

Electrochemical Stability of Fibrous Separators from Recycled Polyethylene Terephthalate Cups in Lithium-Based Batteries

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ABSTRACT

This study demonstrates a sustainable approach for converting post-consumer polyethylene terephthalate (PET) drink cups into electrospun fibrous separators. The recycled PET membrane exhibits a uniform bead-free nanofibrous structure with high porosity and an interconnected network, enabling enhanced electrolyte uptake and ion transport. Compared with Celgard 2400, it shows superior thermal stability, retaining structural integrity up to 190 °C without shrinkage, as well as nearly four-fold higher ionic conductivity ($3.15 \times 10^{-1} \text{ S} \cdot \text{cm}^{-1}$) and lower bulk resistance. However, the electrochemical stability of the PET separator is strongly electrolyte-dependent: ether-based systems induce pronounced instability, while carbonate-based electrolytes provide relatively improved, yet still limited, stability. The PET separator operates stably with LiFePO_4 cathodes but shows limited compatibility with graphite and lithium-sulfur cells due to side reactions and interfacial instability. Overall, recycled PET is shown to be a promising eco-friendly separator material, although further optimization of interfacial chemistry and electrolyte compatibility is required for broader application.

1. Introduction

Lithium-ion batteries remain the dominant technology for portable electronics and electric vehicles owing to their high energy density and long cycle life [1, 2]. In these systems, the separator plays a critical role by physically isolating the electrodes while enabling efficient ion transport [3, 4]. Commercial polyolefin separators, typically based on polyethylene and polypropylene, provide acceptable mechanical strength but suffer from low thermal stability, significant thermal shrinkage, and poor electrolyte wettability, which may lead to internal short circuits and thermal runaway under abusive conditions [5–7]. Their limited porosity also restricts electrolyte uptake and ionic conductivity, motivating the development of alternative separator materials with improved thermal and interfacial properties [6, 7].

Simultaneously, the accumulation of plastic waste has driven increasing interest in converting waste streams into high-value functional materials

[8]. Polyethylene terephthalate (PET), one of the most abundant post-consumer plastics, offers higher thermal stability and mechanical robustness than conventional polyolefins, making it a promising separator candidate if suitable porosity and wettability can be achieved [9–11]. Electrospinning provides an effective route to fabricate highly porous fibrous membranes with interconnected three-dimensional networks, high surface area, and tunable fiber diameter, all of which are beneficial for electrolyte retention and ion transport [12, 13]. Previous studies have shown that electrospun PET membranes, including those derived from recycled sources, can outperform Celgard 2400 in terms of wettability, porosity, and thermal stability [14–16].

However, two key limitations remain. First, most studies focus on PET bottles, whereas other abundant waste sources, such as disposable cups, remain largely unexplored [15, 17]. Second, separator evaluation is commonly limited to a single battery chemistry, while compatibility across different lith-

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ium-based systems, particularly lithium-sulfur cells with distinct interfacial requirements, is rarely assessed [18].

Therefore, the main objective of this study was to develop electrospun fibrous separators from recycled PET cups and systematically evaluate their suitability for lithium-based batteries by correlating their structural, thermal, wettability, and electrochemical properties with separator performance in different battery chemistries. To achieve this objective, electrospun PET separators were fabricated and characterized, followed by electrochemical evaluation in half-cell configurations with graphite anodes and LiFePO_4 cathodes, as well as in lithium-sulfur cells, enabling comparison of their behaviour under different electrochemical environments. By addressing both the use of an under explored PET waste source and its performance across multiple battery chemistries, this study contributes to the development of sustainable, waste-derived separator materials for energy storage applications.

2. Experimental part

2.1. Material preparation

Initially, PET plastic collected from cold beverage cups was cut into small pieces, washed sequentially with ethanol and distilled water, and then dried in a drying oven for 12 h. To dissolve the prepared PET fragments, a mixed solvent system of trifluoroacetic acid (TFA) and dichloromethane (DCM) at a 3:7 mass ratio was employed, yielding a solution containing 15 wt.% PET. The solution was magneti-

cally stirred at 500 rpm for 12 h to obtain suitable viscosity and electrical conductivity for the electrospinning process.

Electrospinning was carried out at a solution feed rate of $1.5 \text{ mL}\cdot\text{h}^{-1}$ under an applied voltage of 23 kV, with a tip-to-collector distance of 150 mm. A rotating drum collector operating at 200 rpm was used to collect the fibers. The electrospun PET fibers were deposited onto aluminum foil and subsequently dried under vacuum at 60°C for 24 h to remove residual solvents. The schematic illustration of the process for obtaining a fibrous membrane from recycled PET is shown in Fig. 1.

2.2. Material characterization

Morphological analysis was performed using scanning electron microscopy (SEM; JEOL JSM-IT800, Japan). ATR-FTIR spectra were acquired using a Bruker Alpha II ATR-FTIR spectrometer equipped with an ATR accessory. Measurements were carried out over the spectral range of $400\text{--}4000 \text{ cm}^{-1}$ at a resolution of 2 cm^{-1} , with 24 scans accumulated for each sample. All spectra were baseline-corrected, and each sample was analysed in triplicate to ensure data reliability and reproducibility.

Mechanical properties of the electrospun PET separators were evaluated using a universal testing machine (Testometric X100-1, UK). The membranes were cut into uniform rectangular strips measuring $45 \text{ mm} \times 10 \text{ mm}$. Uniaxial tensile tests were performed at a constant crosshead speed of $50 \text{ mm}\cdot\text{min}^{-1}$ using appropriate grips to ensure stable clamping of the fibrous samples.

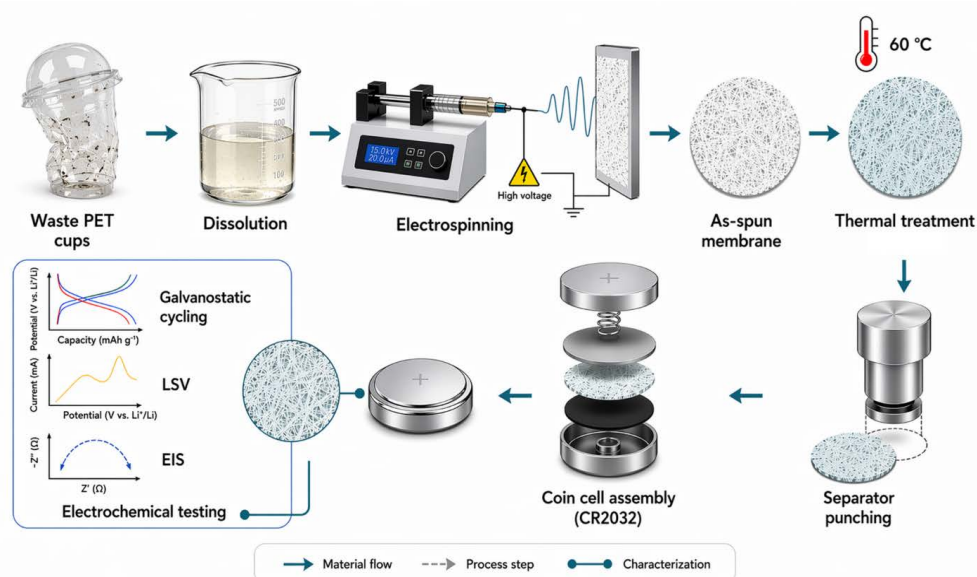


Fig. 1. Schematic illustration of the electrospinning process for the fabrication of a PET fibrous membrane.

Thermal stability of the electrospun PET separators was evaluated using a vacuum drying oven by exposing the membranes to 120–190 °C for 15 min, while the untreated sample at room temperature was used as the reference.

The electrolyte uptake of the fabricated PET fibrous separators and the commercial Celgard 2400 separator was evaluated using a gravimetric method. Prior to the test, all separator samples were dried at 60 °C and punched into circular discs with a diameter of 19 mm. The dry weight of each sample (W_0) was measured using an analytical balance. The separator discs were then fully immersed in 1 M lithium hexafluorophosphate (LiPF_6) dissolved in a mixture of ethylene carbonate (EC), diethyl carbonate (DEC), and ethyl methyl carbonate (EMC) (1:1:1, v/v/v) electrolyte and kept at room temperature for 2 h to ensure sufficient electrolyte absorption. After soaking, the samples were carefully removed from the electrolyte, and the excess electrolyte on the surface was gently removed with filter paper without applying pressure. The wet weight (W_1) was immediately recorded. The electrolyte uptake was calculated using the following Eq.(1):

$$\frac{\text{Electrolyte uptake}}{\text{Swelling test (\%)}} = \left(\frac{W_1 - W_0}{W_0} \right) \times 100 \quad (1)$$

where: W_0 and W_1 are the weights of the separator before and after electrolyte immersion, respectively. Each measurement was performed in triplicate, and the average value was reported.

Ionic conductivity of the separators was evaluated using CR2032-type coin cells assembled with the membrane placed between two stainless-steel spacers and wetted with 25 μL of electrolyte consisting of 1 M LiPF_6 in EC/DEC/EMC. Electrochemical impedance spectroscopy (EIS) measurements were performed over a frequency range from 1×10^5 Hz to 0.1 Hz with 10 points per decade and an AC perturbation amplitude of 10 mV. The ionic conductivity (σ , $\text{S}\cdot\text{cm}^{-1}$) was evaluated based on EIS measurements according to the following Eq.(2):

$$\sigma = L / (R \times A), \quad (2)$$

where: L is the thickness of the separator (cm), R is the bulk resistance obtained from the high-frequency intercept of the Nyquist plot (Ω), and A is the effective electrode-separator contact area (cm^2). The bulk resistance (R) represents the combined ohmic resistance of the separator, impregnated with electrolyte, and of the electrolyte itself.

2.3. Electrochemical investigations

The assembly was carried out in an Ar-sealed glove box (MBRAUN LABMaster Pro, Germany) under a high-purity argon atmosphere with <0.1 ppm H_2O and <0.1 ppm O_2 to avoid moisture and oxygen contamination. The dried fibrous PET membrane was used as a separator.

Electrodes were prepared using a conventional slurry-casting method. PVDF was first dissolved in N-methyl-2-pyrrolidone (NMP), followed by the addition of active material and acetylene black (AB). The mixtures were homogenized using a Thinky mixer at 1200 rpm for 30 min to obtain uniform slurries. The slurries were coated onto appropriate current collectors and dried under vacuum at 60 °C for 24 h. After drying, electrodes were punched into circular disks (14 mm for graphite and LiFePO_4 (LFP), 15 mm for sulfur electrodes) prior to cell assembly.

Electrochemical testing was performed using galvanostatic charge-discharge cycling with a multi-channel battery testing system (Neware Co., Shenzhen, China).

2.3.1. Sulfur cathode

The sulfur composite cathode was prepared via a two-step ball-milling process. First, a composite of Sulfur and Ketjenblack (60:40 wt.%) was obtained by wet ball milling (1 g powder, 5 mL ethanol, 40 g of 1 mm balls) at 800 rpm for 4 h, followed by drying at 60 °C overnight. Subsequently, 0.8 g of the composite and 0.1 g AB were ball-milled for 1 h at 500 rpm. The resulting powder was incorporated into a PVDF/NMP solution and homogenised to form a slurry, which was cast onto carbon-coated aluminium foil.

The electrolyte was prepared by dissolving 1 M lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) in a binary solvent of 1,3-dioxolane (DOL) and dimethoxyethane (DME) (1:1, v/v), with 0.1 M lithium nitrate (LiNO_3) added as a stabilising additive. Electrochemical testing was conducted within the potential range of 1.6–2.8 V vs Li/Li^+ at 0.1 C ($1\text{C} = 1675 \text{ mA}\cdot\text{g}^{-1}$).

2.3.2. Graphite anode

The graphite anode slurry was prepared using a mass ratio of 8:1:1 for graphite, AB, and PVDF, respectively, and cast onto copper foil.

The electrolyte consisted of 1 M LiPF_6 dissolved in a mixture of EC, Dimethyl carbonate (DMC), and DEC (1:1:1 by vol.) was employed. Electrochemical measurements were conducted within a potential window of 0.01–3.0 V vs Li/Li^+ at 0.1 C ($1\text{C} = 370 \text{ mA}\cdot\text{g}^{-1}$).

2.3.3. Lithium iron phosphate (LiFePO_4) cathode

The LFP cathode slurry was prepared following the same procedure and composition (8:1:1 weight ratio of LFP, AB, and PVDF) and cast onto aluminum foil.

A commercial electrolyte of 1 M LiPF_6 in a mixture of EC, DEC, and EMC (1:1:1 by vol.) was used as the bare electrolyte. Electrochemical measurements were conducted within a potential range of 2.5–3.65 V vs Li/Li^+ at 0.1C ($1\text{C} = 160 \text{ mA}\cdot\text{g}^{-1}$).

3. Results and discussion

The microstructural features of the electrospun PET membrane are illustrated in Fig. 2. The top-view SEM image (Fig. 2a) reveals a uniform, bead-free fibrous morphology with randomly oriented fibers, forming an interconnected porous network favourable for electrolyte transport. The cross-sectional image (Fig. 2b) shows a membrane thickness of approximately 25 μm , which is comparable to that of commercial battery separators and suitable for coin-cell assembly. Elemental mapping images (Fig. 2c and 2d) confirm the homogeneous distribution of constituent elements throughout the membrane, indicating structural uniformity across the entire thickness. Such morphological characteristics are beneficial for achieving a balance between mechanical integrity and high ionic permeability. On

the other hand, commercial Celgard 2400 exhibits completely different morphology with narrow pore size (Fig. 2e,f).

Figure 3 presents the ATR-FTIR spectra of the original PET plastic and the electrospun PET fibrous membrane obtained after recycling waste plastic. Both spectra exhibit the characteristic absorption bands of PET, including the strong ester carbonyl stretching vibration at approximately 1715–1720 cm^{-1} , C–O–C stretching vibrations in the range of 1100–1300 cm^{-1} , and aromatic ring-related bands at lower wavenumbers [19]. Based on the close spectral similarity, it is suggested that the dissolution and electrospinning processes did not cause significant chemical degradation or structural alteration of the PET backbone.

Mechanical properties are critical for separator safety, durability, and resistance to internal short circuits. Tensile testing of the commercial Celgard 2400 and electrospun PET separators was performed to determine the peak force, peak stress, and elongation at peak (Table 1). The commercial separator exhibited approximately 1.5 times higher peak force and nearly three times higher peak stress than the PET fibrous membrane, which can be attributed to its dense oriented-fibrillar structure and more efficient stress distribution, as reported in previous tensile studies [20, 21]. In contrast, the porous fibrous architecture of the recycled PET separator, together with limited inter-fiber bonding, reduces its effec-

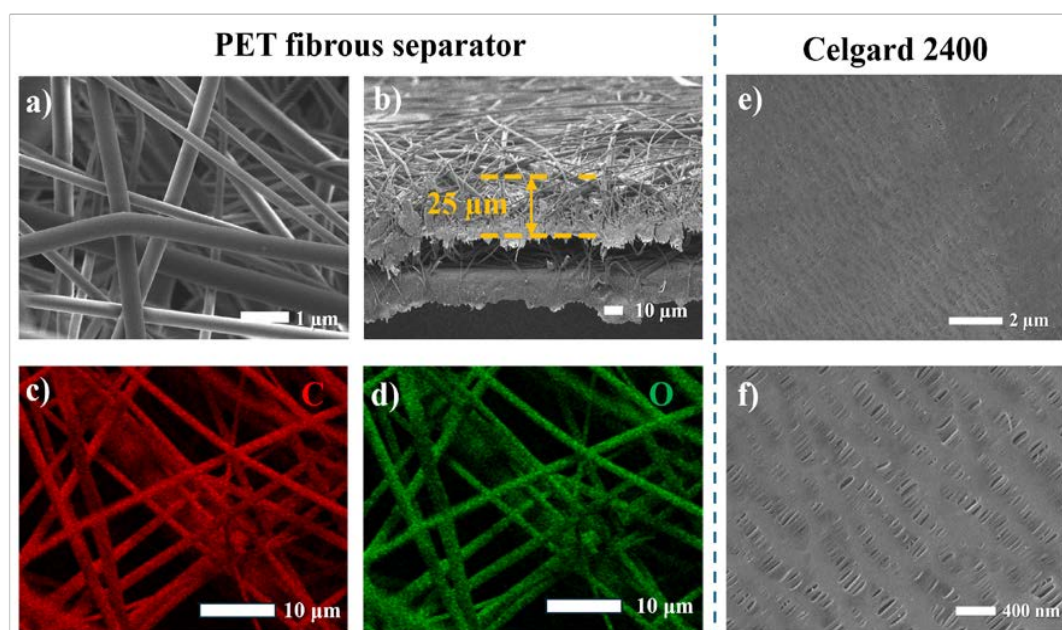


Fig. 2. SEM images and SEM-EDS results of PET fibrous separator: (a) Surface SEM image of the electrospun PET nanofibers; (b) cross-sectional SEM image showing membrane thickness; (c–d) elemental mapping images demonstrating homogeneous distribution within the fibrous membrane. SEM micrographs of the Celgard 2400 separator recorded at different magnifications: (e) 10,000 $\times$, and (f) 40,000 $\times$.

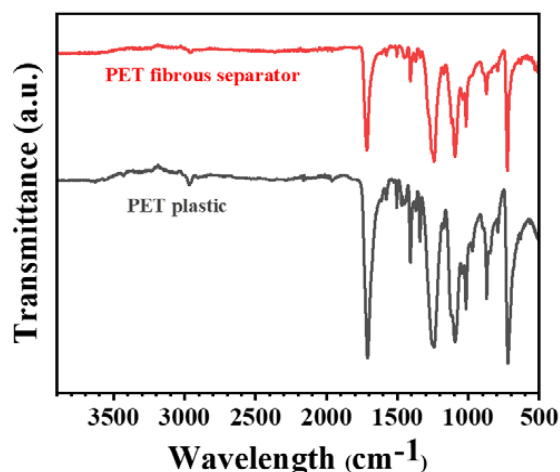


Fig. 3. FT-IR spectra of pristine PET feedstock and electrospun recycled PET fibrous separator.

tive load-bearing capability [22, 23]. However, the PET-derived separator showed substantially greater elongation at peak, indicating a more ductile mechanical response, whereas Celgard 2400 failed at considerably lower deformation.

Table 1. Tensile properties of separators

Sample	Force @ Peak (N)	Stress @ Peak (MPa)	Elong @ Peak (mm)
Celgard 2400	3.74	18.70	1.59
PET fibrous separator	2.59	6.47	21.63

Figures 4 and 5 compare the thermal dimensional and chemical stability of the electrospun PET membrane with the commercial Celgard 2400 separator. As shown in Fig. 4, Celgard 2400 undergoes severe thermal deformation above 150 °C, reaching nearly 80% shrinkage at 170 °C, which is consistent with the low softening and melting temperatures of polyolefin separators and may lead to shutdown failure and internal short circuits [24]. In contrast, the PET fibrous membrane retains its shape across the entire tested temperature range, with shrinkage remaining below ~15% even at 190 °C, reflecting the superior thermal tolerance of its interconnected fibrous network.

This behavior is further supported by FTIR analysis (Fig. 5). The characteristic polypropylene bands of Celgard 2400 at ~2950–2840 cm⁻¹ and ~1450–1375 cm⁻¹ remain largely unchanged after heating, indicating that its thermal instability arises mainly from physical shrinkage rather than chemical degradation [25, 26]. Similarly, the PET separator preserves its characteristic ester-related bands, including the

C=O stretching peak and C–O–C vibrations, with no noticeable spectral changes after thermal treatment [10, 27]. The preserved chemical structure together with the low dimensional shrinkage highlights

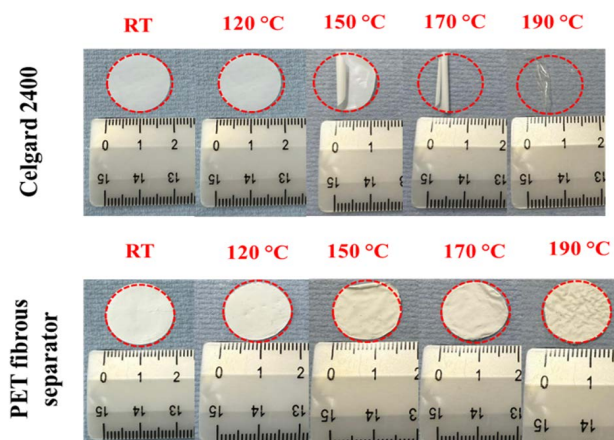


Fig. 4. Comparison of thermal shrinkage behaviour of the electrospun PET fibrous separator and commercial Celgard 2400 after exposure to different temperatures.

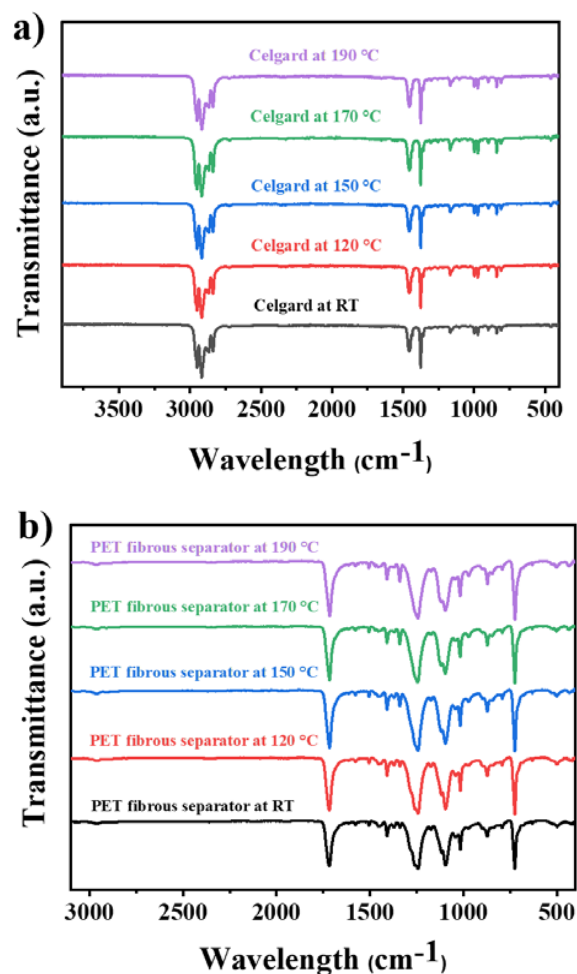


Fig. 5. FT-IR spectra of Celgard 2400 (a) and electrospun PET (b) separators after thermal treatment at different temperatures.

the suitability of the recycled PET-derived fibrous membrane for safer battery operation under elevated-temperature conditions.

To evaluate long-term operational integrity, the dimensional stability and electrolyte uptake of the electrospun PET membrane were examined and compared with those of the commercial Celgard 2400 separator used for LiPF_6 in EC/DEC/EMC. As expected, the electrospun PET separator exhibited a high electrolyte uptake of approximately 347–382% (average around 350%), attributed to efficient capillary filling within its interconnected porous network rather than to bulk polymer swelling. In contrast, the commercial Celgard 2400 separator exhibited a lower electrolyte uptake of 57.5–67.5% due to its denser microporous architecture. Despite these differences in electrolyte retention, the PET membrane exhibited dimensional stability comparable to that of the commercial separator, maintaining its structural integrity without significant expansion under standard battery operating conditions.

The EIS spectra of the electrospun PET separator and Celgard 2400 with 1 M LiPF_6 in EC/DEC/EMC electrolyte and stainless-steel are shown in Fig. 6a. Both spectra display a typical Nyquist profile, featuring a depressed semicircle at high-to-medium frequencies that corresponds to charge-transfer resistance. However, the electrospun PET fibrous separator exhibits significantly lower bulk resistance and a smaller semicircle diameter than the cell with the commercial Celgard 2400 separator. As for the absence of a low-frequency Warburg-diffusion impedance tail, it may be attributed to the use of stainless-steel blocking electrodes [28] and to a focus on evaluating the separator's ionic conductivity rather than electrochemical reaction kinetics. Note that

this bulk resistance (R) represents the combined ohmic resistance of the separator impregnated with electrolyte and the electrolyte itself. The combined ohmic resistance of the separator impregnated with electrolyte and the electrolyte itself.

Accordingly, its ionic conductivity reached $3.15 \times 10^{-5} \text{ S} \cdot \text{cm}^{-1}$, nearly four times higher than that of Celgard 2400 ($8.41 \times 10^{-6} \text{ S} \cdot \text{cm}^{-1}$). This enhancement is attributed to the highly porous interconnected nanofibrous structure, which improves electrolyte uptake and facilitates continuous lithium-ion transport pathways, thereby reducing cell polarization and supporting better rate performance [14, 22].

Figure 6b shows Nyquist plots of half-cells of different chemistries using different separators. PET fibrous separator exhibits a different impedance response from the Celgard 2400 reference across all studied systems (graphite, LFP, and lithium-sulfur cells). The observed differences in the spectra reflect variations in interfacial resistance and ion transport behaviour associated with the separator structure.

The galvanostatic charge-discharge performance of both separators was evaluated under identical testing conditions to assess the compatibility of the recycled PET membrane with different electrode chemistries, using the well-established Celgard 2400 separator as the reference due to its proven compatibility across various battery systems, as shown in Fig. 7.

In sulfur half-cells, as shown in Fig. 7a, b, both membranes exhibited the characteristic two-step voltage profile associated with sulfur redox reactions. However, compared with Celgard 2400, the PET separator showed less distinct plateaus, faster voltage decay, and shifted charging behaviour.

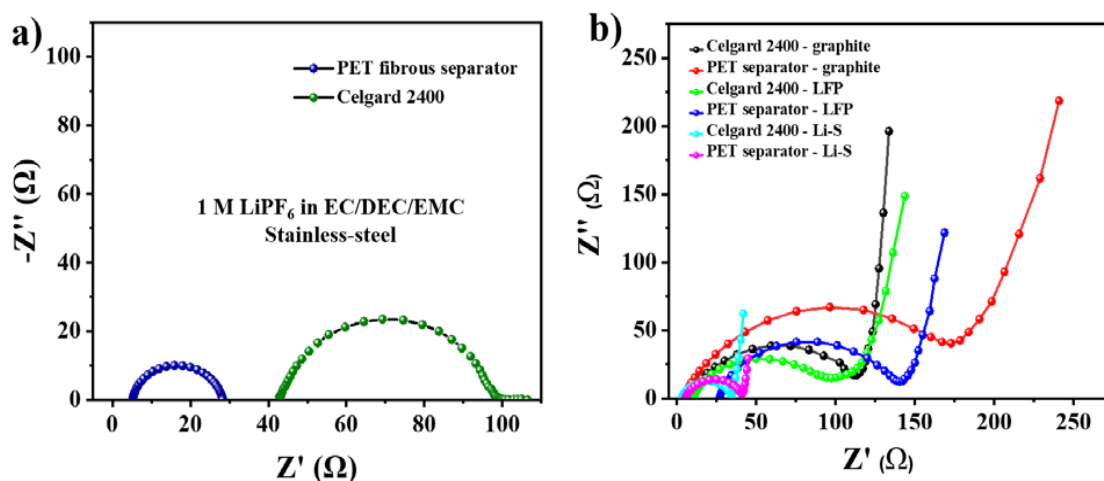


Fig. 6. The Nyquist plots with 1 M LiPF_6 in EC/DEC/EMC electrolyte and stainless-steel (a), and Nyquist plots of half-cells using different separators (b).

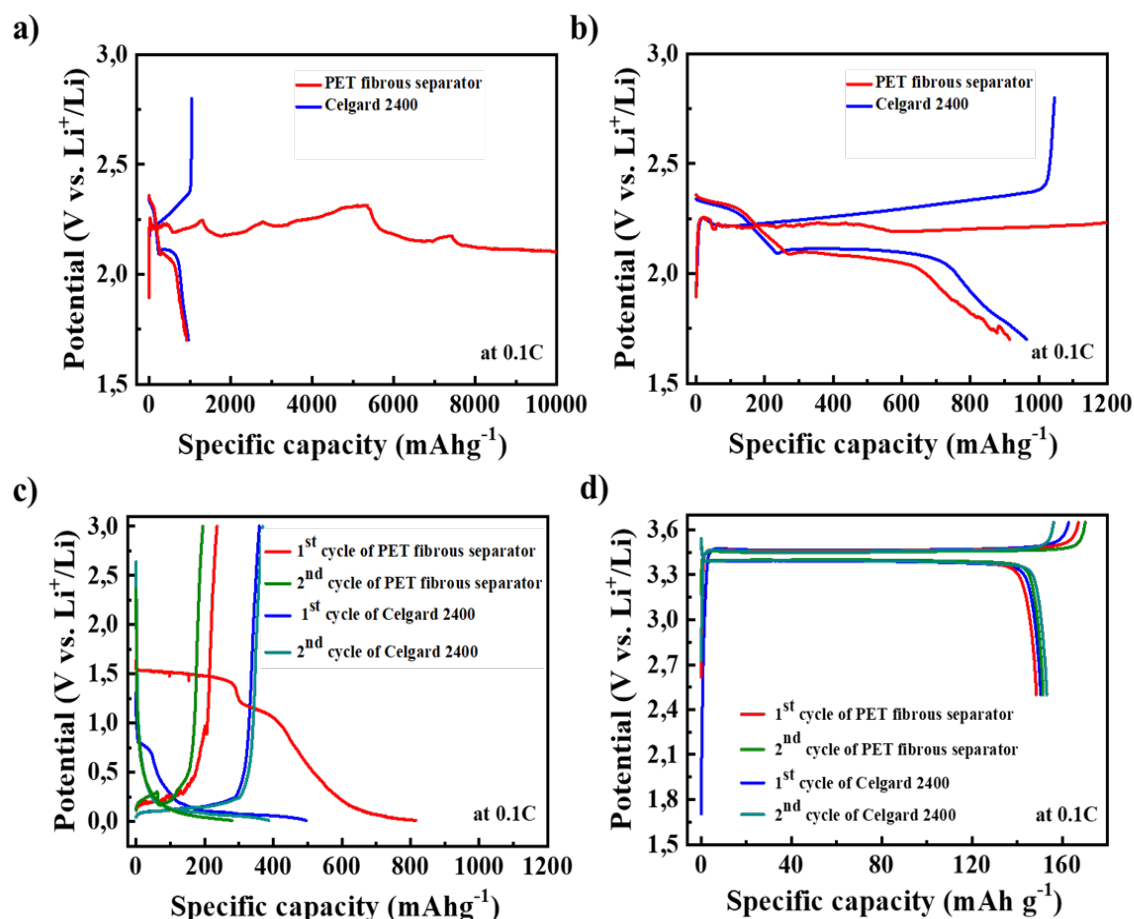


Fig. 7. Charge-discharge curves of half-cells using electrospun PET fibrous membrane and Celgard 2400: (a) half-cells with sulfur cathode; (b) zoomed-in view of the potential profiles shown in (a); (c) half-cells with graphite anode; (d) half-cells with LFP cathode.

For graphite half-cells in Fig. 7c, the commercial separator delivered a stable lithium intercalation plateau with a specific capacity of 300–350 mAh g^{-1} , consistent with the expected behaviour of graphite. In contrast, the PET separator exhibited pronounced voltage fluctuations and a large charge-discharge hysteresis.

In the case of the LFP cathode in Fig. 7d, both separators displayed the characteristic flat plateau at ~3.4–3.5 V, corresponding to the $\text{Fe}^{2+}/\text{Fe}^{3+}$ redox reaction. While Celgard 2400 showed a more defined plateau and lower polarization, the PET separator also operated stably, with only a slight increase in overpotential. This agrees with its lower internal resistance and the absence of significant side reactions in the corresponding voltage window, confirming that the recycled PET membrane can effectively perform the separator function under these conditions. Nevertheless, further optimization of thickness, morphology, and interfacial properties is required to improve compatibility with a wider range of electrode chemistries.

4. Conclusions

This work demonstrated that plastic waste can be upcycled into useful components for energy storage applications by producing electrospun fibrous separators from recovered PET waste derived from disposable cups. Compared with the commercial Celgard 2400 separator, the produced membranes exhibit a highly porous, interconnected nanofibrous structure that enhances electrolyte uptake and ion transport, resulting in significantly higher ionic conductivity. Unlike polyolefin-based separators, which undergo severe shrinkage, PET-based separators exhibit exceptional thermal resilience, retaining structural integrity at temperatures up to 190 °C. These characteristics suggest that PET-based separators might enhance battery safety at high temperatures. Electrochemical analyses indicate that the performance of the PET separator is strongly governed by electrolyte composition: carbonate-based systems provide comparatively more stable operation, whereas ether-based electrolytes, including lithi-

um-sulfur systems, exhibit pronounced instability. Additionally, interfacial side reactions continue to limit compatibility with graphite anodes. However, despite these drawbacks, the PET separator's core functionality is confirmed by its consistent performance with LiFePO_4 cathodes. The findings indicate that if fibrous structure, surface chemistry, and electrolyte compatibility are further optimized, recycled PET-derived separators could offer a viable and sustainable alternative to traditional materials.

Author Contributions

Zhansaya Arkasheva – Investigation, Visualization; Writing – Original Draft. **Ayaulym Belgibayeva** – Conceptualization; Methodology; Supervision; Writing – Review and Editing. **Aitolkyn Uali** – Methodology; Supervision; Writing – Review and Editing. **Elmira Nurgaziyeva** – Investigation. **Aliya Mukanova** – Supervision; Writing – Review and Editing. **Arailym Nurpeissova** – Conceptualization; Supervision; Funding Acquisition; Writing – Review and Editing.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Электрохимическая стабильность волокнистых сепараторов из переработанных стаканов из полиэтилентерефталата в литиевых аккумуляторах

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АННОТАЦИЯ

В данном исследовании предложен экологически эффективный подход к использованию отходов полиэтилентерефталата (ПЭТ), полученных из использованных одноразовых стаканов, для изготовления сепараторных мембран методом электроспиннинга. Полученные мембраны характеризуются однородной бездефектной нановолокнистой структурой, высокой пористостью и взаимосвязанной архитектурой, что обеспечивает эффективное поглощение электролита и быстрый транспорт ионов. Переработанная ПЭТ-мембрана продемонстрировала более высокую термическую стабильность по сравнению с коммерческим Celgard 2400: структурная целостность сохранялась без усадки вплоть до 190 °С. Кроме того, по данным электрохимической импедансной спектроскопии ее ионная проводимость была примерно в четыре раза выше ($3,15 \times 10^{-1}$ См·см⁻¹), а объемное сопротивление существенно ниже. Однако электрохимическая стабильность ПЭТ-сепаратора существенно зависит от типа электролита: эфирные системы вызывают выраженную нестабильность, тогда как карбонатные электролиты обеспечивают относительно более высокую, но все же ограниченную стабильность. В результате, ПЭТ-сепаратор продемонстрировал стабильную работу в полуэлементах с катодом LiFePO₄, однако его применение в системах с графитовым анодом и литий-серными аккумуляторами оказалось ограничено из-за межфазной нестабильности. В целом результаты подтверждают, что переработанный ПЭТ является перспективным и экологически безопасным материалом для создания сепараторных мембран с высокой термической стабильностью и эффективным ионным транспортом. Вместе с тем для его широкого применения в современных аккумуляторных системах необходима дальнейшая оптимизация межфазной химии и совместимости с электролитами.

Ключевые слова: сепаратор полученный электроспиннингом, переработанный ПЭТ, литий-ионные аккумуляторы, литий-серные аккумуляторы, термическая стабильность, ионная проводимость

Қайта өңделген полиэтилентерефталат стақандарынан алынған талшықты сепараторлардың литий негізіндегі аккумуляторлардағы электрохимиялық тұрақтылығы

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АҢДАТПА

Бұл зерттеуде қолданыстан шыққан бір реттік сусын стақандарынан алынған полиэтилентерефталат (ПЭТ) қалдықтарын электроспиннинг арқылы сепаратор мембраналарын дайындауда қолданудың экологиялық тиімді тәсілі көрсетілді. Алынған мембраналар біркелкі түйінсіз наноталшықты құрылымымен, жоғары кеуектілігімен және өзара байланысқан архитектурасымен сипатталып, электролиттің тиімді сіңуін және иондардың жылдам тасымалдануын қамтамасыз етті. Қайта өңделген ПЭТ мембранасы коммерциялық Celgard 2400 сепараторымен салыстырғанда жоғары жылулық тұрақтылық көрсетті: 190 °C-қа дейін шөгу байқалмай, құрылымдық тұтастығы сақталды. Сонымен қатар, оның иондық өткізгіштігі шамамен төрт есе жоғары ($3,15 \times 10^{-1} \text{ См} \cdot \text{см}^{-1}$), ал көлемдік кедергісі айтарлықтай төмен болды. Алайда ПЭТ сепараторының электрохимиялық тұрақтылығы электролит түріне қатты тәуелді: эфир негізіндегі жүйелер айқын тұрақсыздыққа әкеледі, ал карбонат негізіндегі электролиттер салыстырмалы түрде жақсартылған, бірақ әлі де шектеулі тұрақтылықты қамтамасыз етеді. Нәтижесінде ПЭТ сепараторы LiFePO_4 катоды бар жартылай элементтерде тұрақты жұмыс істеді, алайда графит анодтары мен литий-күкірт жүйелерінде интерфейстік тұрақсыздық салдарынан қолданылуы шектеулі болды. Жалпы, қайта өңделген ПЭТ жоғары жылулық тұрақтылық пен тиімді ион тасымалдау қасиеттеріне ие, экологиялық қауіпсіз және болашағы зор сепаратор материалы ретінде көрсетілді. Дегенмен оны заманауи аккумулятор жүйелерінде кеңінен қолдану үшін интерфейстік химияны және электролитпен үйлесімділікті одан әрі оңтайландыру қажет.

Түйін сөздер: электроспиннинг арқылы алынған сепаратор, қайта өңделген ПЭТ, литий-ионды аккумуляторлар, литий-күкіртті аккумуляторлар, термиялық тұрақтылық, иондық өткізгіштік