Electronic Supplementary Material (ESI) for Analytical Methods
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Electronic Supplementary Information

A novel ratiometric sensor for fluormetric and visual dual-mode detection of Al^{3+} in environmental water based on target-regulated the synthesis of Eu MOFs

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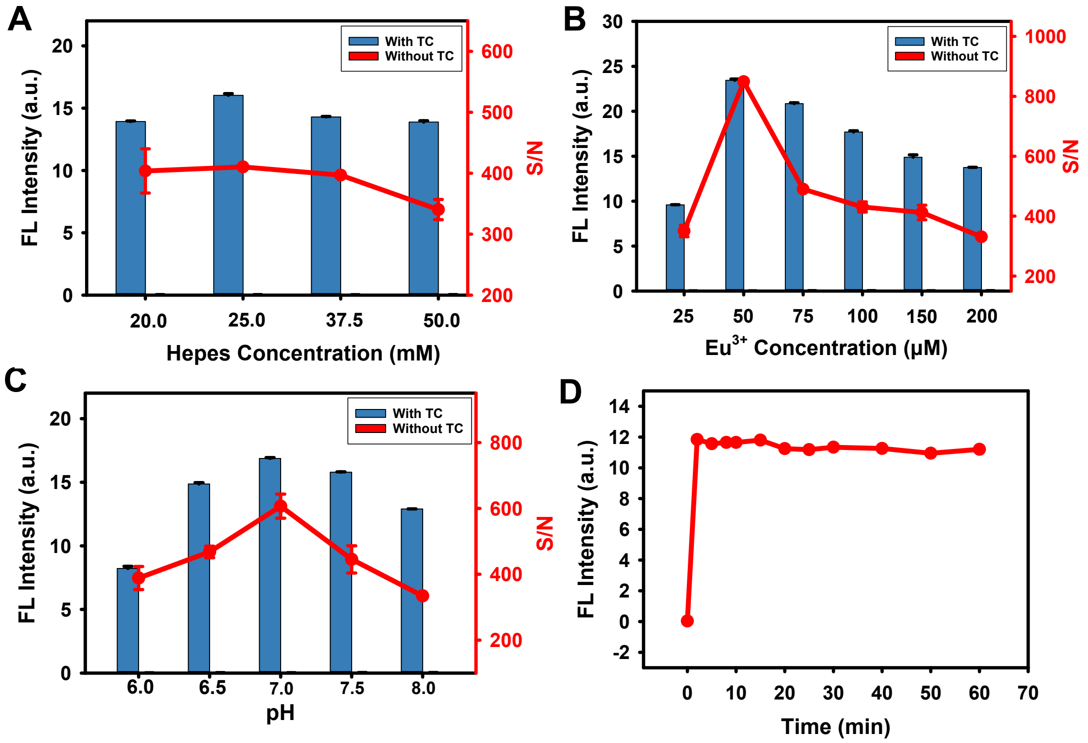

Fig. S1 Optimization of the Eu MOFs preparation. The effect of the Hepes concentration(A), Eu^{3+} concentration (B), the solution pH (C) and reaction time (D) on the emission intensity of Eu MOFs. Error bars represent the standard deviation of three experiments. The conditions of 25 mM Hepes, 50 μM Eu^{3+} concentration, the pH of the solution 7.0 and the reaction time of 2 min were selected.

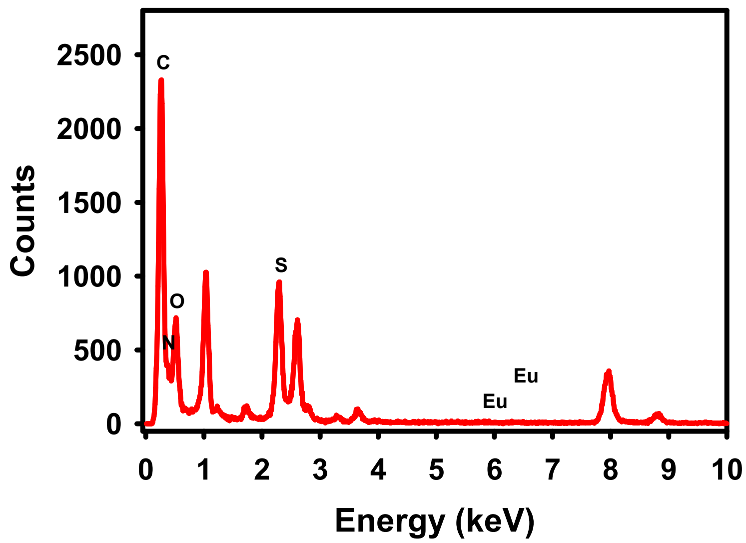

Fig. S2 Energy dispersive X-ray spectroscope (EDS) spectra of Eu MOFs.

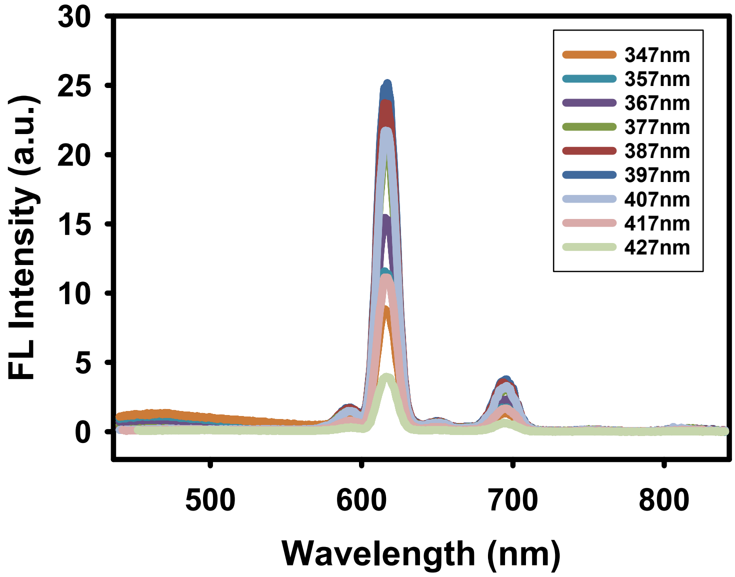

Fig. S3 Fluorescence emission spectra of Eu MOFs at different excitation wavelength.

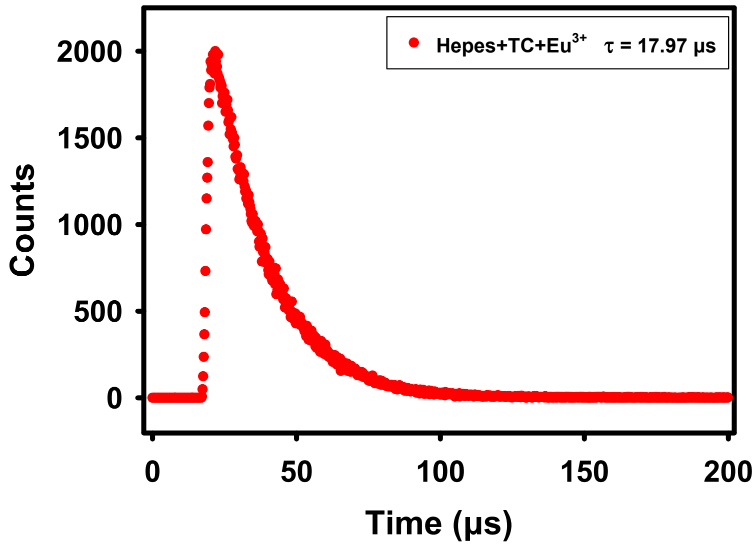

Fig. S4 Fluorescence lifetime of Eu MOFs.

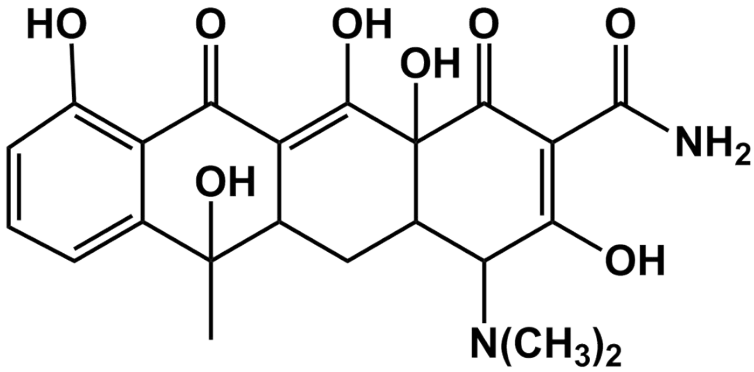

Fig. S5 Chemical structure of TC.

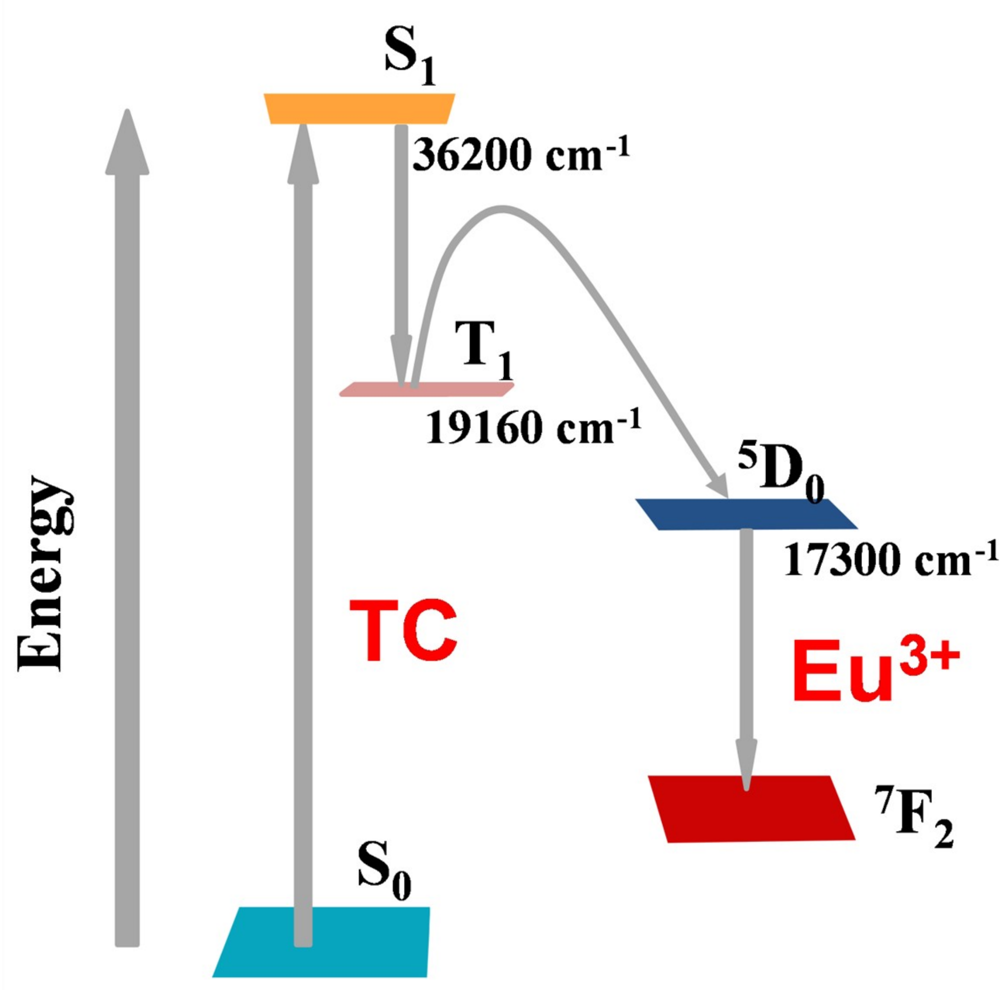

Fig. S6 The energy transfer mechanism diagram of TC to Eu^{3+}.

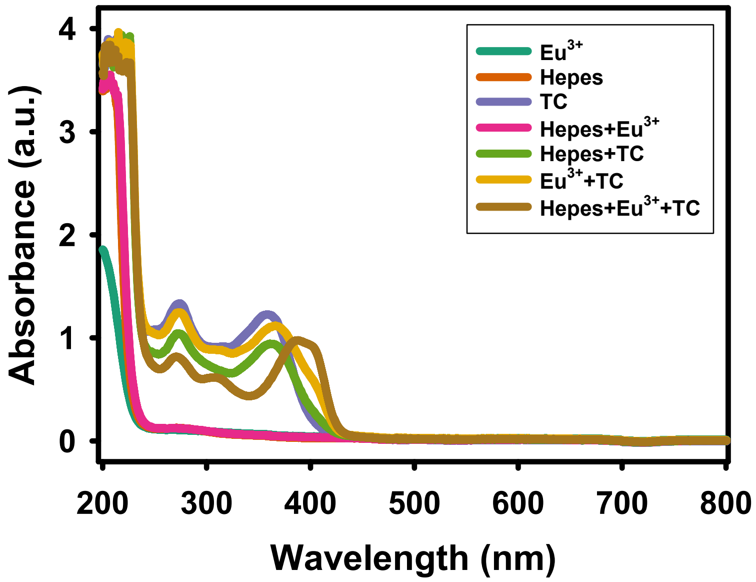

Fig. S7 UV–vis absorbance spectra of the samples under various conditions.

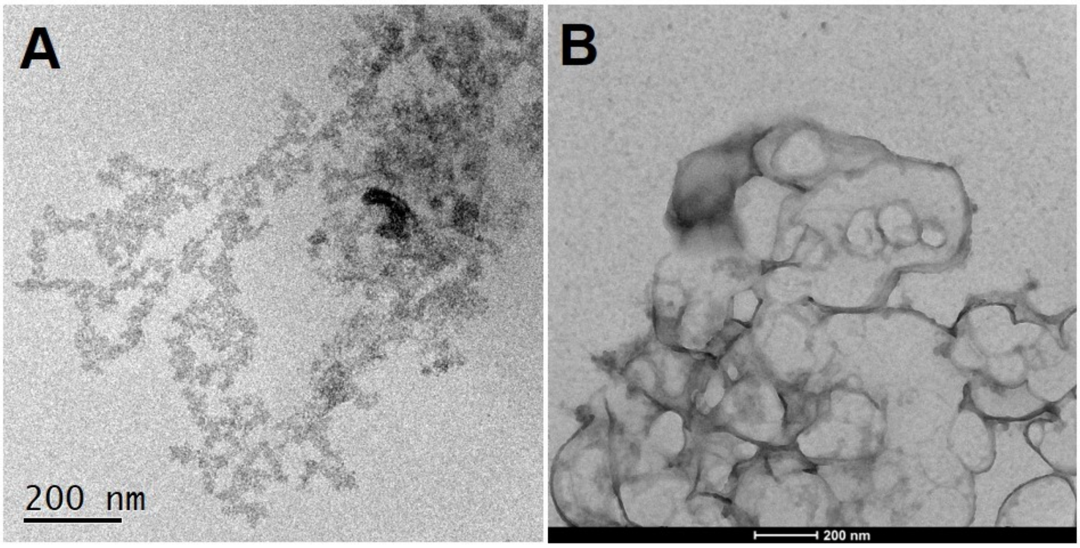

Fig. S8 TEM images of (A)Hepes+Eu^{3+} and (B) TC+Eu^{3+}. The sample of TC+Eu^{3+} were prepared in sterilized water with pH 7.0, which was the same as the pH of Hepes buffer.

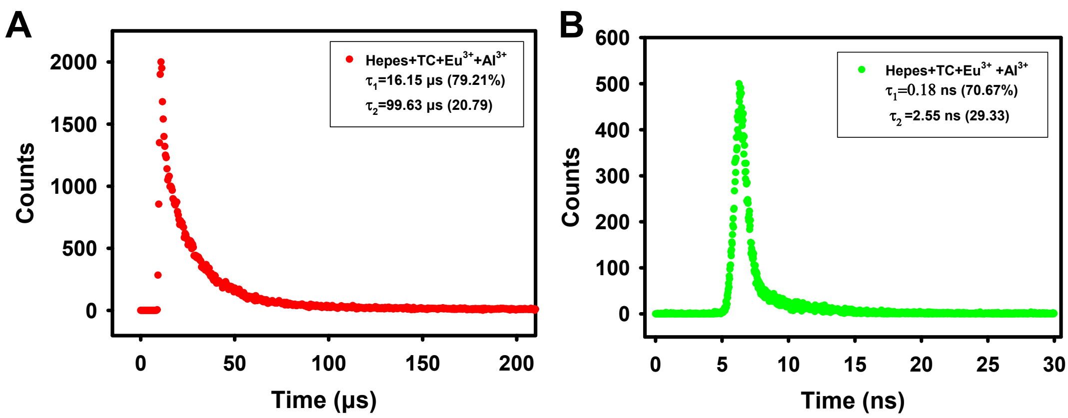

Fig S9. Fluorescence lifetime of Eu MOFs (A) and Al^{3+}-TC complex (B) in the mixture of Al^{3+}, Hepes, TC and Eu^{3+}.

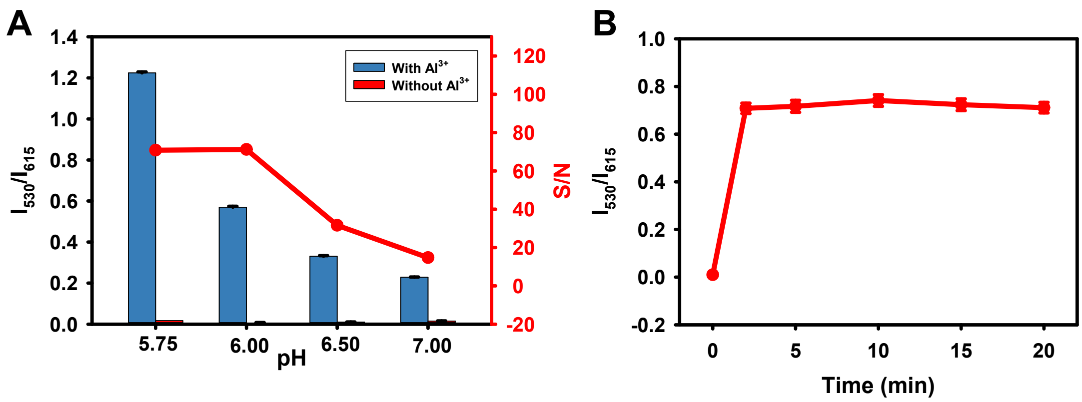

Fig S10. Optimization of the ratiometric sensor for Al^{3+} detection. The effect of the solution pH (A) and the incubation time of TC with Al^{3+} (B) on the emission ratio of I_{530}/I_{615}. Error bars represent the standard deviation of three experiments. The pH of the solution 6.0 and reaction time of 10 min were selected for the coordination of TC with Al^{3+}.

Table S1. Comparison of various reported methods for Al^{3+} detection.

Method/Material	Signal	Detection range	Limit of detection	Reference
Fluorometric and visual methods/ Europium doped carbon dots	Fluorescence Colorimetry	0–50 μM 0–80 μM	28.6 nM 160 nM	S1
Fluorometric analysis/ Multiresponsive tetrarylethylene-based fluorescent dye	Fluorescence	0–180 μM	130 nM	S2
Fluorescence analysis/Quantum dots	Fluorescence	0–0.5 mM	0.56 μM	S3
Fluorescence analysis/ Dual-Functionalized Red-Emitting Copper Nanoclusters	Fluorescence	0–2.4 μM	187 nM	S4
Fluorescence analysis/Ce–N–C nanozyme	Fluorescence	0–27.5 $\mu g \cdot mL^{-1}$	22.98 $ng \cdot mL^{-1}$ (0.85 μM)	S5
Fluorescence analysis/ Chalcone derivative grafted ethylcellulose	Fluorescence	0–45 μM	0.23 μM	S6
Ratiometric fluorescence and colorimetric sensor	Fluorescence Colorimetry	0–400 μM 0–400 μM	0.14 μM 1.21 μM	This work

Table S2. Analytical results of Al^{3+} in lake water samples using the ratiometric dual-mode sensor.

Sample	Added (μM)	Found (μM)	Recovery	RSD (n=3)
1	50.0	48.67	97.34%	2.40%
2	100.0	98.54	98.54%	1.94%
3	200.0	181.96	90.98%	2.29%
4	300.0	295.17	98.39%	3.45%

Table S3. Analytical results of Al^{3+} in tap water samples using fluorescence spectrophotometer with the ratiometric dual-mode sensor.

Sample	Added (μM)	Found (μM)	Recovery	RSD (n=3)
1	50.0	54.73	109.46%	3.47%
2	100.0	96.30	96.30%	2.19%
3	200.0	204.98	102.49%	1.82%
4	300.0	277.41	92.47%	4.82%

Table S4. Analytical results of Al^{3+} in lake water samples using smartphone with the ratiometric dual-mode sensor.

Sample	Added (μM)	Imaging	Measured by G/R (μM)	Recovery	RSD(n=3)
1	50.0		48.69	97.38%	2.34%
2	100.0		99.96	99.96%	1.21%
3	200.0		207.08	103.54%	1.43%
4	300.0		311.91	103.97%	1.07%

Table S5. Analytical results of Al^{3+} in tap water samples with smartphone using the ratiometric dual-mode sensor.

Sample	Added (μM)	Imaging	Measured by G/R (μM)	Recovery	RSD(n=3)
1	50.0		48.62	97.24%	1.31%
2	100.0		97.94	97.94%	1.53%
3	200.0		218.78	109.39%	2.29%
4	300.0		304.80	101.60%	1.41%

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