

INSTITUTE OF NANOSCIENCE AND NANOTECHNOLOGY

# NANOSCOPE

A scanning electron micrograph (SEM) showing several vertical, tapered nanowires or nanorods. The structures are light gray against a darker background, with some showing internal branching or surface texture. The image is framed by a large, stylized circular graphic with orange and red segments.

20  
22



**UPM**  
UNIVERSITI PUTRA MALAYSIA  
BERILMU BERBAKTI





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Image obtained using Scanning  
Electron Microscope (SEM)  
Sample : Graphene Oxide

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NanoScope (ISSN 2976-2545) is published yearly  
by the Institute of Nanoscience and Nanotechnology,  
University Putra Malaysia, 43400 UPM Serdang,  
Malaysia

@Universiti Putra Malaysia 2023

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# ION2 ECOSYSTEMS



Postgraduates



Community Engagement



University-Industry Linkages



Research in Nanotechnology & Advanced Materials



Testing and Services



# DIRECTOR'S FOREWORD

Bismillahirrahmanirrahim. It is my sincere pleasure to welcome you to NanoScope2022, our 9<sup>th</sup> edition of the annual magazine.

2022 was a year of continuing our mission to be focused on the growth of wealth creation, nation-building and universal human development through high-impact research in nanotechnology and advanced materials. To align with our mission, we held an Innovation Day to create rooms for opportunities and collaboration for our researchers and industries to elevate nanotechnology products from the laboratory to the market. We currently have organic conductive pastes and Havast™, a photosynthesis enhancer, in the market. I am looking forward to seeing more of our products in the market soon.

Besides embarking on the new journey of commercialisation, our institute continues our knowledge dissemination practices, such as holding workshops, seminars, and conferences. The 6<sup>th</sup> iSAMN was successfully commemorated online via Zoom on 7<sup>th</sup>-8<sup>th</sup> December 2022, attended by participants worldwide.

Securing research funding is mandatory for the institute to grow in research and innovation businesses. However, sustaining a total high amount of research funding is difficult, especially nowadays. Therefore, we have to strategize our grant proposals to meet public grants providers' requisites and funders of international grants in the next year to achieve our vision. Similar to the number of CIJ publications, which is also challenging to perpetuate, and needs to leverage the existing findings for review-type articles in the future.

Nevertheless, I am heartened to note the achievements of ION2 students and researchers in their respective fields. They are the backbone of ION2's success. We witnessed their hard work in pursuing dreams in the research community. Alhamdulillah, they have been recognised and awarded.

I would like to thank everyone, especially our research partners, industrial collaborators, and supportive community. I would also like to thank our valued researchers, support staff and postgraduate students for standing firm and embracing any difficulties and turning them into opportunities. Your dedication has led our institute to what it has become today.



*Prof. Dr. Mohd Nizar Hamidon*



# OVERVIEW

The Institute of Nanoscience and Nanotechnology (ION2) is one of the research institutes in UPM established in November 1999. ION2 develops research laboratories in the field of nanotechnology and advanced materials focusing on the niche areas of nano-scale green synthesis and applications. We train future research leaders as well as share research findings, expertise, and facilities with research and industry communities around the world. Apart from R&D, we also carry out other key activities such as training future research leaders, sharing research findings and expertise, and networking programs with the industries and the communities.

We also offer testing and calibration services, whereby two of our laboratories are accredited with MS ISO/IEC 17025 by the Department of Standards Malaysia. It shows our commitment to providing cutting-edge equipment to help our researchers conduct research of the highest standard.

## MISSION

To contribute significantly towards wealth creation, nation-building, and universal human development through high-impact research in nanotechnology and advanced materials.

## VISION

To become a research institute of international repute in the field of nanotechnology and advanced materials.

## GOALS

- To empower the institute as a premier center of excellence by providing the best research infrastructures.
- To elevate achievements in research and innovation to international levels.
- To produce knowledgeable and competitive graduates.
- To strengthen the involvement of industry and community to wealth creation and sharing of knowledge.

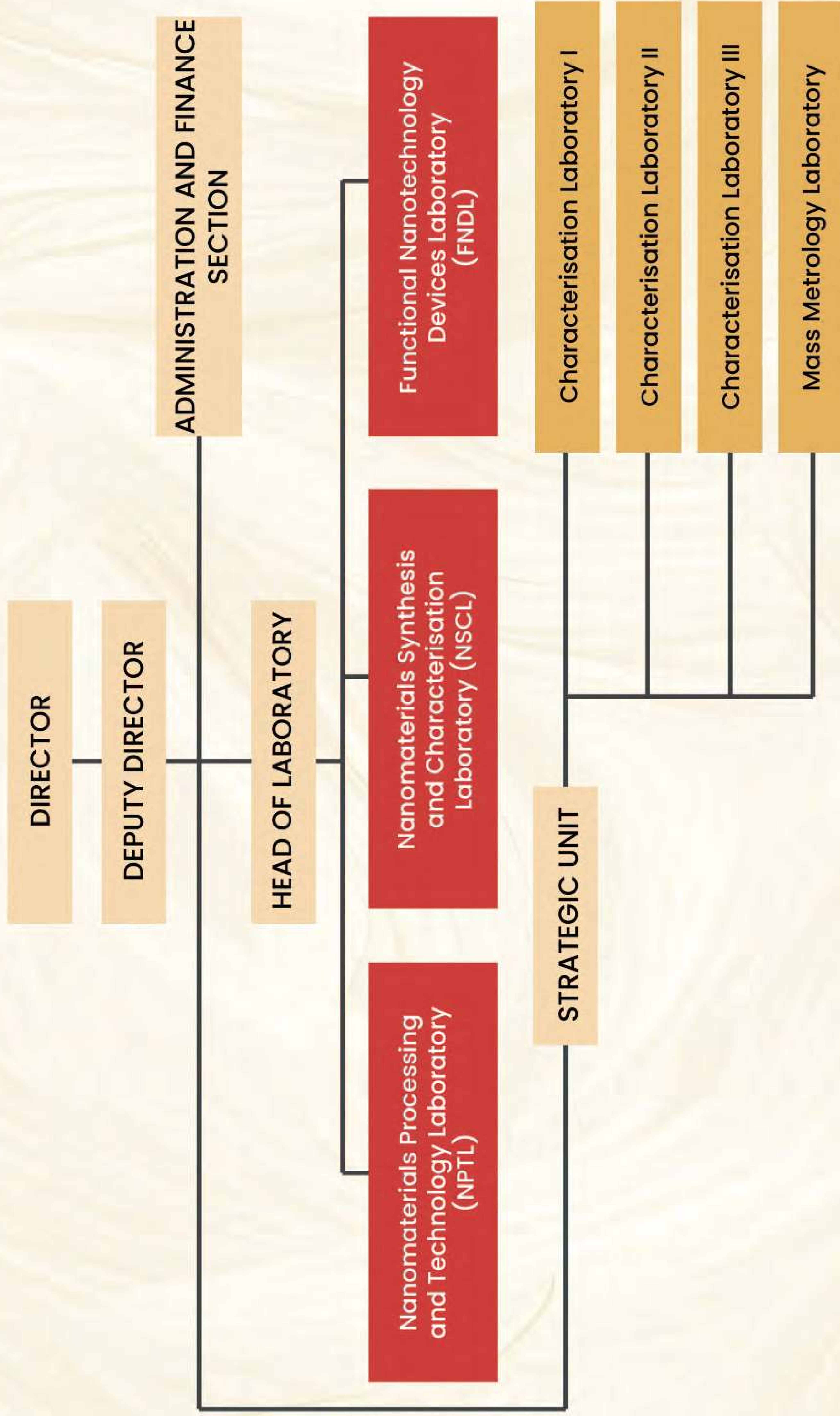
## ION2 FUN FACTS 2022

- Supported by 10 Professors (Including associate researchers)
- Over 40 outstanding researchers
- Secured RM200,995.00 research grants
- Engaged over 14 active MOU/MOA to date
- Published 163 Scopus-indexed Journals including 116 of Q1 & Q2 journals, 1 book and 10 book chapters
- Produced 13 Masters and PhD graduates
- Equipped with high-end facilities worth RM6.8 million



# ORGANISATION CHART

## INSTITUTE OF NANOSCIENCE AND NANOTECHNOLOGY (ION2)





# TOP MANAGEMENT



**PROF. DR. MOHD NIZAR HAMIDON**  
*Director*



**PROF. DR. SURAYA ABDUL RASHID**  
*Deputy Director*



**ASSOC. PROF. DR. CHE AZURHANIM  
CHE ABDULLAH**  
*Head*  
*Nanomaterials Synthesis and  
Characterisation Laboratory (NSCL)*



**ASSOC. PROF. IR. DR. SITI HAJAR  
OTHMAN**  
*Head*  
*Nanomaterials Processing and  
Technology Laboratory (NPTL)*



**ASSOC. PROF. DR. JAAFAR ABDULLAH**  
*Head*  
*Functional Nanotechnology Devices  
Laboratory (FNDL)*



**MUSTAPHA KAMAL TAHIR**  
*Senior Assistant Registrar  
(until Aug. 2022)  
Administration Office*



**ROSIHA ABDUL RAZAK**  
*Senior Assistant Registrar  
Administration Office  
(since Sept. 2022)*



**MD. ALI RANI**  
*Head  
Strategic Unit*



# ADMINISTRATION OFFICE

## ADMINISTRATION AND FINANCE

### Senior Assistant Registrar

Mustapha Kamal Tahir (*until Aug. 2022*)

Rosiha Abdul Razak (*since Sept. 2022*)

### Secretary

Khariza Abdul Wahab

(*Director*)

### Senior Administrative Assistants

Zamzurina Abdul Wahab

(*Management & Human Resources*)

Noor Linda Hassan

(*Laboratory Management*)

### Administrative Assistants

Mohamad Yunus Mohamad Syed

(*Financial- Research*)

Norliyana Mahat

(*Financial- Management*)

### Operation Assistant

Muhammad Fikrul Hasani Che Musa

### Driver

Nor Azli Sulaiman

## RESEARCH & POSTGRADUATE MANAGEMENT

### Executive Officer

Haizum Hanim Ab Halim (*Mar. - Dec. 2022*)

Siti Nur Lidiya Sharudin (*since Dec. 2022*)

### Administrative Assistants

Mohd Eri Mohd Noor

(*Research Management*)

Rokiah Deraman

(*Postgraduate Management*)

## DEVELOPMENT & FACILITIES

### Assistant Engineer

Ab Haffiz Ab Jalil





# STRATEGIC UNIT

**Head**

Md. Ali Rani

**Science Officers**

ChM. Sarinawani Abdul Ghani  
*Characterisation Laboratory*

Nurnazeera Zulkefli  
*Characterisation Laboratory II*

Roslina Abdul Rashid  
*Characterisation Laboratory III*

Zamzuri Zabidin  
*Mass Metrology Laboratory*

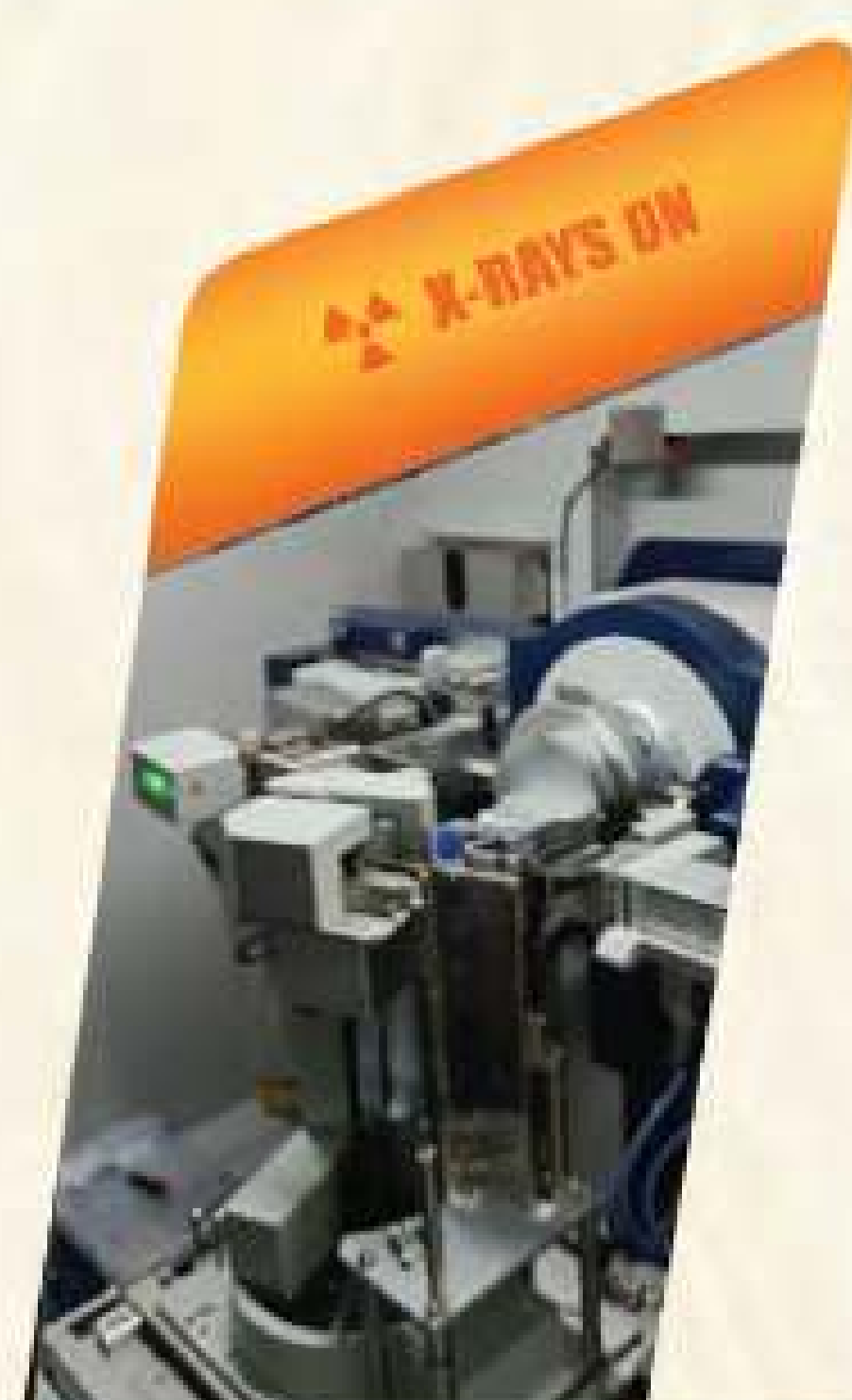
**Assistant Engineers**

Mohd Kadri Masaud  
*Characterisation Laboratory*  
*Characterisation Laboratory III*

Noor Lina Shamsuddin  
*Characterisation Laboratory II*  
*Mass Metrology Laboratory*

**Assistant Science Officer**

Nurshahida S Saleh  
*Centralised Preparation Laboratory*





# RESEARCH ACHIEVEMENTS

## Research Grants 2022

Research funding for the year was relatively lower at RM200,995.00 compared with RM1.4 million in 2021, mainly due to a decrease in public research grant acquisition. However, despite the steep fall, international funds showed a substantial increase by eight folds from RM15,184 in 2021 to RM135,995 in 2022, indicating a research acknowledgement at the international level. The sources of the international funds were the Organisation for the Prohibition of Chemical Weapons (OPCW) fund amounting to EUR 25,000 (RM122,675), and the Kurita Water and Environment Foundation (KWEF) Grant amounting to JPY 400,000 (RM13,320). The other research grant was funded by UPM, namely the Putra Grant (RM65,000). These funding sources were obtained to finance four projects led by ION2 researchers.

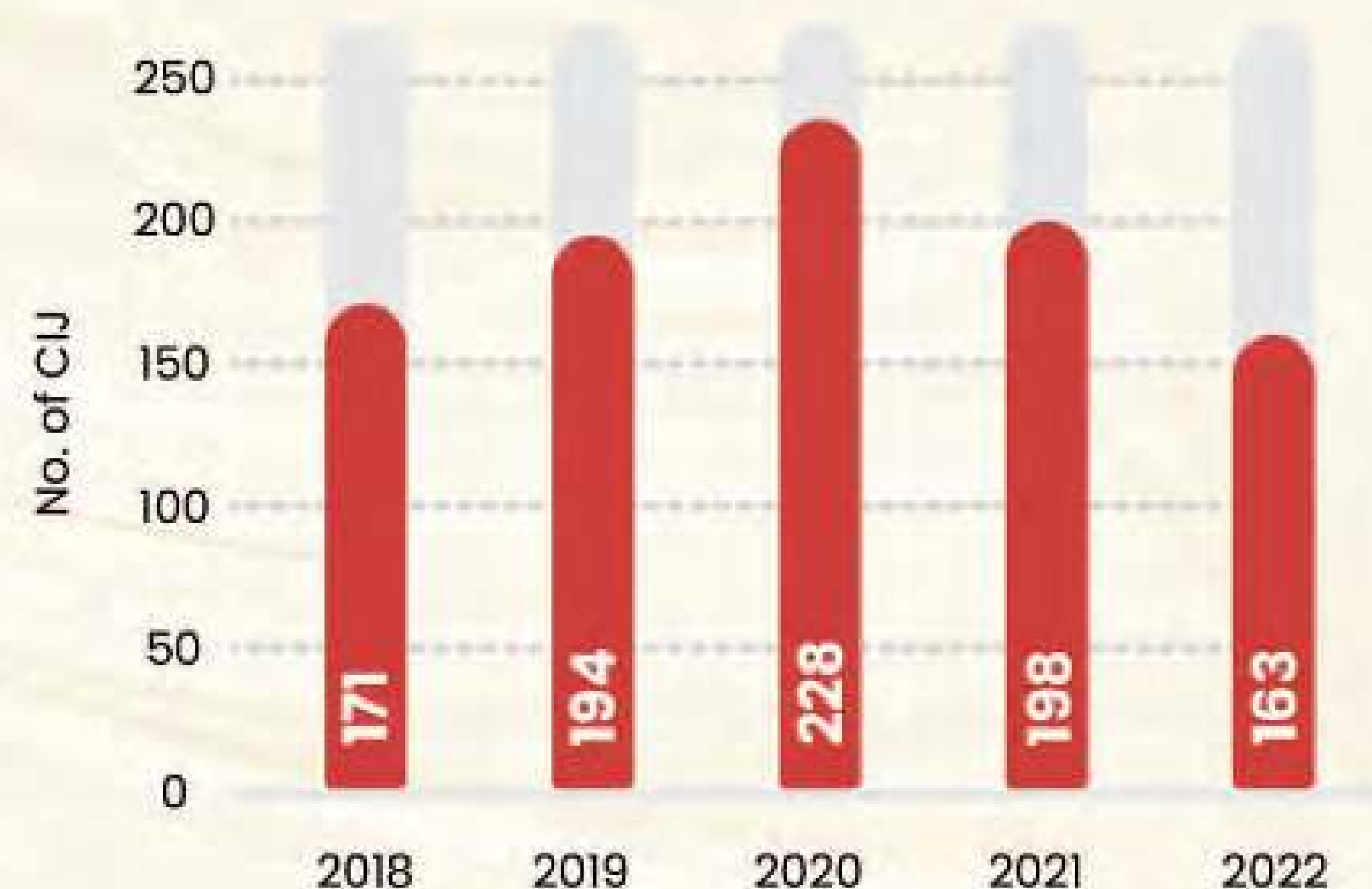
## Publications 2022

ION2 has published 163 journal articles indexed in Scopus, with 116 published in Q1 and Q2 journals, accounting for 71.2% of the total published articles. Additionally, 11 articles were published in the Top 10% Journals. ION2 Fellow researcher, Dr. Umer Rashid, has successfully published a research book on Renewable and Alternative Energy Resources (Elsevier). Furthermore, ION2 researchers have contributed actively to publishing book chapters, with ten publications recorded in research books.

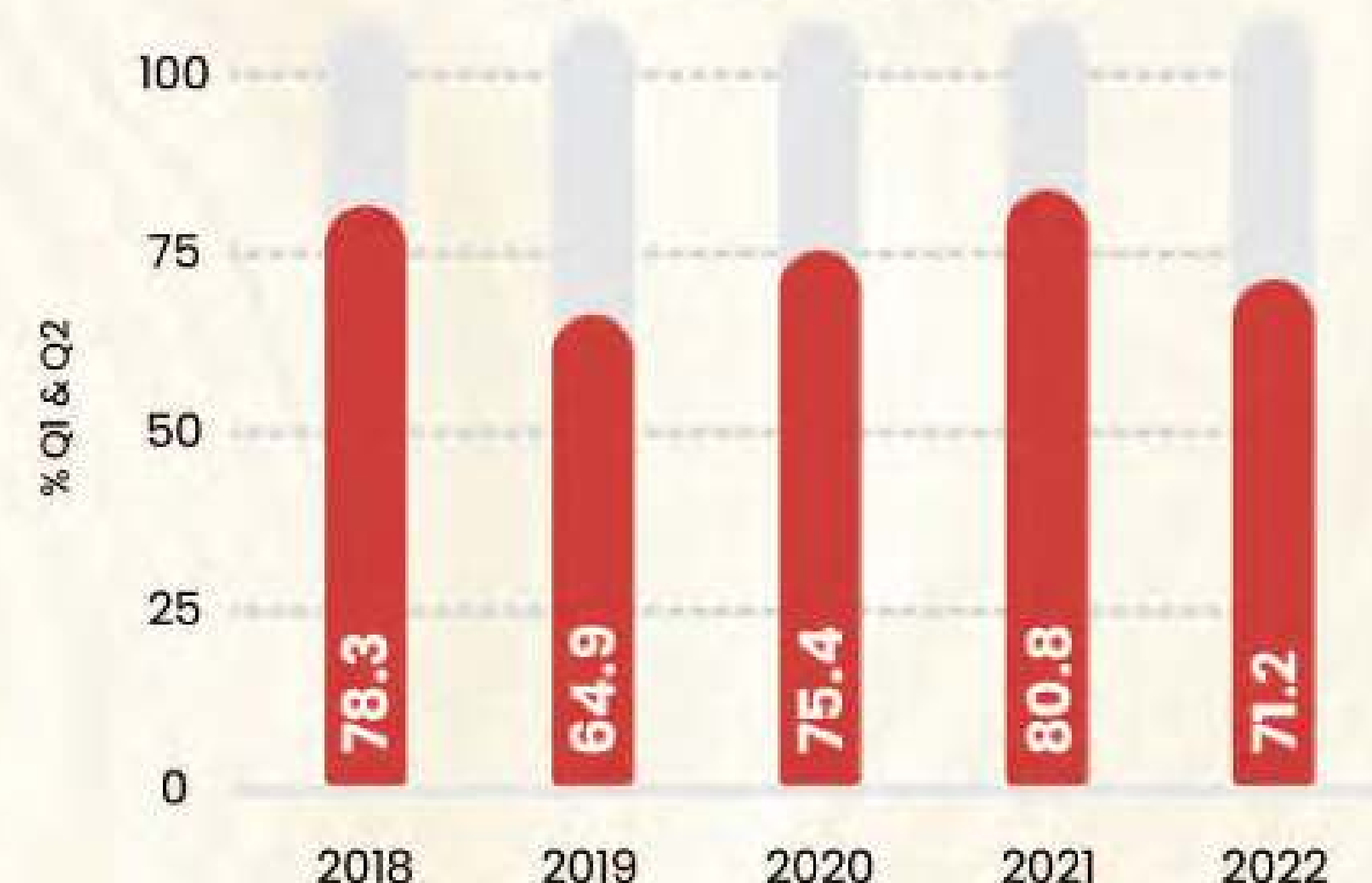
Key Performance Index (KPI)	Achievements
Publications in CIJ	163
Publications in Q1 & Q2 Journals	116 (71.2%)
Publications in Top 10% Journals	11
Research Books	1
Chapter in Research Books	10
Other Publications	25

\*CIJ = citation index journal

Publications in Citation Indexed Journals (CIJ)  
from 2018 to 2022



Percentage of Publications in Q1 and Q2  
Journals from 2018 to 2022



# AWARDS

## ION2 PhD Graduate Awarded Gold Medal by Malaysian Vaccines and Pharmaceuticals

An ION2 PhD graduate, Dr. Farhatun Najat Maluin received the Gold Medal of Doctor of Philosophy Malaysian Vaccines and Pharmaceuticals in conjunction with the 44<sup>th</sup> UPM Convocation Ceremony 2022. This award serves as a recognition of Dr. Farhatun's dedication and hard work in the field of nanotechnology and its applications in agriculture.





Dr. Farhatun was supervised by Prof. Dr. Mohd Zobir Hussein, an ION2 research fellow. She has successfully completed her studies entitled "Chitosan-Based Agronanofungicide Formulations as Potent Antifungal Agents for Ganoderma Disease Management of Palm Oil".

Apart from Farhatun, a total of nine PhD graduates and seven Masters graduates (class of 2020) also received their degrees in the convocation ceremony which took place from 8<sup>th</sup> to 13<sup>th</sup> January 2022.

### **Assoc. Prof. Dr. Che Azuranim Bagged Three Medals in CIEE 2022**

The Head of NSCL, Assoc. Prof. Dr. Che Azuranim Che Abdullah and her research team won three medals at the Cocoa Invention, Innovation & Exhibition (CIEE) 2022. The exhibition was held from 21<sup>st</sup> to 24<sup>th</sup> July 2022, at the Cocoa Biotechnology Research Center in Telipok, Sabah.

Dr. Che Azuranim collaborated with her PhD student, Emmellie Laura Albert, on a project that won a Gold medal. The project, "Biogenic Synthesis and Characterisation of Reduced Graphene Oxide Utilizing Cocoa Waste", showcased the potential of utilizing cocoa waste to synthesize graphene oxide.



Meanwhile, Puteri Hazeera, won a Silver medal for her project entitled "Green Synthesis of Gold Nanoparticles from Cocoa Waste for Potential Colorimetric-based Pesticide Identification". Ashreen Norman, won a Bronze medal for her project entitled "Cocoa Shells as Precursors for Luminescent Nanoparticles in Smart Packaging for Food". Congratulations to all the NSCL team.

### **Showcasing Innovation: Putra Cipta Press Conference Highlights Revolutionary Technology by ION2 Research Officer**

A Putra Cipta press conference was held to promote the technology that had been developed by Ts. Dr. Intan Helina Hasan, a research officer of the ION2. This media conference was held in conjunction with the opening ceremony of the 1<sup>st</sup> Research Officers National Symposium (ReONS 2022) on 29<sup>th</sup> and 30<sup>th</sup> of August 2022. The media conference aims to promote research results by research officers at UPM.

At the press conference, which was also attended by Astro Awani, Dr. Intan described the flexible antenna technology using organic conductive ink for various uses. The organic ink or paste uses carbon nanotubes or CNTs produced from used cooking oil and an environmentally friendly organic binder as the main materials.

This technology is the result of a combination of three research innovations that have been patented by Prof. Dr. Mohd Nizar Hamidon, Ts. Dr. Intan Helina Hasan and Dr. Ismayadi Ismail.



Prof. Ir. Dr. Hj. Kamarul Arifin Ahmad, the Director of UPM's Putra Science Park (PSP) also attended the press conference. "PSP is very committed to bringing UPM's technology and inventions to the market and aims to collaborate with industry to commercialize UPM's best research output at various levels", he told the press.



### Dr. Yap received MASS Young Researcher Award 2022



Assoc. Prof. Dr. Yap Wing Fen, an associate researcher of the Functional Nanotechnology Devices Laboratory, received the MASS Young Researcher Award 2022 in conjunction with the 31<sup>st</sup> Regional Conference on Solid State Science and Technology organised by the Universiti Malaysia Kelantan, Kota Bharu, on 6<sup>th</sup> to 9<sup>th</sup> September 2022. Dr. Yap received a cash prize of RM1,000, a souvenir and a Certificate of Award. Meanwhile, Dr Mohd Hafiz Mohd Zaid, an associate researcher of

the Nanomaterials Synthesis and Characterisation Laboratory, received the best oral presenter award and won two golds through his participation in the Materials Technology Competition.

### National Nanotechnology Innovation Research Project Competition 2022 (PIN'22)

An ION2 masters student, Wan Nadhirah bt Wan Abd Kalam, won the first-runner up place for the master category in the National Nanotechnology Innovation Research Project Competition 2022 (PIN'22), organised by the National Nanotechnology Center, Ministry of Science, Technology and Innovation. The competition was held in conjunction with Program Nano Kebangsaan (NanoKEB) 2022.



Wan Nadhirah received a trophy and cash prize of RM1,000. Her research works were supervised by Prof. Dr. Janet Lim Hong Ngee.

### Prof Janet was Selected as Top Research Scientists Malaysia 2022



Prof. Dr. Janet Lim Hong Ngee, an associate researcher of the Functional Nanotechnology Device Laboratory, ION2 has been recognised as one of the Top Research Scientists Malaysia 2022 (TRSM 2022) by the Academy of Sciences Malaysia (ASM).



This recognition is given to the Malaysian scientists with at least ten years of accumulated contribution in the science, technology, innovation and economics (STIE) sectors. The TRSM Recognition Ceremony 2022 was completed by the Minister of Science, Technology and Innovation (MOSTI), Datuk Seri Dr. Adham Baba.

### **Assoc. Prof. Dr. Siti Aqlima Ahmad Receives Polar Young Scientist Medal Award 2022**

Assoc. Prof. Dr. Siti Aqlima Ahmad received the Young Polar Scientist Medal at the Dinner Ceremony in conjunction with the Tenth Anniversary of the Establishment of the Sultan Mizan Antarctic Research Foundation (YPASM).

The medal, presented by the Minister of Environment and Water, Dato' Sri Tuan Ibrahim Tuan Man, was witnessed by the Sultan of Terengganu and Patron of YPASM, His Majesty Al-Wathiqu Billah Sultan Mizan Zainal Abidin Ibni Almarhum Sultan Mahmud Al-Muktafi Billah Shah.

Dr. Siti Aqlima who is also a lecturer at the Department of Biochemistry, Faculty of Biotechnology and Biomolecular Sciences and a research associate of ION2, UPM said the award was a success for all young Polar scientists in the country.

## **RESEARCH HIGHLIGHTS**

### **Electrospun Polymer Nanofibers and Its Applications**

Electrospinning is a simple and versatile technique for fabricating polymer nanofibers. Electrospinning involves an electrohydrodynamic process, during which a polymer droplet from a polymer solution or polymer melt is electrified to generate a polymer jet, followed by stretching and elongation to generate fibers. Electrospun fiber diameters in the range of micrometers to nanometers. Although electrospun materials are predominantly polymer-based, ceramics, metallics, bioactive particles, and their combinations can be introduced into the fibers and subsequently be part of the final nanocomposites.

The main components in electrospinning include a high-voltage power supply, a syringe pump, a spinneret (usually, a hypodermic needle), and a conductive collector (as shown in Fig. 1). The power supply can be either direct current (DC) or alternating current (AC).



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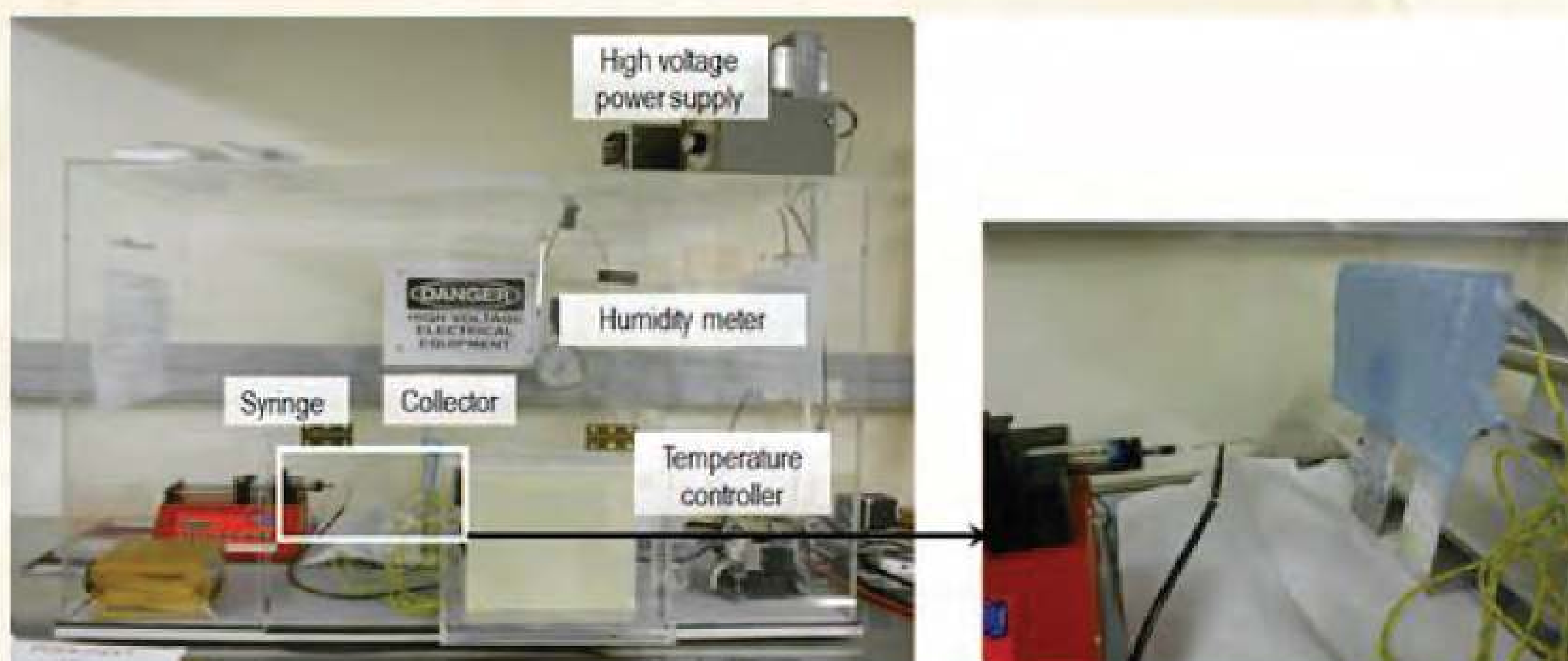


Fig. 1. Electrospinning setup and the collected electrospun nanofibers mats on the conductive collector.



Electrospinning has advanced to generate nanofibers with various secondary structures, such as porous, hollow, or core-sheath structures, in addition to polymer nanofibers with smooth surfaces. These nanofibers' surfaces can be further functionalized with a variety of molecular species or nanoparticles during or after the electrospinning process. Furthermore, by manipulating the alignment, stacking, and/or folding of electrospun nanofibers mats, they can be assembled into ordered arrays or hierarchical structures. These attributes render electrospun nanofibers highly suitable for a wide range of applications, including air filtration, water purification, environmental protection, heterogeneous catalysis, smart textiles, surface coating, energy harvesting/conversion/storage, encapsulation of bioactive species, production of carbon nanofibers, drug delivery, tissue engineering, and regenerative medicine.

For more than 10 years of research on electrospun polymer nanofibers, applications of electrospun nanofibers studied by my research group including DNA sensors (Fig. 2) [1], drug-controlled release (Fig. 3)[2], and scaffold for tissue engineering (Fig. 4)[3]. There are other applications as well such as the production of carbon nanofibers and activated carbon nanofibers as adsorbents for heavy metals and contaminants of emerging concerns (CECs) [4-5].

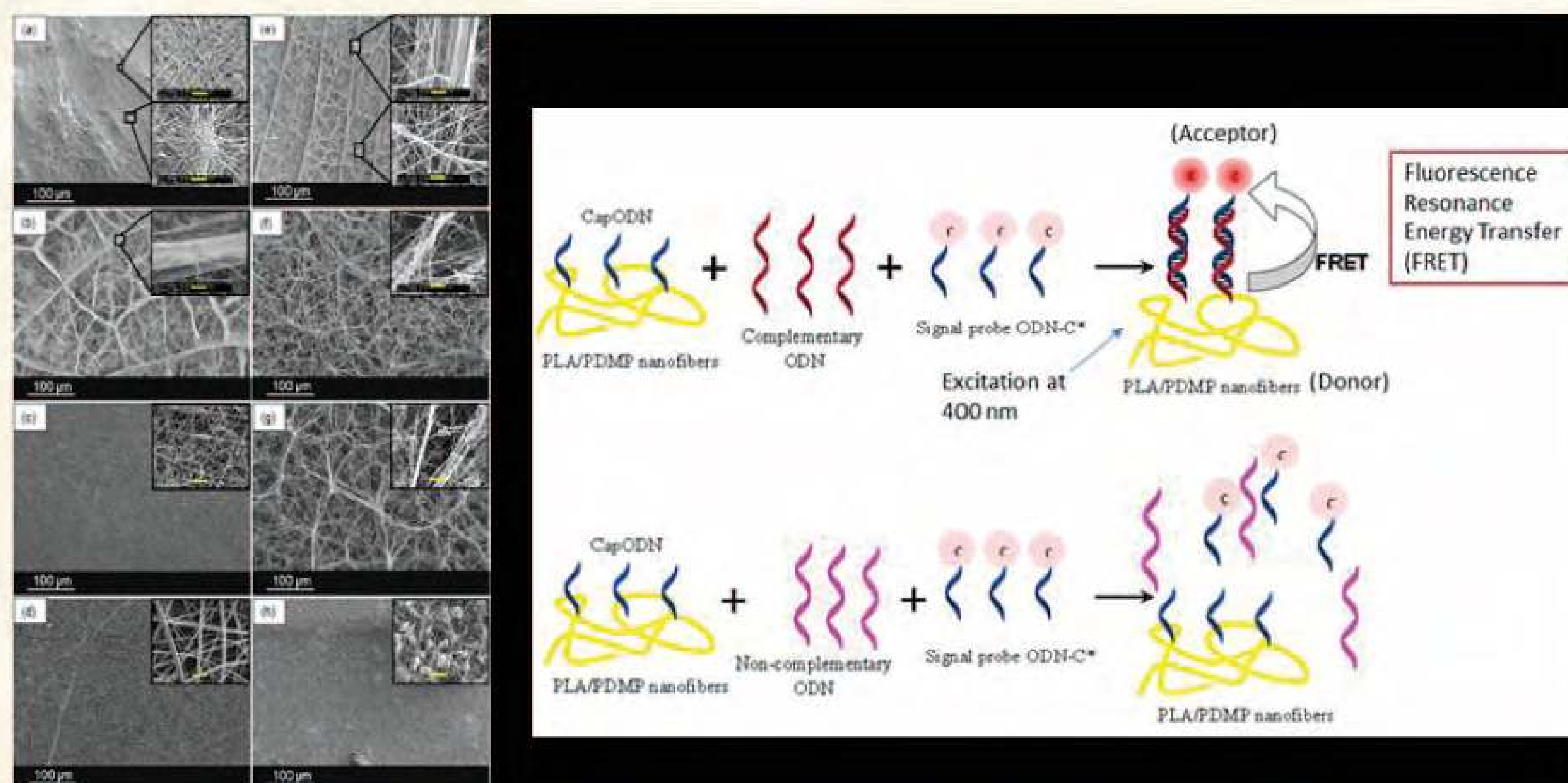


Fig. 2. Electrospun PDMP/PLA nanofibers and illustration of the working mechanism of ODN sensing with PDMP/PLA fibers [1].

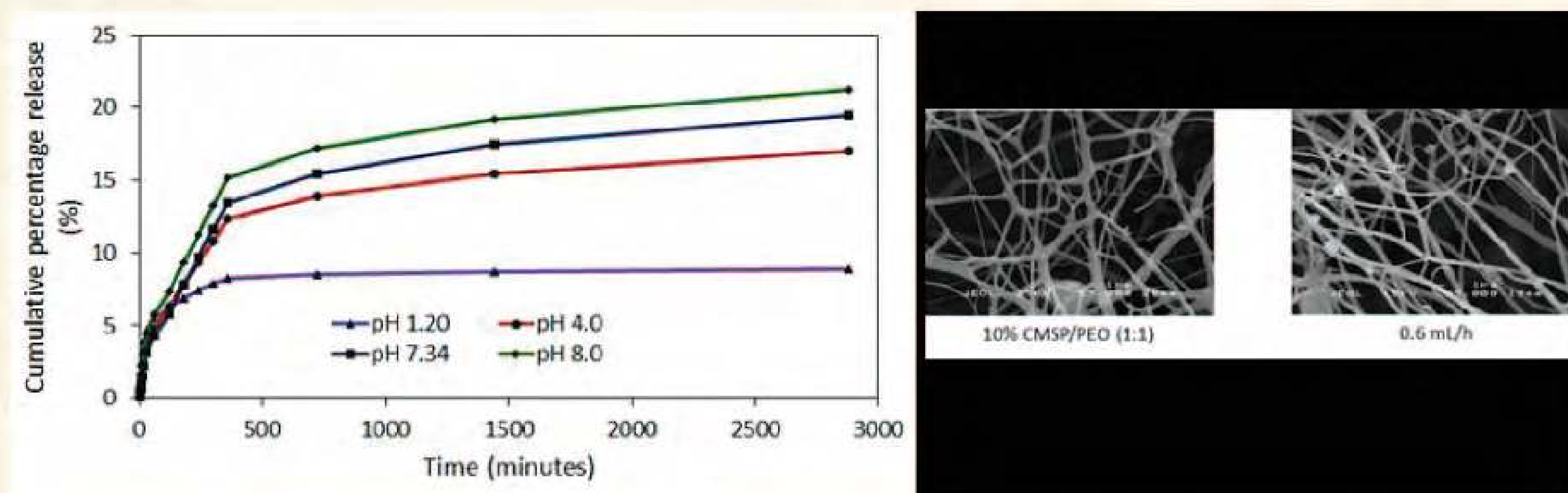


Fig. 3. Effects of pH value on the release of MB from CMSP/PEO hydrogel nanofibers [2].



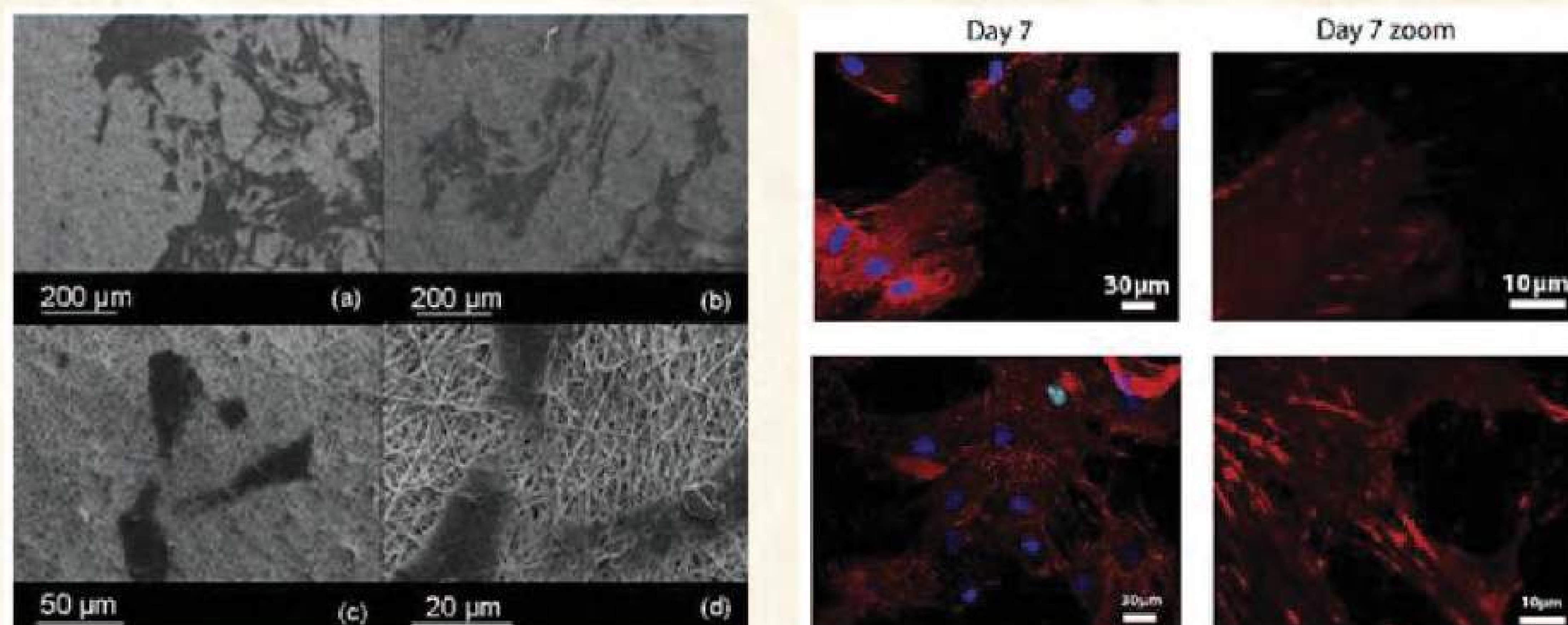


Fig. 4. Images of hASCs cultured on (a) PLLA/PANI ES 1.7 wt% (b) PLLA/P(ANI-co-m-ABA) EB 5.8 wt% (c) and (d) PLLA/P(ANI-co-m-ABA) ES 3.0 wt% for 7 days [3].

#### References

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- [4] NA Nordin, N Abdul Rahman, AH Abdullah, Effective Removal of Pb (II) Ions by Electrospun PAN/Sago Lignin-Based Activated Carbon Nanofibers, *Molecules* 25 (13), 3081, 2020.
- [5] AF Zakaria, S Kamaruzaman, N Abdul Rahman, Electrospun Polyacrylonitrile/Lignin/Poly(Ethylene Glycol)-Based Porous Activated Carbon Nanofiber for Removal of Nickel (II) Ion from Aqueous Solution, *Polymers*, 13(20), 3590, 2021.

### Nanostructured Zinc Oxide: Fabrication, Characterisation, and Electromechanical Properties for Piezoelectric Applications

Zinc oxide (ZnO) nanorods have shown great potential in various applications such as gas sensing, photocatalysis, and piezoelectric nanogenerators. Thus, it is crucial to investigate the growth orientation, morphology and properties of ZnO nanostructures for the aforementioned applications. The work focused on the nanoscale domain imaging and the electromechanical response of ZnO nanorod arrays synthesized process involved the use of a simple, and low-cost hydrothermal method on different substrates, followed by the fabrication and characterisation of optimized ZnO nanostructured on printed microcontact electrode.



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This simple and cost-effective hydrothermal method involves the growth of ZnO nanorods on a substrate through the reaction between zinc nitrate hexahydrate and hexamethylenetetramine in a basic solution. The advantage is because of the relatively simple and requires minimal equipment and expertise, making it a cost-effective option for large-scale production. The use of a printed



microcontact electrode also provided a cost-effective approach to fabricating the nanorod arrays with a high degree of uniformity (Fig. 1). In addition, this approach allowed for the precise control of the nanorod growth and alignment, which is important for the piezoelectric performance of the arrays.

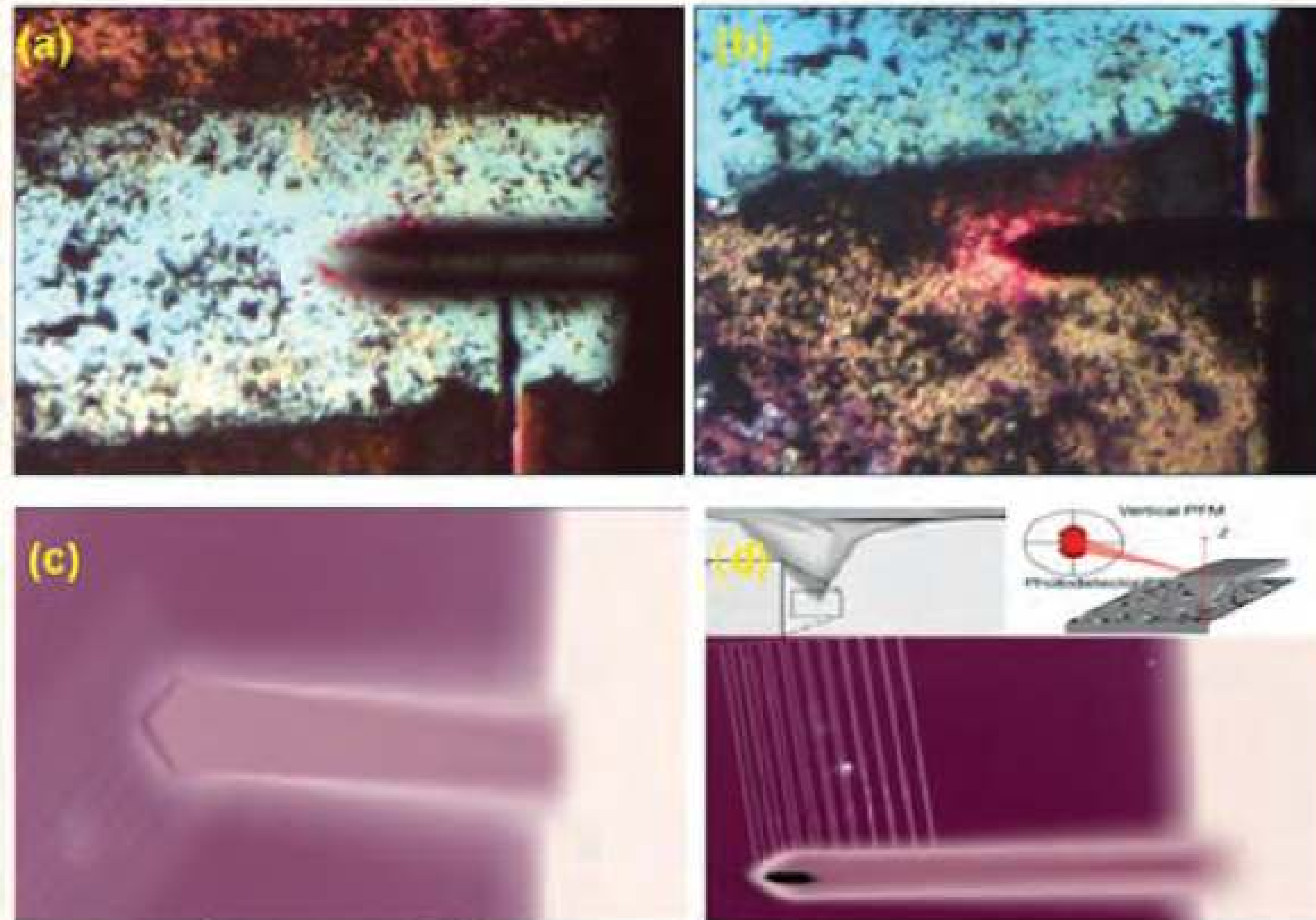


Fig. 1. Schematic of scan camera images of cantilever tip on patterned IDE with ZnO nanorods.

We then investigated their piezoelectric properties using various techniques such as scanning electron microscopy (SEM), X-ray diffraction (XRD), and piezoresponse force microscopy (PFM) (shown in Fig. 2).

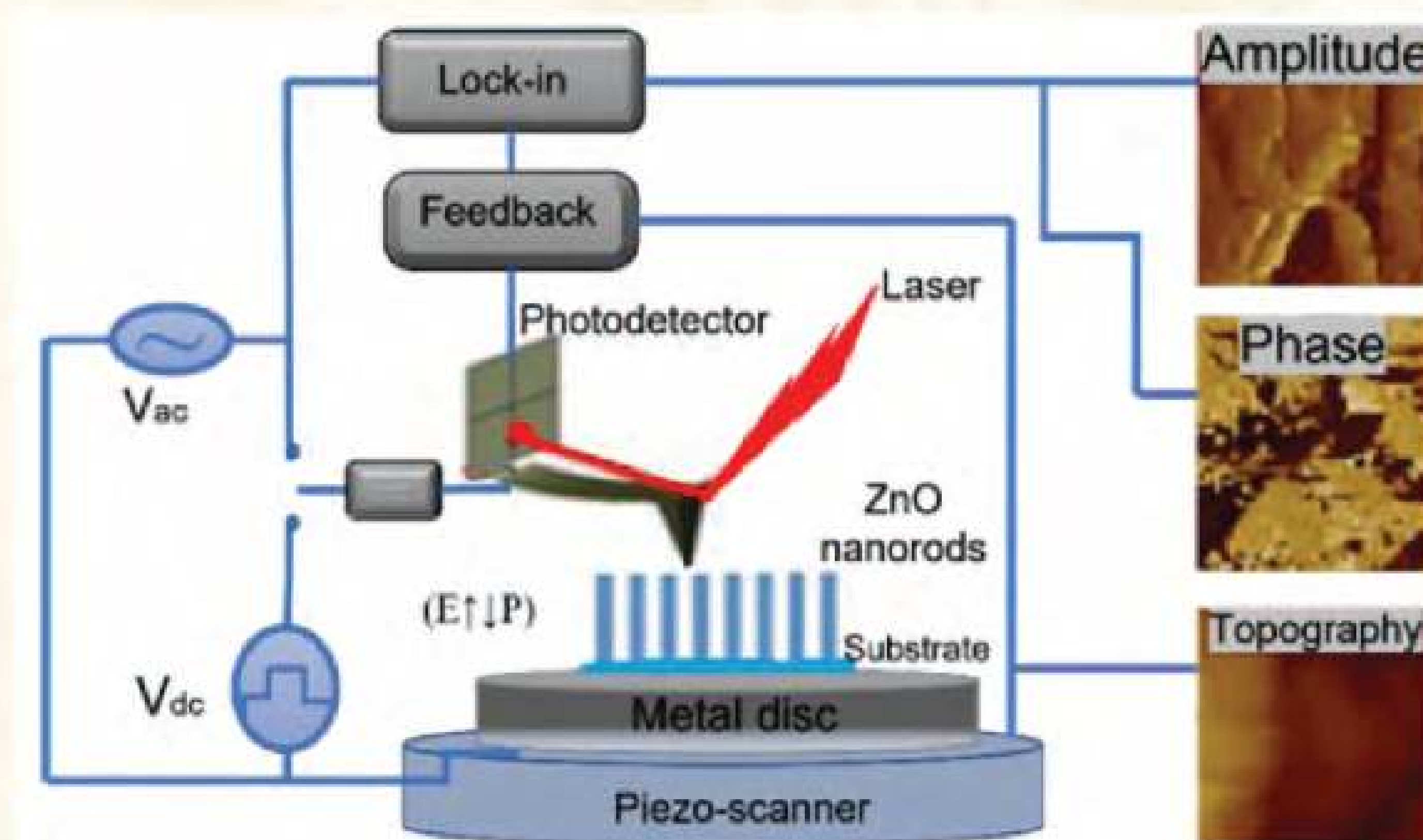


Fig. 2. Schematic of conventional AFM set-up used in PFM-measurements with both AC and DC voltages are applied to the conductive tip and the resulting electromechanical response of the nanorods is measured.

The SEM images revealed that the ZnO nanostructures were uniform in shape and well-aligned on glass, silicon, and the printed microcontact electrode. In addition, the XRD patterns confirmed the crystalline structure of the ZnO nanostructures, which was found to be wurtzite.

Using this PFM and atomic force microscopy (AFM), we could observe the nanoscale electromechanical response and map out the piezoelectric domains (Fig. 3) of the nanorods. We found that the domain size and distribution were influenced by the choice of substrate and that the Young's modulus of the nanorods was dependent on their orientation and aspect ratio. The ZnO



nanostructures had a high impedance, indicating their piezoelectric properties. The AFM measurements also indicated that the ZnO nanorod arrays had a high piezoelectric response, which varied depending on the substrate. Specifically, the ZnO nanorod arrays grown on silicon showed a higher piezoelectric response compared to those grown on glass.

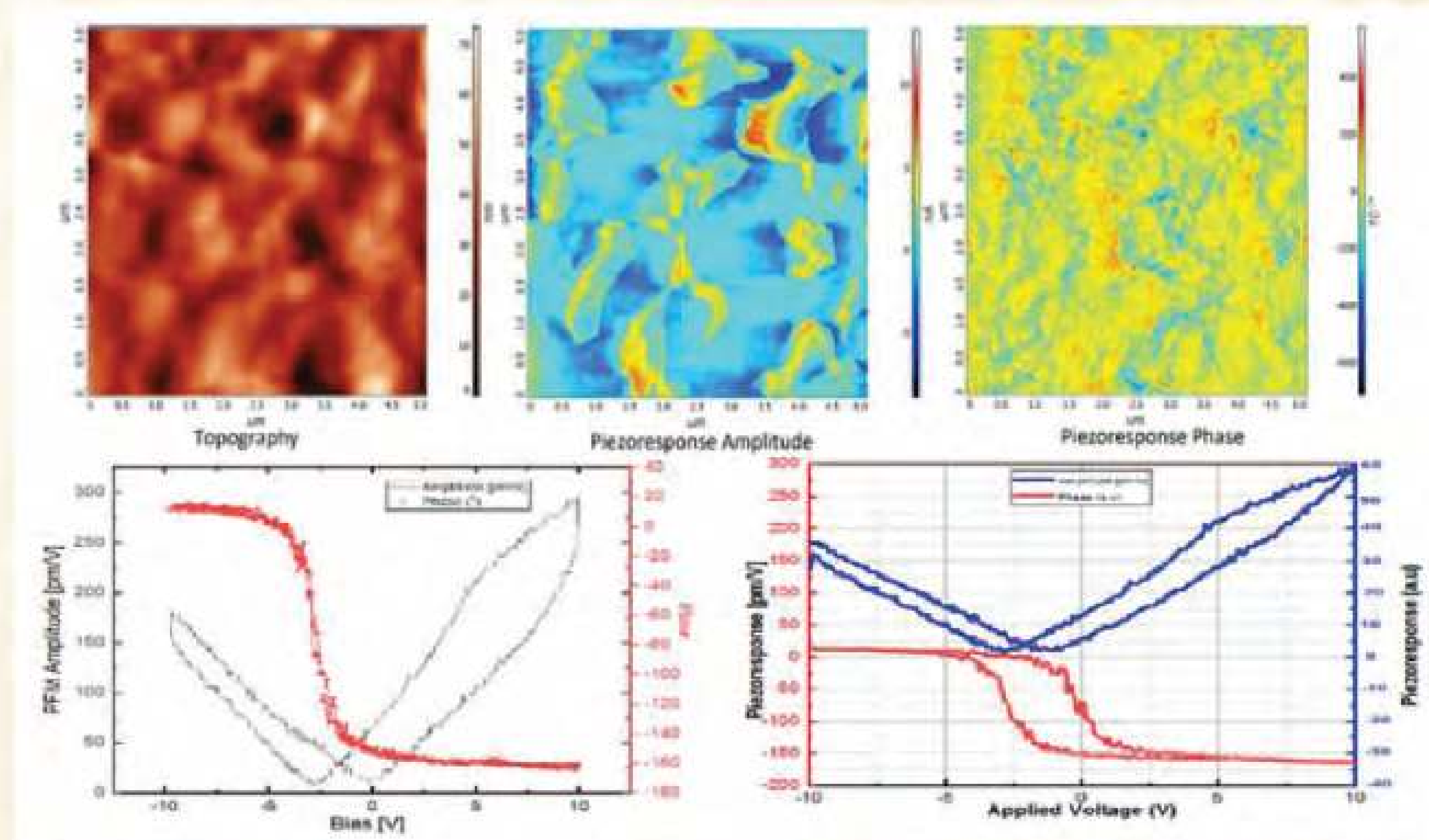


Fig. 3. (a) Hysteresis curves for the PFM Phase and (b) PFM amplitude signal. A phase switch of the response and hysteresis in phase vs. dc voltage plot is known as evidence of local polarization switching, which indicates ferroelectricity, whereas hysteresis in amplitude with field indicates piezoelectric behaviour.

These findings have important implications for the design and fabrication of nanorod arrays for sensing and energy harvesting applications through the precise control of the nanorod growth and alignment, which is important for the piezoelectric performance of the arrays.

### Foam Glass-Ceramics Fabricated from Waste Materials for Construction Insulation Applications

Foamed glass-ceramic is a new type of environment-friendly material which consists of glass phases, tiny pores, and crystalline phases. It maintains diverse advantages such as high strength, sound insulation, heat preservation, moisture-proof, corrosion resistance and lightweight. As a lightweight material, foam glass-ceramic is useful in the construction industry. Thus compressive strength, low density, highly porous, high surface area, chemical resistance, and fire-resistant properties are important.

Producing foam glass-ceramic from recycled glass waste is an alternative to low-cost production of construction materials. The waste materials used as raw materials were soda-lime-silica (SLS) glass from bottle glass waste and eggshell (ES) waste (forming agent). The waste materials were cleaned and dried prior to the experiment. First, the SLS glass was crushed into glass cullets using a plunger. Ball-milling was then used to produce SLS powder. Meanwhile, the ES powder was prepared using a pestle and mortar. Then, the SLS glass and ES powders were sieved by using a 45  $\mu\text{m}$ -stainless sieve, followed by gently mixing using a pestle and mortar (same direction of revolution) for 10 min to ensure the homogeneity of the mixture powder. Then, pellets ( $\Phi = 13 \times 2 \text{ mm}$ , 5 MPa applied load) were prepared from the homogenised powder before undergoing the heat treatment process at 800°C for 30, 60, and 120 min with the heat rate of 10°C/min by using the electric furnace. After the heat treatment process, the bulk pellets were analysed for physical and mechanical analysis. Meanwhile, the pellets were grounded to form a powder for structural analysis.



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The microstructure in the horizontal section of foam glass-ceramics in relation to the sintering duration for calcinated at 800°C present in Fig. 1. As noticeable from Fig. 1 (a), the pores were distributed homogeneously with the average size of pores diameter were 358  $\mu\text{m}$  for 30 min of sintering duration. After increasing the sintering duration to 60 min, the pores were substantially increased with the diameter size 870-1500  $\mu\text{m}$  associated with the presence of holes caused by bursting action of carbon dioxide gas where the coalescence of pores occur and consequently enhance to the formation of open porosity. As increasing the sintering duration to 120 min, the number of pores were unchanged however there was closing of interstitial hole as presented in Fig. 1 (iii) due to the increase of viscosity system. This finding was similar to previous research by using sodium hydroxide (NaOH) as the foaming agent that states that the closing of holes is influenced by high viscosity and high surface tension between liquid and gas interface at high temperature. Consequently, the bubbles are unable to expand thoroughly due to the high viscosity of the system.

The average diameter of pores during 120 min was 699.58  $\mu\text{m}$ . In addition, the large pores tend to escape out from the top surface of the foam glass-ceramics, when prolonging the sintering duration.

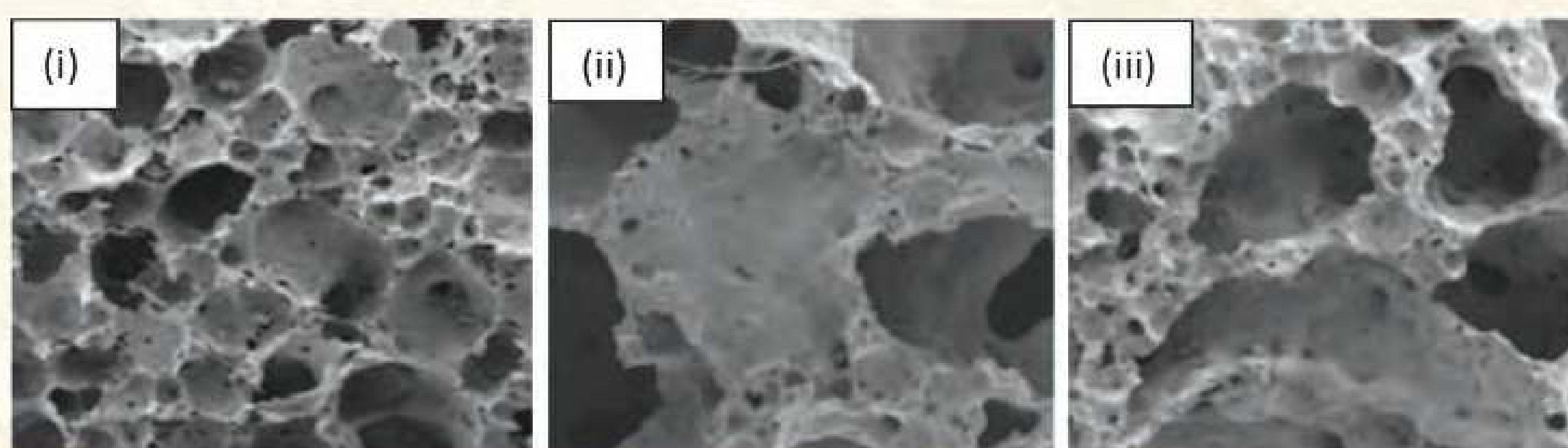


Fig. 1. Cross-section of foam glass-ceramics sintered for different sintering duration (i) 30 (ii) 60 and (iii) 120 min.

Fig. 2 shows the relationship of bulk density and porosity of foam glass-ceramics at variation of sintering duration. By increasing the sintering duration from 30 – 60 min, the bulk density was dropped significantly and rose slightly as prolonging the sintering duration to 120 min. The maximum of bulk density was 0.644  $\text{g/cm}^3$  associated with the minimum porosity of 74.24% at 30 min of sintering duration. This is because there was insufficient gas generated with a short sintering duration hence there was diminish of pores in a sample and exhibit as denser structure. The pores size becomes larger when prolong duration to 60 min where the coalescence occurs and remarks in a low of bulk density at 0.421  $\text{g/cm}^3$  with the maximum porosity of 83.16%. By adding the sintering duration to 120 min, the bulk density was slightly increased to 0.534  $\text{g/cm}^3$  because when extending the sintering duration, the gas bubbles would discharge through the upper surface of foam glass-ceramics and densification occurs.

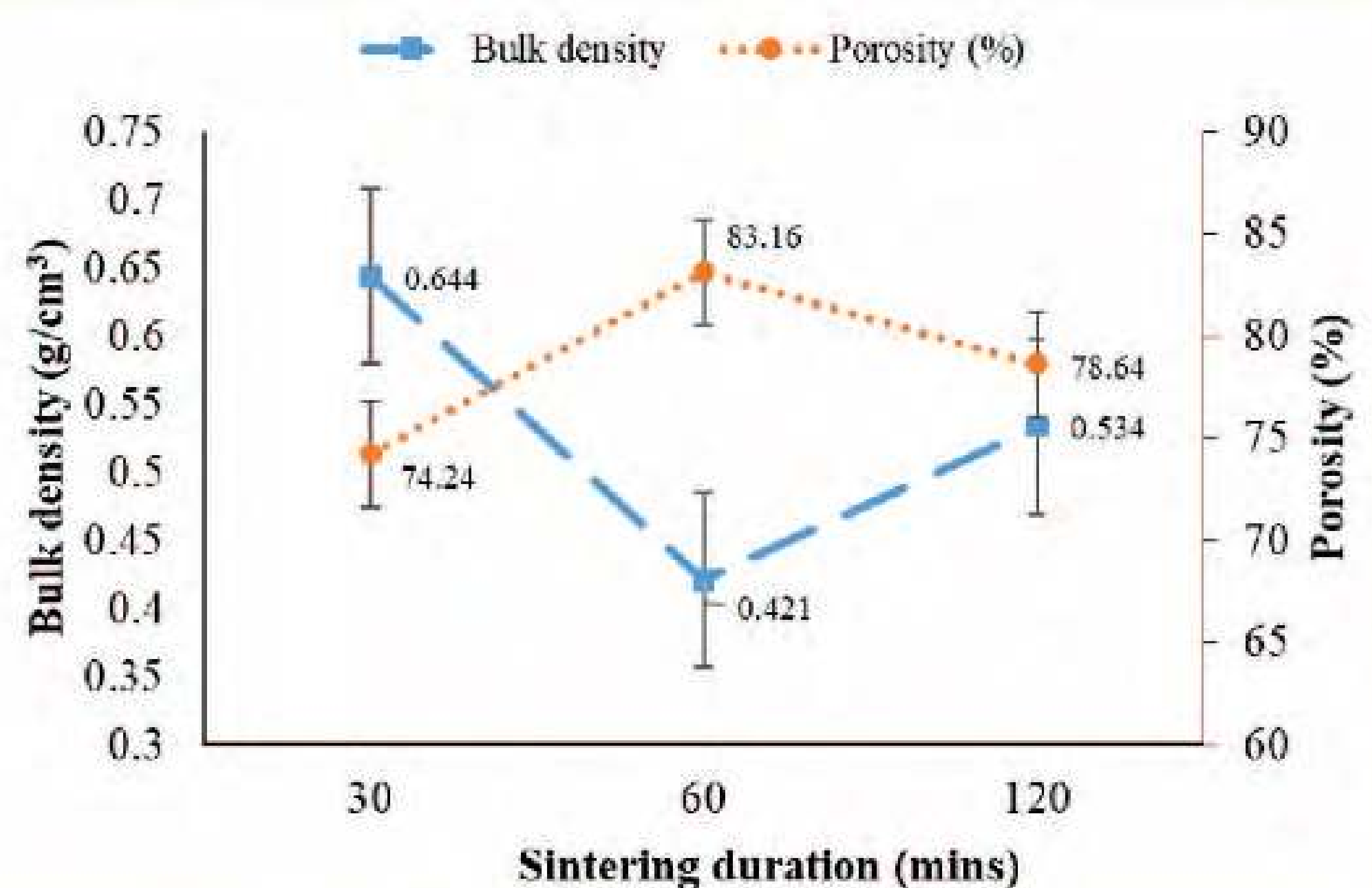


Fig. 2. Bulk density-porosity of foam glass-ceramic in relation to the sintering duration.

Foam glass ceramics have excellent thermal insulation properties, with a low thermal conductivity that helps to reduce heat loss and improve energy efficiency. This makes it a great choice for insulation in building and construction applications. Besides, foam glass ceramics have high compressive strength and are resistant to deformation, making it a durable option for building and construction applications. In the viewpoint of economical aspect, closed porosity of foam glass-ceramics can be fabricated from waste materials which is useful to the construction sector as building materials.



# RESEARCH LABORATORY

## NANOMATERIALS SYNTHESIS AND CHARACTERISATION LABORATORY

Nanomaterials Synthesis and Characterisation Laboratory (NSCL) covers research on synthesis and characterisation of nanomaterials, exploring how the properties of nanomaterials change with morphological features, reaction conditions and processing parameters

The research laboratory focuses on the synthesis of nanoscale materials that can be classed into carbon and non-carbon. These materials cover zero-dimensional, one-dimensional, two-dimensional and three-dimensional nanostructures. Carbon-based materials cover carbon and graphene quantum dots, carbon nanotubes, graphene and nanographene derivatives and various hierarchical nanostructures. Non-carbon-based materials cover metals, ceramics and layered hydroxides having various functional properties such as magnetic, dielectric, and superconducting properties.

### RESEARCH PROGRAMME

#### Nanomaterials and Carbon Nanomaterials

The programme includes both basic and applied research in understanding the nature of behavior and the application of technology. The programme focuses on the science and technology of nanomaterials with research topics including dimensional technology for various applications such as carbon nanotubes, graphene and its derivatives, graphene oxide, graphene quantum dots, as well as activated carbon.

This research programme also focuses on the fundamentals and use of nanomaterials for various applications, especially for the nanodelivery of active agents for agriculture and medicine, with special emphasis on drug and theranostic nanodelivery systems, as well as the synthesis of novel, safe agro nanochemicals. and effective. The programme also focuses on nanomaterials in energy, eco-materials and water safety.

#### Functional and Structural Nanomaterials

This programme focuses on the synthesis and characterization of functional materials and advanced structural materials. The study of these materials covers advanced materials such as electronic materials, magnetic materials and superconducting materials, the dielectric of ceramic materials, semiconductor materials, photonic materials, thin film materials and smart materials. It also focuses on composite matrix advanced polymer, metal alloy structure and ceramic materials.

The focus for magnetic and dielectric ceramics is on microstructure-property evolving relationships. For the other materials, electrical and optical characteristics are studied in depth: fundamental understanding of property behavior and technological applications are equally important. Of particular importance is materials' property enhancement via use of nanomaterials in material syntheses. Mechanical alloying, wet-chemistry, electrodeposition and physical and chemical vapour deposition synthesis methods are employed. Targeted technological applications are wide ranging: electrical, electronic, optical, opto-electronic, etc.



### Foundry of Reticular Materials for Sustainability

Foundry of Reticular Materials for Sustainability (FORMS) is a long-term collaborative programme between Universiti Putra Malaysia and the University of California, Berkeley, America. The program focuses on research involving the synthesis and application of metal-organic frameworks (MOFs). MOFs applications include, but are not limited to materials science and technology, biosystems and biotechnology, agriculture, water, veterinary and animal science, energy, health and medicine.

The laboratory focuses on synthesis of MOFs and can be divided into general and post-synthetic modification. General synthesis method includes study of MOFs developed from the study of zeolite. Except for the use of preformed ligands, MOFs and zeolites are produced almost exclusively by hydrothermal or solvothermal techniques, where crystals are slowly grown from a hot solution. In contrast with zeolites, MOFs are constructed from bridging organic ligands that remain intact throughout the synthesis. Post-synthetic modification methods cover ligand exchange, metal exchange, stratified synthesis and open coordinate sites.

## LABORATORY MEMBERS

### ASSOC. PROF. DR. CHE AZURAHANIM CHE ABDULLAH

Head of Laboratory  
BSc (USM), PhD (Surrey, UK)  
Expertise: Materials for Biomedical  
Applications, Nanotechnology

### PROF. CHM. DR. MOHD ZOBIR HUSSEIN

Head of Nanomaterials Programme  
BSc (UKM), PhD (Reading, UK)  
Expertise: Nanomaterials and Materials  
Chemistry

### ASSOC. PROF. DR. CHEN SOO KIEN

Head of Functional and Structural Programme  
Research Associate  
BSc (UKM), MSc (UKM), PhD (Cambridge)  
Expertise: Superconducting Materials

### DR. ISMAYADI ISMAIL

Research Officer  
BSc (UKM), MSc (UPM), PhD (UPM)  
Expertise: Magnetic Materials, EM-wave  
Absorbing Materials, Carbon-based  
Nanomaterials

### DR. MOHD HAFIZUDDIN AB GHANI

Research Officer  
BSc (UKM), MSc (UKM), PhD (UKM)  
Expertise : Advanced Polymer, Biocomposite,  
Nanocomposite

### ASSOC. PROF. DR. KHAMIRUL AMIN MATORI

Research Associate  
BSc (UPM), MSc (UPM),  
PhD (Sheffield, UK)  
Expertise: Materials Science,  
Materials Engineering, Ceramics

### ASSOC. PROF. DR. ABDUL HALIM ABDULLAH

Research Associate  
BSc (New Brunswick), PhD (Dundee)  
Expertise: Analytical Chemistry, Catalysis,  
Environmental Chemistry, Materials Chemistry

### ASSOC. PROF. DR. RABA'AH SYAHIDAH AZIZ

Research Associate  
BSc (UPM), MSc (UPM),  
PhD (Warwick, UK)  
Expertise: Ceramics, Magnetic Materials,  
Nuclear Magnetic Resonance

### ASSOC. PROF. DR. MAS JAFRI MASRUDDIN

Research Associate  
PhD (La Trobe University, Australia)  
Expertise: Nanobiotechnology,  
Drug delivery, Anticancer Therapeutics,  
Microbial-Synthesis of Nanomaterials



**PROF. ChM. DR. ZULKARNAIN ZAINAL**

Research Associate

BSc (Hons) (UKM), PhD (UMIST)

Expertise: Electrochemistry, Material Chemistry

**PROF. ChM. DR. MOHD BASYARUDDIN  
ABDUL RAHMAN**

Research Associate

BSc (UTM), PhD (Southampton)

Expertise: Theoretical and Computational  
Chemistry, Catalysis, Synthesis, Oleochemistry**DR. MOHD HAFIZ MOHD ZAID**

Research Associate

BSc (UPM), MSc (UPM), PhD (UPM)

Expertise: Material Science, Glass,  
Ceramic, Composites, Nanomaterials**DR. NURUL HUDA OSMAN**

Research Associate

BEng (Surrey, UK), PhD (Surrey, UK)

Expertise: Microwave Planar Components,  
Material Characterisation, Sensor Design**ASSOC. PROF. DR. NORMI MOHD YAHAYA**

Research Associate

PhD, (Riken, Japan &amp; USM, Malaysia)

Expertise: Molecular & Structural Biology,  
Protein Engineering**ASSOC. PROF. DR. SITI AQLIMA AHMAD**

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BSc (UPM), MSc (UPM), PhD (UPM)

Expertise: Green Nanomaterials,  
Bioremediation (Toxicology)**DR. JOSEPHINE LIEW YING CHYI**

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Expertise: Semiconductor Materials  
Characterisation, Synthesis, & Utilisation**DR. MUHAMMAD ALIF MOHAMMAD LATIF**

BSc (UPM), MSc (UPM), PhD (UPM)

Expertise: Computational and Experimental  
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Assistant Engineer

DipEng (Mechanical), BEng (UTM)

Expertise: BET and 3D Modeling Software

**NOOR LINDA HASSAN**

Laboratory Personal Assistant





## NANOMATERIALS PROCESSING AND TECHNOLOGY LABORATORY

Nanomaterials Technology and Processing Laboratory (NPTL) was established to meet research needs in the field of nanomaterials processing and nanotechnology applications. NPTL was developed to complement the ecosystem of institutes that aim to be leaders in the field of nanoscience and nanotechnology.

NPTL focuses on developing and promoting research in the processing of green nanomaterials, as well as the development of sustainable and innovative products for various applications. NPTL also has expertise related to agri-nanotechnology, which is in line with UPM's main research in agriculture.

The main activities of this laboratory are conducting research in related fields, offering postgraduate programmes, as well as providing training and consulting services.

### RESEARCH PROGRAMME

#### Nanomaterials Processing

The programme focuses on developing research related to scalable and energy efficient nano processing and materials. We have expertise in the bottom-up synthesis and processing of carbon nanomaterials such as carbon nanotubes (CNTs), CNT cotton, graphene and graphene homologs by both batch and continuous chemical vapor deposition (CVD) processes.

A scalable top-down process for the preparation of graphene oxide and carbon quantum dots is also in progress. Other processes for advanced materials and nanomaterials include hydrothermal and solvothermal techniques, electrospinning nanofibers, nanoemulsion processing, nanoencapsulation and nanocoating methods. research under this programme is from basic research to processing that can be used as a proof of concept.

#### Nanomaterials Technology

The programme focuses on the development of sustainable and innovative products using advanced materials and nanomaterials for various applications. The various types of materials and nanomaterials used include biochars and biocatalysts, carbon nanotubes, graphene, homologous graphene, carbon quantum dots, as well as various types of metal oxide nanoparticles.

The products developed are diverse and include bio-based products such as bio-lubricants, green drilling fluids with nano-materials, green polymers and nano-composites for membranes and packaging, green corrosion inhibitors, environmental sensors, renewable agro-chemicals such as green nanoemulsion poisons / herbicides, various nanofertilisers and novel carbon quantum for photosynthesis enhancement. The types of research under this programme include basic research to application research for proof of concept and performance testing.

### LABORATORY MEMBERS

#### ASSOC. PROF. IR. DR. SITI HAJAR OTHMAN

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Food Packaging Engineering

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**TS. DR. UMER RASHID**

Head of Nanomaterials Processing Programme  
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MSc & PhD (University of Agriculture Faisalabad)  
Expertise: Renewable Energy (Green Fuels)

**ASSOC. PROF. TS. DR. NORKHAIRUNNISA MAZLAN**

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**DR. SITI ZULAIKA RAZALI**

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Nanotechnology, Drilling Fluids

**JURAINA MD YUSOF**

Research Officer  
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Expertise: Carbon Nanomaterials,  
Carbon Particles, Piezoelectric Materials

**PROF. TS. DR. SURAYA ABDUL RASHID**

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**ASSOC. PROF. DR. MOHAMAD AMRAN MOHD SALLEH**

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**ZAKKY YAMANIE JAMIAUDDIN**

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Expertise: Conducting Polymers and  
Electrospun Polymer Nanofiber

**DR. DAYANG RADIAH AWANG BIAK**

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Expertise: Heat Transfer, Modelling,  
Food Processing, Crystallisation,  
Pharmaceutical Products

**DR. SHAFREEZA SOBRI**

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Expertise: Electrocrystallisation and  
Electrochemical Engineering

**DR. NORDIN BIN SABLİ**

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Expertise: Photoelectrochemical, Fuel Cell

**DR. TAN SIN TEE**

Research Associate  
BSc (UKM), PhD (UKM)  
Expertise: Nanomaterials, Solar Cells,  
Photo(electro)catalysis, Optical Gas Sensor

**ASSOC. PROF. DR. MOHD NAZLI NAIM**

Research Associate  
BEng (UKM), PhD (Japan)  
Expertise: Bionanotechnology,  
Food and biomaterial coating,  
Nanotechnology-enhanced water treatment

**NOOR LINDA HASSAN**

Laboratory Personal Assistant





## FUNCTIONAL NANOTECHNOLOGY DEVICES LABORATORY

Functional Nanotechnology Devices Laboratory (FNDL) aims to be a leader in sensor technology and electron devices for nanotechnology and advanced materials. FNDL conducts innovative research related to advanced nanomaterials such as carbon-based nanomaterials in the areas of sensors, electron devices as well as energy.

This laboratory aims to provide affordable enabling green and sustainable technology in advanced sensor technologies, advanced radio frequency (RF) technologies, electronic nanomaterials and devices, and renewable energy. Research works also focus on the nanoscale green synthesis and its application as the new niche area of the institute, while promoting 17 Sustainable Development Goals (SDGs) and the 10-10 MySTIE framework.

We coordinate these technologies within FNDL and other laboratories in ION2, with other services agencies, industry, and academia, to leverage basic and applied research opportunities for the benefit of the nation.

### RESEARCH PROGRAMME

#### Sensor Technology

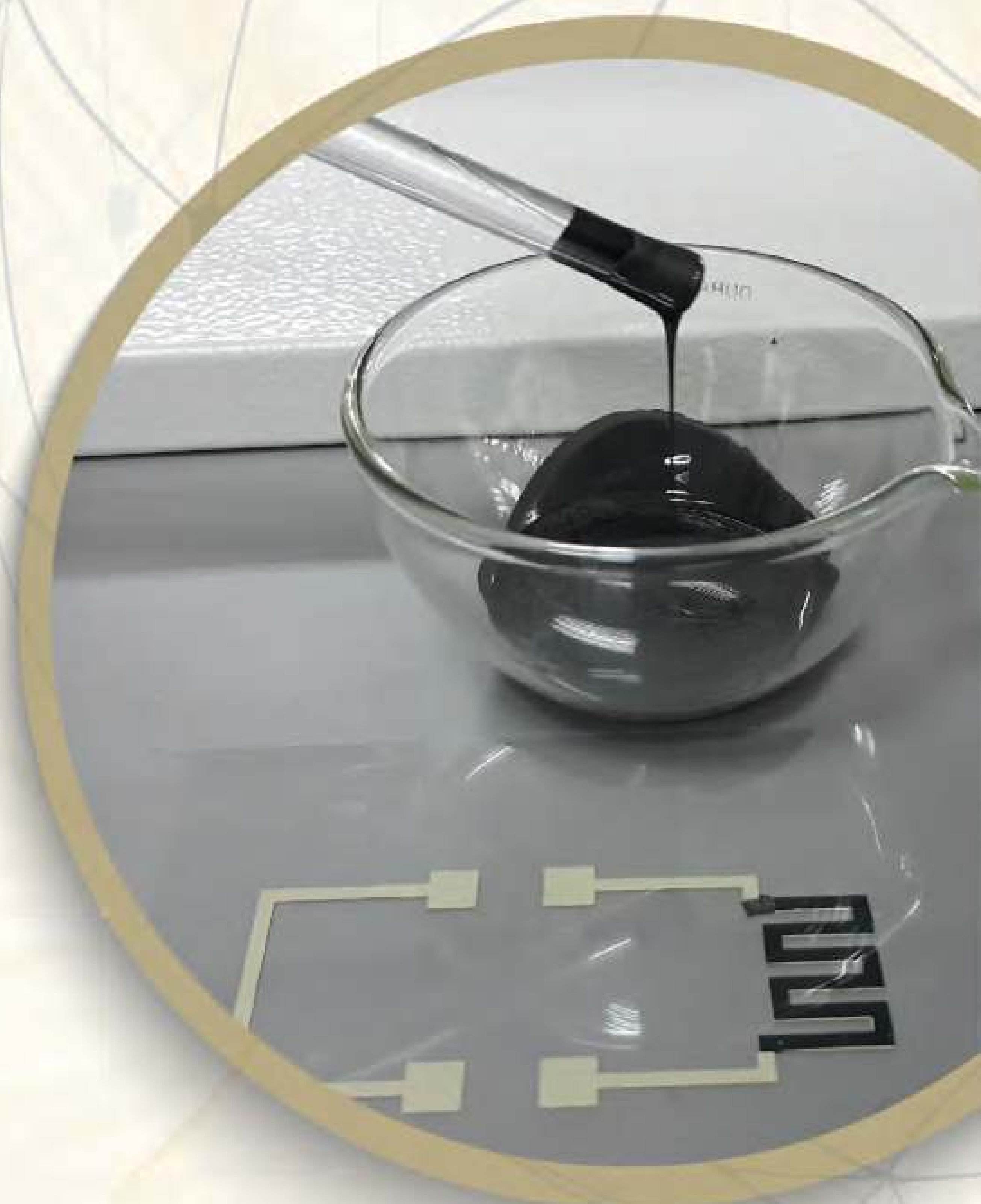
The focus of this programme includes the study and preparation of sensors based on nanomaterials and characterised by related transducers, signal processing and system or device design in the development of sensors to meet the demands of society (Society 5.0) and industry (IR5.0), which will include the well-being of society through green technology. Sensor systems include (but are not limited to) electronic sensors, biosensors, and chemical sensors.

Sensor technology has a very important role as a key technology to support various research and industrial applications. It is also an important element that can be used for water security, agriculture, environment, sustainable and green technology.

#### Electron Devices

Electron Devices is a programme that aims to carry out applied research in the growth of semiconductors and related nanomaterials, as well as analysis with the aim of developing new and improved electronic devices.

The vision in this field is the next generation of electronic devices and solar cells for better performance and reliability in complex environments to meet the demands of society (Society 5.0) and industry (IR 5.0), which will include the well-being of society through green technology. Research areas include nanoelectronics, RF energy harvesting and usable energy for energy security, agriculture, environment, sustainable and green technology.





## LABORATORY MEMBERS

**ASSOC. PROF. ChM. DR. JAAFAR ABDULLAH**

Head of Laboratory  
BSc (UKM), PhD (UKM)  
Expertise : Analytical Chemistry

**ASSOC. PROF. DR. YAP WING FEN**

Head of Sensor Technology Programme  
BSc (UPM), PhD (UPM)  
Expertise : Optical Sensor Based on Surface Plasmon Resonance Technique, Optical Studies on Glass Ceramics Composite Materials, Optical Properties of Nanocomposite Thin Film, Physics Literacy, Simulation & Multimedia

**TS. DR. MOHD NAZIM MOKHTAR**

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Expertise: Electron Devices, Thick Film Technology, Printed Electronics

**MOHD ALI MAT NONG**

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**PROF. DR. MOHD NIZAR HAMIDON**

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**PROF. ChM. DR. JANET LIM HONG NGEE**

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DEng (Nanovision) (Japan)  
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**ASSOC. PROF. ChM. DR. YUSRAN SULAIMAN**

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**ASSOC. PROF. IR. DR. NORHAFIZ AZIS**

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BEng (UPM), PhD (Manchester)  
Expertise: Transformer Condition Monitoring, Insulation Ageing, and Diagnostics, Asset Management and Alternative Insulation Materials for High Voltage Power Equipment

**PROF. DR. NORHISAM MISRON**

Research Associate  
BEng (Shinshu), PhD (Shinshu),  
PhD (Shinshu), MIEEE, MIEM, IEEJ  
Expertise: Electrical Machine, Power Electronic Drive, Magnetic Sensor

**DR. AMRALLAH MUSTAFA**

Research Associate  
BEng (UPM), MSc (UPM),  
PhD (Eng)(Shizuoka, Japan)  
Expertise: Solar Cell, CMOS Image Sensors, Analog IC Design, Robotics



**PROF. ChM. DR. NOR AZAH YUSOF**

Research Associate  
BSc (UKM), PhD (UKM)  
Expertise: Chemical Analysis,  
Electrochemistry, Environmental Chemistry

**ASSOC. PROF. DR. SHARUL  
AINLIAH ALANG AHMAD**

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BSc (UPM), PhD (Sheffield)  
Expertise: Analytical Chemistry

**TS. DR HASLINA JAAFAR**

Research Associate  
BEng (UKM), MSc (UKM),  
PhD (USM)  
Expertise: Flexible Sensors & Electronics,  
Micro-Electro Mechanical Systems (MEMS),  
Carbon Nanomaterials and  
Embedded Systems

**DR. FATIN NABILAH MOHD FAUDZI**

Postdoctoral Researcher  
BSc (UTM), PhD (UniMAP)  
Expertise: Biosensor, Carbon nanomaterials

**DR. IZWAHARYANIE IBRAHIM**

Postdoctoral Researcher  
BSc (UPM), PhD (UPM)  
Expertise: Analytical Chemistry,  
Materials Chemistry

**DR. NUR HAWA NABILAH AZMAN**

Postdoctoral Researcher  
BSc (UPM), PhD (UPM)  
Expertise: Materials Science

**MOHD WAFI AZIMIN MOHAMMAD JAN**

Assistant Engineer  
Certificate of Electronic Engineering  
Expertise: Inkjet Printing

**NOOR LINDA HASSAN**

Laboratory Personal Assistant





# POSTGRADUATE

The National Nanotechnology Policy and Strategy (DSNN) 2021-2030 is the Government's commitment to increase, accelerate and advance nanotechnology towards driving the nation's socioeconomic growth. With a main mission to mainstream nanotechnology in everyday life, solid commitments and support from various parties are important. Therefore, ION2 is highly committed to supporting the DSNN 2021-2030 policy by offering twelve fields of study related to nanoscience and nanotechnology. From 2018 to 2022, the total number of graduates from ION2 was 91, including eight students with Doctor of Philosophy (PhD) degrees and five students with Masters degrees by research who graduated in 2022. The graduation of the students in the field related to nanoscience and nanotechnology is aligned with the DSNN agendas, which comprised four strategic trusts with 15 strategies and 32 initiatives to provide a sustainable nanotechnology ecosystem in Malaysia.

## STUDENT ENROLMENT

Programme	Nationality	No. of Students	Total
MSc	China	2	38
	Malaysia	34	
	Iraq	1	
	India	1	
PhD	China	2	56
	India	2	
	Iran	1	
	Iraq	2	
	Malaysia	40	
	Nigeria	4	
	Pakistan	3	
	Sri Lanka	1	
	Libya	1	
		Total Enrolment	94

## STUDENT ADMISSION

Programme	Nationality	No. of Students	Total
MSc	Malaysia	2	3
	India	1	
PhD	China	1	7
	Iraq	1	
	Malaysia	1	
	Nigeria	1	
	Pakistan	2	
	Libya	1	
Total Admission			10



## DOCTOR OF PHILOSOPHY



Name : Aznizan Binti Shaari  
 Supervisor : Prof. Ir. Dr. Robiah Bt Yunus  
 Field of Study : Green Engineering  
 Thesis : Development of Palm Methyl Ester-Based Oil-In-Water Insecticide Nanoemulsions in Extermination of Aedes Mosquitoes

Name : Rose Fadzilah Binti Abdullah  
 Supervisor : Ts. Dr. Umer Rashid  
 Field of Study : Green Engineering  
 Thesis : Development of Bifunctional Catalysts Synthesized from Pyrolyzed and Hydrothermalized Palm Waste for Biodiesel Production Using Waste Cooking Oil



Name : Mohammad Zulhasif Bin Ahmad Khiri  
 Supervisor : Assoc Prof. Dr. Khamirul Amin B. Matori  
 Field of Study : Material Engineering  
 Thesis : Effect of Water Ratio and Aging Time on Glass Ionomer Cement Derived from Calcium Fluoroaluminosilicate-Based Glass

Name : Abdul Hadi Bin Ismail  
 Supervisor : Assoc. Prof. Dr Yusran Bin Sulaiman  
 Field of Study : Sensor Technology  
 Thesis : Sensitivity and Stability of Conducting Polymers and Copper-Based Metal Organic Framework for Optical Ammonia Gas Sensor



Name : Nur Asyikin Binti Ahmad Nazri  
 Supervisor : Assoc. Prof. Dr Rabaah Syahidah Azis  
 Field of Study : Nanotechnology  
 Thesis : Modification of Magnetite Extracted from Mill Scales Waste with CTAB And Chitosan for Cadmium Ions Removal from Aqueous Solution

Name : Wan Mohd Ebtisyam Mustaqim Bin Mohd Daniyal  
 Supervisor : Assoc. Prof. Dr. Yap Wing Fen  
 Field of Study : Sensor Technology  
 Thesis : Development of Nanocrystalline Cellulose/Graphene Oxide-Based Composite Thin Film for Metal Ions Detection Using Surface Plasmon Resonance Spectroscopy



Name : Siti Aisyah Binti Abdul Wahab  
 Supervisor : Assoc. Prof. Dr. Khamirul Amin B. Matori  
 Field of Study : Advanced Materials  
 Thesis : Effect of Cobalt Oxide on Optical and Dielectric Properties of Willemite-Based Glass-Ceramics Using White Rice Husk Ash as Silica Source





Name : Mahnoush Beygisangchin  
 Supervisor : Prof. Ts. Dr. Suraya Abdul Rashid  
 Field of Study : Nanotechnology  
 Thesis : Synthesis and Characterization of Polyaniline-Graphene Quantum Dot and the Potential for Pyrene Detection Using Photoluminescence Spectroscopy

PHD

## MASTER OF SCIENCE



Name : Siti Akhtar Binti Mohshim  
 Supervisor : Assoc. Prof. Dr. Shahrul Ainliah Binti Alang Ahmad  
 Field of Study : Sensor Technology  
 Thesis : Development of Gold Nanoparticles-DNA-Based Sensor for Detection of Ganoderma Boninense

Name : Nur Haziqah Binti Abdul Aziz  
 Supervisor : Dr. Haslina Binti Jaafar  
 Field of Study : Electronic Engineering  
 Thesis : Improvement in Dispersement and Agglomeration Properties for Carbon Nanotube Ink



Name : Syazana Binti Sulaiman  
 Supervisor : Assoc. Prof. Dr. Rabaah Syahidah Binti Azis  
 Field of Study : Materials Science  
 Thesis : Magnetite Nanoparticles from Waste Mill Scale as a Nanoabsorbent for Copper Metal Removal in Aqueous Solution

Name : Nurshahiera Binti Rosdi  
 Supervisor : Assoc. Prof. Dr. Rabaah Syahidah Binti Azis  
 Field of Study : Advanced Materials  
 Thesis : Fabrication of Barium Hexaferrite Nanocomposite and Hybrid Multiwalled Carbon Nanotubes/Barium Hexaferrite as Microwave Absorbing Material



Name : Nurul 'Illya Binti Muhamad Fauzi  
 Supervisor : Assoc. Prof. Dr. Yap Wing Fen  
 Field of Study : Sensor Technology  
 Thesis : Optical and Structural Studies of Graphene-Polyvinyl Alcohol-Based Thin Film For Potential Sensing of Carbaryl Using Surface Plasmon Resonance Spectroscopy



# FIELDS OF STUDY

## NANOSCIENCE

The nanoscience field of study is designed to prepare the students with nanoscience knowledge in any materials field, from metal and metal oxides, carbon nanomaterials, nanocomposite and others. Nanoscience studies matter, particles, and structures at the nanometer scale, including atoms and molecules. It explores how these interactions lead to unique properties different from those observed in microscale materials due to quantum mechanics. Metal and metal oxide nanoparticles are noteworthy for their exceptional optical, electronic, magnetic, and electrochemical properties. Carbon nanomaterials, like carbon quantum dots, carbon nanotubes, graphene, and graphene oxide, are gaining prominence as emerging nanomaterials. Metal-organic frameworks (MOFs), a type of porous crystalline materials made up of metal ions linked by organic ligands, offer a fascinating class of nanomaterials with numerous potential applications. Various cutting-edge techniques will be employed to analyse and characterise nanomaterials, including microscopy and spectroscopy techniques as well as thermal analysis. These characterisation techniques help understand and exploit nanomaterials' unique properties for diverse industrial applications.

## NANOTECHNOLOGY

The nanotechnology field of study is designed to prepare students with knowledge related to nanotechnology, which deals with developing start-of-art materials, devices, or other structures with at least one dimension sized from 1 to 100 nanometers. Nanotechnology harnesses the power of nanoscience to produce revolutionary nanomaterials and nanoscale components with limitless applications. It enables the creation of tailor-made materials with exceptional properties. Furthermore, nanotechnology can facilitate the establishment of interfaces between electronic and biological systems. Nanotechnology entails the application of fields of science as diverse as surface science, organic chemistry, molecular biology, semiconductor physics, and microfabrication. Some typical nanotechnology applications are in sensors, delivery systems, 'smart' medicines, nanoabsorbents, nanoelectronics, nanomachines, active and intelligent packaging, and others.

## ADVANCED MATERIALS

The advanced materials field of study is designed to educate students in materials and processes, emphasising the exploration and creation of engineered materials with exceptional or enhanced properties. These enhanced properties result in superior performance relative to conventional materials, effectively bridging the gap between high-tech and conventional industries at a graduate level. The primary goal of the programme is to equip students with comprehensive and multidisciplinary knowledge that addresses contemporary issues and practises in the field of advanced materials. This programme introduces students to advanced materials such as composites, ceramics, electronic materials, magnetic materials, smart materials, plastics, and polymers. By gaining an in-depth understanding of these topics, students are better prepared to address real-world challenges and contribute to the innovative advancement of various industries.





## GREEN ENGINEERING

The green engineering field of study is designed to prepare the students to be able to integrate environmental impact assessment tools, adopt life-cycle thinking, ensure that all material and energy inputs and outputs are as inherently safe and benign as possible, minimise the depletion of natural resources, and avoid waste. Green engineering is a sustainable approach to the design, production, and use of processes, materials and products that minimise pollution, reduce risk to human health and the environment, and enhance economic viability and efficiency. With green engineering, critical decisions to safeguard human health and the environment are made early in the process or product development stage, maximising cost-effectiveness.

## ENERGY

The energy field of study is designed to prepare students to design and develop new technologies related to harnessing energy. It encompasses fundamental and applied research on the development, design, and usage of renewable energy, energy storage and energy materials. Research areas for renewable energy cover solar, wind, biomass, and hydrogen. Energy storage covers technologies such as batteries, supercapacitors, and other methods to store energy for later use, enabling better integration of intermittent renewable energy sources. Energy materials such as advanced catalysts, photovoltaic materials, and high-performance materials are explored and developed to optimise their cost and performance, enabling economic viability for energy applications.

## SENSOR TECHNOLOGY

The sensor technology field of study is designed to focus on the design and development of sensors to meet the need for the growth in products and services that utilise information from different types of sensors. Sensor technology has a very important role as the key technology to support a wide variety of research and industrial applications. It is also a vital element that can be applicable in agriculture, water quality, food security, the environment, and healthcare. The study of sensor technology can include sensor devices, physical sensors, biosensors, and chemical sensors. This programme aims to allow students to acquire knowledge of sensor technology covering the design, development, fabrication and performance analysis of the developed sensors.





# LINKAGES & NETWORKING

The objective of the industrial and community linkages is to enhance collaboration between the ION2 and industries or communities so that ION2 can contribute to human progress through the exploration and transfer of knowledge in the areas related to it. In addition, this network is intended to enhance ION2's visibility as a leading center in industry and community partnerships.

## INDUSTRIAL LINKAGES

### ION2 and DKSH Holdings Collaboration: Advanced Materials Characterisation Talk

ION2 and DKSH Holdings (Malaysia) Berhad collaborated on a programme that involved an academy-industry partnership. The collaboration was a knowledge-sharing session called "Advanced Materials Characterisation Talk," led by Assoc. Prof. Dr. Che Azurahanim Che Abdullah, head of NSCL. This event was held physically at the ION2 Seminar Hall on 7<sup>th</sup> July 2022.

The programme was to provide a platform for experience sharing by invited speakers (academia and industry) regarding nano-scale materials characterisation and their applications in various fields. In addition, it also aimed to obtain information from the industry related to materials characterisation and analytical techniques that provide accurate data to reduce errors during testing.

Assoc. Prof. Dr. Che Azurahanim, who represented academia, discussed the importance of precise nanomaterials characterisation in her talk "Necessities for Reliable Nanomaterials Characterisation for Biomedical Applications". The industry representatives also presented a range of characterisation and material analysis techniques, including X-ray diffraction and dynamic light scattering instruments, which can be used to analyse batteries, carbon materials, additive manufacturing, gold nanoparticles, quantum dots, PLGA, and metal-organic frameworks.

At the end of the programme, Dr. Che Azurahanim emphasised the potential collaboration between academic researchers and industries in future projects related to nanomaterials and industry applications. She believed that collaborative research between academia and industry would create more advanced and sustainable products and innovations, in contrast to conducting the same project independently and as separate entities.



### ION2 received a visit from Rom Ren Pen Suk TM Co. Ltd. (Thailand)

Rom Ren Pen Suk TM Co. Ltd (RRPS), a Thailand-based company, visited ION2 on 25<sup>th</sup> July 2022 and was represented by their president, Adisak Vachirasamphan. During his visit, the president was taken on a tour of several laboratories and given a brief explanation by Prof. Ts. Dr. Suraya Abdul Rashid (Deputy Director) and Prof. Dr. Mohd Zobir Hussein (Research Fellow).



The one-day visit was a part of the successful discussion between the Industrial Relations and Networking Center (CiRNeT) of UPM and RPK Bio Resources (Coop Center Rom Yen Pen Suk TM. Co Ltd) back on 16<sup>th</sup> March 2022. Besides ION2, Adisak Vachirasamphan was also taken to the



Institute of Tropical Agriculture & Food Security (ITAFoS), Deer Farm and Cattle Farm at Putra Science Park (PSP), Mushroom House, Horticulture Unit, University Agricultural Park and Putra Mart. The visit aimed to introduce the places relevant to the core of the RRPS Co-op Centre in carrying out joint ventures in terms of research networks and commercialisation collaboration.

At the end of the programme, a Memorandum of Understanding signing session between UPM and the Co-op Centre of Thailand was held at CiRNeT. UPM was represented by the Deputy Vice-Chancellor (Industry and Community Network), YBhg. Professor Ir. Dr. B.T. Hang Tuah bin Baharudin.

### Expanding Your Research Career with EURAXESS

FNDL, in collaboration with the Faculty of Science, hosted a webinar on "Expanding Your Research Career with Euraxess" in conjunction with the EURAXESS info session at UPM. EURAXESS is a one-stop centre for comprehensive information and support tools for researchers wishing to conduct research in Europe or with European partners.

Dr. Susanne presented "Euraxess: Supporting Research Worldwide", while Timea Magony talked about the Erasmus+ programme offered by the EU. The speakers also introduced the opportunities offered under the Marie Skłodowska Curie Actions (MSCA) and the European Research Council (ERC). The programme was moderated by Prof. Dr. Nor Azah Yusof from FNDL.a

The webinar was attended by 47 individuals, including postgraduate students and lecturers from UPM and external institutions. The participants interacted with the speakers by asking various questions, and their feedback was positive. The programme hopes to give insight to the participants with opportunities to develop their research and scientific collaborations.



### Delegation from Egyptian Institute Visits ION2

A delegation from the Nanomaterials and Nanotechnology Department, Advanced Materials Division, Central Metallurgical Research and Development Institute (CMRDI) in Egypt visited the Institute of Nanoscience and Nanotechnology (ION2) on 16<sup>th</sup> November 2022. The delegates were Dr. Soliman E. Elhout and Dr. Aliaa M. S. Saleem.

The visit began with a presentation of the institute's profile by Assoc. Prof. Dr. Jaafar Abdullah, Head of FNDL, at the ION2 Meeting Room. Following that, Dr. Soliman E. Elhout briefly introduced CMRDI, and Dr. Aliaa M. S. Saleem presented the ongoing research at CMRDI, including the preparation of advanced nanomaterials and electrochemical deposition of magnetic nanomaterials into nanostructured porous silicon for data application storage.



The delegation also visited the FNDL and NSCL laboratories to learn about ongoing and commercialised research, as well as the facilities available at ION2. At the end of the visit, CMRDI and ION2 hope that the collaboration between the two institutes can be carried out in the future, especially in sensor technology.



## COMMUNITY ENGAGEMENTS

### ION2 Showcases Cutting-edge Nanotechnology Solutions at NanoKEB 2022 Technical Exhibition

ION2 participated in the Technical Exhibition on Industry and Nanotechnology in conjunction with the Program Nano Kebangsaan (NanoKEB) 2022 organised by the National Nanotechnology Centre (NNC), Ministry of Science, Technology and Innovation (MOSTI) located at Bangi Resort Hotel. NanoKEB, which took place from 6<sup>th</sup> to 9<sup>th</sup> September 2022, has brought together nanotechnology industry players as well as nanotechnology development-related agencies in Malaysia.

This event aims to provide a platform for knowledge and information sharing on the development of nanotechnology in the country. In addition, it encourages discussions and engagements on issues and directions of research and development in nanotechnology, besides becoming a medium to raise awareness of nanotechnology in the community, especially among university and school students.

ION2 exhibited several UPM nanotechnology products such as Organic Conductive Paste, Harvast™ Photosynthesis Enhancer, Nanoezinn fungicide, TB Nanosens Kit, Biosite Hydrogel Wound Dressing and Nanocellulose.

The closing ceremony of NanoKEB 2022 on 9<sup>th</sup> September 2022 was officiated by the Minister of Science, Technology, and Innovation, Dato' Seri Dr. Adham Baba. During the event, Dato' Seri Adham also launched the Malaysia Nanotechnology Industrial Group (MNIG). Two UPM startups under ION2, Serdang Paste Tech. Sdn. Bhd. and Qarbotech Sdn. Bhd. were elected as the founding members of MNIG. The Minister had a chance to visit the ION2 exhibition booth and see the products displayed by ION2.



### Dr. Intan Helina's Innovative Flexible Antenna Technology Showcased at Semarak Patriotik IPT 2022

A research product by Ts. Dr. Intan Helina, a flexible antenna fabrication technology, was selected to be exhibited by UPM through the Putra Science Park at an exhibition in conjunction with the Semarak Patriotik IPT 2022. This technology uses organic conductive paste or ink with an additional layer of magnetic material to improve antenna performance.



This programme was held on 15<sup>th</sup> September 2022 at the National Defense University of Malaysia. It was officiated by YAB Prime Minister of Malaysia, Dato' Sri Ismail Sabri Yaakob, with the theme of *Mahasiswa Patriotik, Keluarga Malaysia*.

ION2 encourages participation to showcase products from their researchers, while increasing visibility as a nanoscience and nanotechnology research center.



### University of Surrey and ION2 Explore Mutual Interests in Research and Education

A senior delegation from the University of Surrey, England, visited ION2 on 15<sup>th</sup> September 2022 to discuss mutual research and education interests between the two institutions. Their Pro-Vice-Chancellor and Dean Executive, Prof. Bob Nichol, led the visit.



ION2 was presented by Director, Prof. Dr. Mohd Nizar Hamidon and fellow researchers during the visit. The discussion includes business-to-business matters, research collaboration and staff and students mobility. After the discussion, the delegates were shown ION2's research products including thick film paste technology, photosynthesis enhancer and others.

### ION2 Director's Visit to Bayburt University

Prof. Dr. Mohd Nizar Hamidon, Director of ION2 visited Bayburt University, Turkiye besides attending the 4<sup>th</sup> International Conference on Advanced Engineering Technologies (ICADET2022), held at the university from 28<sup>th</sup> to 30<sup>th</sup> September 2022. He was invited as a keynote presenter at ICADET2022 for a talk entitled "Recent Applications in Thick Film Technology".

In addition, the Director was also invited as the Session Chair for the Electrical and Electronic Engineering session on the second day. ION2 research officers also participated in the international conference as presenters in their respective fields, physically and online.

Prof. Dr. Mohd Nizar also had the opportunity to meet with Prof. Dr. Mutlu Turkmen, the Rector of Bayburt University, and discuss the direction and potential of cooperation between UPM and Bayburt University.

The ION2 delegation then visited the Central Research Laboratory, which accommodates high-technology equipment such as XRD, TEM and SEM. The director also had the opportunity to brief the staff and researchers of the laboratory about UPM and ION2.





### ION2 Receives a Visit from the SMS Tuanku Aishah Rohani Delegation

ION2 received a visit from 40 students and three teachers from SMS Tuanku Aishah Rohani (SGS), Seremban, on 12<sup>th</sup> October 2022. This visit aimed to expose the nanotechnology research activities at ION2 and the high-tech equipment used to produce nanomaterials.

This programme is also a starting point for the collaborative relationship between SGS and ION2 in planning and developing nanotechnology innovation projects for the upcoming national-level innovation competition, besides producing a generation of innovation savvy.

The programme started with a welcome speech and an ION2 introduction session by YBhg. Prof. Dr. Mohd Nizar Hamidon, Director of ION2. After the photo session, the students were divided into four groups and taken on a tour of the laboratories and the analysis laboratory to learn more about the research and analysis at ION2.

Afterwards, a discussion session was held to allow students to share ideas with ION2 researchers. At the end of the programme, students took part in an ION2 quiz session to assess the students' understanding of the visit programme session.

It is hoped that this programme will be able to motivate students to come up with creative and innovative ideas that can compete in innovation project competitions at the national level up to the international level.



### Knowledge Transfer Programme with MRSM Batu Pahat, Johor

ION2 received a visit from 38 students and three teachers from MRSM Batu Pahat on 28<sup>th</sup> October 2022. The delegation was led by Puan Siti Noorliza Samsu.

They were welcomed by ION2 Director, Prof. Dr. Mohd Nizar Hamidon, followed by a speech "Introduction to Nanoscience and Nanotechnology." His speech gave students insight into nanoscale materials in terms of their characteristics, morphology, and field of applications.

After the speech, the students and teachers were guided to the laboratories and characterisation units. They had been introduced to the characterisation equipment such as XRD, FESEM and Raman. ION2 hopes the students benefited from the visit and shared their knowledge and experience with others in their school.

### A Visit and Knowledge Transfer Programme with Sek. Men. Keb. Jalan Tiga

A 'visit and knowledge transfer' session was held with SMKJ3, Bandar Baru Bangi, Bandar Baru Bangi on 1<sup>st</sup> December 2022 from 9.30 am until 1.00 pm. The programme was organised by the NPTL, ION2.

"Basic knowledge on nanoscience and nanotechnology to the society" is one of the approaches to disseminating knowledge and intangibly empowering humanity by keeping them abreast with the



latest technologies. This programme serves as a platform to increase awareness and understanding of nanoscience and nanotechnology to students and teachers, facilitated by the experts in ION2. This programme aligns with the Ministry of Education's aspiration to emphasise a curriculum based on ideas, technology, and innovation instead of Science, Technology, Engineering and Mathematics (STEM).



The programme started with a welcoming speech from the Head of NPTEL, Assoc. Prof. Ir. Dr. Siti Hajar Othman, followed by her sharing session entitled "Nanoscience and Nanotechnology." Afterwards, the students and teachers visited the laboratories and characterisation units to better understand nanomaterials and nanotechnology research in ION2. SMKJ3 Headmistress, Puan Massita Mohammed Sin, led the delegation of students and teachers.

## MOBILITY PROGRAMME

### Staff Mobility Program from Universitas Brawijaya to ION2

ION2 received a visit from two staff members of the Faculty of Dentistry, Universitas Brawijaya (UB), Indonesia, through a Staff Mobility Program for four days, starting Monday, 12<sup>th</sup> July 2022, to Saturday, 16<sup>th</sup> July 2022.

During the programme, the UB's staff had the opportunity to hold several discussion sessions with researchers, be introduced to some related facilities available in several institutes and faculties, and tour around UPM. Prof. Dr. Mohd Zobir Hussein (ION2 Research Fellow and program advisor) and Assoc. Prof. Dr. Che Azurahaman Che Abdullah (head of the programme) organised the activity schedules to meet the parties' needs. Among the activities carried out in this programme were visits to the CANRES Laboratory, the Institute of Biosciences (IBS), and the Research Laboratory of the Faculty of Science, UPM, accompanied by ION2 research officers, namely Dr. Ismayadi Ismail and Puan Rosnah Nawang. The visit aimed to expose and promote to UB's participants regarding the latest research facilities and projects available at UPM. In addition, mobility participants also took the opportunity to carry out the sample analysis with the guidance of the person in charge. Among the equipment are X-ray Diffractometer (XRD), Nano-sizer, High-Resolution Transmission Electron Microscope (HRTEM), and others.

At the end of the programme, both participants from UB, Dr. Ratih Pusporini and Dr. Diena Fuadiyah agreed that the first visit was effective and opened up other opportunities for bilateral cooperation in the field of research and commercialisation in the future. "We greatly appreciate the excellent service and hospitality throughout our stay here. Hopefully, such programs will be held often in the future," added Dr. Ratih at the end of the meeting before they left for home.

### International Student Mobility Programme of Universitas Airlangga

Two students from the University of Airlangga (UNAIR), Kampus Mulyorejo, Surabaya, Indonesia, visited ION2, UPM, under the International Student Mobility Programme for four weeks, starting from 1<sup>st</sup> to 29<sup>th</sup> July 2022.

They were Andika Pramudya Wardana, a PhD candidate, and Tio Christiawan Bramayudha, a final year student of the Bachelor of Chemistry from the Faculty of Science and Technology, UNAIR.



The programme aimed to strengthen the relationship between the two regional universities, enhancing the students' experience and knowledge in various materials analysis and managing research activities.



Assoc. Prof. Dr. Che Azurahaman Che Abdullah led the programme, which involved sharing ION2 expertise and facilities and visiting the Institute of Biosciences and Faculty of Science, UPM. In addition, the students also had the opportunity to attend a series of workshops and discussion sessions with UPM researchers.

The students also had the opportunity to visit Putrajaya and Kuala Lumpur as well as experience the Eid al-Adha celebration in Malaysia. "I will go back to UNAIR and encourage my colleagues and researchers to participate in this mobility programme because this program provides useful experience and knowledge to the participant", replied Mr. Andika about the experience of participating in the mobility programme at ION2, UPM, before leaving Malaysia.

### Kyutech Student Mobility Programme for DSSC Workshop

The Kyutech Student Mobility Programme for the DSSC workshop at ION2 was held from 3<sup>rd</sup> to 16<sup>th</sup> November 2022. Five students from Kyushu Institute of Technology, Japan, participated in the mobility programme. Professor Dr. Suhaidi Shafie facilitated the DSSC Workshop, which included modules on the preparation of FTO/Pt Counter Electrode,



separation of dye from plants, preparation of dye baths, performance evaluation, and adsorption of dye molecules on nanoporous TiO<sub>2</sub> electrode to fabricate photoanodes. In addition, the participants also took part in social activities, such as visiting the Malay

Heritage Museum. The museum has collected over a hundred Malay heritage artefacts in Peninsular Malaysia, from textiles to architecture. Finally, the programme concluded with a final presentation.

## LIST OF INBOUND PROGRAMMES 2022

No.	University	Country	Virtual / Physical	Quantity
1	Universitas Airlangga	Indonesia	Physical	2
2	Nigerian Defence Academy	Nigeria	Physical	1
3	Bayero University Kano	Nigeria	Physical	1
4	Universiti Malaysia Pahang	Malaysia	Physical	1
5	Universiti Teknologi Malaysia	Malaysia	Physical	2
6	Universiti Malaya	Malaysia	Physical	1
7	Kyutech	Japan	Physical	5
Total Inbound				13



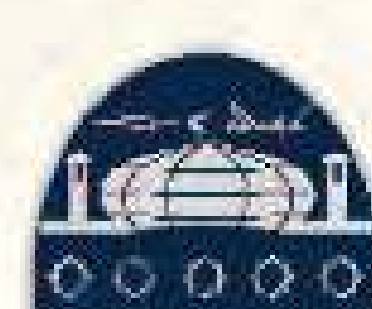
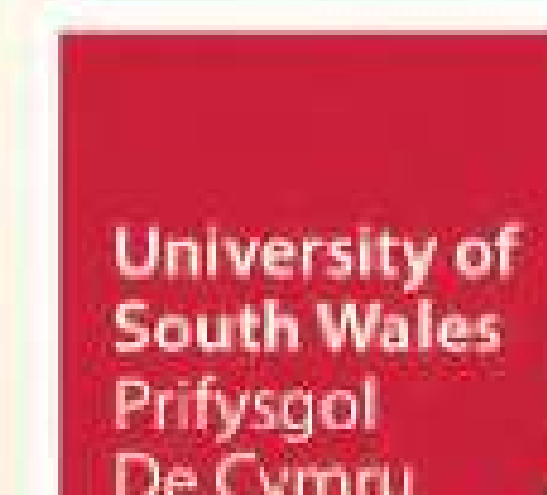
## LIST OF OUTBOUND PROGRAMMES 2022

No.	Program	Country	Virtual / Physical	Quantity
1	Synchrotron - Light For Experimental Science And Application In The Middle East (Sesame)	Jordan	Physical	1
2	Synchrotron - Light Research Institute	Thailand	Physical	2
			Total Inbound	3

## LIST MOU/MOA/LOI 2022

No.	Institution	MOU / MOA / LOI	Signature Date	Expiry Date	Status
1	Organisation for the Prohibition of Chemical	MOU	25 February 2022	25 February 2026	Official
2	Universitas Brawijaya	LOI	16 September 2022		Official
3	Proxima Technologies PLT	LOI	19 September 2022		Official
4	Applied Energy Solution Sdn Bhd	LOI	25 October 2022		Official

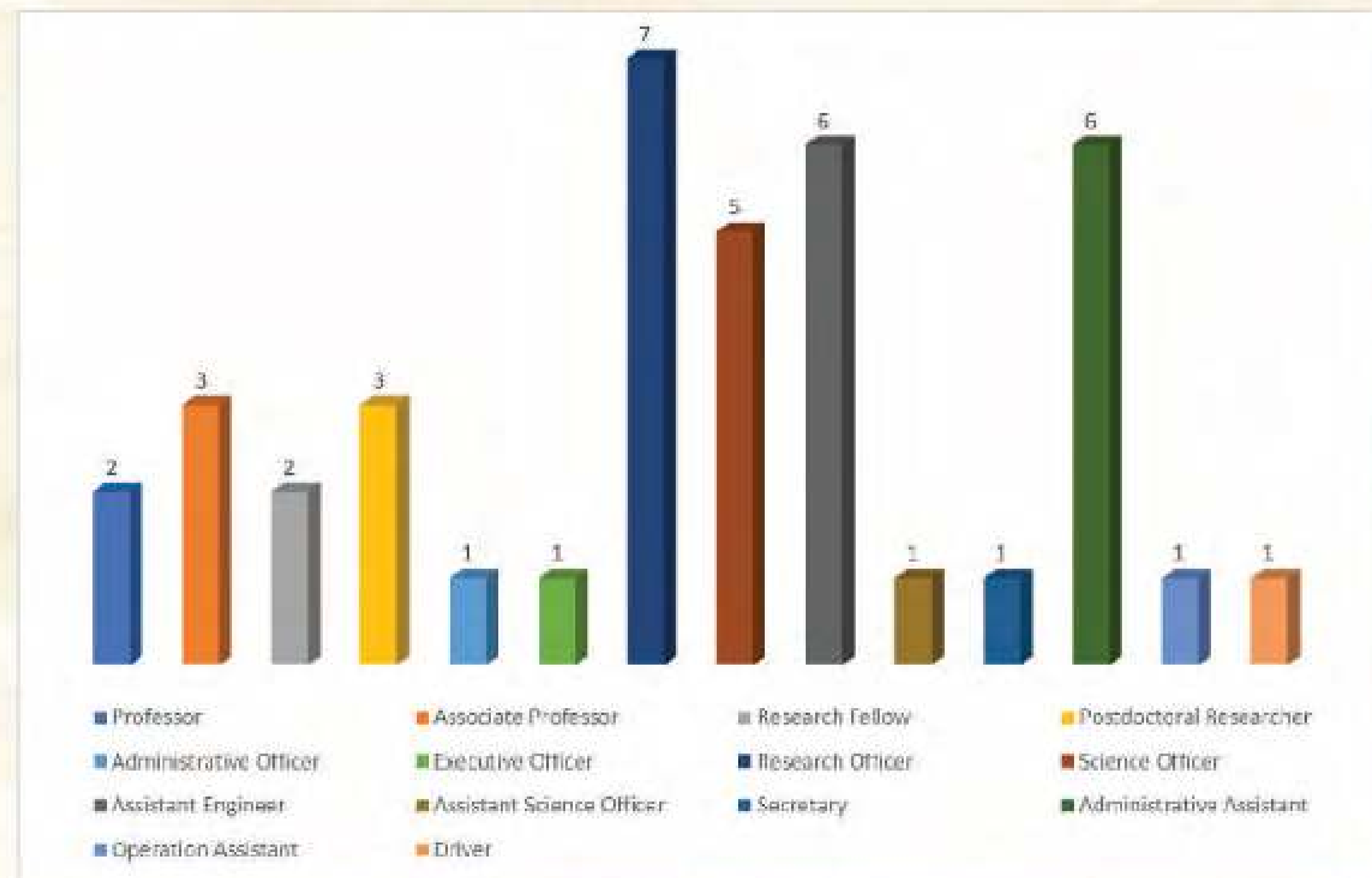
## ACTIVE MOUs/MOAs





# HUMAN RESOURCES

ION2 is supported by a group of dedicated staff to facilitate the overall operation of the institute's functions and activities. In addition, several committees are also formed to implement and monitor various activities from research management, university-industry-community linkages, research funding, quality system and laboratory safety.



## UPM EXCELLENT SERVICE AWARD 2021

UPM will hold an annual recognition ceremony called Majlis Gemilang Putra to honour its employees who uphold a high standard of excellence in their job and significantly contribute to the university. The ceremony was held on 24<sup>th</sup> July 2022 at Pusat Kebudayaan dan Kesenian, Sultan Salahuddin Abdul Aziz Shah UPM.

The Excellent Service Award 2021 has been awarded to three of ION2's staff. They were Assoc. Prof. Dr. Che Azurahaman binti Che Abdullah, Dr. Siti Zulaika binti Razali and Ms. Khariza binti Abdul Wahab. Heartfelt congratulations to the recipients, and may this recognition serve as motivation for ION2 staff to thrive in their roles continually, act with integrity and portray a strong dedication to the institution's goals and values.



STAFF RETIRED



STAFF LEAVING





# LISTS OF COMMITTEES

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Prof. Dr. Mohd Nizar Hamidon

### Deputy Chairman

Ts.Dr. Intan Helina Hasan

### Secretary

Haizum Hanim Ab Halim (Mar-Dec 2022)

Siti Nur Lidiya Sharudin (since Dec 2022)

### Committee Members

Dr. Ismayadi Ismail

Dr. Siti Zulaika Razali

Dr. Mohd Hafizuddin Ab Ghani

Rosnah Nawang

Juraina Md Yusof

Mohd Ali Mat Nong

## INDUSTRY AND COMMUNITY LINKAGES (JINM) COMMITTEE

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Prof. Ts. Dr. Suraya Abdul Rashid

### Deputy Chairman

Juraina Md Yusof

### Secretary

Rosnah Nawang

### Committee Members

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Ts. Dr. Intan Helina Hasan

Dr. Siti Zulaika Razali

Md Ali Rani

Mohd Ali Mat Nong

Zamzuri Zabidin

ChM. Sarinawani Abdul Ghani

Roslina Abdul Rashid

Nurnazeera Zulkefli

Mohd Wafi Azimin Mohamad Jan

Noor Linda Hassan

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Rosiha Abdul Razak (since Sept. 2022)

### Facilitator

Nurainakmal Kamal Bahrin

(Pusat Pertanian Putra)

### Coordinator

Haizum Hanim Ab Halim (Mar-Dec 2022)

Siti Nur Lidiya Sharudin (since Dec 2022)

### Secretary

Khariza Abdul Wahab

### Head of Promotion Committee

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### Head of Audit Committee

ChM. Sarinawani Abdul Ghani

### Head of Training Committee

Zamzurina Abdul Wahab

### Head of Zone

Graphene Zone

Zakky Yamanie Jamiauddin

### Graphite Zone

Mohd Wafi Azimin Mohamad Jan

### Biochar Zone

Noor Linda Hassan

### CNT Zone

Nazrul Abdullah

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Prof. Ts. Suhaidi Shafie (until April 2022)

Prof. ChM Dr. Jaafar Abdullah (since May 2022)



**TECHNICAL AND QUOTATION MEETING****Chairman**

Prof. Ts. Suhaidi Shafie (until April 2022)

Prof. ChM. Dr. Jaafar Abdullah (since May 2022)

**Secretary**

Mustapha Kamal Tahir (until Aug. 2022)

Rosiha Abdul Razak (since Sept. 2022)

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Assoc. Prof. Ir. Dr. Siti Hajar Othman

Assoc. Prof. Dr. Che Azura Hanim Che Abdullah

ChM. Sarinawani Abdul Ghani

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Rosiha Abdul Razak (since Sept. 2022)

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Mohd Ali Mat Nong

**Deputy Customer's Satisfaction Coordinator**

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Siti Nur Lidiya Sharudin (since Dec 2022)

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Zamzuri Zabidin

**Lead Auditor**

Md Ali Rani

**Internal Auditors**

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Md Ali Rani

Rokiah Deraman

Mohd. Wafi Azimin Mohammad Jan

Nazrul Abdullah

Juraina Md Yusof

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Zamzurina Abdul Wahab

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Norliyana Mahat (Finance)

Mohd Eri Mohd Noor (Research)

Khariza Abdul Wahab (Office record)

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**Deputy Chairman**

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Mohamad Yunus bin Mohamad Syed

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Zamzurina Abdul Wahab

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Noor Lina Shamsuddin

**Employer Representatives**

ChM. Sarinawani Abdul Ghani

Roslina Abdul Rashid

Nurnazeera Zulkefli

Zamzuri Zabidin

Nazrul Abdullah



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 Mohd Wafi Azimln Mohammad Jan  
 Mohd Kadri Masaud  
 Zakky Yamanie Jamiauddin  
 Nurshahida S Saleh  
 Zamzurina Abdul Wahab

**Chemical Waste and E-Waste Coordinator**

Nurshahida S Saleh

**Chemical Coordinator**

Nurshahida S Saleh

**First Aider**

Zamzurina AbdulWahab

**Radiation Worker**

ChM. Sarinawani Abdul Ghani  
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Roslina AbdulRashid

**Head of ERT Operation**

Ab Haffiz Ab Jalil

**Logistic**

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**Finance**

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**First Aider**

Zamzurina Abdul Wahab  
 Muhammad Fikrul Hasani Che Musa

**Fire Fighting Officer**

Mohd Kadri Masaud

**Evacuation Team**

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 Nazrul Abdullah  
 Zakky Yamanie Jamiauddin  
 Nurnazeera Zulkefli  
 Noor Linda Hassan

**Traffic Control**

Zamzuri Zabidin  
 Nor Azli Sulalman

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 Siti Nur Lidiya Sharudin (since Dec. 2022)

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 Dr. Mohd Hafizudin Ab Ghani  
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 Mohd Ali Mat Nong  
 Juraina Md Yusof  
 Md Ali Rani  
 Zamzurina Zabidin  
 Nurnazeera Zulkefli  
 ChM Sarinawani Abdul Ghani

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ChM. Sarinawani Abdul Ghanl

**Deputy Quality Manager**

Roslina Abdul Rashid

**Technical Manager**

Dr. Ismayadi Ismail (CL)  
 Zamzuri Zabidin (MML)

**Deputy Technical Manager**

Md Ali Rani (CL)  
 Nurnazeera Zulkefli (MML)

**Document Control Officer**

Mohd Ali Mat Nong



**Technical Staff/Competent Personnel**

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ChM. Sarinawani Abdul Ghani (CL)  
Zamzuri Zabidin (MML)  
Nurnazeera Zulkefli (MML)  
Nazrul Abdullah (MML)  
Noor Lina Shamsuddin (MML)  
Zakky Yamanie Jamiauddin (MML)

**Approved Signatory**

Prof. ChM. Dr. Mohd Zobir Hussein (CL)  
Prof. ChM. Dr. Nor Azah Yusof (CL)  
Prof. ChM. Dr. Zulkarnain Zainal (CL)  
Assoc. Prof. Dr. Khamirul Amin Matori (CL)  
Prof. ChM. Dr. Janet Lim Hong Ngee (CL)  
Dr. Ismayadi Ismail (CL)  
ChM. Sarinawani Abdul Ghani (CL)

**Signatory**

Dr. Khairil Anas Md Rezali (MML)  
Zamzuri Zabidin (MML)  
Nurnazeera Zulkefli (MML)  
\*CL- Characterisation Laboratory  
\*MML- Mass Metrology Laboratory

**WEBSITE COMMITTEE****Chairman**

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**Deputy Chairman**

Roslina Abdul Rashid

**Secretary**

Rokiah Deraman

**Committee Members**

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Dr. Siti Zulaika Razali  
Dr. Mohd Hafizudin Ab Ghani  
Rosnah Nawang  
Juraina Md Yusof  
Nurnazeera Zulkefli  
Khariza Abdul Wahab  
Noor Linda Hassan

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Md Ali Rani

**Secretary**

Nurnazeera Zulkefli

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ChM. Sarinawani Abdul Ghani  
Zamzuri Zabidin  
Nazrul Abdullah  
Ab Haffiz Ab Jalil  
Mohd Wafi Azim In Mohammad Jan  
Mohd Kadri Masaud  
Zakky Yamanie Jamiauddin  
Noor Lina Shamsuddin  
Nurshahida S Saleh

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Mustapha Kamal Tahir (until Aug. 2022)  
Rosiha Abdul Razak (since Sept. 2022)

**Secretary**

Md Ali Rani

**Committee Members**

Ts. Dr. Intan Helina Hasan  
Dr. Ismayadi Ismail  
Dr. Siti Zulaika Razali  
Zamzuri Zabidin  
Juraina Md Yusof  
ChM. Sarinawani Abdul Ghani  
Nurnazeera Zulkefli  
Haizum Hanim Ab Halim (Mar. - Dec. 2022)  
Siti Nur Lidiya Sharudin (since Dec. 2022)

**KELESTARIAN HIJAU COMMITTEE****Chairman**

Assoc. Prof. Ir. Dr. Siti Hajar Othman

**Deputy Chairman**

Mohd Ali Mat Nong

**Secretary**

Khariza Abdul Wahab

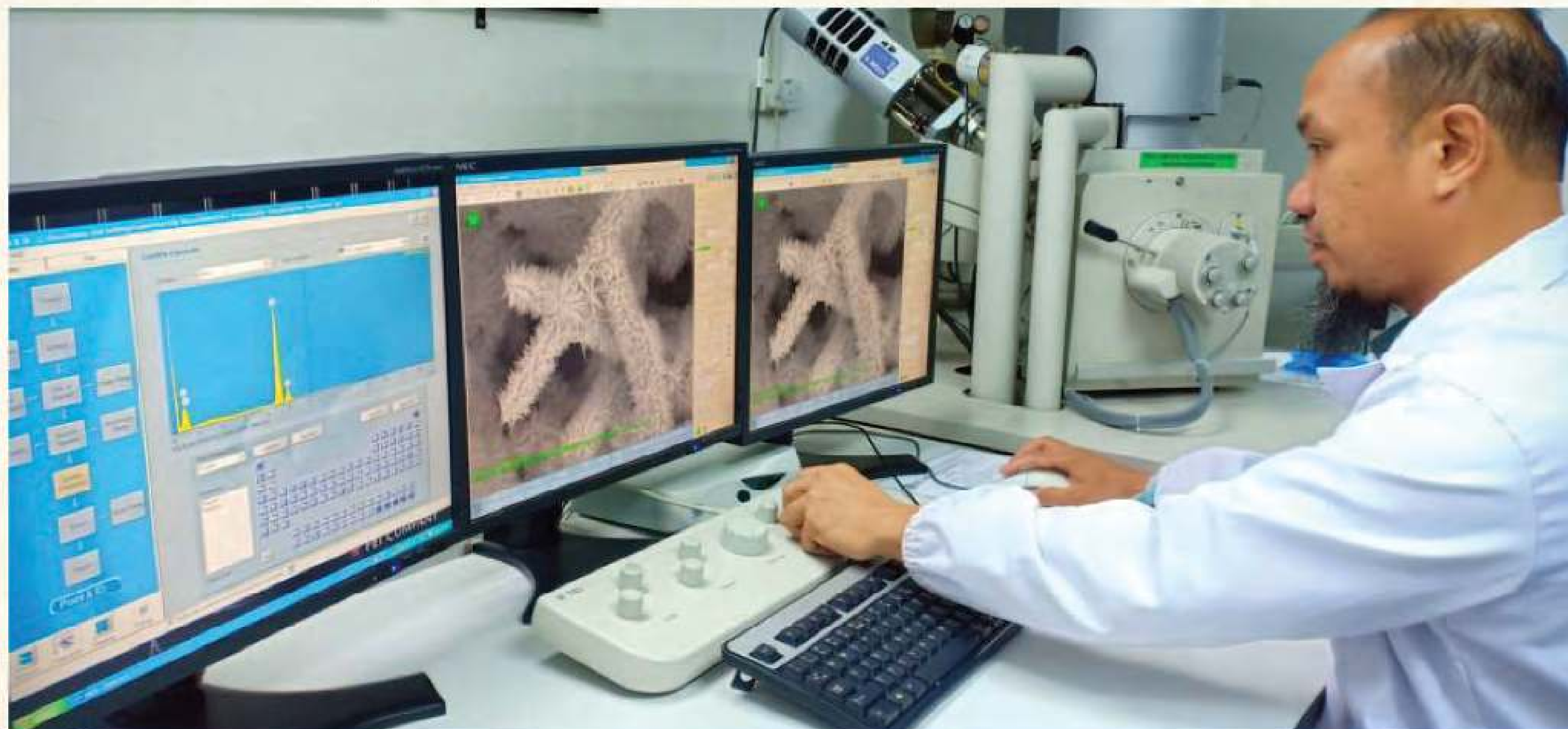
**Committee Members**

Ts. Dr. Intan Helina Hasan  
Dr. Mohd Hafizudin Ab Ghani  
Juraina Md Yusof  
Ab Haffiz Ab Jalil  
Norazli Sulaiman



# TESTING FACILITIES

Accreditation laboratory of MS ISO/IEC 17025 for FESEM/EDX



**Field Emission Scanning Electron Microscope (FESEM)**

**Energy Dispersive X-Ray (EDX)**



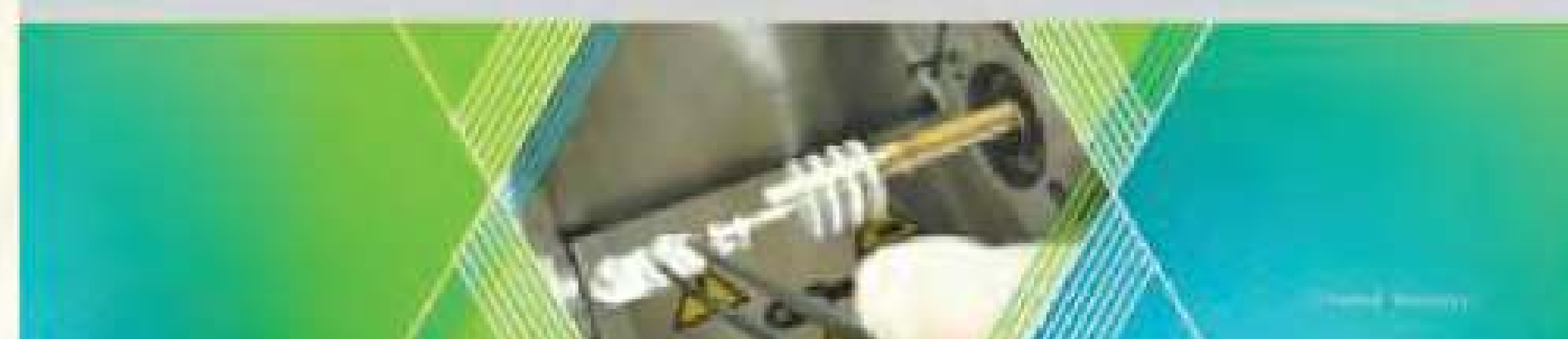
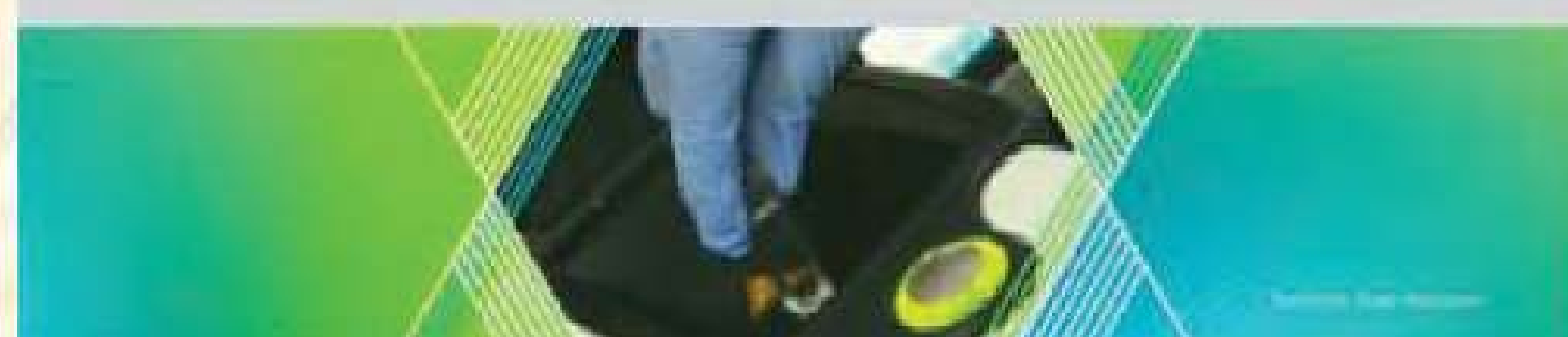
**X-ray Diffractometer (XRD)**

**RAMAN Spectroscopy**



**Nano-sizer**

**Simultaneous Thermal Analysis (TGA/DSC)**



**Multimode Microplate Reader**



EXISTING  
FACILITIES



# PROGRAMME HIGHLIGHTS

## ION2 Innovation Day in Conjunction with UPM's 50<sup>th</sup> Golden Jubilee Celebration

14<sup>th</sup> June - ION2 Innovation Day was organised at the ION2 Seminar Hall in conjunction with UPM's 50<sup>th</sup> Golden Jubilee Celebration. The programme aimed to showcase research products from ION2's researchers that have the potential to be commercialised and to collaborate with local agencies and industries to develop nanotechnology-based products. The programme also provided an opportunity for ION2 to continue to increase its visibility as an institute focussing on nanotechnology, especially after the rebranding on 15<sup>th</sup> November 2021.

YBhg. Dato' Dr. Hasan Mad, a UPM Board of Directors member, officiated the programme. The programme was also attended by the Deputy Vice-Chancellor (Research and Innovation), UPM, Prof. Dr. Nazamid Saari, as a representative of UPM Management.

In his speech, Dato' Dr. Hasan Mad called on nanotechnologists to offer "nano solutions" services, where they help industry players show how nanotechnology can improve the productivity of their business. According to him, the network between nanotechnology experts, industry players, and agencies is critical in translating the technology and expertise built for so long in ION2 to be immediately utilised.

ION2 managed to gather 16 exhibitions of UPMs' nano-based products and technologies, which are ready to be commercialised for display to guests to explore commercialisation opportunities with the industry and local agencies. The presence of local agencies and industry representatives, especially those under the auspices of the Malay Consultative Council (MPM), is also very encouraging. It is hoped that discussions between researchers and local industry players with leading agencies in the field of nanotechnology, such as the National Nanotechnology Center (NNC) and NanoMalaysia Berhad, can achieve the objective of organising this programme, which is to lift nano products for commercialisation.



## 3<sup>rd</sup> Malaysian Metal-Organic Frameworks Workshop (MyMOF3)

17<sup>th</sup> Nov - The 3<sup>rd</sup> Malaysian Metal-Organic Frameworks (MyMOF3) workshop, organised by the Foundry of Reticular Materials for Sustainability (FORMS) of ION2 and the Faculty of Science, was successfully held from 14<sup>th</sup> - 17<sup>th</sup> November 2022.

The intensive full-day workshop was conducted by Mr. Kyle E. Cordova (Royal Scientific Society, Jordan), Dr. Felipe Gandara (Materials Science Institute of Madrid), Dr. Muhammad Alif Mohammad Latif (UPM) and Dr. Uwesh Tiwari (Malvern Panalytical). The participants were exposed to "Reticular Chemistry : Synthesis, Characterisation and Applications Speciffucally for Metal-Organic Frameworks"



In addition, "An Introduction to MOF Computational Chemistry" was also in the module to provide more tools for understanding the working of MOF structures.

The workshop was conducted at the ION2 and the Faculty of Science. The participants were from the University of Malaya, University of Science Malaysia and UPM. This workshop is the continuation of the two previous workshops, which were first held in 2017.



### iSAMN2022 Presents 86 Papers during the 2-day Program

8<sup>th</sup> Dec – NSCL successfully organised the 6<sup>th</sup> International Symposium on Advanced Materials and Nanotechnology (iSAMN2022), with 86 conference papers, including keynotes and invited papers, presented over two days on the 7<sup>th</sup> and 8<sup>th</sup> of December 2022. The conference theme, "Sustainability through Green Nanotechnology Research, Development, and Innovations", attracted the interest of 107 participants from 29 local and international institutions, including Indonesia, Philippines, France, India, Japan, Thailand, Egypt, and Australia. The diversity of participants' backgrounds allowed for extensive knowledge transfer throughout the programme.

The symposium served as a platform for participants to share their research output and gain knowledge in advanced materials and nanotechnology. Among the exciting topics selected by participants, nanotechnology devices (23%) were the most popular, followed by smart materials, nano and eco (20%), and 17% each for functional and health structure materials, and medical sciences and biotechnology.

Selected papers from iSAMN2022 will be published in special issues of the International Journal of Chemical and Biochemical Sciences and the American Journal of Engineering and Applied Sciences by the International Association of Scientific Organizations.

iSAMN2022 was chaired by Assoc. Prof. Dr. Che Azurahaman Che Abdullah. In the closing speech, she said, "I would like to thank all the honourable guests, invited speakers, participants and corporate



partners for their support in making this symposium a success. I am confident that each presenter effectively delivers their research work for dissemination and knowledge sharing. I sincerely hope that your presentations and discussions will contribute to wealth creation, nation-building, and human progress in their respective countries. It is still valuable, even if the contribution is small."



Assoc. Prof. Dr. Che Azurahaman also handed over the iSAMN2023 mandate to Assoc. Prof. Dr. Jaafar Abdullah, Head of FNDL, in the closing ceremony. She hoped that iSAMN2023 would receive even more support and participation, which would bring opportunities for future research collaboration.

## OTHER ACTIVITIES

### Strengthening Work and Publication Workshop

18<sup>th</sup> Jan - A workshop entitled "Workshop on Strengthening Work and Publication", was successfully held on 18<sup>th</sup> January 2022, at the Dorsett Hotel Putrajaya. Assoc. Prof. Dr. Yap Wing Fen from FNDL conducted the workshop. This workshop aimed to discuss and analyze the work carried out during 2020-2021 and chart the direction of research to a higher level by building a network of cooperation and collaboration between universities and industries.

Fifteen participants attended the workshop. The workshop lasted from 9 am to 2 pm. During the workshop, participants presented their progress in the work carried out and plans for 2022, including research work and targets for journal publication. In addition, the participants were given souvenirs at the end of the workshop.

"I would like to congratulate the students for their hard work in their research and successful publications of their findings in the journals for 2020-2021. I hope we can achieve more outstanding success this year (2022). The support of ION2 has been instrumental in the success of this program, and I hope we can continue similar programs in the future. Such programs can indirectly encourage more students to perform better and attract potential students to pursue higher studies, especially at ION2, UPM," said the workshop director, Assoc. Prof. Dr. Yap Wing Fen, during his closing speech.





### International Guest Lecture Series Programme

25<sup>th</sup> Jan – ION2 organised an International Guest Lecture Series V programme on 25<sup>th</sup> January 2022, featuring Prof. Dr. Gurumurthy Hegde, Director of the Center for Advanced Research and Development (CARD), Department of Chemistry, Christ University, Bengaluru, India.

The sharing entitled "Tuning the Porosity using Waste Materials: Cost-Effective Nanotechnology" took almost two hours online through the Zoom application and was attended by sixty participants.



The programme aimed to provide the latest knowledge related to the research and application of nano-based wastes to the UPMs' researchers researchers, particularly to ION2's researchers. In addition, the became a platform for research collaborations between ION2-UPM and the Christ University, India.

Meanwhile, the International Guest Lecture Series VI Programme was held on 26<sup>th</sup> May 2022. The speaker was Prof. Tao Wang from Wuhan University of Technology, China. His sharing entitled "Aggregate Control of Organic Semiconductors towards High-Performance Photovoltaics".

Both programmes were conducted by Assoc. Prof. Dr. Che Azurahanim Che Abdullah, NSCL Head of Laboratory. "I would like to thank and congratulate the participants who have spent the time to attend the knowledge-sharing programme today. Hopefully, we can convene such programmes more frequently in the future", said Dr. Che Azurahanim during her concluding speech at the end of the programme.

### ION2 Host X-Ray Diffraction Workshop

9<sup>th</sup> Mar - ION2 hosted an X-Ray Diffraction (XRD) Workshop aimed at teaching participants how to analyse powder and thin film sample data using the Smart Lab Studio II software.

Dr. Muhammad Firdaus bin Omar, an application consultant at RGS Corporation Sdn Bhd (RGS) and a senior lecturer at the Universiti Teknologi Malaysia, led this two-day workshop, assisted by Ms. Shasha Ainaa Zulyazan, an RGS Application Engineer.

The programme was conducted entirely in the XRD laboratory, with a small group of ION2 students and researchers as participants. All participants responded positively and actively participated in the lecture and hands-on sessions.

In addition to providing tips on analyzing XRD data, Dr. Firdaus, who has extensive experience with XRD, shared some advice on sample preparation and testing methods for various types of samples. We hope this workshop will benefit all participants and officers in developing their analytical skills and competencies.





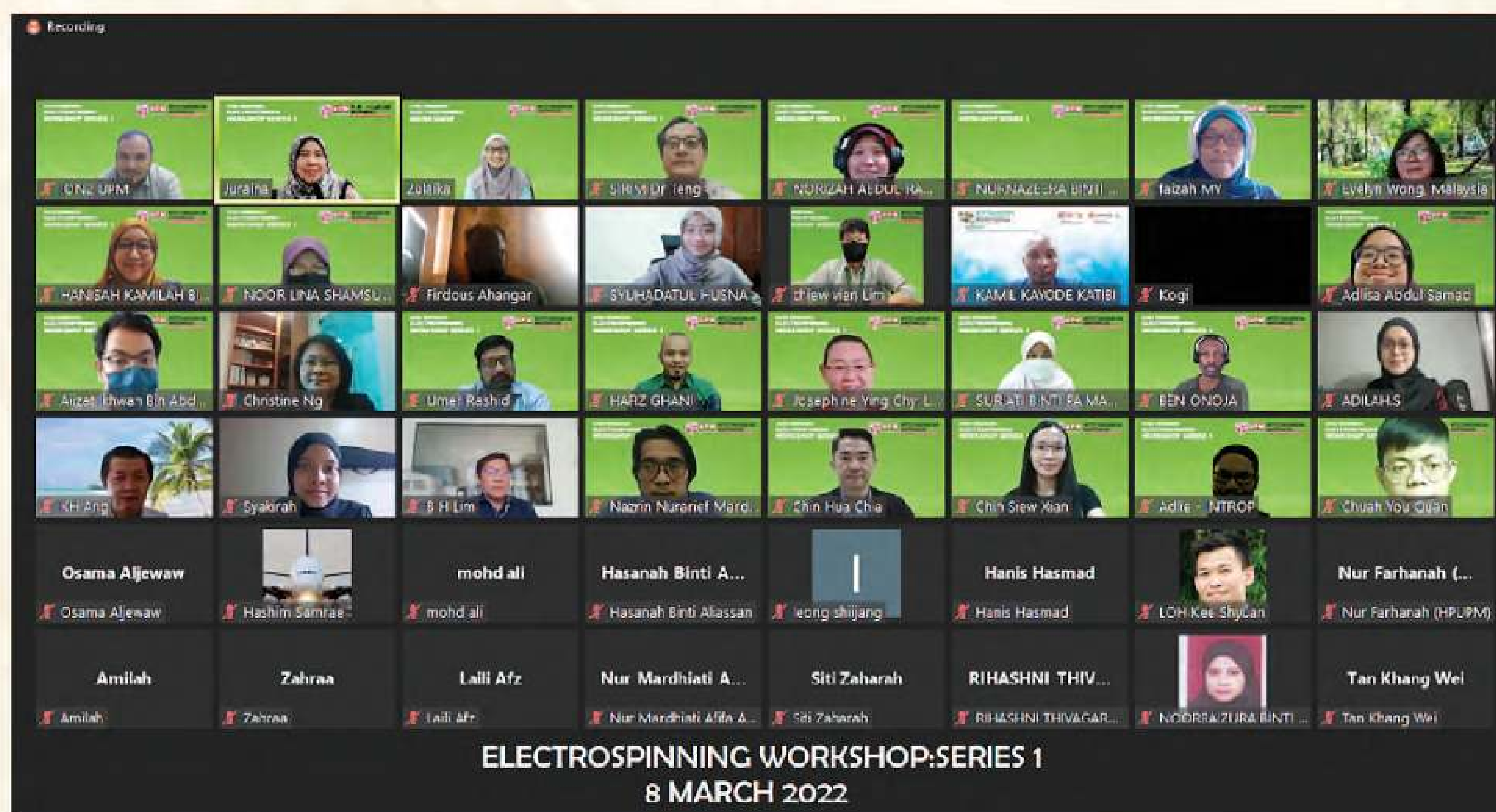
### Electrospinning Workshop Series 1

8<sup>th</sup> Mar - An Electrospinning Seminar Series 1 was successfully held virtually by the NPTL in collaboration with Progene Link Sdn. Bhd. via the Zoom platform.

The organiser invited three speakers to present their insights and experiences in electrospinning technology. One was a principal researcher from the Industrial Center of Innovation, SIRIM, Dr Teng Wan Dung. He shared his research experience in electrospinning technology in his "An Introduction of Electrospinning Technology and its Potential Applications" talk. The second speaker was Ms. Christine Ng from Adastra IP (M) Sdn. Bhd. presented regarding intellectual properties entitled "IP-IT Makes Sense".

The last speaker was Dr. Norizah Abdul Rahman, an associate researcher of NPTL, shared her interesting research works related to electrospinning technology. Her talk was entitled "Electrospun Nanofiber Mats for Biomedical and Environmental Applications".

A total of 72 participants from UPM and other institutions attended this workshop. It is hoped that the workshop benefited the participants and spread knowledge related to the use of electrospinning in the field of nanoscience and nanotechnology.



### Introduction to RSM Series 1

13<sup>th</sup> Apr – An introduction to Response Surface Methodology (RSM) Series 1 was hosted online via the Zoom platform. The course was organised by NPTL.

The half-day course was conducted by Ts. Dr. Mohd Salahuddin Mohd Basri, a lecturer from the Faculty of Engineering, UPM. He gave a clear explanation on the basic concept of RSM, planning, and design of experiment, minimising error and analysis using Minitab software in general.

The introductory course aimed to help participants identify process interactions between parameters, develop a system's mathematical model, and reduce cost and processing time with unlimited trial and error runs. RSM also contributes to the ease of experiment planning and execution to achieve the project's objectives in the timeline.



A total of 138 participants consisted of students and interested individuals who attended the free admission course. Due to the enormous support from participants, NPTL considers organising the second series of RSM course focusing on the hands-on Minitab software soon.



### **Achieving Excellence in Research Publications Seminar**

31<sup>st</sup> May- A seminar entitled “Achieving Excellence in Research Publications” was held on 13<sup>th</sup> May 2022 online. The seminar's objectives were to expose how to choose a suitable publishing platform relatable to the written manuscript, tips, techniques, and style of scientific writing. The webinar also discussed systematic, efficient, and high-impact writing methods to attract publishers and audiences that will increase the manuscript's citations.

Scientific writing and publishing are essential elements in disseminating research findings and knowledge. There is a significant increase in journal publications each year, and this sparked a healthy competition among researchers to produce high-quality and impactful publications. Thus, delivering a high-quality manuscript depends on the precision of contents, sufficient data, and in-depth discussion. However, there is also a need to carefully choose the right publication platform and style of writings suitable for the targeted audience. Another important thing is that it is also crucial to ensure a smooth flow of content and use precise words in the manuscript to convey the gist of information to the audience.

The webinar started at 10.30 am until 12.30 pm and was attended by 117 participants, including students and researchers from UPM and outside UPM. Dr. Umer Rashid, a senior research fellow of ION2, was invited as the speaker, and Mrs. Juraina Md Yusof, a research officer of ION2, acted as the moderator for the session.

The webinar, organised by NPTL, gained massive support and responses from the participants. After the seminar, 65% of participants understood the requirements for scientific writing, 62% knew how to organize the writing style systematically, 60% knew how to discuss their results convincingly, and 60% were confident about publishing in a reputable journal.

The NPTL hopes this seminar benefitted all attended participants so that they will be able to produce high-quality manuscripts that can be published in the impactful journal.



### Workshop on Preparation, Characterisation & Application of MIP as Sensing Materials

26<sup>th</sup> July - FNDL organised a two-day workshop entitled "Preparation, Characterisation, and Application of MIP As Sensing Materials" from 26<sup>th</sup> to 27<sup>th</sup> July at the ION2 Seminar Hall and the Faculty of Science. The programme aimed to introduce the technology of molecular imprinted polymer (MIP), a mimic technology that can imitate the ability of enzymes and antibodies and has a high identification of target molecules. This MIP technology has many advantages to be used as a detection or sensing material, such as having high mechanical and chemical stability and can be widely applied in the sensor industry.



Realising the vast research potential of this technology, FNDL has organised the first workshop of this series to introduce the technology and demonstrate suitable techniques for fabrication in a hands-on session during the workshop. Prof. Dr. Nor Azah Yusof, a professor at the Faculty of Science and an ION2 associate researcher, lectured on the theory of MIP technology, followed by a practical session or "hands-on" in preparing for MIP and the application of the technology.



### Entrepreneurial Minded Researchers Programme

29<sup>th</sup> August – An Entrepreneurial Minded Researcher Program entitled "Commercialisation Strategy for Academia-Industry Cooperation" presented by Assoc. Prof. Ts. Dr. Mohd Hafiz Arzmi took place on 29<sup>th</sup> August 2022. Dr. Mohd Hafiz is a lecturer and researcher from the International Islamic University (UIA) Kuantan, Pahang. This programme was held at the ION2 Seminar Hall, attended by around thirty participants, including lecturers, researchers, support staff, and also UPM students.



This commercialisation and entrepreneurial lecture session aimed to share knowledge, tips and tricks that the researchers and students can deploy to cooperate with the industries. In addition, this programme also provided rooms and opportunities for research collaboration between ION2 and UIA researchers.

The event was led by Associate Professor Dr. Che Azuranim Che Abdullah, also the programme's moderator. At the end of the session, Dr. Che Azuranim thanked the speakers and

participants for attending the programme. She also supported the collaboration between UPM and UIA researchers in research projects and impactful publications and, together, in producing products that have commercial value for sale.



### Advanced Course on Response Surface Methodology

24<sup>th</sup> Aug – An advanced course on Response Surface Methodology (RSM) series 2 was held physically on 24<sup>th</sup> to 25<sup>th</sup> August 2022 at the ION2 Seminar Hall. The course was organised by NPTL.

RSM is a technique incorporating both mathematical and statistical concepts to develop an empirical model, improve and optimise process parameters, and identify interactions among key factors in experiments. There were some other statistical experimental development tools such as Completed Randomized Design, Two Level Factorial Design, Fractional Factorial Design and Taguchi Method. These methods are widely used in experimental development for process optimisation of nanotechnology research.

The first RSM series 1 on the introduction of RSM was held on 13<sup>th</sup> April 2022 virtually and received a massive, good response from the audience with a total of 138 attendees. Based on the responses from RSM series 1, there were requests for advanced level whereby the technical and practical of RSM for research is the focus.

This is the main motivation for NPTL to fill in the gap and offer opportunities for any interested participants to elevate their knowledge for learning and research activities.

The RSM series 2 with a theme of process optimisation was held for one and a half days and attended by 16 participants from UPM and agencies outside UPM. The course discussed important aspects of building and developing experimental designs and how to optimise the process afterward. The speaker also discussed the types of factors, levels, and blocking that needed to be considered in the design.

Participants were exposed to hands-on experimental design using Minitab software during the course. The course was facilitated by Ts. Dr. Mohd Salahuddin Mohd Basri, a senior lecturer of the Faculty of Engineering, UPM.





### Workshop on Gas Chromatography

20<sup>th</sup> Sept – Since 2016, the NPTL has been organising an annual workshop on gas chromatography. The primary objectives of this workshop are to educate participants on the theory of gas chromatography, equipment handling and troubleshooting, sample preparation, and data analysis.

Postgraduate students and lecturers from various faculties, including Faculty of Biotechnology and Biomolecular Science, Faculty of Agriculture, Faculty of Science and Faculty of Engineering, attended the workshop. The workshop was divided into two sessions, the first of which was theoretical and the second was hands-on. The theoretical session was held at the ION2 Seminar Hall, while the hands-on session was conducted at the Analysis Laboratory.

The workshop received positive feedback from all participants, who expressed their desire for more advanced hands-on sessions, particularly in equipment troubleshooting and data analysis, in the future. Dr. Umer Abdul Rashid, a senior Fellow Researcher of ION2, conducted the workshop.



### JINM Workshop for Grants Applications

5<sup>th</sup> Oct– The Industry and Community Linkages (JINM) Committee organised a workshop aimed at securing a grant for a community project. Held at the ION2 Seminar Hall, the workshop focused on the Knowledge Transfer Grant Scheme (KTGS) offered by UCTC, UPM and the relevant grant proposal.

There are knowledge gaps between the teachers and their understanding of nanotechnology. Therefore, ION2 has taken responsibility for bridging these gaps. With experts in the field and cutting-edge equipment for nanomaterials processing, ION2 is well-equipped to help.

The workshop concluded with the presentation of a comprehensive proposal, complete with a relevant budget, to be submitted to the KTGS secretariat for further consideration.





### ION2 Implements EKSA

12<sup>th</sup> Aug– ION2 is dedicated to creating a Public Sector Conducive Ecosystem Practice (EKSA) to support implementation throughout UPM. To achieve this goal, ION2 organised the EKSA Launch Ceremony and Gotong-Royong Perdana Session on 12<sup>th</sup> August, 2022, which were officiated by Prof. Dr. Mohd Nizar Hamidon, Director of ION2, at the ION2 Seminar Hall. 40 staff, including the ION2 Management, attended the event and received a briefing on EKSA practices before the launch.



During the briefing, Puan Haizum Hanim Ab. Halim, EKSA ION2 Coordinator, announced the names of EKSA zones: Graphene, Graphite, Biochar, and Carbon Nanotus (CNT). The briefing aimed to provide an overview of EKSA and its implementation, highlighting the importance of a conducive work environment. EKSA promotes creativity and innovation in workspace optimisation and repurposing used items while maintaining the corporate image.



By implementing EKSA practices, ION2 aims to create an environment that fosters productivity and well-being for its employees. The organisation recognises that a conducive work environment is essential to enhancing employee morale and increasing productivity. This initiative is expected to enhance the work experience of ION2 employees, promote creativity and innovation, and ultimately increase productivity.



# 2022 PICTORIALS

ION2 Innovation Day 2022@ION2  
14<sup>th</sup> June 2022



Quality and  
Innovation Day UPM 2022  
6<sup>th</sup> December 2022





**iSAMN2022 (7<sup>th</sup>-8<sup>th</sup> December 2022)**  
**Behind the Scenes**



**Fire Drill 2022**  
**13<sup>th</sup> December 2022**



**ION2 Meet & Greet Session: Postgraduate and Laboratory Safety Briefing**  
**2<sup>nd</sup> November 2022**





**Accountability and Performance Management Workshop on Budget, Research & KPI ION2  
@Astana Putra**

**19<sup>th</sup>-20<sup>th</sup> Dec 2022**



**Finance & Administration Team**



**Postgraduate Team**



**Research & Innovation Team**



**Income Generation Team**





Industry & Community  
Linkages Team



Read@Uni Audit



Program Bubur Lambuk@ION2  
12<sup>th</sup> April 2022



## PROGRAM AGIHAN BUBUR LAMBUK

12 APRIL 2022  
10 RAMADHAN 1443H

3.30 PETANG  
LOHI INSTITUT NANOSAINS DAN NANOTEKNOLOGI (ION2)

SUMBANGAN:  
STAF DAN KELAB KEBAJIKAN & SOSIAL ION2



**Iftar Ceremony@ION2**  
23<sup>rd</sup> April 2022



**Hari Raya Celebration@ION2**  
30<sup>th</sup> May 2022





**ION2 Family Day@Bukit Ekspo UPM**  
27<sup>th</sup> August 2022



**Happy Retirement, Encik Mustapha Kamal!**  
19<sup>th</sup> September 2022



**Majlis Lambaian Kasih Sanjungan Budi Puan Haizum Hanim**  
23<sup>rd</sup> November 2022





### Extending our Deepest Condolences to our Staff



### Thank you, Prof. Robiah Yunus and Happy Retirement 23<sup>rd</sup> November 2022



### Staff Birthday Celebration



January-February



March-April





May-June



July - September



October - December



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ISSN 2976-2545

