Highly efficient organic solar cells enabled by ultraviolet-ozone treated molybdenum oxide hole transport layers.

Affiliations

Apostolos Panagiotopoulos[a], George Kakavelakis[b], Kyriakos Almpanidis[a], Leslie Askew[b], Dimitar Kutsarov[a], S. Ravi P. Silva[a]

[a] Advanced Technology Institute, School of Computer Science and Electronic Engineering, University of Surrey, Guildford, Surrey GU2 7XH, UK.

[b] Department of Electronic Engineering, School of Engineering, Hellenic Mediterranean University, Romanou 3, Chalepa, GR-73100, Chania, Crete, Greece.

Corresponding Authors

*Email:

Keywords: Organic solar cells, transition metal oxides, UV-Ozone treatment, efficiency enhancement, light soaking stability

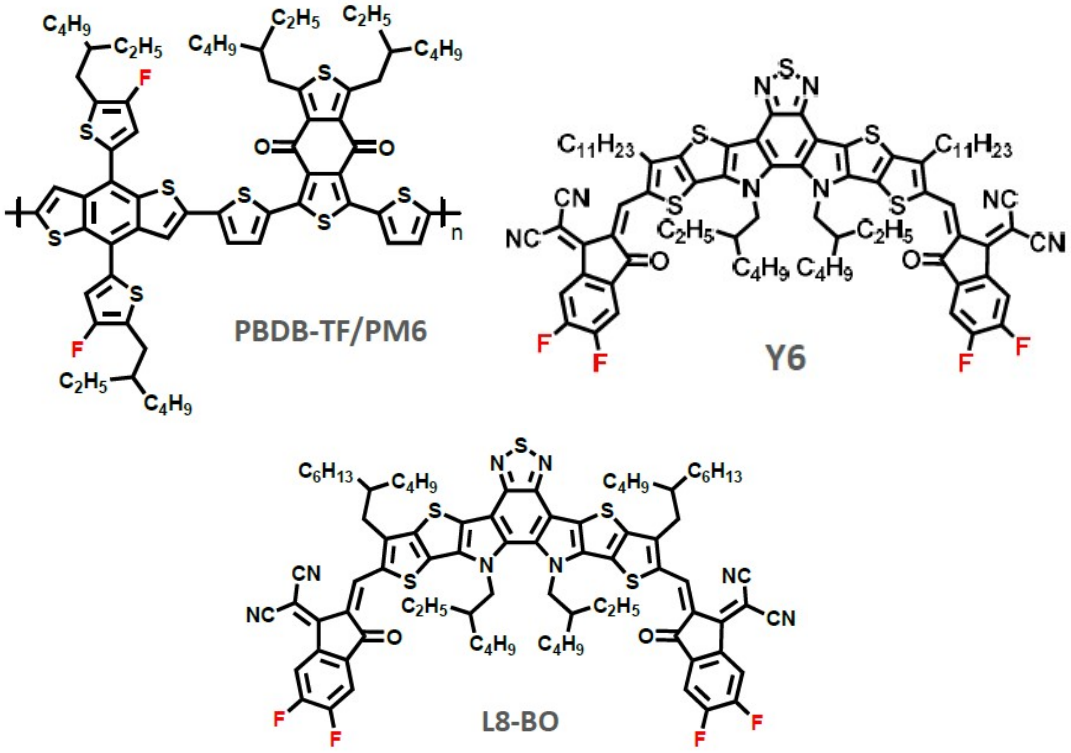


Figure S1. Molecular structures of (a) PM6, (b) Y6 and (d) L8-BO[1].

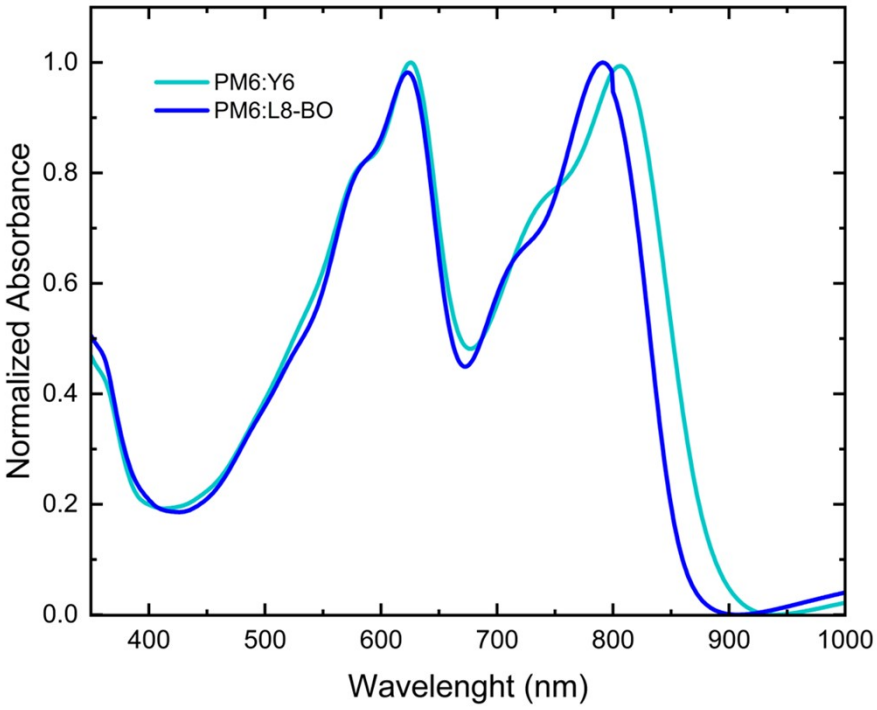


Figure S2. Normalized absorbance spectra of BHJ PM6:Y6 and PM6:L8-BO.

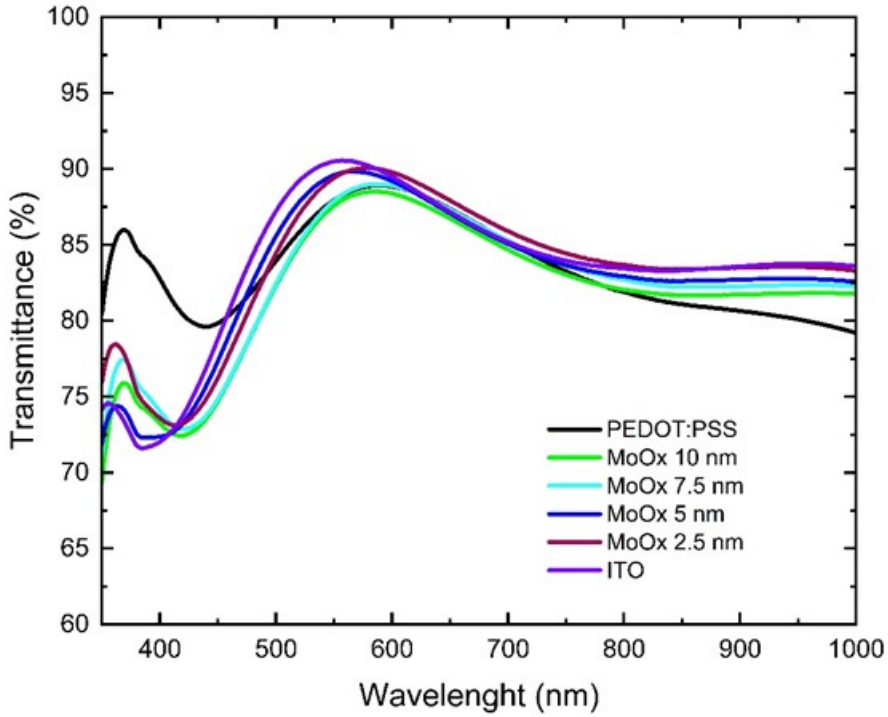


Figure S3. Transmittance spectra of various thickness of evaporated MoOx films.

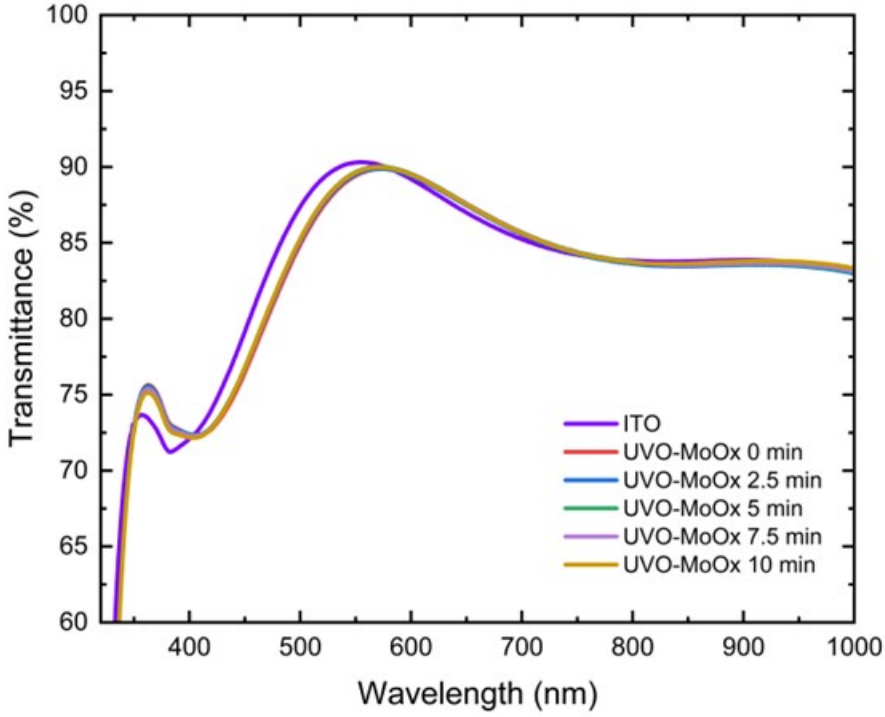
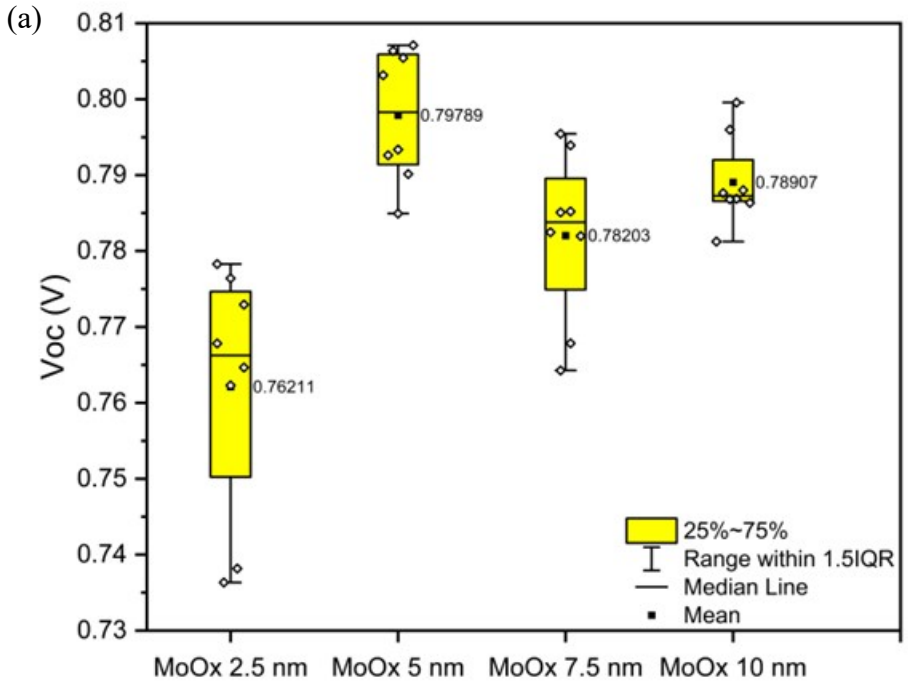
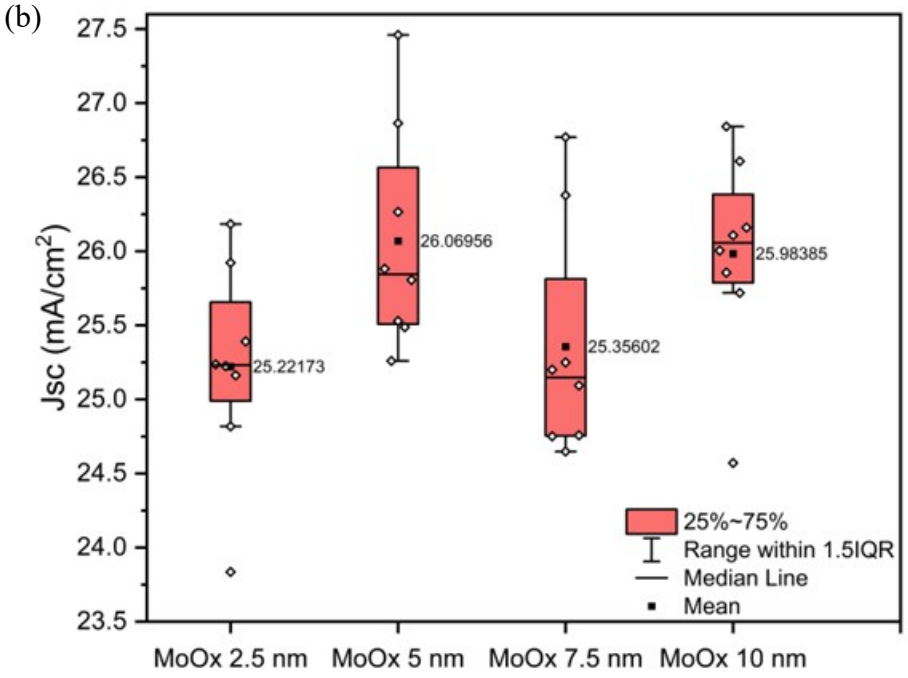


Figure S4. UV-Ozone exposure time versus transmittance of evaporated 5 nm-thick MoOx films.





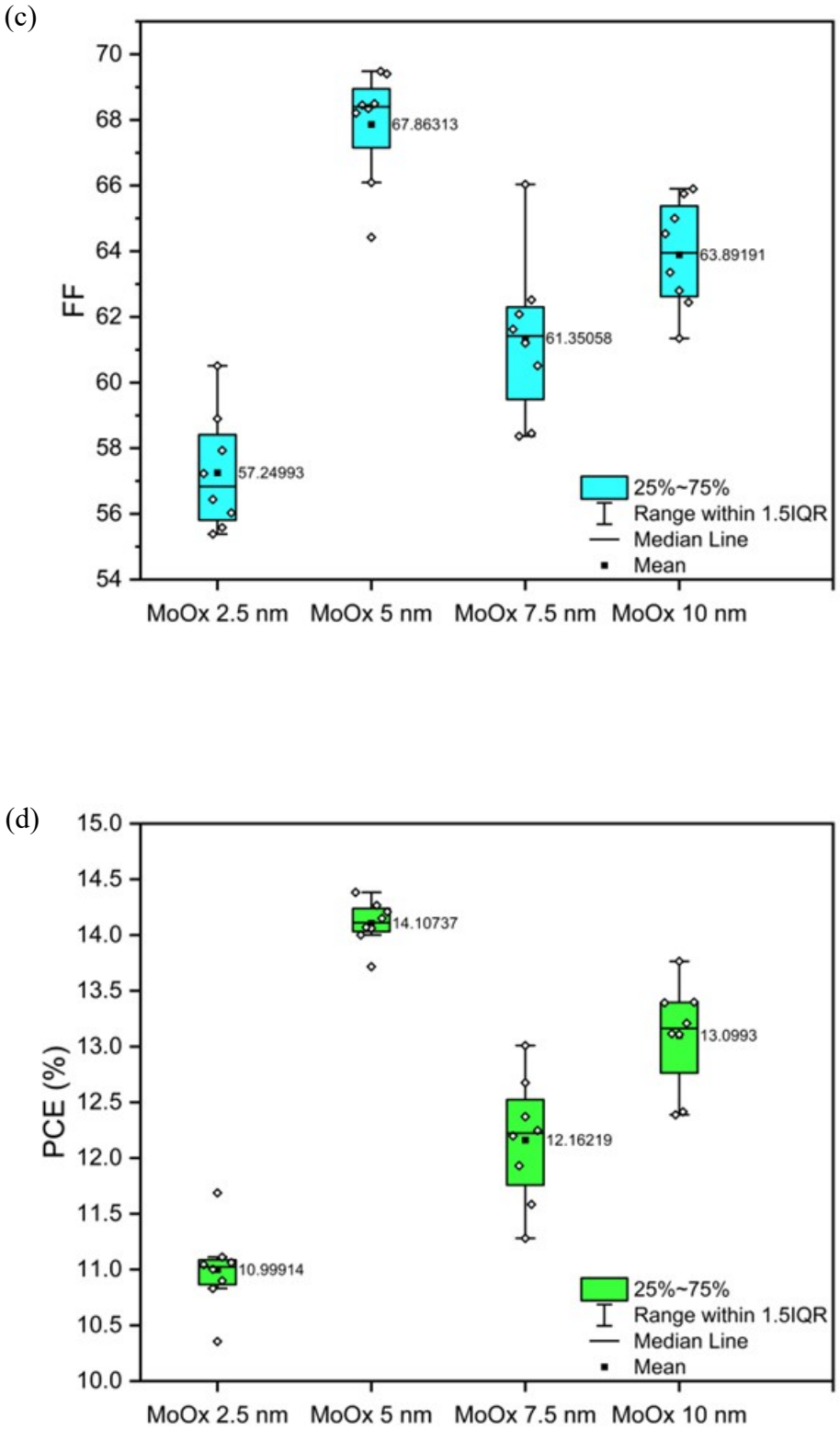
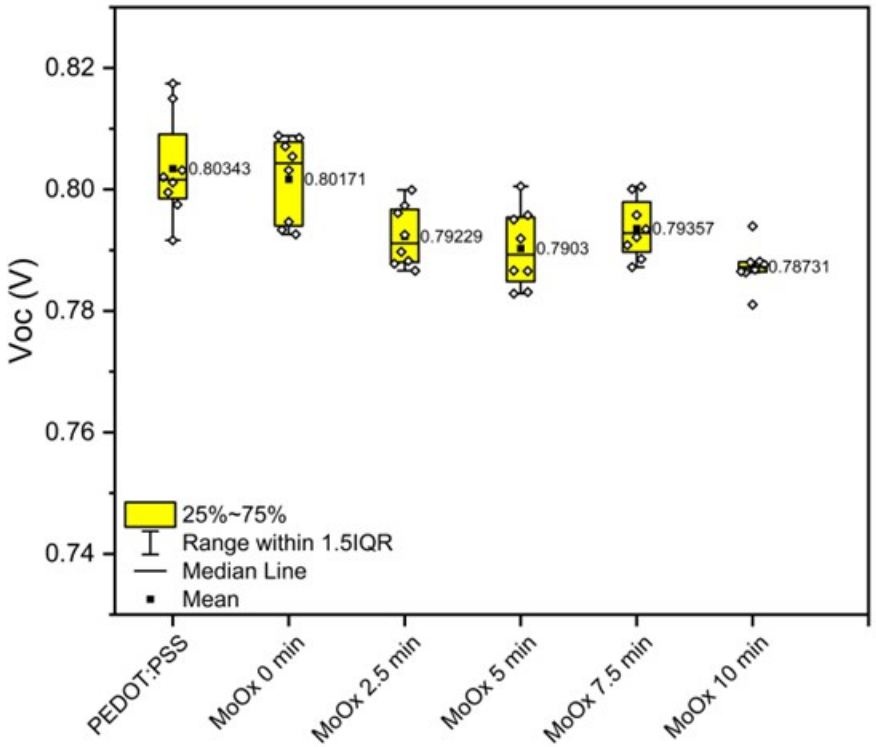
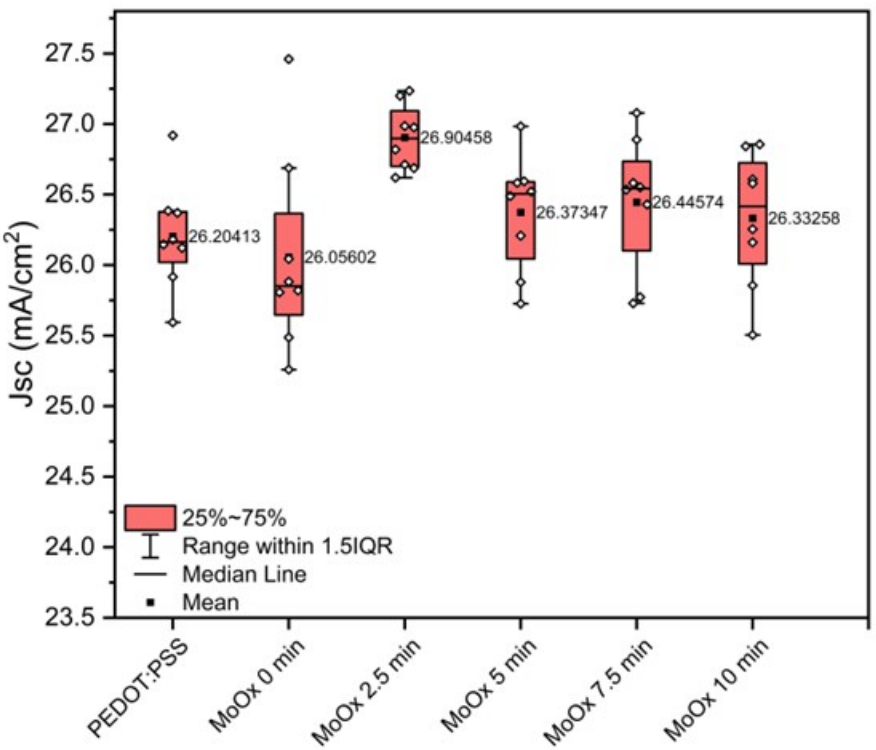


Figure S5.Evaporated MoOx layer thickness optimization statistical analysis on PM6:Y6 BHJ system (a) V_{OC}, (b) J_{SC}, (c) FF and (d) PCE from 8 individuals OSCs.

(a)


Voc (V)
0.82
0.80
0.78
0.76
0.74
0.80343
0.80171
0.79229
0.7903
0.79357
0.78731
25%~75%
Range within 1.5IQR
Median Line
Mean
PEDOT:PSS
MoOx 0 min
MoOx 2.5 min
MoOx 5 min
MoOx 7.5 min
MoOx 10 min

(b)


Jsc (mA/cm^2)
27.5
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
26.20413
26.05602
26.90458
26.37347
26.44574
26.33258
25%~75%
Range within 1.5IQR
Median Line
Mean
PEDOT:PSS
MoOx 0 min
MoOx 2.5 min
MoOx 5 min
MoOx 7.5 min
MoOx 10 min

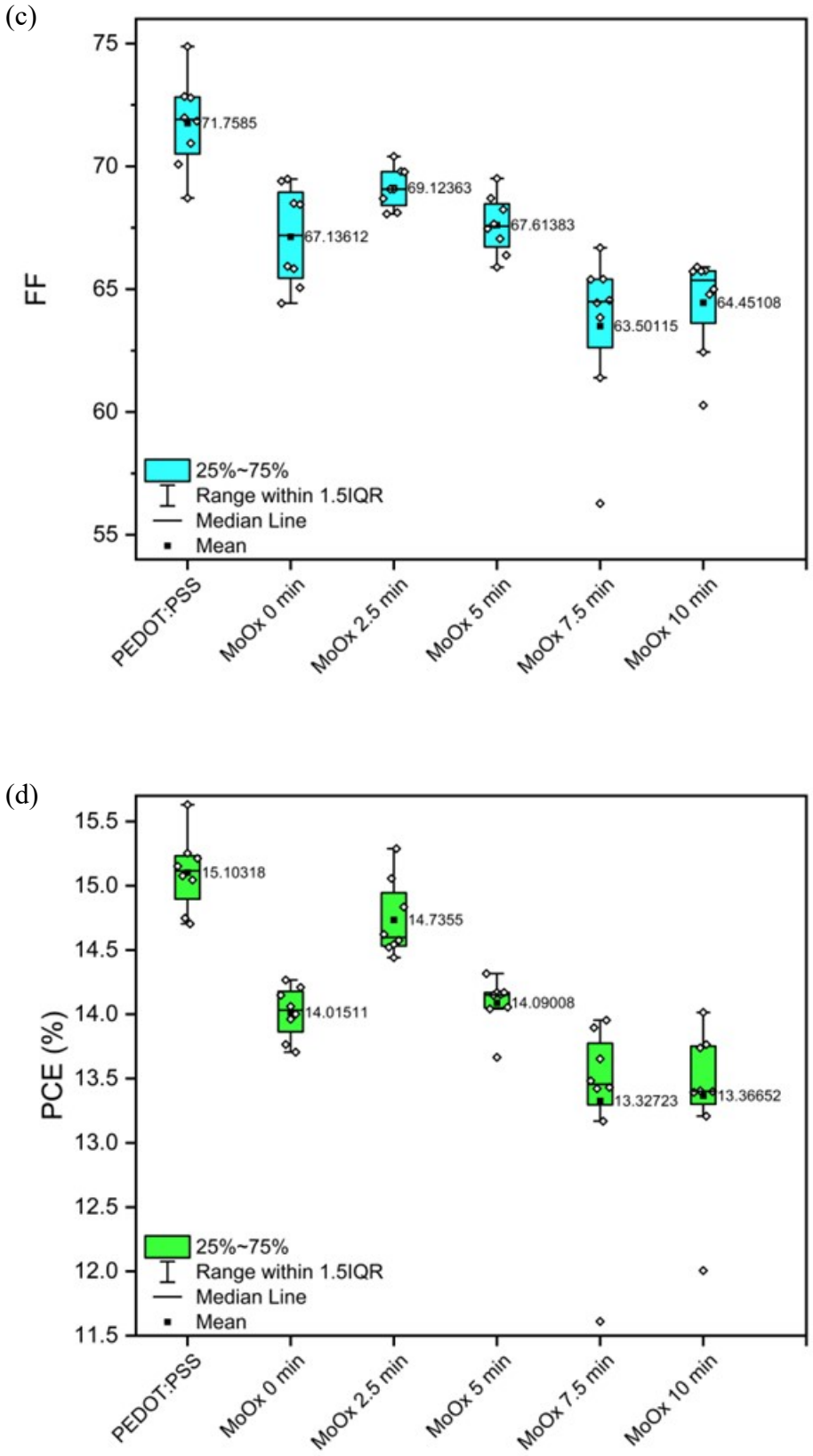
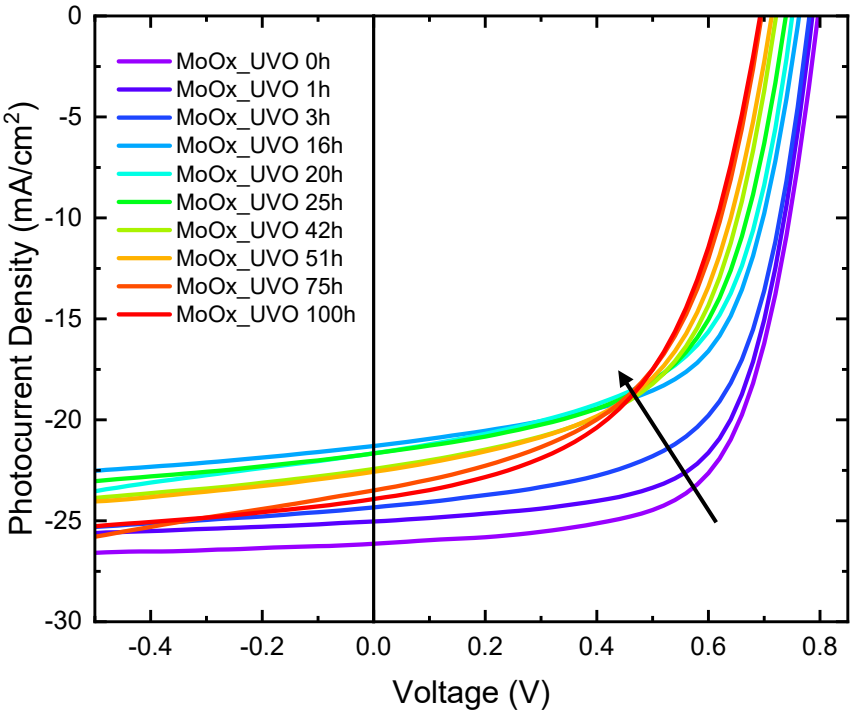
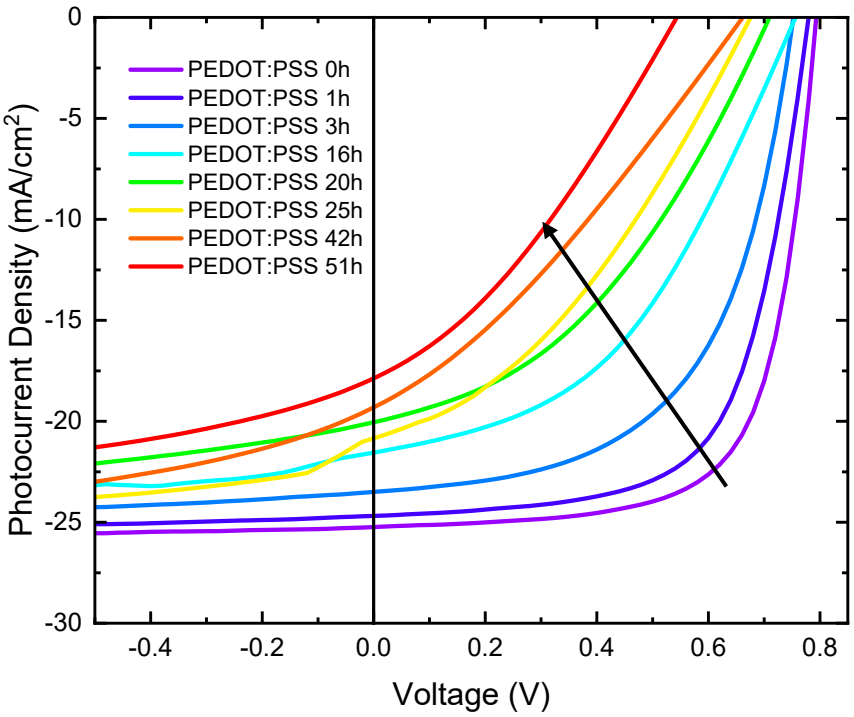


Figure S6. UV-Ozone exposure time optimization (5nm MoOx) statistical analysis on PM6:Y6 BHJ system (a) V_{OC}, (b) J_{SC}, (c) FF and (d) PCE from 8 individuals OSCs.

(a)


MoOx_UVO 0h
MoOx_UVO 1h
MoOx_UVO 3h
MoOx_UVO 16h
MoOx_UVO 20h
MoOx_UVO 25h
MoOx_UVO 42h
MoOx_UVO 51h
MoOx_UVO 75h
MoOx_UVO 100h
Photocurrent Density (mA/cm2)
Voltage (V)
0
-5
-10
-15
-20
-25
-30
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8

(b)


PEDOT:PSS 0h
PEDOT:PSS 1h
PEDOT:PSS 3h
PEDOT:PSS 16h
PEDOT:PSS 20h
PEDOT:PSS 25h
PEDOT:PSS 42h
PEDOT:PSS 51h
Photocurrent Density (mA/cm2)
Voltage (V)
0
-5
-10
-15
-20
-25
-30
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8

(c)

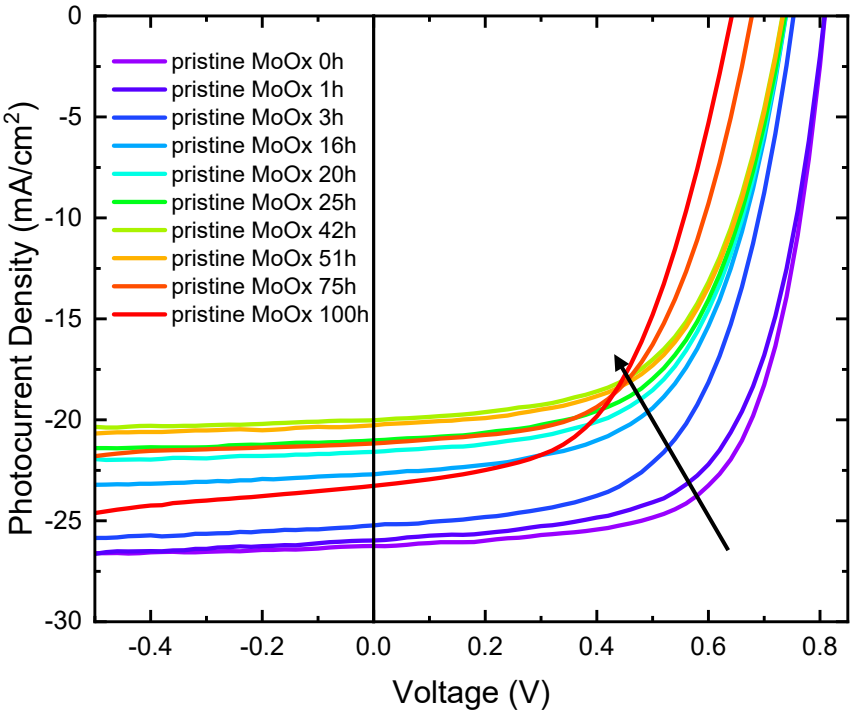
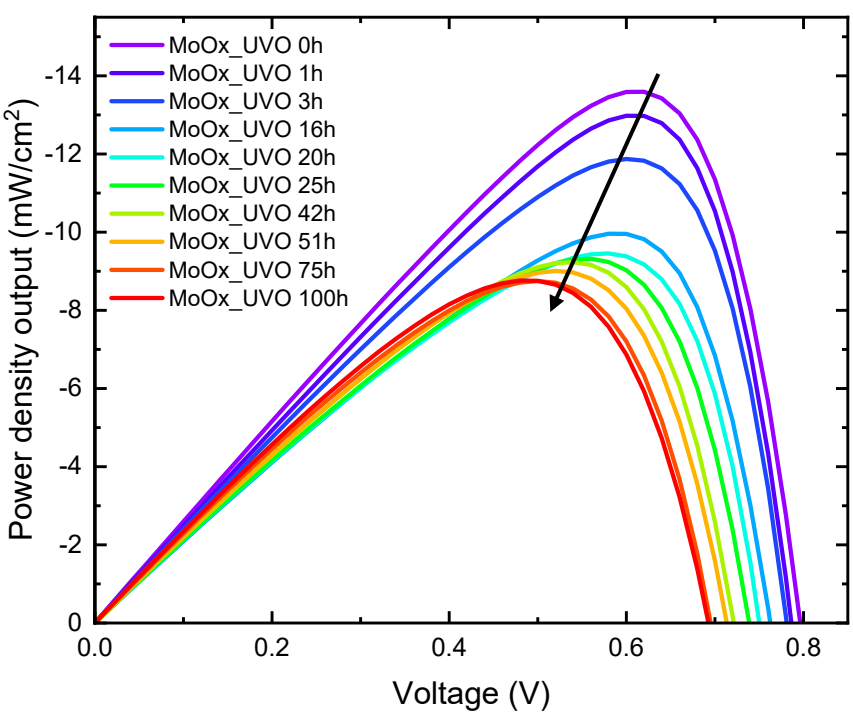


Figure S7. Time depended J-V curves (a) UV-Ozone-treated MoOx-based cells, (b) PEDOT:PSS-based cells and (c) pristine MoOx-based cells.

(a)



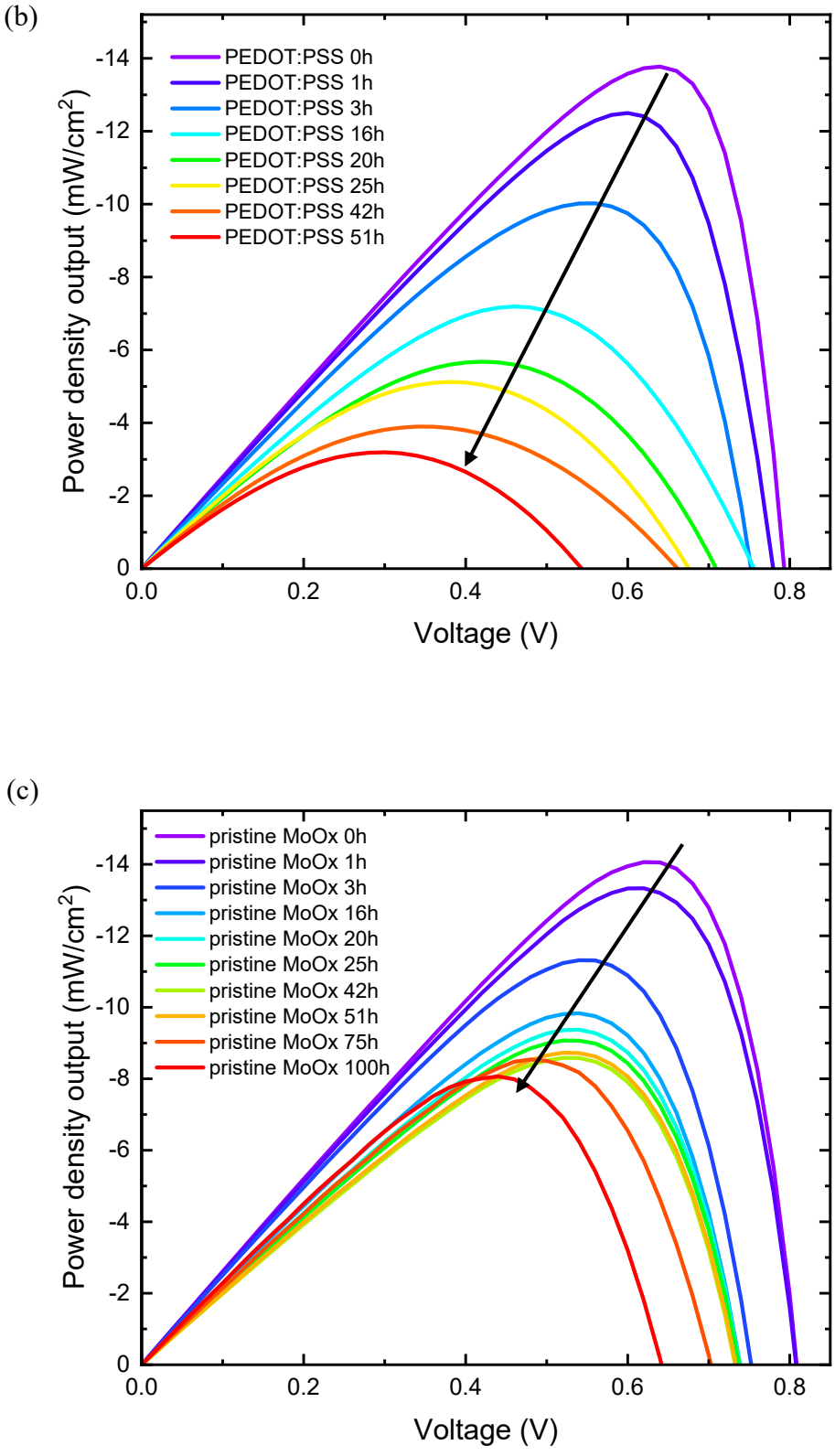
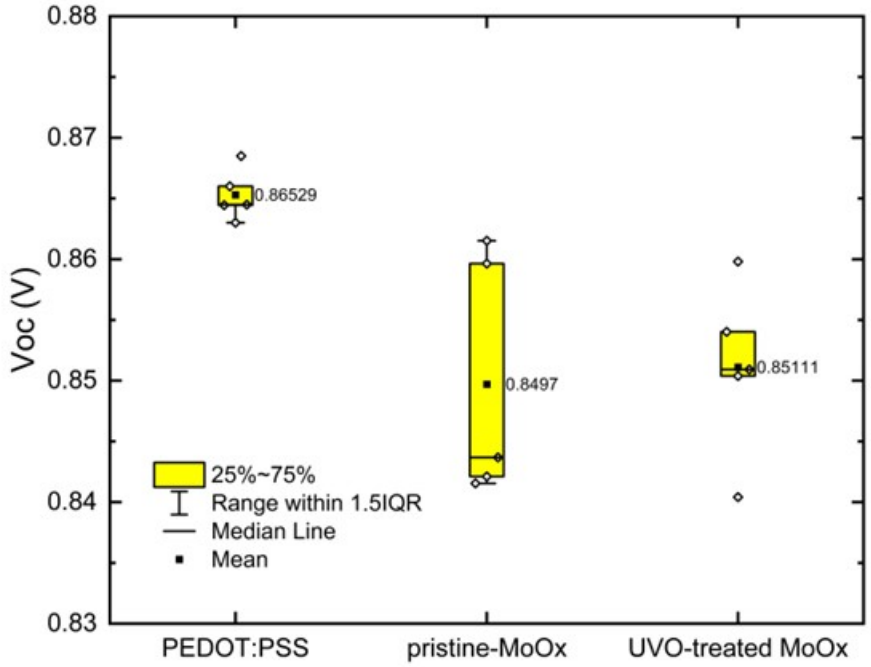
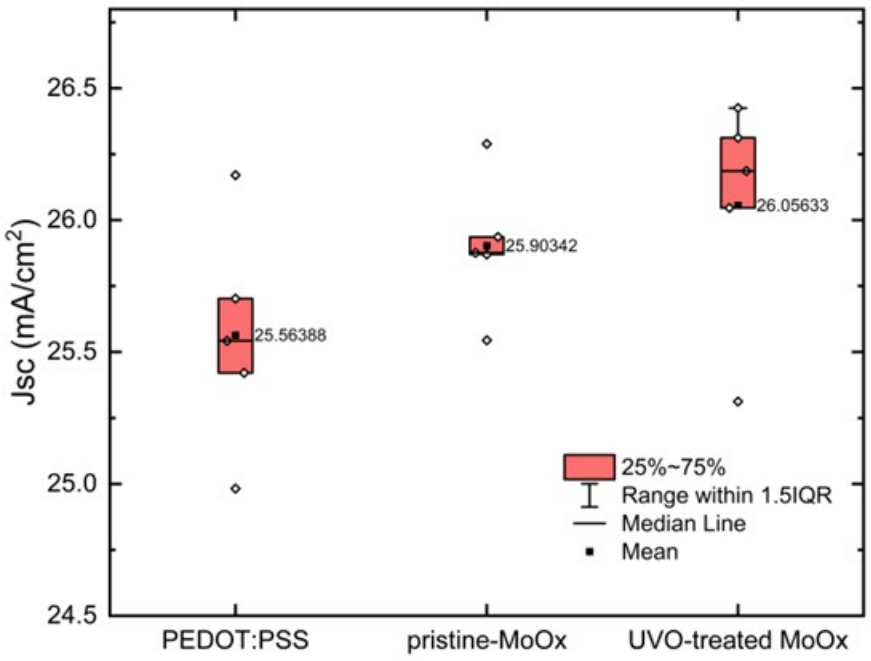


Figure S8. Time depended Power Output-Voltage curves (a) UV-Ozone-treated MoOx-based cells, (b) PEDOT:PSS-based cells and (c) pristine MoOx-based cells.

(a)


0.88
0.87
0.86
0.85
0.84
0.83
Voc (V)
0.86529
0.8497
0.85111
25%~75%
Range within 1.5IQR
Median Line
Mean
PEDOT:PSS
pristine-MoOx
UVO-treated MoOx

(b)


26.5
26.0
25.5
25.0
24.5
Jsc (mA/cm^2)
25.56388
25.90342
26.05633
25%~75%
Range within 1.5IQR
Median Line
Mean
PEDOT:PSS
pristine-MoOx
UVO-treated MoOx

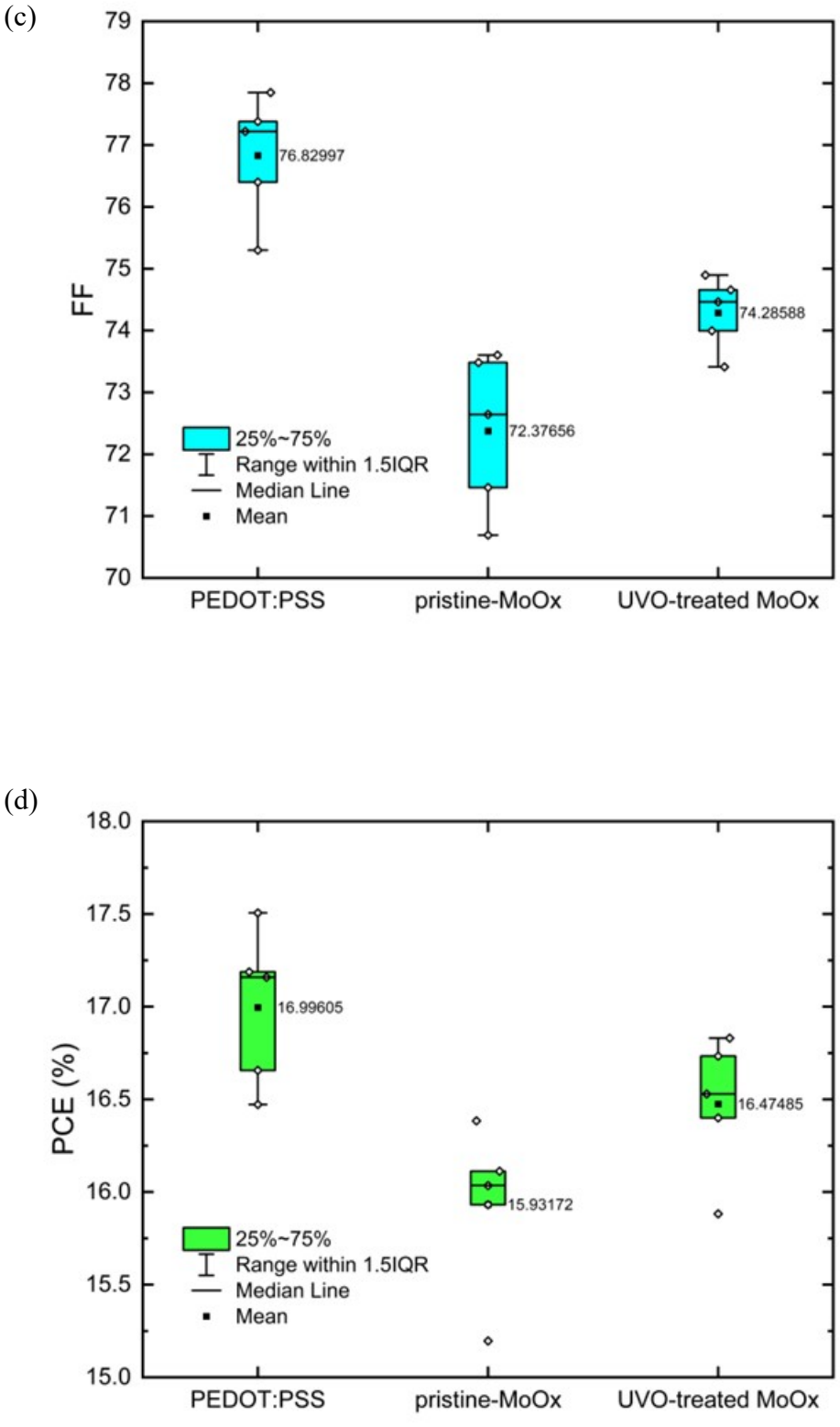
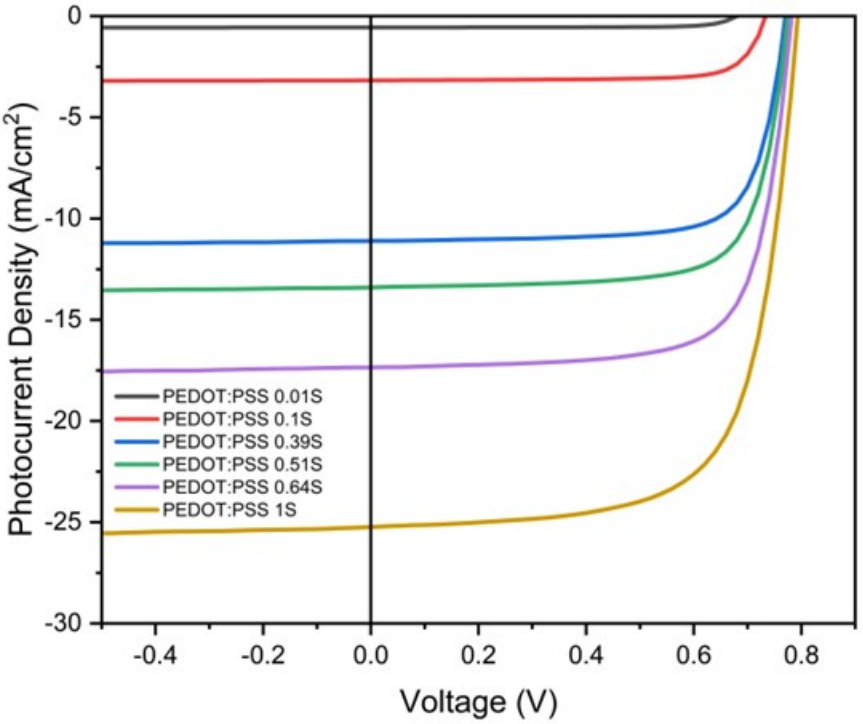


Figure S9. Statistical analysis (a) V_{OC}, (b) J_{SC}, (c) FF and (d) PCE from 5 individuals OSCs incorporating PM6:L8BO BHJ system with different HTLs.

(a)



(b)

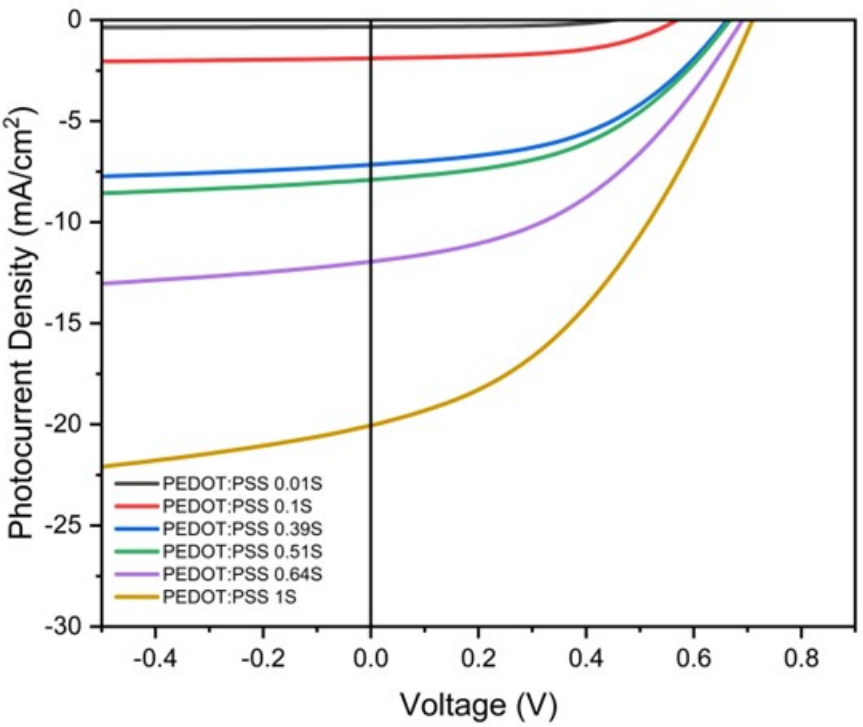
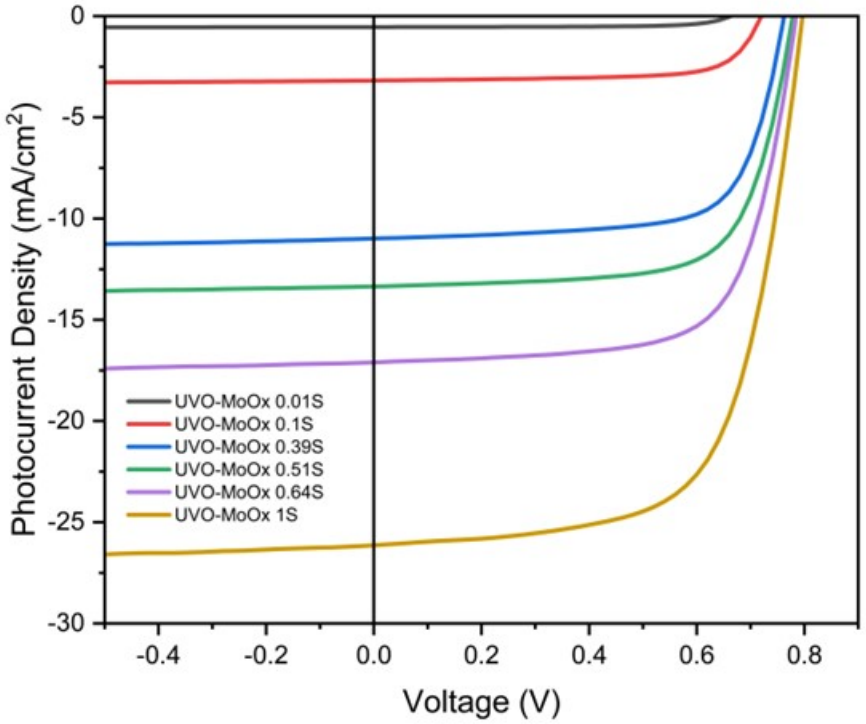


Figure S10. Light depended J-V curves (a) before light soaking test and (b) after light soaking test of PEDOT:PSS-based cells.

(a)



(b)

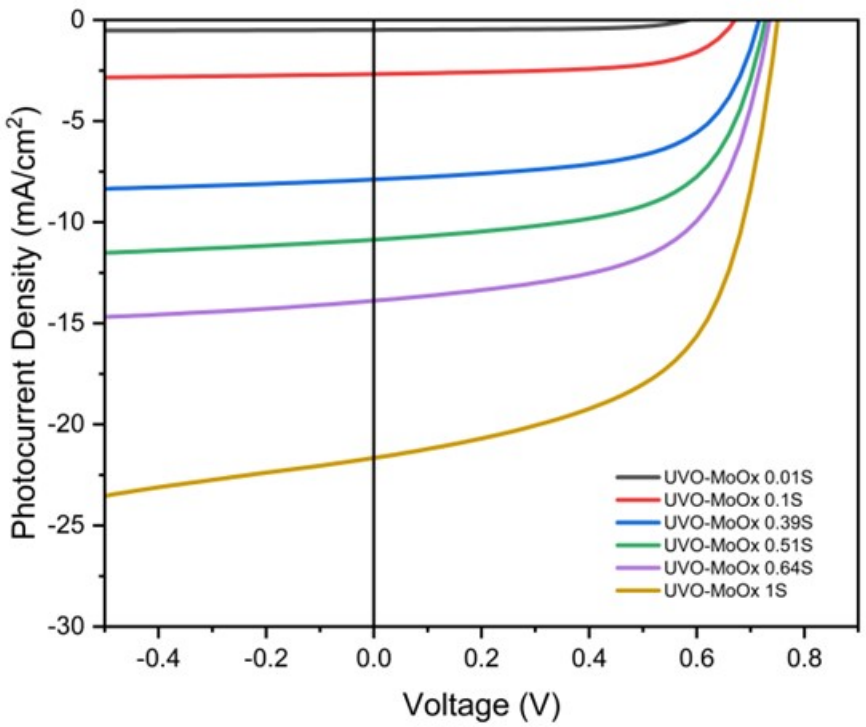


Figure S11. Light depended J-V curves (a) before light soaking test and (b) after light soaking test of UVO-treated MoOx-based cells.

Reference

(1) Solarmer. Solarmer Catalog 2022 v1.1 p-Type n-Type Organic Materials. 2022.