

Muhammad Khalid,^a
Gul Shahzada Khan,^a Ghulam
Qadeer,^a Nasim Hasan Rama^{a*}
and Wai-Yeung Wong^b

^aDepartment of Chemistry, Quaid-I-Azam
University, Islamabad 45320, Pakistan, and
^bDepartment of Chemistry, Hong Kong Baptist
University, Waterloo Road, Kowloon Tong,
Hong Kong, People's Republic of China

Correspondence e-mail:
nasim_hasan_rama@hotmail.com

Key indicators

Single-crystal X-ray study
 $T = 293$ K
Mean $\sigma(\text{C}-\text{C}) = 0.002$ Å
 R factor = 0.025
 wR factor = 0.069
Data-to-parameter ratio = 12.2

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

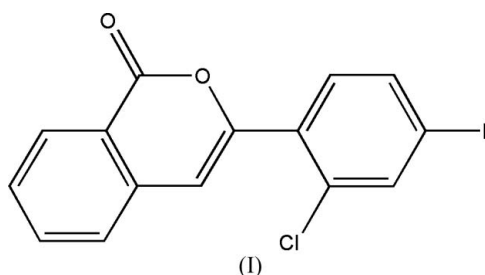
3-(2-Chloro-4-fluorophenyl)-1*H*-isochromen-1-one

The title compound, $\text{C}_{16}\text{H}_{11}\text{O}_2\text{ClF}$, is a chemically synthesized isocoumarin. The molecule is not planar and the dihedral angle between the isocoumarin and benzene ring systems is $42.43(6)^\circ$. The structure is stabilized by $\text{C}-\text{H}\cdots\text{O}$ and $\text{C}-\text{H}\cdots\text{F}$ intermolecular interactions, forming a one-dimensional chain parallel to the b axis and stacking down the a axis by $\pi-\pi$ interactions.

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Comment

The isocoumarin nucleus is an abundant structural motif in natural products (Barry, 1964). Many constituents of the steadily growing class of known isocoumarins exhibit valuable biological properties such as antifungal (Meepagala *et al.*, 2002), antitumor or cytotoxic, anti-inflammatory, anti-allergic (Rossi *et al.*, 2003) and enzyme-inhibitory activity (Powers *et al.*, 2002). Naturally occurring halo-isocoumarins and their halogeno-3,4-dihydroisocoumarin derivatives are very rare. However, a few examples of naturally occurring chlorine-containing isocoumarins are known (Larsen *et al.*, 1999). In view of the importance of this class of compounds, the title compound, (I), an isocoumarin derivative containing a 2-chloro-4-fluorophenyl substituent, has been synthesized.



The molecule is not planar (Fig. 1). The isocoumarin ring system ($\text{O1}/\text{O2}/\text{C1}-\text{C9}$) is planar, with a maximum deviation

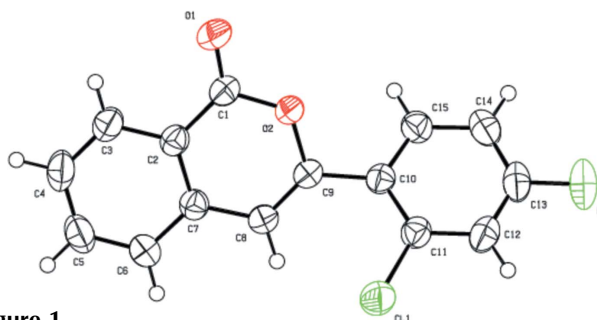


Figure 1
The molecular structure of the title compound, (I), with displacement ellipsoids drawn at the 50% probability level.

of 0.021 (1) Å for atom O1 and makes a dihedral angle of 42.43 (6)° with the the C10–C15 benzene ring. The bond lengths and angles are within normal ranges (Allen *et al.*, 1987) and comparable with those in 3-(2-chlorobenzyl)isocoumarin, (II) (Abid *et al.*, 2006). In the crystal structure, the molecules are linked by weak intra- and intermolecular hydrogen bonds (Table 1), forming one-dimensional chains parallel to the *b* axis (Fig. 2). There are also π – π interactions between the (O2/C1–C9)ⁱⁱⁱ and (C10–C15)^{iv} rings [symmetry codes: (iii) $\frac{1}{2} + x, \frac{1}{2} - y, 1 - z$; (iv) $-\frac{1}{2} + x, \frac{1}{2} - y, 1 - z$], with a distance between centroids of 3.713 Å.

Experimental

A mixture of 2-chloro-4-fluorobenzoic acid (5 g, 28 mmol) and thionyl chloride (2.94 ml, 34 mmol) was heated for 30 min in the presence of a few drops of DMF under reflux at 343 K to give 2-chloro-4-fluorobenzoyl chloride. Completion of the reaction was indicated by the disappearance of gas evolution. Removal of excess thionyl chloride was carried out under reduced pressure to afford 2-chloro-4-fluorobenzoyl chloride. Homophthalic acid (1.3 g, 7.2 mmol) was then added and the solution was refluxed for 6 h at 473 K with stirring. The reaction mixture was extracted with ethyl acetate (3 × 100 ml), and an aqueous solution of sodium carbonate (5%, 200 ml) was then added to remove the unreacted homophthalic acid. The organic layer was separated, concentrated and chromatographed on silica gel using petroleum ether (313–353 K fractions) as eluent to afford the title compound (yield 62%; m.p. 447–448 K). Colorless single crystals suitable for X-ray analysis were obtained by slow evaporation of an ethyl acetate solution.

Crystal data

C ₁₅ H ₈ ClFO ₂	<i>Z</i> = 4
<i>M_r</i> = 274.66	<i>D_x</i> = 1.522 Mg m ^{−3}
Orthorhombic, <i>P</i> 2 ₁ 2 ₁	Mo <i>K</i> α radiation
<i>a</i> = 7.4621 (4) Å	μ = 0.32 mm ^{−1}
<i>b</i> = 12.1011 (6) Å	<i>T</i> = 293 (2) K
<i>c</i> = 13.2757 (7) Å	Block, colorless
<i>V</i> = 1198.79 (11) Å ³	0.34 × 0.25 × 0.20 mm

Data collection

Bruker SMART CCD diffractometer	5893 measured reflections
φ and ω scans	2097 independent reflections
Absorption correction: multi-scan (SADABS; Bruker, 2000)	2047 reflections with <i>I</i> > 2σ(<i>I</i>)
<i>T</i> _{min} = 0.928, <i>T</i> _{max} = 1.000 (expected range = 0.870–0.937)	<i>R</i> _{int} = 0.014
	θ _{max} = 25.0°

Refinement

Refinement on <i>F</i> ²	$w = 1/[\sigma^2(F_o^2) + (0.0439P)^2 + 0.1315P]$
$R[F^2 > 2\sigma(F^2)] = 0.025$	where $P = (F_o^2 + 2F_c^2)/3$
$wR(F^2) = 0.069$	(Δ/σ) _{max} < 0.001
<i>S</i> = 1.06	$\Delta\rho$ _{max} = 0.13 e Å ^{−3}
2097 reflections	$\Delta\rho$ _{min} = −0.22 e Å ^{−3}
172 parameters	Absolute structure: Flack (1983),
H-atom parameters constrained	860 Friedel pairs
	Flack parameter: 0.00 (6)

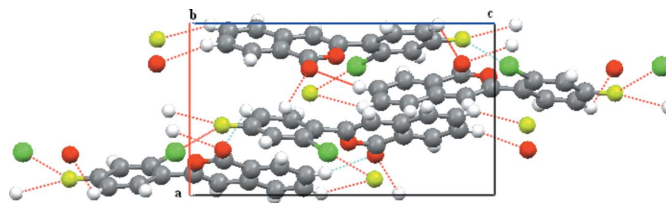


Figure 2

The crystal packing of (I), viewed down the *b* axis. Hydrogen-bonds are shown as dashed lines. H atoms not involved in hydrogen bonds have been omitted for clarity.

Table 1

Hydrogen-bond geometry (Å, °).

<i>D</i> –H... <i>A</i>	<i>D</i> –H	H... <i>A</i>	<i>D</i> ... <i>A</i>	<i>D</i> –H... <i>A</i>
C8–H8A...C11	0.93	2.81	3.2059 (15)	107
C4–H4A...O1 ⁱ	0.93	2.56	3.476 (2)	167
C5–H5A...F1 ⁱⁱ	0.93	2.55	3.368 (2)	147

Symmetry codes: (i) $-x + \frac{3}{2}, -y + 1, z + \frac{1}{2}$; (ii) $x, y, z + 1$.

H atoms were positioned geometrically, with C–H = 0.93 Å, and constrained to ride on their parent atoms, with $U_{iso}(H) = 1.2U_{iso}(C)$.

Data collection: SMART (Bruker, 2000); cell refinement: SAINT (Bruker, 2000); data reduction: SAINT; program(s) used to solve structure: SHELXS97 (Sheldrick, 1997a); program(s) used to refine structure: SHELXL97 (Sheldrick, 1997a); molecular graphics: SHELXTL (Sheldrick, 1997b); software used to prepare material for publication: SHELXTL, PARST (Nardelli, 1995) and PLATON (Spek, 2003).

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