## **Supporting information**

## Nanoscale LnMOF-functionalized nonwoven fiber protected by polydimethysiloxane coating layer as highly sensitive ratiometric oxygen sensor

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**Fig. S1** FTIR spectra of pristine PP and oxidation treated PP (O-PP). The spectra of pristine PP exhibited the characteristic peaks at 2950, 2915, 2833, and 1454 cm<sup>-1</sup>. These peaks correspond to asymmetric -CH<sub>3</sub>, asymmetric -CH<sub>2</sub>-, and symmetric -CH<sub>2</sub>- stretching vibration and methylene deformation in the PP.<sup>S1</sup> The peaks at 803 cm<sup>-1</sup> correspond to CH<sub>2</sub> rocking, C-C chain stretching, and C-CH stretching; those at 897 cm<sup>-1</sup> correspond to CH<sub>2</sub> rocking and C-CH<sub>3</sub> stretching; those at 975 cm<sup>-1</sup> correspond to CH<sub>3</sub> rocking and C-C chain stretching; those at 1164cm<sup>-1</sup> correspond to CH<sub>2</sub> twisting, C-C chain stretching, and CH bending; and those at 1373 cm<sup>-1</sup> correspond to CH<sub>3</sub> symmetric bending and CH<sub>2</sub> wagging.<sup>S2</sup>



**Fig. S2** Structure of SUMOF-6-Eu viewed along the [001] (a), [100] (b) and [010] (c) directions, respectively.  $EuO_n$  polyhedral are shown in purple; oxygen, carbon and nitrogen atoms in red, gray and blue, respectively. Hydrogen atoms and guest molecules are omitted for clarity.



**Fig. S3** (a) PXRD patterns of simulated MOFs, as-prepared MOFs and nanoscale MOFs (NMOFs); (b) SEM images of low magnification and high magnification of as-prepared MOFs and (c) SEM images of low magnification and high magnification of as-prepared NMOFs.



**Fig. S4** Thermal gravimetric analysis (TGA) of NMOFs (blue line) and Coated NMOFs (red line). At first step (300-400 °C, partial decomposition of the organic ligand), coated NMOFs show less weight loss than pristine one due to the presence of PDMS layer. When heated over 400 °C, the departure of remaining organics in MOFs and silicone molecules occurs. And in this step, the more weight loss (40.52%) of coated NMOFs can provide additional condition to prove the presence of the layer.



Fig. S5 Room-temperature photoluminescence spectra of  $H_2$  bpydc (black: excitation; red: emission) in solid state.



**Fig. S6** UV-vis absorption spectra of suspended H<sub>2</sub>bpydc and NMOFs in aqueous solution. The  $\pi$ - $\pi^*$  absorption band of H<sub>2</sub>bpydc shows a significant blue-shift (12 nm) after binding to Eu<sup>3+</sup> ions. This indicates the formation of coordination bonds between the Eu<sup>3+</sup> ions and free –COOH of in H<sub>2</sub>bpydc.<sup>S3</sup>



**Fig. S7** The FTIR spectra of NMOFs (black line), NMOFs@O-PP (red line) and coated NMOFs@O-PP (blue line). The instet is partial enlarged detail in range of 2000-1000 cm<sup>-1</sup> of NMOFs@O-PP (red line) and coated NMOFs@O-PP (blue line).



**Fig. S8** (a) Represcentative SEM image of NMOFs@O-PP fabric and (b) SEM elemental mapping of Eu distribution on the fabric in green demonstrating overall distribution of Eu throughout the material.



**Fig. S9** Day-to-day fluorescence stability of NMOFs@O-PP (a) and coated NMOFs@O-PP (b) in laboratory air (55% relative humidity) under excitation at 395 nm.



**Fig. S10** Illustration of PDMS-coating on the surface of NMOFs@O-PP. The cuboids represent the structure of NMOFs.



**Fig. S11** (a) Represcentative SEM image of coated NMOFs@O-PP fabric, SEM elemental mapping of (b) Si distribution on the fabric in white and (c) Eu distribution on the fabric in green.



Fig. S12 N<sub>2</sub> sorption isotherms for NMOFs@O-PP and PDMS-coated NMOFs@O-PP.



**Fig. S13** (a) The relative intensities of ligand ( $I_L$ , 557 nm) and  $Eu^{3+}$  ( $I_{Eu}$ , 614 nm) under different oxygen partial pressure  $Po_2$  and (b) The inset is corresponding CIE chromaticity coordinates calculated from the emission spectra shown in (Fig. 4a).



**Fig. S14** Luminescence decay times ( ${}^{5}D_{0} \rightarrow {}^{7}F_{2}$ ) of coated NMOFs@O-PP films after exposed to O<sub>2</sub> of different Po<sub>2</sub>. The excitation wavelength is 336 nm.



Fig. S15 Emission spectra of coated NMOFs@O-PP film under different oxygen partial pressure Po<sub>2</sub>,  $\lambda_{ex}$ =336 nm.



**Fig. S16** (a) Emission spectra of coated NMOFs power under different oxygen partial pressure ( $Po_2 = 0$  or 100). The inset is relative intensities of ligand ( $I_L$ , 557 nm) and  $Eu^{3+}$  ( $I_{Eu}$ , 614 nm) calculated by luminescent spectra; (b) Emission spectra of NMOFs@O-PP film under different oxygen partial pressure ( $Po_2 = 0$  or 100). The inset is relative intensities of ligand ( $I_L$ , 557 nm) and  $Eu^{3+}$  ( $I_{Eu}$ , 614 nm) calculated nm) calculated by luminescent spectra. The quenching efficiencies of (a) and (b) are calculated to be 80.2% and 55.9%, respectively.



**Fig. S17** (a) Emission spectra of coated NMOFs@O-PP monitored in pure  $O_2$  (Po<sub>2</sub> = 0.21) (blue line) and air (red line) at room temperature and (b) Comparison of relative intensities of ligand (I<sub>L</sub>, 557 nm) and Eu<sup>3+</sup> (I<sub>Eu</sub>, 614 nm) calculated by luminescent spectra.



**Fig. 18** Luminescence intensity ratio ( $I_{Eu}/I_L$ ) values monitored in pure O<sub>2</sub> (Po<sub>2</sub> = 0.21) (red dots) and air (black dots) for six cycles ( $\lambda_{ex}$  = 395 nm).



**Fig. S19** Emission spectra of coated NMOFs@O-PP monitored for different times (0, 1, 3, 5 and 7 days) upon 395 nm excitation when exposed to  $0\% O_2$  (a) and  $100\% O_2$  (b).

![](_page_9_Figure_0.jpeg)

**Fig. S20** (a) Emission spectra of coated NMOFs@O-PP upon 395 nm excitation after exposed to air, acetone, p-xylene and toluene; (b) Comparison of relative intensities of ligand ( $I_L$ , 557 nm) and Eu<sup>3+</sup> ( $I_{Eu}$ , 614 nm) in coated NMOFs@O-PP exposed to air, acetone, p-xylene and toluene and (c) The device of coated NMOFs@O-PP for vapors and corresponding optical photograph under UV light irradiation at 365 nm.

Table	<b>S1</b>	luminescence	lifetime	(τ)	and	absolute	quantum	yield	(φ)	of	pristine	and	coated
NMO	Fs@	O-PP.											

NMOFs@O-PP	τ (ms)	ф (%)	λ <sub>ex</sub> (nm)	λ <sub>em</sub> (nm)
pristine	0.765	46	333	614
coated	1.074	62	336	614
coated	0.386	12	395	614

Luminophor	Quenching efficiency	I <sub>0</sub> /I <sub>100</sub>	K <sub>sv</sub> , R <sup>2</sup>	Detection limit (LOD)	Referenc e
Yb <sup>3+</sup> @bio-MOF-1	40%	1.67	NR	NR	14a
Eu(tta)₃phen	NR	2.4	0.015, 0.996	NR	14b
CPMϽ⊃Tb³⁺	47%	1.89	0.78, 0.9971	1.7%	5
Ir complexes doped Uio-67	29%	1.41ª	78.6 <sup>b</sup> , NR	0.76	14c
Ru complexes doped Uio-67	60%	2.5ª	227.5 <sup>b</sup> , NR	8.4%	14c
0.32Ru:MAF-34	75%	4	8.5 <sup>♭</sup> , NR	1.5	14d
Coated NMOFs@O-PP	89.9%	7.66	6.73, 0.99765	0.45%	This work

Table S2 Comparison of the key parameters of known O2-sensing systems.

NR: Not reported.

 $^{\rm a}$  The value is reported at 0.8 bar  $\rm O_2~(I_0/I_{80})$ 

<sup>b</sup> The value is the largest K<sub>sv</sub> value obtained by nonlinear Stern-Volmer plot.

Reference

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