

Acta Crystallographica Section E

Structure Reports

Online

ISSN 1600-5368

8-Chloro-2-methylquinoline

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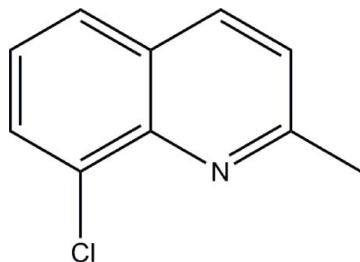
Received 25 May 2009; accepted 27 May 2009

 Key indicators: single-crystal X-ray study; $T = 173$ K; mean $\sigma(\text{C}-\text{C}) = 0.003$ Å; R factor = 0.029; wR factor = 0.075; data-to-parameter ratio = 16.4.

In the title compound, $\text{C}_{10}\text{H}_8\text{ClN}$, the crystal packing shows π - π stacking between the heterocyclic ring and the aromatic ring, with a centroid-centroid distance of 3.819 Å. The crystal studied was a racemic twin, the ratio of the twin components being 0.65 (7):0.35 (7).

Related literature

The title compound is an important intermediate in the pharmaceutical industry, see: Shen & Hartwig (2006); Ranu *et al.* (2000); Lee & Hartwig (2005).



Experimental

Crystal data

$\text{C}_{10}\text{H}_8\text{ClN}$	$V = 850.38$ (11) Å ³
$M_r = 177.62$	$Z = 4$
Orthorhombic, $Pca2_1$	Mo $K\alpha$ radiation
$a = 12.7961$ (9) Å	$\mu = 0.39$ mm ⁻¹
$b = 5.0660$ (4) Å	$T = 173$ K
$c = 13.1181$ (9) Å	$0.47 \times 0.46 \times 0.23$ mm

Data collection

Bruker SMART 1000 CCD diffractometer	3943 measured reflections
Absorption correction: multi-scan (SADABS; Sheldrick, 2004)	1821 independent reflections
$T_{\min} = 0.840$, $T_{\max} = 0.917$	1703 reflections with $I > 2\sigma(I)$
	$R_{\text{int}} = 0.016$

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.029$	1 restraint
$wR(F^2) = 0.075$	H-atom parameters constrained
$S = 1.09$	$\Delta\rho_{\text{max}} = 0.20$ e Å ⁻³
1821 reflections	$\Delta\rho_{\text{min}} = -0.16$ e Å ⁻³
111 parameters	

Data collection: SMART (Bruker, 2001); cell refinement: SAINT-Plus (Bruker, 2003); data reduction: SAINT-Plus; 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: SHELXL97.

This work was funded by the SIT program of Hunan University (2008).

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: BT2969).

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supplementary materials

Acta Cryst. (2009). E65, o1463 [doi:10.1107/S1600536809020194]

8-Chloro-2-methylquinoline

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Comment

The structure of the title compound, 8-chloro-2-methylquinoline, is shown in Fig 1. It is an important intermediate of medicine industry (Shen *et al.*, 2006; Ranu *et al.*, 2000; Lee *et al.*, 2005). The crystal packing shows π - π stacking between the N containing aromatic ring and the aromatic ring with the chloro substituent with a centroid-centroid distance of 3.819 Å.

Experimental

A solution of 13 g of 2-chloroaniline in 200 mL chlorobenzene and 0.5 g of *p*-toluenesulfonic acid was heated to 393 K. 14 g of crotonaldehyde were added dropwise with in 1 h, then refluxed for 2 h. The solution was concentrated under reduced pressure to give rude product, which was then recrystallized from dimethylbenzene to get 10 g of the product as a white solid. The yield was 57%. Crystals suitable for X-ray structure determination were obtained by slow evaporation of an ethanol solution at room temperature.

Refinement

H atom were positioned geometrically ($C_{\text{aromatic}}\text{—H} = 0.95 \text{ \AA}$, $C_{\text{methyl}}\text{—H} = 0.98 \text{ \AA}$) and refined as riding with $U_{\text{iso}}(\text{H}) = 1.2U_{\text{eq}}(C_{\text{aromatic}})$ or $U_{\text{iso}}(\text{H}) = 1.5U_{\text{eq}}(C_{\text{methyl}})$. The crystal under investigation turned out to be a racemic twin with a ratio of the twin components of 0.65 (7) to 0.35 (7).

Figures

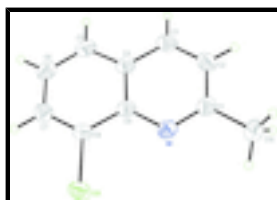


Fig. 1. Molecular structure of the title compound showing 50% probability displacement ellipsoids.

8-Chloro-2-methylquinoline

Crystal data

$C_{10}H_8ClN$

$M_r = 177.62$

Orthorhombic, $Pca2_1$

Hall symbol: P 2c -2ac

$a = 12.7961 (9) \text{ \AA}$

$D_x = 1.387 \text{ Mg m}^{-3}$

Melting point: 333 K

Mo $K\alpha$ radiation

$\lambda = 0.71073 \text{ \AA}$

Cell parameters from 2761 reflections

$\theta = 3.1\text{--}27.0^\circ$

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$b = 5.0660 (4) \text{ \AA}$
 $c = 13.1181 (9) \text{ \AA}$
 $V = 850.38 (11) \text{ \AA}^3$
 $Z = 4$
 $F_{000} = 368$

$\mu = 0.39 \text{ mm}^{-1}$
 $T = 173 \text{ K}$
Block, colourless
 $0.47 \times 0.46 \times 0.23 \text{ mm}$

Data collection

Bruker SMART 1000 CCD diffractometer
Radiation source: fine-focus sealed tube
Monochromator: graphite
 $T = 173 \text{ K}$
 ω scans
Absorption correction: multi-scan (SADABS; Sheldrick, 2004)
 $T_{\min} = 0.840$, $T_{\max} = 0.917$
3943 measured reflections

1821 independent reflections
1703 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.016$
 $\theta_{\max} = 27.1^\circ$
 $\theta_{\min} = 3.1^\circ$
 $h = -16 \rightarrow 16$
 $k = -2 \rightarrow 6$
 $l = -15 \rightarrow 16$

Refinement

Refinement on F^2
Least-squares matrix: full
 $R[F^2 > 2\sigma(F^2)] = 0.029$
 $wR(F^2) = 0.075$
 $S = 1.09$
1821 reflections
111 parameters
1 restraint
Primary atom site location: structure-invariant direct methods

Secondary atom site location: difference Fourier map
Hydrogen site location: inferred from neighbouring sites
H-atom parameters constrained
 $w = 1/[\sigma^2(F_o^2) + (0.0403P)^2 + 0.17P]$
where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\max} = 0.004$
 $\Delta\rho_{\max} = 0.20 \text{ e \AA}^{-3}$
 $\Delta\rho_{\min} = -0.16 \text{ e \AA}^{-3}$
Extinction correction: none

Special details

Experimental. MS (m/z): M^+ 177. ^1H NMR(CDCl₃, 400 MHz, δ ppm): 2.83(s, 3H, CH₃), 7.38(m, 2H, quinoline 3,6-H), 7.80(d, J=7.2 Hz, 1H, quinoline 7-H), 8.03(d, J=8.0 Hz, 1H, quinoline 5-H), 8.00(d, J=8.4 Hz, 1H, quinoline 4-H)

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 (\AA^2)

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$
C11	0.13075 (3)	-0.06692 (9)	-0.13065 (4)	0.03616 (14)
C1	0.33097 (14)	0.5106 (4)	0.00528 (15)	0.0286 (4)
C2	0.33961 (16)	0.5667 (4)	0.11114 (16)	0.0336 (4)
H2	0.3873	0.6971	0.1345	0.040*
C3	0.27923 (15)	0.4323 (3)	0.17875 (15)	0.0323 (4)
H3	0.2846	0.4675	0.2497	0.039*
C4	0.20807 (14)	0.2386 (3)	0.14243 (14)	0.0277 (4)
C5	0.14115 (15)	0.0969 (4)	0.20801 (15)	0.0327 (4)
H5	0.1427	0.1293	0.2793	0.039*
C6	0.07432 (15)	-0.0864 (4)	0.16908 (16)	0.0349 (4)
H6	0.0285	-0.1792	0.2134	0.042*
C7	0.07260 (15)	-0.1394 (4)	0.06385 (16)	0.0330 (4)
H7	0.0266	-0.2701	0.0377	0.040*
C8	0.13698 (14)	-0.0033 (4)	-0.00123 (15)	0.0271 (4)
C9	0.20665 (13)	0.1930 (3)	0.03548 (13)	0.0248 (3)
C10	0.39634 (17)	0.6615 (5)	-0.06992 (17)	0.0393 (5)
H10A	0.4700	0.6137	-0.0613	0.059*
H10B	0.3877	0.8513	-0.0582	0.059*
H10C	0.3740	0.6181	-0.1394	0.059*
N1	0.26803 (12)	0.3289 (3)	-0.03180 (11)	0.0268 (3)

Atomic displacement parameters (\AA^2)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C11	0.0393 (2)	0.0441 (3)	0.0251 (2)	-0.00280 (19)	-0.0036 (2)	-0.0074 (2)
C1	0.0279 (9)	0.0261 (8)	0.0319 (10)	0.0032 (7)	-0.0008 (8)	0.0037 (7)
C2	0.0343 (10)	0.0291 (10)	0.0374 (11)	-0.0015 (8)	-0.0081 (8)	-0.0030 (8)
C3	0.0397 (10)	0.0305 (9)	0.0266 (9)	0.0039 (8)	-0.0052 (8)	-0.0054 (7)
C4	0.0320 (9)	0.0253 (9)	0.0259 (9)	0.0060 (7)	-0.0009 (7)	-0.0001 (7)
C5	0.0412 (10)	0.0344 (10)	0.0223 (9)	0.0063 (8)	0.0002 (8)	0.0031 (7)
C6	0.0339 (10)	0.0382 (11)	0.0325 (10)	-0.0010 (8)	0.0045 (8)	0.0086 (8)
C7	0.0297 (9)	0.0334 (10)	0.0360 (10)	-0.0033 (8)	-0.0023 (8)	0.0029 (8)
C8	0.0294 (9)	0.0310 (8)	0.0209 (9)	0.0033 (7)	-0.0029 (7)	-0.0013 (7)
C9	0.0253 (8)	0.0245 (8)	0.0247 (9)	0.0056 (7)	-0.0025 (7)	0.0005 (6)
C10	0.0408 (10)	0.0375 (10)	0.0396 (12)	-0.0067 (10)	0.0004 (9)	0.0082 (9)
N1	0.0265 (7)	0.0274 (7)	0.0264 (8)	0.0039 (6)	0.0013 (6)	0.0030 (6)

Geometric parameters (\AA , $^\circ$)

C11—C8	1.730 (2)	C5—H5	0.9500
C1—N1	1.316 (3)	C6—C7	1.407 (3)
C1—C2	1.422 (3)	C6—H6	0.9500
C1—C10	1.503 (3)	C7—C8	1.372 (3)
C2—C3	1.359 (3)	C7—H7	0.9500
C2—H2	0.9500	C8—C9	1.420 (3)

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C3—C4	1.421 (2)	C9—N1	1.367 (2)
C3—H3	0.9500	C10—H10A	0.9800
C4—C5	1.410 (3)	C10—H10B	0.9800
C4—C9	1.422 (2)	C10—H10C	0.9800
C5—C6	1.362 (3)		
N1—C1—C2	123.25 (18)	C7—C6—H6	119.7
N1—C1—C10	116.99 (18)	C8—C7—C6	120.36 (18)
C2—C1—C10	119.76 (18)	C8—C7—H7	119.8
C3—C2—C1	119.55 (18)	C6—C7—H7	119.8
C3—C2—H2	120.2	C7—C8—C9	121.19 (18)
C1—C2—H2	120.2	C7—C8—C11	119.30 (15)
C2—C3—C4	119.44 (18)	C9—C8—C11	119.49 (15)
C2—C3—H3	120.3	N1—C9—C8	119.62 (16)
C4—C3—H3	120.3	N1—C9—C4	123.21 (16)
C5—C4—C3	122.42 (17)	C8—C9—C4	117.16 (16)
C5—C4—C9	120.76 (17)	C1—C10—H10A	109.5
C3—C4—C9	116.82 (16)	C1—C10—H10B	109.5
C6—C5—C4	119.98 (18)	H10A—C10—H10B	109.5
C6—C5—H5	120.0	C1—C10—H10C	109.5
C4—C5—H5	120.0	H10A—C10—H10C	109.5
C5—C6—C7	120.54 (18)	H10B—C10—H10C	109.5
C5—C6—H6	119.7	C1—N1—C9	117.70 (16)
N1—C1—C2—C3	-1.4 (3)	C11—C8—C9—N1	-0.1 (2)
C10—C1—C2—C3	179.05 (18)	C7—C8—C9—C4	1.1 (2)
C1—C2—C3—C4	-0.3 (3)	C11—C8—C9—C4	179.55 (13)
C2—C3—C4—C5	-178.29 (18)	C5—C4—C9—N1	178.44 (15)
C2—C3—C4—C9	1.5 (2)	C3—C4—C9—N1	-1.4 (2)
C3—C4—C5—C6	179.90 (17)	C5—C4—C9—C8	-1.2 (2)
C9—C4—C5—C6	0.1 (3)	C3—C4—C9—C8	178.99 (15)
C4—C5—C6—C7	1.1 (3)	C2—C1—N1—C9	1.5 (3)
C5—C6—C7—C8	-1.2 (3)	C10—C1—N1—C9	-178.87 (16)
C6—C7—C8—C9	0.1 (3)	C8—C9—N1—C1	179.50 (16)
C6—C7—C8—C11	-178.36 (15)	C4—C9—N1—C1	-0.1 (2)
C7—C8—C9—N1	-178.55 (17)		

Fig. 1

