永續可循環複合材料:PVA/稻殼灰水凝膠

Sustainable recyclable composite material: PVA/rice husk ash hydrogel

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[a]義守大學化工系暨生物技術與化學工程研究所

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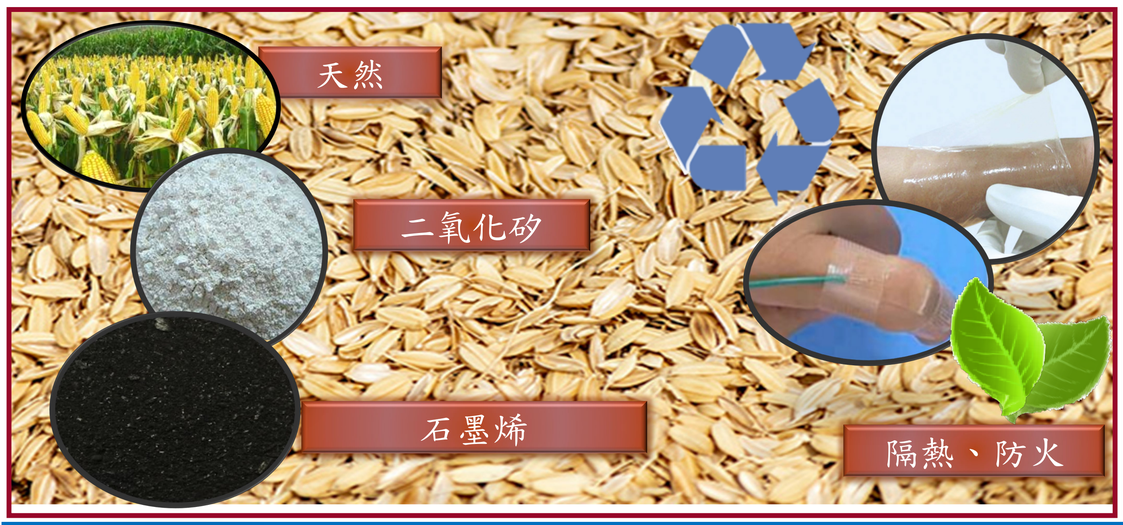
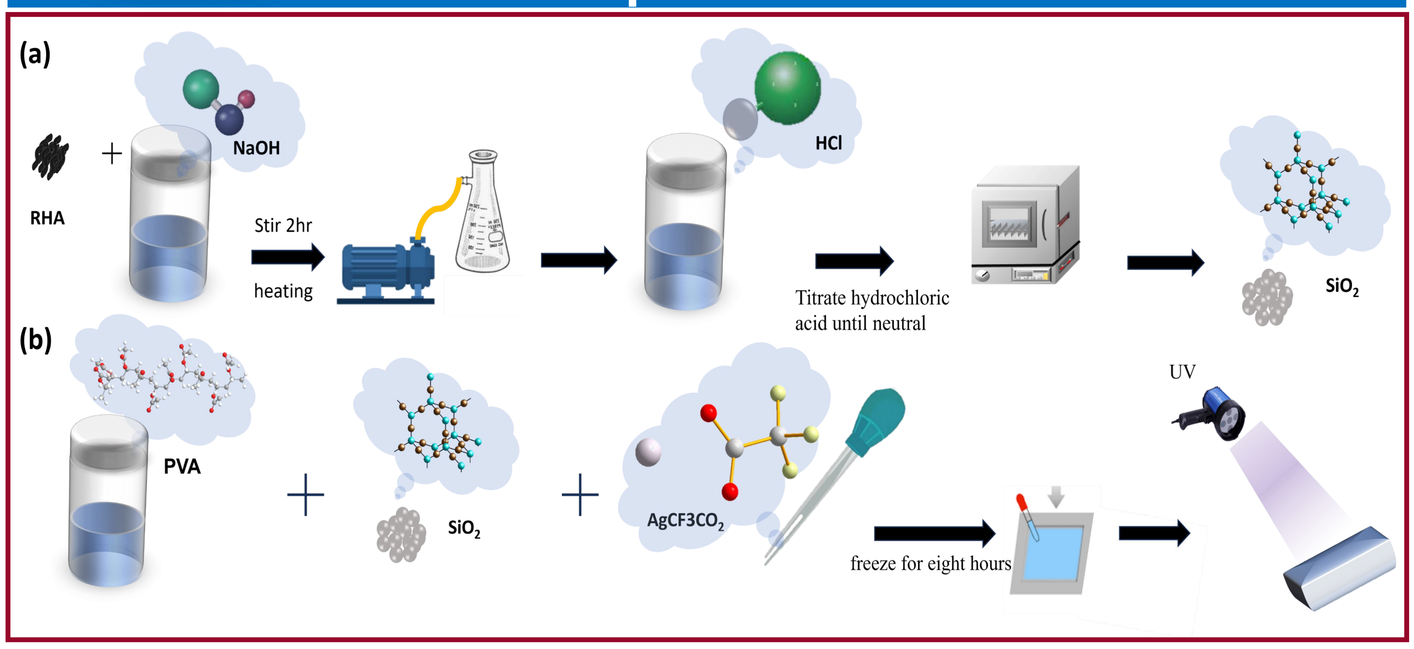
Introduction



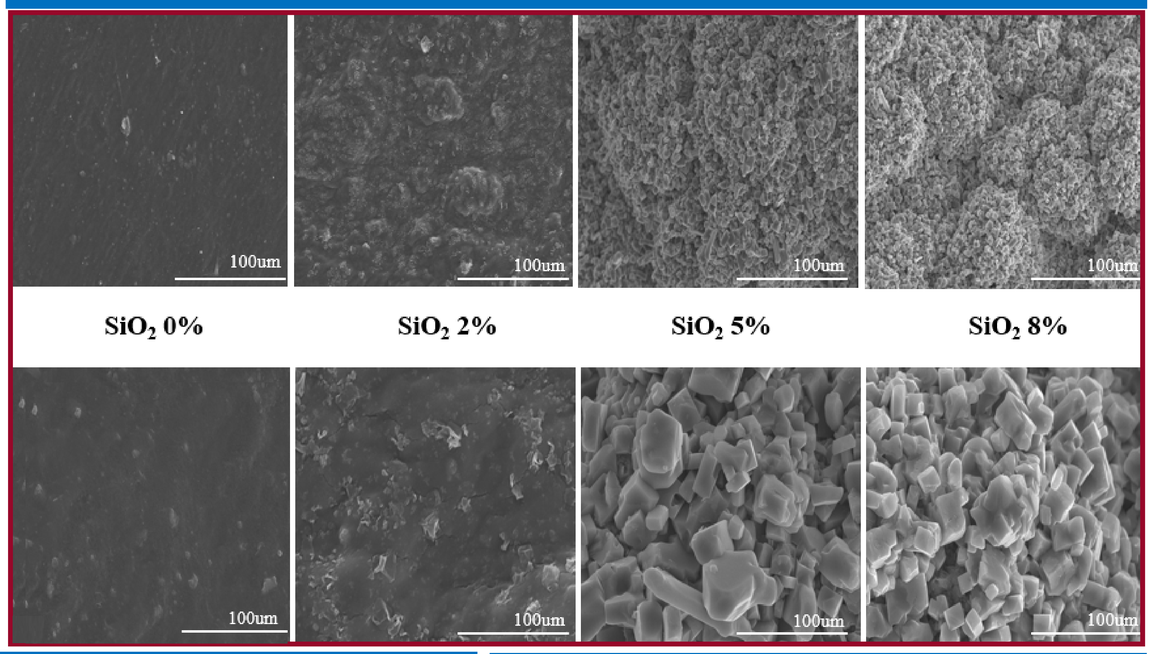
Abstract

- 本研究旨在利用農業廢棄物稻殼灰作為二氧化矽的來源，通過溶膠-凝膠法萃取高純度的二氧化矽，並將其混入聚乙烯醇（PVA）中，通過凍融循環製備出二氧化矽/PVA水凝膠。
- 該水凝膠具有良好的交聯結構和機械性能，並且具有生物相容性和生物降解性。為了提高水凝膠的導電性，本研究還將三氟醋酸銀溶液滴加到水凝膠中，並在微波輻射下還原生成奈米銀顆粒，形成二氧化矽/PVA/奈米銀複合水凝膠。
- 該複合水凝膠具有優異的導電性和靈敏度，可以用於人體運動檢測的應用。本研究為利用農業廢棄物開發高性能的水凝膠材料提供了一種簡單而有效的方法。

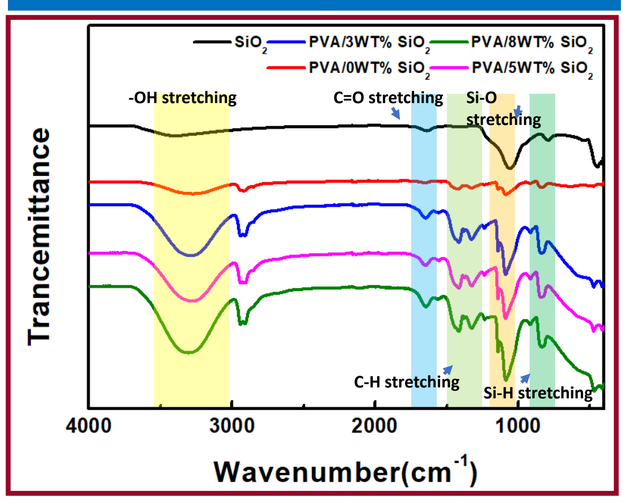
Experiment



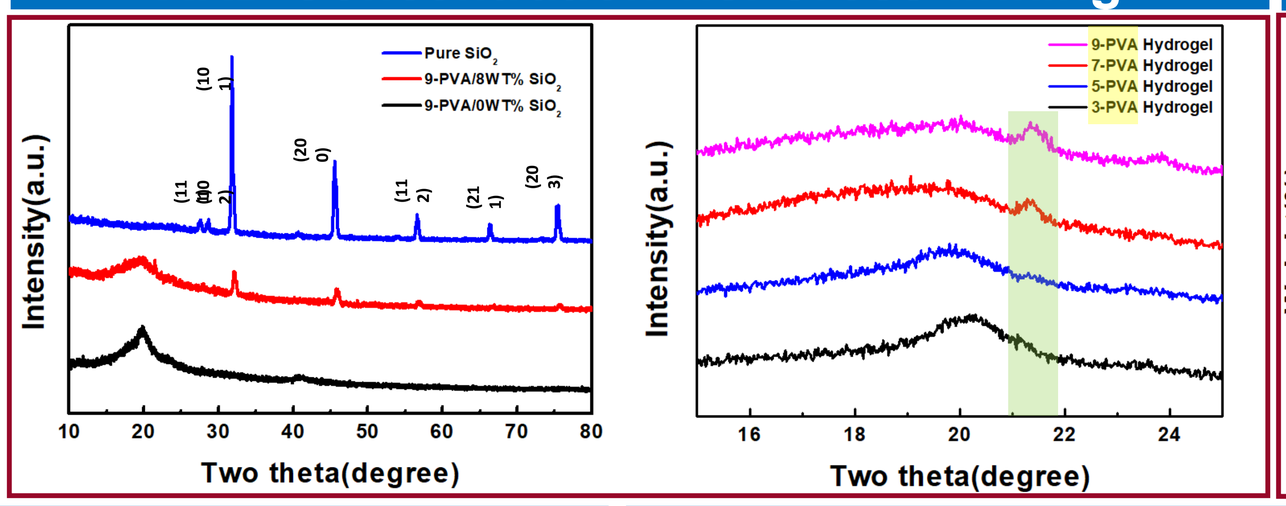
SEM



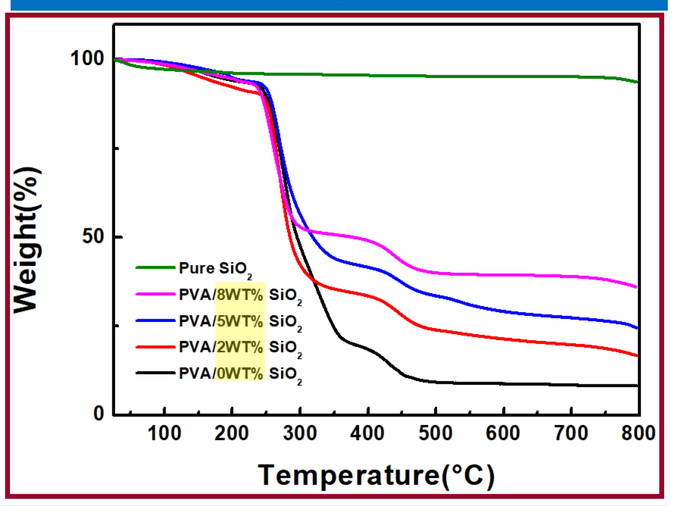
FTIR



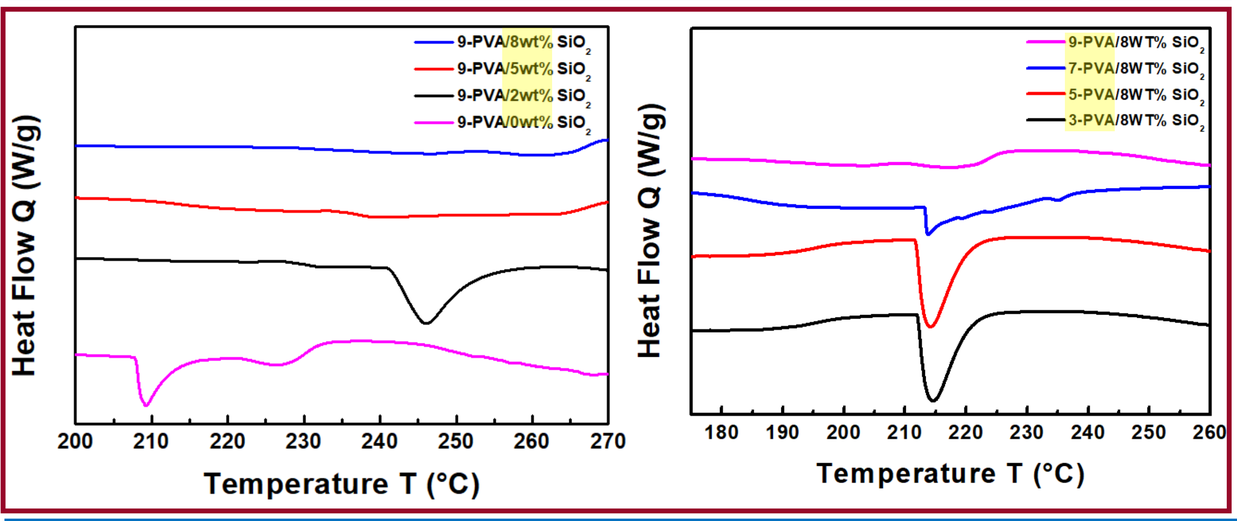
XRD Concentration v.s. Cross-linking



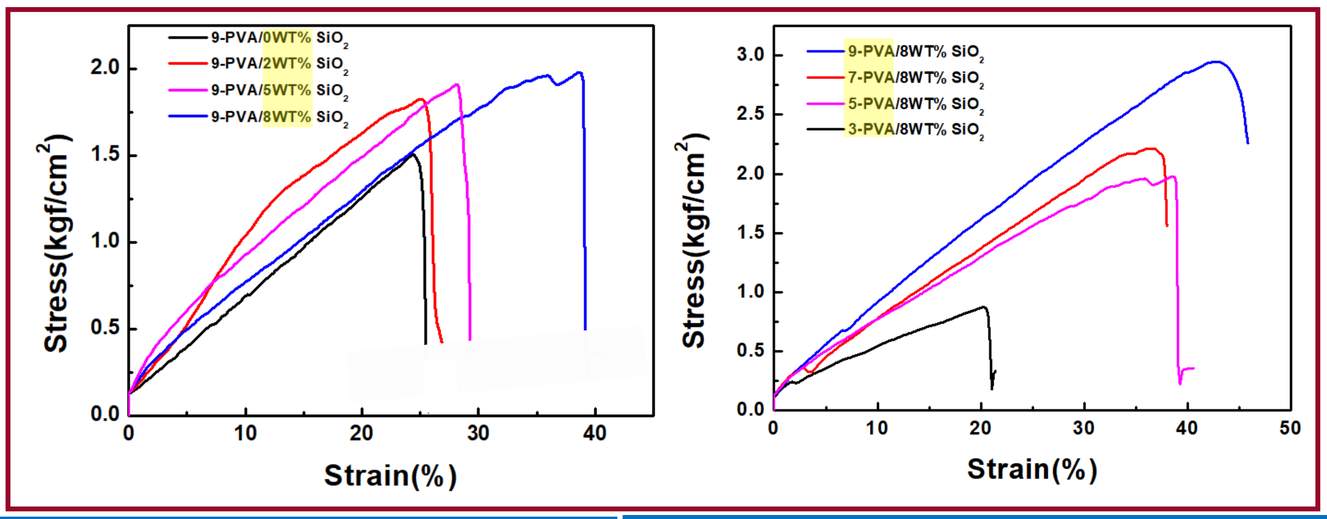
TGA



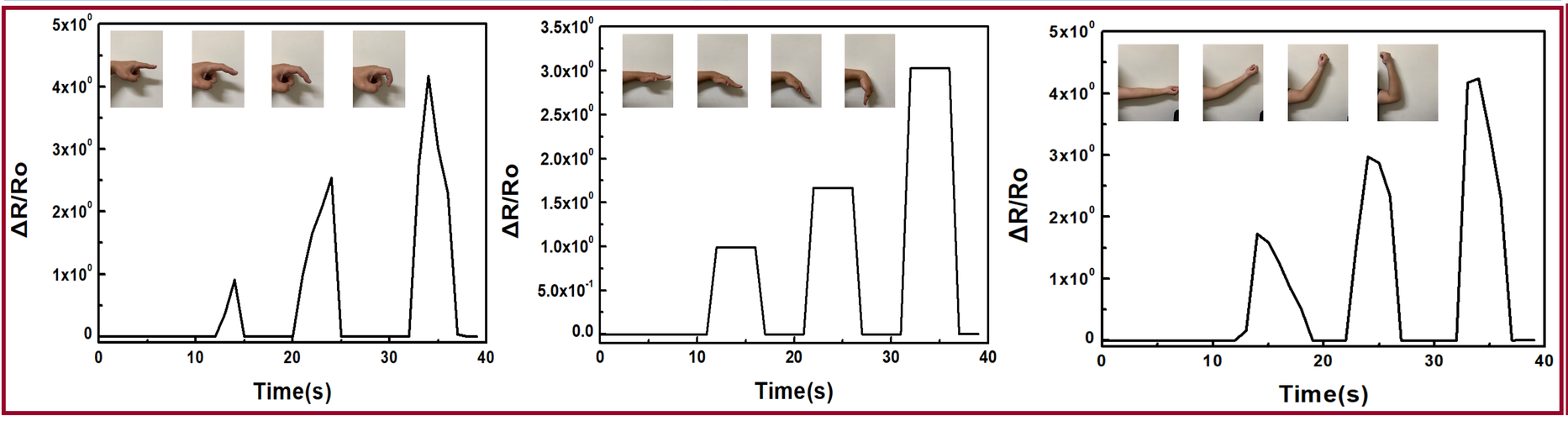
DSC Concentration v.s. Cross-linking



Tensile Strength Concentration v.s. Cross-linking



Application



Conclusion

- 我們成功利用農業廢棄物稻殼灰，萃取出二氧化矽。
- 我們藉由凍融循環製作出PVA水凝膠，在九次凍融循環下的到最好的拉伸性能，並且混入我們萃取的二氧化矽，再次提高了水凝膠的拉伸應力及交聯程度。
- 在我們的複合水凝膠中混入三氟醋酸銀，制備出導電水凝膠，並且應用在人體監測上。

農業廢棄物之新穎轉化循環經濟

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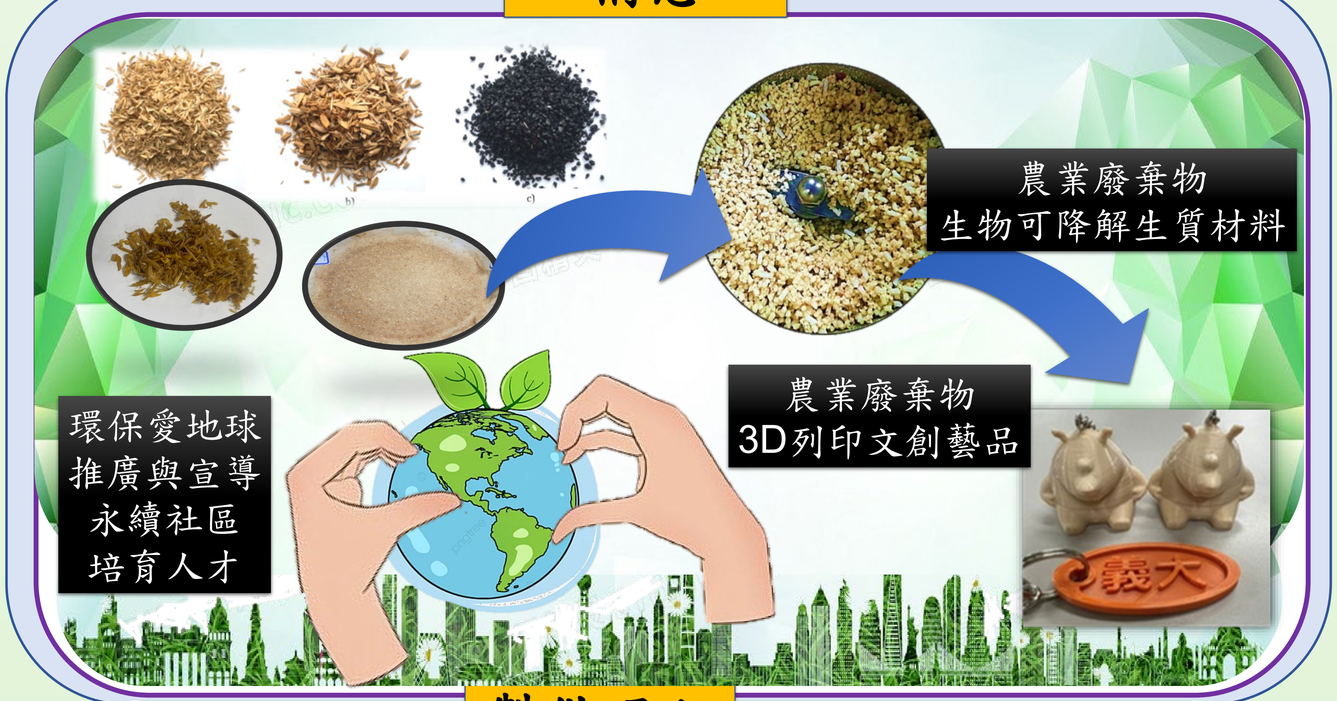
謝名家、卓家榮*

Department of Chemical Engineering , I-Shou University

＊Email : ppaul28865@gmail.com

構想



摘要

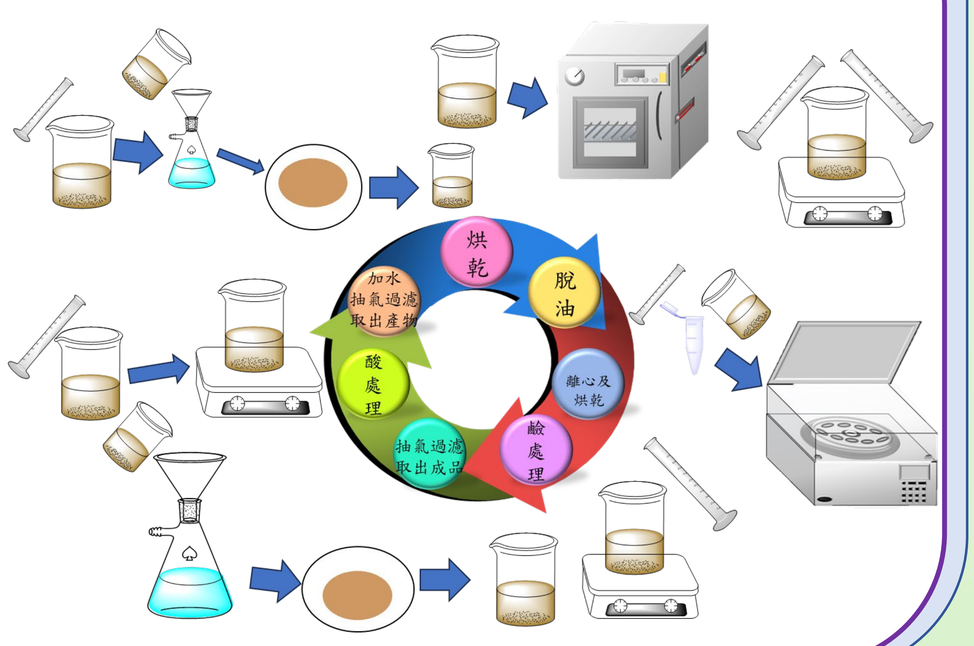
- 這項研究針對農業廢棄物稻殼，進行去殼、脫油處理，並透過強酸和強鹼處理提取纖維素，以提高稻殼的可利用價值。這一過程有助於有效處理廢棄物，同時提供了可再利用的原材料。
- 將纖維素改性後加入PLA進行拉絲後應用於3D列印上，便可製造出更多生物可降解的物品，對大自然有幫助，並培育跨領域技術、永續人才。

製備過程

新豐農民需求會議

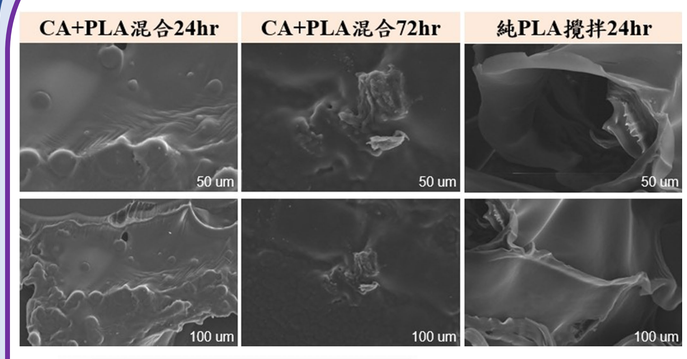
場域夥伴提供
農業廢棄物

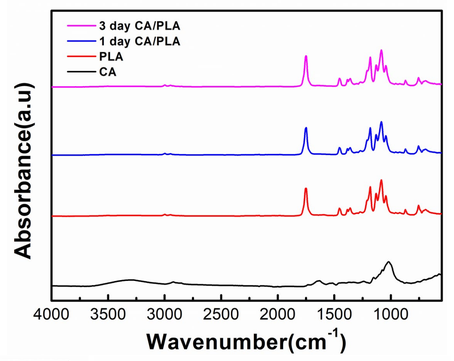
化工系團隊-進行纖維素萃取技術

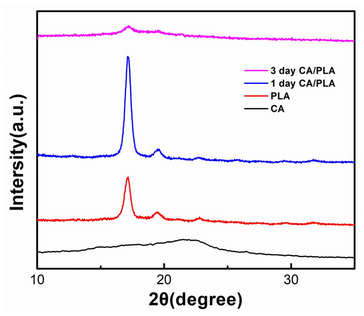


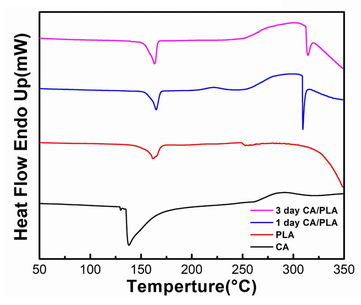
光學檢測

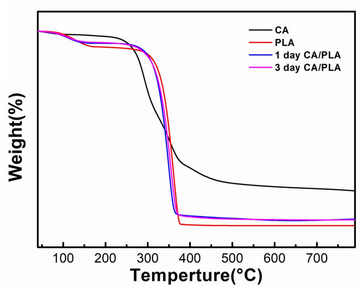
SEM　FT-IR　XRD　DSC　TGA







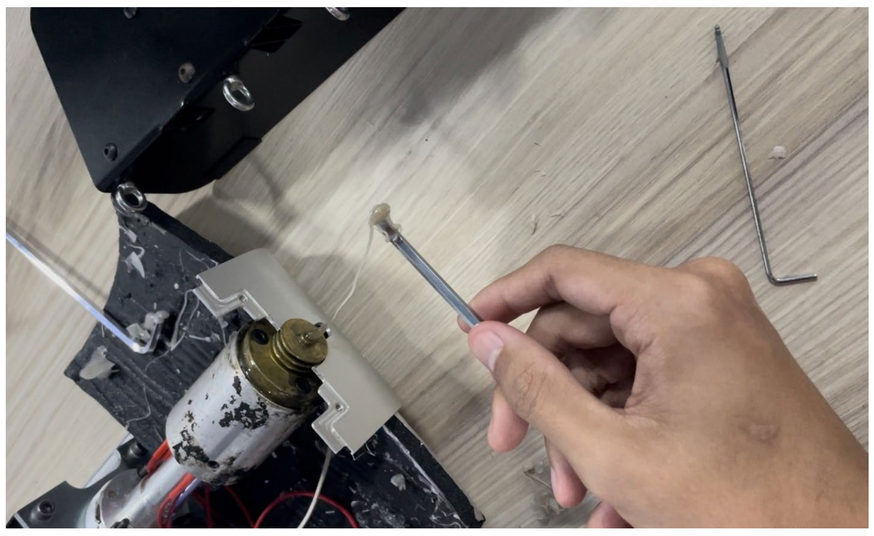


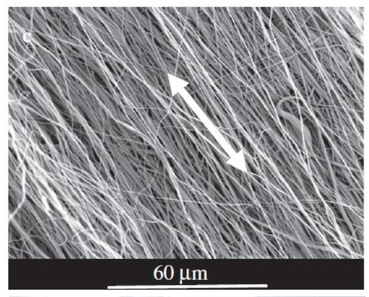


3D列印與文創藝品製備

機動系團隊-進行3D列印技術

- 化工系將纖維素混合PLA後放入拉絲機進行拉絲。
- 由機動系將拉出之線材做為3D列印材料，進行文創藝品開發。
- 由資工系進行良品與不良品SEM光學檢測。





在地特色推廣

觀光系、新媒系團隊-進行在地產業碳盤查講習與知識傳授、建構食農教育APP推廣地方特色

減碳知識傳授

食農教育推廣地方特色

社區培力活動(深入場域)

社區培力活動
培育在地人才

總結

我們透過此研究，有效將纖維素混入PLA，成功製備出一種生物可降解之複合材料，不僅提升農業廢棄物利用價值，也透過3D列印技術製作出可再利用之文創藝品，為未來的環保材料創新方法提供一條可行途徑；此外也培育跨領域技術、永續人才協助地方發展，在文化永續面:透過食農教育APP推廣地方特色地圖，有助於帶動觀光、新園鄉食農文化傳承。

新型多孔性矽材料(PSP)於產氫及綠能應用

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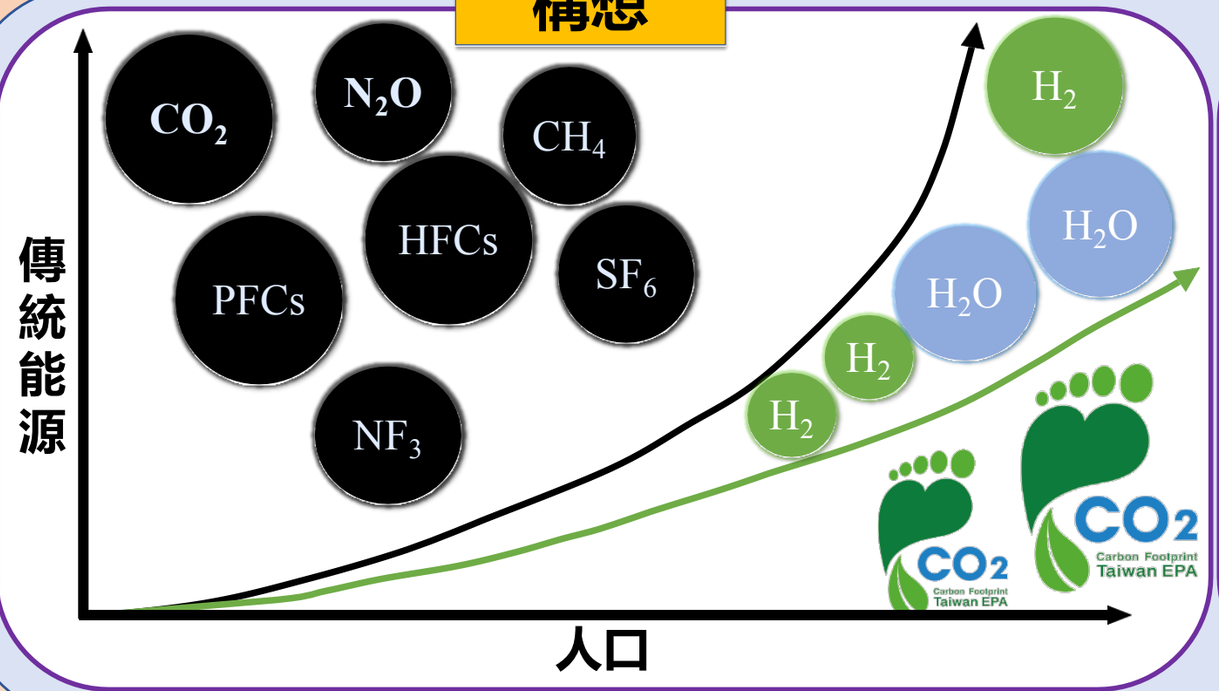
Institute of Biotechnology and Chemical Engineering, I-Shou University

* Email : ppaul28865@gmail.com

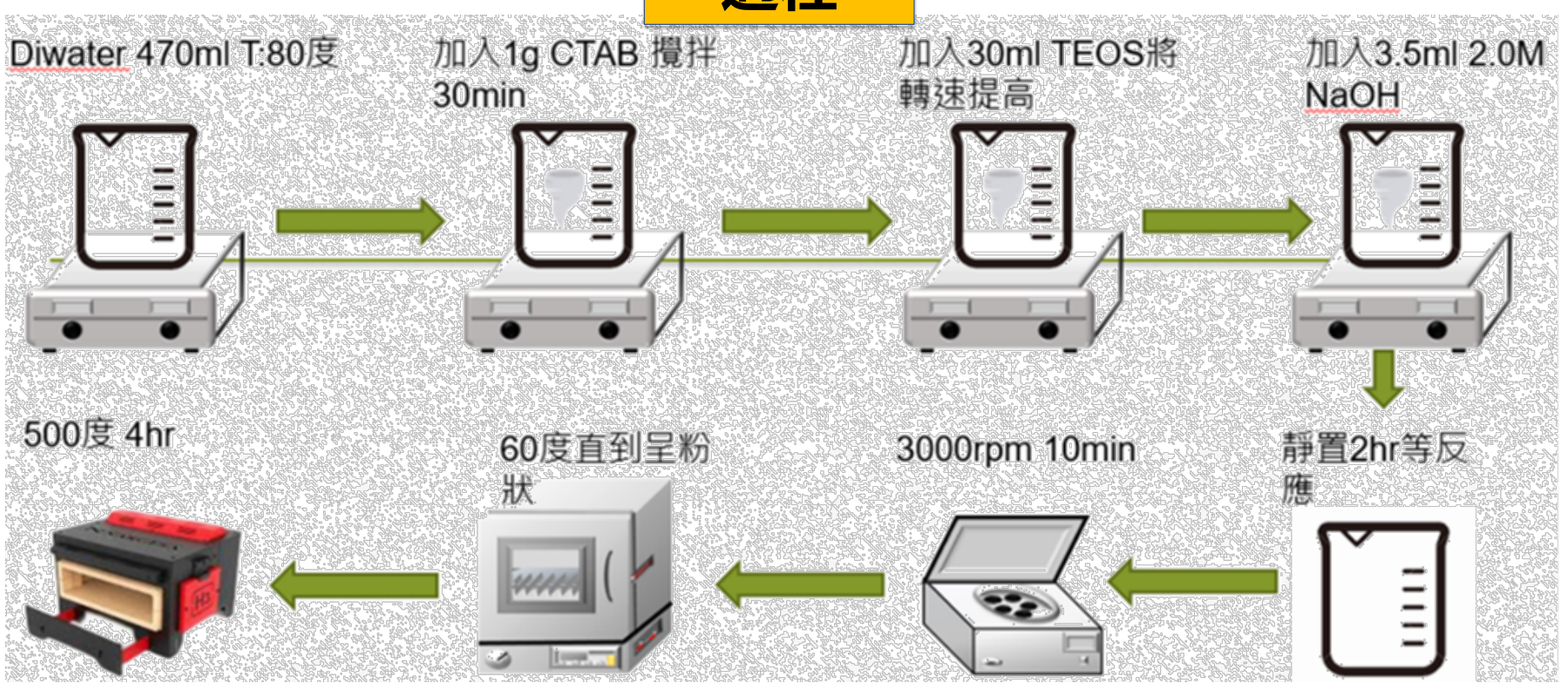
構想



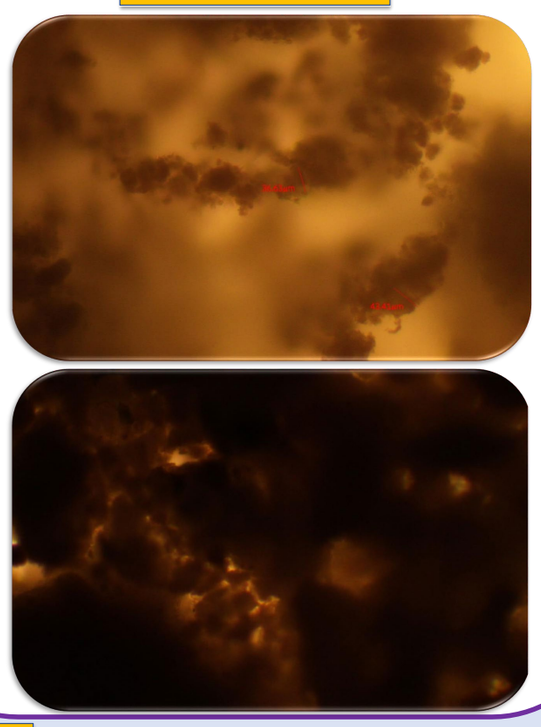
摘要

- 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

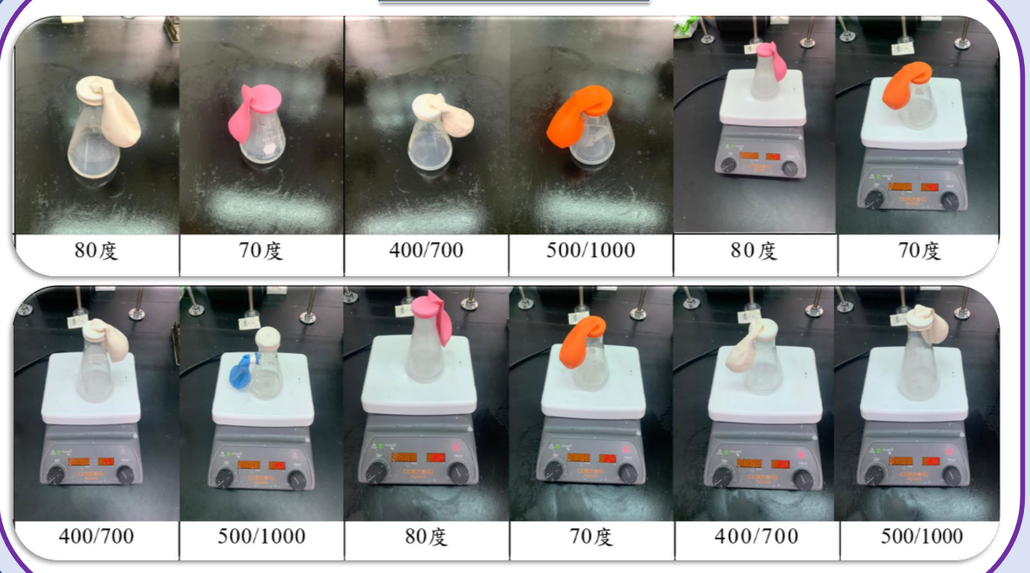
過程



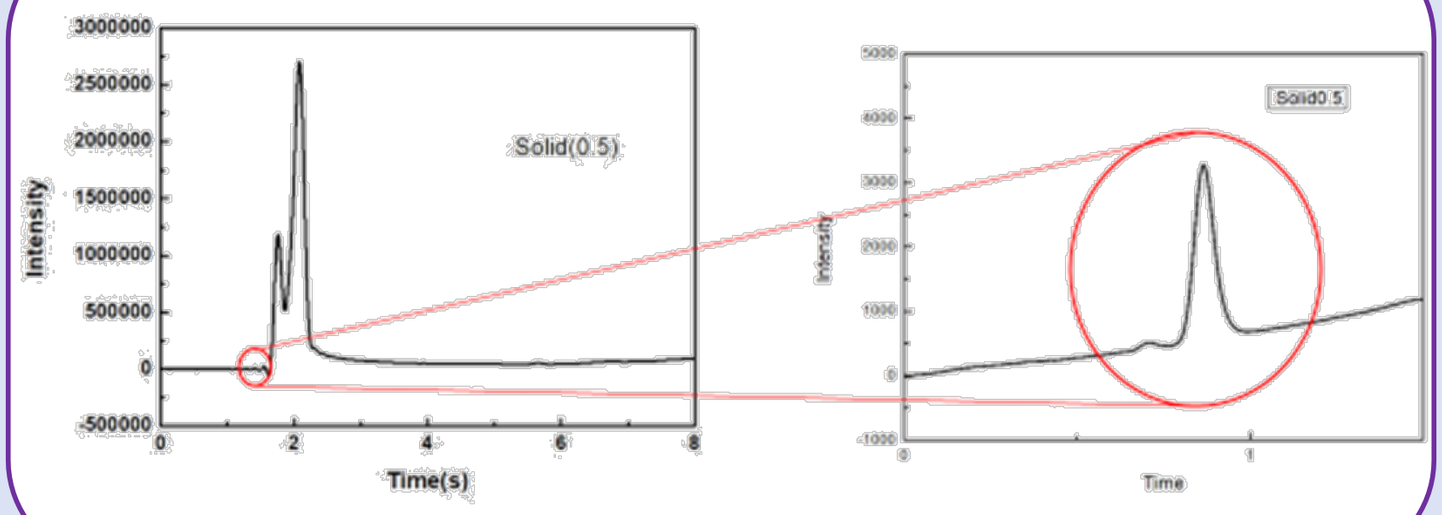
OM



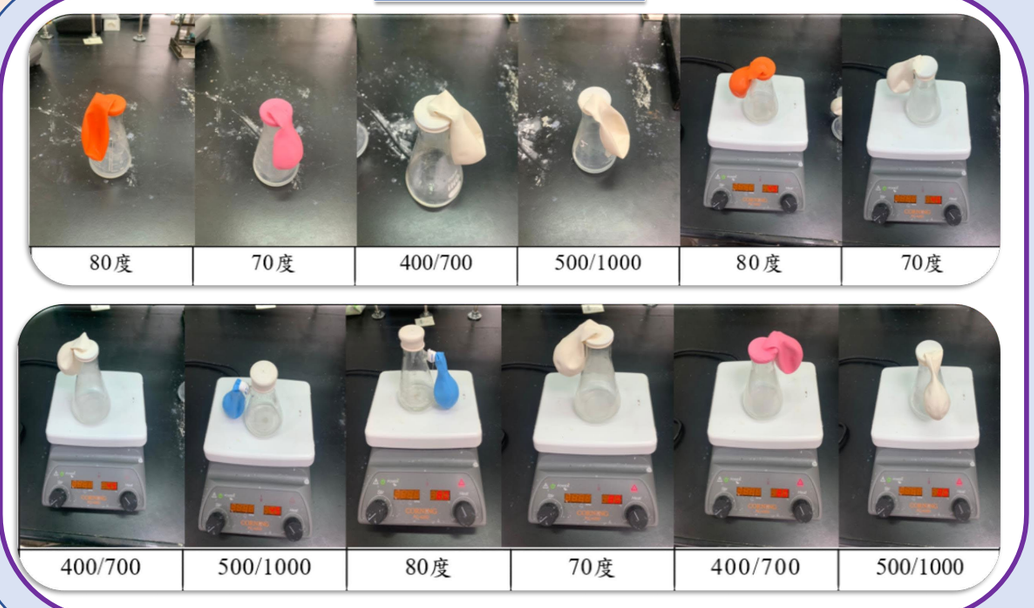
固體產氫



GC



液體產氫



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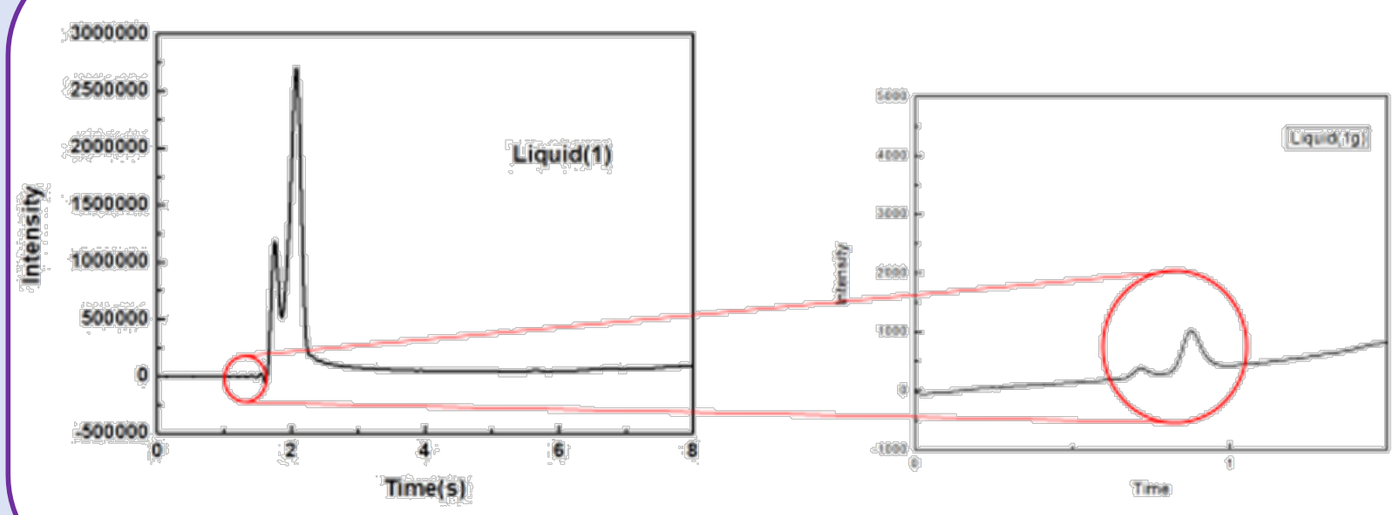

總結

- 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

嵌入式RGO彈性導電奈米纖維於運動感測之應用

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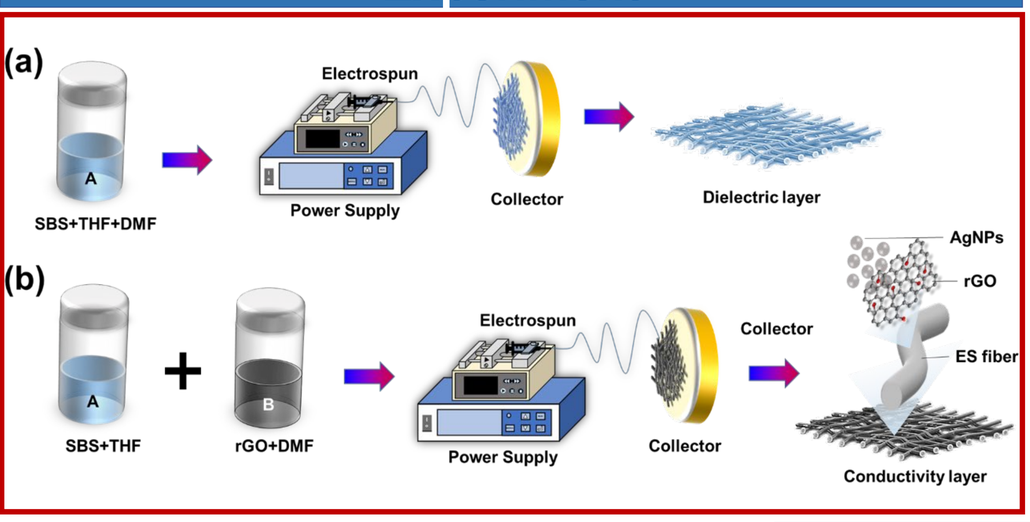
Introduction

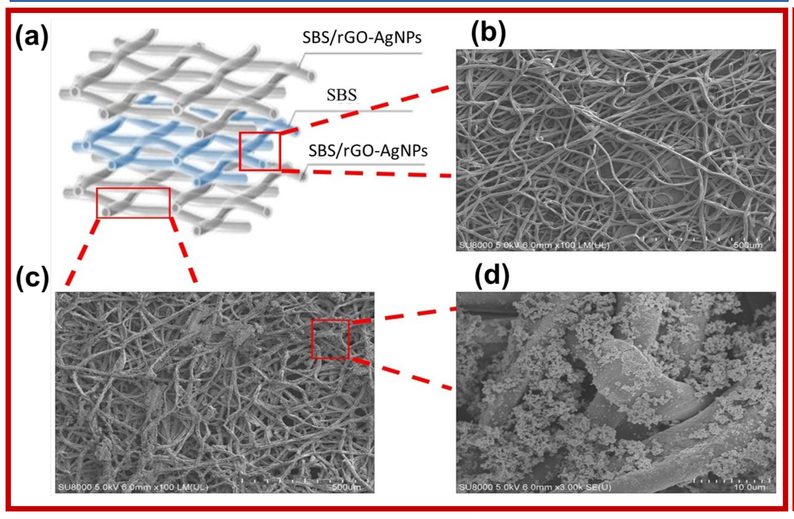
Abstract

- 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.

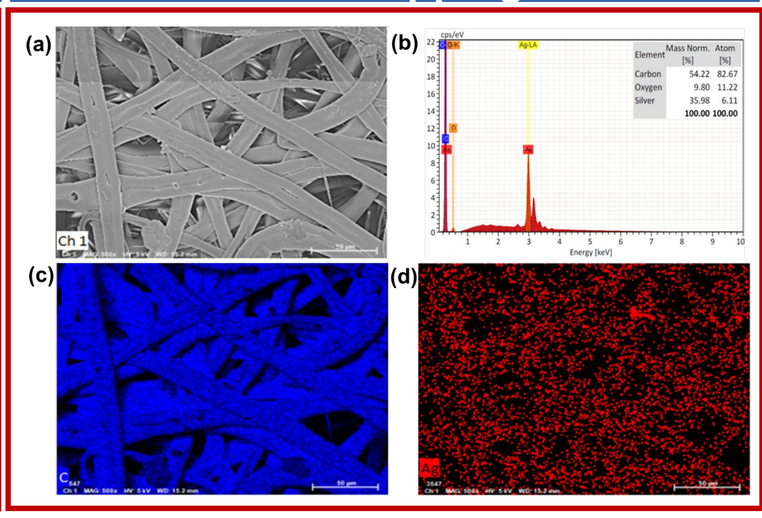
Experiment



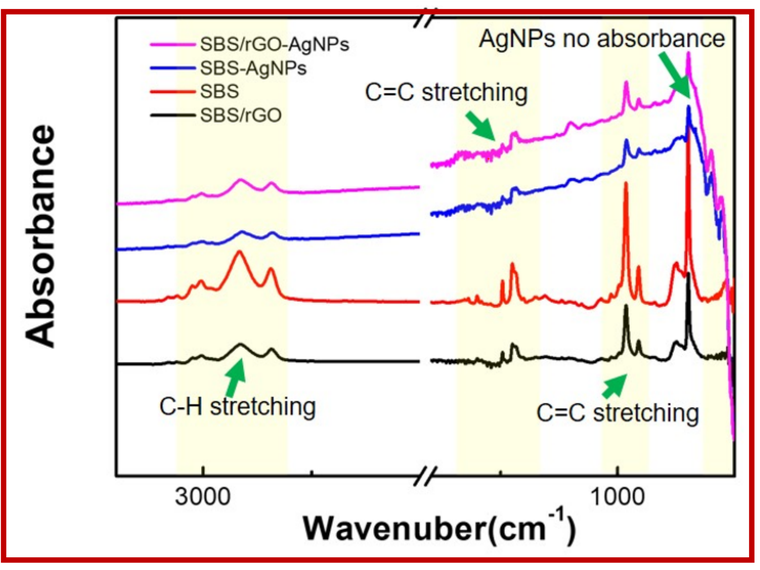
SEM



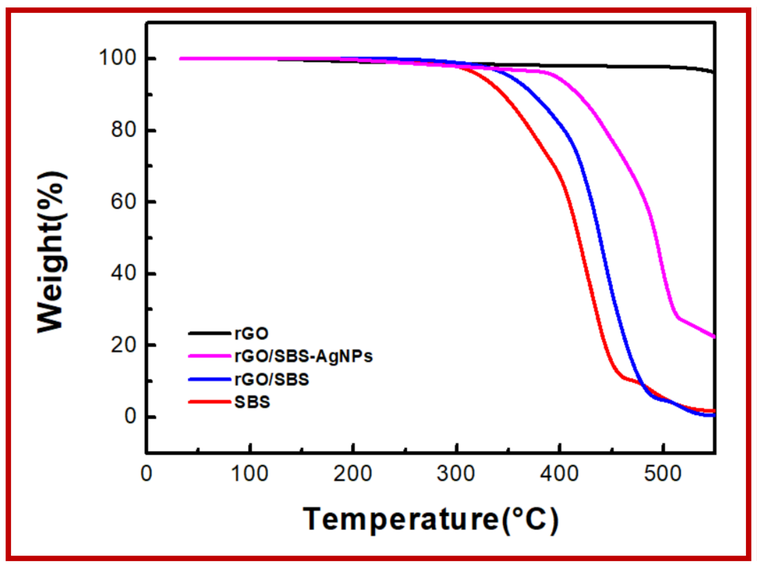
EDS/Mapping



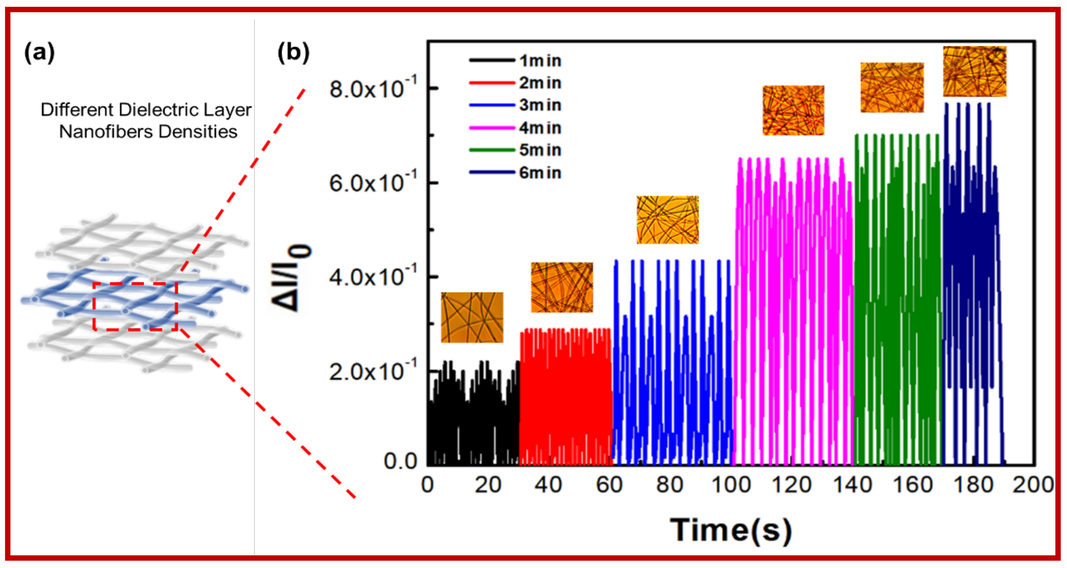
FTIR



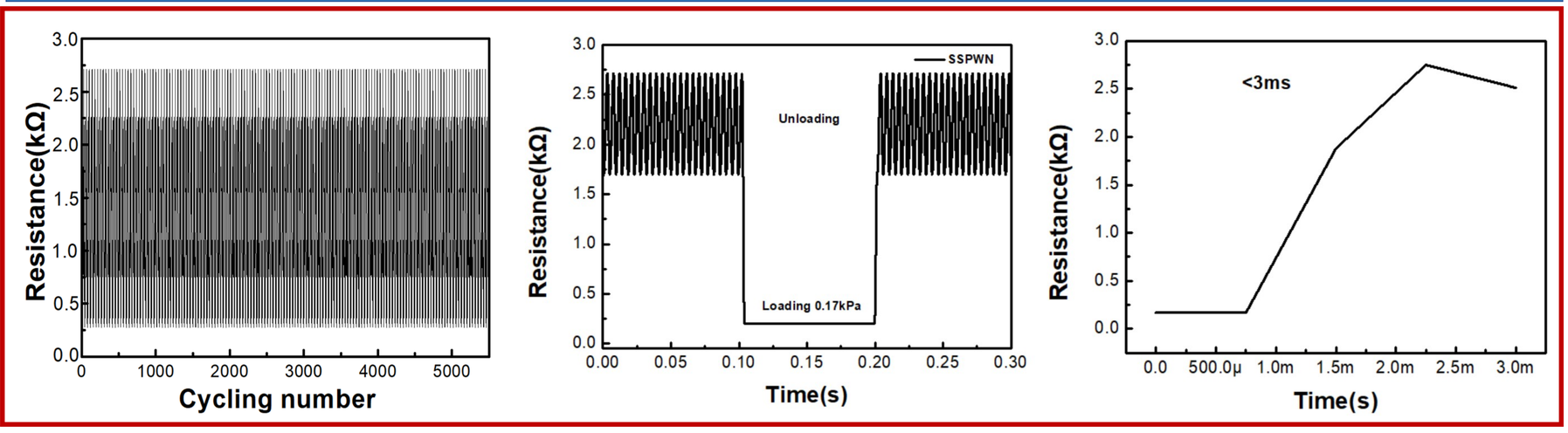
TGA



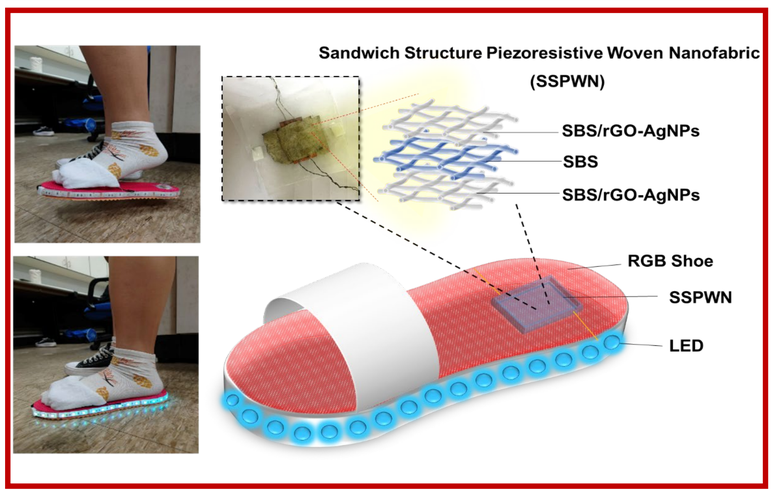
Dielectric Layer



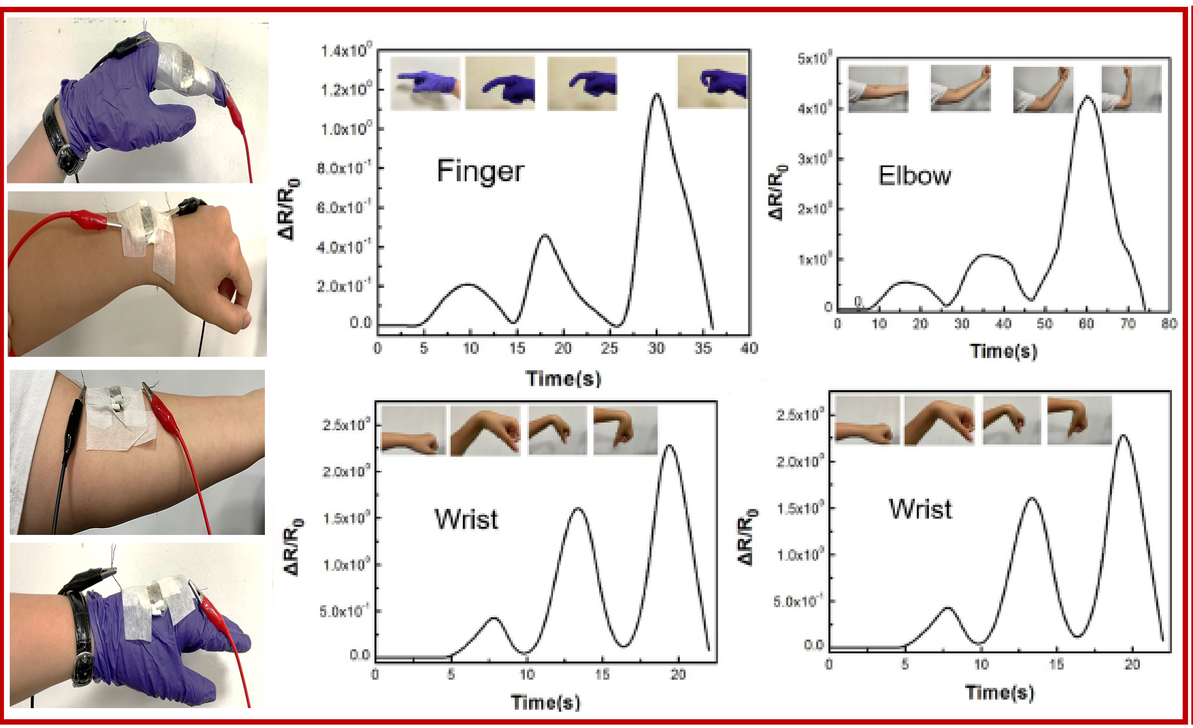
Mechanical Character



On-Off Application



Joint Stretched



Compare

NO.	Samples	Methodology	Conductivity (S/cm)
1.	Silver foam	Reduction self-assembly/Freeze drvingt	170
2.	Silver nanowire aerogels	Emulsion template synthesist	66
3.	polyurethane/PPy (PU/PPy)	Electrospinning/in-situ chemical polymerization	276
4.	PEDOT	Electrospinning/ vapor-phase polymerization	60
5.	SBS/rGO-AgNPs	Electrospinning/in-situ AgNPs	653

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.

環保PVA/稻殼灰複合水凝膠開發及應用

Development and Application of Eco-Friendly PVA/Rice Husk Ash Composite Hydrogel

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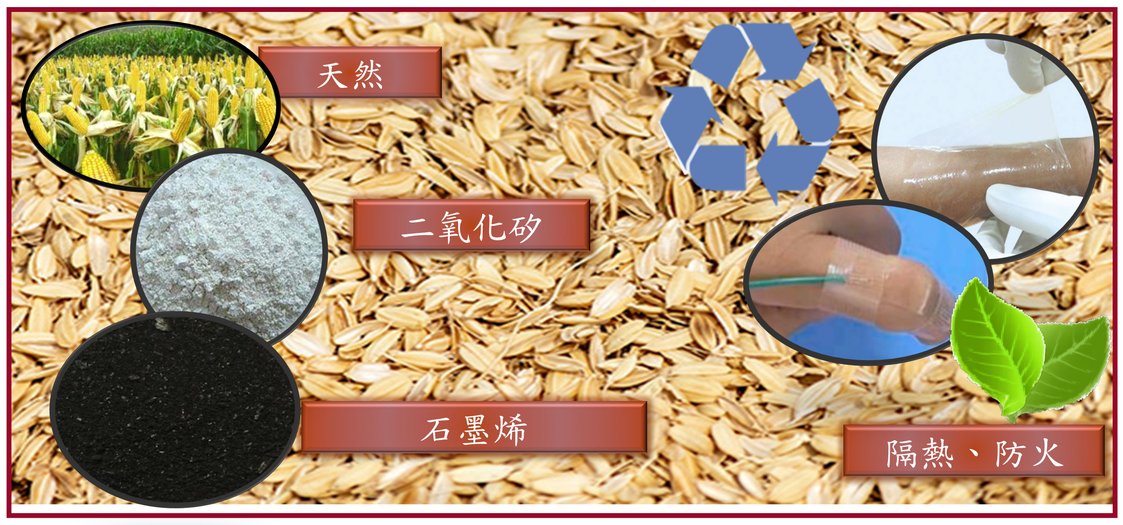
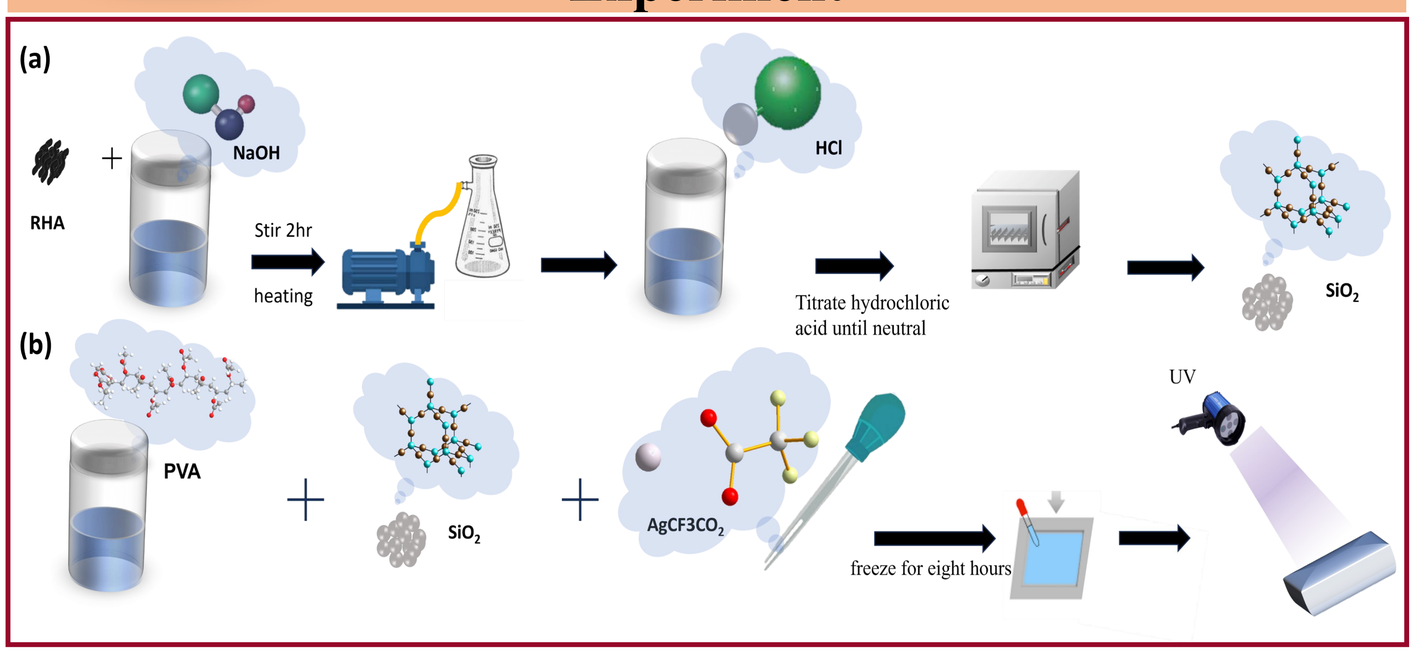
Introduction



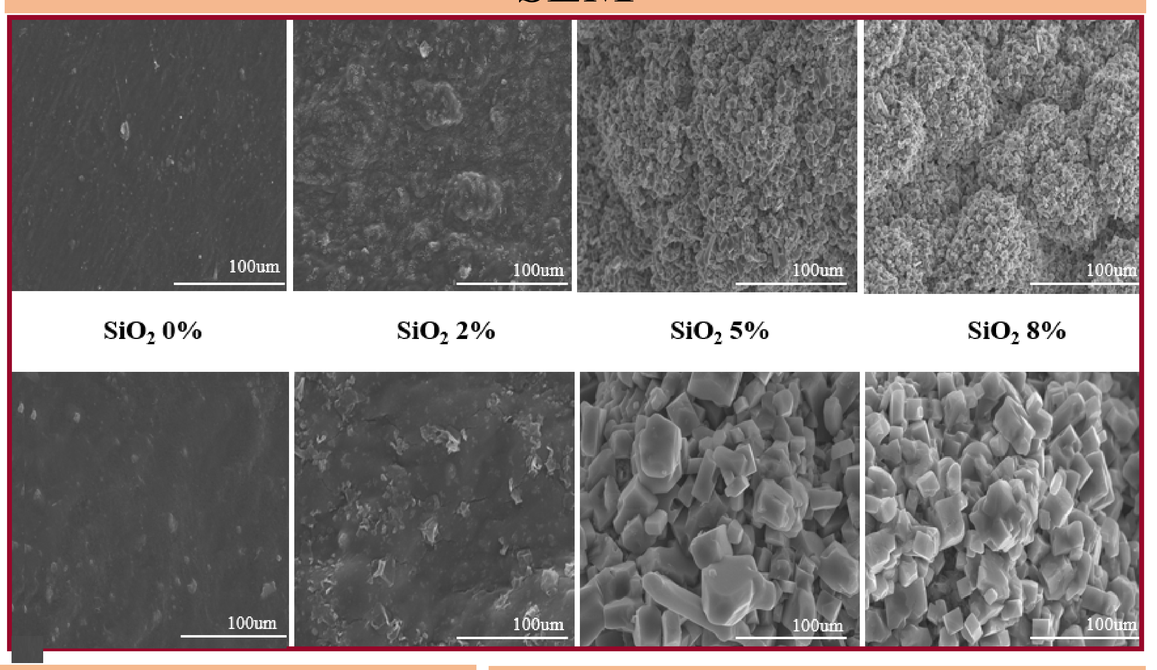
Abstract

- 本研究旨在利用農業廢棄物稻殼灰作為二氧化矽的來源，通過溶膠-凝膠法萃取高純度的二氧化矽，並將其混入聚乙烯醇（PVA）中，通過凍融循環製備出二氧化矽/PVA水凝膠。
- 該水凝膠具有良好的交聯結構和機械性能，並且具有生物相容性和生物降解性。為了提高水凝膠的導電性，本研究還將三氟醋酸銀溶液滴加到水凝膠中，並在微波輻射下還原生成奈米銀顆粒，形成二氧化矽/PVA/奈米銀複合水凝膠。
- 該複合水凝膠具有優異的導電性和靈敏度，可以用於人體運動檢測的應用。本研究為利用農業廢棄物開發高性能的水凝膠材料提供了一種簡單而有效的方法。

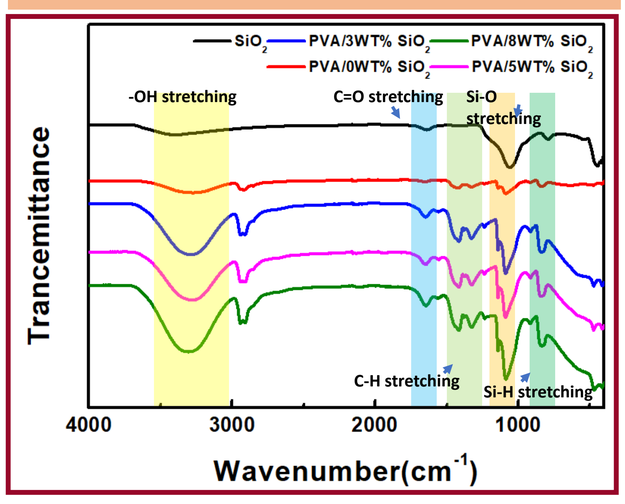
Experiment



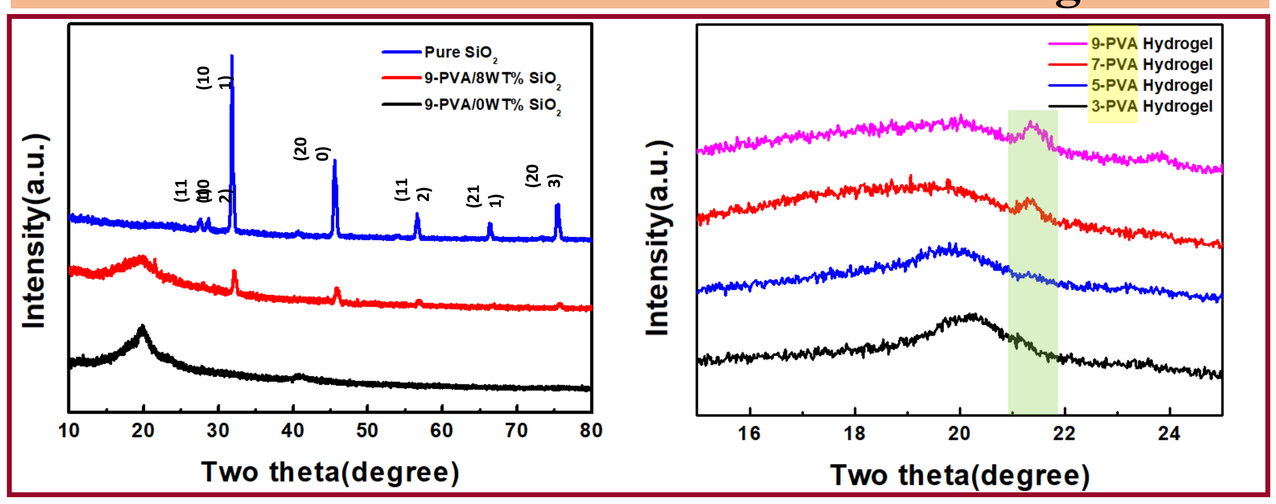
SEM



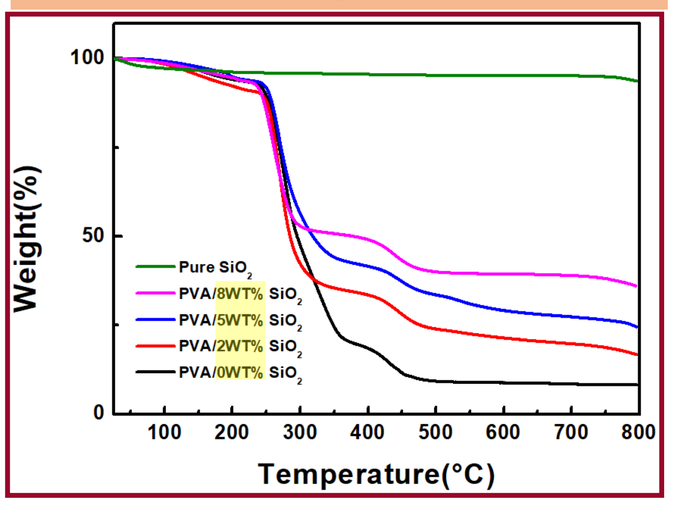
FTIR



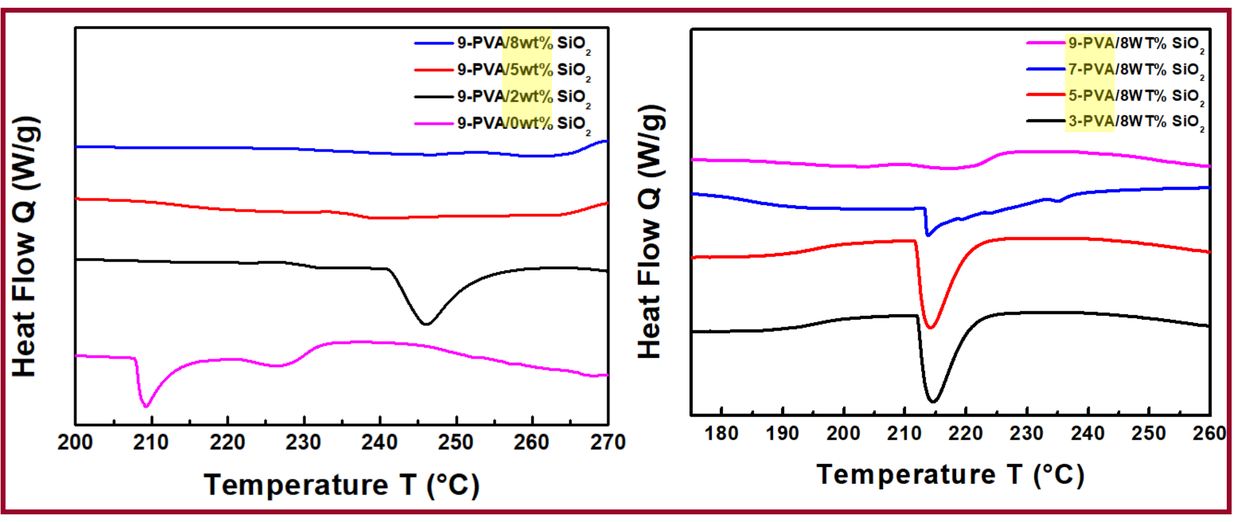
XRD Concentration v.s. Cross-linking



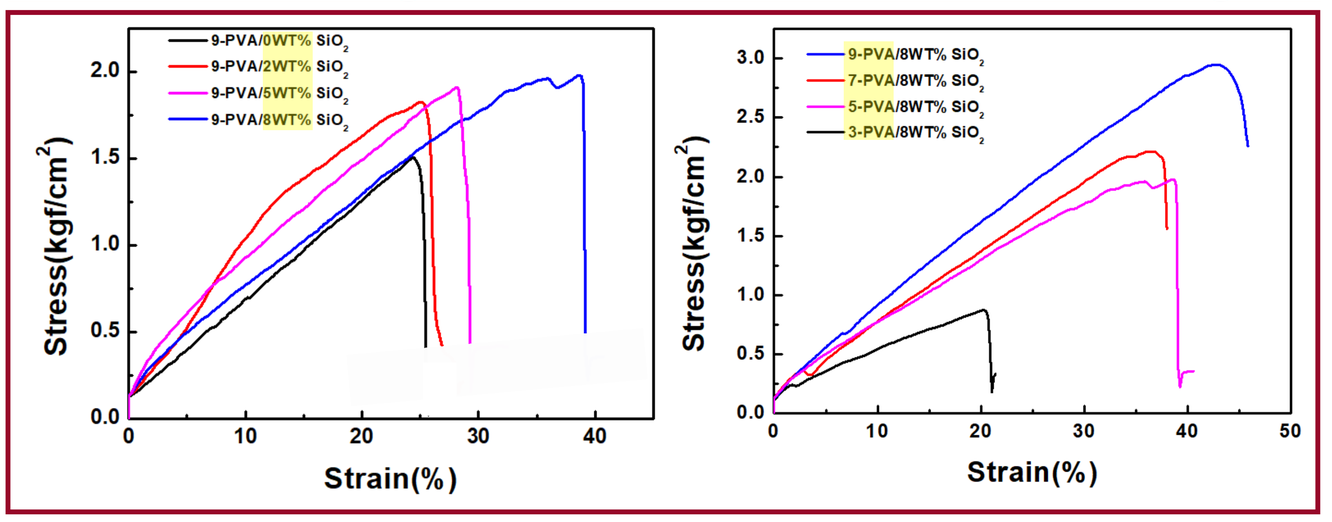
TGA



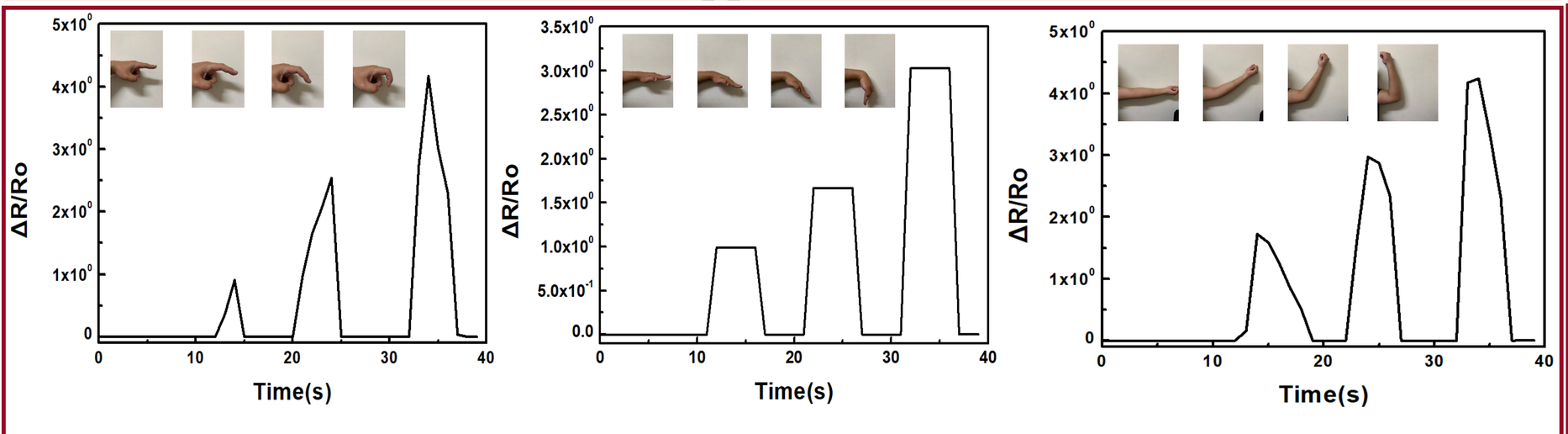
DSC Concentration v.s. Cross-linking



Tensile Strength Concentration v.s. Cross-linking



Application



Conclusion

- 我們成功利用農業廢棄物稻殼灰，萃取出二氧化矽。
- 我們藉由凍融循環製作出PVA水凝膠，在九次凍融循環下的到最好的拉伸性能，並且混入我們萃取的二氧化矽，再次提高了水凝膠的拉伸應力及交聯程度。
- 在我們的複合水凝膠中混入三氟醋酸銀，制備出導電水凝膠，並且應用在人體監測上。

新型熱塑性澱粉超臨界二氧化碳發泡技術的開發與應用

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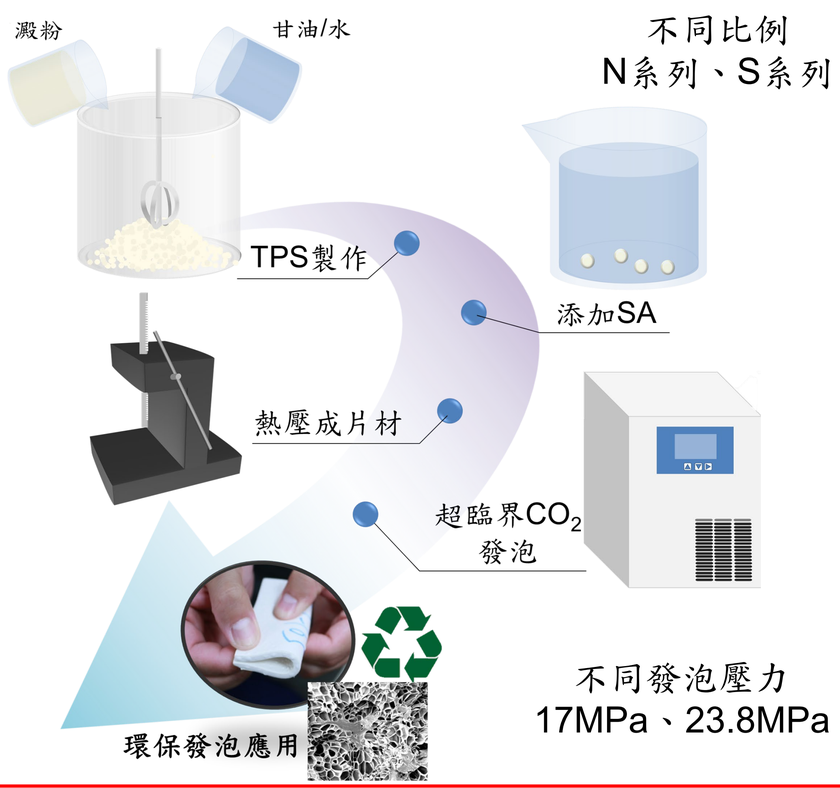
構想

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

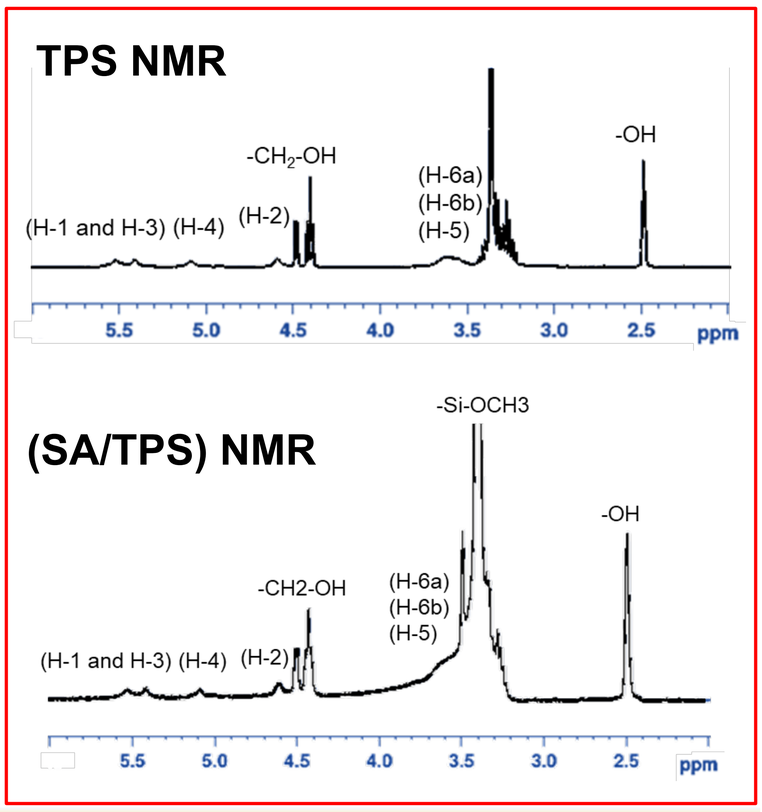
實驗



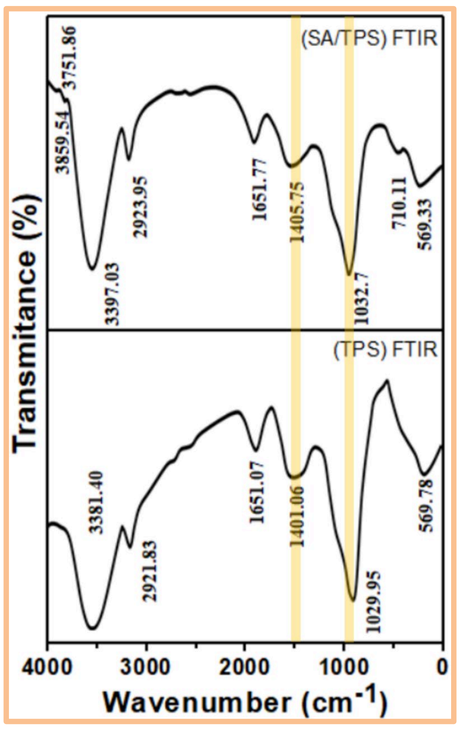
Data

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

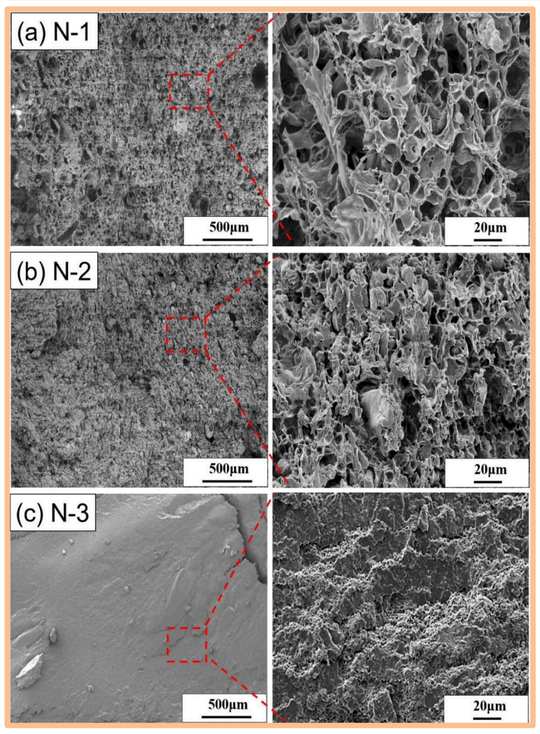
NMR

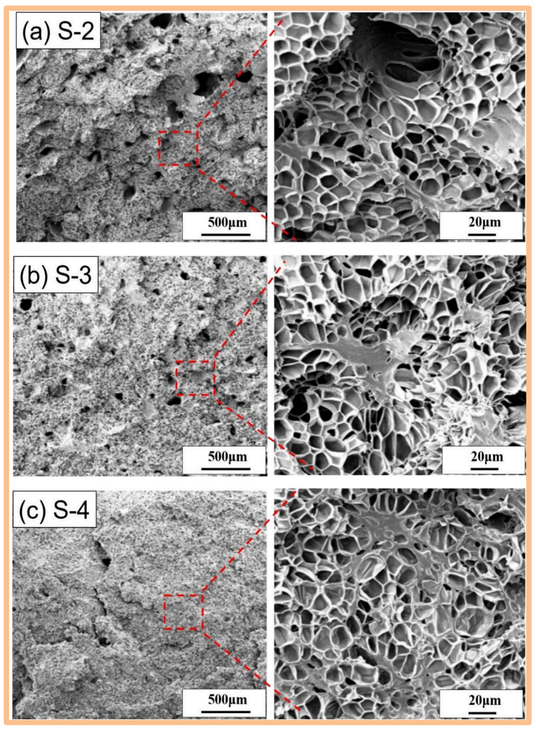


FT-IR

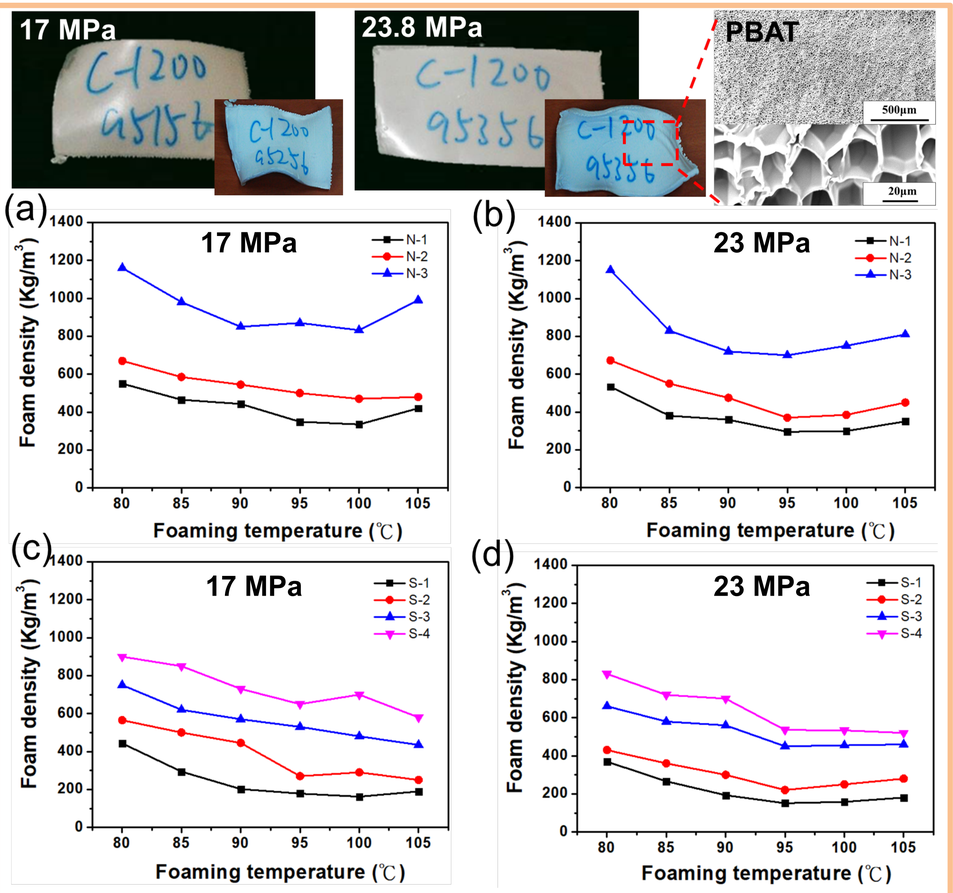


SEM

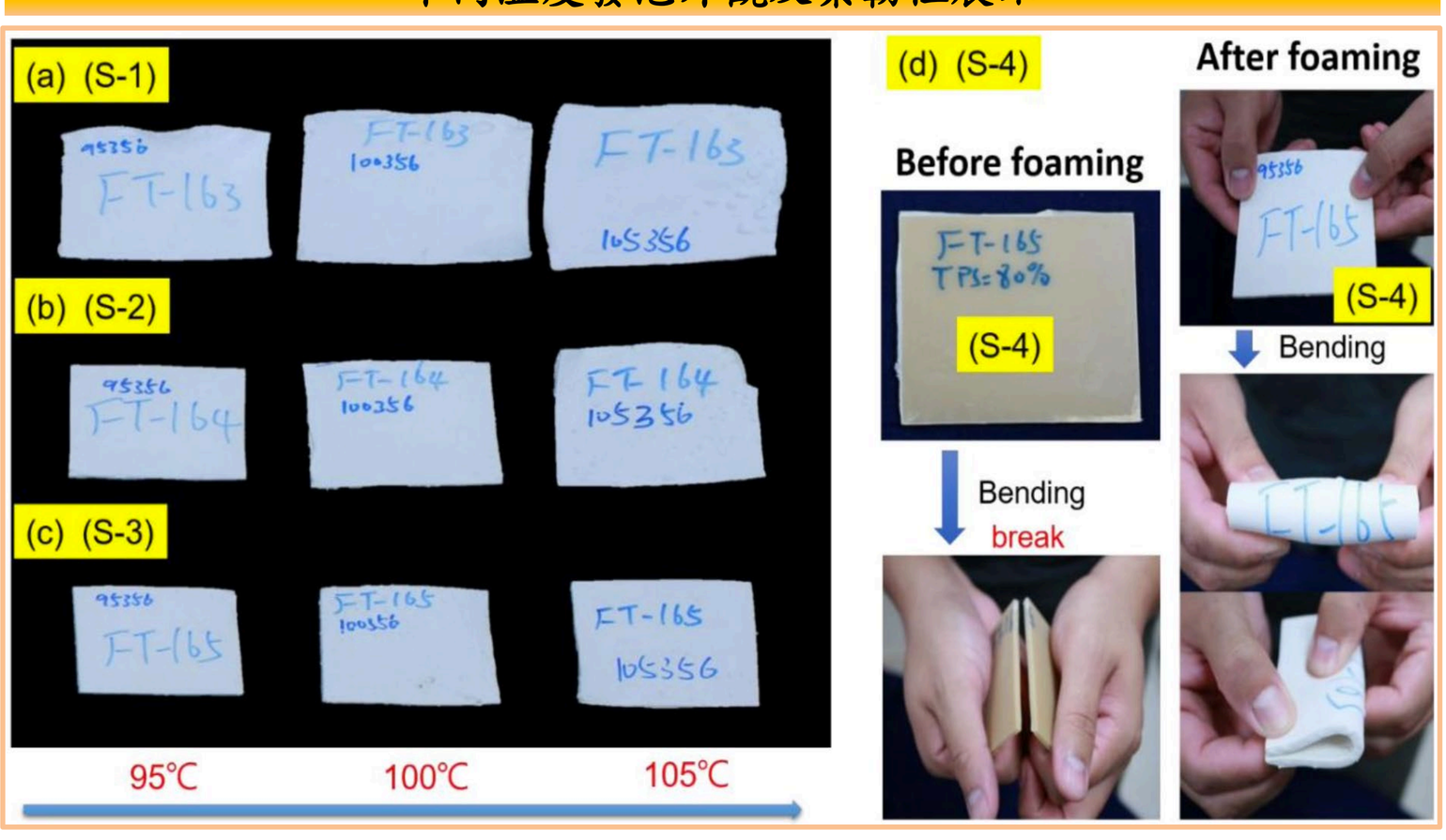




不同溫度與壓力對發泡密度影響



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

可拉伸式rGO感測器之人體運動監測穿戴式元件

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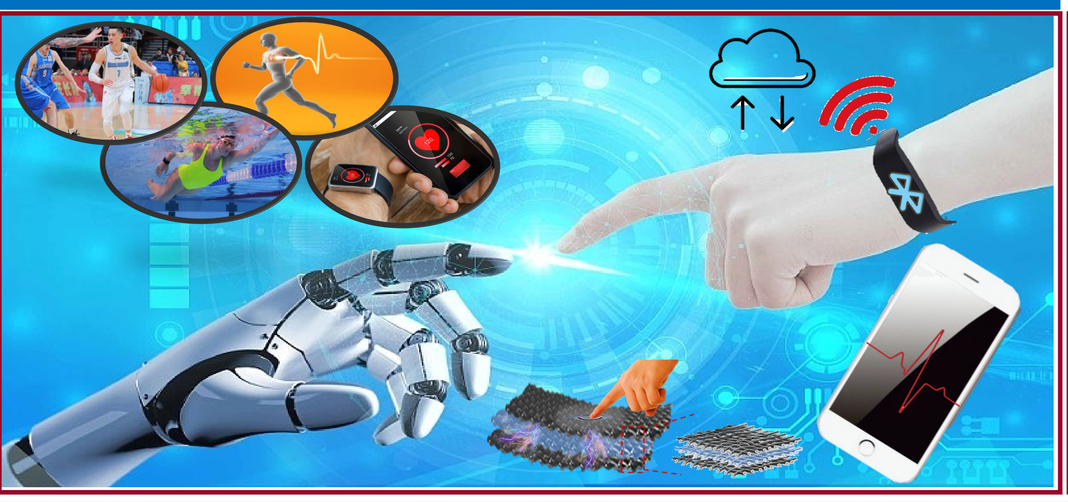
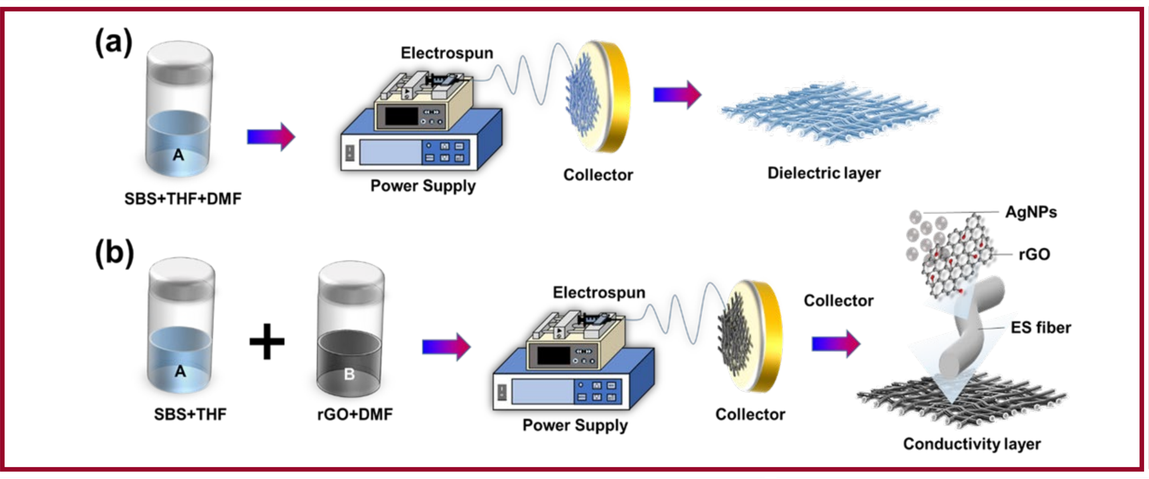
Introduction



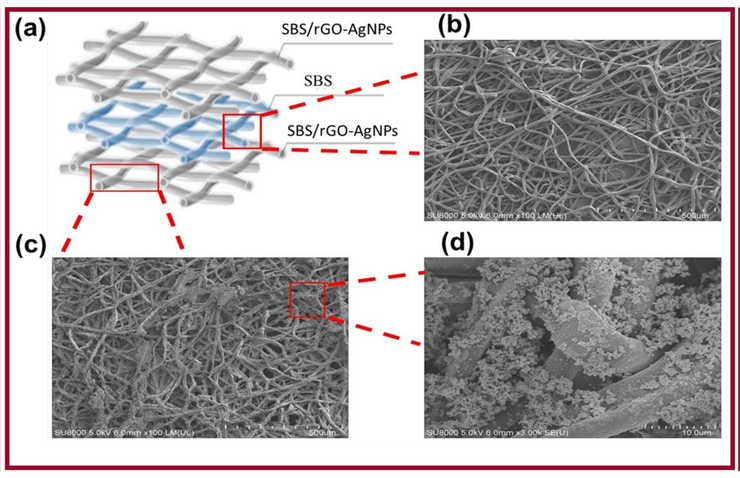
Abstract

- 人體監測系統仍然是一個重要的焦點，為了解決穿戴式感測器的挑戰，提出了一種奈米技術增強策略來設計可拉伸金屬有機聚合物奈米複合材料。
- 彈性三明治結構導電奈米纖維包含（聚苯乙烯－聚丁二烯－聚苯乙烯三嵌段共聚物）(SBS)、還原氧化石墨烯(rGO)和銀奈米粒子(AgNPs)；中間層是由SBS 奈米纖維構成介電層，上下兩層 SBS/ rGO-AgNPs為電極，包覆介電層。
- 有快速反應時間（ <3 ms ）和高穩定性（至少5500 次循環）
- 由於rGO和AgNP之間的有效連接，此奈米複合材料也表現出卓越的熱穩定性，使其適合穿戴式電子應用。

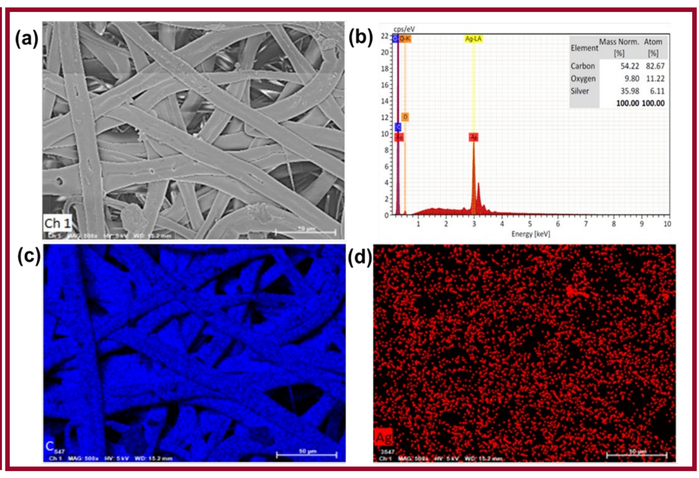
Experiment



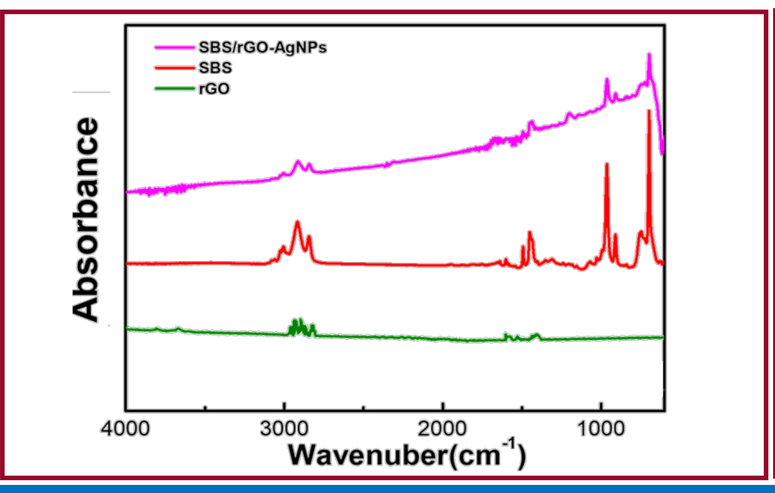
SEM



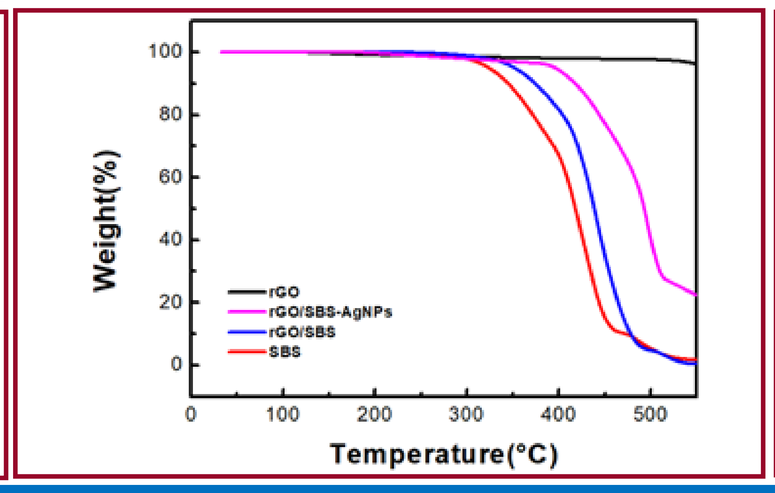
SEM/EDS/Mapping



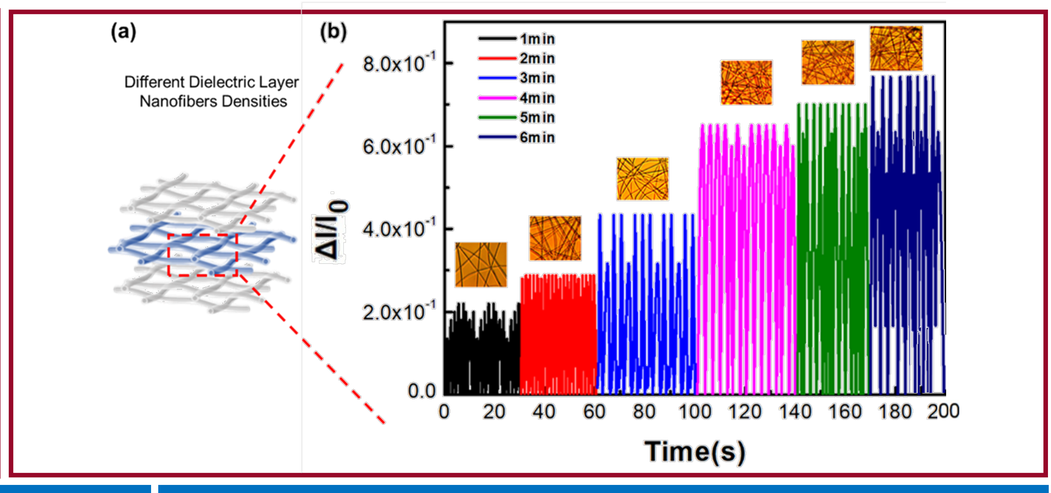
FTIR



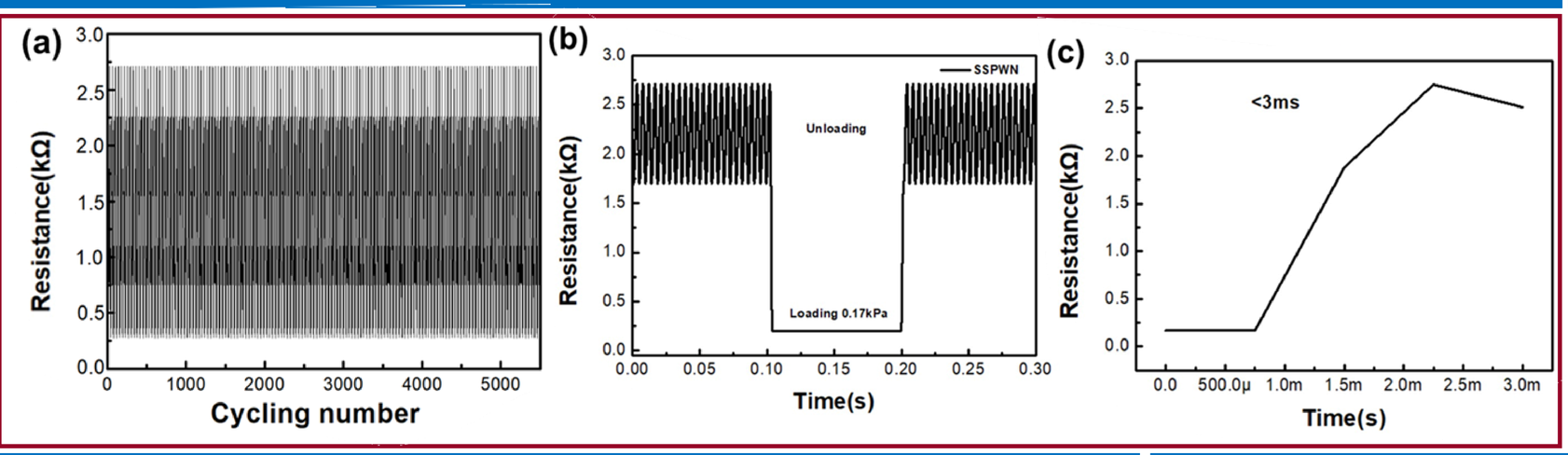
TGA



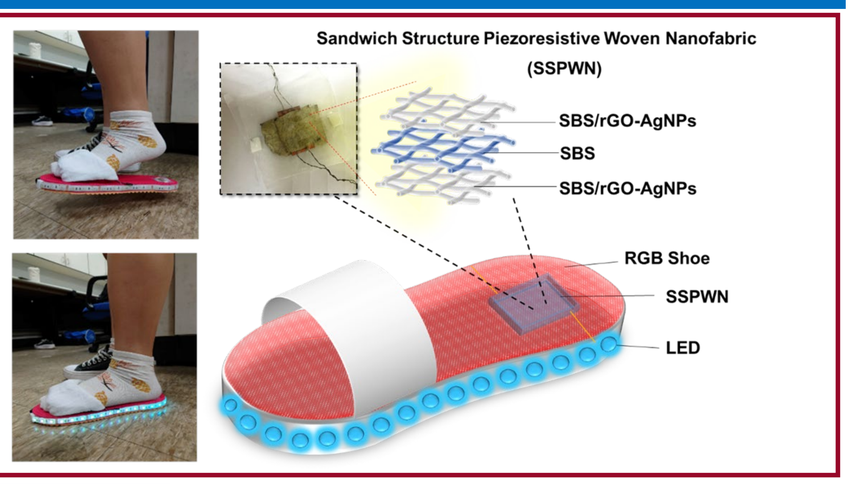
介電層



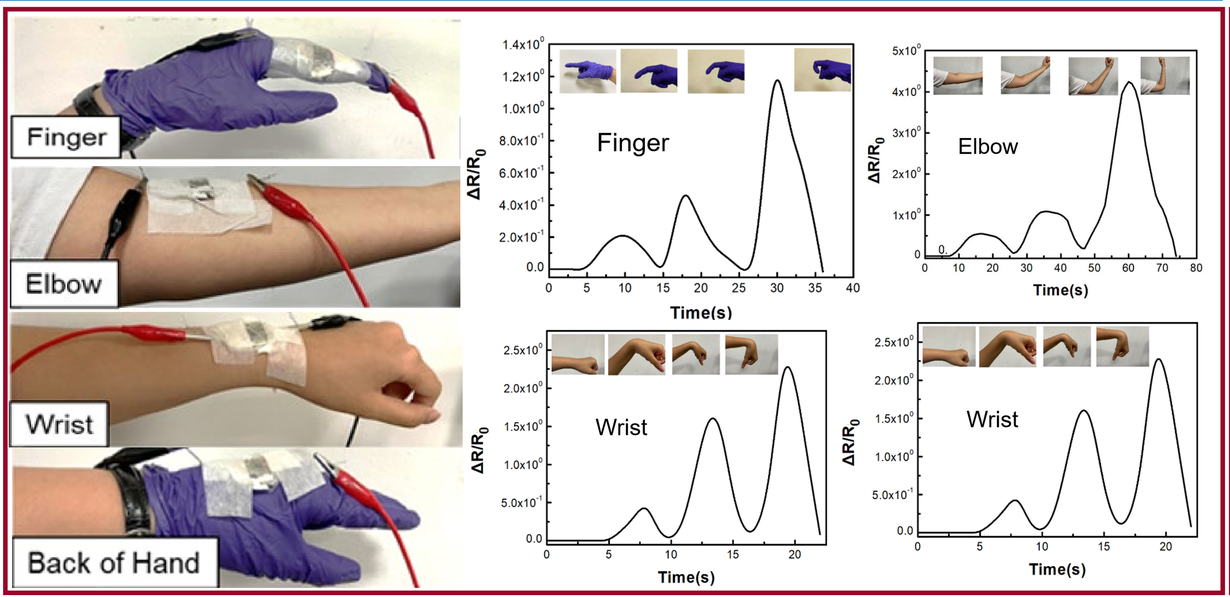
壓力檢測



應用



壓力測試



比較

NO.	Samples	Methodology	Conductivity (S/cm)
1.	Silver foam	Reduction self-assembly/Freeze drvingt	170
2.	Silver nanowire aerogels	Emulsion template synthesist	66
3.	polyurethane/PPy (PU/PPy)	Electrospinning/in-situ chemical polymerization	276
4.	PEDOT	Electrospinning/ vapor-phase polymerization	60
5.	SBS/rGO-AgNPs	Electrospinning/in-situ AgNPs	653

結論

- 將rGO和AgNPs混合到SBS纖維中，做成三明治結構導電奈米纖維（SSPWN）
- SSPWN感測器具有快速的反應時間（<3ms）和超過5500個週期的高穩定性。成功地將SSPWN應用於人體運動監測。
- 將SSPWN感測器應用於醫療保健、健康監測和足部監測的方面在未來很有可看性

生物廢棄物Human Hair/PVA靜電紡絲奈米發電織物

Bio-waste Human Hair/PVA Electrospun Nanogenerator Fabric

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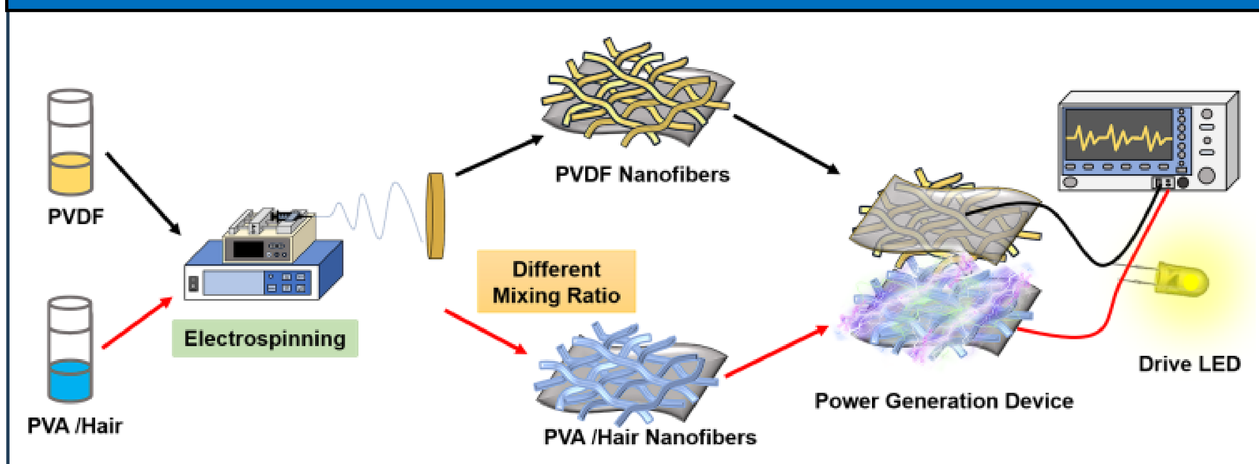
Introduction

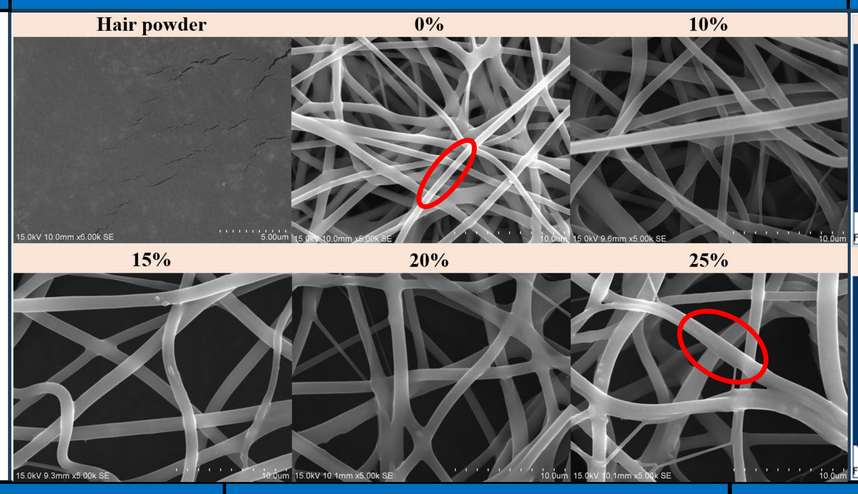
Abstract

本實驗結合靜電紡絲技術，透過人類頭髮帶正電的特性與PVA高度生物相容性的特性相互結合，開發出一種使用人類毛髮與水溶性高分子PVA結合的新穎綠色正摩擦電極。通過添加處理後的頭髮，可以明顯提高摩擦奈米發電機的性能，特別是在20%添加量下，電流和電壓增加兩倍，同時功率密度提高了216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。

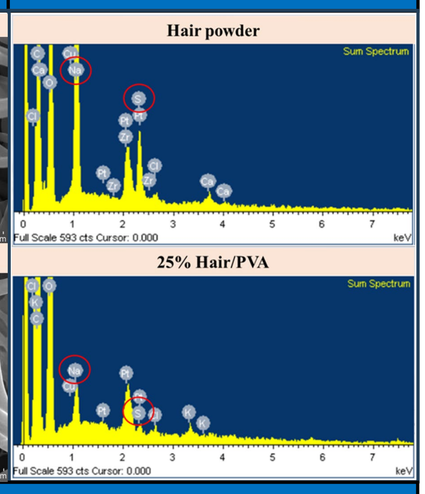
Experimental



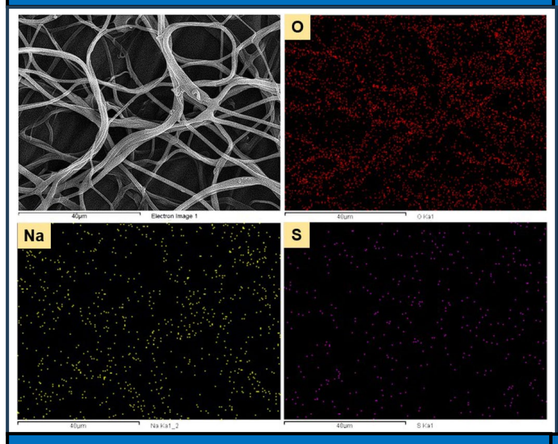
SEM



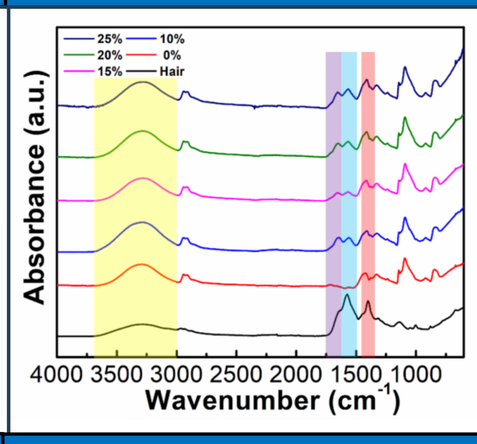
EDS



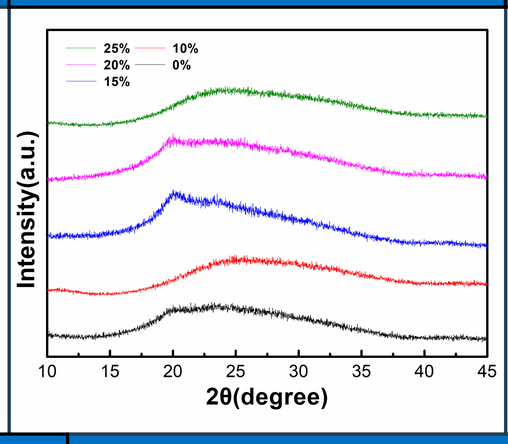
Mapping



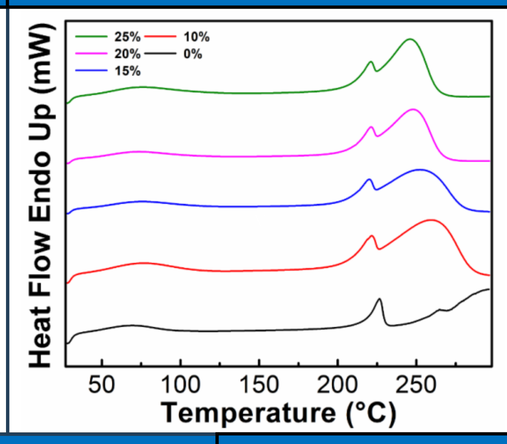
FT-IR



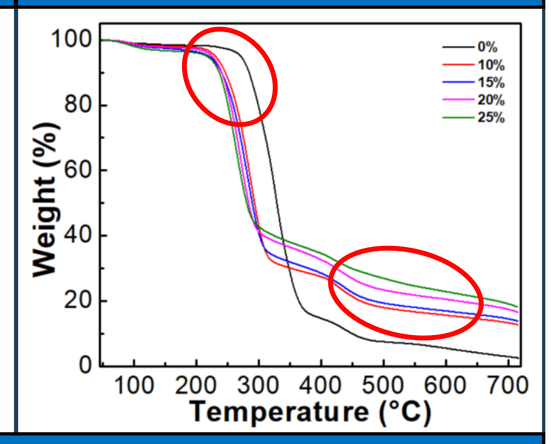
XRD



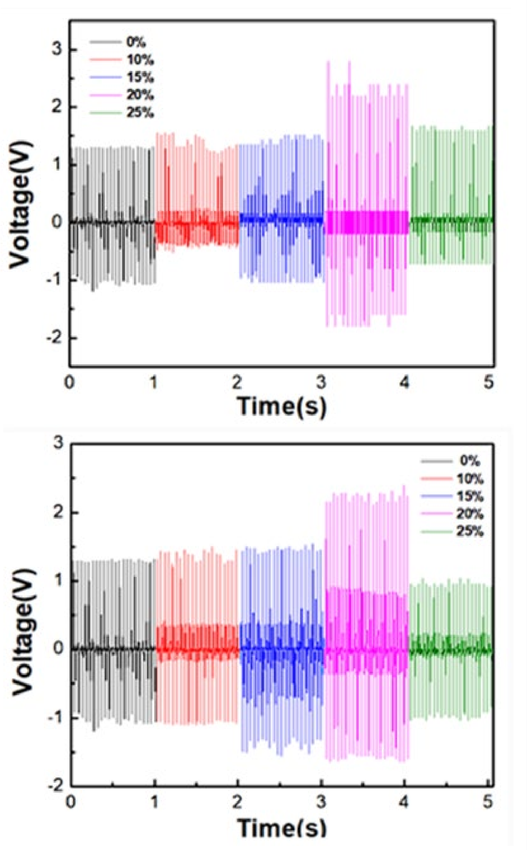
DSC



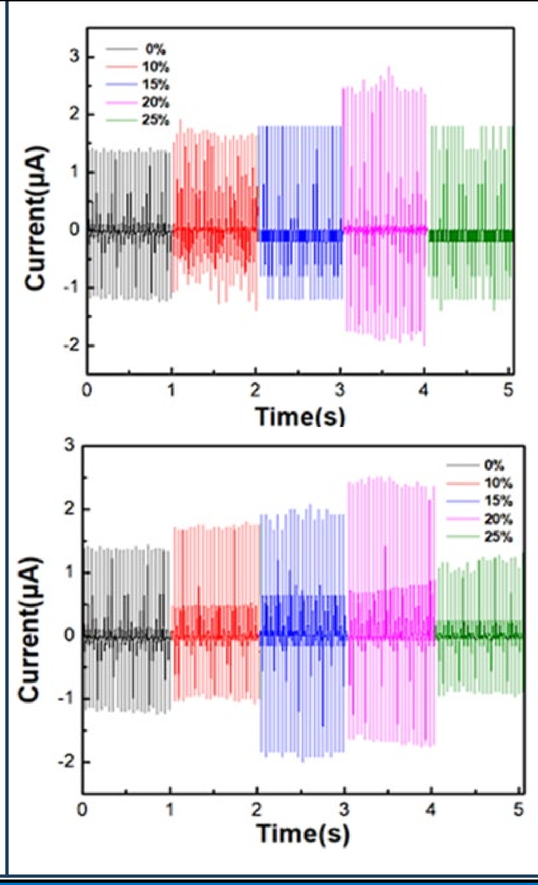
TGA



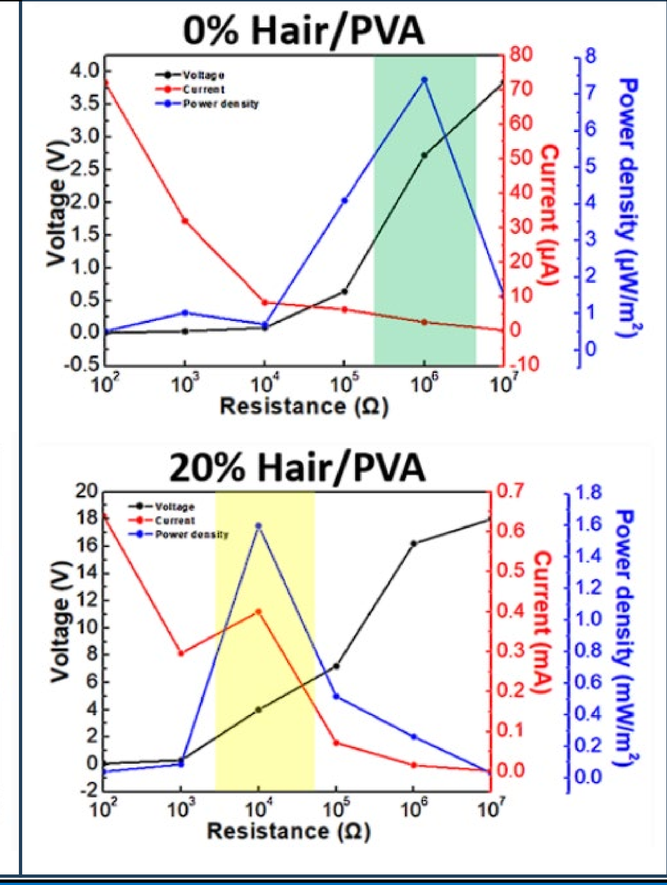
Voltage



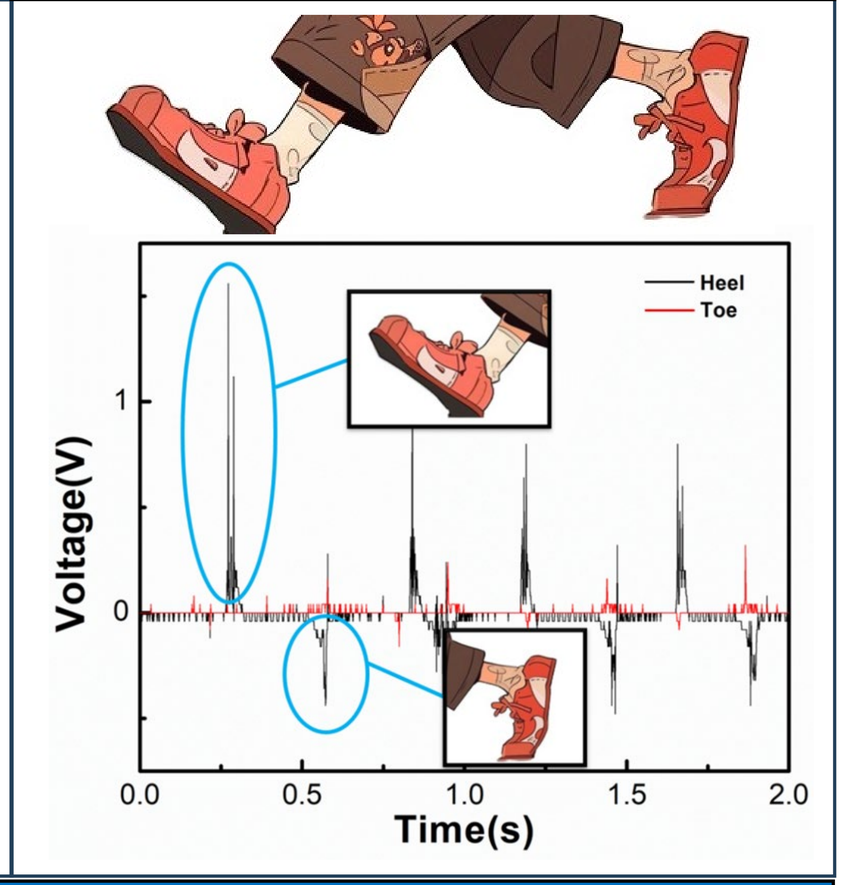
Current



Power density



Application



Conclusion

1. 成功製備出一種使用生物廢棄物人髮與 PVA 結合的綠色正摩擦電極，將不具任何價值的人髮透過處理廢棄物再利用，並與 PVA 結合成新穎的綠色複合纖維 Hair/PVA NFs。
2. 測試電壓和電流獲得最大兩倍的提升，與 0% Hair/PVA 相較下在 20% Hair/PVA 中，最大功率密度也有 216 倍的增幅。
3. 在腳部動態偵測上也能夠明確辨識腳底特定部位的施力起始點，提供更為細緻的資訊能夠有效辨識腳部動態。

基於MXene/Human Hair奈米複合可穿戴能源織物
MXene/Human Hair Nanocomposite Wearable Energy Fabric

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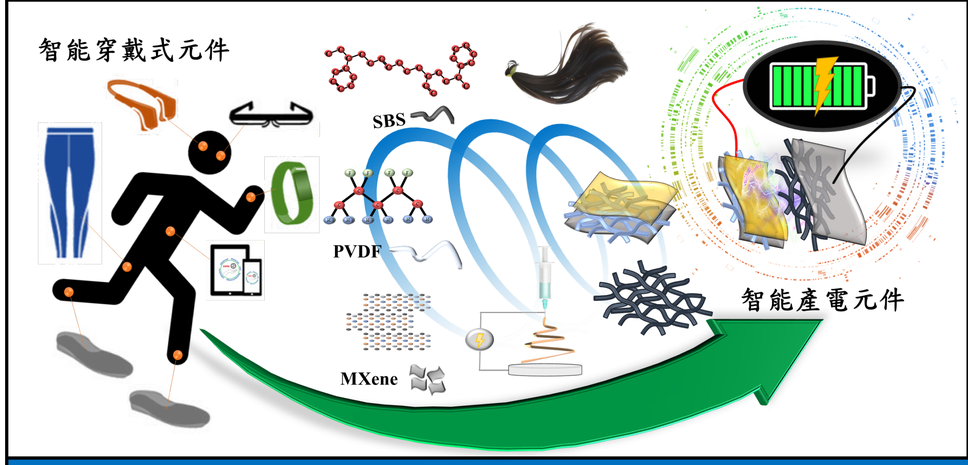
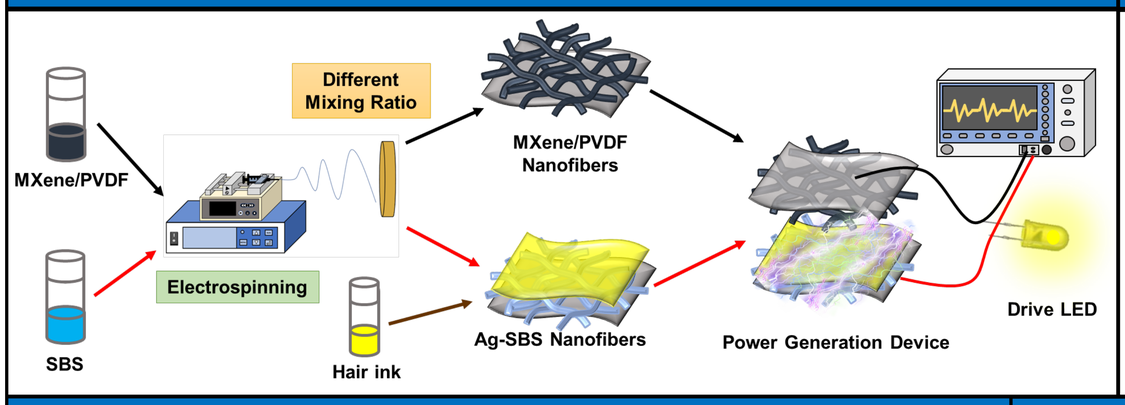
Introduction



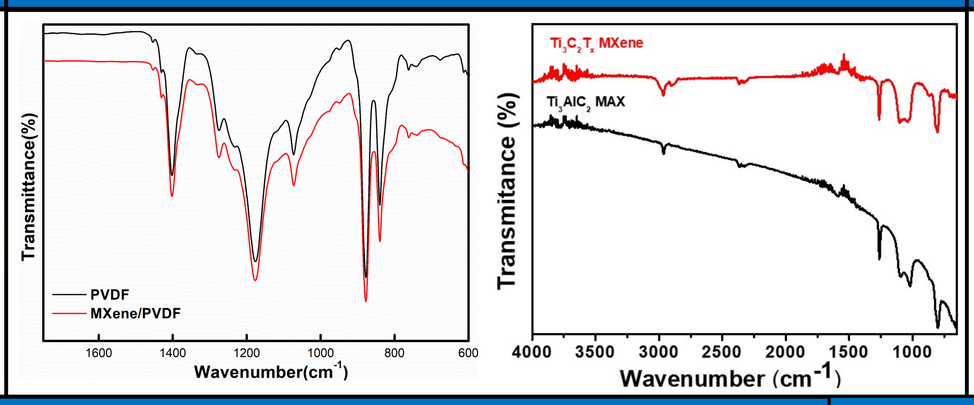
Abstract

本研究藉由耦合效應與靜電紡絲技術，將兩種不同材料接觸起電，將**機械能轉化為電能**，製備MXene/Human Hair新穎奈米複合能源織物(TENG)。將**MXene導入偏二氟乙烯(PVDF)**中，由靜電紡絲技術製備奈米纖維，做為強摩擦負電極，**正電極由人髮進行萃取**，最後進行全織物結構組裝及應用。本**研究首次提出，新穎MXene/Human Hair奈米複合發電織物**，具耐用性和電穩定性，可產生最大電壓為50V、功率密度約20-70mW/m^2、在30秒可將1μF電容器充滿電。

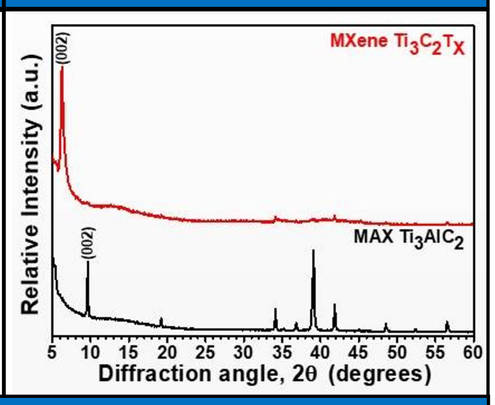
Experimental



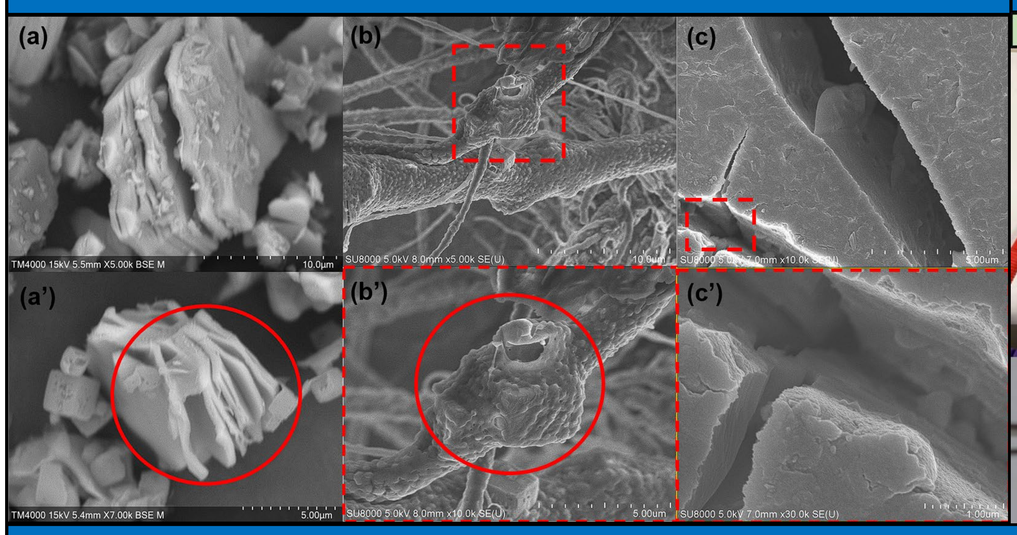
FTIR



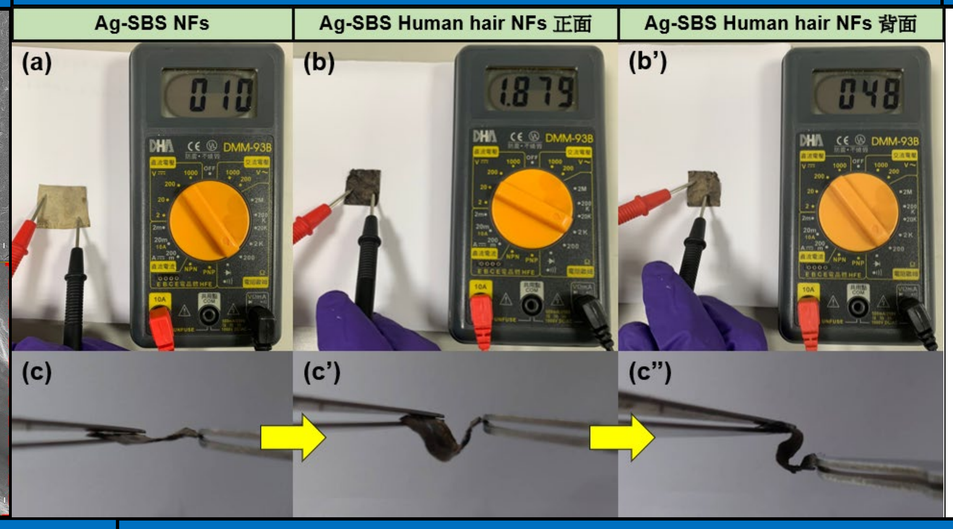
XRD



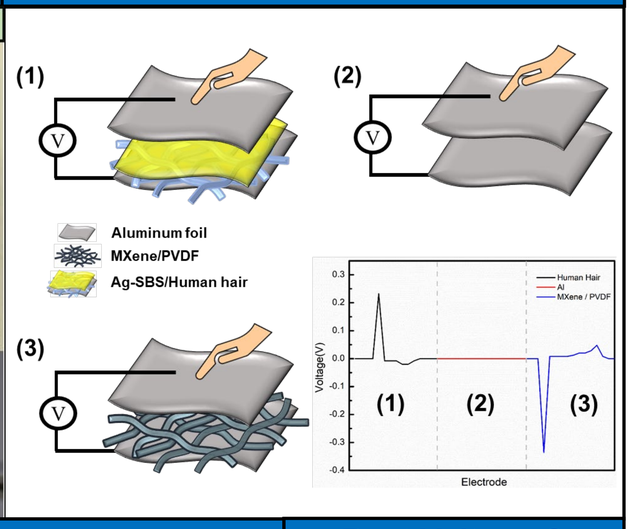
SEM



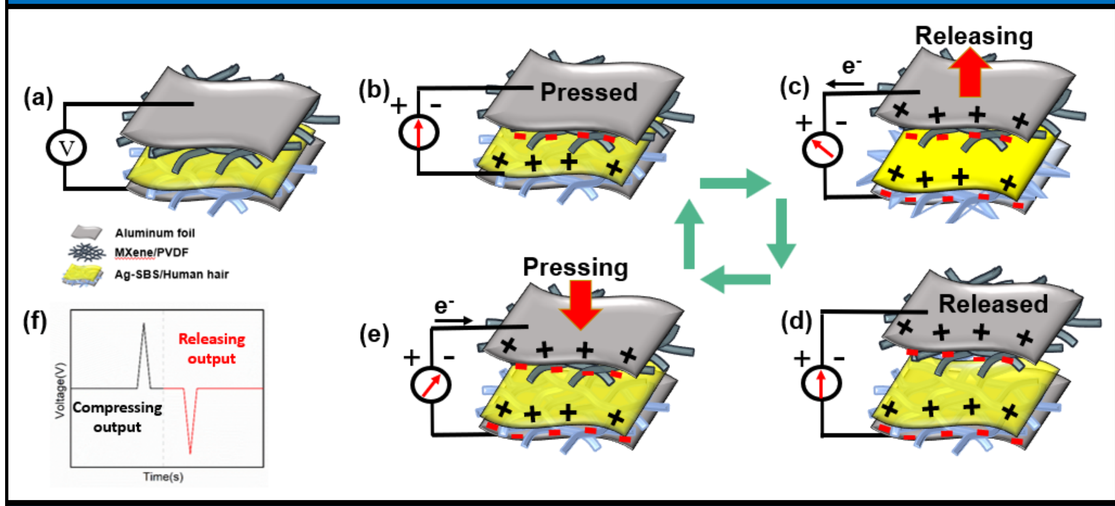
Hair Resistance & flexible



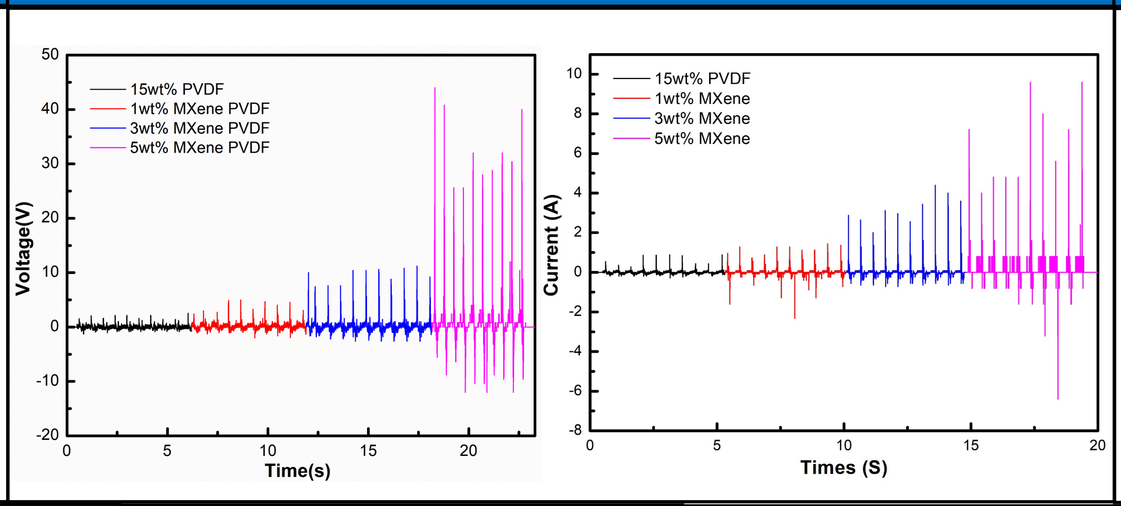
Electrical Properties



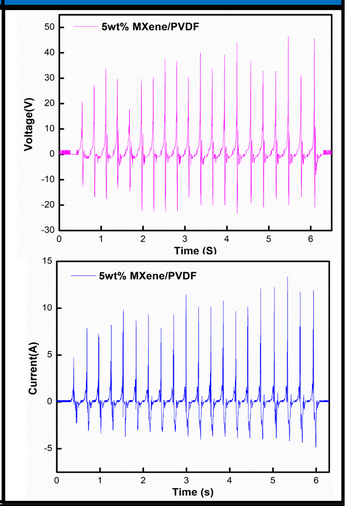
Working mechanism of TENGs



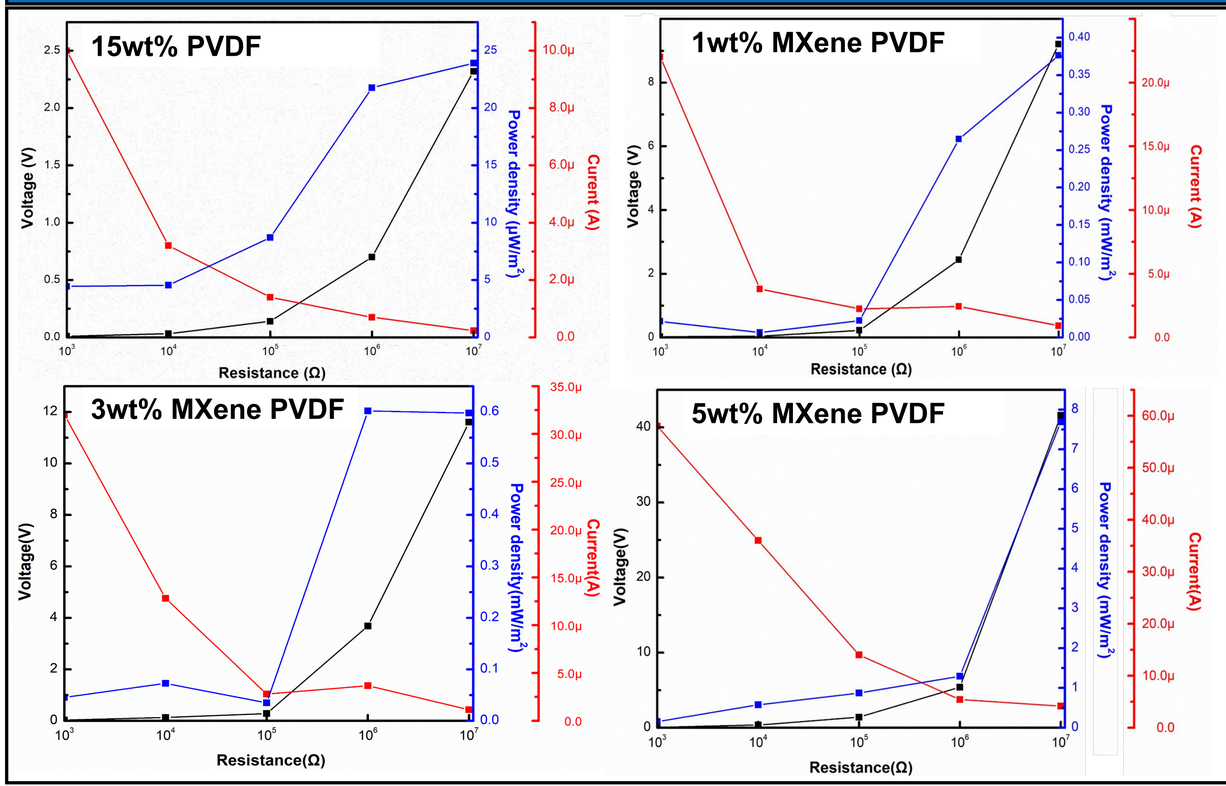
Overturned Voltage & Current



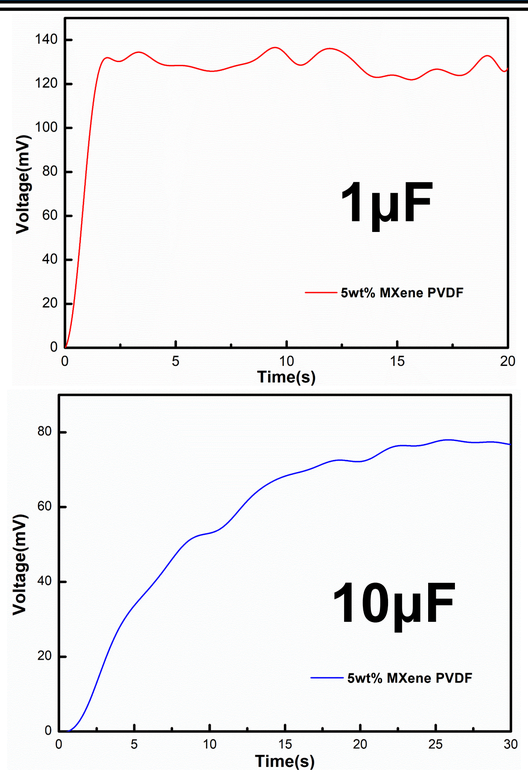
Beat Voltage & Current



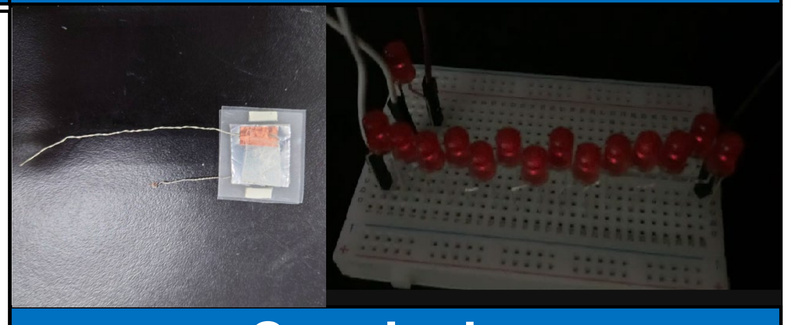
Power Density



Capacitor charge



Drive LED lights



Conclusion

1. TENG的**正摩擦層選用對環境友善的頭髮**製備而成，能夠減輕人髮緩慢降解帶來的生物廢棄物，讓人髮對於環境的壓力降低，使具有**生物循環經濟的TENG**。
2. 添加**5 wt% MXene**時，僅需**20、30秒**即可使**1μF、10μF**電容器充滿電，在電壓、電流、功率密度上分別提升了**17.5、11、321倍**，這代表**Mxene片材的添加能夠使TENG性能提升**。
3. 將可彎折的**Ag-SBS/Human Hair NFs**與**MXene/PVDF NFs**結合，使整個TENG結構變為**全織物型的輕型電源**，柔軟的性質更容易與穿戴裝置結合。

新世代全織物健康監測手環
New Generation All-Fabric Health Monitoring Wristband

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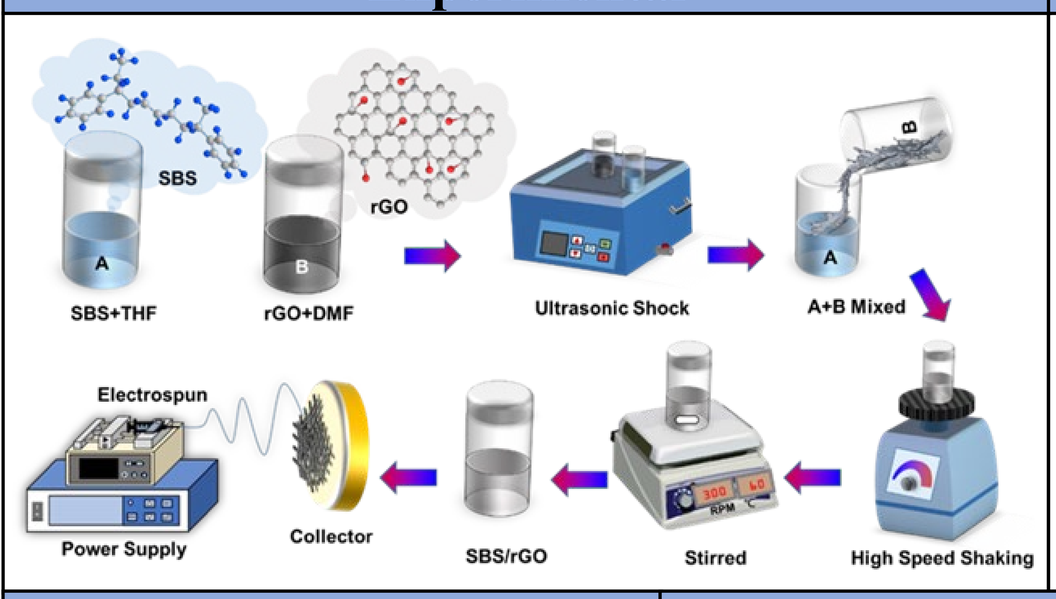
Introduction

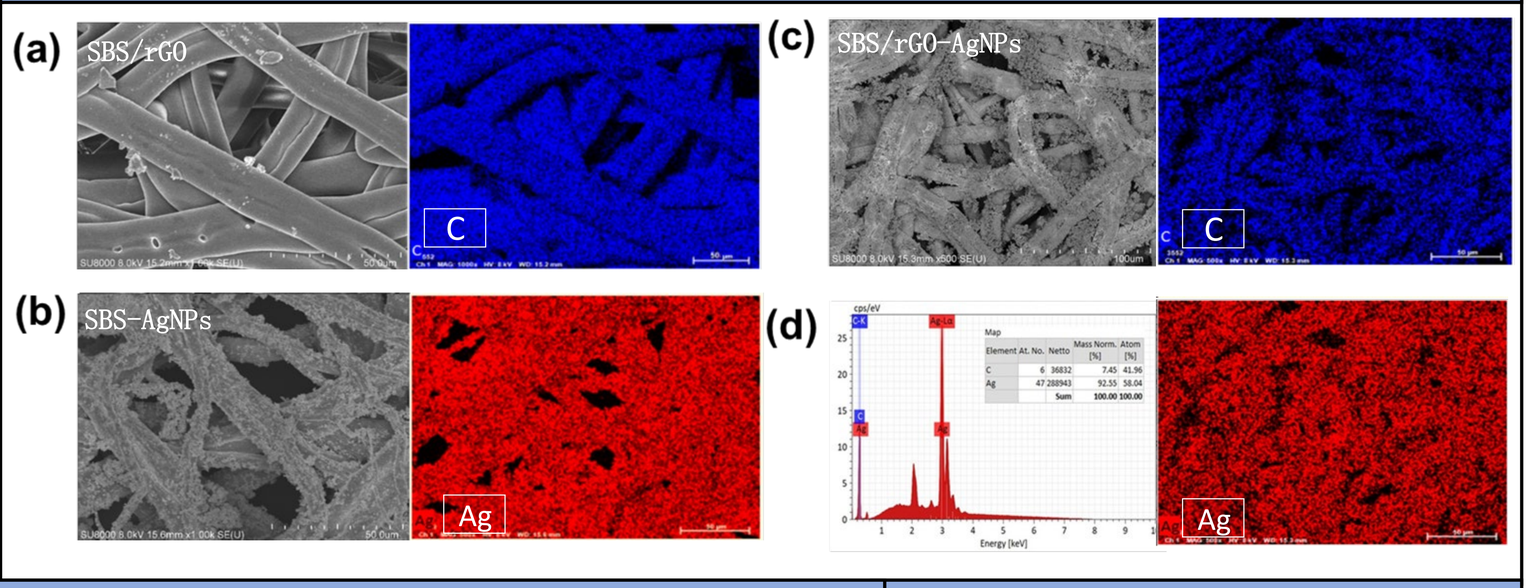
Abstract

- 模仿人類觸覺系統的關鍵是使皮膚能夠探測低壓力的範圍，同時保持靈活性、高靈敏度和快速反應，這些是觸覺靈敏感測器不可或缺的特質。
- 利用靜電紡絲技術（ES）製作了單層壓阻編織奈米織物的觸覺壓阻電子裝置（SLPWN）。採用了可拉伸奈米複合材料，材料有還原氧化石墨烯（rGO）和原位生成的銀奈米顆粒（AgNPs），可以增強可穿戴感測器的機械性能。
- 在輕微施加壓力下（0.04 kPa），能夠擁有80.4791 kPa^{-1}的極高靈敏度。
- 這種技術對光電子學 和皮膚相關領域有著推進作用，同時為日常健康監測提供了便捷而有效的幫助。

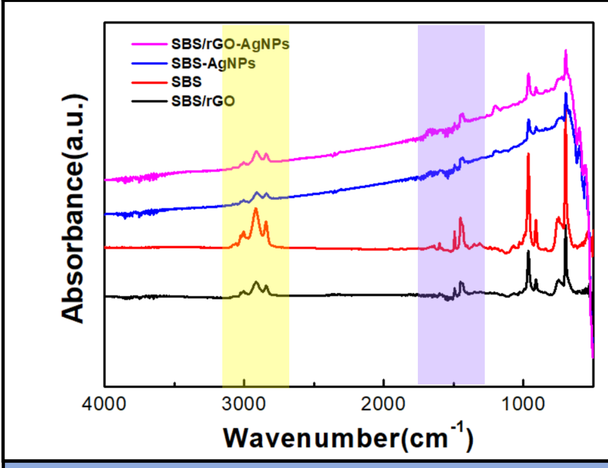
Experimental



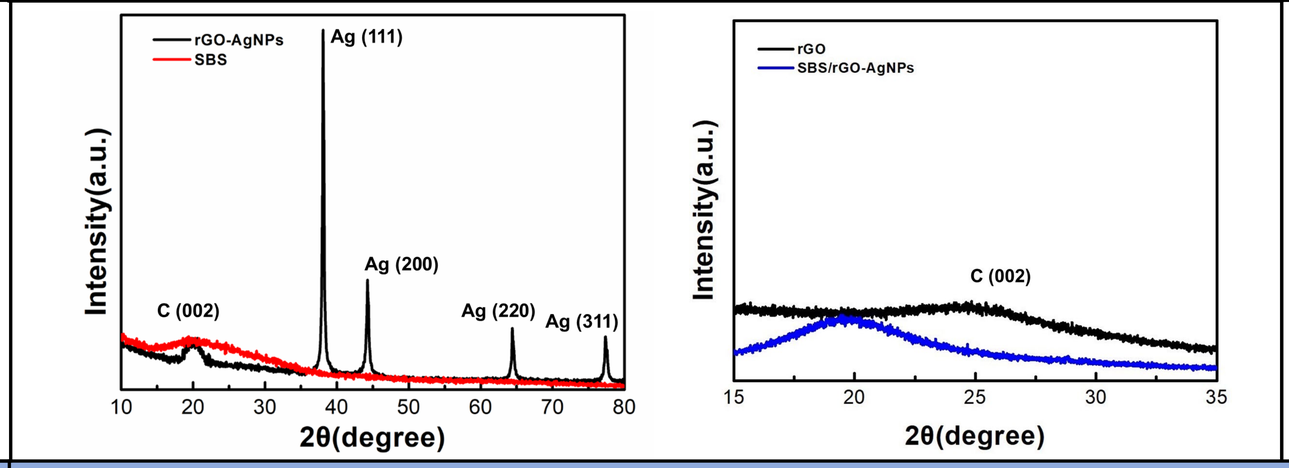
SEM/EDS



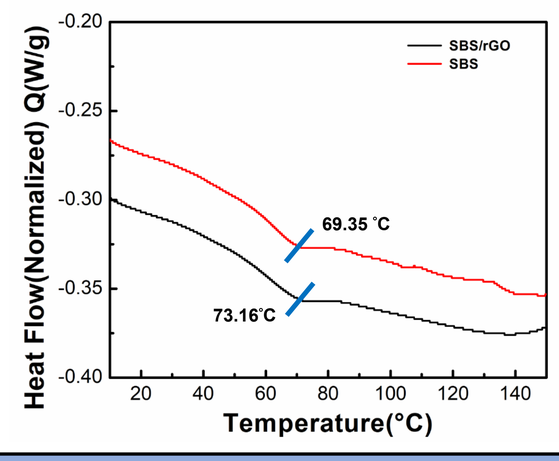
FT-IR



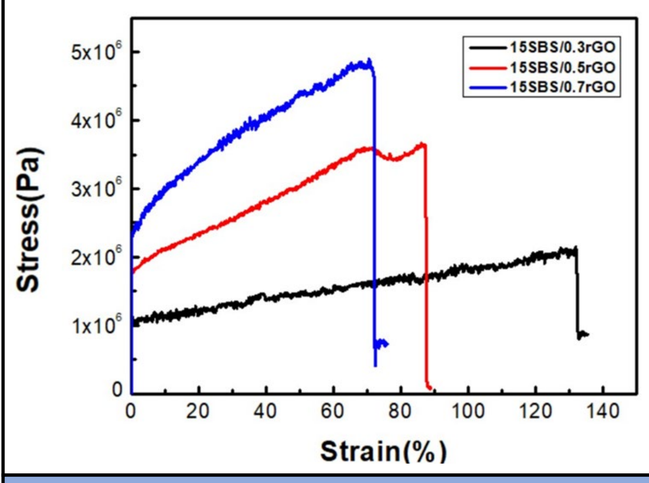
XRD



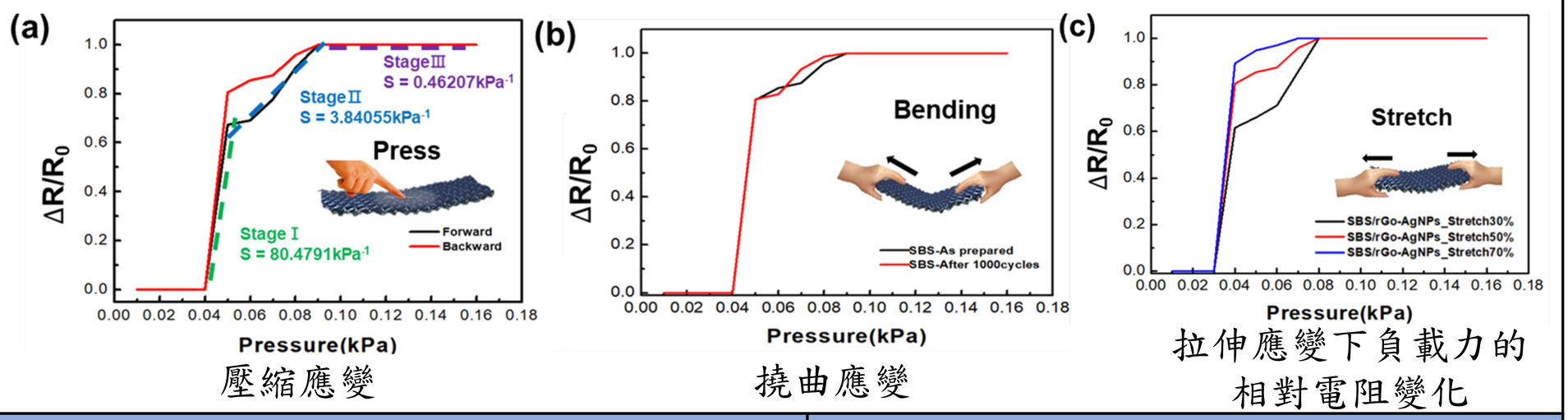
DSC



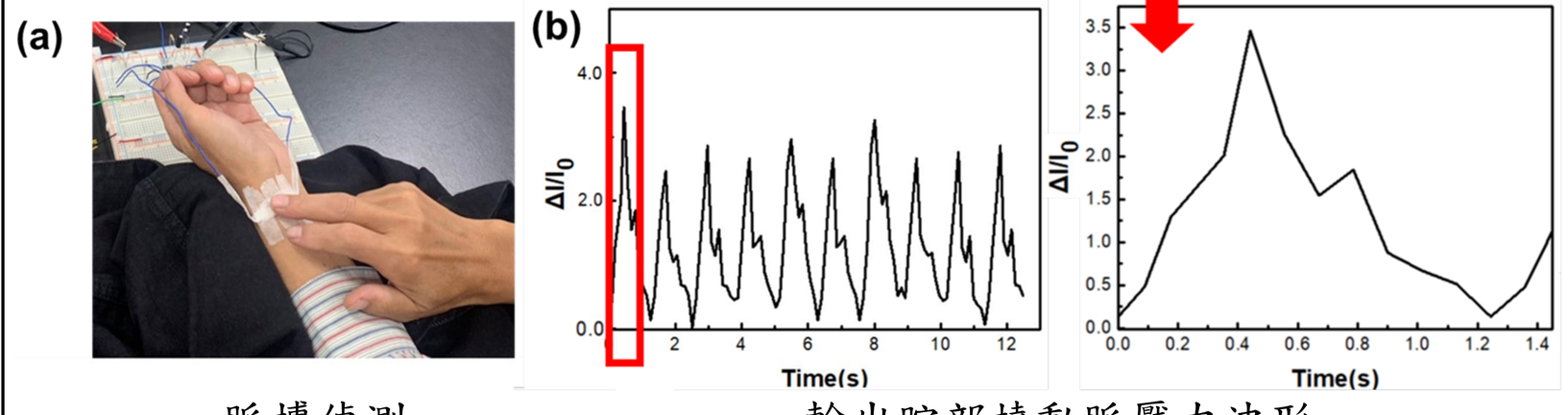
Tensile strength



Electrical analysis



Instant pressure waveform measured on the wrist by SLPWN



脈搏偵測

輸出腕部撓動脈壓力波形

Conclusion

- 透過靜電紡絲技術，成功開發了 SBS/rGO-AgNPs 複合奈米織物。
- 材料不僅具有高比表面積和熱穩定性，還展現了優異的拉伸強度和優秀的電性。
- 通過掌握靜電紡絲參數和條件，能夠調控奈米織物的直徑、形態和分佈。同時透過對SBS混合物進行 rGO 和 AgNPs 處理，分子結構得到改善和強化，進一步增強奈米織物的機械和導電性能。
- 在脈搏監測應用中，其極高的精確度和穩定性，為脈搏監測和光電裝置等領域提供了巨大潛力。

Electrochemical recognition of D-and L-tryptophan chiral isomers by using molecularily imprinting polymer on Ag-SPE electrodes

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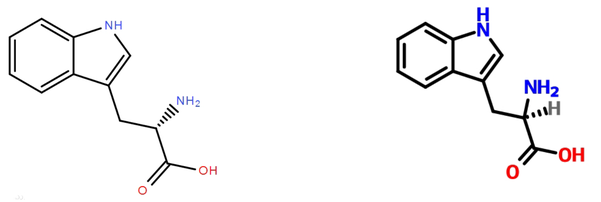
MOST 109-2221-E-214-009, ISU 111-01-03A

Tryptophan imprinted polypyrrole films with shape complementary cavities were electrochemically prepared using a multi-step current method on silver screened printed electrodes (Ag-SPE) in an aqueous solution of pyrrole, Tryptophan (D or L) together with HCl as a supporting electrolyte. High enantioselectivity for the recognition of D and L Tryptophan was attained for the molecularly imprinted polypyrrole (MIP) film on the Ag-SPE by applying a positive potential pretreatment to induce the rebinding of target molecules and the sacrificial dissolution of printed silver particles on the SPE. The sensing performance was evaluated by using multi-step potentials at 0 and 2V (vs. Ag/AgCl), held for 5sec and 5 sec, respectively, over 20 cycles with the two enantiomers being present at the same concentration after the pretreatment, i.e. 10V (vs. Ag/AgCl) for 600s. From the results, the optimum individual selectivities for L- and D- Tryptophan on their respective imprinted films were estimated to be L/D＞100 and D/L＞100, based on the current change between 0 and 2 V (vs. Ag/AgCl) with the two enantiomers being present at the same concentration (10 mM). Matters affecting recognition ability were investigated including: the cross-selectivity of D and L- Tryptophan imprinted films, and a preservation method for maintaining the recognition activity of MIP film on Ag-SPE. The Tryptophan imprinted films were also characterized by AC impedance, FTIR, SEM, and EDS. Finally, a mechanism for the interaction of the polypyrrole film with its template and for the dissolution of silver from the SPE, under positive potentials, are discussed.

Introduction

Since the early studies of molecularly imprinted technology (starting circa 1972), molecularly imprinted polymer (MIP) matrices have been prepared with functional and well-defined three-dimensional cavities with affinity for template molecules. L-tryptophan is an important metabolic precursor and has the function of constructing or enzymatically active protein. It is an essential amino acid that cannot be synthesized by the human body. In this study, molecularly imprinted polymers were nanofabricated by electrodeposition on Ag screen-printed electrodes for the enantioselective recognition of D and L-tryptophan.



L-tryptophan acid **D-tryptophan acid**

Figure 1 The structures of D and L -tryptophan acids

Experimental

Preparation electroplating solution

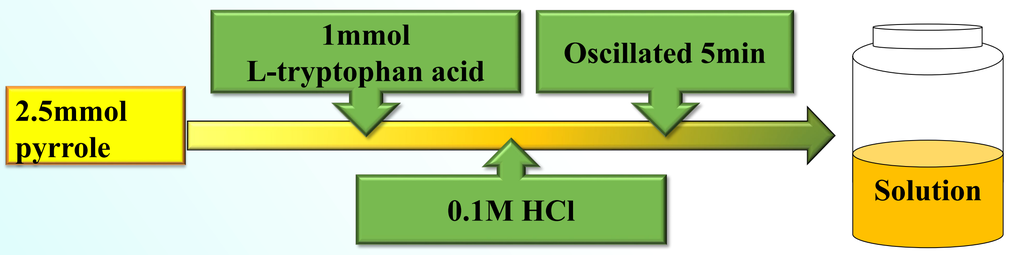


Figure 2. preparation process of molecular imprinting solution

Electrodeposition and test system

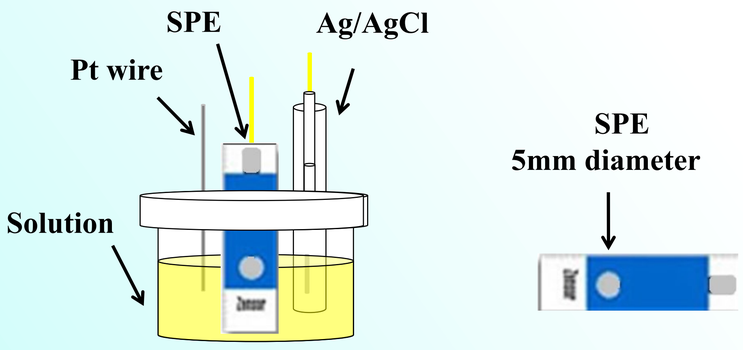


Figure 3. Diagram of electrodeposition and test system.

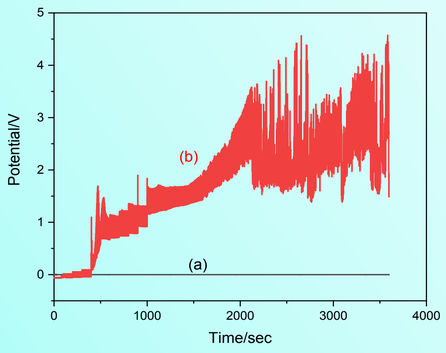


Figure 4. The trend of more pyrrole coatings, when there is less pyrrole, the film deposition will lead to an increase in the initial voltage during electrodeposition, (a) Py:L= 0.5:0.04, (b) Py:L=0.7:0.04

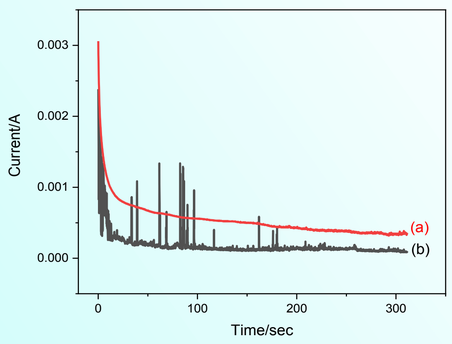


Figure 5. Current change with time for the L-tryptophan acid printed MIP film on Ag SPE during the pretreatment process by amperometry method at 10V(vs. Ag/AgCl) in (a) 10mM L-tryptophan acid and (b) 10mM D-tryptophan acid solutions.

Results and Discussion

Recognition abilities

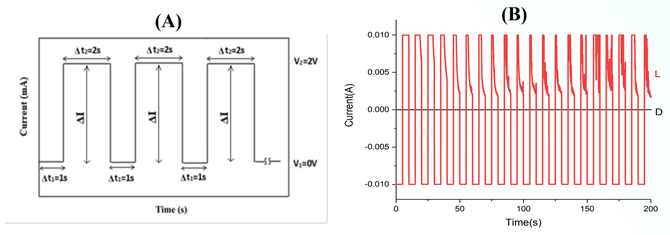


Figure 6 (A) Multi-potential steps method. Applied potentials V_1 and V_2 respectively maintained for the times t_1 and t_2 to obtain the periodic current change △I. (B) Typical rebinding test of L-glutamic acid imprinted/SPE for 10mM (a) L- tryptophan acid (b) D- tryptophan acid solutions.

Interference analysis

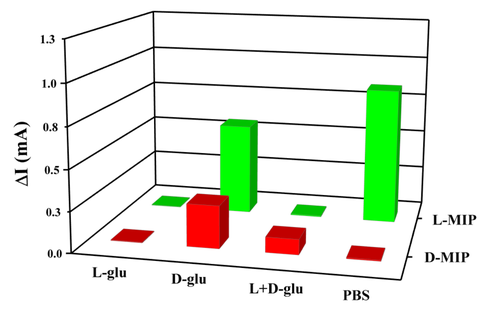


Figure. 8. (A) the L- tryptophan acid imprinted films/SPEs (B) the D- tryptophan acid imprinted films/SPEs used to test different solutions including: 10 mM L-glutamic acid, 10 mM D- tryptophan acid, 10 mM>L- tryptophan acid and 10 mM D-tryptophan acid, and 10 mM phosphate buffer solution(PBS) pH = 7.0 solutions.

SEM-EDS aanalysis

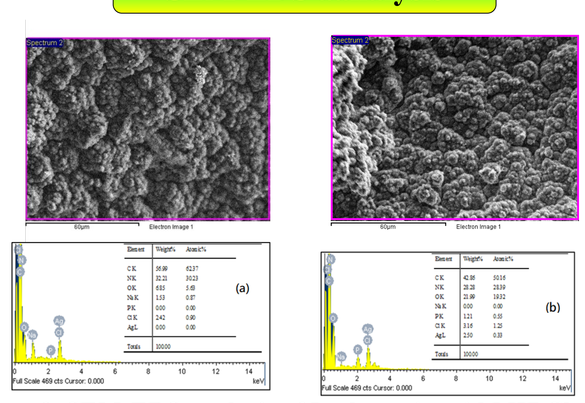


Figure.9. SEM-EDS analysis of L-glutamic acid MIP film on SPE pretreated by amperometry method at 10V(vs. Ag/AgCl) for 10mins in 10mM (a) L- tryptophan acid (b) D- tryptophan acid solutions.

Effect of pH on MIP/SPE

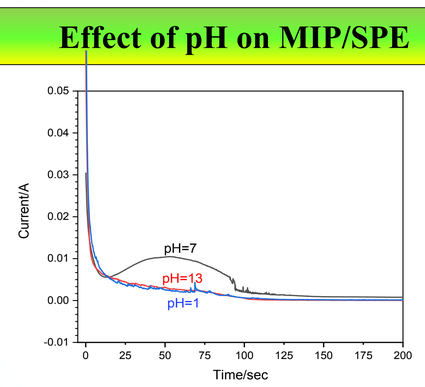


Figure 10. I-t curves of the NIP/Ag-SPEs in different solutions with pH values 1, 7, 13 at constant voltage of 10V(vs. Ag/AgCl) . The best value is at pH=7。

Cross-selectivity of d and l- tryptophan MIP

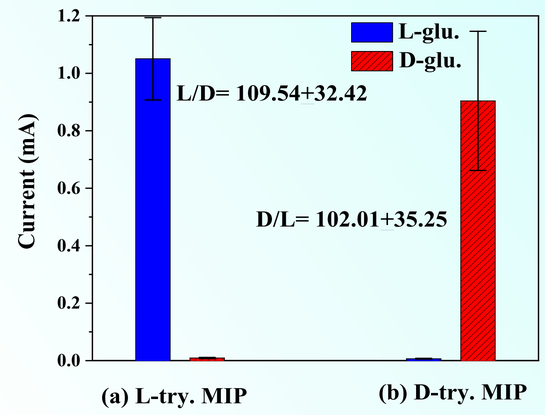


Figure 7. Current change of D and L- tryptophan acids rebinding on (a) L- tryptophan acid and (b) D-tryptophan acid imprinted polypyrrole films, respectively. The Multi-Potential Steps at 0 and 2V(vs. Ag/AgCl) held for 1sec and 2sec, respectively, the total test was 20 cycles with the two enantiomers being present at the same concentration (10mM) in phosphate buffer at pH 7.0.

Recognition Mechanism

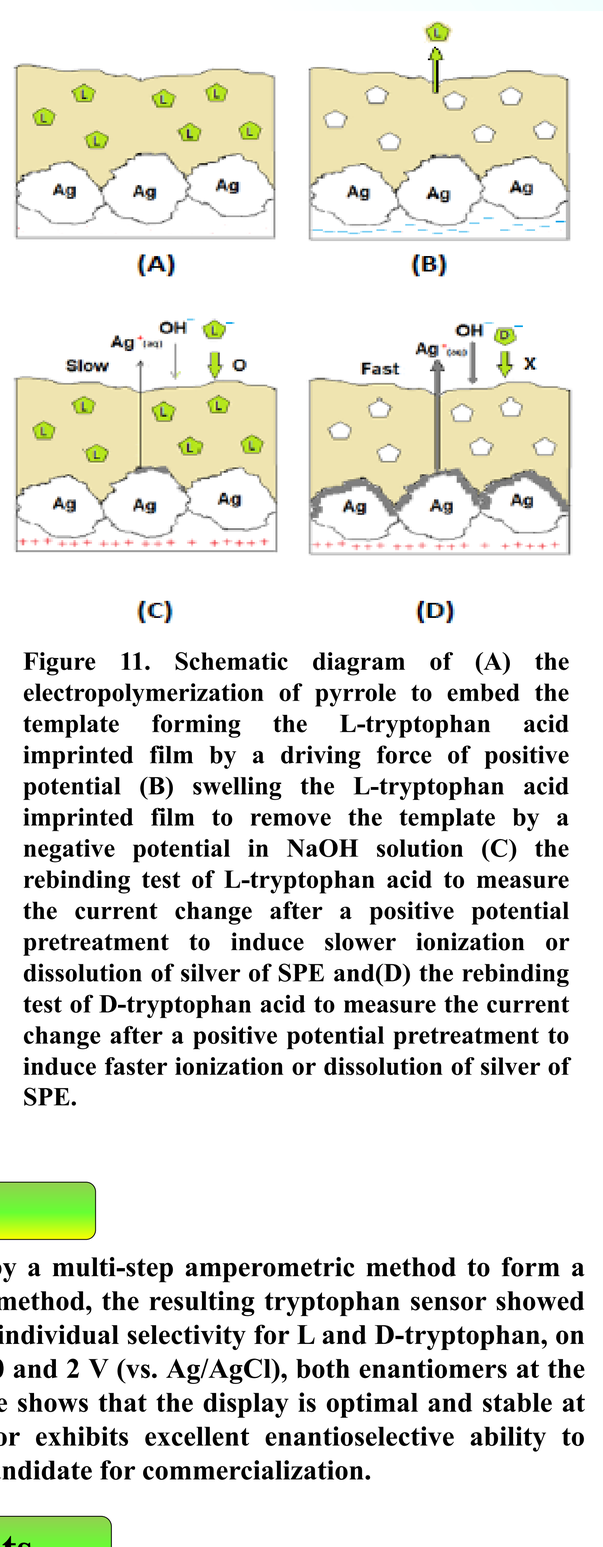


Figure 11. Schematic diagram of (A) the electropolymerization of pyrrole to embed the template forming the L-tryptophan acid imprinted film by a driving force of positive potential (B) swelling the L-tryptophan acid imprinted film to remove the template by a negative potential in NaOH solution (C) the rebinding test of L-tryptophan acid to measure the current change after a positive potential pretreatment to induce slower ionization or dissolution of silver of SPE and(D) the rebinding test of D-tryptophan acid to measure the current change after a positive potential pretreatment to induce faster ionization or dissolution of silver of SPE.

Conclusions

An electrochemical MIP sensor was successfully fabricated by a multi-step amperometric method to form a glutamate-imprinted polypyrrole film on SPE. By using this method, the resulting tryptophan sensor showed high enantioselectivity to its own template molecule. The best individual selectivity for L and D-tryptophan, on their respective blot membranes, according to the current at 0 and 2 V (vs. Ag/AgCl), both enantiomers at the same concentration (10 mM)) exist. The work presented here shows that the display is optimal and stable at pH=7 at different pH values. The imprinted pyrrole sensor exhibits excellent enantioselective ability to recognize its L-glutamate template and is therefore a strong candidate for commercialization.

Acknowledgements

Funding for this work, provided for this research by the Ministry of Science and Technology of Republic of China (Grant No.: MOST 109-2221-E-214-009, ISU 111-01-03A), are gratefully acknowledged.