[Supporting Information]

New methods of synthesis and varied properties of carbon quantum dots with high nitrogen content

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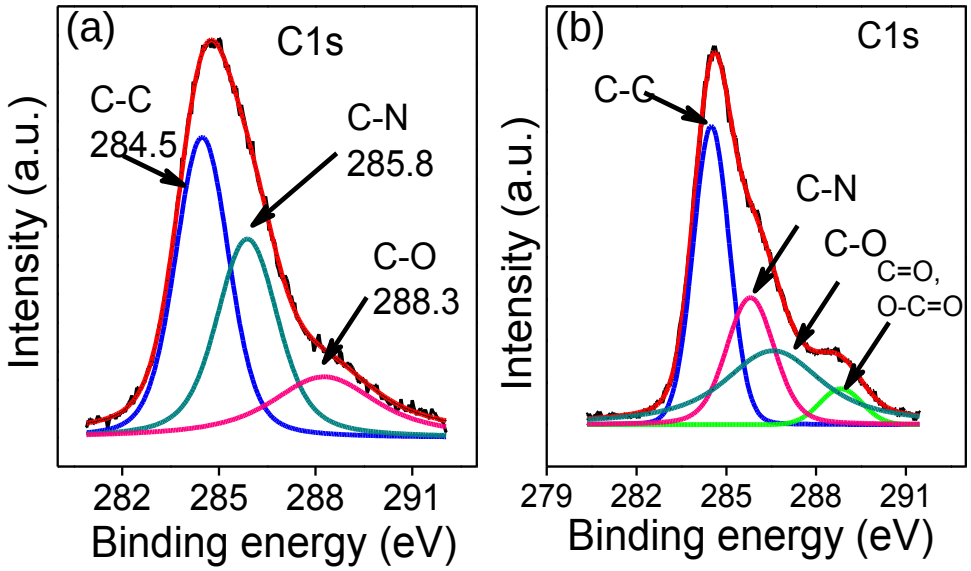

FIG. SI. High resolution C1s peak of N-CQDs prepared by (a)Hydrothermal and (b) Microwave synthesis.

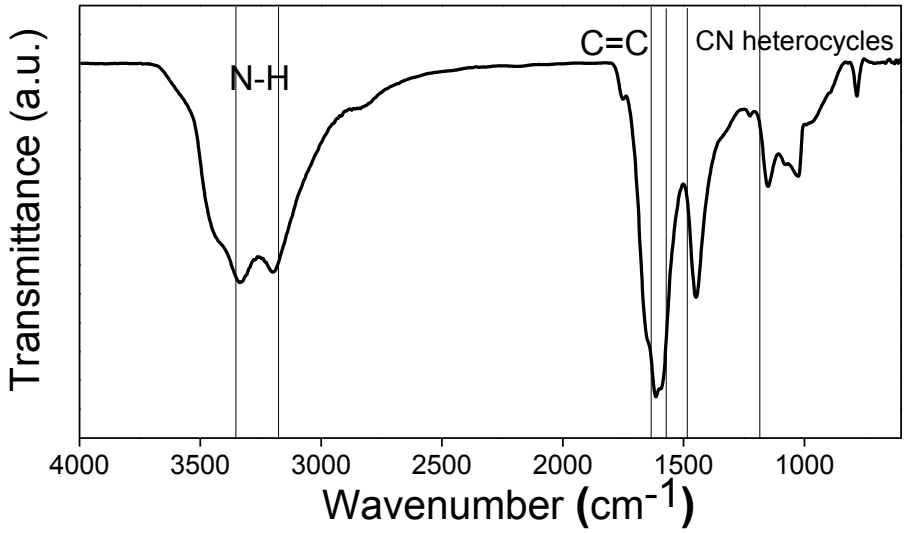

FIG. SII. FTIR spectra of N-CQDs

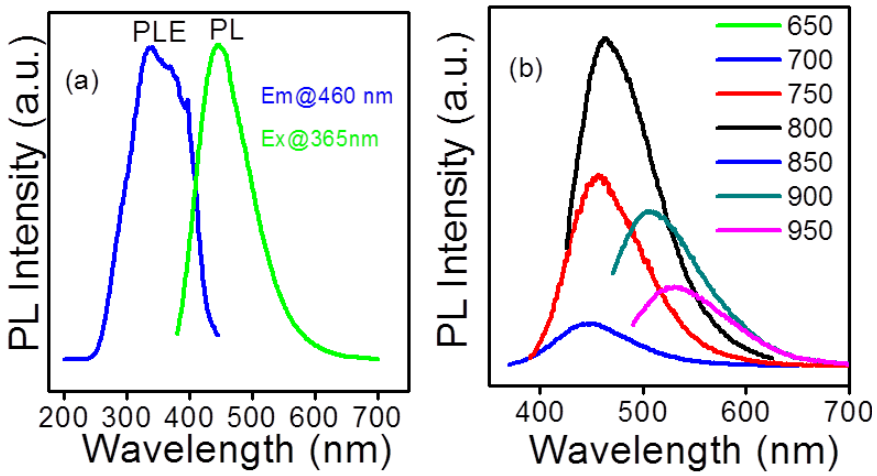

FIG. SIII. (a) PLE of N-CQDs (prepared by hydrothermal method) with the emission wavelength 460 nm and PL spectrum excited at 365 nm. (b) Up converted PL spectra of N-CQDs (prepared by hydrothermal method) at different excitation wavelengths.

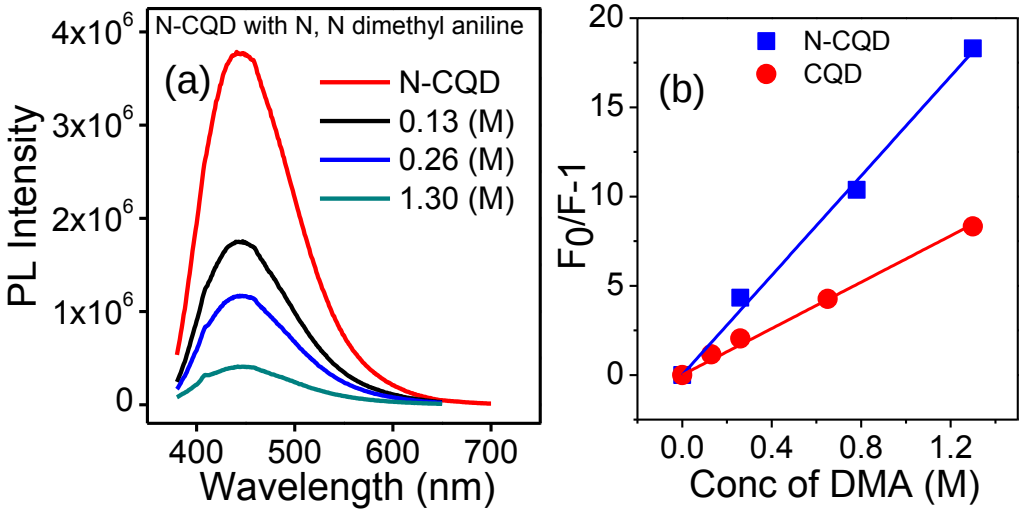

FIG. SIV. (a) Luminescence emission spectra (365 nm excitation) and (b) Stern-Volmer plots for the quenching of luminescence of N-CQDs in ethanol in presence of N, N dimethyl aniline.

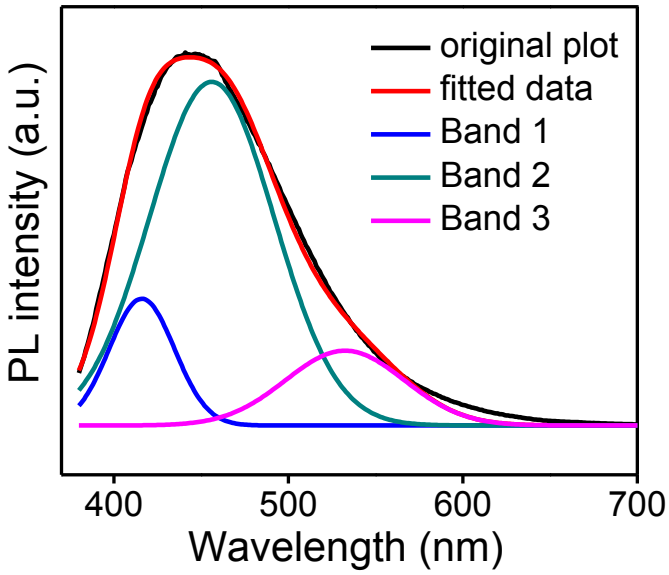

FIG. SV. Fluorescence spectrum of N-CQDs deconvoluted in multiple Gaussian function, suggesting the presence of multiple emissive sites.

TABLE S1. The C, H, N content of the samples synthesize at different reaction conditions

	%C	%N	%H	%O (calculated)
N-CQD (hydrothermal)	49.89	20.29	6.53	23.29
N-CQD (microwave)	53.49	23.30	6.54	16.67

Measurement of fluorescence quantum yields:

Coumarin 102 in ethanol was chosen as a standard (Φ =0.74). The quantum yield of NCQDs were measured in water using following equation,

$\Phi_x = \Phi_{st} (I_x/ I_{st})(\eta^2_x/\eta^2_{st})(A_{st}/A_x)$

Where, Φ is the quantum yield, I is the integrated emission intensity, η is the refractive index of solvent and A is the optical density. The subscript "x" refers to the sample and "st" to the standard with known quantum yield.

TABLE SII. Quantum yield calculation of N-CQDs prepared at different reaction conditions

Sample	Integrated emission intensity (I)	Absorbance at 385 nm (A)	Refractive index of solvent (η)	Quantum Yield (φ)
COUMARIN 102	1.2×10^{9}	0.02	1.36	74%
N-CQDs (hydrothermal)	2.9×10^{9}	0.51	1.33	0.7%
N-CQDs (microwave)	1.3×10^{9}	0.17	1.33	1.0%

TABLE SIII. Lifetime measurement of N-CQDs prepared by both hydrothermal method and microwave irradiation.

Sample	N-CQDs hydrothermal	N-CQDs microwave
Lifetime (nano Sec)	2.58	2.52

Calculation of quenching rate constant (k_q):

Stern-Volmer equation,

$F_0/F = 1 + k_q\tau_0$. [Q], Here F_0 and F is the emission intensity without and with quencher respectively. τ_0 is the lifetime of emissive excited state and [Q] is the conc. of quencher.

TABLE SIV. Calculation of Stern-Volmer quenching constant

Quencher	N-CQDs (M^{-1} s^{-1})	CQDs (M^{-1} s^{-1})
TTF	6.11×10^{12}	2.58×10^{12}
Exfoliated graphene	1.14×10^{11}	2.8×10^{11}
N,Ndimethyl aniline	2.52×10^{9}	5.4×10^{9}

TABLE SV. Variation of luminescence (365 nm excitation) intensity, emission position and band width upon interaction of N-CQDs with TCNE

Conc. of TCNE (mM)	PL Intensity (counts)	PL position (λ_{max} in nm)	FWHM
0	3.7×10^{6}	445	117
0.1	4.1×10^{6}	441	113
1	5.5×10^{6}	438	82
10	5.8×10^{5}	450	61

Calculation of photo degradation efficiency and rate constant:

We have calculated the percentage degradation of MB (fig 6b) as a function of irradiation time using the following equation,

$$\% \text{ degradation} = \frac{A_0 - A_t}{A_t} \times 100$$

where, A_0 is the absorbance at time t = 0 min and A_t is the absorbance at given time interval t.

The kinetics of photodegradation reaction of MB dye in presence of both N-CQDs and CQD is following pseudo first order kinetics at very low dye concentration. We have fitted our data according to the following equation

$$\ln \frac{C_0}{C_t} = kt$$

Here, C_0 and C_t are the absorbance of MB at 666 nm recorded at time 0 min and t min. k is the apparent rate constant.