ELECTRONIC SUPPLEMENTARY MATERIAL

Confined Synthesis of Carbon Dots with Tunable Long-Wavelength Emission in Layered Double Hydroxides 2-Dimentional Matrix

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Supplementary Figures

Table S1 Elements content and chemical composition of CDs/LDH

Mg^{2+}/Al^{3+} ratio	C [wt.%]	N [wt.%]	S [wt.%]	H [wt.%]	O [wt.%]
2.16	22.16	0.86	2.39	4.13	52.54
Chemical composition					
$[Mg_{0.68}Al_{0.32}(OH)_2][C_{2.59}H_{3.74}O_{2.61}N_{0.09}S_{0.10}]$					

Table S2 The fitting of fluorescence decay data of CDs/LDH

τ_i (ns)[a]	A_i (%)	$<\tau>$ (ns)	χ^{2}[b]
0.363	25.38		
3.608	30.42	5.53	1.082
9.811	44.2		

[a] τ_i (i=1, 2, 3) is the fitted fluorescence lifetime. A_i is the percentage of τ_i. In this case, $<\tau>=A_1\tau_1+A_2\tau_2+A\tau_3$; $A_1+A_2+A_3=1$. [b] The goodness of fit is indicated by the value of χ^2.

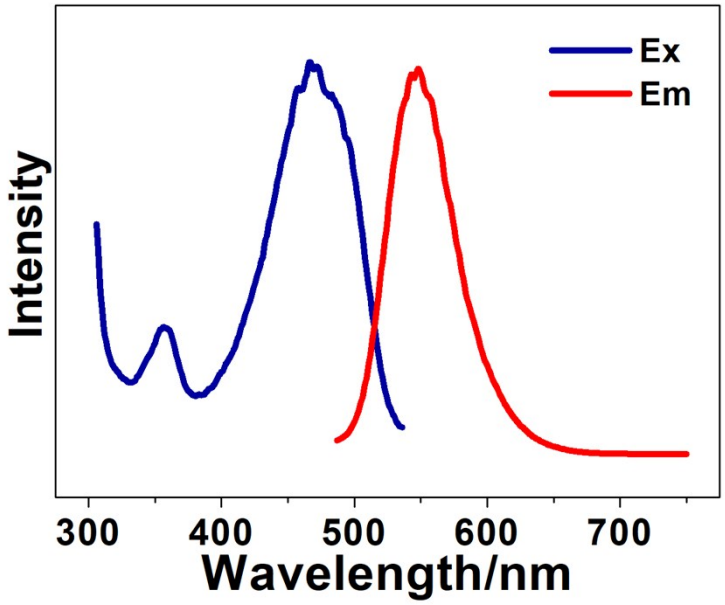

Fig. S1 Fluorescence excitation and emission spectra of i-CDs.

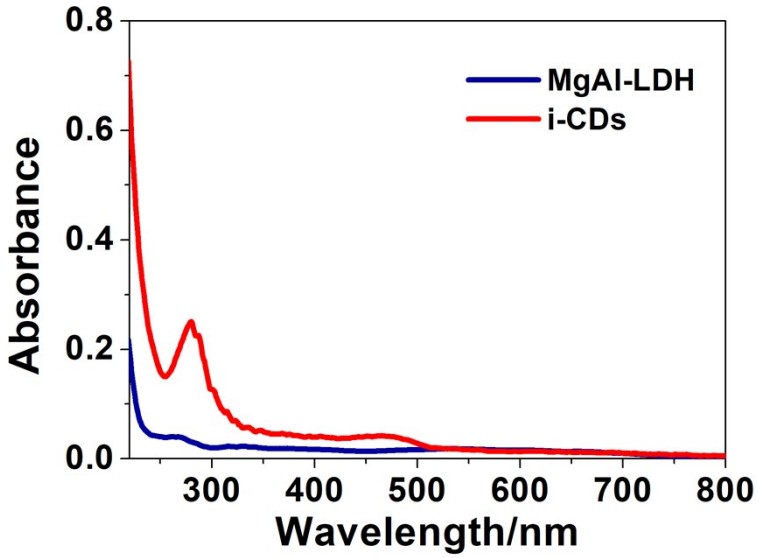

Fig. S2 UV-vis absorption spectra of MgAl-LDH and i-CDs.

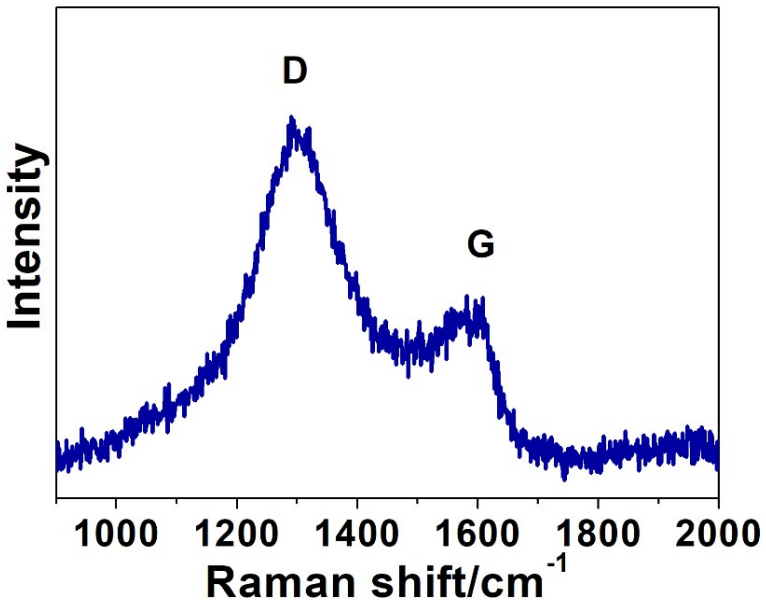

Fig. S3 Raman spectrum of i-CDs.

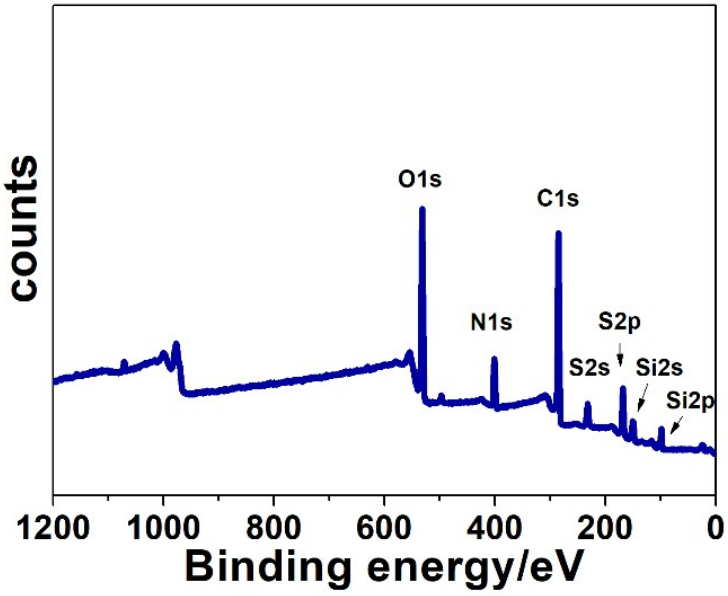

Fig. S4 XPS survey spectrum of i-CDs.

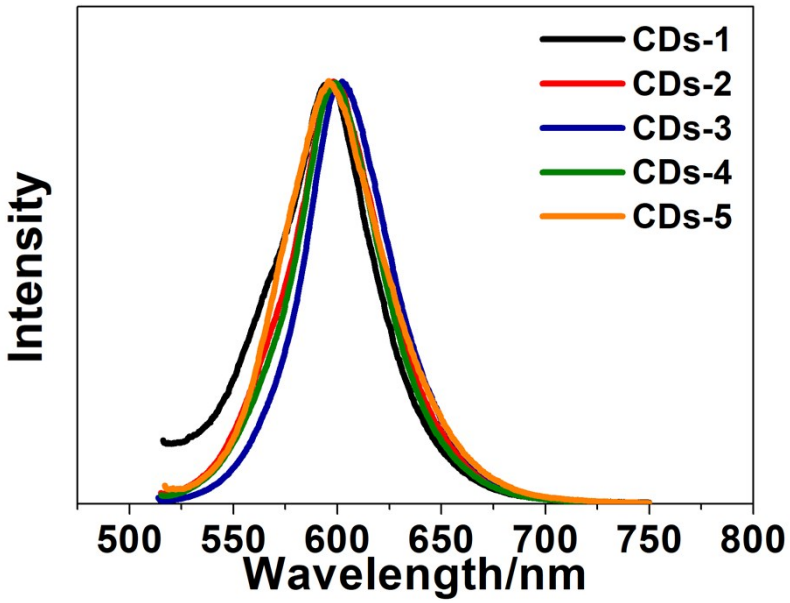

Fig. S5 Fluorescence emission spectra of CDs-*X* (*X*= 1-5, CDs synthesized with different DBS/DS ratio under hydrothermal condition without LDHs).

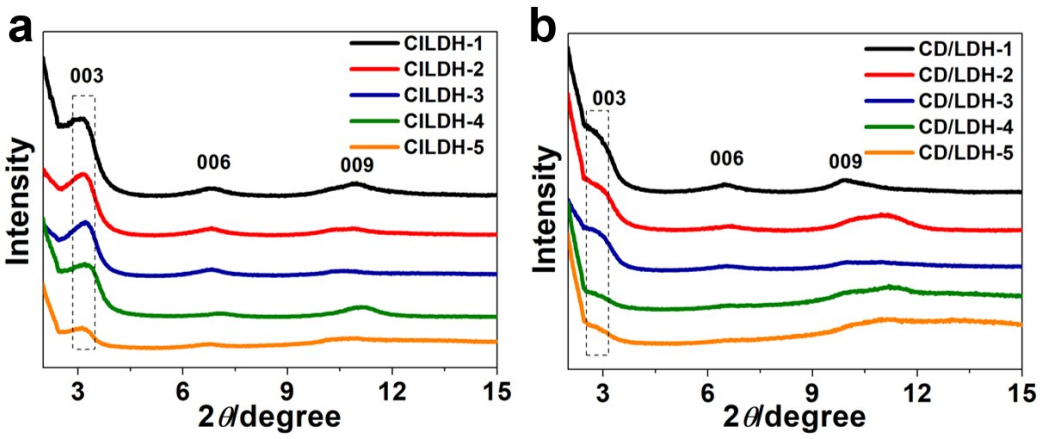

Fig. S6 XRD patterns of a) CILDH-*X* (*X* = 1-5) and b) CDs/LDH-*X* (*X* = 1-5).

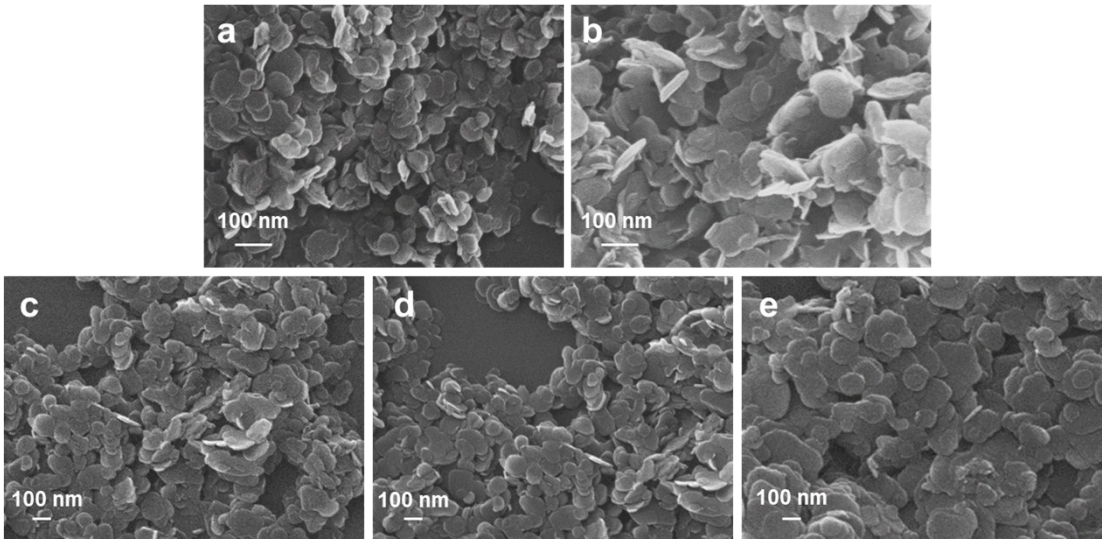

Fig. S7 SEM images of a) CILDHs-1, b) CILDH-2, c) CILDH-3, d) CILDH-4 and e) CILDH-5.

Table S3 Solid state Quantum yields (QYs) of CDs-based solid-state materials with long-wavelength emission

Reference	Emission wavelength/nm	QY/%
ACS Nano, 2015, **9**, 312	574	0.1
Small, 2017, **13**, 1700075	640	9.6
Adv. Sci., 2017, **4,** 1700395	575, 625	5.54, 8.5
Carbon, **2018, 136,** 359	537	17.6
Chem. Commun., 2019, **55**, 6531	550	11.0
Small, 2019, **15**, 1901161	605	32.7

Table S4 The fitting of fluorescence decay data of CDs/LDH-*X* (*X* = 1-5)

Sample	τ_i (ns)[a]	A_i (%)	$<\tau>$ (ns)	χ^{2}[b]
	0.38	29.57		
CDs/LDH-1	2.801	30.94	4.52	1.219
	8.955	39.49		
	0.524	23.59		
CDs/LDH-2	4.970	43.28	6.23	1.257
	11.930	33.13		
	0.363	25.38		
CDs/LDH-3	3.608	30.42	5.53	1.082
	9.811	44.2		
	0.518	30.73		
CDs/LDH-4	3.765	38.38	5.05	1.322
	11.140	30.89		
	0.337	48.48		
CDs/LDH-5	3.145	37.02	2.81	1.049
	10.230	14.5		

[a] τ_i (i=1, 2, 3) is the fitted fluorescence lifetime. A_i is the percentage of τ_i. In this case, $<\tau>=A_1\tau_1+A_2\tau_2+A\tau_3$; $A_1+A_2+A_3=1$. [b] The goodness of fit is indicated by the value of χ^2.

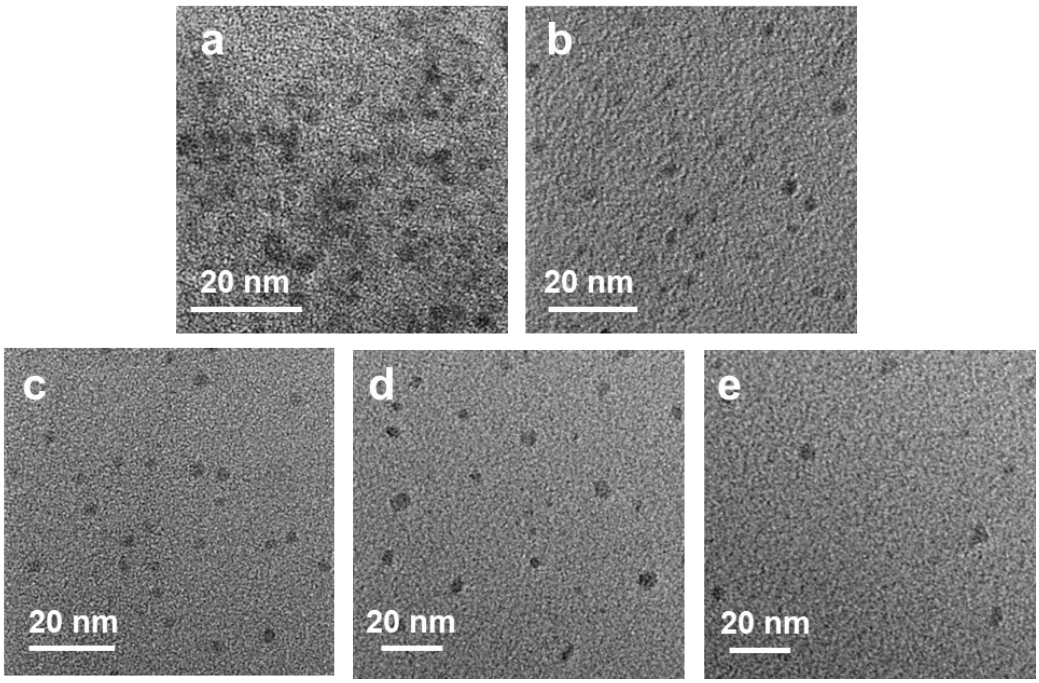

Fig. S8 TEM images of a) i-CD-1, b) i-CD-2, c) i-CD-3, d) i-CD-4 and e) i-CD-5.

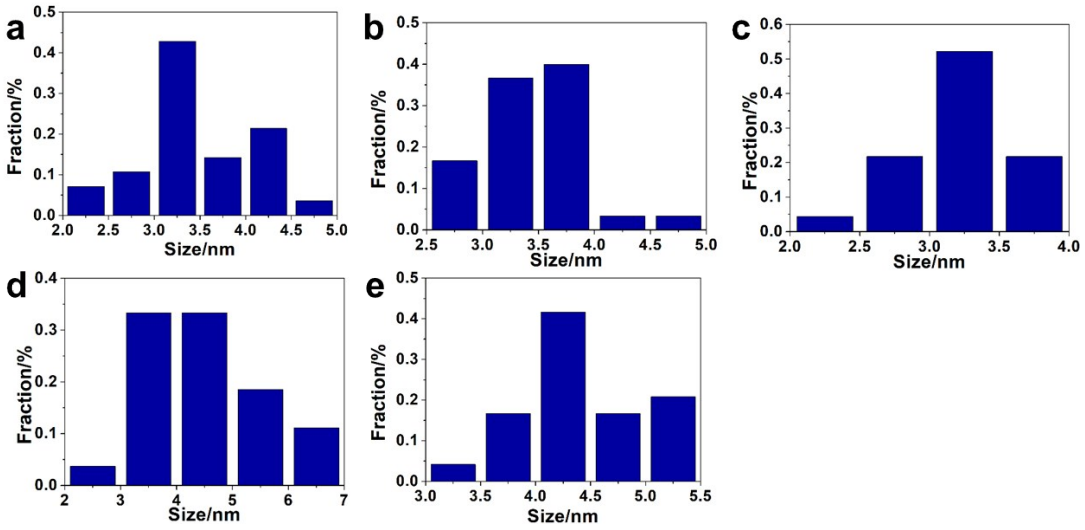

Fig. S9 Particle size distributions of a) i-CD-1, b) i-CD-2, c) i-CD-3, d) i-CD-4 and e) i-CD-5.

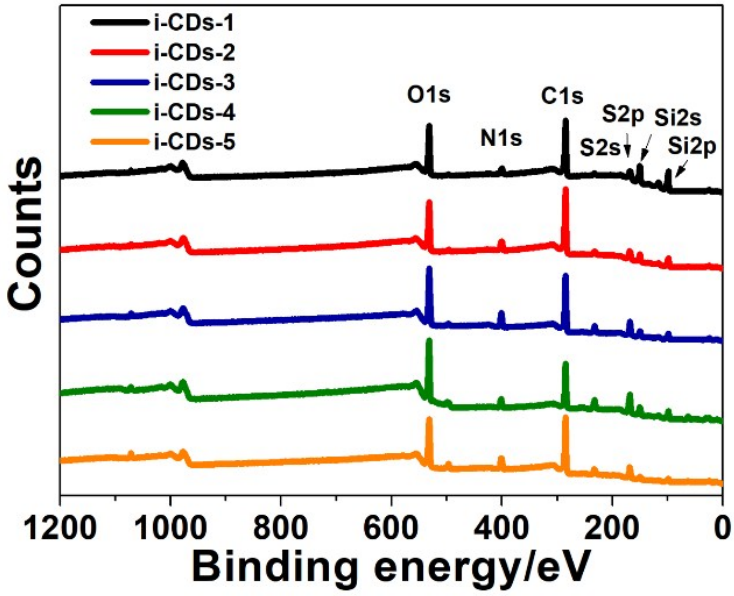

Fig. S10 XPS survey spectra of i-CDs-*X* (*X* = 1-5)

Table S5. Elements content of i-CDs-*X* (*X* = 1-5)

Samples	C% (atom%)	N% (atom%)	S% (atom%)	N/C
i-CDs-1	86.78	6.49	6.74	0.075
i-CDs-2	86.60	8.26	5.14	0.095
i-CDs-3	79.85	8.58	11.57	0.107
i-CDs-4	76.53	9.20	14.27	0.120
i-CDs-5	82.70	10.69	6.61	0.129

Table S6. The nitrogen speciation percentages of i-CDs-*X* (*X* = 1-5) integrated from N1s XPS spectra

Samples	Graphitic N (401.5 eV)	Pyrrolic N (399.6 eV)
i-CDs-1	55%	45%
i-CDs-2	57%	43%
i-CDs-3	75%	25%
i-CDs-4	84%	16%
i-CDs-5	86%	14%

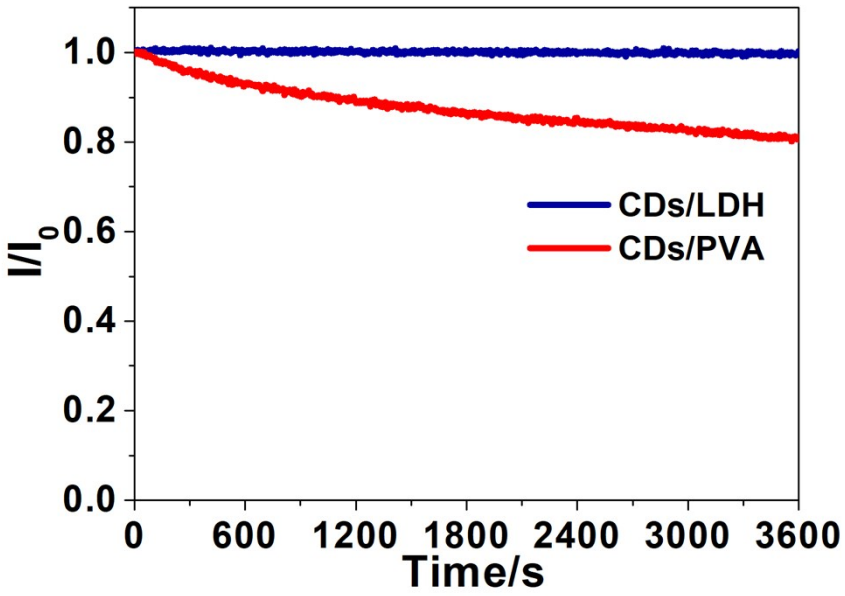

Fig. S11 Photostability of the CDs/LDH and CDs/PVA upon irradiation by UV light (365 nm) for 3600 s.

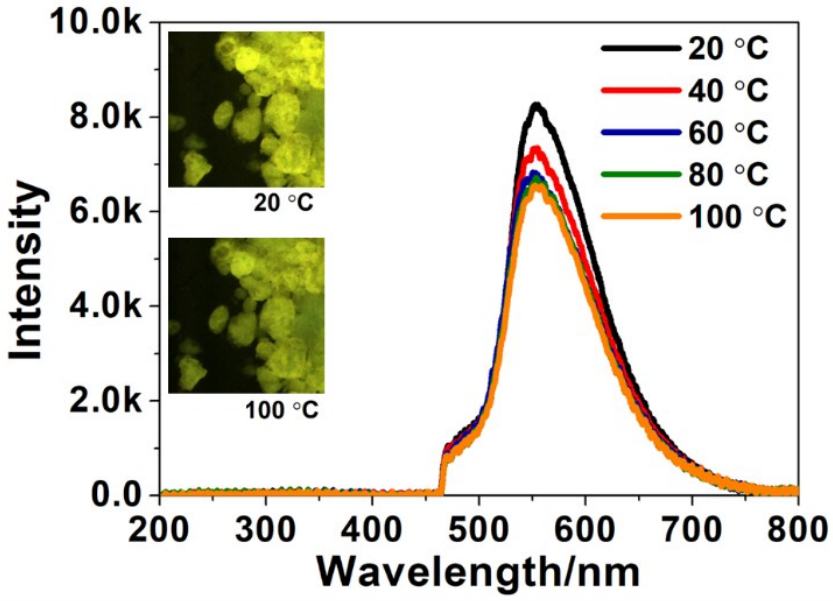

Fig. S12 In situ fluorescence spectra of CDs/LDHs-3 in the range from 20 °C to 100 °C; the insets display fluorescent microscopy images at 20 °C and 100 °C.

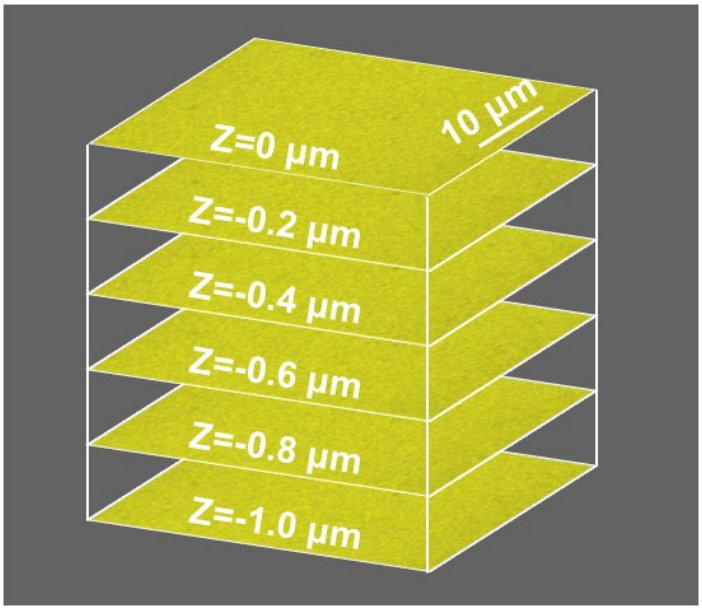

Fig. S13 Cross profile microscopy images of CDs/LDH@PVA film with various film thickness.

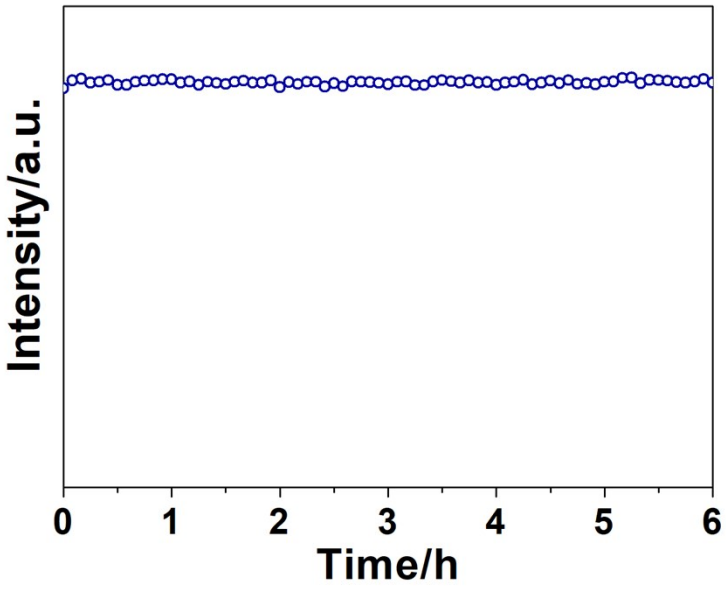

Fig. S14 Stability of CDs/LDH based WLED under operation conditions for 12 h.