Supplementary information

A ratiometric luminescence sensing platform based on lanthanide-based silica nanoparticles for selective and sensitive detection of Fe^{3+} and Cu^{2+} ions

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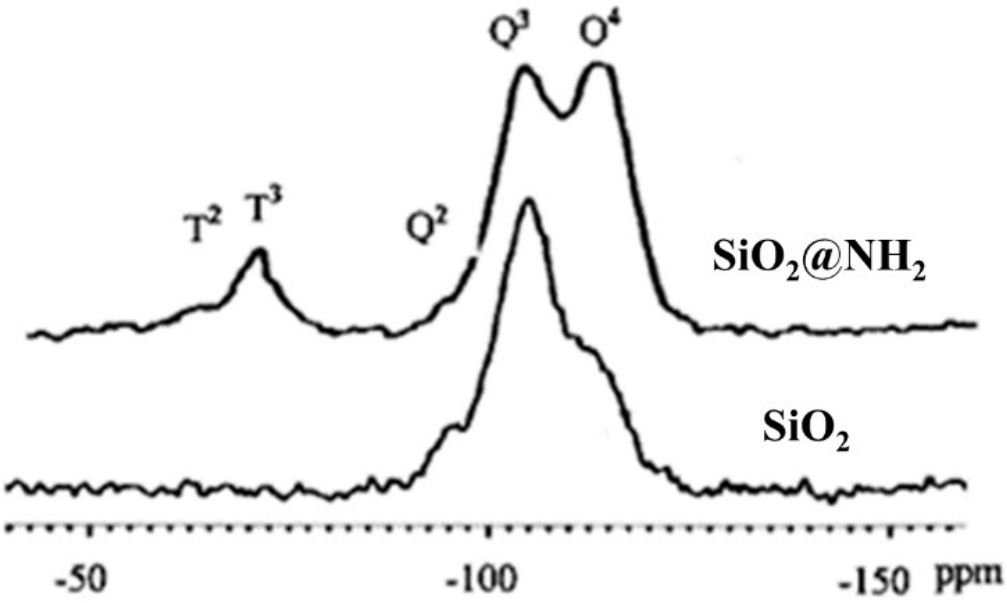

Fig. S1. ^{29}Si MAS NMR spectra of SiO_2 and SiO_2@NH_2 nanoparticles.

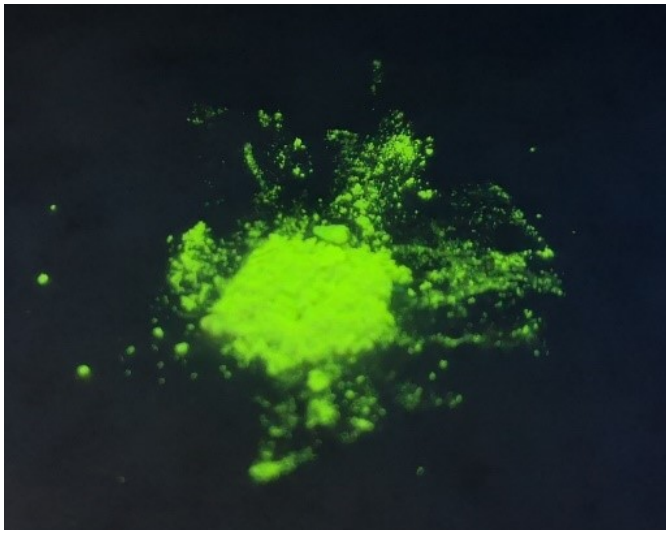

Fig. S2. Optical image of SiO_2@Tb nanocomposites under a UV lamp (254 nm).

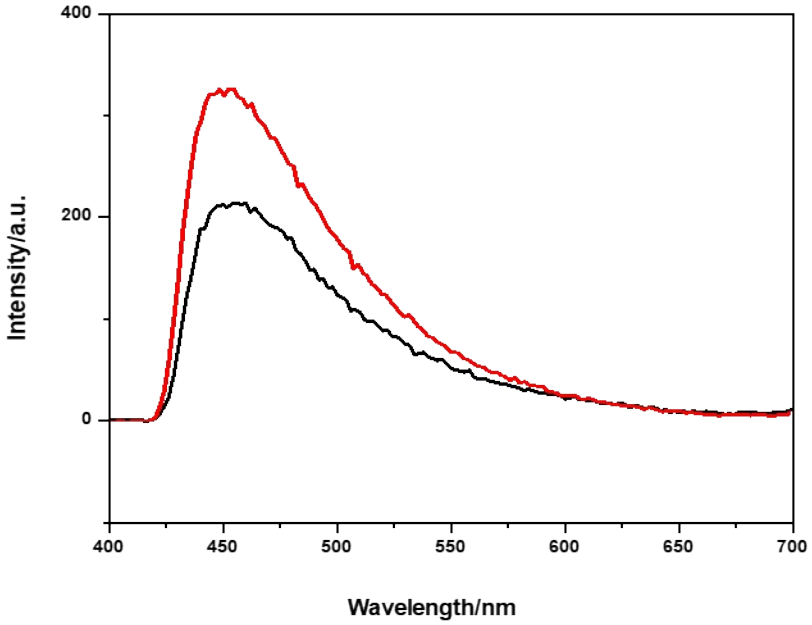

Fig. S3. Emission spectra (λ_{ex}=237 nm) of the suspension of SiO_2 nanoparticles (red) and SiO_2@COOH (black).

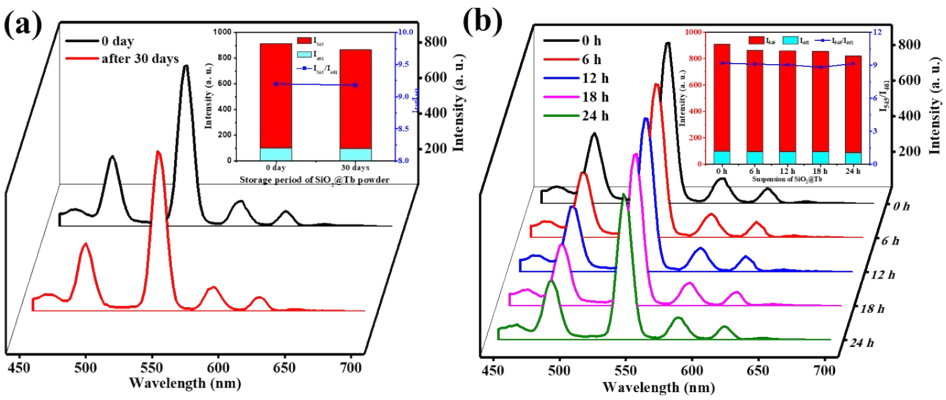

Fig. S4. Emission spectra of SiO_2@Tb suspensions (λ_{ex}=237 nm). (a) SiO_2@Tb powder storage 0 or 30 days. (b) the suspension of SiO_2@Tb at 6-hour intervals in a day. (inset: Luminescence intensity of SiO_2@Tb at 545 nm and 461 nm and the corresponding intensity ratio of I_{545}/I_{461}). The SiO_2@Tb nanoparticles were immersed into water and ultrasonicated to obtain a stable suspension before fluorescence measurement.

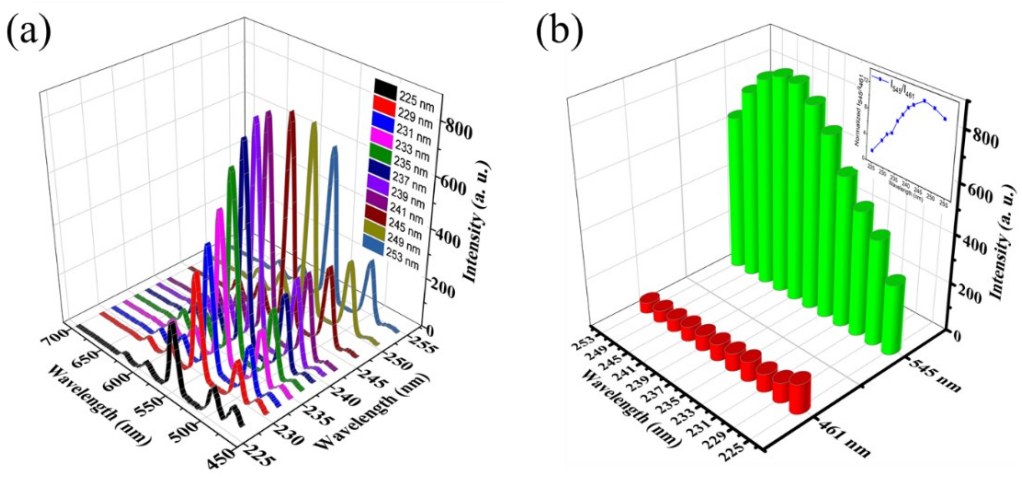

Fig. S5. (a) Emission spectra of the suspension of SiO_2@Tb under the excitation from 225 to 253 nm. (b) Luminescence intensity of 545 nm and 461 nm of SiO_2@Tb (inset: plot of the intensity ratio of I_{545} and I_{461} vs excitation wavelength).

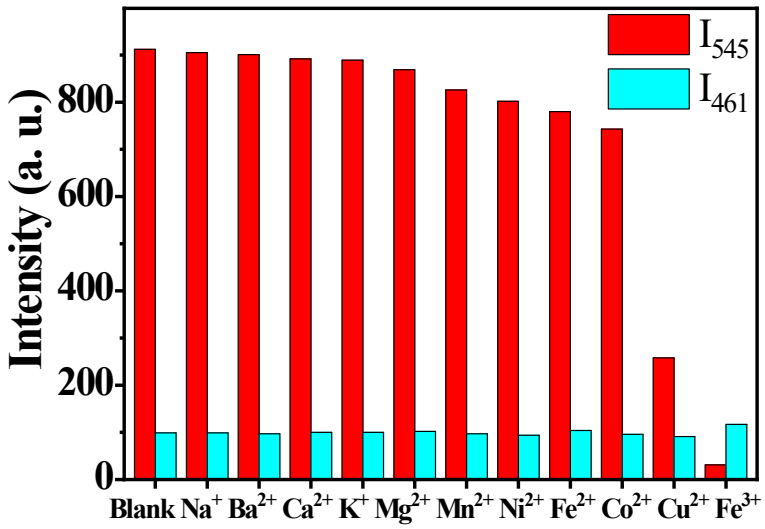

Fig. S6. Luminescence intensitiy of 545 nm and 461 nm of SiO_2@Tb upon the addition of various metal ions under excitation at 237 nm.

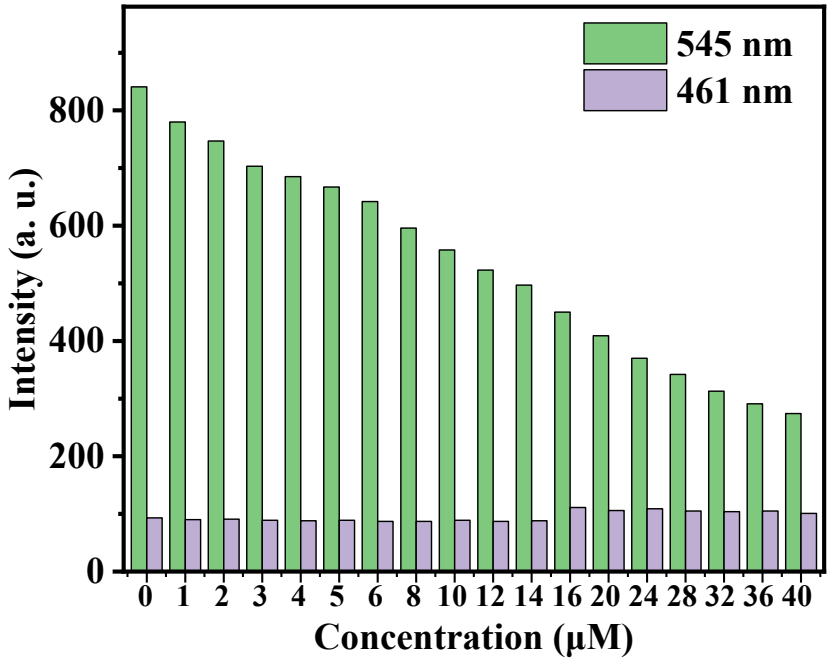

Fig. S7. Luminescence intensitiy of 545 nm and 461 nm of SiO_2@Tb upon gradual addition of Cu^{2+} ions under excitation at 237 nm (0-40 μM).

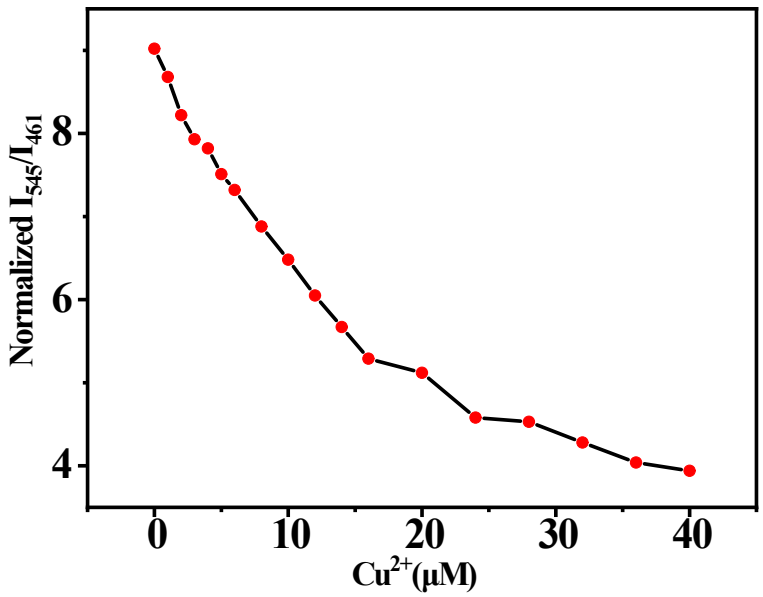

Fig. S8. Intensity ratio of I_{545}/I_{461} vs Cu^{2+} ions concentration in the range of 0-40 μM.

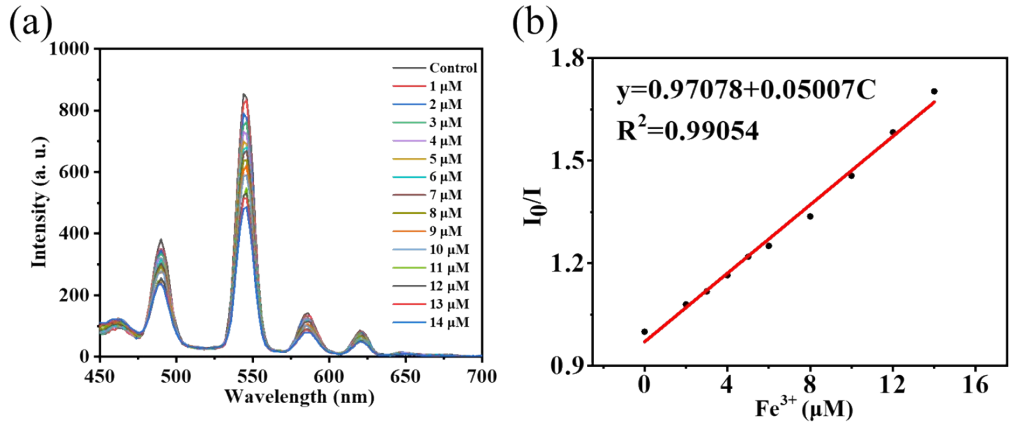

Fig. S9. (a) Photoluminescence spectra (λ_{ex} = 237 nm) and (b) the corresponding Stern–Volmer plots of the suspension of SiO_2@Tb upon progressive addition of Fe^{3+} aqueous solution (0-14 μM)

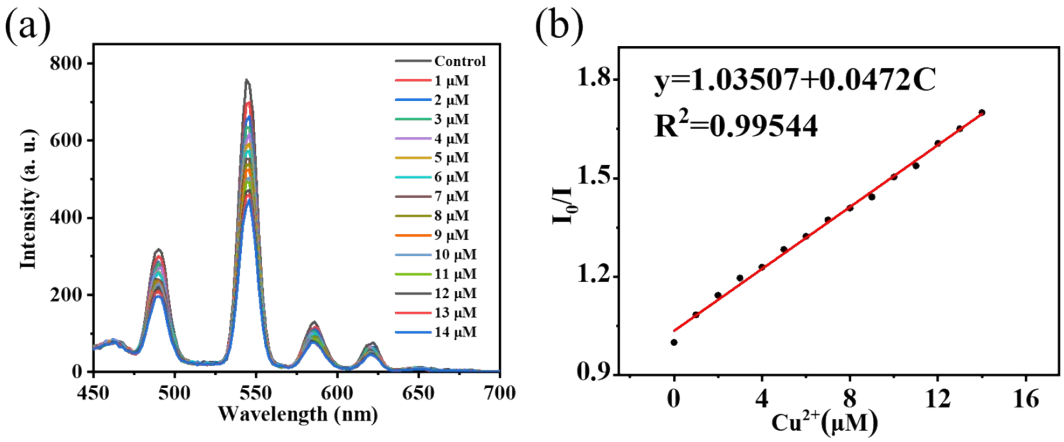

Fig. S10. (a) Photoluminescence spectra (λ_{ex} = 237 nm) and (b) the corresponding Stern–Volmer plots of the suspension of SiO_2@Tb upon progressive addition of the Cu^{2+} aqueous solution (0-14 μM).

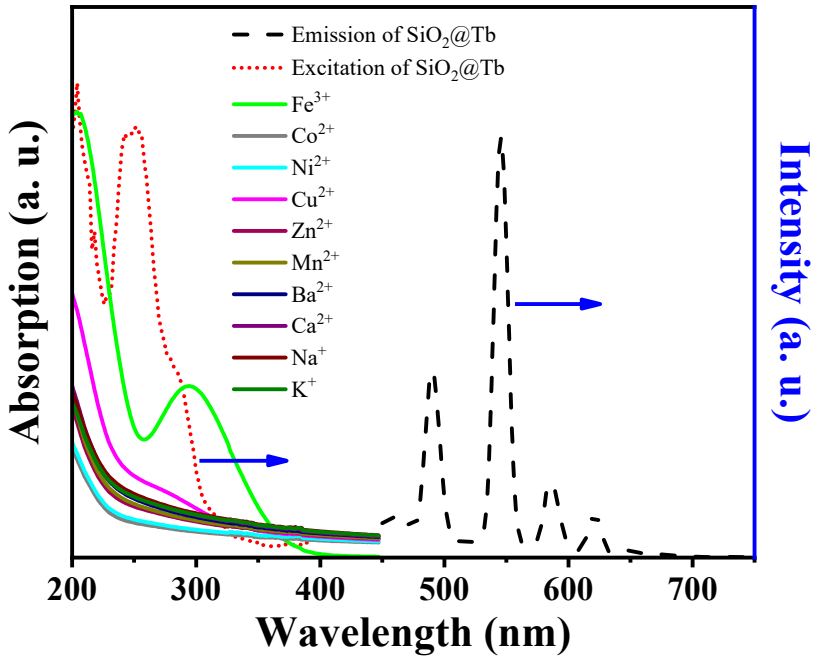

Fig. S11. Fluorescent excitation spectrum (Dotted line) and emission spectrum (Dashed line) of the suspension of SiO_2@Tb and the absorption spectra of various metal ions (Solid line).

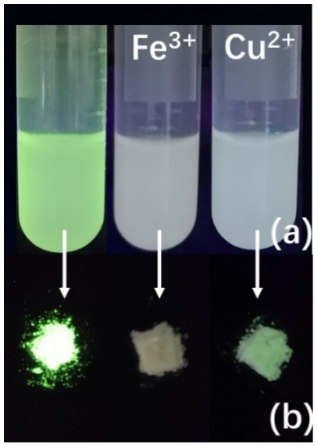

Fig. S12. Optical images of (a) SiO_2@Tb suspension before and after treatment with Fe^{3+} and Cu^{2+} ion under a UV lamp (from left to right, λ = 254 nm) and (b) corresponding images of SiO_2@Tb nanocomposites in dry solid state.

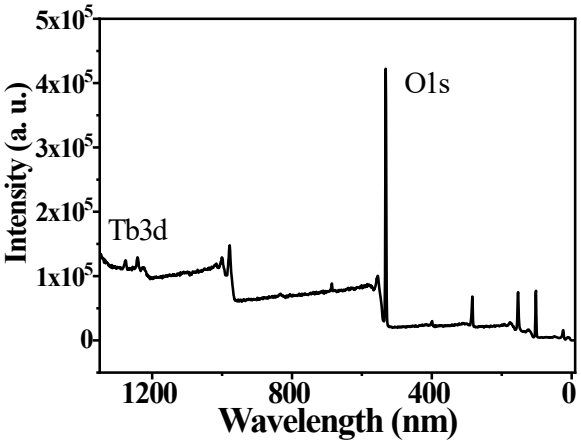

Fig. S13. XPS spectrum of SiO_2@Tb.

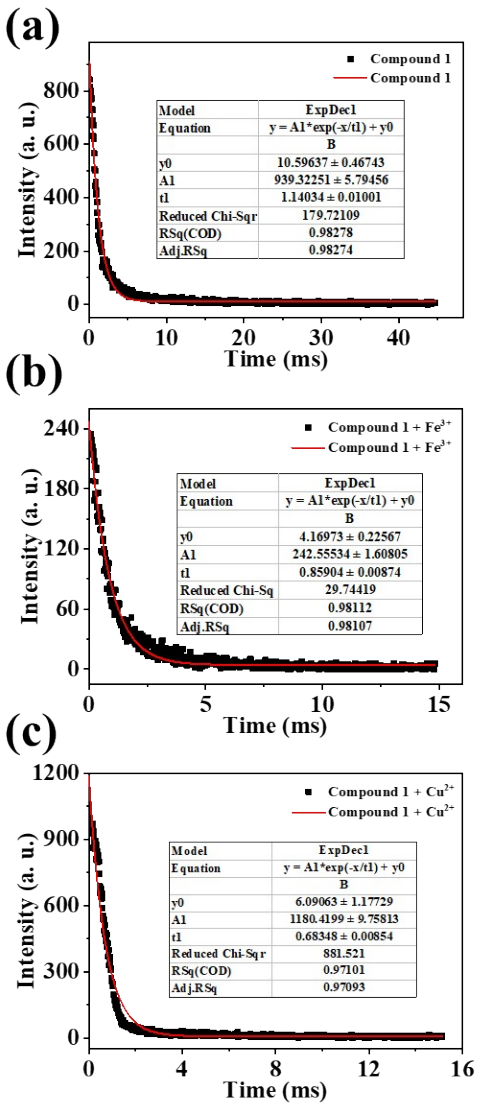

Fig. S14. Decay curves for Tb^{3+} $^5D_4 \rightarrow {}^7F_5$ emission in aqueous dispersion of SiO_2@Tb (a) and treated with Fe^{3+} (b) and Cu^{2+} (c).

Table S1 Sensitivity of various nanosensors for detection of Fe^{3+}

	Materials	Probe	LOD	FL Ratios	Refs.
1	HPEI-CDs	Dual emission probe	0.47 μM	I_{321}/I_{382}	[1]
2	C-dots	Dual emission probe	0.16 μM	I_{350}/I_{570}	[2]
3	C-dots	single emission probe	1.68 μM	\	[3]
4	NS-CDs	Dual emission probe	0.56 μM	I_{480}/I_{650}	[4]
5	B-CQD/CdTe–Eu^{3+}	Dual emission probe	0.053 μM	I_{410}/I_{530}	[5]
6	Neo-CDs	single emission probe	0.854 μM	\	[6]
7	R6G-CD	Dual emission probe	0.727 μM	I_{550}/I_{455}	[7]
8	GN-CDs	Dual emission probe	0.8 μM	I_{470}/I_{570}	[8]
9	**SiO_2@Tb**	**Dual emission probe**	**0.75 μM**	**I_{545}/I_{461}**	**This work**

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Table S2 Sensitivity of various nanosensors for detection of Cu^{2+}

	Materials	Probe	LOD	FL Ratios	Refs.
1	GQD	Single emission probe	0.226 μM	\	[1]
2	AuNPs	Single emission probe	5.8 μM	\	[2]
3	Amino- CQDs	single emission probe	93 nM	\	[3]
4	Nitrogen-doped CQDs	single emission probe	0.16 μM	\	[4]
5	BSA-capped AuNCs	single emission probe	10 nM	\	[5]
6	NCDs	Dual emission probe	17.7 nM	I_{515}/I_{454}	[6]
7	Eu-DPA–CQDs	Single emission probe	6 nM	\	[7]
8	CQDs	Dual emission probe	0.076 μM	I_{562}/I_{446}	[8]
9	GSH@CDs-Au NCs	Dual emission probe	2.59 μM	I_{430}/I_{700}	[9]
10	MOF/ CdTe QDs	Dual emission probe	0.26 ng mL^{-1}	I_{425}/I_{605}	[10]
11	QDC	Dual emission probe	34.9 nM	I_{430}/I_{600}	[11]
12	**SiO_2@Tb**	**Dual emission probe**	**0.91 μM**	**I_{545}/I_{461}**	**This work**

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