

Supporting information

Visible LED-based photo-redox properties of sulfur and nitrogen-doped carbon dots designed by solid-state synthesis

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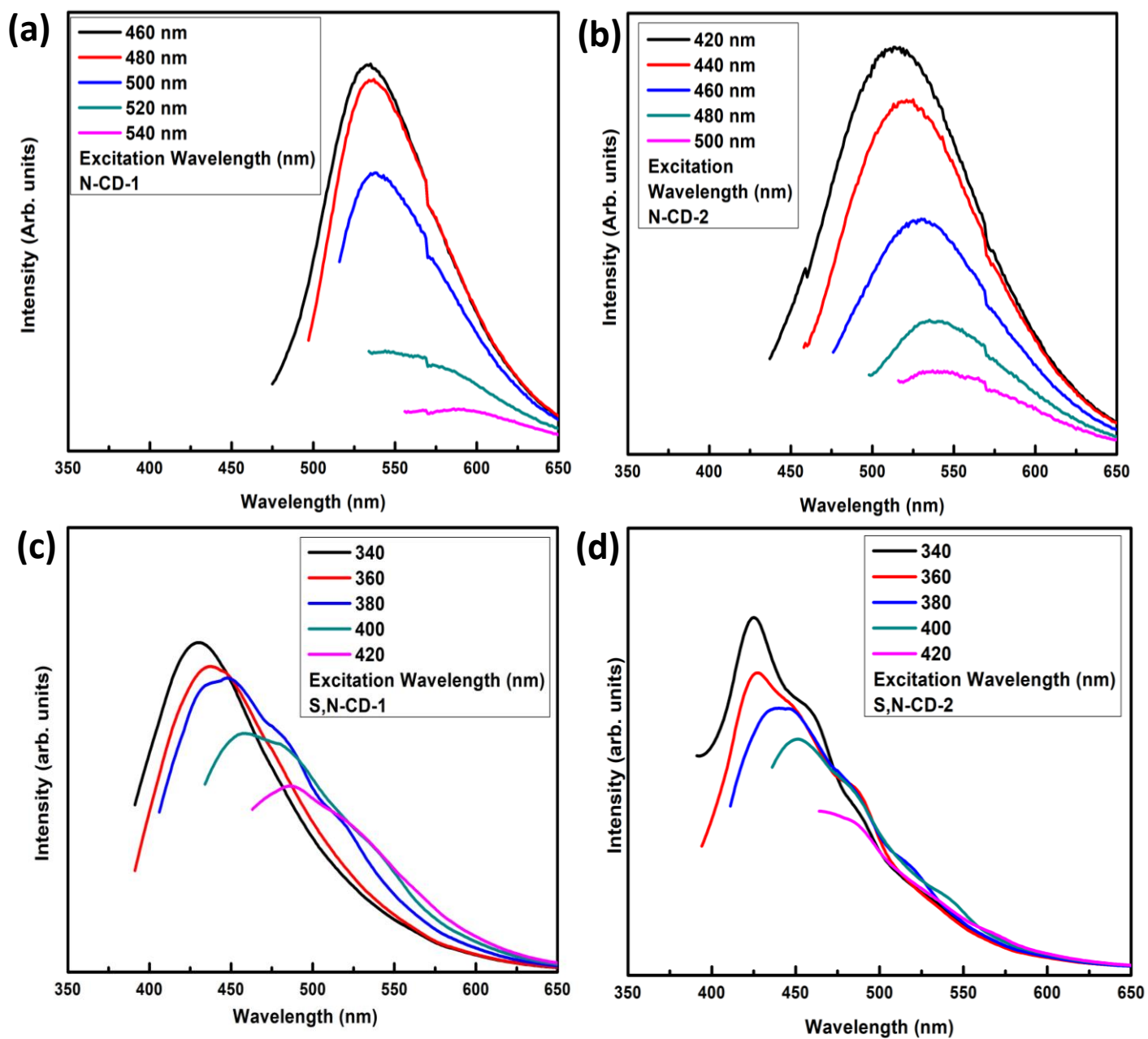


Figure S1: Excitation dependent photoluminescence spectra for (a) N-CD-1, (b) N-CD-2, (c) S,N-CD-1 and (d) S,N-CD-2 with emission maxima at 460 nm, 420 nm, 340 nm and 340 nm excitation wavelength respectively.

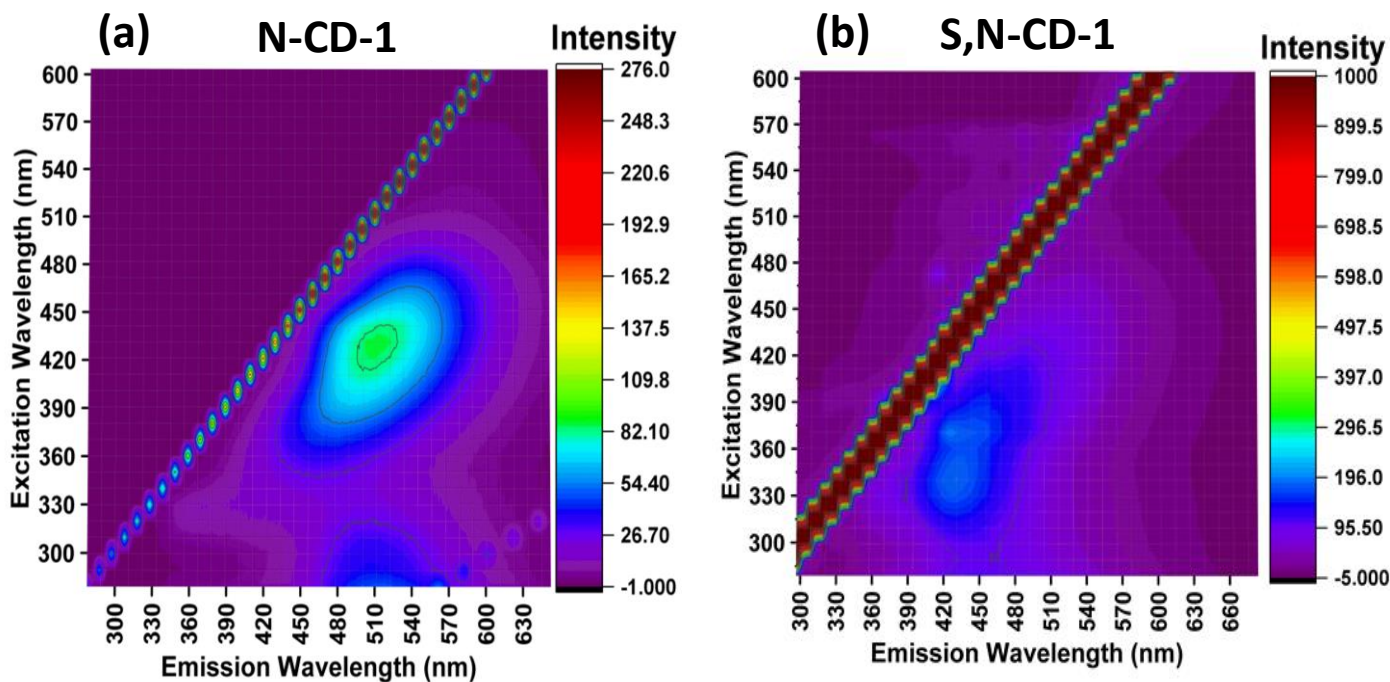


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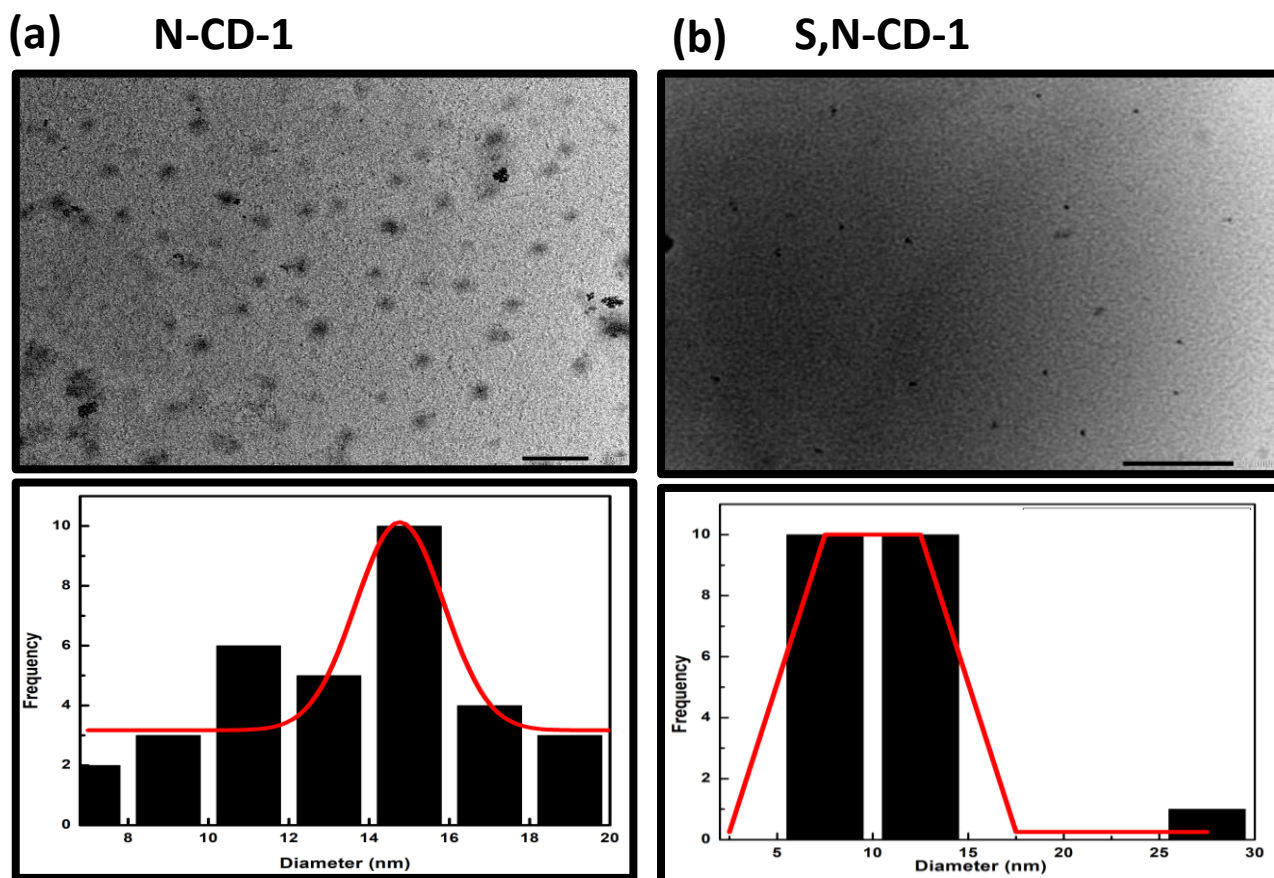


Figure S3: HR-TEM images (scale bar = 200 nm) of (a) N-CD-1 and (b) S,N-CD-1 along with their size distributions, analyzed by ImageJ software.

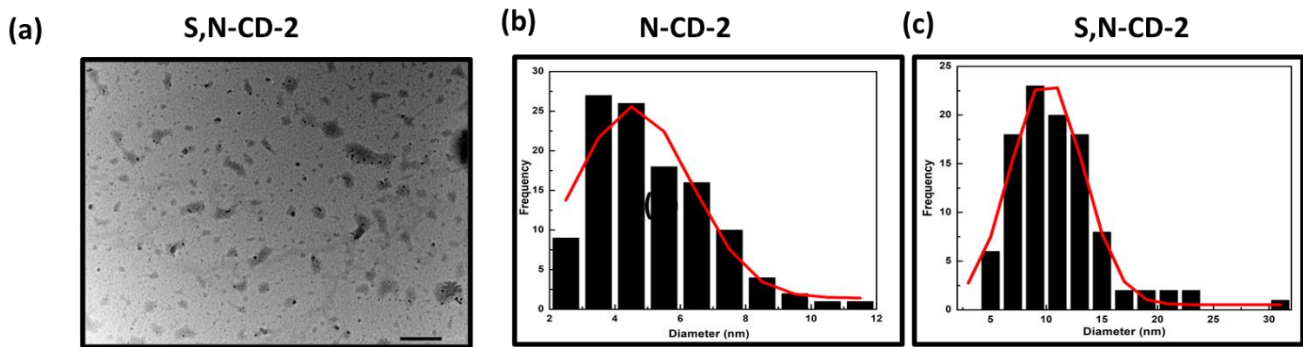


Figure S4: (a) HR-TEM images (scale bar = 200 nm) of N-CD-2 and size-distributions for (b) N-CD-2 and (c) S , N-CD-2, analyzed by ImageJ software.

Sample	Average Nanoparticle size (\bar{x}) in (nm)	Standard deviation (σ)	% age Polydispersity (σ/\bar{x})*100
N-CD-1	14.76	1.100	7.45%
N-CD-2	04.55	1.776	38.97%
S,N-CD-1	10.00	1.320	13.2%
S,N-CD-2	10.05	3.253	32.35%

TABLE S1: The average nanoparticle size and polydispersity value were measured by Gaussian fitting of size distribution.

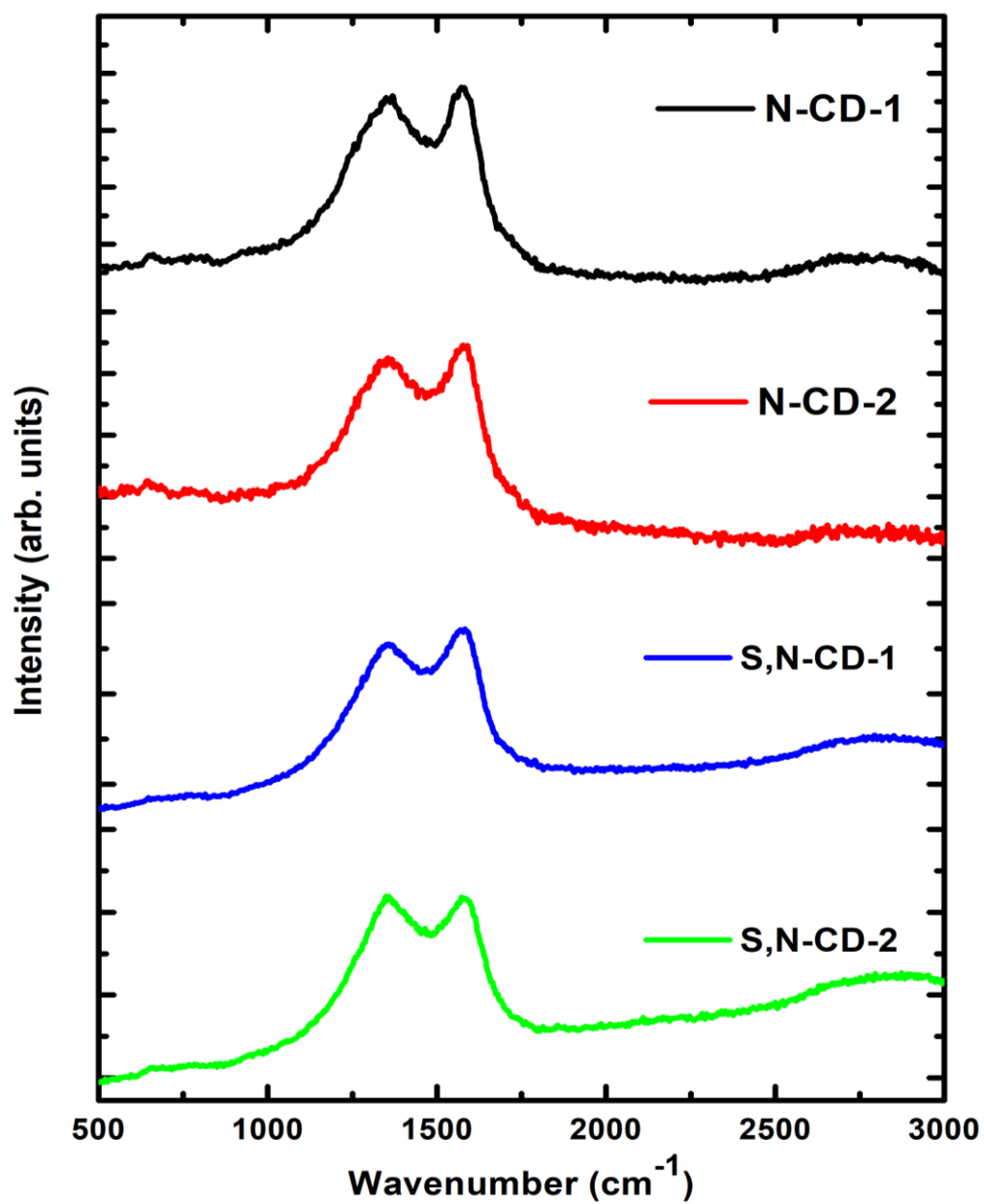


Figure S5: Raman Spectra of N-CD-1, N-CD-2, S, N-CD-1, and S, N-CD-2 measured with 514 nm excitation.

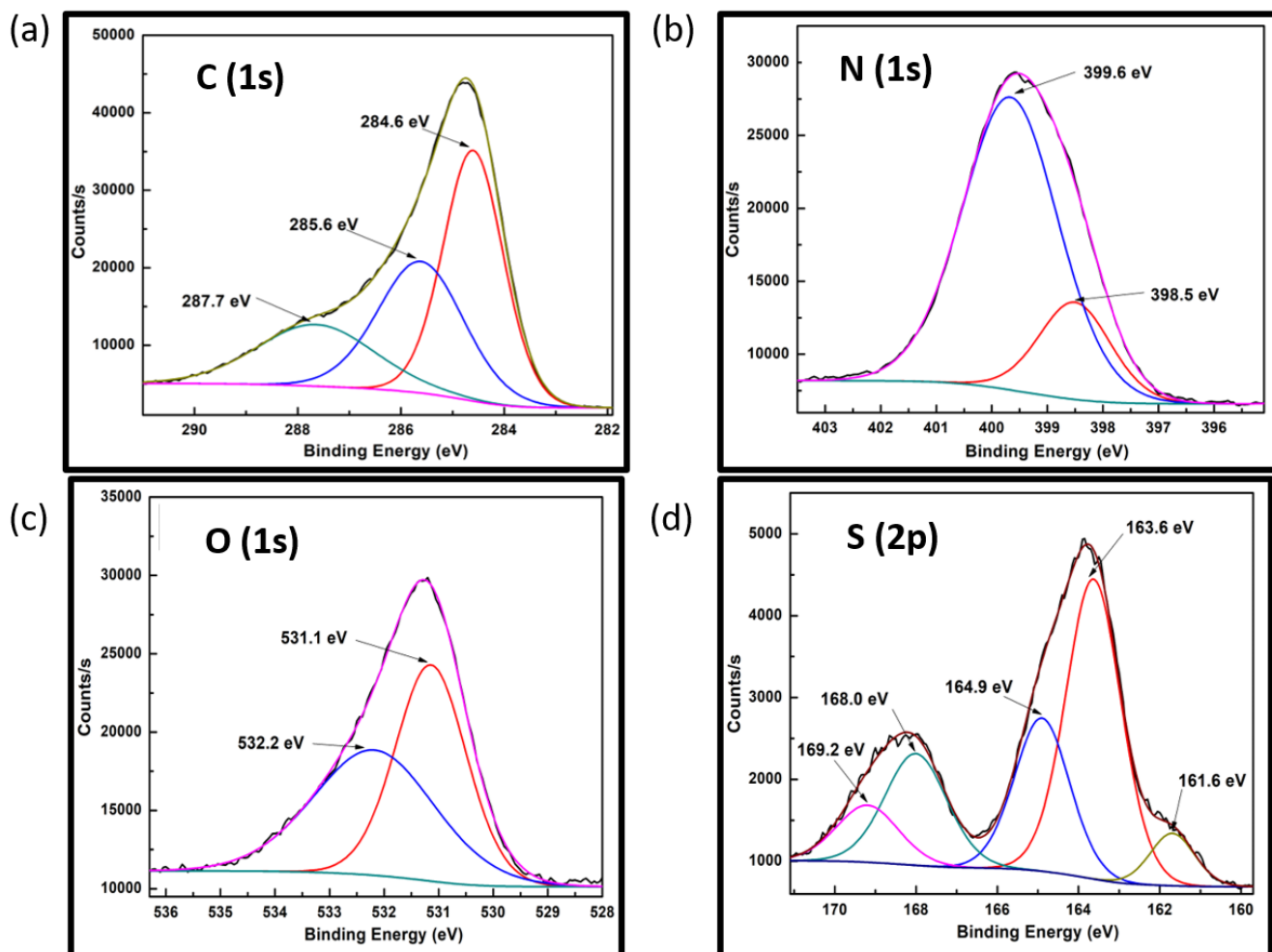


Figure S6: The deconvoluted plots for (a) C(1s), (b) N(1s), (c) O (1s) and (d) S(2p) elements in XPS spectra of S,N-CD-2.

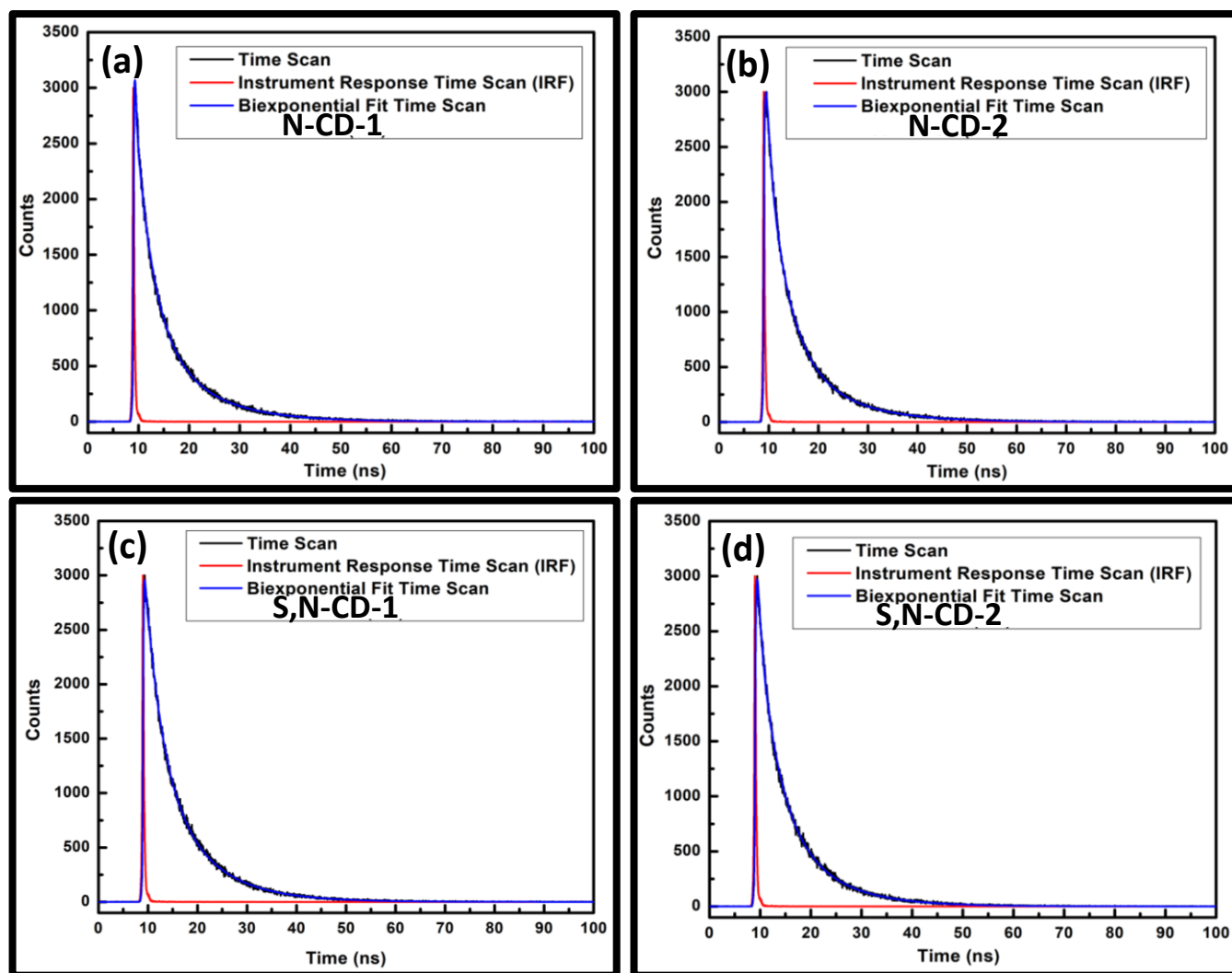


Figure S7: Lifetime measurement plots for (a) N-CD-1, (b) N-CD-2, (c) S,N-CD-1 and (d) S,N-CD-2 fitted with biexponential curve fitting method.

Sample	τ_1 ns, (rel %)	τ_2 ns, (rel%)	τ_{avg} (ns)
N-CD-1	2.54 (31.6%)	9.63 (68.4%)	7.34
N-CD-2	2.94 (37.2%)	10.06 (62.8%)	7.41
S,N-CD-1	2.39 (27.3%)	8.97 (72.7%)	7.17
S,N-CD-2	2.58 (27.9%)	8.93 (72.1%)	7.15

TABLE S2: Photoluminescence bi-exponential decay constants of all the CDs.

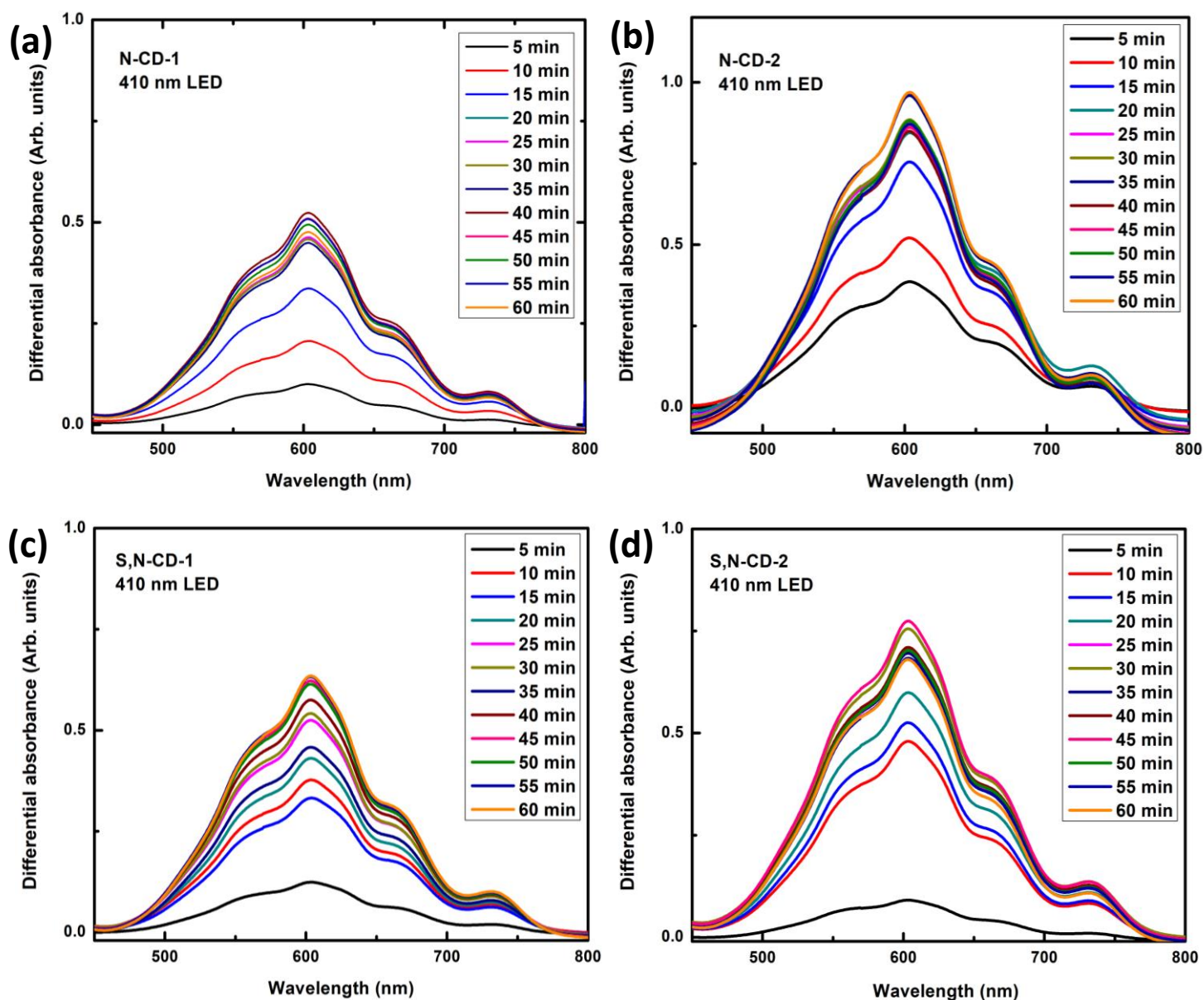


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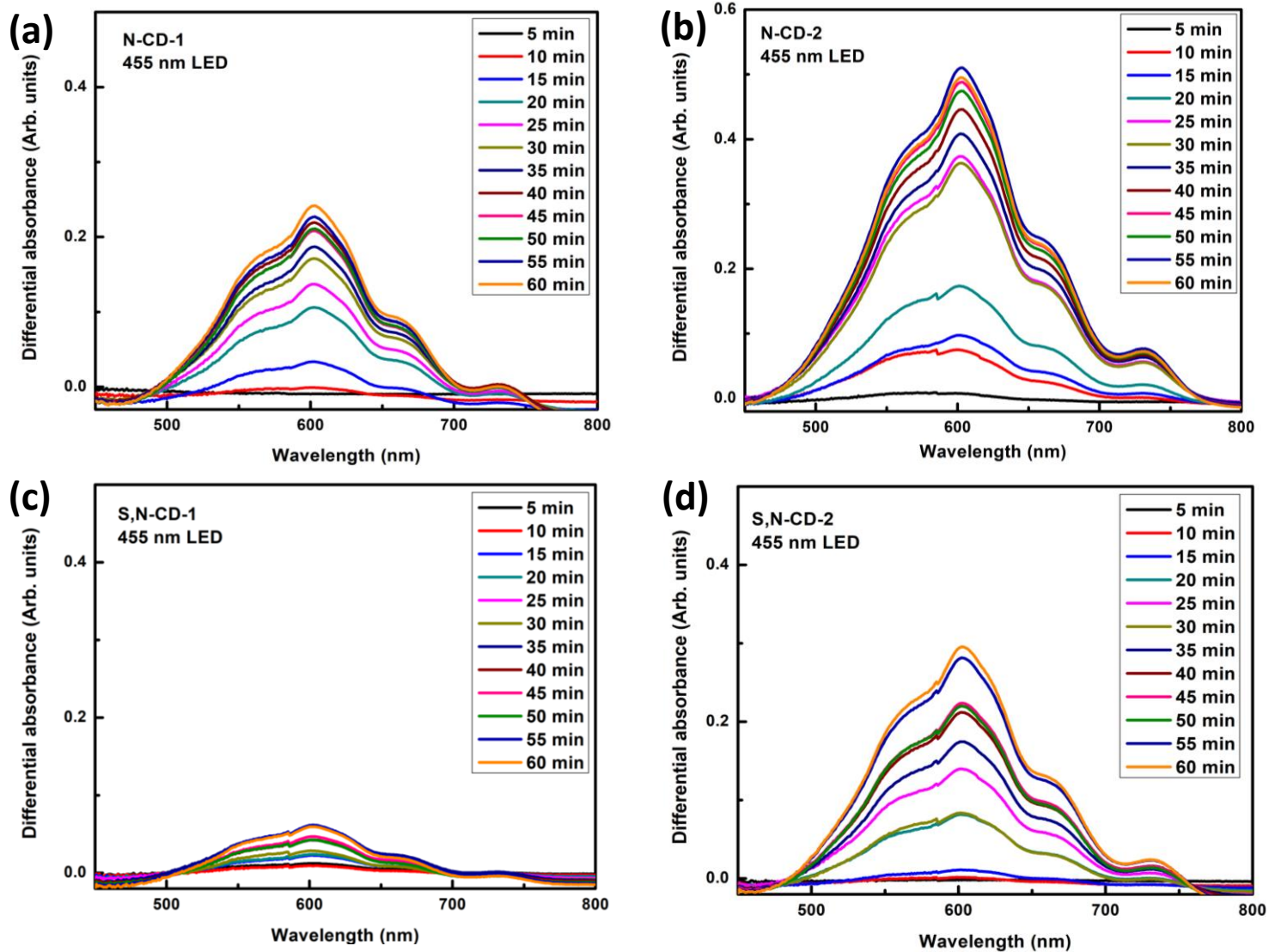


Figure S9: Time -resolved UV-Vis absorbance spectra of (a) N-CD-1, (b) N-CD-2, (c) S,N-CD-1 and (d) S,N-CD-2 in the presence of methyl viologen (1 mM) and EDTA (0.1M, pH 6) at different time intervals upon LED (455 nm) illumination under inert atmosphere. The spectra are background corrected for all samples.

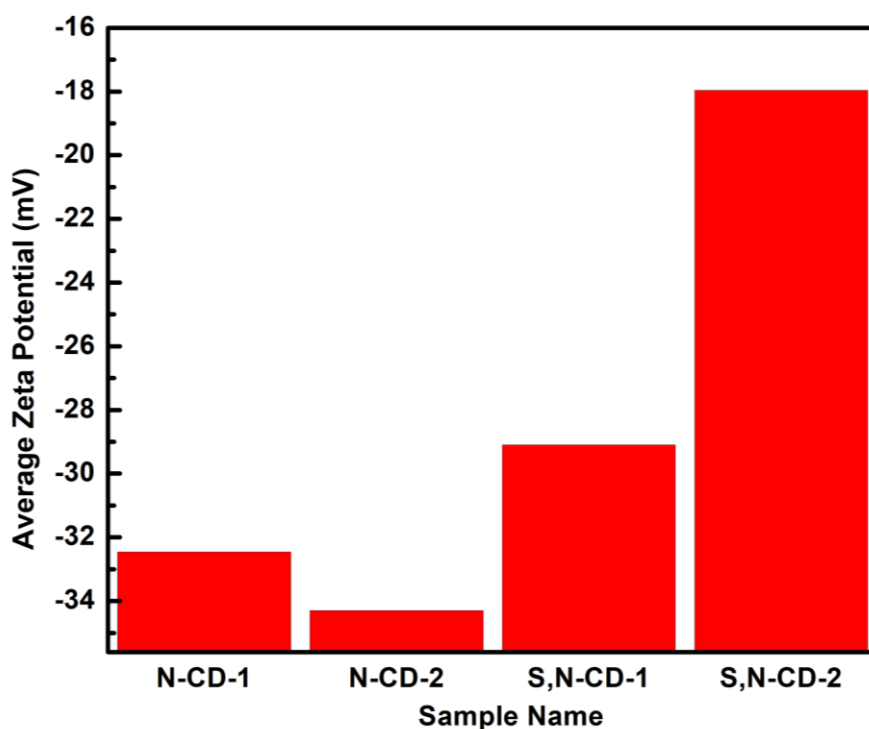


Figure S10: Bar graph representing Zeta potential values of N-CD-1, N-CD-2, S, N-CD-1 and S, N-CD-2 in mV (Taken in three consecutive measurements with D.I. water as solvent).

Sample Name	Zeta Potential value(mV) for three measurements (M1, M2, M3)	Average Zeta Potential Value (mV)	Standard Deviation
N-CD-(1:1)-250 (N-CD-1)	M1 = -32.6	-32.46	0.4989
	M2 = -33.0		
	M3 = -31.8		
N-CD-(1:3)-250 (N-CD-2)	M1 = -34.0	-34.3	1.363
	M2 = -36.1		
	M3 = -32.8		
S, N-CD-(1:1)- 250 (S,N-CD-1)	M1 = -28.3	-29.1	0.5715
	M2 = -29.4		
	M3 = -29.6		
S, N-CD-(1:3)- 250 (S,N-CD-2)	M1 = -18.1	-17.96	0.66
	M2 = -17.1		
	M3 = -18.7		

TABLE S3: Average Zeta Potential Value of all CDs with Standard Deviation values.

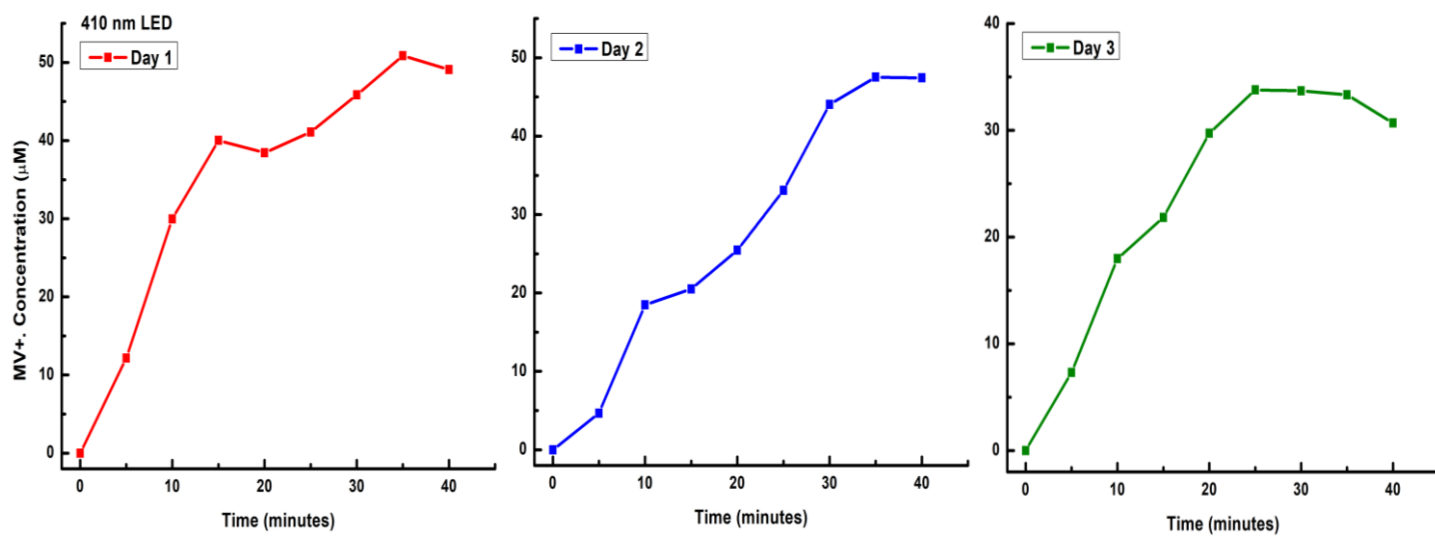


Figure S11: Sequential MV²⁺ photoreduction runs using N-CD-2 using 410 nm LED.

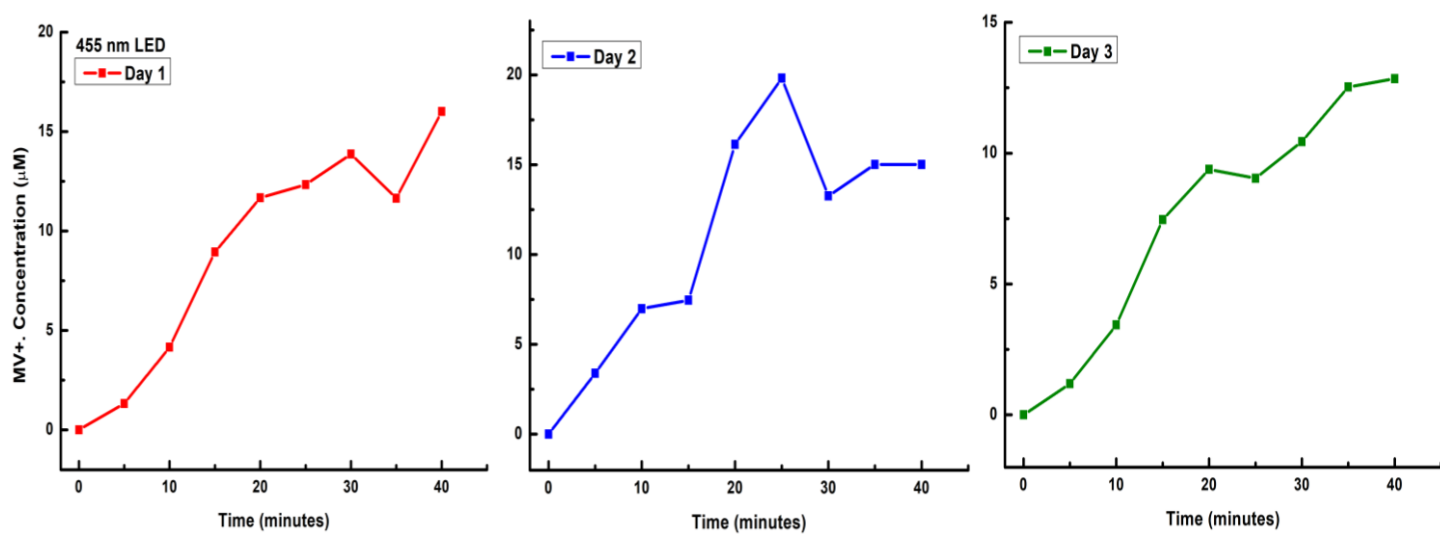


Figure S12: Sequential MV²⁺ photoreduction runs using N-CD-2 using 455 nm LED.

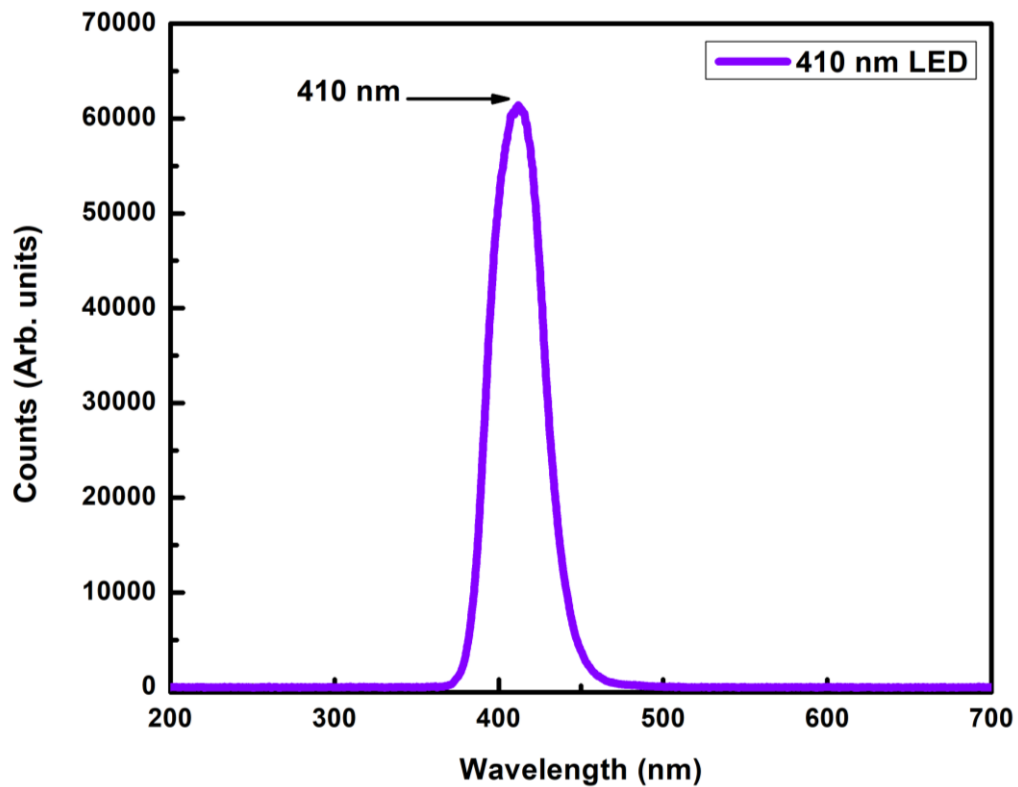


Figure S13: Spectra of 410 nm LED employed as light source of illumination, taken via absorption spectrometer, Model No. Avantes Starline, Avaspec-3648.

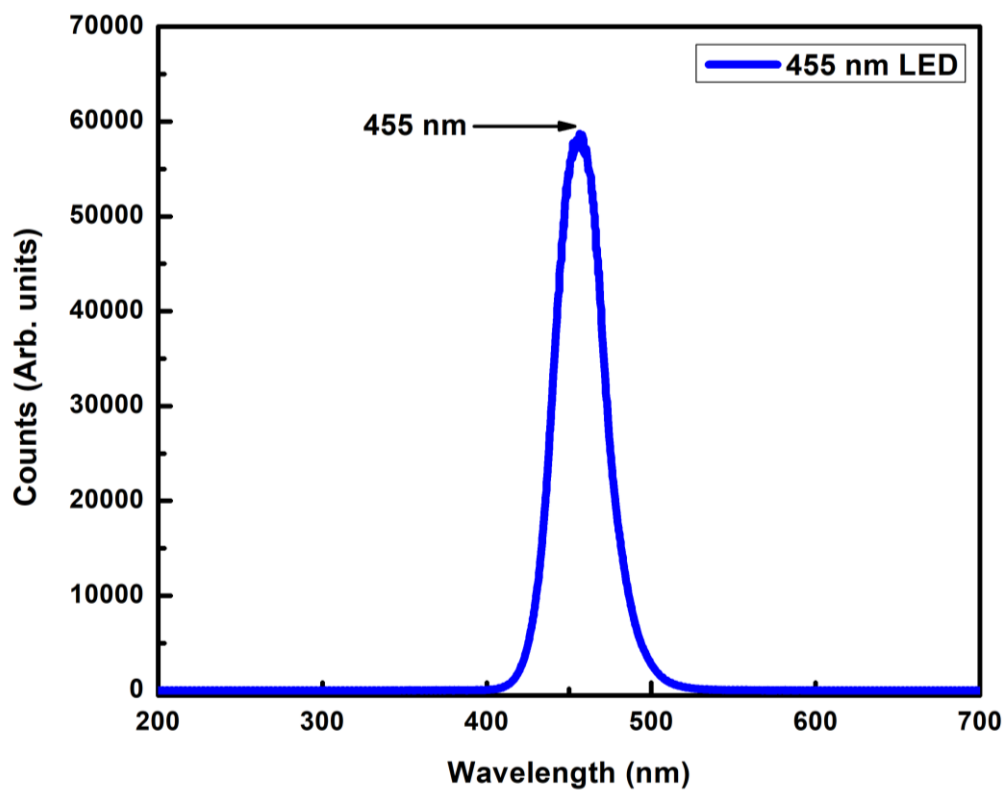


Figure S14: Spectra of 455 nm LED employed as light source of illumination, taken absorption spectrometer, Model No. Avantes Starline, Avaspec-3648.