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# *cis*-Dichloridobis(dimethoxyphenylphosphine)palladium(II)

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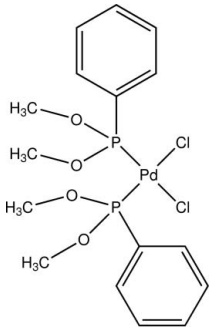
Key indicators: single-crystal X-ray study; $T$ = 125 K; mean $\sigma$(C–C) = 0.004 Å; $R$ factor = 0.023; $wR$ factor = 0.050; data-to-parameter ratio = 15.2.

The title compound, $[PdCl_2(C_8H_{11}O_2P)_2]$, has a comparable structure to those of related palladium dichloride complexes containing trimethyl phosphinite and methyl diphenyl phosphinite. The Pd atom is located on a crystallographic twofold rotation axis: thus, there is just one half-molecule in the asymmetric unit. The structure is isomorphous with the platinum analogue *cis*-$[PtCl_2\{P(OMe)_2Ph\}_2]$.

## Related literature

For related structures, see: Slawin *et al.* (2009, 2007); Powell & Jacobson (1980). For preparation of the title compound, see: Jenkins & Shaw (1966).




## Experimental

### Crystal data

$[PdCl_2(C_8H_{11}O_2P)_2]$ $M_r$ = 517.60
Monoclinic, $C2/c$
$a$ = 10.876 (7) Å
$b$ = 9.174 (5) Å
$c$ = 20.722 (13) Å
$\beta$ = 102.196 (7)°
$V$ = 2021 (2) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 1.36 mm$^{-1}$
$T$ = 125 K
0.16 × 0.15 × 0.09 mm

### Data collection

Rigaku Mercury CCD diffractometer
Absorption correction: multi-scan (*ABSCOR*; Higashi, 1995)
$T_{min}$ = 0.812, $T_{max}$ = 0.888
8406 measured reflections
1775 independent reflections
1653 reflections with $F^2 > 2\sigma(F^2)$
$R_{int}$ = 0.032

### Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.023
$wR(F^2)$ = 0.050
$S$ = 1.09
1775 reflections
117 parameters
All H-atom parameters refined
$\Delta\rho_{max}$ = 1.15 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.32 e Å$^{-3}$

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

| | | | |
|---|---|---|---|
| Pd1—Cl1 | 2.3515 (16) | Pd1—P1 | 2.2300 (16) |
| Cl1—Pd1—Cl1$^{i}$ | 91.49 (2) | Cl1—Pd1—P1$^{i}$ | 83.85 (2) |
| Cl1—Pd1—P1 | 174.86 (2) | P1—Pd1—P1$^{i}$ | 100.88 (2) |

Symmetry code: (i) $-x, y, -z+\frac{3}{2}$.

Data collection: *SCXmini* (Rigaku/MSC, 2006); cell refinement: *PROCESS-AUTO* (Rigaku, 1998); data reduction: *PROCESS-AUTO*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *CrystalStructure* (Rigaku/MSC, 2006); software used to prepare material for publication: *CrystalStructure*.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: BT5195).

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# supporting information

*Acta Cryst.* (2010). E**66**, m321 [doi:10.1107/S1600536810006471]

## *cis*-Dichloridobis(dimethoxyphenylphosphine)palladium(II)

**Alexandra M. Z. Slawin, Paul G. Waddell and J. Derek Woollins**

### S1. Experimental

Based on the method of Jenkins & Shaw (1966). To (0.3 g (0.93 mmol) of potassium tetrachloropalladate was dissolved in 10 ml e thanol and 0.147 ml (1.86 mmol) of $P(OMe)_2Ph$ was added. The solution was stirred at room temperature for 30 min s before being filtered and then precipitated by slow addition of hexane to give a white crystalline solid. Crystals were grown for X-ray crystallography via slow diffusion of hexane into a solution of the product in dichloromethane [cis-$PdCl_2(P(OMe)_2Ph)_2$] (0.40 mmol, ca. 68 %). $^{31}P$-{$^1H$} NMR: $\delta$ 125.8 ppm.

### S2. Refinement

All H atoms were included in calculated positions (C—H distances are 0.96 Å for methyl H atoms, 0.93 Å for aromatic H atoms) and were refined as riding atoms with $U_{iso}(H) = 1.2\ U_{eq}(C)$ or $U_{iso}(H) = 1.5\ U_{eq}(C_{methyl})$. The highest peak in the difference map is 1.23 Å from atom Pd1.

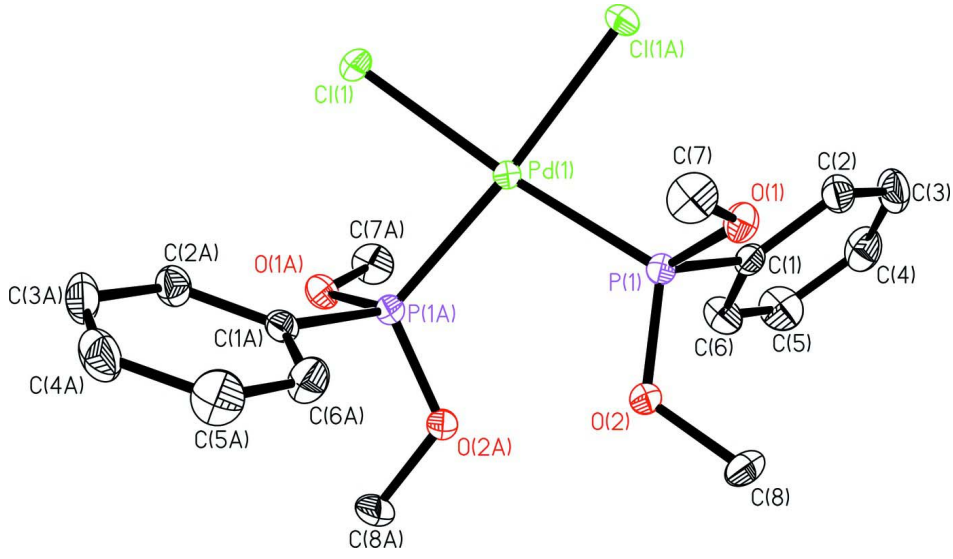


**Figure 1**

The structure of the title compound with displacement ellipsoids drawn at the 50% probability level, hydrogen atoms omitted for clarity. Symmetry operator for generating equivalent atoms (A): -x, y, 1.5-z.

### *cis*-Dichloridobis(dimethoxyphenylphosphine)palladium(II)

*Crystal data*

$[PdCl_2(C_8H_{11}O_2P)_2]$
$M_r = 517.60$

Monoclinic, *C*2/*c*
Hall symbol: -C 2yc

$a$ = 10.876 (7) Å
$b$ = 9.174 (5) Å
$c$ = 20.722 (13) Å
$\beta$ = 102.196 (7)°
$V$ = 2021 (2) Å$^3$
$Z$ = 4
$F$(000) = 1040.00
$D_x$ = 1.701 Mg m$^{-3}$

Mo $K\alpha$ radiation, $\lambda$ = 0.71075 Å
Cell parameters from 2591 reflections
$\theta$ = 2.9–25.4°
$\mu$ = 1.36 mm$^{-1}$
$T$ = 125 K
Prism, colorless
0.16 × 0.15 × 0.09 mm

*Data collection*

Rigaku Mercury CCD diffractometer
Detector resolution: 0.83 pixels mm$^{-1}$
$\omega$ scans
Absorption correction: multi-scan (*ABSCOR*; Higashi, 1995)
$T_{min}$ = 0.812, $T_{max}$ = 0.888
8406 measured reflections

1775 independent reflections
1653 reflections with $F^2 > 2\sigma(F^2)$
$R_{int}$ = 0.032
$\theta_{max}$ = 25.0°
$h$ = −13→13
$k$ = −11→11
$l$ = −24→24

*Refinement*

Refinement on $F^2$
$R[F^2 > 2\sigma(F^2)]$ = 0.023
$wR(F^2)$ = 0.050
$S$ = 1.09
1775 reflections
117 parameters

All H-atom parameters refined
$w = 1/[\sigma^2(F_o^2) + (0.0162P)^2 + 4.843P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.001
$\Delta\rho_{max}$ = 1.15 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.32 e Å$^{-3}$

*Special details*

**Geometry**. ENTER SPECIAL DETAILS OF THE MOLECULAR GEOMETRY

**Refinement**. Refinement was performed using all reflections. The weighted $R$-factor (wR) and goodness of fit ($S$) are based on $F^2$. $R$-factor (gt) are based on $F$. The threshold expression of $F^2 > 2.0\ \sigma(F^2)$ is used only for calculating $R$-factor (gt).

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

| | $x$ | $y$ | $z$ | $U_{iso}$*/$U_{eq}$ |
|---|---|---|---|---|
| Pd1 | 0.0000 | 0.09671 (3) | 0.7500 | 0.01397 (8) |
| Cl1 | −0.09211 (6) | −0.08216 (6) | 0.67365 (3) | 0.02090 (14) |
| P1 | 0.10038 (6) | 0.25152 (7) | 0.82618 (3) | 0.01521 (14) |
| O1 | 0.24303 (15) | 0.21038 (18) | 0.85487 (8) | 0.0189 (3) |
| O2 | 0.10272 (16) | 0.41579 (17) | 0.80284 (8) | 0.0199 (3) |
| C1 | 0.0398 (2) | 0.2542 (2) | 0.90033 (12) | 0.0172 (5) |
| C2 | 0.0988 (2) | 0.1823 (2) | 0.95758 (12) | 0.0220 (5) |
| C3 | 0.0459 (2) | 0.1856 (3) | 1.01266 (13) | 0.0285 (6) |
| C4 | −0.0648 (2) | 0.2601 (3) | 1.01080 (13) | 0.0302 (6) |
| C5 | −0.1248 (2) | 0.3298 (3) | 0.95385 (14) | 0.0328 (6) |
| C6 | −0.0733 (2) | 0.3264 (2) | 0.89844 (13) | 0.0259 (5) |
| C7 | 0.3242 (2) | 0.1770 (3) | 0.80984 (14) | 0.0278 (6) |
| C8 | 0.1786 (2) | 0.5209 (2) | 0.84682 (13) | 0.0274 (6) |
| H1 | 0.2993 | 0.0858 | 0.7883 | 0.033* |
| H2 | 0.1736 | 0.1321 | 0.9588 | 0.026* |
| H3 | 0.0851 | 0.1376 | 1.0510 | 0.034* |

| | | | | |
|---|---|---|---|---|
| H4 | −0.0994 | 0.2634 | 1.0482 | 0.036* |
| H5 | −0.1999 | 0.3791 | 0.9528 | 0.039* |
| H6 | −0.1143 | 0.3724 | 0.8599 | 0.031* |
| H7 | 0.4097 | 0.1704 | 0.8340 | 0.033* |
| H8 | 0.3175 | 0.2528 | 0.7773 | 0.033* |
| H9 | 0.1697 | 0.5038 | 0.8913 | 0.033* |
| H10 | 0.1508 | 0.6179 | 0.8337 | 0.033* |
| H11 | 0.2654 | 0.5103 | 0.8444 | 0.033* |

*Atomic displacement parameters (Å²)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| Pd1 | 0.01670 (15) | 0.01215 (14) | 0.01241 (14) | 0.0000 | 0.00162 (10) | 0.0000 |
| Cl1 | 0.0256 (3) | 0.0154 (3) | 0.0190 (3) | −0.0012 (2) | −0.0014 (2) | −0.0041 (2) |
| P1 | 0.0170 (3) | 0.0143 (3) | 0.0137 (3) | −0.0012 (2) | 0.0020 (2) | −0.0000 (2) |
| O1 | 0.0154 (8) | 0.0217 (8) | 0.0194 (8) | −0.0021 (7) | 0.0029 (6) | −0.0027 (7) |
| O2 | 0.0266 (9) | 0.0151 (8) | 0.0163 (8) | −0.0040 (6) | 0.0002 (7) | 0.0006 (6) |
| C1 | 0.0198 (12) | 0.0159 (12) | 0.0159 (11) | −0.0031 (9) | 0.0037 (9) | −0.0022 (9) |
| C2 | 0.0212 (13) | 0.0248 (14) | 0.0188 (12) | 0.0032 (10) | 0.0017 (10) | −0.0012 (10) |
| C3 | 0.0336 (15) | 0.0356 (16) | 0.0153 (13) | −0.0020 (12) | 0.0025 (11) | 0.0020 (11) |
| C4 | 0.0363 (16) | 0.0370 (16) | 0.0203 (14) | −0.0054 (12) | 0.0125 (12) | −0.0051 (12) |
| C5 | 0.0279 (15) | 0.0383 (17) | 0.0352 (16) | 0.0073 (12) | 0.0132 (12) | 0.0003 (13) |
| C6 | 0.0265 (14) | 0.0271 (14) | 0.0245 (14) | 0.0048 (11) | 0.0062 (11) | 0.0048 (11) |
| C7 | 0.0239 (14) | 0.0317 (15) | 0.0308 (15) | −0.0024 (11) | 0.0127 (11) | −0.0017 (12) |
| C8 | 0.0387 (16) | 0.0172 (13) | 0.0249 (14) | −0.0079 (11) | 0.0034 (12) | −0.0043 (11) |

*Geometric parameters (Å, º)*

| | | | |
|---|---|---|---|
| Pd1—Cl1 | 2.3515 (16) | C4—C5 | 1.379 (3) |
| Pd1—Cl1$^{i}$ | 2.3515 (16) | C5—C6 | 1.380 (4) |
| Pd1—P1 | 2.2300 (16) | C2—H2 | 0.930 |
| Pd1—P1$^{i}$ | 2.2300 (16) | C3—H3 | 0.930 |
| P1—O1 | 1.5853 (16) | C4—H4 | 0.930 |
| P1—O2 | 1.5846 (17) | C5—H5 | 0.930 |
| P1—C1 | 1.795 (2) | C6—H6 | 0.930 |
| O1—C7 | 1.446 (3) | C7—H1 | 0.960 |
| O2—C8 | 1.458 (2) | C7—H7 | 0.960 |
| C1—C2 | 1.390 (3) | C7—H8 | 0.960 |
| C1—C6 | 1.391 (3) | C8—H9 | 0.960 |
| C2—C3 | 1.383 (4) | C8—H10 | 0.960 |
| C3—C4 | 1.378 (4) | C8—H11 | 0.960 |
| | | | |
| O1···C3$^{ii}$ | 3.324 (2) | H3···H9$^{ii}$ | 2.979 |
| O2···C7$^{iii}$ | 3.551 (3) | H3···H11$^{ii}$ | 2.774 |
| C3···O1$^{ii}$ | 3.324 (2) | H4···Cl1$^{xiv}$ | 3.073 |
| C3···C3$^{iv}$ | 3.557 (3) | H4···C5$^{xii}$ | 3.112 |
| C7···O2$^{v}$ | 3.551 (3) | H4···C8$^{xiii}$ | 3.191 |
| C7···C8$^{v}$ | 3.542 (3) | H4···H4$^{xii}$ | 3.467 |

| | | | |
|---|---|---|---|
| C8···C7$^{iii}$ | 3.542 (3) | H4···H5$^{xii}$ | 2.542 |
| Cl1···H3$^{vi}$ | 3.536 | H4···H7$^{ii}$ | 2.908 |
| Cl1···H4$^{vi}$ | 3.073 | H4···H9$^{xiii}$ | 2.669 |
| Cl1···H5$^{vii}$ | 3.099 | H4···H10$^{xiii}$ | 2.840 |
| Cl1···H6$^{vii}$ | 3.149 | H5···Cl1$^{xv}$ | 3.099 |
| Cl1···H7$^{v}$ | 3.041 | H5···C2$^{xi}$ | 3.554 |
| Cl1···H8$^{viii}$ | 2.961 | H5···C4$^{xii}$ | 3.093 |
| Cl1···H8$^{v}$ | 3.311 | H5···C5$^{xii}$ | 3.552 |
| Cl1···H10$^{ix}$ | 2.822 | H5···H2$^{xi}$ | 2.715 |
| O1···H3$^{ii}$ | 2.775 | H5···H4$^{xii}$ | 2.542 |
| O1···H6$^{x}$ | 3.459 | H5···H5$^{xii}$ | 3.396 |
| O2···H1$^{iii}$ | 2.826 | H5···H9$^{xiii}$ | 3.354 |
| O2···H7$^{xi}$ | 3.294 | H5···H10$^{viii}$ | 3.575 |
| C2···H2$^{ii}$ | 3.196 | H6···Cl1$^{xv}$ | 3.149 |
| C2···H3$^{iv}$ | 3.535 | H6···O1$^{xi}$ | 3.459 |
| C2···H5$^{x}$ | 3.554 | H6···C7$^{xi}$ | 3.007 |
| C3···H2$^{ii}$ | 3.419 | H6···H1$^{xi}$ | 2.515 |
| C3···H3$^{iv}$ | 3.431 | H6···H7$^{xi}$ | 2.809 |
| C3···H7$^{ii}$ | 3.381 | H6···H10$^{viii}$ | 3.418 |
| C4···H5$^{xii}$ | 3.093 | H6···H11$^{viii}$ | 3.560 |
| C4···H7$^{ii}$ | 3.363 | H7···Cl1$^{iii}$ | 3.041 |
| C4···H9$^{xiii}$ | 3.329 | H7···O2$^{x}$ | 3.294 |
| C5···H2$^{xi}$ | 3.551 | H7···C3$^{ii}$ | 3.381 |
| C5···H4$^{xii}$ | 3.112 | H7···C4$^{ii}$ | 3.363 |
| C5···H5$^{xii}$ | 3.552 | H7···C6$^{x}$ | 3.417 |
| C6···H1$^{xi}$ | 3.384 | H7···C8$^{x}$ | 3.190 |
| C6···H7$^{xi}$ | 3.417 | H7···H3$^{ii}$ | 2.955 |
| C6···H10$^{viii}$ | 3.572 | H7···H4$^{ii}$ | 2.908 |
| C6···H11$^{viii}$ | 3.451 | H7···H6$^{x}$ | 2.809 |
| C7···H3$^{ii}$ | 3.313 | H7···H9$^{x}$ | 3.213 |
| C7···H6$^{x}$ | 3.007 | H7···H10$^{x}$ | 2.668 |
| C7···H10$^{x}$ | 3.523 | H7···H10$^{v}$ | 3.431 |
| C7···H10$^{v}$ | 3.092 | H8···Cl1$^{xvi}$ | 2.961 |
| C7···H11$^{v}$ | 3.491 | H8···Cl1$^{iii}$ | 3.311 |
| C8···H1$^{iii}$ | 2.922 | H8···C8$^{v}$ | 3.345 |
| C8···H3$^{ii}$ | 3.301 | H8···H1$^{iii}$ | 3.474 |
| C8···H4$^{xiii}$ | 3.191 | H8···H10$^{v}$ | 2.698 |
| C8···H7$^{xi}$ | 3.190 | H8···H11$^{v}$ | 3.341 |
| C8···H8$^{iii}$ | 3.345 | H9···C4$^{xiii}$ | 3.329 |
| H1···O2$^{v}$ | 2.826 | H9···H2$^{ii}$ | 3.445 |
| H1···C6$^{x}$ | 3.384 | H9···H3$^{ii}$ | 2.979 |
| H1···C8$^{v}$ | 2.922 | H9···H4$^{xiii}$ | 2.669 |
| H1···H6$^{x}$ | 2.515 | H9···H5$^{xiii}$ | 3.354 |
| H1···H8$^{v}$ | 3.474 | H9···H7$^{xi}$ | 3.213 |
| H1···H10$^{v}$ | 2.712 | H10···Cl1$^{xvii}$ | 2.822 |
| H1···H11$^{v}$ | 2.779 | H10···C6$^{xvi}$ | 3.572 |
| H2···C2$^{ii}$ | 3.196 | H10···C7$^{xi}$ | 3.523 |
| H2···C3$^{ii}$ | 3.419 | H10···C7$^{iii}$ | 3.092 |

| | | | |
|---|---|---|---|
| H2···C5$^{x}$ | 3.551 | H10···H1$^{iii}$ | 2.712 |
| H2···H2$^{ii}$ | 3.026 | H10···H4$^{xiii}$ | 2.840 |
| H2···H3$^{ii}$ | 3.409 | H10···H5$^{xvi}$ | 3.575 |
| H2···H5$^{x}$ | 2.715 | H10···H6$^{xvi}$ | 3.418 |
| H2···H9$^{ii}$ | 3.445 | H10···H7$^{xi}$ | 2.668 |
| H3···Cl1$^{xiv}$ | 3.536 | H10···H7$^{iii}$ | 3.431 |
| H3···O1$^{ii}$ | 2.775 | H10···H8$^{iii}$ | 2.698 |
| H3···C2$^{iv}$ | 3.535 | H11···C6$^{xvi}$ | 3.451 |
| H3···C3$^{iv}$ | 3.431 | H11···C7$^{iii}$ | 3.491 |
| H3···C7$^{ii}$ | 3.313 | H11···H1$^{iii}$ | 2.779 |
| H3···C8$^{ii}$ | 3.301 | H11···H3$^{ii}$ | 2.774 |
| H3···H2$^{ii}$ | 3.409 | H11···H6$^{xvi}$ | 3.560 |
| H3···H3$^{iv}$ | 3.552 | H11···H8$^{iii}$ | 3.341 |
| H3···H7$^{ii}$ | 2.955 | | |

| | | | |
|---|---|---|---|
| Cl1—Pd1—Cl1$^{i}$ | 91.49 (2) | C1—C2—H2 | 120.1 |
| Cl1—Pd1—P1 | 174.86 (2) | C3—C2—H2 | 120.1 |
| Cl1—Pd1—P1$^{i}$ | 83.85 (2) | C2—C3—H3 | 120.0 |
| Cl1$^{i}$—Pd1—P1 | 83.85 (2) | C4—C3—H3 | 120.0 |
| Cl1$^{i}$—Pd1—P1$^{i}$ | 174.86 (2) | C3—C4—H4 | 119.8 |
| P1—Pd1—P1$^{i}$ | 100.88 (2) | C5—C4—H4 | 119.8 |
| Pd1—P1—O1 | 114.07 (6) | C4—C5—H5 | 120.0 |
| Pd1—P1—O2 | 115.26 (6) | C6—C5—H5 | 120.0 |
| Pd1—P1—C1 | 113.66 (7) | C1—C6—H6 | 120.0 |
| O1—P1—O2 | 105.27 (9) | C5—C6—H6 | 120.0 |
| O1—P1—C1 | 100.91 (10) | O1—C7—H1 | 109.5 |
| O2—P1—C1 | 106.30 (10) | O1—C7—H7 | 109.5 |
| P1—O1—C7 | 119.39 (14) | O1—C7—H8 | 109.5 |
| P1—O2—C8 | 118.82 (14) | H1—C7—H7 | 109.5 |
| P1—C1—C2 | 122.50 (19) | H1—C7—H8 | 109.5 |
| P1—C1—C6 | 117.70 (18) | H7—C7—H8 | 109.5 |
| C2—C1—C6 | 119.7 (2) | O2—C8—H9 | 109.5 |
| C1—C2—C3 | 119.8 (2) | O2—C8—H10 | 109.5 |
| C2—C3—C4 | 120.1 (2) | O2—C8—H11 | 109.5 |
| C3—C4—C5 | 120.4 (2) | H9—C8—H10 | 109.5 |
| C4—C5—C6 | 120.0 (2) | H9—C8—H11 | 109.5 |
| C1—C6—C5 | 119.9 (2) | H10—C8—H11 | 109.5 |

| | | | |
|---|---|---|---|
| Cl1—Pd1—P1$^{i}$—O1$^{i}$ | 47.02 (7) | O1—P1—O2—C8 | −46.3 (2) |
| Cl1—Pd1—P1$^{i}$—O2$^{i}$ | 169.01 (8) | O2—P1—O1—C7 | −77.89 (18) |
| Cl1—Pd1—P1$^{i}$—C1$^{i}$ | −67.93 (8) | O1—P1—C1—C2 | −21.0 (2) |
| Cl1$^{i}$—Pd1—P1—O1 | 47.02 (7) | O1—P1—C1—C6 | 161.81 (18) |
| Cl1$^{i}$—Pd1—P1—O2 | 169.01 (8) | C1—P1—O1—C7 | 171.69 (17) |
| Cl1$^{i}$—Pd1—P1—C1 | −67.93 (8) | O2—P1—C1—C2 | −130.59 (19) |
| P1—Pd1—P1$^{i}$—O1$^{i}$ | −135.01 (7) | O2—P1—C1—C6 | 52.2 (2) |
| P1—Pd1—P1$^{i}$—O2$^{i}$ | −13.03 (8) | C1—P1—O2—C8 | 60.2 (2) |
| P1—Pd1—P1$^{i}$—C1$^{i}$ | 110.03 (8) | P1—C1—C2—C3 | −178.50 (19) |
| P1$^{i}$—Pd1—P1—O1 | −135.01 (7) | P1—C1—C6—C5 | 179.1 (2) |

| | | | |
|---|---|---|---|
| P1$^{i}$—Pd1—P1—O2 | −13.03 (8) | C2—C1—C6—C5 | 1.8 (3) |
| P1$^{i}$—Pd1—P1—C1 | 110.03 (8) | C6—C1—C2—C3 | −1.3 (3) |
| Pd1—P1—O1—C7 | 49.44 (18) | C1—C2—C3—C4 | −0.1 (3) |
| Pd1—P1—O2—C8 | −172.89 (16) | C2—C3—C4—C5 | 1.0 (4) |
| Pd1—P1—C1—C2 | 101.57 (19) | C3—C4—C5—C6 | −0.6 (4) |
| Pd1—P1—C1—C6 | −75.6 (2) | C4—C5—C6—C1 | −0.8 (4) |

Symmetry codes: (i) −*x*, *y*, −*z*+3/2; (ii) −*x*+1/2, −*y*+1/2, −*z*+2; (iii) −*x*+1/2, *y*+1/2, −*z*+3/2; (iv) −*x*, −*y*, −*z*+2; (v) −*x*+1/2, *y*−1/2, −*z*+3/2; (vi) *x*, −*y*, *z*−1/2; (vii) −*x*−1/2, *y*−1/2, −*z*+3/2; (viii) *x*−1/2, *y*−1/2, *z*; (ix) −*x*, *y*−1, −*z*+3/2; (x) *x*+1/2, *y*−1/2, *z*; (xi) *x*−1/2, *y*+1/2, *z*; (xii) −*x*−1/2, −*y*+1/2, −*z*+2; (xiii) −*x*, −*y*+1, −*z*+2; (xiv) *x*, −*y*, *z*+1/2; (xv) −*x*−1/2, *y*+1/2, −*z*+3/2; (xvi) *x*+1/2, *y*+1/2, *z*; (xvii) −*x*, *y*+1, −*z*+3/2.