An NMR Crystallography Investigation of Furosemide

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Experimental data as reported in MRC2018

Figure 2 A ^{13}C CP MAS spectrum of furosemide (form I) (black) with the GIPAW calculated chemical shifts for ^{13}C FURSEM01 overlaid in red.

structures	data
Furosemide (form I)	Furosemide_CP

Figure 3 Plot of the experimental ^{13}C chemical shifts of furosemide (form I) against the GIPAW calculated absolute isotropic shielding for the twelve carbon atoms in the two distinct furosemide molecules in the asymmetric unit cell (FURSEM01). The line of best fit had not been constrained to a gradient to -1.

structures	data
Furosemide (form I)	Furosemide_CP

Figure 4 A ^{1}H (500 MHz)-^{13}C refocused INEPT (12.5 kHz MAS, eDUMBO-1_{22} ^{1}H homonuclear decoupling) spectrum, together with skyline projections, of furosemide form I, recorded using a spin-echo (τ - π - τ) duration, $\tau = \tau_0 = 0.96$ ms. 256 transients were co-added for each of 26 t_1 FIDs, corresponding to a total experimental time of 4 days and 15 hours. The base contour level is at 15%. Crosses (in red) correspond to the GIPAW calculated ^{13}C and ^{1}H chemical shifts for directly bonded CH moieties, using $\sigma_{ref} = 29.6$ ppm for ^{1}H and $\sigma_{ref} = 168.4$ ppm for ^{13}C for the geometry optimised (CASTEP) crystal structure of furosemide form I based on CSD structure FURSEM01.

structures	data
Furosemide (form I)	Furosemide_INEPT

Figure 5 A ^{1}H (500 MHz) DQ MAS (30 kHz) NMR spectrum, together with skyline projections, of furosemide from I, recorded using one rotor period of BABA recoupling. 64 transients were co-added for each of 256 t_1 FIDs, corresponding to a total experimental time of 13.8 h. The base contour level is at 7% of the maximum peak height. The $F_1 = 2F_2$ diagonal is shown as a dashed line. Horizontal lines (in light blue) indicate pairs of DQ peaks corresponding to close (<3.5 Å) H –H proximities. Crosses represent the GIPAW calculated shift with a dipolar coupling weighting. A partial assignment of the peaks is presented on the spectrum. The number refers to the label of the hydrogen (see Scheme 1) and the superscript to the

molecular unit (a or b, corresponding to the two molecules in the asymmetric unit).

structures	data
Furosemide (form I)	Furosemide_DQ

Computational Files

Figure 6 Decomposition maps visualizing the effect of aromatic ring currents on the NMR chemical shifts of (a) hydrogen 9 in molecule a in FURSEM01 (a) hydrogen 3 in molecule b in FURSEM01 (c) hydrogen 3 in FURSEM14 (d) hydrogen 7 in FURSEM16.

structures	data
(a) (b) Furosemide (form I) (c) Furosemide (form II) (d) Furosemide (form III)	(a) nomol_cell_H1_FURSEM01.dec.0001.cube
	(b) nomol_cell_H23_FURSEM01.dec.0001.cube
	(c) nomol_cell_H1_FURSEM14.dec.0001.cube
	(d) nomol_cell_H1_FURSEM16.dec.0001.cube

CIF files

*cif files after geometry optimisation in CASTEP

MAGRES files

*.magres magres files containing calculated NMR parameters and are an output file of an NMR calculation in CASTEP. Magres files can be visualized using MagresView software, the online version can be found at: http://ccpnc.materials.ox.ac.uk/magresview/magresview/magres_view.html