

11-2015

Crystal structures of tris[1-oxo-pyridine-2-olato(1-)]silicon(IV) chloride chloroform-d1 disolvate, tris[1-oxo-pyridine-2-olato(1-)]silicon(IV) chloride acetonitrile unquantified solvate, and fac-tris[1-oxo-pyridine-2-thiolato(1-)]silicon(IV) chloride chloroform-d1 disolvate

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Publication Information

Kraft, Bradley M.; Brennessel, William W.; Ryan, Amy E.; and Benjamin, Candace K. (2015). "Crystal structures of tris[1-oxo-pyridine-2-olato(1-)]silicon(IV) chloride chloroform-d1 disolvate, tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride acetonitrile unquantified solvate, and fac-tris[1-oxopyridine-2-thiolato(1-)]silicon(IV) chloride chloroform-d1 disolvate." *Acta Crystallographica Section E: Crystallographic Communications* E71, 1531-1535.

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Crystal structures of tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride chloroform-d1 disolvate, tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride acetonitrile unquantified solvate, and fac-tris[1-oxopyridine-2-thiolato(1-)]silicon(IV) chloride chloroform-d1 disolvate

Abstract

The cations in the title salts, [Si(OPO)₃]Cl·2CDCl₃, (I), [Si(OPO)₃]Cl·*x*CH₃CN, (II), and *fac*-[Si(OPTO)₃]Cl·2CDCl₃, (III) (OPO = 1-oxo-2-pyridinone, C₅H₄NO₂, and OPTO = 1-oxo-2-pyridine-thione, C₅H₄NOS), have distorted octahedral coordination spheres. The first two structures contain the same cation and anion, but different solvents of crystallization led to different solvates and packing arrangements. In structures (I) and (III), the silicon complex cations and chloride anions are well separated, while in (II), there are two C-HCl distances that fall just within the sum of the van der Waals radii of the C and Cl atoms. The pyridine portions of the OPO ligands in (I) and (II) are modeled as disordered with the planar flips of themselves [(I): 0.574 (15):0.426 (15), 0.696 (15):0.304 (15), and 0.621 (15):0.379 (15); (II): 0.555 (13):0.445 (13), 0.604 (14):0.396 (14) and 0.611 (13):0.389 (13)], demonstrating that both *fac* and *mer* isomers are co-crystallized. In (II), highly disordered solvent, located in two independent channels along [100], was unable to be modeled. Reflection contributions from this solvent were fixed and added to the calculated structure factors using the SQUEEZE [Spek (2015). *Acta Cryst.* C71, 9-18] function of program PLATON, which determined there to be 54 electrons in 225 Å³ accounted for per unit cell (25 electrons in 109 Å³ in one channel, and 29 electrons in 115 Å³ in the other). In (I) and (II), all species lie on general positions. In (III), all species are located along crystallographic threefold axes.

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**Crystal structures of
tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride
chloroform- d_1 disolvate,
tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride
acetonitrile unquantified solvate, and
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Acta Cryst. (2015). E71, 1531–1535



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Keywords: crystal structure; silicon; pyridinone; pyridine *N*-oxide; pyriothione

CCDC references: 1438045; 1438046;
1438047

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Crystal structures of tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride chloroform-*d*₁ disolvate, tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride acetonitrile unquantified solvate, and *fac*-tris[1-oxopyridine-2-thiolato(1-)]silicon(IV) chloride chloroform-*d*₁ disolvate

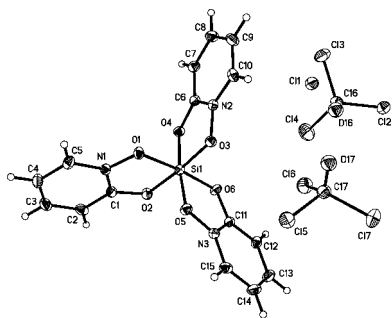
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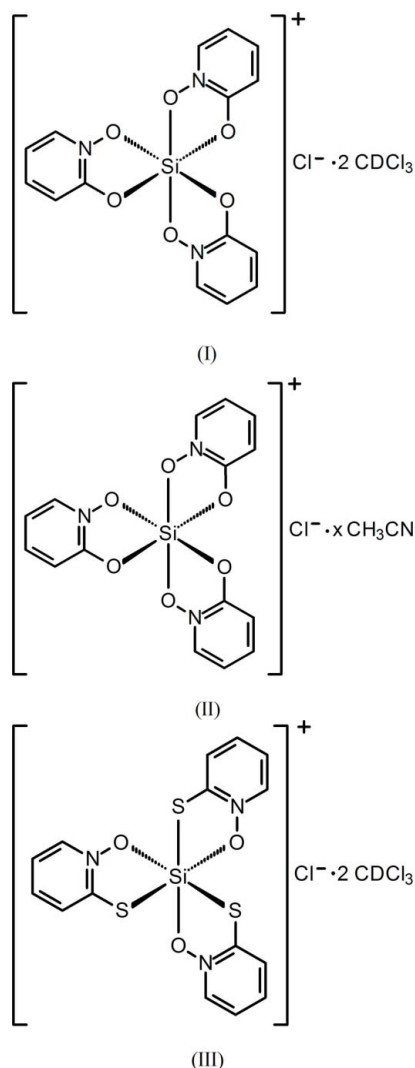
The cations in the title salts, [Si(OPO)₃]Cl·2CDCl₃, (I), [Si(OPO)₃]Cl·*x*CH₃CN, (II), and *fac*-[Si(OPTO)₃]Cl·2CDCl₃, (III) (OPO = 1-oxo-2-pyridinone, C₅H₄NO₂, and OPTO = 1-oxo-2-pyridinethione, C₅H₄NOS), have distorted octahedral coordination spheres. The first two structures contain the same cation and anion, but different solvents of crystallization led to different solvates and packing arrangements. In structures (I) and (III), the silicon complex cations and chloride anions are well separated, while in (II), there are two C—H···Cl distances that fall just within the sum of the van der Waals radii of the C and Cl atoms. The pyridine portions of the OPO ligands in (I) and (II) are modeled as disordered with the planar flips of themselves [(I): 0.574 (15):0.426 (15), 0.696 (15):0.304 (15), and 0.621 (15):0.379 (15); (II): 0.555 (13):0.445 (13), 0.604 (14):0.396 (14) and 0.611 (13):0.389 (13)], demonstrating that both *fac* and *mer* isomers are co-crystallized. In (II), highly disordered solvent, located in two independent channels along [100], was unable to be modeled. Reflection contributions from this solvent were fixed and added to the calculated structure factors using the SQUEEZE [Spek (2015). *Acta Cryst.* **C71**, 9–18] function of program PLATON, which determined there to be 54 electrons in 225 Å³ accounted for per unit cell (25 electrons in 109 Å³ in one channel, and 29 electrons in 115 Å³ in the other). In (I) and (II), all species lie on general positions. In (III), all species are located along crystallographic threefold axes.

1. Chemical context

Dissolution of silica by 1-hydroxy-2-pyridinone (HOPO) at pH = 6 in aqueous solution has been shown to afford the cationic complex [Si(OPO)₃]⁺, OPO = 1-oxo-2-pyridinone, which has been isolated as its chloride, tetrachloroferrate(III), and hexachloridostannate(IV) salts (Weiss & Harvey, 1964). Three other analogs, having trifluoromethanesulfonate, ethyl sulfate, and the isopropyl sulfate anion, were later synthesized by reaction of Si(OCH₃)₄ with HOPO with an appropriate acid and solvent and characterized by NMR spectroscopy (Tacke, Willeke & Penka, 2001). Our encounter with this stable cation occurred through an Si—C bond cleavage reaction involving (CH₂)₃Si(OPO)₂ to yield (I) and through siloxane bond cleavage in Me₃SiOSi(OPO)₂Cl to form (II). We have additionally encountered the formation of the novel related sulfur analog, [Si(OPTO)₃]⁺, OPTO = 1-oxo-2-pyridinethione, also by an Si—C bond cleavage reaction



involving $(\eta^1\text{-allyl})_2\text{Si}(\text{OPTO})\text{Cl}$ to afford (III). The driving force for the formation of the complexes is likely due to a combination of stabilizing lattice energy due to salt formation, ligand-binding strength enhanced by the chelate effect, and the added stabilization due to π -electron delocalization that occurs within the OPO and OPTO ligands upon chelation.



2. Structural commentary

The silicon atom in the structures of (I) and (II) is hexacoordinate, chelated by three bidentate OPO ligands (Figs. 1 and 2). The isosteric ligands are disordered over the two possible coplanar orientations, such that each nitrogen atom and its neighboring carbon atom are modeled as disordered with each other, which indicates both *fac* and *mer* isomers in each. The Si–O bond lengths in (I) and (II) span a narrow

Table 1
Selected bond lengths (\AA) for (I).

Si1–O3	1.7695 (10)	Si1–O1	1.7767 (10)
Si1–O2	1.7727 (10)	Si1–O4	1.7773 (10)
Si1–O6	1.7736 (10)	Si1–O5	1.7774 (10)

Table 2
Selected bond lengths (\AA) for (II).

Si1–O1	1.7727 (10)	Si1–O5	1.7803 (10)
Si1–O6	1.7729 (9)	Si1–O4	1.7808 (10)
Si1–O3	1.7782 (9)	Si1–O2	1.7830 (10)

range from 1.7695 (10)–1.7774 (10) \AA and 1.7727 (10)–1.7830 (10) \AA , respectively (Tables 1 and 2). The O–Si–O ligand bite angles in (I) and (II) range from 86.99 (5)–87.24 (4) $^\circ$ and 87.28 (4)–87.38 (4) $^\circ$, respectively. The *trans*-O–Si–O angles in (I) and (II) have a maximum deviation

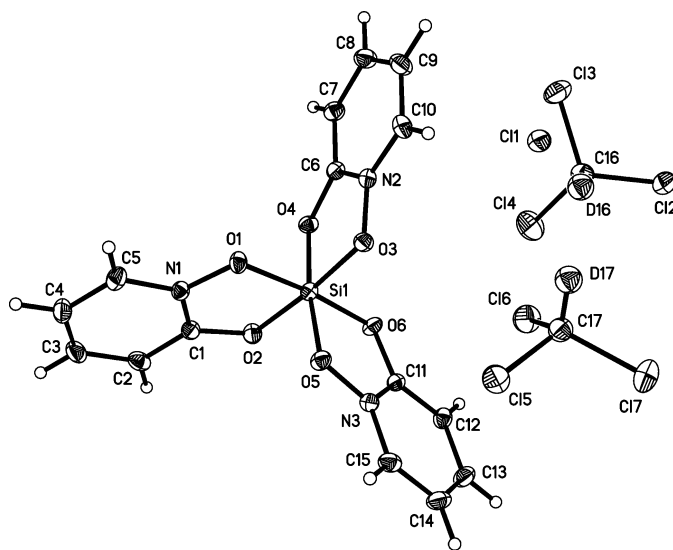


Figure 1
The structures of the molecular components in (I), with displacement ellipsoids drawn at the 50% probability level. The minor components of the ligand disorders are not shown.

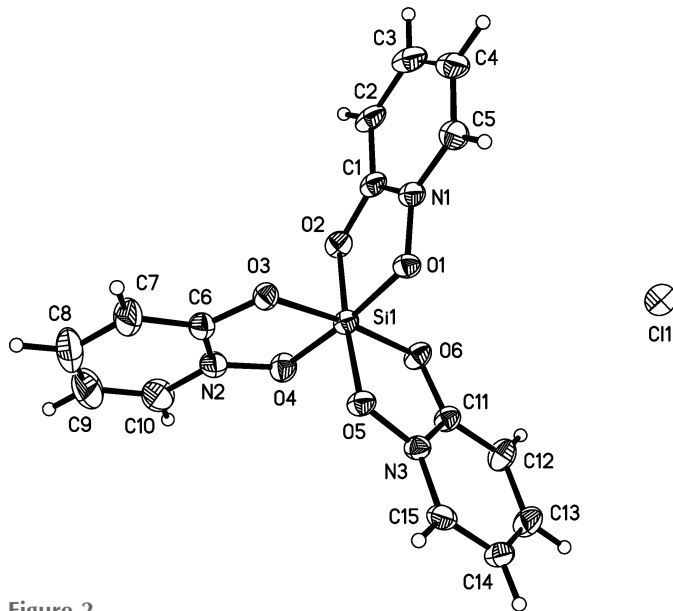


Figure 2
The molecular structure of the cation and the Cl^- anion in (II), with displacement ellipsoids drawn at the 50% probability level. The minor components of the ligand disorders and the unmodeled solvent (see text) are not shown.

Table 3
Selected geometric parameters (Å, °) for (III).

Si1—O1	1.7784 (14)	Si1—S1	2.2654 (7)
O1—Si1—S1	88.33 (4)	O1—Si1—S1 ⁱ	174.00 (5)

Symmetry code: (i) y, z, x .

from ideal (*i.e.*, 180°) of 7.06 (5) and 5.98 (5)°, respectively. The planes formed by the O₂Si chelate rings and the corresponding planar OPO ligand deviate from coplanarity by 9.98 (4), 4.96 (2), and 1.29 (2)° in (I) and by 4.91 (4), 2.15 (2), and 0.61 (4)° in (II).

The cationic complex (III) is octahedral (Fig. 3) with the central Si atom being chelated by three OPTO ligands in a *facial* arrangement. The *trans*-O—Si—S angles deviate by 6.00 (5)° from ideal (only one unique value due to threefold symmetry, Table 3). The O—Si—S bite angles are 88.33 (4)°, ~1° larger than those of the OPO structures. The Si—O distance is 1.7784 (14) Å, and compares similarly with those of (I) and (II) and is typical of Si—O single-bond lengths. The N—O bond is shorter than in the protonated HOPTO ligand [1.359 (2) *versus* 1.373 (2) Å; CSD refcode GIJCAD01, Bond & Jones, 1999, Cambridge Structural Database (CSD), Version 5.36, update No. 3, May 2015; Groom & Allen, 2014). Evidence of a π -electron delocalized structure is given by (1): the Si—S distance of 2.2654 (7) Å, which is similar to Si—S single-bond lengths in hexacoordinate neutral thiophenolate complexes (range = 2.231–2.314 Å, CSD refcodes BOHQIZ, BOXQOV, BOXQUB, BOXRAI, WALTOU, WALTUA) and

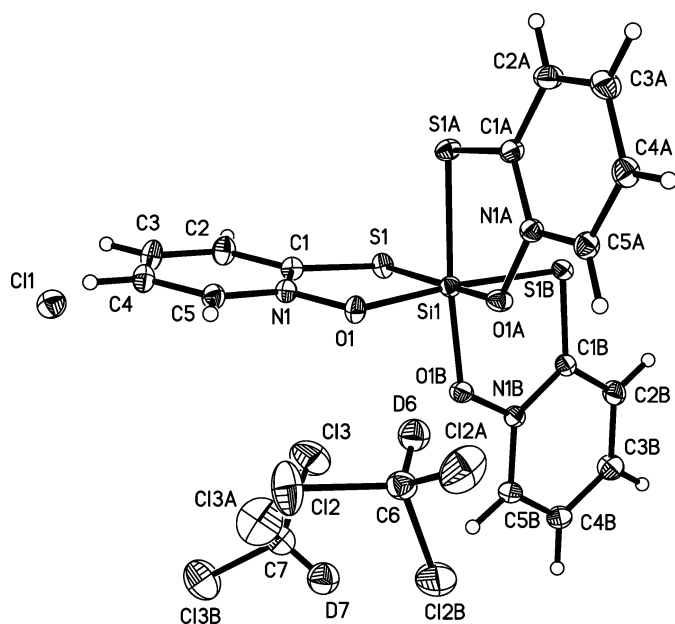


Figure 3

The structures of the molecular components and the Cl[−] anion (III) with displacement ellipsoids drawn at the 50% probability level. All species lie along crystallographic threefold axes, and full molecules are generated with the following symmetry codes. Si(OPTO)₃⁺: (y, z, x) and (z, x, y); CDCl₃ (containing atom C6): (y, z, x) and (z, x, y); CDCl₃ (containing atom C7): ($-\frac{1}{2} + z, \frac{1}{2} - x, 1 - y$) and ($\frac{1}{2} - y, 1 - z, \frac{1}{2} + x$).

(2): the C—S bond length of 1.7184 (19) Å, which compares intermediately between the C=S double bond of HOPTO [1.693 (2) Å] and the mean C—S single bonds of 155 phenylthiols (C—S_{avg} 1.764 Å). However, all four C—C bond lengths in the pyridine ring are unchanged or slightly longer than those in HOPTO, which is inconsistent with the canonical pattern of bond shortening and lengthening that might be expected with π -electron delocalization. The OSSi chelate rings and the corresponding planar OPTO ligands are folded with a dihedral angle of 12.08 (3)°.

3. Supramolecular features

In (II) there are two C—H...Cl distances that fall just within the sum of the van der Waals radii of the C and Cl atoms, 3.45 Å (Bondi, 1964). Atom C2 is 3.4206 (14) Å from atom Cl1 (symmetry operator: $-x, -y + 1, -z + 2$) and atom Cl10 is 3.4018 (18) Å from atom Cl1 (symmetry operator: $x, y - 1, z$).

4. Database survey

A CSD search (Groom & Allen, 2014) revealed one hit of the homoleptic cation in the form of [Si(OPO)₃][CF₃SO₃][−]·0.5HOPO (CSD refcode QOXSIF; Tacke, Willeke & Penka, 2001). The Si—O bond lengths and bite angles in (I) and (II) are similar to those of QOXSIF. The dihedral angles formed between the O₂Si chelate and OPO ligands are also similar to those of QOXSIF (9.39, 3.08, and 2.41°). Structures of monodentate organosilicon OPO complexes include Ph₃Si(OPO)·Ph₃Si(OH)·0.5*n*-pentane, Me₃Si(OPO), and *t*Bu₂Si(κ^1 -OPO)(κ^2 -OPO) (respective CSD refcodes NITRIT, NITROZ, and NITSOA; Kraft & Brennessel, 2014), and of bidentate organosilicon OPO complexes include Ph₂Si(OPO)₂, Me₂Si(OPO)Cl, Ph₃Si(OPO), Me₂Si(OPO)₂, Et₂Si(OPO)₂, *i*Pr₂Si(OPO)₂, *t*Bu₂Si(κ^1 -OPO)(κ^2 -OPO), and (CH₂)₃Si(OPO)₂ (respective CSD refcodes NISMIN, NISMOT, NITRUF, NITSAM, NITSEQ, NITSOA, NITSIU, and NITSUG; Kraft & Brennessel, 2014), and [Si(OPO)₂(μ -CH₂CH₂SCH₂C(=O)O)]₂·2CH₃CN and [O(CH₂)₃Si(OPO)₂] (respective CSD refcodes UBUWET and UBUWIX; Tacke, Burschka *et al.*, 2001). (I) and (II) have 0.06–0.17 Å shorter Si—O bond lengths and 3–5° larger ligand bite angles than those in chelated R₂Si(OPO)₂ (R = alkyl, phenyl) complexes, indicating a stronger chelate presumably due, in part, to their cationic character. As a result of C/N site disorders, the N—O, C—O, and C—N bond lengths are unreliable in providing evidence of π -electron delocalization. Only small changes (\pm ~0.02–0.06 Å) or no change (in C3—C4) in the distances of alternating long and short C—C bonds in the pyridine ring are observed compared with the more localized π -bonding structure of the free HOPO ligand (CSD refcode JEMJUG; Ballesteros *et al.*, 1990). The Si—O bond lengths in (I) and (II) are similar to those of other cationic SiO₆ cores (CSD refcodes CUZKOX: Ueyama *et al.*, 1985; EJOBUB: Sarkar *et al.*, 2011, JAZPIK: Pal *et al.*, 2005; PUMBUU: Kira *et al.*, 1998; VILLUX: Thewalt & Link, 1991). There are two other non-silicon homoleptic M(OPO)₃ (M = Fe, Co) structures known

Table 4
Experimental details.

	(I)	(II)	(III)
Crystal data			
Chemical formula	C ₁₅ H ₁₂ N ₃ O ₆ Si ⁺ ·Cl ⁻ ·2CDCl ₃	C ₁₅ H ₁₂ N ₃ O ₆ Si ⁺ ·Cl ⁻	C ₁₅ H ₁₂ N ₃ O ₃ S ₃ Si ⁺ ·Cl ⁻ ·2CDCl ₃
<i>M_r</i>	634.56	393.82	682.74
Crystal system, space group	Monoclinic, <i>P</i> 2 ₁ / <i>n</i>	Triclinic, <i>P</i> $\bar{1}$	Cubic, <i>P</i> 2 ₁ 3
Temperature (K)	100	100	100
<i>a</i> , <i>b</i> , <i>c</i> (Å)	13.5133 (7), 13.5039 (7), 13.7752 (7)	6.8347 (7), 11.1232 (12), 13.1513 (14)	13.9483 (12), 13.9483 (12), 13.9483 (12)
α , β , γ (°)	90, 101.866 (1), 90	90.479 (2), 93.269 (2), 102.356 (2)	90, 90, 90
<i>V</i> (Å ³)	2460.0 (2)	974.85 (18)	2713.7 (7)
<i>Z</i>	4	2	4
Radiation type	Mo <i>K</i> α	Mo <i>K</i> α	Mo <i>K</i> α
μ (mm ⁻¹)	0.90	0.29	1.03
Crystal size (mm)	0.20 × 0.18 × 0.16	0.30 × 0.30 × 0.24	0.18 × 0.18 × 0.18
Data collection			
Diffractionmeter	Bruker SMART APEXII CCD Platform	Bruker SMART APEXII CCD Platform	Bruker SMART APEXII CCD Platform
Absorption correction	Multi-scan (<i>SADABS</i> ; Sheldrick, 2014)	Multi-scan (<i>SADABS</i> ; Sheldrick, 2014)	Multi-scan (<i>SADABS</i> ; Sheldrick, 2014)
<i>T</i> _{min} , <i>T</i> _{max}	0.667, 0.748	0.645, 0.748	0.681, 0.748
No. of measured, independent and observed [<i>I</i> > 2σ(<i>I</i>)] reflections	61259, 13615, 9035	27002, 10311, 6677	66318, 5067, 4360
<i>R</i> _{int} (sin θ/λ) _{max} (Å ⁻¹)	0.051 0.880	0.037 0.875	0.059 0.877
Refinement			
<i>R</i> [<i>F</i> ² > 2σ(<i>F</i> ²)], <i>wR</i> (<i>F</i> ²), <i>S</i>	0.044, 0.117, 1.04	0.050, 0.132, 1.03	0.037, 0.088, 1.03
No. of reflections	13615	10311	5067
No. of parameters	310	238	103
H-atom treatment	H-atom parameters constrained	H-atom parameters constrained	H-atom parameters constrained
Δρ _{max} , Δρ _{min} (e Å ⁻³)	0.81, -0.85	0.45, -0.45	0.88, -0.67
Absolute structure	–	–	Flack <i>x</i> determined using 1775 quotients [(<i>I</i> ⁺) – (<i>I</i> ⁻)] / [(<i>I</i> ⁺) + (<i>I</i> ⁻)] (Parsons <i>et al.</i> , 2013)
Absolute structure parameter	–	–	–0.018 (18)

Computer programs: *APEX2* (Bruker, 2014), *SAINTE* (Bruker, 2013), *SIR2011* (Burla *et al.*, 2012), *SHELXL2012* (Sheldrick, 2015), *SHELXL2014* (Sheldrick, 2015) and *SHELXTL* (Sheldrick, 2008).

(CSD refcodes DAGZOA and DAGZIU01; Scarrow *et al.*, 1985).

There are currently no structurally characterized silicon OPTO complexes. Other triply ligated homoleptic *M*(OPTO)₃ structures are: *M* = Cr (CSD refcode ZUZWEW; Wen *et al.*, 1996), *M* = Mn (IFOPAU; Liaw *et al.*, 2002; SUJYEB; Manivannan *et al.*, 1993), *M* = Fe (PEDEKO; Hu *et al.*, 1993), *M* = Co (VOGHAA; Hu *et al.*, 1991; SUJYAX, SUJYEB; Manivannan *et al.*, 1993; WINFUU, WINGAB; Xu *et al.*, 1995; ROLQUE; Tong *et al.*, 2001; UGUCUU; Fang *et al.*, 2002), *M* = In, Tl (JIVQAG, JIVQE; Rodríguez *et al.*, 1998), *M* = Bi (BEHDOI; Niu *et al.*, 2003).

There are currently nine CSD entries for other group 14 complexes containing an OPTO ligand, all with tin: CSD refcodes ENEWEZ, ENEWID, FOFNAP/FOFNAP10, FOTBOF, IMECAE, IMECEI, IMECIM, and YEDVEI.

5. Synthesis and crystallization

[Si(OPO)₃]Cl·2CDCl₃ (I): (CH₂)₃Si(OPO)₂ was prepared according to the literature method (Kraft & Brennessel, 2014). (CH₂)₃Si(OPO)₂ was heated in an oil bath at 463 K for 3 days in CDCl₃ upon which crystals of (I) deposited.

[Si(OPO)₃]Cl·*x*CH₃CN (II): A solution of Me₃Si(OPO) (0.183 g, 1.00 mmol) in 8 ml of CH₃CN was added to a solution of Me₃SiOSiCl₃ (98 μL, *d* = 1.14 g/ml, 0.50 mmol) in 4 ml of CH₃CN. Me₃SiOSi(OPO)₂Cl is formed as an intermediate. Allowing the solution to stand undisturbed for one day resulted in precipitation of colorless crystals of (II) (0.090 g) which were isolated by filtration. Evidence for the presence of *fac* and *mer* isomers was given by the presence of closely spaced OPO resonances in the ¹³C NMR spectrum in accord with those reported in the literature (Tacke, Willeke & Penka, 2001). The synthesis, isolation, and characterization of Me₃SiOSi(OPO)₂Cl will be reported elsewhere.

[Si(OPTO)₃]Cl·2CDCl₃ (III): Crystals of (III) deposited from a solution of (η¹-allyl)₂Si(OPTO)Cl in CDCl₃ upon standing for one year at room temperature in the dark. The synthesis of (η¹-allyl)₂Si(OPTO)Cl will be published elsewhere.

6. Refinement

Crystal data, data collection and structure refinement details are summarized in Table 4. The pyridine portions of the OPO ligands in (I) and (II) are modeled as disordered with the

coplanar flips of themselves [0.574 (15):0.426 (15), 0.696 (15):0.304 (15), and 0.621 (15):0.379 (15) for rings containing N1, N2, and N3, respectively, in (I), and 0.555 (13):0.445 (13), 0.604 (14):0.396 (14) and 0.611 (13):0.389 (13) for rings containing N1, N2, and N3 in (II)]. The disorders were modeled by refining the nitrogen/carbon ratios in each of the specific sites while using a common variable for pairs of sites on the same ligand. Atoms at each of these sites were constrained to be isopositional and to have equivalent anisotropic displacement parameters.

In (II) highly disordered solvent, located in two independent channels along [100], was unable to be modeled. Reflection contributions from this solvent were fixed and added to the calculated structure factors using the SQUEEZE (Spek, 2015) function of the PLATON program, which determined there to be 54 electrons in 225 Å³ accounted for per unit cell (25 electrons in 109 Å³ in one channel, and 29 electrons in 115 Å³ in the other). Although the exact amount of solvent was unknown, the only solvent involved in the reaction was acetonitrile and both starting materials were confirmed by ¹H NMR to be unsolvated. Thus the structure is represented as an acetonitrile solvate of unknown amount. Because no solvent was included in the atom list or molecular formula for (II), all calculated quantities that derive from the molecular formula [e.g., F(000), density, molecular weight, etc.] are known to be incorrect.

D and H atoms were placed geometrically and treated as riding atoms: methine, C–D = 1.00 Å, and aromatic, C–H = 0.95 Å, with $U_{\text{iso}}(\text{H/D}) = 1.2U_{\text{eq}}(\text{C})$.

Acknowledgements

The authors thank St. John Fisher College and the University of Rochester X-ray Crystallographic Facility for support.

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supporting information

Acta Cryst. (2015). E71, 1531-1535 [doi:10.1107/S2056989015022203]

Crystal structures of tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride chloroform-*d*₁ disolvate, tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride acetonitrile unquantified solvate, and *fac*-tris[1-oxopyridine-2-thiolato(1-)]silicon(IV) chloride chloroform-*d*₁ disolvate

Bradley M. Kraft, William W. Brennessel, Amy E. Ryan and Candace K. Benjamin

Computing details

For all compounds, data collection: *APEX2* (Bruker, 2014); cell refinement: *SAINT* (Bruker, 2013); data reduction: *SAINT* (Bruker, 2013); program(s) used to solve structure: *SIR2011* (Burla *et al.*, 2012). Program(s) used to refine structure: *SHELXL2012* (Sheldrick, 2015) for (I); *SHELXL2014* (Sheldrick, 2015) for (II), (III). For all compounds, molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL* (Sheldrick, 2008).

(I) Tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride chloroform-*d*₁ disolvate

Crystal data

C₁₅H₁₂N₃O₆Si⁺·Cl⁻·2CDCl₃

M_r = 634.56

Monoclinic, *P*2₁/*n*

a = 13.5133 (7) Å

b = 13.5039 (7) Å

c = 13.7752 (7) Å

β = 101.866 (1)°

V = 2460.0 (2) Å³

Z = 4

F(000) = 1272

D_x = 1.713 Mg m⁻³

Mo *Kα* radiation, *λ* = 0.71073 Å

Cell parameters from 3986 reflections

θ = 2.4–37.0°

μ = 0.90 mm⁻¹

T = 100 K

Block, pale red-yellow

0.20 × 0.18 × 0.16 mm

Data collection

Bruker SMART APEXII CCD Platform
diffractometer

Radiation source: sealed tube

Graphite monochromator

area detector, *ω* scans per *φ*

Absorption correction: multi-scan

(*SADABS*; Sheldrick, 2014)

T_{min} = 0.667, *T_{max}* = 0.748

61259 measured reflections

13615 independent reflections

9035 reflections with *I* > 2σ(*I*)

R_{int} = 0.051

θ_{max} = 38.7°, *θ_{min}* = 1.9°

h = -23→23

k = -23→23

l = -24→23

Refinement

Refinement on *F*²

Least-squares matrix: full

R[*F*² > 2σ(*F*²)] = 0.044

wR(*F*²) = 0.117

S = 1.04

13615 reflections

310 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-atom parameters constrained
 $w = 1/[\sigma^2(F_o^2) + (0.0513P)^2 + 0.4945P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\max} = 0.001$
 $\Delta\rho_{\max} = 0.81 \text{ e } \text{\AA}^{-3}$
 $\Delta\rho_{\min} = -0.85 \text{ e } \text{\AA}^{-3}$

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.

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

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$	Occ. (<1)
Si1	0.23776 (3)	0.49175 (3)	0.47775 (3)	0.01307 (7)	
O1	0.10428 (7)	0.47729 (7)	0.44717 (7)	0.01561 (17)	
O2	0.24538 (7)	0.36073 (7)	0.48242 (7)	0.01631 (17)	
O3	0.22003 (7)	0.62136 (7)	0.46597 (7)	0.01524 (16)	
O4	0.25223 (7)	0.49211 (7)	0.35240 (7)	0.01496 (16)	
O5	0.23135 (7)	0.50555 (7)	0.60463 (7)	0.01575 (17)	
O6	0.37121 (7)	0.49674 (7)	0.51655 (7)	0.01554 (17)	
N1	0.07670 (9)	0.38170 (8)	0.45015 (8)	0.0137 (2)	0.574 (15)
N2	0.21142 (9)	0.65110 (8)	0.37143 (8)	0.0146 (2)	0.696 (15)
N3	0.32336 (9)	0.51079 (9)	0.66292 (8)	0.0149 (2)	0.621 (15)
N1'	0.15514 (9)	0.31791 (9)	0.47064 (9)	0.0150 (2)	0.426 (15)
N2'	0.22799 (9)	0.57936 (9)	0.30881 (9)	0.0146 (2)	0.304 (15)
N3'	0.40015 (9)	0.50504 (9)	0.61468 (8)	0.0135 (2)	0.379 (15)
C1	0.15514 (9)	0.31791 (9)	0.47064 (9)	0.0150 (2)	0.574 (15)
C1'	0.07670 (9)	0.38170 (8)	0.45015 (8)	0.0137 (2)	0.426 (15)
C2	0.13816 (12)	0.21819 (10)	0.47797 (10)	0.0194 (2)	
H2	0.1929	0.1728	0.4936	0.023*	
C3	0.03977 (12)	0.18600 (11)	0.46201 (11)	0.0228 (3)	
H3	0.0263	0.1173	0.4663	0.027*	
C4	-0.04059 (12)	0.25241 (12)	0.43964 (11)	0.0228 (3)	
H4	-0.1083	0.2291	0.4289	0.027*	
C5	-0.02127 (10)	0.35157 (11)	0.43323 (10)	0.0189 (2)	
H5	-0.0750	0.3980	0.4174	0.023*	
C6	0.22799 (9)	0.57936 (9)	0.30881 (9)	0.0146 (2)	0.696 (15)
C6'	0.21142 (9)	0.65110 (8)	0.37143 (8)	0.0146 (2)	0.304 (15)
C7	0.21831 (10)	0.59879 (10)	0.20932 (10)	0.0177 (2)	
H7	0.2293	0.5485	0.1645	0.021*	
C8	0.19215 (11)	0.69353 (11)	0.17687 (11)	0.0208 (3)	
H8	0.1833	0.7087	0.1083	0.025*	
C9	0.17853 (11)	0.76731 (11)	0.24355 (11)	0.0215 (3)	
H9	0.1625	0.8328	0.2205	0.026*	
C10	0.18812 (11)	0.74589 (10)	0.34229 (11)	0.0187 (2)	
H10	0.1788	0.7954	0.3886	0.022*	

C11	0.40015 (9)	0.50504 (9)	0.61468 (8)	0.0135 (2)	0.621 (15)
C11'	0.32336 (9)	0.51079 (9)	0.66292 (8)	0.0149 (2)	0.379 (15)
C12	0.49892 (10)	0.50876 (10)	0.66439 (10)	0.0169 (2)	
H12	0.5528	0.5049	0.6298	0.020*	
C13	0.51771 (11)	0.51829 (11)	0.76596 (10)	0.0211 (3)	
H13	0.5854	0.5204	0.8025	0.025*	
C14	0.43758 (12)	0.52481 (11)	0.81544 (10)	0.0214 (3)	
H14	0.4510	0.5316	0.8856	0.026*	
C15	0.33966 (11)	0.52145 (10)	0.76344 (10)	0.0182 (2)	
H15	0.2847	0.5264	0.7964	0.022*	
Cl1	0.20123 (3)	0.95652 (2)	0.49660 (2)	0.01944 (6)	
C16	0.47965 (12)	0.85178 (11)	0.41139 (11)	0.0230 (3)	
D16	0.4348	0.8696	0.4581	0.028*	
Cl2	0.59065 (3)	0.92375 (3)	0.44147 (3)	0.02772 (8)	
Cl3	0.41495 (3)	0.87758 (4)	0.29021 (3)	0.03465 (10)	
Cl4	0.50920 (4)	0.72498 (3)	0.42591 (4)	0.03726 (10)	
C17	0.35128 (11)	0.83844 (11)	0.70226 (11)	0.0211 (3)	
D17	0.3135	0.8897	0.6569	0.025*	
Cl5	0.26553 (3)	0.77821 (3)	0.76321 (3)	0.02750 (8)	
Cl6	0.40505 (3)	0.75370 (3)	0.63070 (3)	0.02850 (8)	
Cl7	0.44653 (3)	0.89800 (3)	0.78891 (3)	0.02811 (8)	

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Si1	0.01221 (14)	0.01345 (15)	0.01315 (14)	0.00003 (11)	0.00173 (11)	-0.00084 (11)
O1	0.0135 (4)	0.0115 (4)	0.0211 (4)	-0.0006 (3)	0.0019 (3)	-0.0015 (3)
O2	0.0136 (4)	0.0141 (4)	0.0207 (4)	0.0013 (3)	0.0024 (3)	0.0007 (3)
O3	0.0192 (4)	0.0140 (4)	0.0124 (4)	-0.0008 (3)	0.0031 (3)	-0.0008 (3)
O4	0.0167 (4)	0.0136 (4)	0.0138 (4)	0.0025 (3)	0.0014 (3)	-0.0003 (3)
O5	0.0124 (4)	0.0209 (4)	0.0140 (4)	0.0001 (3)	0.0027 (3)	0.0001 (3)
O6	0.0127 (4)	0.0227 (5)	0.0109 (4)	-0.0005 (3)	0.0015 (3)	-0.0016 (3)
N1	0.0142 (5)	0.0124 (4)	0.0142 (5)	-0.0003 (4)	0.0023 (4)	-0.0016 (4)
N2	0.0149 (5)	0.0141 (5)	0.0145 (5)	-0.0018 (4)	0.0020 (4)	-0.0007 (4)
N3	0.0163 (5)	0.0142 (5)	0.0137 (5)	-0.0006 (4)	0.0023 (4)	0.0006 (4)
N1'	0.0150 (5)	0.0138 (5)	0.0158 (5)	0.0003 (4)	0.0025 (4)	-0.0002 (4)
N2'	0.0142 (5)	0.0151 (5)	0.0140 (5)	0.0000 (4)	0.0018 (4)	-0.0004 (4)
N3'	0.0141 (5)	0.0136 (5)	0.0124 (5)	0.0004 (4)	0.0017 (4)	-0.0002 (4)
C1	0.0150 (5)	0.0138 (5)	0.0158 (5)	0.0003 (4)	0.0025 (4)	-0.0002 (4)
C1'	0.0142 (5)	0.0124 (4)	0.0142 (5)	-0.0003 (4)	0.0023 (4)	-0.0016 (4)
C2	0.0271 (7)	0.0134 (5)	0.0180 (6)	0.0015 (5)	0.0054 (5)	0.0013 (4)
C3	0.0331 (8)	0.0163 (6)	0.0188 (6)	-0.0086 (5)	0.0053 (5)	-0.0004 (5)
C4	0.0226 (6)	0.0255 (7)	0.0199 (6)	-0.0105 (5)	0.0037 (5)	-0.0025 (5)
C5	0.0138 (5)	0.0240 (6)	0.0188 (6)	-0.0017 (5)	0.0031 (4)	-0.0029 (5)
C6	0.0142 (5)	0.0151 (5)	0.0140 (5)	0.0000 (4)	0.0018 (4)	-0.0004 (4)
C6'	0.0149 (5)	0.0141 (5)	0.0145 (5)	-0.0018 (4)	0.0020 (4)	-0.0007 (4)
C7	0.0176 (5)	0.0206 (6)	0.0148 (5)	0.0006 (5)	0.0033 (4)	-0.0002 (4)
C8	0.0211 (6)	0.0234 (6)	0.0177 (6)	-0.0003 (5)	0.0037 (5)	0.0048 (5)

C9	0.0236 (6)	0.0161 (6)	0.0249 (7)	0.0003 (5)	0.0050 (5)	0.0055 (5)
C10	0.0199 (6)	0.0137 (5)	0.0229 (6)	-0.0014 (4)	0.0057 (5)	-0.0001 (4)
C11	0.0141 (5)	0.0136 (5)	0.0124 (5)	0.0004 (4)	0.0017 (4)	-0.0002 (4)
C11'	0.0163 (5)	0.0142 (5)	0.0137 (5)	-0.0006 (4)	0.0023 (4)	0.0006 (4)
C12	0.0138 (5)	0.0169 (5)	0.0195 (6)	0.0002 (4)	0.0019 (4)	-0.0009 (4)
C13	0.0207 (6)	0.0205 (6)	0.0186 (6)	0.0009 (5)	-0.0043 (5)	-0.0007 (5)
C14	0.0305 (7)	0.0193 (6)	0.0127 (5)	0.0022 (5)	0.0003 (5)	0.0003 (4)
C15	0.0245 (6)	0.0172 (5)	0.0136 (5)	0.0009 (5)	0.0054 (5)	0.0008 (4)
C11	0.02314 (15)	0.01732 (13)	0.01640 (13)	-0.00044 (11)	0.00069 (11)	0.00007 (10)
C16	0.0255 (7)	0.0195 (6)	0.0223 (6)	0.0015 (5)	0.0013 (5)	0.0020 (5)
C12	0.02631 (17)	0.02598 (17)	0.02676 (17)	-0.00130 (13)	-0.00412 (14)	0.00140 (13)
C13	0.02946 (19)	0.0446 (2)	0.02482 (18)	-0.00543 (17)	-0.00619 (15)	0.00552 (16)
C14	0.0459 (3)	0.01883 (17)	0.0466 (3)	0.00556 (16)	0.0084 (2)	-0.00106 (16)
C17	0.0231 (6)	0.0175 (6)	0.0213 (6)	0.0024 (5)	0.0015 (5)	-0.0001 (5)
C15	0.02676 (17)	0.02573 (17)	0.02922 (18)	-0.00212 (14)	0.00391 (14)	0.00239 (14)
C16	0.0362 (2)	0.02194 (16)	0.02728 (18)	0.00365 (14)	0.00644 (15)	-0.00488 (13)
C17	0.02268 (16)	0.02851 (18)	0.03154 (19)	-0.00142 (13)	0.00187 (14)	-0.01005 (14)

Geometric parameters (Å, °)

Si1—O3	1.7695 (10)	C5—H5	0.9500
Si1—O2	1.7727 (10)	C7—C8	1.377 (2)
Si1—O6	1.7736 (10)	C7—H7	0.9500
Si1—O1	1.7767 (10)	C8—C9	1.393 (2)
Si1—O4	1.7773 (10)	C8—H8	0.9500
Si1—O5	1.7774 (10)	C9—C10	1.370 (2)
O1—N1	1.3465 (15)	C9—H9	0.9500
O2—N1'	1.3290 (15)	C10—H10	0.9500
O3—N2	1.3448 (14)	C12—C13	1.376 (2)
O4—N2'	1.3323 (15)	C12—H12	0.9500
O5—N3	1.3361 (15)	C13—C14	1.396 (2)
O6—N3'	1.3325 (15)	C13—H13	0.9500
N1—C5	1.3586 (17)	C14—C15	1.370 (2)
N2—C10	1.3591 (18)	C14—H14	0.9500
N3—C15	1.3643 (17)	C15—H15	0.9500
N1'—C2	1.3732 (18)	C16—C13	1.7528 (15)
N2'—C7	1.3750 (18)	C16—C14	1.7603 (15)
N3'—C12	1.3700 (17)	C16—C12	1.7637 (16)
C2—C3	1.373 (2)	C16—D16	1.0000
C2—H2	0.9500	C17—C17	1.7596 (15)
C3—C4	1.393 (2)	C17—C16	1.7618 (15)
C3—H3	0.9500	C17—C15	1.7634 (16)
C4—C5	1.371 (2)	C17—D17	1.0000
C4—H4	0.9500		
O3—Si1—O2	175.08 (5)	N1—C5—H5	120.9
O3—Si1—O6	95.75 (5)	C4—C5—H5	120.9
O2—Si1—O6	88.80 (5)	N2'—C7—C8	117.79 (13)

O3—Si1—O1	88.58 (5)	C8—C7—H7	121.1
O2—Si1—O1	86.99 (5)	C7—C8—C9	120.70 (13)
O6—Si1—O1	174.48 (5)	C7—C8—H8	119.7
O3—Si1—O4	87.03 (4)	C9—C8—H8	119.7
O2—Si1—O4	91.19 (5)	C10—C9—C8	120.34 (13)
O6—Si1—O4	89.11 (4)	C10—C9—H9	119.8
O1—Si1—O4	94.54 (5)	C8—C9—H9	119.8
O3—Si1—O5	87.33 (5)	N2—C10—C9	117.44 (13)
O2—Si1—O5	94.77 (5)	N2—C10—H10	121.3
O6—Si1—O5	87.24 (4)	C9—C10—H10	121.3
O1—Si1—O5	89.56 (5)	N3'—C12—C13	117.96 (13)
O4—Si1—O5	172.94 (5)	C13—C12—H12	121.0
N1—O1—Si1	111.84 (8)	C12—C13—C14	120.20 (13)
N1'—O2—Si1	112.63 (8)	C12—C13—H13	119.9
N2—O3—Si1	111.55 (8)	C14—C13—H13	119.9
N2'—O4—Si1	111.98 (8)	C15—C14—C13	120.37 (13)
N3—O5—Si1	111.66 (8)	C15—C14—H14	119.8
N3'—O6—Si1	112.15 (8)	C13—C14—H14	119.8
O1—N1—C5	123.22 (11)	N3—C15—C14	118.12 (13)
O3—N2—C10	122.40 (11)	N3—C15—H15	120.9
O5—N3—C15	123.49 (12)	C14—C15—H15	120.9
O2—N1'—C2	125.51 (12)	C13—C16—C14	111.02 (9)
O4—N2'—C7	125.60 (12)	C13—C16—C12	110.35 (8)
O6—N3'—C12	124.24 (11)	C14—C16—C12	110.31 (8)
C3—C2—N1'	118.02 (13)	C13—C16—D16	108.4
C3—C2—H2	121.0	C14—C16—D16	108.4
C2—C3—C4	121.11 (13)	C12—C16—D16	108.4
C2—C3—H3	119.4	C17—C17—C16	110.37 (8)
C4—C3—H3	119.4	C17—C17—C15	110.40 (8)
C5—C4—C3	119.54 (13)	C16—C17—C15	110.72 (8)
C5—C4—H4	120.2	C17—C17—D17	108.4
C3—C4—H4	120.2	C16—C17—D17	108.4
N1—C5—C4	118.25 (13)	C15—C17—D17	108.4
O3—Si1—O1—N1	-177.57 (8)	O5—Si1—O6—N3'	1.60 (9)
O2—Si1—O1—N1	4.57 (8)	Si1—O1—N1—C5	177.54 (10)
O4—Si1—O1—N1	95.53 (8)	Si1—O3—N2—C10	173.83 (10)
O5—Si1—O1—N1	-90.23 (8)	Si1—O5—N3—C15	-179.99 (10)
O6—Si1—O2—N1'	171.18 (9)	Si1—O2—N1'—C2	-175.03 (11)
O1—Si1—O2—N1'	-5.25 (9)	Si1—O4—N2'—C7	-170.73 (11)
O4—Si1—O2—N1'	-99.73 (9)	Si1—O6—N3'—C12	178.86 (10)
O5—Si1—O2—N1'	84.05 (9)	O2—N1'—C2—C3	-178.96 (12)
O6—Si1—O3—N2	97.69 (8)	N1'—C2—C3—C4	-0.4 (2)
O1—Si1—O3—N2	-85.74 (8)	C2—C3—C4—C5	0.1 (2)
O4—Si1—O3—N2	8.88 (8)	O1—N1—C5—C4	-179.05 (12)
O5—Si1—O3—N2	-175.36 (8)	C3—C4—C5—N1	-0.7 (2)
O3—Si1—O4—N2'	-9.74 (8)	O4—N2'—C7—C8	179.67 (12)
O2—Si1—O4—N2'	165.67 (8)	N2'—C7—C8—C9	1.5 (2)

O6—Si1—O4—N2'	-105.55 (9)	C7—C8—C9—C10	-1.9 (2)
O1—Si1—O4—N2'	78.60 (9)	O3—N2—C10—C9	-178.23 (12)
O3—Si1—O5—N3	-96.91 (9)	C8—C9—C10—N2	0.2 (2)
O2—Si1—O5—N3	87.55 (9)	O6—N3'—C12—C13	179.45 (12)
O6—Si1—O5—N3	-1.02 (9)	N3'—C12—C13—C14	-0.6 (2)
O1—Si1—O5—N3	174.49 (8)	C12—C13—C14—C15	0.2 (2)
O3—Si1—O6—N3'	88.63 (9)	O5—N3—C15—C14	179.28 (12)
O2—Si1—O6—N3'	-93.24 (9)	C13—C14—C15—N3	0.5 (2)
O4—Si1—O6—N3'	175.55 (9)		

(II) Tris[1-oxopyridine-2-olato(1-)]silicon(IV) chloride acetonitrile unknown solvate

Crystal data

C₁₅H₁₂N₃O₆Si⁺·Cl⁻
M_r = 393.82
 Triclinic, *P* $\bar{1}$
a = 6.8347 (7) Å
b = 11.1232 (12) Å
c = 13.1513 (14) Å
 α = 90.479 (2)°
 β = 93.269 (2)°
 γ = 102.356 (2)°
V = 974.85 (18) Å³

Z = 2
F(000) = 404
D_x = 1.342 Mg m⁻³
 Mo *K* α radiation, λ = 0.71073 Å
 Cell parameters from 4067 reflections
 θ = 2.5–36.4°
 μ = 0.29 mm⁻¹
T = 100 K
 Block, colorless
 0.30 × 0.30 × 0.24 mm

Data collection

Bruker SMART APEXII CCD Platform
 diffractometer
 Radiation source: fine-focus sealed tube
 ω scans
 Absorption correction: multi-scan
 (*SADABS*; Sheldrick, 2014)
T_{min} = 0.645, *T_{max}* = 0.748
 27002 measured reflections

10311 independent reflections
 6677 reflections with *I* > 2 σ (*I*)
R_{int} = 0.037
 θ_{\max} = 38.5°, θ_{\min} = 1.6°
h = -11→11
k = -19→19
l = -22→22

Refinement

Refinement on *F*²
 Least-squares matrix: full
R[*F*² > 2 σ (*F*²)] = 0.050
wR(*F*²) = 0.132
S = 1.03
 10311 reflections
 238 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-atom parameters constrained
 $w = 1/[\sigma^2(F_o^2) + (0.0537P)^2 + 0.1944P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\max} = 0.001$
 $\Delta\rho_{\max} = 0.45 \text{ e \AA}^{-3}$
 $\Delta\rho_{\min} = -0.45 \text{ e \AA}^{-3}$

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. Highly disordered solvent, located in two independent channels along [100], was unable to be modeled. Reflection contributions from this solvent were fixed and added to the calculated structure factors using the SQUEEZE function of program *PLATON* (Spek, 2009), which determined there to be 54 electrons in 225 Å³ accounted for per unit cell (25 electrons in 109 Å³ in one channel, and 29 electrons in 115 Å³ in the other). Because the exact identity and amount of solvent were unknown, no solvent was included in the atom list or molecular formula. Thus all calculated quantities that derive from the molecular formula (*e.g.*, $F(000)$, density, molecular weight, *etc.*) are known to be incorrect.

The pyridine portions of the oxopyridinone ligands are modeled as disordered with the planar flips of themselves (0.55:0.45, 0.60:0.40, and 0.61:0.39, for rings containing N1, N2, and N3, respectively). The disorders were modeled by refining the nitrogen/carbon ratios at the six particular atom sites, and refining the same ratio variable for pairs that were on the same ligand. Atoms at each of the six sites were constrained to be isopositional and to have equivalent anisotropic displacement parameters.

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

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$	Occ. (<1)
Si1	0.12051 (5)	0.29394 (3)	0.75582 (3)	0.01923 (7)	
Cl1	−0.28682 (5)	0.69679 (3)	0.72923 (3)	0.02991 (8)	
O1	0.24002 (13)	0.45107 (8)	0.77479 (7)	0.02124 (16)	
O2	0.07949 (13)	0.29060 (9)	0.88854 (7)	0.02376 (18)	
O3	0.35872 (12)	0.25406 (8)	0.77135 (7)	0.02194 (17)	
O4	0.01261 (14)	0.13330 (9)	0.74814 (8)	0.02702 (19)	
O5	0.15614 (13)	0.30843 (9)	0.62308 (7)	0.02244 (17)	
O6	−0.12215 (13)	0.32303 (9)	0.72917 (7)	0.02439 (18)	
N1	0.25249 (16)	0.48589 (11)	0.87312 (9)	0.0221 (2)	0.555 (13)
N2	0.15376 (18)	0.06613 (11)	0.75335 (10)	0.0268 (3)	0.604 (14)
N3	−0.00733 (16)	0.33084 (10)	0.57121 (8)	0.0206 (2)	0.611 (13)
C1	0.16641 (16)	0.39789 (12)	0.93573 (9)	0.0230 (2)	0.555 (13)
C6	0.34428 (18)	0.13298 (11)	0.76534 (10)	0.0247 (2)	0.604 (14)
C11	−0.15960 (16)	0.34008 (11)	0.63017 (9)	0.0221 (2)	0.611 (13)
C1′	0.25249 (16)	0.48589 (11)	0.87312 (9)	0.0221 (2)	0.445 (13)
C6′	0.15376 (18)	0.06613 (11)	0.75335 (10)	0.0268 (3)	0.396 (14)
C11′	−0.00733 (16)	0.33084 (10)	0.57121 (8)	0.0206 (2)	0.389 (13)
N1′	0.16641 (16)	0.39789 (12)	0.93573 (9)	0.0230 (2)	0.445 (13)
N2′	0.34428 (18)	0.13298 (11)	0.76534 (10)	0.0247 (2)	0.396 (14)
N3′	−0.15960 (16)	0.34008 (11)	0.63017 (9)	0.0221 (2)	0.389 (13)
C2	0.17350 (19)	0.41721 (15)	1.03917 (10)	0.0288 (3)	
H2	0.1159	0.3534	1.0829	0.035*	
C3	0.2666 (2)	0.53190 (17)	1.07748 (11)	0.0354 (3)	
H3	0.2733	0.5481	1.1488	0.042*	
C4	0.3511 (2)	0.62439 (15)	1.01246 (12)	0.0336 (3)	
H4	0.4119	0.7040	1.0394	0.040*	
C5	0.34709 (19)	0.60096 (13)	0.90880 (11)	0.0279 (3)	
H5	0.4078	0.6625	0.8639	0.034*	
C7	0.5050 (2)	0.07662 (16)	0.77229 (14)	0.0419 (4)	
H7	0.6388	0.1233	0.7807	0.050*	
C8	0.4648 (4)	−0.0500 (2)	0.7667 (2)	0.0644 (6)	
H8	0.5723	−0.0919	0.7713	0.077*	
C9	0.2670 (4)	−0.11734 (17)	0.75419 (19)	0.0637 (6)	

H9	0.2414	-0.2047	0.7505	0.076*
C10	0.1110 (3)	-0.05921 (14)	0.74725 (15)	0.0438 (4)
H10	-0.0236	-0.1046	0.7384	0.053*
C12	-0.33579 (19)	0.36479 (14)	0.58824 (12)	0.0304 (3)
H12	-0.4423	0.3720	0.6297	0.037*
C13	-0.3527 (2)	0.37871 (14)	0.48454 (12)	0.0357 (3)
H13	-0.4730	0.3948	0.4534	0.043*
C14	-0.1941 (2)	0.36936 (13)	0.42463 (11)	0.0327 (3)
H14	-0.2068	0.3803	0.3532	0.039*
C15	-0.0198 (2)	0.34451 (12)	0.46814 (10)	0.0264 (2)
H15	0.0882	0.3371	0.4279	0.032*

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Si1	0.01513 (13)	0.02434 (16)	0.01861 (15)	0.00486 (11)	0.00187 (11)	0.00053 (11)
Cl1	0.02417 (14)	0.03503 (17)	0.03014 (17)	0.00432 (12)	0.00548 (11)	0.00471 (13)
O1	0.0231 (4)	0.0246 (4)	0.0161 (4)	0.0050 (3)	0.0017 (3)	-0.0003 (3)
O2	0.0223 (4)	0.0297 (4)	0.0203 (4)	0.0069 (3)	0.0041 (3)	0.0028 (3)
O3	0.0170 (4)	0.0237 (4)	0.0257 (4)	0.0060 (3)	0.0001 (3)	-0.0006 (3)
O4	0.0209 (4)	0.0258 (4)	0.0335 (5)	0.0039 (3)	-0.0018 (4)	0.0007 (4)
O5	0.0179 (4)	0.0313 (4)	0.0189 (4)	0.0073 (3)	0.0006 (3)	-0.0013 (3)
O6	0.0177 (4)	0.0354 (5)	0.0218 (4)	0.0091 (3)	0.0021 (3)	0.0042 (4)
N1	0.0167 (4)	0.0310 (6)	0.0206 (5)	0.0102 (4)	-0.0003 (4)	-0.0041 (4)
N2	0.0251 (5)	0.0252 (5)	0.0293 (6)	0.0052 (4)	-0.0039 (4)	-0.0045 (4)
N3	0.0188 (4)	0.0231 (5)	0.0196 (5)	0.0041 (4)	-0.0009 (4)	-0.0017 (4)
C1	0.0170 (4)	0.0368 (6)	0.0182 (5)	0.0129 (4)	0.0007 (4)	-0.0009 (4)
C6	0.0230 (5)	0.0255 (5)	0.0265 (6)	0.0081 (4)	-0.0007 (4)	-0.0029 (4)
C11	0.0179 (4)	0.0277 (5)	0.0211 (5)	0.0061 (4)	0.0005 (4)	0.0013 (4)
C1'	0.0167 (4)	0.0310 (6)	0.0206 (5)	0.0102 (4)	-0.0003 (4)	-0.0041 (4)
C6'	0.0251 (5)	0.0252 (5)	0.0293 (6)	0.0052 (4)	-0.0039 (4)	-0.0045 (4)
C11'	0.0188 (4)	0.0231 (5)	0.0196 (5)	0.0041 (4)	-0.0009 (4)	-0.0017 (4)
N1'	0.0170 (4)	0.0368 (6)	0.0182 (5)	0.0129 (4)	0.0007 (4)	-0.0009 (4)
N2'	0.0230 (5)	0.0255 (5)	0.0265 (6)	0.0081 (4)	-0.0007 (4)	-0.0029 (4)
N3'	0.0179 (4)	0.0277 (5)	0.0211 (5)	0.0061 (4)	0.0005 (4)	0.0013 (4)
C2	0.0193 (5)	0.0548 (9)	0.0174 (5)	0.0194 (5)	0.0010 (4)	-0.0006 (5)
C3	0.0226 (6)	0.0654 (10)	0.0240 (6)	0.0243 (6)	-0.0038 (5)	-0.0141 (6)
C4	0.0215 (6)	0.0463 (8)	0.0354 (8)	0.0155 (6)	-0.0073 (5)	-0.0177 (6)
C5	0.0185 (5)	0.0335 (7)	0.0335 (7)	0.0104 (5)	-0.0019 (5)	-0.0067 (5)
C7	0.0306 (7)	0.0450 (9)	0.0548 (11)	0.0208 (7)	-0.0046 (7)	-0.0084 (8)
C8	0.0654 (13)	0.0514 (11)	0.0862 (17)	0.0405 (11)	-0.0166 (12)	-0.0175 (11)
C9	0.0809 (16)	0.0280 (8)	0.0836 (17)	0.0226 (9)	-0.0216 (13)	-0.0183 (9)
C10	0.0499 (10)	0.0241 (7)	0.0529 (11)	0.0030 (6)	-0.0146 (8)	-0.0060 (7)
C12	0.0190 (5)	0.0378 (7)	0.0359 (7)	0.0098 (5)	-0.0014 (5)	0.0046 (6)
C13	0.0337 (7)	0.0370 (7)	0.0363 (8)	0.0117 (6)	-0.0141 (6)	0.0001 (6)
C14	0.0476 (8)	0.0264 (6)	0.0225 (6)	0.0076 (6)	-0.0100 (6)	-0.0020 (5)
C15	0.0352 (7)	0.0236 (6)	0.0199 (6)	0.0051 (5)	0.0020 (5)	-0.0032 (4)

Geometric parameters (Å, °)

Si1—O1	1.7727 (10)	C6'—N2'	1.3542 (17)
Si1—O6	1.7729 (9)	C6'—C10	1.3626 (19)
Si1—O3	1.7782 (9)	C11'—N3'	1.3533 (15)
Si1—O5	1.7803 (10)	C11'—C15	1.3651 (17)
Si1—O4	1.7808 (10)	N1'—C2	1.3719 (17)
Si1—O2	1.7830 (10)	N2'—C7	1.3755 (18)
O1—C1'	1.3396 (14)	N3'—C12	1.3777 (16)
O1—N1	1.3396 (14)	C2—C3	1.375 (2)
O2—N1'	1.3433 (16)	C2—H2	0.9500
O2—C1	1.3433 (16)	C3—C4	1.393 (2)
O3—N2'	1.3305 (15)	C3—H3	0.9500
O3—C6	1.3305 (15)	C4—C5	1.383 (2)
O4—C6'	1.3399 (15)	C4—H4	0.9500
O4—N2	1.3399 (15)	C5—H5	0.9500
O5—C11'	1.3457 (13)	C7—C8	1.376 (3)
O5—N3	1.3457 (13)	C7—H7	0.9500
O6—N3'	1.3356 (14)	C8—C9	1.398 (3)
O6—C11	1.3356 (14)	C8—H8	0.9500
N1—C1	1.3434 (17)	C9—C10	1.360 (3)
N1—C5	1.3703 (18)	C9—H9	0.9500
N2—C6	1.3542 (17)	C10—H10	0.9500
N2—C10	1.3626 (19)	C12—C13	1.375 (2)
N3—C11	1.3533 (15)	C12—H12	0.9500
N3—C15	1.3651 (17)	C13—C14	1.397 (2)
C1—C2	1.3719 (17)	C13—H13	0.9500
C6—C7	1.3755 (18)	C14—C15	1.374 (2)
C11—C12	1.3777 (16)	C14—H14	0.9500
C1'—N1'	1.3434 (17)	C15—H15	0.9500
C1'—C5	1.3703 (18)		
O1—Si1—O6	94.90 (5)	N3'—C11'—C15	122.31 (11)
O1—Si1—O3	89.28 (4)	O2—N1'—C1'	114.28 (10)
O6—Si1—O3	174.02 (5)	O2—N1'—C2	123.88 (12)
O1—Si1—O5	89.48 (4)	C1'—N1'—C2	121.81 (13)
O6—Si1—O5	87.36 (4)	O3—N2'—C6'	114.34 (10)
O3—Si1—O5	88.40 (4)	O3—N2'—C7	124.56 (13)
O1—Si1—O4	174.42 (5)	C6'—N2'—C7	121.09 (13)
O6—Si1—O4	88.77 (5)	O6—N3'—C11'	114.24 (10)
O3—Si1—O4	87.38 (4)	O6—N3'—C12	124.74 (11)
O5—Si1—O4	94.90 (5)	C11'—N3'—C12	121.02 (12)
O1—Si1—O2	87.28 (4)	N1'—C2—C3	117.86 (14)
O6—Si1—O2	89.96 (4)	C1—C2—C3	117.86 (14)
O3—Si1—O2	94.51 (4)	C1—C2—H2	121.1
O5—Si1—O2	175.60 (5)	C3—C2—H2	121.1
O4—Si1—O2	88.53 (5)	C2—C3—C4	120.44 (13)
C1'—O1—Si1	111.97 (8)	C2—C3—H3	119.8

N1—O1—Si1	111.97 (8)	C4—C3—H3	119.8
N1'—O2—Si1	111.62 (8)	C5—C4—C3	120.34 (14)
C1—O2—Si1	111.62 (8)	C5—C4—H4	119.8
N2'—O3—Si1	112.12 (8)	C3—C4—H4	119.8
C6—O3—Si1	112.12 (8)	C1'—C5—C4	117.69 (14)
C6'—O4—Si1	111.55 (8)	N1—C5—C4	117.69 (14)
N2—O4—Si1	111.55 (8)	N1—C5—H5	121.2
C11'—O5—Si1	111.74 (7)	C4—C5—H5	121.2
N3—O5—Si1	111.74 (7)	N2'—C7—C8	117.54 (17)
N3'—O6—Si1	112.42 (7)	C6—C7—C8	117.54 (17)
C11—O6—Si1	112.42 (7)	C6—C7—H7	121.2
O1—N1—C1	114.61 (11)	C8—C7—H7	121.2
O1—N1—C5	123.59 (12)	C7—C8—C9	120.50 (17)
C1—N1—C5	121.79 (12)	C7—C8—H8	119.7
O4—N2—C6	114.51 (11)	C9—C8—H8	119.7
O4—N2—C10	123.25 (13)	C10—C9—C8	120.72 (17)
C6—N2—C10	122.24 (13)	C10—C9—H9	119.6
O5—N3—C11	114.23 (10)	C8—C9—H9	119.6
O5—N3—C15	123.46 (11)	C9—C10—N2	117.90 (17)
C11—N3—C15	122.31 (11)	C9—C10—C6'	117.90 (17)
O2—C1—N1	114.28 (10)	C9—C10—H10	121.1
O2—C1—C2	123.88 (12)	N2—C10—H10	121.1
N1—C1—C2	121.81 (13)	C13—C12—C11	117.91 (13)
O3—C6—N2	114.34 (10)	C13—C12—N3'	117.91 (13)
O3—C6—C7	124.56 (13)	C13—C12—H12	121.0
N2—C6—C7	121.09 (13)	C11—C12—H12	121.0
O6—C11—N3	114.24 (10)	C12—C13—C14	120.48 (13)
O6—C11—C12	124.74 (11)	C12—C13—H13	119.8
N3—C11—C12	121.02 (12)	C14—C13—H13	119.8
O1—C1'—N1'	114.61 (11)	C15—C14—C13	120.58 (13)
O1—C1'—C5	123.59 (12)	C15—C14—H14	119.7
N1'—C1'—C5	121.79 (12)	C13—C14—H14	119.7
O4—C6'—N2'	114.51 (11)	C11'—C15—C14	117.70 (13)
O4—C6'—C10	123.25 (13)	N3—C15—C14	117.70 (13)
N2'—C6'—C10	122.24 (13)	N3—C15—H15	121.1
O5—C11'—N3'	114.23 (10)	C14—C15—H15	121.1
O5—C11'—C15	123.46 (11)		
O6—Si1—O1—C1'	93.66 (8)	O5—N3—C11—O6	-1.19 (15)
O3—Si1—O1—C1'	-90.62 (8)	C15—N3—C11—O6	179.43 (11)
O5—Si1—O1—C1'	-179.03 (7)	O5—N3—C11—C12	178.96 (12)
O2—Si1—O1—C1'	3.93 (7)	C15—N3—C11—C12	-0.4 (2)
O6—Si1—O1—N1	93.66 (8)	Si1—O1—C1'—N1'	-2.53 (12)
O3—Si1—O1—N1	-90.62 (8)	Si1—O1—C1'—C5	176.61 (9)
O5—Si1—O1—N1	-179.03 (7)	Si1—O4—C6'—N2'	1.35 (15)
O2—Si1—O1—N1	3.93 (7)	Si1—O4—C6'—C10	-178.70 (13)
O1—Si1—O2—N1'	-4.51 (7)	Si1—O5—C11'—N3'	1.34 (13)
O6—Si1—O2—N1'	-99.42 (8)	Si1—O5—C11'—C15	-179.29 (10)

O3—Si1—O2—N1'	84.55 (8)	Si1—O2—N1'—C1'	4.17 (12)
O4—Si1—O2—N1'	171.81 (8)	Si1—O2—N1'—C2	-174.11 (9)
O1—Si1—O2—C1	-4.51 (7)	O1—C1'—N1'—O2	-1.10 (14)
O6—Si1—O2—C1	-99.42 (8)	C5—C1'—N1'—O2	179.75 (10)
O3—Si1—O2—C1	84.55 (8)	O1—C1'—N1'—C2	177.22 (10)
O4—Si1—O2—C1	171.81 (8)	C5—C1'—N1'—C2	-1.93 (17)
O1—Si1—O3—N2'	178.35 (8)	Si1—O3—N2'—C6'	-2.72 (14)
O5—Si1—O3—N2'	-92.16 (9)	Si1—O3—N2'—C7	178.47 (13)
O4—Si1—O3—N2'	2.82 (9)	O4—C6'—N2'—O3	0.90 (17)
O2—Si1—O3—N2'	91.13 (9)	C10—C6'—N2'—O3	-179.05 (14)
O1—Si1—O3—C6	178.35 (8)	O4—C6'—N2'—C7	179.75 (14)
O5—Si1—O3—C6	-92.16 (9)	C10—C6'—N2'—C7	-0.2 (2)
O4—Si1—O3—C6	2.82 (9)	Si1—O6—N3'—C11'	0.47 (13)
O2—Si1—O3—C6	91.13 (9)	Si1—O6—N3'—C12	-179.69 (11)
O6—Si1—O4—C6'	173.11 (9)	O5—C11'—N3'—O6	-1.19 (15)
O3—Si1—O4—C6'	-2.31 (9)	C15—C11'—N3'—O6	179.43 (11)
O5—Si1—O4—C6'	85.86 (9)	O5—C11'—N3'—C12	178.96 (12)
O2—Si1—O4—C6'	-96.90 (9)	C15—C11'—N3'—C12	-0.4 (2)
O6—Si1—O4—N2	173.11 (9)	O2—N1'—C2—C3	-179.73 (10)
O3—Si1—O4—N2	-2.31 (9)	C1'—N1'—C2—C3	2.12 (17)
O5—Si1—O4—N2	85.86 (9)	O2—C1—C2—C3	-179.73 (10)
O2—Si1—O4—N2	-96.90 (9)	N1—C1—C2—C3	2.12 (17)
O1—Si1—O5—C11'	-95.80 (8)	N1'—C2—C3—C4	-0.29 (18)
O6—Si1—O5—C11'	-0.87 (8)	C1—C2—C3—C4	-0.29 (18)
O3—Si1—O5—C11'	174.91 (8)	C2—C3—C4—C5	-1.73 (19)
O4—Si1—O5—C11'	87.67 (8)	O1—C1'—C5—C4	-179.23 (10)
O1—Si1—O5—N3	-95.80 (8)	N1'—C1'—C5—C4	-0.15 (17)
O6—Si1—O5—N3	-0.87 (8)	O1—N1—C5—C4	-179.23 (10)
O3—Si1—O5—N3	174.91 (8)	C1—N1—C5—C4	-0.15 (17)
O4—Si1—O5—N3	87.67 (8)	C3—C4—C5—C1'	1.94 (18)
O1—Si1—O6—N3'	89.47 (9)	C3—C4—C5—N1	1.94 (18)
O5—Si1—O6—N3'	0.22 (9)	O3—N2'—C7—C8	178.70 (17)
O4—Si1—O6—N3'	-94.73 (9)	C6'—N2'—C7—C8	0.0 (3)
O2—Si1—O6—N3'	176.74 (9)	O3—C6—C7—C8	178.70 (17)
O1—Si1—O6—C11	89.47 (9)	N2—C6—C7—C8	0.0 (3)
O5—Si1—O6—C11	0.22 (9)	N2'—C7—C8—C9	0.1 (3)
O4—Si1—O6—C11	-94.73 (9)	C6—C7—C8—C9	0.1 (3)
O2—Si1—O6—C11	176.74 (9)	C7—C8—C9—C10	0.1 (4)
Si1—O1—N1—C1	-2.53 (12)	C8—C9—C10—N2	-0.3 (3)
Si1—O1—N1—C5	176.61 (9)	C8—C9—C10—C6'	-0.3 (3)
Si1—O4—N2—C6	1.35 (15)	O4—N2—C10—C9	-179.58 (17)
Si1—O4—N2—C10	-178.70 (13)	C6—N2—C10—C9	0.4 (3)
Si1—O5—N3—C11	1.34 (13)	O4—C6'—C10—C9	-179.58 (17)
Si1—O5—N3—C15	-179.29 (10)	N2'—C6'—C10—C9	0.4 (3)
Si1—O2—C1—N1	4.17 (12)	O6—C11—C12—C13	-179.28 (13)
Si1—O2—C1—C2	-174.11 (9)	N3—C11—C12—C13	0.6 (2)
O1—N1—C1—O2	-1.10 (14)	O6—N3'—C12—C13	-179.28 (13)
C5—N1—C1—O2	179.75 (10)	C11'—N3'—C12—C13	0.6 (2)

O1—N1—C1—C2	177.22 (10)	C11—C12—C13—C14	−0.8 (2)
C5—N1—C1—C2	−1.93 (17)	N3'—C12—C13—C14	−0.8 (2)
Si1—O3—C6—N2	−2.72 (14)	C12—C13—C14—C15	0.9 (2)
Si1—O3—C6—C7	178.47 (13)	O5—C11'—C15—C14	−178.84 (12)
O4—N2—C6—O3	0.90 (17)	N3'—C11'—C15—C14	0.48 (19)
C10—N2—C6—O3	−179.05 (14)	O5—N3—C15—C14	−178.84 (12)
O4—N2—C6—C7	179.75 (14)	C11—N3—C15—C14	0.48 (19)
C10—N2—C6—C7	−0.2 (2)	C13—C14—C15—C11'	−0.7 (2)
Si1—O6—C11—N3	0.47 (13)	C13—C14—C15—N3	−0.7 (2)
Si1—O6—C11—C12	−179.69 (11)		

(III) *fac*-Tris[1-oxypyridine-2-thiolato(1-)]silicon(IV) chloride chloroform-*d*₁ disolvate*Crystal data*

C₁₅H₁₂N₃O₃S₃Si⁺·Cl[−]·2CDCl₃
M_r = 682.74
 Cubic, *P*2₁3
a = 13.9483 (12) Å
V = 2713.7 (7) Å³
Z = 4
F(000) = 1368
D_x = 1.671 Mg m^{−3}

Mo *K*α radiation, λ = 0.71073 Å
 Cell parameters from 4002 reflections
 θ = 2.5–33.8°
 μ = 1.03 mm^{−1}
T = 100 K
 Tetrahedron, pale yellow
 0.18 × 0.18 × 0.18 mm

Data collection

Bruker SMART APEXII CCD Platform
 diffractometer
 Radiation source: fine-focus sealed tube
 ω scans
 Absorption correction: multi-scan
 (*SADABS*; Sheldrick, 2014)
T_{min} = 0.681, *T_{max}* = 0.748
 66318 measured reflections

5067 independent reflections
 4360 reflections with *I* > 2σ(*I*)
R_{int} = 0.059
 θ_{max} = 38.5°, θ_{min} = 2.1°
h = −24→24
k = −23→24
l = −23→24

Refinement

Refinement on *F*²
 Least-squares matrix: full
R [*F*² > 2σ(*F*²)] = 0.037
wR (*F*²) = 0.088
S = 1.03
 5067 reflections
 103 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-atom parameters constrained
w = 1/[σ²(*F_o*²) + (0.0387*P*)² + 1.2622*P*]
 where *P* = (*F_o*² + 2*F_c*²)/3
 (Δ/σ)_{max} = 0.001
 Δρ_{max} = 0.88 e Å^{−3}
 Δρ_{min} = −0.67 e Å^{−3}
 Absolute structure: Flack *x* determined using
 1775 quotients [(*I*⁺−*I*[−])/(*I*⁺+*I*[−])] (Parsons *et al.*, 2013)
 Absolute structure parameter: −0.018 (18)

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.

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

	<i>x</i>	<i>y</i>	<i>z</i>	$U_{\text{iso}}^*/U_{\text{eq}}$
Cl1	0.47976 (3)	−0.02024 (3)	0.52024 (3)	0.01864 (13)
Si1	0.48307 (3)	0.48307 (3)	0.48307 (3)	0.01248 (14)
S1	0.47110 (3)	0.49896 (3)	0.64425 (3)	0.01526 (8)
O1	0.45832 (11)	0.35879 (9)	0.49722 (10)	0.0153 (2)
N1	0.46124 (12)	0.31975 (11)	0.58645 (11)	0.0138 (2)
C1	0.46796 (14)	0.37754 (13)	0.66485 (13)	0.0146 (3)
C2	0.47203 (16)	0.33345 (14)	0.75505 (14)	0.0190 (3)
H2	0.4772	0.3713	0.8114	0.023*
C3	0.46853 (18)	0.23462 (15)	0.76169 (15)	0.0220 (4)
H3	0.4708	0.2045	0.8228	0.026*
C4	0.46163 (15)	0.17883 (14)	0.67861 (15)	0.0187 (3)
H4	0.4592	0.1109	0.6831	0.022*
C5	0.45834 (14)	0.22276 (13)	0.59068 (14)	0.0161 (3)
H5	0.4541	0.1858	0.5337	0.019*
C6	0.30918 (15)	0.30918 (15)	0.30918 (15)	0.0212 (6)
D6	0.3506	0.3506	0.3506	0.025*
Cl2	0.30061 (7)	0.19603 (5)	0.36357 (6)	0.04462 (19)
C7	0.12879 (19)	0.37121 (19)	0.62879 (19)	0.0264 (7)
D7	0.0874	0.4126	0.5874	0.032*
Cl3	0.21080 (7)	0.44529 (6)	0.68782 (8)	0.0511 (2)

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Cl1	0.01864 (13)	0.01864 (13)	0.01864 (13)	0.00093 (14)	−0.00093 (14)	−0.00093 (14)
Si1	0.01248 (14)	0.01248 (14)	0.01248 (14)	−0.00028 (14)	−0.00028 (14)	−0.00028 (14)
S1	0.01940 (18)	0.01277 (16)	0.01360 (16)	−0.00101 (14)	0.00168 (14)	−0.00190 (13)
O1	0.0215 (6)	0.0125 (5)	0.0121 (5)	−0.0009 (4)	−0.0009 (4)	0.0005 (4)
N1	0.0148 (6)	0.0134 (6)	0.0132 (6)	0.0002 (5)	0.0003 (5)	0.0004 (5)
C1	0.0158 (7)	0.0144 (6)	0.0137 (6)	0.0004 (5)	0.0008 (5)	−0.0009 (5)
C2	0.0252 (9)	0.0184 (7)	0.0134 (7)	0.0009 (7)	0.0013 (7)	0.0004 (6)
C3	0.0300 (10)	0.0182 (8)	0.0176 (8)	0.0021 (8)	−0.0003 (7)	0.0049 (6)
C4	0.0218 (8)	0.0144 (7)	0.0201 (8)	0.0008 (6)	0.0004 (7)	0.0028 (6)
C5	0.0177 (7)	0.0130 (7)	0.0178 (7)	0.0005 (5)	−0.0005 (6)	−0.0001 (5)
C6	0.0212 (6)	0.0212 (6)	0.0212 (6)	−0.0019 (7)	−0.0019 (7)	−0.0019 (7)
Cl2	0.0654 (5)	0.0202 (3)	0.0482 (4)	0.0016 (3)	0.0125 (4)	0.0041 (3)
C7	0.0264 (7)	0.0264 (7)	0.0264 (7)	−0.0015 (8)	0.0015 (8)	−0.0015 (8)
Cl3	0.0493 (5)	0.0432 (4)	0.0610 (5)	−0.0147 (3)	−0.0130 (4)	−0.0089 (4)

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

Si1—O1 ⁱ	1.7784 (14)	C3—C4	1.399 (3)
Si1—O1 ⁱⁱ	1.7784 (14)	C3—H3	0.9500
Si1—O1	1.7784 (14)	C4—C5	1.372 (3)
Si1—S1	2.2654 (7)	C4—H4	0.9500

Si1—S1 ⁱ	2.2654 (7)	C5—H5	0.9500
Si1—S1 ⁱⁱ	2.2654 (7)	C6—C12 ⁱ	1.7552 (13)
S1—C1	1.7184 (19)	C6—C12 ⁱⁱ	1.7552 (13)
O1—N1	1.359 (2)	C6—C12	1.7552 (13)
N1—C5	1.355 (2)	C6—D6	1.0000
N1—C1	1.362 (2)	C7—C13 ⁱⁱⁱ	1.7476 (16)
C1—C2	1.402 (3)	C7—C13 ^{iv}	1.7476 (16)
C2—C3	1.383 (3)	C7—C13	1.7476 (16)
C2—H2	0.9500	C7—D7	1.0000
O1 ⁱ —Si1—O1 ⁱⁱ	86.60 (7)	C3—C2—H2	120.1
O1 ⁱ —Si1—O1	86.59 (7)	C1—C2—H2	120.1
O1 ⁱⁱ —Si1—O1	86.59 (7)	C2—C3—C4	120.09 (18)
O1 ⁱ —Si1—S1	96.31 (5)	C2—C3—H3	120.0
O1 ⁱⁱ —Si1—S1	174.00 (5)	C4—C3—H3	120.0
O1—Si1—S1	88.33 (4)	C5—C4—C3	119.64 (17)
O1 ⁱ —Si1—S1 ⁱ	88.33 (4)	C5—C4—H4	120.2
O1 ⁱⁱ —Si1—S1 ⁱ	96.31 (5)	C3—C4—H4	120.2
O1—Si1—S1 ⁱ	174.00 (5)	N1—C5—C4	118.94 (17)
S1—Si1—S1 ⁱ	89.04 (3)	N1—C5—H5	120.5
O1 ⁱ —Si1—S1 ⁱⁱ	174.00 (5)	C4—C5—H5	120.5
O1 ⁱⁱ —Si1—S1 ⁱⁱ	88.33 (4)	C12 ⁱ —C6—C12 ⁱⁱ	110.91 (11)
O1—Si1—S1 ⁱⁱ	96.31 (5)	C12 ⁱ —C6—C12	110.91 (11)
S1—Si1—S1 ⁱⁱ	89.04 (3)	C12 ⁱⁱ —C6—C12	110.91 (11)
S1 ⁱ —Si1—S1 ⁱⁱ	89.04 (3)	C12 ⁱ —C6—D6	108.0
C1—S1—Si1	94.09 (6)	C12 ⁱⁱ —C6—D6	108.0
N1—O1—Si1	119.10 (11)	C12—C6—D6	108.0
C5—N1—O1	116.05 (15)	C13 ⁱⁱⁱ —C7—C13 ^{iv}	110.93 (14)
C5—N1—C1	123.93 (16)	C13 ⁱⁱⁱ —C7—C13	110.93 (14)
O1—N1—C1	120.02 (14)	C13 ^{iv} —C7—C13	110.93 (14)
N1—C1—C2	117.64 (16)	C13 ⁱⁱⁱ —C7—D7	108.0
N1—C1—S1	116.80 (13)	C13 ^{iv} —C7—D7	108.0
C2—C1—S1	125.56 (14)	C13—C7—D7	108.0
C3—C2—C1	119.75 (18)		
O1 ⁱ —Si1—O1—N1	-108.75 (16)	Si1—S1—C1—N1	-7.82 (15)
O1 ⁱⁱ —Si1—O1—N1	164.47 (14)	Si1—S1—C1—C2	171.97 (18)
S1—Si1—O1—N1	-12.32 (12)	N1—C1—C2—C3	-0.4 (3)
S1 ⁱⁱ —Si1—O1—N1	76.53 (13)	S1—C1—C2—C3	179.79 (18)
Si1—O1—N1—C5	-168.92 (13)	C1—C2—C3—C4	0.5 (4)
Si1—O1—N1—C1	10.3 (2)	C2—C3—C4—C5	0.0 (4)
C5—N1—C1—C2	0.0 (3)	O1—N1—C5—C4	179.61 (17)
O1—N1—C1—C2	-179.14 (18)	C1—N1—C5—C4	0.5 (3)
C5—N1—C1—S1	179.76 (15)	C3—C4—C5—N1	-0.4 (3)
O1—N1—C1—S1	0.7 (2)		

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