Supporting Information

Red, Orange, yellow and Green Luminescence by Carbon Dots: Hydrogen Bond Induced Solvation Effect

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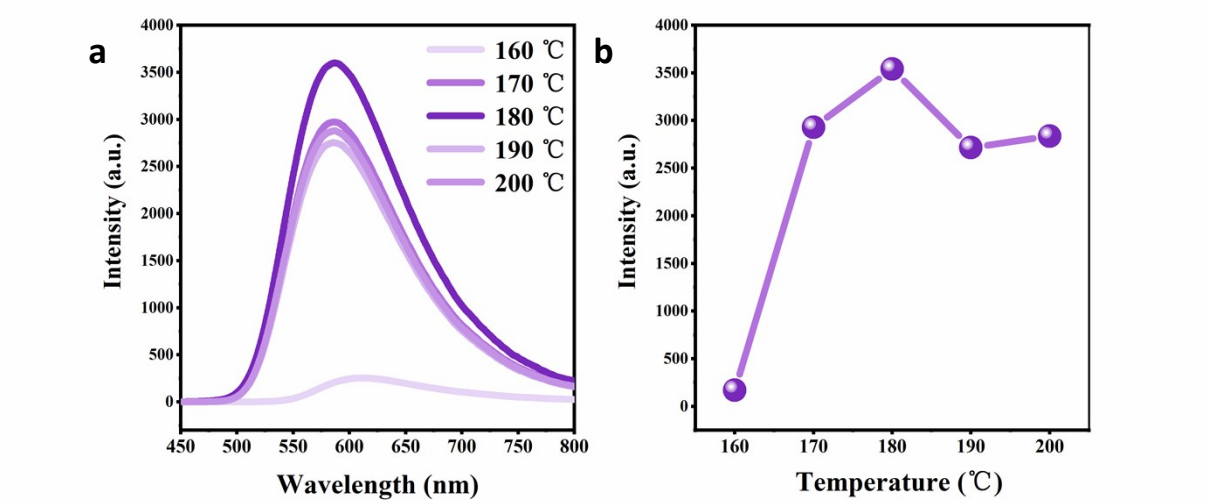

Figure S1. a) Fluorescence spectrum of CDs synthesized at different temperatures. b) The line chart of the luminescence intensity of synthesized CDs at different temperatures.

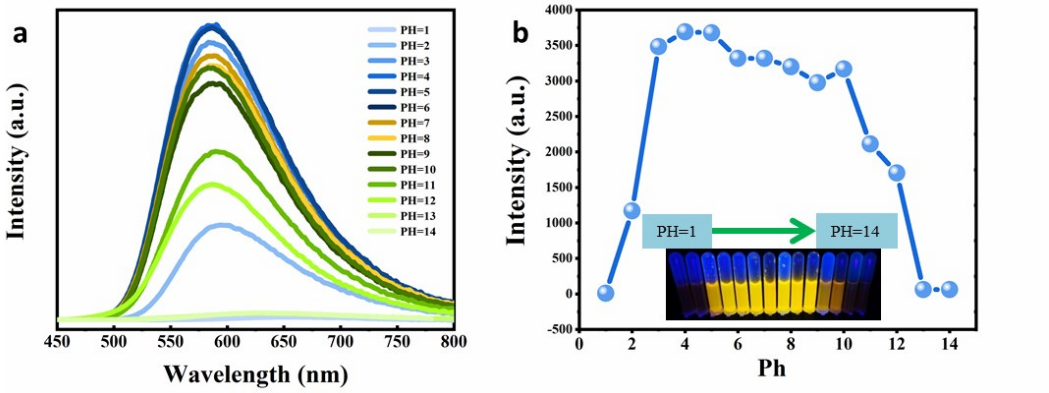

Figure S2. Fluorescence spectrum CDs solution at different PH. b) The line chart of the luminescence intensity of synthesized carbon dots at different PH.

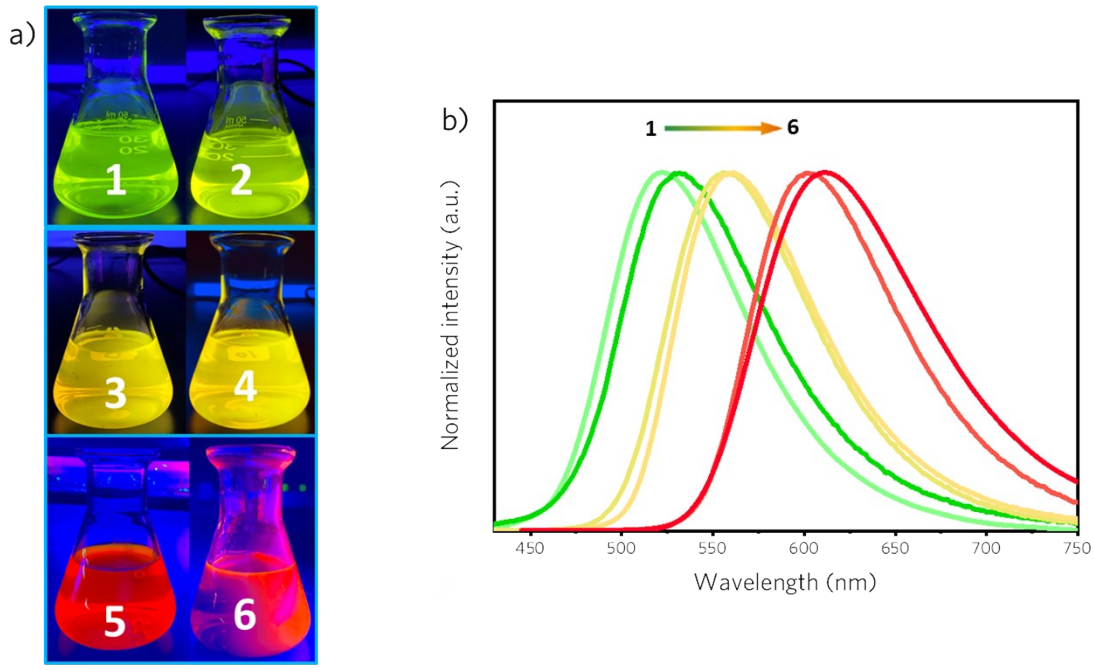

Figure S3. a) Photographs of CDs in different solvents under 365 nm excitation, b) Fluorescence spectrum of CDs in different solvents under 365 nm excitation. (1: acetone, 2:DMSO, 3: methyl alcohol, 4: propyl alcohol, 5: acetic acid, 6: formic acid)

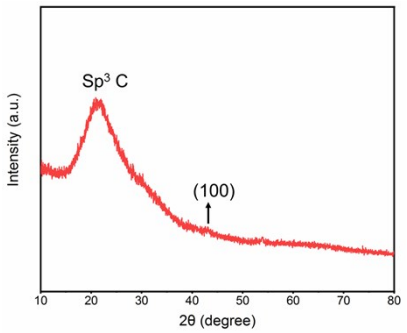

Figure S4. XRD pattern of CDs powder.

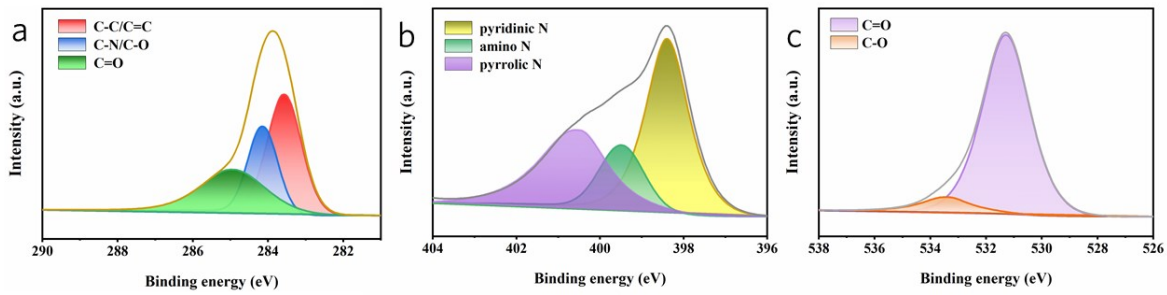

Figure S5. XPS spectrum of CDs powers , high-resolution XPS spectra of C 1s a), N 1s b), O 1s c).

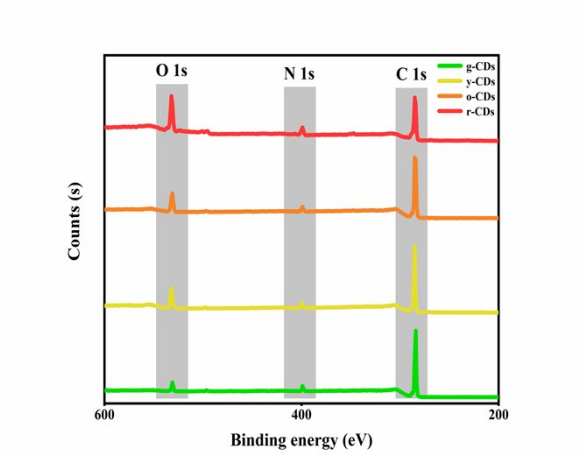

Figure S6. XPS spectrum of g-CDs, y-CDs, o-CDs and r-CDs.

Table S1. Element content of high-resolution XPS spectrum of g-CDs, y-CDs, o-CDs and r-CDs.

Sample	g-CDs	y-CDs	o-CDs	r-CDs
C	89.29%	83.96%	80.99%	67.23%
O	5.62%	11.39%	14.25%	23.92%
N	5.1%	4.66%	4.76%	8.77%

Table S2. Chemical bond content of high-resolution C 1s of g-CDs, y-CDs, o-CDs and r-CDs.

Sample	g-CDs	y-CDs	o-CDs	r-CDs
C-C/C=C	68.89%	63.46%	15.63%	17.32%
C-N/C-O	27.40%	32.69%	54.94%	28.38%
C=O	3.71%	3.84%	26.13%	48.45%
COOH	/	/	3.30%	5.85%

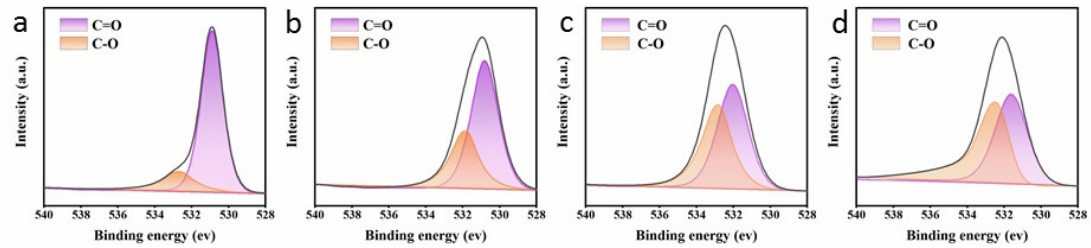

Figure S7. High-resolution O 1s spectrum of g-CDs, y-CDs, o-CDs and r-CDs a-d).

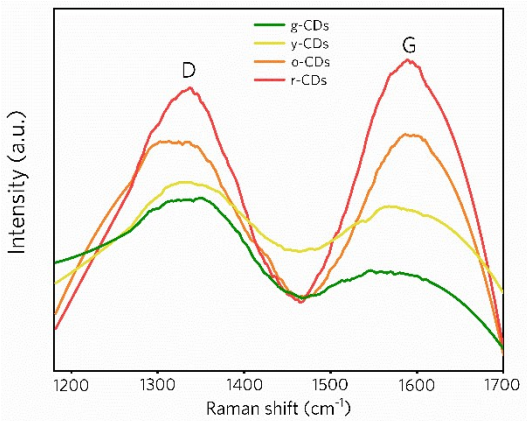

Figure S8. Raman spectra of g-CDs, y-CD, o-CDs, r-CD.

Table S3. A_D/A_G of g-CDs, y-CDs, o-CDs and r-CDs.

Sample	g-CDs	y-CDs	o-CDs	r-CDs
A_D/A_G	1.67	1.25	1.03	0.85

Table S4. QY, lifetimes and photostability of the g-CDs, y-CDs, o-CDs, r-CDs, and composites. (Photostability refers to the attenuation's percentage by continuing radiation for 10 h, under excitation at 400 nm. Voltage is 600 V)

	QY (%)	Lifetimes (ns)	Light stability (%)
g-CDs solution	18.05%	3.38 ns	85%
y-CDs solution	33.53%	2.42 ns	83%
o-CDs solution	6.60%	2.34 ns	87%
r-CDs solution	1.05%	1.71 ns	85%
g-CDs/cellulose	2.25%	3.44 ns	90%
y-CDs/cellulose	1.90%	3.59 ns	91%
o-CDs/cellulose	5.23%	3.30 ns	90%
r-CDs/cellulose	3.71%	3.15 ns	89%
g-CDs/starch	6.77%	3.75 ns	90%
y-CDs/starch	2.47%	3.72 ns	95%
o-CDs/starch	3.40%	3.68 ns	92%
r-CDs/starch	5.03%	3.29 ns	90%
g-CDs/B_2O_3	5.90%	5.06 ns	89%
y-CDs/B_2O_3	6.50%	3.84 ns	87%
o-CDs/B_2O_3	2.10%	3.72 ns	89%
r-CDs/B_2O_3	2.70%	3.89 ns	90%

Table S5. K_{NR} of the g-CDs, y-CDs, o-CDs, r-CDs.

	g-CDs	y-CDs	o-CDs	r-CDs
$K_{NR(ns)}$	0.2958	0.2967	0.3991	0.5787

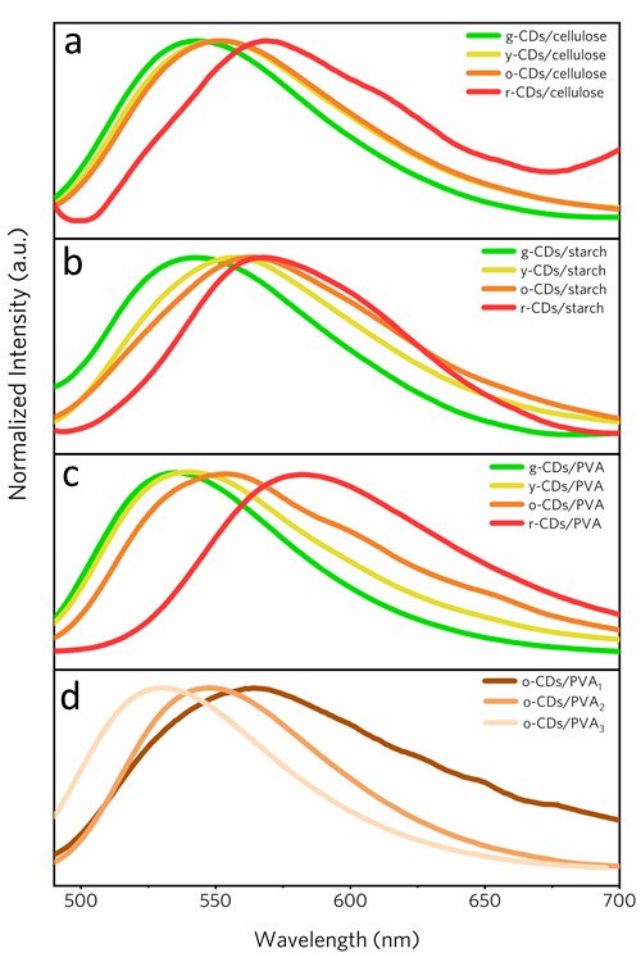

Figure S9. The normalized fluorescence spectrum of the CDs/cellulose a), CDs/starch b) and CDs/PVA c) state. d) The normalized fluorescence spectrum of different concentrations of CDs/PVA (1:1g/L, 2:5g/L, 3:10g/L).

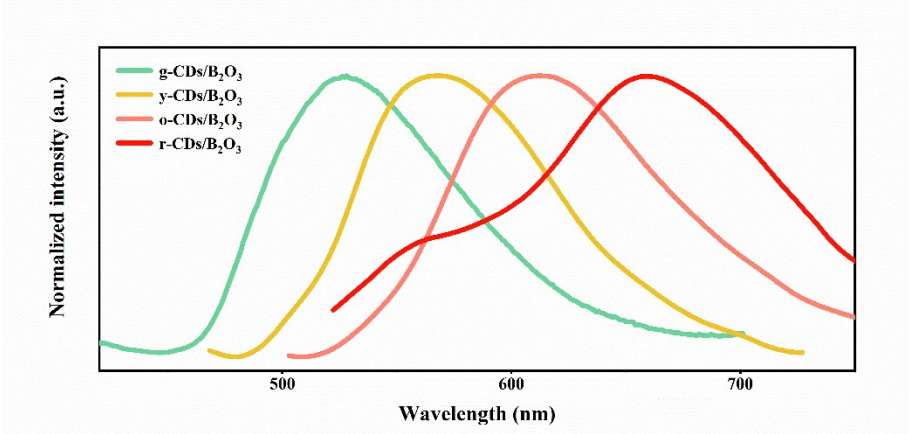

Figure S10. The normalized fluorescence spectrum of g-CDs/B_2O_3, y-CDs/B_2O_3, o-CDs/B_2O_3 and r-CDs/B_2O_3 phosphors.

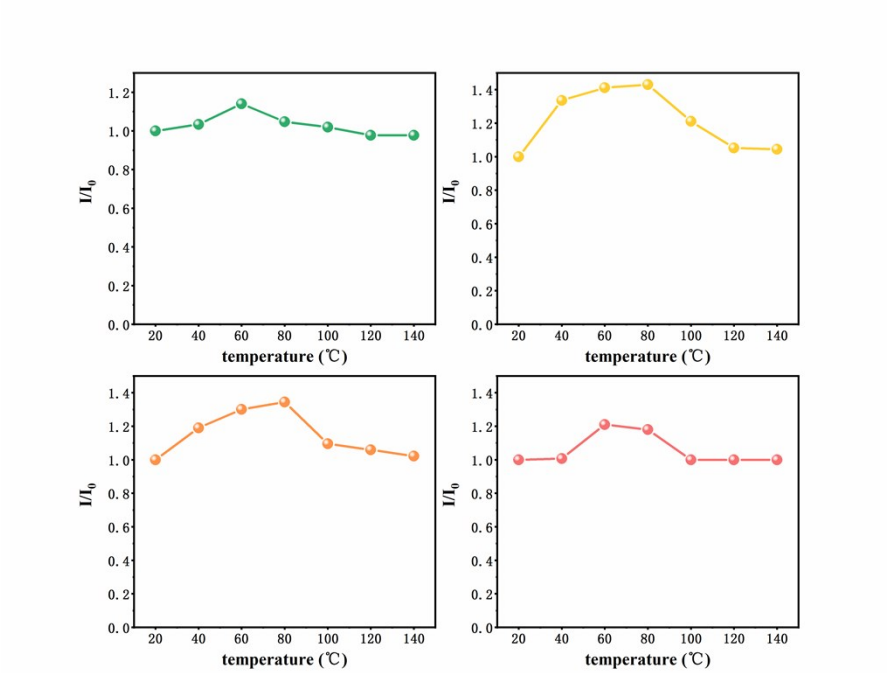

Figure S11. The integrated fluorescence intensity of g-CDs/B_2O_3 a) y-CDs/B_2O_3 b) o-CDs/B_2O_3 and r-CDs/B_2O_3 phosphors at different temperatures.

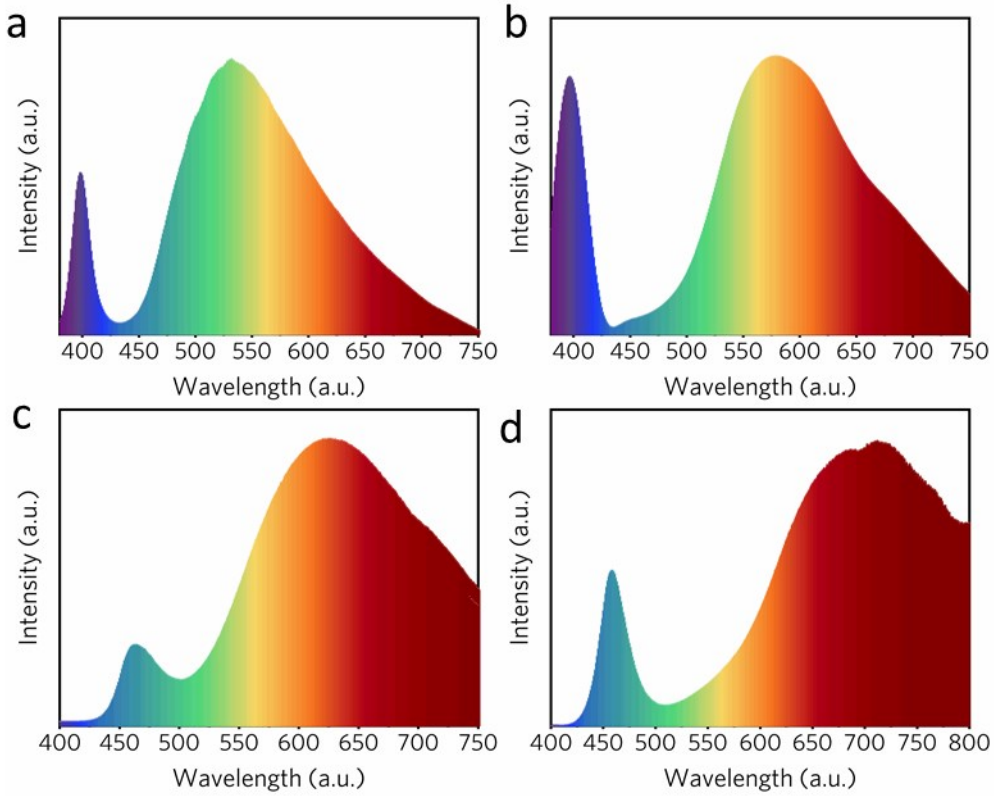

Figure S12. a-d) The photoluminescence spectrum of single emissive UV-LED and blue-LED coating g-CDs/B_2O_3, y-CDs/ B_2O_3, o-CDs/ B_2O_3, r-CDs/ B_2O_3, respectively.

Table S6. CIE color coordinates (x, y), CRI, CCT, and mass ratios (g-CDs/B_2O_3, y-CDs/B_2O_3, o-CDs/B_2O_3 , r-CDs/B_2O_3 phosphors) of WLEDs.

Number	Mass Ratio	CIE (x,y)	CCT (K)	CRI
460 nm chip-1	1:1:2:2	(0.64, 0.35)	1072	87.0
460 nm chip-2	1:1:1:1	(0.45, 0.33)	2170	81.6
395 nm chip-1	1:1:2:2	(0.43, 0.37)	2815	85.4
395 nm chip-2	1:1:1:1	(0.40, 0.36)	3335	74.9

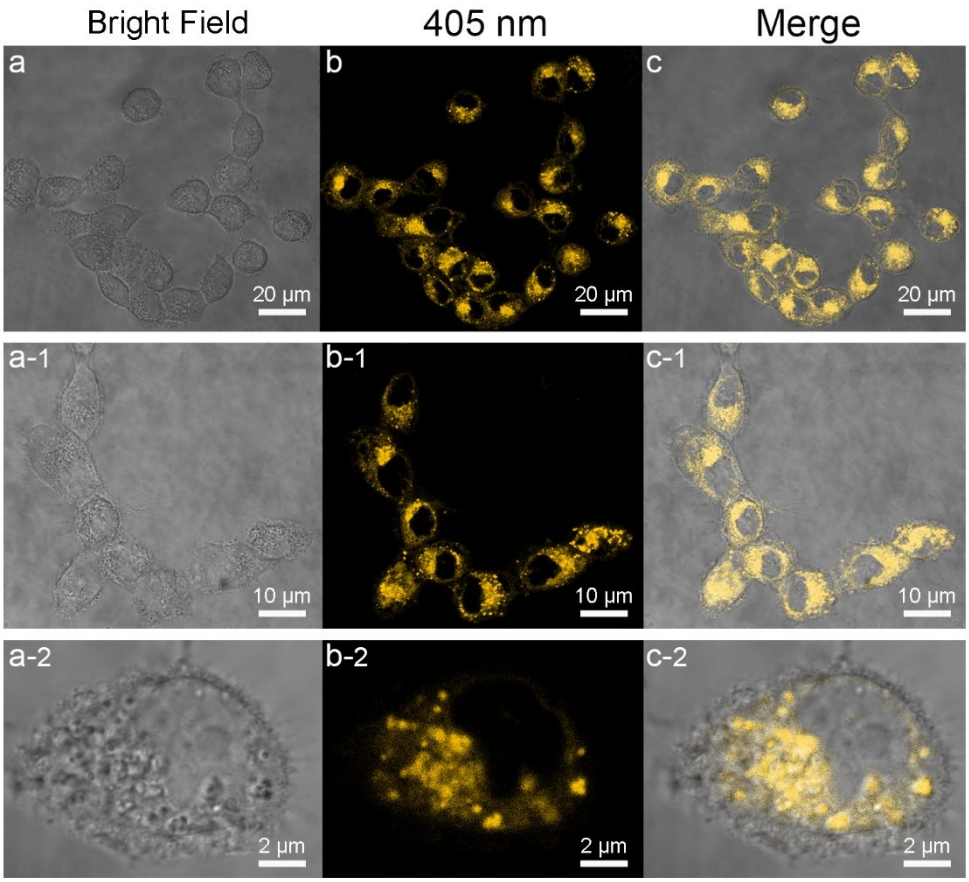

Figure S13. Laser scanning confocal microscopy images of Cal27 cells labeled by o-CDs aqueous solution (100 μg mL^{-1}) with bright field a), excitation at 405 nm b) and merge c).

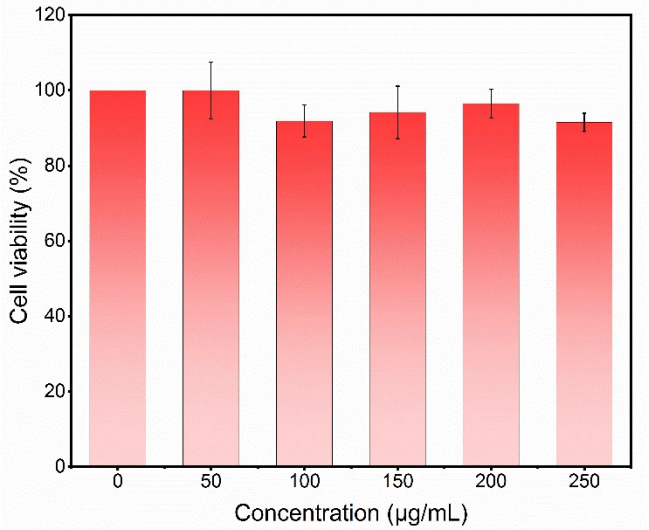

Figure S14. MTT assay on Cal27 cells line after incubating with different concentration of CDs solution.