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Dichlorido(4,5-diazafluoren-9-one- κ^2N,N')palladium(II)Zhi-Guang Xu,^{a*} Hai-Yang Liu,^b Qing-Guang Zhan,^a Jian Chen^a and Min-Jian Xu^a

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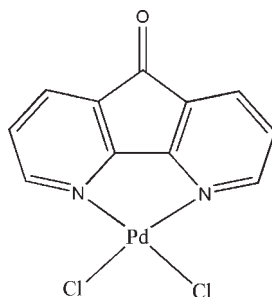
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Key indicators: single-crystal X-ray study; $T = 293$ K; mean $\sigma(\text{C}-\text{C}) = 0.005$ Å; R factor = 0.029; wR factor = 0.058; data-to-parameter ratio = 15.2.

The structure of the title compound, $[\text{PdCl}_2(\text{C}_{11}\text{H}_6\text{N}_2\text{O})]$, shows a nearly square-planar geometry for the Pd^{II} atom within a Cl_2N_2 donor set.

Related literature

For related palladium complexes, see: Klein *et al.* (1998).



Experimental

Crystal data

 $[\text{PdCl}_2(\text{C}_{11}\text{H}_6\text{N}_2\text{O})]$ $M_r = 359.48$

Monoclinic, $P2_1/c$
 $a = 5.131$ (5) Å
 $b = 17.105$ (5) Å
 $c = 12.763$ (5) Å
 $\beta = 99.183$ (5)°
 $V = 1105.8$ (12) Å³

$Z = 4$
Mo $K\alpha$ radiation
 $\mu = 2.14$ mm⁻¹
 $T = 293$ K
 $0.35 \times 0.33 \times 0.25$ mm

Data collection

Bruker SMART APEXII
diffractometer
Absorption correction: multi-scan
(*SADABS*; Bruker, 2005)
 $T_{\text{min}} = 0.477$, $T_{\text{max}} = 0.586$

6785 measured reflections
2703 independent reflections
2198 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.028$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.029$
 $wR(F^2) = 0.058$
 $S = 1.04$
2703 reflections

178 parameters
All H-atom parameters refined
 $\Delta\rho_{\text{max}} = 0.37$ e Å⁻³
 $\Delta\rho_{\text{min}} = -0.54$ e Å⁻³

Data collection: *APEX2* (Bruker, 2005); cell refinement: *SAINT* (Bruker, 2005); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *ORTEP-3 for Windows* (Farrugia, 1997); software used to prepare material for publication: *SHELXTL* (Sheldrick, 2008).

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: TK2532).

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supplementary materials

Acta Cryst. (2009). E65, m1166 [doi:10.1107/S1600536809035272]

Dichlorido(4,5-diazafluoren-9-one- κ^2N,N')palladium(II)

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Comment

The title compound, (I), Fig. 1, shows the palladium atom to be coordinated by two chlorides and two nitrogen atoms, the latter derived from a chelating 4,5-diazafluoren-9-one (dafo) ligand. The coordination geometry is based on a square planar arrangement of the four donor atoms. Related palladium structures featuring dafo ligands are known (Klein *et al.*, 1998).

Experimental

Compound (I) was synthesized hydrothermally from an aqueous mixture (10.0 ml) containing PdCl₂ (0.1758 g) and 4,5-diazafluoren-9-one (0.301 g) in a 30 ml Teflon-lined stainless steel vessel. In the vessel, the solution was heated to 413 K for 72 h then cooled to room temperature at a rate of 10 K per hour. Brown prisms were obtained after washed thoroughly with deionized water and air-drying.

Refinement

All H atoms were refined: range of C-H = 0.89 (3) to 0.99 (4) Å.

Figures

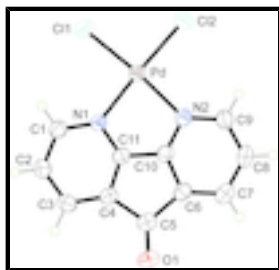


Fig. 1. Molecular structure of (I) with displacement ellipsoids drawn at the 50% probability level.

Dichlorido(4,5-diazafluoren-9-one- κ^2N,N')palladium(II)

Crystal data

[PdCl₂(C₁₁H₆N₂O)]

$M_r = 359.48$

Monoclinic, $P2_1/c$

Hall symbol: -P 2ybc

$a = 5.131$ (5) Å

$b = 17.105$ (5) Å

$c = 12.763$ (5) Å

$F_{000} = 696$

$D_x = 2.159$ Mg m⁻³

Mo $K\alpha$ radiation, $\lambda = 0.71069$ Å

Cell parameters from 13853 reflections

$\theta = 1.8$ – 28.2°

$\mu = 2.14$ mm⁻¹

$T = 293$ K

supplementary materials

$\beta = 99.183 (5)^\circ$ Block, yellow
 $V = 1105.8 (12) \text{ \AA}^3$ $0.35 \times 0.33 \times 0.25 \text{ mm}$
 $Z = 4$

Data collection

Bruker SMART APEXII CCD area-detector diffractometer	2703 independent reflections
Monochromator: graphite	2198 reflections with $I > 2\sigma(I)$
Detector resolution: 10 pixels mm^{-1}	$R_{\text{int}} = 0.028$
$T = 293 \text{ K}$	$\theta_{\text{max}} = 28.4^\circ$
ω scans	$\theta_{\text{min}} = 2.0^\circ$
Absorption correction: multi-scan (SADABS; Bruker, 2005)	$h = -6 \rightarrow 6$
$T_{\text{min}} = 0.477$, $T_{\text{max}} = 0.586$	$k = -22 \rightarrow 13$
6785 measured reflections	$l = -16 \rightarrow 16$

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)] = 0.029$	All H-atom parameters refined
$wR(F^2) = 0.058$	$w = 1/[\sigma^2(F_o^2) + (0.0199P)^2 + 0.6053P]$
$S = 1.04$	where $P = (F_o^2 + 2F_c^2)/3$
2703 reflections	$(\Delta/\sigma)_{\text{max}} < 0.001$
178 parameters	$\Delta\rho_{\text{max}} = 0.37 \text{ e \AA}^{-3}$
Primary atom site location: structure-invariant direct methods	$\Delta\rho_{\text{min}} = -0.54 \text{ e \AA}^{-3}$
	Extinction correction: none

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	$U_{\text{iso}}^*/U_{\text{eq}}$
Pd1	0.08571 (4)	0.152850 (13)	0.283179 (18)	0.03075 (8)
N2	0.2819 (5)	0.16090 (14)	0.15176 (19)	0.0336 (6)

N1	0.2865 (4)	0.04745 (13)	0.30833 (19)	0.0303 (5)
C6	0.6231 (5)	0.08217 (18)	0.0892 (2)	0.0343 (7)
C4	0.6221 (6)	-0.01682 (17)	0.2253 (2)	0.0322 (6)
C5	0.7568 (6)	0.00609 (19)	0.1320 (2)	0.0378 (7)
O1	0.9357 (5)	-0.02803 (14)	0.10159 (19)	0.0532 (6)
C11	0.4449 (5)	0.04170 (17)	0.2364 (2)	0.0319 (6)
C10	0.4439 (5)	0.10020 (17)	0.1557 (2)	0.0317 (6)
C3	0.6398 (6)	-0.0784 (2)	0.2962 (3)	0.0402 (8)
C8	0.4677 (7)	0.1976 (2)	-0.0016 (3)	0.0434 (8)
C1	0.3028 (6)	-0.01242 (19)	0.3780 (3)	0.0367 (7)
C9	0.2942 (6)	0.2103 (2)	0.0695 (3)	0.0397 (7)
C7	0.6379 (7)	0.1337 (2)	0.0064 (3)	0.0414 (8)
C2	0.4742 (6)	-0.0747 (2)	0.3724 (3)	0.0413 (8)
Cl1	-0.10542 (16)	0.13410 (5)	0.42956 (7)	0.0445 (2)
Cl2	-0.11747 (16)	0.26981 (5)	0.24949 (7)	0.0479 (2)
H1	0.187 (6)	-0.0098 (17)	0.429 (2)	0.038 (9)*
H3	0.762 (7)	-0.123 (2)	0.295 (3)	0.052 (10)*
H4	0.753 (6)	0.1289 (19)	-0.038 (3)	0.048 (10)*
H2	0.477 (6)	-0.115 (2)	0.420 (3)	0.046 (9)*
H5	0.465 (6)	0.2338 (19)	-0.055 (3)	0.043 (9)*
H6	0.181 (6)	0.2543 (19)	0.064 (2)	0.046 (9)*

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Pd1	0.02879 (12)	0.02863 (13)	0.03619 (14)	-0.00123 (9)	0.00940 (9)	-0.00117 (10)
N2	0.0321 (13)	0.0332 (14)	0.0364 (14)	-0.0019 (11)	0.0084 (10)	0.0016 (11)
N1	0.0293 (12)	0.0303 (13)	0.0328 (14)	-0.0010 (10)	0.0097 (10)	0.0015 (10)
C6	0.0300 (15)	0.0392 (18)	0.0341 (17)	-0.0042 (13)	0.0070 (12)	-0.0008 (13)
C4	0.0306 (15)	0.0341 (16)	0.0330 (17)	-0.0017 (12)	0.0086 (12)	-0.0034 (13)
C5	0.0351 (16)	0.0419 (18)	0.0373 (18)	-0.0013 (14)	0.0093 (14)	-0.0042 (14)
O1	0.0540 (14)	0.0596 (16)	0.0516 (15)	0.0154 (12)	0.0258 (12)	0.0029 (12)
C11	0.0281 (15)	0.0337 (16)	0.0340 (17)	-0.0032 (12)	0.0056 (12)	-0.0019 (12)
C10	0.0279 (14)	0.0343 (17)	0.0329 (16)	-0.0027 (12)	0.0049 (12)	0.0010 (13)
C3	0.0390 (18)	0.0366 (18)	0.046 (2)	0.0071 (14)	0.0092 (15)	0.0012 (15)
C8	0.051 (2)	0.045 (2)	0.0340 (19)	-0.0075 (16)	0.0075 (15)	0.0118 (15)
C1	0.0366 (17)	0.0387 (18)	0.0366 (18)	-0.0027 (14)	0.0112 (14)	0.0016 (14)
C9	0.0401 (18)	0.0362 (18)	0.043 (2)	0.0004 (15)	0.0070 (14)	0.0079 (14)
C7	0.0427 (19)	0.049 (2)	0.0345 (19)	-0.0075 (15)	0.0114 (15)	-0.0019 (15)
C2	0.0461 (19)	0.0348 (18)	0.044 (2)	0.0026 (15)	0.0122 (15)	0.0084 (15)
Cl1	0.0490 (5)	0.0435 (5)	0.0461 (5)	-0.0033 (4)	0.0235 (4)	-0.0035 (4)
Cl2	0.0470 (5)	0.0334 (4)	0.0651 (6)	0.0065 (4)	0.0147 (4)	0.0033 (4)

Geometric parameters (\AA , $^\circ$)

Pd1—N1	2.076 (2)	C4—C5	1.521 (4)
Pd1—N2	2.094 (3)	C5—O1	1.203 (4)
Pd1—Cl2	2.2652 (11)	C11—C10	1.436 (4)
Pd1—Cl1	2.2672 (12)	C3—C2	1.391 (5)

supplementary materials

N2—C10	1.326 (4)	C8—C9	1.387 (5)
N2—C9	1.356 (4)	C8—C7	1.392 (5)
N1—C11	1.323 (4)	C1—C2	1.390 (5)
N1—C1	1.350 (4)	H3—C3	0.99 (4)
C6—C10	1.382 (4)	H1—C1	0.95 (3)
C6—C7	1.387 (4)	H2—C2	0.92 (4)
C6—C5	1.531 (4)	H5—C8	0.92 (4)
C4—C11	1.375 (4)	H6—C9	0.95 (3)
C4—C3	1.382 (4)	H4—C7	0.89 (3)
N1—Pd1—N2	83.74 (10)	C4—C11—C10	111.1 (3)
N1—Pd1—C12	176.78 (7)	N2—C10—C6	128.8 (3)
N2—Pd1—C12	93.17 (8)	N2—C10—C11	120.2 (3)
N1—Pd1—C11	91.09 (7)	C6—C10—C11	111.0 (3)
N2—Pd1—C11	174.80 (7)	C4—C3—C2	116.1 (3)
C12—Pd1—C11	92.00 (4)	C9—C8—C7	122.3 (3)
C10—N2—C9	114.2 (3)	N1—C1—C2	121.3 (3)
C10—N2—Pd1	107.26 (19)	N2—C9—C8	121.6 (3)
C9—N2—Pd1	138.5 (2)	C6—C7—C8	116.4 (3)
C11—N1—C1	114.8 (3)	C1—C2—C3	122.2 (3)
C11—N1—Pd1	107.58 (19)	C7—C8—H5	121.(2)
C1—N1—Pd1	137.5 (2)	C9—C8—H5	116.(2)
C10—C6—C7	116.7 (3)	N1—C1—H1	115.8 (18)
C10—C6—C5	106.0 (3)	C2—C1—H1	122.8 (18)
C7—C6—C5	137.4 (3)	C1—C2—H2	119.(2)
C11—C4—C3	117.6 (3)	C3—C2—H2	119.(2)
C11—C4—C5	106.5 (3)	N2—C9—H6	116.7 (17)
C3—C4—C5	135.9 (3)	C8—C9—H6	121.8 (17)
O1—C5—C4	126.4 (3)	C4—C3—H3	124.(2)
O1—C5—C6	128.2 (3)	C2—C3—H3	120.(2)
C4—C5—C6	105.3 (2)	C6—C7—H4	124.(2)
N1—C11—C4	128.0 (3)	C8—C7—H4	120.(2)
N1—C11—C10	120.9 (3)		

Fig. 1

