



Innovative
Research
Universities

MRUN

Malaysia Research University Network



Outcomes of the IRU-MRUN research program

Joint research projects by Australian
and Malaysian universities

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REPRESENTATIVES OF MRUN AND IRU MEETING IN MALAYSIA IN 2017

Joint MRUN-IRU research gets results



In 2018, Innovative Research Universities (IRU) and the Malaysia Research University Network (MRUN) published a booklet showcasing four collaborative Teaching and Learning projects completed by IRU universities and MRUN universities.

This follow-up publication covers projects undertaken as part of the second stream of the IRU-MRUN partnership: Research.

The projects featured here are true partnerships across universities from the two nations, some involving more than one university from each country.

The joint projects have encouraged and supported researchers from IRU and MRUN universities to learn from each other, find new ways of doing things and build long-lasting international links. Outcomes include conference papers, journal articles, inter-country research visits and the development of innovative new products and techniques.

The IRU-MRUN partnership was first formed in 2014 through a three-year Memorandum of Understanding. While this publication marks the formal end of that partnership, the relationships formed between the universities and researchers from across the two networks – and the learnings they jointly discovered – will continue for many years to come.

Conor King
Executive Director
Innovative Research Universities (IRU)

Development of a low-cost ventricular assist device



Partners:

Griffith University
Universiti Teknologi Malaysia

About the project

Heart failure is a global healthcare problem affecting 2.6 million people worldwide and the leading cause of human mortality. While there are various treatments, including lifestyle modification and medication, heart transplantation remains the gold-standard therapy in treating heart failure, with survival extended by around a decade.

Unfortunately, with high numbers of heart failure patients and a restricted number of available donor hearts, the need for heart transplants far outstrips the availability. Mechanical heart pumps such as Left Ventricular Assist Devices (LVAD)

have developed as a key technology to fill this gap and a preferred treatment for end-stage heart failure victims. The substitution of LVAD as an alternative treatment for heart transplant has shown an improvement in patient survival rate, rivalling transplantation in terms of outcomes. However, LVADs are expensive devices.

The main objective of this project was to design, fabricate and evaluate a mechanical heart assist device that can be produced at much lower cost than existing devices.

Outcomes



Testing of a centrifugal pump for blood circulation to find optimum configurations for blood fluid flow.



Implementation of a spiral groove bearing, which reduced shear stress within the LVAD and blood flow damage.



Two peer-reviewed journal articles and two conference papers.



Staff exchanges and visits including a three-month placement of a Universiti Teknologi Malaysia PhD student at Griffith University.



Ongoing co-supervision and advice from Griffith University staff for Universiti Teknologi Malaysia research students.

Mangrove ecosystem services from restored mangroves

Partners:

University of Malaya
Griffith University

About the project

The project investigated how mangrove forests respond to mangrove clearing and restoration, with implications for improving the management of mangrove forests for a continuous flow of ecosystem services.

The main objectives were to assess the loss and recovery of carbon and nitrogen after mangrove clearing; to analyse sediment CO₂ emissions in a chronosequence of recovering mangrove forests; and to examine how mangrove restoration affects the mangrove forest trophodynamics.

The mangrove rehabilitation, restoration and carbon sequestration results have potential economic impacts for carbon credits and trading in carbon markets.

Outcomes



Joint field visits to Australian and Malaysian mangroves by researchers from both countries.



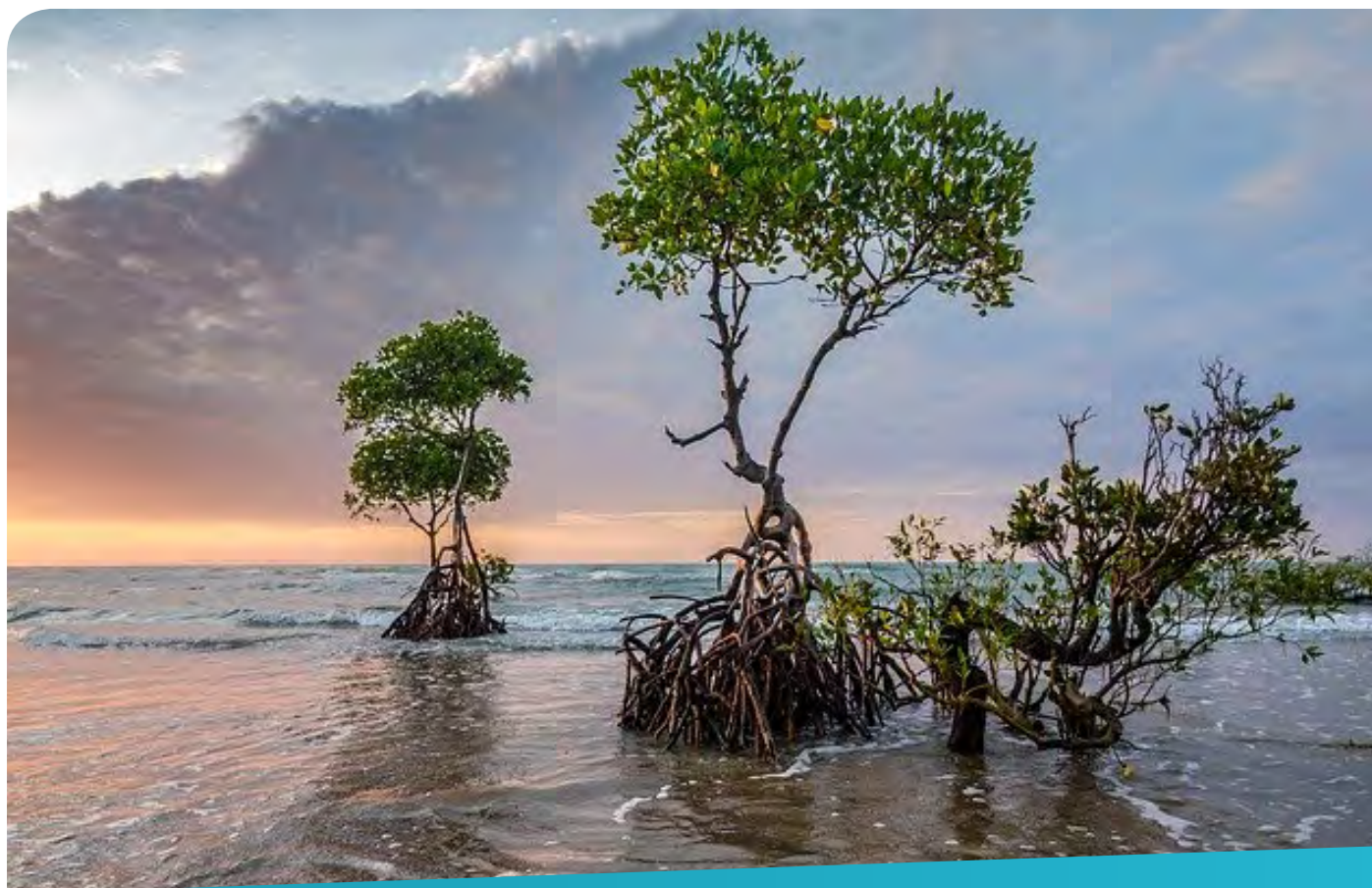
Training workshop run by Australian researchers for staff and students at University of Malaya.



One collaborative publication indexed in a Web of Science journal and a second under preparation.



Two conference papers or presentations.



Enhancing the energy performance of building envelopes in hot and humid climates of Darwin and Kuala Lumpur



Partners:

Charles Darwin University
University of Malaya

About the project

The climates of Darwin and Kuala Lumpur, which are warm and humid, can negatively impact health and lead to heat stress among inhabitants. One of the most crucial and significant agendas in recent years in both Australia and Malaysia is the sustainable development of cities and sustainable buildings with a higher level of comfort for users.

Building envelope and façade designs play a large role in the thermal properties inside a building, affecting both human thermal comfort and energy load for appliances. However, it is so far a topic with relatively little research. By taking both comfort and energy demand into account, this project critically explored the most appropriate building façade designs for tropical climates.

The outcomes of this research, both directly and indirectly, has social, environmental and economic implications for sustainable living in Australia and Malaysia.

Outcomes



Technical evaluation of the impacts of building façade design configuration on the indoor performance of buildings and user comfort.



Comparison of the proposed building façade design configurations for Darwin and Kuala Lumpur.



Development of key guidelines and technical recommendations for further enhancing the performance of both existing and future buildings in Darwin and Kuala Lumpur.



Three collaborative publications indexed in Web of Science journals.



Silicon carbide-based MEMS microphone for sonic detection

About the project

This project aimed to develop a new type of microphone for detecting gas leakages in high temperature and highly pressurised environments.

Due to the extremely high temperature resilience and excellent chemical inertness of silicon carbide, a new sensor using MEMS (microelectro-mechanical systems) microphones and cubic silicon carbide (3C-SiC) film as the acoustic membrane, has potential to function in harsh environments.

The pilot project developed and employed such a microphone, using it at ultrasonic frequencies to locate specific acoustic signatures of poisonous gasses.

The project's impact on the development of low-cost sensors to detect poisonous gasses (e.g. in petrol stations) and wearable sensors (e.g. for miners) could be crucial for ensuring worker safety in oil exploration, coal and other natural resources mining where work-related fatalities are relatively common.

Partners:

Griffith University
Universiti Kebangsaan Malaysia

Outcomes



The development of a low-cost sensor using MEMS to monitor poisonous gas.



Agreement for an international staff exchange program including five visits per year by Griffith University staff to the Universiti Kebangsaan Malaysia and a two-month stay for an early career researcher at Griffith University.



Two collaborative publications indexed in Web of Science journals and two conference papers, with a further three articles under review.

Detecting food contamination and pesticides: Surface-Enhanced Raman Spectroscopy (SERS) biosensors



Partners:

Flinders University

Universiti Kebangsaan Malaysia

About the project

Research on food contamination and pesticide detection is critically important. In 2016, 39 people in Perak (Malaysia) were hospitalized due to contamination from weed killer that was blown by the wind when sprayed near food stalls.

Current experimental and laboratory techniques in Malaysia to obtain evidence of the contamination are not sufficient. Monitoring of the chemical load in the environment is vital for safety and activity in this area will only increase in coming years.

The project developed Surface Enhanced Raman Spectroscopy (SERS) substrates, a highly sensitive detection technique for verifying the extent of persistent organic pollutants (POPs) contamination and the exact chemical involved.

The project is highly relevant to Australia and Malaysia because many of the POPs are used in agriculture. The project also contributes to the Australian Government's Food and Environmental Change science research priorities.

Outcomes



Development of SERS substrates providing unprecedented sensitivity and selectivity, presenting opportunities for other species to build on this technology with significant commercial opportunities.



Research collaborations and reciprocal staff and student exchanges between Flinders University and Universiti Kebangsaan Malaysia.



A new PhD position in Malaysia to continue the collaborations involving Malaysia and Australia.



Six collaborative publications indexed in Scopus or Web of Science journals.

Emerging viruses in agriculture: development of a network for biosecurity and biosurveillance to support food security

Partners:

University of Malaya
La Trobe University
Murdoch University

About the project

Agricultural production is highly likely to be impacted by an increased rate of emergence of new diseases over the next few years, due to climate change and the ease for unintentional trans-boundary movement of new pathogens.

Australia and Malaysia are in a region experiencing high rates of population growth, economic development and international transport, all placing pressure on agriculture. This underpins the need for improved knowledge and sharing of expertise in the areas of biosecurity threats and biosurveillance practices in the region to support food security, public health, economic development and sustainability.

This project brought together research centres with expertise in agricultural viruses and bioinformatics to form a network to focus on biosecurity and biosurveillance of potentially emerging agricultural diseases.

The pilot project focused on viral diseases of crop plants, leveraging on the pooled resources of sequence data from important crops, together with expertise in biosafety, biondiagnostics, biosecurity and bioinformatics. The outcomes are relevant to public and private researchers/educators, policy makers, practitioner and consumers.

Outcomes



A network and framework for exchanging data and models for monitoring, control and early warning systems for agricultural diseases.



A dedicated website for the research network.



Two international MRUN-IRU workshops and six conferences or seminars based on project goals.



Dedicated research programs and training support for early career researchers.



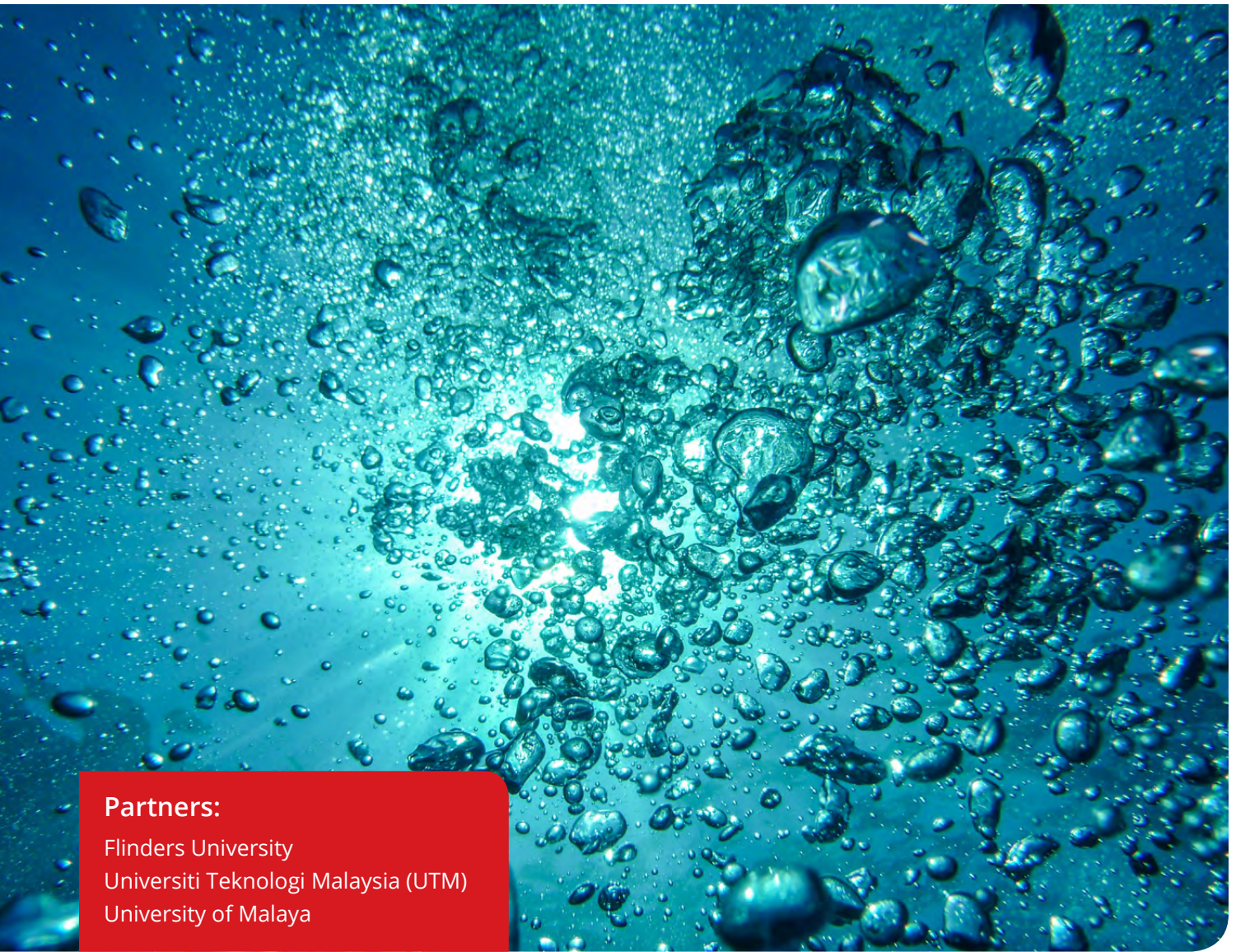
Two peer-reviewed publications and 30+ other publications directly resulting from the project.



Proposed bilateral joint PhD programs between University of Malaya, and Murdoch and La Trobe universities.



Additional research grants from the Malaysian government, La Trobe University and the International Centre for Genetic Engineering and Biotechnology.



Partners:

Flinders University
Universiti Teknologi Malaysia (UTM)
University of Malaya

Multiple autonomous underwater vehicles

About the project

Current practices for controlling multiple autonomous underwater vehicles (MAUVs) treat the loads as deterministic even though the environmental loads induced by waves, wind and ocean currents on ocean vehicles are naturally stochastic. This deteriorates the control performance and can result in instability. Therefore, it is important to design and investigate a stochastic control for multiple MAUVs.

This project explored the use of a new stochastic control which makes it possible to design controllers that guarantee robustness against exogenous disturbances and communication problems. Knowledge gained from this project also contributes to reducing energy requirements for multiple MAUV tracking.



Formulation, implementation and evaluation of a new control approach for MAUVs operated under stochastic communication delays.



Grant obtained through the UTM Shine funding scheme (Early Career Researcher funding) to help develop and support research staff.



Awarded first place for 2017 IEEE Malaysia Final Year Project Competition (sponsored by IEEE OES Malaysia Chapter).



Two peer-reviewed international journal articles, five conference papers and a book chapter.

Fabrication of graphene based flexible supercapacitor from electrospun nanofiber

About the project

The market for alternative energy technologies has grown significantly in the last 20 years and is now of increasing importance due to the threat of global warming and the reliance on finite conventional energy sources. Supercapacitors have a longer life cycle and higher power density than batteries and higher energy density than conventional capacitors, propelling their use in pulse power and power backup applications.

The overall aim is to fabricate a novel supercapacitor by electrospinning technique, with an underlying aim to enhance the conductivity of the Carbon Nano Bundle (CNB). The market of CNB peaked at more than US\$850 million in 2017.

Outcomes of this project will facilitate the production of a commercially viable graphene-based CNB with unique applications in many strategic energy and electronic applications. The proposed supercapacitor will find direct applications in automotive bodies, wearable devices and foldable electronic products. The work undertaken in this project involved use of wet chemistry techniques to fabricate the supercapacitor, molecular modelling and surface characterisation techniques.

Partners:

Murdoch University
Universiti Putra Malaysia

Outcomes



Development of light-weight supercapacitors with a commercial potential.



Murdoch University PhD training delivered in Malaysia on molecular and materials modelling.



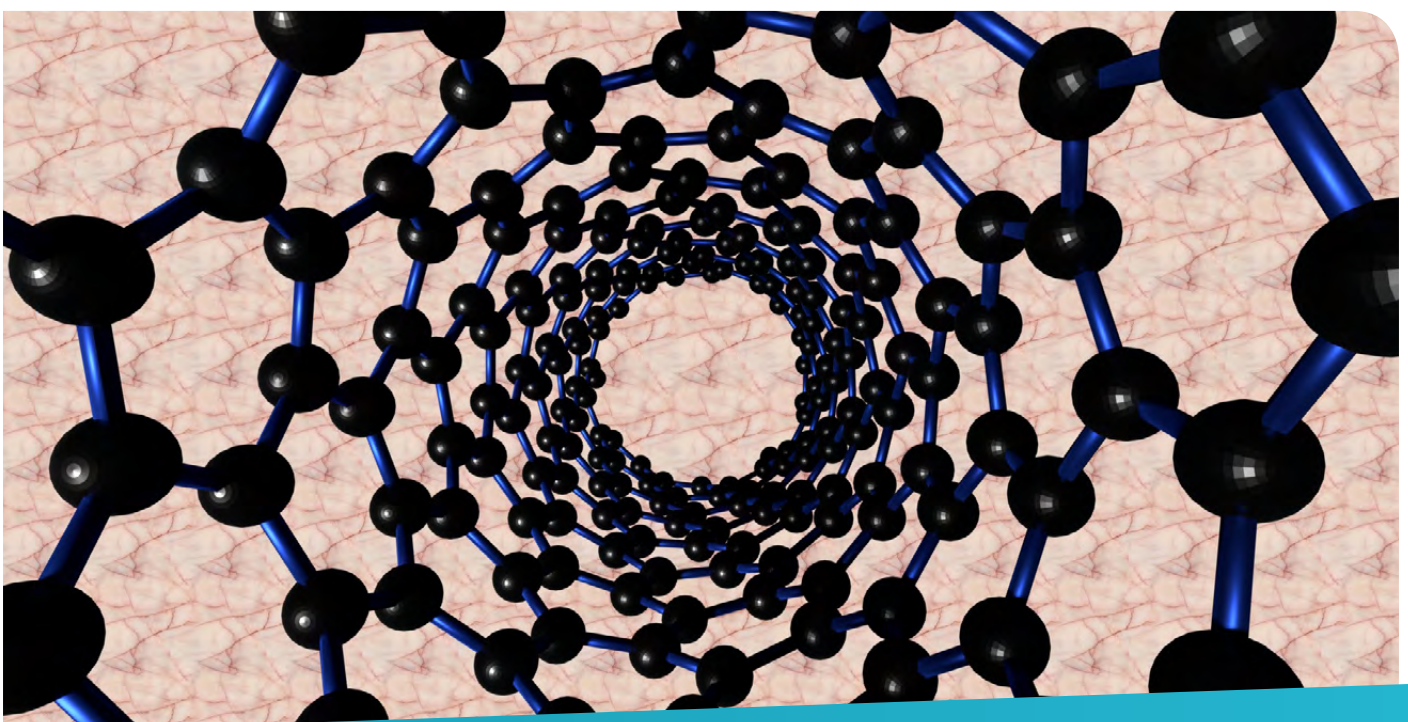
Financial support for four Malaysian PhD students to attend training on computational software and XPS analysis at Murdoch University.



Ten collaborative publications indexed in the Web of Science journals.



Establishing a joint PhD program between Murdoch and Universiti Putra Malaysia.



Improved solar selectivity of mixed metal oxide incorporated with graphene

Partners:

Murdoch University
Universiti Sains Malaysia

About the project

Sunlight is the most sustainable source of energy available to humanity. Earth receives solar energy in a reliable and distributed manner, at levels exceeding the current worldwide energy consumption rate. To make full use of the ubiquitous sunlight energy, we need efficient materials capable of absorbing most of the incoming solar radiation.

The use of quality solar selective absorber coatings can increase the efficiency of the solar energy conversion. Despite a concerted worldwide effort to develop such solar selective absorbing coatings, mass commercialisation has been hampered by relatively low solar energy selectivity, weak long-term durability and mechanical hardness.

The work undertaken in this project involved fabricating and testing enhancements to the solar selectivity and mechanical durability of coating materials.

Outcomes



Improved solar selectivity and better thermal-mechanical durability from solar selective absorber coatings, enhancing future commercialisation potential.



Three joint visits from Murdoch researchers to Universiti Sains Malaysia including workshops on computational modelling with ten Universiti Sains Malaysia PhD students.



Reciprocal access to specialised research facilities.



Preparation of a MoU between the universities supporting a further five years of collaboration.



Co-proposed funding applications.



Ten peer-reviewed journal articles directly supported by the project and a further eight peer-reviewed journal articles in this area.



Pursuit of a joint PhD degree program with joint supervision.





Partners:

Flinders University

Universiti Kebangsaan Malaysia

Fabrication and characterisation of regenerated cellulose graphene membrane from oil palm fibre

About the project

Malaysia is the world's second largest palm oil producer, but the biomass of its palm oil industry has not been fully utilised on a commercial scale. It is estimated that around 100 million tonnes of biomass are generated from fibre derived from empty fruit bunches (EFB).

Most research has focused on the dissolving of oil palm fibre cellulose to form cellulose derivatives. None have reported on utilising EFB fibre as regenerated fibre.

This project investigated the physical, mechanical and chemical properties of membrane produced under different methods for reducing EFB pulp molecular weight.

The project also evaluated the distribution of graphene embedded in the cellulose membrane, its effect on the mechanical, physical, chemical and electrical properties of the graphene-cellulose membrane, and the absorption of graphene.

Outcomes



Development of technological knowhow for dissolving oil palm fibre pulp, preparation of membrane and distribution of graphene.



Two Malaysian professors hosted for four months at Flinders University with support from APEC Women Fellowships.



Joint supervision of a Malaysian PhD student.



Three international peer-reviewed journal articles supported by the project and a further one under review.



Nanofibrous membranes for energy applications

Partners:

Universiti Teknologi Malaysia
James Cook University

About the project

The project aimed to advance energy conversion systems through lower-cost and mechanically-stable polymer electrolyte membranes (PEMs) with tailored fuel/electrolyte permeable properties without losing the desired conductivity.

This is an important task for new energy devices with numerous electrochemical applications. Such materials can be developed from the electrospun based materials. Electrospinning of polyelectrolyte materials such as Nafion and base electrospun mat for LbL membranes have been considered for electrochemical application.

The main objective of this project was to develop innovative nanofibrous based membranes using electrospinning and modify the material properties using plasma exposure.

To optimise the material functionalities and tailor its properties, a methodology was proposed and all associated tasks were successfully carried out.

Outcomes



Validation of initial concepts, substantiated with data.



Two research visits by JCU staff to present research at AIM.



Three international peer-reviewed journal articles supported by the project and four conference papers.

About the MRUN-IRU partnership

In November 2014, Innovative Research Universities (IRU) and the Malaysia Research University Network (MRUN) signed a three-year Memorandum of Understanding to establish close and continuing partnerships between IRU and MRUN universities.

As part of their collaboration, MRUN and IRU agreed to finance a select number of projects to stimulate stronger connections.

Collaborative projects were established across two streams: *Teaching and Learning*; and *Research*. This booklet showcases the projects completed through the Research stream of that work.



A MEMORANDUM OF UNDERSTANDING WAS SIGNED IN 2014 TO ESTABLISH A FORMAL RELATIONSHIP BETWEEN IRU AND MRUN MEMBER UNIVERSITIES.

About IRU

Innovative Research Universities (IRU) is a network of seven comprehensive universities committed to inclusive excellence in teaching and research in Australia.

Its membership is Charles Darwin University, Flinders University, Griffith University, James Cook University, La Trobe University, Murdoch University and Western Sydney University.

About MRUN

The Malaysia Research University Network (MRUN) comprises of five Malaysia research universities.

Its membership is University of Malaya (UM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM), Universiti Putra Malaysia (UPM) and Universiti Teknologi Malaysia (UTM).

