Supporting Information

Ultrafast Insights into Full-Color Light-Emitting C-Dots

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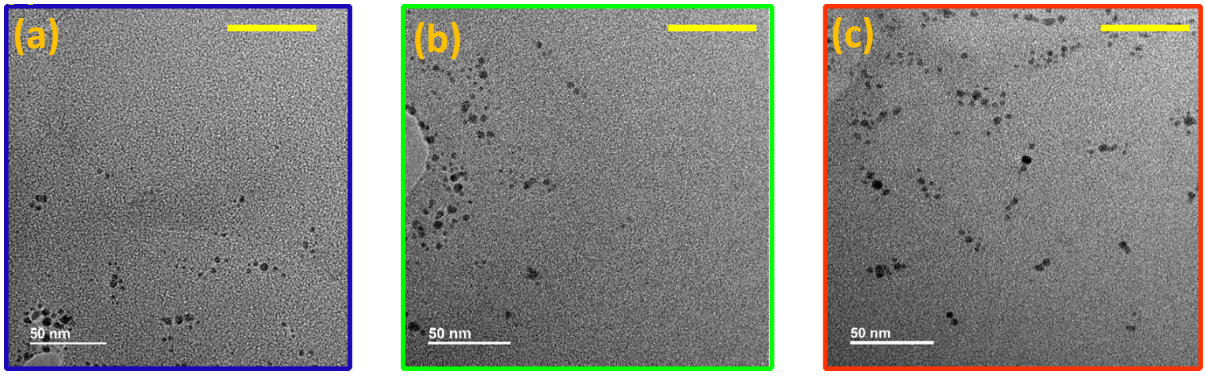

Figure S1: Wide area TEM images of (a) B-C-Dots (b) G-C-Dots (c) R-C-Dots.

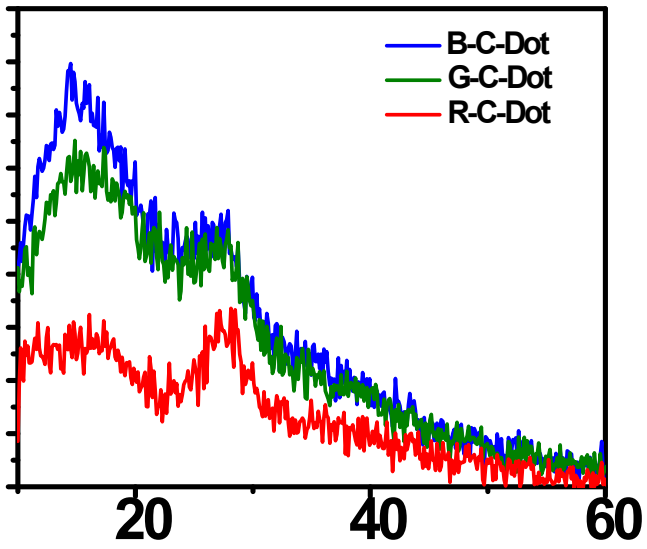

Figure S2: X-ray diffraction (XRD) of B-C-Dots, G-C-Dots and R-C-Dots.

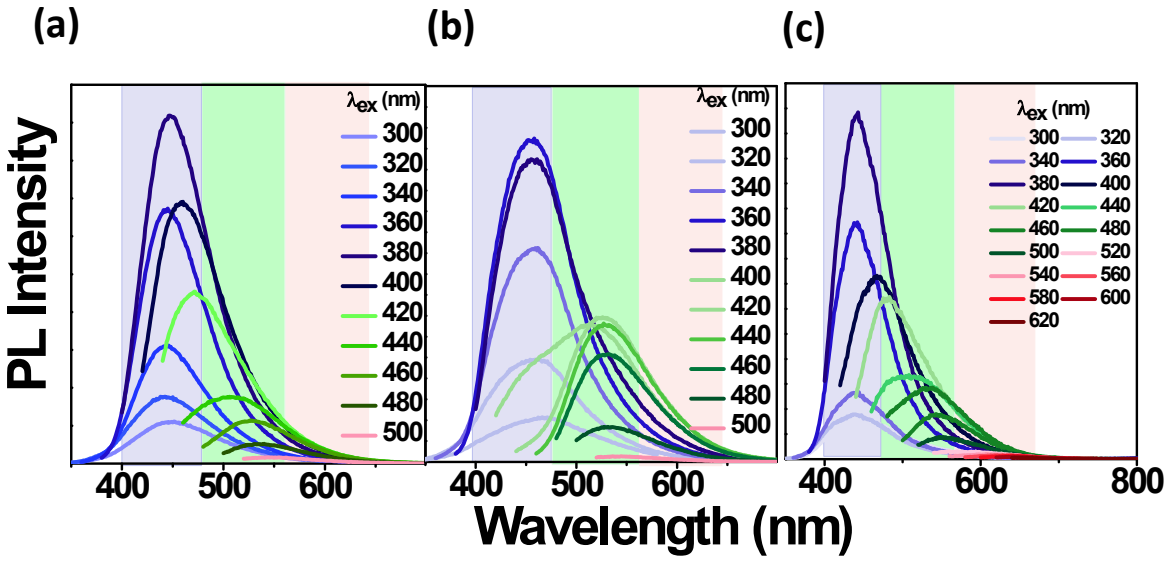

Figure S3: Emission spectra of (a) B-C-Dots (b) G-C-Dots (c) R-C-Dots after exciting at different wavelengths.

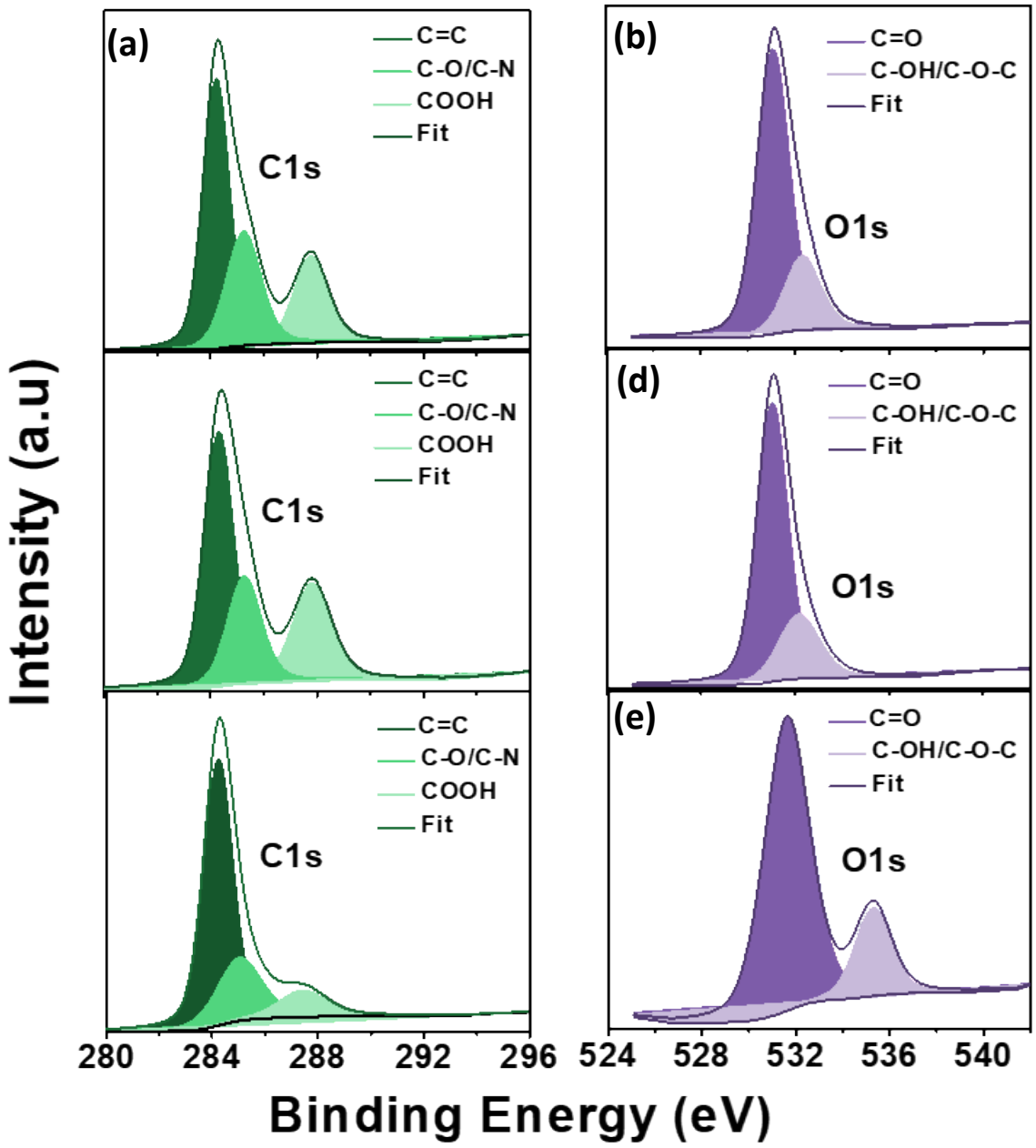

Figure S4 High-resolution XPS spectra for C1s signal (a, b, c) and O1s signal (d, e, f) of B-C-Dot, G-C-Dot and R-C-Dot.

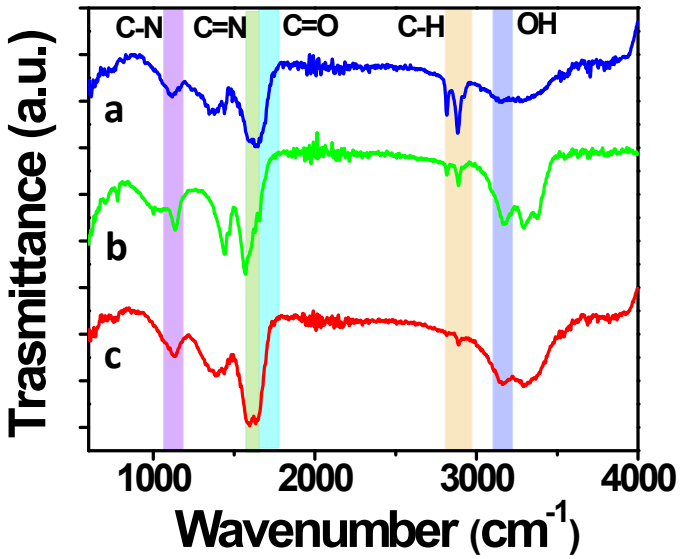

Figure S5: FTIR spectra of (a) B-C-Dots (b) G-C-Dots (c) R-C-Dots.

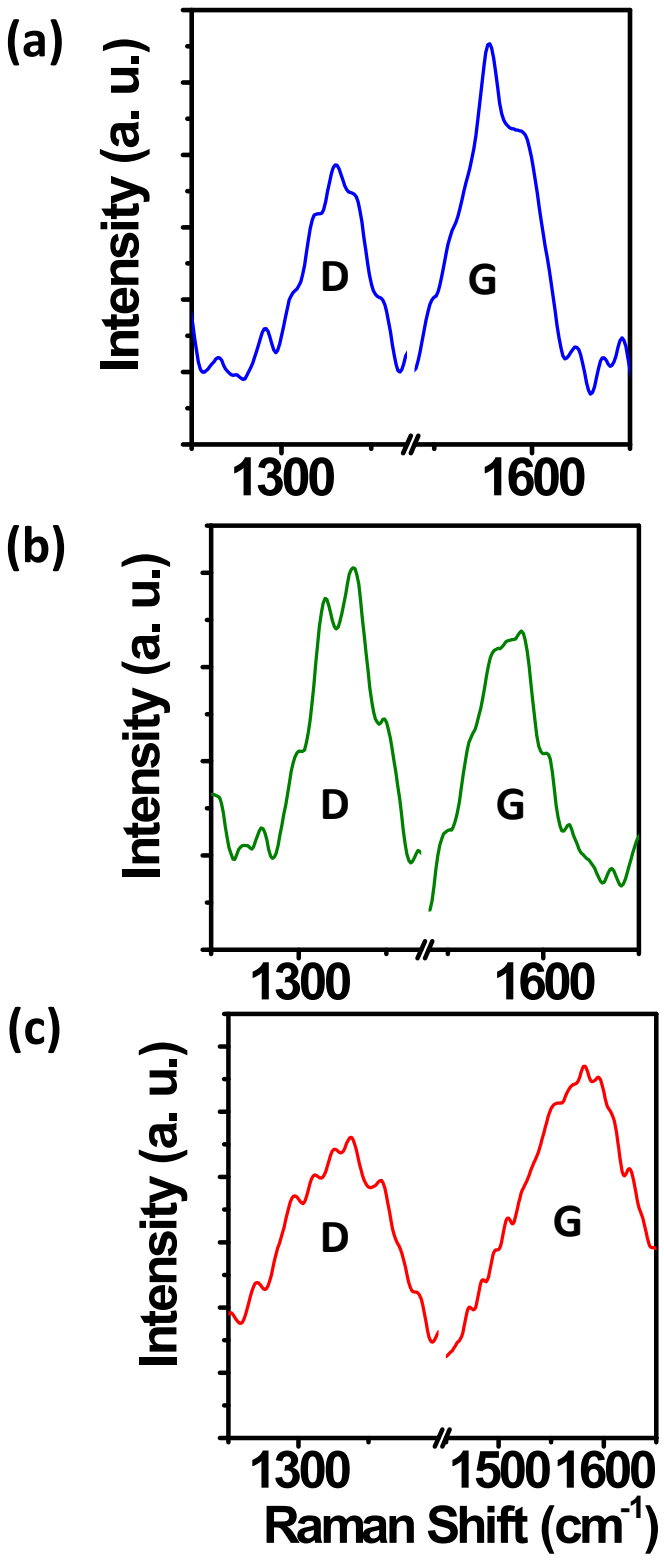

Figure S6: Raman spectra of (a) B-C-Dots (b) (a) G-C-Dots (c) (a) R-C-Dots after exciting at 785 nm.

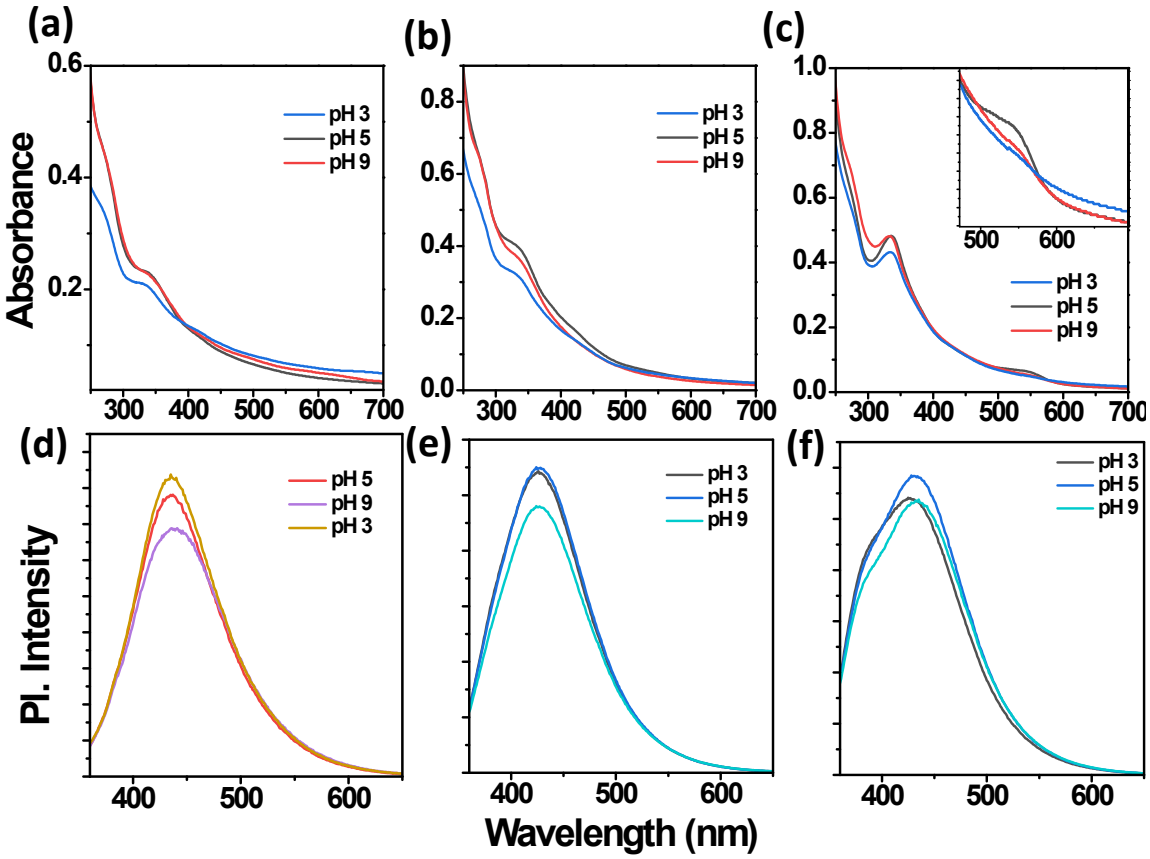

Figure S7: (a-c) Absorption and (**d-f**) emission spectra of B-C-Dots, G-C-Dots, and R-C-Dots (left to right) at different pH.

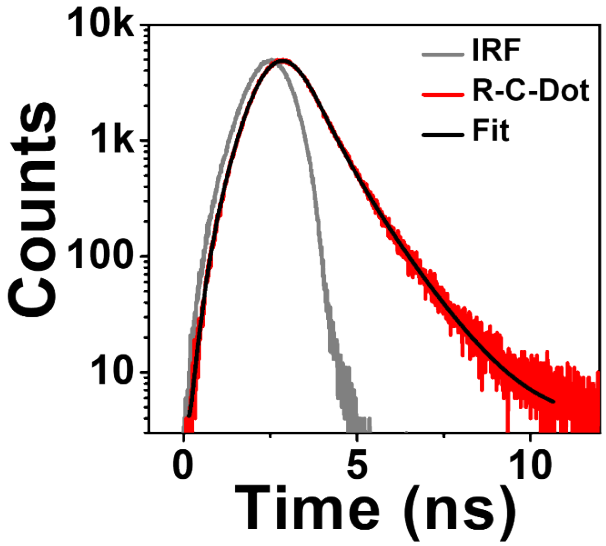

Figure S8: Time-resolved PL decay of the R-C-Dots monitored at 630 nm after excitation at 605 nm.

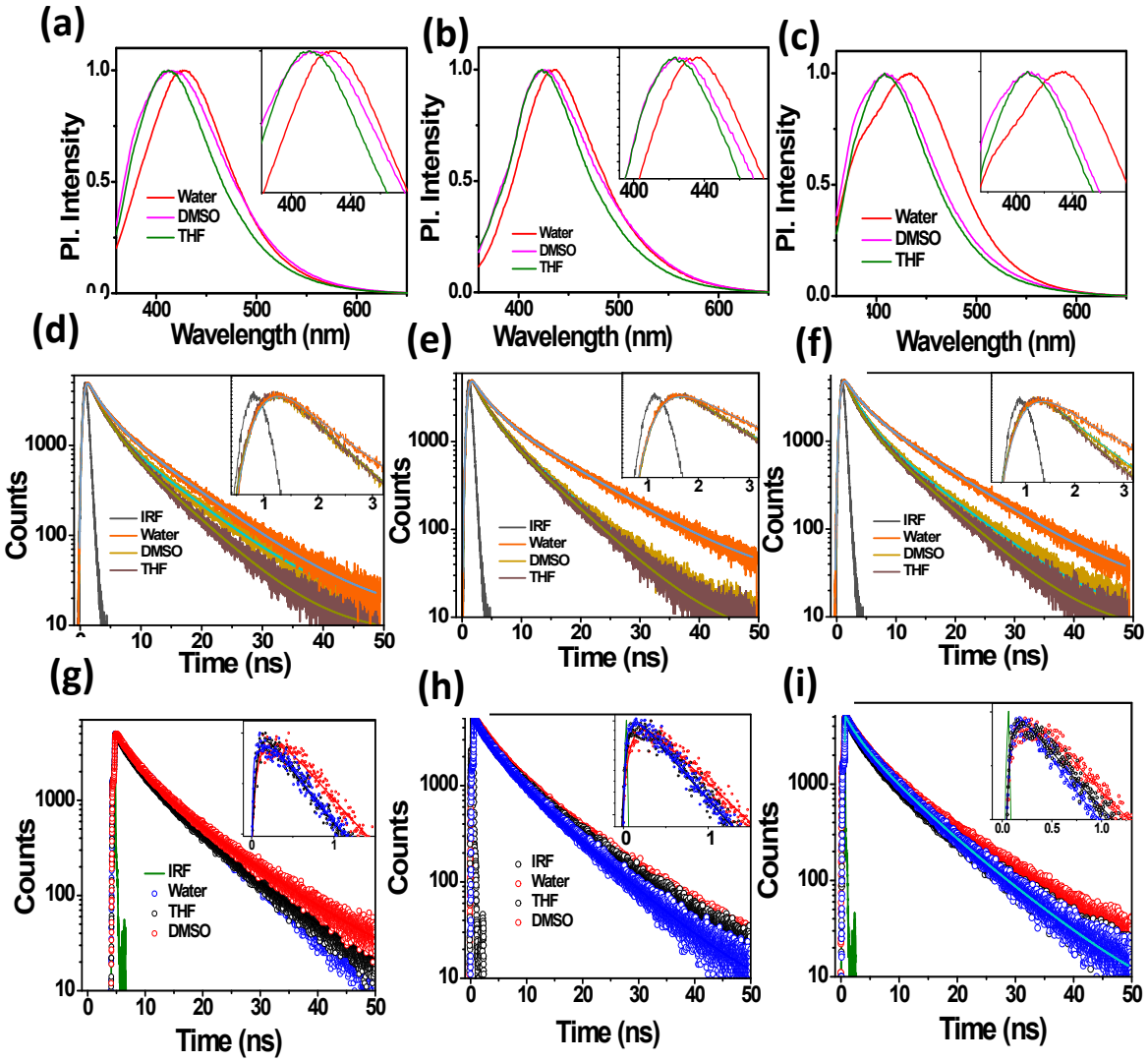

Figure S9: Top panel: Steady-State normalized emission spectra of (a) B-C-Dots (b) G-C-Dots (c) R-C-Dots in water, dimethyl sulfoxide (DMSO), dimethylformamide (DMF) (d-f) Time resolved PL of B-C-Dots, G-C-Dots and R-C-Dots (**middle panel**: left to right) after excitation at 340 nm and monitoring wavelength at 440 nm (g-i) Time resolved PL of B-C-Dots, G-C-Dots and R-C-Dots (**bottom panel**: left to right) after excitation at 405 nm and monitoring wavelength at 520 nm

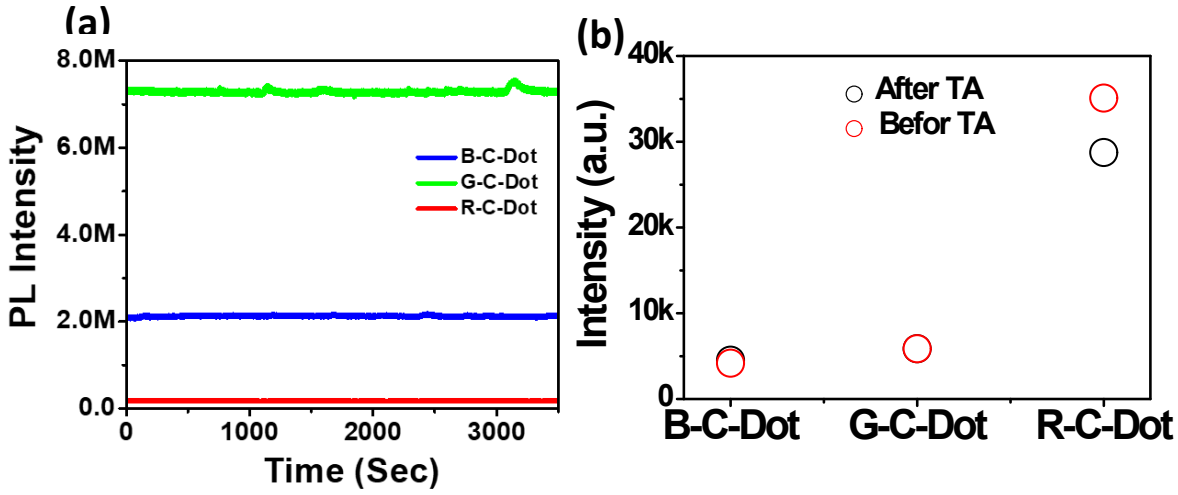

Figure S10: Photostability of B-C-Dot, G-C-Dot and R-C-Dot measured (a) steady state PL luminescence intensity after irradiation at 340 nm at with a constant power (~75-Watt) (b) Steady state PL luminescence intensity before and after the TA.

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Samples	τ_1 (a_1)	τ_2 (a_2)	
λ_{ex} =340 nm, λ_{em}=440 nm			
B-C-Dot	1.5 ns (30%)	9.50 ns (70%)	
G-C-Dot	1.8 ns (20%)	10.00 ns (80%)	
R-C-Dot	2.0 ns (7%)	10.20 ns (93%)	
λ_{ex} =340 nm, λ_{em}=530 nm			
	τ_{1g} (a_{1g})	**τ_1 (a_1)**	**τ_2 (a_2)**
B-C-Dot	400 ps	2.5 ns (10%)	9.5 ns (90%)
G-C-Dot	450 ps	2.4 ns (9%)	9.3 ns (91%)
R-C-Dot	600 ps	-	10 ns(100%)
λ_{ex} =405 nm, λ_{em}=440 nm			
Samples	**τ_1 (a_1)**	**τ_2 (a_2)**	
B-C-Dot	2.5 ns (17%)	8.30 ns (83%)	
G-C-Dot	2.5 ns (17%)	8.30 ns (83%)	
R-C-Dot	2.5 ns (15%)	8.50 ns (83%)	
λ_{ex} =405 nm, λ_{em}=530 nm			
	τ_{1g} (a_{1g})	**τ_1 (a_1)**	**τ_2 (a_2)**
B-C-Dot	<200 ps	2.02 ns (10%)	7.8 ns (90%)
G-C-Dot	500 ps	3.0 ns (9%)	7.0 ns (91%)
R-C-Dot	500 ps	2.18 (15%)	7.8 ns (100%)
λ_{ex} =605 nm,λ_{em}=630 nm			
Samples	**τ_1 (a_1)**	**τ_2 (a_2)**	
R-C-Dot	0.54 ns (60%)	1.07 (40%)	

Table S1: Fitting Time Constants for the Kinetics at 440 nm, 530 nm and 630 nm of the B-, G- and R-C-Dots after exciting the samples at 340 nm, 405 nm and 605 nm using TCSPC mode.[a]

[a] The "a" values are the relative amplitudes of each lifetime component. The χ^2 values determine the goodness of the fits, which is >0.99 for all decays. Standard deviation for the lifetime analysis is ±5%.

Table S2: Fitting Time Constants for the Kinetics at 440 nm and 530 nm of the B-, G- and R-

λ_{probe} = 440 nm						
B-C-Dot						
Solvent	τ_1 (ns)	a_1 (%)	τ_2 (ns)	a_2 (%)		
Water	2.145	34.12	8.277	65.88		
DMSO	2.134	35.75	6.942	64.25		
THF	2.321	25.74	8.748	74.26		
G-C-Dot						
Water	2.324	31.19	7.296	68.81		
DMSO	2.157	31.59	6.942	68.41		
THF	2.653	24.27	10.62	75.73		
R-C-Dot						
Water	2.313	35.44	8.207	64.56		
DMSO	1.953	32.98	7.199	67.02		
THF	2.473	20.89	9.868	79.11		
λ_{probe} = 530 nm						
Solvent	τ_g (ns)	a_g (%)	τ_1 (ns)	a_1 (%)	τ_2 (ns)	a_2 (%)
B-C-Dot						
Water	0.150	-100	2.695	15.50	7.821	84.50
DMSO	0.222	-100	3.629	3.56	10.27	66.44
THF	<0.100	-100	3.031	28.13	8.735	71.87
G-C-Dot						
Water	0.155	-100	2.852	21.06	8.178	78.94
DMSO	0.200	-100	3.699	30.79	9.998	69.21
THF	<0.100	-100	3.069	25.28	9.384	74.72
R-C-Dot						
Water	0.170	-100	2.797	21.79	8.256	78.21
DMSO	0.285	-100	3.297	29.65	10.07	70.35
THF	<0.100	-100	2.734	27.72	8.464	72.28

C-Dots after exciting the samples at 340 nm and 405 nm in different solvent.

[a] The "a" values are the relative amplitudes of each lifetime component. The χ^2 values determine the goodness of the fits, which is >0.99 for all decays. Standard deviation for the lifetime analysis is ±5%. b Averaged lifetimes.

Table S3: Literature survey of Multi-color Fluorescent C-Dots synthesized from Citric acid and urea.

Carbon Precursor	Method of synthesis	PL origin	References
Citric acid and urea	Hydrothermal	Graphitic nitrogen tunes the fluorescence of blue, green, yellow, or red emitting C-Dots	***1***
Citric acid and urea	Hydrothermal	Blue to red emission of C-Dot depends on extent of graphitization and the amount of surface functional groups, such as —COOH	***2***
Citric acid and urea	Hydrothermal	Blue to red emission of C-Dot can be shifted with the increasing incorporation of oxygen species into their surface structure	***3***
Citric acid and urea	Microwave	Short wavelength emission governs from the core state, and longer wavelength emission from the surface state	***4***
Citric acid and urea	Hydrothermal	Blue emission generates from graphitic carbon core which is an inherent property of all C-Dots and green to red emission create from the surface states, containing different oxygen-containing functional groups	***Our work***

References:

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2. X. Miao, D. Qu, D. Yang, B. Nie, Y. Zhao, H. Fan and Z. Sun, *Adv. Mater.*, 2018, **30**, 1704740.
3. H. Ding, S.-B. Yu, J.-S. Wei and H.-M. Xiong, *ACS Nano*, 2016, **10**, 484–491.
4. V. Strauss, J. T. Margraf, C. Dolle, B. Butz, T. J. Nacken, J. Walter, W. Bauer, W. Peukert, E. Spiecker, T. Clark and D. M. Guldi, *J. Am. Chem. Soc.*, 2014, **136**, 17308–17316.