Crystal structure of 3-{[4-(4-fluorophenyl)piperazin-1-yl]methyl}-5-(thiophen-2-yl)-2,3-dihydro-1,3,4-oxadiazole-2-thione, $C_{17}H_{17}FN_4OS_2$

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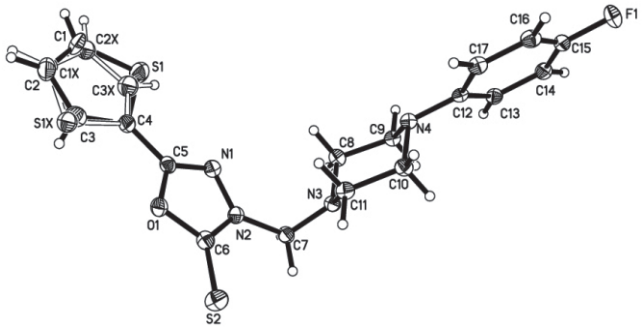

Abstract

$C_{17}H_{17}FN_4OS_2$, triclinic, $P\bar{1}$ (no. 2), a = 6.3278(8) Å, b = 9.6250(13) Å, c = 14.789(2) Å, α = 81.739(5)°, β = 82.226(4)°, γ = 76.611(4)°, V = 862.3 Å^3, Z = 2, $R_{gt}(F)$ = 0.0798, $wR_{ref}(F^2)$ = 0.2072, T = 150 K.

Table 1. Data collection and handling.

Crystal:	colourless needles, size 0.168×0.189×0.567 mm
Wavelength:	Mo K_α radiation (0.71073 Å)
μ:	3.32 cm^{-1}
Diffractometer, scan mode:	Bruker APEX-II D8 venture, φ and ω
$2\theta_{max}$:	61.16°
$N(hkl)_{measured}$, $N(hkl)_{unique}$:	5225, 5225
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\ \sigma(I_{obs})$, 4245
$N(param)_{refined}$:	245
Programs:	SHELX [10], SAINT , SADABS [11]

Source of material

1-(4-Fluorophenyl)piperazine (360 mg, 2 mmol) and a formaldehyde solution (0.5 mL, 37%) were added to a solution of 5-(thiophen-2-yl)-1,3,4-oxadiazole-2-thiol (369 mg, 2 mmol) in ethanol (8 mL). The mixture was stirred at room temperature for two hours and allowed to stand overnight. The precipitated crude product was filtered, washed with cold ethanol, dried, and crystallized from ethanol to yield 580 mg (77%) of the title compound as pale yellow needle-shaped crystals. **M. p.** 390-395 K. Single crystals suitable for X-ray analysis were obtained by slow evaporation of $CHCl_3$:EtOH (1:1, *v*:*v*; 5 ml) solution at room temperature. **^{1}H NMR** ($CDCl_3$, 500.13 MHz): δ 3.02-3.10 (m, 4H, Piperazine-H), 3.18 (s, 4H, Piperazine-H), 5.24 (s, 2H, CH_2), 6.96 (d, 2H, Ar-H, J = 7.5 Hz), 7.35-7.41 (m, 3H, Ar-H & Thiophene-H), 7.52 (d, 1H, Thiophene-H, J = 5.0 Hz), 7.70 (d, 1H, Thiophene-H, J = 5.0 Hz). **^{13}C NMR** ($CDCl_3$, 125.76 MHz): δ 50.12, 51.60 (Piperazine-C), 69.95 (CH2), 115.23, 117.23, 125.28, 127.43, 127.46, 129.37, 145.01, 149.606 (Ar & Thiophene-C), 157.0 (CH=N), 177.49 (C=S).

Experimental details

There is a 2:1 disorder in the thiophen-2-yl moiety (cf. fig.). All hydrogen atoms are attached to the parent atoms using riding models (AFIX 23 and AFIX 43 [10]). The measured crystal was a non-merohedral twin.

Discussion

1,3,4-Oxadiazole nucleus represents the key pharmacophore of several biologically-active agents. Thus, several 1,3,4-oxadiazole derivatives were reported to possess marked chemotherapeutic activities as antibacterial, antifungal, anti-HIV and anticancer activities [1–4]. In addition, potent anti-inflammatory activity was observed for several 1,3,4-oxadiazole derivatives [4, 5]. The title compound was synthesized among a series of 2-thienyl-1,3,4-oxadiazoles and related derivatives as potential antimicrobial agents [6]. In continuation to our previous studies on the molecular structures of 3-aminomethyl-5-substituted-2,3-dihydro-1,3,4-oxadiazole-2-thiones [7–9], we report herein the crystal structure of the title compound. In the title compound, $C_{17}H_{17}FN_4OS_2$, the piperazine ring adopts a chair conformation. The oxadiazole ring forms dihedral angles of 4.03(4)°, 68.87(8)° and 87.68(9)° with the thiophene, piperazine and benzene rings, respectively, resulting in an approximate V-shaped conformation for the molecule. The molecule is twisted about the C7, with a N1–N2–C7–N3 torsion angle of 69.4(4)°. The molecules packing in the crystal structure is stabilized by two intermolecular hydrogen bonds, of which F1 and S2 work as hydrogen bond acceptors and C1 and C7 work as hydrogen bond donors. The distance of the interactions between C1–H1A···F1 is 2.54(1) Å and C7–H7B···S2 is 2.75(1) Å and the angles are 139° and 152°, respectively.

Table 2. Atomic coordinates and displacement parameters (in Å^2).

Atom	Site	Occ.	x	y	z	U_{iso}
H(1A)	2*i*	0.682	0.7632	0.0433	–0.0956	0.049
H(2A)	2*i*	0.682	1.0553	0.1679	–0.1117	0.043
H(3A)	2*i*	0.682	0.9533	0.3664	–0.0213	0.042
S(1X)	2*i*	0.318	0.9306(7)	0.3124(5)	–0.0172(3)	0.031(1)
C(1X)	2*i*	0.318	0.889(4)	0.184(3)	–0.082(2)	0.028(5)
H(1XA)	2*i*	0.318	0.9873	0.1538	–0.1312	0.033
C(2X)	2*i*	0.318	0.707(3)	0.132(2)	–0.056(1)	0.029(4)
H(2XA)	2*i*	0.318	0.6724	0.0555	–0.0778	0.035
C(3X)	2*i*	0.318	0.583(2)	0.216(2)	0.009(1)	0.035(4)
H(3XA)	2*i*	0.318	0.4407	0.2082	0.0306	0.042

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Table 2. continued.

Atom	Site	Occ.	*x*	*y*	*z*	U_{iso}
H(7A)	2*i*		0.2155	0.6461	0.3025	0.030
H(7B)	2*i*		0.0713	0.5805	0.2496	0.030
H(8A)	2*i*		0.1735	0.2717	0.3096	0.027
H(8B)	2*i*		–0.0543	0.3804	0.3104	0.027
H(9A)	2*i*		–0.1053	0.3363	0.4719	0.023
H(9B)	2*i*		–0.0740	0.1920	0.4287	0.023
H(10A)	2*i*		0.4291	0.2741	0.5313	0.028
H(10B)	2*i*		0.2039	0.3847	0.5389	0.028
H(11A)	2*i*		0.4298	0.4760	0.4186	0.028
H(11B)	2*i*		0.4734	0.3334	0.3723	0.028
H(13A)	2*i*		–0.1873	0.1689	0.5829	0.026
H(14A)	2*i*		–0.2467	0.0250	0.7198	0.030
H(16A)	2*i*		0.4013	–0.1080	0.7284	0.031
H(17A)	2*i*		0.4618	0.0321	0.5897	0.028

Table 3. Atomic coordinates and displacement parameters (in $Å^2$).

Atom	Site	Occ.	*x*	*y*	*z*	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
S(2)	2*i*		0.6348(2)	0.7002(1)	0.24006(7)	0.0222(4)	0.0356(5)	0.0427(5)	–0.0085(4)	–0.0034(4)	–0.0119(4)
O(1)	2*i*		0.6970(4)	0.4985(3)	0.1259(2)	0.022(1)	0.028(1)	0.027(1)	–0.006(1)	0.0022(9)	–0.0031(9)
N(1)	2*i*		0.4009(5)	0.4053(3)	0.1595(2)	0.028(2)	0.025(1)	0.026(1)	–0.006(1)	0.001(1)	–0.002(1)
N(2)	2*i*		0.3932(5)	0.5131(3)	0.2137(2)	0.021(1)	0.023(1)	0.024(1)	–0.005(1)	0.001(1)	–0.003(1)
N(3)	2*i*		0.1741(5)	0.4557(3)	0.3590(2)	0.018(1)	0.020(1)	0.024(1)	–0.004(1)	–0.001(1)	–0.002(1)
N(4)	2*i*		0.1872(4)	0.2048(3)	0.4880(2)	0.015(1)	0.019(1)	0.022(1)	–0.0025(9)	–0.005(1)	–0.0023(9)
F(1)	2*i*		0.0373(4)	–0.1384(3)	0.8153(2)	0.047(1)	0.036(1)	0.024(1)	–0.008(1)	–0.006(1)	0.0070(9)
C(4)	2*i*		0.6772(6)	0.3077(4)	0.0392(2)	0.028(2)	0.024(2)	0.022(2)	–0.003(1)	–0.001(1)	0.000(1)
S(1)	2*i*	0.682	0.5482(3)	0.1769(2)	0.0209(1)	0.045(1)	0.041(1)	0.0374(9)	–0.0154(9)	0.0043(7)	–0.0150(8)
C(1)	2*i*	0.682	0.762(2)	0.118(1)	–0.0620(6)	0.045(5)	0.041(4)	0.030(3)	–0.001(4)	0.012(4)	–0.016(3)
C(2)	2*i*	0.682	0.926(2)	0.189(1)	–0.0735(8)	0.035(5)	0.041(5)	0.028(4)	–0.004(3)	0.003(4)	–0.001(3)
C(3)	2*i*	0.682	0.867(2)	0.2996(8)	–0.0189(5)	0.046(5)	0.033(3)	0.030(3)	–0.015(3)	–0.009(3)	–0.005(2)
C(5)	2*i*		0.5844(6)	0.4007(3)	0.1087(2)	0.022(2)	0.022(1)	0.021(1)	–0.004(1)	–0.003(1)	0.001(1)
C(6)	2*i*		0.5695(5)	0.5711(4)	0.1947(2)	0.018(1)	0.025(2)	0.027(2)	–0.002(1)	–0.002(1)	–0.001(1)
C(7)	2*i*		0.2022(6)	0.5582(4)	0.2811(2)	0.022(2)	0.021(1)	0.027(2)	–0.001(1)	0.003(1)	–0.000(1)
C(8)	2*i*		0.0707(6)	0.3407(4)	0.3447(2)	0.020(2)	0.025(2)	0.024(2)	–0.007(1)	–0.004(1)	–0.001(1)
C(9)	2*i*		–0.0018(5)	0.2671(3)	0.4372(2)	0.016(1)	0.021(1)	0.023(1)	–0.004(1)	–0.005(1)	–0.003(1)
C(10)	2*i*		0.2997(6)	0.3175(4)	0.5004(2)	0.024(2)	0.024(2)	0.025(2)	–0.009(1)	–0.005(1)	–0.003(1)
C(11)	2*i*		0.3653(6)	0.3981(4)	0.4085(2)	0.020(2)	0.024(2)	0.027(2)	–0.006(1)	–0.004(1)	–0.004(1)
C(12)	2*i*		0.1432(5)	0.1178(3)	0.5716(2)	0.019(1)	0.016(1)	0.021(1)	–0.002(1)	–0.002(1)	–0.005(1)
C(13)	2*i*		–0.0687(5)	0.1134(3)	0.6117(2)	0.019(1)	0.021(1)	0.023(2)	0.001(1)	–0.002(1)	–0.003(1)
C(14)	2*i*		–0.1053(6)	0.0275(4)	0.6937(2)	0.024(2)	0.024(2)	0.025(2)	–0.003(1)	0.001(1)	–0.004(1)
C(15)	2*i*		0.0719(6)	–0.0533(4)	0.7351(2)	0.033(2)	0.021(1)	0.020(1)	–0.003(1)	–0.003(1)	–0.002(1)
C(16)	2*i*		0.2844(6)	–0.0528(4)	0.6985(2)	0.026(2)	0.023(2)	0.030(2)	–0.000(1)	–0.010(1)	–0.004(1)
C(17)	2*i*		0.3197(6)	0.0321(4)	0.6159(2)	0.019(2)	0.024(2)	0.027(2)	–0.002(1)	–0.005(1)	–0.005(1)

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