-Triplet Excitons in Luminescent Materials”.



**Dr Zhang Mengmi** (Scientist, I<sup>2</sup>R) was awarded for the research titled “What AI cannot do but humans can: Closing gaps in visual search efficiency between AIs and humans with neuroscience-inspired approaches”.



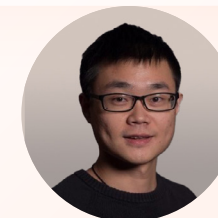
**Yan Chuan** (Junior Investigator, IMCB) was awarded for the research titled “Precision oncology approaches for hepatocellular carcinoma”.



**Dr Low Jun Siong** (Principal Scientist, ID Labs) was awarded for the project titled “Clonal analysis of antigen-specific T and B cells in stomach cancer to guide personalised immunotherapy and vaccine design”.



**Dr Tedrick Thomas Salim Lew** (Assistant Professor, NUS and Scientist, IMRE) was awarded for the project titled “Rational Design of Plant Nanotechnology: Towards Climate-Resilient and Smart Agriculture”.



**Dr Zhu Di** (Scientist, IMRE) was awarded for the project titled “Developing an integrated photonic platform for scalable quantum information processing”.

## ST Engineering Distinguished Professor Award

The ST Engineering Distinguished Professor Award from ST Engineering saw four recipients.

**Dr Andrew Ngo** (Senior Scientist, IMRE) received the award for his outstanding contributions in accelerating the translation of research in infrared imaging into industry applications.





## National Research Foundation (NRF) Investigatorship 2023

*The NRF Investigatorship is awarded to mid-career scientists who have a track record of research achievements that identify them as leaders in their respective fields of research.*



**Dr Tam Wai Leong** (Group Leader of the Lab of Translational Cancer Biology, GIS) was awarded for the research titled "Understanding the metabolic milieu of the tumor microenvironment for niche-based therapy".



**Dr Wan Yue** (Group Leader of the Laboratory of RNA Genomics & Structure, GIS) was awarded for the research titled "Developing high throughput technologies to study RNA structure and function".



**Dr Jay Shin** (Senior Group Leader of the Laboratory of Regulatory Genomics, GIS) was awarded for the research titled "Autonomous Genomics: AI-Driven Omics to Drug Discovery".



**Dr Marco Vignuzzi** (Senior Principal Investigator of Anti-viral Therapeutics Lab, ID Labs) was awarded for the research titled "Predicting and pre-empting the next alphavirus outbreaks using comparative proteomics and experimental evolution".

## 2022 IEEE Communications Society Award for Advances in Communication



*This award recognises high-quality papers that opened new lines of work, envisioned bold approaches to communication and formulated new problems to solve in the field of communications engineering.*

**Dr Zeng Yong Hong** (Senior Scientist, I<sup>2</sup>R), **Dr Hoang Anh Tuan** (Deputy Division Head, ITS), Dr Liang Ying Chang and Dr Edward Peh have won the prestigious IEEE Communications Society Award for Advances in Communication for their paper "Sensing-Throughput Tradeoff for Cognitive Radio Networks".



## IEEE Signal Processing Society (SPS) Distinguished Lecturer

*The IEEE SPS Distinguished Lecturer is a highly competitive recognition where awardees must be recognised experts in the signal processing field with an IEEE grade of Senior Member or higher.*



**Dr Nancy Chen** (Senior Scientist, I<sup>2</sup>R) was awarded the IEEE Signal Processing Society (SPS) Distinguished Lecturer Award for her expertise in the signal processing field.

## The Institute of Electrical and Electronics Engineers (IEEE) Fellow

*The Institute of Electrical and Electronics Engineers (IEEE) Fellow is a prestigious grade elevation reserved for IEEE members who have made extraordinary accomplishments in any of the IEEE fields of interest.*



**Dr Li Zhengguo** (Senior Scientist, I<sup>2</sup>R) was elevated by the IEEE Board of Directors to IEEE Fellow, the highest grade of membership in the IEEE.

## 2023 Optica Fellow Optica

*The Optica Fellow is dedicated to promoting the generation, application, archiving and dissemination of knowledge in optics and photonics worldwide.*



**Dr Teng Jinghua** (*Principal Scientist, IMRE*) was awarded the 2023 Optica Fellow Optica for his achievements and leadership in both use-inspired basic research and technology translation to industry application in nano-optics and optoelectronics.

## 2023 Society of Engineering Science (SES) Fellow

*The Society of Engineering Science (SES) develops and strengthens the interfaces between various disciplines in engineering, science, and mathematics.*



**Professor Zhang Yong Wei** (*Distinguished Institute Fellow, IHPC*) was conferred the 2023 Society of Engineering Science (SES) Fellow for his significant contributions to the activities of the SES and for his independent, original research that had made a major impact on the advance of the engineering sciences.

## Fellow Member of the Australian Academy of Science

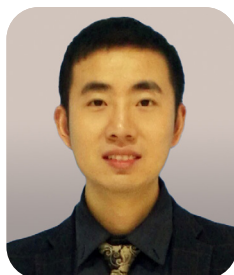
*Fellows of the Australian Academy of Science are among Australia's most distinguished scientists, elected by their peers for ground-breaking research and contributions that have made an impact.*



**Professor Lam Ping Koy** (*Chief Quantum Scientist, IMRE*) was officially conferred a fellow at the Australian Academy of Science's annual flagship event, "Science at the Shine Dome", for his successful work in demonstrating end-to-end quantum key distribution.

## Fellow of International Association of Advanced Materials

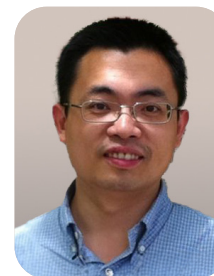
*The Fellowship of International Association of Advanced Materials is awarded to researchers who made significant contributions to the advancements of engineering, technology and materials science.*



**Dr Chaolin Tan** (*Scientist, SIMTech*), was awarded the Fellow of International Association of Advanced Materials, along with the entitlement to use the designatory letters "FIAMM", for his contribution to "Materials Processing and Manufacturing".

## 2022 American Physical Society (APS) Fellow

*The American Physical Society Fellowship is awarded to individuals who have made exceptional contributions to the physics enterprise.*



**Dr Zhang Gang** (*Senior Scientist and Group Manager, IHPC*) was elected for his seminal contributions to understanding the phononic physics in low-dimensional quantum materials. Of particular note was the discovery of anomalous size dependence in thermal conductivity, and pioneering work on developing and applying methods to study nanoscale and interfacial thermal conduction.

## 2023 King Faisal Prize



**Professor Jackie Ying** (*Senior Fellow and Director, NBL*) was awarded the 2023 King Faisal Prize for her work on the synthesis of various advanced nanomaterials and systems, and their applications in catalysis, energy conversion, and biomedicine. Her inventions have been used to solve challenges in different fields of medicine, chemistry and energy.



## Dr Susan Lim Award for Outstanding Young Investigator 2022

**Dr Su Xinyi** (*National Science Scholarship (MBBS-PhD) scholar and Senior Principal Investigator, IMCB*) received the **2022 Dr Susan Lim Award for Outstanding Young Investigator** from the Stem Cell Society Singapore in December 2022. This award is supported by the Dr Susan Lim Endowment for Education and Research and recognises the exceptional achievements of an investigator in the early part of his/her independent career in stem cell research. The award emphasises the numerous and continued contributions of Singapore-based researchers toward understanding the fundamental biology of stem cells and promoting their potential as powerful tools in disease modelling, drug screening, and regenerative medicine.



## National finalist in the Underwriters Laboratories-ASEAN-U.S. Science Prize for Women 2022



**Dr Li Jingmei** (*AGS scholar and Group Leader, Laboratory of Women's Health & Genetics, GIS*) was announced to represent Singapore as the national finalist in the **Underwriters Laboratories-ASEAN-U.S. Science Prize for Women 2022**. Selected from 56 candidates, she is one of seven national finalists to compete for the category "Mid-career Scientist". This award strengthens science and technology capacity in ASEAN while promoting gender equality and women's empowerment, it also recognises ASEAN women scientists for their outstanding work in AI adoption and development to improve the health and safety of more than 662 million people living in Southeast Asia.

## NMRC Clinician Scientist Award (CSA) – Investigator (INV)

**Dr Su Xinyi** (*National Science Scholarship (MBBS-PhD) scholar and Senior Principal Investigator, IMCB*) was awarded the **NMRC Clinician Scientist Award (CSA) – Investigator (INV)** for her project titled "Thermogel Enhanced Retinal Cell Therapy for Age-Related Retinal Degenerative Disease". CSA (INV) is a talent award for outstanding clinician scientists with established research track records and the potential to become leaders in their fields. It aims to develop clinician scientists in internationally competitive translational and clinical research.



## SEMI-MEMS and Sensors Industry Group (SEMI-MSIG) Global Emerging Young Leader Award



*The award recognises innovative emerging leaders under 40 who have made a significant impact by creating the products, methods, and materials of tomorrow.*

**Dr Zhu Yao** (*Senior Scientist, IME*) received the SEMI-MSIG Global Emerging Young Leader Award at the Advanced Semiconductor Technology Conference (ASTC).

## Fellow Evaluation Committee Chair, Institute of Electrical and Electronics Engineers (IEEE) Communications Society, 2022-2023



*The Fellow Evaluation Committee is responsible for the Society's evaluation of Fellow nominations being considered by the IEEE Fellow Committee.*

**Dr Sun Sumei** (Deputy Executive Director in Research, I<sup>2</sup>R) was appointed as the Fellow Evaluation Committee Chair of the IEEE Communications Society from 2022-2023.

## Institute of Electrical and Electronics Engineers (IEEE) Antennas and Propagation Society (IEEE APS) Committees



**Dr Qing Xianming** (Principal Scientist, I<sup>2</sup>R) has been appointed to two significant committees of the IEEE Antennas and Propagation Society (IEEE APS); the IEEE APS fellow committee for IEEE fellow evaluation and IEEE APS Standards committee for standards policies and procedures development.

In these roles, he will provide his expertise in the evaluation of IEEE Fellow candidates for IEEE APS, as well as being pivotal in the development and maintenance of standards related to antennas and propagation.

## The Long Service Medal award



*The National Day Awards (NDA) recognises staffs' significant contributions to A\*STAR and Singapore.*

**Dr Xu Xiaoli** (Senior Research Office, ID Labs) received The Long Service Medal Award during the NDA 2022 on 15 August 2022.

## Most Promising Startup Award at the Emerging Enterprise 2022



*The Most Promising Startup Award at the Emerging Enterprise 2022 was organised by the OCBC Bank and The Business Times.*

**Dr Davy Cheong** (Senior Scientist, IMRE) and **Dr Ivan Tan** (Senior Scientist, IMRE), co-founded in February 2022 startup Plasma Science. The startup, which produces air sanitisers, received the Most Promising Startup Award.



## Steering Committee chair of the new Institute of Electrical and Electronics Engineers (IEEE) Journal "IEEE Transactions on Machine Learning in Communications and Networking (TMLCN)"



**Dr Sun Sumei** (Deputy Executive Director in Research, I<sup>2</sup>R), for her four years of commitment and achievements as the Steering Committee member of the IEEE Transactions on Wireless Communications, and as the inaugural Editor-in-Chief of the IEEE Open Journal of Vehicular Technology, was tasked with greater responsibility as the Steering Committee chair of a new IEEE journal "IEEE Transactions on Machine Learning in Communications and Networking (TMLCN)".



## Exemplary Firefly Award (Gold)



The Firefly Awards celebrate the best of ideas, and recognise individuals within the MTI Family who have exemplified strengths in the respective award categories.

**Dr David Low** (Chief Executive Officer, ARTC and Executive Director, SIMTech) was awarded the Exemplary Firefly Award – Gold for his contributions towards Singapore's COVID-19 efforts.

## Commendation Award (CA) from SSC/ESG

The Commendation Award (CA) from SSC/ESG is given to individual standards partners who have contributed actively to Standards Development, and the implementation and promotion of projects.

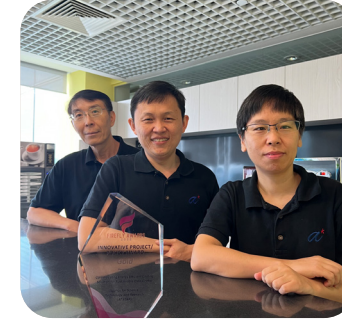


**Dr Wang Li**  
(Principal Scientist, NMC)



**Dr Xu Baoxi**  
(Principal Scientist, NMC)

## Innovative Policy / Project Award



IHPC received the Gold award for their partnership with a local SME, ERS Industries Pte Ltd, to co-develop an energy-efficient cooling system KoolLogix technology.

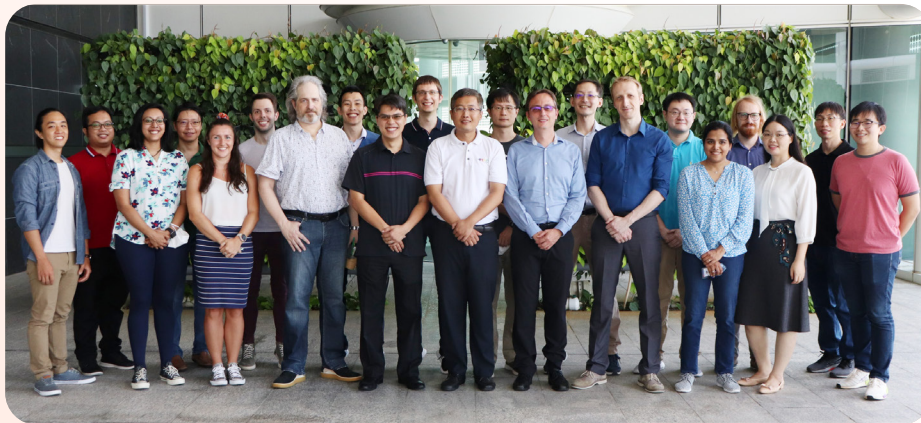


IMRE, IHPC and SIMTech received the Bronze award for developing the programme to promote sustainable low-energy solutions for crop growth in greenhouse and indoor farms.



ARTC and SIMTech received the Bronze award for their partnership with local SME systems integrator Sysmatic Global, MOH and Thomson Medical, to develop the Automated Vaccine Inoculation Dispenser (AVID) to help overcome challenges faced by staff in COVID-19 vaccination while dispensing vaccines from vials to syringes.

## Ministry of Trade and Industry (MTI) Firefly Borderless Award (Silver)



IHPC was awarded the MTI Firefly Borderless Award (Silver) for its work on the Singapore Integrated Transport & Energy Model (SITEM).

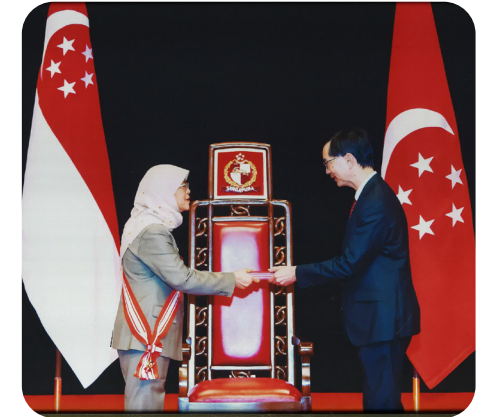
## Agility Award at Public Sector Transformation COVID Awards Ceremony

SIMTech partnered with Ramatex to design, source for materials and manufacture reusable masks given the tight timeline requirements of the COVID-19 pandemic. The team for the Development & Manufacturing of the Reusable Mask was awarded the Agility Award for the project, which also garnered media attention.



## The Public Administration Medal (Silver) 2022

**Professor Patrick Tan** (*Executive Director, GIS*) has been awarded the prestigious Public Administration Medal (Silver) by the Prime Minister's Office Singapore under the Ministry of Trade and Industry. Instituted in 1963, the Medals are awarded to individuals for outstanding efficiency, competence and industry. Professor Patrick Tan leads the GIS team in asking the right biological questions, applying and developing cutting-edge technology platforms, and embracing multi-disciplinary team science to improve the lives of every Singaporean, in one way or another.



## A\*STAR Highly Cited Researchers (HCR) 2022

According to the Clarivate Analytics Web of Science Group, A\*STAR's researchers are [renowned for their expertise](#) in fields such as immunology, molecular biology and genetics, as well as in cross-disciplinary work. They continue to exemplify our dedication to fostering a multi-disciplinary approach, and strong collaborative and innovation environment.



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**01 Dr Gan Ren-You**  
*Principal Investigator, SIFBI*

**02 Dr Lai Ruenn Chai**  
*Research Scientist, IMCB*

**03 Dr Lim Sai Kiang**  
*Research Director, IMCB*

**04 Dr Ng Lai Guan**  
*Principal Investigator, SlgN*

**05 Dr Xi Shibo**  
*Scientist, ISCE<sup>2</sup>*

**06 Dr Seh Zhi Wei**  
*Senior Scientist, IMRE*

**07 Professor Yang Yiyan**  
*Covering Executive Director, IBB*

**08 Professor Zhang Yong-Wei**  
*Distinguished Institute Fellow, IHPC*

**09 Dr Chen Jinmiao**  
*Principal Investigator, SlgN*

**10 Dr Subhra K. Biswas**  
*Principal Investigator, SlgN*

**11 Professor Nicholas Barker**  
*Research Director, IMCB*



07



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## SIGNIFICANT GRANTS

### Combatting Weaponisation of the Internet (CWI) Research Programme



**Dr Yang Yinping** (*Senior Scientist & Programme Director, IHPC*) was awarded for the project titled "Combatting Weaponisation of the Internet (CWI) Research Programme"

### 27<sup>th</sup> Competitive Research Programme (CRP)



**Dr Wan Yue** (*Group Leader of the Laboratory of RNA Genomics & Structure, GIS*) was awarded for the project titled "Identifying Functional RNA Tertiary Structures in Dengue Virus"

### AI Technology Challenge (Open-Theme) – Industry Edition (OTTC4I)



**Dr Yang Feng** (*Senior Scientist, Group Manager and Co-Innovation Lead, IHPC*) was awarded for the project titled "SmartRx: Safe Medication Management Platform Augmented by ARTificial Intelligence for Prescribers [Rx]"

### 28<sup>th</sup> NRF Competitive Research Programme (CRP)



**Professor Hong Wanjin** (*Executive Director, IMCB*) was awarded for the project titled "Targeting Novel Genes to Overcome Drug Resistance in EGFR-mutant Non-small Cell Lung Cancer (NSCLC)"



**Dr Huajun Liu** (*Group Leader, IMRE*) was awarded for the project titled "Integrating Wideband Tuneable Acoustic Filters on Silicon for High-speed Wireless Communication"

### Programme for Research in Epidemic Preparedness and Response (PREPARE) - Outbreak Research Strategic Funds



**Professor Lisa Ng** (*Executive Director, BMRC and ID Labs*) was awarded for the project titled "PREPARE Outbreak Research on Monkeypox in Singapore"

### AI in Education Grand Challenge



**Dr Nancy Chen** (*Senior Scientist, I<sup>2</sup>R*) was awarded for the project titled "SingaKids Pic2Speak: Multilingual AI Tutor – Uplifting Singapore's Bilingual Edge"

### Manufacturing, Trade and Connectivity Individual Research Grant & Young Individual Research Grant

20 A\*STAR researchers were awarded for both grants which support novel and fresh R&D investigator-led ideas in the manufacturing, trade and connectivity domain sectors. [Full list of awardees.](#)

### National Medical Research Council (NMRC) Individual Research Grant and Young Individual Research Grant

A total of 36 A\*STAR researchers were awarded the funds from NMRC to nurture basic, translational and clinical research that are relevant to human health and potential. [Full list of awardees.](#)





# ESTABLISHING A NEW OFFICE FOR OUR SUSTAINABILITY GOALS





A\*STAR recognises the importance of sustainability as a national goal. In March 2023, we established the A\*STAR Office of Sustainability (AOS).

The AOS' primary goal is coordinating A\*STAR's sustainability goals, strategies, policies and implementation plans. Additionally, it assumes the responsibility of preparing the A\*STAR Sustainability Report that encapsulates our sustainability efforts. The AOS also provides secretariat support to the Sustainability Working Committee (SWC) and Sustainability Working Group (SWG), facilitating effective communication and collaboration with key stakeholders.

With this governance structure in place, A\*STAR fosters a comprehensive approach to sustainability. By aligning our operations, research, and initiatives with sustainable practices, we leverage our capabilities to drive positive environmental and social impacts.

**AOS provides secretariat support to the Sustainability Governance Structure**



## COMMITTING TO A GREENER FUTURE

As the effects of climate become increasingly prominent, the public sector plays a critical role in pushing for sustainability, starting with the commitment to a net zero emission future by 2045. A\*STAR has taken a proactive stance by committing as an Advocate of the Green Nation Pledge in December 2022. Initiated by the Ministry of Sustainability and Environment (MSE), the pledge focuses on taking action for a green, liveable and climate-resilient Singapore.

### A\*STAR pledges to:



Set the air-con temperature to 25°C



Reduce usage of single-use disposables



Use energy-efficient appliances



Track our carbon footprint



Avoid bottled water for meetings and events



Publish a sustainability report annually





## CULTIVATING GOOD RECYCLING HABITS



Recycling is a key component of reducing carbon footprint. To promote a strong culture of recycling at A\*STAR, we provided separate plastic, metal, paper and e-waste recycling bins. We also placed more recycling bins in our printing rooms and pantries. By making recycling accessible and easily understandable, we encourage staff to recycle their waste instead of discarding them. With this initiative, we collected a total of 6,100 kg of recyclable materials and 10,200 kg of recyclable e-waste in FY2022 at the Institute of Sustainability for Chemicals, Energy and Environment (ISCE<sup>2</sup>).



## REDUCING OUR WASTE PRODUCTION

Reduction is the first of the three Rs — the most efficient way to manage waste is by preventing it. To cut down on acquiring surplus equipment and parts in our laboratories, we created the freecycle lane. This initiative encourages the adoption of unused yet functional laboratory resources among researchers. Through this lane, other departments can adopt items no longer required due to personnel changes, lab relocations or evolving research requirements, cutting down on the purchase of surplus resources and subsequent waste.



## PROMOTING EQUIPMENT SHARING FOR A GREENER A\*STAR

Reusing equipment and parts eliminates the need for purchasing new resources while reducing unnecessary waste. A\*STAR's equipment-sharing initiatives promote the sharing of project equipment and parts among teams and divisions. By encouraging the reusing of resources, we ensure adequate support is provided for each team while optimising resource allocation, resulting in minimal equipment idle time. This initiative, through collaboration and sharing, maximises resource efficiency and productivity while reducing unnecessary costs and environmental waste.

## ELIMINATING DISPOSABLE WASTE

In addition to embracing the principles of the 3 Rs, A\*STAR has taken further strides to tamp down single-use waste. Aligned with the Green Nation Pledge, we have made a conscious effort to eliminate the use of single-use plastics, such as plastic water bottles, during meetings and events. Instead, water jugs and reusable cups are provided to promote the use of sustainable alternatives.

To foster a waste-reducing culture within A\*STAR offices, we installed drinking water dispensers in all pantries and removed disposable cups. This encourages employees to use reusable cups and bottles. By implementing these measures, A\*STAR actively contributes to creating a sustainable environment and sets an example for waste reduction and responsible consumption practices.





## COLLABORATING GLOBALLY FOR ENVIRONMENTAL WELLNESS

Beyond promoting good practices internally, A\*STAR also focuses on green efforts with external stakeholders.

In March 2023, we participated in the inaugural WWF Earth Hour Summit with Mr Frederick Chew, Chief Executive Officer of A\*STAR, joining as a keynote panellist to share the importance of adopting a science-based approach in tackling climate change through tech and innovation. Organised by the World Wide Fund for Nature Singapore (WWF Singapore), the summit was attended by thought leaders and division-makers from both private and public sectors. This platform fostered the discussion of how various stakeholders can engage in partnerships and collaborations to address the climate crisis and work towards Singapore's Net Zero goals.





# HAPPENINGS AT A\*STAR





## A\*STAR SUPER MUMS (DIVERSITY WORKING GROUP)

Managing the dual role of a mother and a working professional has its unique challenges. The SUPER MUMS programme was initiated by the A\*STAR Diversity Working Group, to help mothers and mothers-to-be navigate the challenges of motherhood.

It is common knowledge that there are fewer women than men working in STEM fields. For instance, in 2017, women held barely 20% of tenured professorships in engineering and 15% in the physical sciences, despite the fact that their proportion of PhD degrees in those subjects has significantly increased in recent decades. Likewise, according to a global study conducted in 2020 by Moms in Science (MiS), scientist mothers experience a progressive decline in research output that is substantially worse than that experienced by scientist dads.





### THRIVING AS A SUPER MUM

Q: What's harder than being a woman in STEM?  
A: Being a working mum in STEM.

The A\*STAR Diversity Working Group organised a series of experiential coaching sessions to help SUPER Mums thrive in your roles as mothers and working professionals.

**1 MANAGING DUAL ROLES**

Manage situations within your control and **learn to let go**. It's okay not to have everything under control. No one does!

In addition to focusing on being a mother, ensure that you have opportunities to learn and grow in your career.



**2 SELF-CARE BEGINS WITH YOU**

Take care of yourself so that you can be **healthy, be well, do your job and care** for others.

**3 OVERCOME MUMMY'S GUILT**

Learn to trust caregivers and allocate time for yourself. Take a walk or watch a TV show without your children every now and then.

**4 BE PRESENT AT HOME AND AT WORK**

At home, take every opportunity such as meal times as a way to spend **quality time** with your children.

At work, ensure that you're **learning and growing**.

Look out for opportunities that will help your career, so you can be the best for your child.

**5 HAVE CONVERSATIONS WITH YOUR REPORTING OFFICER**

Have **regular 1-to-1 sessions** with ROs so they can better understand your challenges. Manage your own expectations as it can be difficult for ROs to understand your particular circumstances.

Remember to **stay open-minded** when receiving feedback from ROs!



## DISTRIBUTION TO HCSA BENEFICIARIES

On 23 December 2022, more than 20 A\*STAR staff set aside time during the festive season and stepped forward to help deliver Christmas goodie bags containing food and necessities. They travelled island-wide to visit the beneficiaries of HCSA Dayspring SPIN (Single Parents INformed, INvolved, INcluded) which comprises 68 single parents/families with 110 children in total.





## THE PURPLE PARADE'S 10<sup>TH</sup> YEAR ANNIVERSARY CELEBRATIONS

A\*STAR participated in the 10<sup>th</sup> year anniversary celebrations of The Purple Parade, Singapore's largest ground-up movement to Support Inclusion and Celebrate Abilities of Persons with Disabilities. To celebrate, 13 colleagues and their family members gathered to form a small contingent for the Purple Parade march, flying the A\*STAR flag high, and participating in fringe activities at Suntec City on 29 October 2022.



## GARAGE SALE FOR GOOD!



An initiative by A\*STAR Corporate Group, staff were encouraged to donate their preloved or even brand-new items they have little to no use for before the Lunar New Year as a way of spring cleaning. This initiative also allowed staff to come together and shop for a good cause. The donation campaign raised a total of S\$2,000, which went towards benefitting students on the autism spectrum at Pathlight School.

The remaining unsold items were also donated to Pathlight School's beneficiaries and Dignity Kitchen, a social enterprise in Singapore that trains, finds jobs and employs a range of people with disabilities, and intellectual and social challenges. The sales of these items raised another S\$200 through Dignity Kitchen's Community Fair in early March, which will go towards supporting their beneficiaries' daily afternoon meals.





## HANDS-ON ROBOTIC VEHICLE SMART CAMP AND VISIT TO ARTC

In collaboration with the Singapore Science Centre, A\*STAR provided the opportunity for 10 students (aged 12 to 16) from the Pertapis Children's Home (PCH) to take part in a hands-on experience at the Robotic Vehicle SMART Camp where they get to learn, build and programme a Bluetooth robotic vehicle from scratch.

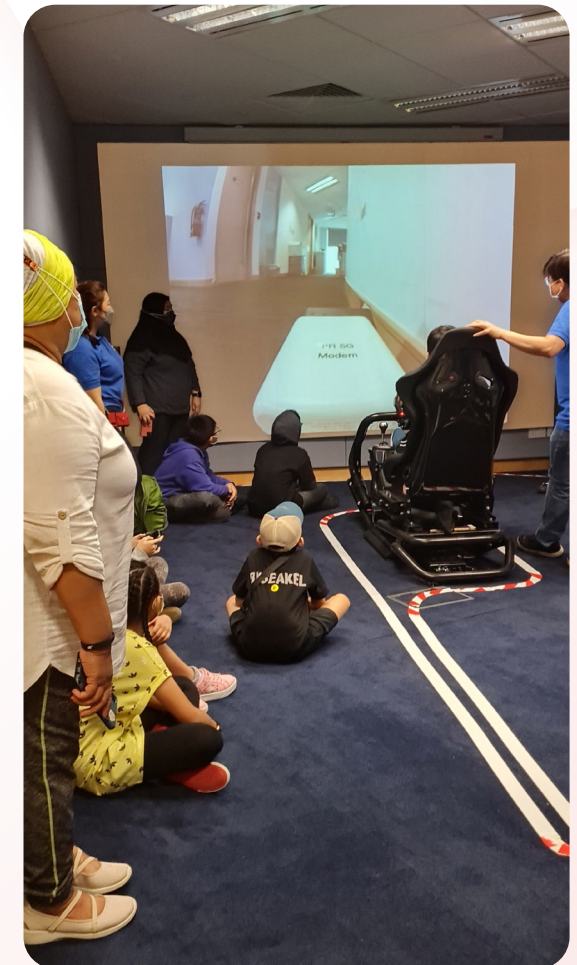
The students also got to visit A\*STAR's Advanced Remanufacturing and Technology Centre from 22 to 24 November 2022 to experience and appreciate our initiatives in translating research to industry applications.



## VISIT TO I<sup>2</sup>R AND FUSIONWORLD TO EXPLORE A\*STAR'S RESEARCH CAPABILITIES

The Corporate Social Responsibility (CSR) Committee worked with A\*STAR's philanthropic partner, Community Chest (ComChest) to invite more than 20 students (aged 10 to 17) from the three social service agencies: Children's Aid Society, SHINE Children and Youth Services as well as Beyond Social Services to tour A\*STAR's Institute for Infocomm Research (I<sup>2</sup>R) and FusionWorld on 6 September 2022.

The various social service agencies expressed their appreciation to A\*STAR and shared that they gained better insights on new technologies in the areas of machine intellection, robotics and AI.





## A\*STAR EVENTS

### 8 August 2022 – National Day Observance Ceremony

The A\*STAR National Day Observance Ceremony (NDOC) 2022 was a virtual event held on 8 August 2022 to celebrate Singapore's 57<sup>th</sup> birthday with the theme "Stronger Together, A\*STAR". This theme serves to remind the A\*STAR community that unity in our diversity is what makes us stronger. This event was attended by more than 3,000 staff, both virtually and at our community screening sites across Fusionopolis and Biopolis. The NDOC 2022 featured a light-hearted video of A\*STAR's senior leadership, a performance by LabRats, a National Day Song quiz, and our very own NDOC photo contest.



### 28 October 2022 – Dinner and Dance



The A\*STAR Dinner and Dance 2022 was the first large-scale in-person event held since the pandemic, to celebrate the achievements and milestones of A\*STAR and its employees in the past year. With the theme "Time Traveller", the event was attended by over 600 A\*STAR staff. The event featured performances by teams of staff and a "Style Showdown" competition in accordance with the theme. The event enhanced the morale of the A\*STAR employees and strengthened their bonds with one another.

### 17 March 2023 – Family Day

A\*STAR Family Day is a Whole-of-A\*STAR event for staff and their family members to build stronger bonds, deepen the A\*STAR culture as well as promote inclusiveness, diversity and our vision of One A\*STAR. It was held at Our Tampines Hub.





# KEY PERFORMANCE INDICATORS

RIE 2025 KPIs	A*STAR Achievement in FY2022	RIE2025 Target
Industry R&D Projects	1,806	6,500
Industry R&D Spending (S\$ mil)	\$227.2mil	\$1,200.0 mil
Licensing Revenue (S\$ mil)	\$15.2 mil	\$24.0 mil (\$16mil + \$8mil)
Number of Licenses	56	N/A
Number of Successful Spin-offs	9	40
Industry Cash Funding Received (S\$ mil) <i>(Tracking indicator in RIE2025, subset of indicator no. 2)</i>	\$87.6 mil	N/A*
Number of Research Scientists and Engineers from Research Institutes seconded to industry	42	230
Number of local R&D talent trained or being trained	127 <i>(cumulative since the start of RIE2025)</i>	390

\*Excludes Characterisation, Measurement and Technical Consultancy (C/M/TC) projects.

In addition to the indicators above, 848 of A\*STAR publications were amongst the top 10% of the world's most highly cited.



## ORGANISATION DETAILS ---

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