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# Di-$\mu$-chloro-bis[bis(3-methylisoquinoline-$\kappa N$)silver(I)]

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The title dinuclear compound, $[Ag_2Cl_2(C_{10}H_9N)_4]$, has $C_2$ symmetry. The $Ag^I$ ion is coordinated by two methylisoquinoline molecules and two $Cl^-$ anions with a distorted tetrahedral geometry. The distance of 3.0630 (9) Å between the two Ag atoms suggests the existence of an Ag—Ag bonding interaction within the dinuclear complex molecule.

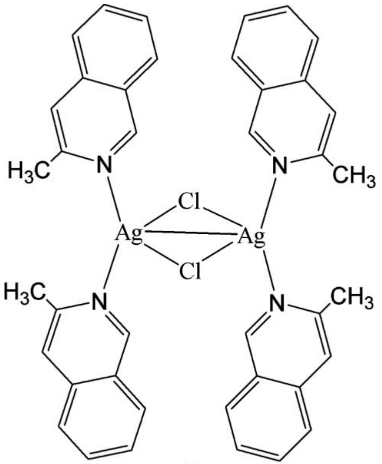
**Key indicators**

Single-crystal X-ray study
$T$ = 291 K
Mean $\sigma$(C–C) = 0.005 Å
$R$ factor = 0.031
$wR$ factor = 0.096
Data-to-parameter ratio = 19.3

For details of how these key indicators were automatically derived from the article, see http://journals.iucr.org/e.

## Comment

The $Ag^I$ ion exhibits flexible coordination geometry (Sharma & Rogers, 1998). For silver halides, 1:1 crystalline adducts are usually obtained (Mills & White, 1985). In our previous work, a 1:2 adduct of $[AgL_2]NO_3$ ($L$ = 3-methylisoquinoline) was reported (Dong *et al.*, 2005). We present here the structure of another 1:2 adduct $[AgClL_2]_2$, (I).



(I)

The molecular structure of (I) is shown in Fig. 1. Compound (I) shows a dinuclear structure, with the mid-point of the Ag—Ag bond located on a twofold axis. The structure is similar to that found in $[AgBr(2Me\text{-}py)_2]_2$ (Mills & White, 1985). Each $Ag^I$ ion is coordinated by two methylisoquinoline molecules with normal Ag—N bond distances (Table 1). Two $Ag^I$ ions are further bridged by two $Cl^-$ anions to form the dinuclear structure. Thus, the $Ag^I$ ion has a distorted tetrahedral coordination geometry. The Ag—Ag distance of 3.0630 (9) Å is identical to the sum of the covalent radii for the silver atoms and suggests the existence of metal–metal bonding within the dinuclear molecule.

## Experimental

AgCl (0.072 g, 0.5 mmol) was dissolved in an aqueous solution of $NH_3$ (14 $M$, 5 ml), then a solution of 3-methylisoquinoline (0.143 g, 1.0 mmol) in methanol (2 ml) was added, and a white precipitate formed immediately. The precipitate was collected by filtration, washed with water and dissolved in acetonitrile. Crystals of (I) were obtained by evaporating the solution for several days at room temperature.

### *Crystal data*

$[Ag_2Cl_2(C_{10}H_9N)_4]$
$M_r = 859.37$
Monoclinic, $C2/c$
$a = 24.760$ (5) Å
$b = 10.963$ (5) Å
$c = 16.881$ (5) Å
$\beta = 126.328$ (5)°
$V = 3692$ (2) Å$^3$
$Z = 4$

$D_x = 1.546$ Mg m$^{-3}$
Mo $K\alpha$ radiation
Cell parameters from 11437 reflections
$\theta = 2.1$–27.5°
$\mu = 1.24$ mm$^{-1}$
$T = 291$ (2) K
Block, colorless
0.27 × 0.22 × 0.21 mm

### *Data collection*

Rigaku R-AXIS RAPID diffractometer
$\omega$ scans
Absorption correction: multi-scan (*ABSCOR*; Higashi, 1995)
$T_{min} = 0.711$, $T_{max} = 0.776$
17327 measured reflections

4228 independent reflections
2635 reflections with $I > 2\sigma(I)$
$R_{int} = 0.037$
$\theta_{max} = 27.5°$
$h = -32 \rightarrow 25$
$k = -14 \rightarrow 14$
$l = -21 \rightarrow 21$

### *Refinement*

Refinement on $F^2$
$R[F^2 > 2\sigma(F^2)] = 0.031$
$wR(F^2) = 0.096$
$S = 0.88$
4228 reflections
219 parameters

H-atom parameters constrained
$w = 1/[\sigma^2(F_o^2) + (0.0537P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.002$
$\Delta\rho_{max} = 0.52$ e Å$^{-3}$
$\Delta\rho_{min} = -0.81$ e Å$^{-3}$

**Table 1**
Selected geometric parameters (Å, °).

| | | | |
|---|---|---|---|
| Ag1—N1 | 2.299 (2) | Ag1—Cl$^i$ | 2.6671 (10) |
| Ag1—N2 | 2.306 (3) | Ag1—Ag1$^i$ | 3.0630 (9) |
| Ag1—Cl | 2.6612 (11) | | |
| N1—Ag1—N2 | 130.96 (8) | N2—Ag1—Cl$^i$ | 95.56 (6) |
| N1—Ag1—Cl | 96.53 (7) | Cl—Ag1—Cl$^i$ | 106.02 (3) |
| N2—Ag1—Cl | 112.58 (7) | Ag1—Cl—Ag1$^i$ | 70.18 (3) |
| N1—Ag1—Cl$^i$ | 113.83 (6) | | |

Symmetry code: (i) $-x + 2, y, -z + \frac{3}{2}$.

Methyl H atoms were placed at calculated positions with C—H = 0.96 Å and the torsion angles refined to fit the electron density. Aromatic H atoms were positioned geometrically with C—H = 0.93 Å and refined as riding atoms. $U_{iso}$(H) was set as 1.2 or 1.5 times $U_{eq}$(C).

Data collection: *PROCESS-AUTO* (Rigaku, 1998); cell refinement: *PROCESS-AUTO*; data reduction: *PROCESS-AUTO*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *SHELXTL-Plus* (Sheldrick, 1990); software used to prepare material for publication: *SHELXL97*.

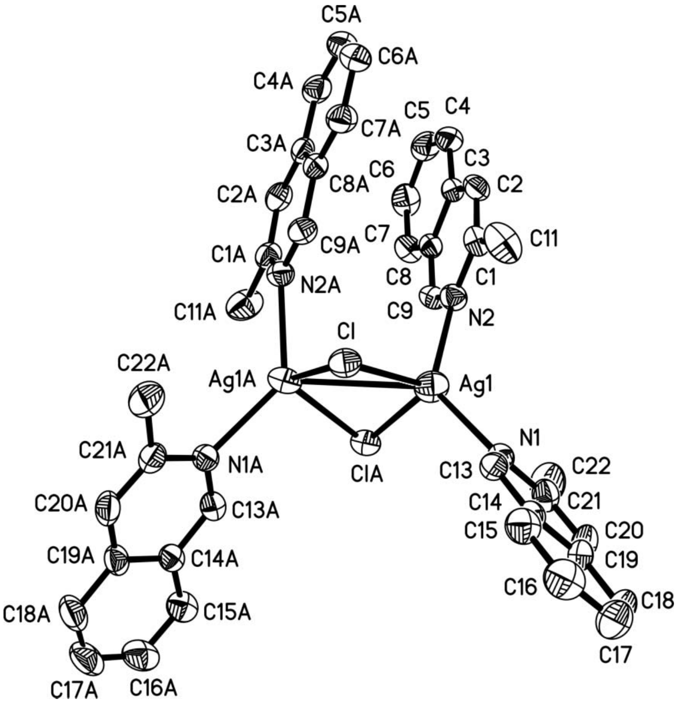


**Figure 1**
The molecular structure of (I), with 30% probability displacement ellipsoids [symmetry code: (A) $2 - x, y, \frac{3}{2} - z$]. H atoms have been omitted for clarity.

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