# Supplementary Information

## Molecularly Designed Star-Shaped PLA-Based Polymer with Enhanced Piezoelectricity for Ultrasound-Driven Wound Healing

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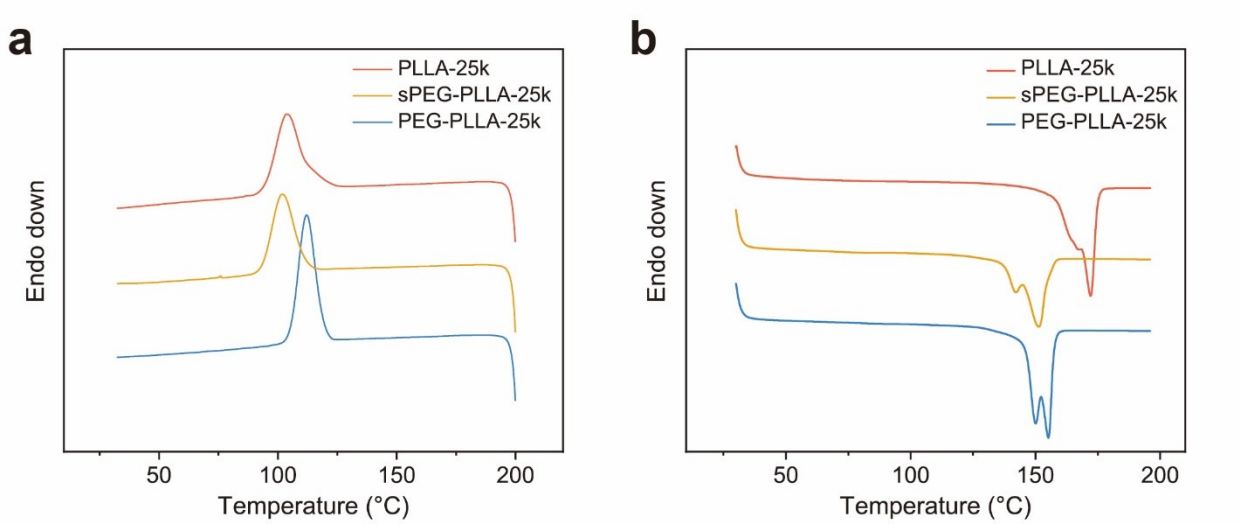


**Fig. S1** (a) DSC primary cooling curves of the polymers. (b) DSC secondary heating curves of the polymers.

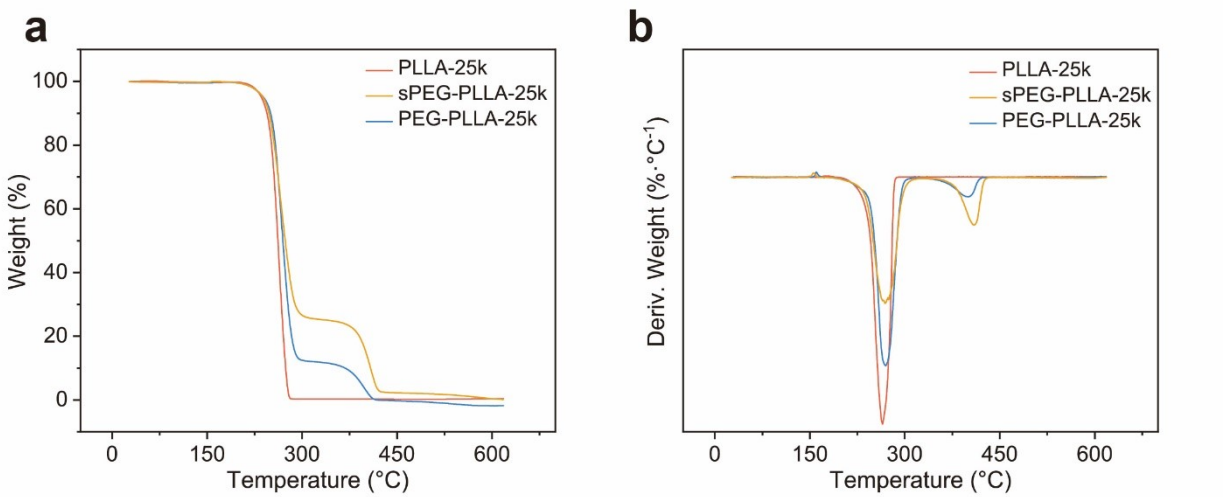


**Fig. S2** (a) TG curves of the polymers. (b) DTG curves of the polymers.

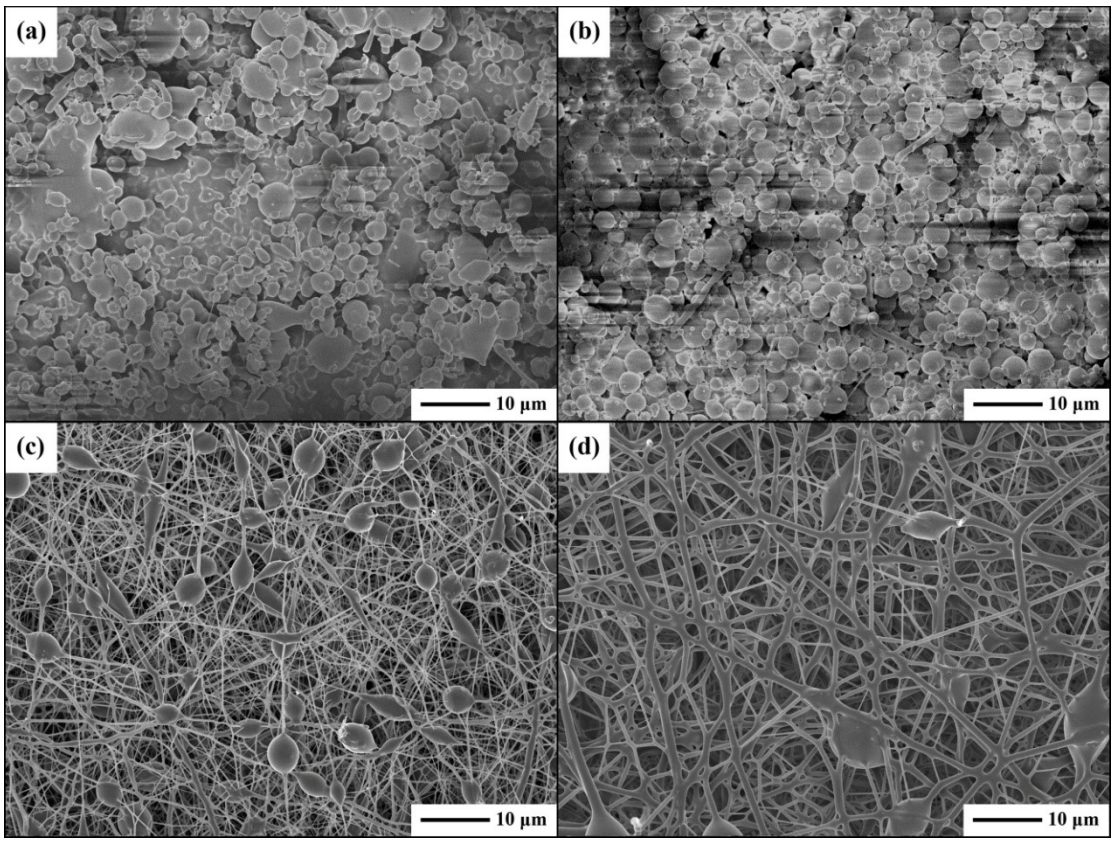


**Fig. S3** SEM of sPEG-PLLA-25k nanofiber membranes with different spinning solution concentrations: (a) 0.1 $g \cdot mL^{-1}$, (b) 0.2 $g \cdot mL^{-1}$, (c) 0.3 $g \cdot mL^{-1}$, (d) 0.4 $g \cdot mL^{-1}$.

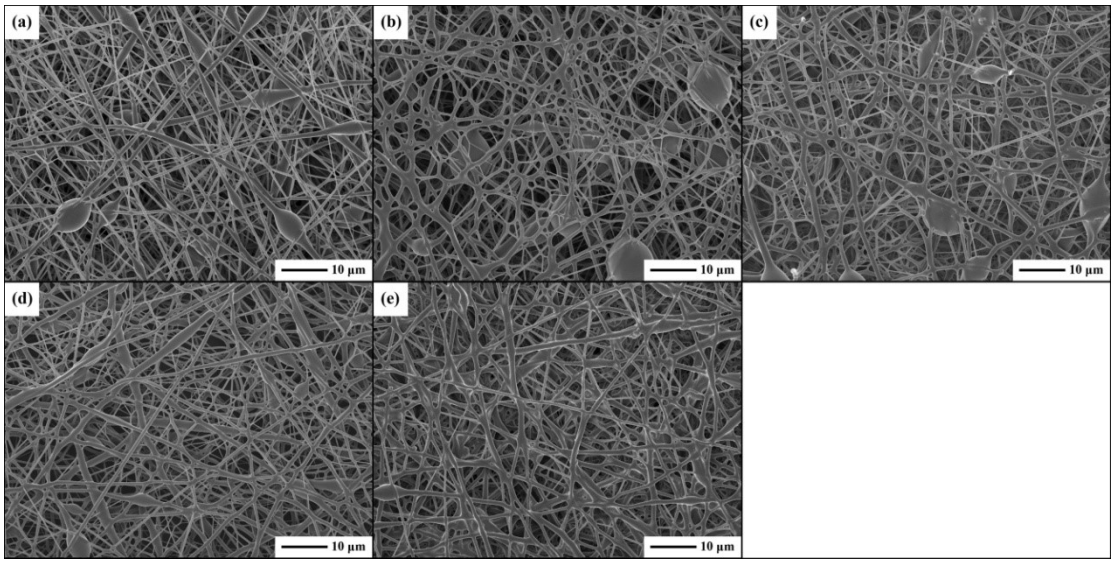


**Fig. S4** SEM of sPEG-PLLA-25k nanofiber membranes with different spinning voltage: (a) 14 kV, (b) 16 kV, (c) 18 kV, (d) 20 kV, (e) 22 kV.

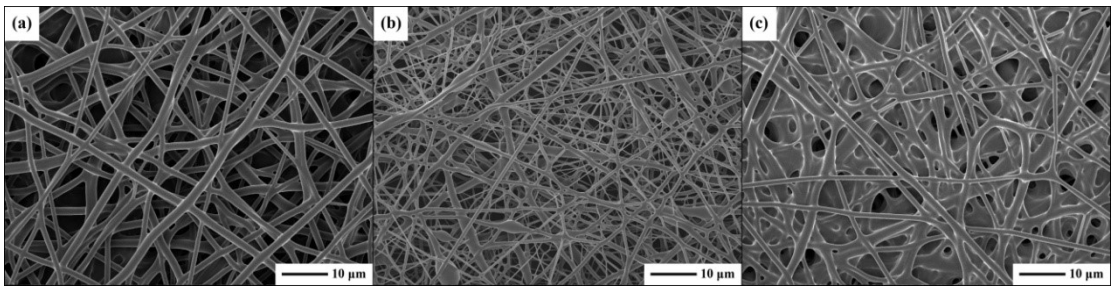


**Fig. S5** SEM of sPEG-PLLA-25k nanofiber membranes with different spinning speed: (a) 1.5 $mL \cdot h^{-1}$, (b) 2 $mL \cdot h^{-1}$, (c) 2.5 $mL \cdot h^{-1}$.

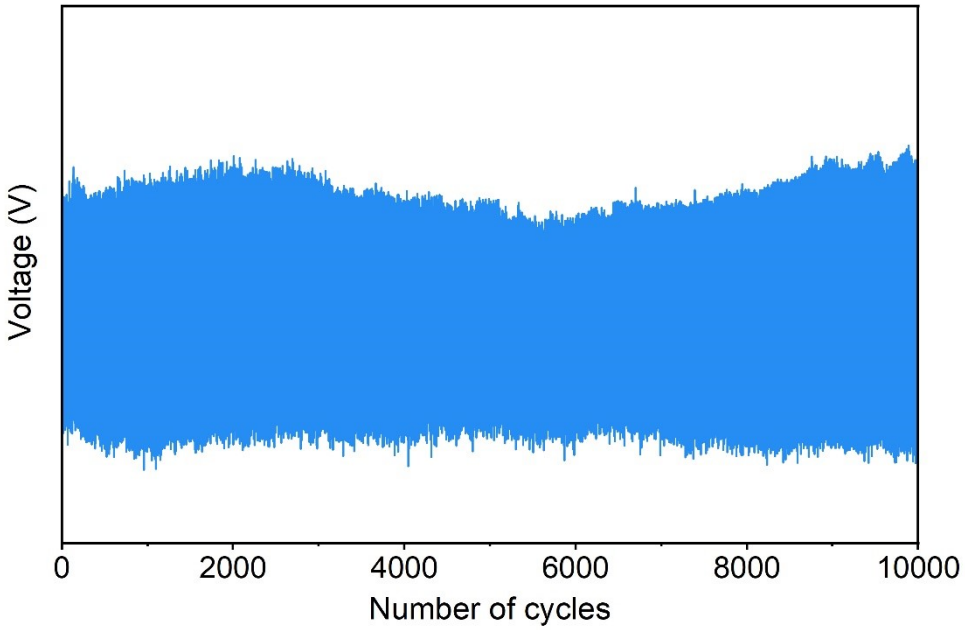


**Fig. S6** Durability test of sPEG-PLLA-25k nanofiber membrane.

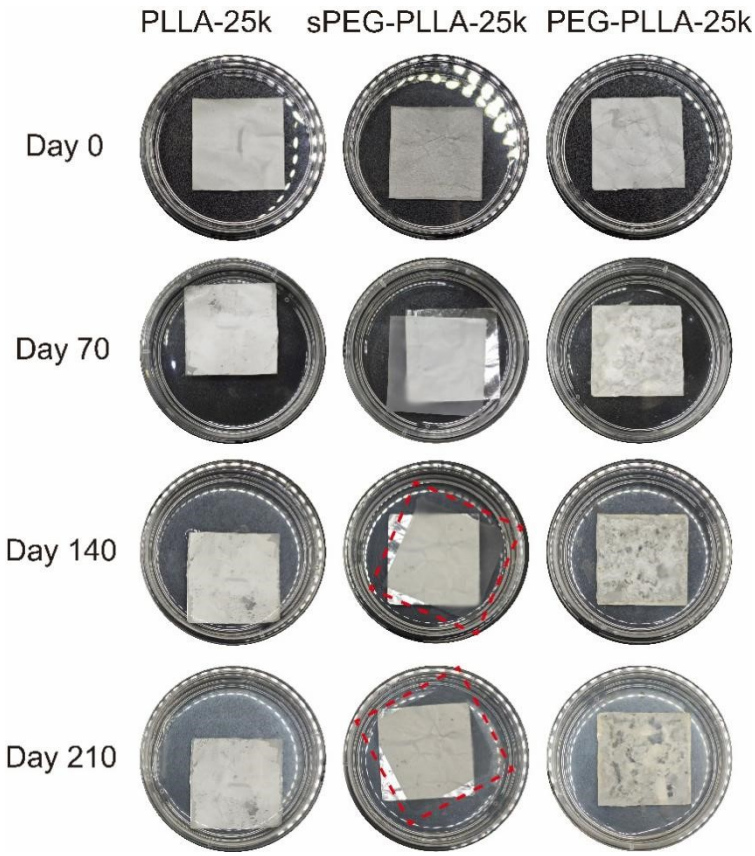


**Fig. S7** Degradation performance test of nanofiber membranes.

**Table S1** Representative results of Biomedical piezoelectric materials

| Materials | Applied Force | Output Voltage | Ref |
|---|---|---|---|
| PLLA | under US | 0.5 V | S1 |
| PLLA/$VB_2$ | bending | 4.47 V | S2 |
| PLLA/PDA/MXene | 1 N | ~ 0.9 V | S3 |
| PLLA/BTO | 30 N | 3 V | S4 |
| PLLA/Li-doped ZnO | under US | 5.2 V | S5 |
| P(VDF-TrFE)/TBAC | 5N | 1.6 V | S6 |
| sPEG-PLLA-25k | 5N | 9 V | This work |

**Notes:**

$VB_2$-vitamin $B_2$

PDA- polydopamine

P(VDF-TrFE)-poly(vinylidene fluoride-trifluoroethylene)

TBAC-tetrabutylammonium chloride

**Table S2** DSC data of nanofiber membranes

| | Crystallinity ($X_c$%) |
|---|---|
| PLLA-25k | 23.1% |
| sPEG-PLLA-25k | 34.0% |
| sPEG-PLLA-105k | 30.0% |
| Sc(sPEG-PLA-25k) | 33.8% |
| PEG-PLLA-25k | 30.6% |

**Notes:** $X_c$ was calculated using the following equation:

$$X_c = \frac{\Delta H_m - \Delta H_c}{\Delta H_{100\%}} \times 100\%$$

where $X_c$ is the degree of crystallinity, $\Delta H_m$ is the heat of melting ($J \cdot g^{-1}$) determined from the melting peak integral, $\Delta H_c$ is the heat of cold crystallization ($J \cdot g^{-1}$) determined from the cold crystallization peak integral, and $\Delta H_{100\%}$ is the heat of melting of 100% crystalline material (93.1 $J \cdot g^{-1}$ for homocrystallites, 142 $J \cdot g^{-1}$ for stereocomplex crystallites).

## Supplemental References


S1 R. Das, T.T. Le, B. Schiff, M.T Chorsi, J. Park, P. Lam, A. Kemerley, A.M. Supran, A. Eshed and N. Luu, *Biomaterials*, 2023, **301**, 122270.

S2 Z. Zhang, L.M. Wang, Q. Zhang, H.K. Li, Y. Xiang, X.Y. Wang and X.R. Hu, *Eur. Polym. J.*, 2023, **189**, 111962.

S3 Y.X. Wu, Q.Q. Yu, X.Y. Zhou, W.X. Ding, X.M. Li, P. Zhou, Y.L. Qiao, Z. Huang, S.J. Wang, J.A. Zhang, L.Y. Yang, L. Zhang and D.P. Sun, *Int. J. Biol. Macromol.*, 2024, **278**, 134971.

S4 C. Zhang, W. Song, X. Guo, Z. Li, Y. Kong, J.P. Du, L.H. Hou, Y. Feng, Y.Z. Wang, M.D. Zhang, L.T. Liang, Y.Y. Huang, J.J. Li, D.Z. Zhu, Q.H. Liu, Y.X. Tan, Z.T. Zhao, Y.T. Zhao, X.B. Fu and S. Huang, *Biomater. Adv.*, 2025, **167**, 214119.

S5 X.L. Wang, K. Sun, C. Wang, M.M. Yang, K. Qian, B. Ye, X.D. Guo, Y. Shao, C.L. Chu, F. Xue, J. Li and J. Bai, *Biomaterials*, 2025, **313**, 122803.

S6 N. Yang, Y.N. Chen, N.H. Dan, X. Zheng, R.X. Feng, G.F. Yu, X.T. He, W.H. Dan and Y.B. Wang, *J. Mater. Sci.*, 2022, **57**, 19532-19552.