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Key indicators

Single-crystal X-ray study
 $T = 170$ K
Mean $\sigma(\text{C}-\text{C}) = 0.003$ Å
 R factor = 0.034
 wR factor = 0.089
Data-to-parameter ratio = 23.9For details of how these key indicators were
automatically derived from the article, see
<http://journals.iucr.org/e>.Chlorobis(piperidine- κ N)copper(I)

In the title compound, $[\text{CuCl}(\text{C}_{10}\text{H}_{22}\text{N}_2)]$, the Cu atom is connected to two N atoms of two crystallographically independent piperidine ligands and one Cl atom within a distorted trigonal-planar coordination. The complex molecules are stacked in the direction of the crystallographic b axis and are connected into chains *via* $\text{N}-\text{H}\cdots\text{Cl}$ hydrogen bonding along the crystallographic c axis.

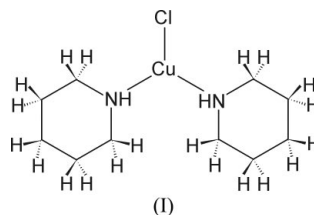
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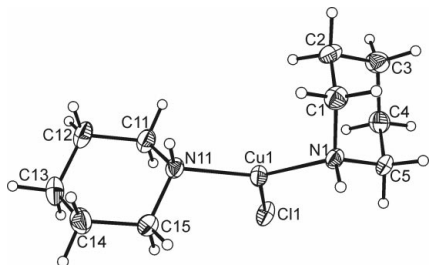
Comment

Recently, we have been interested in the synthesis, crystal structures and thermal properties of coordination polymers built up of copper(I) halides and N-donor ligands (Näther & Jeß, 2002, 2003; Näther, Greve & Jeß, 2002; Näther, Wriedt & Jeß, 2002). During these investigations, we have synthesized and structurally characterized the ligand-rich title compound, (I). For copper(I) halides and piperidine, only a few structures are known. In the ligand-poorer compound copper(I) iodide-piperidine, Cu_4I_4 cubes are found, in which each Cu atom is coordinated by three I atoms and one N atom of a piperidine ligand (Schramm, 1978). In the copper(I) halide-rich compounds $(\text{Cu}X)_2$ -piperidine-triphenylphosphine ($X = \text{Cl}, \text{Br}, \text{I}$), $(\text{Cu}X)_2$ dimers are found in which each Cu atom is coordinated by one piperidine and one triphenylphosphine ligand (Bowmaker *et al.*, 1994).



In (I), each Cu atom is coordinated by two N atoms of two crystallographically independent piperidine ligands and one Cl atom. The Cu–N bond lengths of 1.9959 (16) and 2.0045 (15) Å and the Cu–Cl bond length of 2.3187 (6) Å are in the range of those found in related structures retrieved from the Cambridge Structural Database (Version 1.6; Allen, 2002). The N–Cu–N and N–Cu–Cl angles are 135.37 (7), 116.68 (5) and 107.92 (5)°, and the Cu atoms show distorted trigonal-planar coordination.

In the crystal structure, discrete copper(I) chloride complexes are stacked in the direction of the crystallographic b axis and are connected by $\text{N}-\text{H}\cdots\text{Cl}$ hydrogen bonding. The Cl atom of one complex is connected to both N atoms of a neighbouring complex; the $\text{N}\cdots\text{Cl}$ distances are 3.2807 (17) and 3.31093 (18) Å, the $\text{Cl}\cdots\text{H}$ distances 2.38 and 2.42 Å and

**Figure 1**

The crystal structure of the title compound, with labelling and displacement ellipsoids drawn at the 50% probability level.

the N—H...Cl angles are 164 and 159°. From this arrangement, infinite chains result, which extend in the direction of the crystallographic *c* axis.

Experimental

The title compound was prepared by the reaction of 110.8 mg (0.824 mmol) CuCl and 1 ml (10.1 mmol) piperidine in a glass container. After about 7 d, large colourless crystals had grown, which were light-sensitive and had to be stored in the dark.

Crystal data

[CuCl(C₁₀H₂₂N₂)]
 $M_r = 269.29$
 Monoclinic, $P2_1/c$
 $a = 20.355$ (2) Å
 $b = 6.5407$ (4) Å
 $c = 9.7669$ (11) Å
 $\beta = 98.314$ (13)°
 $V = 1286.7$ (2) Å³
 $Z = 4$

$D_x = 1.390$ Mg m⁻³
 Mo $K\alpha$ radiation
 Cell parameters from 7942 reflections
 $\theta = 10$ –23°
 $\mu = 1.87$ mm⁻¹
 $T = 170$ (2) K
 Block, colourless
 $0.30 \times 0.18 \times 0.07$ mm

Data collection

Stoe IPDS diffractometer
 φ scans
 Absorption correction: numerical
 (*X-SHAPE*; Stoe & Cie, 1998)
 $T_{\min} = 0.670$, $T_{\max} = 0.873$
 7942 measured reflections
 3062 independent reflections

2373 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.033$
 $\theta_{\text{max}} = 27.9^\circ$
 $h = -26 \rightarrow 26$
 $k = -8 \rightarrow 8$
 $l = -12 \rightarrow 9$

Refinement

Refinement on F^2
 $R[F^2 > 2\sigma(F^2)] = 0.034$
 $wR(F^2) = 0.089$
 $S = 0.97$
 3062 reflections
 128 parameters
 H-atom parameters constrained

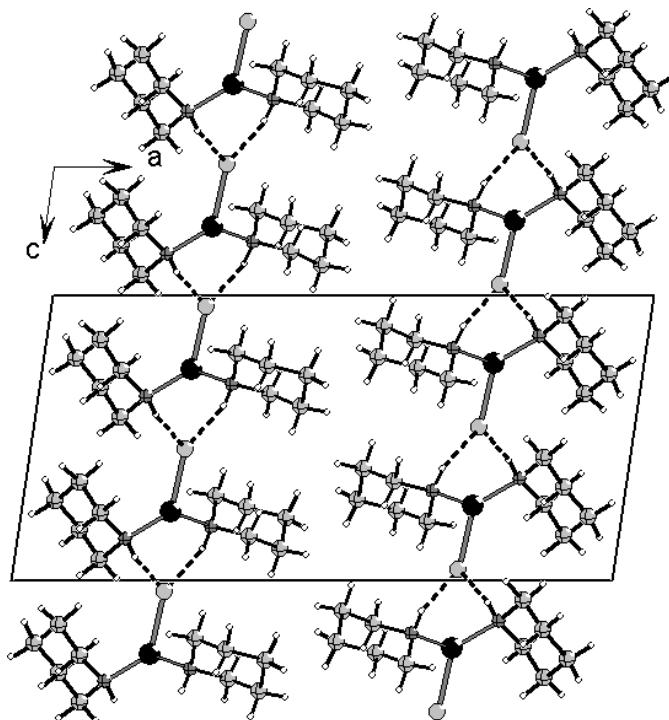
$w = 1/[\sigma^2(F_o^2) + (0.0611P)^2]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} = 0.001$
 $\Delta\rho_{\text{max}} = 0.63$ e Å⁻³
 $\Delta\rho_{\text{min}} = -0.48$ e Å⁻³
 Extinction correction: *SHELXL97*
 Extinction coefficient: 0.0148 (17)

Table 1

Selected geometric parameters (Å, °).

Cu1—N1	1.9959 (16)	Cu1—Cl1	2.3187 (6)
Cu1—N11	2.0045 (15)		
N1—Cu1—N11	135.37 (7)	Cl1—N1—Cu1	112.47 (11)
N1—Cu1—Cl1	116.68 (5)	C5—N1—Cu1	114.66 (13)
N11—Cu1—Cl1	107.92 (5)		

H atoms were located in a difference map, but were positioned with idealized geometry (C—H = 0.99 Å and N—H = 0.93 Å) and

**Figure 2**

The crystal structure of the title compound, viewed along the crystallographic *b* axis. N—H...Cl hydrogen bonding is shown as dashed lines.

refined with fixed isotropic displacement parameters [$U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(\text{C,N})$], using a riding model.

Data collection: *IPDS Program Package* (Stoe & Cie, 1998); cell refinement: *IPDS Program Package*; data reduction: *IPDS Program Package*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 1997); program(s) used to refine structure: *SHELXL97* (Sheldrick, 1997); molecular graphics: *XP* in *SHELXTL* (Bruker, 1998); software used to prepare material for publication: *CIFTAB* in *SHELXTL*.

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