Supporting Information

Nitrogen-doped carbon nanoparticles modulated turn-on fluorescence probes for histidine detection and its imaging in living cells

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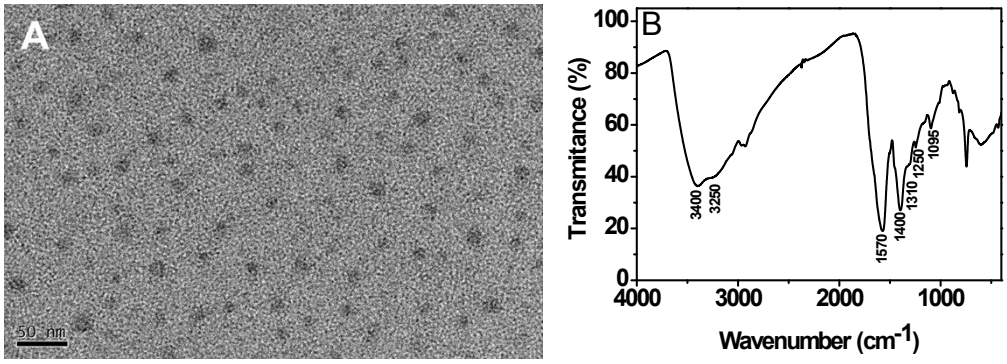

Fig. S1 (A) TEM image and (B) FT-IR spectra of the N-CNPs.

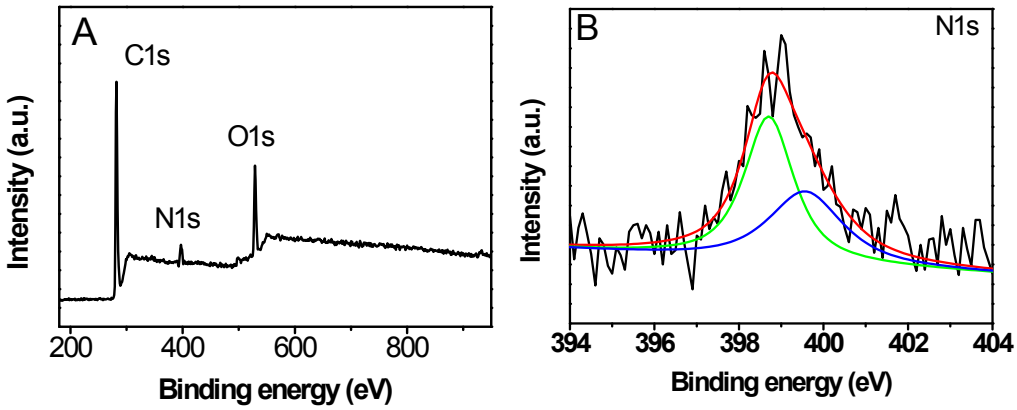

Fig. S2 (A) Survey XPS and (B) N1s spectra of the N-CNPs.

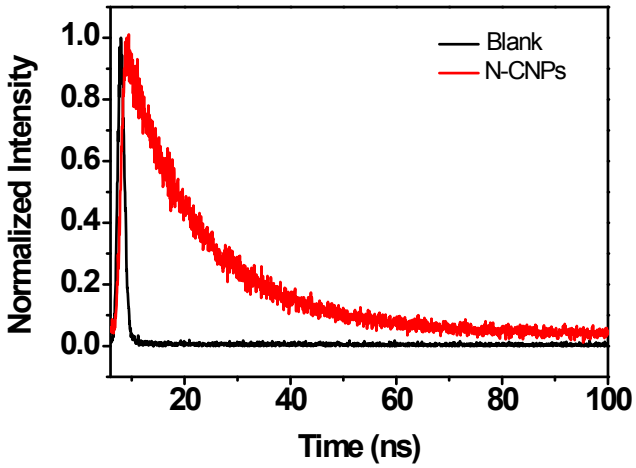

Fig. S3 Time-resolved fluorescence decay of N-CNPs. The black line was the instrument response function. $\tau = \tau_1 + \tau_2 = 7.50 \times 22\ \% + 18.00 \times 78\ \% = 15.69$ ns.

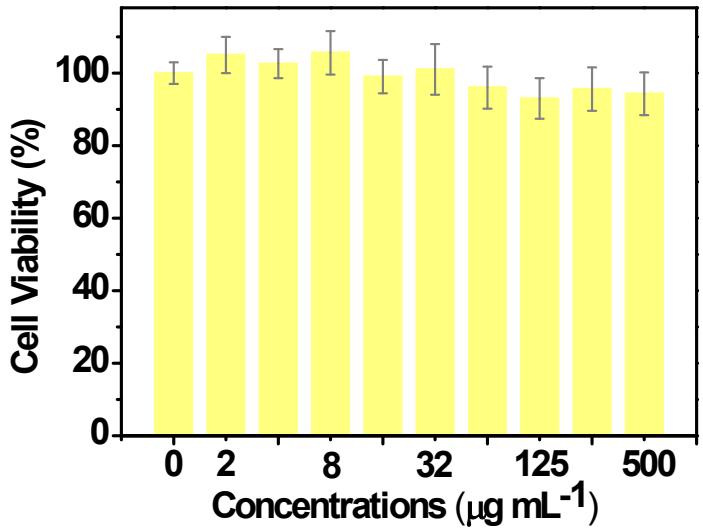

Fig. S4 Cell viability after incubation with N-CNPs for 24 h

***In vitro* cytotoxicity characterization.** Cells were cultured and maintained in DMEM medium (GIBCO, Gaithersburg, MD, USA) supplemented with 10 % fetal bovine serum (FBS), 100 U mL^{-1} penicillin, 100 μg mL^{-1} streptomycin, 2 mM L-glutamine and 1 mM pyruvate acid at 37 ^{o}C in a humidified 5% CO_2 atmosphere. MTT [3-(4, 5-dimethyl-2- thiazolyl)-2, 5-diphenytetrazolium bromide] assay was performed to evaluate the cytotoxic activities of N-CNPs to the cultured cells. Hela cells seeded in 96-well plates were exposed to 100 μL of different concentrations (500 μg mL^{-1}, 250 μg mL^{-1}, 125 μg mL^{-1}, 62.5 μg mL^{-1}, 32 μg mL^{-1}, 16 μg mL^{-1}, 8 μg mL^{-1}, 4 μg mL^{-1} and 2 μg mL^{-1}) of N-CNPs and N-CNPs/Cu^{2+} in triplicate. After 24 h of incubation, 10 μl of MTT (5 mg mL^{-1}) were added to each well and the plate was incubated for another 4 h. The MTT solution was then removed and 100 μl of dimethyl sulfoxide (DMSO) was added to dissolve the formazan. The optical density was measured at 570 nm using 96-well plate reader (Spectra Max M5 Microplate reader, Molecular Devices, USA). Cell viability was expressed as the percentage of survival cells compared to the cells in untreated control wells.

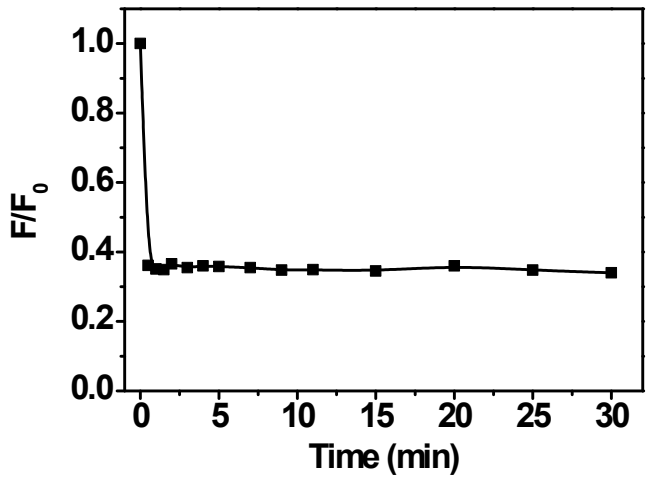

Fig. S5 Time-dependent fluorescence intensity of N-CNPs with the addition of Cu (II) ions at room temperature.

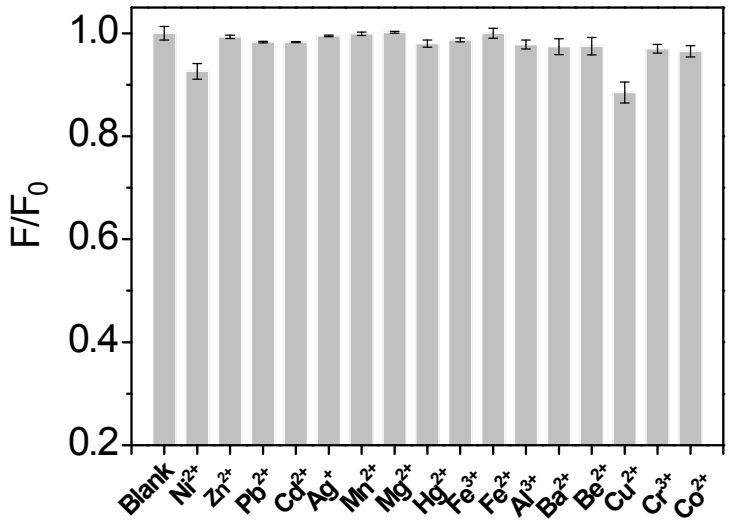

Fig. S6 The influence of different metal ions on the fluorescence of CNPs. F_0 is the fluorescence intensity of CNPs and F is the fluorescence intensity of a mixture of metal ions and CNPs.

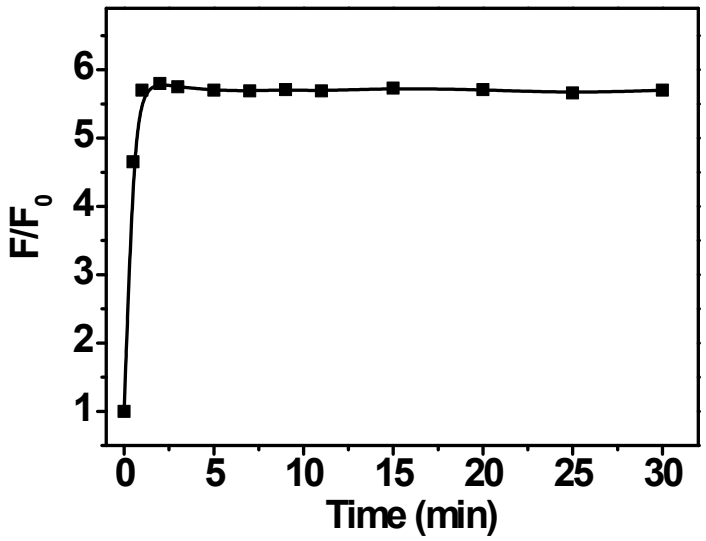

Fig. S7 Time-dependent fluorescence intensity of N-CNPs/Cu (II) ions with the addition histidine.

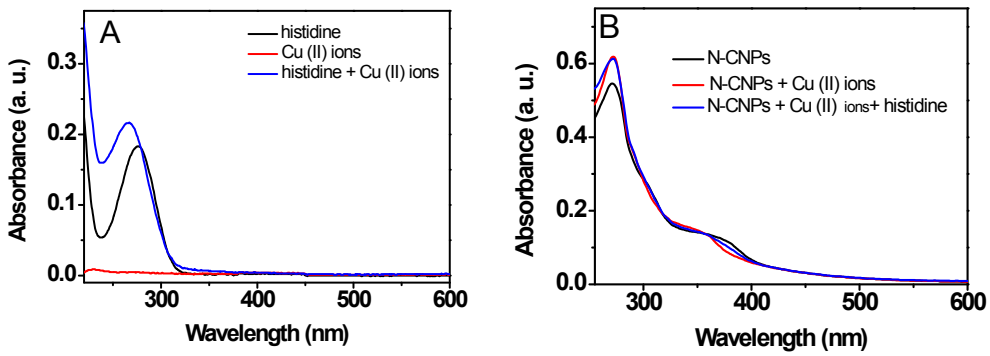

Fig. S8 (A) UV-vis spectra of histidine (black), Cu (II) ions (red), and the Cu (II) ions histidine complex (blue) in aqueous solution. (B) UV-vis spectra of N-CNPs (black), N-CNPs-Cu (red), N-CNPs- Cu-histidine complex (blue).

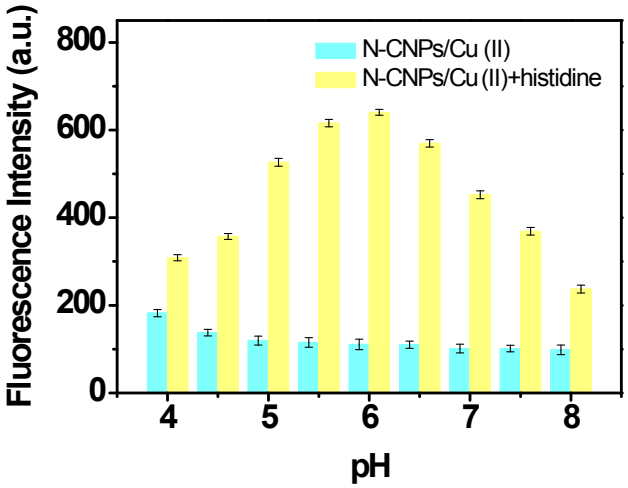

Fig. S9 Fluorescence responses of N-CNPs/Cu (II) ions in the absence (blue bar) and presence (yellow bar) of histidine at different pH values.

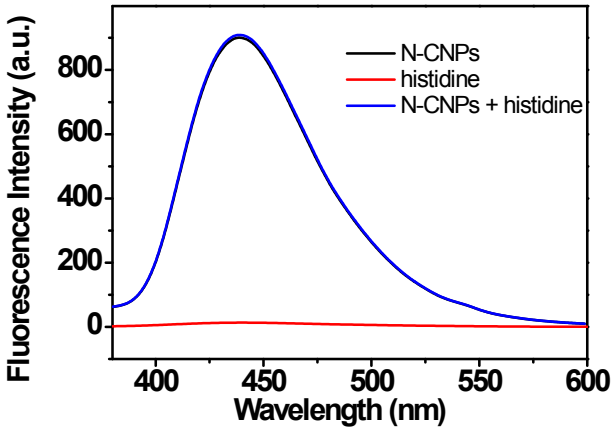

Fig. S10 Fluorescence response of N-CNPs solution before (black) and after (blue) the addition of 30 μM histidine. The red line is the fluorescence spectra of histidine solution.

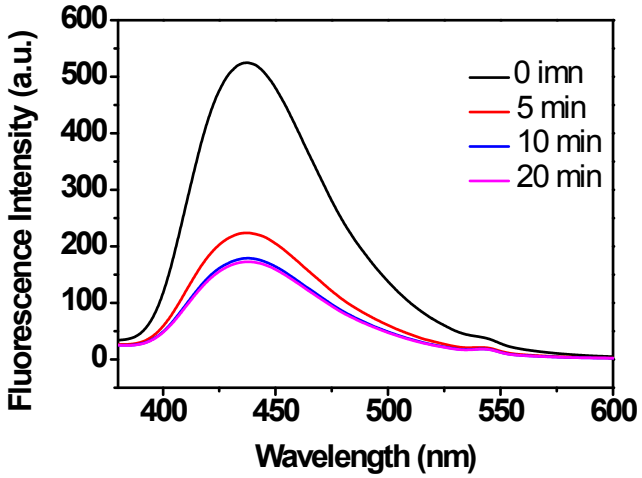

Fig. S11 Time-dependent fluorescence intensity of N-CNPs/Cu (II) ions with the addition of cysteine at different time.

Table S1 Comparison of the linear range and detect limit for histidine using different methods

Method	Linear range (μM)	Detection limit (μM)	Refs
HPLC	3.7 - 1000	1.1	1
Electrochemical	10 - 100000	5.0	2
Capillary electrophoresis	1.0 - 150	0.14	3
Fluorescence based on Ag NCs/Cu (II) ions	0-100	1.4	4
Fluorescence based on CdTe/Ni (II) ions	1-30	0.2	5
Phosphorescence based on Mn: ZnS QDs/Co (II) ions	1.25-30	0.74	6
Fluorescence based on N-CNPs/ Cu (II) ions	0.5-60	0.1	This work

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