Supplementary Information (SI) for Journal of Materials Chemistry A.

Source Dependence of Polyacrylonitrile Electrospun Nanofibers on Piezoelectric Response

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Electronic Supplementary Information

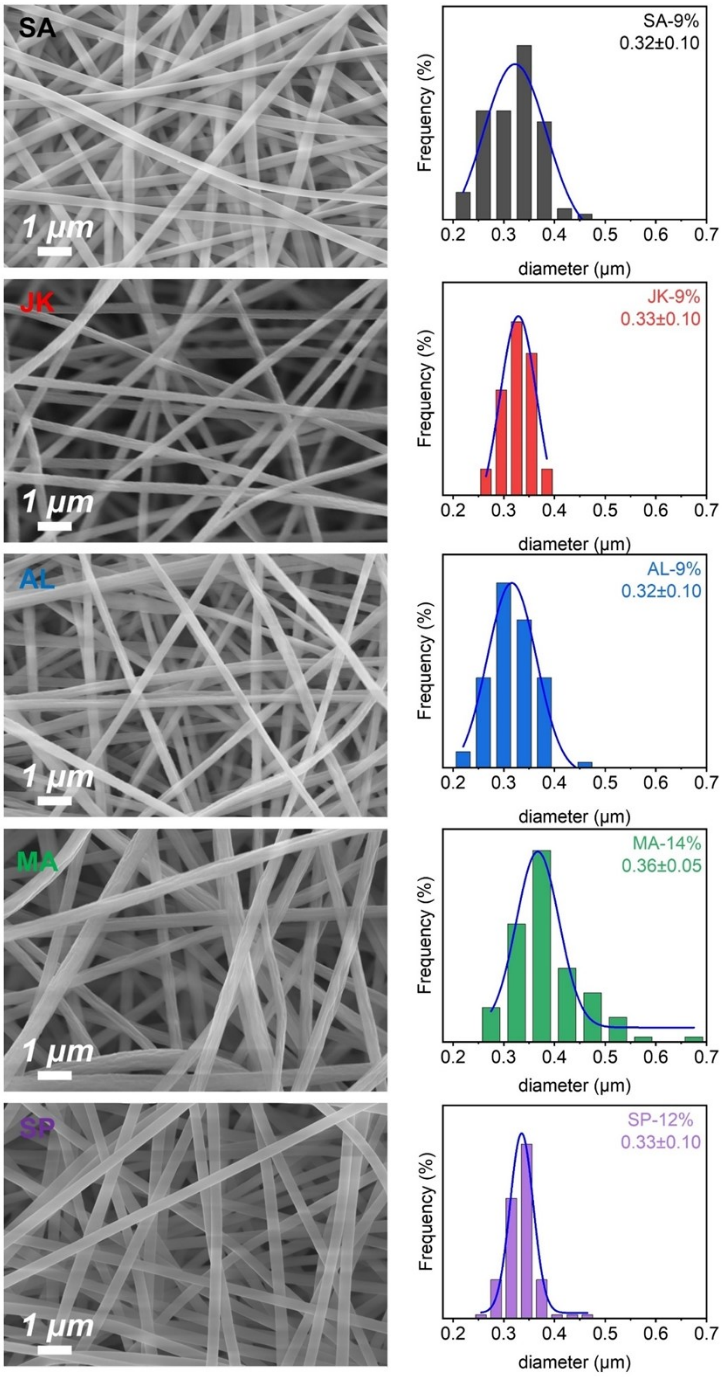

Fig. S1 SEM images and diameter distribution histograms of the PAN nanofibers electrospun from different commercial sources.

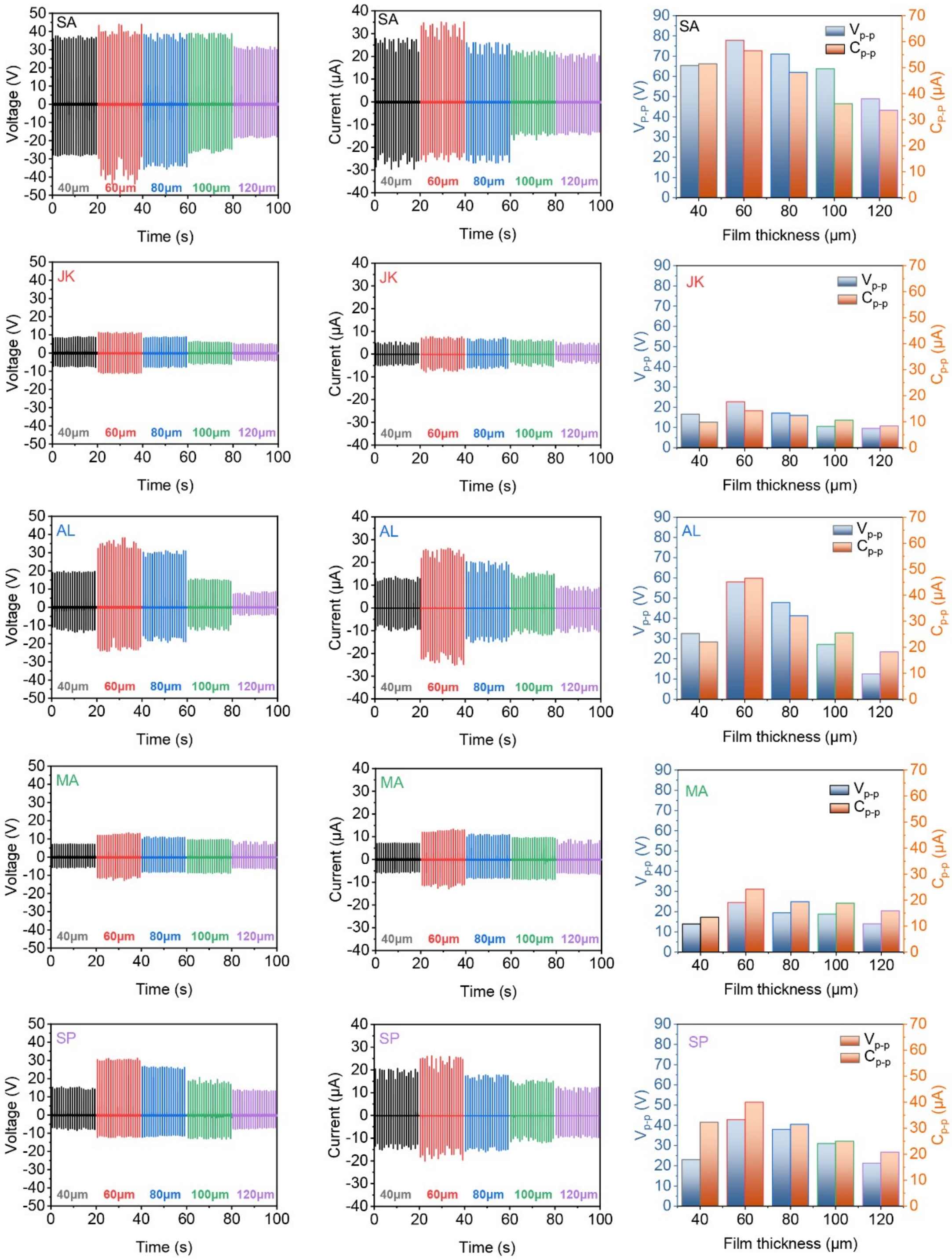

Fig. S2 Piezoelectric outputs of the nanofiber devices with different thicknesses (working area 5 cm^2; impacting frequency 1 Hz).

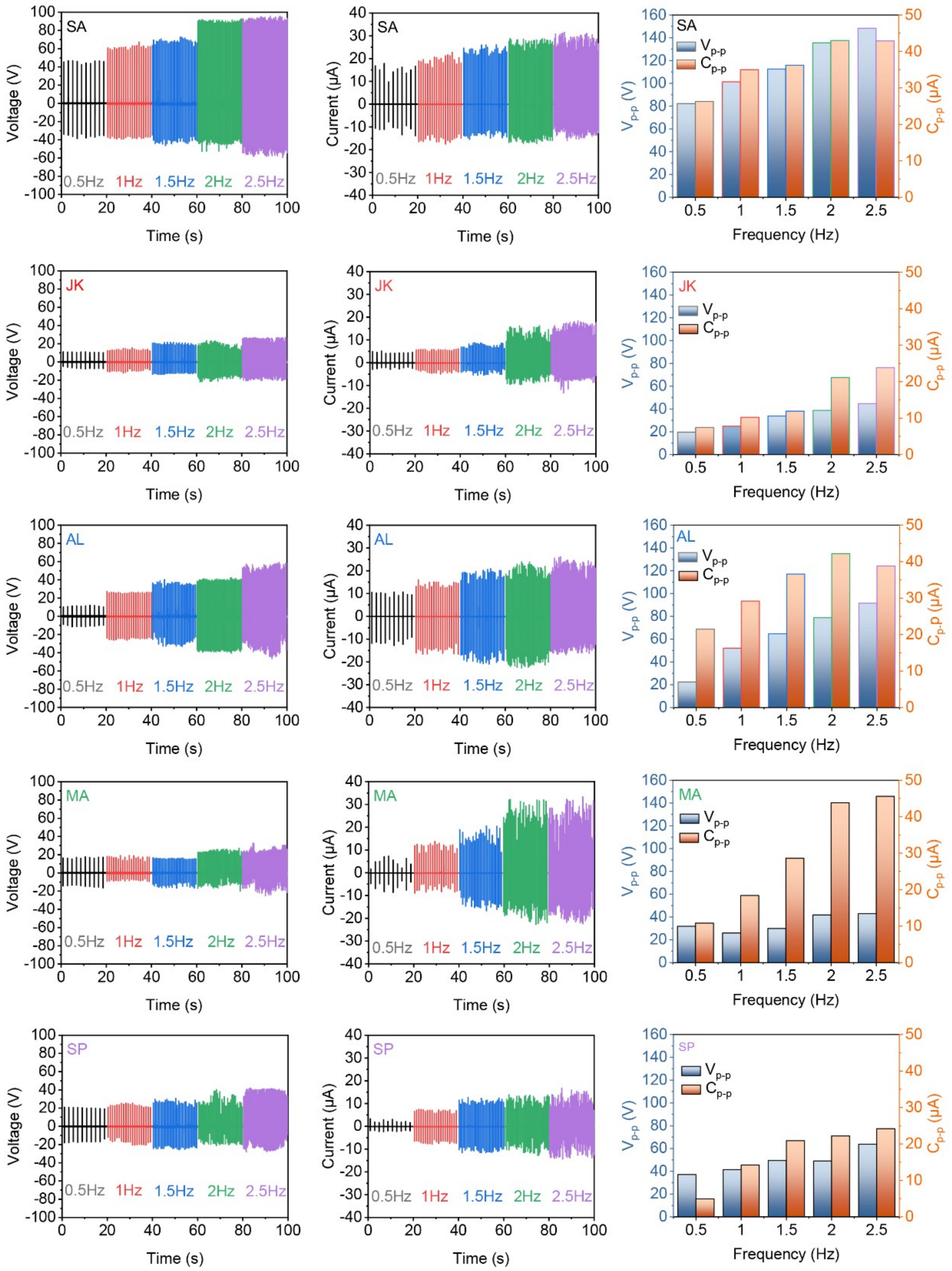

Fig. S3 Piezoelectric outputs of the nanofiber devices under different impacting frequencies (working area 5 cm^2; thickness 60 μm).

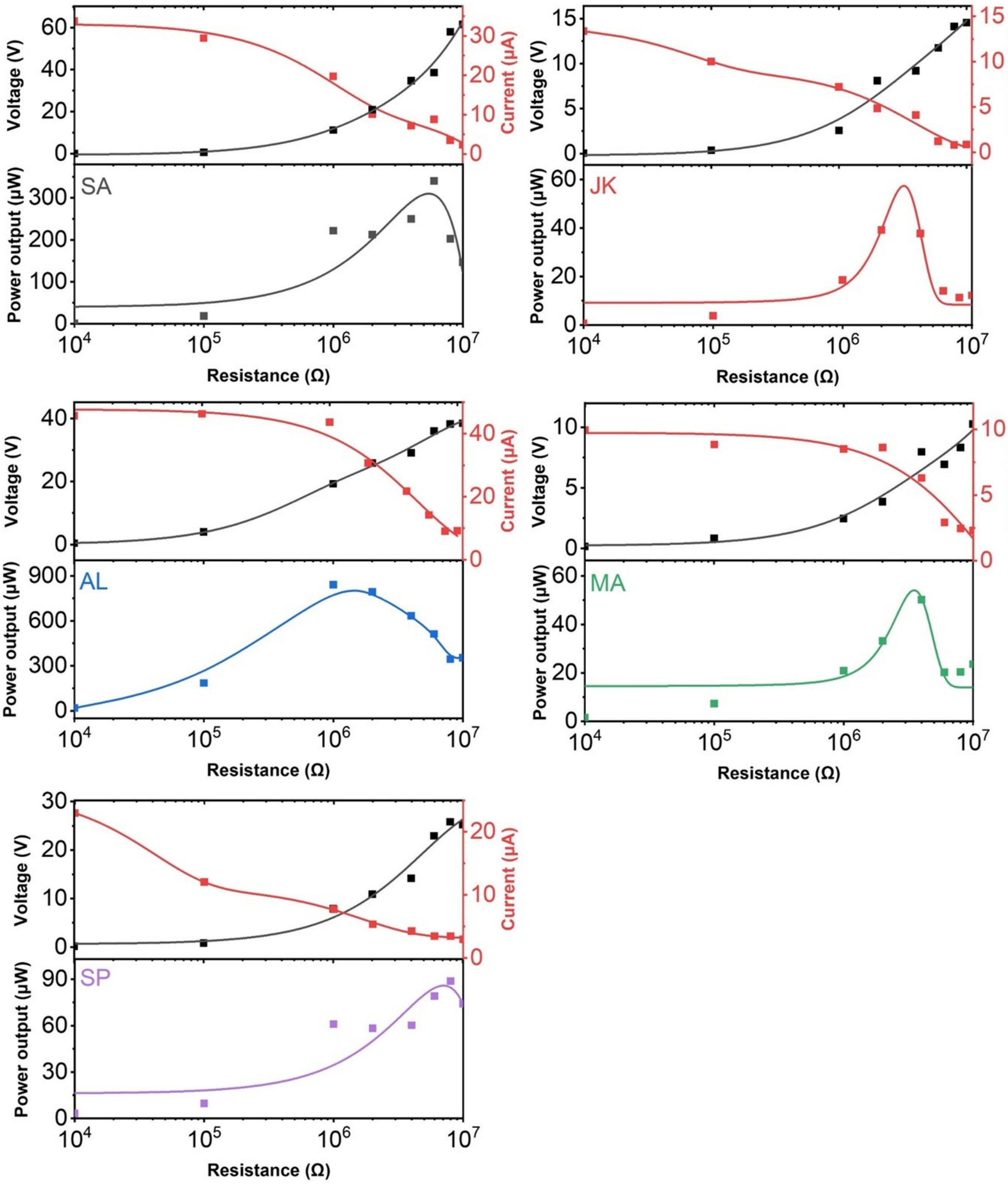

Fig. S4 U~R, I~R, and P~R curves of the PAN devices.

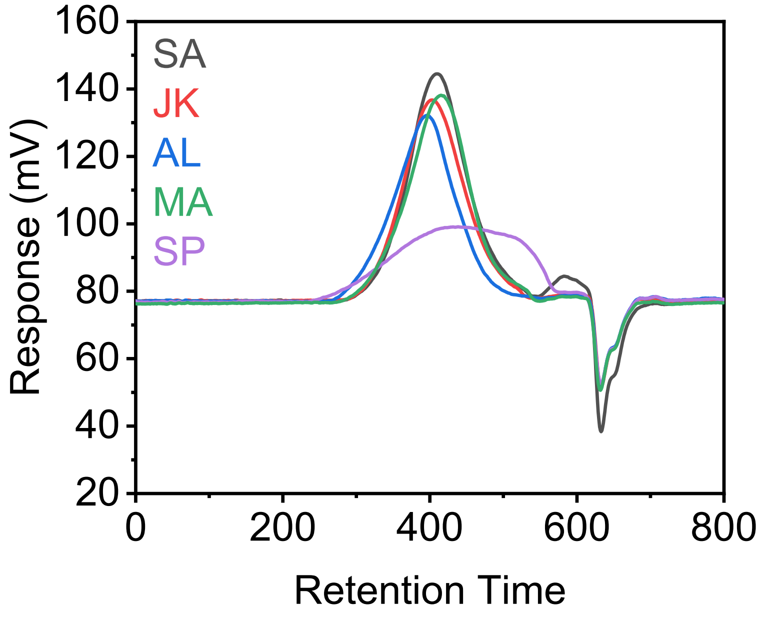

Fig. S5 GPC curves of the PAN powder from different commercial sources.

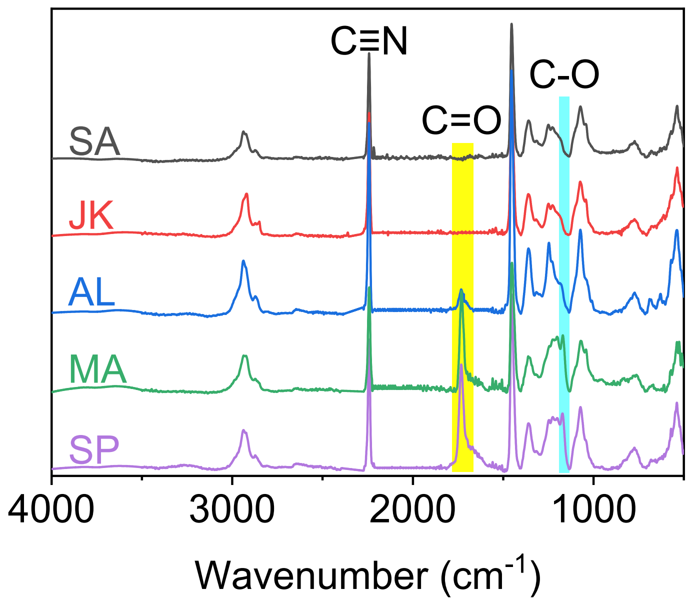

Fig. S6 FTIR spectra of PAN raw materials from different commercial sources.

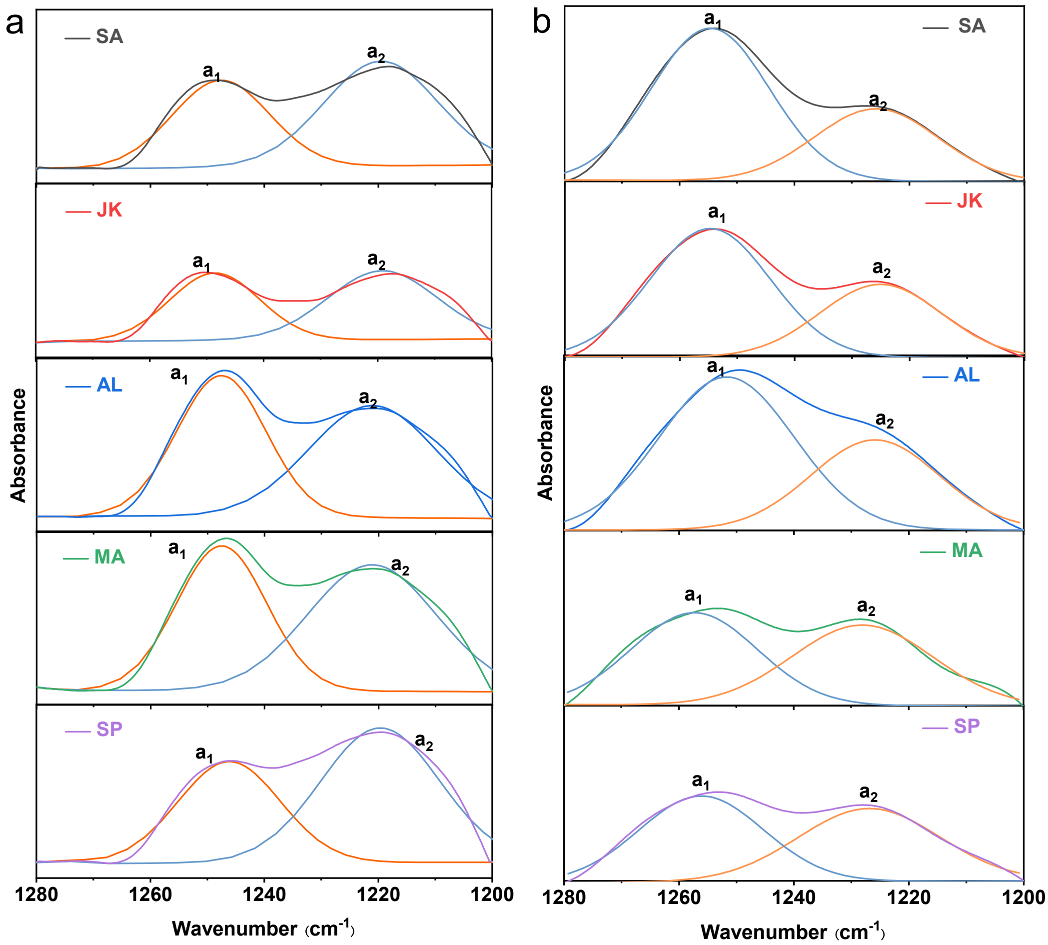

Fig. S7 The split peak fits at 1250 cm^{-1} and 1230 cm^{-1} for a) PAN powder and b) the as-spun PAN nanofibers from different commercial sources.

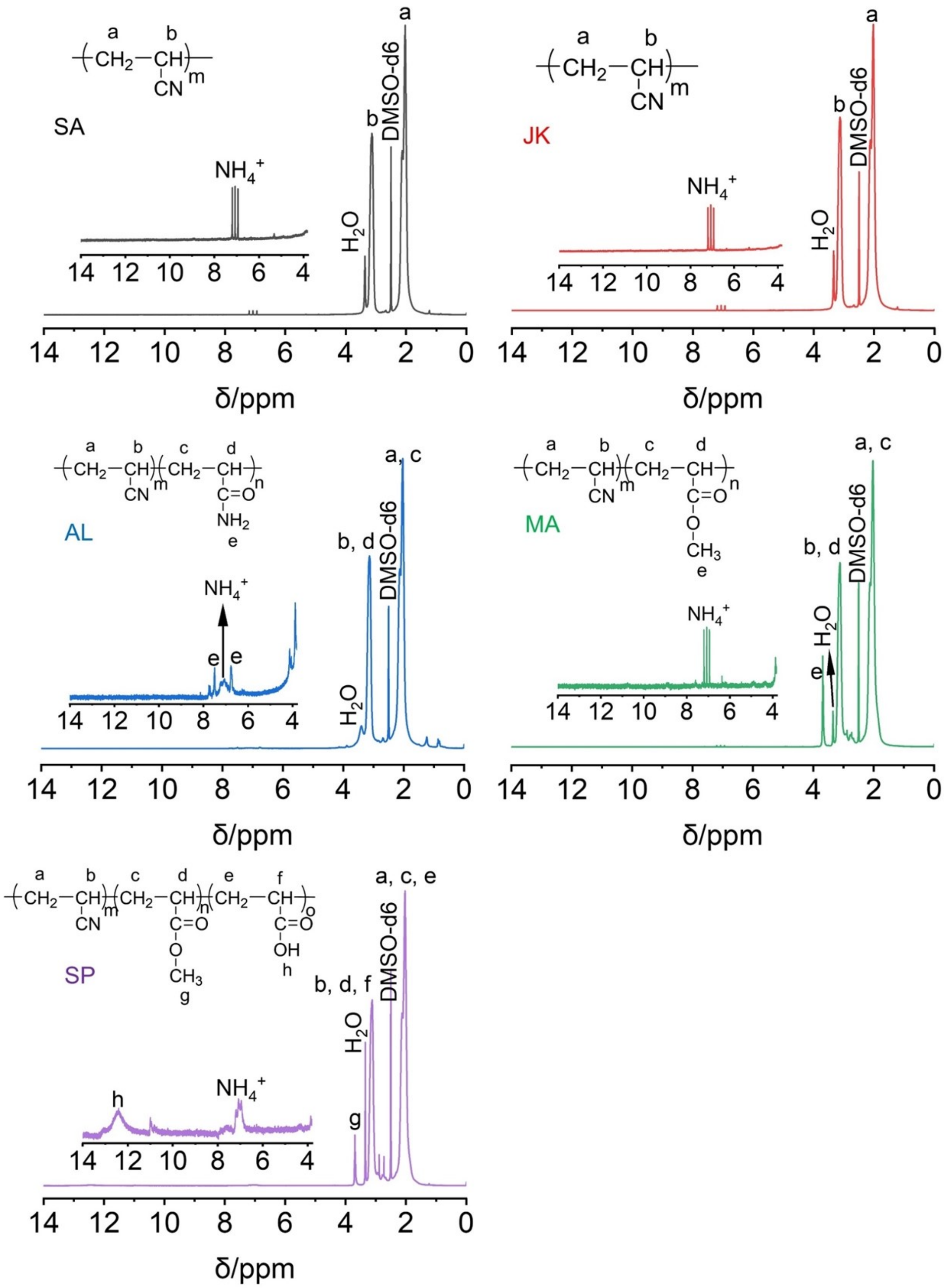

Fig. S8 liquid-state ^{1}H-NMR PAN raw materials from different sources (solvent DMSO-d6).

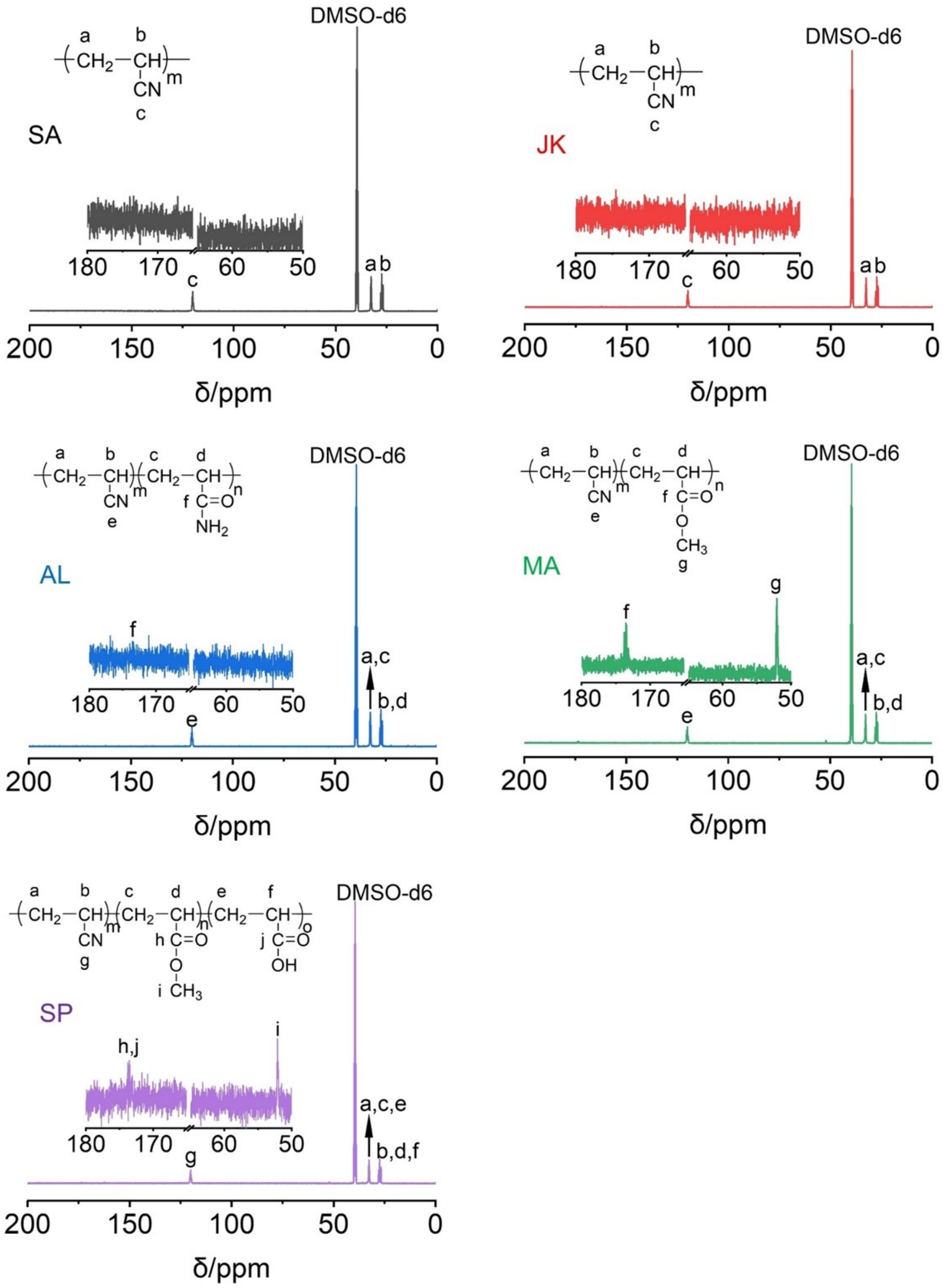

Fig. S9 ^{13}C-NMR spectra of PAN raw materials from different sources (solvent DMSO-d6).

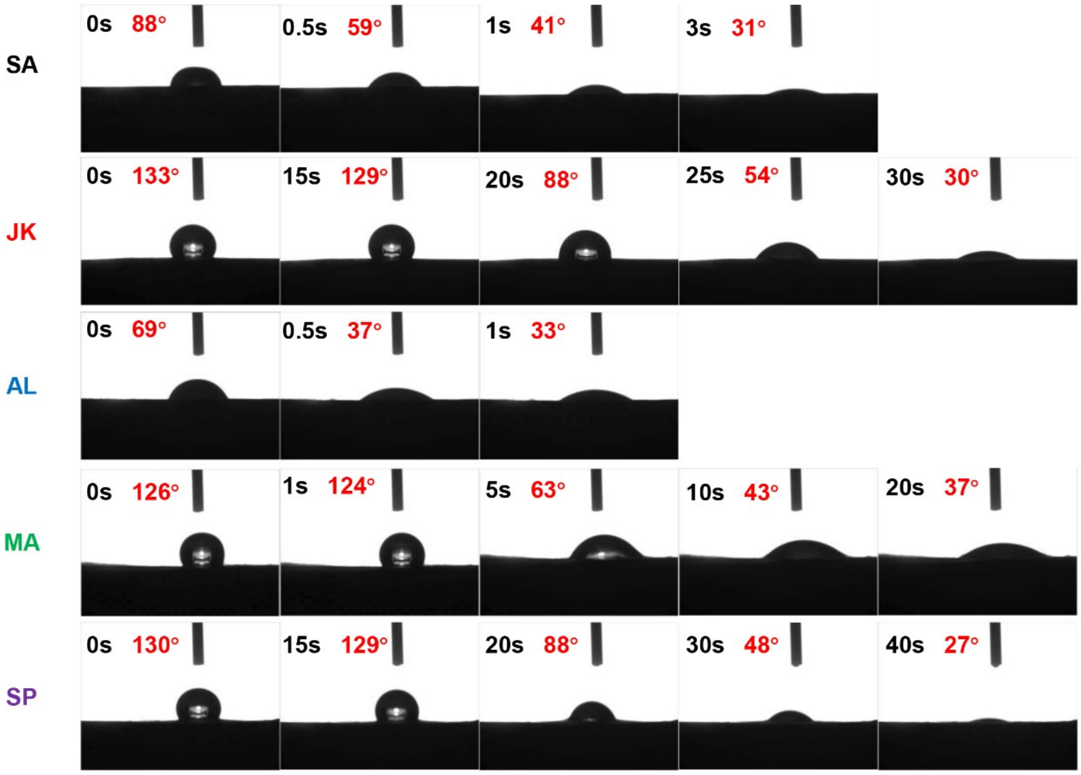

Fig. S10 Contact angle of the PAN nanofiber membranes prepared from different PAN sources.

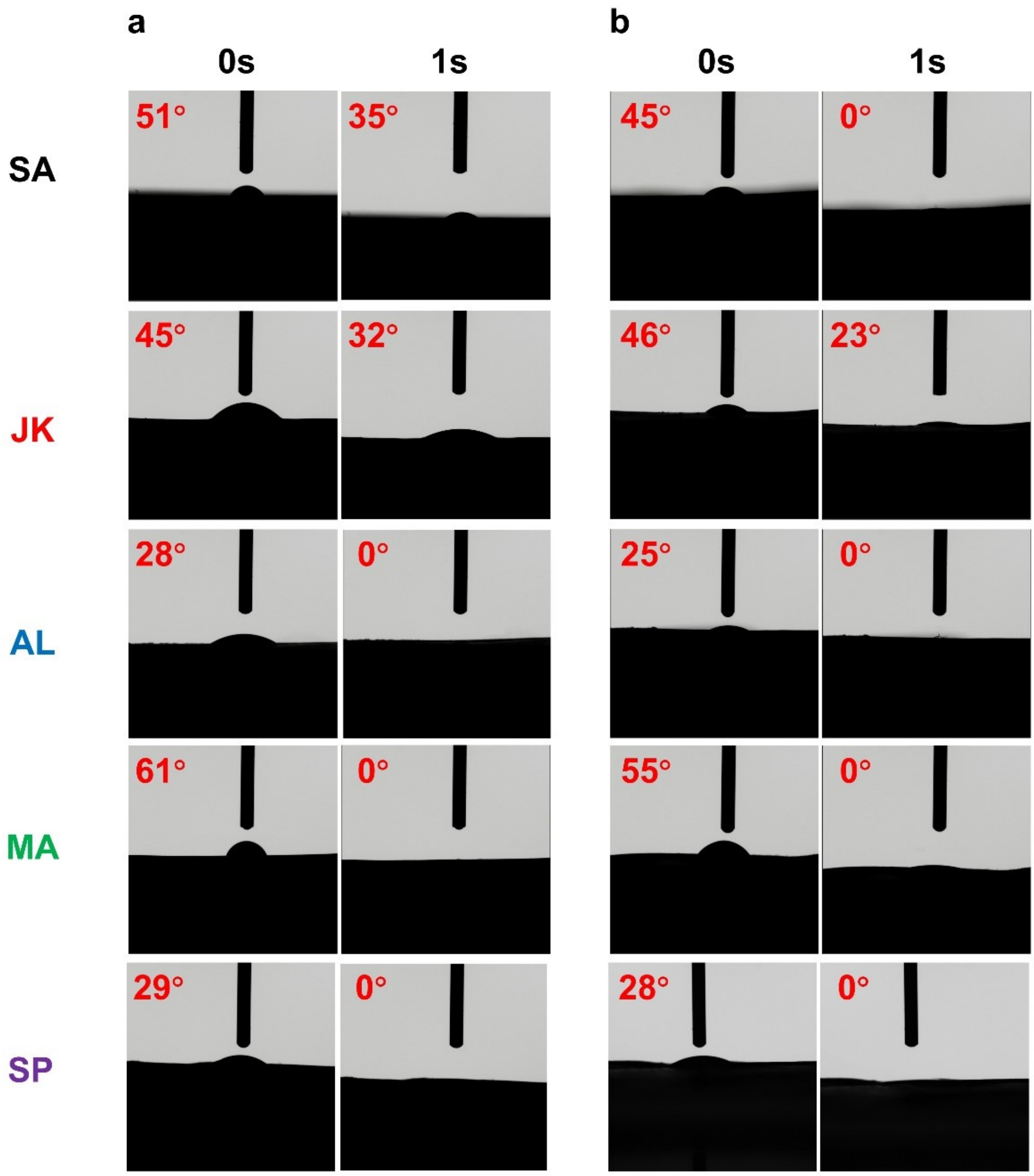

Fig. S11 Picture of the water contact angle of a) PAN nanofiber membranes subjected to a humid environment (80% RH) to absorb water, and b) after removing the absorbed water at elevated temperature.

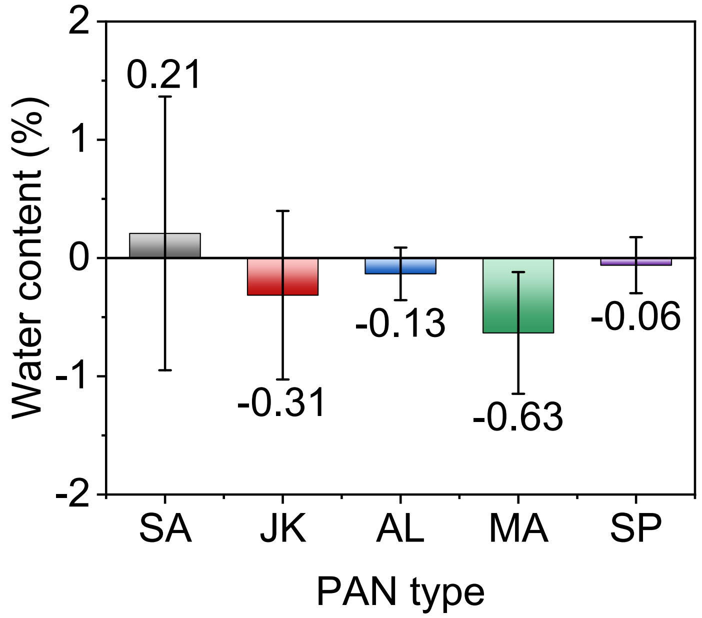

Fig. S12 The water content of after moisture-absorbing samples drying relative to the sample dried before absorption.

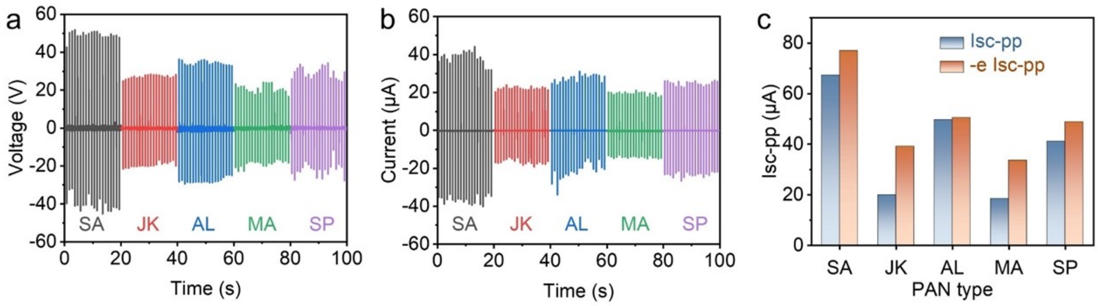

Fig. S13 a) Voc and b) Isc, and c) Isc-pp of PAN nanofiber membranes after residual charge removal. (Membrane thickness 60 μm; working area 5 cm^2)

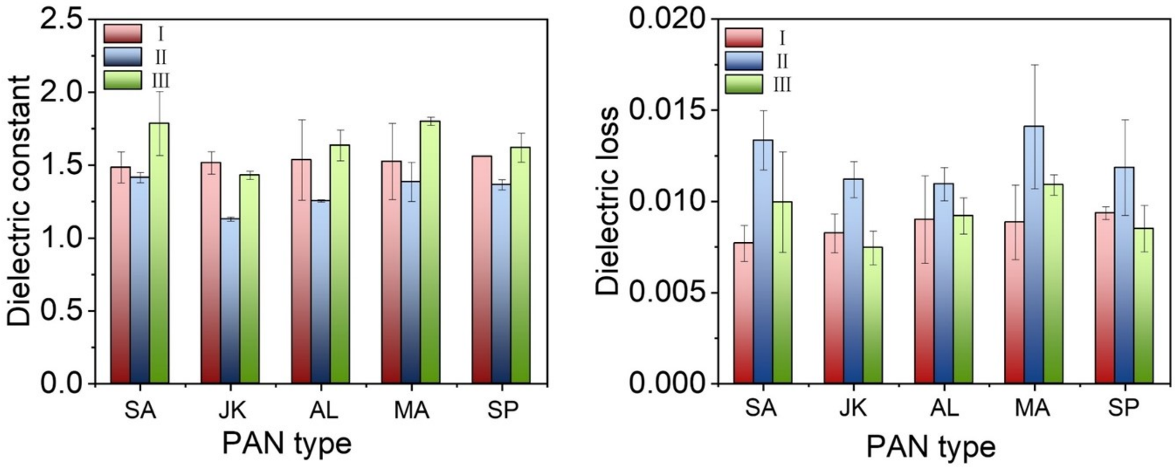

Fig. S14 a) Dielectric constant and b) Dielectric loss of (I) dried PAN nanofibers, (II) absorbed in a humid environment (RH-80%), and (III) finally dried again.

Table S1 Voltage outputs of electrospun PAN nanofiber nonwoven devices reported in the previous literature

Working areas	Force	Impact frequency	Voltage outputs	PAN sources	Research purposes/applications	Ref.
5 cm^2	-	Deflection rate 0.1 mm/s	3.2 V	-	Structural health monitoring	S1
2.5×2.5 cm^2	15 N	10 Hz	0.85 V	Sinopharm Chemical Reagent	Nanogenerators	S2
4 cm^2	0.5 N	5 Hz	20 mV	Macklin	Flexible piezoelectric membrane	S3
4×1.2 cm^2	-	10 Hz	2.2 V	Sigma-Aldrich	Piezoelectric	S4
5×5 cm^2	6 kPa	3 Hz	0.5 V	Sigma Co. Ltd.	Flexible sensor	S5
4×4 cm^2	-	-	3.2 V	Macklin	Flexible piezoelectric sensors	S6
3×3 cm^2	0.23 N	3 Hz	1.5 V	Macklin	Flexible piezoelectric sensors	S7
3×3 cm^2	2 N	3 Hz	1.3 V	Macklin	Piezoelectric sensors	S8
4×4 cm^2	-	-	10 V	Macklin	Flexible touch sensor	S9
2×2 cm^2	-	1 Hz	1.6 V	Dupont Company	Self-powered wearable sensor	S10
4×4 cm^2	12.5 kPa	1 Hz	1.6 V	Beijing J&K SCIENTIFIC LTD	Piezoelectric composite fibers	S11
5 cm^2	-	2 Hz	2 V	Spectrum Chemical Manufacturing Corp	Piezoelectricity	S12
4×4 cm^2	8 N	2 Hz	2.4 V	Beijing JinBeiNuo Technology Co., Ltd.	Piezoelectric Nanogenerators	S13
3×3 cm^2	~20 N	7 Hz	0.57 V	Pasupati Acrylon Private Limited	Piezoelectric Nanogenerator	S14
4×2 cm^2	0.2 N	5 Hz	5 mV	Macklin	Flexible Conductive-Piezoelectric Nanoresistance Network Material	S15

Table S2 *Mw* and PDI data of the PAN powder measured by GPC method

PAN sources	*Mw* ($\times 10^5$, g/mol)	Measured *Mw* ($\times 10^5$, g/mol)	PDI
SA	1.5	21.3	10.8
JK	1.5	24.5	10.9
AL	1.5	51.4	11.5
SP	0.9	68.4	228.8
MA	1.5	25.5	15.7

Table S3 FTIR peak assignment of PAN powder and nanofibers

Wavenumber/cm^{-1}	SA	JK	AL	MA	SP
2940			$-CH_2-$		
2244			C≡N		
1730		-		C=O	
1453			$-CH_2-$		
1250			Zig-zag		
1230			3^1-helical		
1173		-		C-O	

Table S4 NMR peak assignment of PAN powder

<table>
<tr><th></th><th>ppm</th><th>SA</th><th>JK</th><th>AL</th><th>MA</th><th>SP</th></tr>
<tr><td rowspan="10">^{1}H-NMR</td><td>12.5</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-COOH</td></tr>
<tr><td>7.9</td><td colspan="5">C-H of DMF</td></tr>
<tr><td>7.7, 7.5, 6.7</td><td>-</td><td>-</td><td>$-NH_2$</td><td>-</td><td>-</td></tr>
<tr><td>7.1</td><td colspan="5">NH_4^+</td></tr>
<tr><td>4.15, 3.9</td><td colspan="5">-CH of monomer</td></tr>
<tr><td>3.67</td><td>-</td><td>-</td><td>-</td><td colspan="2">$-OCH_3$</td></tr>
<tr><td>3.14</td><td colspan="5">-CH of polymer</td></tr>
<tr><td>2.89, 2.72</td><td colspan="5">The methine protons of monomer</td></tr>
<tr><td>2.04</td><td colspan="5">$-CH_2-$ of polymer</td></tr>
<tr><td>0.8-0.9</td><td colspan="5">The terminal proton of a copolymer chain</td></tr>
<tr><td rowspan="5">^{13}C-NMR</td><td>173</td><td>-</td><td>-</td><td>-</td><td colspan="2">C=O</td></tr>
<tr><td>120.5</td><td colspan="5">-CN</td></tr>
<tr><td>52</td><td>-</td><td>-</td><td>-</td><td colspan="2">$-OCH_3$</td></tr>
<tr><td>32.6</td><td colspan="5">$-CH_2-$</td></tr>
<tr><td>27.2</td><td colspan="5">-CH-</td></tr>
</table>

Table S5 NMR peak integration data and structural regularity of PAN powder and nanofibers

	Test	Type / ppm/ vertical structure regularity	SA	JK	AL	MA	SP
Powder	^{1}H-NMR	12.5	-	-	-	-	2.27
		7.10	0.37	0.10	0.71	0.60	0.87
		7.7, 7.5, 6.7	-	-	1.01	-	-
		3.67	-	-	-	3.41	1.44
		3.14	32.67	32.87	32.41	30.50	30.59
		2.04	66.96	67.03	65.77	65.49	64.82
	^{13}C-NMR	rr	0.21	0.21	0.22	0.20	0.22
		mr	0.50	0.50	0.50	0.52	0.51
		mm	0.29	0.29	0.28	0.27	0.28
		m/%	54.0	54.0	53.0	53.0	53.5
Nanofiber	^{1}H-NMR	12.4	-	-	-	-	0.45
		7.10	0.41	0.22	0.22	0.39	0.16
		7.7, 7.5, 6.7	-	-	0.26	-	-
		3.67	-	-	-	3.98	2.33
		3.12	32.02	32.42	33.13	29.45	30.62
		2.00	67.58	67.35	66.38	66.19	66.43
	^{13}C-NMR	rr	21.92	21.84	22.61	21.20	21.50
		mr	49.12	49.58	48.85	50.33	50.93
		mm	28.96	28.58	28.53	28.47	27.57
		m/%	53.52	53.37	53.00	53.64	53.04

Table S6 Peak assignment for solid-state ^{13}C-NMR spectra

<table>
<tr><th></th><th></th><th>SA</th><th>JK</th><th>AL</th><th>MA</th><th>SP</th></tr>
<tr><td rowspan="4">Powder</td><td>C=O</td><td>-</td><td>-</td><td>-</td><td colspan="2">173.0</td></tr>
<tr><td>C≡N</td><td>119.40</td><td>118.74</td><td>118.12</td><td>118.41</td><td>118.74</td></tr>
<tr><td>$-OCH_3$</td><td>-</td><td>-</td><td>-</td><td>52.0</td><td>-</td></tr>
<tr><td>CH、CH_2</td><td colspan="5">27.40</td></tr>
<tr><td rowspan="4">Nanofiber</td><td>C=O</td><td>-</td><td>-</td><td>-</td><td colspan="2">173.0</td></tr>
<tr><td>C≡N</td><td>119.44</td><td>119.78</td><td>119.15</td><td>119.15</td><td>119.44</td></tr>
<tr><td>$-OCH_3$</td><td>-</td><td>-</td><td>-</td><td colspan="2">52.0</td></tr>
<tr><td>CH、CH_2</td><td colspan="5">27.40</td></tr>
</table>

Table S7 Element content of PAN nanofibers obtained from XPS spectra

Element content (%) \ Type	SA	JK	AL	MA	SP
C	75.54	74.85	75.72	75.42	75.45
C-C/C-H	63.48	62.90	65.27	58.92	60.85
C≡N	12.06	11.95	7.83	14.73	12.78
C=O	-	-	-	1.76	1.83
$-CONH_2$	-	-	2.61	-	-
N	21.84	22.71	17.51	20.49	20.25
C≡N			13.4		
$-CONH_2$			4.14		
O	2.15	1.95	5.45	3.47	4.17
S	0.31	0.35	0.59	0.35	0.07
Na	0.16	0.14	0.73	0.28	0.06

Table S8 Mechanical properties of electrospun PAN nanofiber membranes from different papers

Sources	M_w ($\times 10^5$, g/mol)	Concentration (wt%)	Diameter (nm)	Yong's modulus (MPa)	Tensile strength (MPa)	Elongation at break (%)	Additives	Ref.
Sigma-Aldrich	1.5	-	515±01		2.95	95		S16
Lukoil Neftochim	0.45	17	-	23.6±3.0	1.3±0.3	56.3±3.0	Sodium vinylsulfonate 1.4%)	S17
Shanghai Chemical Fibers Institute	0.9	10	-	40±10	0.61±0.12	5.89±0.95	-	S18
Aladdin	1.5	10	300	-	27.5±0.5	20.1±0.3	-	S19
Institute of Shanghai Petrochemical	0.8	12	204±45	0.84	0.043	25.5	-	S20
Sigma Aldrich	1.5	10	400	0.6	0.29	200	-	S21
Sigma Aldrich	1.5	10	-	160±8	55.2±2.2	-	-	S22
Aladdin	0.7	14	-	1.13	4.53	41.03	-	S23
Shenzhen Xiangu High-Tech. Co., Ltd	-	10	-	-	2.21	-	-	S24
Taekwang Company	1-2	15	-	10.3±5.4	20.3±0.6	50.2±8.3	Methyacrylate (8.6%)	S25
Scientific Polymer Products	1.5	8	-	19.6	1.09	27	-	S26
Sinopharm Chemical Reagent Co. Ltd.	-	10	-	15.01	0.16	10.47	-	S27
Stable	3	22	3180.46	39.49	2.50	-	-	S28
Aldrich	0.15	7	20.9	12.09	5.73	63	-	S29
Sigma Aldrich	1.5	7	515.34±75.45	69.78±19.28	10.58±2.04	8.47±2.24	-	S30
Sigma-Aldrich	1.5	9	320±100	117.35±28.98	8.33±0.26	130.85±24.61	-	This work
J&K	1.5	9	330±100	78.28±3.51	9.10±0.37	171.66±33.26	-	This work
Aladdin	1.5	9	320±100	69.31±1.13	2.79±0.41	30.96±7.92	-	This work
Macklin	1.5	14	360±50	152.83±14.24	4.90±0.21	13.46±0.41	-	This work
Spectrum	0.9	12	330±10	220.14±51.09	2.42±0.23	2.79±0.50	-	This work

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