UNIVERSITI SAINS MALAYSIA

RESEARCH AND INNOVATION

RESEARCH CREATIVITY & MANAGEMENT OFFICE

Research and Innovation

NEWSLETTER

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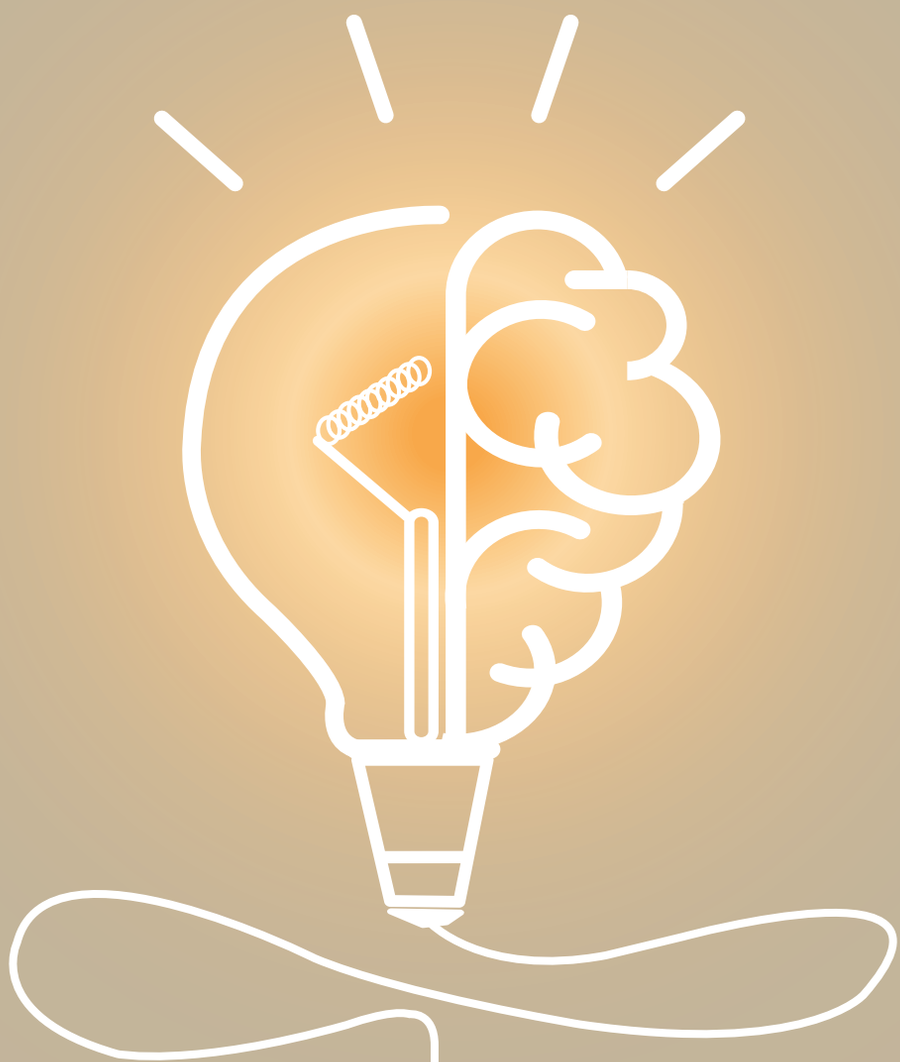

CURIOUSMIND

Fostering Impactful Transformative Research

Level 2, Chancellory II, Building E42, Universiti Sains Malaysia
11800 USM Penang, Malaysia

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curioUSMind R & I

Togetherness

I am proud to see our academics, young and senior alike, working collaboratively to ensure more impactful research findings. The spirit of togetherness is one culture which must be embedded within us to achieve success for greater purposes. We work as a team and achieve success as a team.

USM is blessed with researchers from various disciplines and domains. This is what makes our research unique. The Research and Innovation Division (R & I) will continuously assist all our "intellectual assets" to lead in their respective fields and go beyond the boundaries to translate knowledge further. This is in line with USM's mission "We Lead". Translating knowledge, requires researchers to work across domains and expertise. Therefore, I encourage multi-disciplinary type research across Schools and Centres in USM. Researchers should also be more proactive in doing so. Knowledge can grow through collaboration. Research efforts conducted by experts from different disciplines will create collective knowledge that translates into innovations beyond discipline-specific approaches.

In this edition of curioUSMind, we once again celebrate the success of our researchers. We feature our top researchers who have contributed to the success of USM's research output and those who have contributed immensely in their field, thus bringing an impact to the country. Research environment is one of the most important elements to ensure research productivity. A conducive research environment matters. A favourable environment can provide a dynamic culture to support researchers in their research. R & I is committed to offering continuous quality support for all our researchers.

PROFESSOR DATO' IR. DR. ABDUL RAHMAN MOHAMED, FASc.
Deputy Vice-Chancellor, Research and Innovation
Universiti Sains Malaysia

TRSM 2022

TOP RESEARCH SCIENTISTS MALAYSIA

Academy of Sciences Malaysia

Our own research scientists, awarded as top scientists of the country.

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TOP RESEARCH SCIENTISTS MALAYSIA
Academy of Sciences Malaysia

Prof. Dr. Chow Wen Shyang

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Research Interest

Polymer nanocomposites; Biodegradable Polymer; Biopolymer; Nanofiller; Latex Processing.

My Research: Contribution and Expertise

I am an established researcher who is passionate about the development of sustainable and environmentally friendly polymer nanocomposites. I have published a total of 110 international journals, permeation theories and fouling journals, and 11 book chapters from 2005 to 2022. My expertise is the processing and characterisation of biodegradable polymers, biopolymers and polymer nanocomposites. Most of my research, which focuses on the sustainability, environmental friendliness and recyclability of polymers, is in line with the Circular Economy. Well-structured human resources development is essential to catalysing the socio-economic growth of Malaysia.

A total of eight PhD and fifteen MSc postgraduate students have graduated under my supervision. The students were well trained, which can be justified by their high-quality theses and international journal publications (approximately 3 publications per postgraduate) and their job market competitiveness (100% graduate employability for the 23 students). Bionanocomposites can help to improve sustainability for the environment and create potential industrialisation opportunities. The latest contribution of my research is working with the polymer industry to develop a sustainable recirculating aquaculture filtration system (containing nanocomposite foam) to solve the water quality problems of fish farms. Overall, the scientific findings from my research work can have a great impact on the advancement of knowledge in the polymer industry.

My view: Qualities of a Good Researcher

In my personal view, to be a good researcher, we need to apply the "STREAM" approach. We should not only focus on the continuous "flow" (continuous contribution), but the empowerment of the elements in "STREAM" as well:

S- Sharing
T – Transform
R – Relearn
E – Enthusiastic
A – Action
M – Management

We need to share findings from our research with the scientific community as well as other stakeholders.

We can think out-of-the-box but it should always be relevant.

Last but not least, manage your time well so that you can have good quality "research time", "family time" and "me time".

Assoc. Prof. Ir. Dr. Cheah Chee Ban

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Academy of Sciences Malaysia

Research Interest

Construction Materials and Technology.

My view: Qualities of a Good Researcher

I believe an excellent research scientist has a specific area of research focus and specialisation. With that, the researcher can exert a consistent effort to develop new knowledge in the research focus area. Such effort contributes to developing the body of knowledge in the field. In essence, a good researcher focuses on three key results: to create new knowledge, share new knowledge locally and globally, and translate the scientific knowledge developed to the community, businesses and industry. The translation of knowledge is an important process to create a tangible impact of the research output to benefit the society and businesses towards developing the country into a high-tech nation. Besides high-quality research, an academic researcher's role is also oriented towards developing new talent for nation-building. In the context of the university, the talents are research students such as masters and PhD students who undertake their apprenticeship to learn crucial research skills that will benefit them in their long-term career and professional development. Therefore, the role of an academic researcher is, in essence, "Transforming Higher Education for a Sustainable Tomorrow".

My Research: Contribution and Expertise

To overcome the severe environmental degradation associated with natural resources mining for concrete production, Assoc. Prof. Ir. Dr. Cheah Chee Ban an strived to create novel reduced carbon footprint cement, alternative sand and stone for the construction industry. These alternative materials are produced from industrial by-products, solving the solid waste disposal problems through recycling them into functional construction material. As a result, he invented three national and one international patent granted and four national patents filed on green concrete, which received several national and international invention awards. Furthermore, by integrating the inventions with the industrialized building system(IBS), he designed and built the first full-scale green concrete detached house in Malaysia for technology demonstration, research, development and education.

Currently, he leads the national research supported by the Ministry of Science, Technology & Innovation (MOSTI) to develop new processes and innovative material designs for large volume reuse of coal combustion by-products to manufacture concrete. Moreover, he initiated a collaboration with one of the country's top five concrete producers to create tangible value for businesses and the society based on his inventions. Through the industry linkage, Dr. Cheah has led the technology transfer to produce sustainable concrete used nationwide in structure and infrastructure construction to reduce the material and environmental costs of the construction industry.

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TOP RESEARCH SCIENTISTS MALAYSIA
Academy of Sciences Malaysia

Assoc. Prof. Dr. Low Siew Chun

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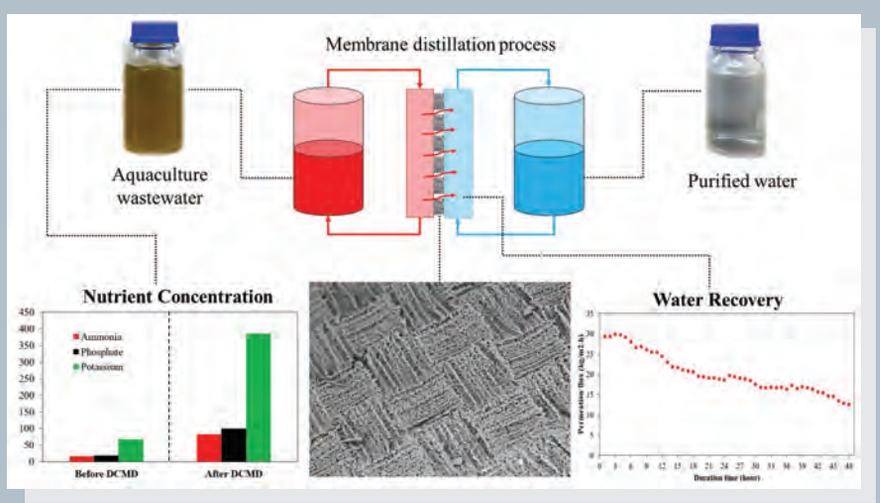
Research Interest

Separation Technology; Membrane Synthesis; Wastewater Treatment, Biosensor.

My Research: Contribution and Expertise

My research focuses on air purification and water recovery using separation technologies that can be accomplished with minimal cost and energy. This approach transforms air pollution control and wastewater treatment from a liability to a desirable activity for industries. Currently, my research team focuses on extracting and recycling valuable materials from aquaculture effluent rather than purifying water. Aquaculture is expected to emerge as one of the major agricultural contributors to the national economy. However, the problem associated to this aquaculture industry is the huge volume of wastes. In this regard, I am focusing on exploiting membrane technology to extract nutrients from wastewater.



We develop smart materials that alleviate membrane fouling problems, paving the way for more industrial uses of membrane separation technology. My team aims to achieve zero-waste discharge by recycling the purified water used in aquaculture activities and at the same time concentrating the wastewater feed as liquid fertiliser. The produced nutrient-rich liquid organic fertiliser its effectiveness as nutrients for soil microbes and improving the soil structure. The research outputs are not only beneficial for the environment, but also have a favorable influence on the country's social-economic well-being.

My view: Qualities of a Good Researcher

This is a question I often ask myself, and one which has been pondered over. I firmly believe that the study we conduct must be the kind of research that interests us and piques our curiosity. We might have the necessary intelligence. However, without curiosity and interest, we are not driven to go further to discover more commitment also plays a major role. Research is a challenging job. The working hours can be long and deadlines can be tight. In terms of job execution, researchers must systematically plan their work. It may sound simple, but it took me a long time to understand how to prepare for the overall scope of research activities so that I could revalidate my work within the allotted period. The last is the transmission of information. We may be talking to different audiences. To ensure that people can understand our results and what the results mean to them, excellent written and verbal communication is necessary.

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TOP RESEARCH SCIENTISTS MALAYSIA
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Research Interest

Pharmacognosy

My Research: Contribution and Expertise

Fundamentally, I am a pharmaceutical biologist and pharmacognosist. I have vast research experience in transdisciplinary aspects of medicinal plant research, with the principal aim of highlighting the importance of medicinal plants in drug discovery. In recent years, herbal remedies have been considered as dietary supplements for disease prevention and alternative/complementary medicine. The WHO estimates that 80% of the world's population relies on traditional herbal medicine for primary health care. While thousands of plants have been documented in traditional medicine, few studies have examined how these wild resources are integrated into modern medicine. My scientific research on medicinal plants, based on modern methods, has significantly contributed to the generation of scientific data, leading to the merging of this knowledge into modern medicine.

My view: Qualities of a Good Researcher

I believe an excellent researcher's three most crucial attributes are imagination, creativity and innovation. In science, if the outcome of the research activities creates new knowledge, imagination offers the research questions to be explored. Moreover, imagination also helps excellent scientists leapfrog ahead of their contemporaries to the next level of science. Hence, as Einstein told an interviewer in 1929, imagination is more important than knowledge in science. Besides that, a good researcher should also be creative in their research journey to achieve the research goal. In addition, innovation in scientific research is the key to unlocking societal benefits, specifically in industries. The innovative approach is behind scientists' success in discovering and developing new, world-changing technologies.

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Prof. Dr. Chan Yean Yean

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Research Interest

Medical Molecular Microbiology, Biosensor, Diagnostics.

My Research: Contribution and Expertise

My research has contributed to the progress in Life Sciences and the resultant innovations have improved of human life by tackling the bottleneck in current diagnostic testing platforms. Working in the field of diagnostics, my research has contributed to improving management strategies for diagnostics and surveillance of various infectious and genetic diseases, enabling rapid, accurate, sensitive, inexpensive, and point-of-care diagnosis. The multi- disciplinary efforts in the development of assays provide users with portable multi-sensor detection technologies that are able to give quick preventive actions and early diagnoses to ensure the quality of life now and in the future. I have filed various propriety technologies, specialising in providing affordable point-of-care tests, ambient temperature-stable end-point PCR, multiplex real-time PCR and biosensor tests. Besides working in the university environment, I am also involved in licensing and am a consultant to industrial partners to help generate income for the university and country through the commercialisation of my research products.

My view: Qualities of a Good Researcher

The criteria to be a "good researcher" is having a curious mind and attitude. All the issues surrounding us require ideas to solve the problems. Thus, through well-planned works, proof by scientific data and reproducible results, all issues can be solved in systematic ways. A good researcher enjoys exploring new findings to the problem and timely literature review for the latest technologies. The enthusiasm in research work will not be easily affected by the negative feedback, but is an energy to move further with different approaches and always consider alternative possibilities. In whatever future undertaking that they put their efforts into, they will prove to be an excellent achiever.

Prof. Chan in Lab

Assoc. Prof. Ir. Dr. Leo Choe Peng

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Research Interest

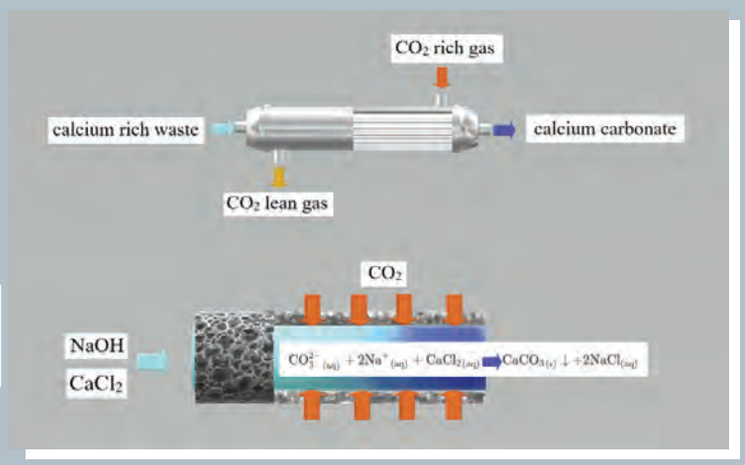
Membrane science and technology for carbon capture, water recovery, and food purification.

My Research: Contribution and Expertise

My research focuses on mass transport through membranes and the interaction with a planar surface. The findings are vital to understand the permeation theories and fouling mechanisms. I also study the enhanced extraction of functional food such as microwave-assisted and subcritical extraction. Our team has developed carbon capture strategies, water recovery innovations, and food purification methods using the knowledge generated from our past studies. We have introduced carbonate as the carbon carrier which enables us to store and utilise carbon dioxide. The carbonates are useful to kick-start the carbon circular economy involving fertiliser, paint and coating. My team has also incorporated IoT systems in our water reuse projects. Data collection and system monitoring allow us to understand public acceptance and social behaviour in water reuse. Furthermore, sustainable food processing has been promoted by introducing enhanced extraction involving local products such as propolis and roselle seed.

My view: Qualities of a Good Researcher

A good researcher must have ethics, specifically using moral principles to govern their research decisions. Without ethics, actual findings will not be revealed. Useful knowledge will not be generated, and we will be going nowhere in our research.



Carbon capture and conversion technology

Outreach activities

INDUSTRIAL COLLABORATION

Research and innovation
that solve real problems

Conversion of CO_2 and Petcoke to Fuel Gas (Carbon Monoxide and Syngas) Using Microwave Heating: USM-Petronas Collaboration

Universiti Sains Malaysia (USM), through the School of Chemical Engineering, has completed a research and technological collaboration with Petronas Research Sdn. Bhd., one of the research and development arms of Petroleum National Bhd. (PETRONAS). The project, which was led by Professor Dato' Ir. Dr. Abdul Rahman, started in February 2020 and was successfully completed in August 2022. Researchers from the Schools of Aerospace and Mechanical Engineering collaborated in this knowledge transfer and technology implementation between USM and Petronas Research. The project entitled 'Conversion of CO_2 and Petcoke to Fuel Gas (Carbon Monoxide and Syngas) Using Microwave Heating' aimed to produce value-added products from waste residues, including petcoke and lignocellulosic biomass, and the most notorious greenhouse gas, CO_2. The project was accomplished at the Technology Rediness Level (TRL) 4 and 5 levels (technology validated in the lab), wherein specific approaches for microwave CO_2 gasification of carbon-rich material and the resulting fuel gas clean-up were developed.

This project was financially supported by PETRONAS's aspiration to achieve MFT50.30.0, where the utilization of waste feedstock and, ultimately, sustainable feedstock has been identified as essential in reducing Green House Gas (GHG) emissions.

This collaboration was also in line with the Thirteenth Malaysia Sustainable Development Goals (2026-2030) and CO_2 mitigation plans which seek ways to develop long-term strategies for the remediation of this GHG in the environment and the scope to offer comprehensive solutions for climate change mitigation. Such processes incorporate CO_2 into a valorisation cycle to produce marketable fuels for various downstream applications along with the utilisation of petcoke which is plentifully available as the by-product of oil refineries.

Notably, this achievement is the result of several successful research activities and published papers from the research funding awarded to Professor Dato' Ir. Dr. Abdul Rahman Mohamed by the Ministry of Education Malaysia (MOE) via the Long-Term Research Grant Scheme (LRGS) for a research program entitled 'Sustainable Energy Production Towards Low Carbon Economy' from 2011 – 2014, which was further renewed for a second time with the title 'Green Technology and Nanomaterial Applications for the Mitigation of Green House Gases (GHGs)' from 2015 – 2019. The successful completion of this collaboration and the knowledge obtained from this project have paved the way for further scale-up of the process to an industrial scale and commercialisation of this technology. Accordingly, technical discussions are in progress for the next phase of the project, which will be TRL 6 and 7 (system prototype demonstration in an operational environment).

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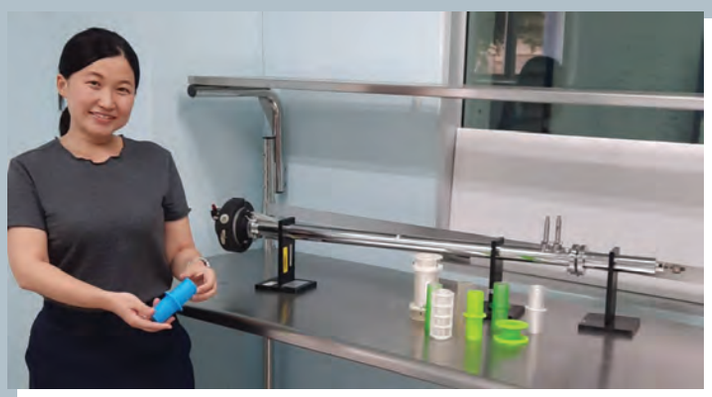
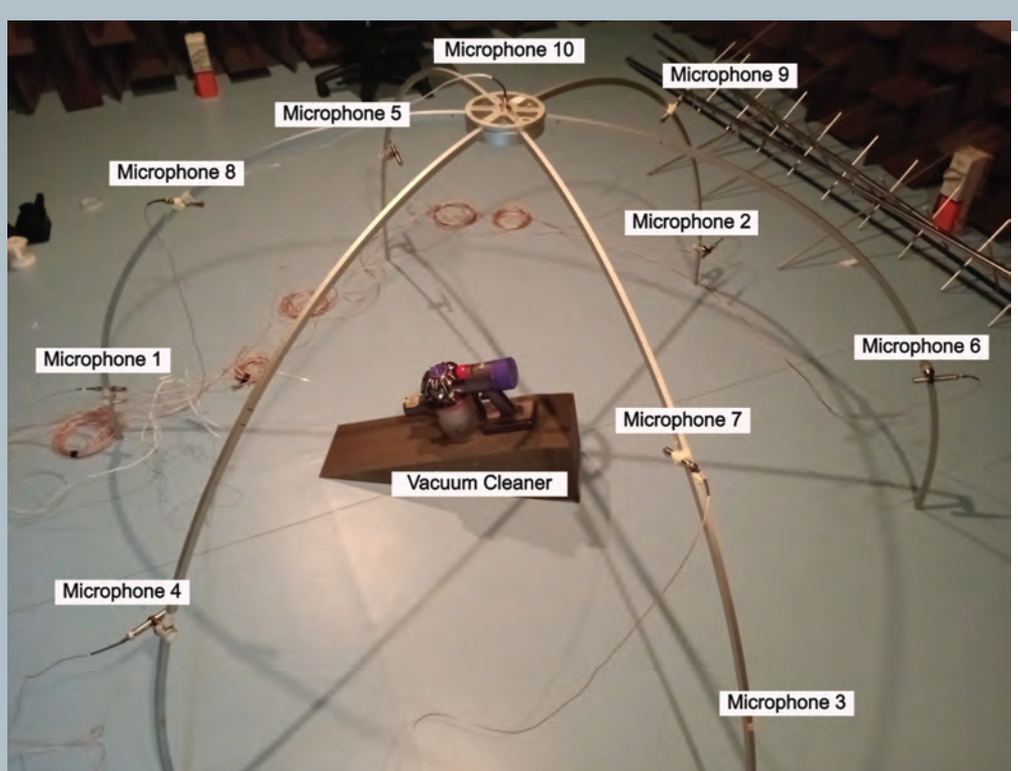


Dr. Ooi displays micro-perforated panel samples developed from the Dyson-USM Crest research grant project

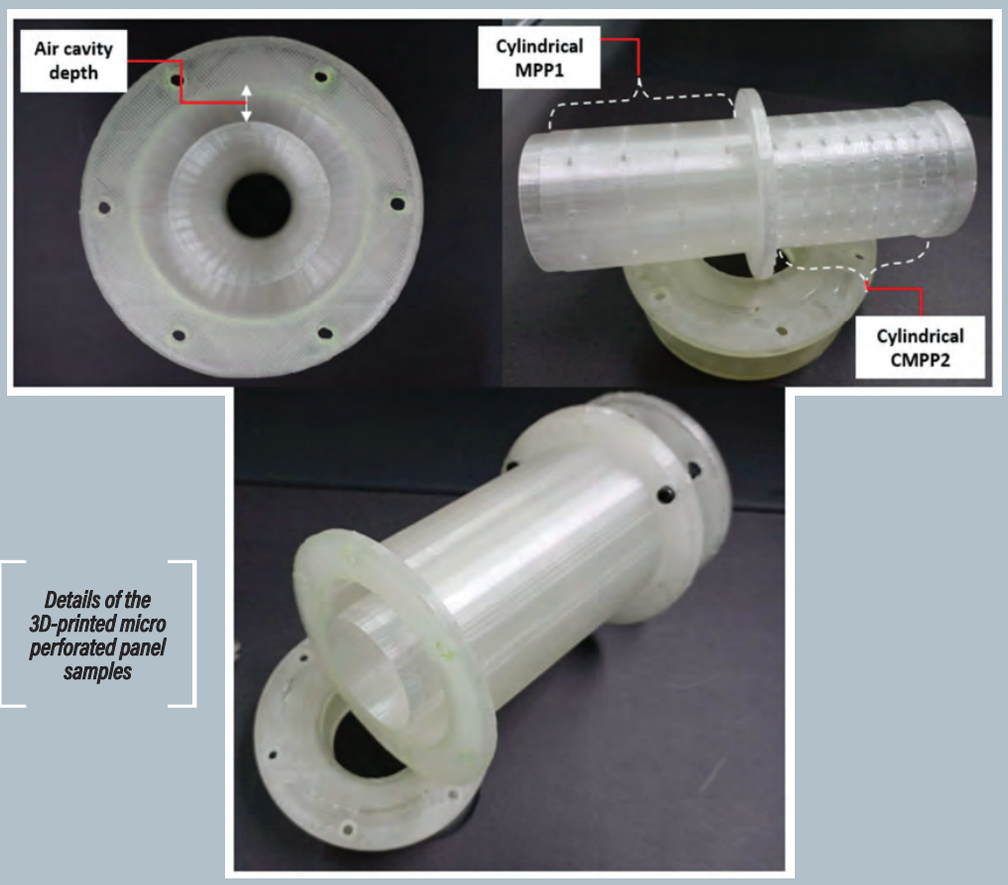
What is the proudest moment

When Dyson first approached me for a collaboration, I was still very new to the lecturing profession. I want to establish healthy, long-lasting relationships with the people I work with in the industry. As a researcher at a university, of my goals is to produce results that will be useful to the society or industry, particularly if those results would hasten economic growth or result in an increase in graduate employability for students. I want to express my appreciation for the fact that the contact between the USM team and the Dyson team has been positive from the very beginning of the partnership.

We broadened the scope of our collaboration to encompass a variety of exchanges. The team from TheVibrationLab at USM put together a specialised training programme for the Dyson team to demonstrate various measurement techniques and facilitate information sharing. The members of the Dyson team also participated in the International Conference on Vibration, Sound, and System Dynamics which was hosted by TheVibrationLab.



Configuration for measuring the vacuum cleaner in the semi-anechoic chamber



Details of the 3D-printed micro perforated panel samples

This was done to demonstrate their support and to further our connections. Postgraduate students who participated in this project were provided with the opportunity to complete an industry attachment with Dyson, which comprised both on-site and off-site employment. These are encouraging indicators for the industry collaboration project that which will result in improved bonding and further knowledge exchange. My proudest moment was when I saw the high degree of interest from our industry partner after witnessing the efficiency of the strategy that I proposed. Knowing that the efforts were recognised by a global corporation was both satisfying and reassuring. It was especially encouraging that it occurred at the beginning of my research journey because it indicated that that I was on the right track. I was able to demonstrate that the idea that was proposed had commercial value and was capable of resolving actual challenges that are being faced by the industry in terms of design and development.

What is the biggest challenge you faced to ensure the success of the project

The establishment of trust between two individuals is essential to the development of any kind of relationship or personal connection. Establishing trust is not an easy process under any circumstances, but it becomes especially challenging when working on a project that requires cooperation from various organisations. Due to the possibility that the project would contain confidential information, trust is an absolute necessity for the success of the partnership. By conducting myself in a professional manner, I can earn the trust of my industry partners and keep our long- term partnerships strong. As a member of the university staff, it is my responsibility to strike a balance between the benefits for the university and our industry partners. Depending on the nature of the collaboration, the deliverables could be a research article or a patent. When discussing any kind of research collaboration, patent ownership is guaranteed to be the most interesting topic. We are glad to have reached a mutually beneficial agreement that benefits both USM and Dyson. We are grateful for the trust that has been earned throughout the duration of the project as it will assist in ensuring the smooth completion of the project.

What is the future direction of the project

Establishing a long-term partnership with an industry partner, in my opinion, is essential for advancing research and benefiting students. The experience obtained from each project is unique and can undoubtedly aid in developing a two-way transfer of knowledge that are advantageous to both the academic community and industry.

My work with Dyson involved analysing the viability of an option for a sound absorber that is known as a micro perforated panel. We collaborate very closely to ensure that the outcome of the project is of high quality and that it is a successful endeavour. I am confident that the industry research collaboration project will increase the number of opportunities available to both students and researchers. My ability to identify solutions for industry problems has been improved by the experiences I have gained through industry research projects. I can apply the lessons that I have learned as well as the experiences that I have gained to my class.

This sound absorber project is currently focused on expanding its fundamental investigation and application breadth. I hope it can be implemented on a larger scale. The implementation will have a significant impact on the society. I hope that the results of the industry collaboration project will have a positive impact on the local community and contribute positively to future development.

Staffs from USM team, Dyson team and Crest team in the International Conference on Vibration, Sound and System Dynamics 2019 organised by The Vibration Lab, USM

Dyson staffs attend the workshop organised by TheVibrationLab, USM

Assoc. Prof. Ir. Dr. Norlaili Mohd Noh

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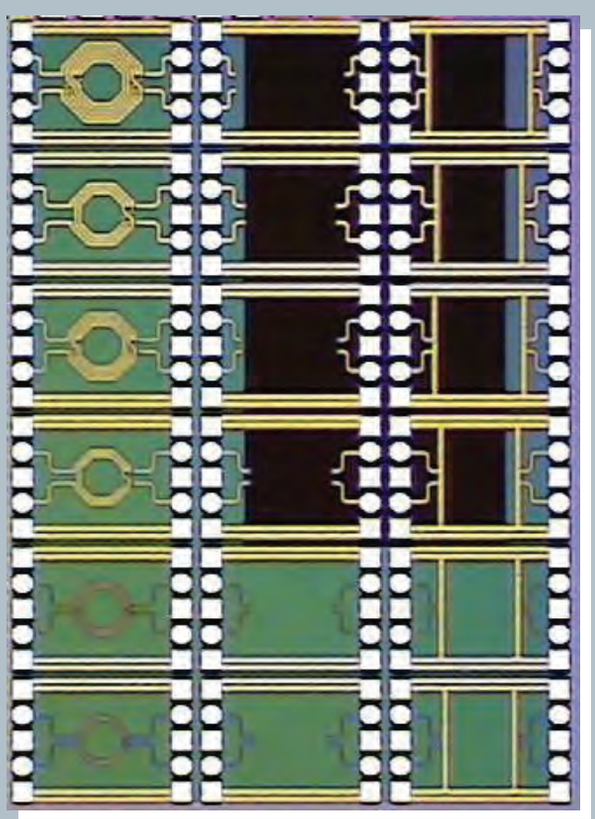
What is the proudest moment

Prior to 2011, Silterra Sdn Bhd had always been a good supporter for the fabrication of chips from the research projects conducted in USM via its multipurpose project wafer (MPW). The chips designed from my PhD work benefitted from such support where silicon data from at least four designs were obtained for analysis and validity tests.

From December 2011 to November 2012, I was offered a 1-year attachment with Silterra. I took up the opportunity via the industrial, research and sabbatical leave granted by USM. The project was on "CMOS13 High Frequency Noise Characterisation and Modelling". Besides conducting the project, I had also given classes on low noise amplifiers to the engineers in the device department. The contents of the classes were based on my PhD thesis.

The work on Silterra has initiated a grant proposal entitled "Development of High Frequency Noise Characterisation Methodology and Modelling for Wide Range RFCMOS Integrated Circuit Application". The project was granted a RM305,280.00 support by CREST in 2013 and completed in November 2015. The team comprised six members from USM and two from Silterra. The outputs were one patent filing application, three ISI journal publications, one conference presentation and one MSc graduate. The patent was successfully granted in August 2020.

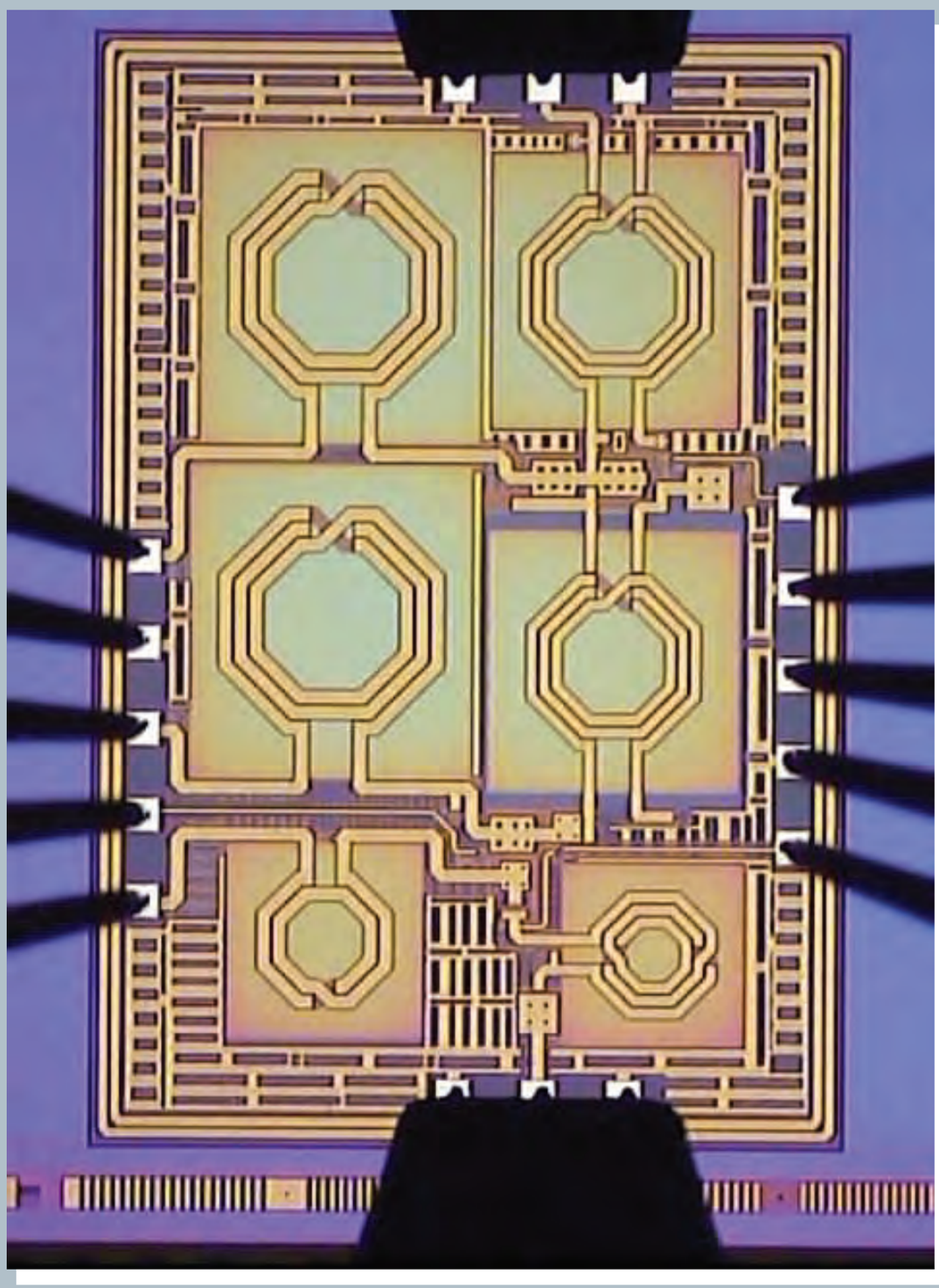


Transformer die

The patent from the first project had initiated a second project proposal with Silterra which was granted another RM557,096.62 support by CREST. The project, entitled "Design of Tunable Inductor and Transformer in CMOS Process for Multimode Low Power IoT Transceiver" was conducted from February 2018 until January 2021. The team comprised five members from USM, one member from UM and two members from Silterra. The outputs were one patent filing application, ten journal publications, three conference presentations, and one MSc + one PhD graduates.

Other project benefits from the collaborations above were the industrial experience and training on industrial related research for PhD and MSc graduates. Silterra had given monetary support for presentations in flagship conferences as well as award for publications in good and prestigious journals. CREST also supported final year projects (FYP) based on CREST's projects in the form of a one-off allowance to the FYP students.

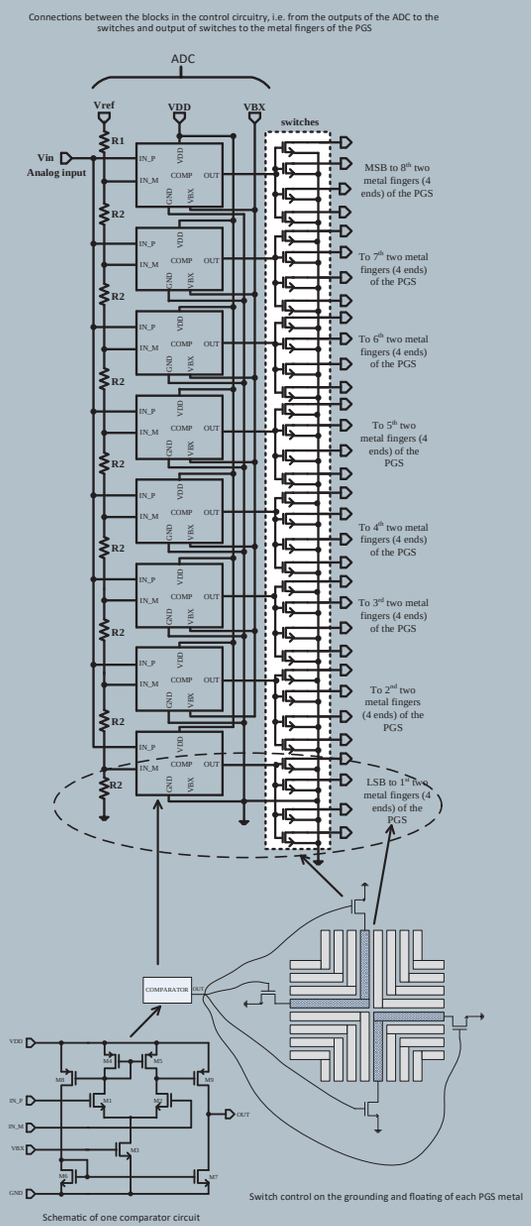
Four students had benefitted from this scheme. More importantly, the FYP's involvements in industrial-relevant projects realised the concept of "from research to classroom".



Fabricated power amplifier (PA) with Transformer - Micrograph

The collaborations with the industry had qualified me for professional registration (Chartered Engineer, CEng) with the UK Engineering Council in 2014 and the Board of Engineers Malaysia (BEM) (P.Eng./Ir.) in 2016. Professional registration of academic staff is very crucial for the accreditation of the undergraduate programmes in engineering schools. My proudest moment is when I reminiscence about the more than a decade long relationship with the people I work with in the industry. The collaborations were with the same people and team in Silterra.

This indicates that the researches were not only useful for the university and the integrated circuit research community, but also relevant for the semiconductor industry. I am thankful that the collaboration between the USM team and the Silterra team had always been positive from the beginning and had lasted more than a decade. I am also proud to have a young yet talented and dedicated USM member, Dr. Jagadheswaran Rajendran, working in the same team. It is good to have a young colleague in the team who is able to continue the fruitful collaboration, or start new ones, with the industries in the coming future.



Mr Yusman and AP Ir Dr Norlaili

Photos after final presentation with CREST on 11/5/2022

Mr Yusman and Dr Jagadheswaran

What is the biggest challenge you faced to ensure the success of the project

It was vital for us to establish and maintain a long-term trust between the university and industry. This included negotiating the content of the papers for publication and the patent to be submitted for filing. In addition, it was also important to ensure that the benefits gained from the project were fair for both the university and industry.

What is the future direction of the project

This work can be pursued by future RFIC designers in designing and enhancing the performances of the circuit using different techniques or ideas. The symmetrical impedance matching technique (which was submitted for patent filing) can be implemented in various RF circuits for performance enhancement.
The tunability of the inductor and the wide band property of the symmetrical matching network technique can be employed for 5G circuits. The output of this work has led to new research projects in which the symmetrical matching network is being tested with other RF circuits such as the VCO. A continuous research and enhancement will be conducted in order to stay relevant with the global trends in the wireless system.

IMPACTFUL RESEARCH

Research that demonstrates contribution to the respective field significantly

Assoc. Prof. Dr. Raa Khimi Shuib

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Rubber that heals itself.

Rubber that will naturally repair itself after damage has been developed by researchers at the School of Materials and Mineral Resources Engineering at the Universiti Sains Malaysia. In addition to its most obvious everyday uses, such as in vehicle tyres, rubber also serves in a vast range of engineering and domestic applications and failure can have damaging or even catastrophic consequences. Components such as bearings, gaskets, hoses and cables, for example, can play a critical role in everything from vehicles, aircraft and spacecraft, to industrial machinery and domestic appliances.

Normally, any critical rubber parts need to be regularly inspected by human eye or automatic monitoring equipment to identify degradation and damage and arrange replacement or repair before failure might occur.

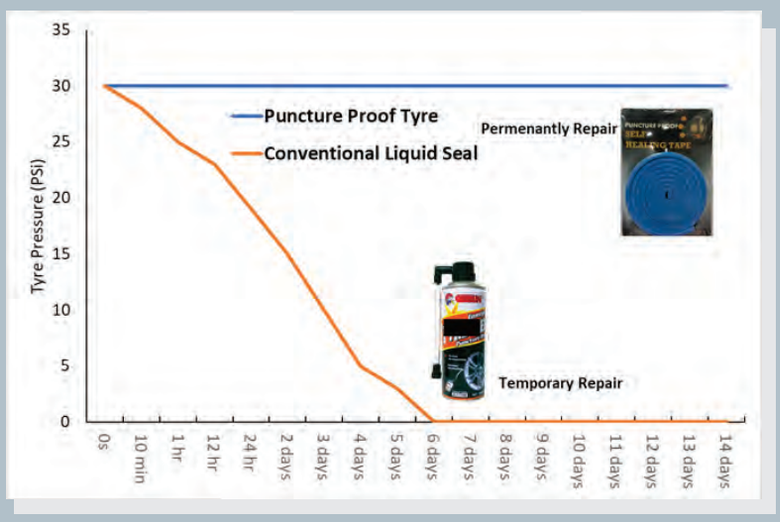
> The natural healing chemistry within rubber trees has inspired the development of self-healing rubber that could prevent catastrophic failures of rubber components.

"Our new self-healing rubber contributes to worldwide effort to avoid these difficulties," says Dr. Raa Khimi, of the USM team. He points out that the problems with conventional rubber lead to vast quantities of it being scrapped every year. Much of this waste cannot be readily recycled due to the strong chemically cross-linked networks in vulcanized rubber.

"We need more sustainable rubber products for environmental, economic, reliability and safety reasons," Dr. Raa Khimi adds, " and self-healing rubber is one of the most appealing approaches."

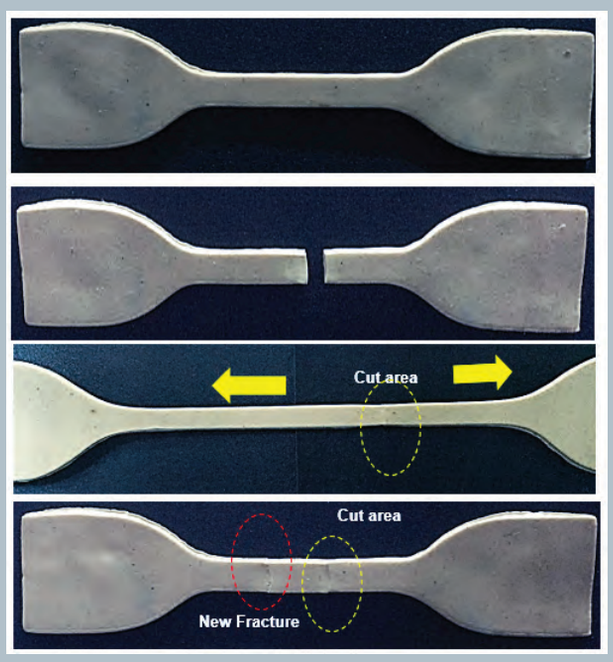
The USM team took inspiration from the natural processes in rubber trees to develop their new self- healing rubber. Natural rubber tree contains small bodies called lutiods that burst open when the tree is damaged.

The lutiods release a repair protein called hevein, which is stimulated by calcium ions to formmolecular crosslinks that seal the wound and prevent more latex from escaping. In a related way, the USM system uses zinc ions to form reversible ionic molecular networks based on sulfur-containing chemicals called thiolate ions. The healing can occur at normal room temperature with no external intervention required.

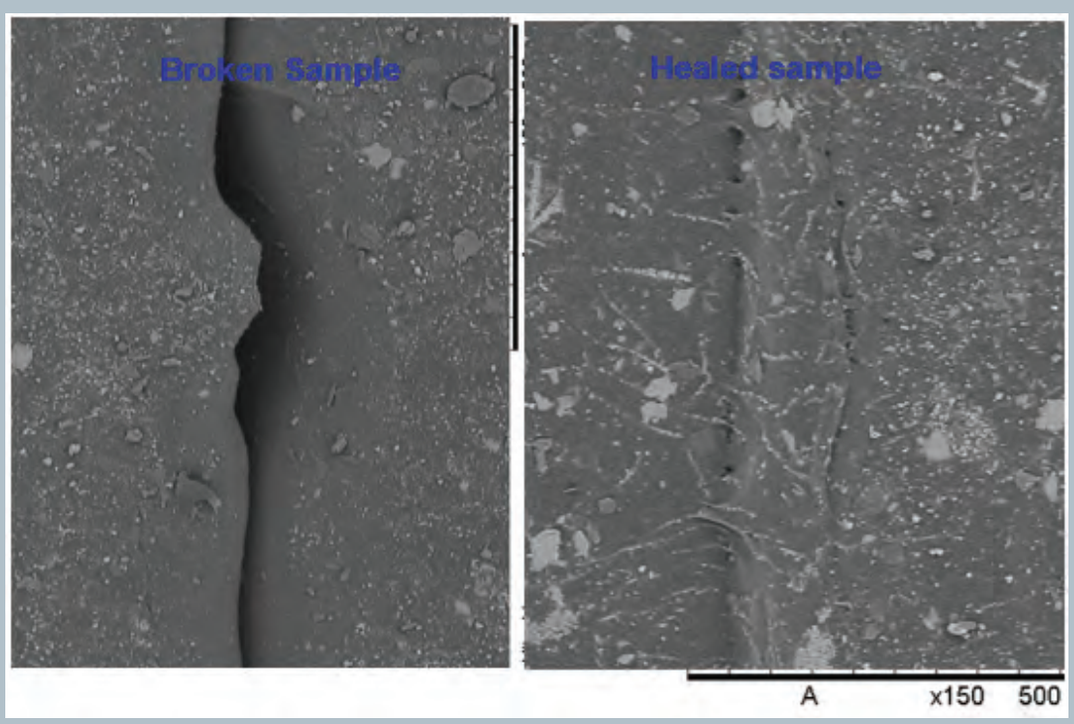


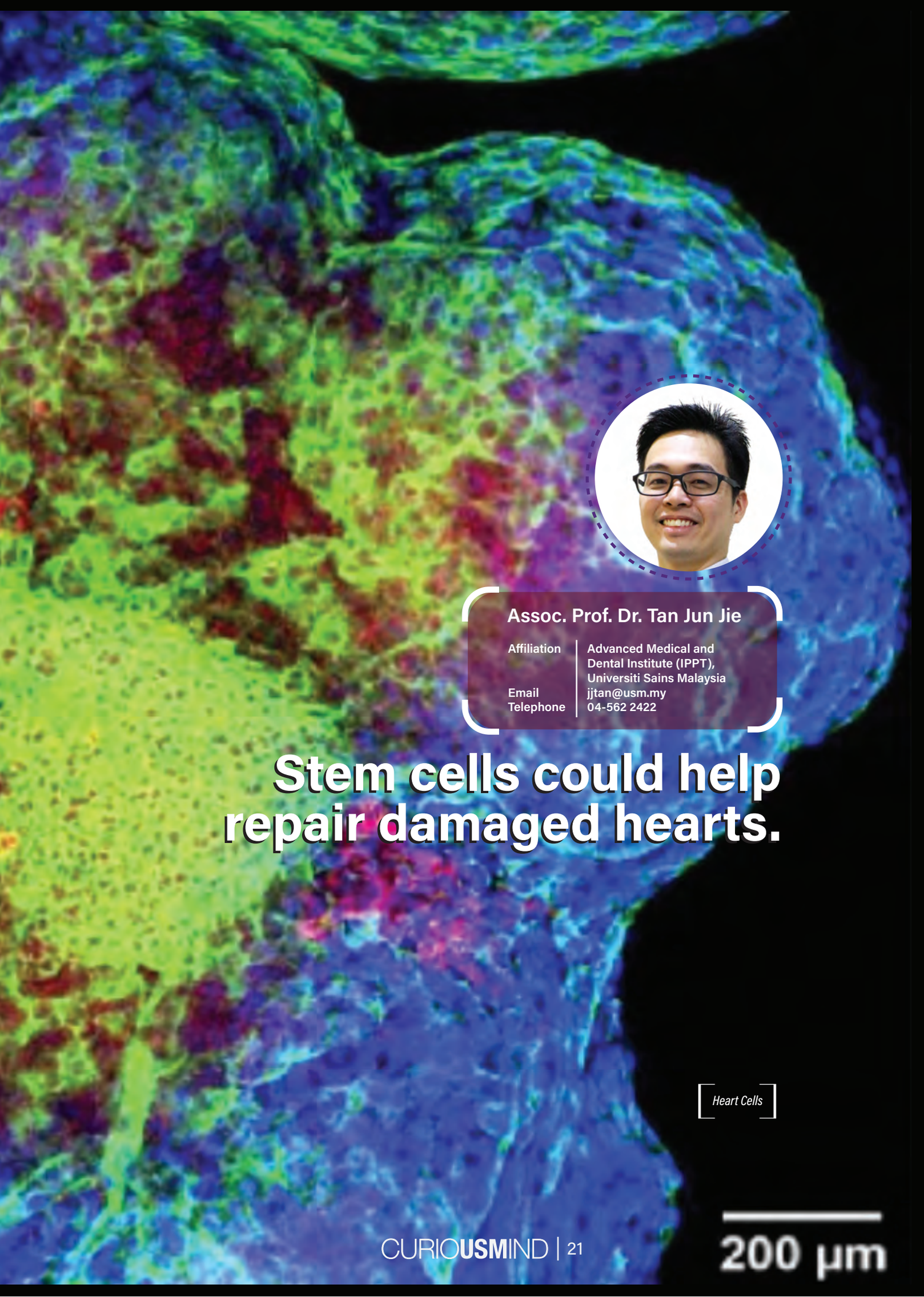
The research was published in the journal Polymer Testing and the team are now working to further characterise and refine the performance of their innovative material.

"We believe that our novel approach could be widely applied and may greatly increase interest in the use of rubber products in automotive, aerospace, engineering and electronics applications," Dr Raa Khimi concludes.



Self Healing Tape





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Stem cells could help repair damaged hearts.

Heart Cells

200 µm

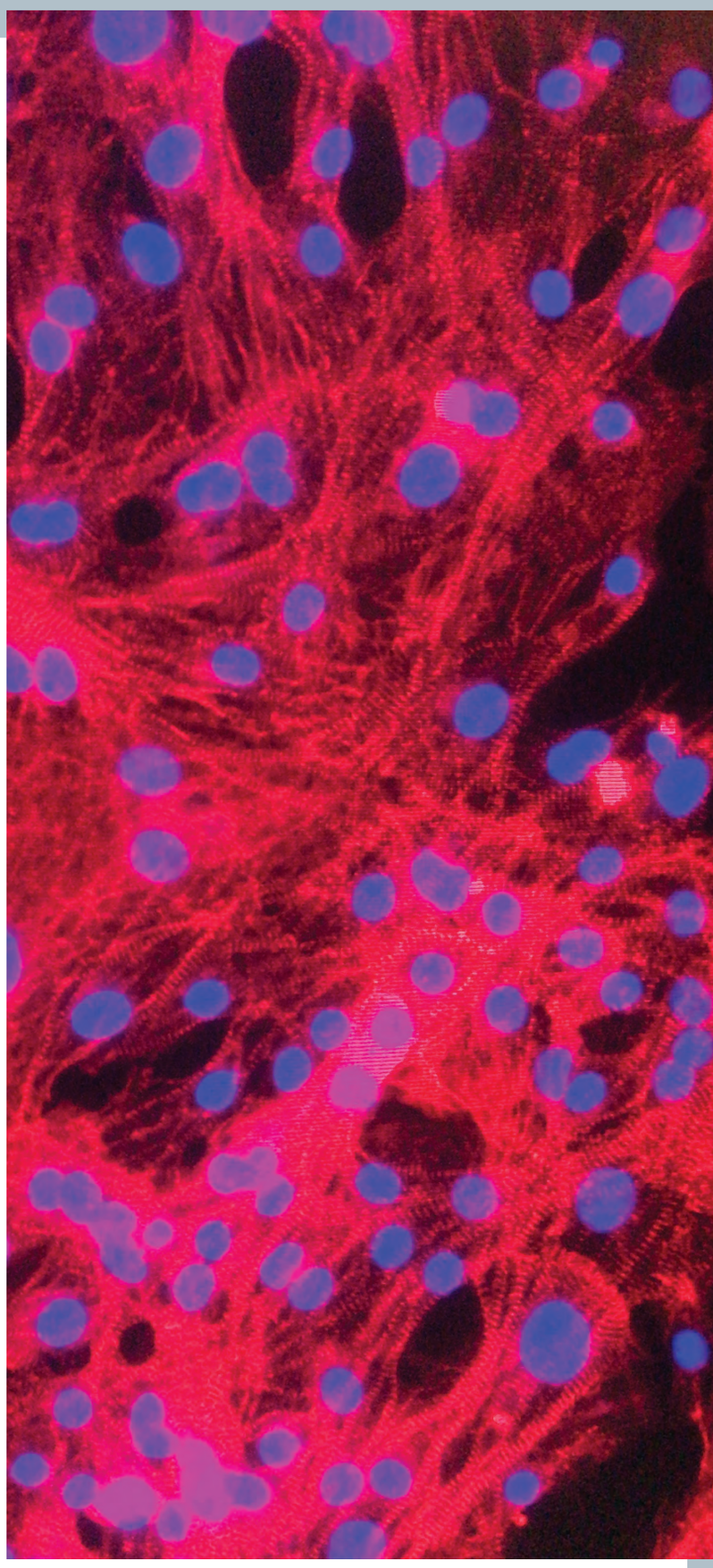
> Understanding how different types of cells interact in embryos to build a human heart could lead to better grafts for healing mature hearts.

New stem cell research at Universiti Sains Malaysia's Advanced Medical and Dental Institute could lead to more sophisticated and in the journal Nature Communications. Mature human cells collected from blood or skin can be programmed to re-enter an embryonic state and eventually go on to develop into different types of mature cells.

The USM scientists used a cocktail of natural cell-stimulating proteins to convert these 'human induced pluripotent stem cells' (hiPSC cells) into a premature form of epicardial cells: essential precursors of several essential cell type needed to build a developing heart. The team investigated how these pre-epicardial cells can direct the essential activities of the heart muscle cells (known as cardiomyocytes) that power heart contraction.

"Cardiomyocytes derived from hiPSCs hold broad potential for treating heart conditions, and for promoting research to investigate heart disease, engineer heart tissues for therapeutic grafts and screen potential drugs targeting heart conditions," says USM Associate Professor Jun Jie Tan.

Tan and his USM colleagues worked on the research with a team from the Center for Regenerative Medicine at Massachusetts General Hospital, Harvard Medical School in the USA. The Harvard researchers, led by Harald Ott, are exploring options for developing organ and tissue engineering methods as an alternative to organ transplantation.



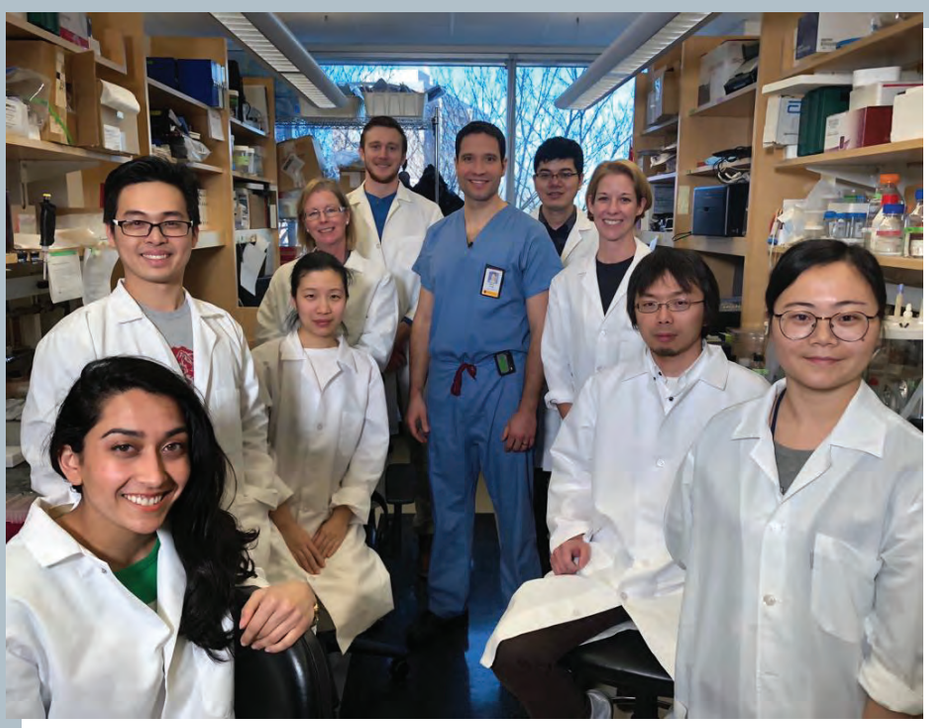
PEC-CM

The researchers co-cultured their pre-epicardial cells with cardiomyocytes to explore how they interact, modelling what happens in a developing embryo. They found that the cardiomyocytes grouped together into dense aggregates with the help of the pre-epicardial cells, and formed a connected and regularly beating tissue mass.

These changes occurred while the pre-epicardial cells became more mature and secreted a growth factor protein that could stimulate cardiomyocyte proliferation. So, with cultured cells in a dish, the team has recreated key steps towards a beating heart.

Overall, this study suggests that pre-epicardial cells could be used to help produce viable, engineered cardiac tissues for use in therapeutic tissue grafts and in research. It also advances the basic understanding of how hearts develop in human embryos, which could assist developments in the diagnosis and treatment of a variety of heart conditions.

"We believe our work could help create more sophisticated, mature and therefore more useful cardiac tissue grafts," Tan says.

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