Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.
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Supporting Information

Electrospun nanofiber fabric: an efficient breathable and wearable moist-electric generator

Zhaoyang Sun [a], Lanlan Feng [a], Chengdong Xiong [a], Xinyang He [a], Liming Wang [a,*], Xiaohong Qin [a,*], Jianyong Yu [b]

[a] *Key Laboratory of Textile Science & Technology, Ministry of Education, College of Textiles, Donghua University, Shanghai 201620, China*

[b] *Innovation Center for Textile Science and Technology, Donghua University, Shanghai 201620, China*

[*] Corresponding authors.

E-mail addresses: wangliming@dhu.edu.cn (L. Wang), xhqin@dhu.edu.cn (X. Qin)

Additional Information

Materials

PEO (Mw ~ 400,000), ethyl cellulose powders (Mw ~ 30,000), PS (Mw ~ 350,000), PVDF (Mw ~ 400,000) and PSSA (Mw ~ 750,000, 18 wt% in H_2O) were purchased from Sigma Aldrich. PAN (Mw ~ 850,000) was provided by Shanghai Chemical Fibers Institute. PAA (Mw ~ 400,000) was supplied by Aladdin. PEG (Mw ~ 6000), N, N-dimethylformamide (DMF, 99%), tetrahydrofuran (THF, 99%), and N, N-dimethylacetamide (DMAc, 99%) were provided by Sinopharm Chemical Reagent Co., Ltd.

Preparation of PEO nanofiber fabric

10 wt% PEO solution was prepared for electrospinning by using deionized water as solvent. The obtained solution was magnetically stirred for 8 h. The applied voltage connected to the needle was 15 kV, the collection distance was 15 cm, and the flow rate was 0.5 ml h^{-1}.

Preparation of silk fibroin nanofiber fabric

Cocoons were boiled for 60 min in an aqueous solution of Na_2CO_3 with concentration of 0.5 wt% and then rinsed thoroughly with distilled water to extract the sericin proteins. The degummed silk was then directly dissolved in $CaCl_2$/formic acid at room temperature. The degummed silk above was dissolved in 9.3 M LiBr solution at 60 °C for 4 h, yielding a 20% solution. This solution was dialyzed against distilled water using Slide-A-Lyzer dialysis cassettes (Pierce, molecular weight cut-off 3500) for 72 h to remove LiBr. The final concentration of aqueous silk solution was ∼ 8 wt%, determined by weighing the remaining solid after drying. To electrospin silk fibroin nanofiber, the applied voltage connected to the needle was 15 kV, collection distance was 15 cm, and the flow rate was 1 ml h^{-1}.

Preparation of ethyl cellulose nanofiber fabric

20 wt% ethyl cellulose solution was prepared for electrospinning by using mixture of DMAc and THF with weight ratio of 9:1 as solvent. The obtained solution was magnetically stirred for 3 h. The applied voltage was 15 kV, collection distance was 15 cm, and the flow rate was 0.6 ml h^{-1}.

Preparation of PAN/PSSA nanofiber fabric

PAN/PSSA with different weight ratios (2:1, 4:1, 8:1) were dissolved in DMF to prepare the spinning solution. The content of PAN/PSSA blend system in the solution was 12 wt%.

The obtained PAN/PSSA solution was taken into a 10 ml syringe and delivered with a flow rate of 0.6 ml h^{-1}. The applied voltage and collection distance were maintained at 13 kV and 15 cm, respectively.

Preparation of PAN/PAA nanofiber fabric

12 wt% PAN/PAA (weight ratio of 4:1) solution was prepared by using DMF as solvent. The obtained PAN/PAA solution was taken into a 10 ml syringe and delivered with a flow rate of 0.6 ml h^{-1}. The applied voltage and collection distance were maintained at 13 kV and 13 cm, respectively.

Preparation of PAN/PEG nanofiber fabric

12 wt% PAN/PEG (weight ratio of 4:1) solution was prepared for electrospinning by using DMF as solvent. The applied voltage was 15 kV, collection distance was 15 cm, and the flow rate was 0.5 ml h^{-1} during electrospinning.

Preparation of PS/PSSA nanofiber fabric

20 wt% PS/PSSA (weight ratio of 4:1) solution was prepared for electrospinning by using DMF as solvent. The applied voltage was 13 kV, collection distance was 15 cm, and the flow rate was 0.6 ml h^{-1} during electrospinning.

Preparation of PVDF/PSSA nanofiber fabric

10 wt% PVDF/PSSA (weight ratio of 4:1) solution was prepared for electrospinning by using DMF as solvent. The applied voltage was 15 kV, collection distance was 14 cm, and the flow rate was 0.5 ml h^{-1} during electrospinning.

Preparation of PEO, PVA, silk fibroin and ethyl cellulose films

The preparation of PEO, PVA, silk fibroin and ethyl cellulose solutions was same with the corresponding spinning solutions. Then polymer solution was casted into a Teflon mold and dried overnight in an oven at 40 °C to obtain the polymer film.

Supplementary Figure

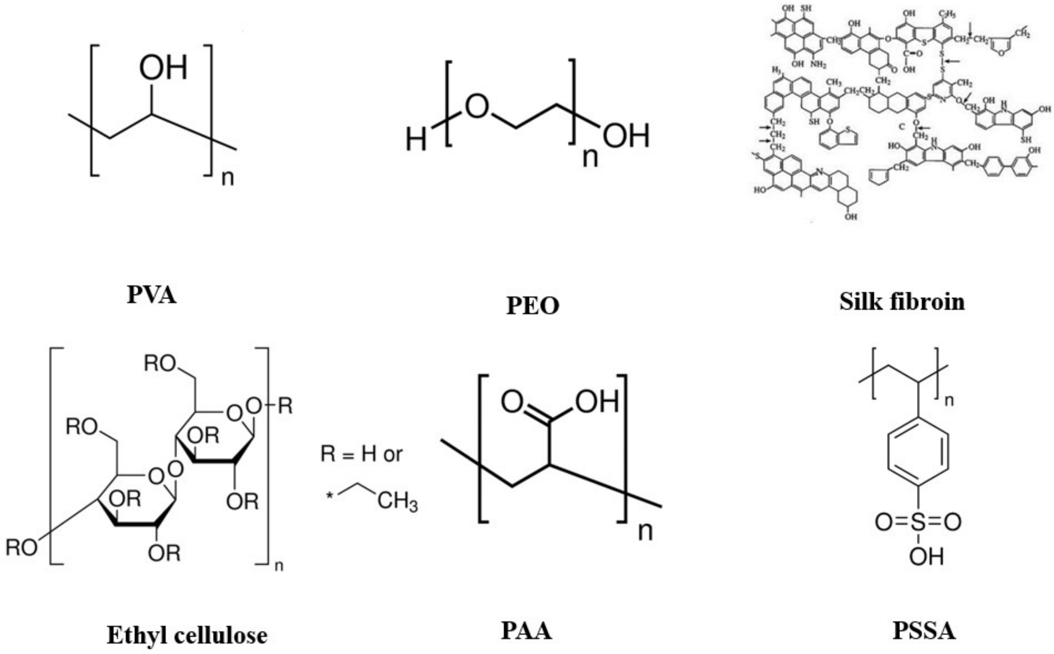

Fig. S1. Chemical structure of PVA, PEO, silk fibroin, ethyl cellulose, PAA, and PSSA.

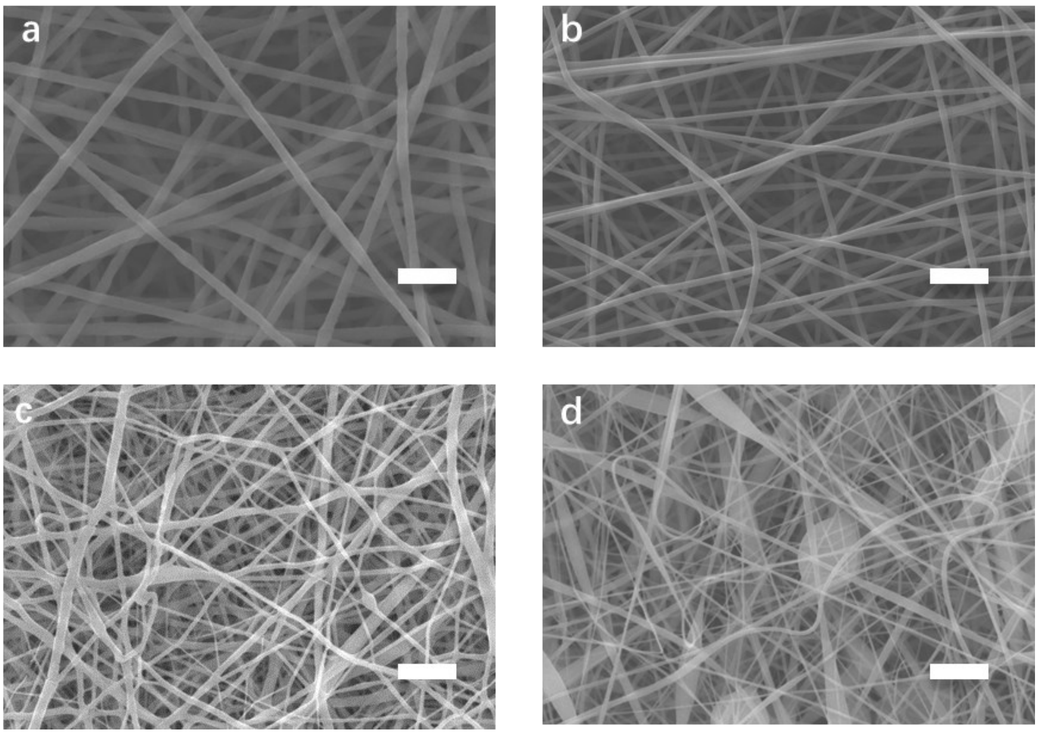

Fig. S2. SEM images of nanofiber fabrics: (a) PEO, (b) PVA, (c) silk fibroin, (d) ethyl cellulose. All the scale bars are 1 μm.

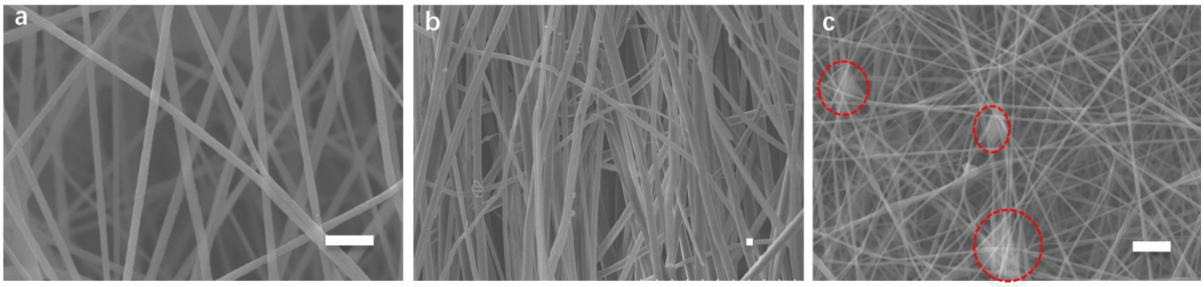

Fig. S3. SEM images of nanofiber fabrics. (a) PAN/PSSA nanofiber fabric. (b) PS/PSSA nanofiber fabric. (c) PVDF/PSSA nanofiber fabric. All the scale bars are 1 μm.

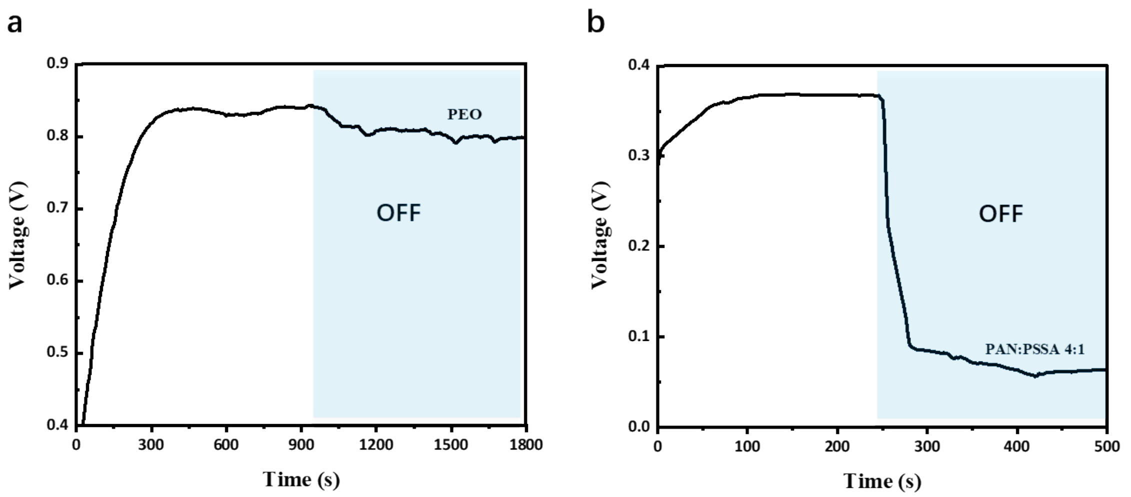

Fig. S4. (a) Voltage output of PEO nanofiber fabric after cutting off the moist air flow. (b) Voltage output of PAN/PSSA nanofiber fabric after cutting off the moist air flow.

Table S1. Specific surface area of casting membrane and electrospun nanofiber fabirc

Material form	PVA	PEO
Casting membrane	2.158×10^{-7} g m^{-2}	2.507×10^{-7} g m^{-2}
Electrospun nanofiber fabirc	11.529 g m^{-2}	10.335 g m^{-2}

Table S2. Current outputs, power density, air permeability and density of PEO, PVA and PAN/PSSA (4:1) nanofiber fabrics.

Material	Current outputs (nA cm^{-2})	Power density (nW cm^{-2})	Air permeability (mm s$^{-1)}$	Density (g cm^{-3})
PEO	30	24.3	62.22	6.709×10^{-5}
PVA	28	19.88	47.22	6.424×10^{-5}
PAN/PSSA	82	27.88	103.70	1.264×10^{-4}

Table S3. Summary of recent rising MEGs.

Ref.	Material	Form	Mechanism	Voltage	Current density
1	GO	Film	Gradient diffusion	0.026 V	5 μA cm^{-1}
2	GO	Printed film	Gradient diffusion	0.45 V	2 μA cm^{-1}
3	GO	3D-aerogel	Gradient diffusion	0.3 V	3.5 mA cm^{-1}
4	GO	Foam	Gradient diffusion	1.5 V	0.136 mA cm^{-1}
5	GO	Fiber shape	Gradient diffusion	0.3 V	0.7 μA cm^{-1}
6	GO	Porous structure	Gradient diffusion	0.45 V	90 nA cm^{-1}
7	Carbon	Porous film	Gradient diffusion	0.68 V	3 nA cm^{-1}
8	Carbon	Carbon dots on paper	Gradient diffusion	0.04 V	0.142 μA cm^{-1}
9	PPy	Nanowire	Gradient diffusion	0.072 V	0.14 μA cm^{-1}
10	PSSA	Membrane	Gradient diffusion	0.8 V	0.15 mA cm^{-1}
11	PSS/PVA	Membrane	Gradient diffusion	0.6 V	2 μA cm^{-1}
12	GO/PAAS	Membrane	Gradient diffusion	0.6 V	1.2 μA cm^{-1}
13	HCl/PVA	Electrolyte gel	Gradient diffusion	0.348 V	655 μA cm^{-1}
14	Cellulose	Aerogel	Streaming current	0.11 V	22 nA cm^{-1}
15	Cellulose	Paper	Streaming current	0.25 V	15 nA cm^{-1}
16	Protein	Nanowires	Self-recharging	0.5 V	115 nA cm^{-1}
17	TiO_2	Nanowire network	Streaming current	0.5 V	50 μA cm^{-1}
Our work	**PEO**	**Electrospun nanofiber fabric**	**Gradient diffusion and streaming current**	**0.83 V**	**30 nA cm^{-1}**

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