

**Label-free fluorescence assay based on near-infrared B, N-doped
carbon dots as a fluorescent probe for the detection of sialic acid**

Nan Wang¹, Mengke Wang¹, Yang Yu², Guojian Yang², Xingguang Su^{1*}

¹ *Department of Analytical Chemistry, College of Chemistry, Jilin University, Changchun 130012, China*

² *State Key Lab of Supramolecular Structure and Materials, College of Chemistry, Jilin University, Changchun, 130012, P. R. China.*

*Corresponding author Tel.: +86-431-85168352 E-mail address: suxg@jlu.edu.cn

Chemicals and reagents

The chemical reagents used in the experiments are of analytical grade without further purification. The deionized water used in this experiment has a resistivity greater than $18 \text{ M}\Omega \text{ cm}^{-1}$. 3-Aminophenylboronic acid (APBA) (98%) and glycine were purchased from Aladdin (<http://www.aladdin-e.com>). O-phenylenediamine (OPD) (98.5%), Maltose and Galactose were purchased from Sinopharm Chemical Reagent Co. Ltd. (<https://www.sinoreagent.com>). Sialic acid (SA) was purchased from Beijing Dingguo Biotechnology Co. Ltd. (<http://www.dingguo.com>) which need to be stored at below $20 \text{ }^\circ\text{C}$. Hydrochloric acid, Ammonium chloride, Potassium thiocyanate, Sodium chloride, Potassium chloride, Urea, Anhydrous calcium chloride, Anhydrous sodium sulfate, Potassium dihydrogen phosphate, Sodium hydrogencarbonate were purchased from Beijing Chemical Works (<http://www.beijingchemworks.com>). This experiment used a $10 \text{ mM}\cdot\text{L}^{-1}$ glycine buffer solution to adjust the pH of the reaction. And the configured solutions were all stored at 4°C .

Instrumentation

Fluorescence spectral data were obtained from a Shimadzu RF-5301PC spectrofluorometer instrument equipped with a xenon lamp, and the data were measured using a quartz cuvette with an optical path length of 1 cm (Shimadzu Co., Kyoto, Japan, <http://www.shimadzu.com>). UV-visible absorption spectroscopy data were obtained by testing with a Varian GBC Cintra 10e UV-Vis spectrometer (Japan, <http://www.shimadzu.com>). Fourier transform infrared spectroscopy data were measured by using a Bruker IFS66V FT-IR spectrometer equipped with a DGTS detector (32 scans) (Germany, <https://www.bruker.com>). All pH measurements and the configured buffer solutions were performed using a PHS-3C pH meter (Tuopu Co., Hangzhou, China,

<http://www.lei-ci.com>). Transmission Electron Microscopy (TEM) was obtained by Hitachi H-800 electron microscope using an accelerating voltage of 300 KeV (<http://www.hitachi.com.cn/>).

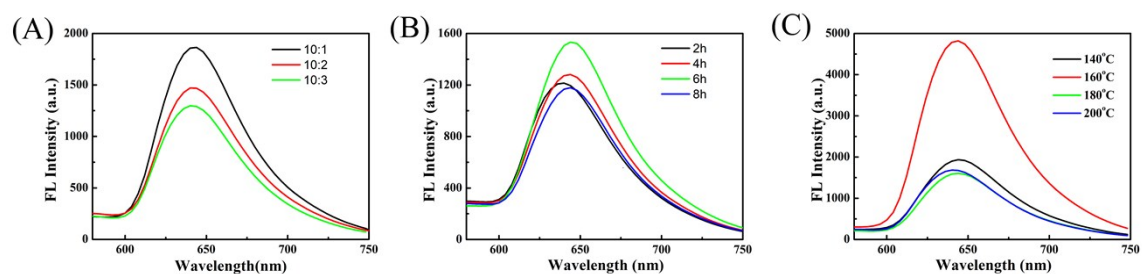


Fig. S1 Effect of reactant ratio (A) and reaction time (B) hydrothermal temperature (C) on the fluorescence spectra of the near-infrared B, N co-doped carbon dots .

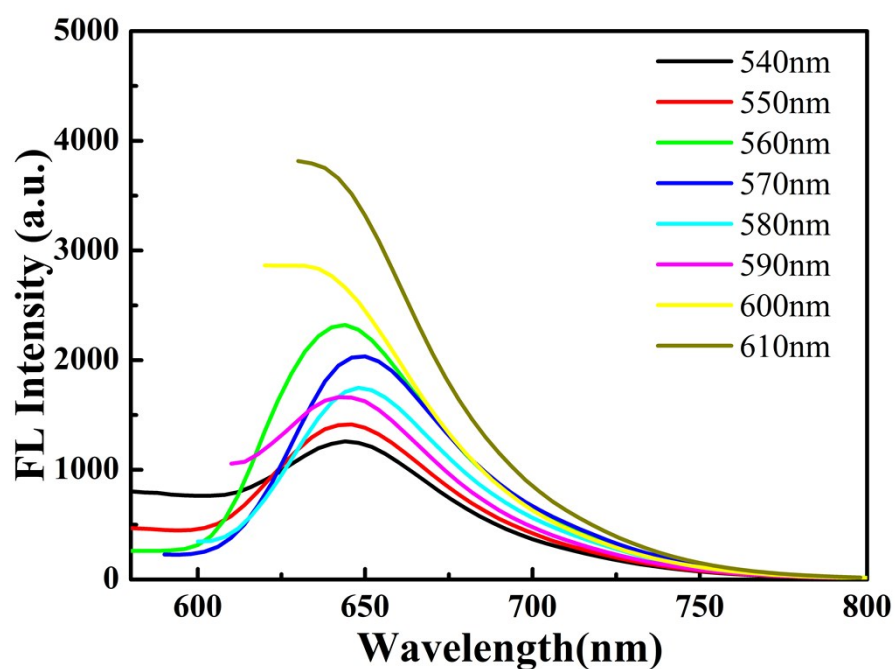


Fig. S2 The fluorescence spectra of B, N co-doped carbon dots at various excitation wavelengths from 540 nm to 610 nm.

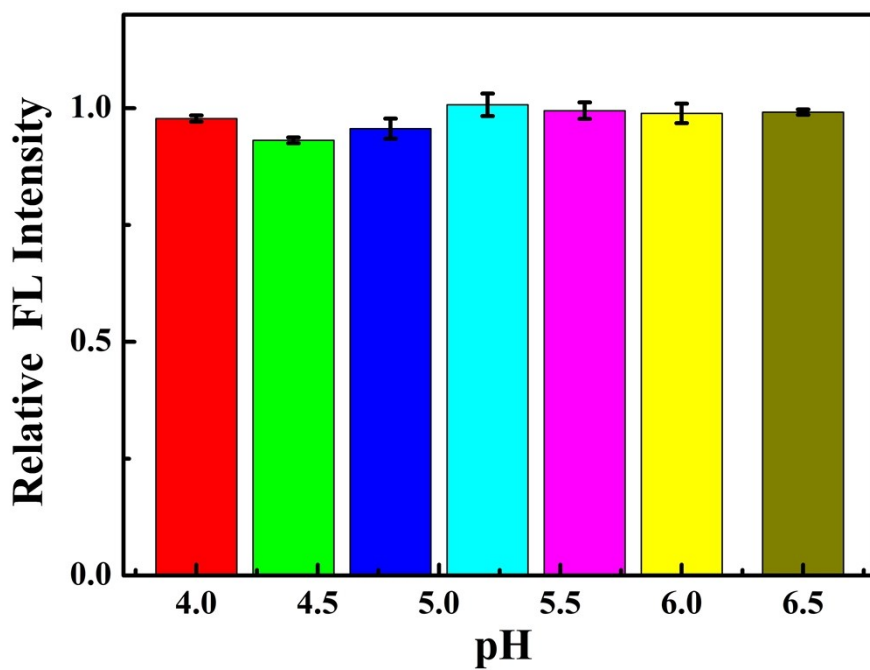


Fig. S3 The effect of glycine buffer on the fluorescence intensity change of the CDs/ SA system.

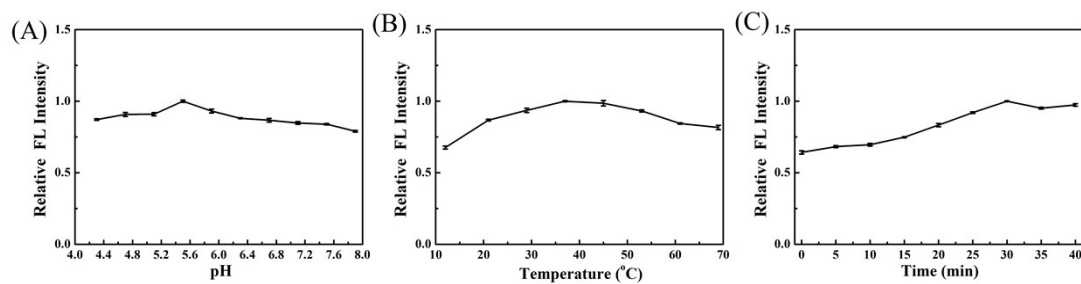


Fig. S4 The effect of pH (A), temperature (B) and reaction time (C) on the fluorescence intensity of the CDs/ SA system.

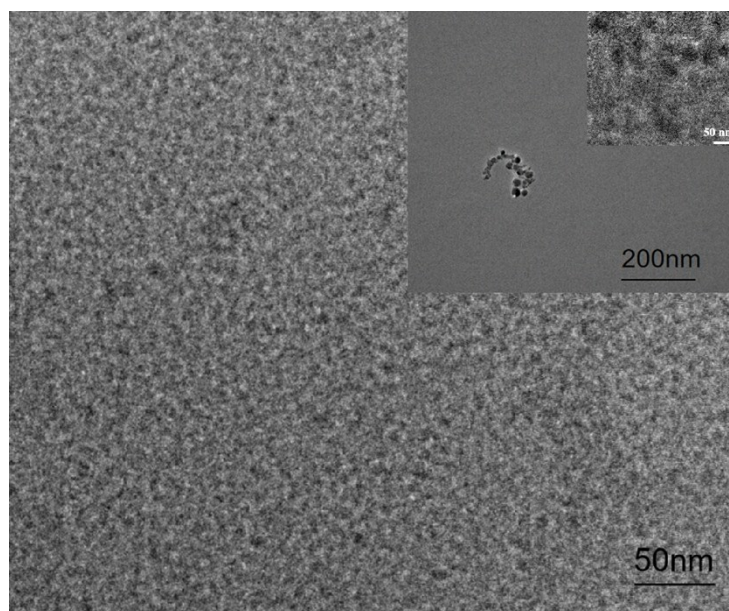


Fig. S5 TEM image of B, N co-doped carbon dots and the B, N co-doped carbon dots /SA complex (Inset).

Table S1. Comparison with previous methods for the detection of SA

Methods	Materials	Linear range(μM)	Detection limit(μM)	Reference
LC-MS	-	1.40 -1000	1.4	1
Electrochemical	porphine/graphene oxide modified electrode	100-7500	28.5	2
Electrochemical	MWCNT electrode	2-3000	0.8	3
Colorimetric	gold nanoparticles (AuNPs) modified with 3-aminophenylboronic acid (3-APBA)	150-1000	60	4
Colorimetric	4-MPBA-AuNPs	80-2000	68	5
Fluorescence	Boronic acid functionalized graphene quantum dots	100-10000	5	6
Fluorescence	NIR-CDs	20-1000	9.24	This work

References

1. A. Tebani, D. Schlemmer, A. Imbard, O. Rigal, D. Porquet and J. F. Benoist, *J Chromatogr B*, 2011, **879**, 3694– 3699.
2. T. Liu, B. Fu, J. Chen, Z. Yan and K. Li, *Electrochimica Acta*, 2018, **269**, 136-143.
3. W. D. Zhang, B. Xu, Y. X. Hong, Y. X. Yu, J. S. Ye and J. Q. Zhang, *Journal of Solid State Electrochemistry*, 2010, **14**, 1713-1718.
4. T. J. Jayeoye, W. Cheewasedtham, C. Putson and T. Rujiralai, *Microchimica Acta*, 2018, **185**.
5. S. Sankoh, C. Thammakhet, A. Numnuama, W. Limbut, P. Kanatharana and P. Thavarungkul, *Biosens Bioelectron*, 2016, **85**, 743–750.
6. Y. Chen, L. Ding and H. Ju, *Chem Commun*, 2013, **49**, 862-864.