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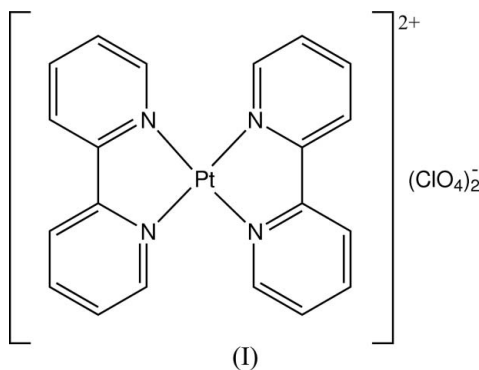
Key indicators

Single-crystal X-ray study
 $T = 85\text{ K}$
Mean $\sigma(\text{C}-\text{C}) = 0.003\text{ \AA}$
 R factor = 0.014
 wR factor = 0.036
Data-to-parameter ratio = 18.8For details of how these key indicators were
automatically derived from the article, see
<http://journals.iucr.org/e>.Bis(2,2'-bipyridine- κ^2N,N')platinum(II)
bis(perchlorate)

The title complex, $[\text{Pt}(\text{C}_{10}\text{H}_8\text{N}_2)_2](\text{ClO}_4)_2$, adopts a square-planar geometry in which all four N-atom donors are strictly coplanar as the Pt ion lies on an inversion centre. However, the 2,2'-bipyridine ligand deviates significantly from planarity, as demonstrated by the angle of $20.52(11)^\circ$ between the mean planes of the two pyridine rings.

Comment

The title complex, (I) (Fig. 1), was obtained during a study of the reactivity of $[\text{Pt}(\text{C}_{10}\text{H}_8\text{N}_2)_2]^{2+}$ in aqueous alkaline solution (McInnes *et al.*, 2003). Complex (I) crystallizes in the triclinic space group $P\bar{1}$ with the Pt ion lying on an inversion centre, thus requiring it to be strictly coplanar with the four attached N atoms. The Pt–N distances [$2.0227(18)$ and $2.0292(17)\text{ \AA}$] are similar to those found in $[\text{Pt}(\text{C}_{10}\text{H}_8\text{N}_2)_2](\text{NO}_3)_2 \cdot \text{H}_2\text{O}$ (Hazell *et al.*, 1986) and $[\text{Pt}(\text{C}_{10}\text{H}_8\text{N}_2)_2](\text{CF}_3\text{SO}_3)_2$ (Fedotova *et al.*, 2003), and are typical of those found in Pt complexes containing pyridine ligands (mean = 2.064 \AA , SD = 0.074 \AA for 997 structurally characterized complexes and 2214 individual Pt–N distances; Cambridge Structural Database, Version 5.26 of November 2004 (Allen, 2002)).



The 2,2'-bipyridine ligands display a bow distortion (Fig. 2) with a remarkably large angle of $20.52(11)^\circ$ between the mean planes of the two rings (Hazell, 2004). A similar distortion is seen in the trifluoromethanesulfonate salt of the complex (Fedotova *et al.*, 2003) and presumably prevents the close inter-ligand approach of atoms H1 and H10 (attached to C1 and C10, respectively). It is tempting to speculate that the strain inherent in such a distortion is responsible for the unusual behaviour of $[\text{Pt}(\text{C}_{10}\text{H}_8\text{N}_2)_2]^{2+}$ in aqueous alkaline solution, allowing facile coordination of hydroxide ion to give a pseudo-five-coordinate complex (McInnes *et al.*, 2003).

There are weak π -stacking interactions throughout the three-dimensional structure (Fig. 3), with centroid-to-centroid distances between the pyridine rings of $3.703(3)$ ($-1 - x, -y,$

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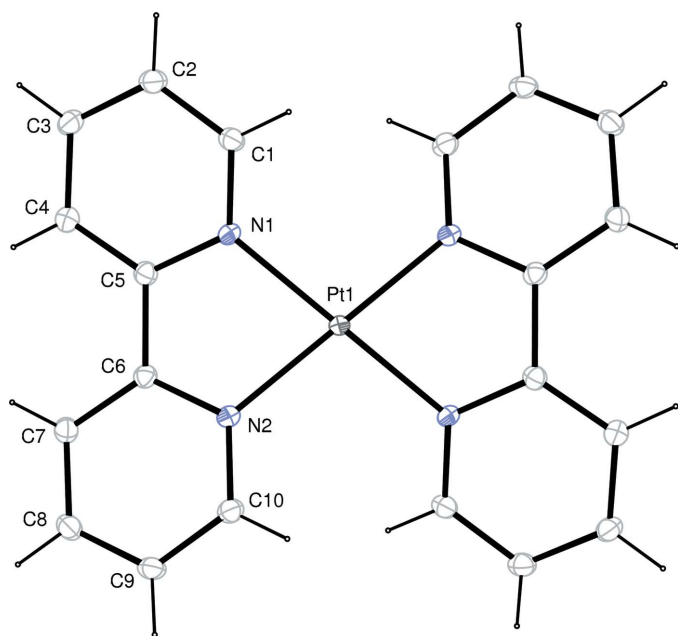


Figure 1
The structure of the cation of (I), with displacement ellipsoids drawn at the 50% probability level. [Symmetry code for unlabelled atoms: $-x, -y, -z$.]

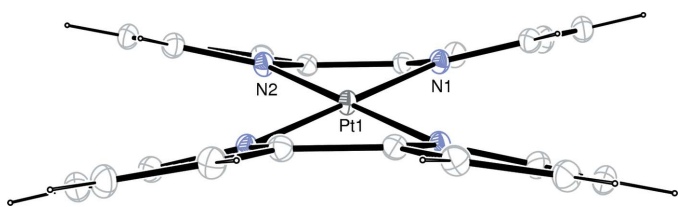


Figure 2
View of the cation of (I), emphasizing the bow distortion of the 2,2'-bipyridine ligands.

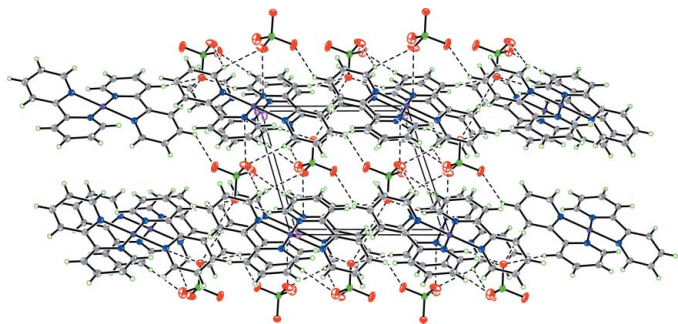


Figure 3
Packing, viewed down the a axis. Close interactions are indicated as dashed lines.

$-z$) and 3.924 (3) Å ($-x, -y, 1 - z$). The perchlorate ions are also involved in anion- π interactions, with O1-centroid (at $1 + x, y, 1 + z$) and O4-centroid (at $-x, 1 - y, 1 - z$) distances of 3.064 (3) and 3.356 (3) Å, respectively.

Experimental

Complex (I) precipitated on addition of one drop of 6 M NaClO₄(aq) to a solution of [Pt(C₁₀H₈N₂)₂](NO₃)₂·H₂O (53 mg), prepared

according to McInnes *et al.* (2003) in water (1 ml) to which one equivalent of 1 M NaOH(aq) (84 μ l) had been added. Dilution to approximately 20 ml with hot water and subsequent slow cooling gave (I) as small pale-yellow crystals.

Crystal data

[Pt(C₁₀H₈N₂)₂](ClO₄)₂
 $M_r = 706.35$
 Triclinic, $P\bar{1}$
 $a = 7.811$ (5) Å
 $b = 8.621$ (5) Å
 $c = 9.054$ (5) Å
 $\alpha = 72.972$ (5)°
 $\beta = 86.553$ (5)°
 $\gamma = 64.960$ (5)°
 $V = 526.7$ (5) Å³

$Z = 1$
 $D_x = 2.227$ Mg m⁻³
 Mo $K\alpha$ radiation
 Cell parameters from 5644 reflections
 $\theta = 2.4$ – 33.0°
 $\mu = 6.97$ mm⁻¹
 $T = 85$ (2) K
 Plate, pale-yellow
 $0.32 \times 0.16 \times 0.08$ mm

Data collection

Bruker Kappa-APEX-II area-detector diffractometer
 φ and ω scans
 Absorption correction: multi-scan (SADABS; Bruker, 2001)
 $T_{\min} = 0.361, T_{\max} = 0.572$
 11349 measured reflections

3010 independent reflections
 3010 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.028$
 $\theta_{\text{max}} = 33.2^\circ$
 $h = -7 \rightarrow 10$
 $k = -11 \rightarrow 12$
 $l = -13 \rightarrow 13$

Refinement

Refinement on F^2
 $R[F^2 > 2\sigma(F^2)] = 0.014$
 $wR(F^2) = 0.036$
 $S = 1.08$
 3010 reflections
 160 parameters
 H-atom parameters constrained

$w = 1/[\sigma^2(F_o^2) + (0.0182P)^2 + 0.2101P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} < 0.001$
 $\Delta\rho_{\text{max}} = 1.19$ e Å⁻³
 $\Delta\rho_{\text{min}} = -1.34$ e Å⁻³

All H atoms were included in the riding-model approximation, with C–H = 0.93 Å and $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C})$. The highest residual peak in the difference map is 0.79 Å from atom Pt1 and the deepest hole is 0.81 Å from atom Pt1.

Data collection: APEXII (Bruker, 2004); cell refinement: APEXII and SAINT (Bruker, 2001); data reduction: SAINT; program(s) used to solve structure: SIR97 (Altomare *et al.*, 1999); program(s) used to refine structure: SHELXL97 (Sheldrick, 1997); molecular graphics: ORTEP3 (Farrugia, 1997) and SHELXTL (Bruker, 2001); software used to prepare material for publication: WinGX (Farrugia, 1999).

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