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8-Methoxy-4-(4-methoxyphenyl)-quinoline

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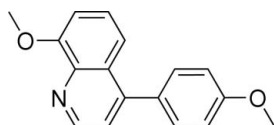
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Key indicators: single-crystal X-ray study; $T = 295$ K; mean $\sigma(\text{C}-\text{C}) = 0.003$ Å; R factor = 0.057; wR factor = 0.145; data-to-parameter ratio = 15.4.

In the title compound, $\text{C}_{17}\text{H}_{15}\text{NO}_2$, the dihedral angle between the quinoline and benzene ring systems is $62.17(1)^\circ$. In the crystal, zigzag chains propagating in c are linked by $\text{C}-\text{H}\cdots\text{O}$ hydrogen bonds, and weak $\text{C}-\text{H}\cdots\pi$ interactions link the chains.

Related literature

The title compound was prepared as an intermediate for the synthesis of aluminium(III) quinolinolate complexes, which are important for their semiconductor properties and as electron-transport layer materials in organic light-emitting devices (OLEDs) (Montes *et al.*, 2006). For related literature, see: Dienys *et al.* (1977); Muscia *et al.* (2006); Pérez-Bolívar *et al.* (2006).



Experimental

Crystal data

$\text{C}_{17}\text{H}_{15}\text{NO}_2$
 $M_r = 265.30$
 Monoclinic, $P2_1/c$
 $a = 9.362(2)$ Å
 $b = 10.355(2)$ Å

$c = 14.276(4)$ Å
 $\beta = 101.556(6)^\circ$
 $V = 1355.9(5)$ Å³
 $Z = 4$
 Mo $K\alpha$ radiation

$\mu = 0.09$ mm⁻¹
 $T = 295$ K

0.45 × 0.42 × 0.40 mm

Data collection

Rigaku AFC-7S Mercury diffractometer
 Absorption correction: multi-scan (ABSCOR; Jacobson, 1998)
 $T_{\min} = 0.940$, $T_{\max} = 0.980$

15093 measured reflections
 2785 independent reflections
 1868 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.037$
 Standard reflections: 0

Refinement

$R[F^2 > 2\sigma(F^2)] = 0.057$
 $wR(F^2) = 0.145$
 $S = 1.12$
 2785 reflections

181 parameters
 H-atom parameters constrained
 $\Delta\rho_{\max} = 0.14$ e Å⁻³
 $\Delta\rho_{\min} = -0.23$ e Å⁻³

Table 1

Hydrogen-bond geometry (Å, °).

| $D-\text{H}\cdots A$ | $D-\text{H}$ | $\text{H}\cdots A$ | $D\cdots A$ | $D-\text{H}\cdots A$ |
|---|--------------|--------------------|-------------|----------------------|
| $\text{C}17-\text{H}17\text{A}\cdots\text{O}1^{\text{i}}$ | 0.96 | 2.55 | 3.322 (3) | 137 |
| $\text{C}2-\text{H}2\text{A}\cdots\text{C}g2^{\text{ii}}$ | 0.93 | 2.81 | 3.622 (2) | 146 |
| $\text{C}6-\text{H}6\text{A}\cdots\text{C}g3^{\text{iii}}$ | 0.93 | 2.80 | 3.592 (2) | 144 |
| $\text{C}17-\text{H}17\text{B}\cdots\text{C}g2^{\text{iv}}$ | 0.96 | 2.78 | 3.580 (3) | 142 |

Symmetry codes: (i) $x - 1, -y + \frac{1}{2}, z + \frac{1}{2}$; (ii) $-x, y + \frac{1}{2}, -z + \frac{1}{2}$; (iii) $-x, -y, -z + 1$; (iv) $x - 1, y, z$. $\text{C}g2$ and $\text{C}g3$ are the centroids of the C4–C9 and C10–C14 rings, respectively.

Data collection: *CrystalClear* (Rigaku/MSK, 2005); cell refinement: *CrystalClear*; data reduction: *CrystalClear*; program(s) used to solve structure: *SHELXTL* (Sheldrick, 2008); program(s) used to refine structure: *SHELXTL*; molecular graphics: *SHELXTL* and *DIAMOND* (Brandenburg, 1999); software used to prepare material for publication: *SHELXTL* and *PLATON* (Spek, 2009).

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: HB5272).

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supplementary materials

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8-Methoxy-4-(4-methoxyphenyl)quinoline

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Comment

The title compound (I), was prepared as a valued intermediate for the synthesis of aluminium (III) quinolinolate complexes, important for their semiconductor properties and useful properties as electron-transport layer materials in organic light-emitting devices (OLEDs) (Montes *et al.*, 2006).

The molecular structure of (I) is shown in Figure 1 with their respective labels. All bond lengths are in good agreement with the tabulated standard values (Table 1). In this structure quinoline motif is essentially planar (with a mean deviation 0.0213 Å), in which the maximum deviation is around atoms C1 (0.0277 Å) and C6 (0.0333 Å), respectively (see Figure 1). The methoxyphenyl substituent make a dihedral angle of 62.17 (1)° with respect to the quinoline group. Other striking feature of (I) is that the plane defined by atoms contained for the methoxy groups C16/O1/C8/C9 and C17/O2/C13/C14 are almost co-planar with the phenyl rings with values of dihedral angle 1.73 (3) and 1.42 (2)°, respectively.

Experimental

A solution of 3-dimethylamino-1-(4-methoxy-phenyl)-propan-1-one (300 mg, 1.45 mmol) and 2-methoxy-phenylamine (180 mg, 1.46 mmol) in ethanol (15 ml) was stirred at room temperature in a round bottom flask. After 15 minutes, concentrated hydrochloric acid (0.5 ml) was added dropwise and the mixture stirred under reflux for 8 h. The reaction mixture was cooled to room temperature and poured into an ice bath. The yellow solution was neutralized with a saturated solution of sodium bicarbonate to pH 7, extracted with ethyl acetate (20 ml × 3), and washed with water (20 ml × 3) and brine (10 ml × 2). The aqueous layer was extracted with dichloromethane (20 ml × 2). The organic layers were dried over anhydrous magnesium sulfate, filtered through cotton and the filtrate concentrated under vacuum to provide a reddish oil. The oil was purified by column chromatography on silica gel (mobile phase: ethyl acetate-hexane, 6:4) to afford a light-brown solid (100 mg, 26%). *M.p.* 146–147 °C; ¹H NMR (500 MHz, CDCl₃), d(p.p.m.): 3.82 (s, 3H), 4.05 (s, 3H), 6.99 (t, 3H, *J* = 8.5 Hz), 7.27 (d, ¹H, *J* = 4.4 Hz), 7.34 (t, ¹H, *J* = 8.2 Hz), 7.37 (d, 2H, *J* = 8.7 Hz), 7.47 (d, ¹H, *J* = 8.6 Hz), 8.88 (d, ¹H, *J* = 4.4 Hz). ¹³C NMR (126 MHz, CDCl₃), d (p.p.m.): 55.29 (C17), 55.99 (C16), 107.21 (C7), 113.90 (C12 and C14), 117.59 (C5), 121.91 (C6), 126.37 (C2), 127.93 (C4), 130.48 (C9), 130.73 (C11 and C15), 140.67 (C3), 147.95 (C10), 148.68 (C1), 155.55 (C8), 159.72 (C13). IR (KBr, cm⁻¹) 3004, 2934, 2838, 1673, 1607, 1501, 1249. EI—MS: *m/z* (%): 266 (100) [*M*⁺], 251 (40) [*M*—CH₃⁺].

Light brown blocks of (I) were obtained by slow evaporation of dichloromethane/hexane

Refinement

All H atoms were placed in geometrically idealized positions and constrained to ride on their parent atoms, with C—H distances of 0.93 (aromatic) and 0.96 Å (methyl) and with *U*_{iso}(H) = 1.5 (1.2 for aromatic H atoms) times *U*_{eq}(C).

Figures

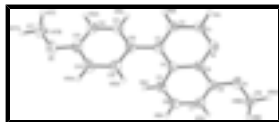


Fig. 1. The molecular structure of (I), showing displacement ellipsoids drawn at the 35% probability level and H atoms are shown as spheres of arbitrary radii.

8-Methoxy-4-(4-methoxyphenyl)quinoline

Crystal data

| | |
|--------------------------------|---|
| $C_{17}H_{15}NO_2$ | $F(000) = 560$ |
| $M_r = 265.30$ | $D_x = 1.300 \text{ Mg m}^{-3}$ |
| Monoclinic, $P2_1/c$ | Mo $K\alpha$ radiation, $\lambda = 0.71070 \text{ \AA}$ |
| Hall symbol: $-P 2_1/c$ | Cell parameters from 8153 reflections |
| $a = 9.362 (2) \text{ \AA}$ | $\theta = 4.4\text{--}55.8^\circ$ |
| $b = 10.355 (2) \text{ \AA}$ | $\mu = 0.09 \text{ mm}^{-1}$ |
| $c = 14.276 (4) \text{ \AA}$ | $T = 295 \text{ K}$ |
| $\beta = 101.556 (6)^\circ$ | Block, light brown |
| $V = 1355.9 (5) \text{ \AA}^3$ | $0.45 \times 0.42 \times 0.40 \text{ mm}$ |
| $Z = 4$ | |

Data collection

| | |
|--|---|
| Rigaku AFC-7S Mercury diffractometer | 2785 independent reflections |
| Radiation source: Normal-focus sealed tube graphite | 1868 reflections with $I > 2\sigma(I)$ |
| ω scans | $R_{\text{int}} = 0.037$ |
| Absorption correction: multi-scan (ABSCOR; Jacobson, 1998) | $\theta_{\text{max}} = 28.1^\circ$, $\theta_{\text{min}} = 56.1^\circ$ |
| $T_{\text{min}} = 0.940$, $T_{\text{max}} = 0.980$ | $h = -12 \rightarrow 12$ |
| 15093 measured reflections | $k = -13 \rightarrow 13$ |
| | $l = -18 \rightarrow 18$ |

Refinement

| | |
|---------------------------------|--|
| Refinement on F^2 | Primary atom site location: structure-invariant direct methods |
| Least-squares matrix: full | Secondary atom site location: difference Fourier map |
| $R[F^2 > 2\sigma(F^2)] = 0.057$ | Hydrogen site location: inferred from neighbouring sites |
| $wR(F^2) = 0.145$ | H-atom parameters constrained |
| $S = 1.12$ | $w = 1/[\sigma^2(F_o^2) + (0.0538P)^2 + 0.3325P]$ |
| 2785 reflections | where $P = (F_o^2 + 2F_c^2)/3$ |
| 181 parameters | $(\Delta/\sigma)_{\text{max}} < 0.001$ |
| 0 restraints | $\Delta\rho_{\text{max}} = 0.14 \text{ e \AA}^{-3}$ |
| | $\Delta\rho_{\text{min}} = -0.23 \text{ e \AA}^{-3}$ |

Special details

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)

| | <i>x</i> | <i>y</i> | <i>z</i> | $U_{\text{iso}}^*/U_{\text{eq}}$ |
|------|---------------|--------------|--------------|----------------------------------|
| O1 | 0.42442 (15) | 0.09277 (15) | 0.26653 (10) | 0.0576 (4) |
| O2 | -0.41766 (17) | 0.34353 (16) | 0.58150 (11) | 0.0644 (5) |
| N1 | 0.22017 (18) | 0.27365 (17) | 0.23541 (12) | 0.0507 (5) |
| C1 | 0.1179 (2) | 0.3624 (2) | 0.22134 (16) | 0.0554 (6) |
| H1A | 0.1163 | 0.4196 | 0.1709 | 0.066* |
| C2 | 0.0111 (2) | 0.3774 (2) | 0.27655 (15) | 0.0522 (5) |
| H2A | -0.0583 | 0.4424 | 0.2618 | 0.063* |
| C3 | 0.0082 (2) | 0.29631 (19) | 0.35232 (14) | 0.0427 (5) |
| C4 | 0.1152 (2) | 0.19600 (18) | 0.36953 (13) | 0.0397 (5) |
| C5 | 0.1192 (2) | 0.10133 (19) | 0.44199 (14) | 0.0456 (5) |
| H5A | 0.0515 | 0.1042 | 0.4815 | 0.055* |
| C6 | 0.2215 (2) | 0.0066 (2) | 0.45375 (15) | 0.0493 (5) |
| H6A | 0.2217 | -0.0556 | 0.5007 | 0.059* |
| C7 | 0.3275 (2) | 0.0006 (2) | 0.39636 (15) | 0.0495 (5) |
| H7A | 0.3978 | -0.0641 | 0.4066 | 0.059* |
| C8 | 0.3271 (2) | 0.08987 (19) | 0.32555 (14) | 0.0441 (5) |
| C9 | 0.2189 (2) | 0.18964 (19) | 0.30946 (13) | 0.0414 (5) |
| C10 | -0.1047 (2) | 0.31030 (19) | 0.41186 (14) | 0.0447 (5) |
| C11 | -0.2518 (2) | 0.2989 (2) | 0.37074 (15) | 0.0504 (5) |
| H11A | -0.2788 | 0.2841 | 0.3053 | 0.060* |
| C12 | -0.3598 (2) | 0.3091 (2) | 0.42425 (15) | 0.0512 (5) |
| H12A | -0.4574 | 0.3001 | 0.3950 | 0.061* |
| C13 | -0.3213 (2) | 0.33263 (19) | 0.52103 (16) | 0.0491 (5) |
| C14 | -0.1750 (2) | 0.3464 (2) | 0.56353 (16) | 0.0554 (6) |
| H14A | -0.1487 | 0.3634 | 0.6287 | 0.066* |
| C15 | -0.0685 (2) | 0.3350 (2) | 0.50986 (15) | 0.0524 (5) |
| H15A | 0.0289 | 0.3440 | 0.5394 | 0.063* |
| C16 | 0.5389 (2) | -0.0015 (2) | 0.28179 (17) | 0.0632 (7) |
| H16A | 0.5999 | 0.0110 | 0.2359 | 0.095* |
| H16B | 0.4973 | -0.0865 | 0.2745 | 0.095* |
| H16C | 0.5962 | 0.0080 | 0.3452 | 0.095* |
| C17 | -0.5693 (2) | 0.3254 (2) | 0.54239 (18) | 0.0653 (7) |
| H17A | -0.6242 | 0.3361 | 0.5919 | 0.098* |

supplementary materials

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|------|---------|--------|--------|--------|
| H17B | -0.5847 | 0.2401 | 0.5161 | 0.098* |
| H17C | -0.6007 | 0.3879 | 0.4929 | 0.098* |

Atomic displacement parameters (\AA^2)

| | U^{11} | U^{22} | U^{33} | U^{12} | U^{13} | U^{23} |
|-----|-------------|-------------|-------------|--------------|-------------|--------------|
| O1 | 0.0497 (8) | 0.0726 (10) | 0.0547 (9) | 0.0123 (7) | 0.0206 (7) | 0.0055 (8) |
| O2 | 0.0592 (10) | 0.0763 (11) | 0.0643 (10) | -0.0038 (8) | 0.0281 (8) | -0.0167 (8) |
| N1 | 0.0478 (10) | 0.0584 (11) | 0.0476 (10) | 0.0007 (9) | 0.0135 (8) | 0.0117 (9) |
| C1 | 0.0549 (13) | 0.0598 (14) | 0.0523 (13) | 0.0004 (11) | 0.0127 (11) | 0.0194 (11) |
| C2 | 0.0478 (12) | 0.0542 (13) | 0.0549 (13) | 0.0060 (10) | 0.0113 (10) | 0.0133 (10) |
| C3 | 0.0396 (10) | 0.0438 (11) | 0.0442 (11) | -0.0042 (9) | 0.0074 (9) | 0.0013 (9) |
| C4 | 0.0384 (10) | 0.0414 (11) | 0.0387 (10) | -0.0056 (8) | 0.0067 (8) | -0.0004 (8) |
| C5 | 0.0474 (11) | 0.0458 (11) | 0.0455 (11) | -0.0047 (9) | 0.0136 (9) | 0.0041 (9) |
| C6 | 0.0557 (12) | 0.0451 (11) | 0.0470 (11) | -0.0009 (10) | 0.0101 (10) | 0.0065 (10) |
| C7 | 0.0498 (12) | 0.0463 (12) | 0.0521 (12) | 0.0068 (9) | 0.0099 (10) | 0.0020 (10) |
| C8 | 0.0405 (11) | 0.0498 (12) | 0.0425 (11) | -0.0012 (9) | 0.0095 (9) | -0.0013 (9) |
| C9 | 0.0396 (10) | 0.0450 (11) | 0.0394 (10) | -0.0053 (9) | 0.0073 (9) | 0.0018 (9) |
| C10 | 0.0454 (11) | 0.0423 (11) | 0.0477 (12) | 0.0003 (9) | 0.0125 (9) | 0.0029 (9) |
| C11 | 0.0474 (12) | 0.0601 (14) | 0.0447 (11) | 0.0037 (10) | 0.0116 (10) | 0.0042 (10) |
| C12 | 0.0441 (11) | 0.0561 (13) | 0.0543 (13) | 0.0033 (10) | 0.0117 (10) | 0.0022 (10) |
| C13 | 0.0523 (13) | 0.0434 (11) | 0.0558 (13) | 0.0006 (10) | 0.0210 (11) | -0.0056 (10) |
| C14 | 0.0600 (14) | 0.0581 (14) | 0.0496 (12) | -0.0061 (11) | 0.0147 (11) | -0.0129 (10) |
| C15 | 0.0481 (12) | 0.0558 (13) | 0.0533 (13) | -0.0051 (10) | 0.0097 (10) | -0.0078 (10) |
| C16 | 0.0515 (13) | 0.0772 (17) | 0.0623 (14) | 0.0151 (12) | 0.0149 (11) | -0.0052 (13) |
| C17 | 0.0538 (14) | 0.0707 (16) | 0.0780 (17) | 0.0002 (12) | 0.0290 (12) | -0.0118 (13) |

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

| | | | |
|--------|-----------|----------|-----------|
| O1—C8 | 1.360 (2) | C7—H7A | 0.9300 |
| O1—C16 | 1.434 (3) | C8—C9 | 1.433 (3) |
| O2—C13 | 1.373 (2) | C10—C11 | 1.390 (3) |
| O2—C17 | 1.429 (3) | C10—C15 | 1.396 (3) |
| N1—C1 | 1.313 (3) | C11—C12 | 1.388 (3) |
| N1—C9 | 1.371 (2) | C11—H11A | 0.9300 |
| C1—C2 | 1.401 (3) | C12—C13 | 1.378 (3) |
| C1—H1A | 0.9300 | C12—H12A | 0.9300 |
| C2—C3 | 1.374 (3) | C13—C14 | 1.390 (3) |
| C2—H2A | 0.9300 | C14—C15 | 1.379 (3) |
| C3—C4 | 1.430 (3) | C14—H14A | 0.9300 |
| C3—C10 | 1.490 (3) | C15—H15A | 0.9300 |
| C4—C9 | 1.419 (3) | C16—H16A | 0.9600 |
| C4—C5 | 1.420 (3) | C16—H16B | 0.9600 |
| C5—C6 | 1.358 (3) | C16—H16C | 0.9600 |
| C5—H5A | 0.9300 | C17—H17A | 0.9600 |
| C6—C7 | 1.409 (3) | C17—H17B | 0.9600 |
| C6—H6A | 0.9300 | C17—H17C | 0.9600 |
| C7—C8 | 1.369 (3) | | |

| | | | |
|------------|-------------|---------------|-------------|
| C8—O1—C16 | 117.66 (17) | C11—C10—C15 | 117.36 (19) |
| C13—O2—C17 | 118.02 (17) | C11—C10—C3 | 120.48 (18) |
| C1—N1—C9 | 116.31 (17) | C15—C10—C3 | 122.16 (18) |
| N1—C1—C2 | 124.90 (19) | C12—C11—C10 | 122.1 (2) |
| N1—C1—H1A | 117.5 | C12—C11—H11A | 119.0 |
| C2—C1—H1A | 117.5 | C10—C11—H11A | 119.0 |
| C3—C2—C1 | 120.3 (2) | C13—C12—C11 | 119.5 (2) |
| C3—C2—H2A | 119.9 | C13—C12—H12A | 120.3 |
| C1—C2—H2A | 119.9 | C11—C12—H12A | 120.3 |
| C2—C3—C4 | 117.12 (18) | O2—C13—C12 | 124.90 (19) |
| C2—C3—C10 | 121.17 (18) | O2—C13—C14 | 115.56 (19) |
| C4—C3—C10 | 121.69 (17) | C12—C13—C14 | 119.5 (2) |
| C9—C4—C5 | 119.13 (17) | C15—C14—C13 | 120.5 (2) |
| C9—C4—C3 | 118.05 (17) | C15—C14—H14A | 119.7 |
| C5—C4—C3 | 122.80 (18) | C13—C14—H14A | 119.7 |
| C6—C5—C4 | 120.22 (19) | C14—C15—C10 | 121.0 (2) |
| C6—C5—H5A | 119.9 | C14—C15—H15A | 119.5 |
| C4—C5—H5A | 119.9 | C10—C15—H15A | 119.5 |
| C5—C6—C7 | 121.45 (19) | O1—C16—H16A | 109.5 |
| C5—C6—H6A | 119.3 | O1—C16—H16B | 109.5 |
| C7—C6—H6A | 119.3 | H16A—C16—H16B | 109.5 |
| C8—C7—C6 | 120.08 (19) | O1—C16—H16C | 109.5 |
| C8—C7—H7A | 120.0 | H16A—C16—H16C | 109.5 |
| C6—C7—H7A | 120.0 | H16B—C16—H16C | 109.5 |
| O1—C8—C7 | 124.69 (18) | O2—C17—H17A | 109.5 |
| O1—C8—C9 | 115.14 (17) | O2—C17—H17B | 109.5 |
| C7—C8—C9 | 120.16 (18) | H17A—C17—H17B | 109.5 |
| N1—C9—C4 | 123.31 (18) | O2—C17—H17C | 109.5 |
| N1—C9—C8 | 117.77 (17) | H17A—C17—H17C | 109.5 |
| C4—C9—C8 | 118.92 (17) | H17B—C17—H17C | 109.5 |

Hydrogen-bond geometry (\AA , $^\circ$)

Cg2 and Cg3 are the centroids of the C4–C9 and C10–C14 rings, respectively.

| $D-H\cdots A$ | $D-H$ | $H\cdots A$ | $D\cdots A$ | $D-H\cdots A$ |
|-------------------------------------|-------|-------------|-------------|---------------|
| C17—H17A \cdots O1 ⁱ | 0.96 | 2.55 | 3.322 (3) | 137 |
| C2—H2A \cdots Cg2 ⁱⁱ | 0.93 | 2.81 | 3.622 (2) | 146 |
| C6—H6A \cdots Cg3 ⁱⁱⁱ | 0.93 | 2.80 | 3.592 (2) | 144 |
| C17—H17B \cdots Cg2 ^{iv} | 0.96 | 2.78 | 3.580 (3) | 142 |

Symmetry codes: (i) $x-1, -y+1/2, z+1/2$; (ii) $-x, y+1/2, -z+1/2$; (iii) $-x, -y, -z+1$; (iv) $x-1, y, z$.

Fig. 1

