Supporting Information

Bendable and Foldable Flexible organic solar cells based on Ag nanowire films with 10.30% Efficiency

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Figure S1. Chemical structures of PM6, IT-4F and PFN-Br.

Figure S2. XPS spectra of (a) pure PH1000, (b) doping with 3 vol% EG, (c) doping with 6 vol% EG and (d) doping with 9 vol% EG.

Figure S3. AFM phase images of PEDOT:PSS (PH1000) of 6 vol% EG additives based on Ag NWs film with sheet resistance of 25 Ω. Scale bar: 2×2 μm^2.

Figure S4. SEM images of Ag NWs film with sheet resistance of (a) 25 Ω, (b) 50 Ω, (c) 60 Ω and (d) 80 Ω.

Figure S5. (a) Photograph of the FOSCs based on Ag NW/PET film. (b) Schematic diagram of the bending tests of FOSCs under bending states with r=3 mm. (c) Photos of FOSCs being totally folded. (d) Photos of FOSCs being re-spread after totally folded for *J-V* test again.

Figure S6. Normalized PCEs of the Ag NWs with 25 Ω sq^{-1}/PET/FTE (containing 6% EG)/FOSCs as functions of bending cycle at a fixed bending radius of 3 mm.

Figure S7. *J*−*V* characteristics of Ag NW(X Ω sq^{-1})/PET/FTE (Y vol% EG, 1 vol% Zonyl)/FOSCs with different bending cycles (a) X=25, Y=6; (b) X=50, Y=3; (c) X=50, Y=6; (d) X=50, Y=9; (e) X=60, Y=3; (f) X=60, Y=9; (g) X=80, Y=3; (h) X=80, Y=6; (i) X=80, Y=9.

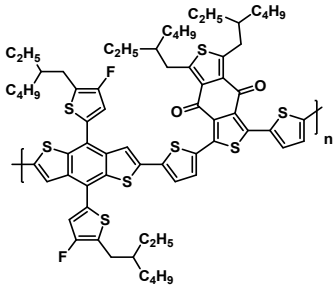
Figure S8. *J*−*V* characteristics of FOSCs after bending at 1000 times and following fully folding.

Figure S9. *J*−*V* characteristics of optimal FOSC and ITO glass based OSC.

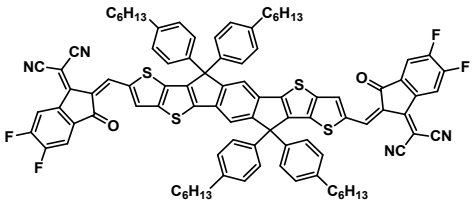
Figure S10. SEM images of Ag NWs film with sheet resistance of 60 Ω after (a) 50, (b) 100, (c) 200, (d) 300, (e) 500 and (f) 1000 bending cycles; Ag NWs film with sheet resistance of 25 Ω after (g) 500 and (h) 1000 bending cycles; Ag NWs film with sheet resistance of 50 Ω after (i) 500 and (j) 1000 bending cycles; Ag NWs film with sheet resistance of 80 Ω after (k) 500 and (l) 1000 bending cycles.

Figure S11. AFM height, phase and 3D images (2 μm× 2 μm) of active layer after (a) 0, (b) 50, (c) 100, (d) 200, (e) 300, (f) 500 and (g) 1000 bending cycles.

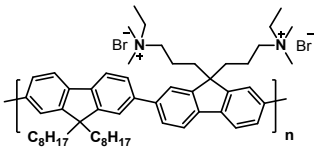
Figure S12. Plotted values of PCEs of FOSCs with Ag electrodes so far.



PM6



IT-4F



PFN-Br

Figure S1.

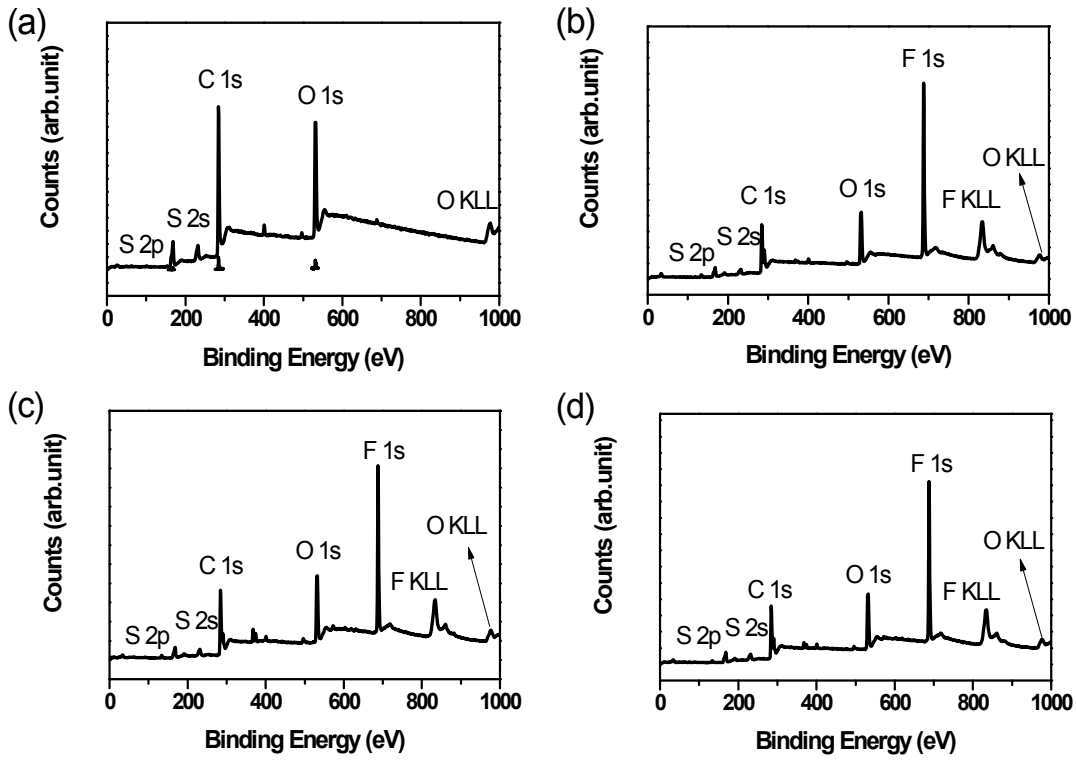


Figure S2.

As shown in S2b-d, the peak of the F element corresponds to the F element in Zonyl.

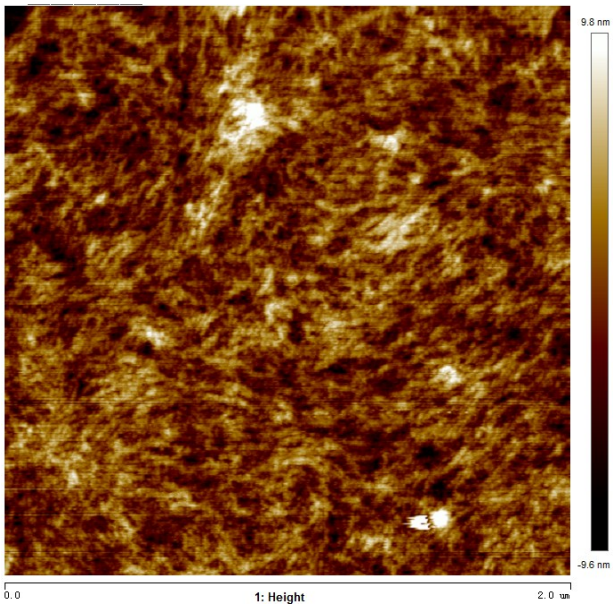


Figure S3.

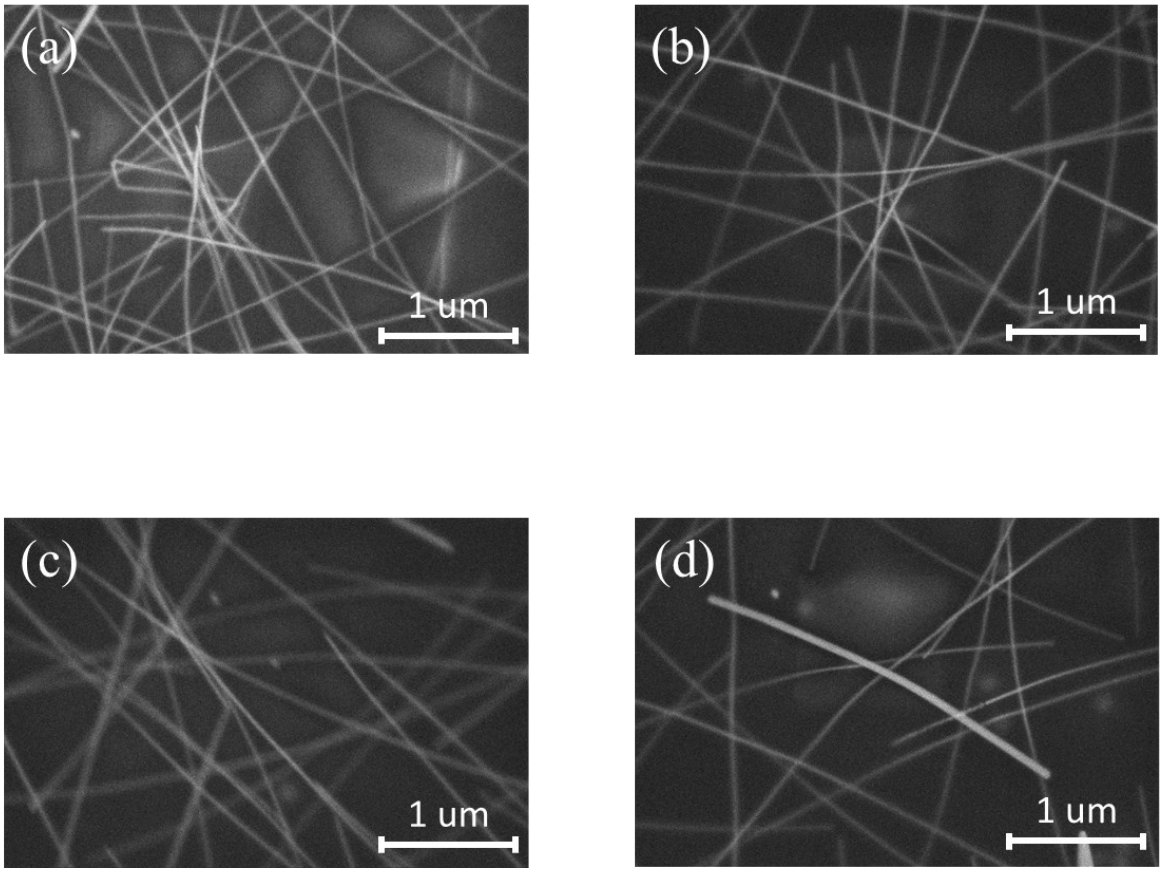


Figure S4.

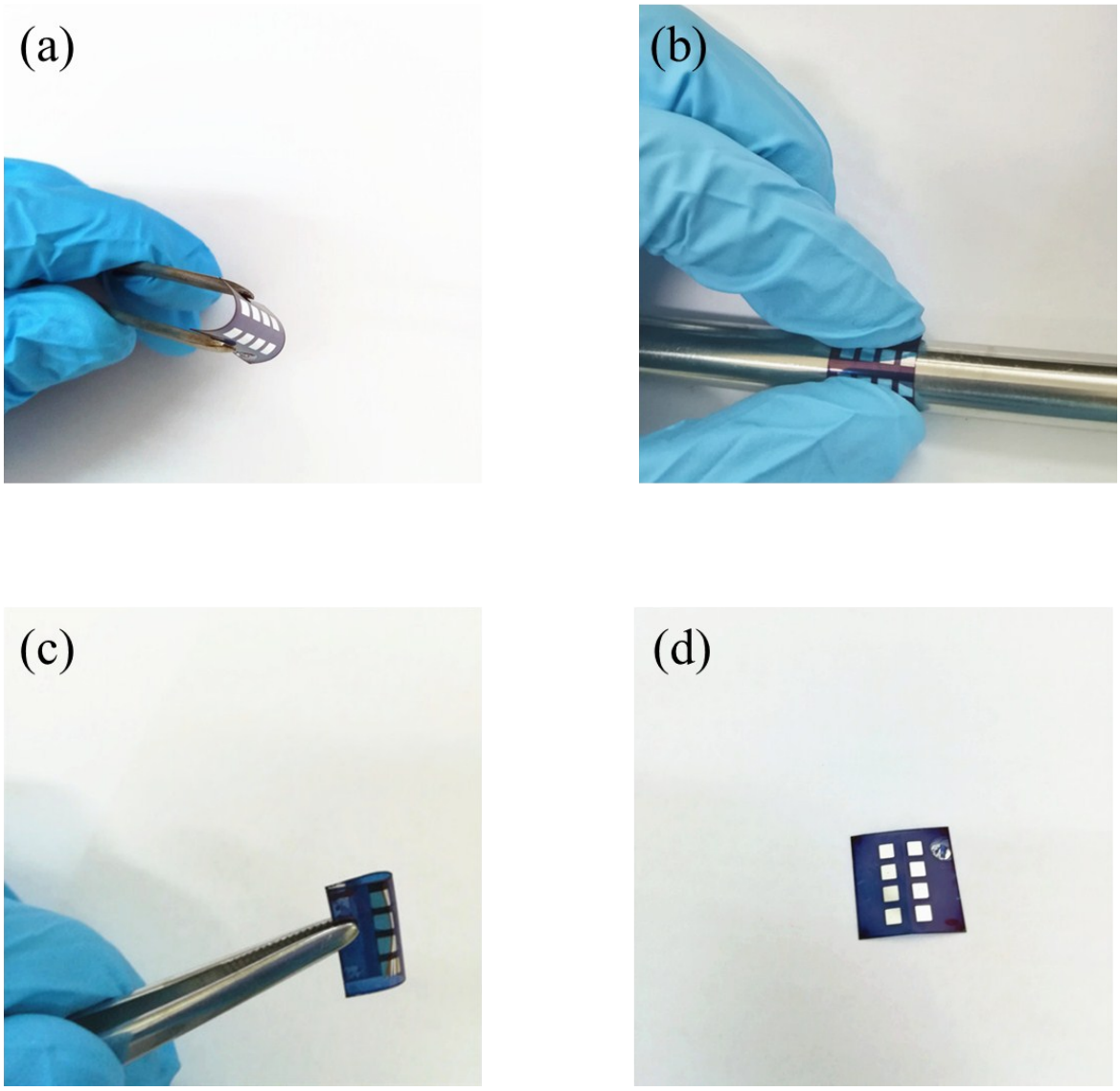


Figure S5.

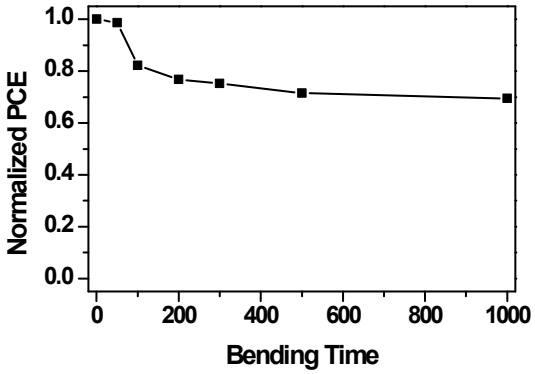

Normalized PCE
1.0
0.8
0.6
0.4
0.2
0.0
0
200
400
600
800
1000
Bending Time

Figure S6.

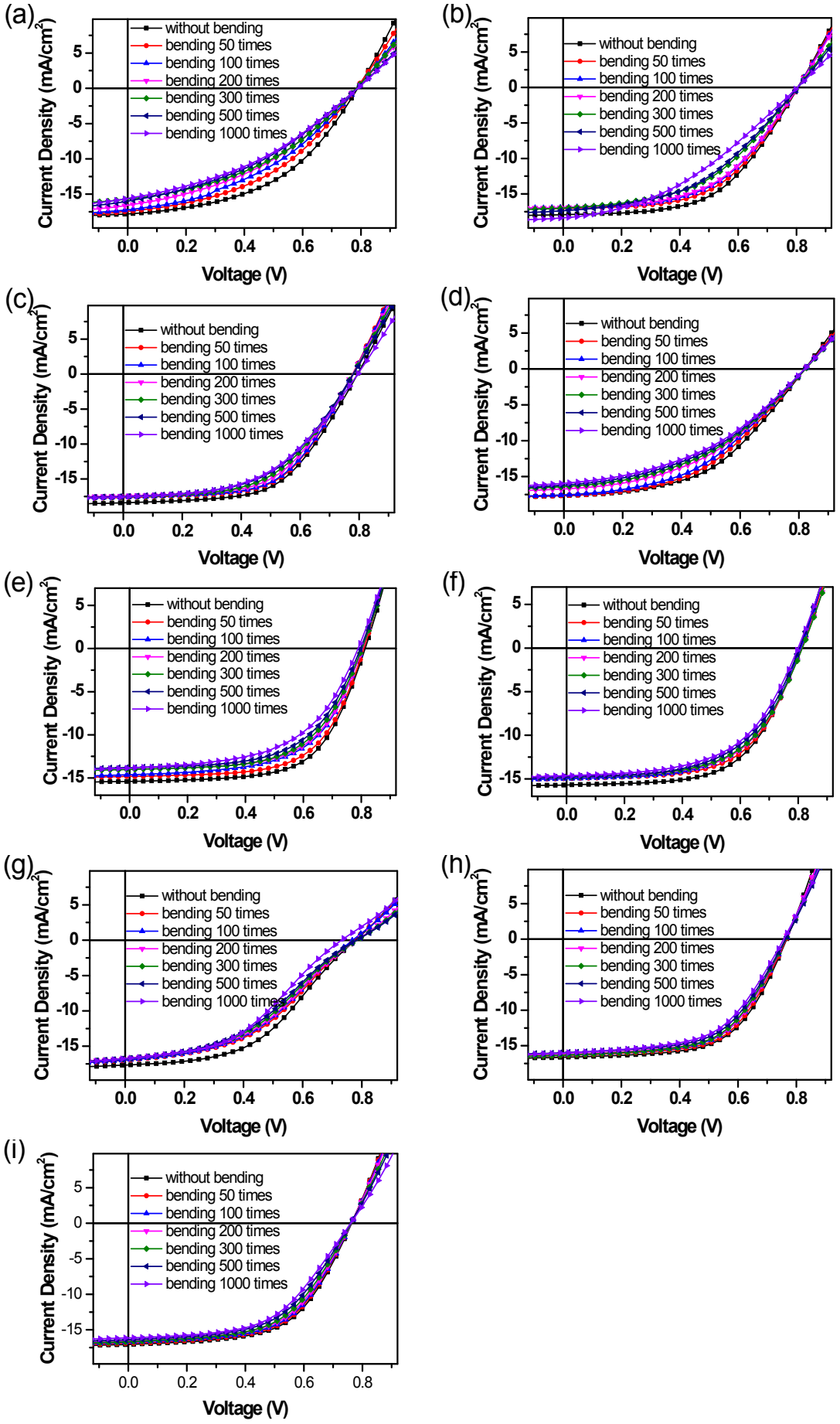

(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
Current Density (mA/cm^2)
Voltage (V)
without bending
bending 50 times
bending 100 times
bending 200 times
bending 300 times
bending 500 times
bending 1000 times

Figure S7.

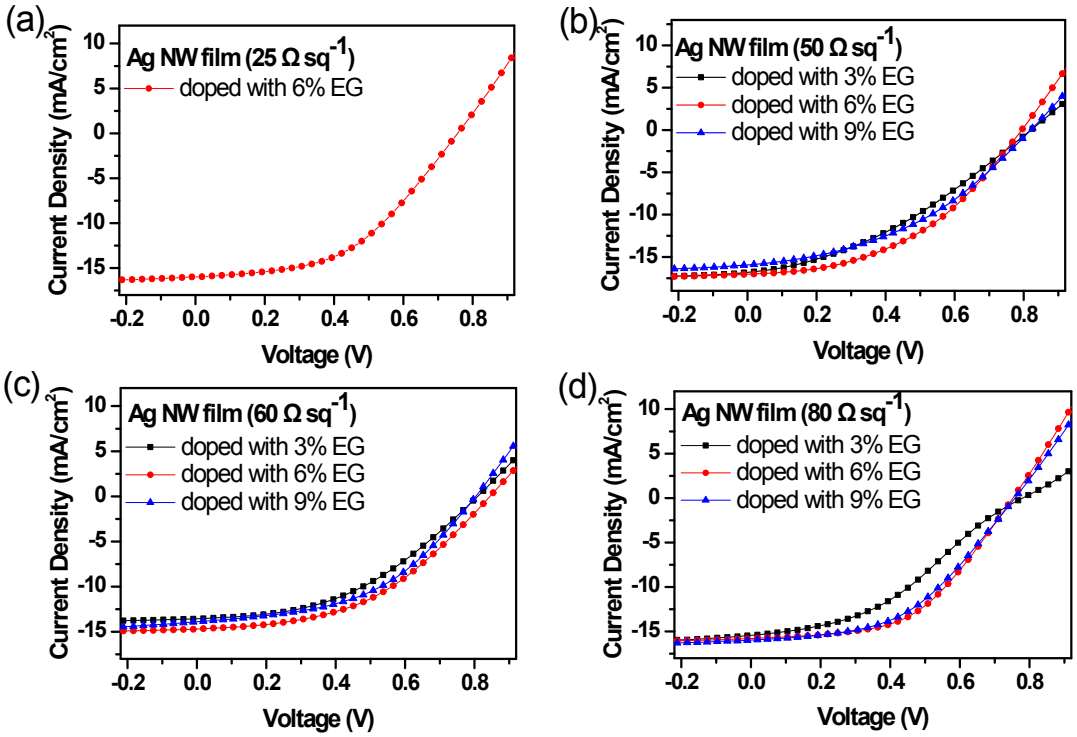

(a)
Ag NW film (25 Ω sq-1)
doped with 6% EG
Current Density (mA/cm2)
Voltage (V)
(b)
Ag NW film (50 Ω sq-1)
doped with 3% EG
doped with 6% EG
doped with 9% EG
Current Density (mA/cm2)
Voltage (V)
(c)
Ag NW film (60 Ω sq-1)
doped with 3% EG
doped with 6% EG
doped with 9% EG
Current Density (mA/cm2)
Voltage (V)
(d)
Ag NW film (80 Ω sq-1)
doped with 3% EG
doped with 6% EG
doped with 9% EG
Current Density (mA/cm2)
Voltage (V)

Figure S8.

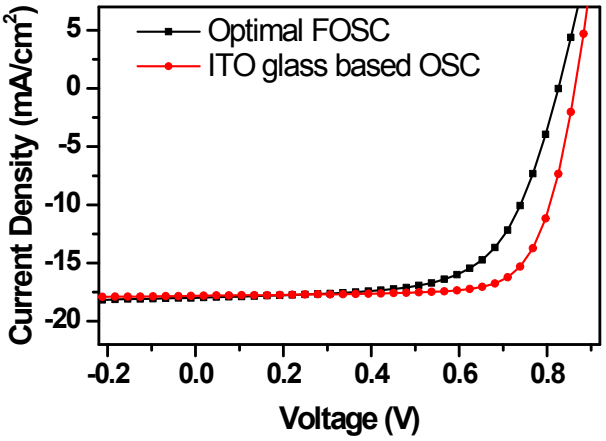


Figure S9.

The performance of OSC was achieved as V_{oc} of 0.863 V, J_{sc} of 18.75 mA/cm^2, FF of 75.00% and PCE of 12.13% based on ITO glass.

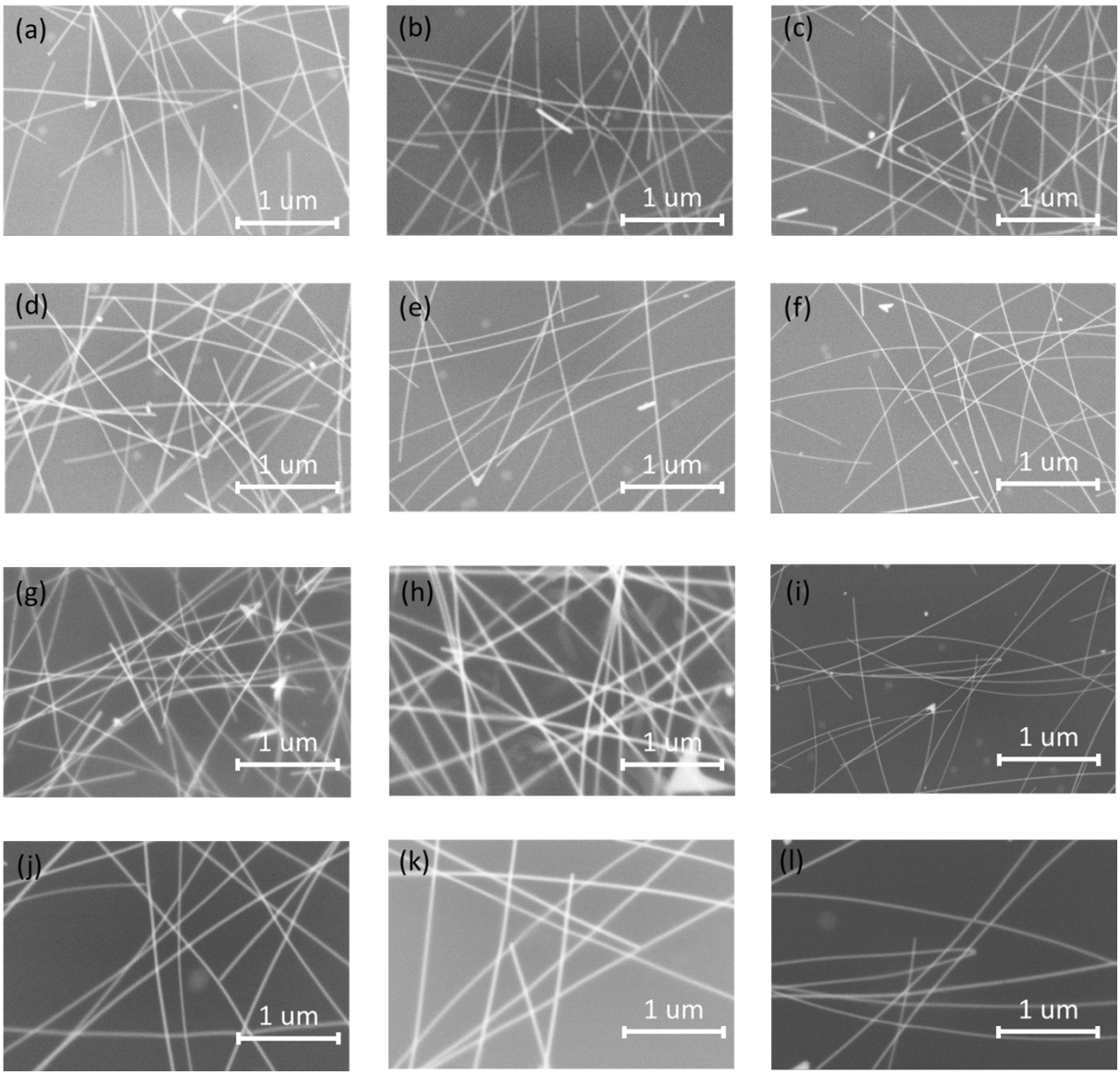
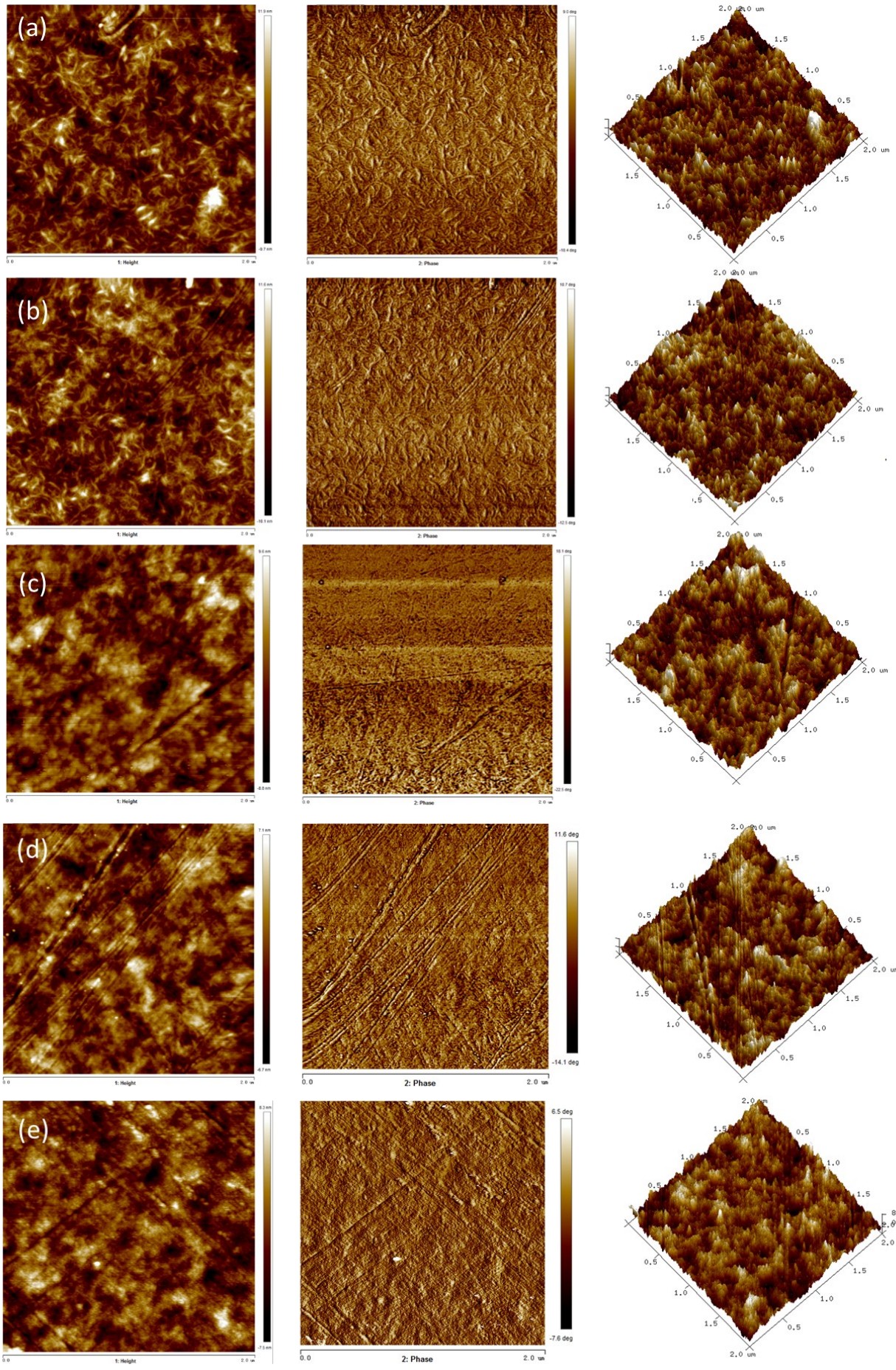


Figure S10.


(a)
1: Height
2: Phase
2.0 um
(b)
1: Height
2: Phase
2.0 um
(c)
1: Height
2: Phase
2.0 um
(d)
1: Height
11.6 deg
-14.1 deg
0.0
2: Phase
2.0 um
2.0 um
(e)
1: Height
6.5 deg
-7.6 deg
0.0
2: Phase
2.0 um
2.0 um

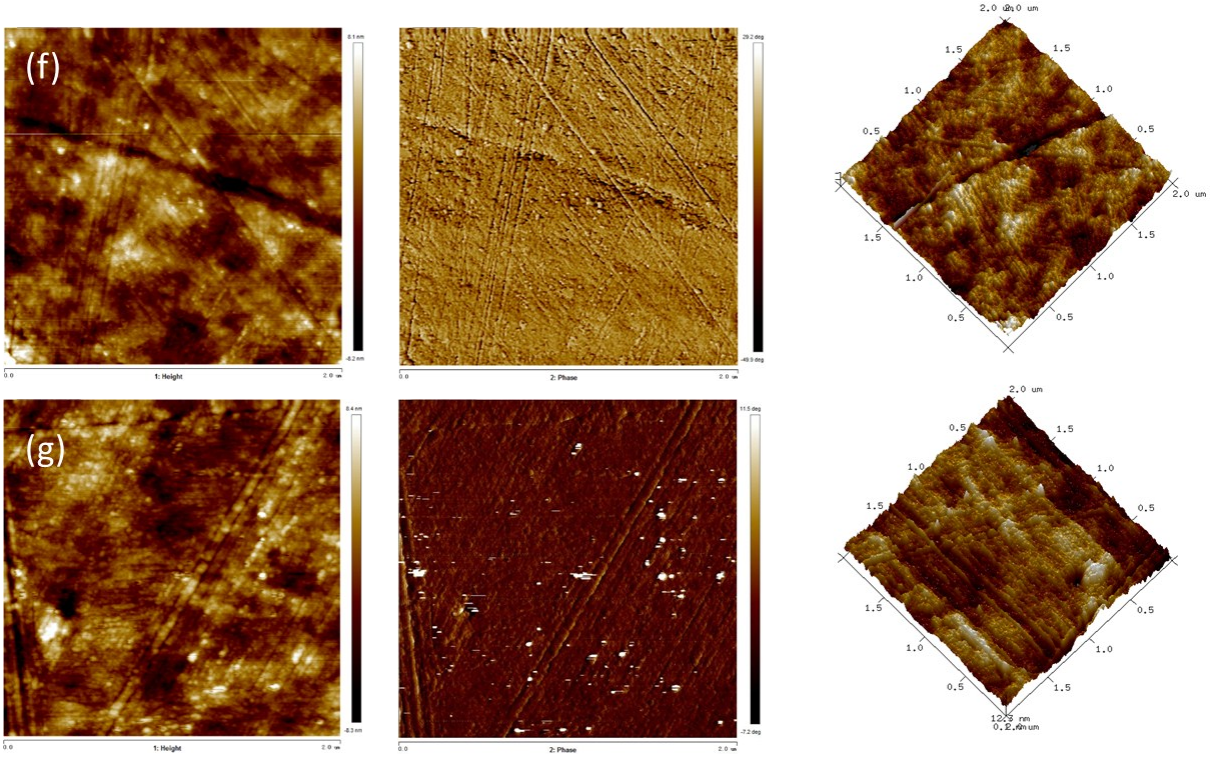


Figure S11.

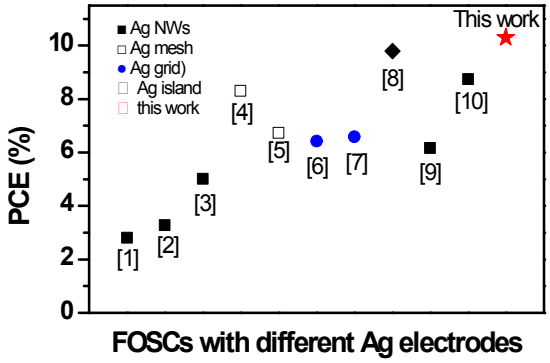

Ag NWs
Ag mesh
Ag grid)
Ag island
this work
This work
PCE (%)
0
2
4
6
8
10
[1]
[2]
[3]
[4]
[5]
[6]
[7]
[8]
[9]
[10]
FOSCs with different Ag electrodes

Figure S12.

Table S1. Comparisons of PCE values of FOSCs with Ag electrodes.

Structure of Ag	Active Layer	Best PCE (%)	Refer.
Ag NWs	PBnDT-DTffBT: $PC_{71}BM$	2.8	1
Ag NWs	P3HT:$PC_{71}BM$	3.28	2
Ag NWs	PTB7-F20:$PC_{71}BM$	5.02	3
Ag Mesh	PTzNTz:$PC_{71}BM$	8.3	4
Ag Mesh	PTB7:$PC_{71}BM$	6.73	5
Ag grid	PTB7-Th: $PC_{71}BM$	6.43	6
Ag grid	PTB7-Th: $PC_{71}BM$	6.58	7
Ag island	PTB7-Th: $PC_{71}BM$	9.8	8
Ag NWs	PTB7:$PC_{71}BM$	6.17	9
Ag NWs with CIP	PTB7-Th:$PC_{71}BM$	8.75	10
Ag NWs	PM6:IT-4F	10.30	Our work

Table S2. Photovoltaic Performance of the OSCs based on Ag NWs film with 60 Ω sq^{-1}.

additives	V_{oc} [V]	J_{sc} [mA/cm^2]	FF [%]	PCE (ave.) [%]
none	0.764	16.67	27.16	3.46 (3.36)
only 6% EG	0.777	18.63	37.76	5.47 (5.36)
only 1% Zonyl	0.767	16.84	42.28	5.46 (5.27)

Supplemental References

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