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catena-Poly[[diaquazinc(II)]- μ -L-cysteinato(2-)- κ^4 S:S,N,O-[di- μ -sulfido-bis[oxidomolybdate(V)](Mo—Mo)]- μ -L-cysteinato(2-)- κ^4 S,N,O:S]

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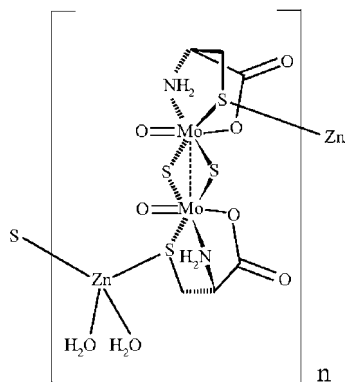
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 Key indicators: single-crystal X-ray study; $T = 93$ K; mean $\sigma(\text{C}-\text{C}) = 0.003$ Å; R factor = 0.020; wR factor = 0.049; data-to-parameter ratio = 21.8.

The title compound, $[\text{Mo}_2\text{Zn}(\text{C}_3\text{H}_5\text{NO}_2\text{S})_2\text{O}_2\text{S}_2(\text{H}_2\text{O})_2]$, forms a one-dimensional chain. The cysteine S atom of the dinuclear molybdenum complex anion coordinates to the zinc ion, which has a tetrahedral environment by the additional coordination of two water molecules. The one-dimensional chains are connected to each other by hydrogen bonds. The Zn—S(cysteine) distances [2.3599 (6) and 2.3072 (6) Å] are close to the value in ZnS (2.35 Å). The distances and angles within the complex are very close to those reported for the sodium and potassium di- μ -sulfido species.

Related literature

For related literature, see: Brown & Jeffreys (1973); Hong *et al.* (1983); Kay & Mitchell (1970); Knox & Prout (1969); Shibahara *et al.* (1987); Lee *et al.* (1989); Liu & Williams (1981); Xing *et al.* (1998).


Experimental
Crystal data

$[\text{Mo}_2\text{Zn}(\text{C}_3\text{H}_5\text{NO}_2\text{S})_2\text{O}_2\text{S}_2(\text{H}_2\text{O})_2]$ $V = 843.23$ (16) Å³
 $M_r = 627.69$ $Z = 2$
 Monoclinic, $P2_1$ $\text{Mo } K\alpha$ radiation
 $a = 8.6881$ (11) Å $\mu = 3.40$ mm⁻¹
 $b = 10.3529$ (8) Å $T = 93.1$ K
 $c = 9.8686$ (11) Å $0.35 \times 0.30 \times 0.10$ mm
 $\beta = 108.2022$ (14)°

Data collection

Rigaku Mercury diffractometer 9357 measured reflections
 Absorption correction: multi-scan 4556 independent reflections
 (Jacobson, 1998) 4549 reflections with $F^2 > 2\sigma(F^2)$
 $T_{\min} = 0.382$, $T_{\max} = 0.727$ $R_{\text{int}} = 0.019$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.019$ H atoms treated by a mixture of independent and constrained refinement
 $wR(F^2) = 0.049$ $\Delta\rho_{\text{max}} = 0.47$ e Å⁻³
 $S = 1.02$ $\Delta\rho_{\text{min}} = -0.94$ e Å⁻³
 4556 reflections Absolute structure: Flack (1983), with 2010 Friedel pairs
 209 parameters Flack parameter: 0.002 (7)
 15 restraints

Table 1

Selected geometric parameters (Å, °).

Mo1—S1	2.3201 (6)	Mo2—S4	2.5428 (6)
Mo1—S2	2.3378 (6)	Zn1—O8	2.0052 (17)
Mo1—S3	2.5572 (6)	Zn1—O7	2.0275 (19)
Mo1—Mo2	2.8354 (3)	Zn1—S4 ⁱ	2.3072 (6)
Mo2—S2	2.3276 (6)	Zn1—S3	2.3599 (6)
Mo2—S1	2.3368 (6)		
O8—Zn1—O7	96.70 (7)	O8—Zn1—S3	93.73 (5)
O8—Zn1—S4 ⁱ	129.42 (5)	O7—Zn1—S3	104.55 (6)
O7—Zn1—S4 ⁱ	107.94 (6)	S4 ⁱ —Zn1—S3	120.25 (2)

 Symmetry code: (i) $x - 1, y, z$.

Table 2

Hydrogen-bond geometry (Å, °).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
O7—H11 \cdots O3 ⁱⁱ	0.84	2.03	2.832 (2)	161
O8—H13 \cdots O5 ⁱⁱ	0.84	1.77	2.604 (2)	171
O8—H14 \cdots O4 ⁱ	0.84	2.00	2.789 (2)	158

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

Data collection: *CrystalClear* (Rigaku, 1999); cell refinement: *CrystalClear*; data reduction: *CrystalStructure* (Rigaku, 2007); program(s) used to solve structure: *SIR97* (Altomare *et al.*, 1999); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *CrystalStructure*; software used to prepare material for publication: *CrystalStructure*.

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: WK2080).

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supplementary materials

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***catena*-Poly[[diaquazinc(II)]- μ -L-cysteinato(2-)- κ^4 S:S,N,O-[di- μ -sulfido-bis[oxidomolybdate(V)](*Mo-Mo*)]- μ -L-cysteinato(2-)- κ^4 S,N,O:S]**

T. Shibahara, S. Ogasahara and G. Sakane

Comment

Molybdenum and *L*-cysteine are important components of many enzymes. X-ray structures of sulfur/oxygen-bridged dinuclear molybdenum complexes with *L*-cysteine ligands: Na₂[Mo₂(μ -S)₂O₂(cys)₂].4H₂O (Brown & Jeffreys, 1973; Hong *et al.*, 1983); K₂[Mo₂S₂O₂(cys)₂].4H₂O.CH₃OH (Xing *et al.*, 1998), Ca[Mo₂(μ -S)(μ -O)O₂(cys)₂].3H₂O (Shibahara *et al.*, 1987), and Na₂[Mo₂O₄(cys)₂].5H₂O (Knox & Prout, 1969; Kay & Mitchell, 1970; Liu & Williams, 1981), have been reported, where alkaline or alkaline earth metals are counter cations, and the existence of metal-oxygen (cysteine oxygen) bonds has been reported. Seeking another crystal structure type, we used Zn²⁺ ion, as the counter ion. The present structural study of the complex compound Zn[Mo₂O₂S₂(cys)₂].2H₂O (I) reveals the existence of Zn—S(cysteine sulfur) bonds, which result in polymerization; this type of Zn—S bond has been found in zinc finger proteins. The asymmetric unit of I is shown in Fig. 1 and a view of part of a one-dimensional polymeric chain of I is shown in Fig. 2. The zinc ion bridges the molybdenum complex anions: the coordination of the cysteine sulfur in the complex anion to the zinc ion results in the formation of one dimensional chains, where the zinc forms a tetrahedral structure by the additional coordination of two water molecules. The one dimensional chains are connected to each other by hydrogen bonds. Intra-chain hydrogen bonds also exist. The dimensions of the molybdenum complex and of the zinc tetrahedron are listed in Table 1, and the hydrogen bonds are listed in Table 2. The Zn—S(cysteine) distances (2.3599 (6), 2.3072 (6) Å) are close to that in ZnS (2.35 Å). The distances and angles within the complex are very close to those reported in the sodium and potassium salts in the di- μ -sulfide species.

Experimental

The title compound was prepared by the addition of ZnCl₂ to a diluted aqueous solution of Na₂[Mo₂O₂S₂(cys)₂].4H₂O. A crystal suitable for single-crystal X-ray diffraction was selected directly from the prepared sample.

Refinement

H atoms bonded to C, N, and O (H₂O) atoms were located in a difference map and refined with distance restraints of C—H = 0.99 (1), N—H = 0.92 (1), and O—H, 0.84 (1) Å, and with $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C, N, O})$. The absolute structure was confirmed by the value of Flack parameter (0.003 (7)).

Figures

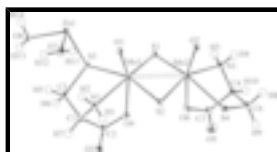


Fig. 1. The asymmetric unit of I with atom labels and 50% probability displacement ellipsoids for non-H atoms.

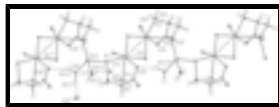


Fig. 2. A view of part of a one-dimensional polymeric chain with hydrogen bonds (dashed lines).

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Crystal data

$[\text{Mo}_2\text{Zn}(\text{C}_3\text{H}_5\text{NO}_2\text{S})_2\text{O}_2\text{S}_2(\text{H}_2\text{O})_2]$	$F_{000} = 612.00$
$M_r = 627.69$	$D_x = 2.472 \text{ Mg m}^{-3}$
Monoclinic, $P2_1$	Mo $K\alpha$ radiation
Hall symbol: P 2yb	$\lambda = 0.71070 \text{ \AA}$
$a = 8.6881 (11) \text{ \AA}$	Cell parameters from 3004 reflections
$b = 10.3529 (8) \text{ \AA}$	$\theta = 5.5\text{--}30.0^\circ$
$c = 9.8686 (11) \text{ \AA}$	$\mu = 3.41 \text{ mm}^{-1}$
$\beta = 108.2022 (14)^\circ$	$T = 93.1 \text{ K}$
$V = 843.23 (16) \text{ \AA}^3$	Platelet, orange
$Z = 2$	$0.35 \times 0.30 \times 0.10 \text{ mm}$

Data collection

Rigaku Mercury diffractometer	4549 reflections with $F^2 > 2\sigma(F^2)$
Detector resolution: $14.63 \text{ pixels mm}^{-1}$	$R_{\text{int}} = 0.019$
ω scans	$\theta_{\text{max}} = 30.0^\circ$
Absorption correction: multi-scan (Jacobson, 1998)	$h = -12 \rightarrow 11$
$T_{\text{min}} = 0.382, T_{\text{max}} = 0.727$	$k = -14 \rightarrow 14$
9357 measured reflections	$l = -13 \rightarrow 13$
4556 independent reflections	

Refinement

Refinement on F^2	$w = 1/[\sigma^2(F_o^2) + (0.0303P)^2 + 0.5406P]$
$R[F^2 > 2\sigma(F^2)] = 0.019$	where $P = (F_o^2 + 2F_c^2)/3$
$wR(F^2) = 0.049$	$(\Delta/\sigma)_{\text{max}} = 0.001$
$S = 1.02$	$\Delta\rho_{\text{max}} = 0.47 \text{ e \AA}^{-3}$
4556 reflections	$\Delta\rho_{\text{min}} = -0.94 \text{ e \AA}^{-3}$
209 parameters	Extinction correction: none
15 restraints	Absolute structure: Flack (1983), with 2010 Friedel pairs
H atoms treated by a mixture of independent and constrained refinement	Flack parameter: 0.002 (7)

Special details

Geometry. ENTER SPECIAL DETAILS OF THE MOLECULAR GEOMETRY

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

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

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$
Mo1	-0.056910 (19)	0.591229 (16)	0.808774 (16)	0.00615 (4)
Mo2	0.113206 (19)	0.533750 (19)	0.613333 (16)	0.00647 (4)
Zn1	-0.46728 (3)	0.59442 (3)	0.84366 (3)	0.01008 (4)
S1	-0.07812 (7)	0.40574 (6)	0.67221 (6)	0.00917 (8)
S2	0.16158 (6)	0.70395 (5)	0.77534 (6)	0.00880 (8)
S3	-0.22984 (6)	0.46976 (5)	0.93439 (5)	0.00813 (8)
S4	0.39318 (6)	0.59322 (6)	0.60271 (5)	0.01009 (8)
O1	-0.2167 (2)	0.68209 (17)	0.71583 (17)	0.0104 (2)
O2	0.00101 (19)	0.60344 (18)	0.45909 (16)	0.0111 (2)
O3	0.2203 (2)	0.45050 (18)	1.21945 (17)	0.0125 (3)
O4	0.13324 (19)	0.49461 (16)	0.98677 (16)	0.0089 (2)
O5	0.4690 (2)	0.2383 (2)	0.7999 (2)	0.0217 (3)
O6	0.2865 (2)	0.39663 (18)	0.77426 (17)	0.0125 (3)
O7	-0.3954 (2)	0.77830 (18)	0.9006 (2)	0.0182 (3)
O8	-0.54704 (19)	0.55572 (18)	1.00931 (17)	0.0136 (3)
N1	-0.0163 (2)	0.70357 (19)	1.01408 (19)	0.0087 (3)
N2	0.1744 (2)	0.3658 (2)	0.4962 (2)	0.0102 (3)
C1	0.0084 (2)	0.6095 (2)	1.1320 (2)	0.0092 (3)
C2	0.1322 (2)	0.5110 (2)	1.1161 (2)	0.0083 (3)
C3	-0.1525 (2)	0.5421 (2)	1.1147 (2)	0.0099 (3)
C4	0.3455 (2)	0.3284 (2)	0.5675 (2)	0.0112 (3)
C5	0.3694 (2)	0.3165 (2)	0.7269 (2)	0.0116 (4)
C6	0.4534 (2)	0.4378 (2)	0.5447 (2)	0.0130 (4)
H1	0.0683	0.7596	1.0256	0.010*
H2	-0.1027	0.7551	1.0124	0.010*
H3	0.1090	0.2957	0.4919	0.012*
H4	0.1624	0.3890	0.4039	0.012*
H5	-0.2299	0.6042	1.1334	0.012*
H6	-0.1366	0.4727	1.1869	0.012*
H7	0.0460	0.6482	1.2291	0.011*
H8	0.4318	0.4416	0.4403	0.016*
H9	0.5706	0.4243	0.5928	0.016*
H10	0.3821	0.2458	0.5359	0.013*
H11	-0.3638	0.8290	0.8487	0.022*
H12	-0.4303	0.8035	0.9659	0.022*
H13	-0.5293	0.6197	1.0646	0.016*
H14	-0.6424	0.5281	0.9816	0.016*

supplementary materials

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Mo1	0.00760 (7)	0.00633 (8)	0.00567 (7)	0.00053 (6)	0.00374 (5)	0.00047 (6)
Mo2	0.00756 (7)	0.00729 (8)	0.00565 (7)	0.00067 (6)	0.00364 (5)	0.00022 (6)
Zn1	0.01030 (10)	0.01118 (12)	0.00928 (10)	0.00082 (10)	0.00382 (8)	-0.00105 (9)
S1	0.0114 (2)	0.0085 (2)	0.0091 (2)	-0.00148 (18)	0.00549 (17)	-0.00119 (17)
S2	0.0109 (2)	0.0077 (2)	0.0098 (2)	-0.00074 (18)	0.00601 (17)	-0.00107 (17)
S3	0.0087 (2)	0.0085 (2)	0.0086 (2)	-0.00003 (18)	0.00480 (16)	-0.00014 (17)
S4	0.0088 (2)	0.0127 (2)	0.0098 (2)	-0.0003 (2)	0.00436 (16)	0.00152 (19)
O1	0.0111 (6)	0.0117 (8)	0.0102 (6)	0.0024 (5)	0.0060 (5)	0.0015 (5)
O2	0.0113 (6)	0.0135 (8)	0.0097 (6)	0.0019 (6)	0.0048 (5)	0.0014 (6)
O3	0.0152 (7)	0.0123 (8)	0.0101 (6)	0.0030 (6)	0.0039 (5)	0.0014 (6)
O4	0.0102 (6)	0.0099 (7)	0.0074 (6)	0.0011 (5)	0.0041 (5)	0.0002 (5)
O5	0.0216 (8)	0.0185 (9)	0.0221 (8)	0.0064 (7)	0.0027 (7)	0.0083 (7)
O6	0.0166 (7)	0.0129 (8)	0.0087 (6)	0.0010 (6)	0.0049 (5)	-0.0004 (5)
O7	0.0217 (9)	0.0131 (8)	0.0250 (8)	-0.0031 (7)	0.0146 (7)	-0.0054 (7)
O8	0.0096 (6)	0.0217 (10)	0.0103 (6)	-0.0025 (5)	0.0045 (5)	-0.0045 (6)
N1	0.0111 (7)	0.0069 (8)	0.0096 (7)	0.0002 (6)	0.0053 (6)	0.0004 (6)
N2	0.0096 (7)	0.0125 (9)	0.0084 (7)	0.0010 (6)	0.0026 (6)	-0.0032 (6)
C1	0.0131 (8)	0.0086 (10)	0.0067 (7)	0.0002 (7)	0.0043 (6)	-0.0005 (7)
C2	0.0099 (8)	0.0060 (10)	0.0107 (8)	-0.0019 (6)	0.0058 (6)	-0.0008 (6)
C3	0.0118 (8)	0.0109 (9)	0.0088 (7)	-0.0005 (7)	0.0060 (6)	0.0001 (7)
C4	0.0114 (8)	0.0130 (10)	0.0088 (8)	0.0038 (7)	0.0024 (6)	-0.0032 (7)
C5	0.0126 (9)	0.0095 (10)	0.0124 (9)	-0.0007 (7)	0.0034 (7)	0.0003 (7)
C6	0.0117 (9)	0.0186 (11)	0.0099 (8)	0.0019 (7)	0.0052 (7)	-0.0024 (8)

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

Mo1—O1	1.6905 (17)	O5—C5	1.238 (3)
Mo1—O4	2.2366 (16)	O6—C5	1.279 (3)
Mo1—N1	2.2662 (19)	O7—H11	0.837
Mo1—S1	2.3201 (6)	O7—H12	0.835
Mo1—S2	2.3378 (6)	O8—H13	0.841
Mo1—S3	2.5572 (6)	O8—H14	0.838
Mo1—Mo2	2.8354 (3)	N1—C1	1.481 (3)
Mo2—O2	1.6914 (16)	N1—H1	0.915
Mo2—N2	2.2419 (19)	N1—H2	0.917
Mo2—O6	2.3044 (18)	N2—C4	1.484 (3)
Mo2—S2	2.3276 (6)	N2—H3	0.914
Mo2—S1	2.3368 (6)	N2—H4	0.915
Mo2—S4	2.5428 (6)	C1—C3	1.523 (3)
Zn1—O8	2.0052 (17)	C1—C2	1.526 (3)
Zn1—O7	2.0275 (19)	C1—H7	0.995
Zn1—S4 ⁱ	2.3072 (6)	C3—H5	0.989
Zn1—S3	2.3599 (6)	C3—H6	0.991
S3—C3	1.852 (2)	C4—C5	1.527 (3)

S4—C6	1.838 (3)	C4—C6	1.531 (4)
S4—Zn1 ⁱⁱ	2.3072 (6)	C4—H10	0.996
O3—C2	1.237 (3)	C6—H8	0.989
O4—C2	1.290 (2)	C6—H9	0.989
O1—Mo1—O4	162.73 (7)	C6—S4—Zn1 ⁱⁱ	102.50 (7)
O1—Mo1—N1	94.11 (7)	C6—S4—Mo2	99.79 (8)
O4—Mo1—N1	69.93 (6)	Zn1 ⁱⁱ —S4—Mo2	99.22 (2)
O1—Mo1—S1	104.04 (6)	C2—O4—Mo1	119.10 (14)
O4—Mo1—S1	89.50 (4)	C5—O6—Mo2	117.99 (14)
N1—Mo1—S1	154.97 (5)	Zn1—O7—H11	123.4
O1—Mo1—S2	102.18 (6)	Zn1—O7—H12	110.6
O4—Mo1—S2	84.32 (4)	H11—O7—H12	122.9
N1—Mo1—S2	87.91 (5)	Zn1—O8—H13	109.3
S1—Mo1—S2	104.59 (2)	Zn1—O8—H14	111.1
O1—Mo1—S3	91.69 (6)	H13—O8—H14	116.3
O4—Mo1—S3	78.52 (4)	C1—N1—Mo1	107.99 (13)
N1—Mo1—S3	76.70 (5)	C1—N1—H1	113.9
S1—Mo1—S3	85.55 (2)	Mo1—N1—H1	109.3
S2—Mo1—S3	160.022 (19)	C1—N1—H2	108.3
O1—Mo1—Mo2	105.18 (6)	Mo1—N1—H2	112.6
O4—Mo1—Mo2	91.51 (4)	H1—N1—H2	104.8
N1—Mo1—Mo2	138.35 (5)	C4—N2—Mo2	108.76 (13)
S1—Mo1—Mo2	52.760 (15)	C4—N2—H3	109.3
S2—Mo1—Mo2	52.411 (14)	Mo2—N2—H3	113.3
S3—Mo1—Mo2	137.441 (15)	C4—N2—H4	109.0
O2—Mo2—N2	91.69 (8)	Mo2—N2—H4	109.8
O2—Mo2—O6	162.14 (7)	H3—N2—H4	106.6
N2—Mo2—O6	70.64 (6)	N1—C1—C3	108.11 (17)
O2—Mo2—S2	103.00 (6)	N1—C1—C2	107.01 (16)
N2—Mo2—S2	156.97 (5)	C3—C1—C2	109.49 (18)
O6—Mo2—S2	93.10 (5)	N1—C1—H7	114.5
O2—Mo2—S1	102.18 (6)	C3—C1—H7	107.9
N2—Mo2—S1	89.44 (5)	C2—C1—H7	109.8
O6—Mo2—S1	80.89 (5)	O3—C2—O4	123.7 (2)
S2—Mo2—S1	104.38 (2)	O3—C2—C1	121.88 (18)
O2—Mo2—S4	98.59 (6)	O4—C2—C1	114.38 (18)
N2—Mo2—S4	77.44 (5)	C1—C3—S3	109.75 (13)
O6—Mo2—S4	75.53 (5)	C1—C3—H5	109.6
S2—Mo2—S4	82.83 (2)	S3—C3—H5	112.2
S1—Mo2—S4	155.71 (2)	C1—C3—H6	109.6
O2—Mo2—Mo1	104.26 (5)	S3—C3—H6	109.0
N2—Mo2—Mo1	140.49 (5)	H5—C3—H6	106.7
O6—Mo2—Mo1	91.59 (4)	N2—C4—C5	107.66 (18)
S2—Mo2—Mo1	52.737 (15)	N2—C4—C6	107.82 (19)
S1—Mo2—Mo1	52.226 (15)	C5—C4—C6	108.60 (18)
S4—Mo2—Mo1	133.300 (15)	N2—C4—H10	116.5
O8—Zn1—O7	96.70 (7)	C5—C4—H10	107.4
O8—Zn1—S4 ⁱ	129.42 (5)	C6—C4—H10	108.7

supplementary materials

O7—Zn1—S4 ⁱ	107.94 (6)	O5—C5—O6	125.6 (2)
O8—Zn1—S3	93.73 (5)	O5—C5—C4	119.9 (2)
O7—Zn1—S3	104.55 (6)	O6—C5—C4	114.4 (2)
S4 ⁱ —Zn1—S3	120.25 (2)	C4—C6—S4	110.80 (15)
Mo1—S1—Mo2	75.014 (19)	C4—C6—H8	104.8
Mo2—S2—Mo1	74.853 (18)	S4—C6—H8	108.1
C3—S3—Zn1	98.94 (7)	C4—C6—H9	114.2
C3—S3—Mo1	100.08 (7)	S4—C6—H9	109.0
Zn1—S3—Mo1	97.09 (2)	H8—C6—H9	109.7

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

Hydrogen-bond geometry (\AA , $^\circ$)

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
O7—H11 \cdots O3 ⁱⁱⁱ	0.84	2.03	2.832 (2)	161
O7—H11 \cdots O4 ⁱⁱⁱ	0.84	2.75	3.139 (2)	110
O7—H12 \cdots O5 ⁱⁱⁱ	0.84	2.53	3.239 (3)	144
O7—H12 \cdots O6 ⁱⁱⁱ	0.84	2.66	3.285 (2)	133
O7—H12 \cdots O8 ^{iv}	0.84	2.64	3.093 (2)	116
O8—H13 \cdots O5 ⁱⁱⁱ	0.84	1.77	2.604 (2)	171
O8—H14 \cdots O4 ⁱ	0.84	2.00	2.789 (2)	158
O8—H14 \cdots O6 ⁱ	0.84	2.37	2.844 (2)	116
N1—H2 \cdots O4 ⁱⁱⁱ	0.92	2.49	3.179 (2)	132
N1—H2 \cdots O7	0.92	2.45	3.224 (2)	143
N2—H3 \cdots O2 ^v	0.91	2.32	3.212 (2)	164
N2—H4 \cdots O1 ^v	0.92	2.56	2.934 (2)	105
N2—H4 \cdots O3 ^{vi}	0.92	2.13	3.011 (2)	161

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

Fig. 1

