MONASH University

MALAYSIA

SYNC

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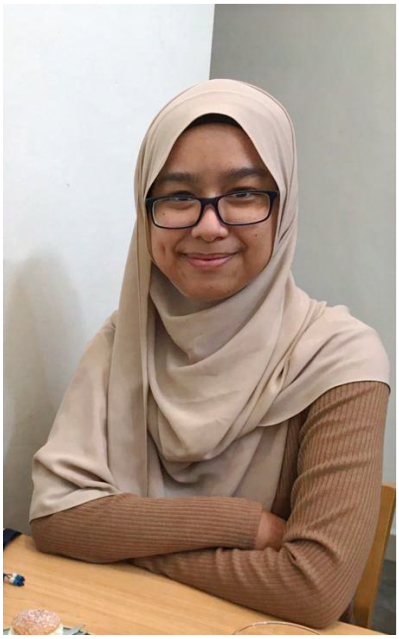
EARTH DAY

Join The Fight, Do What's Right

ISSUE 6, MARCH 2021

Letter from the Editor



Welcome, old and new readers alike to the sixth issue of SYNC, the official online newsletter of the School of Engineering (SOE) of Monash University Malaysia (MUM). To commemorate the upcoming annual "Earth Day" celebration that is observed worldwide on April 22nd, this issue of SYNC focuses on the efforts that demonstrate our support for environmental protection.

In this issue, we featured research that closely relates to the environment, including water purification and solar energy harvesting. SOE has many researchers that are working on sustainable issues, and we are very proud to share their findings, in hopes that it may inspire others to play their parts in protecting and preserving Mother Earth.

As always, we hope there is something of interest for everyone in this issue, and may it be an enjoyable and informative read. Many thanks for your continuous support, especially to our contributors for their time and effort. We welcome feedback and suggestions via email at mum.soe.sync@monash.edu. For those of you who are interested in going behind the scenes and joining our team, please do not hesitate to contact us via the email above. Take care and stay safe everyone.

Let us **SYNC - Say Yes 'N' Collaborate**
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Insight on Earth Day

A message from **Assoc. Prof. Wu Ta Yeong**
Associate Head of School (Graduate Research), School of Engineering

April 2021, or more precisely 22nd April 2021 will mark the 51st anniversary of Earth Day. Earth Day is an annual event that reminds the public about the pollution which we are now facing and our collective responsibilities in protecting Mother Earth. Compared to 50 years ago, the new challenges nowadays are more difficult but not impossible to handle. Advances in science and engineering have significantly helped to protect the environment and overcome the challenges that we are currently facing. All scientists and engineers who are working to address those challenges must stay and work together in motivation for achieving a betterment in sustaining the health of the planet's life and ecosystems.

We require new energy systems which use sustainable feedstock, new materials that can be sourced from renewable resources and technologies that are novel. In the School of Engineering, Monash University Malaysia, we are joining hands across the Disciplines to find sustainable and green solutions to address the challenges in protecting the environments. For example, Prof. Chai Siang Piao (Chemical Engineering) uses photocatalysis and synthesized catalyst in pollutants degradation, hydrogen and oxygen evolution by water splitting as well as carbon dioxide photoreduction into hydrocarbon fuels such as methane and methanol. On the other hand, Assoc. Prof. Poh Phaik Eong (Chemical Engineering) uses biological methods via anaerobic digestion to transform highly polluted wastewater into biomethane, which can be used as renewable energy. Assoc. Prof. Amin Talei (Civil Engineering) develops a biofiltration system to monitor and manage stormwater quality and quantity. Dr. Arshad Salema (Mechanical Engineering) designs a continuous microwave pyrolysis system to process various biomass materials. Assoc. Prof. N. Ramakrishnan (Electrical and Computer Systems Engineering) develops novel micro sensors to detect pollutants, UV, humidity, gas pressure, liquid, and biomolecules. According to Assoc. Prof. Tan Chee Pin (Robotics and Mechatronics Engineering), a state estimator can be used to diagnose abnormal conditions in a dynamic system, and therefore, enhance its reliability and efficiency. Very clearly, the researches conducted in the School of Engineering allow us to collectively contribute to overcoming those environmental challenges together.

Let's all join hands and move together in one direction for a better and greener world!

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Poseidon

Turning dirty water clean as a disaster relief effort

-Khanisya Palaniandy

Contaminated water isn't just dirty,it is deadly to life on Earth. In 2019, the World Health Organization (WHO) data revealed that at least 2 billion people use contaminated and unsafe drinking water [1]. Annually, 485,000 people die from waterborne diseases, which are easily transmitted during floodings.

Access to safe drinking water is recognized as a fundamental human right and has long been a goal of national and international policies. However, clean water supplies to regions affected by disasters require enormous effort by the government bodies and security forces. Such a situation demands innovative engineering solutions to provide clean drinking water to people in concentrated areas.

To this end, Associate Professor Pooria Pasbakhsh from the School of Engineering, in collaboration with The Sri Lanka Institute of Nanotechnology (SLINTEC), and Newcastle University, have developed a portable filtration device, Poseidon, as a disaster relief effort. The team is now working on filing a patent for the filter in Sri Lanka.

In an interview with Assoc. Prof. Pooria, we learned the details of this initiative and his views on the project's prospects. We include our conversation in this article and the list of published articles.

Tell us about Poseidon and how it came about.

The idea of developing a portable water filtration device first came up during a friendly hiking activity with a few team members. When we looked deeper into the issues in poorer countries or regions that often experience natural disasters, it became more apparent that the need for clean and safe drinking water is more crucial.

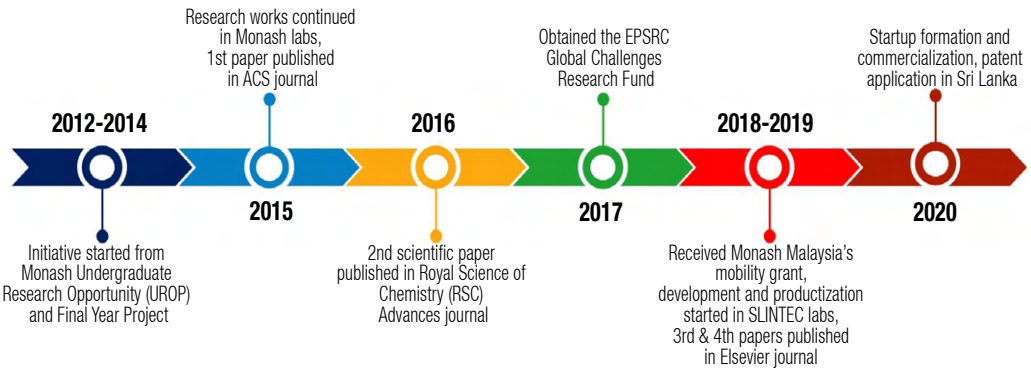
Even though portable filtration devices exist in the market, the device's affordability and efficiency in removing heavy metals from water remain a disadvantage.

Assoc. Prof. Pooria Pasbakhsh (Mechanical Engineering)

Heavy metals are a major concern in lower-income countries. Therefore, we developed a nanofiber filtration membrane using nanomaterials that successfully removes bacteria, bisphenol A (BPA), heavy metals, foul odor, and taste, as well as microplastics. In regard to that, our prototype testing has passed both industrial and WHO safe water standards.

Poseidon, a Greek word, literally means God of Water and Seas; hence it aptly suits our invention. Poseidon filter has a filtration capacity of up to 1000 liters. It could easily help affected people to filter the water they drink for at least a few days until they receive help. Hence, in the event of natural disasters such as flooding, relief support could opt to distribute these filters instead of bottled water. We are making this as cheap, light, and as easy as possible to be distributed, especially for such events.

The timeline of this project is as follows;



Source: [1] https://www.who.int/news-room/fact-sheets/detail/drinking-water

Tell us more about the team and their roles.

The project was kickstarted by Maziyar Makaremi as part of Monash UROP, and it became part of his FYP. We also have academic researchers from Newcastle University UK and Singapore who are specialized in the design and mechanics of the membrane and who took the lead in grant application from the UK government. The product development and testing are being led in SLINTEC by Rangika De Silva, our Ph.D. alumni, in addition to the patent application. The team is continuously expanding with new research assistants and postgraduate students in both universities. This eight-year project would not be possible without the fantastic teamwork of all the members. Special thanks to Sheik Ambarine Banon Auckloo at Monash Malaysia for her efforts to make the membranes for the prototypes. The trust shared in this professional association has brought this project to where it is today.

Dr. Rangika De Silva
SLINTEC

> **"At present, we are working with material engineering scientists, and in the future, we are keen on working with data scientists. This is a multidisciplinary team working towards the same target."**

- Assoc. Prof. Pooria Pasbakhsh

Assoc. Prof. Kheng-Lim Goh
Newcastle University, Singapore

What are the ongoing challenges you and your team are facing?

We have developed prototypes that have been tested for filtration, antibacterial and antiviral properties etc. The initial prototypes have been certified for some aspects and are currently awaiting certifications from various parties, including the Sri Lankan government bodies for the rest of the features. Interested investors were keen to know the filter's efficiency and have it tested on as many as 100 prototypes. To that end, we are still facing challenges on financial funding, space, and larger-scale equipment for the filters' mass production.

What are Poseidon's prospects and your thoughts on engineering approaches to solving environmental problems?

At the moment, our SLINTEC counterpart has applied for an international startup fund as we intend to patent the filter internationally in the future. In addition to that, to commercialize the filter, we are looking forward to developing the prototypes on an industrial scale to secure more funding. In the future, we would like to expand Poseidon's application as a portable household water filter.

As with this project, applying engineering approaches to solve environmental problems creates a golden opportunity for the skilful alliance of experts from various fields. At present, we are working with material and mechanical engineering scientists at "Nanocomposite lab" at Monash University to improve and fabricate the filtration membrane for our prototypes. In the future, we want to collaborate with data scientists to fit sensors to the filters that will help determine the survival rate and safety of people in the event of disasters. This is a multidisciplinary team working towards the same target to provide engineering solutions.

The team's publications are listed below. Read more through the following links.

[1] https://www.sciencedirect.com/science/article/abs/pii/S0142941818310833
[2] https://www.sciencedirect.com/science/article/pii/S235234091831432X
[3] https://pubs.acs.org/doi/abs/10.1021/acs.jpcc.5b00662
[4] https://pubs.rsc.org/en/content/articlelanding/2016/ra/c6ra05942b#!divAbstract

Monash Solar Panels

Campus Initiative Towards A Sustainable Future

-Abishek Pravin Manoharan

While many researchers are working towards a greener future, MUM contributes to this goal in the same way. As a leading research university in the nation, MUM leads the effort towards sustainability by setting an example.

"IF YOU DON'T LIKE IT, CHANGE IT."

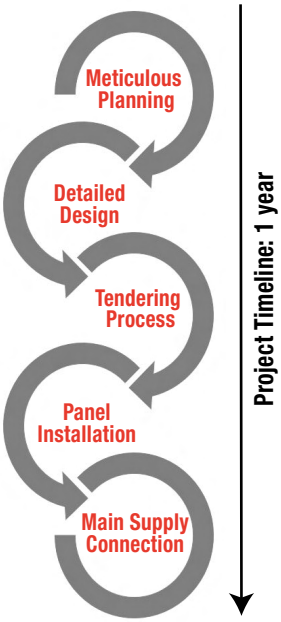
How many of you all know that MUM produces its electricity? Yes, our campus generates a portion of the overall electricity consumption via solar energy. Solar panels installed on the roofing sections of Building 6 and a part of Building 7, harness the sunlight energy and generate power to be used on campus.

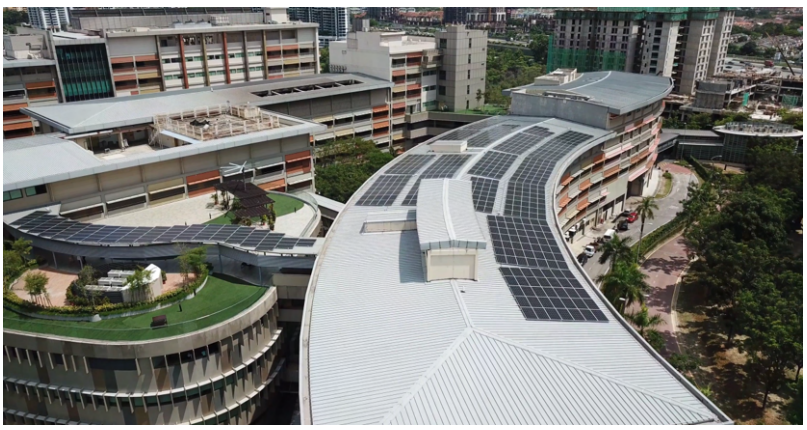
General Information

This installation follows the 'self-consumption' model, where all the electricity generated is used for campus activities. While the panels harness and generate direct current, an inverter converts this to an alternating current which is then supplied to the primary power unit. Meanwhile, a data logger records all the panel-related data in real-time. Guess what, you can have a look at the data for yourself (TV @ 'The Hive' – B7L5).

No. of Panels: **646**
Total Area Covered: **2169 m²**
Breakdown: **1993 m² - B6, 16 m² - B7L5**
Average Power Generation: **300 MWhr/year**

Covers 80% of Library Power Consumption (During Normal Campus Operation)





Aerial view of solar panels installed on Monash Malaysia buildings rooftops.

Project Economics

This installation features high-performance panels with coatings to reduce dust deposits, while occasional rains clear out little debris, if there should be any, hence, keeping operational costs at a minimum. Moreover, the annual power generation limit of 300 MWhr/year can be retained with an overall system efficiency of 80% at the end of the panel's lifetime (25 years).

Initial Investment: **RM 750,000**
Expected Payback Period: **6 to 7 years**
Operational Cost: **Licensing (Data Logger)**

Saves more than RM 100,000 on the Electricity Cost per annum

Key Challenges

A careful shading analysis was required during the planning phase of the project. This is to ensure sufficient exposure of the panels to sunlight. This analysis needs to take into account the current, and future township development plans as neighbouring buildings might cast a shadow on the panels, causing the reduction in power generation. Other factors beyond control, such as temperature, climate change and effective sunlight, also play a significant role in the power output. With the help of a professional consultancy firm, the feasibility studies on the technical and economic aspects were completed, finalizing B6 and B7L5 as installation locations.

Performance Statistics

Total Yield: **662.33 MWhr**
CO_2 Emission Reduction: **459.66 tonnes**
Oil Saved: **399.78 barrels**
Trees Saved: **63.69**
Nuclear Waste Reduction: **2.11 kg**

As at January 2021

Team Involved

- Rajeev Suberamany (Associate Director, Planning and Compliance): **Project Leader**
- Dr. Arshad Salema (Senior Lecturer, SOE): **Technical Advisor**
- Facilities Management Unit
- Occupational Health, Safety and Environment Unit
- External Consultants

For a bird's-eye view clip of the solar panels at Monash, click on this link:
https://www.facebook.com/monashmalaysia/videos/429849331134585/

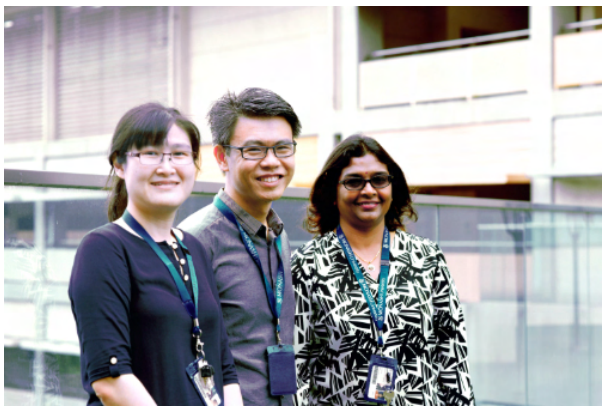
Piping Guide

Providing a comprehensive piping guide for better water distribution systems

-Yasmin Zaifullizan

In 2010, the United Nations (UN) recognized water as a fundamental right for sanitation and everyday life's basic needs (Resolution A/RES/64/29) [2]. Water availability & sanitation is also one of the Sustainable Development Goals (SDGs) adopted by all United Nations Members to help achieve a more sustainable future for all [3]. To this end, a team of researchers from the School of Engineering (SOE) and School of Business (SOB) have come together to help water stakeholders in Malaysia to make better-informed decisions in their effort to provide the country with reliable access to clean water.

In an interview with team members Ir. Dr. Lim Jen Nee Jones (SOE), Associate Professor Tan Boon Thong (SOE), Dr. Daniel Kong Lean Yew (SOE), and Dr. Puspavathy Rassiah (SOB), we asked them about the details of the project and their views on water issues in Malaysia.



From left: Ir. Dr. Lim Jen Nee Jones (Mechanical Engineering), Dr. Daniel Kong Lean Yew (Civil Engineering) and Dr. Puspavathy Rassiah (School of Business)

Photo credits: Uma Mageswary and Karmelia Yasmin

What is the project about?

The project studies the different water piping materials, looking into their mechanical properties, transportability, corrosion resistance, cost, and other criteria. The aim is to make a systematic and comprehensive evaluation of different piping materials under different applications, to help stakeholders make an informed decision when choosing the materials. Another aspect of the project is looking into reducing non-revenue water (NRW) – water lost en route to reaching end users, by choosing suitable piping materials where needed. In 2017, it was reported that 35.3% of treated water does not reach the intended recipients in Malaysia [4]. This is a huge loss, equating to about 5929 million litres per day (MLD).

The current materials used are considered conventional and reliable choices. They are ductile iron, mild steel, and High-Density Polyethylene (HDPE). Each material has its own advantages and disadvantages. For example, mild steel pipes are strong and can withstand high pressures, but they are prone to corrosion in the long term, especially if installation works were not carried out according to strict procedures. Ductile iron is costlier than mild steel but is more corrosion resistant and has systematic push-in joints and tapping, and this leads to a longer life expectancy.

Plastic pipes are more costly with lower pressure ratings but are light and flexible, thus making installation easier. Thus, only using plastic pipes with smaller diameters are cost-effective. They are also ideally suited for corrosive environments. HDPE is currently the dominant plastic option. A new type of material called "molecular oriented PVC" (PVC-O) which uses a process to favourably orient the molecular chains and strengthen the pipe is struggling to establish due to lack of familiarity by the industry players. In the long run, this study hopes to guide relevant authorities to choose the right materials that suit the specific area at the right cost.

Who will benefit from this study?

The project is a desktop research, where we objectively identify specific or useful qualitative and quantitative data relevant to the project's needs. We make technical and cost comparisons based on the existing literature, catalogues, technical specifications and quotations. This is what constitutes the data to help guide decision making for the relevant parties. Furthermore, we also look at existing piping infrastructure in Malaysia and the distribution of the piping material.

Source: [2] https://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/64/292
[3] https://sdgs.un.org/goals/goal6
[4] https://www.data.gov.my/data/en_US/dataset/non-revenue-water-nrw-statistics

Associate Professor Tan Boon Thong
(Mechanical Engineering)
Photo credits: Uma Mageswary and Karmelia Yasmin

Hence, it is not about satisfying one group of people. Instead, it looks at how the project can contribute to a larger body of knowledge. This is in hopes that each stakeholder, from the water authorities to the contractors and end-users, will gain some benefit somewhere along the line.

"It is interesting to see different point of views from members of different fields. Working in a multidisciplinary team gives us a balanced feedback and that's how we compliment each other."

- Ir. Dr. Lim Jen Nee Jones

How did the team formation happen, and what are each person's roles?

The team was formed due to the funder's requirements and the nature of the project. The funder initially approached the School of Business (SOB), but the project needed a systematic and scientific approach in order to give conclusive results. This is where experts from the School of Engineering are introduced. Dr. Puspavathy from SOB oversees cost and statistical analysis. From SOE, Dr. Daniel Kong is from the Civil Engineering discipline and is familiar with corrosion problems and piping systems as a whole. Assoc. Prof Tan (Dr. Kenny) is an expert in pipe flows and Computational Fluid Dynamics (CFD). Last but not least, Dr. Jones is the team leader and has experience in the water pipe manufacturing industry. Both are from the Mechanical Engineering discipline. The collaboration provided good synergy for a successful project.

Thoughts on water conservation education

In recent years, the National Water Services Commission (SPAN) has been working with relevant foundations and local communities to educate the public on the importance of water conservation and protecting its source. This is a good step, but more can be done. Water authorities can reach wider audiences with the help of social media campaigns and roadshows. The public needs to understand how water is supplied and the workings behind them to increase their appreciation of the system. At the end of the day, the authorities and the public need to work together to ensure smooth and reliable water distribution. While authorities put in the effort to maintain water quality and prevent water pollution, the public also needs to be educated on the current situation. Water management and distribution is not a simple problem, especially on a nationwide scale, and on a budget, due to water being a low-priced commodity. Hence, every person should try their best and do their part to ensure clean water accessibility and reliability for all.

Links to the publications regarding this project:

Jones, L. J. N., Kong, D., Tan, B. T., & Rassiah, P. (2021). Non-Revenue Water in Malaysia: Influence of Water Distribution Pipe Types. Sustainability, 13(4), 2310. MDPI AG. Retrieved from http://dx.doi.org/10.3390/su13042310

Jones, L. J. N., Kong, D., Tan, B. T., & Rassiah, P. (2020). Water Pipes in Malaysia: Technical and Capital Cost Comparison. Proceedings of the 6th International Conference on Accounting Business and Economics (ICABEC) 2020, 52-61.

Industry Roles for Earth Day

-Khanisya Palaniandy

The official theme for Earth Day 2020 was **"Climate Action"**. The mission was to encourage individuals and organizations around the world to continue moving towards a zero-carbon future that makes our world more habitable. In line with this, both local and international industries as well as tech companies stepped up with a variety of initiatives and events. Some of them are listed here.

Malaysian Companies

- **Petronas (Petroleum Corporation)**

Petronas aspires to achieve net zero emissions by 2050 by focusing on carbon footprint reduction. Some of its initiatives include building on operational excellence strengths by minimising waste and promote recycling throughout the value chain, making cleaner energy more accesible, accelarating technology and innovation stewardship, and investing in nature-based solutions.

For more info: https://bit.ly/38l1Q8v

- **Digi (Mobile service provider)**

In 2009, Digi became the first Malaysian company to sign up on the UN Global Compact Caring for Climate policy. It commits to achieve a 50% reduction in its carbon emissions by 2030. Digi's key initiative focuses providing a sustainable workplace by restoring natural resources.

For more infor: https://bit.ly/3cdUm8A

International Companies

- **Nestlé (Food and Beverage)**

Nestlé aims to halve their greenhouse gas emissions by 2030 and reach net zero by 2050. During this period, their initiative include supporting farmers and suppliers to advance regenerative agriculture, planting 20 million trees every year for the next 10 years and completing their transition to use 100% renewable electricity by 2025.

For more info: https://bit.ly/3rxD7Wn

- **Atos (Information technology)**

Atos commits to halve its global emissions in the next 10 years and achieve net-zero carbon emissions by 2035. During this period, their initiaves include decreasing their operational carbon intensity, reducing energy consumption at their datacenters and introducing an internal carbon pricing (80/ tons CO_2) to drive business decisions towards decarbonization.

For more info: https://bit.ly/3rx5Dr7

Meet other companies taking action for a zero-carbon economy...

Automotive
- Toyota Motor Corporation
- Daimler AG

Cement and concrete
- Heidelberg Cement AG
- CRH Plc
- Shree Cement

Chemicals
- MercK KGaA
- Bayer AG

Food, beverage and agriculture
- The Coca-Cola Company
- Pepsi Co. Inc.

Paper and forests products
- Kimberly-Clark Corporation
- Uni-Charm Corporation

Committed
Targets Set

Source: https://bit.ly/38mPtca

Research Focus

-Kang Kai Dean

The academic staff in SOE Monash Malaysia engage in exciting research to find sustainable solutions as a step to protect the environment. This featurette shares a few of their research work.

DR. CHANG WEI SEA
(MECHANICAL ENGINEERING)

My research focuses on the complex functional oxide and GaN-based semiconductors for energy storage and photoconversion that lead to clean energy. One of our projects utilises complex functional oxides, ferroelectric oxide perovskites in particular, to split water into hydrogen and oxygen by using solar energy, replacing fossil fuel. Ferroelectrics have a strong dipole moment that can be switched by an external electric field. The strong dipole moment in ferroelectrics can increase the internal electric field within the material, behave like batteries to separate the electrons and holes in opposite directions, and therefore decrease recombination to ensure efficient charge separation and transfer in solar water splitting.

Ferroelectrics are also piezoelectric, which means they are capable of electro-mechanical energy conversion as a result of the coupling effect between mechanical strain and electric field. For this unique property, we use visible-light to induce ferroelectricity to control the piezoelectric strain, which could be used in the development of micro-opto-electro-mechanical systems (MOEMS). In simple terms, we use ferroelectricity to interact with visible light for energy harvesting and conversion to reuse / convert various energy sources from the environment with an on-board storage capacity. Companies such as Fujitsu and Ferroelectric Memory Company (FMC) Germany are involved in mass production of ferroelectric devices, for example, Ferroelectric RAM (FRAM) technology which is incorporated in Fujitsu laptops to reduce energy consumption. We collaborate with Ming Chi University of Technology (MCUT) Taiwan, National Chiao Tung University (NCTU) Taiwan and Institute of Microengineering and Nanoelectronics (IMEN) for ferro- and piezoelectricity research.

Another ongoing project is the Gallium nitride-on-Gallium Nitride (GaN-on-GaN) epitaxial program. This is a national program which involves collaboration with academia and industry, including University of California Santa Barbara (UCSB), Monash University Malaysia (MUM), University Malaya (UM), University Sains Malaysia (USM), University Malaysia Perlis (UNIMAP), OSRAM, Inari, ItraMAS, Penchem, Lumileds, and more.

The program aims to develop green technology to ensure that the products are environment friendly and sustainable. Owing to its high efficient power conversion, GaN could advance electronic devices into clean energy such as light-emitting diodes (LED), electric car chargers and solar powered electronics. Furthermore, since GaN is a piezoelectric material we demonstrated that the mechanical strain in GaN can be enhanced by ~50% by harnessing light energy, which makes GaN a promising candidate for optomechanical devices.

As researchers, we can contribute to Mother Earth by selecting and improving harmless materials to give excellent properties performance. One of the toxic elements is lead (Pb) which can be found in the most commonly used ferro- and piezoelectric materials in practical applications such as ultrasound transducers for medical imaging applications and many other electronic devices. The EU's Restriction of Hazardous Substances (RoHS) regulations has put a strict restriction on the use of lead due to its toxicity to humans and the environment. My team has been focusing on Pb-free materials for energy storage and photoconversion. We hope that one day we will be able to develop a high performance yet Pb-free material for technological applications.

Research Focus

-Kang Kai Dean

ASSOC. PROF. CHONG MENG NAN
(CHEMICAL ENGINEERING)

Our research group focuses on the development of advanced energy material systems for the production of solar hydrogen in a more sustainable way (i.e., solar hydrogen route), as the conventional routes of hydrogen production via coal gasification, steam methane reforming and water electrolysis contributes to carbon footprint which negatively impacts the environment. Photoelectrocatalytic water splitting occurs by harnessing light photons using bespoke photoelectrodes, which are made from semiconductor materials with well controlled synthesis of active surfaces and interfaces. Once a photoelectrode is illuminated with solar light, photoexcited electron-hole pairs are formed within the structure of the photoelectrode and later being diffused to the active surfaces for oxidising water molecules into O_2 and H_2.

When I joined Monash University Malaysia in June 2012, I managed to secure an eScience grant later in the same year to establish and build my research group. Our research group is involved in the material and process system development, starting from the fabrication of (photo)electrodes to various electrochemical, bioelectrochemical and photoelectrochemical (PEC) systems for a range of sustainable engineering applications.

I am fortunate enough to obtain my second and third external grants from MOHE Malaysia and Royal Society of UK-Newton Ungku Omar Fund in 2014 and 2016, respectively, to venture into a more holistic and rational synthesis of advanced heterostructure photoelectrode based on the fundamentals probing of electron-hole pairs' dynamics. In order to obtain a higher cost parity between the investment and solar energy fuel to be produced (i.e., amount of solar hydrogen produced), a conversion efficiency of at least 15% must be achieved. Meanwhile, we are still pushing ourselves to go beyond the limit by applying various multidisciplinary approaches to reveal the latent characteristics of photoelectrodes as well as making informed decisions on their synthesis methods. We are also collaborating with researchers from the UK, USA, Germany, Australia, South Korea and the Philippines to further expand and progress the knowledge in the field.

Research Focus

-Abishek Pravin Manoharan

DR. SAMAN ILANKOON
(CHEMICAL ENGINEERING)

Our work on electronic waste or e-waste handling has two major components, 'e-waste management' and 'value recovery'. The first component primarily involves collecting and sorting of household and industrial e-waste (mobile phones, computers, CFL bulbs and more). Legislation frameworks on industrial e-waste have been well established in Malaysia, while household e-waste does not have any regulations governing it, explicitly. This gap needs to be addressed. Although certain governmental bodies, such as the Department of Environment (DOE) Malaysia, Malaysian Communications and Multimedia Commission (MCMC), e-waste recycling companies and NGOs have introduced collection boxes (i.e. conventional collection boxes) for e-waste collection. Establishing a proper system in place can help monitor the collection volumes and track household E-waste movement. We hypothesised that this system could be implemented using mobile apps and data servers (i.e. modified collection boxes with internet of things - IOT) to ensure proper data logging, increased awareness, and provide a hassle-free disposal for the general public.

As for 'value recovery', for-profit companies typically focus on gold and silver recovery during the extraction process while discarding a significant amount of metals as a solid waste fraction. This discarded fraction consists of metals from the lanthanide series, commonly referred to as 'rare earth metals'. These metals are scarce, and extraction of its pure form is complicated despite being a major component of all electronic equipment; hence, reusing is critical for the growing demand. The primary reasons to discard these metals, in most developing nations, is the reduced monetary value compared to gold and silver, lower metal concentrations and complex recovery processes.

Currently, we are working on alternative ways to recover the value in e-waste. Initial research works include changes to the milling process of the e-waste. Conventionally, pulverising has been done to increase the recovery amount, but this process is energy-intensive. Therefore, to minimise the utility cost, we plan to reduce the e-waste to regular, measurable pieces that are not too fine. The next step is to increase the recovery amounts to balance the cost and extent of recovery by continuous optimisations and experimental parameter variations. Moreover, we are currently in talks with the Facilities Management Department at Monash to roll out our IOT based e-waste collection boxes on campus with data logging facilities and an interactive mobile application, as an initiative to optimise collection.

Tackling E-Waste Together!

-Abishek Pravin Manoharan

According to the DOE (Department of Environment) Malaysia, Electronic waste or e-waste is a term used for electronic items that are unwanted, not working, and nearing or at the end of their 'useful life'. E-waste has evolved into a global issue due to the tremendous growth of demand for electricals and electronic equipment and the disposal, after use and shorter replacement intervals. Disposed e-waste can trigger health and environmental hazards if they are not appropriately handled, for example landfilling and informal recycling activities. Moreover, most of these discarded equipment can be reused, refurbished, or recycled. In this edition of SYNC, Dr. Saman advises us on how we, the general public with the help of the government, can contribute to solving this issue besides research contributions.

Dr. Saman (Chemical Engineering) with his FYP students.

1. DISPOSAL OF E-WASTE

E-waste should be collected and disposed of at **designated facilities only.** As electronic equipment users, we produce a significant portion of the total e-waste generated (11.1 kg per capita in Malaysia in 2019). Collecting and disposing of this waste at the designated facilities can optimise collection and ensure adequate volume is present to keep the 'value recovery' plants running 24/7. Moreover, new campaigns on e-waste collection have already been introduced by the government and public participation will drive these initiatives. A full list of collection points in Malaysia has been included below.

2. GOVERNMENT SUBSIDIES & FUNDING

Government subsidies for e-waste handlers, including informal collectors could be a major step towards boosting e-waste management and processing within the nation. **Tax incentives, free training programs and low-interest loans** can help e-waste collectors and companies understand the value and possible consequences of the waste they deal with. Although e-waste management is not a top tier priority, especially in developing nations, increased subsidising can promote the industry's growth, hence, fostering sustainable aspects of the industry. Moreover, funding plays a significant role in the development of any industry. Increased fund allocation, especially for the research sector, can help develop niche research operations on the recovery of valuable metals, thereby increasing the efficiency of the overall process.

3.AWARENESS

Awareness of the topic of e-waste is key to tackling this growing issue. At the current rate, the effects of unhandled waste will primarily affect the next generation to come. Including topics such as e-waste and other pressing social and global issues into the curriculum would make sure students have an idea on the topic which would mould them into responsible citizens. Additionally, **awareness programs** can be conducted in various locations throughout the country, along with potential rewarding schemes to encourage the public's participation.

4. CHANGE IN LIFESTYLE

Finally, a change in our lifestyles can cause a significant reduction in the rate of e-waste generation in the long run. All the electronic equipment we use in our day to day lives contain many valuable metals commonly referred to as 'rare earth metals' and 'critical metals'. Extraction of these metals from natural resources requires extensive mining and purification, which is highly energy-intensive. That being said, replacing electronic equipment such as mobile phones **only when the need arises** ensures that fewer e-waste quantities are generated in the long term. This can also help reduce the extent of mining, hence, helping to maintain the natural landscapes. 'No, FOMO!'

Additional Information

- **On-campus locations for E-waste collection:**

Sunway Monash Residence (opposite the management office)

Building 2 (annexe area between B3 & B4 next to the construction waste bin) – managed by OHSE

- **Sources:**

State-wise list of DOE recognised E-waste collectors in Malaysia: https://bit.ly/38nKoAt

General list of E-waste collectors operated by local authorities: https://bit.ly/3sZU0t5

Article by the Star Media Group on e-waste: https://bit.ly/3rvX4gj

Monash Alumni

My Ph.D. Experience & Post Ph.D. Career

-Kang Kai Dean

In an interview with alumni Dr. Alvin Lee Neam Heng, Dr. Ong Wee Jun, Dr. Alan Yip Yao Hong, and Dr. Yogeswaran Mohan, we asked them about their Ph.D. experience at Monash University Malaysia (MUM) and their journeys in their careers afterwards. Read their experiences below.

Dr. Ong Wee Jun

Previous and current affiliations

Dr. Ong is currently a lecturer at Xia Men University Malaysia. He is working on renewable energy applications using nanomaterials. Before that, he has worked in Singapore for two years as Singapore was looking for expertise in renewable energy and environmental science at the time of his thesis submission.

Research topic selection

The sunlight sparked Dr. Ong's imagination, which slowly unfolded into his research inspiration. His current project focuses on converting sunlight into energy/ fuel using nanotechnology, mimicking the photosynthesis process carried out by green leaves.

How they got into post-graduate studies

Dr. Ong compared his experience of being a research assistant while in his undergraduate years and working as an intern in the industry. He realized that he was more inclined towards research and decided to pursue a Ph.D.

Advice for GRS

Dr. Ong emphasizes that time management and self-discipline are crucial. He always analyses the experimental results when he still has a fresh mind, as the action of recalling is time-consuming and could be counter effective. He also spends time planning the experimental work in advance.

Dr. Alvin Lee Neam Heng

Current affiliations

Dr. Alvin works as a software engineer at Intel Penang. His research topic provides him with the fundamental knowledge for his future career (i.e., silicon fabrication design).

Research topic selection

Dr. Alvin slaved through research papers and referred to big companies' different technologies in the semiconductor field (e.g., Intel and TSMC).

How they got into post-graduate studies

Dr. Alvin discovered his interest in building robots and hardware during a robot design unit in his undergraduate years. He also managed to develop a UV-photolithography machine prototype in his final year project, for which he has foreseen the possibility of enhancing. This sparked his hope to further his studies with a Ph.D. At the end of his Ph.D. journey, he managed to file some Intellectual Property (IP) on the prototype design.

Dr. Alan Yip Yao Hong

Current affiliations

Dr. Alan is working in a management consulting firm and handles the discipline that oversees corporates' digital transformation projects. His job scope includes implementing the Human Resource (HR) system for corporates with regional officers due to the growing demand of sensors for managing human activities (e.g., use CCTV to take attendance).

Research topic selection

Dr. Alan told us his experience of pivoting his research topic a few times away from his intended plan. Eventually, he converted his Ph.D. topic to a fundamental study using mathematical models and achieved a certain novelty level using low resources. To him, interest in the project is what motivates him to sustain in his Ph.D. journey.

How they got into post-graduate studies

For Dr. Alan, research has always been his childhood dream, so taking the Ph.D. course was a no brainer. He planned to keep the momentum going as he was offered an opportunity to pursue his dream after his undergraduate studies.

Dr. Yogeswaran Mohan

Previous and current affiliations

Dr. Yoges is now working with the company he did his internship with previously. In this company, a technology department comprising of product management, software development, Research and Development (R&D) activities, social media activities, branding, and marketing was started up for him. His research area is related to the Fourth Industrial Revolution (IR 4.0), where industries are currently heavily interested in. Dr. Yoges also has experience teaching as a tutor in MUM and Assistant Professor at the University of Tunku Abdul Rahman (UTAR).

Research topic selection

If given the chance to choose again, Dr. Yoges will opt to go for the multidisciplinary title, as his strength is Artificial intelligence (AI) and programming, which can be applied anywhere. He will also choose a topic that is easy to publish. Of course, the ability to work with supervisors will also be taken into consideration.

How they got into post-graduate studies

Dr. Yoges was heavily involved in R&D activities during his university days, and he managed to publish journal and conference papers towards the end of his undergraduate studies. His supervisor informed him of an available post-graduate position, and he quickly took the chance to grab it.

Introducing Our New Academic Staff

Name: Assoc. Prof. Sudharshan N. Raman
Position/Department: Associate Professor, Civil Engineering Discipline, School of Engineering
Expertise: Structures and Materials (Cement and concrete engineering; Structural resilience; Sustainable infrastructure; Structural repair/rehabilitation)

Ongoing/ Completed Projects:
- Synthesis of low-energy, low-carbon clinkers for next-gen sustainable cement/binder.
- Computational-data driven approach in the development and optimisation of prefabricated fibre-reinforced concrete structural components
- Development of innovative precast concrete-composite piles
- Ferrocomposite-based structural rehabilitation system

Contact: sudharshan.raman@monash.edu
For more information, please visit https://bit.ly/3jF0D0d

Name: Dr. Khong Wei Leong
Position/Department: Lecturer, Common Engineering Discipline, School of Engineering
Expertise: Image and Signal Processing, Biomedical Engineering and Artificial Intelligence

Ongoing/ Completed Projects:
- [Research Grant Universiti Malaysia Sabah 2019] Analysing Viola-Jones Algorithm and Kanada-Lucas-Tomasi Algorithm in iOS Platform for Face Detection and Tracking Purposes

Contact: Khong.WeiLeong@monash.edu
For more information, please visit https://bit.ly/3aaV9ao

Name: Dr. Goh Kek Boon
Position/Department: Lecturer, Mechanical Engineering Discipline, School of Engineering
Expertise: Modeling and Simulation of Soft Matters

Ongoing/ Completed Projects:
- Development of Multiphysics Model to Simulate Enzyme-Polymer Conjugates
- Modeling of Ion Transport in Nanochannels
- Deriving Design Rules to Develop High-Performance Nanoreactors

Contact: KekBoon.Goh@monash.edu
For more information, please visit http://bit.ly/2OqMB78

Name: Dr. Ziyuan Pu
Position/Department: Lecturer, Civil Engineering Discipline, School of Engineering
Expertise: Intelligent Transportation Systems (ITS), Traffic Sensing, Connected and Autonomous Vehicles (CAV), and Urban Computing.

Ongoing/ Completed Projects:
• Identifying Real-Time Usage Patterns of Curbside Parking Space Based on Computer Vision and Edge Computing Technologies
• Advancing Novel Sensing Technologies for Improving Traffic Safety Under Inclement Weather Conditions
• Modeling and Managing Dynamic Transportation Networks with Heterogeneous Multi-source Data: An Individual-Oriented Perspective

Contact: Ziyuan.Pu@monash.edu
For more information, please visit https://bit.ly/3d0cgO2

Name: Dr. Lim Hui Peng
Position/Department: Research Fellow, Chemical Engineering Discipline, School of Engineering
Expertise: Polymer/particle engineering, Actives stabilization and controlled delivery application

Ongoing/ Completed Projects:
• Development of mucoadhesive emulsion system for controlled delivery of nutraceuticals
• Scale-up production of spray-dried Pickering emulsion containing palm tocotrienols
• Sustained oral delivery of palm tocotrienols using mucoadhesive Pickering emulsion approach

Contact: lim.huipeng@monash.edu
For more information, please visit http://bit.ly/3jE1AGr

Name: Dr. Ng Boon Junn
Position/Department: Research Fellow, Chemical Engineering Discipline, School of Engineering
Expertise: Early career researcher who is active in the field of photocatalysis for energy application, functional materials and nanotechnology.

Ongoing/ Completed Projects:
• Design and development of advanced nanomaterials with Z-scheme configuration for seawater splitting
• Rational development of Z-scheme photocatalytic system in miniature device with potential scalability
• Study on the fundamental aspects of photocatalytic systems in correspondence to the water splitting performance, i.e. kinetics of charge transfer, light-harvesting capabilities.

Contact: ng.boon.junn@monash.edu
For more information, please visit https://bit.ly/3aXuQDM

ITEX 2020 Online Winners

GOLD MEDAL:
Drone Tracking System Using IOT Streetlight with Computer Vision (DROGATLIGHT-DGL)

Ir. Dr. Joanne Lim Mun Yee, Kok Yuan Ting, Soh Owen, Tay Liang Yu & Lim Teik Aun (School of Engineering)

BRONZE MEDAL:
Ambulate Me

Dr. Alpha Agape Gopalai & Saeed Pirbogaghi (School of Engineering)

SILVER MEDAL:
Waterlyzer-World's First Self-Cleaning Hemodialyzer

Dr. Yong Siek Ting (Estee), Associate Professor Dr. Ooi Chien Wei, Professor Dr. Chai Siang Piao, Dr. Wong Lai Ling, Professor Dato' Abdul Wahab Mohammad & Dr.Ang Wei Lun (School of Engineering)

BRONZE MEDAL:
Smart Instrumented Shoes for Walking and Running

Dr. Darwin Gouwanda & Khor Wei Zhong (School of Engineering)

SYNC IS LOOKING FOR YOU

Join us and boost your soft skills

Journalists, writers and designers needed

Interested? Please contact:-

Yasmin (Yasmin.MohdZaifullizan@monash.edu) or
Khanisya (Khanisya.Palaniandy1@monash.edu)

GRS Leadership

Monash University Postgraduate Association (MUPA) is a student body recognized by the University as the body that represents Postgraduate students from all disciplines. In this "GRS Leadership" section, we want to highlight one of the most famous student associations in MUM, in order to promote leadership roles and let our readers know who their representatives are. If you're not a member, be sure to contact the committee to sign up soon!

The purposes of MUPA are:

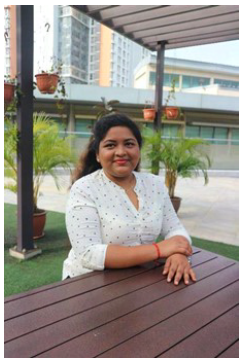
- To be the recognized means of communication between Postgraduate students and the academic and the administrative authorities of the University
- To make representation on matters affecting Postgraduate students to any member or body of the University and in particular to the MUPA Executive Committee
- To make representations on behalf of Postgraduate students to the community at large
- To provide a forum for open discussion on matters of general concern to Postgraduate students
- To be an accountable, representative and democratic body for Postgraduate students
- To protect, promote and develop the interests and welfare of Postgraduate students
- To use the funds of MUPA for payment of any expenses incurred in furthering the purposes of the MUPA

MUPA past and future events

1. Nature Retreat
2. Webinars to develop the skills and networking
3. Yoga & Zumba classes
4. Tea breaks
5. Mingle night(s)
6. Movie night(s)
7. Badminton competition
8. Welcome back challenge
9. Annual Dinner
10. Postgraduate Alumni & Industrial Networking

11. Mental Health Wellbeing Event
12. Coffee Talks
13. MUPA Charity event
14. MUPA Virtual Quiz
15. MUPA Camping event
16. Annual General Meeting
17. MUPA Gets Healthy
18. MUPA Merchandise
19. Coffee Talk with PVC
20. Appreciation Awards

MUPA Committee members



Guggilla Mrudula
MUPA 2021 President
Ph.D. candidate, School of Science

Monash University Postgraduate Association (MUPA) is not just a student association, in my view, it's a bridge connecting postgraduate students and the administration. I have been in MUPA since 2019 till date. In this long journey , the one precious thing I learnt is that the leadership position is not something that makes you superior to others but it's a responsibility towards everyone. Leadership is not something to lead or dominate, it's to grow with everyone, making everyone to realize their own potential and nurture it, helping them to complete their responsibilities.

Ali Ahmed
Vice President 1
Ph.D. candidate, School of Pharmacy

Amardeep Singh Dhillon
Vice President 2
Ph.D. candidate, School of Engineering

Lim Han Yin
School of Pharmacy Representative
Ph.D. candidate, School of Pharmacy

For more information on MUPA: https://mupa.monash.edu.my/

TED Talks

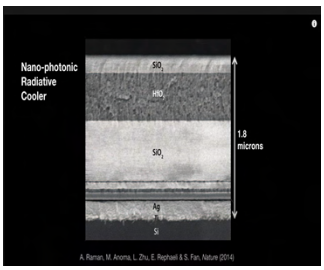
Why we should research solar geoengineering | David Keith | TEDxHarvardCollege
Watch here: https://youtu.be/wzUvOqKKiOM

4 ways we can avoid a catastrophic drought | David Sedlak | TEDxMarin
Watch here: http://bit.ly/3cYQnyE

A novel idea for cleaning up oil spills | Cesar Harada | TEDxSummit
Watch here: http://bit.ly/2MHsz7X

Emergency medicine for our climate fever | Kelly Wanser | TED Summit 2019
Watch here: http://bit.ly/3q92EUS

Why renewables can't save the planet | Michael Shellenberger | TEDxDanubia
Watch here: https://bit.ly/3cYMGsT



How we can turn the cold of outer space into a renewable resource | Aaswath Raman | TED2018
Watch here: http://bit.ly/2LFZWrc

Did You Know?

- Global temperatures have increased by about 1°C in the past century.
- 15-20% or at least one in six species will be at risk of extinction if the global temperature rises above 1.5°C. (Approximately more than 1 million species)
- 800 million people or 11% of the world's population is currently vulnerable to climate change impacts such as droughts, floods, heat waves, extreme weather events and sea-level rise.
- Indonesia will move its capital city as its current one is sinking.

  Source: https://bbc.in/20j092S
- There's more carbon dioxide in our atmosphere than at any time in human history.
- The Golden Toad is the first species to go extinct due to climate change.

Online quizzes on Earth Day

National Geographic
- How Well Do You Understand Global Warming?
  https://on.natgeo.com/2Oe6gas

EarthDay.org
- Climate Change Quiz
  https://bit.ly/38kSdH2
- Environmental Literacy Quiz
  https://bit.ly/3t9EyuB
- Clean Energy Quiz
  https://bit.ly/2N7bHYs

NASA
- Our home planet
  https://go.nasa.gov/3l31oRM
- Our worlds, other worlds
  https://go.nasa.gov/30uBpcp
- How's your energy level?
  https://go.nasa.gov/3bt2TFq