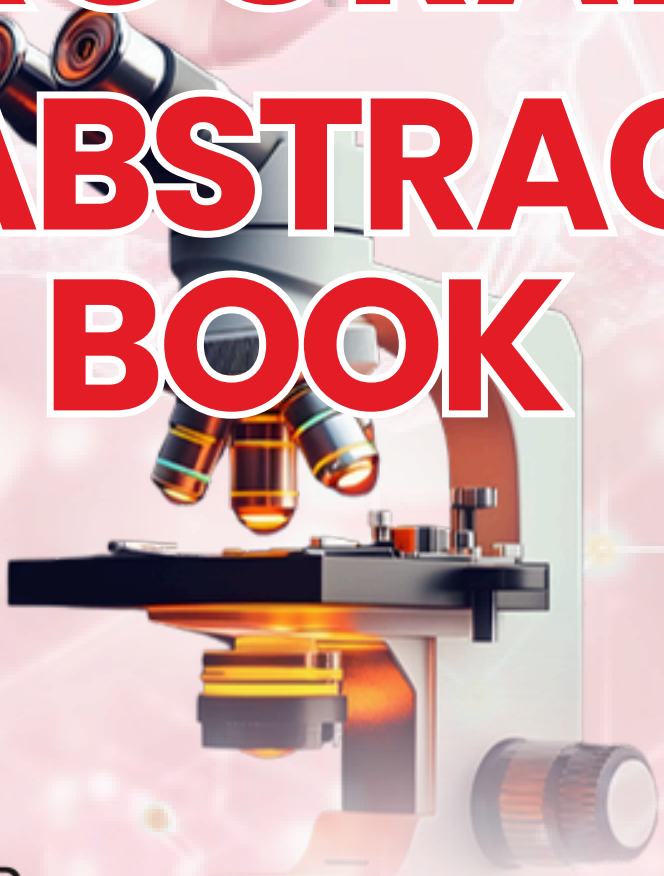
UTM Universiti Teknologi Malaysia | Faculty of Mechanical Engineering

Persatuan Mikroskopi Malaysia

PROGRAM & ABSTRACT BOOK



33RD SCMSM2025

SCIENTIFIC CONFERENCE OF MICROSCOPY SOCIETY MALAYSIA

EXPLORING THE INVISIBLE THROUGH LENS : INNOVATIONS IN MODERN MICROSCOPY

25 - 26 NOVEMBER 2025

OPERO HOTEL , SOUTHKEY

JOHOR BAHRU , MALAYSIA

ORGANIZED BY : FACULTY OF MECHANICAL ENGINEERING UNIVERSITI TEKNOLOGI MALAYSIA, JOHOR & MICROSCOPY SOCIETY MALAYSIA

CO-ORGANIZER : UTHM | Malaysian Journal of Microscopy MJM | UTeM

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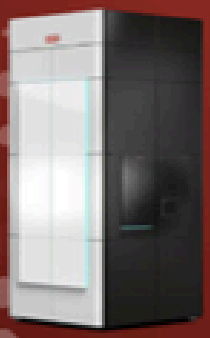

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FOREWORD MESSAGE

Prof. Ir. Ts. Dr. Zaini Bin Ahmad

Dean, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia

Assalamualaikum Warahmatullahi Wabarakatuh

It is my great honour to welcome our distinguished guests, President of the Microscopy Society of Malaysia (MSM), Dr Mohd Shukri Baba; Past President of MSM, Dr Ahmad Fauzi Mohd Noor; dedicated Chairperson of SCMSM 2025, Assoc. Prof. Dr Tuty Asma Abu Bakar, and the hardworking members of the organising committee; distinguished members of the MSM council; our valued exhibitors and industry partners, especially our gold sponsors, Interscience Sdn Bhd and Hitech Instruments Sdn Bhd; respected judges, invited speakers, participants and delegates, colleagues, students, and ladies and gentlemen.

Prof. Ir. Ts. Dr. Zaini bin Ahmad
Dean,
Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

It is indeed my great pleasure and honour to welcome all of you to 33rd Scientific Conference of Microscopy Society Malaysia (SCMSM 2025), proudly hosted by Universiti Teknologi Malaysia (UTM) and held at the Opero Hotel, Johor Bahru.

This year's conference holds special significance as it brings together a vibrant community of experts, researchers, and industry leaders from Malaysia, Singapore, China, and beyond to share the latest advancements, innovations, and applications in microscopy. As the main organizer, UTM, through the Faculty of Mechanical Engineering, in collaboration with the Microscopy Society of Malaysia (MSM), is honored to facilitate this prestigious platform that fosters research excellence, collaboration, and knowledge exchange across academia and industry.

Microscopy plays a pivotal role in scientific discovery, enabling us to observe and analyze matter at the nanoscale and unlocking new insights in materials science, engineering, biomedical applications, and environmental research. Through SCMSM 2025, we aim to encourage interdisciplinary dialogue and inspire new directions in research and innovation that will advance this exciting field.

I would also like to extend my sincere appreciation to our sponsors and partners from Malaysia, Singapore, and China for their unwavering support and contribution in making this event a success. Your commitment to advancing microscopy and nurturing scientific collaboration is deeply valued. To all participants, I encourage you to seize this opportunity to network, share ideas, and explore collaborative ventures. May your experience at SCMSM 2025 be both rewarding and inspiring. Welcome to Johor Bahru, and I wish you a successful and memorable conference.

PREFACE

Dr. Mohd Shukri bin Baba

President, Microscopy Society Malaysia (MSM)

Assalamualaikum w.b.t, good day and Salam Madani.

Dr. Mohd Shukri bin Baba
President, Microscopy Society Malaysia (MSM)

First and foremost, I would like to thank and express my highest gratitude to all speakers, participants, sponsors and everyone for being participating in this prestigious annual conference. Selamat datang and welcome to 33rd Scientific Conference of Microscopy Society Malaysia 2025 (33rd SCMSM 2025).

For this year, Universiti Teknologi Malaysia (UTM) has been entrusted to host the 33rd SCMSM. Even more meaningfully, this year's conference is further strengthened by a strong collaboration with Universiti Teknologi Malaysia (UTM) and the Microscopy Society Malaysia. With the chosen theme for this session's conference, 'Exploring the Invisible Through Lens: Innovations in Modern Microscopy', I believe this year's edition will spark fresh and valuable ideas from various microscopy-related sectors, such as academia, research, diagnostics, industry, and innovation. To me, the selected theme is highly relevant, and its implementation is very timely, especially as we are now in an era where the exploration of artificial intelligence (AI) is rapidly gaining the momentum.

I would like to express my utmost appreciation to both plenary speakers for this year's conference: Prof. Ts. Dr. Mohd Hafiz Dzarfan bin Othman from UTM and Dr. Md Azman bin Seani Mohamed from SIRIM Industrial Research Kedah. I would also like to extend my gratitude to the two keynote speakers from UTM, Assoc. Prof. Ir. Ts. Dr. Muhamad Azizi bin Mat Yajid and Assoc. Prof. Ts. ChM Dr. Nik Ahmad Nizam bin Nik Malik, as well as Mr. Afdzal Syahadat Husni bin Husin from MIMOS Berhad, Kuala Lumpur. All of them are distinguished individuals entrusted to share their expertise with all conference participants, and I believe the information they provide will be highly beneficial to all of us.

I would also like to take this opportunity to express my deepest appreciation and thanks to all the companies that generously agreed to be the sponsor for this conference. Special thanks go to our two gold sponsors, InterScience and Hi-Tech Instruments, as well as our two silver sponsors, JEOL and CIQTEK. Not to be forgotten are our two bronze sponsors, Oxford Instruments and Matrix Optics, along with all the other exhibitors who have contributed to the success of this

conference. Year after year, the sponsors of the SCMSM conference have served as the backbone of SCMSM organization. Without their support and collaboration, I am certain this conference would not have been as successful. It is my hope that the continued contribution and support from these industry players will further strengthen the networking between MSM and industries through SCMSM and other related activities in the future.

Last but not least, I would like to express my highest gratitude to all dedicated members of 33rd SCMSM Committee and MSM Exco members for their everlasting commitment and hard work.
I welcome all oral and poster presenters, participants and speakers to 33rd SCMSM 2025.
I wish you all a fruitful, safe and enjoyable experience..!

Thank you.

PREFACE

Assoc. Prof. Dr. Tuty Asma Binti Abu Bakar

CHAIRMAN OF SCMSM 2025

Assalamualaikum warahmatullahi wabarakatuh
Good day and Salam UTM Sanjungan Bangsa

Assoc. Prof. Dr.
Tuty Asma Binti Abu Bakar
Chairman

It is my great honour to welcome all of you to the 33rd Scientific Conference of the Microscopy Society Malaysia (SCMSM 2025).

First and foremost, I would like to extend my deepest appreciation and sincere gratitude to the Microscopy Society Malaysia (MSM) for the trust and confidence placed in Universiti Teknologi Malaysia (UTM) to host this prestigious annual conference. I would like to welcome warmly and thank all our distinguished speakers, participants, sponsors, collaborators, and guests for joining us at this meaningful gathering of the microscopy community.

This year, UTM is honoured to host the 33rd SCMSM 2025. What makes this event even more special is the strong collaboration between UTM and MSM, which continues to strengthen our shared commitment to advancing microscopy research and innovation. Guided by the conference theme, "Exploring the Invisible Through Lens: Innovations in Modern Microscopy," I am confident that this year's addition will inspire new perspectives and generate impactful discussions among participants from diverse backgrounds, academia, researchers and industry.

I would like to convey my heartfelt appreciation to our plenary speakers, Prof. Ts. Dr Mohd Hafiz Dzarfan bin Othman and Dr Md Azman bin Seeni Mohamed, for their invaluable contribution to this conference. My gratitude also goes to our keynote speakers, Assoc. Prof. Ir. Ts. Dr Muhamad Azizi bin Mat Yajid, Assoc. Prof. Ts. ChM. Dr. Nik Ahmad Nizam bin Nik Malek and Mr Afdzal Syahadat Husni bin Husin for sharing their expertise and insights with us. We are truly privileged to have such distinguished experts whose knowledge will undoubtedly enrich this conference.

A special note of thanks also goes to the generous sponsors, whose unwavering support makes this event possible. I wish to acknowledge our gold sponsors, InterScience (ITS) and Hi-Tech Instruments; our silver sponsors, JEOL and CIQTEK; our bronze sponsors, Oxford Instruments and Matrix Optics; and other exhibitors who have contributed to the success of SCMSM 2025. Over the years, our sponsors have been the backbone of this conference, and their continuous partnership has played a vital role in sustaining and growing this platform. I hope that this strong collaboration between UTM/MSM and our industry partners will continue to flourish, further strengthening networks and fostering future opportunities through SCMSM and other related initiatives.

I would also like to take this opportunity to welcome and thank two former Presiden of the MSM, Dr Ahmad Fauzi Mohd Noor and Professor Captain (Rtd.) Dr Farid bin Che Ghazali, the current chairman of MSM, Dr Mohd Shukri Baba and the MSM Executive Committee for joining and supporting this conference.

Last but certainly not least, I wish to extend my utmost gratitude to the 33rd SCMSM 2025 Organising Committee for their unwavering hard work, dedication, and exceptional teamwork in making this conference a reality.

To all our speakers, oral and poster presenters, participants and guests, welcome once again to the 33rd SCMSM 2025. I wish you all a productive, inspiring and enjoyable conference experience.

Thank you.

ORGANIZING COMMITTEE OF 33RD SCIENTIFIC CONFERENCE OF MICROSCOPY SOCIETY MALAYSIA (SCMSM 2025)

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Assoc. Prof. Dr. Tuty Asma binti Abu Bakar

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Mr. Muhammad Muaz bin Mahmud
Mr. Norhafizan bin Hussin

Protocol / Local Arrangement
Ir. Dr. Norikhwan bin Hamzah
Mr. Isamir bin Isa
Mr. Adnan bin Ali

PROGRAM SCHEDULE

Pre-Conference Workshop

Date : 24 November 2025 (Tuesday)
Venue : Opero Hotel Southkey, Johor Bahru, Malaysia
Time : 1.30 pm - 6.00 pm

Time	Activities
1:30 PM	: Registration
2:00 PM	: Opening remark
2.10 PM	: **Module 1**: Dr. Loh long Ying from Park Systems *Introduction to Nanoscale Imaging and Characterization*
2.40 PM	: **Module 2**: Assoc. Prof. Dr. William Chong from UTM *Seeing Friction at the Molecular Scale*
3.10 PM	: **Module 3**: Chok Xun Hao from Park Systems *Beyond AFM*
3.40 PM	: Tea break
4.00 PM	: **Module 4**: Dr. Loh long Ying, Application Scientist *Hands-on with AFM*
5.30 PM	: Closing speech by SCMSM2025

PROGRAM

SCHEDULE DAY 1

Conference

Date : 25 November 2025 (Tuesday)
Venue: Opero Hotel Southkey, Johor Bahru, Malaysia
Time : 8.00 AM - 5.00 PM

Time	Activities
8.00 AM	: Registration
9:00 AM	: Welcoming Remarks by Chairman of SCMSM 2025 Opening Remarks by Dean, Faculty of Mechanical Engineering, UTM Photo Session
9:30 AM	: **Plenary Speaker 1** Dr. Md Azman Bin PKM Seeni Mohamed Senior Director, Advanced Material Research Centre (AMREC) SIRIM Industrial Research *AI for Micro World: From Pixels to Perception*
10.15 AM	: Tea break
10:45 AM	: **Invited Speaker 1 ~ Interscience Sdn. Bhd** Dr. Nie Xin Senior Product Specialist, APAC Electron Microscopy for Life Science *AI Powered Electron Microscopy for Translational Biomedicine Advancing Therapeutics and Vaccines*
11:15 AM	: **Keynote Speaker 1** Assoc. Prof. Ts. ChM Dr. Nik Ahmad Nizam bin Nik Malek Deputy Dean (Research, Development & Innovation), Faculty of Science, Universiti Teknologi Malaysia (UTM) *Microscopic Evaluation on Bacterial Morphology Post-Treatment with Silver Nanocomposites*
11:45 AM	: **Invited Speaker 2 ~ Hi-tech Instruments Sdn. Bhd.** Mr. Tay Khoon Yang Managing Director *Aberration-corrected TEM / STEM / SEM for both static (HV) and (in-situ) atomic-scale studies*
12:30 PM	: **Keynote Speaker 2** Mr. Afdzal Syahadat Husni bin Husin CEO of MIMOS Technology MIMOS Berhad, Kuala Lumpur *MIMOS' Role and Capabilities in Advancing Microscopy and Materials Characterisation in Malaysia*
1:00 PM	: Lunch
2:00 PM	: **Parallel Session 1**
3.30 PM	: **Parallel Session 2 & Poster Evaluation**
5.00 PM	: Refreshments

PROGRAM

SCHEDULE DAY 1

Conference Dinner-SCMSM 2025

Date : 25 November 2025 (Tuesday)
Venue: Main Ballroom
Time : 8:00 PM – 10:00 PM
Attire/Theme : Smart casual

Time	Activities
8:00 PM	: Arrival & Registration
8:30 PM	: SCMSM Opening remark
8:30 PM	: Dinner is Served
	1st Performance
8:35 PM	: **Award Ceremony**
	Award - Travel Grant (5 paper)
8:45 PM	: *2nd Performance*
9:00 PM	: **Lucky Draw 1**
9:10 PM	: *3rd Performance*
9:25 PM	: Token of Appreciation to Sponsors & Exhibitors
	MSM announcement
9:45 PM	: *4th Performance*
10:00 PM	: **Lucky Draw 2**
10:10 PM	: *5th Performance*
10:25 PM	: Networking & Dinner end

PROGRAM

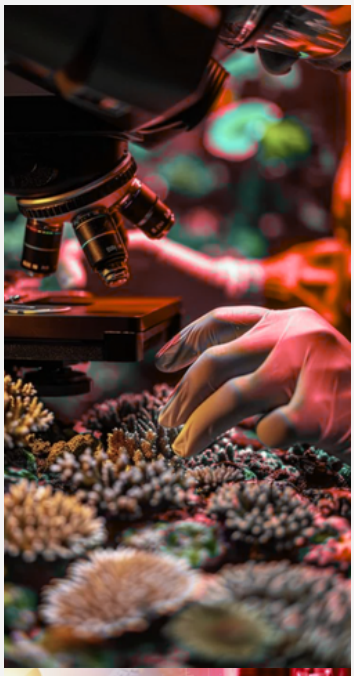
SCHEDULE DAY 2

Conference

Date : 26 November 2025 (Wednesday)
Venue : Opero Hotel Southkey, Johor Bahru, Malaysia
Time : 8.30 am - 5.15 pm

Time	Activities
8.30 AM	: **Plenary Speaker 2** Prof. Ts. Dr. Mohd Hafiz Dzarfan bin Othman Chair of Frontier Materials Research Alliance, Universiti Teknologi Malaysia (UTM) *From Microstructure to Impact : Membrane Technologies for Environmental Sustainability*
9.15 AM	: **Keynote Speaker 3** Assoc. Prof. Ir. Ts. Dr. Muhammad Azizi Mat Yajid Deputy Dean (Research, Innovation and Development), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM) *Aerogel Composites and Coatings:Enhancing Performance Through Nanostructured Materials*
9.45 AM	: **Invited Speaker 3 ~ Interscience Sdn. Bhd.** Dr. Shawn Yu Shu Hearn Product Specialist Thermo Fisher Scientific *Modern TEM for Materials Research: Advancements from Talos F200(atomic resolution) to Spectra 300 (sub-Å) and Iliad (integrated EELS)*
10.15 AM	: Tea break
10.45 AM	: **Invited Speaker 4 ~ JEOL (Malaysia) Sdn. Bhd.** Dr. Rizuan Mohd Rosnan Application engineer *Empowering Nanoscale Research: The Versatility of JEOL F200/F2 TEM*
11.15 AM	: **Invited Speaker 5 ~ CIQTEK Sdn. Bhd.** Mr. Wu Liang Laboratory Manager & Solution Engineer *The Innovation Path of CIQTEK's Ultra-High-Resolution Electron Microscope and Integrated Solutions*
11.45 AM	: **Invited Speaker 6 ~ Oxford Instruments** Mr Simon Fong Territory Sales Engineer *Correlative Raman-SEM-EDX Study on Lithium-Ion Battery Degradation with RISE Microscopy*
12.15 AM	: **Invited Speaker 7 ~ Matrix Optics Sdn. Bhd.** Dr. Lim Fang Sheng Product Application Specialists *Exploring the Frontiers of Microscopy: Integrating SEM, FIB-SEM, Micro-CT, and 4D-STEM with TESCAN Technologies*
12.45 PM	: Lunch
2.00 PM	: **Parallel Session 3**
3.30 PM	: Award Presentation & Closing Ceremony
4.15 PM	: Refreshments

PARTICIPANT GUIDELINES



Registration / Helpdesk
The registration will be held as follow:
Date: **24 - 26 November 2025**
Time: **8.00 am**
Venue: Opero Hotel Southkey, Johor Bahru, Malaysia

At registration, you will be given conference kit, including the detailed program tentative schedule. Staff will be available at the registration desk located in front of session room to answer any enquiry.

Presentation Instructions
The room are equipped with a laptop and a projector. Presenters must provide the presentation slides in PPT (PowerPoint) format on a USB memory stick. This must be done before each session started. Chairpersons are requested to keep the session on the schedule.

Papers should be presented in the order they are listed in the program for convenience of attendees. IT teams will be available during the conference to be contacted in case of arising problems.

Meals and Refreshments

Tea breaks
Coffee breaks will be served according to the program and they will be served at the Grand Florius Hall.

Buffet lunch
Buffet lunch will be served at the Olive Cafe.

PRE-CONFERENCE WORKSHOP

INTRODUCTION TO ATOMIC FORCE MICROSCOPY (AFM) HALF-DAY WORKSHOP

Park Systems Pte.Ltd. www.parksystems.com
10 Science Park Rd, #01-03, TheAlpha, Science Park 2, Singapore 117684
UEN/GST Reg. No.201218101E Tel. +65-6634-7470

Date : 24 November 2025 (Monday)
Time : 1.00 pm - 6.00 pm
Venue : Opero Hotel Southkey, Johor Bahru, Malaysia

Overview

This half-day workshop provides a concise yet comprehensive introduction to Atomic Force Microscopy (AFM), a powerful and versatile nanotechnology tool for surface analysis. Participants will gain a foundational understanding of AFM principles, operational modes, and its diverse applications across various scientific disciplines.

Workshop Objectives

Upon completion of this workshop, participants will be able to:

- Understand the fundamental principles behind AFM operation.
- Identify and differentiate between common AFM imaging modes
- Recognize the capabilities and limitations of AFM for surface characterization.
- Appreciate the diverse applications of AFM in various fields.
- Understand basic considerations for sample preparation and data interpretation.

Workshop Outline (4 hours). 2.00- 6.00 pm

Module 1: Dr. Loh Iong Ying from Park Systems (30 minutes)

- Introduction to Nanoscale Imaging and Characterization
- Basic Principle of AFM: Cantilever, Tip, and Sample Interaction
- How AFM Works: Deflection, Feedback Loop, and Image Formation
- Key Components of an AFM System
- Contact Mode AFM: Principles, Advantages, and Disadvantages
- Tapping Mode AFM (Intermittent Contact Mode): Principles, Advantages, and Disadvantages
- Non-Contact Mode AFM: Principles and Niche Applications
- Introduction to Advanced AFM Modes (e.g., Phase Imaging, Force Spectroscopy - overview)

Module 2: Assoc. Prof. Dr. William Chong from UTM (30 minutes)

- Seeing Friction at the Molecular Scale: Lateral Force Microscopy for Understanding Boundary Lubricity in Sustainable Lubricants

Module 3: Chok Xun Hao from Park Systems (30 minutes)

- Beyond AFM - New Characterization Techniques For Film Thickness and Nanometrology Analysis

Module 4: Hands on with AFM (1 hour 30 minutes)

- Basic operation of AFM (cantilever exchange, laser alignment, sample placement).
- Live demo of different imaging modes (Contact, non-contact, tapping)
- Demonstration of advanced modes (KPFM, C-AFM, PinPoint NanoMechanical)
- Common Artifacts and Troubleshooting Tips
- Data Interpretation Basics

Instructor

Dr. Loh Iong Ying, Application Scientist (Park Systems Singapore)

PARALLEL SESSION 1

TUESDAY, 25 NOVEMBER 2025, 2:00 PM – 3:30 PM

BREAKOUT ROOM	PAPER ID, TITTLE, PRESENTER NAME
Venue: Grand Florius Ballroom **Theme:** Materials **Session Chair & Jury** Dr. Yazid Yaakob (UPM) **Jury:** Dr. Md Azman Seeni Mohamed (SIRIM) **Time Keeper:** Mr. Muhammad Afiq Irfan Mohd Shumiri *2.00 - 3.15 pm	**UTM07** **Effects of Sintering Temperature on The Microstructures and Adhesion Strength of Slurry Sprayed Functionally Graded-Thermal Barrier Coating** *Fadzlun Nadrah Mohd Sharuddin, Muhammad Azizi Mat Yajid* **UTEM02** **Influence of Ball Milling Speed on the Structural and Hardness Properties of Eggshell-Derived Hydroxyapatite for Biomedical Applications** *Zhi Xian Woon, Adibah Haneem Mohammad Dom, Toibah Ab Rahim, Zurina Shamsuddin, Fatma Zehra Koçak* **UTHM04** **Utilization of Natural Silica from Rice Husk Ash to Improve Electrical Conductivity Of SDC-Based IT-SOFC Electrolyte** *Zolhafizi Jaidi, Mohd Azham Azmi & Hamimah Abd Rahman* **UTHM01** **Sustainable Recovery and Classification Recovered Materials of Electric Vehicle (EV) Discarded Battery** *Zolhafizi Jaidi, Mohd Azham Azmi, Siti Nordiana Binti Jamil, Nurul Farahin Mohd Zulkafli* **UTM16** **Thermal treatment-driven evolution of deformation geometry and yield strength in Zn–Mn alloys** *Kar Fei Chan, Cong Li Ng, Batrisyia Balqis, Yazid Yaakob, Hidetoshi Miyazaki, Masaki Tanemura, Mohd Zamri Mohd Yusop*
Venue: OMNIA I Hall **Theme:** Nanotechnology **Session Chair & Jury:** PM Ts. ChM Dr. Nik Ahmad Nizam Nik Malek (UTM) **Jury:** Prof Dr. Ismail Zainol (UPSI) **Time Keeper:** Miss Nur Diyana Nadhah Norhasrul Hadi	**UNITEN01** **UiO-66 Nanocrystals: Modulated Synthesis and Multi-Technique Characterizations** *Azieyanti Nurain Azmin, Fei Ling Pua@Grace Pua, Halina Misran* **UPM01** **Anodic Aluminum Oxide Composite Coatings Reinforced with Carbon Nanotubes and Graphene Nanoplatelets: Surface Morphology and Corrosion Resistance** *Nik Hafizuddin Effandi Nazila, Tan Sin Tee, Md Shuhazlly Mamat, Shahira Liza, and Yazid Yaakob* **UTM12** **Phase Stability and High-Temperature Oxidation Mechanism Divergence in Al30Cr15Ni15Si10Ti30 High-Entropy Alloy at 1000 °C** *Mudassar Hussain, Junsen Wang, Abdillah Sani Mohd Najib, Nor Akmal Fadil, Jing Liu, and Tuty Asma Abu Bakar* **VEN01** **Advanced Applications of Atomic Force Microscope** *Iong Ying Loh* **UTEM12** **Correlations between Porosity, Thermal Conductivity and Mechanical Strength in Bi-layered Ceramics with Different Pressing Pressure** *Mohamed Lokman Jalaluddin, Umar Al-Amani Azlan, Mohd Warikh Abd Rashid, Norfauzi Tamin and Muchlis*
Venue: OMNIA II Hall **Theme:** Engineering **Session Chair & Jury:** Dr. Abdul Hakim bin Md Yusop (UTM) **Jury:** Prof. Dr. Maizlinda Izwana Idris (UTHM) **Time keeper:** Cik Nurul Syafiqah Tapak	**UMP01** **Characterization and Analysis of Surface Morphology in Ti-6Al-4V Components Fabricated via Selective Laser Melting** *Mohd Faizal Sadali, Syahir Amzar Zulkifli, Mohd Yusrizal Mohd Yusoof, Mahadzir Ishak, Mohamad Zaki Hassan* **USM01** **Chemically Activated Sunflower Seed Shell Based Activated Carbon for Allopurinol Removal: Isotherm, Kinetics and Regeneration Studies** *Siti Zawiyah Baharom, Azrina Aziz, Erniza Mohd Johan Jaya, and Mohd Azmier Ahmad* **UTEM05** **Mechanical and Microstructural Comparison of FDM-Printed and SLS-Printed for Additive Manufacturing of Rehabilitation Devices** *Ruzy Haryati Hambali, Vinna Chia, Siti Hajar Binti Sheikh Md Fadzullah* **UTEM08** **Effect of Pulse Frequency on TiC Nanocomposite Coating Fabricated by TIG Torch Melting** *Alin Qistina Shamsuri, Lailatul Harina Paijan, Aslam Hadi Hamzah, Mohd Fauzi Mamat, Shahira Liza Kamis*

PARALLEL SESSION 2

TUESDAY, 25 NOVEMBER 2025, 3:30 PM – 5:00 PM

BREAKOUT ROOM	PAPER ID, TITTLE, PRESENTER NAME
Venue: Grand Florius Ballroom **Theme:** Materials **Session Chair &Jury:** Prof. Dr. Nur Izan Syahriah Hussein (UTEM) **Jury:** PM Ts. Dr. Che Nor Aiza Jaafar (UPM) **Time keeper:** Pn. Fadzlun Nadrah Mohd Sharuddin *3.15 - 4.30 pm	**UTHM03** **Impact of Calcination Temperature (600 – 750°C) On $SRCO_3$ Formation and Microstructural-Thermal Properties Of SSC-SDCC Cathodes for Low-Temperature Solid Oxide Fuel Cells** *Sufizar Ahmad, Umira Asyikin Yusop, Siti Fairus Mohammad, Hamimah Abd Rahman, Mohd Azham Azmi* **UTM10** **Development of Thermal Insulating Paint: Influence of Aerogel Slurry Loading on Dispersion Stability, Surface Wettability and Thermal Performance** *Rozalina Amran, Hong Ling Chuan, Nuhairi Alias, Muhamad Azizi Mat Yajid, Zaiton Abdul Majid, Abdillah Sani Mohd Najib, Nuha Awang, Zulhelmi Alif Abdul Halim* **UTM09** **Microstructures and Physicochemical Evaluations of Mg-Fe Anodes for Implantable Battery Applications** *Gonga Sutradhar, Abdul Hakim Md Yusop* **GOV03** **Evaluating The Effect of Precipitated Calcium Carbonate (PCC) Morphologies on Paper Coating Using FESEM Imaging** *Siti Noorzidah Mohd Sabri, Rohaya Othman, Zawawi Mahim, and Emee Marina Salleh*
Venue: OMNIA I Hall **Theme:** Applied Sciences **Session Chair & Jury:** Dr. Siti Salwa Alias (UTM) **Jury:** PM Dr. Intan Shameha Abdul Razak (UPM) **Time keeper:** En. Mudassar Hussain	**UTM06** **The Corrosion Behaviour of Zn–Al Alloys in Alkaline Environment: Influence of Composition, Cooling Rate, And Heat Treatment** *Nur Diyana Nadhah Norhasrul Hadi, Abdillah Sani Mohd Najib, Nor Akmal Fadil* **GOV01** **The Utilization of Local Silica Sand for the Production of Decorative Coloured Glass** *Nabihah Othman, Mohd Idham Mustaffar, Syarifah Aminah Ismail and Mohd Hakim Ibrahim* **UTM08** **Effect of Surface Laser Shock Peening on the Tensile Properties and Hardness of Selective Laser Melted (SLMed) A357 Alloy** *Agbaye Ignatius Uyabemem, Tuty Asma Abu Bakar, Aini Zuhra* **UTHM05** **Effect of Calcination on Crayfish Shells** *Saraswathy A/P Vellaitham, Hasan Zuhudi Abdullah, Muhammad Abdul Latiff Abu Bakar, Maizlinda Izwana Idris* **UTHM06** **Effect of Calcination Temperature on Hydroxyapatite from Tilapia Fish Bone for Biomedical Application** *Mohamad Hashim Mohd Sabirin, Maizlinda Izwana Idris, Hasan Zuhudi Abdullah* **UNIKL01** **Temperature-Modified Biochar Enhances Methane Yield and Process Stability in Anaerobic Digestion of Palm Oil Mill Effluent** *Stasha Eleanor Rosland Abel, Soh Kheang Loh, Robert Thomas Bachmann, Amelia Md Som*
Venue: OMNIA II Hall **Theme:** Materials / Applied Sciences / Life Science **Session Chair & Jury:** Dr. Najlaa Nazihah Mas'ood (UTM) **Jury:** Dr. Syahriza Ismail (UTEM) **Time keeper:** Cik Nurul Syafiqah Tapak	**UTM15** **Effect of Load and Counterpart Ball on The Friction and Wear Behavior Of DLC-Flake-Reinforced Composite Oxide Films** *Nur Aszreen Zulkifli, Shahira Liza, Kanao Fukuda, Yazid Yaakob, Hiroki Akasaka* **UTHM10** **Fabrication and Characterisation of Microcapsule from Sunflower Oil for Self-Healing Applications** *Norwahdah Rahmat, Z. Baharom, *Hassan Zuhudi Abdullah, M. I. Idris, and Nor Adrian Nor Salim* **UTM18** **Effect of Addition of Pr-Sb on Microstructural and Mechanical Properties of Al-15%Mg2Si Composite** *Alif Fajar Putrawan, Nor Akmal Fadil, Tuty Asma Abu Bakar, Hamidreza Ghandvar ,Shazarel Shamsudin* **UTEM22** **Engineering by Nature: Scanning Electron Microscopy-Based Structural Analysis and Surface Wettability Assessment of Tropical Foliage for Biomimetic Applications** *Hans Ezechiel A/L Henry, Aiman Roslizar* **UTHM07** **Fabrication of Wound Healing Materials from Fish Gelatin and Chitosan** *Noor Athirah Aida Noor Rizan @ Noor Jehan, Maizlinda Izwana Idris* **LUCM01** **The Translational Imperative: Microscopic and Spectroscopic Blueprint of Optimized Fucosylated Chondroitin Sulfate Scaffolds for Craniomaxillofacial Regeneration** *Farid Che Ghazali, Rasheed Abu Salam*

PARALLEL SESSION 3

WEDNESDAY, 26 NOVEMBER 2025, 2:00 PM – 3:30 PM

BREAKOUT ROOM	PAPER ID, TITTLE, PRESENTER NAME
Venue: Grand Florius Ballroom **Theme:** Materials **Session Chair & Jury:** Dr. Aizuddin Supee (UTM) **Jury:** Ir. Ts. Dr. Wan Fahmin Faiz (UTM) **Time keeper:** Cik Nur Diyana Nadhah Norhasrul Hadi	**UTM02** **Electrochemical Performance of Antimony-Modified Porous Lamellar Zinc Alloy Anode in Alkaline Aqueous Electrolyte** *Muhammad Afiq Irfan Mohd Shumiri, Abdillah Sani Mohd Najib, Hikari Sakaebe, Nor Akmal Fadil* **GOV02** **Development of Creamed Ammonia-Free Deproteinized Natural Rubber Latex for the Cottage Industry** *Azman Sampol, Ahmad Syaheer Abu Aswad, Siti Shuhada Shuib, Roslim Ramli, Nurulhuda Abdullah* **UMT01** **Synthesis and Characterization of Cobalt-Doped Zinc Silicate Via Thermal Treatment Method** *Engku Abd Ghapur Engku Ali, Annas Farha Barkat Ali, Mohd Al Amin Muhamad Nor, Mohd Sabri Mohd Ghazali* **UTM01** **Effect of Zinc Oxide/ Calcium Carbonate hybrid nanoparticles on wear properties of nanocoating on carbon steel** *Nurul Nabila Mohd Din, Norhasnidawani Johari, Mohd Aidy Faizal Johari, Noor Azlina Hassan, Abd Halim Md Ali, Rizal Arifin*
Venue: OMNIA I Hall **Theme:** Nanotechnology **Session Chair & Jury:** PM Ir. Ts. Dr. Muhammad Azizi Mat Yajid (UTM) **Jury:** PM Dr. Jeefferie Abd Razak (UTEM) **Time keeper:** En. Muhammad Afiq Irfan Mohd Shumiri	**UNITEN02** **Structural Evaluation of MXenes Synthesized Using Environmental-Friendly Approach for Flexible Energy Storage** *Halina Misran, Nurul Atiqah Izzati Md Ishak, Siti Zubaidah Othman, Azieyanti Nurain Azmin, Fazliyana 'Izzati Za'abar and Ahmad Wafi Mahmmod Zuhdi* **UTEM10** **Effect of TiO2/ZnO Composition on the Properties of Plasma Spray Feedstock Powders** *Muhamad Akmal bin Mohd Sani, Yusliza binti Yusuf, Jariah binti Mohamad Juoi, Azhar Shah Bin Abu Hassan, Sarita Morakul* **UTM14** **Hybrid Gold Nanoparticles: Sample Preparation for Scanning Electron Microscopy Imaging** *Khairunnisa Mohd Paad, Adibah Shakri, Norazalina Saad, Izzat Fahimuddin Mohamed Suffian* **VEN02** **Nanomechanical Testing in Extreme Environments: High Strain Rate Nanoindentation at High Temperatures** *Viola Paul, Nicholas Randall, Renato Pero, Jean-Marc. Breguet* ***UTEM09*** **Martensitic Features of WAAM-Deposited Stainless Steel 410 in As-Deposited and Heat-Treated Conditions** *Nur Izan Syahriah Hussein, Ahmad Amirul Aizad Samsuri, Mohd Rizal Alkahari, Nor Ana Rosli, Abd Rahman Dullah, Syahrul Azwan Suandi, Mohamad Nizam Ayof, Azril Dahari Johari, Salmi Mohd Yunus*
Venue: OMNIA II Hall **Theme:** Engineering / Nanotechnology **Session Chair & Jury:** Ir. Ts. Dr. Wan Rosmiza Zana Wan Dagang (UTM) **Jury:** Dr. Mohd Shukri Baba (IIUM) **Time Keeper:** Pn. Rozalina Amran	**UTM05** **High Entropy Alloy Anodes for Solid Oxide Fuel Cells: A Critical Review of Structural Stability and Carbon Coking Resistance under Hydrocarbon Fuel** *Nurul Syafiqah Tapak, Nor Akmal Fadil, Mohd Hafiz Dzarfan Othman, Mohd Zamri Mohd Yusop* **UTM11** **Influence of Titanium Dioxide on the Microstructure, Porosity and Corrosion Performance of Magnesium Phosphate Ceramic** *Muhammad Faiz Bin Ibrahim, Abdillah Sani Mohd Najib* **UMP02** **Fatigue Damage Evolution in Glass Fibre Reinforced Polymer: Insights from Fractographic Examination** *Miminorazeansuhaila Loman, Mohd Hafizi Zohari & Fauziana Lamin* **UTEM06** **Effect using Vacuum Clamp on End Mill Process of Acrylic Towards Surface Integrity under Microscope** *Norfariza binti Ab Wahab* **UTM19** **Engineered Microporosity: Tailoring Thermoplastic Films Through Phase Separation** *Zurina Binti Mohamad, Norhayani Binti Othman, Vitali Lipik*

POSTER SESSION

TUESDAY, 25 NOVEMBER 2025, 10.00 AM – 12:30 PM

PAPER CATEGORY: PHYSICAL SCIENCE		
1	**UTHM11** Dr. Fazimah Binti Mat Noor	Effects of Mixing Time on the Properties of Hydroxyapatite Foam Prepared by Space Holder Method
2	**UTEM03** Assoc. Prof. Dr. Siti Hajar Sheikh Md Fadzullah	Dynamic behaviour of biodegradable pineapple leaf fibre (PALF) composites for protective packaging applications
3	**UTEM04** Assoc. Prof. Dr. Zaleha Mustafa	Weibull analysis of the fatigue behaviour of self-reinforced PLA composites with different filler sizes under high stress conditions for bone fixation applications
4	**UTEM07** Dr. Syahriza Ismail	Characterization of modified titanium dioxide nanotubes by anodization
5	**UiTM01** Norhafini Hambali	Solvent extraction of rubber seed oil as a feedstock for epoxidation process via mixed solvent system: Optimization of extraction parameters
6	**UTHM12** Tew Heng Yao	SEM morphology and EDX analysis of refractory insulators exposed to high-temperature petrochemical environments
7	**UTHM14** Nursyazwani Zulkefli	Comparative evaluation of calcination temperature for cockle shell-derived hydroxyapatite in polylactic acid composites
8	**UTEM14** Hazril Hisham Hussin	Microscopic insights into the morphological and electrical behaviour of GNP hybrid ink under cyclic bending
9	**UTEM18** Norashikin Shari	Electrical and morphological evaluation of graphene nanoplatelet/silver hybrid conductive ink on various substrates under moisture stress
10	**UTHM15** Prof. Dr. Hasan Zuhudi Abdullah	Influence of Carbon Filler on The Properties and Performance of Starch-Based Carbon Foams
11	**UTM03** Ir. Ts. Dr. Wan Fahmin Faiz Wan Ali	Stimuli-Responsive Nanoporous Alumina Carrier for Magnetically Regulated Release
12	**UTHM09** Nurul Farhana Abdul Rahman	Electrochemical Performance Properties of Planar Solid Oxide Fuel Cells: A Review of Methods Employed in Fabricating Electrodes and Electrolyte Components
13	**UTM17** Dr. Richard	PVD Nano-Columnar DLC Coating on Cutting Tool for High Speed Drilling Application
14	**UTM20** Assoc. Prof. Dr. Mohd Fairus Mohd Yasin	Thermo-Fluidizing Analysis for Scalable CNT Growth in Flame Chemical Vapor Deposition (FCVD) with Fluidized Bed

POSTER SESSION

TUESDAY, 25 NOVEMBER 2025, 10.00 AM – 12:30 PM

PAPER CATEGORY: LIFE SCIENCE		
1	**UKM01** Ts. Nur Nasuha Zolkifli	FESEM-based morphological profiling of animal hair and skin for halal certification: A comparative study
2	**UNIMAP01** Assoc. Prof. Dr. Sam Sung Ting	Elucidating the antifungal mechanism and properties of fungal chitosan–nanocrystalline cellulose composites for food packaging applications

NUMBER OF PARTICIPATION

Transmission Electron Microscopy (TEM)

Physical Sciences **9**

Life Sciences **4**

Scanning Electron Microscopy (SEM)

Physical Sciences **39**

Life Sciences **11**

Optical Microscopy and other microscopy technique

Physical Sciences **3**

Life Sciences **3**

All micrograph will be judged through:

- Originality
- Information Content
- Unique of Concept
- Creativity
- Visual Performance
- Technical Proficiency & Style

PLENARY SPEAKER 1

Dr. Md Azman Bin Seeni Mohamed

Senior Director,
Advanced Material Research Centre (AMREC) SIRIM Industrial Research

Assoc. Prof. Dr. Md Azman Seeni Mohamed is an experienced toxicologist and research leader with more than 14 years of academic and industrial expertise. He is currently the Director of SIRIM AMREC, where he oversees advanced materials research, including biomaterials for biomedical applications, nanotechnology, and energy solutions for electric vehicles. r. Azman previously served as an Associate Professor at Universiti Sains Malaysia (USM) for over 15 years, contributing extensively to teaching, postgraduate supervision, and contract research. He also held key leadership roles at the Malaysian Institute of Pharmaceutical and Nutraceutical (IPharm–NIBM), including Acting Executive Director (2017–2019) and Research Director (2016–2017). He holds a PhD in Molecular Toxicopathology from Nagoya City University, Japan, and multiple qualifications in medical laboratory technology and biotechnology. His research focuses on molecular toxico-pathology, biomarkers, nano-therapeutics, and biomaterials safety assessment, particularly in breast, prostate, and oral cancer.

Dr. Azman has an impactful scientific track record with over 2,900 citations, an h-index of 15, and 65 journal publications. He has supervised numerous PhD and MSc candidates and attracted significant national and international research funding. His achievements include 13 international awards, consultancy engagements surpassing MYR 400k, and contributions to scientific societies and editorial boards. He is also the inventor of a granted Malaysian patent and a registered trade secret.

PLENARY 1

AI FOR MICRO WORLD: FROM PIXELS TO PERCEPTION

Azman Seeni

Advanced Material Research Center (AMREC), SIRIM Industrial Research, SIRIM Berhad

Kulim Hi-Tech Park, Kedah.

**Corresponding email: Azman Seeni, mdazman@sirim.my*

The microscopic world is rich with patterns, structures, and behaviors that often remain invisible to the human eye. Artificial intelligence is reshaping this landscape by turning raw pixel-level data into meaningful biological perception. This talk highlights how machine learning and deep learning models extract features, classify organisms, detect abnormalities, and uncover complex relationships within microbial and cellular systems. By bridging imaging, computation, and biological interpretation, AI enables faster diagnostics, enhances research accuracy, and opens new frontiers in automated microscopy. The session also discusses emerging trends including explainable AI, multi-omics integration, and real-time intelligent imaging that will shape the future of micro-scale discovery. Deep learning pushes this further that can identify pathogens directly from unstained microscopic images which enable pixel-accurate segmentation of cells, tissues, and microbial colonies. Transformer-based models are now being used to predict antimicrobial resistance patterns from micrographs, providing faster insights compared to conventional laboratory methods. Automated microscopy systems integrate these AI models to perform continuous, hands-free biological monitoring. Examples include live-cell tracking platforms that follow bacterial motility or cell division in real time, as well as smart imaging systems that automatically adjust focus, illumination, and capture parameters based on AI-driven feedback. These microscopes no longer just "capture but also they "interpret " immediately!! Beyond images alone, AI is increasingly used to link microscopy outputs with multi-omics datasets. By integrating genomics, transcriptomics, proteomics, and metabolomics with cellular images, machine learning models can, for example, correlate cell morphology with gene expression changes or identify microbial phenotypes associated with specific virulence factors. This cross-layer integration allows a deeper understanding of microbial behavior and disease mechanisms. Together, these advancements illustrate how AI transforms microscopic imaging from static snapshots into a powerful, automated perception system that accelerating diagnostics, improving research accuracy, and opening new pathways for understanding the micro world.

PLENARY SPEAKER 2

Prof. Ts. Dr. Mohd Hafiz Dzarfan bin Othman

Chair of Frontier Materials Research Alliance,

Universiti Teknologi Malaysia (UTM)

Associate Professor Ts. Dr. Mohd Hafiz Dzarfan Othman is a well-known figure in the membrane technology field and has more than 15 years of experience in the development of the membrane technology. He is currently director of the Advanced Membrane Technology Research Centre (AMTEC) UTM. His research contributions include the development of inexpensive ceramic hollow fiber membranes from waste materials, innovative membrane technology for the water treatment and efficient energy generation. As an enthusiastic leading, researcher, he holds some key positions in several national and international networks, including the Secretary General of Malaysia Membrane Society (MyMembrane), Board Member of Aseanian Membrane Society (AMS), and the committee of HICoE council. Having the strong sense of responsibility to contribute his research and knowledge to the society, he actively involved in several corporate social responsibility (CSR) projects by providing water filter system developed by AMTEC UTM for clean water supply in Pantai Senok, Kelantan under Translational Research Project (TR@M) and flood relief in Pekan, Pahang under New Blue Ocean Strategy (NBOS) project.

PLENARY 2

FROM MICROSTRUCTURE TO IMPACT: MEMBRANE TECHNOLOGIES FOR ENVIRONMENTAL SUSTAINABILITY

Mohd Hafiz Dzarfan Othman

Advanced Membrane Technology Research Centre (AMTEC), Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Johor, Malaysia.

**Corresponding email: hafiz@petroleum.utm.my, dzarfan@utm.my*

Abstract

Hollow fibre membranes are presented as fine, straw-like filters whose internal microstructure is shown to drive real-world impacts in water and wastewater treatment. Emphasis is placed on how invisible features, such as pore size, skin-layer thickness, and the arrangement of internal channels, are engineered to influence visible outcomes, including water throughput, fouling resistance, cleaning frequency, energy use, and service life. Polymeric (plastic-based) hollow fibre membranes are described as being widely adopted due to affordability and scalable fabrication, with recent formulations and additives being employed to improve hydrophilicity, mitigate clogging, and enhance flux. Ceramic hollow fibre membranes are highlighted for superior mechanical, chemical, and thermal stability, allowing operation under harsher conditions and longer lifetimes, while cost barriers are being reduced through optimized sintering and the use of natural clays, industrial by-products, and agricultural wastes as feedstocks. Advances in phase inversion and related fabrication methods are shown to enable asymmetric structures and graded porosity that increase surface area and mass transfer, thereby improving efficiency and reducing chemical and energy demands. Case examples from municipal and industrial wastewater treatment are referenced to illustrate how microstructural tuning has been associated with higher water recovery, fewer cleanings, smaller footprints, and lower overall treatment costs. By tracing the pathway from microstructure to impact, a practical framework is offered for selecting and improving polymeric and ceramic hollow fibre membranes so that cleaner water can be delivered more sustainably at scale.

Keywords: *Membrane technology; Hollow fiber; Water treatment and purification; Polymer; Ceramic*

KEYNOTE SPEAKER 1

Assoc. Prof. Ts. ChM Dr. Nik Ahmad Nizam bin Nik Malek

Deputy Dean (Research, Development & Innovation), Faculty of Science,

Universiti Teknologi Malaysia (UTM)

Assoc. Prof. Ts. ChM. Dr. Nik Ahmad Nizam Nik Malek is currently the Deputy Dean (Research, Innovation and Development) at the Faculty of Science, Universiti Teknologi Malaysia (UTM), and Acting Director of the Centre for Sustainable Nanomaterials (CSNano) as well as the Ibnu Sina Institute for Scientific and Industrial Research (ISI-ISIR). He holds a BSc in Industrial Chemistry, MSc and PhD in Chemistry from UTM. Dr. Nik specializes in applied materials science with a focus on nanomaterials for biological and medical applications. Recognized as a Top Research Scientist Malaysia (TRSM 2023), he has authored over 120 publications indexed in WoS, with significant contributions in antimicrobial coatings, drug delivery systems, and sustainable nanomaterials. He actively fosters interdisciplinary collaborations and industry partnerships to drive impactful innovations.

KEYNOTE 1

MICROSCOPIC EVALUATION ON BACTERIAL MORPHOLOGY POST-TREATMENT WITH SILVER NANOCOMPOSITES

[1,2]Nik Ahmad Nizam Nik Malek*, [1]Mashitah Mad Salim, [1]Muhammad Hariz Asraf, [1,3]Mustapha Isah

[1]Centre for Sustainable Nanomaterials (CSNano), Ibnu Sina Institute for Scientific and Industrial Research (ISI-ISIR), Universiti Teknologi Malaysia (UTM). 81310 UTM Johor, Malaysia

[1]Department of Biosciences, Faculty of Science, Universiti Teknologi Malaysia (UTM), 81310 UTM Johor, Malaysia

[3]Department of Biochemistry, Faculty of Science, Sokoto State University (SSU), 840001 Sokoto, Nigeria.

**Corresponding author: niknizam@utm.my*

Abstract

The growing challenge of antimicrobial resistance demands innovative materials with effective bactericidal properties. This study presents a morphological investigation of bacteria Escherichia coli and Staphylococcus aureus following treatment with various silver-based nanocomposites, including Ag-exchanged zeolite NaY, Orthosiphon aristatus-phytosynthesized AgNP-supported zeolite A, and Moringa oleifera-silver nanoparticle-kaolinite nanocomposite (Mo-Ag-Kao). The structural and morphological changes in bacterial cells were examined using high-resolution field emission scanning electron microscopy (FESEM) and Gram staining techniques. The AgY zeolites released silver ions (Ag^+) into the culture media, interacting with bacterial thiol groups without rupturing cell morphology, as revealed by preserved outer structures in FESEM images even after cell death. Gram staining further supported this observation, showing intact cell walls despite effective bactericidal action. In contrast, the Mo-Ag-Kao nanocomposite induced significant morphological disruptions, including surface roughening, porosity formation, and membrane disintegration, which were attributed to Ag^+ release and the generation of reactive oxygen species (ROS). Additionally, the O. aristatus-AgNP-zeolite composite demonstrated anti-biofilm activity, with FESEM revealing membrane deformation and inhibited biofilm formation. The findings suggest that silver nanocomposites act via two modes: Ag^+ release, which disrupts intracellular processes without immediate structural collapse, and, in some cases, direct mechanical damage to membranes. This study highlights the value of microscopy in elucidating antimicrobial mechanisms at the cellular level, supporting the development of silver nanocomposites as promising agents against pathogenic bacteria, including resistant strains. The results highlight the significance of material design in modulating antibacterial performance and cell interaction.

Keywords: *Silver nanocomposites; Bacterial morphology; Field emission scanning electron microscopy (FESEM); Antibacterial mechanism.*

KEYNOTE SPEAKER 2

Mr. Afdzal Syahadat Husni bin Husin

CEO of MIMOS Technologies Sdn Bhd

Mr. Afdzal Syahadat Husni Husin is the Chief Executive Officer (CEO) of MIMOS Technologies Sdn. Bhd., an agency under the Ministry of Science, Technology and Innovation (MOSTI). He leads national efforts in advancing research, development, and innovation in microelectronics, semiconductor technology, and advanced materials, which form the foundation for progress in microscopy and nanoscale characterization. With a professional background in electronics and communication engineering. Mr. Afdzal has extensive experience in RF systems, semiconductor devices, and materials characterization. His work at MIMOS has supported the development of state-of-the-art microscopy and analytical capabilities, enabling deeper understanding of materials and devices at the micro- and nanoscale. MIMOS continues to play a pivotal role in fostering collaboration between academia, research institutions, and industry, particularly in the use of microscopy and materials analysis to drive innovation in electronics, photonics, and advanced manufacturing.

KEYNOTE 2

MIMOS' ROLE AND CAPABILITIES IN ADVANCING MICROSCOPY AND MATERIALS CHARACTERISATION IN MALAYSIA

Mr. Afdzal Syahadat Husni Husin

MIMOS Technologies Sdn Bhd, Technology Park Malaysia, 57000 Kuala Lumpur, Malaysia

Abstract

As Malaysia's National Applied R&D Centre under the Ministry of Science, Technology and Innovation (MOSTI), MIMOS plays a vital role in advancing microscopy and materials characterisation to support national innovation and industrial competitiveness. Through its ISO/IEC 17025-accredited Failure Analysis and Material Analysis (FAMA) laboratories, MIMOS provides world-class analytical capabilities including UHR-FESEM, Plasma FIB, 300 kV TEM, XPS, and TOF-SIMS. These facilities enable atomic-scale imaging, defect localisation, and compositional analysis for sectors such as semiconductors, nanotechnology, photonics, and advanced materials. This keynote highlights MIMOS' evolution from traditional failure analysis to a hub for advanced analytical science, showcasing key case studies, technological milestones, and collaborative initiatives with industry and academia. By integrating cutting-edge microscopy with national R&D priorities, MIMOS continues to strengthen Malaysia's position as a regional leader in materials characterisation and nanotechnology innovation.

KEYNOTE SPEAKER 3

Assoc. Prof. Ir. Ts. Dr. Muhamad Azizi bin Mat Yajid

Deputy Dean (Research, Innovation and Development), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia (UTM)

Dr Muhamad Azizi Mat Yajid is an Associate Professor of Materials Engineering within the Faculty of Mechanical Engineering, Universiti Teknologi Malaysia. He received his B. Eng (Hon's) Materials Engineering from University Science of Malaysia in 2000. He obtained MSc in Nanoscale Science and Technology from The University of Leeds, UK in 2004 and PhD degree in Materials Engineering from The University of Sheffield, UK in 2009. Currently, he served as Deputy Dean for Research, Innovation and Development, Faculty of Mechanical Engineering, UTM. He is also a registered Professional Engineer under Board of Engineers Malaysia (BEM) and Chartered Engineer (C. Eng) registred under Institute of Materials, Mineral and Mining (IOM3) UK. He is actively involved in various research projects mainly in the area of materials engineering and managed to publish more than 78 indexed papers in high reputable journals. His research interests include hard coatings, coatings for aerospace applications, thermal barrier coatings, thermal insulation material and composite, electroplating, engineering materials.

KEYNOTE 3

AEROGEL COMPOSITES AND COATINGS: ENHANCING PERFORMANCE THROUGH NANOSTRUCTURED MATERIALS

[1,2]Assoc. Prof. Ir. Ts. Dr. Muhamad Azizi bin Mat Yajid*

[1]*Department of Materials, Manufacturing and Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor, Malaysia.*

[2]*Materials Research & Consultancy Group (MRCG), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor, Malaysia.*

**Corresponding Author: M. A. Mat Yajid, azizi@utm.my*

Abstract

Nanostructured silica aerogels have emerged as next-generation thermal insulation materials due to their highly porous network, vast surface area, and ultra-low thermal conductivity. These nanoscale characteristics enable outstanding insulation performance, lightweight structure, and hydrophobicity—surpassing conventional materials such as mineral wool. Incorporation of polymer matrices such as epoxy, acrylic, and polyurethane enhances the dispersion of aerogel nanoparticles and reinforces the composite mechanically, while maintaining excellent thermal resistance. The transition from traditional aerogel blankets to nanostructured aerogel coatings addresses limitations like dust emission, fragility, and complex handling. Such coatings, applied as thermal paints, can conform to irregular geometries, enable in-situ application, and reduce maintenance costs. Key challenges include maintaining nanoscale dispersion, interfacial adhesion, and mechanical durability within coating formulations. In oil and gas systems, aerogel-based coatings deliver both insulation and corrosion-under-insulation (CUI) protection, while in construction they enhance energy efficiency and surface self-cleaning. Continued advances in surface grafting, nanointerface engineering, and hybrid composite design are essential to further improve performance and sustainability. These developments will accelerate the adoption of aerogel nanocomposites and coatings as high-performance, energy-efficient materials for industrial and domestic applications.

Keywords: *aerogels, insulation, corrosion-under-insulation (CUI) protection*

ABSTRACT

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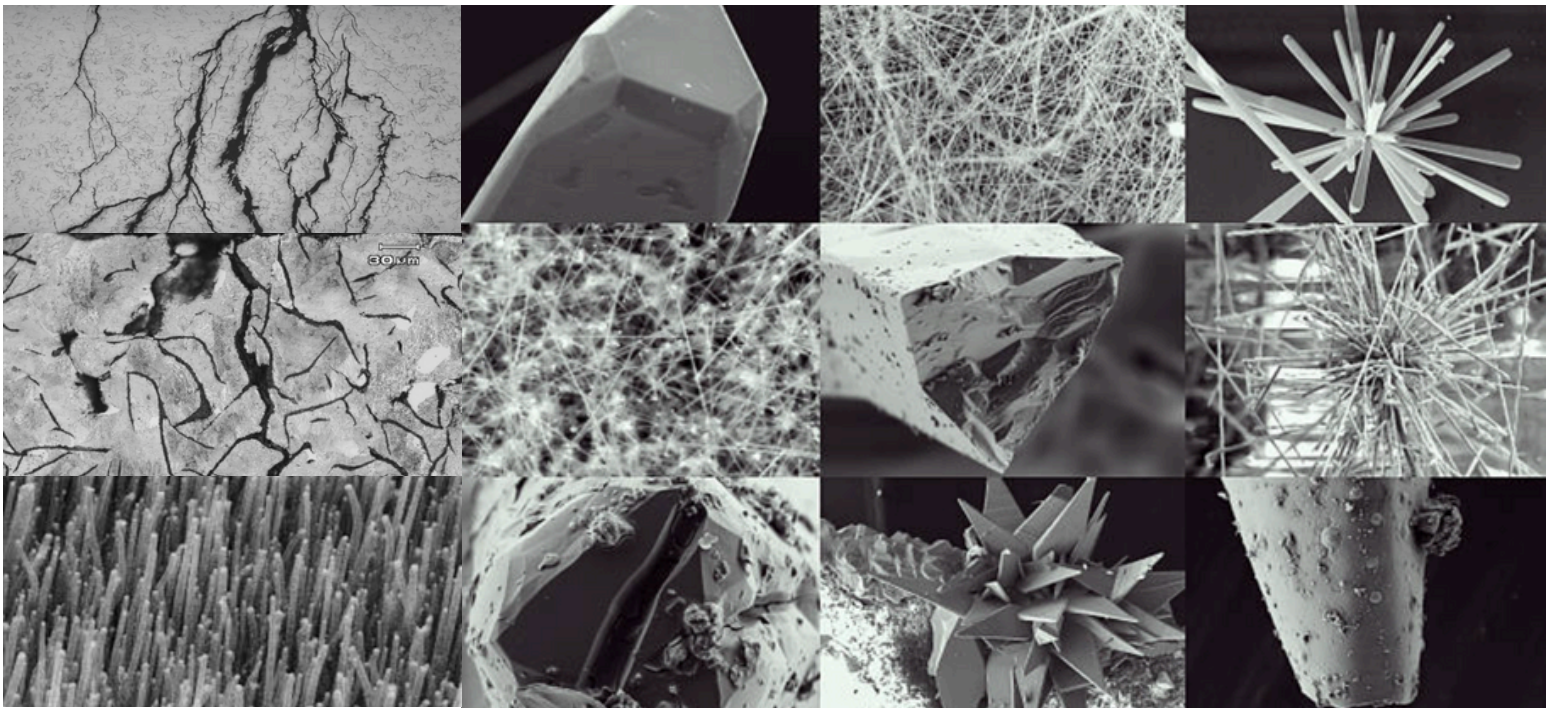

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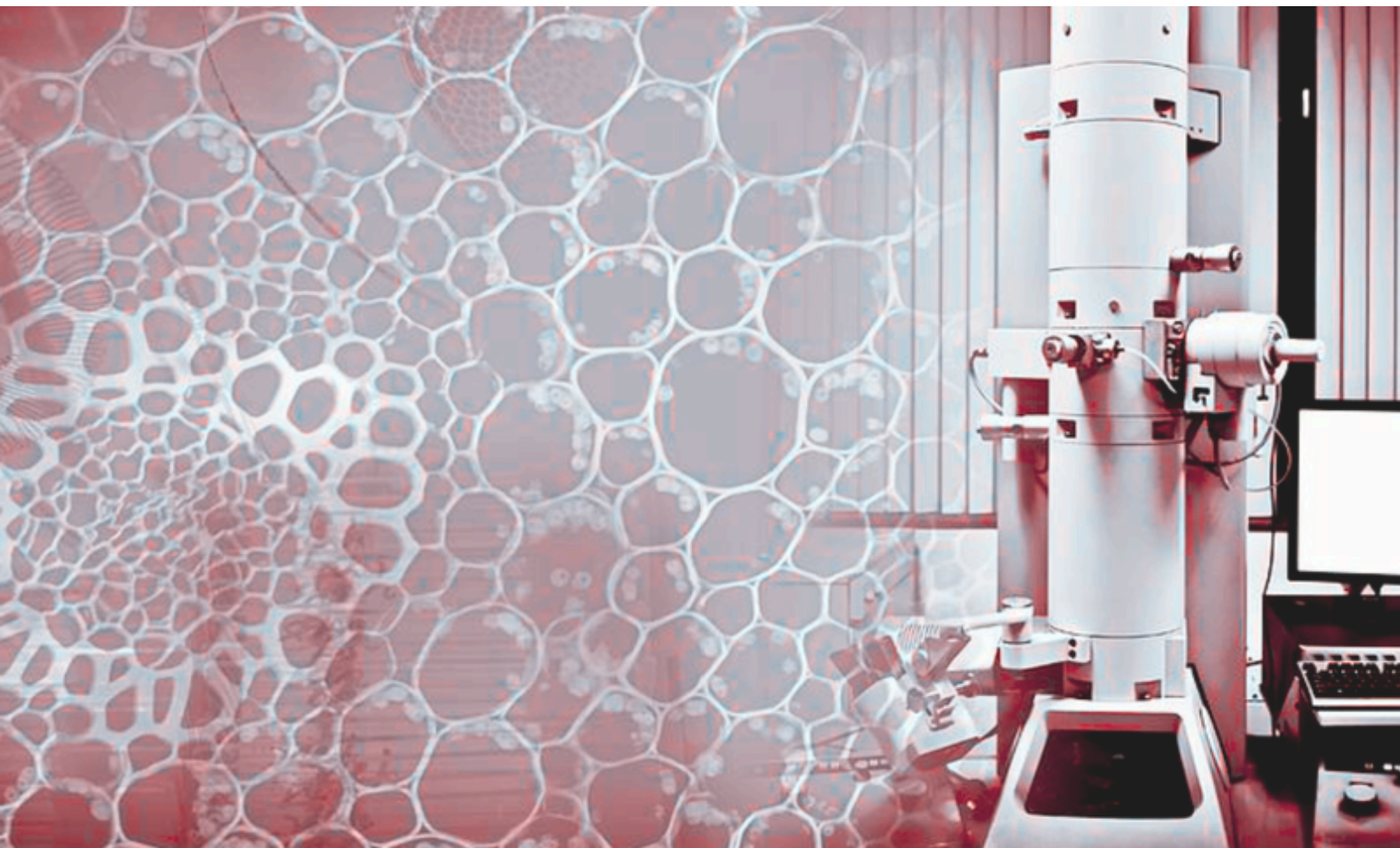


Paper ID: GOV01

THE UTILIZATION OF LOCAL SILICA SAND FOR THE PRODUCTION OF DECORATIVE COLOURED GLASS

Nabihah Othman*, Mohd Idham Mustaffar, Syarifah Aminah Ismail and Mohd Hakim Ibrahim

[1]*Mineral Research Centre, Department of Mineral and Geoscience Malaysia, Jalan Sultan Azlan Shah, 31400 Ipoh, Perak.*

**Corresponding Author: N. Othman, nabihah@jmg.gov.my*

Abstract

Malaysia has rich but underutilized silica sand deposits, the main raw ingredient for glass manufacture. In previous studies, the chemical and physical properties of local silica sand from Gong Belibis, Setiu, Terengganu have been examined by using X-ray fluorescence (XRF), X-ray diffraction (XRD), particle size distribution analysis, grain morphology (refer to Figure 1), moisture content evaluation, clay content analysis, pH measurement, and specific gravity determination. This study explores the suitability of local silica sand for manufacturing coloured glass. The glass composition contains silica sand, soda, lime, magnesium oxide, aluminum oxide, recycled soda lime glass, and metal oxide. The glass formulations were made by varying the types of metal oxide used, such as iron (III) oxide, chromium (VI) oxide, cobalt oxide, and manganese (IV) oxide. The recycled soda lime glass was added to the formulations to reduce the melting temperature. The formulations were melted in a furnace at 1250°C for 10 hours. The coloured glass underwent various tests to assess its properties and suitability for decorative applications purposes. The refractive index of a coloured glass was measured using a refractometer, and the absorbance or transmission of light through a substance at different wavelengths was analyzed using a spectrophotometer. The exact composition of the glass was determined by using XRF. The physical properties of coloured glass like hardness were determined by the Vickers hardness test while its coefficient of thermal expansion was determined by a dilatometer. Each of these tests helps to ensure that coloured glass meets quality standards and performs as expected for decorative purposes.

Keywords: *Silica sand, coloured glass, recycle soda lime glass, spectrophometer, simultaneous thermal analyzer*

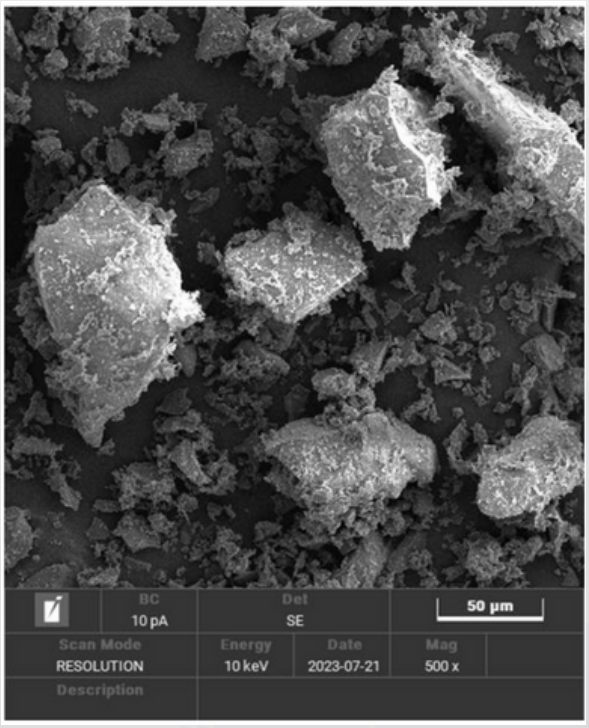


Figure 1: Morphology of silica sand grains

Paper ID: GOV02

DEVELOPMENT OF CREAMED AMMONIA-FREE DEPROTEINIZED NATURAL RUBBER LATEX FOR THE COTTAGE INDUSTRY

[1]Azman Sampol*, [1]Ahmad Syaheer Abu Aswad, [1]Nurulhuda Abdullah,[1]Roslim Ramli, [2]Siti Shuhada Shuib

[1]Technology and Engineering Division, Malaysian Rubber Board, 47000 Sungai Buloh, Selangor.

[2]Production Development Division, Malaysian Rubber Board, 47000 Sungai Buloh, Selangor.

**Corresponding Author: A. Sampol, azman.s@lgm.gov.my*

Abstract

Natural rubber (NR) latex obtained from tapping rubber trees must be preserved with ammonia to prevent premature coagulation and is typically subjected to a concentration process to improve its quality and stability. Traditionally, latex concentration is carried out using expensive and complex centrifugation machines. During this process, additional ammonia and other stabilizing chemicals are added to maintain the colloidal stability of the concentrated latex. However, the use of centrifuge machines is generally limited to large-scale factories due to their high cost. Operating these machines also requires technical expertise and complex maintenance, making them unsuitable for smallholder rubber tappers or cottage industries. Furthermore, the use of such chemicals may pose potential health hazards to factory workers. This study explores the feasibility of using the creaming process as an alternative to the centrifugation process, combined with a biocide as a substitute for ammonia in the production of concentrated NR latex. The study found that physicochemical properties of the creamed latex such as total solid content and dry rubber content reached 63% and 61%, respectively, which are comparable to those of centrifuged latex. FESEM images revealed no significant differences in the morphological structure of latex between the centrifuged and creamed samples. The study also shows that the creamed latex is suitable for manufacturing latex-based products for cottage industries, such as rubber bands and toys.

Keywords: *creamed latex, ammonia-free, cottage industry*

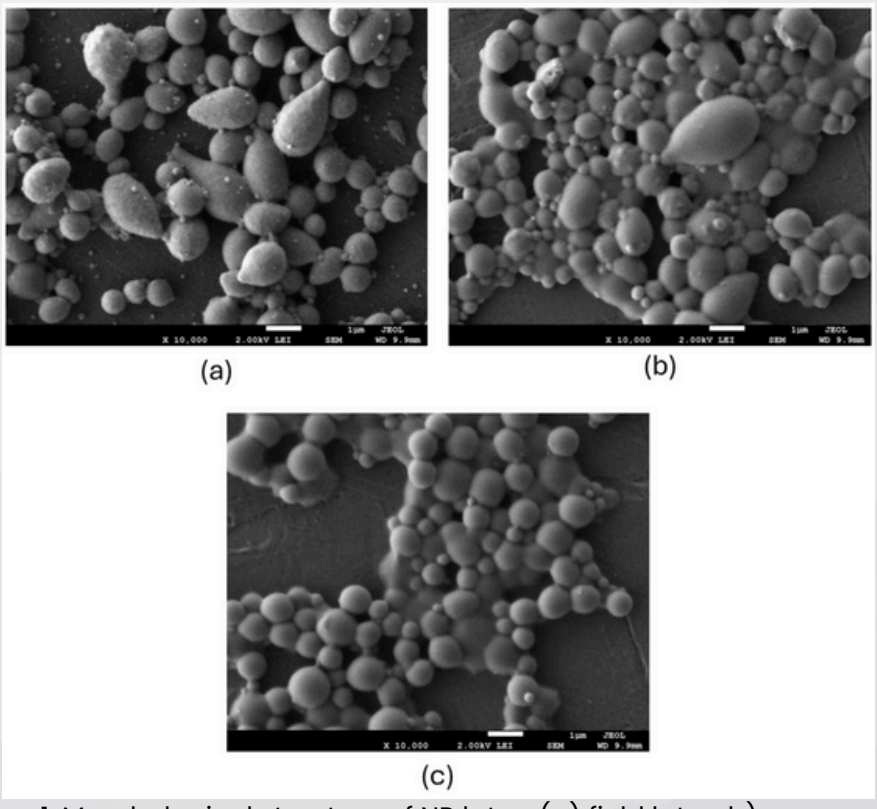


Figure 1: Morphological structure of NR latex: (a) field latex, b) creamed latex, c) centrifuged latex.

Paper ID: UiTM01

SOLVENT EXTRACTION OF RUBBER SEED OIL AS A FEEDSTOCK FOR EPOXIDATION PROCESS VIA MIXED SOLVENT SYSTEM: OPTIMIZATION OF EXTRACTION PARAMETERS

Norhafini Hambali*

Faculty of Chemical Engineering, Universiti Teknologi MARA, Cawangan Johor, Kampus Pasir Gudang, Johor, Malaysia

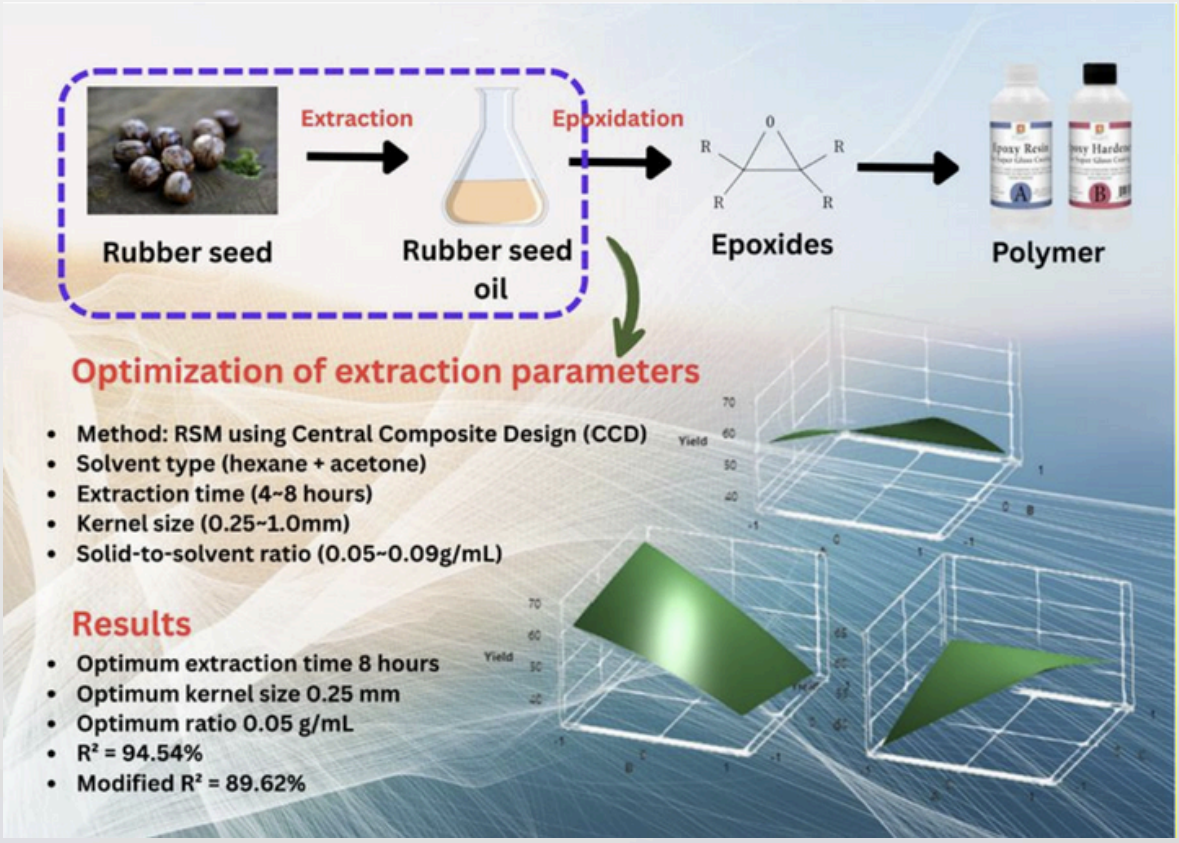
Faculty of Chemical Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, Pulau Pinang, Malaysia.

**Corresponding Author: N. Hambali, norhafini@uitm.edu.my*

Abstract

Vegetable oil such as rubber seed oil serves as a good feedstock for epoxides production which acts as an intermediate for producing various chemicals and polymers. This research examines the enhancement of rubber seed oil (RSO) extraction employing a mixed solvent system as a substrate for epoxidation activities. Response Surface Methodology (RSM) utilizing Central Composite Design (CCD) was utilized to assess the impacts of extraction duration (4–8 hours), kernel dimensions (0.25–1 mm), and solid-to-solvent ratio (0.05–0.09 g/mL) on oil production. The experimental yields varied between 34.21% and 77.65%, with the maximum yield attained at an extraction duration of 8 hours, a kernel size of 0.25 mm, and a solid-to-solvent ratio of 0.05 g/mL. Statistical study indicated that extraction duration and kernel size significantly affected the yield ($p < 0.05$), whereas the solid-to-solvent ratio had an insignificant impact. Interaction terms, specifically between extraction time and kernel size (AB), as well as between extraction time and solid-to-solvent ratio (AC), were determined to be significant. The established quadratic model had a strong match with R2 = 94.54% and modified R2 = 89.62%, however the anticipated R2 was low, suggesting possible limitations in extrapolation. The optimal parameters reported in this work improve the extraction efficiency of RSO, facilitating sustainable feedstock preparation for subsequent epoxidation and other bio-based chemical processes.

Keywords: *Rubber seed oil, epoxidation, optimization, Response Surface Methodology, Oil yield*



Paper ID: UMP01

CHARACTERIZATION AND ANALYSIS OF SURFACE MORPHOLOGY IN TI-6AL-4V COMPONENTS FABRICATED VIA SELECTIVE LASER MELTING

[1]Mohd Faizal Sadali, [1]Syahir Amzar Zulkifli, [1]Mohd Yusrizal Mohd Yusoof, [1]Mahadzir Ishak, [2]Mohamad Zaki Hassan

[1]Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, 26600 Pekan, Pahang.

[2]Faculty of Artificial Intelligence, Universiti Teknologi Malaysia, 54100 Kuala Lumpur.

**Corresponding Author: M.F. Sadali, faizalsadali@umpsa.edu.my*

Abstract

Selective Laser Melting (SLM) is an additive manufacturing (AM) process that employs a high-power laser to fully melt and fuse metallic powders layer by layer to produce three-dimensional (3D) components directly from computer-aided design (CAD) data. SLM process achieves complete melting, resulting in near-fully dense metallic parts with mechanical properties comparable to, or in some cases exceeding to conventionally manufactured parts. The process is particularly attractive for producing complex geometries, lattice structures, and customized components with minimal material wastage. The design properties that are affected the topography and morphology of titanium for a biomedical implant that closely suit to human cortical bone fabricated via additive manufacturing is still limited. In this study, the effect of different scanning speed effected on the morphology and surface microscopy of Ti6Al4V using SLM. The square cube of Ti6Al4V with the dimension of 10x10x10mm was fabricated at three different level of scanning speed (697.5mm/s, 775mm/s, 852.5mm/s). Here, the volumetric energy density parameter, including hatching distance, layer thickness, and laser power were fixed. The surface morphology of the parts consisting of the splashing effect, dimples impact, burnt defects and crystalline effect was found on top of the surfaces. Besides, the average roughness on the uppermost side surfaces is between 11.76 µm and 29.40 µm and indicated almost full in pits which is well suit for the bone-implant application.

Keywords: *Sintering Laser Melting, Titanium Alloy, Surface Morphology, Scanning speed.*

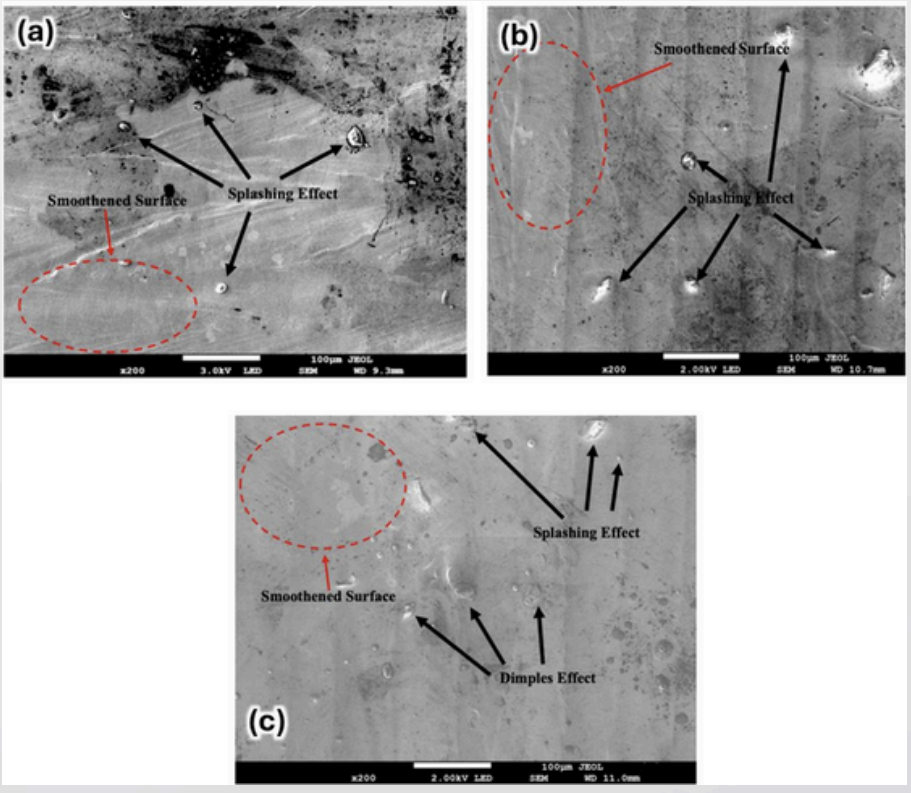


Figure 1: Splashing Effect on the Top Surface of the Ti64Al samples following, (a) 697.5mm/s, (b) 775.0mm/s and (c) 852.5mm/s Scanning Speeds.

Paper ID: UMP02

FATIGUE DAMAGE EVOLUTION IN GLASS FIBRE REINFORCED POLYMER: INSIGHTS FROM FRACTOGRAPHIC EXAMINATION

[1]Miminorazeansuhaila Loman*, [1]Mohd Hafizi Zohari & [2]Fauziana Lamin

[11]Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang.

[2]Vehicle Safety and Biomechanics Research Centre, Malaysian Institute of Road Safety Research, Lot 125-135, Jalan TKS 1, Taman Kajang Sentral, 43000 Kajang, Selangor, Malaysia

**Corresponding Author: Miminorazeansuhaila, Loman, miminorazean@umpsa.edu.my*

Abstract

This study aims to investigate the fracture behavior and fractography of glass fibre reinforced polymer (GFRP) subjected to cyclic loading at both low and high stress amplitudes. In this research, scanning electron microscope (SEM) material testing was conducted on specimens of three different stress amplitude which are 0 kN, 3.81 kN and 4.59 kN. Both specimens were cyclically loaded with fatigue stress at 40 % and 75 % from the GFRP's ultimate stress. The untested or 0 kN load specimen for a fatigue test is referred to as a pre-fatigue specimen. The fractured surfaces of the specimens from fatigue test were then examined under the Scanning Electron Microscope (SEM). It was to investigate the fractography of the fractured GFRP. The findings from this study provide valuable insights into the fracture behavior of GFRP under cyclic loading at low and high stress amplitude. It shows that the damage evolution at low stress amplitude is dominated by matrix cracking, fibre debonding and fibre fracture. However, the influence of mode of failure like matrix cracking is lower at high stress amplitude and only fibre debonding and fibre fracture are obvious.

Keywords: *fractography, fatigue damage, fracture behavior, stress amplitude.*

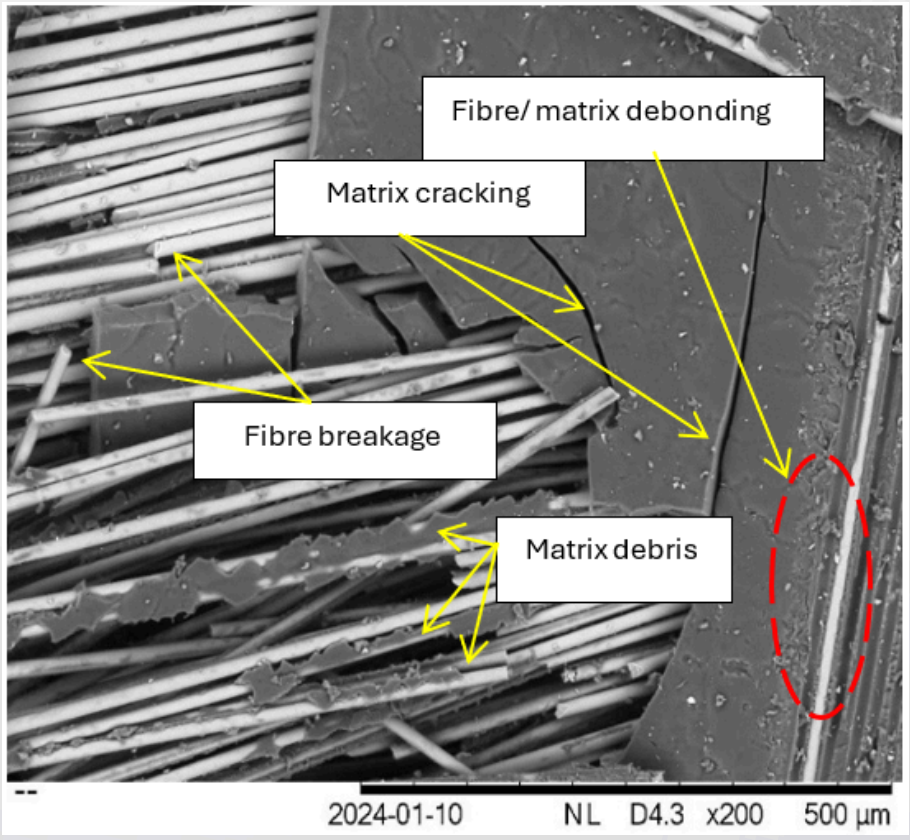


Figure 1: Fractography of GFRP under SEM magnification of 200 µm at 75% stress amplitude

Paper ID: UMT01

SYNTHESIS AND CHARACTERIZATION OF COBALT-DOPED ZINC SILICATE VIA THERMAL TREATMENT METHOD

[1,2]Engku Abd Ghapur Engku Ali*, [1]Annas Farha Barkat Ali, [1,2]Mohd Al Amin Muhamad Nor, [1,2]Mohd Sabri Mohd Ghazali

[1]Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu.

[2]Advanced Nano Materials (ANoMa) Research Group, Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu.

**Corresponding Author: E.A.G. Engku Ali, engku_ghapur@umt.edu.my*

Abstract

Zinc silicate (Zn_2SiO_4), or willemite, is a promising ceramic material with broad applications in optics and electronics. In this study, Zn_2SiO_4 was synthesized using zinc acetate dihydrate and tetraethyl orthosilicate (TEOS) as precursors, with cobalt (II) acetate (0.02–0.15 wt%) as a dopant via thermal treatment. The mixture was dried at 120 °C for 24 h, followed by calcination at 600–900 °C for 2 h. Characterization was carried out using X-ray Diffraction (XRD), Scanning Electron Microscope (SEM), Thermogravimetric analysis (TGA), Ultraviolet-Visible (UV-Vis) spectroscopy, and Photoluminescence (PL) spectroscopy. XRD confirmed the crystalline Zn_2SiO_4 phase at 800 °C and 900 °C, with increased crystallinity and particle size at higher temperatures. SEM revealed spherical morphology at lower temperatures and a transition to dumbbell-like or irregular structures depending on the Co^{2+} content and temperature. TGA indicated major weight loss (31–36%) between 255–327 °C. UV-Vis spectra showed enhanced UV absorbance in Co-doped samples, with a decrease in bandgap energy from ~3.16 eV (undoped) to ~3.04 eV (doped). PL analysis revealed blue (420, 480 nm) and green (530 nm) emissions attributed to Co^{2+} d–d transitions, suggesting potential application in blue and green phosphor materials. These findings highlight the tunability of Zn_2SiO_4's optical and structural properties through Co^{2+} doping and thermal treatment, demonstrating its suitability for luminescent optical devices.

Keywords: *Zinc silicate, thermal treatment method, phosphor material*

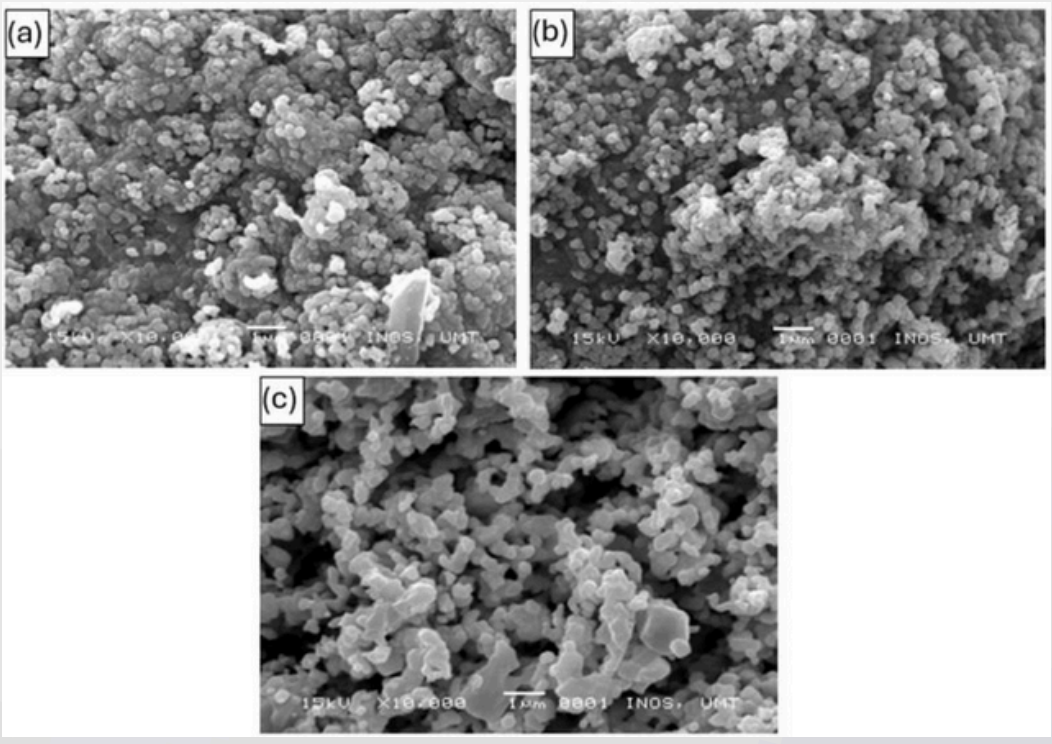


Figure 1: SEM micrographs of undoped Zn2SiO4, sintered at: (a) 600 °C; (b) 700 °C and (c) 900 °C.

Paper ID: UNIKL01

TEMPERATURE-MODIFIED BIOCHAR ENHANCES METHANE YIELD AND PROCESS STABILITY IN ANAEROBIC DIGESTION OF PALM OIL MILL EFFLUENT

[1,3]Stasha Eleanor Rosland Abel*, [1]Soh Kheang Loh, [2]Robert Thomas Bachmann, [3]Amelia Md Som

[1]Engineering and Processing Division, Malaysian Palm Oil Board, 6, Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia

[2]Raw Energy Sdn Bhd, E-2-2, M Avenue, No. 1 Jalan 1/38a, Segambut, 51200 Kuala Lumpur, Malaysia

[3]Universiti Kuala Lumpur, Green Chemistry and Sustainable Engineering Technology Cluster, Malaysian Institute of Chemical and Bioengineering Technology, Lot 1988, Taboh Naning, 78000 Alor Gajah, Melaka, Malaysia

**Corresponding Author: SER Abel, stasha.eleanor@mpob.gov.my*

Abstract

Disposal of palm oil mill effluent (POME) poses environmental concerns due to its high organic and nutrient content. Biogas (methane) produced through anaerobic digestion (AD) of POME is captured as a renewable energy. Higher yield of methane translates to economic benefits. This study investigates the potential of carbonized biochar from empty fruit bunch cellulose (EFBC) as an additive in enhancing methane via AD of POME. An AD system of 800 mL of POME was dosed with 2g each of biochar carbonized at 250°C, 400°C, and 750°C under mesophilic conditions for 10 weeks. The AD performance of POME and methane yield were significantly influenced by carbonization temperature and the resultant biochar properties. EFBC-750 generated the highest methane yield (7.38 L CH_4 g^{-1} VS), followed by EFBC-400 (2.46 L CH_4 g^{-1} VS) and EFBC-250 (0.75 L CH_4 g^{-1} VS), against EFBC and the control (0.02 and 1.01 L CH_4 g^{-1} VS, respectively). The enhanced AD performance by biochar at 750°C was attributed to an improved surface area, conductivity, and microbial electron transfer, which had promoted syntrophic microbial activity and methanogenesis. POME quality treated by EFBC-750 was much better with reduction of chemical oxygen demand (38.9%) and biochemical oxygen demand (>50%), indicating efficient organic degradation. A complete ammoniacal nitrogen removal was achieved in both POME treated with EFBC-400 and EFBC-750 through ammonium adsorption and potential nitrification–denitrification processes. Volatile fatty acid removal rate exceeded 43% in all three types of biochar, higher than the control (33.3%), thus promoting efficient conversion of intermediate acids to methane. The biochar structural changes and densed microbial colonization, as verified via transmission electron microscope particularly on EFBC-750, reflected on a stable AD performance and efficient biofilm development. These findings highlight that high-temperature-derived biochar promotes favourable microbial-substrate interactions, reinforces AD stability and methane recovery from POME, gearing towards sustainable milling practices.

Keywords: *Anaerobic digestion, biochar, palm oil mill effluent, methane yield, morphology*

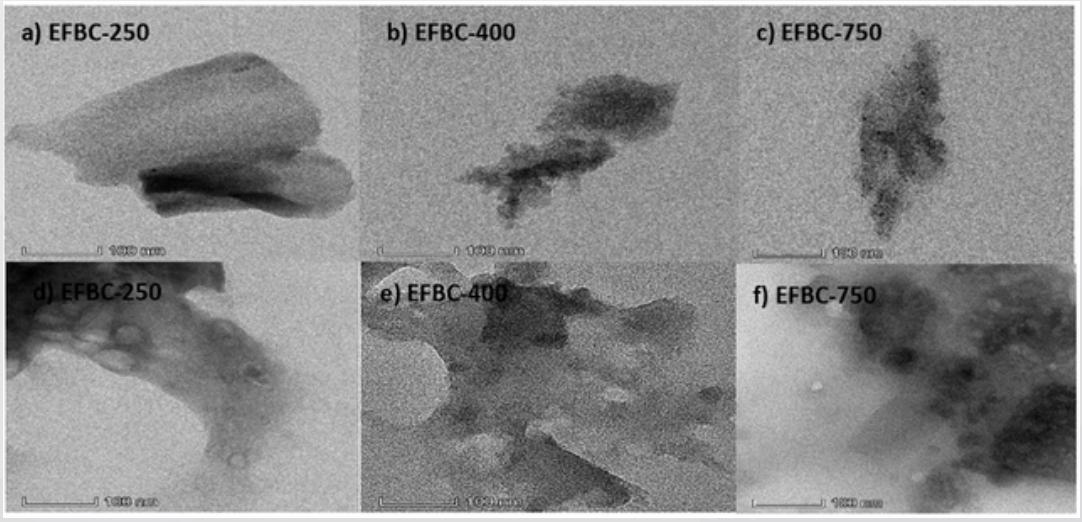


Figure 1: Transmission electron micrographs showing morphological changes of biochar before (a–c) and after (d–f) anaerobic digestion, indicating surface modification and microbial colonization

Paper ID: UNITEN01

UiO-66 NANOCRYSTALS: MODULATED SYNTHESIS AND MULTI-TECHNIQUE CHARACTERIZATIONS

Azieyanti Nurain Azmin*, Fei Ling Pua@Grace Pua, Halina Misran

Department of Mechanical Engineering, College of Engineering, Universiti Tenaga Nasional, 43000 Kajang, Selangor.

**Corresponding Author: A.N. Azmin, azieyanti@uniten.edu.my*

Abstract

UiO-66 is a zirconium-based metal-organic framework widely known for its strong field interest in adsorption area. In this study, polyethylene terephthalate was used as a sustainable source of linker for synthesis. UiO-66 was synthesized using zirconium oxynitrate (IV) hydrate as chloride-free metal precursor. Different molar ratios of metal salt, acetic acid (modulator), and DMF solvent were explored, and the resulting samples were labeled UiO/x/y, where x and y denote modulator and solvent volumes. Increasing the amount of acetic acid as a modulator led to an increase in crystallite size of 26.2 nm (UiO/9/25) and 22.4 nm (UiO/9/75), surpassing the original sample's size (21.3 nm). X-ray diffraction peaks corresponding to (111), (200), and (600) reflection planes. Raman analysis used the representative sample from UiO/9/75 showing higher intensities. The FESEM morphologies at 200x magnification corroborate with the crystallite trends with morphological differences among the samples; UiO_comm exhibited well-defined octahedral crystallites with uniform particle distribution. UiO/3/25 and UiO/3/75 showed less crystalline and more aggregated structures. UiO/6/50 demonstrated improved crystal development, while UiO/9/25 and UiO/9/75 showed densely packed, uniform, with crystalline nanocrystals indicated that higher modulator ratios enhanced the crystallization. Furthermore, UiO/9/75 demonstrates the highest BET and Langmuir surface areas among the synthesized samples, with 652 m2/g and 678 m2/g, respectively. The commercial UiO_comm, serving as the benchmark, has a BET surface area of 653 m2/g and a Langmuir surface area of 682 m2/g. These findings suggest that samples UiO/9/25 and UiO/9/75 have higher surface areas and diverse pore size distributions indicating potential for high-performance adsorption applications.

Keywords: *UiO-66, metal-organic framework, nanocrystal, modulator*

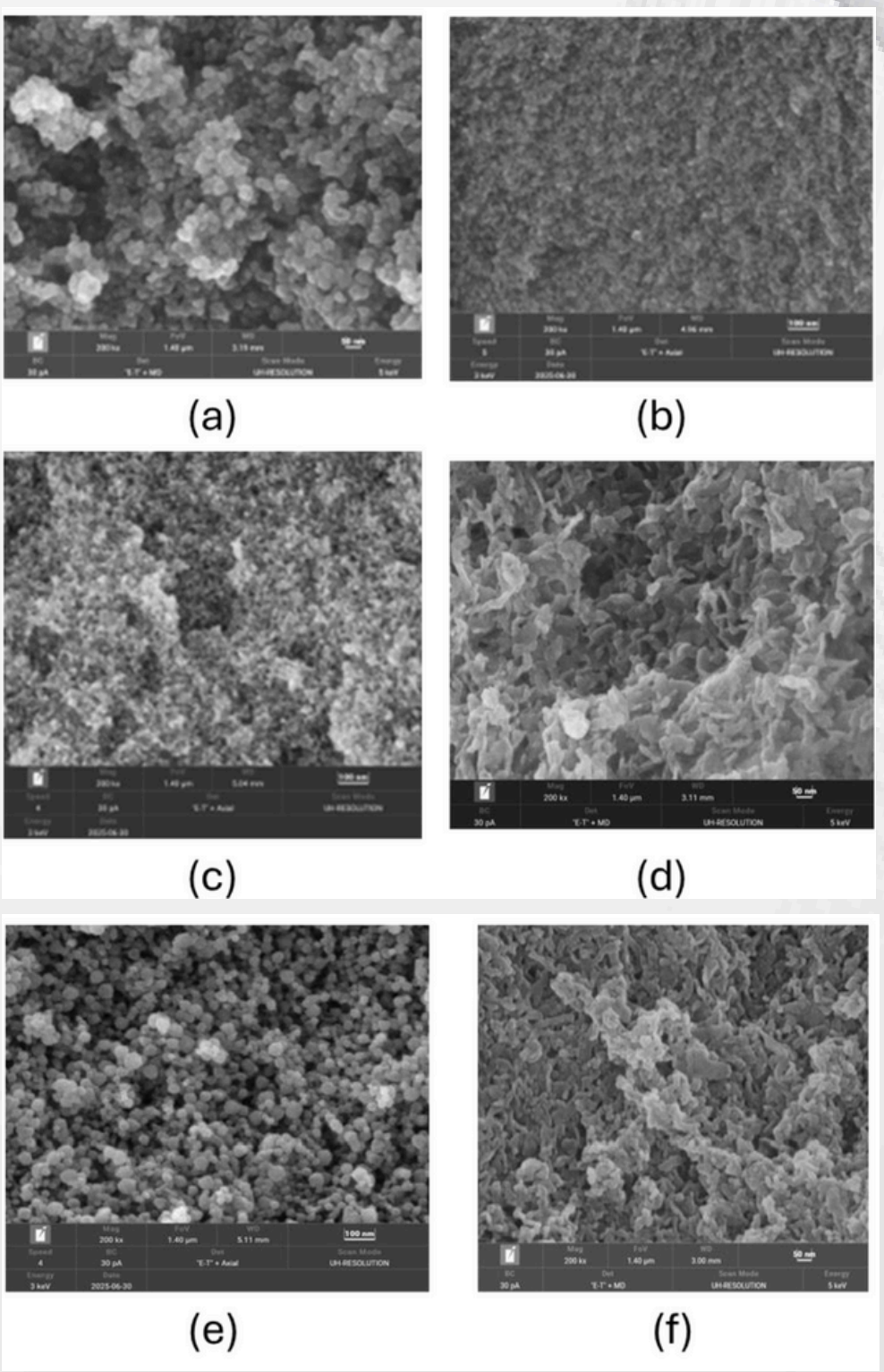


Figure 1: FESEM morphologies (a) UiO_comm, (b) UiO/3/25, (c) UiO/3/75, (d) UiO/6/50, (e) UiO/9/25, (f) UiO/9/75

Paper ID: UNITEN02

STRUCTURAL EVALUATION OF MXENES SYNTHESIZED USING ENVIRONMENT-FRIENDLY APPROACH FOR FLEXIBLE ENERGY STORAGE

[1]Halina Misran*, [2]Nurul Atiqah Izzati Md Ishak, [1]Siti Zubaidah Othman, [1]Azieyanti Nurain Azmin, [3]Fazliyana 'Izzati Za'abar and [3]Ahmad Wafi Mahmmod Zuhdi

[1]Nanoarchitectonic Lab, Department of Mechanical Engineering, Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia

[2]Research Center for Carbon Dioxide Capture and Utilisation (CCDCU), School of Engineering and Technology, Sunway University, Bandar Sunway, 47500 Petaling Jaya, Selangor, Malaysia

[3]Institute of Sustainable Energy (ISE), Universiti Tenaga Nasional, Jalan IKRAM-UNITEN, 43009 Kajang, Selangor, Malaysia

**Corresponding Author: H. Misran, halina@uniten.edu.my*

Abstract

Sustainable synthesis of nanomaterials having large functional interfaces or surfaces especially MXenes is a rapidly growing field with various methods focusing to reduce environmental impacts, promoting energy-efficient methods, safer, greener and scalable while maintaining/improving materials' properties. Among such methods, green solvents and/or solvent-less synthesis, using biomass-derived small molecules as template and modulators, low temperature synthesis and ageing process, sustainable and/or recycled precursors were some of the approaches done in this study to produce various MXenes as well as their extended families. The methods adopted in this study are green and sustainable as well as requiring much lower energy input. In this study, MXenes are synthesized using alternative approach of in-situ HF via lithium fluoride-LiF and hydrochloric acid-HCl. This method offers better control of properties such as layer thickness and surface termination while reducing direct HF exposure. However, lattice distortion can occur due to selective etching and surface termination procedure as shown in the Williamson-Hall (W-H) plots. Structural characterizations elucidated by Raman analyses and SEM images elucidated successful formation of MXenes. SEM images shows accordion-like multi-layered textures of MXenes at ca. 60 nm. Furthermore, Raman peak shift at ca. 157 cm-1 and 206 cm-1 suggested vibration from Ti3C2Tx species while peak shift at ca. 375 cm-1 suggested vibration from surface functional groups Tx. (Tx = OH, O or F) similar to MXenes prepared using the conventional method. The C-C covalent bond was observed at ca. 569 cm-1 while the D and G band peak shift was at ca. 1560 cm-1. In conclusion, although the methods used in this study improves overall sustainability factor of MXenes, developing fluoride-free etching methods remains crucial for environmental-friendly and scalable MXenes synthesis.

Keywords: MXenes, in-situ HF, environmental friendly, Raman spectroscopy, green

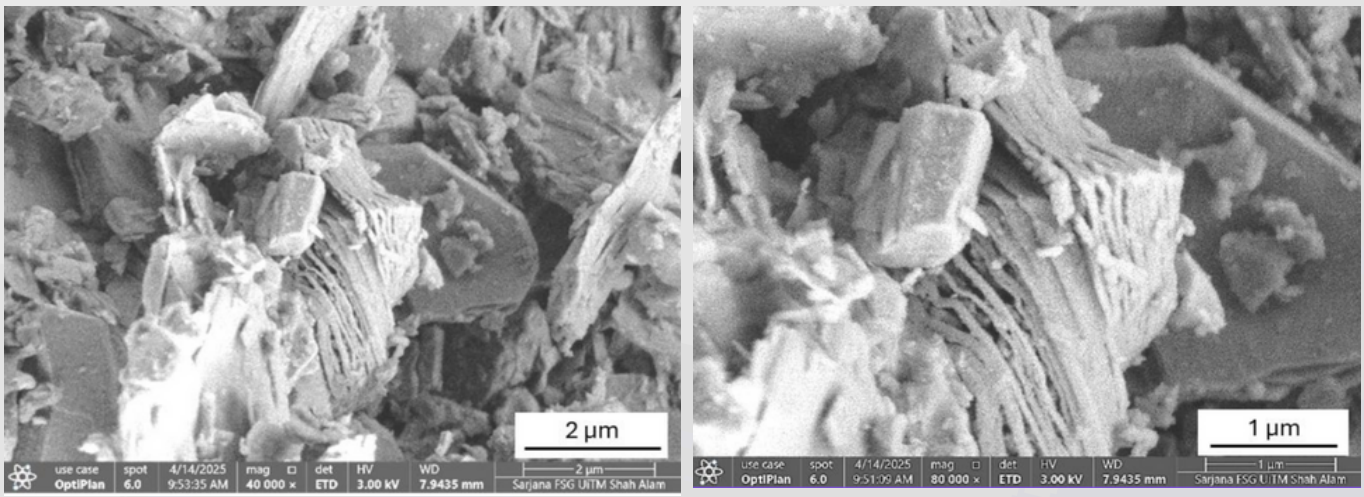


Figure 1. MXenes synthesized using in-situ hydrofluoric acid method.

Paper ID: UPM01

ANODIC ALUMINUM OXIDE COMPOSITE COATINGS REINFORCED WITH CARBON NANOTUBES AND GRAPHENE NANOPLATELETS: SURFACE MORPHOLOGY AND CORROSION RESISTANCE

[1]Nik Hafizuddin Effandi Nazila, [1]Tan Sin Tee, [1]Md Shuhazlly Mamat, [2]Shahira Liza, and [1]Yazid Yaakob*

[1]Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, MALAYSIA.

[2]Tribology and Precision Machining i-Kohza (TriPreM), Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia.

**Corresponding Author: Y. Yaakob, yazidakob@upm.edu.my*

Abstract

Graphene nanoplatelets (GNPs) and carbon nanotubes (CNTs) are well-known for their excellent mechanical and functional qualities, but their natural tendency to agglomerate frequently reduces performance. Combining CNTs and GNPs as hybrid reinforcements can help to minimise agglomeration, improve dispersion, and improve coating performance. In this study, anodic aluminium oxide (AAO) layers were anodized and reinforced with CNTs and GNPs to improve the surface and mechanical properties of aluminium alloy. The study used a fixed 5 g of reinforcement with changing CNT:GNP ratios (0:1, 1:0, 0.5:0.5, 0.25:0.75, and 0.75:0.25) under controlled anodizing conditions (60 min in 20% diluted H2SO4). XRD investigation showed the presence of orthorhombic and γ-Al2O3 phases in AAO and AAO-carbon nanocomposite coatings. Compared to AAO and AAO-CNT coatings, the 0.5CNT:0.5GNP sample had lower surface roughness (5.701 µm) and more refined pore dimensions (width: 50.10 µm; depth: 60.13 µm) as measured by a Zygo 3D Profiler. SEM-EDX investigation showed lower porosity in CNT- and GNP-modified coatings. The 0.5CNT:0.5GNP composition also had the highest Vickers hardness (240.3 HV), beating out AAO (133 HV), AAO-CNT (186.2 HV), and AAO-GNP (171 HV), demonstrating the advantages of hybrid carbon reinforcement. Wettability assays revealed a contact angle of 71.73° for the 0.5CNT:0.5GNP sample, indicating a transition to a more hydrophobic surface. Corrosion analysis discovered that the 0.5CNT:0.5GNP coating had a higher positive corrosion potential and lower corrosion current density than the unmodified AAO. Overall, this study shows that CNT and GNP hybrid reinforcement can improve AAO coatings created through anodising.

Keywords: *Anodic Aluminium Oxide, Carbon Nanotubes, Graphene Nanoplatelets, Surface Properties, Corrosion Resistance*

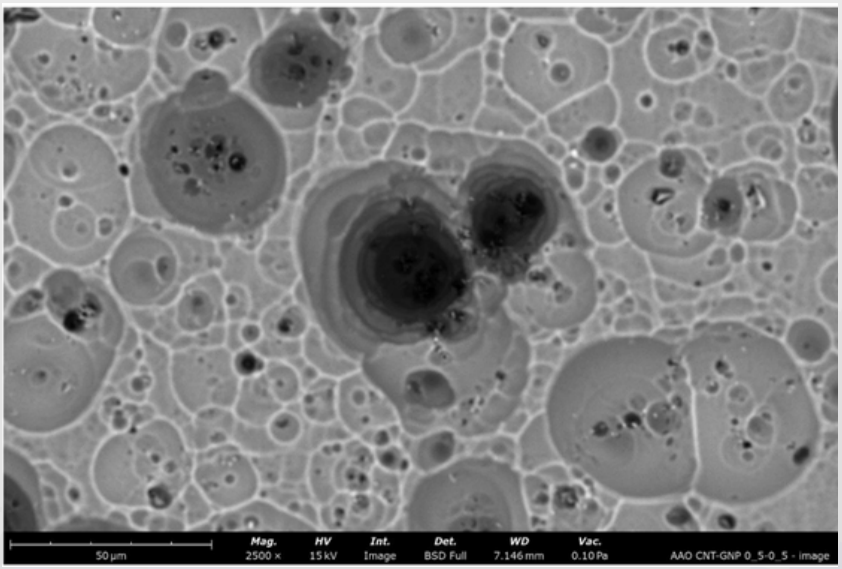


Figure 1: Scanning Electron Image focusing on pores and crates of AAO with a composition ratio of 0.5CNT:0.5GNP

Paper ID: UPSI01

MORPHOLOGICAL CHARACTERIZATION OF EXHAUST PARTICULATE MATTER (EPM) AND ANIONIC SURFACTANT FROM DIESEL AND PETROL VEHICLES

[1]Kauselyaa Chandrasagaran, [1]Nurul Bahiyah Abd Wahid*, [1]Venusha Segar, [1]Muhammad Afiq Mohd Nor, [2]Anggi Tias Pratama

[1]Department of Biology, Faculty of Science and Mathematics, Universiti Pendidikan Sultan Idris, 35900 Tanjong Malim, Perak, Malaysia

[2]Department of Biology Education, Faculty of Mathematics and Natural Science, Universitas Negeri Yogyakarta, Kampus Karangmalang Jl. Colombo No 1 Yogyakarta, Indonesia

**Corresponding Author: N.B. Abd Wahid, nurul_bahiyah@fsmt.upsi.edu.my*

Abstract

Exhaust particulate matter (EPM) emitted from vehicle is an important source of airborne contaminants that pose threats to both humans and the environment. This study explores the morphology of exhaust PM from petrol and diesel vehicles, and anionic surfactants as Methylene Blue Active Substances (MBAS) embedded within the exhaust PM structure. Samples were collected and analyzed using field emission scanning electron microscopy (FESEM), which disclosed characteristic morphological features from the five types of vehicle categories such as motorcycles, cars, vans, buses, and lorries. A colorimetric method was performed to determine the concentration of anionic surfactants as MBAS, and the absorption was determined by using a UV spectrophotometer at a wavelength of 650 nm. FESEM images revealed that different vehicles exhibited distinct particle structures. Motorcycles had a porous and loosely agglomerated form of soot, while buses and lorries had compact, clustered particles with thick layers of carbon. Cars and vans showed intermediate morphologies with irregular soot flakes and micro-fractures. MBAS quantification revealed that lorries and buses had the highest levels of MBAS (1.04 µmol g-1), followed by vans (0.79 µmol g-1), motorcycles (0.69 µmol g-1), and cars (0.65 µmol g-1). These findings provide a particle-surfactant dynamics. Vehicular emissions from diesel and petrol vehicles are a cause for concern due to their potentially harmful impacts, especially on human health and the environment.

Keywords: *Exhaust Particulate matter, FESEM, vehicular emissions, anionic surfactants, MBAS*

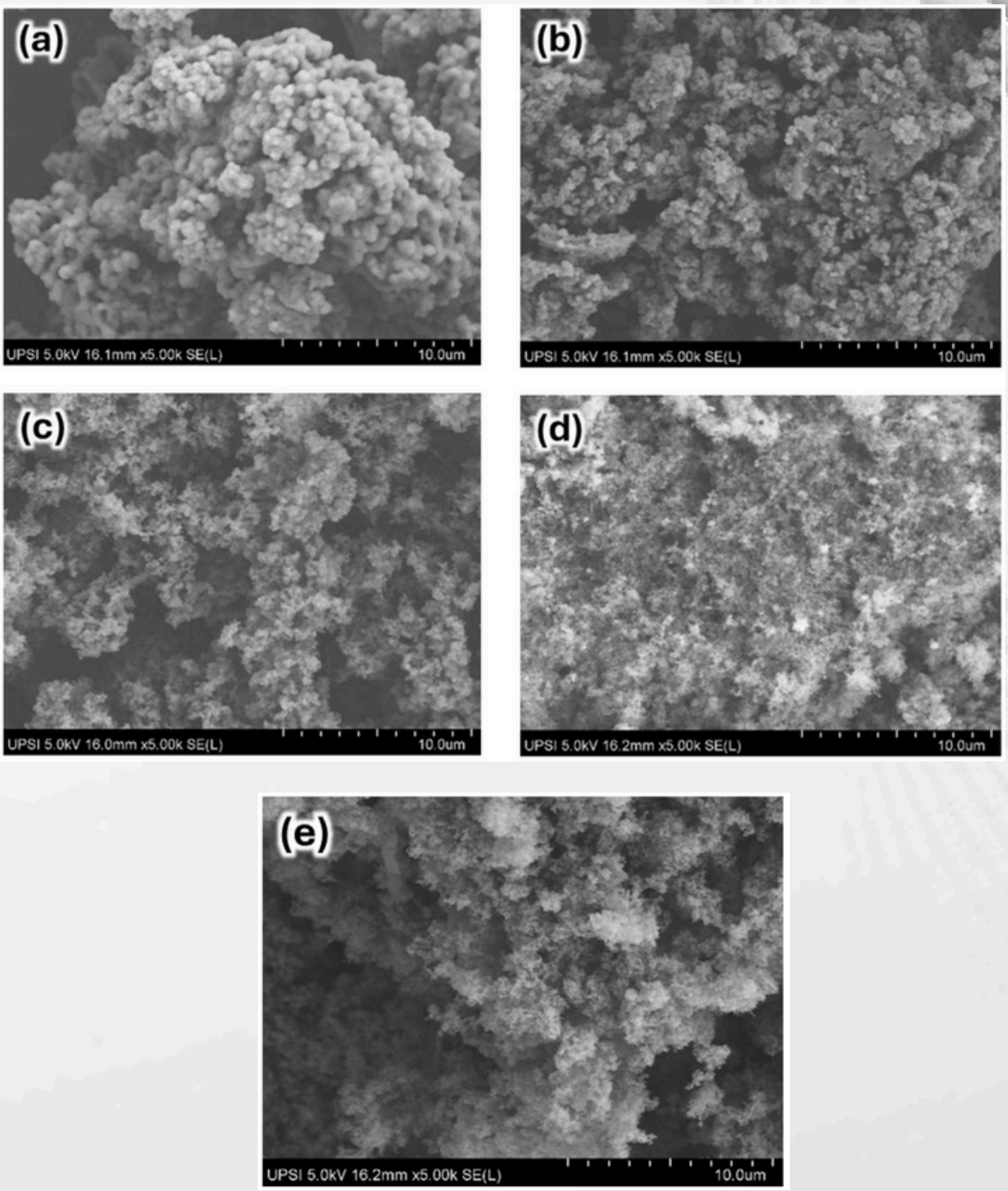


Figure 1: Field Emission Scanning Electron Microscope (FESEM) micrographs of exhaust particulate matter captured for (a) motorcycle, (b) car, (c) van, (d) bus, and (e) lorry at 5,000 magnifications.

Paper ID: USM01

CHEMICALLY ACTIVATED SUNFLOWER SEED SHELL BASED ACTIVATED CARBON FOR ALLOPURINOL REMOVAL: ISOTHERM, KINETICS, AND REGENERATION STUDIES

Siti Zawiyah Baharom, Azrina Aziz, Erniza Mohd Johan Jaya, and Mohd Azmier Ahmad*

School of Chemical Engineering, Engineering Campus, Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Pinang, Malaysia.

**Corresponding Author: M.A. Ahmad, chazmier@usm.my*

Abstract

Allopurinol (ALP) is an emerging contaminant that enters aquatic environments due to inadequate wastewater treatment and poses serious ecological risks to aquatic organisms. This concern prompted the present study, which aimed to synthesize activated carbon from sunflower seed shells (SSSAC) for the adsorption of ALP from aqueous solutions. SSSAC was prepared via chemical activation using potassium hydroxide (KOH). Scanning electron microscopy (SEM) analysis revealed that the raw sunflower seed shells lacked visible pores, whereas the activated SSSAC exhibited a highly porous structure, confirming the effectiveness of the activation process. In the adsorption experiments, increasing the initial ALP concentration from 10 to 100 mg/L led to an increase in adsorption capacity from 9.52 to 82.57 mg/g. However, the percentage removal decreased from 95.20% to 82.57% with higher concentrations. Isotherm analysis showed that the Freundlich model provided the best fit, with the lowest root mean square error (RMSE) of 1.38 mg/g and an average error of 5.97%, indicating a multilayer adsorption mechanism. The Langmuir model yielded a maximum monolayer adsorption capacity (Qm) of 119.27 mg/g. Kinetic analysis revealed that the adsorption process followed the pseudo-first-order (PFO) model, supported by the lowest RMSE of 1.61 mg/g and an average error of 9.68%. Regeneration studies indicated that SSSAC remained effective for up to four cycles, after which the ALP uptake declined to 41.88 mg/g and the adsorbent yield reduced to 33.97%.

Keywords: *activated carbon, chemical activation, isotherm, kinetic, regeneration*

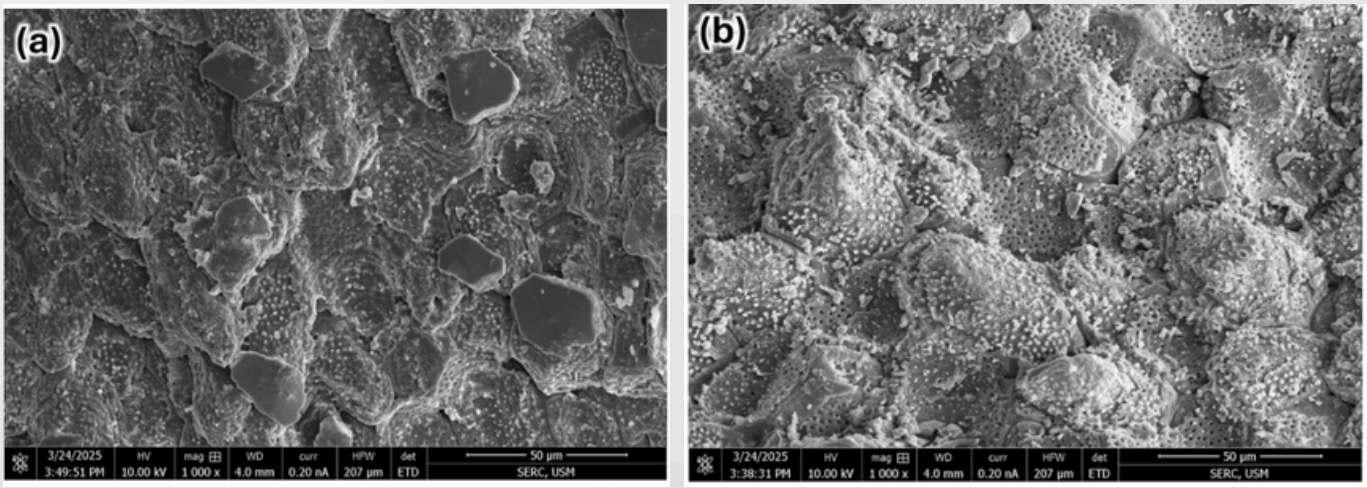


Figure 1: SEM images (1000 × magnification level) for (a) precursor and (b) SSSAC.

Paper ID: UTEM02

INFLUENCE OF BALL MILLING SPEED ON THE STRUCTURAL AND HARDNESS PROPERTIES OF EGGSHELL-DERIVED HYDROXYAPATITE FOR BIOMEDICAL APPLICATIONS

[1]Zhi Xian Woon, [1]Adibah Haneem Mohammad Dom*, [1]Toibah Ab Rahim, [1]Zurina Shamsuddin, [2]Fatma Zehra Koçak

[1]Faculty of Industrial and Manufacturing Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

[2]Engineering-Architecture Faculty, Metallurgy and Materials Engineering, Nevsehir HaciBektas Veli University, Nevsehir, 50300, Turkiye

**Corresponding Author: A.H. Mohammad Dom, adibah@utem.edu.my*

Abstract

Hydroxyapatite (HA), a calcium phosphate compound with the chemical formula $Ca_{10}(PO_4)_6(OH)_2$, is widely recognized for its exceptional biocompatibility, bioactivity, and structural similarity to human bone mineral. These properties make HA a prominent material in biomedical applications, particularly in bone tissue engineering, dental implants, and drug delivery systems. However, synthetic HA often suffers from insufficient mechanical strength and lacks essential trace elements, limiting its performance in load-bearing implants. This study addresses these limitations by proposing a sustainable method for synthesizing HA using calcium oxide (CaO) derived from eggshell waste through ball milling and heat treatment. The eggshell-derived CaO and diammonium hydrogen phosphate powders were milled at varying speeds of 200, 300, and 400 rpm, followed by heat treatment at 800 °C for 2 hours. Structural and compositional analyses were conducted using scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and X-ray diffraction (XRD), while mechanical properties were assessed via micro-Vickers hardness testing. The results revealed that increasing the milling speed significantly enhanced HA crystallinity, particle uniformity, and hardness. Additionally, the Ca/P ratios approached the ideal stoichiometric value of 1.67 at higher milling speeds, confirming successful HA formation. These findings underscore the importance of optimizing milling parameters and thermal treatment to improve the structural and mechanical performance of biowaste-derived HA, highlighting its promising potential for biomedical applications.

Keywords: *Hydroxyapatite, Ball milling, Eggshells waste, biomaterials application*

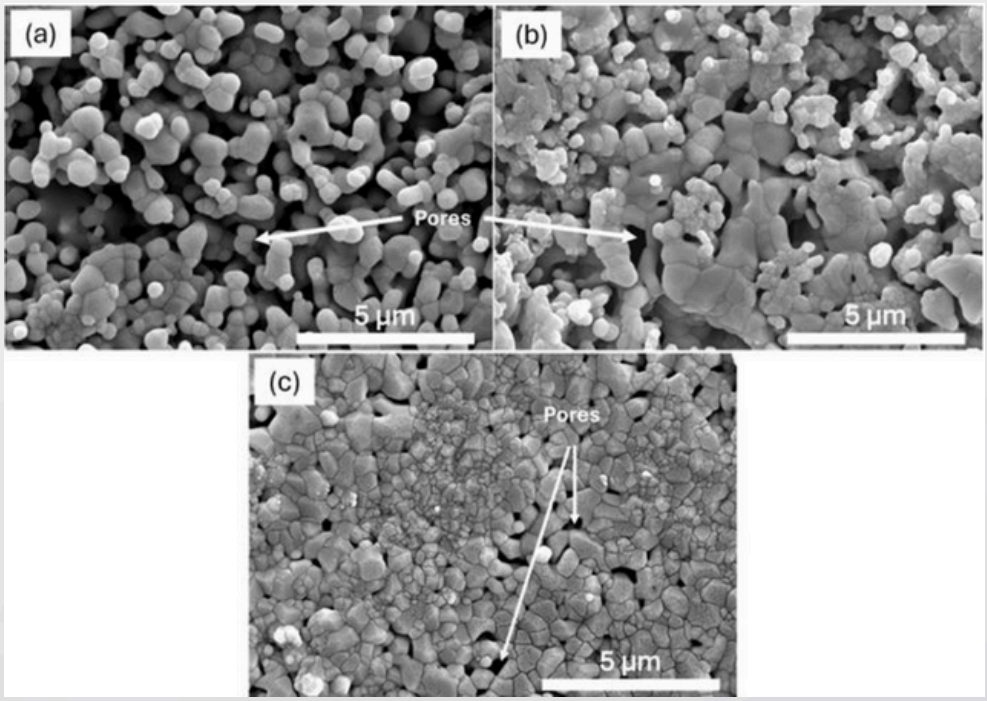


Figure 1: FESEM micrographs after sintering (a) 200 (b) 300 and (d) 400 rpm.

Paper ID: UTEM03

DYNAMIC BEHAVIOUR OF BIODEGRADABLE PINEAPPLE LEAF FIBRE (PALF) COMPOSITES FOR PROTECTIVE PACKAGING APPLICATIONS

[1]Siti Hajar Sheikh Md Fadzullah*, [2]Zaleha Mustafa, [2]Amirah Ain Asyiqin Mohammad Sappa, [1]Mohd NurAzmi Nordin, [1]Sivakumar Dhar Malingam, [3]Mohamad Zaki Bin Hassan

[1]Faculty of Mechanical Technology and Engineering (FTKM), Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya,76100 Durian Tunggal, Melaka.

[2]Faculty of Industrial and Manufacturing Technology and Engineering (FTKIP), Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya,76100 Durian Tunggal, Melaka.

[3]Faculty of Artificial Intelligence, Level 7, Menara Razak, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra,54100 Kuala Lumpur, Malaysia.

**Corresponding Author: S.H.Sheikh Md.Fadzullah, hajar@utem.edu.my*

Abstract

The dynamic mechanical performance of biodegradable biocomposites, designed for protective packaging, was evaluated. Composites comprising a polybutylene succinate (PBS) matrix blended with 10 wt.% ethylene-vinyl acetate (EVA) were reinforced with 30 wt.% and 40 wt.% treated pineapple leaf fibre (PALF). To assess their suitability for protecting fragile components, the materials were tested under both quasi-static indentation (1 mm/min) and low-velocity drop weight impact (15 J at 1.92 m/s). Both tests utilized a 12.7 mm hemispherical indenter to replicate realistic contact stresses during accidental drops. The composites demonstrated significant strain rate sensitivity, exhibiting superior energy absorption and load-bearing capacity under impact conditions versus quasi-static loading. Crucially, scanning electron microscopy (SEM) of the fracture surfaces revealed distinct failure mechanisms dictated by the loading rate. Impact loading was characterized by extensive fibre pull-out and fracture, which are the key mechanisms for energy dissipation, whereas quasi-static conditions led primarily to matrix cracking and delamination. These findings confirm that ALF-reinforced PBS/EVA biocomposites present a feasible, sustainable alternative to petroleum-based packaging, offering tailored impact resistance for fragile goods.

Keywords: *pineapple leaf fibre (PALF), biocomposites, impact behaviour, failure analysis, packaging applications.*

Figure 1: SEM micrograph of the fracture surface of a PALF-reinforced PBS/EVA composite (40 wt.% fibre) following a 15 J low-velocity impact test

Paper ID: UTEM04

WEIBULL ANALYSIS OF FATIGUE BEHAVIOUR IN SELF-REINFORCED PLA COMPOSITES WITH DIFFERENT FILLER SIZES UNDER HIGH STRESS FOR BONE FIXATION

[1]Zaleha Mustafa and [2]K.E. Tanner

[1]Fakulti Teknologi dan Kejuruteraan Industri dan Pembuatan, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

[2]School of Engineering and Materials Science and Institute of Bioengineering, Queen Mary University of London, London, UK

**Corresponding Author: Z. Mustafa, zaleha@utem.edu.my*

Abstract

In this study, the fatigue behaviour of self-reinforced polylactic acid (sr-PLA) at high stress levels was studied, and the influence of different filler sizes (2.99 µm and 20nm) was investigated on the fatigue behaviour using Weibull distribution analysis. The composite was produced by drawing PLA fibres in PLA matrix containing hydroxyapatite of micro-metre and nano-meter size particles to produce HA/PLA/PLA prepreg. The pre-impregnated sheets were then compression moulded and tested in bending quasi and flexural fatigue at 80% stress level, 2 Hz until failure. The addition of the filler enhances the bending properties of the composite. At the same time, the bending strength and modulus increase with a decrease in the filler size. Under the cyclic loading, the Weibull median fatigue life of sr-PLA reduces with the presence of the fillers. However, the Weibull median fatigue life of HA/PLA/PLA composite increases when a smaller filler size is used, from 132,458 cycles to 254,884 cycles for µm-HA filled PLA/PLA and nm-HA filled PLA/PLA composite, respectively. During the fatigue testing, the modulus of the composite was reduced due to damage in the materials, predominantly failure at the HA/matrix interface, as confirmed by SEM analysis. The materials are weaker in tension than in compression due to weak bonding between the HA/matrix interface.

Keywords: *Weibull distribution, fatigue testing, polylactic acid, hydroxyapatite, filler size*

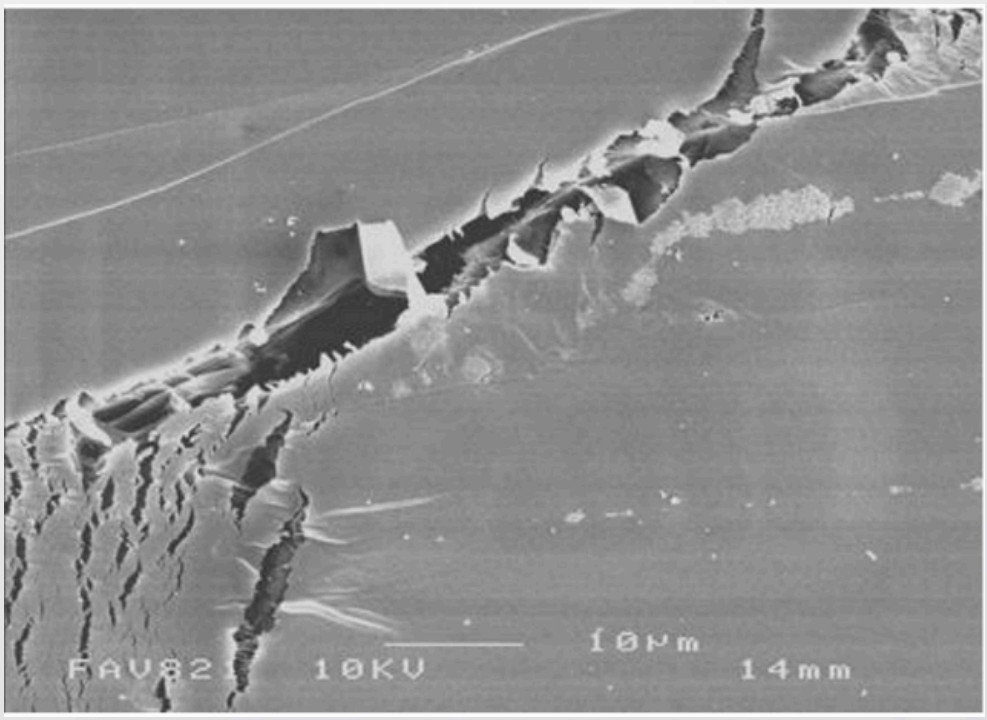


Figure 1: Crack propagation path under fatigue loading in HA-filled PLA-PLA composite

Paper ID: UTEM05

MECHANICAL AND MICROSTRUCTURAL COMPARISON OF FDM-PRINTED AND SLS-PRINTED COMPONENTS FOR ADDITIVE MANUFACTURING OF REHABILITATION DEVICES

[1]Ruzy Haryati Hambali*, [1]Vinna Chia, [2]Siti Hajar Binti Sheikh Md Fadzullah

[1]Faculty of Industrial & Manufacturing Technology & Engineering, Universiti Teknikal Malaysia Melaka, 76100, Durian Tunggal, Melaka.

[2]Faculty of Mechanical Technology & Engineering, Universiti Teknikal Malaysia Melaka, 76100, Durian Tunggal, Melaka.

**Corresponding Author: R.H. Hambali, ruzy@utem.edu.my*

Abstract

Additive manufacturing enables the design and fabrication of customised rehabilitation devices with optimised geometry and tailored performance. This study presents a comparative evaluation of polylactic acid (PLA) and nylon produced by fused deposition modelling (FDM) and nylon produced by selective laser sintering (SLS), focusing on mechanical, surface, and microstructural properties. Tensile testing, surface roughness measurements, and scanning electron microscopy (SEM) analyses were performed to assess performance differences. Results showed that SLS-printed nylon achieved highest tensile strength (56.84 MPa) and elongation at break (8.75%) compared to FDM-printed PLA lowest (42.15 MPa, 4.21%), indicating superior load-bearing capacity. Conversely, PLA exhibited smoother surfaces (Ra = 1.73 µm) than nylon (Ra = 3.42 µm), making it advantageous for applications prioritising aesthetics. SEM observations revealed fracture morphologies comparison of nylon for FDM and SLS. SLS-printed nylon displayed compact, homogeneous fracture surfaces with minimal porosity and well-fused layers, reflecting strong interlayer adhesion and ductile fracture behaviour. In contrast, FDM-printed nylon exhibited irregular fracture lines, visible interlayer voids, and rough fracture paths, consistent with its lower elongation at break and susceptibility to interfacial failure. These microstructural observations align with mechanical results, demonstrating the influence of process–material interactions on performance. In conclusion, the outcomes of this work suggest that SLS-printed nylon is more suitable for high-strength, load-bearing rehabilitation components, while FDM-printed PLA is ideal for lightweight, visually refined applications. This comparative insight provides valuable guidance for material and process selection in additive manufacturing of durable, patient-specific rehabilitation devices.

Keywords: *Nylon, PLA, Additive Manufacturing, Mechanical Properties, Rehabilitation Devices*

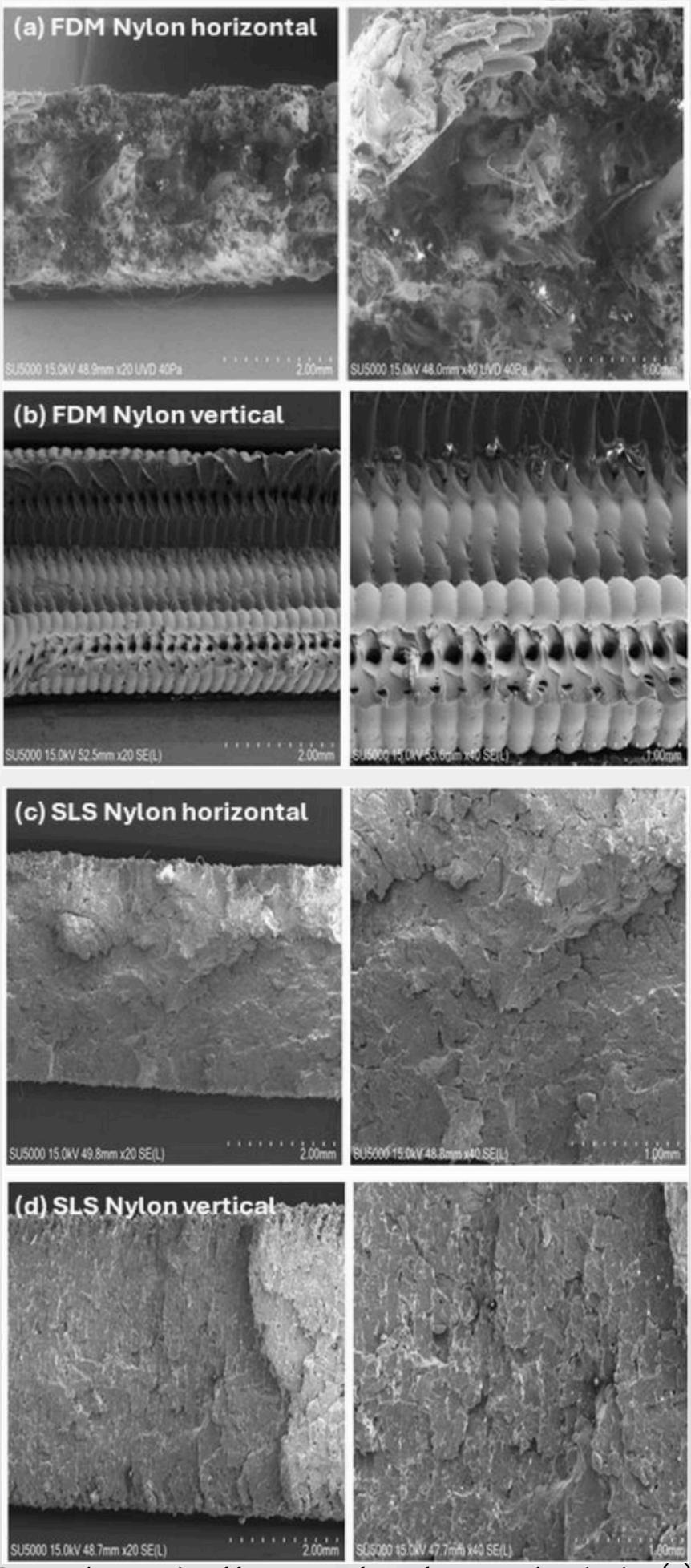


Figure 1: SEM micrographs of fracture surfaces for FDM-printed nylon (a) horizontal (b) vertical and SLS-printed Nylon (c) horizontal (d) vertical.

Paper ID: UTEM06

EFFECT OF USING VACUUM CLAMP ON END MILL PROCESS OF ACRYLIC TOWARDS SURFACE INTEGRITY UNDER MICROSCOPE

Norfariza binti Ab Wahab*

Faculty of Mechanical & Manufacturing Engineering Technology (FTKMP), Kampus Teknologi, Universiti Teknikal Malaysia Melaka, Jalan Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

**Corresponding Author: N. Abd Wahab, norfariza@utem.edu.my*

Abstract

The machining of thin-walled acrylic components presents challenges in maintaining dimensional accuracy and surface quality due to low stiffness and susceptibility to vibration during clamping. Conventional clamping methods often induce distortion or surface damage, necessitating alternative approaches. This study investigates the effect of a dual vacuum clamp system on the end milling of acrylic, focusing on surface integrity evaluated under a microscope. A systematic experimental design was employed using a high-speed steel two-flute end mill (3 mm diameter), with machining parameters set at a spindle speed of 3714 rpm and a feed rate of 445 mm/min. The vacuum clamping performance was analyzed under two conditions: continuously applied pressure and remain-pressure modes. Thrust forces were recorded using a Kistler 9257BA dynamometer, while surface roughness was measured using a Mitutoyo SJ-420 tester. The findings demonstrate that vacuum clamping significantly enhances surface integrity compared to conventional methods. Average surface roughness values of 0.585 µm (continuous pressure) and 0.663 µm (remain pressure) were achieved, reflecting improved machining stability. Results from the thesis (Section 4.5) further confirm that continuous pressure maintained lower thrust force values and consistent surface morphology, while remain pressure exhibited gradual pressure drop (2.6 kPa over 15 minutes), influencing surface uniformity. Additionally, microscopic evaluation in Section 4.8 revealed reduced micro-tearing, smoother feed direction marks, and improved edge definition under continuous vacuum pressure. Overall, the dual vacuum clamp system provided stable clamping without distortion, minimized vibration effects, and improved surface roughness quality. These results indicate that vacuum clamping is a promising method for enhancing machining performance of thin-walled acrylic components, ensuring higher surface integrity and repeatability in precision manufacturing applications.

Keywords: *vacuum clamp, end milling, surface integrity, thrust force, acrylic machining.*

Paper ID: UTEM07

CHARACTERIZATION OF MODIFIED TITANIUM DIOXIDE NANOTUBES BY ANODIZATION

[1]Syahriza Binti Ismail, [1]Iman Hanis Binti Kamal Baharin, [2]Noor Irinah Omar, [3]Monna Rozana

[1]Faculty of Industrial and Manufacturing Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

[2]Faculty of Mechanical Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

[3]Research Centre for Environmental and Clean Energy, National Research and Innovation Agency Republic of Indonesia, KST Samaun Samadikun Bandung 40135, Indonesia

**Corresponding Author: S. Ismail, syahriza@utem.edu.my*

Abstract

This study focuses on the characterization of modified titanium dioxide (TiO2) nanotubes synthesized through anodization, a versatile electrochemical technique. TiO2 nanotubes have garnered significant interest due to their unique structural, optical, and electronic properties, making them promising candidates for applications in photocatalysis, sensors, and energy storage. The anodization process parameters, including voltage, electrolyte composition, and duration, were systematically varied to optimize the morphology and crystalline structure of the nanotubes. Post-synthesis modifications were also applied to enhance surface properties, such combining with non-metal elements and thermal treatment, aiming to improve photocatalytic efficiency and charge carrier dynamics. Comprehensive characterization techniques, including scanning electron microscopy (SEM), X-ray diffraction (XRD), and UV-Vis spectroscopy, were employed to analyze the surface morphology, crystalline phases, and optical properties of the nanotubes. The results demonstrated that controlled anodization leads to highly ordered nanotube arrays with tunable dimensions and surface chemistry. Modifications significantly influenced the band gap and surface reactivity, indicating potential for improved performance in environmental and energy applications. This research advances the understanding of functionalized TiO2 nanotubes and provides a foundation for designing tailored nanostructures for specific industrial and technological uses.

Keywords: TiO2, nanotubes, anodization

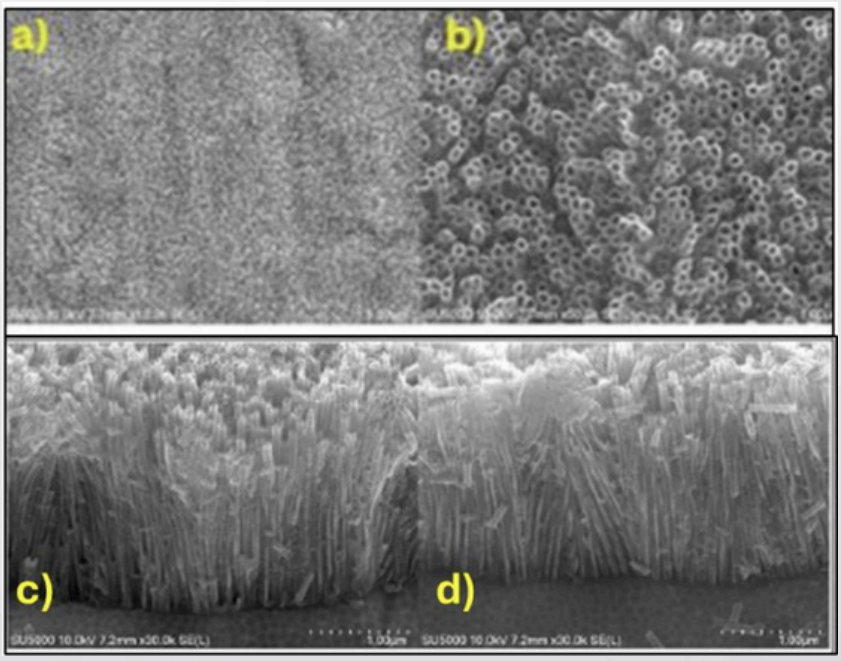


Figure 1: FESEM images of TiO2 nanotubes

Paper ID: UTEM08

EFFECT OF PULSE FREQUENCY ON TIC NANOCOMPOSITE COATING FABRICATED BY TIG TORCH MELTING

[1]Alin Qistina Shamsuri, [1]Lailatul Harina Paijan*, [2]Aslam Hadi Hamzah, 1Mohd Fauzi Mamat, [3]Shahira Liza Kamis

[1]Faculty of Industrial and Manufacturing Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

[2]ORS Technologies Sdn Bhd, Unit 2-5 MH Avenue, 2, Jalan Bunga Kantan, Taman P Ramlee,53000, Kuala Lumpur, Malaysia

[3]Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia.

**Corresponding Author: L.H. Paijan, lailatulharina@utem.edu.my*

Abstract

This study investigates the effect of pulse frequency on the deposition of TiC nanoparticles into duplex stainless steel, ASTM A240 fabricated by TIG torch method. While ASTM A240 exhibits advantageous properties, its softness and low wear resistance pose challenges for engineering applications, necessitating innovative durability solutions. Thus, surface reinforcement is necessary to address this issue. The primary aim of this work was to explore the influence of varying pulse frequency during TIG torch process on the nanocomposite coating fabrication to improve hardness and wear resistance. The methodology employed precise control of TIG torch parameters, including a constant arcing current of 140 A and varying pulse frequencies of 15, 20, and 25 PPS, to achieve optimal nanoparticle deposition and uniform distribution. Key assessments included coating thickness, microstructural analysis, microhardness profiles, intermetallic compound formation, and wear performance, utilizing equipment such as digital microscopy, Field Emission Scanning Electron Microscopy (FE-SEM), Vickers microhardness testing, X-ray diffraction (XRD), and linear reciprocating wear tests. The results revealed that at 25 PPS, the coatings exhibited peak performance, achieving a 1.78 mm thickness layer, 415.96 Hv microhardness, and the lowest CoF of 0.08 with shallow surface grooves. These findings offer valuable insights for industries aiming to enhance the durability of wear-resistant components, contributing to material engineering advancements and sustainability.

Keywords: *Pulse frequency, nanocomposite coating, intermetallic compound, TIG, surface modification.*

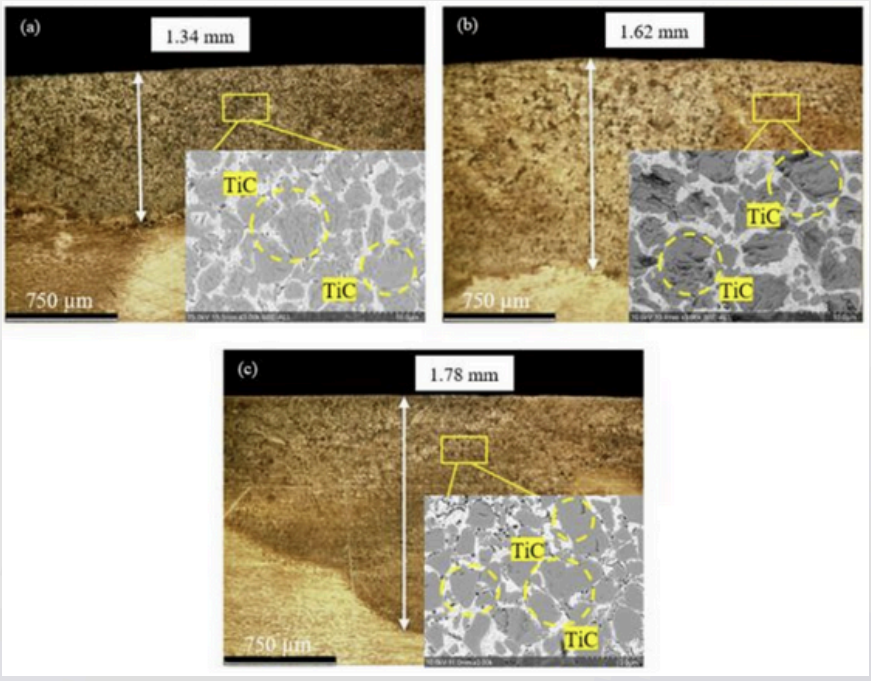


Figure 1: Thickness layer (digital microscope) and FESEM micrographs of cross-sectional images for TiC nanocomposite coating at different pulse frequency settings (a) 15 PPS, (b) 20 PPS and (c) 25 PPS.

Paper ID: UTEM09

MARTENSITIC FEATURES OF WAAM-DEPOSITED STAINLESS STEEL 410 IN AS-DEPOSITED AND HEAT-TREATED CONDITIONS

[1]Nur Izan Syahriah Hussein*, [1]Ahmad Amirul Aizad Samsuri, [2]Mohd Rizal Alkahari, 1Nor Ana Rosli, [2]Abd Rahman Dullah, [1]Syahrul Azwan Suandi, [1]Mohamad Nizam Ayof, [3]Azril Dahari Johari, [3]Salmi Mohd Yunus

[1]Faculty of Industrial and Manufacturing Technology and Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka.

[2]Faculty of Mechanical Technology and Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka.

[3]TNB Power Generation Sdn Bhd, 41000 Klang, Selangor.

**Corresponding Author: N.I.S. Hussein, izan@utem.edu.my*

Abstract

Wire Arc Additive Manufacturing (WAAM) of martensitic stainless steel 410 offers a cost-effective route for producing large components, yet as-deposited parts typically suffer from heterogeneous microstructures, anisotropic mechanical properties, and internal defects that compromise performance. In this research, stainless steel 410 WAAM samples were studied in the as-deposited state and after two post-deposition heat treatment cycles to address these issues. The objective was to correlate microstructural features, microhardness, and tensile properties to identify processing–property relationships that enhance strength and ductility. Microstructural analysis showed the as-deposited material was predominantly martensitic with round inclusions (up to ~1392 µm at the top region), while cross-sections revealed generally sound welds; after both heat treatments (980°C/205°C temper and 950°C/300°C temper), the microstructure remained martensitic but with improved uniformity and no visible macro-indications. Microhardness testing revealed as-deposited weld metal was high (~375–400 HV) but heterogeneous, with sharp drops in the HAZ (219–287 HV) and base metal (161–194 HV). Heat treatment homogenized hardness across the weld to ~340–360 HV (first HT) and ~340–370 HV (second HT), indicating tempered martensite with reduced residual stress. Tensile testing confirmed anisotropy in the as-deposited state (UTS ≈1116 MPa vertical, 854 MPa horizontal), strongly influenced by dendritic alignment and porosity. Based on hardness–strength correlations suggest both heat treatments retain high strength (~1050–1220 MPa UTS) while reducing anisotropy and improving ductility (~12–18%). Overall, the study demonstrates that controlled heat treatments mitigate microstructural heterogeneity, relieve stress, and balance strength–toughness, making WAAM stainless steel 410 more reliable for structural applications.

Keywords: *Wire Arc Additive Manufacturing, stainless steel 410, heat treatment, martensite, microstructural properties.*

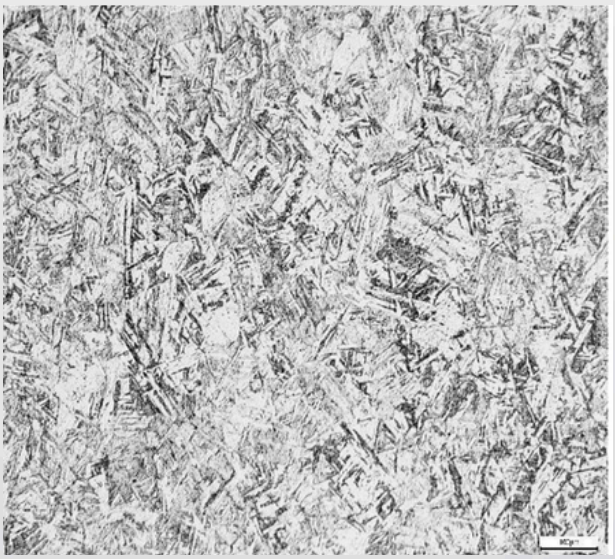


Figure 1: Quenched and tempered WAAM-deposited Stainless Steel 410 containing martensite.

Paper ID: UTEM10

EFFECT OF TIO_2/ZNO COMPOSITION ON THE PROPERTIES OF PLASMA SPRAY FEEDSTOCK POWDERS

[1]Muhamad Akmal bin Mohd Sani, [1]Yusliza binti Yusuf, [1]Jariah binti Mohamad Juoi, [1]Azhar Shah Bin Abu Hassan, [2]Sarita Morakul

[1]Fakulti Teknologi Dan Kejuruteraan Industri Dan Pembuatan, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

[2]Department of Mechancial Engineering, Chulalongkorn University, Bangkok, Thailand

**Corresponding Author: Y. Yusuf, yusliza@utem.edu.my*

Abstract

Titanium dioxide (TiO_2) is widely used as a plasma spray feedstock because of its high hardness, chemical stability, and wear resistance. However, its inherent brittleness and limited mechanical resilience reduce its effectiveness in demanding applications. Incorporating zinc oxide (ZnO) into TiO2 powders provides a potential strategy to tailor powder characteristics and enhance their suitability as feedstock materials. In this study, TiO_2/ZnO mixed powders containing 10, 20, and 30 wt% ZnO were prepared and systematically evaluated. Comprehensive characterization was carried out to assess particle morphology, phase composition, apparent density, and flowability—parameters that directly influence feedstock performance during plasma spraying. The results demonstrated that moderate ZnO incorporation (20 wt%) improved packing density and powder flowability, indicating superior feedstock processability. Conversely, excessive ZnO addition (30 wt%) led to increased porosity and reduced apparent density, which may compromise powder stability under plasma spraying conditions. These findings emphasize the critical role of compositional balance in determining feedstock quality, with 20 wt% ZnO identified as the optimal composition for achieving desirable powder characteristics. This work provides new insights into the effects of ZnO content on TiO_2-based mixed powders and offers guidance for the design of ceramic feedstock materials with improved performance for plasma spray applications.

Keywords: ZnO, TiO_2, Plasma Spraying, Feedstock powder

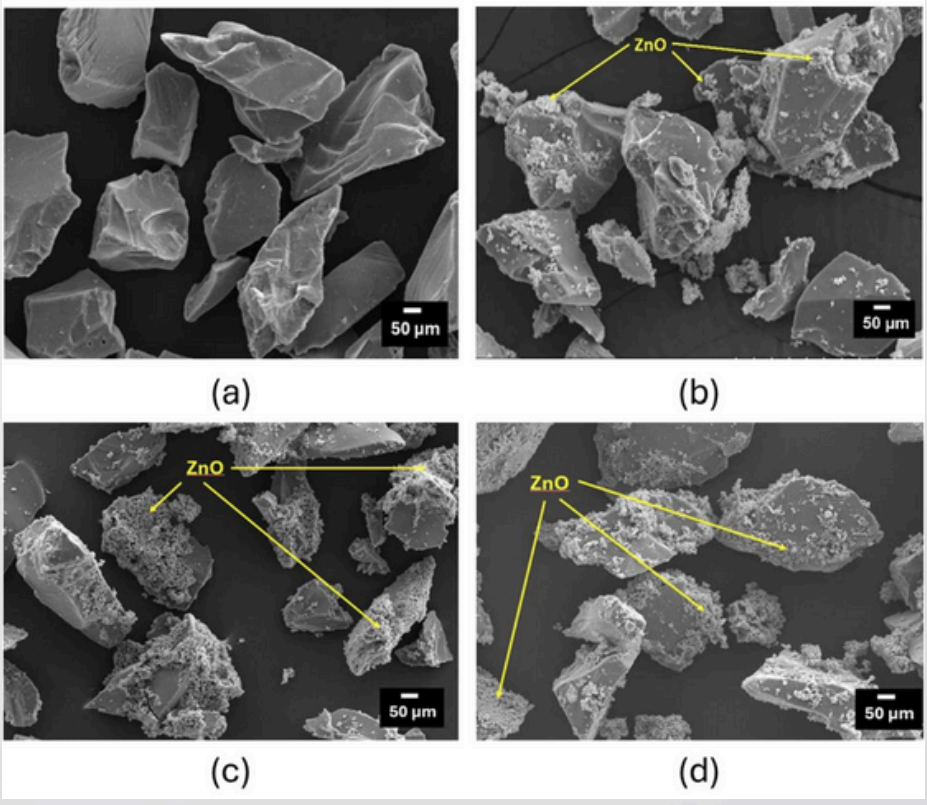


Figure 1: SEM micrographs of TiO2/ZnO mixed powders with varying ZnO contents: (a) pure TiO2, (b) 10 wt% ZnO, (c) 20 wt% ZnO, and (d) 30 wt% ZnO

Paper ID: UTEM12

CORRELATIONS BETWEEN POROSITY, THERMAL CONDUCTIVITY AND MECHANICAL STRENGTH IN BI-LAYERED CERAMICS WITH DIFFERENT PRESSING PRESSURE

[1]Mohamed Lokman Jalaluddin, [1]Umar Al-Amani Azlan*, [1]Mohd Warikh Abd Rashid, [2]Norfauzi Tamin and [3]Muchlis

[1]Fakulti Teknologi Dan Kejuruteraan Industri Dan Pembuatan, Universiti Teknikal Malaysia Melaka, 76100, Durian Tunggal, Melaka, Malaysia

[2]Faculty of Technical and Vocational Education, Universiti Tun Hussien Onn Malaysia, Parit Raja, Batu Pahat 86400, Johor, Malaysia

[5]Faculty of Science and Information Technology, Universitas AKPRIND Indonesia, Jl. Kalisahak No.28, Klitren, Kec. Gondokusuman, Kota Yogyakarta, Daerah Istimewa Yogyakarta 55222, Indonesia

**Corresponding Author: U.A. Haji Azlan, umar@utem.edu.my*

Abstract

This study examines the correlations between porosity, thermal conductivity, and mechanical strength in dense/porous bi-layered ceramics fabricated under varying pressing pressures of 10–30 MPa. The objective was to determine how pressing pressure influences the interdependent evolution of microstructure and functional properties. Field Emission Scanning Electron Microscopy (FESEM) revealed notable changes in pore morphology and grain compaction, with increasing pressure promoting densification and reducing pore connectivity. Quantitative measurements showed that porosity increased from 4.31 % at 10 MPa to 9.90 % at 20 MPa, before declining to 5.95 % at 30 MPa, indicating a critical pressure threshold governing pore formation and collapse. The variations in porosity exhibited a strong inverse correlation with thermal conductivity, which decreased from 2.018 W/m·K to 1.503 W/m·K as porosity increased, then recovered slightly to 1.561 W/m·K at higher densification. Similarly, mechanical strength displayed a nonlinear relationship, attaining a maximum flexural strength of 29.21 MPa at 20 MPa pressing pressure—corresponding to an optimal pore distribution that enhanced crack deflection and stress accommodation. The analysis highlights that the thermal–mechanical performance of bi-layered ceramics is governed by the competitive interplay between densification and residual porosity. Overall, 20 MPa emerged as the optimal pressing pressure, yielding a favourable balance between mechanical integrity and thermal insulation efficiency, thus underscoring its potential for energy-efficient structural ceramic applications.

Keywords: *Porosity, Thermal Conductivity, Mechanical Strength*

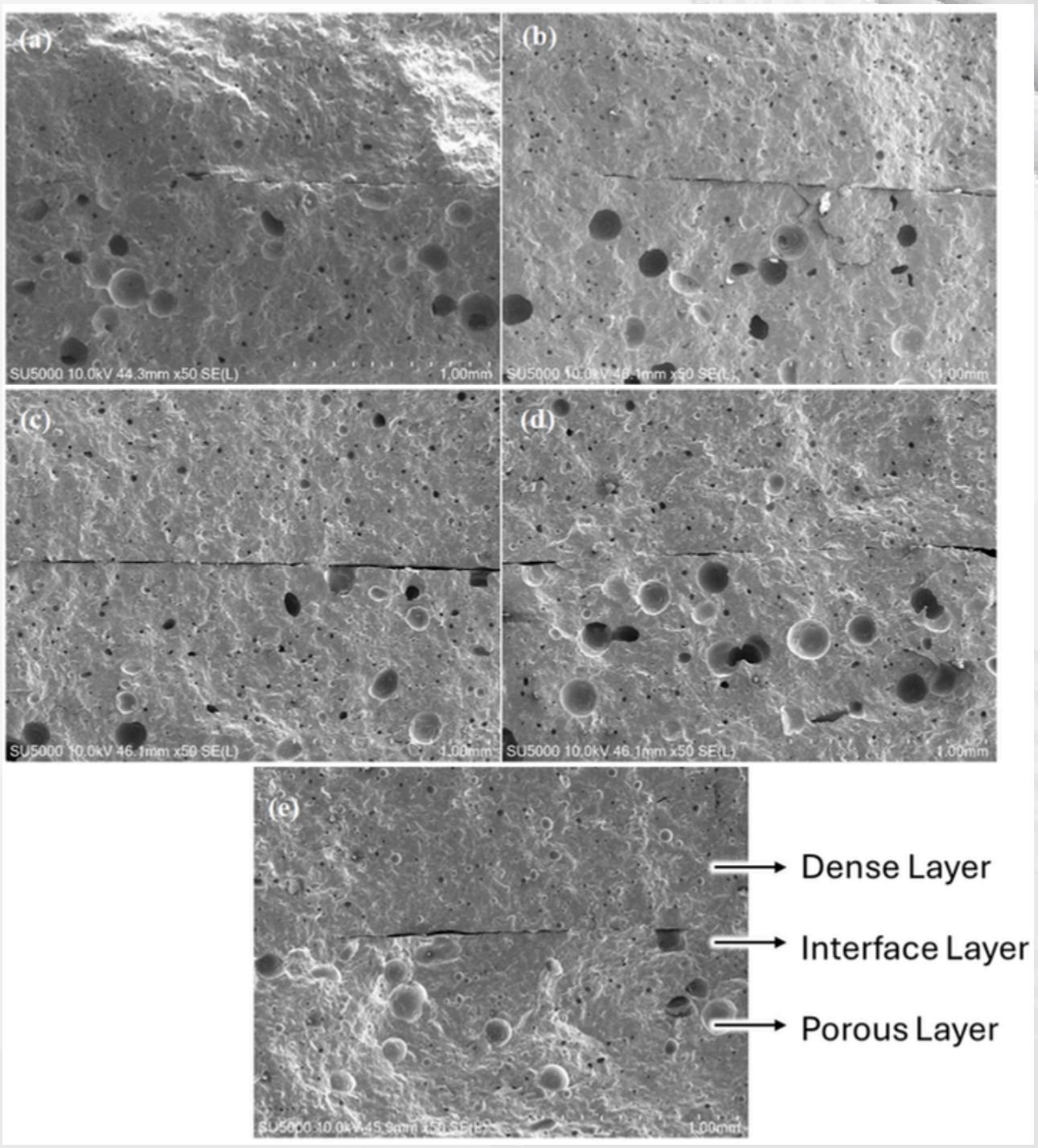


Figure 1: FESEM micrograph of the interface between dense and porous in bi-layered ceramic pressed at different pressures: (a) 10 MPa, (b) 15 MPa, (c) 20 MPa, (d) 25 MPa, and (e) 30 MPa.

Paper ID: UTEM13

PREDICTIVE MODELLING OF MALAYSIAN NATURAL RUBBER PROPERTIES FOR VIBRATION ISOLATION SYSTEMS

[1]Mohd Azli Salim*, [1]Mohd Zaid Akop, [1]Nor Azmmi Masripan, [2]Azma Putra

[1]Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Melaka.

[2]School of Civil and Mechanical Engineering, Faculty of Science and Engineering, Curtin University, Australia

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

This study presents a predictive modelling approach for evaluating the vibration transmissibility of a vibration isolator manufactured from Malaysian Natural Rubber. The primary aim is to predict the transmitted force and excitation force using a mathematical model capable of accurately capturing the dynamic response of the isolator under operational loading conditions. The modelling framework incorporates the inherent nonlinearity and viscoelastic characteristics of natural rubber, enabling a more realistic representation of its vibration isolation behaviour. In parallel, morphological analysis using Scanning Electron Microscopy (SEM) is conducted to examine the internal microstructural features of the developed isolator. The SEM observations provide insights into filler dispersion, strain-induced micro-void formation, and surface deformation patterns that occur during dynamic loading. This microstructural evidence is used to validate and verify the predictive capability of the mathematical model by linking observed morphological behaviour with the modelled vibration response. The results demonstrate that the proposed model delivers reliable and consistent predictions of vibration transmissibility, with strong agreement between analytical outputs and experimental observations. The predicted transmitted force closely matches the measured response, confirming the suitability of the modelling approach for natural rubber-based isolators. The findings also verify that Malaysian Natural Rubber possesses favourable dynamic properties that enable effective attenuation of vibration across the tested frequency range. Overall, this study highlights the significance of integrating mathematical modelling with morphological verification to enhance the design, characterisation, and optimisation of natural rubber vibration isolators. The combined approach establishes a robust foundation for future development of cost-effective, high performance vibration isolation systems based on sustainable Malaysian materials.

Keywords: *Malaysian Natural Rubber, Transmissibility, SEM*

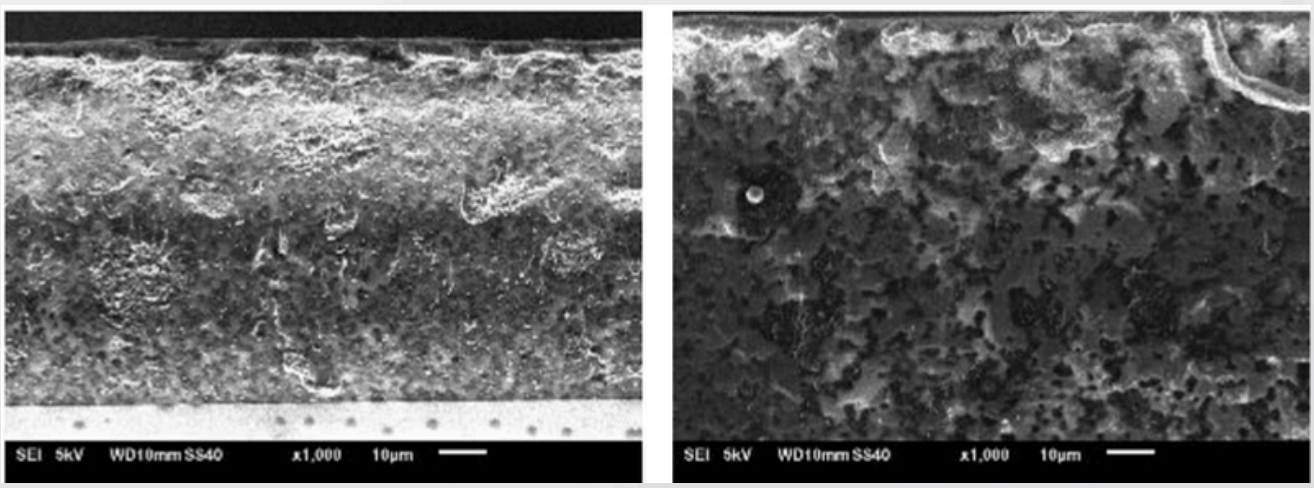


Figure 1: SEM Results

Paper ID: UTEM14

MICROSCOPIC INSIGHTS INTO THE MORPHOLOGICAL AND ELECTRICAL BEHAVIOUR OF GNP HYBRID INK UNDER CYCLIC BENDING

[1,2]Hazril Hisham Hussin, [2]Nor Azmmi Masripan, [3]Chonlatee Photong, [4]Alan Watson, [2]Mohd Azli Salim*

[1] *Jabatan Kejuruteraan Mekanikal, Politeknik Ungku Omar, Ipoh, Perak, Malaysia.*

[2] *Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Melaka.*

[3] *Faculty of Engineering, Mahasarakham University, Thailand.*

[4] *Power Electronics and Machines Centre, The University of Nottingham, UK*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

Hybrid conductive ink formulations based on graphene nanoplatelet (GNP), silver (Ag) and silver acetate (SA) demonstrate high potential for flexible and wearable electronic applications attributed to their superior electrical and mechanical properties. However, maintaining conductivity stability under repeated deformation remains a major challenge. This study evaluates the morphological behavior and electrical stability of GNP hybrid conductive ink under cyclic bending stress, with focus on resistance, resistivity and microstructural changes. Hybrid ink samples printed on thin copper (Cu) films were bent up to 4000 cycles, while resistance and resistivity measurements were obtained using the Two-Point Probe method. Surface morphology and elemental composition were analyzed through Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray (EDX) analysis. Results showed resistance increased from 0.66 Ω to 1.06 Ω and resistivity from 1.99 x 10^{-5} Ω.m to 3.17 x 10^{-5} Ω.m, indicating minor conductivity degradation resulting from repeated mechanical stress. SEM and EDX analysis revealed crack and void formation at high cycles that contributed to increased electrical resistance. Mapping results confirmed the presence and distribution of carbon (C), Ag and Cu elements, with Ag dominating the conductive network. Elemental variations across the spectrum indicated particle agglomeration and non-uniform filler dispersion from repeated bending. Overall, the GNP hybrid formulation demonstrated stable conductivity and morphological integrity under cyclic stress, proving its suitability for flexible electronic applications with potential for further optimization through improved filler dispersion and curing control.

Keywords: *Hybrid conductive ink, graphene nanoplatelet (GNP), cyclic bending test.*

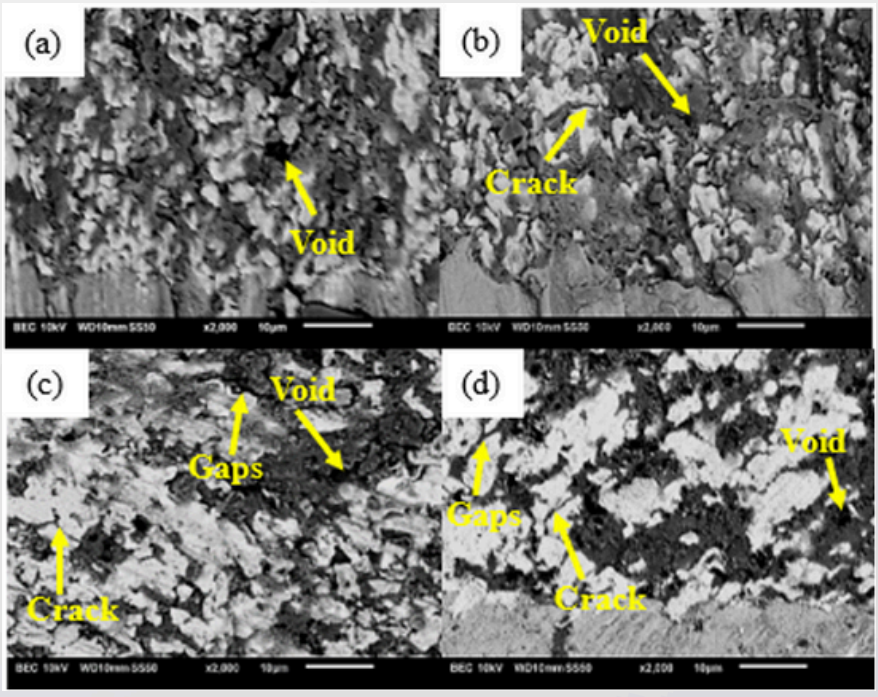


Figure 1: SEM micrographs of GNP hybrid ink after cyclic bending at (a) 500, (b) 1000, (c) 2000 and (d) 4000 cycles.

Paper ID: UTEM15

INVESTIGATION OF ELECTRICAL AND MICROSTRUCTURAL CHANGES IN GNP/AG HYBRID INK UNDER TORSIONAL LOADING

[1]Ismaniza Ismail, [1]Nor Azmmi Masripan, [2]Chonlatee Photong, [3]Alan Watson, [1]Mohd Azli Salim

[1]*Faculty of Technology and Mechanical Engineering, Universiti Teknikal Malaysia Melaka*

[2]*Faculty of Engineering, Mahasarakham Universiti, Thailand*

[3]*Power Electronics and Machines Centre, The University of Nottingham, UK*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

Flexible electronics have gained significant attention due to their potential in next generation wearable and adaptable technologies. Numerous studies have been conducted to optimize their electrical and mechanical performance. However, challenges remain in achieving long term durability, stability and consistent mechanical behavior. This study aims to investigate the mechanical and electrical characteristics of hybrid Graphene nanoplatelet and silver (GNP/Ag) conductive ink under torsional loading. The GNP/Ag hybrid ink was formulated and screen printed onto a copper substrate, followed by curing at 250° C for one hour. The resistivity of the samples was measured before and after torsional cyclic testing at room temperature. Subsequently, morphological analysis was performed using Scanning Electron Microscopy (SEM) to observe the structural changes in the ink after torsion loading. The findings revealed an increase in resistivity after 2000 torsion cycles which correlated with the SEM images showing the formation of microcracks and voids within the ink matrix. These changes are attributed to particle aggregation and fracture under mechanical stress, consistent with observations reported in previous studies. Energy Dispersive X-ray (EDX) analysis further indicated compositional variations showing a reduction in conductive filler content and an increase in oxygen concentration probably due to oxidation and degradation of the ink film. Despite the observed negative trend, this study contributes to deeper understanding to torsional fatigue mechanisms in hybrid conductive inks and provides valuable insight for future formulation improvements. It is recommended that future work focuses on enhancing GNP dispersion through surfactant assisted mixing to improve mechanical resilience under torsional stress.

Keywords: *Flexible electronics, GNP/Ag hybrid ink, torsional fatigue, microstructural analysis*

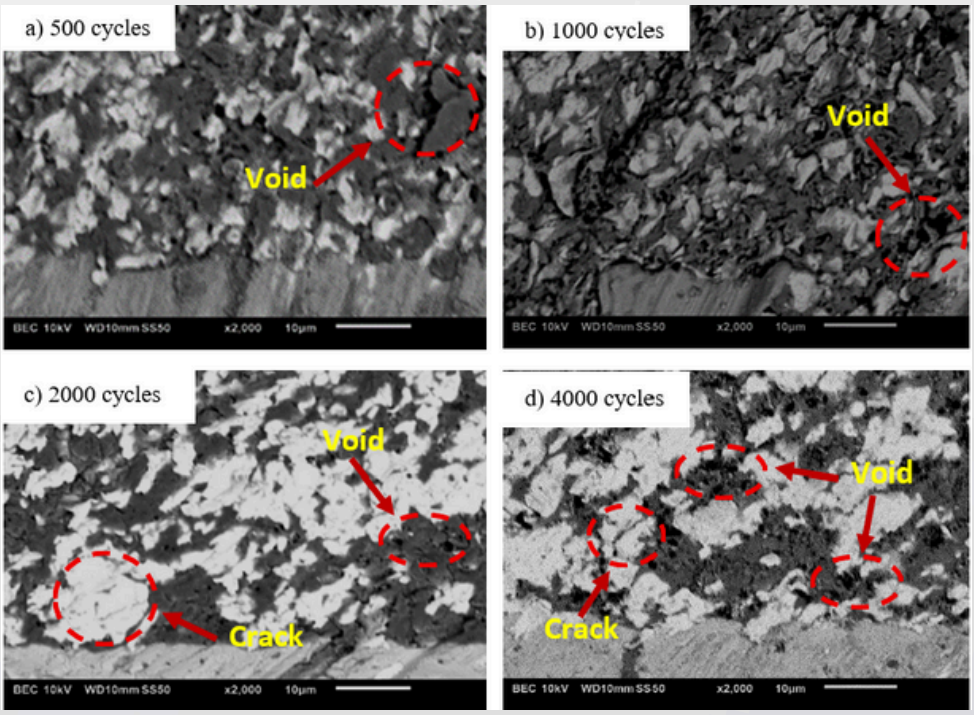


Figure 1: Filler loading cross section images after torsional test

Paper ID: UTEM16

MORPHOLOGY AND CONDUCTIVITY OF GNP/AG HYBRID INK AFTER CYCLIC LOADING

[1]Zikriah Zakaria, [2]Mohd Azli Salim, [2]Nor Azmmi Masripan

[1] *Unit Akademik dan Pendidikan Berterusan, Kolej Komuniti Rompin, Pahang.*

[2] *Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti teknikal Malaysia Melaka, Melaka.*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

Graphene nanoplatelet with silver (GNP/Ag) hybrid conductive inks are attractive materials for flexible and wearable electronic applications regarding their high conductivity and mechanical flexibility. However, the stability of their electrical performance under cyclic deformation remains a thoughtful concern. This study investigates the microstructural and electrical evolution of GNP/Ag hybrid conductive ink subjected to torsional and bending fatigue tests. The ink, formulated with GNP and Ag fillers and cured at 250 °C for 5 hours, was deposited on copper substrates and exposed to 0, 2,000, 4,000, 8,000, and 16,000 loading cycles. Post-deformation characterization was conducted using scanning electron microscopy (SEM) at ×400 and ×2000 magnifications, while the electrical resistance and resistivity were measured after each cycle set. Results show that the electrical resistance of both samples increased with cycle count, correlating with the gradual development of surface cracks and particle agglomeration observed in SEM micrographs. The torsional sample exhibited only a lowest resistance of 0.230 Ω at 1000 cycles, maintaining a uniform conductive network with minimal delamination. In contrast, the bending sample showed a lowest resistance of 0.450 Ω at 16000 cycles, accompanied by microcrack propagation and localized particle detachment at higher magnification. Overall, the GNP/Ag hybrid ink demonstrated greater structural integrity and electrical stability under torsional stress compared to bending fatigue. These findings highlight the strong correlation between mechanical deformation, microstructural integrity, and electrical performance in hybrid conductive inks for flexible electronic applications.

Keywords: *GNP/Ag, conductive ink, cyclic loading, morphological analysis, scanning electron microscopy.*

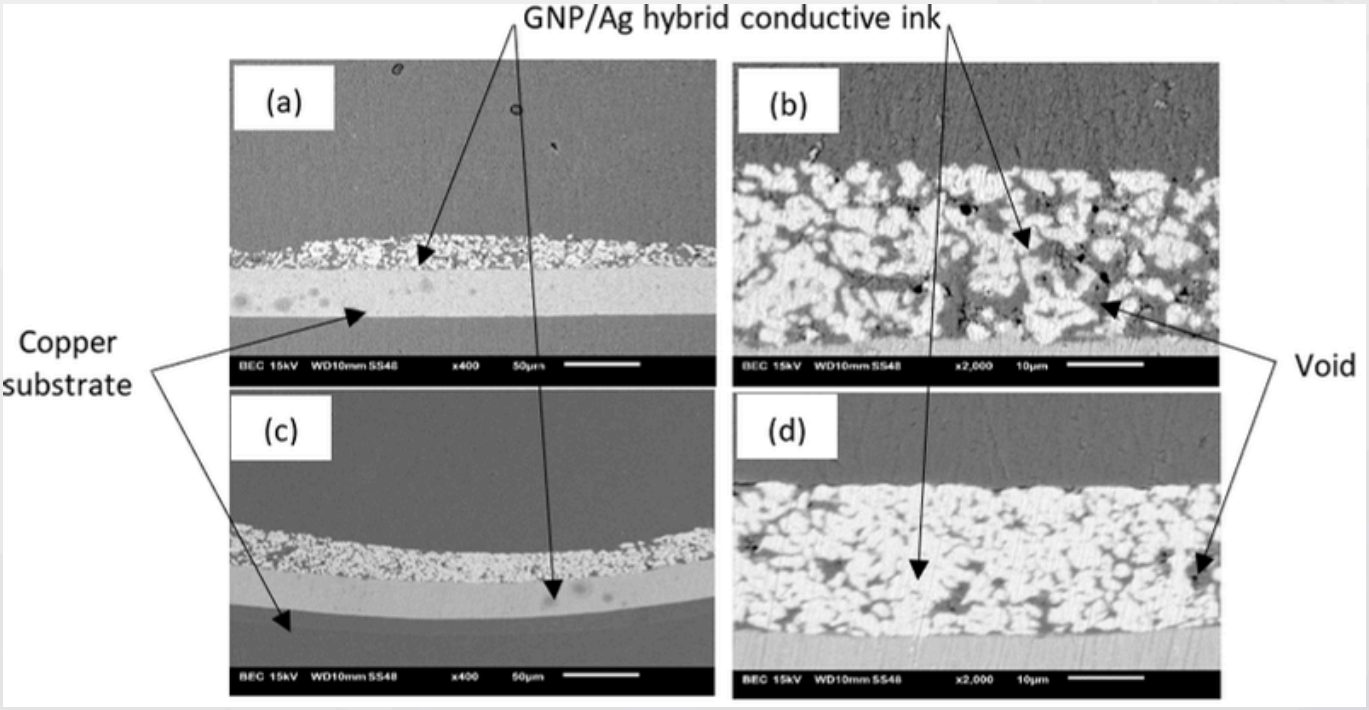


Figure 1: (a) Hybrid GNP/Ag conductive ink after torsional test at x400 magnification (b)The particles distribution of 10-Butanol to 10-Terpineol at x2000 magnification (c) Hybrid GNP/Ag conductive ink after bending test at x400 magnification (b)The particles distribution of 10-Butanol to 10-Terpineol at x2000 magnification

MICROSTRUCTURAL AND ELECTRICAL CHARACTERIZATION OF GNP/AG AND GNP/CB HYBRID CONDUCTIVE INKS FOR FLEXIBLE ELECTRONIC APPLICATIONS

[1,2]Mazilah Abu Bakar, [2] Nor Azmmi Masripan, [3] Chonlatee Photong, [4] Alan Watson, [2*] Mohd Azli Salim

[1] *Jabatan Kejuruteraan Mekanikal, Politeknik Sultan Haji Ahmad Shah, 25350 Kuantan, Pahang.*

[2] *Fakulti Teknologi dan Kejuruteraan Mekanikal, University Teknikal Malaysia Melaka, 76100, Malaysia.*

[3] *Faculty of Engineering, Mahasarakham University, Thailand*

[4] *Power Electronics and Machines Centre, The University of Nottingham, UK*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

The rapid development of flexible and printed electronic devices has increased research into conductive inks that combine excellent electrical performance and mechanical stability. Hybrid systems based on graphene nanoplatelets (GNP), silver nanoparticles (Ag), and carbon black (CB) provide combined advantages that enhance both conductivity and flexibility. This study investigates the microstructural and electrical behavior of hybrid conductive inks developed for flexible and printed electronic applications. The GNP were combined with Ag and CB to form hybrid inks, which were cured at 260 °C for 5 hours. Scanning Electron Microscopy (SEM) revealed that curing produced well-formed, continuous conductive networks with enhanced particle bonding and uniform dispersion. The GNP/Ag hybrid ink showed a compact structure with strong interparticle contact, resulting in lower resistivity and improved electron transport, while the GNP/CB ink exhibited partial agglomeration and slightly higher resistance. Electrical measurements before and after 16,000 bending cycles indicated only minor resistance changes, confirming the inks' excellent mechanical flexibility and structural stability. Overall, curing at 260 °C effectively promotes conductive network formation and enhances the overall electrical performance of the hybrid inks, highlighting their potential for flexible and printed electronic applications.

Keywords: *Graphene nanoplatelets, Silver nanoparticles, Carbon black, Conductive ink, SEM*

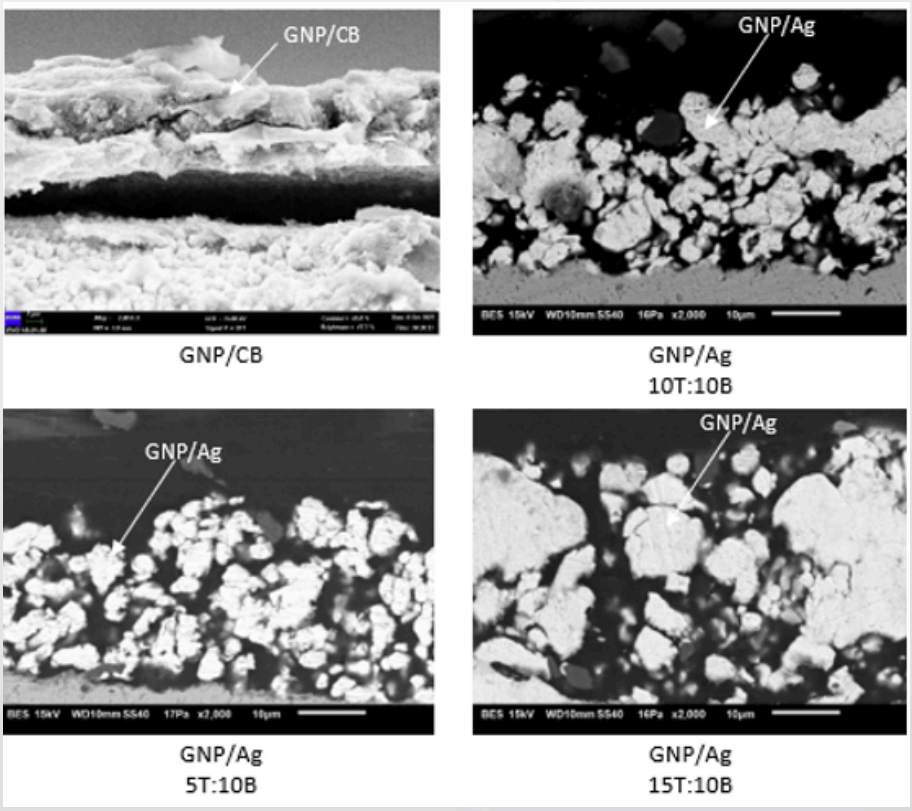


Figure 1: Hybrid GNP/Ag and GNP/CB conductive inks

Paper ID: UTEM18

ELECTRICAL AND MORPHOLOGICAL EVALUATION OF GRAPHENE NANOPLATELET/SILVER HYBRID CONDUCTIVE INK ON VARIOUS SUBSTRATES UNDER MOISTURE STRESS

[1]Norashikin Shari, [2]Nurfaizey Abd Hamid, [3]Chonlatee Photong, [4]Alan Watson, [*2]Mohd Azli Salim

[1] *Jabatan Matematik, Sains dan Komputer, Politeknik Ungku Omar, Perak, Malaysia.*

[2] *Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Melaka.*

[3] *Faculty of Engineering, Mahasarakham University, Thailand.*

[4] *Power Electronics and Machines Centre, the University of Nottingham, UK.*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

This work systematically investigates the impact of terpinol: butanol solvent ratio at 5T, 10T, 15T on the electrical, morphological, and adhesion properties of graphene nanoplatelet (GNP) hybrid inks incorporating silver acetate (SA) and silver (Ag). Inks were screen printed at 60µm thickness onto copper (Cu), polyethylene terephthalate (PET), and thermoplastic polyurethane (TPU) substrates. After curing, all samples underwent a 10minute immersion in water prior to electrical evaluation. The Scanning Electron Microscopy (SEM) revealed that solvent ratio has significant role in thickness of GNP hybrid conductive inks after water immersion. On Cu substrates, higher terpinol ratios enabled the formation of thick of 61µm, uniform, and well-adhered inks and SEM images confirmed minimal morphological degradation or detachment under moist conditions. In contrast, PET and TPU substrates yielded progressively thinner inks down to 19.67µm on PET and below 28µm on TPU with observable surface defects and substantial ink loss after water exposure, indicating weaker adhesion and susceptibility to moisture induced degradation. These morphological trends correlated clearly with electrical results of Cu samples consistently exhibited the lowest resistivity between 3.60×10^{-5} to $2.04\times10^{-5}\Omega$m and stable voltage performance, while thinner, degraded PET and TPU ink displayed higher and more variable resistivities, aligning with their compromised ink structures. Thus, SEM based visualization of ink thickness and surface uniformity serves as a robust predictor of both adhesion stability and electronic conductivity in moisture exposed to GNP hybrid conductive inks. The findings highlight the necessity of jointly optimizing ink formulation and substrate selection to achieve durable, high-performance printed electronics.

Keywords: *Graphene nanoplatelet hybrid ink; Solvent ratio optimization; SEM morphological analysis; Adhesion and electrical properties*

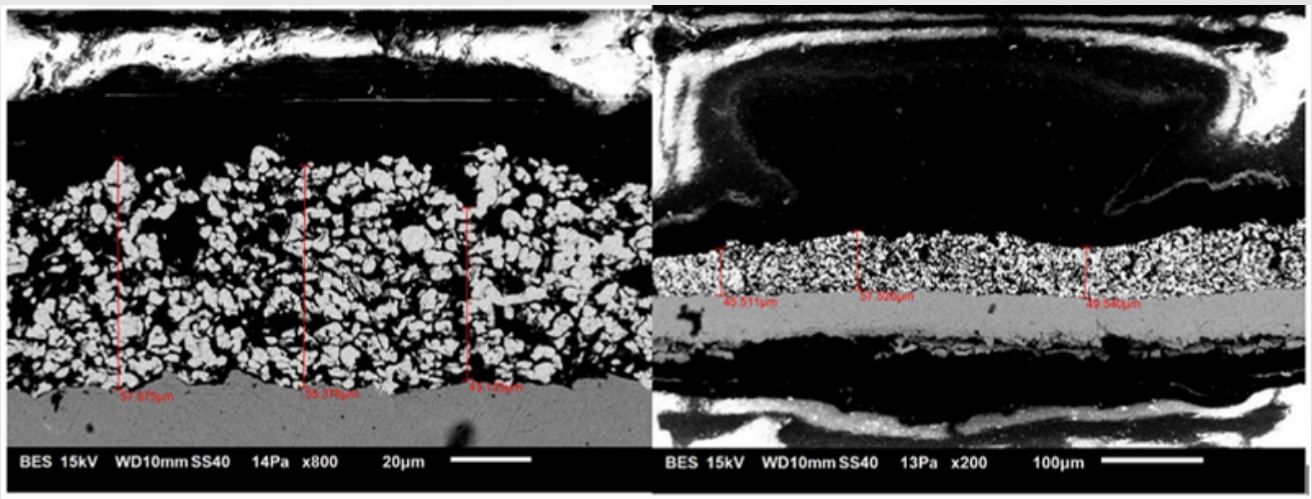


Figure 1: SEM morphological on Cu substrate after water immersion

Paper ID: UTEM19

MICROSTRUCTURAL EVOLUTION AND CONDUCTIVITY STABILITY OF GRAPHENE–SILVER HYBRID CONDUCTIVE INK UNDER CYCLIC LOADING

[1]Rospi bin Mat Husin, [2]Mohd Azli Salim, [2]Nor Azmmi Masripan

[1] *Jabatan Kejuruteraan Mekanikal, Politeknik Sultan Haji Ahmad Shah, Kuantan, Pahang*

[2]*Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Melaka*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

This study investigates the microstructural evolution and electrical stability of hybrid conductive ink composed of graphene nanoplatelets (GNP) and silver acetate (SA) under cyclic mechanical loading. The inks were formulated with a GNP/SA ratio of 5T:10B and thermally cured at 250°C and 260°C to evaluate the influence of curing temperature on conductive network formation. Scanning Electron Microscopy (SEM) analyses were performed at multiple cyclic intervals 0, 1000, 2000, 4000, 8000, and 16000 cycles to assess morphological changes, crack propagation, and filler dispersion within the printed layers. Results reveal that higher curing temperatures enhanced filler interconnectivity and reduced void formation, leading to improved adhesion and structural compactness. The GNP/SA network exhibited notable resilience, maintaining conductive pathways despite gradual microcrack development over extended cyclic tests. At 260°C, the conductive film demonstrated superior particle coalescence and minimal interfacial delamination compared to samples cured at 250°C, suggesting enhanced thermal stability and electron transport continuity. Progressive cyclic deformation, however, introduced localized defects that contributed to incremental resistance increase beyond 8000 cycles. Overall, the findings highlight the critical role of curing temperature and microstructural integrity in determining the long-term performance of hybrid GNP/SA conductive inks. These insights provide a foundation for optimizing flexible electronic materials with robust mechanical endurance and stable electrical conductivity under repetitive mechanical stress key for next generation wearable and flexible electronic applications.

Keywords: *graphene nanoplatelets (GNP), silver acetate (SA), hybrid conductive ink, cyclic mechanical loading, and flexible electronics.*

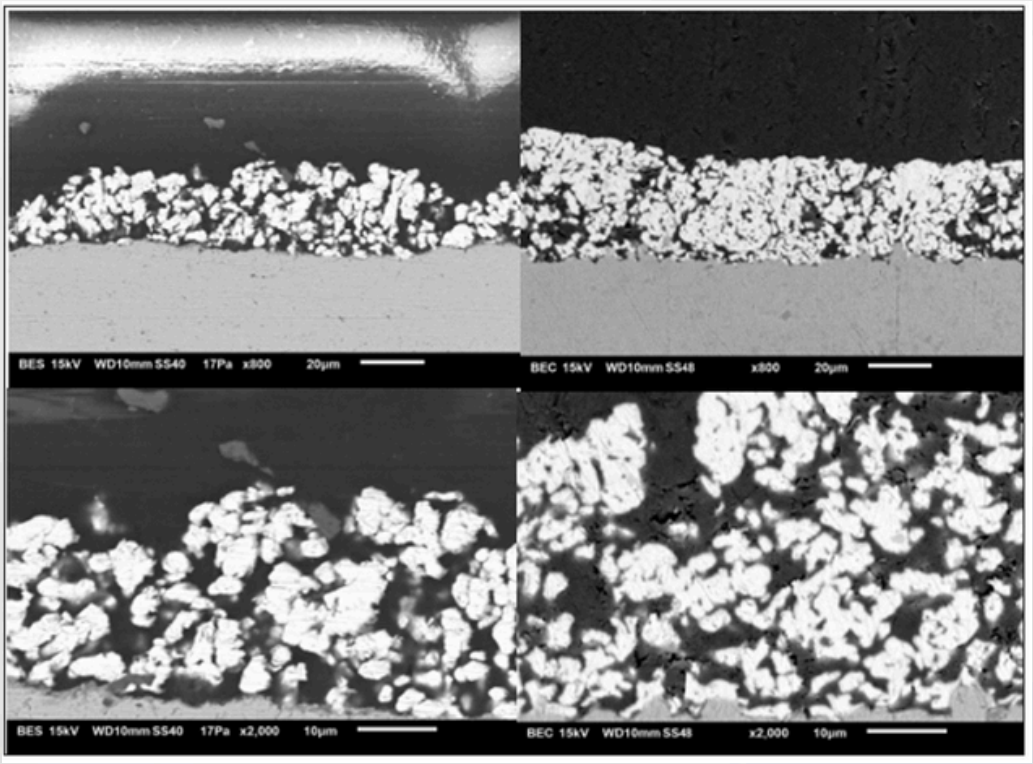


Figure 1: SEM images of GNP/SA conductive ink under cyclic loading.

Paper ID: UTEM20

MORPHOLOGY CHARACTERISATION OF GRAPHENE–SILVER HYBRID INK PRINTED ON COPPER SUBSTRATES WITH RESPECT TO DAMPING, STIFFNESS, AND ELECTRICAL CONDUCTIVITY

[1]Ahmad Zaifazlin bin Zainordin, [2]Mohd Azli Salim*, [2]Nor Azmmi Masripan

[1] *Jabatan Kejuruteraan Mekanikal, Politeknik Sultan Haji Ahmad Shah, Kuantan, Pahang*

[2]*Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Melaka*

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

The morphology of hybrid conductive coatings plays a pivotal role in governing their damping factor, stiffness, and electrical resistivity behavior under dynamic loading. Graphene nanoplates (GNPs) and silver (Ag) flakes are widely recognized as promising materials for lightweight and low resistance printed electronic applications. Therefore, this study is to investigate the morphological performance relationship of GNP and Ag hybrid conductive ink (HCI) printed on copper (Cu) substrate. The HCI formulations comprising GNPs, Ag flakes, silver acetate (SA), terpineol, and 1-butanol were combined and thermally sintered at 260 °C. Three Cu samples with varied HCI compositions were fabricated using a 60 µm mesh stencil printing process. The particle dispersion uniformity, hybrid interconnect formation, and agglomeration tendencies were examined by using optical microscopy and SEM. Then, electrical conductivity was measured by using Two-Point probe techniques with IEEE Std 118-1978 method. After that the damping factors, stiffness, and natural frequency were determined by using the ASTM E756-05 impact test. Finally, the morphology and damping correlation were evaluated by comparing the mechanical impact assessment with dispersion redistribution, crack initiation, and network degradation. Results demonstrate that enhanced morphological uniformity, characterized by increased GNP and Ag bridging and reduced agglomeration, directly contributes to lower resistive losses (≤0.2 Ω; ≤1.2 mΩ/cm) and improved viscoelastic damping stability. Additionally, moderate stiffness (~1.40 kN/m) and a natural frequency of approximately 37.5 Hz were observed at the baseline composition, indicating a balanced mechanical response. Therefore, the result showed that morphology acts as a primary determinant of multifunctional performance, whereby morphology-driven formulation optimization is crucial for future development of flexible printed electronic systems and vibration-control components.

Keywords: *Graphene nanoplates, silver flakes, binder, resistivity, SEM*

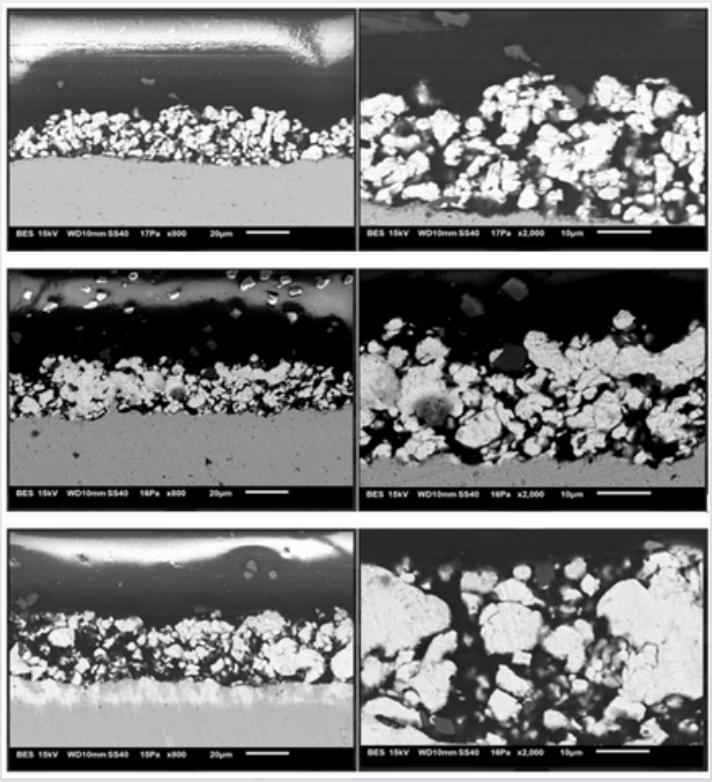


Figure 1: SEM images of GNP/SF/SA HCI under impact test.

Paper ID: UTEM21

RESISTANCE AND RESISTIVITY OF HYBRID GNP/AG AND ETHANOL-BASED GNP/CB CONDUCTIVE INKS AGEING ASSESSMENT VIA MICROSCOPY ANALYSIS

[1]Muhammad Arieef Hussain, [1]Azmi Naroh, [2]Nor Arni Zuraimi Md Noar, [3]Nor Azmmi Masripan, [4]Chonlatee Photong , [5]Alan Watson, [2]Mohd Azli Salim*

[1]Department of Mechanical Engineering, Politeknik Ungku Omar, 31400, Ipoh, Perak, Malaysia

[2]Department of Electrical Engineering, Politeknik Mersing Johor, 86800, Mersing, Malaysia

[3]Department of Mechanical Engineering Technology, Faculty of Mechanical Technology and Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia.

[4]Faculty of Engineering.Mahasarakham University, Thailand

[5]Power Electronics and Machines Centre, The University of Nottingham, United Kingdom

**Corresponding Author: M.A. Salim, azli@utem.edu.my*

Abstract

This study examines the ageing-related microstructural evolution and electrical behaviour of two graphene-based conductive inks for flexible electronics. A hybrid graphene nanoplatelet (GNP) and silver (Ag), using terpinol and butanol (10T:10B) as solvents. The other is an ethanol-based ink with graphene nanoplatelets (GNP) and carbon black (CB). Both films underwent cyclic torsion at 250 °C, followed by ageing for five weeks at 25 °C and 68% RH. Morphology was assessed by SEM at ×800 and ×2000 magnifications. Electrical resistance and resistivity were measured weekly using a Two-Point probe. After ageing, the GNP/Ag ink showed a dense, uniform surface with few voids and only a 6% increase in resistivity, likely related to limited Ag oxidation and strong particle bridging during curing. In contrast, GNP/CB ink appeared porous with visible carbon black agglomerates. Over five weeks, progressive compaction and particle recontacting caused a 13% drop in resistance and resistivity. Microscopy confirms the co-solvent ink forms a rigid, oxidation-prone network, while the ethanol-based ink creates a looser, self-adjusting structure that stabilises via densification. These findings demonstrate that solvent architecture strongly influences surface morphology, ageing response and long-term electrical stability of hybrid conductive inks.

Keywords: *graphene nanoplatelets, silver, carbon black, ageing, SEM, morphology.*

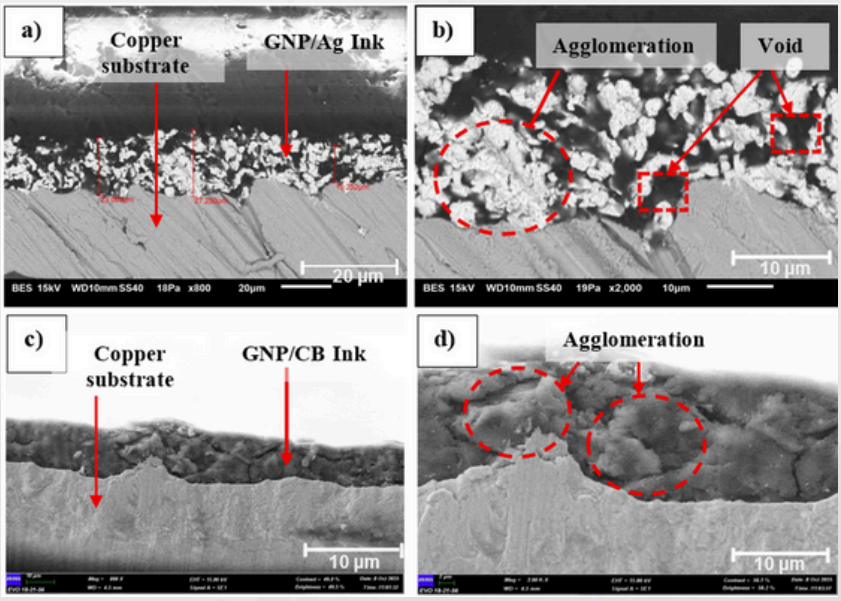


Figure 1: (a) GNP/Ag conductive ink distribution at a magnification of x800 after ageing (b) Particle dispersion of GNP/Ag conductive ink composition at a magnification of x2000 after ageing (c) GNP/CB conductive ink distribution at a magnification of x800 after ageing (d) Particle dispersion of GNP/CB conductive ink composition at a magnification of x2000 after ageing

Paper ID: UTEM23

DEVELOPMENT OF OPTIMIZED GRAPHENE NANOPLATELET CONDUCTIVE INKS FOR FLEXIBLE ELECTRONIC APPLICATIONS

[1,2]Azmi Naroh, [1,2]Muhammad Arieef Hussain, [1,2]Khirwizam Md Hkhir, [2]Mohd Azli Salim*, [2] Nor Azmmi Masripan, [3]Ameeruz Kamal Ab Wahid

[1] *Jabatan Kejuruteraan Mekanikal, Politeknik Ungku Omar, Jalan Raja Musa Mahadi, 31400 Ipoh, Perak, Malaysia.*

[2] *Fakulti Teknologi dan Kejuruteraan Mekanikal, Universiti Teknikal Malaysia Melaka, Melaka, 75450 Ayer Keroh, Melaka, Malaysia.*

[3]*Jabatan Kejuruteraan Mekanikal, Politeknik Sultan Azlan Shah, Behrang Stesyen 35950 Behrang, Perak.*

**Corresponding Author: M.A.Salim, azli@utem.edu.my*

Abstract

This study investigates the relationship between graphene nanoplatelet (GNP) concentration, microstructural morphology, and electrical resistivity in conductive ink formulations for flexible electronic applications device. The main objective was to evaluate the different of GNP loadings affect electrical performance and structural characteristics, with particular focussing on percolation threshold behavior and conductive network formation. GNP concentrations ranging from 10 to 30 wt.% were systematically examined using four-point probe resistivity measurements and scanning electron microscopy (SEM) analysis. Results demonstrated that samples containing 10 wt.% GNP exhibited greatly higher resistivity due to poor dispersion and insufficient percolation network formation. However, formulations with 20–30 wt.% GNP showed substantially lower and more stable resistivity values, indicating well-developed conductive pathways. SEM analysis indicated that extended curing times (up to 30 minutes) promoted larger microstructures and enhanced GNP dispersion, resulting in more uniform and compact image morphology. Energy dispersive X-ray (EDX) analysis identified an interaction at higher graphene loadings, where increased electrical conductivity was accompanied by greater brittleness and crack formation. The study concludes that optimal conductive ink performance is achieved at GNP concentrations of 20–30 wt.% with appropriate curing methods, providing crucial information for the future development of flexible electronic devices utilizing GNP-based conductive inks.

Keywords: *Conductive Ink, Graphene Nanoplatelet (GNP), Morphology, Resistivity, Curing.*

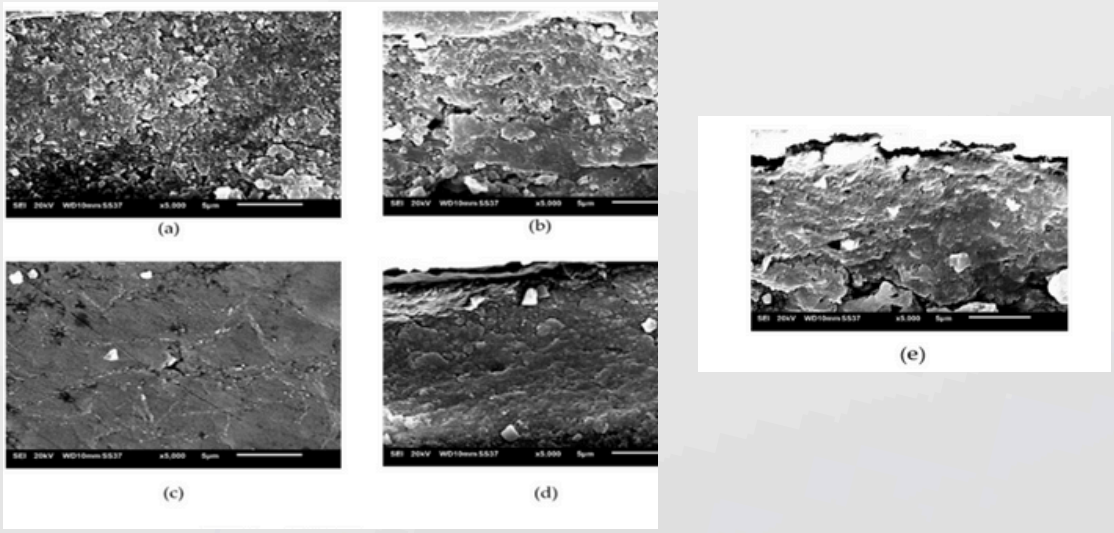


Figure 1: SEM images of filler loading cross-section area on different curing times (a) 10 min., (b) 20 min., (c) 30 min., (d) 40 min., and (e) 50 min

Paper ID: UTHM01

SUSTAINABLE RECOVERY AND CLASSIFICATION OF RECOVERED MATERIALS FROM ELECTRIC VEHICLE (EV) DISCARDED BATTERY

Zolhafizi Jaidi, Mohd Azham Azmi*, Siti Nordiana Binti Jamil, Nurul Farahin Mohd Zulkafli

Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.

**Corresponding Author: M.A. Azmi, azham@uthm.edu.my*

Abstract

The rapid adoption of electric vehicles (EVs) has significantly increased the demand for lithium-ion batteries (LIBs), particularly those utilizing Nickel-Cobalt-Aluminium (NCA) chemistry, such as Tesla's 21700 cells. However, the limited lifespan and improper disposal of these batteries pose major environmental and resource management challenges. Currently, less than 3% of LIBs are recycled globally, leading to critical material loss and environmental pollution. Despite the urgency, there remains a research gap in the sustainable recovery and classification of materials from discarded NCA-based LIBs. This study aims to address this gap by establishing a structured methodology for recovering and characterizing key components from spent NCA battery cells. The objective is to promote circular economy practices and reduce reliance on raw material extraction. The methodology involved discharging, dismantling, and separating the battery into individual components—plastic casing, separator, metallic casing, anode, and cathode—followed by analysis using advanced techniques such as Fourier Transform Infrared Spectroscopy (FTIR), Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS), and X-ray Diffraction (XRD). Results revealed that the separator is made of polycarbonate, the casing of nickel-coated steel, the anode of copper foil with graphite, and the cathode of aluminium foil coated with lithium nickel cobalt aluminium oxide. These findings support the potential for efficient material recovery, contributing to more sustainable battery lifecycle management and reduced environmental impact.

Keywords: *electric vehicle recycling, lithium-ion batteries, nickel-cobalt-aluminium, sustainability, circular economy, material recovery*

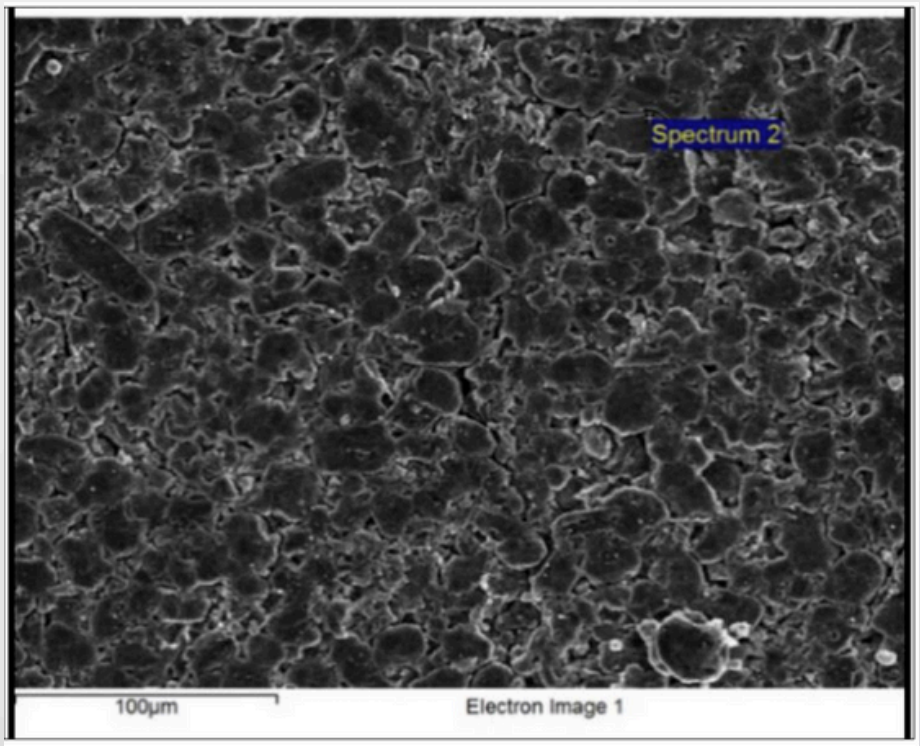


Figure 1: SEM Micrograph for discarded anode layer Copper - Graphite.

Paper ID: UTHM03

IMPACT OF CALCINATION TEMPERATURE (600–750°C) ON $SRCO_3$ FORMATION AND MICROSTRUCTURAL-THERMAL PROPERTIES OF SSC-SDCC CATHODES FOR LOW-TEMPERATURE SOLID OXIDE FUEL CELLS

Sufizar Ahmad*, Umira Asyikin Yusop, Siti Fairus Mohammad, Hamimah Abd Rahman, Mohd Azham Azmi

Faculty of Mechanical and Manufacturing, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Malaysia.

**Corresponding Author: S. Ahmad, sufizar@uthm.edu.my*

Abstract

Solid oxide fuel cells (SOFCs) operating at low temperatures require cathodes with tailored microstructural and thermal properties to address performance challenges. The formation of SrCO3 during the calcination process significantly influences the properties of the SSC-SDCC composite cathode for LT-SOFCs. This study systematically investigates the effect of calcination temperature (600 – 750°C) on SrCO3 formation and its correlation with the microstructural and thermal properties of SSC-SDCC (60:40 wt.%) composite cathodes. The cathode powders were mixed through the high-energy ball milling (HEBM) method and calcined at four different temperatures (600, 650, 700, and 750°C). The pellet cathodes were fabricated using the uniaxial pressing method and sintered at 600°C. Comprehensive characterizations using XRD revealed that calcination temperatures ≥700°C effectively minimized SrCO3 formation while maintaining phase purity. FESEM analysis revealed that all samples exhibited particle agglomeration, consistent with calcination powder theory, where particle bonding intensifies with increasing temperature and this scenario directly increases the average particle size. Porosity analysis reveals optimal cathode functionality with measured values of 35.91–38.78%, residing within the established 20 – 40% target range for effective gas diffusion while maintaining structural stability. The thermal expansion coefficients (15.1–16.00 × 10^{-6} K^{-1}) align well with ceria electrolytes (11.1 × 10^{-6} K^{-1}), exhibiting comparable thermal behavior while retaining beneficial SrCo3 phases that enable functional compatibility. This systematic variation provides valuable insights for interface engineering in real-world SOFC operating conditions for the development of efficient and durable LT-SOFC systems for clean energy applications.

Keywords: *Ceria-based electrolyte, calcination, LT-SOFC, SSC-SDCC cathode, $SrCO_3$*

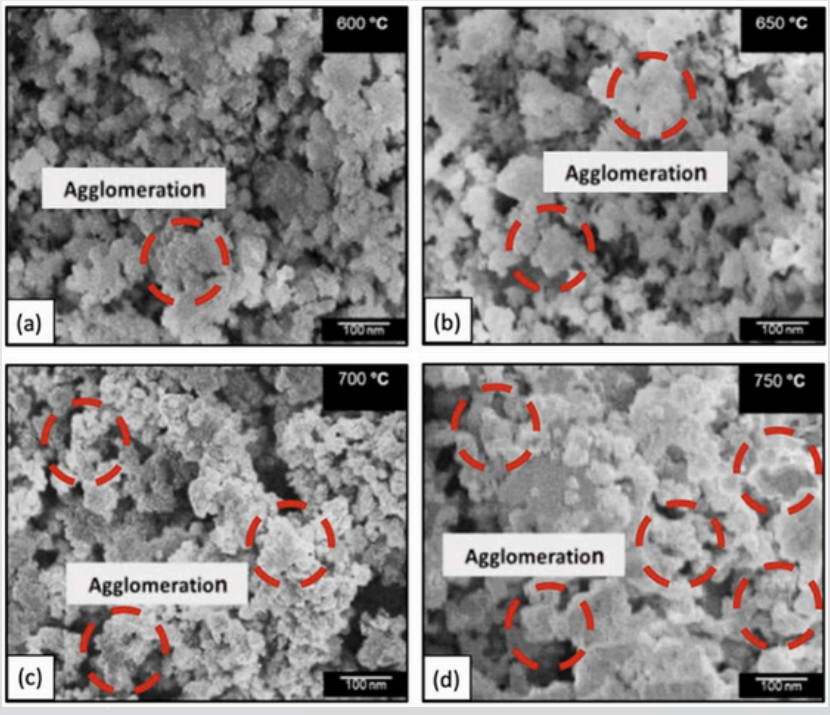


Figure 1: FESEM micrograph for SSCB64 composite cathode powder as prepared and calcined at (a) 600 °C, (b) 650 °C, (c) 700 °C and (d) 750 °C.

Paper ID: UTHM04

UTILIZATION OF NATURAL SILICA FROM RICE HUSK ASH TO IMPROVE ELECTRICAL CONDUCTIVITY OF SDC-BASED IT-SOFC ELECTROLYTE

Zolhafizi Jaidi, Mohd Azham Azmi* & Hamimah Abd Rahman

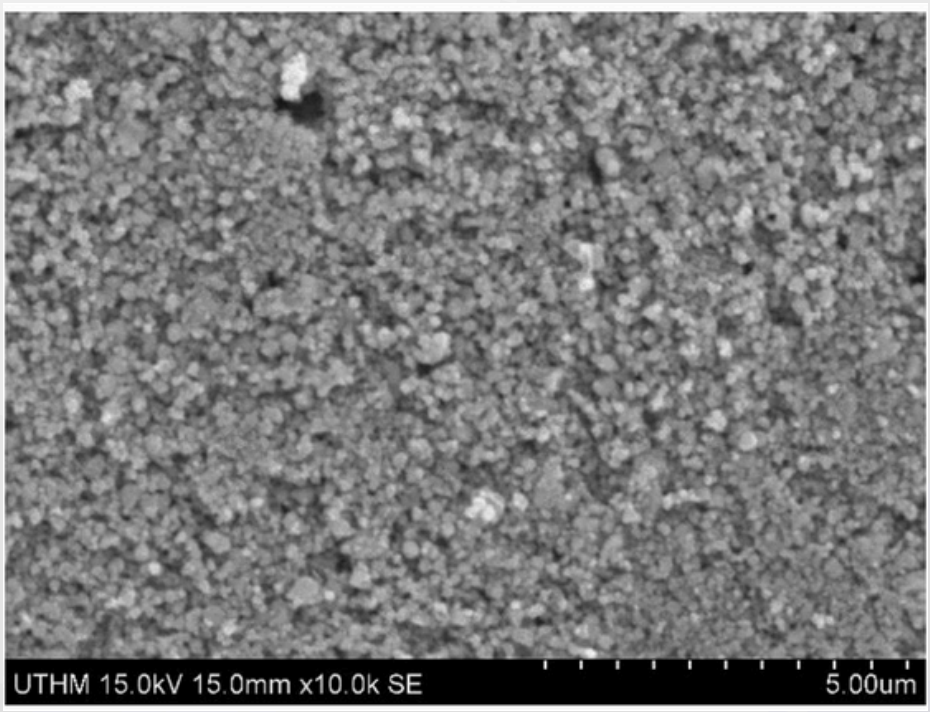
Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.

**Corresponding Author: M.A. Azmi, azham@uthm.edu.my*

Abstract

Solid oxide fuel cells (SOFCs) rely on electrolytes with high ionic conductivity and thermal stability, especially for intermediate-temperature operations (500–700 °C). Yttria-stabilized zirconia (YSZ), the conventional SOFC electrolyte, requires high operating temperatures, which leads to thermal mismatch, interfacial degradation, and other performance issues. Samarium-doped ceria (SDC) is a promising alternative due to its superior ionic conductivity at lower temperatures. However, SDC still faces challenges in achieving full densification and minimal porosity without elevated sintering temperatures. This study explores the incorporation of natural silica derived from rice husk ash ($RHASiO_2$) as an eco-friendly sintering aid to enhance the structural and electrochemical performance of SDC electrolytes. RHASiO2 was calcined at 700 °C and combined with commercial SDC powder in various weight percentages (0%–3%) using dry ball milling. The mixtures were uniaxially pressed into pellets and sintered at 1200 °C. Thermogravimetric analysis (TGA) showed that RHASiO2 improved thermal stability by reducing weight loss during intermediate and final degradation phases. Porosity analysis using ImageJ software revealed a decreasing trend in porosity with increasing RHASiO2 content, reaching the lowest value of 4.58% in the SDC3.0 sample. Electrochemical impedance spectroscopy (EIS) demonstrated enhanced conductivity and reduced grain boundary resistance for RHASiO2-modified samples. The highest total ionic conductivity, 0.017 $S{\cdot}cm^{-1}$ at 600 °C, was achieved by SDC3.0, which also exhibited the lowest activation energy of 0.768 eV. These results confirm that RHASiO2 effectively promotes densification and enhances the electrical conductivity of SDC electrolytes, offering a sustainable and low-cost route to improve SOFC performance.

Keywords: *Samarium-doped ceria (SDC), Rice husk ash silica (RHASiO2), Solid oxide fuel cell (SOFC), Electrochemical impedance spectroscopy (EIS), Sintering aid*



SEM images of surface morphology for SDC-RHASiO2 electrolyte at 1200°C

Paper ID: UTHM05

EFFECT OF CALCINATION ON CRAYFISH SHELLS

[1]Saraswathy A/P Vellaitham, [1,2]Hasan Zuhudi Abdullah, [3]Muhammad Abdul Latiff Abu Bakar, [1,2]Maizlinda Izwana Idris*

[1]Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor,

[2]Centre of Bioactive Materials (BioMA), Faculty of Mechanical and Manufacturing Engineering, University Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor

[3]Faculty of Applied Sciences and Technology, University Tun Hussein Onn Malaysia, UTHM Edu Hub Pagoh, KM1, Jalan Panchor, Pagoh, 84600, Johor

**Corresponding Author: M.I. Idris, izwana@uthm.edu.my*

Abstract

This study investigates the characteristics and microstructure of raw and calcined crayfish shells, which can serve as sustainable materials for reuse. The increasing buildup of marine waste, especially crayfish shells, has raised significant environmental concerns due to current disposal methods. As an invasive species, crayfish threaten aquatic plants and animals and disrupt biodiversity. The components of crayfish shells, including chitin, protein, and calcium carbonate, are valuable resources that can be employed in various industries such as biomedicine, agriculture, and wastewater treatment. In this research, after cleaning, crayfish shells were dried for 24 hours at 90°C in an oven and then mechanically ground into a powder with a particle size of 63µm. The powdered shells were subsequently calcined at 500°C, 600°C, 700°C, and 900°C in a muffle furnace. The raw and calcined powders were analyzed using X-ray Diffraction (XRD) to examine their mineral composition, Fourier Transform Infrared Spectroscopy (FTIR) to identify functional groups and Scanning Electron Microscopy (SEM) to study surface morphology. The XRD results showed an increasing formation of calcium oxide (CaO) as the calcination temperature rose, indicating successful thermal decomposition of calcium carbonate. The structural changes likely suggest effective adsorption properties of calcined crayfish shells. Thus, this material has the potential to be a low-cost option for filtering heavy metals in wastewater treatment. This study highlights the valuable and sustainable uses of biological waste, which reduce ecosystem threats and support a circular economy.

Keywords: *Crayfish shells, Calcination, Calcium Oxide*

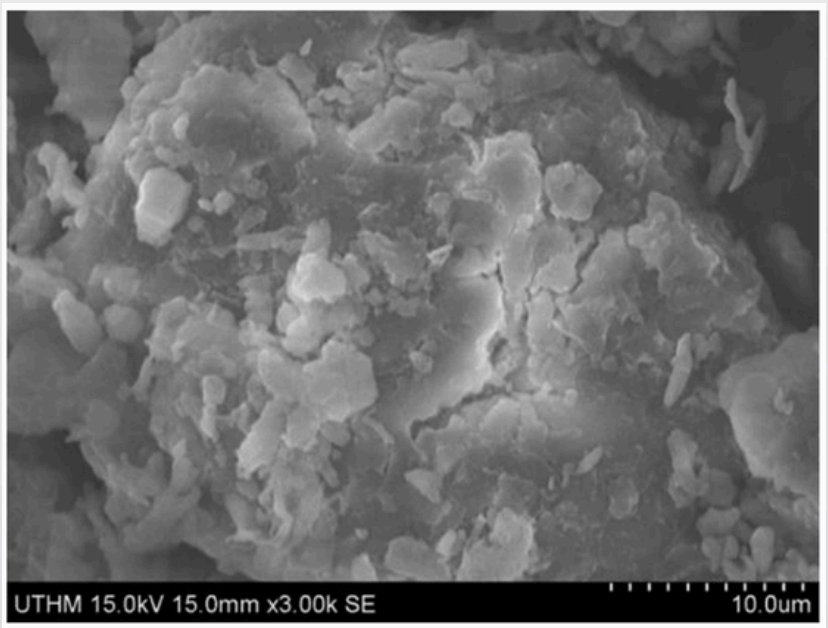


Figure 1: Microscopic image at 3k x magnification

Paper ID: UTHM06

EFFECT OF CALCINATION TEMPERATURE ON HYDROXYAPATITE FROM TILAPIA FISH BONE FOR BIOMEDICAL APPLICATION

[1]Mohamad Hashim Mohd Sabirin, [1,2]Maizlinda Izwana Idris*, [1,2]Hasan Zuhudi Abdullah

[1]Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor.

[2]Bioactive Materials (BioMa), Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor.

**Corresponding Author: M.I. Idris, izwana@uthm.edu.my*

Abstract

In the field of regenerative medicine, bone defects brought on by trauma, infections, or tumours pose serious difficulties because traditional grafting techniques are constrained by issues like disease transmission concerns and donor scarcity. This study investigated the effect of calcination temperature (600°C, 900°C, 1100°C) on hydroxyapatite (HAp) derived from tilapia fish bones for bone regeneration applications. The extraction process involved sequential cleaning through boiling (100°C, 1 hour), drying (100°C, 1 hour), and thermal treatment at varying temperatures (600°C, 900°C, and 1100°C) in order to maximise the structural qualities and purity of HAp for 3 hours, followed by ball milling (250 rpm, 1 hour) and sieving. Analysis using scanning electron microscopy (SEM) showed significant microstructural alterations; calcination at 900°C produced a homogeneous and porous morphology that was on par with commercial Hap, X-ray diffraction (XRD) was used to confirm crystallinity, and energy-dispersive X-ray spectroscopy (EDS) was used to determine elemental composition. With a Ca/P ratio comparable to that of both synthetic and naturally occurring human-derived HAp, the results validated the effective extraction of high-purity HAp. These findings systematically demonstrate how calcination temperature critically determines the morphological and crystallographic properties of bio-derived HAp, with 900°C identified as optimal for producing biomaterial suitable for bone tissue engineering applications. The study establishes tilapia bone waste as a viable, sustainable source of high-quality HAp while providing specific processing parameters for biomedical material development.

Keywords: *Hydroxyapatite, Biomedical Applications, Bone Regeneration, Calcination Temperature, Tilapia Fish Bone*

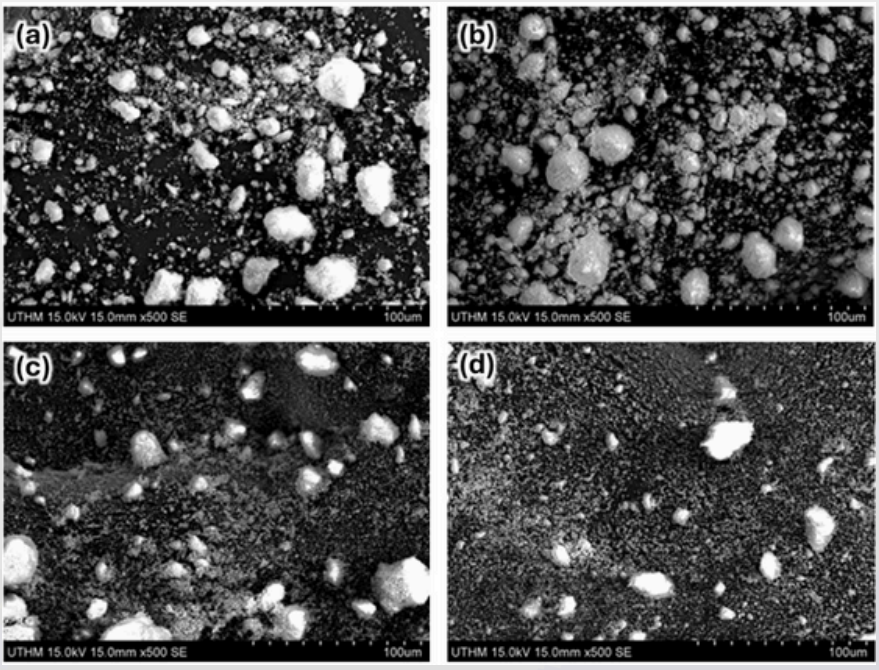


Figure 1: SEM micrograph of (a) Commercial Hydroxyapatite, (b) Tilapia Hydroxyapatite (600 °C), (c) Tilapia Hydroxyapatite (900 °C), and (d) Tilapia Hydroxyapatite (1100 °C).

Paper ID: UTHM09

ELECTROCHEMICAL PERFORMANCE PROPERTIES OF PLANAR SOLID OXIDE FUEL CELLS: A REVIEW OF METHODS EMPLOYED IN FABRICATING ELECTRODES AND ELECTROLYTE COMPONENTS

[1]Nurul Farhana Abdul Rahman, [2]Kang Huai Tan, [1]Mohd Azham Azmi, [1]Hamimah Abd Rahman*

[1]Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, Malaysia

[2]Faculty of Engineering and Technology, Tunku Abdul Rahman University of Management and Technology, Jalan Genting Kelang, Setapak, 53300, Kuala Lumpur, Malaysia.

**Corresponding Author: H. Abdul Rahman, hamimah@uthm.edu.my*

Abstract

There is a growing interest in Solid Oxide Fuel Cells (SOFC) as an alternative source of green power generation. Anode, electrolyte, and cathode are the basic components of SOFC. In a single SOFC cell, a dense electrolyte is typically sandwiched between a porous cathode and anode. The fundamental interaction of cathode oxygen oxidation, anode hydrogen reduction, and electrolyte ions transportation contributes to SOFC's vital role. Thus, the contact layer between each porous anode, cathode, and dense electrolyte must be completely cohesive. SOFC application is particularly concerned with solid construction, either a planar SOFC or a tubular SOFC. In this context, an appropriate fabrication method for a planar SOFC stack is essential for enhancing SOFC reliability and performance. A review of fabrication processes such as magnetron sputtering, screen printing, tape casting, dip coating, slurry spin coating, electrophoretic uniaxial pressing, and sol-gel is presented in this study. This review includes fabrication working principles, advantages and limitations, and more assessments of prior work on each fabrication technique parameter. Also discussed in this paper are the electrochemical performance of each of the above-mentioned fabrication techniques and how each component might be utilized in SOFCs. It's interesting how different materials result in distinct material properties. Thus, the suitability and compatibility of materials with fabrication parameters are also covered in this study. Briefly summarized, the various fabrication methods for planar SOFC stacks, as well as the overall performance of the created single cells, are the key points of this review work.

Keywords: *Cathode, Electrochemical, Fabrication method, Planar SOFC, Single cell*

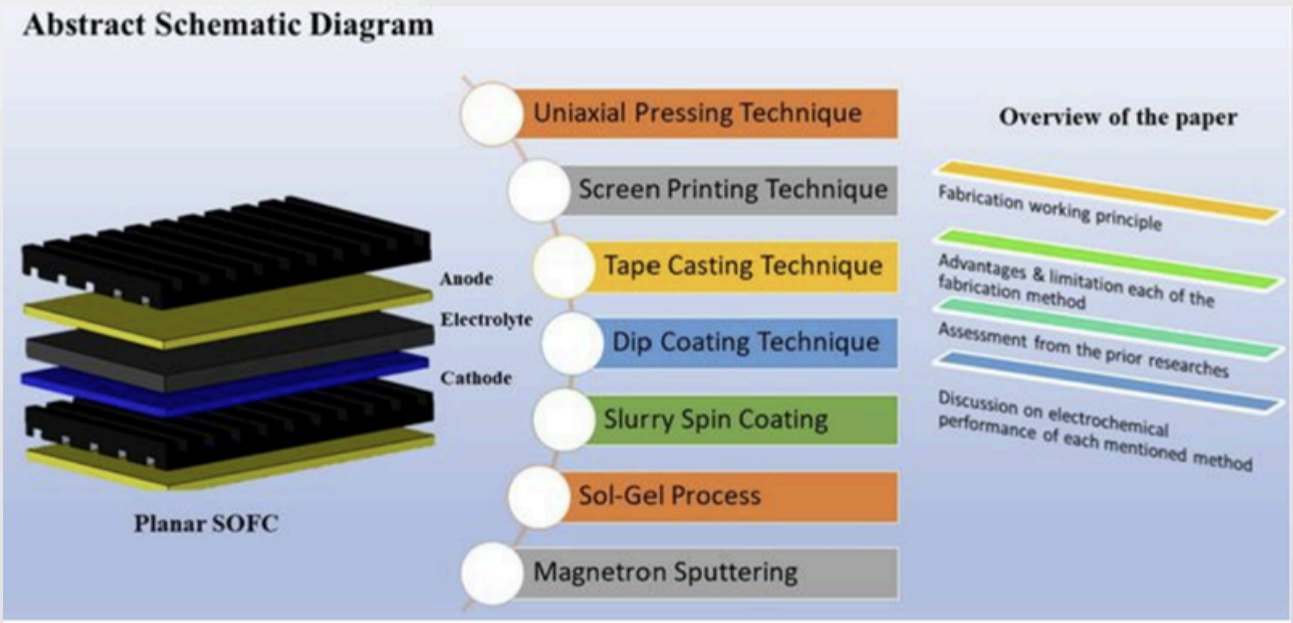


Figure 1: Overview of the paper

Paper ID: UTHM11

EFFECTS OF MIXING TIME ON THE PROPERTIES OF HYDROXYAPATITE FOAM PREPARED BY SPACE HOLDER METHOD

Sagadran Nair A/L Thevan Nair, Fazimah Binti Mat Noor*

Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia,86400 Parit Raja, Batu Pahat, Johor.

**Corresponding Author: F. Mat Noor, fazimah@uthm.edu.my*

Abstract

This study examines the effect of mixing time on the physical, mechanical, and microstructural properties of hydroxyapatite (HAp) foam prepared via the space holder method for bone tissue engineering applications. The foam was fabricated from HAp powder (65 wt.%), corn starch (25 wt.%) as a space holder, and polyethylene glycol (PEG) and carboxymethyl cellulose (CMC) (5 wt.% each) as binders. Five compositions (C1–C5) with mixing times of 30–150 minutes were characterized through shrinkage, density, porosity, compressive strength, and SEM-based pore analysis. Results showed that increasing mixing time enhanced particle dispersion and sintering efficiency, leading to reduced porosity (50.77% to 40.61%), higher bulk density (1.480 to 1.821 g/cm^3), and improved compressive strength (0.328 to 0.775 MPa) and Young's modulus (1.382 to 4.568 MPa). Microstructural analysis confirmed finer and more uniform pore distribution with extended mixing, which contributed to improved mechanical integrity. While C3 exhibited minor defects, C4 and C5 displayed properties comparable to cancellous bone, indicating their potential as scaffolds for low-load-bearing applications. These findings highlight mixing time as a key parameter in tailoring HAp foams, with C5 identified as the optimal formulation for scaffold development.

Keywords: *Hydroxyapatite foam, mixing time, space holder method, ceramic foam*

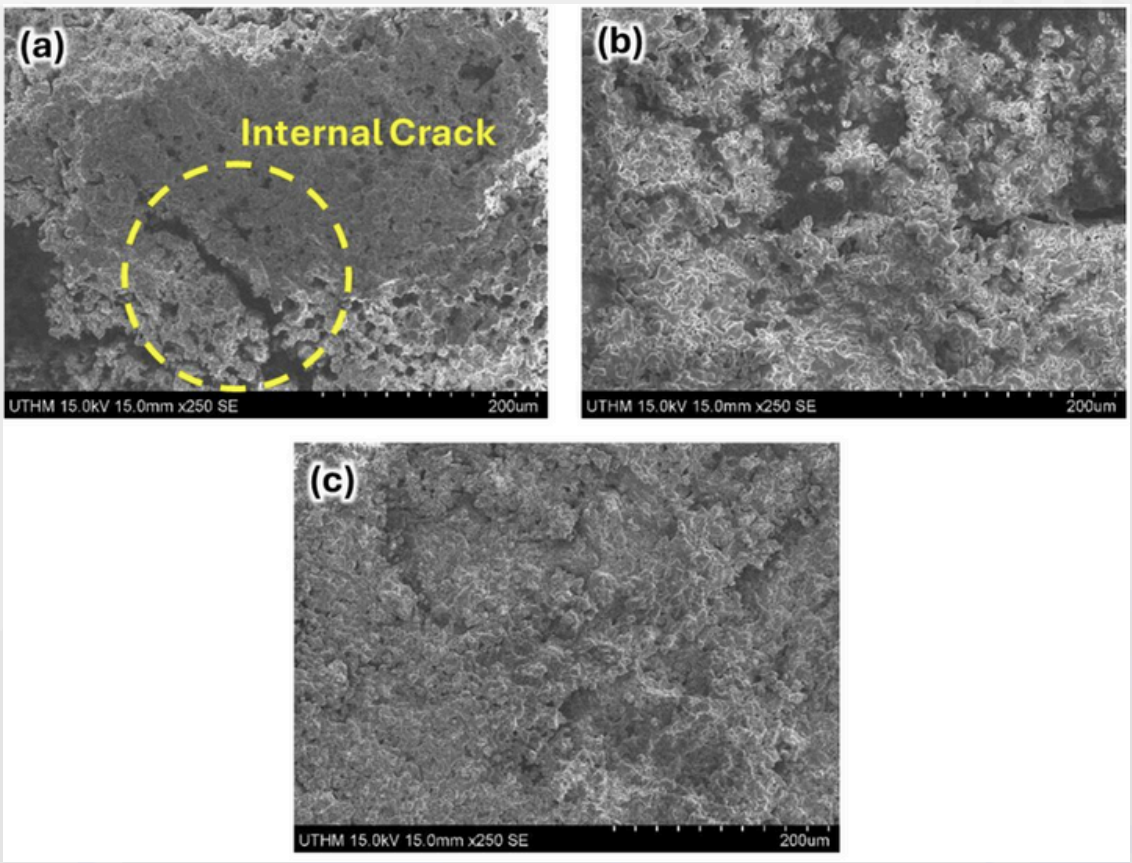


Figure 1: The microstructure of (a) Sample C3, (b) Sample C4 and (c) sample C5

Paper ID: UTHM12

SEM MORPHOLOGY AND EDX ANALYSIS OF REFRACTORY INSULATORS EXPOSED TO HIGH-TEMPERATURE PETROCHEMICAL ENVIRONMENTS

Tew Heng Yao, Azzura Binti Ismail*

Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor.

**Corresponding Author: A. Ismail, azzura@uthm.edu.my*

Abstract

Refractory insulators are critical to the performance of petrochemical reformers, as they provide thermal resistance and structural stability under high-temperature operating conditions. While many studies have reported contamination-related degradation of refractory linings, there remains limited research on the elemental stability of alumina-based insulators retrieved directly from the operational petrochemical furnaces. This study investigates hot face and internal insulator collected from an operational petrochemical reformer after extended service. Both hot face and internal insulator samples were analysed using Scanning Electron Microscopy (SEM) equipped with Energy-Dispersive X-ray Spectroscopy (EDX) to evaluate surface morphology and elemental composition. The analysis focused on identifying potential contaminants such as iron (Fe), sodium (Na), potassium (K), chlorine (Cl), and sulfur (S), which are commonly associated with corrosion products, process leaks, and airborne particulates. The results revealed that no significant external contaminants were present, instead the elemental composition was dominated by alumina (Al2O3) and silica (SiO2), reflecting the intrinsic refractory phases of the material. These findings highlight the resilience of the insulation materials in withstanding harsh operating conditions and provide valuable insights into their performance, enabling informed selection of more durable refractory systems and the optimization of maintenance practices in petrochemical reformers.

Keywords: *Thermal Refractory insulators, hot face insulators, internal insulators, SEM, EDX, surface morphology and elemental composition.*

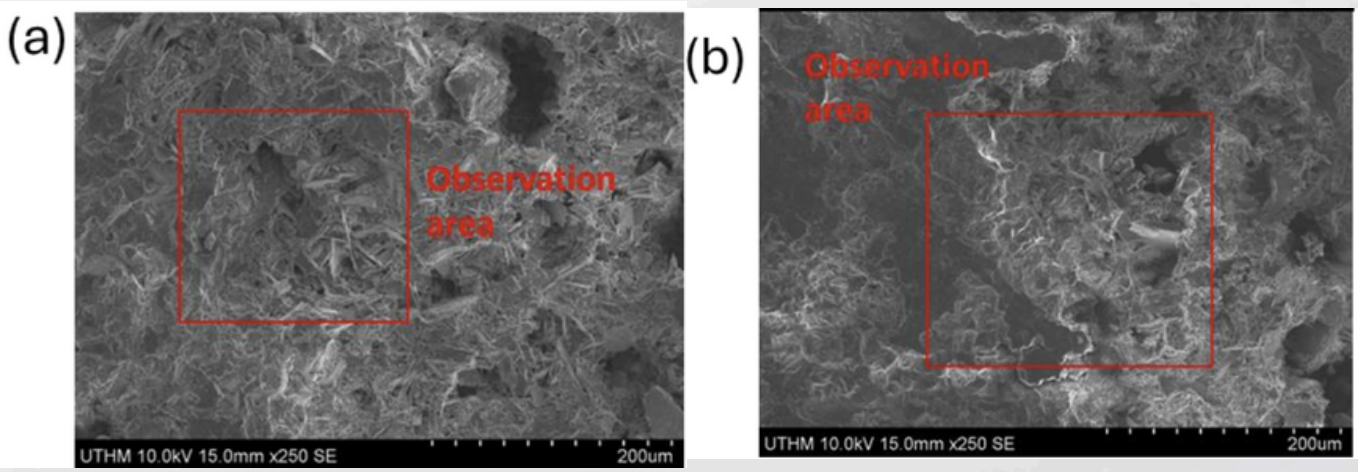


Figure 1: SEM micrographs of (a) Hot Face Insulator (HF) and (b) Internal Insulator (INS).

Paper ID: UTHM13

COMPARATIVE STUDY OF COCKLE, MUSSEL AND OBTUSE HORN SHELL CALCIUM CARBONATE FOR TOOTHPASTE ABRASIVE APPLICATIONS

Shakilla Nur Asimah Mat Hussin, Shahmir Hayyan Sanusi*, Nursyazwani Zulkefli

Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor.

**Corresponding Author: S.H. Sanusi, shahmir@uthm.edu.my*

Abstract

The increasing demand for sustainable materials in the cosmetic industry has encouraged the exploration of biowaste as alternative raw materials. Seashell waste—particularly from cockle, mussel, and obtuse horn shell (Cerithidea obtusa)—is an abundant, underutilized source of calcium carbonate ($CaCO_3$), with potential application as natural abrasives in toothpaste formulations. This study aims to extract, characterize, and compare calcium carbonate from these three shell types to assess their suitability as toothpaste abrasives. The shells will be processed into fine powders and analyzed using Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDX). SEM will reveal particle morphology, size distribution, and surface texture, all of which influence abrasive performance. EDX will assess elemental composition and detect impurities that may affect safety or efficacy in oral care products. The study will compare the samples based on particle characteristics and chemical purity to determine the most promising shell-derived material for toothpaste applications. By converting marine shell waste into high-value functional ingredients, this research supports the circular economy and offers the oral care industry a sustainable alternative to synthetic abrasives. The findings aim to guide the development of eco-friendly toothpaste, contributing to both environmental conservation and green innovation in personal care products.

Keywords: *Calcium carbonate, marine shell waste, toothpaste abrasive, SEM-EDX, biowaste valorization*

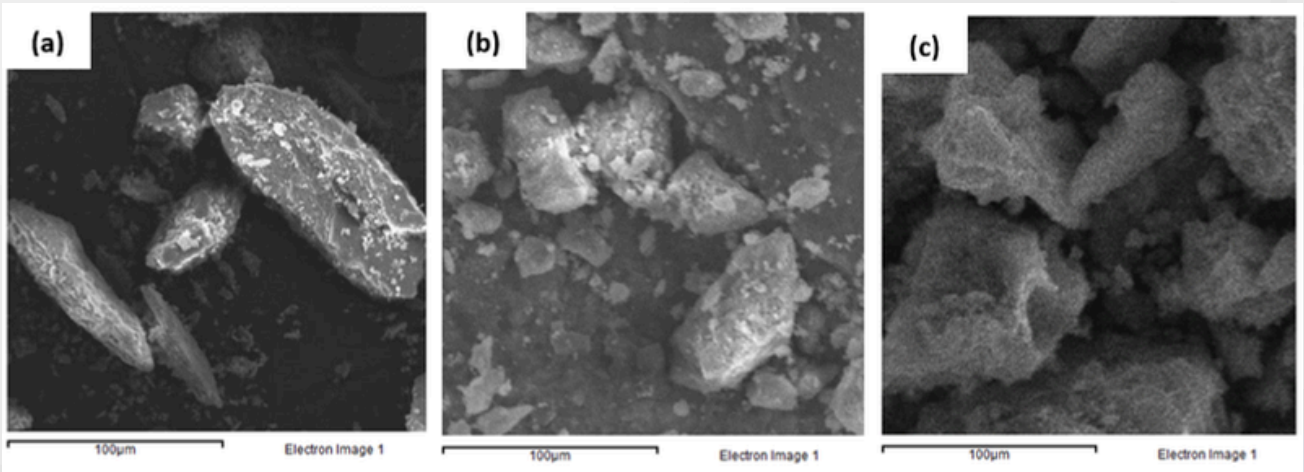


Figure 1: SEM image of Calcium Carbonate from: (a) Mussel Shells, (b) Obtuse Horn Shells and (c) Cockle Shells

Paper ID: UTHM14

COMPARATIVE EVALUATION OF CALCINATION TEMPERATURE FOR COCKLE SHELL-DERIVED HYDROXYAPATITE IN POLYLACTIC ACID COMPOSITES

[1]Nursyazwani Zulkefli, [1]Eliza M. Yusup*, [1]Shakilla Nur Asimah Mat Hussin, [2]Nur Muhamad Afif Norazam

[1] *Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor*

[2] *Faculty of Technology Management & Business, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor*

**Corresponding Author: E.M. Yusop, elizay@uthm.edu.my*

Abstract

Calcination temperature represents a critical processing parameter influencing the properties of hydroxyapatite (HAp) synthesized from marine waste sources. This study compares the effect of calcination temperature (850°C versus 900°C) on the characteristics of HAp and the subsequent mechanical performance of polylactic acid (PLA) composites for bone tissue engineering applications. HAp was synthesized from cockle shell (Anadara granosa) waste through chemical precipitation, with systematic characterisation at each calcination temperature. X-ray diffraction analysis (XRD) revealed enhanced crystallinity at 900°C, while energy dispersive X-ray (EDX) spectroscopy demonstrated improved calcium-to-phosphorus (CaP) ratios (1.79 at 900°C versus 1.62 at 850°C), approaching the stoichiometric value of 1.67 for pure hydroxyapatite. Fourier transform infrared spectroscopy (FTIR) confirmed the presence of characteristic phosphate and hydroxyl groups at both temperatures, with the 900°C samples exhibiting more defined spectral peaks. Scanning electron microscopy (SEM) revealed more uniform particle morphology with reduced agglomeration at the higher temperature. Mechanical characterisation of PLA composites at three HAp loadings (10%, 20%, 30%) demonstrated consistent performance advantages for 900°C-calcined HAp. Tensile testing revealed that 20% HAp composites prepared at 900°C exhibited a Young's modulus of 8.71 GPa, representing a 12.5% improvement over equivalent samples prepared at 850°C (7.74 GPa). Impact testing revealed 900°C samples absorbed 3.2% more energy (0.64 J versus 0.62 J). All compositions maintained mechanical properties within the range of cortical bone (7-30 GPa). This systematic comparison establishes 900°C as the optimal calcination temperature for valorizing cockle shell waste, producing HAp with superior crystallographic properties that consistently translate to enhanced mechanical performance in composites.

Keywords: *Calcination temperature, hydroxyapatite, cockle shells, polylactic acid, marine waste*

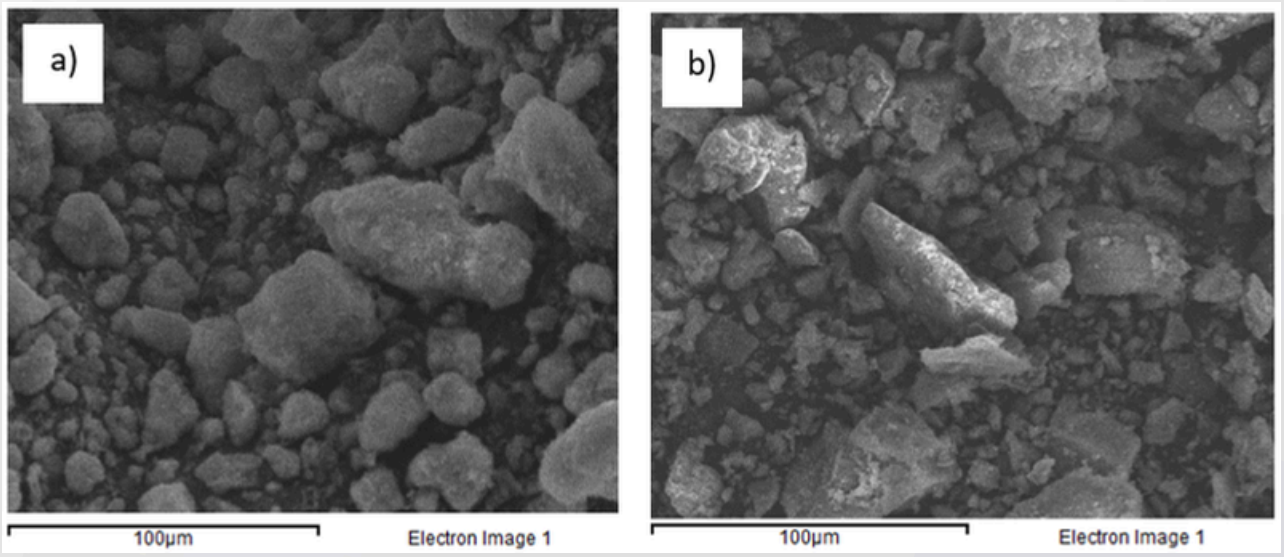


Figure 1: SEM comparison of hydroxyapatite morphology: (a) 850°C showing irregular particles, (b) 900°C showing uniform morphology with reduced agglomeration

Paper ID: UTHM15

INFLUENCE OF CARBON FILLER ON THE PROPERTIES AND PERFORMANCE OF STARCH-BASED CARBON FOAMS

[1]Mohamed Nasrul Mohamed Hatta, [2]Kamarul-Azhar Kamarudin, [3]Shaavinkumar Ganesan, [4]Hasan Zuhudi Abdullah

[1]Nano Structure and Surface Modificationa, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor.

[2]Crashworthiness and Collisions Research Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor.

[3] Gunnebo Malaysia Sdn Bhd, Suite 13A.01, Level 13A, Menara Summit, Persiaran Kewajipan, USJ 1, 47600 Subang Jaya, Selangor.

[4] Bioactive Materials Research Centre, Faculty of Mechanical and Manufacturing Engineering, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor.

**Corresponding Author:*

Abstract

This research addresses the need for sustainable carbon foam materials made from tapioca starch as a renewable carbon source. The study focuses on enhancing the characteristics of starch-based carbon foam by incorporating carbon powder as filler. Carbon foam composites were produced by controlled foaming method and carbonization. The carbonization was carried out at 800°C for 2 hours under argon atmosphere. The influence of varying carbon powder concentrations from 0% to 8% on density and porosity, mechanical strength, and absorption properties was assessed. The microstructure was observed by Scanning Electron Microscope (SEM). Results showed that increasing of carbon powder concentration significantly enhanced carbon foam properties. Higher carbon powder content led to increase density up to 0.1513 g/cm^3, greater mechanical strength up to 0.123 N/mm^2 and improved absorption capabilities where the carbon foam with 8% carbon filler sample exhibited drastically improved oil absorption about 1.3 ml compared to the carbon foam without filler about 0.2 ml/g respectively. The SEM micrographs show the decreasing of pores size and irregular shape when increase the concentration of the carbon filler. The optimizing carbon powder concentration in tapioca starch-based carbon foam successfully provides a sustainable carbon foam with potential applications in filtration and structural components.

Keywords: *Natural based carbon foam, carbon foam structure, carbon filler, absorption properties.*

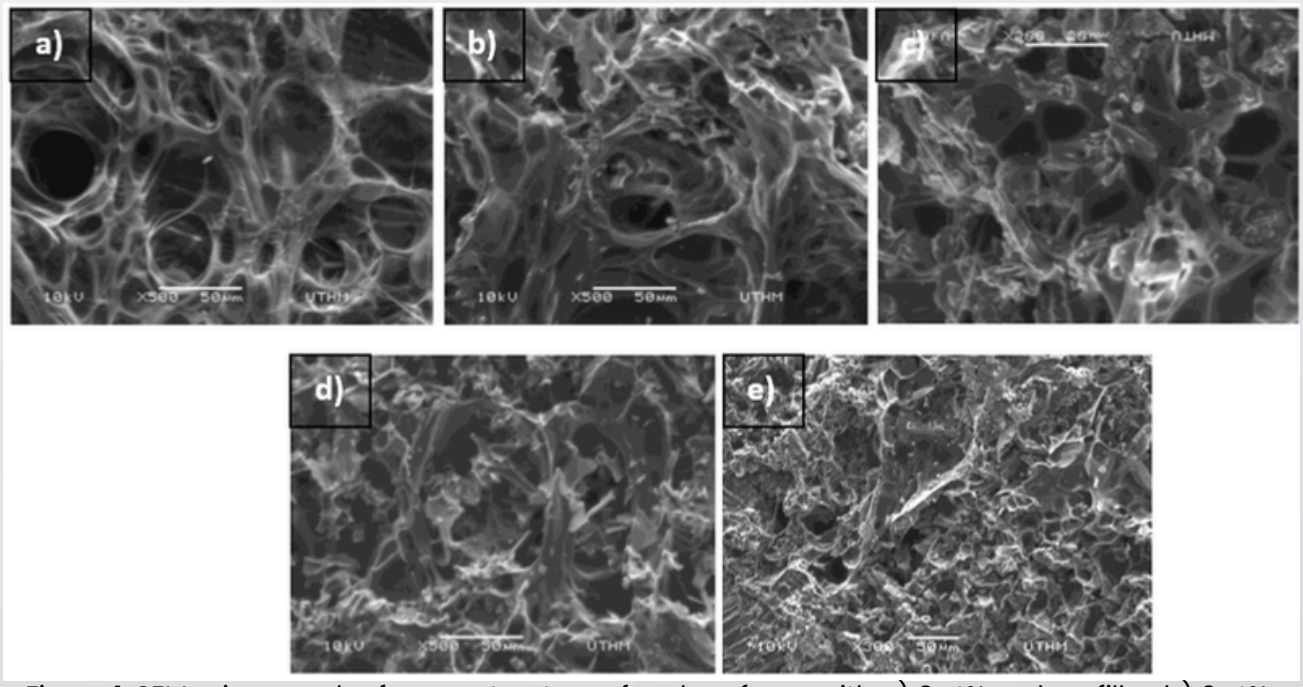


Figure 1: SEM micrograph of pores structure of carbon foam with a) 0wt% carbon filler, b) 2wt% carbon filler, c) 4wt% carbon filler, d) 6wt% carbon filler and e) 8wt% carbon filler

Paper ID: UTM01

EFFECT OF ZINC OXIDE/CALCIUM CARBONATE HYBRID NANOPARTICLES ON WEAR PROPERTIES OF NANOCOATING ON CARBON STEEL

[1]Nurul Nabila Mohd Din, [2]Norhasnidawani Johari*, [1]Mohd Aidy Faizal Johari, [3]Noor Azlina Hassan, [4]Abd Halim Md Ali, [5]Rizal Arifin

[1]Engineering Materials and Structures (EMaSt), Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), Jalan Sultan Yahya Petra, 54100, Kuala Lumpur, Malaysia,

[2]Department of Mechanical Precision Engineering (MPE), Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), Jalan Sultan Yahya Petra, 54100, Kuala Lumpur, Malaysia

[3]Department of Manufacturing and Materials Engineering, Faculty of Engineering, International Islamic University Malaysia (IIUM), Jalan Gombak, 53100, Kuala Lumpur, Malaysia

[4]Malaysia-Japan Advanced Research Centre (MJARC), Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), Jalan Sultan Yahya Petra, 54100, Kuala Lumpur, Malaysia

[5]Faculty of Engineering, Universitas Muhammadiyah Ponorogo, Jl. Budi Utomo No. 10 Ponorogo, 63471, Indonesia

**Corresponding Author: N. Johari, norhasnidawani@utm.my*

Abstract

This research investigates the tribological performance of a novel superhydrophobic coating system composed of epoxy resin (Ep), polydimethylsiloxane (PDMS), calcium carbonate ($CaCO_3$), zinc oxide (ZnO), and stearic acid, applied on S50C carbon steel substrates. The primary objective is to enhance wear resistance and reduce friction under dry sliding conditions, a critical concern in tribology, especially for industrial applications involving steel components exposed to mechanical contact and environmental degradation. Tribological behavior was assessed using a pin-on-disc tribometer, evaluating parameters such as coefficient of friction (COF), wear rate, and surface morphology before and after testing. The hierarchical micro/nano-structured surface, induced by the hybrid fillers and surface modification with stearic acid, exhibited excellent wear resistance and low COF compared to uncoated and conventionally coated samples. The synergy between the hydrophobic matrix and embedded inorganic fillers contributed to energy dissipation and minimized adhesive wear mechanisms. Results demonstrate that the developed superhydrophobic coating not only provides corrosion resistance but also significantly improves tribological performance. The superhydrophobic coating with elaborate design of micro-nano structure exhibits excellent mechanical stability and friction coefficient reduction efficiency of 76.2 %. This study offers insight into the dual-functional potential of superhydrophobic surfaces and their application in reducing mechanical wear and friction in metallic components, providing a sustainable alternative for extending service life in tribology-critical systems.

Keywords: *Superhydrophobic coating, Micro-$CaCO_3$/ nano-ZnO, Mechanical robustness Durability, Wear/Corrosion resistance, Brushing, Multifunctionalities*

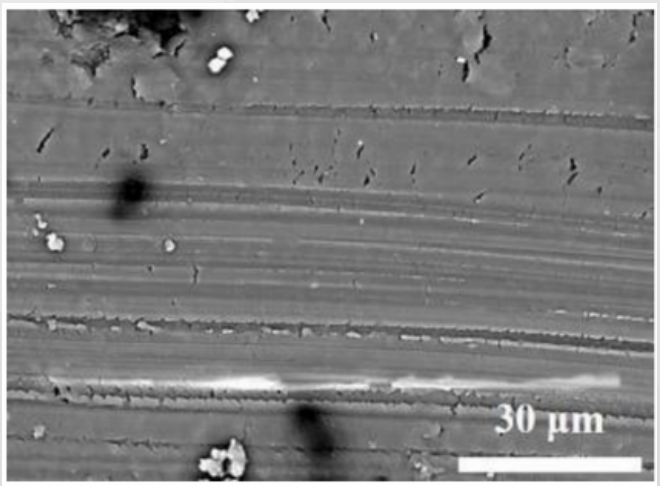


Figure 1: Worn surface of superhydrophobic coating

Paper ID: UTM02

ELECTROCHEMICAL PERFORMANCE OF ANTIMONY-MODIFIED POROUS LAMELLAR ZINC ALLOY ANODE IN ALKALINE AQUEOUS ELECTROLYTE

[1]Muhammad Afiq Irfan Mohd Shumiri, [1,2]Abdillah Sani Mohd Najib, [3]Hikari Sakaebe, [1,2]Nor Akmal Fadil*

[1]Materials Research and Consultancy Group, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia.

[2]Department of Materials, Manufacturing and Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Malaysia.

[3]Institute for Materials Chemistry and Engineering, Kyushu University.

**Corresponding Author: N.A. Fadil, norakmal@utm.my*

Abstract

Metallic zinc is one of the most attractive anode materials for post-lithium batteries due to its natural abundance, safety, low cost and high theoretical capacity. However, it often suffers from high voltage polarization and poor reversibility, which hinder the practical application in aqueous alkaline rechargeable zinc-ion batteries. To address this issue, this work presents antimony-modified porous lamellar zinc anode (Sb-pZn) as a promising high-performance negative electrode. Porous zinc structure was fabricated by chemical dealloying of eutectic Zn–Al alloy, where the less noble Al component was selectively removed in NaOH solution. This process results in a well-defined lamellar pattern with interconnected porous channels. The engineered morphology offers high surface area, uniform architecture and confined interlayer spacing, which promote efficient ion transport and improve electrochemical stability. Surface modification was performed through galvanic replacement reaction in $SbCl_3$–ethanol solution. This introduces zincophilic antimony sites that facilitate uniform zinc nucleation and enhance electron transfer. As a result, Sb-pZn anode shows significantly improved zinc plating-stripping reversibility, with an ultralow nucleation overpotential even at high current densities. Cyclic voltammetry shows enhanced redox kinetics with stronger peak currents and reduced peak separation, while electrochemical impedance spectroscopy confirms a notable decrease in charge transfer resistance. The combined effects of antimony incorporation and the tailored porous structure effectively reduce polarization and enhance overall electrochemical performance. This study offers a simple and scalable strategy for developing high-performance zinc anodes and provides valuable insights for advancing next-generation aqueous zinc-based energy storage systems.

Keywords: *Zinc anode, surface modification, electrochemical performance, lamellar porous structure*

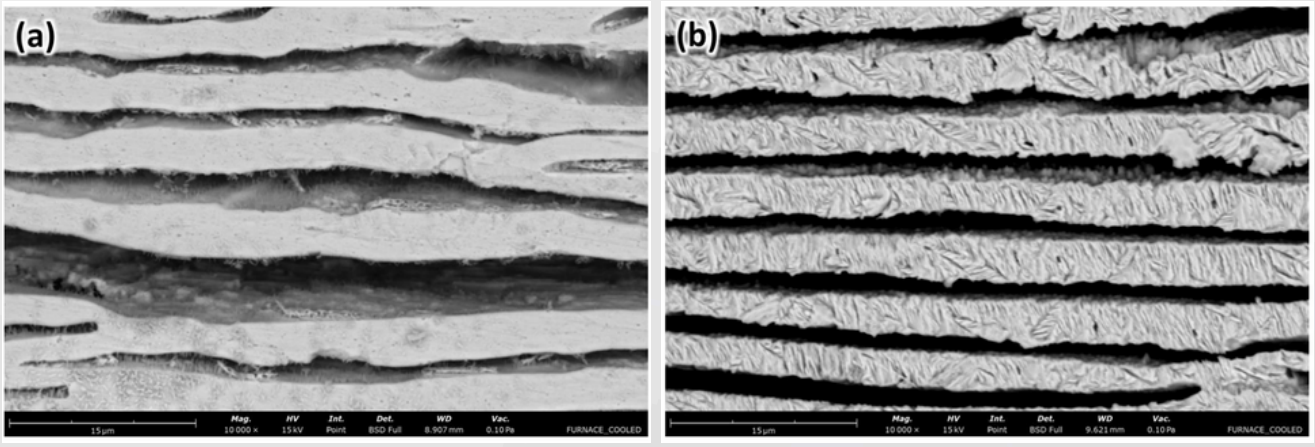


Figure 1: SEM images of porous lamellar zinc structure a) before and b) after antimony modification at 10 kx magnification and 15 kV accelerating voltage.

Paper ID: UTM05

HIGH ENTROPY ALLOY ANODES FOR SOLID OXIDE FUEL CELLS: A CRITICAL REVIEW OF STRUCTURAL STABILITY AND CARBON COKING RESISTANCE UNDER HYDROCARBON FUEL

[1]Nurul Syafiqah Tapak, [2,3]Nor Akmal Fadil*, [1]Mohd Hafiz Dzarfan Othmana, [1,3]Mohd Zamri Mohd Yusop

[1]*Advanced Membrane Technology Research Centre (AMTEC), Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia, Skudai 81310, Johor, Malaysia*

[2]*Material Research Consultancy Group, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Malaysia*

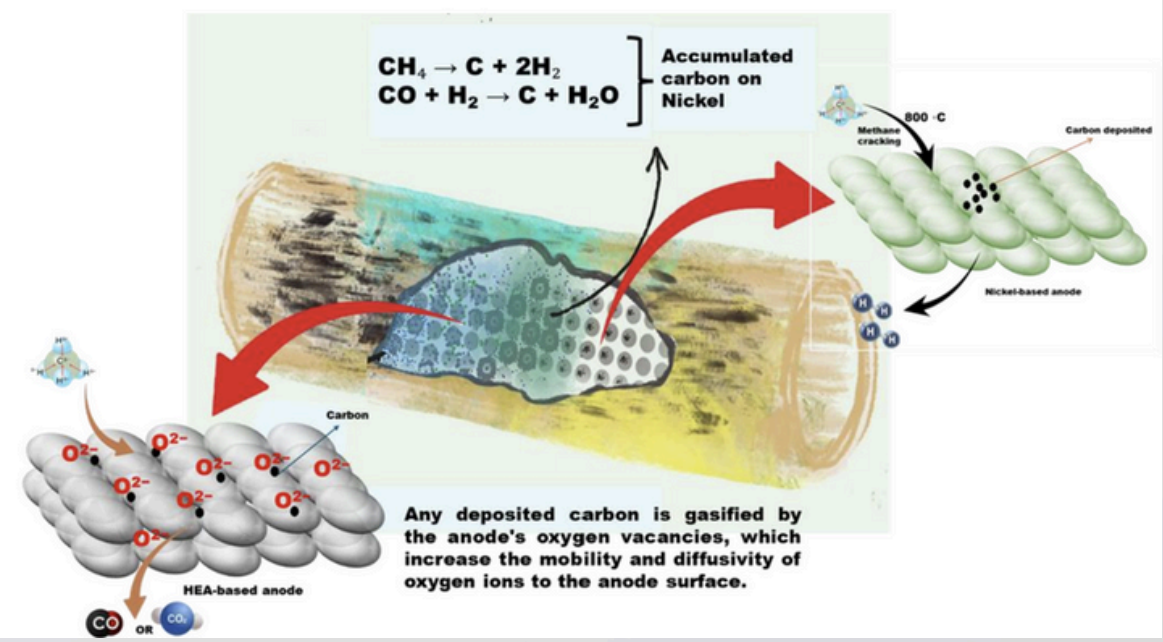
[3]*Department of Materials, Manufacturing and Industry, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia*

**Corresponding Author: N.A. Fadil, norakmal@utm.my*

Abstract

Solid oxide fuel cells (SOFCs) face several significant issues primarily related to their high operating temperatures, which typically range from 600 to 1000 °C. These high temperatures create challenges such as thermal stress leading to cell delamination, cracking, or failure. SOFCs are also vulnerable to carbon coking (carbon deposition) and poisoning, especially when hydrocarbon fuels are used. Carbon coking occurs when hydrocarbons crack on the anode surface, forming solid carbon deposits that block active sites and pores, hindering the electrochemical reactions. This leads to performance degradation and potential anode damage. High entropy alloys (HEAs), comprising five or more principal elements in near equiatomic proportions, are gaining considerable attention as compelling anode materials for SOFCs. The high configurational entropy, together with lattice distortion, sluggish diffusion, and cocktail effect synergy, confers these materials with unmatched structural stability, coking resistance, and multifunctional catalytic activity under harsh redox and high temperature conditions. From previous studies reported outcomes emphasize HEAs' potential for superior robustness, good electronic conductivity, tolerance to fuel impurities, and catalytic versatility. Therefore, this review critically discussed the present research such as composition, temperature, fuel complexity, fabrication methods, and characterization encouraging investigation into novel HEAs formulations for SOFCs application. This roadmap may provide a clear route for the development of robust, fuel flexible, and scalable HEAs anode materials for future SOFCs technologies.

Keywords: *SOFCs, carbon coking, hydrocarbons, high entropy alloy, fuel cell*



Paper ID: UTM06

THE CORROSION BEHAVIOUR OF ZN–AL ALLOYS IN ALKALINE ENVIRONMENT: INFLUENCE OF COMPOSITION, COOLING RATE, AND HEAT TREATMENT

Nur Diyana Nadhah Norhasrul Hadi, Abdillah Sani Mohd Najib, Nor Akmal Fadil*

Materials Research & Consultancy Group (MRCG), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81300 Skudai, Johor

**Corresponding Author: N.A. Fadil, norakmal@utm.my*

Abstract

Based on recent studies on Zn–Al alloys between 2020 and 2025, the application of varying heat treatment methods substantially elevated the alloys' resistance again st corrosion. The undergraduate study at Universiti Teknologi Malaysia (UTM) investigating the influence of post-treatment conditions, aluminium mole percentage, cooling rate on the alkaline medium response of Zn–Al alloys' microstructure and corrosion behaviour is the focal subject of the present review. One recurring observation in the said studies was that samples heat-treated at temperatures ranging between 370°C and 470°C for one hour up to three hours transformed their grain shapes from equiaxed morphologies into columnar morphologies. An interesting aspect of refining the microstructure was the use of a rapid cooling medium, primarily water quenching. An optimal condition observed was heat treatment at 420°C for three hours with subsequent water quenching, significantly increasing corrosion resistance against alkaline media. The outcomes shed light on the ability of tailor-made heat treatment parameters to improve microstructural characteristics of Zn–Al alloys with potential application in corrosive mediums such as battery systems or as an industrial component.

Keywords: Zn–Al alloy, aluminium composition, cooling rate, heat treatment, corrosion in alkaline

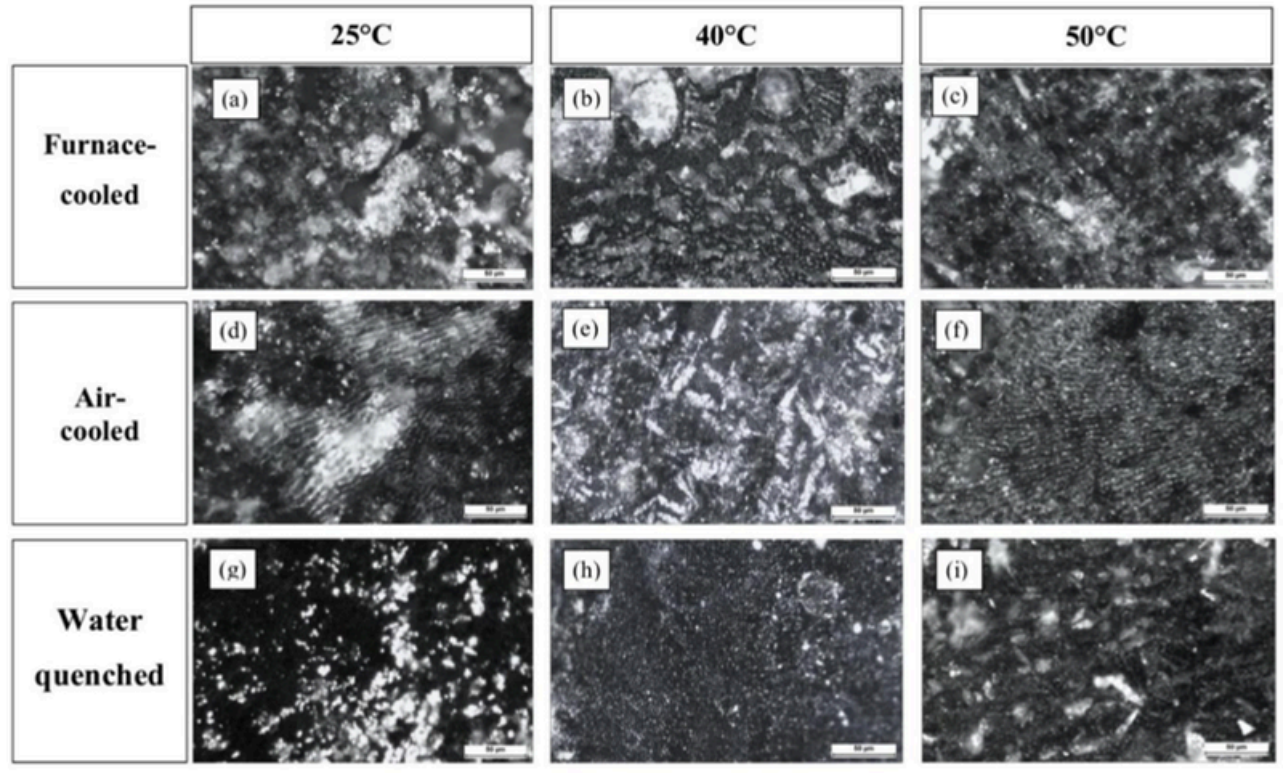


Figure 1: After water quenching, optical micrographs of the 95Zn–5Al alloy at varying cooling speeds reveal a refined and consistent lamellar morphology, indicating the maximum corrosion resistance in 5 M NaOH.

Paper ID: UTM07

EFFECTS OF SINTERING TEMPERATURE ON THE MICROSTRUCTURES AND ADHESION STRENGTH OF SLURRY-SPRAYED FUNCTIONALLY GRADED THERMAL BARRIER COATING

Fadzlun Nadrah Mohd Sharuddin, Muhammad Azizi Mat Yajid*

Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81300 Skudai, Johor.

**Corresponding Author: M.A. Mat Yajid, azizi@utm.my*

Abstract

Thermal barrier coating (TBC) has been widely used in protecting turbine components exposed to the extreme temperature condition. The conventional TBC system comprises of a metallic bond coat layer deposited on the substrate and yttria stabilized zirconia (YSZ) top layer. However, the thermal expansion mismatch between the bond coat and top coat layer has become a problem that leads to coating delamination. In order to mitigate this issue, functionally graded-thermal barrier coating (FG-TBC) method is adopted where a homogenous coating structure consist of composite materials layered on the substrate by gradually changes the compositional ratios over the coating thickness. This smooth transition from the substrate to the top layer minimizes the thermal expansion mismatch between the coating layers, reduces the internal residual stresses and increases the bonding strength. On the other hand, plasma spray has been the commonly used method for depositing TBC. But, in this study, YSZ/NiCoCrAlYTa FG-TBC was fabricated by using slurry spray technique (SST) considering the lower cost and simplicity of the method. For the purpose of determining the optimum sintering temperature, the effects of varying the sintering temperature on the microstructures and adhesion strength are investigated. Scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) were used to characterize the microstructures while pull-off adhesion tester was used to measure the adhesion strength between the coating layers and the substrate. Based on the findings, the optimum temperature for sintering slurry sprayed YSZ/NiCoCrAlYTa FG-TBC is 1100 °C.

Keywords: *Thermal barrier coating, functionally graded coating, yttria stabilized zirconia, sintering temperature.*

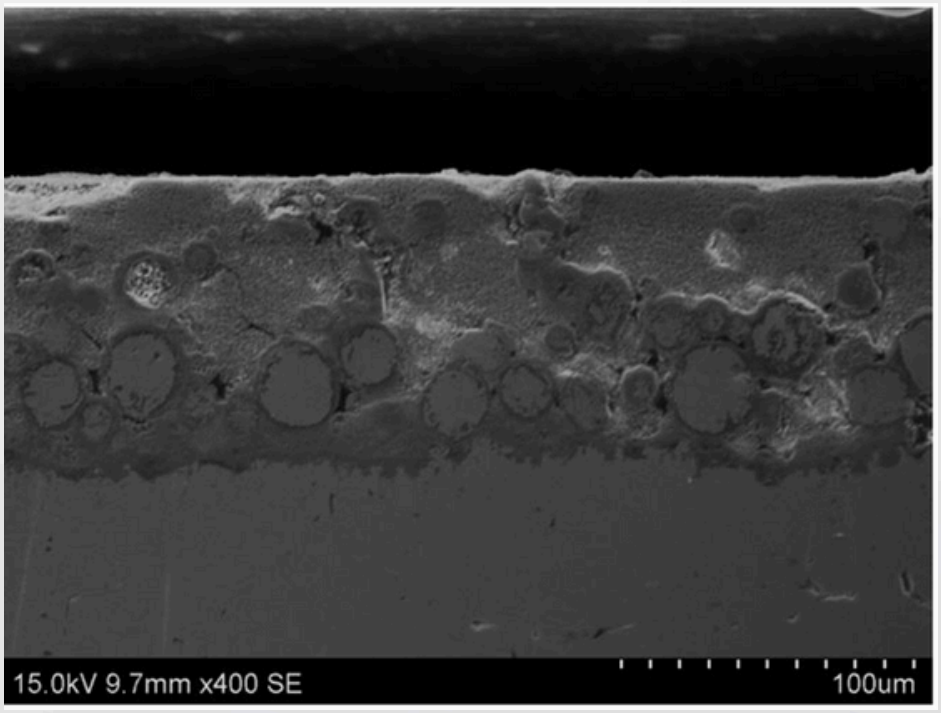


Figure 1: Slurry sprayed YSZ/NiCoCrAlYTa functionally graded-thermal barrier coating

Paper ID: UTM08

EFFECT OF SURFACE LASER SHOCK PEENING ON THE TENSILE PROPERTIES AND HARDNESS OF SELECTIVE LASER MELTED (SLMED) A357 ALLOY

[1]Agbaye Ignatius Uyabemem, [1-2]Tuty Asma Abu Bakar*, [2]Aini Zuhra Abdul Kadir

[1]Materials Research and Consultancy Group (MRCG), Faculty of Mechanical Engineering, University Teknologi Malaysia, 81310 Johor Bahru. Malaysia.

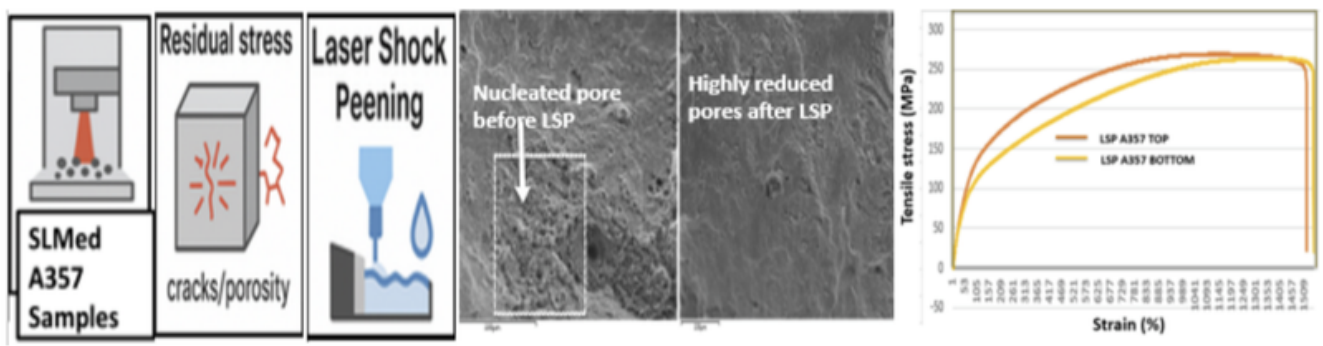
[2]Department of Materials & Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 31310 Johor Bahru. Malaysia.

**Corresponding Author: T.A. Abu Bakar, tuty@utm.my*

Abstract

The selective laser melting (SLM) is known for its remarkable ability for near-net-shape fabrication of light weight metallic alloys, which has enabled the manufacturing of complex shapes. It has been widely applied in the fabrication of cast Al-Si-Mg alloys, which are extensively used in the automotive, aerospace and biomedical industries. However, due to its rapid solidification and cooling rates, the process creates thermal fluctuations that lead to residual stresses in the fabricated parts, such that stress relief post processing is needed for practical applications of the parts. This study characterized the residual stresses in As-printed and LSP A357 samples. It further employ laser shock peening (LSP) as post processing method on the selective laser melted (SLMed) A357 alloy sample. The residual stresses in the As-printed and LSP were measured using robotic and pulstec X-ray diffraction machines. The findings established that LSP-induced plastic deformation created grain refinement, which developed dislocation density that increased both strength and hardness of the sample. The LSP induced compressive residual stresses up to the magnitude of -51MPa, which modified the tensile residual stresses, and significantly improved the strength and hardness. This confirmed LSP process as an effective method for mitigating acquired residual stresses for enhancing mechanical properties in SLMed A357 to enable its use in critical structural applications.

Keywords: *Laser shock peening, selective laser melting, residual stress, aluminium alloys, additive manufacturing*



Graphic Abstract

Paper ID: UTM09

MICROSTRUCTURES AND PHYSICOCHEMICAL EVALUATIONS OF MG-FE ANODES FOR IMPLANTABLE BATTERY APPLICATIONS

[1]Gonga Sutradhar, [1,2]Abdul Hakim Md Yusop*

[1]Department of Materials, Manufacturing and Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor, Malaysia.

[2]Materials Research & Consultancy Group (MRCG), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor, Malaysia.

**Corresponding Author: A.H. Md Yusop, abdul.hakim@utm.my*

Abstract

Magnesium (Mg)-based materials have shown great potential as anodes for implantable battery applications due to their high energy density, excellent biocompatibility, and natural degradability. Despite these advantages, Mg degrades too rapidly in physiological environments, which remains a major concern for its use as an anode. In the present study, Mg was combined with iron (Fe) to form Mg–Fe composites, and the anode surfaces were treated with a CO2 laser to alter their surface properties in order to modulate the Mg–Fe degradation rate. The addition of Fe was selected because of its slower degradation rate as well as its higher and more desirable mechanical strength. The Mg–Fe anodes were fabricated using the powder metallurgy method, followed by laser irradiation at 4 W and 40 W with 1, 5, and 10 scan passes. The findings revealed that the compressive strength and Young's modulus of Mg–Fe increased as the Fe content rose to 20 wt.%. Interestingly, all composite Young's moduli were within the range of cancellous bone (0.1–20 GPa). At higher scan passes (up to 10) and at 40 W power, a more widespread stream-like particle morphology was observed, attributed to the localized melting of Mg—which has a relatively low melting point—leading to dragging of Fe particles. Furthermore, at the highest scan pass (10 times) and laser power of 40 W, more oxides were detected on the surface, resulting in higher surface roughness and greater hydrophilicity compared with samples subjected to fewer scan passes.

Keywords: *CO_2 laser irradiation, Mg-Fe anodes, physicochemical properties, implantable battery.*

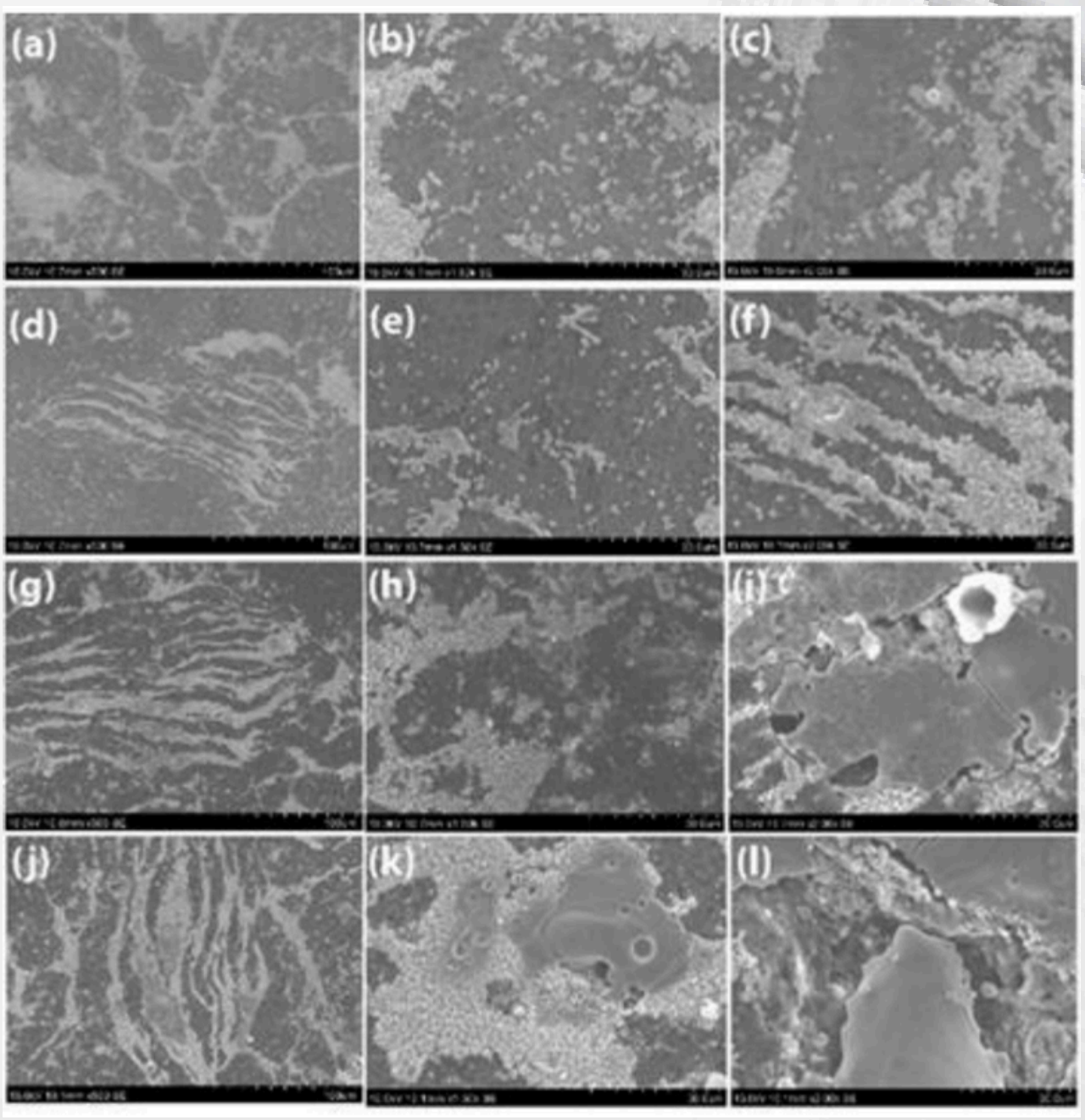


Figure 1: SEM images of (a–c) Unlasered Mg-Fe; (d–f) Mg-Fe lasered with 40 W and 1 scanning pass; (g–i) Mg-Fe lasered with 40 W and 5 scanning pass; (j–l) Mg-Fe lasered with 40 W and 10 scanning pass.

Paper ID: UTM10

DEVELOPMENT OF THERMAL INSULATING PAINT: INFLUENCE OF AEROGEL SLURRY LOADING ON DISPERSION STABILITY, SURFACE WETTABILITY, AND THERMAL PERFORMANCE

[1]Rozalina Amran, [1]Hong Ling Chuan, [2]Nuhairi Alias, [1,3]Muhamad Azizi Mat Yajid*, [2]Zaiton Abdul Majid, [1,3]Abdillah Sani Mohd Najib, [4]Nuha Awang, [1]Zulhelmi Alif Abdul Halim

[1]*Department of Materials, Manufacturing and Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Johor, Malaysia*

[2]*Department of Chemistry, Faculty of Science, Universiti Teknologi Malaysia, 81310, Johor Bahru, Johor, Malaysia*

[3]*Materials Research and Consultancy Group (MRCG), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Johor, Malaysia*

[4]*Facilities and Maintenance Engineering Section, Malaysian Institute of Industrial Technology, Universiti Kuala Lumpur, 81750 Johor Bahru, Johor, Malaysia*

**Corresponding Author: M.A. Mat Yajid, azizi@utm.my*

Abstract

Silica aerogel is a lightweight, highly porous, and naturally hydrophobic material widely recognized for its unique thermal and surface properties. In this study, silica aerogel was modified using Sodium dodecyl sulphate (SDS) at 5, 7.5, and 10 wt.%, producing Slurry A, B, and C, respectively. The modified slurries were evaluated by zeta potential and contact angle measurements to determine stability and hydrophobicity. Among the formulations, Slurry C exhibited the highest stability, with a zeta potential of −40.67 mV, and showed a contact angle of 11°, confirming improved dispersion. The aerogel slurries were subsequently incorporated into a silicone acrylic paint matrix at 10, 30, and 50 wt.% loadings to develop thermal insulation coatings. The addition of aerogel significantly enhanced surface hydrophobicity, as the contact angle of pristine paint (76.08°) increased to 131.18° with 50 wt. % slurry. However, increasing slurry content resulted in higher surface temperatures of coated steel, indicating reduced thermal insulation performance. Despite this, the 50 wt.% formulation demonstrated the most stable thermal behaviour, with a char residue of 25%. In terms of mechanical properties, the optimal adhesion strength was achieved with 10 wt.% slurry incorporation, yielding 2.37 MPa, which balances adhesion, thermal stability, and surface performance.

Keywords: *Thermal insulating paint, silica aerogel, slurry loading, thermal stability, SEM*

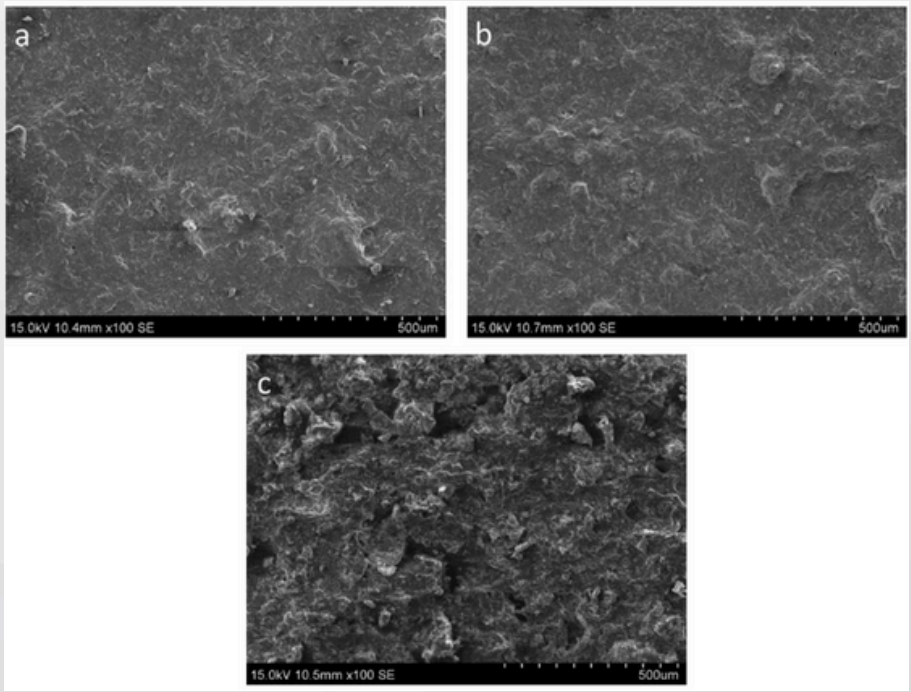


Figure 1. SEM images of the painted steel surface with aerogel slurry for (a) 10, (b) 30, (c) 50 wt.%

Paper ID: UTM11

INFLUENCE OF TITANIUM DIOXIDE ON THE MICROSTRUCTURE, POROSITY, AND CORROSION PERFORMANCE OF MAGNESIUM PHOSPHATE CERAMIC

Muhammad Faiz Bin Ibrahim, Abdillah Sani Mohd Najib*

Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81300 Skudai, Johor.

**Corresponding Author: A.S. Mohd Najib, abdillahsani@utm.my*

Abstract

Magnesium phosphate ceramic (MPC) has recently attracted attention as promising protective coatings due to their strong adhesion, rapid setting, and chemical stability. However, their performance is often limited by residual porosity, which facilitates ingress of corrosive species and compromises long-term durability. To address this challenge, this study investigates the effect of incorporating titanium dioxide (TiO_2) as a filler in MPC formulations. TiO_2 is expected to act as a pore-refining additive, reducing the connectivity of capillary pores while enhancing barrier properties. Samples with varying TiO2 contents will be synthesized and subjected to detailed microscopy analysis, including scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS), to evaluate pore morphology, distribution, and TiO_2 dispersion within the matrix. Electrochemical methods, including potentiodynamic polarization and electrochemical impedance spectroscopy, will be employed to evaluate the corrosion resistance of coated mild steel substrates. It is anticipated that the addition of TiO2 will decrease overall porosity, promote a denser microstructure, and thereby improve corrosion resistance compared to unmodified MPC. The findings are expected to provide new insights into tailoring MPC compositions for advanced anti-corrosion applications, contributing to the development of durable and sustainable protective coatings.

Keywords: *magnesium phosphate ceramic, anti-corrosion coating, titanium dioxide, porosity, corrosion resistance*

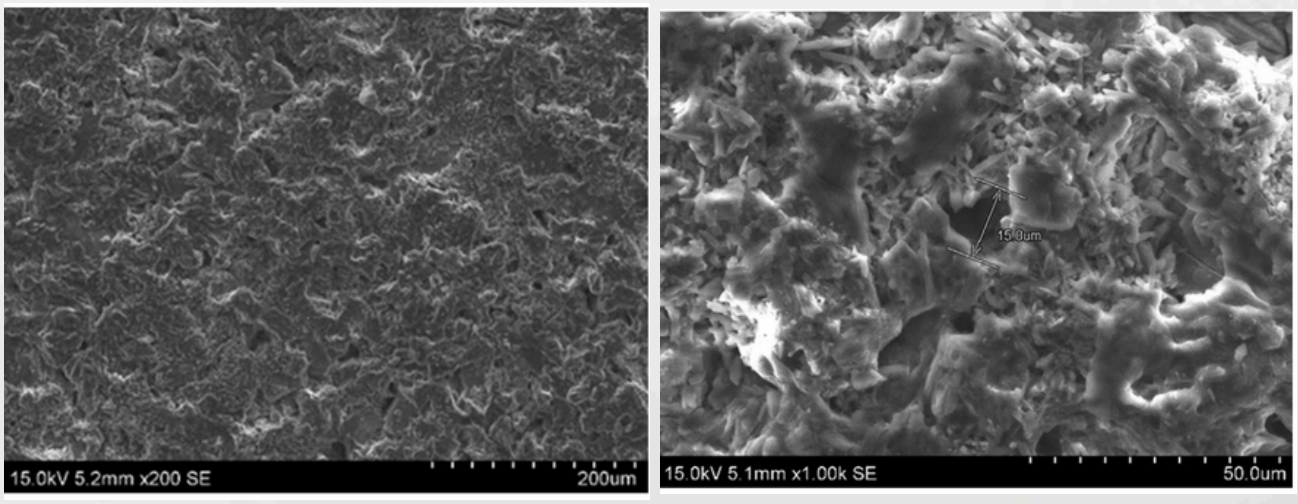


Figure 1: Microporosity of magnesium phosphate ceramic coating

Paper ID: UTM12

PHASE STABILITY AND HIGH-TEMPERATURE OXIDATION MECHANISM DIVERGENCE IN AL30CR15NI15SI10TI30 HIGH-ENTROPY ALLOY AT 1000 °C

[1,2]Mudassar Hussain, [2]Junsen Wang, [1]Abdillah Sani Mohd Najib, [1]Nor Akmal Fadil, [2]Jing Liu, and [1]Tuty Asma Abu Bakar*

[1]Materials Research and Consultancy Group (MRCG), Department of Materials, Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, Johor Bahru, Johor, Malaysia.

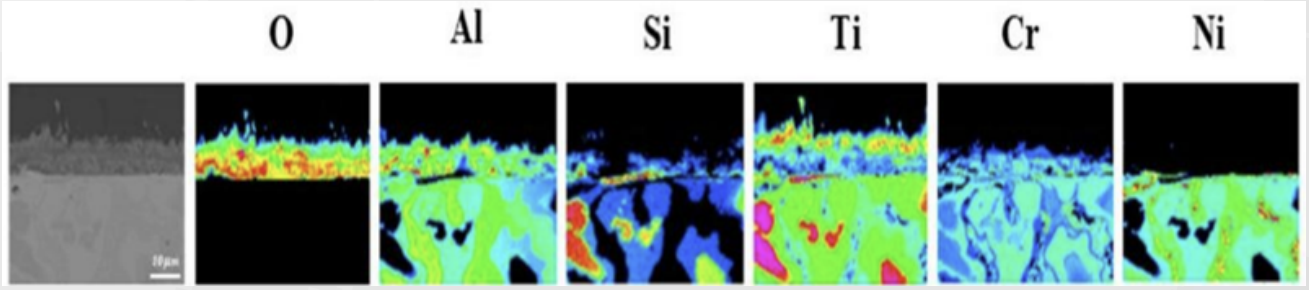
[2]Guangdong Provincial Key Laboratory of New Energy Materials Service Safety, College of Materials Science and Engineering, Shenzhen University, Shenzhen, Guangdong, P.R. China

**Corresponding Author: T.A. Abu Bakar, tuty@utm.my*

Abstract

Al-Ti-rich, AlCrNiSiTi high-entropy alloys (HEAs) have emerged as promising next-generation candidates to replace Ni-based superalloys and refractory alloys due to their lightweight nature and excellent phase stability. However, their high-temperature performance is constrained by complex oxidation behavior. This study aims to examine the phase stability and high-temperature oxidation mechanisms of an as-cast $Al_{30}Cr_{15}Ni_{15}Si_{10}Ti_{30}$ HEA at 1000 °C over 100 hours to assess its suitability for extreme-temperature applications. Weight changes during oxidation were monitored using thermogravimetric analysis (TGA). Phase transformation was monitored using differential scanning calorimetry (DSC). Microstructural and chemical evolution were characterised using X-ray diffraction (XRD), scanning electron microscopy with energy-dispersive spectroscopy (SEM-EDS), and X-ray photoelectron spectroscopy (XPS). DSC results up to 1400 °C confirmed the absence of phase transformations. Oxidation was dominated by rapid TiO2 formation and internal aluminum oxidation, resulting in a porous, non-adherent oxide layer. Protective Cr_2O_3 or Al_2O_3 scales were supressed, limiting oxidation resistance. These results indicate that while $Al_{30}Cr_{15}Ni_{15}Si_{10}Ti_{30}$ HEA retains structural stability at elevated temperatures, its high titanium content compromises oxidation performance, emphasizing the need for compositional optimisation or surface engineering. This work offers critical insights into the design of AlCrNiSiTi HEAs as potential high-temperature materials for extreme environments.

Keywords: *Al-Ti-rich AlCrNiSiTi High-Entropy Alloy, Phase stability, High-Temperature oxidation, TiO_2 formation, Limited oxidation resistance*



Paper ID: UTM14

HYBRID GOLD NANOPARTICLES: SAMPLE PREPARATION FOR SCANNING ELECTRON MICROSCOPY IMAGING

[1]Adibah Shakri, [1]Khairunnisa Mohd Paad*, [2]Norazalina Saad, [3]Izzat Fahimuddin Mohamed Suffian

[1]Department of Chemical and Environmental Engineering, Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia Kuala Lumpur, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia

[2]UPM-MAKNA Cancer Research Laboratory (CANRES), Institute of Bioscience, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

[3]Department of Pharmaceutical Technology, Kulliyyah of Pharmacy, International Islamic University of Malaysia, Bandar Indera Mahkota, 25200 Kuantan, Pahang, Malaysia

**Corresponding Author: MP Khairunnisa, khairunnisa.kl@utm.my*

Abstract

Hybrid gold nanoparticles (AuNPs) are a combination of gold, polymer and drug in which gold and polymer serve as a nanocarrier for the drug to improve its effectiveness in drug delivery systems. Accurate morphological characterisation of Hybrid AuNPs is continuously a challenge due to the polymer's sensitivity to beam damage, deformation and charging. In addition, the nature of SEM requires solid and non-liquid materials, adding to the challenge because some nanoparticles are stored in a liquid suspension to maintain particle dispersion and stability. Hence, this study focuses on improving the SEM sample preparation for reliable SEM imaging of hybrid gold nanoparticles. Several preparation strategies such as drying method, substrate type and voltage, were evaluated to determine their influence on image quality and morphology characterisation. Among the parameters tested, air-dry samples on carbon tape (copper addition) with 5 kV voltage provided a high-resolution image with minimal particle aggregation. These results highlight the importance of sample preparation for SEM imaging which offers a practical and reproducible method applicable for accurate interpretation of hybrid gold nanoparticles at the nanoscale.

Keywords: *Gold nanoparticles, PLGA-PEG, gemcitabine, liquid suspension, drying*

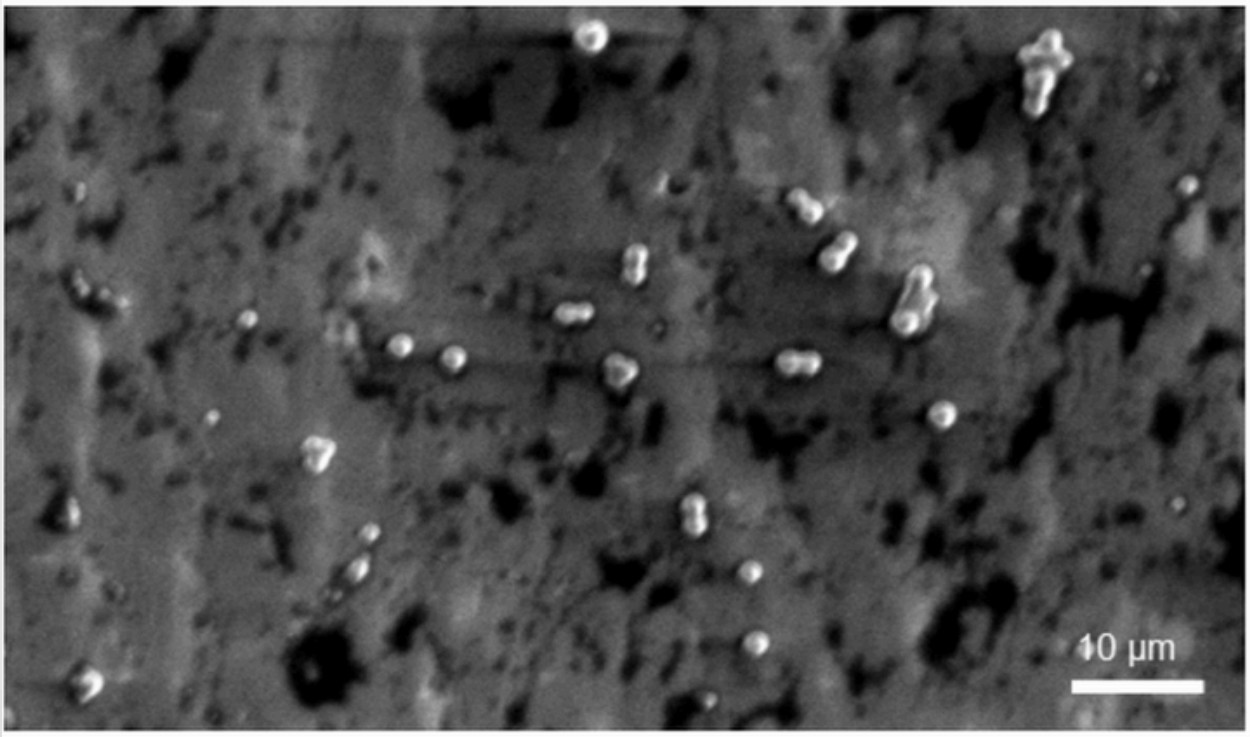


Figure 1: Morphological characterisation of hybrid gold nanoparticles

Paper ID: UTM18

EFFECT OF ADDITION OF Pr-Sb ON MICROSTRUCTURAL AND MECHANICAL PROPERTIES OF Al-15%Mg_2Si COMPOSITE

[1]Alif Fajar Putrawan, [1-2]Nor Akmal Fadil*, [1-3]Tuty Asma Abu Bakar, [4]Hamidreza Ghandvar ,[5]Shazarel Shamsudin

[1] Department of Materials, Manufacturing & Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81300 Johor Bahru, Johor.

[2]Materials Research and Consultancy Group (MRCG), Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.

[3]Centre for Advanced Composite Materials, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia.

[4]Department of Mechanical Engineering, School of Engineering, New Uzbekistan University, Movarounnahr Street 1, Mirzo Ulugbek District, Tashkent, 100000, Uzbekistan

[5]Advanced Manufacturing and Materials Center (AMMC), Universiti Tun Hussein Onn Malaysia (UTHM), 86400, Parit Raja, Batu Pahat, Johor, Malaysia

**Corresponding Author: N.A. Fadil, norakmal@utm.my*

Abstract

Aluminium-based metal matrix composites (MMCs) are widely recognised as advanced materials for many applications, including automotive, marine, and aerospace. They offer high specific strength, wear resistance, and corrosion resistance while maintaining low density. The addition of Mg_2Si further enhances the performance of aluminium MMCs; however, its microstructure is typically coarse and dendritic. The sharp corners of primary Mg_2Si particles act as stress concentration sites, which can initiate failure. To address this challenge, various modifications of the Mg_2Si approach have been proposed, whether by modifying with other elements or by post-processing. One of the proposed methods of modifying Mg_2Si is the addition of Pr-Sb. This study aims to investigate the effects of adding different weight percentages of Pr-Sb on mechanical and microstructural properties. Mechanical performance was assessed through tensile and hardness testing, while microstructural properties were analysed using optical microscopy and scanning electron microscopy (SEM) with energy-dispersive X-ray spectroscopy (EDX). The result showed that Pr-Sb at 2.0 wt% concentration gave the highest tensile strength of 124 MPa compared to the base, which is 99 MPa, and 0.5 wt% gave the best hardness of 160 HV compared to the base, which is 120 HV, while also giving the Mg_2Si phase with the highest density per area. It is concluded that Pr-Sb improved the microstructural and mechanical properties by making Mg_2Si finer.

Keywords: *Mg_2Si, Pr-Sb, Refinement, Microstructure, Mechanical Properties.*

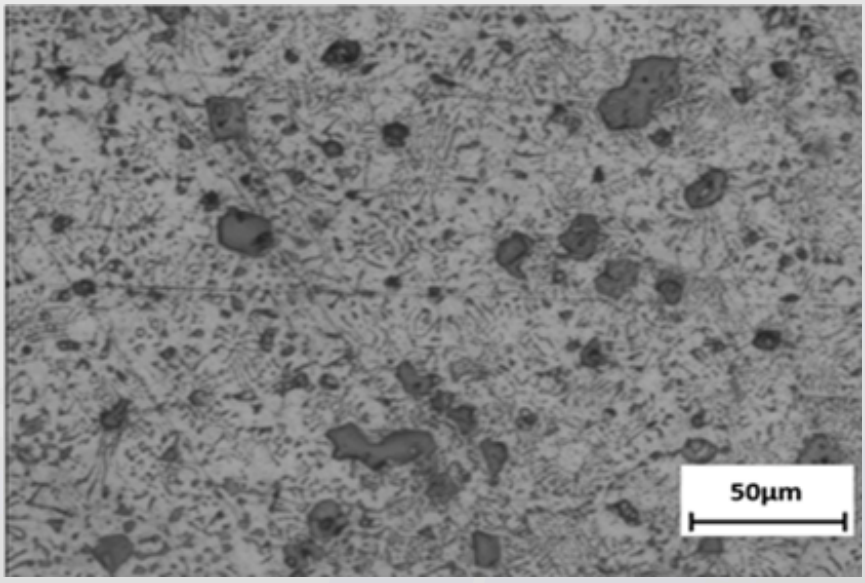


Figure 1: Microstructure of Al-15Mg2Si 0.5wt% Pr-Sb

Paper ID: VEN01

ADVANCED APPLICATIONS OF ATOMIC FORCE MICROSCOPE

Iong Ying Loh

Park Systems Pte Ltd

**Corresponding Author: I.Y. Loh, iyloh@parksystems.com*

Abstract

Atomic Force Microscopy (AFM) offers a range of advanced modes beyond conventional topographical imaging. For example, Scanning Capacitance Microscopy (SCM) enables high-resolution dopant profiling and capacitance measurements, making it indispensable in failure analysis in semiconductor industry. Kelvin Probe Force Microscopy (KPFM) measures surface potential at the nanoscale, providing insights into electronic properties. Magnetic Force Microscopy (MFM) uses magnetically sensitive cantilevers to map magnetic domains and interactions. Lateral Force Microscopy (LFM) detects variations in surface friction, revealing inhomogeneities in material composition. Recent advancements have further improved these advanced techniques with enhanced sensitivity and resolution, such as Scanning Microwave Impedance Microscopy (sMIM), Heterodyne KPFM, Frequency-modulated MFM and Torsional Force Microscopy. These developments position AFM as a versatile and powerful tool for both academic research and industrial applications.

Keywords: *Atomic force microscopy, scanning probe microscopy, nanoscale characterization, surface analysis, advanced AFM modes*

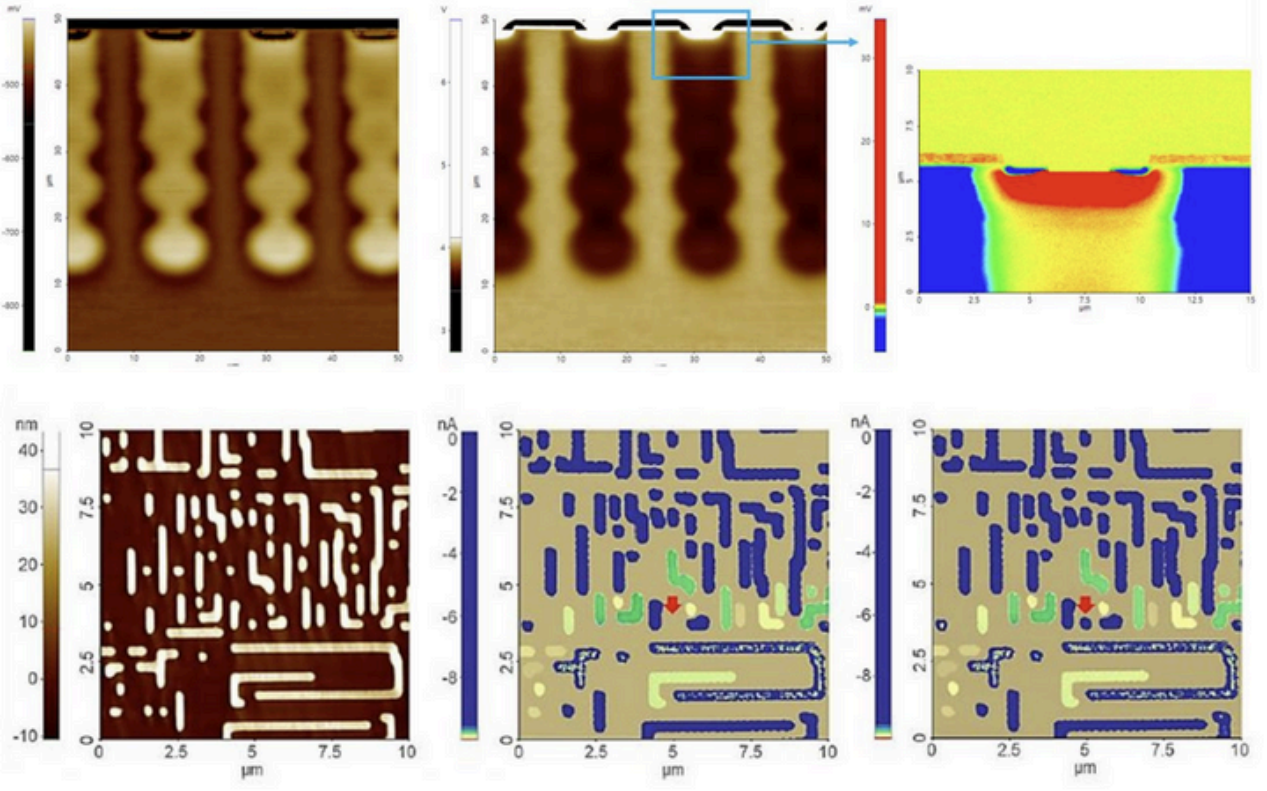


Figure 1: Top. Characterization of MOSFET using Scanning Microwave Impedance Microscopy (sMIM). Bottom. Conductive AFM measurement on semiconductor devices with integrated circuits for failure analysis

Paper ID: VEN02

NANOMECHANICAL TESTING IN EXTREME ENVIRONMENTS: HIGH STRAIN RATE NANOINDENTATION AT HIGH TEMPERATURES

Viola Paul, Nicholas Randall, Renato Pero, Jean-Marc. Breguet

Alemnis AG, Thun, Switzerland

**Corresponding Author: V. Paul, viola.paul@alemnis.ch*

Abstract

The strain rate dependence of the mechanical properties of materials at high strain rates is of great interest for a wide range of applications, including metal forming, machining, crashworthiness, projectile impact, and other dynamic processes. Understanding how materials respond under such conditions is essential for improving performance and reliability. Therefore, it is highly desirable to extend the high strain rate capabilities of nanoindentation beyond the quasi-static regime (10-5 to 10-2 s-1), taking advantage of its relatively simple sample preparation, high-throughput testing potential, and compact instrumentation. Recent technological developments have significantly broadened the applicability of nanoindentation, enabling experiments across a wide temperature range from -150 °C to 1000 °C and strain rates up to 105 s-1. This allows detailed investigation of deformation mechanisms under extreme environmental and mechanical conditions. In this presentation, we report nanoindentation experiments performed under combined variations of temperature and strain rate. A customized piezoelectric in situ nanomechanical setup is introduced, capable of measuring rate-dependent hardness over strain rates ranging from 101 to 105 s^{-1} and oscillation frequencies up to 10 kHz. This approach provides access to dynamic regimes previously unattainable with conventional methods and offers quantitative insight into high-rate deformation mechanisms. Selected case studies demonstrate the synergistic effects of temperature and strain rate on material behavior, providing guidance for designing and understanding advanced materials under extreme conditions.

Keywords: *In-situ, High Temperature, Low temperature, Micromechanical Testing, High Strain Rate*

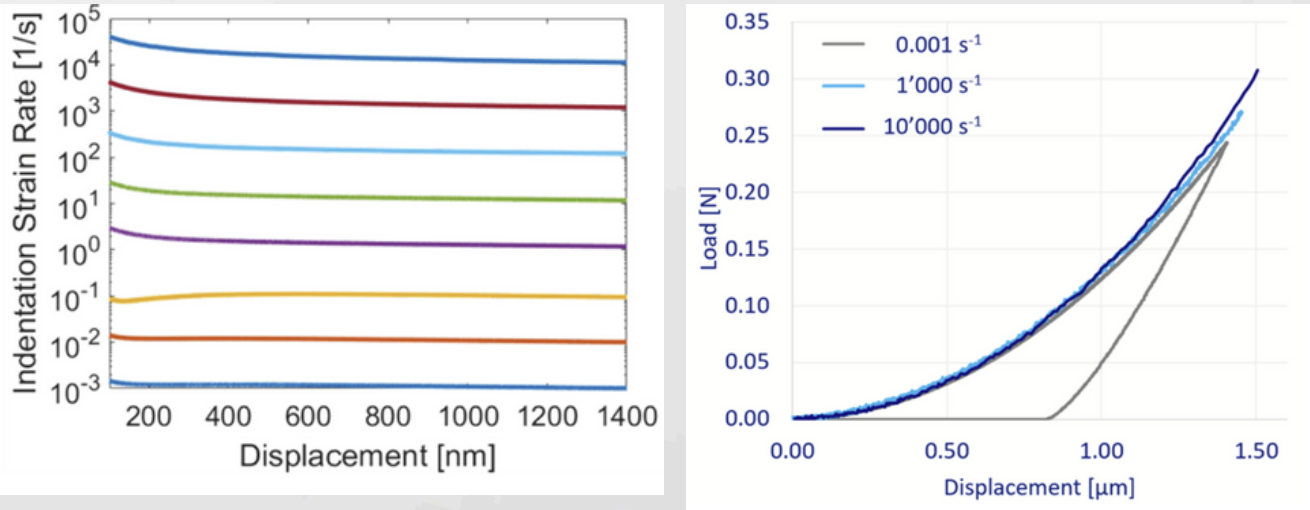


Figure 1: Constant strain rate nanoindentations on fused silica. Strain rate vs depth and load vs displacement curves.

Paper ID: UTHM10

FABRICATION AND CHARACTERISATION OF MICROCAPSULE FROM SUNFLOWER OIL FOR SELF-HEALING APPLICATIONS

Norwahdah Rahmat, Z. Baharom, Hassan Zuhudi Abdullah*, M. I. Idris, and Nor Adrian Nor Salim

Department of Mechanical Engineering, Faculty of Mechanical and Manufacturing Engineering, University Tun Hussein Onn Malaysia, Parit Raja, 86400 Batu Pahat, Johor

**Corresponding Author: H.Z. Abdullah, hasan@uthm.edu.my*

Abstract

The emerging technology of microencapsulating natural self-healing agents offers a promising solution to combat structural defects in metal coatings caused by corrosion. By integrating these self-healing agents into mild steel coatings, the system can automatically repair damage, thereby prolonging the lifespan of the mild steel and, consequently, the entire structure. This study focuses on the fabrication and characterization of microcapsules containing waste sunflower oil for self-healing coating applications. Microcapsules were synthesized via in situ polymerization using urea-formaldehyde as the shell material and ethylene maleic anhydride (EMA) as a surfactant. The process parameters, including stirring speed (200-400 rpm), reaction time (2-4 h), and EMA concentration (2.5-7.5 wt.%), were varied to optimize microcapsule morphology and performance. Scanning Electron Microscopy (SEM) revealed that increasing stirring speed resulted in reduced capsule size from 2.32 µm at 200 rpm to 1.63 µm at 400 rpm. Similarly, higher EMA concentrations also led to smaller capsules, with a minimum diameter of 1.10 µm at 7.5 wt.%. Conversely, increased reaction time led to larger capsules, reaching 3.06 µm at 4 hours. The highest encapsulation efficiency (45%) was achieved at 400 rpm and 4 h reaction time, while the highest core content (63%) was observed at 200 rpm and 3 h. Characterization techniques including FTIR confirmed the successful encapsulation of sunflower oil (2921.3 cm-1 peak) and the presence of urea-formaldehyde shell (1630.5 cm-1). TGA results demonstrated good thermal stability of microcapsules, retaining 82% weight at 224 °C. EDS analysis validated the elemental composition corresponding to the shell and core phases, while XRD confirmed the semi-crystalline nature of the urea-formaldehyde shell. This research highlights the potential of waste sunflower oil as a natural self-healing agent, offering an environmentally friendly alternative to polymeric and carcinogenic materials. These findings suggest that waste sunflower oil microcapsules are a promising, sustainable alternative for smart corrosion-protective coatings, aligning with green environmental demands.

Keywords: *Microcapsules, self-healing agent*

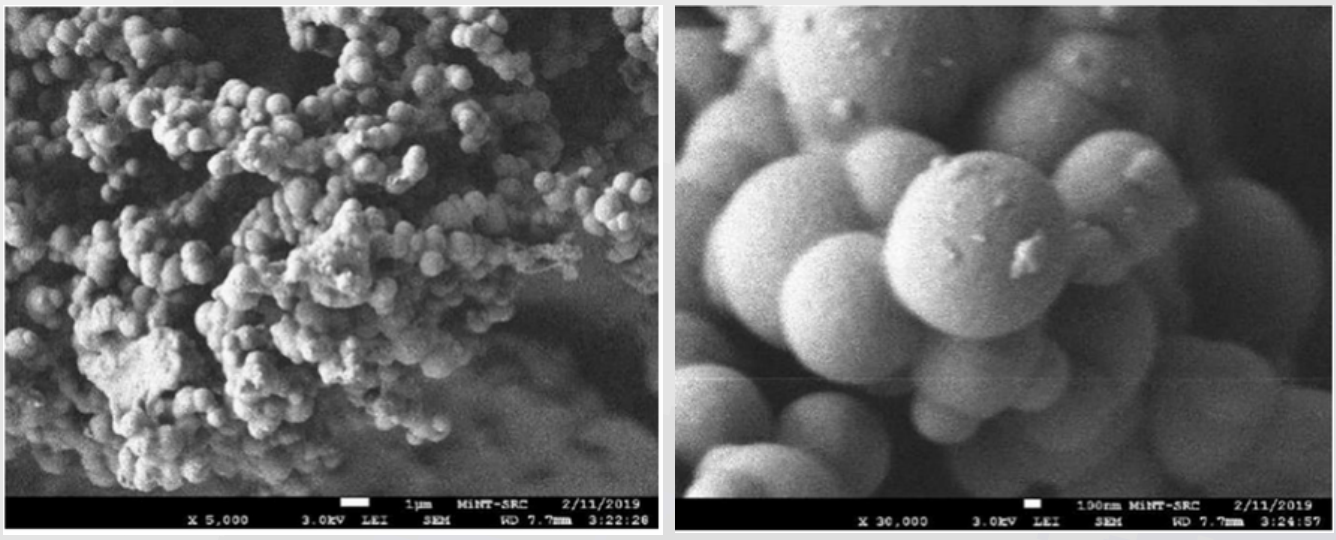


Figure 1 Microcapsules image under FESEM synthesized from waste sunflower oil with variant parameters.

Paper ID: UTM15

EFFECT OF LOAD AND COUNTERPART BALL ON THE FRICTION AND WEAR BEHAVIOR OF DLC-FLAKE-REINFORCED COMPOSITE OXIDE FILMS

[1]Nur Aszreen Zulkifli, [1]Shahira Liza*, [1]Kanao Fukuda, [2]Yazid Yaakob, [3]Hiroki Akasaka

[1]Tribology and Precision Machining i-Kohza, Malaysia-Japan Institute of Technology, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia

[2]Halal Products Research Institute, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor,Malaysia

[3]Department of Mechanical Engineering,School of Engineering, Institute of Science Tokyo, 2-12-1, O-okayama, Meguro-ku, Tokyo 152-8552, Japan

**Corresponding Author: Shahira Liza, shahiraliza@utm.my*

Abstract

Conventional anodic oxide films on aluminium alloys provide good hardness but often fail under high contact stress due to brittleness and limited self-lubricating ability, leading to increased friction and wear in mechanical components. To address this issue, diamond-like carbon (DLC) flakes were incorporated into anodic oxide films on AA2017 alloy through pulse anodizing in 20 wt.% H_2SO_4 containing DLC-coated Cu particles. The objective of this study was to evaluate the tribological performance of the resulting composite oxide film under different contact pressures and counterpart materials that simulate industrial conditions. The composite oxide film with 5 g/L DLC was tested under dry sliding at loads of 1 N and 10 N against Si_3N_4 and SUJ2 balls representing ceramic and steel counterparts. The coefficient of friction decreased from 0.77 to 0.4, and the wear rate was reduced by nearly 50% compared with the conventional oxide film. The SUJ2 counterpart provided smoother sliding and lower wear due to a carbon-rich transfer layer, while higher load promoted the formation of a lubricative DLC-based tribo-film. These findings indicate that DLC-reinforced anodic coatings can significantly improve the durability of lightweight aluminium components operating under variable contact pressures in industrial systems.

Keywords: *Anodizing, composite coating, friction, wear*

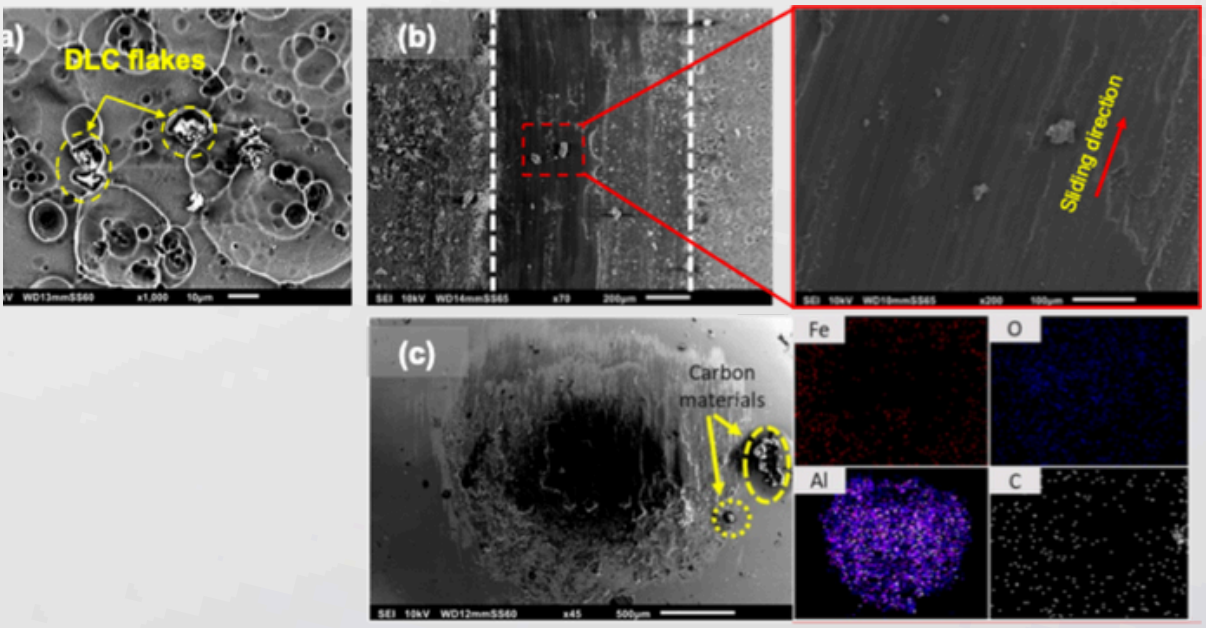


Figure 1: SEM images showing (a) DLC flakes incorporated within the anodic oxide film, (b) the worn surface of the composite oxide coating after sliding, and (c) the SUJ2 steel ball with corresponding EDS mapping after testing under a 10 N applied load.

Paper ID: UTM16

THERMAL TREATMENT-DRIVEN EVOLUTION OF DEFORMATION GEOMETRY AND YIELD STRENGTH IN ZN–MN ALLOYS

[1]Kar Fei Chan, [1]Ng Cong Li, [1]Batrisyia Balqis, [2]Yazid Yaakob, [3]Hidetoshi Miyazaki, [3]Masaki Tanemura, [1]Mohd Zamri Mohd Yusop*

[1]Department of Materials, Manufacturing and Industrial Engineering, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310, Johor Bahru, Johor, Malaysia.

[2]Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia.

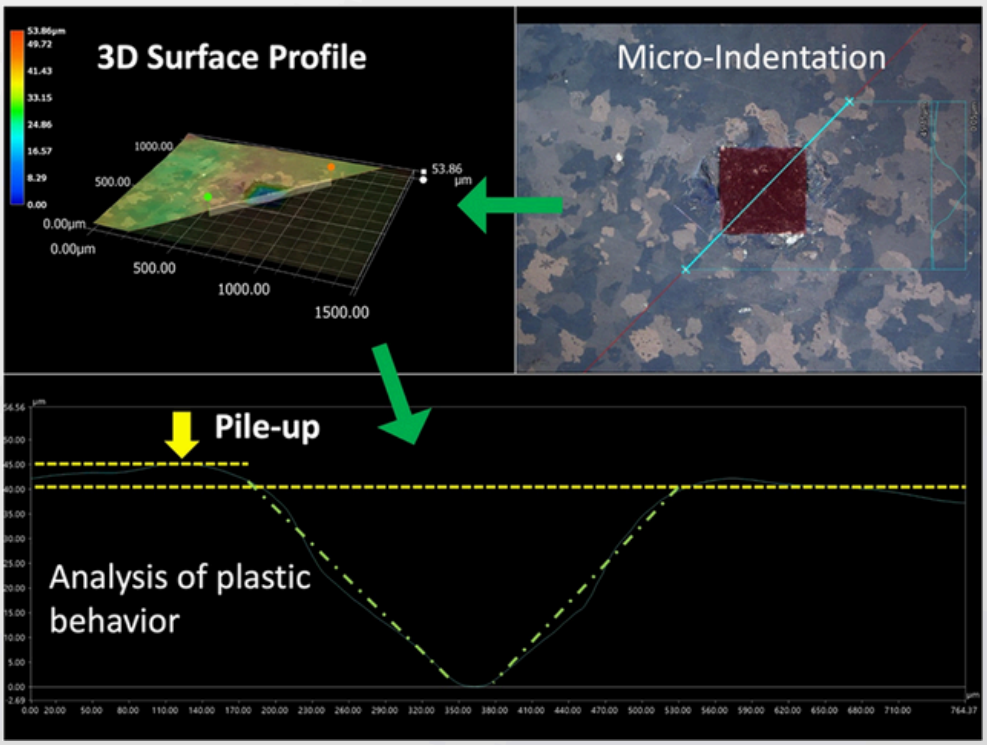
[3]Department of Physical Science and Engineering, Nagoya Institute of Technology, 466-8555, Nagoya, Aichi, Japan

**Corresponding Author: M.Z. Mohd Yusop, zamriyusop@utm.my*

Abstract

This study investigates the evolution of deformation geometry in Zn 2.4 wt.% Mn alloys subjected to thermal processing, using cross-sectional indentation profiling as a localized mechanical characterization technique. A total of eighteen samples encompassing As Cast, Homogenized, and 1–4 hour annealed states were analysed via optical profilometry, enabling precise extraction of indentation depth, pile-up height, and plastic zone width. Results reveal a significant reduction in indentation depth from ~13.8 µm in the As Cast condition to ~9.1 µm in the Annealed 4H sample, accompanied by an increase in maximum pile-up height from ~1.4 µm to ~2.9 µm and an expansion in plastic zone width from ~298 µm to ~378 µm. Yield strength, estimated from Vickers hardness using the empirical relation $\sigma_y \approx (HV \times 9.807)/3$, increased from 167 MPa to 244 MPa across the treatment spectrum. Correlation plots demonstrate that higher σ_y promotes lateral redistribution of plastic strain and surface-constrained deformation. These geometric signatures are indicative of increasing dislocation restriction and grain boundary activity during annealing, as corroborated by grain size evolution and hardness trends. The study confirms that cross-sectional indentation analysis offers a robust, high-resolution approach for linking thermal history to subsurface deformation behaviour in Zn-based biodegradable alloys.

Keywords: *Zinc-Manganese alloys; Thermal annealing; Plastic deformation; Grain refinement; mechanical characterization.*



Paper ID: GOV03

STIMULI-RESPONSIVE NANOPOROUS ALUMINA CARRIER FOR MAGNETICALLY REGULATED RELEASE

Ao Wang[1,2], Shumin Yang[2], Jianjun[2], Muhamad Azizi Mat Yajid[1,3], Wan Fahmin Faiz Wan Ali[1,3,*]

[1]*Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor Bahru, Malaysia*

[2]*College of Physics and Electronic Engineering, Hebei Minzu Normal University, Chengde 067000, Hebei, China*

[3]*Materials Research Consultancy Group (MRCG), Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor Bahru, Malaysia*

**Corresponding Author: W.F.F Wan Ali, wan_fahmin@utm.my*

Abstract

Doxorubicin (DOX) is an effective chemotherapy drug, but its clinical use is hindered by systemic toxicity and dose-limited cardiotoxicity. To address these issues, we developed a composite drug delivery platform based on nanoporous anodic alumina (NAA) integrated with superparamagnetic Fe_3O_4 nanoparticles and sealed with a chitosan polymer gate. NAA provides a highly ordered porous structure for efficient DOX loading. The Fe_3O_4 magnetic nanoparticles (MNPs) impart responsiveness to external magnetic fields for on-demand release and the chitosan coating acts as a biocompatible gatekeeper to prevent premature drug leakage. We systematically characterized the system's structure, magnetic responsiveness, drug release kinetics, and in vitro performance. The composite exhibited high drug loading capacity and stability, and magnetic field stimulation markedly accelerated DOX release compared to passive diffusion, while the chitosan membrane effectively suppressed the initial burst release. In vitro cell studies further showed that applying a magnetic field enhanced the inhibition of cancer cell proliferation compared to the no-field condition. These results highlight the promise of the NAA–MNP–DOX nanosystem as a magnetically responsive drug delivery strategy for spatiotemporally controlled chemotherapy.

Keywords: *nanoporous anodic alumina; magnetic nanoparticles; controlled drug release*

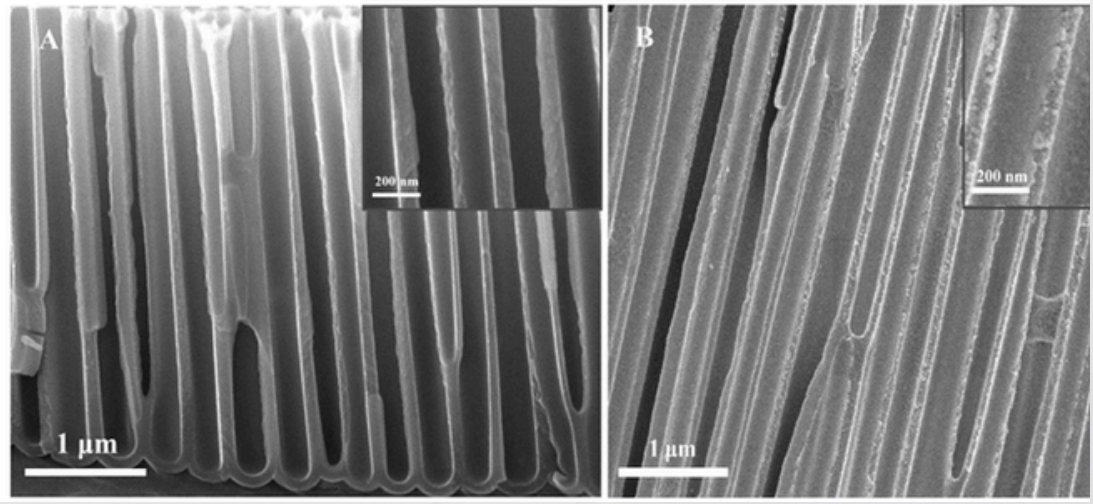


Figure 1 Porous anodic alumina before and after nanoparticles filling. (a) Cross-section of the porous anodic alumina as formed after anodization and pore-widening; (b) cross-section of the middle part of the porous oxide layer showing CA-MNPs-DOX inside the nanochannels

Paper ID: UTM03

EVALUATING THE EFFECT OF PRECIPITATED CALCIUM CARBONATE (PCC) MORPHOLOGIES ON PAPER COATING USING FESEM IMAGING

Siti Noorzidah Mohd Sabri, Rohaya Othman, Zawawi Mahim, and Emee Marina Salleh

Mineral Research Centre, Department of Mineral and Geoscience Malaysia, 31400 Ipoh, Perak.

**Corresponding Author: S.N. Mohd Sabri, snoorzidah@jmg.gov.my*

Abstract

This study investigates the effect of precipitated calcium carbonate (PCC) morphology on the microstructural characteristics of paper coatings. Different morphologies of PCC consist of micron-grained, nano-cubic, and broccoli-like were synthesized under controlled conditions and incorporated into paper coating formulations. Field emission scanning electron microscopy (FESEM) was performed to evaluate the surface topography, particle distribution, and packing behaviour of the coated substrates. The FESEM analysis revealed that nano-cubic PCC particles formed a highly uniform and densely packed coating layer, resulting in smoother surfaces with minimal voids. In contrast, coatings with micron-grain PCC exhibited moderate surface roughness and irregular particle alignment, while broccoli-like PCC led to porous and uneven coatings due to its complex, aggregated structure. Among the three morphologies, nano-cubic PCC demonstrated superior coating performance, offering enhanced surface smoothness and structural integrity. These findings highlight the critical role of PCC morphology in determining coating quality in order to optimize paper surface properties for high-end printing and packaging applications.

Keywords: *mineral, precipitated calcium carbonate, PCC, coatings, morphology*

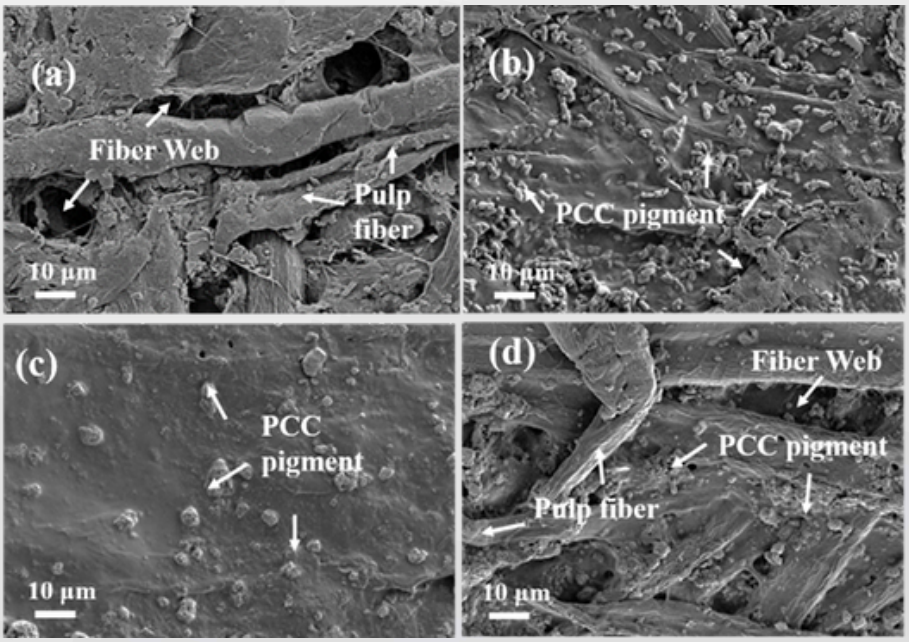
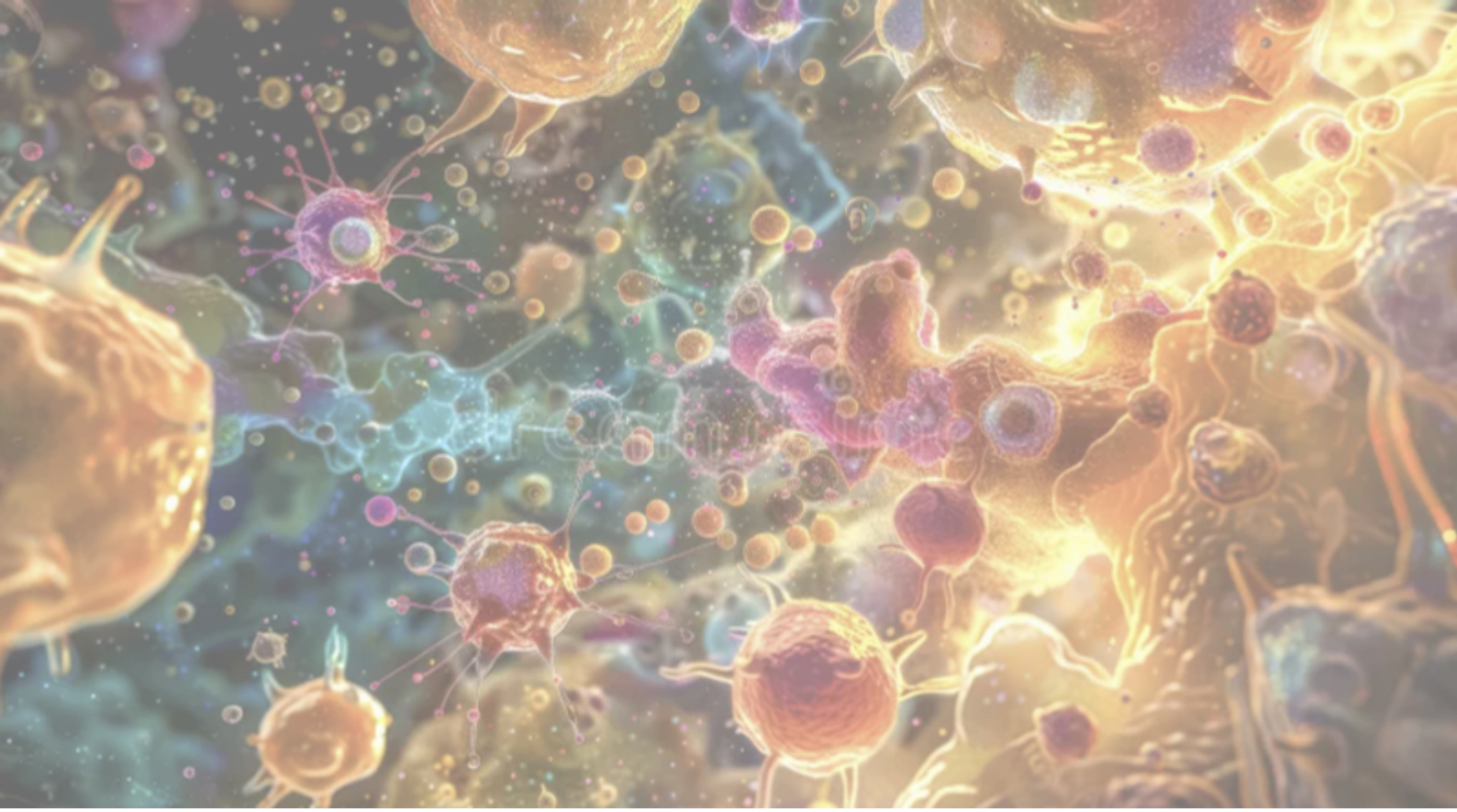


Figure 1: FESEM micrographs of coated paper with different PCC morphologies (a) blank paper, (b) micron-grained, (c) nano-cubic and (d) broccoli-like.



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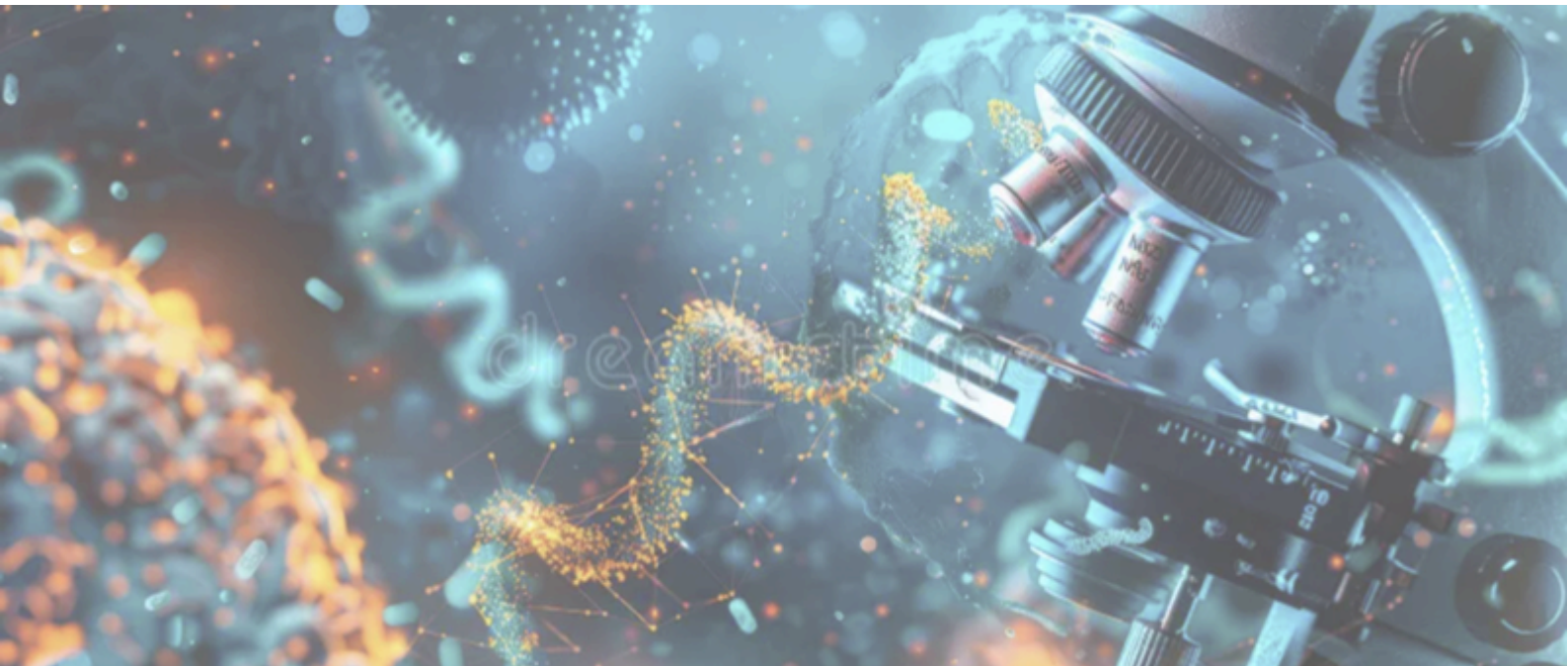

Paper ID: UKM01

FESEM-BASED MORPHOLOGICAL PROFILING OF ANIMAL HAIR AND SKIN FOR HALAL CERTIFICATION: A COMPARATIVE STUDY

Mohamad Hasnul Naim Abd Hamid, Nur Nasuha Zolkifli, Seri Zurina Abd Kayum, Siti Zuliana Dzulkifli

Makmal i-CRIM, Pusat Pengurusan Makmal Alami dan Fizikal (ALAF-UKM), Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor.

**Corresponding Author: N.N. Zolkifli, nunasuha@ukm.edu.my*

Abstract

Halal certification requires verifying animal-derived materials such as hair and skin, which are used in cosmetic, fashion, and construction industries. This study investigates the use of Field Emission Scanning Electron Microscopy (FESEM) to differentiate hair and skin from pig, horse, goat, and synthetic sources based on micromorphological features. Samples were prepared using standard protocols and analyzed with FESEM to observe cuticle patterns and surface textures. The results revealed distinct morphological traits for each species, with pig hair showing significantly different features, allowing clear identification. Synthetic hair also exhibited clearly non-biological structures. Compared to traditional methods, FESEM provides higher resolution, sensitivity, and non-destructive analysis, making it a powerful tool for halal material verification. This technique offers strong scientific and technical support to enhance transparency and reliability in halal certification processes across multiple industries.

Keywords: *halal, FESEM, skin, hair, profile*

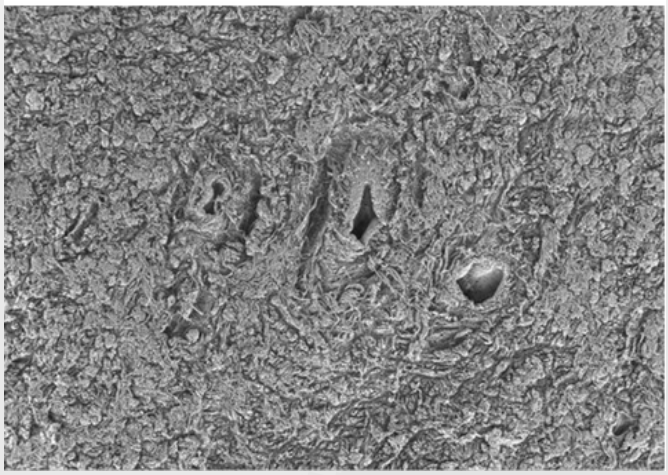

Figure 1: the skin of an animal, specifically a pig

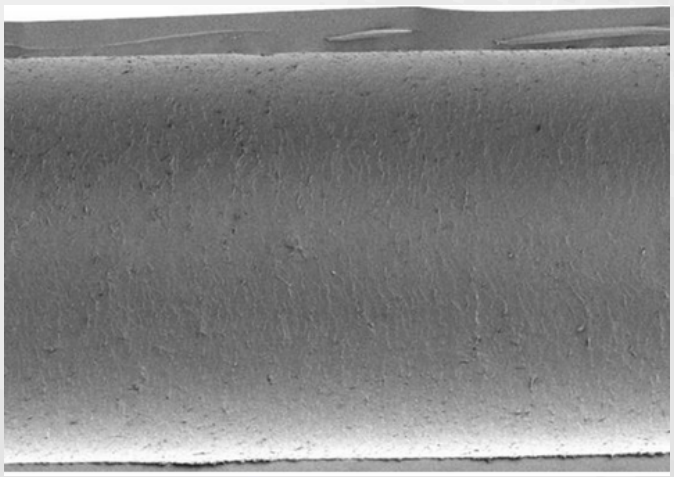

Figure 2: the hair of an animal, specifically a pig

Paper ID: UNIMAP01

ELUCIDATING THE ANTIFUNGAL MECHANISM AND PROPERTIES OF FUNGAL CHITOSAN–NANOCRYSTALLINE CELLULOSE COMPOSITES FOR FOOD PACKAGING APPLICATIONS

[1,2]Sam Sung Ting*, [1]Madah Hussain, [1]Noorulnajwa Diyana Yaacob, [3]Tan Lian See and [4,5]Tan Wai Kian

[1] Faculty of Chemical Engineering & Technology, Universiti Malaysia Perlis (UniMAP), Kompleks Pusat Pengajian Jejawi 3, 02600 Arau, Perlis, Malaysia

[2]Center of Excellence Geopolymer and Green Technology, Universiti Malaysia Perlis (UniMAP), 01000, P.O. Box 77, D/A Pejabat Pos Besar, Kangar, Perlis, Malaysia

[3]Department of Chemical Process Engineering, Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, 54100 Kuala Lumpur, Malaysia

[4]Institute of Liberal Arts and Sciences, Toyohashi University of Technology, Toyohashi, Aichi 441-8580, Japan

[5]Institute for Research on Next Generation Semiconductor and Sensing Science, Toyohashi University of Technology, 1-1, Hibarigaoka, Tempaku-cho, Toyohashi, Aichi, 441-8580 Japan

**Corresponding Author: S.T. Sam, stsam@unimap.edu.my*

Abstract

The exploration of fungal-derived chitosan as a sustainable alternative to crustacean-based sources offers significant advantages in biopolymer applications, particularly for food packaging. In this study, chitosan extracted from agaricus bisporus mushroom was reinforced with nanocrystalline cellulose (NCC) to form biocomposite films. The molecular weight of the extracted fungal chitosan were determined using viscometric, while the crystalline characteristics were investigated through X-ray diffraction (XRD). The morphological structure of the composite films was examined using field emission scanning electron microscopy (FESEM), revealing a dense and uniform microstructure with well-dispersed cellulose crystals within the chitosan matrix, suggesting strong interfacial compatibility. Antifungal assays conducted against Aspergillus flavus demonstrated significant inhibition zones, indicating synergistic antifungal performance arising from the electrostatic interactions between the NH_3^+ groups of chitosan and the negatively charged fungal membranes. Fourier transform infrared spectroscopy (FTIR) and thermal analysis further supported the existence of hydrogen bonding and improved thermal stability in the composite films. The composites with different NCC content was also subjected to tensile test. It was found that the tensile strength and elongation at break was in optimum at 4 wt% NCC content. The excellent mechanical properties and antifungal behavior in fungal chitosan/NCC composites has highlighted their potential as packaging material in prolonging the shelf life of food.

Keywords: *Antifungal mechanism, fungal chitosan, nanocrystalline cellulose, tensile properties, packaging materials.*

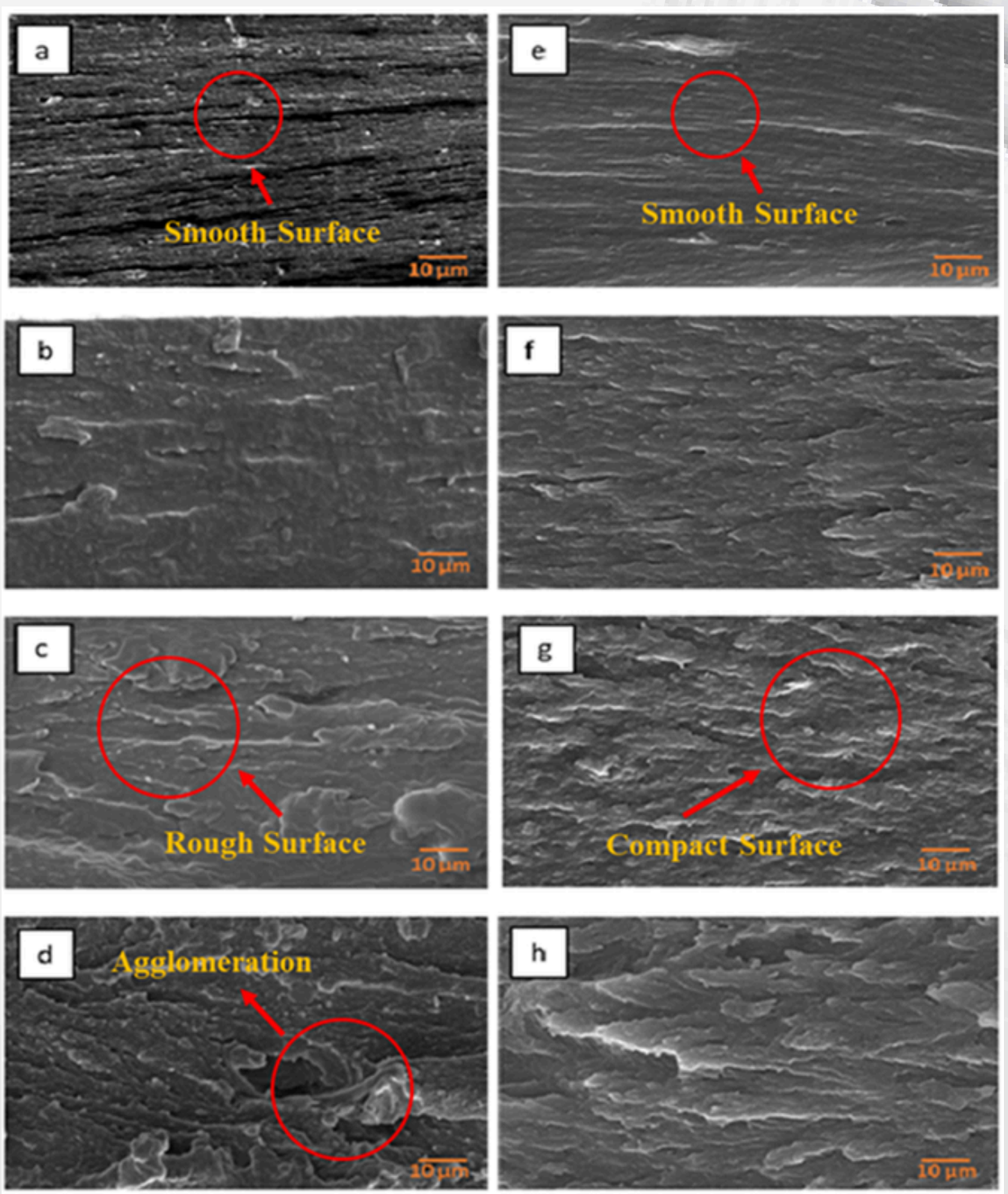

Figure 1: Tensile fracture surface of fungal chitosan/NCC composites with different NCC content

Paper ID: USM02

ENCAPSULATION OF LACTOBACILLUS PLANTARUM USING PINEAPPLE PEEL EXTRACT AND EVALUATION OF ITS PHYSICOCHEMICAL PROPERTIES

[1]Beauty Akter, [1]Rabeta Mohd Salleh*, [2]Mohamad Hafizi Abu Bakar, [3]Cheng Lai Hoong, [2]Husnul Azan Tajarudin

[1]Department of Community Health, Advanced Medical & Dental Institute, Universiti Sains Malaysia, Kepala Batas, Penang 13200, Malaysia.

[2]Bioprocess Technology, School of Industrial Technology, Universiti Sains Malaysia, Minden 11800, Penang, Malaysia.

[3]Food Technology Division, School of Industrial Technology, Universiti Sains Malaysia, Minden 11800, Penang, Malaysia.

**Corresponding Author: R. Mohd Salleh, rabeta@usm.my*

Abstract

Pineapple generates large amounts of peel rich in functional bioproducts and potential probiotics such as Meyerozyma caribbica. Encapsulation, particularly for sensitive probiotics like Lactobacillus plantarum, is an essential technique to enhance stability, protect against environmental stresses, and ensure effective delivery and functionality in food and nutraceutical applications. The objective of this study is to assess the potential of pineapple peel extract in enhancing the stability and functional properties of encapsulated L. plantarum or application in functional foods. In this study, L. plantarum was encapsulated using pineapple peel extract (PPE), inulin (IN), and gum arabic (GA) as wall materials, prepared in different combinations and processed through freeze-drying. The resulting microcapsules ere then evaluated for morphology, particle size distribution, water activity, color properties, and bulk density to assess their physicochemical characteristics. The encapsulated L. plantarum exhibited irregular but intact microstructures without visible cracks, confirming successful entrapment. Particle sizes ranged from 256.3–668.16 nm, influenced by the type of wall material, with PPE+GA producing smoother and more aggregated surfaces. Color properties varied significantly depending on wall materials. Bulk density was highest in PPE+GA microcapsules, suggesting improved storage stability and protective capability for probiotics. The encapsulation of L. plantarum using PPE and other wall materials showed distinct morphological and physicochemical properties, with PPE+GA producing smoother, more stable microcapsules and all formulations maintaining low water activity (0.15–0.33) favorable for stability and shelf life. These findings highlight PPE, alone or combined with GA, as a promising natural encapsulating agent that protects probiotics during processing.

Keywords: *Encapsulation, Lactobacillus plantarum, Pineapple peel extract, Physicochemical properties, Microcapsules*

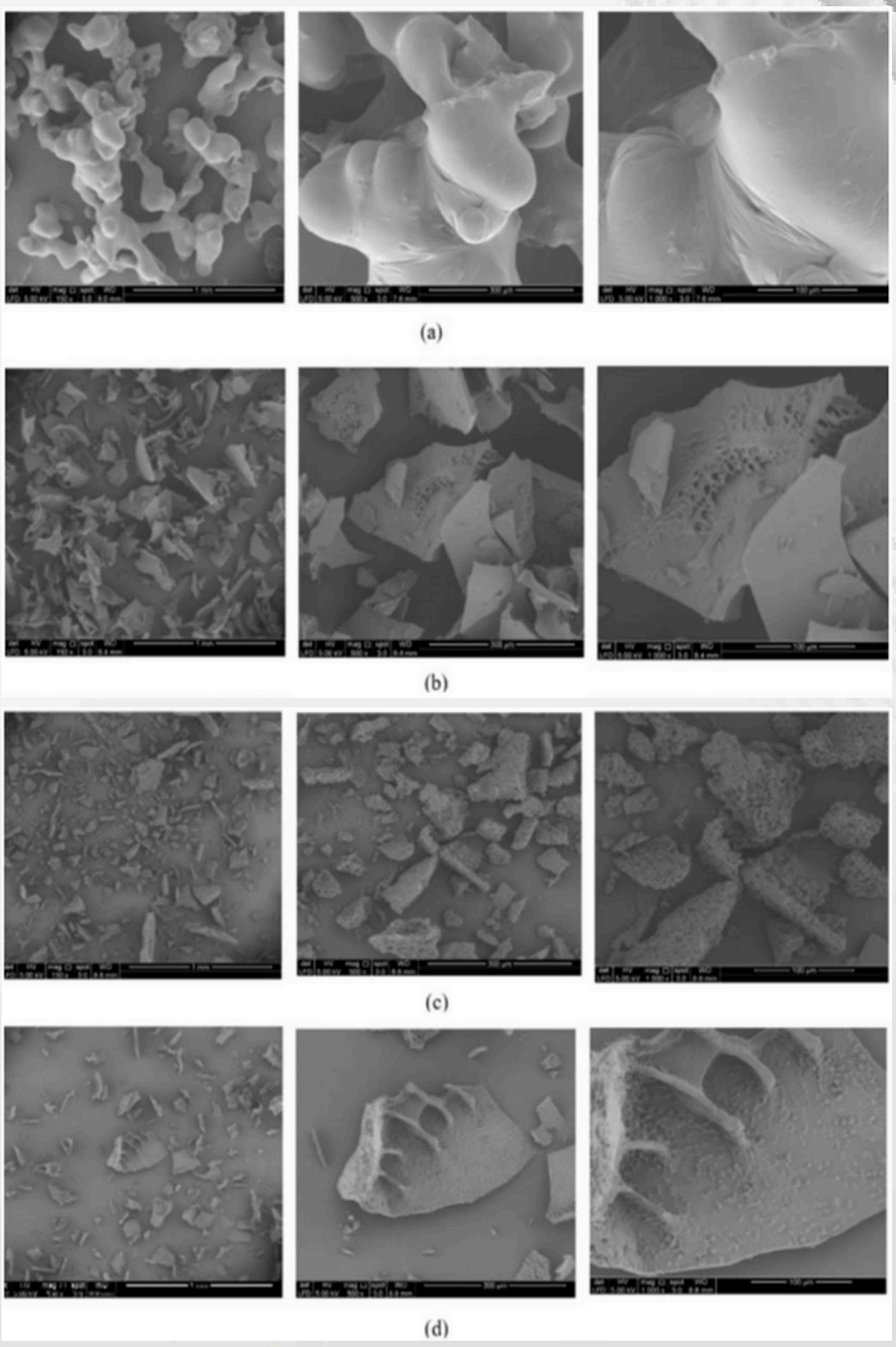

Figure 1: Micrograph of the encapsulated L. plantarum with different wall materials (a) PPE, (b) PPE+GA, (c) IN, and (d) IN+GA.

Paper ID: UTEM22

ENGINEERING BY NATURE: SCANNING ELECTRON MICROSCOPY-BASED STRUCTURAL ANALYSIS AND SURFACE WETTABILITY ASSESSMENT OF TROPICAL FOLIAGE FOR BIOMIMETIC APPLICATIONS

[1]Hans Ezechiel A/L Henry, [1] Aiman Roslizar*

[1] Faculty of Mechanical Technology and Engineering, Universiti Teknikal Malaysia Melaka, 76100 Durian Tunggal, Melaka.

**Corresponding Author: A Roslizar, aiman@utem.edu.my*

Abstract

Nature provides complex, highly optimized surface architectures for liquid-solid interaction, offering critical insights for advanced materials design. This study investigates the structure-function relationship governing water repellency in five species of Malaysian tropical foliage: Nelumbo nucifera (Lotus), Pandanus amaryllifolius (Pandan), Caladium bicolor (Caladium), Musa acuminata (Banana), and Saccharum officinarum (Sugarcane). The primary objective is to quantify wettability and correlate it with the surface's morphological adaptations to inform biomimetic engineering. The methodology combines contact angle goniometry to precisely measure droplet behavior with high-resolution Scanning Electron Microscopy (SEM) for detailed characterization of micro- and nano-scale topography. Wettability analysis confirmed strong hydrophobic properties ($\theta > 90°$) across all species. The Nelumbo nucifera leaf demonstrated superior performance, achieving the highest contact angle of approximately 113.4° and confirming the 'Lotus Effect.' SEM images revealed this hydrophobicity is driven by a hierarchical structure of micro-papillae covered in nanofibrous wax, which minimizes water contact area and traps air. Other leaves, such as Caladium (≈ 108.3°) and Pandanus (≈ 105.9°), also showed significant hydrophobicity correlated with their unique epidermal cell textures. These quantitative and morphological results establish blueprints from nature, demonstrating how tailored surface roughness is key to wetting property management. The findings offer valuable parameters for developing next-generation biomimetic surfaces, including robust self-cleaning coatings, anti-fouling materials, and efficient water-harvesting technologies.

Keywords: *Biomimetics, Scanning Electron Microscopy (SEM), Contact Angle, Hydrophobicity, Tropical Foliage.*

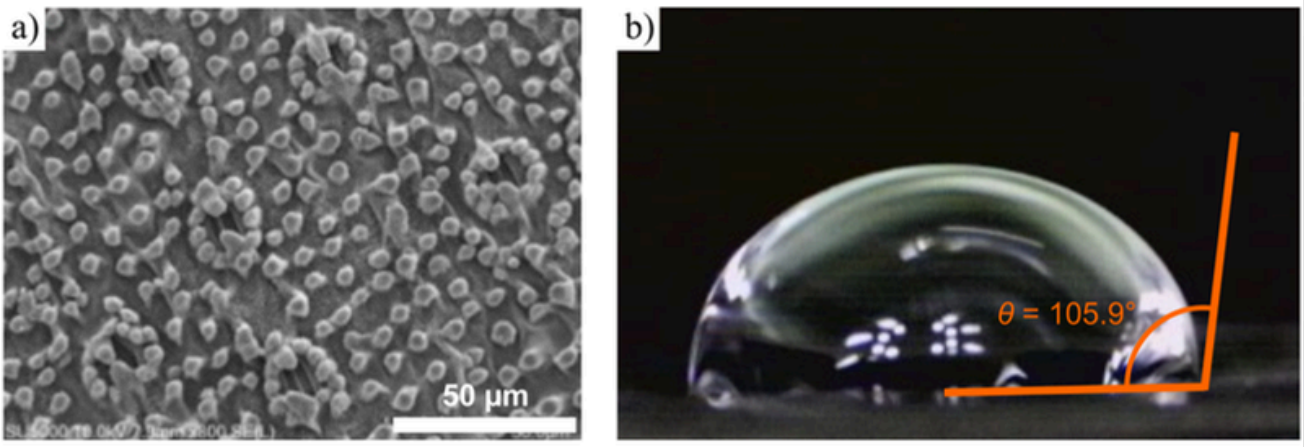

Figure 1: Morphology of a Pandanus amaryllifolius leaf and the resulting water contact angle.

Paper ID: UTHM07

FABRICATION OF WOUND HEALING MATERIALS FROM FISH GELATIN AND CHITOSAN

[1]Noor Athirah Aida Noor Rizan @ Noor Jehan, [1,2]Maizlinda Izwana Idris*

[1]Department of Mechanical & Manufacturing Engineering, Faculty of Mechanical & Manufacturing Engineering, University Tun Hussein Onn Malaysia, Batu Pahat, 86400 Parit Raja, Johor, Malaysia

[2]Centre of Bioactive Materials (BioMa) centre of Research, Faculty of Mechanical and Manufacturing Engineering, University Tun Hussien Onn Malaysia, Batu Pahat, 86400 Parit Raja, Johor, Malaysia

**Corresponding Author: M.I. Idris, izwana@uthm.edu.my*

Abstract

This work focuses on the fabrication of wound healing materials from natural fish gelatin and a bio-based polymer. The objective was to develop a biocompatible film with suitable physicochemical properties to support wound recovery. Fish gelatin was selected for its low immunogenicity and film-forming ability, while chitosan improved mechanical strength and moisture retention. The fish gelatin/chitosan biofilms were prepared using the solution casting method with different chitosan to gelatin ratios (100:0 95:5, 85:15, and 80:20) and crosslinked with 0.3 mL glutaraldehyde to enhance structural stability without inducing brittleness. The physicochemical properties of fish gelatin/chitosan film were observed, and among the formulations, the 95:5 ratio with 17-hour gelatin extraction (FC-17H) showed the most promising results, whereas microscopy analysis revealed biofilms had smooth, flat, and crack-free surfaces. EDX analysis confirmed that carbon (C) and oxygen (O) as the main elements. The FTIR analysis indicated strong molecular interactions between chitosan and gelatin through O–H and N–H stretching bands. Surface roughness analysis by AFM showed FC-17H 95:5 had the roughness surface (Ra = 2.827 nm, Rq = 5.544 nm), enhancing adhesiveness to the wound site. While contact angle measurement of FC-17H 95:5 showed hydrophilicity properties which are less than 90 degrees. In addition, the thickness evaluation of film FC-17H 95:5 recorded a consistent and uniform film at 0.067 ± 0.001 mm, ideal for moderate wound applications. In conclusion, the fish gelatin/chitosan biofilms fabrication approach offers an ethical and sustainable alternative to conventional wound dressing materials, aligning with both medical and cultural requirements.

Keywords: *Fish gelatin, Chitosan, Biofilm, Wound healing, Wound dressing*

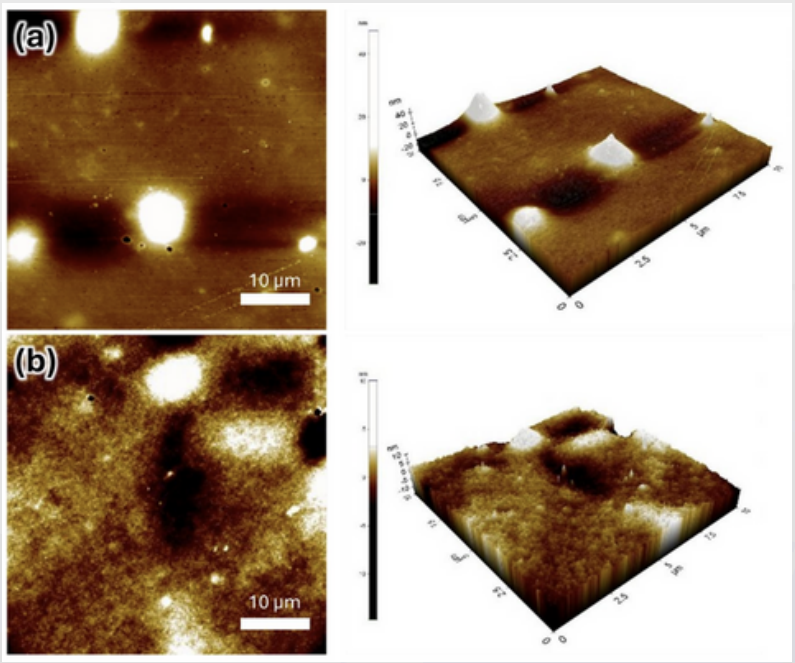

Figure 1: 2D and 3D AFM Image of Sample (a) Chitosan Film (b) Fish Gelatin/Chitosan Film (FC-17H 95:5)

Paper ID: LUCM01

THE TRANSLATIONAL IMPERATIVE: MICROSCOPIC AND SPECTROSCOPIC BLUEPRINT OF OPTIMIZED FUCOSYLATED CHONDROITIN SULFATE SCAFFOLDS FOR CRANIOMAXILLOFACIAL REGENERATION

Farid Bin Che Ghazali, Rasheed Abu Salam

Faculty of Dentistry, Lincoln University College, Malaysia. Lincoln University College, Malaysia. Wisma Lincoln, No. 12-18, Jalan SS 6/12, 47301 Petaling Jaya, Selangor Darul Ehsan, Malaysia

**Corresponding Author: F. Che Ghazali, drfaridghazali@gmail.com*

Abstract

Sulfated polysaccharides (SPs), particularly Fucosylated Chondroitin Sulfates (FucCS) derived from marine sources like the local geochemical Malaysian sea cucumber, Stichopus vastus, that possess unique structural features that underpin their proven biological activities. This manuscript constitutes a translational synthesis effort that leverages the established body of work by the corresponding author on the bioactivity of marine Sulfated Polysaccharides (SPs). Specifically, we focus on Fucosylated Chondroitin Sulfates (FucCS) derived from the Malaysian sea cucumber, Stichopus vastus, which possess unique structural features underpinning proven biological activities such as wound healing and anti-inflammatory effects. Moving beyond initial biological validation, this study investigates the physicochemical and ultrastructural characteristics of low-molecular-weight FucCS {LMW-FucCS} derived from a proprietary extract (My. StichoGAG). The core objective is to correlate the molecular optimization of these {LMW-FucCS}—focusing on the degree and pattern of sulfation—with the resultant nanostructure and morphology of fabricated hydrogel scaffolds, a critical translational step for regenerative applications in craniomaxillofacial surgery. Characterization utilizes advanced microscopy techniques: Scanning Electron Microscopy (SEM) for macroscopic scaffold porosity and surface texture, Transmission Electron Microscopy (TEM) for nanometer-scale fibril visualization, and Atomic Force Microscopy (AFM) to quantify surface roughness and elasticity. FTIR and NMR spectroscopy were employed to confirm the precise sulfation and fucosylation patterns. The microscopic findings reveal that optimized LMW-FucCS formulations yield scaffolds with highly interconnected, uniform porous structures (average pore size 50 - 150 µm) and a nanoscale fibrous network that successfully mimics the native extracellular matrix (ECM). This robust structural integrity, confirmed by advanced microscopy, is crucial for enhancing cell migration, nutrient transport, and ultimately, superior performance in advanced craniomaxillofacial tissue regeneration. Thus, the research provides a crucial microscopic blueprint for the translational development of next-generation marine-derived biomaterials.

Keywords: *Fucosylated Chondroitin Sulfate; Stichopus vastus; Regenerative Biomaterials; Scanning Electron Microscopy (SEM); Nanostructure; Sulfated Polysaccharides; Tissue Engineering.*

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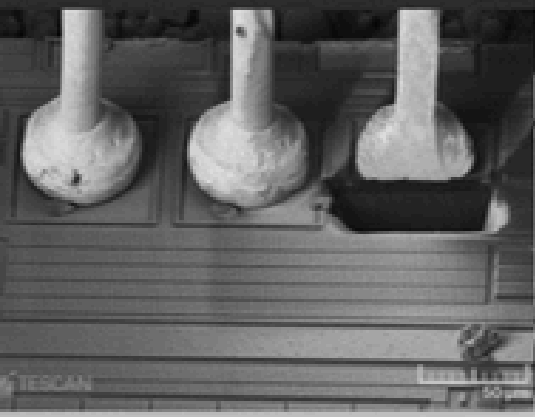
IMAGING

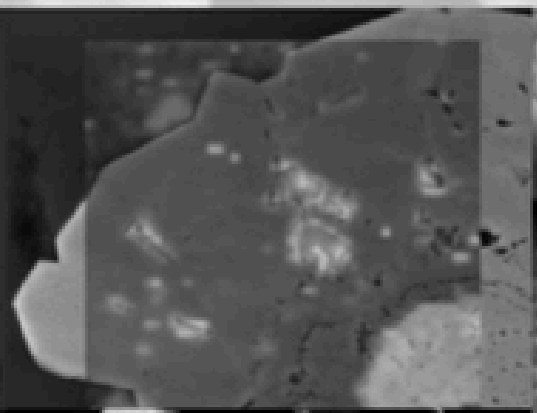
Head of a mole

Cross-section of bond pad

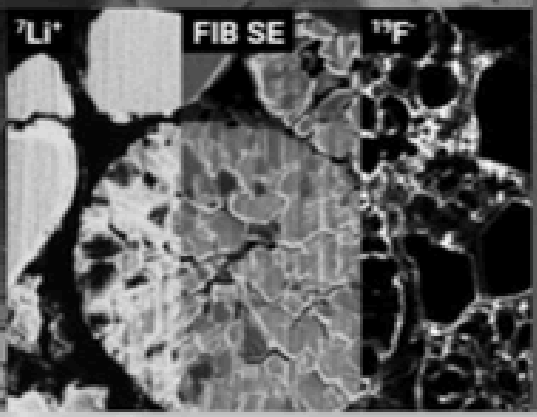


ANALYTICAL

Tescan-Rise: Raman

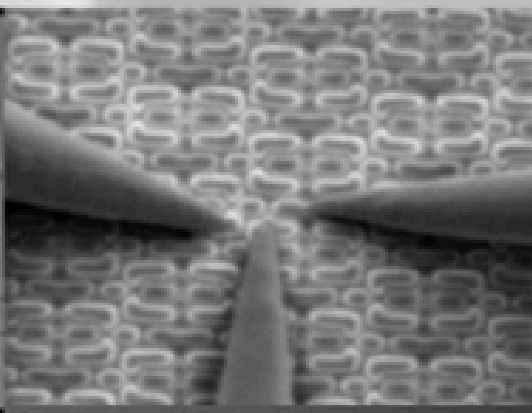


TOF-SIMS:
Lithium-ion Battery

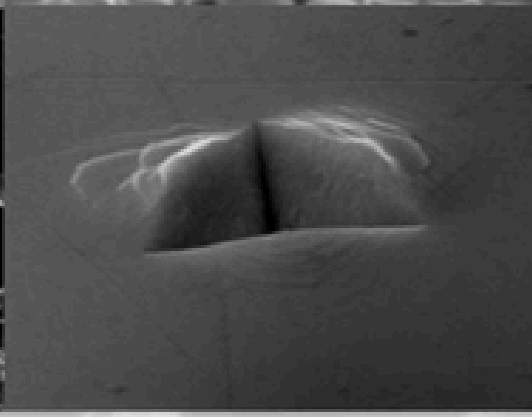


TESTING

Nano-Probing

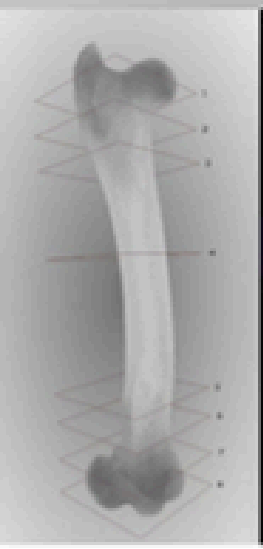


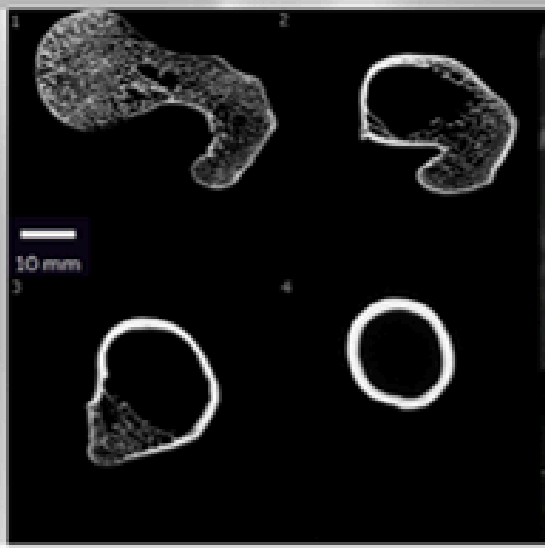
Nano-Indentation



Micro-CT

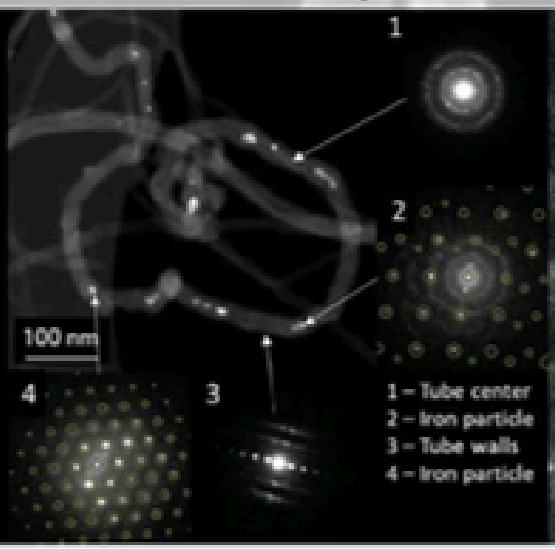
Cross-section of femur bone

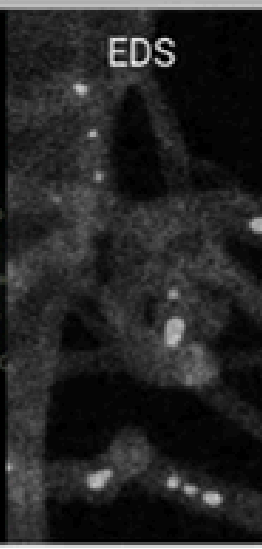




4D-STEM

CNT encapsulated Iron NPs





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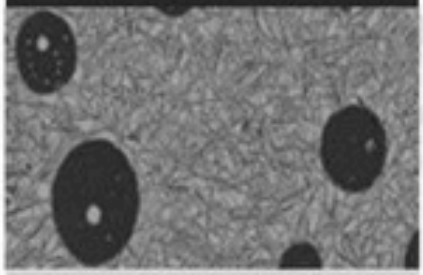

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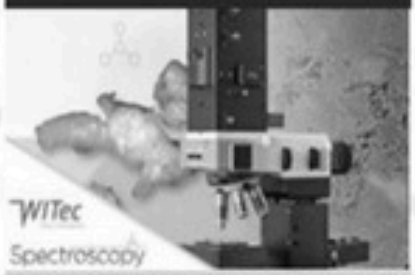

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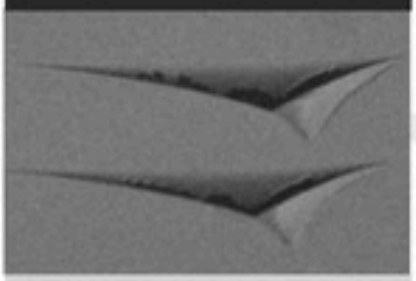

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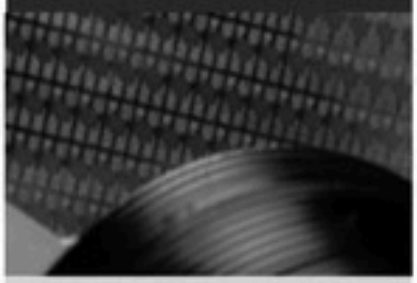

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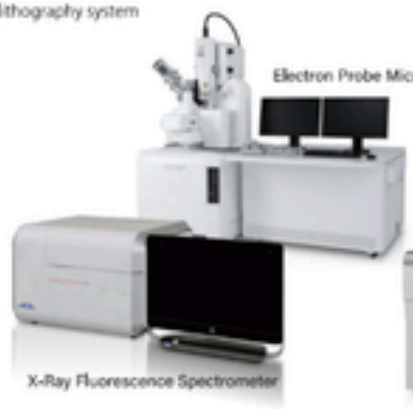

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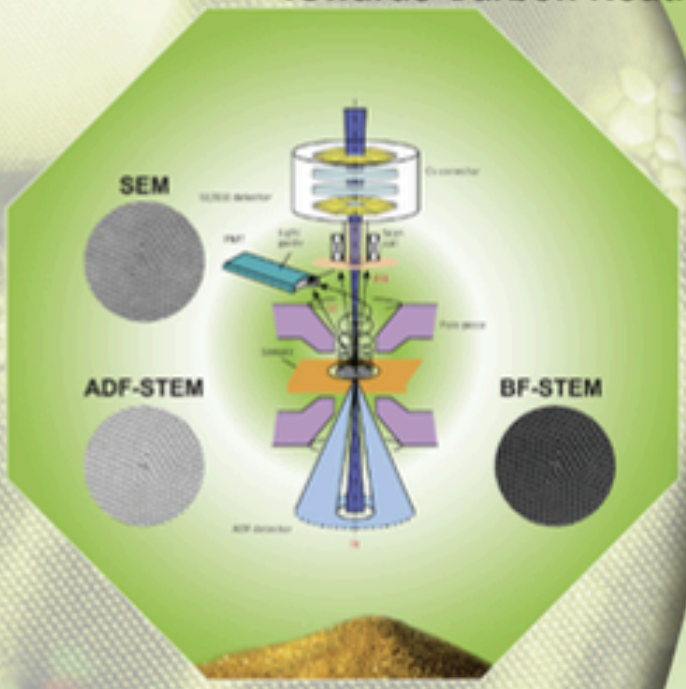

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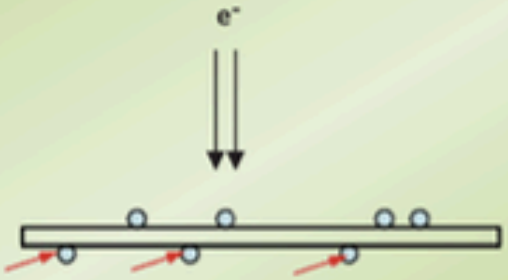
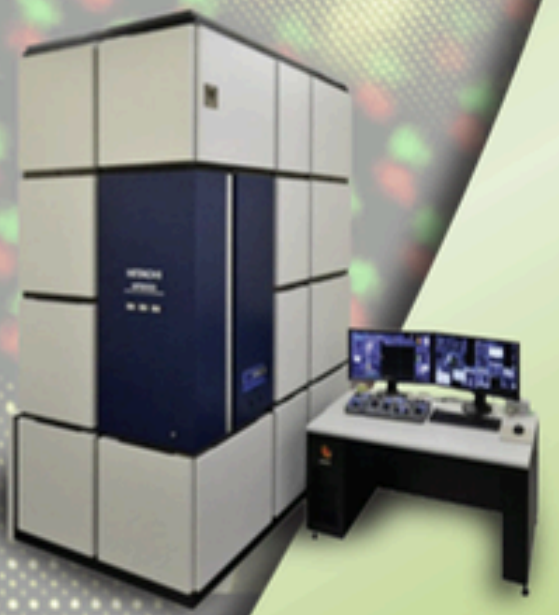
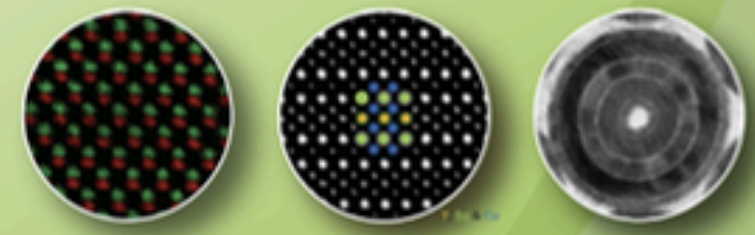




Simultaneous Cs-corrected SEM & STEM imaging

ADF-STEM | ABF-STEM | SEM

Specimen: Au nanoparticle



Ga and As atomic column EDX mapping | ADF-STEM imaging of superconductor YBCO ($YBa_2Cu_3O_7$) | Atomic lattice layer structure Of DRAM capacitor

(SEM) | (BF-STEM) | (ADF-STEM)

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