## Supporting Information for

Syntheses, structures, color tunable and white–light emitting lanthanide metal–organic framework materials constructed from conjugated 1, 1'-butadiynebenzene-3, 3', 5, 5'tetracarboxylate ligand

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## **Details for 2–7**

 $[Eu_2(BBTC)_{1.5}(DMF)_4] \cdot 2DMF \cdot 4H_2O$  (2). An identical procedure with 1 was followed to prepare 2 except SmCl<sub>3</sub>·6H<sub>2</sub>O was replaced by EuCl<sub>3</sub>·nH<sub>2</sub>O. Light–yellow block–shaped crystals were achieved (yield: 70% based on Eu). Anal. calcd for C<sub>48</sub>H<sub>59</sub>Eu<sub>2</sub>N<sub>6</sub>O<sub>22</sub>: C, 41.90; H, 4.32; N, 6.11. Found: C, 41.82; H, 4.06; N, 6.21. Selected IR data (KBr pellet, cm<sup>-1</sup>): 3424 (m), 3060 (w), 2930 (w), 1648 (s), 1560 (s), 1426 (s), 1378 (s), 1113 (s), 780 (m), 714 (m).

 $[Gd_2(BBTC)_{1.5}(DMF)_4] \cdot 2DMF \cdot 4H_2O$  (3). An identical procedure with 1 was followed to prepare 3 except SmCl<sub>3</sub>·6H<sub>2</sub>O was replaced by GdCl<sub>3</sub>·6H<sub>2</sub>O. Colorless block–shaped crystals were achieved (yield: 71% based on Gd). Anal. calcd for  $C_{48}H_{59}Gd_2N_6O_{22}$ : C, 41.58; H, 4.29; N, 6.06. Found: C, 41.25; H, 4.19; N, 6.18 Selected IR data (KBr pellet, cm<sup>-1</sup>): 3414 (m), 3062 (w), 2940 (w), 1655 (s), 1550 (s),

1

1418 (s), 1370 (s), 1105 (s), 787 (m), 716 (m).

 $[Tb_2(BBTC)_{1.5}(DMF)_4] \cdot 2DMF \cdot 4H_2O$  (4). An identical procedure with 1 was followed to prepare 4 except SmCl<sub>3</sub>·6H<sub>2</sub>O was replaced by TbCl<sub>3</sub>·nH<sub>2</sub>O. Light–yellow block–shaped crystals were achieved (yield: 65% based on Tb). Anal. calcd for C<sub>48</sub>H<sub>59</sub>Tb<sub>2</sub>N<sub>6</sub>O<sub>22</sub>: C, 41.48; H, 4.28; N, 6.05. Found: C, 41.35; H, 4.15; N, 6.09 Selected IR data (KBr pellet, cm<sup>-1</sup>): 3374 (m), 3054 (w), 2920 (w), 1660 (s), 1550 (s), 1438 (s), 1378 (s), 1101 (s), 787 (m), 717 (m).

 $[Dy_2(BBTC)_{1.5}(DMF)_4] \cdot 2DMF \cdot 4H_2O$  (5). An identical procedure with 1 was followed to prepare 5 except SmCl<sub>3</sub>·6H<sub>2</sub>O was replaced by DyCl<sub>3</sub>·nH<sub>2</sub>O. Colorless block-shaped crystals were achieved (yield: 68% based on Dy). Anal. calcd for  $C_{48}H_{59}Dy_2N_6O_{22}$ : C, 41.27; H, 4.26; N, 6.02. Found: C, 41.05; H, 4.18; N, 6.14. Selected IR data (KBr pellet, cm<sup>-1</sup>): 3344 (m), 3036 (w), 2935 (w), 1650 (s), 1540 (s), 1420 (s), 1371 (s), 1103 (s), 778 (m), 710 (m).

 $[Er_2(BBTC)_{1.5}(DMF)_4] \cdot 2DMF \cdot 4H_2O$  (6). An identical procedure with 1 was followed to prepare 6 except SmCl<sub>3</sub>·6H<sub>2</sub>O was replaced by ErCl<sub>3</sub>·nH<sub>2</sub>O. Light–pink block–shaped crystals were achieved (yield: 73% based on Er). Anal. calcd for C<sub>48</sub>H<sub>59</sub>Er<sub>2</sub>N<sub>6</sub>O<sub>22</sub>: C, 40.99; H, 4.23; N, 5.98. Found: C, 40.64; H, 4.25; N, 6.05 Selected IR data (KBr pellet, cm<sup>-1</sup>): 3390 (m), 3064 (w), 2934 (w), 1670 (s), 1560 (s), 1430 (s), 1368 (s), 1093 (s), 789 (m), 737 (m).

 $[Yb_2(BBTC)_{1.5}(DMF)_4] \cdot 2DMF \cdot 4H_2O$  (7). An identical procedure with 1 was followed to prepare 7 except SmCl<sub>3</sub>·6H<sub>2</sub>O was replaced by YbCl<sub>3</sub>·nH<sub>2</sub>O. Colorless block-shaped crystals were achieved (yield: 74% based on Yb). Anal. calcd for  $C_{48}H_{59}Yb_2N_6O_{22}$ : C, 40.65; H, 4.19; N, 5.93. Found: C, 40.19; H, 4.14; N, 6.03 Selected IR data (KBr pellet, cm<sup>-1</sup>): 3385 (m), 3042 (w), 2956 (w), 1660 (s), 1510 (s), 1460 (s), 1378 (s), 1109 (s), 789 (m), 707 (m).

	Formula	С%	Н%	N%	Main IR Bands
		(Found) <sup>a</sup>	(Found)	(Found)	
1	$C_{48}H_{59}Sm_2N_6O_{22}$	42.00	4.33	6.12	3390 m, 3065 w, 2933 w, 1650 s, 1550 s,
		(41.98)	(4.26)	(6.24)	1430 s, 1378 s, 1103 s, 787 m, 717 m
2	$C_{48}H_{59}Eu_{2}N_{6}O_{22}$	41.90	4.32	6.11	3424 m, 3060 w, 2930 w, 1648 s, 1560 s,
		(41.82)	(4.06)	(6.21)	1426 s, 1378 s, 1113 s, 780 m, 714 m
3	$C_{48}H_{59}Gd_2N_6O_{22}\\$	41.58	4.29	6.06	3414 m, 3062 w, 2940 w, 1655 s, 1550 s,
		(41.25)	(4.19)	(6.18)	1418 s, 1370 s, 1105 s, 787 m, 716 m
4	$C_{48}H_{59}Tb_2N_6O_{22}\\$	41.48	4.28	6.05	3374 m, 3054 w, 2920 w, 1660 s, 1550 s,
		(41.35)	(4.15)	(6.09)	1438 s, 1378 s, 1101 s, 787 m, 717 m
5	$C_{48}H_{59}Dy_2N_6O_{22}\\$	41.27	4.26	6.02	3344 m, 3036 w, 2935 w, 1650 s, 1540 s,
		(41.05)	(4.18)	(6.14)	1420 s, 1371 s, 1103 s, 778 m, 710 m
6	$C_{48}H_{59}Er_{2}N_{6}O_{22}$	40.99	4.23	5.98	3390 m, 3064 w, 2934 w, 1670 s, 1560 s,
		(40.64)	(4.25)	(6.05)	1430 s, 1368 s, 1093 s, 789 m, 737 m
7	$C_{48}H_{59}Yb_2N_6O_{22}\\$	40.65	4.19	5.93	3385 m, 3042 w, 2956 w, 1660 s, 1510 s,
		(40.19)	(4.14)	(6.03)	1460 s, 1378 s, 1109 s, 789 m, 707 m

Table S1 Elemental analysis and main IR bands for 1–7

<sup>a</sup>Calculated value from formula, followed by experimental value in parentheses.



Fig. S1 Powder X-ray diffraction patterns of Gd-BBTC, Eu<sub>0.25</sub>Gd<sub>0.75</sub>-BBTC and Tb<sub>0.5</sub>Gd<sub>0.5</sub>-BBTC at ambient temperature.



**Fig. S2** The PXRD patterns for complex **Gd–BBTC** (**F**) and the co–doped complexes **Eu**<sub>x</sub>**Tb**<sub>y</sub>**Gd**<sub>1-x-y</sub>–**BBTC** (**A–E**) (Eu, Tb, Gd%): **A** (4.5, 5.5, 90), **B** (4, 5, 91), **C** (3, 4.5, 92.5), **D** (2.5, 4, 93.5) and **E** (1.5, 3.5, 95).

Table S2 Elemental analysis for  $Eu_xGd_{1-x}$ -BBTC and  $Tb_yGd_{1-y}$ -BBTC co-doped compounds

Ln-BBTC	Wt% C	Wt% H	Wt% N
	Calcd (Found)	Calcd (Found)	Calcd (Found)
Eu <sub>0.40</sub> Gd <sub>0.60</sub> -BBTC	41.72 (41.59)	4.30 (4.09)	6.08 (6.09)
Eu <sub>0.25</sub> Gd <sub>0.75</sub> -BBTC	41.66 (41.37)	4.30 (4.25)	6.07 (6.19)
Tb <sub>0.75</sub> Gd <sub>0.25</sub> -BBTC	41.50 (41.24)	4.28 (4.05)	6.05 (6.12)
Tb <sub>0.50</sub> Gd <sub>0.50</sub> -BBTC	41.53 (41.35)	4.28 (4.03)	6.05 (6.18)
Tb <sub>0.25</sub> Gd <sub>0.75</sub> -BBTC	41.56 (41.43)	4.29 (4.15)	6.06 (6.14)

Table S3 Elemental analysis for Eu<sub>x</sub>Tb<sub>y</sub>Gd<sub>1-x-y</sub>-BBTC co-doped compounds

Ln-BBTC	Wt% C	Wt% H	Wt% N
	Calcd (Found)	Calcd (Found)	Calcd (Found)
Eu <sub>0.045</sub> Tb <sub>0.055</sub> Gd <sub>0.9</sub> -BBTC	41.59 (41.26)	4.29 (4.18)	6.06 (6.12)
Eu <sub>0.04</sub> Tb <sub>0.05</sub> Gd <sub>0.91</sub> -BBTC	41.58 (41.34)	4.29 (4.15)	6.06 (6.15)
Eu <sub>0.03</sub> Tb <sub>0.045</sub> Gd <sub>0.925</sub> -BBTC	41.58 (41.41)	4.29 (4.21)	6.06 (5.95)
Eu <sub>0.025</sub> Tb <sub>0.04</sub> Gd <sub>0.935</sub> -BBTC	41.58 (41.39)	4.29 (4.13)	6.06 (6.09)
Eu <sub>0.015</sub> Tb <sub>0.035</sub> Gd <sub>0.95</sub> -BBTC	41.58 (41.29)	4.29 (4.18)	6.06 (6.01)



Fig. S3 Elemental mapping images of (a, b)  $Eu_{0.25}Gd_{0.75}$ -BBTC (red and green dots represent the Gd and the Eu elements, respectively), (c, d)  $Tb_{0.50}Gd_{0.50}$ -BBTC (red and green dots represent the Gd and the Tb elements, respectively) and (g, h, i)  $Eu_{0.045}Tb_{0.055}Gd_{0.9}$ -BBTC (green, red and yellow dots represent the Gd, Eu and Tb elements, respectively), and EDX-spectra of (e)  $Eu_{0.25}Gd_{0.75}$ -BBTC, (f)  $Tb_{0.50}Gd_{0.50}$ -BBTC and (j)  $Eu_{0.045}Tb_{0.055}Gd_{0.9}$ -BBTC.

Ln-BBTC	Wt% Gd	Wt% Eu	Wt% Tb
	Calcd (Found)	Calcd (Found)	Calcd (Found)
Eu <sub>0.25</sub> Gd <sub>0.75</sub> -BBTC	75.64 (75.42)	24.36 (24.58)	_
Tb <sub>0.5</sub> Gd <sub>0.5</sub> -BBTC	49.74 (49.50)	-	50.26 (50.50)
Eu <sub>0.045</sub> Tb <sub>0.055</sub> Gd <sub>0.9</sub> -BBTC	90.09 (89.85)	4.35 (4.52)	5.56 (5.63)

Table S4 ICP analysis for  $Eu_xGd_{1-x}$ -BBTC,  $Tb_yGd_{1-y}$ -BBTC and  $Eu_xTb_yGd_{1-x-y}$ -BBTC co-doped compounds

Table S5 Crystallographic data and structural refinements for 1 and 3

Compound	1	3		
Formula	$C_{48}H_{59}Sm_2N_6O_{22}$	$C_{48}H_{59}Gd_2N_6O_{22}$		
Formula weight	1373	1387		
Temperature (K)	296(2)	296(2)		
Crystal system	monoclinic	monoclinic		
Space group	C2/c	C2/c		
<i>a</i> (Å)	29.919(5)	30.62(4)		
<i>b</i> (Å)	21.281(3)	21.76(3)		
<i>c</i> (Å)	19.185(3)	19.90(3)		
$\alpha$ (deg)	90.00	90.00		
$\beta$ (deg)	93.690(4)	93.52(2)		
γ (deg)	90.00	90.00		
$V(Å^3)$	12190(3)	13231(31)		
Ζ	8	8		
<i>F(000)</i>	4552	4584		
GOF	1.079	1.021		
$R_1, wR_2[I > 2\sigma(I)]^a$	0.1225, 0.2493	0.0885, 0.2018		
${}^{a}R_{1} = \Sigma   F_{o}  -  F_{c}   / \Sigma  F_{o} ; \ wR_{2} = \{ \Sigma [w(F_{o}^{2} - F_{c}^{2})^{2}] / \Sigma (w(F_{o}^{2})^{2}] \}^{1/2}$				

	1					
Sm1–O11	2.332(5)	Sm1-013	2.372(7)	Sm1–O6	2.373(5)	
Sm1–O5	2.402(5)	Sm1-012	2.417(5)	Sm1-015	2.438(6)	
Sm1–O2	2.455(5)	Sm1–O1	2.477(5)	Sm2-016	2.287(7)	
Sm2–O3	2.319(5)	Sm2–O4	2.337(5)	Sm2–O9	2.388(6)	
Sm2–O14	2.426(7)	Sm2–O8	2.429(5)	Sm2-O10	2.507(6)	
Sm2–O7	2.508(5)					
			2			
Eu1–O11	2.332(3)	Eu1–O6	2.364(3)	Eu1–O5	2.390(3)	
Eu1–O12	2.406(3)	Eu1-O13	2.419(5)	Eu1–O14	2.419(5)	
Eu1–O2	2.444(3)	Eu1–O1	2.496(3)	Eu2–O4	2.297(3)	
Eu2–O3	2.303(4)	Eu2-O15	2.343(6)	Eu2-O16	2.377(8)	
Eu2-O10	2.415(4)	Eu2-08	2.418(3)	Eu2-O9	2.488(4)	
Eu2–O7	2.489(3)					
			3			
Gd1–O8	2.368(10)	Gd1-011	2.374(9)	Gd1015	2.401(16)	
Gd1-07	2.419(12)	Gd1-016	2.448(14)	Gd1-012	2.465(9)	
Gd1-O2	2.492(10)	Gd1-01	2.536(10)	Gd2013	2.186(17)	
Gd2O3	2.331(11)	Gd204	2.350(10)	Gd2014	2.402(16)	
Gd2-06	2.453(12)	Gd209	2.463(11)	Gd2010	2.537(11)	
Gd205	2.544(8)					
			4			
Tb1–O11	2.299(4)	Tb1–O8	2.327(4)	Tb1–O7	2.362(5)	
Tb1O12	2.370(4)	Tb1-O17	2.399(7)	Tb1-O19	2.400(14)	
Tb1–O1	2.421(4)	Tb1–O2	2.464(4)	Tb2–O4	2.277(5)	
Tb2–O3	2.287(5)	Tb2018	2.316(8)	Tb2-O20	2.324(7)	
Tb2–O9	2.368(18)	Tb2-O6	2.402(5)	Tb2-O10	2.44(2)	
Tb2–O5	2.471(4)					
			5			
Dy1-011	2.294(6)	Dy1-08	2.324(5)	Dy1–O7	2.353(6)	
Dy1-012	2.370(5)	Dy1-O2	2.389(6)	Dy1-016	2.395(8)	
Dy1-013	2.395(9)	Dy1-O1	2.458(6)	Dy2–O4	2.274(5)	
Dy2–O3	2.284(7)	Dy2-014	2.285(11)	Dy2-015	2.319(11)	
Dy2–O9	2.365(7)	Dy2-06	2.396(6)	Dy2-O10	2.447(7)	
Dy2-O5	2.454(5)					
			6			
Er1-011	2.265(6)	Er1–O8	2.276(5)	Er1–O7	2.335(6)	
Er1–O12	2.345(6)	Er1–O1	2.356(7)	Er1-013	2.374(9)	
Er1–O14	2.393(9)	Er1–O2	2.427(6)	Er2–O4	2.256(5)	
Er2–O3	2.287(7)	Er2016	2.292(10)	Er2015	2.300(11)	
Er2–O9	2.356(7)	Er2–O6	2.380(6)	Er2010	2.421(7)	
Er2–O5	2.435(5)					

Table S6 Selected bond distances (Å) in 1–7

7						
Yb1-011	2.248(6)	Yb1–O8	2.260(5)	Yb1–O7	2.300(6)	
Yb1-012	2.303(5)	Yb1–O2	2.319(6)	Yb1-O13	2.321(9)	
Yb1–O1	2.397(6)	Yb1–O14	2.405(9)	Yb2–O4	2.216(6)	
Yb2–O3	2.242(7)	Yb2015	2.265(10)	Yb2-O16	2.281(11)	
Yb2010	2.324(7)	Yb2–O6	2.349(6)	Yb2–O9	2.412(7)	
Yb205	2.423(5)					

Table S7 Selected bond angles (°) in 1–7

		1	
O11-Sm1-O13	142.5(2)	O11-Sm1-O6	76.72(18)
O13-Sm1-O6	75.61(19)	O11-Sm1-O5	78.77(18)
O13-Sm1-O5	138.61(19)	O6–Sm1–O5	126.89(16)
O11-Sm1-O12	123.37(18)	O13-Sm1-O12	75.4(2)
O6-Sm1-O12	79.59(17)	O5-Sm1-O12	75.93(18)
O11-Sm1-O15	81.5(2)	O13-Sm1-O15	66.6(2)
O6-Sm1-O15	73.30(18)	O5-Sm1-O15	146.50(19)
O12-Sm1-O15	137.5(2)	O11-Sm1-O2	85.96(18)
O13–Sm1–O2	103.2(2)	O6–Sm1–O2	145.47(17)
O5–Sm1–O2	77.05(18)	O12–Sm1–O2	134.24(18)
O15– Sm1–O2	74.8(2)	O11-Sm1-O1	136.00(19)
O13-Sm1-O1	70.5(2)	O6–Sm1–O1	145.56(18)
O5–Sm1–O1	78.55(18)	O12-Sm1-O1	86.34(17)
O15-Sm1-O1	97.87(19)	O2–Sm1–O1	52.37(17)
O16–Sm2–O3	85.5(2)	O16-Sm2-O4	151.5(2)
O3–Sm2–O4	90.16(18)	O16– Sm2–O9	86.1(2)
O3–Sm2–O9	150.58(19)	O4–Sm2–O9	110.0(2)
O16-Sm2-O14	71.1(2)	O3–Sm2–O14	81.7(2)
O4–Sm2–O14	80.5(2)	O9–Sm2–O14	121.7(2)
O16–Sm2–O8	129.7(2)	O3–Sm2–O8	84.77(19)
O4–Sm2–O8	77.63(18)	O9–Sm2–O8	79.16(19)
O14–Sm2–O8	154.15(18)	O16-Sm2-O10	94.7(2)
O3-Sm2-O10	158.06(19)	O4–Sm2–O10	79.24(18)
O9-Sm2-O10	50.91(19)	O14-Sm2-O10	77.6(2)
O8-Sm2-O10	111.19(19)	O16-Sm2-O7	77.2(2)
O3–Sm2–O7	77.21(17)	O4–Sm2–O7	129.16(19)
O9–Sm2–O7	73.44(18)	O14–Sm2–O7	142.97(19)
O8–Sm2–O7	52.55(16)	O10-Sm2-O7	124.28(17)
		2	
O11–Eu1–O6	77.33(11)	O11–Eu1–O5	78.00(12)
O6–Eu1–O5	127.15(10)	O11-Eu1-O12	124.34(11)
O6-Eu1-O12	79.78(11)	O5-Eu1-O12	76.94(12)

O11-Eu1-O13	142.59(16)	O6-Eu1-O13	74.67(14)
O5-Eu1-O13	139.23(15)	O12-Eu1-O13	74.11(16)
O11–Eu1–O14	77.60(15)	O6-Eu1-O14	75.49(15)
O5-Eu1-O14	141.07(15)	O12-Eu1-O14	141.95(16)
O13-Eu1-O14	71.75(18)	O11-Eu1-O2	85.63(10)
O6-Eu1-O2	144.08(12)	O5–Eu1–O2	78.29(12)
O12-Eu1-O2	135.01(11)	O13-Eu1-O2	103.09(15)
O14–Eu1–O2	70.03(15)	O11-Eu1-O1	135.21(11)
O6-Eu1-O1	145.90(11)	O5-Eu1-O1	78.07(11)
O12–Eu1–O1	85.65(10)	O13-Eu1-O1	71.73(15)
O14–Eu1–O1	99.02(14)	O2-Eu1-O1	52.66(9)
O4–Eu2–O3	87.43(12)	O4-Eu2-O15	79.94(17)
O3-Eu2-O15	78.19(19)	O4–Eu2–O16	87.45(18)
O3-Eu2-O16	150.0(2)	O15-Eu2-O16	71.8(2)
O4-Eu2-O10	153.10(13)	O3-Eu2-O10	111.97(15)
O15-Eu2-O10	121.05(18)	O16-Eu2-O10	84.2(2)
O4–Eu2–O8	86.00(14)	O3–Eu2–O8	80.11(12)
O15-Eu2-O8	154.56(17)	O16-Eu2-O8	128.96(19)
O10-Eu2-O8	79.57(16)	O4–Eu2–O9	154.89(12)
O3–Eu2–O9	78.61(12)	O15-Eu2-O9	76.85(18)
O16-Eu2-O9	94.24(18)	O10-Eu2-O9	51.63(13)
O8–Eu2–O9	111.60(15)	O4–Eu2–O7	79.33(11)
O3–Eu2–O7	131.57(12)	O15-Eu2-O7	142.31(18)
O16-Eu2-O7	76.18(18)	O10-Eu2-O7	73.85(12)
O8–Eu2–O7	52.86(10)	O9–Eu2–O7	125.42(11)
		3	
O8–Gd1–O11	77.7(4)	O8-Gd1-O15	77.1(4)
O11–Gd1–O15	76.4(4)	O8-Gd1-O7	126.3(3)
O11–Gd1–O7	77.6(4)	O15-Gd1-O7	139.4(4)
O8–Gd1–O16	76.4(4)	O11–Gd1–O16	144.0(5)
O15–Gd1–O16	73.8(5)	O7–Gd1–O16	138.4(4)
O8-Gd1-O12	79.8(4)	O11-Gd1-O12	124.2(3)
O15-Gd1-O12	144.4(5)	O7-Gd1-O12	76.2(4)
O16-Gd1-O12	74.8(4)	O8–Gd1–O2	145.1(4)
O11–Gd1–O2	85.2(3)	O15-Gd1-O2	69.4(5)
O7–Gd1–O2	77.8(4)	O16-Gd1-O2	102.4(4)
O12-Gd1-O2	134.3(4)	O8–Gd1–O1	145.8(4)
O11–Gd1–O1	135.0(4)	O15-Gd1-O1	98.8(4)
O7–Gd1–O1	78.7(4)	O16-Gd1-O1	70.0(4)
O12-Gd1-O1	85.6(3)	O2–Gd1–O1	52.6(3)
O13-Gd2-O3	146.8(5)	O13–Gd2–O4	92.0(5)
O3-Gd2-O4	88.3(4)	O13-Gd2-O14	70.2(5)
O3-Gd2-O14	77.2(5)	O4-Gd2-O14	80.6(4)
013-Gd2-06	131 4(4)	03-Gd2-06	81.7(4)

O4–Gd2–O6	86.0(4)	O14–Gd2–O6	155.2(4)
O13-Gd2-O9	79.0(5)	O3–Gd2–O9	113.5(4)
O4-Gd2-O9	152.3(3)	O14–Gd2–O9	119.5(4)
O6-Gd2-O9	80.8(4)	O13-Gd2-O10	87.9(5)
O3-Gd2-O10	78.6(4)	O4-Gd2-O10	155.2(4)
O14-Gd2-O10	76.1(4)	O6–Gd2–O10	112.4(4)
O9–Gd2–O10	51.5(3)	O13-Gd2-O5	79.0(5)
O3–Gd2–O5	133.3(4)	O4–Gd2–O5	79.5(3)
O14–Gd2–O5	142.4(4)	O6–Gd2–O5	52.8(3)
O9–Gd2–O5	73.1(3)	O10-Gd2-O5	124.6(3)
		4	
O11-Tb1-O8	77.48(16)	O11-Tb1-O7	78.20(17)
O8-Tb1-O7	126.98(16)	O11-Tb1-O12	124.21(17)
O8-Tb1-O12	79.42(17)	O7-Tb1-O12	76.69(17)
O11-Tb1-O17	142.5(2)	O8-Tb1-O17	75.19(19)
O7–Tb1–O17	139.2(2)	O12-Tb1-O17	74.9(2)
O11-Tb1-O19A	83.2(6)	O8-Tb1-O19A	74.5(7)
O7-Tb1-O19A	146.4(6)	O12-Tb1-O19A	136.5(6)
O17-Tb1-O19A	65.2(6)	O11-Tb1-O19	74.5(5)
O8-Tb1-O19	76.6(5)	O7–Tb1–O19	138.3(5)
O12-Tb1-O19	145.0(5)	O17-Tb-O19	74.6(5)
O9-Tb2-O10A	48.6(7)	O11-Tb1-O1	84.85(16)
O8-Tb1-O1	144.11(18)	O7–Tb1–O1	78.12(19)
O12-Tb1-O1	135.56(17)	O17–Tb1–O1	103.0(2)
O19A –Tb1–O1	72.5(6)	O19-Tb1-O1	68.6(5)
O11–Tb1–O2	135.15(16)	O8–Tb1–O2	145.72(15)
O7–Tb1–O2	78.35(16)	O12-Tb1-O2	86.13(15)
O17–Tb1–O2	71.1(2)	O19A-Tb1-O2	96.2(6)
O19-Tb1-O2	99.7(5)	O1–Tb1–O2	53.12(14)
O4–Tb2–O3	87.84(19)	O4-Tb2-O18A	78.6(5)
O3-Tb2-O18A	146.6(5)	O4-Tb2-O18	93.0(4)
O3-Tb2-O18	151.1(4)	O6-Tb2-O10A	104.4(12)
O4-Tb2-O20	80.4(2)	O3-Tb2-O20	77.8(3)
O18A-Tb2-O20	70.0(6)	O18-Tb2-O20	73.9(5)
O4–Tb2–O9	154.1(4)	O3–Tb2–O9	105.9(8)
O18A-Tb2-O9	99.1(9)	O18-Tb2-O9	85.3(9)
O20-Tb2-O9	123.5(4)	O4–Tb2–O6	86.0(2)
O3-Tb2-O6	79.96(18)	O18A-Tb2-O6	128.5(6)
O18-Tb2-O6	128.9(4)	O20-Tb2-O6	154.3(3)
O9–Tb2–O6	75.2(5)	O4-Tb2-O10	153.3(3)
O3–Tb2–O10	81.7(6)	O18A-Tb2-O10	96.9(9)
O18-Tb2-O10	84.8(8)	O20-Tb2-O10	73.5(5)
O9-Tb2-O10	52.4(3)	O6-Tb2-O10	115.8(6)
O4–Tb2–O9A	149.5(5)	O3–Tb2–O9A	120.6(10)

O18A-Tb2-O9A	81.6(14)	O18-Tb2-O9A	67.6(15)
O20-Tb2-O9A	114.0(12)	O5-Tb2-O10A	123.5(7)
O6–Tb2–O9A	88.5(14)	O10-Tb2-O9A	52.1(5)
O4–Tb2–O5	79.55(16)	O3-Tb2-O5	131.95(17)
O18A-Tb2-O5	75.6(6)	O18-Tb2-O5	76.3(4)
O20–Tb2–O5	142.9(3)	O9–Tb2–O5	74.9(5)
O6–Tb2–O5	53.24(15)	O10-Tb2-O5	125.2(3)
O9A-Tb2-O5	73.2(5)	O4-Tb2-O10A	156.6(6)
O3-Tb2-O10A	73.8(6)	O18A-Tb2-O10A	108.9(11)
O18-Tb2-O10A	96.2(10)	O20-Tb2-O10A	81.6(11)
		5	
O11-Dy1-O8	77.2(2)	O11-Dy1-O7	78.6(2)
O8-Dy1-O7	126.72(18)	O11-Dy1-O12	125.1(2)
O8-Dy1-O12	79.6(2)	O7-Dy1-O12	76.8(2)
O11-Dy1-O2	84.4(2)	O8-Dy1-O2	143.5(2)
O7–Dy1–O2	78.8(2)	O12–Dy1–O2	135.9(2)
O11-Dy1-O16	78.2(3)	O8-Dy1-O16	74.4(2)
O7-Dy1-O16	143.4(2)	O12-Dy1-O16	139.8(3)
O2-Dy1-O16	71.1(3)	O11-Dy1-O13	142.4(3)
O8-Dy1-O13	75.0(2)	07–Dy1–O13	138.8(3)
O12-Dy1-O13	73.7(3)	O2-Dy1-O13	103.6(2)
O16-Dy1-O13	70.3(3)	O11-Dy1-O1	134.9(2)
08-Dy1-O1	146.0(2)	O7-Dy1-O1	78.7(2)
O12-Dy1-O1	86.3(2)	O2-Dy1-O1	53.1(2)
O16-Dy1-O1	98.5(2)	O13-Dy1-O1	71.3(3)
O4–Dy2–O3	88.2(2)	O4-Dy2-O14	78.6(3)
O3-Dy2-O14	77.7(3)	O4-Dy2-O15	88.4(3)
O3-Dy2-O15	149.5(3)	O14–Dy2–O15	71.9(4)
O4–Dy2–O9	152.6(2)	O3-Dy2-O9	111.3(3)
O14-Dy2-O9	123.2(3)	O15–Dy2–O9	83.9(3)
O4–Dy2–O6	85.4(2)	O3-Dy2-O6	80.1(2)
O14-Dy2-O6	152.9(3)	O15-Dy2-O6	129.8(3)
O9–Dy2–O6	79.6(3)	O4-Dy2-O10	154.6(2)
O3-Dy2-O10	78.1(2)	O14–Dy2–O10	77.7(3)
O15-Dy2-O10	92.7(3)	O9-Dy2-O10	52.4(2)
O6-Dy2-O10	112.6(2)	O4–Dy2–O5	79.8(2)
O3–Dy2–O5	132.5(2)	O14–Dy2–O5	141.8(3)
O15-Dy2-O5	76.4(3)	O9–Dy2–O5	72.9(2)
O6–Dy2–O5	53.43(18)	O10–Dy2–O5	125.1(2)
-		6	. ,
O11–Er1–O8	77.3(2)	O11–Er1–O7	78.4(2)
O8-Er1-O7	127.21(19)	O11–Er1–O12	125.4(2)
O8-Er1-O12	80.2(2)	O7–Er1–O12	77.1(2)
011 - Fr1 - 01	84.4(2)	08–Er1–O1	141.4(2)

07-Er1-01 $80.5(2)$ $012-Er1-013$ $136.9(2)$ $01-Er1-013$ $141.5(3)$ $08-Er1-013$ $74.7(2)$ $07-Er1-013$ $140.0(3)$ $012-Er1-013$ $74.8(3)$ $01-Er1-013$ $101.6(3)$ $011-Er1-014$ $74.8(3)$ $01-Er1-014$ $121.(3)$ $07-Er1-014$ $144.9(2)$ $012-Er1-014$ $138.1(3)$ $01-Er1-014$ $144.9(2)$ $012-Er1-014$ $138.1(3)$ $01-Er1-02$ $134.5(2)$ $08-Er1-02$ $146.1(2)$ $07-Er1-02$ $78.6(2)$ $012-Er1-02$ $86.2(2)$ $01-Er1-02$ $93.3(2)$ $013-Er1-02$ $71.8(3)$ $014-Er1-02$ $99.6(3)$ $04-Er2-03$ $88.9(2)$ $04-Er2-016$ $79.2(3)$ $03-Er2-016$ $77.0(3)$ $04-Er2-015$ $90.1(3)$ $03-Er2-015$ $149.9(3)$ $016-Er2-015$ $73.3(3)$ $04-Er2-09$ $152.2(2)$ $03-Er2-06$ $79.0(2)$ $016-Er2-09$ $123.4(3)$ $015-Er2-06$ $79.0(2)$ $016-Er2-06$ $51.5(3)$ $015-Er2-06$ $79.0(2)$ $016-Er2-06$ $77.3(3)$ $04-Er2-010$ $154.4(2)$ $03-Er2-010$ $18.7(2)$ $016-Er2-05$ $79.6(219)$ $03-Er2-010$ $13.7(2)$ $016-Er2-05$ $79.6(219)$ $03-Er2-05$ $71.0(3)$ $09-Er2-05$ $72.6(219)$ $03-Er2-05$ $71.0(3)$ $09-Er2-05$ $72.6(219)$ $03-Er2-05$ $71.0(3)$ $09-Er2-05$ $72.6(2)$ $06-Er2-05$ $71.0(3)$ $09-Er2-05$ $72.6(2)$ $06-Er2-05$				
O11-Er1-O13 141.5(3) 08-Er1-O13 74.7(2)   O7-Er1-O13 140.0(3) 012-Er1-O13 74.8(3)   O1-Er1-O13 101.6(3) 011-Er1-O14 74.8(3)   08-Er1-O14 72.1(3) 07-Er1-O14 144.9(2)   012-Er1-O14 188.1(3) 01-Er1-O14 71.2(3)   013-Er1-O14 68.0(3) 011-Er1-O2 78.6(2)   012-Er1-O2 86.2(2) 01-Er1-O2 78.6(2)   012-Er1-O2 71.8(3) 014-Er1-O2 99.6(3)   03-Er2-O16 77.0(3) 04-Er2-O15 73.3(3)   04-Er2-O3 88.9(2) 04-Er2-O15 73.3(3)   04-Er2-O4 152.2(2) 03-Er2-O4 79.0(3)   04-Er2-O5 149.9(3) 015-Er2-O9 82.6(3)   04-Er2-O6 151.5(3) 015-Er2-O6 79.0(2)   016-Er2-O6 151.5(3) 015-Er2-O10 76.3(3)   03-Er2-O10 18.7(2) 016-Er2-O10 76.3(3)   015-Er2-O10 18.7(2) 014-Er2-O5 79.62(19)   03-Er2-O5<	07–Er1–O1	80.5(2)	O12-Er1-O1	136.9(2)
O7-ErI-O13140.0(3) $O12$ -ErI-O1374.8(3) $O1$ -ErI-O13101.6(3) $O11$ -ErI-O1478.6(3) $O8$ -Er1-O1472.1(3) $O7$ -ErI-O14144.9(2) $O12$ -ErI-O14138.1(3) $O1$ -ErI-O1471.2(3) $O13$ -ErI-O1468.0(3) $O1$ -ErI-O2134.5(2) $O8$ -Er1-O2146.1(2) $O7$ -ErI-O278.6(2) $O12$ -ErI-O286.2(2) $O1$ -ErI-O253.3(2) $O13$ -Er1-O271.8(3) $O14$ -Er1-O299.6(3) $O4$ -Er2-O388.9(2) $O4$ -Er2-O1579.3(3) $O3$ -Er2-O1677.0(3) $O4$ -Er2-O1573.3(3) $O4$ -Er2-O388.9(2) $O3$ -Er2-O1573.3(3) $O4$ -Er2-O15149.9(3) $O16$ -Er2-O1573.3(3) $O4$ -Er2-O9152.2(2) $O3$ -Er2-O679.0(2) $O16$ -Er2-O9152.3(3) $O15$ -Er2-O982.6(3) $O4$ -Er2-O685.2(2) $O3$ -Er2-O679.0(2) $O16$ -Er2-O1078.7(2) $O16$ -Er2-O10154.4(2) $O3$ -Er2-O1078.7(2) $O4$ -Er2-O1076.3(3) $O15$ -Er2-O579.0(2) $O16$ -Er2-O579.62(19) $O3$ -Er2-O10113.7(2) $O4$ -Er2-O579.62(19) $O3$ -Er2-O579.0(2) $O16$ -Er2-O572.6(2) $O6$ -Er2-O10113.7(2) $O1$ -Er2-O572.6(2) $O6$ -Er2-O579.0(2) $O1$ -Er2-O572.6(2) $O6$ -Er2-O579.0(2) $O1$ -Er2-O572.6(2) $O6$ -Er2-O574.0(19) $O11$ -Yb1-O178.9(2) $O3$ -Er2-O572.6(2) <td>O11-Er1-O13</td> <td>141.5(3)</td> <td>O8-Er1-O13</td> <td>74.7(2)</td>	O11-Er1-O13	141.5(3)	O8-Er1-O13	74.7(2)
O1=Er1-O13101.6(3)O11=Er1-O1478.6(3)O8=Er1-O1472.1(3)O7=Er1-O14144.9(2)O12=Er1-O14138.1(3)O11=Er1-O1471.2(3)O13=Er1-O1468.0(3)O11=Er1-O2134.5(2)O8=Er1-O2146.1(2)O7=Er1-O253.3(2)O12=Er1-O286.2(2)O1=Er1-O253.3(2)O13=Er1-O271.8(3)O14=Er1-O299.6(3)O4=Er2-O388.9(2)O4=Er2-O1679.2(3)O3=Er2-O1677.0(3)O4=Er2-O1590.1(3)O3=Er2-O15149.9(3)O16=Er2-O9110.6(3)O4=Er2-O9152.2(2)O3=Er2-O9110.6(3)O4=Er2-O9123.4(3)O15=Er2-O982.6(3)O4=Er2-O685.2(2)O3=Er2-O679.0(2)O16=Er2-O6151.5(3)O15=Er2-O10154.4(2)O3=Er2-O1078.7(2)O16=Er2-O10154.4(2)O3=Er2-O1078.7(2)O16=Er2-O1076.3(3)O15=Er2-O10133.7(2)O4=Er2-O579.62(19)O3=Er2-O5132.2(2)O16=Er2-O5143.2(3)O15=Er2-O577.0(3)O9=Er2-O5125.1(2)TT77O11=Yb1-O378.6(2)01=Yb1-O1278.4(2)O11=Yb1-O379.4(2)01=Yb1-O12135.5(2)O8=Yb1-O1279.4(2)01=Yb1-O1374.8(2)O7=Yb1-O13138.8(3)O8=Yb1-O1374.8(2)O7=Yb1-O13138.8(3)O2=Yb1-O1477.6(3)O2=Yb1-O14145.7(2)O7=Yb1-O14142.7(3) <td>O7–Er1–O13</td> <td>140.0(3)</td> <td>O12-Er1-O13</td> <td>74.8(3)</td>	O7–Er1–O13	140.0(3)	O12-Er1-O13	74.8(3)
08-Er1-014 72.1(3) $07$ -Er1-014 144.9(2) $012$ -Er1-014 138.1(3) $01$ -Er1-014 71.2(3) $013$ -Er1-014 68.0(3) $011$ -Er1-02 134.5(2) $08$ -Er1-02 146.1(2) $07$ -Er1-02 78.6(2) $012$ -Er1-02 86.2(2) $01$ -Er1-02 99.6(3) $04$ -Er2-03 88.9(2) $04$ -Er2-016 79.2(3) $03$ -Er2-016 77.0(3) $04$ -Er2-015 73.3(3) $04$ -Er2-03 88.9(2) $03$ -Er2-015 73.3(3) $04$ -Er2-09 152.2(2) $03$ -Er2-09 110.6(3) $016$ -Er2-09 152.4(3) $015$ -Er2-06 79.0(2) $04$ -Er2-06 85.2(2) $03$ -Er2-010 154.4(2) $03$ -Er2-010 78.7(2) $016$ -Er2-010 76.3(3) $015$ -Er2-010 78.7(2) $016$ -Er2-05 79.62(19) $03$ -Er2-010 113.7(2) $04$ -Er2-05 79.62(19) $03$ -Er2-05 132.2(2) $016$ -Er2-05 143.2(3) $015$ -Er2-05 70.4(2) $07$ -Vb1-01	O1-Er1-O13	101.6(3)	O11–Er1–O14	78.6(3)
012-Er1-014 $138.1(3)$ $01-Er1-014$ $71.2(3)$ $013-Er1-014$ $68.0(3)$ $011-Er1-02$ $134.5(2)$ $08-Er1-02$ $146.1(2)$ $07-Er1-02$ $78.6(2)$ $012-Er1-02$ $86.2(2)$ $01-Er1-02$ $53.3(2)$ $013-Er1-02$ $71.8(3)$ $014-Er1-02$ $99.6(3)$ $04-Er2-03$ $88.9(2)$ $04-Er2-016$ $79.2(3)$ $03-Er2-016$ $77.0(3)$ $04-Er2-015$ $90.1(3)$ $03-Er2-016$ $77.0(3)$ $04-Er2-09$ $110.6(3)$ $016-Er2-09$ $152.2(2)$ $03-Er2-09$ $82.6(3)$ $04-Er2-09$ $152.2(2)$ $03-Er2-06$ $79.0(2)$ $016-Er2-06$ $85.2(2)$ $03-Er2-06$ $79.0(2)$ $016-Er2-06$ $79.7(3)$ $04-Er2-010$ $76.3(3)$ $09-Er2-06$ $79.7(3)$ $04-Er2-010$ $76.3(3)$ $015-Er2-010$ $78.7(2)$ $016-Er2-010$ $76.3(3)$ $015-Er2-010$ $89.7(3)$ $09-Er2-05$ $72.6(2)$ $06-Er2-05$ $71.0(2)$ $01-Er2-05$ $72.6(2)$ $06-Er2-05$ $71.0(2)$ $01-Yb1-07$ $78.9(2)$ $01-Yb1-08$ $77.1(2)$ $01-Yb1-012$ $78.4(2)$ $011-Yb1-08$ $77.1(2)$ $01-Yb1-012$ $78.4(2)$ $011-Yb1-013$ $138.8(3)$ $08-Yb1-013$ $74.8(2)$ $07-Yb1-013$ $142.2(3)$ $01-Yb1-013$ $77.6(3)$ $02-Yb1-013$ $98.4(3)$ $011-Yb1-014$ $77.6(3)$ $02-Yb1-013$ $98.8(3)$ $01-Yb1-014$ $78.2(2)$ $01-Yb1-014$ $73.3(3)$	O8–Er1–O14	72.1(3)	O7–Er1–O14	144.9(2)
013-Er1-01468.0(3)011-Er1-02134.5(2)08-Er1-02146.1(2)07-Er1-0278.6(2)012-Er1-0286.2(2)01-Er1-0253.3(2)013-Er1-0271.8(3)014-Er1-0299.6(3)04-Er2-0388.9(2)04-Er2-01679.2(3)03-Er2-01677.0(3)04-Er2-01590.1(3)03-Er2-019149.9(3)016-Er2-01573.3(3)04-Er2-09152.2(2)03-Er2-09110.6(3)016-Er2-09123.4(3)015-Er2-0982.6(3)04-Er2-0685.2(2)03-Er2-0679.0(2)016-Er2-06151.5(3)015-Er2-06130.9(3)09-Er2-0679.7(3)04-Er2-010154.4(2)03-Er2-01078.7(2)016-Er2-01076.3(3)015-Er2-010113.7(2)04-Er2-0579.62(19)03-Er2-05132.2(2)016-Er2-05143.2(3)015-Er2-0577.0(3)09-Er2-05125.1(2)06-Er2-0554.02(19)010-Er2-05125.1(2)06-Er2-0577.1(2)011-Yb1-0778.9(2)08-Yb1-07128.07(19)011-Yb1-012125.5(2)08-Yb1-01279.4(2)07-Yb1-01278.4(2)011-Yb1-0877.1(2)012-Yb1-01377.6(3)02-Yb1-013138.8(3)08-Yb1-01377.6(3)02-Yb1-013138.8(3)08-Yb1-01377.6(3)02-Yb1-013142.2(3)012-Yb1-0178.4(2)011-Yb1-01145.7(2)07-Yb1-0178.2(2)011-Yb1-01134.9(2)07	O12-Er1-O14	138.1(3)	O1-Er1-O14	71.2(3)
O8-Er1-O2 $146.1(2)$ $O7-Er1-O2$ $78.6(2)$ $O12-Er1-O2$ $86.2(2)$ $O1-Er1-O2$ $53.3(2)$ $O13-Er1-O2$ $71.8(3)$ $O14-Er1-O2$ $99.6(3)$ $O4-Er2-O3$ $88.9(2)$ $O4-Er2-O16$ $79.2(3)$ $O3-Er2-O16$ $77.0(3)$ $O4-Er2-O15$ $90.1(3)$ $O3-Er2-O15$ $149.9(3)$ $O16-Er2-O15$ $73.3(3)$ $O4-Er2-O9$ $152.2(2)$ $O3-Er2-O9$ $110.6(3)$ $O16-Er2-O9$ $123.4(3)$ $O15-Er2-O9$ $82.6(3)$ $O4-Er2-O6$ $85.2(2)$ $O3-Er2-O6$ $79.0(2)$ $O16-Er2-O6$ $151.5(3)$ $O15-Er2-O6$ $130.9(3)$ $O9-Er2-O6$ $79.7(3)$ $O4-Er2-O10$ $154.4(2)$ $O3-Er2-O10$ $78.7(2)$ $O16-Er2-O10$ $76.3(3)$ $O15-Er2-O10$ $89.7(3)$ $O9-Er2-O5$ $79.62(19)$ $O3-Er2-O5$ $132.2(2)$ $O16-Er2-O5$ $79.62(19)$ $O3-Er2-O5$ $77.0(3)$ $O9-Er2-O5$ $72.6(2)$ $O6-Er2-O5$ $54.02(19)$ $O10-Er2-O5$ $125.1(2)$ $O6-Er2-O5$ $79.4(2)$ $O7-Yb1-O12$ $78.4(2)$ $O11-Yb1-O8$ $77.1(2)$ $O11-Yb1-O7$ $78.9(2)$ $O8-Yb1-O12$ $79.4(2)$ $O7-Yb1-O12$ $78.4(2)$ $O11-Yb1-O2$ $83.9(2)$ $O8-Yb1-O12$ $139.2(2)$ $O7-Yb1-O1$ $128.7(2)$ $O7-Yb1-O1$ $74.8(2)$ $O11-Yb1-O1$ $134.9(2)$ $O2-Yb1-O1$ $74.8(2)$ $O7-Yb1-O1$ $86.6(2)$ $O2-Yb1-O1$ $74.8(2)$ $O11-Yb1-O1$ $88.8$	O13-Er1-O14	68.0(3)	O11–Er1–O2	134.5(2)
$\begin{array}{c ccccc} 012-\text{Er1}-\text{O2} & 86.2(2) & 01-\text{Er1}-\text{O2} & 53.3(2) \\ 013-\text{Er1}-\text{O2} & 71.8(3) & 014-\text{Er1}-\text{O2} & 99.6(3) \\ 04-\text{Er2}-O3 & 88.9(2) & 04-\text{Er2}-O16 & 79.2(3) \\ 03-\text{Er2}-O16 & 77.0(3) & 04-\text{Er2}-O15 & 90.1(3) \\ 03-\text{Er2}-O16 & 77.0(3) & 04-\text{Er2}-O15 & 73.3(3) \\ 04-\text{Er2}-O9 & 152.2(2) & 03-\text{Er2}-O9 & 110.6(3) \\ 016-\text{Er2}-O9 & 123.4(3) & 015-\text{Er2}-O9 & 82.6(3) \\ 04-\text{Er2}-O6 & 85.2(2) & 03-\text{Er2}-O6 & 79.0(2) \\ 016-\text{Er2}-O6 & 151.5(3) & 015-\text{Er2}-O6 & 130.9(3) \\ 09-\text{Er2}-O6 & 79.7(3) & 04-\text{Er2}-O10 & 154.4(2) \\ 03-\text{Er2}-O10 & 78.7(2) & 016-\text{Er2}-O10 & 76.3(3) \\ 015-\text{Er2}-O10 & 89.7(3) & 09-\text{Er2}-O10 & 52.8(2) \\ 06-\text{Er2}-O10 & 113.7(2) & 04-\text{Er2}-O5 & 79.62(19) \\ 03-\text{Er2}-O5 & 132.2(2) & 016-\text{Er2}-O5 & 143.2(3) \\ 015-\text{Er2}-O5 & 77.0(3) & 09-\text{Er2}-O5 & 125.1(2) \\ \hline & & & & & & & & & & & & & & & & & &$	O8–Er1–O2	146.1(2)	O7–Er1–O2	78.6(2)
$\begin{array}{c ccccc} 013-Er1-02 & 71.8(3) & 014-Er1-02 & 99.6(3) \\ 04-Er2-03 & 88.9(2) & 04-Er2-016 & 79.2(3) \\ 03-Er2-016 & 77.0(3) & 04-Er2-015 & 90.1(3) \\ 03-Er2-015 & 149.9(3) & 016-Er2-015 & 73.3(3) \\ 04-Er2-09 & 152.2(2) & 03-Er2-09 & 110.6(3) \\ 016-Er2-06 & 85.2(2) & 03-Er2-06 & 79.0(2) \\ 016-Er2-06 & 85.2(2) & 03-Er2-06 & 130.9(3) \\ 09-Er2-06 & 151.5(3) & 015-Er2-06 & 130.9(3) \\ 09-Er2-06 & 79.7(3) & 04-Er2-010 & 154.4(2) \\ 03-Er2-010 & 78.7(2) & 016-Er2-010 & 76.3(3) \\ 015-Er2-010 & 78.7(2) & 016-Er2-05 & 79.6(2) \\ 06-Er2-010 & 113.7(2) & 04-Er2-05 & 79.6(2) \\ 06-Er2-05 & 132.2(2) & 016-Er2-05 & 143.2(3) \\ 015-Er2-05 & 77.0(3) & 09-Er2-05 & 72.6(2) \\ 06-Er2-05 & 54.02(19) & 010-Er2-05 & 125.1(2) \\ \hline \\ $	O12–Er1–O2	86.2(2)	O1–Er1–O2	53.3(2)
O4-Er2-O3 $88.9(2)$ $O4-Er2-O16$ $79.2(3)$ $O3-Er2-O16$ $77.0(3)$ $O4-Er2-O15$ $90.1(3)$ $O3-Er2-O15$ $149.9(3)$ $O16-Er2-O15$ $73.3(3)$ $O4-Er2-O9$ $152.2(2)$ $O3-Er2-O9$ $110.6(3)$ $O16-Er2-O9$ $123.4(3)$ $O15-Er2-O9$ $82.6(3)$ $O4-Er2-O6$ $85.2(2)$ $O3-Er2-O6$ $79.0(2)$ $O16-Er2-O6$ $151.5(3)$ $O15-Er2-O6$ $130.9(3)$ $O9-Er2-O6$ $79.7(3)$ $O4-Er2-O10$ $154.4(2)$ $O3-Er2-O10$ $78.7(2)$ $O16-Er2-O10$ $76.3(3)$ $O3-Er2-O10$ $87.7(3)$ $O9-Er2-O5$ $79.2(19)$ $O3-Er2-O10$ $113.7(2)$ $O4-Er2-O5$ $79.2(19)$ $O3-Er2-O10$ $113.7(2)$ $O4-Er2-O5$ $79.2(2)$ $O6-Er2-O10$ $113.7(2)$ $O4-Er2-O5$ $72.6(2)$ $O6-Er2-O5$ $77.0(3)$ $O9-Er2-O5$ $72.6(2)$ $O6-Er2-O5$ $71.0(2)$ $O11-Yb1-O7$ $78.9(2)$ $O6-Er2-O5$ $74.02(2)$ $01-Er2-O5$ $125.1(2)$ $T$ $T1(2)$ $O11-Yb1-O7$ $78.9(2)$ $O8-Yb1-O1$ $128.07(19)$ $O11-Yb1-O1$ $78.4(2)$ $O11-Yb1-O2$ $83.9(2)$ $O8-Yb1-O2$ $139.2(2)$ $O7-Yb1-O2$ $81.7(2)$ $O7-Yb1-O1$ $78.4(2)$ $O11-Yb1-O13$ $138.8(3)$ $O8-Yb1-O13$ $77.6(3)$ $O2-Yb1-O13$ $98.4(3)$ $O11-Yb1-O1$ $78.2(2)$ $O7-Yb1-O1$ $88.6(2)$ $O2-Yb1-O1$ $54.8(2)$ $O7-Yb1-O1$ $78.4(2)$	O13-Er1-O2	71.8(3)	O14–Er1–O2	99.6(3)
O3-Er2-O16 $77.0(3)$ O4-Er2-O15 $90.1(3)$ O3-Er2-O15149.9(3)O16-Er2-O15 $73.3(3)$ O4-Er2-O9152.2(2)O3-Er2-O9110.6(3)O16-Er2-O9123.4(3)O15-Er2-O982.6(3)O4-Er2-O685.2(2)O3-Er2-O679.0(2)O16-Er2-O6151.5(3)O15-Er2-O6130.9(3)O9-Er2-O679.7(3)O4-Er2-O10154.4(2)O3-Er2-O1078.7(2)O16-Er2-O1076.3(3)O15-Er2-O1089.7(3)O9-Er2-O579.62(19)O3-Er2-O10113.7(2)O4-Er2-O579.62(19)O3-Er2-O5132.2(2)O16-Er2-O5143.2(3)O15-Er2-O577.0(3)O9-Er2-O5125.1(2)O6-Er2-O554.02(19)O10-Er2-O5125.1(2)O6-Er2-O554.02(19)O11-Yb1-O778.9(2)O6-Er2-O577.0(2)O11-Yb1-O778.9(2)O6-Er2-O554.02(19)O11-Yb1-O12125.5(2)O6-Yb1-O1128.07(19)O11-Yb1-O12125.5(2)O8-Yb1-O1279.4(2)O7-Yb1-O1278.4(2)O11-Yb1-O283.9(2)O8-Yb1-O1377.6(3)O2-Yb1-O13138.8(3)O8-Yb1-O1374.8(2)O7-Yb1-O13138.8(3)O8-Yb1-O1374.8(2)O7-Yb1-O1145.7(2)O7-Yb1-O178.2(2)O2-Yb1-O186.6(2)O2-Yb1-O154.8(2)O11-Yb1-O1477.5(3)O3-Yb1-O1447.5(3)O2-Yb1-O188.8(3)O2-Yb1-O1467.5(3)O3-Yb1-O14138.8(3) <td>O4–Er2–O3</td> <td>88.9(2)</td> <td>O4-Er2-O16</td> <td>79.2(3)</td>	O4–Er2–O3	88.9(2)	O4-Er2-O16	79.2(3)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	O3–Er2–O16	77.0(3)	O4–Er2–O15	90.1(3)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	O3–Er2–O15	149.9(3)	O16-Er2-O15	73.3(3)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	O4–Er2–O9	152.2(2)	O3–Er2–O9	110.6(3)
$\begin{array}{c ccccc} 04-Er2-06 & 85.2(2) & 03-Er2-06 & 79.0(2) \\ 016-Er2-06 & 151.5(3) & 015-Er2-06 & 130.9(3) \\ 09-Er2-06 & 79.7(3) & 04-Er2-010 & 154.4(2) \\ 03-Er2-010 & 78.7(2) & 016-Er2-010 & 76.3(3) \\ 015-Er2-010 & 89.7(3) & 09-Er2-010 & 52.8(2) \\ 06-Er2-010 & 113.7(2) & 04-Er2-05 & 79.62(19) \\ 03-Er2-05 & 132.2(2) & 016-Er2-05 & 143.2(3) \\ 015-Er2-05 & 77.0(3) & 09-Er2-05 & 72.6(2) \\ 06-Er2-05 & 54.02(19) & 010-Er2-05 & 125.1(2) \\ \hline \\ $	O16– Er2– O9	123.4(3)	O15-Er2-O9	82.6(3)
$\begin{array}{cccccccc} 0.16-Er2-06 & 151.5(3) & 015-Er2-06 & 130.9(3) \\ 09-Er2-06 & 79.7(3) & 04-Er2-010 & 154.4(2) \\ 03-Er2-010 & 78.7(2) & 016-Er2-010 & 52.8(2) \\ 06-Er2-010 & 113.7(2) & 04-Er2-05 & 79.62(19) \\ 03-Er2-05 & 132.2(2) & 016-Er2-05 & 143.2(3) \\ 015-Er2-05 & 77.0(3) & 09-Er2-05 & 72.6(2) \\ 06-Er2-05 & 54.02(19) & 010-Er2-05 & 125.1(2) \\ \hline & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & & \\ & & & & & & & & & & & \\ & & & & & & & & & & & & \\ & & & & & & & & & & & & \\ $	O4–Er2–O6	85.2(2)	O3–Er2–O6	79.0(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O16-Er2-O6	151.5(3)	O15-Er2-O6	130.9(3)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O9–Er2–O6	79.7(3)	O4-Er2-O10	154.4(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O3–Er2–O10	78.7(2)	O16-Er2-O10	76.3(3)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O15-Er2-O10	89.7(3)	O9–Er2–O10	52.8(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O6–Er2–O10	113.7(2)	O4–Er2–O5	79.62(19)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O3–Er2–O5	132.2(2)	O16–Er2–O5	143.2(3)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	O15-Er2-O5	77.0(3)	O9–Er2–O5	72.6(2)
7 $O11-Yb1-O8$ $77.1(2)$ $O11-Yb1-O7$ $78.9(2)$ $O8-Yb1-O7$ $128.07(19)$ $O11-Yb1-O12$ $125.5(2)$ $O8-Yb1-O12$ $79.4(2)$ $O7-Yb1-O12$ $78.4(2)$ $O11-Yb1-O2$ $83.9(2)$ $O8-Yb1-O2$ $139.2(2)$ $O7-Yb1-O2$ $81.7(2)$ $O12-Yb1-O2$ $139.5(2)$ $O11-Yb1-O13$ $138.8(3)$ $O8-Yb1-O13$ $74.8(2)$ $O7-Yb1-O13$ $142.2(3)$ $O12-Yb1-O13$ $77.6(3)$ $O2-Yb1-O13$ $98.4(3)$ $O11-Yb1-O1$ $134.9(2)$ $O8-Yb1-O1$ $145.7(2)$ $O7-Yb1-O1$ $78.2(2)$ $O12-Yb-O1$ $86.6(2)$ $O2-Yb1-O1$ $54.8(2)$ $O12-Yb1-O1$ $71.7(3)$ $O11-Yb1-O14$ $77.5(3)$ $O8-Yb1-O14$ $73.3(3)$ $O7-Yb1-O14$ $42.7(3)$ $O12-Yb1-O14$ $73.3(3)$ $O7-Yb1-O14$ $99.0(2)$ $O4-Yb2-O3$ $88.8(2)$ $O4-Yb2-O16$ $88.8(3)$ $O3-Yb2-O15$ $77.4(3)$ $O4-Yb2-O16$ $88.8(3)$ $O3-Yb2-O16$ $149.4(3)$ $O15-Yb2-O16$ $72.1(4)$ $O4-Yb2-O10$ $152.6(2)$ $O3-Yb2-O10$ $109.3(3)$	O6–Er2–O5	54.02(19)	O10-Er2-O5	125.1(2)
O11-Yb1-O8 $77.1(2)$ $O11-Yb1-O7$ $78.9(2)$ $O8-Yb1-O7$ $128.07(19)$ $O11-Yb1-O12$ $125.5(2)$ $O8-Yb1-O12$ $79.4(2)$ $O7-Yb1-O12$ $78.4(2)$ $O11-Yb1-O2$ $83.9(2)$ $O8-Yb1-O2$ $139.2(2)$ $O7-Yb1-O2$ $81.7(2)$ $O12-Yb1-O2$ $139.5(2)$ $O11-Yb1-O13$ $138.8(3)$ $O8-Yb1-O13$ $74.8(2)$ $O7-Yb1-O13$ $142.2(3)$ $O12-Yb1-O13$ $77.6(3)$ $O2-Yb1-O13$ $98.4(3)$ $O11-Yb1-O1$ $134.9(2)$ $O8-Yb1-O1$ $145.7(2)$ $O7-Yb1-O1$ $78.2(2)$ $O12-Yb-O1$ $86.6(2)$ $O2-Yb1-O1$ $78.2(2)$ $O12-Yb-O1$ $86.6(2)$ $O2-Yb1-O1$ $54.8(2)$ $O12-Yb-O1$ $71.7(3)$ $O11-Yb1-O14$ $77.5(3)$ $O8-Yb1-O14$ $73.3(3)$ $O7-Yb1-O14$ $42.7(3)$ $O12-Yb1-O14$ $73.3(3)$ $O7-Yb1-O14$ $99.0(2)$ $O4-Yb2-O3$ $88.8(2)$ $O4-Yb2-O15$ $79.4(3)$ $O3-Yb2-O16$ $149.4(3)$ $O15-Yb2-O16$ $88.8(3)$ $O3-Yb2-O10$ $152.6(2)$ $O3-Yb2-O10$ $109.3(3)$ $O15-Yb2-O10$ $123.7(3)$ $O16-Yb2-O10$ $85.5(3)$			7	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O11-Yb1-O8	77.1(2)	O11-Yb1-O7	78.9(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O8-Yb1-O7	128.07(19)	O11-Yb1-O12	125.5(2)
O11-Yb1-O2 $83.9(2)$ $O8-Yb1-O2$ $139.2(2)$ $O7-Yb1-O2$ $81.7(2)$ $O12-Yb1-O2$ $139.5(2)$ $O11-Yb1-O13$ $138.8(3)$ $O8-Yb1-O13$ $74.8(2)$ $O7-Yb1-O13$ $142.2(3)$ $O12-Yb1-O13$ $77.6(3)$ $O2-Yb1-O13$ $98.4(3)$ $O11-Yb1-O1$ $134.9(2)$ $O8-Yb1-O1$ $145.7(2)$ $O7-Yb1-O1$ $78.2(2)$ $O12-Yb-O1$ $86.6(2)$ $O2-Yb1-O1$ $78.2(2)$ $O12-Yb-O1$ $86.6(2)$ $O2-Yb1-O1$ $54.8(2)$ $O13-Yb1-O1$ $71.7(3)$ $O11-Yb1-O14$ $77.5(3)$ $O8-Yb1-O14$ $73.3(3)$ $O7-Yb1-O14$ $142.7(3)$ $O12-Yb1-O14$ $138.8(3)$ $O2-Yb1-O14$ $47.5(3)$ $O12-Yb1-O14$ $138.8(3)$ $O2-Yb1-O14$ $99.0(2)$ $O4-Yb2-O3$ $88.8(2)$ $O4-Yb2-O15$ $79.4(3)$ $O3-Yb2-O15$ $77.4(3)$ $O4-Yb2-O16$ $88.8(3)$ $O3-Yb2-O16$ $149.4(3)$ $O15-Yb2-O16$ $72.1(4)$ $O4-Yb2-O10$ $152.6(2)$ $O3-Yb2-O10$ $109.3(3)$ $O15-Yb2-O10$ $123.7(3)$ $O16-Yb2-O10$ $85.5(3)$	O8-Yb1-O12	79.4(2)	O7-Yb1-O12	78.4(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O11-Yb1-O2	83.9(2)	O8-Yb1-O2	139.2(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O7–Yb1–O2	81.7(2)	O12-Yb1-O2	139.5(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O11-Yb1-O13	138.8(3)	O8-Yb1-O13	74.8(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O7-Yb1-O13	142.2(3)	O12-Yb1-O13	77.6(3)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	O2-Yb1-O13	98.4(3)	O11-Yb1-O1	134.9(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O8-Yb1-O1	145.7(2)	O7-Yb1-O1	78.2(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O12 –Yb–O1	86.6(2)	O2-Yb1-O1	54.8(2)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O13-Yb1-O1	71.7(3)	O11-Yb1-O14	77.5(3)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	O8-Yb1-O14	73.3(3)	O7-Yb1-O14	142.7(3)
O13-Yb1-O1466.0(3)O1-Yb1-O1499.0(2)O4-Yb2-O388.8(2)O4-Yb2-O1579.4(3)O3-Yb2-O1577.4(3)O4-Yb2-O1688.8(3)O3-Yb2-O16149.4(3)O15-Yb2-O1672.1(4)O4-Yb2-O10152.6(2)O3-Yb2-O10109.3(3)O15-Yb2-O10123.7(3)O16-Yb2-O1085.5(3)	O12-Yb1-O14	138.8(3)	O2-Yb1-O14	67.5(3)
O4-Yb2-O388.8(2)O4-Yb2-O1579.4(3)O3-Yb2-O1577.4(3)O4-Yb2-O1688.8(3)O3-Yb2-O16149.4(3)O15-Yb2-O1672.1(4)O4-Yb2-O10152.6(2)O3-Yb2-O10109.3(3)O15-Yb2-O10123.7(3)O16-Yb2-O1085.5(3)	O13-Yb1-O14	66.0(3)	O1-Yb1-O14	99.0(2)
O3-Yb2-O1577.4(3)O4-Yb2-O1688.8(3)O3-Yb2-O16149.4(3)O15-Yb2-O1672.1(4)O4-Yb2-O10152.6(2)O3-Yb2-O10109.3(3)O15-Yb2-O10123.7(3)O16-Yb2-O1085.5(3)	O4-Yb2-O3	88.8(2)	O4-Yb2-O15	79.4(3)
O3-Yb2-O16149.4(3)O15-Yb2-O1672.1(4)O4-Yb2-O10152.6(2)O3-Yb2-O10109.3(3)O15-Yb2-O10123.7(3)O16-Yb2-O1085.5(3)	O3-Yb2-O15	77.4(3)	O4-Yb2-O16	88.8(3)
O4-Yb2-O10152.6(2)O3-Yb2-O10109.3(3)O15-Yb2-O10123.7(3)O16-Yb2-O1085.5(3)	O3-Yb2-O16	149.4(3)	O15-Yb2-O16	72.1(4)
O15-Yb2-O10 123.7(3) O16-Yb2-O10 85.5(3)	O4-Yb2-O10	152.6(2)	O3-Yb2-O10	109.3(3)
	O15-Yb2-O10	123.7(3)	O16-Yb2-O10	85.5(3)

O4–Yb2–O6	85.3(2)	O3-Yb2-O6	79.0(2)
O15-Yb2-O6	152.0(3)	O16-Yb2-O6	131.2(3)
O10-Yb2-O6	78.5(3)	O4– Yb2– O9	154.4(2)
O3-Yb2-O9	78.1(2)	O15-Yb2-O9	76.3(3)
O16-Yb2-O9	91.5(3)	O10-Yb2-O9	52.8(2)
O6-Yb2-O9	113.1(2)	O4-Yb2-O5	79.6(2)
O3-Yb2-O5	132.2(2)	O15-Yb2-O5	142.9(3)
O16-Yb2-O5	77.2(3)	O10-Yb2-O5	73.0(2)
O6-Yb2-O5	54.09(19)	O9-Yb2-O5	125.4(2)







**Fig. S4** PXRD patterns of simulated from the X-ray single–crystal structures and as–synthesized samples of 1–7.



Fig. S5 The IR spectra of 1–7 recorded from a KBr pellet.





(b)

(d)

(f)

(h)











Fig. S6 (a) Coordination environments of Sm<sup>3+</sup> ions with the H atoms omitted for clarity; symmetry codes: a = 0.5-x, 1.5+y, 0.5-z; b = 1+x, 2-y, 0.5+z; c = 1-x, 2+y, 0.5-z; d = 1-x, 1+y, 0.5-z; e = 1+x, 1+y, 1+z; (b) Coordination polyhedron of Sm<sup>3+</sup> ions; (c) Coordination environments of Eu<sup>3+</sup> ions with the H atoms omitted for clarity; symmetry codes: a = 1-x, -1+y, 1.5-z; b = 0.5-x, -0.5+y, 1.5-z; c = x, -y, 0.5+z; d = 1-x, 1-y, 2-z; e = x, 1-y, 0.5+z; (d) Coordination polyhedron of  $Eu^{3+}$  ions; (e) Coordination environments of Gd<sup>3+</sup> ions with the H atoms omitted for clarity; symmetry codes: a = 0.5-x, 0.5+y, 2.5-z; b = 1+x, 2-y, 0.5+z; c = 1-x, 1+y, 2.5-z; d = 1-x, y, 2.5-z; e = 1+x, y, 1+z; (f) Coordination polyhedron of  $Gd^{3+}$  ions; (g) Coordination environments of  $Dy^{3+}$  ions with the H atoms omitted for clarity; symmetry codes: a = 0.5-x, 0.5-y, -z; b = 1-x, -y, -z; c = -0.5+x, 0.5+y, z; d = -0.5+x, -0.5-y, -0.5+z; e = 0.5-x, -0.5-y, -z; (h) Coordination polyhedron of  $Dy^{3+}$ ions; (i) Coordination environments of Er<sup>3+</sup> ions with the H atoms omitted for clarity; symmetry codes: a = 1-x, -y, 2-z; b = -0.5+x, 0.5+y, z; c = x, 1+y, z; d = 1-x, 1+y, 2.5-z; (j) Coordination polyhedron of Er3+ ions; (k) Coordination environments of  $Yb^{3+}$  ions with the H atoms omitted for clarity; symmetry codes: a = x, y, 1+z; b =

1.5–x, –0.5–y, 3–z; c = 0.5+x, –0.5+y, 1+ z; d = 0.5+x, 0.5+y, 1+ z; e = 1.5–x, 0.5+y, 3.5–z; (1) Coordination polyhedron of Yb<sup>3+</sup> ions.



**Fig. S7** Space filled representation of the 3–D framework in 4 seen from a, b, and c directions; Hydrogens, coordinated DMF molecules are omitted for clarity.



Fig. S8 The TG curves of 1–7.



Fig. S9 (a) UV–vis absorption and (b) emission spectra of  $H_4BBTC$  in solid state at room temperature.



Fig. S10 The excitation spectra of 2 (a), 3 (b), 4 (c), and 5 (d) in solid state at room temperature, monitored at 615, 467, 542 and 576 nm, respectively.



Fig. S11 Emission spectra of 1 (a) and 5 (b), and NIR emission spectra of 5 (c), 6 (d) and 7 (e).



Fig. S12 Luminescence decay profiles for 1 (a), 5 (b), 6 (c) and 7 (d).



Fig. S13 (a) Emission spectra of  $\mathbf{Eu}_{\mathbf{x}}\mathbf{Gd}_{\mathbf{1-x}}$ -BBTC with wide ranges of  $\mathbf{x} = 0.05-0.4$ ( $\lambda_{ex} = 340$  nm) in the solid state at room temperature and plot of luminescence intensity of the band corresponding to the  ${}^{5}\mathbf{D}_{0} \rightarrow {}^{7}\mathbf{F}_{2}$  transition of  $\mathbf{Eu}^{3+}$  ions against  $\mathbf{Eu}^{3+}$  ions concentration; (b) CIE chromaticity diagram for  $\mathbf{Eu}_{\mathbf{x}}\mathbf{Gd}_{\mathbf{1-x}}$ -BBTC excited at 340 nm.  $\mathbf{Eu}_{\mathbf{x}}\mathbf{Gd}_{\mathbf{1-x}}$ -BBTC (Eu, Gd%): **3** (0, 100), **A** (5, 95), **B** (15, 85), **C** (20, 80), **D** (25, 75), **E** (40, 60) and **2** (100, 0).

	CIE chromaticity coordinates
Gd-BBTC	(0.144, 0.199)
Eu <sub>0.05</sub> Gd <sub>0.95</sub> -BBTC	(0.360, 0.251)
Eu <sub>0.15</sub> Gd <sub>0.85</sub> -BBTC	(0.384, 0.267)
Eu <sub>0.20</sub> Gd <sub>0.80</sub> -BBTC	(0.400, 0.274)
Eu <sub>0.25</sub> Gd <sub>0.75</sub> -BBTC	(0.412, 0.277)
Eu <sub>0.4</sub> Gd <sub>0.6</sub> -BBTC	(0.463, 0.276)
Eu-BBTC	(0.622, 0.340)

Table S8 The corresponding CIE coordinates of the  $Eu_xGd_{1-x}$ -BBTC excited at 340nm



Fig. S14 (a) Emission spectra of  $Tb_yGd_{1-y}$ -BBTC with the ranges of y = 0.01-1.0( $\lambda_{ex} = 340$  nm) in the solid state at room temperature and Plot of luminescence intensity (the  ${}^5D_4 \rightarrow {}^7F_5$  band) of  $Tb^{3+}$  ions against  $Tb^{3+}$  ion concentration; (b) CIE chromaticity diagram for  $Tb_yGd_{1-y}$ -BBTC excited at 340 nm.  $Tb_yGd_{1-y}$ -BBTC (Tb, Gd%): **3** (0, 100), **A** (1, 99), **B** (10, 90), **C** (25, 75), **D** (50, 50), **E** (75, 25), **F** (95, 5) and **4** (100, 0).

	CIE chromaticity coordinates
Tb <sub>0.01</sub> Gd <sub>0.99</sub> -BBTC	(0.247, 0.299)
Tb <sub>0.1</sub> Gd <sub>0.9</sub> -BBTC	(0.251, 0.402)
Tb <sub>0.25</sub> Gd <sub>0.75</sub> -BBTC	(0.258, 0.434)
Tb <sub>0.5</sub> Gd <sub>0.5</sub> -BBTC	(0.265, 0.464)
Tb <sub>0.75</sub> Gd <sub>0.25</sub> -BBTC	(0.273, 0.512)
Tb <sub>0.95</sub> Gd <sub>0.05</sub> -BBTC	(0.277, 0.531)
ТЬ-ВВТС	(0.278, 0.536)

Table S9 The corresponding CIE coordinates of the  $Tb_yGd_{1-y}$ -BBTC excited at 340 nm



Fig. S15 The excitation spectra of  $Eu_{0.25}Gd_{0.75}$ -BBTC (a),  $Tb_{0.5}Gd_{0.5}$ -BBTC (b), and  $Eu_{0.015}Tb_{0.035}Gd_{0.95}$ -BBTC (c) in solid state at room temperature, monitored at 615, 542 and 615 nm, respectively.



Fig. S16 (a) Emission spectra and (b) CIE chromaticity diagram for  $Eu_{0.015}Tb_{0.035}Gd_{0.95}$ -BBTC excited at 340 nm.

**Table S10** The corresponding CIE coordinates of the  $Eu_xTb_yGd_{1-x-y}$ -BBTC excitedat 340nm

	CIE chromaticity coordinates
Eu <sub>0.045</sub> Tb <sub>0.055</sub> Gd <sub>0.9</sub> -BBTC	(0.386, 0.409)
Eu <sub>0.04</sub> Tb <sub>0.05</sub> Gd <sub>0.91</sub> -BBTC	(0.370, 0.403)
Eu <sub>0.03</sub> Tb <sub>0.045</sub> Gd <sub>0.925</sub> -BBTC	(0.344, 0.391)
Eu <sub>0.025</sub> Tb <sub>0.04</sub> Gd <sub>0.935</sub> -BBTC	(0.345, 0.364)
Eu <sub>0.015</sub> Tb <sub>0.035</sub> Gd <sub>0.95</sub> -BBTC	(0.334, 0.336)



Fig. S17 Emission spectra of complexes 2, 4 and the doped  $Eu_{0.015}Tb_{0.035}Gd_{0.95}$ -BBTC complex excited at 340 nm.



**Fig. S18** Luminescence decay profiles of  $Eu^{3+}$  (a) and  $Tb^{3+}$  (b) in the doped complex  $Eu_{0.015}Tb_{0.035}Gd_{0.95}$ –**BBTC** excited at 340 nm (monitored at 615 nm for  $Eu^{3+}$  (a), and 542 nm for  $Tb^{3+}$  (b), respectively).