Acta Crystallographica Section E
**Structure Reports Online**
ISSN 1600-5368

# (2*E*)-Methyl 2-(7-benzyloxy-1-naphthyl)-3-methoxyacrylate

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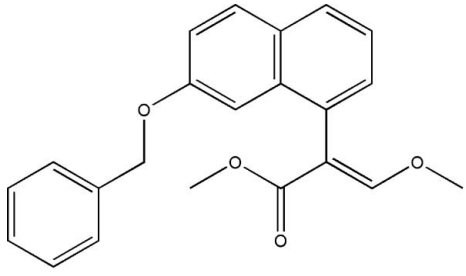
Received 28 April 2010; accepted 2 June 2010

Key indicators: single-crystal X-ray study; $T$ = 293 K; mean $\sigma$(C–C) = 0.003 Å; disorder in main residue; $R$ factor = 0.044; $wR$ factor = 0.131; data-to-parameter ratio = 17.0.

In the title compound, $C_{22}H_{20}O_4$, the dihedral angle between the phenyl and naphthalene ring systems is 86.10 (10)°. The methoxyacrylate group is disordered over two orientations in a 0.905 (3):0.095 (3) ratio.

## Related literature

For bond-length data, see: Allen *et al.* (1987). For a related synthesis and crystal structure, see: Fun *et al.* (2008). For general background to and applications of compounds containing aromatic rings, see: Gunatilaka (2006); Kozikowski *et al.* (2000). Methylene carbonyl compounds are often found in biologically active natural compounds, see: Gotthardt & Weisshuhn (1978); Shono *et al.* (1979).



## Experimental

### Crystal data

$C_{22}H_{20}O_4$
$M_r$ = 348.38
Monoclinic, $P2_1/n$
$a$ = 10.996 (5) Å
$b$ = 7.873 (5) Å
$c$ = 21.417 (5) Å
$\beta$ = 102.493 (5)°
$V$ = 1810.2 (15) Å$^3$
$Z$ = 4
Mo $K\alpha$ radiation
$\mu$ = 0.09 mm$^{-1}$
$T$ = 293 K
0.4 × 0.4 × 0.3 mm

### Data collection

Bruker SMART CCD area-detector diffractometer
Absorption correction: multi-scan (*SADABS*; Bruker, 2000)
$T_{min}$ = 0.826, $T_{max}$ = 0.973
21877 measured reflections
4203 independent reflections
3273 reflections with $I > 2\sigma(I)$
$R_{int}$ = 0.025

### Refinement

$R[F^2 > 2\sigma(F^2)]$ = 0.044
$wR(F^2)$ = 0.131
$S$ = 1.04
4203 reflections
247 parameters
H-atom parameters constrained
$\Delta\rho_{max}$ = 0.19 e Å$^{-3}$
$\Delta\rho_{min}$ = −0.17 e Å$^{-3}$

Data collection: *SMART* (Bruker, 2001); cell refinement: *SAINT* (Bruker, 1999); data reduction: *SAINT*; 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*.

Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: ZQ2038).

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# supplementary materials

*Acta Cryst.* (2010). E**66**, o1600 [ **doi:10.1107/S1600536810020994** ]

# (2*E*)-Methyl 2-(7-benzyloxy-1-naphthyl)-3-methoxyacrylate

**X. Zhu, H. Li, J. Yang and H. Li**

## Comment

Ether compounds containing aromatic rings are present in many bioactivity compounds and are useful intermediates in organic synthesis (Kozikowski *et al.*, 2000; Gunatilaka, 2006). Methylene carbonyl compounds have been studied extensively in recent years, since they are not only useful as synthetic intermediates but also often found in biologically active natural compounds (Gotthardt *et al.*, 1978; Shono *et al.*, 1979). Here we report the synthesis and the crystal structure of the title compound $C_{22}H_{20}O_4$, namely (*E*)-methyl 2-(7-(benzyloxy)naphthalen-1-yl)-3-methoxyacrylate (I).

In the crystal structure, the molecule of (I) adopts two different conformations according to the relative position of the methoxyacrylate group. The minor and major conformers could be distinguished by the disorder of the oxygen atom O2 of the carbonyl group which occupies two different sites A (bound to C19) and B (bound to C21), the refined site-occupancy factors are 0.905 (3) and 0.095 (3), respectively. The naphthalene and benzene rings are essentially planar with r.m.s. deviations of 0.0036 (14) Å and 0.0001 (3) Å, respectively. The phenyl ring is almost perpendicular to the naphthalene ring, the dihedral angle between them is 86.10 (10)°, which is different from that in methyl 2-(7-benzyloxy-1-naphthyl)-2-oxoacetate, of 43.78 (7)° (Fun *et al.*, 2008). The dihedral angle between the mean plane of the methoxyvinyl and methoxycarbonyl groups is only 6.47 (18)°. The latter long and almost planar substituent plays an important role in the whole folded conformation of (I). Nevertheless, no classic hydrogen bonds were found in the crystal structure.

## Experimental

Methyl 2-(7-benzyloxy-1-naphthyl)-2-oxoacetate was synthesized according with a published procedure (Fun *et al.*, 2008). To a solution of methyl 2-(7-benzyloxy-1-naphthyl)-2-oxoacetate (4 g, 12.5 mmol) in dry THF (10 ml) was slowly added an excess of (methoxymethyl)triphenylphosphonium chloride (5.1 g, 20 mmol) in dry ether and 2.5 *M* butyl lithium in hexane (6 ml) under nitrogen. The mixture was allowed to warm to room temperature for 24 h, and then was quenched with dilute hydrochloric acid. The crude product was purified by column chromatography with petroleum ether - ethyl acetate (5: 1) as the eluent, to afford I as a white powder (0.5 g, 11.9%). Single crystals suitable for a X-ray analysis were obtained by slow evaporation from ethanol at room temperature for several days (m.p. 125–126°C).

## Refinement

All H atoms were positioned geometrically and refined as riding atoms, with C—H = 0.93Å and $U_{iso}$ = 1.2$U_{eq}$(C) for aromatic hydrogen atoms, with C—H = 0.97 Å and $U_{iso}$ = 1.2$U_{eq}$(C) for methylene hydrogen atoms, and with C—H=0.96 Å and $U_{iso}$ = 1.5$U_{eq}$(C) for methyl hydrogen atoms. The minor and major conformers could be distinguished by the disorder of the oxygen atom O2 of the carbonyl group which occupies two different sites A (bound to C19) and B (bound to C21), the refined site-occupancy factors are 0.905 (3) and 0.095 (3), respectively.

## Figures

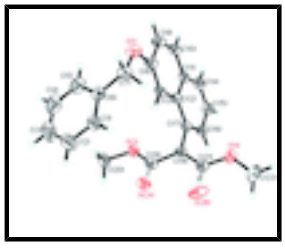


Fig. 1. The molecular structure of (I) showing 30% probability displacement ellipsoids and the atomic numbering.

## (2*E*)-Methyl 2-(7-benzyloxy-1-naphthyl)-3-methoxyacrylate

### *Crystal data*

| | |
|---|---|
| $C_{22}H_{20}O_4$ | $F(000) = 736$ |
| $M_r = 348.38$ | $D_x = 1.278$ Mg m$^{-3}$ |
| Monoclinic, $P2_1/n$ | Melting point = 398–399 K |
| Hall symbol: -P 2yn | Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å |
| $a = 10.996$ (5) Å | Cell parameters from 7659 reflections |
| $b = 7.873$ (5) Å | $\theta = 2.3$–$27.6°$ |
| $c = 21.417$ (5) Å | $\mu = 0.09$ mm$^{-1}$ |
| $\beta = 102.493$ (5)° | $T = 293$ K |
| $V = 1810.2$ (15) Å$^3$ | Block, colorless |
| $Z = 4$ | 0.4 × 0.4 × 0.3 mm |

### *Data collection*

| | |
|---|---|
| Bruker SMART CCD area-detector diffractometer | 4203 independent reflections |
| Radiation source: fine-focus sealed tube | 3273 reflections with $I > 2\sigma(I)$ |
| graphite | $R_{int} = 0.025$ |
| phi and ω scans | $\theta_{max} = 27.6°$, $\theta_{min} = 2.3°$ |
| Absorption correction: multi-scan (*SADABS*; Bruker, 2000) | $h = -14 \rightarrow 14$ |
| $T_{min} = 0.826$, $T_{max} = 0.973$ | $k = -10 \rightarrow 9$ |
| 21877 measured reflections | $l = -27 \rightarrow 27$ |

### *Refinement*

| | |
|---|---|
| Refinement on $F^2$ | Primary atom site location: structure-invariant direct methods |
| Least-squares matrix: full | Secondary atom site location: difference Fourier map |
| $R[F^2 > 2\sigma(F^2)] = 0.044$ | Hydrogen site location: inferred from neighbouring sites |
| $wR(F^2) = 0.131$ | H-atom parameters constrained |
| $S = 1.04$ | $w = 1/[\sigma^2(F_o^2) + (0.0575P)^2 + 0.3948P]$ where $P = (F_o^2 + 2F_c^2)/3$ |

| | |
|---|---|
| 4203 reflections | $(\Delta/\sigma)_{max} = 0.020$ |
| 247 parameters | $\Delta\rho_{max} = 0.19$ e Å$^{-3}$ |
| 0 restraints | $\Delta\rho_{min} = -0.17$ e Å$^{-3}$ |

*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 (Å$^2$)*

| | *x* | *y* | *z* | $U_{iso}$*/$U_{eq}$ | Occ. (<1) |
|---|---|---|---|---|---|
| C1 | 0.89564 (15) | 0.8419 (2) | 0.43935 (8) | 0.0617 (4) | |
| H1 | 0.9075 | 0.9125 | 0.4750 | 0.074* | |
| C2 | 0.9022 (2) | 0.6687 (3) | 0.44746 (13) | 0.0899 (7) | |
| H2 | 0.9175 | 0.6215 | 0.4882 | 0.108* | |
| C3 | 0.8857 (2) | 0.5660 (3) | 0.39409 (18) | 0.1101 (9) | |
| H3 | 0.8900 | 0.4486 | 0.3991 | 0.132* | |
| C4 | 0.8631 (2) | 0.6339 (3) | 0.33425 (16) | 0.1042 (8) | |
| H4 | 0.8528 | 0.5629 | 0.2988 | 0.125* | |
| C5 | 0.85536 (18) | 0.8070 (3) | 0.32603 (10) | 0.0768 (5) | |
| H5 | 0.8392 | 0.8531 | 0.2851 | 0.092* | |
| C6 | 0.87165 (13) | 0.91229 (19) | 0.37869 (7) | 0.0515 (3) | |
| C7 | 0.85480 (15) | 1.1015 (2) | 0.37234 (7) | 0.0554 (4) | |
| H7A | 0.7704 | 1.1295 | 0.3755 | 0.067* | |
| H7B | 0.9111 | 1.1558 | 0.4079 | 0.067* | |
| C8 | 0.99755 (14) | 1.19352 (19) | 0.30829 (6) | 0.0497 (3) | |
| C9 | 1.00816 (16) | 1.2723 (2) | 0.25038 (7) | 0.0591 (4) | |
| H9 | 0.9368 | 1.3001 | 0.2200 | 0.071* | |
| C10 | 1.12174 (16) | 1.3073 (2) | 0.23908 (7) | 0.0573 (4) | |
| H10 | 1.1274 | 1.3592 | 0.2008 | 0.069* | |
| C11 | 1.23257 (14) | 1.26688 (17) | 0.28418 (6) | 0.0464 (3) | |
| C12 | 1.22164 (13) | 1.18630 (16) | 0.34233 (6) | 0.0411 (3) | |
| C13 | 1.10149 (13) | 1.15120 (17) | 0.35316 (6) | 0.0437 (3) | |
| H13 | 1.0934 | 1.0991 | 0.3910 | 0.052* | |
| C14 | 1.35110 (16) | 1.3059 (2) | 0.27324 (7) | 0.0563 (4) | |
| H14 | 1.3578 | 1.3577 | 0.2351 | 0.068* | |
| C15 | 1.45600 (16) | 1.2686 (2) | 0.31784 (7) | 0.0580 (4) | |
| H15 | 1.5338 | 1.2961 | 0.3103 | 0.070* | |
| C16 | 1.44661 (14) | 1.18867 (19) | 0.37519 (7) | 0.0513 (3) | |
| H16 | 1.5189 | 1.1635 | 0.4053 | 0.062* | |

| | | | | | |
|---|---|---|---|---|---|
| C17 | 1.33331 (13) | 1.14669 (16) | 0.38795 (6) | 0.0421 (3) | |
| C18 | 1.32816 (12) | 1.06687 (17) | 0.45059 (6) | 0.0431 (3) | |
| C19 | 1.28723 (12) | 0.89191 (18) | 0.45565 (6) | 0.0457 (3) | |
| H19 | 1.2753 | 0.8435 | 0.4935 | 0.055* | 0.095 (3) |
| O2A | 1.26989 (13) | 0.82617 (16) | 0.50464 (5) | 0.0647 (4) | 0.905 (3) |
| C20 | 1.22339 (19) | 0.6374 (2) | 0.39907 (9) | 0.0704 (5) | |
| H20A | 1.2762 | 0.5730 | 0.4323 | 0.106* | |
| H20B | 1.2236 | 0.5868 | 0.3583 | 0.106* | |
| H20C | 1.1400 | 0.6380 | 0.4060 | 0.106* | |
| C21 | 1.36400 (13) | 1.15235 (19) | 0.50605 (6) | 0.0495 (3) | |
| H21 | 1.3621 | 1.0975 | 0.5443 | 0.059* | 0.905 (3) |
| O2B | 1.3729 (13) | 1.076 (2) | 0.5625 (5) | 0.084 (5) | 0.095 (3) |
| C22 | 1.43189 (19) | 1.3923 (3) | 0.56949 (8) | 0.0780 (5) | |
| H22A | 1.3574 | 1.4053 | 0.5855 | 0.117* | |
| H22B | 1.4680 | 1.5019 | 0.5659 | 0.117* | |
| H22C | 1.4902 | 1.3228 | 0.5984 | 0.117* | |
| O1 | 0.87669 (10) | 1.16997 (16) | 0.31413 (5) | 0.0632 (3) | |
| O3 | 1.26886 (10) | 0.80927 (12) | 0.39999 (5) | 0.0546 (3) | |
| O4 | 1.40199 (12) | 1.31265 (15) | 0.50759 (5) | 0.0662 (3) | |

*Atomic displacement parameters (Å$^2$)*

| | $U^{11}$ | $U^{22}$ | $U^{33}$ | $U^{12}$ | $U^{13}$ | $U^{23}$ |
|---|---|---|---|---|---|---|
| C1 | 0.0605 (9) | 0.0539 (9) | 0.0707 (10) | 0.0037 (7) | 0.0145 (8) | 0.0037 (8) |
| C2 | 0.0809 (13) | 0.0625 (12) | 0.1244 (19) | 0.0085 (10) | 0.0181 (12) | 0.0259 (12) |
| C3 | 0.0878 (16) | 0.0439 (11) | 0.194 (3) | 0.0031 (10) | 0.0207 (18) | −0.0089 (16) |
| C4 | 0.0886 (15) | 0.0765 (15) | 0.140 (2) | 0.0046 (12) | 0.0081 (15) | −0.0512 (16) |
| C5 | 0.0719 (11) | 0.0777 (13) | 0.0778 (12) | 0.0062 (9) | 0.0099 (9) | −0.0239 (10) |
| C6 | 0.0437 (7) | 0.0521 (8) | 0.0597 (8) | 0.0019 (6) | 0.0135 (6) | −0.0058 (7) |
| C7 | 0.0574 (8) | 0.0559 (9) | 0.0572 (8) | 0.0078 (7) | 0.0216 (7) | 0.0049 (7) |
| C8 | 0.0570 (8) | 0.0514 (8) | 0.0415 (7) | 0.0089 (6) | 0.0122 (6) | 0.0052 (6) |
| C9 | 0.0684 (10) | 0.0673 (10) | 0.0396 (7) | 0.0144 (8) | 0.0074 (7) | 0.0125 (7) |
| C10 | 0.0792 (11) | 0.0581 (9) | 0.0362 (7) | 0.0076 (8) | 0.0160 (7) | 0.0133 (6) |
| C11 | 0.0671 (9) | 0.0404 (7) | 0.0332 (6) | −0.0003 (6) | 0.0144 (6) | 0.0016 (5) |
| C12 | 0.0587 (8) | 0.0342 (6) | 0.0314 (6) | 0.0007 (5) | 0.0118 (5) | −0.0012 (5) |
| C13 | 0.0580 (8) | 0.0413 (7) | 0.0332 (6) | 0.0042 (6) | 0.0129 (5) | 0.0055 (5) |
| C14 | 0.0783 (10) | 0.0531 (9) | 0.0423 (7) | −0.0088 (7) | 0.0238 (7) | 0.0048 (6) |
| C15 | 0.0643 (9) | 0.0628 (10) | 0.0515 (8) | −0.0155 (8) | 0.0223 (7) | −0.0018 (7) |
| C16 | 0.0568 (8) | 0.0534 (8) | 0.0438 (7) | −0.0064 (7) | 0.0111 (6) | −0.0024 (6) |
| C17 | 0.0571 (8) | 0.0377 (6) | 0.0326 (6) | −0.0025 (6) | 0.0119 (5) | −0.0024 (5) |
| C18 | 0.0478 (7) | 0.0468 (7) | 0.0341 (6) | 0.0029 (6) | 0.0079 (5) | 0.0027 (5) |
| C19 | 0.0497 (7) | 0.0477 (8) | 0.0396 (6) | 0.0056 (6) | 0.0092 (5) | 0.0053 (6) |
| O2A | 0.0923 (10) | 0.0599 (8) | 0.0444 (7) | −0.0086 (6) | 0.0204 (6) | 0.0093 (5) |
| C20 | 0.0862 (12) | 0.0485 (9) | 0.0765 (11) | −0.0104 (8) | 0.0171 (9) | −0.0040 (8) |
| C21 | 0.0541 (8) | 0.0563 (9) | 0.0373 (6) | 0.0015 (7) | 0.0080 (6) | 0.0019 (6) |
| O2B | 0.084 (9) | 0.134 (14) | 0.030 (6) | 0.019 (9) | 0.008 (5) | 0.004 (7) |
| C22 | 0.0847 (12) | 0.0914 (14) | 0.0562 (10) | −0.0192 (10) | 0.0114 (8) | −0.0297 (9) |
| O1 | 0.0549 (6) | 0.0787 (8) | 0.0559 (6) | 0.0109 (5) | 0.0117 (5) | 0.0176 (5) |

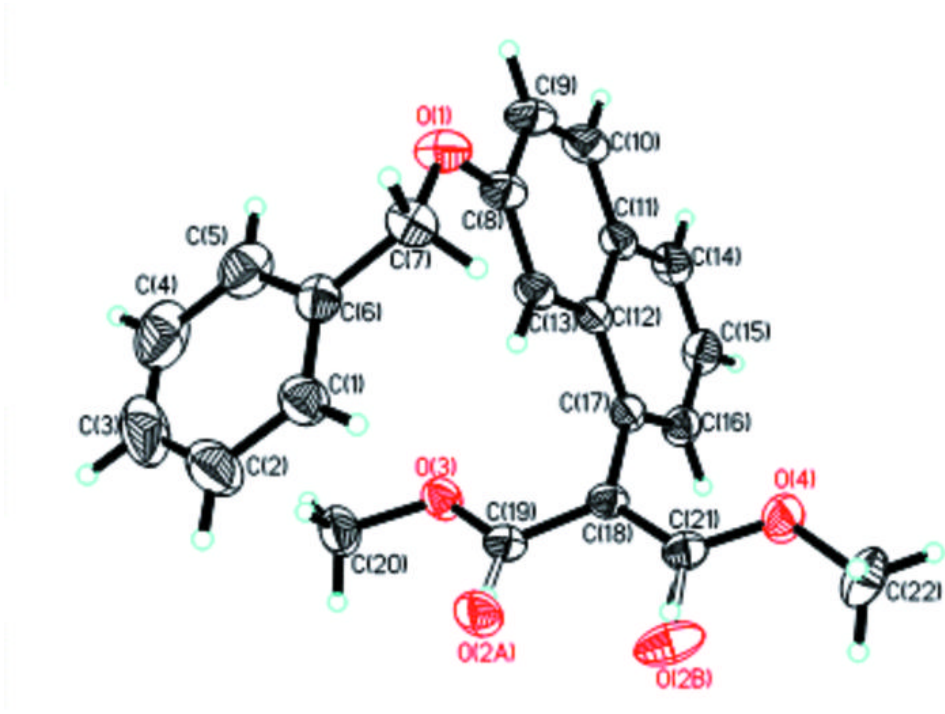
| | | | | | | |
|---|---|---|---|---|---|---|
| O3 | 0.0762 (7) | 0.0432 (5) | 0.0462 (5) | −0.0023 (5) | 0.0168 (5) | −0.0016 (4) |
| O4 | 0.0954 (9) | 0.0593 (7) | 0.0424 (6) | −0.0142 (6) | 0.0114 (5) | −0.0093 (5) |

*Geometric parameters (Å, °)*

| | | | |
|---|---|---|---|
| C1—C2 | 1.375 (3) | C12—C13 | 1.417 (2) |
| C1—C6 | 1.384 (2) | C12—C17 | 1.4285 (19) |
| C1—H1 | 0.9300 | C13—H13 | 0.9300 |
| C2—C3 | 1.380 (4) | C14—C15 | 1.361 (2) |
| C2—H2 | 0.9300 | C14—H14 | 0.9300 |
| C3—C4 | 1.361 (4) | C15—C16 | 1.404 (2) |
| C3—H3 | 0.9300 | C15—H15 | 0.9300 |
| C4—C5 | 1.375 (3) | C16—C17 | 1.372 (2) |
| C4—H4 | 0.9300 | C16—H16 | 0.9300 |
| C5—C6 | 1.380 (2) | C17—C18 | 1.4936 (17) |
| C5—H5 | 0.9300 | C18—C21 | 1.3477 (19) |
| C6—C7 | 1.504 (2) | C18—C19 | 1.460 (2) |
| C7—O1 | 1.4255 (17) | C19—O3 | 1.3345 (16) |
| C7—H7A | 0.9700 | C19—H19 | 0.9300 |
| C7—H7B | 0.9700 | C20—O3 | 1.441 (2) |
| C8—C13 | 1.366 (2) | C20—H20A | 0.9600 |
| C8—O1 | 1.3741 (19) | C20—H20B | 0.9600 |
| C8—C9 | 1.414 (2) | C20—H20C | 0.9600 |
| C9—C10 | 1.351 (2) | C21—O4 | 1.328 (2) |
| C9—H9 | 0.9300 | C21—H21 | 0.9300 |
| C10—C11 | 1.418 (2) | C22—O4 | 1.4388 (18) |
| C10—H10 | 0.9300 | C22—H22A | 0.9600 |
| C11—C14 | 1.407 (2) | C22—H22B | 0.9600 |
| C11—C12 | 1.4258 (17) | C22—H22C | 0.9600 |
| C2—C1—C6 | 120.64 (19) | C8—C13—C12 | 120.35 (12) |
| C2—C1—H1 | 119.7 | C8—C13—H13 | 119.8 |
| C6—C1—H1 | 119.7 | C12—C13—H13 | 119.8 |
| C1—C2—C3 | 118.9 (2) | C15—C14—C11 | 120.73 (13) |
| C1—C2—H2 | 120.6 | C15—C14—H14 | 119.6 |
| C3—C2—H2 | 120.6 | C11—C14—H14 | 119.6 |
| C4—C3—C2 | 121.0 (2) | C14—C15—C16 | 119.95 (14) |
| C4—C3—H3 | 119.5 | C14—C15—H15 | 120.0 |
| C2—C3—H3 | 119.5 | C16—C15—H15 | 120.0 |
| C3—C4—C5 | 120.2 (2) | C17—C16—C15 | 121.60 (14) |
| C3—C4—H4 | 119.9 | C17—C16—H16 | 119.2 |
| C5—C4—H4 | 119.9 | C15—C16—H16 | 119.2 |
| C4—C5—C6 | 119.8 (2) | C16—C17—C12 | 119.62 (12) |
| C4—C5—H5 | 120.1 | C16—C17—C18 | 119.51 (12) |
| C6—C5—H5 | 120.1 | C12—C17—C18 | 120.81 (11) |
| C5—C6—C1 | 119.45 (17) | C21—C18—C19 | 116.21 (12) |
| C5—C6—C7 | 121.96 (16) | C21—C18—C17 | 121.38 (13) |
| C1—C6—C7 | 118.43 (14) | C19—C18—C17 | 122.39 (11) |
| O1—C7—C6 | 114.39 (13) | O3—C19—C18 | 112.53 (11) |
| O1—C7—H7A | 108.7 | O3—C19—H19 | 123.7 |

| | | | |
|---|---|---|---|
| C6—C7—H7A | 108.7 | C18—C19—H19 | 123.7 |
| O1—C7—H7B | 108.7 | O3—C20—H20A | 109.5 |
| C6—C7—H7B | 108.7 | O3—C20—H20B | 109.5 |
| H7A—C7—H7B | 107.6 | H20A—C20—H20B | 109.5 |
| C13—C8—O1 | 125.56 (12) | O3—C20—H20C | 109.5 |
| C13—C8—C9 | 120.59 (14) | H20A—C20—H20C | 109.5 |
| O1—C8—C9 | 113.83 (13) | H20B—C20—H20C | 109.5 |
| C10—C9—C8 | 120.10 (14) | O4—C21—C18 | 121.81 (13) |
| C10—C9—H9 | 120.0 | O4—C21—H21 | 119.1 |
| C8—C9—H9 | 120.0 | C18—C21—H21 | 119.1 |
| C9—C10—C11 | 121.59 (13) | O4—C22—H22A | 109.5 |
| C9—C10—H10 | 119.2 | O4—C22—H22B | 109.5 |
| C11—C10—H10 | 119.2 | H22A—C22—H22B | 109.5 |
| C14—C11—C10 | 121.88 (13) | O4—C22—H22C | 109.5 |
| C14—C11—C12 | 119.91 (13) | H22A—C22—H22C | 109.5 |
| C10—C11—C12 | 118.20 (13) | H22B—C22—H22C | 109.5 |
| C13—C12—C11 | 119.17 (12) | C8—O1—C7 | 118.70 (11) |
| C13—C12—C17 | 122.65 (11) | C19—O3—C20 | 117.07 (12) |
| C11—C12—C17 | 118.17 (12) | C21—O4—C22 | 116.43 (13) |

**Fig. 1**


C(9)
O(1)
C(10)
C(8)
C(11)
C(5)
C(7)
C(14)
C(4)
C(6)
C(13)
C(12)
C(15)
C(1)
C(17)
C(3)
C(16)
C(2)
O(3)
O(4)
C(19)
C(18)
C(21)
C(20)
C(22)
O(2A)
O(2B)