

Supporting information

Interparticle distance as a key factor for controlling the dual-emission properties of carbon dots

Hyo Jeong Yoo, Byeong Eun Kwak and Do Hyun Kim*

Department of Chemical & Biomolecular engineering, Korea Advanced institute of Science and Technology (KAIST), 291 Daehak-ro, Yuseong-gu, Daejeon 34141, Republic of Korea.

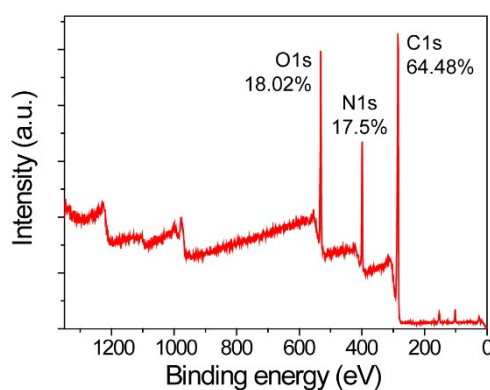


Fig. S1 XPS survey scan spectrum of the CDs.

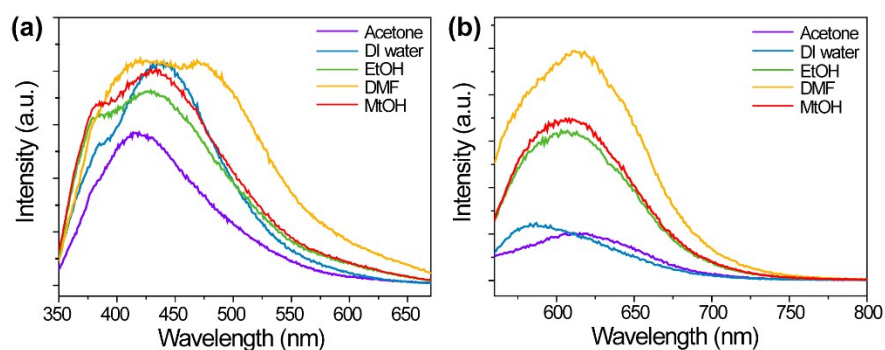


Fig. S2 PL spectra of the CD solutions dissolved in DMF excited at (a) 340 nm and (b) 550 nm. The solution concentration was fixed at 0.01 mg/mL.

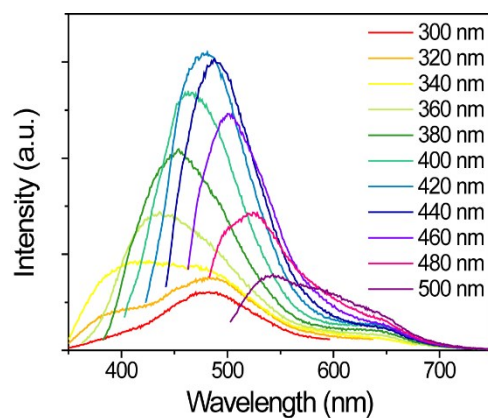


Fig. S3 Excitation dependent PL spectra of the CDs dissolved in DMF with the concentration of 0.01 mg/mL.

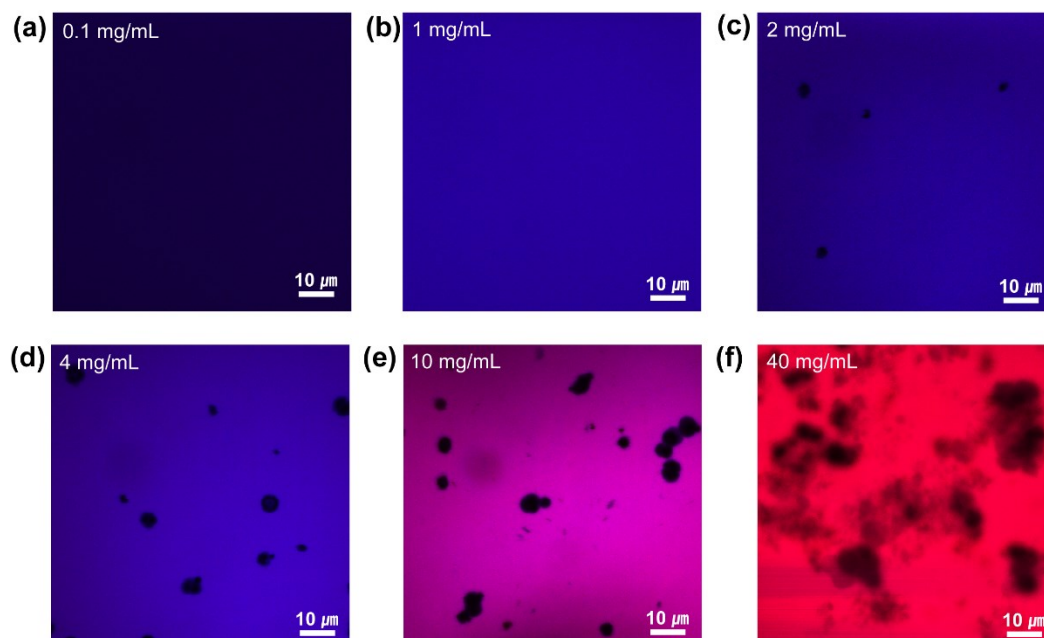


Fig.S4 Confocal laser scanning microscopy images of the CD solutions with the concentration of (a) 0.1, (b) 1, (c) 2, (d) 4, (e) 10, and (f) 40 mg/mL dissolved in DMF under 405 nm excitation.

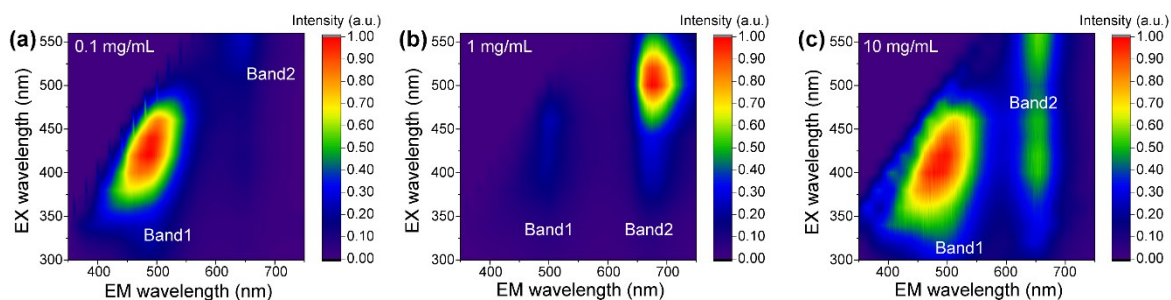


Fig. S5 PL maps of the dialyzed CD solutions dissolved in DMF with the concentrations of (a) 0.1, (b) 1, and (c) 10 mg/mL.

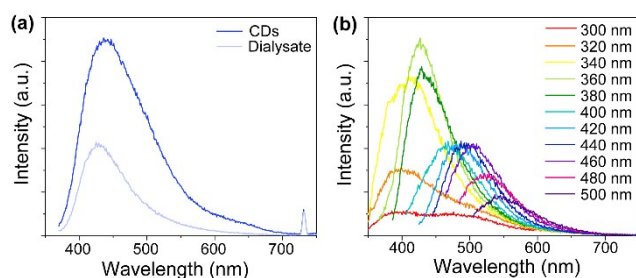


Fig. S6 (a) PL spectra of the CDs and dialysate under 365 nm excitation and (b) excitation-dependent PL spectra of the dialysate. All of the solution concentration was fixed at 0.01 mg/mL dissolved in DMF.

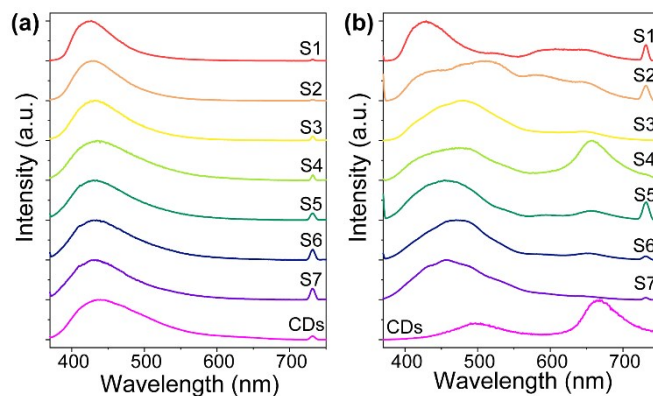


Fig. S7 PL spectra of S1, S2, S3, S4, S5, S6, S7, and the CDs with the concentration of (a) 0.01 mg/mL and (b) 1 mg/mL dissolved in DMF under 365 nm excitation.

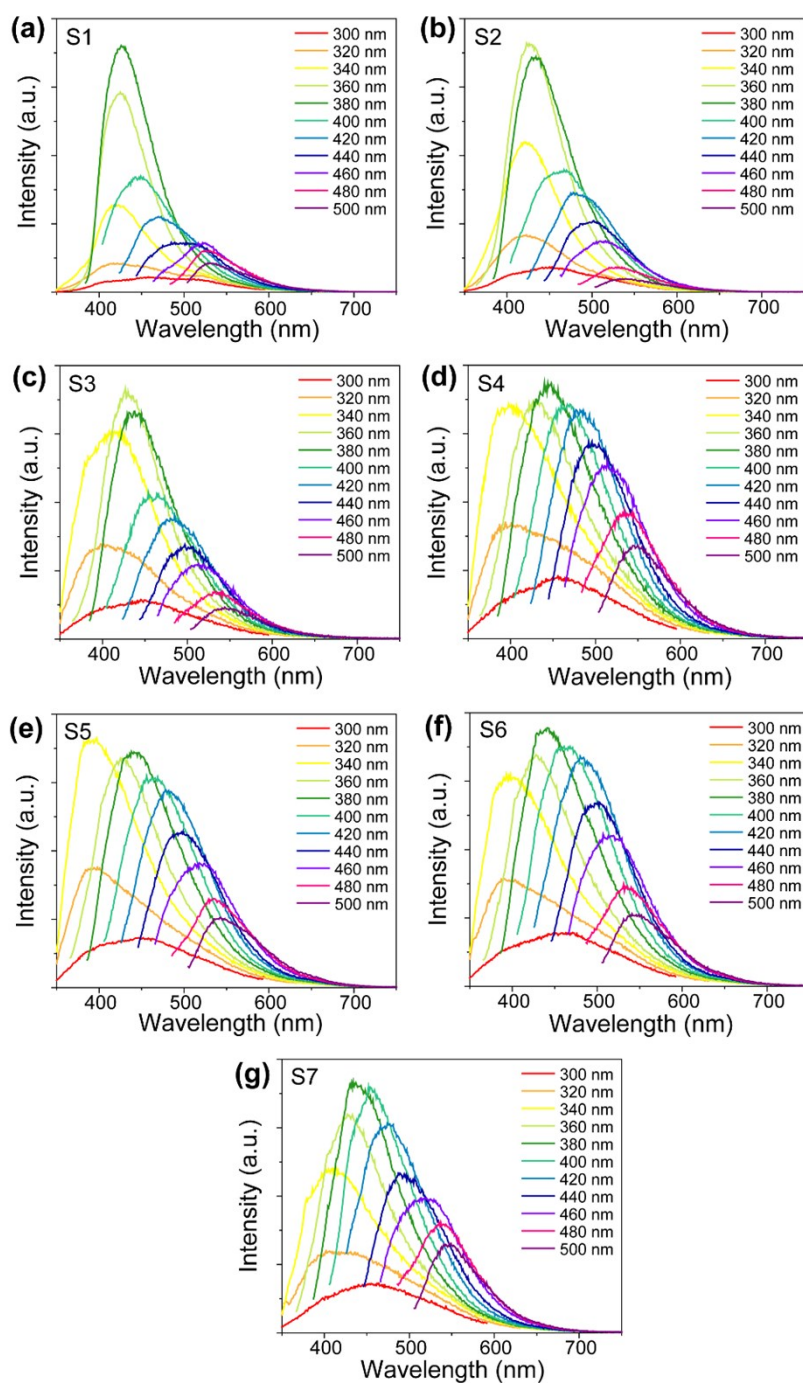


Fig. S8 PL spectra of (a) S1, (b) S2, (c) S3, (d) S4, (e) S5, (f) S6, and (g) S7 with the concentration of 0.01 mg/mL dissolved in DMF under different excitation wavelengths ranging from 300 to 500 nm with the increment of 20 nm.

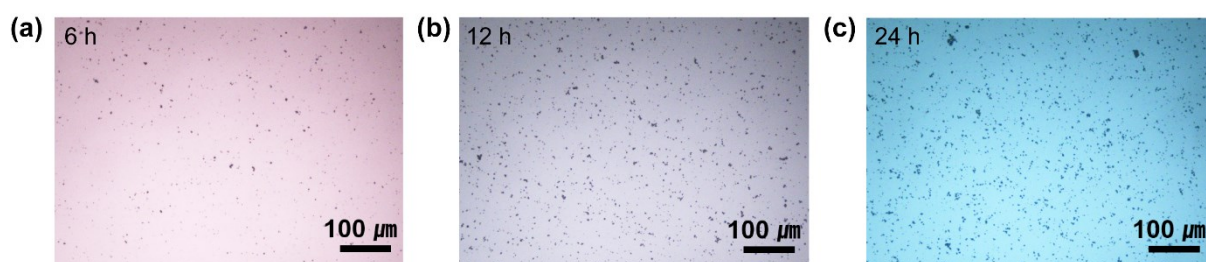


Fig. S9 Fluorescence microscope images of the CDs synthesized with different reaction time of (a) 6 h, (b) 12 h, and (c) 24 h.

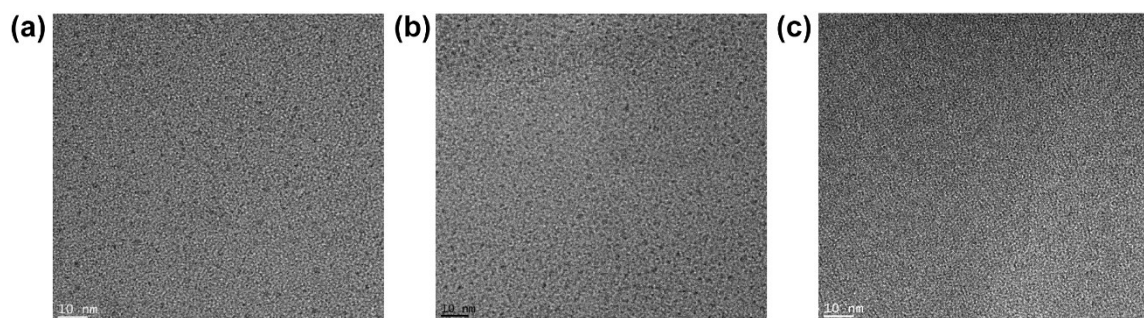


Fig. S10 TEM images of the CDs synthesized with different reaction times of (a) 6 h, (b) 12 h, and (c) 24 h.

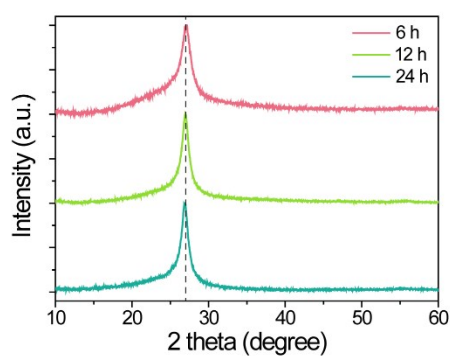


Fig. S11 XRD patterns of the CDs with different reaction times.

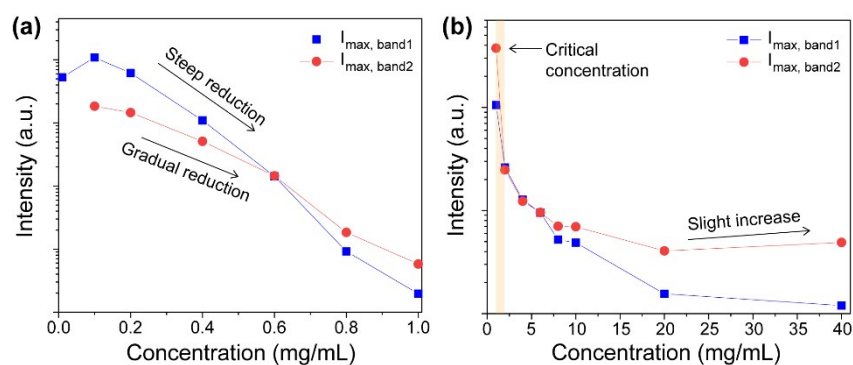


Fig. S12 Concentration-dependent change of emission intensity maxima of band 1 and band 2 under (a) low concentration region from 0.01 to 1 mg/mL and (b) high concentration region from 1 to 40 mg/mL. The concentration of 1 mg/mL case was added in the high concentration region for comparison.

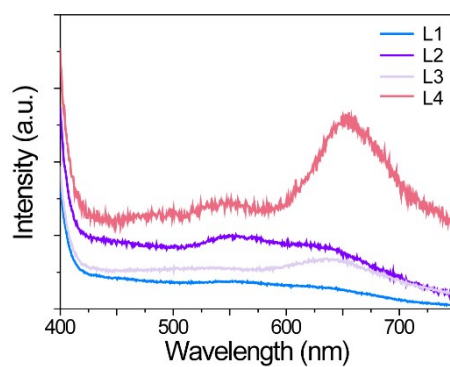


Fig. S13 PL spectra of the fabricated WLEDs with different concentrations of the CDs.

Conc. (mg/mL)	τ_1 (ns)	A_1 (%)	τ_2 (ns)	A_2 (%)	$\tau_{avg.}$ (ns)
0.01	2.7455	35.71	7.5477	64.29	6.741
0.1	3.0466	36.69	7.7684	63.31	6.894
0.2	3.1864	32.84	7.9989	67.16	7.214
0.4	3.8764	31.95	9.0424	68.05	8.176
0.6	3.8714	23.2	9.0499	76.8	8.458

Table. S1 PL lifetime results of the CD solutions with different concentrations dissolved in DMF excited at 375 nm.

LED	Chromaticity coordinate	CCT(K)	CRI
L1	(0.301, 0.298)	7738	93.6
L2	(0.324, 0.326)	5900	95.3
L3	(0.338, 0.321)	5196	86.8
L4	(0.375, 0.335)	3794	77

Table. S2 Photoelectric parameters of the CD-based WLEDs of L1, L2, L3, and L4.