Acta Crystallographica Section E
Structure Reports Online
ISSN 1600-5368

Bis(2,2′-bipyridyl)(dichloroacetato)-copper(II) dichloroacetate dihydrate

Yu-Feng Li,[a] Lin-Tong Wang[b] and Fang-Fang Jian[c]*

[a]Microscale Science Institute, Department of Chemistry and Chemical Engineering, Weifang University, Weifang 261061, People's Republic of China, [b]Department of Chemistry and Chemical Engineering, Weifang University, Weifang 261061, People's Republic of China, and [c]Microscale Science Institute, Weifang University, Weifang 261061, People's Republic of China
Correspondence e-mail: ffjian2008@163.com

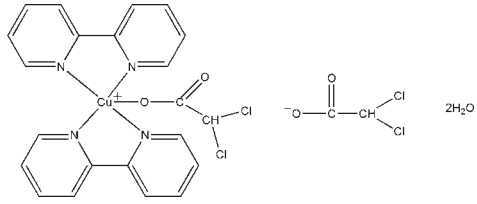
Received 25 December 2009; accepted 29 December 2009

Key indicators: single-crystal X-ray study; T = 293 K; mean σ(C–C) = 0.004 Å; R factor = 0.034; wR factor = 0.097; data-to-parameter ratio = 14.5.

In the title compound, $[Cu(C_2HCl_2O_2)(C_{10}H_8N_2)_2](C_2HCl_2O_2)\cdot 2H_2O$, the Cu^{II} ion is bonded to two N,N'-bidentate 2,2′-bipyridyl ligands and one O-monodentate 2,2-dichloroacetate anion in a distorted $CuON_4$ trigonal-bipyramidal geometry, with the O atom occupying an equatorial site. In the crystal, the components are linked by O—H···O and O—H···Cl hydrogen bonds.

Related literature

For a related structure, see: Barszcz *et al.* (2004).



Experimental

Crystal data

$[Cu(C_2HCl_2O_2)(C_{10}H_8N_2)_2]\cdot(C_2HCl_2O_2)\cdot 2H_2O$
M_r = 667.80
Triclinic, $P\overline{1}$
a = 9.9710 (7) Å
b = 11.7307 (9) Å
c = 12.4736 (9) Å
α = 105.407 (1)°
β = 101.499 (1)°
γ = 95.513 (1)°
V = 1361.07 (17) Å^3
Z = 2
Mo $K\alpha$ radiation
μ = 1.24 mm^{-1}
T = 293 K
0.22 × 0.20 × 0.18 mm

Data collection

Bruker SMART CCD diffractometer
7789 measured reflections
5280 independent reflections
4592 reflections with $I > 2\sigma(I)$
R_{int} = 0.033

Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.034
$wR(F^2)$ = 0.097
S = 1.06
5280 reflections
365 parameters
7 restraints
H atoms treated by a mixture of independent and constrained refinement
$\Delta\rho_{max}$ = 0.65 e Å^{-3}
$\Delta\rho_{min}$ = −0.64 e Å^{-3}

Table 1
Selected bond lengths (Å).

Cu1—N1	1.9879 (18)	Cu1—N3	2.0711 (18)
Cu1—N4	1.9889 (18)	Cu1—N2	2.1201 (18)
Cu1—O1	2.0121 (16)		

Table 2
Hydrogen-bond geometry (Å, °).

D—H···A	D—H	H···A	D···A	D—H···A
O1W—H1A···Cl2	0.84 (2)	2.79 (2)	3.571 (3)	155 (4)
O1W—H1B···O4	0.86 (2)	1.93 (2)	2.787 (4)	171 (4)
O2W—H2A···Cl1	0.88 (2)	2.76 (2)	3.511 (3)	144 (3)
O2W—H2B···O3^{i}	0.87 (2)	1.89 (2)	2.757 (3)	172 (4)

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

Data collection: *SMART* (Bruker, 1997); cell refinement: *SAINT* (Bruker, 1997); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL*.

The authors would like to thank the Science Foundation of Weifang University (No. 2009Z24) and the Natural Science Foundation of Shandong Province (No. ZR2009BM041)

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HB5295).

References

Barszcz, B., Glowiak, T., Jezierska, J. & Tomkiewicz, A. (2004). *Polyhedron*, **23**, 1308–1316
Bruker (1997). *SMART* and *SAINT*. Bruker AXS Inc., Madison, Wisconsin, USA.
Sheldrick, G. M. (2008). *Acta Cryst.* A**64**, 112–122.

supplementary materials

Acta Cryst. (2010). E**66**, m141 [**doi:10.1107/S1600536809055640**]

Bis(2,2'-bipyridyl)(dichloroacetato)copper(II) dichloroacetate dihydrate

Y.-F. Li, L.-T. Wang and F.-F. Jian

Experimental

Copper(II) 2,2-dicholoracetate, 0.32 g (1 mmol) and 2,2'-bipyridine 0.31 g (2 mmol) were added to 65 ml anhydrous alcohol under stirring. The mixture was refluxed for 7 h. The blue solution was filtered and the filtrate was left to stand undisturbed. Upon slow evaporation at room temperature, blue blocks of (I) appeared three days later and were separated by filtration.

Refinement

The water H atoms were located in a difference map and freely refined. The C-bonded H atoms were positioned geometrically (C—H = 0.93–0.98 Å) and refined as riding with U_{iso}(H) = 1.2U_{eq}(C).

Figures

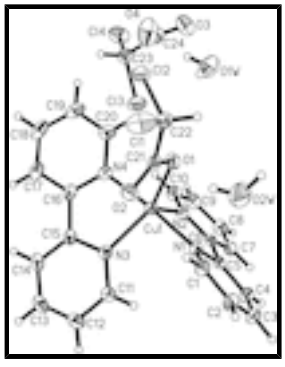


Fig. 1. The molecular structure for (I), with displacement ellipsoids drawn at the 30% probability level.

Bis(2,2'-bipyridyl)(dichloroacetato)copper(II) dichloroacetate dihydrate

Crystal data

$[Cu(C_2HCl_2O_2)(C_{10}H_8N_2)_2](C_2HCl_2O_2)\cdot 2H_2O$	$Z = 2$
$M_r = 667.80$	$F(000) = 678$
Triclinic, $P\overline{1}$	$D_x = 1.629$ Mg m^{-3}
Hall symbol: -P 1	Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å
$a = 9.9710$ (7) Å	Cell parameters from 2240 reflections
$b = 11.7307$ (9) Å	$\theta = 2.2$–$28.3°$
$c = 12.4736$ (9) Å	$\mu = 1.24$ mm^{-1}
$\alpha = 105.407$ (1)°	$T = 293$ K
$\beta = 101.499$ (1)°	Block, blue
$\gamma = 95.513$ (1)°	0.22 × 0.20 × 0.18 mm
$V = 1361.07$ (17) Å^3	

Data collection

Bruker SMART CCD diffractometer	4592 reflections with $I > 2\sigma(I)$
Radiation source: fine-focus sealed tube	$R_{int} = 0.033$
graphite	$\theta_{max} = 26.0°$, $\theta_{min} = 1.8°$
phi and ω scans	$h = -11 \rightarrow 12$
7789 measured reflections	$k = -13 \rightarrow 14$
5280 independent reflections	$l = -15 \rightarrow 14$

Refinement

Refinement on F^2	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)] = 0.034$	H atoms treated by a mixture of independent and constrained refinement
$wR(F^2) = 0.097$	$w = 1/[\sigma^2(F_o^2) + (0.0542P)^2 + 0.3598P]$ where $P = (F_o^2 + 2F_c^2)/3$
$S = 1.06$	$(\Delta/\sigma)_{max} < 0.001$
5280 reflections	$\Delta\rho_{max} = 0.65$ e Å^{-3}
365 parameters	$\Delta\rho_{min} = -0.64$ e Å^{-3}
7 restraints	Extinction correction: *SHELXL97* (Sheldrick, 2008), $Fc^* = kFc[1+0.001xFc^2\lambda^3/\sin(2\theta)]^{-1/4}$
Primary atom site location: structure-invariant direct methods	Extinction coefficient: 0.0256 (15)

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. Refinement of F^2 against ALL reflections. The weighted *R*-factor *wR* and goodness of fit *S* are based on F^2, conventional *R*-factors *R* are based on *F*, with *F* set to zero for negative F^2. The threshold expression of $F^2 > \sigma(F^2)$ is used only for calculating *R*-factors(gt) *etc*. and is not relevant to the choice of reflections for refinement. *R*-factors based on F^2 are statistically about twice as large as those based on *F*, and *R*- factors based on ALL data will be even larger.

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

	x	*y*	*z*	U_{iso}*/U_{eq}
Cu1	0.02070 (3)	0.28505 (2)	0.24318 (2)	0.03074 (11)
Cl1	0.45242 (8)	0.39464 (9)	0.06435 (8)	0.0741 (3)
Cl2	0.50350 (6)	0.30032 (6)	0.25678 (6)	0.04867 (17)
O1	0.21727 (16)	0.36582 (14)	0.27220 (14)	0.0396 (4)
O2	0.17501 (17)	0.31459 (16)	0.08196 (15)	0.0459 (4)

N1	−0.06224 (19)	0.43199 (16)	0.24029 (15)	0.0318 (4)
N2	−0.05985 (19)	0.31277 (16)	0.39146 (15)	0.0326 (4)
N3	−0.13923 (19)	0.17107 (16)	0.11654 (15)	0.0328 (4)
N4	0.08416 (19)	0.12907 (17)	0.24147 (16)	0.0347 (4)
C1	−0.0573 (3)	0.4885 (2)	0.1606 (2)	0.0406 (5)
H1	−0.0007	0.4659	0.1103	0.049*
C2	−0.1329 (3)	0.5790 (2)	0.1503 (2)	0.0465 (6)
H2	−0.1280	0.6162	0.0936	0.056*
C3	−0.2157 (3)	0.6134 (2)	0.2255 (2)	0.0467 (6)
H3	−0.2691	0.6732	0.2193	0.056*
C4	−0.2185 (2)	0.5581 (2)	0.3104 (2)	0.0415 (5)
H4	−0.2722	0.5816	0.3629	0.050*
C5	−0.1403 (2)	0.46721 (18)	0.31641 (18)	0.0303 (4)
C6	−0.1365 (2)	0.40123 (18)	0.40308 (17)	0.0299 (4)
C7	−0.2055 (2)	0.4282 (2)	0.4908 (2)	0.0404 (5)
H6	−0.2572	0.4905	0.4982	0.049*
C8	−0.1960 (3)	0.3608 (2)	0.5670 (2)	0.0460 (6)
H8	−0.2415	0.3771	0.6263	0.055*
C9	−0.1187 (3)	0.2699 (2)	0.5541 (2)	0.0472 (6)
H9	−0.1114	0.2233	0.6041	0.057*
C10	−0.0515 (3)	0.2483 (2)	0.4653 (2)	0.0411 (5)
H10	0.0013	0.1868	0.4569	0.049*
C11	−0.2514 (2)	0.1998 (2)	0.0568 (2)	0.0405 (5)
H11	−0.2605	0.2802	0.0702	0.049*
C12	−0.3538 (3)	0.1155 (3)	−0.0237 (2)	0.0495 (6)
H12	−0.4300	0.1383	−0.0644	0.059*
C13	−0.3404 (3)	−0.0027 (3)	−0.0422 (2)	0.0525 (7)
H13	−0.4082	−0.0614	−0.0960	0.063*
C14	−0.2268 (3)	−0.0348 (2)	0.0188 (2)	0.0457 (6)
H14	−0.2175	−0.1150	0.0072	0.055*
C15	−0.1260 (2)	0.05451 (19)	0.09785 (18)	0.0334 (5)
C16	0.0007 (2)	0.0309 (2)	0.16703 (19)	0.0351 (5)
C17	0.0356 (3)	−0.0829 (2)	0.1571 (2)	0.0478 (6)
H17	−0.0222	−0.1500	0.1051	0.057*
C18	0.1576 (3)	−0.0946 (3)	0.2256 (3)	0.0571 (8)
H18	0.1831	−0.1698	0.2199	0.069*
C19	0.2412 (3)	0.0060 (3)	0.3024 (2)	0.0528 (7)
H19	0.3232	−0.0005	0.3495	0.063*
C20	0.2015 (3)	0.1165 (2)	0.3086 (2)	0.0450 (6)
H20	0.2577	0.1843	0.3607	0.054*
C21	0.2517 (2)	0.35388 (19)	0.1777 (2)	0.0341 (5)
C22	0.4076 (2)	0.3961 (2)	0.1938 (2)	0.0402 (5)
H22	0.4324	0.4778	0.2456	0.048*
Cl3	0.17481 (9)	0.06640 (8)	0.59492 (10)	0.0833 (3)
Cl4	0.36379 (9)	−0.04850 (8)	0.72163 (7)	0.0722 (2)
O3	0.4801 (3)	0.2075 (2)	0.7501 (2)	0.0807 (7)
O4	0.4943 (3)	0.1598 (2)	0.5687 (3)	0.0971 (9)
C23	0.3436 (3)	0.0293 (2)	0.6185 (2)	0.0466 (6)
H23A	0.3545	−0.0240	0.5466	0.056*

C24	0.4501 (3)	0.1442 (3)	0.6506 (3)	0.0550 (7)
O1W	0.4574 (3)	0.3842 (2)	0.5424 (2)	0.0744 (7)
H1A	0.455 (4)	0.384 (4)	0.4747 (19)	0.089*
H1B	0.467 (4)	0.312 (2)	0.543 (3)	0.089*
O2W	0.2759 (3)	0.6333 (2)	0.1579 (3)	0.0885 (8)
H2A	0.299 (3)	0.579 (2)	0.104 (2)	0.106*
H2B	0.349 (3)	0.686 (3)	0.192 (3)	0.106*

Atomic displacement parameters (Å^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
Cu1	0.03054 (16)	0.02735 (16)	0.03555 (17)	0.00635 (10)	0.00873 (11)	0.00987 (11)
Cl1	0.0572 (4)	0.1167 (7)	0.0791 (5)	0.0245 (5)	0.0366 (4)	0.0615 (5)
Cl2	0.0370 (3)	0.0532 (4)	0.0565 (4)	0.0097 (3)	0.0046 (3)	0.0210 (3)
O1	0.0362 (8)	0.0390 (9)	0.0408 (9)	0.0010 (7)	0.0126 (7)	0.0062 (7)
O2	0.0399 (9)	0.0490 (10)	0.0437 (10)	0.0044 (8)	0.0057 (8)	0.0091 (8)
N1	0.0333 (9)	0.0273 (9)	0.0355 (9)	0.0062 (7)	0.0103 (8)	0.0083 (7)
N2	0.0341 (9)	0.0306 (9)	0.0314 (9)	0.0031 (7)	0.0070 (8)	0.0073 (7)
N3	0.0332 (9)	0.0300 (9)	0.0337 (9)	0.0034 (7)	0.0085 (8)	0.0070 (7)
N4	0.0354 (10)	0.0352 (10)	0.0375 (10)	0.0100 (8)	0.0118 (8)	0.0130 (8)
C1	0.0478 (14)	0.0352 (12)	0.0423 (13)	0.0085 (10)	0.0143 (11)	0.0140 (10)
C2	0.0562 (16)	0.0365 (13)	0.0501 (14)	0.0084 (11)	0.0097 (12)	0.0199 (11)
C3	0.0469 (14)	0.0349 (13)	0.0582 (16)	0.0147 (11)	0.0073 (12)	0.0140 (11)
C4	0.0384 (12)	0.0368 (13)	0.0480 (14)	0.0108 (10)	0.0112 (11)	0.0076 (10)
C5	0.0250 (10)	0.0268 (10)	0.0339 (11)	−0.0008 (8)	0.0038 (8)	0.0040 (8)
C6	0.0251 (10)	0.0287 (10)	0.0300 (10)	−0.0027 (8)	0.0036 (8)	0.0031 (8)
C7	0.0343 (12)	0.0429 (13)	0.0396 (12)	0.0027 (10)	0.0116 (10)	0.0034 (10)
C8	0.0433 (14)	0.0579 (16)	0.0347 (12)	−0.0009 (12)	0.0162 (11)	0.0078 (11)
C9	0.0540 (15)	0.0526 (15)	0.0374 (13)	−0.0002 (12)	0.0121 (11)	0.0191 (11)
C10	0.0464 (14)	0.0402 (13)	0.0401 (13)	0.0074 (10)	0.0115 (11)	0.0160 (10)
C11	0.0361 (12)	0.0399 (13)	0.0423 (13)	0.0057 (10)	0.0047 (10)	0.0100 (10)
C12	0.0372 (13)	0.0603 (17)	0.0445 (14)	0.0023 (12)	0.0023 (11)	0.0119 (12)
C13	0.0465 (15)	0.0520 (16)	0.0445 (14)	−0.0091 (12)	0.0039 (12)	0.0008 (12)
C14	0.0526 (15)	0.0332 (12)	0.0450 (14)	−0.0018 (11)	0.0142 (12)	0.0018 (10)
C15	0.0377 (12)	0.0306 (11)	0.0328 (11)	0.0034 (9)	0.0149 (9)	0.0068 (9)
C16	0.0426 (12)	0.0314 (11)	0.0382 (12)	0.0084 (10)	0.0209 (10)	0.0123 (9)
C17	0.0645 (17)	0.0339 (13)	0.0553 (15)	0.0157 (12)	0.0273 (13)	0.0179 (11)
C18	0.081 (2)	0.0492 (16)	0.0656 (18)	0.0368 (15)	0.0391 (17)	0.0323 (14)
C19	0.0521 (16)	0.0683 (19)	0.0564 (16)	0.0319 (14)	0.0212 (13)	0.0349 (15)
C20	0.0412 (13)	0.0545 (15)	0.0449 (13)	0.0157 (12)	0.0108 (11)	0.0207 (12)
C21	0.0345 (11)	0.0244 (10)	0.0450 (13)	0.0052 (9)	0.0116 (10)	0.0110 (9)
C22	0.0361 (12)	0.0368 (12)	0.0500 (14)	0.0044 (10)	0.0134 (11)	0.0148 (11)
Cl3	0.0527 (4)	0.0712 (5)	0.1169 (8)	0.0183 (4)	−0.0088 (5)	0.0304 (5)
Cl4	0.0675 (5)	0.0819 (6)	0.0722 (5)	0.0014 (4)	−0.0030 (4)	0.0485 (4)
O3	0.0808 (17)	0.0708 (16)	0.0752 (16)	−0.0105 (13)	0.0049 (13)	0.0133 (13)
O4	0.139 (3)	0.0615 (15)	0.108 (2)	0.0046 (15)	0.068 (2)	0.0287 (14)
C23	0.0518 (15)	0.0491 (15)	0.0428 (13)	0.0156 (12)	0.0092 (12)	0.0187 (11)
C24	0.0577 (17)	0.0466 (16)	0.0661 (19)	0.0142 (13)	0.0198 (15)	0.0196 (14)

O1W	0.0842 (16)	0.0731 (16)	0.0853 (17)	0.0306 (13)	0.0462 (15)	0.0298 (14)
O2W	0.0756 (17)	0.0565 (15)	0.130 (2)	0.0066 (12)	0.0219 (17)	0.0243 (15)

Geometric parameters (Å, °)

Cu1—N1	1.9879 (18)	C9—H9	0.9300
Cu1—N4	1.9889 (18)	C10—H10	0.9300
Cu1—O1	2.0121 (16)	C11—C12	1.378 (3)
Cu1—N3	2.0711 (18)	C11—H11	0.9300
Cu1—N2	2.1201 (18)	C12—C13	1.368 (4)
Cl1—C22	1.755 (3)	C12—H12	0.9300
Cl2—C22	1.780 (2)	C13—C14	1.377 (4)
O1—C21	1.268 (3)	C13—H13	0.9300
O2—C21	1.225 (3)	C14—C15	1.390 (3)
N1—C1	1.340 (3)	C14—H14	0.9300
N1—C5	1.352 (3)	C15—C16	1.476 (3)
N2—C10	1.333 (3)	C16—C17	1.391 (3)
N2—C6	1.341 (3)	C17—C18	1.382 (4)
N3—C11	1.339 (3)	C17—H17	0.9300
N3—C15	1.349 (3)	C18—C19	1.377 (4)
N4—C20	1.341 (3)	C18—H18	0.9300
N4—C16	1.350 (3)	C19—C20	1.379 (4)
C1—C2	1.378 (3)	C19—H19	0.9300
C1—H1	0.9300	C20—H20	0.9300
C2—C3	1.377 (4)	C21—C22	1.542 (3)
C2—H2	0.9300	C22—H22	0.9800
C3—C4	1.385 (4)	Cl3—C23	1.766 (3)
C3—H3	0.9300	Cl4—C23	1.757 (3)
C4—C5	1.388 (3)	O3—C24	1.225 (4)
C4—H4	0.9300	O4—C24	1.239 (4)
C5—C6	1.484 (3)	C23—C24	1.540 (4)
C6—C7	1.388 (3)	C23—H23A	0.9800
C7—C8	1.384 (4)	O1W—H1A	0.839 (18)
C7—H6	0.9300	O1W—H1B	0.861 (19)
C8—C9	1.369 (4)	O2W—H2A	0.884 (16)
C8—H8	0.9300	O2W—H2B	0.867 (18)
C9—C10	1.385 (3)		
N1—Cu1—N4	174.19 (8)	C9—C10—H10	118.8
N1—Cu1—O1	94.77 (7)	N3—C11—C12	122.9 (2)
N4—Cu1—O1	91.01 (7)	N3—C11—H11	118.5
N1—Cu1—N3	94.63 (7)	C12—C11—H11	118.5
N4—Cu1—N3	80.37 (7)	C13—C12—C11	118.3 (3)
O1—Cu1—N3	142.56 (7)	C13—C12—H12	120.9
N1—Cu1—N2	79.44 (7)	C11—C12—H12	120.9
N4—Cu1—N2	98.73 (7)	C12—C13—C14	120.0 (2)
O1—Cu1—N2	114.17 (7)	C12—C13—H13	120.0
N3—Cu1—N2	103.17 (7)	C14—C13—H13	120.0
C21—O1—Cu1	109.56 (14)	C13—C14—C15	119.0 (2)
C1—N1—C5	119.18 (19)	C13—C14—H14	120.5

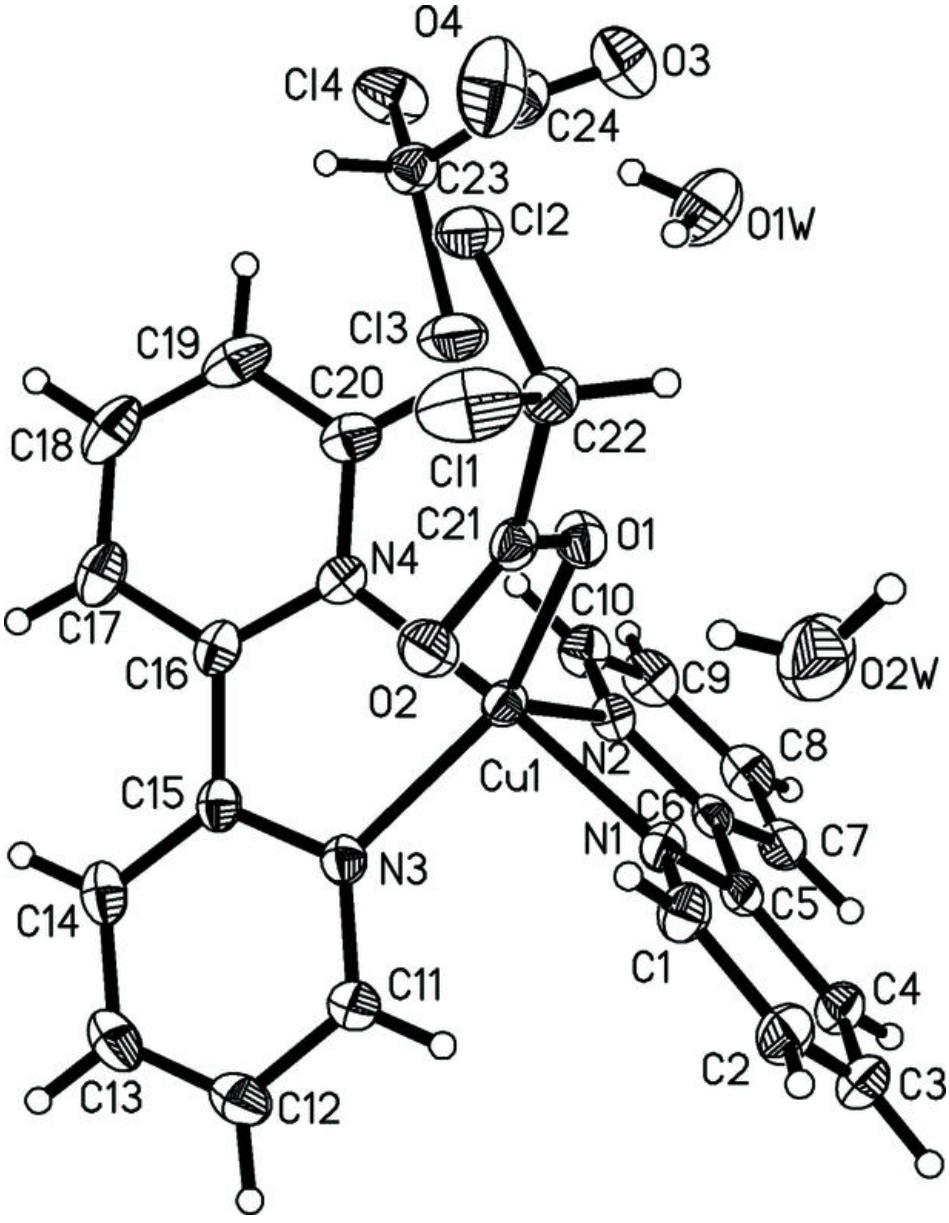
C1—N1—Cu1	123.79 (15)	C15—C14—H14	120.5
C5—N1—Cu1	116.62 (15)	N3—C15—C14	121.1 (2)
C10—N2—C6	118.93 (19)	N3—C15—C16	115.17 (19)
C10—N2—Cu1	127.95 (16)	C14—C15—C16	123.8 (2)
C6—N2—Cu1	112.90 (14)	N4—C16—C17	121.1 (2)
C11—N3—C15	118.69 (19)	N4—C16—C15	115.04 (19)
C11—N3—Cu1	127.97 (16)	C17—C16—C15	123.8 (2)
C15—N3—Cu1	113.30 (14)	C18—C17—C16	119.0 (3)
C20—N4—C16	119.4 (2)	C18—C17—H17	120.5
C20—N4—Cu1	124.53 (17)	C16—C17—H17	120.5
C16—N4—Cu1	116.08 (15)	C19—C18—C17	119.5 (2)
N1—C1—C2	122.5 (2)	C19—C18—H18	120.3
N1—C1—H1	118.7	C17—C18—H18	120.3
C2—C1—H1	118.7	C18—C19—C20	119.1 (3)
C3—C2—C1	118.8 (2)	C18—C19—H19	120.5
C3—C2—H2	120.6	C20—C19—H19	120.5
C1—C2—H2	120.6	N4—C20—C19	121.9 (3)
C2—C3—C4	119.2 (2)	N4—C20—H20	119.0
C2—C3—H3	120.4	C19—C20—H20	119.0
C4—C3—H3	120.4	O2—C21—O1	126.7 (2)
C3—C4—C5	119.4 (2)	O2—C21—C22	120.8 (2)
C3—C4—H4	120.3	O1—C21—C22	112.5 (2)
C5—C4—H4	120.3	C21—C22—Cl1	112.61 (17)
N1—C5—C4	120.8 (2)	C21—C22—Cl2	108.80 (16)
N1—C5—C6	115.24 (18)	Cl1—C22—Cl2	108.94 (13)
C4—C5—C6	123.9 (2)	C21—C22—H22	108.8
N2—C6—C7	121.7 (2)	Cl1—C22—H22	108.8
N2—C6—C5	114.97 (18)	Cl2—C22—H22	108.8
C7—C6—C5	123.4 (2)	C24—C23—Cl4	113.67 (19)
C8—C7—C6	118.9 (2)	C24—C23—Cl3	109.08 (18)
C8—C7—H6	120.6	Cl4—C23—Cl3	109.69 (15)
C6—C7—H6	120.6	C24—C23—H23A	108.1
C9—C8—C7	119.2 (2)	Cl4—C23—H23A	108.1
C9—C8—H8	120.4	Cl3—C23—H23A	108.1
C7—C8—H8	120.4	O3—C24—O4	128.5 (3)
C8—C9—C10	119.0 (2)	O3—C24—C23	118.1 (3)
C8—C9—H9	120.5	O4—C24—C23	113.4 (3)
C10—C9—H9	120.5	H1A—O1W—H1B	104 (4)
N2—C10—C9	122.3 (2)	H2A—O2W—H2B	107 (2)
N2—C10—H10	118.8		

Hydrogen-bond geometry (Å, °)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
O1W—H1A···Cl2	0.84 (2)	2.79 (2)	3.571 (3)	155 (4)
O1W—H1B···O4	0.86 (2)	1.93 (2)	2.787 (4)	171 (4)
O2W—H2A···Cl1	0.88 (2)	2.76 (2)	3.511 (3)	144 (3)
O2W—H2B···O3^{i}	0.87 (2)	1.89 (2)	2.757 (3)	172 (4)

Symmetry codes: (i) −*x*+1, −*y*+1, −*z*+1.

Fig. 1


O4
O3
Cl4
C24
C23
Cl2
O1W
Cl3
C19
C20
C18
Cl1
C22
C21
O1
N4
C10
C17
C16
O2
C9
O2W
C8
N2
Cu1
C15
C6
N1
C7
N3
C5
C14
C1
C4
C11
C2
C3
C13
C12