Supporting Information

Graphitic Nitrogen Induced Identical Fluorescent Emission of Carbon Dots for Scalable Anti-Counterfeiting Applications

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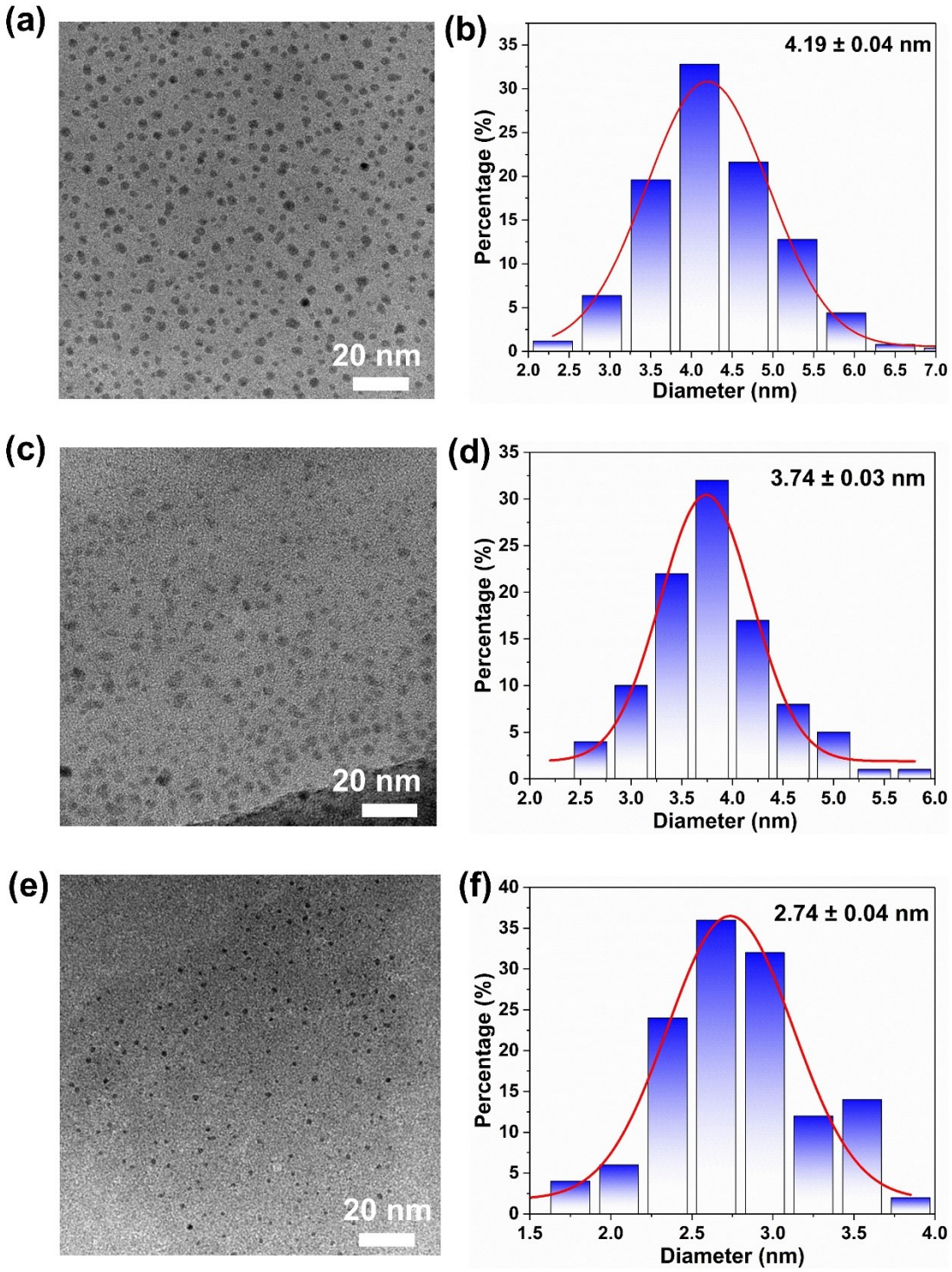

Fig. S1 TEM images of (a) N-CDs-1, (c) N-CDs-2 and (d) N-CDs-3. Size distributions of (b) N-CDs-1, (d) N-CDs-2 and (f) N-CDs-3.

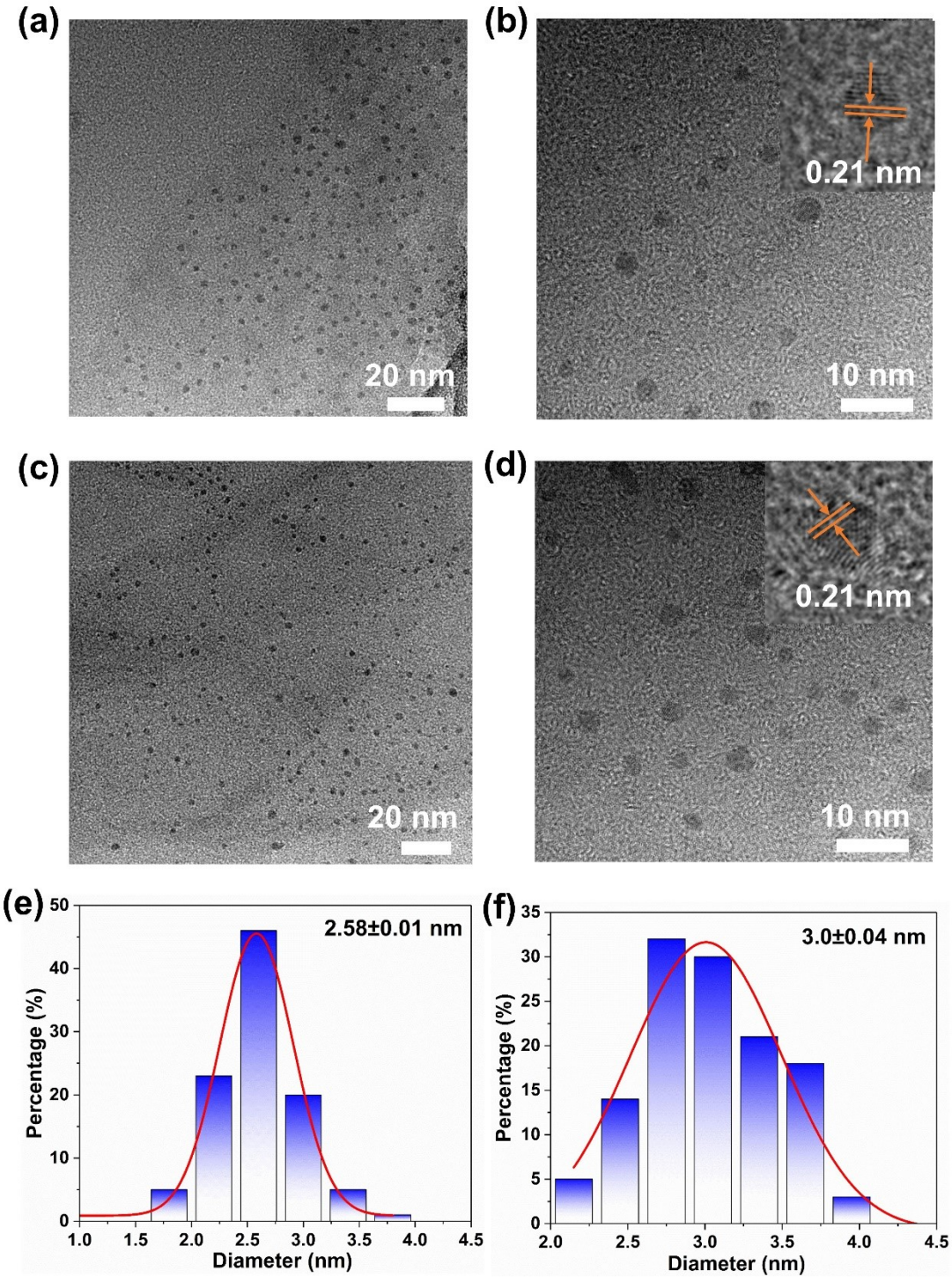

Fig. S2 TEM images of (a), (b) r-CDs-1 and (c), (d) r-CDs-2. Size distributions of (e) r-CDs-1 and (f) r-CDs-2.

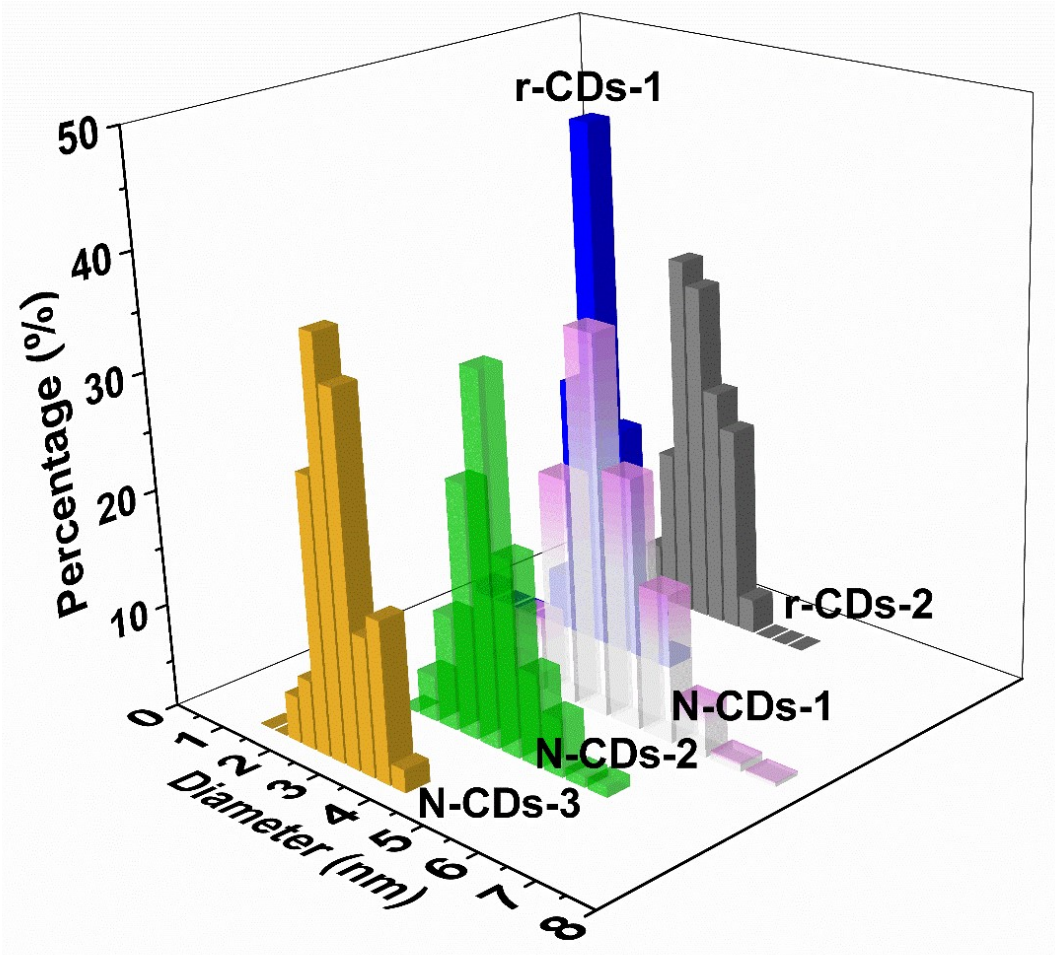

Fig. S3 Summary chart of the size distribution results.

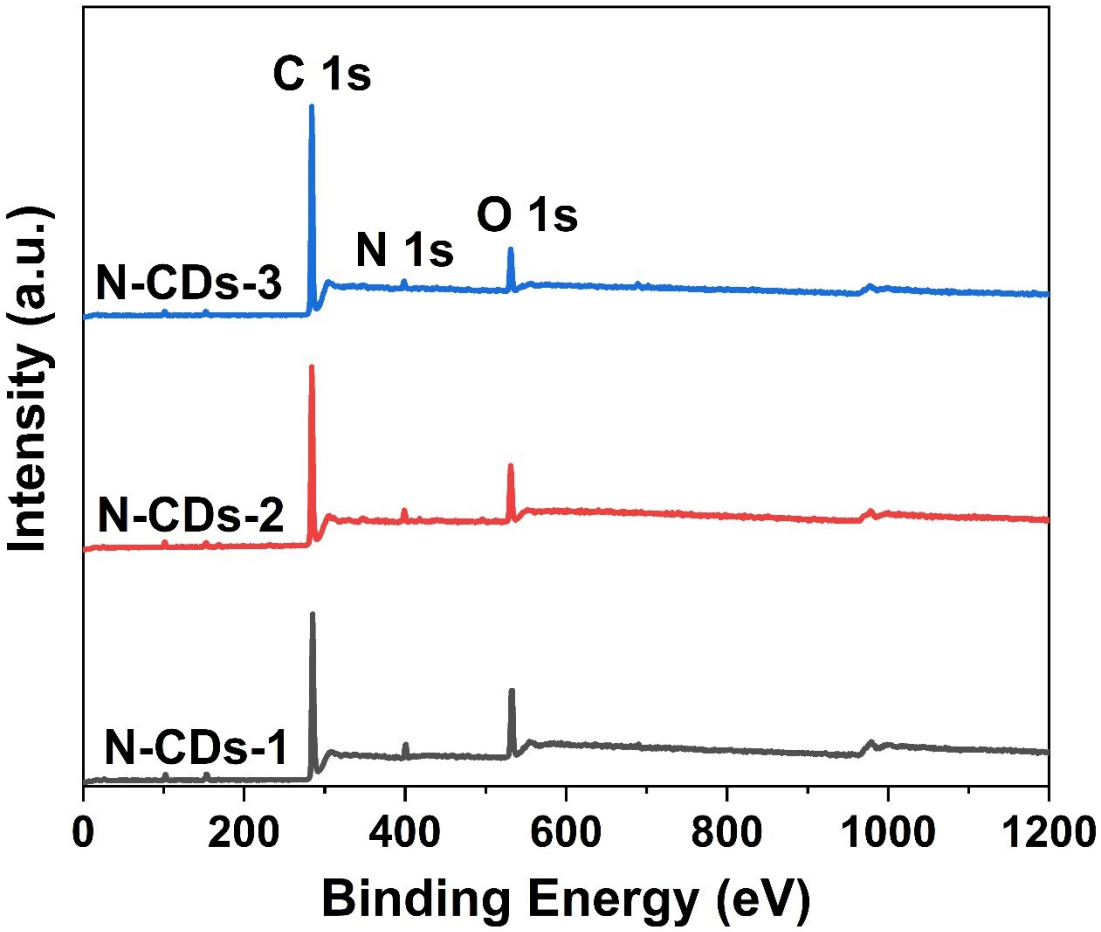

Fig. S4 XPS scan spectra of three N-CDs.

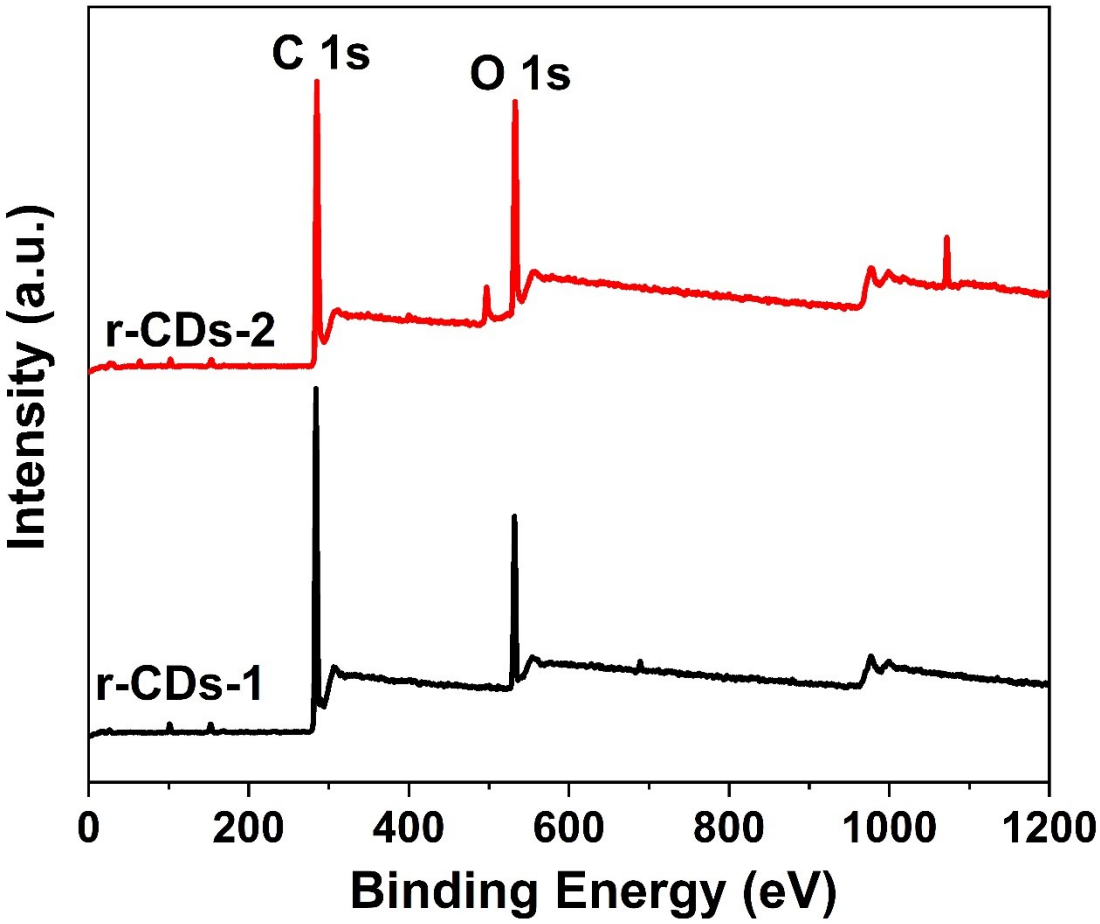

Fig. S5 XPS scan spectra of two r-CDs.

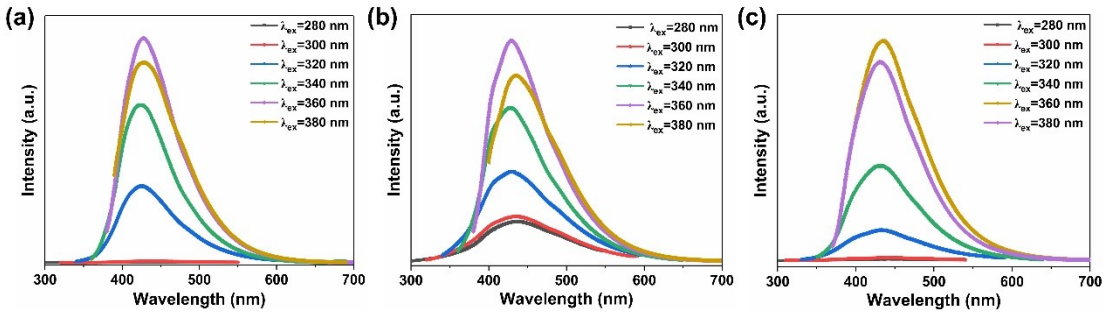

Fig. S6 The PL spectra of (a) N-CDs-1, (b) N-CDs-2, and (c) N-CDs-3, under different excitation wavelengths.

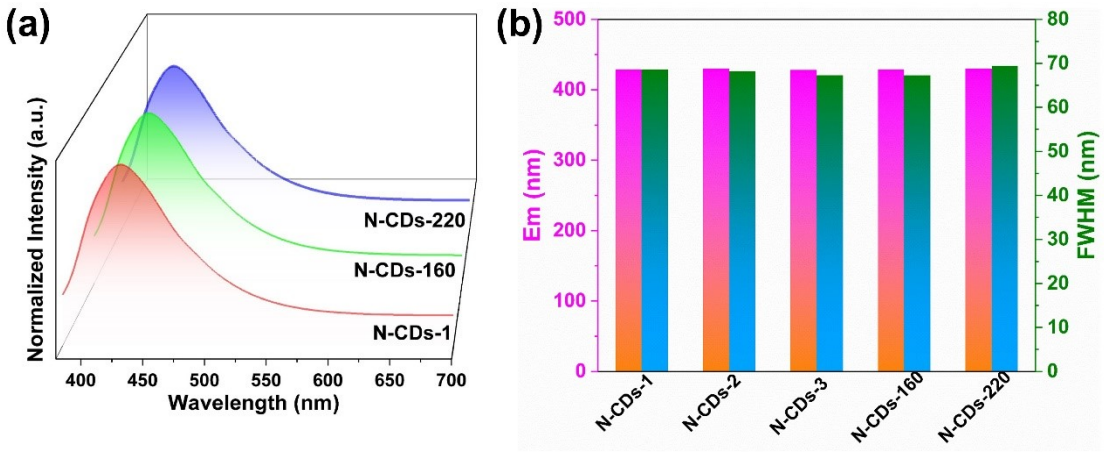

Fig. S7 (a) The PL spectra of N-CDs-1, N-CDs-160, and N-CDs-220, under 365 nm excitation wavelengths. (b) The summary of the emission peak and full width at half maximum (FWHM) of N-CDs under different pH and reaction temperatures.

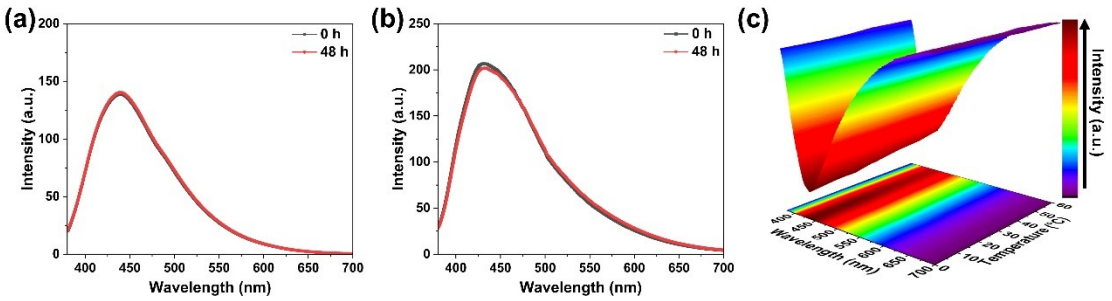

Fig. S8 (a) The PL spectra of N-CDs-1 was measured after 48 h, at pH = 0.76. (b) The PL spectra of N-CDs-1 was measured after 48 h, at 50 °C. (c) The temperature-dependent PL 3D spectra of N-CDs-1 in ethanol (0–60 °C).

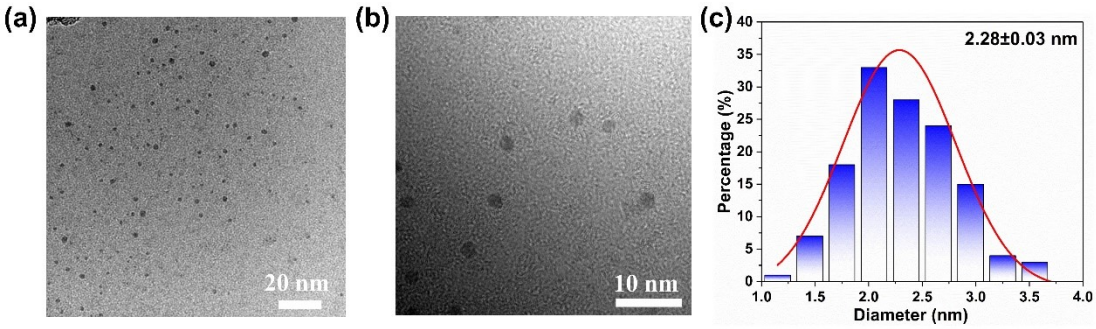

Fig. S9 TEM images of (a), (b) N-CDs-4. Size distributions of (c) N-CDs-4. More than 200 particles are counted for these distributions.

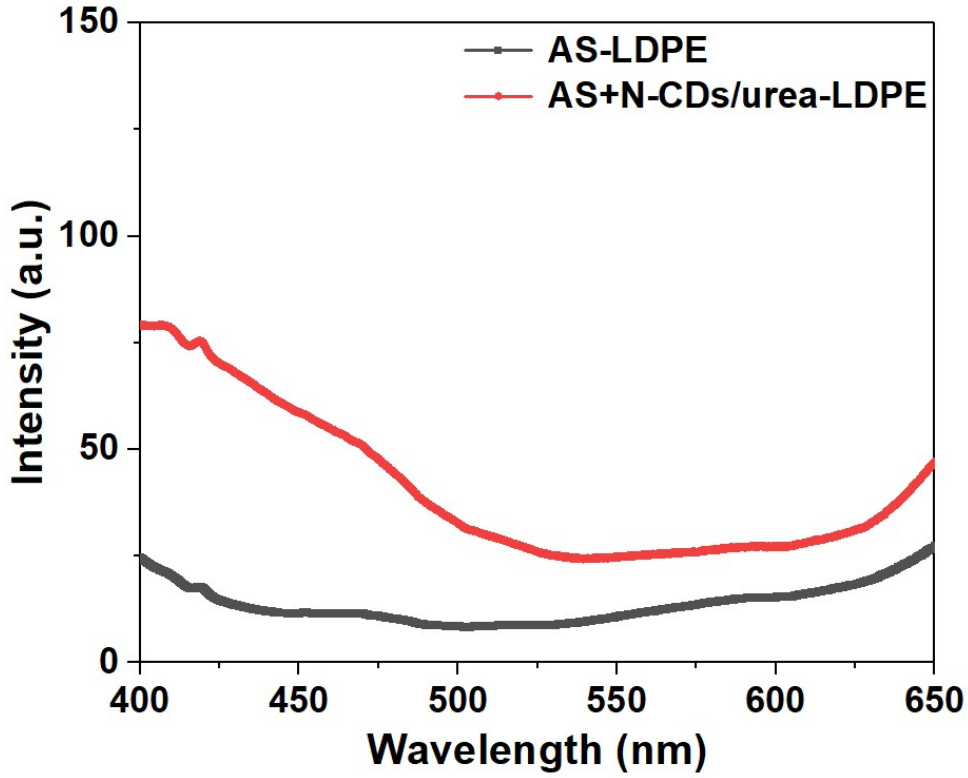

Fig. S10 The PL spectra of AS and AS+N-CDs/urea coated on LDPE under 365 nm excitation wavelengths.

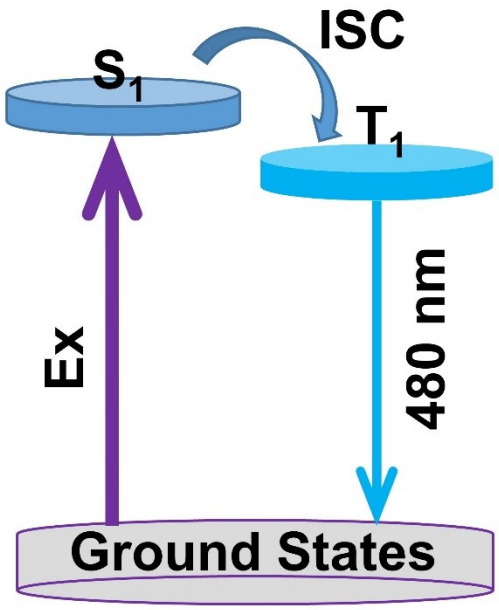

Fig. S11 Proposed phosphorescence emission processes of N-CDs/urea (Ground state, S_1: First excited singlet state, T_1: First excited triplet state).

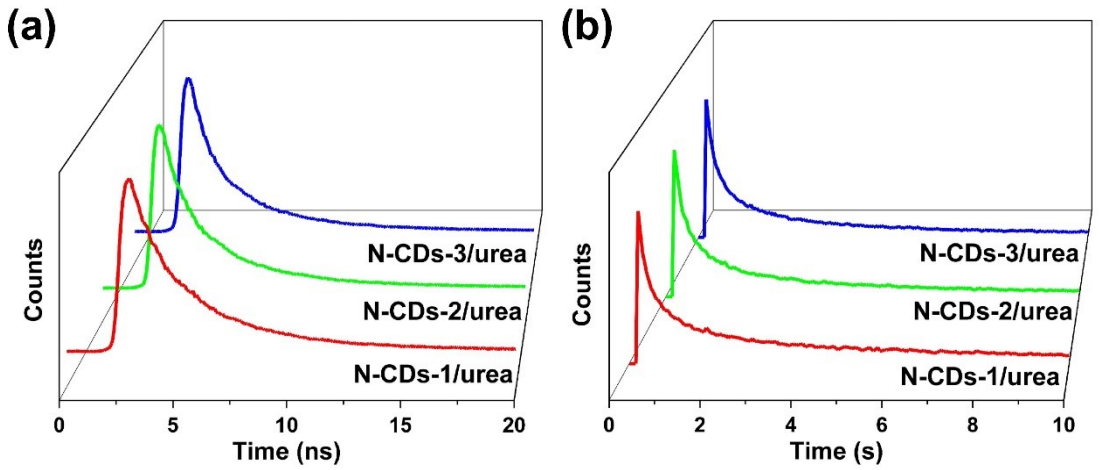

Fig. S12 Time-resolved decay spectra of N-CDs/urea measured at 404 nm: (a) fluorescence, (b) phosphorescence.

Table S1 XPS data analysis of full spectra of N-CDs and r-CDs.

Samples	C (at.%)	N (at.%)	O (at.%)
N-CDs-1	79.24	4.65	16.11
N-CDs-2	83.29	4.28	12.43
N-CDs-3	86.51	3.01	10.48
r-CDs-1	75.85	-	24.15
r-CDs-2	82.91	-	17.09

Table S2 XPS data analysis of C 1s spectra of N-CDs and r-CDs.

Samples	C=C/C-C (%)	C-N (%)	C-O (%)	C=N (%)
N-CDs-1	61.49	13.25	19.49	5.77
N-CDs-2	62.03	18.99	13.99	4.99
N-CDs-3	64.47	18.46	12.57	4.50
r-CDs-1	62.01	-	37.99	-
r-CDs-2	71.99	-	28.01	-

Table S3 XPS data analysis of N 1s spectra of N-CDs.

Samples	Graphitic N (%)	Pyridinic N (%)
N-CDs-1	48.60	51.40
N-CDs-2	42.76	57.24
N-CDs-3	48.53	51.47

Table S4 Elemental analysis results of N-CDs.

Samples	C (wt.%)	N (wt.%)	H (wt.%)	O* (wt.%)
N-CDs-1	53.93	10.61	4.68	30.78
N-CDs-2	45.21	7.54	4.45	42.80

*:by difference.