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ESI

## **Supporting Information**

# Fast Response and Highly Selective Sensing for Amine

## Vapors Using a Luminescent Coordination Polymer

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## **1. Experimental Details**

## 1.1. Materials and Methods

The ligand (**HL**) was prepared according to the previous reports.<sup>1-3</sup> All other reagents and solvents were obtained from commercial sources without further purification.

Powder X-ray diffraction (PXRD) data were performed on a Rigaku/max 2550 diffractometer with Cu K $\alpha$  radiation Field-emission ( $\lambda = 1.5418$  Å, continuous, 40 kV, 40 mA, increment = 0.02°). The elemental analysis (C, H, N) in the solid sample was carried out on a Perkin-Elmer 2400LS II elemental analyzer. TGA (thermal gravimetric analysis) was recorded under an air atmosphere with a heating rate of 10 °C/min using a TGA Q500 V20.10 Build 36 in the temperature range of 35-800 °C. The infrared (IR) spectra were recorded on a Perkin Elmer Spectrum 1 spectrophotometer with KBr pellets within the 4000-400 cm<sup>-1</sup> region. Luminescence lifetime was calculated with the Origin 7.5 software package.

## 1.2 Synthesis of {[EuL<sub>2</sub>(H<sub>2</sub>O)<sub>3</sub>](NO<sub>3</sub>)} (EuL)

Eu(NO<sub>3</sub>)<sub>3</sub>•6H<sub>2</sub>O (0.1 mmol, 44.6 mg), and HL (0.3 mmol, 60.1 mg) in a mixed solvent of acetonitrile (CH<sub>3</sub>CN, 6 ml) and distilled water (H<sub>2</sub>O, 1 ml) were placed in a Teflon-lined stainless steel vessel (20 mL) and heated to 80 °C in 300 min, maintained at this temperature for four days and then cooled to room-temperature at a rate of 0.5 °C/min. The resulting colorless crystals were obtained, after being washed by distilled water, yield ~50 mg (75% based on Eu<sup>3+</sup>). Its purity was confirmed by powder X-ray diffraction (Fig. S3a,b). Elemental analysis (% calc/found) for EuL  $C_{22}H_{20}EuN_5O_{10}$  (Mr = 666.39): C, 39.65/39.70; H, 3.03/2.98; N, 10.51/10.53.

## 1.3 Single Crystal X-ray structure determination

Single crystal of **EuL** was selected for indexing and data collection on a Bruker Apex II CCD diffractometer with graphite monochromated Mo-K*a* radiation ( $\lambda = 0.71073$  Å) at 293 K. Data processing was accomplished with the SAINT program. All absorption corrections were applied using the multi-scan program SADABS.<sup>4</sup> All structures were solved by direct methods using SHELXS-97 program of the SHELXTL package and refined by the full-matrix least squares method with SHELXTL-97.<sup>5</sup> All non-hydrogen atoms were easily found from the difference Fourier map and refined using the full-matrix least-squares method on  $F^2$  with anisotropic thermal parameters during the final cycles. All hydrogen atoms were placed by geometrical considerations and were added to the structure factor calculation. See the CIF file for details. Crystallographic data for **EuL** is summarized in Table S1. Selected bond distances and angles are given in Table S2.

CCDC	1005405			
Empirical formula	$C_{22}H_{20}EuN_5O_{10}$			
structural formula	$\{[EuL_2(H_2O)_3](NO_3)\}$			
fw	666.39			
Crystal system	Triclinic			
Space group	<i>P</i> -1			
Temperature (K)	293(2)			
$\lambda$ (Mo K $\alpha$ ), Å	0.71073			
<i>a</i> /Å	9.5509(5)			
b /Å	11.2004(5)			
c /Å	12.8518(6)			
α /°	66.2700(10)			
eta /°	76.4140(10)			
γ /°	80.5810(10)			
$V/{ m \AA}^3$	1219.66(10)			
Ζ	2			
$2\theta \max (\text{deg})$	52.34			
$\mu$ (Mo-K $\alpha$ ) mm <sup>-1</sup>	2.638			
D, g/cm <sup>3</sup>	1.815			
F(000)	660			
Crystal size (mm <sup>3</sup> )	0.35  imes 0.30  imes 0.26			
Reflections collected / unique	7804/4848 [ <i>R</i> (int) = 0.0219]			
Final <i>R</i> indices $[I > 2\sigma(I)]$	${}^{a}R_{1} = 0.0269, {}^{b}wR_{2} = 0.0588$			
R indices (all data)	<sup><i>a</i></sup> $R_1 = 0.0314$ , <sup><i>b</i></sup> $wR_2 = 0.0608$			
GOF	1.029			
${}^{a}R_{1} = \sum   F_{o}  -  F_{c}   / \sum  F_{o} , {}^{b}wR_{2} = \{\sum w[(F_{o})^{2} - (F_{c})^{2}]^{2} / \sum w[(F_{o})^{2}]^{2}\}^{1/2}$				

Table S2. Selected bond lengths and bond angles for EuL.

Eu(1)-O(1)	2.510(2)	Eu(1)-O(2)	2.435(2)

Eu(1)-O(3)	2.384(2)		Eu(1)-O(4)#1		2.409(2)			
Eu(1)-O(5)	2.513(3)		Eu(1)-O(6)		2.540(3)			
Eu(1)-O(1W)	2.436(2)		Eu(1)-O(2W)		2.427(2)			
Eu(1)-O(3W)	2.436(2)		O(4)-Eu(1)#1		2.409(2)			
O(1)-Eu(1)-O(6)	69.78(8)		O(1)-E	u(1)-O(5)	109.89(8)			
O(1)-Eu(1)-N(5)	90.13(8)		O(2)-Eu(1)-O(1)		52.94(7)			
O(2)-Eu(1)-O(5)	127.61(8)		O(2)-Eu(1)-O(6)		78.81(8)			
O(2)-Eu(1)-O(3W)	127.35(8)		O(2)-Eu(1)-N(5)		103.01(9)			
O(2)-Eu(1)-O(1W)	87.38(9)		O(3)-Eu(1)-O(2W)		73.76(8)			
O(3)-Eu(1)-O(4)#1	87.98(7)		O(3)-Eu(1)-O(1W)		82.38(9)			
O(3)-Eu(1)-O(2)	149.18(9)		O(3)-Eu(1)-O(1)		146.74(8)			
O(3)-Eu(1)-O(3W)	76.99(8)		O(3)-Eu(1)-O(5)		75.15(9)			
O(3)-Eu(1)-N(5)	100.46(9)		O(3)-Eu(1)-O(6)		125.62(9)			
O(4)#1-Eu(1)-O(2W)	72.88(8)		O(4)#1-Eu(1)-N(5)		66.62(8)			
O(4)#1-Eu(1)-O(2)	83.31(8)		O(4)#1	-Eu(1)-O(1W)	143.82(9)			
O(4)#1-Eu(1)-O(3W)	138.26(8	\$)	O(4)#1	-Eu(1)-O(1)	124.94(7)			
O(4)#1-Eu(1)-O(5)	68.85(8)		O(4)#1-Eu(1)-O(6)		70.32(8)			
O(5)-Eu(1)-O(6)	50.66(8)		O(5)-E	u(1)-N(5)	25.47(8)			
O(6)-Eu(1)-N(5)	25.21(8)		O(1W)	-Eu(1)-O(1)	73.18(8)			
O(1W)-Eu(1)-O(3W)	72.98(9)		O(1W)-Eu(1)-O(6)		141.47(8)			
O(1W)-Eu(1)-O(5)	139.75(9	)	O(1W)-Eu(1)-N(5)		149.44(8)			
O(2W)-Eu(1)-O(2)	75.42(8)		O(2W)-Eu(1)-O(1W)		70.95(9)			
O(2W)-Eu(1)-O(3W)	135.81(8)		O(2W)-Eu(1)-O(5)		130.80(8)			
O(2W)-Eu(1)-O(1)	117.09(8)		O(2W)-Eu(1)-O(6)		136.93(8)			
O(2W)-Eu(1)-N(5)	139.30(8)		O(3W)-Eu(1)-O(5)		69.70(8)			
O(3W)-Eu(1)-O(1)	74.53(7)		O(3W)-Eu(1)-N(5)		78.03(8)			
O(3W)-Eu(1)-O(6)	87.18(8)							
Hydrogen bonds								
D-HA d(D-H)		d(DA)		<(DHA)				
O(1W)-H(1WA)N(2)#2	.N(2)#2 0.85		2.836(4)		135.1			
O(2W)-H(2WB)O(4)	0.85		2.759(3)		156.8			
O(2W)-H(2WA)N(1)#3	3 0.85			2.763(4)	129.7			
O(3W)-H(3WA)O(1)#4 0.85			2.720(3)	140.4				
O(3W)-H(3WB)N(3)#5 0.85		0.85		2.887(4)	154.7			

Symmetry transformations used to generate equivalent atoms: #1 -x+1, -y, -z+1; #2 x, y-1, z+1; #3 -x+2, -y+1, -z; #4 -x+1, -y+1, -z+1; #5 -x, -y, -z+2.

# 2. Structural images



Fig. S1 (a) ORTEP representation of the asymmetric unit of **EuL**. Thermal ellipsoids are drawn at the 50% probability level, and the hydrogen atoms are omitted for clarity. (b) Coordination mode and its polyhedron of Eu1. (b) The dihedral angles between phenyl and pyrimidine rings, calculated with SHELXTL-97 program.







(c)



(d)



(e) 6

Fig. S2 (a-d) The H-bonded one-dimensional (1D) chains along different directions among coordinated water molecules (O(1W), O(2W), and O(3W)) as well as non-coordinated N sites (N(1), N(2), and N(3)) and oxygen atom (O(1)) of carboxylate group. (e) A H-bonded 3D framework viewed along the [010] direction. EuO<sub>9</sub> polyhedra are shaded in green. Hydrogen bonds are drawn as dashed lines (red).

### 3. Powder X-ray diffraction, FTIR, and thermogravimetric analyses:

### 3.1 PXRD analyses

All Powder X-ray diffraction (PXRD) patterns containing as-made **EuL** and samples after immersing various solvents were performed on a Rigaku/max 2550 diffractometer with graphite-filtered Cu K $\alpha$  radiation Field-emission ( $\lambda = 1.5418$  Å) at 40 kV and 40 mA. The spectra were collected in the range of 5-60° (2 $\theta$ ) at a scan speed of 5 deg/min.

As shown in Fig. S3a and b, the measured PXRD patterns of **EuL** match well with the simulated pattern generated from the result of single-crystal diffraction data, confirming the phase purity of as-synthesized product.

In order to demonstrate the thermal stability of **EuL**, its temperature-dependent powder X-ray diffraction patterns (Fig. S3c) are recorded on a PANalytical diffractometer with Cu K $\alpha$  radiation Field-emission ( $\lambda = 1.5418$  Å, continuous, 40 kV, 30 mA, increment = 0.02°) at 25 °C, 30 °C, 100 °C, 150 °C, 250 °C, 350 °C, 400 °C and 500 °C, respectively, which is accordant with the inflection points of TGA curve. The results show that the framework of **EuL** is thermally stable till 350 °C.

**EuL** samples are insoluble in various common solvents containing water solution. In order to determine the solvent-stability of **EuL** treated by different solvents, the samples of **EuL** /solvents were prepared by introducing each sample (30 mg) as a powder into different solvents (ethanol, 1-prapanol (1-PA), 2-propanol (2-PA), acetonitrile (CH<sub>3</sub>CN), dichloromethane (CH<sub>2</sub>Cl<sub>2</sub>), aniline, and H<sub>2</sub>O) and then agitated for 48 h. After treatment, the powder was obtained by filtration, and drying in the air. The obtained PXRD patterns are shown in Figure S3d. It is clear that the basic frameworks of the compound remain intact after immersing in solvent molecules and illustrate good solvent-stability.

Before researching the quenching behavior of various amines in detail, such as ammonium hydroxide (NH<sub>3</sub>·H<sub>2</sub>O, 25%~28%), methylamine (CH<sub>3</sub>NH<sub>2</sub>, 25%~30%), ethylamine (C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub>, 65%~70%), propylamine (C<sub>3</sub>H<sub>7</sub>NH<sub>2</sub>, 98.5%), N,N'-diethylamine ((C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>NH, analytical reagent), triethylamine ((C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>N, analytical reagent), and aniline (analytical reagent), the stabilities of **EuL** introduced by various amine solvents have been also demonstrated by PXRD, as shown in Fig. S3e.



![](_page_7_Figure_1.jpeg)

![](_page_7_Figure_2.jpeg)

![](_page_7_Figure_3.jpeg)

![](_page_7_Figure_4.jpeg)

![](_page_7_Figure_5.jpeg)

![](_page_8_Figure_0.jpeg)

![](_page_8_Figure_1.jpeg)

Fig. S3 (a) PXRD pattern of EuL sample: simulated from the single-crystal structure (black), as-synthesized (red). (b) In situ temperature-dependent PXRD patterns of EuL at different temperatures. (c) PXRD patterns of EuL after immersing in several organic solvents: EuL/ethanol (red); EuL/1-propanol (blue); EuL/2-propanol (olive); EuL/aniline (pink); EuL/CH<sub>3</sub>CN (acetonitrile) (dark yellow); EuL/CH<sub>2</sub>Cl<sub>2</sub> (navy); and EuL/H<sub>2</sub>O (dark red). (d) PXRD patterns of EuL after immersing in different amines: EuL/aniline (red); EuL/NH<sub>3</sub>•H<sub>2</sub>O (dark yellow); EuL/CH<sub>3</sub>NH<sub>2</sub> (blue); EuL/(C<sub>2</sub>H<sub>5</sub>)NH<sub>2</sub> (olive); EuL/(C<sub>3</sub>H<sub>7</sub>)NH<sub>2</sub> (pink); EuL/(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>NH (navy); and EuL/(C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>N (dark red).

#### 3.2 IR analyses

IR peaks (cm<sup>-1</sup>) for **EuL**: 3403 (s), 3066 (w) , 3041 (w), 2426 (w), 1642 (w), 1589 (m), 1529 (m), 1468 (w), 1408(m), 1381 (s), 1300 (m), 1185 (m), 1125 (w), 1103 (w), 1033 (w), 1006 (w), 918 (w), 859 (w), 815 (w), 793 (m), 717 (m), 690 (w), 651 (w), 543 (w), 482 (w).

IR peaks (cm<sup>-1</sup>) for **HL**: 3080 (w), 3038 (w), 2927 (w), 2778 (w), 2604 (w), 2497 (w), 1914 (m), 1719 (s), 1613 (m), 1554 (m), 1512 (m), 1412 (s), 1359 (w), 1284 (s), 1190 (s), 1110 (s), 1004 (m), 972 (w), 919 (m), 856 (s), 803 (w), 765 (vs), 718 (m), 697 (m), 649 (s), 633 (m), 549 (m), 523 (m).

IR peaks (cm<sup>-1</sup>) for **EuL/1-propanol**: 3297 (s), 1587 (m), 1528 (m), 1470 (m), 1412 (s), 1300 (s), 1184 (m), 1036 (m), 1004 (m), 919 (w), 856 (m), 813 (w), 793 (m), 718 (m), 686 (w), 649 (w), 538 (m).

IR peaks (cm<sup>-1</sup>) for **EuL/2-propanol**: 3292 (s), 1587 (m), 1534 (m), 1465 (m), 1407 (s), 1300 (s), 1190 (m), 1126 (w), 1036 (m), 1004 (m), 919 (w), 861 (s), 819 (w), 792 (s), 718 (m), 686 (w), 654 (m), 538 (w).

IR peaks (cm<sup>-1</sup>) for EuL/ethanol: 3287 (s), 1592 (m), 1534 (m), 1465 (w), 1406 (s),

1295 (m), 1190 (m), 1126 (w), 1105 (w), 1036 (w), 1004 (m), 919 (w), 861 (m), 813 (w), 787 (m), 718 (m), 680 (w), 649 (w), 543 (m).

IR peaks (cm<sup>-1</sup>) for **EuL/aniline**: 3529 (w), 3288 (m), 3065 (w), 3033 (w), 1646 (w), 1603 (w), 1587 (m), 1529 (m), 1471 (m), 1408 (s), 1301 (m), 1190 (m), 1121 (w), 1106 (w), 1031 (w), 1004 (w), 857 (m), 814 (w), 788 (m), 724 (m), 687 (w), 645 (w), 539 (w).

IR peaks (cm<sup>-1</sup>) for **EuL/CH<sub>2</sub>Cl<sub>2</sub>**: 3271 (m), 3068 (w), 1645 (w), 1608 (m), 1592 (m), 1534 (m), 1470 (m), 1412 (vs), 1343 (w), 1300 (s), 1184 (m), 1126 (w), 1105 (w), 1052 (w), 1036 (m), 1004 (m), 919 (w), 856 (m), 813 (w), 787 (m), 718 (m), 686 (w), 649 (w), 543 (w).

IR peaks (cm<sup>-1</sup>) for **EuL/CH<sub>3</sub>CN**: 3276 (m), 3065 (w), 3038 (w), 1645 (w), 1608 (w), 1586 (m), 1534 (m), 1465 (m), 1407 (vs), 1300 (s), 1184 (m), 1126 (w), 1105 (w), 1036 (w), 1009 (w), 919 (w), 856 (m), 813 (w), 792 (m), 723 (m), 686 (w), 849 (w), 543 (w).

As shown in Fig. S4b-g, these infrared spectra also confirm that the framework of **EuL** is retained after the introduction of various solvents, and each of them shows slightly changes for position and intensity of absorption bands, confirming the successful incorporation of guest molecules during the immersing process.

Take **EuL**/aniline as an example (Fig. S4e), the absorption band at about 1300 cm<sup>-1</sup> clearly strengthen than the one of **EuL**, which are attributed to the characteristic stretching vibration of C-N. Besides, the shift of the v(O-H) band of coordinated water molecules from 3403 to 3288 cm<sup>-1</sup> and one new v(N-H) band at 3529 cm<sup>-1</sup> indicate the formation of hydrogen bonds between aniline and coordinated water molecules of **EuL** framework.

As shown in Fig. 4i, the framework of **EuL** after heating at 200 °C is retained, and coordinated water molecules have been released, since the adsorption band at 3403 cm<sup>-1</sup>, coming from the vibration of  $v(H_2O)$  band, became very weak.

![](_page_9_Figure_7.jpeg)

![](_page_9_Figure_8.jpeg)

![](_page_10_Figure_0.jpeg)

![](_page_10_Figure_1.jpeg)

![](_page_10_Figure_2.jpeg)

![](_page_10_Figure_3.jpeg)

![](_page_10_Figure_4.jpeg)

![](_page_10_Figure_5.jpeg)

![](_page_10_Figure_6.jpeg)

(h)

![](_page_10_Figure_8.jpeg)

(c)

![](_page_10_Figure_10.jpeg)

![](_page_10_Figure_11.jpeg)

![](_page_10_Figure_12.jpeg)

![](_page_10_Figure_13.jpeg)

![](_page_10_Figure_14.jpeg)

(i)

Fig. S4 The IR spectra of EuL (a), and EuL immersed in different solvents, namely, EuL/1-propanol (b), EuL/2-propanol (c), EuL/ethanol (d), EuL/aniline (e), EuL/CH<sub>2</sub>Cl<sub>2</sub> (f), EuL/CH<sub>3</sub>CN (g), as well as contrastive spectra between EuL and EuL/aniline (h), and IR spectra of EuL after heating 150 °C, and 200 °C for one hour (i).

### 3.3 TGA analysis

![](_page_11_Figure_2.jpeg)

Fig. S5 TGA-DTA curves of **EuL** under air atmosphere with a heating rate of 10 °C/min.

As shown in Fig. S5, the TGA curve displays three continuous weight losses of 8.0% (calculated 8.1%) at 120-231 °C corresponding to the loss of three coordinated water molecules. The dehydrated framework is stable to 395 °C, then the framework begins to collapse, accompanying the release of organic ligands (two  $\{L\}^-$  ligands) and one nitrate ion. The total weight loss at 504 °C is 59.6%. So, this compound **EuL** has a certain thermal stability, which has been also verified by the FTIR spectra (Fig. S4i) and PXRD patterns (Fig. 3c) at different temperatures.

### 4. Photoluminescent Properties

The fluorescent property of **EuL** was investigated in the solid state, in various solvent emulsions and vapors at room temperature.

#### 4.1 Solid-state spectra

The photoluminescent spectra of **EuL** and HL in the solid state were recorded on a Hitachi F-4500 fluorescence spectrophotometer. The photomultiplier tube (PMT) voltage was 700 V, the scan speed was 1200 nm min<sup>-1</sup> and the slit width of excitation and emission was 2.5 nm and 5.0 nm, respectively.

![](_page_12_Figure_0.jpeg)

Fig. S6 Room-temperature excitation (black) and emission spectra (red) of ligand HL ( $\lambda_{em} = 349 \text{ nm}$  and  $\lambda_{ex} = 237 \text{ nm}$ ) as well as complex **EuL** ( $\lambda_{em} = 620 \text{ nm}$  and  $\lambda_{ex} = 308 \text{ nm}$ ).

#### 4.2 Sensing for organic solvent molecules in the liquid

The photoluminescent (PL) spectra of EuL in various solvent emulsions at room temperature were recorded on a Hitachi F-7000 fluorescence spectrophotometer, a LS 55 florescence spectrophotometer, and a Hitachi F-4500 fluorescence spectrophotometer, respectively. The photomultiplier tube (PMT) voltage was 700 V and 650 V, the scan speed was 1200 nm min<sup>-1</sup> and the slit width of excitation and emission was 2.5 nm, respectively. The EuL-solvent emulsions were prepared by introducing 5 mg of its powder into 3.0 mL of methanol, ethanol, 1-propanol, 2propanol, acetonitrile (CH<sub>3</sub>CN), chloroform (CHCl<sub>3</sub>), dichloromethane (CH<sub>2</sub>Cl<sub>2</sub>), tetrahydrofuran (THF), N,N-Dimethylformamide (DMF), benzene, toluene, aniline, chlorobenzene, H<sub>2</sub>O, and were then vigorously agitated by using ultrasound to form stable emulsions before fluorescence study. For sensing properties with respect to aniline, different amounts of aniline were added into a standard EuL emulsion in 2propanol, while the concentration of the Eu<sup>3+</sup> ions was kept constant.

![](_page_12_Figure_4.jpeg)

![](_page_13_Figure_0.jpeg)

Fig. S7 The room-temperature photoluminescence spectra of **EuL** in different solvents with excited at 308 nm (top), and the amplifying image (down).

![](_page_13_Figure_2.jpeg)

Fig. S8 (a) Luminescence quenching of EuL/2-propanol emulsion with increasing aniline content ( $\mu$ L) ( $\lambda_{ex}$  =308 nm). (b) The emission intensity of the  ${}^{5}D_{0} \rightarrow {}^{7}F_{2}$  transition (620 nm) for EuL/2-propanol emulsion as function of aniline content ( $\mu$ L).

![](_page_13_Figure_4.jpeg)

Fig. S9 (a) Suspension-state PL spectra and (b) the relative intensities of  ${}^{5}D_{0} \rightarrow {}^{7}F_{2}$ 

transition at 620 nm for **EuL** dispersed in various amine solvents (3 mL) when excited at 308 nm, such as  $NH_3 \cdot H_2O$ ,  $CH_3NH_2$ ,  $C_2H_5NH_2$ ,  $C_3H_7NH_2$ ,  $(C_2H_5)_2NH$ , and  $(C_2H_5)_3N$ .

![](_page_14_Figure_1.jpeg)

Fig. S10 Spectra of **EuL**/2-propanol emulsion in the presence of different amounts of other amines (NH<sub>3</sub>·H<sub>2</sub>O, CH<sub>3</sub>NH<sub>2</sub>, C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub>, C<sub>3</sub>H<sub>7</sub>NH<sub>2</sub>, (C<sub>2</sub>H<sub>5</sub>)<sub>2</sub>NH, and (C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>N)) ( $\lambda_{ex} = 308 \text{ nm}$ ).

### 4.3 Sensing for various amines vapors

The synthesized sample was ground and used for vapor sensing experiments. For each experiment, 30 mg of **EuL** was placed into a glass tube (5 mL), then exposure to various amines vapors for 24 h. Subsequently the sample tube was taken out of the container, quickly sealed and the emission spectra were measured in the solid sample

holder. The experimental set-up is depicted in Fig. S11.

![](_page_15_Figure_1.jpeg)

Fig. S11 Diagram of gas-sensing measurements for amines vapors.

![](_page_15_Figure_3.jpeg)

Fig. S12 (a) The luminescence spectra of **EuL** after incubated for 24h under various amine vapors when excited at 308 nm; (b) the related luminescence intensity of the  ${}^{5}D_{0} \rightarrow {}^{7}F_{2}$  transition (620 nm).

In order to test the response rate of **EuL** for each amine vapor, the timedependent fluorescence quenching profile need to be obtained. Design a new experimental sensor setup to measure solid-state photoluminescence in various amine vapors, as shown in Fig. S13. Solid samples of EuL (60 mg) were ground into powder, which is further pressed into firm sheet sample. A quartz slide was carved into the dimensions  $0.7 \text{ cm} \times 1.5 \text{ cm}$ , equal to the diagonal distance of suprasil cuvette. The firm sheet sample sticks to the quartz slide through a double-sided black conductive adhesive, far from the bottom side about 1.2 cm. Any excess samples are removed by gently scraping the edges of the sheet sample with a drawknife in order to be placed readily into a cuvette (1.0 cm). The cuvette containing the sensor slide is positioned on the universal solid sample holder, existing in the Hitachi F-4500 spectrophotometer, and adjusted to a suitable position. The solid state emission spectrum of firm sheet sample is carried out and as an original standard, then different amines solution  $\sim 150 \text{ uL}$  are added into the cuvette by toppette pipettor. Caution! To eliminate the measurement errors, the cuvette must be kept still, so the toppette pipettor does not touch with cuvette during adding solution. Then the cap is carefully put on the cuvette. The luminescence spectra and intensity as well as the response rate of the sensor slide versus time plots were obtained in different amine vapors.

As shown in Fig. S13, the length and width are 1 cm, the height is 2 cm for the cuvette used, so its volume is 2 cm<sup>3</sup>. The amines solution about 150  $\mu$ L is added into it. Take aniline as an example, the concentration of aniline in the cuvette is 7.13 mmol/cm<sup>3</sup>, if the 150  $\mu$ L solution of aniline is fully vaporized. But in fact, the concentration of target vapor is difficultly measured in the cuvette because the saturate vapor pressure of each analyte is different.

![](_page_16_Figure_2.jpeg)

Fig. S13 Designed sensor setup used for the solid-state photoluminescence measurements as a function of time in different amine vapors.

![](_page_17_Figure_0.jpeg)

Fig. S14 Emission spectra of **EuL** upon exposure to different amine vapors at various time intervals at room temperature ( $\lambda_{ex} = 308 \text{ nm}$ ). 's' stands for 'second', and 'min' stands for 'minute'.

## 5. The mechanism of luminescent response

![](_page_18_Figure_0.jpeg)

![](_page_18_Figure_1.jpeg)

Fig. S15 UV absorption spectra of **EuL** and ligand HL (a) as well as various solvents (b) and target different amines (c) in ethanol.

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