

CA:TU=1:20, Volume of APTES

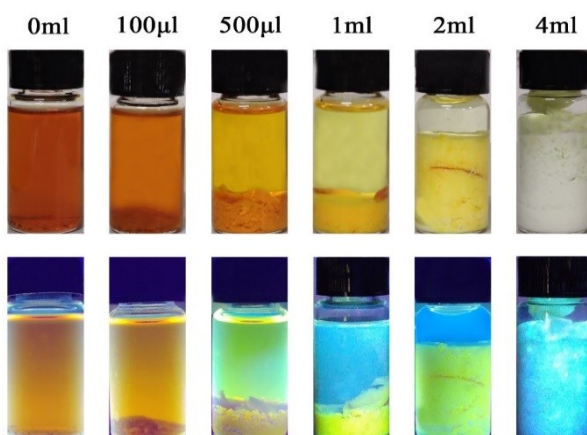


Figure s1. Optical images of S, N-CNDs/silica composites synthesized at different volume of APTES ($H_2O:EtOH=3:7$ (volume ratio, total 10 ml), $200\text{ }^\circ\text{C}$).

APTES=1ml, CA:TU=1:20

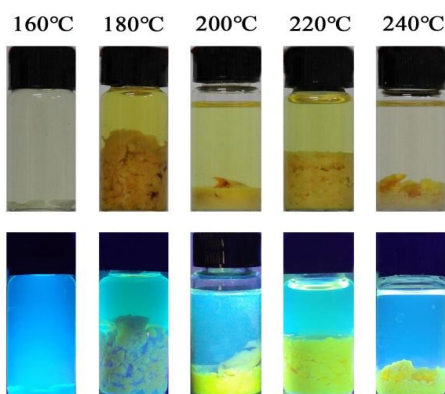


Figure s2. Optical images of S, N-CNDs/silica composites synthesized at different temperatures at $H_2O:EtOH=3:7$ (total 10 ml).

APTES=1ml, CA:TU=1:20, Volume ratio of $H_2O/EtOH$

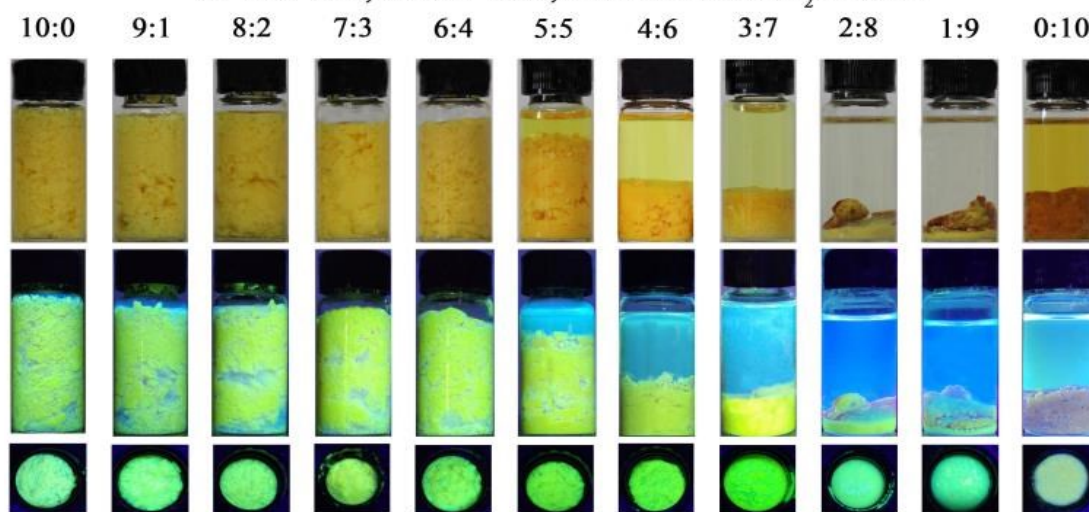


Figure s3. Optical images of S, N-CNDs/silica composites synthesized at different

volume ratio of H₂O and EtOH (total 10 ml, 200 °C).

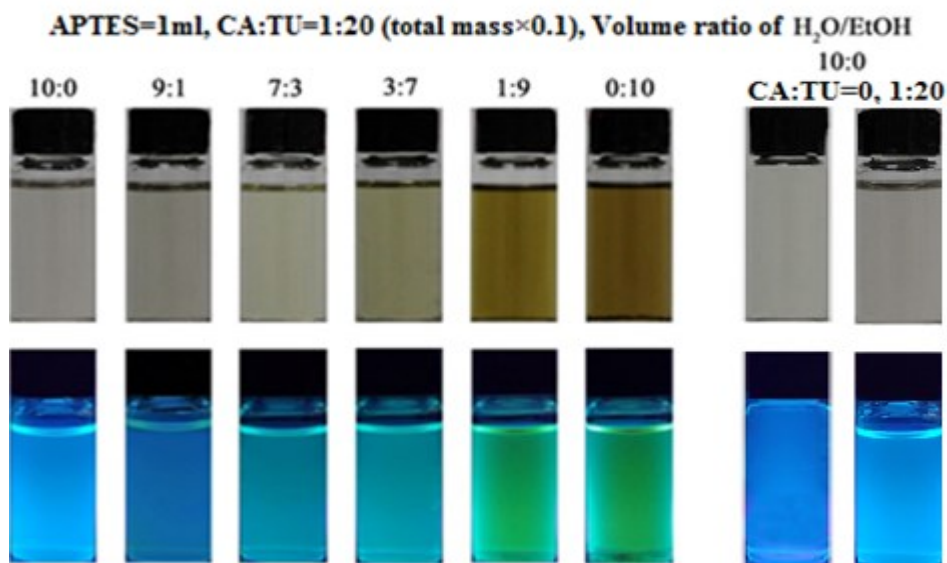


Figure s4. Optical images of S, N-CNDs/silica composites synthesized at different volume ratio of H₂O and EtOH (total 10 ml, 200 °C) as well as the corporation of CA:TU=0 and CA:TU=1:20 at H₂O:EtOH=10:0.

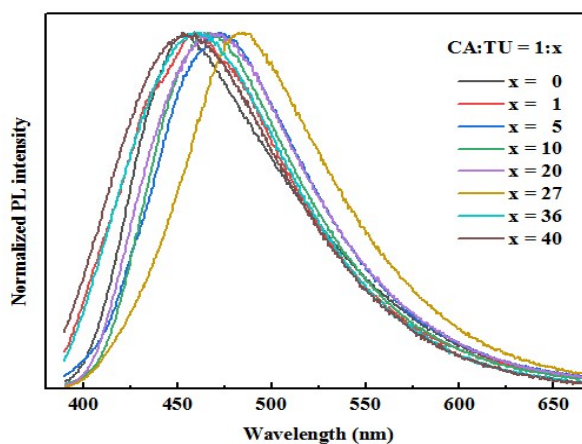


Figure s5. PL emission spectra of S, N-CNDs/silica composites corresponding to the supernates in fig. 1a.

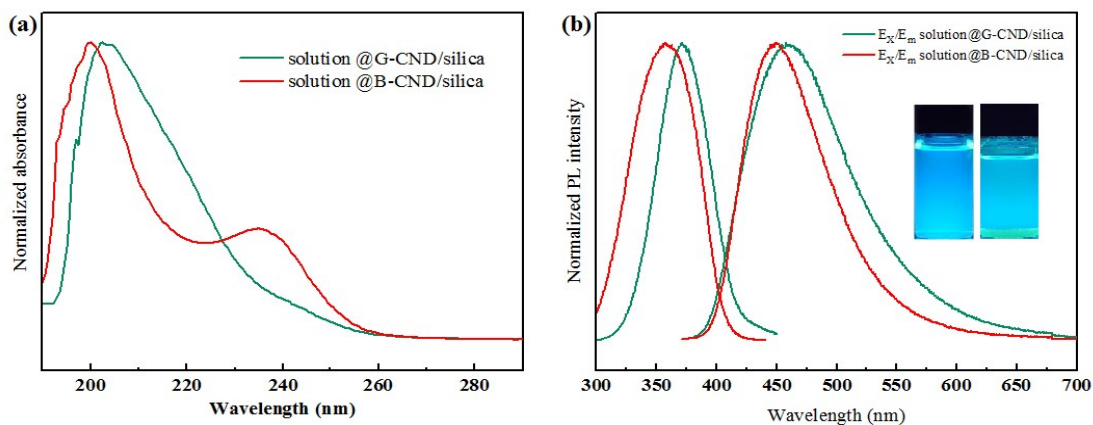


Figure s6. UV-vis (Abs) (a), PL excitation (E_x) and emission (E_m) spectra (b) of the solutions in B-CND/silica and G-CND/silica, respectively.

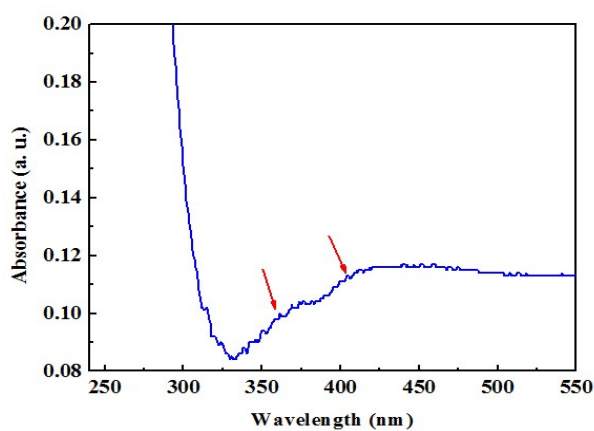


Figure s7. Enlarged UV-vis spectrum of B-CND/silica.

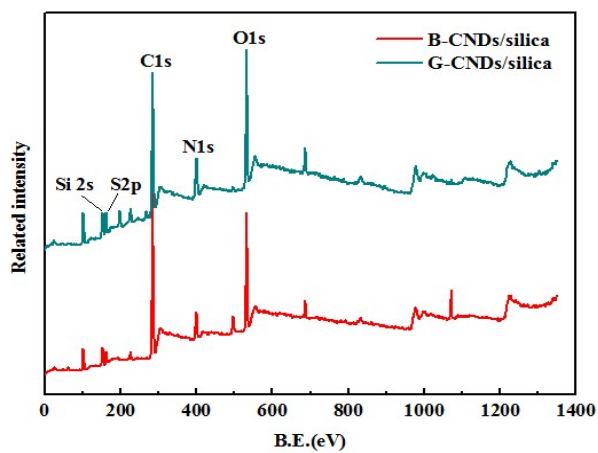


Figure s8. The full survey of XPS scan of B-CND/silica and G-CND/silica.

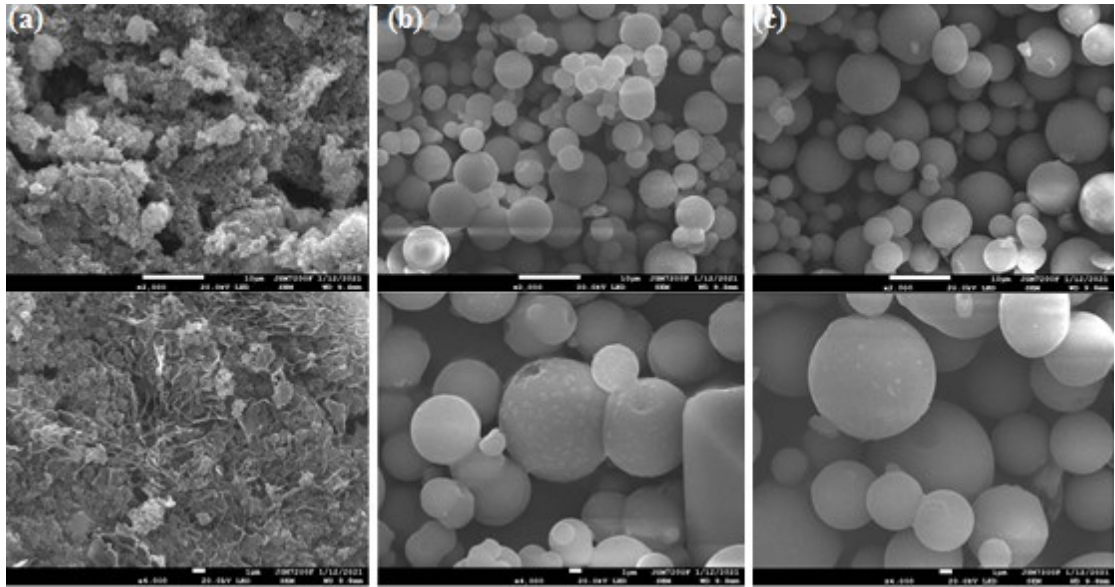


Figure s9. SEM images in 10um and 1 um of H-CND/silica (a), M-CND/silica (b) and E-CND/silica (c).

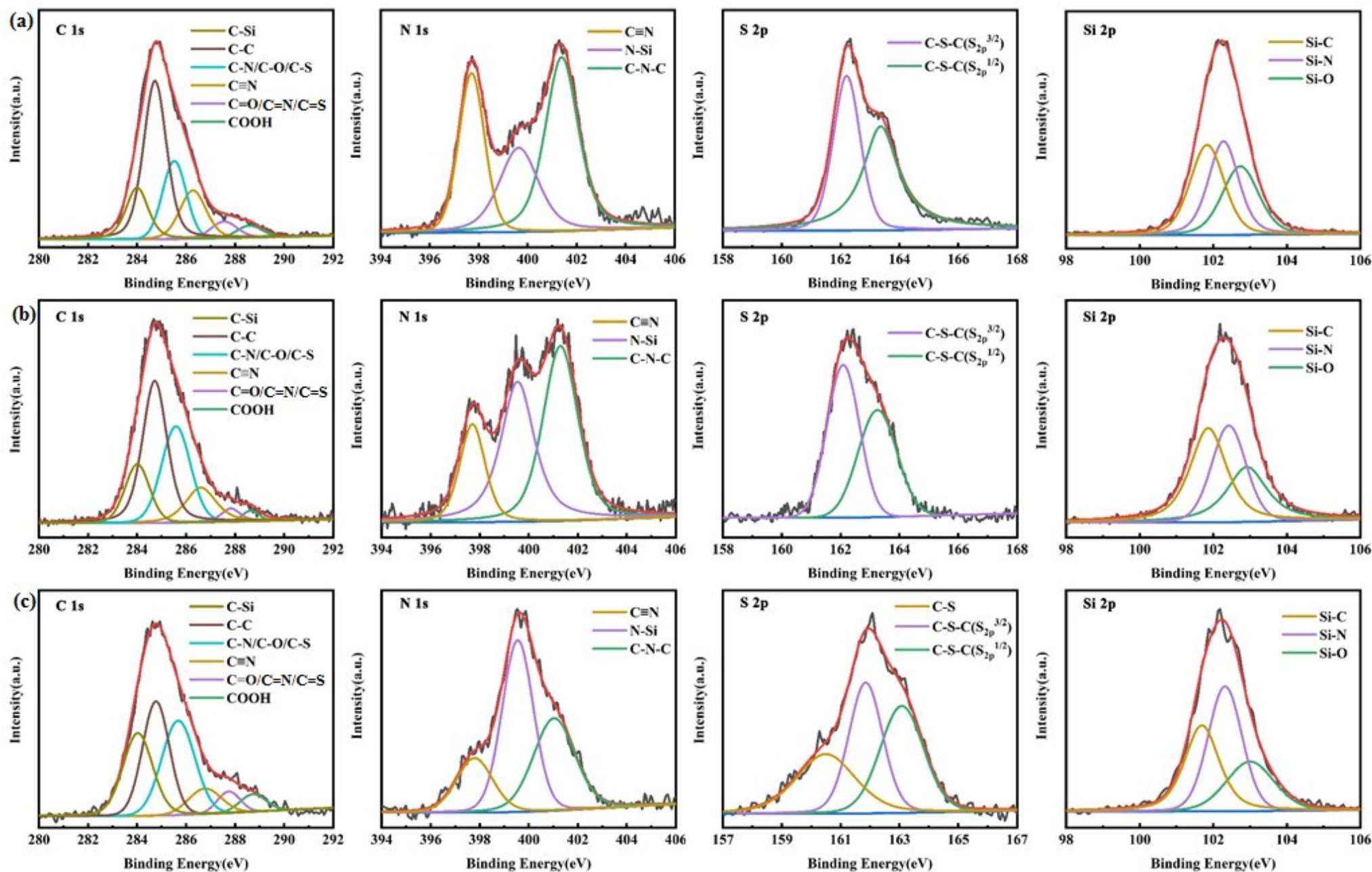


Figure s10. The high-resolution XPS spectra of H-CND/silica (a), M-CND/silica (b) and E-CND/silica (c).

table s1. Content of sectional chemical bonds in H-CND/silica, M-CND/silica and E-CND/silica respectively.

samples	C 1s						N 1s			S 2p		Si 2p			
	C-Si	C-C/C=C	C-O/C-N/C-S	C≡N	C=O/C=N/C=S	COOH	C≡N	N-Si	C-N-C	C-S	S 2p ^{3/2}	S 2p ^{1/2}	Si-C	Si-N	Si-O
H-CNDs/silica	14.4%	43.68%	19.52%	14.47%	4.81%	3.12%	28.75%	25.91%	45.34%	0	45.41%	54.59%	38.73%	31.68%	29.59%
M-CNDs/silica	14.99%	39.36%	28.15%	12.56%	3.11%	1.83%	17.65%	38.33%	44.02%	0	54.43%	45.57%	40.07%	32.22%	27.71%
E-CNDs/silica	24.8%	29.36%	29.21%	7.8%	4.53%	4.3%	17.1%	47.07%	35.83%	29.7%	34.56%	35.74%	34.21%	41.7%	24.09%

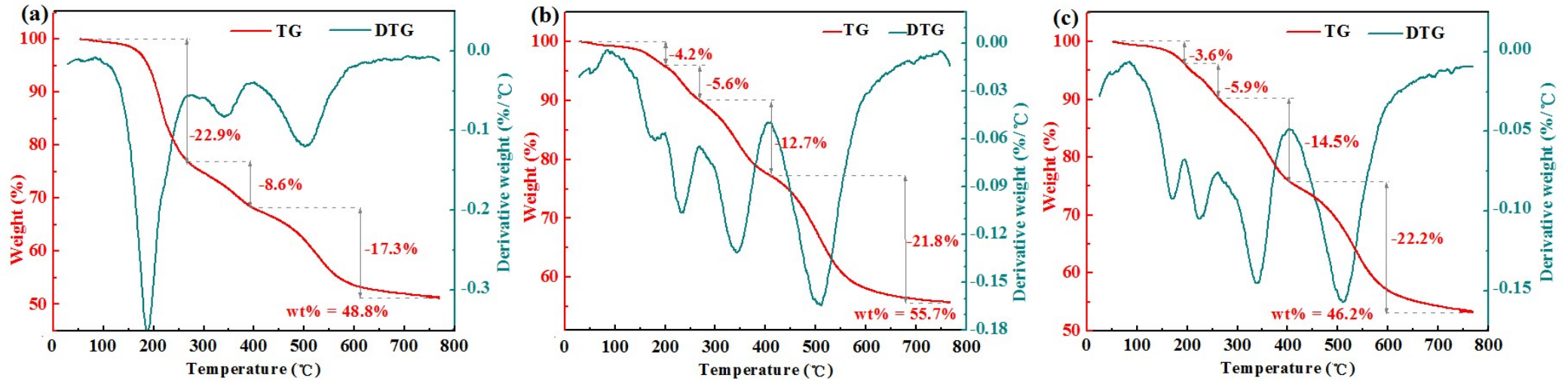


Figure s11. TG/DTG analysis of H-CND/silica (a), M-CND/silica (b) and E-CND/silica (c).

table s2. Fitting parameters of the corresponding PL decay curve of the B-CND/silica, G-CND/silica and E-CND/silica.

samples	τ_1 (ns)	A ₁ (%)	τ_2 (ns)	A ₂ (%)	τ_3 (ns)	A ₃ (%)	Ave. τ (ns)
B-CNDs/silica	0.3	13.0	4.7	13.6	12.2	73.4	1.6
G-CNDs/silica	1.1	3.1	5.2	40.5	12.0	56.4	6.3
E-CNDs/silica	1.0	9.4	3.8	54.5	9.8	36.1	3.3

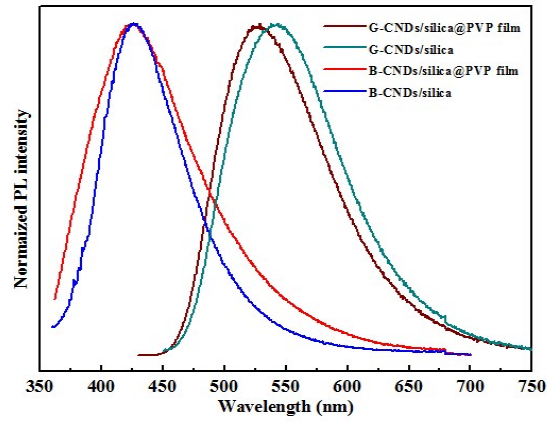


Figure s12. PL emission spectra of B-CND/silica and G-CND/silica as well as the film composited with PVP respectively.

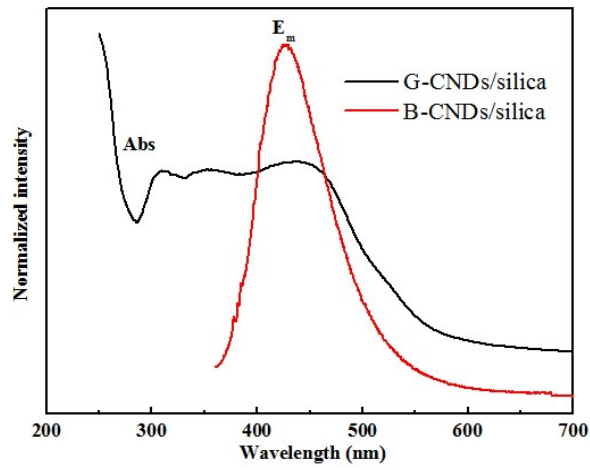


Figure s13. Spectral overlap of B-CNDs/silica and G-CNDs/silica.

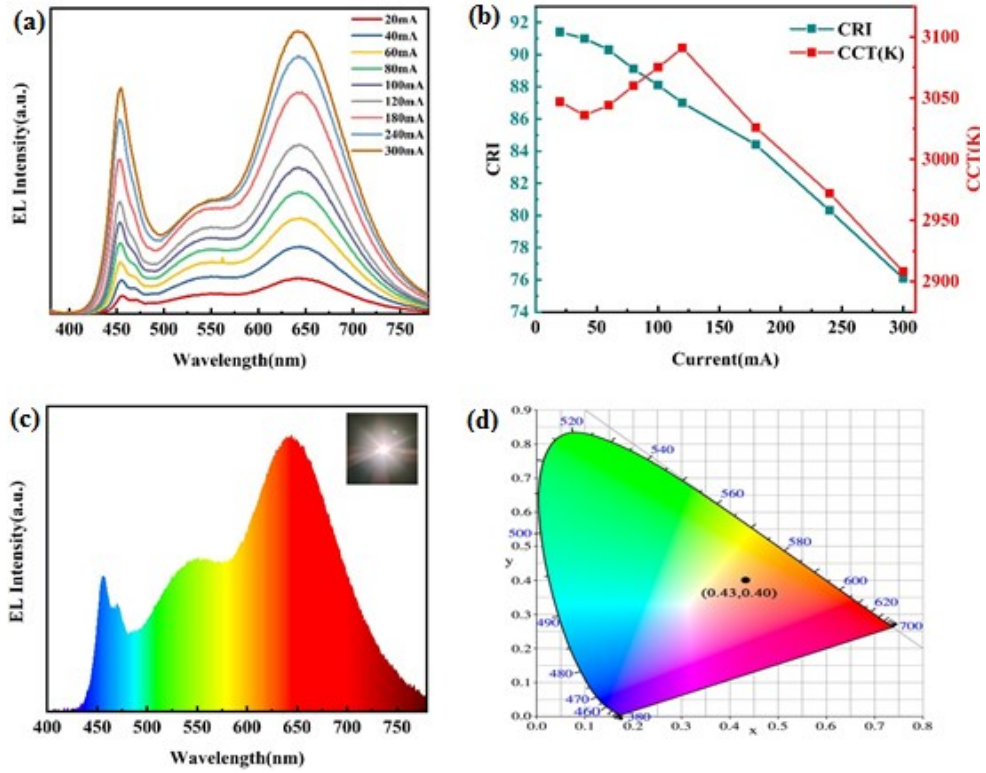


Figure s14. (a) EL spectra of the WLED in different currents, and corresponding CRI and CCT variations with increasing currents is shown in (b). (c) Emission spectrum of the above WLED at the current of 20 mA, real photo is in the inset. (d) Calculated CIE coordinates from the PL spectrum of fig. s14c.