

1-(*p*-Tolylsulfonyl)-L-proline ethyl esterYong-Jiang Chen, Gang Xu,
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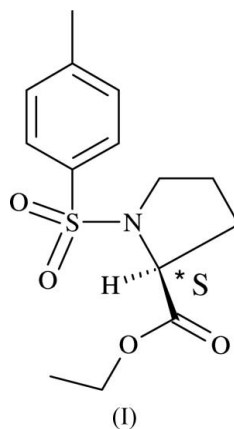
Key indicators

Single-crystal X-ray study
 $T = 291$ K
Mean $\sigma(\text{C}-\text{C}) = 0.005$ Å
 R factor = 0.048
 wR factor = 0.088
Data-to-parameter ratio = 14.5For details of how these key indicators were
automatically derived from the article, see
<http://journals.iucr.org/e>.

The title compound, $\text{C}_{14}\text{H}_{19}\text{NO}_4\text{S}$, an intermediate for the synthesis of the pentacyclic antitumour alkaloid camptothecin, has been crystallographically characterized. The crystal structure is stabilized by intra- and intermolecular hydrogen bonds.

Comment

Camptothecin is a pentacyclic alkaloid isolated from barks, roots, fruits, and leaves of *camacuminata* by Wall *et al.* (1966) and Wani *et al.* (1980). This compound is known to exhibit antitumor activity because it can inhibit nucleic acid synthesis. L-1-(*p*-Tolylsulfonyl)proline ethyl ester, (I), derived from L-proline, is an intermediate in the synthesis of camptothecin. The molecular and crystal structure of (I) are reported here.



Compound (I) crystallizes in the orthorhombic space group $P2_12_12_1$. The atom-numbering scheme is shown in Fig. 1, while selected bond distances and angles are given in Table 1. The chiral atom C11 is in an *S* configuration. The bond distances and angles within this structure are in the normal ranges (Angle & Belanger, 2004; Van Esseveldt *et al.*, 2003).

Intermolecular $\text{C}-\text{H}\cdots\text{O}$ hydrogen bonds between one benzene H atom (H6) and one O atom (O1) bonded to sulfur help build a one-dimensional chain (Fig. 2); all the benzene rings in the chain are parallel (Fig. 3). In addition, the structure is stabilized by intramolecular $\text{C}-\text{H}\cdots\text{O}$ hydrogen bonds between the H atoms bonded to C6 and C11 and atom O2 (Table 2). Neighboring chains are packed *via* van der Waals interactions. There are no $\pi-\pi$ stacking interactions between the aromatic rings (Fig. 3), although they are parallel.

Experimental

Compound (I) was synthesized *via* a method described by Barton & Morgan (1962). Colorless crystals suitable for X-ray analysis were

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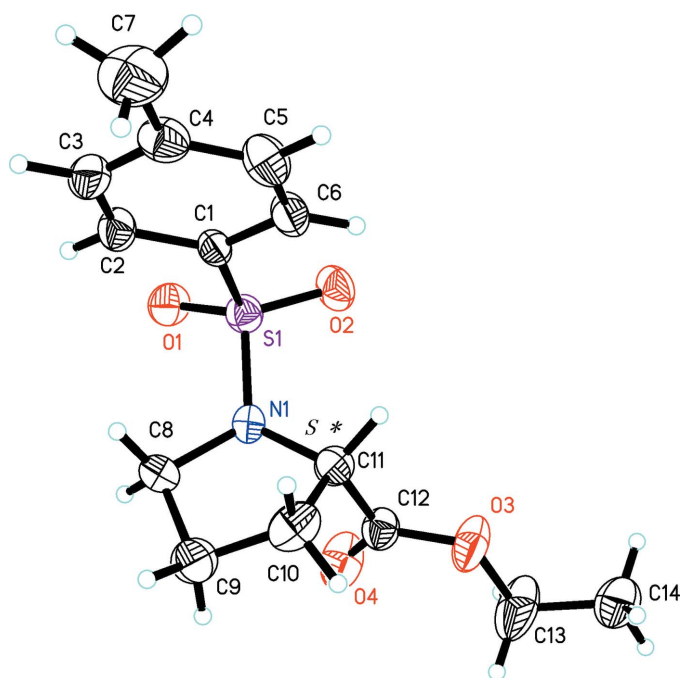


Figure 1
Drawing of the title molecule with the atom-numbering scheme. Displacement ellipsoids for non-H atoms are drawn at the 30% probability level.

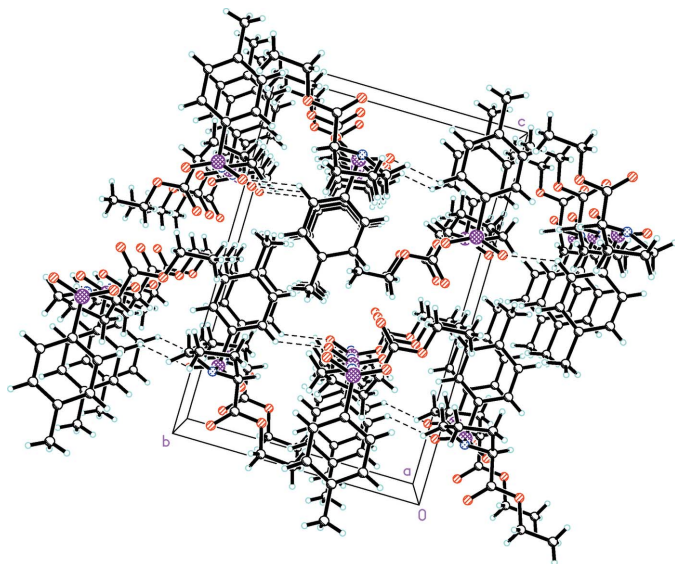


Figure 2
The packing of (I), viewed along the *a* axis, sustained by C–H...O hydrogen bonds (dashed lines).

grown from a mixture of ethanol and water (3:1 *v/v*) by slow evaporation at room temperature.

Crystal data

$C_{14}H_{19}NO_4S$
 $M_r = 297.36$
 Orthorhombic, $P2_12_12_1$
 $a = 7.4671$ (17) Å
 $b = 11.547$ (3) Å
 $c = 17.445$ (4) Å
 $V = 1504.1$ (6) Å³
 $Z = 4$
 $D_x = 1.313$ Mg m⁻³

Mo $K\alpha$ radiation
 Cell parameters from 784 reflections
 $\theta = 3.0$ – 25.1°
 $\mu = 0.23$ mm⁻¹
 $T = 291$ (2) K
 Block, colorless
 0.60 × 0.50 × 0.40 mm

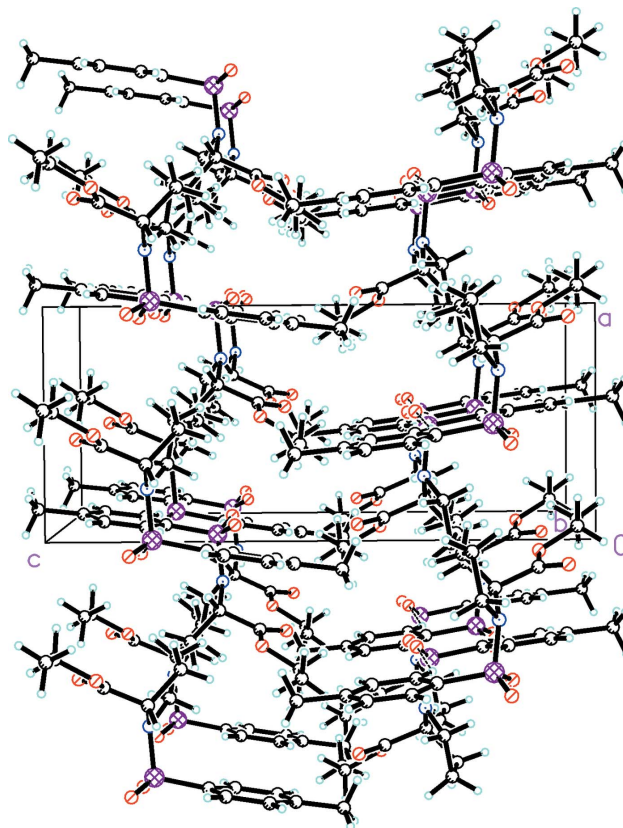


Figure 3
The packing of (I), viewed along the *b* axis.

Data collection

Bruker SMART CCD area-detector diffractometer
 φ and ω scans
 Absorption correction: multi-scan (SADABS; Bruker, 2000)
 $T_{min} = 0.876$, $T_{max} = 0.915$
 7523 measured reflections

2652 independent reflections
 1855 reflections with $I > 2\sigma(I)$
 $R_{int} = 0.069$
 $\theta_{max} = 25.0^\circ$
 $h = -8 \rightarrow 6$
 $k = -13 \rightarrow 13$
 $l = -20 \rightarrow 20$

Refinement

Refinement on F^2
 $R[F^2 > 2\sigma(F^2)] = 0.048$
 $wR(F^2) = 0.088$
 $S = 0.91$
 2652 reflections
 183 parameters
 H-atom parameters constrained

$w = 1/[\sigma^2(F_o^2) + (0.024P)^2]$
 where $P = (F_o^2 + 2F_c^2)/3$
 $(\Delta/\sigma)_{max} < 0.001$
 $\Delta\rho_{max} = 0.31$ e Å⁻³
 $\Delta\rho_{min} = -0.15$ e Å⁻³
 Absolute structure: Flack (1983),
 1104 Friedel pairs
 Flack parameter: -0.08 (10)

Table 1

Selected geometric parameters (Å, °).

C1–S1	1.752 (3)	C13–O3	1.456 (4)
C8–N1	1.485 (4)	N1–S1	1.610 (2)
C11–N1	1.459 (4)	O1–S1	1.426 (2)
C12–O4	1.185 (3)	O2–S1	1.422 (2)
C12–O3	1.318 (4)		
C11–N1–C8	111.4 (2)	O1–S1–N1	106.57 (14)
C11–N1–S1	121.0 (2)	O2–S1–C1	108.30 (14)
C8–N1–S1	119.0 (2)	O1–S1–C1	107.48 (14)
O2–S1–O1	120.37 (13)	N1–S1–C1	106.61 (12)
O2–S1–N1	106.77 (15)		

Table 2
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>
C6—H6···O2	0.93	2.59	2.933 (4)	102
C11—H11···O2	0.98	2.55	2.883 (4)	100
C6—H6···O1 ⁱ	0.93	2.46	3.202 (4)	137

Symmetry code: (i) $-x + 1, y + \frac{1}{2}, -z + \frac{1}{2}$.

The H atoms were placed in geometrically idealized positions (C—H = 0.93–0.98 Å) and refined as riding atoms, with $U_{\text{iso}}(\text{H}) = 1.2_{\text{eq}}(\text{C})$ or 1.5_{eq}(methyl C). The absolute configuration of chiral atom C11 was the same as that in the starting material L-proline.

Data collection: *SMART* (Bruker, 2000); cell refinement: *SMART*; data reduction: *SAINTE* (Bruker, 2000); program(s) used to solve structure: *SHELXTL* (Bruker, 2000); program(s) used to refine

structure: *SHELXTL*; molecular graphics: *SHELXTL*; software used to prepare material for publication: *SHELXTL*.

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