Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Interface modification of Electron Transport Layer using Europium Acetate for Enhancing the Performance of P3HT-Based Inorganic perovskite Solar Cells

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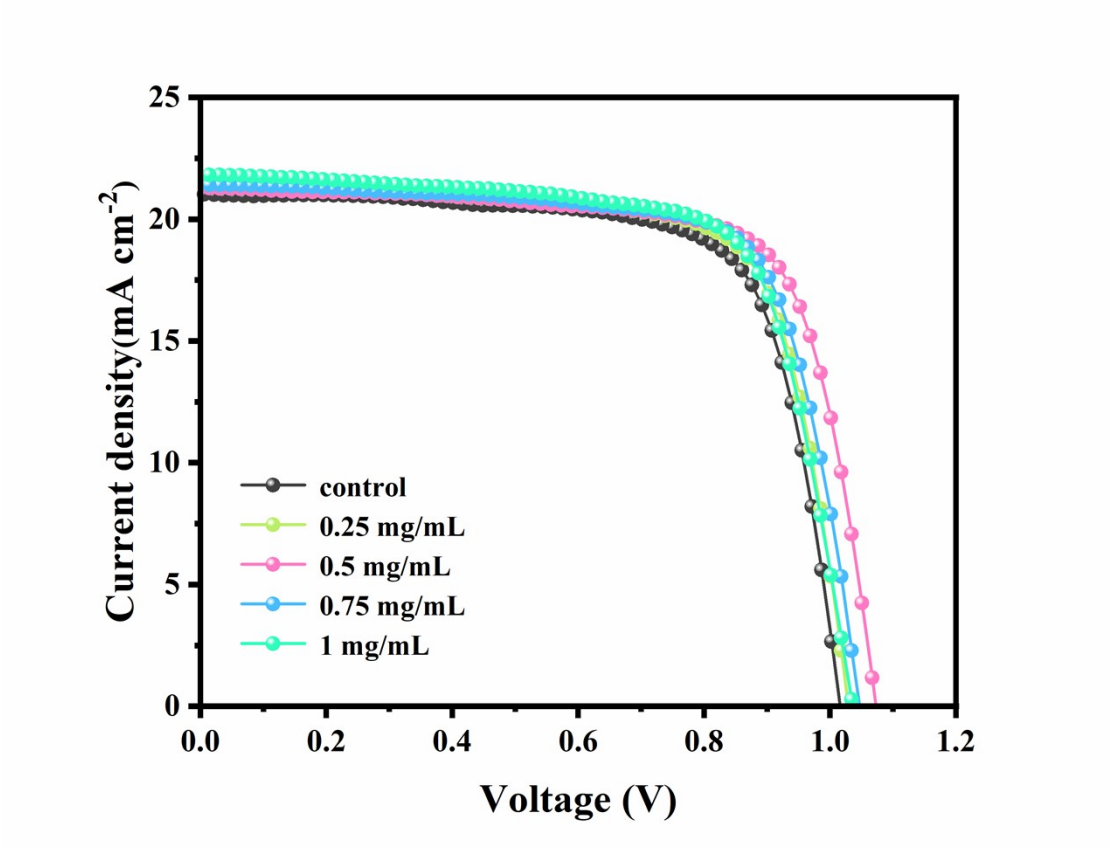

Figure S1. *J-V* curves of $CsPbI_3$ PSCs made with various concentration $EuAc_3$

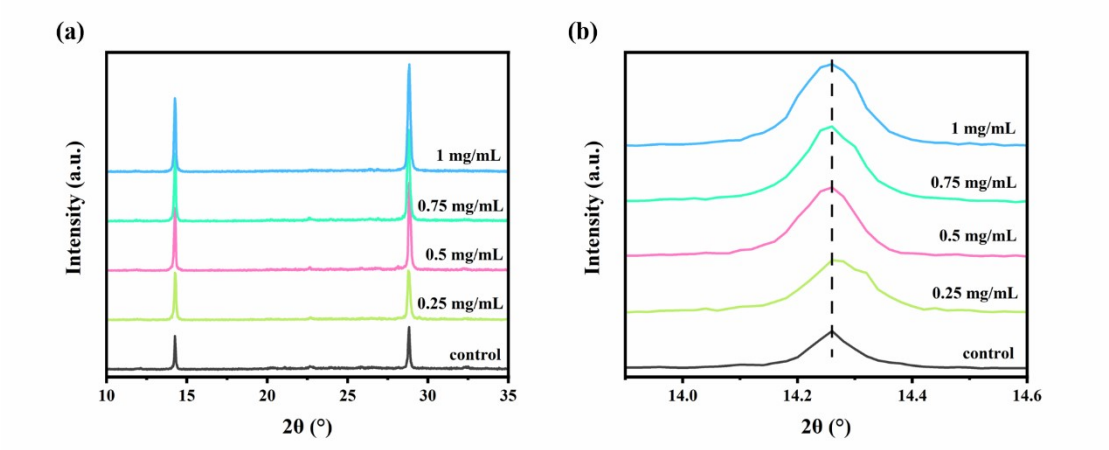

Figure S2. (a) XRD patterns and (b) (110) diffraction peaks of $CsPbI_3$ perovskite films made with $EuAc_3$ of different concentration

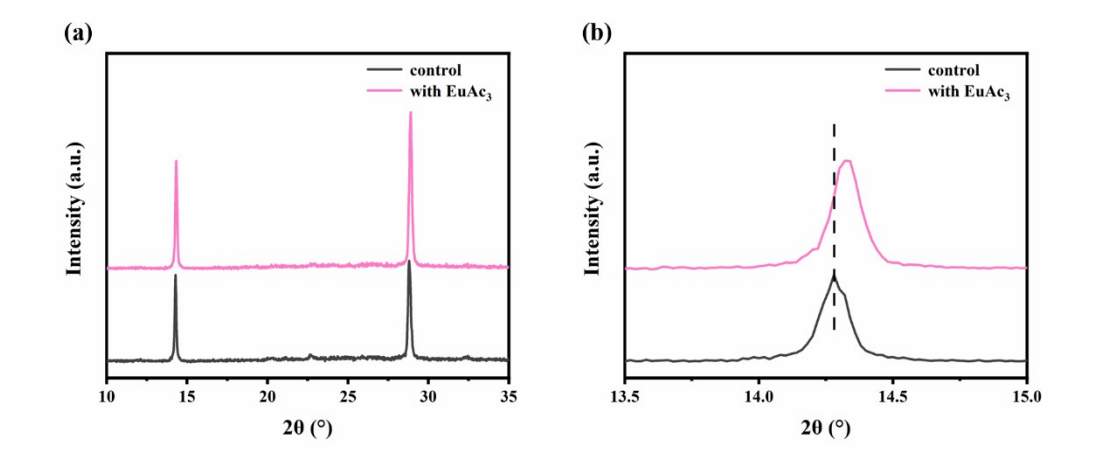

Figure S3. (a) XRD patterns of $CsPbI_3$ perovskite films on different TiO_2 substrate without and with $EuAc_3$ treatment, (b) (110) diffraction peaks of $CsPbI_3$ perovskite films without and with $EuAc_3$

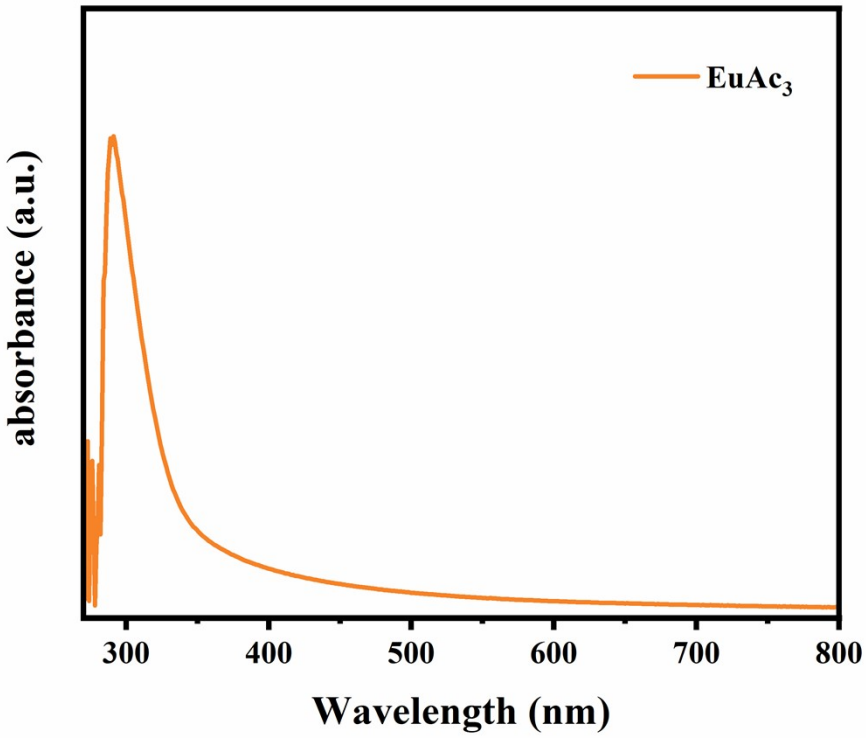

Figure S4. UV-vis absorption spectra of the $EuAc_3$ films

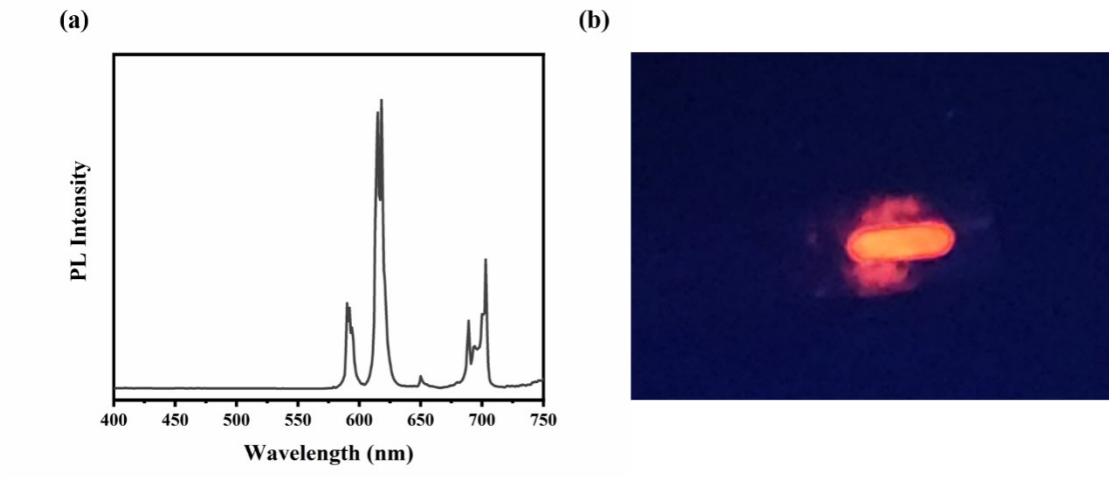

Figure S5 (a) PL spectra of $EuAc_3$ film, (b) Photoluminescence picture of $EuAc_3$ powder under UV light at 365nm

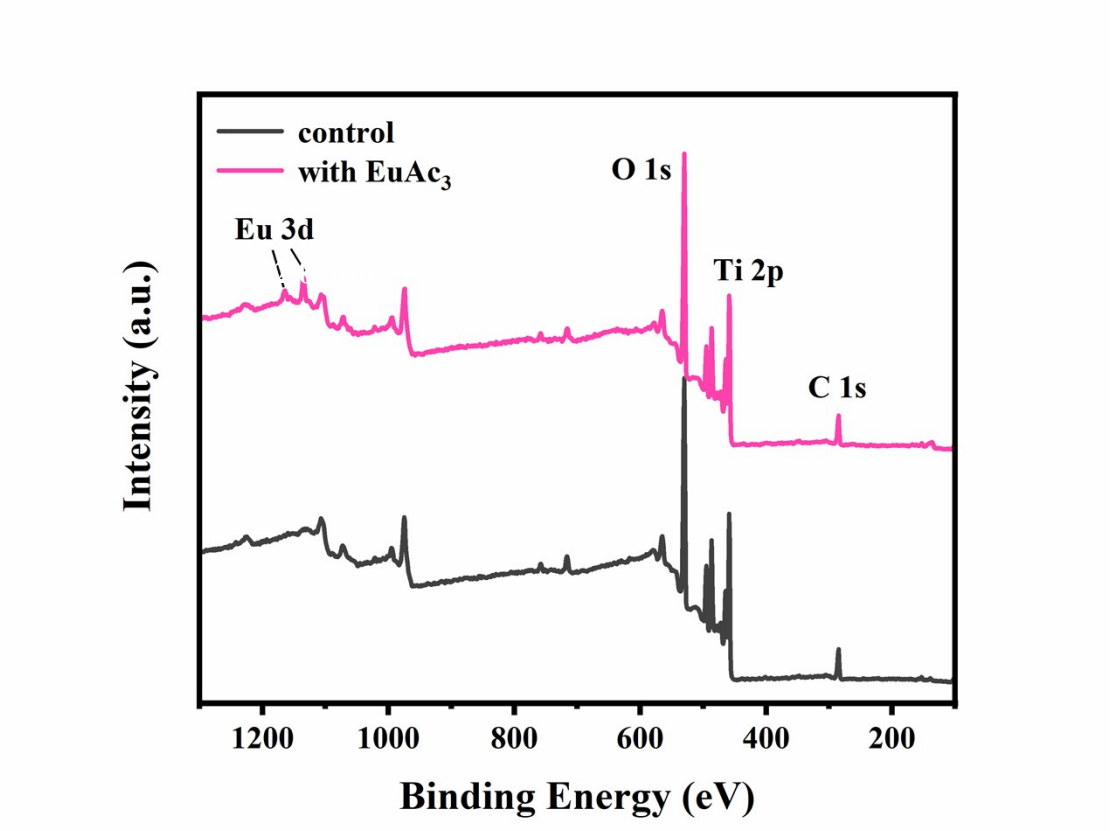

Figure S6. XPS whole spectra of TiO_2 and TiO_2-$EuAc_3$ films.

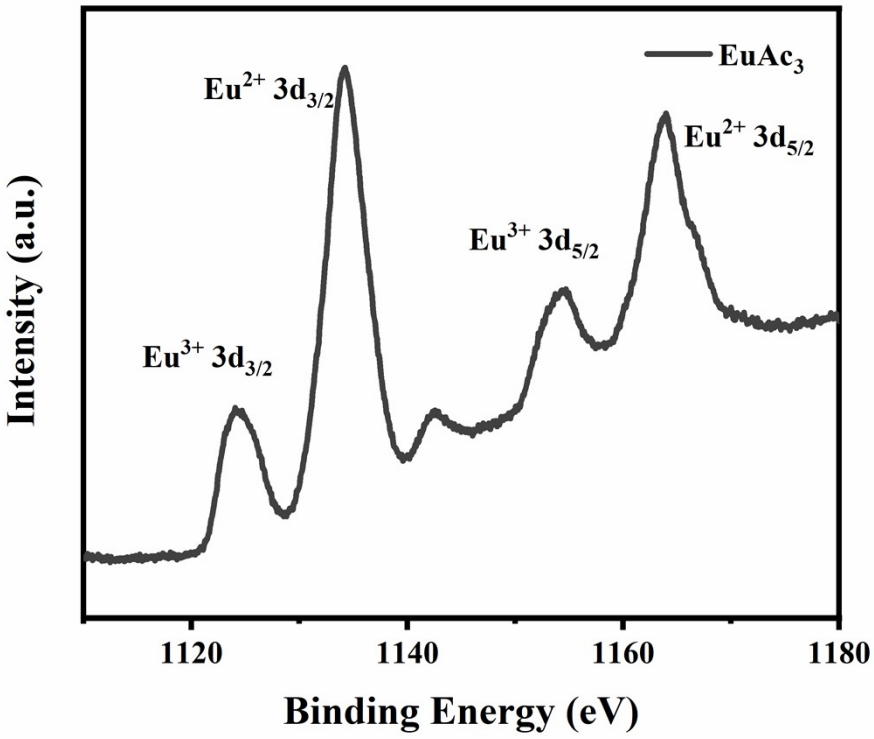

Figure S7. XPS spectra of $EuAc_3$ powder

(a)

Data Grid

Ref	Name	Peak BE	Height CPS	Height Ratio	Area CPS.eV	Area Ratio
C	O1s	529.86	167393.72	1.00	211971.84	1.00
D	O1s Scan A	531.10	34289.03	0.20	89321.73	0.42

(b)

Data Grid

Ref	Name	Peak BE	Height CPS	Height Ratio	Area CPS.eV	Area Ratio
C	O1s	529.46	167977.85	1.00	224496.01	1.00
D	O1s Scan A	531.08	30424.45	0.18	63403.76	0.28

Figure S8. XPS data of different TiO_2 (a) without $EuAc_3$; (b) with $EuAc_3$

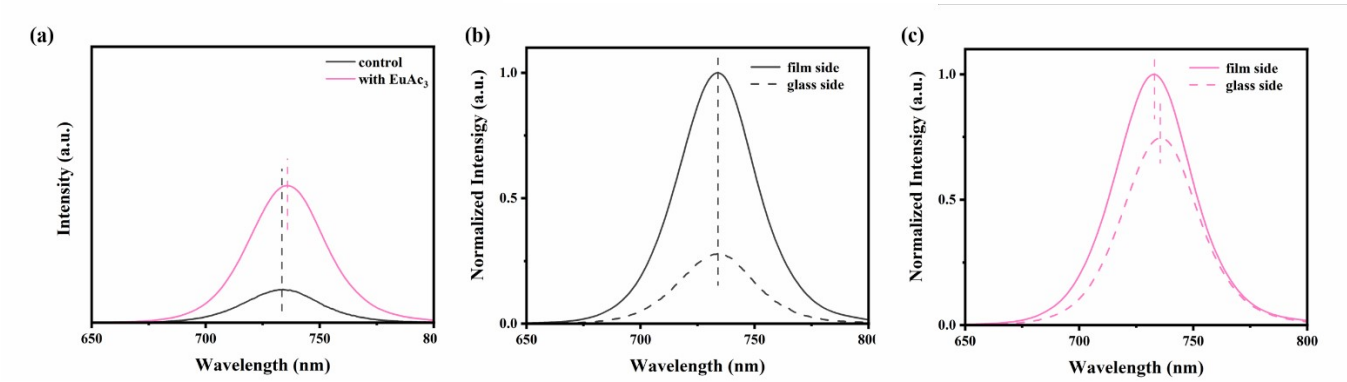

Figure S9. (a) PL spectra of the $CsPbI_3$ perovskite without and with $EuAc_3$, in which the $CsPbI_3$ film was excited from glass side. Normalized PL spectra of (b) control and (c) $EuAc_3$ modified $CsPbI_3$ film with different excited direction.

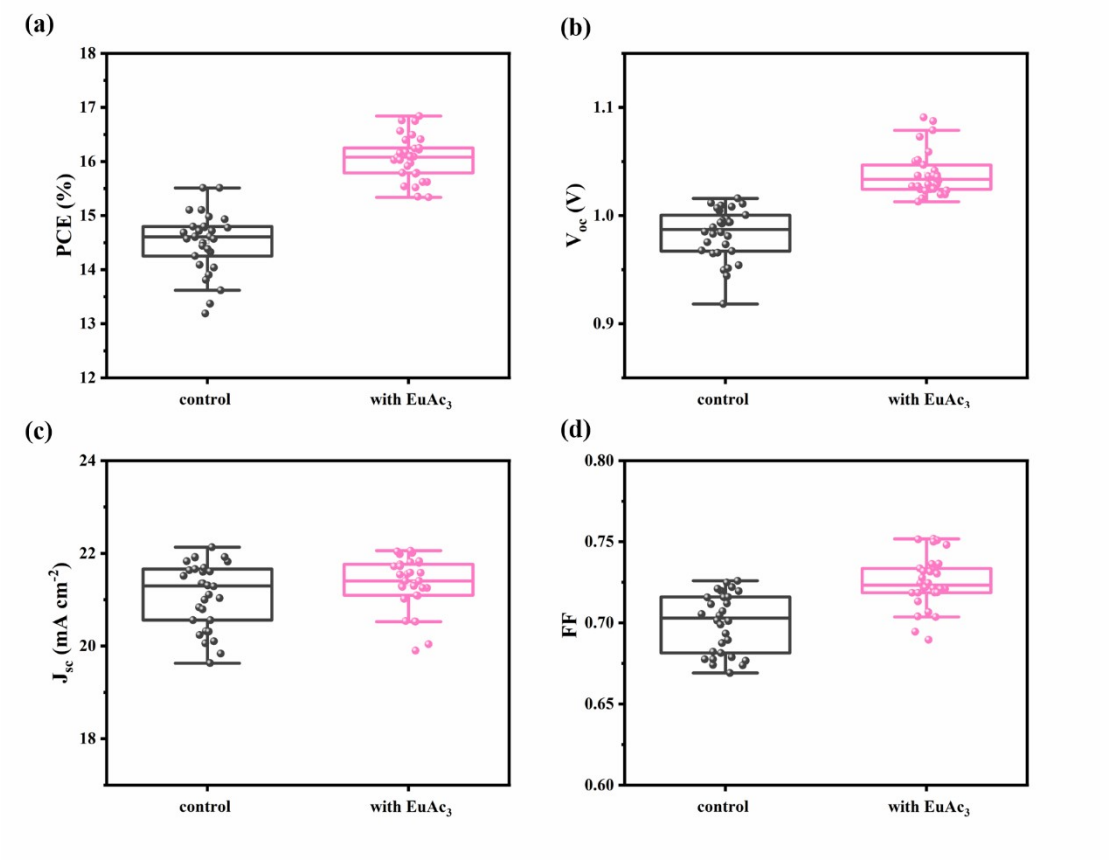

Figure S10. Box charts of (a) *PCE*, (b) *V*oc, (c) *FF* and (d) *J*sc of control and $EuAc_3$ modified PSCs

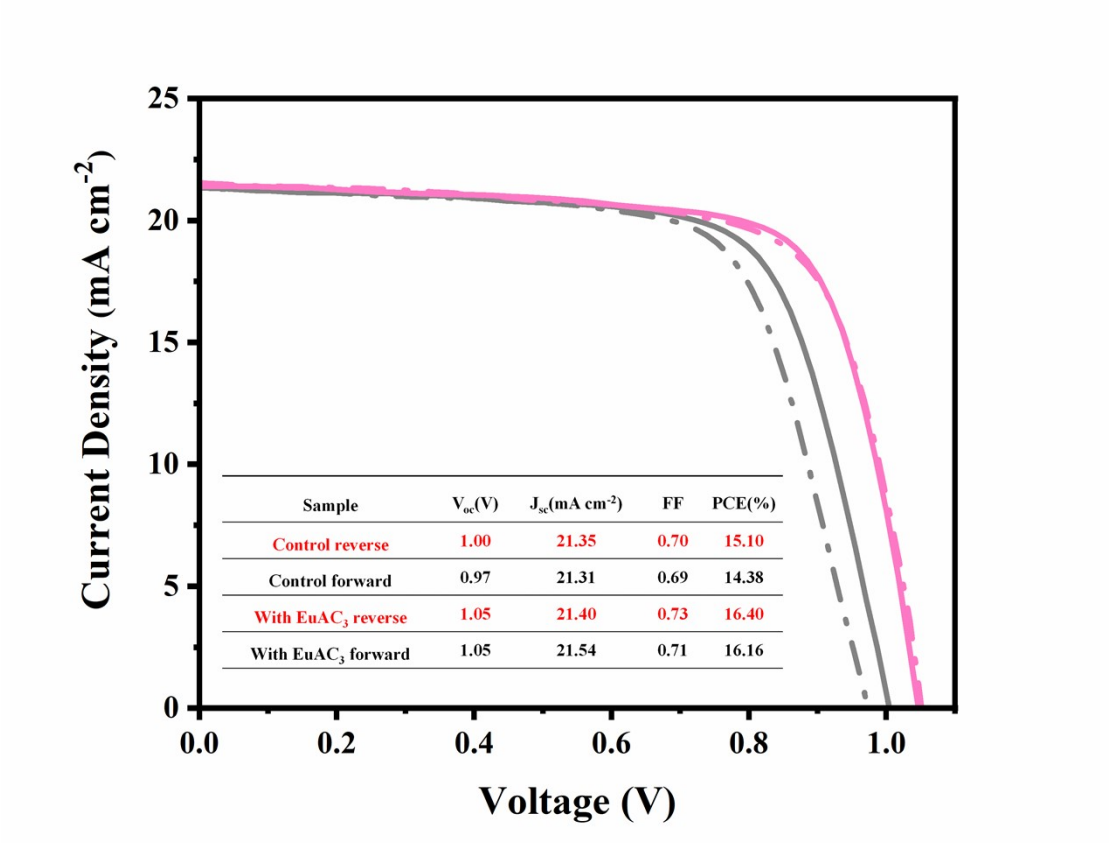

Figure S11. *J-V* curves of control and $EuAc_3$ modified $CsPbI_3$ PSCs under reverse and forward scan.

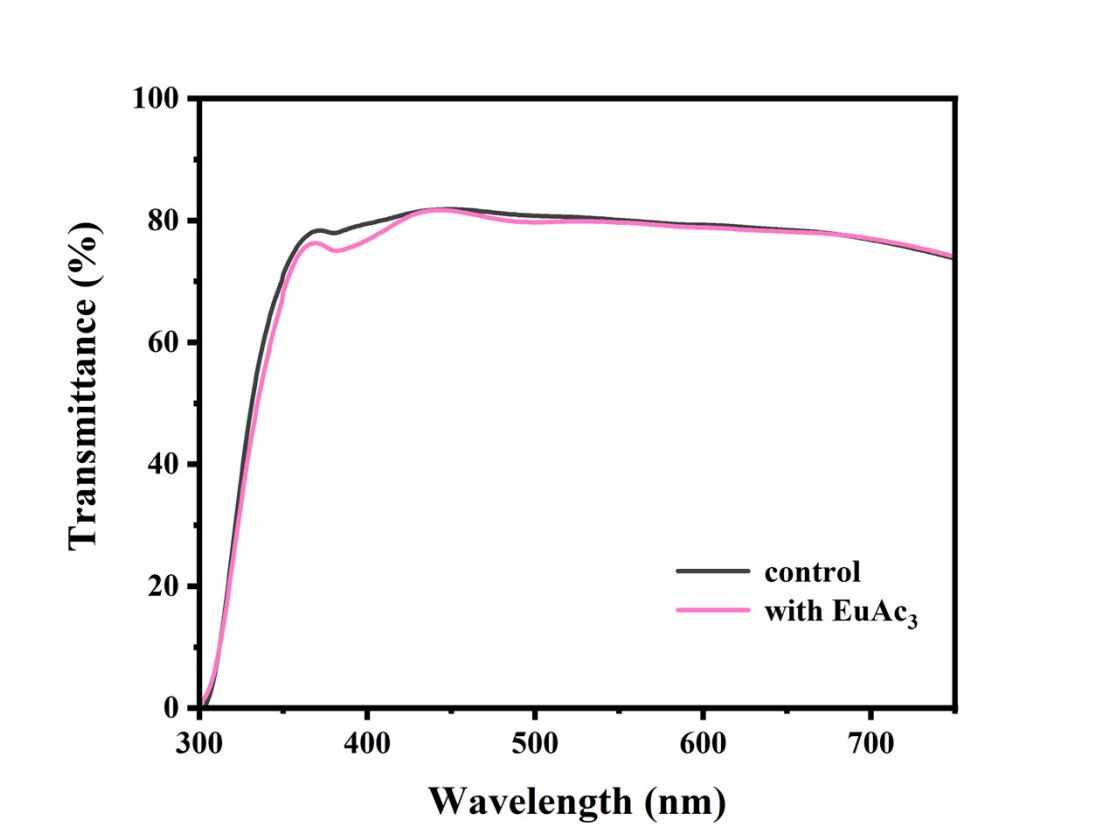

Figure S12. Transmission spectra of different TiO_2 films with and without $EuAc_3$ treatment on FTO substrate.

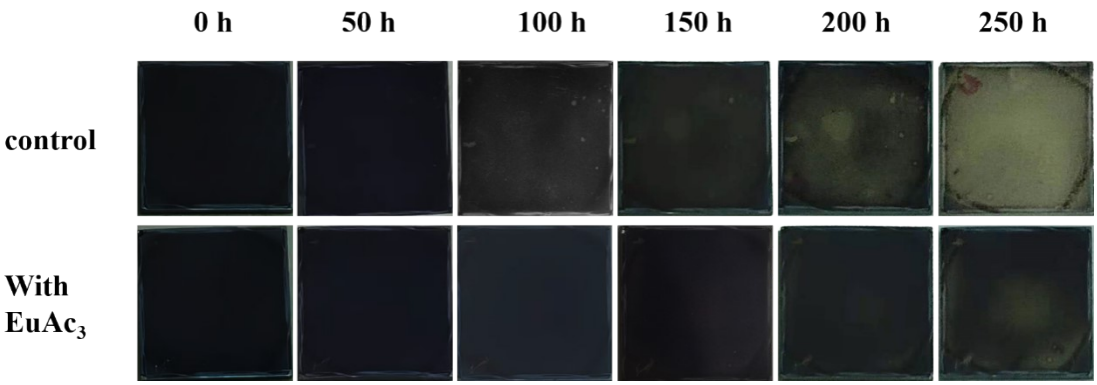

Figure S13. Pictures of UV stability measurement of control and $EuAc_3$ treated $CsPbI_3$ film.

Table S1 parameters of the TRPL spectra of control and $EuAc_3$ passivated perovskite film with different concentration (extracted from Figure 3b)

	A1 (%)	τ1 (ns)	A2 (%)	τ1 (ns)	τavg (ns)
Control	89.54	2.02	10.46	9.45	4.62
With $EuAc_3$	85.43	4.22	14.57	17.13	9.50

Table S2 parameters of the EIS spectra of control and 0.5 mg/ml $EuAc_3$ passivated PSCs

	Rs (Ω)	Rct (MΩ)	Rrec (MΩ)
Control	57.71	0.20	4.44
With $EuAc_3$	59.87	0.18	10.94

Table S3 summary of high performance of the $CsPbI_3$ PSCs based on P3HT HTL

Device structure	Voc (V)	Jsc (mA cm^{-2})	FF	PCE (%)	Ref
FTO/c-TiO_2/m-TiO_2/PVK/P3HT/MoO_3/Au	0.67	11.3	0.67	4.6	[1]
FTO/c-TiO_2/PVK/P3HT/Au	1.06	13.8	0.72	10.5	[2]
FTO/c-TiO_2/PVK/P3HT/Au	0.71	12.1	0.67	5.7	[3]
FTO/c-TiO_2/PVK/P3HT/Ag	0.81	12.1	0.72	6.8	[4]
MgF_2/FTO/c-TiO_2/m-TiO_2/PVK/P3HT/Au	0.95	17.9	0.80	13.5	[5]
FTO/c-TiO_2/PVK/P3HT/Au	1.02	17.4	0.80	14.1	[6]
FTO/c-TiO_2/PVK/P3HT/Au	1.06	12.21	0.61	7.90	[7]
FTO/c-TiO_2/$EuAc_3$/PVK/P3HT/Au	1.10	21.20	0.77	17.92	This work

References

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