Electronic Supplementary Information

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Performance enhancement of carbon dot-based luminescent solar concentrators via surface modification and TiO_2-enhanced scattering

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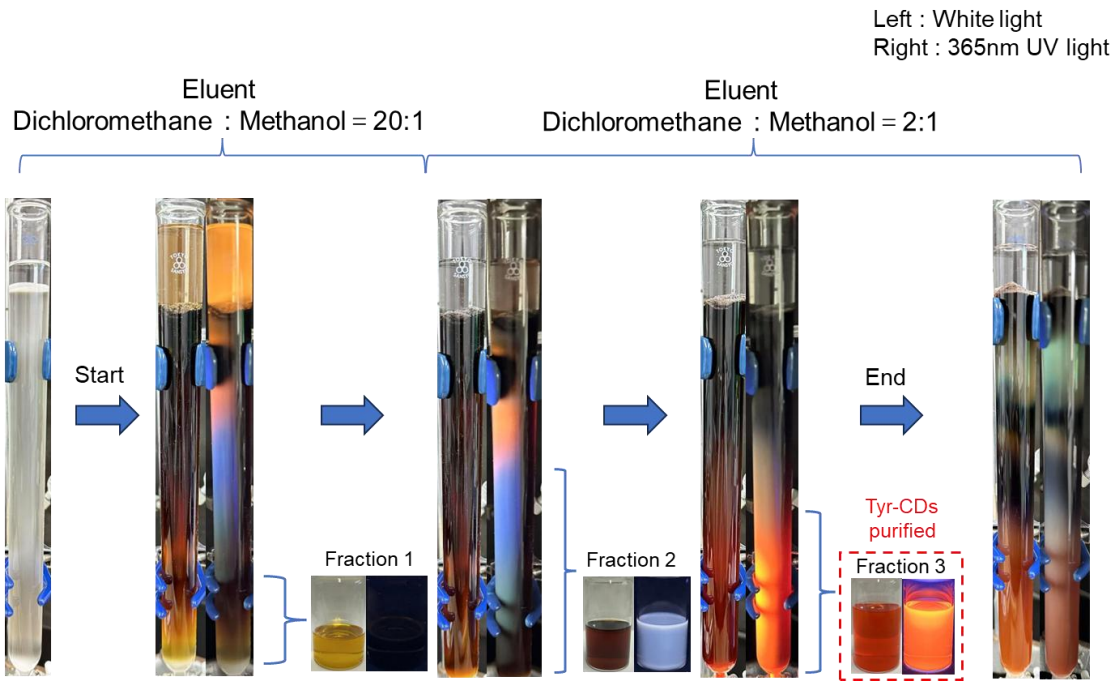

Fig. S1 Purification of crude Tyr-CDs by silica gel column chromatography.

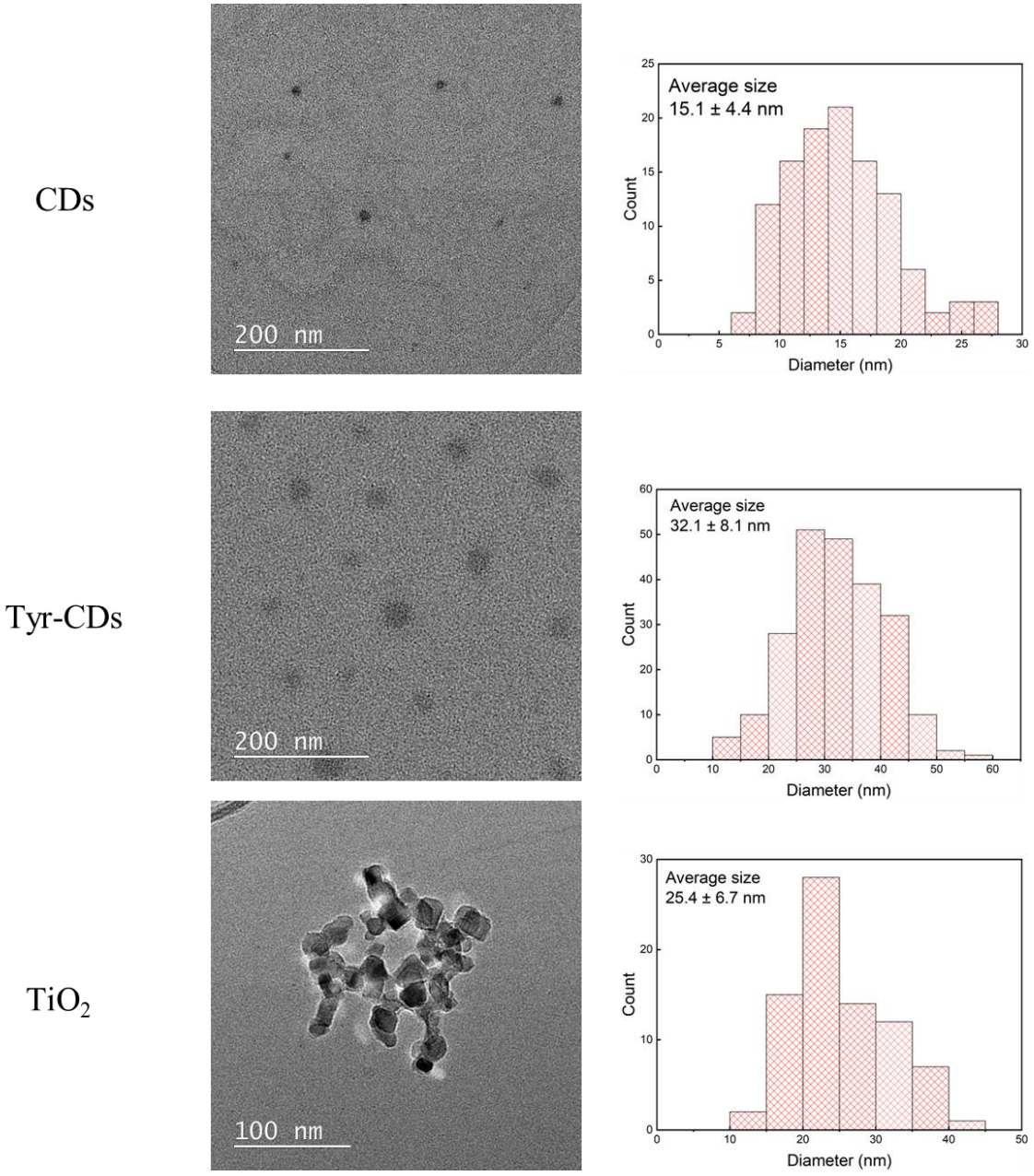

Fig. S2 FE-TEM images and particle size distributions of purified CDs, purified Tyr-CDs, and TiO_2.

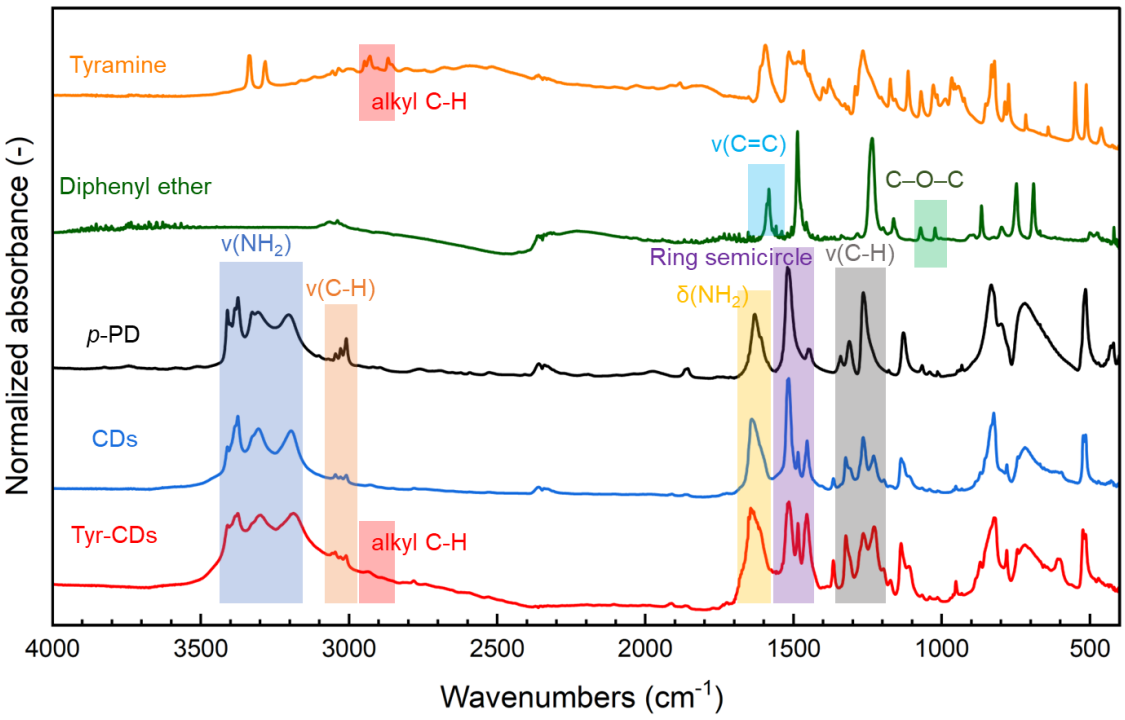

Fig. S3 FT-IR spectra of tyramine, diphenyl ether, *p*-PD, purified CDs, and Tyr-CDs.

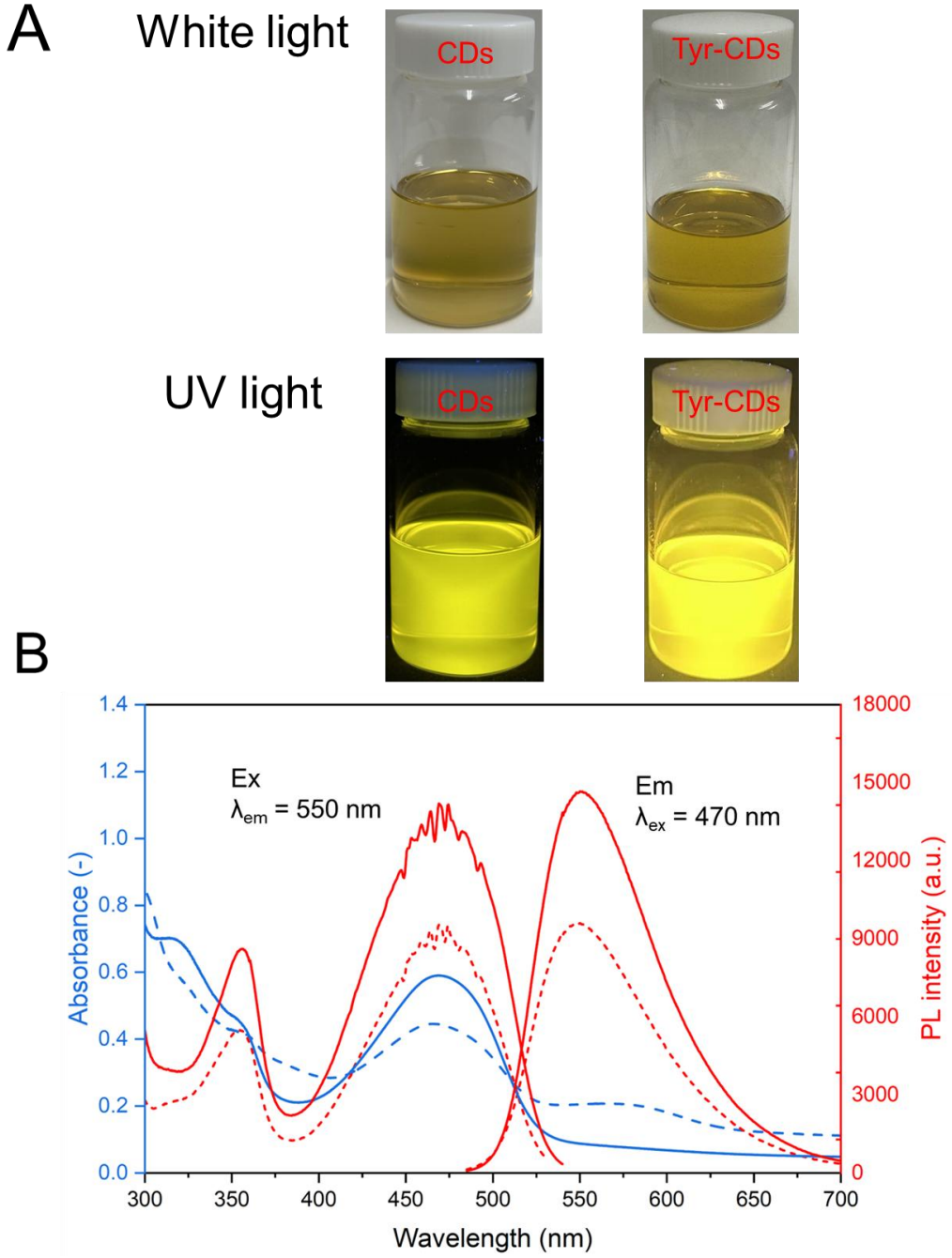

Fig. S4 (A) Photographs of purified CDs and Tyr-CDs in chloroform under white light and 365 nm UV light. (B) UV-vis and PL/PLE spectra of purified CDs (dashed line) and Tyr-CDs (solid line) in chloroform.

Table S1 PL/PLE properties of three different synthesized and purified CDs and Tyr-CDs in chloroform.

Sample No.	λ_{ex} (nm)	λ_{em} (nm)	Stokes shift (nm)	PLQY (%)
CDs #1	470	550	80	53
CDs #2	470	549	79	60
CDs #3	470	550	80	55
Average	470	550	80	56
Tyr-CDs #1	470	550	80	67
Tyr-CDs #2	469	552	83	68
Tyr-CDs #3	470	554	84	68
Average	470	552	82	68

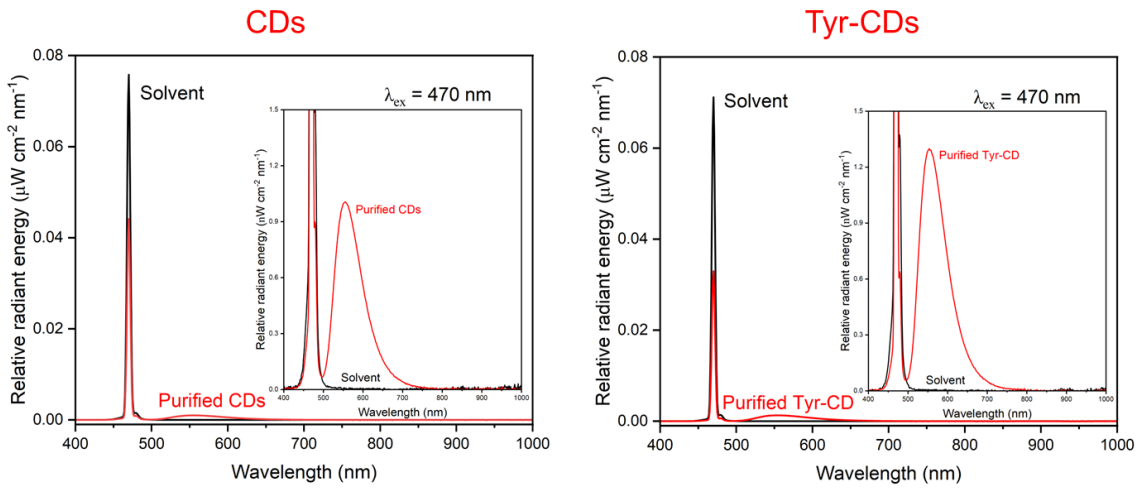

Fig. S5 PL spectra for evaluating the PLQYs of the purified CDs and Tyr-CDs in chloroform.

Table S2 Concentrations of CDs, Tyr-CDs, and TiO_2, film thicknesses, excitation peak wavelengths, λ_{ex}, emission peak wavelengths, λ_{em}, and PLQYs for the films.

Sample name	CD or Tyr-CD concentration (wt%)	TiO_2 concentration (wt%)	λ_{ex} (nm)	λ_{em} (nm)	Film thickness (μm)	PLQY (%)
EVA	0.00	0.00	-	-	133 ± 2	-
CDs@EVA	0.05	0.00	493	540	427 ± 2	49
Tyr-CDs@EVA	0.05	0.00	494	540	434 ± 2	64
TiO_2@EVA #1	0.00	0.05	-	-	140 ± 3	-
TiO_2@EVA #2	0.00	0.10	-	-	144 ± 3	-
TiO_2@EVA #3	0.00	0.15	-	-	147 ± 6	-
Tyr-CDs/ TiO_2@EVA #1	0.05	0.05	494	540	549 ± 5	64
Tyr-CDs/ TiO_2@EVA #2	0.05	0.1	494	540	535 ± 4	60
Tyr-CDs/ TiO_2@EVA #3	0.05	0.15	494	540	546 ± 5	60
Tyr-CDs+ TiO_2@EVA	0.05	0.15	494	540	445 ± 2	64

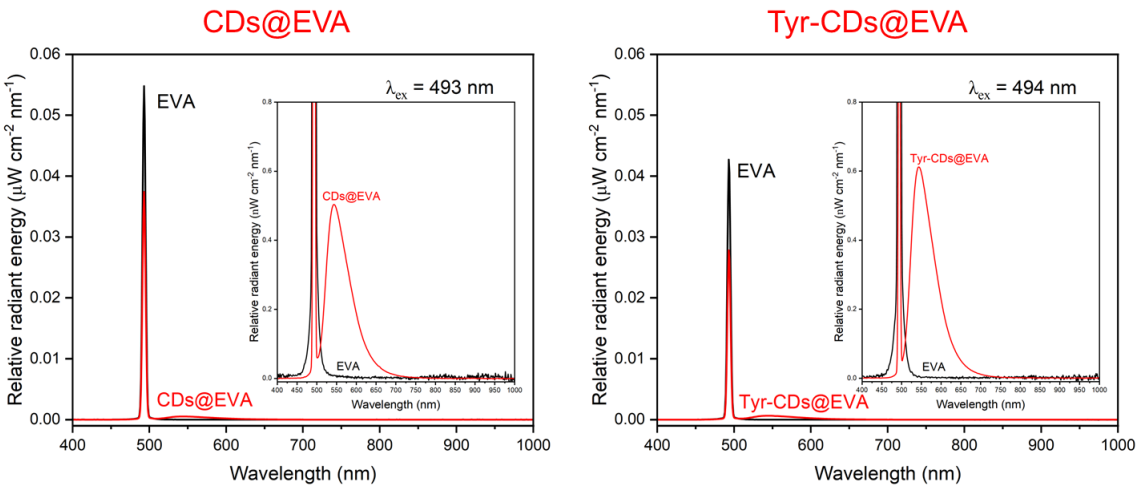

Fig. S6 PL spectra for evaluating the PLQYs of CDs@EVA and Tyr-CDs@EVA films.

Table S3 Results of *I–V* curve measurements for LSC applications.

Sample	I_{sc} (mA)	V_{oc} (V)	*FF*	η (%)
Under the one-window condition				
No film	0.842±0.0004	0.475±0.00025	0.692±0.0012	0.0226±0.00004
EVA	0.909±0.0008	0.478±0.00042	0.694±0.0015	0.0246±0.00009
CDs@EVA	0.988±0.0021	0.484±0.00025	0.700±0.0013	0.0273±0.00002
Tyr-CDs@EVA	1.084±0.0159	0.485±0.00092	0.701±0.0016	0.0301±0.00056
Under the two-window condition with a white background				
No film	0.615±0.0004	0.462±0.00032	0.680±0.0009	0.0158±0.00003
EVA (Front)	0.816±0.0019	0.472±0.00015	0.690±0.0007	0.0217±0.00003
EVA (Rear)	0.800±0.0091	0.474±0.00020	0.691±0.0009	0.0214±0.00023
CDs@EVA (Front)	0.890±0.0040	0.482±0.00025	0.691±0.0009	0.0244±0.00016
CDs@EVA (Rear)	1.071±0.0021	0.489±0.00019	0.703±0.0009	0.0301±0.00003
Tyr-CDs@EVA (Front)	0.962±0.0239	0.480±0.00078	0.697±0.0013	0.0263±0.00071
Tyr-CDs@EVA (Rear)	1.246±0.0039	0.491±0.00035	0.705±0.0011	0.0352±0.00018
Under the two-window condition with a black background				
No film	0.232±0.0000	0.420±0.00060	0.641±0.0029	0.0051±0.00003
EVA (Front)	0.264±0.0010	0.423±0.00067	0.644±0.0010	0.0059±0.00004
EVA (Rear)	0.257±0.0022	0.422±0.00082	0.642±0.0021	0.0057±0.00007
CDs@EVA (Front)	0.371±0.0033	0.440±0.00044	0.658±0.0011	0.0088±0.00010
CDs@EVA (Rear)	0.379±0.0024	0.443±0.00070	0.662±0.0016	0.0091±0.00009
Tyr-CDs@EVA (Front)	0.542±0.0084	0.449±0.00091	0.670±0.0018	0.0133±0.00027
Tyr-CDs@EVA (Rear)	0.530±0.0105	0.448±0.00092	0.668±0.0010	0.0129±0.00029
Tyr-CDs/ TiO_2@EVA #1 (Rear)	0.539±0.0099	0.453±0.00090	0.672±0.0011	0.0134±0.00028
Tyr-CDs/ TiO_2@EVA #2 (Rear)	0.555±0.0088	0.453±0.00077	0.674±0.0012	0.0138±0.00027
Tyr-CDs/ TiO_2@EVA #3 (Rear)	0.580±0.0092	0.455±0.00088	0.675±0.0012	0.0145±0.00028
Tyr-CDs+ TiO_2@EVA (Rear)	0.658±0.0099	0.457±0.00077	0.677±0.0009	0.0167±0.00030

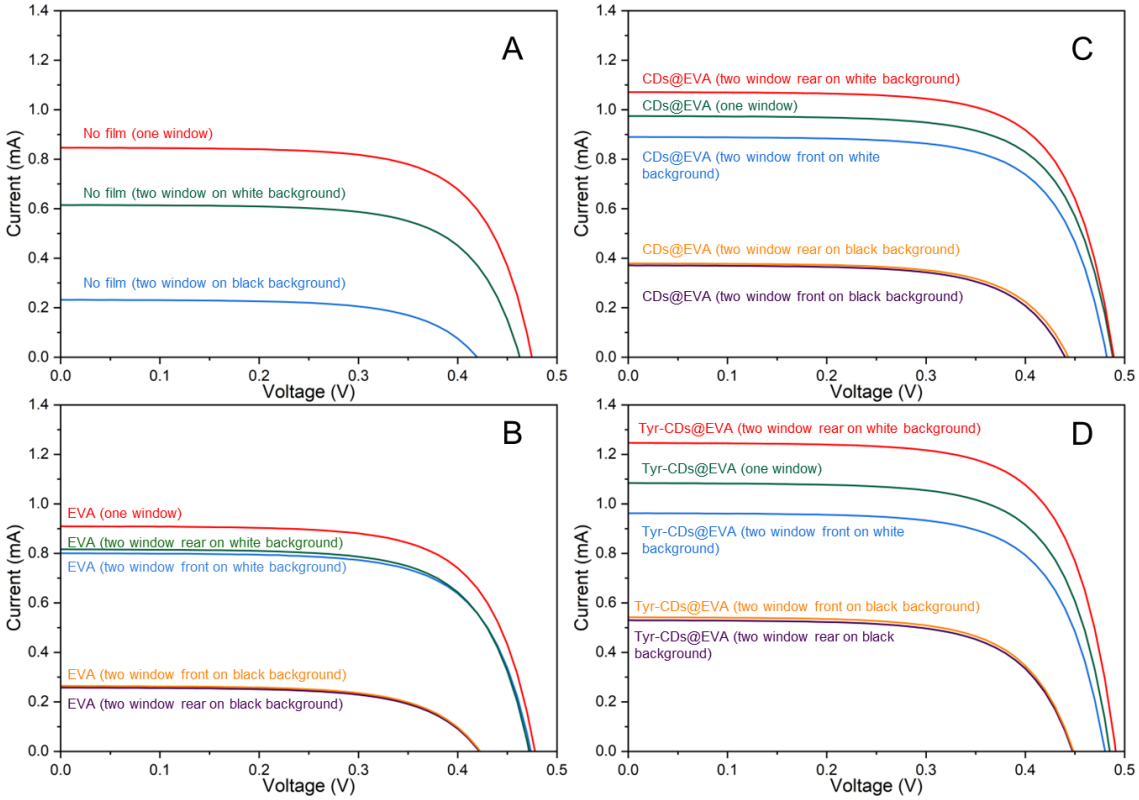

Fig. S7 (A) *I-V* curves of LSC with no film under the different conditions. (B) *I-V* curves of LSC with EVA film under the different conditions. (C) *I-V* curves of LSC with CDs@EVA film under the different conditions. (D) *I-V* curves of LSC with Tyr-CDs@EVA film under the different conditions.

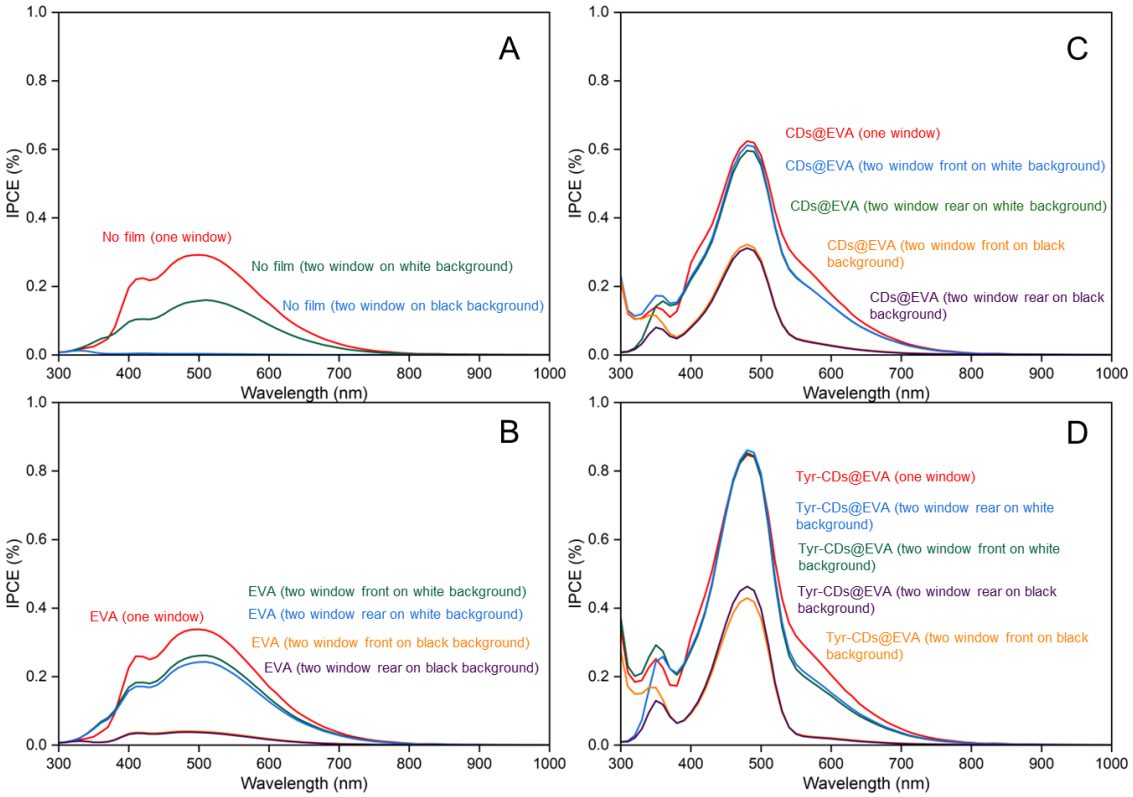

Fig. S8 (A) IPCE spectra of LSC with no film under the different conditions. (B) IPCE spectra of LSC with EVA film under the different conditions. (C) IPCE spectra of LSC with CDs@EVA under the different conditions. (D) IPCE spectra of LSC with Tyr-CDsEVA films under the different conditions.

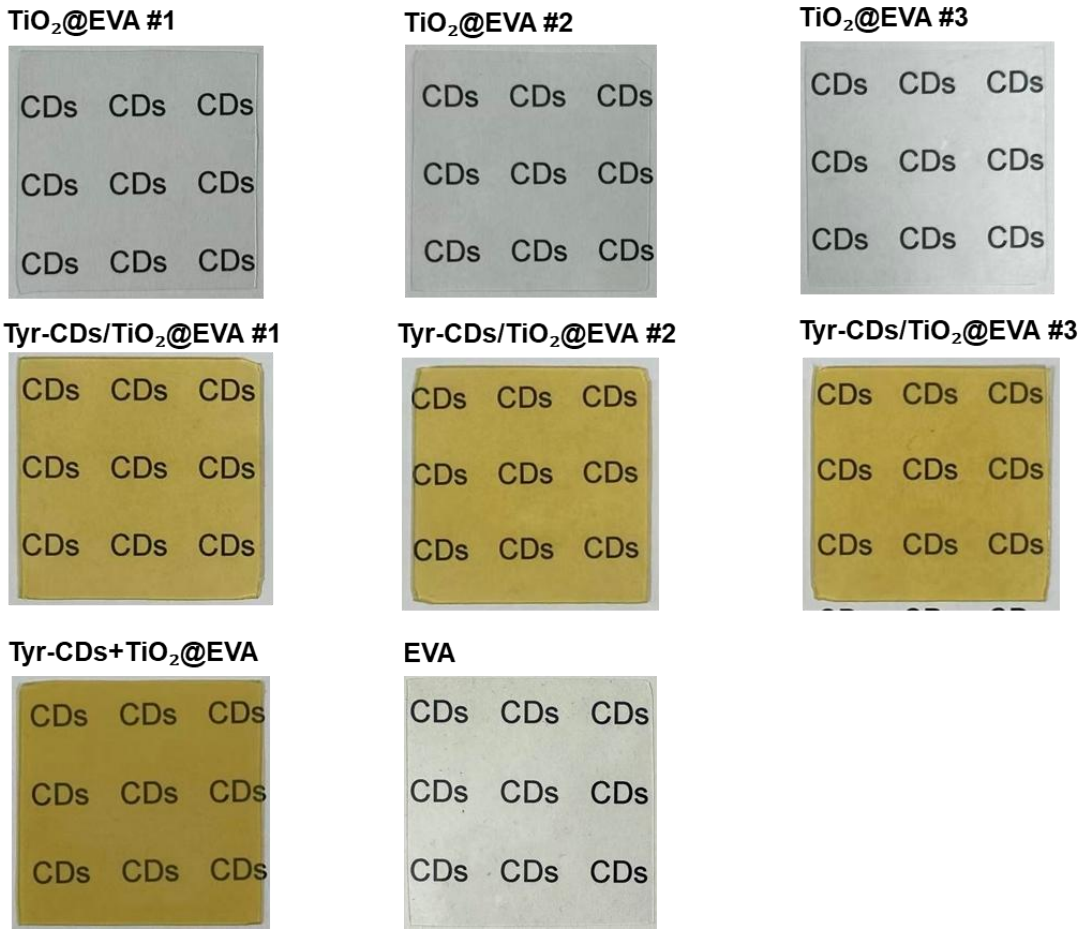

Fig. S9 (A) Photographs of EVA, TiO_2@EVA, Tyr-CDs/TiO_2@EVA, and Tyr-CDs+TiO_2@EVA films under white light.

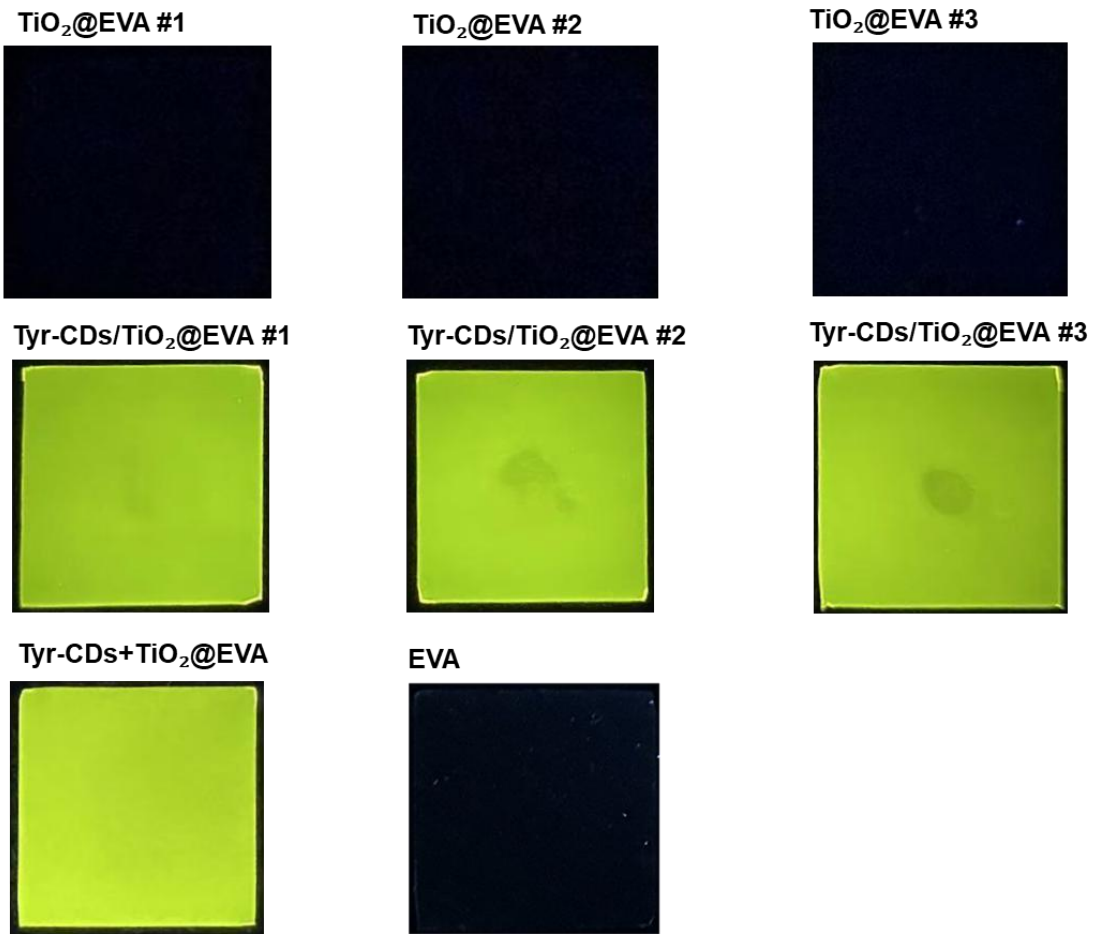

Fig. S9 (B) Photographs of EVA, TiO_2@EVA, Tyr-CDs/TiO_2@EVA and Tyr-CDs+TiO_2@EVA films under 365 nm UV light.

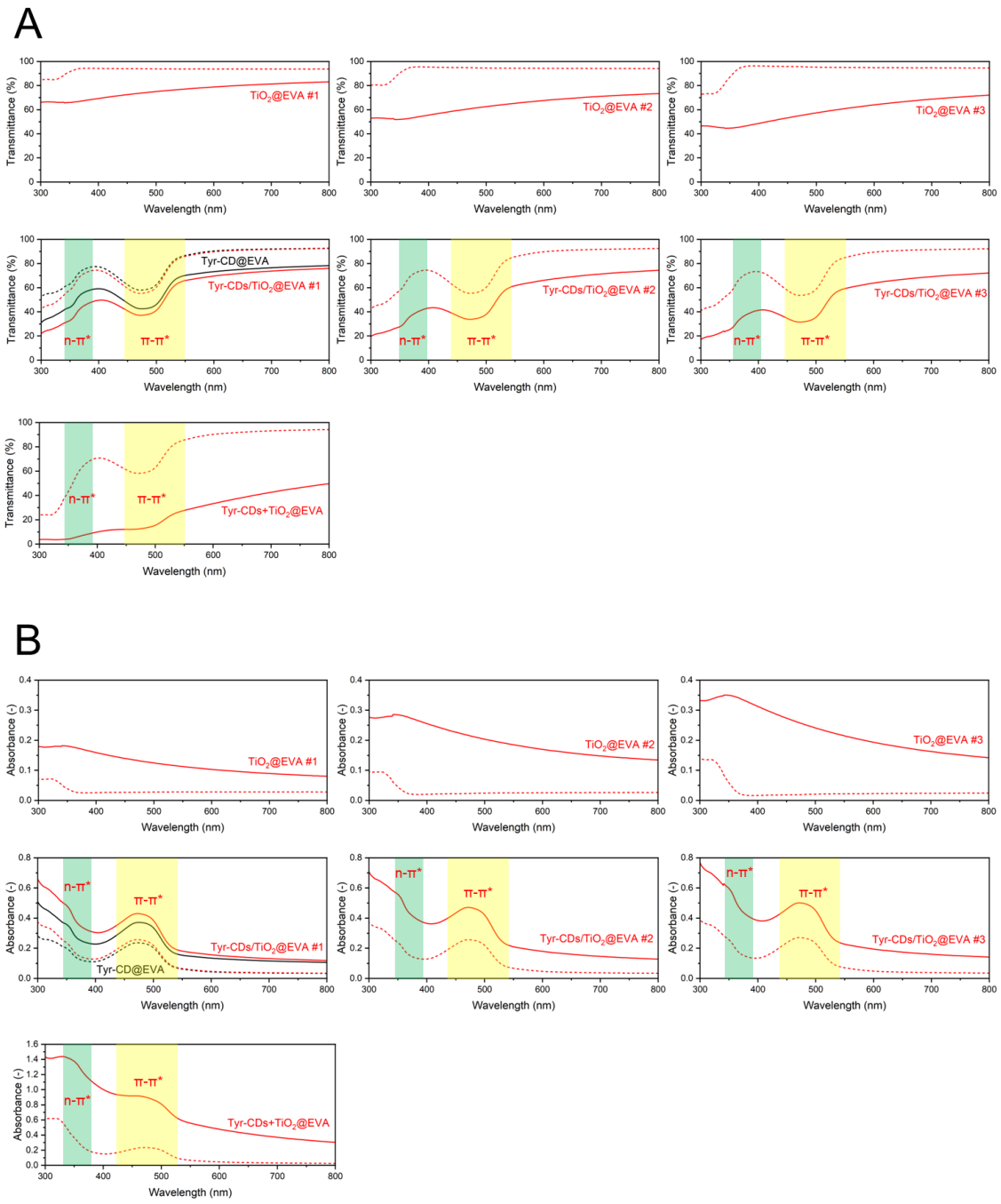

Fig. S10 (A) In-line transmission (solid lines) and total transmission (dashed lines) spectra, and (B) in-line absorbance (solid lines) and total absorbance (dashed lines) spectra of TiO_2@EVA, Tyr-CDs@EVA, Tyr-CDs/TiO_2@EVA, and Tyr-CDs+TiO_2@EVA films.

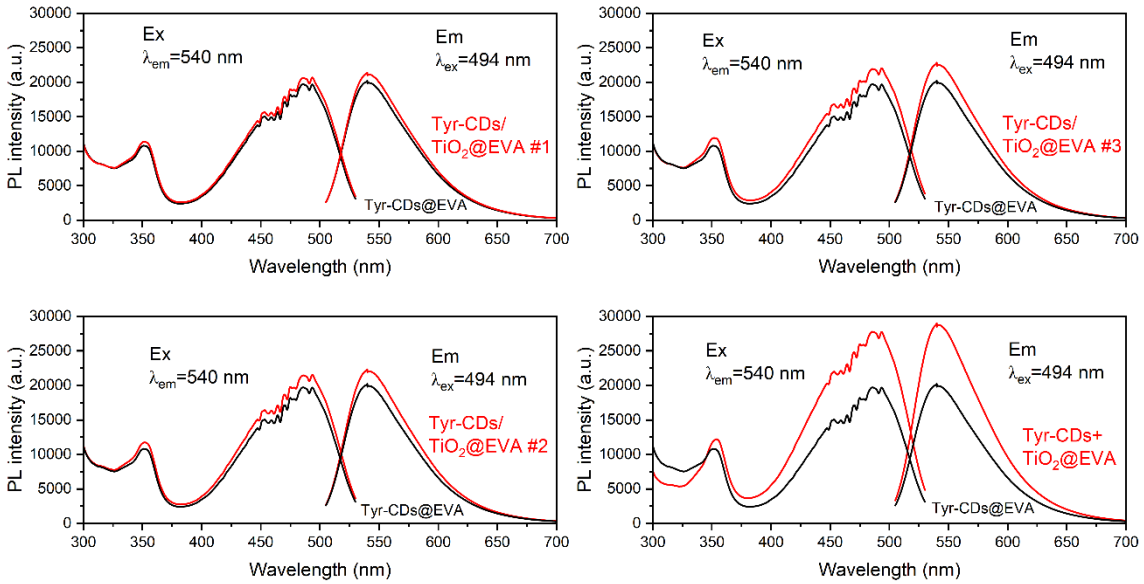

Fig. S11 PL and PLE spectra of Tyr-CDs@EVA, Tyr-CDs/TiO_2@EVA, and Tyr-CDs+TiO_2@EVA films.

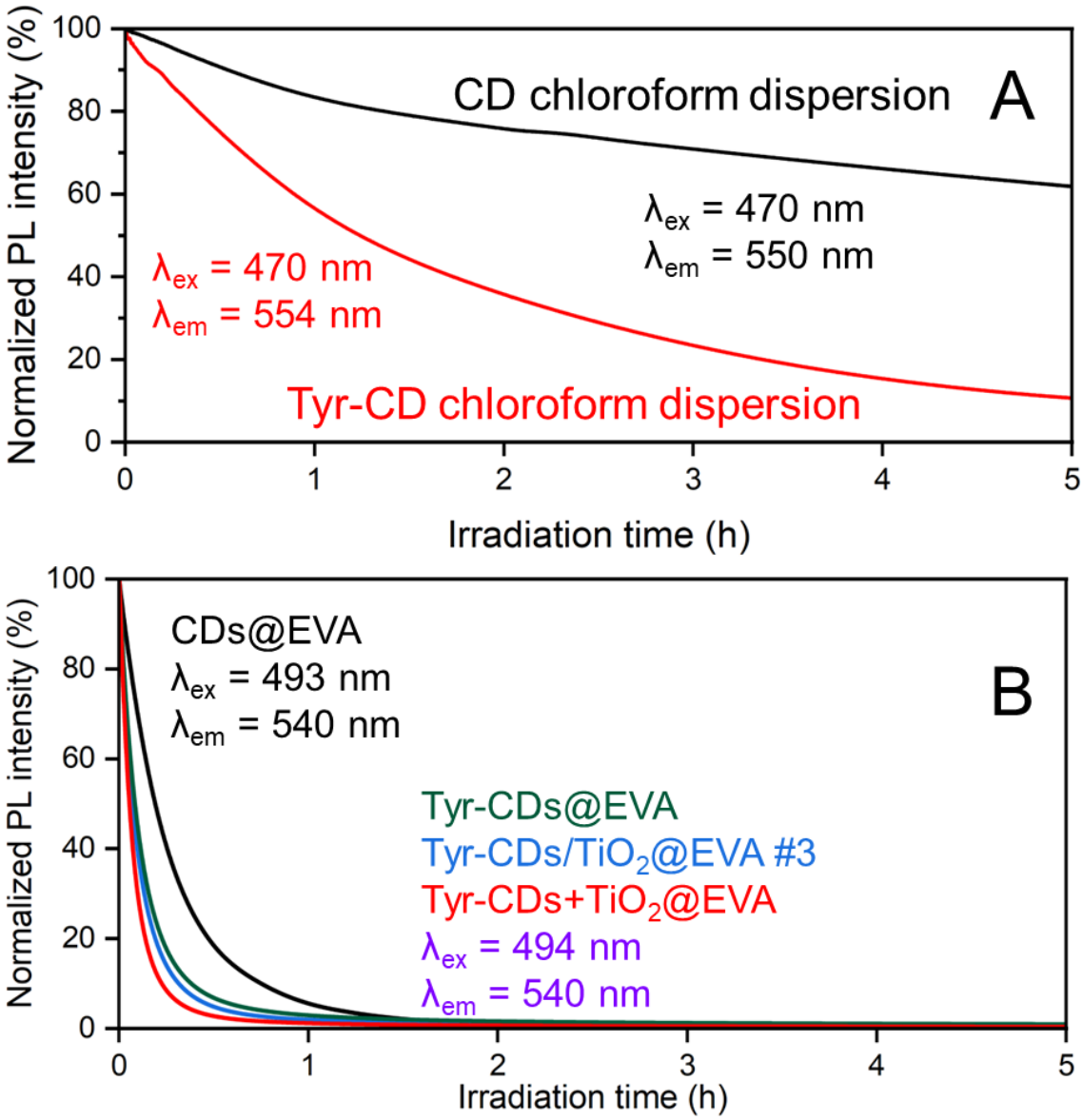

Fig. S12 Changes in the PL intensities of CDs and Tyr-CDs (A) in chloroform dispersions and (B) in EVA-based films under continuous optimal excitation.