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Supporting Information

A Feasible Scalable Porphyrin Dye for Dye-Sensitized Solar Cells under One Sun and Dim Light Environments

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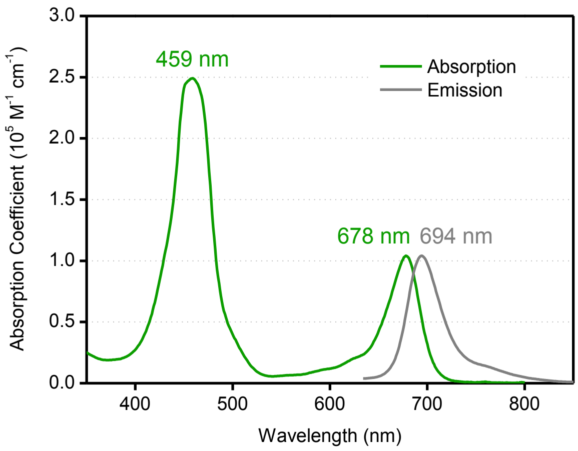


Figure S1. UV-vis absorption and emission spectra of **Y1A1** in THF.

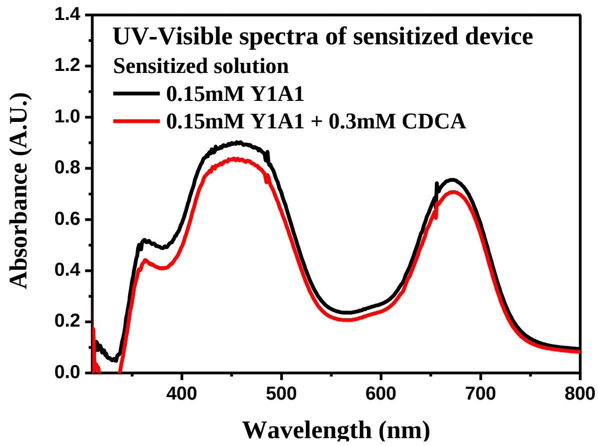


Figure S2. Thin-film absorption spectra of **Y1A1** on TiO_2 with and without the presence of CDCA.

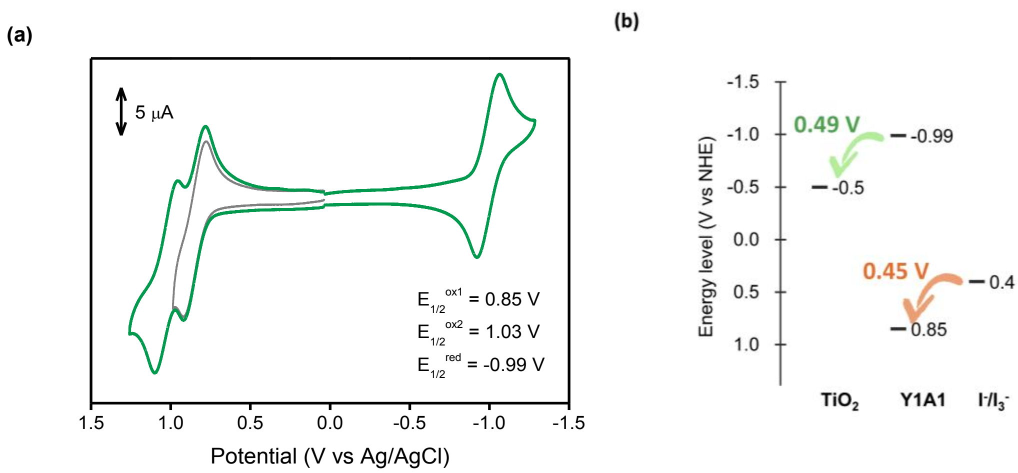


Figure S3. (a) Cyclic voltammegram of **Y1A1** and (b) energy level diagram of **Y1A1**-based DSC.

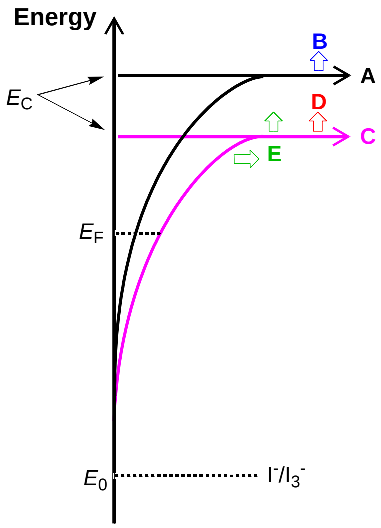


Figure S4. Representation of proposed density of states showing the influence of additives and CDCA.

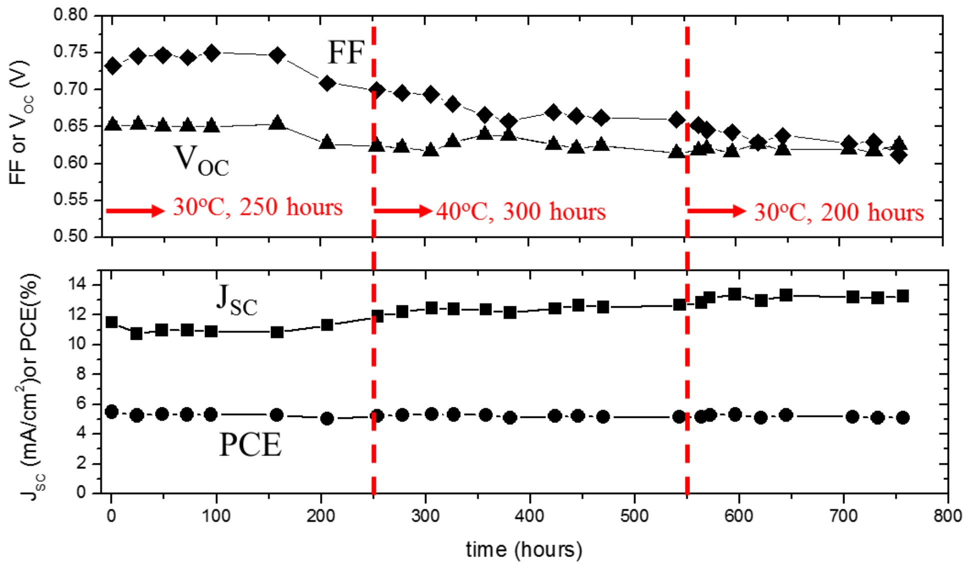
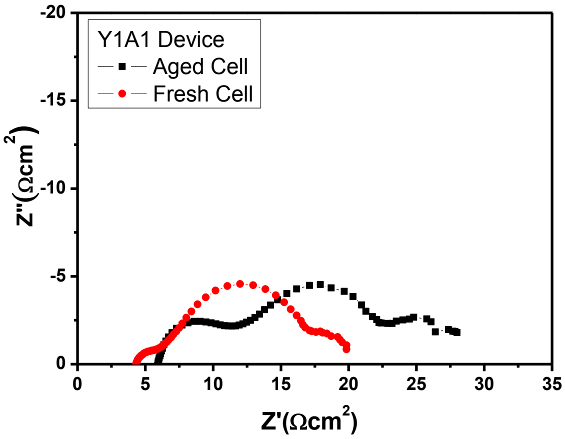


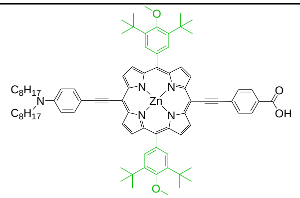
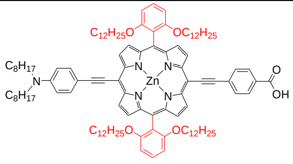
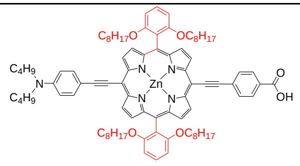
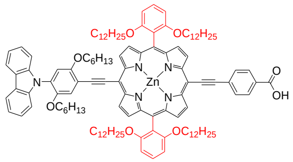
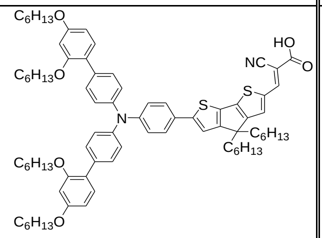
Figure S5. Preliminary thermal aging test on **Y1A1**-sensitized cells by a simulated indoor condition profile

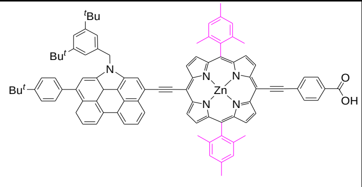
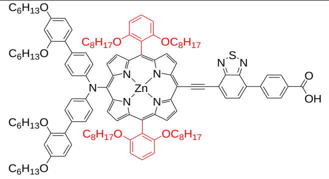
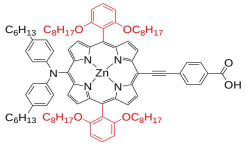
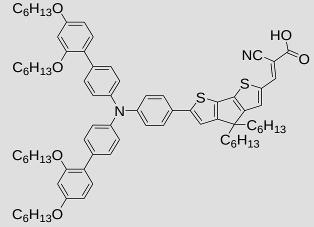
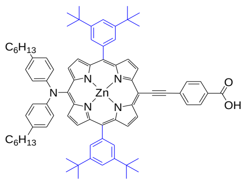
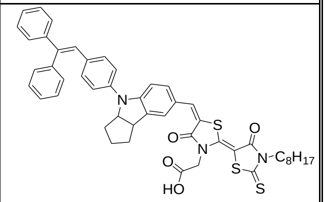


Y1A1 Device	R_{CT} (Ωcm^2)	R_{TiO2} (Ωcm^2)
Aged Cell	5.68	12.38
Fresh Cell	2.88	10.56

Figure S6. Nyquist plot and impedance elements of **Y1A1** aged cell and fresh cell after a simulated indoor condition profile.

Table S1. Comparison of photophysical and electrochemical properties for several porphyrin dyes.

Entry	Porphyrin dye	Photophysical properties			Energy levels		Best device performance						Ref.
		λ_{abs} (ε), nm (10^3 M^{-1} cm^{-1})	λ_{em}, nm	$E_{0\text{-}0}$, eV	$E_{1/2}$(ox), V	$E_{0\text{-}0}$*, V	V_{OC}, V	J_{SC}, mA cm^{-2}	FF	PCE, %	E[a]	Co-sensitizer	
1	 **Y1A1**	459 (300), 678 (12.8)	694	1.81	+0.85	-0.99	0.66	18.60	0.75	9.22	A	×	This work
2	 **LD16**	461 (224), 671 ()	683, 746	–	+0.72	–	0.71	20.59	0.70	10.24	A	×	1
3	 **YD22**	459 (22.3), 671 (6.8)	676	1.84	+0.78	-1.06	0.70	14.92	0.72	7.56	A	×	2
4	 **XW-4**	457 (314), 611 (10.7), 663 (77.3)	675	1.86	+0.83	-1.03	0.70	16.22	0.70	7.94	A	×	
							0.73	20.0	0.74	10.75	A	 **XS-3**	3, 4

5	 **WW5**	441 (159), 466 (115), 502 (61.5), 679 (75.4)	–	1.71	+0.74	-0.97	0.77	18.43	0.73	10.3	B	×	5
6	 **SM315**	440 (105), 454 (117), 581 (12), 668 (53)	732	1.79	+0.88	-0.91	0.91	18.1	0.78	13.0	B	×	6
7	 **YD2-o-C8**	448 (212), 581 (12), 645 (31)	663	–	+0.82	–	0.83	15.8	0.71	9.4	A	×	7
							0.97	17.3	0.71	11.9	B	×	
							0.94	17.7	0.74	12.3	B	 **Y123**	
8	 **YD2**	444 (217), 589 (10.8), 648 (33.7)	676	1.81	+0.89	-1.09	0.74	16.7	0.72	8.8	A	×	8
							0.77	18.6	0.76	11	A	 **D205**	
							0.83	14.9	0.69	8.4	B	×	7

[a] E denotes to electrolyte where electrolyte A is based on I^-/I_3^- and electrolyte B is based on $Co(bpy)^{2+/3+}$.

Table S2. Performance of **Y1A1** device illuminated under different light source at varied light intensity.

Photon flux, lux	T5-White Fluorescent lamp						T8-White Fluorescent lamp						LED planar light					
	J_{SC}, μAcm^{-2}	V_{OC}, V	FF	η, %	P_{in}, μWcm^{-2}	P_{Max}, μWcm^{-2}	J_{SC}, μAcm^{-2}	V_{OC}, V	FF	η, %	P_{in}, μWcm^{-2}	P_{Max}, μWcm^{-2}	J_{SC}, μAcm^{-2}	V_{OC}, V	FF	η, %	P_{in}, μWcm^{-2}	P_{Max}, μWcm^{-2}
300	52.6	0.467	0.739	19.3	94.01	18.2	45.8	0.471	0.765	17.0	96.8	16.5	_	_	_	_	_	_
350	50.9	0.471	0.754	16.4	10.11	18.1	47.3	0.472	0.744	14.2	117.0	16.6	56.6	0.476	0.755	19.5	104.3	20.3
600	81	0.486	0.768	16.1	18.81	30.2	75.1	0.487	0.753	14.3	192.2	27.6	83	0.490	0.772	17.5	179.2	31.4
900	117	0.500	0.779	16.1	28.24	45.5	114	0.501	0.761	15.0	289.3	43.5	117	0.502	0.768	16.7	269.0	45
1200	148	0.508	0.761	15.2	37.67	57.2	150	0.510	0.763	15.0	3889	58.4	144	0.510	0.769	15.7	358.4	56.3
1750	211	0.520	0.762	15.3	54.95	83.8	205	0.521	0.766	14.1	5818	81.9	215	0.523	0.760	16.4	522.3	85.5
2400	293	0.530	0.766	15.8	75.54	119	293	0.532	0.754	15.3	7671	117	299	0.534	0.755	16.9	716.6	121
5250	653	0.558	0.769	17.0	1650	280	581	0.556	0.765	13.5	1835	247	634	0.560	0.768	17.4	1567	272
6000	755	0.561	0.771	17.4	1882	327	687	0.560	0.765	14.5	2029	295	735	0.564	0.762	17.7	1783	316
7000	876	0.566	0.765	17.4	2186	380	741	0.562	0.765	13.8	2315	319	873	0.570	0.763	18.2	2086	380

S5. NMR spectra of Y1A1