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catena-Poly[[triphenyltin(IV)]-μ-phenylphosphinato-κ^2O:O']

Tidiane Diop,[a] Libasse Diop,[a]* Gabriele Kociok-Köhn,[b] Kieran C. Molloy[b] and Helen Stoeckli-Evans[c]*

[a]Laboratoire de Chimie Minérale et Analytique, Département de Chimie, Faculté des Sciences et Techniques–Université Cheikh Anta Diop, Dakar, Senegal, [b]Department of Chemistry, University of Bath, Claverton Down, Bath BA2 7AY, England, and [c]Institute of Physics, University of Neuchâtel, Rue Emile-Argand 11, CH-2000 Neuchâtel, Switzerland
Correspondence e-mail: dlibasse@gmail.com, helen.stoeckli-evans@unine.ch

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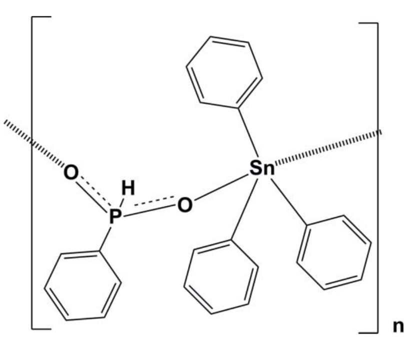
Key indicators: single-crystal X-ray study; T = 173 K; mean σ(C–C) = 0.009 Å; R factor = 0.052; wR factor = 0.079; data-to-parameter ratio = 14.9.

In the structure of the title coordination polymer, $[Sn(C_6H_5)_3(C_6H_6O_2P)]_n$ or $[PhP(H)O_2Sn^{IV}(Ph)_3]_n$, the Sn^{IV} atom is five-coordinate, with the SnC_3O_2 framework in a *trans* trigonal–bipyramidal arrangement having the $PhP(H)O_2^-$ anions in apical positions. In the crystal, neighbouring polymer chains are linked *via* C—H$\cdots\pi$ interactions, forming a two-dimensional network lying parallel to (001).

Related literature

For medical applications of tin(IV) compounds, see: Evans & Karpel (1985); Kapoor *et al.* (2005); Yin & Wang (2004). For literature on new organotin compounds, see: Chandrasekhar *et al.* (2003); Davies & Smith (1982); Zhang *et al.* (2006). For work in this field carried out by the authors, see: Diassé-Sarr *et al.* (1997); Diop *et al.* (2002, 2003); Diallo *et al.* (2009). For related structures, see: Molloy *et al.* (1981); Adair *et al.* (2003).



Experimental

Crystal data

$[Sn(C_6H_5)_3(C_6H_6O_2P)]$
M_r = 491.07
Orthorhombic, $Pbca$
a = 14.0108 (6) Å
b = 11.7674 (7) Å
c = 25.7068 (12) Å
V = 4238.3 (4) Å^3
Z = 8
Mo $K\alpha$ radiation
μ = 1.30 mm^{-1}
T = 173 K
0.18 × 0.13 × 0.10 mm

Data collection

Stoe IPDS II diffractometer
Absorption correction: multi-scan (*MULscanABS* in *PLATON*; Spek, 2009)
T_{min} = 0.973, T_{max} = 1.000
27270 measured reflections
3829 independent reflections
2467 reflections with $I > 2\sigma(I)$
R_{int} = 0.117

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.052
$wR(F^2)$ = 0.079
S = 1.00
3829 reflections
257 parameters
H atoms treated by a mixture of independent and constrained refinement
$\Delta\rho_{max}$ = 0.47 e Å^{-3}
$\Delta\rho_{min}$ = −0.68 e Å^{-3}

Table 1
Hydrogen-bond geometry (Å, °).

Cg1 is the centroid of the C19–C24 ring.

D—H$\cdots A$	D—H	H$\cdots A$	$D\cdots A$	D—H$\cdots A$
C9—H9$\cdots Cg1^{i}$	0.95	2.79	3.656 (9)	151
C18—H18$\cdots Cg1^{ii}$	0.95	2.91	3.714 (6)	143

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

Data collection: *X-AREA* (Stoe & Cie, 2009); cell refinement: *X-AREA*; data reduction: *X-RED32* (Stoe & Cie, 2009); program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *PLATON* (Spek, 2009) and *Mercury* (Macrae *et al.*, 2008); software used to prepare material for publication: *SHELXL97*, *PLATON* and *publCIF* (Westrip, 2010).

HSE thanks the staff of the X-ray Diffraction Application Laboratory, CSEM, Neuchâtel, for access to the X-ray diffraction equipment.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: MW2028).

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Acta Cryst. (2011). E**67**, m1674–m1675 [https://doi.org/10.1107/S1600536811043625]

catena-Poly[[triphenyltin(IV)]-μ-phenylphosphinato-κ^2O:O']

Tidiane Diop, Libasse Diop, Gabriele Kociok-Köhn, Kieran C. Molloy and Helen Stoeckli-Evans

S1. Comment

As some compounds belonging to the organotin (IV) family have been found to be the subject of applications in medicine, agriculture, industry (Evans & Karpel, 1985; Kapoor *et al.*, 2005; Yin & Wang, 2004), many groups have been involved in the search for new organotin compounds (Davies & Smith, 1982; Zhang *et al.*, 2006; Chandrasekhar *et al.*, 2003). Our group has published a number of papers in this field (Diassé-Sarr *et al.*, 1997; Diop *et al.*, 2003; Diop *et al.*, 2002; Diallo *et al.*, 2009). In a continuation of this work we initiated the study of the interaction between $Cy_2NH_2PhP(H)O_2$ and $Sn(Ph)_3Cl$, which has led to the synthesis of the title coordination polymer.

The structure of the asymmetric unit of the title compound is illustrated in Fig. 1. The molecular units associate to form an infinite one-dimensional polymer (Fig. 2) in which trimethyltin(IV) groups are axially bridged by –O—P—O– linkages of the phenylphosphinate ligand to yield an almost perfect trigonal bipyramid at the tin(IV) atom; with equatorial location of the phenyl groups and axial disposition of the oxygenated ligand.

The sum of the angles at atom Sn1 by the *ipso*-carbons [124.1 (2), 119.4 (3), 116.4 (3) °] is 359.9°. The corresponding axial O1—Sn—O2 angle is 175.99 (15) °, indicating a slight deviation from linearity. The two axial Sn—O distances, [Sn1—O1 2.241 (4) Å and Sn—O2 2.237 (3) Å], are longer than the Sn—O axial distances [2.116 (2) Å and 2.132 (3) Å] observed in *catena*-(μ_2-phenylphosphinato-O,*O*')-choro-tin(II) [Adair *et al.*, 2003]. The two P—O distances of the bridging O1—P1—O2 moieties are also almost equal [P1—O1 1.514 (4) Å and P1—O2 1.501 (4) Å]. The geometry around the phosphorus atom is a distorted tetrahedron with bond angles ranging from 114.4 (2)° for O1—P1—O2 to 103 (2)° for C1—P1—H1. The P1—H1 distance is 1.33 (5) Å, similar to the same distance, of 1.39 (7) Å, observed in the compound mentioned above.

In the crystal, neighbouring chains are linked *via* C—H···π interactions, involving the phenyl ring (C19—C24). This results in the formation of a two-dimensional network structure lying parallel to the *ab*-plane (Table 1 and Fig. 3).

Footnote to Table 1: *Cg*1 is the centroid of ring (C19—C24).

S2. Experimental

Synthesis: $Cy_2NH_2Ph(H)PO_2$ (*L*) was obtained on neutralizing phenylphosphinic acid with dicyclohexylammine, in 1:2 ratio, in water; a white powder was collected after evaporation at 333 K. When (*L*) was mixed with $Sn(Ph)_3Cl$ (1:1 ratio, *M*.p. +533 K), both in ethanol, a white precipitate formed and the solution was stirred for a further 2 h. The mixture was then filtered and the solid dissolved in 25 ml of slightly hydrated methanol. The solution was then left for the solvent to slowly evaporate giving colourless crystals, suitable for X-ray diffraction analysis, of the title compound. Reaction: $Cy_2NH_2Ph(H)PO_2 + Sn(Ph)_3Cl \rightarrow PhP(H)O_2Sn(Ph)_3 + Cy_2NH_2Cl$. The same compound could be obtained by refluxing trimethyltin chloride with phenylphosphinic acid in water: $Ph(H)PO_2H + Sn(Ph)_3Cl \rightarrow PhP(H)O_2Sn(Ph)_3 + HCl$.

S3. Refinement

The PH H-atom was located in a difference Fourier map and was refined with $U_{iso}(H) = 1.2U_{eq}(P)$; [P—H = 1.33 (5) Å]. The C-bound H atoms were included in calculated positions and treated as riding atoms: C—H = 0.95 Å with $U_{iso}(H) = 1.2U_{eq}(C)$.

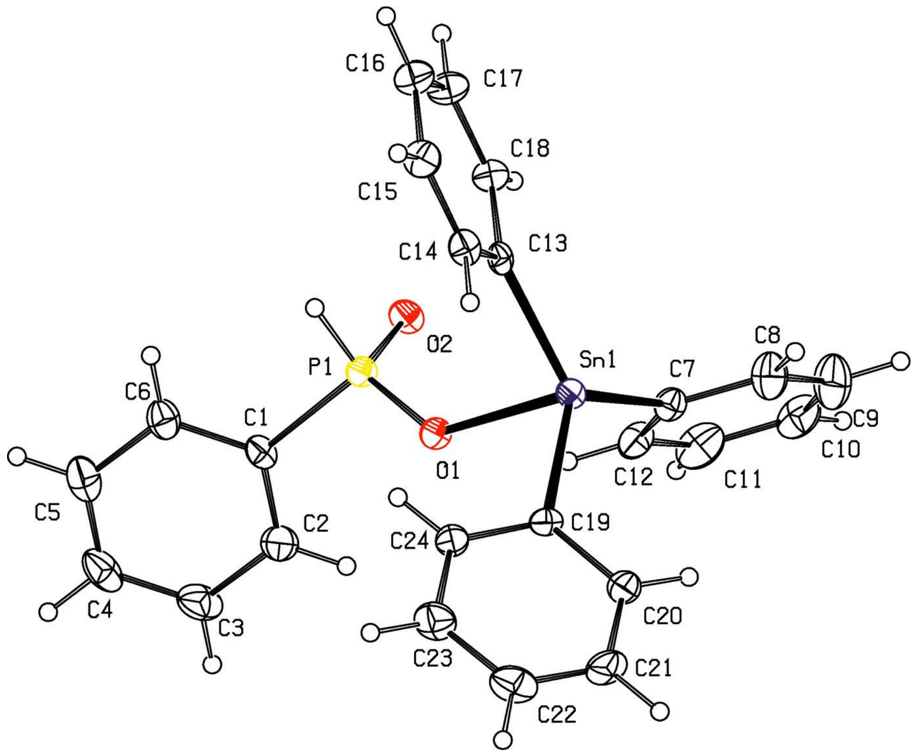

Figure 1

A view of the asymmetric unit of the title compound, showing the numbering scheme and displacement ellipsoids drawn at the 50% probability level.

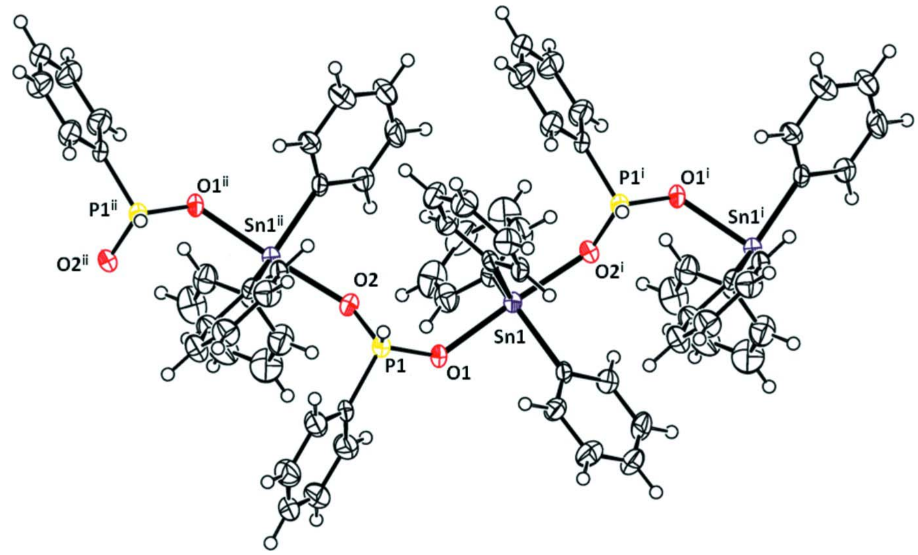

Figure 2

A view normal to (001) of the polymer chain of the title compound [Symmetry codes: (i) -*x* - 1/2, *y* - 1/2, *z*; (ii) -*x* - 1/2, *y* + 1/2, *z*; displacement ellipsoids are drawn at the 50% probability level].

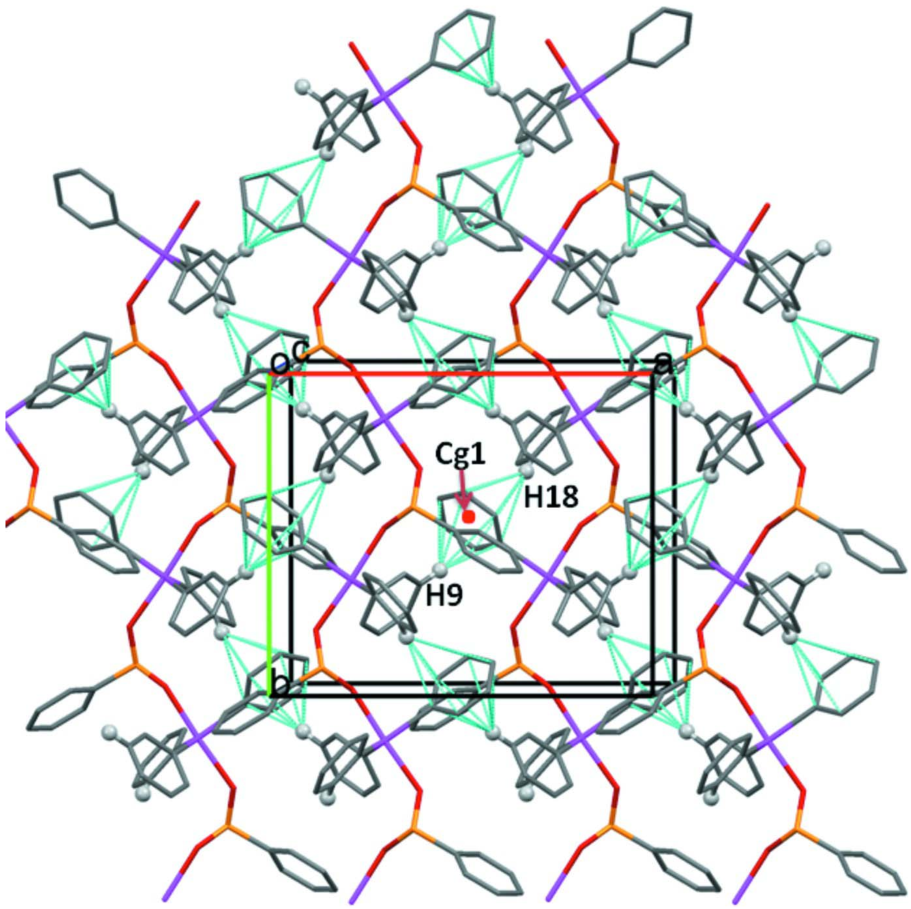

Figure 3

A view along the c axis of the crystal packing of the title compound showing the weak C—H···π interactions [represented by the H···C dashed cyan lines; Sn violet; P yellow; O red; H grey ball; $Cg1$ = centroid of ring (C19—C24)].

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Crystal data

$[Sn(C_6H_5)_3(C_6H_6O_2P)]$
M_r = 491.07
Orthorhombic, *Pbca*
Hall symbol: -P 2ac 2ab
a = 14.0108 (6) Å
b = 11.7674 (7) Å
c = 25.7068 (12) Å
V = 4238.3 (4) Å^3
Z = 8
$F(000)$ = 1968
D_x = 1.539 Mg m^{-3}
Mo $K\alpha$ radiation, λ = 0.71073 Å
Cell parameters from 10452 reflections
θ = 1.6–26.1°
μ = 1.30 mm^{-1}
T = 173 K
Rod, colourless
0.18 × 0.13 × 0.10 mm

Data collection

Stoe IPDS II diffractometer
Radiation source: fine-focus sealed tube
Plane graphite monochromator
φ and ω scans
Absorption correction: multi-scan (MULscanABS in *PLATON*; Spek, 2009)
T_{min} = 0.973, T_{max} = 1.000
27270 measured reflections
3829 independent reflections
2467 reflections with $I > 2\sigma(I)$

R_{int} = 0.117
θ_{max} = 25.3°, θ_{min} = 1.6°
h = −16→16
k = −14→14
l = −28→30

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)]$ = 0.052
$wR(F^2)$ = 0.079
S = 1.00
3829 reflections
257 parameters
0 restraints
Primary atom site location: structure-invariant direct methods
Secondary atom site location: difference Fourier map
Hydrogen site location: inferred from neighbouring sites
H atoms treated by a mixture of independent and constrained refinement
$w = 1/[\sigma^2(F_o^2) + (0.0275P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.001
$\Delta\rho_{max}$ = 0.47 e Å^{-3}
$\Delta\rho_{min}$ = −0.68 e Å^{-3}
Extinction correction: *SHELXL97* (Sheldrick, 2008), $Fc^*=kFc[1+0.001xFc^2\lambda^3/\sin(2\theta)]^{-1/4}$
Extinction coefficient: 0.00036 (5)

Special details

Geometry. Bond distances, angles *etc*. have been calculated using the rounded fractional coordinates. All su's are estimated from the variances of the (full) variance-covariance matrix. The cell e.s.d.'s are taken into account in the estimation of distances, angles and torsion angles

Refinement. The PH H-atom was located in a difference Fourier map and was refined with U_{iso}(H) = 1.2U$_e$q(P). The C-bound H-atoms were included in calculated positions and treated as riding atoms: C—H = 0.95 Å for CH(aromatic), with U_{iso}(H) = 1.2U$_e$q(C).

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å^2)

	x	y	z	U_{iso}*/U_{eq}
Sn1	−0.29327 (3)	−0.35558 (3)	0.36284 (1)	0.0260 (1)
P1	−0.36921 (12)	−0.08232 (12)	0.38935 (6)	0.0286 (5)
O1	−0.3855 (3)	−0.2003 (3)	0.36764 (17)	0.0295 (11)
O2	−0.2923 (3)	−0.0161 (2)	0.36231 (17)	0.0350 (11)
C1	−0.4806 (4)	−0.0060 (4)	0.3878 (3)	0.029 (2)
C2	−0.5372 (5)	−0.0034 (5)	0.3438 (3)	0.047 (3)
C3	−0.6217 (5)	0.0586 (6)	0.3440 (3)	0.053 (3)
C4	−0.6498 (5)	0.1153 (5)	0.3884 (3)	0.052 (3)
C5	−0.5930 (5)	0.1151 (5)	0.4317 (3)	0.050 (3)
C6	−0.5077 (5)	0.0548 (5)	0.4313 (3)	0.040 (2)
C7	−0.2349 (4)	−0.3088 (5)	0.2893 (2)	0.0317 (19)
C8	−0.1608 (5)	−0.3689 (6)	0.2669 (3)	0.050 (3)
C9	−0.1227 (6)	−0.3364 (7)	0.2197 (3)	0.065 (3)
C10	−0.1576 (6)	−0.2451 (6)	0.1937 (3)	0.054 (3)
C11	−0.2315 (6)	−0.1838 (6)	0.2150 (3)	0.059 (3)
C12	−0.2705 (5)	−0.2148 (5)	0.2623 (2)	0.041 (2)
C13	−0.2300 (4)	−0.3139 (4)	0.4356 (2)	0.0260 (18)
C14	−0.2518 (5)	−0.3764 (4)	0.4803 (2)	0.0323 (17)
C15	−0.2086 (5)	−0.3528 (5)	0.5273 (2)	0.0400 (17)
C16	−0.1414 (5)	−0.2654 (5)	0.5310 (3)	0.042 (3)
C17	−0.1206 (5)	−0.2024 (5)	0.4872 (2)	0.039 (2)
C18	−0.1629 (4)	−0.2252 (5)	0.4404 (2)	0.0327 (19)

C19	−0.4177 (4)	−0.4597 (4)	0.3655 (3)	0.0273 (16)
C20	−0.4303 (5)	−0.5480 (5)	0.3302 (3)	0.038 (2)
C21	−0.5101 (5)	−0.6171 (5)	0.3344 (3)	0.047 (3)
C22	−0.5766 (5)	−0.5986 (5)	0.3719 (3)	0.050 (3)
C23	−0.5660 (5)	−0.5107 (6)	0.4068 (3)	0.048 (3)
C24	−0.4866 (4)	−0.4413 (5)	0.4031 (2)	0.034 (2)
H1	−0.351 (4)	−0.089 (4)	0.440 (2)	0.0340*
H2	−0.51850	−0.04380	0.31350	0.0570*
H3	−0.66010	0.06180	0.31360	0.0640*
H4	−0.70900	0.15470	0.38890	0.0620*
H5	−0.61170	0.15600	0.46190	0.0590*
H6	−0.46790	0.05530	0.46120	0.0480*
H8	−0.13570	−0.43360	0.28430	0.0600*
H9	−0.07140	−0.37860	0.20510	0.0770*
H10	−0.13120	−0.22350	0.16120	0.0650*
H11	−0.25600	−0.11970	0.19700	0.0710*
H12	−0.32180	−0.17200	0.27650	0.0500*
H14	−0.29720	−0.43620	0.47820	0.0390*
H15	−0.22460	−0.39600	0.55730	0.0480*
H16	−0.11060	−0.24970	0.56310	0.0510*
H17	−0.07590	−0.14200	0.48960	0.0460*
H18	−0.14700	−0.18070	0.41070	0.0390*
H20	−0.38480	−0.56080	0.30350	0.0450*
H21	−0.51820	−0.67840	0.31080	0.0570*
H22	−0.63100	−0.64670	0.37400	0.0600*
H23	−0.61240	−0.49800	0.43310	0.0570*
H24	−0.47930	−0.37990	0.42670	0.0410*

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Sn1	0.0255 (2)	0.0192 (2)	0.0334 (2)	−0.0004 (2)	0.0006 (2)	0.0008 (2)
P1	0.0288 (9)	0.0191 (7)	0.0380 (9)	−0.0004 (7)	−0.0023 (8)	−0.0018 (7)
O1	0.031 (2)	0.0156 (16)	0.042 (2)	−0.0002 (15)	−0.002 (2)	−0.0021 (18)
O2	0.029 (2)	0.0209 (16)	0.055 (2)	−0.0052 (18)	0.002 (3)	−0.0016 (19)
C1	0.027 (4)	0.014 (3)	0.047 (4)	0.002 (3)	0.002 (3)	0.003 (3)
C2	0.041 (5)	0.037 (3)	0.064 (5)	0.006 (3)	−0.010 (4)	−0.012 (3)
C3	0.042 (5)	0.041 (4)	0.076 (5)	0.008 (3)	−0.018 (4)	0.003 (4)
C4	0.033 (4)	0.026 (4)	0.096 (6)	0.004 (3)	0.007 (4)	0.003 (3)
C5	0.044 (5)	0.041 (4)	0.064 (5)	0.006 (3)	0.015 (4)	−0.001 (3)
C6	0.041 (4)	0.031 (3)	0.048 (4)	0.006 (3)	0.006 (3)	0.002 (3)
C7	0.036 (4)	0.025 (3)	0.034 (3)	−0.003 (3)	0.001 (3)	−0.001 (3)
C8	0.061 (5)	0.041 (4)	0.048 (4)	0.005 (4)	0.013 (4)	0.003 (3)
C9	0.076 (6)	0.065 (5)	0.053 (5)	0.001 (5)	0.030 (4)	0.001 (4)
C10	0.070 (6)	0.063 (5)	0.030 (4)	−0.022 (4)	0.010 (4)	0.000 (4)
C11	0.086 (7)	0.052 (4)	0.040 (4)	−0.009 (4)	−0.005 (4)	0.007 (3)
C12	0.053 (5)	0.036 (3)	0.035 (4)	0.003 (3)	−0.006 (3)	−0.006 (3)
C13	0.027 (4)	0.017 (2)	0.034 (3)	0.005 (2)	0.004 (3)	−0.001 (2)

C14	0.035 (3)	0.019 (3)	0.043 (3)	−0.001 (2)	0.006 (3)	0.003 (2)
C15	0.043 (3)	0.045 (3)	0.032 (3)	−0.001 (4)	0.002 (3)	0.007 (3)
C16	0.045 (5)	0.045 (4)	0.037 (4)	−0.004 (3)	−0.006 (3)	0.000 (3)
C17	0.044 (4)	0.031 (3)	0.041 (4)	−0.010 (3)	−0.008 (3)	0.004 (3)
C18	0.036 (4)	0.031 (3)	0.031 (3)	−0.003 (3)	−0.004 (3)	0.005 (3)
C19	0.030 (3)	0.015 (2)	0.037 (3)	0.001 (2)	−0.010 (4)	0.001 (3)
C20	0.035 (4)	0.030 (3)	0.048 (4)	0.000 (3)	−0.003 (3)	−0.008 (3)
C21	0.051 (5)	0.026 (4)	0.064 (5)	−0.007 (3)	−0.012 (4)	−0.012 (3)
C22	0.041 (4)	0.034 (3)	0.075 (6)	−0.014 (3)	−0.005 (4)	0.009 (4)
C23	0.040 (5)	0.045 (4)	0.059 (5)	−0.013 (3)	0.005 (4)	0.002 (4)
C24	0.031 (4)	0.030 (3)	0.042 (4)	−0.006 (3)	0.002 (3)	−0.006 (3)

Geometric parameters (Å, º)

Sn1—O1	2.241 (4)	C19—C24	1.383 (9)
Sn1—C7	2.132 (5)	C19—C20	1.391 (9)
Sn1—C13	2.127 (5)	C20—C21	1.387 (9)
Sn1—C19	2.132 (5)	C21—C22	1.358 (10)
Sn1—O2^{i}	2.237 (3)	C22—C23	1.377 (10)
P1—O1	1.514 (4)	C23—C24	1.383 (9)
P1—O2	1.501 (4)	C2—H2	0.9500
P1—C1	1.801 (6)	C3—H3	0.9500
P1—H1	1.33 (5)	C4—H4	0.9500
C1—C2	1.382 (10)	C5—H5	0.9500
C1—C6	1.381 (10)	C6—H6	0.9500
C2—C3	1.391 (10)	C8—H8	0.9500
C3—C4	1.380 (10)	C9—H9	0.9500
C4—C5	1.368 (11)	C10—H10	0.9500
C5—C6	1.390 (10)	C11—H11	0.9500
C7—C12	1.398 (8)	C12—H12	0.9500
C7—C8	1.382 (9)	C14—H14	0.9500
C8—C9	1.380 (11)	C15—H15	0.9500
C9—C10	1.357 (11)	C16—H16	0.9500
C10—C11	1.376 (11)	C17—H17	0.9500
C11—C12	1.382 (10)	C18—H18	0.9500
C13—C14	1.398 (7)	C20—H20	0.9500
C13—C18	1.410 (8)	C21—H21	0.9500
C14—C15	1.380 (8)	C22—H22	0.9500
C15—C16	1.398 (9)	C23—H23	0.9500
C16—C17	1.379 (9)	C24—H24	0.9500
C17—C18	1.368 (8)		
O1—Sn1—C7	93.41 (19)	C19—C20—C21	119.3 (7)
O1—Sn1—C13	90.22 (17)	C20—C21—C22	121.0 (6)
O1—Sn1—C19	89.73 (17)	C21—C22—C23	120.6 (6)
O1—Sn1—O2^{i}	175.99 (15)	C22—C23—C24	119.0 (6)
C7—Sn1—C13	124.1 (2)	C19—C24—C23	121.1 (6)
C7—Sn1—C19	119.4 (3)	C1—C2—H2	120.00

O2^{i}—Sn1—C7	90.41 (19)	C3—C2—H2	120.00
C13—Sn1—C19	116.4 (3)	C2—C3—H3	120.00
O2^{i}—Sn1—C13	88.66 (17)	C4—C3—H3	120.00
O2^{i}—Sn1—C19	87.32 (17)	C3—C4—H4	120.00
O1—P1—O2	114.4 (2)	C5—C4—H4	120.00
O1—P1—C1	108.6 (3)	C4—C5—H5	120.00
O2—P1—C1	110.7 (2)	C6—C5—H5	120.00
O1—P1—H1	110 (2)	C1—C6—H6	120.00
O2—P1—H1	110 (2)	C5—C6—H6	120.00
C1—P1—H1	103 (2)	C7—C8—H8	119.00
Sn1—O1—P1	132.9 (3)	C9—C8—H8	120.00
Sn1^{ii}—O2—P1	145.1 (2)	C8—C9—H9	120.00
P1—C1—C2	121.8 (5)	C10—C9—H9	119.00
C2—C1—C6	119.6 (6)	C9—C10—H10	120.00
P1—C1—C6	118.6 (5)	C11—C10—H10	120.00
C1—C2—C3	119.8 (7)	C10—C11—H11	120.00
C2—C3—C4	120.0 (7)	C12—C11—H11	120.00
C3—C4—C5	120.4 (6)	C7—C12—H12	120.00
C4—C5—C6	119.7 (7)	C11—C12—H12	120.00
C1—C6—C5	120.5 (7)	C13—C14—H14	119.00
Sn1—C7—C8	121.7 (5)	C15—C14—H14	120.00
Sn1—C7—C12	120.5 (4)	C14—C15—H15	120.00
C8—C7—C12	117.8 (5)	C16—C15—H15	120.00
C7—C8—C9	121.0 (7)	C15—C16—H16	121.00
C8—C9—C10	120.9 (7)	C17—C16—H16	121.00
C9—C10—C11	119.4 (7)	C16—C17—H17	119.00
C10—C11—C12	120.6 (7)	C18—C17—H17	119.00
C7—C12—C11	120.3 (6)	C13—C18—H18	120.00
Sn1—C13—C14	120.7 (4)	C17—C18—H18	120.00
C14—C13—C18	117.6 (5)	C19—C20—H20	120.00
Sn1—C13—C18	121.7 (4)	C21—C20—H20	120.00
C13—C14—C15	121.2 (5)	C20—C21—H21	119.00
C14—C15—C16	120.2 (6)	C22—C21—H21	120.00
C15—C16—C17	118.8 (6)	C21—C22—H22	120.00
C16—C17—C18	121.4 (6)	C23—C22—H22	120.00
C13—C18—C17	120.7 (5)	C22—C23—H23	121.00
Sn1—C19—C20	120.8 (5)	C24—C23—H23	120.00
Sn1—C19—C24	120.2 (4)	C19—C24—H24	119.00
C20—C19—C24	119.0 (5)	C23—C24—H24	119.00

C7—Sn1—O1—P1	−89.4 (4)	O1—P1—C1—C6	134.2 (5)
C13—Sn1—O1—P1	34.8 (4)	O2—P1—C1—C2	78.1 (5)
C19—Sn1—O1—P1	151.2 (4)	O2—P1—C1—C6	−99.4 (5)
O1—Sn1—C7—C8	172.5 (5)	P1—C1—C2—C3	−178.7 (5)
O1—Sn1—C7—C12	−7.0 (5)	C6—C1—C2—C3	−1.2 (9)
C13—Sn1—C7—C8	79.9 (6)	P1—C1—C6—C5	179.9 (5)
C13—Sn1—C7—C12	−99.6 (5)	C2—C1—C6—C5	2.3 (9)
C19—Sn1—C7—C8	−95.9 (5)	C1—C2—C3—C4	−1.4 (10)

C19—Sn1—C7—C12	84.6 (5)	C2—C3—C4—C5	2.8 (10)
O2^{i}—Sn1—C7—C8	−8.7 (5)	C3—C4—C5—C6	−1.7 (10)
O2^{i}—Sn1—C7—C12	171.8 (5)	C4—C5—C6—C1	−0.9 (10)
O1—Sn1—C13—C14	107.3 (5)	Sn1—C7—C8—C9	−178.9 (6)
O1—Sn1—C13—C18	−74.6 (4)	C12—C7—C8—C9	0.6 (10)
C7—Sn1—C13—C14	−158.4 (4)	Sn1—C7—C12—C11	179.1 (5)
C7—Sn1—C13—C18	19.7 (5)	C8—C7—C12—C11	−0.5 (9)
C19—Sn1—C13—C14	17.5 (5)	C7—C8—C9—C10	−0.7 (12)
C19—Sn1—C13—C18	−164.4 (4)	C8—C9—C10—C11	0.5 (12)
O2^{i}—Sn1—C13—C14	−68.9 (5)	C9—C10—C11—C12	−0.3 (12)
O2^{i}—Sn1—C13—C18	109.3 (4)	C10—C11—C12—C7	0.3 (11)
O1—Sn1—C19—C20	132.0 (5)	Sn1—C13—C14—C15	177.6 (5)
O1—Sn1—C19—C24	−49.1 (5)	C18—C13—C14—C15	−0.6 (9)
C7—Sn1—C19—C20	38.2 (6)	Sn1—C13—C18—C17	−177.7 (5)
C7—Sn1—C19—C24	−142.8 (5)	C14—C13—C18—C17	0.5 (8)
C13—Sn1—C19—C20	−137.9 (5)	C13—C14—C15—C16	−0.2 (10)
C13—Sn1—C19—C24	41.0 (5)	C14—C15—C16—C17	1.1 (10)
O2^{i}—Sn1—C19—C20	−50.8 (5)	C15—C16—C17—C18	−1.3 (10)
O2^{i}—Sn1—C19—C24	128.2 (5)	C16—C17—C18—C13	0.5 (9)
C7—Sn1—O2^{i}—P1^{i}	117.5 (5)	Sn1—C19—C20—C21	177.3 (5)
C13—Sn1—O2^{i}—P1^{i}	−6.6 (4)	C24—C19—C20—C21	−1.7 (10)
C19—Sn1—O2^{i}—P1^{i}	−123.2 (5)	Sn1—C19—C24—C23	−177.4 (5)
O2—P1—O1—Sn1	63.4 (4)	C20—C19—C24—C23	1.6 (9)
C1—P1—O1—Sn1	−172.4 (4)	C19—C20—C21—C22	1.0 (10)
O1—P1—O2—Sn1^{ii}	−174.3 (4)	C20—C21—C22—C23	−0.2 (11)
C1—P1—O2—Sn1^{ii}	62.6 (5)	C21—C22—C23—C24	0.1 (11)
O1—P1—C1—C2	−48.3 (6)	C22—C23—C24—C19	−0.8 (10)

Symmetry codes: (i) $-x-1/2, y-1/2, z$; (ii) $-x-1/2, y+1/2, z$.

Hydrogen-bond geometry (Å, º)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
C9—H9···*Cg*1^{iii}	0.95	2.79	3.656 (9)	151
C18—H18···*Cg*1^{ii}	0.95	2.91	3.714 (6)	143

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