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Supporting information

A New Fluorescence Probe of Nitrogen-doped Graphene Quantum Dots for The Selective and Quantitative Determination of Cerium (Ⅳ) Ion of The Rare Earth Element

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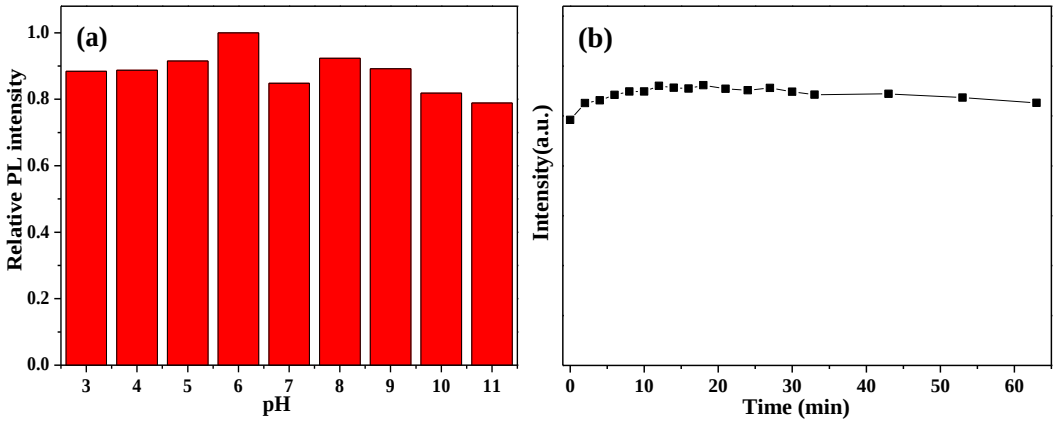

Fig. S1 (a) the relative PL intensity of the prepared N-GQDs at different pH values; Excitation wavelength: 320 nm; Emission wavelength: 450 nm. (b) The fluorescence intensity of the prepared N-GQDs during continuous excitation with a UV beam. Irradiation time covered from 0 to 60 mins.

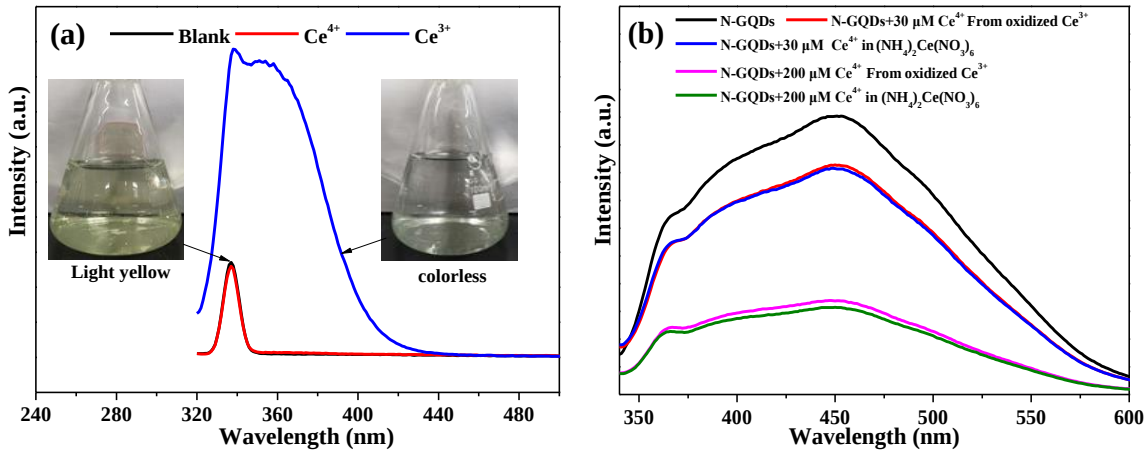

Fig. S2 (a) fluorescence responses of aqueous solution (black line). fluorescence responses of Ce^{4+} ions (red line). fluorescence responses of Ce^{3+} ions (red line).inset: photographs of the Ce^{4+} ions (left) and Ce^{3+} ions (right); The use of Ce^{4+} was from Ce^{3+} of $Ce(NO_3)_3$ after its oxidation, and the evidence of Ce^{4+} was shown in Fig. S2a which exhibited the disappeared typical fluorescence peak of Ce^{3+} to support the existence of truly Ce^{4+} in $Ce(NO_3)_3$. (b) fluorescence responses of N-GQDs aqueous solution (0.015 mg/mL) (black line). The red line represents the FL changes of the prepared N-GQDs solution at the addition of Ce^{4+} (30 μM). The blue line represents the FL changes of the prepared N-GQDs solution at the addition of $(NH_4)_2Ce(NO_3)_6$ (30 μM) .The magenta line represents the FL changes of the prepared N-GQDs solution at the addition of Ce^{4+} (200 μM) from Ce^{3+} of $Ce(NO_3)_3$ after its oxidation. The olive line represents the FL changes of the prepared N-GQDs solution at the addition of $(NH_4)_2Ce(NO_3)_6$ (200 μM). We compared the fluorescence in following five cases, 1) the N-GQDs solution only, 2) and 3) the addition of the small amount of cerium (IV) in the N-GQDs solution in the presence or absence of the NH_4^+ ion, 4)

and 5) the addition of the excessive amount of cerium (IV) in the N-GQDs solution in the presence or absence of the NH_4^+ ion. Results were shown in Fig. S2b (ESI†), exhibiting the ignorant effect of the presence of the NH_4^+ ion on the fluorescence system of the N-GQDs solution and cerium (IV), and only significant response of the fluorescence upon the addition of the Ce^{4+} ion in the N-GQDs solution whatever the NH_4^+ ion presented.

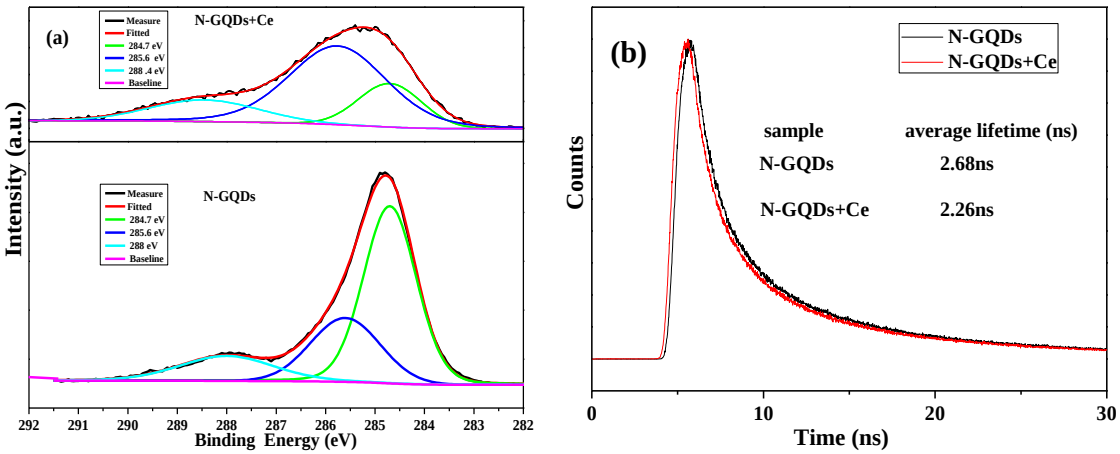

Fig. S3 (a) high resolution C1s XPS spectra of the N-GQDs before and after the addition of Ce^{4+};(b) the time-resolved fluorescence spectra of N-GQDs and N-GQDs-Ce with excitation wavelength of 286 nm and emission wavelength of 450 nm.

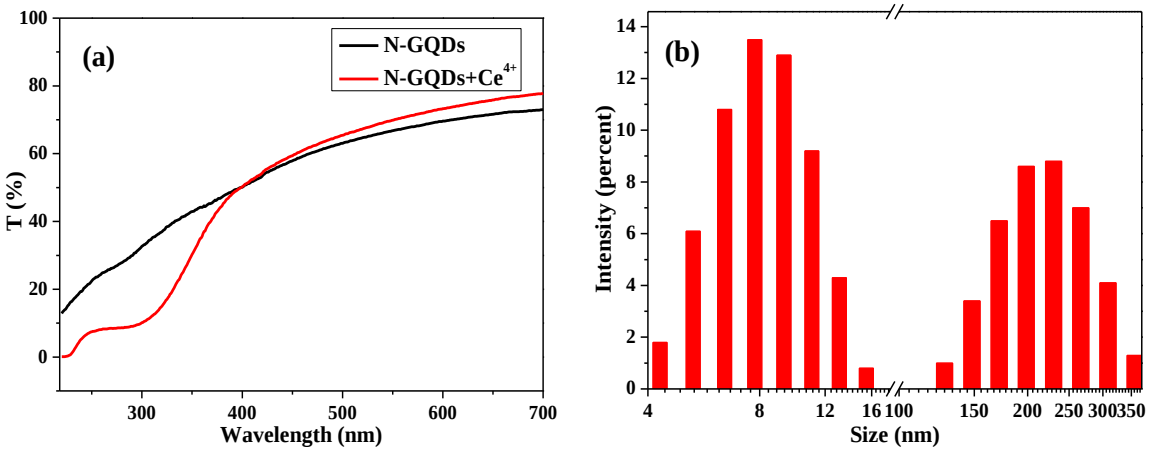

Fig. S4 (a) UV transmission spectra of N-GQDs (0.015 mg/mL) with and without Ce^{4+} ion (Concentration: 200 μM). (b) Dynamic light scattering analysis result of N-GQDs (0.015 mg/mL).