

catena-Poly[[silver(I)- μ -[(*E*)-1,2-bis(2-pyridyl)ethylene-*N*:*N'*]] nitrate]

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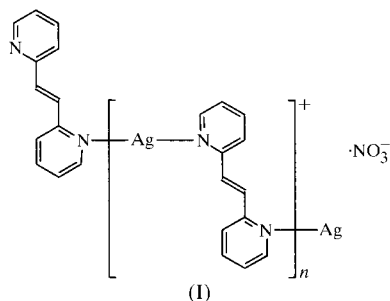
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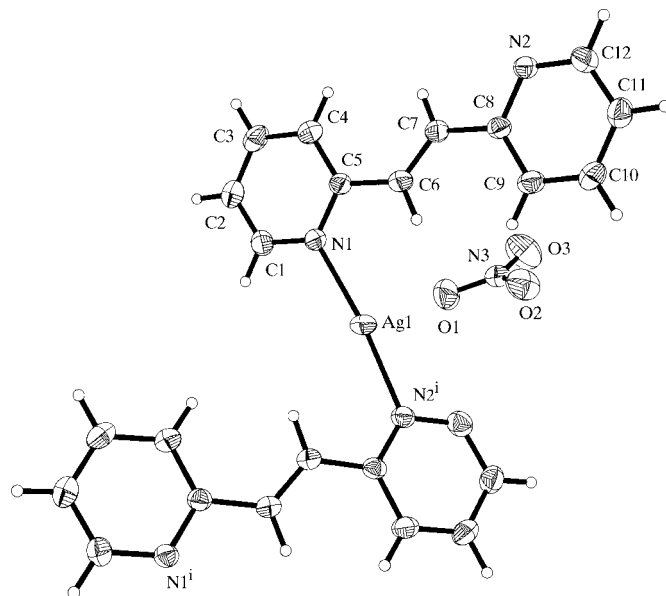
In the title complex, $\{[\text{Ag}(\text{C}_{12}\text{H}_{10}\text{N}_2)]\text{NO}_3\}_n$, the Ag atom, which is in a linear AgN_2 geometry, is surrounded by two *trans*-related N atoms of two bpe ligands [$\text{Ag}-\text{N} = 2.173$ (3) and 2.176 (3) Å; bpe is *trans*-1,2-bis(2-pyridyl)ethylene]. The bpe ligands bridge neighbouring Ag atoms to form zigzag polymeric chains in the lattice. These adjacent one-dimensional zigzag chains are extended into a three-dimensional supramolecular array by strong interchain $\pi \cdots \pi$ interactions between the pyridyl rings of adjacent chains.

Comment

The synthesis of coordination polymers with large channels or cavities is currently an active field due to their intriguing structural diversity and potential function as microporous solids for molecular adsorption, ion exchange and heterogeneous catalysis (Batten & Robson, 1998; Fujita *et al.*, 1994; Hoskins & Robson, 1990; Janiak, 1997; Subramanian & Zaworotko, 1995; Yaghi *et al.*, 1998). We have initiated a synthetic strategy for the preparation of non-interpenetrating open frameworks with variable cavities or channels, in which rod-like rigid spacers such as 4,4'-bipyridine, pyrazine and related species are chosen as building blocks (Chen *et al.*, 1996; Tong, Chen, Yu & Mak, 1998; Tong, Ye *et al.*, 1998; Tong, Chen, Ye & Ng, 1998; Tong, Zheng & Chen, 1999; Tong, Chen, Ye & Ji, 1999; Tong, Lee *et al.*, 1999). We report here the preparation and crystal structure of a one-dimensional zigzag

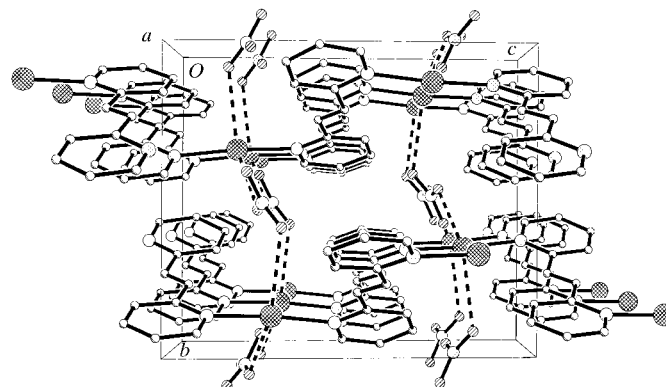


coordination chain of *trans*-1,2-bis(2-pyridyl)ethylene (bpe), namely, $\{[\text{Ag}(\text{bpe})]\text{NO}_3\}_n$, (I).

**Figure 1**

A molecular view of the coordination environment in (I) with 35% probability displacement ellipsoids. H atoms are shown as small spheres of arbitrary radii; the symmetry code is as in Table 1.

The crystal structure of (I) consists of cationic $[\text{Ag}(\text{bpe})]_n$ polymeric chains and nitrate counter-ions. As shown in Fig. 1, each Ag^{I} atom in the polymeric chain is coordinated in a nearly linear geometry to two bpe ligands [$\text{Ag}-\text{N} = 2.173$ (3) and 2.176 (6) Å, and $\text{N}-\text{Ag}-\text{N} = 172.05$ (10)°]. The $\text{Ag}-\text{N}$ distances in (I) are slightly longer than those in the isomorphous $\{[\text{Ag}(\text{bpe})]\text{ClO}_4\}_n$ structure [2.158 (3) and 2.166 (3) Å; Kitagawa *et al.*, 1991]. Each pair of adjacent intrachain Ag^{I} ions, at a separation of 7.747 (3) Å, is alternately bridged by a bpe ligand to form the polymeric chains. There are strong interchain $\pi \cdots \pi$ interactions between the pyridyl rings of adjacent chains, with a face-to-face separation of *ca* 3.16–3.46 Å, resulting in an extended three-dimensional supramolecular array (Fig. 2). The nitrate counter-ions occupy the cavities enclosed by the coordination chains and contact the adjacent interchain Ag^{I} atoms ($\text{Ag} \cdots \text{O} = 2.848$ – 2.947 Å), the weaker link furnishing a wavy three-dimensional network structure for (I).

**Figure 2**

A perspective view of the molecular packing in (I)

It should also be noted that hydrogen-bonding interactions play a role in consolidating the solid-state structure of (I). The nitrate counter-ions are hydrogen bonded to the adjacent bpe ligands [$C \cdots O = 3.209(3)–3.394(3) \text{ \AA}$], which is also observed in other related compounds (Krishnamohan *et al.*, 1998; Tong, Lee *et al.*, 1999).

Experimental

To a solution of AgNO_3 (1.0 mmol) in 1:1 (v/v) MeCN/ H_2O (10 ml), a solution of *trans*-1,2-bis(2-pyridyl)ethylene (1.0 mmol) in MeOH (5 ml) was added slowly with stirring for 15 min at 333 K. Colourless block crystals of (I) were deposited within 5 d (90% yield).

Crystal data

$[\text{Ag}(\text{C}_{12}\text{H}_{10}\text{N}_2)]\text{NO}_3$
 $M_r = 352.10$
 Monoclinic, $P2_1/n$
 $a = 8.516(3) \text{ \AA}$
 $b = 10.915(4) \text{ \AA}$
 $c = 13.054(6) \text{ \AA}$
 $\beta = 95.31(1)^\circ$
 $V = 1208.2(8) \text{ \AA}^3$
 $Z = 4$

$D_x = 1.936 \text{ Mg m}^{-3}$
 Mo $K\alpha$ radiation
 Cell parameters from 25 reflections
 $\theta = 7.5–15.0^\circ$
 $\mu = 1.675 \text{ mm}^{-1}$
 $T = 293(2) \text{ K}$
 Block, colourless
 $0.3 \times 0.3 \times 0.2 \text{ mm}$

Data collection

Siemens *R3m* diffractometer
 ω scans
 Absorption correction: semi-empirical via ψ scans (North *et al.*, 1968)
 $T_{\min} = 0.566$, $T_{\max} = 0.716$
 2944 measured reflections
 2764 independent reflections
 2081 reflections with $I > 2\sigma(I)$

$R_{\text{int}} = 0.019$
 $\theta_{\text{max}} = 27.50^\circ$
 $h = 0 \rightarrow 11$
 $k = 0 \rightarrow 14$
 $l = -16 \rightarrow 16$
 2 standard reflections every 150 reflections
 intensity decay: none

Refinement

Refinement on F^2
 $R[F^2 > 2\sigma(F^2)] = 0.034$
 $wR(F^2) = 0.080$
 $S = 1.018$
 2764 reflections
 173 parameters
 H atoms constrained

$w = 1/[\sigma^2(F_o^2) + (0.0341P)^2 + 0.7235P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} = 0.002$
 $\Delta\rho_{\text{max}} = 0.37 \text{ e \AA}^{-3}$
 $\Delta\rho_{\text{min}} = -0.33 \text{ e \AA}^{-3}$
 Extinction correction: *SHELXL97* (Sheldrick, 1997)
 Extinction coefficient: 0.0029 (5)

Data collection: *R3m Software* (Siemens, 1990); cell refinement: *R3m Software*; data reduction: *R3m Software*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL* (Sheldrick, 1995); software used to prepare material for publication: *SHELXL97*.

Table 1

Selected geometric parameters (\AA , $^\circ$).

$\text{Ag1}–\text{N2}^i$	2.173 (3)	$\text{Ag1}–\text{N1}$	2.176 (3)
$\text{N2}^i–\text{Ag1}–\text{N1}$	172.05 (10)	$\text{C5}–\text{N1}–\text{Ag1}$	122.5 (2)
$\text{C1}–\text{N1}–\text{C5}$	118.3 (3)	$\text{C12}–\text{N2}–\text{Ag1}^{ii}$	116.5 (2)
$\text{C1}–\text{N1}–\text{Ag1}$	119.0 (2)	$\text{C8}–\text{N2}–\text{Ag1}^{ii}$	124.8 (2)

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

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Supplementary data for this paper are available from the IUCr electronic archives (Reference: TA1291). Services for accessing these data are described at the back of the journal.

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