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ISSN 2414-3146

(η^2,η^2-Cycloocta-1,5-diene)[2-(diphenylphosphanylmethyl)pyridine-κ^2N,P]rhodium(I) tetrafluoridoborate 1,2-dichloroethane monosolvate

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Received 12 August 2016
Accepted 16 August 2016

Edited by M. Bolte, Goethe-Universität Frankfurt Germany

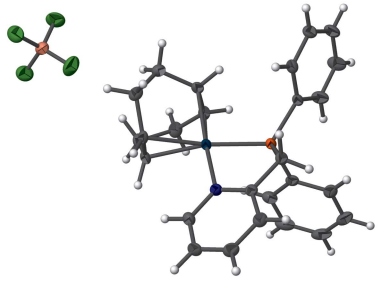
Keywords: crystal structure; polymorph; rhodium complex.

CCDC reference: 1499364

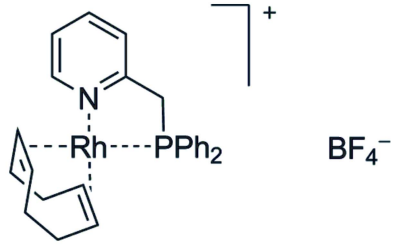
Structural data: full structural data are available from iucrdata.iucr.org

The title compound, $[Rh(C_8H_{12})(C_{18}H_{16}NP)]BF_4$ has been prepared as a precatalyst for applications in rhodium-catalysed additions of carbocyclic acids to terminal alkynes leading to *anti*-Markovnikov *Z*-enol esters. Here the triclinic pseudopolymorph of the title compound is presented. In contrast to the earlier reported pseudopolymorph (orthorhombic space group) [Wei *et al.* (2013). *Chem. Eur. J.* **19**, 12067–12076], the triclinic polymorph contains half a molecule of dichloromethane as solvent in the asymmetric unit. The rhodium(I) atom exhibits a square-planar coordination. The estimated diffraction contribution of the disordered solvent (a half molecule of dichloroethane per asymmetric unit) was subtracted from the observed diffraction data using the SQUEEZE [Spek (2015). *Acta Cryst.* C**71**, 9–16] routine in *PLATON*. The given chemical formula and other crystal data do not take the solvent into account.

3D view



Chemical scheme



Structure description

The title compound was formed by the exchange of aectylacetonate (acac) by dppmp in presence of HBF_4 starting from the precursor [Rh(acac)(COD)] (Fennis *et al.*, 1990; Wei *et al.*, 2013). Two pseudo-polymorphs (triclinic, space group $P\overline{1}$ with dichloromethane as solvent; orthorhombic, space group *Pbca*, no solvent) of the title compound were observed, of which the triclinic one is presented here (Fig. 1).

The main difference to the earlier reported pseudo polymorph (Wei *et al.*, 2013; CCDC 914750) is the half molecule of a disordered 1,2-dichloroethane solvate. On the other hand, there are only minor differences in the conformation of the complex cations (Figs. 2 and 3) and the bond lengths and angles are nearly equal (Table 1). An important structural feature is the square-planar coordination of the rhodium(I) atom. The dihedral

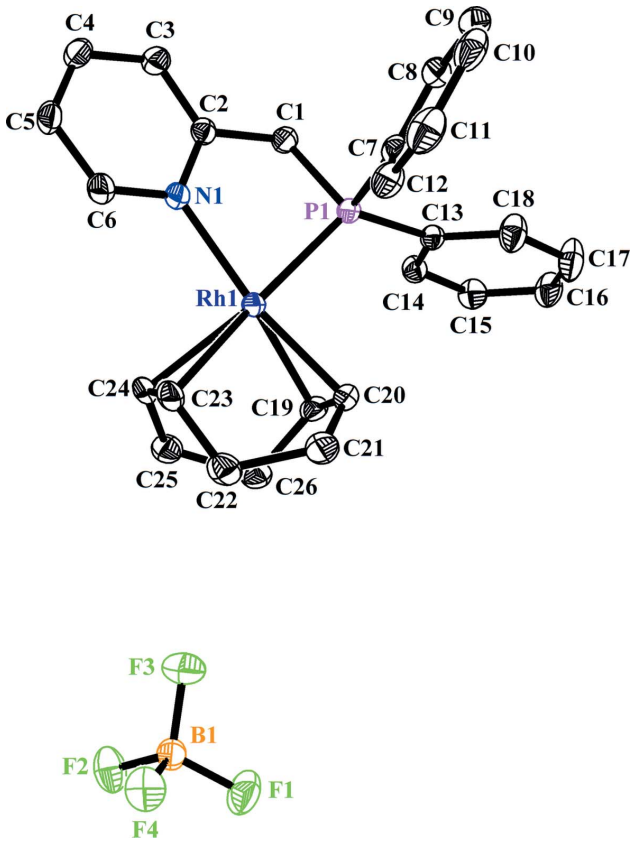


Figure 1
The molecular structure of the title compound, with atom labelling and displacement ellipsoids drawn at the 50% probability level. All H atoms have been omitted for clarity.

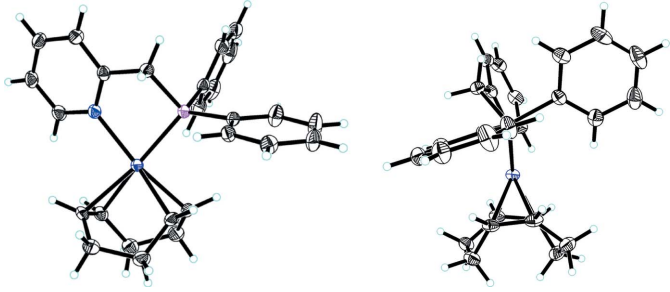


Figure 2
Front view (left) and side view (right) of triclinic polymorph of $[Rh(COD)(dppmp)]^+$ (ellipsoids drawn at the 50% probability level).

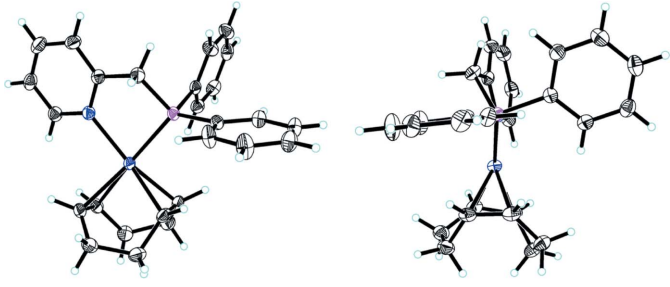


Figure 3
Front view (left) and side view (right) of pseudopolymorph of $[Rh(COD)(dppmp)]^+$ (ellipsoids drawn at the 50% probability level).

Table 1
Selected distances and angles (Å, °) of the two polymorphs of $[Rh(COD)(dppmp)]BF_4$.

C_M are the centroids of the COD double bonds.

	Triclinic polymorph	Orthorhombic pseudopolymorph
Rh—P	2.2371 (4)	2.2491 (5)
Rh—N	2.1295 (14)	2.1333 (17)
Rh—C_M	2.019 (2), 2.140 (2)	2.119 (2), 2.140 (2)
P—Rh—N	80.58 (4)	80.81 (5)
C_M—Rh—C_M	86.48 (7)	86.47 (8)

Table 2
Experimental details.

Crystal data	
Chemical formula	$[Rh(C_8H_{12})(C_{18}H_{16}NP)]BF_4$
M_r	575.18
Crystal system, space group	Triclinic, $P\overline{1}$
Temperature (K)	150
a, b, c (Å)	8.7638 (2), 9.2286 (2), 16.7192 (3)
α, β, γ (°)	89.402 (1), 88.904 (1), 76.121 (1)
V (Å^3)	1312.47 (5)
Z	2
Radiation type	Mo $K\alpha$
μ (mm^{-1})	0.75
Crystal size (mm)	0.46 × 0.40 × 0.21
Data collection	
Diffractometer	Bruker APEXII CCD
Absorption correction	Multi-scan (*SADABS*; Bruker, 2014)
T_{min}, T_{max}	0.639, 0.746
No. of measured, independent and observed [$I > 2\sigma(I)$] reflections	17088, 5176, 4973
R_{int}	0.017
(sin $\theta/\lambda)_{max}$ (Å^{-1})	0.617
Refinement	
$R[F^2 > 2\sigma(F^2)]$, $wR(F^2)$, S	0.021, 0.054, 1.05
No. of reflections	5176
No. of parameters	307
H-atom treatment	H-atom parameters constrained
$\Delta\rho_{max}$, $\Delta\rho_{min}$ (e Å^{-3})	0.41, −0.46

Computer programs: *APEX2* (Bruker, 2014), *SAINT* (Bruker, 2013), *SHELXS97* (Sheldrick, 2008), *SHELXL2014* (Sheldrick, 2015), *XP* in *SHELXTL* (Sheldrick, 2008), *publCIF* (Westrip, 2010) and *PLATON* (Spek, 2009).

angles between the P/Rh/N and *X*/Rh/*X* (*X* = centroid of the double bond) planes are 4.7° (triclinic polymorph) and 2.8° (pseudo polymorph). The r.m.s. deviation of P/N/*X*/*X* to this plane is in both cases very small (0.0333 and 0.0474 Å, respectively).

Synthesis and crystallization

A dry argon-flushed Schlenk tube was charged with dppmp (110 mg), Rh(COD)(acac) (124 mg) and THF (40 ml). The HBF_4 in water (40%) (50 µL) was added directly. After stir-

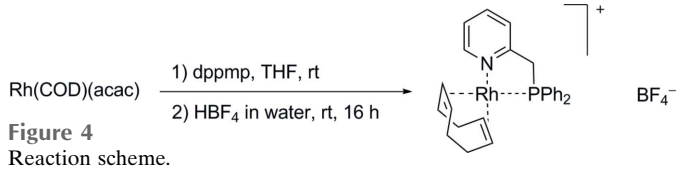


Figure 4
Reaction scheme.

ring for 16 h under room temperature, the solvent was removed under vacuum. Orange-coloured rystals suitable for X-ray crystallography were obtained by slow diffusion of diethyl ether into a dichloroethane solution. The reaction scheme is shown in Fig. 4.

Refinement

Crystal data, data collection and structure refinement details are summarized in Table 2. The estimated diffraction contribution of the disordered solvent (a half molecule of dichloroethane per asymmetric unit) was subtracted from the observed diffraction data using SQUEEZE (Spek, 2015) in *PLATON* (Spek, 2009).

Acknowledgements

We thank our technical staff for assistance. This work was supported by the Deutsche Forschungsgemeinschaft (HE2890/7–1). The publication of this article was funded by the Open Access Fund of the Leibniz Association.

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full crystallographic data

IUCrData (2016). **1**, x161318 [doi:10.1107/S2414314616013183]

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Crystal data

$[Rh(C_8H_{12})(C_{18}H_{16}NP)]BF_4$
M_r = 575.18
Triclinic, $P\overline{1}$
a = 8.7638 (2) Å
b = 9.2286 (2) Å
c = 16.7192 (3) Å
α = 89.402 (1)°
β = 88.904 (1)°
γ = 76.121 (1)°
V = 1312.47 (5) Å^3
Z = 2
$F(000)$ = 584
D_x = 1.455 Mg m^{-3}
Mo $K\alpha$ radiation, λ = 0.71073 Å
Cell parameters from 9922 reflections
θ = 2.3–27.5°
μ = 0.75 mm^{-1}
T = 150 K
Part of block, orange
0.46 × 0.40 × 0.21 mm

Data collection

Bruker APEXII CCD diffractometer
Radiation source: fine-focus sealed tube
Detector resolution: 8.3333 pixels mm^{-1}
φ and ω scans
Absorption correction: multi-scan (SADABS; Bruker, 2014)
T_{min} = 0.639, T_{max} = 0.746
17088 measured reflections
5176 independent reflections
4973 reflections with $I > 2\sigma(I)$
R_{int} = 0.017
θ_{max} = 26.0°, θ_{min} = 2.3°
h = −10→10
k = −10→11
l = −20→20

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)]$ = 0.021
$wR(F^2)$ = 0.054
S = 1.05
5176 reflections
307 parameters
0 restraints
Hydrogen site location: inferred from neighbouring sites
H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0262P)^2 + 0.9042P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.001
$\Delta\rho_{max}$ = 0.41 e Å^{-3}
$\Delta\rho_{min}$ = −0.46 e Å^{-3}

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.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å²)

	x	*y*	*z*	U_{iso}*/U_{eq}
Rh1	0.06970 (2)	0.24000 (2)	0.32462 (2)	0.01711 (5)
P1	−0.00629 (5)	0.06162 (5)	0.25753 (2)	0.01705 (9)
N1	−0.09923 (16)	0.19334 (16)	0.40800 (8)	0.0195 (3)
C1	−0.0567 (2)	−0.04882 (18)	0.34135 (10)	0.0204 (3)
H1A	−0.1288	−0.1094	0.3235	0.025*
H1B	0.0395	−0.1171	0.3622	0.025*
C2	−0.13519 (19)	0.05816 (18)	0.40573 (10)	0.0187 (3)
C3	−0.2401 (2)	0.0188 (2)	0.46045 (10)	0.0237 (4)
H3	−0.2632	−0.0765	0.4578	0.028*
C4	−0.3105 (2)	0.1194 (2)	0.51872 (11)	0.0264 (4)
H4	−0.3804	0.0934	0.5573	0.032*
C5	−0.2774 (2)	0.2587 (2)	0.51993 (11)	0.0262 (4)
H5	−0.3264	0.3305	0.5585	0.031*
C6	−0.1723 (2)	0.2917 (2)	0.46427 (11)	0.0246 (4)
H6	−0.1502	0.3875	0.4655	0.030*
C7	−0.18679 (19)	0.12701 (19)	0.20282 (10)	0.0210 (3)
C8	−0.2745 (2)	0.0289 (2)	0.17701 (11)	0.0270 (4)
H8	−0.2407	−0.0748	0.1884	0.032*
C9	−0.4113 (2)	0.0836 (3)	0.13474 (12)	0.0353 (5)
H9	−0.4709	0.0171	0.1169	0.042*
C10	−0.4612 (2)	0.2350 (3)	0.11839 (12)	0.0378 (5)
H10	−0.5548	0.2717	0.0893	0.045*
C11	−0.3758 (2)	0.3324 (2)	0.14405 (12)	0.0364 (5)
H11	−0.4109	0.4361	0.1327	0.044*
C12	−0.2384 (2)	0.2795 (2)	0.18655 (11)	0.0274 (4)
H12	−0.1799	0.3470	0.2044	0.033*
C13	0.12691 (19)	−0.06447 (18)	0.19045 (10)	0.0191 (3)
C14	0.2673 (2)	−0.15094 (19)	0.22032 (10)	0.0217 (3)
H14	0.2877	−0.1494	0.2759	0.026*
C15	0.3777 (2)	−0.2394 (2)	0.16938 (11)	0.0255 (4)
H15	0.4725	−0.2989	0.1903	0.031*
C16	0.3497 (2)	−0.2407 (2)	0.08854 (12)	0.0303 (4)
H16	0.4253	−0.3013	0.0538	0.036*
C17	0.2122 (2)	−0.1543 (3)	0.05804 (12)	0.0379 (5)
H17	0.1935	−0.1550	0.0023	0.045*
C18	0.1007 (2)	−0.0661 (2)	0.10865 (11)	0.0312 (4)
H18	0.0063	−0.0066	0.0873	0.037*
C19	0.0899 (2)	0.46505 (19)	0.36720 (11)	0.0233 (4)
H19	−0.0080	0.5251	0.3936	0.028*
C20	0.1787 (2)	0.35865 (19)	0.41578 (10)	0.0223 (3)
H20	0.1353	0.3556	0.4714	0.027*
C21	0.3542 (2)	0.2977 (2)	0.40802 (11)	0.0263 (4)
H21A	0.3842	0.2037	0.4392	0.032*
H21B	0.4075	0.3699	0.4316	0.032*
C22	0.4131 (2)	0.2669 (2)	0.32124 (11)	0.0266 (4)

H22A	0.4344	0.3592	0.2978	0.032*
H22B	0.5133	0.1896	0.3212	0.032*
C23	0.2964 (2)	0.21490 (19)	0.26906 (11)	0.0229 (4)
H23	0.3392	0.1138	0.2456	0.027*
C24	0.1833 (2)	0.3075 (2)	0.22174 (10)	0.0239 (4)
H24	0.1619	0.2602	0.1709	0.029*
C25	0.1473 (2)	0.4753 (2)	0.21814 (11)	0.0289 (4)
H25A	0.0411	0.5134	0.1959	0.035*
H25B	0.2237	0.5060	0.1813	0.035*
C26	0.1537 (2)	0.5468 (2)	0.30030 (11)	0.0276 (4)
H26A	0.2640	0.5474	0.3116	0.033*
H26B	0.0919	0.6518	0.2987	0.033*
B1	0.6485 (2)	0.6941 (3)	0.33427 (13)	0.0267 (4)
F1	0.74911 (15)	0.65862 (16)	0.26872 (7)	0.0450 (3)
F2	0.73545 (15)	0.67145 (14)	0.40401 (7)	0.0402 (3)
F3	0.53948 (16)	0.60835 (16)	0.33567 (8)	0.0483 (3)
F4	0.57017 (14)	0.84420 (14)	0.32976 (8)	0.0403 (3)

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Rh1	0.01708 (7)	0.01760 (7)	0.01754 (8)	−0.00597 (5)	0.00292 (5)	−0.00431 (5)
P1	0.0170 (2)	0.0176 (2)	0.0168 (2)	−0.00476 (15)	0.00187 (15)	−0.00293 (16)
N1	0.0178 (7)	0.0226 (7)	0.0184 (7)	−0.0051 (5)	0.0011 (5)	−0.0036 (6)
C1	0.0221 (8)	0.0196 (8)	0.0202 (8)	−0.0063 (6)	0.0022 (6)	−0.0014 (6)
C2	0.0165 (7)	0.0219 (8)	0.0170 (8)	−0.0031 (6)	−0.0020 (6)	−0.0009 (6)
C3	0.0241 (9)	0.0269 (9)	0.0214 (9)	−0.0085 (7)	0.0000 (7)	0.0014 (7)
C4	0.0223 (8)	0.0374 (10)	0.0200 (9)	−0.0086 (7)	0.0030 (7)	−0.0006 (7)
C5	0.0235 (9)	0.0330 (10)	0.0207 (9)	−0.0043 (7)	0.0037 (7)	−0.0094 (7)
C6	0.0238 (9)	0.0252 (9)	0.0250 (9)	−0.0061 (7)	0.0025 (7)	−0.0079 (7)
C7	0.0170 (8)	0.0270 (9)	0.0178 (8)	−0.0032 (7)	0.0032 (6)	−0.0029 (7)
C8	0.0230 (9)	0.0354 (10)	0.0235 (9)	−0.0091 (7)	0.0027 (7)	−0.0049 (7)
C9	0.0217 (9)	0.0618 (14)	0.0253 (10)	−0.0154 (9)	0.0023 (7)	−0.0063 (9)
C10	0.0193 (9)	0.0660 (15)	0.0219 (10)	0.0015 (9)	0.0026 (7)	0.0023 (9)
C11	0.0301 (10)	0.0407 (11)	0.0302 (11)	0.0067 (9)	0.0049 (8)	0.0058 (9)
C12	0.0255 (9)	0.0283 (9)	0.0256 (9)	−0.0016 (7)	0.0044 (7)	−0.0009 (7)
C13	0.0197 (8)	0.0186 (8)	0.0194 (8)	−0.0059 (6)	0.0042 (6)	−0.0047 (6)
C14	0.0253 (8)	0.0206 (8)	0.0197 (8)	−0.0066 (7)	0.0004 (7)	−0.0023 (6)
C15	0.0234 (9)	0.0228 (9)	0.0279 (9)	−0.0012 (7)	0.0007 (7)	−0.0016 (7)
C16	0.0279 (9)	0.0327 (10)	0.0261 (10)	0.0006 (8)	0.0066 (7)	−0.0077 (8)
C17	0.0328 (10)	0.0549 (13)	0.0189 (9)	0.0033 (9)	0.0010 (8)	−0.0062 (9)
C18	0.0246 (9)	0.0419 (11)	0.0215 (9)	0.0029 (8)	−0.0006 (7)	−0.0021 (8)
C19	0.0248 (9)	0.0198 (8)	0.0258 (9)	−0.0061 (7)	0.0031 (7)	−0.0094 (7)
C20	0.0236 (8)	0.0257 (9)	0.0203 (8)	−0.0106 (7)	0.0008 (7)	−0.0088 (7)
C21	0.0217 (9)	0.0311 (9)	0.0272 (9)	−0.0084 (7)	−0.0032 (7)	0.0001 (7)
C22	0.0197 (8)	0.0290 (9)	0.0317 (10)	−0.0070 (7)	0.0033 (7)	−0.0043 (8)
C23	0.0207 (8)	0.0235 (8)	0.0257 (9)	−0.0083 (7)	0.0091 (7)	−0.0062 (7)
C24	0.0283 (9)	0.0283 (9)	0.0187 (8)	−0.0140 (7)	0.0067 (7)	−0.0048 (7)

C25	0.0350 (10)	0.0283 (9)	0.0260 (10)	−0.0129 (8)	−0.0008 (8)	0.0034 (7)
C26	0.0319 (10)	0.0193 (8)	0.0326 (10)	−0.0078 (7)	0.0005 (8)	−0.0023 (7)
B1	0.0223 (10)	0.0352 (11)	0.0237 (10)	−0.0086 (8)	0.0005 (8)	−0.0040 (8)
F1	0.0380 (7)	0.0615 (8)	0.0326 (7)	−0.0071 (6)	0.0122 (5)	−0.0084 (6)
F2	0.0400 (7)	0.0453 (7)	0.0307 (6)	−0.0002 (5)	−0.0116 (5)	−0.0063 (5)
F3	0.0461 (8)	0.0579 (8)	0.0510 (8)	−0.0323 (7)	0.0007 (6)	−0.0018 (7)
F4	0.0370 (7)	0.0390 (7)	0.0408 (7)	−0.0011 (5)	−0.0031 (5)	−0.0002 (5)

Geometric parameters (Å, º)

Rh1—N1	2.1295 (14)	C13—C14	1.394 (2)
Rh1—C24	2.1323 (17)	C14—C15	1.390 (2)
Rh1—C23	2.1395 (16)	C14—H14	0.9500
Rh1—P1	2.2371 (4)	C15—C16	1.379 (3)
Rh1—C20	2.2423 (16)	C15—H15	0.9500
Rh1—C19	2.2503 (17)	C16—C17	1.380 (3)
P1—C7	1.8135 (17)	C16—H16	0.9500
P1—C13	1.8166 (16)	C17—C18	1.391 (3)
P1—C1	1.8331 (17)	C17—H17	0.9500
N1—C6	1.354 (2)	C18—H18	0.9500
N1—C2	1.359 (2)	C19—C20	1.368 (3)
C1—C2	1.508 (2)	C19—C26	1.515 (3)
C1—H1A	0.9900	C19—H19	1.0000
C1—H1B	0.9900	C20—C21	1.509 (2)
C2—C3	1.391 (2)	C20—H20	1.0000
C3—C4	1.383 (3)	C21—C22	1.537 (3)
C3—H3	0.9500	C21—H21A	0.9900
C4—C5	1.384 (3)	C21—H21B	0.9900
C4—H4	0.9500	C22—C23	1.521 (2)
C5—C6	1.380 (3)	C22—H22A	0.9900
C5—H5	0.9500	C22—H22B	0.9900
C6—H6	0.9500	C23—C24	1.396 (3)
C7—C8	1.397 (3)	C23—H23	1.0000
C7—C12	1.397 (3)	C24—C25	1.506 (3)
C8—C9	1.388 (3)	C24—H24	1.0000
C8—H8	0.9500	C25—C26	1.538 (3)
C9—C10	1.386 (3)	C25—H25A	0.9900
C9—H9	0.9500	C25—H25B	0.9900
C10—C11	1.376 (3)	C26—H26A	0.9900
C10—H10	0.9500	C26—H26B	0.9900
C11—C12	1.392 (3)	B1—F3	1.379 (2)
C11—H11	0.9500	B1—F1	1.385 (2)
C12—H12	0.9500	B1—F2	1.392 (2)
C13—C18	1.392 (3)	B1—F4	1.393 (3)
N1—Rh1—C24	164.31 (6)	C13—C14—H14	119.8
N1—Rh1—C23	156.54 (6)	C16—C15—C14	120.08 (17)
C24—Rh1—C23	38.15 (7)	C16—C15—H15	120.0

N1—Rh1—P1	80.58 (4)	C14—C15—H15	120.0
C24—Rh1—P1	92.74 (5)	C15—C16—C17	120.07 (17)
C23—Rh1—P1	97.92 (5)	C15—C16—H16	120.0
N1—Rh1—C20	93.09 (6)	C17—C16—H16	120.0
C24—Rh1—C20	97.17 (7)	C16—C17—C18	120.23 (18)
C23—Rh1—C20	81.31 (7)	C16—C17—H17	119.9
P1—Rh1—C20	162.34 (5)	C18—C17—H17	119.9
N1—Rh1—C19	100.93 (6)	C17—C18—C13	120.29 (17)
C24—Rh1—C19	81.10 (7)	C17—C18—H18	119.9
C23—Rh1—C19	87.72 (6)	C13—C18—H18	119.9
P1—Rh1—C19	161.96 (5)	C20—C19—C26	125.25 (16)
C20—Rh1—C19	35.45 (7)	C20—C19—Rh1	71.96 (10)
C7—P1—C13	105.76 (8)	C26—C19—Rh1	110.01 (11)
C7—P1—C1	105.55 (8)	C20—C19—H19	113.9
C13—P1—C1	107.98 (8)	C26—C19—H19	113.9
C7—P1—Rh1	114.28 (6)	Rh1—C19—H19	113.9
C13—P1—Rh1	121.83 (5)	C19—C20—C21	125.40 (16)
C1—P1—Rh1	100.07 (6)	C19—C20—Rh1	72.60 (10)
C6—N1—C2	117.88 (14)	C21—C20—Rh1	106.52 (11)
C6—N1—Rh1	123.16 (12)	C19—C20—H20	114.5
C2—N1—Rh1	118.96 (11)	C21—C20—H20	114.5
C2—C1—P1	107.80 (11)	Rh1—C20—H20	114.5
C2—C1—H1A	110.1	C20—C21—C22	113.70 (15)
P1—C1—H1A	110.1	C20—C21—H21A	108.8
C2—C1—H1B	110.1	C22—C21—H21A	108.8
P1—C1—H1B	110.1	C20—C21—H21B	108.8
H1A—C1—H1B	108.5	C22—C21—H21B	108.8
N1—C2—C3	121.73 (15)	H21A—C21—H21B	107.7
N1—C2—C1	117.45 (14)	C23—C22—C21	113.02 (14)
C3—C2—C1	120.82 (15)	C23—C22—H22A	109.0
C4—C3—C2	119.49 (17)	C21—C22—H22A	109.0
C4—C3—H3	120.3	C23—C22—H22B	109.0
C2—C3—H3	120.3	C21—C22—H22B	109.0
C5—C4—C3	118.97 (16)	H22A—C22—H22B	107.8
C5—C4—H4	120.5	C24—C23—C22	125.30 (16)
C3—C4—H4	120.5	C24—C23—Rh1	70.65 (10)
C6—C5—C4	119.06 (16)	C22—C23—Rh1	113.35 (11)
C6—C5—H5	120.5	C24—C23—H23	113.4
C4—C5—H5	120.5	C22—C23—H23	113.4
N1—C6—C5	122.84 (17)	Rh1—C23—H23	113.4
N1—C6—H6	118.6	C23—C24—C25	126.26 (16)
C5—C6—H6	118.6	C23—C24—Rh1	71.21 (10)
C8—C7—C12	119.70 (17)	C25—C24—Rh1	109.23 (12)
C8—C7—P1	121.64 (14)	C23—C24—H24	113.9
C12—C7—P1	118.66 (14)	C25—C24—H24	113.9
C9—C8—C7	119.72 (19)	Rh1—C24—H24	113.9
C9—C8—H8	120.1	C24—C25—C26	113.05 (15)
C7—C8—H8	120.1	C24—C25—H25A	109.0

C10—C9—C8	120.2 (2)	C26—C25—H25A	109.0
C10—C9—H9	119.9	C24—C25—H25B	109.0
C8—C9—H9	119.9	C26—C25—H25B	109.0
C11—C10—C9	120.35 (18)	H25A—C25—H25B	107.8
C11—C10—H10	119.8	C19—C26—C25	112.51 (15)
C9—C10—H10	119.8	C19—C26—H26A	109.1
C10—C11—C12	120.2 (2)	C25—C26—H26A	109.1
C10—C11—H11	119.9	C19—C26—H26B	109.1
C12—C11—H11	119.9	C25—C26—H26B	109.1
C11—C12—C7	119.78 (19)	H26A—C26—H26B	107.8
C11—C12—H12	120.1	F3—B1—F1	110.61 (17)
C7—C12—H12	120.1	F3—B1—F2	110.21 (17)
C18—C13—C14	118.88 (15)	F1—B1—F2	109.38 (16)
C18—C13—P1	121.84 (13)	F3—B1—F4	109.06 (16)
C14—C13—P1	118.95 (13)	F1—B1—F4	109.12 (17)
C15—C14—C13	120.44 (16)	F2—B1—F4	108.41 (16)
C15—C14—H14	119.8		