Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting information for

A facile "off-on" pattern based on one-pot synthesis of N doped carbon dots for sensitive detection of Ag^+ and $S_2O_3^{2-}$

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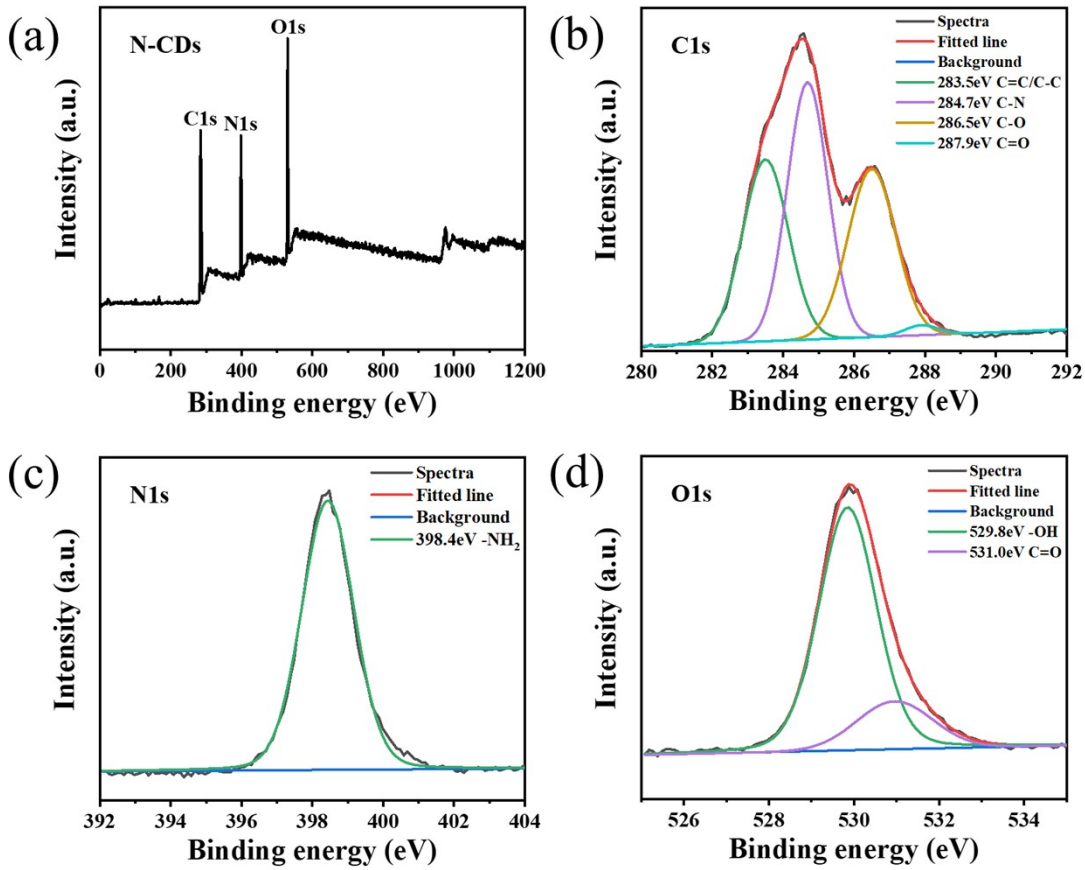

Fig. S1 (a) Total XPS, (b) C1s, (c) N1s, (d) O1s XPS spectrum.

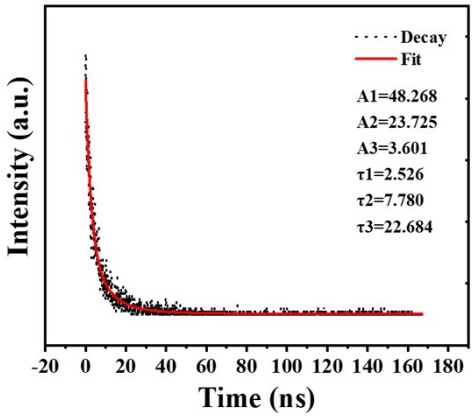

Fig. S2 FL lifetime curves of N-CDs.

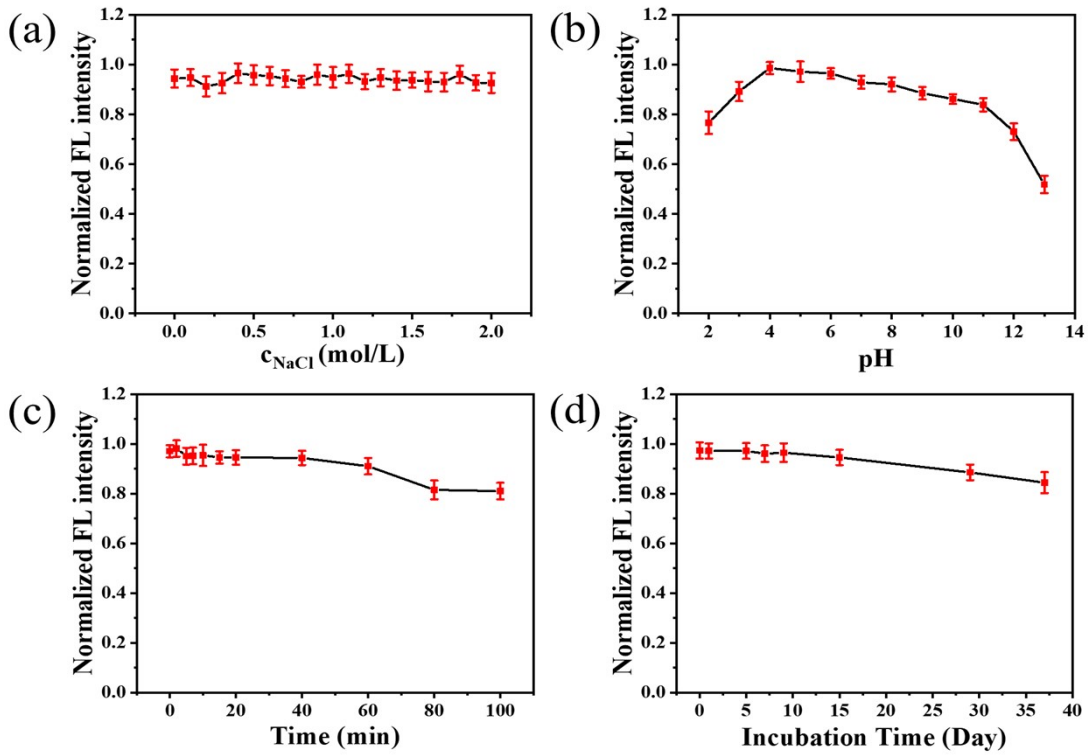

Fig. S3 The N-CDs at (a) different concentrations of NaCl, (b) different pH values, (c) under continuous excitation at 365 nm with a UV lamp, (d) different storage time.

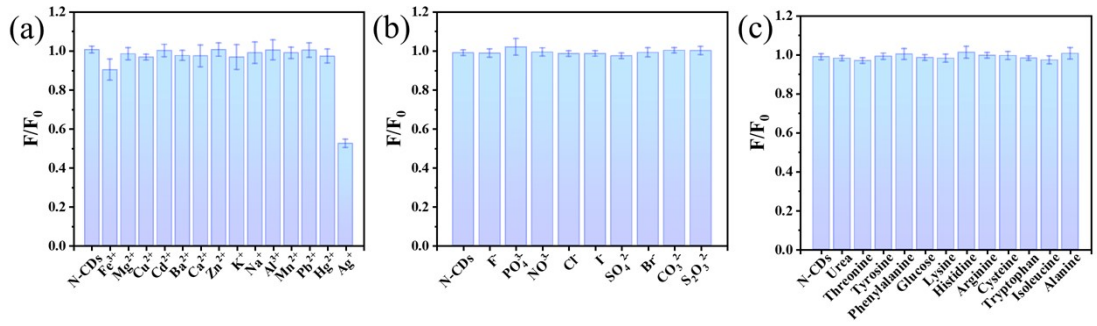

Fig. S4 Selectivity experiments of the N-CDs probe towards cation ions (a), anions (b) and small molecules (c) (pH=7, concentration=100 μM).

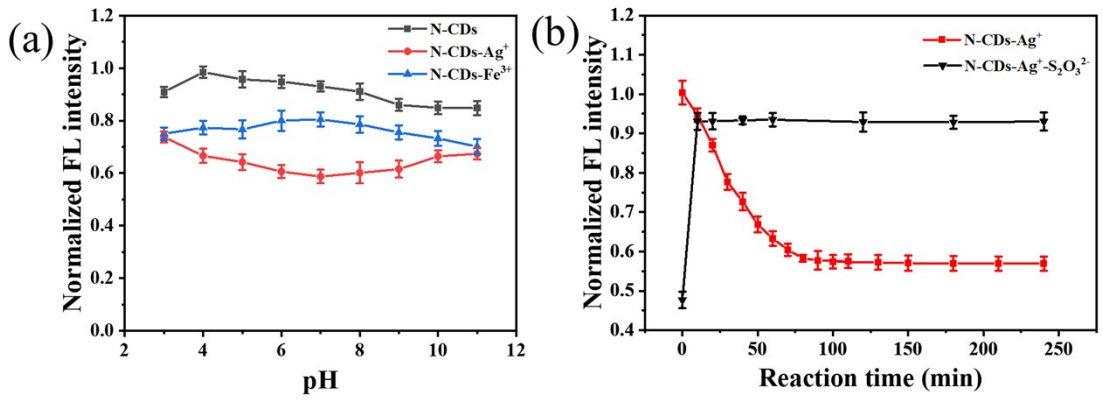

Fig. S5 (a) Effect of pH (3–11) on the quenching efficiency of N-CDs toward 100 μM Ag^{+} and Fe^{3+}, (b) incubation time of the N-CDs and N-CDs-Ag^{+} system for the detection of Ag^{+} and $S_2O_3^{2-}$.

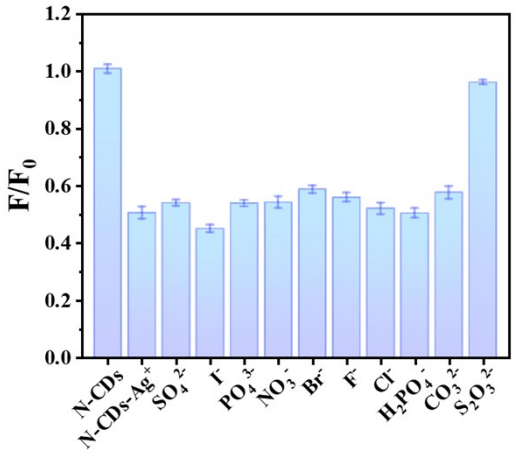

Fig. S6 Selectivity experiments of the N-CDs-Ag^{+} towards anions (pH=7, concentration = 100 μM).

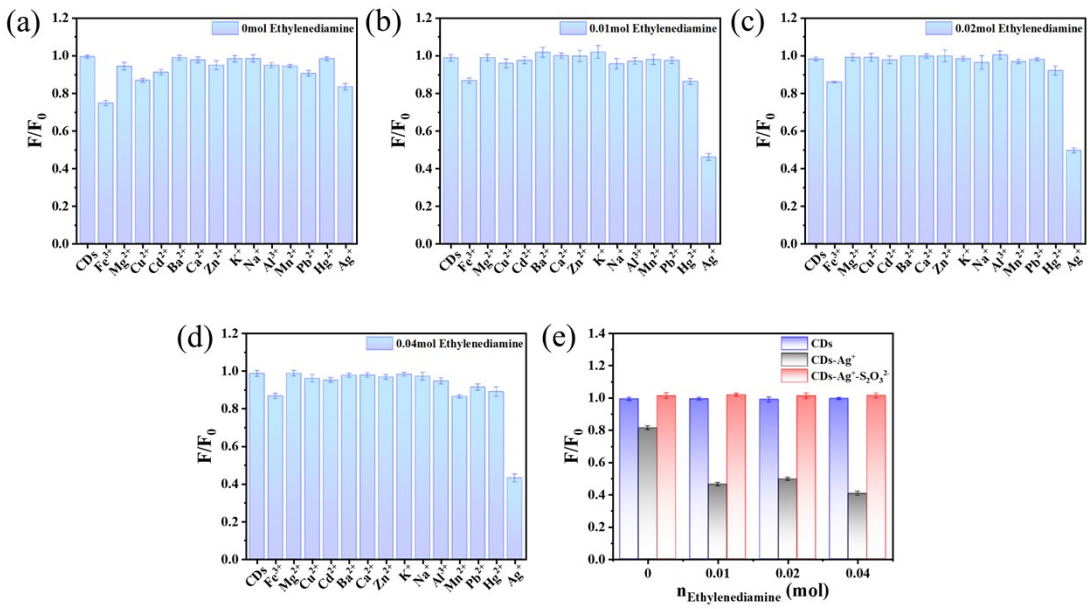

Fig. S7 (a) 0 mol ethylenediamine, (b) 0.01 mol ethylenediamine, (c) 0.02 mol ethylenediamine, (d) 0.04 mol ethylenediamine synthesis CDs solution to cation selectivity experiment. Selectivity experiments of CDs-Ag^{+} solutions with different nitrogen contents to anions, (pH=7, concentration = 100 μM).

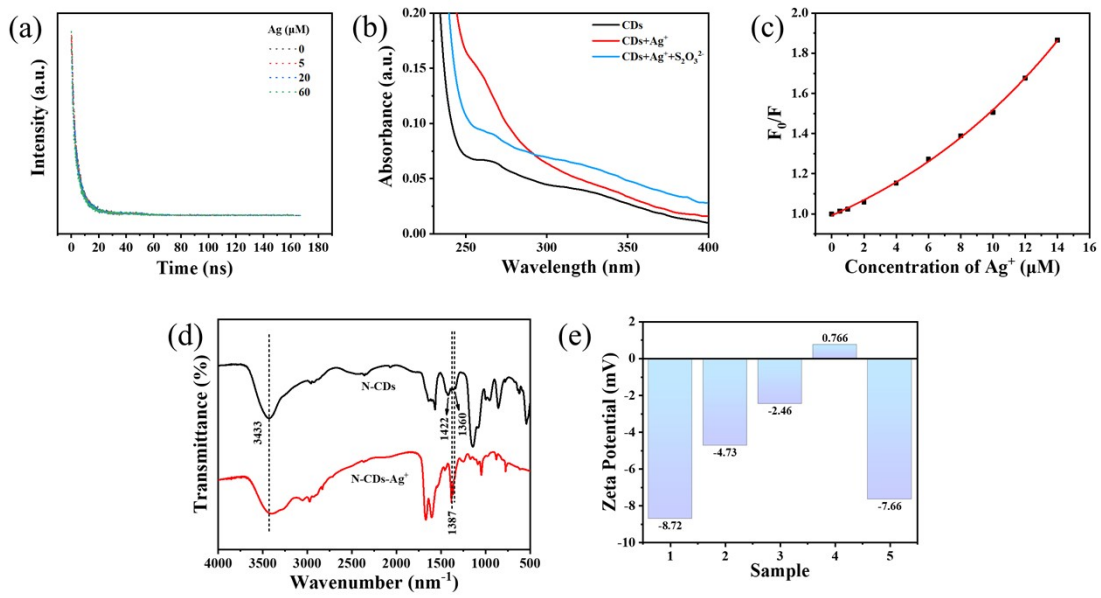

Fig. S8 (a) The fluorescence decay curves of the N-CDs solution after the addition of 0, 5, 20, 60 μM Ag^+, (b) absorption spectrum of N-CDs and N-CDs-Ag^+ and N-CDs-Ag^+-$S_2O_3^{2-}$, (c) Stern-Volmer plot of the N-CDs after the addition of Ag^+. (d) FT-IR spectra of N-CDs and N-CDs added with Ag^+. (e) Zeta potential of 5 samples that the N-CDs solution of adding 0, 5, 20, 60 μM Ag^+ and N-CDs solutions of 60 μM Ag^+ and 60 μM $S_2O_3^{2-}$, respectively.

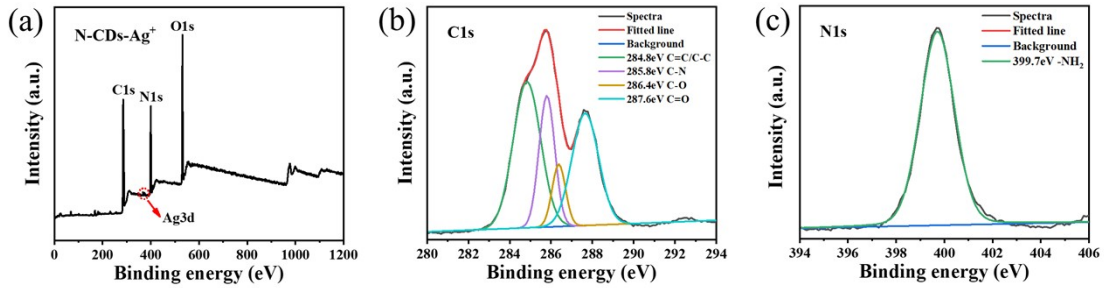

Fig. S9 (a) Total XPS, (b) C1s and (c) N1s of XPS spectrum of N-CDs-Ag^{+}.

Table S1 Fluorescence lifetimes of N-CDs.

c_{Ag^+} (μM)	A_1	A_2	A_3	τ_1	τ_2	τ_3	τ_{ave} (ns)
0	388.054	542.317	41.247	1.104	4.673	25.136	9.60
5	318.701	616.854	43.061	1.162	4.663	25.409	9.59
20	524.257	462.591	32.555	2.061	5.514	28.525	9.38
60	538.358	444.997	34.111	5.239	1.968	28.071	9.32

Table S2 Detection of Ag^{+} in real water samples.

Real samples	Added (μM)	Found (μM)	Recoveries (%)	RSD (%) (n=3)
Tap water	5	5.16	103.20	2.04
	10	9.92	99.19	1.32
	50	46.95	100.66	3.03
Surface water	5	5.05	100.97	0.77
	10	10.31	103.13	2.13
	50	49.52	99.04	2.50

Table S3 Detection of $S_2O_3^{2-}$ in real water samples.

Real samples	Added (nM)	Found (nM)	Recoveries (%)	RSD (%) (n=3)
Tap water	10	9.85	98.53	2.59
	30	29.13	97.11	3.98
Surface water	10	9.85	98.46	3.09
	30	29.95	99.84	1.38

Table S4 Comparison of different fluorescence materials for Ag^+ detection.

Fluorescent material	Synthetic method	Quantum yield (%)	Linear range	LOD	Recovery (%)	RSD (%)	Ref.
Bio-dots	Hydrothermal carbonization	Not given	0-10 μM	310 nM	87-100	0.8-3.3	1
CMC/SA/CDs	Hydrothermal and stirring method	4.17	50-500 μM	29.18μM	95.1-98.6	0.84-2.15	2
N-H-CDs	Hydrothermal method	23.45	0-2.5, 2.5-100 μM	21 nM	98.30-108.75	0.45-1.32	3
B, N-CDs/MnO_2	Hydrothermal and stirring method	18	0.81-70.0 μM	240 nM	98.70-102.25	1.65-4.01	4
CSM-dots	Ultrasonic method and stirring method	Not given	5-290 μM	500 nM	90.7-106.3	2.3-4.5	5
UCDs	pyrolysis	52.06	0.1-2 μM	39 nM	98.7-105.5	1.4-2.2	6
G-CDs	Microwave method	10.4	0-80 μM	90 nM	95.8-105.9	1.2-4.4	7
Carbon dots	One-step pyrolysis method	33	0-6 μM	280 nM	92.39-109.46	0.34-0.92	8
N-CDs	Hydrothermal method	26.01	0-14, 14-80 μM	150 nM	99.04-103.20	0.77-3.03	this work

Table S5 Comparison of different analytical methods for detection of $S_2O_3^{2-}$.

Method	Comment	Real sample	Linear range	LOD	Recovery (%)	RSD (%)	Ref.
Fluorescence/Colorimetric	Cu^{2+}-p-CPIP	Milk	0-6 μM	0.442 μM	97.5-105	0.82-2.2	9
Electrochemical	2,4-DDMA-NiO/NP/CPE	Water	0.05-400 μM	10 nM	Not given	Not given	10
UV–Vis spectrophotometry	VA-CPE	Water	0.2–120 μg/L	0.05 μg/L	97-104	1.1-3.3	11
Fluorescence	C-dots/Fe^{3+}	No	0-1.25 mM	8.47 μM	Not given	Not given	12
Fluorescence	N-CDs	Water	0-50nM	1.5 nM	97.11-99.84	1.38-3.98	this work

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