RESEARCH HIGHLIGHT ON FRONTIER MATERIALS & INDUSTRIAL APPLICATION 2017

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IRMI UiTM

Foreword

I am very delighted to be able to write a few words of introduction to this FMIA Research Highlights 2017 book since it is published at a very important time. Today in Malaysia, research has become more broadly important than ever before. Hence, there is increasing interest in the emerging of scientific works, particularly the outcomes of the research.

Many issues that have become a great concern to Malaysian government and people are related to science and engineering field. Therefore, it is our responsibility as university researchers to give back to the society by acknowledging these concerns and provide necessary solutions to those problems. Often, many do not understand how research is done and how it progresses in our scientific community. Thus, it is now become the obligation of all researchers to make the general public well-informed of their works, expertise and achievement.

I believe that FMIA researchers are a critical component in our research culture and environment and I hope the publication of this book will further enhance the visibility of their works. I am very glad to see the completion of FMIA Research Highlights 2017 book, which makes it a vital reference to the academia, other groups of research communities, government agencies as well as industrial partners.

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Foreword

Frontier Materials and Industrial Application (FMIA) is one of the main research priority areas in Universiti Teknologi MARA (UiTM). As of October 2017, FMIA consists of 392 researchers, and 25 Research Interest Groups (RIG) established since 2014. All RIGs are all strategically aligned to the FMIA niche areas (global, national and university priorities), which are Transportation & Mobility, Chemical & Advanced Materials, Advanced Manufacturing & Automation as well as Industry 4.0. These RIGs comprised of dynamic and enthusiastic researchers who play a vital role in stimulating innovation and encouraging commercialization to produce high quality research outputs within the specified niche areas.

FMIA Research Highlights 2017 e-Book is produced based on the compilation of various research works conducted by active researchers in the RIGs under FMIA, mostly are funded by government or industrial grants. This book specifically highlights the expertise, strength and achievements of RIGs, which were accumulated from 2015 to 2017. It is hoped that this book could serve as a directory of expertise to the academia, external researchers, industrialists and government agencies for future collaborations and new partnerships.

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Institute of Research Management & Innovation (IRMI)
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Table of Content

Foreword

Table of Content

1.0

Introduction to FMIA

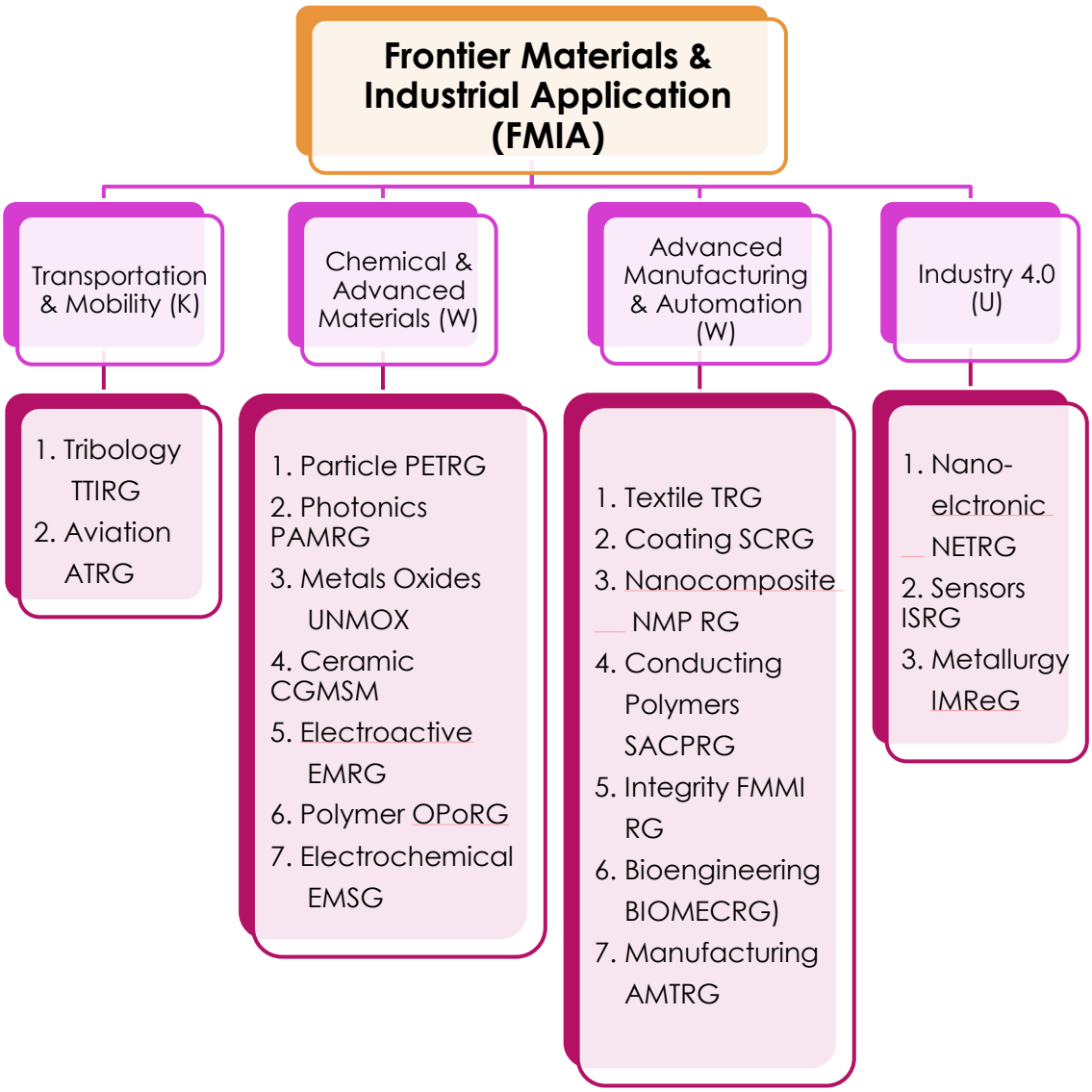
Frontier Materials and Industrial Application (FMIA) is one of the main research priority areas in UiTM. FMIA is managed by the Communities of Research (CoRe) Institute of Research Management and Innovation (IRMI). FMIA is responsible for managing and inculcating research activities at UiTM in the field of materials, technology and industrial application. FMIA consists of 25 Research Interest Group (RIG) and 392 reserchers as of October 2017. The researchers are encouraged to blend their expertise in various field related to functional materials and industry applications. Communication among materials scientists, chemists, physicists, engineers, mathematicians and others in interdisciplinary fields associated with materials and industrial technology are significantly meaningful in order to blossom research and make it a culture in UiTM. This is aligned with the objective of the development of CoRe which is to foster inter-disciplinary and trans-disciplinary collaborations that could transform UiTM's researchers to possess internationally acknowledged research capabilities.

2.0

Area of Interest

Niche area of FMIA CoRe is Industrial Technology. Industrial technology covers eight (8) research clusters including Transportation & mobility, Chemical & advanced materials, Advanced manufacturing & Automation, Industrial engineering, Design, modelling, software & simulation, Industrial & Operation management, Statistics, marketing & Business, and Art & architecture. Research Interest Groups (RIG) are formed based on these research clusters. Research trust of each RIG may include theoretical, experimental,characterisation, simulation, maintenance, design or fabrication studies of materials and its relation to real industrial applications and sectors. Research on engineering and functional materials in macro-, micro- and nano-scale science are conducted and aligned with advanced technology applied and used in various industries such as automotive, robotics, automation, manufacturing, construction, defense, marine, aviation, agrotechnology, food, sports, textile, oil and gas, chemical and petroleum, dentistry and surgical, processing and packaging, biomaterials and biotechnology, etc. In addition, research on analysis, statistics, economic growth, marketing and management are also important and need to be focused in future.

Research areas of FMIA denominators include Advanced Manufacturing, Nano Materials, Nanostructures, Superconductor, Fracture Mechanics, Advanced Polymers, Advanced Ceramics, Defense Materials, Flight Technology, Carbon Nanotube, Nano-sensors and nano-tracking, Nano Pharmaceutical, Nano Medicine, Biomedical and Pharmaceutical Instrumentation, Automation and Robotic, Advanced Signal Processing, Unmanned Aerial Vehicle, Automated Guided Vehicle, Agro-Technology, Industrial Electronics, Tribology, Thermofluid and Engineering Mechanism, Functional polymers, glasses, ceramics, semiconductors and composites, Electroactive materials, Multi ferroic and magnetic materials, Green and biomaterials, Energy materials, Smart materials, Photonic materials, Graphene and its applications, Rechargeable batteries, supercapacitors, solar cells, sensors, actuators and smart windows, Drug design and delivery, Organic coatings and corrosion, Nano materials, nanoscale architectures and nanodevices, Synthesis and characterization of functional materials, Theoretical modelling/computer simulations of functional materials, Engineering Materials and Power Sources


Frontier Materials & Industrial Application (FMIA)
Transportation & Mobility (K)
Chemical & Advanced Materials (W)
Advanced Manufacturing & Automation (W)
Industry 4.0 (U)
1. Tribology TTIRG
2. Aviation ATRG
1. Particle PETRG
2. Photonics PAMRG
3. Metals Oxides UNMOX
4. Ceramic CGMSM
5. Electroactive EMRG
6. Polymer OPoRG
7. Electrochemical EMSG
1. Textile TRG
2. Coating SCRG
3. Nanocomposite NMP RG
4. Conducting Polymers SACPRG
5. Integrity FMMI RG
6. Bioengineering BIOMECRG)
7. Manufacturing AMTRG
1. Nano-elctronic NETRG
2. Sensors ISRG
3. Metallurgy IMReG

3.0

List of Research Interest Group (RIG) *Enititi* Kecemerlangan *Tier 5* (EK Tier 5) FMIA UiTM

NO	EK CODE	EK NAME	TIER	LEADER	MEMBERS	REGISTRATION YEAR
1	CoRe1/T5/2014/ 1/FMIA/1	PARTICLE ENGINEERING TECHNOLOGY RESEARCH GROUP	TIER 5	PROF. MADYA DR. NOOR FITRAH BINTI ABU BAKAR (FAKULTI KEJURUTERAAN KIMIA-FKK)	1. DR. NORAZAH BINTI ABD RAHMAN (FKK) 2. DR. NORNIZAR BINTI ANUAR (FKK) 3. DR. AHMAD IHSAN BIN MOHD YASSIN (FKE) 4. SYAFIZA BINTI ABD HASHIB (FKK) 5. SITI NORAZIAN BINTI ISMAIL (FKK)	2014
2	CoRe12/T5/2014 /12/FMIA/2	TEXTILE RESEARCH GROUP	TIER 5	PROF. MADYA DR. MOHD. ROZI BIN AHMAD (FAKULTI SAINS GUNAAN-FSG)	1. DR. NUR'AIN YUSOF (FSG) 2. JAMIL BIN SALLEH (PROF. DR) (FSG) 3. DR. MOHAMAD FAIZUL B YAHYA (FSG) 4. DR. SUZAINI BT ABDUL GHANI (FSG) 5. DR. AMILY BINTI FIKRY @ AZIZ (FBM) 6. DR. NOR DALILA NOR AFFANDI (FSG)	2014
3	CoRe15/T5/2014 /15/FMIA/3	FUNCTIONAL FOODS RESEARCH GROUP	TIER 5	DR. NOORLAILA BT AHMAD (FAKULTI SAINS GUNAAN-FSG)	1. DR. AISAH BT BUJANG (FSG) 2. DR. NORMAH BINTI ISMAIL (FSG) 3. DR. FADHILAH BINTI LAMUN @ JAILANI (FSG) 4. DR. CHEMAH BINTI TAMBY CHIK (FPHP)	2014
4	CoRe19/T5/2014 /19/FMIA/4	PHOTONICS AND MATERIALS RESEARCH GROUP	TIER 5	PROF. DR. HAJI MOHD KAMIL BIN ABD. RAHMAN (FAKULTI SAINS GUNAAN-FSG)	1. PROF. MADYA DR. MOHD HANAPIAH BIN MOHD YUSOFF (FSG) 2. ABDEL BASET MOHAMED EL NABWI ABDEL HAMID IBRAHIM (FSG) 3. SITI NAFISAH BINTI MD RASHID (FSG) 4. DR. IKHWAN NAIM BIN MD NAWI (FSG) 5. DR. RAMZYZAN BIN RAMLY (FKM)	2014

NO	EK CODE	EK NAME	TIER	LEADER	MEMBERS	REGISTRATION YEAR
5	CoRe31/T5/2014 /31/FMIA/5	ULTRASONIC OF NOVEL METALS AND OXIDES RESEARCH GROUP (UNMOX)	TIER 5	PROF. DR. AHMAD KAMAL HAYATI BIN YAHYA (FAKULTI SAINS GUNAAN-FSG)	1. DR. MAHESH KUMAR TALARI (FSG) 2. SITI NURBAYA BINTI SUPARDAN (FSG) 3. DR. ROSDIYANA BINTI HASHAM @ HISAM (FSG) 4. MOHD ISA BIN MOHD YUSOF (FSG) 5. MOHAMED NADZRI BIN MOHD YUSOFF (FSK) 6. DR. ZAKIAH MOHAMED (FSG)	2014
6	CoRe32/T5/2014 /32/FMIA/6	FATS AND OILS CHEMISTRY RESEARCH GROUP	TIER 5	PROF. DR. NORIZZAH BINTI ABD RASHID (FAKULTI SAINS GUNAAN-FSG)	1. DR. ZAIBUNNISA BINTI ABDUL HAIYEE (FSG) 2. DR. ANIDA BINTI YUSOFF (FSG) 3. HALIMAHTON ZAHRAH BINTI MOHAMED SOM (DR.) (FSG) 4. PROF. MADYA DR. MOHD HEZRI BIN FAZALUL RAHIMAN (FKE)	2014
7	CoRe33/T5/2014 /33/FMIA/7	CERAMIC GAS AND MAGNETIC SENSOR MATERIALS RESEARCH GROUP (CGMSM)	TIER 5	DR. MISBAH BIN HASSAN (FAKULTI SAINS GUNAAN-FSG)	1. DR. NORAZILA BINTI IBRAHIM (FSG) 2. SURAYA BINTI AHMAD KAMIL (FSG) 3. MOHD FAUZI BIN MAULUD (FSG) 4. HAFIZI BIN LUKMAN (FKM)	2014
8	CoRe36/T5/2014 /36/FMIA/8	ELECTROACTIVE MATERIALS RESEARCH GROUP	TIER 5	DR. ROSNAH BINTI ZAKARIA (FAKULTI SENI LUKIS & SENI REKA - FSSR)	1. PM. DR. OSKAR HASDINOR BIN HASSAN (FSSR) 2. NAZLI BIN AHMAD AINI (FSG) 3. NOOR `AISYAH BINTI JOHARI (FSG) 4. FAIZATUL FARAH BINTI HATTA (FSG) 5. DR. MOHAMAD FARIZ MOHAMAD TAIB (FSG) 6. DR. MUHAMAD KAMIL YAACOB (FSG)	2014
9	CoRe58/T5/2014 /58/FMIA/9	ORCHESTRATED POLYMER RESEARCH GROUP (OPoR)	TIER 5	PROF. MADYA DR. DZARAINI BTE KAMARUN (FAKULTI SAINS GUNAAN-FSG)	1. PM. DR. ROZANA BT MOHD DAHAN (FSG) 2. PM. DR. RAMLAH BT MOHD TAJUDDIN (FKA) 3. DR. ENGKU ZAHARAH BINTI ENGKU ZAWAWI (FSG) 4. PM. SITI ZALEHA SAAD (FSG) 5. DR. NORAZURA BINTI IBRAHIM (FSG)	2014

NO	EK CODE	EK NAME	TIER	LEADER	MEMBERS	REGISTRATION YEAR
10	CoRe68/T5/2015 (3)/FMIA/10	SURFACE COATING RESEARCH GROUP	TIER5	DR. JUNAIDAH BINTI JAI (FAKULTI KEJURUTERAAN KIMIA - FKK)	1. DR. NORLIZA BINTI IBRAHIM (FKK) 2. DR. ISTIKAMAH BINTI SUBUKI (FKK) 3. NOORSUHANA BINTI MOHD YUSOF(FKK) 4. NORASHIKIN BINTI AHMAD ZAMANHURI (FKK) 5. RAFEQAH BINTI RASLAN (FKK) 6. DR. ANIZAH BINTI KALAM (FKM)	2015
11	CoRe80/T5/2015 (15)/FMIA(11)	NANOCOMPOSITE MATERIALS & INDUSTRIAL APPLICATION RESEARCH GROUP	TIER 5	MOHD NAZARUDIN ZAKARIA (FAKULTI SAINS GUNAAN-FSG)	1. PM. DR. SITI NORASMAH BINTI SURIP (FSG) 2. DR. MIMI AZLINA BT ABU BAKAR (FKM) 3. DR. NOOR NAJMI BONNIA (FSG) 4. PROF. MADYA DR. MANSUR AHMAD (FSG)	2015
12	CoRe81/T5/2015 (16)/FMIA(12)	SYNTHESIS AND APPLICATION OF CONDUCTING POLYMERS RESEARCH GROUP	TIER 5	PROF. MADYA DR. TAN WINIE (FAKULTI SAINS GUNAAN-FSG)	1. PROF. MADYA DR. CHAN CHIN HAN (FSG) 2. PM. DR. FAMIZA BINTI ABD LATIF (FSG) 3. DR. TAY CHIA CHAY (FSG) 4. PM. DR. OSKAR HASDINOR BIN HASSAN (FSSR) 5. SHARIL FADLI BIN MOHAMAD ZAMRI (FSG) 6. FADIATUL HASINAH BINTI MUHAMMAD (FSG)	2015
13	CoRe89/T5/2015 (24)/ FMIA(13)	NANO-ELECTRONIC (NET) RESEARCH GROUP	TIER 5	DR. MOHAMAD HAFIZ BIN MAMAT (FAKULTI KEJURUTERAAN ELEKTRIK - FKE)	1. DR. AHMAD SABIRIN BIN ZOOLFAKAR (FKE) 2. DR. PUTERI SARAH BINTI MOHAMAD SAAD (FKE) 3. DR. ZURITA BINTI ZULKIFLI (FKE) 4. PUAN NORULHUDA BINTI ABD RASHEID (FKE) 5. DR. PUAN SHAFINAZ SOBIHANA BT. SHARIFFUDIN (FKE) 6. ENCIK UZER BIN MOHD NOOR (FKE) 7. DR. MOHAMAD FARIZ BIN MOHAMAD TAIB (FSG)	2015

NO	EK CODE	EK NAME	TIER	LEADER	MEMBERS	REGISTRATION YEAR
14	CoRe90/T5/2015 (25)/ FMIA(14)	PROCESS INSTRUMENTATION AND CONTROL RESEARCH GROUP	TIER 5	PROF. MADYA DR. RAMLI ADNAN (FAKULTI KEJURUTERAAN ELEKTRIK - FKE)	1. PROF. MADYA DR. MOHD HEZRI BIN FAZALUL RAHMAN (FKE) 2. PUAN NORLELA BINTI ISHAK (FKE) 3. DR. FAZLINA BINTI AHMAT RUSLAN (FKE) 4. DR. PUAN MAZIDAH BINTI TAJJUDIN (FKE) 5. PROF. IR. DR. MUHAMMAD AZMI BIN AYUB (FKM)	2015
15	CoRe91/T5/2015 (26)/ FMIA(15)	AVIATION TECHNOLOGY RESEARCH GROUP	TIER 5	PROF. DR.WAHYU KUNTJORO (FAKULTI KEJURUTERAAN MEKANIKAL - FKM)	1. PROF. DR. WIRACHMAN WISNOE (FKM) 2. DR. BIBI INTAN SURAYA MURAT (FKM) 3. DR. RIZAL EFFENDY BIN MOHD NASIR (FKM) 4. DR. RAMZYZAN BIN RAMLY (FKM) 5. DR. KHAIRUL NIZAM BINTI TAHAR (FSPU) 6. DR. ZURRIATI BINTI MOHD ALI (FKM) 7. DR. NOOR ISWADI BIN ISMAIL (FKM)	2015
16	CoRe98/T5/2016 (3)/FMIA(16)	INTEGRATED SENSORS RESEARCH GROUP	TIER 5	DR. SUKREEN HANA HERMAN (FAKULTI KEJURUTERAAN ELEKTRIK - FKE)	1. DR. WAN FAZLIDA HANIM ABDULLAH (FKE) 2. DR. ZULFAKRI MOHAMAD (FKE) 3. DR. ROSALENA IRMA ALIP (FKE) 4. PROF. MADYA DR. ZAINIHARYATI MOHD ZAIN (FSG) 5. IR. DR. HASHIMAH HASHIM (FKE) 6. PUAN AZNILINDA ZAINODON@ZAINUDDIN (FKE) 7. DR. PUAN ROSMALINI AB KADIR (FKE)	2016
17	CoRe108/T5/2016 (13)/FMIA(17)	FRACTURE MECHANIC & MATERIALS INTEGRITY RESEARCH GROUP (FMMI)	TIER 5	DR. AIDAH BINTI JUMAHAT (FAKULTI KEJURUTERAAN MEKANIKAL-FKM)	1. DR. ZURAIDAH BT SALLEH (FKM) 2. DR. ANIZAH BINTI KALAM (FKM) 3. DR. KOAY MEI HYIE (FKM) 4. DR. NIK ROZLIN BINTI NIK MOHD MASDEK (FKM) 5. MARDZIAH BINTI CHE MURAD (FKM) 6. DR. SHAHRIMAN BIN ZAINAL ABIDIN (FSSR)	11 OKTOBER 2016

NO	EK CODE	EK NAME	TIER	LEADER	MEMBERS	REGISTRATION YEAR
18	CoRe120/T5/2016 (25)/FMIA(18)	ELECTROCHEMICAL MATERIALS & SENSORS RESEARCH GROUP (EMSG)	TIER 5	PROF. MADYA DR. ZAINIHARYATI B. MOHD ZAIN (FAKULTI SAINS GUNAAN-FSG)	1. PROF. MADYA DR. YUSAIRIE MOHD (FSG) 2. DR. LIM YING CHIN (FSG) 3. DR. LOW KIM FATT (FSG) 4. DR. IRNI HAMIZA HAMZAH (FKE) 5. PM. DR. WAN FAZLIDA HANIM ABDULLAH (FSG) 6. DR. MOHAMAD NOOR JALIL (FSG)	2016
19	CoRe121/T5/2016 (26)/FMIA(19)	TRIBOLOGY FOR TRANSPORTATION INDUSTRY RESEARCH GROUP	TIER 5	PROF. DR. SALMIAH KASOLANG (FAKULTI KEJURUTERAAN MEKANIKAL-FKM)	1. DR. MOHAMAD ALI AHMAD (FKM) 2. DR. MIMI AZLINA BINTI ABU BAKAR (FKM) 3. DR. NOOR AZLINA BINTI MOHD SALLEH (FKM) 4. DR. MOHD FAIZUL BIN MOHD IDROS (FKE)	2016
20	CoRe125/T5/2016 (30)/FMIA(20)	BIOMECHANICAL & CLINICAL ENGINEERING (BIOMEC) RESEARCH GROUP	TIER 5	PROF. MADYA. IR. DR. JAMALUDDIN MAHMUD (FAKULTI KEJURUTERAAN MEKANIKAL-FKM)	1. DR. SOLEHUDDIN BIN SHUIB (FKM) 2. DR. NOR FAZLI BIN ADULL MANAN (FKM) 3. DR. ABDUL HALIM BIN ABDULLAH (FKM) 4. DR. MOHD AFZAN BIN MOHD ANUAR (FKM) 5. SHAHRUL HISYAM BIN MARWAN (FKM) 6. DR. MUHAMMAD FAIRUZ BIN AZMI (FP)	2016
21	CoRe126/T5/2016 (31)/FMIA(21)	INDUSTRIAL METALLURGY RESEARCH GROUP (IMReG)	TIER 5	DR. MUHAMMAD HUSSAIN BIN ISMAIL (FAKULTI KEJURUTERAAN MEKANIKAL-FKM)	1. PROF. MADYA NOR 'AINI WAHAB (FKM) 2. IR. DR. BULAN ABDULLAH (FKM) 3. DR. MOHD AZMAN YAHYA (FKM) 4. DR. ISTIKAMAH SUBUKI (FKK) 5. IR. DR. SALINA BUDIN (FKM) 6. DR. SITI KHADIJAH ALIAS (FKM) 7. FAUZIAH YUSOFF (FKM)	2016

NO	EK CODE	EK NAME	TIER	LEADER	MEMBERS	REGISTRATION YEAR
22	CoRe127/T5/2016 (32)/FMIA(22)	ADVANCED MANUFACTURING TECHNOLOGY (AMT) RESEARCH GROUP	TIER 5	PROF. MADYA DR. ING. YUPITER HP MANURUNG (FAKULTI KEJURUTERAAN MEKANIKAL-FKM)	1. DR. JURI SAEDON (FKM) 2. DR. WAN EMRI WAN ABDUL RAHMAN (FKM) 3. DR. NOR HAFIEZ MOHAMAD NOR (FKM) 4. DR. MOHD SHAHRIMAN ADENAN (FKM) 5. SUHAILA ABD HALIM(FSKM) 6. MUHD FAIZ MAT @ MUHAMMAD (FKM)	2016
23	CoRe144/T5/2017 (4)/FMIA(23)	HYBRID NANOMATERIALS, INTERFACES & SIMULATION (HYMFAST)	Tier 5	DR. NOR AIDA ZUBIR (FAKULTI KEJURUTERAAN KIMIA-FKK)	1. PROF. MADYA DR. ABDUL HADI ZAINAL (FKK) 2. MOHAMED SYAZWAN OSMAN (FKK) 3. RASYIDAH ALROZI (FKK) 4. DR. AHMAD ZIA UL-SAUFIE MOHAMAS JAPERI (FSKM) 5. DR. ALHAN FARHANAH ABD RAHIM (FKE) 6. DR. ATIKAH KADRI (FKK)	2017
24	CoRe147/T5/2017 (7)/FMIA(24)	POLYMER AND MATERIAL PROCESS ENGINEERING	Tier 5	DR. RAHIDA WATI BINTI SHARUDIN (FAKULTI KEJURUTERAAN KIMIA-FKK)	1. CHRISTINA VARGIS JONES (FKK) 2. SUFFIYANA AKHBAR (FKK) 3. ARBANAH MUHAMMAD (FKK) 4. AHMAD RAMLI RASHIDI (FKK) 5. DR. ANA NAJWA MUSTAPA (FKK) 6. DR. SUHAIZA HANIM HANIPAH (FKK) 7. PROF. MADYA DR. RAHMAH MOHAMED (FSG)	2017
25	CoRe150/T5/2017 (10)/FMIA(25)	INDUSTRIAL PROCESS RELIABILITY & SUSTAINABILITY (INPRES)	Tier 5	DR. AZIL BAHARI (FAKULTI KEJURUTERAAN KIMIA-FKK)	1. PROF. DR. KU HALIM (FKK) 2. DR. ALAWI SULAIMAN (F.AGROTEKNOLOGI) 3. DR. ZULKIFLI ABD. RASHID (FKK) 4. DR. NIK RAIKHAN (FKK) 5. DR. NAJMIDDIN YAAKOB (FKK) 6. PROF DR. KHUDZIR BIN ISMAIL(FSG) 7. PN DR. MOHD AZLAN BIN MOHD ISHAK	2017

4.0

PARTICLE ENGINEERING TECHNOLOGY (PET) RESEARCH

Noor Fitrah Abu Bakar, Norazah Abd Rahman, Nornizar Anuar, Siti Norazian Ismail, Syafiza Abd Hashib, Ahmad Ihsan Mohd Yassin

4.1 Introduction

PET research group fosters research on applying particle engineering technologies including electric-force assisted techniques, microwave assisted techniques, crystallization, drying and gasification for production of material and nanomaterial for pharmaceutical, energy, food, oil and gas applications.

Research activities emphasize on the following areas:

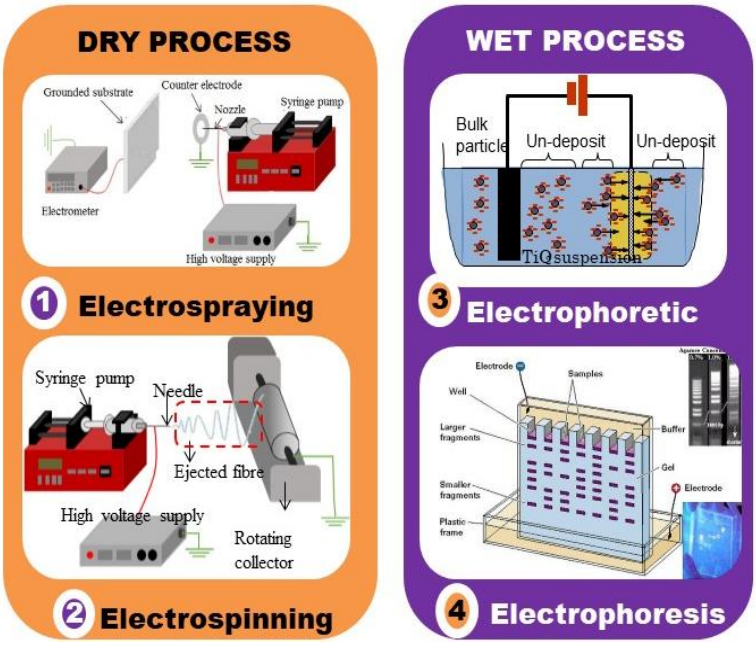
1. Development of latest and advanced techniques and processes for synthesizing and characterizing of material and nanomaterial based on experimental, mathematical modeling and simulation
2. Development of new materials including advanced specialty chemicals and biomaterial for pharmaceutical, energy, food, oil and gas application
3. Knowledge and technology transfer to industrial partners including chemical design, improvement of processes for clean and optimized production

The group members are actively involved in supervising post graduate students and collaborating research activities at international level including Japan, United Kingdom, Tunisie and recently China. The postgraduate students undergone outbound and inbound research attachment at those countries.

4.2 Research Highlights

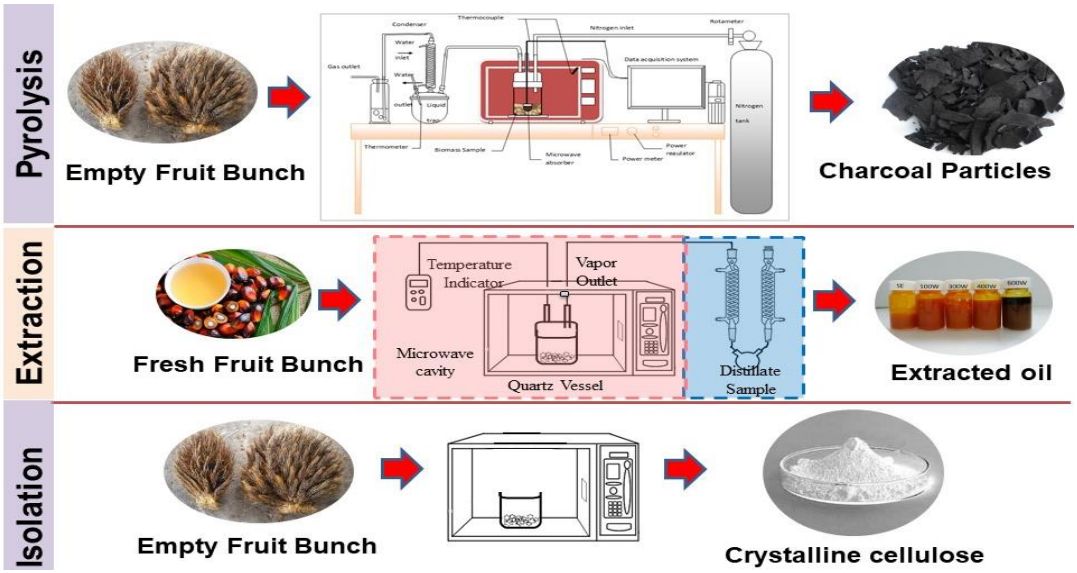
4.2.1 Electric Force Assisted Technique for Synthesizing Nanomaterials

Electric force assisted techniques are introduced for designing and producing nanomaterials in a form of nanoparticles, nanofibers and nanoemulsions via electrospraying, electrospinning and ultrasonication, respectively. The electrospraying technique can be applied for any materials that are suspended in solution by referring to the surface charge (zeta potential values). Electrospinning technique can be applied on polymeric material for producing nanofiber that can be applied for coating and forming nanocomposite for immobilization of biomaterial such as enzyme and antibiotic. Emulsified nanoemulsion produced oil droplet with surface charge that can be separated using electrophoresis according to the applied voltage. This technique can be applied for separating bioactive compounds in the emulsified oil. The electric force assisted technique such as electrophoretic deposition (EPD) can be applied for depositing nanomaterials on any conductive surface in a wet condition. This technique has been applied for removing iron oxide fine particles in tap water.



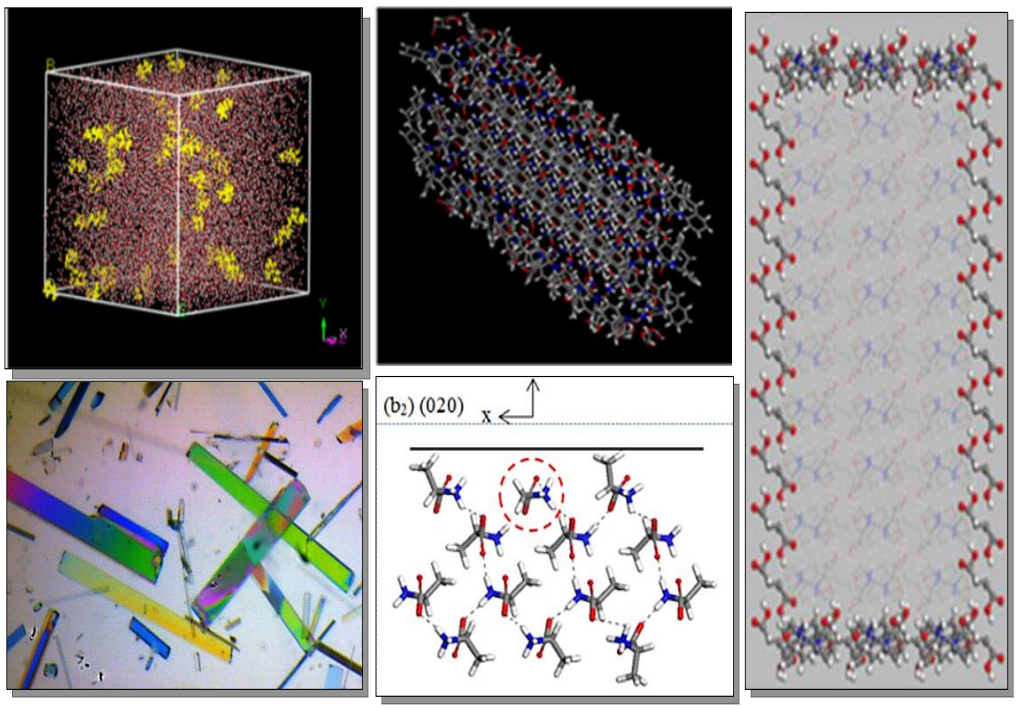
4.2.2 Material Processing via Microwave Assisted Technology

Microwave (MW) assisted technology is an effective technique that manipulates the dielectric properties of materials to shorten the heating duration. This technique is suitable for thermochemical conversion process namely pyrolysis and torrefaction; oil extraction process, and isolation of cellulose from palm oil fruit bunches. The solid char particles derived from microwave assisted pyrolysis of oil palm biomass can be produced. Sterilization of oil palm fruit and extraction of palm oil can also be conducted via MW assisted technique with small addition of water in comparison to traditional sterilisation technique which consumes enormous amount of water in a form of steam. The MW assisted technique is also applicable in assisting the isolation of cellulose from any cellulosic material. The time required for heating process is reduced as compared to conventional heating technique.



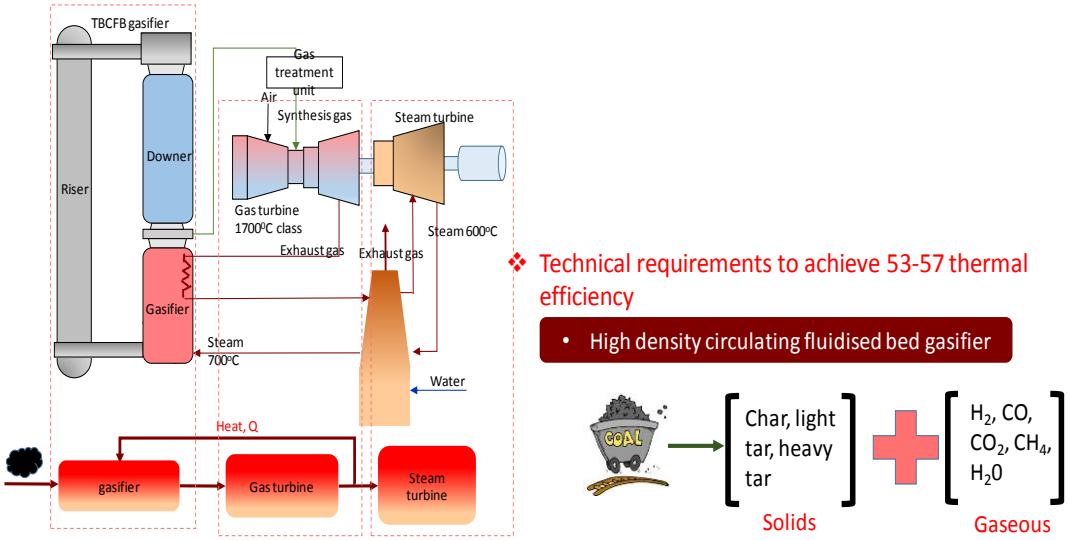
4.2.3 Crystals Behaviour Prediction using Molecular Modelling Technique

Molecular modelling technique is used to predict the behaviour of molecular interactions between solute and solution prior to nucleation, between molecules and atoms within crystals and between clustering solutes in solution. The most recent work is the prediction of dissolubilisation behaviour of crystals in solution. Detail calculation on the hydrogen bonds interactions of the molecules enables prediction of foreign molecules (eg: solvents or impurities molecules) inclusions to the crystal structures. It also explains the most unstable sites of the crystals, and hence allows shape modification, to ease materials downstream processing. Calculation of the most stable energy, as a summation of hydrogen bond, van der Waals and electrostatic force validates the observations of the molecular interactions carried out.



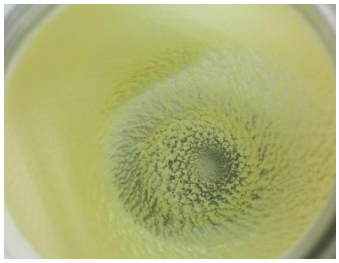
4.3.4 Advanced-Integrated Gasification Combined Cycle (A-IGCC)

Advanced-Integrated Gasification Combined Cycle (A-IGCC) is a system developed using coal to overcome the technical limitation in IGCC system in order to obtain higher plant efficiency. Triple bed circulation fluidised bed operated at 700-900^{o}C is used in the system while steam is used as gasifying agent instead of oxygen. In this system, the endothermic heat for downer pyrolysis and gasification is supplied using gas turbine and riser.



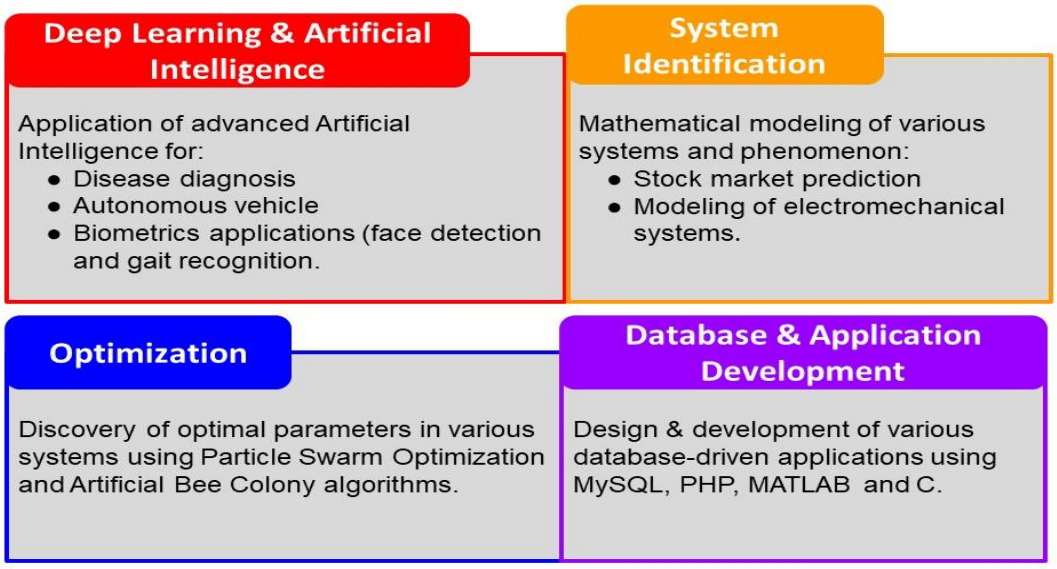
4.2.5 Spray Drying of Ananas Comosus using Centella Asiatica as Encapsulation Matrix

Spray drying provides a hygienic handling of the powders while retaining the nutrients and enzymes of the fruit. However, the conventional encapsulation through spray drying could degrade Ananas Comosus nutritional properties due to high temperature application and extensive energy usage. Furthermore, in conventional encapsulation process, the amount of food additives (Maltodextrin) usage is quite extensive. This work is proposed in order to investigate the capabilities of spray dryer in Ananas Comosus encapsulation and minimizing the amount of Maltodextrin and substitution with Centella Asiatica as encapsulation matrix. This proposed study will combine the encapsulation inlet temperature and substitution of Maltodextrin with Centella Asiatica, which should be able to reduce the amount of extensive energy usage and retaining Ananas Comosus nutritional properties.


4.2.6 Advanced Computational Simulation and Modeling

Computer sciences can be applied in various sectors in life. Advanced artificial intelligence for example can be applied in disease diagnosis, autonomous vehicle and biometrics applications (i.e face detection and gait recognition. Mathematical modelling of various systems and phenomenon can be used to predict the stock market and predict electromechanical systems. Optimization of a system also can be achieved through the application of computer sciences. For example, the application of Particle Swarm Optimization and Artificial Bee Colony algorithms is used to find the optimal parameters in various systems. Various software build with specific algorithms (i.e MySQL, PHP, MATLAB and C) also helps in design and development of database.

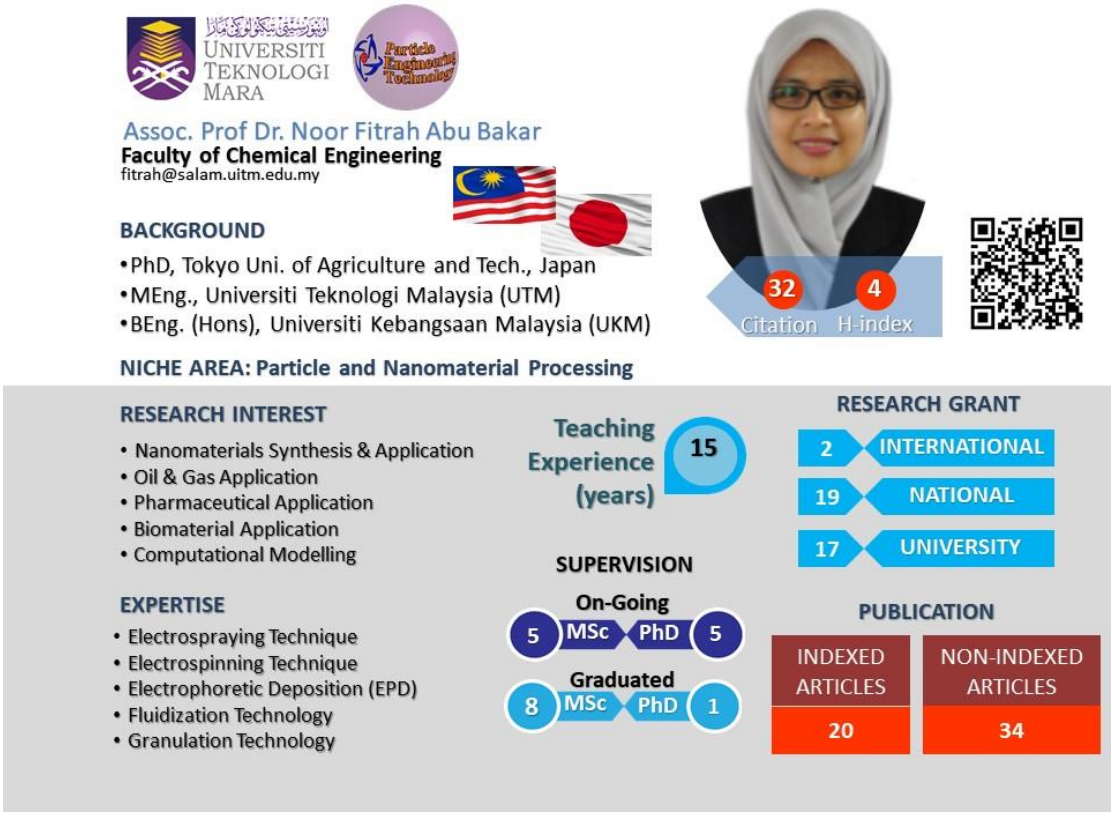


4.3 Group Information

Name of RIG	Particle Engineering Technology
Leader	Assoc. Prof. Dr. Noor Fitrah Abu Bakar
Tier	5
RIG Code	CoRe1/T5/2014/1/FMIA/1
Registration Year	2014

(Senate Approval)	
UiTM Niche Area	Chemical & Advanced Materials
RIG Niche Area	Research on applying particle engineering technologies including electric-force assisted techniques, microwave assisted techniques, crystallization, drying and gasification for production of material and nanomaterial for pharmaceutical, energy, food, oil and gas applications

4.4 Background of Members and Achievement (2015-2017)



Prof Dr. Norazah Abd Rahman
Faculty of Chemical Engineering
noraz695@salam.uitm.edu.my

BACKGROUND
- PhD, Universiti Kebangsaan Malaysia (UKM)
- MSc., University of Brunel, UK
- BSc, University of Missouri, Rolla, USA

NICHE AREA: Particle Processing and Green Technology

RESEARCH INTEREST
- Particle Processing
- Microwave technology
- Non Destructive Testing
- Clean Technology

EXPERTISE
- Mixing Processes
- Energy and Environment
- Thermochemical conversion
- Fluidization
- Drying

Teaching Experience (years) 27

SUPERVISION

On-Going: 6 MSc, 12 PhD

Graduated: 19 MSc, 4 PhD

RESEARCH GRANT

1	INTERNATIONAL
21	NATIONAL
16	UNIVERSITY

PUBLICATION

INDEXED ARTICLES	NON-INDEXED ARTICLES
36	54

Dr. Nornizar Binti Anuar
Faculty of Chemical Engineering
nornizar@salam.uitm.edu.my

BACKGROUND
- PhD, Universiti Kebangsaan Malaysia (UKM)
- MSc., Universiti Kebangsaan Malaysia (UKM)
- BEng. (Hons), University of Bradford, UK

NICHE AREA: Crystallization

RESEARCH INTEREST
- Crystallization
- Solution Chemistry
- Thermochemical Properties of Solution
- Process Modelling and Simulation

EXPERTISE
- Crystallization Technique
- Molecular Modelling Technique
- Solution Chemical Thermodynamics
- Fluidization Processing

Teaching Experience (years) 21

SUPERVISION

On-Going: 5 MSc, 3 PhD

Graduated: 5 MSc, 1 PhD

RESEARCH GRANT

10	NATIONAL
14	UNIVERSITY

PUBLICATION

INDEXED ARTICLES	NON-INDEXED ARTICLES
9	14

Siti Norazian Ismail
Faculty of Chemical Engineering
azian83@salam.uitm.edu.my

BACKGROUND

- PhD, Tokyo Uni. of Agriculture and Tech., Japan (on-going)
- MEng., Universiti Putra Malaysia (UPM)
- BEng. (Hons), Universiti Teknologi Malaysia (UTM)

NICHE AREA: Nanomaterial Technology and Energy Engineering

RESEARCH INTEREST

- Nanomaterials
- Advanced-IGCC

EXPERTISE

- Nanomaterial
- Polymer for Composite
- Electrospraying
- Coal pyrolysis and gasification
- Fluidization

Teaching Experience (years) 8

SUPERVISION
Graduated
1 MSc

RESEARCH GRANT
1 NATIONAL
2 UNIVERSITY

PUBLICATION

INDEXED ARTICLES	NON-INDEXED ARTICLES
4	1

Syafiza Abd Hashib
Faculty of Chemical Engineering
syafiza0358@salam.uitm.edu.my

BACKGROUND

- PhD student, Universiti Teknologi MARA (UiTM)
- MEng., Universiti Putra Malaysia (UPM)
- BEng. (Hons), Universiti Teknologi Malaysia (UTM)

NICHE AREA: Drying Technology

RESEARCH INTEREST

- Drying Technology
- Process Separation
- Particle Processing
- Electric Force Assisted Technique

EXPERTISE

- Spray drying
- Biomaterial
- Electrospraying
- Electrospinning
- Co-crystallization via cryogenic milling

Teaching Experience (years) 8

Industrial Experience (years) 8

SUPERVISION
On-Going
3 MSc

RESEARCH GRANT
4 NATIONAL
8 UNIVERSITY

PUBLICATION

INDEXED ARTICLES	NON-INDEXED ARTICLES
4	11

Ir. Dr. Ahmad Ihsan Mohd Yassin, CEng.
Faculty of Electrical Engineering (Computer)
ihsan_yassin@salam.uitm.edu.my

BACKGROUND

- PhD, Universiti Teknologi MARA, Malaysia
- MSc., Universiti Teknologi MARA, Malaysia
- BSc. Electrical Engineering (Information Systems) Universiti Tun Hussein Onn, Malaysia

NICHE AREA: Advanced Computation, Electrical Engineering

RESEARCH INTEREST

- Fuzzy logic
- Neural Network
- Deep Learning
- System Identification
- Optimization

EXPERTISE

- System Modelling
- Pattern Classification
- Forecasting
- Artificial Intelligence

Teaching Experience (years) 10

SUPERVISION

On-Going: 5 MSc, 10 PhD

Graduated: 1 MSc, 0 PhD

RESEARCH GRANT

5	NATIONAL
10	UNIVERSITY

PUBLICATION

INDEXED ARTICLES	NON-INDEXED ARTICLES
128	62

5.0

TEXTILE RESEARCH GROUP (Textile TRG)

Mohd Rozi Ahmad, Mohamad Faizul Yahya, Amily Fikri Aziz, Suzaini Abd Ghani, Nur'ain Yusof, Nor Dalila Nor Affandi and Mohd Iqbal Misnon.

5.1 Introduction

The objective of the Textile TRG is to serve as a center for research ana advancement in Technical Textiles and Smart Apparel.

Research themes:

- Smart Textiles
- Simulation and Modelling of Textiles
- Textile & Clothing Comfort Studies
- Nanofibres via Electrospinning
- Songket Mechanization
- Natural Dyes Extraction & Coloration

Services and Activities:

- Testing services
- Consultations
- Short courses / Seminars
- Research projects
- Industrial collaborations

5.2 Research Highlights

5.2.1 Songket Structures with Jacquard Technology

The project revolves on utilizing Jacquard technology to produce songket fabrics and motif using mechanical loom. With this technique, production of songket can be increased tremendously with very consistent fabric quality. The production rate of songket making using Jacquard technology is extremely high (if a local hand weaver takes a minimum of one week to produce a piece of songket, Jacquard weaving technology takes only 20 minutes). The songket produced is suitable for use such as uniforms, special events such as convocations, and for the hotel industry as interior decorations and so on. In summary, among the advantages of producing songket using the Jacquard technology are as follows:

- High quality songket and free from defects
- Able to use multiple types of yarns and colors
- Able to produce different colors on both sides of the songket fabric
- The songket can be used on both surfaces (double-face)
- The songket has flat surfaces and no issues with floating threads

After a few years of research efforts, the researchers signed a MOU with a local textile company, Ara-Borgstena Sdn Bhd on 28 April 2010. The company agrees to

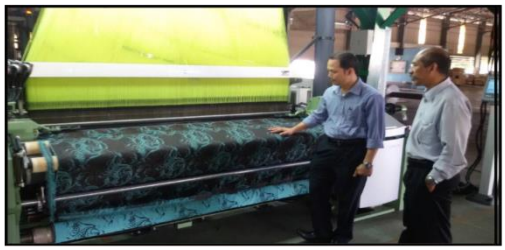
produce, market and commercialized songket fabrics and products using Jacquard technology through transfer of technology and licensing. The MOU was renewed in 2016. The company has been paying annual licensing fees to UiTM as well as royalties from the sales they make since 2011. The innovation was among the finalist for Anugerah Inovasi Negara 2017 (AIN2017), a yearly event organised by the Ministry of Science, Technology & Innovation.

Throw Pillow

Neck Tie

5.2.2 Electromagnetic Shielding Fabrics

Electromagnetic (EM) shielding tests are conducted in plane state, however, upon forced deformation of textile shields, the warp and weft yarns tends to slip away perpendicular to the direction of force and hence causes enlarged interstices. Since the electromagnetic waves can pass though the openness in the shields without attenuation of power, therefore the effectiveness of these textile EM shields declines. The study utilizes hybrid yarns which locks the adjacent warp and weft yarns in between the spiral of the metallic filament. The increase in cell size, upon forced deformation during puncture testing, was reduced 4.5 times in the proposed (self-locking) fabrics as compared to the conventional fabric. This self-locking behaviour of hybrid yarn is not only responsible for stability of interstices, but also resists during yarn pull-out from the fabrics. The electromagnetic shielding effectiveness of the proposed design could attenuate 99.9% power at 3 GHz threshold frequency.



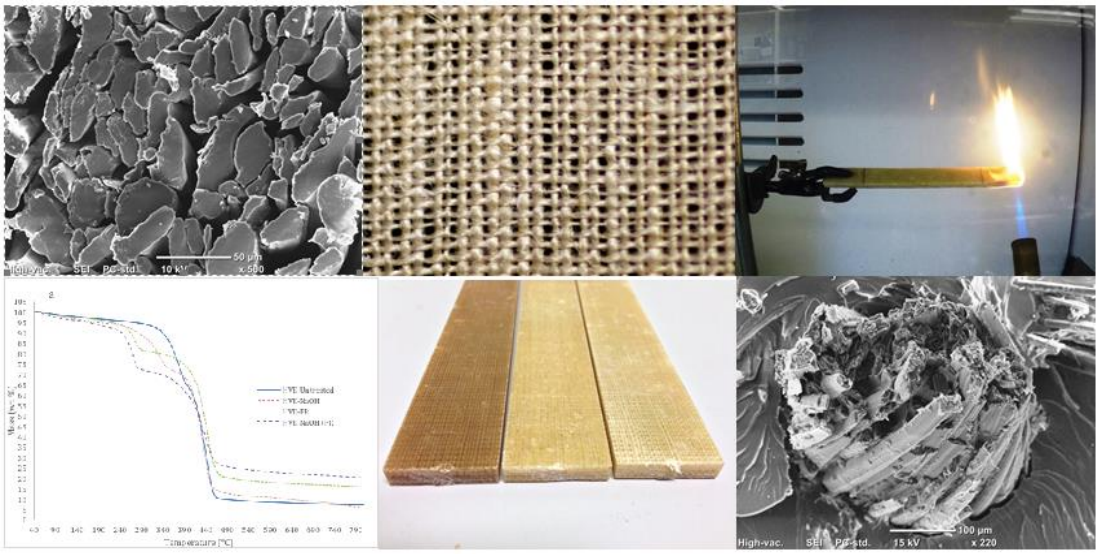
5.2.3 Natural dyes extraction from Seaweeds

The research currently focuses on the extraction of natural dye from green seaweed of *Caulerpa lentillifera* as textile colourant. The seaweeds were extracted using boiling water and ammonia fermentation methods. The dyeing was then performed by exhaustion at 85°C for 60 min. Three types of mordant were used by metachrome or simultaneous addition of mordant and dye in the dyebath. The dyed samples were measured using spectrophotometer to analyse the shades obtained with regards to L*a*b* values and K/S values. The dyed samples were also compared in terms of their ability to withstand washing, perspiration, rubbing/crocking and light. The results have shown that the natural dye obtained from boiling water extraction method gave higher K/S values in comparison with the dye obtained from ammonia fermentation method. Fastness properties of the dyed samples were evaluated according to MS ISO standard and ranged from good to excellent rating except for lightfastness which is poor. The research is currently in progress for other types of extraction techniques.



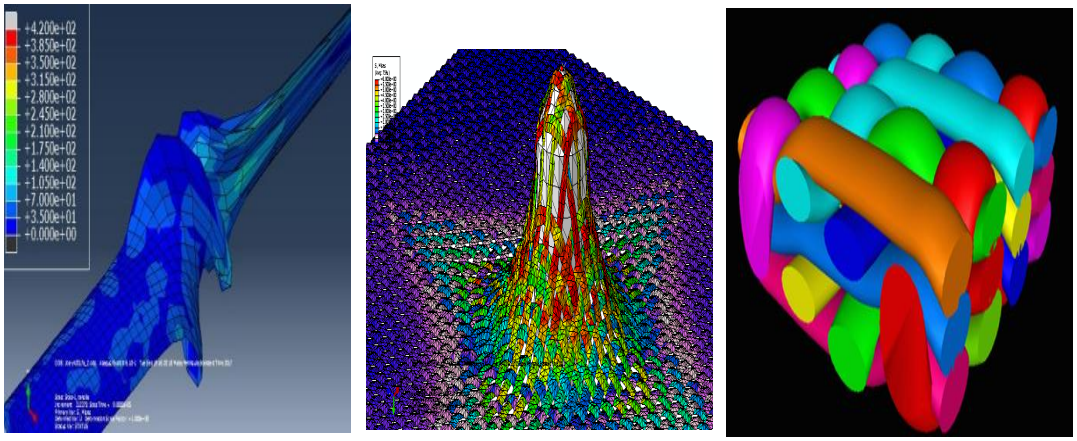
5.2.4 Natural Fibres Reinforced Composites

Traditional building materials are progressively being replaced by natural fibre reinforced composites (NFRC) due to its advantages and some big environmental issues such as congested landfill and over logging activities. Nevertheless, its degradability due to several factors such as fire, moisture and weather (sunlight) could stops its popularity. The knowledge on the NFRP degradation rates is important to be obtained for the sake of consumers' safety issues. Therefore, this research investigates the degradation factors such as fire retardancy, water absorptions, weather etc. on several types of NFRC's (e.g. jute, hemp, ramie etc) properties. This research will open rooms for composite quality improvement and new applications in construction industry.



5.2.5 Geometric Model Research

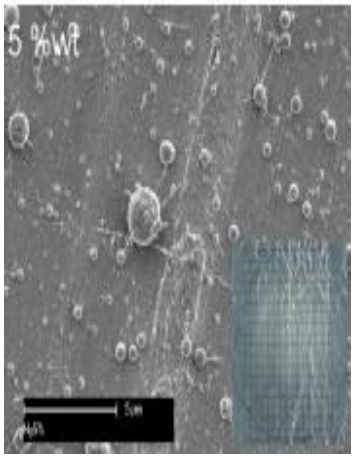
The research focuses on the development and application of quantitative methods for solving textile engineering problems. The group attempts to understand, analyze and predict complex textile mechanical and thermal responses by using numerical analysis methods such as Finite Element Analysis (FEA) and Structural Equation Modeling (SEM). Woven fabric geometry are developed with FEA preprocessor for multitude numerical analysis procedures of tensile and impact modeling, at various material properties. The simulated models are compared with experimental for validation. Future work is expected in composites modeling. Further work in Structural Equation Modeling involved in measuring thermal management and objective evaluation of woven fabric. The study gives a better understanding on human reaction to thermal and moisture management properties based on first touch experience and compared to measurement using standard equipment.

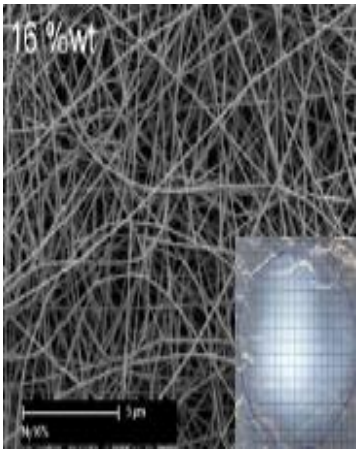


5.2.6 Electrospun Nanofibre Research

Electrospinning has gained a great deal of attention due to its versatile and simple technique to fabricate polymeric nanofibres in long and continuous fibre form. A random accumulation of the nanofibres forms an electrospun membrane which exhibits high porosity and surface area as well as light weight. Due to these

outstanding properties, the Textile Research Group has carried out a number of research studies particularly on the formation and characterization of electrospun nanofibres made from synthetic and biodegradable polymers. The study investigates the effects of electrospinning parameters such as applied voltage, nozzle tip-to-collector distance and flow rate on the morphological structures of electrospun nanofibres. A combination of the parameter produces different structures such as cylindrical, beaded, ribbon-like fibre as well as nano and microbeads. The resultant fibre diameter is in a range of 50nm to 1000nm. The research group also studied the feasibility to incorporate functional materials such as zeolite and titanium dioxide (TiO_2) in order to enhance the properties of nanofibre composites. Another area of study is to employ electrospun nanofibre membranes as filter media. The membrane has been tested for remediation of pigment from textile wastewater. Future direction of the study is to identify potential application of the fibres that leads to the commercialization of nanofibre product produced by electrospinning process.





5.3 Group Information

Name of RIG	Textile Research Group (TRG)
Leader	Assoc. Prof. Dr. Mohd Rozi Ahmad
Tier	5
RIG Code	CoRe12/T5/2014/12/FMIA/2
Registration Year (Senate Approval)	2014
UiTM Niche Area	Textile Science & Technology
RIG Niche Area	Smart Textiles, Simulation and Modelling of Textiles, Textile & Clothing Comfort Studies, Nanofibres via Electrospinning, Songket Mechanization, Natural Dyes Extraction & Coloration

5.4 Background of Members

Assoc. Prof. Dr. Mohd Rozi Ahmad
Faculty of Applied Sciences

Expertise: Textile Mechanics and Natural Dyes

Dr. Suzaini Abd Ghani
Faculty of Applied Sciences

Expertise: Textile Evaluation

Dr. Mohamad Faizul Yahya
Faculty of Applied Sciences

Expertise: Textile Mechanics and Modelling

Dr. Amily Fikri Aziz
Faculty of Business and Management

Expertise: Consumer Behaviour

Dr. Nur'Ain Yusof
Faculty of Applied Sciences

Expertise: Clothing Science

Dr. Nor Dalila Nor Affandi
Faculty of Applied Sciences

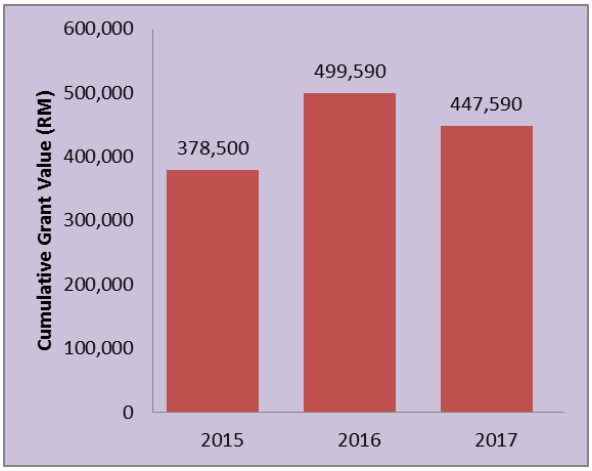
Expertise: Fibre Science, Nanofibre Formation

Dr. Mohd Iqbal Misnon
Faculty of Applied Sciences

Expertise: Textile Composites

5.5 Achievement (2015-2017)

RESEARCH GRANTS (Accumulative)



PUBLICATIONS

POSTGRADUATE

AWARDS AND RECOGNITION

INDUSTRIAL LINKAGES IN 2017

MOU	• Malaysian Textile & Apparel Centre (MATAC), 12 October 2017
Services	• Jabatan Bomba Malaysia - Training • SK Apparels Sdn Bhd – Testing • Filtermation (Mfg) Sdn Bhd – Testing • Institut Kraf Negara – Training • Malaysian Knitting Manufacturers Association
Visits to TRG	• Ilham Ramadhan Sdn Bhd (printing) • Jabatan Penjara Bentong (songket) • My-Sutera Sdn Bhd (Canggih brand) • Trans-Pacific Textiles Sdn Bhd (textiles) • SK Apparels Sdn Bhd (Siti Khadijah brand)

6.0

ULTRASONIC OF NOVEL METALS AND OXIDES RESEARCH

Ahmad Kamal Yahya, Rosdiyana Hisam, Mahesh Kumar Talari, Mohd Isa Mohd Yusof, Mohamed Nazri Mohd Yusof, Siti Nurbaya Supardan and Zakiah Mohamed

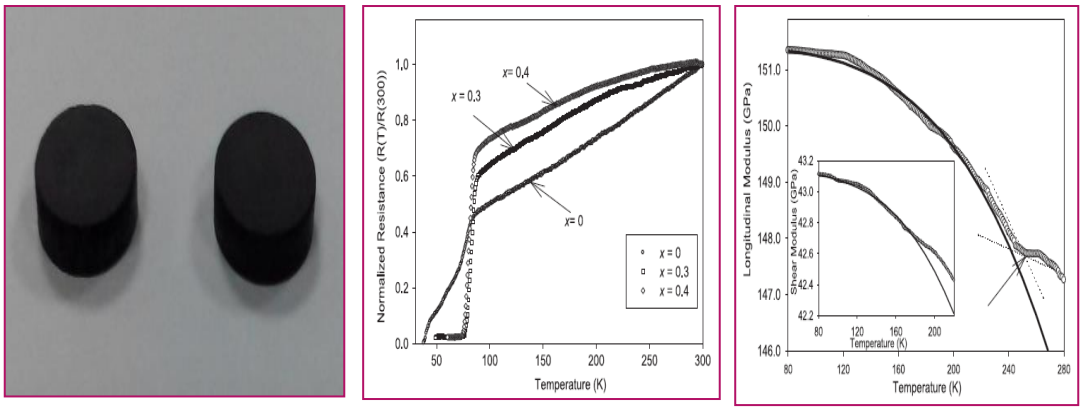
6.1 Introduction

The Ultrasonics of Novel Metals and Oxides (UNMOX) research interest group (RIG) was established in 2014 under the Faculty of Applied Sciences and is registered with the Research and Management Institute (RMI). UNMOX aims to be amongst the country's leading group in elastic and structural properties of novel oxides such as superconducting and magnetic polycrystalline and amorphous oxides. The group also conducts research on other complementary physical properties of the oxides such as electrical, optical and structural properties of oxides relevant for practical applications. Currently our independent researchers are in collaboration with other leading local and overseas groups and laboratories.

6.2 Research Highlights

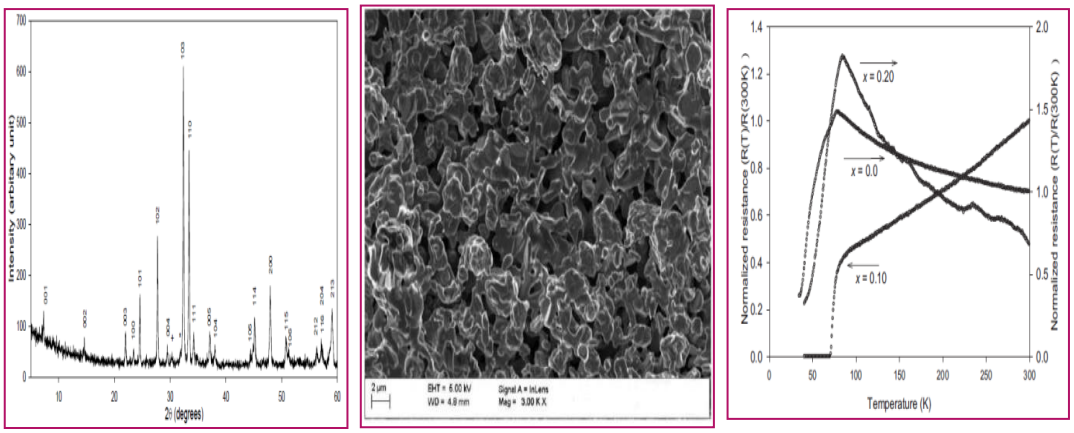
6.2.1 Effects of Cd^{2+} substitution on elastic properties and step-like anomalies in $Tl_{0.9}Bi_{0.1}Sr_{1.8}Yb_{0.2}Ca_{1-x}Cd_xCu_{1.99}Fe_{0.01}O_{7-\delta}$ superconductors

Cd-doped $Tl_{0.9}Bi_{0.1}Sr_{1.8}Yb_{0.2}Ca_{1-x}Cd_xCu_{1.99}Fe_{0.01}O_{7-\delta}$ (x = 0–0.4) bulk superconductor samples were prepared by solid-state reaction method,to examine the effect of Cd on ultrasonic velocity and elastic behavior of the samples. The samples were characterized by X-ray diffraction, DC electrical resistivity and temperature dependent ultrasonic velocity measurements. DC electrical resistivity measurement showed all the samples exhibit metallic normal-state behavior with the highest Tc zero observed at around 76.4K (x = 0.3). Ultrasonic velocity measurements at 80K showed a non-linear increase in both absolute longitudinal and shear velocities as well as elastic moduli with Cd substitution with the largest increase observed for the x = 0.3 sample. Temperature dependant longitudinal modulus showed elastic anomaly characterized by a step-like slope change at around 230K for x = 0 & x = 0.3 and at around 250K for x = 0.4 with the x = 0.3 sample showing the sharpest slope change. A comparison between experimental data and calculated lattice anharmonicity curve based on the model proposed by Lakkad, showed large deviation of the experimental longitudinal modulus curves for (x = 0.3) from the calculated anharmonicity curves indicating that the elastic behavior was strongly influenced by the existence of the step-like longitudinal anomaly. On the other hand, our analysis using the Landau free energy model found that the anomalous step-like elastic behavior fitted well with the equation derived from the model for regions below and above the elastic anomaly temperature, T_A. The fitting indicated that the anomaly is related to a phase transition that is suggested to involve ordering of oxygen which introduces strain in the system.



6.2.2 Elastic moduli and step-like elastic anomalies in Ce-substituted $Tl_{0.9}Bi_{0.1}Sr_{2-x}Ce_xCa_{0.9}Y_{0.1}Cu_{1.99}Fe_{0.01}O_{7-\delta}$ (x = 0–0.20) superconductors

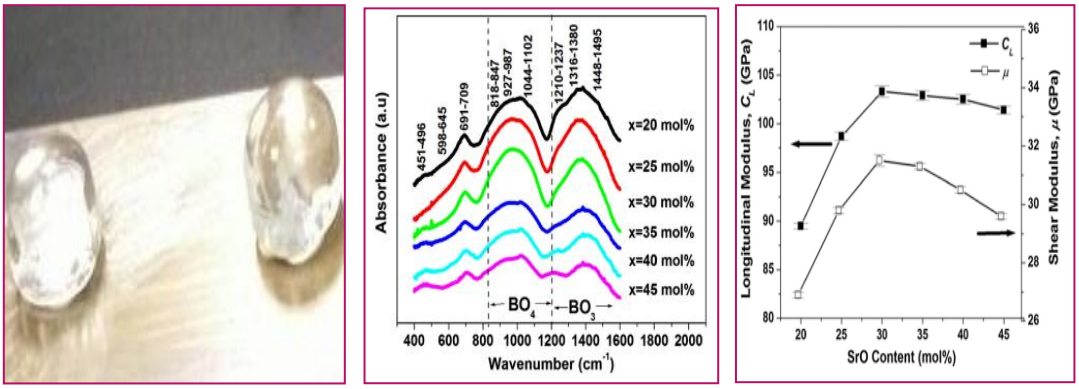
Ultrasonic velocity measurements have been performed on polycrystalline $Tl_{0.9}Bi_{0.1}Sr_{2-x}Ce_xCa_{0.9}Y_{0.1}Cu_{1.99}Fe_{0.01}O_{7-\delta}$superconductor to study the influence of Ce substitution on elastic properties of the samples. Ce was observed to influence elastic moduli at 80 K which showed the largest value obtained at x = 0.10 where, coincidentally, the highest superconducting temperature T_c among samples was also shown. A longitudinal velocity anomaly was observed at around 260 K for the unsubstituted sample (x = 0). Ce substitution caused the temperature of the elastic anomaly to shift to 250 K (x = 0.1) and 262 K (x = 0.2). The existence of the step-like elastic anomaly was suggested to be due to oxygen ordering taking place in Tl-O planes. The analysis of elastic behavior in the vicinity of the elastic anomalies using the Landau free-energy model suggests that the anomaly is due to a phase transition which involves oxygen ordering.



6.2.3 Anomalous elastic behaviour of xSrO-10PbO-(90-x)B_2O_3 glass system

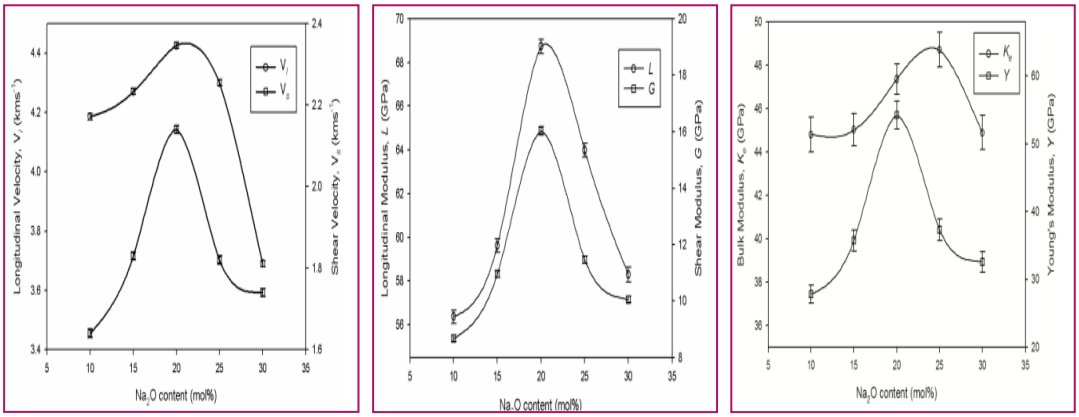
Glass samples with composition xSrO-10PbO-(90-x)B_2O_3 (x = 20, 25, 30, 35, 40 and 45) were prepared by melt-quenching method to elucidate the elastic behaviour due to borate anomaly. Structural investigation of glass samples were carried out by X-ray diffraction (XRD) and Fourier transform infrared (FTIR) spectroscopy while elastic properties were studied by measuring both longitudinal and shear velocities using pulse-echo method at 5 MHz frequency. FTIR analysis revealed the presence of BO_4 and BO_3 vibration groups. Addition of SrO has

resulted in increased ultrasonic velocities, elastic moduli (*CL, μ K* and *Y*), hardness (*H*), Debye temperature (*θD*) for SrO content up to 30% but decreased for higher SrO addition. The fraction of the four coordinated boron atoms (N_4) values, calculated from FTIR spectra increased for $x \leq 30$ mol% followed by decrease at $x > 30$ mol%. Quantitative analysis of ultrasonic data using the bulk compression and ring deformation models showed reduction in the ratio of calculated bulk modulus to the experimental bulk modulus, K_{bc}/K_e for $x \leq 30$ mol% indicating decreased ring deformation in borate anomaly region.



6.2.4 Effect of increasing concentration of Na_2O on structural, elastic and optical properties of (90 – *x*)GeO_2–*x*Na_2O–10PbO glass system in the germanate anomaly region

Ternary germanate glasses (90 – *x*)GeO_2–*x*Na_2O–10PbO (*x* = 10–30 mol%) have been prepared by the melt-quenching method. Density, *ρ* increased with Na_2O content up to maxima at 20 mol% while molar volume, V_a showed an opposite trend to the density, with a minima at 20 mol% of Na_2O content indicating the presence of the germanate anomaly. Ultrasonic velocity measurements showed both longitudinal, v_l and shear, v_s velocities increased up to 20 mol% before decreasing with further addition of Na_2O. Independent longitudinal, *L* and shear, *G* moduli along with Young's modulus, *Y*, mean sound velocity, v_m, Debye temperature, *θD*, and hardness, *H* recorded maximum values at 20 mol% of Na_2O content which were suggested to be related to the germanate anomaly. Structural modification occurring due to conversion of six-membered GeO_4 rings to three-membered rings of GeO_4 changed bond density and compactness of the glass systems and caused the increase in rigidity and stiffness of the glasses. Beyond 20 mol% of Na_2O, the decrease in the elastic moduli was due to depolymerization of the glass network. Meanwhile, optical energy gap, E_{opt} exhibited a minima at 20 mol% whereas Urbach energy, E_U and refractive index, *n* showed a maxima at the same concentration, thereby indicating variation in polarizability due to changes in concentration of bridging and non-bridging oxygen.



6.3 Group Information

Name of RIG	Ultrasonic of Novel Metals and Oxides (UNMOX)
Leader	Prof. Dr. Ahmad Kamal Hayati Yahya
Tier	5
RIG Code	CoRe31/T5/2014/31/FMIA/5
Registration Year (Senate Approval)	2014
UiTM Niche Area	Applied Sciences
RIG Niche Area	Research on elastic and structural properties of novel oxides such as superconducting and magnetic polycrystalline and amorphous oxides

6.4 Background of Members

Prof. Dr. Ahmad Kamal Hayati Yahya

Faculty of Applied Sciences
Expertise: Ultrasound & Superconductor

Dr. Mahesh Kumar Talari
Faculty of Applied Sciences
Expertise:
Metal & Ceramic

Dr. Rosdiana Hasham@Hisam
Faculty of Applied Sciences
Expertise:
Glass & Dielectric

Mohd Isa Mohd Yusof
Faculty of Applied Sciences
Expertise:
Glass & Elastic

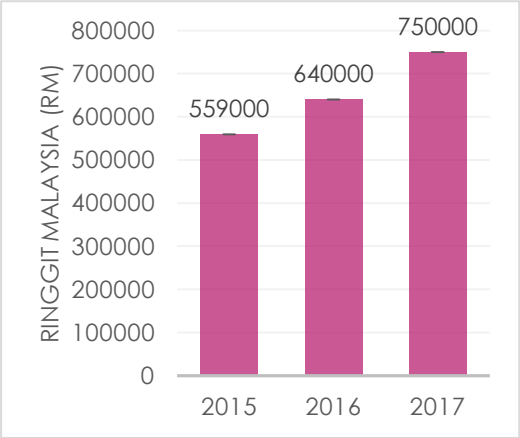
Mohamed Nadzri Mohd Yusof
Faculty of Health Sciences
Expertise:
X-Ray

Siti Nurbaya Supardan
Faculty of Applied Sciences
Expertise:
Semiconductor & Magnetism

Dr. Zakiah Mohamed
Faculty of Applied Sciences
Expertise:
Magnetic & Diffraction

6.5 Achievement (2015-2017)

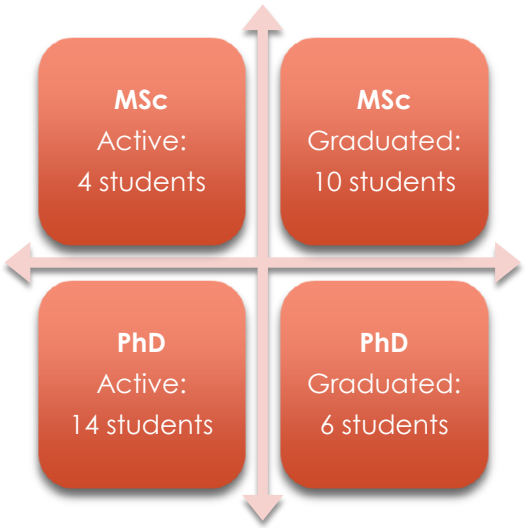
GRANTS OBTAINED



PUBLICATIONS

2017	2016	2015
Indexed Journal 9	Indexed Journal 18	Indexed Journal 18
Others 0	Others 0	Others 0

POSTGRADUATE SUPERVISION



AWARDS AND RECOGNITION

Design Competition	• 2017 (2 • 2016 (-) • 2015 (-)
Thesis Examiner Judge & Reviewer Invited Speech	• 2017 (5) • 2016 (5) • 2015 (5)

7.0

ELECTROACTIVE MATERIALS RESEARCH

Rosnah Zakaria, Oskar Hasdinor Hassan, Mohamad Fariz Mohamad Taib, Muhamad Kamil Yaakob, Noor 'Aisyah Johari, Faizatul Farah Hatta, Nazli Ahmad Aini

7.1 Introduction

Electroactive Materials research group is formed to promote the development of synthesis, characterization and computational investigations of advanced materials for energy applications.

Many activities emphasize on the following areas:

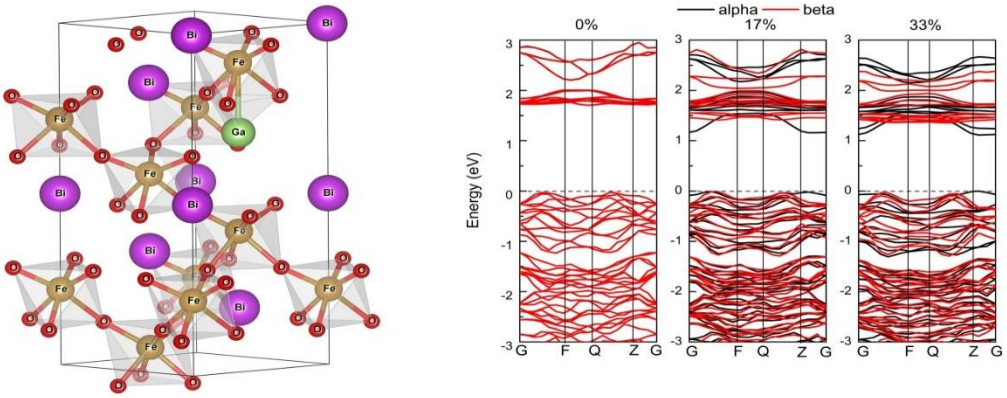
1. Design and analysis of advanced materials based on experimental and computational quantum mechanical method
2. Development of new materials, high performance of electrochemical devices
3. Correlation of existing materials properties and their fundamental knowledges such as condensed matter physics, quantum mechanics and solid state ionic.

Knowledge and scientific skill transfer to students and other collaborators includes synthesis, characterization and computational techniques

7.2 Research Highlights

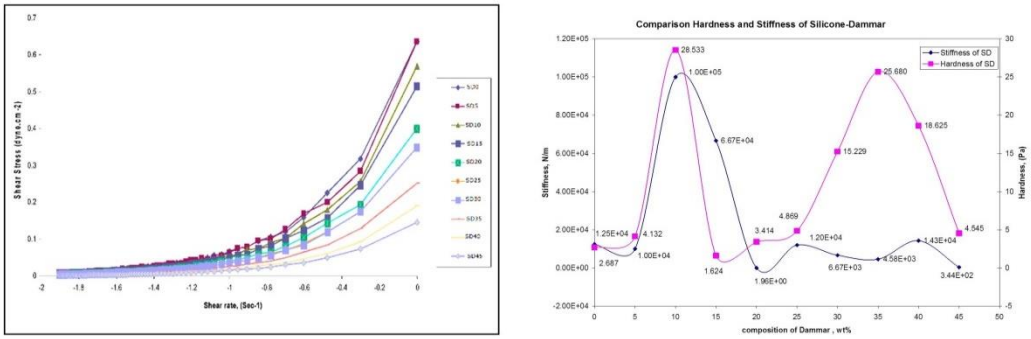
7.2.1 Design and Discovery of Novel Room Temperature Multiferroic $Bi_{1-x}Ga_xFeO_3$ Materials: A combined theoretical and experimental approach

$BiFeO_3$ is known for its promising candidate to be a room temperature multiferroic due to its high phase transition temperature. This causes the material to produce extra functionalities that usually cannot be handled by a single ferroic order material. However, $BiFeO_3$ comes with problems such as high leakage current and weak magnetization. In this work, we develop a combined first principles calculation and hydrothermal synthesis method to predict the novel material $Bi_{1-x}Ga_xFeO_3$ in antiferromagnetic *R3c* phase and improve the desired optimal properties. Our investigation predicts such material on theoretical approach firstly, which then the material was design experimentally. The synthetization so far aligned with theoretical studies regarding phase structure prediction and energy gap. Further experimental analysis may provide significant insight to strengthen our theoretical prediction and results. Also, this technique could be an alternative to the conventional experiment method, as it reduces try and error practice and greener approach.



7.2.2 Silicone-Dammar Thin Film as Organic Coating

Most silicone resins contain methyl and phenyl group. The phenyl groups will improve heat resistance, flexibility and compatibility with pigment. The use of natural resin as additional materials to produce new formulation of natural and synthetic binder especially dammar and mastic resin are already popular and a mixture of paint varnishes. In this studies, properties of Silicone-Dammar thin film as organic coating materials at various weight percent of Silicone and Dammar were mix to make a thin film on aluminum Q-panel. Properties like rheology, cross hatch test, nanoindentation, and Electrochemical Impedance Spectroscopy were investigated.



7.2.3 Alkaline solid polymer blends electrolyte films

Alkaline solid polymer blends electrolyte (ASPBE) films comprising a blend of poly(vinylalcohol) (PVA) and poly(vinylpyrrolidone) (PVP), potassium hydroxide (KOH) as ionic dopant, ethylene carbonate (EC) and propylene carbonate (PC) as plasticizer have been prepared by solution casting technique by varying the polymer blend-ionic dopant-plasticizer concentration ratio systematically. The PVA combined with PVP had good mechanical strength performed by tensile strength (TS) test. X-ray diffraction (XRD) studies have been conducted to investigate the complexation in the alkaline solid polymer blends electrolyte. The XRD results revealed that the amorphous domain of PVA was increased when the PVP was blended. The variation in film morphology was examined by scanning electron microscopic (SEM). The thermal properties of these films were performed using differential scanning calorimeter (DSC) and the result has confirmed the miscibility between the polymeric components. The conductivity was studied using complex impedance spectroscopy to investigate ionic conduction in blending PVA/PVP, PVA/PVP-KOH, PVA/PVP-KOH-EC and PVA/PVP-KOH-PC electrolyte systems. The complex impedance spectroscopy results revealed that the high-frequency semicircle was due to the bulk effect of the material.

7.3 Group Information

Name of RIG	ELECTROACTIVE MATERIALS (EM)
Leader	Dr. Rosnah Binti Zakaria
Tier	5
RIG Code	CoRe108/T5/2016(13)/FMIA(08)
Registration Year (Senate Approval)	2016
UiTM Niche Area	Advanced Materials for Energy Applications
RIG Niche Area	Research on Electrochemical Devices (Synthesis & Computational)

7.4 Background of Members

DR. ROSNAH BINTI ZAKARIA
Faculty of Applied Sciences
Expertise:
Coating, Solid State Ionic

DR. MUHAMAD KAMIL BIN YAAKOB
Faculty of Applied Sciences
Expertise:
Multiferroic, Condensed Matter Physics, Computational

DR. MOHAMAD FARIZ BIN MOHAMAD TAIB
Faculty of Applied Sciences
Expertise:
Computational Materials Sciences, Ferroelectric, Half-metallic Materials

ASSOC. PROF. DR. OSKAR HASDINOR BIN HASSAN
Faculty of Arts and Design
Expertise:
Ceramics, Cathode Materials, Fuel Cell, Computational

NAZLI AHMAD AINI
Faculty of Applied Sciences
Expertise:
Magnetic Materials, Fuel Cell, Polymer Electrolyte

FAIZATUL FARAH HATTA
Foundation
Expertise:
Polymer Electrolyte, Battery

NOOR 'AISYAH JOHARI
Foundation
Expertise:
Polymer Electrolyte, Battery

7.5 Achievement (2015-2017)

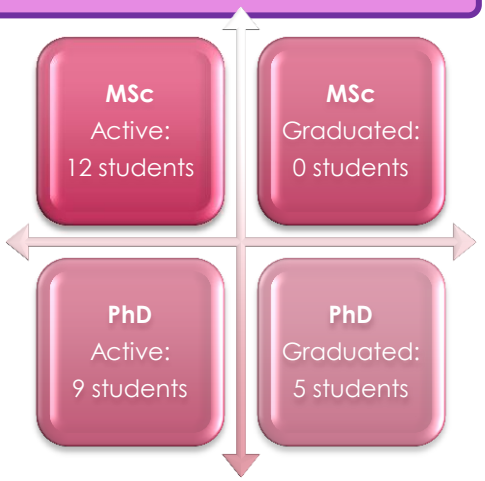
GRANTS OBTAINED

2017	2016	2015
Number 7	Number 2	Number 5
Total (RM) 303200	Total (RM) 405600	Total (RM) 408400

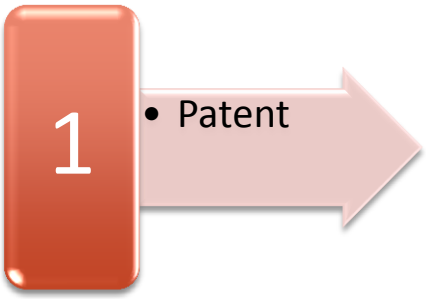
PUBLICATIONS

2017	2016	2015
Indexed Journal 15	Indexed Journal 19	Indexed Journal 10
Others 10	Others 4	Others 28

POSTGRADUATE SUPERVISION



INTELLECTUAL PROPERTY



AWARDS AND RECOGNITION

Awards

- 2017 4
- 2016 10
- 2015 5

Special Invitation

- 2017 17
- 2016 8
- 2015 4

8.0

SURFACE COATING RESEARCH

Junaidah Jai, Norliza Ibrahim, Istikamah Subuki, Anizah Kalam, Norsuhana Mohd Yusof, Rafeqah Raslan, Nurashikin Zamanhuri

8.1 Introduction

Surface coating (SC) research group is formed to focus research on development of surface coating protection for various applications.

Many activities emphasize on the following areas:

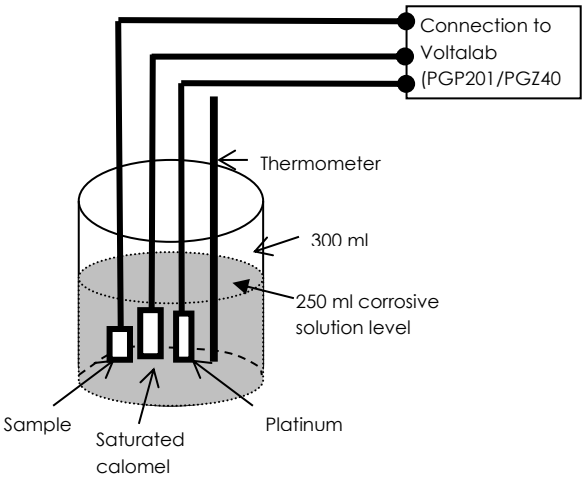
1. Development of corrosion inhibitor for metal protection.
2. Development of film coating material for food packaging incorporated with antimicrobial and antioxidant agents from plant extract.
3. Encapsulation of essential oil from plant extract to be used as antimicrobial and mosquito repellent in household products.
4. Development of palm leaves extract as reducing agent in the synthesis of nano-particle and recovery of precious metals from electroplating waste

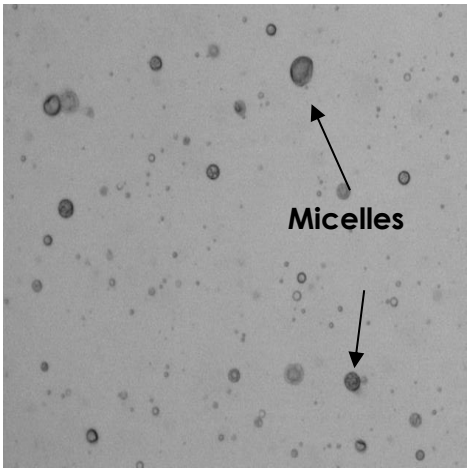
8.2 Research Highlights

8.2.1 Palm oil as corrosion Inhibitor for aluminium car radiator

Aluminium (Al) is an amazing material due to its low cost, lightweight and corrosion resistance. However, Al is easily corroded when exposed in solution containing pitting agents. Suitable corrosion inhibitor should be used and palm olein has a promising characteristics. For this work, formulation of palm olein (PO) as corrosion inhibitor for Al in aqueous solution was developed. Tween 20, hexane and diethyl triamine were used as the additives and the formulated inhibitor was labeled as POT20HA. The X-ray diffractometer (XRD) spectrum revealed that the POT20HA was an amide compound. The inhibition efficiency (IE) and behaviour of the POT20HA were determined through weight loss (WL), potentiodynamic polarization (PP) and electrochemical impedance spectroscopy (EIS). For the tests, Al 6061 was immersed in 1 M HCl solution at different temperatures of 26^{o}C, 50^{o}C and 70^{o}C with different concentrations of POT20HA of 0, 0.03, 0.07, 0.10, 0.13 and 0.17 M. Scanning Electron Microscopy (SEM) coupled with Energy Dispersion X-ray analysis (EDAX) was used to examine the morphology of the corroded Al 6061. The WL test had shown that the IE increased with increasing concentration of POT20HA at all temperatures under study. However, the IE decreased with increasing of temperature and immersion time. The PP study revealed the POT20HA as a mixed type of inhibitor, which is capable of protecting both the anodic and cathodic reactions of the corrosion process. The EIS study had shown the ability of POT20HA in forming protective passive film on Al 6061 surface. The thickness of the passive film increased accordingly with the increase in concentration but decreased with increasing temperature. The corrosion tests showed that POT20HA adsorbed on the Al 6061 surface through physical adsorption according to the Langmuir isotherm relationship. The adsorption mechanism of POT20HA on the Al 6061 was through protonation of micelles by the HCl solution. The protonated micelles, with the presence of Cl^- ions, adsorbed

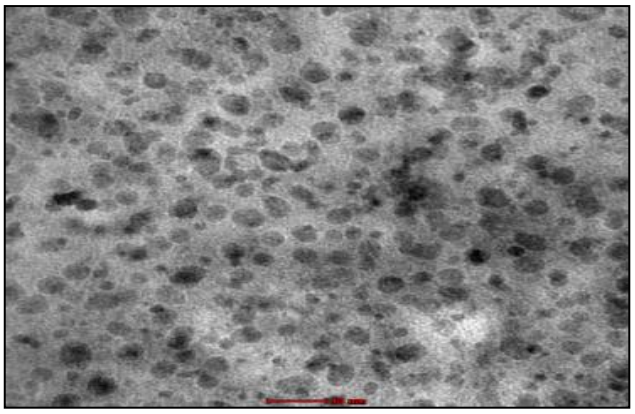
both on the cathodic and anodic sides of the corroding surface. Performance test had shown that the POT20HA has performed as an anticorrosion with glycerin as a coolant in an Al car radiator.





8.2.2 Palm oil leave extract as reduction agent - nanoparticles

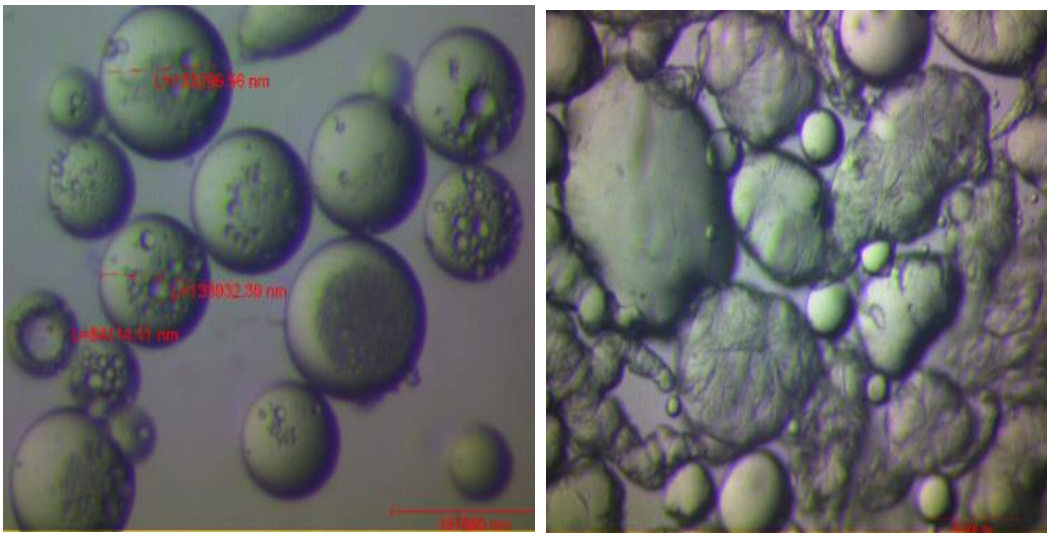
Platinum nanoparticles were biologically synthesized by reducing H_2PtCl_6 with palm leaves extract at room temperature. The effect of metal salt concentration and plant extract percentage on platinum ions conversion and the size distribution of the platinum nanoparticles were studied. The result showed that the conversion of platinum ions reached 87.2% and the platinum nanoparticles with average size of 1.67 ± 0.11 nm were obtained by reducing 1mM of H_2PtCl_6 with 10% of palm leaves extract. FTIR result revealed that compounds such as hydroxyl and carbonyl act as reducing agents for platinum ions reduction while proteins amine groups stabilized the nanoparticles. EDX spectrum confirms the presence of platinum element in the nanoparticles.



8.2.3 Encapsulated citronella oil as mosquitoes repellent agent in water based paint

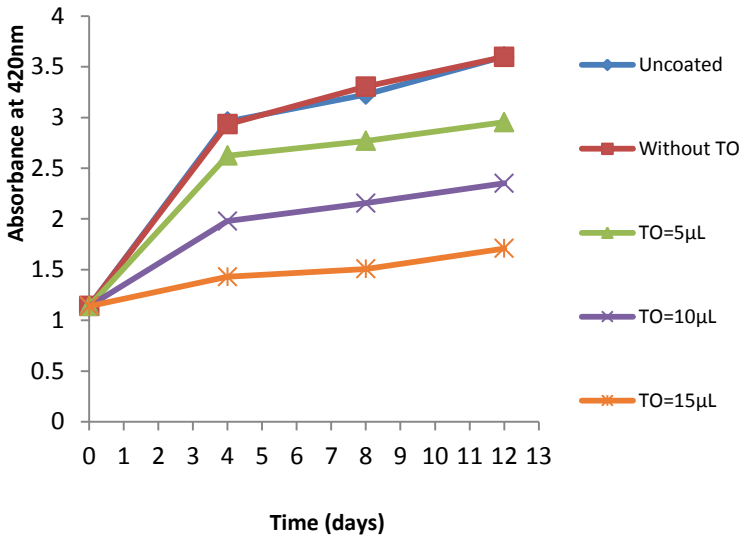
The aim of the study is to produce a CO paint as mosquito repellent and able to provide protection for more than a year. The performance of the CO paint indicated by its mosquito repellency properties and basic standard paint characteristic which are paint VOCs content, adhesion and viscosity. To provide control release, the

CO was encapsulated via simple and complex coacervation methods. Both method have provided good efficiency with encapsulation efficiency around 94%. Comparison was made for capsules morphology to find suitable capsules to be added in water based paint. From the observation, capsules from complex coacervation has given better morphology to be added in water based paint. The capsules wall able to sustain in wet and capsule wall start ruptured in dried conditions. Basic water based paint is required in the study because addition of CO has increase the viscosity of the paint and emission of chemical VOCs from the commercial paint was considered can decrease the concentration of citronella compounds in air thus decrease its effectiveness as repellent. CO was added in basic water based paint at 0 to 5 %v/v. The study found that, 3.5 % CO paint was good enough to be function as mosquito repellent. But, release kinetic study found that the paint able to release the citronella in 4 days only. Encapsulated citronella oil (ECO) in paint has lower release kinetic thus able to provide longer release duration. 12% ECO paint able to provide protection for 1 year and 236 days. With the calculated dosage, the paint able to give 100% repellency to A. *aegypti*.



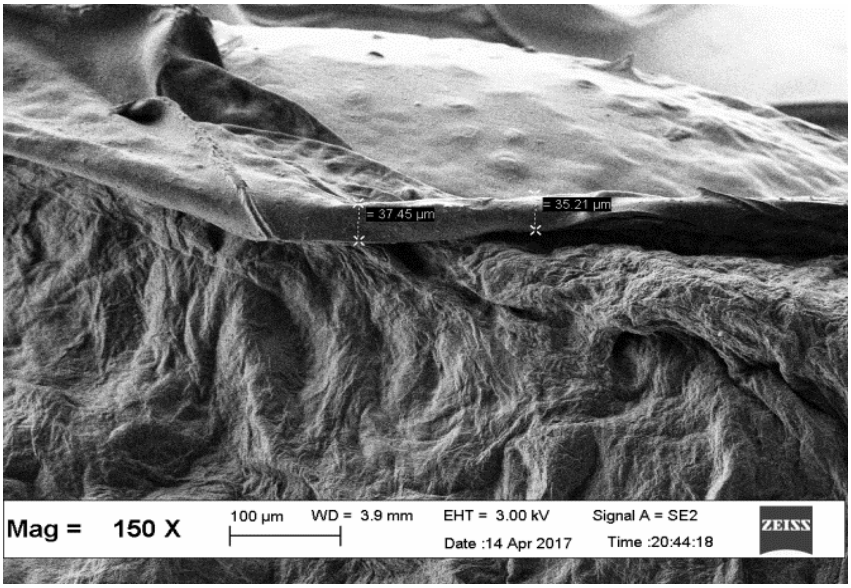
8.2.4 Tumeric oil as the antioxidation agent in edible coating film

Turmeric oil (TO) has been studied for its potential as an antioxidation agent in starch edible coating for fresh cut apples and its degree of oxidation wasanalysed. TOincorporate with starch edible coating was examined using FT-IR Spectroscopy to determine the presence of secondary metabolites. The presence of alcohol and aromatic ring in the edible coating film proved that the secondary metabolites from TO were existed. The fresh cut apples were underwent the sensory test and six out of tenpanellist concluded that coated fresh cut apples have good appearance and surface colour. Fresh cut apples were coated with edible coating incorporated with different concentrations of TO (uncoated, 0µL, 5µL, 10µL, 15µL. Percentage weight loss for 15µL were the least which were 1.98% (day 6) and 3.95% (day 12). Colour measurement were done for few days and it shows that the total colour difference (ΔE) for 15µL were the lowest. Thus, the oxidation activities for 15µL is the slowest compared to the others. These can be proved through the degree of oxidation analysis using UV-Vis spectroscopy. Uncoated fresh cut apples havethe highest degree of oxidation whilethose with 15µLhave the lowest. This study can be illustrated that the oxidation activities of fresh cut apples could be postponed using edible film incorporated with TO.



8.2.5 Curcuma longa L. on chitosan–starch based edible coating

The ability of chitosan-starch based coating to extend shelf life of strawberry were studied. The main objectives of this paper is to study the effects of different concentrations (20, 15, 10 and 5 µL) of *Curcuma longa L.* (CUR) essential oil into chitosan-based edible coating on surface tension in order to increase the effectiveness of the coating. CUR or turmeric is one of the commercially planted herbs in Malaysia for its phytochemical benefits. Application of edible coating using dipping technique has been analysed and evaluated for their effectiveness in extending shelf life of fruits. Surface tension was analysed to investigate the adhesion properties. The best CUR concentration was 15 µL with the optimum surface tension was found to be 31.92 dynes/cm.



8.3 Group Information

Name of RIG	SURFACE COATING RESEARCH GROUP (Coating SCRG)
Leader	Assoc. Prof. Dr. Junaidah Jai
Tier	5
RIG Code	CoRe108/T5/2016(13)/FMIA(17)
Registration date (Senate Approval)	16 APRIL 2014
UiTM Niche Area	Advanced Manufacturing & Automation
RIG Niche Area	Material science and engineering on surface protection.

8.4 Background of Members

Dr. Norliza Ibrahim
Faculty Of Chemical Engineering
Expertise: Ceramic mambrane

Rafeqah Raslan
Faculty Of Chemical Engineering
Expertise: Product from natural resource

Dr. Anizah Kalam
Faculty of Machanical Engineering
Expertise: Fracture Mechanics

Assc. Prof Dr.Junaidah Jai
Faculty of Chemical Engineering
Expertise: Corrosion Inhibitor

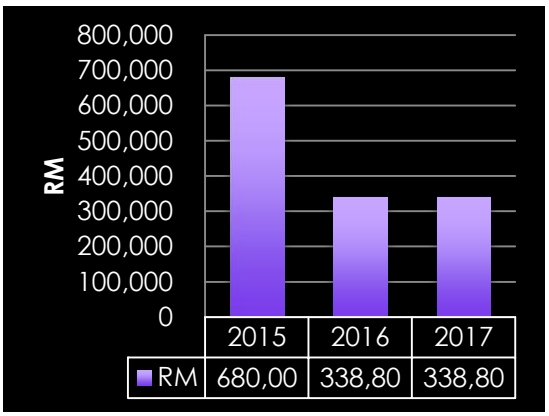
Dr. Istikamah Subuki
Faculty Of Chemical Engineering
Expertise: Powder Metallurgy

Noorsuhana Mohd Yusof
Faculty Of Chemical Engineering
Expertise: Food coating

Norashikin Zamanhuri
Faculty Of Chemical Engineering
Expertise: Extraction

8.5 Achievement (2015-2017)

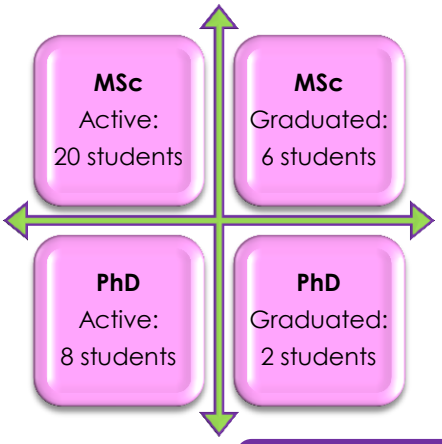
GRANTS OBTAINED



PUBLICATIONS

2017	2016	2015
Indexed Journal 11	Indexed Journal 7	Indexed Journal 12
Others 0	Others 1	Others 4

POSTGRADUATE



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- 3 • Copy Right
- 4 • Patent

AWARDS AND RECOGNITION

Design Competition	• 2017 (2 gold, 2 Silver) • 2016 (2 gold, 2 Silver) • 2015 (2 Silver)
Thesis Examiner	• 2017 (2) • 2016 (2) • 2015 (2)
Judge & Reviewer	• 2017 (10) • 2016 (12) • 2015 (15)

9.0

NANOCOMPOSITE MATERIALS & INDUSTRIAL APPLICATION RESEARCH

Mohd Nazarudin Zakaria, Noor Najmi Bonnia, Siti Norasmah Surip, Mansor Ahmad and Mimi Azlina Abu Bakar

9.1 Introduction

Research activities emphasize on the following areas:

1. Nanocomposites
2. Nanomaterials
3. Synthesis of nanomaterials & nanofibers
4. Wood Composites
5. Thermoset Polymer
6. Materials Science
7. Advanced Materials
8. Bacteria Cellulose
9. Silver Nanoparticles

Consultation Services:

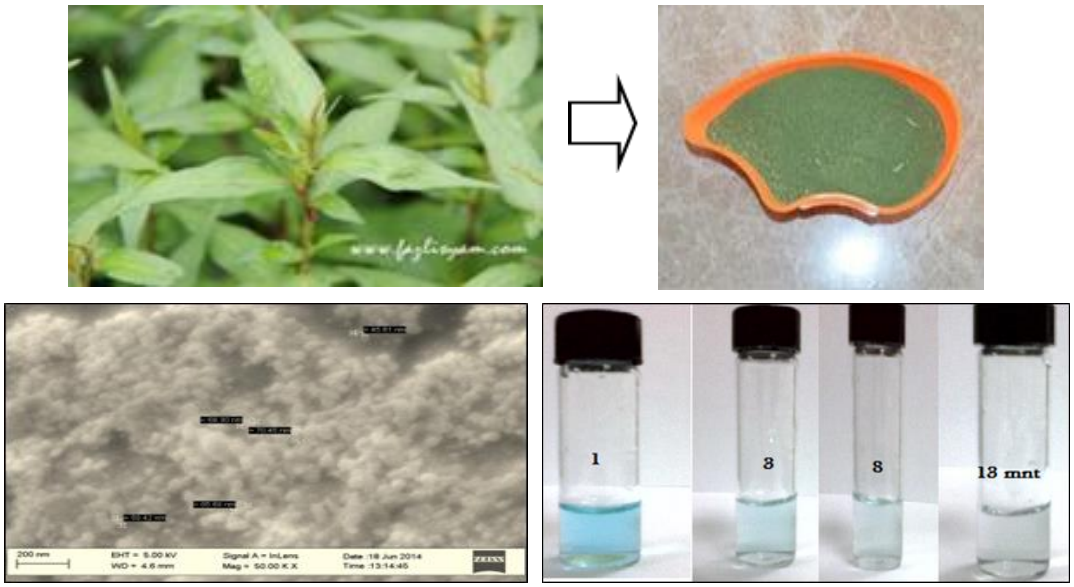
1. Polymeric and Composites Materials
2. Wood Composites
3. ESCR testing /degradation behaviour of polymer composites based product.
4. Mechanical, Thermal, Physical, Morphological properties of nanocomposite materials.
5. Biomechanic

9.2 Research Highlights

9.2.1 Green Biosynthesis Of Silver Nanoparticles Using 'Polygonum Hydropiper' And Study Its Catalytic Degradation Of Methylene Blue

The green synthesis of silver nanoparticles with the small size and high stability paved the way to improve and protect the environment by decreasing the use of toxic chemicals and eliminating biological risks in biomedical applications. Plant mediated synthesis of silver nanoparticles is gaining more importance owing its simplicity, rapid rate of synthesis of nanoparticles and eco-friendliness.. In this study, focus on biosynthesis of silver nanoparticles using *Polygonum hydropiper* extract and its catalytic degradation of hazardous dye, methylene blue has been highlighted. The rapid reduction of silver (Ag) ions was monitored using UV-Visible spectrophotometer and showed formation of silver nanoparticles within less than one hour with maximum absorption of silver nanoparticles at 430 nm. The major functional groups present in the synthesized silver nanoparticles responsible for the formation of silver

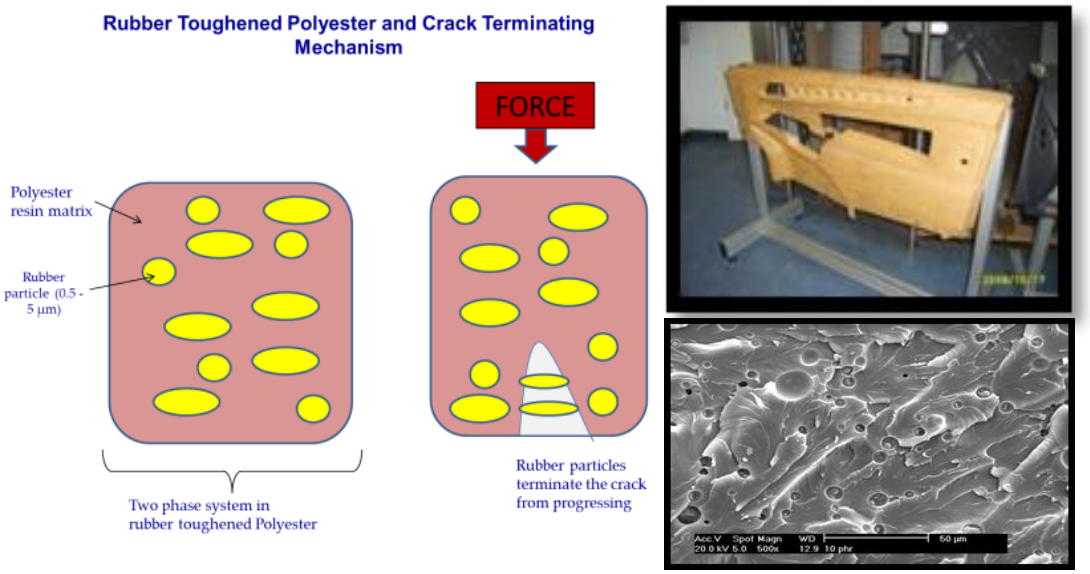
nanoparticles are identified using Fourier Transform Infrared spectrophotometer (FTIR). Field Electron Scanning Microscope (FESEM) was used to characterise the nanoparticles synthesized using *P.hydropiper.* The morphology of silver nanoparticles was predominantly spherical and aggregated into irregular structure with average diameter of 60 nm. In addition, this report emphasizes the effect of the silver nanoparticles on the degradation rate of hazardous dyes by sodium borohydride ($NaBH_4$). The efficiency of silver nanoparticles as a promising candidate for the catalysis of organic dyes by $NaBH_4$ through the electron transfer process is established in the present study.



9.2.2 Superb Structural Of Toughened Biocomposites For High End Applications

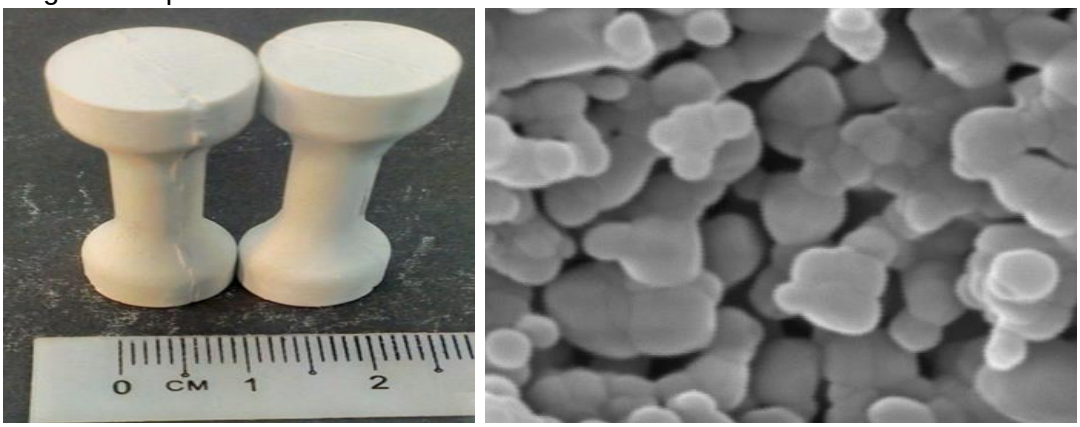
Brittleness of thermoset polyester due to cross linking process enhances the idea of producing rubber toughened polyester composite. Rubber toughened polyester - kenaf composite were prepared by adding various percentage of kenaf fiber in unsaturated polyester resin and subsequently cross linked using methyl ehtyl ketone peroxide and accelerator Cobalt Octanoate. Liquid Natural Rubber (LNR) was also added in producing this composite. Addition of LNR promotes excellent properties on fracture toughness, impact strength, flexural strength and hardness compared to without LNR. Even though polyester and rubber particles are in different phases, not blended, still the rubber particles can help the crack from propagate and increase the strength of thermoset polymer. Environmental stress cracking (ESC) in plastics can be explain by the failure of the polymeric materials at room temperature due to continuously alternating internal and/or external stresses generally in the presence of surface-active wetting agents that is also known as stress cracking agents . From ESCR result, after being exposed to 4 difference environments (sea water, distilled water, soil buried & natural weather) for 3 months shows that rubber toughened polyester composite have high resistance to active environment and suitable for outdoor used. This is a quality local product from a combination of good properties polyester and high performance natural fiber; kenaf suitable for many applications such as in automotive and construction sectors. Product also expected to be applied in the interior of passenger cars and truck cabins. The advantages of rubber toughened polyester have widened the applications of polyester resin replacing epoxy within the area of outdoor used furniture, automotive, transport, aircraft and

sporting sectors.



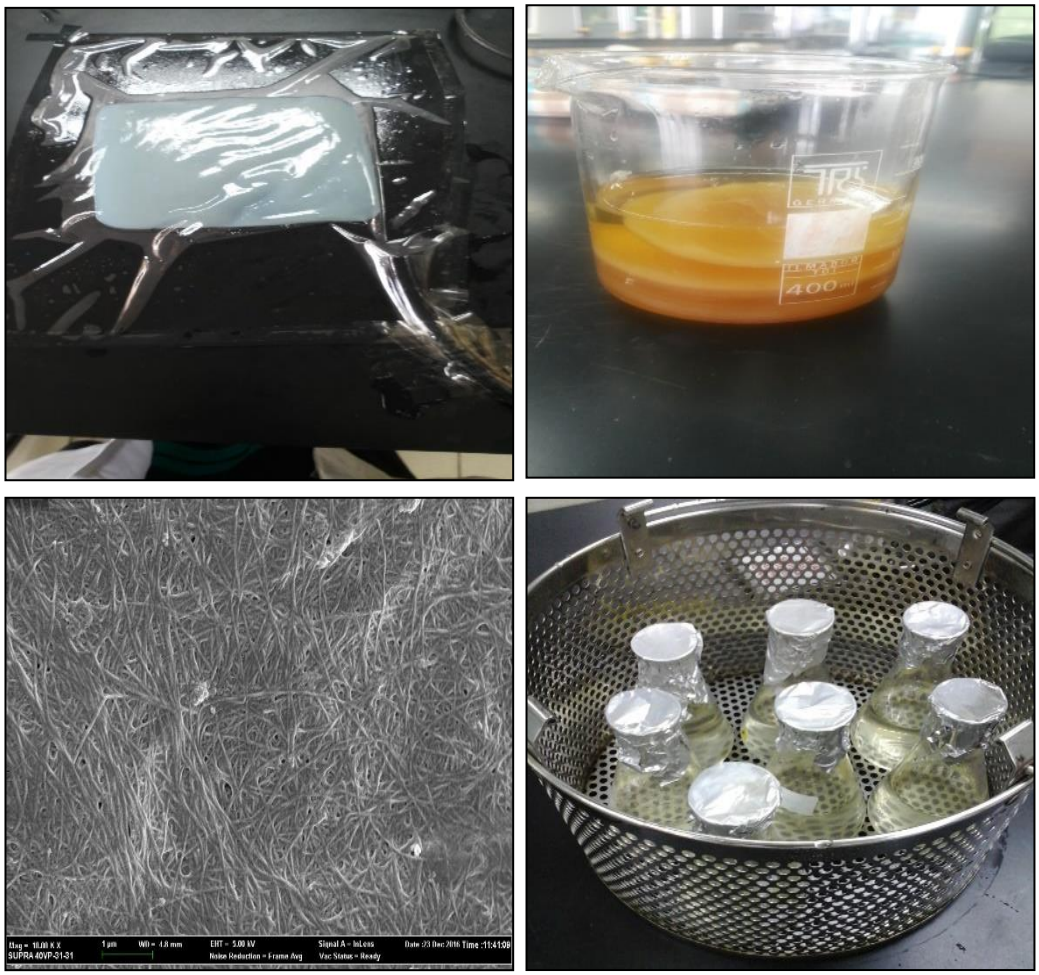
9.2.3 Dual Function of Palm Stearin in Processing of Hydroxyapatite (HAp) Scaffold

Binder in ceramic injection molding (CIM) is important as it acts as a temporary vehicle to support the ceramic powder during mixing and injection molding. Besides promoting good adhesion to powder during mixing and good flow properties during injection moulding, the binder should also exhibit sufficient dimensional rigidity and strength towards the process. Conventional CIM requires at least two binder systems which are known as (i) primary binder (low melting point) and (ii) backbone binder (high melting point).There are many binder system being used by CIM industries, however non reporting the use of single binder system, particularly for biomedical scaffold implant. The main objective of this work is to investigate the potential of local binder system namely palm stearin to be used as main binder system without employing the backbone constituent. The results show that the palm stearin exhibits promising behaviour especially during mixing and injection moulding, whereby temperature for both processes can be reduced significantly. Besides, the parts are easily sintered using a single step firing process at an elevated temperature. The scaffold structure developed encourages osseointegration between bone tissue and implant, thus minimizing the problems of stress shielding effects for long term implantation.

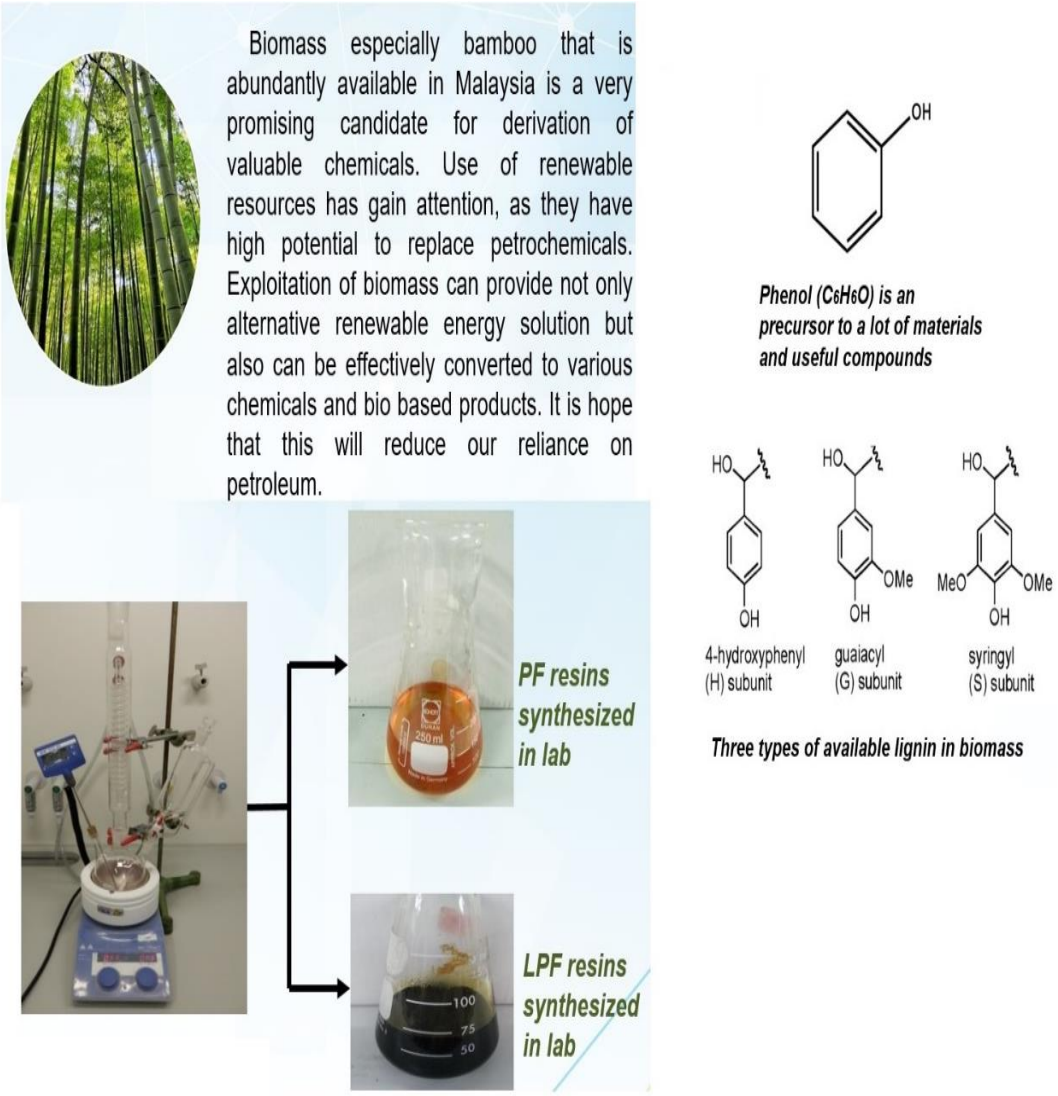


9.2.4 Effect of growth times on the physical and mechanical properties of hydrophobic and oleophilic silylated bacterial cellulose membranes

Bacterial cellulose is an extracellular natural byproduct of the metabolism of various bacteria. Its physical and mechanical properties were determined by growth period, method of cultivation either static or agitate, fermentation condition and medium. This paper presented works done on the effect of culture time on the physical and mechanical properties of silylated bacteria cellulose membranes. Bacterial cellulose (BC) growth under 4, 5, 6 and 7 days had been used as a natural reinforcement material and silane as a hydrophobic coating material. With extended culture time, the tensile strength and tensile modulus were increased linearly as result of more compact structure. Due to hydrophobic properties of silane, the water absorption and thickness swelling improved correspondingly. Contact angle testing using three different liquid proven the functionality of silane as hydrophobic and oleophilic coating agent. The experimental results suggested that hydropobic and oleophilic silylated bacteria cellulose membranes with controlled growth time could be prepared and regarded as a reusable oil spills membrane.

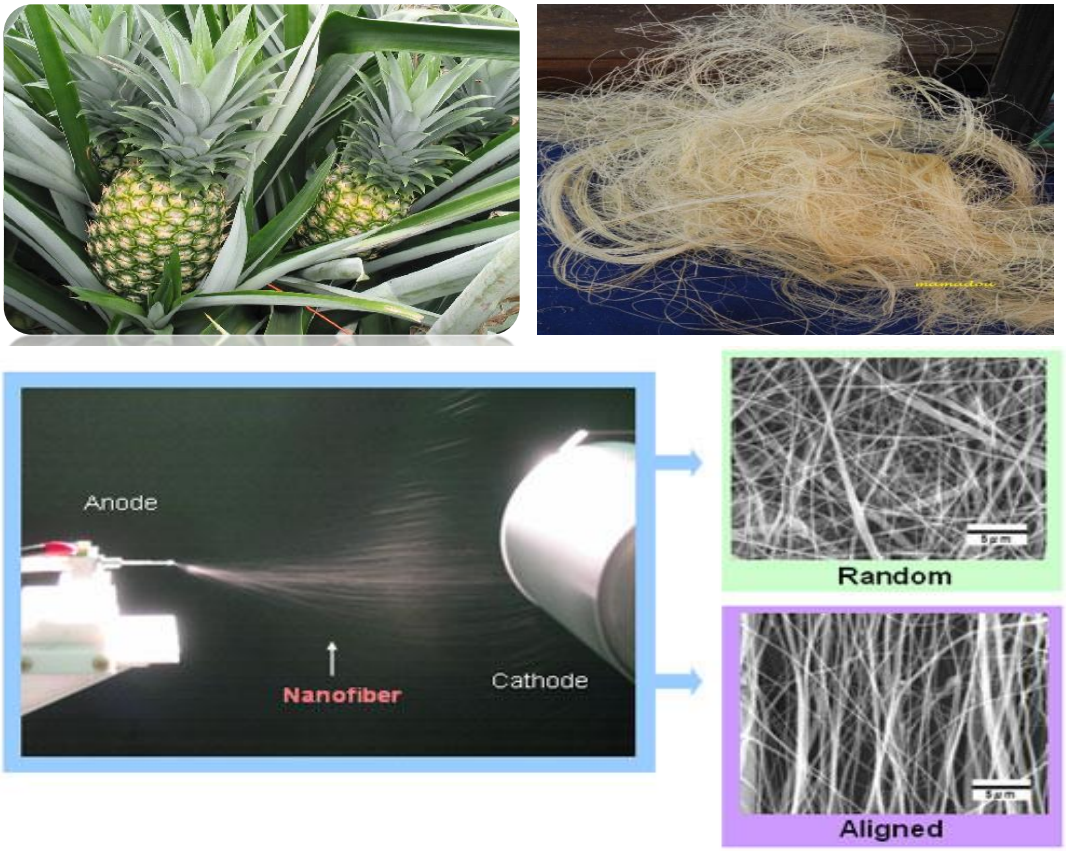


9.2.5 Green Phenolic Resins from Bamboo



9.2.6 Electrospinning Of Pineapple Leaf Nanofibers (PALF)

Electrospinning technique provides a straightforward and highly versatile method for processing polymer solutions into continues fibers with diameters ranging from a few micrometers to a few nanometers (*R.P.O Santos et al.,2015*). In this study, mats of nanofibers were prepared via electrospinning method. Lignocellulosic pineapple leaf fibers (PALF) were dissolved in trifluoroacetic acid (TFA) solutions. Optimum ratios of PALF were studied.



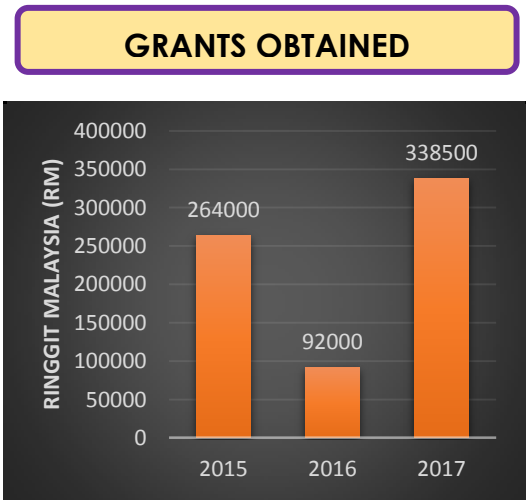
9.3 Group Information

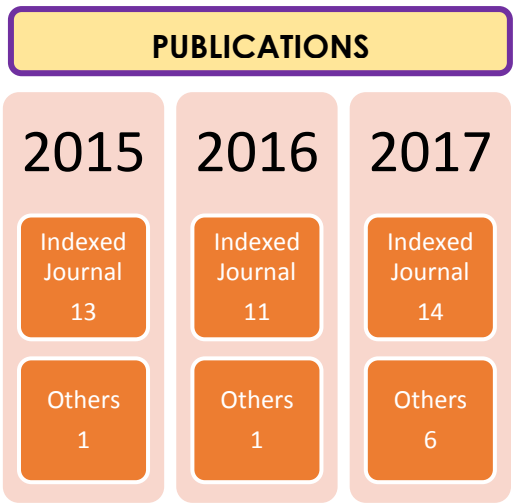
Name of RIG	NANOCOMPOSITE MATERIALS AND INDUSTRIAL APPLICATIONS RESEARCH GROUP
Leader	Dr Mohd Nazarudin Zakaria
Tier	5
RIG Code	CoRe81/T5/2015(15)/FMIA(11)
Registration Year (Senate Approval)	2015
UiTM Niche Area	INDUSTRY 4.0
RIG Niche Area	Nanocomposite , nanomaterials, Synthesis of nanomaterial & nanofibre, Wood composites., Polymeric Materials,Materials Science, Advanced Materials, Bacteria cellulose , Material Processing & instrumentation ,

	manufacturing products.

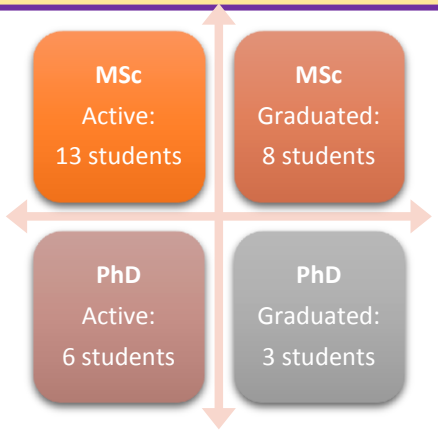
9.4 Background of Members

9.5 Achievement (2015-2017)





POSTGRADUATE SUPERVISION



AWARDS AND RECOGNITION

Design Competition	• 2017 (-) • 2016 (2 Gold) • 2015 (3 Gold)
Thesis Examiner Judge &	• 2017 (36) • 2016 (29) • 2015 (22)

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10.0

NANO-ELECTRONIC (NET) RESEARCH

Mohamad Hafiz Mamat, Ahmad Sabirin Zoolfakar, Zurita Zulkifli, Shafinaz Sobihana Shariffudin, Puteri Sarah Mohamad Saad, Norulhuda Abd Rasheid, Uzer Mohd. Noor, Mohamad Fariz Mohamad Taib

10.1 Introduction

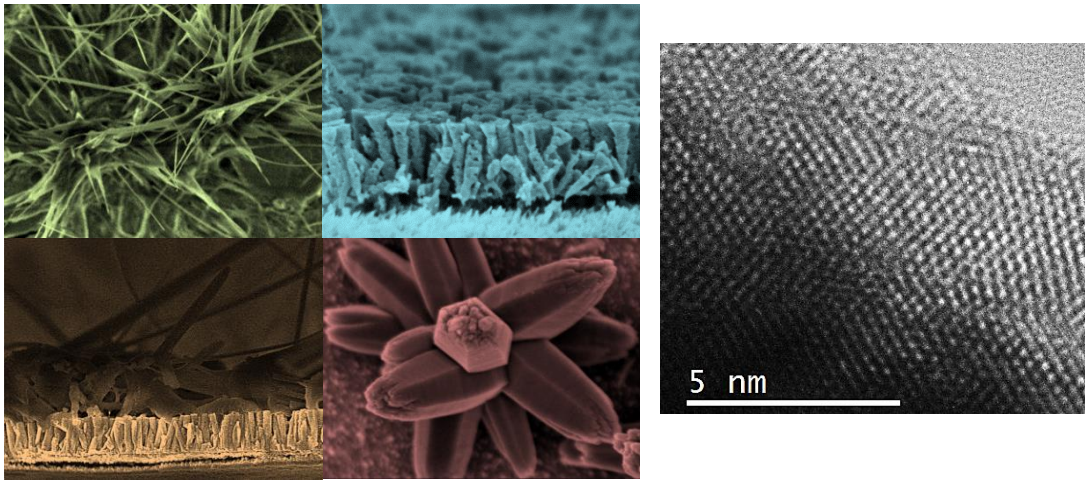
Niche Area: Nanoelectronics

- Optical sensors (UV and Vis sensors)
- Humidity sensors
- Gas and chemical sensors (oxygen, ethanol, etc)
- Solar cells (DSSC, organic solar cells)
- Nanometal oxide related research (ZnO, CuO, NiO, NbO, TiO2, etc)
- Nanocarbon and polymer related research (graphene, CNTs, amorphous carbon,etc)

10.2.1 Research Highlights

10.2.2 Novel Heterogeneous Zinc Oxide/Tin Oxide Nano-Array Films: Towards Development of Facile and High Quality Humidity Sensors

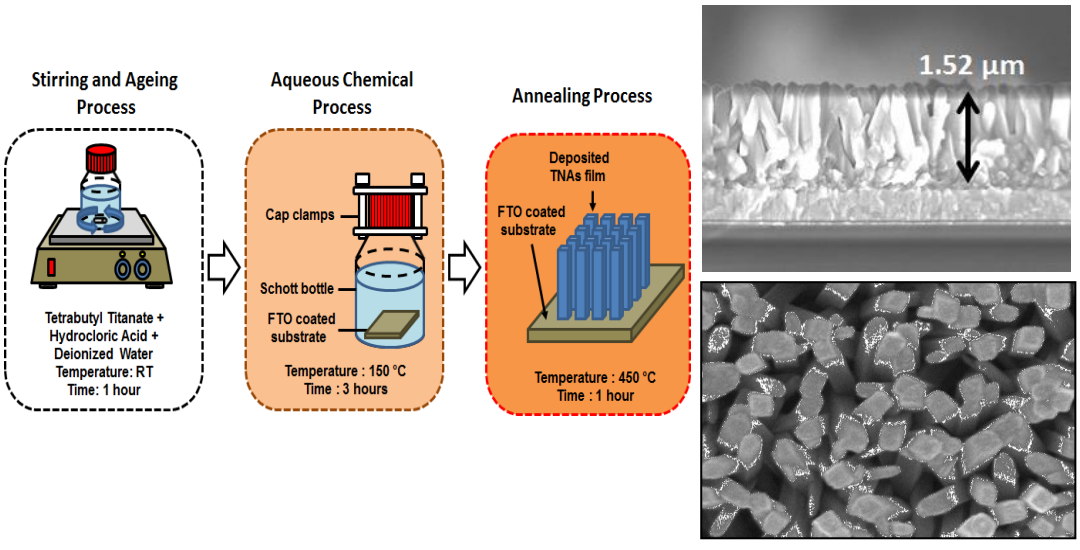
Humidity sensors have been widely fabricated because of their broad applications in meteorology, health science, food science, and agriculture. Uncontrollable amount of humidity level in ambient can bring damages to many equipment and devices. This will cost a lot for the maintenance and repairing process. Thus, a good humidity sensor is required to control the humidity level. Low surface area, high surface defects, and poor electron mobility induced poor performance of humidity sensor. Hence, we invented highly sensitive humidity sensor comprising of zinc oxide (ZnO)/tin oxide (SnO_2) nanocomposited arrays as the sensing membrane using a facile sol-gel immersion method. Besides the simple and low cost process, this immersion method involved a use of very low deposition temperature (95 °C), yet producing high quality film. Zinc oxide (ZnO) and tin oxide (SnO_2) are semiconducting materials which meet the criteria needed by the current semiconductor devices industry. They are known to be abundantly available in nature which ensures the availability of the materials source. Excellent properties possess by ZnO and SnO_2 such as non-toxicity, highly sensitive, and low cost make them very important to the device fabrication.



Structural images of the sensors

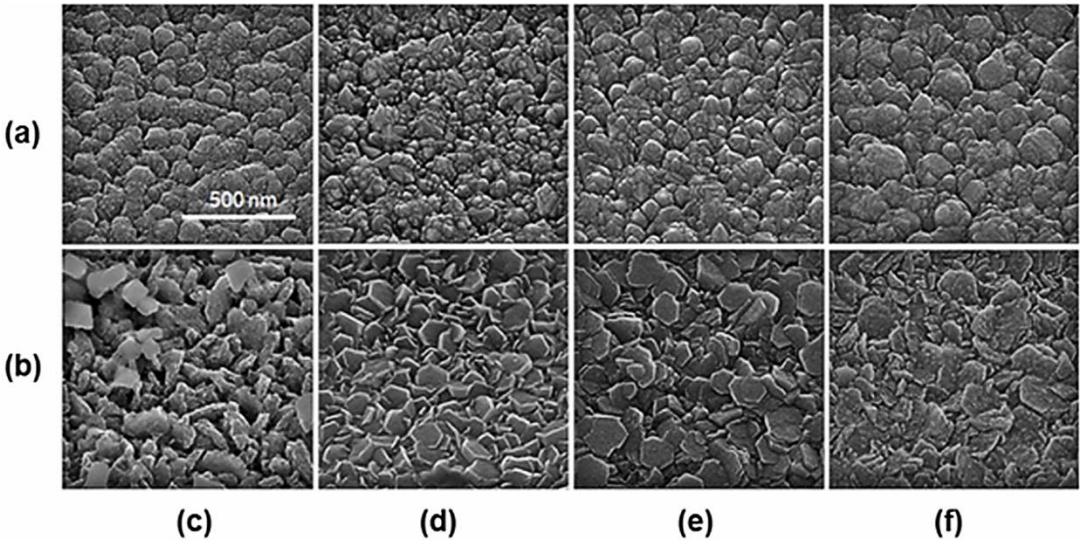
10.2.3 Self-Biased UV Photosensor Composed of Titanium Dioxide Nanorod Arrays Fabricated by Facile One-Step Aqueous Chemical Process

Ultraviolet (UV) monitoring is extremely important and extensively used in various applications such as phototherapy treatment, flame detection, environmental monitoring and others. Therefore, a reliable UV photosensor is required to monitor the UV level. However, most conventional sensors require an external supplies, which prominently reduced the independency and mobility of the sensing system. Furthermore, energy supply has becoming one of the great challenges for the large-scale area applications. Hence, we designed a self-biased photoelectrochemical cell (PEC)-based UV photosensor composed of titanium dioxide (TiO2) Nanorod Arrays (TNAs) fabricated by facile aqueous chemical process. Besides the simple and low cost method, this aqueous chemical process involves the use of low deposition temperature (<150 °C), yet producing a high quality film. TiO2 is intrinsically prone to UV irradiation, which makes it applicable for the application. It is widely used material in present industries and abundantly available in nature. Excellent structural, optical and electrical properties of TiO2 make it excellent for the fabrication of PEC-based device system.



10.2.4 Engineering and Tuning Transition Metal Oxides via Electric Field Driven Technique

Transition metal oxides are functional materials that offer a large number of applications in various areas, owing to their diverse properties including their versatile electronic band structure, optical, electrical, magnetic, mechanical and thermal specifications. However, these properties should be adjusted to enhance functionalities of such transition metal oxides for each specific application. Engineering and tuning transition metal oxides syntheses' parameters such as changes in the temperature and pressure, the incorporation of seeds or templates, nanostructuring and introducing foreign atoms or molecules *via* doping or intercalation as well as applying electric, mechanical, optical and/or magnetic fields, provide pathways for the enhancement in their functionalities.The interest in engineering and tuning procedures has been fuelled by the recent advances in advanced synthesis processes, which now allow better control over the electronic structure, crystallinity, morphology, and stoichiometry of the transition metal oxides. Such abilities have led to newer opportunities in disciplines as diverse as physics, chemistry, biology, medicine and engineering. Currently, NET's researcher have conducted several experiments by employing "nanostructuring" as the core method for tuning and engineering transition metal oxides which uses for the development of model sensors, solar cells and storage devices with enhanced properties. Nanostructured transition metal oxides can potentially offer remarkable mechanical, electrical, magnetic, thermal and optical properties, in comparison to their bulk counterparts, endowed by confining the dimensions to nano size ranges.

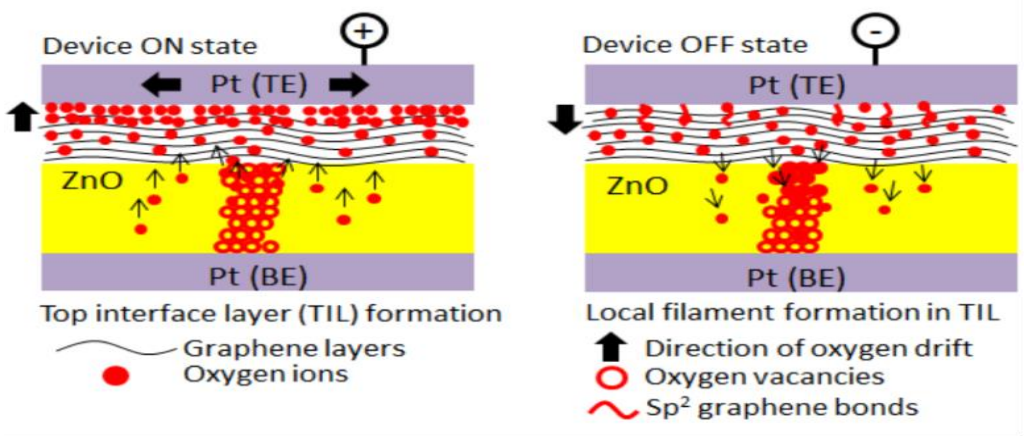


SEM images of the surface of ZnO samples (a, c-f) RF sputtered, (b, c-f) electrodeposited under various sputtered powers, (c) 60 W, (d) 80 W, (e) 100 W and (f) 110 W. Scale bars are similar for all figures.

10.2.5 Transfer of Opaque Liquid Graphene onto Substrate for Transparent and Large Area Graphene Film Using Low Temperature Water Bath for Memristor Application

This research demonstrates the transfer of graphene in water solution to a thin film at low temperature using water bath. Graphene in water solution (highly opaque) was transferred onto Platinum/Glass (Pt/Glass) substrate and also on ZnO film with the unique technique that not involves any additional chemicals. The

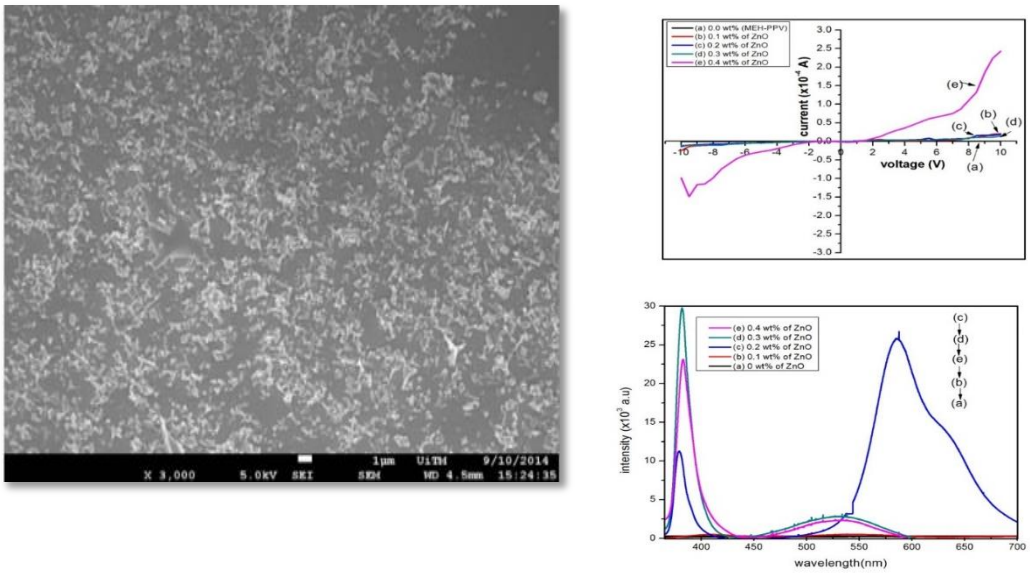
transferred graphene is characterized using FESEM, Raman spectroscopy and I-V measurements. Raman spectra and FESEM images show the thin film exhibited multilayers graphene on ZnO surface. The multilayer graphene is highly transparent as the ZnO surface morphology can be observed underneath the graphene layer. This transfer method enables us to transfer graphene onto ZnO thin film for memristive devices. Without a layer of graphene film on ZnO, the hysteresis loop of pristine ZnO memristor easily degraded and the resistance ratio dropped more than 50% after several time repeating the ON and OFF state. This condition leads to the unstable switching cycle. Our finding shows, the graphene on ZnO film improved the stability switching cycle for a memristor device. The insertion of graphene can limits atomic diffusion, altering the oxygen vacancy interactions between metal and insulator and thus helped increase the endurance and improving the stability of the device. During the ON state, positive voltage attracts the oxygen ions within the oxide bulk to the top electrode (TE), leaving behind oxygen vacancies that form the conductive filament (CF). As the voltage becomes higher, more ions accumulate at the TE, leaving behind enough oxygen vacancies to form a complete CF throughout the oxide bulk. The ions are trapped at the Graphene layer and are unable to interact with the TE. Due to the high mobility of Graphene, the ions move laterally to form sp2 bonding with the Graphene surface. During the OFF state, negative voltage is applied to the TE, pushing the ions back into the oxide bulk. The high electric field is able to overcome the energy of sp2 bonding, freeing the ions from Graphene. The ions recombine with the oxygen vacancies to form a neutral oxide. During this cycle and coupled with Joule heating, the CF becomes disconnected, giving rise to the high resistance state of the device.



10.2.6 MEH-PPV: ZnO nanocomposite thin film for OLEDs application

Incorporating inorganic nanostructures into organic optoelectronic devices has been growing in the past few years. The instability of organic material is an important issue faced by the organic device caused by the degradation and low conductivity due to high operating voltage of OLEDs device. In this research, nanocomposite organic-inorganic thin film was studied by incorporating ZnO nanotetrapods in MEH-PPV solutions. The growth of the ZnO nanotetrapods has been studied in order to synthesis uniform ZnO nanotetrapods by varying its evaporation temperature and gas flow rate using double furnace thermal chemical vapor deposition (CVD) method. It can be seen that the ZnO nanotetrapods has good electrical properties that can transport the electron efficiently in the

nanocomposites thin film. The deposition of ZnO nanotetrapods has been embedded into the MEH-PPV polymer matrix. Furthermore, the optimum parameter for ZnO nanotetrapods and MEH-PPV deposition was selected and used to fabricate MEH-PPV: ZnO nanocomposites thin film using the spin coating method. This condition was achieved by preparing ZnO nanotetrapods weight composition of 0.2 wt% in MEH-PPV solutions that produced a smaller length of ZnO nanotetrapods (~600 nm) and highest conductivity 7.40 x 10^{-1} S. cm^{-1}. The ZnO weight composition of 0.2 wt% showed highest visible emission due to high energy transfer from particle to the polymer. The MEH-PPV: ZnO nanocomposites thin film improved the performance of electrical properties compared to a single layer of MEH-PPV thin film for OLEDs application.



10.2.7 Nanocomposite P3HT: Graphene thin film for organic solar cell applications; TiO_2 thin film for optical sensor; SnO2thin film for water quality sensor

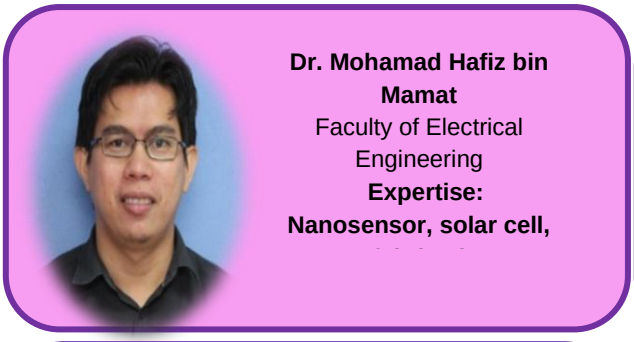
Our group carried several studies involving oxide material and carbon material with polymer by sol-gel dip coating technique and spin coating technique respectively. On the part for graphene and P3HT polymer, the studies investigates the performance of P3HT:Graphene nanocomposite thin film. The active layer was than being used in organic solar cells. The main work done was to increase the electron mobility. Low electron mobility is recognizing as the main factor that contribute to low efficiency organic solar cells. Therefore, the scope of this research is mainly to improve the photocurrent by increasing the electron mobility. Hall effect measurements has been done and proves that electron mobility increases in P3HT:Graphene nanocomposite. The current also improves as the electron mobility improves. Meanwhile, we also did research on TiO_2 as the sensing membrane in optical sensor. The main scope of TiO_2 as the sensing membrane focus on the application to study the oil quality where we got to know whether the used cooking oil is a new or a recycle cooking oil. This can be monitor by analyzing the wavelength shifting using UV-Visible spectrometer. Besides that, we also have group using SnO_2 to check the water quality. The water quality involves whether the water contains more chlorine and rusk. The sample of water is only from domestic water. The reason why we are doing this research due to now we have low water quality level and the installation of filter is quite expensive.

All these researches (organic solar cells, optical sensor and water quality sensor) done are expected to give benefit to human kind.

10.3 Group Information

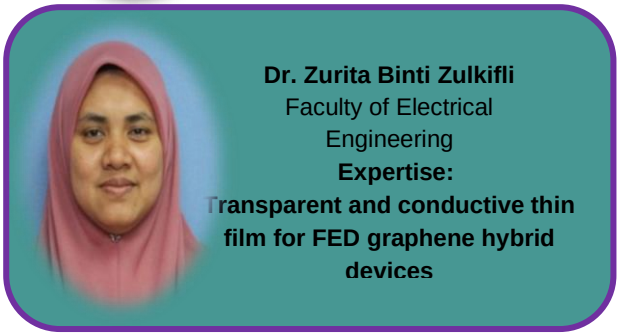
Name of RIG	NANO-ELECTRONIC (NET) RESEARCH GROUP (Nano-elctronic NETRG)
Leader	Dr. Mohamad Hafiz bin Mamat
Tier	5
RIG Code	CoRe89/T5/2015(24)/FMIA(13)
Registration Year (Senate Approval)	2015
UiTM Niche Area	Advanced Manufacturing & Automation
RIG Niche Area	Nanoelectronics Research on nanoelectronics, nanofabrication, and advanced electronic nanomaterials .

10.4 Background of Members



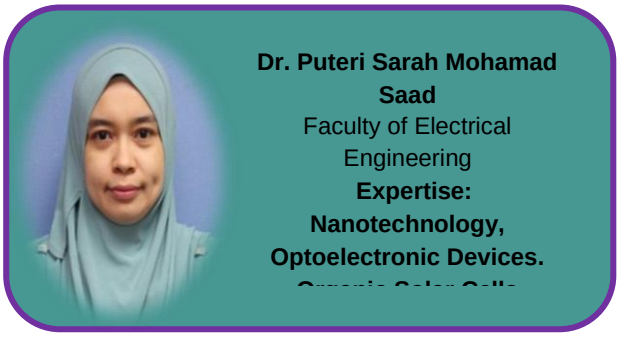
Dr. Mohamad Hafiz bin Mamat
Faculty of Electrical Engineering
Expertise:
Nanosensor, solar cell,

Dr. Ahmad Sabirin bin Zoolfakar
Faculty of Electrical Engineering
Expertise:
Sensor, Nanotechnology, Solar Cells, Memristor

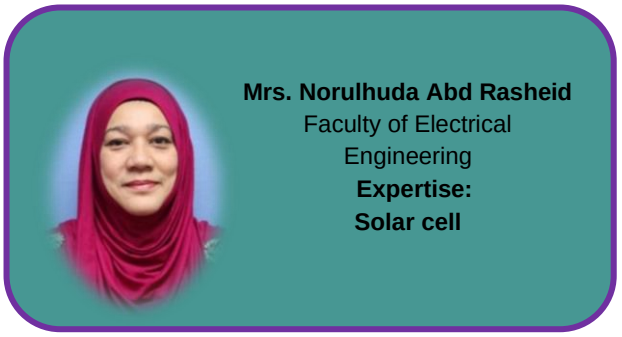


Dr. Zurita Binti Zulkifli
Faculty of Electrical Engineering
Expertise:
Transparent and conductive thin film for FED graphene hybrid devices

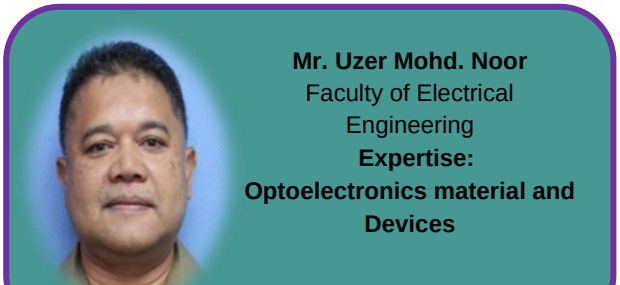
Dr. Shafinaz Sobihana Bt Shariffudin
Faculty of Electrical Engineering
Expertise:
Organic LED, Thin Film, Fabrications Nanoelectronics



Dr. Puteri Sarah Mohamad Saad
Faculty of Electrical Engineering
Expertise:
Nanotechnology, Optoelectronic Devices.



Mrs. Norulhuda Abd Rasheid
Faculty of Electrical Engineering
Expertise:
Solar cell

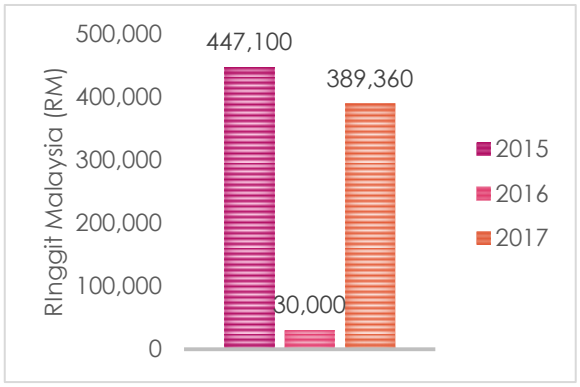


Mr. Uzer Mohd. Noor
Faculty of Electrical Engineering
Expertise:
Optoelectronics material and Devices

Dr. Mohamad Fariz Bin Mohamad Taib
Faculty of Electrical Engineering
Expertise:
Nanomaterial Computational Analysis

10.5 Achievement (2015-2017)

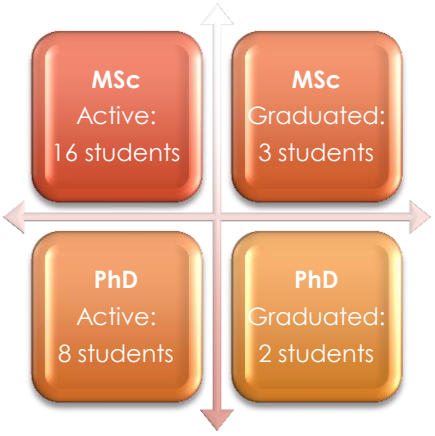
GRANTS OBTAINED



PUBLICATIONS

2015	2016	2017
Indexed Journal 49	Indexed Journal 64	Indexed Journal 36
Others 26	Others 2	Others 4

POSTGRADUATE SUPERVISION



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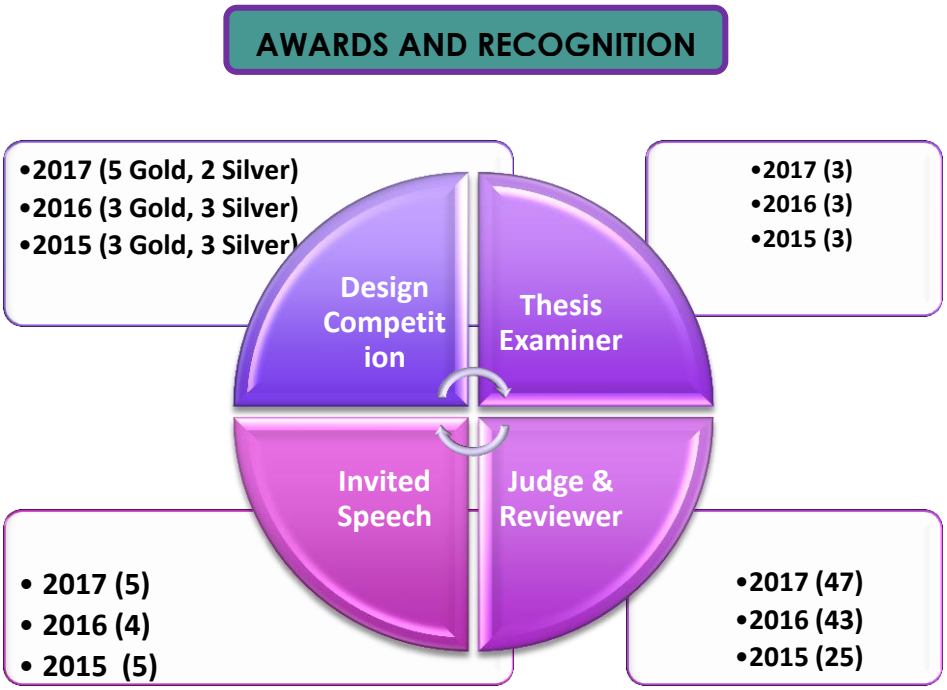


11.0

FRACTURE MECHANIC & MATERIALS INTEGRITY RESEARCH

Aidah Jumahat, Zuraidah Salleh, Anizah Kalam, Koay Mei Hyie, Nik Rozlin Nik Mohd Masdek, Mardziah Che Murad, Shahriman Zainal Abidin

11.1 Introduction

Fracture Mechanics and Materials Integrity research group is formed to foster research on behavior, deformation, damage and failure of engineering materials when subjected to various types of loading and conditions.

Many activities emphasize on the following areas:

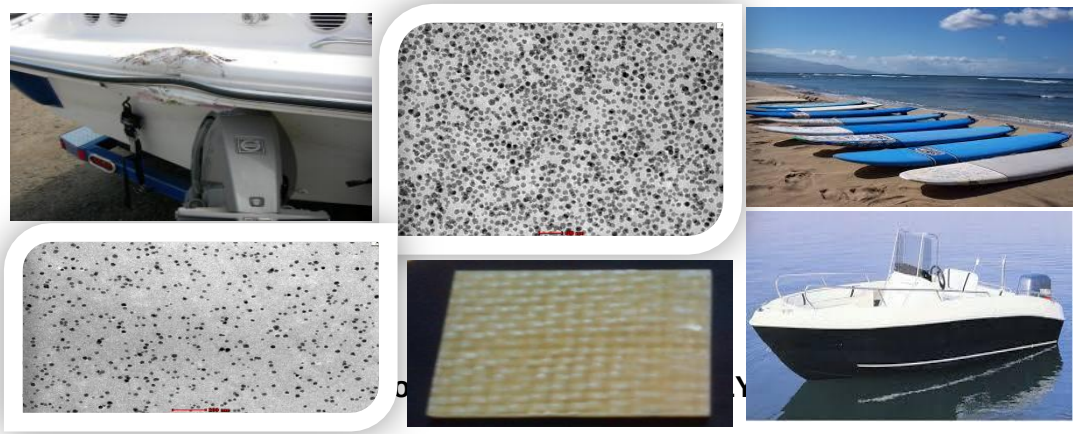
1. Design and analysis of mechanical structures and machine elements based on experimental, mathematical modeling and simulation
2. Development of new materials, high-strength light-weight components and structures
3. Integration of materials properties and their applications in real engineering and manufacturing industries including automotive, railway, aerospace and marine

Knowledge and technology transfer to clients includes guidelines, software, action plans, problem solving and industrial designs.

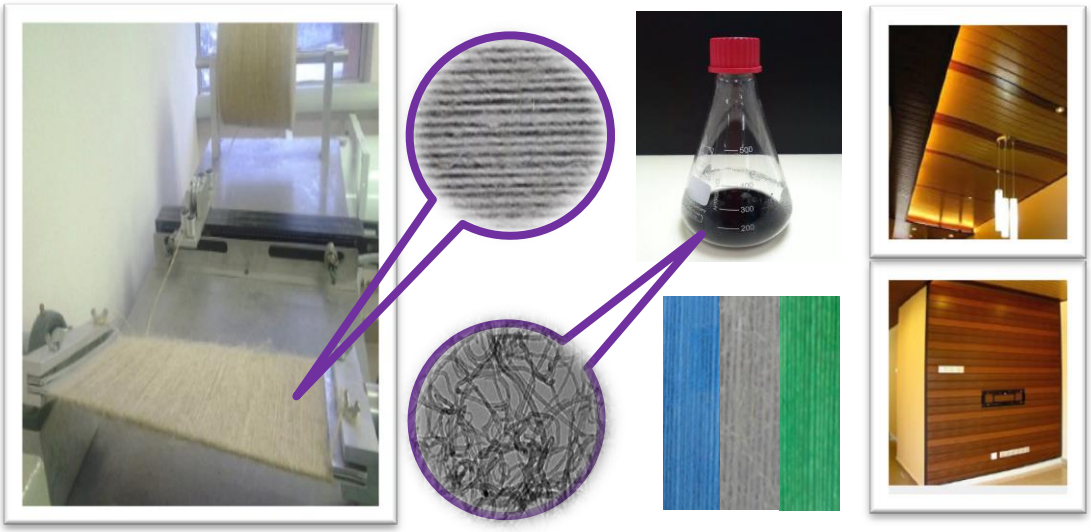
11.2 Research Highlights

11.2.1 Fibre Nano-Hybrid

Damage resistance and tolerance of fibre reinforced polymer (FRP) composites is one of the most important properties to be considered during structural design process. In this research, a new composite material consists of glass fibre was hybridized with Kevlar fibre as reinforcement materials. The matrix epoxy resin system was modified by incorporating nanosilica into the resin system. Combination of glass fibre and Kevlar fibre produces a good impact resistance, high strength and lightweight materials. In future, this new composite material will be used in marine application such as boat hull which this application requires high damage resistance and tolerance properties.



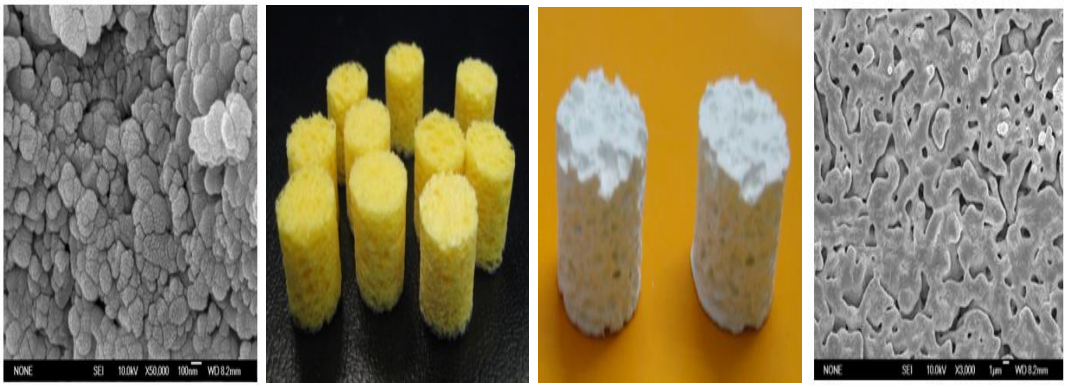
Due to environmental awareness and sustainability concept, kenaf fibre has been considered as reinforcement in polymer based composites. However, kenaf fibre possesses low mechanical and high moisture absorption properties. This limits its usage to low stress application and secondary structures only. Therefore, the modification of matrix by incorporating carbon nanotube (CNT) is an effective way to overcome this problem. In future, this new composite material will be used in buildings and constructions application.



11.2.3 Porous **Strontium Doped Hydroxyapatite (SrHA)**

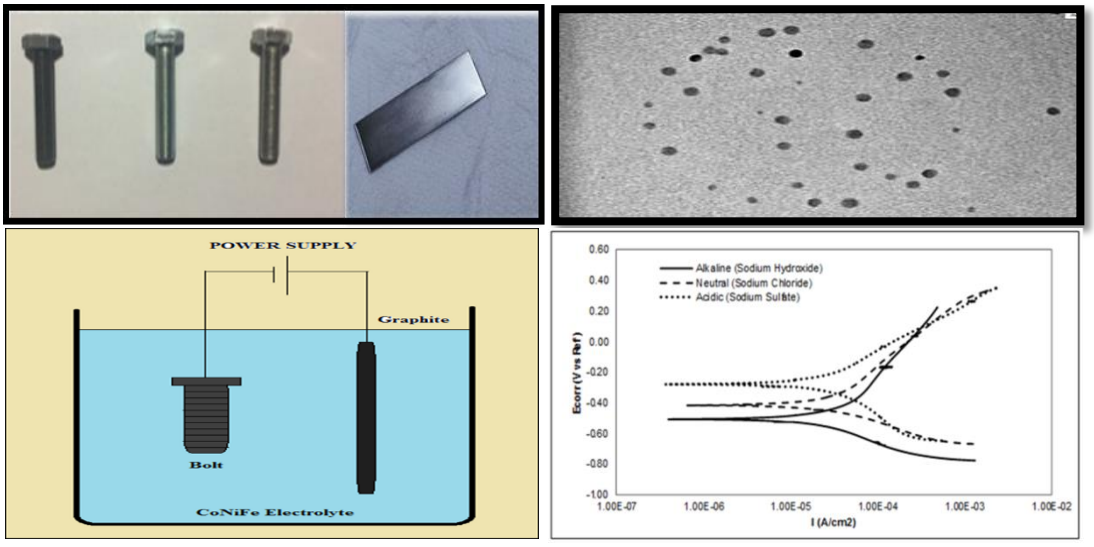
For tissue regeneration in medicine, three-dimensional scaffolds with specific characteristics are required. These scaffolds are expected to have good interconnection between pores, biocompatible and controllable degradation rate to promote bone ingrowth and to support bone-cell attachment. In this study, strontium doped hydroxyapatite (SrHA) porous bodies were fabricated by using

polymeric sponge method. Polymeric sponge was chosen as a porous template because it owns the characteristic of partly hydrophilic which allows it to adhere with water based slurry which contains SrHA. To prepare the porous samples, the synthesized SrHA nanopowders were mixed with distilled water and appropriate amount of dispersing agent followed by drying in the ambient air and sintering at 1300°C. Morphological evaluations by FESEM measurement revealed that the SrHA scaffolds were characterized by macro-micro interconnected porosity, which replicates the morphology of the cancellous bone.



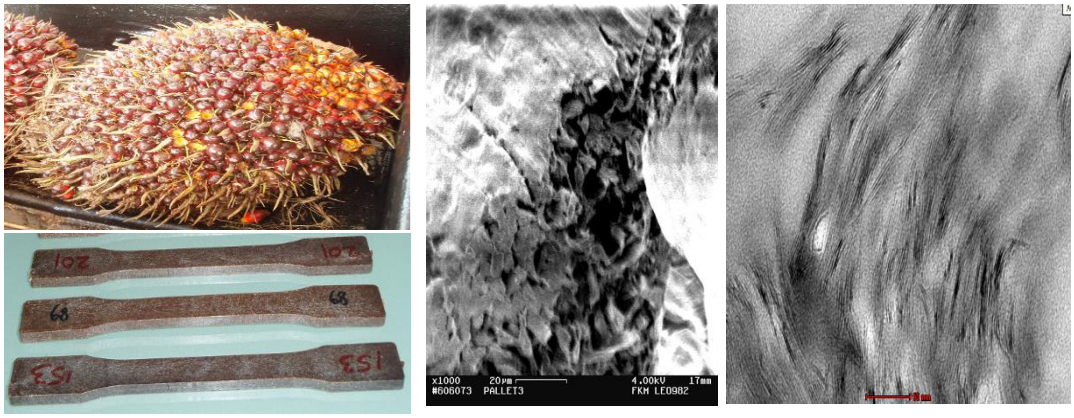
11.2.4 Co-Ni-Fe coated steel

Coating is one of the economic and long lasting solutions to protect the steel from corrosion. Coating can improve the lifetime of the material by two to ten times if compared to original material. The objective of this project is to coat steel with Co-Ni-Fe nanocoating using electrodeposition method. Corrosion and wear testing were carried out revealing good performances of Co-Ni-Fe coated steel. The corrosion rate is less than 0.003 mm per year. The wear loss of coating is less than 5% after 12 hours slurry wear test. Hence, the new Co-Ni-Fe nano-coating has the potential to replace the established chromium coating as a green and non-toxic corrosion protection layer. The Co-Ni-Fe coated steel has been proposed for potential application in bolt, coupling and wear resistant parts and suitable to be used in alkaline environment. The Co-Ni-Fe coating can be applied in all industries using steel parts even at high temperature environment. The benefit of Co-Ni-Fe coating is to enhance the corrosion and wear protection thus prolong the lifespan of the steel parts.



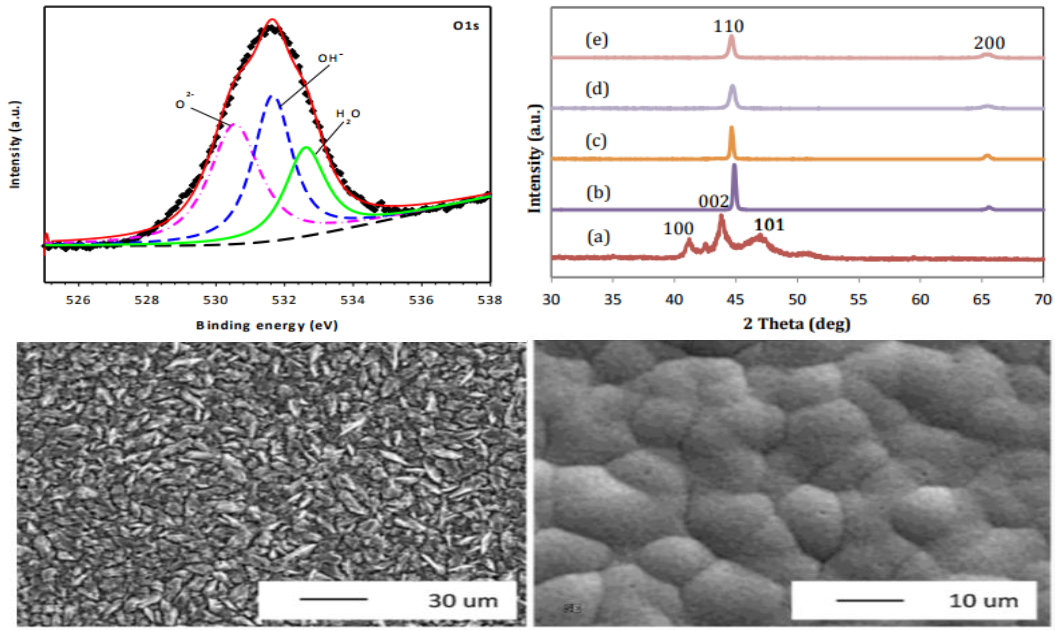
11.2.5 Clay modified- Oil Palm Fruit Bunch (OPFB) Composite

Natural fibres have attracted the interest of material scientists, researchers, and industries because of their specific advantages as compared to conventional or synthetic fibres to be used as reinforcement or filler in composites. Several attempts have been successfully done to enhance the mechanical properties by treating the fibres to improve the bonding. This research investigates the use of clay polymer nanocomposites as the matrix to improve the mechanical properties of OPFB composites, besides the adoption of fibre treatment.



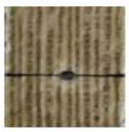
11.2.6 Nanocystalline Cobalt-Iron (CoFe) Alloys Coating

Nanocrystalline materials with grain sizes less than 100 nm, have attracted considerable attention due to their enhanced properties as compared to their polycrystalline counterparts. However, investigation on the corrosion resistance of these materials is still lacking. In order to further expand their future applications, their corrosion behaviour is of great importance. Hence, in this study, nanocrystalline Co and CoFe alloy coatings were prepared through the electrodeposition process and their electrochemical corrosion behaviour were investigated. Depending on the environment, the effect of the nanocrystaline grain sizes as well as Fe alloying resulted in different corrosion responses. A decrease in grain size was observed with an increase in iron concentration that also leads to a change in crystal structure from HCP to BCC phase structure. In This study, the corrosion properties of these electrodeposited nanocrystalline Co and CoFe alloy coatings were also studied in solutions ranging from acidic to alkaline.



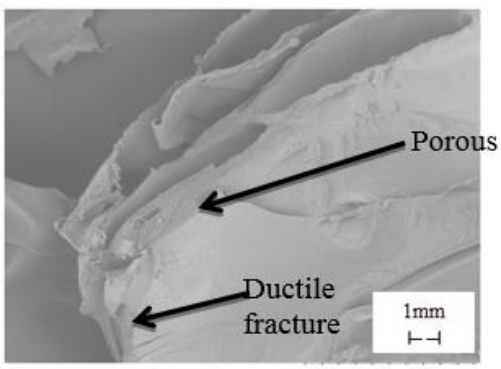
11.2.7 Hybrid Natural-Synthetic Fibres Composites

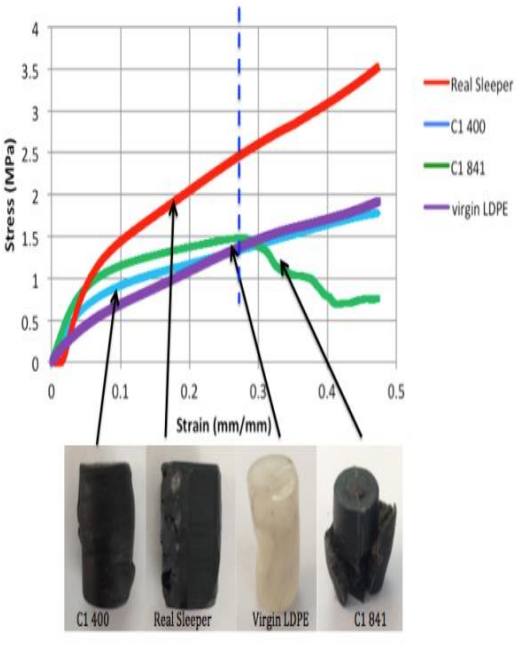
Hybridization of natural long kenaf fibre with woven fibreglass provides an alternative way to reduce the usage of non-renewable and toxicity man-made synthetic fibres. Besides that, the advantages of kenaf fibre that are environmental friendly, low cost, light weight and high availability in Malaysia can be used as one of great reinforcement material for this hybrid composite. Therefore, this study involved investigation of impact resistance of this hybrid composites with unsaturated polyester matrix resin through special built falling weight test.

Impact	2J	4J	6J	8J	16J
Before					
After					

11.2.8 Kenaf Composite Material For Railway Sleeper Application

Railway transportation is one of the public transports that are mainly being used in Malaysia. Thus, the need of railways is also increased to meet the target. A railway sleeper is a rectangular support for the rails in railroad tracks. The sleeper used now is shipped from the KLP Company based in Netherlands. Since Malaysia currently does not produce enough sleepers, the government needs to import the sleeper from the other country. In this project, a new composite based on natural fibres has been developed as alternative materials to produce railway sleeper.





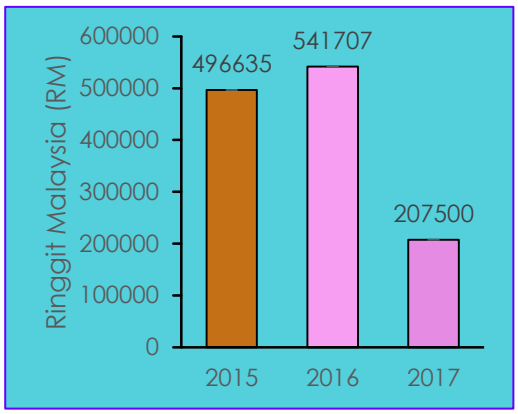
11.3 Group Information

Name of RIG	Fracture Mechanics & Materials Integrity (FMMI)
Leader	Assoc. Prof. Dr. Aidah Jumahat
Tier	5
RIG Code	CoRe108/T5/2016(13)/FMIA(17)
Registration Year (Senate Approval)	2016
UiTM Niche Area	Advanced Manufacturing & Automation
RIG Niche Area	Materials Integrity & Failure Analysis Research on integrity and failure mechanisms of advanced materials subjected to various types of loadings and conditions.

11.4 Background of Members

11.5 Achievement (2015-2017)

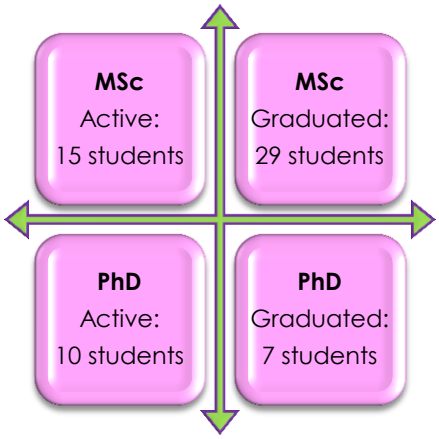
GRANTS OBTAINED



PUBLICATIONS

2015	2016	2017
Indexed Journal 37	Indexed Journal 6	Indexed Journal 16
Others 5	Others 6	Others 2

POSTGRADUATE SUPERVISION



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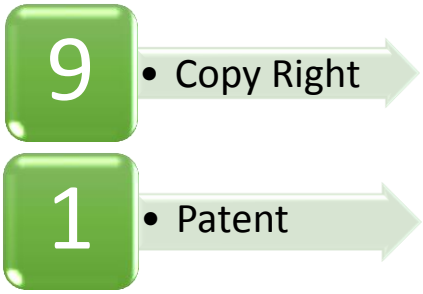
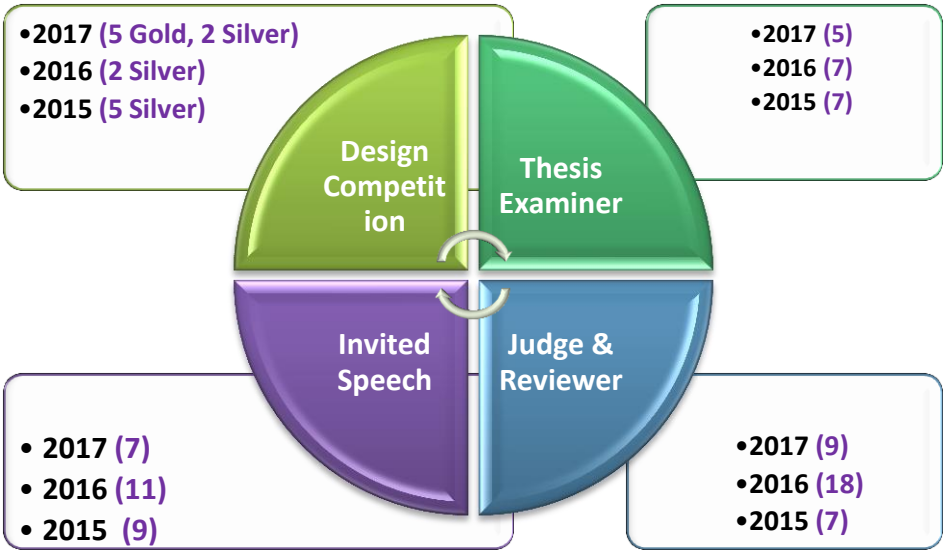


AWARDS AND RECOGNITION



12.0

BIOMECHANICAL & CLINICAL ENGINEERING (BIOMEC)

Jamaluddin Bin Mahmud, Soleuddin Bin Shuib, Muhammad Fairuz Bin Azmi,, Mohd Afzan Bin Mohd Anuar, Addul Halim Bin Addullah, Nor Fazli Bin Abdull Manan, Sharul Hiyam Bin Marwan

12.1 Introduction

Biomechanical and Clinical Engineering is formed to encourage multidisciplinary research on mechanical engineering and medical physics. The research activities involve mechanical/clinical testing, analytical equations, modeling and computer simulation, and also development of medical support prototype and components. This section also integrates the perspectives of applied mechanics and materials science to solve practical and biomechanics problems based on clinical experiences and industrial demands.

Many activities call attention on the following areas:

- Development of new design of medical support components which minimized the shortcomings as identified by surgeons and medical physician.
- Synthesis, processing, fabrication, machining, testing and modeling of engineering materials and medical support components
- Integration of engineering design and potential medical applications.
- Knowledge and technology transfer to researchers and clients includes guidelines, software, problem solving and innovation of design.

12.2 Research Highlights

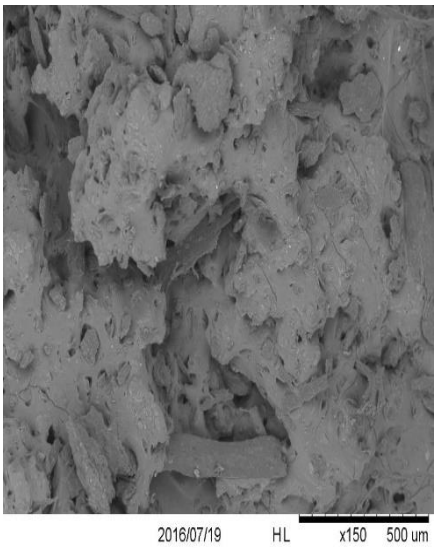
12.2.1 Development of a low cost portable motion capture-analysis system for modified RULA (MRULA)

Computer is now one of the common office tools associated with daily job activities. The usage of computer for a long period and with poor postures would cause several upper limb disorders. **Upper limb disorders (ULDs)** can be defined generally as injuries or disorders that affect the human body and musculoskeletal system. It has been a significant and costly health problems among the working population during the past decades. One of ergonomic approach is using survey method to evaluate the level of ergonomic risk by observation of participants' posture while they were working. Several survey methods such as the **Rapid Upper Limb Assessment** (RULA). **Rapid Entire Body Assessment** (REBA), and **Rapid Office Strain Assessment** (ROSA).RULA then has undergone modification for the computer use only, called RULA for computer use (mRULA. The research objective is to assemble a simple and low cost motion capture-analysis system prototype with reasonable accuracy (FJ Sense) by integrating Kinect and MATLAB.

Infra-red Motion Capture System (VICON)

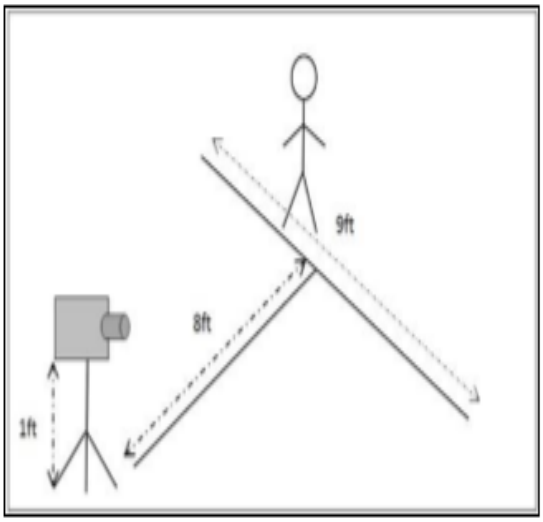
12.2.2 APSil: Arenga Pinnata-Silicone BioComposites

Due to increase awareness on environmental issues especially global warming that leads to rapid melting of ice in the Arctic, researches on seeking alternatives to replace man-made fibres in composite materials have been rapidly discovered. Therefore, the project introduces the employment of natural fibres called Arenga pinnata (Figure 1) as the filler in silicone rubber (Figure 2). The purpose of adding filler in silicone rubber benefits in terms of the stiffness property. Besides that, compare to synthetic fibres, natural fibres can be obtained at a very low cost with low density. They are also abundant in nature which made them easy to be obtained. This material is now readily used and for sale. Nevertheless, the project is still on-going for the long-term aim, which is to seek its ability in sealing and cushioning applications specifically in marine, heavy industries and medical sectors.



12.2. 3 Measuring Ankle Angle and Analysis of Walking Gait using Kinovea

Understanding the biomechanics of motion related to human walking gait is important in the area of rehabilitation. Infrared cameras motion capture systems have been widely used. Nevertheless, the system is very expensive and thus alternative solutions are explored. This study is aimed to measure the angle of ankle, knee and hip during walking and then assess the reliabilty of Kinovea in analysing walking gait.



12.3 Group Information

Name of RIG	Biomechanical & Clinical Engineering (BioMeC)
Leader	Assoc. Prof. Ir. Dr. Jamaluddin Mahmud
Tier	5
RIG Code	CoRe125/T5/2016 (30)/FMIA(20)
Registration Year (Senate Approval)	2016
UiTM Niche Area	Advanced Manufacturing & Automation
RIG Niche Area	Research on Biomechanics, Clinical Engineering, behavior, deformation, damage and failure of bioengineering materials and manufacturing products

12.4 Background of Members

Assoc. Prof. Ir. Dr. Jamaluddin Mahmud
Faculty of Mechanical Engineering
Expertise:
Engineering Mechanics & Materials

Assoc. Prof. Dr. Solehuddin Bin Shuib
faculty of Mechanical Engineering
Expertise:
Engineering Mechanics & Materials

Dr. Abdul Halim Bin Abdullah
Faculty of Mechanical Engineering
Expertise:
Engineering Mechanics & Materials

Dr Muhammad Fairuz Bin Azmi
Faculty of Medicine
Expertise:
Anatomy and Tissue Culture

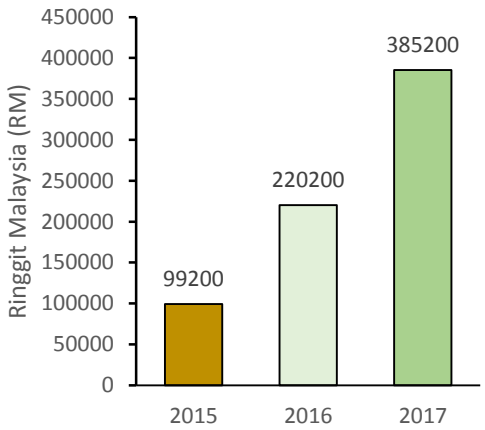
Dr. Nor Fazli Bin Adull Manan
Faculty of Mechanical Engineering
Expertise:
Engineering Mechanics & Materials

Dr. Mohd Afzan Bin Mohd Anuar
Faculty of Mechanical Engineering
Expertise:
Dynamics and Vibration

En. Shahrul Hiyam Bin Marwan
Faculty of Mechanical Engineering
Expertise:
Engineering Mechanics & Materials

12.5 Achievement (2015-2017)

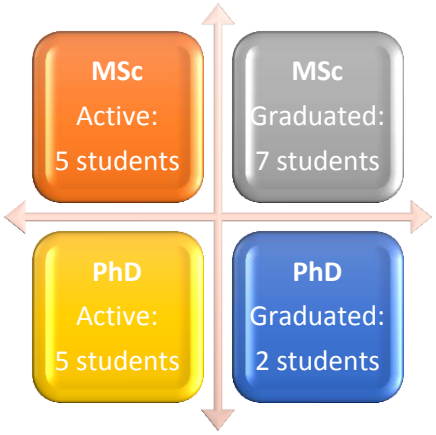
GRANTS OBTAINED



PUBLICATIONS

2015	2016	2017
Indexed Journal 14	Indexed Journal 3	Indexed Journal 9
Others 5	Others 2	Others 2

POSTGRADUATE



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AWARDS AND RECOGNITION

Design Competition	Thesis Examiner Judge Reviewer	Consultation Industrial Linkage Collaboration
• 2017(4 Gold) • 2016(3) • 2015(3)	• 2017(10) • 2016(7) • 2015(6)	• 2017(5) • 2016(2) • 2015(2)

13.0

HYBRID NANOMATERIALS, INTERFACES & SIMULATION

Nor Aida Zubir, Mohamed Syazwan Osman, Abdul Hadi Zainal, Rasyidah Alrozi,
Ahmad Zia Ul-Saufie Mohamad Japeri, Alhan Farhanah Abdul Rahim, Atikah Kadri

13.1 Introduction

Hybrid Nanomaterials, Interfaces & Simulation (HYMFAST) research group is formed to foster research and simulation on the development of hybrid nanomaterials towards sustainable environment and energy.

Activities are emphasize on the following areas:

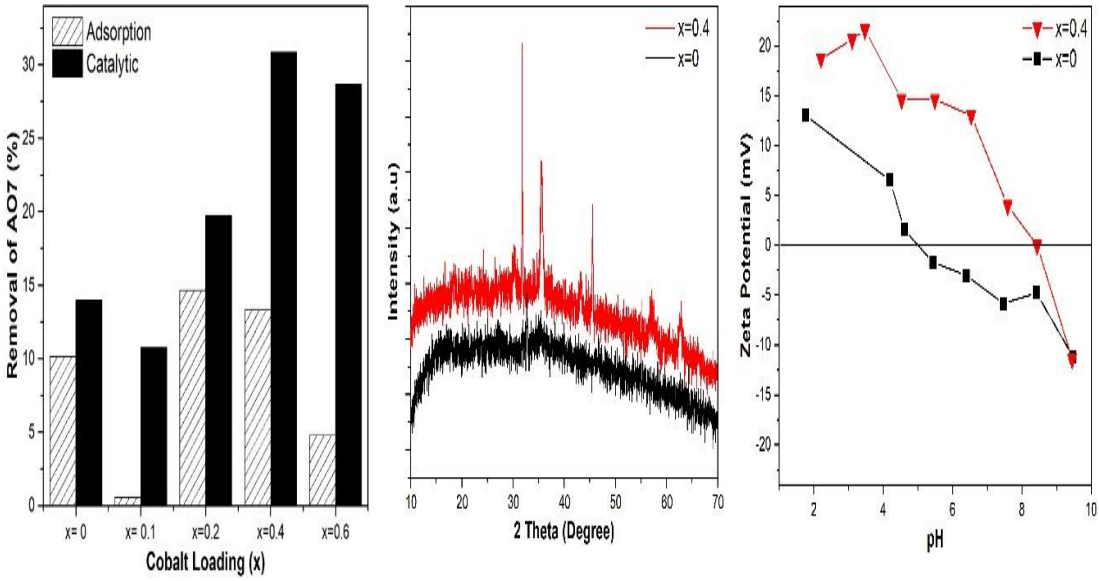
1. Development of new hybrid nanomaterials and its applications towards sustainable environment and energy.
2. In depth fundamental studies of hybrid nanomaterials properties which underlying its behavioral applications.

Modeling the prediction of nanomaterials properties as well as its performance within the domain of framework.

13.2 Research Highlights

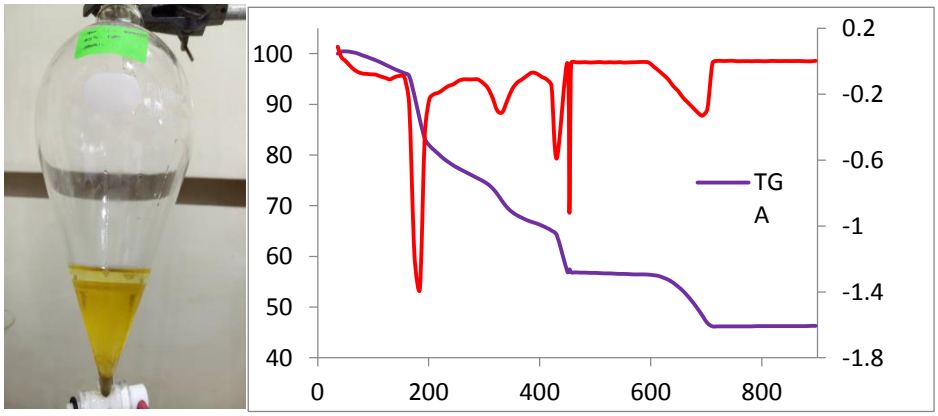
13.2.1 Hybrid nanocatalyst: isomorphic substitution of transition metals into magnetite structure

Oxidation using heterogeneous Fenton and/ or Fenton like reaction has been proven as promising and efficient treatment method for dye degradation by using iron oxide (magnetite) catalyst and hydrogen peroxide as an oxidant. The limitation of this treatment is the lack of recyclability of magnetite as this catalyst continuously loses its activity after a few reaction cycles, thus requiring the addition of a fresh catalyst. Thus, several transition metal cations have been isomorphically substituted into the magnetite structure to enhance its long term catalytic activity as well as its stability. However, details investigation on the synergistic interactions between the substituted metals and the Fe cations in the magnetite structure, which influences the overall catalytic activity, remains unaddressed. Hence, details understanding in these synergistic interactions is crucial towards an establishment of the plausible thermodynamically favourable redox pairs and properties during the catalysis. The objective of this work is to determine the synergistic interaction between the substituted transition metals with Fe cations through the oxidative degradation of dye in the heterogeneous Fenton like reaction as well as the resultant material characterizations



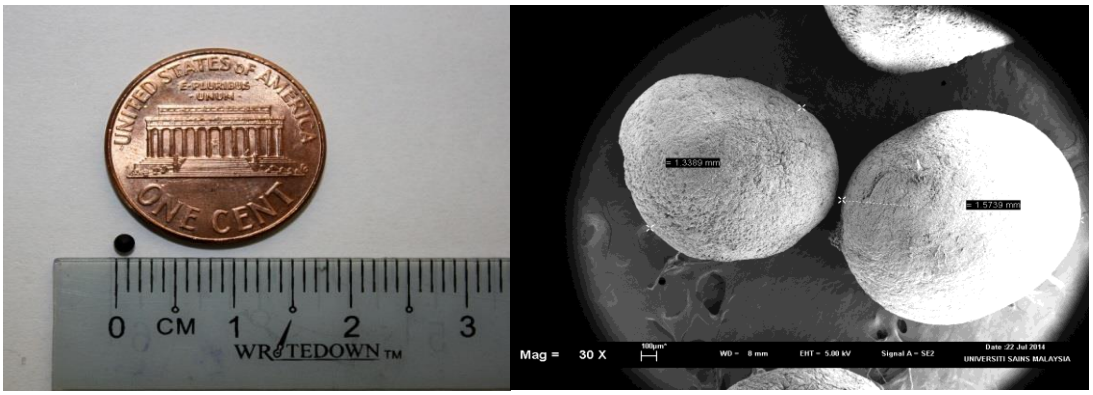
13.2.2 CAO nanocatalysts doped with transition metals in transesterification reaction of palm oil

Depletion of fossil fuel sources in a few decades due to industrialization and motorization has led to a keen interest in the production of alternative fuels like biodiesel. In relation with that, research on the development and improvement of more efficient transesterification process for biodiesel production has great attention in the last decade. As a basic heterogeneous catalyst, CaO has been examined in the transesterification of vegetable oils for biodiesel production due to its lower cost production and high catalytic performance reasons. In this research, calcium oxide (CaO-X) catalysts were prepared by sol-gel method at different Ca^{2+} reactant concentration (X = 1.0, 1.5, 2.0 M). All the synthesized catalysts were then applied to transesterification reaction of palm oil to produce biodiesel. It was also found that CaO-2.0 has high catalytic activity wherein 81% of FAME yield was obtained within 3h reaction.



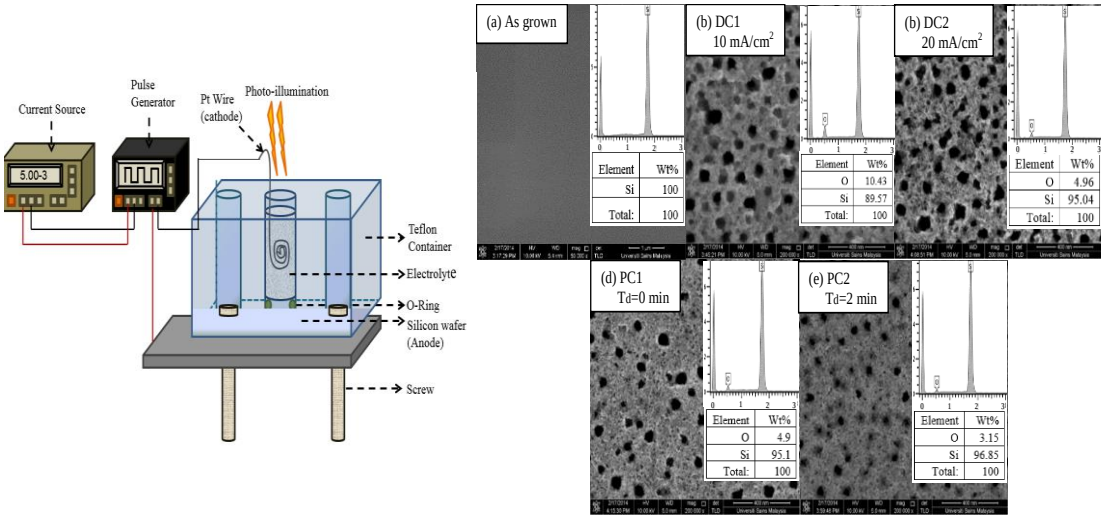
13.2.3 Hybrid nanoparticles augmented polymeric microcapsules

Microcapsule has remarkable advantages in engineering application for pollutants removal and biomedical field for transportation. It has obviously drawn attention from the research community. In environmental engineering application, microcapsules could serve as encapsulation agent of nanoparticles (NPs) to drastically reduce the risk associated to nano-toxicity when it is indirect contact with surroundings. Even though magnetic responsiveness of capsules can be used for ease of separation, one of the constraints is that the encapsulated particles will restrict the performance of capsules materials in pollutants removal. Therefore, tuning morphology of the microcapsules could be crucial to further enhance the performance of pollutant removal efficiency. Hence, this work primarily focuses on tuning morphology of the magnetic nanoparticles-polymeric microcapsules via various physical properties. The fundamental understanding at the interfaces and its mass transport properties is simulated using physics simulation software in order to understand the phenomenon well. Feasibility study using synthetic dyes as the representable model system for degradation indicates magnetic nanoparticles augmented microcapsules could be a viable option to degrade dye pollutant effectively.



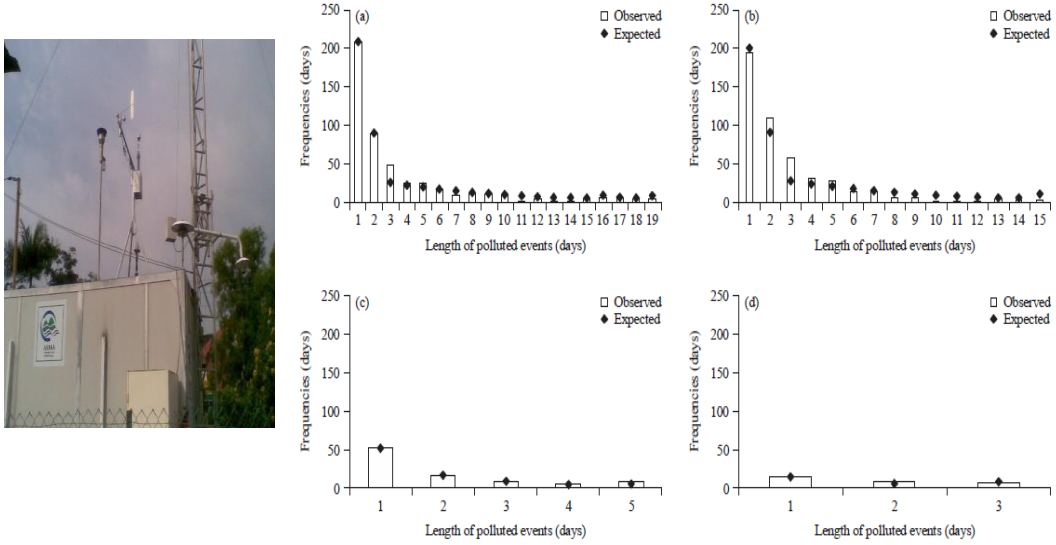
13.2.4 Novel Integrated Pulsed Electrochemical Etching of Porous Si and porous GaN for Potential Optoelectronics Application

Porous silicon (PS) attracted many attention for optoelectronic device since the discovery of its efficient visible room temperature photoluminescence (PL). The sensitivity of PS depends upon the morphological characteristics of pores, which is the diameter of the pores, its surface uniformity and the thickness of the layer. The changes on the porous surfaces can subsequently alter the electrical and optical characteristics of porous semiconductors. Electrochemical etching is a simple technique for fabrication of pores on the surface of silicon. To optimize the surface characteristics of porous layer, parameters involved are current density, time etching, shape of the current and electrolyte used. However, the challenge faced in obtaining a stable current and a stable current-based etching process suffered from the formation of hydrogen bubbles in pores while decreasing the speed of etching and resulted in shallow pores formation. To overcome this problem, the pulse current method has been introduced by applying the discontinuous current with combination of cycle time (T) and pause time (T_off) in order to decline the hydrogen bubbles and allow HF react with substrate. In this project, the porous silicon were fabricated by using pulse etching technique. The pause time (T_off) has a significant effect on the size of pores and porosity formation which can improve the porosity.



13.2.5 Air Pollution Modelling In Malaysia

Air pollution is poisonous gases and trapped particles that come from primary and secondary pollutants. Primary pollutant is a natural source of pollution that happen directly from natural disasters such as earthquakes, while secondary pollutant is a man-made pollution as a result from the haze, open burning and exhaust fumes from motor vehicles. Due to the factors that trigger air pollution, the level of air pollution concentrations needs to be modelled with several predictors in order to predict the level of air pollutant concentrations for the next few days. The multiple linear regression model developed by past researchers is by the method of ordinary least square (OLS) where this method includes the influential outliers. In other words, OLS method is sensitive to the outliers and would lead to an incorrect information of air pollution in Malaysia. The aim of this study is to develop model with reduce influential of outlier (extreme event) and to predict future air pollution concentrations level in selected area in. Various method were used in this study i.e. statistical models, machine learning approach and a new approach in hybrid models. The models were useful in helping authorities to actuate air pollution impact preventative measures in Malaysia.

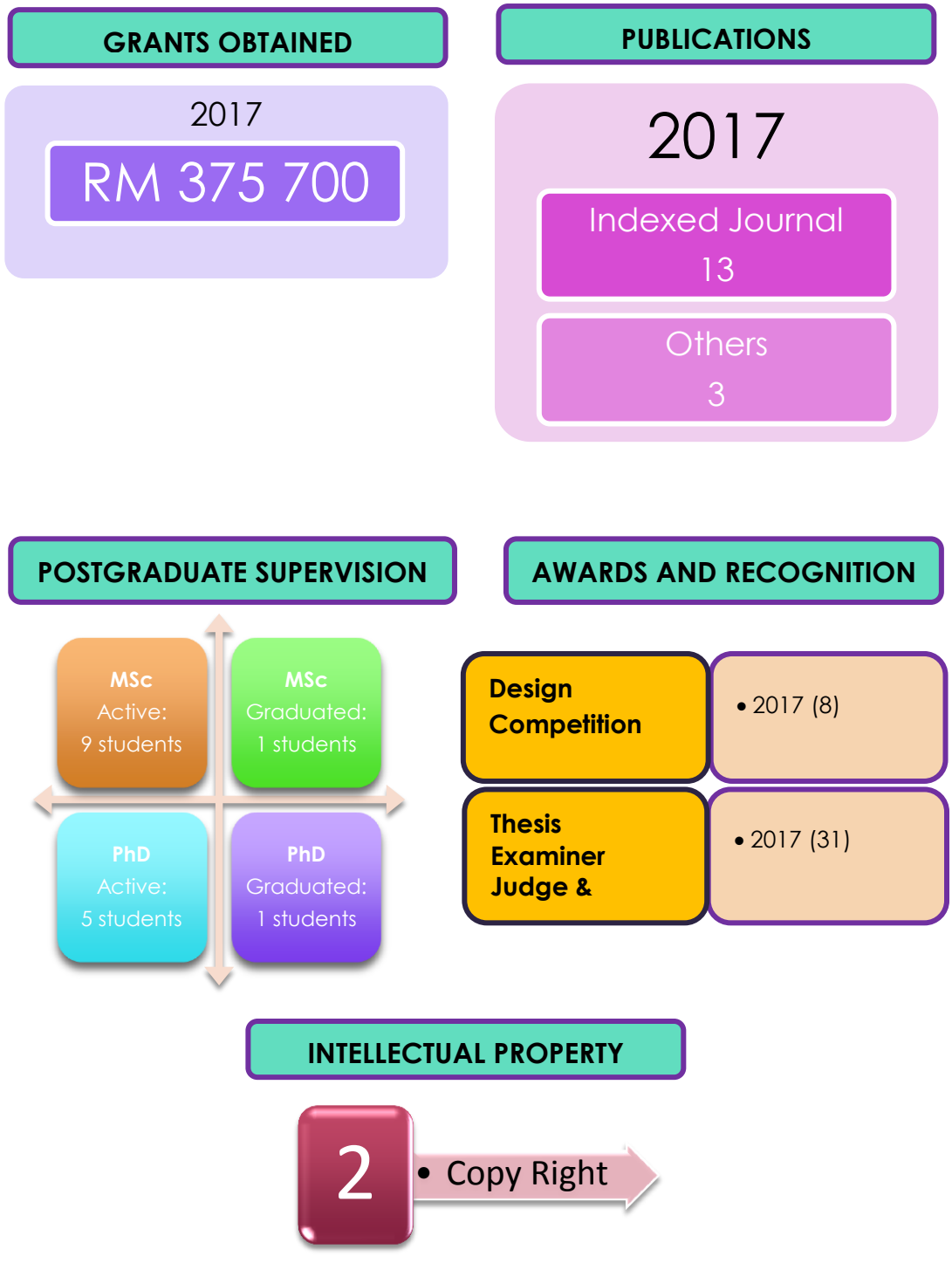


13.3 Group Information

Name of RIG	Hybrid Nanomaterials, Interfaces & Simulation (HYMFAST)
Leader	Dr Nor Aida Zubir
Tier	5
RIG Code	CoRe144/T5/2017(4)/FMIA(23)
Registration Year (Senate Approval)	2017
UiTM Niche Area	Chemical & Advanced Materials
RIG Niche Area	Research & simulation of hybrid nanomaterials towards sustainable environment and energy.

13.4 Background of Members

13.5 Achievement (2015-2017)



14.0

INDUSTRIAL PROCESS RELIABILITY & SUSTAINABILITY (INPRES)

Azil Bahari Alias, Najmiddin Yaakob, Zulkifli Abdul Rashid, Ku Halim Ku Hamid, Nik Raikhan Nik Him, Alawi Sulaiman, Mohd Azlan Mohd Ishak, Khudzir Ismail

14.1 Introduction

Industrial Process Reliability and Sustainability research group is formed to champion research on corrosion engineering, process safety and environmental engineering (solid, water and air) focusing on the industrial applications. Activities emphasize on the following areas:

- Environment: Research on industrial air pollution: Dioxin, Dispersion model (Bayesion Theorem, SPSS, Monte Carlo, ARCGIS), Greenhouse Gases management (CO2, CH4,CFC, N2O, etc), Toxic Gases management (NOX,SOX,etc),and Air Pollution Control Design – (SCRUBBER, CYCLONE. etc.)

- Environment: Research on industrial wastewater treatment (physical, chemical, biological approach), wastewater unit design (primary, secondary, tertiary), and high rate algal ponds (HRAP)-nutrien removal into the biomass potential biofuel production.

- Environment: Research on utilising industrial solid waste (waste to wealth concept) – sludge, biomass, industrial solid waste, MSW etc., developing new material from waste to combat pollution, and industrial solid waste treatment technologies (thermal treatment technologies, composting, landfill).

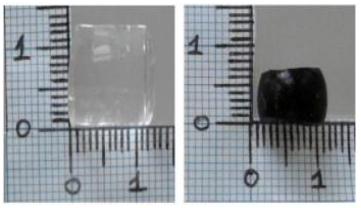
- Process Safety: Research on Consequence Analysis, Facility Siting, Quantitative Risk , Inherent Safety Research and Offshore Safety, Refinery Process Safety.

- Corrosion Engineering: Research on Corrosion Inhibitor Formulation and Testing, Investigation of Corrosion Mechanisms, Corrosion Prediction and Microbial Induced Corrosion.

14.2 Research Highlights

14.2.1 Hydrogel Charsh (HC), a powerful adsorbent

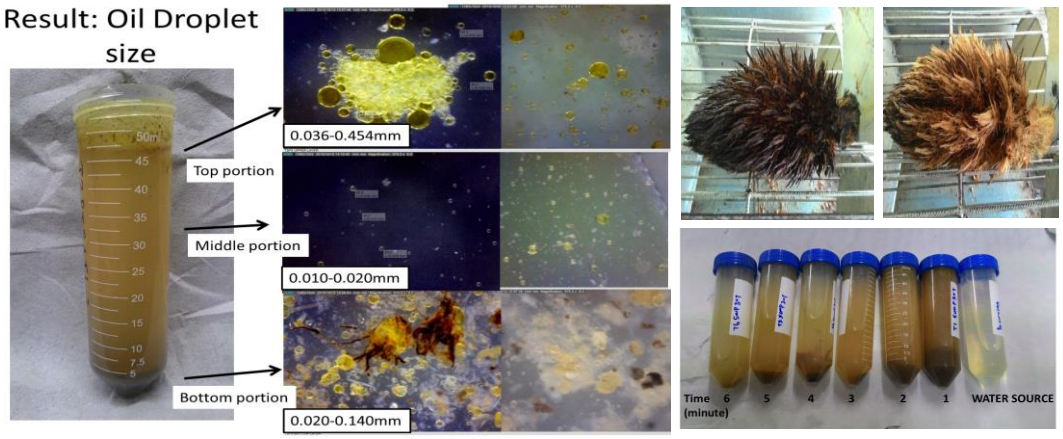
HYDROGEL CHARSH (HC) is a powerful adsorbent to remove unwanted pollutants (gas & liquid forms) and odour. The HC applications are on gas (SO_2, H_2S, and CO_2) and water (heavy metals) filter to combat pollutions and also as a pet litter to tackle odour. HC is originated from combination of polymerize biomass with coal fly ash (waste) as a new improved adsorbent. The research focuses on waste to wealth concept, utilizing waste and adding values to the waste for environmental purposes. HC offers several benefits such as economical viable, high sorption capacity, shorter sorption time, longer lifetime usage and versatile adsorbent. The HC benefits exceeded the current activated carbon (AC) used for the same applications. The HC residues also are very stable and addition of these materials to the soil has the potential to improve soil quality.



Hydrogel | Biochar containing hydrogel

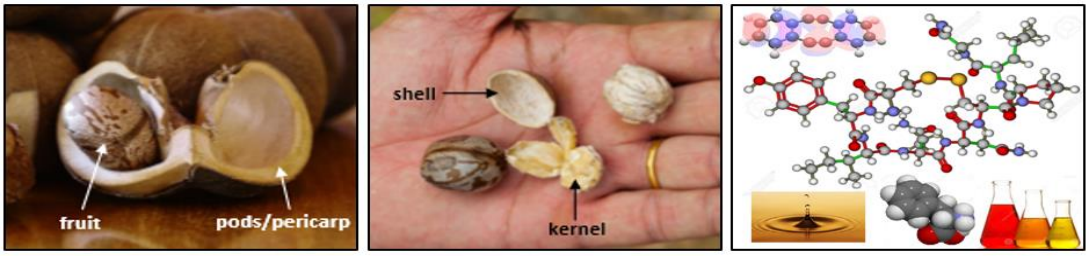
14.2.2 Improvement of Palm Oil Extraction Rate (OER) Through Oil Recovery from Wastes Towards Achieving Zero Waste Strategy

In Malaysia, millions of tons of oil palm biomass are disposed into the environment annually. The oil palm biomass includes oil palm empty fruit bunches (OPEFB), palm oil mill effluent (POME) and oil palm decanter cake (OPDC). Improper disposal of this biomass could lead to soil, water and air pollution. Our study showed that this biomass still contains a small amount of residual oil. After careful investigation, the mechanism of residual oil presence in this biomass was identified and thus possible recommendations to separate the oil from the biomass were made. Interestingly once this biomass was freed from the residual oil, their uses could be enhanced through improved biochemical fermentation process such as in biomethanation and biocompositng. The oil free biomass could also be used for the production of biosugars and biocomposite polymer. The residual oil although could not be used as crude palm oil (CPO), it is still can be used to produce other biochemicals such as biodiesel, biogrease and biolubricant. Towards the end, the final discharge effluent can also be treated and the cleaned water can be used back in the palm oil mill and therefore reducing the environmental impacts of the river water intake and discharge.



14.2.3 Biomass as potential alternative fuels

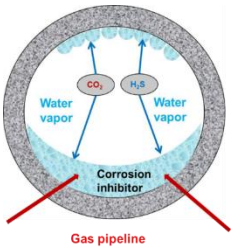
The IEA's World Energy Outlook reveals that fossil fuels will continue to dominate the energy mix; with 95% of the additional energy demands between 1995 and 2020 will be met by fossil fuels. Therefore, coal will become more important both as an energy source and as the source for organic chemical feedstock in the 21st century. Equally important, biomass is considered to be potential for the renewable energy sources in the future. It already supplies 15% of world's total energy consumption. Biomass is also a source of a large variety of chemicals and materials. Biomass resources that can be used for energy production cover a wide range of materials such as forestry residues, energy crops, organic wastes, agricultural residues, etc. Agricultural waste, readily available biomass, is produced annually worldwide and is vastly under utilized.



14.2.4 Clay modified- Oil Palm Fruit Bunch (OPFB) Composite

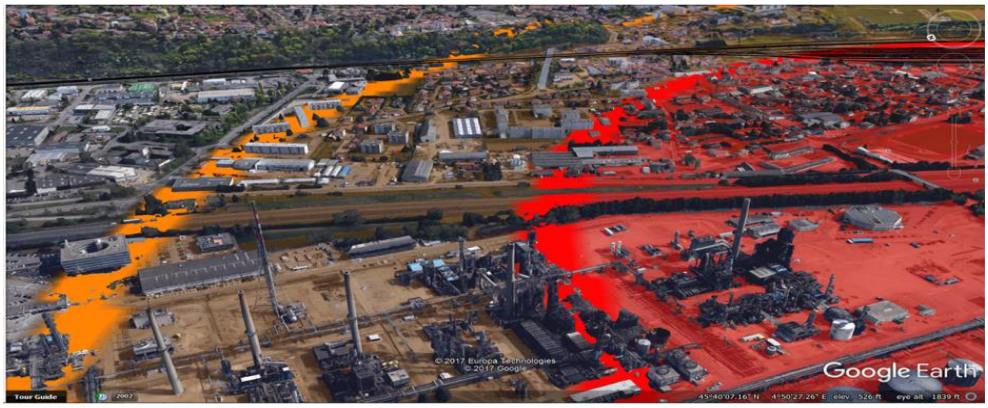
The internal corrosion of pipelines occurs during the transportation of fluids, usually in multiphase form and containing gaseous or liquid hydrocarbons, water or brine, acidic gases such as carbon dioxide (CO_2) and hydrogen sulfide (H_2S), organic acids, bacteria and often entrained solids (sand). The presence of these acidic gases, bacteria and water has the potential to accelerate corrosion in pipelines which are normally made of carbon steel. The mechanism on the corrosion need to be further understood before any mitigation method is proposed. Thus, the researches highlight are:

1) Top of the Line Corrosion in CO_2/H_2S Environments
2) CO_2/H_2S pipeline corrosion mechanism
3) Development of volatile and non-volatile corrosion inhibitor
4) Microbial Induced Corrosion
5) Development of Biocide in Oil and Gas Application



14.2.5 Accident Modeling and Consequences Analysis

Consequence analysis is an evaluation of the predicted outcome from an incident and how it affects the surrounding equipment and people. It is one of the main components of risk assessment and can be used to optimize plant layout, reduce the risk from an unacceptable level by improving design, develop an emergency preparedness plan, and assess the mitigation system. By using consequence models, consequence analysis includes the prediction of the magnitude of potential jet and pool fire, Boiling Liquid Expanding Vapour Explosion (BLEVE), vapour dispersion, toxic chemical release, and explosion caused by incidental release.



14.2.6 Quantitative Risk Assessment

Transportation Risk Analysis for Hazardous Materials Transportation

A numerical procedure, which allows the coupling of time effectiveness and mathematical accuracy, will be developed for the individual risk evaluation, and therefore provides criteria for the route selection of hazardous materials transportation. User-friendly software on transportation risk analysis and the route selection can be developed based on this research. With sufficient data, the incident frequency of different road could be measured given the data of affecting parameters, and then the general models could be built to assess the incident

frequency for any kind of road.

Continuous Operational Risk Assessment for a Chemical Process
In this study, the methodology is designed for continuous operational risk assessment. Process variable evolution follows physical/engineering laws, and this evolution is also governed by the performance of the components within the system under assessment. Discrete event simulation is applied to study the stochastic process behaviour of a specific component. Then the process variable evolution directed along discrete event paths is simulated to obtain the real time probability of process variable to exceed safety boundaries.

Uncertainty Delimitation and Reduction for Improved Mishap Probability Prediction
It is important to increase accuracy of the results. Therefore, analysis on uncertainties associated with a QRA is crucial to evaluate the QRA, how close the evaluation is from reality, and how the risk is reliably identified to make good decisions that affect chemical process safety design.

14.2.7 Facility Siting

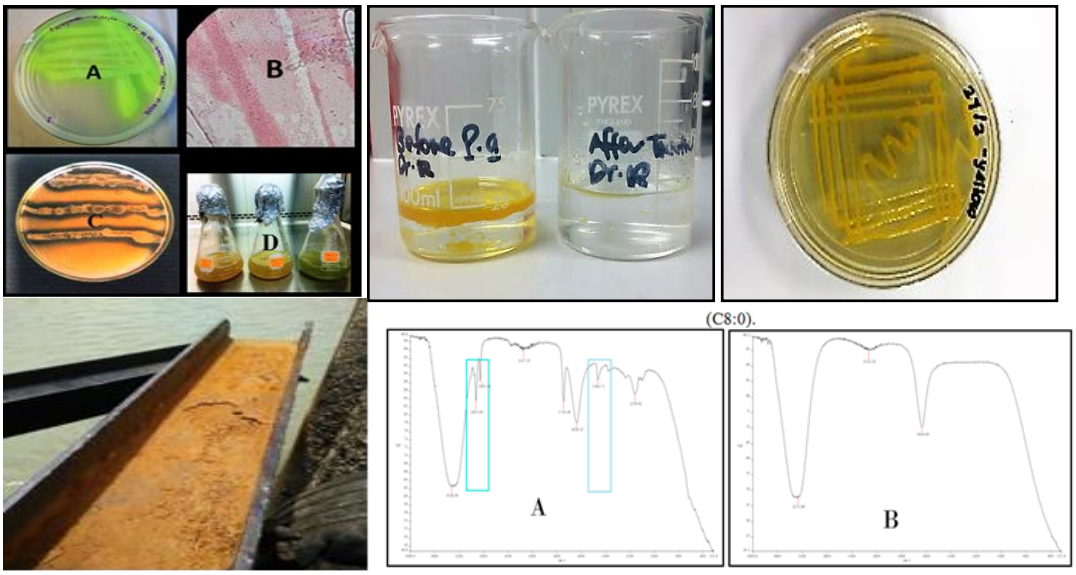
Facility siting and layout is a process for finding an optimal location for a chemical or petroleum processing site and then arranging the units and equipment. They are related to how to select a site, how to recognize and assess long-term risks, and how to lay out the facilities and equipment within that site. Appropriate siting and layout establishes a foundation for a safe and secure site. Facility layout optimization based on risk analysis-The purpose of this research is combining optimization concepts and safety concepts in a facility layout. The objective function is the sum of costs for land, piping, managing, protection devices and safety (risk). Based on real meteorological data and various hazardous facilities which have flammable materials, optimal separation distances and directions will be obtained.

14.2.8 Offshore Safety, Refinery Process Safety

Some current and potential process-safety research for offshore applications include facility siting and layout, LOPA/SIS and SIL application in offshore facilities, QRA of offshore facilities (drilling and production), fire protection system (air curtain, water curtain, deluge, expansion foam), fire suppressant agent, and human error assessment.

14.2.9 Application of Microbial of Research in Chemical Engineering (Microbial Engineering)

Microbial engineering based technology has been practiced in my research activities along with other fields such as biotechnology, chemical engineering and alternative fuel development to study the role of microbes into a production of useful products and biorefinery based applications. As an Industrial Microbiologist, I have identified the importance of few industrial microbes such as Pseudomonas aeruginosa, Ochrobactrum anthropic, Pseudomonas luteola, Sphingomonas paucimobilis, Burkholderia cepacia, E.coli, Pseudomonas putida and Pseudomonas fluorescens. For example, the Accelerated Low-Water Corrosion (ALWC) has been confirmed to degrade maritime steel structure in Port Klang, Malaysia and was grouped as one of microbial induced corrosion (MIC) type. This study was performed to isolate, identify, and characterized the growth of the microbes that has induced ALWC in order to decide for the best treatment using understanding of its potential EPS through biofilm formation. Another interesting research is treatment of heavily oiled wastewater using Pseudomonas aeruginosa NR.22 producing usable free fatty acids (FFA) that has been used to produce biodiesel. Apart from this, enzymatic deinking of waste newspapers and laser jet waste paper has been research using fruits and microbes and managed to offer potential opportunities for changing the pulp & paper industry towards more environmentally friendly and efficient operations compared to conventional methods.



14.2.10 Biodiesel

Trans-esterification is a method to convert vegetable oils or animal fats into fatty acid methyl esters. Base catalyst such as sodium or potassium hydroxide and sodium or potassium methoxide are commonly used for trans-esterification. This process is carried out in batch mode, time consuming and requires several steps of processing units. In fact, such technology needs high investment and no longer competitive especially when the global oil price is low. Thus, new technology is required to overcome the problem and to cater low grade of feed stocks. With the believe that in case of methyl ester production, the role of catalyst can be replaced and enhancement of molecular collision can be done differently, ultrasonic wave and high speed mixing were exploited to transpire the NON CATALYTIC REACTION FOR METHYL ESTER PRODUCTION. Ultrasonic waves are longitudinal mechanical waves which generate cavitation bubbles as they transmit through a liquid medium. In chemical reaction, the progress of the reaction depends heavily on how quickly the reactants are brought together. For the reaction to occur, the pure reactants need to be homogenized at the molecular scale so that molecules can collide. If the mixing is fast enough, the intrinsic chemical kinetics governs the rate of production of new species. Based on this understanding, high speed mixing was introduced to enhance successful molecular collision of methyl ester reactants after gaining energy from ultra-sonic device. We have a very strong believe that most of catalytic chemical reactions nowadays can be replaced by using this technique. Probably, it is a breakthrough in chemical reaction engineering and inspires the green technology.

Trans-esterification was performed in a reactor comprising a combination of a high speed mixer operating at 1000 to 5000 rpm and a sonic source operating at 2.4 MHz. Waste oil and ethanol are mixed at temperature ranging from 50 to 60 ºC to separate solid impurities from the oil. Temperature greater than 60 ºC will cause vaporization of alcohol from the mixture. The mixture is heated to reduce the

viscosity of the waste oil and stirred at speed ranging from 50 to 100 rpm for 30 to 45 minutes. Thereinafter, solid impurities are allowed to settle for about 20 minutes. The heating process is conducted to reduce the viscosity of the waste oil to facilitate the pumping process. Trans-esterification process is performed in a reactor comprising high speed mixer operating and sonic mixer. Preferably, high speed mixing is conducted at 1000 to 5000 rpm while sonic mixing is carried out at 2.4 MHz. The mixed of waste oil and alcohol enters the reactor from the bottom and is exposed to sonic waves. Mixing is further enhanced by exposing the mixture to a high speed mixer at the top of the reactor. Since trans-esterification is an exothermic process, the temperature of the mixture increases to 70ºC during trans-esterification. Final product is separated based on boiling point of a substance wherein ethanol, whose boiling point is at 70ºC vaporizes and is recycled back to the system leaving only biodiesel which is collected from the bottom of the separation vessel. Main objective of the invention is relates to a method of producing biodiesel from high sludge and free fatty acid content of palm oil without using catalyst and consequently, eliminates the generation of by-products and glycerin. Subsequently it will shorten the processing period, high conversion of feed stocks and reduces the processing steps required. Overall, the invention introduces an economic production of methyl ester (biodiesel) from low grade of raw material via continuous processing technology.

14.3 Group Information

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RIG Code	CoRe150/T5/2017(10)/FMIA(25)
Registration Year (Senate Approval)	2017
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RIG Niche Area	Reliability and Sustainability Engineering Research on corrosion engineering , process safety and environmental engineering focuses on industrial applications.

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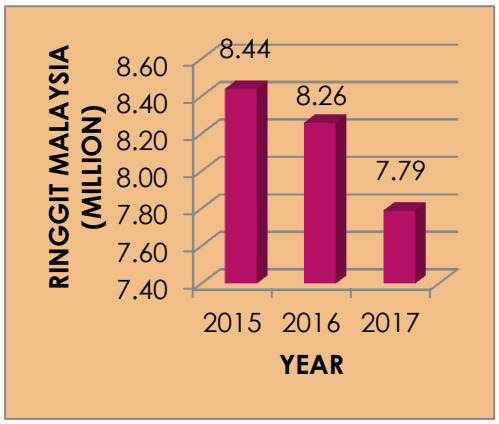
14.5 Achievement (2015-2017)

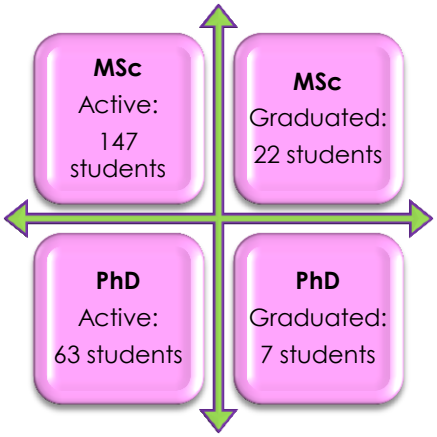
GRANTS OBTAINED



PUBLICATIONS

2017	2016	2015
Indexed Journal 18	Indexed Journal 32	Indexed Journal 36
Others 6	Others 14	Others 15

POSTGRADUATE SUPERVISION



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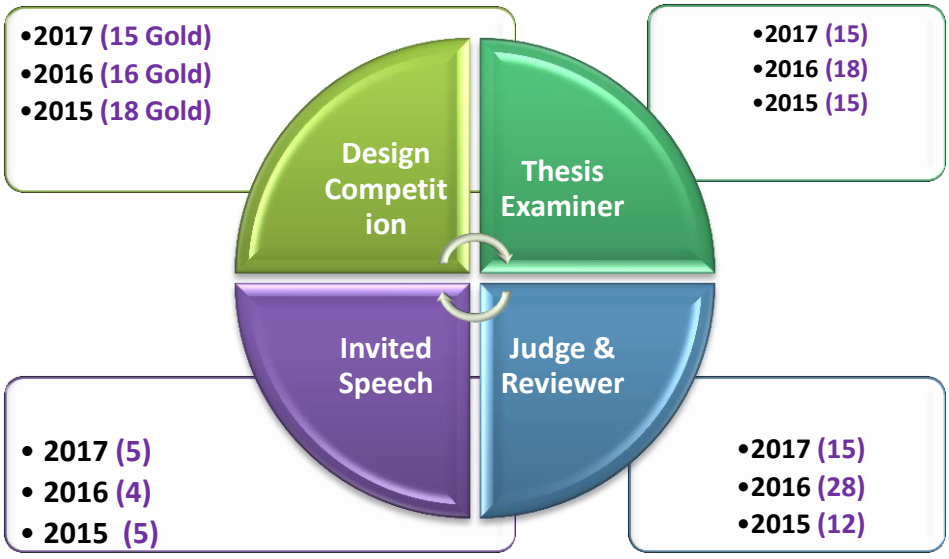
AWARDS AND RECOGNITION



15.0

CERAMIC GAS AND MAGNETIC SENSOR MATERIALS RESEARCH

Misbah Hassan, Norazila Ibrahim, Suraya Kamil, Mohd Fauzi Maulud, Hafizi Lukman

15.1 Introduction

Ceramic Gas and Magnetic Sensor Materials Research Group (CGMSM) was set up in 2014 as a new group at Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam and is registered under Research and Management Institute (RMI). Our research focuses on the physical properties of novel perovskite oxide materials such some titanites and manganites which relevant for their potential applications. Our research activities also involve in variation of projects in order to improve the physical properties, the performance of the studied materials as well as to understand the underlying mechanism which may responsible for the observed behaviour of the materials. Our aims are to advance knowledge as well as to enhance research capabilities in order to place our group at the international level in the field of gas sensor and magnetic sensor.

At present, our group involved in the preparation and characterization of novel perovskite materials and the research is divided into two main areas:

1. **Magnetic Sensor element**

   Spintronics which employs spin of charge carriers for determining direction and intensity of currents have been initially used since the discovery of giant magnetoresistance (GMR) phenomena where the resistance changed dramitcally in response to a magnetic field. Spintronic-based manganites is a new class of material under study for future magnetic sensors elements due to its collosal magnetoresistance (CMR), the large drop of the electric resistance when magnetic field is applied, which may increased sensing efficiency. Manganites possess interesting features such as metal-insulator transition accomponied by ferromagnetic-paramagnetic transition, and free electrons are almost completely spin polarized, make these materials are important for spintronic area of research.

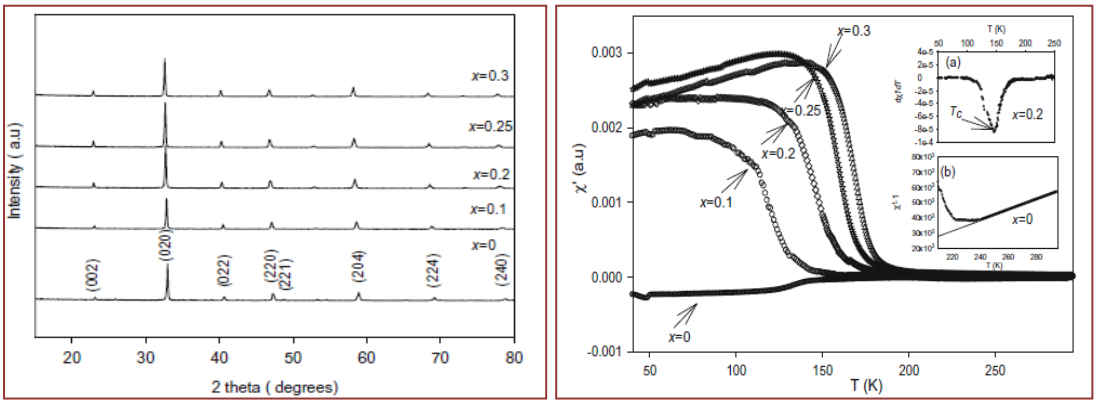
2. Gas Sensor

The mechanism of hot spot formation in the ceramic rods upon application of external voltage has been explained in terms of large joule heating due to large voltage drop as a result of large increase in resistivity. The application of some ceramic rods utilizing the hot spot phenomenon as oxygen sensing elements has also been introduced. At present, further extensive research on oxygen-sensitive hot spot by using novel ceramic materials is being conducted for industrial applications.

15.2 Research Highlight

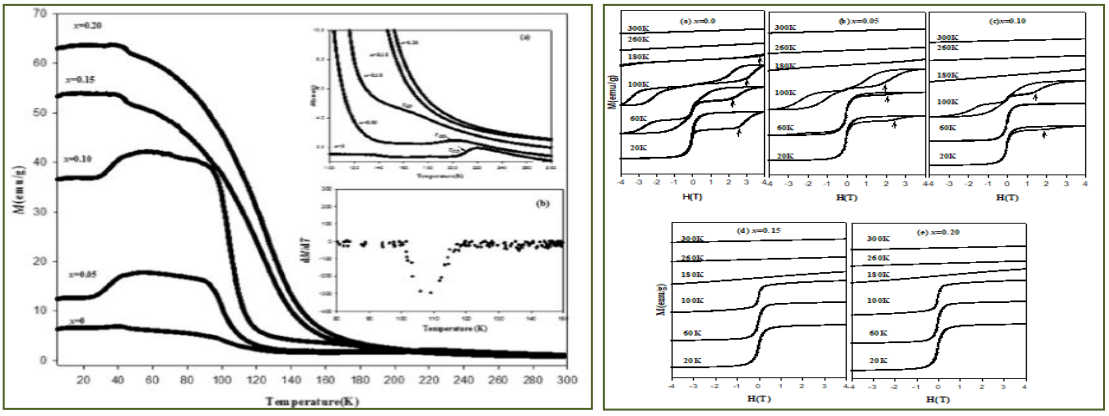
15.2.1 Inducement of Itinerant Electron Transport in Charge-Ordered $Pr_{0.6}Ca_{0.4}MnO_3$ by Ba Doping

The effects of Ba^{2+} doping on the electrical and magnetic properties of charge-ordered $Pr_{0.6}Ca_{0.4}MnO_3$ were investigated through electrical resistivity and AC susceptibility measurements. X-ray diffraction data analysis showed an increase in unit cell volume with increasing Ba^{2+} content indicating the possibility of substituting Ba^{2+} for the Ca-site. Electrical resistivity measurements showed insulating behavior and a resistivity anomaly at around 220 K. This anomaly is attributed to the existence of charge ordering transition temperature, T_{CO} for the x = 0 sample. The Ba-substituted samples exhibited metallic to insulator transition (MI) behavior, with transition temperature, T_{MI}, increasing from ~98 K (x = 0.1) to ~122 K (x = 0.3). AC susceptibility measurements showed ferromagnetic to paramagnetic (FM-PM) transition for Ba-substituted samples with FM-PM transition temperature, T_c, increasing from ~121 K (x = 0.1) to ~170 K (x = 0.3), while for x = 0, an antiferromagnetic to paramagnetic transition behavior with transition temperature, T_N, ~170 K was observed. In addition, inverse susceptibility versus T plot showed a deviation from the Curie–Weiss behavior above T_c, indicating the existence of the Griffiths phase with deviation temperature, TG, increasing from 160 K (x = 0.1) to 206 K (x = 0.3). Magnetoresistance, MR, behavior indicates intrinsic MR mechanism for x = 0.1 which changed to extrinsic MR for x > 0.2 as a result of Ba substitution. The weakening of charge ordering and inducement of ferromagnetic metallic (FMM) state as well as increase in both T_c and T_{MI} are suggested to be related to the increase of tolerance factor τ and increase of e_g–electron bandwidth as average ionic radius at A-site,< r_A > increased with Ba substitution. The substitution may have reduced MnO_6 octahedral distortion and changed the Mn–O–Mn angle which, in turn, promotes itinerancy of charge carrier and enhanced double exchange mechanism. On the other hand, increase in A-site disorder, which is indicated by the increase in σ^2 is suggested to be responsible for the widening of the difference between T_c and T_{MI}.



15.2.2. Inducement of ferromagnetic-metallic phase in intermediate-doped Charge-ordered Pr0.75Na0.25MnO3 manganite by K^+ - substitution

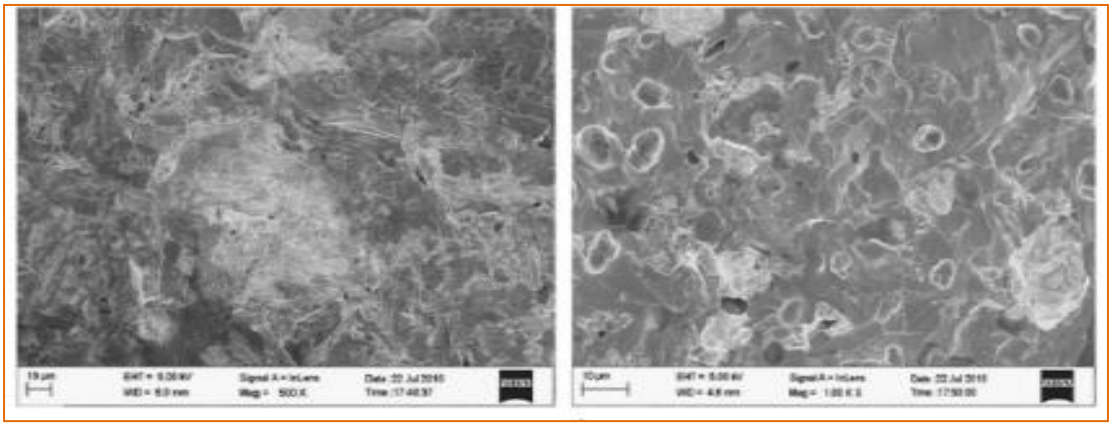
Polycrystalline $Pr_{0.75}Na_{0.25-x}K_xMnO_3$ (x = 0, 0.05, 0.10, 0.15 and 0.20) ceramics were prepared using conventional solid-state method and their structural, magnetic and electrical transport properties were investigated. Magnetization versus temperature measurements showed un-substituted sample exhibited paramagnetic 88ehaviour with charge-ordered temperature, T_{CO} around 218 K followed by antiferromagnetic 88ehaviour at transition temperature, T_N ~ 170 K. K^+-substitution initially weakened CO state for x = 0.05–0.10 then successfully suppressed the CO state for x = 0.15–0.20 and inducing ferromagnetic-paramagnetic transition with Curie temperature, T_C increased with x. In addition, deviation of the temperature dependence of inverse magnetic susceptibility curves from the Curie-Weiss law suggests the existence of Griffiths phase-like increased with x. Magnetization versus magnetic field curves show existence of hysteresis loops at T < 260 K (x = 0) and T < 180 K (x = 0.05–0.10), which related to metamagnetic transition occurring at critical field. Electrical resistivity measurements showed an insulating 88ehaviour for x = 0 sample while for x = 0.05–0.20 samples showed metal-insulator transition and transition temperature, T_{MI} increased with x. The increased in T_C and T_{MI} are attributed to the increase in tolerance factor which indicates reduction in MnO_6 octahedral distortion consequently enhanced double exchange interaction.



15.2.3 Effect of divalent ion substitution on oxygen sensing properties of hot-spot based $Eu_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$ and $Eu_{1-y}Mg_yBa_2Cu_3O_{7-\delta}$ ceramics

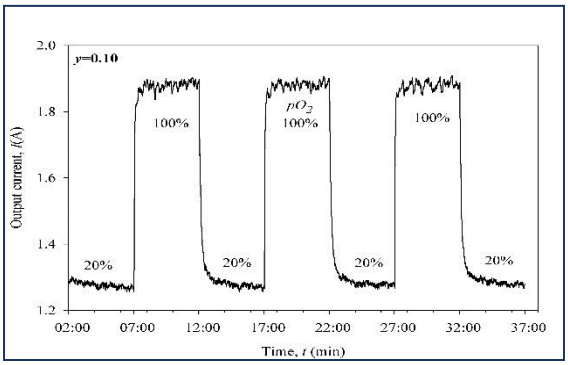
This research study on the effects of Ca and Mg substitution on oxygen sensing properties of hot spot based Eu123 rods are reported. $Eu_{1-x}Ca_xBa_2Cu_3O_{7-\delta}$($x$ = 0.2–0.5) and $Eu_{1-y}Mg_yBa_2Cu_3O_{7-\delta}$ (y = 0.2–0.5) ceramics were synthesized from oxide

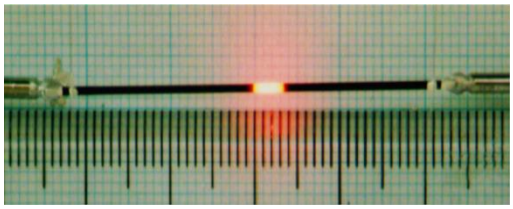
powders using the standard solid state method and fabricated into short rods. For Ca-substituted rods, after appearance of a visible hot spot, a constant current plateau in *I–V* curve was formed. The output current response of the rod in periodically changing pO_2 between 20% and 100% showed improved stability and reproducibility for x = 0.4 compared to x = 0.2. Improved oxygen absorption and desorption time was observed for x = 0.4 compared to previously reported un-substituted rod. On the other hand, for Mg-substituted rods the *I–V* behavior after formation of hot spot showed a negative slope. Faster absorption time of 3.0s and desorption time of 6.9s were observed for y = 0.4 compared to y = 0.2. The improved output current stability, reproducibility and response time is suggested to be due to changes in oxygen activation energy and increased hole concentration as a result of Ca^{2+}/Mg^{2+} substitutions. The Mg-substituted rods showed better performance compared to Ca-substituted rods possibly due to higher porosity and vacancy concentration.



15.2.4 Oxygen sensing behaviour of Pr doped ceramic rods with hot-spot

In this study, $Eu_{1-x}Pr_xBa_2Cu_3O_{7-\delta}$ (x = 0.05, 0.10, and 0.20) ceramic rectangular rods were prepared by the solid-state reaction method to investigate the effect of Pr doping on oxygen sensing behaviours. X-ray powder diffraction analysis showed all rods were orthorhombic in structure with reduction in orthorhombicity upon doping. For all samples, the *I-V* curve showed a relatively constant output current after the appearance of hot-spot. The magnitude of the constant output current was observed to be decreasing with increasing Pr doping which indicates possible reduction in intrinsic hole concentration. In addition, the output current for rods with x = 0.0, 0.05 and 0.10 showed a sudden drop upon the appearance of hot-spot, due to the sudden increase in hot-spot temperature, before becoming slightly constant. However, the sudden drop of output current upon appearance of hot-spot was not observed when Pr was increased to x = 0.15 and 0.20 but instead a stable output current was observed. Interestingly, the output current after appearance of hot-spot for all rods showed strong dependency on ambient oxygen concentration. The sensitivity for each rod, however, reduces with increasing ambient oxygen concentration. The doping seems to prevent the sensitivity from dropping to almost zero as was previously reported for $Eu(Ba_{1-y}Pr_y)_2Cu_3O_{7-\delta}$ rods due to existence of Cu-O chains in the orthorhombic structure. Pr doping (for x = 0.10) has also resulted in better oxygen absorption response time and better output current stability compared to other rods.





15.3 Group Information

Name of RIG	Ceramic Gas and Magnetic Sensor Materials Research Group (CGMSM)
Leader	Dr Misbah Bin Hassan
Tier	5
RIG Code	CoRe108/T5/2014(33)/FMIA/7
Registration Year (Senate Approval)	1 Julai 2016
UiTM Niche Area	Chemicals and Advanced Materials
RIG Niche Area	Spintronic –based manganites for future magnetic sensor element Novel oxide materials : Ceramic gas sensor element

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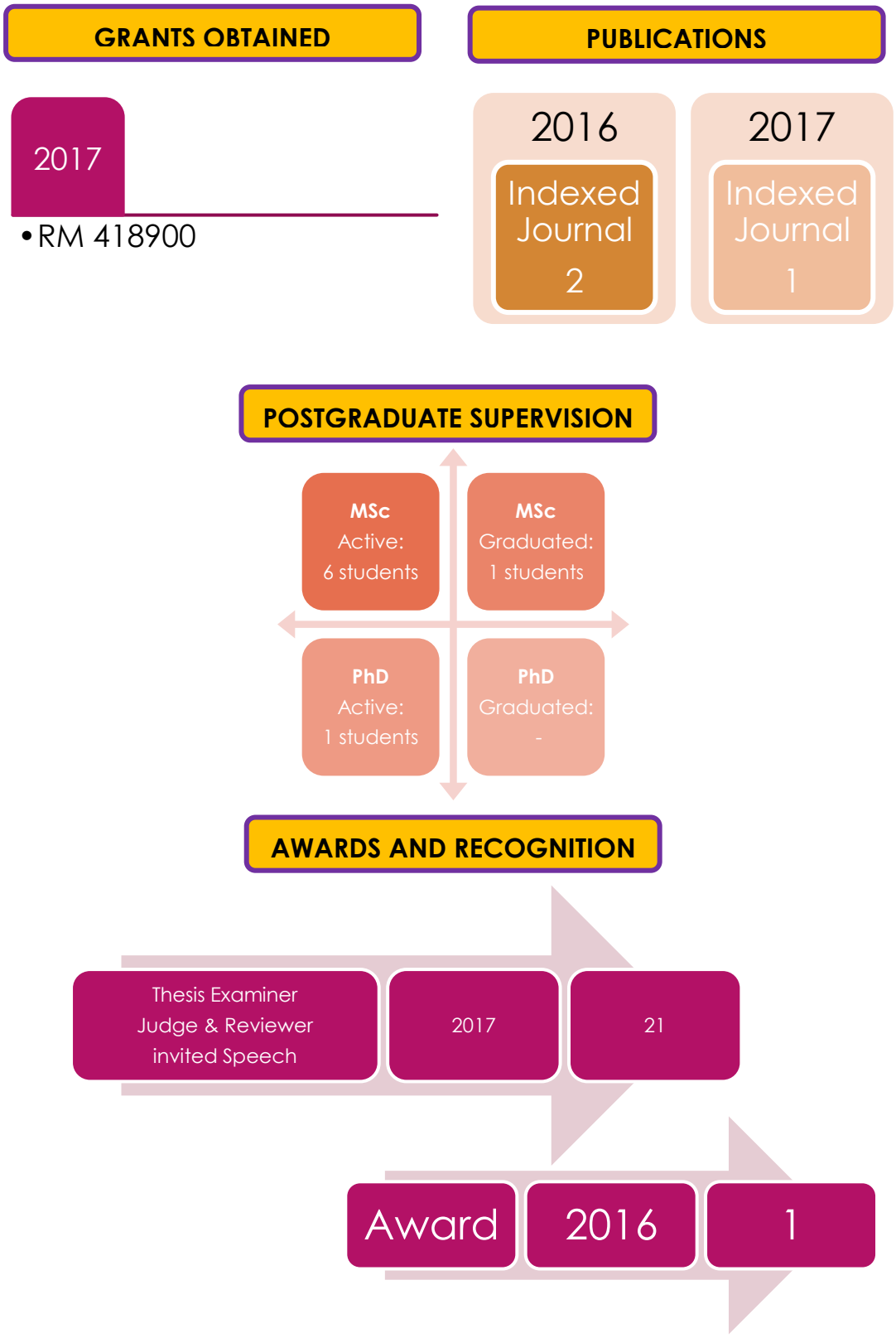
15.5 Achievement (2015-2017)



16.0

Researchers in FMIA

LIST OF FMIA DENOMINATORS YEAR 2017
COMMUNITY OF RESEARCH: FRONTIER MATERIALS & INDUSTRIAL APPLICATION (FMIA)

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30	NOOR EZAN BINTI ABDULLAH	PENSYARAH	FAKULTI KEJURUTERAAN ELEKTRIK
31	NOOR HAFIZAH BINTI ABDUL AZIZ	PENSYARAH	FAKULTI KEJURUTERAAN ELEKTRIK
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59	FAIRUL NAZMIE BIN OSMAN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN ELEKTRIK
60	ROZANA AZRINA BINTI SAZALI	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
61	SUFFIYANA BINTI AKHBAR	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
62	ZALIZAWATI BINTI ABDULLAH	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
63	NOR FAEQAH BINTI IDRUS	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
64	MIRADATUL NAJWA BINTI MUHD RODHI	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
65	SAKINAH BINTI MOHD ALAUDDIN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
66	WAN ZAIRANI BINTI WAN BAKAR	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
67	TENGKU AMRAN BIN TENGKU MOHD	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
68	FUZIEAH BINTI SUBARI	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
69	NORASHIKIN BINTI AHMAD ZAMANHURI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
70	NOORSUHANA BINTI MOHD YUSOF	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
71	AZLINDA BINTI AZIZI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
72	MUNAWAR ZAMAN BIN SHAHRUDDIN	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
73	RAFEQAH BINTI RASLAN	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
74	NUR SHAHIDAH BINTI AB AZIZ	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
75	NURUL AIMI BINTI GHAZALI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
76	SITI NORAZIAN BINTI ISMAIL	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
77	NUR AZRINI BINTI RAMLEE	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
78	'AQILAH BINTI DOLLAH	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
79	'AZZAH NAZIHAH BINTI CHE ABDUL RAHIM	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
80	ARINA BINTI SAUKI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
81	ASDARINA BINTI YAHYA	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
82	FAIZNUR BINTI MOHD FUAD	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
83	FAUZIAH BT MARPANI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
84	HANAFIAH BIN ZAINAL ABIDIN	PENSYARAH	FAKULTI KEJURUTERAAN

			KIMIA
85	HARUMI VENY (DR)	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
86	HUSNA HAYATI BINTI JARNI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
87	KHALIL BIN ABDUL RAZAK	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
88	MOHD AIZAD BIN AHMAD	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
89	MOHD FAZRIL IRFAN BIN AHMAD FUAD	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
90	MUHAMAD FITRI BIN OTHMAN	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
91	MUHAMMAD SHAFIQ BIN MAT SHAYUTI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
92	NIK KHAIRUL IRFAN BIN NIK AB LAH	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
93	NORAIDA AMIN BINTI MD TAIB	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
94	NORASMAH BINTI MOHAMMED MANSHOR	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
95	NORAZLINAWATI BINTI MAAROF	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
96	NUR SHUHADAH BINTI JAPPERI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
97	RADZIAH BINTI WAHID (DR)	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
98	SITI FATMA BINTI ABD KARIM	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
99	SITI NURLIYANA BINTI CHE MOHAMED HUSSEIN	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
100	SUHAIZA HANIM BINTI HANIPAH	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
101	SURIATIE BINTI MAT YUSUF	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
102	SYAZANA BINTI MOHAMAD PAUZI	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
103	MOHD SAFUAN BIN ABD RAHMAN	PENSYARAH	FAKULTI KEJURUTERAAN KIMIA
104	ERFAN MOHAMMADIAN (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
105	FARAH HANIM BINTI AB HAMID (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
106	ISTIKAMAH BINTI SUBUKI (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
107	NORHIDAYAH BINTI IDERIS (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
108	NORMADYZAH BINTI AHMAD (IR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
109	NUR HIDAYATI BINTI OTHMAN (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
110	NURUL FADHILAH BINTI KAMALUL ARIPIN (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
111	PUTRI NADZRUL FAIZURA BINTI MEGAT KHAMARUDDIN (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
112	RAHIDA WATI BINTI SHARUDIN (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
113	SHARIF ABDULBARI ALI	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA

114	SITI NURUL'AIN BINTI YUSOP (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
115	TAN HUEY LING (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
116	ABDUL AZIZ BIN ISHAK	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
117	ATIKAH BT KADRI (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
118	CHRISTINA VARGIS A/P JONES @ JOHN VARGIS	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
119	FARIZA BT HAMIDON	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
120	HAZLINA BINTI HUSIN (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
121	NAJMIDDIN BIN YAAKOB (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
122	NOOR HARLIZA BINTI ABD RAZAK	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
123	NOORHALIZA BINTI AZIZ	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
124	NOR HALALIZA BINTI ALIAS	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
125	NOR HAZELAH BINTI KASMURI	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
126	NOR ROSLINA BINTI ROSLI (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
127	NORIN ZAMIAH BINTI KASSIM SHAARI (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
128	NORLIZA BINTI IBRAHIM (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
129	RABIATUL ADAWIYAH BINTI ABDOL AZIZ	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
130	SITI WAHIDAH BINTI PUASA (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
131	SITINOOR ADEIB BINTI IDRIS	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
132	SYAFIZA BINTI ABD HASHIB	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
133	UMMI KALTHUM BINTI IBRAHIM	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
134	ZULKIFLI BIN ABD RASHID (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
135	FARID MULANA (DR)	PROFESOR MADYA	FAKULTI KEJURUTERAAN KIMIA
136	NADIAHNOR BINTI MD YUSOP	PROFESOR MADYA	FAKULTI KEJURUTERAAN KIMIA
137	MD. AMIN BIN HASHIM	PROFESOR MADYA	FAKULTI KEJURUTERAAN KIMIA
138	JUNAIDAH BINTI JAI (DR.)	PROFESOR MADYA	FAKULTI KEJURUTERAAN KIMIA
139	KAMARIAH NOOR BT ISMAIL (DR)	PROFESOR MADYA	FAKULTI KEJURUTERAAN KIMIA
140	NOOR FITRAH BINTI ABU BAKAR (DR)	PROFESOR MADYA	FAKULTI KEJURUTERAAN KIMIA
141	MD. ASADULLAH MD. ABUL HOSSAIN	PROFESOR	FAKULTI KEJURUTERAAN KIMIA
142	NORNIZAR BINTI ANUAR (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN KIMIA
143	MOHD SUHAIRIL BIN MEON	PENSYARAH KANAN	FAKULTI KEJURUTERAAN

			MEKANIKAL
144	MUHAMAD FAUZI BIN OTHMAN	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
145	MOHD SYAHAR BIN MOHD SHAWAL	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
146	FARRAHSHAIDA BINTI MOHD SALLEH	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
147	IZDIHAR BINTI THARAZI	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
148	MOHD HANIF BIN MAT @ MUHAMMAD	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
149	MUHD AZIMIN BIN AB GHANI	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
150	AMALINA BINTI AMIR	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
151	NIK ROSELINA BINTI NIK ROSELEY	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
152	NURZAKI BIN IKHSAN	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
153	WAN SULAIMAN BIN WAN MOHAMAD	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
154	NURUL HAYATI BINTI ABDUL HALIM	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
155	FIRDAUS BIN MOHAMAD	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
156	AHMAD KHUSHAIRY BIN MAKHTAR (DR.)	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
157	AHSANA AQILAH BINTI AHMAD	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
158	AMINUDDIN BIN HAMID	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
159	BIBI INTAN SURAYA BINTI MURAT (DR)	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
160	ELI NADIA BINTI ABDUL LATIP	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
161	FAUZIAH BT MD YUSOF	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
162	FREDDAWATI BINTI RASHIDDY WONG	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
163	HAFIZAN BIN HASHIM	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
164	HAFIZI BIN LUKMAN	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
165	MOHAMAD MAZWAN BIN MAHAT	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
166	MOHAMMAD AZZEIM BIN MAT JUSOH (DR.)	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
167	MOHD HANIF BIN MOHD RAMLI (DR.)	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
168	MOHD NOR AZMI BIN AB PATAR	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
169	MOHD SAIFUL BAHARI BIN SHAARI	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
170	MUHAMMAD HUSSAIN BIN ISMAIL (DR.)	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
171	MUHAMMAD ZAIYAD BIN MUDA @ ISMAIL	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
172	MUHD FAIZ BIN MAT @ MUHAMMAD	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL

173	NOOR LEHA BINTI ABDUL RAHMAN	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
174	NOR MERLISA BINTI ALI	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
175	NORHELIENA BINTI AZIZ	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
176	NURSALBIAH BINTI NASIR	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
177	NURUL MUTHMAINNAH BINTI MOHD NOOR	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
178	NURUL SYUHADAH BINTI KHUSAINI	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
179	RAHANI BINTI ABDUL RAHMAN	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
180	ROSNADIAH BINTI BAHSAN	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
181	YA'AKOB BIN YUSOF	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
182	MOHAMAD ALI BIN AHMAD (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
183	MOHD AZMI BIN YUNUS (IR)(DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
184	MUHAD ROZI BIN MAT NAWI (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
185	MUHAMAD NORHISHAM BIN ABDUL RANI (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
186	RAMLAN BIN KASIRAN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
187	SITI MARIAM BINTI ABDUL RAHMAN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
188	ABDUL HALIM BIN ABDULLAH (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
189	AHMAD HUSSEIN BIN ABDUL HAMID (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
190	ALIAS BIN MOHD SAMAN (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
191	AMIRUL BIN ABD. RASHID (IR).(DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
192	ANIZAH BINTI KALAM (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
193	BULAN BINTI ABDULLAH (IR.)(DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
194	CHE FARIDAH BINTI MAT TAIB	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
195	FAUZIAH BINTI JERAI @ JUNAIDI (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
196	HAZRAN BIN HUSAIN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
197	HELMI BIN RASHID	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
198	IDRIS BIN SAAD (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
199	JURI BIN SAEDON (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
200	KAUSALYAH A/P VENKATASON (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
201	MOHD AFZAN BIN MOHD ANUAR (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
202	MOHD AZMAN BIN YAHAYA (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN

			MEKANIKAL
203	MOHD HAFIZ BIN MOHD NOH	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
204	MOHD SHAHRIMAN BIN ADENAN (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
205	MUHAMAD AZHAN BIN ANUAR	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
206	NOOR AYUNI BINTI CHE ZAKARIA (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
207	NOR FAZLI BIN ADULL MANAN (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
208	NOR HAFIEZ BIN MOHAMAD NOR (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
209	NORIAH BINTI YUSOFF (IR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
210	NORLIANA BINTI MOHD ABBAS (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
211	RAZALI BIN HASSAN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
212	RIZAL EFFENDY BIN MOHD NASIR (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
213	SAHRIL B KUSHAIRI	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
214	SHAHRUL AZAM BIN ABDULLAH @ AB AZIZ (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
215	SUKARNUR BIN CHE ABDULLAH (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
216	WAN EMRI BIN WAN ABDUL RAHAMAN (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
217	ZAINAL ABIDIN B KAMARUL BAHARIN (IR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
218	ZULKIFLI BIN MOHAMED (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
219	ZURAIDAH BT SALLEH (DR.)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
220	NOR AMALINA BT NORDIN	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
221	NOR 'AINI BT WAHAB	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
222	SOLEHUDDIN BIN SHUIB (DR.)	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
223	YUPITER HARANGAN PRASADA MANURUNG (DR)	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
224	YA'KUB B MD TAIB	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
225	ISMAIL NASIRUDDIN BIN AHMAD	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
226	JAMALUDDIN BIN MAHMUD (IR.) (DR)	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
227	MIMI AZLINA BT ABU BAKAR (DR.)	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
228	ZAMRI BIN ABDUL RAHMAN	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
229	AHMAD AZLAN BIN MAT ISA (DR)	PROFESOR	FAKULTI KEJURUTERAAN MEKANIKAL
230	MUHAMMAD AZMI BIN AYUB (IR)(DR)	PROFESOR	FAKULTI KEJURUTERAAN MEKANIKAL
231	WAHYU KUNTJORO (PROF. DR.)	PROFESOR	FAKULTI KEJURUTERAAN MEKANIKAL

232	WIRACHMAN WISNOE (DR)	PROFESOR	FAKULTI KEJURUTERAAN MEKANIKAL
233	MARDZIAH BINTI CHE MURAD	PENSYARAH	FAKULTI KEJURUTERAAN MEKANIKAL
234	AIDAH BINTI JUMAHAT (DR)	PROFESOR MADYA	FAKULTI KEJURUTERAAN MEKANIKAL
235	SHAHARUDIN BIN AHMAD (DR)	PENSYARAH KANAN	FAKULTI KEJURUTERAAN MEKANIKAL
236	MOHAMMAD MUBARRAK BIN MOHD YUSOF	PENSYARAH	FAKULTI PENDIDIKAN
237	NOREZAN BINTI IBRAHIM	PENSYARAH	FAKULTI PENDIDIKAN
238	HAMIZAD BIN ABDUL HADI	PENSYARAH	FAKULTI PENGURUSAN HOTEL & PELANCONGAN
239	MOHD TAUFIK BIN ZAMRI @ ZIMRI	PENSYARAH	FAKULTI PENGURUSAN HOTEL & PELANCONGAN
240	AZREEN JOANNA BINTI ABDUL	PENSYARAH	FAKULTI PENGURUSAN PERNIAGAAN
241	NORSIAH BT AHMAD	PENSYARAH	FAKULTI PENGURUSAN PERNIAGAAN
242	NURAKMAL BINTI RAMLI	PENSYARAH	FAKULTI PENGURUSAN PERNIAGAAN
243	NURYUSMAWATI BINTI MOHD YUSOF	PENSYARAH	FAKULTI PENGURUSAN PERNIAGAAN
244	AINUN NADZIRAH BINTI MAHMOOD	PENSYARAH	FAKULTI PENGURUSAN PERNIAGAAN
245	ABDUL LATIFF BIN ABDUL RAHMAN	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
246	AMILY BINTI FIKRY @ AZIZ (DR)	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
247	FAIZAH BINTI MD SOHID	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
248	NORZEHAN BINTI ABU BAKAR	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
249	SHAH RIZAL B ZAMBAHARI	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
250	SITI AMINAH BINTI MAINAL	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
251	YUSLINA LIZA BT MOHD YUSOF	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
252	ZATUL FAHANY BINTI HARUN	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
253	ZULKEFLI BIN ABDUL RAHMAN	PENSYARAH KANAN	FAKULTI PENGURUSAN PERNIAGAAN
254	MOHD AZAHARI BIN BASRI (DR.)	PENSYARAH	FAKULTI PERUBATAN
255	SHAFI MUHAMMAD NIZAMANI(DR)	PROFESOR MADYA	FAKULTI PERUBATAN
256	WAN SYAMEEN AFIRA BT WAN AHMAD KAMAL (DR.)	PENSYARAH	FAKULTI PERUBATAN
257	ADLI AZAM BIN MOHAMMAD RAZI (DR.)	PENSYARAH	FAKULTI PERUBATAN
258	NOR ELINA BINTI NOOR SHAARI (DR.)	PENSYARAH	FAKULTI PERUBATAN
259	RUSNAINI BINTI MUSTAPHA KAMAR (DR)	PENSYARAH	FAKULTI PERUBATAN
260	KARIS BIN MISIRAN	PROFESOR	FAKULTI PERUBATAN
261	SYAHRUL IMRAN BIN ABU BAKAR	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
262	NORIZAN BINTI AHMAT @ ABDUL HAMID (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
263	RAJA RAZUAN BIN RAJA DERIS (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
264	LIM YING SIEW	PENSYARAH	FAKULTI SAINS GUNAAN
265	MONA RITA BINTI OTHMAN	PENSYARAH KANAN	FAKULTI SAINS GUNAAN

266	SYAFAWATI NADIAH BINTI MOHAMED	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
267	NUR AIMI BINTI JANI	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
268	SURAYA BINTI AHMAD KAMIL	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
269	NURUL IZRINI BINTI IKHSAN	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
270	MOHD FAUZI BIN MAULUD	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
271	ZAINATHUL AKHMAR SALIM BT ABDUL SALIM	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
272	ROSLINDA BINTI FAUZI	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
273	NAJUA BINTI TULOS	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
274	SITI NURBAYA BINTI SUPARDAN	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
275	FALAH BIN ABU	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
276	NOR JULIANA BINTI MOHD YUSOF	PENSYARAH	FAKULTI SAINS GUNAAN
277	RABIATULADAWIYAH BINTI MD AKHIR	PENSYARAH	FAKULTI SAINS GUNAAN
278	RAJA ROSLAN BIN RAJA MOHAMED	PENSYARAH	FAKULTI SAINS GUNAAN
279	REENA BINTI ABD RASHID	PENSYARAH	FAKULTI SAINS GUNAAN
280	ZURIANTI BINTI ABD RAHMAN (DR.)	PENSYARAH	FAKULTI SAINS GUNAAN
281	ABDEL BASET MOHAMED EL NABWI ABDEL HAMID IBRAHIM	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
282	ALI H. JAWAD AL-TAIE	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
283	AMALINA BINTI MOHD TAJUDDIN (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
284	AZLAN BIN ZAKARIA	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
285	CHE PUTEH BINTI OSMAN (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
286	MAHESH KUMAR TALARI (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
287	MOHAMAD FARIZ BIN MOHAMAD TAIB (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
288	MOHD AZRI BIN AB RANI (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
289	MOHD HUSAIRI BIN FADZILAH SUHAIMI (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
290	MUHAMAD KAMIL BIN YAAKOB (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
291	NOOR ASNIDA BINTI ASLI (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
292	NOOR NAJMI BINTI BONNIA (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
293	NOR DALILA BINTI NOR AFFANDI (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
294	ROSSURIATI BINTI DOL HAMID (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
295	SITI AIMI SARAH BINTI ZAINAL ABIDIN (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
296	SITI ROHA AB MUTALIB (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
297	TAY CHIA CHAY (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
298	ADI BIN MD SIKIN (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
299	AHMAD FAIZA BIN MOHD	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
300	ANIDA BINTI YUSOFF (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
301	ANISZAWATI BT AZIS (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
302	AZRENA BINTI ABDUL KARIM	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
303	ENGKU ZAHARAH BINTI ENGKU ZAWAWI (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
304	FADHILAH BINTI LAMUN @ JAILANI (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
305	FAIRUS BIN MUHAMAD DARUS	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
306	FARAH LIYANA BINTI MUHAMMAD KHIR	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
307	HAIRUL AMANI BT ABDUL HAMID	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
308	JUDITH GISIP (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
309	KAMARULZAMAN BIN NORDIN (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
310	KHAIRUNNADIM BIN AHMAD SEKAK (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN

311	LIM YING CHIN (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
312	MISBAH BIN HASSAN (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
313	MOHAMAD FAIZUL BIN YAHYA (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
314	MOHD IQBAL BIN MISNON	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
315	MOHD MUZAMIR BIN MAHAT (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
316	MUHAMMAD ISMAIL BIN AB KADIR	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
317	NORAZILA BINTI IBRAHIM (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
318	NORAZURA BINTI IBRAHIM (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
319	NUR NADIAH BINTI MD. YUSOF	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
320	NUR'AIN BINTI YUSOF (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
321	RADIN SITI FAZLINA NAZRAH BT HIRZIN	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
322	ROSDIYANA BINTI HASHAM @ HISAM (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
323	ROSMAMUHAMADANI BIN RAMLI (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
324	ROSNAH BINTI ZAKARIA (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
325	SHARIL FADLI BIN MOHAMAD ZAMRI	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
326	SITI RAFEDAH BT ABDUL KARIM (DR.)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
327	SUZAINI BT ABDUL GHANI (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
328	SUZANA BINTI RATIM	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
329	SYED YUSAINEE BIN SYED YAHYA(DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
330	ZAKIAH BINTI MOHAMED (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
331	ABU HASSAN BIN HUSIN (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
332	HAIDER FA. ABDULAMIR	PROFESOR MADYA	FAKULTI SAINS GUNAAN
333	KHADIJAH BINTI OMAR (HAJAH) (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
334	LAILA HANIM BINTI MD IDRUS	PROFESOR MADYA	FAKULTI SAINS GUNAAN
335	MOHD ARIFF BIN JAMALUDIN (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
336	ROSLAN BIN ALI	PROFESOR MADYA	FAKULTI SAINS GUNAAN
337	TUAN DAUD @ WAN RAMLEE WAN A. KADIR (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
338	RUSNAH BT SAMSUDDIN (DR.)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
339	FAMIZA BINTI ABD LATIF (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
340	MOHD HANAPIAH BIN MOHD YUSOFF (DR.)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
341	MOHD. ROZI BIN AHMAD (PROFESOR MADYA DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
342	NAZLINDA BINTI ABDULLAH (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
343	SITI NORASMAH BINTI SURIP (DR.)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
344	TAN WINIE (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
345	YUSAIRIE BIN MOHD (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
346	AHMAD KAMAL HAYATI BIN YAHYA (PROF. DR.)	PROFESOR	FAKULTI SAINS GUNAAN
347	MOHAMAD KAMAL BIN HJ HARUN (PROF. DR.)	PROFESOR	FAKULTI SAINS GUNAAN
348	MOHD KAMIL BIN ABD. RAHMAN (HAJI)(PROF. DR.)	PROFESOR	FAKULTI SAINS GUNAAN
349	NORIZZAH BINTI ABD RASHID (DR)	PROFESOR	FAKULTI SAINS GUNAAN
350	SAIFOLLAH BIN ABDULLAH (PROF.) (DR)	PROFESOR	FAKULTI SAINS GUNAAN
351	AHMAD TAUFEK BIN ABDUL RAHMAN (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
352	JAAFAR BIN JANTAN (DR)	PROFESOR MADYA	FAKULTI SAINS GUNAAN
353	AISAH BT BUJANG (DR)	PENSYARAH	FAKULTI SAINS GUNAAN

354	KELIMAH ANAK ELONG	PENSYARAH	FAKULTI SAINS GUNAAN
355	MUHD FIRDAUS BIN KASIM (DR)	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
356	MASNAWI BIN MUSTAFFA	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
357	NAZLI BIN AHMAD AINI	PENSYARAH KANAN	FAKULTI SAINS GUNAAN
358	MOHD POZI BIN MOHD TAHIR	PENSYARAH KANAN	FAKULTI SAINS KESIHATAN
359	SHAPINA BINTI ABDULLAH	PENSYARAH KANAN	FAKULTI SAINS KOMPUTER & MATEMATIK
360	AHMAD SUKRI B ABD AZIZ	PROFESOR MADYA	FAKULTI SAINS KOMPUTER & MATEMATIK
361	JULIANA BINTI MANAN	PENSYARAH	FAKULTI SENI LUKIS & SENI REKA
362	NABILA AIMI BINTI MOHAMED GHAZALI	PENSYARAH	FAKULTI SENI LUKIS & SENI REKA
363	RAHMAN BIN ROSMAN	PENSYARAH KANAN	FAKULTI SENI LUKIS & SENI REKA
364	WAN NOR RAIHAN BINTI WAN RAMLI	PENSYARAH KANAN	FAKULTI SENI LUKIS & SENI REKA
365	OSKAR HASDINOR BIN HASSAN (DR)	PROFESOR MADYA	FAKULTI SENI LUKIS & SENI REKA
366	NORULNAZILAH BINTI AB'LAH	PENSYARAH	PUSAT ASASI
367	FADIATUL HASINAH BINTI MUHAMMAD	PENSYARAH KANAN	PUSAT ASASI
368	MEGAT MOHD IZHAR BIN SAPELI	PENSYARAH	PUSAT ASASI
369	NURUL RAIHAN BINTI MOHD SUIB	PENSYARAH	PUSAT ASASI
370	AIDA FAZLIZA BINTI MAT FADZIL	PENSYARAH KANAN	PUSAT ASASI
371	A'BIR WARDATI BINTI ABD LATIF	PENSYARAH	PUSAT ASASI
372	ERNEE SAZLINAYATI BINTI OTHMAN	PENSYARAH	PUSAT ASASI
373	MASNITA BINTI MAT JUSOH	PENSYARAH	PUSAT ASASI
374	NOOR ARDA ADRINA BINTI DAUD	PENSYARAH	PUSAT ASASI
375	NOOR `AISYAH BINTI JOHARI	PENSYARAH	PUSAT ASASI
376	NOORAKMAR HIDAYAH BT MOHAMED HASHINI	PENSYARAH	PUSAT ASASI
377	NOR FARIDAH HANIM BTE MAT JUNIT	PENSYARAH	PUSAT ASASI
378	NORJULIYATI BINTI HAMZAH	PENSYARAH	PUSAT ASASI
379	NUR ASYIKIN BINTI AHMAD NAZRI	PENSYARAH	PUSAT ASASI
380	NUR'AIN BINTI HAMDAN	PENSYARAH	PUSAT ASASI
381	NURKHAIZAN BT ZULKEPLI	PENSYARAH	PUSAT ASASI
382	NURUL HUDA BINTI MOHD NOOR	PENSYARAH	PUSAT ASASI
383	PUTERI NOOR SAFURA BINTI MEGAT MAHMUD	PENSYARAH	PUSAT ASASI
384	SITI AISYAH BT ZAWAWI	PENSYARAH	PUSAT ASASI
385	SITI IRMA YUANA BINTI SHEIKH MOHD SAAID	PENSYARAH	PUSAT ASASI
386	IKHWAN NAIM BIN MD NAWI (DR.)	PENSYARAH KANAN	PUSAT ASASI
387	MOHD ISA BIN MOHD YUSOF	PENSYARAH KANAN	PUSAT ASASI
388	NOR HAYATI BINTI MUHAMMAD (DR)	PENSYARAH KANAN	PUSAT ASASI
389	QISTINA BINTI OMAR	PENSYARAH KANAN	PUSAT ASASI
390	SITI RUDHZIAH BINTI CHE BALIAN (DR.)	PENSYARAH KANAN	PUSAT ASASI
391	ZUHAIRUSNIZAM BIN MD. DARUS	PENSYARAH KANAN	PUSAT ASASI
392	MOHD AZAM BIN ABDUL RAHMAN	PROFESOR MADYA	PUSAT ASASI