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SUPPORTING INFORMATION

Facile Synthesis of Graphene Quantum Dots with Red Emission and High Quantum Yield

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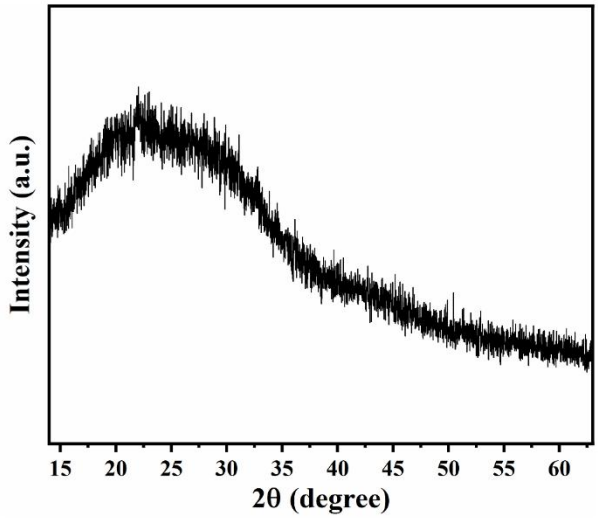

Fig. S1 XRD pattern of GQDs.

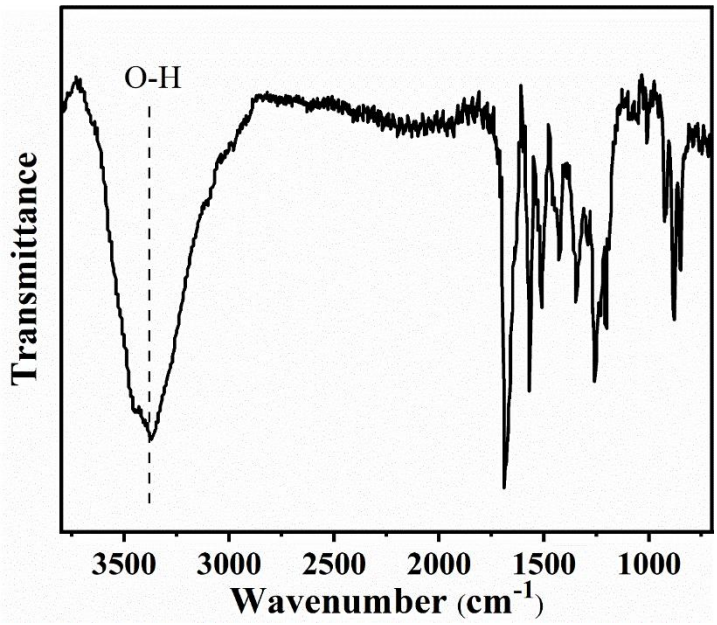

Fig. S2 FTIR spectrum of synthesized GQDs using 2,7-DHN as single carbon source under the same conditions.

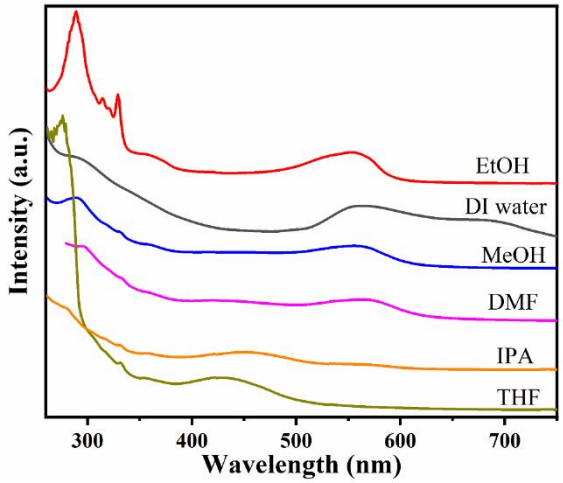

Fig. S3 UV-vis spectra of the GQDs dissolved in various solvents.

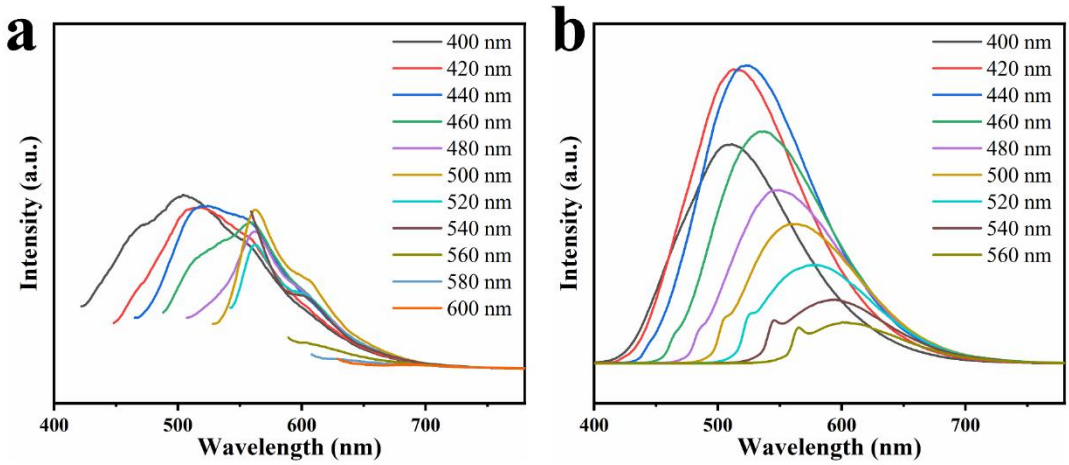

Fig. S4 PL spectra of (a) DHN-GQDs (0.05 mg/mL) and (b) PA-GQDs (0.05 mg/mL) in ethanol solution.

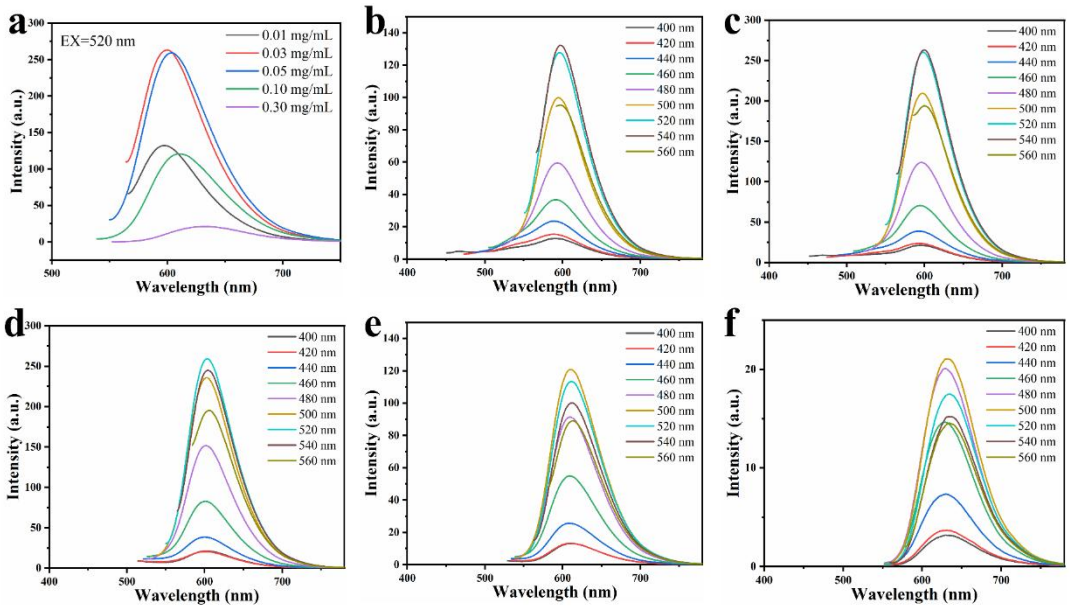

Fig. S5 (a) The emission peak of band 2 under excitation wavelength at 520 nm with different concentrations of the GQDs in DI water. Fluorescence emission spectra for GQDs in DI water with different concentrations of (b) 0.01 mg/mL, (c) 0.03 mg/mL,

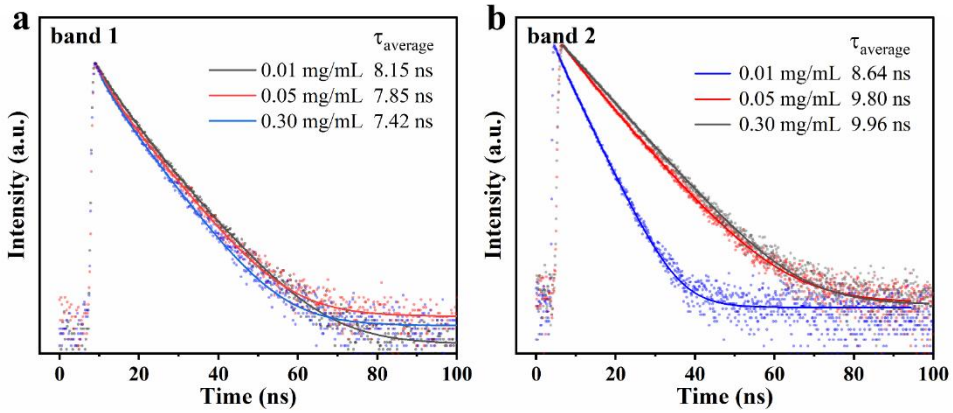

Fig. S6 Time resolved PL decay curves of GQDs for (a) band 1 and (b) band 2 with different concentrations.

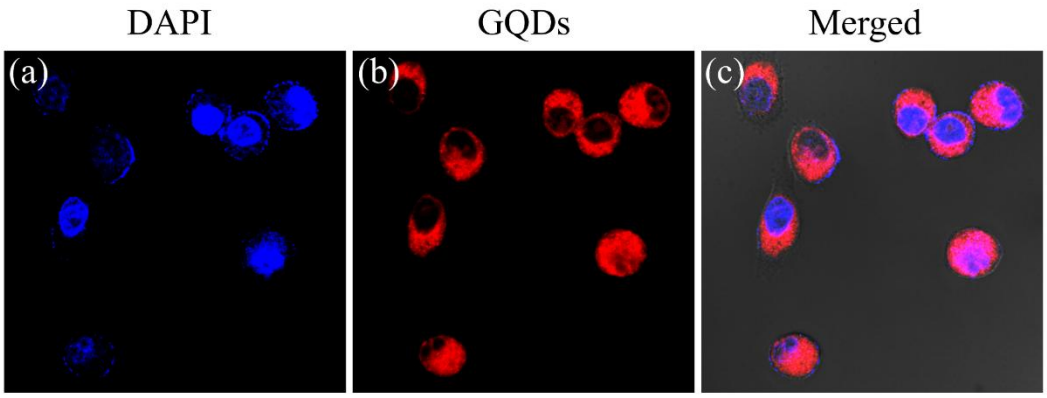

Fig. S7 Confocal images of HeLa cells stained with DAPI and GQDs. (a) DAPI, (b) GQDs and (c) merged image of (a) DAPI and (b) GQDs.

Table S1 Compositions of PL delay time of GQDs with concentration change (from 0.01 to 0.30 mg/mL) for the emission of band 1 and band 2 under 475 nm excitation.

Sample	c (mg/mL)	τ_1[a] (ns)	Percentage (b_1)	τ_2 (ns)	Percentage (b_2)	τ_{avg}[b] (ns)
band 1	0.01	5.03	34.23%	9.78	65.77%	8.15
band 1	0.05	3.66	23.10%	9.11	76.90%	7.85
band 1	0.30	3.48	22.98%	8.60	77.02%	7.42
band 2	0.01	6.33	33.09%	9.78	66.91%	8.64
band 2	0.05	9.15	93.10%	18.59	6.90%	9.80
band 2	0.30	9.96	100%	0	0	9.96

a) The decay time of GQDs was obtained from the decay curves, which simulated by using multiexponetial model $I(t) = \sum_{i=1}^{n} \alpha_i \exp(-t/\tau_i)$ The 0.30 mg/mL of band 2 shows the single exponential fluorescence decay and other wavelengths present the biexponential decay.

where α_i is the pre-exponential factor for the time-resolved decay lifetime of τ_i.

b) Average fluorescence lifetime: $\tau_{avg} = b_1\tau_1 + b_2\tau_2$

where b_1 and b_2 are the fractional contributions of time-resolved decay lifetimes of τ_1 and τ_2, respectively.

Table S2 Summary of the QY of GQDs with red emission obtained previous reports and in this work.

Precursor	Environmental condition	QY (%)	Reference
1,3,6-trinitropyrene and boric acid	Organic solvent	17.1	1
catechol and o-phenylenediamine	Organic solvent	15	2
catechol and o-phenylenediamine	Organic solvent	35	3
p-phenylenediamine and dimethylformamide	Aqueous solution	52	4
graphite target	Organic solvent	47	5
2,7-dihydroxynaphthalene and piperazine anhydrous	Organic solvent	54.9	Our work

References

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