Table 2. *Geometric parameters* (Å, °)

Ir—*M*1	2.090	Ir—*M*2	2.101
Ir—P1	2.346 (3)	Ir—P2	2.358 (3)
Ir—C35	2.191 (11)	Ir—C36	2.197 (12)
Ir—C39	2.223 (12)	Ir—C40	2.208 (12)
Fe—Cp1	1.630	Fe—Cp2	1.640
Fe—C1	2.002 (12)	Fe—C2	2.016 (13)
Fe—C3	2.006 (12)	Fe—C4	2.067 (14)
Fe—C5	2.039 (13)	Fe—C18	2.000 (11)
Fe—C19	2.019 (13)	Fe—C20	2.049 (14)
Fe—C21	2.068 (15)	Fe—C22	2.035 (11)
P1—C1	1.784 (11)	P1—C6	1.830 (11)
P1—C12	1.800 (12)	P2—C18	1.806 (13)
P2—C23	1.809 (13)	P2—C29	1.818 (11)
Ir···Fe	4.340 (2)		
*M*1—Ir—*M*2	83.4	*M*1—Ir—P1	172.8
*M*1—Ir—P2	87.9	*M*2—Ir—P1	89.6
*M*2—Ir—P2	170.8	P1—Ir—P2	99.2 (1)
Cp1—Fe—Cp2	178.9	Ir—P1—C1	119.1 (4)
Ir—P1—C6	112.2 (4)	Ir—P1—C12	113.1 (4)
C1—P1—C6	101.9 (5)	C1—P1—C12	104.9 (6)
C6—P1—C12	104.2 (5)	Ir—P2—C18	121.7 (4)
Ir—P2—C23	110.6 (4)	Ir—P2—C29	111.8 (4)
C18—P2—C23	103.1 (6)	C18—P2—C29	102.4 (5)
C23—P2—C29	105.7 (6)		

We thank the University of Sussex for a bursary (to RBB), and Johnson Matthey PLC for a generous loan of iridium salts.

Lists of structure factors, anisotropic thermal parameters, H-atom coordinates and complete geometry have been deposited with the British Library Document Supply Centre as Supplementary Publication No. SUP 71128 (36 pp.). Copies may be obtained through The Technical Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England. [CIF reference: LI1043]

References

Abbassioun, M. S., Chaloner, P. A., Hitchcock, P. B. & Koziorowski, J. M. (1991). *Acta Cryst.* C**47**, 437–439.
Abbassioun, M. S., Hitchcock, P. B. & Chaloner, P. A. (1989). *Acta Cryst.* C**45**, 331–333.
Abbassioun, M. S., Hitchcock, P. B. & Chaloner, P. A. (1990*a*). *Acta Cryst.* C**46**, 902–904.
Abbassioun, M. S., Hitchcock, P. B. & Chaloner, P. A. (1990*b*). *Acta Cryst.* C**46**, 1111–1113.
Brunie, S., Mazan, J., Langlois, N. & Kagan, H. B. (1976). *J. Organomet. Chem.* **114**, 225–232.
Butler, I. R., Cullen, W. R., Kim, T.-J., Rettig, S. J. & Trotter, J. (1985). *Organometallics*, **4**, 972–980.
Chaloner, P. A., Hitchcock, P. B. & Reisinger, R. (1992). *Acta Cryst.* C**48**, 735–737.
Churchill, M. R. & Bezman, S. A. (1973). *Inorg. Chem.* **12**, 260–265.
Crabtree, R. H. (1979). *Acc. Chem. Res.* **12**, 331–338.
Crabtree, R. H. & Moorehouse, S. M. (1986). *Inorg. Synth.* **24**, 173–176.
Cullen, W. R., Kim, T.-J., Einstein, F. W. B. & Jones, T. (1985). *Organometallics*, **4**, 346–351.
Fair, C. K. (1990). *MolEN. An Interactive Intelligent System for Crystal Structure Analysis.* Enraf–Nonius, Delft, The Netherlands.
Hayashi, T., Konishi, M., Kobori, Y., Kumada, M., Higuchi, T. & Hirotsu, K. (1984). *J. Am. Chem. Soc.* **106**, 158–163.
Hayashi, T., Tanaka, M., Ogata, I., Kodama, T., Takahashi, T., Uchida, Y. & Uchida, T. (1983). *Bull. Chem. Soc. Jpn*, **56**, 1780–1785.
Mague, J. T. & Lloyd, C. L. (1988). *Organometallics*, **7**, 983–993.
Walker, N. & Stuart, D. (1983). *Acta Cryst.* A**39**, 158–166.

Acta Cryst. (1993). C**49**, 1616–1619

Ferrocenyl Ligands. Part 4. Structure of [1,1′-Bis(diphenylphosphino)-3,3′-bis-(trimethylsilyl)ferrocene]dichlorocobalt†

M. T. Ahmet, R. A. Brown, R. M. G. Roberts,
J. R. Miller, J. Silver* and A. Houlton

Department of Chemistry and Biological Chemistry,
University of Essex, Wivenhoe Park,
Colchester CO4 3SQ, England

(*Received* 22 *July* 1992; *accepted* 11 *February* 1993)

Abstract

1,1′-Bis(diphenylphosphino)-3,3′-bis(trimethylsilyl)-ferrocene acts as a bidentate ligand when reacted with $CoCl_2$, producing a tetrahedral P_2Cl_2 coordination sphere that is significantly distorted. The influence of the trimethylsilyl groups in this distortion is considerable, restraining the ferrocenyl moiety from adopting the eclipsed configuration preferred for binding tetrahedral ions.

Comment

Recently we have embarked on a study of ferrocenyl ligands with a view to synthesizing novel tunable ligands (Houlton, Roberts, Silver & Drew 1990; Houlton, Ibrahim, Dilworth & Silver, 1990; Houlton, Ahmet, Miller, Silver & Slade, 1993). A part of this study is the investigation of sterically crowded ligands with the aim of introducing stereoselectivity to complex formation, and we have previously reported 1,1′-bis(diphenylphosphino)-3,3′-bis-(trimethylsilyl)ferrocene (1) (Brown, Houlton, Roberts, Frampton & Silver, 1993). Here we report the crystal and molecular structure of the cobalt chloride complex of this ligand, (1)$CoCl_2$, and discuss the effect of the 3,3′-substituents compared to complexes of the bis(diphenylphosphino)ferrocene (fdpp).

The structure of the parent ligand reveals a *cisoid* arrangment of the diphenylphosphino groups (Brown, Houlton, Roberts, Frampton & Silver,

---

† Dichloro-2κ^2*Cl*-bis{μ-diphenyl[3-(trimethylsilyl)-2κ*P*:1(η^5)-cyclopentadienylidene]phosphine}-cobaltiron.

Acta Crystallographica Section C
ISSN 0108-2701 ©1993

1993) in contrast to the *trans* conformation for fdpp (Casellato, Ajó, Valle, Corrain, Longato & Graziani, 1988). This feature demonstrates the considerable geometric restrictions imposed by the Me_3Si groups. On complexation of the $CoCl_2$ group the ligand remains in essentially the same configuration as when uncoordinated. The P···P distance decreases on complexation from 3.96 to 3.78 Å, but this is still long compared to (fdpp)$NiBr_2$ (Butler, Cullen, Kim, Rettig & Trotter, 1985). The cyclopentadienyl rings are planar, inclined at a slight angle (2.7°), and staggered with respect to each other. This arrangement of the Cp rings is in marked contrast to fdpp when bound to tetrahedral Ni^{II}, which displays eclipsed rings (Butler, Cullen, Kim, Rettig & Trotter, 1985; Casellato, Ajó, Valle, Corrain, Longato & Graziani, 1988). This inability to adopt an eclipsed conformation probably accounts for the comparatively large difference in the phosphorus to metal bond lengths. The largest such difference observed in fdpp complexes is 0.032 Å for (fdpp)$Mo(CO)_4$, the smallest difference being within experimental error (Butler, Cullen, Kim, Rettig & Trotter, 1985). For (1)$CoCl_2$ this difference is considerably larger at 0.057 Å. Fig. 2 presents a profile view of the complex, indicating the displacements of the substituent groups relative to the ferrocenyl moiety and bond lengths for the coordination sphere. The iron–ring distances, also indicated, are at the larger end of the range observed for fdpp complexes, in keeping with tetrahedral coordination (Houlton, Ibrahim, Dilworth & Silver, 1990).

Surprisingly few tetrahedral cobalt complexes were found in the literature. Compared to di-μ-iodo-bis(iodotriphenylphosphine)cobalt(II) bis(benzene) (Gorter, Hinrichs, Reedijk, Rimbault, Pierrard & Hugel, 1985), (1)$CoCl_2$ exhibits both shorter and longer P—Co bond lengths [2.405 (2) and 2.348 (2) Å for (1)$CoCl_2$ *cf.* 2.3635 (8) Å] emphasizing the distorted nature of the coordination sphere. Co—Cl distances for (1)$CoCl_2$ are shorter than in the N_2Cl_2-coordinated dichloro[phenyldi(2-pyridyl)phosphine-*N*,*N*′]cobalt(II) hemiethanolate complex (Ehrlich, Fronczek, Watkins, Newkome & Hager, 1984) and in the O_2Cl_2-coordinated complex dichlorobis(trimethylphosphine oxide)cobalt(II) (Edelmann & Behrens, 1986). The respective distances for these compounds are 2.221 (1) and 2.256 (2) Å, *cf.* an average 2.213 (2) Å for (1)$CoCl_2$.

We have reported a correlation between the ^{57}Fe Mössbauer parameters δ and Δ, and the metal-ion coordination geometry for the complexes of fdpp (Houlton, Ibrahim, Dilworth & Silver, 1990). Such studies of (1) showed Pd^{2+} complexation to decrease the isomer shift compared to the ligand itself, whereas Co^{2+} caused an increase. However, in contrast to fdpp, only a decrease in quadrupole splitting was observed (Brown, Houlton, Roberts, Frampton & Silver, 1992). The structural analysis here shows the inability of (1) to adopt idealized ferrocenyl geometries on complexation, therefore, correlations between the hyperfine interactions of the ferrocenyl group and metal-ion coordination geometry would not be expected.

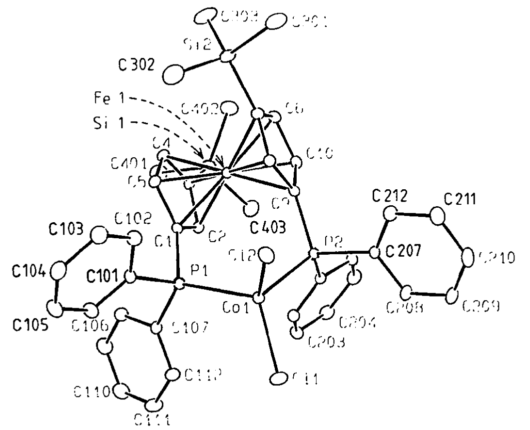


Fig. 1. Molecular structure of (1)$CoCl_2$ showing the labelling scheme, drawn using *ORTEP* (Johnson, 1965) with the thermal ellipsoids set at 0.10.

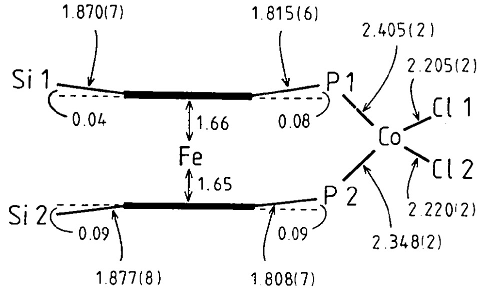


Fig. 2. Profile view of (1)$CoCl_2$ highlighting the P_2Cl_2 coordination sphere and the displacement of the substituent groups from the cyclopentadienyl rings.

Experimental

Crystal data

$[CoFeCl_2(C_{40}H_{44}P_2Si_2)]$
M_r = 828.59
Triclinic
$P\bar{1}$
a = 11.3947 (9) Å
b = 12.653 (1) Å
c = 16.872 (1) Å
α = 90.639 (7)°
β = 107.891 (6)°
γ = 114.817 (7)°
V = 2073.4 (3) Å^3
Z = 2

D_x = 1.327 Mg m^{-3}
Mo $K\alpha$ radiation
λ = 0.71069 Å
Cell parameters from 22 reflections
θ = 17–21°
μ = 1.0378 mm^{-1}
T = 293 K
Plate
0.25 × 0.16 × 0.06 mm
Green

Data collection

Enraf-Nonius CAD-4 diffractometer
$\omega/2\theta$ scans
Absorption correction: none
7552 measured reflections
7283 independent reflections
3331 observed reflections [$I > 3\sigma(I)$]

$R_{\text{int}} = 0.042$
$\theta_{\max} = 25°$
$h = -13 \rightarrow 12$
$k = -15 \rightarrow 15$
$l = 0 \rightarrow 20$
3 standard reflections
frequency: 120 min
intensity variation: 2.7%

Refinement

Refinement on F
Final $R = 0.041$
$wR = 0.046$
$S = 0.332$
3331 reflections
433 parameters
H-atom parameters not refined

$w = 1/[\sigma^2(F) + (0.02F)^2 + 1]$
$(\Delta/\sigma)_{\max} < 0.01$
$\Delta\rho_{\max} = 0.01$ e Å^{-3}
$\Delta\rho_{\min} = -0.01$ e Å^{-3}
Atomic scattering factors from *International Tables for X-ray Crystallography* (1974, Vol. IV)

Table 1. *Fractional atomic coordinates and equivalent isotropic thermal parameters* (Å^2)

$$B_{\text{eq}} = (4/3)[a^2B(1,1)+b^2B(2,2)+c^2B(3,3)+ab(\cos\gamma)B(1,2) +ac(\cos\beta)B(1,3)+bc(\cos\alpha)B(2,3)].$$

	x	y	z	B_{eq}
Co1	0.55941 (8)	0.37002 (7)	0.25986 (6)	3.01 (2)
Fe1	0.25477 (8)	0.02738 (7)	0.21318 (6)	2.72 (2)
Cl1	0.6747 (2)	0.5489 (2)	0.3346 (1)	5.22 (5)
Cl2	0.6572 (2)	0.3331 (2)	0.1747 (1)	4.72 (4)
P1	0.3207 (2)	0.3183 (1)	0.1860 (1)	2.87 (4)
P2	0.5594 (2)	0.2292 (1)	0.3493 (1)	2.81 (4)
Si1	−0.0141 (2)	−0.0972 (2)	0.2966 (1)	4.36 (5)
Si2	0.2888 (2)	−0.1610 (2)	0.0703 (2)	5.20 (6)
C1	0.2055 (5)	0.1645 (5)	0.1805 (4)	2.8 (1)
C2	0.1663 (5)	0.1201 (5)	0.2507 (4)	3.1 (2)
C3	0.0705 (6)	−0.0012 (5)	0.2276 (4)	3.3 (2)
C4	0.0520 (6)	−0.0305 (6)	0.1423 (4)	3.6 (2)
C5	0.1328 (6)	0.0681 (5)	0.1126 (4)	3.6 (2)
C6	0.2973 (6)	−0.1125 (5)	0.2435 (5)	3.8 (2)
C7	0.3417 (6)	−0.0700 (5)	0.1749 (4)	3.7 (2)
C8	0.4387 (5)	0.0513 (5)	0.2040 (4)	3.1 (1)
C9	0.4532 (5)	0.0817 (5)	0.2898 (4)	2.7 (1)
C10	0.3639 (6)	−0.0211 (5)	0.3132 (4)	3.3 (2)
C101	0.2980 (6)	0.3449 (5)	0.0777 (4)	3.3 (2)
C102	0.3399 (7)	0.2906 (6)	0.0280 (5)	4.6 (2)
C103	0.3397 (7)	0.3194 (7)	−0.0502 (4)	5.5 (2)
C104	0.2955 (8)	0.4015 (7)	−0.0799 (5)	5.7 (2)
C105	0.2538 (8)	0.4558 (7)	−0.0323 (5)	6.0 (2)
C106	0.2551 (7)	0.4271 (6)	0.0470 (4)	4.7 (2)
C107	0.2364 (6)	0.3907 (5)	0.2242 (4)	3.2 (2)
C108	0.0940 (7)	0.3412 (6)	0.1981 (5)	4.8 (2)
C109	0.0278 (7)	0.3953 (7)	0.2262 (6)	6.3 (2)
C110	0.1036 (7)	0.5003 (7)	0.2798 (6)	7.0 (3)
C111	0.2412 (8)	0.5496 (7)	0.3051 (6)	7.4 (3)
C112	0.3107 (7)	0.4971 (6)	0.2788 (5)	5.2 (2)
C201	0.4992 (6)	0.2348 (5)	0.4363 (4)	2.9 (1)
C202	0.4475 (6)	0.3140 (5)	0.4428 (4)	3.6 (2)
C203	0.3958 (6)	0.3199 (6)	0.5056 (5)	4.4 (2)
C204	0.3979 (7)	0.2450 (7)	0.5650 (4)	4.9 (2)
C205	0.4516 (7)	0.1672 (7)	0.5608 (4)	5.0 (2)
C206	0.5031 (6)	0.1625 (5)	0.4977 (4)	3.6 (2)
C207	0.7321 (6)	0.2418 (5)	0.3976 (4)	3.2 (2)
C208	0.8224 (6)	0.3239 (6)	0.4695 (5)	4.9 (2)
C209	0.9575 (7)	0.3450 (7)	0.5010 (5)	5.8 (2)
C210	1.0036 (7)	0.2850 (7)	0.4628 (6)	6.5 (3)
C211	0.9176 (8)	0.2042 (8)	0.3918 (7)	8.2 (3)
C212	0.7813 (7)	0.1817 (7)	0.3588 (5)	5.8 (2)
C301	0.4273 (9)	−0.2016 (9)	0.0759 (7)	9.6 (3)
C302	0.264 (1)	−0.075 (1)	−0.0166 (6)	9.7 (4)
C303	0.129 (1)	−0.2958 (9)	0.0549 (7)	8.9 (4)
C401	−0.1925 (7)	−0.1131 (8)	0.2664 (6)	6.8 (3)
C402	−0.0156 (8)	−0.2435 (7)	0.2828 (6)	6.4 (3)
C403	0.0834 (8)	−0.0229 (8)	0.4089 (5)	6.3 (3)

Table 2. *Geometric parameters* (Å, °)

Co1—Cl1	2.205 (2)	Si1—C401	1.857 (9)
Co1—Cl2	2.220 (2)	Si1—C402	1.856 (9)
Co1—P1	2.405 (2)	Si1—C403	1.871 (9)
Co1—P2	2.348 (2)	Si1—C3	1.870 (7)
Fe1—C1	2.068 (6)	Si2—C301	1.83 (1)
Fe1—C2	2.041 (6)	Si2—C302	1.86 (1)
Fe1—C3	2.068 (7)	Si2—C303	1.84 (1)
Fe1—C4	2.041 (7)	Si2—C7	1.877 (8)
Fe1—C5	2.061 (7)	P1—C1	1.815 (6)
Fe1—C6	2.054 (7)	P1—C101	1.821 (7)
Fe1—C7	2.078 (7)	P1—C107	1.812 (7)
Fe1—C8	2.043 (6)	P2—C9	1.808 (7)
Fe1—C9	2.034 (6)	P2—C201	1.813 (7)
Fe1—C10	2.036 (7)	P2—C207	1.820 (7)
C1—C2	1.431 (9)	C6—C7	1.43 (1)
C2—C3	1.421 (9)	C7—C8	1.430 (9)
C3—C4	1.409 (9)	C8—C9	1.435 (9)
C4—C5	1.410 (9)	C9—C10	1.426 (9)
C1—C5	1.423 (9)	C6—C10	1.41 (1)
C101—C102	1.38 (1)	C201—C202	1.377 (9)
C102—C103	1.37 (1)	C202—C203	1.38 (1)
C103—C104	1.37 (1)	C203—C204	1.39 (1)
C104—C105	1.36 (1)	C204—C205	1.37 (1)
C105—C106	1.39 (1)	C205—C206	1.38 (1)
C101—C106	1.37 (1)	C201—C206	1.393 (9)
C107—C108	1.39 (1)	C207—C208	1.38 (1)
C108—C109	1.38 (1)	C208—C209	1.37 (1)
C109—C110	1.36 (1)	C209—C210	1.34 (1)
C110—C111	1.34 (1)	C210—C211	1.36 (1)
C111—C112	1.38 (1)	C211—C212	1.38 (1)
C107—C112	1.38 (1)	C207—C212	1.38 (1)
Cl1—Co1—Cl2	114.32 (9)	Cl2—Co1—P1	111.45 (8)
Cl1—Co1—P1	113.13 (8)	Cl2—Co1—P2	101.51 (8)
Cl1—Co1—P2	109.99 (9)	P1—Co1—P2	105.41 (7)

The data were collected using the *FLAT* method (Enraf-Nonius, 1990) in which each collection was carried out at an azimuthal angle Ψ calculated to minimize absorption by minimizing the path of the X-rays through the crystal. The structure was determined by Patterson methods using *SHELXS*86 (Sheldrick, 1986) and refined by least squares using anisotropic thermal parameters for all non-H atoms. All H atoms were included in calculated positions, riding on their respective bonded atoms. Killean & Lawrence (1969) weights were used in the refinement. The calculations were performed on a VAX computer using *SHELXS*86 and *MolEN* (Fair, 1990). Diagrams were drawn with *ORTEP* (Johnson, 1965) and *PLUTO* (Motherwell & Clegg, 1978).

Lists of structure factors, anisotropic thermal parameters, H-atom coordinates, complete geometry, least-squares-planes data and r.m.s. amplitudes have been deposited with the British Library Document Supply Centre as Supplementary Publication No. SUP 71130 (76 pp.). Copies may be obtained through The Technical Editor, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England. [CIF reference: HU1021]

References

Brown, R. A., Houlton, A., Roberts, R. M. G., Frampton, C. S. & Silver, J. (1993). *Polyhedron*. In the press.

Butler, I. R., Cullen, W. R., Kim, T. J., Rettig, S. J. & Trotter, J. (1985). *Organometallics*, **4**, 972–980.

Casellato, U., Ajó, D., Valle, G., Corrain, B., Longato, B. & Graziani, R. (1988). *J. Crystallogr. Spectrosc. Res.* **18**, 583–590.
Edelmann, F. & Behrens, U. (1986). *Acta Cryst.* C**42**, 1715–1717.
Ehrlich, M. G., Fronczek, F. R., Watkins, S. F., Newkome, G. R. & Hager, D. C. (1984). *Acta Cryst.* C**40**, 78–80.
Enraf–Nonius. (1990). *CAD-4 Operations Manual.* Enraf–Nonius, Delft, The Netherlands.
Fair, C. K. (1990). *MolEN. An Interactive Structure Solution Procedure.* Enraf–Nonius, Delft, The Netherlands.
Gorter, S., Hinrichs, W., Reedijk, J., Rimbault, J., Pierrard, J. C. & Hugel, R. P. (1985). *Inorg. Chim. Acta*, **105**, 181–186.
Houlton, A., Ahmet, M. T., Miller, J. R., Silver, J. & Slade, E. (1993). *Acta Cryst.* C**49**, 682–684.
Houlton, A., Ibrahim, S. K., Dilworth, J. R. & Silver, J. (1990). *J. Chem. Soc. Dalton Trans.* pp. 2421–2424.
Houlton, A., Roberts, R. M. G., Silver, J. & Drew, M. G. B. (1990). *J. Chem. Soc. Dalton Trans.* pp. 1543–1547.
Johnson, C. K. (1965). *ORTEP.* Report ORNL-3794. Oak Ridge National Laboratory, Tennessee, USA.
Killean, R. C. G. & Lawrence, J. L. (1969). *Acta Cryst.* B**25**, 1750–1752.
Sheldrick, G. M. (1976). *SHELXS86. Program for the Solution of Crystal Structures.* Univ. of Göttingen, Germany.

Acta Cryst. (1993). C**49**, 1619–1621

Structure of $Ru_4(CO)_8(O_2CCH_2CH{=}CH_2)_4(NMe_3)_2$

JOSEPH H. REIBENSPIES, BERNARDO FONTAL AND DONALD DARENSBOURG

Department of Chemistry, Texas A&M University, College Station, Texas 77843, USA

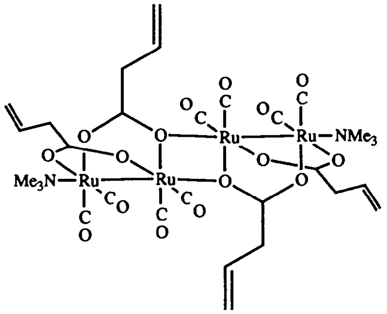
(*Received* 8 *January* 1993; *accepted* 8 *March* 1993)

Abstract

The tetranuclear ruthenium carboxylate complex, bis(μ_3-3-butenoato)-bis(μ-3-butenoato)-octacarbonylbis(trimethylammine)tetraruthenium(2 *Ru*—*Ru*), consists of a dimer of diruthenium carboxylates, $Ru_2(CO)_4(O_2CCH_2CH{=}CH_2)_2$, held together by O-atom bridge bonds. The two terminal Ru atoms complete their six-coordination with trimethylammine ligands.

Comment

Dodecacarbonyltriruthenium reacts with several carboxylic acids to provide polymeric compounds $[Ru(CO)_2(RCO_2)]_n$. Subsequent reactions of these polymeric derivatives with various Lewis bases result in the formation of dimeric carboxylate complexes of the type $Ru_2(CO)_4(RCO_2)_2L_2$ (Crooks, Johnson, Lewis, Williams & Gamlen, 1969). The X-ray structure of $(CH_3CO_2)_2Ru_2(CO)_4(C_5H_5N)_2$, as well as that of an analogous osmium complex, $(CH_3CO_2)_2Os_2(CO)_6$, have been determined (Kilbourn, 1971; Bullitt & Cotton, 1971). The overall structures of these complexes possess sixfold coordination about the metal atoms with *cis*-bridging acetate groups. We have isolated crystals of a ruthenium carboxylate complex (I) containing features of both the polymeric and dimeric carboxylate derivatives from the reaction of $Ru_3(CO)_{12}$ and 1-butenoic acid in the presence of trimethylamine *N*-oxide. The structure reported in this work is similar to that reported for the tetranuclear compound $(CH_3CO_2)_4Ru_4(CO)_8\{P[(CH_2)_3CH_3]_3\}_2$ (Bianchi, Frediani, Nardelli & Pelizzi, 1981).



(I)

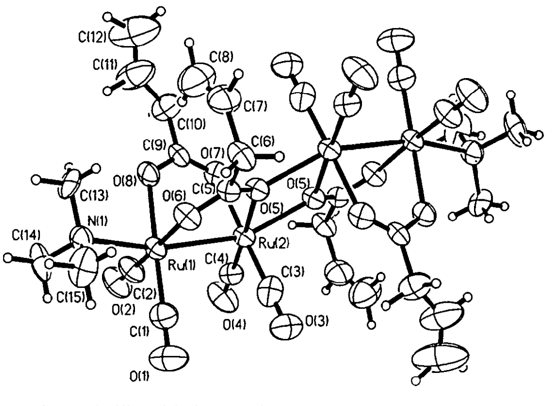


Fig. 1. Thermal ellipsoid plot (50% probability) of $Ru_4(CO)_8(O_2CCH_2CH{=}CH_2)_4(NMe_3)_2$. H atoms have been drawn as spheres with arbitrary radii. For clarity only one of the atoms of each of the disordered atomic pairs [C(13), C(13′); C(14), C(14′); C(15), C(15′)] is displayed.

Experimental

Crystal data

$[Ru_4(C_4H_5O_2)_4(C_3H_9N)_2(CO)_8]$
$M_r = 1086.91$
Monoclinic
$P2/c$
$a = 7.628\ (2)$ Å
$b = 19.526\ (4)$ Å
$c = 13.120\ (3)$ Å

$D_x = 1.863$ Mg m^{-3}
Mo $K\alpha$ radiation
$\lambda = 0.71073$ Å
Cell parameters from 25 reflections
$\theta = 19.89$–$34.23°$
$\mu = 1.568$ mm^{-1}
$T = 197$ K