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# {2,6-Bis[1-(phenylimino)ethyl]pyridine-$\kappa^3N,N',N''$}dichloridocobalt(II)

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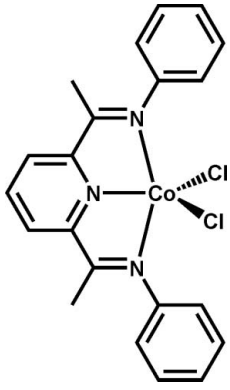
Key indicators: single-crystal X-ray study; $T$ = 273 K; mean $\sigma$(C–C) = 0.004 Å; $R$ factor = 0.037; $wR$ factor = 0.076; data-to-parameter ratio = 14.9.

In the title complex, $[CoCl_2(C_{21}H_{19}N_3)]$, the $Co^{II}$ atom is coordinated by one pyridine and two imine N atoms and by two chloride anions in a distorted trigonal bipyramidal geometry. The structure exhibits a pseudo-mirror plane through the metal atom, two chloride anions and the pyridine ring. In the crystal structure, the complexes are connected via intermolecular C—H···Cl hydrogen bonding.

## Related literature

For related literature on crystal structures of metal complexes of Schiff bases, see: Reardon *et al.* (2002); Pradhan *et al.* (2003); Gibson *et al.* (2001); Trivedi *et al.* (2007); Mentes *et al.* (2001); Esteruelas *et al.* (2003).




## Experimental

### *Crystal data*

$[CoCl_2(C_{21}H_{19}N_3)]$
$M_r$ = 443.22
Monoclinic, $P2_1/n$
$a$ = 10.4580 (3) Å
$b$ = 15.2575 (4) Å
$c$ = 13.1339 (3) Å
$\beta$ = 95.825 (10)°
$V$ = 2084.86 (9) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 1.09 mm$^{-1}$
$T$ = 273 (2) K
0.36 × 0.30 × 0.28 mm

### *Data collection*

Bruker SMART CCD area-detector diffractometer
Absorption correction: none
11050 measured reflections
3665 independent reflections
2594 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.046

### *Refinement*

$R[F^2 > 2\sigma(F^2)]$ = 0.036
$wR(F^2)$ = 0.075
$S$ = 1.01
3665 reflections
246 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.28 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.26 e Å$^{-3}$

**Table 1**
Selected geometric parameters (Å, °).

| | | | |
|---|---|---|---|
| Co1—N23 | 2.027 (2) | Co1—Cl2 | 2.2572 (8) |
| Co1—N24 | 2.208 (2) | Co1—Cl1 | 2.2638 (8) |
| Co1—N22 | 2.223 (2) | | |
| N23—Co1—N24 | 75.36 (8) | N22—Co1—Cl2 | 98.36 (6) |
| N23—Co1—N22 | 75.38 (8) | N23—Co1—Cl1 | 123.81 (6) |
| N24—Co1—N22 | 150.74 (9) | N24—Co1—Cl1 | 96.23 (6) |
| N23—Co1—Cl2 | 119.07 (6) | N22—Co1—Cl1 | 99.58 (6) |
| N24—Co1—Cl2 | 96.11 (6) | Cl2—Co1—Cl1 | 117.03 (3) |

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

| $D$—H···$A$ | $D$—H | H···$A$ | $D$···$A$ | $D$—H···$A$ |
|---|---|---|---|---|
| C2—H2···Cl2$^{i}$ | 0.93 | 2.67 | 3.545 (3) | 156 |
| C7—H7$A$···Cl1$^{ii}$ | 0.96 | 2.76 | 3.663 (3) | 158 |
| C18—H18···Cl2$^{iii}$ | 0.93 | 2.83 | 3.714 (3) | 160 |

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

Data collection: *SMART* (Bruker, 2004); cell refinement: *SAINT* (Bruker, 2004); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL*.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: NC2100).

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# supplementary materials

*Acta Cryst.* (2008). E**64**, m786 [ **doi:10.1107/S1600536808013007** ]

# {2,6-Bis[1-(phenylimino)ethyl]pyridine-$\kappa^3N,N',N''$}dichloridocobalt(II)

**X.-G. Li, D.-C. Zhong, R. He and H.-R. Guo**

## Comment

Recently, numerous crystal structures of metal-organic complexes with Schiff base ligands derived from 2,6-diacetylpyridine have been reported (Reardon *et al.*, 2002; Esteruelas *et al.*, 2003; Pradhan *et al.*, 2003; Gibson *et al.*, 2002; Trivedi *et al.*, 2007) in last several years. In our ongoing investigations on this topic we report here the crystal structure of the title compound.

In the crystal stucture of the title compound the $Co^{II}$ atom is coordinated by three N atoms from the Schiff base ligand and two Cl atoms within a distorted trigonal-bipyramid geometry (Table 1 and Fig. 1). The pyridyl N atom and the two Cl atoms are located in the equatorial plane and the apical position are occupied by the two imino N atoms.

The molecules are connected by intermolecular nonclassical C—H···Cl hydrogen bonding between the aromatic and methyl H atoms and the Cl atoms (Table 2 and Fig 2).

## Experimental

The ligand Plep (2,6-bis[(1-phenylimino)ethyl]pyridine) was prepared in high yield from condensation of two equivalents of aniline with one equivalent of 2,6-diacetylpyridine in methanol according to the literature (Mentes *et al.*, 2001). The title compound was synthesized as follows: To a solution of Plep (1 mmol) in 10 mL methanol, a solution of $CoCl_2.6H_2O$ (1 mmol) in 10 mL methanol was added dropwise at 333 K. After stirring for half an hour, the mixture was allowed to cool to room temperature and filtered off. On slow evaporation of the solvent from the filtrate at room temperature, red well shaped single crystals of the title compound were obtained in one week.

## Refinement

All H atoms were placed in geometrically idealized positions (,ethyl H atoms allowed to rotate but not to tip) and constrained to ride on their parent atoms, with C—H distances of 0.93 Å (0.96 Å for methyl H atoms) $U_{iso}$(H) = 1.2$U_{eq}$(C) (1.5 for methyl H atoms).

Data collection: *SMART* (Bruker, 2004); cell refinement: *SAINT* (Bruker, 2004); data reduction: *SAINT*; program(*s*) used to solve structure: *SHELXS97* (Sheldrick, 1997*a*); program(*s*) used to refine structure: *SHELXL97* (Sheldrick, 1997*a*); molecular graphics: *SHELXTL* (Sheldrick, 1997*b*); software used to prepare material for publication: *SHELXTL*.

**Figures**

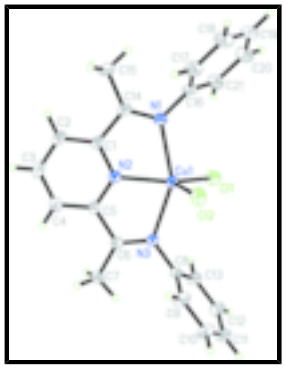


Fig. 1. Crystal structure of the title compound with 30% probability displacement ellipsoids and the atom-labeling scheme.

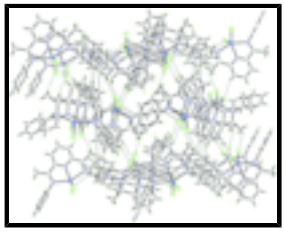


Fig. 2. Crystal structure of the title compound with C—H···Cl hydrogen bonding shown as dashed lines.

**{2,6-Bis[1-(phenylimino)ethyl]pyridine- $\kappa^3$*N*,*N*',*N*''}dichloridocobalt(II)**

*Crystal data*

| | |
|---|---|
| $[CoCl_2(C_{21}H_{19}N_3)]$ | $F_{000}$ = 908 |
| $M_r$ = 443.22 | $D_x$ = 1.412 Mg m$^{-3}$ |
| Monoclinic, $P2_1/n$ | Mo $K\alpha$ radiation<br>λ = 0.71073 Å |
| Hall symbol: -P 2yn | Cell parameters from 1843 reflections |
| $a$ = 10.4580 (3) Å | θ = 2.1–25.0º |
| $b$ = 15.2575 (4) Å | μ = 1.09 mm$^{-1}$ |
| $c$ = 13.1339 (3) Å | $T$ = 273 (2) K |
| β = 95.8250 (10)º | Block, red |
| $V$ = 2084.86 (9) Å$^3$ | 0.36 × 0.30 × 0.28 mm |
| $Z$ = 4 | |

*Data collection*

| | |
|---|---|
| Bruker SMART CCD area-detector diffractometer | 2594 reflections with $I > 2\sigma(I)$ |
| Radiation source: fine-focus sealed tube | $R_{int}$ = 0.046 |
| Monochromator: graphite | $\theta_{max}$ = 25.0º |
| $T$ = 273(2) K | $\theta_{min}$ = 2.1º |
| φ and ω scans | $h$ = −10→12 |
| Absorption correction: none | $k$ = −15→18 |
| 11050 measured reflections | $l$ = −15→15 |
| 3665 independent reflections | |

*Refinement*

| | |
|---|---|
| Refinement on $F^2$ | Secondary atom site location: difference Fourier map |
| Least-squares matrix: full | Hydrogen site location: inferred from neighbouring sites |
| $R[F^2 > 2\sigma(F^2)] = 0.036$ | H-atom parameters constrained |
| $wR(F^2) = 0.075$ | $w = 1/[\sigma^2(F_o^2) + (0.0286P)^2 + 0.0512P]$ where $P = (F_o^2 + 2F_c^2)/3$ |
| $S = 1.01$ | $(\Delta/\sigma)_{max} = 0.003$ |
| 3665 reflections | $\Delta\rho_{max} = 0.28$ e Å$^{-3}$ |
| 246 parameters | $\Delta\rho_{min} = -0.26$ e Å$^{-3}$ |
| Primary atom site location: structure-invariant direct methods | Extinction correction: none |

*Special details*

**Geometry**. All esds (except the esd in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell esds are taken into account individually in the estimation of esds in distances, angles and torsion angles; correlations between esds in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell esds is used for estimating esds 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 $F^2 > 2$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 | 0.24632 (4) | 0.03924 (2) | 0.67087 (3) | 0.03166 (12) |
| Cl1 | 0.09612 (7) | 0.14576 (5) | 0.67423 (5) | 0.0441 (2) |
| Cl2 | 0.45297 (7) | 0.07827 (5) | 0.71366 (6) | 0.0448 (2) |
| N24 | 0.2555 (2) | 0.04147 (15) | 0.50369 (15) | 0.0316 (5) |
| N22 | 0.2133 (2) | −0.03183 (16) | 0.81359 (15) | 0.0343 (6) |
| C6 | 0.2297 (2) | −0.03113 (19) | 0.45798 (19) | 0.0301 (6) |
| N23 | 0.20616 (19) | −0.08547 (15) | 0.62497 (16) | 0.0316 (5) |
| C14 | 0.1919 (3) | −0.1139 (2) | 0.8020 (2) | 0.0353 (7) |
| C3 | 0.1514 (3) | −0.2543 (2) | 0.5634 (2) | 0.0436 (8) |
| H3 | 0.1323 | −0.3115 | 0.5425 | 0.052* |
| C5 | 0.2025 (2) | −0.10652 (18) | 0.5251 (2) | 0.0308 (6) |
| C1 | 0.1845 (2) | −0.14705 (19) | 0.6945 (2) | 0.0331 (7) |
| C2 | 0.1571 (3) | −0.23215 (19) | 0.6658 (2) | 0.0412 (7) |
| H2 | 0.1426 | −0.2742 | 0.7146 | 0.049* |
| C4 | 0.1742 (3) | −0.19112 (19) | 0.4923 (2) | 0.0387 (7) |
| H4 | 0.1705 | −0.2052 | 0.4231 | 0.046* |
| C7 | 0.2247 (3) | −0.0470 (2) | 0.34516 (19) | 0.0423 (8) |
| H7A | 0.1407 | −0.0677 | 0.3200 | 0.063* |

| | | | | |
|---|---|---|---|---|
| H7B | 0.2878 | −0.0901 | 0.3320 | 0.063* |
| H7C | 0.2424 | 0.0067 | 0.3112 | 0.063* |
| C16 | 0.2226 (3) | 0.0074 (2) | 0.9132 (2) | 0.0370 (7) |
| C21 | 0.1319 (3) | 0.0674 (2) | 0.9352 (2) | 0.0496 (9) |
| H21 | 0.0644 | 0.0812 | 0.8862 | 0.059* |
| C8 | 0.2866 (3) | 0.11637 (18) | 0.44589 (18) | 0.0310 (7) |
| C9 | 0.4113 (3) | 0.1313 (2) | 0.4257 (2) | 0.0484 (8) |
| H9 | 0.4758 | 0.0919 | 0.4487 | 0.058* |
| C12 | 0.2231 (3) | 0.2498 (2) | 0.3586 (2) | 0.0487 (8) |
| H12 | 0.1595 | 0.2900 | 0.3362 | 0.058* |
| C13 | 0.1924 (3) | 0.1760 (2) | 0.41291 (19) | 0.0406 (8) |
| H13 | 0.1081 | 0.1668 | 0.4271 | 0.049* |
| C15 | 0.1728 (3) | −0.1794 (2) | 0.8837 (2) | 0.0557 (9) |
| H15A | 0.2453 | −0.2183 | 0.8919 | 0.084* |
| H15B | 0.0961 | −0.2126 | 0.8645 | 0.084* |
| H15C | 0.1648 | −0.1495 | 0.9470 | 0.084* |
| C10 | 0.4405 (3) | 0.2045 (2) | 0.3714 (2) | 0.0552 (9) |
| H10 | 0.5248 | 0.2140 | 0.3572 | 0.066* |
| C20 | 0.1406 (3) | 0.1075 (2) | 1.0304 (2) | 0.0615 (10) |
| H20 | 0.0791 | 0.1485 | 1.0448 | 0.074* |
| C18 | 0.3299 (4) | 0.0281 (2) | 1.0814 (2) | 0.0651 (11) |
| H18 | 0.3971 | 0.0145 | 1.1307 | 0.078* |
| C11 | 0.3473 (3) | 0.2633 (2) | 0.3383 (2) | 0.0505 (9) |
| H11 | 0.3681 | 0.3126 | 0.3018 | 0.061* |
| C17 | 0.3232 (3) | −0.0119 (2) | 0.9863 (2) | 0.0546 (9) |
| H17 | 0.3862 | −0.0516 | 0.9716 | 0.065* |
| C19 | 0.2392 (4) | 0.0873 (3) | 1.1032 (2) | 0.0630 (10) |
| H19 | 0.2442 | 0.1138 | 1.1672 | 0.076* |

*Atomic displacement parameters (Å$^2$)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| Co1 | 0.0368 (2) | 0.0268 (2) | 0.0312 (2) | −0.00071 (18) | 0.00279 (16) | 0.00155 (18) |
| Cl1 | 0.0371 (4) | 0.0479 (5) | 0.0480 (4) | 0.0097 (4) | 0.0080 (3) | 0.0079 (4) |
| Cl2 | 0.0348 (4) | 0.0449 (5) | 0.0538 (5) | 0.0047 (4) | 0.0005 (3) | −0.0052 (4) |
| N24 | 0.0375 (14) | 0.0279 (14) | 0.0297 (12) | −0.0017 (11) | 0.0045 (10) | 0.0018 (11) |
| N22 | 0.0395 (14) | 0.0349 (16) | 0.0289 (13) | 0.0041 (12) | 0.0053 (10) | 0.0033 (11) |
| C6 | 0.0260 (15) | 0.0336 (18) | 0.0310 (15) | 0.0001 (13) | 0.0042 (12) | 0.0003 (14) |
| N23 | 0.0330 (13) | 0.0288 (14) | 0.0331 (13) | 0.0000 (11) | 0.0040 (10) | 0.0038 (11) |
| C14 | 0.0356 (17) | 0.0346 (19) | 0.0364 (16) | 0.0044 (14) | 0.0070 (13) | 0.0094 (14) |
| C3 | 0.0452 (19) | 0.0274 (18) | 0.057 (2) | −0.0019 (14) | 0.0012 (16) | −0.0011 (16) |
| C5 | 0.0261 (15) | 0.0296 (17) | 0.0365 (16) | −0.0010 (13) | 0.0017 (12) | −0.0026 (13) |
| C1 | 0.0316 (16) | 0.0270 (18) | 0.0409 (17) | 0.0028 (13) | 0.0054 (13) | 0.0065 (14) |
| C2 | 0.0419 (19) | 0.0287 (19) | 0.0535 (19) | 0.0042 (14) | 0.0065 (15) | 0.0129 (15) |
| C4 | 0.0373 (17) | 0.037 (2) | 0.0413 (17) | 0.0034 (14) | 0.0000 (14) | −0.0058 (15) |
| C7 | 0.052 (2) | 0.042 (2) | 0.0339 (16) | −0.0104 (15) | 0.0106 (14) | −0.0066 (14) |
| C16 | 0.0446 (18) | 0.0403 (19) | 0.0274 (15) | −0.0006 (15) | 0.0099 (14) | 0.0070 (14) |
| C21 | 0.047 (2) | 0.059 (2) | 0.0435 (18) | 0.0041 (17) | 0.0103 (15) | −0.0010 (17) |

| | | | | | | |
|---|---|---|---|---|---|---|
| C8 | 0.0398 (17) | 0.0307 (17) | 0.0223 (14) | −0.0041 (14) | 0.0025 (12) | 0.0012 (13) |
| C9 | 0.0406 (19) | 0.048 (2) | 0.057 (2) | 0.0016 (16) | 0.0094 (16) | 0.0159 (17) |
| C12 | 0.062 (2) | 0.042 (2) | 0.0404 (18) | 0.0053 (17) | −0.0005 (16) | 0.0130 (16) |
| C13 | 0.0392 (18) | 0.044 (2) | 0.0393 (17) | 0.0009 (15) | 0.0049 (14) | 0.0096 (15) |
| C15 | 0.071 (2) | 0.051 (2) | 0.0494 (19) | 0.0050 (18) | 0.0240 (17) | 0.0184 (17) |
| C10 | 0.049 (2) | 0.058 (3) | 0.060 (2) | −0.0134 (18) | 0.0118 (17) | 0.0200 (19) |
| C20 | 0.068 (2) | 0.067 (3) | 0.054 (2) | 0.003 (2) | 0.0279 (19) | −0.008 (2) |
| C18 | 0.087 (3) | 0.069 (3) | 0.0357 (19) | 0.008 (2) | −0.0104 (19) | 0.0108 (18) |
| C11 | 0.071 (2) | 0.045 (2) | 0.0363 (17) | −0.0114 (19) | 0.0070 (17) | 0.0135 (16) |
| C17 | 0.069 (2) | 0.053 (2) | 0.0396 (19) | 0.0147 (18) | −0.0019 (17) | 0.0086 (17) |
| C19 | 0.095 (3) | 0.066 (3) | 0.0295 (18) | −0.008 (2) | 0.0150 (19) | 0.0039 (18) |

*Geometric parameters (Å, °)*

| | | | |
|---|---|---|---|
| Co1—N23 | 2.027 (2) | C16—C21 | 1.369 (4) |
| Co1—N24 | 2.208 (2) | C16—C17 | 1.382 (4) |
| Co1—N22 | 2.223 (2) | C21—C20 | 1.387 (4) |
| Co1—Cl2 | 2.2572 (8) | C21—H21 | 0.9300 |
| Co1—Cl1 | 2.2638 (8) | C8—C9 | 1.376 (4) |
| N24—C6 | 1.276 (3) | C8—C13 | 1.378 (4) |
| N24—C8 | 1.428 (3) | C9—C10 | 1.377 (4) |
| N22—C14 | 1.278 (3) | C9—H9 | 0.9300 |
| N22—C16 | 1.434 (3) | C12—C11 | 1.368 (4) |
| C6—C5 | 1.495 (4) | C12—C13 | 1.388 (4) |
| C6—C7 | 1.497 (3) | C12—H12 | 0.9300 |
| N23—C1 | 1.345 (3) | C13—H13 | 0.9300 |
| N23—C5 | 1.347 (3) | C15—H15A | 0.9600 |
| C14—C1 | 1.495 (4) | C15—H15B | 0.9600 |
| C14—C15 | 1.495 (4) | C15—H15C | 0.9600 |
| C3—C4 | 1.380 (4) | C10—C11 | 1.363 (4) |
| C3—C2 | 1.382 (4) | C10—H10 | 0.9300 |
| C3—H3 | 0.9300 | C20—C19 | 1.368 (4) |
| C5—C4 | 1.384 (4) | C20—H20 | 0.9300 |
| C1—C2 | 1.374 (4) | C18—C19 | 1.361 (5) |
| C2—H2 | 0.9300 | C18—C17 | 1.386 (4) |
| C4—H4 | 0.9300 | C18—H18 | 0.9300 |
| C7—H7A | 0.9600 | C11—H11 | 0.9300 |
| C7—H7B | 0.9600 | C17—H17 | 0.9300 |
| C7—H7C | 0.9600 | C19—H19 | 0.9300 |
| N23—Co1—N24 | 75.36 (8) | H7A—C7—H7C | 109.5 |
| N23—Co1—N22 | 75.38 (8) | H7B—C7—H7C | 109.5 |
| N24—Co1—N22 | 150.74 (9) | C21—C16—C17 | 119.4 (3) |
| N23—Co1—Cl2 | 119.07 (6) | C21—C16—N22 | 119.2 (3) |
| N24—Co1—Cl2 | 96.11 (6) | C17—C16—N22 | 121.4 (3) |
| N22—Co1—Cl2 | 98.36 (6) | C16—C21—C20 | 120.1 (3) |
| N23—Co1—Cl1 | 123.81 (6) | C16—C21—H21 | 120.0 |
| N24—Co1—Cl1 | 96.23 (6) | C20—C21—H21 | 120.0 |
| N22—Co1—Cl1 | 99.58 (6) | C9—C8—C13 | 119.4 (3) |
| Cl2—Co1—Cl1 | 117.03 (3) | C9—C8—N24 | 120.4 (3) |

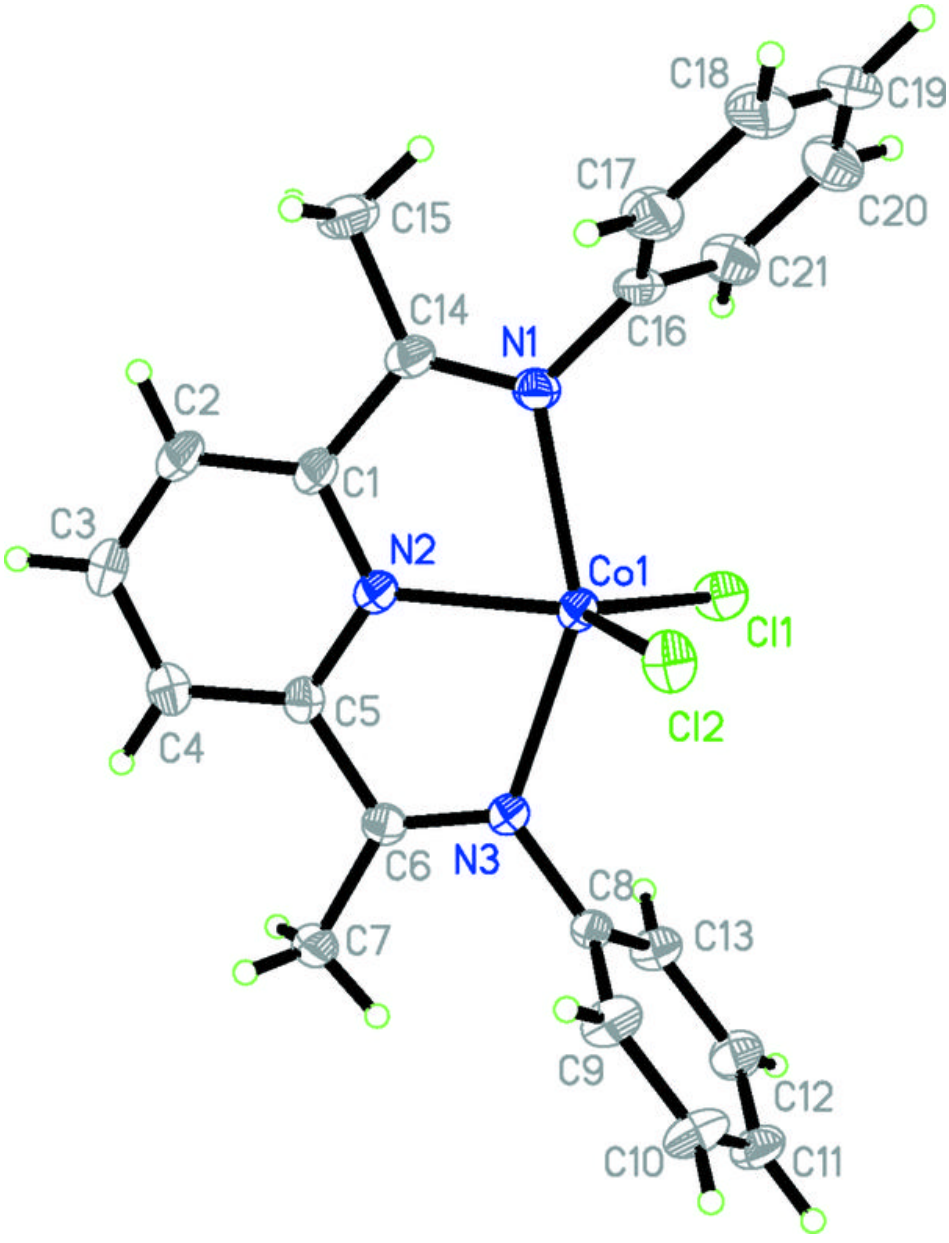
| | | | |
|---|---|---|---|
| C6—N24—C8 | 119.6 (2) | C13—C8—N24 | 120.1 (2) |
| C6—N24—Co1 | 115.23 (18) | C10—C9—C8 | 119.9 (3) |
| C8—N24—Co1 | 125.20 (17) | C10—C9—H9 | 120.0 |
| C14—N22—C16 | 120.8 (2) | C8—C9—H9 | 120.0 |
| C14—N22—Co1 | 114.70 (18) | C11—C12—C13 | 119.7 (3) |
| C16—N22—Co1 | 124.34 (18) | C11—C12—H12 | 120.1 |
| N24—C6—C5 | 115.7 (2) | C13—C12—H12 | 120.1 |
| N24—C6—C7 | 126.2 (3) | C8—C13—C12 | 120.2 (3) |
| C5—C6—C7 | 118.1 (2) | C8—C13—H13 | 119.9 |
| C1—N23—C5 | 120.3 (2) | C12—C13—H13 | 119.9 |
| C1—N23—Co1 | 119.86 (18) | C14—C15—H15A | 109.5 |
| C5—N23—Co1 | 119.87 (18) | C14—C15—H15B | 109.5 |
| N22—C14—C1 | 115.8 (2) | H15A—C15—H15B | 109.5 |
| N22—C14—C15 | 127.2 (3) | C14—C15—H15C | 109.5 |
| C1—C14—C15 | 117.0 (3) | H15A—C15—H15C | 109.5 |
| C4—C3—C2 | 119.6 (3) | H15B—C15—H15C | 109.5 |
| C4—C3—H3 | 120.2 | C11—C10—C9 | 120.7 (3) |
| C2—C3—H3 | 120.2 | C11—C10—H10 | 119.7 |
| N23—C5—C4 | 120.7 (3) | C9—C10—H10 | 119.7 |
| N23—C5—C6 | 113.7 (2) | C19—C20—C21 | 120.4 (3) |
| C4—C5—C6 | 125.5 (3) | C19—C20—H20 | 119.8 |
| N23—C1—C2 | 121.2 (3) | C21—C20—H20 | 119.8 |
| N23—C1—C14 | 114.1 (3) | C19—C18—C17 | 120.6 (3) |
| C2—C1—C14 | 124.6 (3) | C19—C18—H18 | 119.7 |
| C1—C2—C3 | 119.0 (3) | C17—C18—H18 | 119.7 |
| C1—C2—H2 | 120.5 | C10—C11—C12 | 120.1 (3) |
| C3—C2—H2 | 120.5 | C10—C11—H11 | 120.0 |
| C3—C4—C5 | 119.1 (3) | C12—C11—H11 | 120.0 |
| C3—C4—H4 | 120.4 | C16—C17—C18 | 119.8 (3) |
| C5—C4—H4 | 120.4 | C16—C17—H17 | 120.1 |
| C6—C7—H7A | 109.5 | C18—C17—H17 | 120.1 |
| C6—C7—H7B | 109.5 | C18—C19—C20 | 119.7 (3) |
| H7A—C7—H7B | 109.5 | C18—C19—H19 | 120.2 |
| C6—C7—H7C | 109.5 | C20—C19—H19 | 120.2 |

*Hydrogen-bond geometry (Å, °)*

| *D*—H···*A* | *D*—H | H···*A* | *D*···*A* | *D*—H···*A* |
|---|---|---|---|---|
| C2—H2···Cl2$^{i}$ | 0.93 | 2.67 | 3.545 (3) | 156 |
| C7—H7A···Cl1$^{ii}$ | 0.96 | 2.76 | 3.663 (3) | 158 |
| C18—H18···Cl2$^{iii}$ | 0.93 | 2.83 | 3.714 (3) | 160 |

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

**Fig. 1**


C18
C19
C17
C20
C15
C21
C14
N1
C16
C2
C1
C3
N2
Co1
Cl1
Cl2
C5
C4
C6
N3
C8
C7
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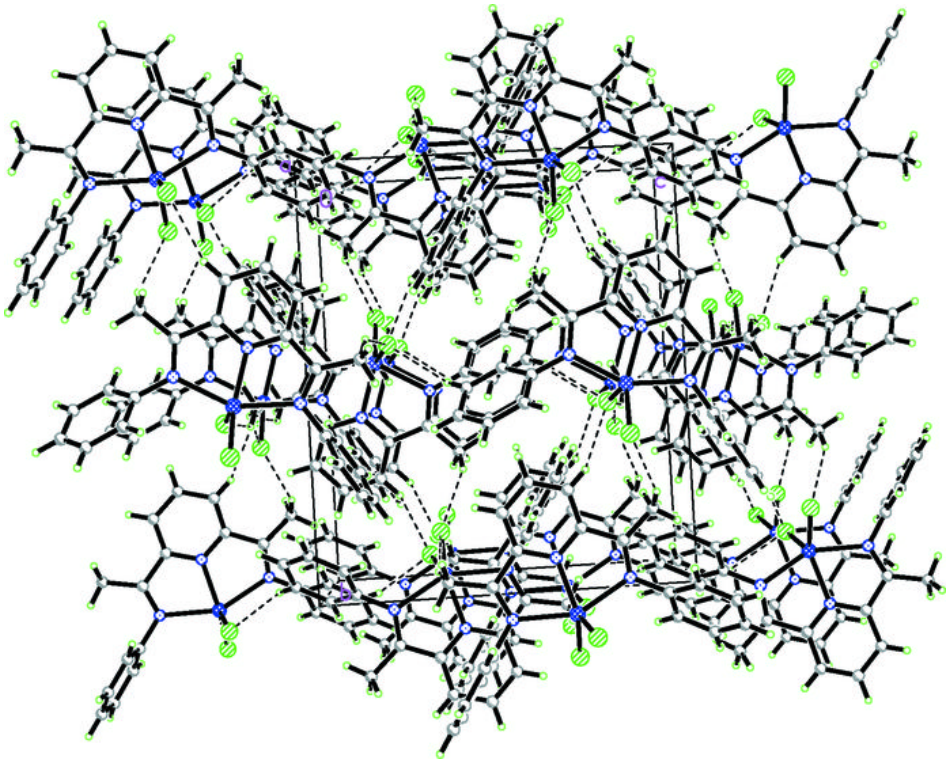
**Fig. 2**