Acta Crystallographica Section E
Structure Reports Online
ISSN 1600-5368

catena-Poly[[(4,7-diphenyl-1,10-phenanthroline)lead(II)]-μ-fumarato]

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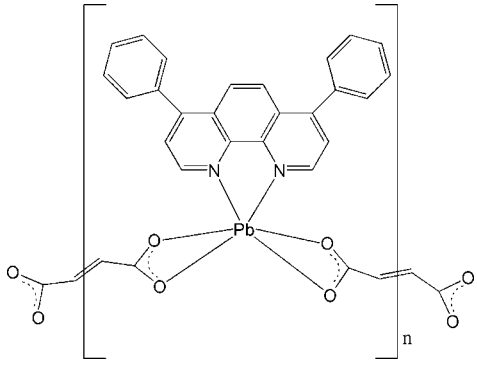
Received 19 October 2007; accepted 27 October 2007

Key indicators: single-crystal X-ray study; T = 293 K; mean σ(C–C) = 0.007 Å; R factor = 0.036; wR factor = 0.061; data-to-parameter ratio = 16.6.

In the title compound, $[Pb(C_4H_2O_4)(C_{24}H_{16}N_2)]_n$, the Pb^{II} atom is chelated by 4,7-diphenyl-1,10-phenanthroline (L) and also bonded to four O atoms from two fumarate dianions to yield an irregular PbN_2O_4 coordination polyhedron. The centrosymmetric fumarate ligands bridge neighboring Pb^{II} atoms to generate a chain structure. Aromatic π–π stacking between L ligands in adjacent chains [minimum centroid–centroid separation = 3.462 (3) Å] leads to a two-dimensional supramolecular array.

Related literature

For studies on related lead(II) carboxylates, see: Fan & Zhu (2006); Yang *et al.* (2007).



Experimental

Crystal data

$[Pb(C_4H_2O_4)(C_{24}H_{16}N_2)]$
M_r = 653.63
Triclinic, $P\overline{1}$
a = 8.3044 (17) Å
b = 11.021 (2) Å
c = 12.746 (3) Å
α = 89.35 (3)°
β = 86.73 (3)°
γ = 82.49 (3)°
V = 1154.7 (4) Å^3
Z = 2
Mo $K\alpha$ radiation
μ = 7.35 mm^{-1}
T = 293 (2) K
0.18 × 0.16 × 0.15 mm

Data collection

Rigaku R-AXIS RAPID diffractometer
Absorption correction: multi-scan (*ABSCOR*; Higashi, 1995)
T_{min} = 0.254, T_{max} = 0.333
11422 measured reflections
5231 independent reflections
4411 reflections with $I > 2\sigma(I)$
R_{int} = 0.041

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.037
$wR(F^2)$ = 0.061
S = 1.06
5231 reflections
316 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.77 e Å^{-3}
$\Delta\rho_{min}$ = −0.70 e Å^{-3}

Table 1
Selected bond lengths (Å).

Pb1—N1	2.590 (4)	Pb1—O2	2.740 (4)
Pb1—N2	2.645 (4)	Pb1—O3	2.313 (3)
Pb1—O1	2.449 (4)	Pb1—O4	2.705 (4)

Data collection: *PROCESS-AUTO* (Rigaku, 1998); cell refinement: *PROCESS-AUTO*; data reduction: *PROCESS-AUTO*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL-Plus* (Sheldrick, 1990); software used to prepare material for publication: *SHELXL97*.

The authors thank Qiqihar University for supporting this work.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HB2602).

References

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  doi:10.1107/S1600536807053743

supplementary materials

Acta Cryst. (2007). E**63**, m2890 [**doi:10.1107/S1600536807053743**]

catena-Poly[[(4,7-diphenyl-1,10-phenanthroline)lead(II)]-μ-fumarato]

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Comment

Metal cations with an s^2 electron configuration have important applications in electroluminescent devices or organic light-emitting diode technology (Fan & Zhu, 2006). Among them, the Pb^{II} coordination polymers have received much attention due to their interesting network topologies and properties (Yang *et al.*, 2007). Herein, we present a new Pb(II) coordination polymer, namely the title compound, (I), [Pb(fum)(*L*)], where fum = the fumarate dianion and *L* = 4,7-diphenyl-1,10-phenanthroline.

In compound (I) the Pb^{II} atom is six-coordinated by four carboxylate O atoms from two different fum ligands and two N atoms from one *L* ligand (Table 1, Fig. 1). The resulting PbN_2O_6 polyhedron is irregular, perhaps caused, in part, by the stereochemical activity of the Pb lone pair of electrons. There are two fum half-molecules in the asymmetric unit, both being completed by inversion symmetry. The neighboring Pb^{II} atoms are linked by the fum dianions to form a chain structure and the *L* ligands are decorded on both sides of the chains (Fig. 2). Furthermore, π-π interactions [minimum centroid-centroid separation = 3.462 (3) Å]. between *L* ligands in neighboring chains yields a two-dimensional supramolecular layer structure (Fig. 3).

Experimental

A mixture of $Pb(NO_3)_2$ (1 mmol), H_2fum (1 mmol) and *L* (1 mmol) were dissolved in 12 ml distilled water, followed by addition of triethylamine until the pH value of the system was adjusted to about 5.8. The resulting solution was sealed in a 23-ml Teflon-lined stainless steel autoclave and heated at 450 K for 10 days under autogenous pressure. Afterwards, the reaction system was slowly cooled to room temperature. Colourless blocks of (I) were collected.

Refinement

All the H atoms were generated geometrically (C—H = 0.93 Å) and refined as riding with U_{iso}(H)= 1.2U_{eq}(C).

Figures

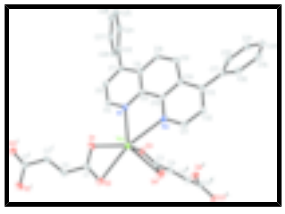


Fig. 1. The asymmetric unit of (I) expanded to show the complete fum dianions, with displacement ellipsoids for the non-hydrogen atoms drawn at the 30% probability level. H atoms omitted for clarity. Symmetry codes: (i) 1 − *x*, −*y*, 1 − *z*; (ii) −*x*, −*y*, −*z*.

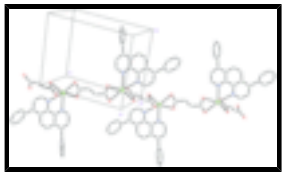


Fig. 2. View of the chain structure of (I). The hydrogen atoms are omitted for clarity.

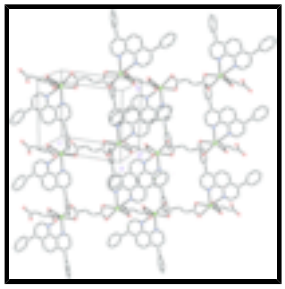


Fig. 3. The supramolecular layer structure of (I). The hydrogen atoms are omitted for clarity.

catena-Poly[[(4,7-diphenyl-1,10-phenanthroline)lead(II)]-μ-fumarato]

Crystal data

$[Pb(C_4H_2O_4)(C_{24}H_{16}N_2)]$	$Z = 2$
$M_r = 653.63$	$F_{000} = 628$
Triclinic, $P\overline{1}$	$D_x = 1.880$ Mg m^{-3}
Hall symbol: -P 1	Mo $K\alpha$ radiation $\lambda = 0.71073$ Å
$a = 8.3044$ (17) Å	Cell parameters from 10181 reflections
$b = 11.021$ (2) Å	$\theta = 3.0$–27.5°
$c = 12.746$ (3) Å	$\mu = 7.35$ mm^{-1}
$\alpha = 89.35$ (3)°	$T = 293$ (2) K
$\beta = 86.73$ (3)°	Block, colorless
$\gamma = 82.49$ (3)°	0.18 × 0.16 × 0.15 mm
$V = 1154.7$ (4) Å^3	

Data collection

Rigaku R-AXIS RAPID diffractometer	5231 independent reflections
Radiation source: rotating anode	4411 reflections with $I > 2\sigma(I)$
Monochromator: graphite	$R_{int} = 0.041$
Detector resolution: 10.0 pixels mm^{-1}	$\theta_{max} = 27.5^\circ$
$T = 293(2)$ K	$\theta_{min} = 3.0^\circ$
ω scan	$h = -10 \rightarrow 10$
Absorption correction: multi-scan (ABSCOR; Higashi, 1995)	$k = -14 \rightarrow 14$
$T_{min} = 0.254$, $T_{max} = 0.333$	$l = -16 \rightarrow 14$
11422 measured reflections	

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)] = 0.037$	H-atom parameters constrained
$wR(F^2) = 0.061$	$w = 1/[\sigma^2(F_o^2) + (0.0096P)^2 + 1.8148P]$ where $P = (F_o^2 + 2F_c^2)/3$
$S = 1.06$	$(\Delta/\sigma)_{max} = 0.002$
5231 reflections	$\Delta\rho_{max} = 0.77$ e Å^{-3}
316 parameters	$\Delta\rho_{min} = -0.70$ e Å^{-3}
Primary atom site location: structure-invariant direct methods	Extinction correction: none

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}
C1	0.4593 (6)	0.0099 (5)	0.3502 (4)	0.0427 (12)
C2	0.4835 (6)	−0.0340 (4)	0.4607 (4)	0.0432 (12)
H2	0.4744	−0.1158	0.4750	0.052*
C3	0.1800 (6)	0.0473 (4)	0.0722 (4)	0.0401 (12)
C4	0.0161 (6)	0.0255 (4)	0.0441 (4)	0.0419 (12)
H4	−0.0706	0.0494	0.0920	0.050*
C5	0.2750 (6)	0.3741 (4)	0.3041 (4)	0.0400 (12)
H5	0.2981	0.3115	0.3526	0.048*
C6	0.1994 (7)	0.4868 (4)	0.3407 (4)	0.0429 (12)
H6	0.1737	0.4979	0.4122	0.051*
C7	0.1623 (6)	0.5819 (4)	0.2720 (4)	0.0384 (11)
C8	0.2041 (6)	0.5598 (4)	0.1626 (4)	0.0377 (11)
C9	0.2769 (6)	0.4420 (4)	0.1324 (4)	0.0342 (11)
C10	0.3062 (6)	0.4128 (4)	0.0226 (4)	0.0356 (11)
C11	0.3919 (7)	0.2663 (4)	−0.1023 (4)	0.0492 (14)
H11	0.4357	0.1865	−0.1197	0.059*
C12	0.3552 (7)	0.3488 (4)	−0.1829 (4)	0.0470 (13)
H12	0.3729	0.3224	−0.2522	0.056*

C13	0.2933 (6)	0.4686 (4)	−0.1631 (4)	0.0382 (11)
C14	0.2685 (6)	0.5034 (4)	−0.0553 (4)	0.0362 (11)
C15	0.2079 (7)	0.6242 (4)	−0.0196 (4)	0.0513 (15)
H15	0.1918	0.6868	−0.0690	0.062*
C16	0.1732 (7)	0.6510 (4)	0.0830 (4)	0.0517 (15)
H16	0.1285	0.7300	0.1022	0.062*
C17	0.2590 (6)	0.5552 (4)	−0.2513 (4)	0.0372 (11)
C18	0.3689 (6)	0.5503 (5)	−0.3385 (4)	0.0447 (13)
H18	0.4610	0.4922	−0.3403	0.054*
C19	0.3443 (8)	0.6296 (5)	−0.4222 (4)	0.0549 (15)
H19	0.4189	0.6241	−0.4798	0.066*
C20	0.2103 (7)	0.7165 (5)	−0.4208 (4)	0.0511 (14)
H20	0.1956	0.7715	−0.4763	0.061*
C21	0.0971 (7)	0.7223 (5)	−0.3369 (4)	0.0497 (14)
H21	0.0047	0.7800	−0.3367	0.060*
C22	0.1207 (6)	0.6426 (4)	−0.2533 (4)	0.0441 (12)
H22	0.0435	0.6470	−0.1972	0.053*
C23	0.0785 (6)	0.7009 (4)	0.3128 (4)	0.0387 (11)
C24	0.1379 (7)	0.8109 (4)	0.2931 (4)	0.0446 (13)
H24	0.2331	0.8126	0.2513	0.054*
C25	0.0570 (8)	0.9177 (5)	0.3352 (5)	0.0553 (16)
H25	0.0978	0.9913	0.3217	0.066*
C26	−0.0836 (8)	0.9160 (5)	0.3970 (5)	0.0584 (16)
H26	−0.1388	0.9888	0.4242	0.070*
C27	−0.1433 (7)	0.8071 (5)	0.4188 (5)	0.0572 (16)
H27	−0.2372	0.8059	0.4621	0.069*
C28	−0.0632 (6)	0.6999 (4)	0.3762 (4)	0.0454 (13)
H28	−0.1043	0.6264	0.3900	0.054*
N1	0.3158 (5)	0.3512 (3)	0.2036 (3)	0.0363 (9)
N2	0.3676 (5)	0.2954 (3)	−0.0021 (3)	0.0416 (10)
O1	0.4253 (6)	0.1240 (3)	0.3391 (3)	0.0647 (12)
O2	0.4774 (5)	−0.0635 (3)	0.2768 (3)	0.0553 (10)
O3	0.1859 (4)	0.1193 (3)	0.1493 (3)	0.0448 (9)
O4	0.3050 (5)	−0.0021 (3)	0.0238 (3)	0.0571 (10)
Pb1	0.46035 (2)	0.137456 (17)	0.147460 (15)	0.03580 (6)

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C1	0.046 (3)	0.047 (3)	0.032 (3)	0.007 (2)	−0.004 (2)	0.000 (2)
C2	0.049 (3)	0.034 (3)	0.043 (3)	0.006 (2)	0.000 (3)	0.002 (2)
C3	0.045 (3)	0.037 (3)	0.039 (3)	−0.007 (2)	−0.002 (2)	0.001 (2)
C4	0.038 (3)	0.046 (3)	0.041 (3)	−0.006 (2)	−0.002 (2)	−0.009 (2)
C5	0.058 (3)	0.033 (2)	0.029 (3)	−0.005 (2)	−0.005 (2)	−0.001 (2)
C6	0.059 (3)	0.039 (3)	0.028 (3)	−0.001 (2)	−0.001 (2)	−0.008 (2)
C7	0.048 (3)	0.031 (2)	0.037 (3)	−0.007 (2)	−0.001 (2)	−0.006 (2)
C8	0.049 (3)	0.033 (2)	0.030 (3)	−0.004 (2)	−0.001 (2)	−0.004 (2)
C9	0.040 (3)	0.032 (2)	0.031 (3)	−0.004 (2)	−0.004 (2)	−0.0037 (19)

C10	0.043 (3)	0.033 (2)	0.031 (3)	−0.005 (2)	−0.003 (2)	−0.0052 (19)
C11	0.075 (4)	0.034 (3)	0.035 (3)	0.005 (3)	0.002 (3)	−0.006 (2)
C12	0.069 (4)	0.043 (3)	0.027 (3)	−0.002 (3)	0.002 (3)	−0.008 (2)
C13	0.045 (3)	0.036 (2)	0.034 (3)	−0.006 (2)	−0.001 (2)	−0.001 (2)
C14	0.046 (3)	0.033 (2)	0.029 (3)	−0.003 (2)	0.000 (2)	−0.0039 (19)
C15	0.084 (4)	0.033 (3)	0.034 (3)	0.001 (3)	0.003 (3)	0.001 (2)
C16	0.082 (4)	0.029 (2)	0.041 (3)	0.003 (3)	−0.007 (3)	−0.002 (2)
C17	0.045 (3)	0.039 (3)	0.030 (3)	−0.012 (2)	−0.003 (2)	−0.003 (2)
C18	0.046 (3)	0.052 (3)	0.034 (3)	−0.003 (2)	0.004 (2)	−0.003 (2)
C19	0.069 (4)	0.064 (4)	0.033 (3)	−0.015 (3)	0.005 (3)	−0.002 (3)
C20	0.073 (4)	0.049 (3)	0.034 (3)	−0.015 (3)	−0.009 (3)	0.005 (2)
C21	0.054 (4)	0.046 (3)	0.048 (4)	−0.001 (3)	−0.010 (3)	0.005 (2)
C22	0.046 (3)	0.046 (3)	0.039 (3)	0.000 (2)	−0.002 (2)	−0.005 (2)
C23	0.050 (3)	0.039 (3)	0.026 (3)	−0.001 (2)	−0.004 (2)	−0.008 (2)
C24	0.064 (4)	0.036 (3)	0.034 (3)	−0.009 (3)	0.006 (3)	−0.005 (2)
C25	0.080 (4)	0.031 (3)	0.053 (4)	−0.003 (3)	0.004 (3)	−0.008 (2)
C26	0.071 (4)	0.041 (3)	0.059 (4)	0.012 (3)	−0.001 (3)	−0.015 (3)
C27	0.054 (4)	0.055 (3)	0.058 (4)	0.006 (3)	0.011 (3)	−0.004 (3)
C28	0.052 (3)	0.036 (3)	0.049 (3)	−0.007 (2)	−0.002 (3)	−0.003 (2)
N1	0.048 (2)	0.0306 (19)	0.030 (2)	−0.0017 (18)	−0.0039 (18)	−0.0042 (16)
N2	0.058 (3)	0.034 (2)	0.031 (2)	0.0030 (19)	−0.004 (2)	−0.0079 (17)
O1	0.104 (3)	0.046 (2)	0.036 (2)	0.020 (2)	−0.007 (2)	−0.0002 (17)
O2	0.077 (3)	0.045 (2)	0.043 (2)	−0.0011 (19)	−0.007 (2)	−0.0109 (17)
O3	0.050 (2)	0.048 (2)	0.037 (2)	−0.0123 (17)	−0.0021 (17)	−0.0103 (16)
O4	0.043 (2)	0.065 (2)	0.063 (3)	−0.0025 (19)	−0.003 (2)	−0.022 (2)
Pb1	0.03826 (11)	0.03501 (10)	0.03301 (10)	0.00104 (7)	−0.00548 (7)	−0.00209 (7)

Geometric parameters (Å, °)

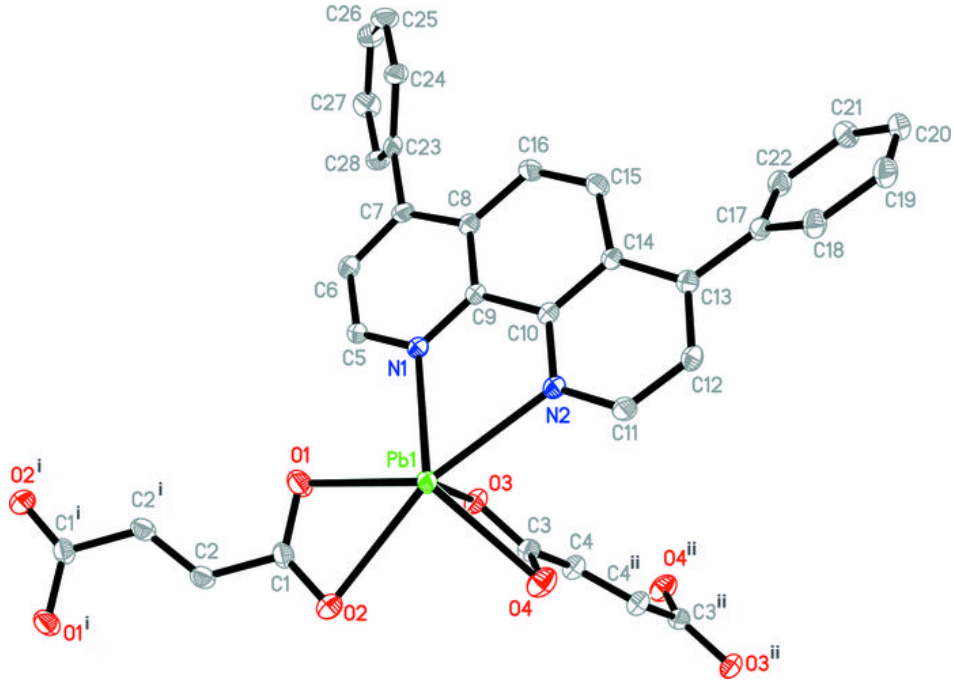
C1—O2	1.234 (6)	C15—C16	1.351 (7)
C1—O1	1.260 (6)	C15—H15	0.9300
C1—C2	1.499 (7)	C16—H16	0.9300
C2—C2^{i}	1.321 (10)	C17—C18	1.394 (6)
C2—H2	0.9300	C17—C22	1.400 (7)
C3—O4	1.242 (6)	C18—C19	1.379 (7)
C3—O3	1.277 (6)	C18—H18	0.9300
C3—C4	1.477 (7)	C19—C20	1.370 (8)
C4—C4^{ii}	1.319 (10)	C19—H19	0.9300
C4—H4	0.9300	C20—C21	1.378 (7)
C5—N1	1.324 (6)	C20—H20	0.9300
C5—C6	1.390 (6)	C21—C22	1.380 (7)
C5—H5	0.9300	C21—H21	0.9300
C6—C7	1.373 (7)	C22—H22	0.9300
C6—H6	0.9300	C23—C24	1.382 (7)
C7—C8	1.433 (6)	C23—C28	1.391 (7)
C7—C23	1.487 (6)	C24—C25	1.375 (7)
C8—C9	1.407 (6)	C24—H24	0.9300
C8—C16	1.430 (7)	C25—C26	1.373 (8)
C9—N1	1.363 (6)	C25—H25	0.9300

C9—C10	1.439 (6)	C26—C27	1.377 (8)
C10—N2	1.361 (6)	C26—H26	0.9300
C10—C14	1.419 (6)	C27—C28	1.379 (7)
C11—N2	1.318 (6)	C27—H27	0.9300
C11—C12	1.385 (7)	C28—H28	0.9300
C11—H11	0.9300	Pb1—N1	2.590 (4)
C12—C13	1.374 (6)	Pb1—N2	2.645 (4)
C12—H12	0.9300	Pb1—O1	2.449 (4)
C13—C14	1.426 (6)	Pb1—O2	2.740 (4)
C13—C17	1.483 (6)	Pb1—O3	2.313 (3)
C14—C15	1.431 (6)	Pb1—O4	2.705 (4)
O2—C1—O1	124.1 (5)	C20—C19—H19	119.9
O2—C1—C2	120.2 (4)	C18—C19—H19	119.9
O1—C1—C2	115.6 (4)	C19—C20—C21	120.0 (5)
$C2^{i}$—C2—C1	125.3 (6)	C19—C20—H20	120.0
$C2^{i}$—C2—H2	117.3	C21—C20—H20	120.0
C1—C2—H2	117.3	C20—C21—C22	120.1 (5)
O4—C3—O3	121.9 (5)	C20—C21—H21	120.0
O4—C3—C4	121.8 (5)	C22—C21—H21	120.0
O3—C3—C4	116.3 (4)	C21—C22—C17	121.1 (5)
$C4^{ii}$—C4—C3	124.6 (6)	C21—C22—H22	119.4
$C4^{ii}$—C4—H4	117.7	C17—C22—H22	119.4
C3—C4—H4	117.7	C24—C23—C28	119.1 (4)
N1—C5—C6	123.4 (4)	C24—C23—C7	123.0 (5)
N1—C5—H5	118.3	C28—C23—C7	117.9 (4)
C6—C5—H5	118.3	C25—C24—C23	120.3 (5)
C7—C6—C5	120.4 (5)	C25—C24—H24	119.8
C7—C6—H6	119.8	C23—C24—H24	119.8
C5—C6—H6	119.8	C26—C25—C24	120.3 (5)
C6—C7—C8	117.5 (4)	C26—C25—H25	119.9
C6—C7—C23	119.5 (4)	C24—C25—H25	119.9
C8—C7—C23	123.0 (4)	C25—C26—C27	120.2 (5)
C9—C8—C16	118.7 (4)	C25—C26—H26	119.9
C9—C8—C7	118.1 (4)	C27—C26—H26	119.9
C16—C8—C7	123.1 (4)	C26—C27—C28	119.7 (5)
N1—C9—C8	122.4 (4)	C26—C27—H27	120.2
N1—C9—C10	117.8 (4)	C28—C27—H27	120.2
C8—C9—C10	119.7 (4)	C27—C28—C23	120.4 (5)
N2—C10—C14	122.3 (4)	C27—C28—H28	119.8
N2—C10—C9	117.2 (4)	C23—C28—H28	119.8
C14—C10—C9	120.5 (4)	C5—N1—C9	118.1 (4)
N2—C11—C12	123.1 (5)	C5—N1—Pb1	119.9 (3)
N2—C11—H11	118.5	C9—N1—Pb1	122.0 (3)
C12—C11—H11	118.5	C11—N2—C10	118.1 (4)
C13—C12—C11	121.6 (5)	C11—N2—Pb1	121.4 (3)
C13—C12—H12	119.2	C10—N2—Pb1	120.3 (3)
C11—C12—H12	119.2	C1—O1—Pb1	99.2 (3)
C12—C13—C14	116.6 (4)	C1—O2—Pb1	86.1 (3)

C12—C13—C17	120.1 (4)	C3—O3—Pb1	102.0 (3)
C14—C13—C17	123.3 (4)	C3—O4—Pb1	84.5 (3)
C10—C14—C13	118.4 (4)	O3—Pb1—O1	85.17 (14)
C10—C14—C15	117.1 (4)	O3—Pb1—N1	75.35 (12)
C13—C14—C15	124.5 (4)	O1—Pb1—N1	75.70 (12)
C16—C15—C14	122.6 (5)	O3—Pb1—N2	79.49 (13)
C16—C15—H15	118.7	O1—Pb1—N2	137.38 (12)
C14—C15—H15	118.7	N1—Pb1—N2	62.03 (12)
C15—C16—C8	121.0 (5)	O3—Pb1—O4	51.31 (11)
C15—C16—H16	119.5	O1—Pb1—O4	120.44 (14)
C8—C16—H16	119.5	N1—Pb1—O4	118.64 (12)
C18—C17—C22	117.1 (5)	N2—Pb1—O4	78.77 (12)
C18—C17—C13	119.0 (5)	O3—Pb1—O2	84.60 (12)
C22—C17—C13	123.8 (4)	O1—Pb1—O2	49.85 (11)
C19—C18—C17	121.5 (5)	N1—Pb1—O2	123.32 (11)
C19—C18—H18	119.2	N2—Pb1—O2	161.17 (12)
C17—C18—H18	119.2	O4—Pb1—O2	83.44 (12)
C20—C19—C18	120.1 (5)		

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

Fig. 1


C26
C25
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C14
C6
C13
C9
C10
C5
N1
C12
N2
C11
O1
Pb1
O2i
C2i
O3
C1i
C3
C4
C2
C4ii
O4ii
C1
O2
O4
C3ii
O1i
O3ii

Fig. 2

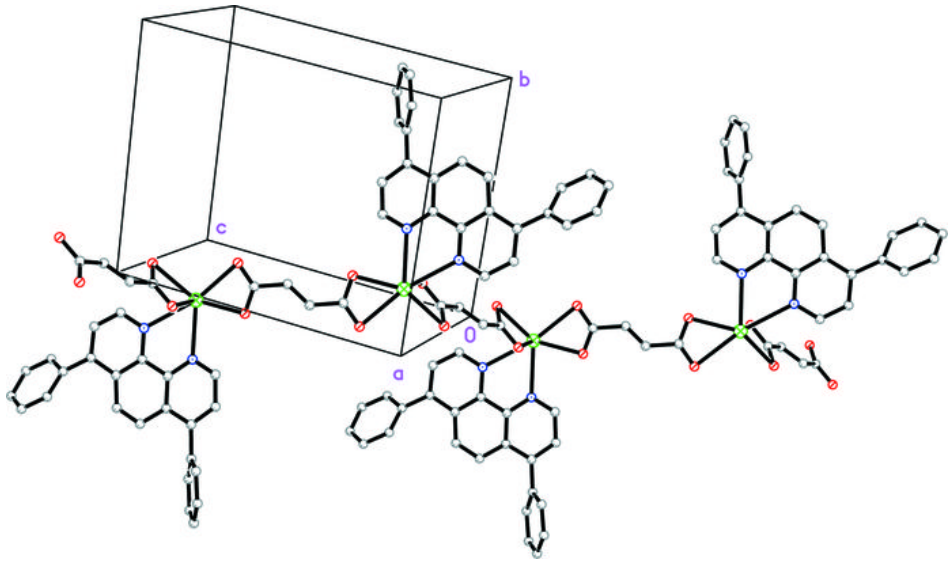

Fig. 3