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# Chlorido[6-phenyl-4-(*p*-tolyl)-2,2′-bipyridyl-$\kappa^2N,N'$]platinum(II)

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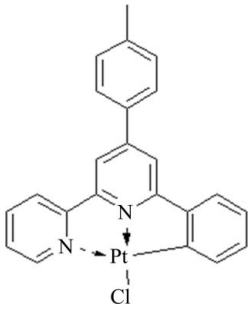
Key indicators: single-crystal X-ray study; $T$ = 298 K; mean $\sigma$(C–C) = 0.015 Å; $R$ factor = 0.038; $wR$ factor = 0.110; data-to-parameter ratio = 16.4.

The asymmetric unit of the title compound, $[Pt(C_{23}H_{17}N_2)Cl]$, contains two independent molecules with distinct dihedral angles between the central pyridyl and methylbenzene rings [7.77 (2) and 24.07 (2)°]. Short intermolecular distances [3.582 (6) and 3.600 (6) Å] between the outer pyridine and the $PtNC_3$ and $PtN_2C_2$ rings, respectively, indicate the existence of $\pi$–$\pi$ interactions, which link the molecules into stacks along the $a$ axis. The crystal structure is further stabilized by weak C—H$\cdots\pi$ interactions.

## Related literature

For related literature, see: Allen *et al.* (1987); Catalano *et al.* (2000); Kubicki *et al.* (2002).




## Experimental

### *Crystal data*

$[Pt(C_{23}H_{17}N_2)Cl]$
$M_r$ = 551.92
Monoclinic, $P2_1$
$a$ = 7.379 (5) Å
$b$ = 18.066 (5) Å
$c$ = 14.222 (5) Å
$\beta$ = 102.551 (5)°
$V$ = 1850.6 (15) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 7.74 mm$^{-1}$
$T$ = 298 (2) K
0.50 × 0.30 × 0.20 mm

### *Data collection*

Bruker APEX area-dectector diffractometer
Absorption correction: multi-scan (*SADABS*; Bruker, 2002)
$T_{min}$ = 0.113, $T_{max}$ = 0.307
(expected range = 0.078–0.213)
14983 measured reflections
8028 independent reflections
6615 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.035

### *Refinement*

$R[F^2 > 2\sigma(F^2)]$ = 0.038
$wR(F^2)$ = 0.110
$S$ = 0.72
8028 reflections
489 parameters
1 restraint
H-atom parameters constrained
$\Delta\rho_{max}$ = 1.91 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.65 e Å$^{-3}$
Absolute structure: Flack (1983), with 3598 Friedel pairs
Flack parameter: 0.001 (11)

**Table 1**
Selected interatomic distances (Å).

*Cg*1, *Cg*2 and *Cg*3 are the centroids of the N4/C24–C28, Pt1/N1/C10/C11/C16 and Pt1/N1/N2/C5/C6 rings, respectively.

| | | | |
|---|---|---|---|
| N3—Pt2 | 1.941 (8) | Pt1—C16 | 1.981 (9) |
| Pt2—C39 | 2.001 (11) | Pt1—N2 | 2.116 (8) |
| Pt2—N4 | 2.130 (9) | Pt1—Cl1 | 2.299 (3) |
| Pt2—Cl2 | 2.302 (3) | *Cg*1···*Cg*2$^{i}$ | 3.582 (6) |
| Pt1—N1 | 1.932 (7) | *Cg*1···*Cg*3 | 3.600 (6) |

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

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

*Cg*4 and *Cg*5 are the centroids of the Pt2/N3/C33/C34/C39 and C41–C45 rings, respectively.

| *D*—H···*A* | *D*—H | H···*A* | *D*···*A* | *D*—H···*A* |
|---|---|---|---|---|
| C3—H3···*Cg*4$^{ii}$ | 0.93 | 2.87 | 3.650 (14) | 142 |
| C14—H14···*Cg*5$^{iii}$ | 0.93 | 2.71 | 3.445 (14) | 136 |

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

Data collection: *SMART* (Bruker, 2002); cell refinement: *SAINT* (Bruker, 2002); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *ORTEPII* (Johnson, 1976); software used to prepare material for publication: *SHELXL97*.

We thank Professor W.-T. Yu of Shan Dong University for his kind assistance with the X-ray structure determination.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: CV2424).

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# supplementary materials

*Acta Cryst.* (2008). E**64**, m1013 [ **doi:10.1107/S1600536808020473** ]

# Chlorido[6-phenyl-4-(*p*-tolyl)-2,2'-bipyridyl-$\kappa^2N,N'$]platinum(II)

**H. B. Lu, G. Q. Lv, J. L. Zuo and J. X. Yang**

## Comment

Recently, the bonding interaction between the closed-shell metal atoms or ions is gaining increasing attention, and while there exist numerous examples of fluorophenyl and cyanate platinum(II) centers aggregating with $s^2$ ions such as Tl(I) or Pb(II) and $d^{10}$ ions such as Au(I) or Ag(I)(Catalano *et al.*, 2000), there are few reports of similar association in the case of alkyl platinum(II) complexes. As a part of our ongoing investigation on platinum complexes, the title compound (I) has been prepared and its crystal structure is presented here.

There are two crystallographically independent molecules in the asymmetric unit of (I) (Fig. 1). Each molecule contains a Pt atom coordinated in a distorted square-planar configuration with two Pt-N, one Pt-C and one Pt-Cl bonds (Table 1). Bond lengths and angles in the two molecules are similar and in a argreement with the values reported in the literature (Allen *et al.*, 1987). The dihedral angles formed by the C17—C22 and C40—C45 benzene rings with N1/C6—C10 and N3/C29—C33 are 24.07 (2)°, 7.77 (2)°, respectively. The crystal packing of the structure exhibits π-π interactions proved by short intermolecular *Cg*1···*Cg*2 and *Cg*1···*Cg*3 distances of 3.582 (6) and 3.600 (6) Å, respectively; *Cg*1, *Cg*2 and *Cg*3 are centroids of N4/C24—C28, Pt1/N1/C10/C11/C16 and Pt1/N1/N2/C5/C6 rings, respectively (Table 1), which link the molecules into stacks along *a* axis. The crystal structure is further stabilized by the weak C—H···π interactions (Kubicki *et al.*, 2002; Table 2).

## Experimental

For the preparation of 3,6-diimidazolyl-9-ethylcarbazole, A mixture of 4-(*p*-tolyl)-6-phenyl-2,2'-bipyridine (96.72 mg, 0.30 mmol) and $K_2PtCl_4$ (124.58 mg, 0.30 mmol) were heated at 363 K with $CH_3CN$ (10 ml) as solvent for 18 h. The mixture was cooled to room temperature. Then it was filtered and concentrated, the re-crystallization from DMF produced red single crystals (38.90 mg, Yield 83.88%).

## Refinement

All hydrogen atoms were placed in geometrically idealized positions and constrained to ride on their parent atoms, with C—H = 0.93 - 0.96 Å and $U_{iso}$(H) = 1.2 or 1.5 $U_{eq}$(C). The highest residual peak [1.91 e Å$^{-3}$] is situated 0.11 Å at atom H30.

## Figures

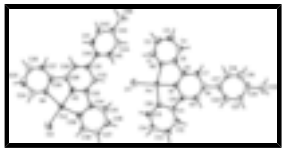


Fig. 1. : The content of asymmetric unit of the title compound showing the atomic numbering and 50% probability displacement ellipsoids.

## Chlorido[6-phenyl-4-(*p*-tolyl)-2,2'-bipyridyl-$\kappa^2$N,N']platinum(II)

*Crystal data*

| | |
|---|---|
| $[Pt(C_{23}H_{17}N_2)Cl]$ | $Z = 4$ |
| $M_r = 551.92$ | $F_{000} = 1056$ |
| Monoclinic, $P2_1$ | $D_x = 1.981$ Mg m$^{-3}$ |
| $a = 7.379$ (5) Å | Mo $K\alpha$ radiation<br>$\lambda = 0.71069$ Å |
| $b = 18.066$ (5) Å | $\mu = 7.74$ mm$^{-1}$ |
| $c = 14.222$ (5) Å | $T = 298$ (2) K |
| $\beta = 102.551$ (5)º | Needle, red |
| $V = 1850.6$ (15) Å$^3$ | 0.50 × 0.30 × 0.20 mm |

*Data collection*

| | |
|---|---|
| Bruker APEX area-dectector diffractometer | 8028 independent reflections |
| Radiation source: fine-focus sealed tube | 6615 reflections with $I > 2\sigma(I)$ |
| Monochromator: graphite | $R_{int} = 0.035$ |
| $T = 298$(2) K | $\theta_{max} = 27.5$º |
| φ and ω scans | $\theta_{min} = 1.9$º |
| Absorption correction: multi-scan (SADABS; Bruker, 2002) | $h = -9 \rightarrow 9$ |
| $T_{min} = 0.113$, $T_{max} = 0.307$ | $k = -23 \rightarrow 23$ |
| 14983 measured reflections | $l = -18 \rightarrow 18$ |

*Refinement*

| | |
|---|---|
| Refinement on $F^2$ | Hydrogen site location: inferred from neighbouring sites |
| Least-squares matrix: full | H-atom parameters constrained |
| $R[F^2 > 2\sigma(F^2)] = 0.038$ | $w = 1/[\sigma^2(F_o^2) + (0.1P)^2]$<br>where $P = (F_o^2 + 2F_c^2)/3$ |
| $wR(F^2) = 0.110$ | $(\Delta/\sigma)_{max} = 0.001$ |
| $S = 0.72$ | $\Delta\rho_{max} = 1.91$ e Å$^{-3}$ |
| 8028 reflections | $\Delta\rho_{min} = -0.65$ e Å$^{-3}$ |
| 489 parameters | Extinction correction: none |
| 1 restraint | Absolute structure: Flack (1983), 3598 Friedel pairs |
| Primary atom site location: structure-invariant direct methods | Flack parameter: 0.001 (11) |
| Secondary atom site location: difference Fourier map | |

*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* | $U_{iso}$*/$U_{eq}$ |
|---|---|---|---|---|
| C19 | 0.7020 (18) | 0.2281 (9) | 0.3338 (8) | 0.071 (3) |
| H19 | 0.7383 | 0.2734 | 0.3628 | 0.085* |
| N3 | 0.0093 (11) | 0.0772 (4) | 0.1479 (6) | 0.0455 (18) |
| Pt2 | −0.09764 (5) | −0.01160 (2) | 0.08126 (2) | 0.04713 (11) |
| Pt1 | 0.35781 (5) | 0.143731 (18) | −0.25831 (2) | 0.04136 (10) |
| Cl2 | −0.2212 (5) | −0.11757 (18) | 0.0028 (2) | 0.0741 (8) |
| Cl1 | 0.2643 (5) | 0.1428 (2) | −0.42342 (17) | 0.0687 (7) |
| N1 | 0.4326 (9) | 0.1481 (5) | −0.1195 (5) | 0.0391 (14) |
| C44 | 0.2848 (18) | 0.3505 (7) | 0.4362 (7) | 0.061 (3) |
| H44 | 0.2739 | 0.3580 | 0.4994 | 0.074* |
| C39 | −0.0498 (14) | −0.0514 (6) | 0.2157 (7) | 0.052 (2) |
| C8 | 0.5388 (12) | 0.1543 (6) | 0.0788 (6) | 0.044 (2) |
| C27 | −0.0172 (14) | 0.1830 (6) | −0.0774 (7) | 0.048 (2) |
| H27 | 0.0347 | 0.2287 | −0.0569 | 0.057* |
| C17 | 0.5989 (13) | 0.1582 (5) | 0.1879 (6) | 0.044 (2) |
| C40 | 0.2257 (12) | 0.2733 (5) | 0.2945 (6) | 0.0400 (19) |
| C33 | 0.0607 (13) | 0.0765 (5) | 0.2432 (7) | 0.044 (2) |
| C9 | 0.4583 (13) | 0.0905 (5) | 0.0326 (7) | 0.045 (2) |
| H9 | 0.4410 | 0.0493 | 0.0689 | 0.054* |
| C45 | 0.2185 (16) | 0.2857 (6) | 0.3890 (7) | 0.050 (2) |
| H45 | 0.1678 | 0.2496 | 0.4222 | 0.060* |
| C31 | 0.1507 (13) | 0.2049 (5) | 0.2432 (6) | 0.041 (2) |
| C41 | 0.3111 (14) | 0.3287 (6) | 0.2493 (6) | 0.047 (2) |
| H41 | 0.3226 | 0.3217 | 0.1861 | 0.056* |
| C12 | 0.2565 (16) | −0.0365 (6) | −0.0924 (9) | 0.058 (3) |
| H12 | 0.2838 | −0.0446 | −0.0262 | 0.069* |
| C10 | 0.4033 (12) | 0.0878 (5) | −0.0677 (7) | 0.0404 (19) |
| C42 | 0.3768 (16) | 0.3918 (6) | 0.2959 (8) | 0.056 (3) |
| H42 | 0.4299 | 0.4275 | 0.2633 | 0.067* |
| C43 | 0.3675 (18) | 0.4046 (6) | 0.3900 (8) | 0.061 (3) |
| N4 | −0.1077 (11) | 0.0607 (5) | −0.0380 (6) | 0.0500 (19) |
| C32 | 0.1347 (12) | 0.1397 (6) | 0.2932 (6) | 0.0457 (19) |
| H32 | 0.1736 | 0.1384 | 0.3599 | 0.055* |

| | | | | |
|---|---|---|---|---|
| C29 | 0.0292 (12) | 0.1399 (7) | 0.0952 (5) | 0.0416 (18) |
| C25 | −0.1501 (16) | 0.0992 (8) | −0.2003 (8) | 0.064 (3) |
| H25 | −0.1893 | 0.0876 | −0.2653 | 0.077* |
| N2 | 0.4760 (11) | 0.2509 (5) | −0.2403 (5) | 0.0440 (17) |
| C16 | 0.2736 (12) | 0.0437 (5) | −0.2302 (7) | 0.0411 (19) |
| C21 | 0.637 (2) | 0.1009 (9) | 0.3453 (9) | 0.081 (4) |
| H21 | 0.6283 | 0.0592 | 0.3823 | 0.097* |
| C37 | −0.0303 (18) | −0.1362 (7) | 0.3487 (9) | 0.066 (3) |
| H37 | −0.0465 | −0.1839 | 0.3699 | 0.079* |
| C38 | −0.0821 (19) | −0.1205 (7) | 0.2512 (8) | 0.064 (3) |
| H38 | −0.1395 | −0.1570 | 0.2089 | 0.077* |
| C34 | 0.0295 (14) | 0.0036 (5) | 0.2848 (7) | 0.046 (2) |
| C30 | 0.0987 (12) | 0.2031 (5) | 0.1427 (6) | 0.0403 (19) |
| H30 | 0.1115 | 0.2455 | 0.1076 | 0.048* |
| C46 | 0.436 (2) | 0.4749 (8) | 0.4407 (10) | 0.088 (4) |
| H46A | 0.4440 | 0.5125 | 0.3941 | 0.131* |
| H46B | 0.5562 | 0.4669 | 0.4814 | 0.131* |
| H46C | 0.3510 | 0.4905 | 0.4793 | 0.131* |
| C11 | 0.3080 (12) | 0.0276 (6) | −0.1299 (7) | 0.044 (2) |
| C6 | 0.5122 (13) | 0.2106 (5) | −0.0761 (7) | 0.044 (2) |
| C18 | 0.6581 (17) | 0.2241 (7) | 0.2346 (8) | 0.059 (3) |
| H18 | 0.6682 | 0.2663 | 0.1985 | 0.070* |
| C28 | −0.0335 (13) | 0.1287 (5) | −0.0092 (6) | 0.045 (2) |
| C22 | 0.594 (2) | 0.0974 (8) | 0.2454 (8) | 0.074 (4) |
| H22 | 0.5608 | 0.0519 | 0.2161 | 0.089* |
| C7 | 0.5620 (15) | 0.2149 (6) | 0.0231 (7) | 0.047 (2) |
| H7 | 0.6112 | 0.2587 | 0.0526 | 0.057* |
| C24 | −0.1648 (14) | 0.0476 (7) | −0.1329 (7) | 0.056 (3) |
| H24 | −0.2161 | 0.0018 | −0.1530 | 0.068* |
| C13 | 0.1620 (16) | −0.0893 (6) | −0.1555 (9) | 0.062 (3) |
| H13 | 0.1259 | −0.1337 | −0.1320 | 0.074* |
| C4 | 0.6150 (16) | 0.3362 (6) | −0.1195 (8) | 0.057 (2) |
| H4 | 0.6526 | 0.3487 | −0.0548 | 0.068* |
| C35 | 0.0742 (16) | −0.0126 (7) | 0.3828 (8) | 0.060 (2) |
| H35 | 0.1243 | 0.0238 | 0.4271 | 0.072* |
| C5 | 0.5346 (14) | 0.2690 (5) | −0.1462 (7) | 0.045 (2) |
| C14 | 0.1223 (16) | −0.0757 (7) | −0.2530 (10) | 0.062 (3) |
| H14 | 0.0578 | −0.1111 | −0.2948 | 0.075* |
| C15 | 0.1765 (14) | −0.0102 (8) | −0.2903 (8) | 0.056 (2) |
| H15 | 0.1472 | −0.0024 | −0.3566 | 0.067* |
| C2 | 0.5799 (19) | 0.3664 (7) | −0.2857 (9) | 0.068 (3) |
| H2 | 0.5929 | 0.3992 | −0.3342 | 0.082* |
| C1 | 0.5009 (15) | 0.2984 (7) | −0.3080 (8) | 0.057 (3) |
| H1 | 0.4633 | 0.2850 | −0.3724 | 0.069* |
| C26 | −0.0770 (16) | 0.1693 (7) | −0.1738 (7) | 0.063 (3) |
| H26 | −0.0694 | 0.2052 | −0.2197 | 0.075* |
| C3 | 0.6396 (17) | 0.3855 (7) | −0.1910 (9) | 0.065 (3) |
| H3 | 0.6962 | 0.4311 | −0.1744 | 0.078* |
| C20 | 0.6946 (17) | 0.1699 (9) | 0.3895 (7) | 0.071 (4) |

| | | | | |
|---|---|---|---|---|
| C36 | 0.044 (2) | −0.0835 (7) | 0.4141 (9) | 0.069 (3) |
| H36 | 0.0738 | −0.0948 | 0.4794 | 0.082* |
| C23 | 0.744 (2) | 0.1739 (10) | 0.5006 (9) | 0.086 (4) |
| H23A | 0.8454 | 0.1408 | 0.5249 | 0.129* |
| H23B | 0.6383 | 0.1597 | 0.5254 | 0.129* |
| H23C | 0.7798 | 0.2235 | 0.5205 | 0.129* |

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

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| C19 | 0.077 (8) | 0.085 (9) | 0.050 (6) | −0.004 (7) | 0.013 (6) | −0.018 (6) |
| N3 | 0.051 (4) | 0.042 (4) | 0.038 (4) | 0.008 (4) | −0.003 (3) | −0.003 (3) |
| Pt2 | 0.0528 (2) | 0.04704 (19) | 0.04067 (19) | 0.00263 (18) | 0.00828 (15) | −0.00699 (16) |
| Pt1 | 0.04689 (18) | 0.03779 (16) | 0.03740 (17) | 0.00176 (16) | 0.00475 (13) | 0.00092 (15) |
| Cl2 | 0.102 (2) | 0.0613 (17) | 0.0567 (16) | −0.0187 (17) | 0.0123 (16) | −0.0182 (14) |
| Cl1 | 0.0953 (19) | 0.0648 (14) | 0.0393 (11) | −0.0045 (19) | −0.0002 (12) | 0.0015 (14) |
| N1 | 0.045 (3) | 0.035 (3) | 0.037 (3) | 0.009 (4) | 0.008 (3) | −0.003 (4) |
| C44 | 0.084 (8) | 0.059 (7) | 0.037 (5) | −0.006 (6) | 0.005 (5) | −0.004 (5) |
| C39 | 0.056 (6) | 0.055 (6) | 0.048 (5) | 0.000 (5) | 0.016 (5) | −0.009 (5) |
| C8 | 0.039 (4) | 0.055 (6) | 0.038 (4) | 0.015 (4) | 0.010 (3) | 0.000 (4) |
| C27 | 0.055 (6) | 0.047 (5) | 0.039 (5) | 0.012 (5) | 0.009 (4) | 0.003 (4) |
| C17 | 0.048 (5) | 0.049 (6) | 0.035 (4) | 0.008 (4) | 0.008 (3) | −0.005 (4) |
| C40 | 0.048 (5) | 0.033 (4) | 0.039 (4) | 0.007 (4) | 0.010 (4) | 0.005 (4) |
| C33 | 0.044 (5) | 0.041 (5) | 0.043 (5) | 0.005 (4) | 0.005 (4) | 0.002 (4) |
| C9 | 0.046 (5) | 0.040 (5) | 0.049 (5) | 0.001 (4) | 0.012 (4) | 0.004 (4) |
| C45 | 0.073 (6) | 0.040 (5) | 0.035 (5) | 0.010 (5) | 0.007 (4) | 0.003 (4) |
| C31 | 0.049 (5) | 0.038 (5) | 0.036 (4) | 0.006 (4) | 0.010 (4) | −0.001 (4) |
| C41 | 0.067 (6) | 0.044 (5) | 0.031 (4) | 0.007 (5) | 0.014 (4) | 0.003 (4) |
| C12 | 0.068 (7) | 0.049 (6) | 0.056 (6) | 0.001 (5) | 0.012 (5) | 0.010 (5) |
| C10 | 0.041 (5) | 0.037 (4) | 0.042 (5) | 0.008 (4) | 0.006 (4) | −0.003 (4) |
| C42 | 0.067 (6) | 0.045 (5) | 0.053 (6) | 0.005 (5) | 0.005 (5) | 0.001 (5) |
| C43 | 0.080 (8) | 0.047 (5) | 0.044 (6) | 0.003 (6) | −0.011 (5) | 0.003 (5) |
| N4 | 0.044 (4) | 0.058 (5) | 0.041 (4) | 0.001 (4) | −0.005 (3) | −0.006 (4) |
| C32 | 0.052 (5) | 0.055 (5) | 0.030 (4) | 0.008 (5) | 0.008 (3) | 0.003 (5) |
| C29 | 0.048 (4) | 0.051 (5) | 0.027 (3) | 0.010 (5) | 0.009 (3) | 0.005 (4) |
| C25 | 0.067 (7) | 0.091 (9) | 0.035 (5) | 0.014 (7) | 0.012 (5) | −0.010 (6) |
| N2 | 0.049 (4) | 0.046 (4) | 0.035 (4) | −0.005 (4) | 0.003 (3) | 0.005 (3) |
| C16 | 0.040 (4) | 0.035 (4) | 0.045 (5) | 0.004 (4) | 0.003 (4) | 0.000 (4) |
| C21 | 0.119 (12) | 0.073 (9) | 0.048 (7) | −0.011 (8) | 0.015 (7) | 0.010 (6) |
| C37 | 0.082 (8) | 0.055 (6) | 0.060 (7) | −0.013 (6) | 0.015 (6) | 0.007 (5) |
| C38 | 0.077 (7) | 0.053 (6) | 0.056 (7) | −0.010 (6) | 0.002 (6) | 0.006 (5) |
| C34 | 0.056 (5) | 0.035 (5) | 0.047 (5) | 0.010 (4) | 0.015 (4) | 0.000 (4) |
| C30 | 0.042 (5) | 0.041 (5) | 0.037 (4) | 0.005 (4) | 0.007 (4) | −0.001 (4) |
| C46 | 0.127 (12) | 0.060 (8) | 0.070 (8) | −0.016 (8) | 0.010 (8) | −0.007 (6) |
| C11 | 0.033 (4) | 0.044 (5) | 0.052 (5) | 0.002 (4) | 0.005 (4) | −0.001 (4) |
| C6 | 0.041 (5) | 0.043 (5) | 0.045 (5) | 0.000 (4) | 0.006 (4) | 0.000 (4) |
| C18 | 0.067 (7) | 0.060 (6) | 0.050 (6) | −0.005 (6) | 0.015 (5) | 0.007 (5) |
| C28 | 0.054 (5) | 0.051 (6) | 0.031 (4) | 0.020 (4) | 0.011 (4) | −0.002 (4) |

| | | | | | | |
|---|---|---|---|---|---|---|
| C22 | 0.108 (10) | 0.066 (8) | 0.044 (6) | −0.007 (8) | 0.007 (6) | −0.003 (5) |
| C7 | 0.060 (6) | 0.041 (5) | 0.041 (5) | 0.001 (4) | 0.010 (4) | −0.006 (4) |
| C24 | 0.050 (5) | 0.072 (7) | 0.042 (5) | −0.002 (5) | 0.000 (4) | −0.016 (5) |
| C13 | 0.063 (7) | 0.041 (5) | 0.078 (8) | −0.009 (5) | 0.005 (6) | −0.002 (5) |
| C4 | 0.076 (7) | 0.041 (5) | 0.053 (6) | 0.000 (5) | 0.014 (5) | 0.001 (5) |
| C35 | 0.077 (7) | 0.045 (5) | 0.054 (5) | 0.001 (6) | 0.006 (5) | 0.005 (5) |
| C5 | 0.052 (5) | 0.042 (5) | 0.040 (5) | 0.002 (4) | 0.008 (4) | −0.004 (4) |
| C14 | 0.058 (6) | 0.047 (6) | 0.082 (9) | −0.008 (5) | 0.013 (6) | −0.016 (6) |
| C15 | 0.053 (5) | 0.056 (6) | 0.053 (5) | −0.010 (6) | 0.000 (4) | −0.006 (6) |
| C2 | 0.084 (8) | 0.060 (7) | 0.064 (7) | −0.003 (7) | 0.025 (6) | 0.018 (6) |
| C1 | 0.061 (6) | 0.055 (6) | 0.054 (6) | −0.005 (5) | 0.011 (5) | 0.019 (5) |
| C26 | 0.066 (7) | 0.081 (8) | 0.039 (5) | 0.017 (6) | 0.006 (5) | 0.003 (5) |
| C3 | 0.069 (7) | 0.048 (6) | 0.076 (8) | −0.017 (6) | 0.011 (6) | −0.005 (6) |
| C20 | 0.069 (7) | 0.111 (11) | 0.030 (5) | 0.006 (7) | 0.007 (5) | 0.006 (6) |
| C36 | 0.093 (8) | 0.063 (7) | 0.055 (7) | 0.001 (7) | 0.026 (6) | 0.017 (6) |
| C23 | 0.105 (10) | 0.105 (11) | 0.048 (7) | 0.000 (9) | 0.016 (7) | −0.010 (7) |

*Geometric parameters (Å, °)*

| | | | |
|---|---|---|---|
| C19—C20 | 1.32 (2) | C32—H32 | 0.9300 |
| C19—C18 | 1.379 (16) | C29—C30 | 1.369 (14) |
| C19—H19 | 0.9300 | C29—C28 | 1.470 (11) |
| N3—C33 | 1.325 (12) | C25—C24 | 1.358 (18) |
| N3—C29 | 1.384 (14) | C25—C26 | 1.397 (18) |
| N3—Pt2 | 1.941 (8) | C25—H25 | 0.9300 |
| Pt2—C39 | 2.001 (11) | N2—C1 | 1.333 (13) |
| Pt2—N4 | 2.130 (9) | N2—C5 | 1.354 (12) |
| Pt2—Cl2 | 2.302 (3) | C16—C15 | 1.388 (14) |
| Pt1—N1 | 1.932 (7) | C16—C11 | 1.422 (14) |
| Pt1—C16 | 1.981 (9) | C21—C22 | 1.388 (17) |
| Pt1—N2 | 2.116 (8) | C21—C20 | 1.42 (2) |
| Pt1—Cl1 | 2.299 (3) | C21—H21 | 0.9300 |
| N1—C6 | 1.357 (13) | C37—C36 | 1.360 (18) |
| N1—C10 | 1.358 (13) | C37—C38 | 1.384 (16) |
| C44—C45 | 1.385 (15) | C37—H37 | 0.9300 |
| C44—C43 | 1.390 (17) | C38—H38 | 0.9300 |
| C44—H44 | 0.9300 | C34—C35 | 1.391 (14) |
| C39—C38 | 1.387 (17) | C30—H30 | 0.9300 |
| C39—C34 | 1.432 (14) | C46—H46A | 0.9600 |
| C8—C7 | 1.384 (14) | C46—H46B | 0.9600 |
| C8—C9 | 1.394 (14) | C46—H46C | 0.9600 |
| C8—C17 | 1.520 (12) | C6—C7 | 1.381 (13) |
| C27—C26 | 1.368 (14) | C6—C5 | 1.486 (14) |
| C27—C28 | 1.403 (14) | C18—H18 | 0.9300 |
| C27—H27 | 0.9300 | C22—H22 | 0.9300 |
| C17—C22 | 1.374 (16) | C7—H7 | 0.9300 |
| C17—C18 | 1.388 (16) | C24—H24 | 0.9300 |
| C40—C45 | 1.375 (13) | C13—C14 | 1.375 (17) |
| C40—C41 | 1.410 (13) | C13—H13 | 0.9300 |

| | | | |
|---|---|---|---|
| C40—C31 | 1.480 (13) | C4—C5 | 1.368 (14) |
| C33—C32 | 1.393 (15) | C4—C3 | 1.393 (16) |
| C33—C34 | 1.482 (13) | C4—H4 | 0.9300 |
| C9—C10 | 1.396 (13) | C35—C36 | 1.390 (17) |
| C9—H9 | 0.9300 | C35—H35 | 0.9300 |
| C45—H45 | 0.9300 | C14—C15 | 1.391 (18) |
| C31—C32 | 1.395 (14) | C14—H14 | 0.9300 |
| C31—C30 | 1.397 (13) | C15—H15 | 0.9300 |
| C41—C42 | 1.354 (15) | C2—C3 | 1.367 (19) |
| C41—H41 | 0.9300 | C2—C1 | 1.367 (18) |
| C12—C11 | 1.364 (15) | C2—H2 | 0.9300 |
| C12—C13 | 1.390 (16) | C1—H1 | 0.9300 |
| C12—H12 | 0.9300 | C26—H26 | 0.9300 |
| C10—C11 | 1.480 (14) | C3—H3 | 0.9300 |
| C42—C43 | 1.374 (16) | C20—C23 | 1.544 (15) |
| C42—H42 | 0.9300 | C36—H36 | 0.9300 |
| C43—C46 | 1.493 (17) | C23—H23A | 0.9600 |
| N4—C24 | 1.344 (13) | C23—H23B | 0.9600 |
| N4—C28 | 1.370 (13) | C23—H23C | 0.9600 |
| Cg1···Cg2$^{i}$ | 3.582 (6) | Cg1···Cg3 | 3.600 (6) |
| C20—C19—C18 | 122.7 (13) | C22—C21—C20 | 118.3 (12) |
| C20—C19—H19 | 118.7 | C22—C21—H21 | 120.9 |
| C18—C19—H19 | 118.7 | C20—C21—H21 | 120.9 |
| C33—N3—C29 | 121.4 (8) | C36—C37—C38 | 121.6 (11) |
| C33—N3—Pt2 | 119.2 (7) | C36—C37—H37 | 119.2 |
| C29—N3—Pt2 | 119.4 (6) | C38—C37—H37 | 119.2 |
| N3—Pt2—C39 | 82.1 (4) | C37—C38—C39 | 121.1 (11) |
| N3—Pt2—N4 | 79.8 (3) | C37—C38—H38 | 119.4 |
| C39—Pt2—N4 | 161.8 (4) | C39—C38—H38 | 119.4 |
| N3—Pt2—Cl2 | 179.3 (2) | C35—C34—C39 | 121.0 (9) |
| C39—Pt2—Cl2 | 97.7 (3) | C35—C34—C33 | 124.3 (9) |
| N4—Pt2—Cl2 | 100.5 (2) | C39—C34—C33 | 114.7 (9) |
| N1—Pt1—C16 | 82.2 (4) | C29—C30—C31 | 121.0 (9) |
| N1—Pt1—N2 | 79.6 (3) | C29—C30—H30 | 119.5 |
| C16—Pt1—N2 | 161.8 (3) | C31—C30—H30 | 119.5 |
| N1—Pt1—Cl1 | 177.9 (3) | C43—C46—H46A | 109.5 |
| C16—Pt1—Cl1 | 99.3 (3) | C43—C46—H46B | 109.5 |
| N2—Pt1—Cl1 | 98.9 (2) | H46A—C46—H46B | 109.5 |
| C6—N1—C10 | 121.6 (7) | C43—C46—H46C | 109.5 |
| C6—N1—Pt1 | 119.9 (6) | H46A—C46—H46C | 109.5 |
| C10—N1—Pt1 | 118.5 (6) | H46B—C46—H46C | 109.5 |
| C45—C44—C43 | 120.7 (10) | C12—C11—C16 | 124.1 (9) |
| C45—C44—H44 | 119.7 | C12—C11—C10 | 121.8 (9) |
| C43—C44—H44 | 119.7 | C16—C11—C10 | 114.1 (8) |
| C38—C39—C34 | 116.9 (10) | N1—C6—C7 | 120.4 (9) |
| C38—C39—Pt2 | 131.6 (8) | N1—C6—C5 | 112.7 (8) |
| C34—C39—Pt2 | 111.6 (8) | C7—C6—C5 | 126.9 (9) |
| C7—C8—C9 | 118.6 (8) | C19—C18—C17 | 120.9 (12) |

| | | | |
|---|---|---|---|
| C7—C8—C17 | 120.2 (9) | C19—C18—H18 | 119.6 |
| C9—C8—C17 | 121.3 (9) | C17—C18—H18 | 119.6 |
| C26—C27—C28 | 120.6 (11) | N4—C28—C27 | 120.5 (8) |
| C26—C27—H27 | 119.7 | N4—C28—C29 | 116.3 (9) |
| C28—C27—H27 | 119.7 | C27—C28—C29 | 123.2 (10) |
| C22—C17—C18 | 116.6 (9) | C17—C22—C21 | 122.8 (12) |
| C22—C17—C8 | 122.1 (9) | C17—C22—H22 | 118.6 |
| C18—C17—C8 | 121.3 (9) | C21—C22—H22 | 118.6 |
| C45—C40—C41 | 116.5 (9) | C6—C7—C8 | 120.0 (9) |
| C45—C40—C31 | 121.9 (9) | C6—C7—H7 | 120.0 |
| C41—C40—C31 | 121.6 (8) | C8—C7—H7 | 120.0 |
| N3—C33—C32 | 120.5 (9) | N4—C24—C25 | 122.1 (11) |
| N3—C33—C34 | 112.5 (8) | N4—C24—H24 | 118.9 |
| C32—C33—C34 | 127.0 (9) | C25—C24—H24 | 118.9 |
| C8—C9—C10 | 120.6 (9) | C14—C13—C12 | 119.7 (11) |
| C8—C9—H9 | 119.7 | C14—C13—H13 | 120.1 |
| C10—C9—H9 | 119.7 | C12—C13—H13 | 120.1 |
| C40—C45—C44 | 121.7 (10) | C5—C4—C3 | 118.9 (10) |
| C40—C45—H45 | 119.1 | C5—C4—H4 | 120.6 |
| C44—C45—H45 | 119.1 | C3—C4—H4 | 120.6 |
| C32—C31—C30 | 117.8 (8) | C36—C35—C34 | 119.7 (11) |
| C32—C31—C40 | 121.2 (8) | C36—C35—H35 | 120.2 |
| C30—C31—C40 | 120.9 (8) | C34—C35—H35 | 120.2 |
| C42—C41—C40 | 121.4 (9) | N2—C5—C4 | 120.9 (9) |
| C42—C41—H41 | 119.3 | N2—C5—C6 | 115.7 (8) |
| C40—C41—H41 | 119.3 | C4—C5—C6 | 123.3 (9) |
| C11—C12—C13 | 118.3 (11) | C13—C14—C15 | 121.4 (10) |
| C11—C12—H12 | 120.9 | C13—C14—H14 | 119.3 |
| C13—C12—H12 | 120.9 | C15—C14—H14 | 119.3 |
| N1—C10—C9 | 118.8 (8) | C16—C15—C14 | 120.9 (10) |
| N1—C10—C11 | 112.1 (8) | C16—C15—H15 | 119.5 |
| C9—C10—C11 | 129.1 (9) | C14—C15—H15 | 119.5 |
| C41—C42—C43 | 122.0 (11) | C3—C2—C1 | 119.1 (11) |
| C41—C42—H42 | 119.0 | C3—C2—H2 | 120.5 |
| C43—C42—H42 | 119.0 | C1—C2—H2 | 120.5 |
| C42—C43—C44 | 117.5 (10) | N2—C1—C2 | 122.0 (11) |
| C42—C43—C46 | 122.1 (12) | N2—C1—H1 | 119.0 |
| C44—C43—C46 | 120.4 (11) | C2—C1—H1 | 119.0 |
| C24—N4—C28 | 118.4 (9) | C27—C26—C25 | 117.1 (11) |
| C24—N4—Pt2 | 129.8 (8) | C27—C26—H26 | 121.4 |
| C28—N4—Pt2 | 111.6 (6) | C25—C26—H26 | 121.4 |
| C33—C32—C31 | 120.0 (8) | C2—C3—C4 | 119.5 (11) |
| C33—C32—H32 | 120.0 | C2—C3—H3 | 120.3 |
| C31—C32—H32 | 120.0 | C4—C3—H3 | 120.3 |
| C30—C29—N3 | 119.2 (7) | C19—C20—C21 | 118.7 (10) |
| C30—C29—C28 | 128.0 (10) | C19—C20—C23 | 122.9 (13) |
| N3—C29—C28 | 112.8 (9) | C21—C20—C23 | 118.4 (12) |
| C24—C25—C26 | 121.1 (10) | C37—C36—C35 | 119.6 (11) |
| C24—C25—H25 | 119.4 | C37—C36—H36 | 120.2 |

| | | | |
|---|---|---|---|
| C26—C25—H25 | 119.4 | C35—C36—H36 | 120.2 |
| C1—N2—C5 | 119.6 (9) | C20—C23—H23A | 109.5 |
| C1—N2—Pt1 | 128.3 (7) | C20—C23—H23B | 109.5 |
| C5—N2—Pt1 | 112.1 (6) | H23A—C23—H23B | 109.5 |
| C15—C16—C11 | 115.5 (9) | C20—C23—H23C | 109.5 |
| C15—C16—Pt1 | 131.2 (8) | H23A—C23—H23C | 109.5 |
| C11—C16—Pt1 | 113.1 (7) | H23B—C23—H23C | 109.5 |

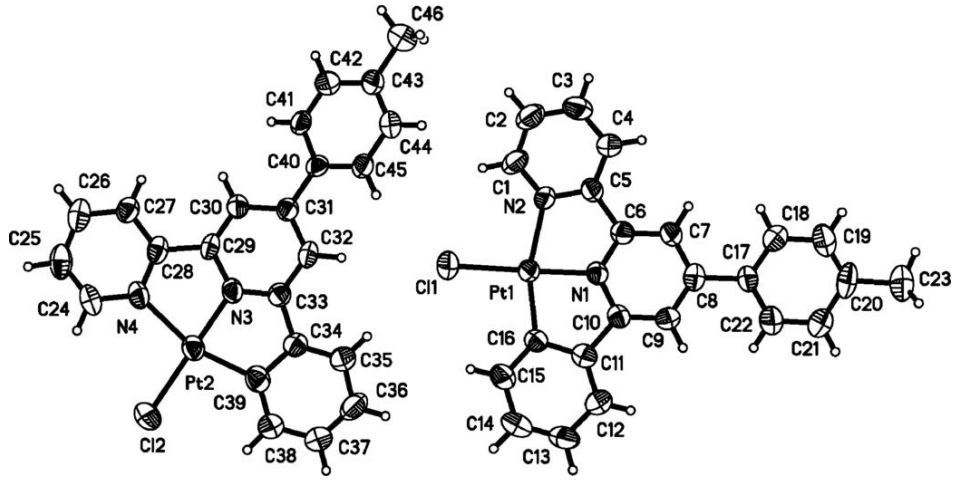
Symmetry codes: (i) *x*+1, *y*, *z*.

*Hydrogen-bond geometry (Å, °)*

| *D*—H···*A* | *D*—H | H···*A* | *D*···*A* | *D*—H···*A* |
|---|---|---|---|---|
| C3—H3···Cg4$^{ii}$ | 0.93 | 2.87 | 3.650 (14) | 142 |
| C14—H14···Cg5$^{iii}$ | 0.93 | 2.71 | 3.445 (14) | 136 |

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

**Fig. 1**


C46
C42
C43
C41
C44
C40
C45
C26
C27
C30
C31
C25
C29
C32
C28
C24
N4
N3
C33
C34
C35
Pt2
C36
C39
Cl2
C38
C37
C3
C2
C4
C1
C5
N2
C6
C7
C18
C19
C17
Cl1
Pt1
N1
C8
C23
C20
C16
C10
C9
C22
C21
C11
C15
C14
C12
C13