Electronic Supplementary Material (ESI) for Analyst.

Supporting Information

Tandem Förster resonance energy transfer induced visual ratiometric fluorescence sensing for tetracyclines based on zeolitic imidazolate framework-8 incorporated with carbon dots and safranine T

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Figure

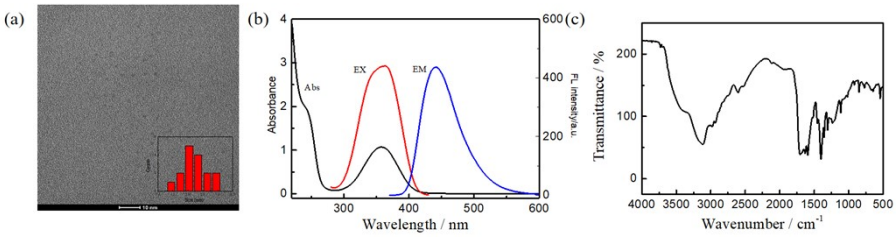

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Fig.S1 (a)TEM images and particle size distribution(inset) of the CDs; (b) UV-vis absorption spectra(black), FL excitation spectra(red) and FL emission spectra(blue) of CDs. (c) FT-IR spectra of CDs

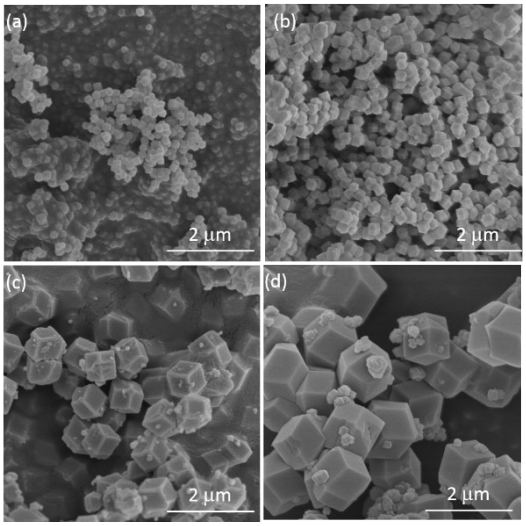

Fig. S2. SEM images of the CDs/ST@ZIF-8 synthesised with different amount of CDs (a) CDs 1/ST@ZIF-8, (b) CDs 2/ST@ZIF-8, (c) CDs 4/ST@ZIF-8, (d) CDs 8/ST@ZIF-8

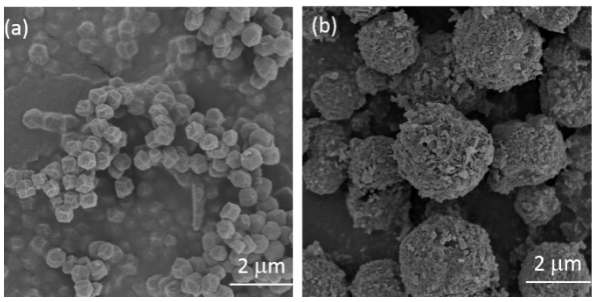

Fig. S3. SEM images of (a) CDs2/ST@ZIF-8, (b) CDs4/ST@ZIF-8 prepared with 25% methanol content in the methanol-water mixed solvent

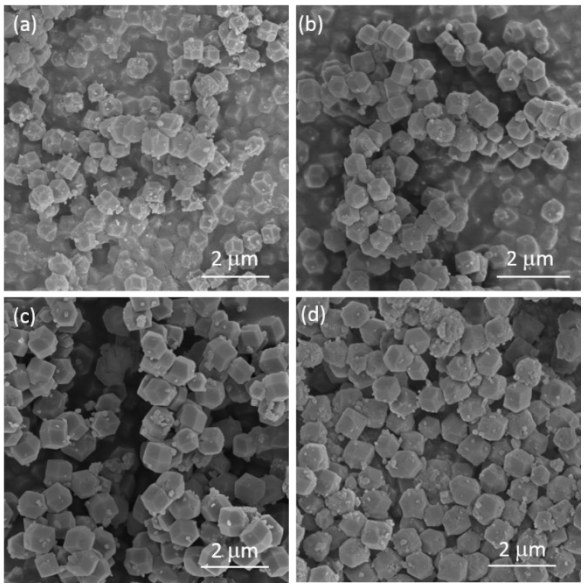

Fig. S4. SEM images of (a) CDs/ST1@ZIF-8, (b) CDs/ST2@ZIF-8, (c) CDs/ST4@ZIF-8, (d) CDs/ST8@ZIF-8

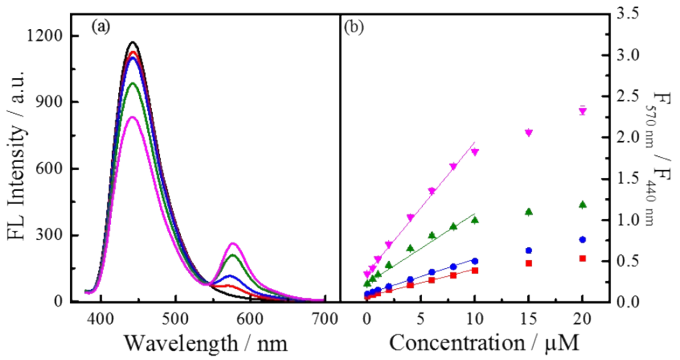

Fig. S5. (a) Fluorescence spectra and (b) the relationship curve between $F_{570\ nm}/F_{440\ nm}$ and tetracycline concentration CDs@ZIF-8(black), CDs/ST1@ZIF-8(red), CDs/ST2@ZIF-8(blue), CDs/ST4@ZIF-8(green) and CDs/ST8@ZIF-8(pink)

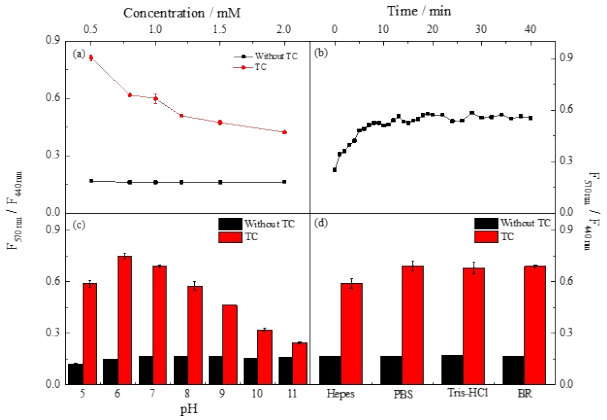

Fig. S6. Effect on fluorescence sensing system (containing 20 μM tetracycline hydrochloride) (a) probe concentration, (b) response time, (c) pH, (d) buffer type

Tables

Table S1. Response of different probes to tetracycline

Probe	Linear equation	Linear range	R^2
CDs@ZIF-8	F_0-F/F_0=0.0480C-0.00343	1.0~10 μM	0.992
CDs/ST 1@ZIF-8	F_{570nm}/F_{440nm}=0.0331C+0.0739	0.5~10 μM	0.995
CDs/ST 2@ZIF-8	$F_{570\ nm}/F_{440nm}$=0.0420C+0.108	0.5~10 μM	0.994
CDs/ST 4@ZIF-8	$F_{570\ nm}/F_{440nm}$=0.0845C+0.234	0.5~10 μM	0.991
CDs/ST 8@ZIF-8	$F_{570\ nm}/F_{440nm}$ =0.159C+0.357	0.5~10 μM	0.995

Table S2 Comparison of CDs/ST@ZIF-8 with different methods for the detection of tetracycline

Sensor	Linear range	LOD	Ref.
CDs	10-400 μM	6.0 μM	[1]
N-CQDs	3.3-32.3 μM	0.746 μM	[2]
$Tb(sbdc)_{1.5}(H_2O)_2$	0-30 μM	0.28 μM	[3]
NH_2-MIL-53(Al)	0-86.67 μM	0.062 μM	[4]
BSA-AuNCs	0.2-10.0 μM	0.065 μM	[5]
CDs/ST@ZIF-8	0.2-10.0 μM	0.046 μM	This work

Table S3 Effect of interfering components on the detection of tetracycline

Coexiting substance	Concentration (μM)	Change of fluorescence intensity (%)	Coexiting substance	Concentration (μM)	Change of fluorescence intensity (%)
Mg^{2+}	100	2.29	Hg^{2+}	20	1.48
Al^{3+}	100	8.90	Arginine	100	-3.18
K^+	100	8.34	Histidine	100	8.78
Na^+	100	6.88	Lysine	100	-0.54
Ca^{2+}	50	-5.58	Enrofloxacin	50	4.26
Cd^{2+}	50	3.01	Furantone	50	3.16
Cr^{2+}	50	5.16	Thiamphenicol	50	0.23
Mn^{2+}	50	5.22	Metronidazole	50	0.60

Table S4. Lifetime of CDs/ST@ZIF-8 system and energy transfer efficiency calculation

System	Lifetime of TC [ns]	Lifetime of CDs [ns]	Energy transfer efficiency (Φ ET) [%]
ZIF-8	1.509(a)		
CDs/ST@ZIF-8		6.320	
CDs/ST@ZIF-8	2.508(a)/1.996(b)/ 1.614(c)	5.408(a)/5.129(b)/ 4.939(c)	14.43(d)/39.83(e)

[(a)(b)(c)] represents the addition of TC 10, 20, 40 μM, [(d)] Φ_{ET} from CDs to TC, [(e)] Φ_{ET} from TC to ST

Table S5. The detection of tetracycline of the tap water samples

Spiked/μM	Detected/μM	Recovery %	RSD%(n=3)
1.00	1.03	103.3	0.30
2.00	1.80	90.1	1.28
4.00	3.73	93.3	0.74
10.0	10.1	101.3	1.40

References

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