KEMENTERIAN SAINS,
TEKNOLOGI DAN INOVASI
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

REPORT

2ND INTERNATIONAL NANOTECHNOLOGY OLYMPIAD (INO) 2024

14-18 NOVEMBER 2024
BANGI RESORT HOTEL,
SELANGOR MALAYSIA

NATIONAL NANOTECHNOLOGY CENTRE
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION (MOSTI)
MALAYSIA

2nd INTERNATIONAL NANOTECHNOLOGY OLYMPIAD (INO) 2024

1. Day 1 | 14 NOVEMBER 2024 | THURSDAY

1.1 Description of Program/Activity:

1.1.1 Visit to Petrosains, KLCC
1.1.2 Visit to Petronas Twin Towers
1.1.3 Visit to Kuala Lumpur Tower

1.2 **Objective:**

1.2.1 To promote Malaysia to the international participants of uniqueness Petronas Twin Towers and Kuala Lumpur Tower.
1.2.2 To introduce participants to Malaysia's unique culture and latest technological advancements.

1.3 Implementation Date: November 14, 2024

1.4 Mode of Implementation: Physical

1.5 Programme Filing

1.5.1 **Schedule of Activities:**

Time	Details of Program/Activity	Venue
10:30 AM - 12:30 PM	Visit to Petrosains, Kuala Lumpur Convention Centre (KLCC)	Petrosains, Suria KLCC
	The bus departs at 9:20 AM, arriving at Petrosains, KLCC at 10:15 AM, with 43 participants, supervisors, panelists, committee members, and facilitators. Participants explore Petrosains from 10:30 AM to 12:30 PM, then gather for lunch at Saprah, KL.	
12:30 PM - 2:30 PM	Lunch at Saprah, Kuala Lumpur	Saprah, Kuala Lumpur
3:30 PM - 6:30 PM	Visit to Petronas Twin Towers (KLCC)	Petronas Twin Towers
	3:30 PM - 4:30 PM: Session for local participants (15 people). 5:30 PM - 6:15 PM: Session for international participants. Participants visit the skybridge on the 41st floor and the top of the tower on the 86th floor.	
7:00 PM - 9:00 PM	Dinner at Kuala Lumpur Tower	Kuala Lumpur Tower
	Arrival at Kuala Lumpur Tower for dinner at 7:00 PM. Participants have 2 hours to enjoy their meal at the Revolving Restaurant, Kuala Lumpur Tower.	
9:30 PM - 10:30 PM	Return to Bangi Resort Hotel	Bangi Resort Hotel
	Participants depart at 9:30 PM and arrive at the destination at 10:30 PM.	

1.6 Pictures of Programme:

Picture 1.6.1: Group photo of INO participants at Bangi Resort Hotel, Selangor.

Picture 1.6.2: Visist to KLCC.

Picture 1.6.3: Lunch at Saprah, Kuala Lumpur.

Picture 1.6.4: Group Photo at Twin Tower, Petronas.

Picture 1.6.5: Visits to KL Tower.

2.0 Day 2 | 15 NOVEMBER 2024 | FRIDAY

2.1 Description of Program/Activity:

2.1.1 Opening Ceremony of 2nd INO 2024
2.1.2 INO Competition briefing and Presentation Sequence Voting
2.1.3 Steering Committee Briefing & Jury Meeting
2.1.4 Nanosafety & Nanotechnology Commercialization Venture Builder Model Talk

2.2 Objective of the Programme

2.2.1 To foster international collaboration in nanotechnology research and innovation through competitions, keynote presentations, and networking sessions.
2.2.2 To give an overview of the competition process and expectations for team presentations with a voting session to determine the order of the presentations for the first and second day of the competition.
2.2.3 To gain knowledge on safe design practices for nanotechnology development & explore strategies for commercializing nanotechnology innovations effectively.
2.2.4 To help the participants to engage with international peers, fostering an exchange of ideas and strengthening teamwork for the competition.
2.2.5 To provide an enriching platform for participants to learn from industry experts, exchange ideas with international teams, and prepare for the upcoming presentations.

2.3 Operation Mode: (Physical & Hybrid)

2.4 Consequential Matters:

2.4.1 Q&A Session during the talk

Q1: Where do you see innovation and research heading in the future? (Mr. Dominic)
A1: Emphasized the importance of selecting raw materials & highlighted the necessity of strategic planning (Dr. Siew's Response)
A2: Encouraged aligning research with business objectives & recommended focusing on materials that support diversification (Mr. Dev's Response)

Q2: How can we identify compatible strategies for sustainability and ensure long-term survival in the industry? (Mr. Sanchai, Team Thailand)
A1: Advised prioritizing compliance with rules and regulations (Mr. Dev's Response)
A2: Advocated for a scientific approach, promoted using a "weight of evidence" methodology, recommended engaging regulators & stressed the importance of collaboration between researchers, stakeholders, and regulators (Dr. Siew's Response)

Q3: How can researchers effectively persuade business leaders to invest in their innovations? (Fatiha, Team Malaysia 2)
A1: Presenting a clear financial incentive & encouraged researcher to frame their innovations in terms of profitability, cost savings, and potential return on investment (Mr. Dev's Response)
A2: The Evening Session of Steering Committee Meeting got delayed and took a significant time to start due to rains and other problems, as additional members that involves in the meeting are not staying near the event venue

2.5 Programme Filing

2.5.1 Schedule of Day 2 INO 2024

Time	Detail of the activities	Venue
9.00 am – 10.30 am	Opening Ceremony INO 2024 officiated by YBhg. Datuk Ts. Dr. Mohd Nor Azman Hassan, Deputy Secretary General (Technology Development), Ministry of Science, Technology & Innovation	**Melur Hall**
11.00 am – 12.00 pm	INO Competition briefing & Presentation Sequence Voting by Encik Ismarul Nizam Ismail	**Melur Hall**
2.00 pm – 3.00 pm	Steering Committee Briefing (Physical & Hybrid)	**Matahari II Room**
3.00 pm – 3.30 pm	Nanosafety Talk	**Melur Hall**
3.30 pm – 4.00 pm	Nanotechnology Commercialization Venture Builder Model Talk	**Melur Hall**
4.00 pm – 5.00 pm	Steering Committee Meeting (Physical)	**Matahari II Room**

2.5.2 List of Invited Guest/Speaker of International Nanotechnology Olympiad 2024:

No.	Name	University/Affiliation	Topic
1.	Dr. Siew Ee Ling	Universiti Kebangsaan Malaysia	“Safe-by-Design for Nanomaterial Development and Innovation"
2.	Ts. Devandran Krishnan	NanoMalaysia Berhad	"Commercialization and Business Development of Nanotechnology"

2.5.3 List of Participants:

No.	Teams	Team Members	Position
1	Malaysia 1	Eugene Ling Wei Hong	Participant
		Nur Azlina Binti Adris	Participant
		Nur Farahin Binti Yusoff	Participant
		Nidhi Rajesh Mavani	Participant
		Dr. Chiu Wee Siong	Supervisor
2	Malaysia 2	Khor Yohanz	Participant
		Badrul Amin bin Badrin	Participant

		Nurul Fatiha Binti Mohd Padzli	Participant
		Mohd. Faridzuan Bin Majid	Participant
		Prof. Dr. Mohd Ambri Mohamed	Supervisor
3	Hong Kong	Mohammad Farhadpour	Participant
		Kaveh Alizadeh Taghlidabad	Participant
4	Iran	Mr. Nima Dehghan	Participant
		Mr. Hamidreza Ghorbani	Participant
		Prof. Masoud Atapour	Supervisor
5	Taiwan	Mr Yan-Ruei, Chen	Participant
		Mr Chin-Yi, Chung	Participant
		Mr Yu Hsuan, Su	Participant
		Mr Wei-Ming, Chen	Participant
		Dr. Po-Wei Chi	Supervisor
6	Thailand	Miss Parinvadee Chukaew	Participant
		Miss Chonthicha Nilapornkul	Participant
		Mr. Aphinan Saengsrichan	Participant
		Mr. Worapak Tanwongwan	Participant
		Dr. Sanchai Kuboon	Supervisor
7	Facilitator	Lokman Hakim Bin Muhamad	Universiti Putra Malaysia
		NurFarhana Binti Mohd Noor	Universiti Putra Malaysia
		Nur Humaira Yasmin Binti Mohd Alimi	Universiti Putra Malaysia
		Nadhirah Aidil Binti Zulkafli	Universiti Putra Malaysia
		Nurul Aisya Nadhirah Binti Yusmadi	Universiti Putra Malaysia
		Nurul Anis Syahirah Binti Adenan	Universiti Putra Malaysia
		Safia Izzati Binti Abd Sukor	Universiti Putra Malaysia
		Syahidatul Mashitah Binti Tuah	Universiti Putra Malaysia
		Muhammad Fakhrul Naim bin Jaafar	Universiti Putra Malaysia

8	Secretariat	Ts. Mohd Helme bin Mohd Helan	Ministry of Science, Technology and Innovation
		Ismarul Nizam bin Ismail @ Abdul Kadir	Ministry of Science, Technology and Innovation
		Dr. Norita Binti Mohd Yusuf	Ministry of Science, Technology and Innovation
		Dr. Nurul Asyikin bt Binti Kamaruzaman	Ministry of Science, Technology and Innovation
		Nur Arifazleen binti Aris	Ministry of Science, Technology and Innovation
		Abdul Rashid bin Abd Rahim	Ministry of Science, Technology and Innovation
		Shahirudin bin Saiidin	Ministry of Science, Technology and Innovation
		Hamidah Binti Mokhtar	Ministry of Science, Technology and Innovation
		Maizatul Akmal binti Ahmad Ariff	Ministry of Science, Technology and Innovation
		Nur Khadijah binti Mohamad Najib	Ministry of Science, Technology and Innovation
		Dominic anak Geruka	Ministry of Science, Technology and Innovation
		Adi Aiman Putra bin Rosdi Yusaini	Ministry of Science, Technology and Innovation
		Nur Alya Batrisyia binti Mat Yaki	Ministry of Science, Technology and Innovation
9	Steering Committee	Prof. Dr Khamirul Amin Matori	Malaysia's Panel
		Ts Devandran Krishnan	Malaysia's Panel
		Mr. Wasawat Kraithong	Thailand's Panel
		Assoc. Prof. Dr. Phillip Wu	Taiwan's Panel
		Prof. Maw-Kuen Wu (attend via Zoom meeting)	Taiwan's Panel
		Dr. Abolfazl Azarniya Eyvazali	Iran's Panel
		Dr. Afshin Ramzi	Iran's Panel

2.6 Picture of Programme

Picture 2.6.1: Arrival of the VIPs at Melur Hall.

Picture 2.6.2: VIPs seat in front row of the stage at Melur Hall.

Picture 2.6.3: Opening remarks speech by Ybrs. Dr Rezal Khairi Ahmad.

Picture 2.6.4: Officiating remarks speech by Ybhg. Datuk Ts. Dr. Mohd Nor Azman, Deputy Secretary General (Technology Development), MOSTI Malaysia.

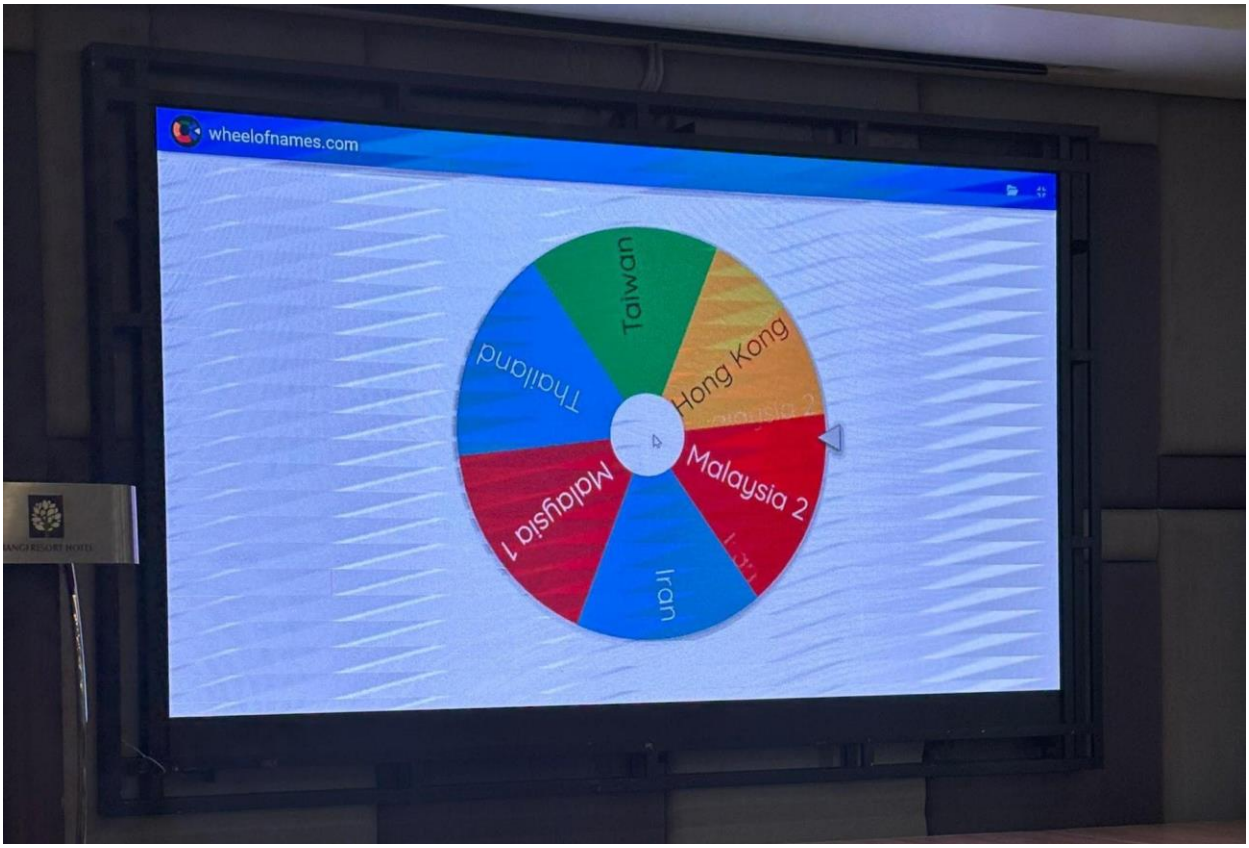
Picture 2.6.5: Group picture with VIPs and all participants from Malaysia, Iran, Taiwan and Hong Kong.

Picture 2.6.6: Group picture of participants from Malaysia 1 and Malaysia 2.

Picture 2.6.7: Group picture of participants from Team Thailand.

Picture 2.6.8: Group picture of participants from Team Hong Kong.

Picture 2.6.9: Group photo of participants from Team Taiwan.



Picture 2.6.10: Voting session for group presentation during briefing session.

Picture 2.6.11: Dr Siew during talk one session.

Picture 2.6.12: Mr. Devandran talks on commercialization and business development nanotechnology.

Picture 2.6.13: Group pictures with speakers from talk one and two with participants of INO 2024.

Picture 2.6.14: Steering Committee Meeting (Iran's Panel)

Picture 2.6.15: Steering Committee Meeting (Physical)

Picture 2.6.16: Steering Committee Meeting (Hybrid)

Picture 2.6.17: Steering Committee Meeting & Presentation

3.0 DAY 3 | 16 NOVEMBER 2024 | SATURDAY
2ND INTERNATIONAL NANOTECHNOLOGY OLYMPIAD (INO)

3.1 Programme Name / Activity: Presentation 1 (Science and Technical).

3.1.1 **Programme Information / Activity:**

3.1.1.1 Presentation for Science and Technical from all the group
3.1.1.2 Question and Answer from the Panels to the Participants
3.1.1.3 Demonstration from Malaysia 1, Malaysia 2 and Taiwan Teams.

3.2 Objective:

3.2.1 Increase understanding and awareness of nanotechnology's principles, applications, and potential among students, researchers, and professionals.
3.2.2 Deepen knowledge of nanoscale phenomena, material properties, and interdisciplinary aspects of nanoscience through problem-solving and research-based activities.
3.2.3 Promote discussions on ethical implications and sustainable practices in nanotechnology research and development.
3.2.4 Highlight the role of nanotechnology in addressing global challenges in areas like healthcare, energy, environment, and electronics.

3.3 Execution Mode: Physical

3.4 Consequential Matters:

Question & Answer (Malaysia Team 1)

Q&A List:
Q1: Silicon technology is not new. What is the novelty of your research?
A: Silicon is indeed a well-established material, which is why we decided not to start from scratch—it saves time and leverages proven knowledge. Instead, we focus on enhancing its properties. Our research improves the light absorption characteristics of silicon to achieve better photoelectrochemical (PC) performance. For example, our literature review revealed that blank silicon nanowires without any co-catalyst show lower solar-to-hydrogen (STH) conversion. Our silicon nanowires demonstrate a conversion rate 2.5 times higher than previous reports, which is a key highlight of our work.

Q2: Why do you use silver?
A: Silver is one of the highly electronegative catalysts, making it highly effective in facilitating the etching process during nanowire synthesis.

Q3: How do you remove the silver towards the end of your process?
A: Silver is removed by thorough rinsing with deionized water and nitric acid. While traces may remain temporarily, they are not present on the silicon nanowires themselves. The remaining silver is disposed of responsibly in compliance with regulations.

Q4: How do you ensure uniform distribution of the nanowires in your process?
A: Uniform distribution of nanowires is achieved by carefully controlling two key parameters: hydrothermal temperature and the concentration of the etching solution. Our studies show that higher temperatures and concentrations lead to better nanowire formation.

Q5: Why does having a larger surface area improve light absorption?
A: A larger surface area directly enhances the optical properties of the nanowires. On a planar silicon surface, reflectance is high, leading to poor light absorption. However, the nanowire structure scatters light more effectively, reducing reflectance and increasing the likelihood of light absorption, thereby improving overall performance.

Q6: What is the color of your samples?
A: The samples appear black. We can showcase them during the demonstration session, along with the process of hydrogen production.

Q7: Hydrofluoric acid (HF) is highly toxic and carcinogenic, and you also use silver nitrate. How do you ensure safety in handling these materials?
A: We follow stringent safety protocols. Our team uses personal protective equipment (PPE) and adheres to proper waste management practices for disposing of hazardous chemicals like HF. These measures ensure the safety of all personnel involved in the experiments.

Q8: Beyond the risks of raw materials, what other potential risks exist in your technical work?
A: Hydrogen production itself poses risks, as hydrogen is highly flammable. We mitigate these by ensuring proper workspace ventilation and avoiding any flammable or corrosive substances during production tests.

Q9: What is the main challenge in maintaining the stability of your nanowires? Do you require any protective coatings?
A: In our lab-scale experiments, we tested the nanowires for up to two hours, and they demonstrated high stability with no signs of degradation. This indicates strong potential for longer stability. However, we have not yet conducted extended tests for 10 to 30 hours to confirm this.

Q10: How do you determine the optimum conditions for synthesis?
A: The synthesis parameters we optimize are hydrothermal temperature and etching solution concentration. We assess performance through several analyses, including optical properties, structural characteristics, and most importantly, photoelectrochemical (PC) analysis. The ideal conditions are those that yield the highest photocurrent density with the lowest onset potential.

Q11: What is the novelty of your work, and what are the associated risks?
A: Our novelty lies in using well-established materials and techniques to enhance the performance of silicon nanowires for hydrogen production. We aim to maximize hydrogen output at the lowest possible cost.

Regarding risks, working with hazardous acids during synthesis and handling hydrogen during production and storage are key concerns. We follow strict safety protocols and regulations to minimize these risks. As we scale up and commercialize this process, further risk assessments will ensure compliance with industry standards.

Q12: Does hydrogen have the potential to grow as an energy source, considering your lab-scale work?
A: On a lab scale, hydrogen production is manageable in an open, well-ventilated environment. However, for large-scale production, ventilation and workspace design become critical considerations. Addressing these challenges will be a focus as we scale up.

Question & Answer (Hong Kong)

Q&A List:
Q1: Which is better, using hydrogen as a pure fuel or using hydrogen in a fuel cell?
A: In fuel cells, hydrogen is used as the fuel along with oxygen or air, avoiding CO2. They don't use methanol or ammonia-powered fuel cells, but hydrogen-based anion exchange membrane fuel cells and water electrolytes.

Q2: What do you mean by clean hydrogen production?
A: Clean hydrogen production refers to not using fossil fuels or excessive power in developing anion exchange membranes and related products for fuel cells.

Q3: What characteristics must a good membrane have for a fuel cell?
A: The most important characteristic is chemical stability, especially in highly alkaline environments and at high temperatures. Durability under real working conditions is also critical.

Q4: How does cross-linking affect the properties of fuel cells?
A: Increasing cross-linking improves mechanical properties, water-alkaline resistance, swelling ratio, and ion conductivity. However, optimization is necessary, as too much or too little cross-linking negatively impacts performance.

Q5: What is the optimum cross-linking degree, and what happens if it's higher or lower?
A: The optimum is 40%. Below 30%, the membrane swells too much, and above 60%, water uptake is too low, leading to poor ion conductivity. A range between 30-60% is acceptable.

Q6: What is the role of nanostructures in anion exchange membranes?
A: Nanophase separation enhances ion conductivity by increasing ion conductive pathways compared to microphase separation. Optimization of polymer properties is key to achieving nanophase separation.

Q7: Can nanophase separation be controlled?
A: Partially. It depends on the membrane casting method, cross-linking degree, and polymeric backbones. While optimization is possible, complete control isn't achievable.

Q8: What is the environmental impact of the membrane and its biodegradability?
A: The membranes are polymeric and stable but require special disposal methods like packing in containers for treatment. Developing biodegradable options is challenging due to the material's alkaline and thermal stability requirements.

Q9: How to simulate long-term durability for the membrane?
A: Accelerated stress tests with higher current densities (e.g., 0.5 A/cm²) to mimic long-term industrial durability.

Q10: What method is use for optimization?
A: Optimization is performed through a combination of literature review, trial-and-error, and process adjustments. No specific statistical methods like DOE were used.

Q11: What is the comparison between piper ion and the membrane?
A: Testing conditions were identical to ensure accurate comparison. Results show their membrane performs well under similar conditions.

Q12: What challenges exist for scaling up the product?
A: Challenges include preparing larger polymeric membranes and using membrane casting machines for industrial-scale production.

Question & Answer (Thailand)

Q&A List
Q1: Which one is better in giving us bio coal? Woody plant or leafy tree?
A: Biomass have classified into hard and soft materials biomass; hyacinth is a soft material biomass. Hard biomass will give us the better quality but if we ignore the soft biomass the environmental impact will be there. So, we will give our technology to solve both hard and soft biomass materials.

Q2: Why did you choose water hyacinth for bio-coal production even though the dry mass of dry hyacinth is quite low? So, any reason for choosing the plant for research.
A: This is a very critical problem to the community that located alongside the river and may cause many problems such as risk damage, transportation, flooding, and habitat for disease. Water hyacinth causes severe environmental and health issues, making it a critical waste material to convert into value-added products.

Q3: What temperature do you use for burning the water hyacinth, and why?
A: The optimal temperature is 225℃, temperature operate hydrothermal carbonization range between 180 to 250. It is determined through design of experiments (DOE). We operate it and optimize it. Optimized condition observed from out water hyacinth is 225.

Q4: what happen if water hyacinth is burn at 500°C?
A: Higher temperatures lead to gasification rather than bio-coal production. So the optimum temperature is lower than 250°C.

Q5: What is the role of nanocatalysts in bio-coal production?
A: Nanocatalysts accelerate the reaction of the carbonization. There are two pathways; first depolymerization of large molecules to carbon but in that pathway, we have another pathways. We have the intermediate from the pathways one. When catalys used pathway one we deoxygenated we dehydrogenate including the carbon. Catalyst can convert the carbon back to biocoal at the end and increase the yield and increasing the heat as well.

Q6: Is the particle size is important to the heating powder later on? And how do you do incoming inspection of your raw material because there will be different content of water and how do you make sure they in certain range of particles size so they can be turned into biocoal?

A: Raw materials are prepared to an optimal range (150-250 μm) and analyzed several parameters using statistical methods to ensure homogeneity and reliable.

Q7: Do you use multiple catalysts, and which is best?
A: Carbon nanomaterials are used to avoid metallic waste, offering high-quality bio-coal without additional environmental burdens.

Q8: How much energy does the hydrothermal carbonization (HTC) reactor consume?
A: Data collection for optimizing energy consumption is ongoing.

Q9: Where do your ideas originate?
A: Ideas stem from patents, and trial-and-error experimentation.

Q10: What is the role of nanotechnology in your project?
A: Nanotechnology focusing on the development of the nanocatalyst that used to reduce the high heating where biocoal get more yield and higher density.

Q11: Nanocatalys is being consumed in the reaction, how does the nano still stay in the system?
A: In the polymerization chain nanocatalyst back to the carbon contain in the product.

Question & Answer (Taiwan)

Q&A List:
Q1: Which part of the battery is the most important in your design?
A: Our batteries use PT and PG, both of which are water-soluble. This makes the cells easy to recycle—simply by soaking them in water. In contrast, commercial cells use PVDF and PV separators, which are difficult to recycle.

Q2: Why did you choose pectin for your battery?
A: We tested several catalysts, including CMC, but found that pectin delivered the best performance.

Q3: Where is pectin used in your battery system?
A: Pectin is incorporated into the electrolyte system.

Q4: What is the role of pectin in your battery?
A: Pectin acts as a binder, combining with PG to form the main binder in our battery system.

Q5: You mentioned that adding 50% pectin and 50% PEG gave optimal results. How does PEG improve performance?
A: PEG forms a secondary cross-link, enhancing the mechanical properties of the system. Additionally, PEG is derived from medical waste, making it a more sustainable option compared to traditional materials.

Q6: Can you recycle all parts of your battery?
A: Yes, all parts of the battery, including the metal foil and materials in the electrolyte, can be recycled. The battery is designed to be easily dissolved and processed with water, enabling efficient recycling.

Q7: Some parts of your battery may not be environmentally friendly. How do you address this during recycling?
A: The active material is recovered during recycling through a simple sintering process. We have also conducted recyclability studies to validate this.

Q8: How does the performance of your battery change after recycling?
A: After water washing, particle sizes in LVO are reduced to nanoscale, improving the surface area and solubility. This enhances both the rate performance and cycling stability of the battery.

Q9: Have you compared pectin to CMC or other binders?
A: Yes, we tested various ratios of pectin and other binders such as CMC. Pectin consistently delivered the best performance when paired with PG.

Q10: What role does nanotechnology play in your work?
A: After water washing, particle sizes decrease to the nanoscale, resulting in improved charging rates and enhanced cycling performance. The pectin binder forms a shell on the material's surface, increasing surface interactions and enhancing capacity.

Q11: How does your battery performance compare to existing commercial products?
A: Our battery offers easier recyclability. Unlike commercial PVDF-based systems that require energy-intensive burning, our approach significantly reduces carbon emissions by simplifying the recycling process.

Q12: Have you tested your battery's performance against similar commercial products?
A: Yes, we used commercially available active materials to ensure compatibility and demonstrated that pectin is suitable for a wide range of materials.

Q13: What improvements have you achieved by replacing conventional materials with pectin?
A: By replacing PVDF with pectin, we achieved a recycling efficiency of approximately 90%.

Q14: Can your battery operate in high-humidity or wet environments?
A: The water-solubility of our materials poses challenges in humid conditions. To address this, we conduct processing in a controlled, dry environment. Further material optimization will be required for applications in extreme climates.

Q15: Can similar biodegradable materials be explored in the future?
A: Yes, pectin’s structure is similar to compounds found in other fruits. We aim to explore alternative fruit-derived materials to further improve sustainability.

Question & Answer (Malaysia Team 2)

Q&A List

Q1: How do you collect and store electricity?
A: We utilize an innovative graphene-based supercapacitor to store charges. It functions similarly to a power bank, allowing the stored energy to be released back for charging other devices.

Q2: People have different weights. How do you account for weight differences in energy collection?

A: We have not yet tested the effect of different weights. Since different forces generate varying voltage outputs, we plan to study the impact of weight and force in future experiments.

Q3: What is the minimum force required to collect energy from the product?
A: While we have not studied the exact force required, our demonstration shows that even minimal force, such as from a step, is sufficient to generate electricity.

Q4: If someone jumps, would the device still work? Could it get damaged?
A: As long as there is force applied, the device will generate an output. However, we will need to conduct future studies to assess its durability under high-impact forces such as jumping.

Q5: How long does it take to fabricate one shoe?
A: Fabrication currently takes about two hours per device, but this process can be optimized to reduce the time.

Q6: How many devices have you fabricated, and do you have statistical data?
A: We have fabricated multiple devices, and all have been tested. The results are consistent and show similar performance across tests.

Q7: What is the standard deviation of the repeatability tests?
A: We have not yet calculated the standard deviation, but it is something we plan to evaluate in the future.

Q8: Why does the voltage increase, as shown in your data?
A: The device incorporates PVDF polymer, barium titanate, graphene quantum dots (as a supercapacitor), and molybdenum disulfide. Each nanomaterial contributes to enhancing the electric effect, leading to the observed increase in voltage.

Q9: What are some alternative approaches?
A: Nanomotions operate within the milliampere to microampere range, which aligns with the requirements for nanoscale materials.

Q10: What are the product's limitations?
A: The current limitations include homogeneity, sensitivity to environmental factors, and adhesion issues.

Q11: What are the proposed solutions to these limitations?
A: Optimization of the materials and processes is the key to overcoming these challenges.

Question & Answer (Iran)

Q&A List:
Q1: What is the current problem in hydrogen production since they are not widely used yet, and what is the future for this technology? What's the future for green hydrogen production?
A: Hydrogen production faces issues with safety, efficiency, and integration into daily life, similar to the historical challenges of electricity and oil. Trends suggest hydrogen may follow a similar adoption timeline of about 20 years, as noted in McKinsey reports. Over time, hydrogen is expected to become safe and integrated into everyday applications.

Q2: Why do you use nanotubes instead of nanowires?
A: Nanotubes offer increased surface area, with inner and outer areas being beneficial. Anodizing titanium dioxide (TiO_2) is a simple and scalable industrial process. However, care must be taken not to reduce the nanotube diameter too much, as it could trap electrons and decrease efficiency.

Q3: What technique do you use to produce nanotubes?
A: Anodizing technology based on electrochemistry is used. The process involves a titanium sheet as the anode, a suitable solution, and a cathode made of materials like platinum, graphite, or stainless steel. A voltage of around 60V is applied for 4–6 hours, depending on the desired diameter and length of the nanotubes.

Q4: How does reducing the bandgap improve the properties of the material?
A: Reducing the bandgap enhances light absorption, making more of the visible spectrum usable. For TiO_2 nanotubes with a larger bandgap, only UV light is used. Lowering the bandgap allows absorption of a broader range of sunlight, as shown by LSV and coronal results.

Q5: How does your coating affect the bandgap? What is the process behind reducing the bandgap from 3.2 eV to a smaller value?
A: By combining different semiconductors (e.g., TiO_2 with smaller bandgap materials), a potential and internal electric field are created, reducing electron-hole recombination. This structural modification results in a reduced bandgap, enhancing light absorption and efficiency.

Q6: Did you do any repeatability study on hydrogen production using your TNT? What limitations do you face?
A: The process is repeatable due to its simplicity. Limitations include challenges in sensing, storage, and transportation of hydrogen. Advanced materials and systems, such as DC-coupled setups, are needed to address these issues.

Q7: What is the volume of hydrogen produced?
A: Approximately 0.04 mL/cm^3/hour in the initial PC system design.

Q8: What is the color of your samples, and does it correlate with UV-visible reflectance spectroscopy data?
A: Initially blue-purple, the color changes to yellow-orange after coating with iron oxide (Fe_2O_3) and zinc oxide (ZnO). The change correlates with the reduced bandgap, shifting from 3.2 eV (UV absorption) to 2.6 eV (visible light absorption).

Q9: How does reducing particle size affect bandgap, electron-hole recombination rate, and performance?
A: Reducing particle size increases surface area and absorption efficiency. However, below a certain threshold, electron trapping occurs, inversely affecting efficiency. A balance is necessary between surface area enhancement and electron trapping.

3.5 Filling Schedule:

3.5.1 **Filling Schedule [Group Presentation Session 1 (Science and Technical)]:**

Time	Programme Details / Activity	Venue
7.30 a.m. – 8.50 a.m.	**Final Preparation for Group Presentation Session 1 (Science and Technical)** Presentation slides and videos were all gathered by the technical team from MOSTI.	**Melur Hall**
9.00 a.m. – 9.35 a.m.	**Malaysia Team 2** Title: Nano Energy Harvester Based on Carbon-Nanocomposites for Powering Wearable Devices.	
9.45 a.m. – 10.20 a.m.	**Hong Kong** Title: Manufacturing of High-Performance Anion Exchange Membranes for Alkaline Fuel Cells, Water Electrolyzers and other electrochemical applications.	
10.30 a.m. – 11.05 a.m.	**Thailand** Title: Biocoal Sustainable Alternative Energy Fuel via Nanotechnology.	
11.15 a.m. – 11.50 a.m.	**Taiwan** Title: Develop Eco-friendly Lithium-ion Battery using Nanoscale Bio-molecules.	
12.00 p.m. – 12.35 p.m	**Malaysia Team 1** Title: Green Hydrogen Production: A Plausible Approach using Earth Abundance Silicon Nanowires via Surface Nanoengineering.	
12.45 p.m. – 13.20 p.m	**Iran** Title: Development of Novel Nanoscale Coatings for Affordable Hydrogen Production.	
13.00 p.m. – 14.00 p.m.	**Lunch Break**	**Funtasia Level 1**

3.5.2 **Lists of Participant 2ND INO 2024:**

(A) Malaysia 1 Team

No.	Name	Country/ University	Title
1.	Eugene Ling Wei Hong	Xiamen University, Malaysia	Green Hydrogen Production: A Plausible Approach using Earth Abundance Silicon Nanowires via Surface Nanoengineering
2.	Nur Azlina Binti Adris	University Kebangsaan Malaysia, Malaysia	
3.	Nur Farahin Binti Yusoff	University Technology Mara, Malaysia	
4.	Nidhi Rajesh Mavani	University Kebangsaan Malaysia, Malaysia	
5.	[Supervisor] Dr. Chiu Wee Siong	University Malaya, Malaysia	

(B) Malaysia 2 Team

No.	Name	Country/ University	Title
1.	Khor Yohanz	Xiamen University, Malaysia	Nano Energy Harvester Based on Carbon-Nanocomposites for Powering Wearable Devices.
2.	Badrul Amin Bin Badrin	University Malaya, Malaysia	
3.	Nurul Fatiha Binti Mohd Padzli	University Sains Malaysia, Malaysia	
4.	Mohd. Faridzuan Bin Majid	University Technology Petronas, Malaysia	
5.	[Supervisor] Prof. Dr Mohd Ambri Mohamed	Universiti Kebangsaan Malaysia, Malaysia	

(C) Hong Kong Team

No.	Name	Country/ University	Title
1.	Mohammad Farhadpour	Hong Kong University of Science and Technology	Manufacturing of High-Performance Anion Exchange Membranes for Alkaline Fuel Cells, Water Electrolyzers and other electrochemical applications
2.	Kaveh Alizadeh Taghlidabad	Hong Kong University of Science and Technology	

(D) Taiwan Team

No.	Name	Country/ University	Title
1.	Mr Yan-Ruei, Chen	National Tsing-Hua University of ESS	Develop Eco-friendly Lithium-Ion Battery using Nanoscale Bio-molecules
2.	Mr Chin-Yi, Chung	National Tsing-Hua University of ESS	
3.	Mr Yu Hsuan, Su	National Tsing-Hua University of ESS	
4.	Mr Wei-Ming, Chen	National Tsing-Hua University of ESS	
5.	[Supervisor] Dr. Po-Wei Chi	Chung Yuan Christian University	

(E) Thailand Team

No.	Name	Country/ University	Title
1.	Miss Parinvadee Chukaew	Mahidol University	Biocoal Sustainable Alternative Energy Fuel via Nanotechnology
2.	Miss Chonthicha Nilapornkul	Mahidol University	
3.	Mr. Aphinan Saengsrichan	Chula University	
4.	Mr. Worapak Tanwongwan	King Mongkut's Institute of Technology Lad Krabong	
5.	[Supervisor] Dr. Sanchai Kuboon	National Nanotechnology Center (Nanotech)	

(F) Iran Team

No.	Name	Country/ University	Title
1.	Mr. Nima Dehghan	Amirkabir University of Technology, Iran	Development of Novel Nanoscale Coatings for Affordable Hydrogen Production
2.	Mr. Hamidreza Ghorbani	Isfahan University of Technology, Iran	
3.	[Supervisor] Prof. Masoud Atapour	Isfahan University of Technology, Iran	

(G)Lists of Panel:

No.	Name	Organisation
1	Prof. Dr Khamirul Amin Matori	Universiti Kebangsaan Malaysia
2	Ts Devandran Krishnan	NanoMalaysia Berhad
3	Mr. Wasawat Kraithong	National Nanotechnology Centre Thailand
4	Assoc. Prof. Dr. Phillip Wu	National Taipei University of Technology, Taiwan
5	Dr. Abolfazl Azarniya Eyvazali	INIC, Iran
6	Dr. Afshin Ramzi	INIC, Iran

3.6 Pictures of Programme

Picture 3.6.1: Picture of Malaysia Team 2 after finished presenting their research

Picture 3.6.2: Picture of Hong Kong team explaining to the audience about their project.

Picture 3.6.3: Picture of two members from Iran showing their videos.

Picture 3.6.4: Mr. Aphinan Saengsrichan as one of the representator explaining their research in Presentation Session 1.

Picture 3.6.5: Picture of team from Taiwan waiting for the question given by all panel that presented on this 2nd INO 2024

Picture 3.6.6: All the panel from Malaysia, Thailand, Taiwan, Hong Kong, Iran participated on this Q&A session.

4.0 DAY 4 | 17 NOVEMBER 2024 | SUNDAY
2nd INTERNATIONAL NANOTECHNOLOGY OLYMPIAD (INO) 2024

4.1 Programme Name / Activity: Presentation 2 (Novelty and Business Plan)

4.1.1 Programme Information / Activity:

4.1.1.1 Presentation on Novelty and Business Plan from all teams.
4.1.1.2 Question and Answer session.
4.1.1.3 Demonstration from Malaysia 1, Malaysia 2 and Taiwan Teams.

4.1.2 Objective:

4.1.2.1 Promote a culture of entrepreneurship and commercialization within the field of nanotechnology. Deepen knowledge of nanoscale phenomena, material properties, and interdisciplinary aspects of nanoscience through problem-solving and research-based activities.
4.1.2.2 Equip participants with the skills and knowledge to translate their research into viable business models.
4.1.2.3 Highlight the role of nanotechnology in addressing global challenges in areas like healthcare, energy, environment, and electronics.
4.1.2.4 Facilitate networking and collaboration among young researchers from different countries.

4.2 Execution Mode: Physical

4.3 Consequential Matters:

Question & Answer (Team Malaysia 2)

Q&A List
Q1: Which of the following are you planning to sell: the piezoelectric material, the entire system, or the shoes?
A: The main product that we plan to sell is the piezoelectric technology, but in the future, the plan is to sell the sole of the shoes embedded with our technology with the circuit. We also plan to collaborate with the sportswear companies.

Q2: The energy demand is declining, and the electric demand is increasing. Elaborate on that.
A: So, the energy demand, we compare the electricity demand with energy demand. Electricity demand is becoming higher because this is the transitional phase in our power consumption.So, majorly, this can be seen in the developed countries. This is the data from the International Energy Agency, and they're saying that this is starting to be seen in the developed countries as well. Electricity demand.

Q3: You're claiming the total cost will be about 66 ringgit. (4:16) Is that the cost of your system or the cost with the Shoes?
A: The rm66 is the cost of our system. It hasn't included with the shoes because the price of the shoes depends on the collaboration of the sportswear company. So, the shoes price would be more to be covered by the sportswear companies. We just provide the sole of the shoes which is embedded with our technology.

Q4: Okay, as we know, the energy housing from the piezoelectric system normally is quite low. So, do you consider that?
A: Technically we hv talk about the whole system, that's why, technically, we have thought about the whole system, how the circuit will be connected.

Q5: Why should the company invest in the piezoelectric technology?
A: Based on the slogan "nano-motion empowered every step", the vision of this project is to create energy to be generated by just movement. As flexibility becomes increasingly important, we are promoting our product as the next-generation solution for portable power, offering a compact and efficient way to charge devices.

Q6: You are going to get some amount of data from whatever you're going to put into the system. What is your business plan in using that? Secondly, how do you think you can pivot technology for the infrastructure technology?
A: To further enhance our product and make it accessible to everyone, we aim to increase its flexibility and affordability. By integrating our piezoelectric technology into building infrastructure, such as walls, we can harness energy from various sources, including wind and thermal energy.

Q7: Spray coating is a good large-scale method. ??
A: we will industrialized our nano-motion, we will try to involved in the scaleup of our spray nanotechnology, for example in the infrastructure building, but we need to consider some aspects about the addition of the material and the surface that we want to coat. We will study on how good the material will stick to the surface of the large scale of the building structure.

Q8: You are going to target a large population. What is your solution of the disposing the waste of your product?
A: Regarding the lifetime of nano-motion material, the disposability is an important consideration. To achieve this, the plan is to conduct a life cycle assessment of the nanomaterials, and explore the development of biodegradable and less toxic alternatives. We are actually planning to do the lifecycle assessment of the nanomaterial, because we know it consists of several nanomaterials, such as the GQD, barium titanate, and all of that. And we also try to replace, we hopefully can find a more sustainable nanomaterial if we can get it in the future.

Q9: Why did you choose this segment market over others? What's the criteria?
A: Because currently, we are in a trend, we call it the athletic trend, where people are currently now more concerned in their health, especially after the pandemic, which occurred a few years ago. So people are also having an athletic trend, where people like to wear, especially youngsters nowadays, are in a trend where they like to wear sportswear, even when they are not doing sports. So technically, this is why we are targeting this market currently, because it is a rising market, which is where after we did some research.

Question & Answer (Team Hong Kong)

Q&A List
Q1: What are the main barriers to commercialize your product? And how can you overcome that challenge? Are there other challenges?

A: Yes. There are some technical challenges. For example, large-scale manufacturing of our product. And we aim to develop a quality control system to guarantee the quality of our products. Or other risks like talent acquisitions. We want to collaborate with universities to identify the potential talents for our company to hire them. And there are other risks that I mentioned in the slides. Operational risks, regulations. For example, regulation challenges and we want to reach out to our university's office of knowledge center to get consultation from them to overcome these challenges.

Q2: In your presentation, you compared your product with another company, right? And how about another technology, PAM or something else? What is your advantage?
A: We use the road-to-road manufacturing method to develop our anion exchange membranes. And most of our customers use the same technique. If I want to compare the anion exchange membranes fuses and water electrolyzers to a proton exchange membranes fuses and water electrolyzers, the most important point is about the catalyst. For proton exchange membranes, we have no other option except using PGM catalysts, which are more than 40% more expensive than catalysts used in anion exchange member fuses and water electrolyzers. So if we use anion exchange members, we can decrease the cost by more than 40%. But the main challenge is about anion exchange membranes. Right now, we have no commercial anion exchange membranes in the market that work for more than one month. And for ex-situ and in-situ durability of membranes, our product is much better than Versogen, which is the best commercially available anion exchange membranes in the market right now.

Q3: You said that you can lower the price by 5%. If the competitor also lowers the price by 10%, what is your strategy?
A: We want to analyze the market accurately and we will take their steps. And then we will take their further steps. For example, if they want to reduce the cost, we will develop more efficient methods and cheaper materials to reduce our cost to compete with them. Thank you

Q4: Would you talk about secondary customers and also how do you plan to achieve capturing market share?
A: Our customers are companies that produce fused cells. For example, Panasonic produces fused cells for stationary (?) applications. Or UTC Power, you can see in the top image, UTC Power is a very well-known company that produces fused cells. And these are the main customers of our product and we want to reach out to them to ask for collaboration or partnership.

Q5: How will you evaluate the sizes of your strategy over time?
A: We have key metrics to evaluate our business and the details are in the report. For example, the growth rate of our company or the benefits rate are the key metrics that we evaluate to understand whether our company operates well or not.

Q6: I saw your financial for revenues, so how do you derive this amount and also what is the kind of revenue stream you are looking at when you talk about research parts and collaboration?
A: For product sets, we suppose that we can produce enough anions in __? for 450 kilowatts to such tanks. Then we discussed with some players in the market in China and they told us that about 10% of the whole product set could be get from licensing agreements. And this is why the amount of licensing agreements is somehow about 10% of the product set. or technology transfer. This is our plan that we want to get money, about 10% of the whole

product from licensing technology transfer. And we aim to reach to these numbers. And these numbers come from our collaborators in China.

Q7: How far of a difference you need to make in your production line so that you can use the resources that you have to convert your business into other kind of areas?
A: We should make our production line efficient. For example, using road road manufacturing or starting some plants on recycling and off-cycling of our membranes. But the initial plan is to use road road manufacturing and then recycle the expensive solvents we use. So this is one strategy we want to save the budget on production.

Q8: Why you decide to sell membrane, not the end product? The fuel cell?
A: We started with membrane technology and currently we're only focusing on membrane technology. And after our company finds its place in market, maybe we can start assembling fuel cells.

Q9: So how confident you are when you sell your membrane to the fuel cell company and then your membrane is still in the top condition?
A: Our confidence originates from the results, the research results. As you can see here, our product surprises the commercially available ones in terms of stability, performance, and durability. And this is why we feel confident to talk to the customers. And also, there are really few players in this field. And I think there's enough space for us to enter into the market.

Q10: In terms of that, who's the minimum skilled person which can handle your product to maintain because you're not selling the end product, right? So who's the minimum person? Is it the degree person or need to have master of PhD level or something? You also want to sell direct sales, your product, and online sale. So how do you elaborate on that part?
A: Actually, in designing the polymer structures, we need a high level of knowledge, organic chemistry to design the polymer. And after, when we establish the production technology, when we establish the material, then other engineers could simply produce our membranes. We want to use online systems to reach out to those customers, not large customers. It's only 5% of sales. I mean, 95% is B2B, and only 5% is B2C. Or maybe for research. So our focus is on larger sales. And our profit margin is also different for online sales and B2B sales

Q11: My last question. In your review stream, the table you just showed us just now give us 5 years. I believe the technology will be changed very fast. So how confident you are for this project?
A: Yeah. Actually, we analyzed the startup companies in fuel cell and battery technology, and we realized that most of them start to benefit in year 3 or 4. And this is based on our market analysis results.

Q12: The table regarding your costs for your revenue stream regarding the years in the fifth year, will be having some $400,000 of costs then your revenue is $550,000. Is it too small amount for a startup company? How can you survive?
A: And this is the plan only for first year and for first 5 years. And at the year 3, we start to benefit. And so the first 3 years are only for surviving. And then we will gradually increase the benefits.

Question & Answer (Team Thailand)

Q&A List

Q1: What are your potential environmental risks associated with your product? For example, raw material production disposal?

A: Final product when you use the vehicle is become to ash, which the ash is not a waste. It can be returned to high value silica or other material such as CO2 can be reversed in the industry. Moreover, in our process, we have a lot of waste water, but it is not waste water because it can recirculate to use again in our process. Moreover, the existing temperature can impact the environment, but we can bypass it to dry in the final process to deliver low moisture content or without moisture content in the final product.

Q2: Your production is more catalytic reaction and theirs is more on dry torrefaction? So, how is the price comparison going to be different compared to your competitors?

A: Our business has an advantage that we can use both wet and dry material which can reduce the cost of drying. Basically, we have the infrastructure and expect the price of the BioCoal from the top 28 will be 129 $ or around 130 $ for our product. And when compared to the TTCL market offer, it is very reasonable because our team has a strong research and development.

Q3: What is your manufacturing readiness level and issues like contamination at a large scale? Are there going to be any fisheries impacts or things like that? And then, what are your scale of OPEX?

A: Our major partner is focusing on the coal plant and they will release the hot water, hot vapor normally. So, we plan to use the high temperature of the vapor to use in the system such as the hydrothermal, drying or major activities of hydrothermal and drying process. So, in our industry, we almost have no advice because we will recycle anything that can. Can I support this information? In our future plan, we plan to use the R&D team to utilize the waste from our process. The most of it is the ash from the burning. But if we can utilize this waste, it can turn the money to us. Because from our experience, we can add silica and use it as a catalyst support to any catalytic relation. And we can use it in the dry forming process to capture the carbon dioxide and convert it to hydrogen via dry forming process.

Q4: In your presentation, you are claiming that 60% of coal is used for the power generation. And you are claiming that by 2040, all those are going to be shut down. Why? Any reason for that? Why you run away from the coal?

A: Because of our business, we would not like to face with the high of tax. Because the existing commercial coal that we use nowadays, it releases many, many pollutants to the environment. Which is carbon dioxide, however we release carbon, but bio coal is carbon neutral. Because the raw material is the waste from agricultural waste. Before we use it, it can absorb carbon dioxide by itself.

Q5: How do you protect your technology? How do you protect your innovation? And how do you make sure others don't copy your innovation?

A: We have a patent and licensing. First, we are the one-stop solution service for Telnet with any of raw material. And we are developing, we have the way to develop our research to fit with any kind of bio coal, any kind of raw material. This is the first aspect. The second aspect is the firstcome, first-served in the market. If we have the service first in the market and we have the reasonable, we already have the flexibility, the key partner, the value chain, we may protect our business. And now we are the new competitor in Malaysia.

Q6: But do you think that it's worth exporting your product to other countries in Asia? Or will you have only a domestic use within Thailand? And if so, how much do you think would be your market size? If it's only within Thailand, how beneficial would it be?
A: Yes. Bio coal is going to compete with thermal coal. And by nature, it's a very cheap material. It's not a high-tech and high-priced material. So it's very cheap and it's usually consumed in tons, not kilos, not grams. We have the technology which can be provided to other investors, which can be applied to any biomedicine.

Q7: You are going to market your product, not your technology. Am I right? The technology. Only the technology. So who will take care of all that water hyacinth in Thailand?
A: Actually, we have two providers. We have one service for the other place. One product is bio coal from maybe kind of raw material, biomass.

Question & Answer (Team Taiwan)

Q&A List
Q1: What are your supply chain challenges associated with the sourcing of pectin and how can you mitigate it?
A: Yeah, actually I'm going to extract the pectin raw material, by some fruits like orange and aiyu. And this is ongoing because we see,the material pectin is the most important in our plan. So the other issue is most risk as you say, if the raw material is by other companies hand, we could not control the cost. So now the plan is I'm going to extract the pectin material.

Q2: What is the key factor that could drive the adoption of your technology to the market?
A: Our emphasize is the recycling because the electrical vehicle grows, the retired petroleum also grows. So our main issue is how to recycle this retired battery.

Q3: Are you going to provide knowledge about the recycling if you are stationed to return the battery or something else?
A: Our battery is very easy to recycle. We can recycle variable material and to reuse and the metal fill also can reuse. So our recycle tin, we can water wash our battery and reproduce our product.

Q4: How far has the scooter been tested? I mean have you tested for very long distance or just a couple of short distances?
A: No, not yet.

Q5: What other key I would say saving that you expect to happen when you do recycling the battery or in other words, what is the kind of revenue that we are looking at by recycling the technology or recycling the battery?
A: we are focusing on recycling the battery and of course the electro including the cathode and anode is making 60% of the battery cost. And another thing is the making a recycling the all batteries is actually expensive making a new one. So,no one will do this. So it's all about the money.

Q6: I heard yesterday that you already have a business partner, is it true? do you have a business partner from industry now for doing your research?
A: Yeah, GUS Energy net. We signed a MOU contract already.

Q7: And don't you mind if I ask how much is the current MOU? How much money do they invest? How much did they invest in the project one year?
A: $3,000,000. 3 million dollars so far, yeah.

Q8: How much money do you foresee to earn per year in future?
A: The third year we can and we can see the 3 years the benefit will come back positive after 3 years. So in five years we will get 41 million.

Q9: So in your course of revenue, I didn't see anything on IP licensing. But in your business plan are you planning to also do licensing or localization if application?
A: It is in the business plan and not in the presentation.

Q Q&A List
10: Because in reality, for example, products from China are very difficult to enter the US for example. So because of many reasons, for example, maybe political issues, maybe the regulation and so on. Do you have a plan to overcome that kind of situation?
A: Electrolyte for sale is workable. So maybe we can not to compete competition maybe is a corporation.

Q11: In your course analysis, you are claiming you don't have a solvent and separator. Is that correct?
A: Yeah, because our solvent is water but the cost of the water is 0. Our electrolyte is also a separator.

Q12: What is the main thing you want to sell to your customer?
A: It's safety because geo electrolyte is more safe than the other.

Q13: So how safe is your battery and how confident you can say your battery is safe?
A: Yeah, we test our punch cell in the cutting test, puncture test and the needle test. We can see the voltage is around the four voltages. So it is useful.

Q14: The major concern for the batteries is explosion?
A: traditional battery leaching, a battery has a liquid electrolyte if we cut it, it will leak and the solvent will burn.

Question & Answer (Team Malaysia 1)

Q&A List:
Q1: Please explain about but if the market for short and long time?
A: So for the short time period actually all of the market if you can really observe for the for the production, our production is not that high. So it can be easily consumed within a nation. So it will be not going to be a global market or a very big market. It will start from a small scale centralized market first only will start to consider about scaling it up outsourcing.

Q2: Are you targeting China's market because you are mostly focused on China?
A: At some horizon yeah, we are targeting because China is a high potential and high. It has a high growth and we can predict that in the far future it will have a bigger market and it has a lot of demand.

Q3: Is it your plant or are you going to sell hydrogen? Which one? How are you going to store it and how are you going to take care of safety aspects 'cause that's out of your field of expertise hydrogen storage?
A: So under current step of work, we are selling hydrogen gas. So we are not going to do this by our own because of it. Even if you want to do it on your own, it will take a long time for you to find for the license to get the the expertise expert enough to prove that you can deal safe with hydrogen. So we're going to collaborate partners with other countries that has established method in storing and handling with hydrogen. So this will make us have more fast and secure way, cost effective way to deal with our hydrogen storage and transportation.

Q4: So how do you foresee the patentability of your work?
A: Actually if the pattern it is for a long time already and the pattern is actually expired. So everyone can do this, but not everyone will try to do that because those patterns have expired already from China. Yeah, the pattern is already expired.

Q5: And how do you foresee the possibility of upscaling your work?
A: So actually if you look deeper down towards the material that we use for the photo cathode silicon, nano silicon wafer is actually the most abundant and has the highest production global. And there are a lot of company that's doing silicon wafer and production scale is very high compared to other semi con or other materials which have only high end user ad easily being boycott by other companies because they are holding the technologies some of the companies not all the companies have. But for silicon wafer it is abundant and it is not that high to not that hard to get. And compared to the cost if you see back in 10 years time, the cost of silicon wafer is very high. Just a small piece of 6 inch gravel can cost thousands U.S. dollars. But now a days after China has their own technology in producing silicon wafer, the price is now not that high enough to be limit away from the technologies and the cost effectiveness of silicon wafer is actually higher than other materials.

Q6: So is there currently any company producing this kind of silicon nanowire based pack in China or in other words, who are your competitors inside China?
A: So, yeah, there is one company that is selling silicon nanowires, but they are not going to use it in hydrogen production. So is it we are going to use our nanowire by own in hydrogen production And the cost of the of the price of them selling the nanowires is actually far way higher for other company to use our nano to use the nanowire to synthesize hydrogen because just a centimeter square of silicon nanowire will cost 1000 U.S. dollar for the company.

Question & Answer (Team Iran)

Question & Answer
Q1: Do you have any prototype building activities that you can talk about?
A: Regarding the prototype, we have photo ions and are currently assembling tests for producing hydrogen. As for the TDC systems, we are designing them to improve efficiency. We have some designs, but they are not yet finalized.

Q2: How do we bring the cost down?
A: Yes, it's very interesting that the analyzer is not very expensive. Also, the price of hydrogen in Iran is very high—it's about $70 per kilogram, which is significant. To reduce costs, we use TiO and other ions, but not in large quantities. Additionally, we use sunlight directly, so we don't require solar storage systems or additional infrastructure, which helps reduce costs.

Q3: What are the major challenges?
A: Anodizing is a skeletal technique typically used for aluminum atoms. For titanium, the main challenges are controlling the anodizing time and temperature to achieve precise nanotube structures, which increases efficiency. However, you can modify the solution and adjust the time to produce larger or smaller nanotubes with varying lengths. This flexibility makes it useful for different applications—for instance, larger nanotubes are beneficial for drug delivery and similar uses.

Q4:
A: The equipment and procedures are not very complicated. However, for the initial setup, we need some investments. Additionally, for safety measurements, we require advanced sensors. To improve hydrogen efficiency, we also need GC systems, which are currently limited in Iran but can be obtained through foreign suppliers.

Q5: Since you mentioned CAGR, I'm wondering—what growth are you expecting from your business plan? What critical steps do you think are necessary to increase your market share? Also, what is your target pricing for steel production to ensure a good return?
A: Regarding the price of steel, we are not directly aiming to price steel. Instead, we provide hydrogen and DC systems for the simulation companies. Initially, our hydrogen price will be around $7 per kilogram, but we aim to reduce it to $3–$4 per kilogram within 5 to 7 years. This cost reduction will significantly benefit steelmakers since hydrogen in Iran currently costs about $70 per kilogram.

Q6: What is your target for steel production to generate revenue?
A: Our customers, particularly steelmakers, are not directly focused on producing steel. Our primary goal is to support their operations through hydrogen production.

Q7: What is the investment amount needed to break even, and how long will it take? What is the ROI?
A: The ROI is about 18 months. For the initial investment, we require approximately $450,000.

Q8: What is the largest portion of your investment allocated to? Is it for equipment, tangible assets, intangible assets, or manpower?
A: In Eskomaha, we are near the largest steelmaking company, which faces significant air pollution issues. During winter, schools are sometimes closed due to pollution. This steel company also has the largest cash flow in Iran, making it an ideal investment partner.
We focus on steelmaking because it aligns with global trends in Europe and India. As natural scientists passionate about the hydrogen economy, we see great potential in green steel production.

Q9: Are you going to sell hydrogen to the steelmaking company, or will you set up your own plant at their site?
A: For the first six months, we will produce hydrogen and supply it to their pilot plants. By the end of the first year, we plan to establish our own pilot plant at their site. If this occurs, the company may invest in building the plant.

Q10: How do you share profits with the steelmaking company, considering you might not own the plant anymore?
A: Our main idea is to share stock based on segments, dividing profits over the years until fully distributed.

Q11: How much area is required to produce one kilogram of hydrogen?
A: For the first plant, we plan to use 50 cubic centimeters of titanium photoanodes, producing a total effective surface area of 50 square meters. When divided by two (for coating both sides), this results in an effective area of 25 square meters. Each 50 square centimeters can produce two liters of nitrogen, and our system is capable of generating 10 kilograms of hydrogen per day.

Q12: What is the power consumption of a steel company?
A: This needs to be verified.

Q13: Is it feasible for a steel company to switch to hydrogen? Additionally, steel companies rely on fossil fuels to control steel quality due to the need for carbon in the composition. How do they monitor carbon percentage when switching to hydrogen?
A: Regarding feasibility, there is a large demand for green steel, and the mobile ecosystem company is building its first pilot plant. Our pilot plant will support this effort.
For carbon, it is used in specific stages of the steelmaking process but not during the reduction of iron oxide to iron. These are distinct processes and don't affect overall quality when transitioning to hydrogen.

Q14: So, it won't affect the quality?
A: Correct.

Q15: How do you plan to scale operations from prototype to industrial stages?
A: Initially, we will establish small-scale pilot plants. By the end of the first year, we will transition to larger-scale, more profitable systems. In the future, we plan to use AI to identify more efficient materials to increase hydrogen production while reducing volume requirements.

4.4 Filling Schedule:

4.4.1**[Group Presentation Session 2 (Novelty and Business Plan)]**

Time	Programme Details / Activity	Venue
7.30 a.m. – 9.00 a.m.	**Final Preparation for Group Presentation Session 2 (Novelty and Business Plan)** • Slides and videos were collected from all groups by technical team from MOSTI.	**Melur Hall**
9.00 a.m. – 9.35 a.m.	**Malaysia Team 2** Title: Nano Energy Harvester Based on Carbon-Nanocomposites for Powering Wearable Devices.	
9.40 a.m. – 10.15 a.m.	**Hong Kong** Title: Manufacturing of High-Performance Anion Exchange Membranes (AEMs) for Alkaline Fuel Cells, Water Electrolyzers and other electrochemical applications.	
10.15 a.m- 10.20 a.m	**Morning break**	
10.20 a.m. – 10.55 a.m.	**Thailand** Title: Biocoal – Sustainable Alternative Energy Fuel via Nanotechnology	
11.00 a.m. – 11.35 p.m.	**Taiwan** Title: Formosa Green: Revolution of Battery Technology	
11.40 p.m. – 12.15 p.m	**Malaysia Team 1** Title: Green Hydrogen Production: A Plausible Approach using Earth Abundance Silicon Nanowires via Surface Nanoengineering.	
12.20 p.m. – 12.55 p.m	**Iran** Title: Development of Novel Nanoscale Coatings for Affordable Hydrogen Production.	
13.00 p.m. – 14.00 p.m.	**Lunch Break**	**Funtasia Level 1**
14.00 p.m – 17.00 p.m	**Secretariat Discussion** • Finalization of Marks and Data Entry • Rehearsal for Closing Ceremony	**Melur Hall**

4.4.2 **List of Participant**

A. Malaysia 1 Team

No.	Name	Country/ University	Title
1.	Eugene Ling Wei Hong	Xiamen University, Malaysia	Green Hydrogen Production: A Plausible Approach using Earth Abundance Silicon Nanowires via Surface Nanoengineering
2.	Nur Azlina Binti Adris	Universiti Kebangsaan Malaysia, Malaysia	
3.	Nur Farahin Binti Yusoff	Universiti Teknologi Mara, Malaysia	
4.	Nidhi Rajesh Mavani	Universiti Kebangsaan Malaysia, Malaysia	
5.	[Supervisor] Dr. Chiu Wee Siong	Universiti Malaya, Malaysia	

B. Malaysia 2 Team

No.	Name	Country/ University	Title
1.	Khor Yohanz	Xiamen University, Malaysia	Nano Energy Harvester Based on Carbon-Nanocomposites for Powering Wearable Devices.
2.	Badrul Amin Bin Badrin	Universiti Malaya, Malaysia	
3.	Nurul Fatiha Binti Mohd Padzli	Universiti Sains Malaysia, Malaysia	
4.	Mohd. Faridzuan Bin Majid	Universiti Teknologi Petronas, Malaysia	
5.	[Supervisor] Prof. Dr Mohd Ambri Mohamed	Universiti Kebangsaan Malaysia, Malaysia	

C. Hong Kong Team

No.	Name	Country/ University	Title
1.	Mohammad Farhadpour	Hong Kong University of Science and Technology	Manufacturing of High-Performance Anion Exchange Membranes (AEMs) for Alkaline Fuel Cells, Water Electrolyzers and other electrochemical applications
2.	Kaveh Alizadeh Taghlidabad	Hong Kong University of Science and Technology	

D. Taiwan Team

No.	Name	Country/ University	Title
1.	Mr Yan-Ruei, Chen	National Tsing-Hua University of ESS	FormosaGreen: Revolution of Battery Technology
2.	Mr Chin-Yi, Chung	National Tsing-Hua University of ESS	
3.	Mr Yu Hsuan, Su	National Tsing-Hua University of ESS	
4.	Mr Wei-Ming, Chen	National Tsing-Hua University of ESS	
5.	[Supervisor] Dr. Po-Wei Chi	Chung Yuan Christian University	

E. Thailand Team

No.	Name	Country/ University	Title
1.	Miss Parinvadee Chukaew	Mahidol University	Biocoal Sustainable Alternative Energy Fuel via Nanotechnology
2.	Miss Chonthicha Nilapornkul	Mahidol University	
3.	Mr. Aphinan Saengsrichan	Chula University	
4.	Mr. Worapak Tanwongwan	King Mongkut's Institute of Technology Lad Krabong	
5.	[Supervisor] Dr. Sanchai Kuboon	National Nanotechnology Center (Nanotech)	

F. Iran Team

No.	Name	Country/ University	Title
1.	Mr. Nima Dehghan	Isfahan University of Technology	Development of Novel Nanoscale Coatings for Affordable Hydrogen Production
2.	Mr. Hamidreza Ghorbani	Isfahan University of Technology	
3.	[Supervisor] Prof. Masoud Atapour	Isfahan University of Technology	

4.5 Pictures Programme:

Picture 4.5.1: Team Malaysia 2 presenting their slide in front of Judges.

Picture 4.5.2: Team Thailand during presentation on day two.

Picture 4.5.3: Team Hongkong during presentation on day two.

Picture 4.5.4: Team Taiwan during presentation on day two.

Picture 4.5.5: Team Malaysia 1 during presentation on day two.

Picture 4.5.6: Team Iran during presentation on day two.

Picture 4.5.7: Team Malaysia 1 and Team Iran during the demonstration session.

Picture 4.5.8: Team Taiwan explaining about their project during the demonstration session.

Picture 4.5.9: Judges and Steering Committee during the Jury meeting.

5.0 DAY 5 | 18 NOVEMBER 2024 | MONDAY

5.1 **Activities:**

5.1.1 Rehearsal for Closing Ceremony of 2nd INO 2024
5.1.2 Closing ceremony of 2nd INO 2024
5.1.3 Sightseeing near Putrajaya and cruise Dinner

5.2 **Objective of the Programme**

5.2.1 Announce and honour the winners of the competition, showcasing their achievements to inspire future innovation in nanotechnology.
5.2.2 Officially announce the upcoming 3rd INO 2026 in Taiwan, building anticipation and encouraging participation.
5.2.3 Strengthen bonds through sightseeing and a cruise dinner in Putrajaya.

5.3 **Operation Mode:** Physical

5.4 **Event Schedule:**

5.4.1 **Schedule of International Nanotechnology Olympiad 2024:**

Time	Detail of the activities	Venue
9.00 am – 2.30 pm	Rehearsal for closing ceremony 2nd INO 2024	Melur Hall
3.30 pm – 5.00 pm	Closing Ceremony 2nd INO 2024 officiated by YB Tuan Chang Lih Kang, Ministry of Science, Technology & Innovation	Melur Hall
6.00 pm – 10.00pm	Putrajaya Sightseeing and cruise dinner	Putrajaya & Cruise Tasik Putrajaya

5.4.2 **List of winners:**

NO.	CATEGORY	(RM)	TEAM	GROUP MEMBER	TITLE
1	Gold Medal The Best of The Best Team	RM15,000.00	Iran	Nima Dehghan Hamidreza Ghorbani Prof. Masoud Atapour [Supervisor]	Development of Novel Nanoscale Coatings for Affordable Hydrogen Production
2	Gold Medal The Best Project in Science and Technical Development	RM10,000.00	Malaysia 1	Eugene Ling Wei Hong Nur Azlina binti Adris Nur Farahin binti Yusoff Badrul Amin bin Badrin Dr. Chiu Wee Siong [Supervisor]	Green Hydrogen Production: A Plausible Approach using Earth Abundance Silicon Nano Wires via

					Surface Nano Engineering
3	Gold Medal The Best Project in Business Development	RM10,000.00	Taiwan	Yan-Ruei, Chen Chin-Yi, Chung Yu Hsuan, Su Wei-Ming, Chen Dr. Po-Wei Chi [Supervisor]	Develop Eco-Friendly Li-Ion Battery using Nanoscale Bio-molecules
4	Gold Medal The Most Novel and High Impact Idea	RM10,000.00	Hong Kong	Mohammad Farhadpour Kaveh Alizadeh Taghlidabad Prof. Minhua Shao [Supervisor]	Manufacturing of High Performance Anion Exchange Membranes (AEMs) for Alkaline Fuel Cells, Water Electrolyzers and other Electrochemical Applications
5	Silver Medal	-	Thailand	Parinvadee Chukaew Chonthicha Nilapornkul Aphinan Saengsrichan Worapak Tanwongwan Dr. Sanchai Kuboon [Supervisor]	Sustainable Alternative Energy Fuel via Nanotechnology
6	Silver Medal	-	Malaysia 2	Khor Yohanz Nidhi Rajesh Mavani Nurul Fatiha binti Mohd Padzli Ts. ChM. Mohd. Faridzuan bin Majid Prof. Dr. Azrul Azlan Hamzah Prof. Dr. Mohd Ambri Mohamed [Supervisor]	Nano Energy Harvester Based on Carbon-Nano Composite For Powering Wearable Devices

5.5 Pictures of the Programme:

Picture 5.5.1: Rehearsal preparation for award giving.

Picture 5.5.2: Flow discussion for rehearsal preparation.

Picture 5.5.3: VIPs gather in the waiting room.

Picture 5.5.4: VIP arrival at Melur Hall

Picture 5.5.5: Doa recitation by Fakhrul Naim

Picture 5.5.6: Welcoming speech by Prof. Sharmin Karazzi

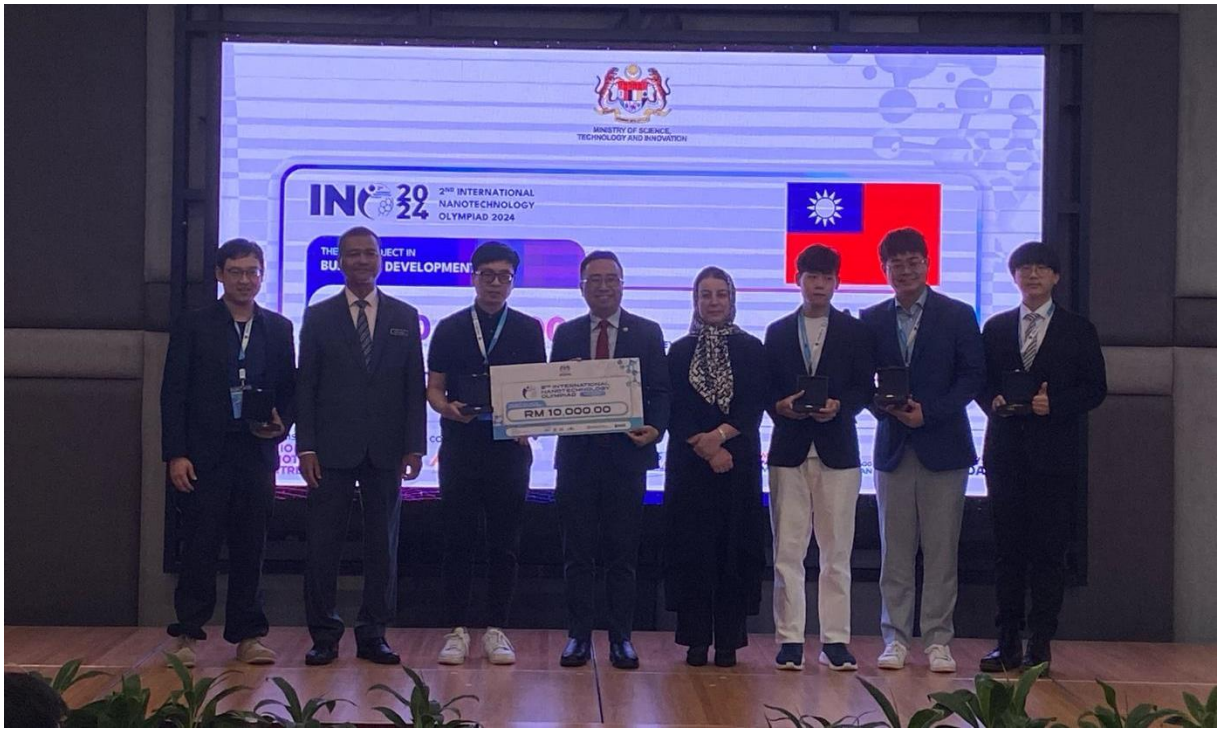
Picture 5.5.7: Closing speech by YB Tuan Chang Lih Kang, Minister of Ministry of Science, Technology and Innovation (MOSTI) Malaysia

Picture 5.5.8: Silver medal winner from Thailand

Picture 5.5.9: Malaysia Team 2 with silver medal award

Picture 5.5.10: Malaysia Team awarded with the best project in Science and Technical Development

Picture 5.5.11: The winner for most novel and high impact idea (Team Hong Kong)



Picture 5.5.12: The winner for the best project in business development (Team Taiwan)

Picture 5.5.13: The best of the best winner Team Iran

Picture 5.5.14: Symbolic handover memento from Mr Ismarul for 3rd INO 2026 for Taiwan representative Prof. Dr Phillip Wu

Picture 5.5.15: Group picture with VIPs and all participants from Malaysia, Iran, Taiwan and Hong Kong.

Picture 5.5.16: Group photo in front of the prime minister's office

Picture 5.5.17: Group photo in front of the Masjid Putra, Putrajaya

Picture 5.5.18: Group Photo at Cruise Putrajaya

Picture 5.5.19: Dinner on the cruise

Picture 5.5.20: Karaoke's session (Team Taiwan)

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