nanomaterials

MDPI

Supplementary Materials

Enhanced Humid Reliability of Organic Thermoelectrics via Crosslinking with Glycerol

Jaeyun Kim [1,†], Jae Gyu Jang [2,†], Jeonghun Kwak [3,*], Jong-In Hong [2,*] and Sung Hyun Kim [4,*]

[1] School of Electrical and Computer Engineering, University of Seoul, Seoul 02504, Korea; kimjaeyun24@naver.com
[2] Department of Chemistry, Seoul National University, Seoul 08826, Korea; jangjaegyu@snu.ac.kr
[3] Department of Electrical and Computer Engineering, Inter-university Semiconductor Research Center, Seoul National University, Seoul 08826, Korea
[4] Department of Carbon Convergence Engineering, Wonkwang Univeristy, Iksan 54538, Korea
* Correspondence: jkwak@snu.ac.kr (J.K.); jihong@snu.ac.kr (J.-I.H.); shkim75@wku.ac.kr (S.H.K.); Tel.: +82-02-880-1782 (J.K.); +82-02-874-5902 (J.-I.H.); +82-063-850-6393 (S.H.K.)
† These authors contributed equally to this work.

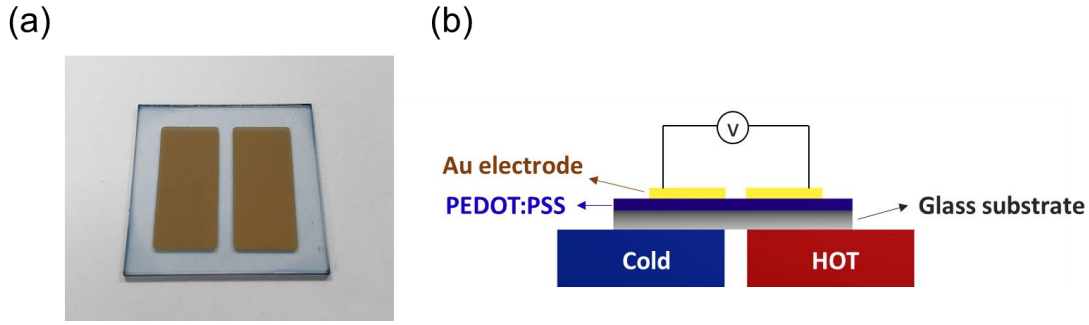

Figure S1. (**a**) Photograph of the Pristine film, (**b**) Schematic illustration for TE measurement.

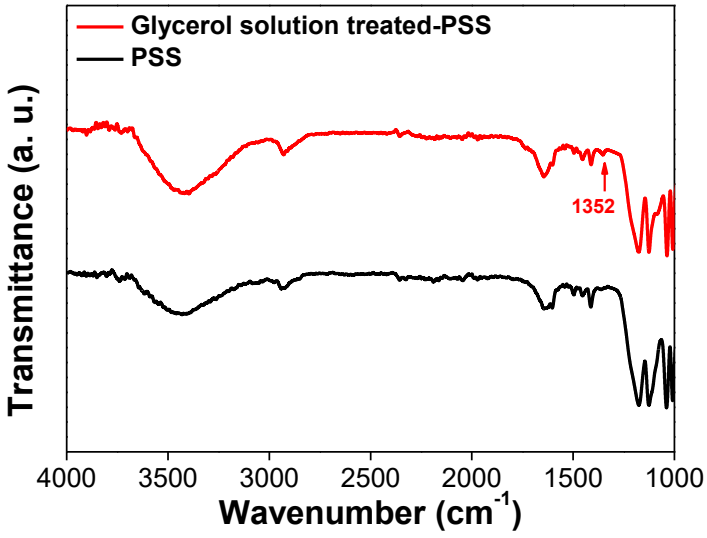

Figure S2. FT-IR spectra of neat PSS and glycerol solution treated PSS.

Figure S3. A photograph of the PEG vapor treated film after storage in humid chamber for 5 min.

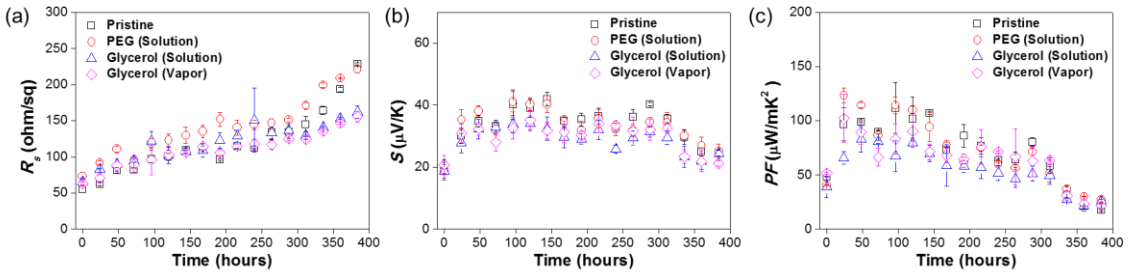

Figure S4. (**a**) R_s, (**b**) S, and (**c**) PF for Pristine-, PEG solution treated-, glycerol solution treated-, and glycerol vapor treated-film as function of storage time. The humid condition is a relative humidity with 95% and temperature with 27 °C.

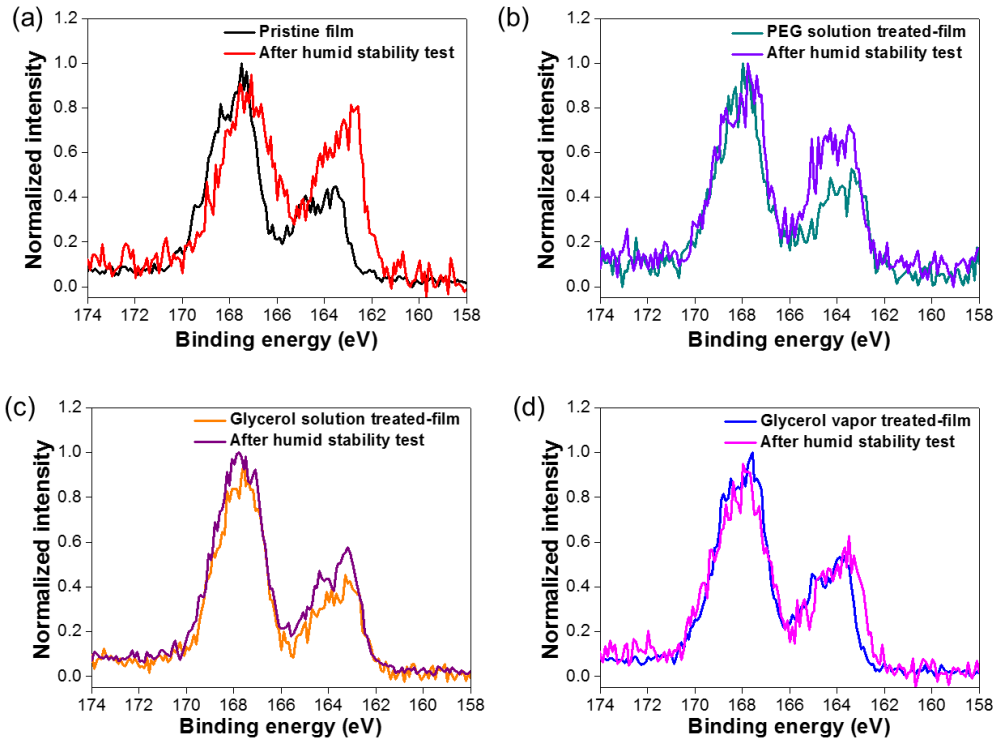

Figure S5. XPS spectra of the PEDOT:PSS films before and after humid stability test. (a) Pristine-, (b) PEG solution treated-, (c) Glycerol solution treated-, and (d) Glycerol vapor treat-film.

Table S1. *Rs and S* in the Pristine, PEG solution treated-, glycerol solution treated-, and glycerol vapor treated-films according to storage time under high humid environment.

Storage time (hours)	Sample							
	Pristine film		PEG solution treated film		Glycerol solution treated film		Glycerol vapor treated film	
	*R*s (ohm/sq)	*S* (μV/K)	*R*s (ohm/sq)	*S* (μV/K)	*R*s (ohm/sq)	*S* (μV/K)	*R*s (ohm/sq)	*S* (μV/K)
0	55.64 ± 4.72	20.22 ± 2.16	72.96 ± 5.55	18.66 ± 2.13	65.60 ± 4.18	18.80 ± 2.81	63.04 ± 1.95	20.90 ± 3.03
24	62.46 ± 2.34	30.11 ± 2.41	92.01 ± 2.58	35.36 ± 3.26	83.14 ± 0.82	27.82 ± 3.14	70.84 ± 5.04	30.97 ± 2.98
48	81.51 ± 3.87	34.90 ± 1.84	110.85 ± 3.99	38.06 ± 1.90	89.31 ± 8.41	32.27 ± 3.07	88.15 ± 10.11	32.45 ± 2.02
72	82.05 ± 3.05	33.28 ± 1.91	95.98 ± 3.32	31.91 ± 1.62	95.26 ± 2.58	32.94 ± 1.61	89.01 ± 10.31	28.09 ± 2.91
96	96.99 ± 4.97	40.23 ± 4.73	118.75 ± 7.09	41.09 ± 3.21	122.11 ± 13.19	33.91 ± 2.79	95.94 ± 20.52	32.59 ± 3.51
120	100.46 ± 4.80	39.07 ± 3.07	122.97 ± 9.23	40.28 ± 1.96	102.84 ± 11.67	34.07 ± 1.96	102.72 ± 6.57	35.14 ± 3.41
144	109.12 ± 3.06	42.01 ± 2.10	129.79 ± 11.41	40.33 ± 2.77	107.28 ± 1.87	32.52 ± 3.78	106.18 ± 2.45	31.85 ± 2.73
168	111.28 ± 3.90	35.06 ± 1.20	135.31 ± 8.80	34.63 ± 1.97	108.90 ± 8.90	29.71 ± 3.32	114.69 ± 4.45	31.35 ± 3.45
192	96.56 ± 1.07	35.36 ± 2.03	152.09 ± 9.62	31.91 ± 2.85	122.86 ± 11.12	29.12 ± 1.69	106.04 ± 3.86	30.35 ± 1.22
216	114.46 ± 3.06	36.45 ± 2.70	140.73 ± 10.59	35.70 ± 2.90	128.82 ± 8.56	32.09 ± 3.12	114.69 ± 3.57	34.03 ± 2.86
240	112.58 ± 2.54	32.90 ± 1.34	144.41 ± 6.28	32.17 ± 1.94	151.01 ± 44.12	25.83 ± 1.22	117.83 ± 5.90	33.44 ± 1.47
264	133.22 ± 8.36	36.21 ± 2.40	146.35 ± 6.31	31.86 ± 1.95	132.79 ± 8.97	29.46 ± 2.27	116.86 ± 5.68	31.70 ± 4.53
288	134.23 ± 8.23	40.33 ± 0.54	150.90 ± 2.83	34.60 ± 1.45	136.49 ± 8.94	31.39 ± 1.59	125.08 ± 2.18	32.21 ± 3.40

Table S2. Degree of *PF* change in the Pristine-, PEG solution treated-, glycerol solution treated-, and glycerol vapor treated-films according to the storage time under a high humid environment.

Storage time (hours)	Sample							
	Pristine film		PEG solution treated film		Glycerol solution treated film		Glycerol vapor treated film	
	PF ($\mu W/mK^2$)	Degree of change*	PF ($\mu W/mK^2$)	Degree of change	PF ($\mu W/mK^2$)	Degree of change	PF ($\mu W/mK^2$)	Degree of change
0	48.70 ± 0.38	-	40.74 ± 0.17	-	38.68 ± 9.57	-	51.67 ± 0.92	-
24	96.83 ± 15.18	99%	123.33 ± 6.86	203%	65.81 ± 5.76	70%	102.18 ± 22.08	98%
48	99.03 ± 0.81	103%	114.36 ± 2.35	181%	82.84 ± 11.88	114%	89.47 ± 11.67	73%
72	89.49 ± 1.82	84%	86.49 ± 4.45	112%	80.51 ± 1.29	108%	66.37 ± 7.99	28%
96	111.87 ± 23.50	130%	114.18 ± 7.69	180%	67.34 ± 14.41	74%	83.19 ± 14.06	61%
120	101.77 ±2 0.36	109%	110.07 ± 3.03	170%	79.80 ± 3.84	106%	90.29 ± 14.78	75%
144	107.22 ± 1.33	120%	94.31 ± 13.11	131%	69.89 ± 7.74	81%	71.45 ± 7.29	38%
168	73.24 ± 3.27	50%	78.12 ± 2.18	92%	58.89 ± 19.24	52%	68.16 ± 6.86	32%
192	86.15 ± 10.66	77%	61.80 ± 4.43	52%	57.93 ± 5.53	50%	64.88 ± 4.49	26%
216	77.11 ± 7.51	58%	75.03 ± 2.61	84%	56.96 ± 10.22	47%	76.15 ±1 5.96	47%
240	63.73 ± 0.81	31%	60.09 ± 1.35	47%	51.76 ± 6.68	34%	71.45 ± 0.81	38%
264	64.03 ± 6.94	31%	56.29 ± 3.16	38%	46.56 ± 8.10	20%	66.75 ± 25.98	29%
288	80.37 ± 3.92	65%	71.34 ± 3.35	75%	51.28 ± 7.14	33%	62.71 ± 14.35	21%

*Degree of change (%) = $(PF_{at\ 0\ hour} - PF_{at\ storage\ time})/ PF_{at\ 0\ hour} \times 100$