Supplementary Materials for:

Co^{2+} detection, cell imaging, and temperature sensing based on excitation-independent green-fluorescent N-doped carbon dots

Lihong Shi[a,*], Dan Chang[a], Guomei Zhang[a], Caihong Zhang[a], Yan Zhang[a], Chuan Dong[a], Lanling Chu[b] and Shaomin Shuang[a,*]

Apparatus

Transmission electron microscopy (TEM) study was carried out in a JEOL JEM-2100 instrument operating at an accelerating voltage of 200 KV. Samples for TEM measurements were prepared by placing a drop of colloidal solution on carbon-coated copper grid and then dried at room temperature. UV–vis absorption spectra were recorded by HITACHI U-2910 UV. Fluorescence spectra were operated with Hitachi F-4500 fluorescence spectrophotometer (Tokyo, Japan). Fourier Transform infrared (FTIR) spectrum was recorded on Bruker tensor 2 spectrometer using a resolution of 4 cm^{-1}. The sample with 1 mg diluted by KBr (ratio 1:200) was pressed into the disc. X-ray photoelectron spectroscopy (XPS) data were obtained with an AXIS ULTRA DLD electron spectrometer from Shimadzu Company using 300W Al Kα radiation.

MTT assay

Cell viability of SMMC-7721 cells was evaluated using the MTT assay. Cells were seeded on 96-well plates with a density of 5 × 104 cells/mL in 100 μL of medium and then were exposed to different concentrations of obtained N-CDs for 24 h. Following incubation, 10 μL of MTT (5 mg/ml) was added to each well. After 4 h of incubation at 37 °C, the culture medium was removed and 100 μL of dimethyl sulphoxide (DMSO, Sangon Biotech, Shanghai, China) was added to dissolve the formazan crystals. The absorbance was measured at 570 nm using a microplate reader (Infinite M200 Pro, Tecan, Switzerland), and the cell viability was expressed as a percentage of the value of the untreated group.

[a] *College of Chemistry and Chemical Engineering, Shanxi University, Taiyuan 030006, PR China*
[b] *School of Light Industry and Food Engineering, Nanjing Forestry University, Jiangsu Province, 210037, China*
* Corresponding author. E-mail address: shilihong@sxu.edu.cn, smshuang@sxu.edu.cn

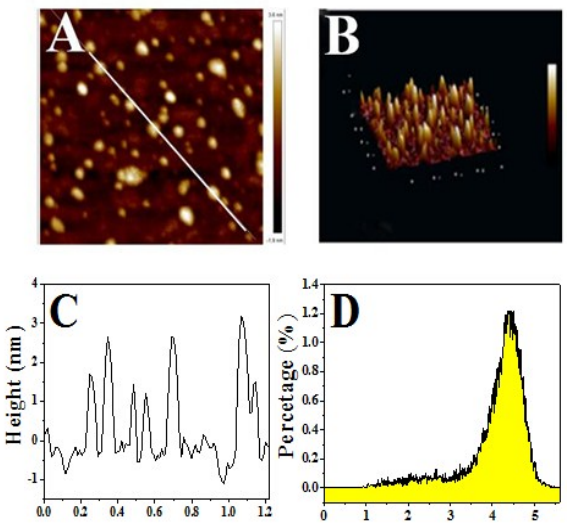

Fig. S1 (A) AFM topography image of N-CDs. (B) AFM three-dimensional image of N-CDs. (C) Height profile along the line in AFM topography image. (D) Height distribution of N-CDs.

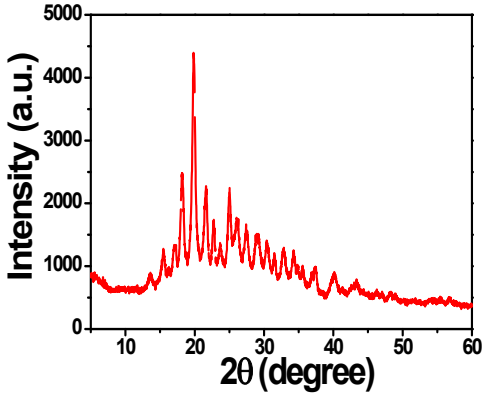

Fig. S2 XRD pattern of obtained N-CDs.

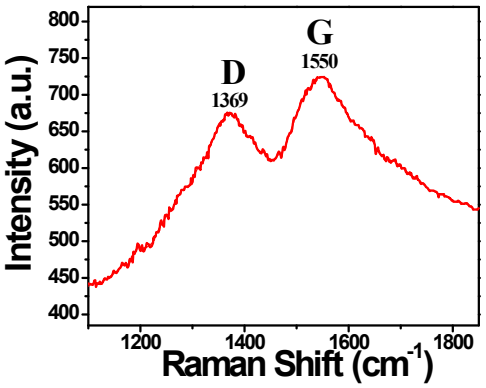

Fig. S3 Raman spectra of N-CDs.

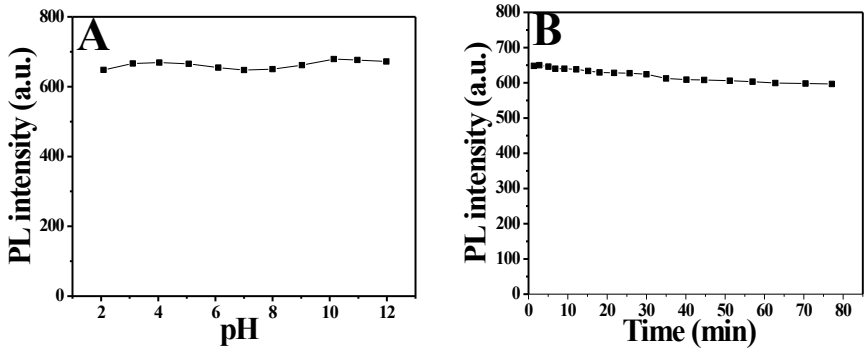

Fig. S4 (A) Response of pH on the PL intensity of obtained N-CDs. (B) Response of excitation time on the PL intensity of obtained N-CDs.

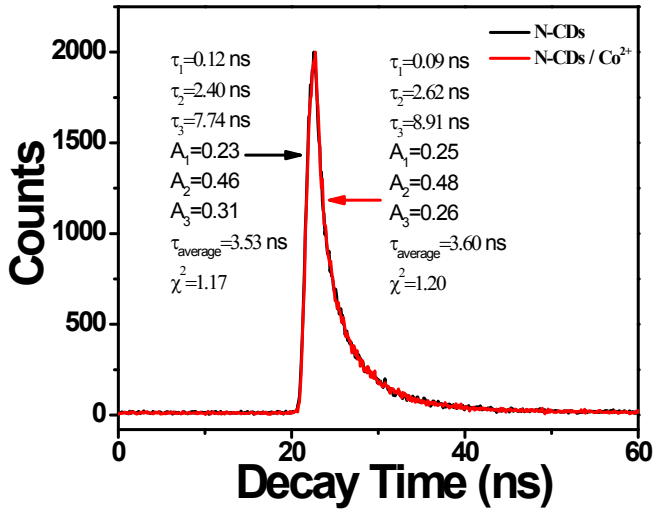

Fig. S5 Fluorescence decay of N-CDs and N-CDs/Co^{2+}.

Table S1 Comparison of different fluorescent CDs based probes for Co^{2+} detection.

Starting material of synthesis	Range	Detection limit	Ref.
pigskin	1 μM–100 μM	0.68 μM	[1]
2, 4, 6-Tris (2′-pyridyl)-s-triazine and citric acid	0.4 μM–50 μM	0.23 μM	[2]
acrylic acid and ethylenediamine	1.0 μM–60 μM	0.25 μM	[3]
kelp	1 μM–200 μM	0.39 μM	[4]
Carbopol 934 and diethylenetriamine	0 μM–40 μM	0.45 μM	[5]
Tyrosine and urea	0.1 μM–10 μM	0.15 μM	This work

References

1 X. Wen, L. Shi, G. Wen, Y. Li, C. Dong, J. Yang and S. Shuang, *Sens. Actuators B Chem.*, 2016, **235**, 179–187.

2 R. Tabaraki, N. Sadeghinejad and A. Nateghi, *J. Fluoresc.*, 2018, **28**, 251–257.

3 N. Jing, M. Tian, Y. Wang and Y. Zhang, *J. Lumin.*, 2019, **206**, 169–175.

4 C. Zhao, X. Li, C. Cheng, Y. Yang, *Microchemical Journal.*, 2019, **147**, 183–190.

5 D. Kong, F. Yan, Z. Han, J. Xu, X. Guo and L. Chen, *RSC Adv.*, 2016, **6**, 67481–67487.