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catena-Poly[[(2,9-dimethyl-1,10-phenanthroline-κ^2N,N')(nitrato-κ^2O,O')-cobalt(II)]-μ-dicyanamido-$\kappa^2N^1:N^5$]

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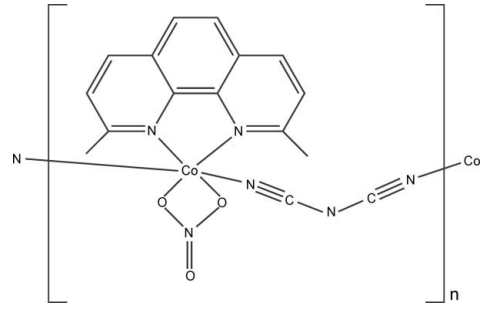
Key indicators: single-crystal X-ray study; T = 153 K; mean σ(C–C) = 0.004 Å; R factor = 0.033; wR factor = 0.098; data-to-parameter ratio = 16.0.

The title compound, $[Co(C_2N_3)(NO_3)(C_{14}H_{12}N_2)]_n$, exhibits a zigzag chain structure. The Co^{II} atom has a slightly distorted octahedral geometry formed by two N atoms of a 2,9-dimethyl-1,10-phenanthroline ligand, two N atoms from two different dicyanamide ligands and two O atoms of a nitrate anion. A one-dimensional chain is formed through the dicyanamides, which act as end-to-end bridging ligands. The chains are linked into a three-dimensional network *via* weak C—H···O hydrogen bonds.

Related literature

For general background, see: Batten & Murray (2003); Burčák *et al.* (2004); Potočňák *et al.* (2002); Vangdal *et al.* (2002); Wu *et al.* (2003).



Experimental

Crystal data

$[Co(C_2N_3)(NO_3)(C_{14}H_{12}N_2)]$
M_r = 395.25
Monoclinic, $P2_1/n$
a = 7.3481 (15) Å
b = 13.925 (3) Å
c = 16.531 (3) Å
β = 101.42 (3)°
V = 1658.0 (6) Å^3
Z = 4
Mo $K\alpha$ radiation
μ = 1.07 mm^{-1}
T = 153 (2) K
0.20 × 0.15 × 0.10 mm

Data collection

Bruker KappaCCD area-detector diffractometer
Absorption correction: multi-scan (*SADABS*; Sheldrick, 1996)
T_{min} = 0.815, T_{max} = 0.901
7407 measured reflections
3784 independent reflections
2450 reflections with $I > 2\sigma(I)$
R_{int} = 0.022

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.033
$wR(F^2)$ = 0.098
S = 0.94
3784 reflections
237 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.44 e Å^{-3}
$\Delta\rho_{min}$ = −0.32 e Å^{-3}

Table 1
Selected bond lengths (Å).

Co—N4^{i}	2.069 (2)	Co—N2	2.123 (2)
Co—N5	2.105 (2)	Co—O2	2.1466 (17)
Co—N6	2.1116 (18)	Co—O3	2.2268 (18)

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

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

D—H···A	D—H	H···A	D···A	D—H···A
C14—H14A···O2	0.96	2.45	3.190 (4)	133
C12—H12···O1^{ii}	0.93	2.54	3.455 (4)	169
C7—H7···O2^{iii}	0.93	2.48	3.388 (3)	167

Symmetry codes: (ii) $-x-\frac{1}{2}, y-\frac{1}{2}, -z+\frac{1}{2}$; (iii) $x+\frac{1}{2}, -y+\frac{3}{2}, z-\frac{1}{2}$.

Data collection: *COLLECT* (Nonius, 1998); cell refinement: *SAINT* (Bruker, 2003); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL* (Bruker, 2003); software used to prepare material for publication: *SHELXTL*.

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HY2068).

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supplementary materials

Acta Cryst. (2007). E**63**, m1986 [**doi:10.1107/S1600536807030279**]

catena-Poly[[(2,9-dimethyl-1,10-phenanthroline-κ^2N,N')(nitrato-κ^2O,O')cobalt(II)]-μ-dicyanamido-$\kappa^2N^1:N^5$]

Y.-Y. Wang and T.-F. Liu

Comment

Due to the stabilization of relatively strong magnetic coupling, multi-dimensional coordination polymers consisting of transition metal ions and dicyanamide ligand are currently being studied (Batten & Murray, 2003). Although the addition of ancillary ligands (*e.g.* pyridine, pyrazine, pyrimidine, 2,2'-bipyrimidine, 4,4'-bipyridine and 2,2'-bipyridine, *etc*.) into these binary systems frequently alters the bridging mode of the dicyanamide ligand from μ-1,3 to μ-1,5 and therefore leads to a paramagnetic behavior, a wide variety of molecular architectures subsequently obtained conduce to establish a better understanding of the relationship between structure and magnetic behavior (Burčák *et al.*, 2004; Potočňák *et al.*, 2002; Vangdal *et al.*, 2002; Wu *et al.*, 2003). Here we describe the structure of an end-to-end dicyanamide-bridged cobalt(II) complex, (I), incorporating 2,9-dimethyl-1,10-phenanthroline (dmphen) as an ancillay ligand.

The structure of compound (I) consists of well isolated chains of Co^{II} atoms bridged by end-to-end dicyanamide ligands (Fig.1). In the chain structure, each Co^{II} atom is coordinated by one dmphen ligand, one nitrate anion and two dicyanamide ligands in an octahedral geometry. The Co—N bond distances are in the range of 2.069 (2) to 2.123 (2)Å (Table 1). The nitrate ion binds in a bidentate fashion and the distances of Co—O are 2.1466 (17) and 2.2268 (18) Å. The shortest Co···Co distance is 7.169 (7)Å in the chain and 7.348 (2)Å between the chains.

An N1—O1···*Cg*(aryl ring) interaction is observed [*Cg* is the centroid of the ring C5, C6, C7, C8, C9 and C10 at $1/2 - x$, $1/2 + y$, $1/2 - z$) with O1···*Cg* = 3.296 Å. No significant π–π interaction between the dmphen rings is observed (the shortest centroid-to-centroid distance is 4.364 Å). The weak C—H···O hydrogen bonds link the chains into a three-dimensional structure (Fig. 2, Table 2).

Experimental

$Co(NO_3)_2{\cdot}6H_2O$ (0.073 g, 0.25 mmol) and sodium dicyanamide (0.022 g, 0.25 mmol) were dissolved in water (10 ml). A methanol solution (10 ml) of dmphen (0.052 g, 0.25 mmol) was added with continuous stirring. The resulting solution was filtrated and allowed to slowly evaporate at room temperature. After one month, red single crystals suitable for X-ray diffraction appeared. The crystals were collected, washed with water and dried in air (0.059 g, yield 60%). IR (KBr, cm^{-1}): 2318 (ms), 2293 (ms), 2269 (ms), 2247 (*m*), 2211 (*s*), 2180 (*s*).

Refinement

H atoms were positioned geometrically and refined as riding atoms, with C—H = 0.93 Å and $U_{iso}(H) = 1.2U_{eq}(C)$ for aromatic rings, and C—H = 0.96 Å and $U_{iso}(H) = 1.5U_{eq}(C)$ for methyl groups.

Figures

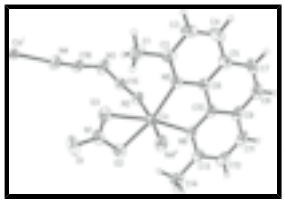

Fig. 1. The structure of (I), showing the Co^{II} coordination. Displacement ellipsoids are drawn at the 30% probability level. [Symmetry codes: (i) 1/2 − *x*, 1/2 + *y*, 1/2 − *z*; (ii) 1/2 − *x*, −1/2 + *y*, 1/2 − *z*.]

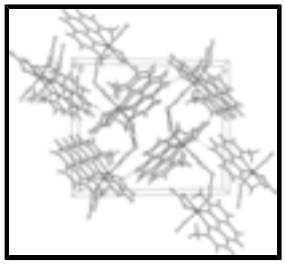

Fig. 2. Hydrogen bonds (dashed lines) between neighboring chains create a three-dimensional structure.

catena-Poly[[(2,9-dimethyl-1,10-phenanthroline-κ^2*N*,*N*')(nitrato- κ^2*O*,*O*')cobalt(II)]-μ-dicyanamido-κ^2*N*^{1}:*N*^{5}]

Crystal data

$[Co(C_2N_3)(NO_3)(C_{14}H_{12}N_2)]$	F_{000} = 804
M_r = 395.25	D_x = 1.583 Mg m^{-3}
Monoclinic, $P2_1/n$	Mo $K\alpha$ radiation λ = 0.71073 Å
Hall symbol: -P 2yn	Cell parameters from 16421 reflections
a = 7.3481 (15) Å	θ = 3.4–27.5º
b = 13.925 (3) Å	μ = 1.07 mm^{-1}
c = 16.531 (3) Å	*T* = 153 (2) K
β = 101.42 (3)º	Block, red
V = 1658.0 (6) Å^3	0.20 × 0.15 × 0.10 mm
Z = 4	

Data collection

Bruker KappaCCD area-detector diffractometer	3784 independent reflections
Radiation source: sealed tube	2450 reflections with $I > 2\sigma(I)$
Monochromator: graphite	R_{int} = 0.022
T = 153(2) K	θ_{max} = 27.5º
ω scans	θ_{min} = 3.6º
Absorption correction: multi-scan (SADABS; Sheldrick, 1996)	*h* = −9→9
T_{min} = 0.815, T_{max} = 0.901	*k* = −18→18
7407 measured reflections	*l* = −21→21

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)] = 0.033$	H-atom parameters constrained
$wR(F^2) = 0.098$	$w = 1/[\sigma^2(F_o^2) + (0.0613P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$S = 0.94$	$(\Delta/\sigma)_{max} < 0.001$
3784 reflections	$\Delta\rho_{max} = 0.44$ e Å^{-3}
237 parameters	$\Delta\rho_{min} = -0.32$ e Å^{-3}
Primary atom site location: structure-invariant direct methods	Extinction correction: none

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

	x	*y*	*z*	U_{iso}*/U_{eq}
Co	0.17457 (4)	0.86364 (2)	0.203521 (18)	0.03941 (12)
C1	0.5626 (4)	0.9754 (2)	0.1736 (2)	0.0718 (8)
H1A	0.5790	0.9478	0.2278	0.108*
H1B	0.4717	1.0257	0.1684	0.108*
H1C	0.6785	1.0013	0.1653	0.108*
C2	0.4981 (3)	0.8998 (2)	0.11066 (16)	0.0550 (6)
C3	0.5930 (4)	0.8817 (2)	0.0460 (2)	0.0689 (8)
H3	0.6973	0.9178	0.0419	0.083*
C4	0.5327 (4)	0.8119 (2)	−0.01033 (18)	0.0710 (9)
H4	0.5974	0.7997	−0.0522	0.085*
C5	0.3748 (4)	0.75839 (19)	−0.00591 (15)	0.0564 (7)
C6	0.2852 (3)	0.77972 (16)	0.05976 (13)	0.0432 (5)
C7	0.3025 (5)	0.6845 (2)	−0.06323 (16)	0.0685 (9)
H7	0.3640	0.6690	−0.1055	0.082*
C8	0.1478 (5)	0.63745 (19)	−0.05684 (16)	0.0683 (9)
H8	0.1021	0.5905	−0.0956	0.082*
C9	0.0506 (4)	0.65740 (17)	0.00819 (15)	0.0544 (7)
C10	0.1201 (3)	0.72828 (15)	0.06690 (13)	0.0422 (5)
C11	−0.1105 (4)	0.60941 (19)	0.01902 (18)	0.0640 (8)
H11	−0.1647	0.5638	−0.0194	0.077*
C12	−0.1875 (4)	0.62898 (18)	0.08485 (19)	0.0644 (8)
H12	−0.2918	0.5951	0.0927	0.077*
C13	−0.1113 (3)	0.69973 (17)	0.14120 (15)	0.0498 (6)
C14	−0.1931 (4)	0.7203 (2)	0.21529 (18)	0.0675 (8)
H14A	−0.2027	0.7884	0.2219	0.101*
H14B	−0.1148	0.6936	0.2635	0.101*
H14C	−0.3144	0.6919	0.2081	0.101*
C15	0.0563 (3)	1.05722 (17)	0.12152 (13)	0.0429 (5)
C16	0.1296 (4)	1.20845 (18)	0.16598 (16)	0.0506 (6)
N1	0.1251 (3)	0.97749 (16)	0.32013 (12)	0.0586 (6)

N2	0.0411 (3)	0.97627 (14)	0.12771 (12)	0.0497 (5)
N3	0.0722 (4)	1.14768 (15)	0.10658 (14)	0.0778 (8)
N4	0.1824 (3)	1.26809 (16)	0.21111 (13)	0.0608 (6)
N5	0.3482 (3)	0.84869 (13)	0.11715 (12)	0.0433 (5)
N6	0.0384 (2)	0.74995 (12)	0.13134 (11)	0.0398 (4)
O1	0.0919 (3)	1.03262 (17)	0.37294 (13)	0.0953 (8)
O2	0.0128 (3)	0.91132 (14)	0.29068 (11)	0.0593 (5)
O3	0.2731 (3)	0.98178 (13)	0.29219 (11)	0.0595 (5)

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Co	0.0450 (2)	0.03348 (18)	0.03892 (18)	−0.00008 (14)	0.00622 (13)	−0.00058 (13)
C1	0.0499 (17)	0.0674 (19)	0.098 (2)	−0.0148 (14)	0.0133 (16)	−0.0054 (17)
C2	0.0438 (15)	0.0568 (15)	0.0646 (16)	0.0035 (12)	0.0112 (13)	0.0095 (13)
C3	0.0508 (17)	0.079 (2)	0.082 (2)	0.0055 (15)	0.0261 (15)	0.0217 (17)
C4	0.076 (2)	0.084 (2)	0.0608 (18)	0.0249 (18)	0.0327 (16)	0.0142 (16)
C5	0.0659 (17)	0.0580 (16)	0.0472 (14)	0.0186 (14)	0.0160 (13)	0.0087 (12)
C6	0.0515 (14)	0.0397 (12)	0.0372 (12)	0.0117 (11)	0.0063 (11)	0.0031 (10)
C7	0.105 (3)	0.0627 (19)	0.0404 (14)	0.0280 (18)	0.0199 (16)	−0.0004 (13)
C8	0.111 (3)	0.0458 (16)	0.0421 (14)	0.0168 (17)	−0.0005 (16)	−0.0048 (12)
C9	0.077 (2)	0.0366 (13)	0.0416 (13)	0.0102 (12)	−0.0073 (13)	0.0002 (10)
C10	0.0514 (14)	0.0315 (11)	0.0399 (12)	0.0059 (10)	−0.0004 (10)	0.0000 (9)
C11	0.079 (2)	0.0379 (14)	0.0621 (17)	−0.0032 (14)	−0.0180 (16)	−0.0042 (12)
C12	0.0582 (17)	0.0427 (15)	0.084 (2)	−0.0113 (13)	−0.0060 (16)	0.0039 (14)
C13	0.0478 (15)	0.0369 (13)	0.0602 (15)	−0.0010 (11)	0.0001 (12)	0.0078 (11)
C14	0.0626 (18)	0.0605 (18)	0.084 (2)	−0.0099 (14)	0.0253 (16)	0.0085 (15)
C15	0.0458 (14)	0.0410 (14)	0.0391 (12)	−0.0005 (10)	0.0018 (10)	0.0000 (10)
C16	0.0627 (16)	0.0350 (13)	0.0492 (14)	−0.0038 (12)	−0.0003 (12)	0.0057 (11)
N1	0.0713 (17)	0.0570 (14)	0.0440 (12)	0.0149 (12)	0.0030 (12)	−0.0053 (10)
N2	0.0554 (13)	0.0367 (12)	0.0545 (12)	0.0012 (9)	0.0051 (10)	0.0024 (9)
N3	0.128 (2)	0.0393 (13)	0.0535 (14)	−0.0122 (13)	−0.0121 (15)	0.0048 (11)
N4	0.0799 (17)	0.0452 (13)	0.0506 (12)	−0.0086 (11)	−0.0034 (12)	0.0024 (10)
N5	0.0407 (11)	0.0412 (11)	0.0475 (11)	0.0039 (9)	0.0077 (9)	0.0024 (9)
N6	0.0428 (11)	0.0325 (10)	0.0419 (10)	0.0005 (8)	0.0033 (9)	0.0017 (8)
O1	0.1099 (19)	0.0995 (18)	0.0737 (14)	0.0292 (14)	0.0117 (13)	−0.0411 (13)
O2	0.0649 (12)	0.0634 (12)	0.0513 (10)	−0.0039 (10)	0.0160 (9)	−0.0018 (9)
O3	0.0559 (11)	0.0576 (12)	0.0617 (11)	0.0011 (9)	0.0039 (10)	−0.0098 (8)

Geometric parameters (Å, °)

Co—N4^{i}	2.069 (2)	C8—C9	1.431 (4)
Co—N5	2.105 (2)	C8—H8	0.9300
Co—N6	2.1116 (18)	C9—C11	1.402 (4)
Co—N2	2.123 (2)	C9—C10	1.407 (3)
Co—O2	2.1466 (17)	C10—N6	1.357 (3)
Co—O3	2.2268 (18)	C11—C12	1.350 (4)
C1—C2	1.490 (4)	C11—H11	0.9300

C1—H1A	0.9600	C12—C13	1.395 (4)
C1—H1B	0.9600	C12—H12	0.9300
C1—H1C	0.9600	C13—N6	1.340 (3)
C2—N5	1.333 (3)	C13—C14	1.495 (3)
C2—C3	1.409 (4)	C14—H14A	0.9600
C3—C4	1.359 (4)	C14—H14B	0.9600
C3—H3	0.9300	C14—H14C	0.9600
C4—C5	1.393 (4)	C15—N2	1.139 (3)
C4—H4	0.9300	C15—N3	1.293 (3)
C5—C6	1.408 (3)	C16—N4	1.132 (3)
C5—C7	1.428 (4)	C16—N3	1.302 (3)
C6—N5	1.365 (3)	N1—O1	1.223 (3)
C6—C10	1.433 (3)	N1—O3	1.264 (3)
C7—C8	1.334 (4)	N1—O2	1.268 (3)
C7—H7	0.9300	N4—Co^{ii}	2.069 (2)
N4^{i}—Co—N5	96.01 (8)	C7—C8—H8	119.2
N4^{i}—Co—N6	91.33 (8)	C9—C8—H8	119.2
N5—Co—N6	79.97 (7)	C11—C9—C10	116.5 (2)
N4^{i}—Co—N2	172.30 (8)	C11—C9—C8	124.3 (3)
N5—Co—N2	86.78 (8)	C10—C9—C8	119.2 (3)
N6—Co—N2	96.23 (8)	N6—C10—C9	122.7 (2)
N4^{i}—Co—O2	90.87 (8)	N6—C10—C6	117.84 (19)
N5—Co—O2	167.53 (7)	C9—C10—C6	119.4 (2)
N6—Co—O2	110.34 (7)	C12—C11—C9	120.4 (2)
N2—Co—O2	85.14 (7)	C12—C11—H11	119.8
N4^{i}—Co—O3	88.35 (8)	C9—C11—H11	119.8
N5—Co—O3	110.97 (7)	C11—C12—C13	120.3 (3)
N6—Co—O3	169.04 (7)	C11—C12—H12	119.9
N2—Co—O3	83.96 (8)	C13—C12—H12	119.9
O2—Co—O3	58.71 (7)	N6—C13—C12	121.2 (2)
C2—C1—H1A	109.5	N6—C13—C14	118.2 (2)
C2—C1—H1B	109.5	C12—C13—C14	120.6 (2)
H1A—C1—H1B	109.5	C13—C14—H14A	109.5
C2—C1—H1C	109.5	C13—C14—H14B	109.5
H1A—C1—H1C	109.5	H14A—C14—H14B	109.5
H1B—C1—H1C	109.5	C13—C14—H14C	109.5
N5—C2—C3	120.4 (3)	H14A—C14—H14C	109.5
N5—C2—C1	118.3 (2)	H14B—C14—H14C	109.5
C3—C2—C1	121.3 (2)	N2—C15—N3	174.2 (3)
C4—C3—C2	120.3 (3)	N4—C16—N3	172.5 (3)
C4—C3—H3	119.9	O1—N1—O3	122.6 (3)
C2—C3—H3	119.9	O1—N1—O2	121.6 (2)
C3—C4—C5	120.6 (3)	O3—N1—O2	115.82 (19)
C3—C4—H4	119.7	C15—N2—Co	137.9 (2)
C5—C4—H4	119.7	C15—N3—C16	121.1 (2)
C4—C5—C6	116.7 (3)	C16—N4—Co^{ii}	169.3 (2)
C4—C5—C7	123.7 (3)	C2—N5—C6	119.5 (2)

C6—C5—C7	119.6 (3)	C2—N5—Co	128.54 (17)
N5—C6—C5	122.5 (2)	C6—N5—Co	111.90 (15)
N5—C6—C10	118.09 (19)	C13—N6—C10	118.8 (2)
C5—C6—C10	119.4 (2)	C13—N6—Co	129.13 (16)
C8—C7—C5	120.8 (3)	C10—N6—Co	112.11 (14)
C8—C7—H7	119.6	N1—O2—Co	94.46 (14)
C5—C7—H7	119.6	N1—O3—Co	90.83 (14)
C7—C8—C9	121.6 (3)		
N5—C2—C3—C4	−0.1 (4)	N2—Co—N5—C2	81.6 (2)
C1—C2—C3—C4	179.4 (3)	O2—Co—N5—C2	31.9 (5)
C2—C3—C4—C5	1.1 (4)	O3—Co—N5—C2	−0.7 (2)
C3—C4—C5—C6	−0.9 (4)	N4^{i}—Co—N5—C6	92.44 (16)
C3—C4—C5—C7	179.5 (3)	N6—Co—N5—C6	2.15 (14)
C4—C5—C6—N5	−0.4 (4)	N2—Co—N5—C6	−94.76 (16)
C7—C5—C6—N5	179.3 (2)	O2—Co—N5—C6	−144.4 (3)
C4—C5—C6—C10	179.0 (2)	O3—Co—N5—C6	−177.03 (14)
C7—C5—C6—C10	−1.4 (3)	C12—C13—N6—C10	−2.6 (3)
C4—C5—C7—C8	−178.3 (3)	C14—C13—N6—C10	176.3 (2)
C6—C5—C7—C8	2.1 (4)	C12—C13—N6—Co	177.26 (18)
C5—C7—C8—C9	−1.3 (4)	C14—C13—N6—Co	−3.8 (3)
C7—C8—C9—C11	−178.9 (3)	C9—C10—N6—C13	2.3 (3)
C7—C8—C9—C10	−0.1 (4)	C6—C10—N6—C13	−177.1 (2)
C11—C9—C10—N6	0.3 (3)	C9—C10—N6—Co	−177.60 (17)
C8—C9—C10—N6	−178.6 (2)	C6—C10—N6—Co	3.1 (2)
C11—C9—C10—C6	179.6 (2)	N4^{i}—Co—N6—C13	81.5 (2)
C8—C9—C10—C6	0.8 (3)	N5—Co—N6—C13	177.3 (2)
N5—C6—C10—N6	−1.3 (3)	N2—Co—N6—C13	−97.05 (19)
C5—C6—C10—N6	179.4 (2)	O2—Co—N6—C13	−9.9 (2)
N5—C6—C10—C9	179.4 (2)	O3—Co—N6—C13	−6.7 (5)
C5—C6—C10—C9	0.0 (3)	N4^{i}—Co—N6—C10	−98.67 (15)
C10—C9—C11—C12	−2.6 (4)	N5—Co—N6—C10	−2.80 (15)
C8—C9—C11—C12	176.2 (3)	N2—Co—N6—C10	82.81 (16)
C9—C11—C12—C13	2.4 (4)	O2—Co—N6—C10	169.91 (14)
C11—C12—C13—N6	0.3 (4)	O3—Co—N6—C10	173.2 (3)
C11—C12—C13—C14	−178.6 (3)	O1—N1—O2—Co	176.7 (2)
N5—Co—N2—C15	−89.6 (3)	O3—N1—O2—Co	−4.1 (2)
N6—Co—N2—C15	−169.1 (3)	N4^{i}—Co—O2—N1	90.02 (15)
O2—Co—N2—C15	80.9 (3)	N5—Co—O2—N1	−33.6 (4)
O3—Co—N2—C15	21.9 (3)	N6—Co—O2—N1	−178.24 (13)
C3—C2—N5—C6	−1.2 (4)	N2—Co—O2—N1	−83.39 (15)
C1—C2—N5—C6	179.3 (2)	O3—Co—O2—N1	2.48 (13)
C3—C2—N5—Co	−177.25 (19)	O1—N1—O3—Co	−176.8 (2)
C1—C2—N5—Co	3.2 (3)	O2—N1—O3—Co	4.0 (2)
C5—C6—N5—C2	1.4 (3)	N4^{i}—Co—O3—N1	−94.50 (14)
C10—C6—N5—C2	−177.9 (2)	N5—Co—O3—N1	169.70 (13)
C5—C6—N5—Co	178.11 (18)	N6—Co—O3—N1	−6.0 (4)
C10—C6—N5—Co	−1.2 (2)	N2—Co—O3—N1	85.49 (14)

N4^{i}—Co—N5—C2	−91.2 (2)	O2—Co—O3—N1	−2.48 (13)
N6—Co—N5—C2	178.5 (2)		

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

Hydrogen-bond geometry (Å, °)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
C14—H14A···O2	0.96	2.45	3.190 (4)	133
C12—H12···O1^{iii}	0.93	2.54	3.455 (4)	169
C7—H7···O2^{iv}	0.93	2.48	3.388 (3)	167

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

Fig. 1

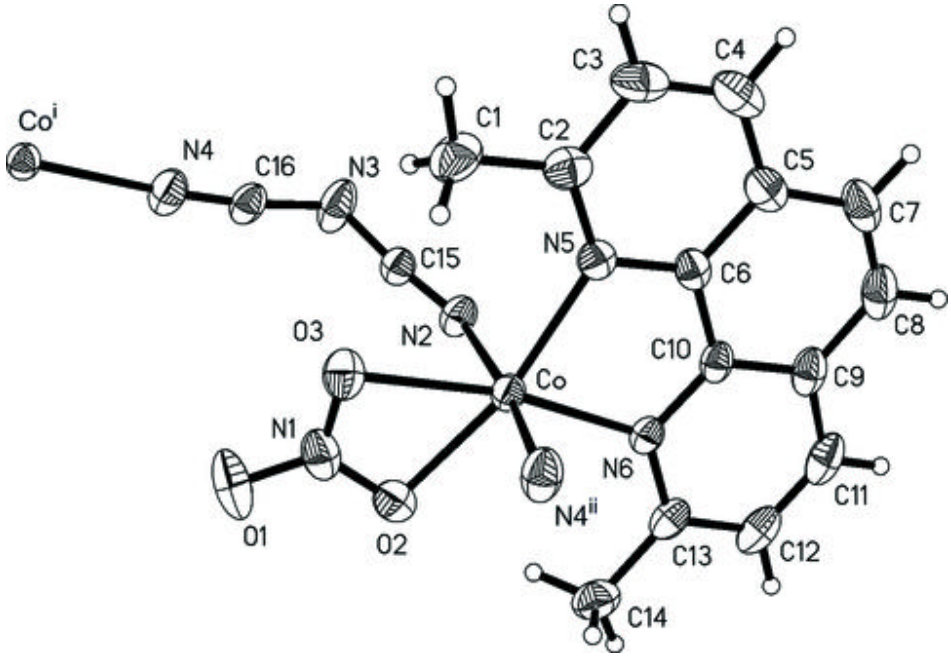
Co^{i}
N4
C16
N3
C15
C1
C2
C3
C4
C5
C7
C8
C9
C10
C6
N5
N2
O3
Co
N1
O1
O2
N6
N4^{ii}
C11
C12
C13
C14

Fig. 2