Supporting Information

1. Measurement of dye loading capacity of the DSSC

The amounts of dye adsorbed on anode TiO_2 surface were spectroscopically estimated. We use UV-vis absorption to quantify the concentration of the dye solution. To measure the dye loading capacity, we compare the concentration difference before and after anode film soaking in the solution for different period of times in terms of different devices. By comparing with a standard solution, the amount of dye loading can be calculated. For concise, we examine dye loading capacities in the typical devices, **1**, **2**, **3**, **6**, and **7** for investigation. The results are shown in Figure S5 and S6, the calculated values are included in Table 1 in the main text.

2. Supporting Tables

Table S1 Absorption wavelength and redox potentials of **ZnP** in THF

Dye	Absorption/λ_{max}/nm(ε,$\times 10^5 M^{-1}$ cm^{-1})	E_{ox} /V[a]	$E_{0\text{-}0}$ /V[b]	E_{re} /V[c]
ZnP	456(1.67), 666(0.47)	+0.62	1.74	-1.12

[a] HOMO level was measured in THF with 0.1 M tetrabutylammonium hexafluorophosphate ($TBAPF_6$) calibrated with ferrocene/ferrocenium (Fc/Fc+) as an internal reference. [b] E_{0-0} was estimated from the absorption threshold of dye in THF. [c] The LUMO was calculated using the equation LUMO = HOMO - E_{0-0}.

Table S2 Simulated device parameter from the EIS data in Figure 3a in main text

Devices	R_{CT} (Ω)	f (Hz)	τ (ms)	J_{sc} (mA cm^{-2})[1]
1	55.70	34.53	4.61	11.83
2	371.2	5.43	29.32	10.89
3	69.84	26.51	6.00	14.49
4	88.08	21.99	7.24	14.76
5	116.47	17.23	9.24	15.10
6	139.45	15.91	10.01	15.10
7	145.12	14.01	11.36	15.24
8	81.11	30.49	5.22	13.47
9	205.15	10.75	14.81	13.75

[1] J_{sc} calculated from the IPCE spectra of the corresponding devices.

3. Supporting Figures

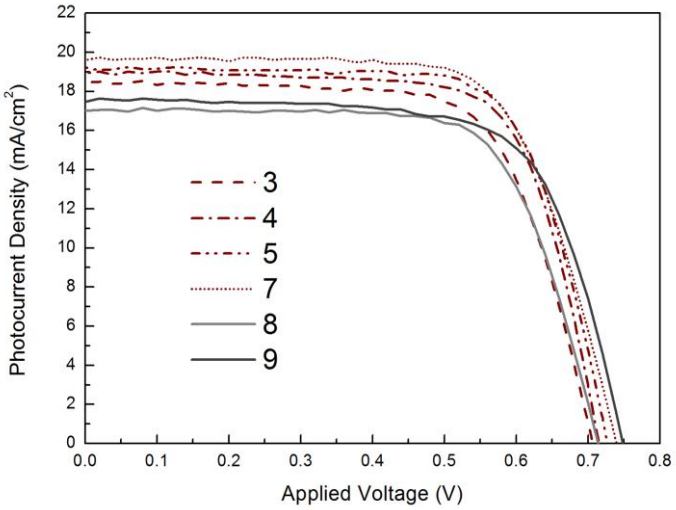

Fig. S1. Photocurrent-voltage (*J*-*V*) characteristics of devices **3**, **4**, **5**, **7** and **9**.

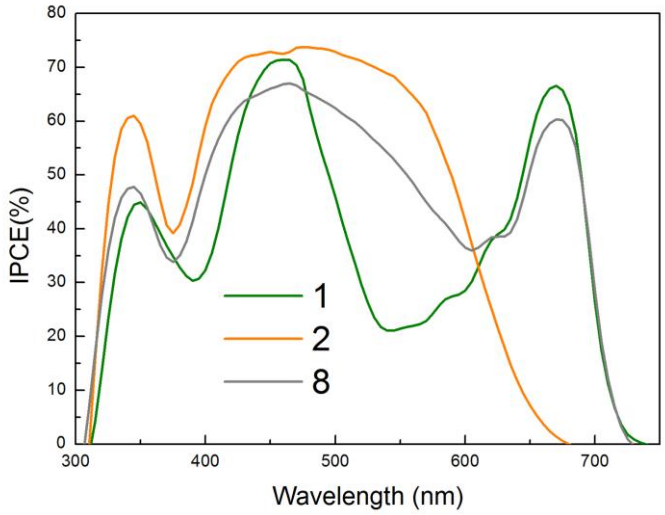

Fig. S2. Incident photon-to-electron conversion efficiency (IPCE) spectra of device **8**; the IPCE spectra of device **1** and **2** are also depicted for reference.

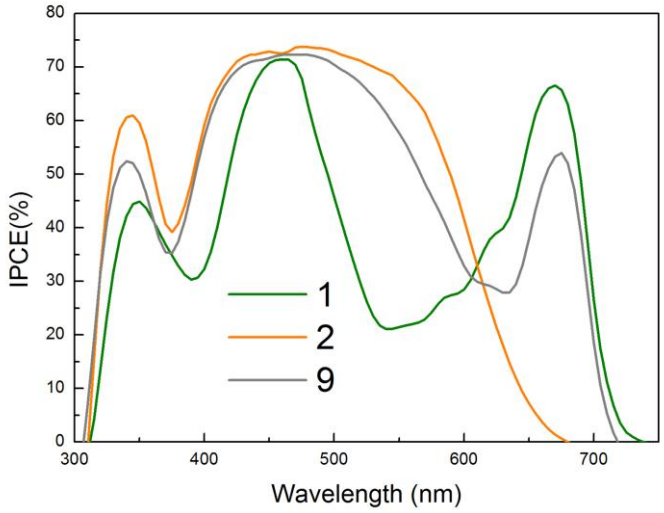

Fig. S3. Incident photon-to-electron conversion efficiency (IPCE) spectra of device **9**; the IPCE spectra of device **1** and **2** are also depicted for reference.

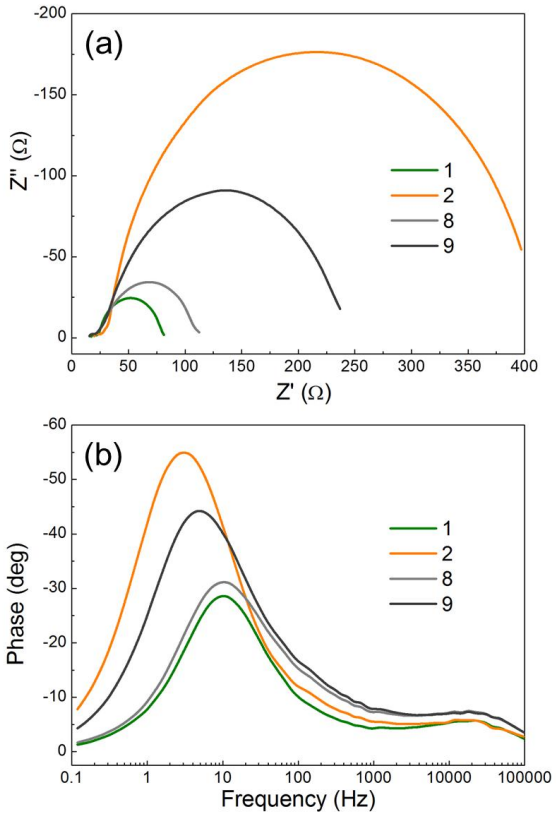

Fig. S4. (a) Nyquist and (b) Bode phase plots of device **8** and **9**; the plots of device **1** and **2** are also depicted for reference.

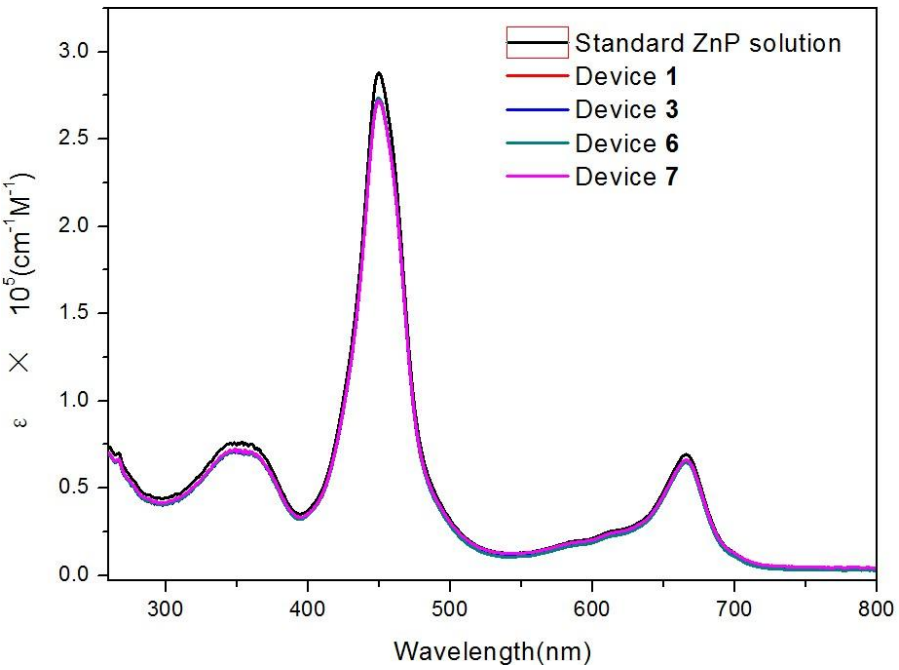

Fig. S5. UV-vis absorption spectra of ZnP solutions and those adsorption by anode film for device **1**, **3**, **6** and **7**.

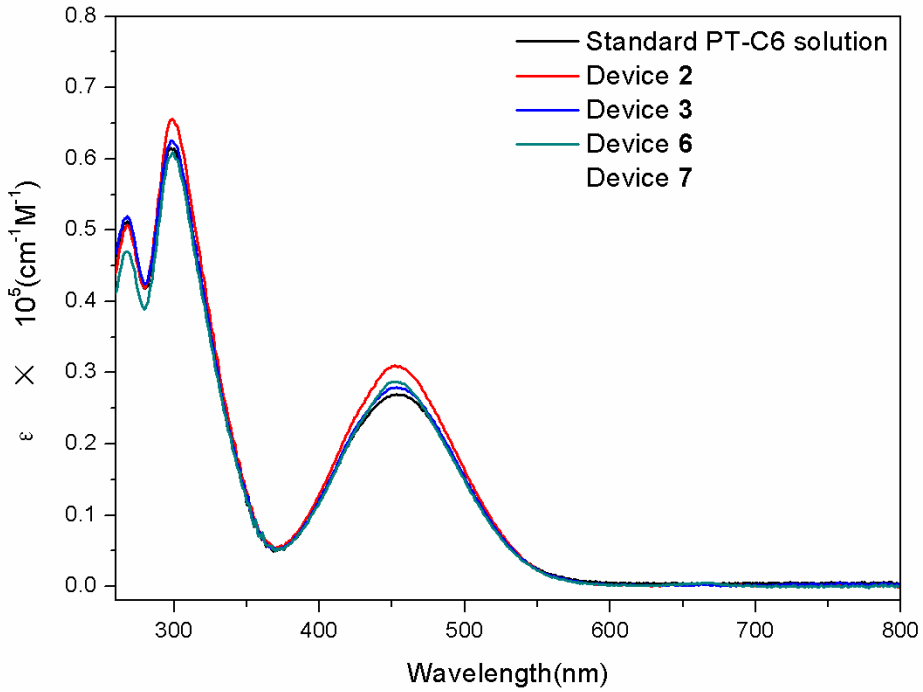

Fig. S6. UV-vis absorption spectra of PT-C6 solution and those adsorption by anode film for device **2**, **3**, **6** and **7**.