Acta Crystallographica Section E
**Structure Reports Online**
ISSN 1600-5368

# *catena*-Poly[[tris[silver(I)-$\mu$-4,4′-bipyridine-$\kappa^2N$:$N'$]] tris(perchlorate) dihydrate]

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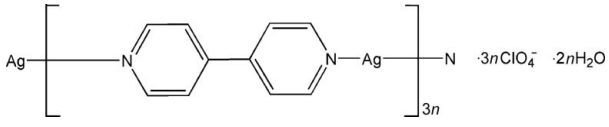
Received 4 September 2011; accepted 29 September 2011

Key indicators: single-crystal X-ray study; $T$ = 296 K; mean $\sigma$(C–C) = 0.010 Å; $R$ factor = 0.062; $wR$ factor = 0.170; data-to-parameter ratio = 12.4.

In the title compound, $\{[Ag_3(C_{10}H_8N_2)_3](ClO_4)_3\cdot 2H_2O\}_n$, one of the $Ag^I$ ions, one of the 4,4′-bipyridine (bipy) ligands and one of the perchlorate anions are each situated on a twofold rotation axis. Each $Ag^I$ ion is coordinated by two N atoms from two bridging bipy ligands, forming chains along [101]. $\pi$–$\pi$ interactions between the pyridine rings [centroid–centroid distances = 3.638 (8) and 3.688 (8) Å] connect the chains. Intermolecular O—H···O hydrogen bonds link the uncoordinated water molecules and the perchlorate anions.

## Related literature

For background to the network topologies and applications of coordination polymers, see: Du *et al.* (2007); Hu *et al.* (2003); Lou *et al.* (2005); Maspoch *et al.* (2007); Ockwig *et al.* (2005); Xiao *et al.* (2006). For O—H···O hydrogen bonds, see: Desiraju (2004). For $\pi$–$\pi$ interactions, see: Zang *et al.* (2010).




## Experimental

### *Crystal data*

$[Ag_3(C_{10}H_8N_2)_3](ClO_4)_3\cdot 2H_2O$
$M_r$ = 1126.54
Monoclinic, $C2/c$
$a$ = 21.259 (2) Å
$b$ = 15.7647 (17) Å
$c$ = 20.949 (3) Å
$\beta$ = 148.768 (5)°
$V$ = 3640.4 (9) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 1.90 mm$^{-1}$
$T$ = 296 K
0.21 × 0.20 × 0.19 mm

### *Data collection*

Bruker APEXII CCD diffractometer
Absorption correction: multi-scan (*SADABS*; Bruker, 2001)
$T_{min}$ = 0.692, $T_{max}$ = 0.715
7095 measured reflections
3145 independent reflections
2229 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.037

### *Refinement*

$R[F^2 > 2\sigma(F^2)]$ = 0.062
$wR(F^2)$ = 0.170
$S$ = 1.01
3145 reflections
254 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 1.87 e Å$^{-3}$
$\Delta\rho_{min}$ = −1.07 e Å$^{-3}$

**Table 1**
Hydrogen-bond geometry (Å, °).

| $D$—H···$A$ | $D$—H | H···$A$ | $D$···$A$ | $D$—H···$A$ |
|---|---|---|---|---|
| O1$W$—H1$WB$···O4$^{i}$ | 0.85 | 2.21 | 3.060 (15) | 173 |
| O1$W$—H1$WA$···O3 | 0.85 | 2.44 | 2.99 (3) | 123 |

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

Data collection: *APEX2* (Bruker, 2007); cell refinement: *SAINT* (Bruker, 2007); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *DIAMOND* (Brandenburg, 1999); software used to prepare material for publication: *SHELXTL* (Sheldrick, 2008).

We thank the Science Research Foundation for High-Level Talents of Pingdingshan University (No. 2006047) for support.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HY2472).

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# supplementary materials

*Acta Cryst.* (2011). E**67**, m1505 [ **doi:10.1107/S1600536811040153** ]

# *catena*-Poly[[tris[silver(I)-$\mu$-4,4'-bipyridine-$\kappa^2N$:$N'$]] tris(perchlorate) dihydrate]

**X.-M. Hu and F.-A. Li**

## Comment

In recent years, supramolecular coordination assemblies have received much attention not only for their variety of architectures but also for potential applications as functional materials (Maspoch *et al.*, 2007; Ockwig *et al.*, 2005). According to literature, 4,4'-bipyridine (bipy) is a good bridging ligand to construct coordination polymers, by which many supramolecular structures have been furnished (Hu *et al.*, 2003; Lou *et al.*, 2005; Xiao *et al.*, 2006). The rational assembly of target metal-organic networks depends on the deliberate designs of ligands with adjustable connectivity and a reasonable choice of metal ions with specific coordination nature. Additionally, the use of auxiliary ligands is also an effective method for the construction of coordination polymers (Du *et al.*, 2007). To further explore the influence of *N*-donor ligands on the properties and construction of coordination polymer, we undertake synthetic and structural studies on an Ag(I) complex based on bipy.

As shown in Fig. 1, the asymmetric unit of the title compound consists of one and a half $Ag^I$ ions, one and a half bipy ligands, one water molecule and one and a half perchlorate anions. Each $Ag^I$ ion is two-coordinated by two N atoms from two bipy ligands, forming two different one-dimensional chains. Ag2 atom has close contacts with the water molecule and perchlorate anions [Ag2···O1W$^{i}$ = 2.872 (9), Ag2···O1$^{ii}$ = 2.84 (3), Ag···O6$^{iii}$ = 2.91 (1) Å. Symmetry codes: (i) 1/2+x, 1/2-y, 1/2+z; (ii) 3/2-x, 1/2-y, 1-z; (iii) 1-x, -y, 1-z]. The chains are further linked by π–π stacking interactions between different pyridine rings [centroid–centroid distances = 3.638 (8) and 3.688 (8) Å] (Zang *et al.*, 2010), resulting in a two-dimensional supramolecular structure in the *ac* plane (Fig. 2). The two-dimensional supramolecular structures which have positive charge are linked by Ag···O contacts and electrostatic attraction with the perchlorate anions, forming a three-dimensional supramolecular structure. O—H···O hydrogen bonds (Table 1) (Desiraju, 2004) link the lattice water molecules and perchlorate anions (Fig. 3).

## Experimental

A mixture of $AgClO_4.6H_2O$ (6.3 mg, 0.02 mmol), 4,4'-bipyridine (3.12 mg, 0.02 mmol) in a 10 ml mixed solution of $H_2O$ and ethanol (v/v = 1:3) and 5 drops of ammonia was sealed in a stainless-steel reactor with a Teflon liner and heated at 393 K for 72 h. A quantity of colorless single crystals were obtained after the mixture was cooled to room temperature at a rate of 10 K h$^{-1}$.

## Refinement

H atoms on C atoms were generated geometrically and refined as riding atoms, with C—H = 0.93 Å and $U_{iso}$(H) = 1.2$U_{eq}$(C). The approximate positions of water H atoms were obtained from a difference Fourier map and refined as riding, with O—H = 0.85 Å and $U_{iso}$(H) = 1.5$U_{eq}$(O). The highest residual electron density was found at 0.05 Å from Ag1 atom and the deepest hole at 0.89 Å from Ag2 atom.

## Figures

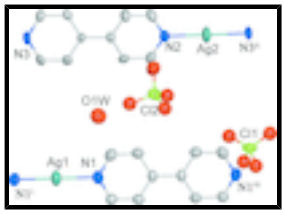

Fig. 1. The asymmetric unit of the title compound. Displacement ellipsoids are drawn at the 50% probability level. H atoms are omitted for clarity. [Symmetry codes: (i) -*x*, *y*, -*z*-1/2; (ii) *x*+1, *y*, *z*+1; (iii) -*x*+1, *y*, -*z*+1/2.]

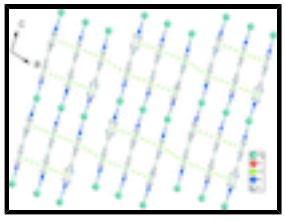

Fig. 2. Two-dimensional supramolecular structure in the title compound. Dashed lines indicate π–π interactions.

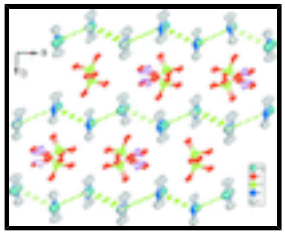

Fig. 3. Three-dimensional supramolecular structure of the title compound. Dashed lines indicate π–π interactions and hydrogen bonds.

### *catena*-Poly[tris[silver(I)-μ-4,4'-bipyridine-κ$^2$*N*:*N*'] tris(perchlorate) dihydrate]

*Crystal data*

| | |
|---|---|
| $[Ag_3(C_{10}H_8N_2)_3](ClO_4)_3·2H_2O$ | $F(000) = 2216$ |
| $M_r = 1126.54$ | $D_x = 2.056$ Mg m$^{-3}$ |
| Monoclinic, *C*2/*c* | Mo *K*α radiation, λ = 0.71073 Å |
| Hall symbol: -C 2yc | Cell parameters from 2263 reflections |
| *a* = 21.259 (2) Å | θ = 3.1–29.0° |
| *b* = 15.7647 (17) Å | μ = 1.90 mm$^{-1}$ |
| *c* = 20.949 (3) Å | *T* = 296 K |
| β = 148.768 (5)° | Block, colorless |
| *V* = 3640.4 (9) Å$^3$ | 0.21 × 0.20 × 0.19 mm |
| *Z* = 4 | |

*Data collection*

| | |
|---|---|
| Bruker APEXII CCD diffractometer | 3145 independent reflections |
| Radiation source: fine-focus sealed tube | 2229 reflections with $I > 2\sigma(I)$ |
| graphite | $R_{int} = 0.037$ |
| φ and ω scans | $\theta_{max} = 25.0°$, $\theta_{min} = 3.2°$ |
| Absorption correction: multi-scan (*SADABS*; Bruker, 2001) | *h* = −25→25 |
| $T_{min} = 0.692$, $T_{max} = 0.715$ | *k* = −12→18 |

| | |
|---|---|
| 7095 measured reflections | $l = -23 \rightarrow 24$ |

*Refinement*

| | |
|---|---|
| Refinement on $F^2$ | Primary atom site location: structure-invariant direct methods |
| Least-squares matrix: full | Secondary atom site location: difference Fourier map |
| $R[F^2 > 2\sigma(F^2)] = 0.062$ | Hydrogen site location: inferred from neighbouring sites |
| $wR(F^2) = 0.170$ | H-atom parameters constrained |
| $S = 1.01$ | $w = 1/[\sigma^2(F_o^2) + (0.0911P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$ |
| 3145 reflections | $(\Delta/\sigma)_{max} = 0.001$ |
| 254 parameters | $\Delta\rho_{max} = 1.87$ e Å$^{-3}$ |
| 0 restraints | $\Delta\rho_{min} = -1.07$ e Å$^{-3}$ |

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

| | *x* | *y* | *z* | $U_{iso}$*/$U_{eq}$ |
|---|---|---|---|---|
| Ag1 | 0.0000 | 0.45375 (5) | −0.2500 | 0.0566 (3) |
| Ag2 | 0.59795 (4) | 0.05250 (4) | 0.68999 (4) | 0.0558 (3) |
| O1 | 0.9612 (11) | 0.3396 (11) | 0.2576 (10) | 0.320 (11) |
| O2 | 1.0878 (12) | 0.2447 (7) | 0.3549 (11) | 0.225 (6) |
| O3 | 0.2999 (8) | 0.2382 (7) | 0.1888 (9) | 0.183 (5) |
| O4 | 0.4471 (17) | 0.2642 (6) | 0.3825 (14) | 0.279 (8) |
| O5 | 0.4822 (10) | 0.2063 (8) | 0.3197 (13) | 0.240 (6) |
| O6 | 0.3993 (6) | 0.1309 (6) | 0.3237 (6) | 0.147 (3) |
| O1W | 0.1272 (4) | 0.2966 (4) | 0.1401 (5) | 0.0789 (16) |
| H1WB | 0.0798 | 0.2751 | 0.0713 | 0.118* |
| H1WA | 0.2000 | 0.2788 | 0.2016 | 0.118* |
| N1 | 0.1878 (5) | 0.4546 (3) | −0.0596 (5) | 0.0465 (14) |
| N2 | 0.4098 (5) | 0.0531 (3) | 0.4983 (5) | 0.0404 (12) |
| N3 | −0.2117 (4) | 0.0492 (3) | −0.1224 (5) | 0.0410 (13) |
| C1 | 0.2488 (6) | 0.5264 (4) | −0.0009 (6) | 0.0390 (14) |
| H1 | 0.2081 | 0.5774 | −0.0424 | 0.047* |
| C2 | 0.3715 (6) | 0.5285 (4) | 0.1205 (6) | 0.0386 (14) |
| H2 | 0.4115 | 0.5803 | 0.1582 | 0.046* |
| C3 | 0.4347 (5) | 0.4539 (4) | 0.1856 (5) | 0.0318 (13) |
| C4 | 0.3680 (6) | 0.3788 (4) | 0.1220 (7) | 0.0522 (17) |
| H4 | 0.4053 | 0.3266 | 0.1612 | 0.063* |
| C5 | 0.2469 (6) | 0.3825 (5) | 0.0010 (6) | 0.0560 (19) |
| H5 | 0.2044 | 0.3319 | −0.0402 | 0.067* |
| C6 | 0.3549 (6) | −0.0171 (4) | 0.4321 (6) | 0.0480 (16) |
| H6 | 0.3989 | −0.0675 | 0.4706 | 0.058* |
| C7 | 0.2379 (5) | −0.0197 (4) | 0.3112 (5) | 0.0459 (16) |
| H7 | 0.2051 | −0.0703 | 0.2679 | 0.055* |
| C8 | 0.1676 (5) | 0.0518 (3) | 0.2521 (5) | 0.0295 (13) |
| C9 | 0.2230 (6) | 0.1252 (4) | 0.3215 (6) | 0.0461 (16) |

| | | | | |
|---|---|---|---|---|
| H9 | 0.1792 | 0.1755 | 0.2862 | 0.055* |
| C10 | 0.3441 (6) | 0.1232 (4) | 0.4441 (6) | 0.0524 (17) |
| H10 | 0.3805 | 0.1729 | 0.4900 | 0.063* |
| C11 | 0.0359 (5) | 0.0509 (3) | 0.1213 (5) | 0.0279 (12) |
| C12 | −0.0267 (5) | −0.0238 (4) | 0.0584 (5) | 0.0318 (13) |
| H12 | 0.0135 | −0.0754 | 0.0971 | 0.038* |
| C13 | −0.1494 (5) | −0.0225 (4) | −0.0625 (5) | 0.0382 (14) |
| H13 | −0.1898 | −0.0737 | −0.1032 | 0.046* |
| C14 | −0.1510 (6) | 0.1215 (4) | −0.0627 (6) | 0.0534 (18) |
| H14 | −0.1926 | 0.1725 | −0.1033 | 0.064* |
| C15 | −0.0293 (5) | 0.1237 (4) | 0.0570 (6) | 0.0490 (17) |
| H15 | 0.0094 | 0.1759 | 0.0948 | 0.059* |
| Cl1 | 1.0000 | 0.28764 (14) | 0.2500 | 0.0493 (6) |
| Cl2 | 0.41235 (16) | 0.21081 (11) | 0.30907 (16) | 0.0539 (5) |

*Atomic displacement parameters (Å$^2$)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| Ag1 | 0.0280 (4) | 0.0644 (6) | 0.0340 (5) | 0.000 | 0.0197 (4) | 0.000 |
| Ag2 | 0.0251 (3) | 0.0706 (5) | 0.0256 (3) | 0.0006 (2) | 0.0144 (3) | 0.0007 (2) |
| O1 | 0.233 (13) | 0.47 (2) | 0.132 (8) | 0.233 (16) | 0.137 (10) | 0.076 (12) |
| O2 | 0.310 (15) | 0.146 (9) | 0.195 (10) | 0.143 (9) | 0.212 (11) | 0.116 (7) |
| O3 | 0.136 (6) | 0.223 (12) | 0.165 (8) | 0.107 (8) | 0.125 (7) | 0.141 (8) |
| O4 | 0.51 (2) | 0.090 (7) | 0.279 (15) | −0.072 (11) | 0.343 (19) | −0.066 (9) |
| O5 | 0.218 (9) | 0.225 (13) | 0.388 (15) | 0.090 (10) | 0.277 (12) | 0.107 (12) |
| O6 | 0.101 (5) | 0.110 (7) | 0.090 (5) | −0.024 (5) | 0.060 (5) | 0.013 (4) |
| O1W | 0.069 (3) | 0.069 (4) | 0.076 (4) | 0.002 (3) | 0.058 (3) | 0.003 (3) |
| N1 | 0.033 (3) | 0.048 (4) | 0.035 (3) | 0.002 (2) | 0.025 (3) | 0.002 (3) |
| N2 | 0.027 (3) | 0.040 (3) | 0.032 (3) | 0.000 (2) | 0.022 (3) | 0.003 (2) |
| N3 | 0.017 (2) | 0.051 (4) | 0.020 (3) | 0.001 (2) | 0.010 (2) | 0.006 (2) |
| C1 | 0.037 (3) | 0.034 (3) | 0.039 (3) | −0.001 (3) | 0.032 (3) | −0.003 (3) |
| C2 | 0.042 (3) | 0.030 (3) | 0.038 (3) | 0.001 (3) | 0.033 (3) | −0.001 (3) |
| C3 | 0.027 (3) | 0.041 (4) | 0.030 (3) | 0.000 (2) | 0.024 (3) | 0.000 (3) |
| C4 | 0.040 (3) | 0.031 (4) | 0.051 (4) | 0.000 (3) | 0.033 (3) | 0.001 (3) |
| C5 | 0.043 (4) | 0.042 (4) | 0.043 (4) | −0.006 (4) | 0.030 (4) | −0.007 (4) |
| C6 | 0.035 (3) | 0.043 (4) | 0.034 (3) | 0.012 (3) | 0.024 (3) | 0.004 (3) |
| C7 | 0.032 (3) | 0.043 (4) | 0.027 (3) | 0.003 (3) | 0.019 (3) | −0.006 (3) |
| C8 | 0.023 (3) | 0.033 (3) | 0.023 (3) | −0.002 (2) | 0.018 (3) | 0.000 (2) |
| C9 | 0.038 (3) | 0.023 (3) | 0.039 (4) | −0.007 (3) | 0.027 (3) | −0.001 (3) |
| C10 | 0.034 (3) | 0.037 (4) | 0.037 (4) | −0.009 (3) | 0.022 (3) | −0.006 (3) |
| C11 | 0.022 (3) | 0.028 (3) | 0.019 (3) | −0.004 (2) | 0.015 (3) | −0.002 (2) |
| C12 | 0.024 (3) | 0.031 (3) | 0.029 (3) | 0.005 (2) | 0.020 (3) | 0.003 (3) |
| C13 | 0.026 (3) | 0.041 (3) | 0.022 (3) | −0.004 (3) | 0.017 (3) | −0.007 (3) |
| C14 | 0.029 (3) | 0.035 (4) | 0.027 (3) | 0.004 (3) | 0.013 (3) | 0.010 (3) |
| C15 | 0.036 (3) | 0.031 (4) | 0.029 (3) | −0.004 (3) | 0.020 (3) | 0.005 (3) |
| Cl1 | 0.0637 (15) | 0.0265 (11) | 0.0578 (15) | 0.000 | 0.0520 (14) | 0.000 |
| Cl2 | 0.0567 (11) | 0.0389 (9) | 0.0568 (11) | 0.0052 (8) | 0.0470 (10) | 0.0060 (8) |

*Geometric parameters (Å, °)*

| | | | |
|---|---|---|---|
| Ag1—N1 | 2.149 (6) | C3—C4 | 1.400 (8) |
| Ag1—N1$^{i}$ | 2.149 (6) | C3—C3$^{iii}$ | 1.475 (12) |
| Ag2—N3$^{ii}$ | 2.151 (5) | C4—C5 | 1.378 (10) |
| Ag2—N2 | 2.158 (6) | C4—H4 | 0.9300 |
| O1—Cl1 | 1.27 (3) | C5—H5 | 0.9300 |
| O2—Cl1 | 1.325 (9) | C6—C7 | 1.353 (8) |
| O3—Cl2 | 1.396 (8) | C6—H6 | 0.9300 |
| O4—Cl2 | 1.295 (10) | C7—C8 | 1.368 (8) |
| O5—Cl2 | 1.30 (3) | C7—H7 | 0.9300 |
| O6—Cl2 | 1.379 (8) | C8—C9 | 1.383 (8) |
| O1W—H1WB | 0.8500 | C8—C11 | 1.492 (8) |
| O1W—H1WA | 0.8500 | C9—C10 | 1.385 (9) |
| N1—C1 | 1.323 (8) | C9—H9 | 0.9300 |
| N1—C5 | 1.324 (9) | C10—H10 | 0.9300 |
| N2—C6 | 1.320 (8) | C11—C15 | 1.364 (8) |
| N2—C10 | 1.323 (8) | C11—C12 | 1.377 (8) |
| N3—C13 | 1.328 (8) | C12—C13 | 1.386 (7) |
| N3—C14 | 1.329 (8) | C12—H12 | 0.9300 |
| C1—C2 | 1.389 (9) | C13—H13 | 0.9300 |
| C1—H1 | 0.9300 | C14—C15 | 1.374 (8) |
| C2—C3 | 1.383 (8) | C14—H14 | 0.9300 |
| C2—H2 | 0.9300 | C15—H15 | 0.9300 |
| N1—Ag1—N1$^{i}$ | 179.3 (3) | C9—C8—C11 | 120.8 (5) |
| N3$^{ii}$—Ag2—N2 | 176.36 (19) | C8—C9—C10 | 119.5 (6) |
| H1WB—O1W—H1WA | 115.0 | C8—C9—H9 | 120.3 |
| C1—N1—C5 | 118.1 (6) | C10—C9—H9 | 120.3 |
| C1—N1—Ag1 | 121.3 (4) | N2—C10—C9 | 122.4 (6) |
| C5—N1—Ag1 | 120.5 (5) | N2—C10—H10 | 118.8 |
| C6—N2—C10 | 117.6 (6) | C9—C10—H10 | 118.8 |
| C6—N2—Ag2 | 121.2 (4) | C15—C11—C12 | 116.1 (6) |
| C10—N2—Ag2 | 121.1 (4) | C15—C11—C8 | 122.1 (5) |
| C13—N3—C14 | 117.3 (5) | C12—C11—C8 | 121.7 (5) |
| C13—N3—Ag2$^{iv}$ | 123.0 (4) | C11—C12—C13 | 120.3 (6) |
| C14—N3—Ag2$^{iv}$ | 119.7 (4) | C11—C12—H12 | 119.9 |
| N1—C1—C2 | 122.4 (6) | C13—C12—H12 | 119.9 |
| N1—C1—H1 | 118.8 | N3—C13—C12 | 122.5 (6) |
| C2—C1—H1 | 118.8 | N3—C13—H13 | 118.7 |
| C3—C2—C1 | 120.4 (6) | C12—C13—H13 | 118.7 |
| C3—C2—H2 | 119.8 | N3—C14—C15 | 122.5 (6) |
| C1—C2—H2 | 119.8 | N3—C14—H14 | 118.8 |
| C2—C3—C4 | 116.2 (6) | C15—C14—H14 | 118.8 |
| C2—C3—C3$^{iii}$ | 121.7 (4) | C11—C15—C14 | 121.2 (6) |
| C4—C3—C3$^{iii}$ | 122.1 (4) | C11—C15—H15 | 119.4 |
| C5—C4—C3 | 119.6 (6) | C14—C15—H15 | 119.4 |

| | | | |
|---|---|---|---|
| C5—C4—H4 | 120.2 | O1$^{v}$—Cl1—O1 | 99.3 (17) |
| C3—C4—H4 | 120.2 | O1$^{v}$—Cl1—O2$^{v}$ | 105.5 (7) |
| N1—C5—C4 | 123.3 (6) | O1—Cl1—O2$^{v}$ | 113.2 (9) |
| N1—C5—H5 | 118.4 | O1$^{v}$—Cl1—O2 | 113.2 (9) |
| C4—C5—H5 | 118.4 | O1—Cl1—O2 | 105.5 (7) |
| N2—C6—C7 | 123.4 (6) | O2$^{v}$—Cl1—O2 | 118.6 (12) |
| N2—C6—H6 | 118.3 | O4—Cl2—O5 | 115.0 (10) |
| C7—C6—H6 | 118.3 | O4—Cl2—O6 | 110.4 (7) |
| C6—C7—C8 | 120.5 (6) | O5—Cl2—O6 | 109.2 (6) |
| C6—C7—H7 | 119.8 | O4—Cl2—O3 | 107.5 (9) |
| C8—C7—H7 | 119.8 | O5—Cl2—O3 | 105.6 (7) |
| C7—C8—C9 | 116.7 (6) | O6—Cl2—O3 | 108.9 (5) |
| C7—C8—C11 | 122.5 (5) | | |
| C5—N1—C1—C2 | 0.5 (10) | C6—N2—C10—C9 | −2.1 (10) |
| Ag1—N1—C1—C2 | −177.1 (4) | Ag2—N2—C10—C9 | −179.5 (5) |
| N1—C1—C2—C3 | −0.8 (9) | C8—C9—C10—N2 | −0.1 (10) |
| C1—C2—C3—C4 | 0.2 (9) | C7—C8—C11—C15 | −169.4 (6) |
| C1—C2—C3—C3$^{iii}$ | 179.6 (6) | C9—C8—C11—C15 | 14.1 (9) |
| C2—C3—C4—C5 | 0.8 (10) | C7—C8—C11—C12 | 10.0 (9) |
| C3$^{iii}$—C3—C4—C5 | −178.7 (7) | C9—C8—C11—C12 | −166.5 (5) |
| C1—N1—C5—C4 | 0.5 (11) | C15—C11—C12—C13 | −1.4 (8) |
| Ag1—N1—C5—C4 | 178.1 (6) | C8—C11—C12—C13 | 179.1 (5) |
| C3—C4—C5—N1 | −1.1 (11) | C14—N3—C13—C12 | 1.3 (9) |
| C10—N2—C6—C7 | 4.0 (10) | Ag2$^{iv}$—N3—C13—C12 | 179.9 (4) |
| Ag2—N2—C6—C7 | −178.7 (5) | C11—C12—C13—N3 | −0.1 (9) |
| N2—C6—C7—C8 | −3.6 (11) | C13—N3—C14—C15 | −1.0 (10) |
| C6—C7—C8—C9 | 1.2 (9) | Ag2$^{iv}$—N3—C14—C15 | −179.7 (5) |
| C6—C7—C8—C11 | −175.4 (6) | C12—C11—C15—C14 | 1.7 (9) |
| C7—C8—C9—C10 | 0.5 (9) | C8—C11—C15—C14 | −178.8 (6) |
| C11—C8—C9—C10 | 177.2 (6) | N3—C14—C15—C11 | −0.5 (11) |

Symmetry codes: (i) −*x*, *y*, −*z*−1/2; (ii) *x*+1, *y*, *z*+1; (iii) −*x*+1, *y*, −*z*+1/2; (iv) *x*−1, *y*, *z*−1; (v) −*x*+2, *y*, −*z*+1/2.

*Hydrogen-bond geometry (Å, °)*

| *D*—H···*A* | *D*—H | H···*A* | *D*···*A* | *D*—H···*A* |
|---|---|---|---|---|
| O1W—H1WB···O4$^{vi}$ | 0.85 | 2.21 | 3.060 (15) | 173 |
| O1W—H1WA···O3 | 0.85 | 2.44 | 2.99 (3) | 123 |

Symmetry codes: (vi) *x*−1/2, −*y*+1/2, *z*−1/2.

**Fig. 1**

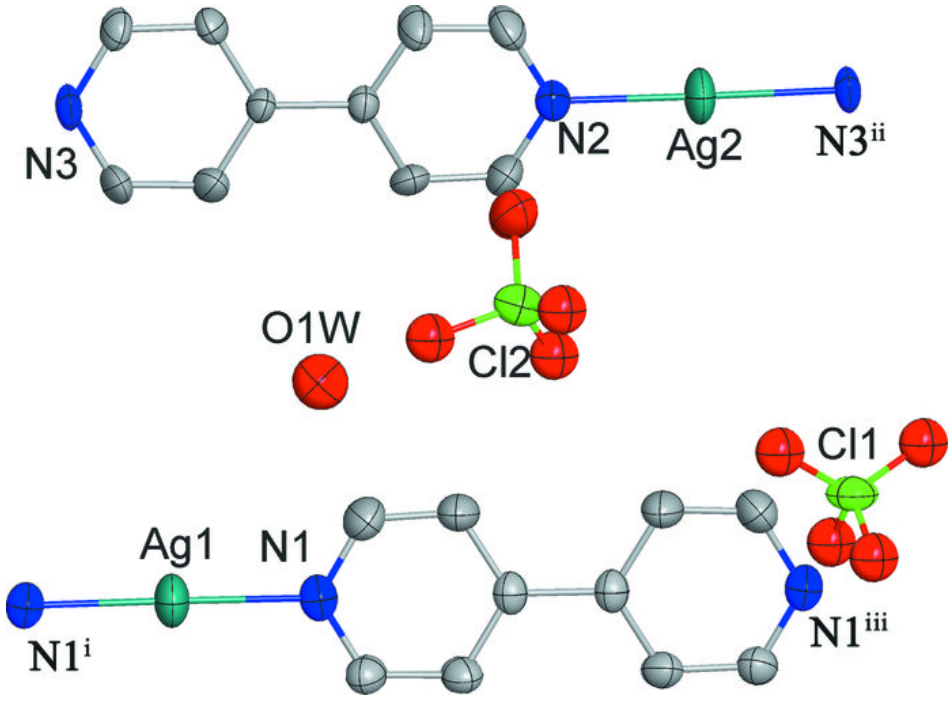

**Fig. 2**

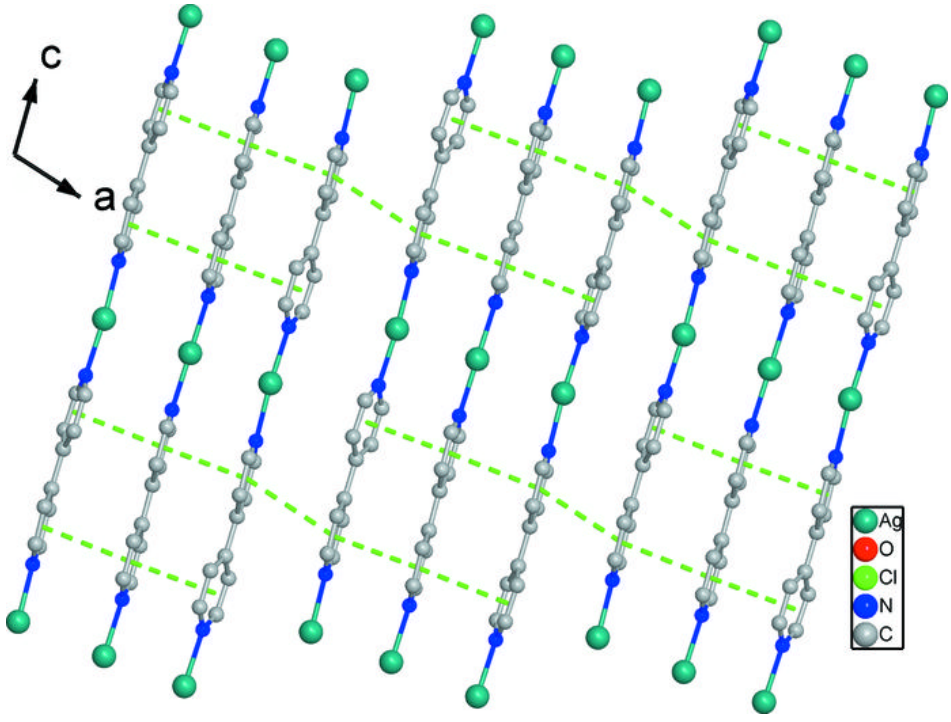

**Fig. 3**