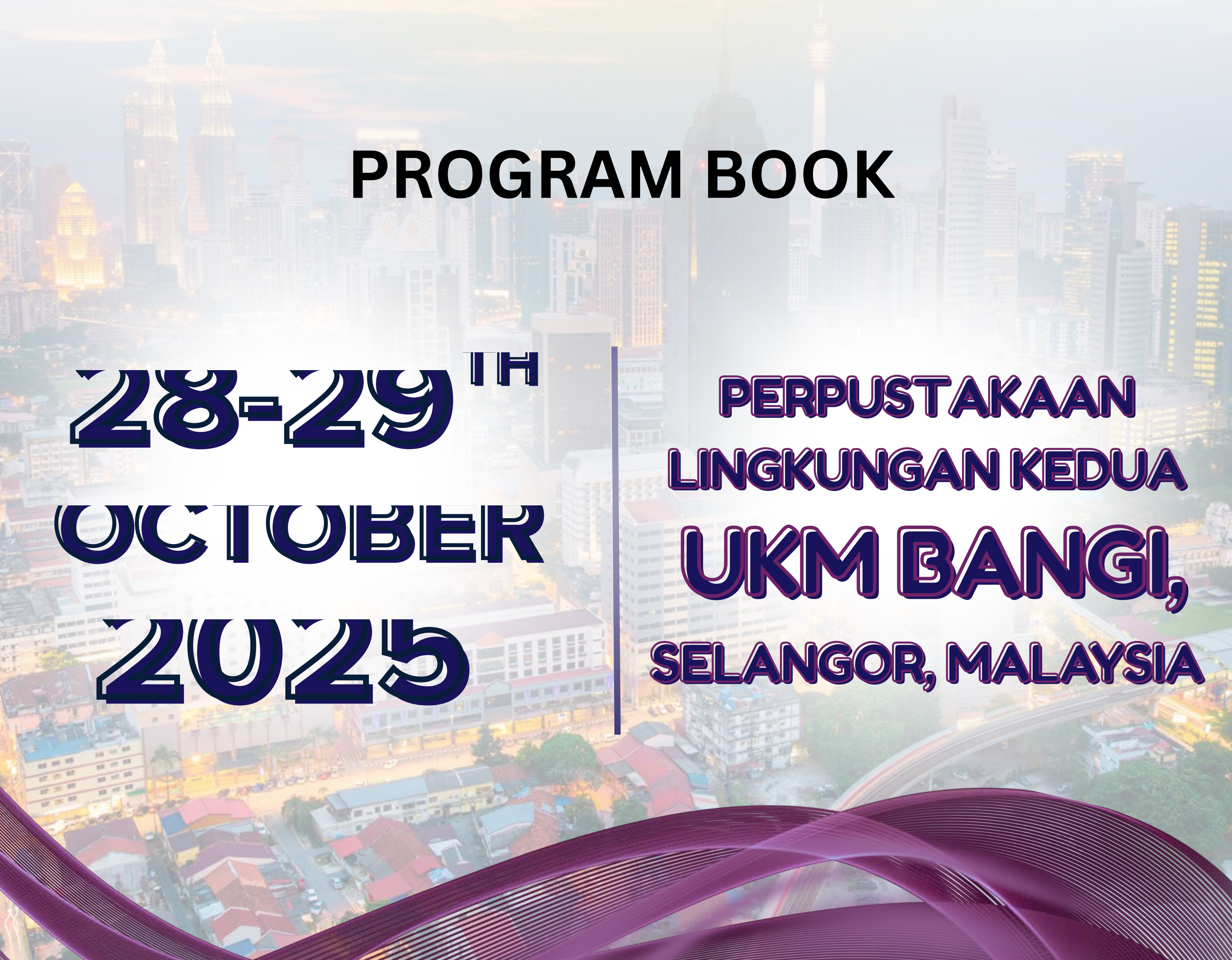
11th Southeast Asia Collaborative Symposium on Energy Materials Malaysia

(11th SACSEM Malaysia 2025)



PROGRAM BOOK

28-29TH OCTOBER 2025

PERPUSTAKAAN LINGKUNGAN KEDUA
UKM BANGI,
SELANGOR, MALAYSIA

11TH SOUTHEAST ASIA COLLABORATIVE SYMPOSIUM ON ENERGY MATERIALS MALAYSIA

(11th SACSEM Malaysia 2025)

OCTOBER 28-29, 2025

PERPUSTAKAAN LINGKUNGAN KEDUA, UKM
BANGI, SELANGOR, MALAYSIA

Jointly organized by:

SOLAR ENERGY RESEARCH INSTITUTE STUDENTS ASSOCIATION
SERISA UKM

UNIVERSITI KEBANGSAAN MALAYSIA
The National University of Malaysia

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UKM International Student Chapter

Co-organized by:

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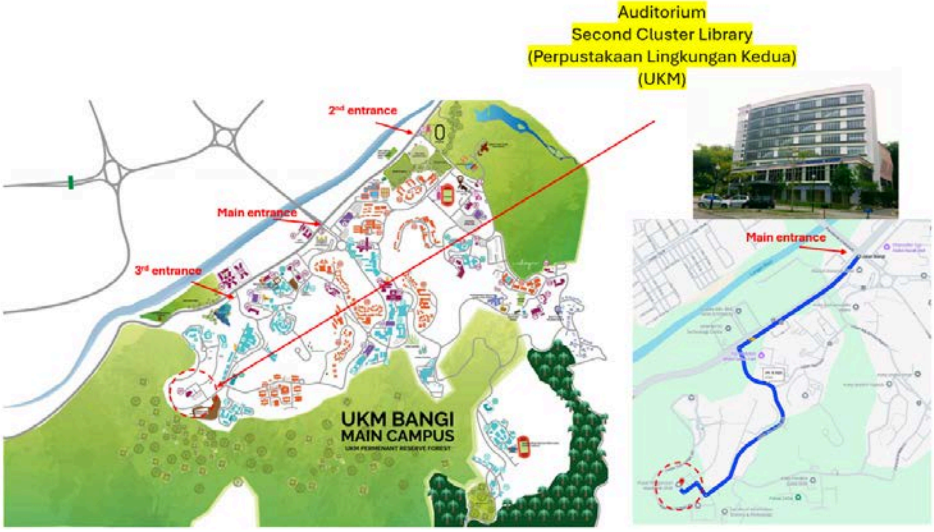
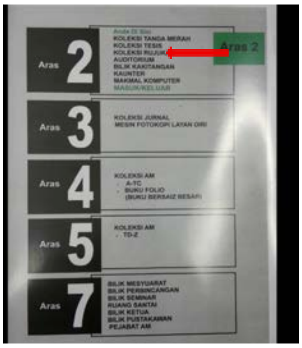
Important Information of 11th SACSEM 2025

Symposium Venue

11th Southeast Asia Collaborative Symposium on Energy Materials Malaysia (11th SACSEM Malaysia 2025) is scheduled to be held on the **28th – 29th October 2025** at the **Auditorium (Second Floor), Second Cluster Library (Perpustakaan Lingkungan Kedua)**, Universiti Kebangsaan Malaysia (UKM), Bangi, Selangor, Malaysia.





Aras 2
Anda Di Sini
KOLEKSI TANDA MERAH
KOLEKSI TESIS
KOLEKSI RUJUKAN
AUDITORIUM
BILIK KAKITANGAN
KAUNTER
MAKMAL KOMPUTER
MASUK/KELUAR

Aras 2

Aras 3
KOLEKSI JURNAL
MESIN FOTOKOPI LAYAN DIRI

Aras 4
KOLEKSI AM
- A-TC
- BUKU FOLIO (BUKU BERSAIZ BESAR)

Aras 5
KOLEKSI AM
- TD-Z

Aras 7
BILIK MESYUARAT
BILIK PERBINCANGAN
BILIK SEMINAR
RUANG SANTAI
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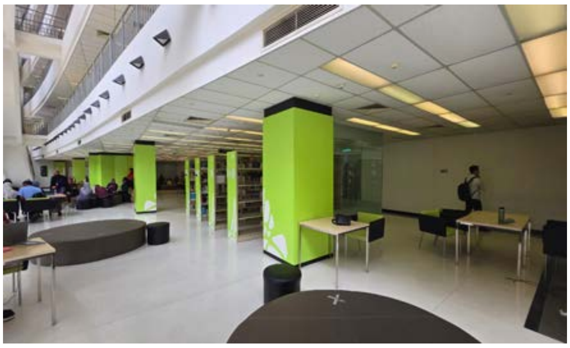
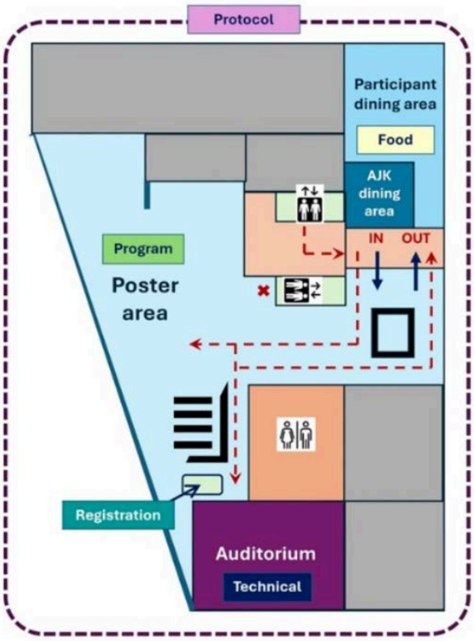
PEJABAT AM





Gala Dinner

Gala Dinner will be held at **Dewan Melur, Bangi Resort Hotel** at 20.00 (8.00 pm Malaysia Time) on 28th October 2025 (Tuesday).
*Time Zone is Malaysia Time (GMT +8)

Bangi Resort Hotel, Bangi, Selangor, Malaysia.

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SACSEM 11th Symposium Program

Invited Speaker (IS): Presentation (20 min.) + Discussion (4 min.) + Change (1 min.)
Student Speaker (SS): Presentation (10 min.) + Discussion (4 min.) + Change (1 min.)

Note: Time Zone is Malaysia Time (GMT +8)

28th October 2025 (Tuesday) Day 1
General Session (Invited Speaker)

Time	No	Presenter's Name	Affiliation	Country
8.00 - 8.30	**Registration**			
8.30 - 8.45	**Opening Remarks**			
	Session I: Chairperson - Prof. Dr. Azizan Ahmad			
8.45 - 9.10	**IS_01**	Prof. Dr. Yohei Yamamoto	University of Tsukuba	Japan
9.10 - 9.35	**IS_02**	Prof. Dr. Norasikin Ahmad Ludin	Universiti Kebangsaan Malaysia (UKM)	Malaysia
9.35 - 10.00	**IS_03**	Prof. Dr. Yoichi Yamada	University of Tsukuba Malaysia	Malaysia
10.00 - 10.25	**IS_04**	Prof. Dr. Takahiro Kondo	University of Tsukuba	Japan
10.25 - 10.50	**Morning Break & Photo Session**			
	Session II: Chairperson - Prof. Dr. Yohei Yamamoto			
10.50 - 11.15	**IS_05**	Assoc. Prof. Dr. Siti Aminah Mohd Noor	Universiti Pertahanan Nasional Malaysia (UPNM)	Malaysia
11.15 - 11.40	**IS_06**	Assoc. Prof. Dr. Arie Wibowo	Bandung Institute of Technology	Indonesia
11.40 - 12.05	**IS_07**	Prof. Dr. Kouji Sakaki	National Institute of Advanced Industrial Science and Technology	Japan
12.05 - 12.30	**IS_08**	Prof. Dr. Takao Mori	National Institute for Materials Science (NIMS), University of Tsukuba	Japan
12.30 - 12.55	**IS_09**	Prof. Dr. Kohsaku Kawakami	National Institute for Materials Science (NIMS), University of Tsukuba	Japan
12.55 - 13.10	**Corporate Slot: RMAICT Sdn. Bhd**			
13.10 - 14.00	**Lunch Break**			
	Session III: Chairperson - Assoc. Prof. Dr. Narges Ataollahi			
14.00 - 14.25	**IS_10**	Dr. Hendra	Politeknik STTT Bandung	Indonesia
14.25 - 14.50	**IS_11**	Prof. Dr. H. Sepehri-Amin	National Institute for Materials Science (NIMS), University of Tsukuba	Japan
14.50 - 15.15	**IS_12**	Prof. Dr. Yuki Nagao	Japan Advanced Institute of Science and Technology (JAIST)	Japan
15.15 - 15.40	**IS_13**	Prof. Dr. Hiroshi AOKI	National Institute of Advanced Industrial Science and Technology (AIST), University of Tsukuba	Japan
15.40 - 16.05	**IS_14**	Prof. Dr. Surawut Chuangchote	King Mongkut's University of Technology Thonburi	Thailand
16.05 - 16.15	**Corporate Slot: Daihatsu (M) Sdn. Bhd.**			
16.15- 16.30	**Coffee Break**			
16.30 - 17.30	**Poster Session I (15 presenters)**			
20.00 - 22.00	**Dinner**			

SACSEM 11th Symposium Program

Invited Speaker (IS): Presentation (20 min.) + Discussion (4 min.) + Change (1 min.)
Student Speaker (SS): Presentation (10 min.) + Discussion (4 min.) + Change (1 min.)

Note: Time Zone is Malaysia Time (GMT +8)

29th October 2025 (Wednesday) Day 2
General Session (Invited Speaker)

Time	No	Presenter's Name	Affiliation	Country
8.00 - 8.30	**Registration**			
	Session IV: Chairperson - Prof. Dr. Yoichi Yamada			
8.30 - 8.55	**IS_15**	Prof. Dr. Mohd. Yusri bin Abd. Rahman	Universiti Kebangsaan Malaysia (UKM)	Malaysia
8.55 - 9.20	**IS_16**	Assoc. Prof. Dr. Ken Sakaushi	National Institute for Materials Science (NIMS), University of Tsukuba	Japan
9.20 - 9.45	**IS_17**	Prof. Dr. Akrajas Ali Umar	Universiti Kebangsaan Malaysia (UKM)	Malaysia
9.45 - 10.10	**IS_18**	Assoc. Prof. Dr. Patiya Kemacheevakul	King Mongkut's University of Technology Thonburi	Thailand
10.10 - 10.30	**Morning Break**			
	Session V: Chairperson - Assoc. Prof. Dr. Arie Wibowo			
10.30 - 10.55	**IS_19**	Assoc. Prof. Dr. Narges Ataollahi	University of Trento	Italy
10.55 - 11.10	**SS_01**	Natsumi Noguchi	University of Tsukuba	Japan
11.10 - 11.25	**SS_02**	Kevin Reynold Wijaya	Bandung Institute of Technology	Indonesia
11.25 - 11.40	**SS_03**	A’rifaturrohmah	Bandung Institute of Technology	Indonesia
11.40 - 11.55	**SS_04**	Shiho Tsutsumi	University of Tsukuba	Japan
11.55 - 13.00	**Poster Session II (19 presenters)**			
13.00 - 14.00	**Lunch Break**			
	Session VI: Chairperson - Prof. Dr. Kohsaku Kawakami			
14.00 - 14.15	**SS_05**	Sota Nakayama	University of Tsukuba	Japan
14.15 - 14.30	**SS_06**	ChM. Ts. Mohd. Faridzuan Bin Majid	Universiti Teknologi PETRONAS (UTP)	Malaysia
14.30 - 14.45	**SS_07**	Sena Sato	University of Tsukuba	Japan
14.45 - 15.00	**SS_08**	Yuan Mei	University of Tsukuba	Japan
15.00 - 15.15	**SS_09**	Nur Adiera Hanna Rosli	Universiti Kebangsaan Malaysia (UKM)	Malaysia
15.15 - 15.30	**SS_10**	Nor Atikah binti Abu Bakar	Universiti Kebangsaan Malaysia (UKM)	Malaysia
15.30 - 15.45	**SS_11**	Mohd Sofi Numin	Universiti Teknologi PETRONAS (UTP)	Malaysia
15.45 -16.00	**SS_12**	Ravi Singh	University of Tsukuba	Japan
16.00 - 16.15	**Coffee Break**			
16.15 - 16.30	**Prize Announcement**			
16.30 - 17.00	**Closing Remaks**			

Supramolecular Design of Organic/Polymeric Micro Photoemitters for Optical and Laser Applications

P

Yohei Yamamoto[1]

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Optical microresonators are small dielectric objects that are utilized as essential components in micrometer-scale light and laser sources, optical integrated circuits, micro-displays, chemo- and biosensors, and so forth. Particularly, microresonators made from organic and polymeric materials find unique applications owing to its structural flexibility, color tunability, and functionality with simple fabrication process, low cost and low energy consumption. In this presentation, we highlight our recent progress on the organic/polymeric microresonators made through precisely controlled self-assembly process. The microstructures display novel optical functions such as circularly polarized luminescence emission, lasers, light energy harvesters, optical gate operations, optical memories and authentications, and optical sensing for environmental changes and mechanical forces. Our methodology for the precise design and control of organic and polymeric microstructures will bridge between nanometer-scale supramolecular chemistry and bulk materials and will pave the way toward flexible optical and laser applications (Fig. 1).[1–4].

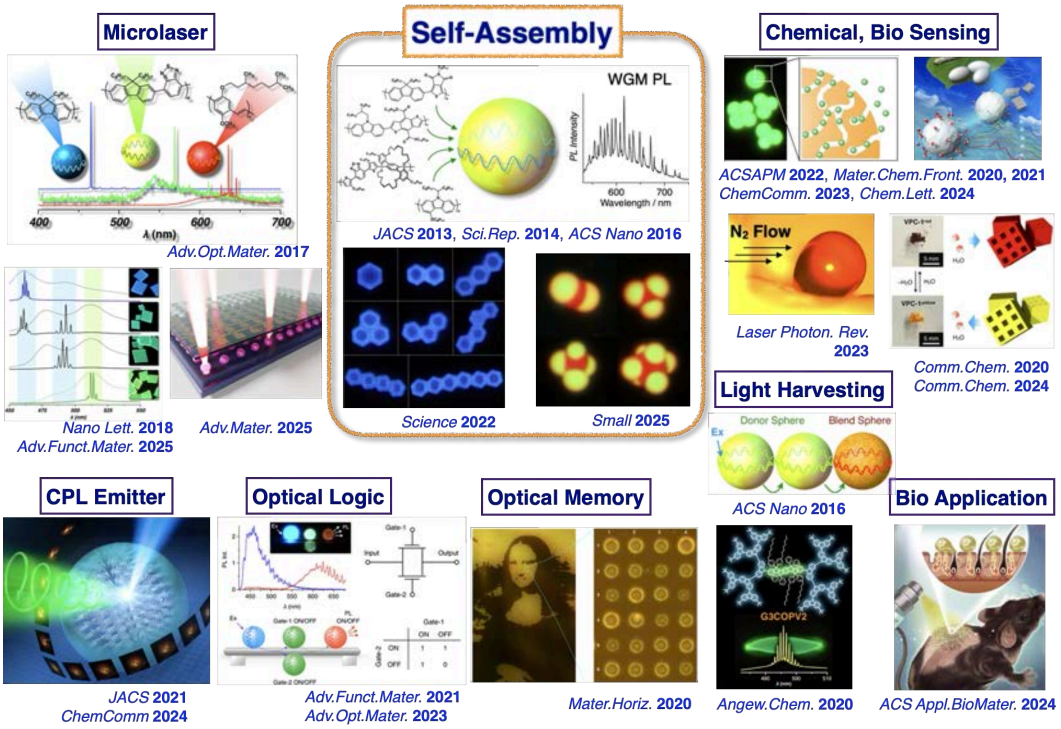

Fig. 1. Summary of our recent works on self-assembled organic/polymeric microlasers.

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Advancing Flexible Perovskite Solar Cells: Research Progress and Development at SERI, UKM

Norasikin Ahmad Ludin, Mohd Sukor Suait, Muhammad Ubaidah Syafiq, Adamu Goje, Fareed Farihin and Chowdhury Afroze Taiwaba

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The emergence of perovskite solar cells (PSCs) has opened new avenues for low-cost, high-efficiency photovoltaic technologies. Among their most promising adaptations is the development of flexible perovskite solar cells (F-PSCs), which offer lightweight, bendable, and portable energy solutions for next-generation applications, including wearable electronics, building-integrated photovoltaics, and aerospace systems. This talk will present a comprehensive review of recent progress in F-PSC research, with a focus on advancements achieved at the Solar Energy Research Institute (SERI), Universiti Kebangsaan Malaysia. Key topics will include materials engineering for flexible substrates, optimization of perovskite layer deposition techniques compatible with roll-to-roll manufacturing, and strategies for enhancing device stability under mechanical stress and environmental exposure. The presentation will also highlight novel encapsulation approaches to extend operational lifetimes, as well as our recent work on scalable fabrication methods for industrial relevance. Challenges such as moisture ingress, ion migration, and thermal instability will be discussed, alongside potential solutions that integrate material innovation, interface engineering, and lifecycle analysis. By combining SERI's developmental research outcomes with global trends, this review aims to provide a forward-looking perspective on the commercialization potential of F-PSCs and their role in accelerating the transition towards sustainable, flexible energy systems.

References

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[3] Adamu Ahmed Goje*, et al. Materials for Renewable and Sustainable Energy* (2024) 13:155–179

Electronic Structure and Molecular Arrangement of Organic Semiconductor Films

Yoichi Yamada[1,2]
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Organic electronics is one of the promising fields for a sustainable world. For the organic semiconductor (OSC) molecules, the relation between the "shape" and electronic structure becomes significant. Therefore, structural determination or structural control of the molecular film is necessary for the innovation of devices for the next generation. We are focusing on the films of new molecules such as high-mobility OSCs, TADF-OLEDs, and endohedral Fullerenes.

I would like to introduce our recent research on the shape of organic semiconductor films, primarily using scanning probe microscopy[1] and photoemission[2] or field emission[3] techniques to image molecules and their molecular orbitals.

I would also like to introduce our collaboration project with Hitachi High-Tech in Japan and Malaysia[4]. Also, I will describe about University of Tsukuba, Malaysia (UTMy), which is the first abroad campus of a Japanese university[5].

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[4] https://advsem.bk.tsukuba.ac.jp/
[5] https://www.utmy.edu.my/

New materials for hydrogen generation, storage, and utilization

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We have experimentally synthesized boron monosulfide (BS) nanosheets [1] and hydrogen boride (HB) nanosheets [2] for the materials to enhance hydrogen utilization. The stacked BS nanosheets, rhombohedral BS (r-BS), is found to be as a p-type semiconductor [3,4] and have a great electrocatalytic property for oxygen evolution reaction in alkaline solution [5]. HB nanosheets are composed of boron and hydrogen at a 1:1 stoichiometric ratio, which can be formed by an ion-exchange reaction between protons and magnesium cations in magnesium diboride with exfoliation [2] and are not reported to be synthesized before our work [6,7]. In the HB nanosheets, boron atoms form a hexagonal 2D network, in which hydrogen atoms are bound to boron by three-center-two-electron bonds (B–H–B) and two-center-two-electron bonds (B–H) [8]. Experimental studies have clarified that HB nanosheets exhibit solid acid catalytic activity [9,10], metal ion reducibility [11-13], semimetal electronic properties, gas-sensor applicability [7], stability against water [14,15], CO_2 adsorption/ conversion property including C-C coupling [16], a light-responsive hydrogen release function [17-20], and an electric-field induced hydrogen release function [21]. Furthermore, they can deactivate various pathogens, including the Omicron variant of SARS-CoV-2, influenza virus, feline calicivirus, and bacteriophages [22]. In the presentation, recent progress of HB and BS nanosheets and the new material of $HCa_{0.5}B_6$ [23] will be introduced together with our recent development of metal organic framework (MOF) for hydrogen storage at room temperature.

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Palm Oil Biomass as a New Lignocellulose Anode Material for Sodium Ion Battery (SIB)

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and Siti Hasnawati Jamal[1,2]

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[2] *Centre for Tropicalization (CENTROP), Defence Research Institute, Universiti Pertahanan Malaysia, Kem SungaiBesi, 57000 Kuala Lumpur, Malaysia.*

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Hard carbon (HC) derived from polysaccharide-rich biomass, such as cellulose and hemicellulose, has attracted growing interest as a sustainable anode material for sodium-ion batteries (SIBs) due to its disordered carbon structure and favourable sodium storage properties. In this study, HC was developed from oil palm mesocarp fibre (OPMF), a lignocellulosic waste rich in polysaccharides, and its performance as an anode material was evaluated. The influence of acid treatment on the structural and electrochemical properties of the precursor was systematically investigated. The resulting HC was characterized their physicochemical properties and electrochemical properties. FTIR analysis identified esterification reaction between the -COOH and -OH groups on the OPMF chains during the molecular stitching process. Meanwhile, XRD patterns showed broad peaks centered at $2\theta \approx 23°$ and 44°, characteristic of amorphous hard carbon while Raman spectra revealed the presence of D and G bands, confirming the disordered carbon structure. Morphological analysis via FESEM displayed porous structures, supported by BET surface areas of 29.63 m^2/g and 22.24 m^2/g for pre-treatment and post-treatment respectively. Moreover, EDX analysis confirmed a carbon content exceeding 90 wt.%. For electrochemical properties, pre-treated hard carbon undergo electrochemical testing at 0.1C demonstrated promising performance with a discharge capacity of 172–140 mAh/g, nearly 100% initial coulombic efficiency, and a capacity retention of 81% over cycling. These results highlight the potential of OPMF-derived hard carbon as a sustainable and effective anode material for next-generation sodium-ion batteries.

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Photocatalysis for remediation of organic pollutants and production of hydrogen

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Photocatalysis is one of attractive strategies to eliminate persistent organic pollutants (POPs) from water stream because it utilizes the abundant solar energy source to generate powerful hydroxyl radical to degrade POPs. Furthermore, photocatalysis can also be used for green hydrogen production. TiO_2 is one of the popular photocatalyst because it is photochemically stable, non-toxic, commercially available, and cheap. However, TiO_2 is not efficient enough to harvest energy from sunlight due to its high bandgap (3.22 eV) so that it can only absorb energy in UV light region, which is only 5% of sunlight irradiation. Here, we report fabrication of black TiO_2 through microwave heating to decrease the bandgap of TiO_2 [1], utilization of graphitic carbon nitride (GCN) [2] and ZnO-Fe_2O_3 heterojunction [3] as visible light-driven photocatalyst to improve its performance in visible-light region of solar energy. Furthermore, we also report our current work to produce hollow TiO_2/GCN type II heterojunction for removal of synthetic dyes and antibiotics, and at the same time, for green hydrogen production through photocatalysis process [4].

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Hydrogen Storage Materials for Hydrogen Compression and Purification

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Global warming is a serious issue for a sustainable society. Utilization of hydrogen technologies has the potential to play an essential role in a zero-emission society. However, significant improvements for their performance such as efficiency and cost are required. Metal hydride (MH) has unique characteristics for hydrogen storage with higher volumetric density. In addition, their thermodynamic stability and selective reactivity may lead to MH as compression and purification applications. MH compressors have several advantages such as no moving parts, compact, silent, and simple to operate [1]. MH based hydrogen purification is operated when needed making it suitable for daily start and stop (DSS) operation [2]. Significant energy efficiency is improved if low-grade waste heat is available nearby [1-3]. In hydrogen refueling stations, MH compressors need to compress up to more than 80 MPa. We have proposed two types of hybrid hydrogen compression systems, one combining with an electrochemical device and the other combining with a formic acid decomposition system. We must develop the MH materials which absorb at 30-40 MPa at RT and desorb at 80 MPa at around 80 °C [3,4]. In addition, since hydrogen generated by the decomposition of formic acid contains CO_2, the effect of CO_2 on hydrogen storage performance was also investigated.

First, the equipment to evaluate hydrogen storage properties up to 100MPa based on Sieverts method was successfully developed [5]. Ternary $Ti(Cr, Mn)_2$ and quaternary $Ti(Cr, Mn, Fe)_2$ compounds were synthesized, and their properties were evaluated. When substitution of Mn by Fe into $TiCr_{1.25}Mn_{0.75}$, $TiCr_{1.25}Mn_{0.75-x}Fe_x$, was carried out, its P-C isotherms and heat-driven compression experiments for $TiCr_{1.25}Fe_{0.75}$ indicate that the hydrogen desorption pressure is 80.1 MPa at 80 °C and reached 76 MPa heated to 80 °C, respectively. Finally, we established equations to predict the chemical composition to meet target pressure condition for various applications. In parallel, we have also investigated the effect of CO_2 as an impurity gas on the hydrogenation properties of $(Ti, Zr)(Cr, Mn, Fe)_2$ compounds and their composite with several different materials. In this presentation, we will also explain our concept of material development for hydrogen purification and show you some achievements.

Acknowledgements

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Overview of NIMS (National Institute for Materials Science)

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I would like to give this overview as special assistant to the president of NIMS, National Institute for Materials Science. NIMS is the largest research institute in Japan which focuses on materials science. As of April 1, 2025, there are 450 permanent researcher & engineer staff and 1597 employees in all. In 2001, NRIM, the National Research Institutes for Metals and NIRIM, National Institute for Research in Inorganic Materials combined to become NIMS, in the form of an Independent Administrative Institution. In 2016 NIMS was selected amongst the many IAI to be a Designated National Research and Development Institute.

There are 7 Research Centers in NIMS; the Research Center for Energy and Environmental Materials, Research Center for Electronic and Optical Materials, Research Center for Magnetic and Spintronic Materials, Research Center for Structural Materials, Research Center for Macromolecules and Biomaterials, the bottom-up Research Center for Materials Nanoarchitectonics, MANA, and the Center for Basic Research on Materials focused on characterization and data driven approaches. And 3 Platforms, the Materials Data PF, the Nanofabrication & Characterization PF, and Battery PF.

In addition to a strong publication activity of 1,437 papers (Top 10% papers 23.9%, Top 1% papers 4.6%) per year in 2023 for example, NIMS has strong activity in terms of company collaboration.

Coming to NIMS, students can obtain PhD degrees by the NIMS Graduate Program (https://www.nims.go.jp/students/en/), where NIMS research staff, serving as adjunct professors/associate professors in 7 universities of Japan of which the University of Tsukuba is the most prominent program. There is also the International Cooperative Graduate Program (ICGP) (https://www.nims.go.jp/eng/hr-development/ICGP.html), a Joint supervision program accepting Ph.D. students for up to one year. And NIMS Internship Program (https://www.nims.go.jp/eng/hr-development/internship.html) which offers stays of up to 3 months to students and can be a gateway to the NIMS Graduate Program.

We hope that participants in SACSEM2025 may have interest in these programs.

Physical Stabilization of Organic Glasses by Controlling Local Molecular Mobility

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In pharmaceutical field, glassy state is utilized for improving dissolution property of poorly soluble drugs, as it has higher energy state relative to crystals. However, much attention must be paid for its physical stability, as long-term storage stability is required for pharmaceutical products. Although physical stabilization is typically done by adding much amount of excipients, it frequently causes a pill burden issue. Therefore, pharmaceutical glasses must be stabilized with scientifically-sound strategy for minimizing amount of excipients with detailed understanding on molecular level dynamics.

Celecoxib is a poorly-soluble anti-inflammatory drug for treating rheumatoid arthritis, osteoarthritis, and low back pain. Both polymeric excipients and mesoporous materials work for stabilizing its glassy state. Addition of such excipients is generally believed to decrease molecular mobility to delay crystallization. Detailed investigation using broadband dielectric spectroscopy (BDS) revealed that slowing down of γ-relaxation, which is originated from rotation of the phenyl ring with respect to the sulfonamide group, seemed to play an important role for the stabilization[1]. Therefore, use of polymeric excipients that interact with the sulfonamide group is notably effective for the stabilization. BDS study also revealed that addition of mesoporous materials may accelerate or suppress molecular mobility, indicating complexity of their effect on the stability. In our study, celecoxib glass was overloaded to the mesoporous silica for reducing amount of excipient. In this case, exchange of molecules inside and outside of pores is an important factor for stabilization, for which large pores are advantageous. Therefore, the materials with 21 nm pores could stabilize the celecoxib glass, whereas those with 2.5 nm pores destabilized it[2]. The same was observed for acetaminophen glass, where acceleration of γ-relaxation was confirmed. These knowledges should work as a basis for stabilizing pharmaceutical glasses with minimum amount of excipients.

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Compressive and Flexural Properties of the Kevlar Fiber as a Textile-Reinforced Concrete for Lightweight Construction Applications

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ABSTRACT Textile-reinforced concrete (TRC) offers a sustainable alternative to conventional steel-reinforced concrete by incorporating textile elements, thereby reducing carbon emissions and enhancing design flexibility. This study examines the use of Kevlar fiber reinforcement in improving the mechanical performance of concrete, with particular attention to compressive and flexural properties. Three Kevlar reinforcement configurations were evaluated: 3-dimensional (3D) rebar, 3D hollow woven fabric, and solid 3D woven fabric, alongside a control sample of unreinforced concrete. Compression tests were conducted in accordance with SNI 03-1974-1990, which is broadly equivalent to ASTM C39 in terms of loading procedure and specimen dimensions. Results showed that the 3D rebar configuration achieved the highest compressive strength of 14.31 MPa, marginally exceeding that of the unreinforced control at 13.28 MPa. Although the gains in compressive strength were modest, the flexural performance exhibited substantial improvement. Flexural tests, following ASTM C78 standards, revealed that the solid 3D woven fabric configuration achieved a flexural strength of 12.17 MPa, whereas that of unreinforced sample was 3.65 MPa. These results indicate that Kevlar-reinforced TRC can be particularly advantageous for applications where superior flexural capacity is required, even if compressive strength remains at a moderate level. Potential uses include non-structural or secondary lightweight elements, such as canopies, facade panels, and other architectural components where weight reduction, crack resistance, and design adaptability are desirable. The findings also highlight the influence of reinforcement configuration, with the solid 3D woven fabric providing the most significant flexural benefits. This research contributes to the growing body of evidence supporting the viability of synthetic fiber reinforcement, such as Kevlar, in sustainable concrete design and construction.

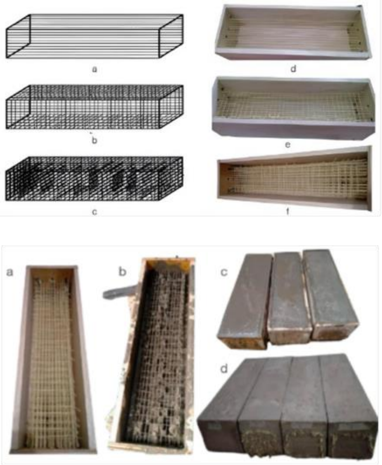

Figure 1. Fabrication of the kevlar Reinforced Concrete

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Development of magnetic materials for green energy conversions

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Magnetic materials play a vital role in a wide range of applications, from energy conversion to data storage. Their functionality is largely determined by their magnetic hysteresis. For instance, large hysteresis is desired in permanent magnets and recording media, while minimizing hysteresis improves the performance of soft magnets and magnetocaloric materials. In this presentation, we will first provide an overview of our team's work on tuning the hysteresis of various functional magnetic materials through material design and multi-length-scale microstructure engineering.

In the first part, we demonstrate how introducing magnetoelastic anisotropy in soft magnetic materials can benefit reduction of core loss for high frequency power electronic applications. We will show that optimum annealing in Fe-based amorphous ribbons with a large magnetostriction induces a small stress-induced perpendicular magnetic anisotropy. This promotes change of magnetic domain configuration from large curvilinear magnetic domain to the formation of narrow stripe-shaped domain and resulted in a change in high frequency magnetization switching mechanism [1]. Unlike conventional approaches that focus on necessity of low magnetostriction values to reduce core loss, we succeeded in 50 % reduction of core loss even in materials with large magnetostriction which can open materials choice for high frequency power electronic applications.

In the second part of this talk, we will highlight our efforts in developing on-demand permanent magnets with tailored properties—such as optimized electrical resistivity, improved thermal stability, flatter recoil curves, and reduced dependence on critical elements—while preserving excellent hard magnetic performance [2-4]. We will demonstrate how combinatorial research approach of advanced processing, multi-length-scale microstructure characterizations and magnetic domain observations, and digital twins of permanent magnets have enabled us in development of high coercivity Dy-free Nd-Fe-B magnets. Additionally, we will discuss how tailoring the magnetism of the thin intergranular phase can enhance the thermal stability of coercivity, bringing it closer to its theoretical limit—a key factor for high-temperature applications.

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Lyotropic Liquid-Crystalline Polymer Electrolytes for Electrochemical Energy Storage

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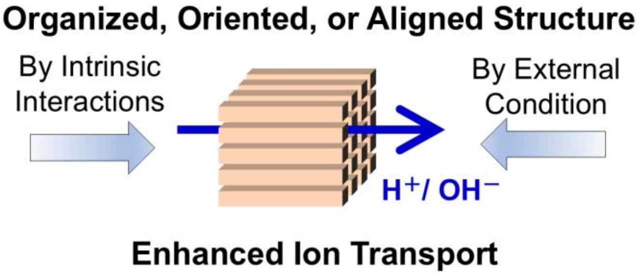
One of the key factors governing the performance of electrochemical energy storage devices is the electrolyte.[1-3] Conventional ionomers such as Nafion provide only nanometer-scale ionic domains, which limit long-range ion transport.[4] To overcome this, we have designed alkyl sulfonated polyimides (ASPI) that exhibit lyotropic liquid-crystalline phases and form lamellar domains with extended ion-conductive pathways.[5-6]

Our studies demonstrated that ASPI thin films achieve proton conductivities on the order of 10^{-1} S cm^{-1} at room temperature, enabled by hierarchical ordering and hydration-induced structural modulation. When applied its Li form as a coating on layered oxide cathodes (NCM523), these organized electrolytes significantly improved C-rate performance and interfacial stability. These results highlight the strong correlation between molecular ordering and macroscopic electrochemical properties.

The concept has further potential for emerging devices, including proton batteries[7], sodium ion batteries, and redox flow cells, underlining the versatility of structurally organized electrolytes as a platform for advanced energy storage.



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Simple and Rapid Technique for DNA Screening from Environmental Waters Aiming at Environmental Assessment

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We focused the development of a cell collecting method and an electrochemical sensing system[1] capable of feasibly detecting cell-derived environmental DNA (eDNA) from aquatic environments without the need for labeling nor external indicator reagents. Conventional eDNA analysis typically involves collecting water samples and transporting them to a laboratory, followed by DNA analysis using next-generation sequencers (NGS). However, this process requires specialized expertise and equipment, spoiling rapid and on-site environmental monitoring.

To address this limitation, we aimed to establish a novel sensing platform that enables efficient eDNA detection directly in the field. As model environmental samples, we prepared suspensions of cells in PBS and natural river water.[2] We then developed a new method for cell recovery and DNA amplification, along with a detection technique based on sequence complementarity that does not require DNA labeling. For cell recovery, we employed a combination of multiple filters, which allowed us to complete the entire pretreatment process within about 10 minutes. For detection, we utilized a sensor array incorporating synthetic nucleic acid probes with terminal ferrocene moieties (Figure 1).[3] This system successfully detected DNA in river water at environmentally relevant concentrations (38 cells/mL) with high sensitivity and specificity. The integration of these technologies enables a streamlined workflow from sample collection to detection, without the need for complex laboratory procedures. These results suggest that our approach significantly enhances the feasibility of rapid, on-site eDNA monitoring, offering a promising tool for real-time environmental assessment and biodiversity studies in various aquatic ecosystems.

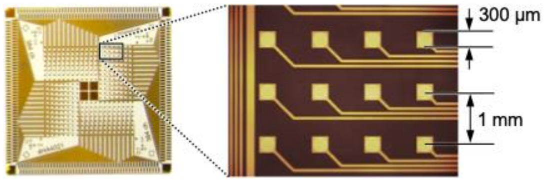

Figure 1. Photo-lithographically fabricated sensor array.

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Graphitic Carbon Nitride-Based Photocatalysts for Conversion of Sugar to High-Value Chemicals

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Photocatalysts offer a notable advantage that has led to their diverse applications: they are recyclable, nontoxic, and utilize solar or visible light as a stimulus. Graphitic carbon nitride (g-C_3N_4) has garnered significant interest because it is a cheap, chemically stable, metal-free material with nontoxic performance. Its narrow band gap energy of 2.7 eV allows it to absorb visible light. Although g-C_3N_4 possesses properties that qualify it as a promising photocatalyst, its actual photocatalytic efficiency is low. This low efficiency stems from its high charge recombination rate. The photocatalytic efficiency of g-C_3N_4 can be significantly enhanced by employing design strategies to mitigate this issue. These strategies include various highly efficient photocatalytic methods such as junction construction, homojunction, and heterojunction creation. In this work, urea was used as a precursor for the synthesis of g-C_3N_4. The urea was calcined for 2 h at a steady temperature of 550°C with a heating rate of 2°C/min. Subsequently, an appropriate urea to g-C_3N_4 ratio that could achieve a high-efficiency photocatalytic reaction was determined. Water was used to mix the components to ensure improved mixing and dispersion. Following this, the synthesis was conducted at 450°C for 1, 3, and 5 h to yield two different g-C_3N_4 structures that promote the synthesis of close-coupled copolymers. The resulting catalysts were characterized using various techniques, including X-ray diffractometry, scanning electron microscopy, transmission electron microscopy, Brunauer-Emmett-Teller (BET) surface area analysis, UV-vis spectrophotometry, and photoluminescence spectroscopy. Finally, the photocatalyst efficiency was demonstrated by converting glucose into value-added compounds, such as arabinose, formic acid, and gluconic acid, under visible light irradiation.

Efficient dye-sensitized solar cells utilizing aurum-palladium binary alloy counter electrode

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Abstract: This work is concerned with the improvement of dye-sensitized solar cell efficiency by incorporating aurum into palladium which serves as counter electrode (CE) for the device. The CE has been prepared via liquid phase deposition (LPD) technique. The effect of the concentration of aurum (III) chloride trihydrate ($HAuCl_4.3H_2O$) on the properties and the performance of the device has been studied. The source of palladium and aurum are potassium hexachloropalladate (K_2PdCl_6) and $HAuCl_4.3H_2O$, respectively. A dominant phase of Au-Pd exists in the sample. The morphological shape of AuPd is truncated nanohexagon plate. The particle size of AuPd increases with the concentration of $HAuCl_4.3H_2O$ but its crystallite size decreases until an optimum concentration of 0.5 mM. The device employing AuPd CE with 0.5 mM $HAuCl_4.3H_2O$ yielded the highest efficiency of 6.69%. This is because this device possesses the highest coverage area, highest particle density, biggest particle size, smallest crystallite size, highest IPCE, lowest R_s and R_{ct}, longest τ, highest J_{pc}, J_o and J_{lim}. In conclusions, AuPd is found as a suitable CE candidate in efficient DSSC.

Keywords: aurum, binary alloy, cathode, dye-sensitized solar cell, palladium

Toward Deeper Understanding of Electrode Processes at Solid–Liquid Interfaces Through Integrated Experiment, Simulation and Machine

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In the era of carbon neutrality, the development of highly-active yet selective electrocatalysts composed of affordable elements is of great importance.[1] This remains a grand scientific challenge, as our fundamental understanding of electrochemistry is still limited.[2-4] Historically, it has taken decades to clarify even well-known observations, such as the volcano plot, while challenges persist in fully elucidating proton-coupled electron transfer. However, with the pressing mandate to achieve carbon neutrality by 2050, time has become a critical constraint. Here, we present several approaches to accelerate the discovery of electrochemical materials and elucidate microscopic electrode processes at electrified solid–liquid interfaces. We contend that both avenues are indispensable and should be jointed: an in-depth understanding of electrochemical fundamentals is essential for the rational design of high-performance electrocatalysts with on-demand elements, while the development of such electrocatalysts, in turn, facilitates deeper insights into microscopic electrode processes. To this end, we respectively employed data-science to expedite the identification of promising electrocatalysts,[5,6] and state-of-the-art computational techniques to unravel the complex microscopic behaviours of electrified solid–liquid interfaces.[7,8] In this talk, several key findings from our research team that exemplify these approaches will be showcased.

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Hot-carrier effect in perovskite solar cells

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Hot carrier solar cells are aimed at harnessing the kinetic energy of hot carriers generated during the absorption of sunlight by rapidly extracting carriers before they dissipate their excess energy through thermalization processes. In the typical process, this phenomenon can be realized by carefully engineering of the device structure and materials, i.e., band gap or interface engineering, to minimize energy loss mechanisms such as carrier scattering and recombination. However, in our study, we observed hot-carrier effect in perovskite solar cells when it is irradiated with white LED light sources, producing power conversion efficiency, reaching up to 54.22% with the Voc (open-circuit voltage) and Jsc (short-circuit current density) values were measured at 1.10 V and 54 mA/cm2, respectively. In comparison, under similar conditions but using a solar simulator, the power conversion efficiency remained below 20%. The experimental and the mechanism behind the hot-carrier phenomena will be discussed in detail during seminar.

Keywords: Hot-carrier effect; perovskite solar cells; energy resonance;

Application of TiO_2-Coated Materials for Photocatalytic Treatment of Caffeine-Contaminated Water

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Caffeine, widely present in everyday beverages such as coffee, tea, and soft drinks, is increasingly being detected in aquatic environments. Its chemical stability and widespread human consumption have contributed to its classification as an emerging contaminant. Due to its resistance to biological degradation [1], conventional wastewater treatment plants often fail to fully eliminate caffeine, allowing it to persist in surface water and wastewater effluents. Although typically present in low concentrations, prolonged exposure to caffeine may cause sub-lethal effects in aquatic organisms, including developmental, behavioral, and physiological disturbances [2]. This raises growing concern regarding its long-term ecological impacts, especially in water bodies that receive continuous discharge from municipal wastewater. In this study, the photocatalytic degradation of caffeine was investigated using titanium dioxide (TiO_2)-coated materials synthesized via the sol-gel method and applied onto various substrates, including glass beads, alumina balls, and ceramic spheres. The degradation performance was evaluated under UV-C irradiation, considering variables such as the type of supporting material, initial caffeine concentration, solution pH, and photocatalyst reusability. Among the tested photocatalysts, TiO_2-coated ceramic balls exhibited the highest removal efficiency, achieving nearly 100 percent degradation and reducing caffeine concentrations to levels well below ecotoxicological thresholds. The degradation followed pseudo-first-order kinetics, with optimal performance observed at near-neutral pH, indicating that highly acidic or alkaline conditions suppressed photocatalytic activity. Furthermore, the photocatalysts retained high efficiency over five reuse cycles, demonstrating excellent reusability and stability. These findings highlight the potential of TiO_2-coated ceramic materials as a sustainable and effective solution for eliminating emerging contaminants like caffeine from aquatic environments.

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Sulfonated PET Membranes from Waste Bottles for Vanadium Redox Flow Batteries

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Pursuing sustainable energy storage technologies has driven significant interest in advancing vanadium redox flow batteries (VRFBs) for large-scale applications. A critical component of VRFBs is the proton exchange membrane (PEM), which must exhibit high ionic conductivity along with chemical, mechanical, and thermal stability under harsh operating conditions. While Nafion membranes are widely used due to their excellent performance, they are increasingly scrutinized for their high cost and the environmental concerns associated with perfluorinated compounds. In this work, we investigate sulfonated polyethylene terephthalate (sPET) membranes synthesized from waste PET bottles [1] as environmentally friendly and economical substitutes for Nafion 117. The membranes were characterized in terms of electrochemical, physicochemical, and mechanical properties and benchmarked against Nafion. A comprehensive assessment of polarization behavior, charge-discharge cycling, and impedance characteristics was conducted under both dynamic and stagnant conditions. The results demonstrate the potential of sPET membranes as viable candidates for VRFB applications, while also providing a circular economy pathway for PET waste valorization in energy technologies [2].

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Formation of highly dispersed Mg on hydrogen-deficient HB nanosheets via solid-state reaction

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Hydrogen boride (HB) nanosheets, discovered in 2017[1], exhibit unique properties including hydrogen release, catalytic activity, and CO_2 conversion reactions. Doping with light metals is expected to further enhance hydrogen storage.

Here, we demonstrate the synthesis of Mg-dispersed, hydrogen-deficient HB nanosheets by heating HB with ball-milled MgH_2 at 823 K. TEM revealed uniformly dispersed Mg atoms on the HB surface. While MgH_2 alone showed peaks of Mg and MgO, HB-containing samples exhibited only MgO in XRD, indicating suppression of Mg aggregation by HB. To gain further insight into the interaction between Mg and HB, XPS confirmed B–Mg bonding with $B^{\delta-}$, and temperature-dependent XRD showed that hydrogen release precedes Mg dispersion, consistent with DFT results. Löwdin charge analysis indicated that Mg carries ~+1.36 electrons, comparable to crystalline MgB_2. These findings establish a solid-state strategy to embed Mg domains within 2D boron frameworks, providing new insights into metal–boron interactions and the design of functional boron-based materials.

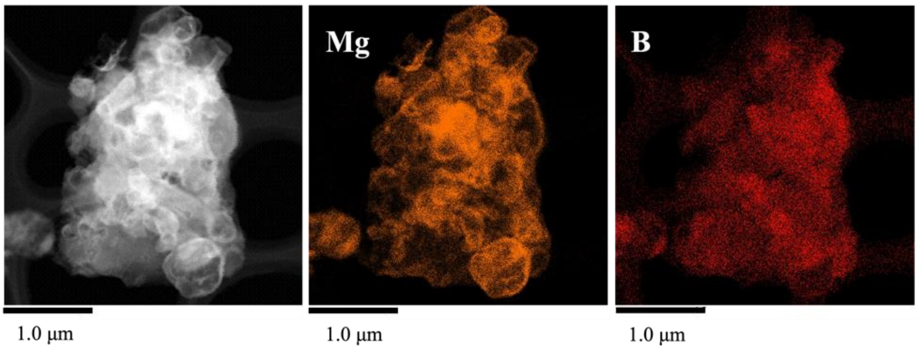

Figure 1. STEM and EDS mapping of highly dispersed Mg on hydrogen-deficient HB nanosheets

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Optimization of pH and Microwave Parameter on Microwave-Assisted Synthesis of Copper Nanoparticles for Potential Conductive Ink Applications

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Copper nanoparticles (Cu NPs) are promising nanomaterials for conductive ink applications due to their high conductivity and low-cost production for large scale applications. However, their tendency to oxidize requires careful control of synthesis conditions to obtain high purity Cu NPs.[1] To obtain high purity of Cu NPs, synthesis in acid-neutral condition is necessary to avoid the formation of oxide. Also, microwave-assisted is an effective approach to accelerate nanoparticles formation, especially under acid-neutral conditions.[2] In this work, Cu NPs were synthesized via microwave-assisted chemical reduction using glucose as both a reducing and capping agent. The effects of pH and microwave irradiation time on nanoparticles' purity and morphology were systematically investigated through speciation modeling and experimental section. The investigation using XRD showed that synthesis of Cu NPs on acid-neutral condition yielded the highest purity which reached 95.7%, while synthesis on base condition yielding very low purity (< 0.2%). Investigation of DLS results gave particles size of approximately 2578, 2705, and 524 nm for 45, 60, and 75 minutes microwave irradiation, respectively. Also, TEM results strongly confirm that 75 minutes irradiation produce homogenous and sub nano particles size (approx. 8 nm). Moreover, zeta potential measurement showed value of less than 10 mV which indicated that the particles are not stable enough. Therefore, acid-neutral condition and 75 microwave irradiation are optimal conditions to produce high purity and homogenous particles.

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Synthesis of Polymeric Carbon Nitride/Silver Phosphate Heterojunction Based Floating Photocatalyst with Cork as a Floating Substrate for Synthetic Dye Degradation

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One of the promising solutions to counteract dye pollution is the utilization of photocatalyst [1] and polymeric carbon nitride (PCN) has been identified as a promising photocatalyst due to its properties [2]. PCN was combined with silver phosphate (Ag_3PO_4) to enhance its photocatalytic efficiency [3]. The composite was subsequently deposited on cork to create a floating photocatalyst [4]. Furthermore, cork can be easily disengaged from the water following the degradation process. The synthesis of the photocatalysts including PCN, Ag_3PO_4, and their composite PCN/Ag_3PO_4, was successfully executed, as confirmed by FTIR, XRD, and SEM-EDS analysis. Subsequently, these photocatalysts were deposited onto cork, thereby forming PCN/Cork, Ag_3PO_4/Cork, and PCN/Ag_3PO_4/Cork. SEM-EDS analysis revealed that the photocatalyst particle successfully deposited into cork with proper adhesion. The photocatalytic performance of the samples was evaluated by measuring the rate of degradation of methyl orange (MO). The findings indicated that PCN exhibited a 7.4% degradation, Ag_3PO_4 demonstrated a degradation of 28.2%, and the PCN/Ag_3PO_4 composite exhibited a substantially higher degradation of 81.2%. This finding indicates that the incorporation of Ag_3PO_4 significantly enhances the photocatalytic performance of the material. It is hypothesized that the utilization of floating photocatalysts will result in the enhancement of their performance in the degradation of dye pollutant.

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Continuous Production Lipid Vesicles and Nanoparticles Using a Crossflow Mixing System

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Nanosized lipid carriers including lipid vesicles and nanoparticles are utilized for delivering drug compounds to the target site or for improving their unfavorable physicochemical properties. The lipid nanoparticles played an important role for the COVID-19 mRNA vaccines, where mRNA was successfully delivered into cytosols with the aid of the lipid nanoparticles. The lipid carriers have lipid and aqueous domains, which can accommodate lipophilic and hydrophilic drug molecules, respectively. However, their detailed structure is totally different; and thus, relevance between manufacturing method and structure/properties of lipid carriers must be comprehended well.

Both the lipid vesicles and nanoparticles can be prepared by injecting lipid ethanolic solution into aqueous solution. Various manufacturing systems have been developed to achieve high efficiency, reproducibility, and scalability. Among them, the crossflow membrane mixing device can produce lipid nanoparticles continuously by injecting lipid-containing ethanolic solution into the flow of an aqueous phase through a microporous membrane.

In this study, we utilized this system for the preparation of the lipid carriers and clarified the parameters affecting the morphology of the lipid carriers. The lipid density of the carriers was strongly affected by the temperature, the lipid concentration in ethanol, and its flow rate. These results work as an important information for large-scale continuous production of the lipid carriers.

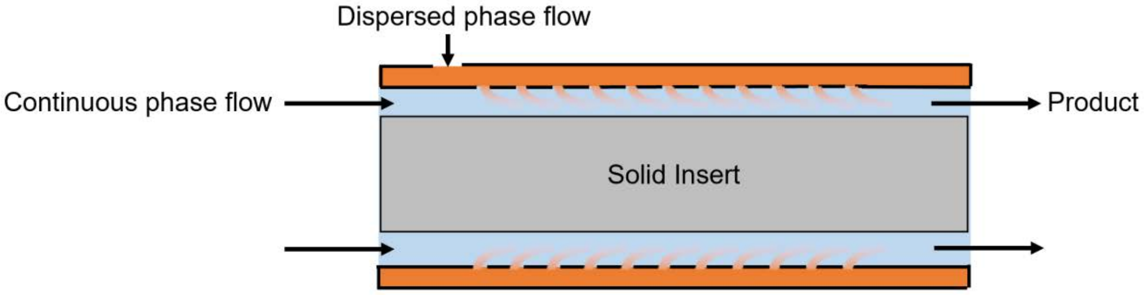

Fig. 1 Schematic illustration of the crossflow mixing system.

Chiral polymeric micro-rugby balls

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1. Introduction

Microparticles with asymmetric morphology attract attention in the field of colloidal science as an angularly anisotropic unit [1]. Microspheres work as optical cavities with whispering gallery mode (WGM) [2], but aspherical particles hardly display clear cavity modes. In this study, we report rugby-ball-like particles (**MRBs**) of Poly[(9,9-di-n-octylfluorenyl-2,7-diyl)-*alt*-(benzo[2,1,3] thiadiazol-4,8-diyl)] (F8BT) with chiral dopants (R5011 and S5011). Single **MRB** displayed anisotropic birefringence in POM observation, indicating twisted bipolar molecular order of F8BT main chain. Single **MRB** exhibited circularly polarized luminescence (CPL) containing large artifact of linear dichroism (LD) and birefringence (LB). Finally, Single **MRB** displayed anisotropic light leakage of cavity modes of the fluorescence under hyper spectral imaging.

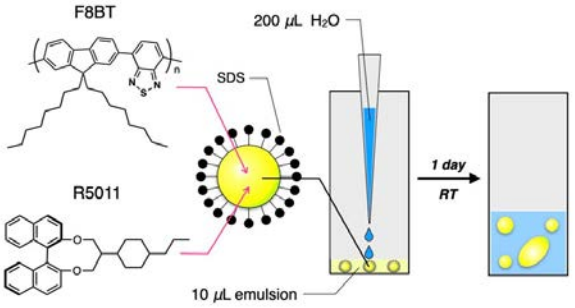

Fig.1. Schematic representation of the self-assembly of microparticles with MRBs.

2. Results and Discussion

F8BT was purchased from Sigma-Aldrich. The $CHCl_3$ solution of F8BT with 10 wt% of R5011 was emulsified into aquas solution of sodium dodecyl sulfide (SDS), and 200μL of H_2O was added to 10 μL of emulsion to induce **MRBs (Fig. 1)**. The morphology of **MRBs** is smooth **(Fig. 2a and d)**, and 10 % out of all particles are **MRBs** with aspect ratio more than 1.4 **(Fig. 2c and f)**. Single **MRB** displayed clear birefringence in POM observation which was oriented from a twisted bipolar (TB) molecular order of F8BT **(Fig. 2b and e)**.

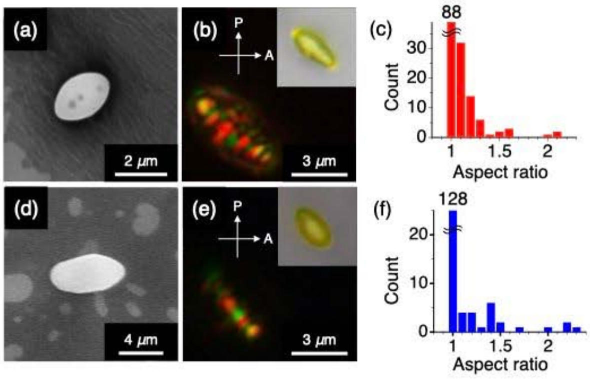

Fig.2. SEM (a,d) and POM (b,e) micrographs of single ***(R)*-MRB** (a–b) and ***(S)*-MRB** (c–d). (c, f) The histogram of the aspect ratio of particles of F8BT with R5011 (c) and S5011 (f).

The CPL from single **MRB** will be discussed in the main presentation. Single **MRB** also works as an anisotropic optical cavity. The bright PL was eradiated selectively from the spots near the bipolar points **(Fig. 3a)**. Spatially resolved PL taken by hyper-spectral imaging (HSI) system showed that resonant PL from F8BT was only leaked from four points near the top of the **MRB**.

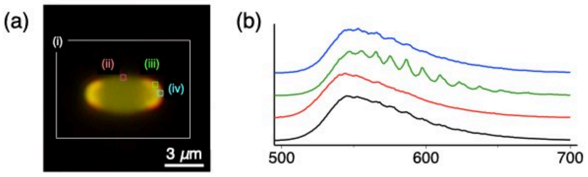

Fig.3. (a) FM micrograph of single ***(R)*-MRB**. (b) Spatially resolved PL spectra from ***(R)*-MRB**.

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The Role of IL@UiO-66 to Promote Fast Li$^+$ Transport in Composite Polymer Electrolyte: An Integrated Experimental and Electronic Structure Modeling Approach

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Composite polymer electrolyte system based on poly(ethylene oxide) (PEO) incorporating molecularly engineered ionic liquid@UiO-66 (IL@UiO-66) nanofillers to enhance lithium-ion conductivity was reported. Among various combinations tested, 1-butyl-3-methylimidazolium tetrafluoroborate ([BMIM][BF$_4$])@UiO-66 achieves the highest ionic conductivity of 1.02 × 10^{-3} S cm^{-1} at 60°C, surpassing several reported fillers at elevated temperature. Field emission scanning electron microscopy (FESEM) analysis reveals a reduction in crystalline lamellae within the composite polymer electrolyte, which enhances the segmental motion of Li$^+$ ions in the poly(ethylene oxide) (PEO) matrix. An optimal balance of lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) loading (0.5 g), IL:MOF ratio (53%), and IL@MOF loading (0.07 g) maximizes ionic conductivity. In addition, electronic structure modeling based on density functional theory (DFT) calculations show that the incorporation of [BMIM][BF$_4$]@UiO-66 modifies the Li$^+$-O bond distance in PEO. The host-guest interactions in IL and UiO-66 restore the optimal tridentate coordination of PEO, while the BF$_4^-$ anion promotes Li$^+$ mobility by forming hydrogen bonds with the PEO backbone. A dual-phase conduction mechanism is proposed, involving IL-assisted hopping and PEO segmental diffusion. These findings provide experimental and theoretical insights into the role of IL@UiO-66 nanofillers in improving ionic conductivity for lithium-ion battery applications.

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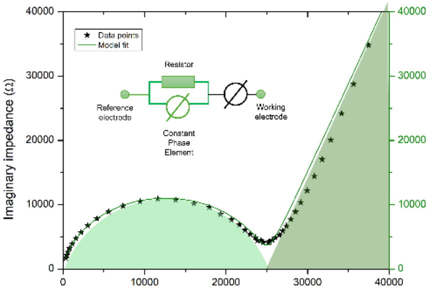

Figure 1. Nyquist plot of polymer electrolyte together with the equivalent model circuits for spectrum fitting.

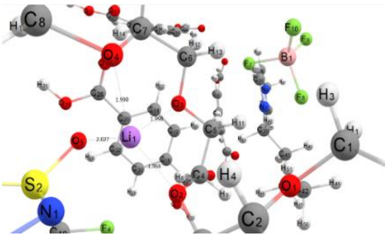

Figure 2. Optimized structure of complexation of Li+ within [BMIM][BF4]@UiO-66 PEO system.

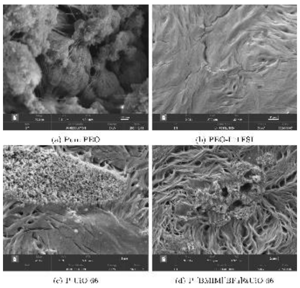

Figure 3. Morphology changes of PEO after incorporated with different filler systems.

Unveiling Electrochemical CO_2 Evolution Mechanism Towards Advanced Direct Ocean Capture Technology

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1. Introduction

In order to prevent further warming the earth up, the attempts to capture already-emitted CO_2 during the last few decades are indispensable. Although CO_2 can be captured from the atmosphere and ocean, the ocean contains approximately 50 times more CO_2 than the atmosphere. Thus, herein we show an CO_2 capture approach from the ocean (i.e. direct ocean capture, DOC) by developing an unconventional electrochemical technology leading to CO_2 evolution from seawater. Our CO_2 evolution technology is based on local pH modulation at electrode surface due to electrochemical reactions (Fig. 1). However, the correlation between electrochemical properties and CO_2 evolution is still unclear. Furthermore, different electrocatalysts exhibit different behaviors. Therefore, this study aimed to clarify the correlation between electrochemical properties and CO_2 evolution, and to investigate promising electrocatalysts for CO_2 evolution.

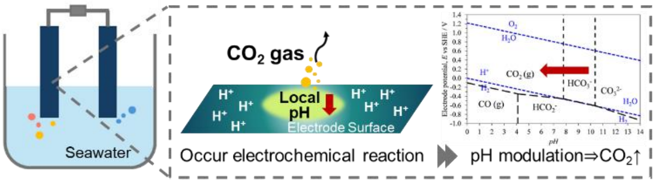

Fig. 1 Schematic diagram of our CO_2 evolution technology.

2. Methodology

There are two key experimental techniques in this study. First is *in-situ* electrochemical mass-spectrometry (EC-MS) measurements. We quantified CO_2 gas evolution using *in-situ* EC-MS (EC-MS Premium, Spectro Inlets Aps, Denmark). The electrocatalyst loaded on Pt substrates served as the working electrode. Second technique is local pH measurements[1]. A three-electrode cell with a rotating ring-disk electrode (RRDE) as the working electrode was used. In both measurements, a Pt coil served as the counter electrode, an Ag/AgCl (saturated with 3 M NaCl) as the reference electrode, and various concentrations of $NaHCO_3$-Na_2CO_3 as the electrolytes.

3. Results and Discussion

In the *in-situ* EC-MS measurements, CO_2 evolution was observed. Therefore, it is suggested that the local pH modulated at the electrode surface and CO_2 evolved as the result of electrochemical reactions. Additionally, the lower the electrolyte concentration, the more CO_2 evolved. On the day of the presentation, the correlation between electrochemical properties, CO_2 evolution, and local pH will be discussed.

4. Conclusion

In this study, we proposed an unconventional electrochemical CO_2 evolution technology towards DOC. Through two key experimental techniques, we observed CO_2 evolution. As current increases, more CO_2 evolved, suggesting that CO_2 evolution occurred due to the local pH modulate caused by electrochemical reactions.

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The effect of oxide layer and ball milling atmosphere on the hydrogen desorption temperature of ball-milled TiH_2

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Titanium hydrides (TiH_2) are reported as hydrogen storage materials because of their high affinity to hydrogen [1]. Titanium can absorb hydrogen atoms and store them in the lattice gaps to form interstitial solid solutions, although it also has a high affinity to oxygen and nitrogen. Also, it has been widely applied as catalysts to lower the temperature of other solid-state hydrogen storage materials [2]. However, there are still many challenges for TiH_2 as a hydrogen storage material and catalyst such as high hydrogen release temperature. Reducing particle size is a common method to decrease the diffusion path of hydrogen, thus lowering the hydrogen release temperature. Ball milling is one of effective and direct mechanical approaches to reduce the size of metal hydride and synthesize various mixture or composite, but there are a great deal of parameters affecting the morphology and property of final products such as ball milling atmosphere, time and rotation speed and so on. Here, we pay more attention to two different ball milling atmosphere (nitrogen and Argon) and systematically work on the effect of different ball milling time on the performance of TiH_2. Further, based on our previously reported paper [3], we discussed the effect of oxide layer on the property of ball milled TiH_2.

We conducted two methods to prepare TiH_2 then measured the composition and the hydrogen release temperature of samples. One is commercial TiH_2 was subjected to mechanical ball milling using a planetary ball milling at 400 rpm for 20 min under nitrogen-filled atmosphere called ball-milled TiH_2 20 min (N_2). The balls to powder ratio was set to 74:1. The other is commercial TiH_2 ball milled for 1 h, 4 h, 12 h under argon-filled atmosphere to called ball-milled TiH_2 1 h, 4 h, 12 h (Ar). Then we selected one sample oxidized by air for 24 hours for each condition.

We compared the size, oxide layer and hydrogen release temperature of ball milling of TiH_2 under different ball milling atmospheres (N_2 and Ar). Similarly, the reduction in the crystallite and grain size and surface oxide layer with ball milling time increased affects the hydrogen desorption temperature significantly decreased. In addition, the ball-milled TiH_2 samples before and after oxidation were compared. The onset hydrogen release temperature and the first-stage hydrogen release temperature of oxidized ball-milled TiH_2 (Ar) both showed a slight increase, but both remained lower than those of the commercial TiH_2. Therefore, our conclusion is the size of TiH_2 is a more important factor than oxide layer for the property of TiH_2 thermaldymic.

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Development of Modified Polybenzimidazole-Based Membranes for Anion Exchange Membrane Water Electrolyzer (AEMWE) Applications

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Anion exchange membrane water electrolysis (AEMWE) offers a promising pathway for sustainable hydrogen production due to its lower cost potential and operation under alkaline conditions. However, the performance of anion exchange membranes (AEMs) remains limited by low hydroxide ion conductivity, poor alkaline stability, and mechanical degradation under harsh conditions. Polybenzimidazole (PBI), with its strong thermal and mechanical properties, provides a stable polymer backbone but suffers from inherently low ionic conductivity, requiring structural modification and reinforcement. In this study, pristine PBI membranes were fabricated via solution casting method. The films exhibited high dimensional stability, low water uptake, and good mechanical integrity, but their conductivity was insufficient for electrolysis applications. To address this, quaternization of the PBI backbone was performed, yielding quaternized PBI (QPBI) membranes. The introduction of cationic functional groups enhanced hydroxide ion transport and improved ionic conductivity (1.308 mS/cm at 80 °C) compared to pristine PBI (0.239 mS/cm at 80 °C). Further reinforcement was achieved by incorporating quaternized graphitic carbon nitride (QGCN) fillers, producing QPBI/QGCN composite membranes. The fillers provided additional ion-conducting sites, suppressed excessive swelling, and improved mechanical stability. Comparative analysis showed that QPBI/QGCN composite membranes outperformed pristine PBI and QPBI, achieving a better balance of conductivity (2.230 mS/cm at 80 °C, with 2 wt.% QGCN filler), water uptake, and structural durability. For future work, radiation-induced grafting (RIG) will be employed to further enhance the properties of these composite membranes. Using reactive monomers such as vinylbenzyl chloride (VBC) and polyvinylpyrrolidone (PVP), controlled irradiation is expected to increase grafting efficiency, promote uniform side-chain distribution, and create more efficient hydroxide ion transport pathways while maintaining mechanical and chemical robustness. In summary, this study demonstrates that backbone quaternization combined with QGCN reinforcement significantly enhances the performance of PBI-based membranes. The proposed integration of RIG in future work provides a clear pathway toward the development of next-generation AEMs with improved conductivity, durability, and long-term stability for AEMWE applications.

SELF-SUPPORTED BIFUNCTIONAL Zn_xCo_xS CATALYSTS MATERIALS FOR ALKALINE WATER-SPLITTING REACTION

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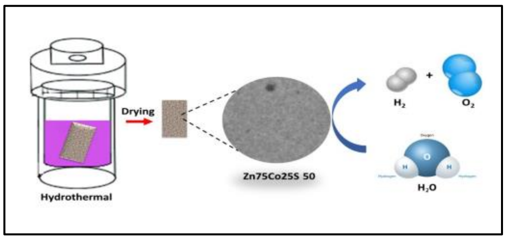
Abstract

Developing highly efficient catalysts utilising simple methods is critical for speeding up the slow reaction kinetics of the alkaline hydrogen (HER) and oxygen (OER) evolution process and assuring cost-effective hydrogen and oxygen production. In this study, a two-step hydrothermal method was effectively employed for the synthesis development of CoS and Zn_xCo_xS on Ni foam as substrate. Parameters studies in this research was the synthesis temperature and the ratio of Zn:Co. Results indicated the addition of Zn to the pristine CoS effects the morphology of the catalysts due to existing Zn ions, encouraging the mossy-like CoS turning to corals-like nanorods Zn_xCo_xS. During hydrothermal synthesis, ZnCoS was directly deposited onto the surface of Ni foam, resulting in a roughened texture with increased troughs between the grains, hence enhancing mass transport during electrochemical reactions. The synthesized $Zn_{75}Co_{25}S$/NF at 50 ºC exhibited a boosted HER and OER overpotential of 178 mV @ -10 mA/cm^2 and 364 mV@ 10 mA/cm^2 with accelerated HER and OER kinetic where the Tafel slope is 94.8 and 74.4 mV/dec respectively compared to the pristine catalyst. This study presents an intuitive synthetic approach for the development of effective non-noble metal catalysts for alkaline hydrogen evolution reaction.

Keywords: Water electrolyser, catalysts, HER, OER, AEMWE

Graphic



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Understanding The Preferential Weld Corrosion and Its Inhibition in Different Conditions

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Preferential weld corrosion (PWC) of steel pipelines in aggressive acetic acid and saturated carbon dioxide (CO_2) environments is a critical threat to petrochemical pipelines, which could lead to premature failure of pipelines within three years. The study investigates localized weld corrosion of X65 and A333 carbon steels and its inhibition under atmospheric and saturated CO_2 conditions using the wire-beam electrode (WBE) method. In a 3% NaCl electrolyte with and without acetic acid exposed to atmospheric conditions, A333 carbon steel was found to suffer more localized weld corrosion than X65 steel. In a 3% NaCl solution saturated with CO_2 with 1500 ppm acetic acid added, A333 steel was found to experienced significantly accelerated PWC with the weld metal showed the highest localized corrosion rate at 4.14 mm/yr after just 24 hours. Two corrosion inhibitors were tested to understand their efficiency for inhibiting PWC. Sodium nitrite ($NaNO_2$) was found to increase PWC, while cetyltrimethyltrimethylammonium bromide (CTAB) was able to reduce PWC, achieving only 50.7% inhibition efficiency. This highlights that common inhibitors are insufficient to mitigate severe PWC in complex environmental conditions, especially at the WM. The WBE method effectively revealed this highly localized corrosion, mirroring real-world industrial pipeline failures and underscoring the urgent need for more effective PWC mitigation technologies.

Biomass-Derived Carbon Catalysts for Acidic ORR: Structural Design To Enhanced Activity and Proton Transfer

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Fuel cells are attracting renewed attention as next-generation energy conversion devices that can directly convert renewable fuels into electricity with high efficiency. In particular, proton exchange membrane fuel cells (PEMFCs), direct methanol fuel cells (DMFCs), and formic acid fuel cells (FAFCs) offer promising routes for utilizing hydrogen, green methanol, or biomass-derived formic acid as carbon-neutral energy carriers [1]. These systems operate under acidic conditions, where proton-conducting membranes like Nafion are employed [2]. Developing sustainable and high-performance electrocatalysts for the oxygen reduction reaction (ORR) in acidic media remains a critical challenge for next-generation fuel cells. Here, we report a rational design strategy for biomass-derived carbon catalysts using rice husk as a renewable precursor. By combining oxidative pretreatment (acid or alkaline) with high-temperature ammonia annealing, we introduced catalytically active nitrogen species and defect structures while tailoring the pore architecture for efficient mass transport. The catalyst treated with alkaline medium and annealed under NH_3 at 1000 °C achieved an onset potential of 0.83 V vs. RHE and exhibited excellent durability and methanol tolerance in acidic electrolyte. This performance, among the highest reported for biomass-derived metal-free catalysts, is attributed to the synergistic effects of graphitic nitrogen incorporation, proton-independent defect site formation, and hierarchical mesoporosity. Our findings highlight the importance of tuning both electronic and structural properties to unlock the full potential of sustainable carbon catalysts for acid-tolerant energy conversion devices.

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SACSEM 11th Symposium Program

Poster Presenter (PP)

28th October 2025 (Tuesday) Day 1

No	Presenter's Name	Affiliation	Country
PP_01	Dr. Bassou Djilali	Djillali Liabes university of Sidi Belabbes	Algeria
PP_02	Maryam Hassan	Universiti Kebangsaan Malaysia (UKM)	Malaysia
PP_03	Kariana Kusuma Dewi	University of Tsukuba	Japan
PP_04	Nurul Aishah Mohd. Amran	Universiti Malaysia Perlis (UniMAP)	Malaysia
PP_05	Karin Oiwa	University of Tsukuba	Japan
PP_06	Hayato Sakai	University of Tsukuba	Japan
PP_07	Dr. Heah Wey Yih	University of Tsukuba	Japan
PP_08	Ammara Firdous	University of Tsukuba	Japan
PP_09	Muhammad Habib Mohd Shehri	Universiti Teknologi MARA (UiTM)	Malaysia
PP_10	Nafees Umar Draz	University of Tsukuba	Japan
PP_11	Yuki Tanaka	University of Tsukuba	Japan
PP_12	Syahla Andini Putri	Politeknik STTT Bandung	Indonesia
PP_13	Gadi Dzikri Maulana	Politeknik STTT Bandung	Indonesia
PP_14	Noor Alam	University of Tsukuba	Japan
PP_15	Li Jinyu	University of Tsukuba	Japan

29th October 2025 (Wednesday) Day 2

No	Presenter's Name	Affiliation	Country
PP_16	Annisa Zahra Ahdaliza	Universiti Kebangsaan Malaysia (UKM)	Malaysia
PP_17	Anis Syafiqa Rosman	Universiti Malaysia Perlis (UniMAP)	Malaysia
PP_18	Dr. Siti Rudzhiah Che Balian	Universiti Teknologi MARA (UiTM)	Malaysia
PP_19	Nurfarhana Ahmad Musri	Universiti Kebangsaan Malaysia (UKM)	Malaysia
PP_20	Shatakshi Mishra / Janarthnanan Supramaniam	Monash University Malaysia	Malaysia (ACS ISC)
PP_21	Puah Yuin Fay / Pang Xue Yin	Universiti Teknologi Malaysia (UTM)	Malaysia (ACS ISC)
PP_22	Muhammad Zhafran Zakaria	Universiti Malaya (UM)	Malaysia (ACS ISC)
PP_23	Greyson Tan / Yeap Swee Pin	UCSI University	Malaysia (ACS ISC)
PP_24	Sashwin A/L Mahendran	Universiti Sains Malaysia (USM)	Malaysia (ACS ISC)
PP_25	Sumayyah Shahrul Nizam / Amira Nabiha Rusjunaizi	International Islamic University Malaysia (IIUM) , Kuantan Campus	Malaysia (ACS ISC)
PP_26	Austin Jason Pui	Curtin University Malaysia	Malaysia (ACS ISC)
PP_27	Nurul Nazira Muhammad Nizam	Universiti Kebangsaan Malaysia (UKM)	Malaysia (ACS ISC)
PP_28	Tai Fei Ya	Universiti Sains Malaysia (USM)	Malaysia (ACS ISC)
PP_29	Wan Nur Alyss Daniela Wan Ali	Universiti Teknologi PETRONAS (UTP)	Malaysia (ACS ISC)
PP_30	Lee Seo Hyeong	Nanyang Technological University (NTU)	Singapore
PP_31	Yim Qi Yao	National University of Singapore (NUS)	Singapore (ACS ISC)
PP_32	Dr. Lee Tian Khoon	Universiti Kebangsaan Malaysia (UKM)	Malaysia
PP_33	Syaza Amira Razali	Universiti Kebangsaan Malaysia (UKM)	Malaysia
PP_34	Ahamed Razeek Najitha	Universiti Kebangsaan Malaysia (UKM)	Malaysia

****Important Notes**

<u>Judging of Poster Presentation for Best Poster Award</u>

Poster PP_01 - PP_15 will be judged on Tuesday (28th October 2025)
Poster PP_16 - PP_34 will be judged on Wednesday (29th October 2025)

Please be present at your poster during your presentation time to maximize your chance of networking and presenting your valuable work to international and local attendees.

Production of biodiesel from recovered vegetable oils by transesterification reaction catalyzed by a geomaterial.

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Abstract

Bentonite clay from Maghnia, Algeria, which is highly rich in montmorillonite (~90%), was purified and intercalated with Al_2O_3, Al_2O_3-NiO, and Al_2O_3-CoO pillars to serve as a catalyst for the conversion of recovered vegetable oils-ethanol mixture into biodiesel. The Al_2O_3-CoO (10%) pillared clay achieved a remarkable 98% ester conversion. The highest biodiesel yield was obtained under the following conditions: a 1:15 oil-to-ethanol molar ratio, a reaction temperature of 250 °C, and the use of 7.5 wt % catalyst. This performance was attributed to the synergistic effect of the clay's significantly increased surface area and the superior catalytic activity of cobalt in a basic medium.

Reusability tests demonstrated that the pillared clays could be safely reused up to three times without any loss in catalytic efficiency. Kinetic studies revealed that the transesterification of castor oil with excess ethanol using the pillared clay catalyst followed pseudo-first-order kinetics. Furthermore, the biodiesel produced exhibited fuel properties comparable to conventional fossil diesel.

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Copper Zinc Tin Sulphide as a Rechargeable Lithium Battery Electrode

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Lithium rechargeable batteries exhibit the advantages of high energy density with a broad range of potential applications, from portable electronics to highly energy-demanding electric vehicles. Recently, transition metal chalcogenides have been regarded as a promising candidate for a microstructure electrode in electrochemical energy storage devices because it has a higher theoretical capacity (~847 mAh g^{-1}) compared to a commercial lithium-ion battery (LIB) (~372 mAh g^{-1}).[1] Thus, this work aims to explore the capacity performance and cycling stabilities of the transition metal chalcogenide, Cu_2ZnSnS_4 (CZTS) microstructure electrode using galvanometric method. The CZTS was synthesised *via* the sol-gel method followed by sulphurisation at 550 ºC under nitrogen atmosphere. The structural analysis showed that the CZTS nanoflower took on morphology of kesterite phase and possessed an average chemical stoichiometric composition of $Cu_{2.7}Zn_{1.9}Sn_{1.4}S_4$.[2] The as-prepared CZTS-Li half-cell configuration exhibited high reversible capacity but lacked cycling performance at room temperature under a potential window from 3.00 to 0.01 V (*vs.* Li^+ /Li). The achieved initial discharge capacity is obtained at 578.9 mAh g^{-1}, which suggests that the CZTS can be a promising electrode material for lithium-CZTS rechargeable batteries.

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Monodisperse and size-modulable spherical optical resonators from synthetic polymers by inkjet printing toward biosensing application

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Micro-spherical optical resonators with high monodispersity and size-modulability are produced from synthetic polymers using an inkjet printing method. The high surface smoothness and sphericity of the synthetic polymer particles contribute to the efficient light confinement inside the particles via whispering gallery mode (WGM) optical resonance in water, demonstrating their suitability for chemical and biological applications. Spherical particles with uniform morphology and size monodispersity are the fundamental bases for enhancing sensitivity, precision, and reproducibility of the resonators' performance.[1][2] Ideally, highly spherical particles with a size modulability less than 1 µm is preferable for generating consistent peaks.

We used an inkjet printing machine specialized for viscous liquid (Microjet model LaboJet-600). As a typical example, an aliquot of $C_2H_4Cl_2$ solution of PS (1.0 mg mL^{-1}) doped with 9,10- bis(phenylethynyl)anthracene (BPEA, 5.0 µg mL^{-1}) was introduced into the inkjet printer head and was ejected as tiny drops with D of 72.5 µm. The inkjet method was feasible to make spheres with different concentration of PS in a range from 0.1 to 10 mg mL^{-1} while the average D increased as condensing the solution, the available range of D was from 5.4 to 14.1 µm, maintaining satisfactory PDI value.

We calculated the satisfactory of the free spectral range and Q factor against the inverse of diameter of the spheres through on the atmosphere and under water condition. The fact that the WGM peaks were still visible even under water is a promising finding since it demonstrates the versatility of the inkjet method for making optical resonators that are functional under biological conditions. Further we observed WGM for detecting BSA in PBS solution with the clearly WGM spectra.

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Effect of low carbonization temperature on graphite utilized palm kernel shell

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This study investigates the effect of carbonization temperature on the structural and defect characteristics of graphite derived from palm kernel shell (PKS). Carbonization process was carried out at 400°C, 500°C, and 600 °C with varying heating rates, and the resulting samples were analyzed using X ray diffraction (XRD) and Raman spectroscopy. XRD patterns revealed broad (002) peaks around 22-24°, indicating the formation of turbostratic graphite carbon structures, with interlayer spacing decreasing as temperature increased. The 600 °C samples, particularly at 5°C/min heating rates, displayed a narrow peak with highest intensity among other samples, signifying well-developed of carbon arrangement with structural stability.

Effect of Catalyst Surface Hydrophilicity on Oxygen Evolution Reaction Activity

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1. Introduction

Clean hydrogen production via water electrolysis is crucial for a sustainable energy future, but its efficiency is hindered by the sluggish oxygen evolution reaction (OER), requiring high-performance catalysts. Rhombohedral boron monosulfide (r-BS), composed of earth-abundant elements, has emerged as a promising OER catalyst[1,2], and this study aims to enhance its performance by optimizing interactions with different carbon supports.

2. Method

All commercial materials were used as received, including boron, sulfur, carbon materials, Nafion, ethanol, and KOH. r-BS was synthesized by mixing boron and sulfur (1:1) under 5.5 GPa and 1600 °C[3], then dispersed with carbon material in ethanol/Nafion, ultrasonicated, and deposited onto Ni foam. The resulting electrode was tested for OER in 1 M KOH using Au and Ag/AgCl electrodes.

3. Results and Discussion

Catalytic performance was evaluated by LSV and violin plots (Figure 1), and surface wettability by contact angle (Figure 2). More hydrophilic carbon supports showed higher OER activity, indicating that improving wettability is a key strategy for enhancing r-BS catalyst efficiency.

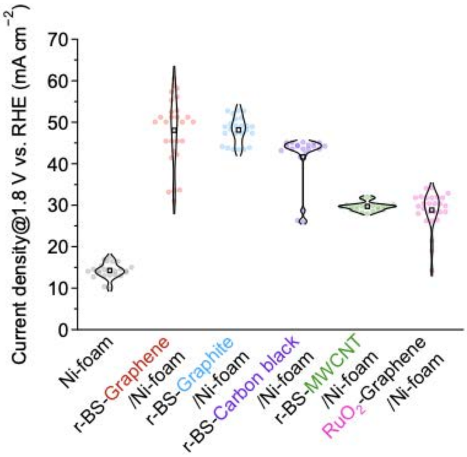

Fig. 1 violin plot

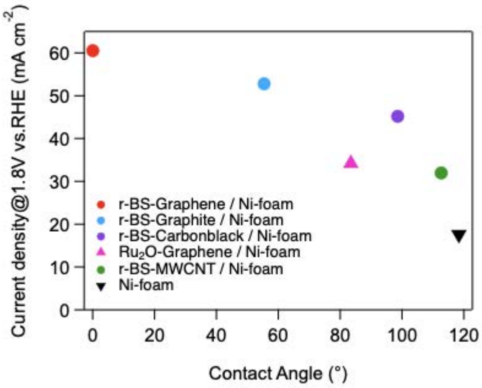

Fig. 2 Influence of Catalyst Surface Hydrophobicity on OER Performance (average current density)

4. Conclusion

The optimized r-BS ink deposition improved catalyst uniformity and activity, while the surface hydrophilicity of the carbon support critically influenced OER performance. These results provide insights for designing earth-abundant OER catalysts to advance sustainable hydrogen production.

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Site-selective formation of twisted-bipolar alignment of chiral conjugated polymer on the colloidal molecules

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1. Introduction

Colloidal molecules (CMs) which mimic the molecular structure model from binary polymer blend are of great interest in colloidal photonic crystals and soft materials. We recently reported an autonomous methodology to form CMs from binary polymer mixtures[1]. However, the main target of the work was the morphology and synthesis methods of CMs. We also reported that a chiral π-conjugated polymer self-assembles into microspheres with twisted bipolar (TB) phase[2]. In this work, we report CMs of chiral and achiral π-conjugated polymer blend and the site selectivity of the satellite colloids in CMs.

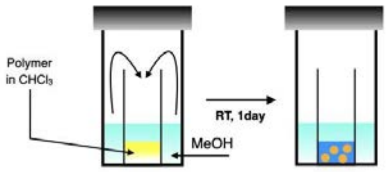

Fig. 1. Schematic representation of the method of co-assembly of polymers by vapor diffusion.

2. Results and Discussion

CMs are assembled by slowly diffusing MeOH vapor into a $CHCl_3$ solution (Fig. 1) of the mixture of chiral (**P1**) and achiral polymers (**P2** and **P3**, respectively, Fig. 2a−c). Well-defined CMs were successfully obtained in 24h after the incubation (Fig. 2d, e). CMs appeared clear birefringent texture in polarized optical microscopy (POM), indicating the regular molecular order of **P1** main chain (Fig. 2f, g).

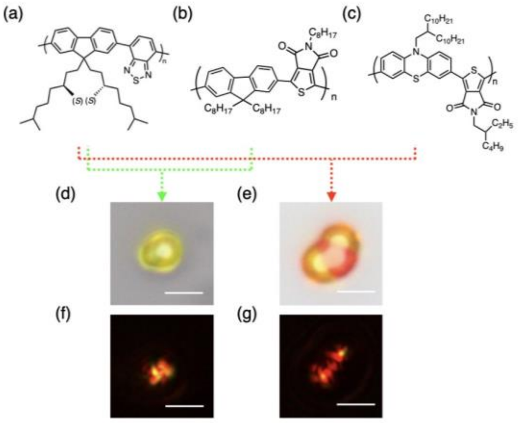

Fig. 2. (a−c) Molecular structures of **P1** (a), **P2** (b), and **P3** (c). (d−g) OM (d,e) and POM (f,g) micrographs of the resultant CMs from mixture of **P1** and **P2**, **P1** and **P3**, respectively. All scale bars represent 3 μm.

Polarized fluorescence microscope (FM) and transmission electron microscope (TEM) images of the sliced CMs of **P1** and **P2** displayed ellipsoidal stripes in the core, which supports the TB phase of **P1**. Notably, the colloid of **P2** was selectively sited at the topological defect of TB microsphere of **P1**. This result suggests that **P2** droplets are affected by the molecular arrangement on the surface of the TB microsphere.

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KERATIN MICROSPHERES AS PROMISING TOOL FOR TARGETING FOLLICULAR GROWTH

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Skin is the body barrier that constrains the infiltration of particles and exogenous aggression, in which the hair follicle plays an important role. Recent studies have shown that small particles can penetrate the skin barrier and reach the hair follicle, making them a potential avenue for delivering hair growth-related substances. In this study, we pursue the effect of newly synthesized 3D spherical keratin particles on inducing hair growth in C57BL/6 male mice and in human hair follicle dermal papilla cells. The microspheres were created from partially sulfonated, water-soluble keratin. The keratin microspheres swelled in water to form spherical gels, which were used for further experiments. Following topical application for a period of 20 days, we observed a regrowth of hair in the previously depleted area on the dorsal part of the mice in the keratin microsphere group. The observation was accompanied by the regulation of hair-growth-related pathways as well as changes in markers associated with epidermal cells, keratin, and collagen. Interestingly, microsphere keratin treatment enhanced the cell proliferation and the expression of hair growth markers in dermal papilla cells. The 3D spherical keratin has the potential to specifically target hair follicle growth and may be employed as a carrier for promoting hair growth-related agents

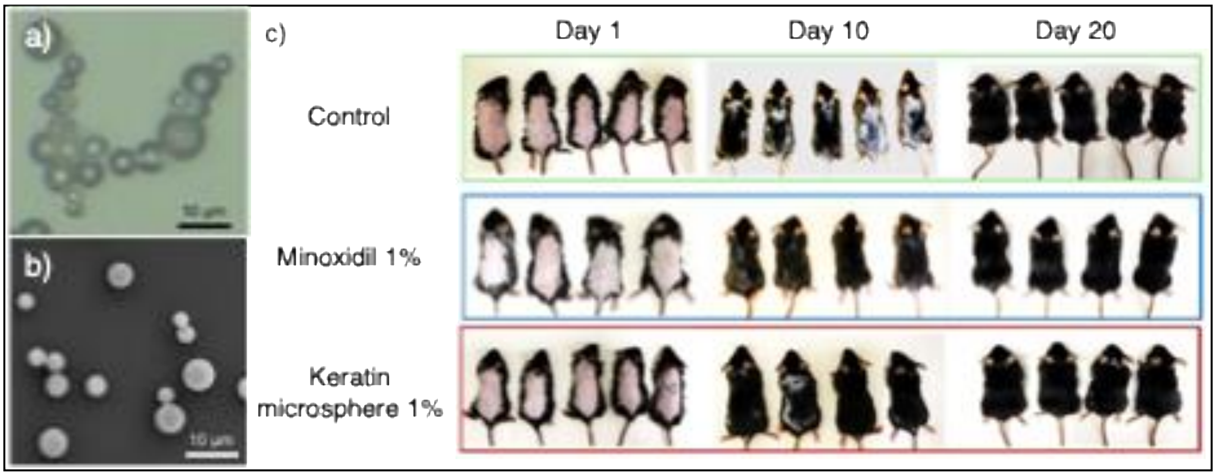

Fig. 1. (a) Micrograph and (b) SEM of keratin microspheres. (c) Mice were photographed on day 1, day 10, and day 20 for control, minoxidil 1%, and keratin microsphere 1% group, respectively.

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Investigation of BaS hole transport layer for $BaSi_2$ thin film solar cells

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Introduction

Barium di-silicide ($BaSi_2$), composed of earth-abundant elements, is one of the suitable materials for thin-film solar cells due to its significant absorption coefficient (α) of 3×10^4 cm^{-1}, a band gap (E_g) of 1.3 eV, and a large minority-carrier diffusion length of 10μm [1,2]. To overcome the challenges of $BaSi_2$ solar cells, such as parasitic absorption at the surface due to large α and diffusion of impurities for p/n control, a new structural design [3], hole transport layer (HTL) /n-$BaSi_2$/ electron transport layer (ETL) has been proposed. HTL requires that the E_g be larger than $BaSi_2$, and the ionization potential (*IP*) be close to or smaller than that of $BaSi_2$. Barium Sulfide (BaS) is a candidate material that satisfies these conditions (Fig. 1.), but research reports are quite limited [4]. Therefore, in this study, we evaluated the basic physical properties of BaS.

Methodology

To gain insights into the intrinsic characteristics and defect behavior of BaS, first-principles calculations were conducted using the Vienna Ab initio Simulation Package (VASP) to optimize structural parameters and evaluate point defect properties. The Perdew-Burke-Ernzerhof (PBE) functional with Generalized Gradient Approximation (GGA) and Heyd–Scuseria–Ernzerhof (HSE06) were used in bulk calculations to provide an accurate E_g, with a self-consistent field of 1×10^{-5} eV and K-points of 4×4×4, the cut-off energy was set at 500 eV. The 20-nm-thick BaS layers were experimentally deposited on Czochralski (CZ)-n^+-Si (111) substrates ($\rho < 0.01$ Ω cm) at five different temperatures by sputtering. The BaS deposition rate was 0.27 nm/min at an Ar-gas pressure of 0.5 Pa. The films were capped with a 3-nm-thick a-Si layer to prevent oxidation.

Results and Discussion

The charged defects of BaS are shown in Fig. 2, which depicts the most favorable defects in BaS with various chemical potential conditions are interstitial Ba, S, and O. Figure-3 signifies the grazing incidence X-ray Diffraction (XRD) patterns of samples formed at 300–600°C. The peaks suggest an amorphous phase of BaS when deposited at 300–450°C. The optimum substrate temperature for polycrystalline BaS films is 500°C. Further we plan to deposit BaS films as HTL on $BaSi_2$ for device application.

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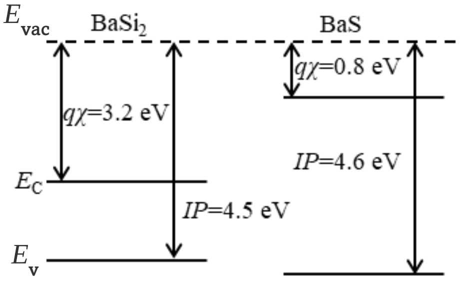

Fig. 1: Schematics of band alignment of $BaSi_2$ with BaS.

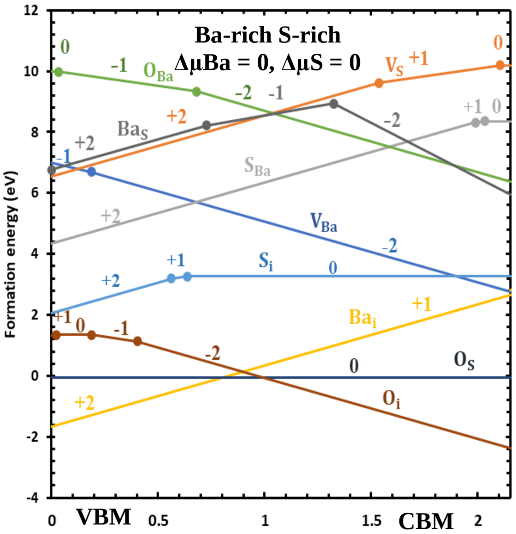

Fig. 2: Calculated Formation energies as a function of the Fermi energy of the point defects

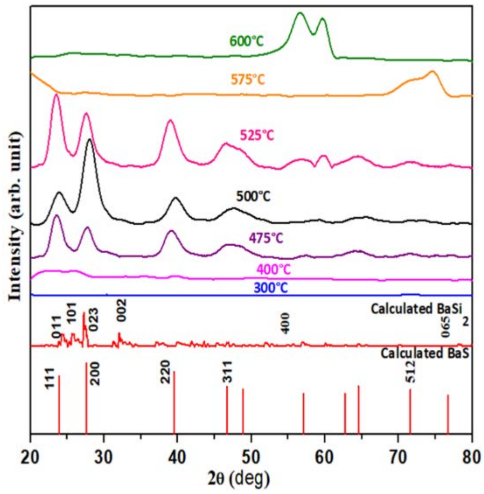

Fig. 3: XRD pattern of grown films at different temperatures.

ALUMINIUM (Al^{3+}) SUBSTITUTED $Mg_{0.5}Ti_2(PO_4)_3$ SOLID ELECTROLYTES PREPARED VIA SOL GEL METHOD

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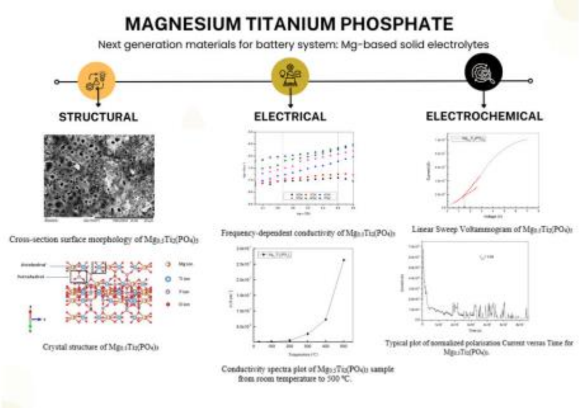
Abstract

$Mg_{0.75}\,Al_{0.5}Ti_{1.5}(PO_4)_3$ was synthesized using sol gel method and the structural, electrical and electrochemical properties of the sample were studied. Rietveld Refinement analysis confirmed the formation of rhombohedral structured of R3c space group and Al^{3+} was successfully substituted into the $Mg_{0.5}Ti_2(PO_4)_3$ structure instead of forming impurities. Impedance spectroscopy indicated the rise of total conductivity which is 5.41×10^{-6} S cm^{-1} compared to the total conductivity of the unsubstituted sample. Furthermore, the AC conductivity, σ_{AC}, was found to increase with rising temperature and the outcomes were discussed using correlated barrier hopping model. The sample indicated that the decomposition voltage of the compound is at almost 1.8 V which is greater than that of the unsubstituted sample. Lastly, the transference number measurement was near to unity and it can be inferred that the majority of mobile charge carriers were ions and anticipated to be Mg^{2+}.



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Mode Number Dependent Photophysical Dynamics of Strong Coupling

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Introduction

Ultra-low threshold lasers at room temperature can be realized by the advanced polariton lasers due to ultra-fast coherence-emission, low effective mass and stimulated scattering into a coherent ground state. Polariton are the hybrid particle created when the coherence energy transfer rate between the matter excitations and resonant electromagnetic waves exceed the individual energy dissipation rates, and the system is said to be in the strong coupling state.

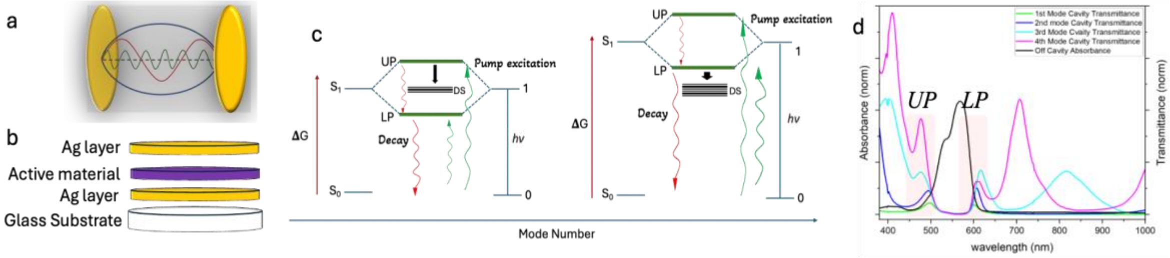

Figure 1: Schematic diagram of a) periodic modes induced in the Fabry Perot Cavity b) Fabry Perot Cavity c) Polariton reorder with mode number d) Uv-visible spectrometry of synthesized cavities.

Fabry Perot cavities are used to realize the strongly coupled system in which molecules sandwiched in between two Brag reflectors, by irradiating coherence light source Rabi splitting can be observed along with some standing waves known as cavity modes as in Figure 1 a & b. Cavity mode number can be tunned i; e, by increasing the active layer thickness within the resonance conditions higher mode numbers can be achieved but changing the cavity mode number polariton states reorders because of the change in Gibbs free energy of the system as in Figure 1 c [1, 2] . This reorder can put the impact on the photophysical dynamics of the overall system which is explored in this work.

Experiments and Results

We have created four Fabry Perot cavities with thickness appropriate to the first four cavity modes. We used 30 nm silver layer as the Brag reflectors. For the active layer of the cavities, we have used the combination of Rhodamine B dye and Polyvinylpyrrolidone (PVP) with 20:80 by weight equivalence respectively. Synthesis of the cavities have been confirmed by the Uv-visible transmittance spectroscopy have calculated the coupling strength such as 0.21 eV, 0.22 eV, 0.3 eV and 0.25 eV in the 1st , 2nd , 3rd and 4th mode cavity respectively can be seen in Figure 1 d. Then we measured the transient absorption (TA) using the home-made setup with Spectra Physics solstice Ace, 1kHz, 800 nm, 110 fs. In the TA we pumped the samples with 500 nm pump with pulsed fs laser, then we recorded the absorption with probe fs laser of the sample by which we have find entirely same photophysical dynamics in all off cavity while very distinct and mode number dependent features and dynamics.

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Self-assembly of natural polymers

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Carrageenan is a type of polysaccharide currently used as a thickening and gelling agent in many foods and is characterized by the presence of sulfate groups. Carrageenans can be classified into three types according to their chemical structure. Carrageenan can be classified into three types according to their chemical structure: κ- carrageenan, which contains one sulfate group in the unit chemical structure; ι-carrageenan, which contains two sulfate groups; and λ-carrageenan, which includes three sulfate groups (Fig1a). It is known that various physical properties change depending on the type of counter cation of the sulfate group [1]. Therefore, we conducted experiments to control the refractive index by changing the counter cations of the sulfate groups by ion-exchange method. By confining light inside a microsphere, they have succeeded in observing a peak that depends on the refractive index and particle size of the sphere, called the Whispering Gallery Mode (WGM) (Fig1b) [2]. Using WGM, it is possible to measure the refractive index of carrageenan spheres.

First, microspheres were prepared from a carrageenan aqueous solution from which free salts were removed by dialysis using the mini-emulsion method prior to ion exchange. H_2O was used as the good solvent and ethyl acetate as the poor solvent. The resulting particles were smooth spherical spheres. Next, we attempted microsphere preparation using an ion-exchanged carrageenan aqueous solution. For the ion exchange method, an excess amount of alkali metal chloride was added to the carrageenan solution, which was then dialyzed against pure water for three days. The solid carrageenan was subsequently freeze-dried and recovered. Solutions of the same concentration were readjusted, and spheres were produced.

Elemental analysis of carrageenan microspheres prior to ion exchange showed potassium ions as the most abundant in both kappa-type and iota-type samples. However, post-ion exchange results revealed the highest concentrations of the alkali metal ions and alkaline earth metal ions used during ion exchange, confirming the process's accuracy. Furthermore, the whispering gallery mode was observed in each microsphere. This confirms the successful preparation of high-quality microspheres in all cases.

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Mechanical Performance of Three Dimensional Integrated Fabric Reinforced Composites under Multiple Loading

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This works investigates the fabrication and mechanical properties of three-dimensional (3D) integrated fabric-reinforced composites, which were produced using a simple hand-lay technique with polyester resin impregnation. Two types of 3D integrated fabrics, with and without core, were constructed using a conventional stitching technique and used as reinforcing materials in the composites. Specimens of standardized size were tested to evaluate the tensile**,** compressive, and flexural properties of the composites. The results demonstrated that both the tensile strength and tensile modulus were greater in the vertical direction test compared to the horizontal direction for both types of composites. Regarding a compression test, the composite with a core showed higher compression stress values in both directions, except for the second peak in the horizontal direction test, where the coreless composite performed better. The compressive modulus of the composite with a core was higher than that of the coreless composite in the vertical direction test, but lower in the horizontal direction test at all measurement peaks. As for flexural properties, the flexural stress was similar for both composites, while the flexural modulus was higher for the composite with a core, indicating enhanced resistance to bending.

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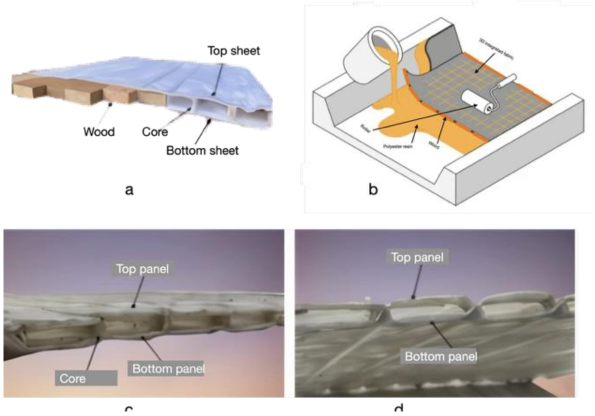

Figure 1. Fabrication of the 3D woven fabric Reinforced Composites

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Development of Antibacterial PVA/PVP Nanofibers for Medical Applications: Antimicrobial Activity Testing Using the Kirby-Bauer Method In Vitro

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Abstract: This study developed poly(vinyl alcohol) (PVA)/poly(vinylpyrrolidone) (PVP) nanofibers incorporating silver nitrate ($AgNO_3$) as an antibacterial agent for medical applications. Nanofibers were synthesized via electrospinning with six PVA/PVP ratios and characterized by SEM, showing smooth, continuous fibers with diameters ranging from 0.42 to 0.55 µm. Antibacterial activity, tested by the Kirby-Bauer disk diffusion method, revealed that 100% PVA produced the largest inhibition zone (10.05 mm) , followed by 70% PVA (6.57 mm) and 50% PVA (0.75 mm). ANOVA and Tukey's HSD confirmed significant differences among samples ($p < 0.05$). The results demonstrate that higher PVA ratios, combined with $AgNO_3$, enhance antibacterial performance. Overall, the 100% PVA formulation showed optimal morphology and antibacterial activity, highlighting its potential as an antimicrobial material for medical use.

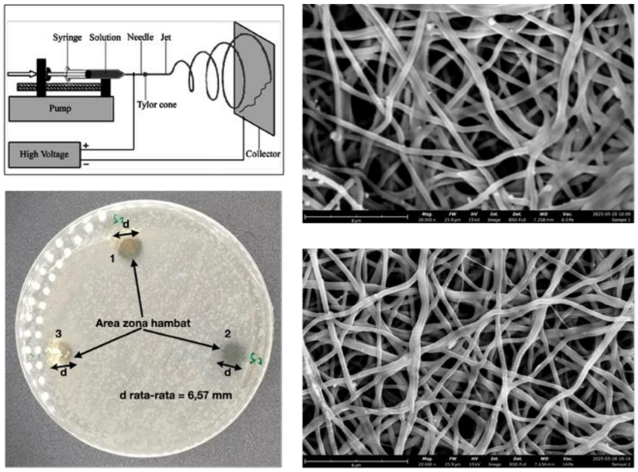

Figure 1. Schematic illustration of the electrospinning (a), nanao fiber prepared by PVA100% (b), PVA/PVP 70/30 (c), and kirby baurer test (d)

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In-situ growth, urea-driven morphological evolution of $NiCo_2O_4$ and $MoCo_2O_4$ nanostructures on stainless steel mesh: A comparative study

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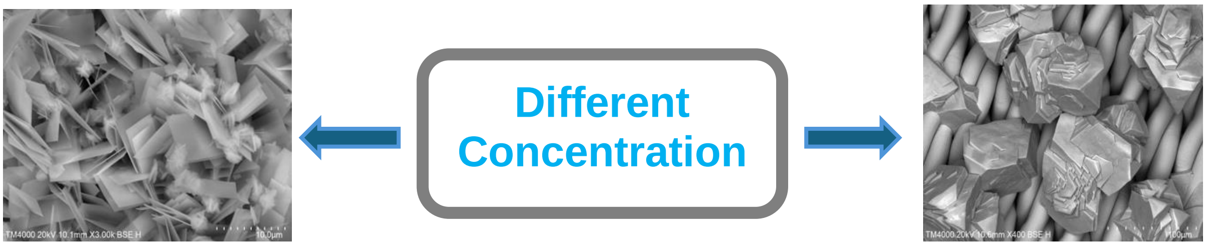
The controlled morphological engineering of bimetallic oxides is crucial for advancing functional nanomaterials, as surface design greatly influences their physicochemical properties. Herein, we investigate the urea-dependent and cation-mediated synthesis of $NiCo_2O_4$ and $MoCo_2O_4$, directly grown on stainless steel mesh (SSM) via a hydrothermal method. By gradually increasing the urea concentration from 0.1 M to 0.7 M, using Ni or Mo as cationic precursors, distinct morphologies were observed: $NiCo_2O_4$ exhibited sea urchin-like structures, nanospikes, and nanosheets, while $MoCo_2O_4$ showed nanorods, nanocubes, nanopyramids, nanopyramids with spikes, and nanorosettes. Phase identification, morphological analysis, elemental composition, vibrational states, and valence states were characterized by X-ray diffraction, scanning electron microscopy with Energy Dispersive X-ray Spectroscopy, Raman spectroscopy, and X-ray photoelectron spectroscopy, respectively. The morphological evolution suggests that urea plays a key role as both a pH controller and morphology-directing agent, whereas Ni and Mo contribute to nucleation rates and crystal growth dynamics. Compared to $MoCo_2O_4$, $NiCo_2O_4$ demonstrated more uniform, adhesive, and homogeneous growth, potentially due to more controlled nucleation, the lower oxidation state of Ni (vs. Mo^{6+}), and the larger atomic radius. This comparative study highlights the critical role of urea and the synergistic effects of cationic species in tailoring complex nanostructures on stainless steel mesh.



$NiCo_2O_4$@SSM $MoCo_2O_4$@SSM

Keywords: morphologies evolution, stainless steel mesh, urea, $MoCo_2O_4$, $NiCo_2O_4$

Exfoliation of rhombohedral boron monsulfide via liquid-phase route toward 2D BS Nanosheets

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Rhombohedral boron monosulfide (r-BS) has shown excellent performance as an electrocatalyst for oxygen evolution reaction,[1,2] as well as photocatalyst[3]. It has also been reported that r-BS can be exfoliated to be nanosheets[4], in which large specific surface area is expected. The exfoliated BS nanosheets are expected to show higher catalytic activity. The objective of this work is to effectively exfoliate r-BS to be BS nanosheets with high efficiency.

Boron and sulfur were mixed at an atomic ratio of 1:1 in a mortar and then pressed at 200 kgfcm^{-2} to form pellets. The pellets were packed in h-BN capsules sandwiched between NaCl discs; they were then sandwiched between graphite discs to prepare the cell. The cells were heated at 1873 K for 40 min at a pressure of 5.5 GPa using a belt-type high pressure apparatus with a cylinder bore diameter of approximately 32 mm. The cell was then quenched and removed; the cell was crushed and separated from the r-BS sample. The sample was pink in color and could be easily crushed to obtain the powdered form.

For exfoliation, the prepared r-BS was dispersed in acetonitrile and subjected to homogenization for different durations (0.5–4 h). The supernatant was then separated and characterized. SEM, TEM, UV-VIS analysis of the sample processed for 4 h confirmed the presence of thin nanosheets, evidencing the effectiveness of this exfoliation approach. Detailed results on the exfoliation mechanism and structural characterizations will be discussed in the poster

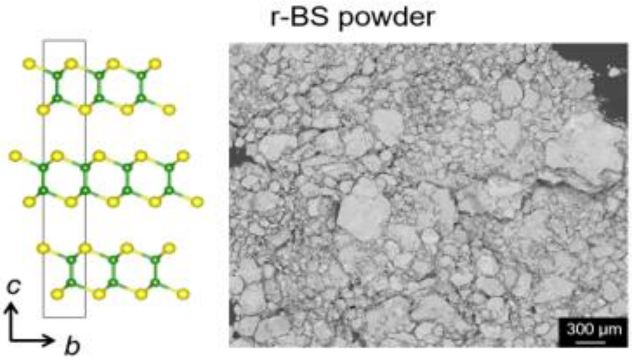

Fig. 1. The molecular structure model of r-BS and the SEM image of r-BS powder

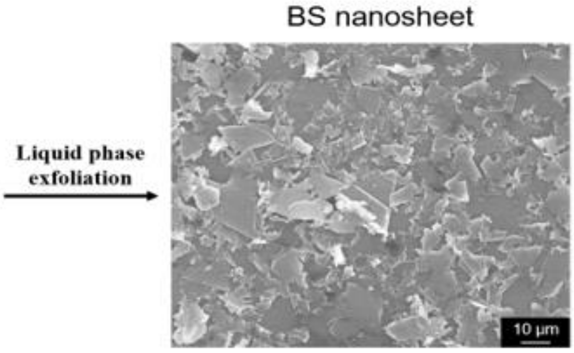

Fig. 2. SEM image of the r-BS nanosheet after exfoliation

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Air-Processed Stable Perovskite Active Layers Fabricated Through Controlled Layer-by-Layer Deposition

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Abstract

The development of cost-effective, scalable, and efficient photovoltaic technology is essential to the improvement of global energy sustainability. Perovskite solar cells (PSCs), have emerged as a competitive alternative to traditional single-junction silicon-based solar cells due to their high-power conversion efficiency (PCE) and solution-processable active materials. However, standard fabrication processes typically need complex anti-solvent procedures and inert conditions, which limit scalability and increase production costs. Layer-by-layer (LBL) deposition offers a good substitute for anti-solvent techniques by separating the crystallization and solidification processes. Despite these advantages, it is still exceedingly challenging to produce high-quality mixed-cation perovskite layers in air, mostly due to the sensitivity of perovskite materials to moisture, which disrupts perovskite phase formation and phase stability. In our work, we used a LBL deposition method to make an air-processable perovskite layer that could help us solve these problems. To fix problems with moisture, the substrate was heated up before the film was applied. This lowered the surface tension and made the film cover better. Hexamethylenetetramine (HMT) was doped to the MAI precursor to passivate the both MA and Pb sites, keep moisture from interfering, and help the transition to the α-phase of methylamonium lead iodide ($MAPbI_3$) without any PbI_2 left in the air. These strategies made it possible to make PSCs in the air with a PCE of 19.8%. The open circuit voltage (Voc), short circuit current density (Jsc), and fill factor (FF) of the device are 0.93V, 23.96 mA/cm^2, 57% respectively. Perovskite behaviour during annealing process in high humidity conditions can be guid for the commercialization of perovskite solar cells. According to stability tests, PSCs with HMT had device lifetime of more than 100 hours.

Synthesis and Characterization of Activated Carbon from Bamboo Charcoal

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This study investigates the synthesis and characterization of activated carbon derived from bamboo through a pyrolysis process under a nitrogen atmosphere to investigate the influence of thermal treatment on its morphology and structural properties. The pyrolysis temperature was varied at (300, 400 and 500 °C) with 3 hours soaking time. The resulting materials were then characterized using Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD) and Brunauer-Emmett-Teller (BET) surface area analysis. The results indicate that the pyrolysis temperature significantly influences the development of the material's porosity. BET analysis revealed that the sample carbonized at 500°C with 3 hours soaking time exhibited the highest surface area of 1.4 m^2/g and the smallest average pore size of 8.25 nm, indicating the development of a more refined porous structure compared to treatments at lower temperatures (0.6 m^2/g at 300°C and 0.2 m^2/g at 400°C). These results were consistent with the SEM images showing enhanced porosity and the XRD patterns confirming the improved in crystallinity as the temperature increase. The findings demonstrate that optimized pyrolysis conditions are crucial for enhancing the morphological and structural properties of bamboo-derived activated carbon, confirming its potential as a sustainable precursor for applications in environmental and industrial applications.

Biopolymer for Energy-Transition: Cathode Binders, Electrolytes and Biomass-Derived Anodes

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Rising global electricity demand and the ongoing energy transition toward variable renewables intensify the need for safe, sustainable, and high-performance energy storage. Batteries are the enabling technology for firming solar/wind and electrifying transport, with layered-oxide Li-ion cells currently offering the best combination of specific energy, power capability, and cycle life. However, conventional high-energy Li-ion systems rely on toxic solvents, NMP, flammable liquid electrolytes, and interfaces that can degrade at high voltage, posing safety and environmental risks. We propose a biopolymer-centric route that replaces hazardous processing steps and stabilizes interfaces without sacrificing performance. Using water-processable CMC/SBR binders for NMC cathodes, we identify an optimal composition window that achieves high first-cycle capacity and near-unity coulombic efficiency, while biopolymer electrolytes (cellulose/carrageenan/agarose matrices with suitable salts and plasticizers) deliver leak-free operation with practical ionic conductivities and electrochemical stability windows. On the anode side, biomass-derived hard carbon and rice-husk-derived SiO_2/Si paired with functional biopolymer binders improve mechanical integrity and SEI control. Collectively, these results support biopolymers as scalable, low-toxicity components for electrodes and electrolytes, advancing safer manufacturing and recyclability while preserving the energy and durability targets required for next-generation storage.

Performance Improvement of Thin Film Thermoelectric Generator via Optimisation of Deposition Parameters

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Thin film thermoelectric generators (TEGs) offer a compact and scalable solution for harvesting waste heat in microelectronic and flexible systems. However, their performance is highly influenced by material properties, fabrication parameters, and device geometry. This work presents a systematic optimization of Bi_2Te_3 and Sb_2Te_3 thin films for high-performance TEG. Thin films were deposited via radio frequency (RF) magnetron sputtering under varying power conditions and characterized using XRD, FESEM, EDX, Hall measurements, and Seebeck coefficient analysis. The optimal sputtering powers were identified as 75 W for Bi_2Te_3 and 30 W for Sb_2Te_3, yielding high crystallinity and balanced electrical conductivity with favourable Seebeck values. A thin film TEG consisting of six n-type/p-type leg pairs was fabricated using these conditions and subjected to post-deposition annealing to improve performance. The TEG annealed at 200°C demonstrated a peak power output of 0.84 µW at ~120 °C ΔT, indicating enhanced crystallinity and reduced internal resistance. Dimensional optimization further revealed wider and shorter TE legs significantly improve output by minimizing internal resistance. The results highlight the importance of integrating material, process, and device-level optimization for the development of efficient and scalable thin film thermoelectric systems.

Inspiring Young Experimenters: ACS International Student Chapter Outreach to Schools in Malaysia

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Chemistry is more than equations and lab coats; it is the key to understanding the world around us. Reflecting this spirit, the ACS Monash University Malaysia International Student Chapter, in collaboration with the School of Pharmacy and with support from the ACS Malaysia Chapter, organizes and performs hands-on experiments and dynamic demonstrations for school students, igniting their curiosity and enthusiasm for science. In 2024, the Chapter conducted a series of in-person outreach programs at local schools, including Sekolah Kebangsaan Bukit Kuchai (600 students, 7 teachers, 7 ACS members), Sekolah Jenis Kebangsaan Tamil Ladang Kinrara (80 students, 2 teachers, 6 ACS members), and Sekolah Kebangsaan USJ 20 (300 students, 7 teachers, 8 ACS members).

Our activities with primary school children inspire their curiosity about chemistry before it becomes their formal subject in secondary school. From feedback, we know that our events help students develop interest, enthusiasm and positive perception. In fact, it is so obvious from children's faces that formal feedback becomes unnecessary. There is no better motivation for us to continue our efforts in this kind of outreach activity than children's smiles, eyes shining with interest and curiosity, their cheerful voices and numerous inquiries. Some of the schools, which we served, have children from economically underprivileged communities and also have limited access to resources and incomplete STEM teaching teams. This adds more value (and responsibilities) to our Chapter, introducing students to safe chemical practice and developing chemical curiosity.

Building on this momentum, in January 2025, the Chapter also launched Chemical Festival, a national-level hybrid outreach program themed "*Picture Perfect Chemistry*". We closely collaborated with the ACS Malaysia Chapter and also engaged volunteers from other ACS International Student Chapters in the country. The event brought together 44 students aged 10 to 15 from across Malaysia and 22 ACS members, combining virtual and physical elements to broaden participation. Feedback from students and educators was overwhelmingly positive, underscoring the program's effectiveness in fostering scientific curiosity and promoting chemistry education. Looking ahead, the ACS Monash University Malaysia International Student Chapter remains committed to advancing community engagement and science literacy through impactful outreach programs that make chemistry accessible, exciting, and relevant to all.

UTM Student Chapter: From Spark to Sustain-A Cycle of Growth

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The American Chemical Society (ACS) Universiti Teknologi Malaysia (UTM) International Student Chapter was among the earliest ACS-recognized student chapters in Malaysia, established in 2016 and officially endorsed by the UTM Student Affairs Office as a university undergraduate academic society in 2020. Guided by the motto “Better Living through Chemistry,” the chapter has continued to grow through purposeful initiatives that integrate professional readiness, scientific creativity and community engagement. Signature programs such as Employment Catalyst, Chemistry Connects, Green Catalyst and the Chemistry Innovation Challenge were introduced to equip students with essential career skills, promote multidisciplinary learning, raise awareness of green chemistry and sustainability and cultivate innovative thinking. The chapter is led entirely by undergraduate students, fostering leadership and teamwork in a dynamic, fast-changing environment. One key challenge is the rapid turnover of student committees, which calls for a structured transition mechanism to ensure continuity and growth. To address this, a Cycle of Growth framework was introduced; exemplified in the Southeast Asian Global Innovation Challenge (SEA-GIC 2025) competition, where senior members manage the preliminary phase while the next cohort leads the final stage. This mentoring cycle not only strengthens sustainability and institutional capacity; but also nurtures a culture of resilience, collaboration and renewal that ensures the chapter continues to evolve.

From Campus to Global Impact: ACS-UM's Journey in Science and Leadership

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The American Chemical Society University of Malaya International Student Chapter (ACS-UM) was established in 2019 as a platform to unite students and academics with a shared passion for chemistry. Guided by its mission to foster academic growth, professional development, and community impact, ACS-UM actively engages in innovative and educational programs aligned with the ACS strategic plan. Over the years, the chapter has organized impactful events such as science fairs, leadership programs, and participation in international meetings, creating opportunities for students to broaden their professional networks and scientific exposure. Supported by a dedicated team of faculty advisors and student leaders, ACS-UM has grown into a vibrant community that connects aspiring chemists with local and global scientific networks. Its efforts have been recognized through notable achievements, including awards and participation in major events such as the Kuala Lumpur Engineering Science Fair(KLESF), the ACS APAC Leadership Summit, ACS Southeast Asia Global Innovation Challenge (ACS SEAGIC), and the ACS Global Innovation Imperatives (ACS Gii) 2023. The chapter has also received multiple American Chemical Society Travel Grants, enabling student participation in national meetings in Philadelphia and New Orleans, as well as international engagements at Chiang Mai University in Thailand. These accomplishments highlight ACS-UM's commitment to collaboration, leadership, and societal contributions, positioning the chapter as a driving force in promoting chemistry and scientific excellence at University of Malaya and beyond.

Integrating Chemistry, Pharmaceutical, and Engineering Innovation: The Spirit of the ACS UCSI International Student Chapter

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Established in 2023, the American Chemical Society (ACS) UCSI International Student Chapter embodies a collaborative spirit uniting students from Chemistry, Pharmaceutical Sciences, and Engineering under a shared passion for chemistry. Guided by three supervisors, one from each discipline, the chapter began modestly but aspires to create meaningful impact through interdisciplinary innovation and community engagement. Its efforts were recognized with the ACS Commendable Student Chapter Award for two consecutive years (2023 and 2024) by the ACS US. Throughout 2023 and 2024, the chapter organized several impactful initiatives promoting chemistry innovation, diversity, inclusion, and educational excellence. The Southeast Asia Global Innovation Challenge (SEA-GIC 2023), themed “Fueling the Future, Give the Earth a Reason to Smile,” gathered ASEAN undergraduates for workshops, demonstrations, and competitions on sustainable energy and environmental solutions aligned with the United Nations Sustainable Development Goals. The IUPAC Global Women’s Breakfast 2024 and EmpowerHer Wellness Workshop further championed inclusivity and professional growth, blending scientific dialogue with practical activities such as lotion formulation, supported by the Faculty of Pharmaceutical Sciences. In 2024, the team has organized a Terrarium Workshop and SDG Sharing Workshop promoted sustainability awareness and creativity among participants. Demonstrating commitment to research and innovation, members of ACS UCSI chapters also initiated a nanoparticle-based CO_2 sensor project, merging nanotechnology and materials engineering to support low-carbon innovation for a sustainable future. Collectively, these initiatives reflect the chapter’s commitment to interdisciplinary collaboration, inclusivity, and the advancement of green chemistry innovation, showing the true spirit of the ACS UCSI International Student Chapter.

Advancing Water Literacy Through Community Engagement: A Highlight from ACS USM International Student Chapter

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The ACS USM International Student Chapter is dedicated to advancing scientific literacy, cultivating student leadership, and strengthening the link between science and society through outreach initiatives. Reflecting this mission, our chapter organized Water Education Day, a collaborative program with Water Watch Penang (WWP) for children from The Asrama Ramakrishna orphanage, supported by student volunteers. The program introduced participants to the importance of clean water, conservation practices, and basic water science through hands-on activities. Guided by student mentors, the children participated in simple experiments, including pH measurement, turbidity testing, biological sampling, and water filtration. This experiential approach fostered curiosity and confidence among participants while enhancing the leadership and communication skills of student mentors. Water Education Day highlighted our chapter's strength in making science accessible and relevant by linking fundamental concepts to real environmental challenges. The initiative inspired children to view water conservation as both a scientific and community responsibility, while reaffirming our chapter's role in impactful student-led outreach. Through thoughtful planning and collaboration, the program demonstrated how science education can be transformed into lasting positive change for society.

Figure 1. Outreach program led by the ACS USM International Student Chapter, engaging students from Asrama Ramakrishna in partnership with Water Watch Penang.

Empowering Young Minds Through Science:
The ACS IIUM-K Approach

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The American Chemical Society (ACS) Student Chapter of International Islamic University Malaysia (IIUM) Kuantan Campus serves as a dynamic platform for chemistry enthusiasts to cultivate scientific knowledge, leadership, and community engagement. It was established in 2019 with the vision of promoting chemistry beyond the classroom, the club connects students with global scientific networks, professional development opportunities as well as outreach initiatives that inspire the younger generation's interest in science. Through academic talks, hands-on workshops, research collaborations, and community-based outreach programs, the ACS IIUM Kuantan Chapter aims to foster the spirit of innovation, collaboration, and social responsibility which directly align with the university's mission to integrate knowledge and values for the benefit of society. Throughout the club's operation, countless of activities have been conducted, ranging from academic seminars and scientific workshops to outreach programs and collaborative projects with schools and local communities.

In 2025, the ACS IIUM-K 24/25 tenure has organized few programs focused on promoting the exposure of STEM to primary and secondary school. All programs conducted were considered highly successful in which most achieved its objectives. The first program conducted in 2025 was the Chemflips: Pamphlet design competition in conjunction with earth day. The next program carried out was Brainy Breaks which designed to create awareness of the importance of STEM among primary school students. Astrovate was the third program of 2025 which focusing on the form three students of SBPI Kuantan located at Bandar Indera Mahkota. Next, ChemLife season 5 was a continuation podcast programme conducted by American Chemical Society ACS-IIUMK Students Chapter 2024/2025 using the official YouTube channel of ACS-IIUMK Students Chapter: https://youtube.com/@acsiiumkstudentchapter9886?si=oozUaT495zNRwjgU.

Empowering Student Connections through Chemistry: The ACS Curtin University Malaysia ISC Journey

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This poster highlights the student-led initiatives of the ACS Curtin University Malaysia International Student Chapter (ACS Curtin ISC), presented as part of the ACS International Student Chapter (ISC) Student Activities Program. After being inactive since the COVID-19 pandemic, the chapter was successfully reactivated in 2025 with a renewed mission to inspire curiosity, collaboration, and creativity through chemistry-focused activities that connect scientific principles with everyday experiences.

To kickstart the semester, the chapter organized a Welcoming Party filled with interactive activities designed to rebuild engagement and foster a sense of community among new members. One of the key highlights was a hands-on demonstration using lemon juice as invisible ink, where participants drew laboratory apparatus and revealed the hidden drawings by gently heating the paper. This activity introduced basic chemical concepts, such as the oxidation of organic compounds upon heating, while promoting teamwork, creativity, and fun learning. The event successfully bridged social and educational aspects of chemistry, allowing students to reconnect with one another while exploring simple yet fascinating chemical reactions.

Another major initiative, Welcome to BrewChem 2.0, was a collaborative science-meets-coffee event between ACS Curtin ISC, the IChemE Student Chapter, and Fukuro Roastery. The event explored the chemistry behind coffee brewing through live hot and cold brew demonstrations, interactive tasting and quiz stations, and sharing sessions by guest lecturer and industry collaborators. Participants learned about extraction, aroma, and flavour chemistry while networking in an informal and engaging environment that blended science with daily life.

Through these activities, ACS Curtin ISC demonstrates how student leadership, creative programming, and interdisciplinary collaboration can make chemistry accessible, enjoyable, and relevant to modern lifestyles. The chapter's efforts also reflect the broader ACS mission of advancing chemistry for the benefit of society by nurturing scientific curiosity and building a vibrant, connected student community. Looking ahead, the chapter aims to expand its outreach initiatives and establish more industry-academic partnerships to sustain long-term engagement in chemistry education and innovation.

American Chemical Society (ACS) Chemistry Festival: Fun with Atoms, Molecules, and Reactions

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Chemistry is often perceived as a complex and abstract discipline, largely due to ineffective teaching methods and inaccurate portrayals in the media. Consequently, students struggle to relate chemical concepts to their everyday lives. The American Chemical Society (ACS) Chemistry Festival aims to change this perception by integrating chemistry into real-life experiences through engaging and interactive experiments. This initiative was conducted at Sekolah Kebangsaan Juara, a remote national school on Tioman Island of Pahang, Malaysia, to spark curiosity and foster scientific thinking among primary students. A dedicated volunteer from ACS UKM Student Chapter and UKM students collaborated as facilitators and organizing committees to ensure the festival's success. The volunteers designed a series of captivating experiments, including colour-changing pH indicators, a density tower, Oobleck, and volcano eruptions. Thirty-four students participated actively, guided closely by the facilitators who maintained their enthusiasm and curiosity throughout the event. The students are introduced to various chemistry concepts and their curiosity is fulfilled through interesting explanations and hands-on demonstrations. As a result, many students expressed newfound interest in pursuing science and STEM-related careers. The organizing committee and the facilitators effectively utilized their knowledge and resources to create a memorable and impactful learning experience, embodying the spirit of community engagement promoted by ACS student chapters in Malaysia. The festival highlighted the value of hands-on learning, which enhances students' psychomotor skills, conceptual understanding, and information retention—ultimately fostering a more dynamic and enthusiastic learning environment [1]. Furthermore, the use of simple explanations and guided questioning stimulated critical thinking and sustained student curiosity [2]. The facilitators demonstrated strong preparation and dedication, successfully inspiring a young generation to appreciate and explore the world of chemistry.

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Building Bridges in Science Communication : SciComm 2025 by ACS USM

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The ACS Universiti Sains Malaysia (USM) International Student Chapter demonstrated its profound responsibility to bridge the gap between scientific innovation and public understanding through its flagship program, SciComm 2025 with the theme of Green Chemistry. Our chapter had the distinct pleasure of hosting students from Universiti Malaysia Terengganu (UMT) as special guests at our SciComm 2025 event, creating a vibrant platform for cross-university dialogue. We facilitated dynamic sessions where UMT and USM students collaborated in substantive discussions, exchanging diverse perspectives and communication approaches. To deepen this exchange, we invited a distinguished Science Communication speaker whose impactful keynote address demystified complex scientific concepts. During the event, participants moved beyond theory into hands-on practice, learning to transform complex chemistry concepts into clear and compelling stories for a non-expert audience. Guided by expert insights, participants learned to master the "3C's" of Content, Clarity and Charisma. This involved deconstructing complex topics through "chunking" techniques to create accessible messages, crafting compelling narratives using a problem-hero-win story structure to sell their ideas and designing powerful hooks to capture audience attention. Furthermore, participants practiced using their voice and body language effectively, learning to speak with more expression and use open gestures to build trust with listeners. The direct outcome of this initiative is students who have transitioned from being knowledge-keepers to becoming articulate advocates for science.

Figure 1. Flagship program of ACS USM International Student Chapter, special guests from UMT and honorable speaker ChM Dr. Shahrul Nizam Ahmad, our speaker.

Chemistry Day 2025 Igniting Curiosity: A Chemistry Workshop to Inspire Future Chemists

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In conjunction with Chemistry Day 2025, the ACS International Student Chapter of Universiti Teknologi PETRONAS organized an interactive workshop themed “Igniting Curiosity” to promote scientific enthusiasm and awareness among students. The event aimed to spark interest in chemistry through engaging demonstrations and experiments, while aligning with key objectives to provide information solutions, empower members and member communities, support excellence in education, communicate chemistry’s value, and embrace and advance inclusion in chemistry.

The workshop was held at SMK St. Bernadette’s Convent, an all-girls secondary school in Perak, to specifically encourage more female participation in science. Despite growing representation, women remain underrepresented in STEM-related fields. By targeting young female students, the program sought to break gender stereotypes and inspire them to pursue scientific studies with confidence. A total of 48 committee members and 26 participants were involved in executing the program, which features a series of hands-on experiments such as “Volcano Eruption” and “Glow-in-the-dark Slime”, designed to give participants the opportunity to explore real-world chemistry concepts in a fun and accessible way.

The event achieved several key successes, most notably in igniting curiosity in STEM pathways by encouraging students to explore scientific careers with confidence and enthusiasm. It also fostered the development of critical thinking through collaborative problem-solving, as participants actively worked together to analyse and discuss experimental outcomes. Furthermore, the workshop strengthened community–academia partnerships by connecting university volunteers with secondary school students, promoting knowledge-sharing, mentorship, and a shared passion for science.

Overall, the workshop successfully enhanced participants’ understanding of chemistry and their confidence in engaging with science. Feedback reflected heightened interest, enjoyment, and appreciation for the role of chemistry in daily life. Moving forward, similar initiatives will continue to focus on inclusivity and empowering young women to become future scientists and innovators.

Solvent-Free Joule Heating of Fe–Co Catalysts for CO_2 to C_{5+} Hydrocarbon Conversion

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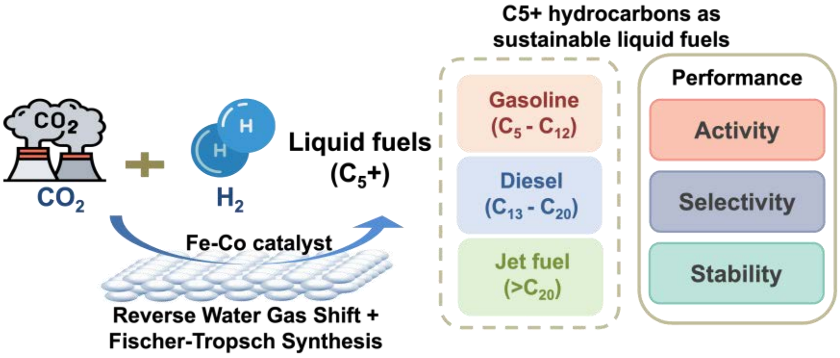
The sustainable conversion of CO_2 into value-added hydrocarbons offers a promising strategy to reduce carbon emissions and produce renewable fuels. Among various products, C_{5+} Are particularly attractive as synthetic liquid fuels and chemical feedstocks. However, achieving high CO_2 conversion and C_{5+} selectivity remains a major challenge. In this study, we developed a rapid, solvent-free Joule heating synthesis method for Na-promoted Fe-Co catalysts to drive CO_2 hydrogenation toward heavier hydrocarbons. The optimized catalyst, $Fe_{0.90}Co_{0.10}Na_{0.05}$ achieved 58.9% CO_2 conversion and 38.1% C_{5+} selectivity under industrial conditions (370 °C, 30 bar). These findings demonstrate that solid-state, non-equilibrium Joule heating can offer a scalable pathway to drive CO_2 hydrogenation toward liquid fuel-range hydrocarbons.



Schematic illustration of CO_2 hydrogenation over Fe-Co catalysts for producing C_{5+} hydrocarbons via Reverse Water Gas Shift and Fischer-Tropsch pathway

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Where Chemistry meets Student Life: ACS at The National University of Singapore

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The National University of Singapore (NUS) ACS Student Chapter, having just marked 10 years of engaging the community in NUS and Singapore in chemical sciences topics, reflects on its journey adapting to changing roles in industry and research alike while continuing to promote outreach in these areas. From our small beginnings as a handful of Chemistry enthusiasts, we have since grown to a full-fledged student organization within the NUS framework with more than 30 members in various majors. One of our key actions was to reform the executive committee and make it more manageable. Our President and Secretary/Treasurer have been assigned welfare, to work together on the admin side of events, to ensure that things are on track and events are within appropriate budget. With an Internal and External Vice President working with Programmes and Publicity Heads respectively, to ensure that all events planned run smoothly, things are done in time and provide regular updates. Lastly, Programmes, Publicity and Welfare are to work together, to ensure that every event is planned well, have sufficient outreach to interested parties, and it runs smoothly. These revised roles allow us to look out for each others' progress, and put together some decent activites throughout the term, though a number of our ideas are being planned out and we look forward to implementing them in the coming year. At the same time, our capacities as budding scientists have been enhanced, notwithstanding our diverse range of interests, as we commit to research and academic excellence within campus as well as outside. The support we have received from our Chapter Advisors, through a close synergy between chapter, department and professional connections, will also be highlighted.

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Dynamics interaction in highly stretchable EGMEA-*g*-ENR-LiTFSI systems: Insights from molecular interactions via real time Raman and DFT analysis

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Improving the properties of natural rubber (NR) for advanced applications remains a critical challenge, particularly in achieving enhanced mechanical, thermal and ionic conductivity properties. Here, ethylene glycol methyl ether acrylate-grafted epoxidized natural rubber with lithium bis(trifluoromethanesulfonyl)imide (EGMEA-*g*-ENR-LiTFSI) was synthesized via a UV-curing process, significantly reducing solvent usage and preparation time. A comprehensive investigation combining experimental and computational approaches was performed to optimize material properties. Analytical techniques, including *in situ* Raman spectroscopy, FTIR, TGA, DSC, XRD, electrochemical analysis and density functional theory (DFT) simulations were employed to evaluate the material properties. The Raman spectra exhibited significant alterations in molecular structure, offering critical insights into the grafting reactions and facilitating a deeper understanding of the electrochemical behaviour of the system. Furthermore, DFT analysis provide insights into the molecular interactions between lithium salts and rubber-based polymer matrix, complementing experimental findings. The results demonstrated enhanced polymer-salt interactions, suppression of crystallinity, and improved ionic conductivity and thermal stability in the rubber-based polymer. In particular, we demonstrate both the applicability and limitations of the epoxide group in ENR, providing key insights for improving the stability and performance of the material.

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Synthesis and Characterization of Nanostructured Nickel-Based Metal Organic Complex as Electrode Material for Supercapacitor Applications

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In recent years, metal-organic complexes (MOCs) have emerged as promising electrode materials for supercapacitor applications owing to their tunable physicochemical properties, including particle size and ionic conductivity. In this work, nickel-based metal–organic complexes (NMCs) were synthesized via a solvothermal approach using different organic ligands to tailor their nanostructural morphology. Field emission scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (FESEM-EDX) confirmed the formation of hollow structures with uniform elemental distribution. The electrochemical performance of the synthesized materials was evaluated in a 1 M KOH electrolyte using cyclic voltammetry (CV), galvanostatic charge–discharge (GCD), and electrochemical impedance spectroscopy (EIS) within a three-electrode configuration. Among the samples, the NMC prepared with terephthalic acid exhibited the highest specific capacity of 652.8 C g^{-1} at 1.0 A g^{-1}, attributed to its uniform nanowheat morphology, as compared to the bulky nanoflake and nanoflower structures observed for trimesic acid and 2,6-naphthalene dicarboxylic acid ligands, respectively. Furthermore, the NMC electrode demonstrated nearly 100% coulombic efficiency, indicating excellent charge–discharge reversibility and cycling stability.

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Influence of Manganese (Mn) Doping on the Structural and Surface Characteristics of Copper Zinc Tin Sulfide (CZTS) Transition Metal Sulfides Synthesized *via* Sol–Gel Method

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Continuous improvement of transition metal sulfides (TMSs) is crucial for advancing next-generation electronic devices and energy technologies. This study investigates the structural and surface properties effects of manganese (Mn) doped on copper zinc tin sulfide (Cu_2ZnSnS_4, CZTS) to improve its physicochemical properties. Mn doped CZTS samples were synthesized *via* sol-gel method under a nitrogen atmosphere at various doping percentage ratios. The samples produced were sulphurized at 550 ºC in nitrogen atmosphere, prior to structural analyses. The structural and surface characterization were performed using X-ray diffraction, Raman spectroscopy, particle size analysis, and field emission scanning electron microscopy (FESEM). XRD results confirmed the formation of a tetragonal Mn-doped CZTS phase, diffraction peaks shifting toward lower angles, indicating lattice expansion due to Mn incorporation. The crystallite size increased from 24.52 nm to 42.01 nm at low Mn doping levels, while degree of crystallinity decreased to 50-65 %. Correspondingly, strain and dislocation density were reduced to 3.32×10^{-3} rad and 0.57×10^{-3} $(nm)^{-2}$, respectively. Raman analysis verified a stannite-dominant structure, with red shifts corroborating the XRD findings. Although, BET surface areas and pore volume of CZTS samples decreased upon Mn doping, but interestingly the porosity showed a notable increment. Particle size distribution ranged from ~1 μm to ~2 μm, and zeta potential shifted from net negative charge to net positive charge after Mn doping. FESEM micrographs revealed reduced particle agglomeration and improved surface uniformity after Mn incorporation. In conclusion, Mn doping effectively altered the lattice structure and surface properties of CZTS, demonstrating its potential to enhance the material's performance in electronic devices, energy storage, and energy harvesting applications.

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