Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

A green heterogeneous synthesis of N-doped carbon dots and their photoluminescence applications with solid and aqueous states

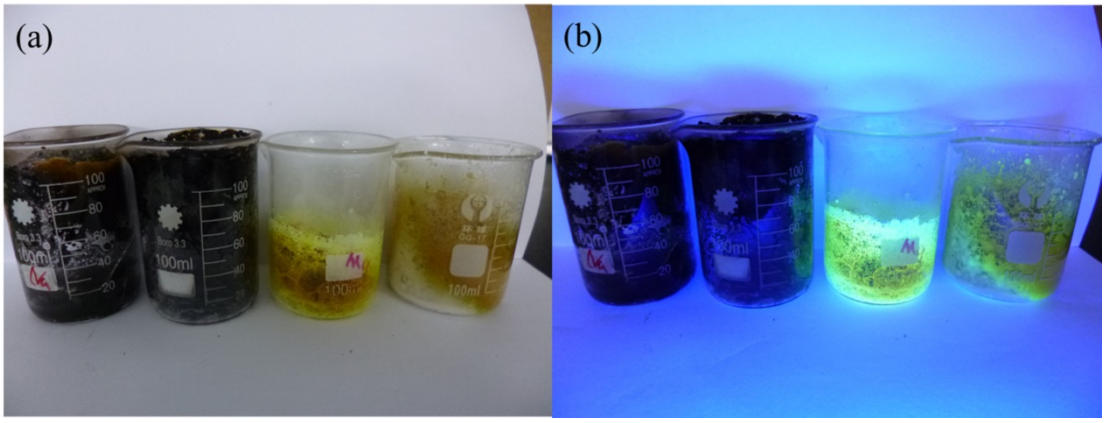

Fig. S1 (a) Daylight photo and (b) 365 nm UV beam photo of different precursors with urea under microwave irradiation in solid state. From left to right: sodium citrate, potassium citrate, magnesium citrate, and calcium citrate.

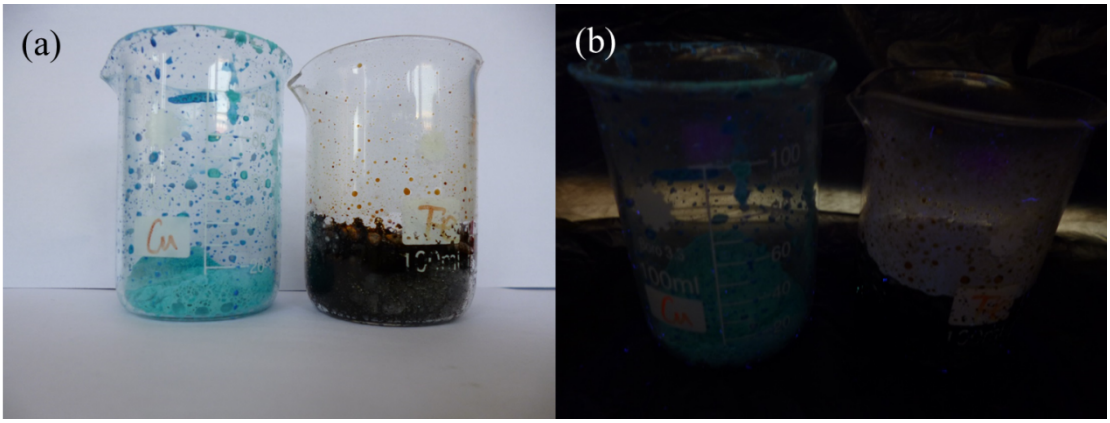

Fig. S2 (a) Daylight photo and (b) 360 nm UV beam photo of different precursors with urea under microwave irradiation in solid state. From left to right: copper citrate and iron citrate.

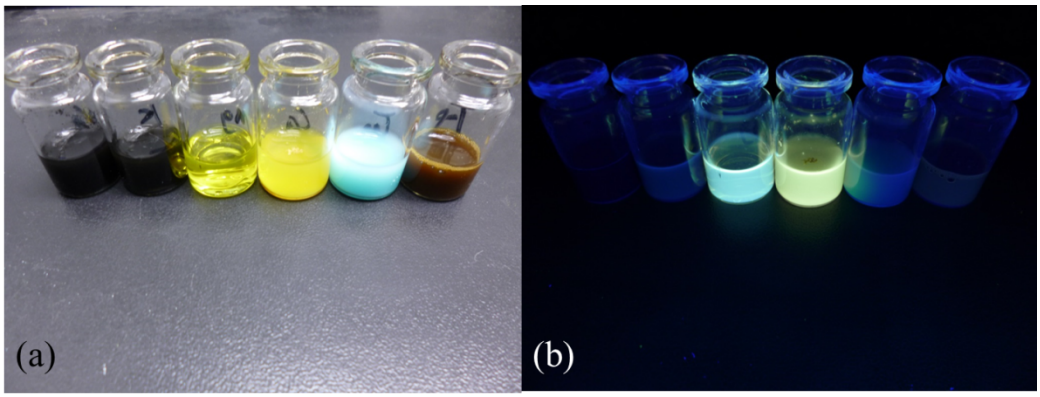

Fig. S3 (a) Daylight photo and (b) 365 nm UV beam photo of different precursors with urea under microwave irradiation in aqueous solution state. From left to right: sodium citrate, potassium citrate, magnesium citrate, and calcium citrate, copper citrate, and iron citrate.

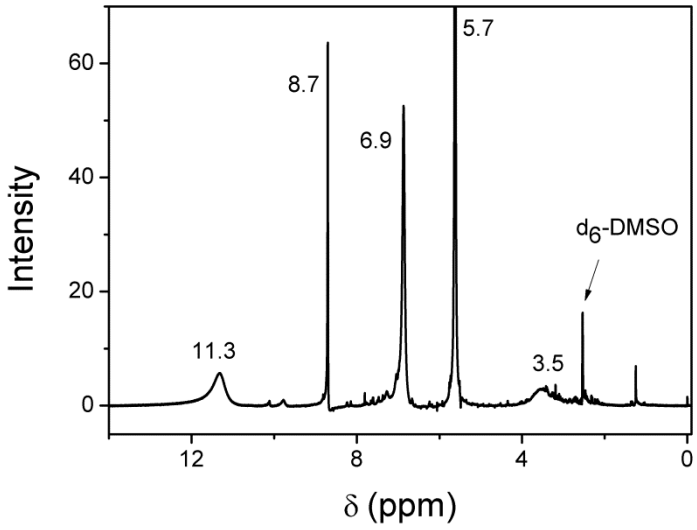

Fig. S4 ^{1}H-NMR spectrum of as-synthesized N-doped CDs.

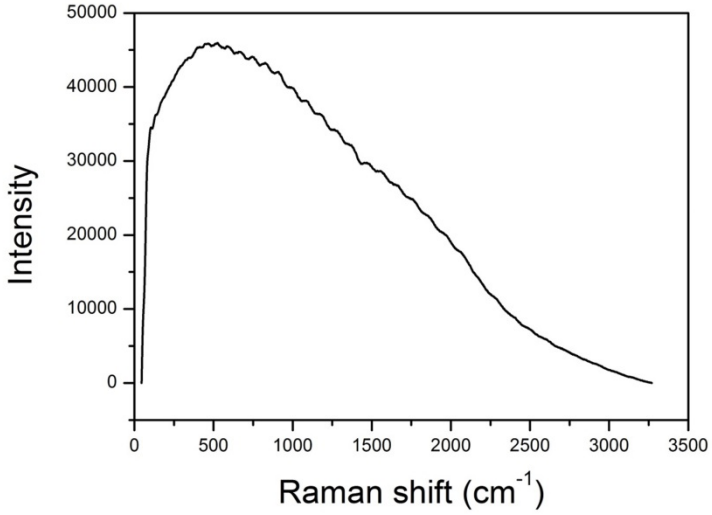

Fig. S5 Raman spectrum of as-synthesized N-doped CDs.

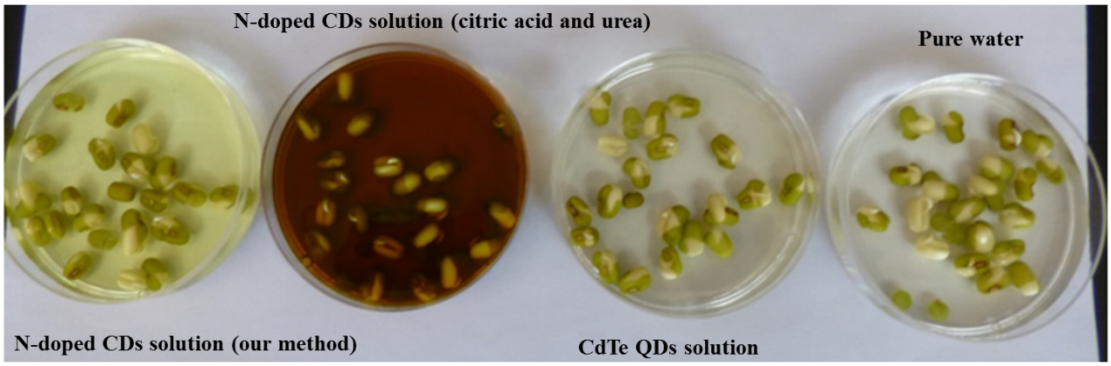

Fig. S6 Growth of green beans after 24 h for toxicity research.

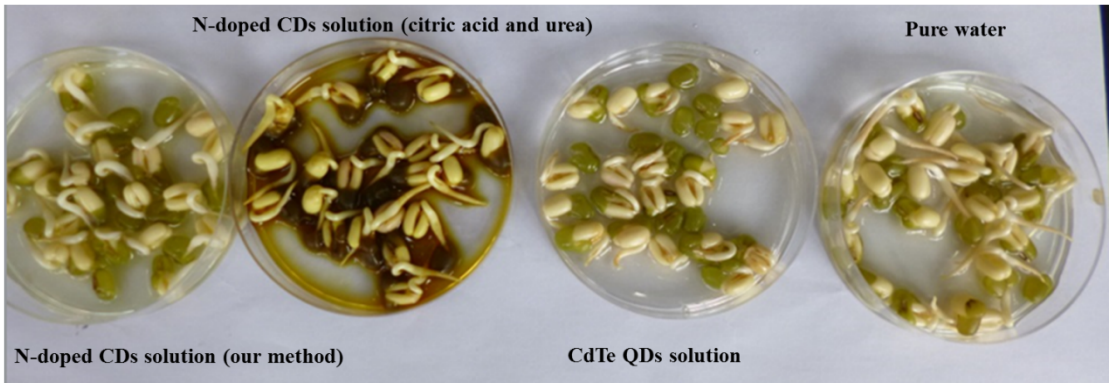

Fig. S7 Growth of green beans after 48 h for toxicity research.

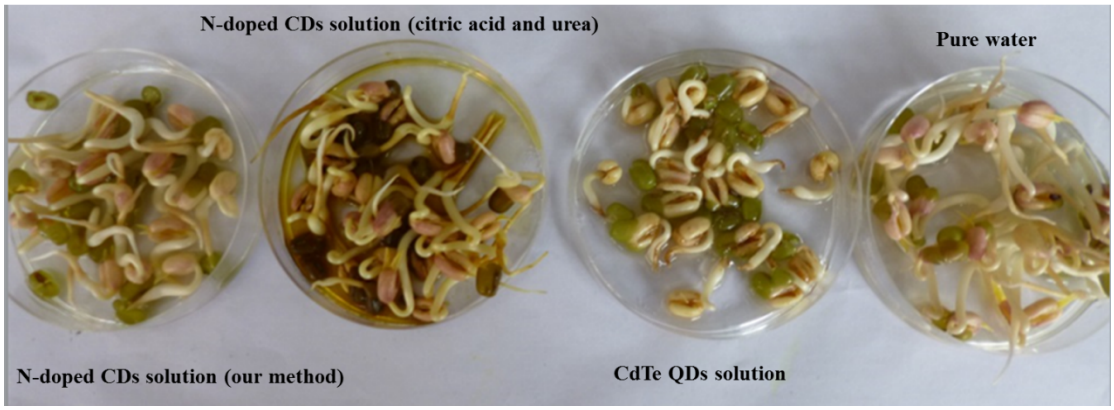

Fig. S8 Growth of green beans after 72 h for toxicity research.

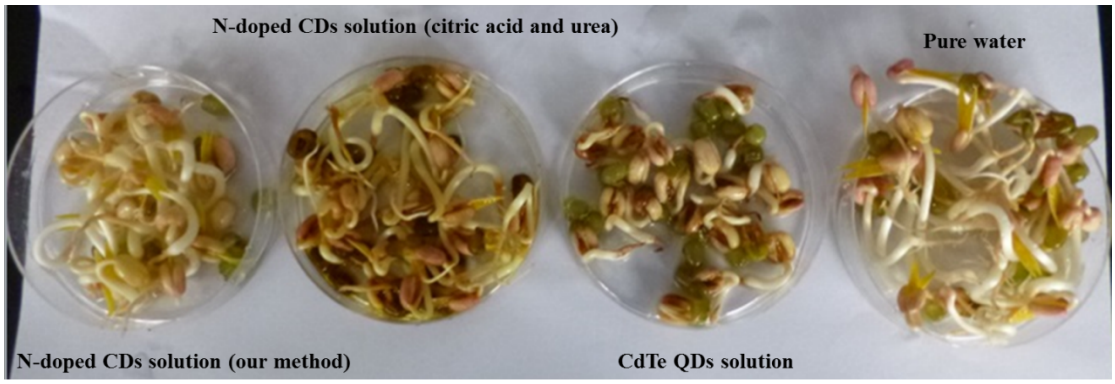

Fig. S9 Growth of green beans after 96 h for toxicity research.

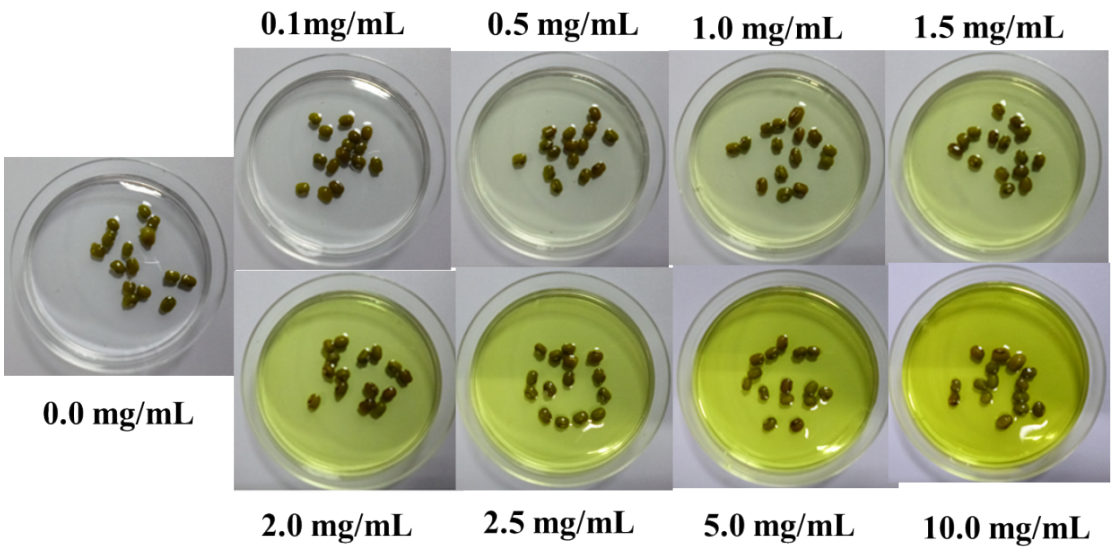

Fig. S10 Growth of green beans after 0 h at different concentration of N-doped CDs.

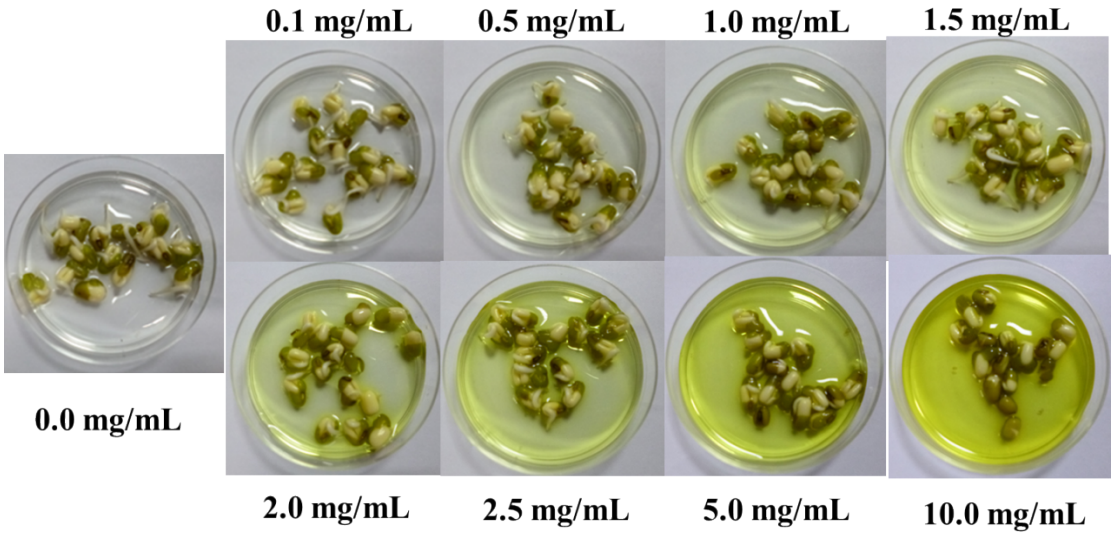

Fig. S11 Growth of green beans after 24 h at different concentration of N-doped CDs.

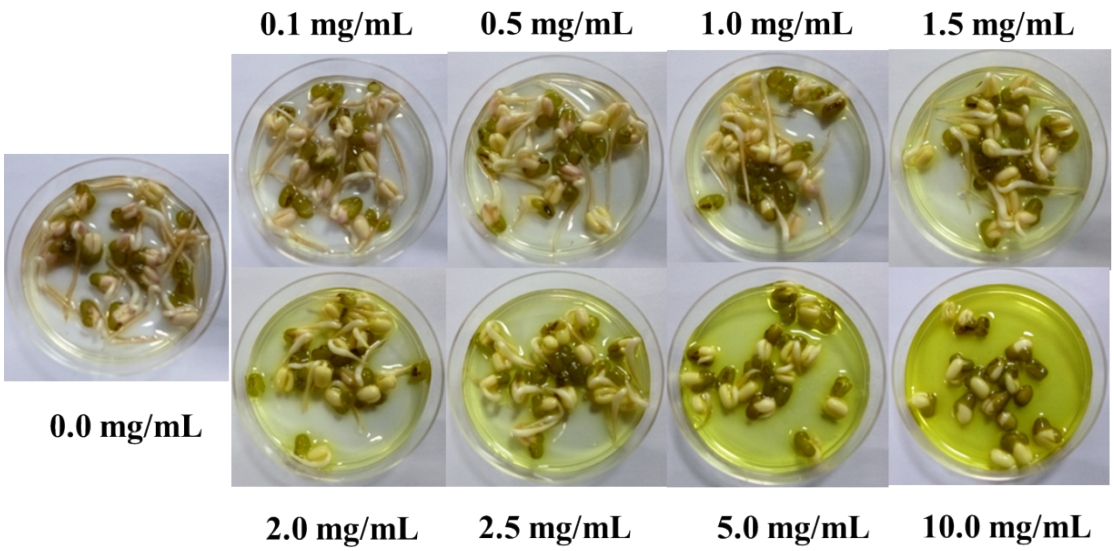

Fig. S12 Growth of green beans after 48 h at different concentration of N-doped CDs.

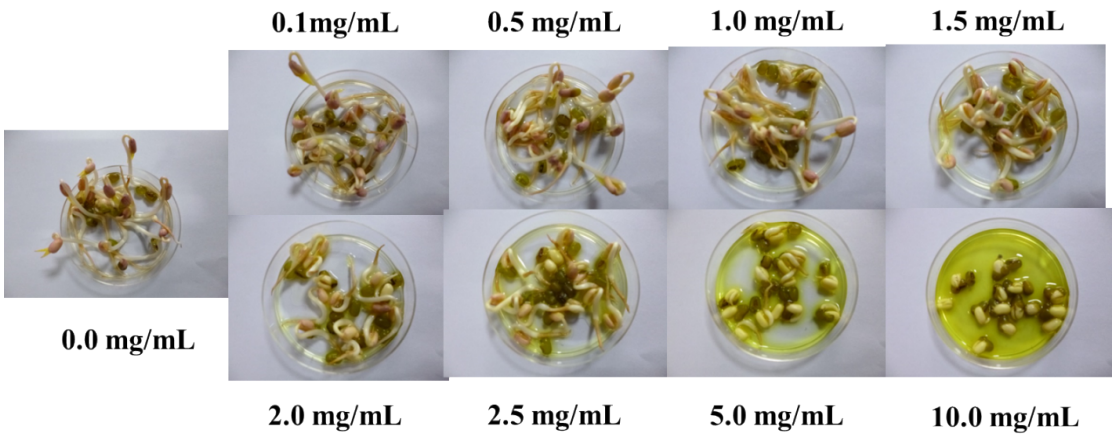

Fig. S13 Growth of green beans after 72 h at different concentration of N-doped CDs.

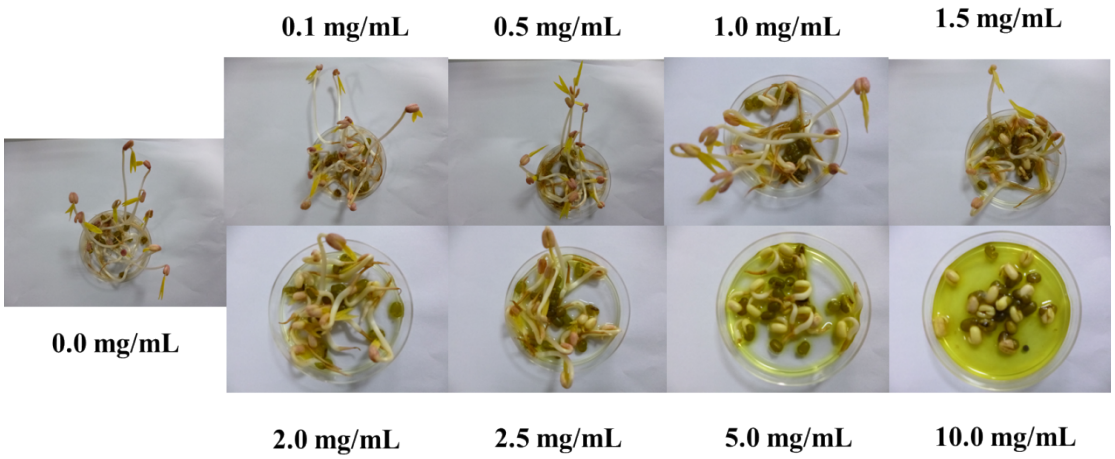

Fig. S14 Growth of green beans after 96 h at different concentration of N-doped CDs.

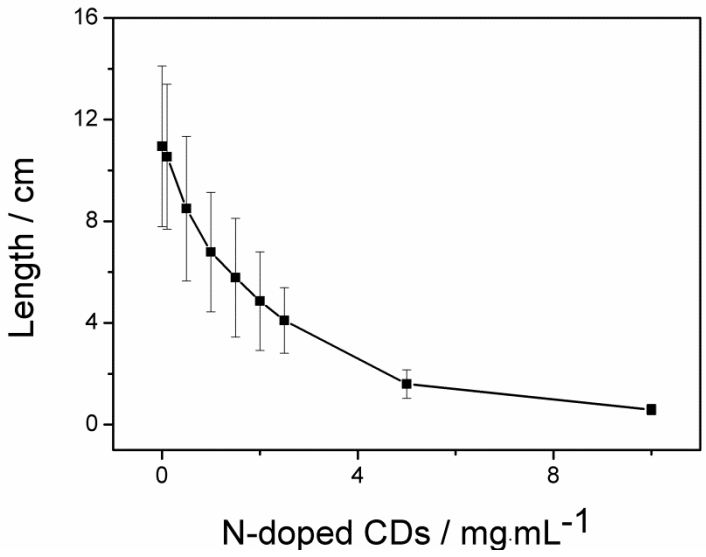

Fig. S15 The correlation of N-doped CDs' concentration and 29 bean sprouts' lengths after 96 h growth.

Table S1. The detailed information of XPS.

Name	Position	FWHM	Area/ (T*MFP)	%At Concn.	%Mass Concn.
N_{1s}	399.65	2.385	3143.83	39.17	39.14
C_{1s}	288.75	1.953	1341.29	30.08	25.77
O_{1s}	531.15	1.905	4016.65	30.75	35.09

Quantum yield (QY) measurements: The QY was measured according to "A guide to Recording Fluorescence Quantum Yields" by Jobin Yvon Horiba Ltd. at http://www.jobinyvon.co.uk/ukdivisions/Fluorescence/plqy.htm.

Quinine sulfate in a 0.1 M H_2SO_4 aqueous solution (QY is 0.54) was selected as a reference for N-doped CDs. The QY was determined by comparing the integrated photoluminescence intensity (excited at 370 nm for N-doped CDs) and the absorbance value (less than 0.1 at the excitation wavelength) of samples with that of the references. The slope method was used to calculate the QYs of N-doped CDs using the equation:

$$QY_u = QY_S\,(m_u/m_s)(n_u/n_s)^2$$

Where QY is the quantum yield, *m* is the slope determined by the curves, *n* is the refractive index (1.33 for water and a 0.1 M H_2SO_4 aqueous solution). The subscript "*s*" refers to the standards and "*u*" refers to the unknown samples.