

2-(Acetamido)-4,5-dimethyl-N-(2-methylphenyl)thiophene-3-carboxamide

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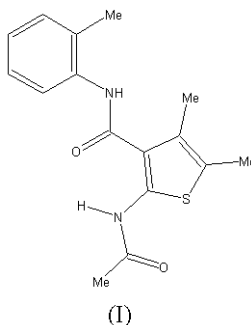
Key indicators

Single-crystal X-ray study
 $T = 293$ K
Mean $\sigma(\text{C}-\text{C}) = 0.003$ Å
 R factor = 0.042
 wR factor = 0.123
Data-to-parameter ratio = 15.4

The title compound, $\text{C}_{16}\text{H}_{18}\text{N}_2\text{O}_2\text{S}$, shows antibacterial and antifungal activities. The dihedral angle between the thiophene and 2-methylphenyl groups is $83.3(1)^\circ$. There are intra- and intermolecular $\text{N}-\text{H}\cdots\text{O}$ hydrogen bonds, and $\text{C}-\text{H}\cdots\text{O}$ intermolecular interactions.

Comment

Schiff bases (Csaszar & Morvay, 1983; Lakshmi *et al.*, 1985; Cohen *et al.*, 1977) and their derivatives of thiophene (El-Maghraby *et al.*, 1984; Dzhurayev *et al.*, 1992; Gewald *et al.*, 1966) possess antibacterial, antitubercular and antifungal properties. Sulfur-containing Schiff bases are the most effective. The title compound, (I), shows the above-mentioned biological properties (Mohan & Saravanan, 2002, 2003).



The molecular structure of (I) is shown in Fig. 1, and a packing diagram is shown in Fig. 2. The $\text{C}2-\text{C}1-\text{N}2-\text{C}15$ torsion angle is $-170.81(16)^\circ$, indicating that the acetamide group and the thiophene ring are essentially planar (Table 1). The dihedral angle between the least-squares plane passing through the amide group ($\text{O}1/\text{C}5/\text{N}1$) and the 2-methylphenyl group is $60.9(1)^\circ$, to avoid steric interaction between the methyl and carbonyl groups.

An intramolecular $\text{N}-\text{H}\cdots\text{O}$ hydrogen bond (Table 2) forms a pseudo-six-membered ring, which locks the molecular conformation and eliminates conformational flexibility. The crystal structure is further stabilized by $\text{N}-\text{H}\cdots\text{O}$ dimers and $\text{C}-\text{H}\cdots\text{O}$ chains running parallel to the b axis, which hold the dimers together to form 'chains of dimers'.

Experimental

The title compound was synthesized using the Gewald reaction (Gewald *et al.*, 1966). *o*-Cyanotoluidine (0.04 mol) was refluxed with ethyl methyl ketone (0.04 mol) in the presence of sulfur (0.04 mol), dimethylamine (4.0 ml) and ethanol (40 ml) at 323 K for 1 h. The product was mixed with acetic anhydride in the molar ratio 1:3 and heated in a beaker in a water bath for 1 h. The mixture was then

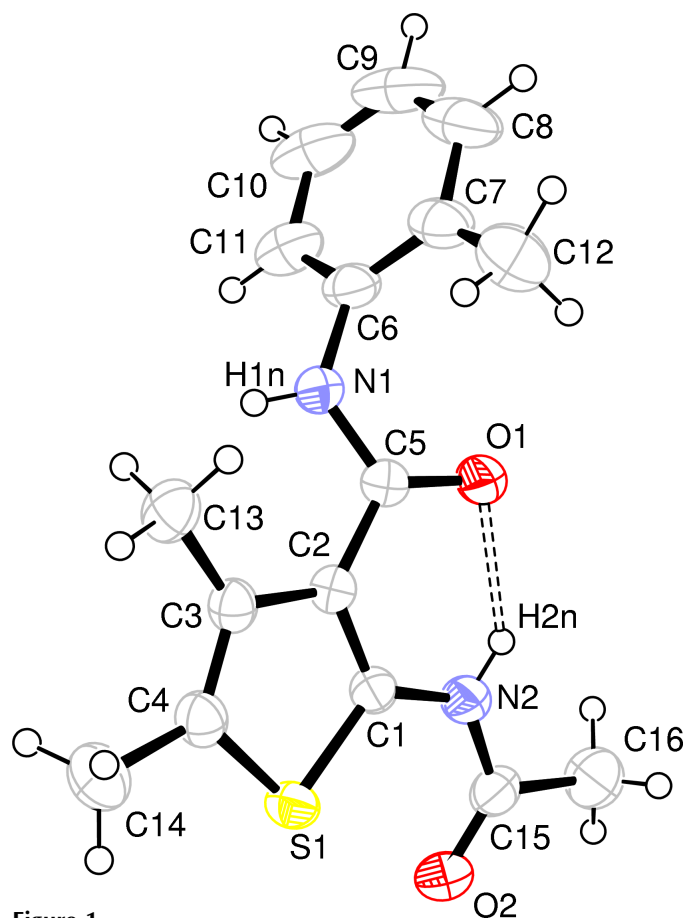


Figure 1
The molecular structure of (I), showing the atom-numbering scheme. Displacement ellipsoids are drawn at the 50% probability level and H atoms are shown as small spheres of arbitrary radii. Dashed lines indicate the intramolecular N—H···O hydrogen bond.

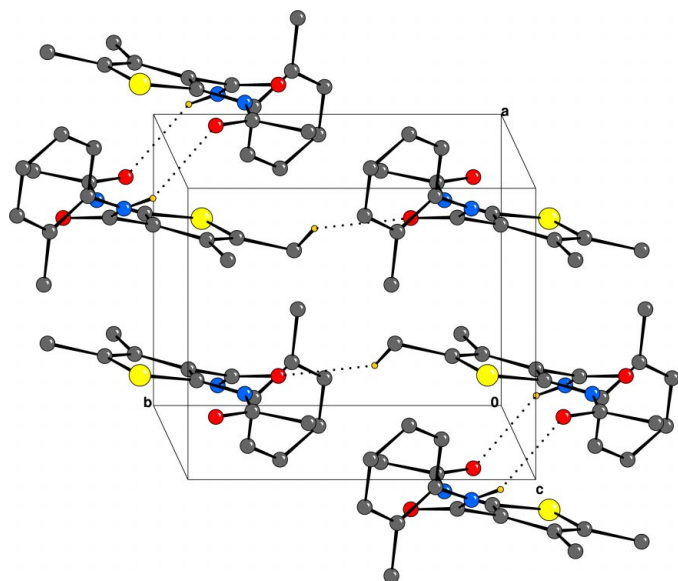


Figure 2
A packing diagram for (I). Dotted lines indicate N—H···O and C—H···O interactions. H atoms have been omitted for clarity.

cooled to room temperature and the solid which separated was filtered off. Crystals of (I) were obtained after recrystallization from ethanol (yield 72%).

Crystal data

$C_{16}H_{18}N_2O_2S$
 $M_r = 302.39$
 Monoclinic, $P2_1/n$
 $a = 7.416$ (2) Å
 $b = 8.858$ (3) Å
 $c = 23.718$ (8) Å
 $\beta = 94.566$ (6)°
 $V = 1553.2$ (9) Å³
 $Z = 4$

$D_x = 1.293$ Mg m⁻³
 Mo $K\alpha$ radiation
 Cell parameters from 650 reflections
 $\theta = 2.5$ – 24.5 °
 $\mu = 0.21$ mm⁻¹
 $T = 293$ (2) K
 Block, yellow
 $0.50 \times 0.20 \times 0.20$ mm

Data collection

Bruker SMART APEX CCD area-detector diffractometer
 φ and ω scans
 Absorption correction: multi-scan (SADABS; Sheldrick, 1996)
 $T_{\min} = 0.910$, $T_{\max} = 0.958$
 11 711 measured reflections

3118 independent reflections
 2715 reflections with $I > 2\sigma(I)$
 $R_{\text{int}} = 0.018$
 $\theta_{\text{max}} = 26.4$ °
 $h = -8 \rightarrow 9$
 $k = -11 \rightarrow 11$
 $l = -29 \rightarrow 28$

Refinement

Refinement on F^2
 $R[F^2 > 2\sigma(F^2)] = 0.042$
 $wR(F^2) = 0.123$
 $S = 1.06$
 3118 reflections
 202 parameters
 H atoms treated by a mixture of independent and constrained refinement

$w = 1/[\sigma^2(F_o^2) + (0.1357P)^2 + 0.8P]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{\text{max}} = 0.001$
 $\Delta\rho_{\text{max}} = 0.32$ e Å⁻³
 $\Delta\rho_{\text{min}} = -0.16$ e Å⁻³

Table 1

Selected torsion angles (°).

C15—N2—C1—C2	−170.81 (16)	C1—C2—C5—N1	154.78 (15)
C6—N1—C5—C2	−174.04 (16)	C5—N1—C6—C11	118.8 (2)

Table 2

Hydrogen-bonding geometry (Å, °).

$D-H\cdots A$	$D-H$	$H\cdots A$	$D\cdots A$	$D-H\cdots A$
N1—H1N···O2 ⁱ	0.786 (19)	2.46 (2)	3.155 (2)	148 (2)
N2—H2N···O1	0.829 (18)	2.029 (19)	2.692 (2)	137 (2)
C14—H14C···O1 ⁱⁱ	0.96	2.575	3.355 (3)	138

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

Amine H atoms were located in difference Fourier maps and refined isotropically. Methyl H atoms were constrained to an ideal geometry [$C-H = 0.96$ Å and $U_{\text{iso}}(H) = 1.5U_{\text{eq}}(C)$], but were allowed to rotate freely about the C—C bond. All benzene H atoms were placed in idealized positions ($C-H = 0.93$ Å) and constrained to ride on their parent atoms, with $U_{\text{iso}}(H) = 1.2U_{\text{eq}}(C)$.

Data collection: SMART (Bruker, 1998); cell refinement: SMART; data reduction: SAINT (Bruker, 1998); program(s) used to solve structure: SIR92 (Altomare *et al.*, 1993); program(s) used to refine structure: SHELXL97 (Sheldrick, 1997); molecular graphics: ORTEP-3 for Windows (Farrugia, 1997) and CAMERON (Watkin *et al.*, 1993); software used to prepare material for publication: PLATON (Spek, 2003).

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