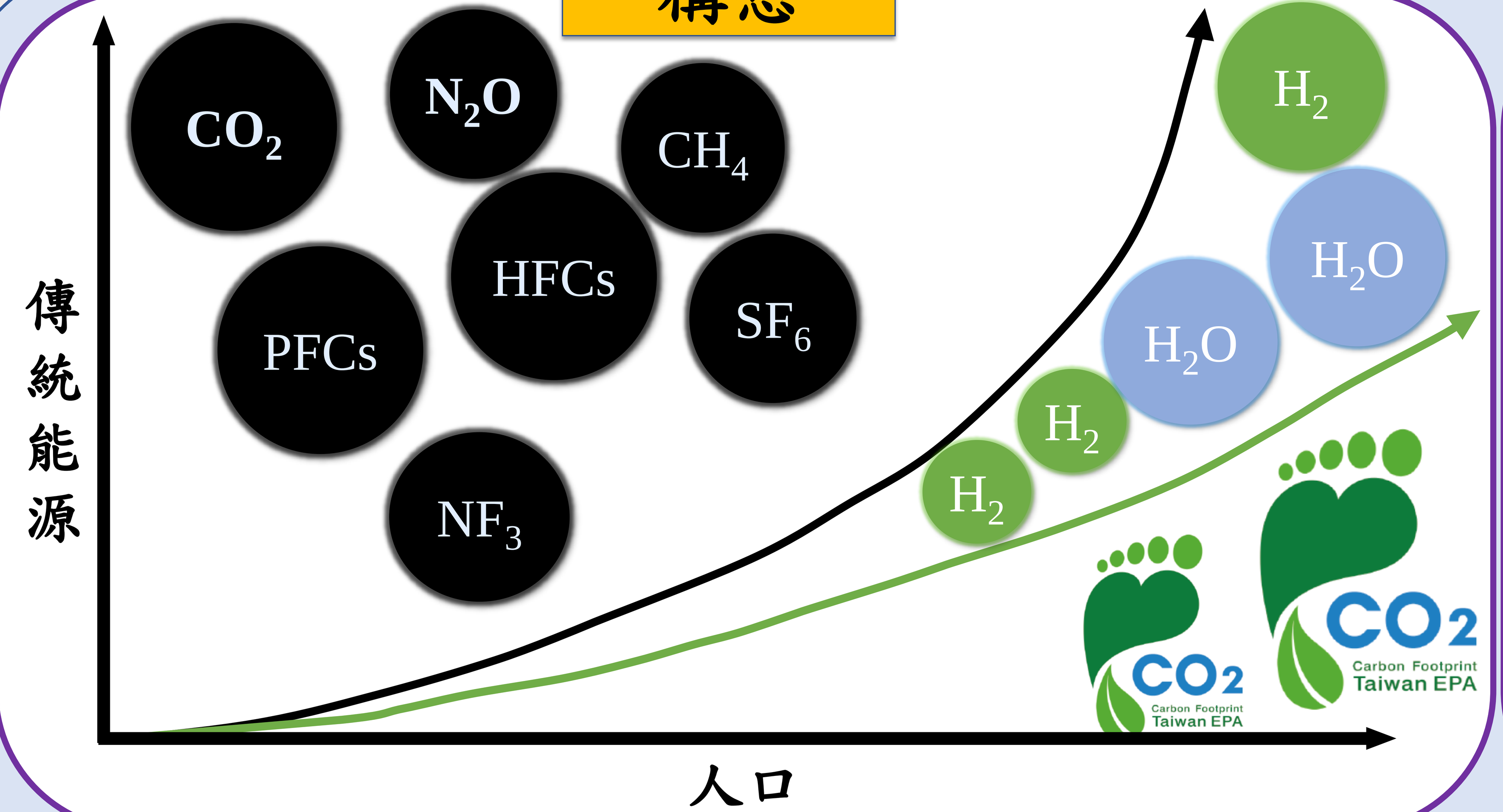
PSP材料於低碳未來中的產氫技術之探討

吳承遠、陳勗仁、陳冠宇、卓家榮*

Institute of Biotechnology and Chemical Engineering, I-Shou University

＊Email : ppaul28865@gmail.com

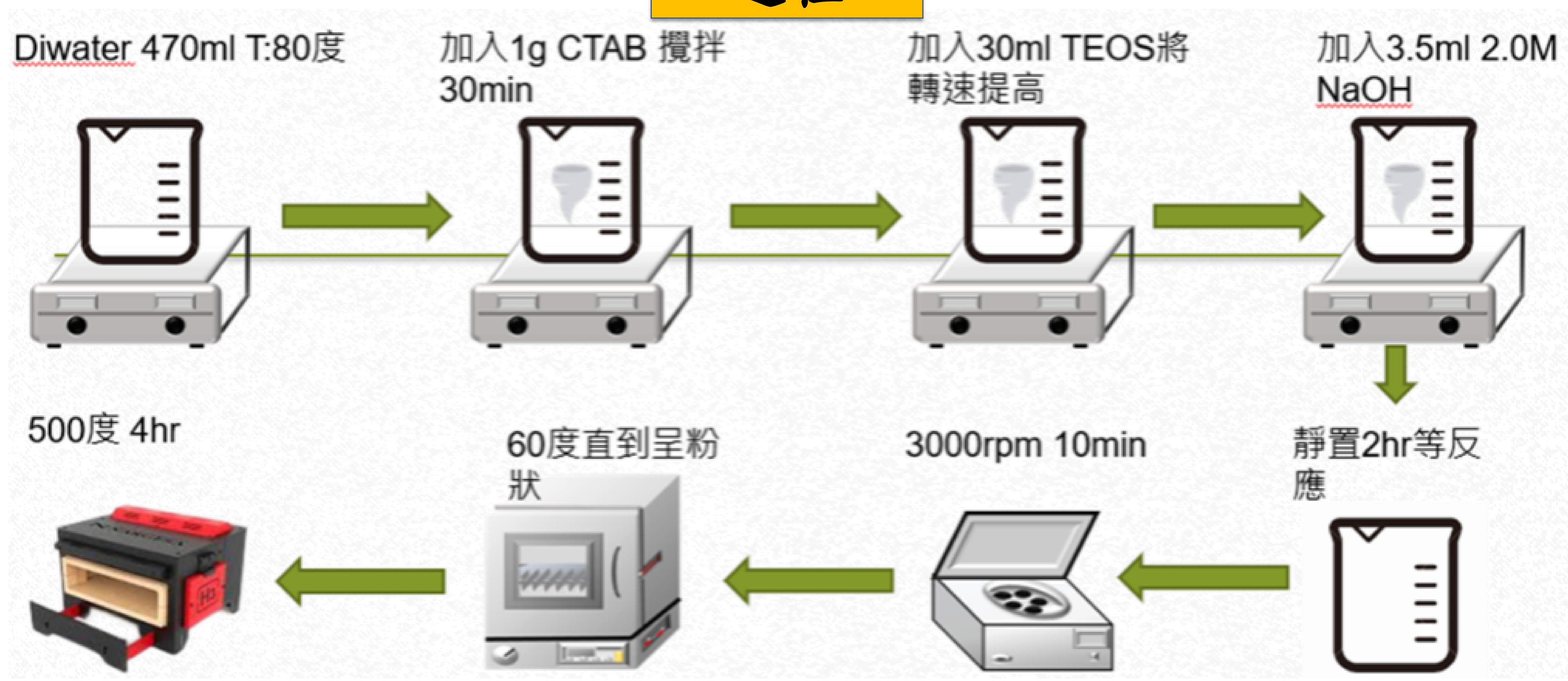
構想



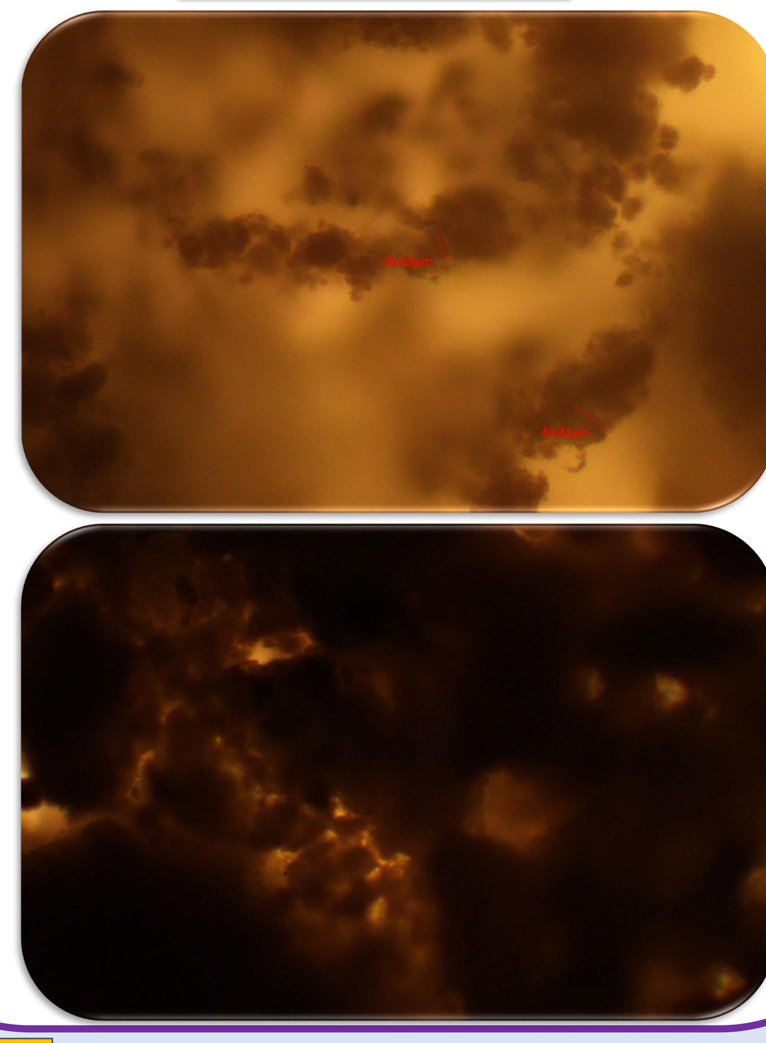
摘要

- 傳統的石化能源作為主要能源，卻帶來了溫室效應和能源儲存受限等問題。
- 我們開發一種成本低廉且效率高的產氫方法-新型多孔性矽材料（PSP）並應用於產氫及綠能領域
- PSP有助於提高產氫效率且成本較低，同時具備良好的穩定性和耐用性
- 通過開發出更先進、更環保的製氫技術，能夠為滿足未來能源需求，同時為地球環境做出貢獻

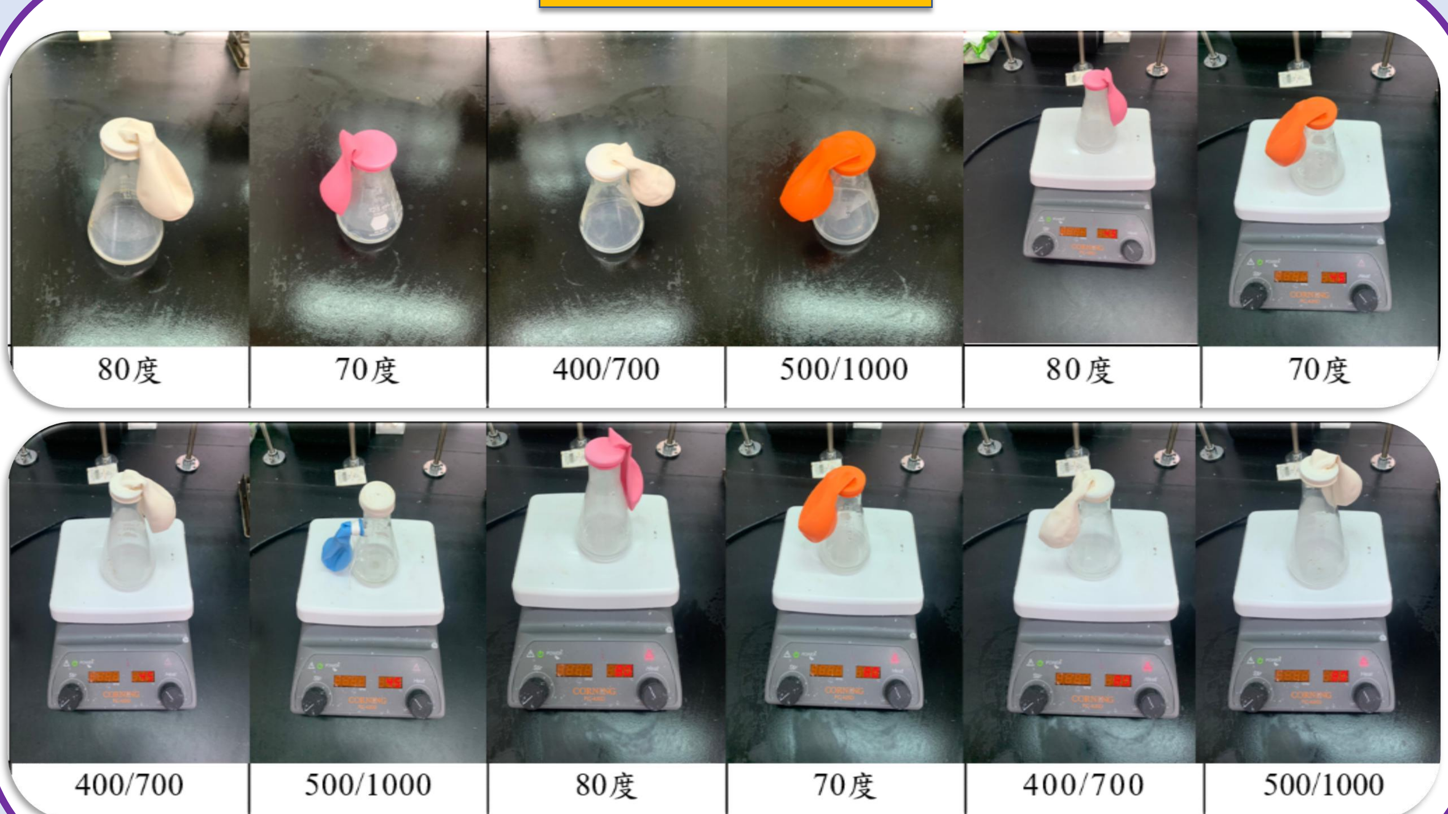
過程



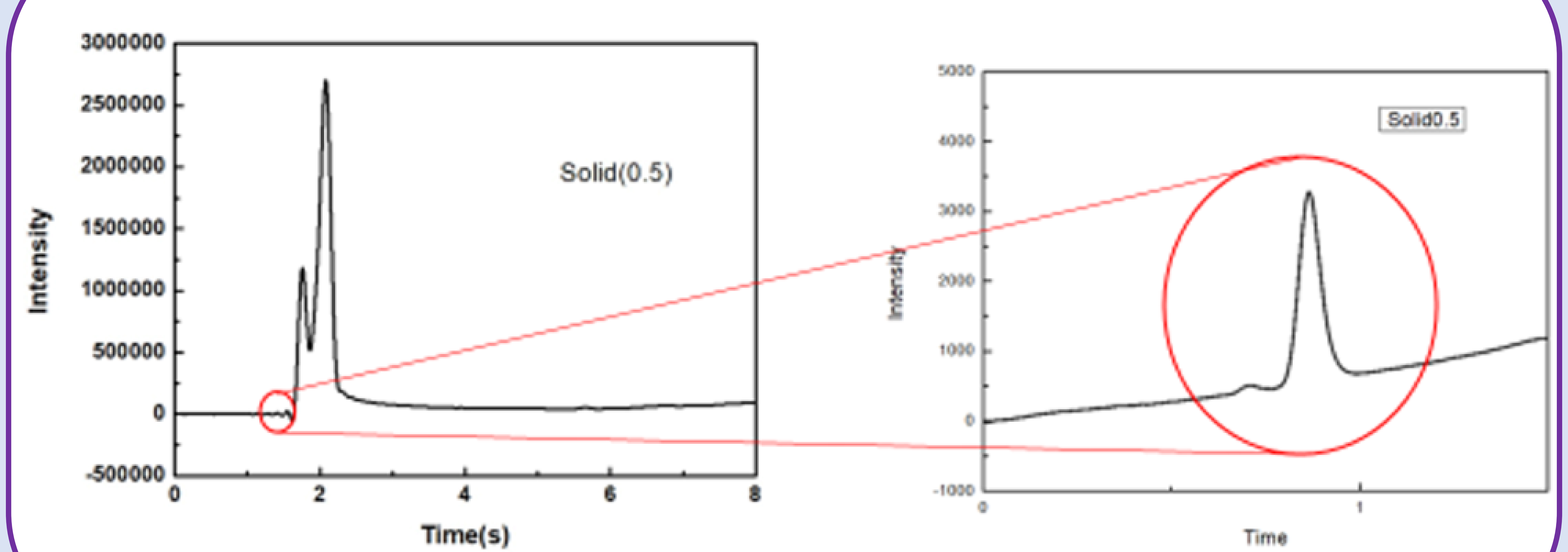
OM



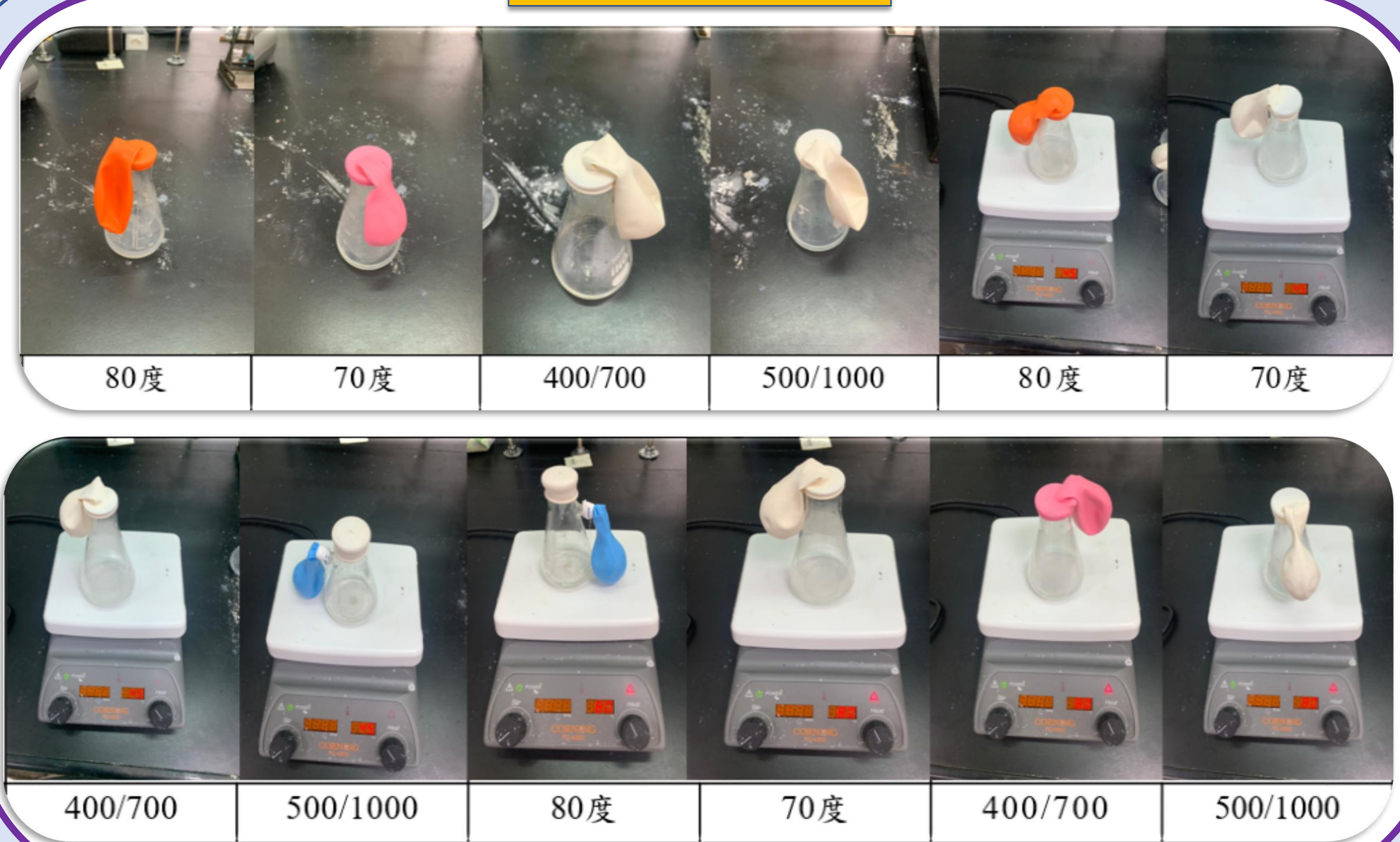
固體產氫



GC



液體產氫



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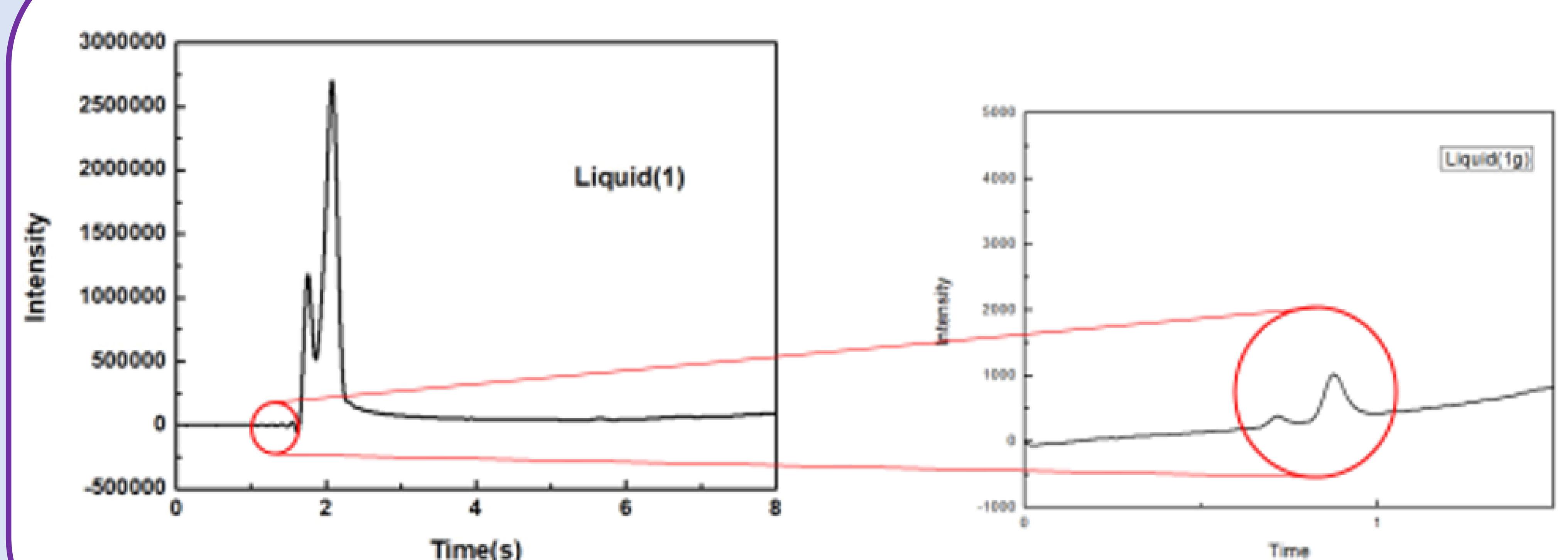


總結

- 主要依賴地球上有限的化石燃料，對環境造成了負面影響
- 研究了PSP材料，並對此進行測試，由於製作時間過長，通過改變參數進行檢驗，從而製造縮短時間
- 恆溫溫度與合成轉速變化與粒子團聚大小尺度分析中，我們可得知變因為恆溫溫度時，70度可產生的團聚粒子尺寸(35微米)
- 改變轉速(rpm)的條件下，500/1000 rpm可產生的團聚粒子尺寸(40微米)，由上述可證實降低溫度並提高轉速有助於團聚粒子尺寸微小化

Elastic Enhancement Conductive Nanofiber Technology Applied to Motion Sensing Devices

Min-Hsuan Chen, Yue-Ni Chen, Min-Hsin Cheng, Chia-Jung Cho*

Institute of Biotechnology and Chemical Engineering, I-Shou University, Kaohsiung 84001, Taiwan

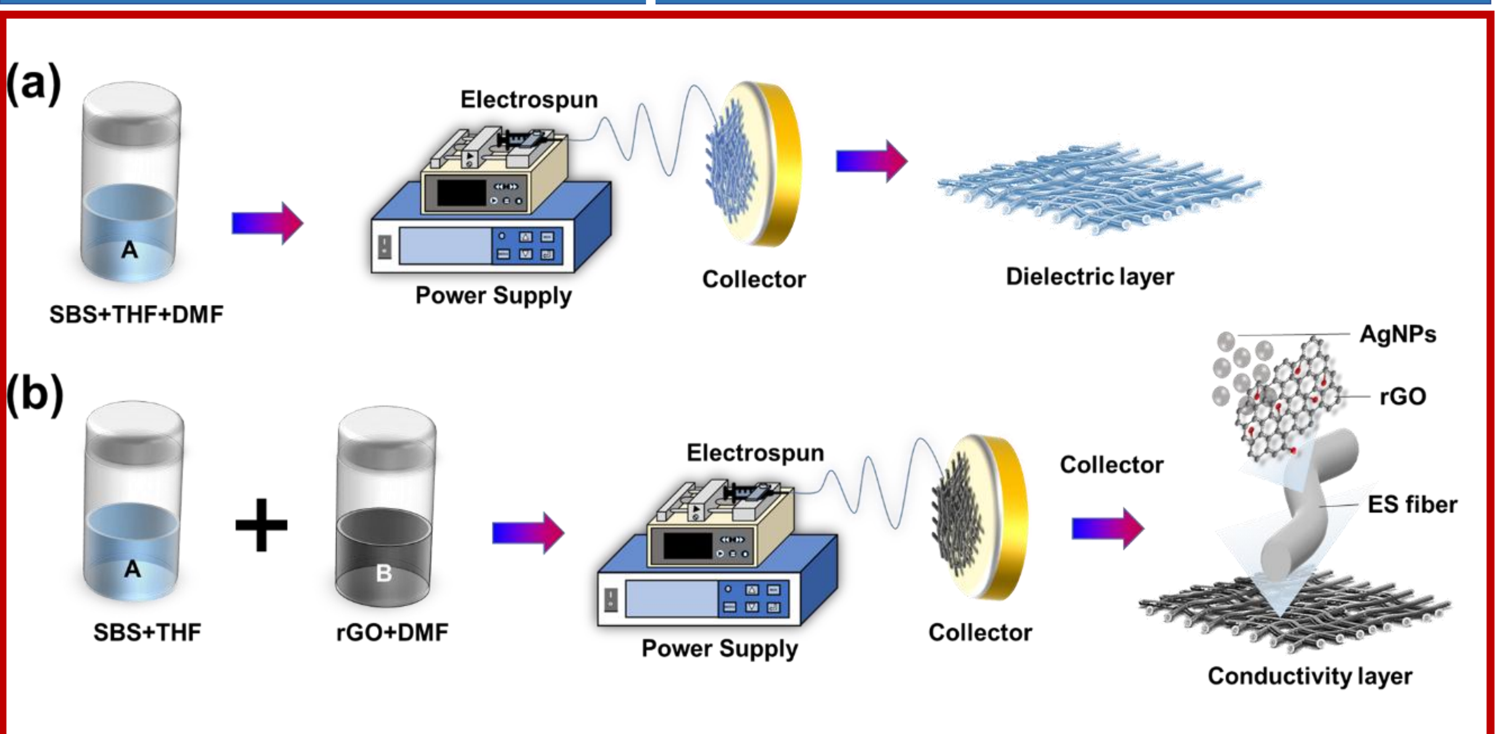
*** Email:**ppaul28865@gmail.com

Introduction

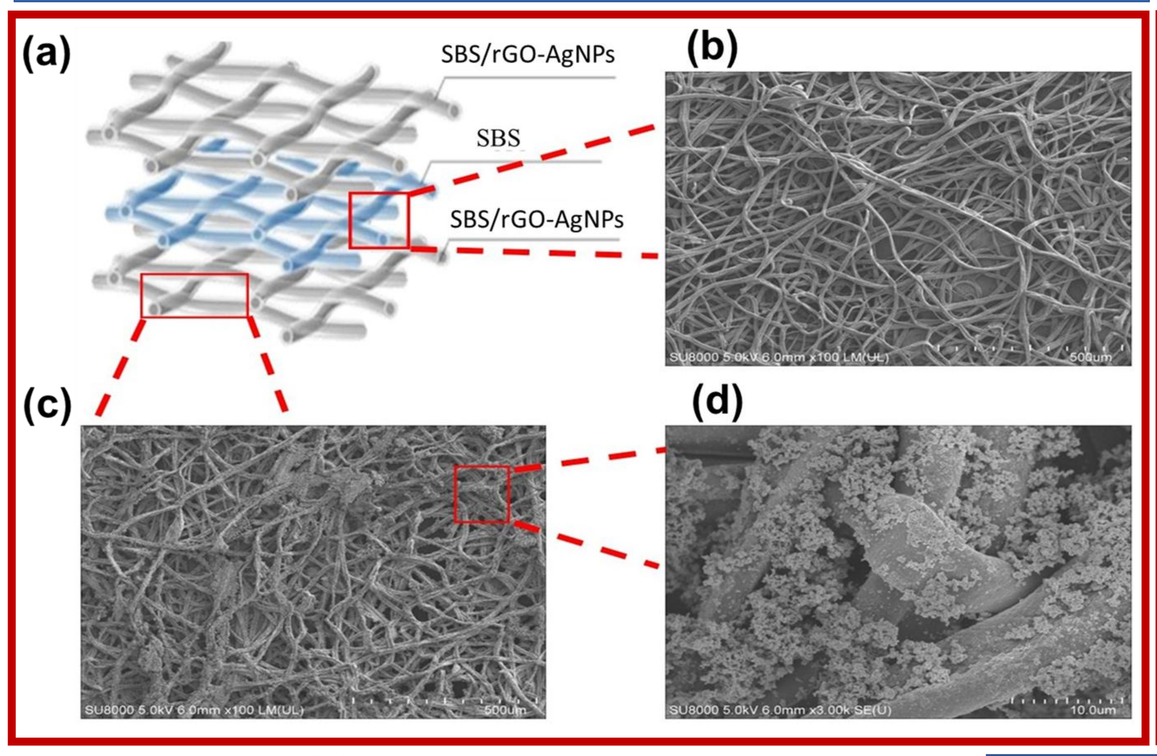
Abstract

- We employ nanotechnology to create flexible metal/organic polymer nanocomposites, incorporating rGO and AgNPs into SBS fibers.
- We've successfully developed the "Sandwich Structure Piezoresistive Woven Nanofabric" (SSPWN), a remarkable fabric with rapid response (<3 ms), lasting stability (even after 5500 used), and exceptional thermal resilience, perfect for wearable electronics.
- SSPWN is used to track body movements and in RGB-sensing shoes for foot motion monitoring. This nanotech approach has vast potential in healthcare, health monitoring, gait analysis and paves the way for innovative wearable electronics.

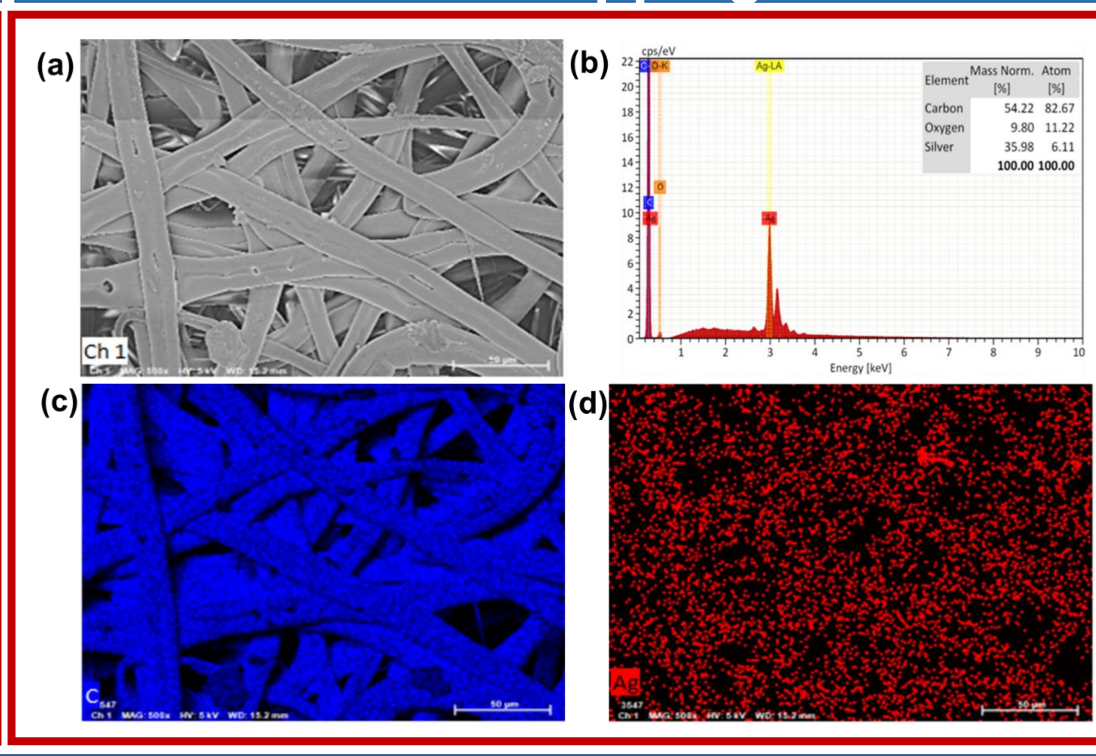
Experiment



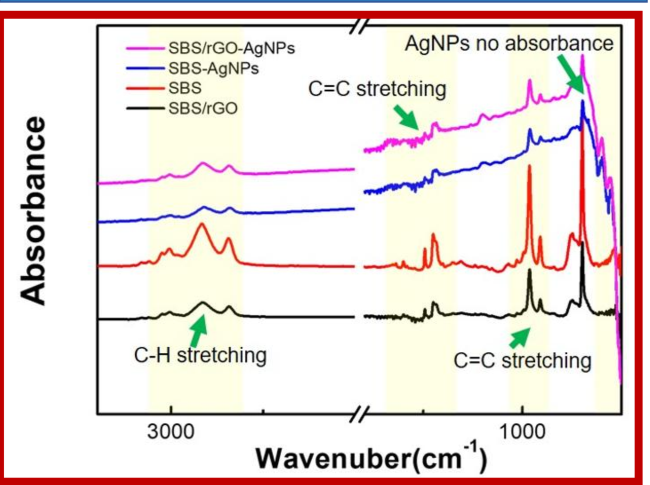
SEM



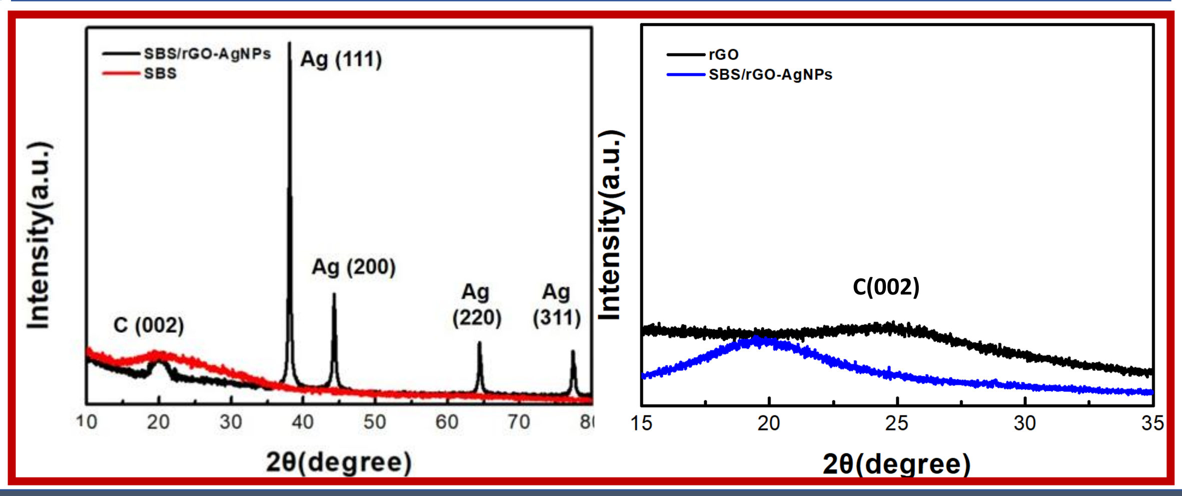
EDS/Mapping



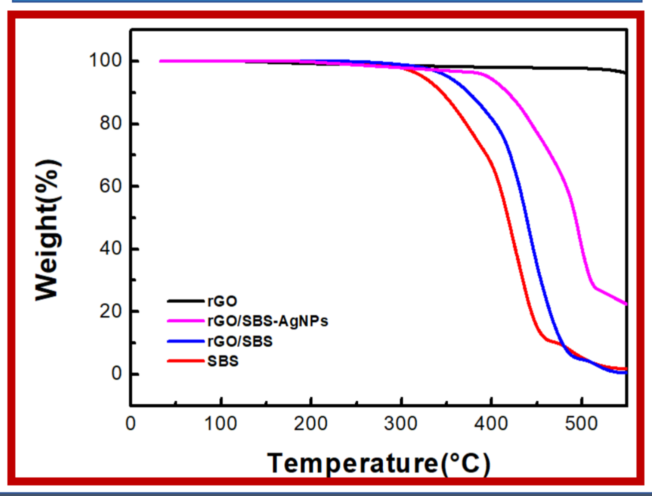
FTIR



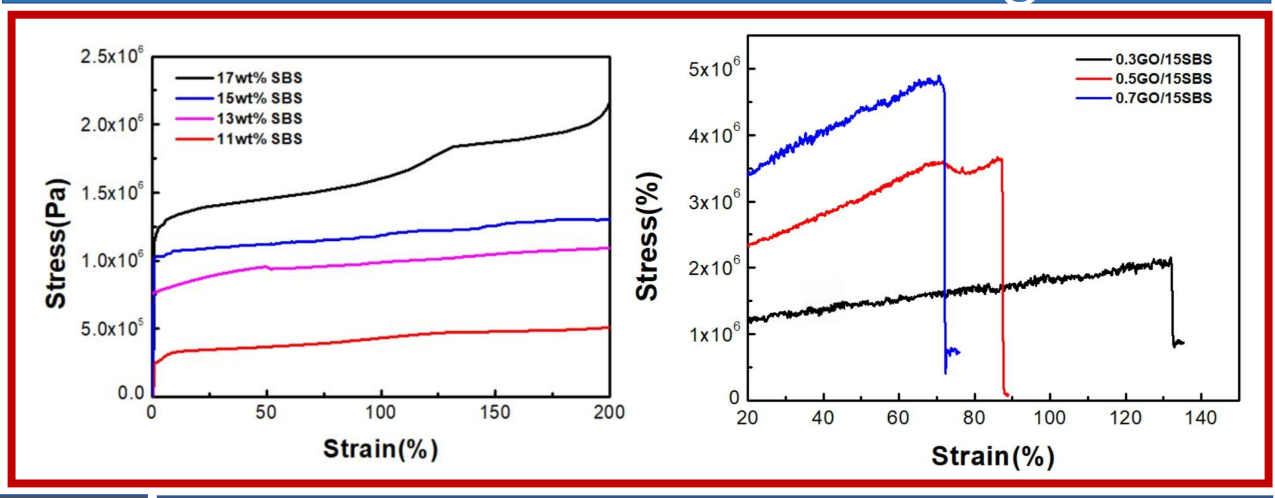
XRD



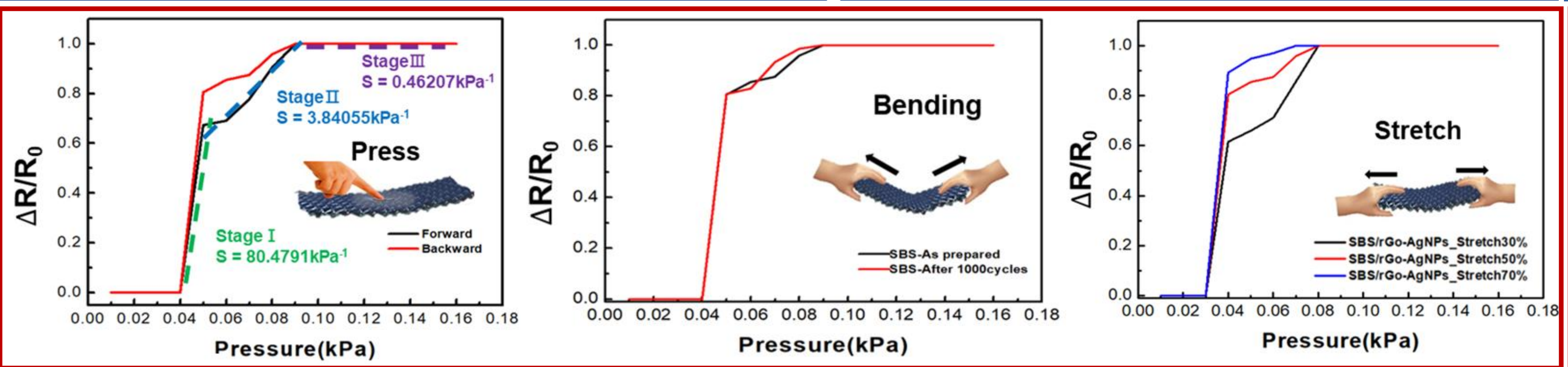
TGA



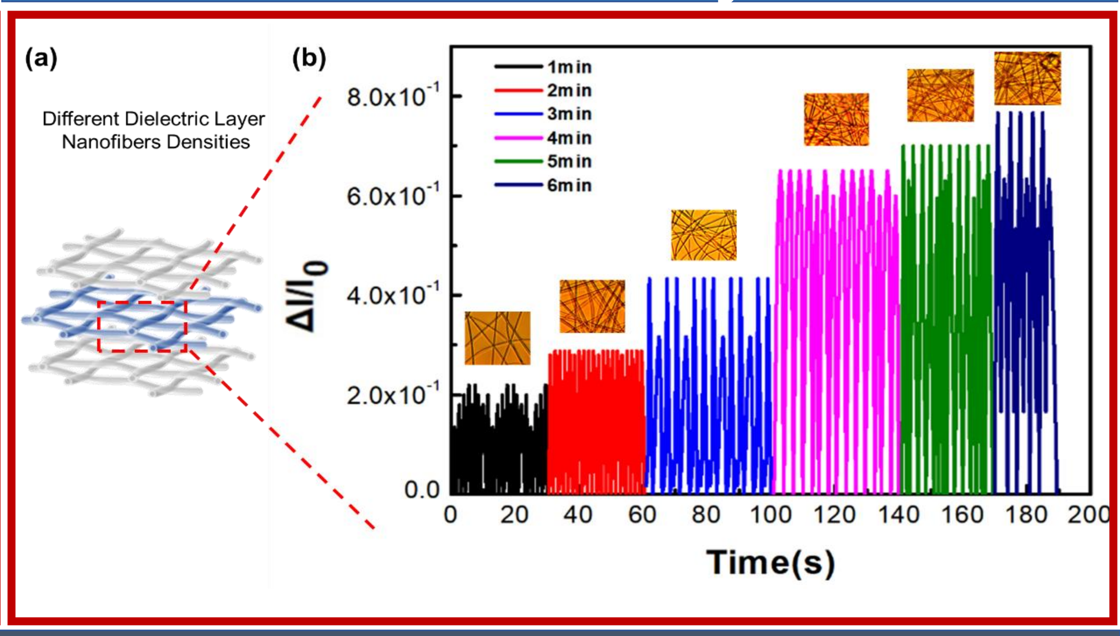
SBS/SBS-rGO Tensile Strength



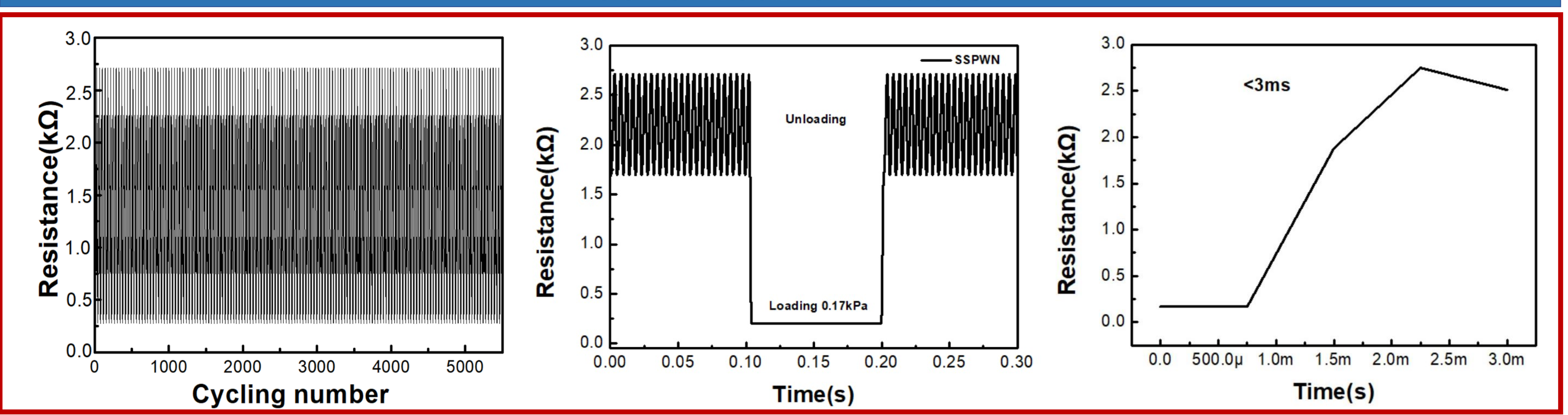
Press v.s. Bending v.s. Stretch



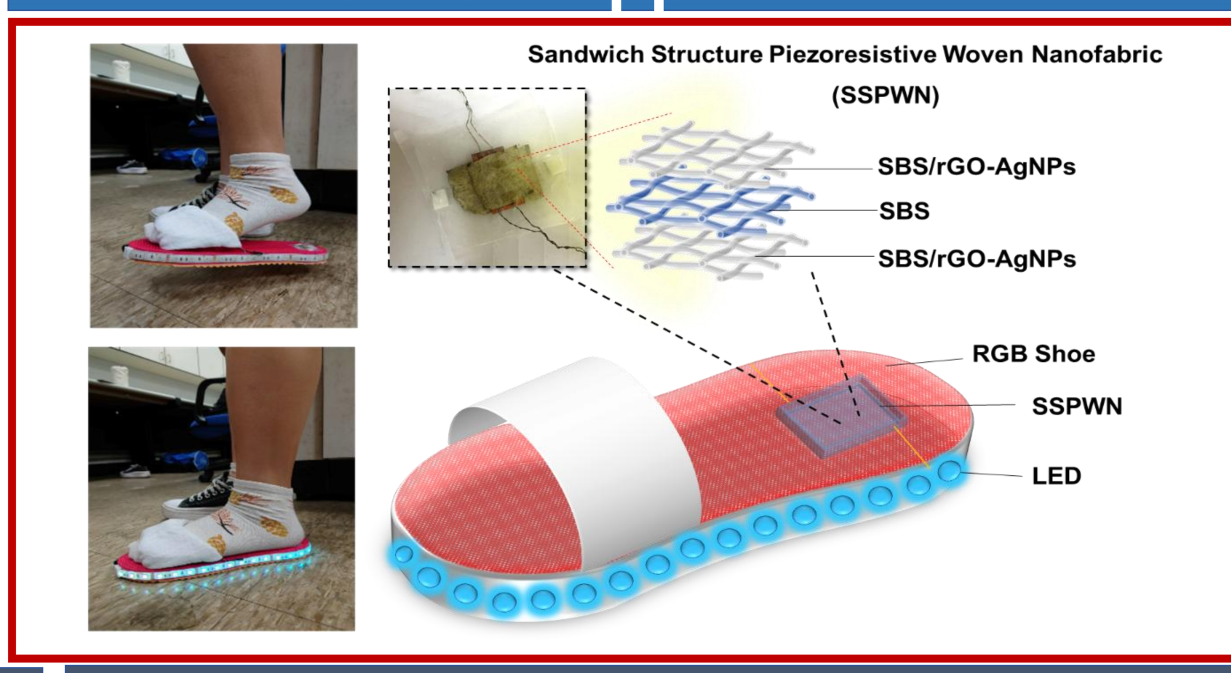
Dielectric Layer



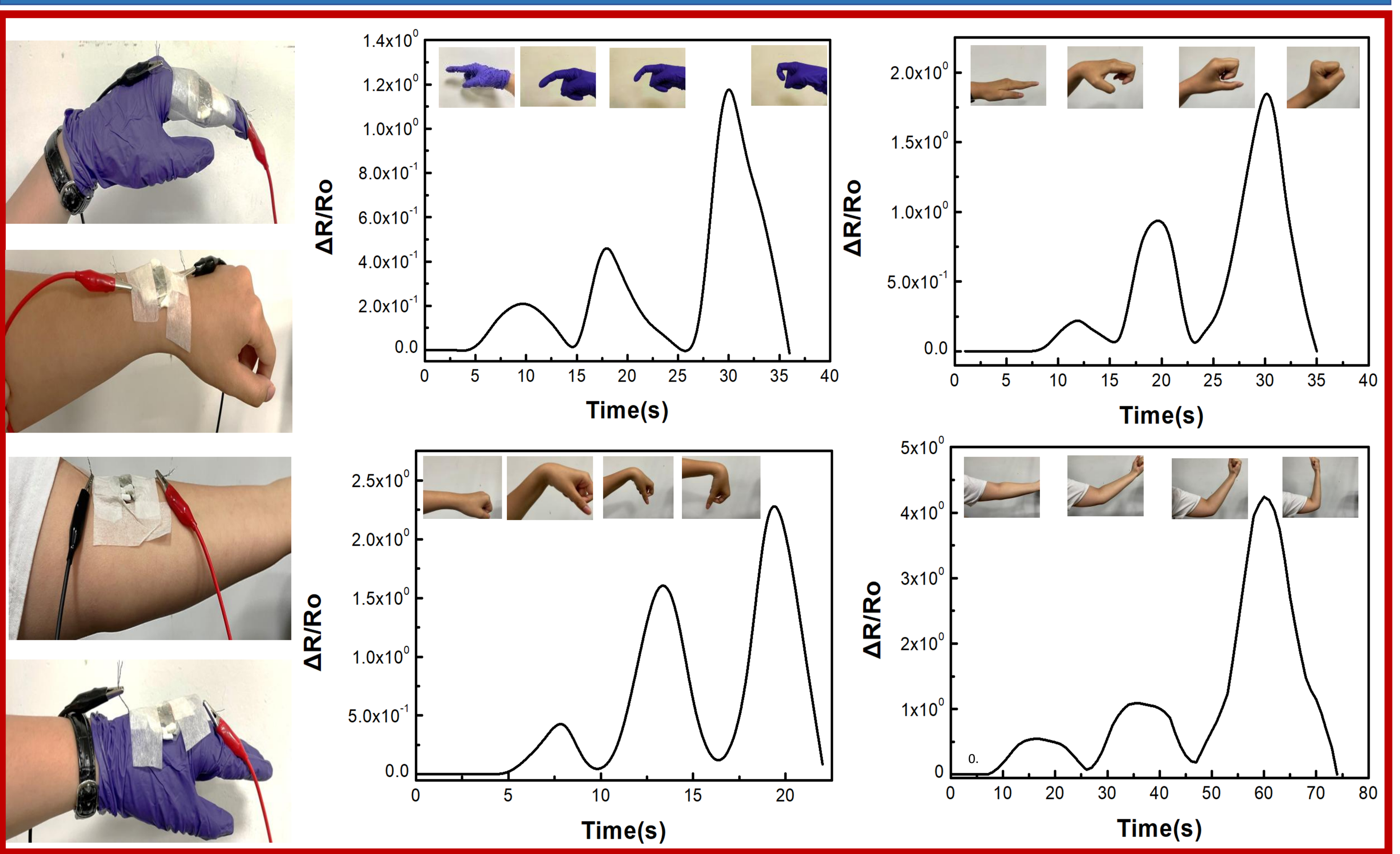
Mechanical Character



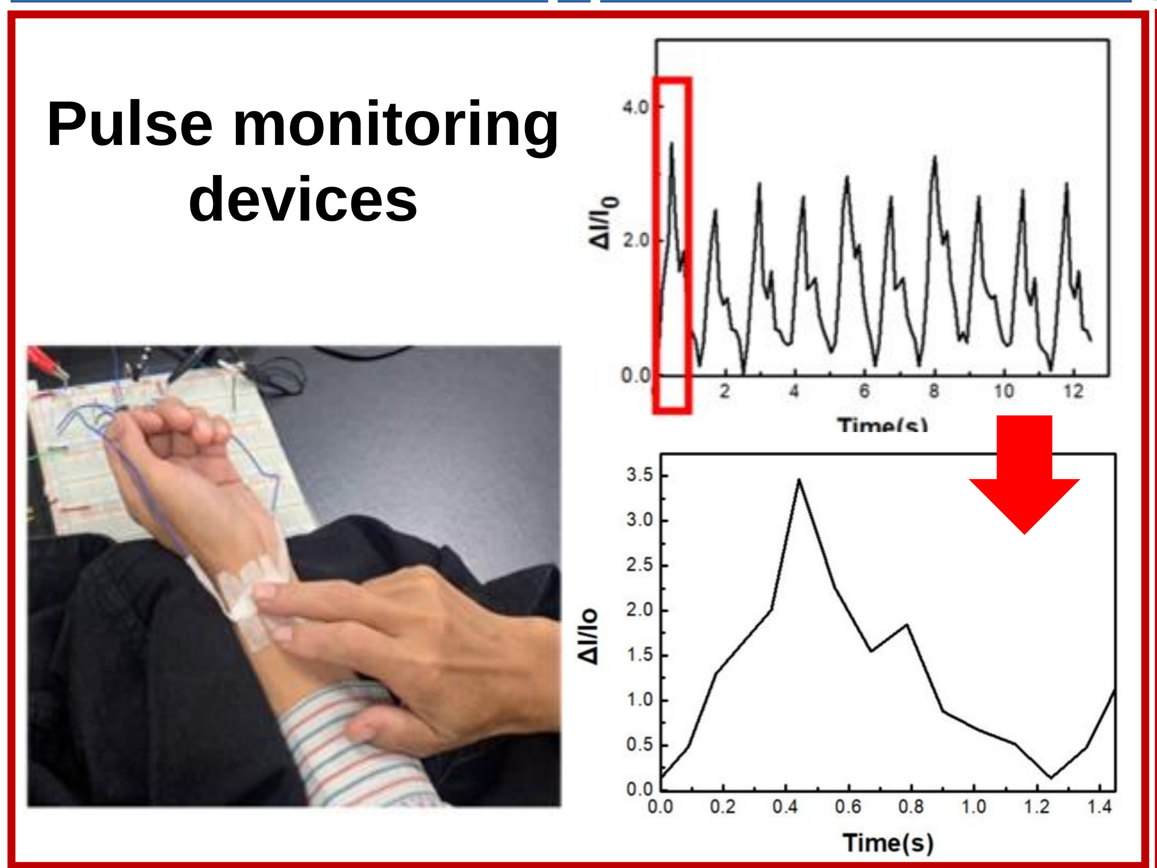
On-Off Application



Joint Stretched



Pulse Application



Conclusion

- SSPWN sensors have a fast response(<3ms), and high stability (5,500+ cycles).
- Applied SSPWN for human motion and foot monitoring.
- Promising itoring, and gait analysis.

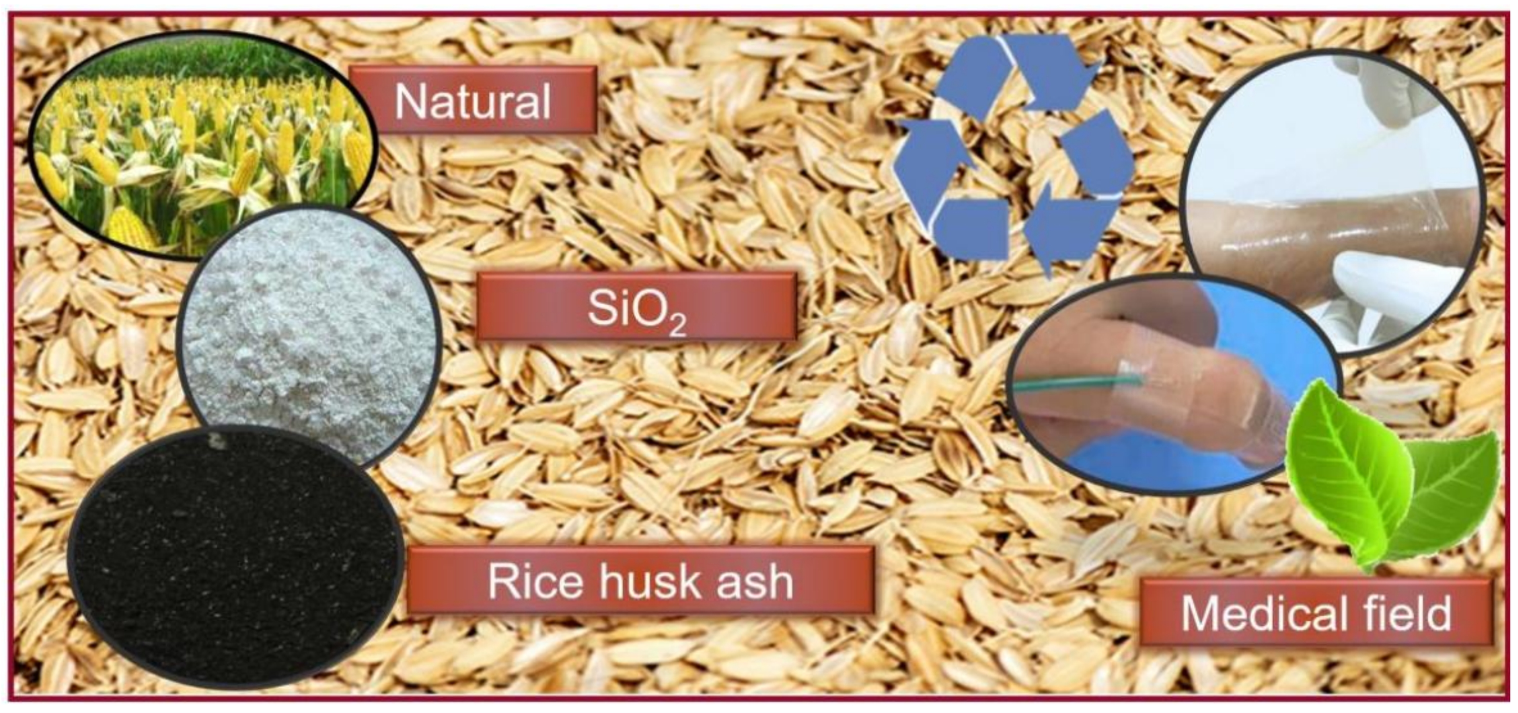
Application of Novel Freeze-Thaw Method in Green PVA/Rice Husk Ash Hydrogel

Pin-Jui Lin, Yi-Hsuan Hung, Cheng-Yuan Wu, Guan-Yu Chen, Chia-Jung Cho*

Institute of Biotechnology and Chemical Engineering, I-Shou University

E-mail: ppaul28865@gmail.com

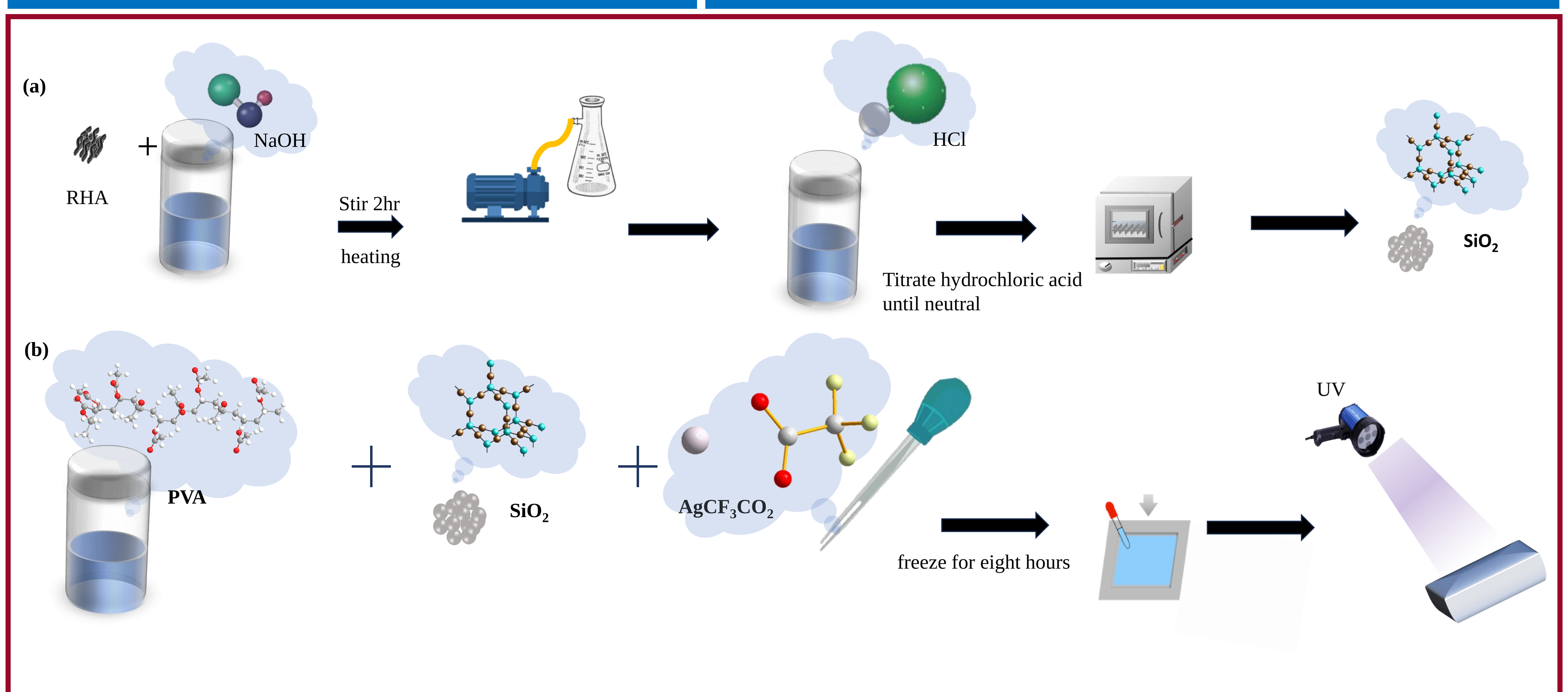
Introduction



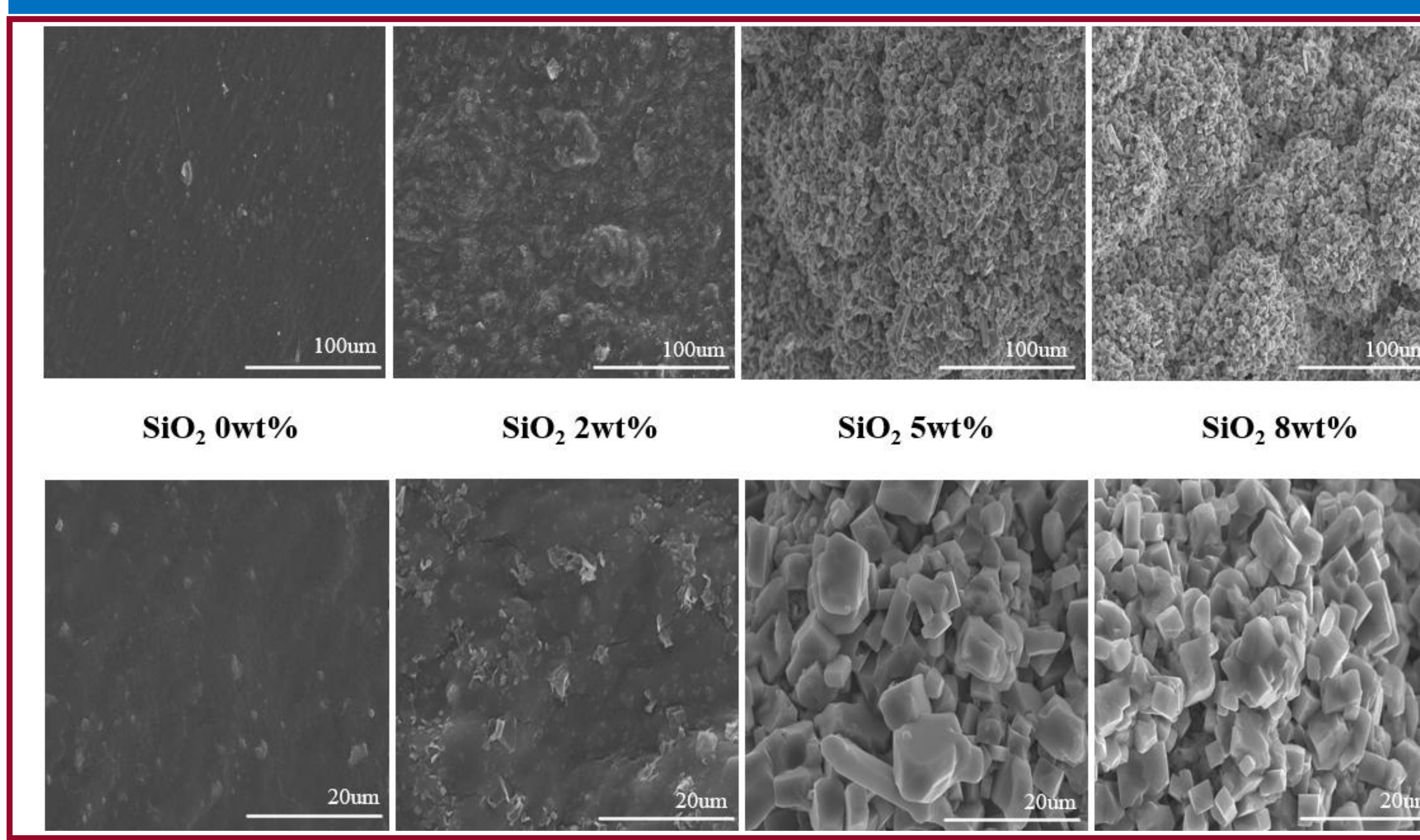
Abstract

- This study aims to explore the utilization of agricultural waste rice husk ash as a source of silicon dioxide, extracted through the sol-gel method, and incorporated into polyvinyl alcohol (PVA) to synthesize silica/PVA hydrogels via freeze-thaw cycles.
- This hydrogel possesses a crosslinked structure, outstanding mechanical properties, biocompatibility, and biodegradability. To enhance its conductivity, silver trifluoroacetate solution was dripped into the hydrogel, forming a silica/PVA/nano-silver composite hydrogel. This composite hydrogel can be applied in fields such as human motion detection.

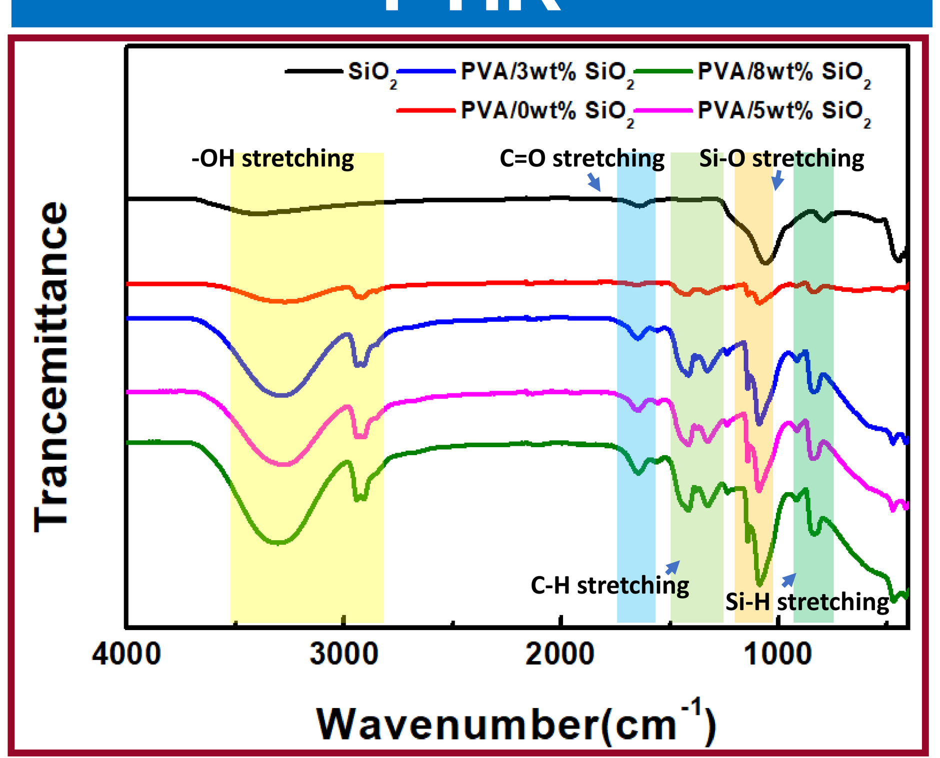
Experiment



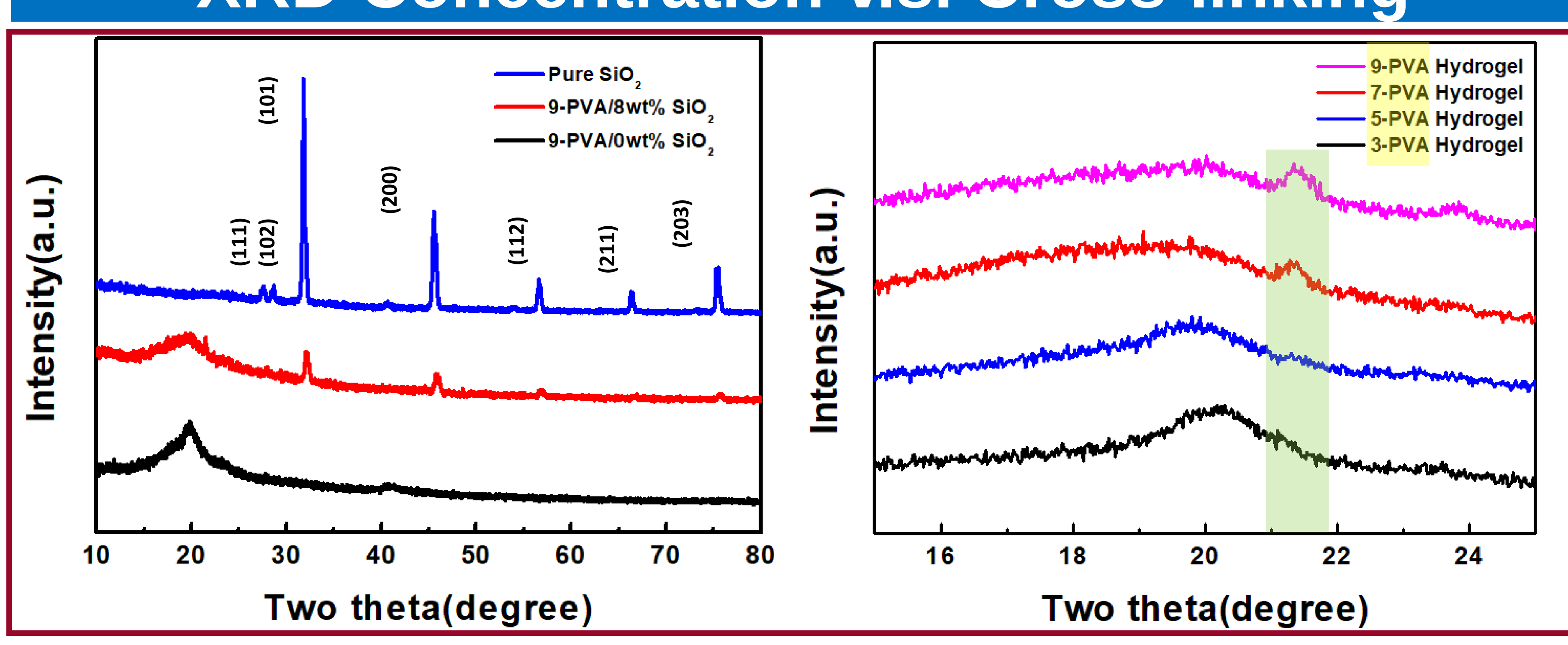
SEM



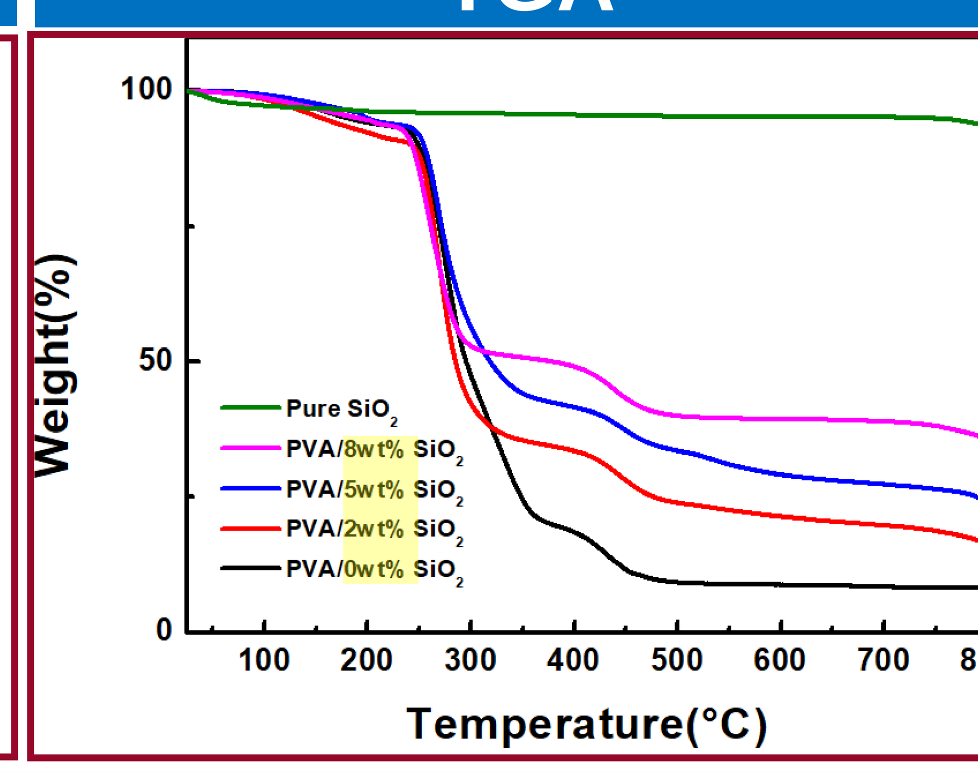
FTIR



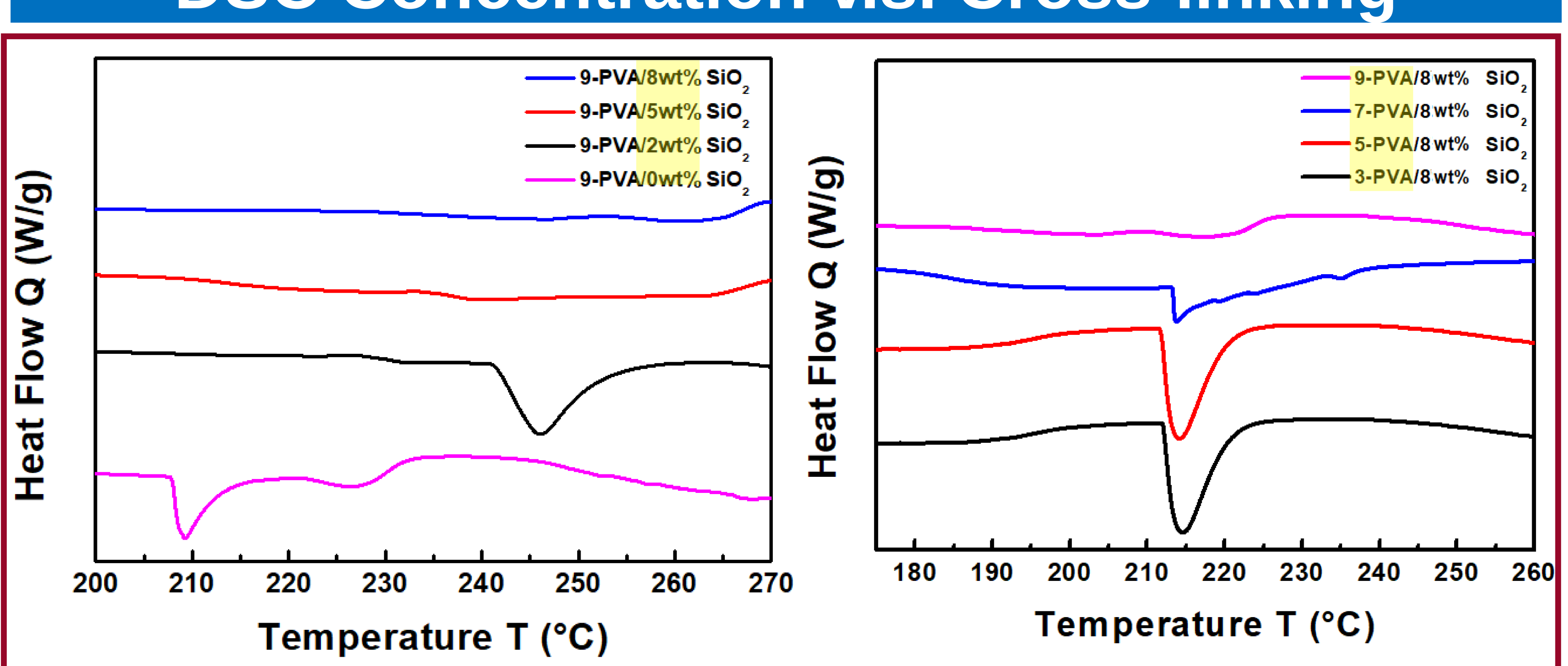
XRD Concentration v.s. Cross-linking



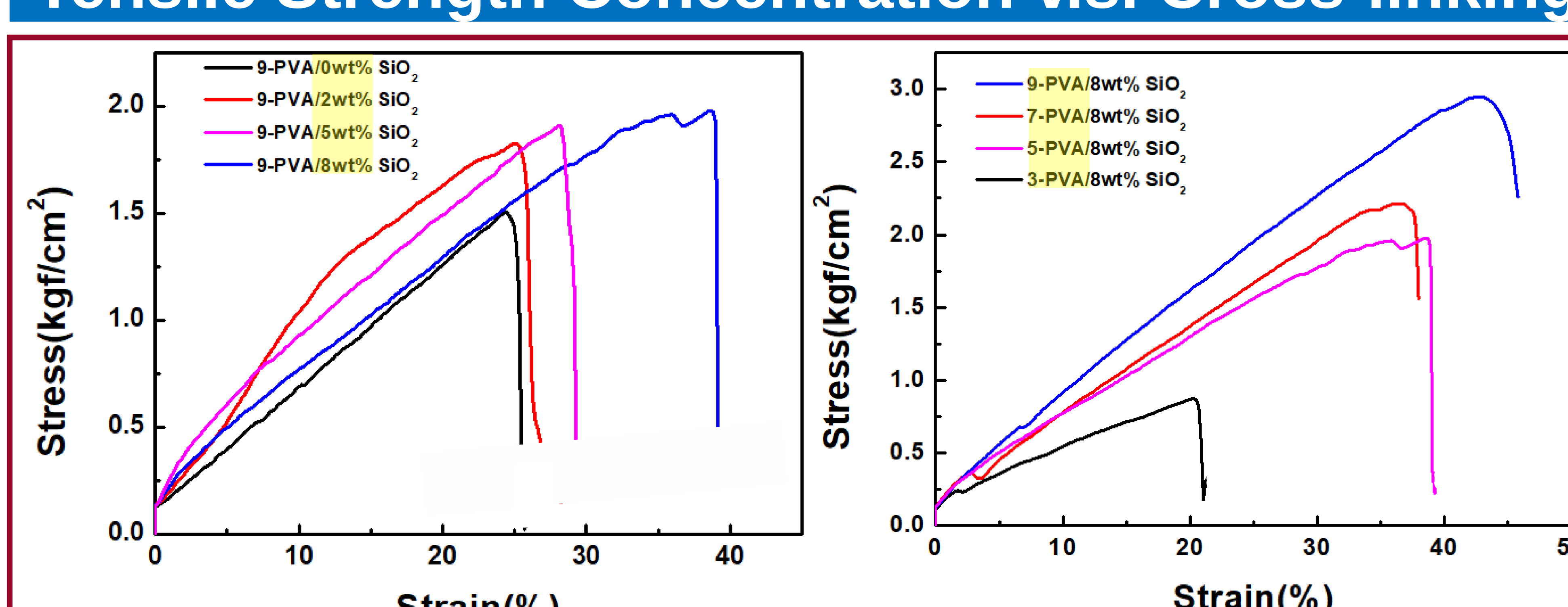
TGA



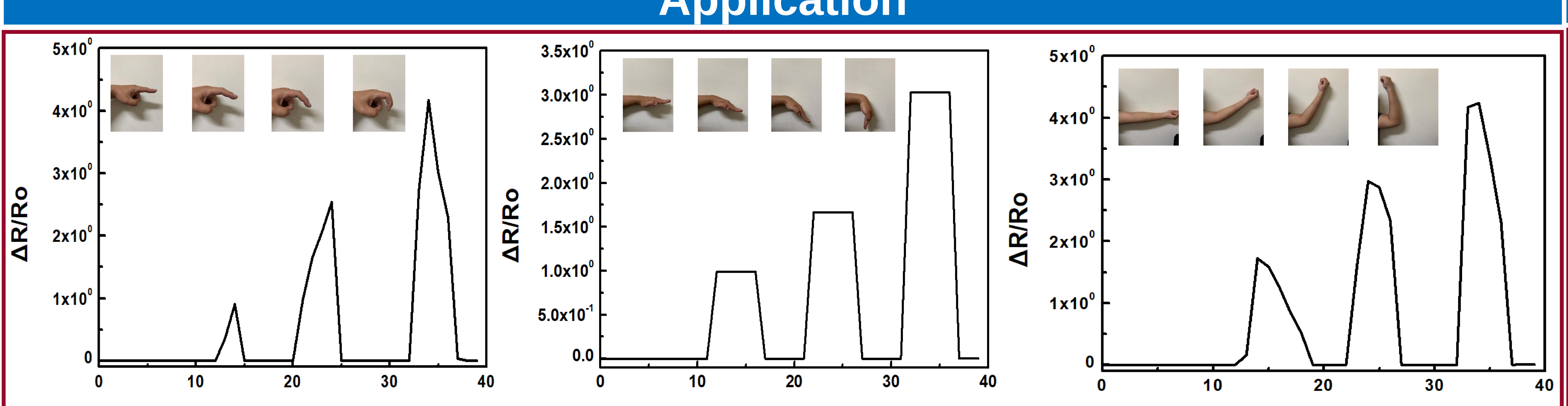
DSC Concentration v.s. Cross-linking



Tensile Strength Concentration v.s. Cross-linking



Application



Conclusion

We utilized agricultural waste rice husk ash to extract silica dioxide. Through a freeze-thaw method, we produced PVA hydrogels, enhancing tensile strength and cross-linking degree.

Furthermore, we incorporated silver trifluoroacetate to prepare conductive hydrogels, which were then applied in human body monitoring systems.

新穎Human hair環保奈米複合發電織物

Novel Human hair environmentally friendly nanocomposite power generation fabric

黃韋程、李玫蓁、陳亞宣、陳婷、卓家榮*

Institute of Biotechnology and Chemical Engineering, I-Shou University

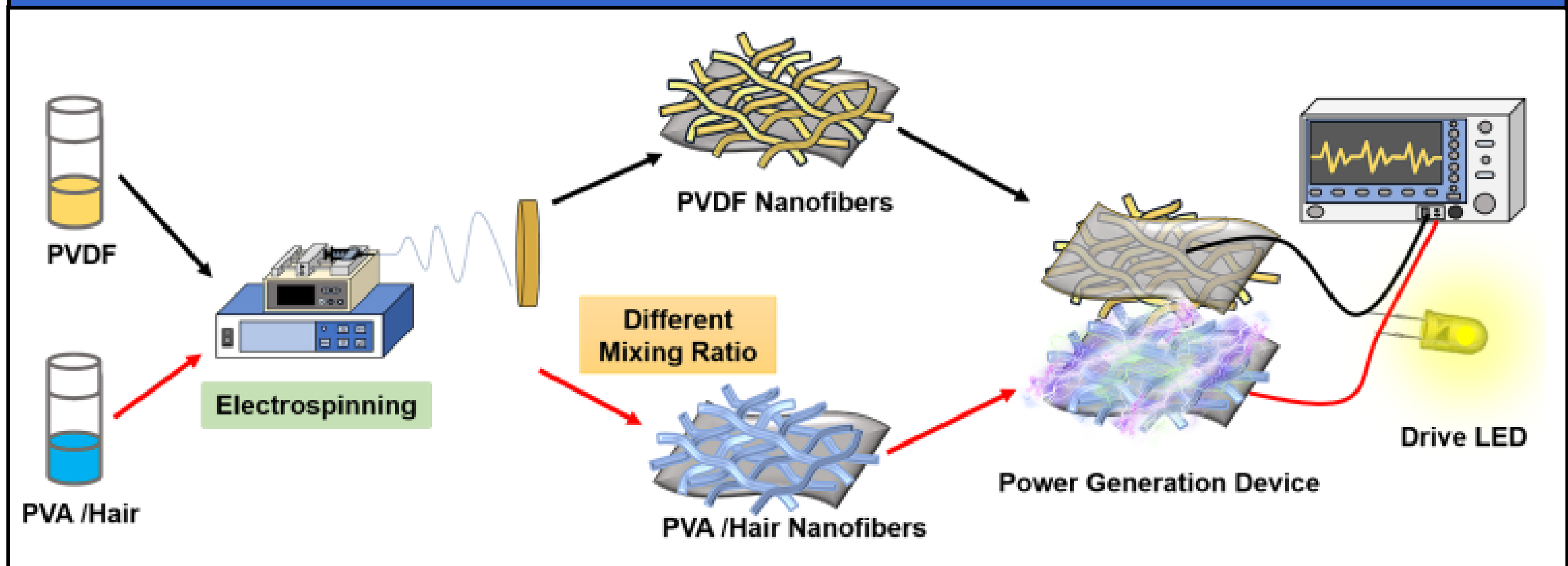
*** Email:** ppaul28865@gmail.com

Introduction

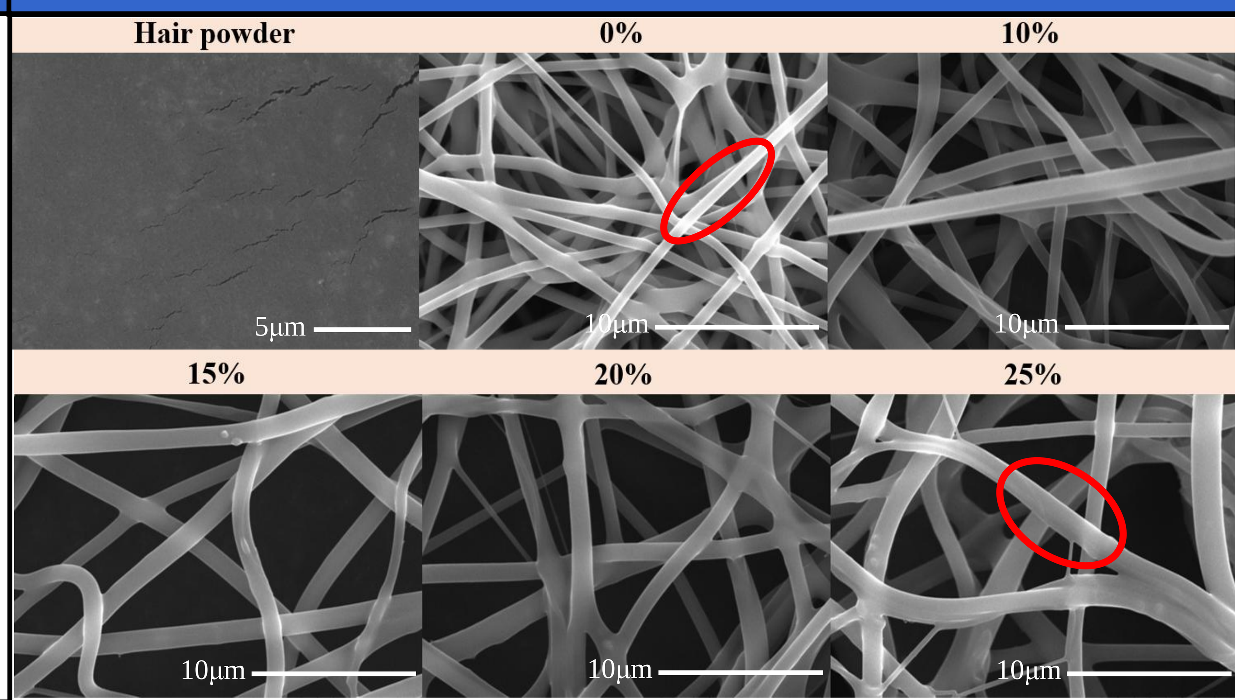
Abstract

本研究聚焦於**綠色環保材料人髮和PVA製備發電織物**，保持摩擦奈米發電機功能性下提高材料的環保性，研究發現，添加處理後的頭髮可改變PVA的排列有序性，並在**20%添加量下**，**輸出電流**和**電壓提高兩倍**，功率密度提高216倍，該技術應用於腳步動態偵測元件，有望在可穿戴裝置和物聯網中實現更可持續的能源解決方案。這項研究提供了**環保和功能性兼備的新複合材料**，為綠色摩擦奈米發電機提供更多材料選擇及發展方向。

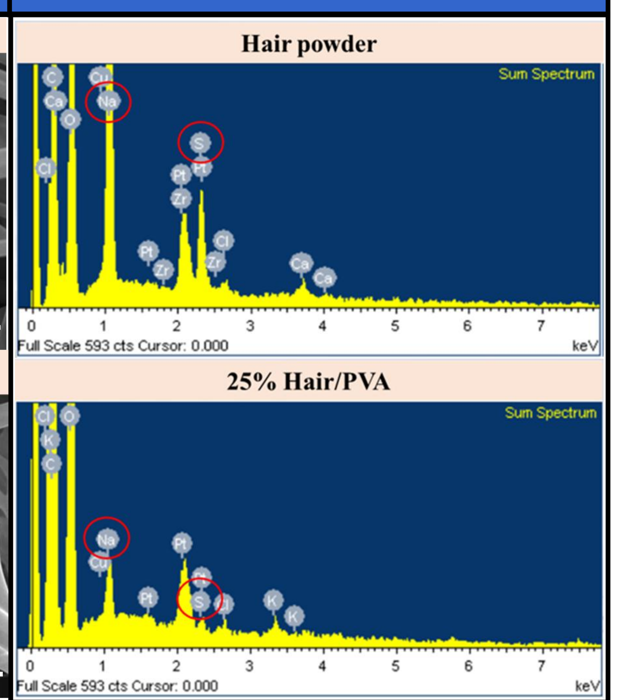
Experimental



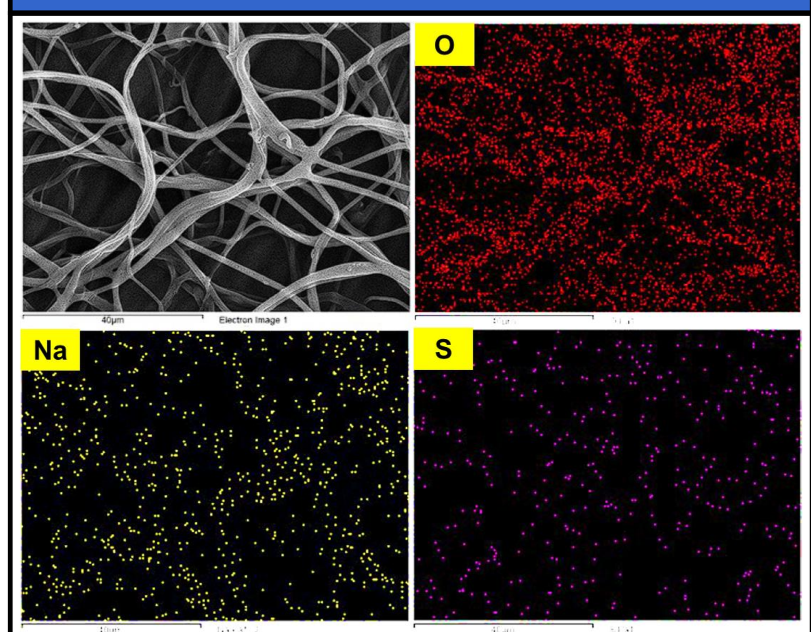
SEM



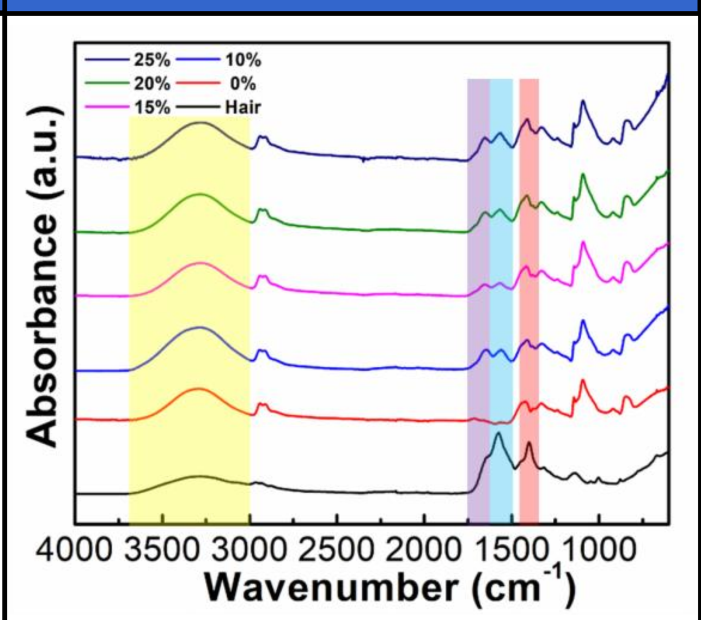
EDS



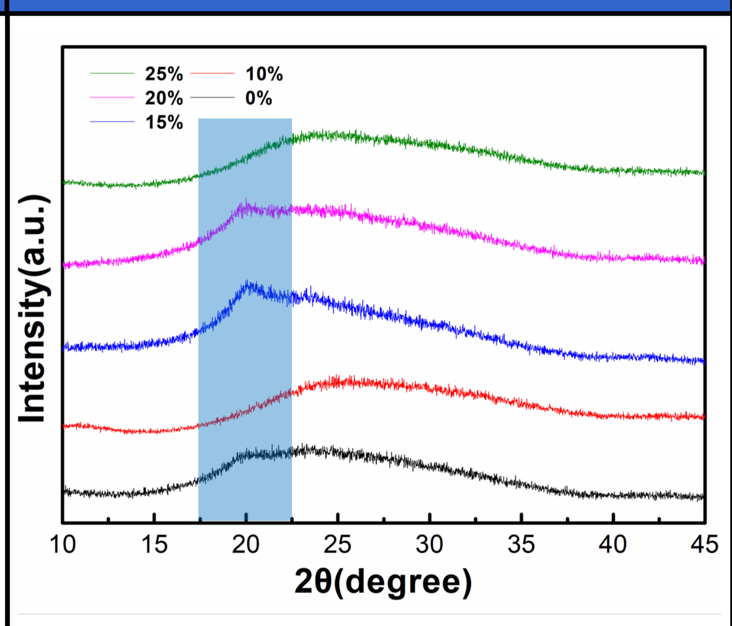
Mapping



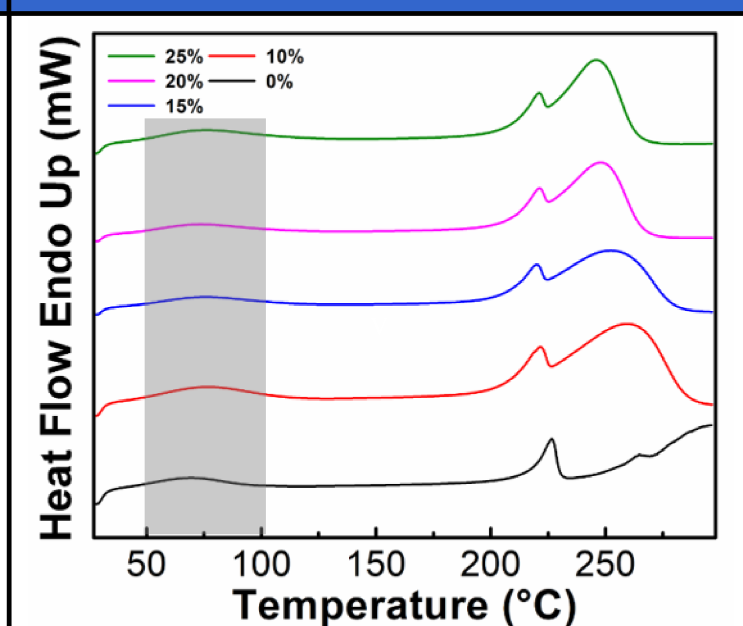
FT-IR



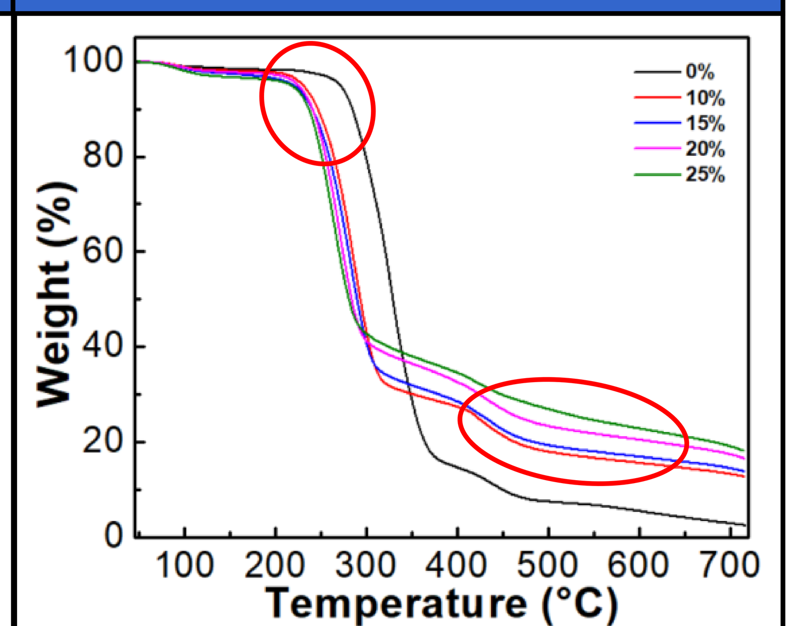
XRD



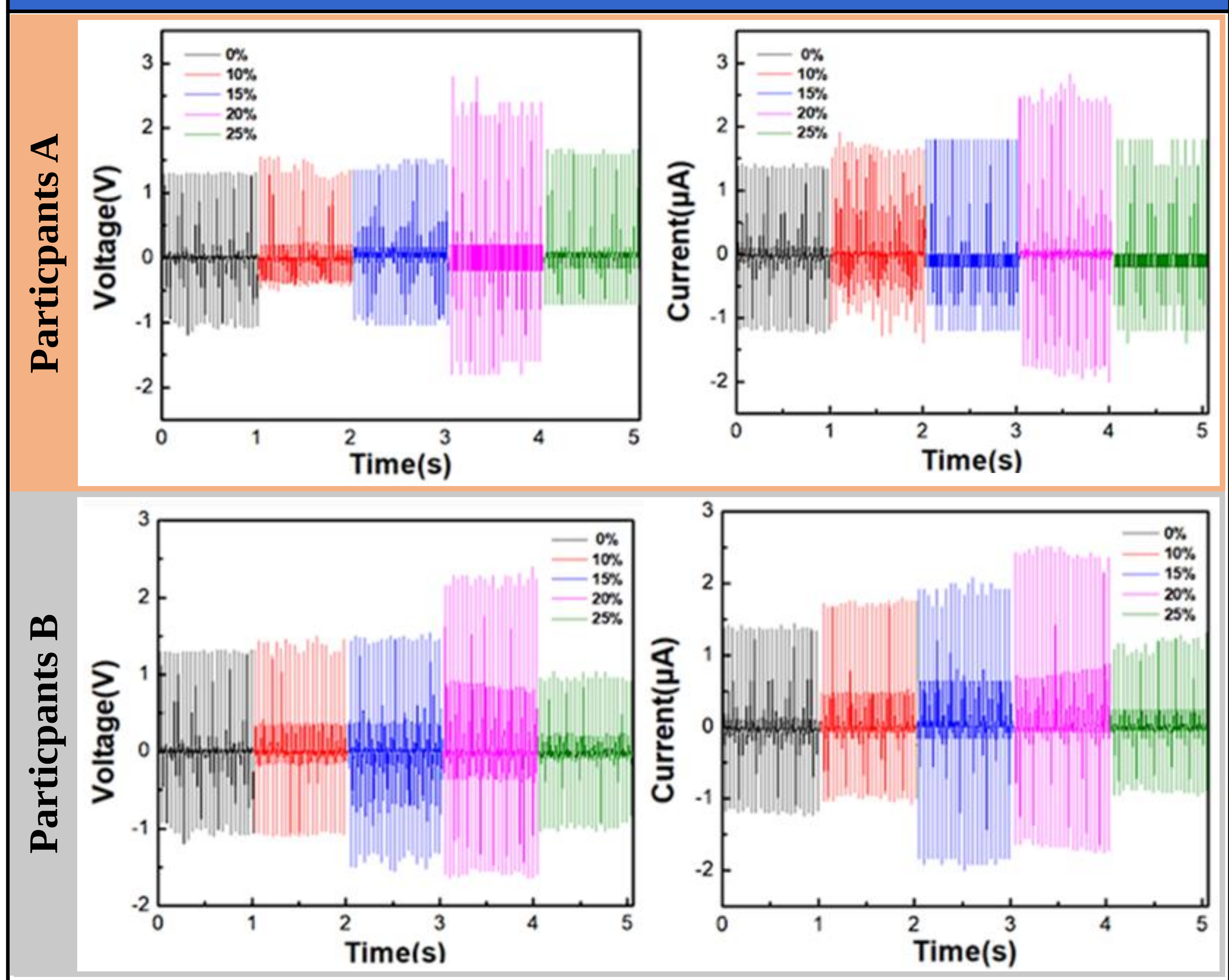
DSC



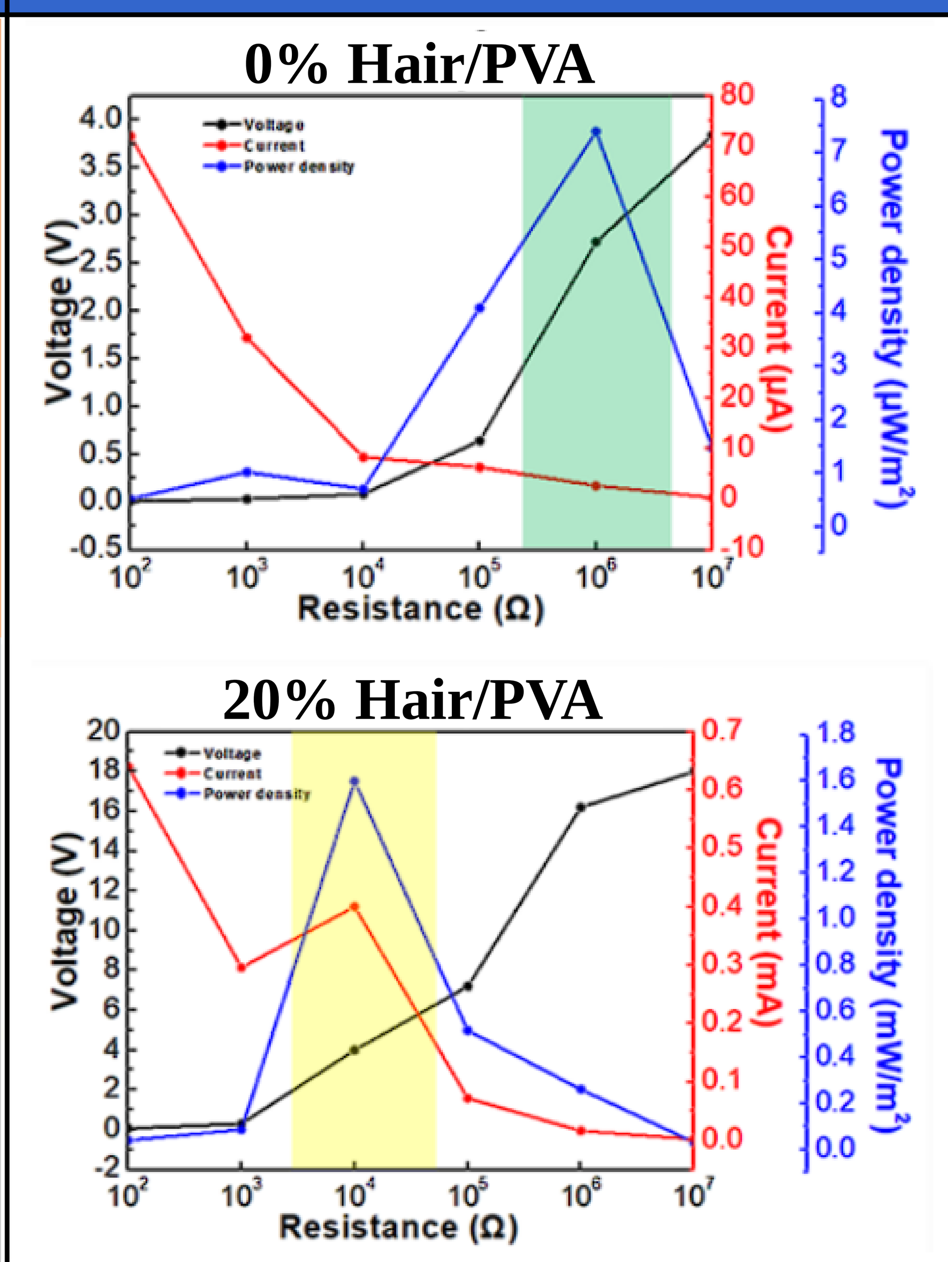
TGA



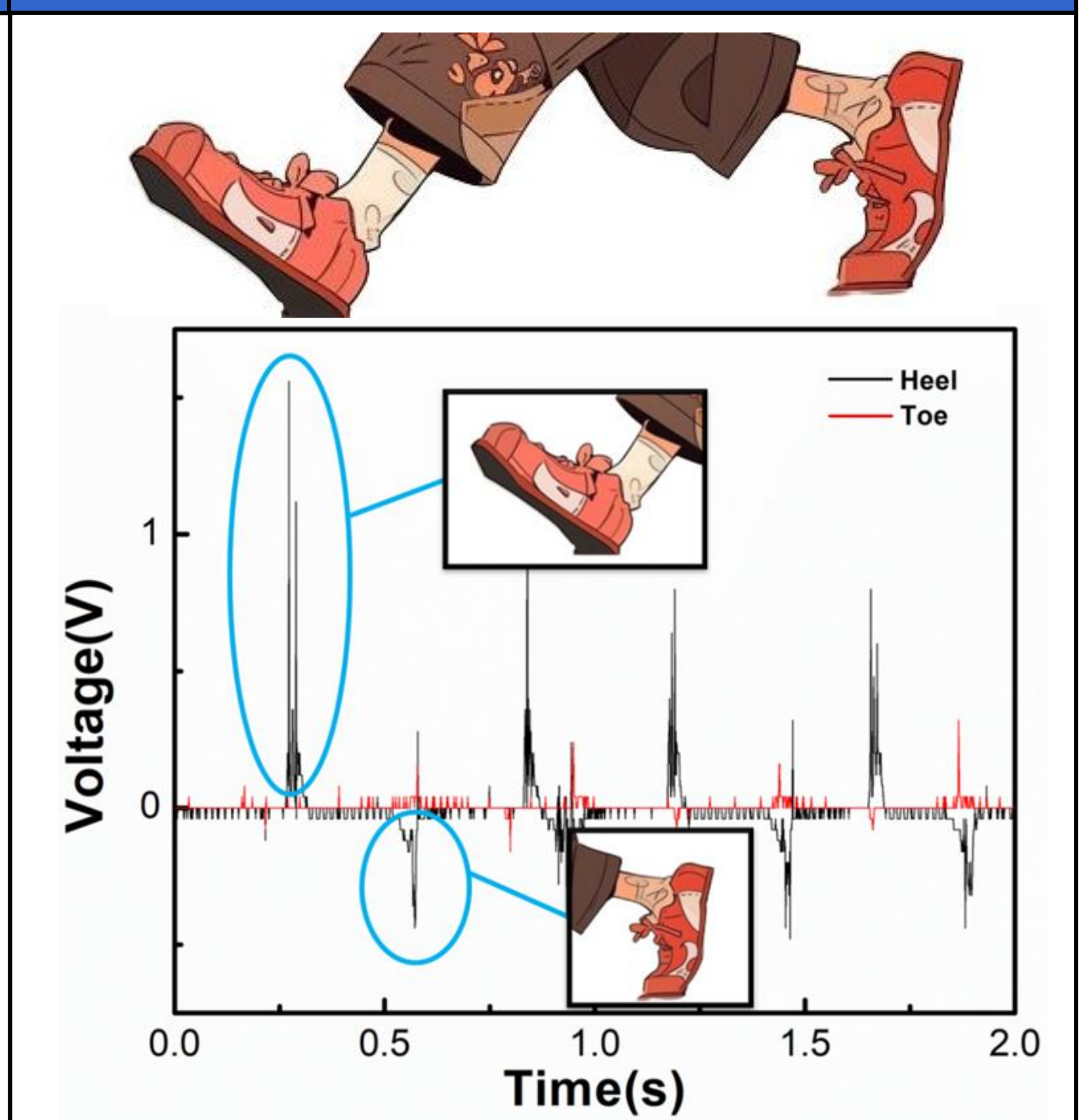
Voltage / Current



Power density



Application



Conclusion

1. 成功利用**廢棄物人髮**與 **PVA** 結合**製備出新穎綠色正摩擦電極**，解決人髮廢棄問題同時優化摩擦奈米發電機的性能。
2. 在 **20% Hair/PVA 中**，**電壓**和**電流**獲得最大**兩倍的提升**，在摩擦奈米發電機的**最大功率密度**也有 **216 倍的增幅**。
3. 新穎**human hair環保奈米複合發電織物**，能夠**明確辨識腳底特定部位的施力起始點**，提供精確的腳步動態資訊。

新型熱塑性澱粉超臨界二氧化碳發泡技術的開發與應用

吳昭翰、胡哲瑋、周子宸、林軒楷、卓家榮*

義守大學化工系暨生物技術與化學工程研究所

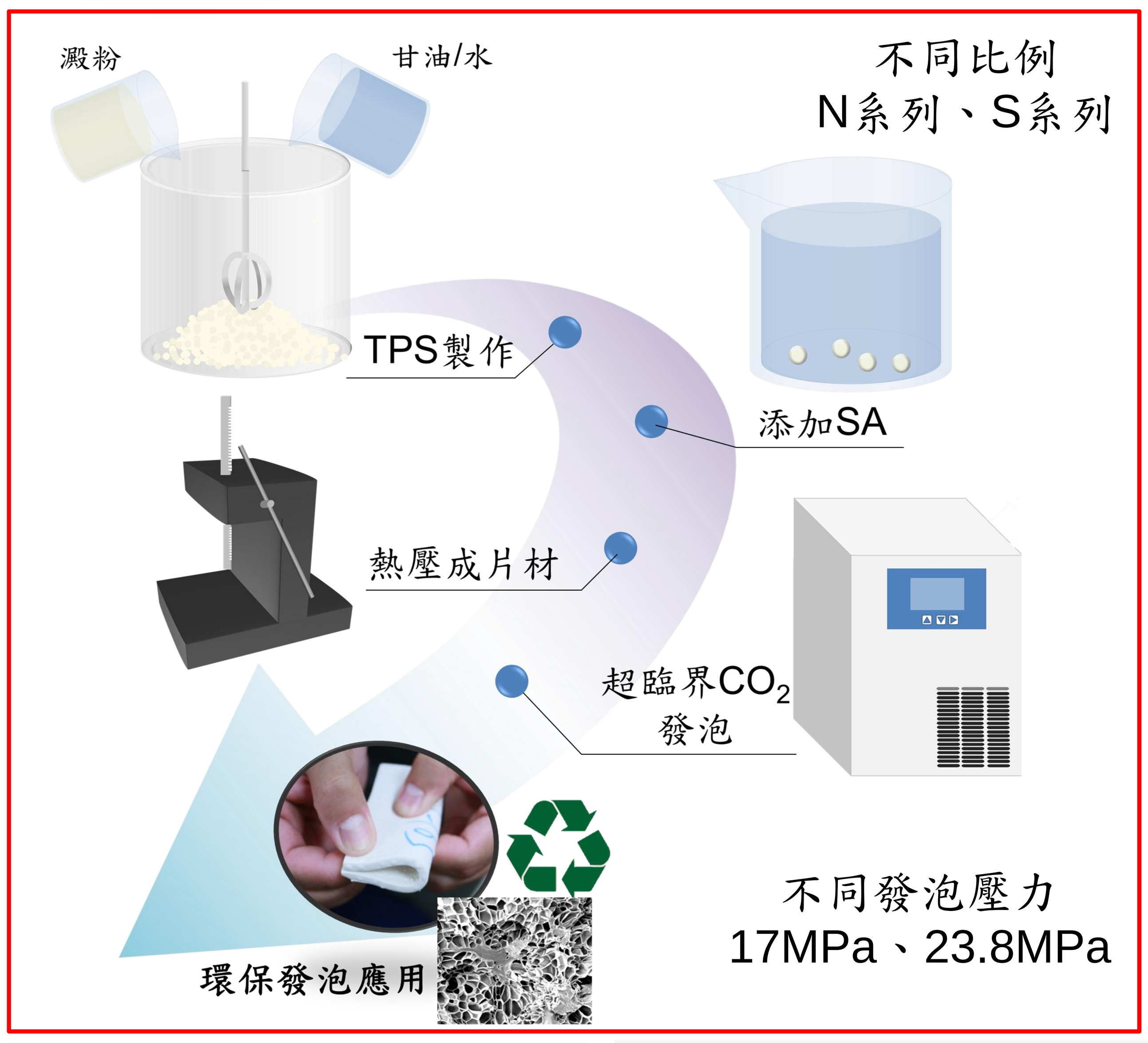
E-mail: ppaul28865@gmail.com

構想

摘要

- 高澱粉含量的澱粉基可生物降解泡沫:以工業澱粉作為基礎材料，以超臨界二氧化碳作為發泡劑
- 將澱粉分散到水或甘油中合成熱塑性澱粉 (TPS) 增加澱粉的加工性能。為了加入聚（己二酸-共對苯二甲酸丁二醇酯）（PBAT）改善機械性能
- 利用增容劑矽烷A（SA）對TPS表面進行改性，改善與PBAT的分散性，成為（TPS with SA）/PBAT複合泡沫。
- 通過在不同成型溫度下及壓力改變TPS和PBAT的比例來優化泡沫成型工藝

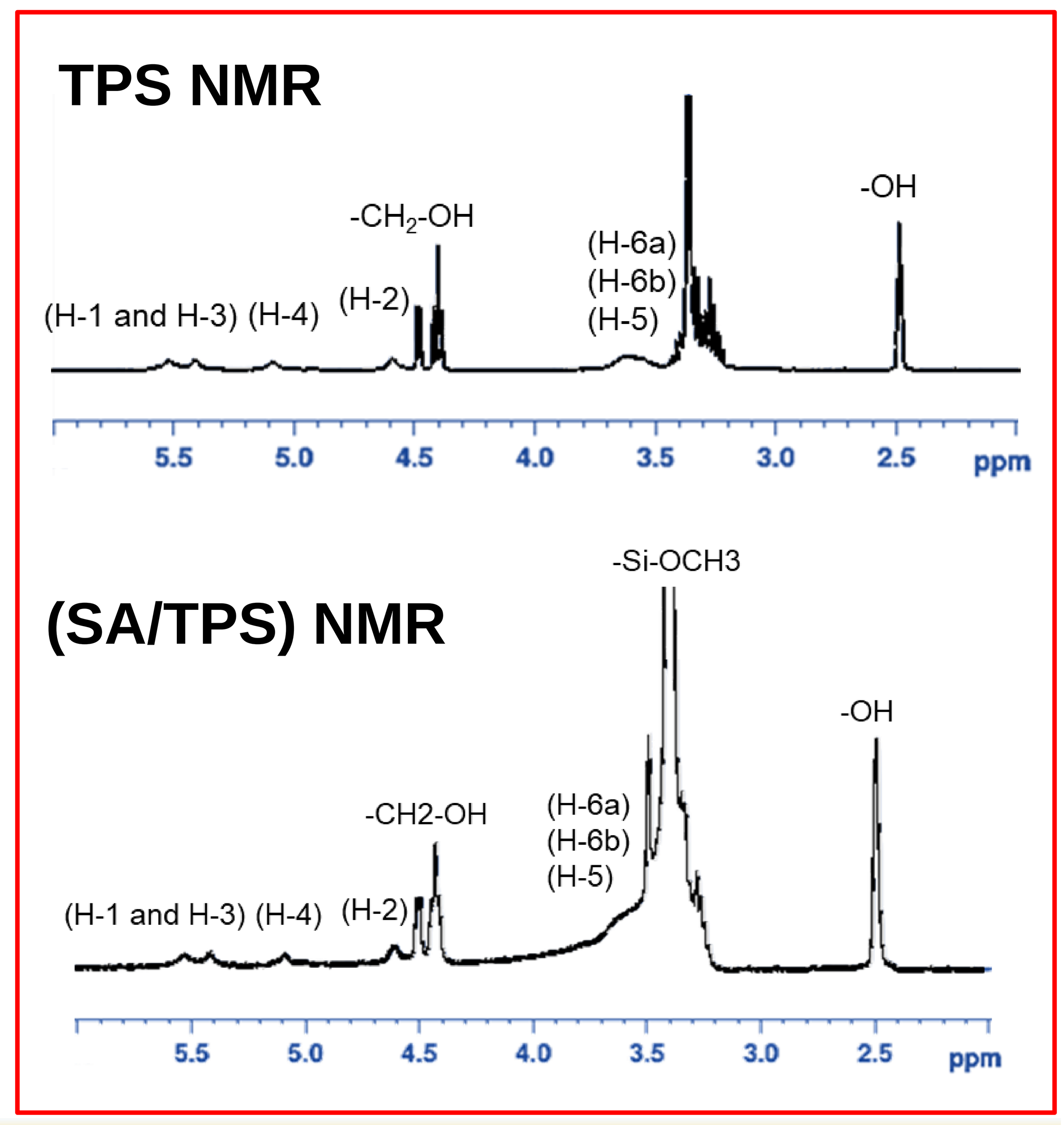
實驗



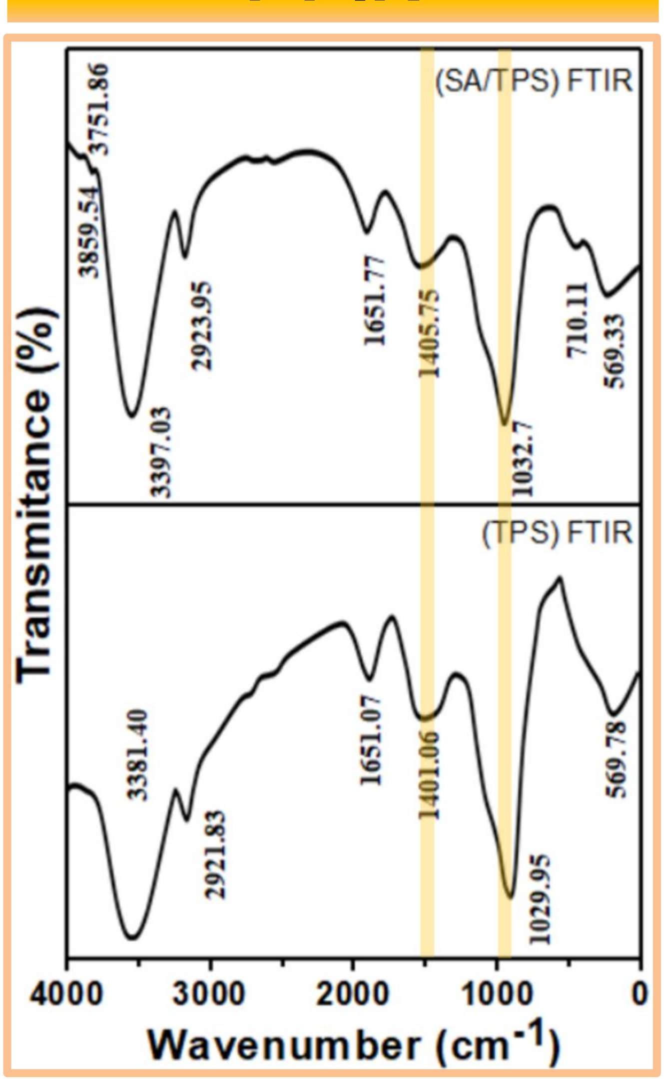
Data

代號	比例
[N-1]	50% TPS/50% PBT
[N-2]	60% TPS/40% PBT
[N-3]	70% TPS/30% PBT
[S-0.5]	50% (TPS with 5PHR SA)/50% PBAT
[S-1]	50% (TPS with 10PHR SA)/50% PBAT
[S-2]	60% (TPS with 10PHR SA)/40% PBAT
[S-3]	70% (TPS with 10PHR SA)/30% PBAT
[S-4]	80% (TPS with 10PHR SA)/30% PBAT

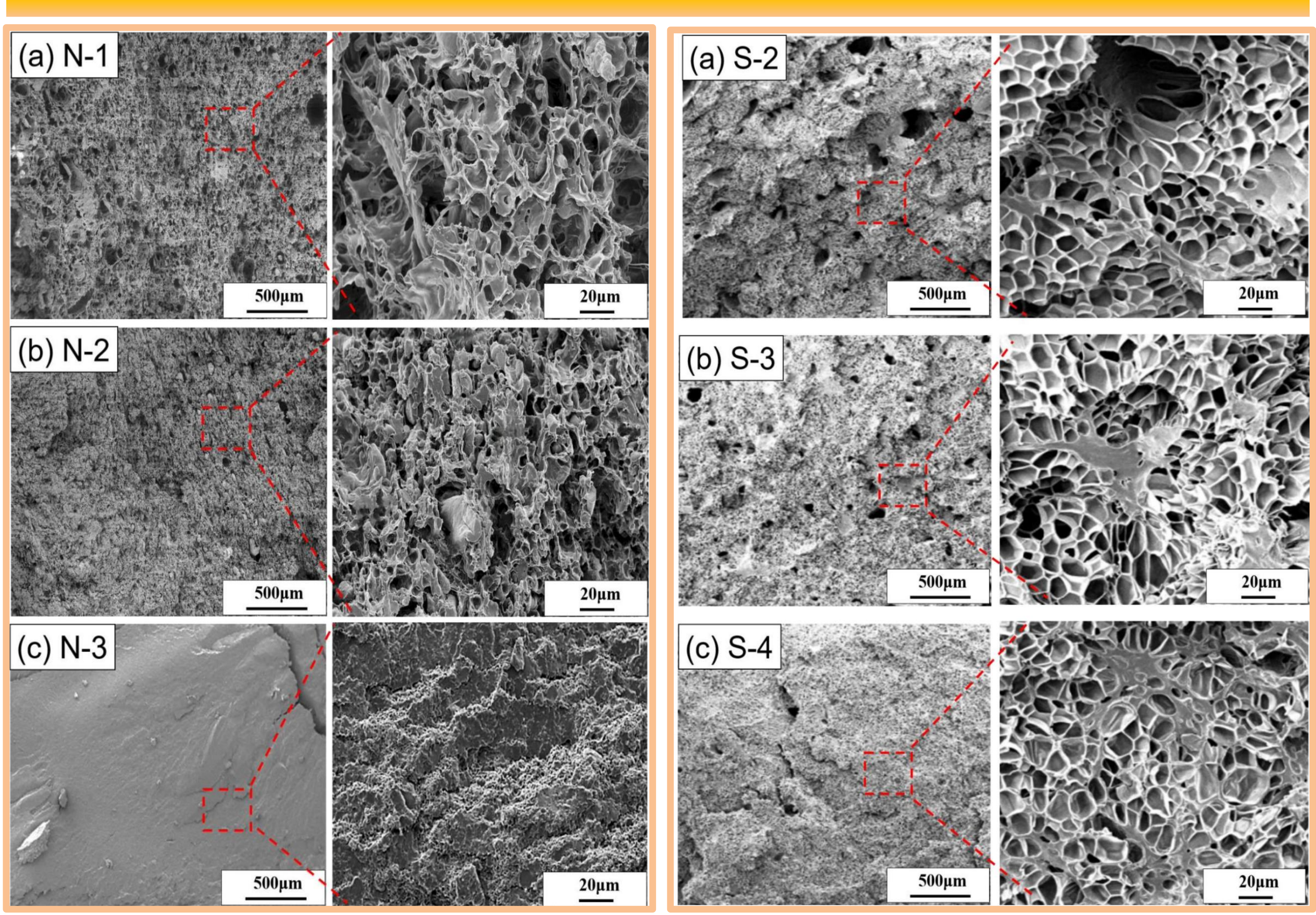
NMR



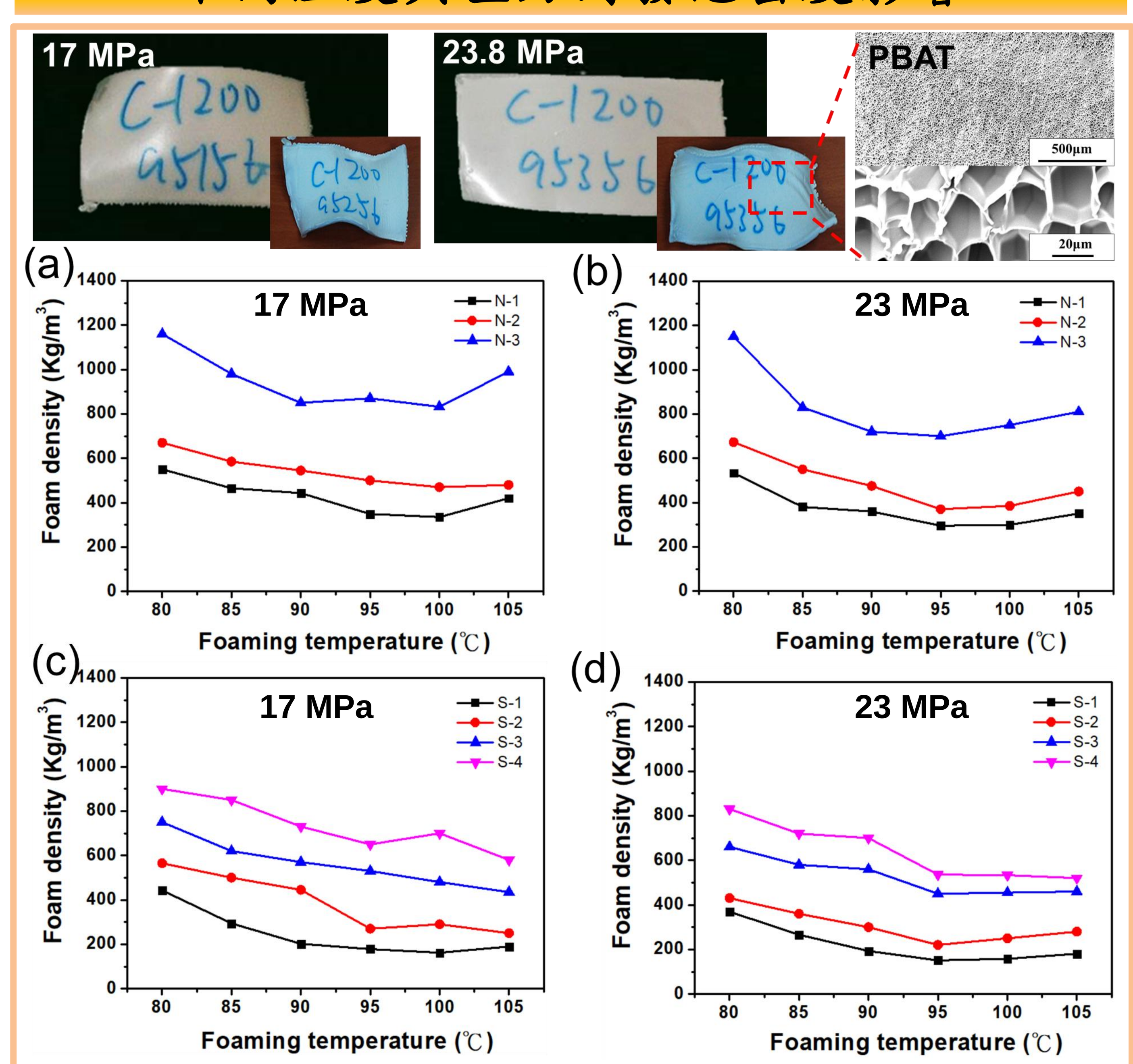
FT-IR



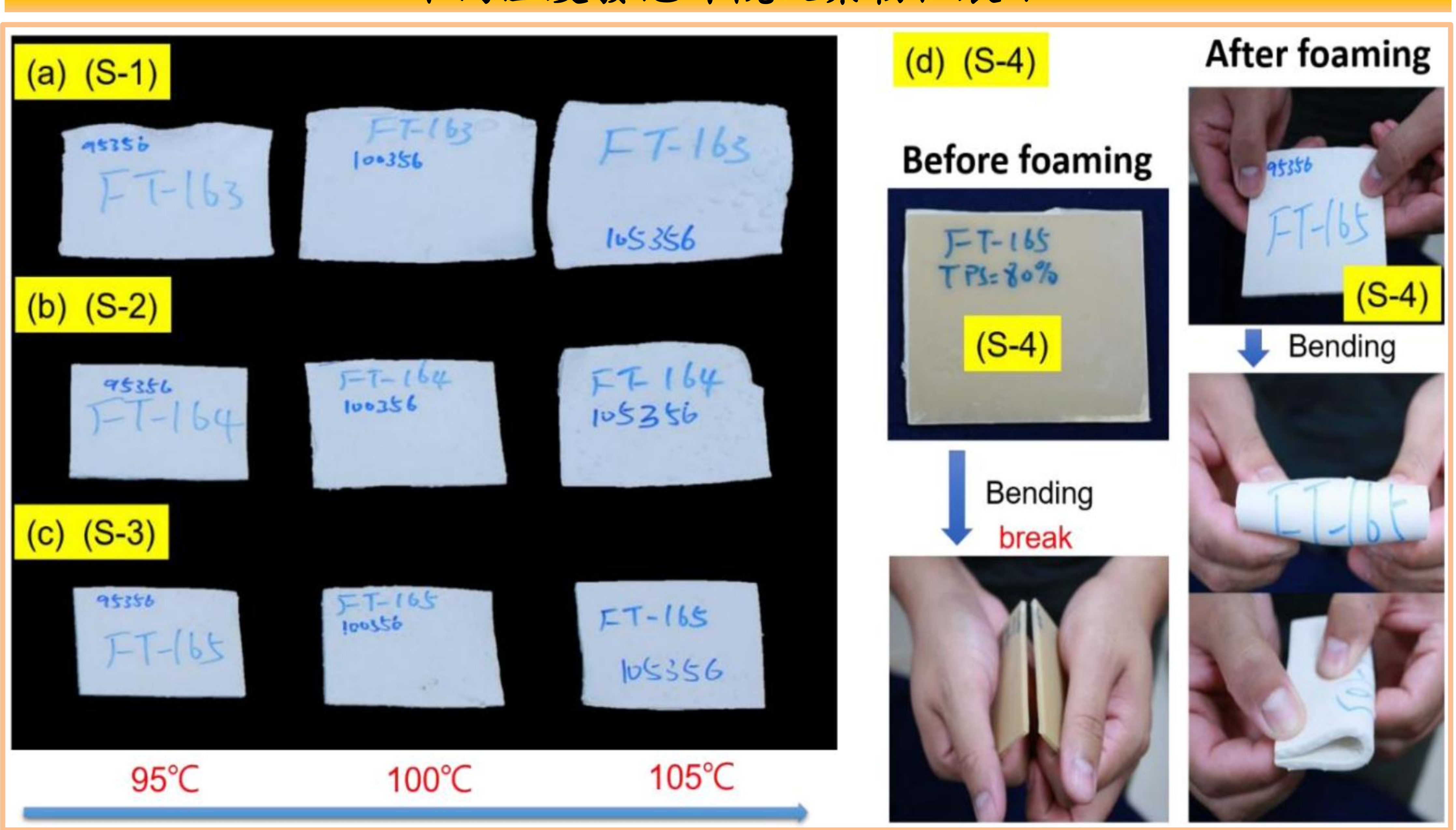
SEM



不同溫度與壓力對發泡密度影響



不同溫度發泡外觀及柔韌性展示



結論

- 我們開發了一種可生物降解的泡沫，以熱塑性澱粉作為主體，利用超臨界 CO_2 當作發泡劑；改變發泡溫度及壓力以及優化材料的比例來優化泡沫的形成。
- SEM圖顯示，（TPS with SA）/PBAT 泡沫具有均勻氣泡及孔洞。
- 結果表明，在 PBAT 中添加表面改性的 SA/TPS 澱粉後，複合泡沫變成了柔軟的泡沫，具有提高的伸長強度和拉伸性能。
- 這種綠色發泡加工技術可用於電子封裝材料等封裝技術，未來更具有醫療器械應用潛力

Electrochemical Glucose Sensors Based on Silver Nanoparticle-Reduced Graphene Oxide/Polypyrrole Hybrid Nanocomposite Films

Chu-Han Yang, **Tien-Tsan Hung***

Department of Chemical Engineering, I-Shou University, Kaohsiung, 84008

E-mail: tthung@isu.edu.tw

NCPO027, ISU-112-01-04A

Glucose sensors often use enzymes to modify electrodes; however, studies have shown that the enzyme activity can be affected during the modification process, which indirectly reduces the sensitivity of the sensor. Therefore, non-enzyme glucose sensors, which do not rely on enzyme modifications, have become more popular. Common materials used in non-enzyme glucose sensors include oxides, metals, and carbon-based materials, which replace traditional enzyme-modified materials. A hybrid nanocomposite film composed of silver nanoparticles (AgNPs), reduced graphene oxide (rGO), and polypyrrole (PPy) can directly catalyze glucose, enabling a low detection limit through electrochemical reactions. The device uses a three-electrode electrochemical cell, including the AgNPs/rGO/PPy nanocomposite film as the working electrode, an Ag/AgCl electrode as the reference electrode, and a Pt plate as the counter electrode for electrochemical analysis. The synergistic effects among these materials enhance the electrochemical performance. Glucose detection is conducted in an alkaline environment, with a scan rate of 50 mV/s, a scan range of -1.35V to -0.55V, a sample interval of 0.001V, and a sensitivity of 0.001 A/V. In this range, well-defined redox peaks are obtained, and plotting current (A) against concentration helps to determine the detection limit and linear range.

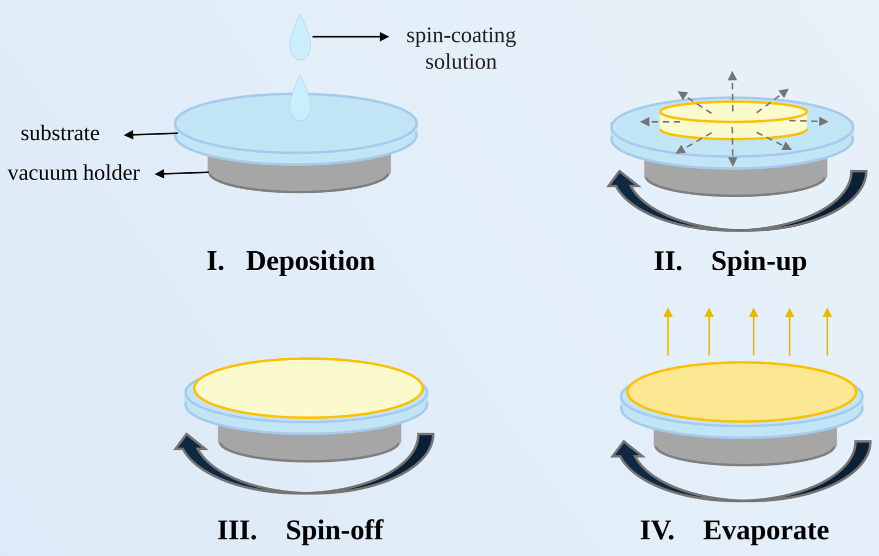
Introduction

Fasting blood glucose is a critical indicator in health examinations, with normal levels below 100 mg/dL (1000 ppm). Levels above 126 mg/dL (1260 ppm) indicate diabetes, while values between these two thresholds suggest prediabetes. Although current sensors capable of detecting blood glucose concentrations between 20 and 40 mg/dL are sufficient for most individuals, people at high risk of developing diabetes require higher sensitivity to detect minor changes, enabling early intervention.

To address this need, this study developed a non-enzymatic glucose sensor based on AgNPs/rGO/PPy. Non-enzymatic sensors offer long lifespan, low cost, and simplified processes. Silver nanoparticles (AgNPs) provide catalytic properties, biocompatibility, and antibacterial effects; reduced graphene oxide (rGO) enhances conductivity and sensitivity; and polypyrrole (PPy), known for its excellent conductivity, low cost, and stability, demonstrates synergistic effects with rGO in the composite material, significantly improving electrochemical activity.

Experimental methods

Spin Coater

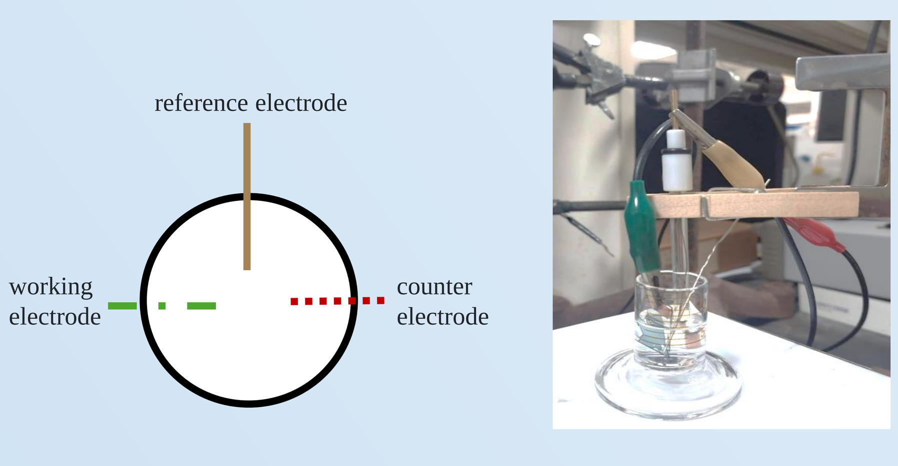


Spin-coating Solution: AgNPs/rGO/PPy

Comparison of the Effects of Electrode Modification Methods on Performance

working electrode	Screen-Printed Electrode, SPE (carbon)	IT0（Indium Tin Oxide）				
		Direct Drop	Dynamic Spin Coating	Static Spin Coating		
				Entire Surface Spin Coating	Fixed-Area Spin Coating	
Modification Method	Direct Drop				Copper Tape Without Contacting the Thin Film	Copper Tape Contacting the Thin Film
Effect	☆☆☆	☆☆☆	★☆☆	★★☆	★★★	★★★
Reason	Film Peeling	Film Peeling	Slight Film Peeling	Slight Contact Issues with Prolonged Exposure to the Film	Excellent Detection Performance	

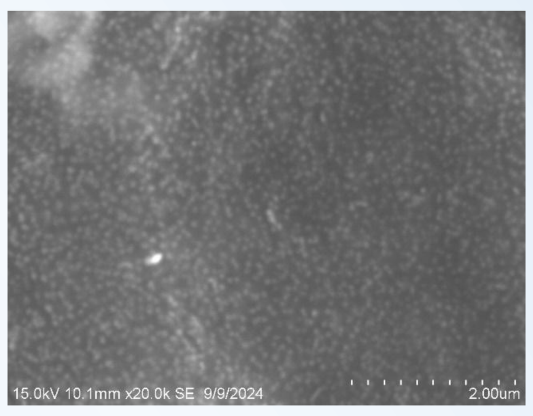
electroanalytical method (three-electrode cell)



counter electrode:Pt
reference electrode: an Ag/AgCl electrode
Blank solution: Simulating different environmental concentrations

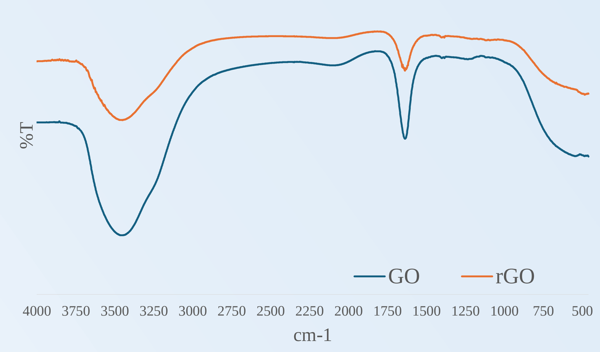
Results and discussion

SEM - x20000



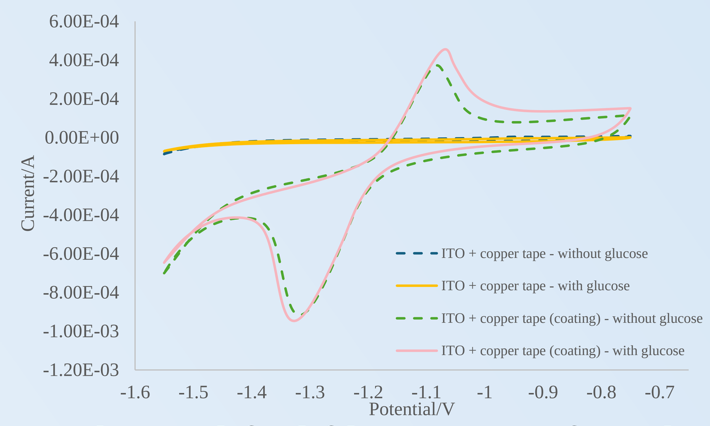
AgNPs/rGO/ppy film
Well-dispersed silver nanoparticles (shown as bright spots) are visible

IR spectroscopy



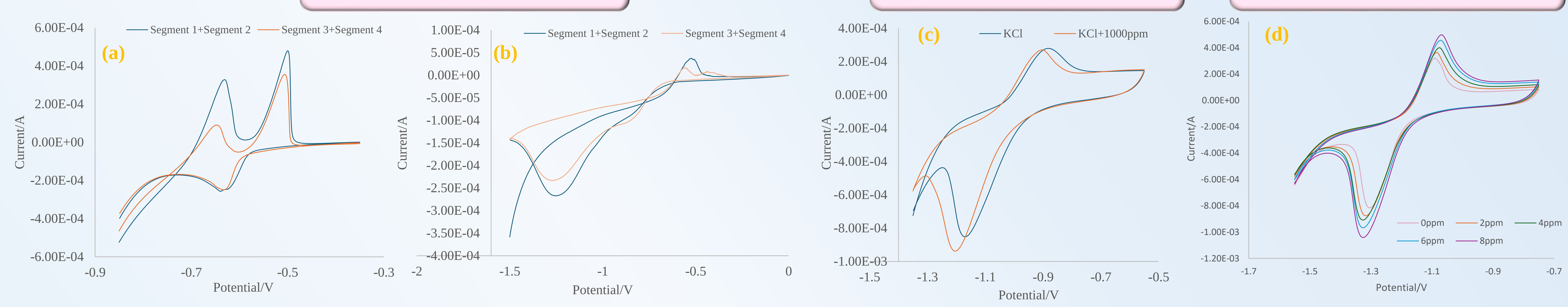
C=C: 1580 cm^{-1}; O-H: 3200-3600 cm^{-1} show distinct absorption peaks, and compared to GO, the O-H peak in rGO is significantly reduced because it has been successfully reduced and removed

Electrochemistry - Cyclic voltammetry (with and without modified film)



The modified film can significantly enhance electrochemical performance

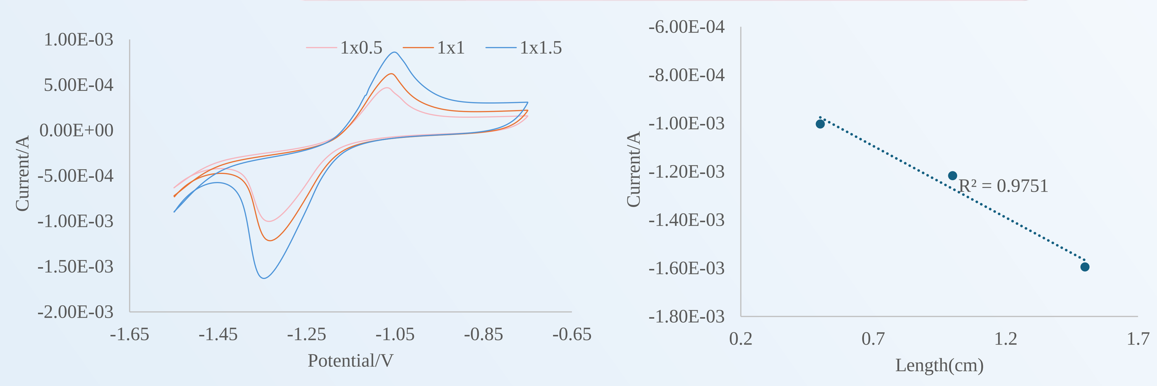
Acidic environment / Neutral environment / Alkaline environment



(a) Without added glucose (b) With added glucose (c)Whether glucose is added or not (d) Adding different glucose concentrations

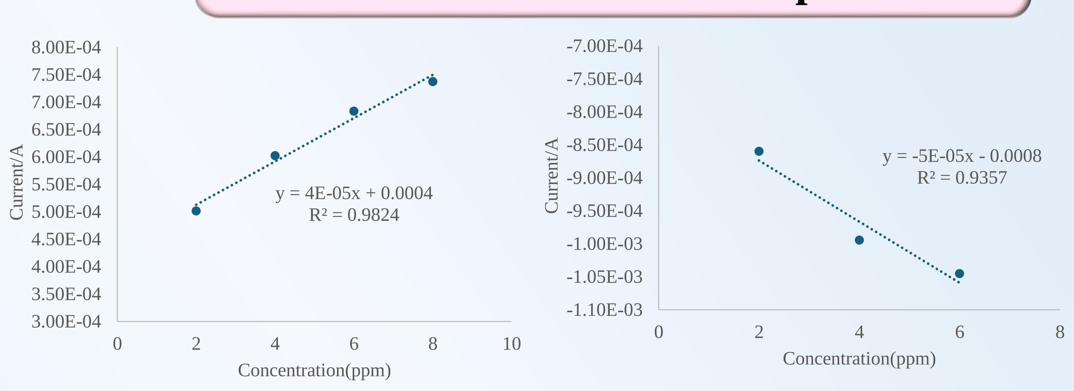
In an acidic environment, the potential changes significantly, with or without glucose, and stability is poor, with a noticeable drop in current during the second scan. Although stability improves in a neutral environment, the linearity is less pronounced than in an alkaline environment, indicating that the best electrochemical performance and stability are achieved under alkaline conditions.

CV curves -Fixed different film areas



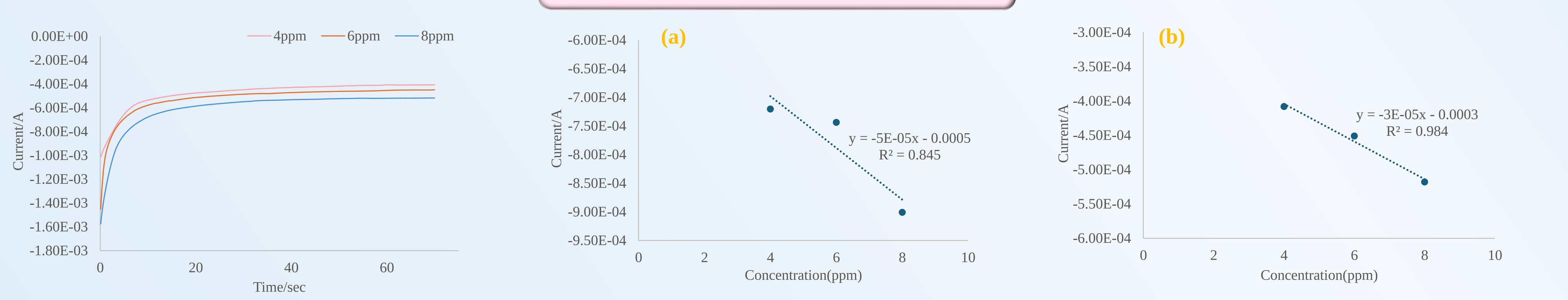
Fixed areas: (I) 1x0.5, (II) 1x1, (III) 1x1.5 (cm^2)
A plot of Current (A) versus Length (cm) shows a linear relationship with R^2 = 0.996, indicating that the film area directly affects the CV current measurement results.

Linear relationship between glucose concentration and redox peaks



Plot of Current (A) versus Concentration (ppm)
Oxidation peak: R^2 = 0.9824; Reduction peak: R^2 = 0.9357

IT curve - the reduction peak



(a) 3.8s (b) 70s,From being not completely stable (a) to fully stable (b), the linear correlation is further enhanced, demonstrating higher accuracy

Conclusions

This study successfully developed a non-enzymatic glucose sensor based on an AgNPs/rGO/PPy nanocomposite film. On the original ITO substrate, silver nanoparticles (AgNPs) were incorporated, leveraging their excellent biocompatibility and electrical conductivity. Combined with reduced graphene oxide (rGO), the sensor's conductivity and surface area were further enhanced, thereby improving its sensitivity. Additionally, the synergistic effect between polypyrrole (PPy) and rGO significantly boosted the sensing performance. Notably, the nanocomposite film amplified the current detected by the original ITO film, effectively enhancing the sensor's detection capability.

Electrochemical tests demonstrated good linearity for both oxidation and reduction peaks (R^2 = 0.9824 and R^2 = 0.9357, respectively). The desired performance was achieved without requiring a large amount of spin-coating solution, as thin-layer preparation was sufficient. The current sensitivity of the sensor is 9.65 x 10^{-6} A/ppm (1.74 μA/μM), with a linear range of 2 to 18 ppm. Even after 80 cycles of cyclic voltammetry scanning, the redox peaks remained stable, indicating excellent long-term stability.

Electrochemical Acetone Sensors Based on ZnO-Ni(OH)$_2$/PANI Hybrid Nanocomposite-Modified Electrodes

I-Ling Xue and Tien-Tsan Hung*
Department of Chemical Engineering, I-Shou University
**E-mail: tthung@isu.edu.tw*

Abstract

In this study, we developed a modified electrode material based on a zinc oxide, nickel hydroxide, and polyaniline hybrid nanocomposite (ZnO-Ni(OH)$_2$/PANI) and explored its potential for electrochemical acetone detection. The nanocomposite was synthesized via in situ chemical oxidative polymerization in an environment where aniline monomers, zinc oxide, nickel hydroxide nanoparticles, and polystyrene sulfonic acid (PSS) coexisted. This method facilitated the formation of a uniform nanocomposite structure, enhancing material compatibility and stability. After depositing the nanocomposite onto the surface of a working electrode to form the sensing layer, we systematically investigated the effects of electrode modification, material composition, scan rate, and acetone concentration on the electrochemical response. The results demonstrated that the modified electrode exhibited significantly enhanced sensitivity toward acetone, with the electrochemical response increasing as the scan rate and acetone concentration rose. Our studies show that the modified electrode is not only suitable for routine acetone detection but also shows promise in monitoring abnormal acetone levels in the breath of diabetic patients. This innovative sensing technology provides a robust foundation for the early diagnosis of diabetes and holds great potential for biomedical applications.

Introduction

Acetone is an important indicator for diabetes screening. For instance, acetone levels in the sweat of diabetic patients are higher than those in healthy individuals, with typical concentrations around 0.2-1.8 ppm in healthy people and 1.5-2.5 ppm in diabetic patients. Unlike traditional glucose meters that require invasive blood sampling, this study developed a modified electrode based on a ZnO-Ni(OH)$_2$/PANI nanocomposite material. The system systematically explored the effects of working electrode configuration, electrode modification, scan rate, and acetone concentration on electrochemical response, offering a non-invasive detection method.

Figure 1. Diagram of a Three-Electrode System

Experimental

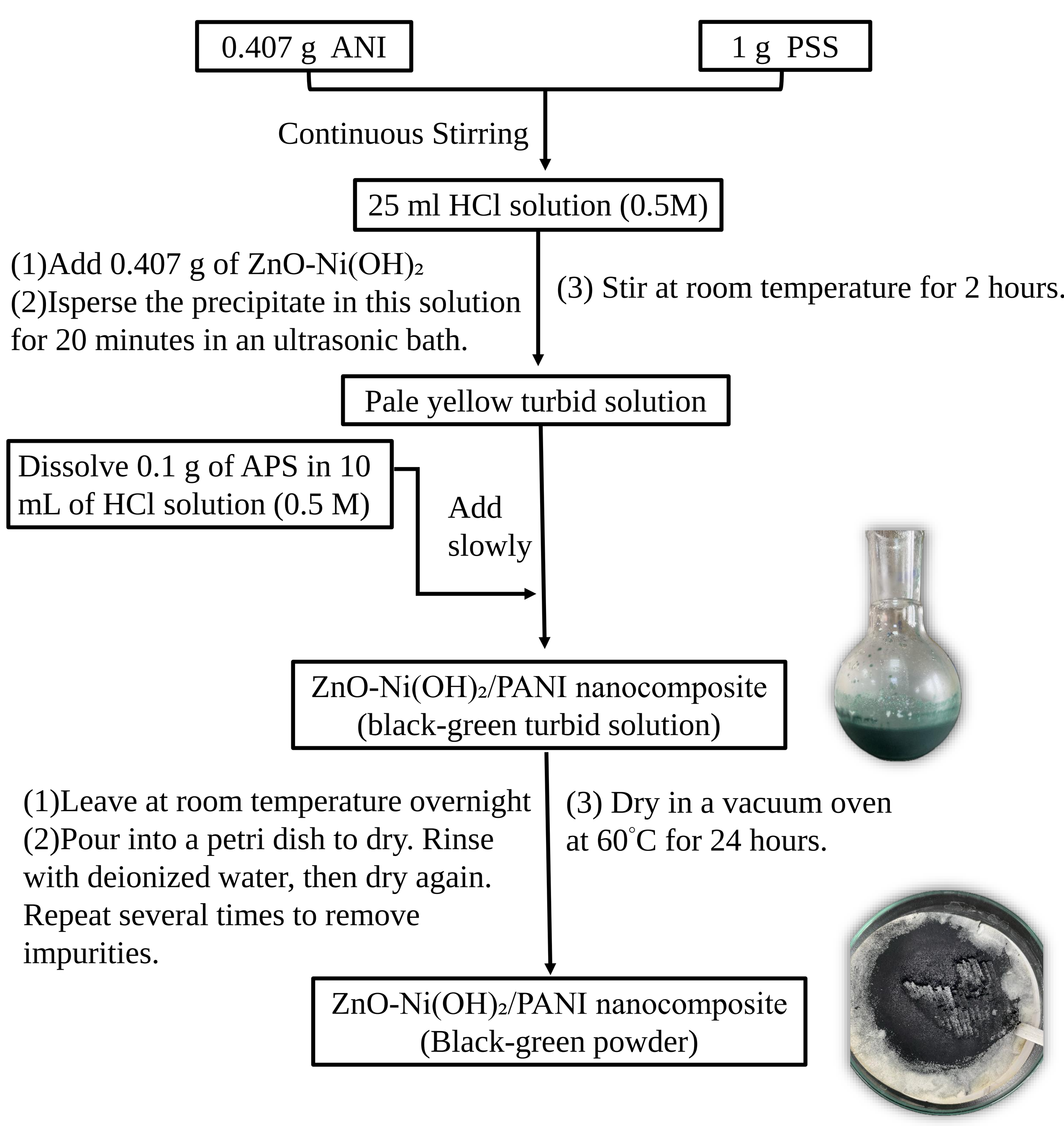


Figure 2. Preparation of ZnO/PANI nanocomposite with a weight ratio of 1:1 (ZnO)

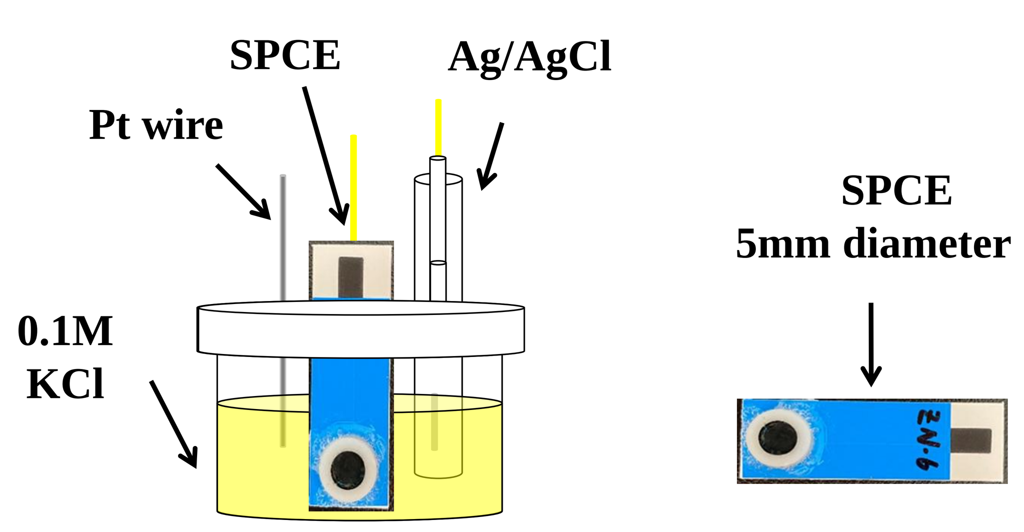


Figure 3. Diagram of electrodeposition and test system.

Investigation of Material Properties

FTIR

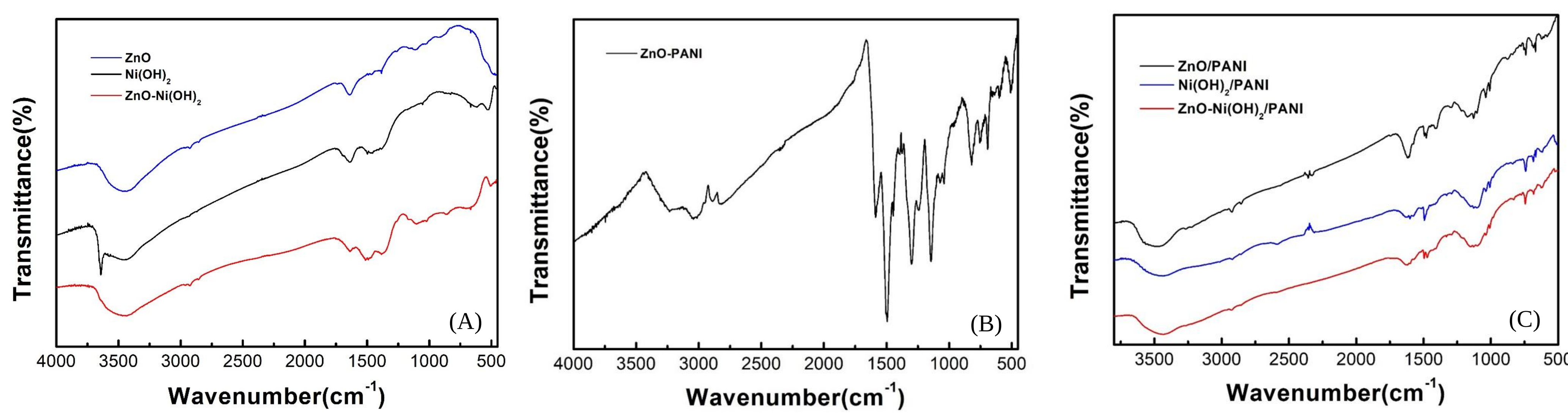


Figure 4. (A)FTIR Spectrum of the nanoparticles (B) FTIR Spectrum of ZnO/PANI (C) FT-IR Spectrum of the PSS-Added Nanocomposite Material

SEM-EDS analysis

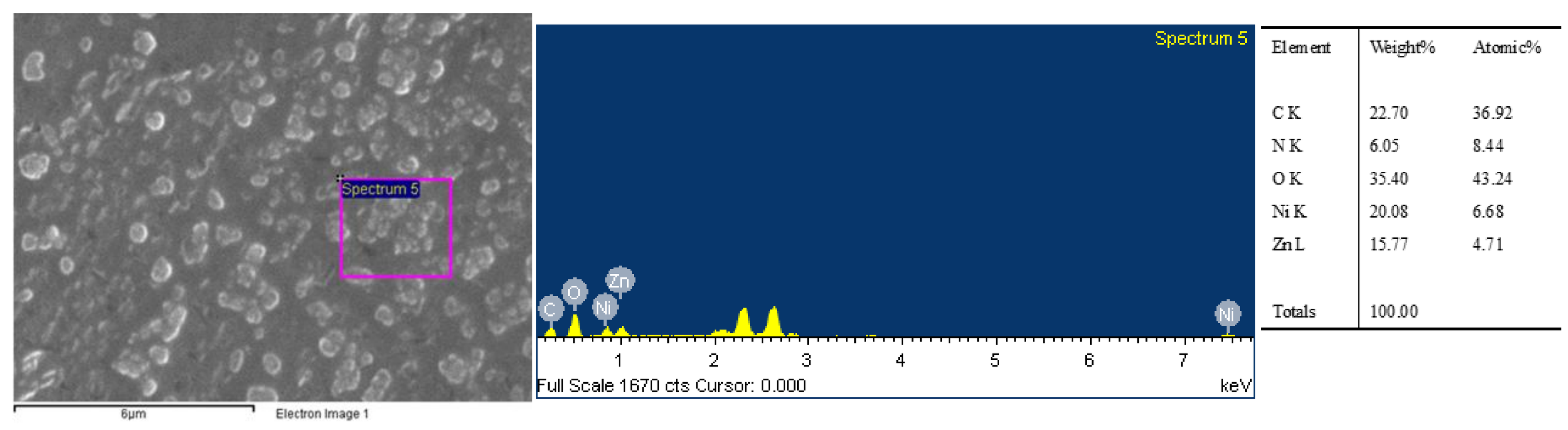


Figure.5. SEM-EDS analysis of ZnO-Ni(OH)$_2$/PANI Nanocomposite Material

Investigation of Material Properties

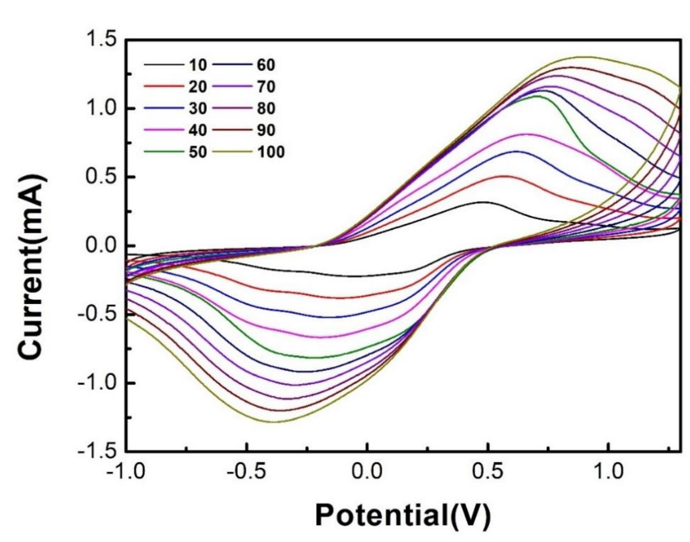


Figure 6. CV curves of ZnO-Ni(OH)$_2$/PANI/SPCE at varying scan rates

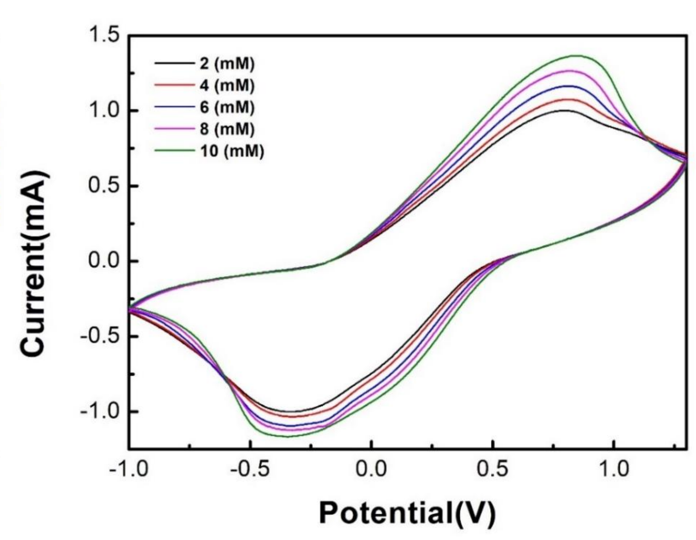


Figure 7. CV curves of ZnO-Ni(OH)$_2$/PANI/SPCE at varying acetone concentration

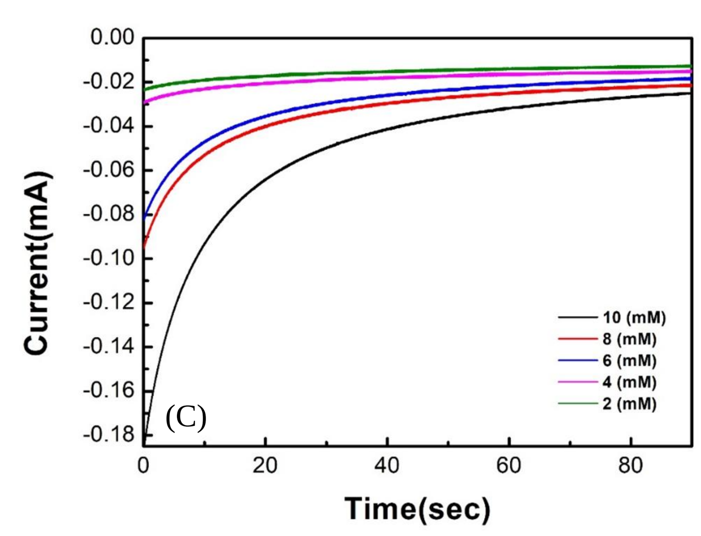


Figure 8. I-t curves of ZnO-Ni(OH)$_2$/PANI/SPCE at varying acetone concentrations

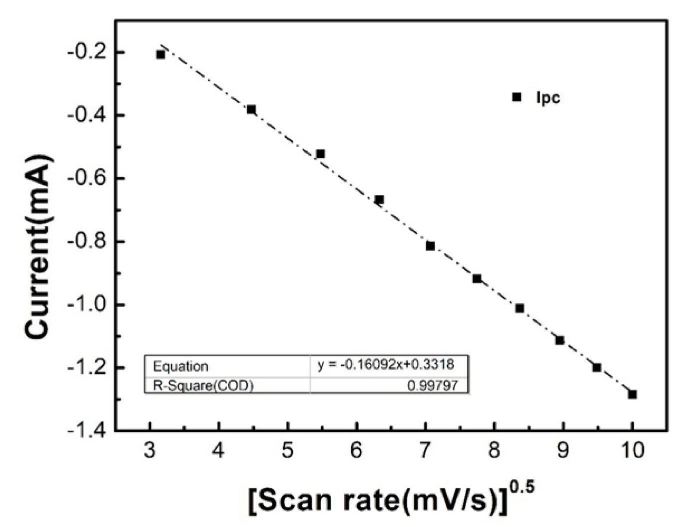


Figure 9. Plot of reduction current versus the square root of scan rate.

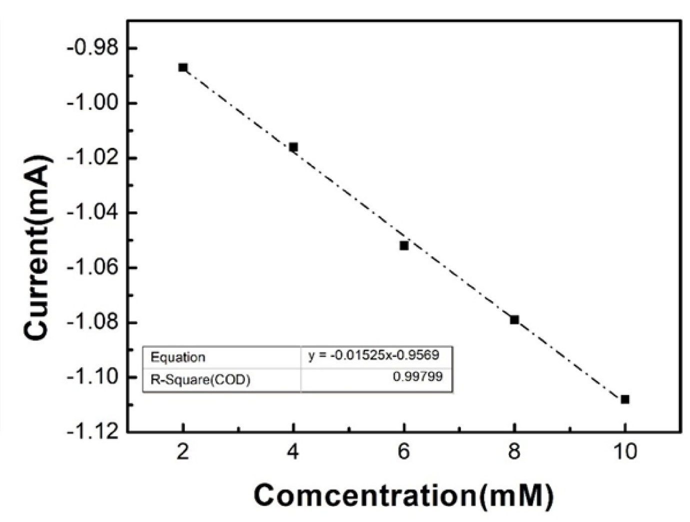


Figure 10. Plot of concentration versus Ipc

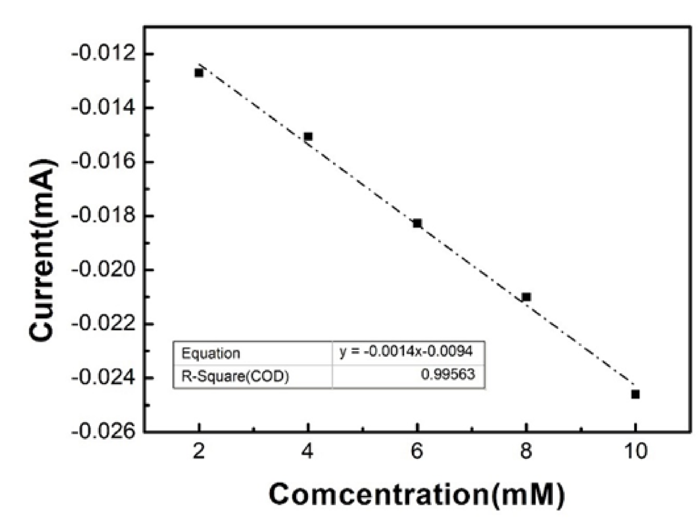


Figure 11. Plot of concentration versus saturated current.

Conclusions

The experimental results demonstrate that, compared to SPCE and ZnO/PANI, the ZnO-Ni(OH)$_2$/PANI nanocomposite material is the optimal sensing material, contributing to enhanced electrochemical performance. This modified electrode shows excellent performance in monitoring acetone concentration, indicating its potential for early diabetes diagnosis. Future research will focus on addressing issues such as film adhesion and long-term stability to further improve material performance and explore additional practical applications.

Performance Study of All-Solid-State Supercapacitors Based on Reduced Graphene Oxide Electrodes

•Chu-Yun Ke and Tien-Tsan Hung*

Department of Chemical Engineering, I-Shou University

•*E-mail: tthung@isu.edu.tw*

ISU-112-01-04A

With the growing global demand for sustainable energy storage, supercapacitors are gaining attention due to their rapid charge-discharge capabilities and long lifespan. However, the widespread application of supercapacitors is hindered by their relatively low energy density. Graphene, owing to its superior electrical conductivity and extensive specific surface area, has garnered significant attention as a promising material to enhance supercapacitor performance. In this study, reduced graphene oxide (rGO) was synthesized via a modified Hummers' method to serve as the electrode material for all-solid-state supercapacitors. The morphological and electrochemical properties of both graphene oxide (GO) and rGO were thoroughly characterized using scanning electron microscopy (SEM) and cyclic voltammetry (CV). The all-solid-state supercapacitor device was fabricated using a polyvinyl alcohol/potassium hydroxide (PVA/KOH) gel as the electrolyte. During CV tests conducted within the voltage range of -0.9V to 0.5V, rGO demonstrated well-defined, quasi-rectangular CV curves across various scan rates, indicating excellent electrochemical reversibility and stability. These findings underscore the potential of rGO as a highly effective electrode material for supercapacitors, offering promising avenues for energy storage applications.

Introduction

With the increasing demand for renewable energy, especially in electric vehicles and portable electronics, developing high energy and power density storage devices is crucial. Supercapacitors are promising due to their fast charge/discharge capabilities, high power density, and long cycle life, making them ideal for current storage needs. However, their low energy density limits practical applications. Traditional supercapacitors use liquid electrolytes, which pose risks of leakage and volatility. All-solid-state supercapacitors offer safer, more stable operation over a wider temperature range. Among many materials, graphene is a key candidate for enhancing all-solid-state supercapacitors due to its excellent conductivity and high surface area. Reduced graphene oxide (rGO), in particular, shows strong electrochemical properties. While rGO synthesis and characteristics have been explored, its application in supercapacitors requires further investigation. This study focuses on the application and electrochemical evaluation of rGO in supercapacitors to assess its potential in energy storage devices.

Experimental

Preparation of Gel Electrolyte

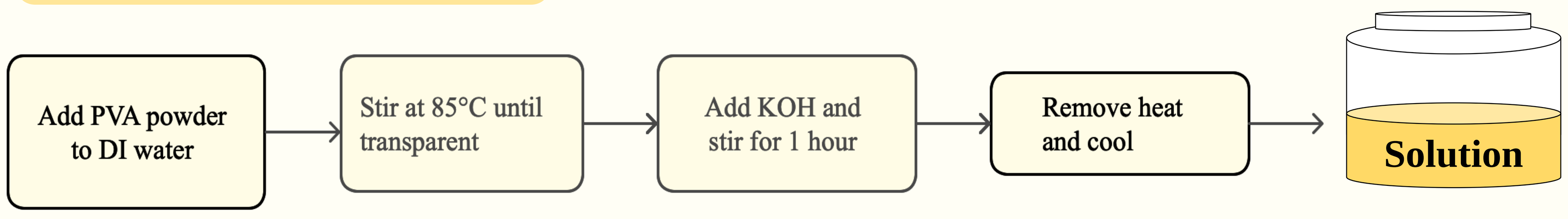


Figure 1. preparation process of Gel Electrolyte

Electrochemical Testing system

Assembly Method

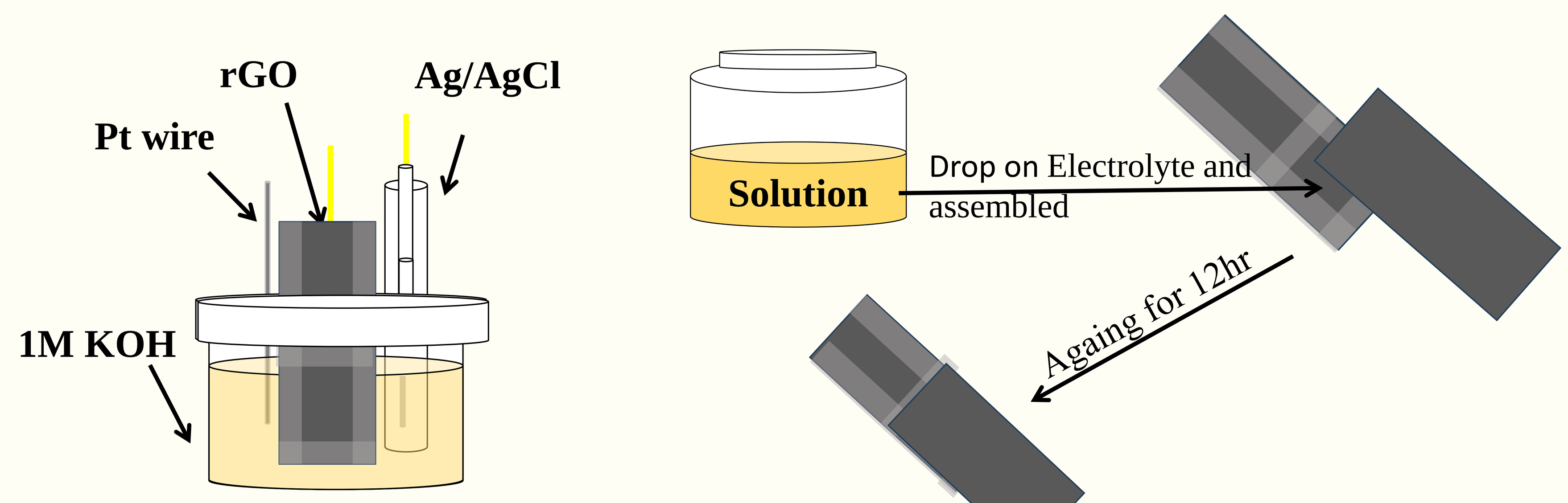


Figure 2. Diagram of Electrochemical Testing and Assembly

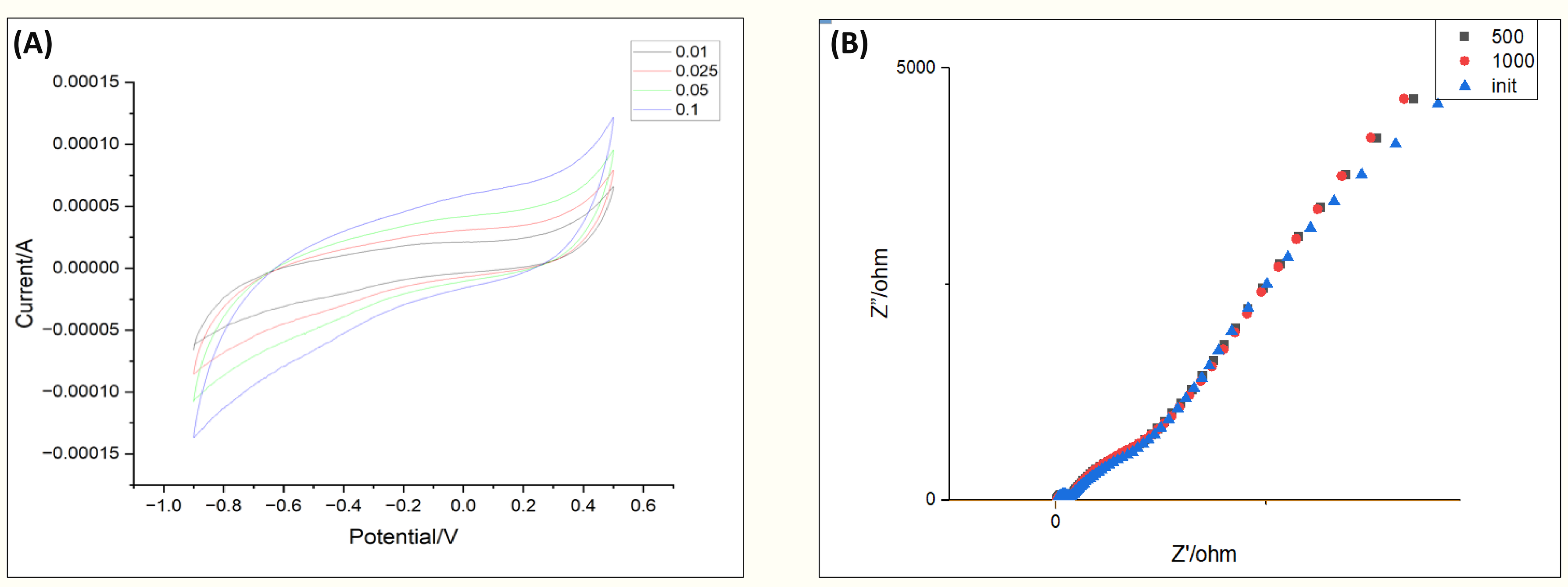


Figure 3. (A) CV results in a three-electrode system with 1M KOH show nearly rectangular curves at various scan rates, indicating excellent capacitance and stability.(B) Nyquist plot from EIS demonstrates minimal change in charge transfer resistance across cycling states, reflecting good short-term stability.

Results and Discussion

SEM aanalysis

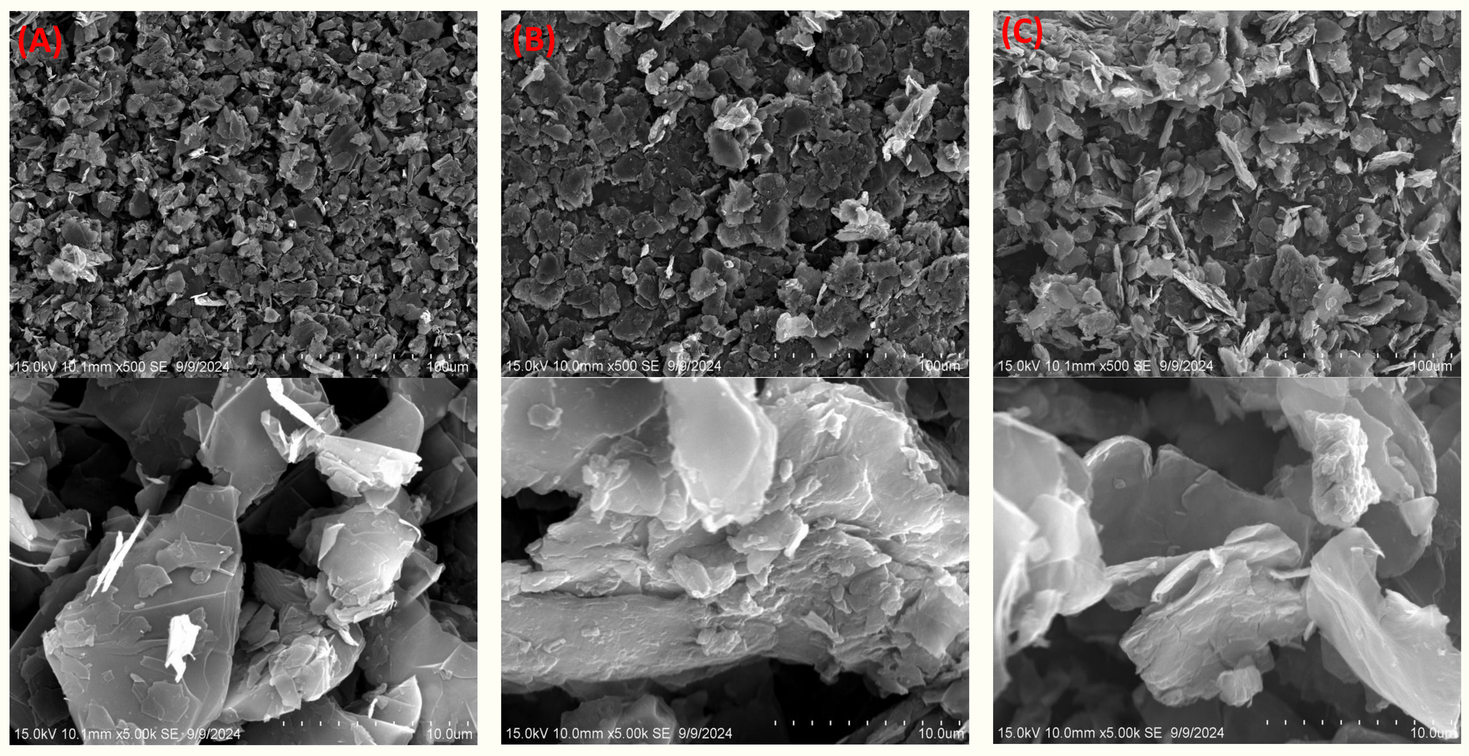


Figure 5.(A) SEM images of graphite at low and high magnification show a well-ordered, tightly packed layered structure, indicating high conductivity. (B) Graphite oxide (GO) images reveal increased layer spacing, rougher surfaces, and defects from oxidation. (C) Reduced graphite oxide (rGO) images display partially restored layers with a smoother surface than GO, though some roughness and defects remain.

FTIR analysis

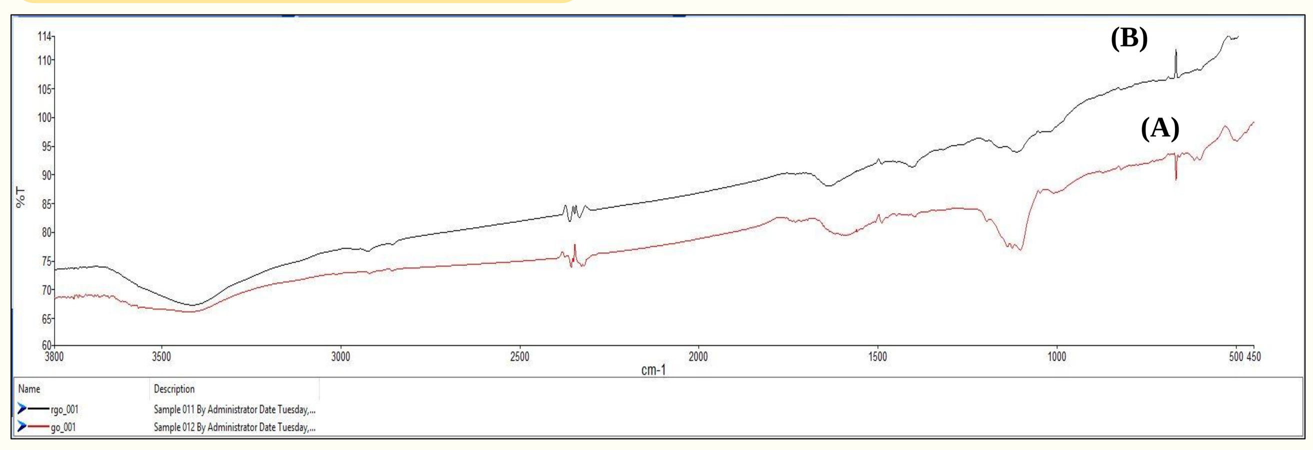


Figure 6. FTIR spectra of graphite oxide (GO) and reduced graphite oxide (rGO). (A) GO shows a broad peak around 3400 cm⁻¹ for hydroxyl (-OH) groups, a peak at 1720 cm⁻¹ for C=O stretching of carboxylic acids, and a peak at 1620 cm⁻¹ for C=C bonds. (B) rGO displays a weakened peak at 3400 cm⁻¹, indicating reduced hydroxyl and carboxyl groups, and a decreased C=O peak at 1700 cm⁻¹, confirming the reduction of oxygen-containing functional groups.

Post-Assembly Analysis

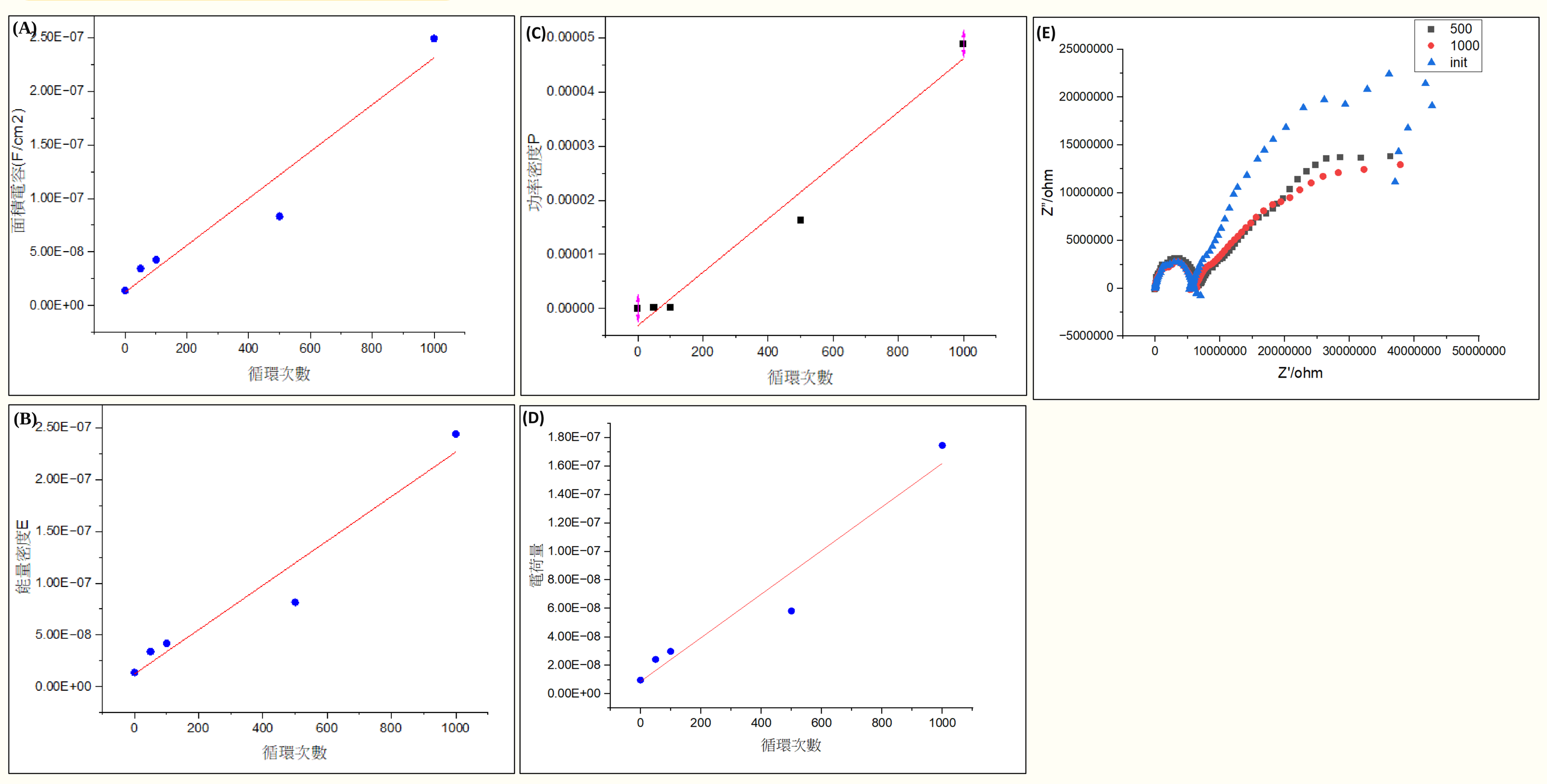


Figure7.(A) Specific capacitance of rGO increased from 7 nF/cm² to 120 nF/cm² after 1000 cycles, indicating enhanced structural stability and performance.(B) Energy density improved from 0.005 Wh/cm² to 0.025 Wh/cm² with cycling, showcasing better energy storage capabilities.(C) Power density rose from 0.1 W/cm² to 0.5 W/cm² as cycling progressed, highlighting rGO's potential for rapid charge-discharge applications.(D) Charge quantity increased with the number of cycles, demonstrating continuous improvement in performance.(E) EIS results show stable charge transfer resistance after 1000 cycles, reflecting the rGO electrode's robust interface with the solid-state electrolyte.

Conclusions

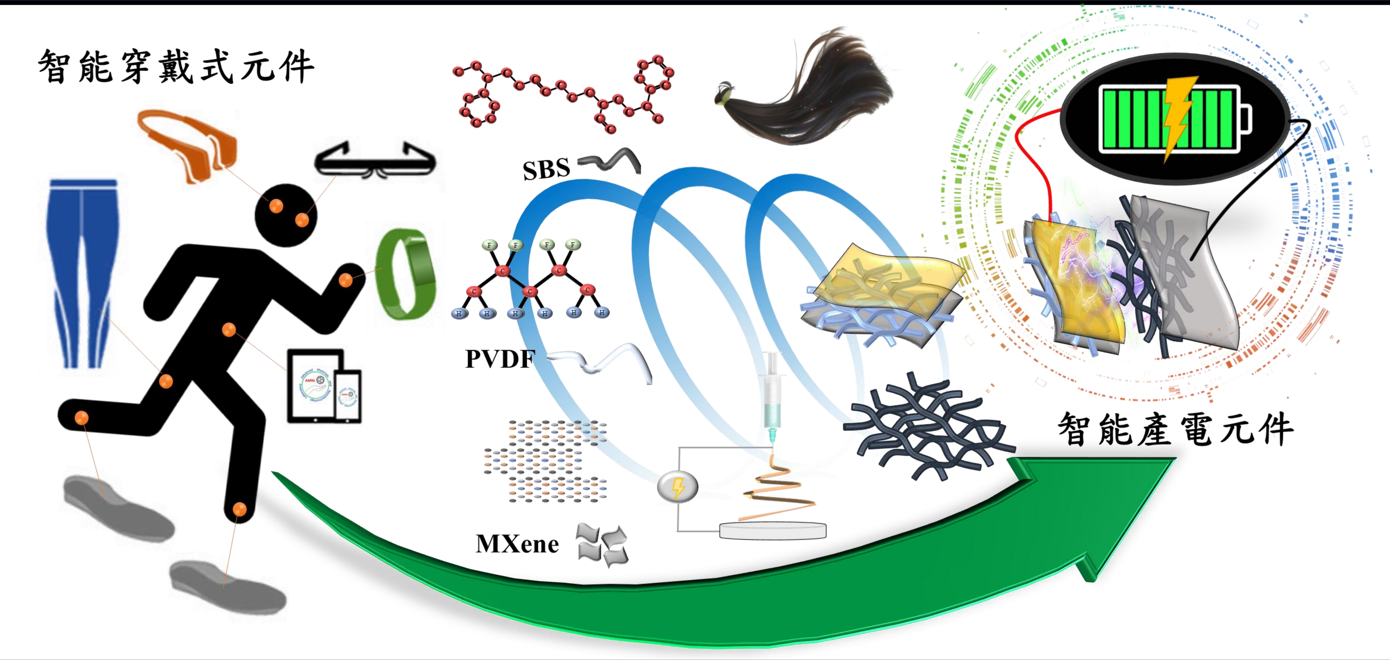
In a three-electrode system, reduced graphene oxide (rGO) demonstrated good electrochemical performance, exhibiting excellent capacitance in a 1M KOH electrolyte. Cyclic voltammetry (CV) results indicated that the current response increased with scanning rate, showcasing fast charge/discharge capabilities. Electrochemical impedance spectroscopy (EIS) showed minimal change in charge transfer resistance after 1000 cycles, reflecting good short-term stability.

In a subsequent two-electrode system, rGO's energy storage performance improved with cycle number, suggesting an activation process. While the initial specific capacitance was low at 7 nF/cm², likely due to poor electrode contact, it rose significantly to 120 nF/cm² in later cycles, highlighting its potential. Energy density increased from 0.005 Wh/cm² to 0.025 Wh/cm², and power density improved from 0.1 W/cm² to 0.5 W/cm² after multiple cycles, indicating promising applications for fast charge/discharge.Despite existing resistance issues, this underlines the need to optimize material preparation and assembly, especially enhancing the contact between the electrode and solid electrolyte to boost performance and stability.

新型Bio-Hair/MXene摩擦奈米纖維於能源織物的開發

呂沂儒、鄭珉欣、陳婷、卓家榮*
Institute of Biotechnology and Chemical Engineering, I-Shou University, Kaohsiung 84001, Taiwan
*Email : ppaul28865@gmail.com

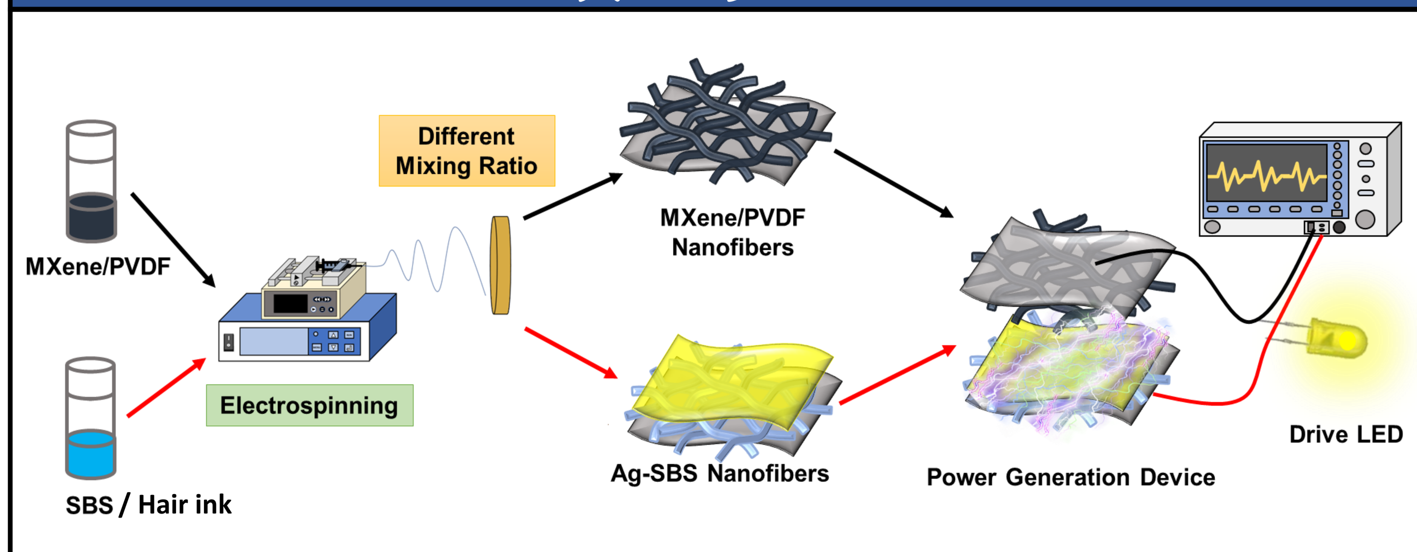
介紹



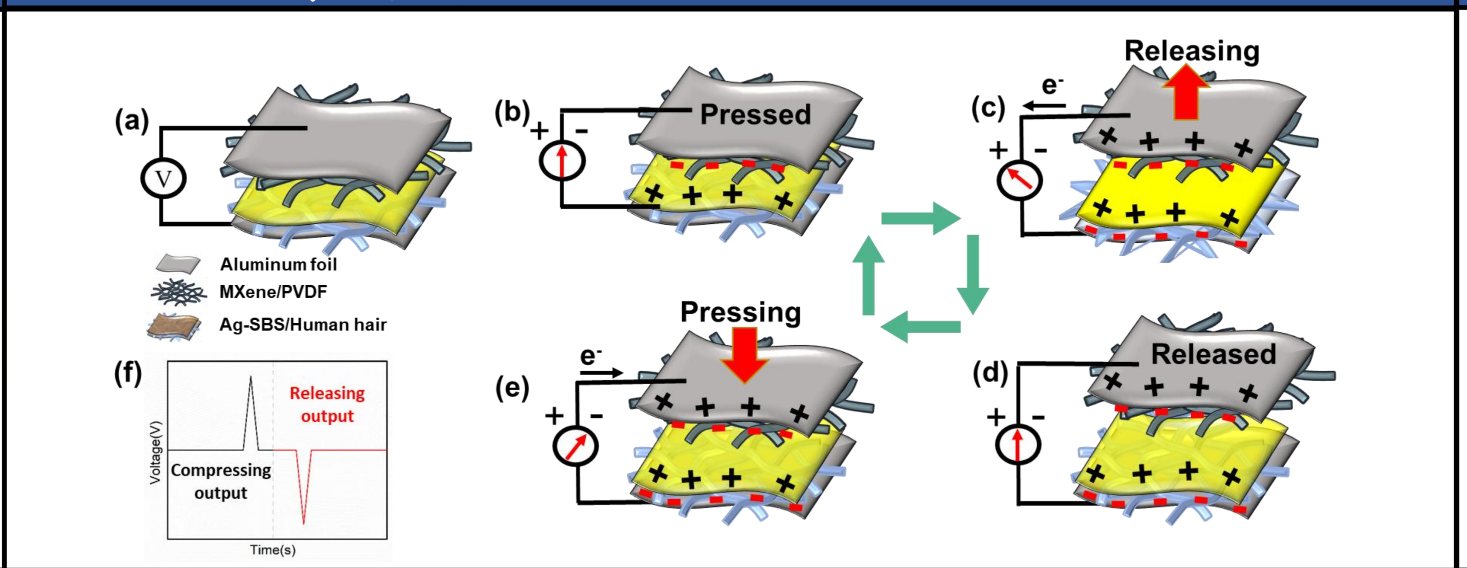
摘要

本研究以壓電和摩擦起電原理與靜電紡絲技術為基礎，開發了一種新型的Bio-Hair／MXene奈米複合能源織物（TENG）。研究中，MXene材料經過二維分層後，與偏二氟乙烯（PVDF）結合，通過靜電紡絲技術製成奈米纖維，作為強負電極；而正電材料則來自人類毛髮，作為摩擦正電材料。這種新型複合材料表現出優良的耐用性和電穩定性，能產生最高50V的電壓和20-70 mW/m²的功率密度，且在不到5秒內就能為1μF的電容器充滿電。

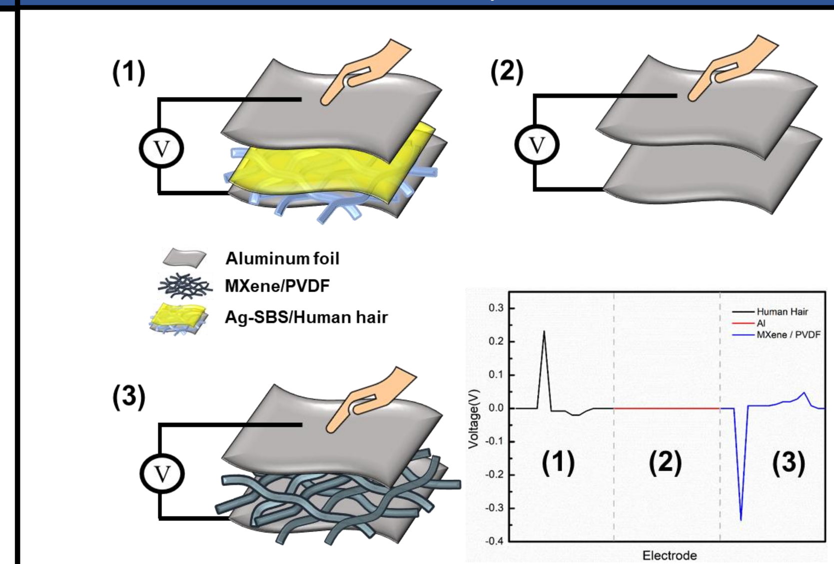
實驗步驟



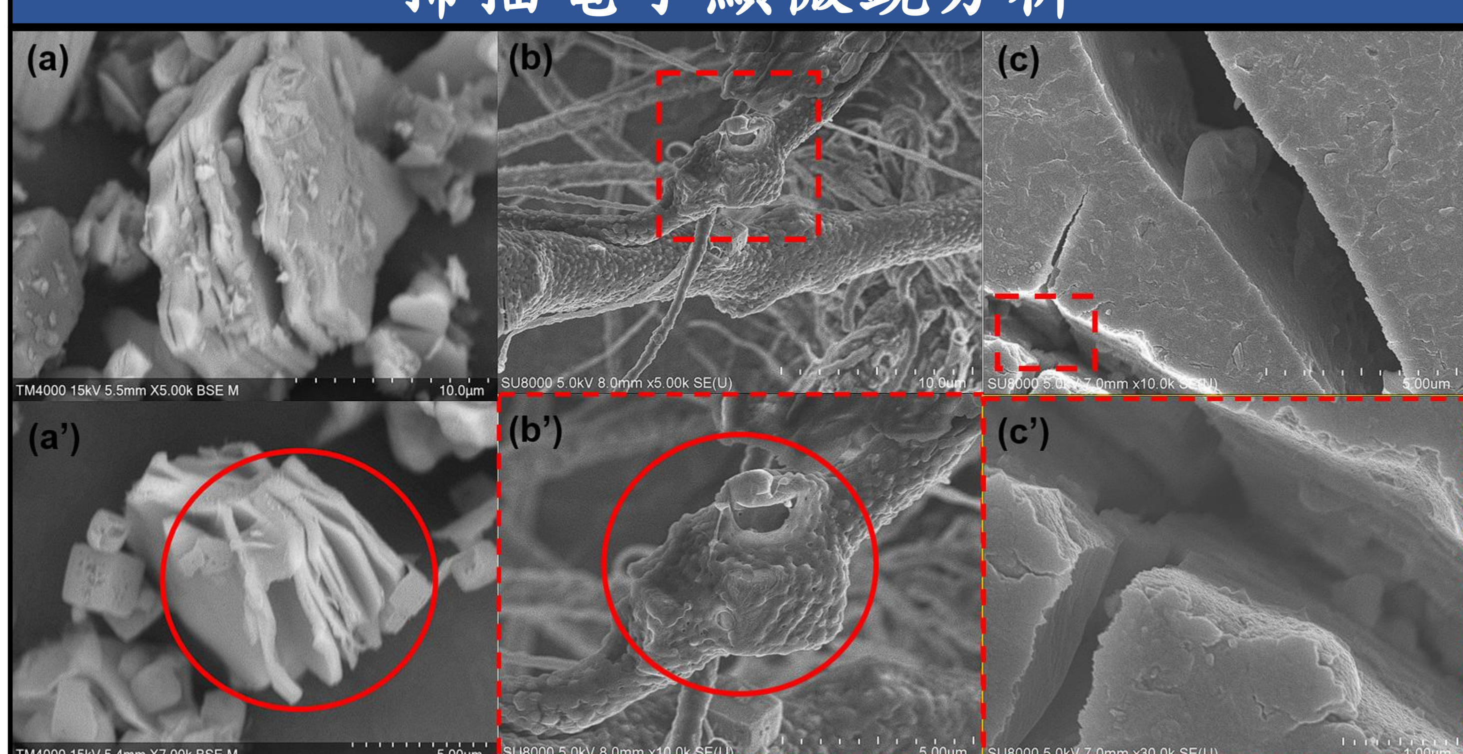
摩擦奈米發電機的工作機制



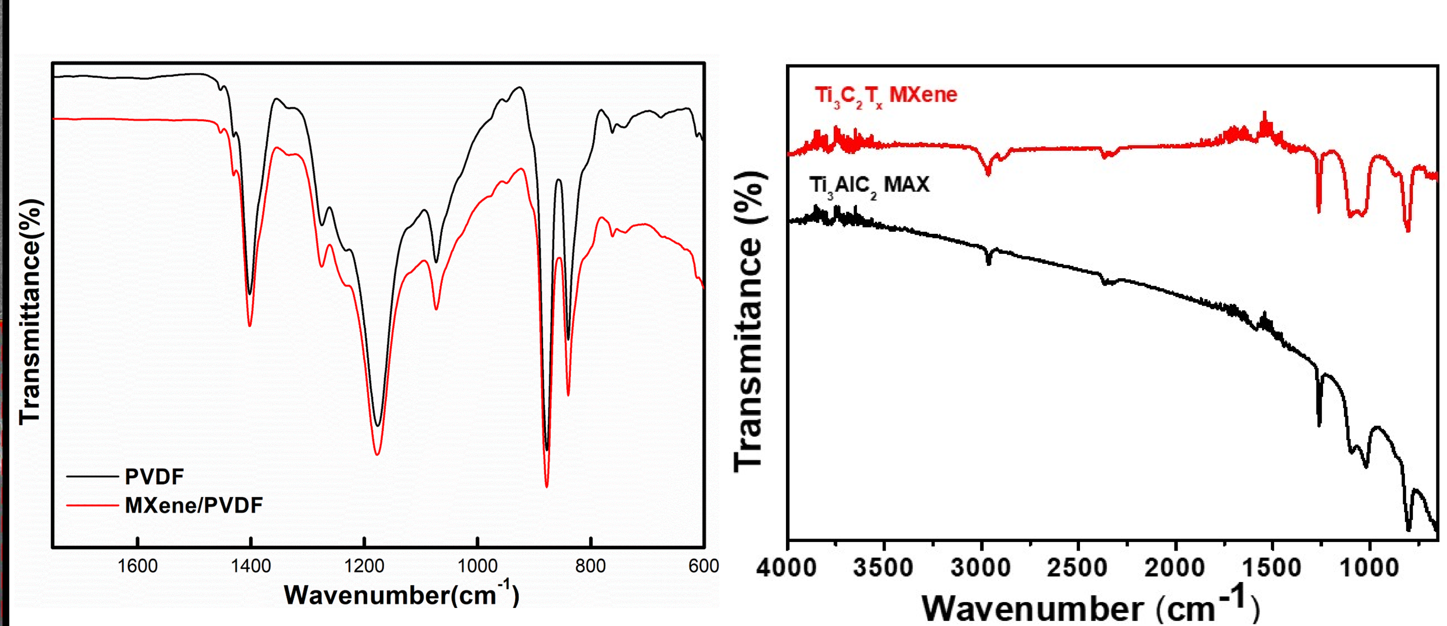
電路屬性



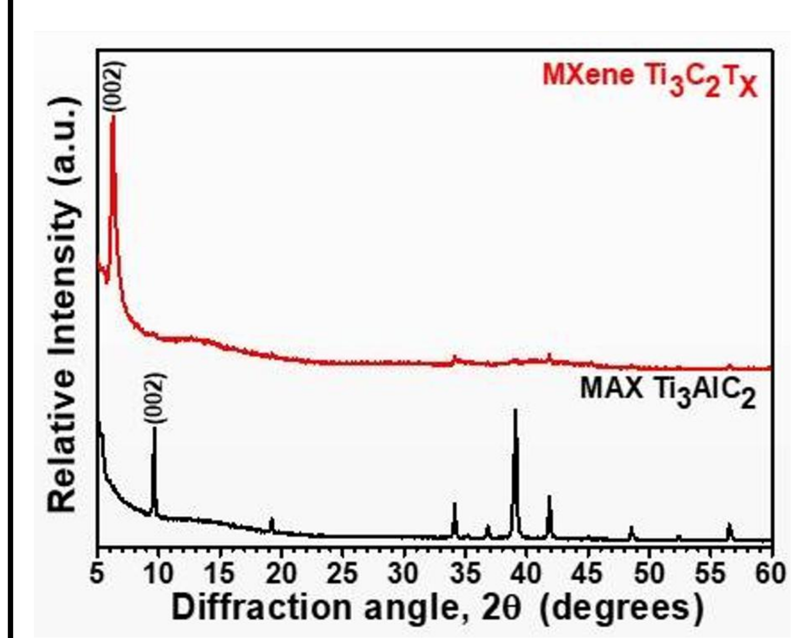
掃描電子顯微鏡分析



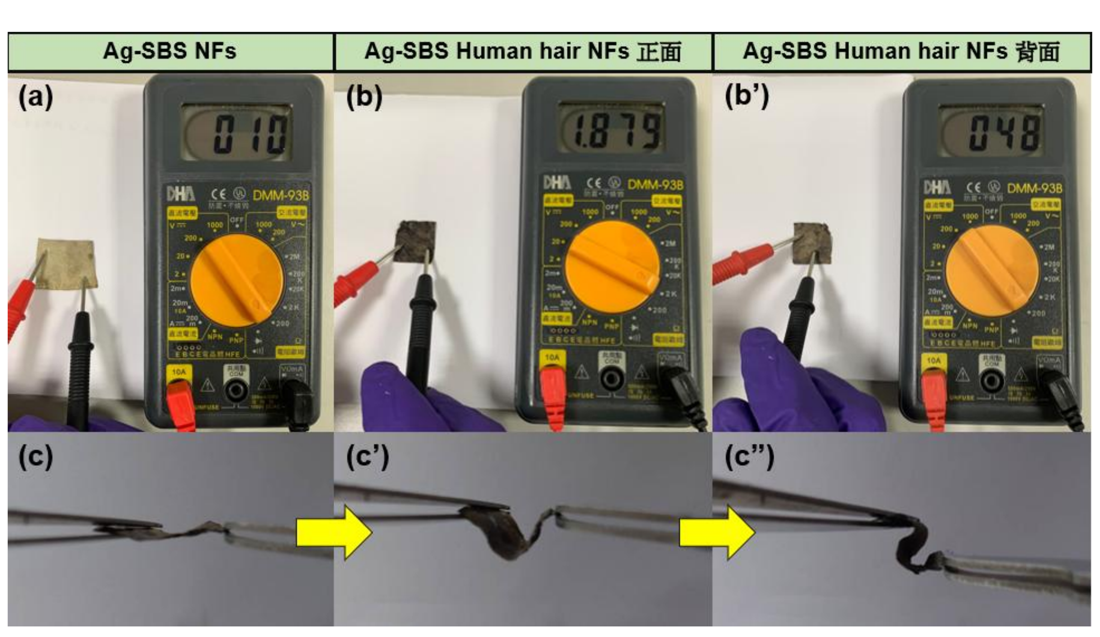
傅立葉式紅外光譜儀



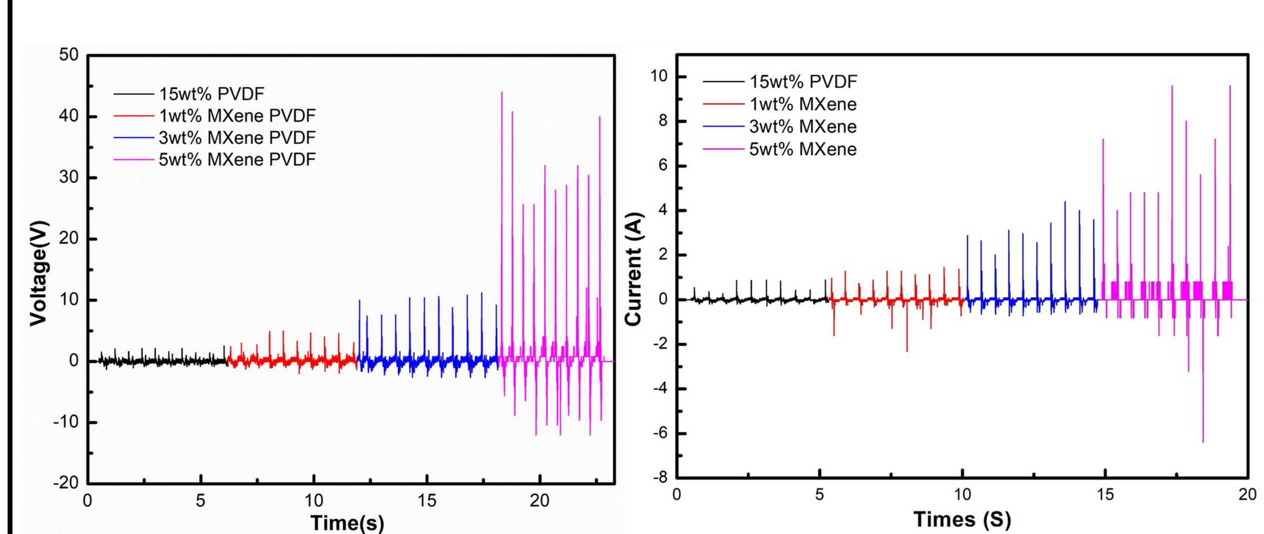
X光繞射分析



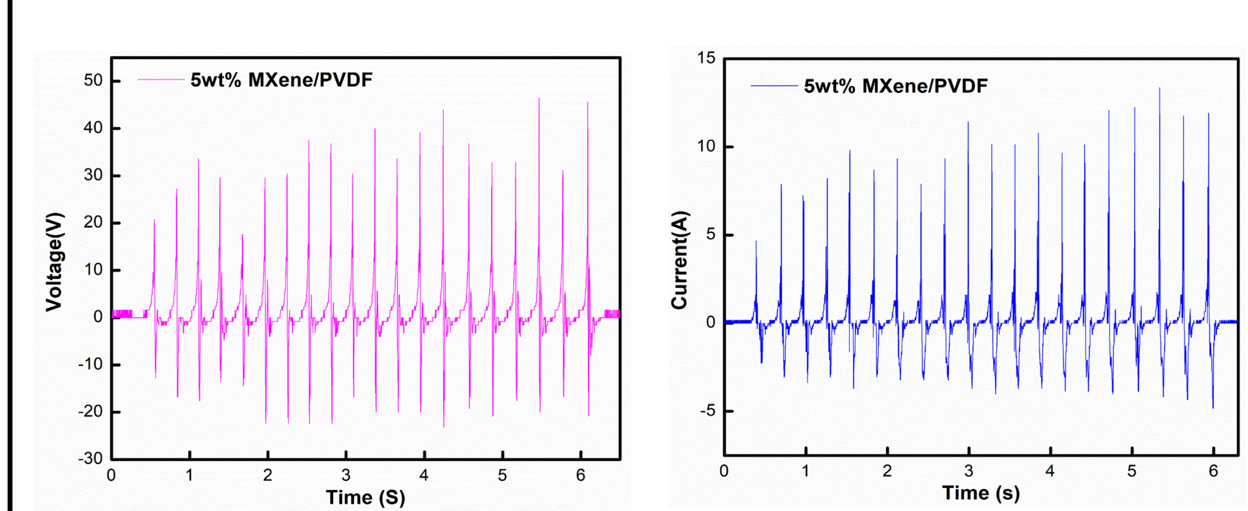
頭髮的抗性和柔韌性



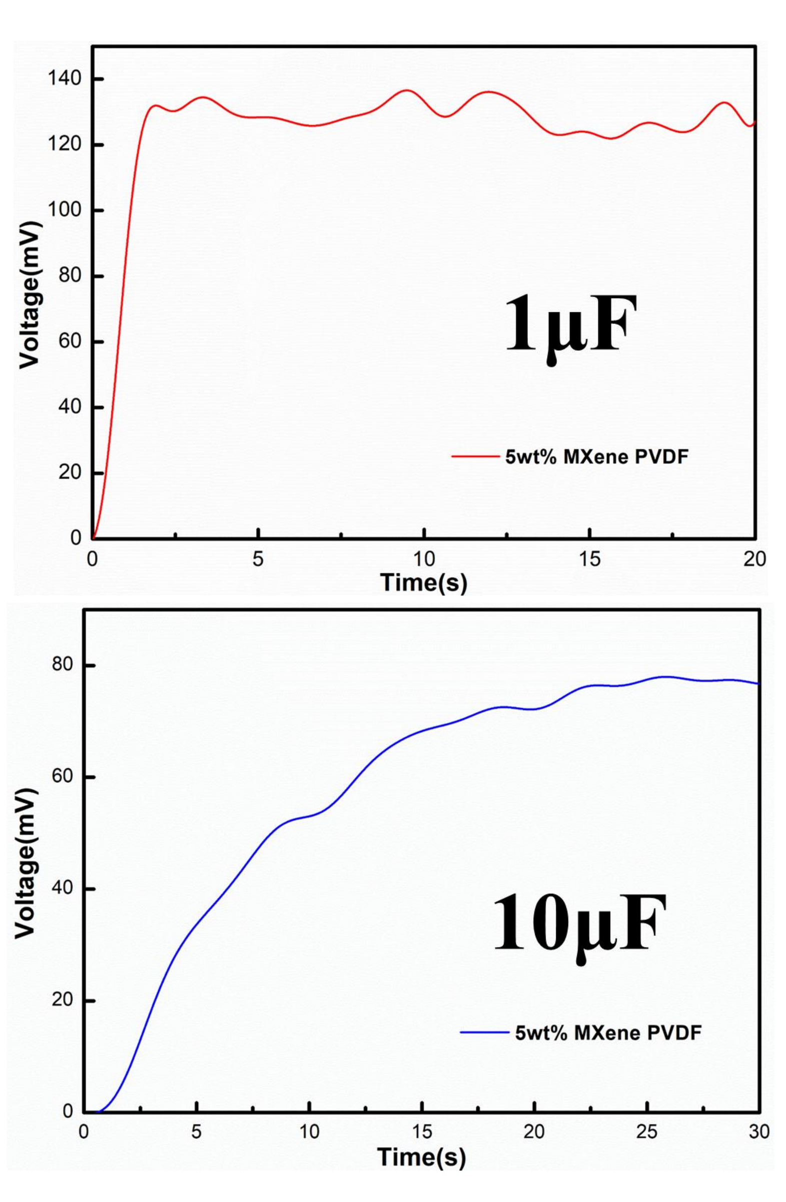
翻轉電壓和電流



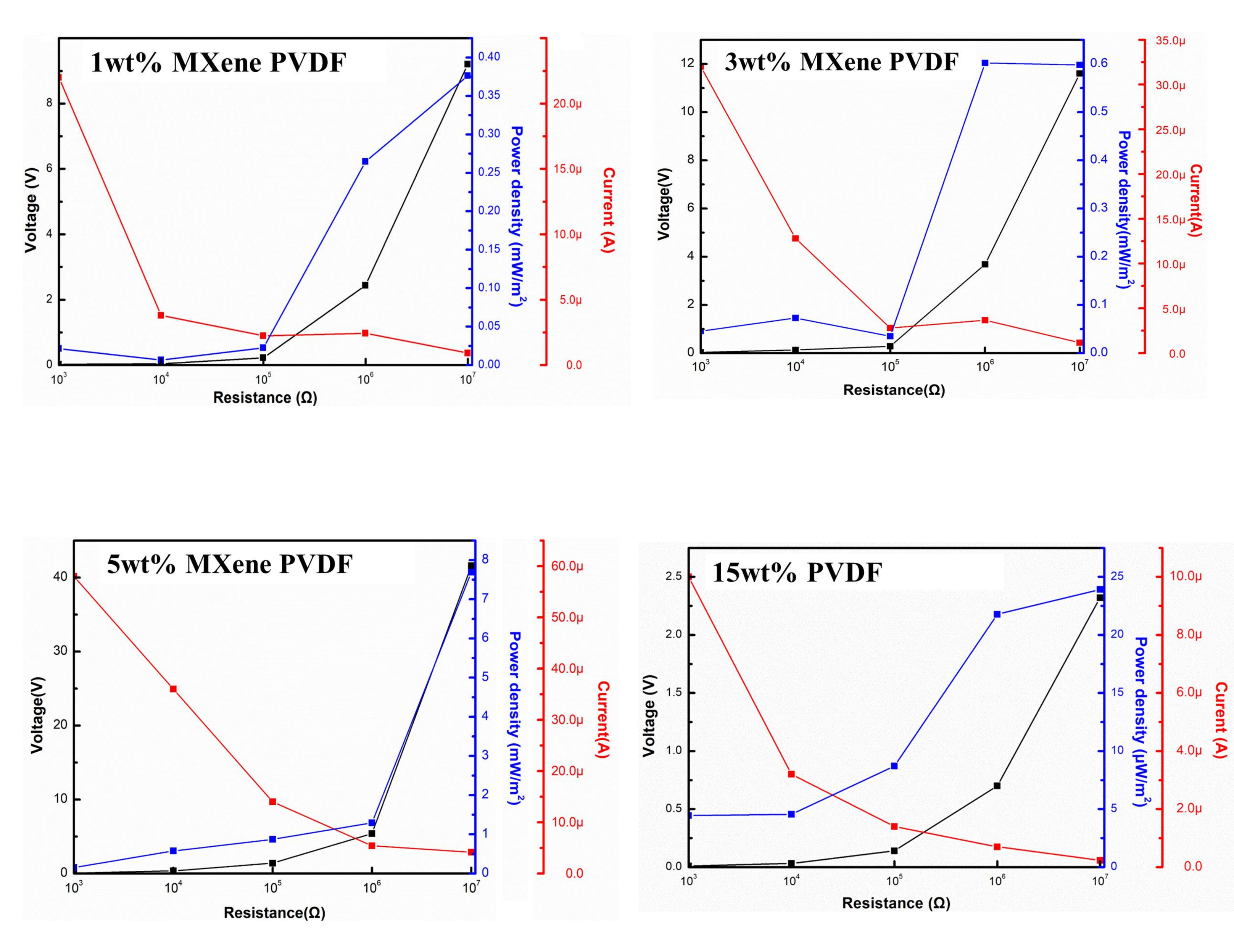
拍打電壓和電流



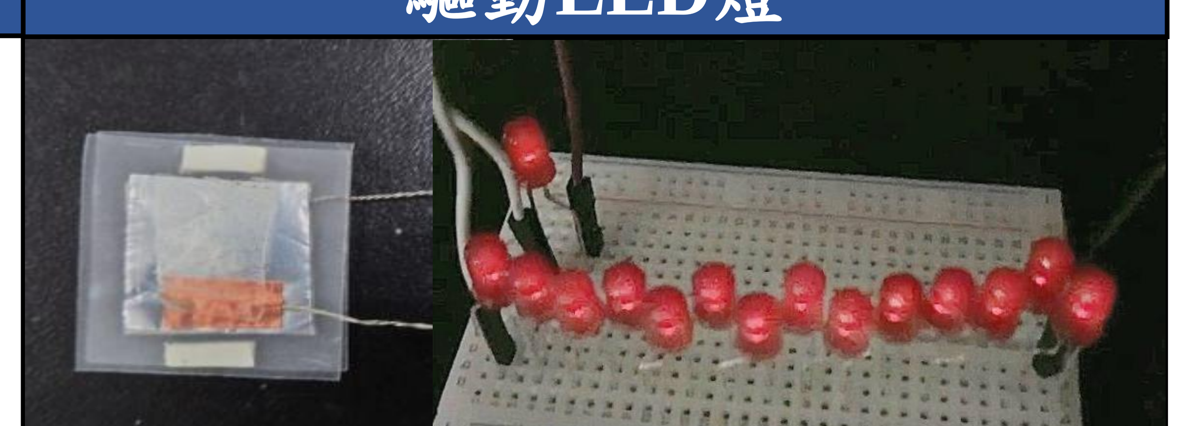
電容充電



功率密度



驅動LED燈



結論

1. TENG的正摩擦層是利用回收而來的人髮所製備，善用這些人髮來減少生物廢棄物的產生，降低對環境的壓力，成為具有生物循環經濟的TENG。
2. 添加5 wt%的MXene後，僅需20到30秒便能充滿1μF和10μF電容器，電壓、電流與功率密度分別提升至原來的17.5倍、11倍與321倍，顯示MXene片材的加入顯著增強了TENG的性能。
3. 我們將可彎折的Ag-SBS/Bio-hair NFs與MXene/PVDF NFs結合，將TENG結構轉化為全纖物型的輕量化電源，柔軟的特性更易於整合至穿戴裝置中。

基於光催化奈米多孔纖維技術應用於綠能科技

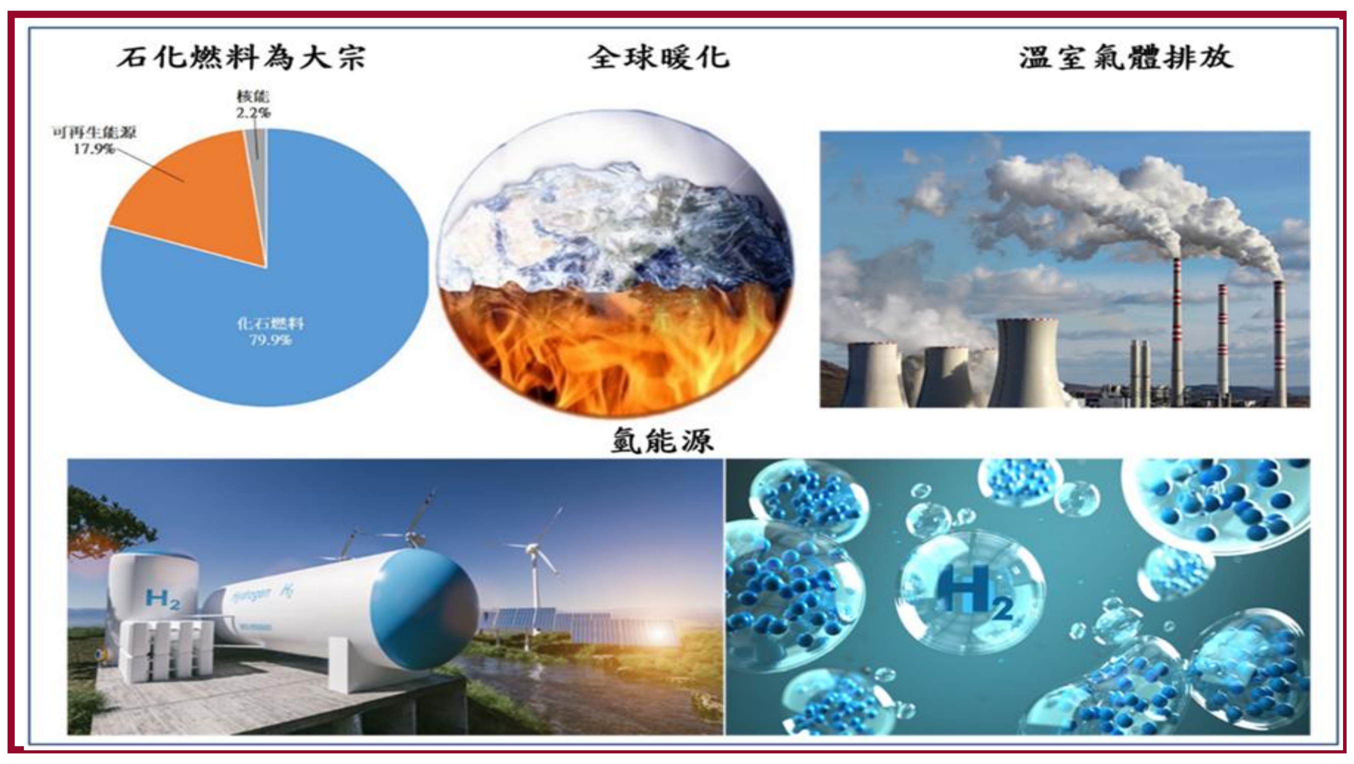
Application of photocatalytic nanoporous fiber technology in green energy technology

陳昜仁、周子宸、陳冠宇、卓家榮*

[a]義守大學化學工程學系

***Email:** ppaul28865@gmail.com

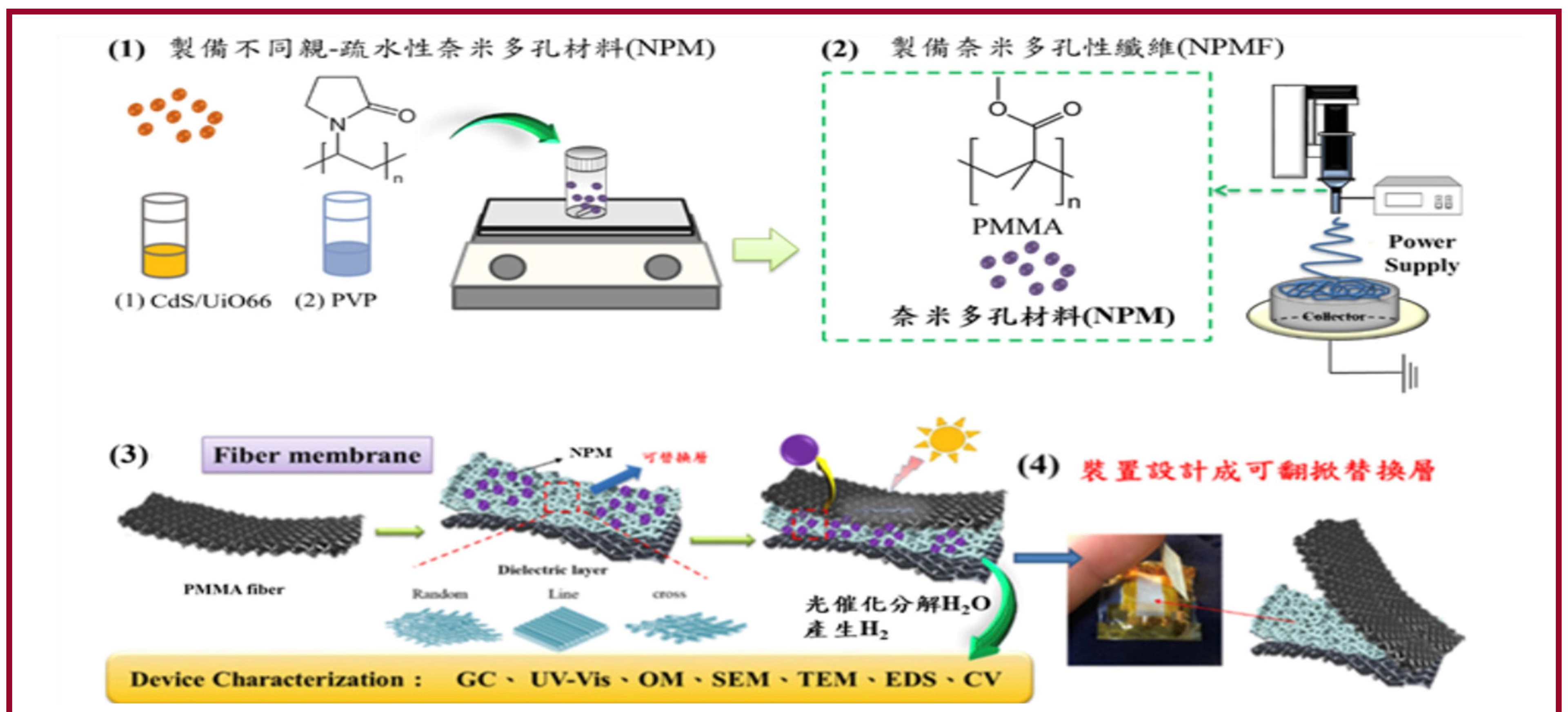
introduction



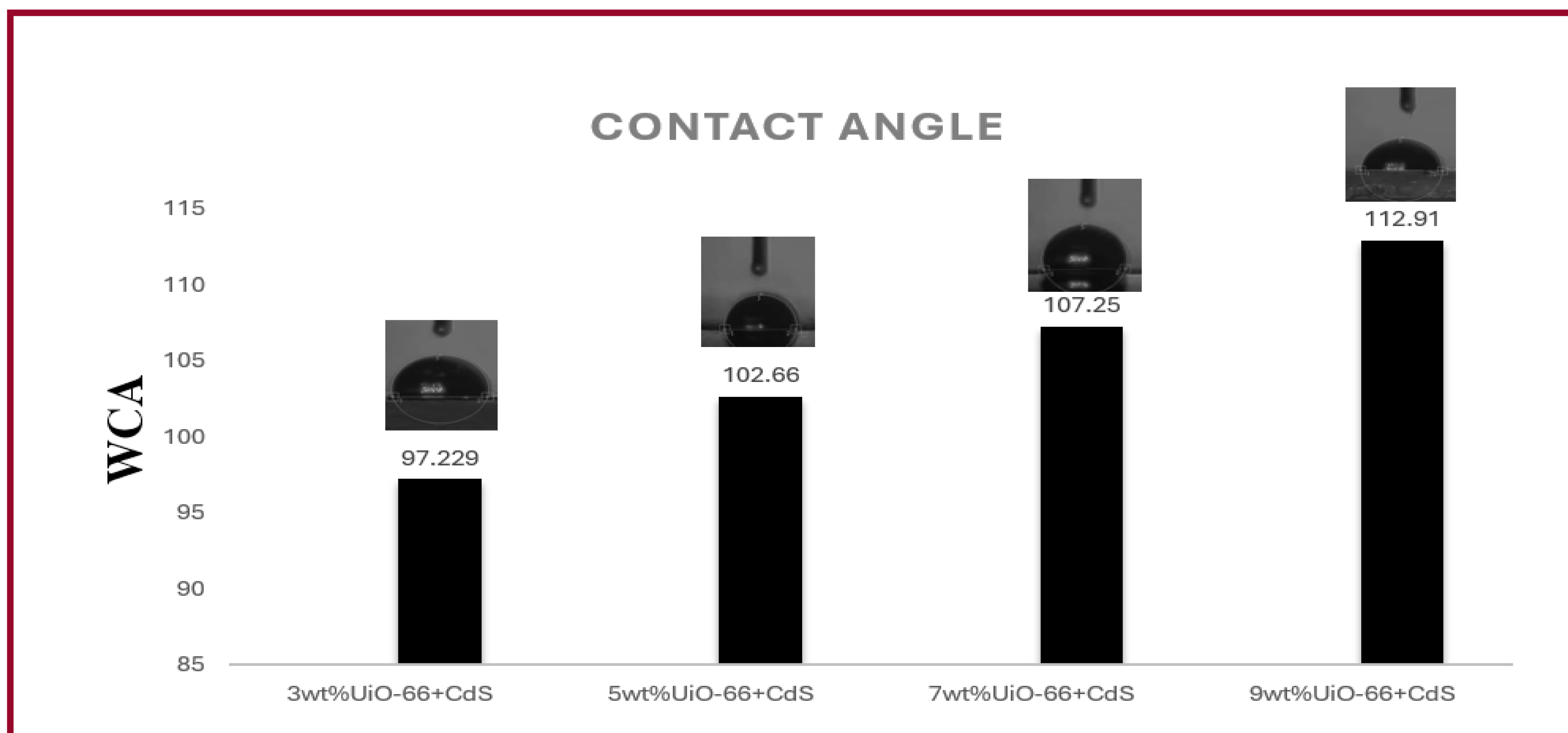
abstract

世界能源枯竭與用盡問題以及化石燃料所造成的巨大環境危害，仍是日常生活中的一個重大的議題與挑戰 “如何研發奈米多孔性纖維(NPMF)於產氫及綠能應用?”將是本計畫案的主軸。所以本計畫主要利用合成技術、靜電紡絲技術和光催化技術，再透過與指導教授的討論合作，製備出具產氫氣功能的親-疏水性NPM進行混摻，最後透過靜電紡絲後應用於產氫及綠能開發上，試圖解決產氫氣之問題與產品開發。

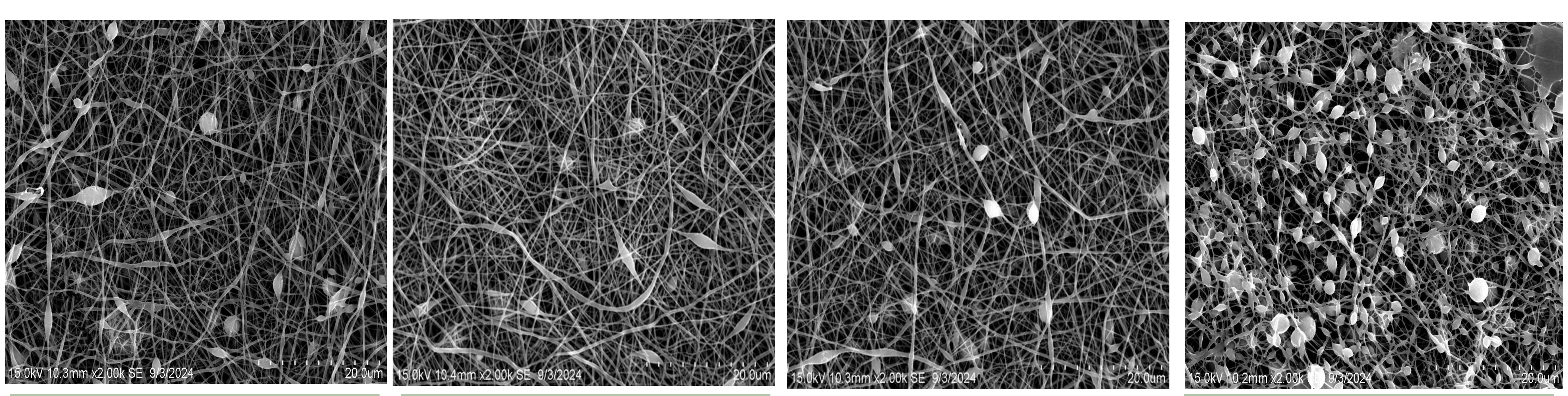
Experiment



WAC

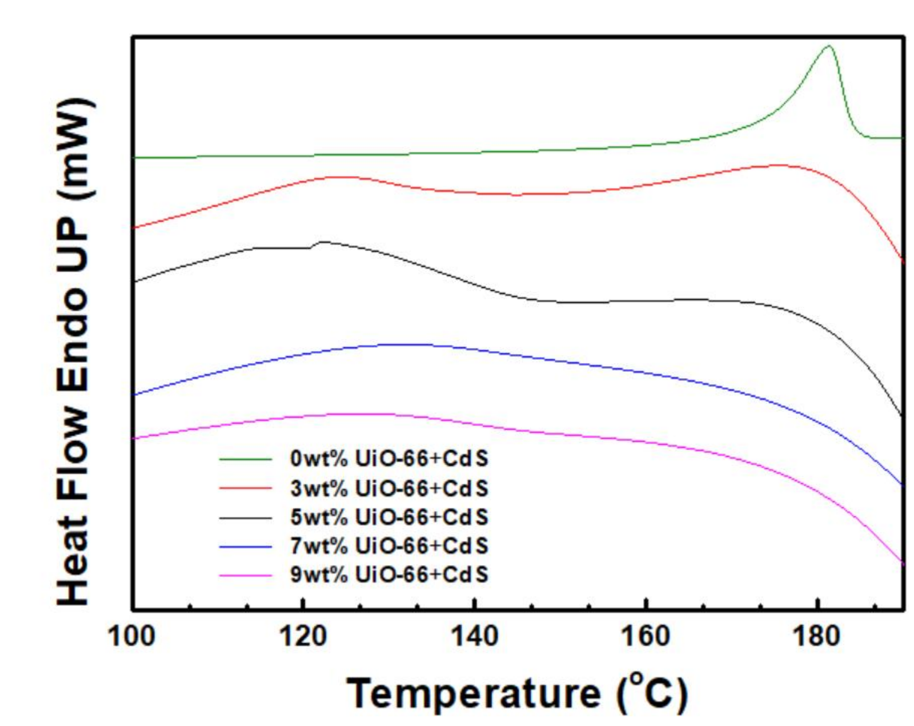


SEM

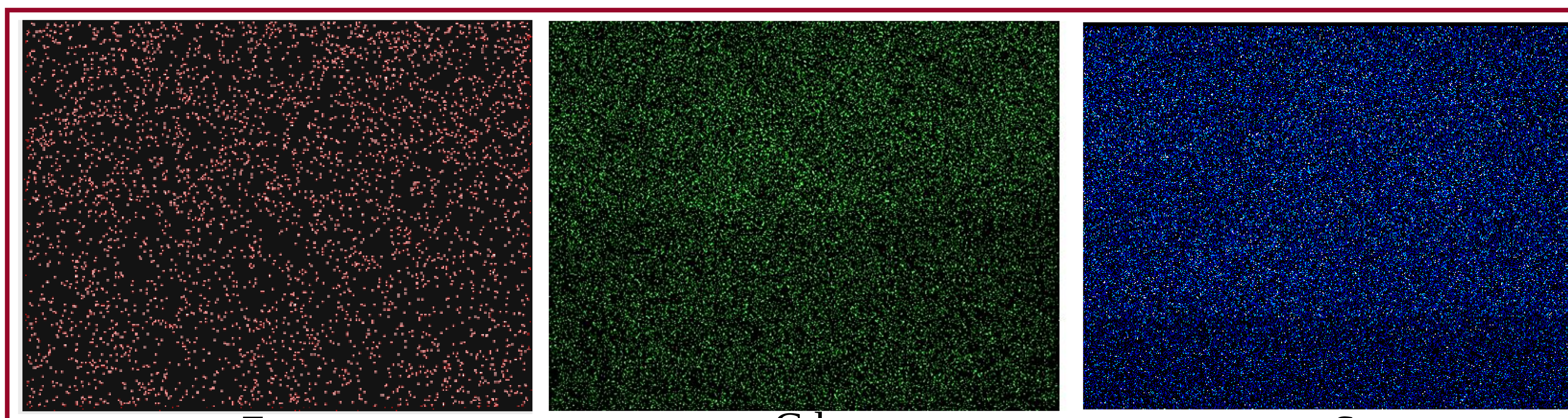


3wt%UiO-66+CdS 5wt%UiO-66+CdS 7wt%UiO-66+CdS 9wt%UiO-66+CdS

DSC

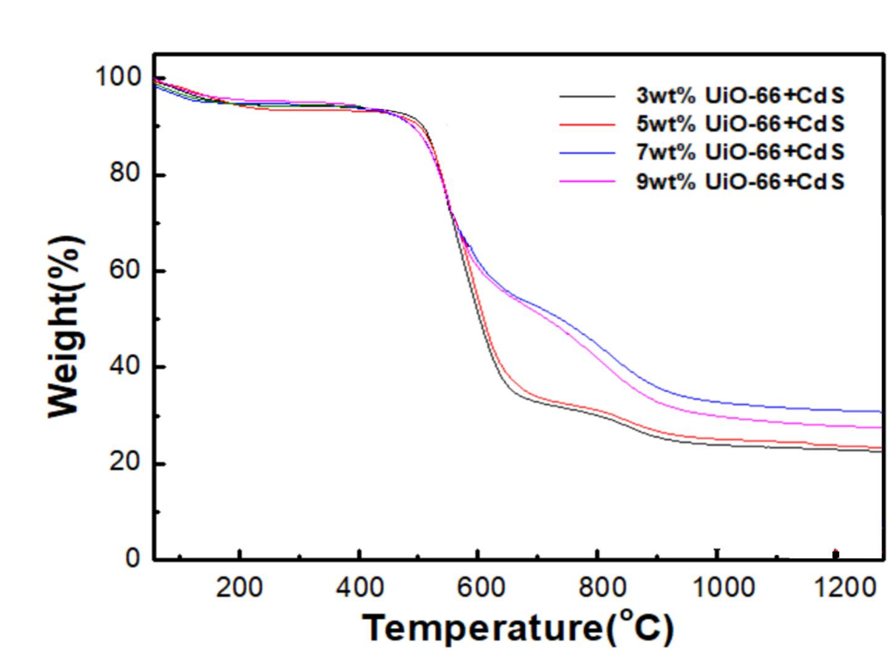


Mapping

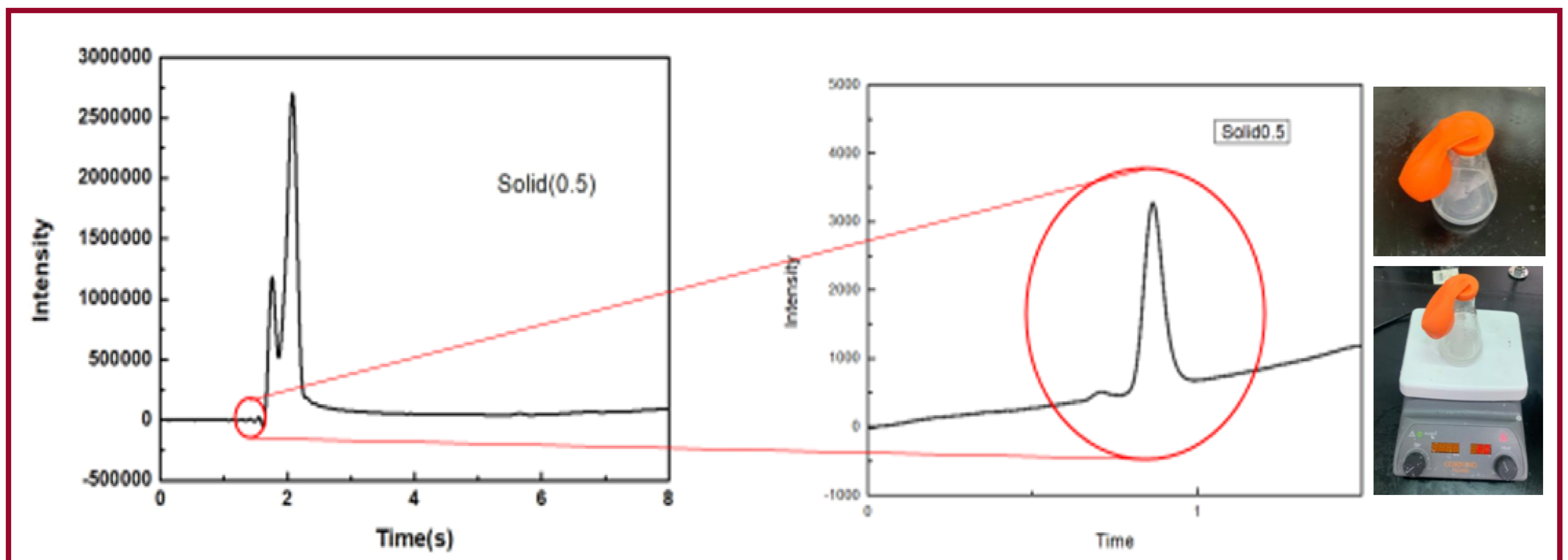


Zr Cd S

TGA



Application



Conclusion

本研究成功製備了以CdS/UiO-66為核心，並結合MOF衍生多孔NiO骨架與PVP的奈米多孔性材料(NPM)。透過調控UiO-66的濃度，實現了不同親水性與疏水性的材料設計。與市售多孔性材料相比，自製NPM展現了更優異的結構穩定性與潛在的功能性，尤其在抗腐蝕性和多孔結構可調性上具有明顯優勢。此外，該製程中所使用的條件（如溫度、濃度等）均具有可重複性，為未來實現產氫奠定基礎。

SnSe/PVDF壓電及熱釋電奈米織物於穿戴式元件的應用

李玫蓁、陳亞宣、林詩妤、卓家榮*

Institute of Biotechnology and Chemical Engineering, I-Shou University[1], Kaohsiung 84001, Taiwan

*Email : ppaul28865@gmail.com

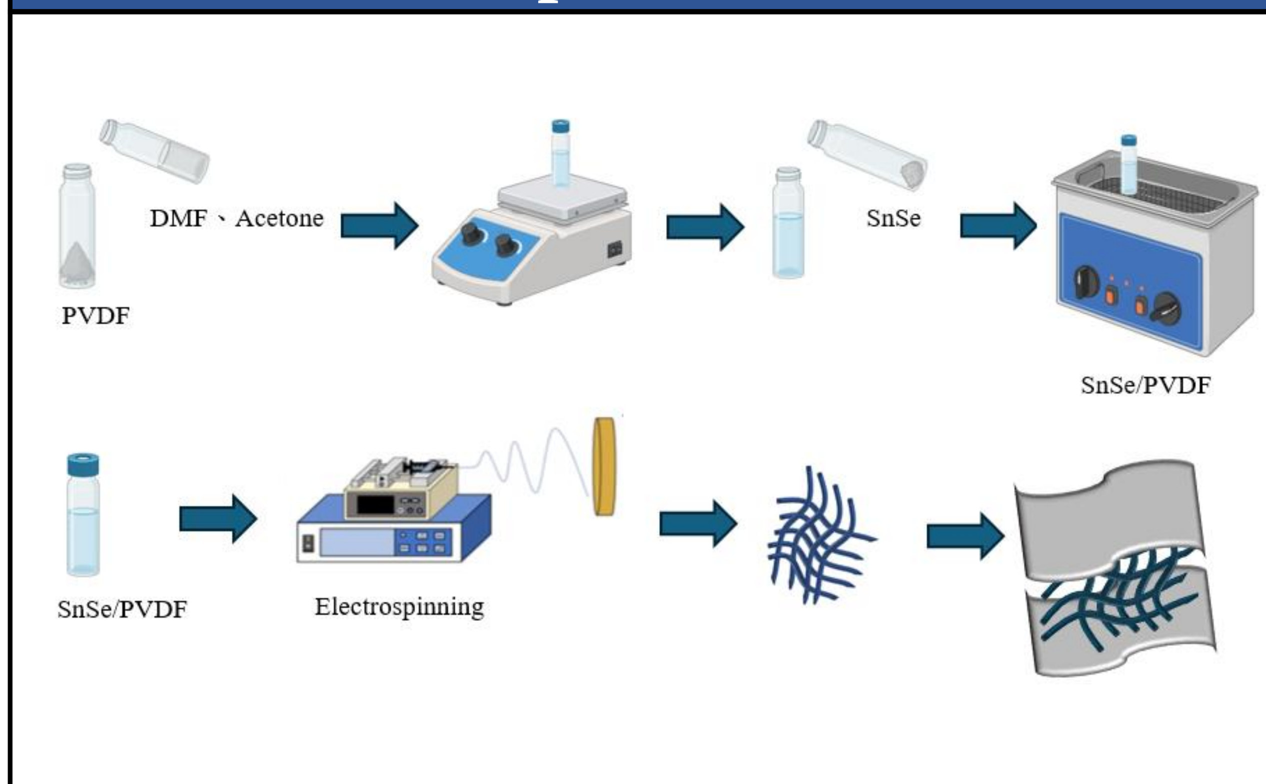
計畫編號: NSTC 113-2221-E-214-001-MY3、ISU-113-01-06A、ISU-113-MCRP-01

Introduction

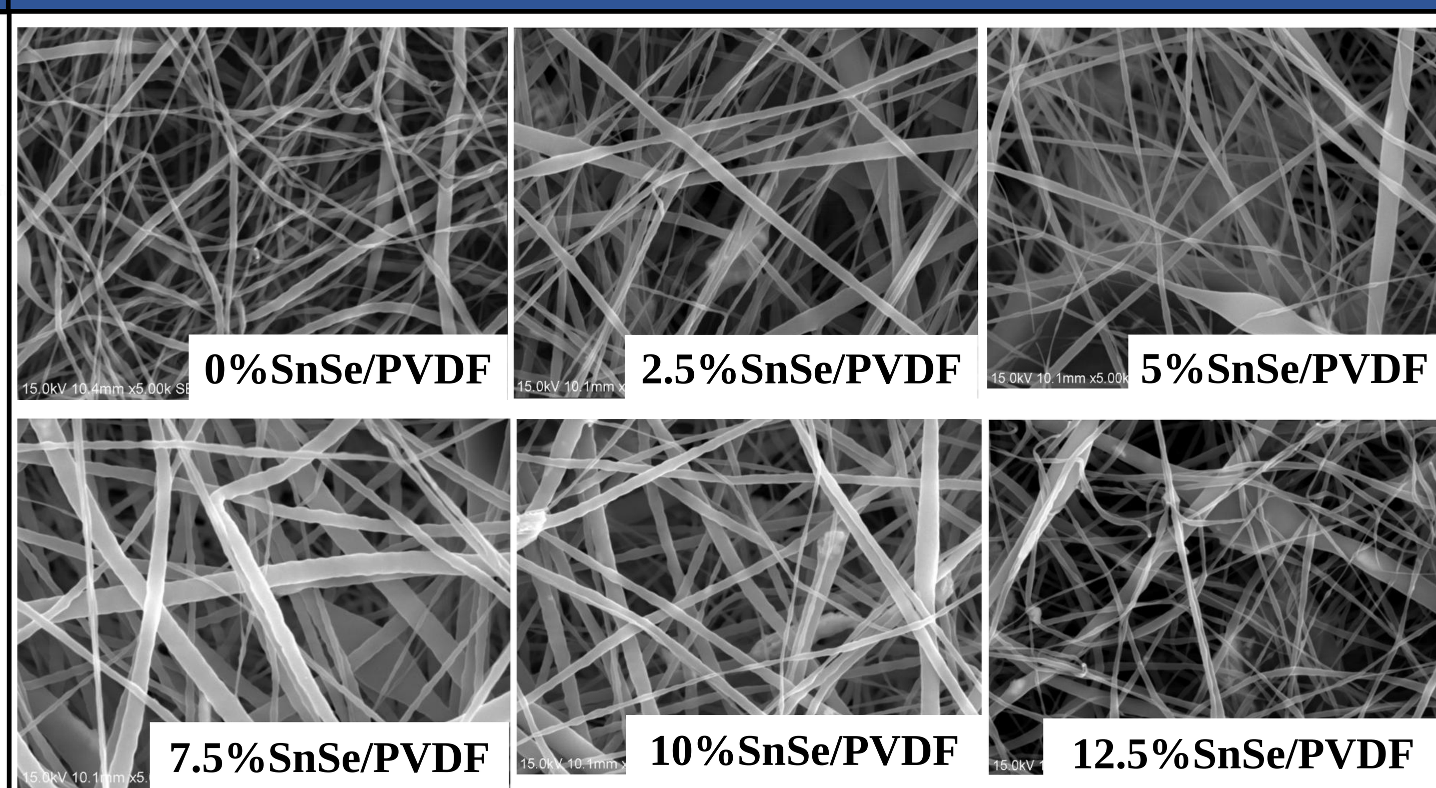
Abstract

本研究以廢熱再利用為基礎，開發了一種 SnSe/PVDF 奈米壓電熱釋電裝置。研究中，透過熱釋電材料 SnSe(硒化錫)以及高分子材料 PVDF (聚偏二氟乙烯) 結合，利用靜電紡絲技術製作出奈米纖維，使生活中的廢熱可以有效的轉為電能。我們分別找出壓電與熱釋電最佳濃度參數為 7.5% SnSe/PVDF、10% SnSe/PVDF，也測得複合材料在更廣的溫度範圍內具有穩定的熱性能和電性能。

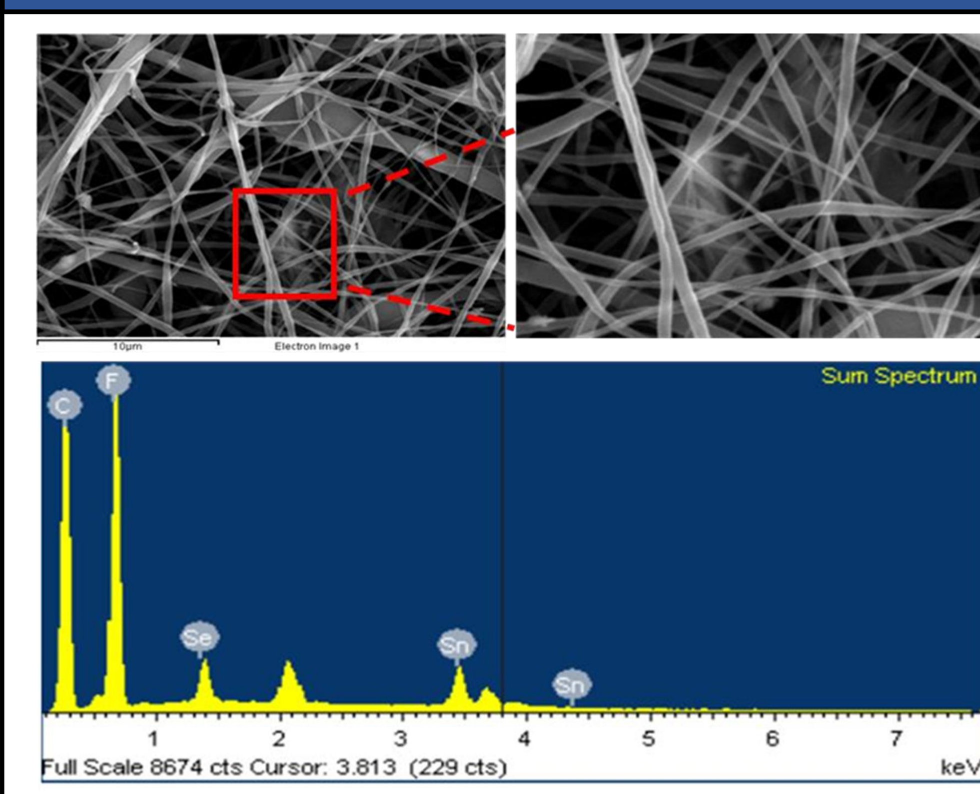
Experiment



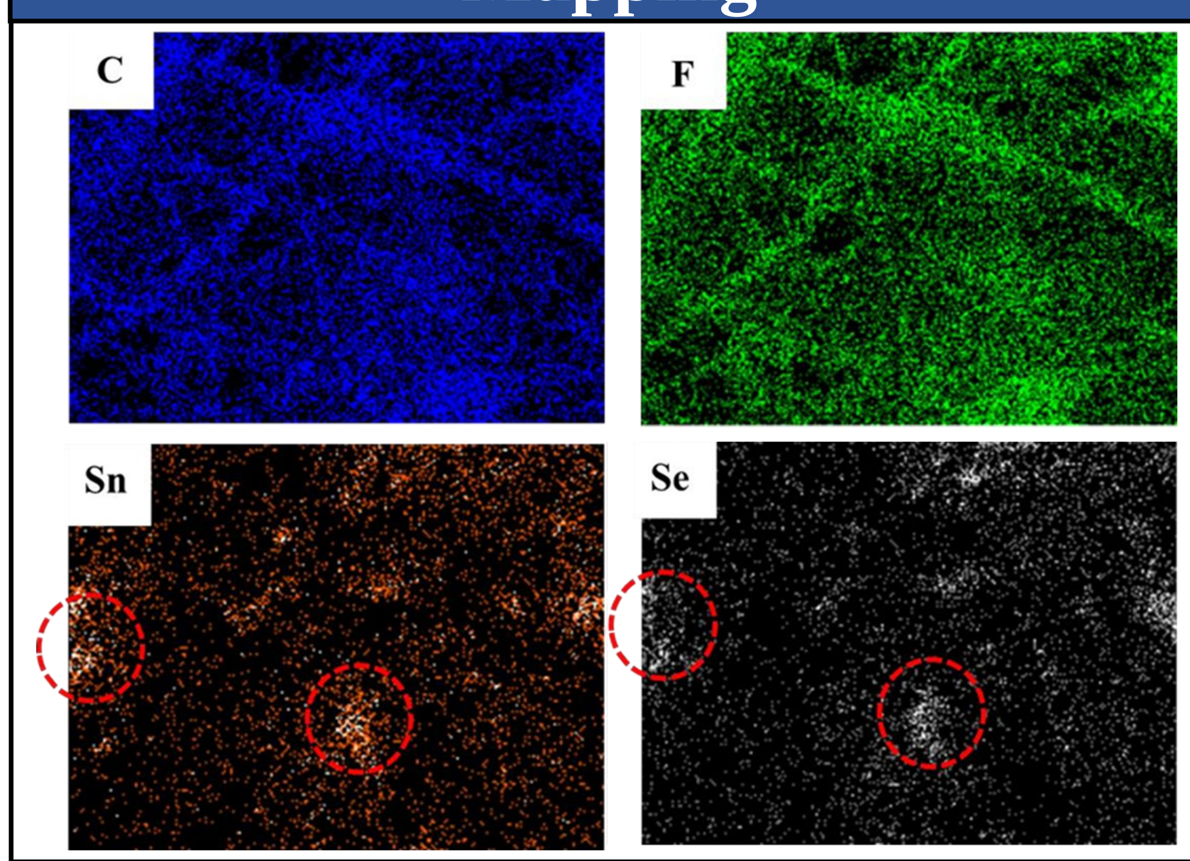
SEM



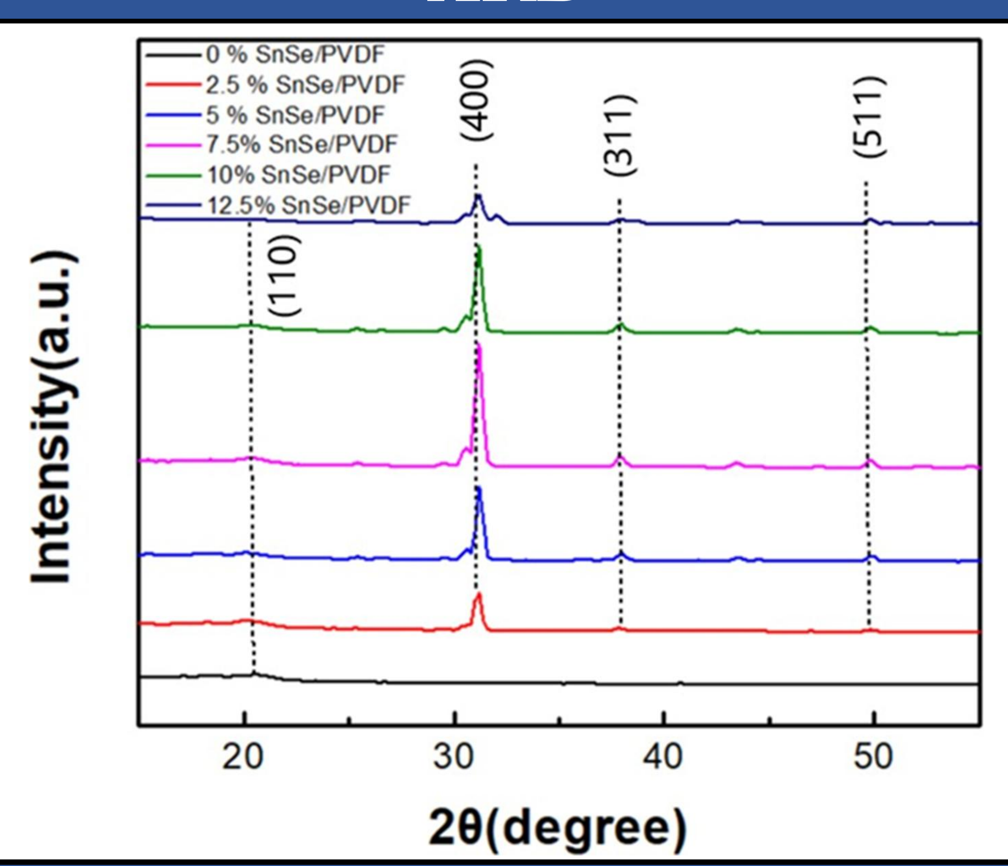
SEM / EDS



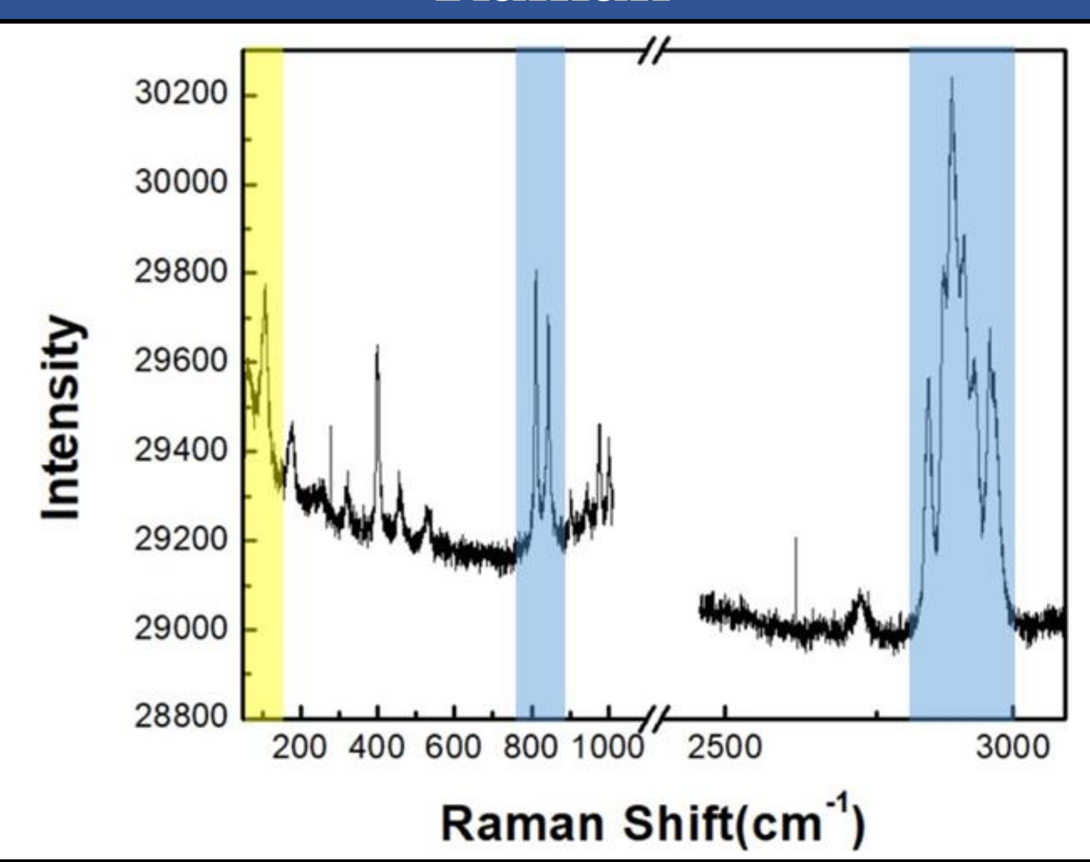
Mapping



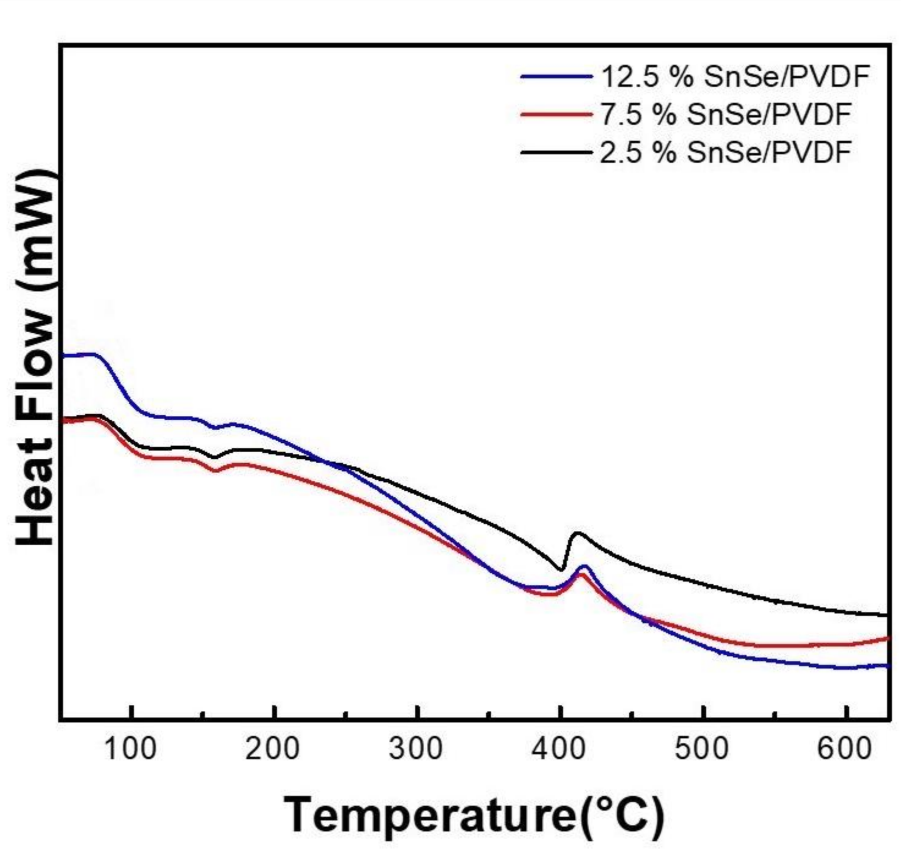
XRD



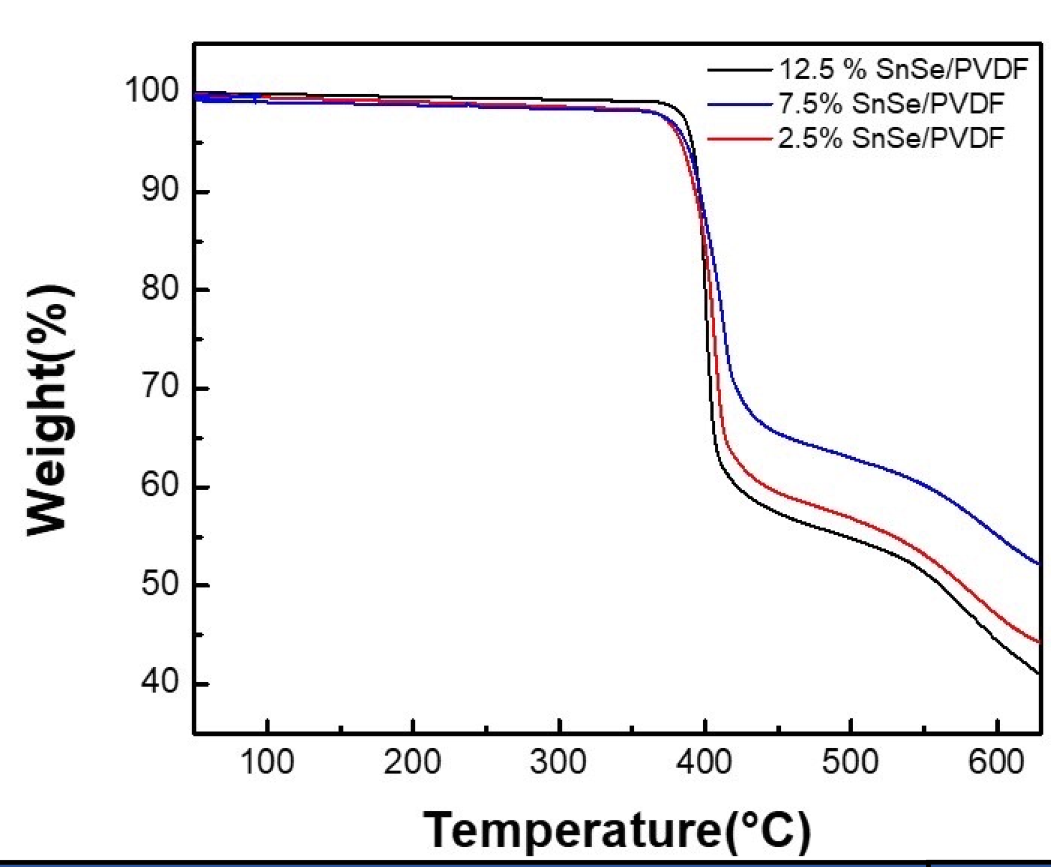
Raman



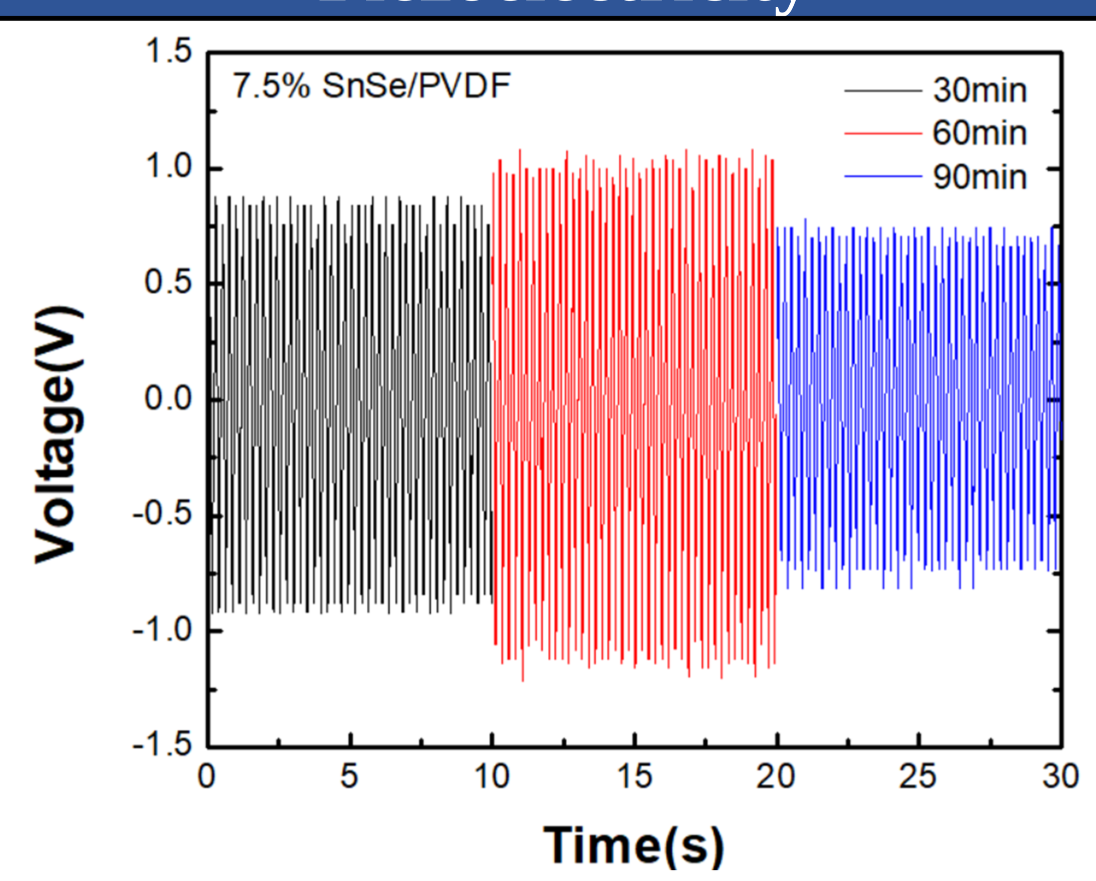
DSC



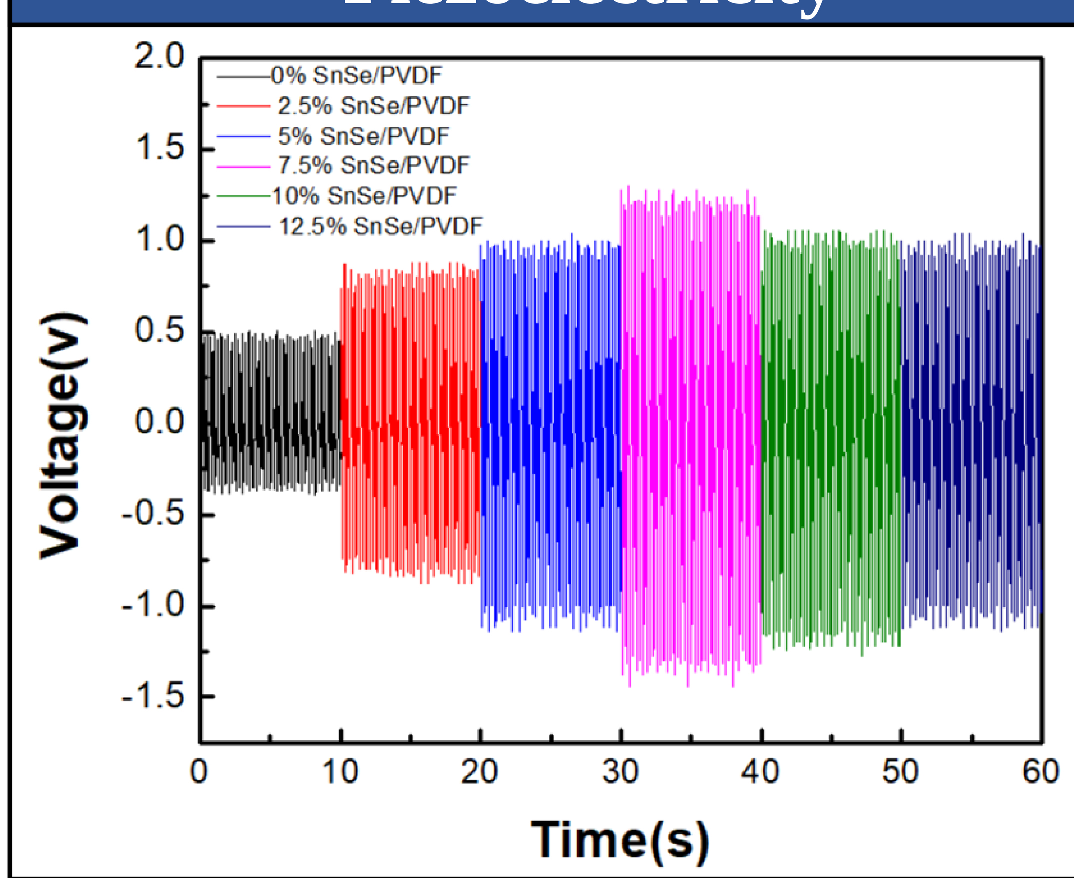
TGA



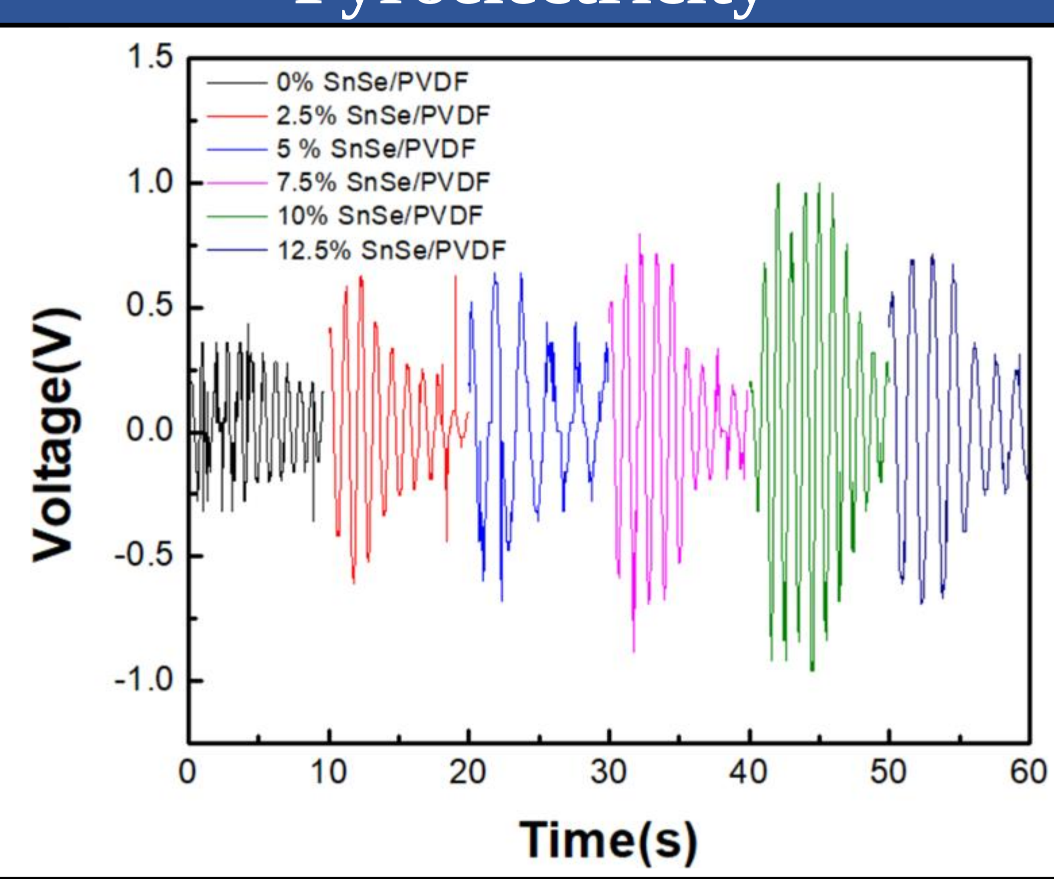
Piezoelectricity



Piezoelectricity



Pyroelectricity



Conclusion

1.本研究成功的利用高分子材料 PVDF (聚偏二氟乙烯) 以及熱釋電材料 SnSe(硒化錫) 結合，製作出同時具有壓電及熱釋電性能的元件。

2.分別找出壓電與熱釋電最佳濃度參數為 7.5% SnSe/PVDF 和 10% SnSe/PVDF。

3.得出 SnSe 添加進 PVDF 纖維裡能夠多方面得到優化，特別是熱穩定性、機械性質、電性性質的提升。

基於稻殼改性纖維素導電複合水凝膠之應用

The application of conductive composite hydrogels based on modified cellulose from rice husks.

周子宸、林軒楷、卓家榮*

義守大學化學工程系

Department of Chemical Engineering , I-Shou University

Email :卓家榮* ppaul28865@gmail.com

計畫編號:NSTC 113-2221-E-214-001-MY3、ISU-113-01-06A、ISU-113-MCRP-01

Introduction

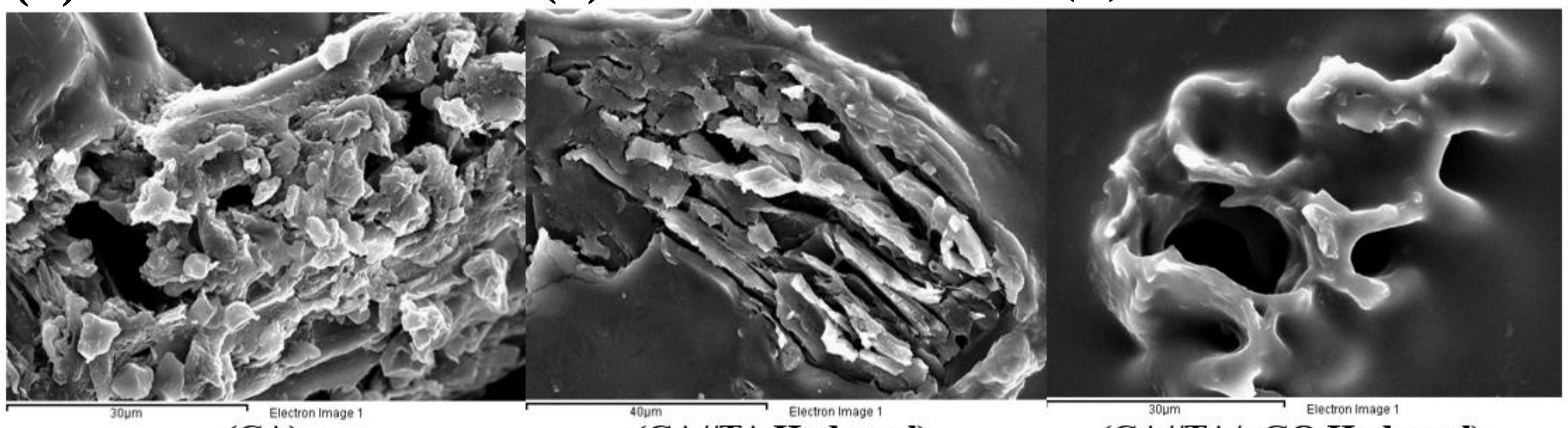
Abstract

- 永續材料在未來是一個重要的焦點，為了解決農業廢棄物過剩的挑戰，提出了一種高熱性質且對環境無害的纖維素導電水凝膠。
- 從稻殼中萃取出纖維素並將其改性為熱性質較好的醋酸纖維素，再將其導入導電水凝膠中。
- 具有高熱穩定性，高導電性(5.208 S/m)
- 由於nGO和CA之間的有效連接與均勻分散，此高分子複合材料也表現出卓越的熱穩定性，使其適合應用於更多地方。

Experiment

SEM

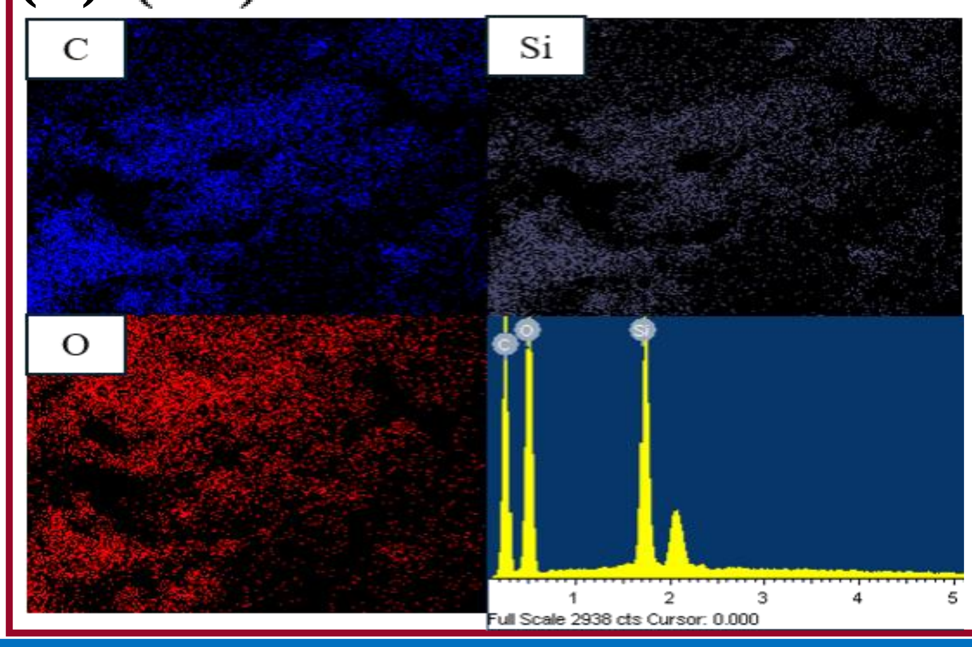
(A) (B) (C)



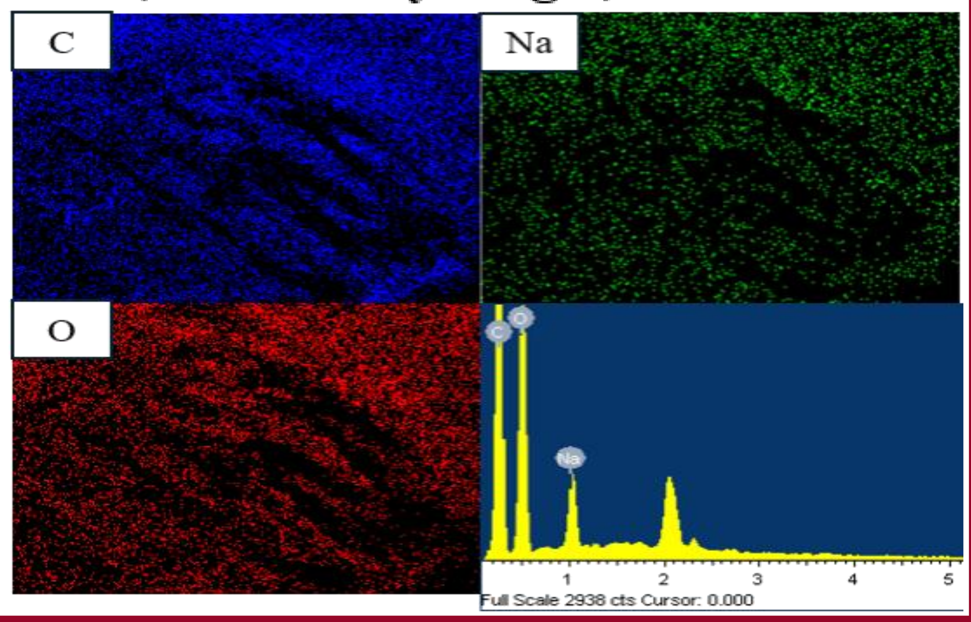
(CA) (CA//TA Hydrogel) (CA//TA/nGO Hydrogel)

EDS / Mapping

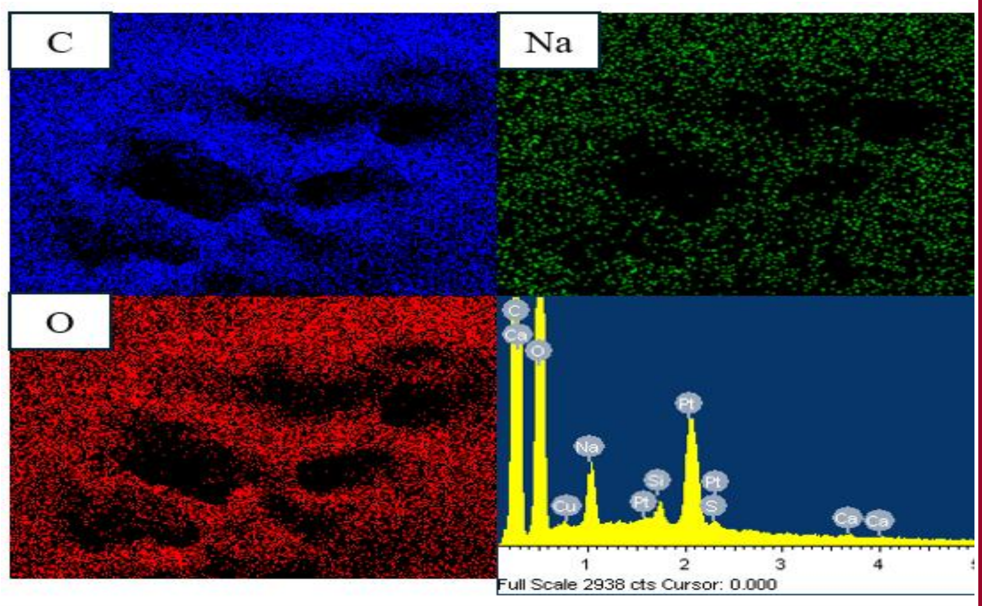
(A) (CA)



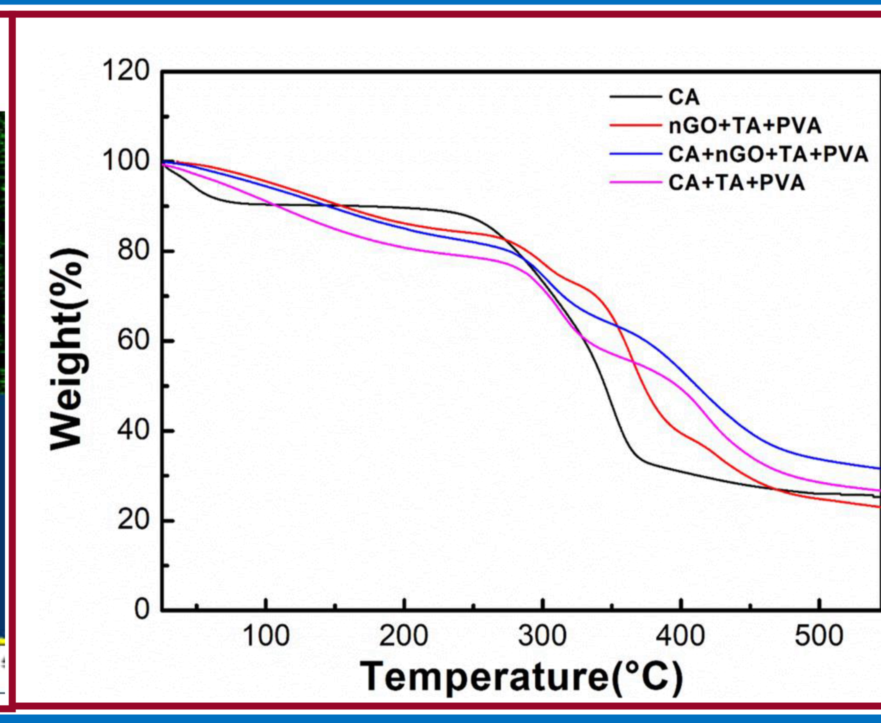
(B) (CA//TA Hydrogel)



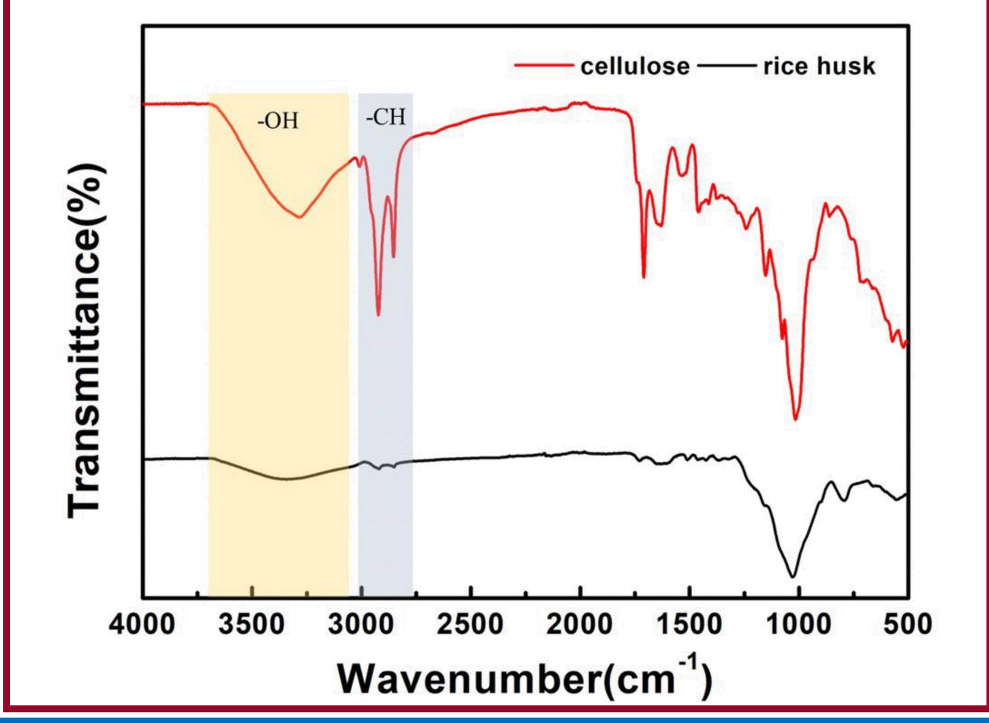
(C) (CA//TA/nGO Hydrogel)

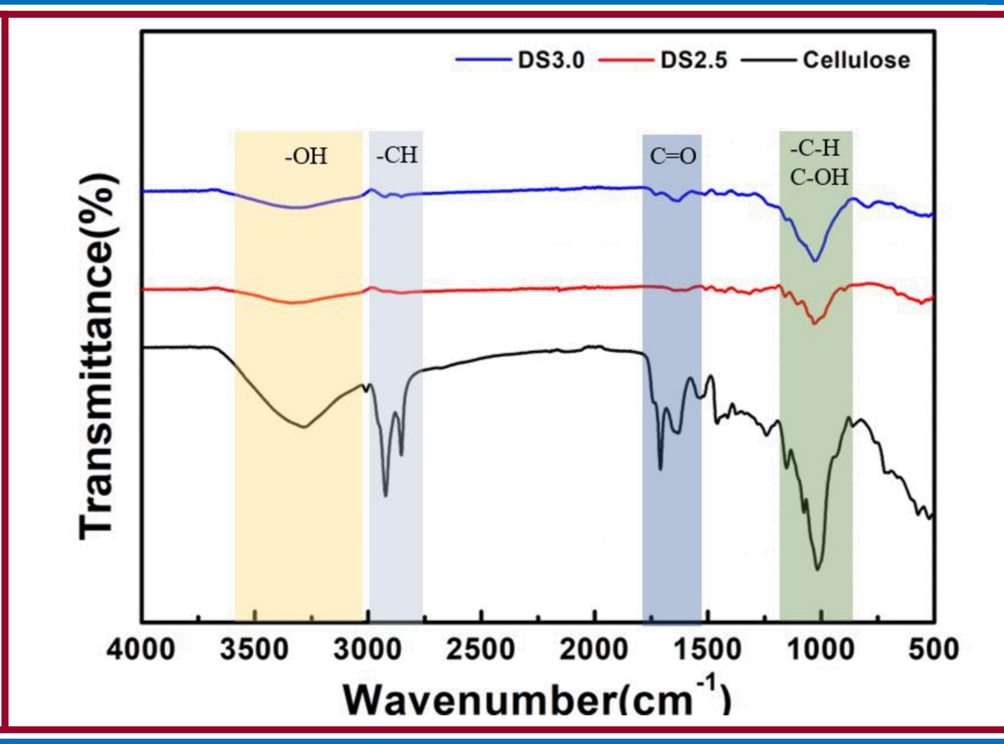


TGA

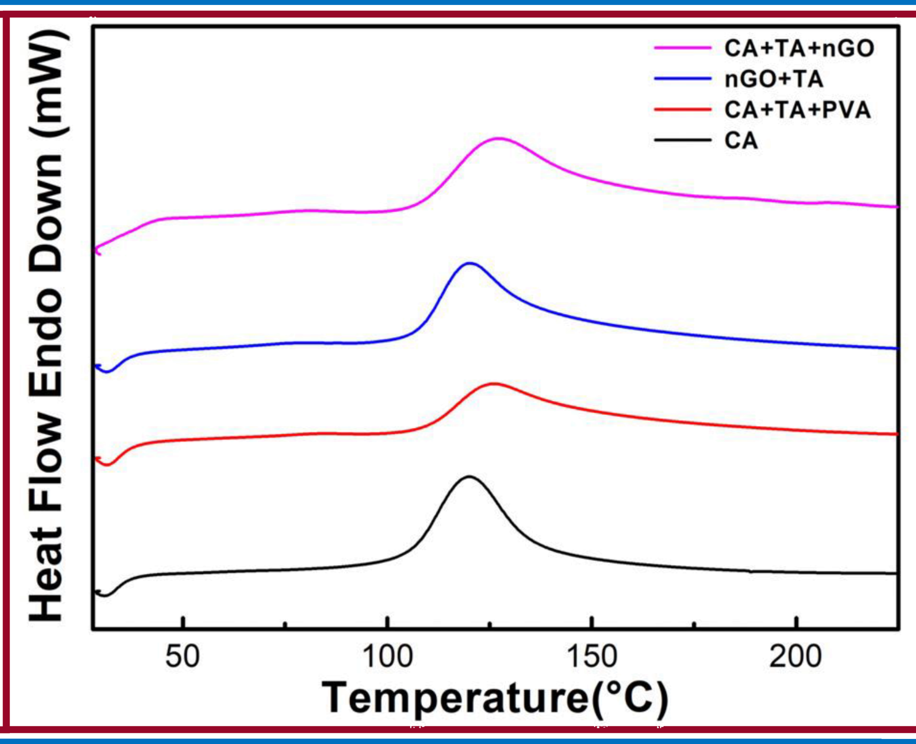


FTIR

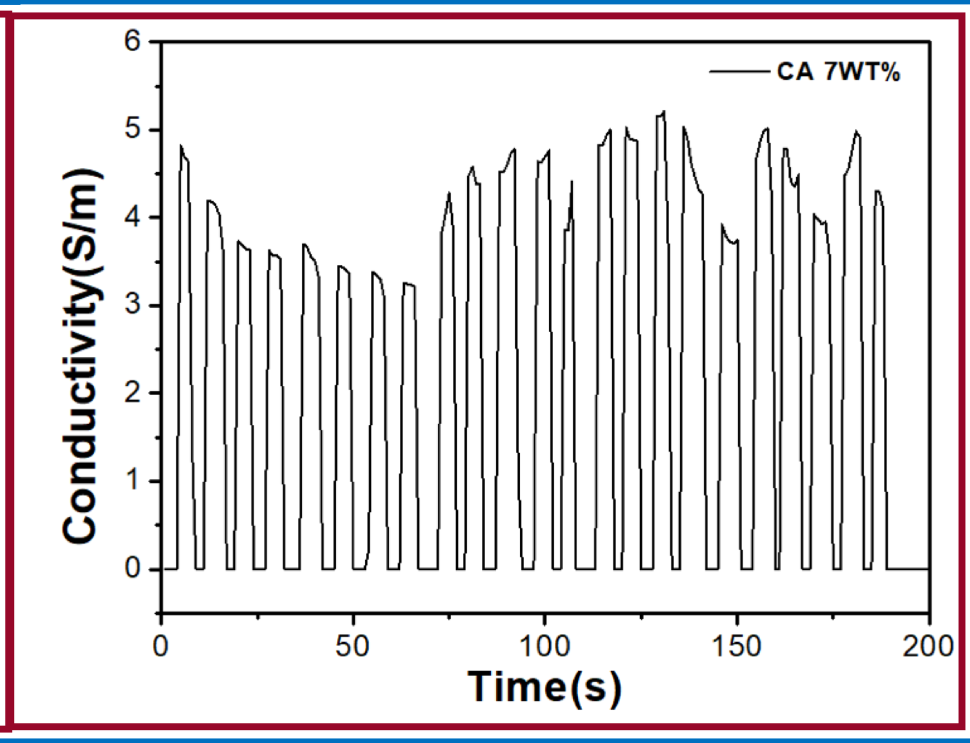




DSC



Electrical test



萬能試驗機(Tensile test)

(3cm~16.7cm，ε=456%) (3cm~>16.6cm，ε>453%) (3cm~<8.5cm，ε<183%)

Conclusion

- 成功將纖維素從稻殼中萃取出來，並將其改性為醋酸纖維素。
- 經由電源供應器進行多組測試，最大導電度達到(5.208 S/m)
- 該導電水凝膠展現了強大的機械性能、生物可降解性及環境友善性，為綠色能源提供了新的方向。

可循環生物廢棄物之魚鱗/Human hair TENG產電元件開發

Development of a Power Generation Device Using Recyclable Biowaste from Fish Scales and Human Hair for Triboelectric Nanogenerators (TENG)

陳玥霓、陳婷、呂沂儒、鄭珉欣、卓家榮*

Institute of Biotechnology and Chemical Engineering, I-Shou University

- **Email:** ppaul28865@gmail.com

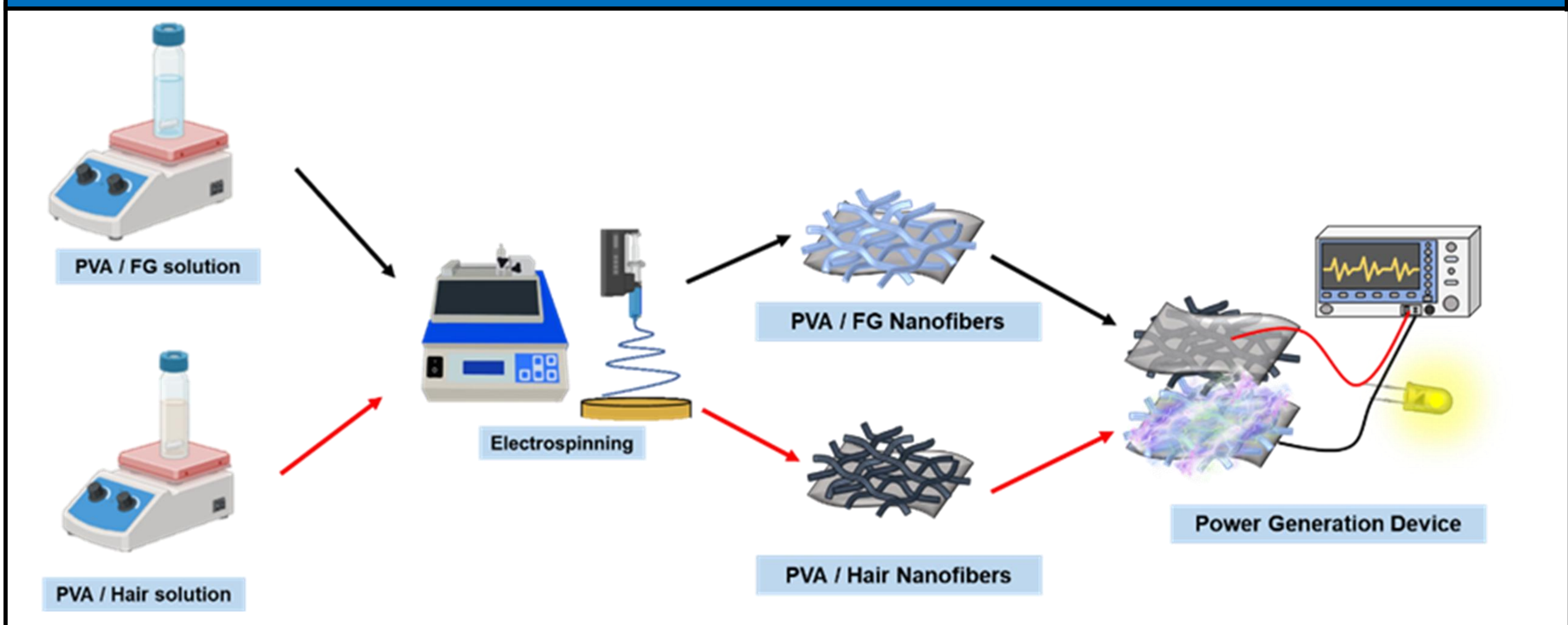
計畫編號: NSTC 113-2221-E-214-001-MY3、ISU-113-01-06A、ISU-113-MCRP-01

Introduction

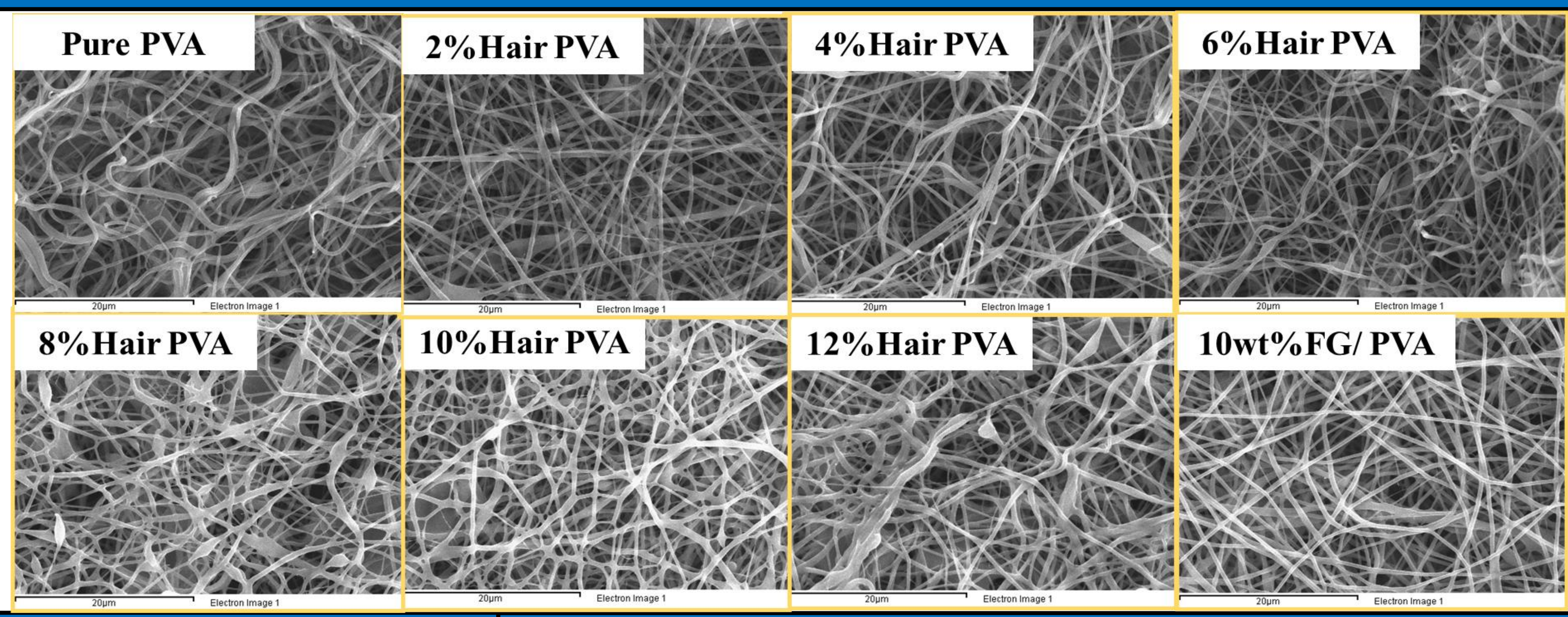
Abstract

本研究成功製備出了魚鱗明膠纖維並透過摩擦起電與靜電感應的耦合從而將機械能轉換成電能，擁有高穩定性、出色的靈敏度、低成本、環保等優點，極大機率能夠延長其壽命並且可以成為未來創能電池。通過添加處理後的頭髮和魚鱗明膠，可以明顯提高摩擦奈米發電機的性能，特別是在10%添加量下，電流和電壓增加兩倍。最後將設計出的摩擦奈米發電機，應用於腳步動態偵測上，也能明確的提供腳步動態資訊，提供了一種兼具環保且機能雙效的新材料。

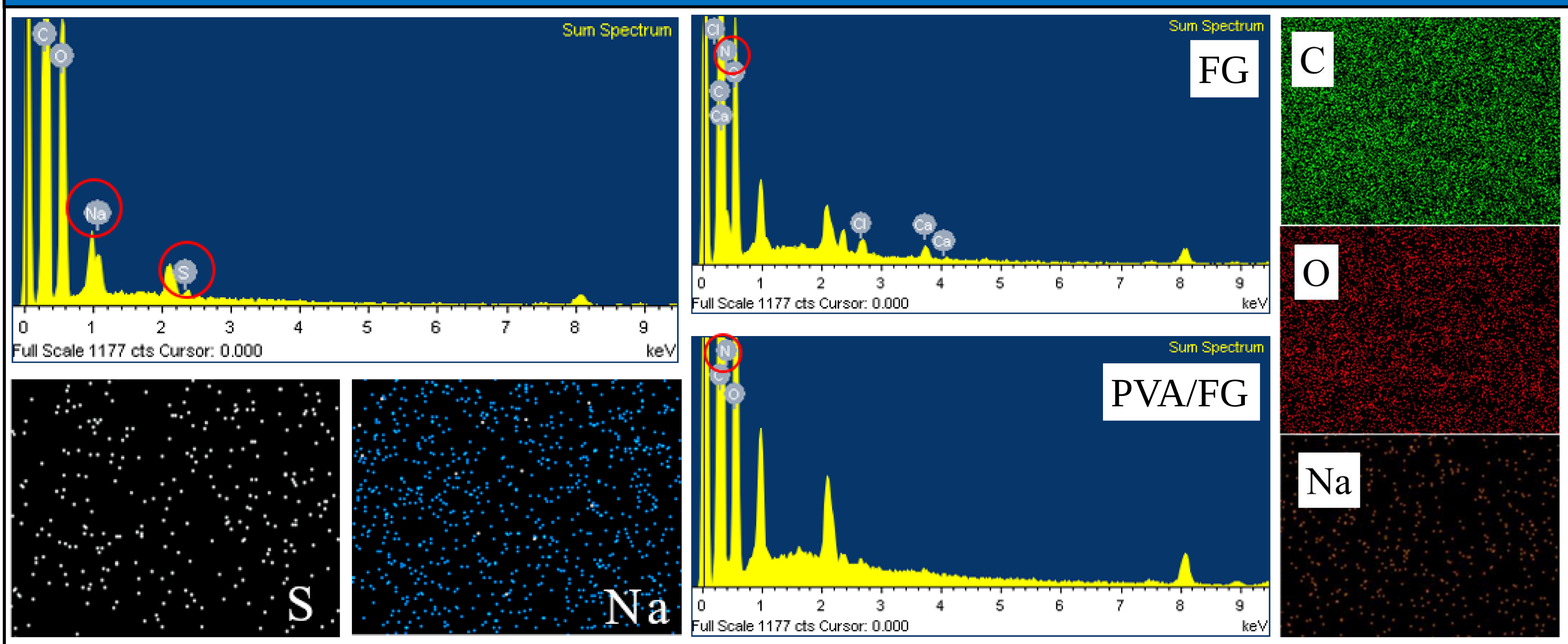
Experimental



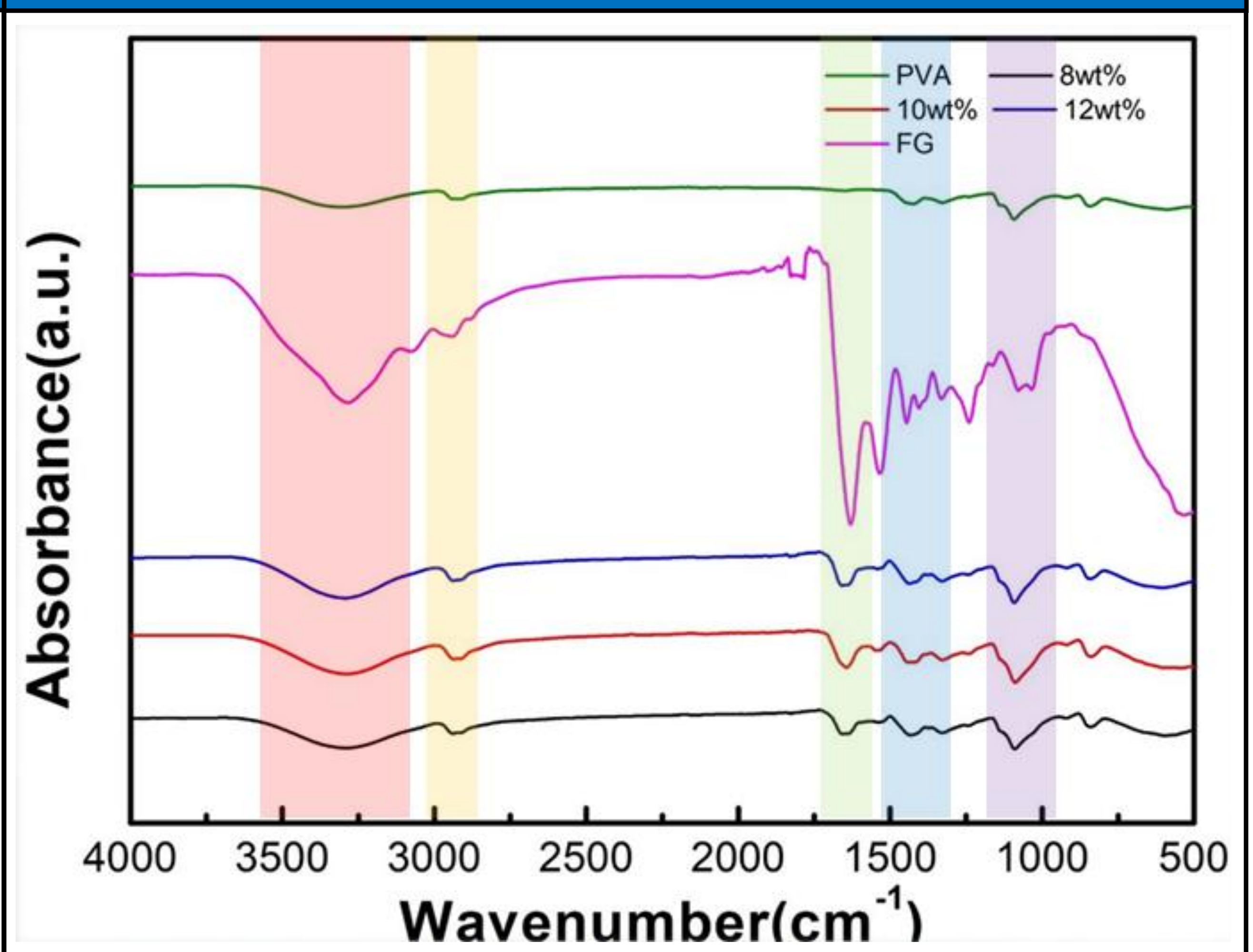
SEM



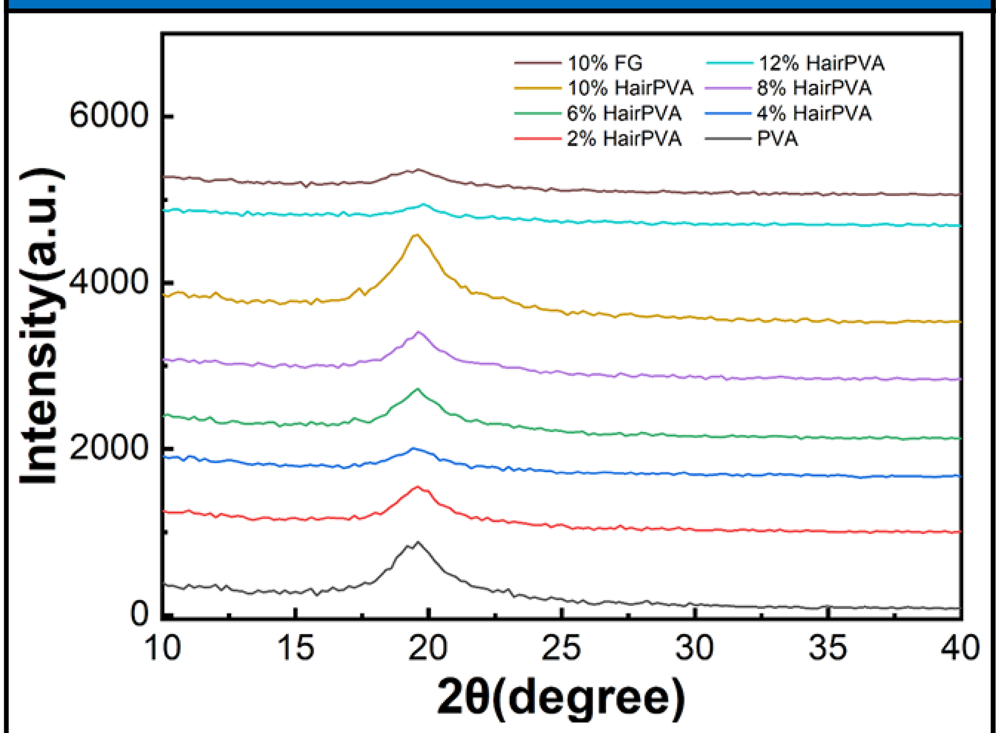
EDS 、 Mapping



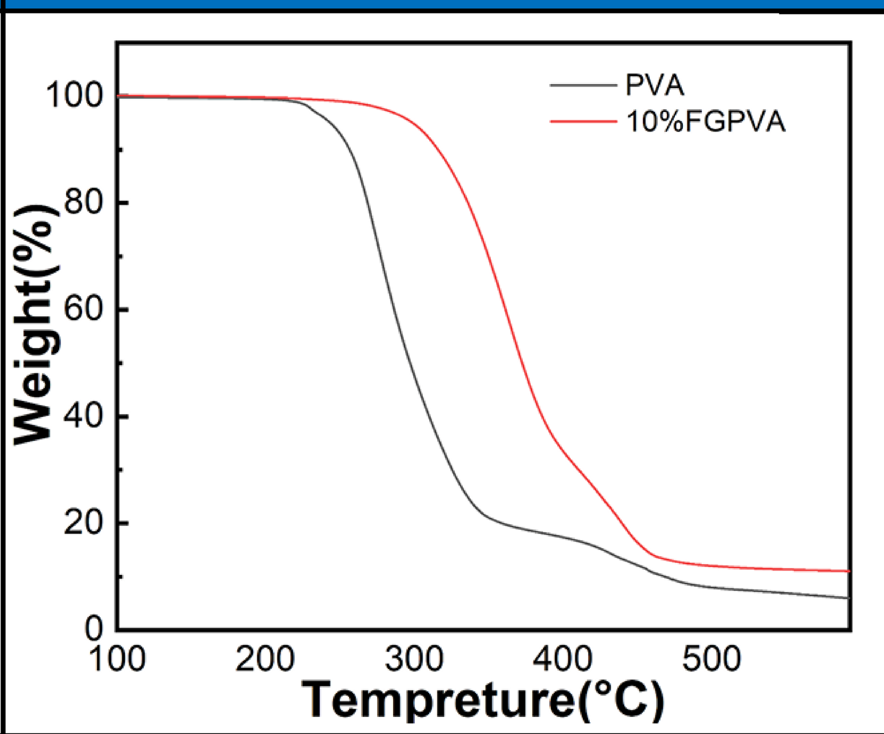
FTIR



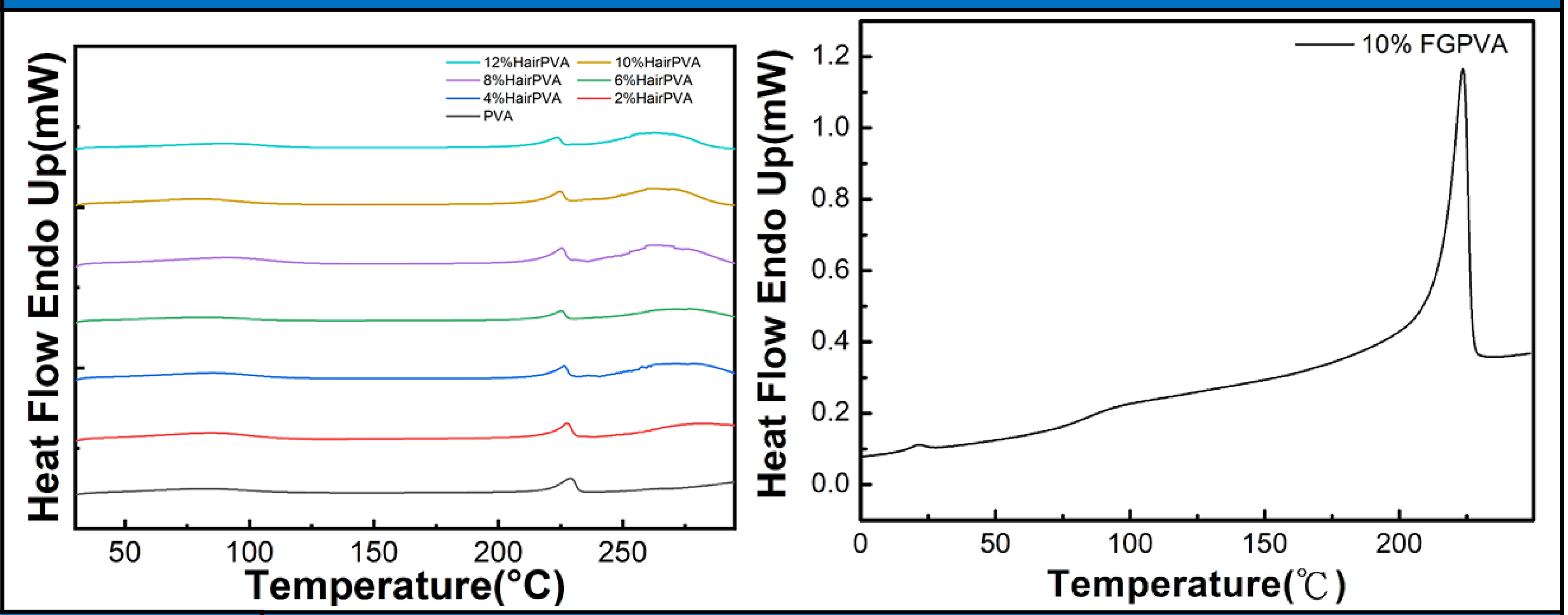
XRD



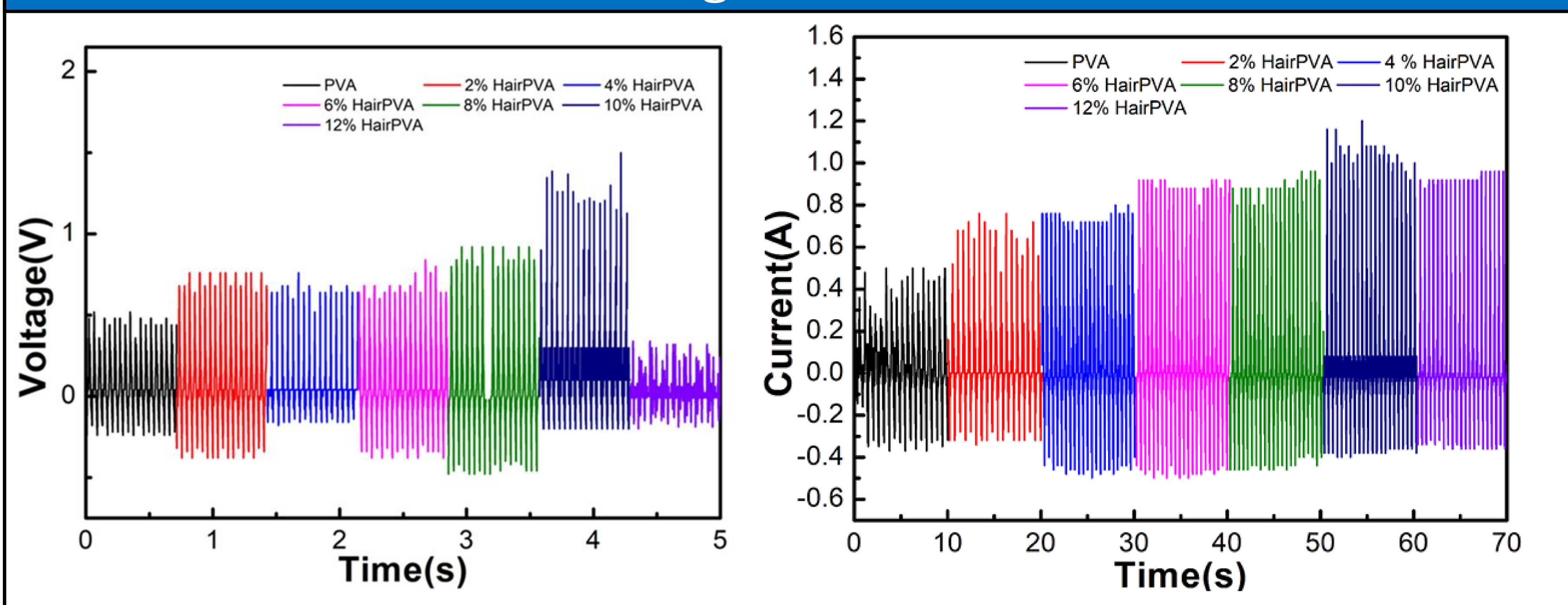
TGA



DSC



Voltage、Current



Conclusion

1. TENG的負摩擦層是利用廢棄魚鱗中的魚明膠所製備而成，善用這些廢棄物來降低對環境的壓力，成為具有生物循環經濟的TENG。
2. 添加10 %的HairPVA後，會獲得最大的電壓、電流值，分別為1.8V和1.4A。
3. 我們將Human hair/PVA 纖維與魚鱗明膠纖維結合，將TENG結構轉化為輕量化電源，在未來的生物醫學、環保材料及可再生能源領域中展現出更大的應用潛力。

創新特點 ✓ 首創32%乙烯含量EVAL薄膜配方 ✓ 整合無線電化學檢測平台 ✓ 可重複使用5次以上的分子印跡電極 ✓ 真實樣品中達98%檢測準確率
創新特點 ✓ 首創32%乙烯含量EVAL薄膜配方 ✓ 整合無線電化學檢測平台 ✓ 可重複使用5次以上的分子印跡電極 ✓ 真實樣品中達98%檢測準確率

Wireless Electrochemical Platform with Molecularly Imprinted Polymers for Dopamine Detection in Clinical Neurological Samples

結合分子拓印技術的無線電化學感測平台應用於臨床神經樣本中多巴胺的檢測

Yi-Yun Hsu(許議云)[1]、Mei-Hwa Lee[2,*]
[1]Department of Chemical Engineering, I-Shou University
[2]Department of Materials Science and Engineering, I-Shou University
NSTC111-2221-E-214-001-MY3

Abstract

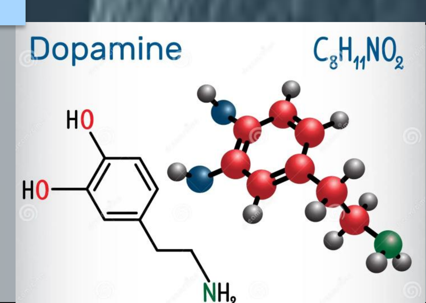
Dopamine plays a crucial role in the central nervous system as both a neurotransmitter and hormone. Abnormal levels are associated with neurological disorders such as Parkinson's disease and schizophrenia, highlighting the need for precise dopamine monitoring. In this study, molecularly imprinted thin films based on ethylene-vinyl alcohol (EVAL) copolymers were fabricated via wet casting, with dopamine as the template. Among **copolymers** with varying ethylene contents, **32% EVAL** exhibited the best sensing performance at a dopamine imprinting concentration **of 10 pg/mL**. The sensor achieved up to **98% accuracy** in real sample testing. Coupled with a wireless electrochemical platform, this system offers high specificity, sensitivity, and cost-efficiency, showing strong potential for early detection and monitoring of neurological diseases.

Keywords: dopamine, wireless electrochemical sensor, molecular imprinting technology, ethylene-vinyl alcohol (EVAL) copolymer

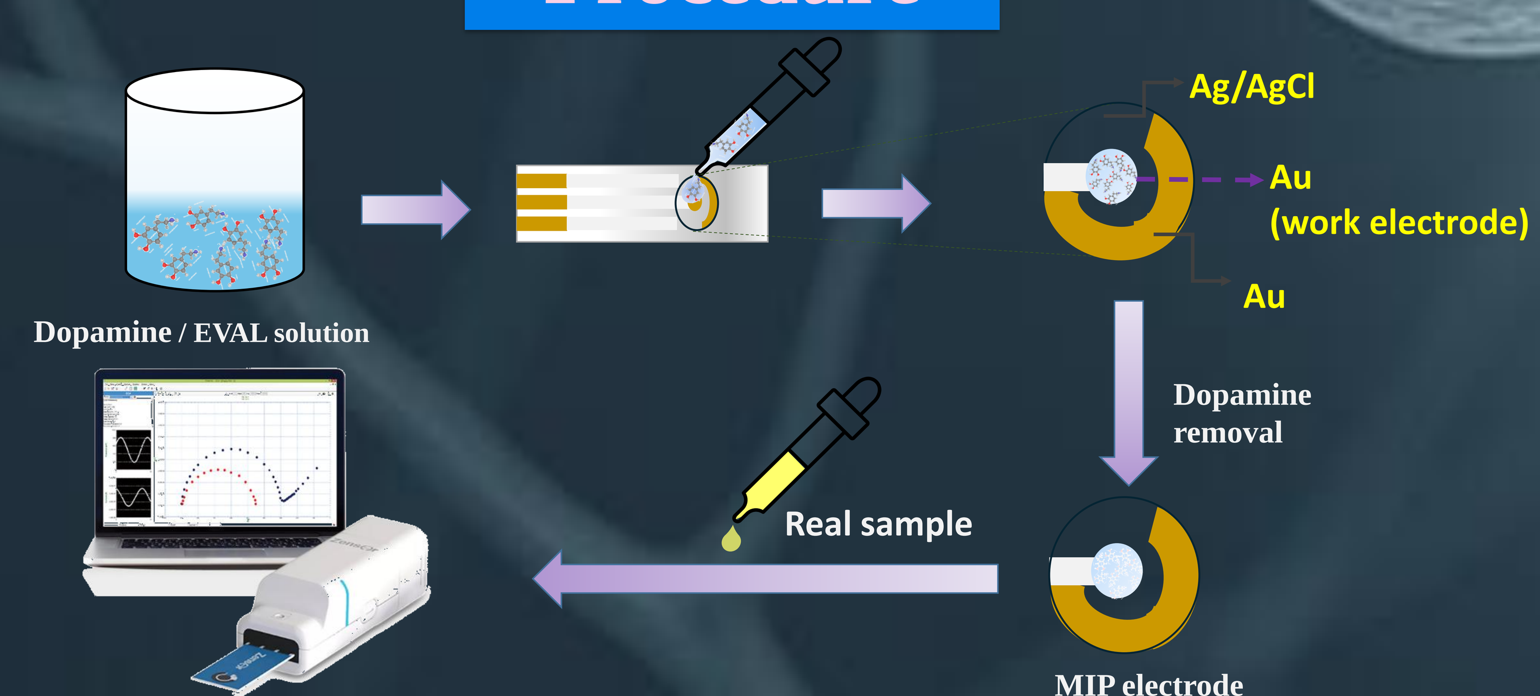
創新特點

1. 首創32%乙烯含量EVAL薄膜配方
2. 整合無線電化學檢測平台
3. 可重複使用5次以上的分子拓印電極
4. 真實檢體 ➡ 達98%檢測準確率
5. 檢測快速(約5分鐘)、簡單、居家檢測

Target Molecule

Chemical Formula	**多巴胺 (Dopamine)** https://cn.dreamstime.com/%E5%A4%9A%E5%B7%B4%E8%83%BAda%E5%88%86%E5%AD%90-%E7%BB%93%E6%9E%84%E5%8C%96%E5%AD%A6%E5%BC%8F%E5%92%8Cmolecul-image121150784	
Functions	Dopamine is a neurotransmitter involved in motor control, reward, sleep, appetite, mood, attention, cognition, sensory perception, hormone regulation, and autonomic nervous system function.	

Procedure



Results

1. 乙烯含量EVAL選擇

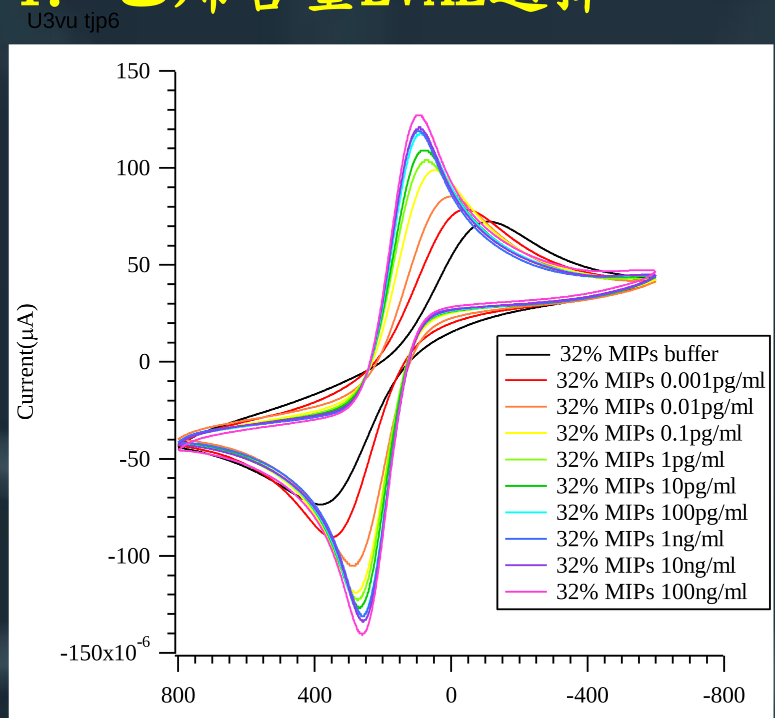


Figure 1. Dopamine concentration analysis using cyclic voltammetry (MIP)

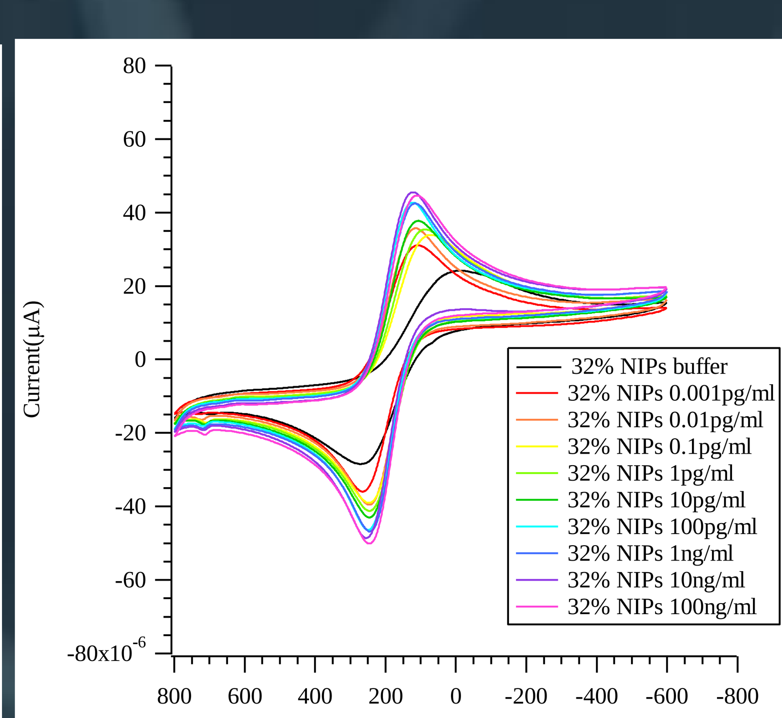


Figure 2. Potassium ferricyanide concentration analysis using cyclic voltammetry (NIP)

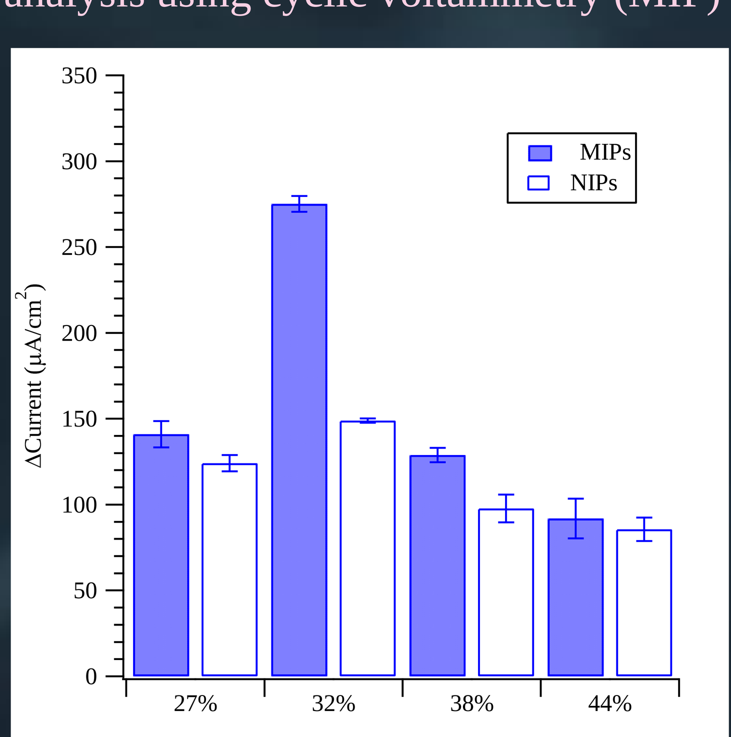


Figure 3. Imprinting efficiency of dopamine-imprinted polymer films on electrodes with varying ethylene content

	MIP (μA)	NIP(μA)	α
27%	137.61	115.79	1.19
32%	260.0	182.06	1.43
38%	125.89	97.73	1.29
44%	83.75	59.84	2.2

- Imprinting efficiency (α)= Adsorption amount of MIPs / Adsorption amount of NIPs

Results

2. 感測器檢量線

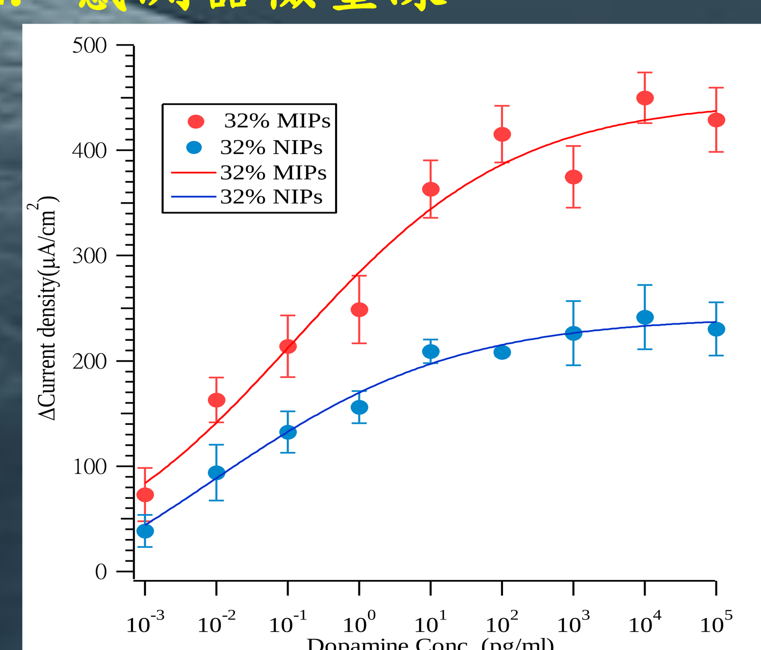


Figure 4. Calibration curve of dopamine concentration for 32% EVAL

3. 感測器重複使用性

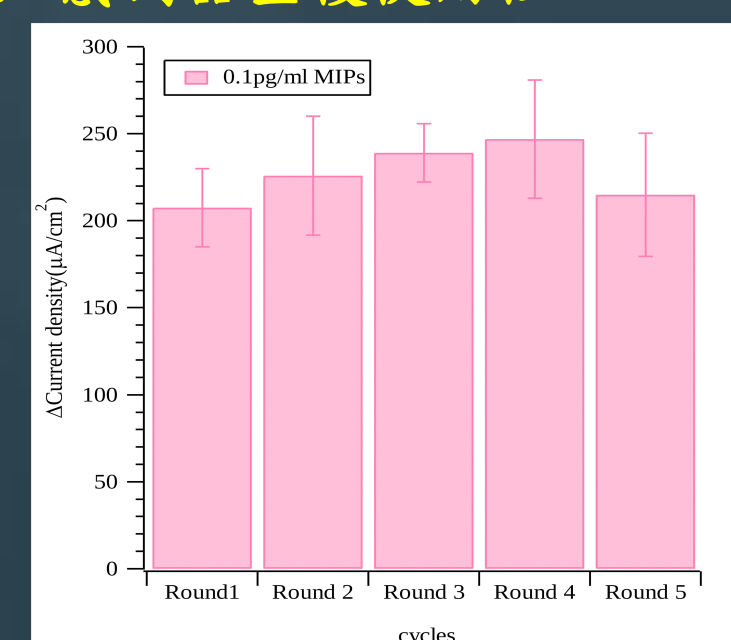
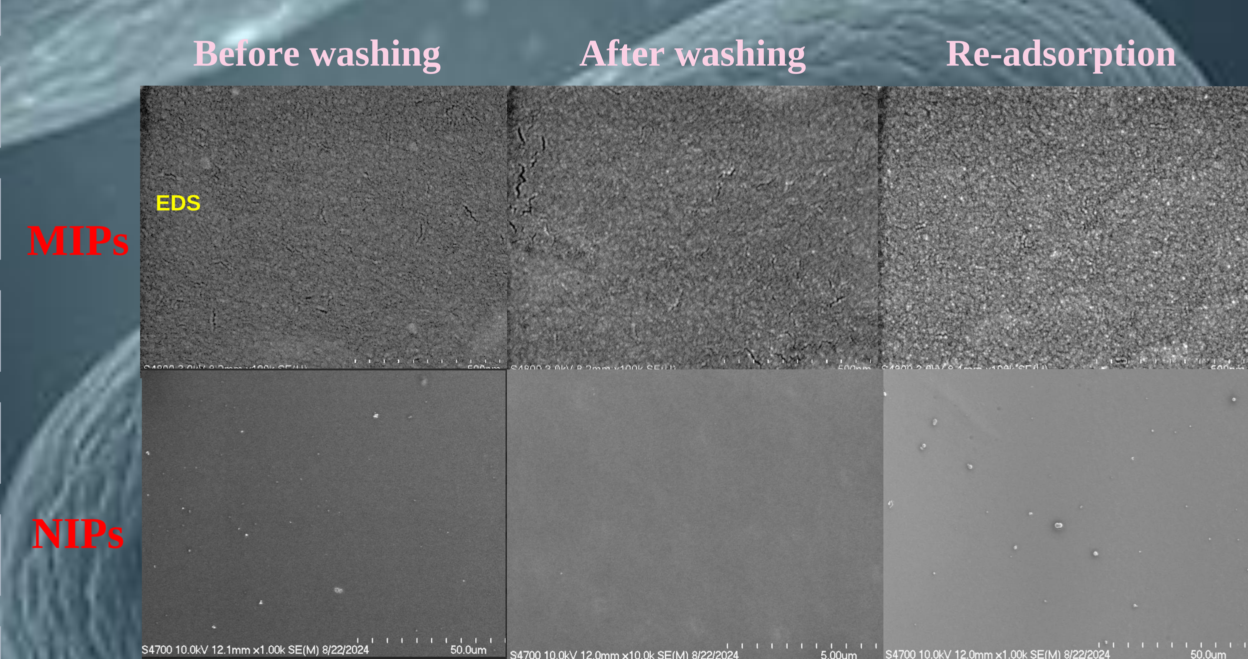


Figure 5. Reusability of dopamine-imprinted polymer film electrodes

4. 材料分析（SEM, EDS）



MIPs	C	N	O
Before washing	80.50	4.81	14.69
After washing	80.26	1.60	18.14
Re-adsorption	83.47	3.99	12.54

NIPs	C	N	O
Before washing	78.91	0.95	20.13
After washing	78.10	0.32	21.58
Re-adsorption	78.41	0.61	20.9

Figure 6. SEM image of 32% EVAL dopamine-imprinted polymer film

5. 真實檢體檢測

Dilution Factor of Biological Samples	ΔC (μA/cm2)	Concentration (pg/mL)	Accuracy (%) 準確率
1000	299.28	1701.88	94.55
	298.48	1654.1	91.89
	298.08	1630.49	90.58
	296.31	1531.42	85.08
10000	230.46	1771.18	98.4
	229.47	1717.2	95.4
	228.9	1687.1	93.73
	228.48	1664.84	92.49
	227.63	1621.2	90.07
	226.71	1575.3	87.52

Conclusion

This study targets dopamine as the analyte of interest and utilizes EVAL-based materials to fabricate a molecularly imprinted sensor electrode for **rapid** and **cost-effective detection**. The main experimental findings are as follows:

1. **The electrode containing 32 mol% EVAL exhibited the best dopamine recognition**, with an imprinting factor (α) of 1.85, indicating excellent performance.
2. **The sensor demonstrated a detection range from 6.53 fM to 65.3 pM**, reflecting high sensitivity toward ultra-low dopamine concentrations.
3. **The dopamine-imprinted EVAL electrode was reusable up to five times** without significant loss in performance.
4. **In neuronal secretome samples, the sensor achieved 98% accuracy in dopamine detection**, confirming its high selectivity.
5. **In real sample testing, the sensor achieved 90% accuracy at 1000-fold dilution and 98% accuracy at 10,000-fold dilution**, demonstrating strong robustness and reliability.

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保存溫度對鮑氏不動桿菌之噬菌體殘存活性之研究

Study on the effects of storage temperature on the phage residual viability of *Acinetobacter baumannii*

Hui-Chieh Cheng (鄭卉婕), Yi-Hsuan Huang (黃怡萱), Chin-Hsin Hung (洪志勳)*
Department of Chemical Engineering, I-Shou University, Kaohsiung 84001, Taiwan
*Email: chhung@isu.edu.tw

鮑氏不動桿菌 (*Acinetobacter baumannii*) 俗稱 AB 菌。由於抗生素的濫用以及細菌的演化，具多重抗藥性的鮑氏不動桿菌不斷的增加，進一步加劇了其的威脅性，因此噬菌體可作為新的治療策略。雖然噬菌體療法維康生素無效時的另一個選擇，但目前並沒有一個良好的長期儲存方式，而目前常見的保存方式，液態培養基保存、甘油保存、液態氮保存、噴霧乾燥、冷凍乾燥等，皆存在各種不同的缺點，如過程複雜、成本過高、保存狀態不穩定等。本實驗使用五株鮑氏不動桿菌噬菌體 (ϕ163, ϕ455, ϕ327, ϕ454, ϕ403) 進行保存期限測試，以測試噬菌體於不同溫度條件下的活性，做為噬菌體治療及噬菌體商品化保存條件參考。根據研究結果顯示，若噬菌體需進行長期保存且較無成本壓力，適合儲存於 -80℃ 或是 -20℃ 的環境中，但存放於 -20℃ 時需添加甘油以提高其穩定度。若是須進行短期儲存且須控制成本時，則適合儲存於 4℃ 的環境。室溫環境的存放活性開始下降，不適合作為噬菌體儲存的環境。

簡介

目前常見的噬菌體保存方式包含了，液態培養基保存、甘油保存、液態氮保存、噴霧乾燥、冷凍乾燥等。液態培養基保存即是將噬菌體置於液態培養基中，存放於 4℃ 環境，可保存數月。甘油保存是將噬菌體添加總體積 20% 至 50% 的 87% 甘油，作為保護噬菌體在凍結過程之結構完整性 。

本實驗將探討鮑氏不動桿菌之噬菌體在 -80°C、-20°C、室溫、4°C 及 37°C 及 -80°C、-20°C添加甘油等條件下，測試噬菌體的保存期限，從而得知最合適且簡單的存方法，以降低保存成本利於噬體商品化使用。

材料與方法

菌株及噬菌體製備

本研究使用 8 株 *A. baumannii* 皆從義大醫院分離出來。本研究使用之噬菌體 ϕ163、ϕ165、ϕ327、ϕ403、ϕ453、ϕ454 及 ϕ455 是於義大醫院廢水分離出來。將隔夜培養之 *A. baumannii* 菌液以 1:30 之比例加入 100 ml 液態培養基 (LB medium) 中，於 37°C，200 rpm 震盪培養至 OD_{600} 約為 1 時，再個別加入噬菌體使 MOI = 0.1。受噬菌體感染之菌液置於 37°C，200 rpm震盪培養 3 小時，以 14,170×g 離心 20 分鐘後取上清液，以 0.45 μm filter 過濾後測其濃度後備用。

噬菌體濃度測試

取隔夜培養之 *A. baumannii* 菌液 (OD_{600}=3)100 μl 與 100 μl 適當稀釋之噬菌體溶液，加入 5 ml 之半固態培養基 (soft agar) 中，混合均勻後倒至含有ampicillin (50 mg/ml) 之固態培養基 (LA plate)，待凝固後將其置於 37°C 培養箱培養至隔夜，以溶菌斑形成數量推算噬菌體濃度。

噬菌體保存溫度測試

不含甘油組的噬菌體溶液，置於 –80°C 及 –20°C、4°C、室溫 (RT) 及 37°C 環境保存。含甘油組的噬菌體溶液為添加 50 wt% 之 87% 甘油，置於 -80°C 及 –20°C 環境保存。每 2 週取樣測定噬菌體活性一次，持續22 週。

結果

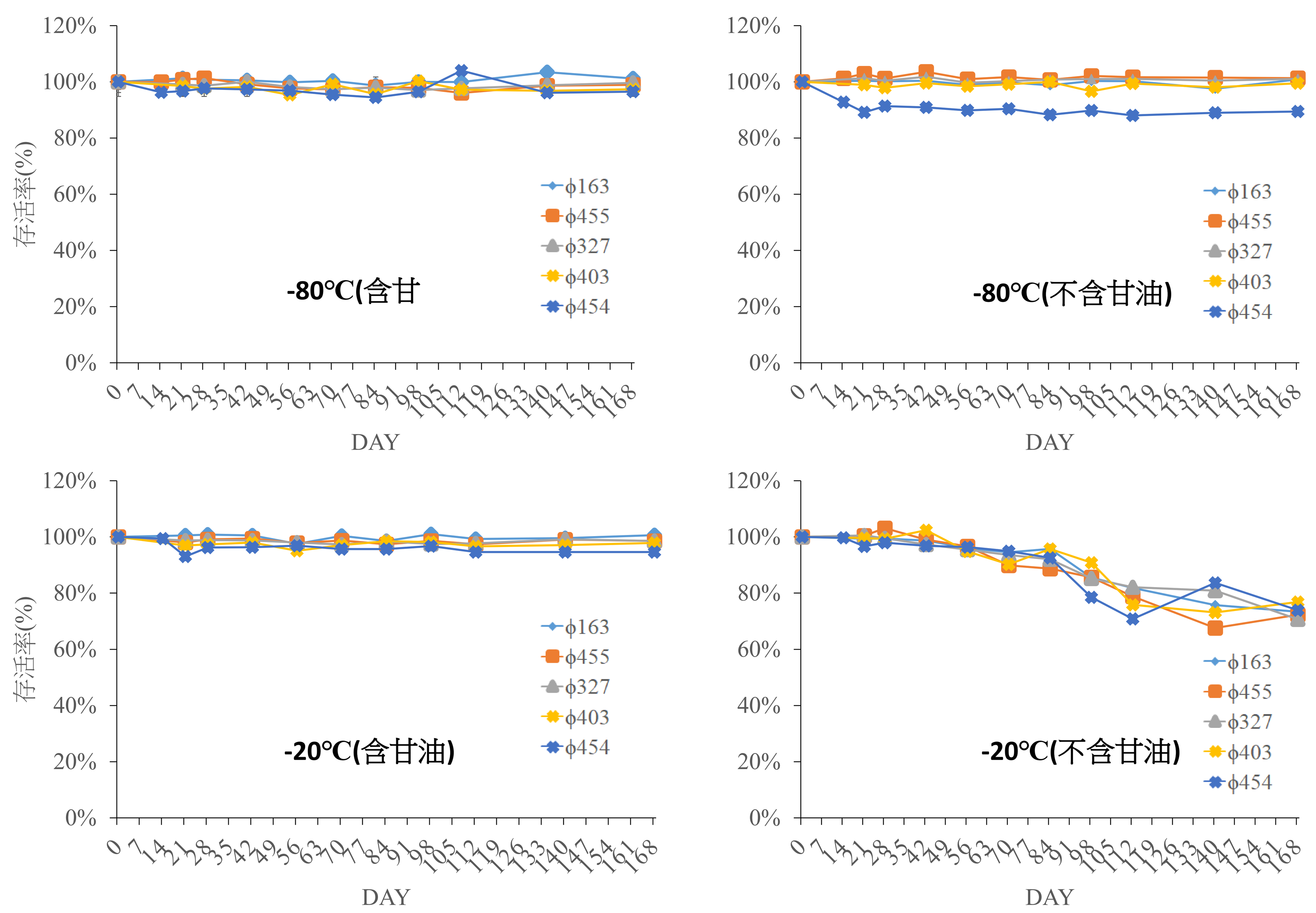

Fig. 1. 噬菌體於 –80°C 及 –20°C 保存時的濃度及存活率測試。

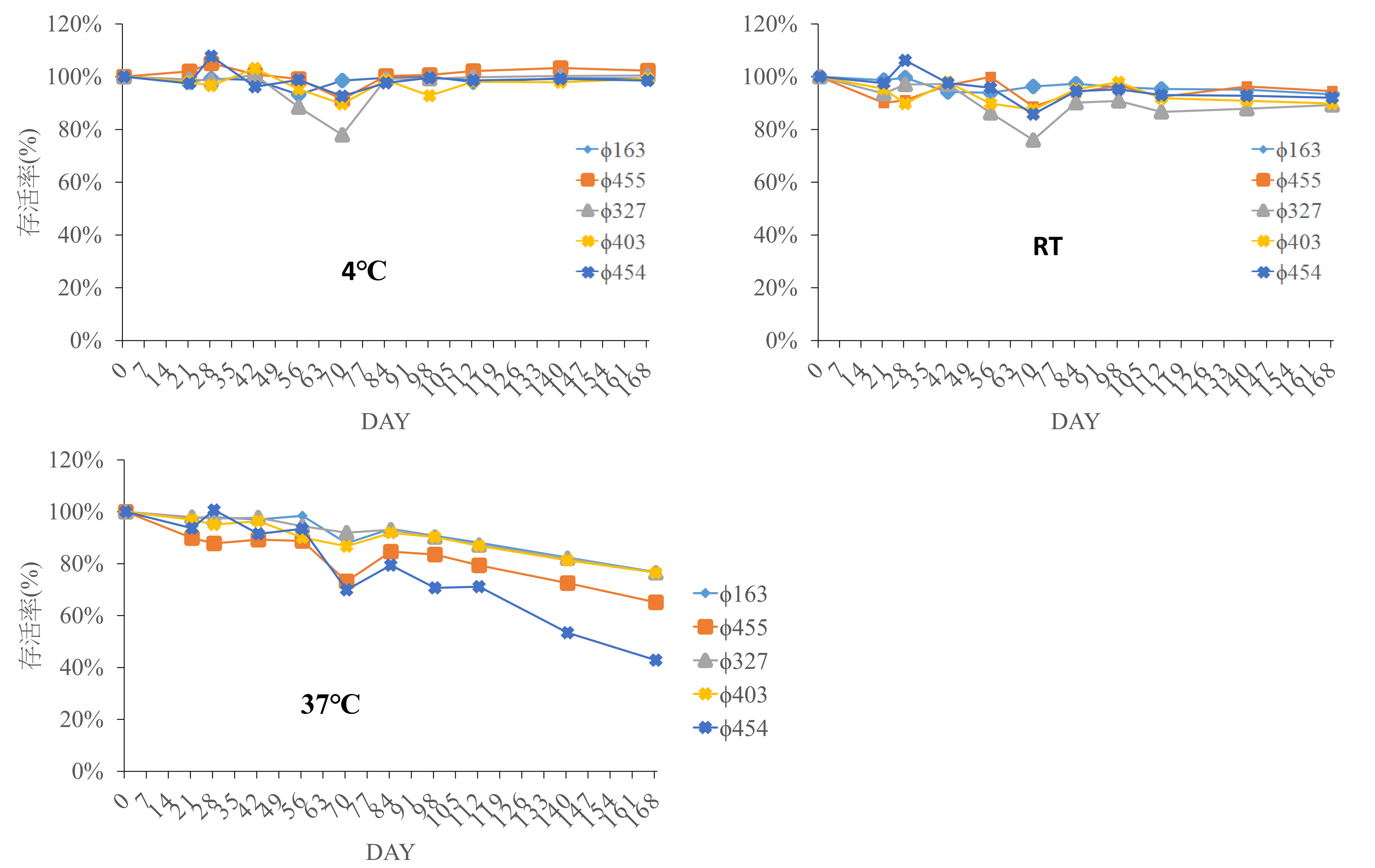

Fig. 1 (續). 5 株噬菌體於 4℃ 、RT 及 37℃ 保存時的濃度及存活率測試。

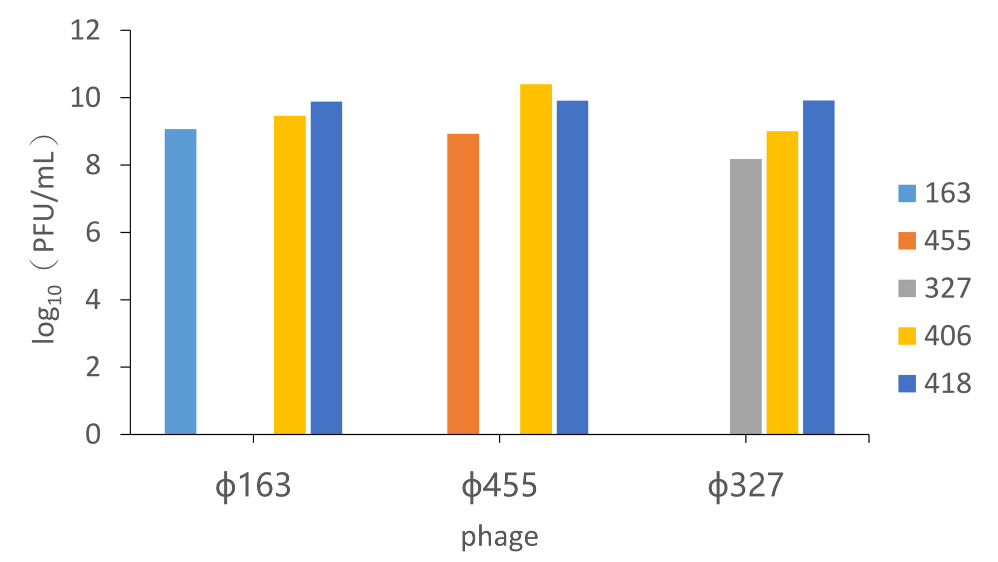

Fig. 2. 不同宿主生產噬菌體 (ϕ163、ϕ455、ϕ327) 之產量測試。163、455、327、406、418 分別為寄主細菌的編號。

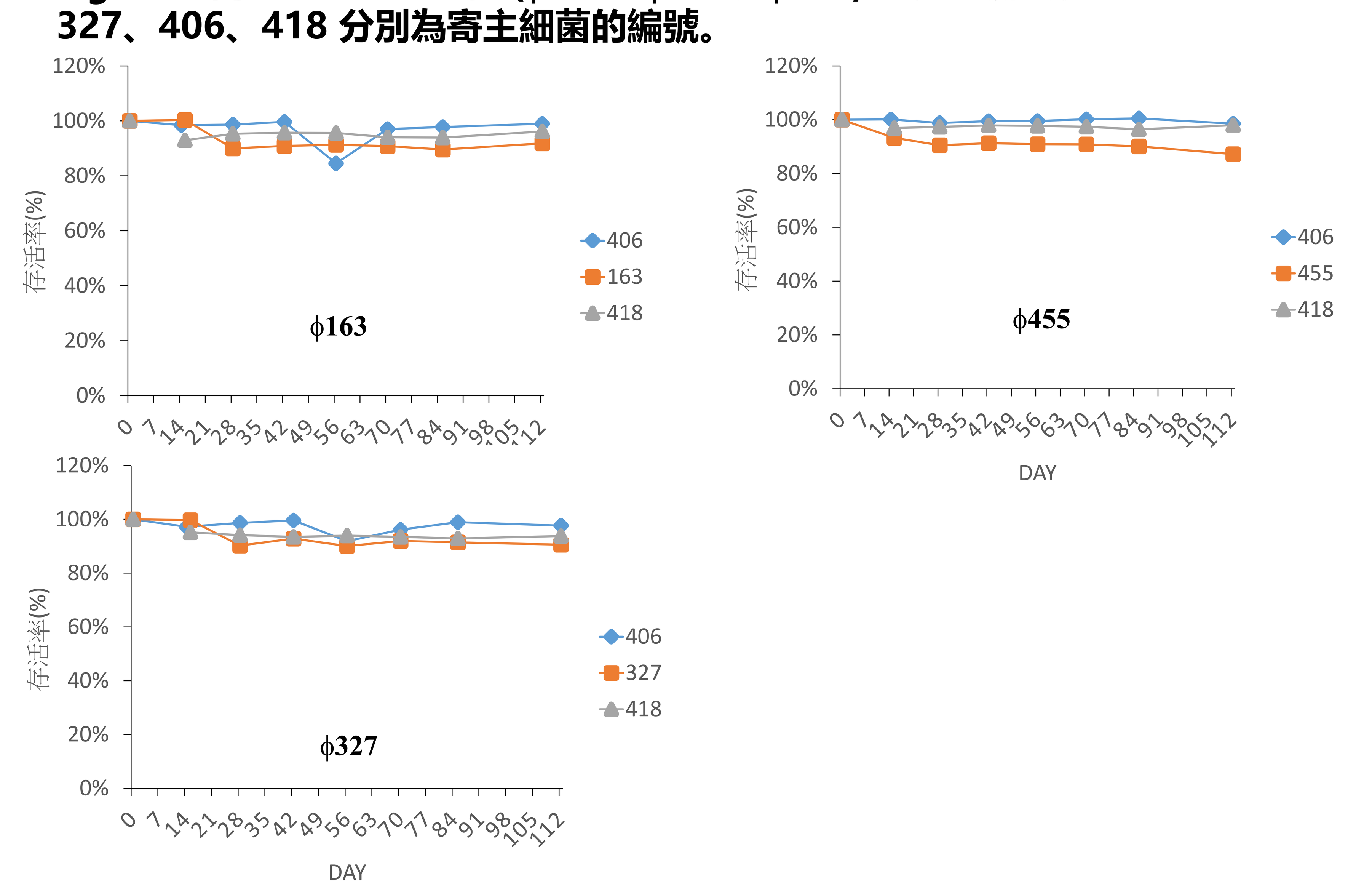

Fig. 3. 利用不同宿主生產之 ϕ163、 ϕ455 及 ϕ327 於 4℃ 保存時的存活率測試。406、163、418 分別為寄主細菌的編號。

結論

1. 鮑氏不動桿菌之噬菌體儲存於 –80℃、–20℃ 及 4℃ 的環境中穩定度是高的，在 4 個月內活性可維持在 95% 左右。
2. 在 –80℃ 的保存環境中，是否添加甘油皆對其穩定度不造成影響，但噬菌體若要儲存於 –20℃ 的環境中則需添加甘油以提高其穩定度。
3. 噬菌體存放於室溫時存活率在4 個月內活性仍有 90% 左右;而當噬菌體儲存於 37℃ 時，5 株噬菌體的存活率皆明顯的下降，且下降幅度皆大於 20%。
4. 噬菌體適合儲存於 –80℃ 或是 –20℃ 的環境中，但存放於 –20℃ 時需添加甘油以提高其穩定度。
5. 同一株噬菌體感染不同寄主，會有不同產量。同一株氏菌體在不同寄主所生產的子代噬菌體，在溫度保存上不會產生不同的差異。