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Poly[(μ_2-4,4′-bipyridine-κ^2N:N')bis(μ_2-2-phenoxypropionato-κ^2O:O')cobalt(II)]

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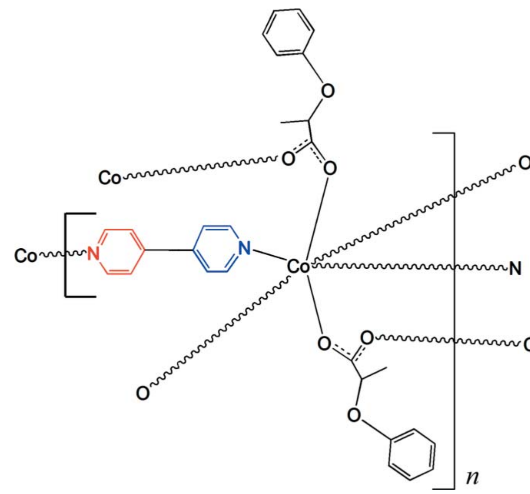
Key indicators: single-crystal X-ray study; T = 296 K; mean σ(C–C) = 0.003 Å; R factor = 0.027; wR factor = 0.068; data-to-parameter ratio = 13.6.

In the polymeric title compound, $[Co(C_9H_9O_3)_2(C_{10}H_8N_2)]_n$, the Co^{II} ion is located on a twofold rotation axis and is six-coordinated by two N atoms from two 4,4′-bipyridine (4,4′-bipy) ligands in axial positions and by four O atoms from four 2-phenoxypropionate (POPA) anions in equatorial positions, defining a slightly distorted octahedral geometry. The carboxylate group of the POPA anion displays a bis-monodentate mode, linking pairs of Co^{II} ions into a chain parallel to [001]. Adjacent chains are connected in a perpendicular manner through 4,4′-bipy ligands into layers parallel to (100). The 4,4′-bipy ligand is likewise located on a twofold rotation axis, with a dihedral angle between the two pyridine rings of 57.05 (7)°. C—H⋯O hydrogen-bonding interactions are present within the layers. π–π stacking interactions between the POPA benzene rings of neighbouring layers [centroid-to-centroid distance = 3.976 (3) Å and plane-to-plane distance = 3.618 (3) Å] stabilize the packing of the structure.

Related literature

For background to phenoxyalkanoic acids, see: Müller & Buser (1997). For other metal complexes derived from phenoxypropionic acid, see: Shen *et al.* (2011*a*,*b*,*c*,*d*). For a related cobalt complex, see: Zhuang *et al.* (2007).



Experimental

Crystal data

$[Co(C_9H_9O_3)_2(C_{10}H_8N_2)]$
M_r = 545.44
Monoclinic, $C2/c$
a = 23.6748 (14) Å
b = 11.6289 (7) Å
c = 9.6440 (6) Å
β = 96.353 (4)°
V = 2638.8 (3) Å^3
Z = 4
Mo $K\alpha$ radiation
μ = 0.70 mm^{-1}
T = 296 K
0.41 × 0.20 × 0.19 mm

Data collection

Bruker APEXII CCD diffractometer
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1996)
T_{min} = 0.847, T_{max} = 0.879
8421 measured reflections
2319 independent reflections
2053 reflections with $I > 2\sigma(I)$
R_{int} = 0.023

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.027
$wR(F^2)$ = 0.068
S = 1.06
2319 reflections
170 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.21 e Å^{-3}
$\Delta\rho_{min}$ = −0.19 e Å^{-3}

Table 1
Selected bond lengths (Å).

Co1—O3	2.0357 (12)	Co1—N1	2.1989 (19)
Co1—O2^i	2.1275 (11)	Co1—N2	2.2051 (19)

Symmetry code: (i) $-x+1, -y+1, -z+2$.

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

D—H⋯A	D—H	H⋯A	D⋯A	D—H⋯A
C10—H10⋯O2^i	0.93	2.51	3.079 (2)	120
C15—H15A⋯O3^i	0.93	2.38	3.272 (2)	159

Symmetry code: (i) $-x+1, -y+1, -z+2$.

Data collection: *APEX2* (Bruker, 2006); cell refinement: *SAINT* (Bruker, 2006); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *XP* in

SHELXTL (Sheldrick, 2008) and *DIAMOND* (Brandenburg, 2006); software used to prepare material for publication: *publCIF* (Westrip, 2010).

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: WM2537).

References

Brandenburg, K. (2006). *DIAMOND*. Crystal Impact GbR, Bonn, Germany.

Bruker (2006). *APEX2* and *SAINT*. Bruker AXS Inc., Madison, Wisconsin, USA.

Müller, M. D. & Buser, H. R. (1997). *Environ. Sci. Technol.* **31**, 1953–1959.

Sheldrick, G. M. (1996). *SADABS*. University of Göttingen, Germany.

Sheldrick, G. M. (2008). *Acta Cryst.* A**64**, 112–122.

Shen, J.-B., Liu, J.-L. & Zhao, G.-L. (2011*a*). *Acta Cryst.* E**67**, m1234.

Shen, J.-B., Liu, J.-L. & Zhao, G.-L. (2011*b*). *Acta Cryst.* E**67**, m1319.

Shen, J.-B., Liu, J.-L. & Zhao, G.-L. (2011*c*). *Acta Cryst.* E**67**, m1320.

Shen, J.-B., Liu, J.-L. & Zhao, G.-L. (2011*d*). *Acta Cryst.* E**67**, m1321.

Westrip, S. P. (2010). *J. Appl. Cryst.* **43**, 920–925.

Zhuang, W.-J., Zheng, X.-J., Li, L.-C., Liao, D.-Z., Ma, H. & Jin, L.-P. (2007). *CrystEngComm*, **9**, 653–667.

supplementary materials

Acta Cryst. (2011). E**67**, m1587-m1588   [**doi:10.1107/S1600536811042875**]

Poly[(μ_2-4,4'-bipyridine-κ^2N:N')bis(μ_2-2-phenoxypropionato-κ^2O:O')cobalt(II)]

J.-B. Shen, J.-L. Liu and G.-L. Zhao

Comment

The group of phenoxyalkanoic acids include important herbicides. The desired biological activity is largely dependent on the length of the carbon chain of the alkanoic acid, the nature of the phenoxy group, and the position of its attachment to the carbon chain (Müller & Buser, 1997). Therefore the structures of metal complexes of 2-phenoxypropionic acid became interesting for us. Recently, we have reported some results in this regard (Shen *et al.*, 2011*a*,*b*,*c*,*d*). Here, we describe a new Co^{II} complex with 4,4'-bipyridine (4,4'-bipy) as a co-ligand.

The structure of the polymeric title complex is shown in Fig. 1. The Co^{II} ion is located on a twofold rotation axis and is six-coordinated by four carboxylate O atoms from four POPA ligands and two N atoms of two 4,4'-bipy ligands in an octahedral geometry. The Co—O distances are 2.0357 (12) and 2.1275 (11) Å, and the Co—N distances are 2.1989 (19) and 2.2051 (19) Å, all of which are similar to related structures (Zhuang *et al.*, 2007). The 4,4'-bipy ligand exhibits symmetry 2, with a dihedral angle between the two pyridine rings of 57.05 (7)°. The carboxylate groups of the POPA anions display a bis-monodentate mode, bridging pairs of Co^{II} ions into chains parallel to [001]. The 4,4'-bipy molecules connect these chains perpendicularly, resulting in a layered arrangement parallel to (100) (Fig. 2).

As also shown in Fig. 2, intra-layer C—H···O hydrogen bonds between the C atoms of 4,4'-bipy ligands and carboxylate O atoms are present. Adjacent layers are stacked along [100] through π—π interactions between benzene rings of the POPA anions, with centroid–centroid and plane to plane distance of 3.976 (3) Å and 3.618 (3) Å, respectively.

Experimental

Reagents and solvents used were of commercially available quality and were not further purified before using. 2-Phenoxyproionic acid (0.332 g, 2 mmol), 4,4'-bipy (0.156 g, 1 mmol) were mixed in distilled water (30 ml), NaOH (1 *M*) was added dropwise to the solution to adjust a pH of 5–6, then $CoCl_2.6H_2O$ (0.238 g, 1 mmol) was added and the mixture sealed in a 50 ml stainless steel reactor and kept at 433 K for 3 d. The reactor was then cooled to room temperature at a speed of 5 K h^{-1}. Red single crystals were obtained in high yield and filtered off from the solution.

Refinement

The H atoms bonded to C and N atoms were positioned geometrically and refined using a riding model [aliphatic C—H = 0.96 Å (U_{iso}(H) = 1.5U_{eq}(C)), aromatic C—H = 0.93 Å (U_{iso}(H) = 1.2U_{eq}(C))].

Figures

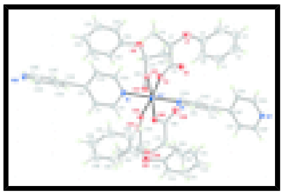


Fig. 1. The molecular structure of the title complex, showing the atom-labelling scheme. Displacement ellipsoids are drawn at the 30% probability level. The atoms labelled with the suffix A, B, C, D, E, F, G are related by the symmetry operations (-*x* + 1, *y*, -*z* + 1.5), (-*x* + 1, -*y* + 1, -*z* + 2), (*x*, -*y* + 1, *z* - 1/2), (*x*, *y* + 1, *z*), (-*x* + 1, 1 + *y*, -*z* + 1.5), (*x*, *y* - 1, *z*), (-*x* + 1, *y* - 1, -*z* + 1.5), respectively.

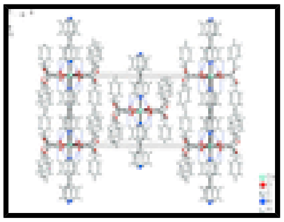


Fig. 2. The layered arrangement of title compound, showing intralayer C—H···O interactions.

Poly[(μ$_2$-4,4'-bipyridine-κ^2*N*:*N*')bis(μ$_2$-2- phenoxypropionato-κ^2*O*:*O*')cobalt(II)]

Crystal data

$[Co(C_9H_9O_3)_2(C_{10}H_8N_2)]$	*F*(000) = 1132
M_r = 545.44	D_x = 1.373 Mg m^{-3}
Monoclinic, *C*2/*c*	Mo *K*α radiation, λ = 0.71073 Å
Hall symbol: -C 2yc	Cell parameters from 3897 reflections
a = 23.6748 (14) Å	θ = 1.7–25.0°
b = 11.6289 (7) Å	μ = 0.70 mm^{-1}
c = 9.6440 (6) Å	*T* = 296 K
β = 96.353 (4)°	Block, red
V = 2638.8 (3) Å^3	0.41 × 0.20 × 0.19 mm
Z = 4	

Data collection

Bruker APEXII CCD diffractometer	2319 independent reflections
Radiation source: fine-focus sealed tube	2053 reflections with $I > 2\sigma(I)$
graphite	R_{int} = 0.023
φ and ω scans	θ_{max} = 25.0°, θ_{min} = 1.7°
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1996)	*h* = −28→26
T_{min} = 0.847, T_{max} = 0.879	*k* = −13→11
8421 measured reflections	*l* = −11→11

Refinement

Refinement on F^2	Primary atom site location: structure-invariant direct methods
Least-squares matrix: full	Secondary atom site location: difference Fourier map

$R[F^2 > 2\sigma(F^2)] = 0.027$	Hydrogen site location: inferred from neighbouring sites
$wR(F^2) = 0.068$	H-atom parameters constrained
$S = 1.06$	$w = 1/[\sigma^2(F_o^2) + (0.0338P)^2 + 1.1007P]$ where $P = (F_o^2 + 2F_c^2)/3$
2319 reflections	$(\Delta/\sigma)_{max} < 0.001$
170 parameters	$\Delta\rho_{max} = 0.21$ e Å^{-3}
0 restraints	$\Delta\rho_{min} = -0.19$ 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}
Co1	0.5000	0.52263 (3)	0.7500	0.02374 (11)
O3	0.55380 (5)	0.53098 (11)	0.92961 (11)	0.0393 (3)
C9	0.58754 (7)	0.49847 (13)	1.02991 (16)	0.0281 (4)
N1	0.5000	0.71171 (16)	0.7500	0.0290 (4)
C8	0.67426 (10)	0.6225 (2)	1.0358 (3)	0.0794 (8)
H8A	0.7136	0.6252	1.0199	0.119*
H8B	0.6708	0.6423	1.1312	0.119*
H8C	0.6530	0.6762	0.9751	0.119*
C7	0.65102 (8)	0.50059 (19)	1.0060 (2)	0.0493 (5)
H7	0.6548	0.4805	0.9088	0.059*
C11	0.45124 (8)	0.89365 (15)	0.76775 (19)	0.0384 (4)
H11	0.4177	0.9315	0.7812	0.046*
O1	0.68453 (5)	0.42260 (14)	1.09706 (14)	0.0555 (4)
C10	0.45282 (7)	0.77274 (15)	0.76537 (19)	0.0367 (4)
H10	0.4194	0.7328	0.7749	0.044*
C6	0.64660 (10)	0.2551 (2)	0.9605 (3)	0.0699 (7)
H6	0.6246	0.3010	0.8965	0.084*
C1	0.64664 (11)	0.1349 (3)	0.9439 (3)	0.0883 (9)
H1	0.6251	0.1027	0.8671	0.106*
C5	0.67937 (8)	0.3048 (2)	1.0721 (2)	0.0536 (6)
C4	0.71055 (10)	0.2322 (2)	1.1675 (2)	0.0651 (7)
H4	0.7324	0.2641	1.2440	0.078*
C3	0.70968 (11)	0.1124 (3)	1.1507 (3)	0.0810 (8)
H3	0.7308	0.0661	1.2158	0.097*

C2	0.67765 (12)	0.0629 (3)	1.0379 (4)	0.0906 (9)
H2	0.6770	−0.0164	1.0256	0.109*
C12	0.5000	0.95685 (19)	0.7500	0.0307 (5)
O2	0.57552 (5)	0.47394 (10)	1.14927 (11)	0.0339 (3)
C13	0.5000	0.08758 (19)	0.7500	0.0294 (5)
N2	0.5000	0.33300 (16)	0.7500	0.0311 (4)
C14	0.48321 (8)	0.15074 (14)	0.86106 (17)	0.0390 (4)
H14A	0.4708	0.1130	0.9371	0.047*
C15	0.48508 (8)	0.27175 (15)	0.85836 (17)	0.0380 (4)
H15A	0.4754	0.3115	0.9360	0.046*

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Co1	0.03125 (19)	0.01885 (18)	0.02070 (16)	0.000	0.00108 (12)	0.000
O3	0.0410 (7)	0.0518 (8)	0.0235 (6)	0.0044 (6)	−0.0037 (5)	−0.0006 (5)
C9	0.0328 (9)	0.0268 (10)	0.0250 (8)	−0.0021 (7)	0.0040 (7)	−0.0023 (6)
N1	0.0354 (11)	0.0228 (11)	0.0283 (10)	0.000	0.0020 (8)	0.000
C8	0.0486 (14)	0.088 (2)	0.1002 (19)	−0.0260 (13)	0.0020 (13)	0.0290 (16)
C7	0.0350 (11)	0.0761 (16)	0.0378 (10)	0.0012 (10)	0.0077 (8)	0.0059 (10)
C11	0.0383 (10)	0.0266 (10)	0.0519 (10)	0.0060 (8)	0.0123 (8)	0.0033 (8)
O1	0.0366 (8)	0.0757 (11)	0.0525 (8)	0.0119 (7)	−0.0024 (6)	−0.0041 (8)
C10	0.0350 (10)	0.0263 (10)	0.0497 (10)	−0.0025 (8)	0.0088 (8)	0.0017 (8)
C6	0.0475 (14)	0.096 (2)	0.0644 (15)	0.0133 (13)	0.0001 (11)	−0.0174 (14)
C1	0.0584 (17)	0.102 (2)	0.103 (2)	0.0051 (16)	0.0024 (15)	−0.0423 (19)
C5	0.0315 (10)	0.0771 (17)	0.0535 (12)	0.0076 (10)	0.0104 (9)	−0.0093 (11)
C4	0.0461 (13)	0.086 (2)	0.0623 (14)	0.0115 (12)	0.0026 (11)	−0.0031 (13)
C3	0.0592 (16)	0.084 (2)	0.101 (2)	0.0153 (15)	0.0129 (15)	0.0090 (17)
C2	0.0567 (17)	0.079 (2)	0.139 (3)	0.0018 (16)	0.0263 (18)	−0.024 (2)
C12	0.0462 (15)	0.0207 (14)	0.0255 (11)	0.000	0.0046 (10)	0.000
O2	0.0351 (7)	0.0398 (7)	0.0276 (6)	0.0029 (5)	0.0070 (5)	0.0071 (5)
C13	0.0388 (14)	0.0197 (13)	0.0294 (11)	0.000	0.0022 (10)	0.000
N2	0.0419 (12)	0.0229 (11)	0.0282 (10)	0.000	0.0019 (9)	0.000
C14	0.0627 (12)	0.0250 (10)	0.0312 (9)	0.0026 (9)	0.0133 (8)	0.0049 (7)
C15	0.0605 (12)	0.0258 (10)	0.0292 (8)	0.0051 (9)	0.0119 (8)	−0.0018 (7)

Geometric parameters (Å, °)

Co1—O3^{i}	2.0357 (12)	C6—C5	1.382 (3)
Co1—O3	2.0357 (12)	C6—C1	1.407 (4)
Co1—O2^{ii}	2.1275 (11)	C6—H6	0.9300
Co1—O2^{iii}	2.1275 (11)	C1—C2	1.384 (4)
Co1—N1	2.1989 (19)	C1—H1	0.9300
Co1—N2	2.2051 (19)	C5—C4	1.398 (3)
O3—C9	1.243 (2)	C4—C3	1.402 (4)
C9—O2	1.2489 (18)	C4—H4	0.9300
C9—C7	1.546 (2)	C3—C2	1.381 (4)
N1—C10	1.3453 (19)	C3—H3	0.9300

N1—$C10^{i}$	1.3453 (19)	C2—H2	0.9300
C8—C7	1.537 (3)	C12—$C11^{i}$	1.395 (2)
C8—H8A	0.9600	C12—$C13^{iv}$	1.520 (3)
C8—H8B	0.9600	O2—$Co1^{iii}$	2.1275 (11)
C8—H8C	0.9600	C13—C14	1.3924 (19)
C7—O1	1.438 (2)	C13—$C14^{i}$	1.392 (2)
C7—H7	0.9800	C13—$C12^{v}$	1.520 (3)
C11—C12	1.395 (2)	N2—$C15^{i}$	1.3439 (19)
C11—C10	1.407 (2)	N2—C15	1.3439 (19)
C11—H11	0.9300	C14—C15	1.408 (2)
O1—C5	1.394 (3)	C14—H14A	0.9300
C10—H10	0.9300	C15—H15A	0.9300
$O3^{i}$—Co1—O3	174.53 (7)	N1—C10—C11	123.57 (16)
$O3^{i}$—Co1—$O2^{ii}$	95.10 (5)	N1—C10—H10	118.2
O3—Co1—$O2^{ii}$	84.80 (5)	C11—C10—H10	118.2
$O3^{i}$—Co1—$O2^{iii}$	84.80 (5)	C5—C6—C1	119.8 (3)
O3—Co1—$O2^{iii}$	95.10 (5)	C5—C6—H6	120.1
$O2^{ii}$—Co1—$O2^{iii}$	177.85 (6)	C1—C6—H6	120.1
$O3^{i}$—Co1—N1	87.26 (4)	C2—C1—C6	122.3 (3)
O3—Co1—N1	87.26 (4)	C2—C1—H1	118.9
$O2^{ii}$—Co1—N1	88.93 (3)	C6—C1—H1	118.9
$O2^{iii}$—Co1—N1	88.93 (3)	C6—C5—O1	125.2 (2)
$O3^{i}$—Co1—N2	92.74 (4)	C6—C5—C4	118.1 (2)
O3—Co1—N2	92.74 (4)	O1—C5—C4	116.7 (2)
$O2^{ii}$—Co1—N2	91.07 (3)	C5—C4—C3	121.6 (2)
$O2^{iii}$—Co1—N2	91.07 (3)	C5—C4—H4	119.2
N1—Co1—N2	180.0	C3—C4—H4	119.2
C9—O3—Co1	159.26 (12)	C2—C3—C4	120.4 (3)
O3—C9—O2	126.46 (16)	C2—C3—H3	119.8
O3—C9—C7	115.51 (14)	C4—C3—H3	119.8
O2—C9—C7	117.75 (15)	C3—C2—C1	118.0 (3)
C10—N1—$C10^{i}$	116.3 (2)	C3—C2—H2	121.0
C10—N1—Co1	121.84 (10)	C1—C2—H2	121.0
$C10^{i}$—N1—Co1	121.84 (10)	C11—C12—$C11^{i}$	116.4 (2)
C7—C8—H8A	109.5	C11—C12—$C13^{iv}$	121.80 (10)
C7—C8—H8B	109.5	$C11^{i}$—C12—$C13^{iv}$	121.80 (10)
H8A—C8—H8B	109.5	C9—O2—$Co1^{iii}$	134.85 (11)
C7—C8—H8C	109.5	C14—C13—$C14^{i}$	116.3 (2)
H8A—C8—H8C	109.5	C14—C13—$C12^{v}$	121.84 (10)
H8B—C8—H8C	109.5	$C14^{i}$—C13—$C12^{v}$	121.84 (10)
O1—C7—C8	107.80 (18)	$C15^{i}$—N2—C15	116.0 (2)
O1—C7—C9	112.24 (15)	$C15^{i}$—N2—Co1	122.01 (10)
C8—C7—C9	108.70 (17)	C15—N2—Co1	122.01 (10)

O1—C7—H7	109.4	C13—C14—C15	120.04 (15)
C8—C7—H7	109.4	C13—C14—H14A	120.0
C9—C7—H7	109.4	C15—C14—H14A	120.0
C12—C11—C10	120.05 (16)	N2—C15—C14	123.75 (15)
C12—C11—H11	120.0	N2—C15—H15A	118.1
C10—C11—H11	120.0	C14—C15—H15A	118.1
C5—O1—C7	118.84 (16)		

O2^{ii}—Co1—O3—C9	−81.2 (3)	C1—C6—C5—C4	−1.7 (3)
O2^{iii}—Co1—O3—C9	101.0 (3)	C7—O1—C5—C6	4.0 (3)
N1—Co1—O3—C9	−170.3 (3)	C7—O1—C5—C4	−176.79 (16)
N2—Co1—O3—C9	9.7 (3)	C6—C5—C4—C3	0.9 (3)
Co1—O3—C9—O2	−96.6 (3)	O1—C5—C4—C3	−178.37 (19)
Co1—O3—C9—C7	89.7 (3)	C5—C4—C3—C2	0.1 (4)
O3^{i}—Co1—N1—C10	65.25 (10)	C4—C3—C2—C1	−0.3 (4)
O3—Co1—N1—C10	−114.75 (10)	C6—C1—C2—C3	−0.4 (4)
O2^{ii}—Co1—N1—C10	160.41 (10)	C10—C11—C12—C11^{i}	−0.79 (12)
O2^{iii}—Co1—N1—C10	−19.59 (10)	C10—C11—C12—C13^{iv}	179.21 (12)
O3^{i}—Co1—N1—C10^{i}	−114.75 (10)	O3—C9—O2—Co1^{iii}	−2.7 (3)
O3—Co1—N1—C10^{i}	65.25 (10)	C7—C9—O2—Co1^{iii}	170.92 (12)
O2^{ii}—Co1—N1—C10^{i}	−19.59 (10)	O3^{i}—Co1—N2—C15^{i}	56.44 (11)
O2^{iii}—Co1—N1—C10^{i}	160.41 (10)	O3—Co1—N2—C15^{i}	−123.56 (11)
O3—C9—C7—O1	−156.70 (16)	O2^{ii}—Co1—N2—C15^{i}	−38.72 (10)
O2—C9—C7—O1	29.0 (2)	O2^{iii}—Co1—N2—C15^{i}	141.28 (10)
O3—C9—C7—C8	84.2 (2)	O3^{i}—Co1—N2—C15	−123.56 (11)
O2—C9—C7—C8	−90.2 (2)	O3—Co1—N2—C15	56.44 (11)
C8—C7—O1—C5	−167.58 (16)	O2^{ii}—Co1—N2—C15	141.28 (11)
C9—C7—O1—C5	72.7 (2)	O2^{iii}—Co1—N2—C15	−38.72 (11)
C10^{i}—N1—C10—C11	−0.85 (13)	C14^{i}—C13—C14—C15	−1.47 (13)
Co1—N1—C10—C11	179.15 (13)	C12^{v}—C13—C14—C15	178.53 (13)
C12—C11—C10—N1	1.7 (3)	C15^{i}—N2—C15—C14	−1.59 (14)
C5—C6—C1—C2	1.5 (4)	Co1—N2—C15—C14	178.41 (14)
C1—C6—C5—O1	177.6 (2)	C13—C14—C15—N2	3.2 (3)

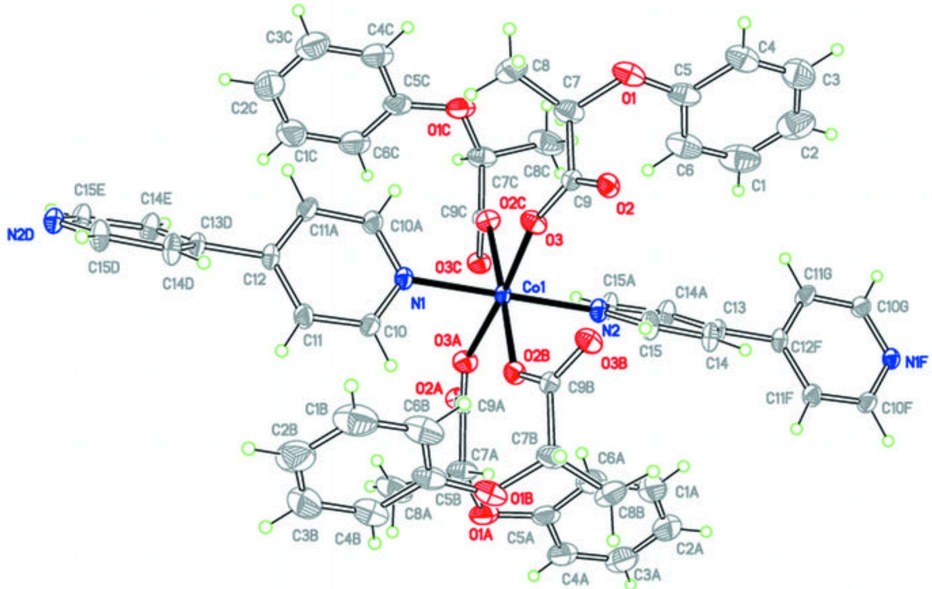
Symmetry codes: (i) −*x*+1, *y*, −*z*+3/2; (ii) *x*, −*y*+1, *z*−1/2; (iii) −*x*+1, −*y*+1, −*z*+2; (iv) *x*, *y*+1, *z*; (v) *x*, *y*−1, *z*.

Hydrogen-bond geometry (Å, °)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
C10—H10···O2^{iii}	0.93	2.51	3.079 (2)	120.
C15—H15A···O3^{iii}	0.93	2.38	3.272 (2)	159.

Symmetry codes: (iii) −*x*+1, −*y*+1, −*z*+2.

Fig. 1


C3C
C4C
C5C
C2C
C1C
C6C
O1C
C8
C7
O1
C5
C4
C3
C2
C1
C6
C7C
C8C
C9
O2
C9C
O2C
O3
C15E
C14E
C13D
N2D
C15D
C14D
C12
C11A
C10A
O3C
N1
Co1
C15A
C14A
C13
C11G
C10G
N2
C15
C14
C12F
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C11
C10
O3A
O2B
O3B
C9B
O2A
C9A
C11F
C10F
C1B
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C7A
C7B
C6A
C1A
C5B
O1B
C8B
C8A
C3B
C4B
O1A
C5A
C2A
C4A
C3A

Fig. 2