Electronic Supporting Information

A Series of 3d-4f Heterometallic Three-Dimensional Coordination Polymers: Syntheses, Structures and Magnetic Properties

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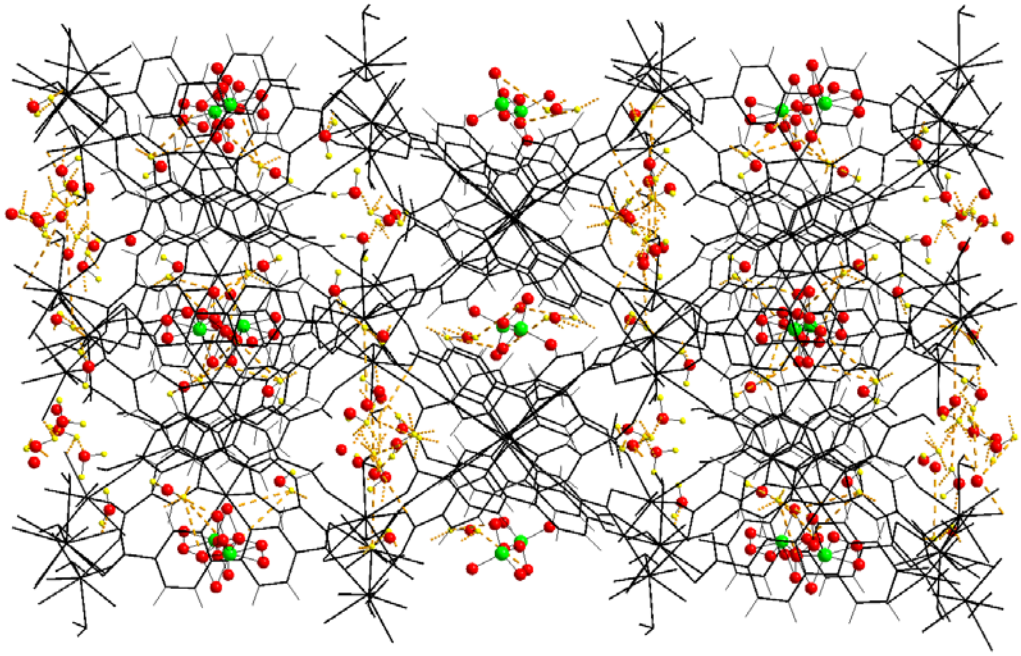

Figure S1 The 3D framework of compound **3** with ClO_4^- anion and lattice water molecules in it, Color codes: green, Cl, red, O, yellow, H, black, the framework.

There are H-bonds between the guest anion or water molecules and the framework, including coordinated water molecules – lattice water molecules, lattice water molecules –ClO_4^- anion, lattice water molecules – lattice water molecules, lattice water molecules –hydrogen on the phenyl, ClO_4^- anion –hydrogen on the phenyl.

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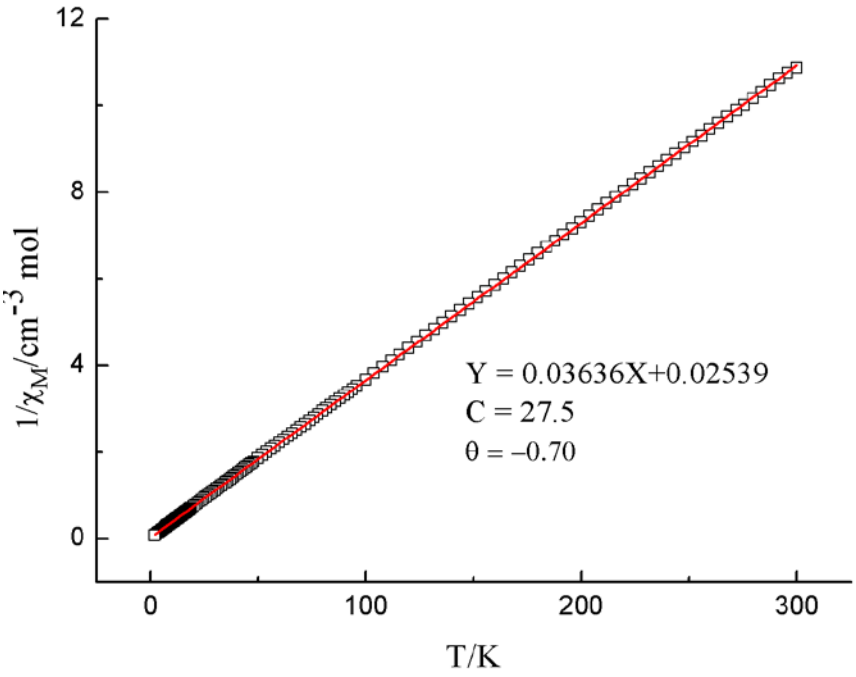

Figure S2. The plots of $1/\chi_M$ versus T for compound **2** (Gd) and the linear fit of Curie-Weiss law at 1000 Oe field.

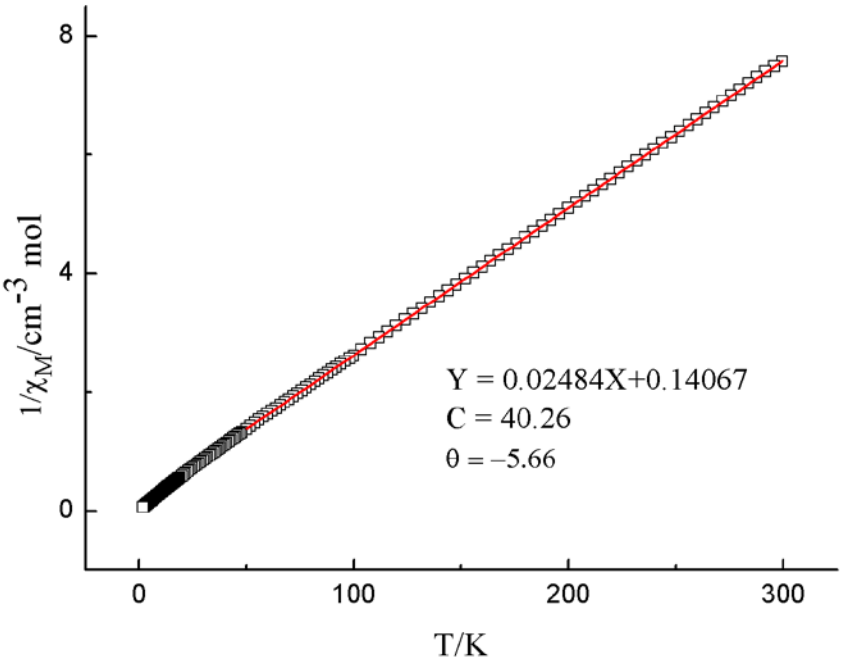

Figure S3. The plots of $1/\chi_M$ versus T for compound **3** (Tb) and the linear fit of Curie-Weiss law at 1000 Oe field.

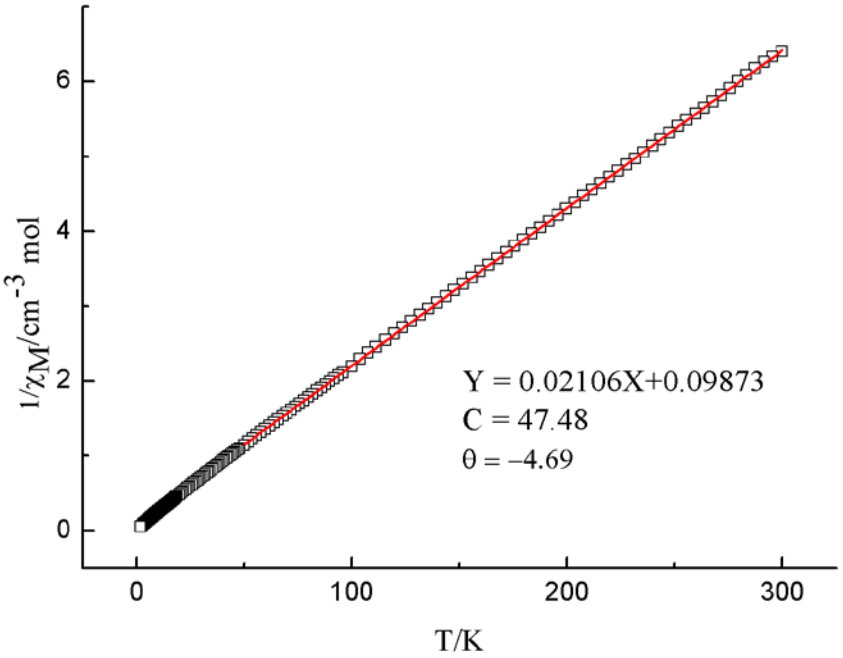

Figure S4. The plots of $1/\chi_M$ versus T for compound **4** (Dy) and the linear fit of Curie-Weiss law at 1000 Oe field.

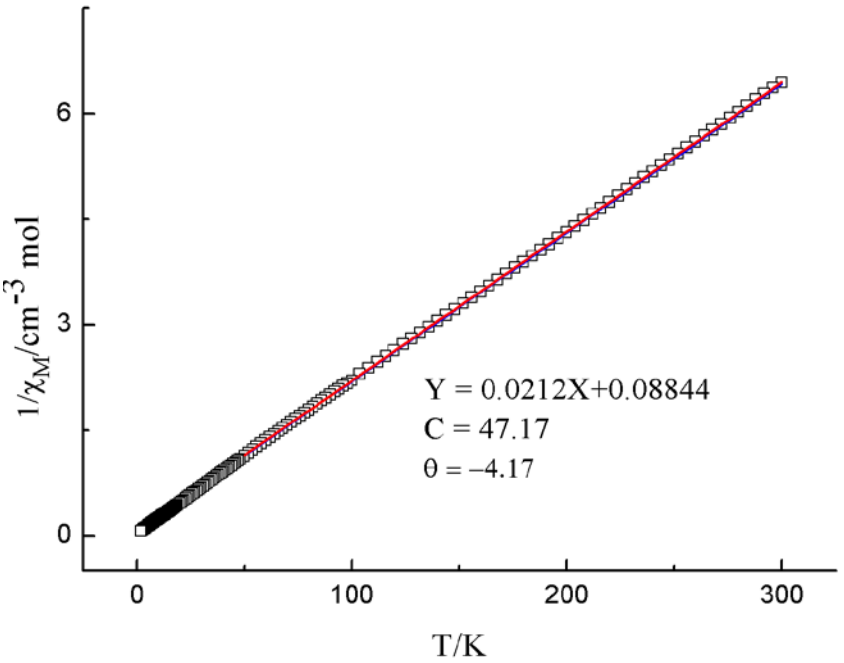

Figure S5. The plots of $1/\chi_M$ versus T for compound **5** (Ho) and the linear fit of Curie-Weiss law at 1000 Oe field.

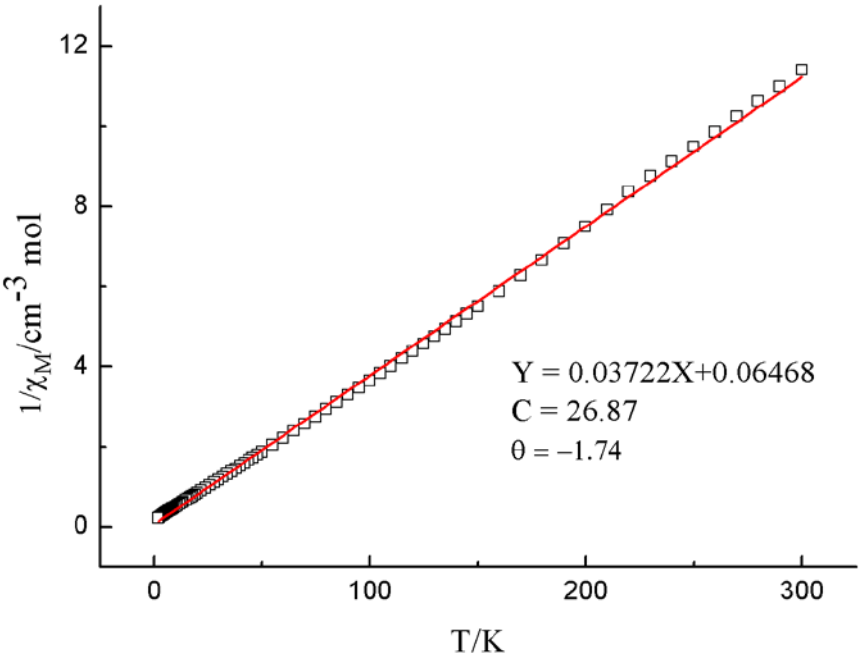

Figure S6. The plots of $1/\chi_M$ versus T for compound **6** (Tm) and the linear fit of Curie-Weiss law at 1000 Oe field.

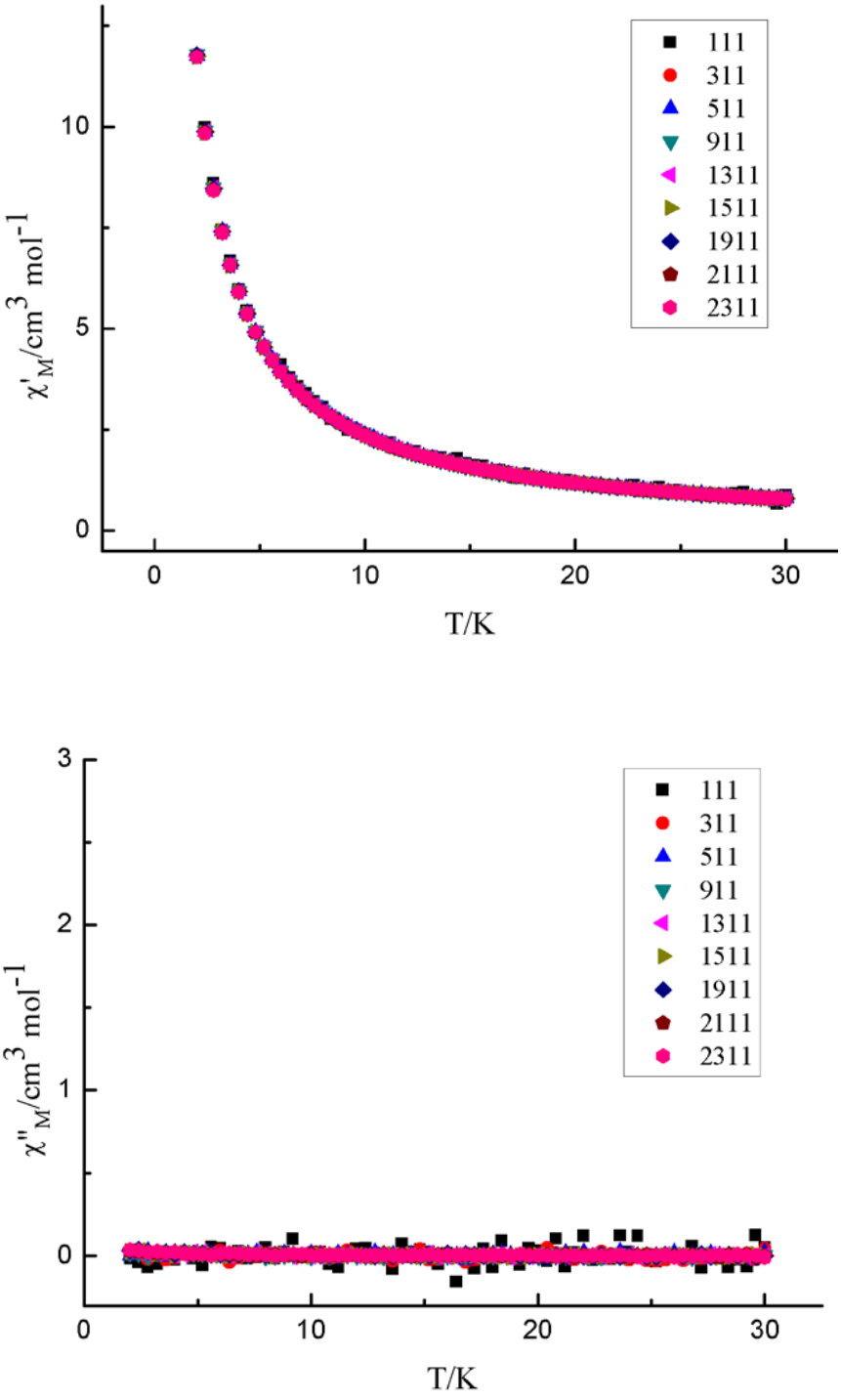

Figure S7. Temperature dependence of the in-phase (χ') and out-of-phase (χ'') AC susceptibilities for **2(Gd)** at the indicated frequencies.

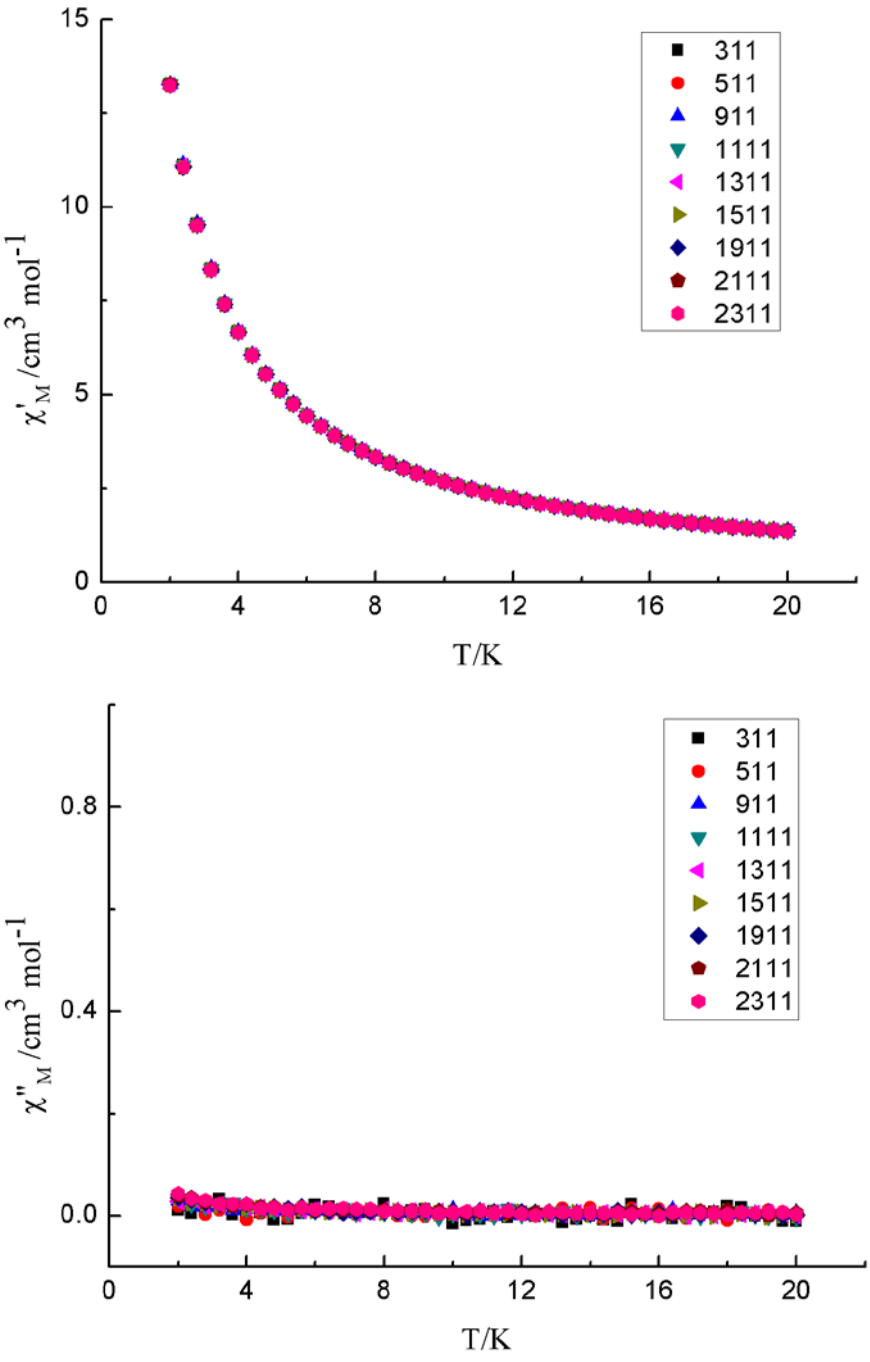

Figure S8. Temperature dependence of the in-phase (χ') and out-of-phase (χ'') AC susceptibilities for **3** (Tb) at the indicated frequencies.

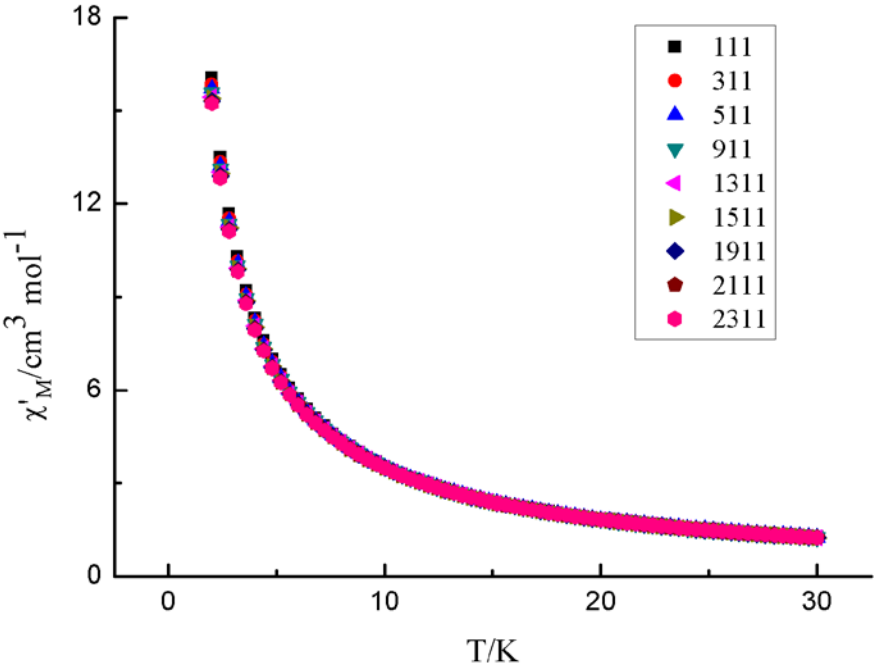

Figure S9 Temperature dependence of the in-phase (χ') AC susceptibilities for **4** (Dy) at the indicated frequencies.

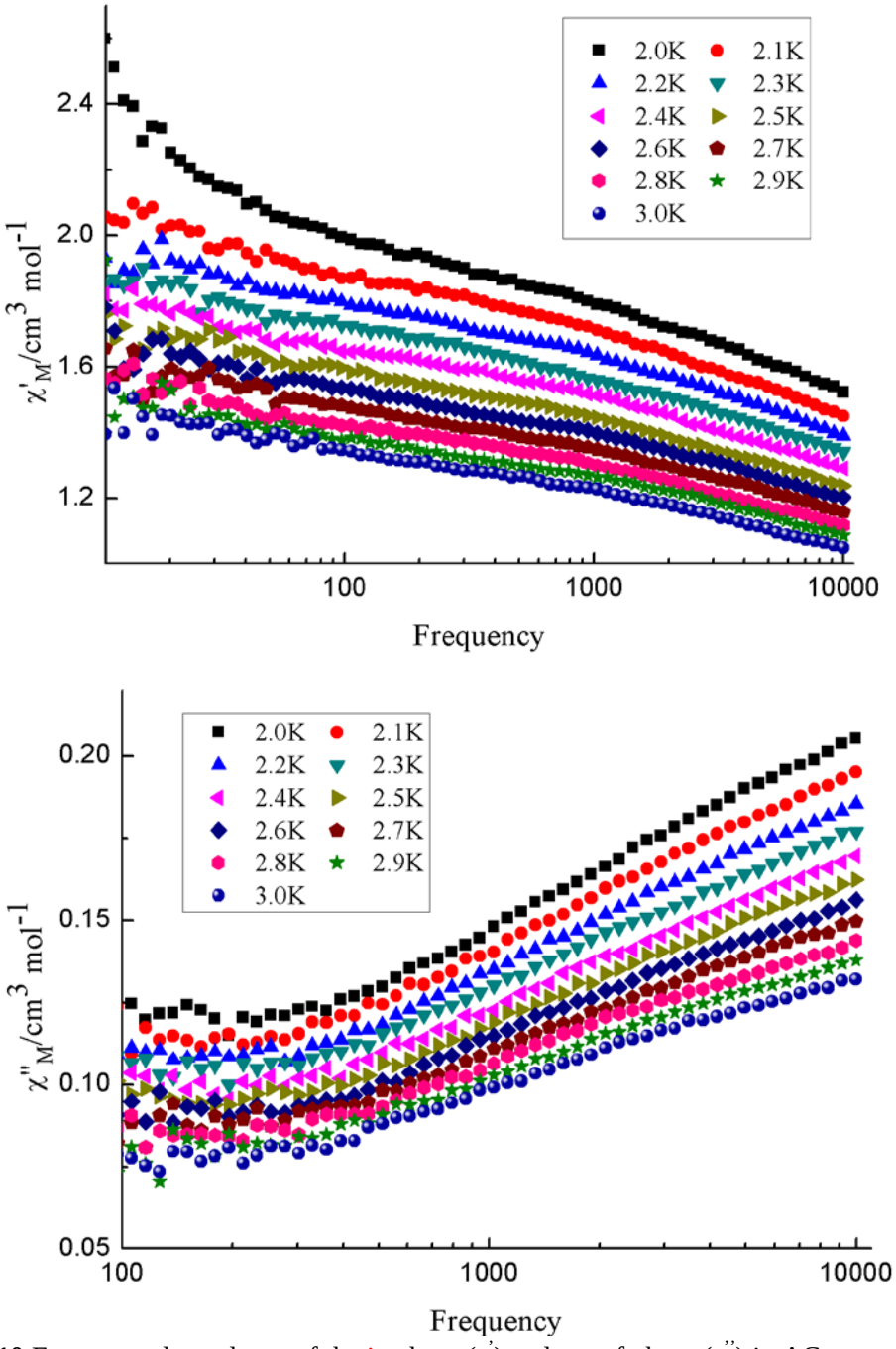

Figure S10 Frequency dependence of the in phase (χ') and out of phase (χ'') in AC susceptibilities of **4** under H_{DC} = 0.

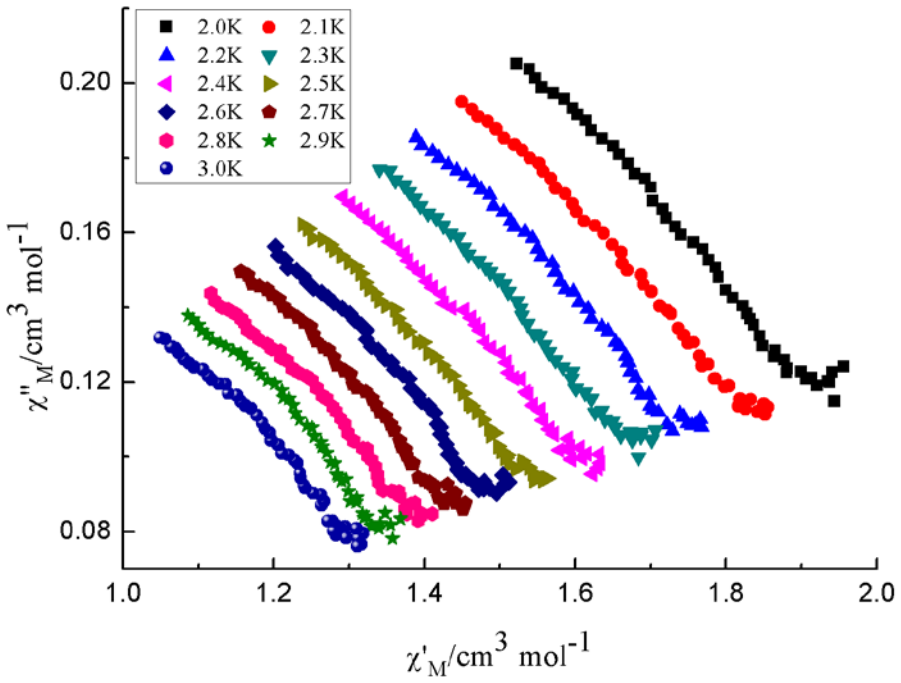

Figure S11. The cole-cole plots at different temperature for **4** under H_{DC} = 0.

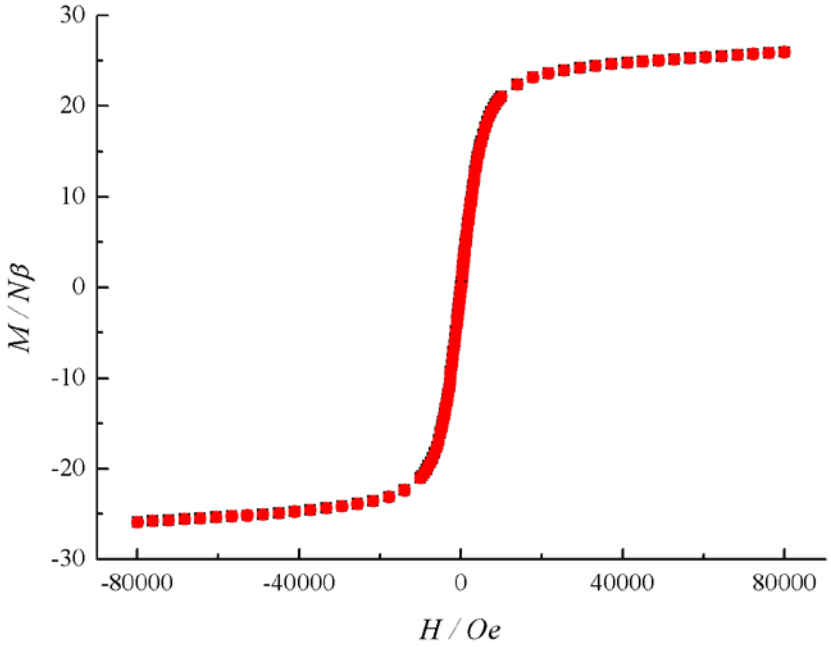

Figure S12. The M-H plot of in compound **4,** displaying no magentic hysteresis loops.

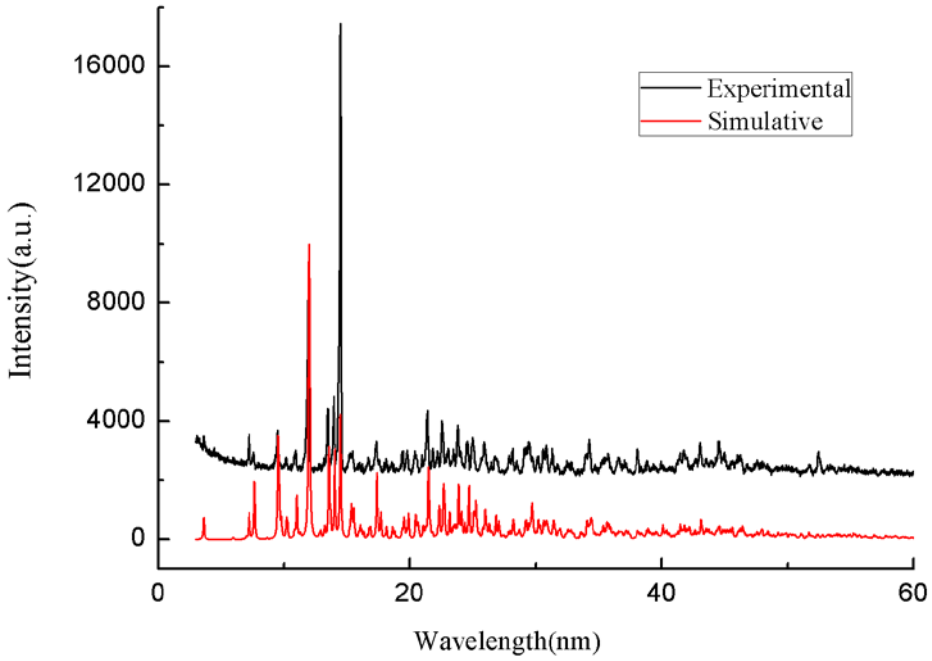

Figure S13. The simulative and experiment PXRD spectra of compound **4**.

Table S1. Selected Bond Lengths (Å) and Angles (deg) for **1 – 7**.

1					
Eu(1)-O(23)	2.318(7)	O(23)-Eu(1)-O(18)	99.3(2)	O(18)-Eu(1)-O(12)	96.3(2)
Eu(1)-O(18)	2.326(6)	O(23)-Eu(1)-O(12)	145.0(3)	O(18)-Eu(1)-O(10)	147.7(2)
Eu(1)-O(12)	2.332(6)	O(23)-Eu(1)-O(10)	90.6(2)	O(18)-Eu(1)-O(4)	74.6(2)
Eu(1)-O(10)	2.351(6)	O(23)-Eu(1)-O(4)	143.1(2)	O(18)-Eu(1)-O(26)	75.7(2)
Eu(1)-O(4)	2.418(6)	O(23)-Eu(1)-O(26)	72.9(3)	O(18)-Eu(1)-O(25)	142.0(2)
Eu(1)-O(26)	2.464(7)	O(23)-Eu(1)-O(25)	76.9(3)	O(18)-Eu(1)-O(22)	72.3(2)
Eu(1)-O(25)	2.509(8)	O(23)-Eu(1)-O(22)	75.8(2)		
Eu(1)-O(22)	2.511(6)				
Eu(2)-O(21)#1	2.245(7)	O(21)#1-Eu(2)-O(3)#1	112.0(2)	O(3)#1-Eu(2)-O(1)	110.41(19)
Eu(2)-O(3)#1	2.305(5)	O(21)#1-Eu(2)-O(1)	118.9(2)	O(3)#1-Eu(2)-O(20)#2	150.7(2)
Eu(2)-O(1)	2.359(6)	O(21)#1-Eu(2)-O(20)#2	82.5(2)	O(3)#1-Eu(2)-O(27)	80.4(2)
Eu(2)-O(20)#2	2.364(6)	O(21)#1-Eu(2)-O(27)	153.5(2)	O(3)#1-Eu(2)-O(17)#1	81.0(2)
Eu(2)-O(27)	2.428(7)	O(21)#1-Eu(2)-O(17)#1	83.7(2)	O(3)#1-Eu(2)-O(11)#1	77.0(2)
Eu(2)-O(17)#1	2.445(5)	O(21)#1-Eu(2)-O(11)#1	78.6(2)		
Eu(2)-O(11)#1	2.537(6)				
Eu(3)-O(13)	2.411(7)	O(13)-Eu(3)-O(6)	118.8(3)	O(6)-Eu(3)-O(16)#3	138.8(3)
Eu(3)-O(6)	2.422(7)	O(13)-Eu(3)-O(16)#3	79.2(2)	O(6)-Eu(3)-O(29)	77.2(3)
Eu(3)-O(16)#3	2.438(6)	O(13)-Eu(3)-O(29)	73.2(3)	O(6)-Eu(3)-O(30)	67.9(2)
Eu(3)-O(29)	2.472(7)	O(13)-Eu(3)-O(30)	141.2(2)	O(6)-Eu(3)-O(7)	68.7(2)
Eu(3)-O(30)	2.469(5)	O(13)-Eu(3)-O(7)	138.9(3)	O(6)-Eu(3)-O(15)#3	126.7(3)

Eu(3)-O(7)	2.514(6)	O(13)-Eu(3)-O(15)#3	114.5(2)	O(6)-Eu(3)-O(8)	77.4(3)
Eu(3)-O(15)#3	2.531(6)	O(13)-Eu(3)-O(8)	88.7(3)	O(6)-Eu(3)-O(14)	148.0(3)
Eu(3)-O(8)	2.523(7)	O(13)-Eu(3)-O(14)	52.2(2)	O(6)-Eu(3)-O(5)	48.2(3)
Eu(3)-O(14)	2.555(6)	O(13)-Eu(3)-O(5)	71.3(2)		
Eu(3)-O(5)	2.796(7)				
Co(4)-N(8)	2.002(8)	N(8)-Co(4)-N(7)	80.9(3)	N(7)-Co(4)-N(12)#3	96.9(3)
Co(4)-N(7)	2.008(8)	N(8)-Co(4)-N(12)#3	172.9(3)	N(7)-Co(4)-N(11)#3	97.0(3)
Co(4)-N(12)#3	2.032(7)	N(8)-Co(4)-N(11)#3	93.5(3)	N(7)-Co(4)-N(9)	92.4(3)
Co(4)-N(11)#3	2.039(7)	N(8)-Co(4)-N(9)	95.0(3)	N(7)-Co(4)-N(10)	171.4(3)
Co(4)-N(9)	2.054(6)	N(8)-Co(4)-N(10)	95.8(3)		
Co(4)-N(10)	2.064(7)				
Co(5)-N(3)#1	1.931(7)	N(3)#1-Co(5)-N(2)	91.7(3)	N(2)-Co(5)-N(5)#4	92.2(3)
Co(5)-N(2)	1.959(7)	N(3)#1-Co(5)-N(5)#4	175.0(3)	N(2)-Co(5)-N(6)#4	169.9(3)
Co(5)-N(5)#4	1.959(7)	N(3)#1-Co(5)-N(6)#4	93.0(3)	N(2)-Co(5)-N(4)#1	96.7(3)
Co(5)-N(6)#4	1.956(6)	N(3)#1-Co(5)-N(4)#1	81.9(3)	N(2)-Co(5)-N(1)	81.5(3)
Co(5)-N(4)#1	1.987(7)	N(3)#1-Co(5)-N(1)	97.3(3)		
Co(5)-N(1)	2.031(7)				
2					
Gd(1)-O(15)#1	2.291(6)	O(15)#1-Gd(1)-O(11)#2	96.2(3)	O(11)#2-Gd(1)-O(5)	145.7(3)
Gd(1)-O(11)#2	2.296(6)	O(15)#1-Gd(1)-O(5)	97.7(2)	O(11)#2-Gd(1)-O(8)#3	94.3(3)
Gd(1)-O(5)	2.310(5)	O(15)#1-Gd(1)-O(8)#3	148.8(2)	O(11)#2-Gd(1)-O(1)	141.6(2)
Gd(1)-O(8)#3	2.330(6)	O(15)#1-Gd(1)-O(1)	74.4(2)	O(11)#2-Gd(1)-O(26)	72.3(3)
Gd(1)-O(1)	2.409(6)	O(15)#1-Gd(1)-O(26)	77.6(3)	O(11)#2-Gd(1)-O(10)	75.9(2)
Gd(1)-O(26)	2.465(7)	O(15)#1-Gd(1)-O(10)	74.2(2)	O(11)#2-Gd(1)-O(25)	75.6(3)
Gd(1)-O(10)	2.499(6)	O(15)#1-Gd(1)-O(25)	141.4(2)		
Gd(1)-O(25)	2.501(6)				
Gd(2)-O(9)	2.240(6)	O(9)-Gd(2)-O(2)	111.6(2)	O(2)-Gd(2)-O(4)#4	110.6(2)
Gd(2)-O(2)	2.293(5)	O(9)-Gd(2)-O(4)#4	117.9(2)	O(2)-Gd(2)-O(14)#5	151.5(2)
Gd(2)-O(4)#4	2.334(6)	O(9)-Gd(2)-O(14)#5	83.1(2)	O(2)-Gd(2)-O(27)	78.7(3)
Gd(2)-O(14)#5	2.342(6)	O(9)-Gd(2)-O(27)	155.6(3)	O(2)-Gd(2)-O(16)#1	81.5(2)
Gd(2)-O(27)	2.404(7)	O(9)-Gd(2)-O(16)#1	82.9(2)	O(2)-Gd(2)-O(6)	76.3(2)
Gd(2)-O(16)#1	2.417(6)	O(9)-Gd(2)-O(6)	77.8(2)		
Gd(2)-O(6)	2.532(6)				
Gd(3)-O(23)#6	2.377(8)	O(23)#6-Gd(3)-O(17)#1	138.3(3)	O(17)#1-Gd(3)-O(20)	80.9(3)
Gd(3)-O(17)#1	2.409(6)	O(23)#6-Gd(3)-O(20)	115.7(3)	O(17)#1-Gd(3)-O(29)	76.6(3)
Gd(3)-O(20)	2.421(7)	O(23)#6-Gd(3)-O(29)	66.9(3)	O(17)#1-Gd(3)-O(28)	71.8(2)
Gd(3)-O(29)	2.453(7)	O(23)#6-Gd(3)-O(28)	76.1(3)	O(17)#1-Gd(3)-O(22)	123.7(2)
Gd(3)-O(28)	2.473(7)	O(23)#6-Gd(3)-O(22)	69.6(3)	O(17)#1-Gd(3)-O(21)	142.8(3)
Gd(3)-O(22)	2.505(6)	O(23)#6-Gd(3)-O(21)	79.1(3)	O(17)#1-Gd(3)-O(18)#1	52.8(2)
Gd(3)-O(21)	2.517(7)	O(23)#6-Gd(3)-O(18)#1	129.9(2)	O(17)#1-Gd(3)-O(19)	74.1(3)
Gd(3)-O(18)#1	2.533(6)	O(23)#6-Gd(3)-O(19)	147.7(3)		
Gd(3)-O(19)	2.567(7)				
Co(1)-N(9)	2.034(7)	N(9)-Co(1)-N(5)	93.6(3)	N(5)-Co(1)-N(10)	97.7(3)

Co(1)-N(5)	2.055(7)	N(9)-Co(1)-N(10)	79.6(3)	N(5)-Co(1)-N(6)	79.6(3)
Co(1)-N(10)	2.050(7)	N(9)-Co(1)-N(6)	172.3(3)	N(5)-Co(1)-N(8)	167.5(3)
Co(1)-N(6)	2.057(7)	N(9)-Co(1)-N(8)	94.9(3)	N(5)-Co(1)-N(7)	90.7(3)
Co(1)-N(8)	2.064(6)	N(9)-Co(1)-N(7)	96.8(3)		
Co(1)-N(7)	2.088(6)				
Co(2)-N(12)	1.934(8)	N(12)-Co(2)-N(2)#7	90.9(3)	N(2)#7-Co(2)-N(3)#8	94.0(3)
Co(2)-N(2)#7	1.965(6)	N(12)-Co(2)-N(3)#8	174.2(3)	N(2)#7-Co(2)-N(11)	96.3(3)
Co(2)-N(3)#8	1.973(6)	N(12)-Co(2)-N(11)	81.8(3)	N(2)#7-Co(2)-N(4)#8	171.0(3)
Co(2)-N(11)	1.979(7)	N(12)-Co(2)-N(4)#8	92.4(3)	N(2)#7-Co(2)-N(1)#7	81.4(3)
Co(2)-N(4)#8	1.979(6)	N(12)-Co(2)-N(1)#7	97.6(3)		
Co(2)-N(1)#7	2.020(7)				
3					
Tb(1)-O(5)	2.284(7)	O(5)-Tb(1)-O(12)#1	97.8(3)	O(12)#1-Tb(1)-O(14)	143.7(3)
Tb(1)-O(12)#1	2.288(8)	O(5)-Tb(1)-O(14)	97.9(3)	O(12)#1-Tb(1)-O(15)#2	93.3(3)
Tb(1)-O(14)	2.289(7)	O(5)-Tb(1)-O(15)#2	149.0(3)	O(12)#1-Tb(1)-O(3)	143.3(3)
Tb(1)-O(15)#2	2.307(8)	O(5)-Tb(1)-O(3)	75.1(3)	O(12)#1-Tb(1)-O(27)	72.3(3)
Tb(1)-O(3)	2.373(7)	O(5)-Tb(1)-O(27)	76.8(3)	O(12)#1-Tb(1)-O(10)	75.8(3)
Tb(1)-O(27)	2.449(8)	O(5)-Tb(1)-O(10)	73.5(2)	O(12)#1-Tb(1)-O(26)	74.3(4)
Tb(1)-O(10)	2.477(7)	O(5)-Tb(1)-O(26)	140.4(3)		
Tb(1)-O(26)	2.549(10)				
Tb(2)-O(9)	2.221(7)	O(9)-Tb(2)-O(4)	111.9(3)	O(4)-Tb(2)-O(7)#3	151.8(3)
Tb(2)-O(4)	2.264(6)	O(9)-Tb(2)-O(7)#3	82.5(3)	O(4)-Tb(2)-O(2)#4	111.2(3)
Tb(2)-O(7)#3	2.317(6)	O(9)-Tb(2)-O(2)#4	116.6(3)	O(4)-Tb(2)-O(25)	80.8(3)
Tb(2)-O(2)#4	2.324(7)	O(9)-Tb(2)-O(25)	154.9(3)	O(4)-Tb(2)-O(6)	81.6(2)
Tb(2)-O(25)	2.376(7)	O(9)-Tb(2)-O(6)	83.7(3)	O(4)-Tb(2)-O(13)	76.9(2)
Tb(2)-O(6)	2.406(6)	O(9)-Tb(2)-O(13)	76.5(3)		
Tb(2)-O(13)	2.508(7)				
Tb(3)-O(23)#5	2.359(11)	O(23)#5-Tb(3)-O(17)#6	116.4(3)	O(17)#6-Tb(3)-O(20)	80.4(3)
Tb(3)-O(17)#6	2.368(8)	O(23)#5-Tb(3)-O(20)	138.0(4)	O(17)#6-Tb(3)-O(29)	141.9(3)
Tb(3)-O(20)	2.407(7)	O(23)#5-Tb(3)-O(29)	66.5(4)	O(17)#6-Tb(3)-O(28)	72.8(4)
Tb(3)-O(29)	2.443(9)	O(23)#5-Tb(3)-O(28)	77.0(3)	O(17)#6-Tb(3)-O(22)	137.7(3)
Tb(3)-O(28)	2.454(8)	O(23)#5-Tb(3)-O(22)	68.9(3)	O(17)#6-Tb(3)-O(21)	86.9(3)
Tb(3)-O(22)	2.466(8)	O(23)#5-Tb(3)-O(21)	79.0(4)	O(17)#6-Tb(3)-O(19)	115.3(3)
Tb(3)-O(21)	2.495(9)	O(23)#5-Tb(3)-O(19)	128.3(4)	O(17)#6-Tb(3)-O(18)#6	52.3(3)
Tb(3)-O(19)	2.508(8)	O(23)#5-Tb(3)-O(18)#6	148.7(4)	O(17)#6-Tb(3)-O(24)#5	69.4(3)
Tb(3)-O(18)#6	2.547(8)	O(23)#5-Tb(3)-O(24)#5	47.5(4)		
Tb(3)-O(24)#5	2.776(14)				
Co(1)-N(10)	1.995(9)	N(10)-Co(1)-N(9)	81.0(3)	N(9)-Co(1)-N(5)	97.0(3)
Co(1)-N(9)	2.003(9)	N(10)-Co(1)-N(5)	93.5(3)	N(9)-Co(1)-N(6)	96.7(3)
Co(1)-N(5)	2.016(8)	N(10)-Co(1)-N(6)	173.7(3)	N(9)-Co(1)-N(3)#6	92.2(3)
Co(1)-N(6)	2.022(8)	N(10)-Co(1)-N(3)#6	94.7(3)	N(9)-Co(1)-N(4)#6	172.1(3)
Co(1)-N(3)#6	2.023(7)	N(10)-Co(1)-N(4)#6	96.0(3)		
Co(1)-N(4)#6	2.041(8)				

Co(2)-N(12)#2	1.955(9)	N(12)#2-Co(2)-N(2)#7	92.0(3)	N(2)#7-Co(2)-N(11)#2	96.7(3)
Co(2)-N(2)#7	1.975(8)	N(12)#2-Co(2)-N(11)#2	81.1(3)	N(2)#7-Co(2)-N(8)	93.0(3)
Co(2)-N(11)#2	1.975(8)	N(12)#2-Co(2)-N(8)	174.1(3)	N(2)#7-Co(2)-N(7)	170.0(3)
Co(2)-N(8)	1.986(8)	N(12)#2-Co(2)-N(7)	92.6(3)	N(2)#7-Co(2)-N(1)#7	81.4(3)
Co(2)-N(7)	1.989(8)	N(12)#2-Co(2)-N(1)#7	97.3(4)		
Co(2)-N(1)#7	2.024(8)				
4					
Dy(1)-O(13)	2.256(10)	O(13)-Dy(1)-O(3)#1	99.9(3)	O(3)#1-Dy(1)-O(21)	140.5(3)
Dy(1)-O(3)#1	2.271(9)	O(13)-Dy(1)-O(21)	99.9(4)	O(3)#1-Dy(1)-O(2)	85.9(3)
Dy(1)-O(21)	2.302(10)	O(13)-Dy(1)-O(2)	148.3(3)	O(3)#1-Dy(1)-O(7)	73.1(3)
Dy(1)-O(2)	2.303(10)	O(13)-Dy(1)-O(7)	75.2(3)	O(3)#1-Dy(1)-O(28)	144.5(3)
Dy(1)-O(7)	2.402(9)	O(13)-Dy(1)-O(28)	79.6(4)	O(3)#1-Dy(1)-O(23)	77.0(3)
Dy(1)-O(28)	2.417(10)	O(13)-Dy(1)-O(23)	76.1(3)	O(3)#1-Dy(1)-O(27)	74.3(4)
Dy(1)-O(23)	2.423(10)	O(13)-Dy(1)-O(27)	143.0(4)		
Dy(1)-O(27)	2.632(11)				
Dy(2)-O(12)	2.248(10)	O(12)-Dy(2)-O(19)	142.9(3)	O(19)-Dy(2)-O(9)	124.2(3)
Dy(2)-O(19)	2.395(10)	O(12)-Dy(2)-O(9)	74.6(3)	O(19)-Dy(2)-O(17)#2	74.4(3)
Dy(2)-O(9)	2.412(9)	O(12)-Dy(2)-O(17)#2	133.0(4)	O(19)-Dy(2)-O(25)	70.6(3)
Dy(2)-O(17)#2	2.425(10)	O(12)-Dy(2)-O(25)	75.4(3)	O(19)-Dy(2)-O(26)	79.1(3)
Dy(2)-O(25)	2.434(10)	O(12)-Dy(2)-O(26)	77.5(4)	O(19)-Dy(2)-O(18)#2	93.4(3)
Dy(2)-O(26)	2.452(11)	O(12)-Dy(2)-O(18)#2	89.5(3)	O(19)-Dy(2)-O(20)	52.8(3)
Dy(2)-O(18)#2	2.453(10)	O(12)-Dy(2)-O(20)	147.3(3)	O(19)-Dy(2)-O(10)	141.1(3)
Dy(2)-O(20)	2.525(10)	O(12)-Dy(2)-O(10)	76.0(3)		
Dy(2)-O(10)	2.544(10)				
Dy(3)-O(24)#1	2.213(10)	O(24)#1-Dy(3)-O(8)#1	109.9(4)	O(8)#1-Dy(3)-O(6)#3	113.5(3)
Dy(3)-O(8)#1	2.272(9)	O(24)#1-Dy(3)-O(6)#3	113.4(4)	O(8)#1-Dy(3)-O(15)#4	153.2(3)
Dy(3)-O(6)#3	2.299(9)	O(24)#1-Dy(3)-O(15)#4	83.4(4)	O(8)#1-Dy(3)-O(29)	74.7(3)
Dy(3)-O(15)#4	2.322(10)	O(24)#1-Dy(3)-O(29)	162.4(4)	O(8)#1-Dy(3)-O(14)#1	81.1(3)
Dy(3)-O(29)	2.353(11)	O(24)#1-Dy(3)-O(14)#1	83.5(4)	O(8)#1-Dy(3)-O(4)	74.1(3)
Dy(3)-O(14)#1	2.377(10)	O(24)#1-Dy(3)-O(4)	76.8(3)		
Dy(3)-O(4)	2.569(9)				
Co(4)-N(11)	2.089(13)	N(11)-Co(4)-N(7)	97.7(5)	N(7)-Co(4)-N(12)	94.2(5)
Co(4)-N(7)	2.096(12)	N(11)-Co(4)-N(12)	77.3(5)	N(7)-Co(4)-N(9)#5	91.6(5)
Co(4)-N(12)	2.099(13)	N(11)-Co(4)-N(9)#5	170.1(5)	N(7)-Co(4)-N(10)#5	164.1(5)
Co(4)-N(9)#5	2.108(13)	N(11)-Co(4)-N(10)#5	93.9(5)	N(7)-Co(4)-N(8)	77.4(5)
Co(4)-N(10)#5	2.111(12)	N(11)-Co(4)-N(8)	97.3(5)		
Co(4)-N(8)	2.128(12)				
Co(5)-N(2)#4	1.919(12)	N(2)#4-Co(5)-N(3)#6	89.2(5)	N(3)#6-Co(5)-N(5)	95.3(5)
Co(5)-N(3)#6	1.936(11)	N(2)#4-Co(5)-N(5)	175.2(5)	N(3)#6-Co(5)-N(1)#4	96.5(5)
Co(5)-N(5)	1.943(11)	N(2)#4-Co(5)-N(1)#4	83.1(5)	N(3)#6-Co(5)-N(6)	171.9(5)
Co(5)-N(1)#4	1.944(11)	N(2)#4-Co(5)-N(6)	91.6(5)	N(3)#6-Co(5)-N(4)#6	82.4(5)
Co(5)-N(6)	1.955(11)	N(2)#4-Co(5)-N(4)#6	95.9(5)		
Co(5)-N(4)#6	1.955(11)				

5					
Ho(1)-O(5)	2.231(6)	O(5)-Ho(1)-O(9)	99.9(2)	O(9)-Ho(1)-O(1)	142.7(2)
Ho(1)-O(9)	2.250(5)	O(5)-Ho(1)-O(1)	96.4(2)	O(9)-Ho(1)-O(11)#1	86.6(2)
Ho(1)-O(1)	2.263(6)	O(5)-Ho(1)-O(11)#1	149.2(2)	O(9)-Ho(1)-O(16)#2	73.2(2)
Ho(1)-O(11)#1	2.295(6)	O(5)-Ho(1)-O(16)#2	75.3(2)	O(9)-Ho(1)-O(26)	143.9(2)
Ho(1)-O(16)#2	2.395(6)	O(5)-Ho(1)-O(26)	80.2(2)	O(9)-Ho(1)-O(4)#3	76.9(2)
Ho(1)-O(26)	2.412(6)	O(5)-Ho(1)-O(4)#3	75.7(2)	O(9)-Ho(1)-O(27)	74.3(2)
Ho(1)-O(4)#3	2.432(6)	O(5)-Ho(1)-O(27)	141.3(2)		
Ho(1)-O(27)	2.613(7)				
Ho(2)-O(3)#3	2.201(6)	O(3)#3-Ho(2)-O(15)#2	110.7(2)	O(15)#2-Ho(2)-O(14)#4	112.6(2)
Ho(2)-O(15)#2	2.255(6)	O(3)#3-Ho(2)-O(14)#4	113.9(2)	O(15)#2-Ho(2)-O(7)#3	153.2(2)
Ho(2)-O(14)#4	2.275(5)	O(3)#3-Ho(2)-O(7)#3	83.1(2)	O(15)#2-Ho(2)-O(25)	77.2(2)
Ho(2)-O(7)#3	2.280(6)	O(3)#3-Ho(2)-O(25)	160.0(2)	O(15)#2-Ho(2)-O(6)	80.6(2)
Ho(2)-O(25)	2.324(6)	O(3)#3-Ho(2)-O(6)	84.1(2)	O(15)#2-Ho(2)-O(10)	75.41(19)
Ho(2)-O(6)	2.361(5)	O(3)#3-Ho(2)-O(10)	76.2(2)		
Ho(2)-O(10)	2.542(6)				
Ho(3)-O(18)#2	2.230(7)	O(18)#2-Ho(3)-O(24)#5	142.7(2)	O(24)#5-Ho(3)-O(21)	89.6(2)
Ho(3)-O(24)#5	2.365(6)	O(18)#2-Ho(3)-O(21)	92.5(3)	O(24)#5-Ho(3)-O(19)	124.2(2)
Ho(3)-O(21)	2.406(6)	O(18)#2-Ho(3)-O(19)	75.0(2)	O(24)#5-Ho(3)-O(28)	78.8(2)
Ho(3)-O(19)	2.416(6)	O(18)#2-Ho(3)-O(28)	77.7(3)	O(24)#5-Ho(3)-O(29)	71.0(2)
Ho(3)-O(28)	2.421(6)	O(18)#2-Ho(3)-O(29)	74.3(2)	O(24)#5-Ho(3)-O(22)	75.6(2)
Ho(3)-O(29)	2.423(6)	O(18)#2-Ho(3)-O(22)	132.9(3)	O(24)#5-Ho(3)-O(23)#5	53.0(2)
Ho(3)-O(22)	2.458(6)	O(18)#2-Ho(3)-O(23)#5	146.3(3)	O(24)#5-Ho(3)-O(20)	141.1(2)
Ho(3)-O(23)#5	2.504(6)	O(18)#2-Ho(3)-O(20)	76.2(2)		
Ho(3)-O(20)	2.536(6)				
Co(1)-N(11)#2	2.082(6)	N(11)#2-Co(1)-N(3)	93.8(3)	N(3)-Co(1)-N(1)#6	165.4(2)
Co(1)-N(3)	2.093(6)	N(11)#2-Co(1)-N(1)#6	96.7(2)	N(3)-Co(1)-N(4)	78.3(3)
Co(1)-N(1)#6	2.103(6)	N(11)#2-Co(1)-N(4)	170.5(3)	N(3)-Co(1)-N(12)#2	99.1(2)
Co(1)-N(4)	2.109(6)	N(11)#2-Co(1)-N(12)#2	77.5(3)	N(3)-Co(1)-N(2)#6	90.6(2)
Co(1)-N(12)#2	2.113(6)	N(11)#2-Co(1)-N(2)#6	97.3(3)		
Co(1)-N(2)#6	2.132(6)				
Co(2)-N(5)	1.901(7)	N(5)-Co(2)-N(8)	89.5(3)	N(8)-Co(2)-N(9)	94.5(3)
Co(2)-N(8)	1.941(6)	N(5)-Co(2)-N(9)	175.6(3)	N(8)-Co(2)-N(10)	173.4(3)
Co(2)-N(9)	1.948(6)	N(5)-Co(2)-N(10)	92.4(3)	N(8)-Co(2)-N(6)	94.7(3)
Co(2)-N(10)	1.954(6)	N(5)-Co(2)-N(6)	82.8(3)	N(8)-Co(2)-N(7)	82.8(3)
Co(2)-N(6)	1.958(7)	N(5)-Co(2)-N(7)	96.5(3)		
Co(2)-N(7)	1.973(7)				
6					
Tm(1)-O(13)	2.191(4)	O(13)-Tm(1)-O(6)	101.18(17)	O(6)-Tm(1)-O(8)	86.35(17)
Tm(1)-O(6)	2.217(4)	O(13)-Tm(1)-O(8)	148.57(18)	O(6)-Tm(1)-O(9)	138.42(18)
Tm(1)-O(8)	2.260(4)	O(13)-Tm(1)-O(9)	100.66(18)	O(6)-Tm(1)-O(11)	76.66(16)
Tm(1)-O(9)	2.261(4)	O(13)-Tm(1)-O(11)	76.57(17)	O(6)-Tm(1)-O(25)	145.49(17)
Tm(1)-O(11)	2.370(4)	O(13)-Tm(1)-O(25)	79.24(17)	O(6)-Tm(1)-O(4)	73.91(16)

Tm(1)-O(25)	2.375(5)	O(13)-Tm(1)-O(4)	75.00(17)	O(6)-Tm(1)-O(29)	73.08(16)
Tm(1)-O(4)	2.378(4)	O(13)-Tm(1)-O(29)	142.00(18)		
Tm(1)-O(29)	2.698(5)				
Tm(2)-O(23)	2.205(5)	O(23)-Tm(2)-O(19)#1	142.74(18)	O(19)#1-Tm(2)-O(22)	124.17(17)
Tm(2)-O(19)#1	2.349(5)	O(23)-Tm(2)-O(22)	75.49(17)	O(19)#1-Tm(2)-O(18)	74.74(19)
Tm(2)-O(22)	2.371(4)	O(23)-Tm(2)-O(18)	132.09(19)	O(19)#1-Tm(2)-O(27)	70.06(17)
Tm(2)-O(18)	2.391(5)	O(23)-Tm(2)-O(27)	75.53(18)	O(19)#1-Tm(2)-O(26)	78.68(18)
Tm(2)-O(27)	2.392(5)	O(23)-Tm(2)-O(26)	78.77(18)	O(19)#1-Tm(2)-O(17)	94.51(18)
Tm(2)-O(26)	2.404(5)	O(23)-Tm(2)-O(17)	87.21(17)	O(19)#1-Tm(2)-O(20)#1	53.61(16)
Tm(2)-O(17)	2.424(5)	O(23)-Tm(2)-O(20)#1	147.36(17)	O(19)#1-Tm(2)-O(21)	141.10(17)
Tm(2)-O(20)#1	2.489(5)	O(23)-Tm(2)-O(21)	76.07(17)		
Tm(2)-O(21)	2.530(5)				
Tm(3)-O(12)#2	2.173(5)	O(12)#2-Tm(3)-O(3)#2	108.39(17)	O(3)#2-Tm(3)-O(1)	113.74(17)
Tm(3)-O(3)#2	2.212(4)	O(12)#2-Tm(3)-O(1)	112.59(17)	O(3)#2-Tm(3)-O(15)#3	154.09(19)
Tm(3)-O(1)	2.249(5)	O(12)#2-Tm(3)-O(15)#3	83.87(19)	O(3)#2-Tm(3)-O(28)	76.51(19)
Tm(3)-O(15)#3	2.268(5)	O(12)#2-Tm(3)-O(28)	163.21(19)	O(3)#2-Tm(3)-O(14)#2	80.80(17)
Tm(3)-O(28)	2.315(5)	O(12)#2-Tm(3)-O(14)#2	83.60(18)	O(3)#2-Tm(3)-O(5)#2	73.59(15)
Tm(3)-O(14)#2	2.321(4)	O(12)#2-Tm(3)-O(5)#2	75.15(17)		
Tm(3)-O(5)#2	2.552(4)				
Co(4)-N(9)	2.094(5)	N(9)-Co(4)-N(10)	77.2(2)	N(10)-Co(4)-N(8)#4	94.3(2)
Co(4)-N(10)	2.105(5)	N(9)-Co(4)-N(8)#4	97.4(2)	N(10)-Co(4)-N(5)	98.8(2)
Co(4)-N(8)#4	2.108(5)	N(9)-Co(4)-N(5)	94.7(2)	N(10)-Co(4)-N(6)	99.0(2)
Co(4)-N(5)	2.118(5)	N(9)-Co(4)-N(6)	170.3(2)	N(10)-Co(4)-N(7)#4	169.3(2)
Co(4)-N(6)	2.128(5)	N(9)-Co(4)-N(7)#4	97.4(2)		
Co(4)-N(7)#4	2.148(5)				
Co(5)-N(12)	1.896(5)	N(12)-Co(5)-N(2)	89.5(2)	N(2)-Co(5)-N(11)	95.8(2)
Co(5)-N(2)	1.933(5)	N(12)-Co(5)-N(11)	83.2(2)	N(2)-Co(5)-N(3)#5	172.4(2)
Co(5)-N(11)	1.940(5)	N(12)-Co(5)-N(3)#5	91.8(2)	N(2)-Co(5)-N(4)#5	94.9(2)
Co(5)-N(3)#5	1.949(5)	N(12)-Co(5)-N(4)#5	175.4(2)	N(2)-Co(5)-N(1)	82.7(2)
Co(5)-N(4)#5	1.951(5)	N(12)-Co(5)-N(1)	95.9(2)		
Co(5)-N(1)	1.963(5)				
7					
Lu(1)-O(18)	2.187(6)	O(18)-Lu(1)-O(12)	102.5(2)	O(12)-Lu(1)-O(23)	139.4(2)
Lu(1)-O(12)	2.215(5)	O(18)-Lu(1)-O(23)	96.2(2)	O(12)-Lu(1)-O(10)	84.0(2)
Lu(1)-O(23)	2.256(6)	O(18)-Lu(1)-O(10)	151.4(2)	O(12)-Lu(1)-O(4)	73.8(2)
Lu(1)-O(10)	2.266(6)	O(18)-Lu(1)-O(4)	77.0(2)	O(12)-Lu(1)-O(26)	144.4(2)
Lu(1)-O(4)	2.369(6)	O(18)-Lu(1)-O(26)	80.5(2)	O(12)-Lu(1)-O(22)	76.7(2)
Lu(1)-O(26)	2.392(6)	O(18)-Lu(1)-O(22)	77.4(2)	O(12)-Lu(1)-O(25)	73.5(3)
Lu(1)-O(22)	2.404(6)	O(18)-Lu(1)-O(25)	141.3(2)		
Lu(1)-O(25)	2.750(8)				
Lu(2)-O(21)#1	2.181(7)	O(21)#1-Lu(2)-O(3)#1	109.5(2)	O(3)#1-Lu(2)-O(1)	112.4(2)
Lu(2)-O(3)#1	2.229(5)	O(21)#1-Lu(2)-O(1)	113.2(2)	O(3)#1-Lu(2)-O(20)#2	155.3(2)
Lu(2)-O(1)	2.254(6)	O(21)#1-Lu(2)-O(20)#2	81.6(2)	O(3)#1-Lu(2)-O(27)	78.5(3)

Lu(2)-O(20)#2	2.270(7)	O(21)#1-Lu(2)-O(27)	160.7(3)	O(3)#1-Lu(2)-O(17)#1	81.8(2)
Lu(2)-O(27)	2.285(7)	O(21)#1-Lu(2)-O(17)#1	83.5(2)	O(3)#1-Lu(2)-O(11)#1	73.8(2)
Lu(2)-O(17)#1	2.344(6)	O(21)#1-Lu(2)-O(11)#1	75.5(2)		
Lu(2)-O(11)#1	2.542(6)				
Lu(3)-O(6)	2.244(7)	O(6)-Lu(3)-O(16)#3	143.9(2)	O(16)#3-Lu(3)-O(7)	126.6(2)
Lu(3)-O(16)#3	2.367(6)	O(6)-Lu(3)-O(7)	74.1(3)	O(16)#3-Lu(3)-O(29)	70.6(2)
Lu(3)-O(7)	2.380(6)	O(6)-Lu(3)-O(29)	75.5(2)	O(16)#3-Lu(3)-O(13)	90.7(3)
Lu(3)-O(29)	2.386(6)	O(6)-Lu(3)-O(13)	89.3(2)	O(16)#3-Lu(3)-O(30)	79.7(3)
Lu(3)-O(13)	2.388(7)	O(6)-Lu(3)-O(30)	79.4(3)	O(16)#3-Lu(3)-O(14)	73.0(3)
Lu(3)-O(30)	2.408(7)	O(6)-Lu(3)-O(14)	132.7(3)	O(16)#3-Lu(3)-O(15)	53.9(2)
Lu(3)-O(14)	2.421(6)	O(6)-Lu(3)-O(15)#3	146.9(3)	O(16)#3-Lu(3)-O(8)	140.3(2)
Lu(3)-O(15)#3	2.477(7)	O(6)-Lu(3)-O(8)	75.4(2)		
Lu(3)-O(8)	2.536(7)				
Co(4)-N(8)	2.096(7)	N(8)-Co(4)-N(12)#3	170.4(3)	N(12)#3-Co(4)-N(9)	91.8(3)
Co(4)-N(12)#3	2.112(7)	N(8)-Co(4)-N(9)	97.2(3)	N(12)#3-Co(4)-N(7)	98.0(3)
Co(4)-N(9)	2.115(7)	N(8)-Co(4)-N(7)	78.4(3)	N(12)#3-Co(4)-N(11)#3	77.9(3)
Co(4)-N(7)	2.115(7)	N(8)-Co(4)-N(11)#3	93.8(3)	N(12)#3-Co(4)-N(10)	88.3(3)
Co(4)-N(11)#3	2.125(8)	N(8)-Co(4)-N(10)	96.6(3)		
Co(4)-N(10)	2.150(7)				
Co(5)-N(3)#1	1.923(8)	N(3)#1-Co(5)-N(2)	90.5(3)	N(2)-Co(5)-N(4)#1	95.4(3)
Co(5)-N(2)	1.955(8)	N(3)#1-Co(5)-N(4)#1	83.0(3)	N(2)-Co(5)-N(5)#4	94.1(3)
Co(5)-N(4)#1	1.959(7)	N(3)#1-Co(5)-N(5)#4	175.0(3)	N(2)-Co(5)-N(6)#4	172.0(3)
Co(5)-N(5)#4	1.964(7)	N(3)#1-Co(5)-N(6)#4	91.6(3)	N(2)-Co(5)-N(1)	83.0(3)
Co(5)-N(6)#4	1.976(7)	N(3)#1-Co(5)-N(1)	96.0(3)		
Co(5)-N(1)	1.983(7)				

Symmetry transformations used to generate equivalent atoms for **1**: #1 -x,-y+1,-z+2; #2 x-1/2,-y+3/2,-z+2; #3 -x+1/2,-y+1,z+1/2; #4 x,-y+3/2,z+1/2; for **2**: #1 -x+1/2,-y,z-1/2; #2 -x+1/2,y-1/2,z; #3 -x+1,-y,-z+1; #4 -x+1,-y,-z; #5 x,-y+1/2,z-1/2; #6 -x,y-1/2,-z+1/2; #7 -x+1/2,y+1/2,z; #8 x-1/2,y,-z+1/2; for **3**: #1 -x+1/2,y+1/2,z; #2 -x,-y+1,-z+2; #3 -x+1/2,y-1/2,z; #4 -x,-y+1,-z+1; #5 -x,y-1/2,-z+5/2; #6 -x+1/2,-y+1,z+1/2; #7 -x,y-1/2,-z+3/2; for **4**: #1 -x,-y+1,-z; #2 -x+1/2,-y+1,z-1/2; #3 x,y,z-1; #4 x-1/2,-y+1/2,-z; #5 x,-y+1/2,z+1/2; #6 x,-y+1/2,z-1/2; for **5**: #1 -x,-y+1,-z; #2 -x,y+1/2,-z+1/2; #3 -x+1/2,y-1/2,z; #4 x,-y+1/2,z+1/2; #5 -x-1/2,-y+1,z-1/2; #6 x,-y+3/2,z-1/2 ; for **6**: #1 -x+1/2,-y+1,z+1/2; #2 -x,-y,-z+1; #3 x-1/2,-y+1/2,-z+1; #4 x,-y+1/2,z-1/2; #5 -x,y+1/2,-z+1/2; for **7**: #1 -x,-y+1,-z+2; #2 x-1/2,-y+3/2,-z+2; #3 -x+1/2,-y+1,z+1/2; #4 x,-y+3/2,z+1/2.