Electronic Supplementary Material (ESI) for Nanoscale.

Electronic supplementary information

Activating Efficient Room Temperature Phosphorescence of Carbon Dots by Synergism of Orderly Non-Noble Metals and Dual Structural Confinements

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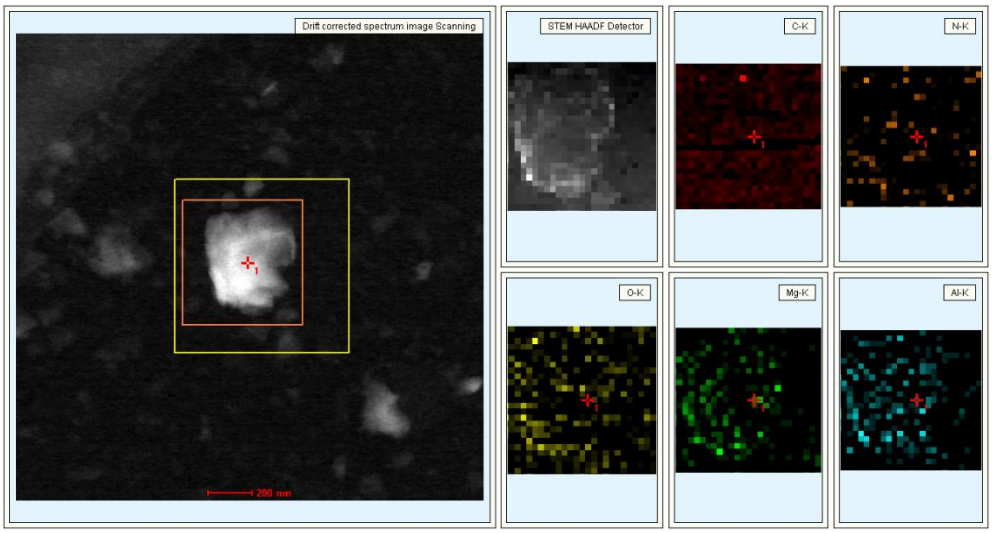

Figure S1. STEM mapping of CDs-LDHs supported on carbon film.

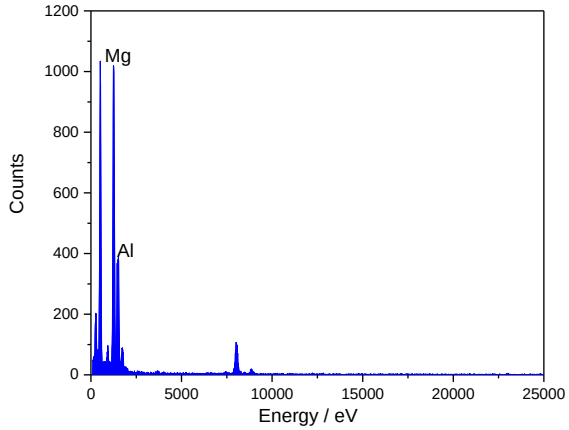

Figure S2. EDS pattern of CDs-LDHs supported on carbon film.

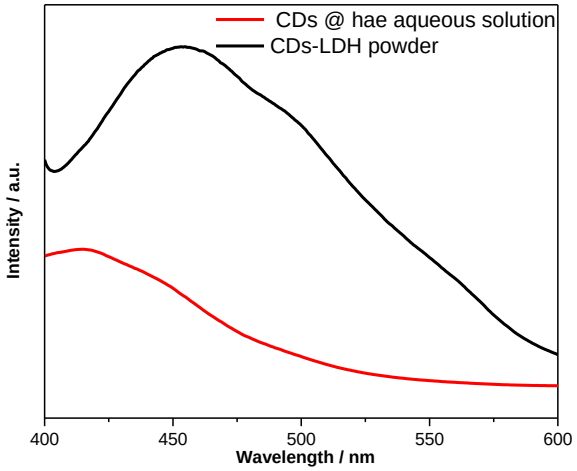

Figure S3. Fluorescence emission spectra of CDs @ hae aqueous solution and CDs-LDH powder.

Table S1. The parameters of fluorescence lifetime of CDs-LDHs at 300 ℃.

lifetime	τ / ns (450 nm)	percentage / %
τ_1	0.9700	25.80
τ_2	3.540	52.07
τ_3	10.76	22.13
Average <τ> / ns	4.478	
χ^2	1.076	

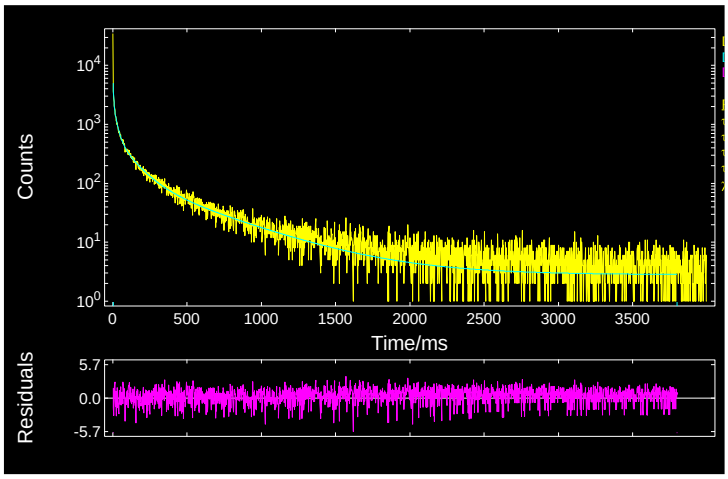

Figure S4. The time-resolved phosphorescence spectrum of CDs-LDHs at 300 ℃.

Table S2. The parameters of phosphorescence lifetime for CDs-LDHs at 300 ℃.

lifetime	τ / ms (525nm)	percentage / %
τ_1	3.626	9.900
τ_2	22.00	22.24
τ_3	108.3	33.64
τ_4	463.0	34.22
Average<τ> / ms	386.8	
χ^2	1.955	

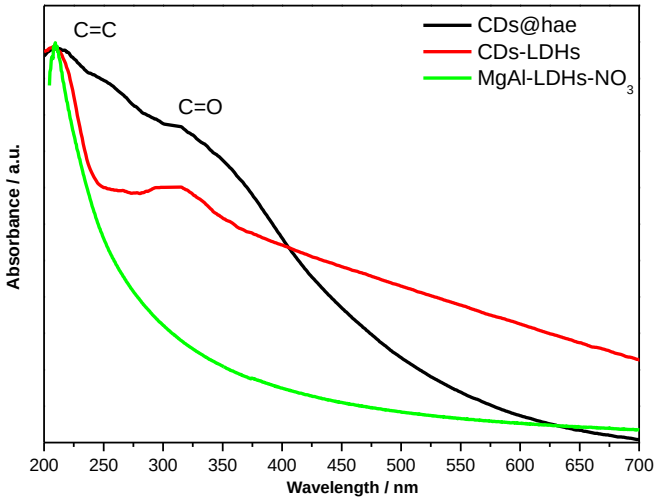

Figure S5. UV-vis absorption spectra of CDs@hae, CDs-LDHs and MgAl-LDHs-NO_3.

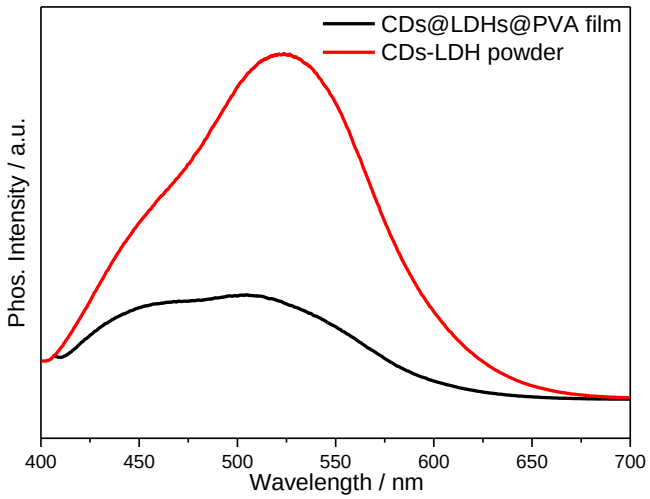

Figure S6. Phosphorescence spectra of CDs-LDH powder and CDs@LDHs@PVA film.

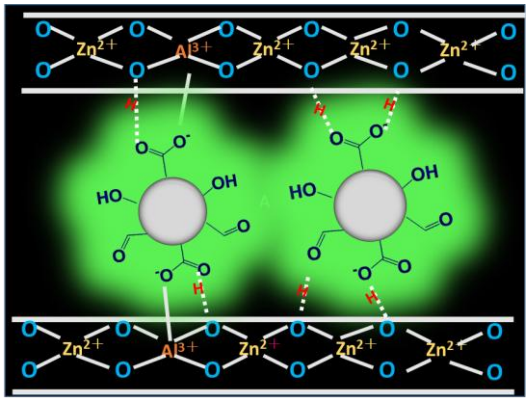

Figure S7. A schematic representation of CDs-ZnAl-LDHs.

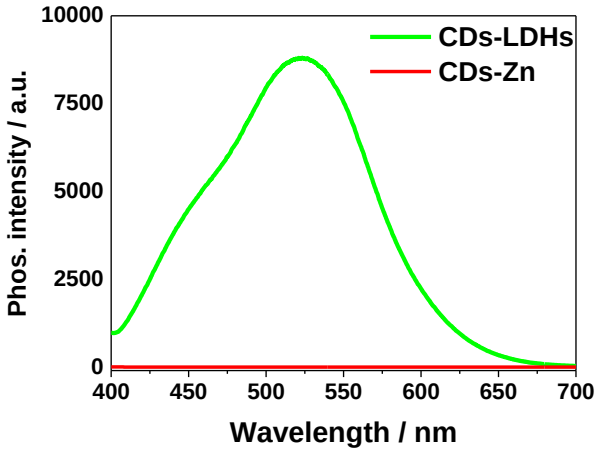

Figure S8. (A) Phosphorescence spectra of CDs-LDHs and CDs-Zn at 250 ℃.

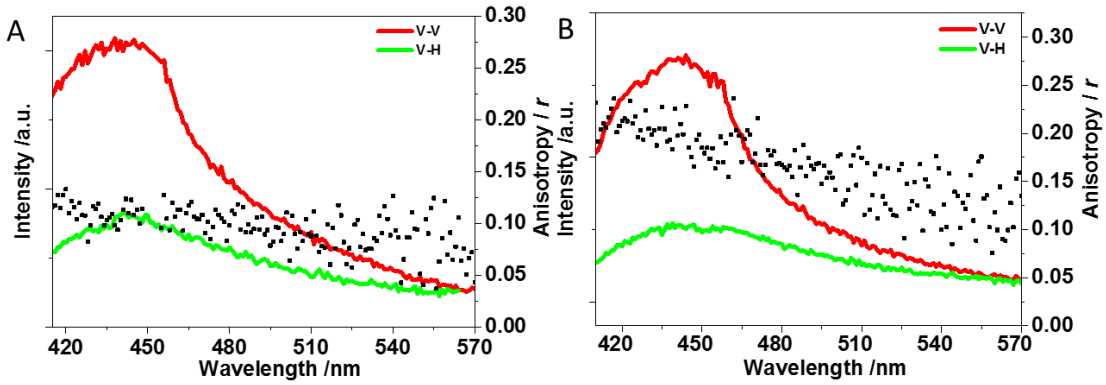

Figure S9. Polarized fluorescence profiles in the VV, VH modes and anisotropic value (*r*) for (A) CDs-MgAl-LDHs and (B) CDs-ZnAl-LDHs deposited on quartz substrate.

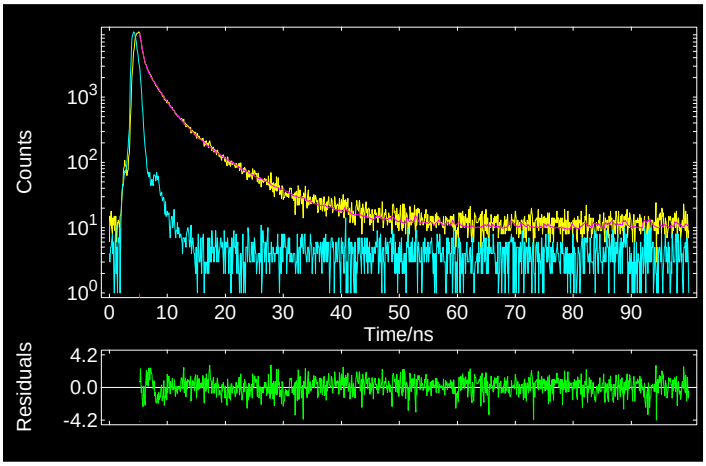

Figure S10. The time-resolved fluorescence spectrum of CDs-ZnAl-LDHs at 250 ℃.

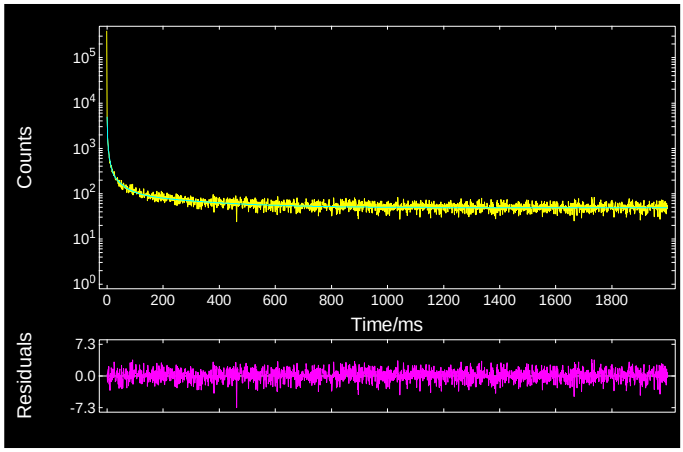

Figure S11. The time-resolved phosphorescence spectrum of CDs-ZnAl-LDHs at 250 ℃.

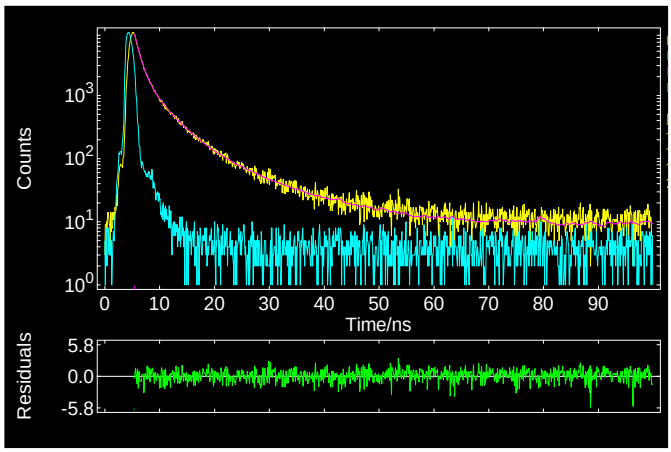

Figure S12. The time-resolved fluorescence spectrum of CDs-MgAl-LDHs at 250 ℃.

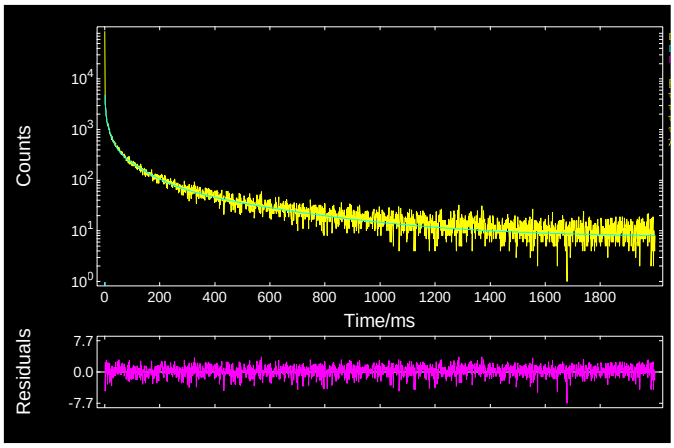

Figure S13. The time-resolved phosphorescence spectrum of CDs-MgAl-LDHs at 250 ℃.

Table S3. Luminescence lifetime data of CDs-LDHs at 250 ℃.

sample	lifetime	τ_1 / ns	τ_2 / ns	τ_3 / ns		<τ> / ns	χ^2
CDs-MgAl-LDHs	fluorescence lifetime	0.9326	3.655	11.37		2.751	1.215
	percentage / %	62.54	27.11	10.35			
CDs-ZnAl-LDHs	fluorescence lifetime	0.3516	2.447	7.683		2.061	1.192
	percentage / %	55.68	29.40	14.92			
sample	lifetime	τ_1 / ms	τ_2 / ms	τ_3 / ms	τ_4 / ms	<τ> / ms	χ^2
CDs-MgAl-LDHs	phosphorescence lifetime	1.842	14.51	78.44	374.0	319.4	1.892
	percentage / %	8.590	20.65	34.29	36.47		
CDs-ZnAl-LDHs	phosphorescence lifetime	0.9763	5.170	39.66	286.5	265.6	1.895
	percentage / %	17.74	17.23	24.23	40.80		

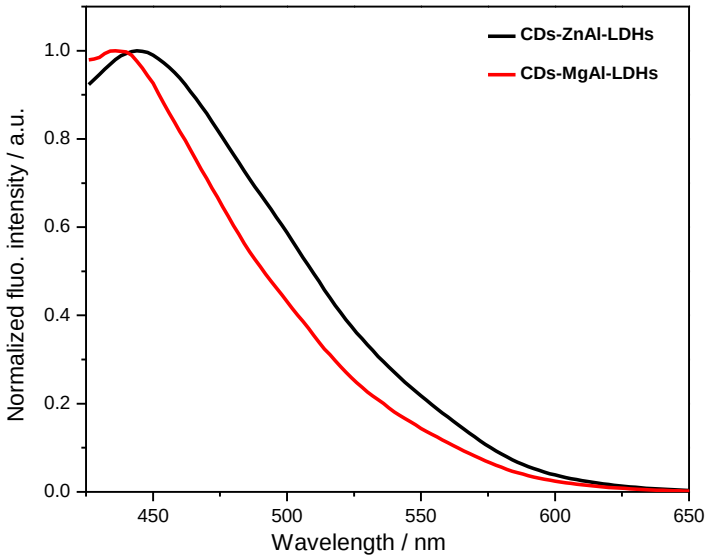

Figure S14. Fluorescence spectra of CDs-ZnAl-LDHs and CDs-MgAl-LDHs at 250 ℃.

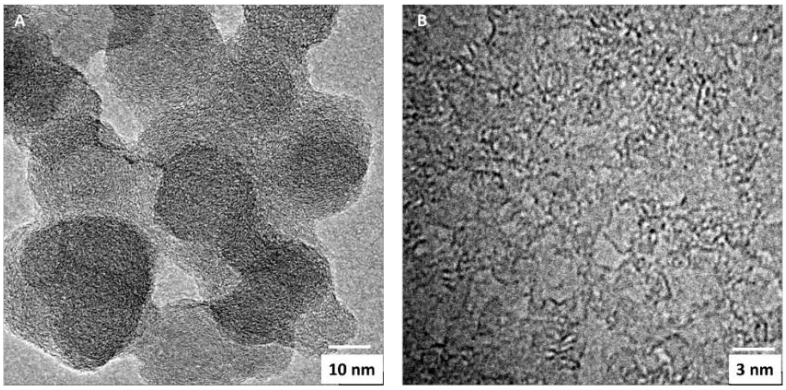

Figure S15. (A) TEM image of CDs@hae at 200 ℃. (B) High magnifications of (A).

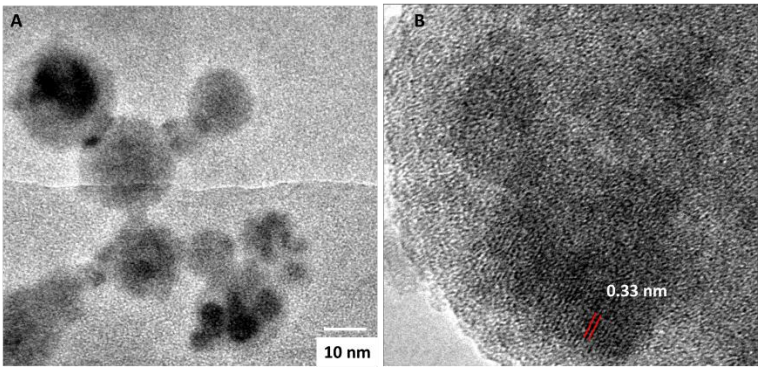

Figure S16. (A) TEM image of CDs@hae at 250 ℃. (B) High magnifications of (A).

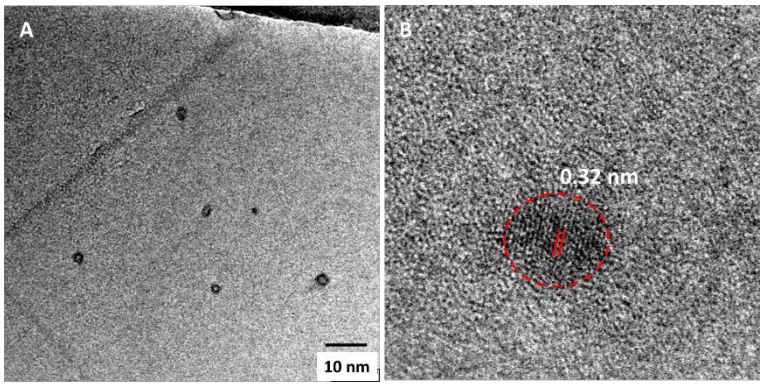

Figure S17. (A) TEM image of CDs@hae at 300 ℃. (B) High magnifications of (A).

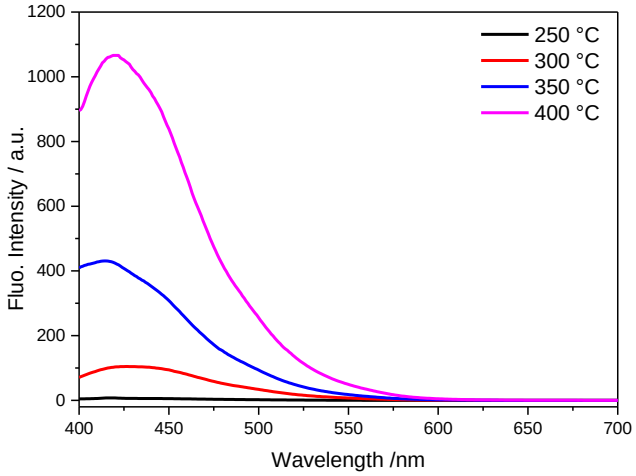

Figure S18. Fluorescence emission spectra of pure CDs@hae solution at different temperatures.

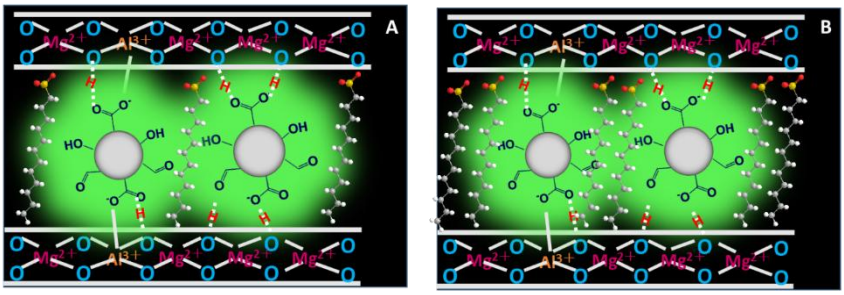

Figure S19. A schematic representation for (A) SDS-CDs-LDHs (SDS : CDs = 1 : 1) and (B) SDS-CDs-LDHs (SDS : CDs = 2 : 1).

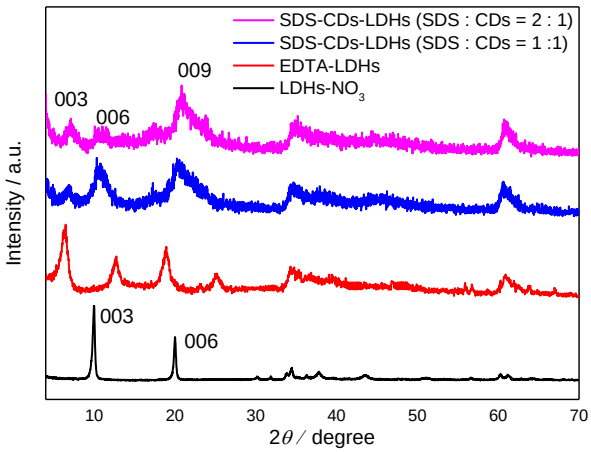

Figure S20. XRD patterns of SDS-CDs-LDHs (SDS : CDs = 1 : 1), SDS-CDs-LDHs (SDS : CDs = 2 : 1), EDTA-LDHs and LDHs-NO_3 at 250 ℃.

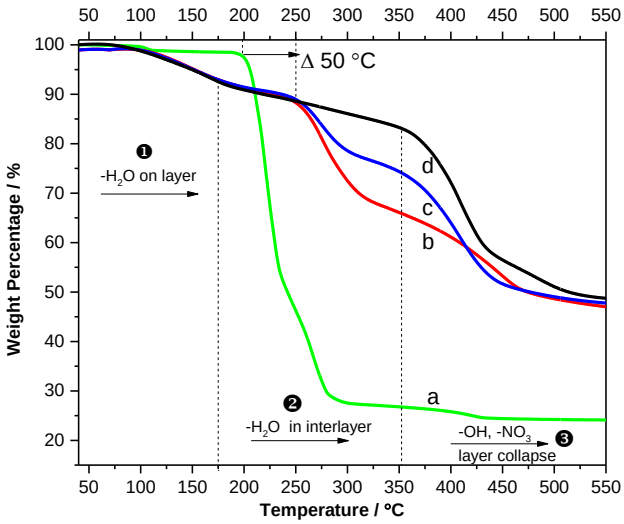

Figure S21. TG curves of (a) SDS, (b) SDS-EDTA-LDHs (SDS : EDTA = 2 : 1), (c) SDS-EDTA-LDHs (SDS : EDTA = 1 : 1) and (d) MgAl-LDHs-NO_3. TG experiments were carried out in an air flow.

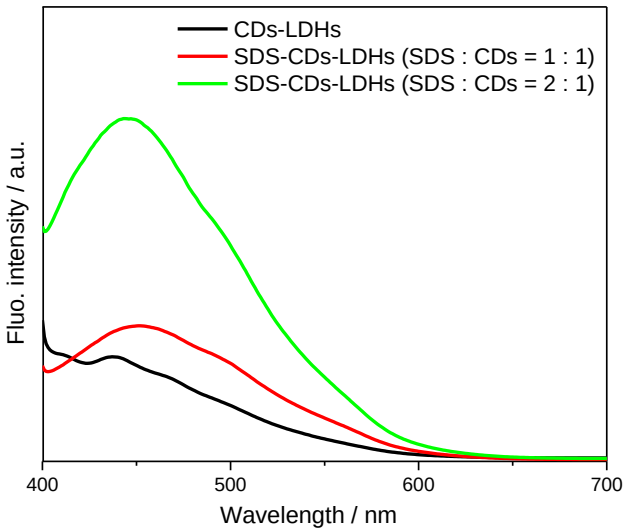

Figure S22. Fluorescence spectra of CDs-LDHs, SDS-CDs-LDHs (SDS : CDs = 1 : 1), and SDS-CDs-LDHs (SDS : CDs = 2 : 1).

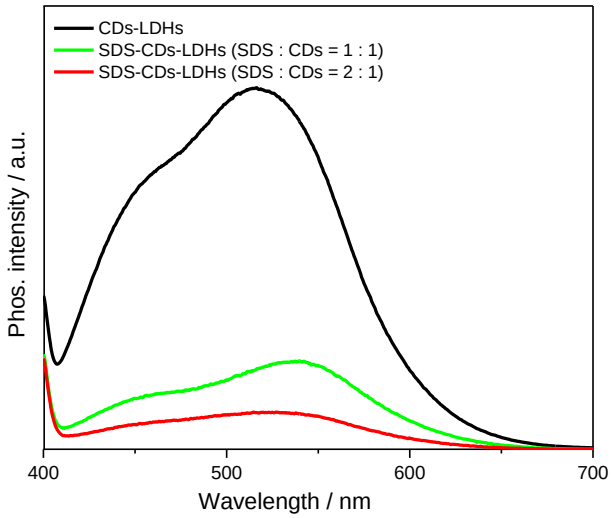

Figure S23. Phosphorescence spectra of CDs-LDHs, SDS-CDs-LDHs (SDS : CDs = 1 : 1), and SDS-CDs-LDHs (SDS : CDs = 2 : 1).

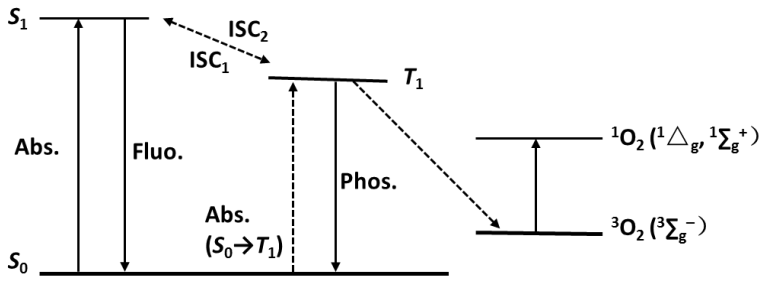

Figure S24. Mechanism diagram for optical oxygen quenching.