Construction of Six New Luminescent Ln(III)-Zn(II) Heterometallic Coordination Polymers Based on Heterometallic Second Building Units

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Supporting information

Table S**1** Selected bond lengths [Å] and angles[°] for the compounds **1**-**6**.[a]

Complex **1**

Eu(1)-O(11)	2.400(2)	Eu(1)-O(7)	2.522(2)
Eu(1)-O(1)	2.436(2)	Eu(1)-O(8)	2.583(2)
Eu(1)-O(2W)	2.445(2)	Zn(1)-O(2W)#1	1.964(2)
Eu(1)-O(10)#1	2.452(2)	Zn(1)-O(2)	1.973(2)
Eu(1)-O(2W)#1	2.454(2)	Zn(1)-O(5)#3	2.003(2)
Eu(1)-O(6)#2	2.455(2)	Zn(1)-N(3)#4	2.040(3)
Eu(1)-O(1W)	2.473(2)	O(11)-Eu(1)-O(1)	77.89(8)
O(1)-Eu(1)-O(7)	78.34(8)	O(11)-Eu(1)-O(2W)	77.64(8)
O(2W)-Eu(1)-O(7)	120.46(7)	O(1)-Eu(1)-O(2W)	146.72(8)
O(10)#1-Eu(1)-O(7)	141.31(8)	O(11)-Eu(1)-O(10)#1	135.42(8)
O(2W)#1-Eu(1)-O(7)	145.10(8)	O(1)-Eu(1)-O(10)#1	104.74(8)
O(6)#2-Eu(1)-O(7)	82.12(8)	O(2W)-Eu(1)-O(10)#1	78.09(8)
O(1W)-Eu(1)-O(7)	75.00(9)	O(11)-Eu(1)-O(2W)#1	68.95(8)
O(11)-Eu(1)-O(8)	67.40(8)	O(1)-Eu(1)-O(2W)#1	75.59(7)
O(1)-Eu(1)-O(8)	119.78(8)	O(2W)-Eu(1)-O(2W)#1	74.75(8)
O(2W)-Eu(1)-O(8)	69.75(7)	O(10)#1-Eu(1)-O(2W)#1	68.86(7)
O(10)#1-Eu(1)-O(8)	134.64(8)	O(11)-Eu(1)-O(6)#2	134.16(8)
O(2W)#1-Eu(1)-O(8)	128.10(7)	O(1)-Eu(1)-O(6)#2	139.72(8)
O(6)#2-Eu(1)-O(8)	69.69(8)	O(2W)-Eu(1)-O(6)#2	73.13(7)
O(1W)-Eu(1)-O(8)	114.61(8)	O(10)#1-Eu(1)-O(6)#2	70.91(7)
O(7)-Eu(1)-O(8)	50.87(7)	O(2W)#1-Eu(1)-O(6)#2	132.47(7)
Zn(1)#1-Eu(1)-Zn(1)	117.901(8)	O(11)-Eu(1)-O(1W)	145.54(8)
O(2W)#1-Zn(1)-O(2)	102.75(9)	O(1)-Eu(1)-O(1W)	71.82(9)
O(2W)#1-Zn(1)-O(5)#3	107.00(9)	O(2W)-Eu(1)-O(1W)	136.56(8)
O(2)-Zn(1)-O(5)#3	112.80(10)	O(10)#1-Eu(1)-O(1W)	69.81(8)
O(2W)#1-Zn(1)-N(3)#4	132.85(10)	O(2W)#1-Eu(1)-O(1W)	117.24(8)
O(2)-Zn(1)-N(3)#4	100.65(11)	O(6)#2-Eu(1)-O(1W)	69.23(8)
O(5)#3-Zn(1)-N(3)#4	100.60(10)	O(11)-Eu(1)-O(7)	83.24(8)

Complex **2**

Eu(1)-O(14)	2.293(3)	Eu(1)-O(7)	2.421(3)
Eu(1)-O(10)#1	2.303(3)	Eu(1)-O(8)	2.809(3)

Eu(1)-O(8)#2	2.334(3)	Eu(1)-Eu(1)#2	4.1933(5)
Eu(1)-O(3)#3	2.380(2)	Zn(1)-O(4)#3	1.962(3)
Eu(1)-O(1)	2.399(2)	Zn(1)-N(3)#7	2.040(3)
Eu(1)-O(1W)	2.399(2)		
O(14)-Eu(1)-O(10)#1	91.86(12)	O(1)-Eu(1)-O(1W)	69.96(9)
O(14)-Eu(1)-O(8)#2	165.15(9)	O(14)-Eu(1)-O(7)	74.70(10)
O(10)#1-Eu(1)-O(8)#2	95.21(11)	O(10)#1-Eu(1)-O(7)	73.29(11)
O(14)-Eu(1)-O(3)#3	80.52(11)	O(8)#2-Eu(1)-O(7)	119.87(9)
O(10)#1-Eu(1)-O(3)#3	74.87(10)	O(3)#3-Eu(1)-O(7)	138.53(9)
O(8)#2-Eu(1)-O(3)#3	88.73(10)	O(1)-Eu(1)-O(7)	135.47(10)
O(14)-Eu(1)-O(1)	82.91(10)	O(1W)-Eu(1)-O(7)	72.61(10)
O(10)#1-Eu(1)-O(1)	146.45(9)	O(14)-Eu(1)-O(8)	123.13(9)
O(8)#2-Eu(1)-O(1)	83.99(9)	O(10)#1-Eu(1)-O(8)	80.29(9)
O(3)#3-Eu(1)-O(1)	71.58(8)	O(8)#2-Eu(1)-O(8)	71.08(9)
O(14)-Eu(1)-O(1W)	91.40(11)	O(3)#3-Eu(1)-O(8)	146.31(9)
O(10)#1-Eu(1)-O(1W)	143.51(10)	O(1)-Eu(1)-O(8)	129.87(8)
O(8)#2-Eu(1)-O(1W)	90.66(10)	O(1W)-Eu(1)-O(8)	67.68(8)
O(3)#3-Eu(1)-O(1W)	141.38(9)	O(7)-Eu(1)-O(8)	48.95(8)
O(2)-Zn(1)-O(4)#3	116.33(12)	O(2)-Zn(1)-N(3)#7	98.33(11)
O(2)-Zn(1)-O(13)	130.71(12)	O(4)#3-Zn(1)-N(3)#7	113.96(11)
O(4)#3-Zn(1)-O(13)	100.47(11)	O(13)-Zn(1)-N(3)#7	95.03(12)

Complex **3**

Tb(1)-O(8)#4	2.265(2)	Tb(1)-O(9)#1	2.860(2)
Tb(1)-O(12)#5	2.272(2)	Tb(1)-C(15)#1	2.996(3)
Tb(1)-O(3)#5	2.356(2)	Zn(1)-O(4)#5	1.965(2)
Tb(1)-O(10)#1	2.397(2)	Zn(1)-O(7)#4	1.966(2)
O(8)#4-Tb(1)-O(12)#5	91.87(11)	O(8)#4-Tb(1)-O(9)#1	122.81(8)
O(8)#4-Tb(1)-O(9)	165.74(9)	O(12)#5-Tb(1)-O(9)#1	80.91(9)
O(12)#5-Tb(1)-O(9)	95.12(10)	O(9)-Tb(1)-O(9)#1	70.71(8)
O(8)#4-Tb(1)-O(3)#5	81.19(9)	O(3)#5-Tb(1)-O(9)#1	146.48(8)
O(12)#5-Tb(1)-O(3)#5	74.80(9)	O(1W)-Tb(1)-O(9)#1	67.03(8)
O(9)-Tb(1)-O(3)#5	88.65(9)	O(1)-Tb(1)-O(9)#1	128.91(7)
O(8)#4-Tb(1)-O(1W)	90.85(10)	O(10)#1-Tb(1)-O(9)#1	48.39(7)
O(12)#5-Tb(1)-O(1W)	143.23(9)	O(8)#4-Tb(1)-C(15)#1	98.29(9)
O(9)-Tb(1)-O(1W)	90.96(9)	O(12)#5-Tb(1)-C(15)#	75.24(9)
O(3)#5-Tb(1)-O(1W)	141.71(9)	O(9)-Tb(1)-C(15)#1	95.51(8)
O(8)#4-Tb(1)-O(1)	83.69(9)	O(3)#5-Tb(1)-C(15)#1	150.00(9)
O(12)#5-Tb(1)-O(1)	146.52(9)	O(1W)-Tb(1)-C(15)#1	68.08(9)
O(9)-Tb(1)-O(1)	83.62(8)	O(1)-Tb(1)-C(15)#1	138.23(8)
O(3)#5-Tb(1)-O(1)	71.73(8)	O(10)#1-Tb(1)-C(15)#	23.43(8)
O(1W)-Tb(1)-O(1)	70.18(8)	O(9)#1-Tb(1)-C(15)#1	24.96(8)
O(8)#4-Tb(1)-O(10)#1	75.14(9)	O(2)-Zn(1)-O(4)#5	116.58(10)
O(12)#5-Tb(1)-O(10)#	72.89(10)	O(2)-Zn(1)-O(7)#4	130.34(11)
O(9)-Tb(1)-O(10)#1	118.83(8)	O(4)#5-Zn(1)-O(7)#4	100.37(11)

O(3)#5-Tb(1)-O(10)#1	138.85(8)	O(2)-Zn(1)-N(2)	98.61(11)
O(1W)-Tb(1)-O(10)#1	72.45(9)	O(4)#5-Zn(1)-N(2)	113.77(11)
O(1)-Tb(1)-O(10)#1	136.39(8)	O(7)#4-Zn(1)-N(2)	95.15(11)

Complex **4**

Eu(1)-O(13)	2.279(4)	Eu(1)-O(16)	2.483(4)
Eu(1)-O(8)	2.339(4)	Eu(1)-O(17)	2.490(3)
Eu(1)-O(18)	2.380(4)	Zn(1)-O(3)#2	1.942(4)
Eu(1)-O(4)#2	2.384(4)	Zn(1)-N(4)#6	2.047(4)
Eu(1)-O(9)#3	2.386(4)	Zn(2)-O(10)#3	1.929(4)
Eu(1)-O(1)	2.413(4)	Zn(2)-N(5)#7	2.021(4)
O(13)-Eu(1)-O(8)	156.95(13)	O(4)#2-Eu(1)-O(16)	125.82(15)
O(13)-Eu(1)-O(18)	103.70(14)	O(9)#3-Eu(1)-O(16)	75.16(13)
O(8)-Eu(1)-O(18)	78.70(14)	O(1)-Eu(1)-O(16)	145.50(13)
O(13)-Eu(1)-O(4)#2	73.55(14)	O(13)-Eu(1)-O(17)	124.59(13)
O(8)-Eu(1)-O(4)#2	85.87(14)	O(8)-Eu(1)-O(17)	78.43(13)
O(18)-Eu(1)-O(4)#2	71.52(13)	O(18)-Eu(1)-O(17)	77.21(13)
O(13)-Eu(1)-O(9)#3	79.52(14)	O(4)#2-Eu(1)-O(17)	147.19(13)
O(8)-Eu(1)-O(9)#3	110.42(13)	O(9)#3-Eu(1)-O(17)	76.02(13)
O(18)-Eu(1)-O(9)#3	149.10(13)	O(1)-Eu(1)-O(17)	130.92(14)
O(4)#2-Eu(1)-O(9)#3	136.76(12)	O(16)-Eu(1)-O(17)	52.90(13)
O(13)-Eu(1)-O(1)	86.54(14)	O(13)-Eu(1)-C(22)	98.27(15)
O(8)-Eu(1)-O(1)	76.93(13)	O(8)-Eu(1)-C(22)	104.60(15)
O(18)-Eu(1)-O(1)	136.52(13)	O(18)-Eu(1)-C(22)	77.88(14)
O(4)#2-Eu(1)-O(1)	71.31(13)	O(4)#2-Eu(1)-C(22)	145.01(16)
O(9)#3-Eu(1)-O(1)	73.92(12)	O(9)#3-Eu(1)-C(22)	71.26(14)
O(13)-Eu(1)-O(16)	73.09(13)	O(1)-Eu(1)-C(22)	143.25(14)
O(8)-Eu(1)-O(16)	128.92(13)	O(16)-Eu(1)-C(22)	26.52(15)
O(18)-Eu(1)-O(16)	76.49(14)	O(17)-Eu(1)-C(22)	26.62(15)
O(3)#2-Zn(1)-O(19)	123.52(19)	O(2)-Zn(2)-O(10)#3	136.0(2)
O(3)#2-Zn(1)-O(7)	116.58(18)	O(2)-Zn(2)-O(14)	107.69(19)
O(19)-Zn(1)-O(7)	109.39(17)	O(10)#3-Zn(2)-O(14)	102.5(2)
O(3)#2-Zn(1)-N(4)#6	94.34(17)	O(2)-Zn(2)-N(5)#7	106.10(18)
O(19)-Zn(1)-N(4)#6	102.42(17)	O(10)#3-Zn(2)-N(5)#7	99.75(18)
O(7)-Zn(1)-N(4)#6	106.64(17)	O(14)-Zn(2)-N(5)#7	99.01(18)

Complex **5**

Eu(1)-O(2)#1	2.298(5)	Eu(1)-O(1W)	2.492(5)
Eu(1)-O(7)	2.356(4)	Eu(1)-O(4)#3	2.527(4)
Eu(1)-O(13)	2.358(4)	Eu(1)-Eu(1)#1	4.4734(6)
Eu(1)-O(14)#1	2.392(4)	Zn(1)-O(10)#8	1.929(5)
Eu(1)-O(9)#2	2.400(4)	Zn(1)-O(8)#5	1.939(4)
Eu(1)-O(1)	2.408(4)	Zn(1)-N(3)#9	2.036(5)
O(2)#1-Eu(1)-O(7)	145.79(16)	O(2)#1-Eu(1)-O(1W)	137.3(2)
O(2)#1-Eu(1)-O(13)	77.69(18)	O(7)-Eu(1)-O(1W)	73.15(18)

O(7)-Eu(1)-O(13)	82.05(16)	O(13)-Eu(1)-O(1W)	140.66(19)
O(2)#1-Eu(1)-O(14)#1	72.96(17)	O(14)#1-Eu(1)-O(1W)	69.28(18)
O(7)-Eu(1)-O(14)#1	141.08(15)	O(9)#2-Eu(1)-O(1W)	72.40(19)
O(13)-Eu(1)-O(14)#1	122.44(15)	O(1)-Eu(1)-O(1W)	71.82(19)
O(2)#1-Eu(1)-O(9)#2	85.32(18)	O(2)#1-Eu(1)-O(4)#3	76.04(15)
O(7)-Eu(1)-O(9)#2	93.21(15)	O(7)-Eu(1)-O(4)#3	71.30(14)
O(13)-Eu(1)-O(9)#2	140.28(16)	O(13)-Eu(1)-O(4)#3	70.47(15)
O(14)#1-Eu(1)-O(9)#2	85.04(16)	O(14)#1-Eu(1)-O(4)#3	141.84(15)
O(2)#1-Eu(1)-O(1)	120.41(17)	O(9)#2-Eu(1)-O(4)#3	70.68(16)
O(7)-Eu(1)-O(1)	78.86(15)	O(1)-Eu(1)-O(4)#3	135.80(16)
O(13)-Eu(1)-O(1)	73.78(16)	O(1W)-Eu(1)-O(4)#3	126.16(17)
O(14)#1-Eu(1)-O(1)	80.18(16)	O(2)#1-Eu(1)-Eu(1)#1	52.35(13)
O(9)#2-Eu(1)-O(1)	144.14(17)	O(10)#8-Zn(1)-O(8)#5	131.9(2)
O(10)#8-Zn(1)-N(3)#9	103.4(2)	O(10)#8-Zn(1)-O(3)	103.4(2)
O(8)#5-Zn(1)-N(3)#9	93.22(18)	O(8)#5-Zn(1)-O(3)	115.4(2)
O(3)-Zn(1)-N(3)#9	105.3(2)		

Complex **6**

Tb(1)-O(14)#3	2.290(9)	Tb(1)-O(13)#6	2.300(10)
Tb(1)-O(2)#1	2.295(10)	Zn(2)-O(4)#2	1.905(11)
Tb(1)-O(10)#5	2.298(9)	Zn(2)-O(9)#5	1.955(9)
O(1)-Tb(1)-O(8)	75.4(5)	O(10)#5-Tb(1)-O(13)#6	76.0(4)
O(1)-Tb(1)-O(14)#3	74.8(4)	O(1)-Tb(1)-O(1W)	135.1(5)
O(8)-Tb(1)-O(14)#3	100.7(4)	O(8)-Tb(1)-O(1W)	78.4(6)
O(1)-Tb(1)-O(2)#1	125.8(5)	O(14)#3-Tb(1)-O(1W)	75.2(4)
O(8)-Tb(1)-O(2)#1	157.7(5)	O(2)#1-Tb(1)-O(1W)	80.6(5)
O(14)#3-Tb(1)-O(2)#1	80.8(4)	O(10)#5-Tb(1)-O(1W)	77.5(4)
O(1)-Tb(1)-O(10)#5	134.6(4)	O(13)#6-Tb(1)-O(1W)	149.6(5)
O(8)-Tb(1)-O(10)#5	85.3(4)	O(4)#2-Zn(2)-O(9)#5	98.0(5)
O(14)#3-Tb(1)-O(10)#5	150.1(4)	O(4)#2-Zn(2)-O(7)	111.0(5)
O(2)#1-Tb(1)-O(10)#5	83.0(4)	O(9)#5-Zn(2)-O(7)	128.8(5)
O(1)-Tb(1)-O(13)#6	75.1(4)	O(4)#2-Zn(2)-N(3)	121.2(5)
O(8)-Tb(1)-O(13)#6	113.7(5)	O(9)#5-Zn(2)-N(3)	96.2(4)
O(14)#3-Tb(1)-O(13)#6	125.8(4)	O(7)-Zn(2)-N(3)	102.9(4)
O(2)#1-Tb(1)-O(13)#6	81.7(4)		

[a]Symmetry transformations used to generate equivalentatoms : #1 –x + 1, -y + 1, -z, #2 –x + 1, -y + 2, -z, #3 x, y - 1, z, #4 –x + 2, -y + 1, -z, #5 x, y + 1, z, #6 –x + 1, y, -z - 1/2 for compound **1**; #1 x, -y - 1/2, z + 1/2, #2 –x + 1, -y, -z, #3 –x + 1, y - 1/2, -z + 1/2, #4 –x + 2, y - 1/2, -z + 1/2, #5 –x + 1, y + 1/2, -z + 1/2, #6 x, -y - 1/2, z - 1/2, #7 –x + 2, y + 1/2, -z + 1/2 compound **2**; #1 –x + 1, -y, -z, #2 –x + 1, y + 1/2, -z + 1/2, #3 –x + 2, y + 1/2, -z + 1/2, #4 –x + 2, y - 1/2, -z + 1/2, #5 –x + 1, y - 1/2, -z + 1/2 for compound **3**; #1 –x + 2, y, -z + 1/2, #2 –x + 3/2, -y + 1/2, -z, #3 –x + 1, y, -z + 1/2, #4 x, -y + 1, z + 1/2, #5 –x + 3/2, y + 1/2, -z + 1/2, #6 x, -y + 1, z - 1/2, #7 –x + 3/2, y - 1/2, -z + 1/2 for compound **4**; #1 –x + 1, -y, -z + 1, #2 –x + 1/2, y - 1/2, -z + 1/2, #3 x - 1, y, z, #4 x - 1/2, -y + 1/2, z + 1/2, 5 x + 1, y, z, #6 –x + 1/2, y + 1/2, -z + 1/2, #7 –x + 3/2, y + 1/2, -z + 1/2, #8 –x + 3/2, y - 1/2, -z + 1/2, #9 x + 1/2, -y + 1/2, z - 1/2 for compound **5** ; #1 –x + 2, -y + 2, -z + 2, #2 –x + 1, -y + 2, -z + 2, #3 –x + 3/2, y - 1/2, -z + 3/2, #4 x - 1/2, -y + 5/2, z - 1/2, #5 –x + 3/2, y + 1/2, -z + 3/2, #6 x + 1/2, -y + 5/2, z + 1/2.

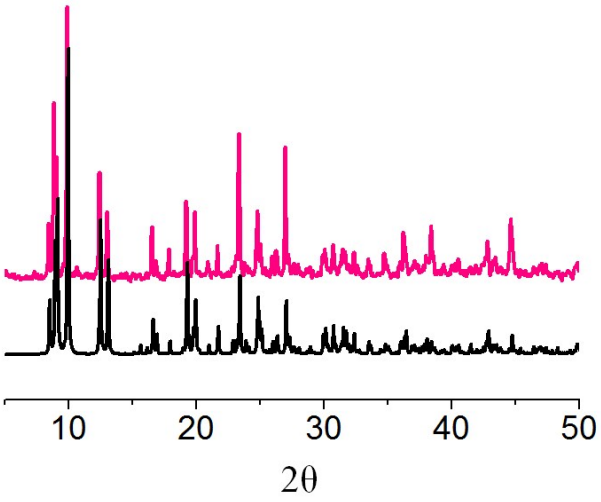

Figure S1. The simulated X-ray powder diffraction patterns (lower) and the measured one (upper) of compound **1**.

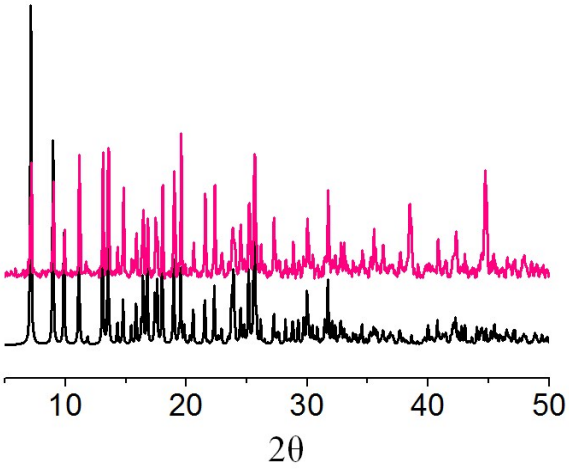

Figure S2. The simulated X-ray powder diffraction patterns (lower) and the measured one (upper) of compound **2**.

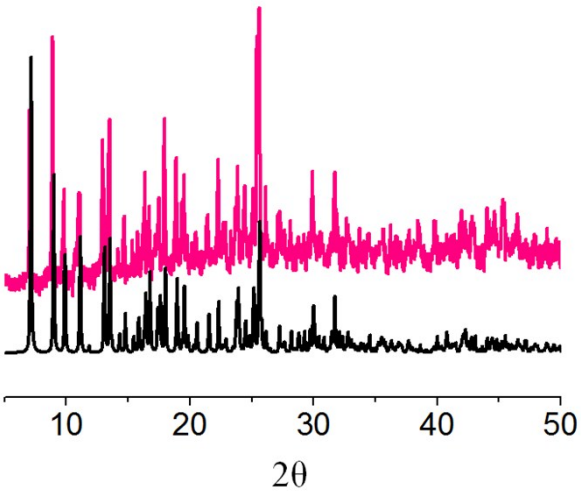

Figure S3. The simulated X-ray powder diffraction patterns (lower) and the measured one (upper) of compound **3**.

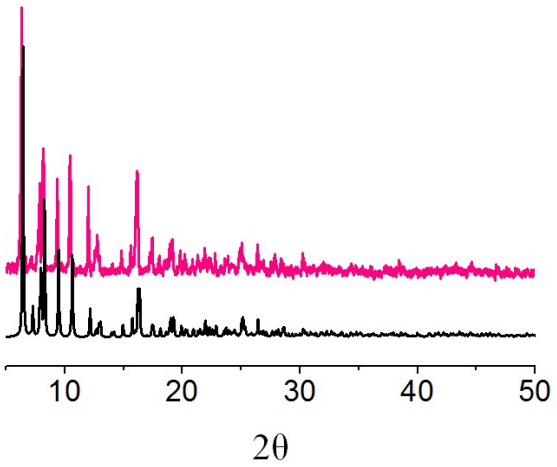

Figure S4. The simulated X-ray powder diffraction patterns (lower) and the measured one (upper) of compound **4**.

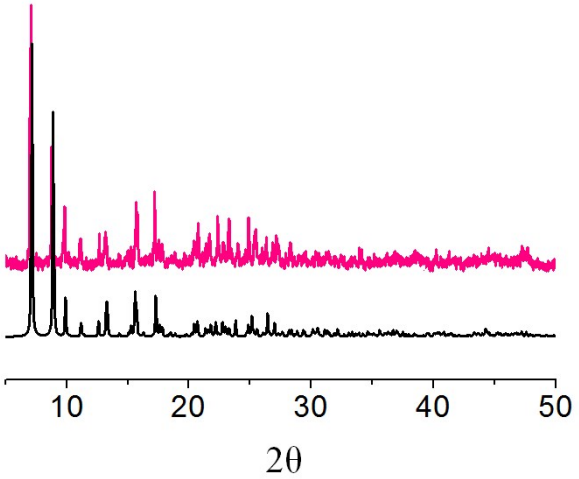

Figure S5. The simulated X-ray powder diffraction patterns (lower) and the measured one (upper) of compound **5**.

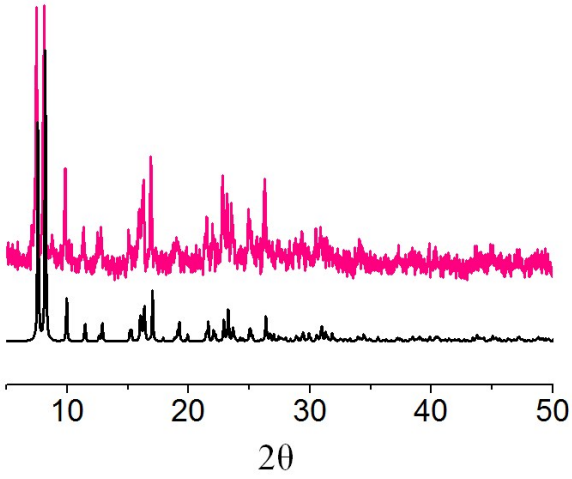

Figure S6. The simulated X-ray powder diffraction patterns (lower) and the measured one (upper) of compound **6**.

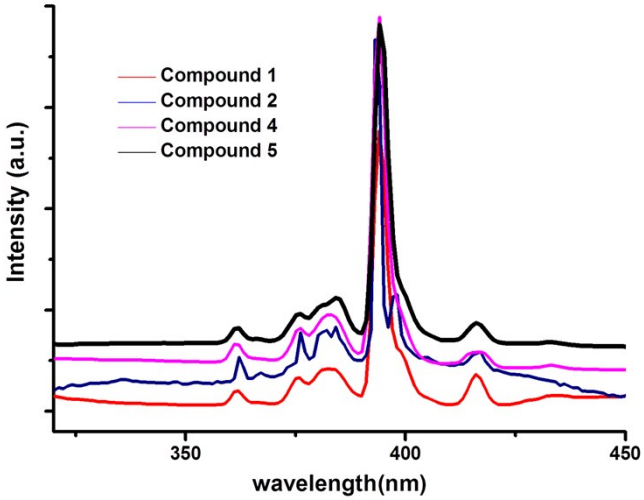

Figure S7. The solid-state excitation spectra for compounds **1**, **2**, **4**, and **5** at room temperature.

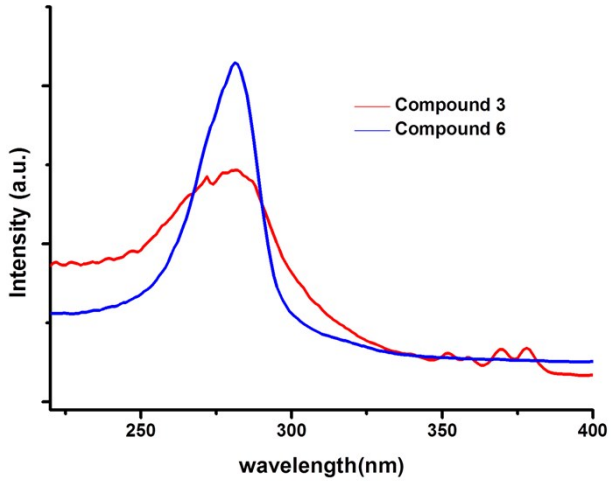

Figure S8. The solid-state excitation spectra for compounds **3** and **6** at room temperature.

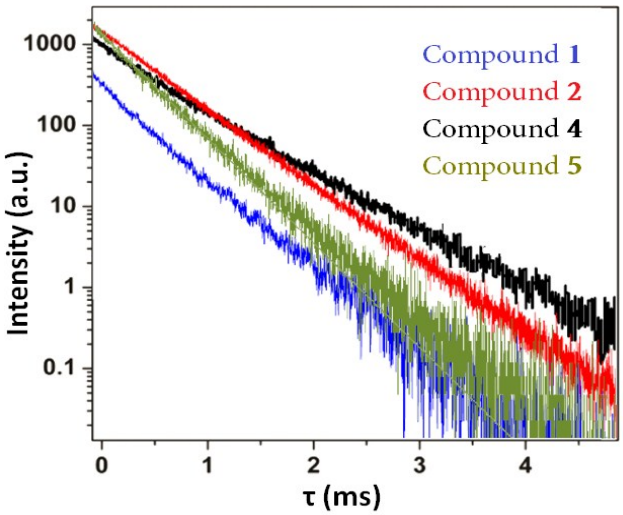

Figure S9. The luminescence decay curves of compounds **1**, **2**, **4** and **5** by monitoring $^5D_0 \rightarrow {}^7F_2$ transition of Eu(III) under the excitation of 395 nm.