Comprehensive exploration of long-wave emission carbon dots for brain tumor visualization

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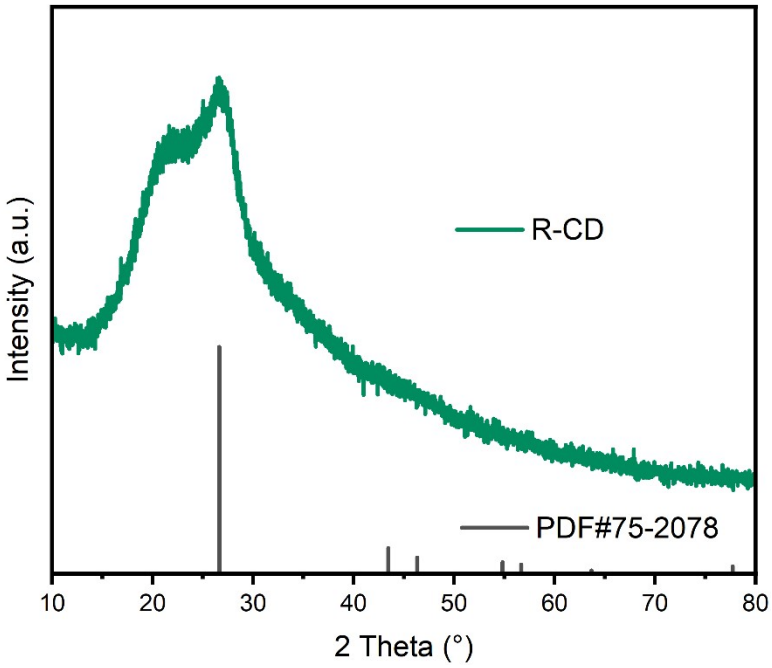

Figure S1 XRD pattern of R-CD

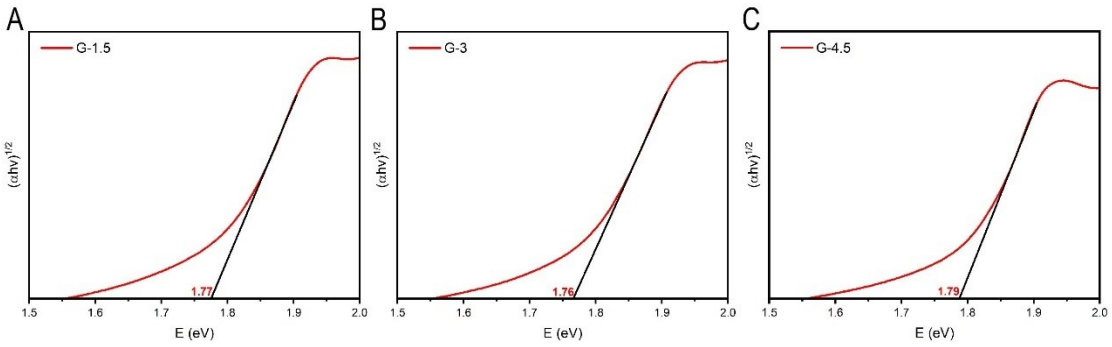

Figure S2 Bandgap of G-1.5, G-3, and G-4.5

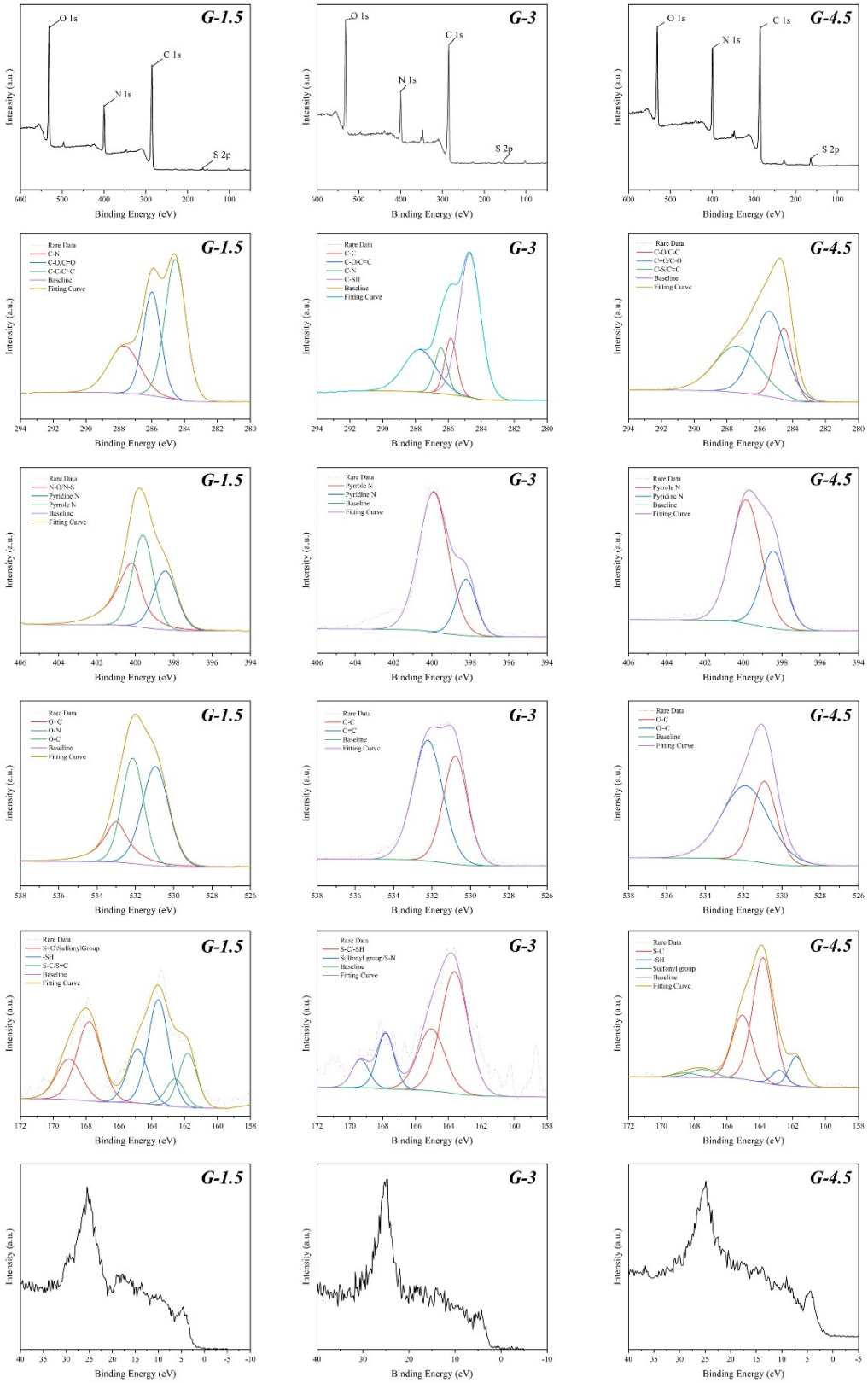

Figure S3 XPS spectra of G-1.5, G-3, and G-4.5 (Top: Survey spectrum, C 1s, N 1s, O 1s, S 2p, VB)

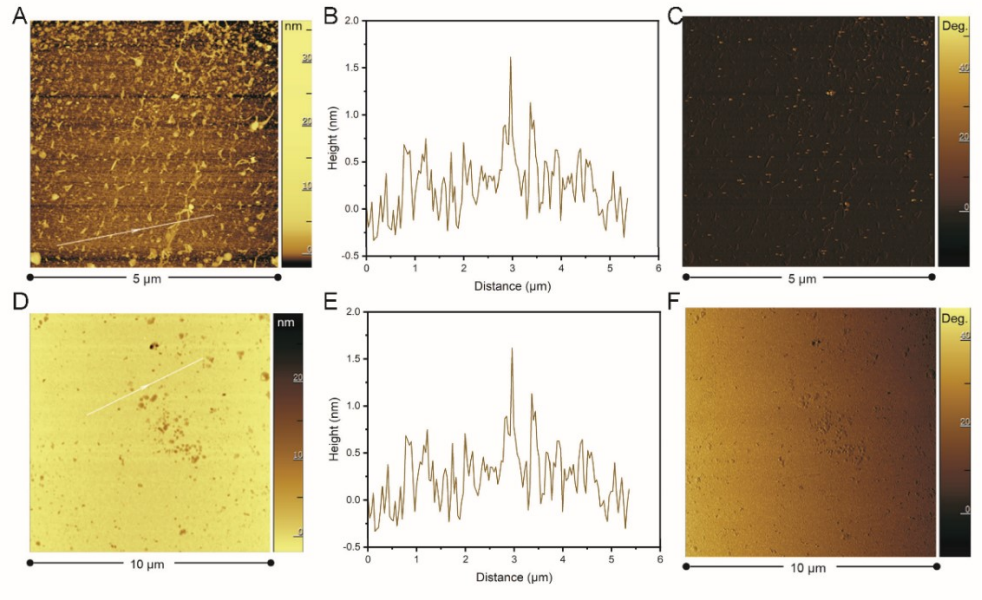

Figure S4 Typical AFM tapping mode images of R-CD with scanning probes of 7 nm (A, B, C) and 2 nm (D, E, F)

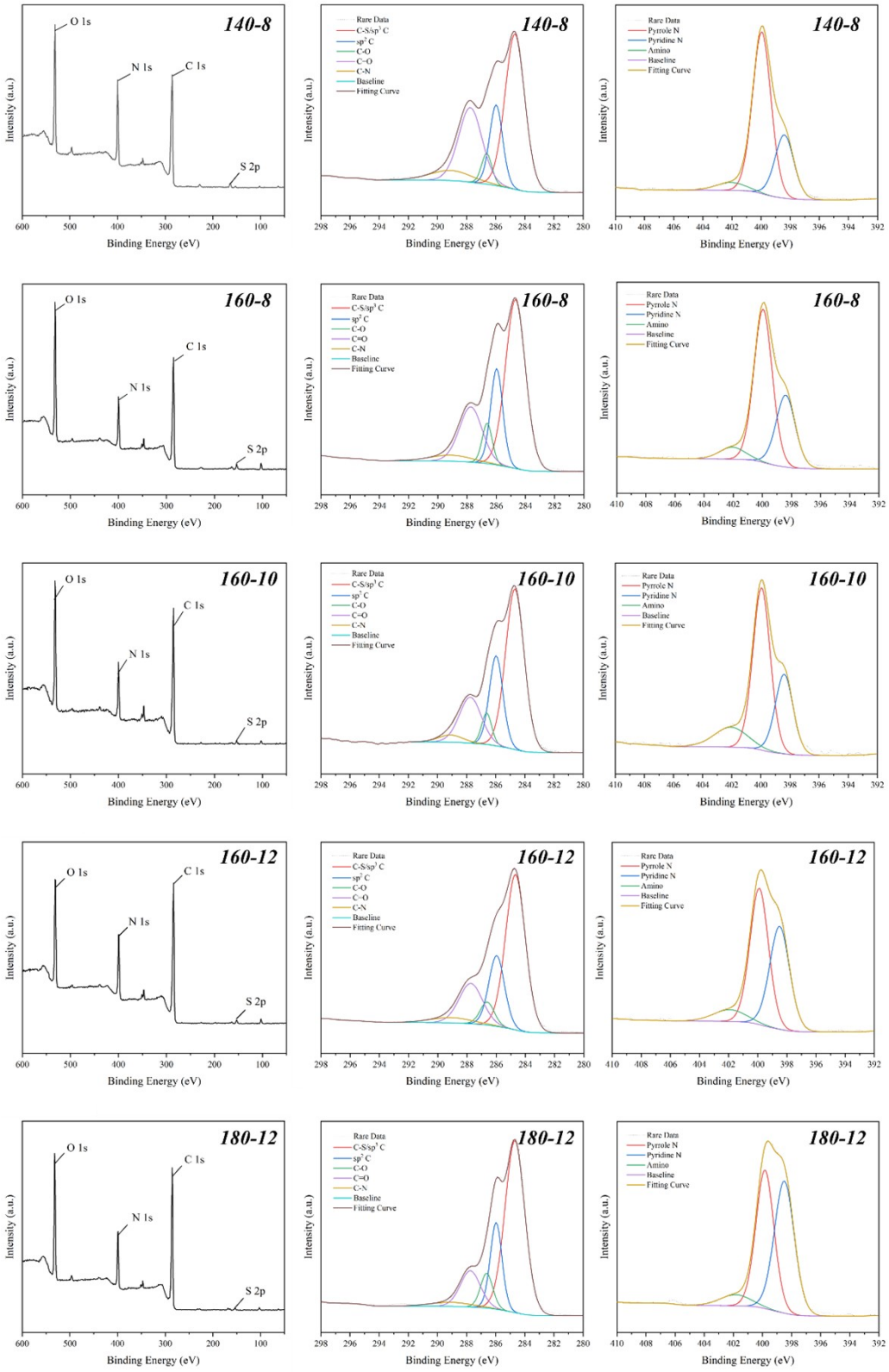

Figure S5 (A) XPS spectra of R-CD under different synthetic conditions (Left: Survey spectrum, C 1s, N 1s)

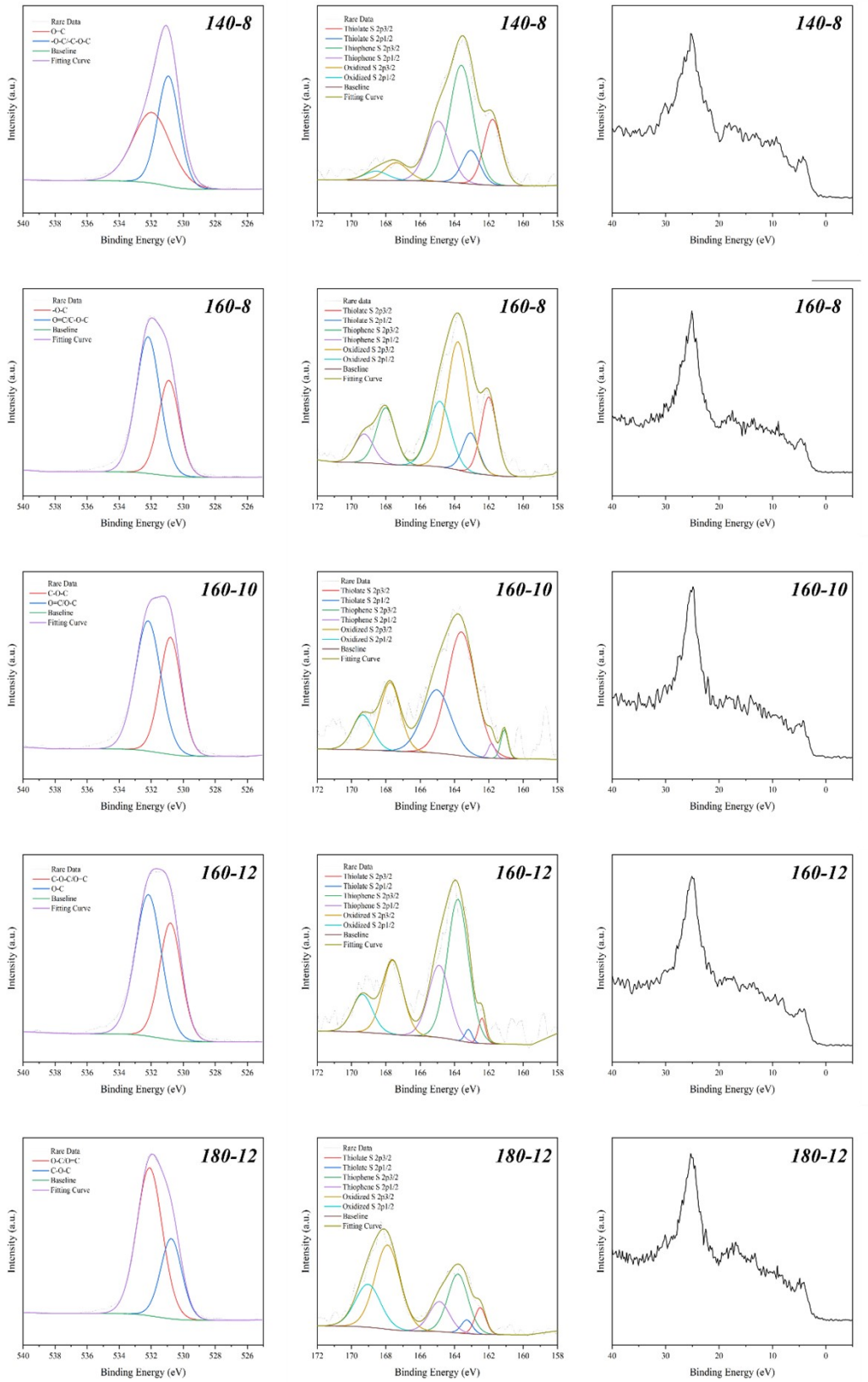

Figure S5 (B) XPS spectra of R-CD under different synthetic conditions (Left: O 1s, S 2p, VB)

Table S1 Element composition ratio and XPS valence band

	C	N	O	S	VB/HOMO
140-8	62.12%	18.21%	18.45%	1.23%	2.28 eV
160-8	62.14%	13.53%	23.40%	0.93%	2.55 eV
160-10	66.89%	11.84%	20.71%	0.56%	2.59 eV
160-12	63.93%	16.87%	18.74%	0.47%	2.45 eV
180-12	63.59%	15.28%	20.45%	0.67%	2.66 eV

Table S2 XPS analysis of C 1s

	sp^3 C	sp^2 C	C-O	C=O	C-N
140-8	46.51%	15.81%	4.65%	26.51%	6.51%
160-8	52.36%	18.32%	6.28%	19.37%	3.66%
160-10	52.08%	21.35%	5.73%	17.71%	3.13%
160-12	54.05%	19.46%	5.95%	16.76%	3.78%
180-12	59.17%	17.75%	7.69%	12.43%	2.96%

Table S3 XPS analysis of N 1s

	Pyrrole N	Pyridine N	Amino
140-8	67.30%	26.96%	5.74%
160-8	62.03%	30.54%	7.43%
160-10	64.38%	28.02%	7.60%
160-12	55.17%	39.44%	5.38%
180-12	40.44%	55.41%	4.15%

Table S4 XPS analysis of S 2p

	Thiolate S	Thiophene S	Oxidized S
140-8	27.20%	63.18%	9.62%
160-8	24.64%	20.65%	54.71%
160-10	68.64%	4.55%	26.82%
160-12	3.81%	63.98%	32.20%
180-12	8.08%	33.85%	58.08%

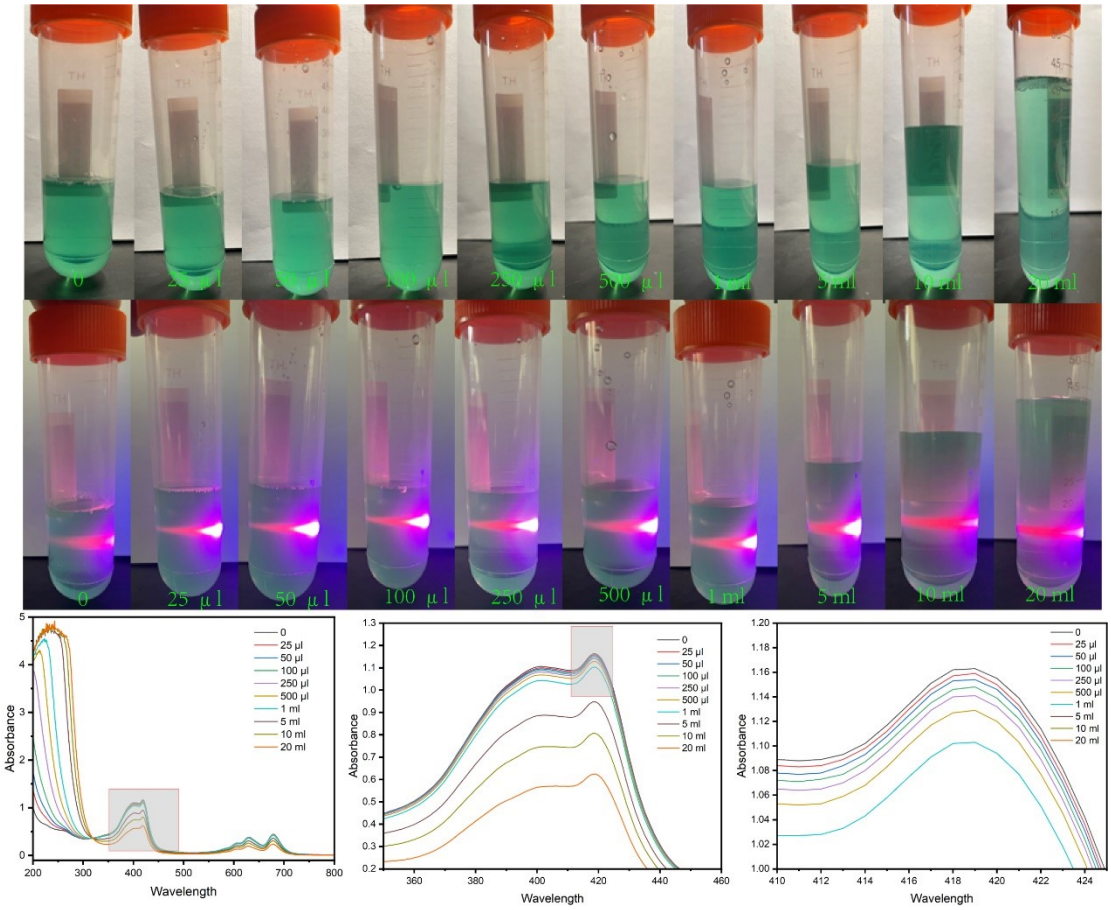

Figure S6 The apparent digital images, the sample images excited by 405nm laser, and UV-vis after adding different volumes of 5w% H_2O_2 solutions

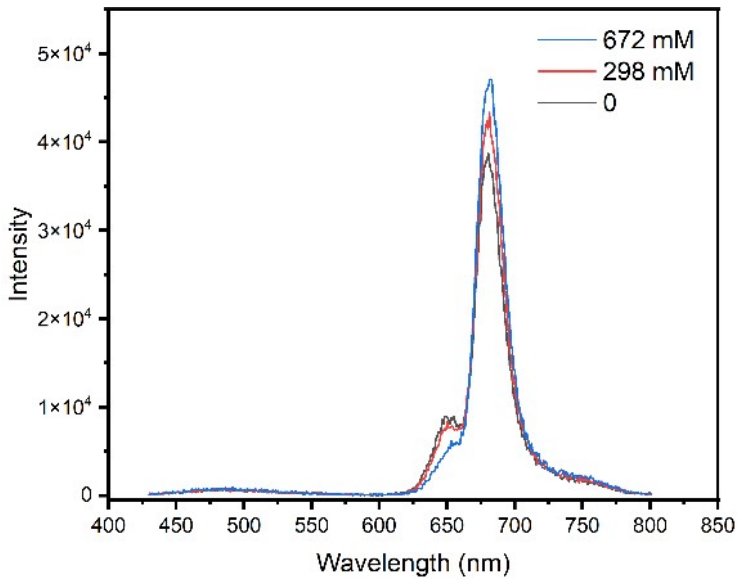

Figure S7 PL spectra of R-CD in H_2O_2 solutions with different concentrations