A dual-function metal phosphate for high proton conduction and selective luminescence turn-on sensing of Co^{2+} ions

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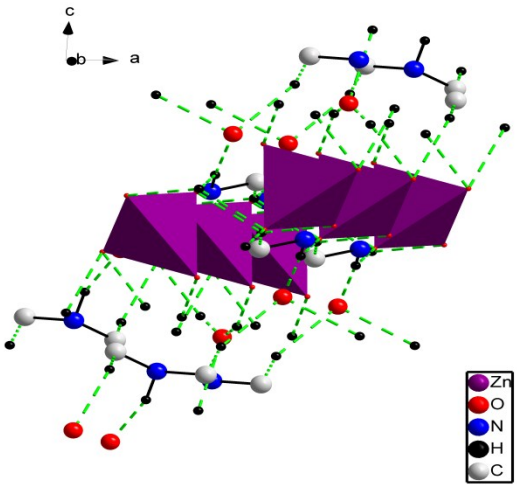

Figure S1. The hydrogen bonds diagram of **1**;

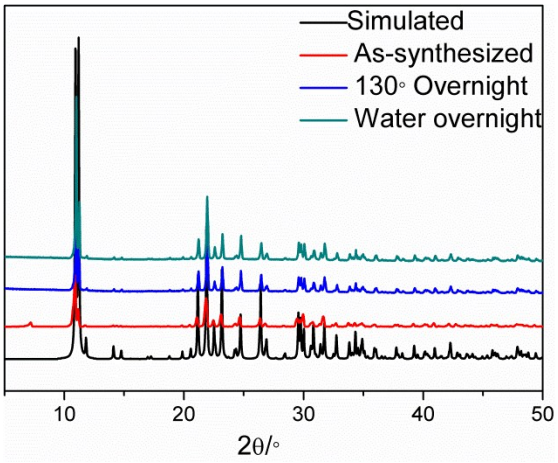

Figure S2. PXRD patterns of compound **1** simulated and 130° C overnight and water overnight.

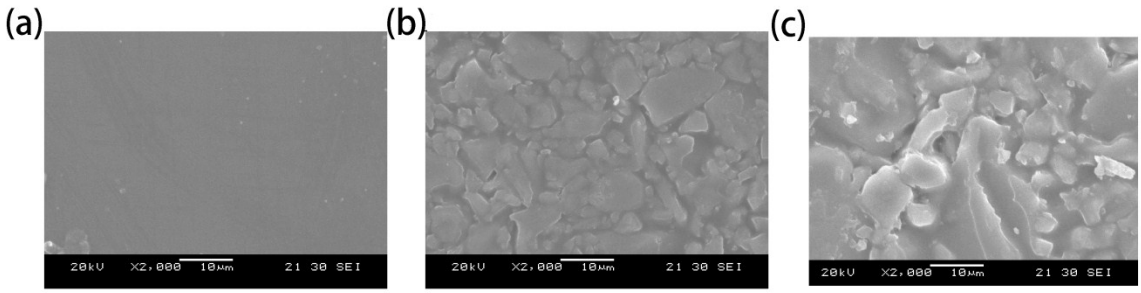

Figure S3. SEM images of composite membranes with PVA(a)，1@PVA-15(b), 1@PVA-20(c).

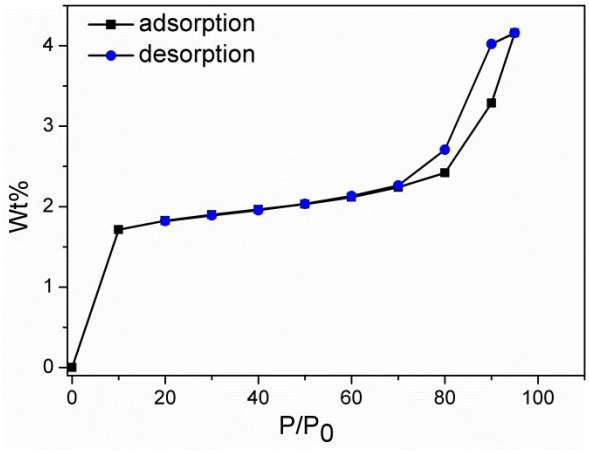

Figure S4. Water adsorption/desorption of compound **1** at 25° C.

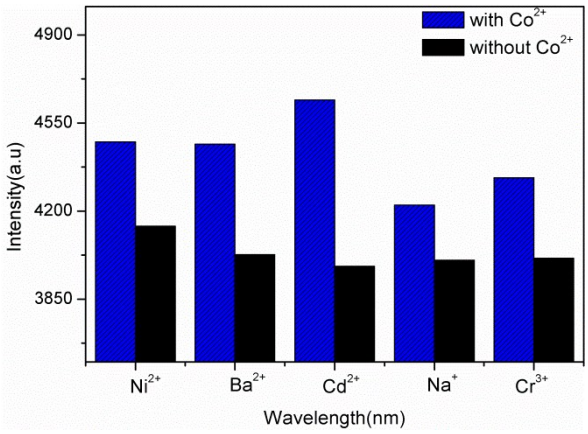

Figure S5. Fluorescence intensity of **1** when other metal ions coexist with cobalt ions

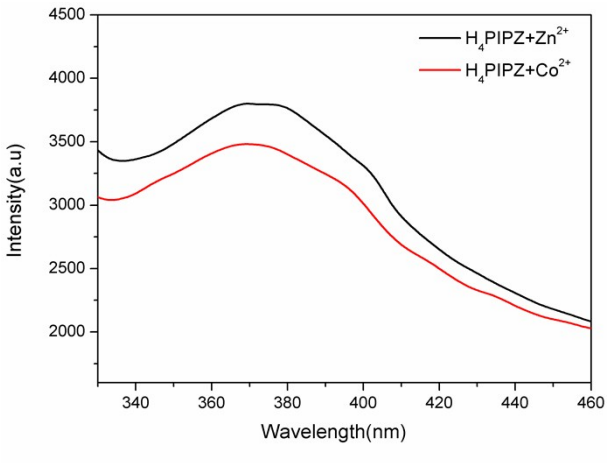

Figure S6. Fluorescence intensity of **H_4PIPZ** introduce into Zn^{2+} and Co^{2+}

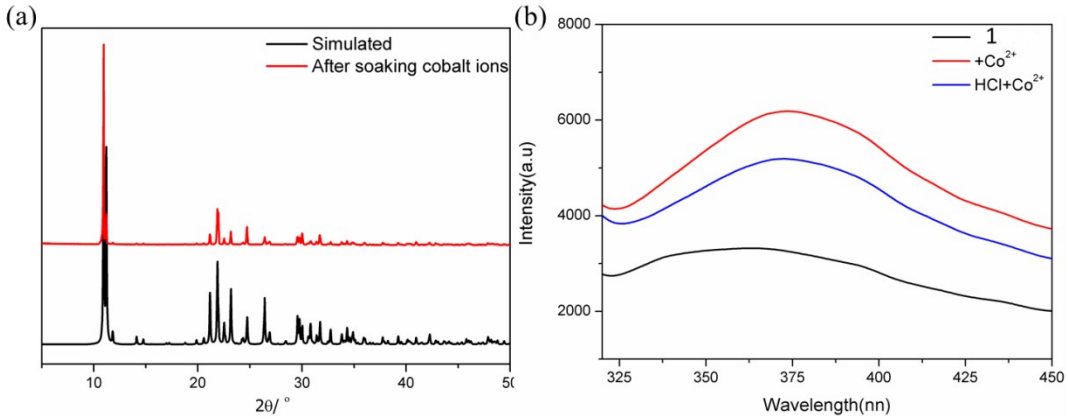

Figure S7. (a)PXRD after **1** is soaked with cobalt ions.(b) Fluorescence intensity of **1** dispersed in aqueous solution addition of HCl and Co^{2+}.

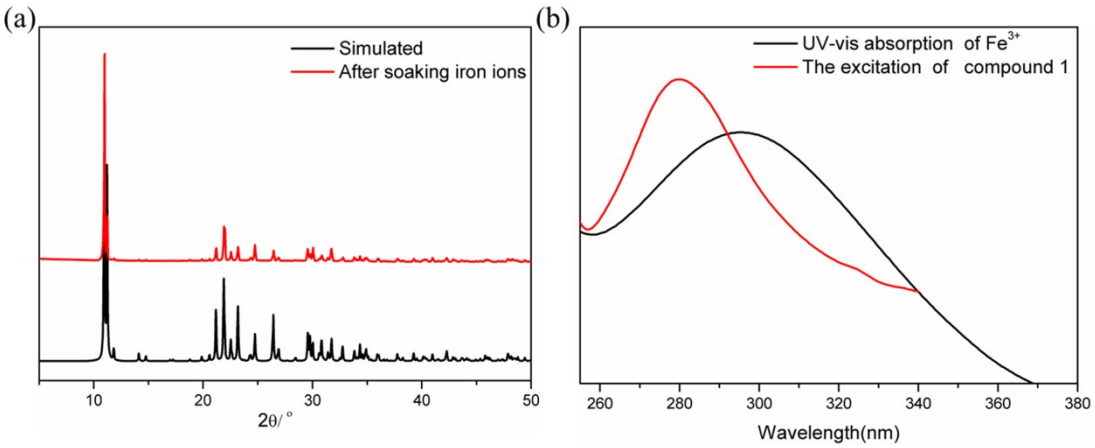

Figure S8. PXRD after **1** is soaked with iron ions.(b) The excitation of **1** and UV-vis absorption of iron ions

Table S1. The Crystallographic data for **1** are summarized

Compound	**1**
Empirical formula	$ZnC_6H_{16}N_2O_7P_2$
Formula weight	355.52
T / K	299
Crystal system	Triclinic
Space group	Pī
a / Å	8.3178(2)
b / Å	8.9144(2)
c / Å	8.9870(3)
α /°	64.183(3)
β /°	86.148(2)
γ/°	78.931(2)
Volume/ $Å^3$	588.60(3)
Z	2
ρ /g cm^{-3}	2.006
μ /mm^{-1}	5.802
F(000)	364
Crystal size(mm^3)	0.15×0.12×0.10
2θ /°	5.420 to 74.895
Index ranges	-10 ≤*h*≤ 9
	-11 ≤*k* ≤ 10

	$-11 \leq l \leq 8$
Reflections collected	5341
$R_{(int)}$	0.0239
Data / restraints / parameters	2303 / 0 / 163
GOF on F^2	1.104
Final R indices [$I>2\delta(I)$]	$R_1 = 0.0304$, $wR_2 = 0.0841$
R indices(all data)	$R_1 = 0.0326$, $wR_2 = 0.0853$

Table S2. Selected bonds and angles for **1**

Zn(1)-O(1)	1.9438(17)
Zn(1)-O(2)#1	1.9189(18)
Zn(1)-O(5)#2	1.9557(18)
Zn(1)-O(4)	1.932(2)
O(1)-Zn(1)-O(5)#2	106.57(7)
O(2)#1-Zn(1)-O(1)	108.48(8)
O(2)#1-Zn(1)-O(5)#2	105.81(8)
O(2)#1-Zn(1)-O(4)	107.05(9)
O(4)-Zn(1)-O(1)	115.71(9)
O(4)-Zn(1)-O(5)#2	112.73(8)
P(1)-O(1)-Zn(1)	122.95(11)
P(1)-O(2)-Zn(1)#1	140.39(12)
P(2)-O(5)-Zn(1)#2	119.02(11)
N(2)-C(5)-C(6)#3	110.5(2)
P(2)-O(4)-Zn(1)	139.59(13)

Symmetry transformations used to generate equivalent atoms:

#1 -x+1,-y+1,-z+1 #2 -x,-y+1,-z+1 #3 -x+1,-y,-z+1 #4 -x+2,-y+1,-z

Table S3. The proton conductivity value of the composite membrane

1@PVA-X	σ/S cm^{-1}	Conditions	*Ea/ev*
1 @PVA-5	2.37×10^{-4}	98% RH, 343 K	0.43 eV
1 @PVA-10	2.78×10^{-4}	98% RH, 353 K	0.45 eV
1 @PVA-15	6.10×10^{-5}	98% RH, 338 K	0.49 eV
1 @PVA-20	6.38×10^{-5}	98% RH, 328 K	0.99 eV