

**Support information for Easy hydrogel preparation with high-purity lignin
separated from DES pretreatment with excellent-performance for moisture-
electric generators and motion sensors**

Table. S1 Different lignins for the hydrogel preparations

Lignin type	AlCl ₃ ·6H ₂ O (g)	AA (g)	APS (mg)	lignin (g)	Water (g)	EG (g)
DESL	1.8	2.8	25	0.03	4	2.5
CLS	1.8	2.8	25	0.03	4	2.5
Kraft lignin	1.8	2.8	25	0.03	4	2.5
Soda lignin	1.8	2.8	25	0.03	4	2.5

Table. S2 The content of Al³⁺ of DESL-Al³⁺-PAA hydrogels

AlCl ₃ ·6H ₂ O content (%)	AlCl ₃ ·6H ₂ O (g)	AA (g)	APS (mg)	DESL (g)	Water (g)	EG (g)
0	0	2.8	25	0.03	4	2.5
3.0	0.3	2.8	25	0.03	4	2.5
6.0	0.6	2.8	25	0.03	4	2.5
9.0	0.9	2.8	25	0.03	4	2.5
12.0	1.2	2.8	25	0.03	4	2.5
15.0	1.5	2.8	25	0.03	4	2.5
18.0	1.8	2.8	25	0.03	4	2.5

Table. S3 The content of DESL of DESL-Al³⁺-PAA hydrogels

DESL content (%)	AlCl ₃ ·6H ₂ O (g)	AA (g)	APS (mg)	DESL (g)	Water (g)	EG (g)
0	1.8	2.8	25	0	4	2.5
0.3	1.8	2.8	25	0.03	4	2.5
0.6	1.8	2.8	25	0.06	4	2.5
0.9	1.8	2.8	25	0.09	4	2.5
1.2	1.8	2.8	25	0.12	4	2.5
1.5	1.8	2.8	25	0.15	4	2.5
1.8	1.8	2.8	25	0.18	4	2.5

Table. S4 The ratio of glycol to water of DESL-Al³⁺-PAA hydrogels

The ratio of EG to water	AlCl ₃ ·6H ₂ O (g)	AA (g)	APS (mg)	DESL (g)	Water (g)	EG (g)
0	1.8	2.8	25	0.03	6.5	0
1:12	1.8	2.8	25	0.03	6	0.5
2:11	1.8	2.8	25	0.03	5.5	1
5:8	1.8	2.8	25	0.03	4	2.5
7:6	1.8	2.8	25	0.03	3	3.5
9:4	1.8	2.8	25	0.03	2	4.5

Table. S5 Start gelation (exothermic) time of hydrogels with different DESL contents(18.0 wt% Al³⁺, 28.0 wt% AA, and 0.25 wt% APS)

DESL content (wt%)	Start gelation time (min)
0.3	10.5±0.8
0.6	8.6±0.5
0.9	5.7±0.5
1.2	4.3±0.4
1.5	2.9±0.6
1.8	1.7±0.2

Table. S6 Relative atomic contents of C and O in DESL before and after APS oxidation

Sample	C (atomic content, %)	O (atomic content, %)
DESL	72.4±0.38	20.7±0.34
APS-DESL	62.1±0.58	29.2±0.46

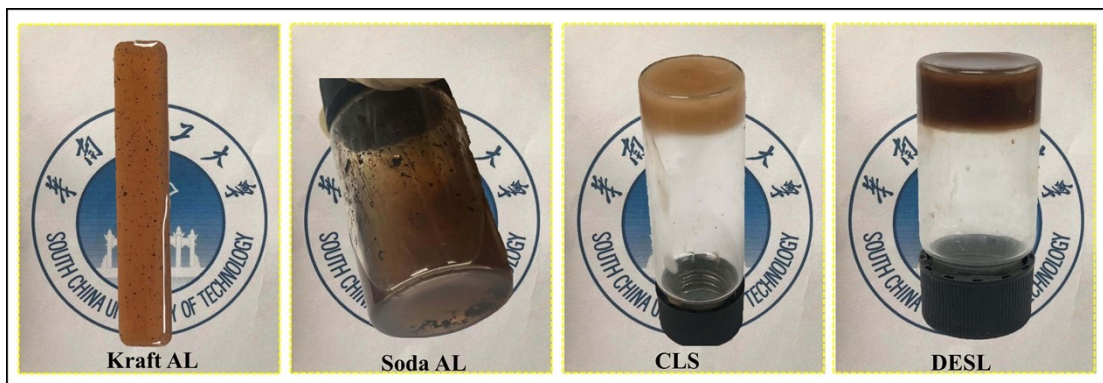


Figure. S1 Hydrogels based on different kinds of lignin.

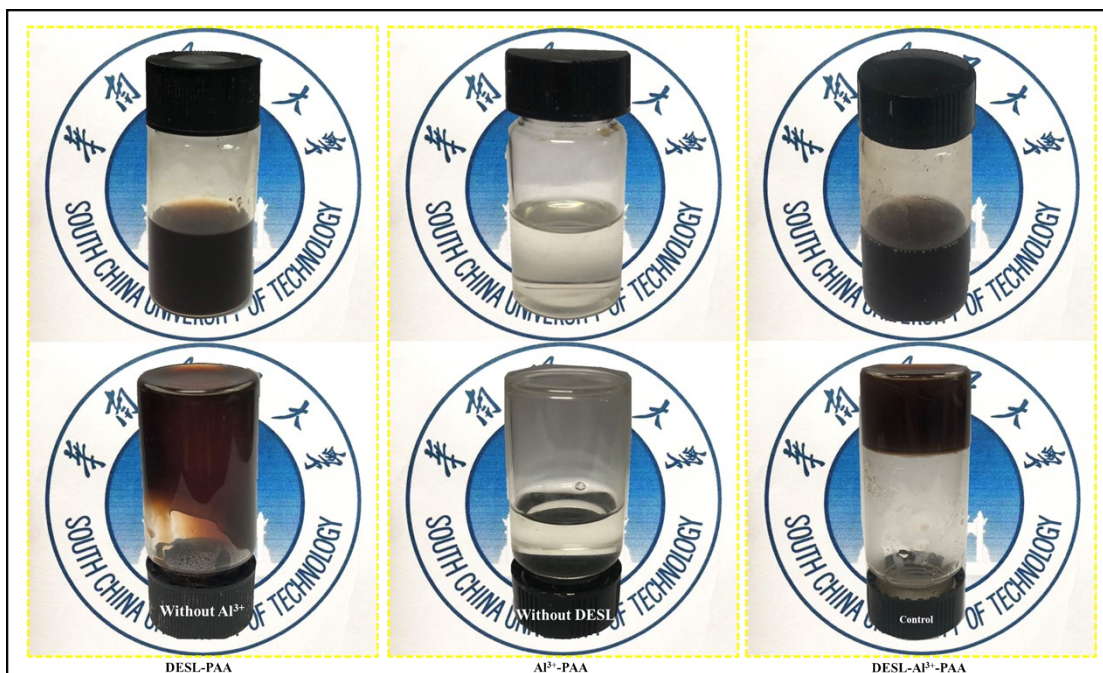


Figure. S2 Experiment with the loss control of DESL and Al^{3+} in hydrogel preparation.



Figure. S3 Various hydrogels from different Al^{3+} contents (28.0 wt% AA, 0.25 wt% APS, and 0.6 wt% DESL).

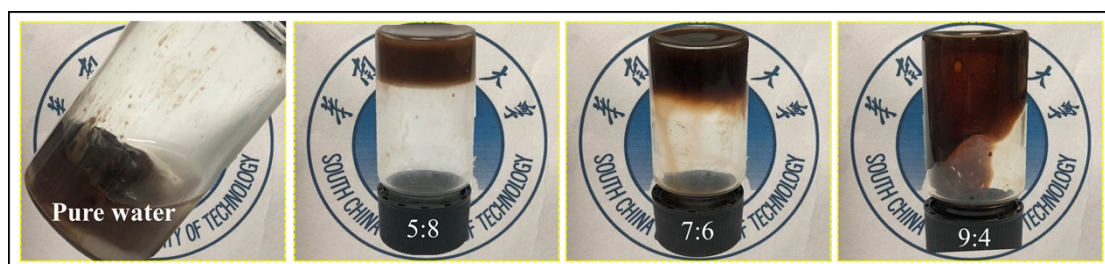


Figure. S4 Various hydrogels from different ratios of glycol to water (28.0 wt% AA, 0.25 wt% APS, and 0.3 wt% DESL).

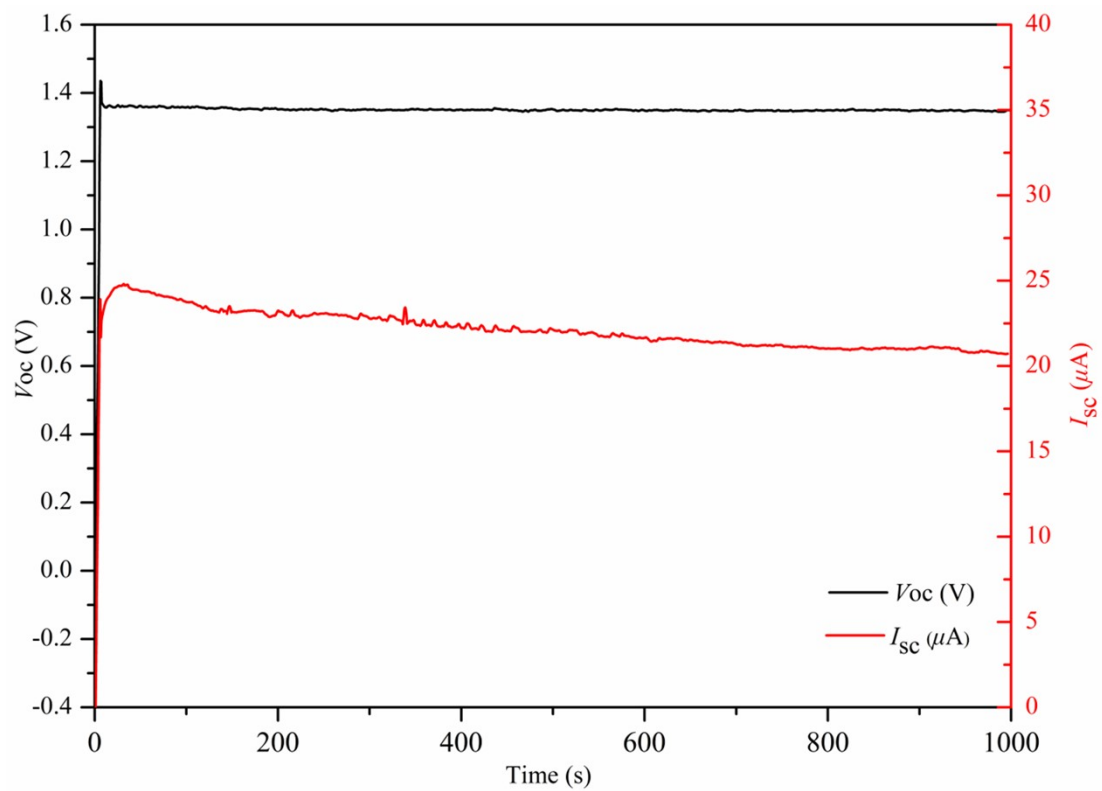


Figure. S5 The electrical output performance curve of the HMEG test with a duration of 1000 seconds.

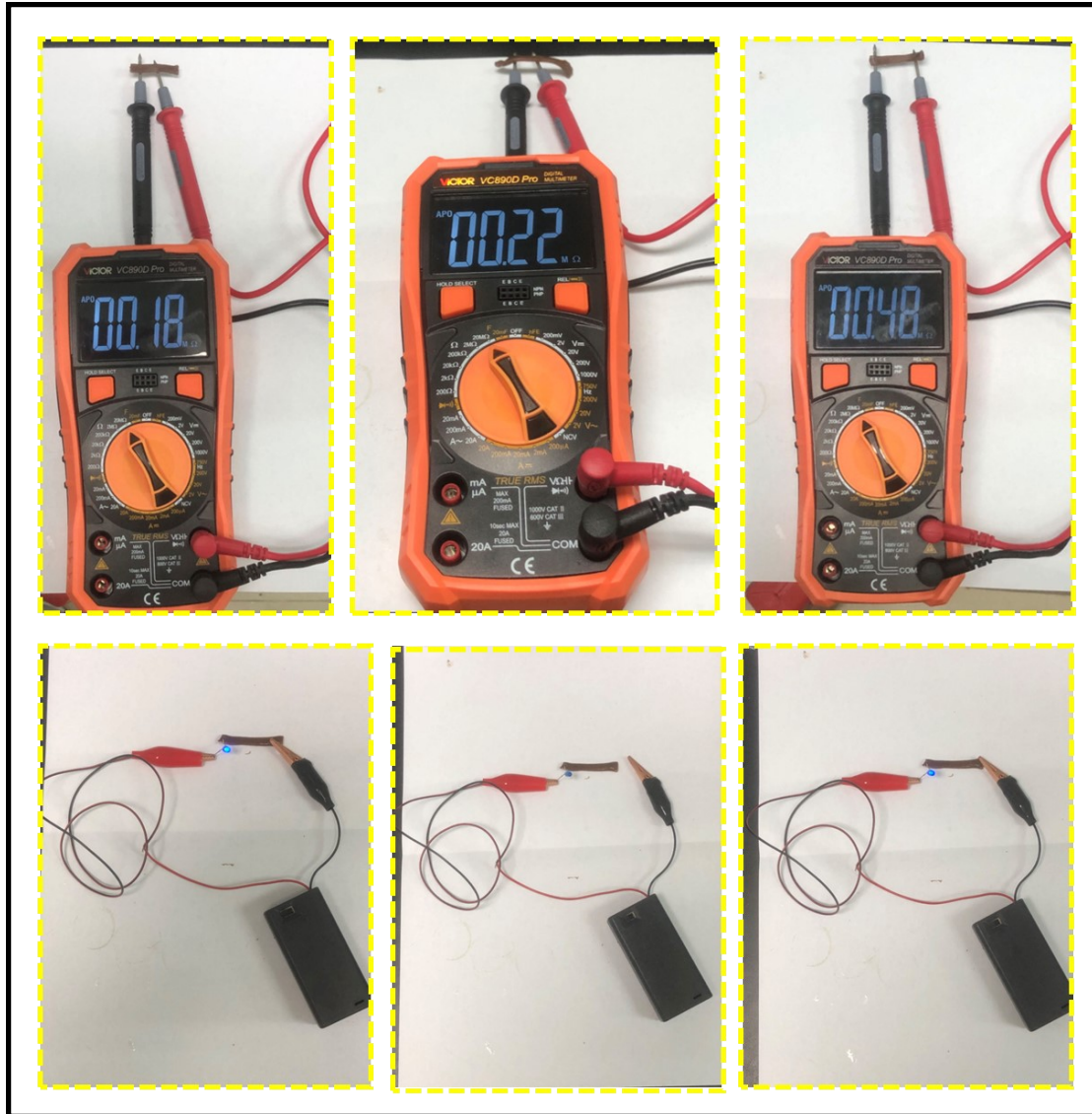


Figure. S6 (a) Resistance of hydrogels with different lengths. (b) The conductivity of hydrogel lights up the small light bulb.

Support video: <https://v.afbcs.cn/LTVm7a>