Electronic Supplementary Information

Highly selective detection toward 2,4-dinitrophenol on fluorescent NH_2-MIL-125(Ti) via Dual-Parameter sensing technology

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Table S1. Some representative examples of efficient luminescent MOF sensors for 2,4-DNP.

Order	MOF	LOD ($\mu g\ L^{-1}$)	Ksv	Linear range (μM)	Parameters for selectivity	Ref.
1	Eu@MOF-253	1.84	$4.2\times10^4\ M^{-1}$	0-100	fluorescence intensity	1
2	FJI-C8（Zn-MOF）	530	$5.11\times10^4\ M^{-1}$	0-5	fluorescence intensity	2
3	$[Y_2(PIA)_3(DMF)_3(CH_3OH)]$	84.69	$3.63\times10^4\ M^{-1}$	/	/	3
4	$\{Zn_2(NDC)_2(AzoAEpP)\cdot2DMF\}_n$	1120	$8.93\times10^3\ M^{-1}$	/	/	4
5	$[Zn_2(oba)_4(4,4'\text{-}bpy)_2]_n$	370	$6.35\times10^3\ M^{-1}$	0-35	fluorescence intensity	5
6	$Mg_{24}(TC_4A)_6(BTC)_8(H_2O)_6$	379.26	$3.98\times10^4\ M^{-1}$	0-40	/	6
7	NH_2-MIL-125(Ti)	186.27	$2.002\times10^4\ M^{-1}$	0-70	fluorescence intensity	This work
		602.61	$1.8\times10^5\ nm*M^{-1}$		emission peak shift	

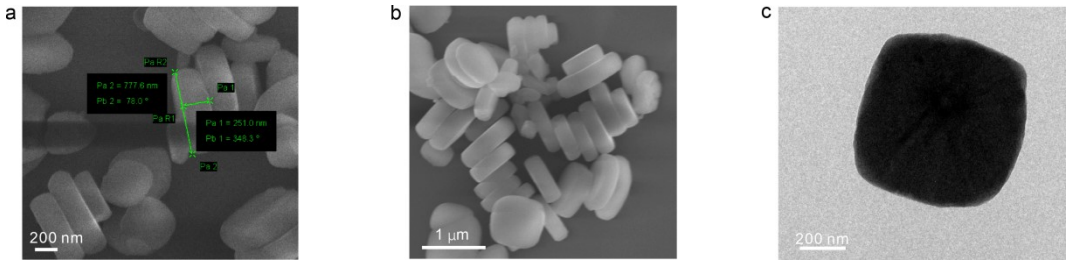


Fig. S1. high-resolution (a-b) SEM and (c) TEM images of NH_2-MIL-125(Ti).

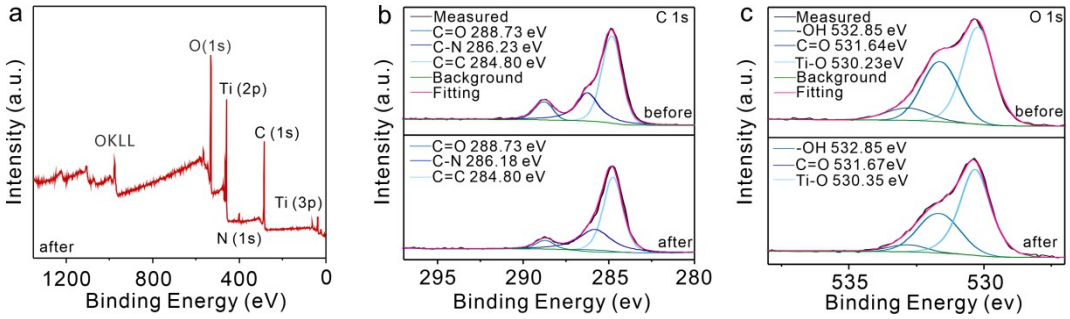


Fig. S2. (a) Full range XPS spectrum of NH_2-MIL-125(Ti) after the reaction with 2,4-DNP, XPS spectra of NH_2-MIL-125(Ti) before and after the reaction with 2,4-DNP in the: (b) C 1s, and (c) O 1s.

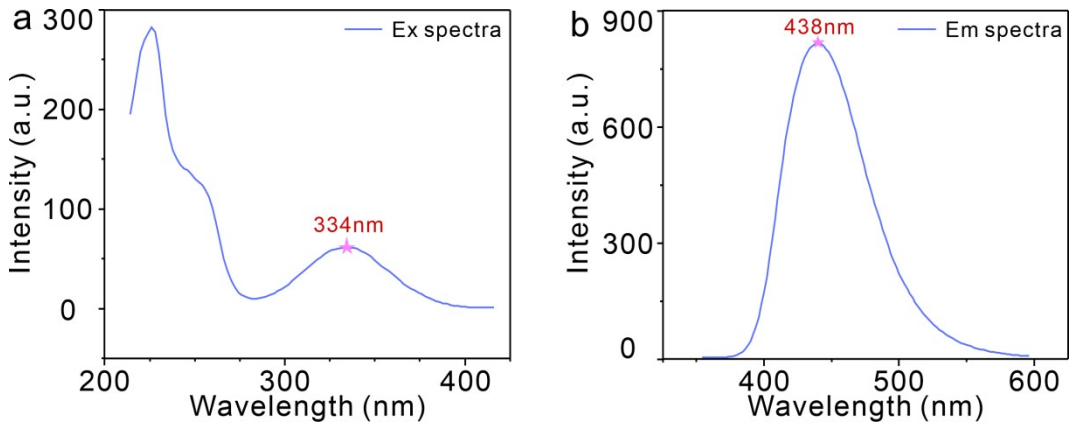


Fig. S3. (a)The excitation spectrum and (b)emission spectrum of NH_2-MIL-125(Ti) dispersed in water.

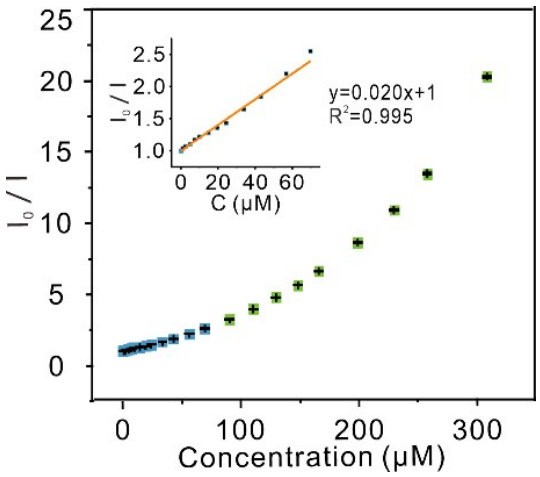


Fig. S4. The correlation curve between I_0/I and the concentration of 2,4-DNP was obtained by the Stern-Volmer equation. A linear relation is shown in the low concentration region (see the inset in **Fig. S4**).

The fluorescence quenching efficiency can be quantitatively explained by the Stern−Volmer (SV) equation: $I_0 / I = 1 + K_{sv}[Q]$, where K_{sv} is the quenching constant (M^{-1}), [Q] is the molar concentration of analyte, and I_0 and I are the fluorescence intensity before and after adding analyte, respectively (**Fig. S4**). The fluorescence emission peak shift ($\Delta\lambda$) of the MOF before and after adding the analyte can be described by $\Delta\lambda = K_{sv}[Q]$, where K_{sv} represents the quenching constant (M^{-1}), [Q] denotes the molar concentration of the analyte (**Fig. 2c**).

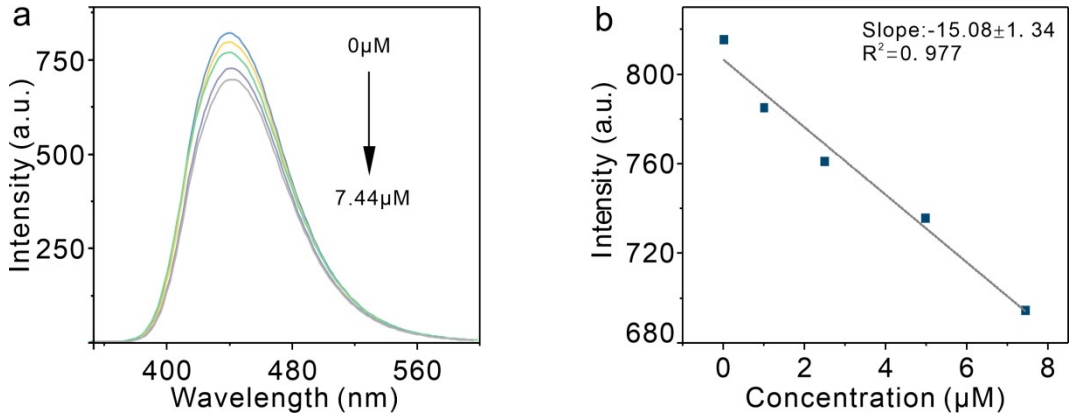


Fig. S5. (a) Fluorescence emission spectra, and (b) the corresponding plot of fluorescence intensity versus analyte concentration of 2,4-DNP in MOF suspension (0.09 mg mL^{-1})

With the fluorescence intensity as a parameter, the Limit of Detection (LOD) for 2,4-DNP in the NH_2-MIL-125(Ti) aqueous phase (3σ rule):

LOD=3*σ/S

=3*1.53/15.08

=304.38nM (186.27 μg L^{-1})

The fluorescence spectra of the NH_2-MIL-125(Ti) suspension were recorded multiple times (n=11) with blank samples. The standard deviation σ of fluorescence intensity for the blank probe, without the addition of 2,4-DNP, was calculated to be 1.53.

With the emission peak wavelength as a parameter, the Limit of Detection (LOD) for 2,4-DNP in the NH_2-MIL-125(Ti) aqueous phase (signal-to-noise ratio, SNR):

LOD=0.99 μM (602.61μg L^{-1}).

The SNR was equal to 3.

Two approaches were used to determine LODs due to the discrepancy between fluorescence intensity and Stoker shift signal.

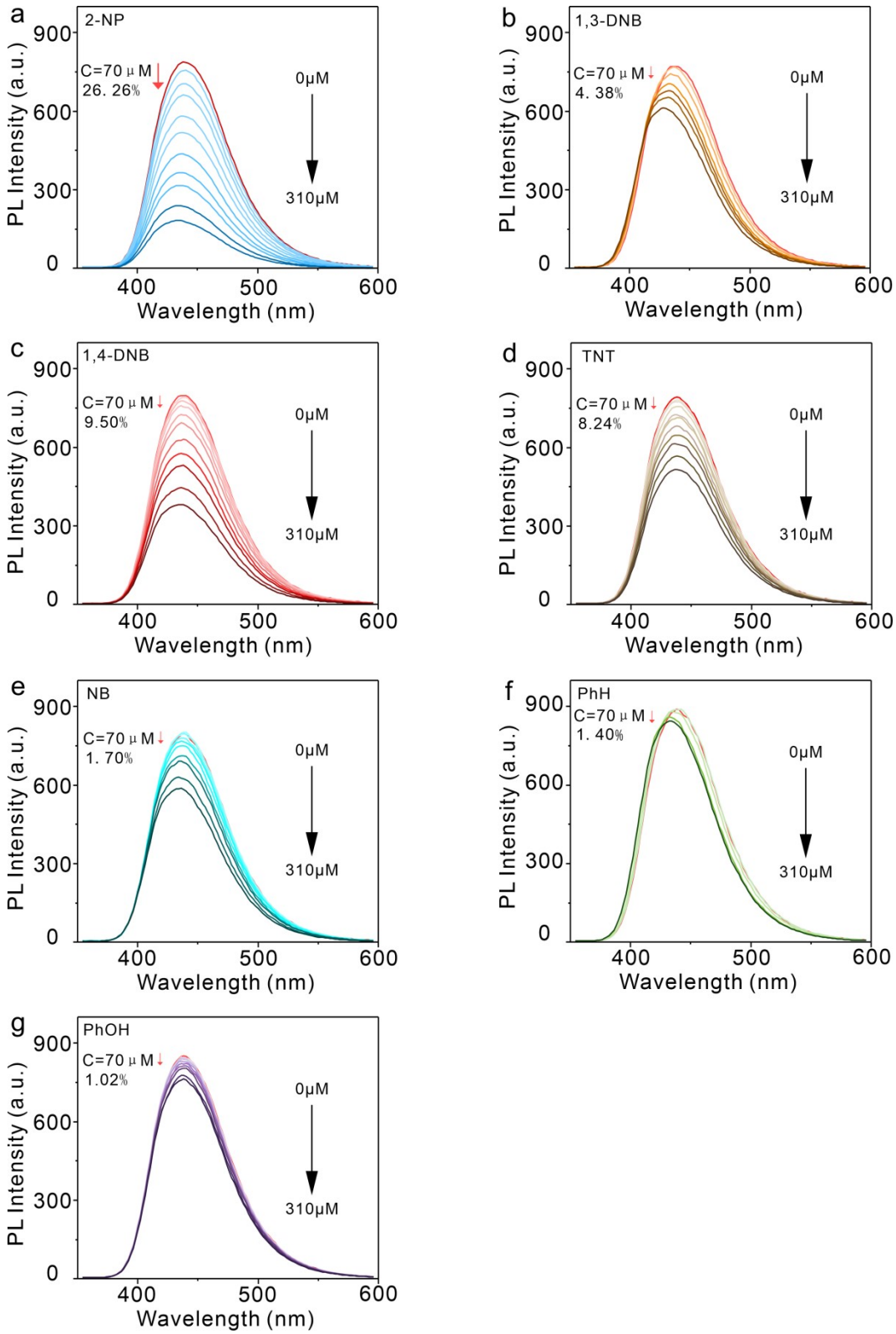


Fig. S6. PL emission spectra of NH_2-MIL-125(Ti) in the presence of various concentrations of (a) 2-NP, (b) 1,3-DNB, (c) 1,4-DNB, (d) TNT, (e) NB, (f) PhH and (g) PhOH upon excitation at 334 nm (the figures showed the quenching efficiency when analyte concentration was 70 μM).

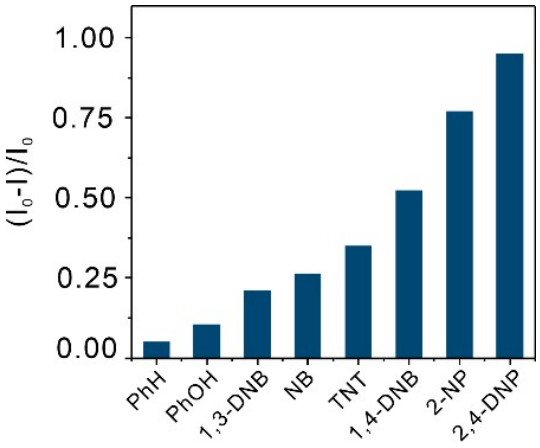


Fig. S7. $(I_0-I)/I_0$ values (i.e., quenching efficiency) of NH_2-MIL-125(Ti) suspension in the presence of different aromatic compounds (310 μM).

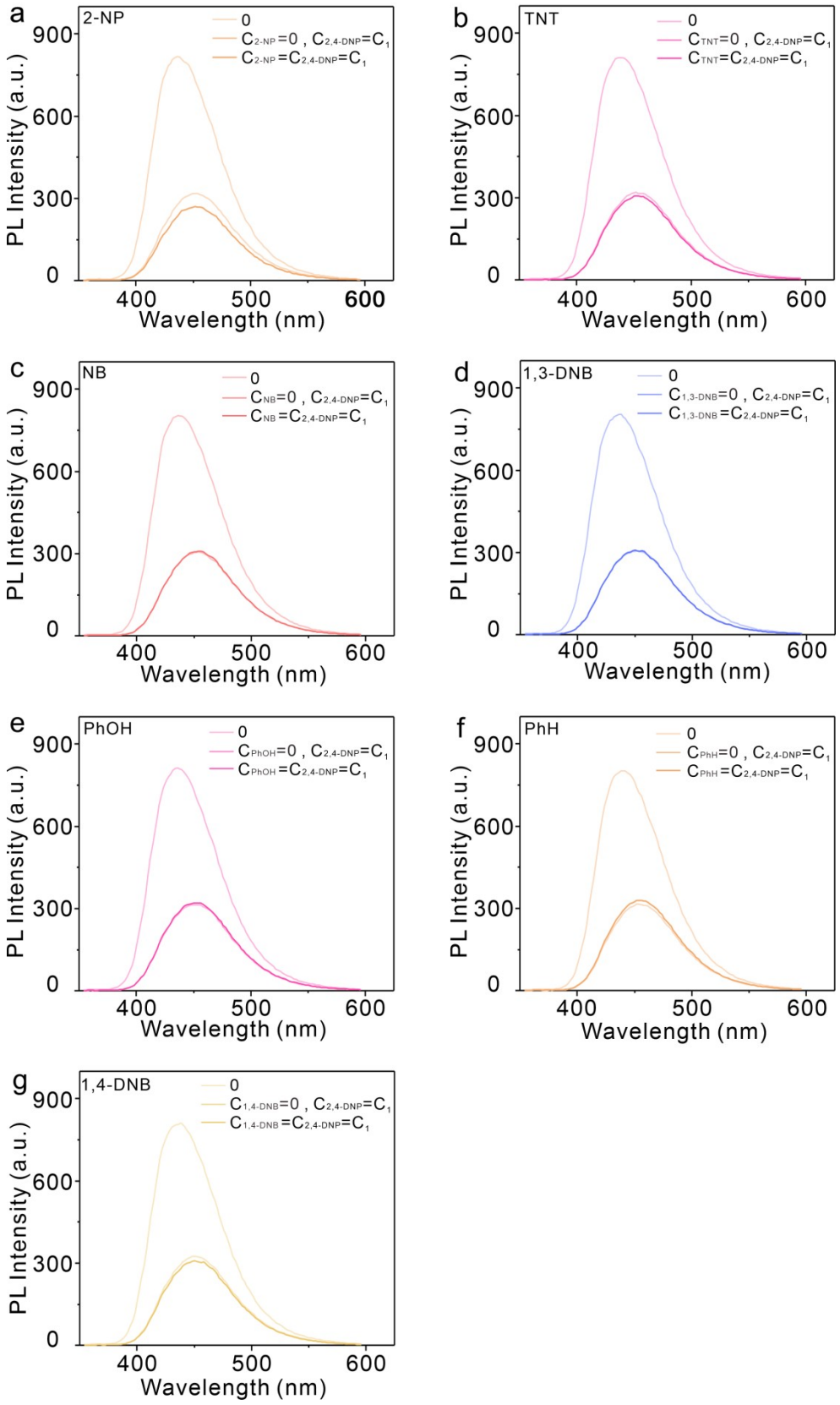


Fig. S8. PL emission spectra of NH_2-MIL-125(Ti) in the presence of 2,4-DNP and (a) 2-NP, (b) TNT, (c) NB, (d) 1,3-DNB, (e) PhOH, (f)PhH and (g) 1,4-DNB upon excitation at 334 nm.

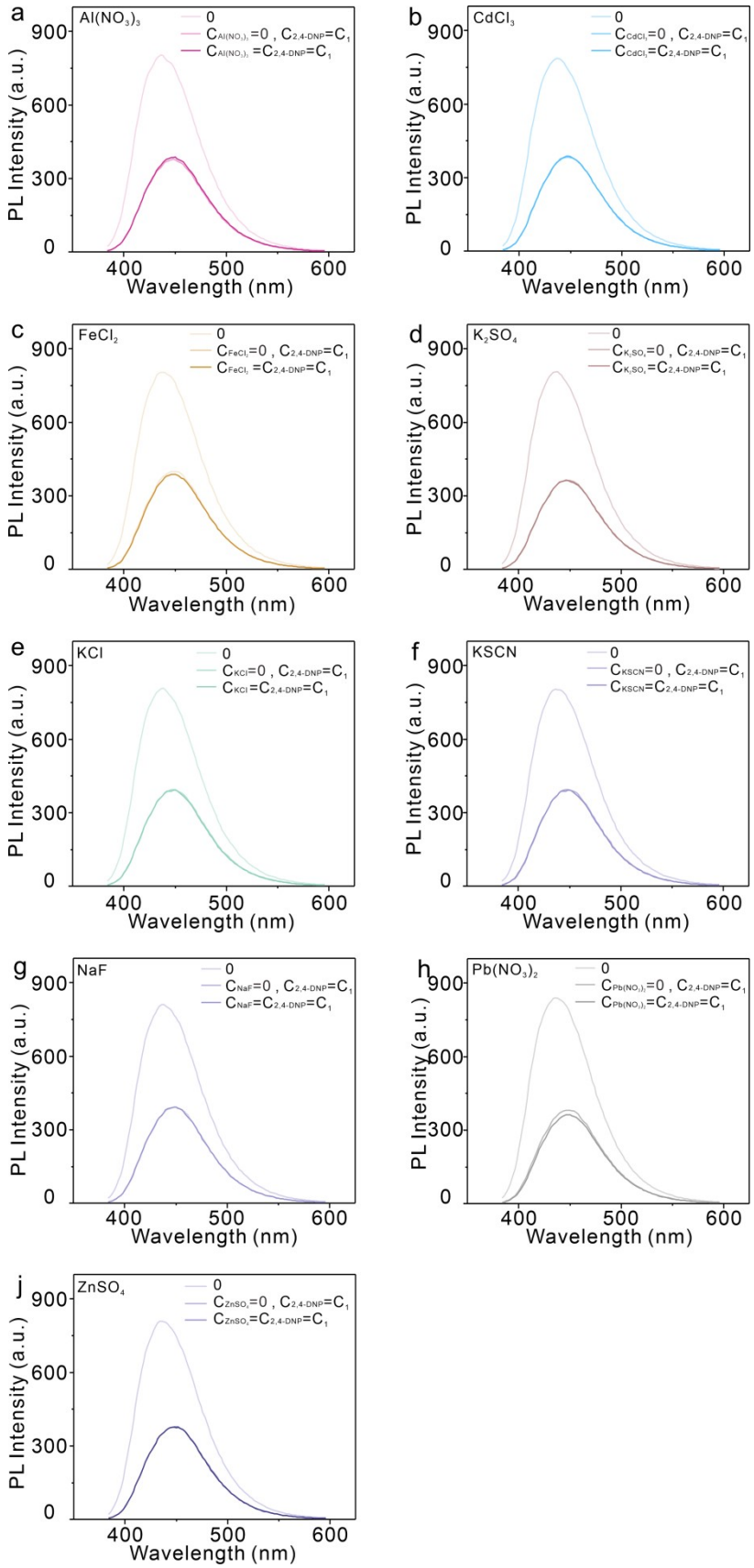


Fig. S9. PL emission spectra of NH_2-MIL-125(Ti) in the presence of 2,4-DNP and (a) $Al(NO_3)_3$, (b) $CdCl_3$, (c) $FeCl_2$, (d) K_2SO_4, (e) KCl, (f) KSCN, (g) NaF, (h) $Pb(NO_3)_2$ and (j) $ZnSO_4$ upon excitation at 334 nm.

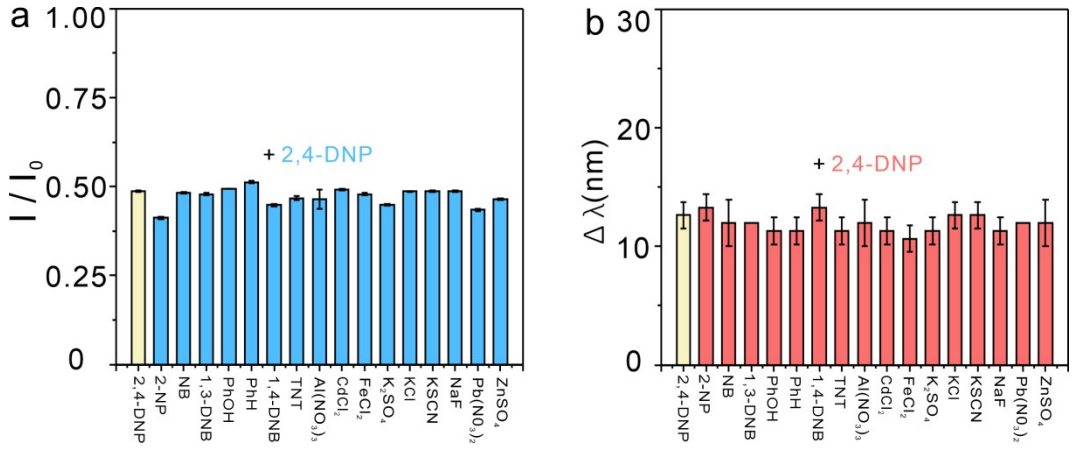


Fig. S10. The anti-interference test of NH_2-MIL-125(Ti) in the detection of 2,4-DNP: (a) I_0/I and (b) Δλ, the yellow color represents the presence of only 2,4-DNP (50 μM), while the blue and red colors indicate the coexistence of both 2,4-DNP (50 μM) and interfering substances (50 μM).

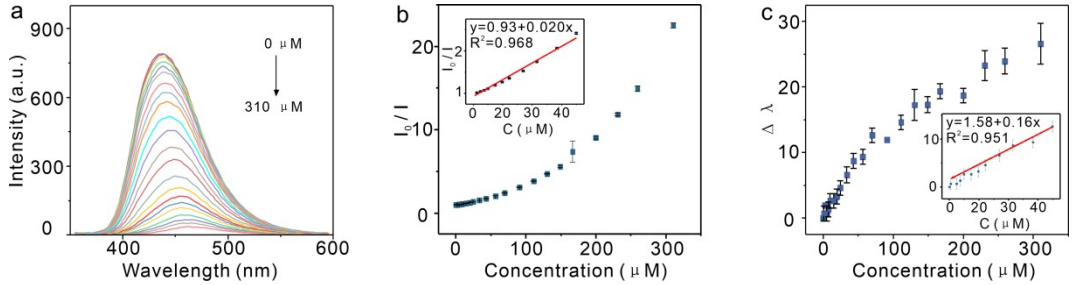


Fig. S11. A real sample test was conducted in tap water, (a) PL emission spectra of NH_2-MIL-125(Ti) were observed in the presence of varying concentrations of 2,4-DNP, (b) the relationship between I_0/I and concentration of 2,4-DNP, (c) the relationship between Δλ and concentration of 2,4-DNP.

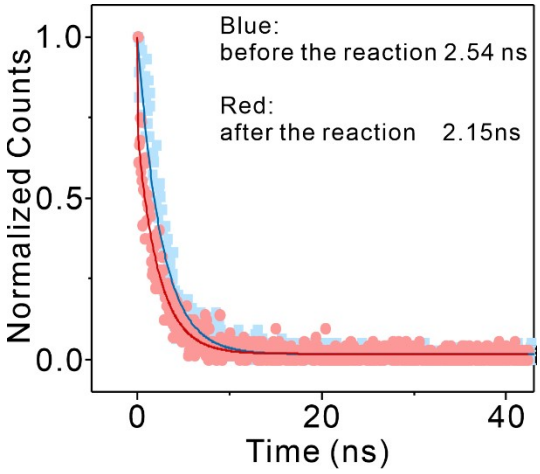
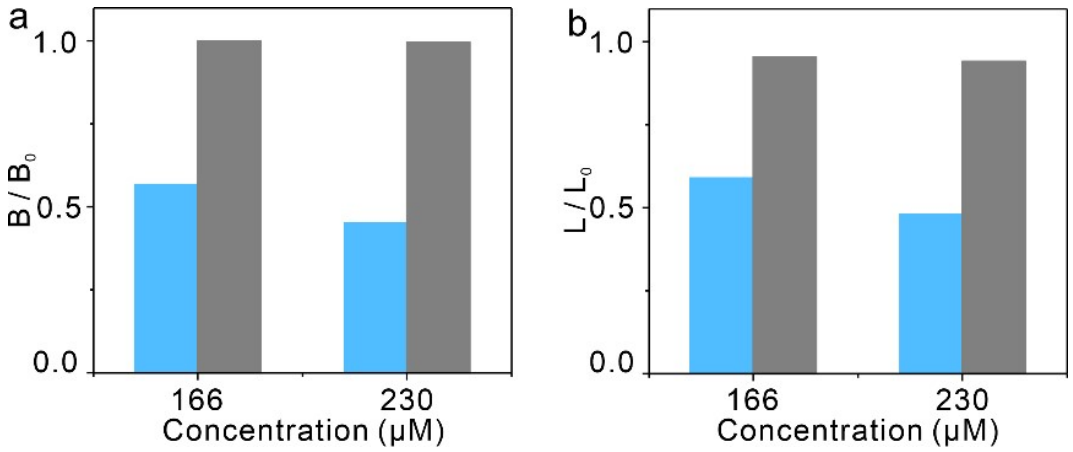


Fig. S12. Fluorescence lifetime of NH_2-MIL-125(Ti) before and after reaction with 70 μM 2,4-DNP.



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