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# Poly[bis($\mu_4$-oxalato)potassium(I)praseodymium(III)]

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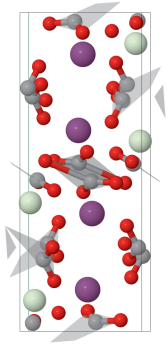
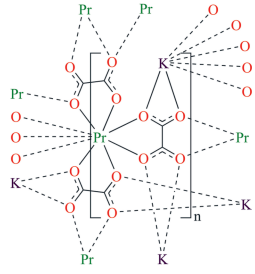
**Structural data:** full structural data are available from iucrdata.iucr.org

The asymmetric unit of the title oxalate-bridged bimetallic coordination polymer, $[KPr(C_2O_4)_2]_n$, contains one $Pr^{3+}$ cation, one $K^+$ cation, one complete $C_2O_4^{2-}$ anion, and one half of each of two $C_2O_4^{2-}$ anions positioned on crystallographic inversion centers in the monoclinic space group $P2_1/c$. The completely deprotonated $C_2O_4^{2-}$ ligands exhibit a $\mu_4$-chelating/bridging coordination mode that connects the $Pr^{3+}$ and $K^+$ cations into a framework structure.

3D view



Chemical scheme




## Structure description

For over a decade, lanthanide-based coordination polymers have garnered significant interest due to their intriguing structural topologies and prospective applications in gas storage, catalysis, separation, luminescence or molecular magnetism (Patra & Pal, 2025; Wang *et al.*, 2025; Zhang *et al.*, 2021). Because of the strong Lewis acidity of lanthanide ions as hard Pearson acids, ligands featuring donor oxygen atoms have been thoroughly investigated. Likewise, polycarboxylate ligands have been attracting interest due to their chemical and thermal stability, capacity to affect structural details *via* hydrogen-bonding interactions, and carboxylate functional groups that provide extensive structural diversity through several possible coordination modes (Janicki *et al.*, 2017; Liu *et al.*, 2010). For the current study, oxalate ($C_2O_4^{2-}$) ligands were employed to synthesize novel bimetallic coordination polymers based on specific rational designs. The oxalate anion has four oxygen atoms capable of coordinating to lanthanide cations in several coordination modes. In addition, alkali metal cations were incorporated with the premise that the synergistic interactions between alkali and lanthanide metal ions might promote the formation of novel heterometallic coordination polymers exhibiting new crystal structures (Ponjan *et al.*, 2020). A search in the Cambridge Structural Database (CSD, version 5.46, last update February 2025; Groom *et al.*, 2016) using the CONQUEST software (Bruno *et al.*, 2002) revealed that only two crystal structures of oxalate-bridged coordination polymers containing potassium(I) and praseodymium(III) ions are documented:

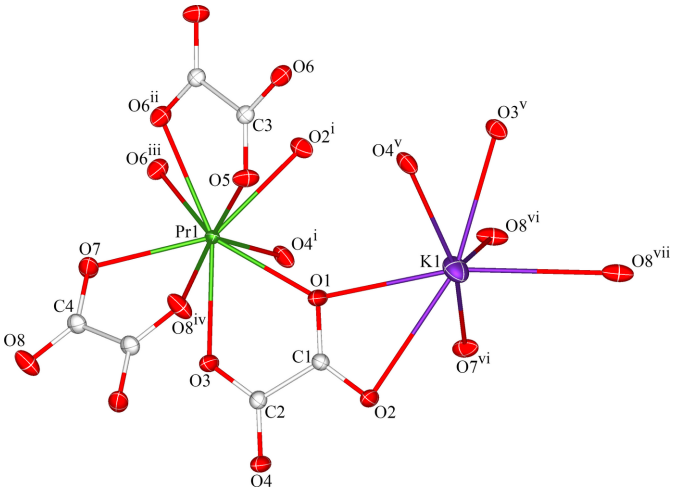



**Figure 1**
The enlarged asymmetric unit of the title coordination polymer illustrating the complete coordination spheres of the $Pr^{3+}$ and $K^+$ cations. Displacement ellipsoids are depicted at the 50% probability level. [Symmetry codes: (i) $x, \frac{3}{2} - y, z - \frac{1}{2}$; (ii) $1 - x, 1 - y, -z$; (iii) $1 + x, y, z$; (iv) $2 - x, 1 - y, 1 - z$; (v) $x - 1, \frac{3}{2} - y, z - \frac{1}{2}$; (vi) $2 - x, \frac{1}{2} + y, \frac{1}{2} - z$; (vii) $x - 1, \frac{3}{2} - y, z - \frac{1}{2}$.]

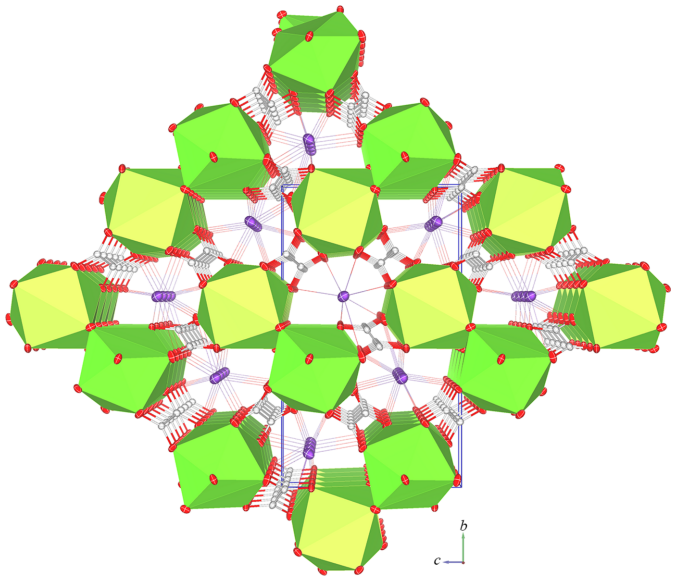



**Figure 3**
Perspective view of the framework structure along the *a* axis containing the coordination polyhedron of the $Pr^{3+}$ cation. The K—O bonds are represented by small rods. Displacement ellipsoids are as in Fig. 1.

$[K_2Pr_2(C_2O_4)_4(H_2O)]$ (COYNOV; Hong *et al.*, 2014) and $[KPr_2(C_2O_4)_{0.5}(C_8H_4O_4)_3(H_2O)_3]$ (NULYOJ; Yang *et al.*, 2009). In the current data report, we present the synthesis and crystal structure of a novel oxalate-bridged potassium(I)-praseodymium(III) heterometallic complex, $[KPr(C_2O_4)_2]_n$.

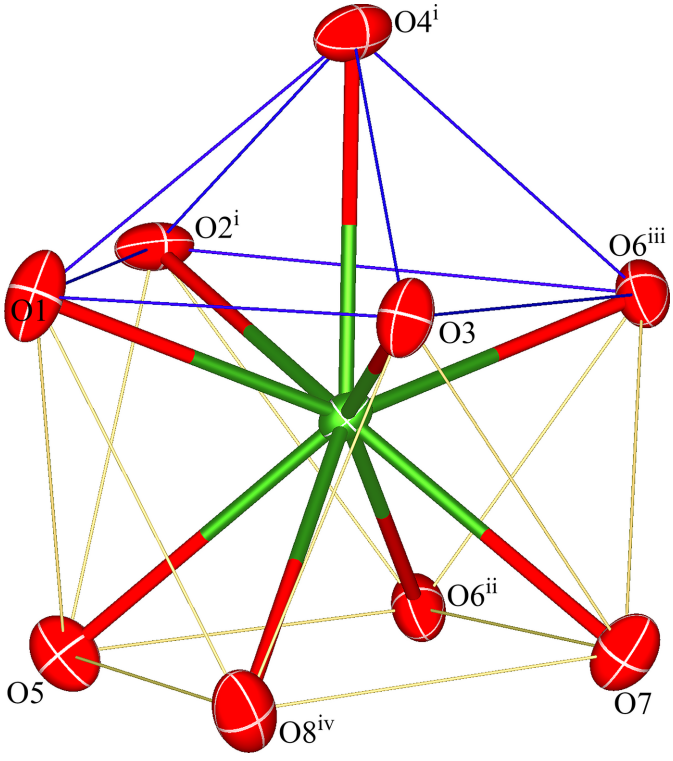



**Figure 2**
Coordination polyhedron around the $Pr^{3+}$ cation in the title coordination polymer. Symmetry codes and displacement ellipsoids are as in Fig. 1.

The asymmetric unit of the title coordination polymer comprises one $Pr^{3+}$ cation, one $K^+$ cation, one complete $C_2O_4^{2-}$ anion, and two half of each of two $C_2O_4^{2-}$ anions situated at crystallographic inversion centers. Fig. 1 shows the ninefold coordination of the $Pr^{3+}$ cation by nine oxygen atoms from five distinct $C_2O_4^{2-}$ ligands with the $O4^i$ atom [symmetry code (i): $x, \frac{3}{2} - y, z - \frac{1}{2}$] occupying the capping position of the distorted monocapped antiprism (Fig. 2). The Pr—O bond lengths vary from 2.4590 (17) to 2.6011 (18) Å, with an average bond length of 2.528 Å. The $K^+$ cation is coordinated by seven oxygen atoms from four different $C_2O_4^{2-}$ ligands. The K—O bond lengths range from 2.7664 (18) to 3.152 (2) Å, with an average bond length of 2.919 Å. The bond lengths in the two metal–oxygen polyhedra are comparable to those for the related compounds mentioned above (Hong *et al.*, 2014; Yang *et al.*, 2009).

The oxalate anion, C1/C2/O1/O2/O3/O4, which is situated in a general position, coordinates to the central $Pr^{3+}$ and $K^+$ cations in a $\mu_4$-$\kappa^2O1,O2$:$\kappa^2O3,O4$:$\kappa^2O1,O3$:$\kappa^2O2,O4$ coordination mode, leading to the formation of a corrugated sheet extending in the *ac* plane. Neighbouring sheets are linked by the two other $C_2O_4^{2-}$ ligands positioned over inversion centers, C3/$C3^{ii}$/O5/$O5^{ii}$/O6/$O6^{ii}$ [symmetry code: (ii) $-x + 1, -y + 1, -z$] and C4/$C4^{iv}$/O7/$O7^{iv}$/O8/$O8^{iv}$ [symmetry code (iv): $-x + 2, -y + 1, -z + 1$], in a $\mu_4$-$\kappa O6$:$\kappa O6^{ii}$:$\kappa^2O5$, $O6^{ii}$:$\kappa^2O5^{ii}$,$O6$ and $\mu_4$-$\kappa^2O7,O8$:$\kappa^2O7^{iv\prime}$,$O8^{iv}$:$\kappa^2O7$,$O8^{iv}$:-$\kappa^2O7^{iv}O8$ coordination mode, respectively, creating a tri-periodic framework structure (Fig. 3).

## Synthesis and crystallization

A mixture of $Pr(NO_3)_3{\cdot}6H_2O$ (0.218 g, 0.5 mmol), oxalic acid (0.045 g, 0.5 mmol) and KOH (0.112 g, 2.0 mmol) in a mixed water (5 ml) and DMF (5 ml) solution was sealed in a 23 ml

Teflon-lined steel autoclave and heated at 463 K for 48 h. The autoclave was then cooled to room temperature, and light-green hexagonal-shaped crystals were obtained in a yield of 57% (0.124 g) based on $Pr(NO_3)_3{\cdot}6H_2O$.

## Refinement

Crystal data, data collection and structure refinement details are summarized in Table 1.

**Table 1**
Experimental details.

| | |
|---|---|
| Crystal data | |
| Chemical formula | $[KPr(C_2O_4)_2]$ |
| $M_r$ | 356.05 |
| Crystal system, space group | Monoclinic, $P2_1/c$ |
| Temperature (K) | 296 |
| $a, b, c$ (Å) | 5.7205 (1), 14.9416 (3), 8.8848 (2) |
| $\beta$ (°) | 92.665 (1) |
| $V$ (Å$^3$) | 758.59 (3) |
| $Z$ | 4 |
| Radiation type | Mo $K\alpha$ |
| $\mu$ (mm$^{-1}$) | 6.99 |
| Crystal size (mm) | 0.12 × 0.06 × 0.06 |
| Data collection | |
| Diffractometer | Bruker D8 QUEST CMOS PHOTON II |
| Absorption correction | Multi-scan (*SADABS*; Krause *et al.*, 2015) |
| $T_{min}$, $T_{max}$ | 0.603, 0.746 |
| No. of measured, independent and observed [$I > 2\sigma(I)$] reflections | 18857, 1889, 1829 |
| $R_{int}$ | 0.032 |
| $(\sin\theta/\lambda)_{max}$ (Å$^{-1}$) | 0.668 |
| Refinement | |
| $R[F^2 > 2\sigma(F^2)]$, $wR(F^2)$, $S$ | 0.016, 0.038, 1.20 |
| No. of reflections | 1889 |
| No. of parameters | 127 |
| $\Delta\rho_{max}$, $\Delta\rho_{min}$ (e Å$^{-3}$) | 0.44, −1.07 |

Computer programs: *APEX6* and *SAINT* (Bruker, 2023), *SHELXT* (Sheldrick, 2015*a*), *SHELXL* (Sheldrick, 2015*b*) and *OLEX2* (Dolomanov *et al.*, 2009).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# full crystallographic data

*IUCrData* (2025). **10**, x250607 [https://doi.org/10.1107/S2414314625006078]

## Poly[bis($\mu_4$-oxalato)potassium(I)praseodymium(III)]

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### Poly[bis($\mu_4$-oxalato)potassium(I)praseodymium(III)]

*Crystal data*

$[KPr(C_2O_4)_2]$
$M_r$ = 356.05
Monoclinic, $P2_1/c$
$a$ = 5.7205 (1) Å
$b$ = 14.9416 (3) Å
$c$ = 8.8848 (2) Å
$\beta$ = 92.665 (1)°
$V$ = 758.59 (3) Å$^3$
$Z$ = 4
$F(000)$ = 664
$D_x$ = 3.118 Mg m$^{-3}$
Mo $K\alpha$ radiation, $\lambda$ = 0.71073 Å
Cell parameters from 9930 reflections
$\theta$ = 2.7–28.3°
$\mu$ = 6.99 mm$^{-1}$
$T$ = 296 K
Hexagonal, light green
0.12 × 0.06 × 0.06 mm

*Data collection*

BRUKER D8 QUEST CMOS PHOTON II diffractometer
Radiation source: sealed x-ray tube
Graphite monochromator
Detector resolution: 7.39 pixels mm$^{-1}$
$\omega$ and $\varphi$ scans
Absorption correction: multi-scan (SADABS; Krause *et al.*, 2015)
$T_{min}$ = 0.603, $T_{max}$ = 0.746
18857 measured reflections
1889 independent reflections
1829 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.032
$\theta_{max}$ = 28.4°, $\theta_{min}$ = 2.7°
$h$ = −7→7
$k$ = −19→19
$l$ = −11→11

*Refinement*

Refinement on $F^2$
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)]$ = 0.016
$wR(F^2)$ = 0.038
$S$ = 1.20
1889 reflections
127 parameters
0 restraints
Primary atom site location: dual
$w = 1/[\sigma^2(F_o^2) + (0.0178P)^2 + 0.5554P]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max}$ = 0.001
$\Delta\rho_{max}$ = 0.44 e Å$^{-3}$
$\Delta\rho_{min}$ = −1.07 e Å$^{-3}$

*Special details*

**Geometry**. All esds (except the esd in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell esds are taken into account individually in the estimation of esds in distances, angles and torsion angles; correlations between esds in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell esds is used for estimating esds involving l.s. planes.

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

| | $x$ | $y$ | $z$ | $U_{iso}$*/$U_{eq}$ |
|---|---|---|---|---|
| K1 | 0.45578 (11) | 0.86950 (4) | 0.15682 (7) | 0.02952 (13) |

| | | | | |
|---|---|---|---|---|
| Pr1 | 0.92864 (2) | 0.59670 (2) | 0.18326 (2) | 0.01100 (5) |
| O1 | 0.7504 (3) | 0.73622 (12) | 0.2696 (2) | 0.0226 (4) |
| O2 | 0.7493 (3) | 0.84258 (11) | 0.44375 (19) | 0.0190 (3) |
| O3 | 1.1506 (3) | 0.66905 (11) | 0.39824 (19) | 0.0190 (3) |
| O4 | 1.1438 (3) | 0.77457 (12) | 0.5752 (2) | 0.0214 (4) |
| O5 | 0.4910 (3) | 0.56301 (12) | 0.16446 (19) | 0.0205 (4) |
| O6 | 0.2083 (3) | 0.53450 (11) | −0.0105 (2) | 0.0182 (3) |
| O7 | 1.1044 (3) | 0.46803 (12) | 0.32627 (18) | 0.0216 (4) |
| O8 | 1.2497 (3) | 0.44223 (14) | 0.56080 (19) | 0.0245 (4) |
| C1 | 0.8346 (4) | 0.77504 (15) | 0.3838 (3) | 0.0139 (4) |
| C2 | 1.0638 (4) | 0.73668 (15) | 0.4589 (3) | 0.0143 (4) |
| C3 | 0.4158 (4) | 0.52864 (14) | 0.0453 (2) | 0.0128 (4) |
| C4 | 1.1034 (4) | 0.47399 (15) | 0.4679 (3) | 0.0159 (4) |

*Atomic displacement parameters (Å²)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| K1 | 0.0228 (3) | 0.0313 (3) | 0.0336 (3) | −0.0036 (2) | −0.0085 (2) | 0.0047 (3) |
| Pr1 | 0.01561 (8) | 0.00942 (7) | 0.00784 (7) | 0.00076 (4) | −0.00097 (5) | −0.00028 (4) |
| O1 | 0.0259 (10) | 0.0200 (8) | 0.0208 (9) | 0.0084 (7) | −0.0103 (7) | −0.0087 (7) |
| O2 | 0.0222 (9) | 0.0178 (8) | 0.0166 (8) | 0.0076 (7) | −0.0035 (7) | −0.0061 (6) |
| O3 | 0.0209 (9) | 0.0185 (8) | 0.0172 (8) | 0.0055 (7) | −0.0043 (7) | −0.0058 (7) |
| O4 | 0.0229 (9) | 0.0196 (8) | 0.0208 (9) | 0.0052 (7) | −0.0085 (7) | −0.0082 (7) |
| O5 | 0.0193 (9) | 0.0271 (9) | 0.0152 (8) | −0.0018 (7) | 0.0018 (7) | −0.0071 (7) |
| O6 | 0.0127 (8) | 0.0172 (8) | 0.0247 (9) | 0.0004 (6) | 0.0002 (7) | −0.0049 (7) |
| O7 | 0.0329 (10) | 0.0201 (9) | 0.0119 (8) | 0.0076 (7) | 0.0017 (7) | 0.0005 (6) |
| O8 | 0.0195 (9) | 0.0383 (11) | 0.0158 (8) | 0.0070 (8) | −0.0001 (7) | 0.0072 (8) |
| C1 | 0.0157 (11) | 0.0129 (10) | 0.0130 (10) | −0.0001 (8) | −0.0016 (8) | 0.0001 (8) |
| C2 | 0.0152 (11) | 0.0123 (10) | 0.0153 (11) | −0.0006 (8) | −0.0001 (8) | 0.0002 (8) |
| C3 | 0.0133 (10) | 0.0121 (10) | 0.0132 (10) | −0.0017 (8) | 0.0026 (8) | 0.0011 (8) |
| C4 | 0.0199 (12) | 0.0152 (10) | 0.0129 (10) | −0.0015 (9) | 0.0011 (8) | 0.0032 (8) |

*Geometric parameters (Å, º)*

| | | | |
|---|---|---|---|
| K1—O1 | 2.7664 (18) | Pr1—O7 | 2.4905 (18) |
| K1—O2 | 3.0138 (18) | Pr1—O8$^{vi}$ | 2.6011 (18) |
| K1—O3$^{i}$ | 2.8785 (18) | O1—C1 | 1.246 (3) |
| K1—O4$^{i}$ | 2.8679 (18) | O2—C1 | 1.251 (3) |
| K1—O7$^{ii}$ | 2.9131 (19) | O3—C2 | 1.258 (3) |
| K1—O8$^{ii}$ | 2.8392 (19) | O4—C2 | 1.247 (3) |
| K1—O8$^{i}$ | 3.152 (2) | O5—C3 | 1.236 (3) |
| Pr1—O1 | 2.4590 (17) | O6—C3 | 1.268 (3) |
| Pr1—O2$^{iii}$ | 2.4901 (17) | O7—C4 | 1.262 (3) |
| Pr1—O3 | 2.4906 (17) | O8—C4 | 1.242 (3) |
| Pr1—O4$^{iii}$ | 2.4990 (17) | C1—C2 | 1.553 (3) |
| Pr1—O5 | 2.5514 (18) | C3—C3$^{iv}$ | 1.543 (4) |
| Pr1—O6$^{iv}$ | 2.5883 (16) | C4—C4$^{vi}$ | 1.547 (5) |
| Pr1—O6$^{v}$ | 2.5777 (17) | | |

| | | | |
|---|---|---|---|
| O1—K1—O2 | 44.88 (5) | O7—Pr1—O5 | 104.63 (6) |
| O1—K1—O3$^{i}$ | 118.80 (5) | O7—Pr1—O6$^{v}$ | 79.29 (5) |
| O1—K1—O4$^{i}$ | 84.99 (6) | O7—Pr1—O6$^{iv}$ | 79.73 (6) |
| O1—K1—O7$^{ii}$ | 80.50 (6) | O7—Pr1—O8$^{vi}$ | 63.05 (6) |
| O1—K1—O8$^{ii}$ | 98.71 (6) | Pr1—O1—K1 | 138.75 (7) |
| O1—K1—O8$^{i}$ | 162.61 (6) | C1—O1—Pr1 | 119.90 (15) |
| O2—K1—O8$^{i}$ | 122.32 (5) | C1—O1—K1 | 99.54 (13) |
| O3$^{i}$—K1—O2 | 160.37 (5) | Pr1$^{vii}$—O2—K1 | 149.93 (7) |
| O3$^{i}$—K1—O7$^{ii}$ | 129.25 (5) | C1—O2—Pr1$^{vii}$ | 120.31 (14) |
| O3$^{i}$—K1—O8$^{i}$ | 75.95 (5) | C1—O2—K1 | 87.73 (13) |
| O4$^{i}$—K1—O2 | 115.43 (5) | Pr1—O3—K1$^{viii}$ | 142.55 (7) |
| O4$^{i}$—K1—O3$^{i}$ | 45.63 (5) | C2—O3—Pr1 | 118.69 (14) |
| O4$^{i}$—K1—O7$^{ii}$ | 156.68 (6) | C2—O3—K1$^{viii}$ | 93.18 (13) |
| O4$^{i}$—K1—O8$^{i}$ | 112.39 (5) | Pr1$^{vii}$—O4—K1$^{viii}$ | 142.41 (7) |
| O7$^{ii}$—K1—O2 | 65.03 (5) | C2—O4—Pr1$^{vii}$ | 119.98 (15) |
| O7$^{ii}$—K1—O8$^{i}$ | 82.78 (5) | C2—O4—K1$^{viii}$ | 93.94 (14) |
| O8$^{ii}$—K1—O2 | 107.59 (5) | Pr1—O5—K1$^{ix}$ | 94.19 (5) |
| O8$^{ii}$—K1—O3$^{i}$ | 83.70 (5) | C3—O5—Pr1 | 116.08 (15) |
| O8$^{ii}$—K1—O4$^{i}$ | 119.81 (6) | C3—O5—K1$^{ix}$ | 93.93 (14) |
| O8$^{ii}$—K1—O7$^{ii}$ | 45.83 (5) | Pr1$^{x}$—O6—Pr1$^{iv}$ | 119.27 (6) |
| O8$^{ii}$—K1—O8$^{i}$ | 72.57 (6) | C3—O6—Pr1$^{iv}$ | 115.59 (14) |
| O1—Pr1—O2$^{iii}$ | 78.31 (6) | C3—O6—Pr1$^{x}$ | 111.22 (14) |
| O1—Pr1—O3 | 66.22 (6) | Pr1—O7—K1$^{xi}$ | 138.04 (7) |
| O1—Pr1—O4$^{iii}$ | 71.70 (7) | C4—O7—Pr1 | 115.73 (15) |
| O1—Pr1—O5 | 76.58 (6) | C4—O7—K1$^{xi}$ | 91.60 (14) |
| O1—Pr1—O6$^{iv}$ | 135.11 (6) | Pr1$^{vi}$—O8—K1$^{viii}$ | 96.89 (6) |
| O1—Pr1—O6$^{v}$ | 142.50 (6) | Pr1$^{vi}$—O8—K1$^{xi}$ | 141.18 (8) |
| O1—Pr1—O7 | 131.20 (6) | K1$^{xi}$—O8—K1$^{viii}$ | 107.43 (6) |
| O1—Pr1—O8$^{vi}$ | 74.44 (6) | C4—O8—Pr1$^{vi}$ | 112.76 (15) |
| O2$^{iii}$—Pr1—O3 | 132.24 (6) | C4—O8—K1$^{xi}$ | 95.54 (14) |
| O2$^{iii}$—Pr1—O4$^{iii}$ | 65.29 (5) | C4—O8—K1$^{viii}$ | 94.06 (15) |
| O2$^{iii}$—Pr1—O5 | 69.64 (6) | O1—C1—O2 | 125.4 (2) |
| O2$^{iii}$—Pr1—O6$^{v}$ | 78.71 (6) | O1—C1—C2 | 117.7 (2) |
| O2$^{iii}$—Pr1—O6$^{iv}$ | 70.61 (5) | O2—C1—C2 | 116.9 (2) |
| O2$^{iii}$—Pr1—O7 | 149.06 (6) | O3—C2—K1$^{viii}$ | 63.74 (12) |
| O2$^{iii}$—Pr1—O8$^{vi}$ | 131.75 (6) | O3—C2—C1 | 117.0 (2) |
| O3—Pr1—O4$^{iii}$ | 73.62 (6) | O4—C2—K1$^{viii}$ | 63.23 (12) |
| O3—Pr1—O5 | 126.83 (6) | O4—C2—O3 | 125.7 (2) |
| O3—Pr1—O6$^{v}$ | 111.02 (6) | O4—C2—C1 | 117.3 (2) |
| O3—Pr1—O6$^{iv}$ | 155.90 (6) | C1—C2—K1$^{viii}$ | 166.83 (15) |
| O3—Pr1—O8$^{vi}$ | 68.48 (6) | O5—C3—O6 | 126.1 (2) |
| O4$^{iii}$—Pr1—O5 | 128.75 (6) | O5—C3—C3$^{iv}$ | 118.5 (2) |
| O4$^{iii}$—Pr1—O6$^{iv}$ | 119.74 (6) | O6—C3—C3$^{iv}$ | 115.4 (2) |
| O4$^{iii}$—Pr1—O6$^{v}$ | 71.88 (6) | K1$^{xi}$—C4—K1$^{viii}$ | 92.69 (6) |
| O4$^{iii}$—Pr1—O8$^{vi}$ | 136.72 (6) | O7—C4—K1$^{xi}$ | 65.24 (13) |
| O5—Pr1—O6$^{iv}$ | 62.79 (5) | O7—C4—K1$^{viii}$ | 120.05 (16) |
| O5—Pr1—O6$^{v}$ | 121.51 (5) | O7—C4—C4$^{vi}$ | 116.2 (3) |

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| O5—Pr1—O8$^{vi}$ | 65.77 (6) | O8—C4—K1$^{viii}$ | 65.02 (14) |
| O6$^{v}$—Pr1—O6$^{iv}$ | 60.73 (6) | O8—C4—K1$^{xi}$ | 61.79 (13) |
| O6$^{iv}$—Pr1—O8$^{vi}$ | 103.22 (6) | O8—C4—O7 | 127.0 (2) |
| O6$^{v}$—Pr1—O8$^{vi}$ | 141.64 (6) | O8—C4—C4$^{vi}$ | 116.8 (2) |
| O7—Pr1—O3 | 76.38 (6) | C4$^{vi}$—C4—K1$^{viii}$ | 85.41 (17) |
| O7—Pr1—O4$^{iii}$ | 126.57 (6) | C4$^{vi}$—C4—K1$^{xi}$ | 178.0 (2) |
| | | | |
| K1—O1—C1—O2 | 17.8 (3) | Pr1—O3—C2—C1 | −5.8 (3) |
| K1—O1—C1—C2 | −162.38 (17) | Pr1$^{vii}$—O4—C2—K1$^{viii}$ | −163.10 (16) |
| K1—O2—C1—O1 | −16.1 (3) | Pr1$^{vii}$—O4—C2—O3 | −176.62 (18) |
| K1—O2—C1—C2 | 164.10 (18) | Pr1$^{vii}$—O4—C2—C1 | 2.1 (3) |
| K1$^{viii}$—O3—C2—O4 | 13.5 (3) | Pr1—O5—C3—O6 | −153.70 (19) |
| K1$^{viii}$—O3—C2—C1 | −165.28 (17) | Pr1—O5—C3—C3$^{iv}$ | 27.5 (3) |
| K1$^{viii}$—O4—C2—O3 | −13.5 (3) | Pr1$^{x}$—O6—C3—O5 | −13.3 (3) |
| K1$^{viii}$—O4—C2—C1 | 165.21 (17) | Pr1$^{iv}$—O6—C3—O5 | −153.45 (19) |
| K1$^{ix}$—O5—C3—O6 | 109.7 (2) | Pr1$^{iv}$—O6—C3—C3$^{iv}$ | 25.4 (3) |
| K1$^{ix}$—O5—C3—C3$^{iv}$ | −69.1 (2) | Pr1$^{x}$—O6—C3—C3$^{iv}$ | 165.52 (19) |
| K1$^{xi}$—O7—C4—K1$^{viii}$ | 78.04 (13) | Pr1—O7—C4—K1$^{xi}$ | −147.06 (14) |
| K1$^{xi}$—O7—C4—O8 | −1.9 (3) | Pr1—O7—C4—K1$^{viii}$ | −69.02 (18) |
| K1$^{xi}$—O7—C4—C4$^{vi}$ | 178.5 (2) | Pr1—O7—C4—O8 | −148.9 (2) |
| K1$^{viii}$—O8—C4—K1$^{xi}$ | 107.97 (7) | Pr1—O7—C4—C4$^{vi}$ | 31.5 (3) |
| K1$^{xi}$—O8—C4—K1$^{viii}$ | −107.97 (7) | Pr1$^{vi}$—O8—C4—K1$^{xi}$ | −152.81 (15) |
| K1$^{xi}$—O8—C4—O7 | 1.9 (3) | Pr1$^{vi}$—O8—C4—K1$^{viii}$ | 99.21 (11) |
| K1$^{viii}$—O8—C4—O7 | 109.9 (2) | Pr1$^{vi}$—O8—C4—O7 | −150.9 (2) |
| K1$^{xi}$—O8—C4—C4$^{vi}$ | −178.5 (2) | Pr1$^{vi}$—O8—C4—C4$^{vi}$ | 28.7 (3) |
| K1$^{viii}$—O8—C4—C4$^{vi}$ | −70.5 (3) | O1—C1—C2—K1$^{viii}$ | −89.4 (7) |
| Pr1—O1—C1—O2 | −174.77 (18) | O1—C1—C2—O3 | 0.6 (3) |
| Pr1—O1—C1—C2 | 5.0 (3) | O1—C1—C2—O4 | −178.3 (2) |
| Pr1$^{vii}$—O2—C1—O1 | 175.37 (19) | O2—C1—C2—K1$^{viii}$ | 90.4 (7) |
| Pr1$^{vii}$—O2—C1—C2 | −4.5 (3) | O2—C1—C2—O3 | −179.6 (2) |
| Pr1—O3—C2—K1$^{viii}$ | 159.52 (15) | O2—C1—C2—O4 | 1.6 (3) |
| Pr1—O3—C2—O4 | 172.99 (19) | | |

Symmetry codes: (i) $x-1, -y+3/2, z-1/2$; (ii) $-x+2, y+1/2, -z+1/2$; (iii) $x, -y+3/2, z-1/2$; (iv) $-x+1, -y+1, -z$; (v) $x+1, y, z$; (vi) $-x+2, -y+1, -z+1$; (vii) $x, -y+3/2, z+1/2$; (viii) $x+1, -y+3/2, z+1/2$; (ix) $-x+1, y-1/2, -z+1/2$; (x) $x-1, y, z$; (xi) $-x+2, y-1/2, -z+1/2$.