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Di-μ-methacrylato-bis[diaquabis(methacrylato)europium(III)] methacrylic acid disolvate

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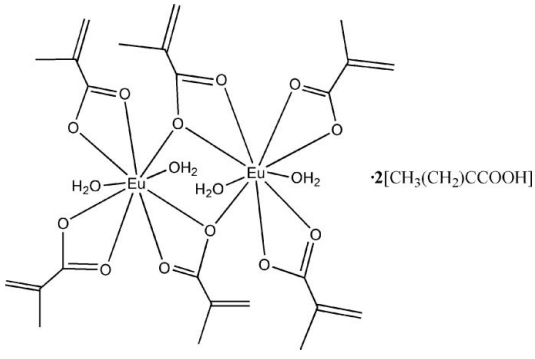
Key indicators: single-crystal X-ray study; T = 293 K; mean σ(C–C) = 0.008 Å; R factor = 0.026; wR factor = 0.063; data-to-parameter ratio = 19.7.

In the title centrosymmetric complex, $[Eu_2(C_4H_5O_2)_6(H_2O)_4]\cdot 2C_4H_6O_2$, the unique Eu^{III} cation is coordinated by seven carboxylate O atoms from four methacrylate ligands and two water molecules in a slightly disorted tricapped trigonal–prismatic environment. Two Eu^{III} ions are bridged by carboxylate groups, forming a dinuclear complex. The formula unit also contains two molecules of methacrylic acid. In the crystal structure, molecules are linked *via* intermolecular O—H···O hydrogen bonds, forming one-dimensional chains propagating along the *b*-axis direction

Related literature

For related literature, see: Millange *et al.* (2004); Petrochenkova *et al.* (2002); Yaghi *et al.* (1998).



Experimental

Crystal data

$[Eu_2(C_4H_5O_2)_6(H_2O)_4]\cdot 2C_4H_6O_2$
M_r = 1058.64
Triclinic, $P\overline{1}$
a = 10.008 (2) Å
b = 10.011 (2) Å
c = 12.523 (3) Å
α = 78.83 (3)°
β = 85.51 (3)°
γ = 61.14 (3)°
V = 1077.9 (5) Å^3
Z = 1
Mo $K\alpha$ radiation
μ = 2.96 mm^{-1}
T = 293 (2) K
0.43 × 0.17 × 0.13 mm

Data collection

Rigaku R-AXIS RAPID diffractometer
Absorption correction: multi-scan (Higashi, 1995)
T_{min} = 0.364, T_{max} = 0.705
10633 measured reflections
4883 independent reflections
4470 reflections with $I > 2\sigma(I)$
R_{int} = 0.023

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.026
$wR(F^2)$ = 0.063
S = 1.03
4883 reflections
248 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 1.21 e Å^{-3}
$\Delta\rho_{min}$ = −0.67 e Å^{-3}

Table 1
Selected bond lengths (Å).

Eu1—O5^{i}	2.348 (3)	Eu1—O7	2.432 (2)
Eu1—O10	2.388 (2)	Eu1—O4	2.543 (2)
Eu1—O6	2.392 (3)	Eu1—O8	2.548 (3)
Eu1—O9	2.409 (2)	Eu1—O5	2.807 (2)
Eu1—O3	2.427 (3)		

Symmetry code: (i) $-x+1, -y+1, -z$.

Table 2
Hydrogen-bond geometry (Å, °).

D—H···A	D—H	H···A	D···A	D—H···A
O10—H1A···O2^{ii}	1.01	1.75	2.684 (4)	152
O10—H1B···O3^{i}	0.96	1.79	2.700 (5)	156
O1—H1···O8^{iii}	0.82	1.90	2.707 (4)	168
O9—H9B···O4^{iv}	0.90	1.98	2.711 (3)	137
O9—H9A···O7^{iv}	0.90	2.15	2.871 (4)	136

Symmetry codes: (i) $-x+1, -y+1, -z$; (ii) $x, y, z-1$; (iii) $x, y, z+1$; (iv) $-x+1, -y, -z$.

Data collection: *RAPID-AUTO* (Rigaku, 1998); cell refinement: *RAPID-AUTO*; data reduction: *RAPID-AUTO*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *PLATON* (Spek, 2003); software used to prepare material for publication: *SHELXL97*.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: LH2579).

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S1. Comment

There has been considerable interest in the design and synthesis of supramolecular architectures (Yaghi *et al.*, 1998; Millange *et al.*, 2004). In preparing target metal complexes, carboxylate ligands have been frequently employed. We present here the hydrothermal synthesis and crystal structure of a europium(III) dinuclear complex $[Eu(C_4H_5O_2)_3(H_2O)_2]_2{\cdot}2(C_4H_6O_2)]$ (I). In the title complex (Fig. 1), each Eu^{III} ion is coordination by seven carboxy O atoms from four methacrylate ligands and two water molecules, with Eu—O distances ranging from 2.348 (3)–2.807 (3) Å. These values are in good agreement with those found in an other closely related structure (Petrochenkova *et al.*, 2002). Two Eu^{III} ions are bridged by carboxylate groups to create a discrete centrosymmetric dinuclear complex. In the crystal structure, complex molecules and solvated methacrylic acid molecules are linked *via* intermolecular O—H···O hydrogen bonds froming one-dimensional chains running along the *b* axis direction (Fig. 2).

S2. Experimental

The title complex was hydrothermally prepared from a mixture of $Eu(NO_3)_3{\cdot}6H_2O$ (0.2 mmol), methacrylic acid (0.6 mmol), NaOH (0.6 mmol) and H_2O (10 ml). The slurry was stirred for 30 min and heated at 393 K for 72 h in a Teflon-lined stainless steel autoclave (25 ml) under autogenous pressure. After cooling to room temperature, the block-shaped crystals were washed with water and dried in air.

S3. Refinement

All H atoms were treated as riding, with C—H = 0.93–0.96 Å, O—H = 0.8199–1.011 (as found positions) Å, and U_{iso}(H) = 1.2U_{eq} (aryl C and O) or 1.5U_{eq} (methyl C). The terminal C atoms of the methacrylate ligands and the methacrylic acid molecules have larger than normal anisotropic displacement parameters. This may be the effect from data collected at room temperature or the result of very slight disorder which has not been modelled.

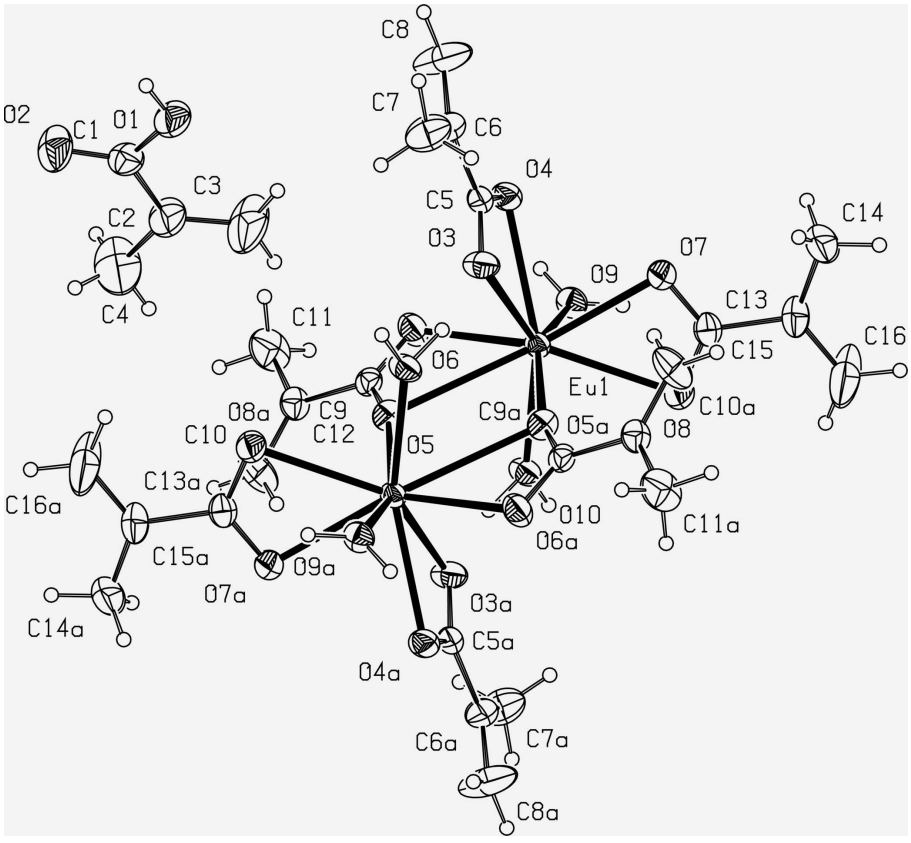

Figure 1

The molecular structure showing displacement ellipsoids at the 30% probability level [symmetry code: (*a*) -*x* + 1,-*y* + 1,-*z*]. Only the unique methacrylic acid of the symmetric unit has been shown.

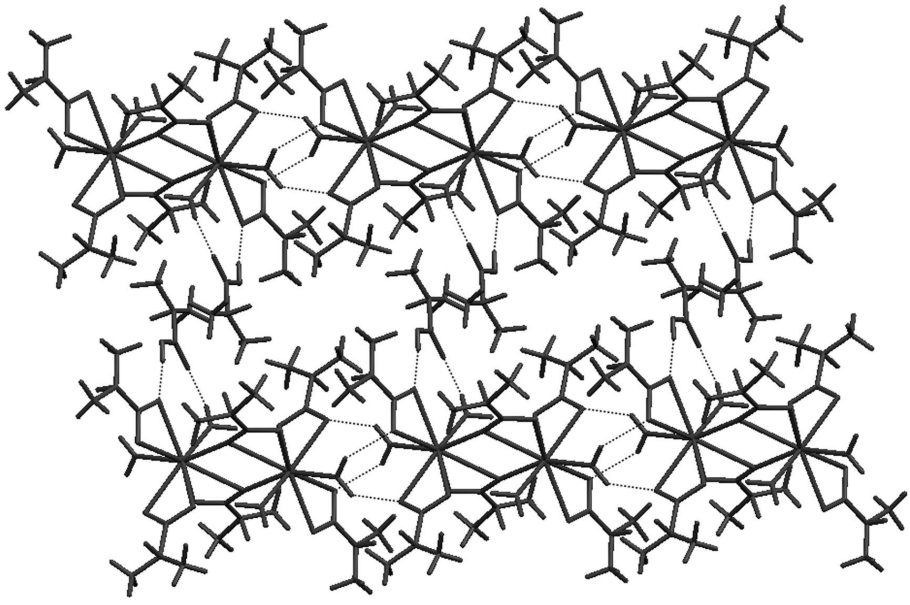

Figure 2

The packing of the title compound. Dashed lines indicate hydrogen bonds.

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Crystal data

$[Eu_2(C_4H_5O_2)_6(H_2O)_4]\cdot 2C_4H_6O_2$
$M_r = 1058.64$
Triclinic, $P\overline{1}$
Hall symbol: -P 1
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$c = 12.523$ (3) Å
$\alpha = 78.83$ (3)°
$\beta = 85.51$ (3)°
$\gamma = 61.14$ (3)°
$V = 1077.9$ (5) Å^3
$Z = 1$
$F(000) = 528$
$D_x = 1.631$ Mg m^{-3}
Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å
Cell parameters from 9849 reflections
$\theta = 3.1$–$27.5°$
$\mu = 2.96$ mm^{-1}
$T = 293$ K
Needle, colorless
0.43 × 0.17 × 0.13 mm

Data collection

Rigaku R-AXIS RAPID diffractometer
Radiation source: fine-focus sealed tube
Graphite monochromator
Detector resolution: 10.0 pixels mm^{-1}
ω scan
Absorption correction: multi-scan (Higashi, 1995)
$T_{min} = 0.364$, $T_{max} = 0.705$
10633 measured reflections
4883 independent reflections
4470 reflections with $I > 2\sigma(I)$
$R_{int} = 0.023$
$\theta_{max} = 27.5°$, $\theta_{min} = 3.1°$
$h = -12\rightarrow12$
$k = -12\rightarrow11$
$l = -16\rightarrow16$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.026$
$wR(F^2) = 0.063$
$S = 1.03$
4883 reflections
248 parameters
0 restraints
Primary atom site location: structure-invariant direct methods
Secondary atom site location: difference Fourier map
Hydrogen site location: inferred from neighbouring sites
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0286P)^2 + 1.0172P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} < 0.001$
$\Delta\rho_{max} = 1.21$ e Å^{-3}
$\Delta\rho_{min} = -0.67$ e Å^{-3}

Special details

Geometry. All e.s.d.'s (except the e.s.d. in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell e.s.d.'s are taken into account individually in the estimation of e.s.d.'s in distances, angles and torsion angles; correlations between e.s.d.'s in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell e.s.d.'s is used for estimating e.s.d.'s involving l.s. planes.

Refinement. Refinement of F^2 against ALL reflections. The weighted R-factor wR and goodness of fit S are based on F^2, conventional R-factors R are based on F, with F set to zero for negative F^2. The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating R-factors(gt) *etc*. and is not relevant to the choice of reflections for refinement. R-factors based on F^2 are statistically about twice as large as those based on F, and R- factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å^2)

	x	y	z	U_{iso}*/U_{eq}
Eu1	0.496997 (17)	0.298680 (17)	−0.024157 (12)	0.03420 (6)
O1	0.5258 (4)	0.3096 (4)	0.5855 (2)	0.0745 (9)
H1	0.5008	0.3100	0.6494	0.089*

O2	0.7431 (4)	0.2686 (5)	0.6523 (3)	0.0849 (11)
O3	0.3543 (3)	0.3761 (3)	0.1388 (2)	0.0519 (6)
O4	0.4607 (3)	0.1270 (3)	0.1408 (2)	0.0469 (5)
O5	0.6467 (3)	0.4299 (3)	0.06309 (19)	0.0446 (5)
O6	0.7243 (3)	0.1818 (3)	0.0854 (2)	0.0538 (6)
O7	0.2929 (3)	0.2521 (3)	−0.06968 (19)	0.0473 (5)
O8	0.4088 (3)	0.3083 (3)	−0.2123 (2)	0.0531 (6)
O9	0.6445 (3)	0.0403 (3)	−0.0634 (2)	0.0445 (5)
H9A	0.7023	−0.0394	−0.0114	0.053*
H9B	0.6181	0.0142	−0.1199	0.053*
O10	0.6665 (3)	0.3480 (3)	−0.1503 (2)	0.0481 (6)
H1A	0.7259	0.3153	−0.2181	0.058*
H1B	0.6891	0.4288	−0.1425	0.058*
C1	0.6667 (5)	0.2842 (5)	0.5769 (3)	0.0576 (9)
C2	0.7280 (6)	0.2703 (7)	0.4668 (4)	0.0808 (14)
C3	0.6410 (8)	0.2790 (12)	0.3849 (5)	0.153 (4)
H3A	0.6790	0.2728	0.3149	0.184*
H3B	0.5435	0.2911	0.3990	0.184*
C4	0.8794 (8)	0.2517 (12)	0.4530 (6)	0.159 (4)
H4A	0.9012	0.2644	0.3768	0.238*
H4B	0.9516	0.1500	0.4886	0.238*
H4C	0.8867	0.3282	0.4844	0.238*
C5	0.3815 (4)	0.2424 (4)	0.1872 (3)	0.0411 (7)
C6	0.3183 (5)	0.2225 (5)	0.2970 (3)	0.0557 (9)
C7	0.2164 (6)	0.3603 (6)	0.3392 (4)	0.0829 (14)
H7A	0.1690	0.3337	0.4034	0.124*
H7B	0.1394	0.4312	0.2853	0.124*
H7C	0.2728	0.4083	0.3572	0.124*
C8	0.3595 (8)	0.0754 (7)	0.3509 (5)	0.114 (2)
H8A	0.3209	0.0598	0.4194	0.137*
H8B	0.4261	−0.0091	0.3190	0.137*
C9	0.7497 (3)	0.2914 (4)	0.0900 (2)	0.0386 (7)
C10	0.9501 (5)	0.3596 (6)	0.1039 (5)	0.0779 (14)
H10A	1.0492	0.3340	0.1216	0.094*
H10B	0.8827	0.4601	0.0710	0.094*
C11	1.0032 (5)	0.0918 (6)	0.1773 (5)	0.0807 (15)
H11A	1.0961	0.0822	0.2024	0.121*
H11B	1.0263	0.0248	0.1254	0.121*
H11C	0.9517	0.0630	0.2379	0.121*
C12	0.9047 (4)	0.2524 (4)	0.1257 (3)	0.0452 (7)
C13	0.3057 (4)	0.2764 (4)	−0.1712 (3)	0.0451 (7)
C14	0.0810 (6)	0.2365 (7)	−0.1881 (5)	0.0894 (17)
H14A	0.0142	0.2421	−0.2418	0.134*
H14B	0.0232	0.3108	−0.1419	0.134*
H14C	0.1282	0.1342	−0.1450	0.134*
C15	0.1952 (4)	0.2696 (5)	−0.2407 (3)	0.0595 (10)
C16	0.2013 (7)	0.3045 (13)	−0.3493 (5)	0.169 (5)
H16A	0.1287	0.3078	−0.3933	0.203*

H16B	0.2781	0.3255	−0.3806	0.203*

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Eu1	0.04010 (9)	0.03521 (9)	0.03404 (9)	−0.02243 (7)	0.00397 (6)	−0.00989 (6)
O1	0.0741 (19)	0.111 (3)	0.0470 (16)	−0.0522 (19)	0.0110 (14)	−0.0135 (16)
O2	0.079 (2)	0.136 (3)	0.0553 (19)	−0.055 (2)	0.0165 (16)	−0.046 (2)
O3	0.0736 (16)	0.0468 (14)	0.0465 (14)	−0.0376 (13)	0.0186 (12)	−0.0149 (11)
O4	0.0618 (14)	0.0430 (13)	0.0452 (13)	−0.0321 (12)	0.0033 (11)	−0.0091 (10)
O5	0.0417 (12)	0.0444 (14)	0.0432 (13)	−0.0171 (11)	0.0011 (9)	−0.0075 (10)
O6	0.0541 (14)	0.0451 (14)	0.0685 (17)	−0.0288 (12)	−0.0140 (12)	−0.0035 (12)
O7	0.0515 (13)	0.0583 (15)	0.0404 (13)	−0.0330 (12)	0.0013 (10)	−0.0082 (11)
O8	0.0550 (14)	0.0765 (18)	0.0386 (13)	−0.0395 (14)	0.0067 (10)	−0.0137 (12)
O9	0.0489 (12)	0.0378 (12)	0.0490 (14)	−0.0208 (10)	0.0034 (10)	−0.0135 (10)
O10	0.0625 (14)	0.0554 (15)	0.0466 (13)	−0.0419 (13)	0.0186 (11)	−0.0221 (11)
C1	0.068 (2)	0.063 (2)	0.048 (2)	−0.036 (2)	0.0153 (18)	−0.0186 (18)
C2	0.086 (3)	0.124 (5)	0.049 (2)	−0.062 (3)	0.017 (2)	−0.025 (3)
C3	0.123 (5)	0.315 (12)	0.054 (3)	−0.126 (7)	0.028 (3)	−0.055 (5)
C4	0.137 (6)	0.315 (13)	0.095 (5)	−0.152 (8)	0.063 (5)	−0.092 (7)
C5	0.0493 (17)	0.051 (2)	0.0357 (16)	−0.0336 (16)	0.0013 (13)	−0.0091 (14)
C6	0.070 (2)	0.070 (3)	0.0378 (19)	−0.043 (2)	0.0078 (16)	−0.0078 (17)
C7	0.093 (3)	0.095 (4)	0.055 (3)	−0.043 (3)	0.026 (2)	−0.017 (3)
C8	0.185 (7)	0.084 (4)	0.065 (3)	−0.068 (4)	0.036 (4)	0.004 (3)
C9	0.0392 (15)	0.0477 (19)	0.0302 (15)	−0.0215 (15)	0.0029 (12)	−0.0088 (13)
C10	0.048 (2)	0.080 (3)	0.121 (4)	−0.039 (2)	0.004 (2)	−0.027 (3)
C11	0.043 (2)	0.069 (3)	0.117 (4)	−0.019 (2)	−0.015 (2)	−0.002 (3)
C12	0.0347 (15)	0.051 (2)	0.0480 (19)	−0.0174 (15)	0.0017 (13)	−0.0136 (15)
C13	0.0441 (17)	0.0443 (19)	0.048 (2)	−0.0193 (15)	−0.0020 (14)	−0.0154 (15)
C14	0.091 (4)	0.103 (4)	0.095 (4)	−0.069 (3)	−0.035 (3)	0.015 (3)
C15	0.0461 (19)	0.073 (3)	0.059 (2)	−0.0237 (19)	−0.0103 (17)	−0.020 (2)
C16	0.105 (5)	0.394 (15)	0.060 (4)	−0.155 (7)	0.008 (3)	−0.057 (6)

Geometric parameters (Å, º)

Eu1—O5^{i}	2.348 (3)	C3—H3A	0.9300
Eu1—O10	2.388 (2)	C3—H3B	0.9300
Eu1—O6	2.392 (3)	C4—H4A	0.9600
Eu1—O9	2.409 (2)	C4—H4B	0.9600
Eu1—O3	2.427 (3)	C4—H4C	0.9600
Eu1—O7	2.432 (2)	C5—C6	1.486 (5)
Eu1—O4	2.543 (2)	C6—C8	1.366 (6)
Eu1—O8	2.548 (3)	C6—C7	1.436 (6)
Eu1—O5	2.807 (2)	C7—H7A	0.9600
Eu1—C13	2.869 (3)	C7—H7B	0.9600
Eu1—C5	2.869 (3)	C7—H7C	0.9600
Eu1—C9	2.965 (3)	C8—H8A	0.9300
O1—C1	1.306 (5)	C8—H8B	0.9300

O1—H1	0.8199	C9—C12	1.489 (4)
O2—C1	1.201 (5)	C10—C12	1.330 (6)
O3—C5	1.262 (4)	C10—H10A	0.9300
O4—C5	1.267 (4)	C10—H10B	0.9300
O5—C9	1.262 (4)	C11—C12	1.463 (6)
O5—Eu1^{i}	2.348 (3)	C11—H11A	0.9600
O6—C9	1.251 (4)	C11—H11B	0.9600
O7—C13	1.256 (4)	C11—H11C	0.9600
O8—C13	1.265 (4)	C13—C15	1.494 (5)
O9—H9A	0.8987	C14—C15	1.419 (6)
O9—H9B	0.8986	C14—H14A	0.9600
O10—H1A	1.0110	C14—H14B	0.9600
O10—H1B	0.9620	C14—H14C	0.9600
C1—C2	1.467 (6)	C15—C16	1.341 (7)
C2—C3	1.360 (8)	C16—H16A	0.9300
C2—C4	1.435 (7)	C16—H16B	0.9300

O5^{i}—Eu1—O10	81.90 (9)	Eu1—O9—H9A	120.9
O5^{i}—Eu1—O6	119.10 (9)	Eu1—O9—H9B	120.1
O10—Eu1—O6	79.03 (9)	H9A—O9—H9B	115.3
O5^{i}—Eu1—O9	156.71 (8)	Eu1—O10—H1A	141.7
O10—Eu1—O9	82.67 (8)	Eu1—O10—H1B	118.3
O6—Eu1—O9	74.59 (9)	H1A—O10—H1B	99.9
O5^{i}—Eu1—O3	73.91 (9)	O2—C1—O1	123.7 (4)
O10—Eu1—O3	141.94 (8)	O2—C1—C2	121.8 (4)
O6—Eu1—O3	87.49 (10)	O1—C1—C2	114.4 (4)
O9—Eu1—O3	127.81 (8)	C3—C2—C4	124.0 (5)
O5^{i}—Eu1—O7	95.23 (9)	C3—C2—C1	120.1 (5)
O10—Eu1—O7	125.78 (8)	C4—C2—C1	115.9 (5)
O6—Eu1—O7	141.54 (8)	C2—C3—H3A	120.0
O9—Eu1—O7	79.87 (9)	C2—C3—H3B	120.0
O3—Eu1—O7	85.95 (9)	H3A—C3—H3B	120.0
O5^{i}—Eu1—O4	124.80 (8)	C2—C4—H4A	109.5
O10—Eu1—O4	148.55 (9)	C2—C4—H4B	109.5
O6—Eu1—O4	73.37 (9)	H4A—C4—H4B	109.5
O9—Eu1—O4	75.78 (8)	C2—C4—H4C	109.5
O3—Eu1—O4	52.07 (8)	H4A—C4—H4C	109.5
O7—Eu1—O4	72.79 (8)	H4B—C4—H4C	109.5
O5^{i}—Eu1—O8	85.16 (9)	O3—C5—O4	119.5 (3)
O10—Eu1—O8	73.95 (8)	O3—C5—C6	119.7 (3)
O6—Eu1—O8	140.49 (9)	O4—C5—C6	120.8 (3)
O9—Eu1—O8	73.85 (9)	O3—C5—Eu1	57.10 (17)
O3—Eu1—O8	131.04 (9)	O4—C5—Eu1	62.36 (17)
O7—Eu1—O8	51.92 (8)	C6—C5—Eu1	176.8 (3)
O4—Eu1—O8	120.10 (8)	C8—C6—C7	124.2 (4)
O5^{i}—Eu1—O5	70.43 (9)	C8—C6—C5	118.3 (4)
O10—Eu1—O5	67.57 (7)	C7—C6—C5	117.5 (4)
O6—Eu1—O5	48.79 (8)	C6—C7—H7A	109.5

O9—Eu1—O5	118.84 (8)	C6—C7—H7B	109.5
O3—Eu1—O5	76.73 (8)	H7A—C7—H7B	109.5
O7—Eu1—O5	159.92 (8)	C6—C7—H7C	109.5
O4—Eu1—O5	103.32 (7)	H7A—C7—H7C	109.5
O8—Eu1—O5	136.54 (8)	H7B—C7—H7C	109.5
O5^{i}—Eu1—C13	89.82 (10)	C6—C8—H8A	120.0
O10—Eu1—C13	100.09 (9)	C6—C8—H8B	120.0
O6—Eu1—C13	150.28 (9)	H8A—C8—H8B	120.0
O9—Eu1—C13	75.84 (9)	O6—C9—O5	120.3 (3)
O3—Eu1—C13	108.63 (10)	O6—C9—C12	117.9 (3)
O7—Eu1—C13	25.76 (9)	O5—C9—C12	121.8 (3)
O4—Eu1—C13	96.56 (9)	O6—C9—Eu1	51.37 (16)
O8—Eu1—C13	26.16 (9)	O5—C9—Eu1	70.44 (17)
O5—Eu1—C13	157.60 (9)	C12—C9—Eu1	162.5 (2)
O5^{i}—Eu1—C5	99.33 (10)	C12—C10—H10A	120.0
O10—Eu1—C5	155.54 (9)	C12—C10—H10B	120.0
O6—Eu1—C5	79.14 (10)	H10A—C10—H10B	120.0
O9—Eu1—C5	101.94 (10)	C12—C11—H11A	109.5
O3—Eu1—C5	25.89 (9)	C12—C11—H11B	109.5
O7—Eu1—C5	78.59 (9)	H11A—C11—H11B	109.5
O4—Eu1—C5	26.19 (9)	C12—C11—H11C	109.5
O8—Eu1—C5	130.48 (8)	H11A—C11—H11C	109.5
O5—Eu1—C5	89.66 (8)	H11B—C11—H11C	109.5
C13—Eu1—C5	104.33 (10)	C10—C12—C11	123.5 (4)
O5^{i}—Eu1—C9	95.46 (9)	C10—C12—C9	119.6 (4)
O10—Eu1—C9	68.69 (8)	C11—C12—C9	116.8 (3)
O6—Eu1—C9	24.12 (9)	O7—C13—O8	119.9 (3)
O9—Eu1—C9	95.06 (9)	O7—C13—C15	118.4 (3)
O3—Eu1—C9	84.62 (9)	O8—C13—C15	121.7 (3)
O7—Eu1—C9	163.21 (8)	O7—C13—Eu1	57.33 (16)
O4—Eu1—C9	90.47 (9)	O8—C13—Eu1	62.64 (17)
O8—Eu1—C9	142.12 (8)	C15—C13—Eu1	175.0 (3)
O5—Eu1—C9	25.07 (8)	C15—C14—H14A	109.5
C13—Eu1—C9	166.67 (9)	C15—C14—H14B	109.5
C5—Eu1—C9	86.92 (9)	H14A—C14—H14B	109.5
C1—O1—H1	109.4	C15—C14—H14C	109.5
C5—O3—Eu1	97.0 (2)	H14A—C14—H14C	109.5
C5—O4—Eu1	91.45 (19)	H14B—C14—H14C	109.5
C9—O5—Eu1^{i}	165.5 (2)	C16—C15—C14	122.7 (4)
C9—O5—Eu1	84.49 (18)	C16—C15—C13	119.1 (4)
Eu1^{i}—O5—Eu1	109.57 (9)	C14—C15—C13	118.0 (4)
C9—O6—Eu1	104.5 (2)	C15—C16—H16A	120.0
C13—O7—Eu1	96.9 (2)	C15—C16—H16B	120.0
C13—O8—Eu1	91.2 (2)	H16A—C16—H16B	120.0

Symmetry code: (i) $-x+1, -y+1, -z$.

Hydrogen-bond geometry (Å, º)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
O10—H1*A*···O2^{ii}	1.01	1.75	2.684 (4)	152
O10—H1*B*···O3^{i}	0.96	1.79	2.700 (5)	156
O1—H1···O8^{iii}	0.82	1.90	2.707 (4)	168
O9—H9*B*···O4^{iv}	0.90	1.98	2.711 (3)	137
O9—H9*A*···O7^{iv}	0.90	2.15	2.871 (4)	136

Symmetry codes: (i) −*x*+1, −*y*+1, −*z*; (ii) *x*, *y*, *z*−1; (iii) *x*, *y*, *z*+1; (iv) −*x*+1, −*y*, −*z*.