Supporting Information

Brønsted acid enabled metal-free remote oxygenation and amidation of unstrained C–C bonds *via* 1,4-heteroaryl migration chaperoned radical-polar crossover

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1.General information

All commercially available reagents were used without further purification. Column chromatography was performed on silica gel (200-300 mesh). ^{1}H NMR, ^{13}C NMR, and ^{19}F NMR spectra were recorded on Bruker 400 MHz and JOEL 500 MHz NMR spectrometers. Chemical shifts (δ) were reported in ppm, and coupling constants (J) were given in Hertz (Hz). Data were reported as s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, br = broad, m = multiplet. High-resolution mass spectra (HRMS) were recorded on an AB SCIEX Triple ESI-TOF 5600+ mass spectrometer. The electrochemical measurements were carried out on a CS2350M electrochemical workstation (Wuhan Corrtest Instrument Co., Ltd). The 15W and 36 W blue LED lamp (λmax = 445 nm) was manufactured by Hongye Photoelectricity Co., Ltd. Photo reactions were carried out in 20 mL reaction tubes at the distance of 2.0 cm from the LED lamp. An electronic fan is equipped to maintain the reaction temperature could in a range of 30 ± 2℃.

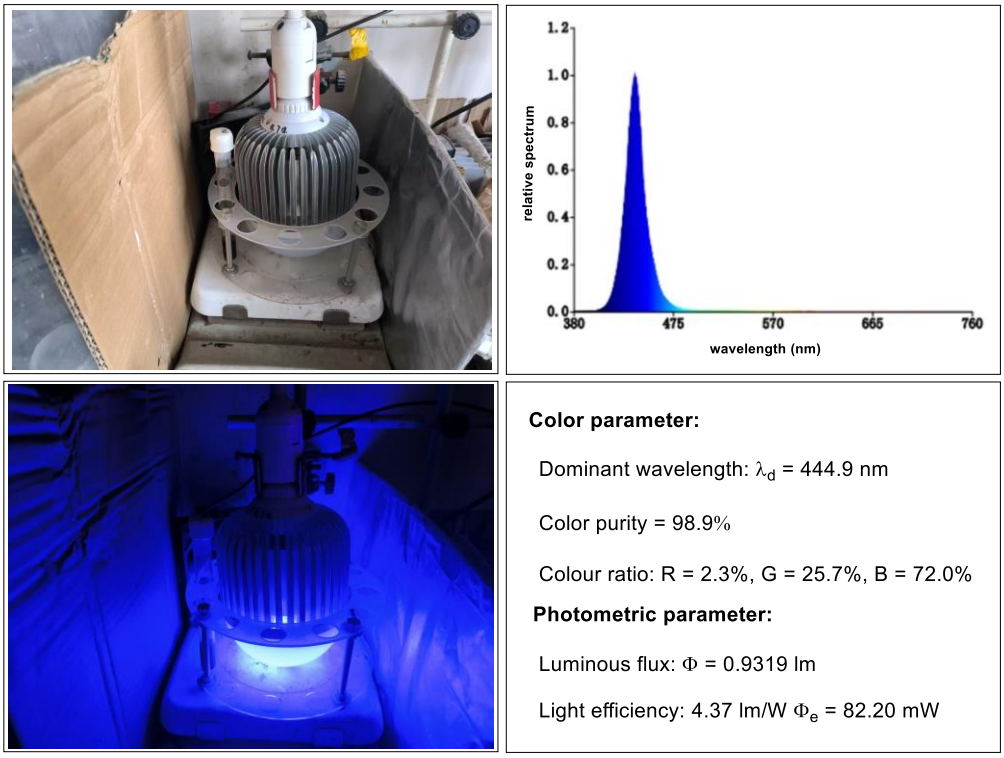
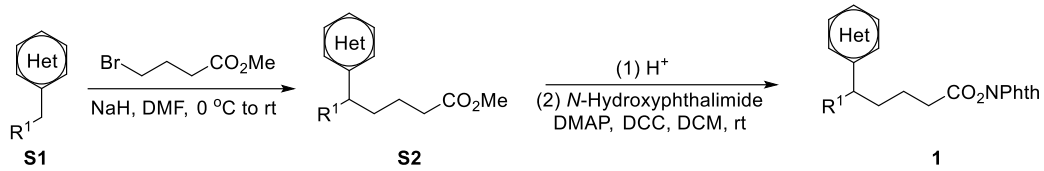


Figure S1. The spectrum of the lamp and the visible-light irradiation instrument

2. General procedure for remote oxygenation and amidation of unstrained C–C bonds *via* 1,4-group migration

2.1 Procedure for the synthesis of substrates 1[1]



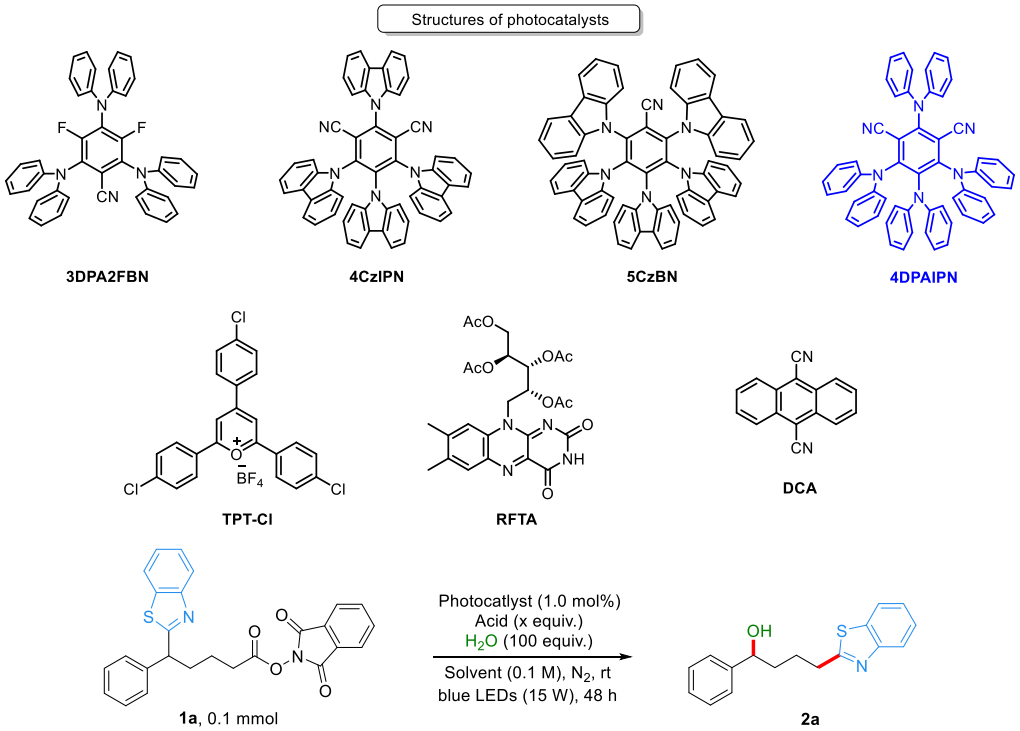
To a 100 mL oven-dried round-bottomed flask equipped with a stirring bar was charged with NaH (800 mg, 20 mmol, 60% suspension in mineral oil), DMF (20 mL) were added under N_2 atmosphere. The aryl acetonitrile and heteroaryl acetonitrile (10 mmol) were added dropwise after the mixture was cooled down by ice bath. Then the reaction mixture was warmed to room temperature and stirred 1 h, the **S1** (15 mmol) were added under the same conditions as above. After stirring at room temperature for 16 h, the reaction mixture was quenched with NH_4Cl (20 mL), and extracted with EtOAc (20 mL×3). The combined organic layers were washed with brine (20 mL), dried over Na_2SO_4, the crude product was further purified by flash chromatography to give the ester **S2**.

To a round-bottomed flask equipped with a magnetic stir bar were added **S2** (10.0 mmol) and EtOH (20 mL). Then the KOH solution (5.0 mL, 6.0 M) was added dropwise, and the reaction mixture was stirred at rt for 12 h. After that, the reaction mixture was brought to pH = 2 ~ 4 with HCl (6.0 M), and extracted with EtOAc (10 mL×3). The combined organic layers were washed with brine (10 mL), dried over Na_2SO_4, and concentrated under reduced pressure. The crude product was further purified by flash chromatography to give corresponding acids.

To the acid (10 mmol) were added *N*-hydroxyphthalimide (15 mmol), *N,N*-dimethylpyridine (1.0 mmol), *N,N*-dicyclohexylcarbodiimide (15 mmol), and CH_2Cl_2 (10 mL). The reaction mixture was stirred at rt for 12 h. After that, the mixture was filtered through a pad of silica gel and rinsed with CH_2Cl_2. The filtrate was concentrated under reduced pressure. The residue was purified by column chromatography on silica gel to afford substrates **1**.

2.2 Optimization of reaction conditions

Table S1. Screening of photocatalysts, acids and solvents[a]

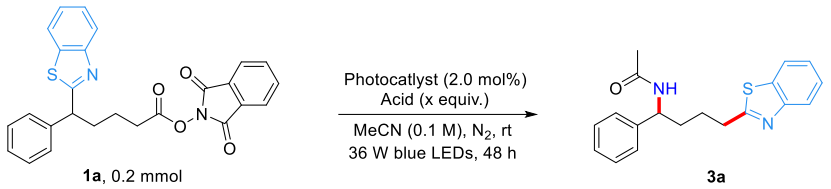


Entry	Photocatalysts	Acids (x equiv.)	Solvent	Yield (%)[b]
1	3DPA2FBN	TsOH•H_2O (2.0)	MeCN	23
2	4CzIPN	TsOH•H_2O (2.0)	MeCN	42
3	5CzBN	TsOH•H_2O (2.0)	MeCN	n.d.
4	4DPAIPN	TsOH•H_2O (2.0)	MeCN	60
5	TPT-Cl	TsOH•H_2O (2.0)	MeCN	n.d.
6	RFTA	TsOH•H_2O (2.0)	MeCN	n.d.
7	DCA	TsOH•H_2O (2.0)	MeCN	n.d.
8	4DPAIPN	H_3PO_4 (2.0)	MeCN	38
9	4DPAIPN	TFA (2.0)	MeCN	42
10	4DPAIPN	HBF_4 (2.0)	MeCN	48
11	4DPAIPN	TsOH•H_2O (1.0)	MeCN	40
12	4DPAIPN	TsOH•H_2O (3.0)	MeCN	77
13	4DPAIPN	TsOH•H_2O (3.0)	DMSO	30
14	4DPAIPN	TsOH•H_2O (3.0)	THF	34
15	4DPAIPN	TsOH•H_2O (3.0)	EtOAC	53

16	4DPAIPN	TsOH•H_2O (3.0)	DMF	47
17	4DPAIPN	TsOH•H_2O (3.0)	Acetone	45
18	-	TsOH•H_2O (3.0)	MeCN	n.d.
19	4DPAIPN	-	MeCN	n.d.
20[c]	4DPAIPN	TsOH•H_2O (3.0)	MeCN	n.d.
21[d]	4DPAIPN	TsOH•H_2O (3.0)	MeCN	n.d.

[a]Reaction conditions: **1a** (0.1 mmol), photocatlyst (1.0 mol%), acid (x equiv.), H_2O (100 equiv.), solvent (1.0 mL), room temperature, N_2, under blue LEDs (15 W) irradiation for 48 h. [b]Isolated yileds were reported. [c]Without light. [d]Under air atmosphere. n.d.= not detected.

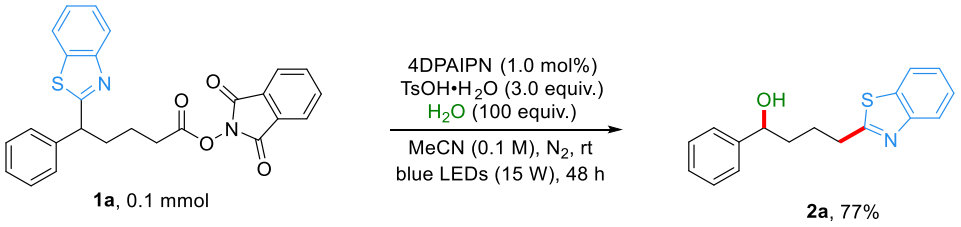
Table S2. Screening of photocatlysts and acids[a]



Entry	Photocatlysts	Acids (x equiv.)	Solvent	Yield (%)[b]
1[c]	4DPAIPN	TsOH•H_2O (2.0)	MeCN	49
2	4DPAIPN	TsOH•H_2O (2.0)	MeCN	55
3	4DPAIPN	TsOH•H_2O (1.0)	MeCN	37
4	4DPAIPN	TsOH•H_2O (3.0)	MeCN	52
5	3DPA2FBN	TsOH•H_2O (2.0)	MeCN	40
6	4CzIPN	TsOH•H_2O (2.0)	MeCN	31
7	5CzBN	TsOH•H_2O (2.0)	MeCN	39
8[d]	4DPAIPN	TsOH•H_2O (2.0)	MeCN	45
9[e]	4DPAIPN	TsOH•H_2O (2.0)	MeCN	51
10	4DPAIPN	TFA (2.0)	MeCN	46
11	4DPAIPN	H_3PO_4 (2.0)	MeCN	54
12	4DPAIPN	HBF_4 (2.0)	MeCN	52
13	4DPAIPN	$MeSO_3H$ (2.0)	MeCN	60
14	-	$MeSO_3H$ (2.0)	MeCN	n.d.
15	4DPAIPN	-	MeCN	n.d.
16[f]	4DPAIPN	$MeSO_3H$ (2.0)	MeCN	n.d.

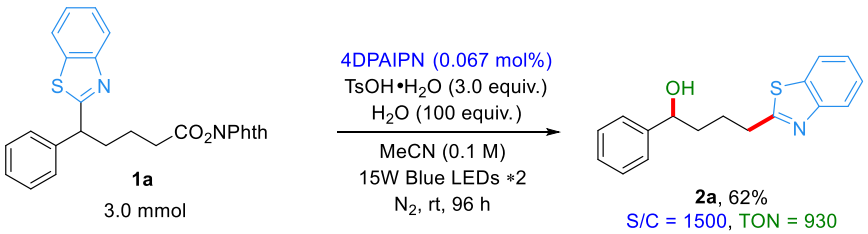
[a]Reaction conditions: **1a** (0.2 mmol), photocatlyst (2.0 mol%), acid (x equiv.), MeCN (0.1 M), room temperature, N_2, under blue LEDs (36 W) irradiation for 48 h. [b]Isolated yields were reported. [c]Under blue LEDs (15 W) irradiation for 48 h. [d]MeCN (0.05 M). [e]MeCN (0.2 M). [f]In the dark. n.d.= not detected.

2.3 General procedure for remote oxygenation of NHPI esters *via* 1,4-group migration



To a 20 mL test tube flask equipped with a stirring bar was charged with **1a** (45.7 mg, 0.1 mmol), 4DPAIPN (0.8 mg, 1.0 mol%) and TsOH•H_2O (57.1 mg, 3.0 equiv.) under N_2 atmosphere. Then, H_2O (180 mg, 10 mmol, 0.18 mL) and MeCN (1.0 mL) were added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 15 W) irradiation at room temperature stirring for 48 h. After completion of the reaction, the reaction mixture was diluted with EtOAc (10 mL), and washed with saturated aq. $NaHCO_3$ (10 mL). The aqueous layer was extracted by EtOAc (10 mL × 2). The combined organic phase was dried over anhydrous Na_2SO_4 and then concentrated in *vacuo*. The residue was further purified by flash chromatography (silica gel, petroleum ether/ethyl acetate/triethylamine = 10:1:0.1, V/V/V) to give the product **2a** (21.8 mg, 77%).

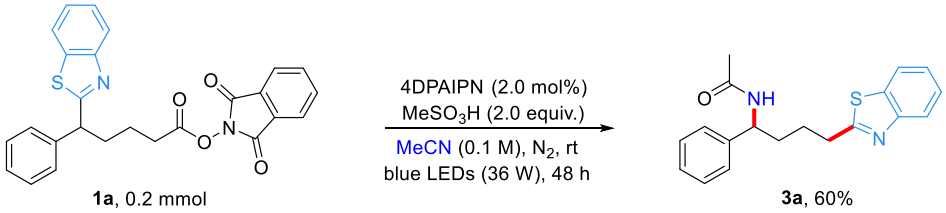
2.4 Procedure for a scale-up reaction of 1a



To a 100 mL round bottom flask equipped with a stirring bar was charged with **1a** (1.370 g, 3.0 mmol), 4DPAIPN (1.6 mg, 0.02 mmol) and TsOH•H_2O (1.712 g, 3.0 equiv.) under N_2 atmosphere. Then, H_2O (5.4 g, 300 mmol, 5.4 mL) and MeCN (30 mL) were added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm,

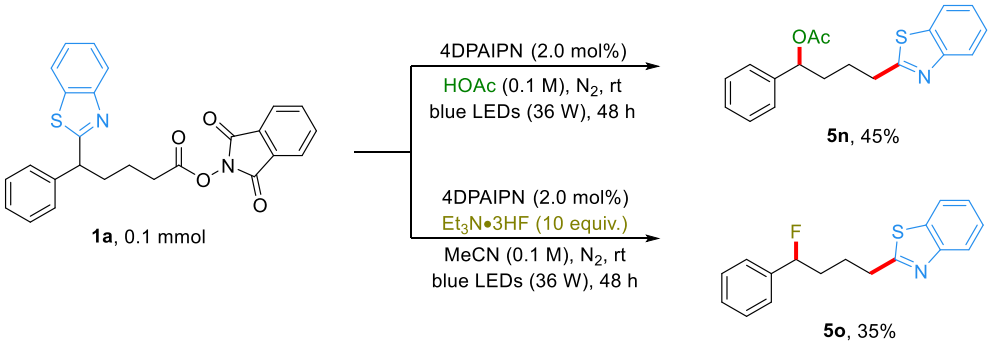
15 W×2) irradiation at room temperature stirring for 96 h. After completion of the reaction, MeCN was removed in *vacuo*, and the residue was diluted with EtOAc (30 mL), and washed with saturated aq. $NaHCO_3$ (15 mL). The aqueous layer was extracted by EtOAc (15 mL×2). The combined organic phase was dried over anhydrous Na_2SO_4 and then concentrated in *vacuo*. The crude product was further purified by flash chromatography (silica gel, petroleum ether/ethyl acetate/triethylamine = 10:1:0.1, V/V/V) to give the product **2a** (527 mg, 62%).

2.5 General procedure for remote amidation of NHPI esters *via* 1,4-group migration



To a 20 mL test tube flask equipped with a stirring bar was charged with **1a** (91.3 mg, 0.2 mmol), 4DPAIPN (3.2 mg, 2.0 mol%) and $MeSO_3H$ (38.4 mg, 2.0 equiv.) dissolved in MeCN (2.0 mL) under N_2 atmosphere. The reaction vessel was exposed to blue LED (450-455 nm, 36 W) irradiation at room temperature stirring for 48 h. After completion of the reaction, the crude mixture was concentrated in *vacuo*. The residue was further purified by flash chromatography for two times (silica gel, petroleum ether/ethyl acetate/triethylamine = 2:1:0.02, V/V/V and afterwards DCM/MeOH = 100: 1, V/V) to give the product **3a** (38.9 mg, 60%).

2.6 General procedure for remote functionalization of NHPI esters with HOAc and Et_3N•3HF as nucleophiles



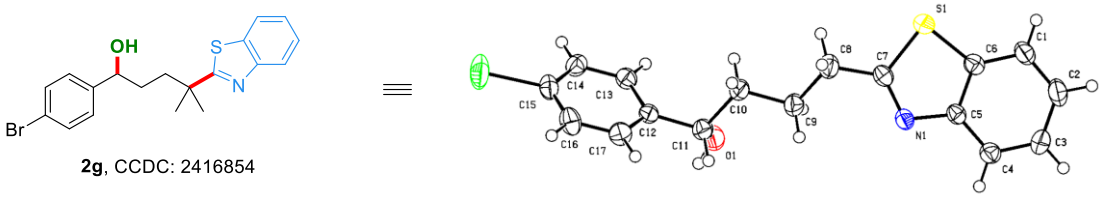
HOAc as the nucleophile:

To a 20 mL test tube flask equipped with a stirring bar were charged with **1a** (45.7 mg, 0.1 mmol) and 4DPAIPN (1.6 mg, 2.0 mol%) under N_2 atmosphere. Then HOAc (1.0 mL) was added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 36 W) irradiation at room temperature stirring for 48 h. After completion of the reaction, the AcOH was removed in *vacuo*. The residue was further purified by flash chromatography (silica gel, petroleum ether/ethyl acetate = 20:1, V/V) to give the product **5n** (14.6 mg, 45%).

Et_3N•3HF as the nucleophile:

To two 20 mL test tube flasks equipped with a stirring bar were charged with **1a** (45.7 mg, 0.1 mmol), 4DPAIPN (1.6 mg, 2.0 mol%) under N_2 atmosphere. Then Et_3N•3HF (322.4 mg, 10 equiv.) and MeCN (2.0 mL) were added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 36 W) irradiation at room temperature stirring for 48 h. After completion of the reaction, the crude mixture was concentrated in vacuo. The residue was further purified by flash chromatography (silica gel, petroleum ether/ethyl acetate = 20:1, V/V) to give the product **5o** (10.0 mg, 35%).

3. X-Ray single crystal diffraction analysis of the products (CCDC: 2416854, 2416902)



2g, CCDC: 2416854

checkCIF/PLATON report

Structure factors have been supplied for datablock(s) 1

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: 1

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Bond precision:   C-C = 0.0042 A          Wavelength=0.71073

Cell:           a=5.8254(11)      b=7.5174(14)      c=18.148(4)
                alpha=87.425(3)   beta=84.849(3)    gamma=84.586(4)
Temperature:    296 K

                 Calculated                Reported
Volume           787.5(3)                  787.5(3)
Space group      P -1                      P -1
Hall group       -P 1                      -P 1
Moiety formula   C17 H16 Br N O S          ?
Sum formula      C17 H16 Br N O S          C17 H16 Br N O S
Mr               362.27                    362.28
Dx,g cm-3        1.528                     1.528
Z                2                         2
Mu (mm-1)        2.740                     2.740
F000             368.0                     368.0
F000'            367.80
h,k,lmax         6,8,21                    6,8,21
Nref             2769                      2758
Tmin,Tmax        0.495,0.518
Tmin'            0.486

Correction method= Not given

Data completeness= 0.996          Theta(max)= 24.999

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                                             0.0985( 2758)
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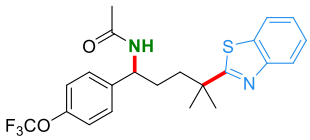
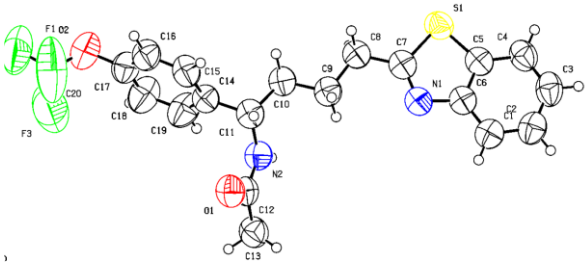


3i, CCDC: 2416902



checkCIF/PLATON report

Structure factors have been supplied for datablock(s) 1

THIS REPORT IS FOR GUIDANCE ONLY. IF USED AS PART OF A REVIEW PROCEDURE FOR PUBLICATION, IT SHOULD NOT REPLACE THE EXPERTISE OF AN EXPERIENCED CRYSTALLOGRAPHIC REFEREE.

No syntax errors found. CIF dictionary Interpreting this report

Datablock: 1

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Cell:             a=16.4672(4)     b=13.2488(3)         c=9.8017(2)
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Temperature:      273 K

                  Calculated                Reported
Volume            2044.67(8)                2044.66(8)
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Hall group        -P 2ybc                   -P 2ybc
Moiety formula    C20 H19 F3 N2 O2 S        C20 H19 F3 N2 O2 S
Sum formula       C20 H19 F3 N2 O2 S        C20 H19 F3 N2 O2 S
Mr                408.43                    408.43
Dx,g cm-3         1.327                     1.327
Z                 4                         4
Mu (mm-1)         1.805                     1.805
F000              848.0                     848.0
F000'             852.18
h,k,lmax          19,15,11                  19,15,11
Nref              3757                      3748
Tmin,Tmax         0.759,0.791               0.567,0.753
Tmin'             0.629

Correction method= # Reported T Limits: Tmin=0.567 Tmax=0.753
AbsCorr = ?

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R(reflections)= 0.0678( 2578)                wR2(reflections)=
                                             0.2415( 3748)
S = 1.075                 Npar= 254
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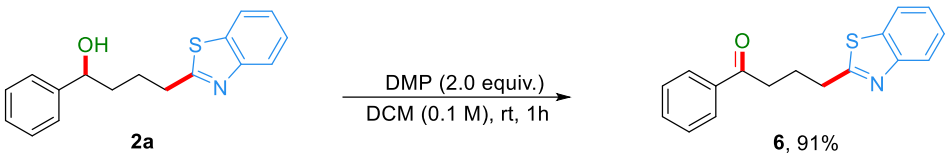
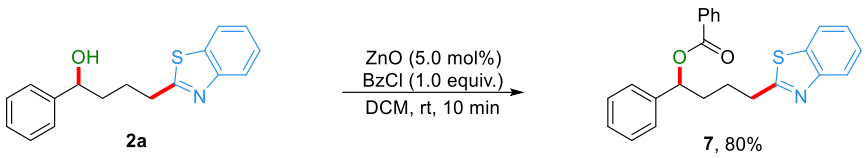
4. Synthetic applications

4.1 The synthesis of ketone 6[2]



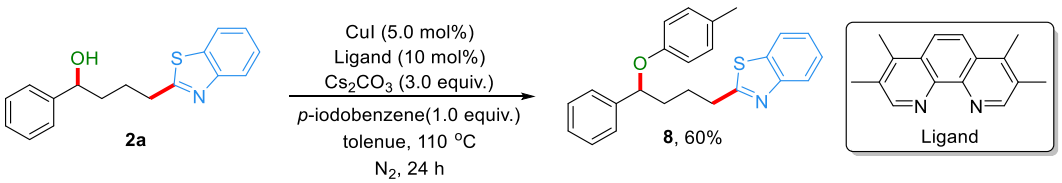
To a reaction tube equipped with a magnetic stir bar were added **2a** (56.7 mg, 0.2 mmol), Dess-Martin periodinane (77.7 mg, 2.0 equiv.) and DCM (2.0 mL). The reaction was stirred at room temperature for 1 h. Then the crude mixture was concentrated in *vacuo*. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 50:1, V/V) to give ketone **6** (51.2 mg, 91%).

4.2 The synthesis of benzyl benzoate 7[3]



To a reaction tube equipped with a magnetic stir bar were added **2a** (56.7 mg, 0.2 mmol), BzCl (28.1 mg, 1.0 equiv.) ZnO (0.8 mg, 5.0 mol%) and DCM (2.0 mL). The reaction was stirred at room temperature for 10 min. Then the crude mixture was concentrated in vacuo. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 20:1, V/V) to give benzoate **7** (62.0 mg, 80%).

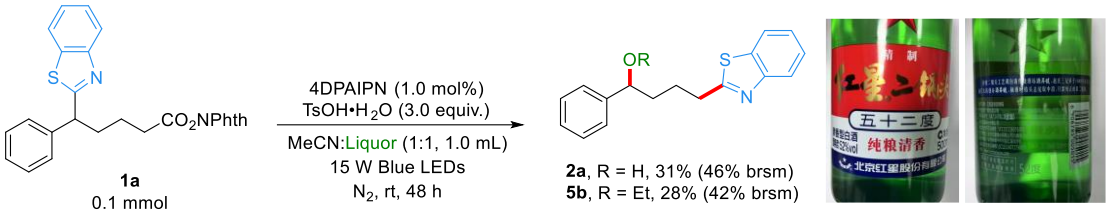
4.3 The synthesis of aryl ether 8[4]



To a reaction tube equipped with a magnetic stir bar were added **2a** (56.7 mg, 0.2 mmol), *p*-iodobenzene (21.6 mg, 1.0 equiv.), CuI (1.9 mg, 5.0 mol%), Ligand (4.8 mg,

10 mol%), Cs_2CO_3 (195.5 mg, 3.0 equiv.) and tolenue (2.0 mL). The reaction was stirred at 110 ℃ for 24 h. The reaction mixture was concentrated in *vacuo*. The residue was purified by column chromatography on silica gel (eluent: petroleum ether/ethyl acetate = 20:1, V/V) to give aryl ether **8** (44.8 mg, 60%).

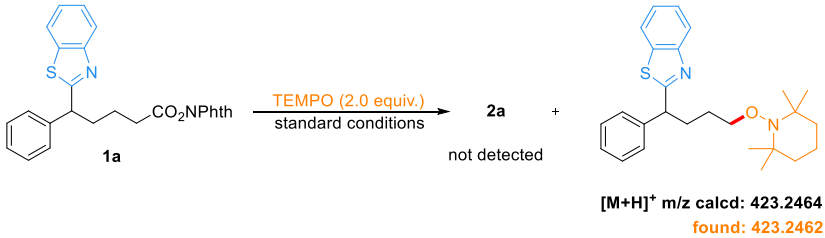
4.4 The remote oxygenation of NHPI ester 1a with Chinese liquor *Erguotou*



To a 20 mL test tube flask equipped with a stirring bar was charged with **1a** (45.7 mg, 0.1 mmol), 4DPAIPN (0.8 mg, 1.0 mol%) and TsOH•H_2O (57.1 mg, 3.0 equiv.) under N_2 atmosphere. Then, Chinese liquor *Erguotou* (alc/vol: 52%vol) was added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 15 W) irradiation at room temperature stirring for 48 h. After completion of the reaction, the reaction mixture was diluted with EtOAc (10 mL), and washed with saturated aq. $NaHCO_3$ (10 mL). The aqueous layer was extracted by EtOAc (10 mL×2). The combined organic phase was dried over anhydrous Na_2SO_4 and then concentrated in *vacuo*. The residue was further purified by flash chromatography (silica gel, petroleum ether/ethyl acetate/triethylamine = 10:1:0.1, V/V/V) to give the recovered **1a** (15.1 mg, 33%), alcohol **2a** (8.8 mg, 31%) and ether **5b** (8.7 mg, 28%), respectively.

5. Mechanistic studies

5.1 Radical-trapping experiment



To a 20 mL test tube flask equipped with a stirring bar was charged with **1a** (45.7 mg, 0.1 mmol), 4DPAIPN (0.8 mg, 1.0 mol%), TsOH•H_2O (57.1 mg, 3.0 equiv.) and TEMPO (93.8 mg, 0.6 mmol) under N_2 atmosphere. Then, H_2O (180 mg, 10 mmol,

0.18 mL) and MeCN (1.0 mL) were added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 15 W) irradiation at room temperature stirring for 48 h. Thin-layer chromatography (TLC) analysis indicated that the formation of product **2a** was not observed, and radical trapping adduct was detected by HRMS analysis (Figure S2).

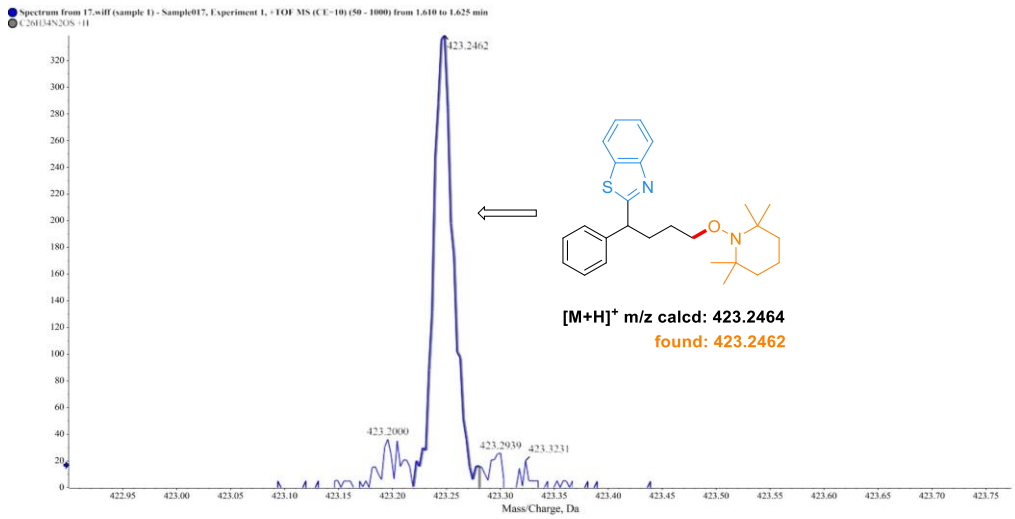
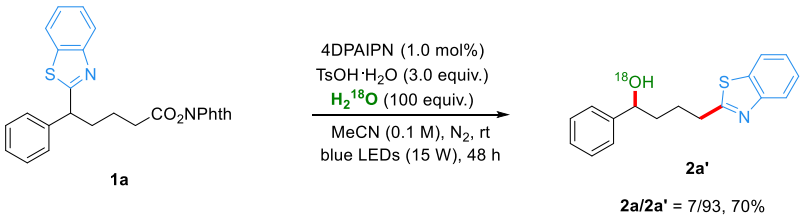


Figure S2. HRMS analysis of the TEMPO trapping adduct.

5.2 Isotope labeling experiment



To a 20 mL test tube flask equipped with a stirring bar was charged with **1a** (45.7 mg, 0.1 mmol), 4DPAIPN (0.8 mg, 1.0 mol%) and TsOH•H_2O (57.1 mg, 3.0 equiv.) under N_2 atmosphere. Then, $H_2{}^{18}O$ (200 mg, 10 mmol, 0.20 mL) and MeCN (1.0 mL) were added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 15 W) irradiation at room temperature stirring for 48 h. Then, the reaction mixture was diluted with EtOAc (10 mL), and washed with saturated aq. $NaHCO_3$ (10 mL). The aqueous layer was extracted by EtOAc (10 mL×2). The combined organic phase was dried over anhydrous Na_2SO_4 and then concentrated in *vacuo*. The residue was purified by chromatography (silica gel, petroleum ether/ethyl acetate/triethylamine = 10:1:0.1, V/V/V) to afford the products **2a**/**2a'** (19.9 mg, 70%). The ^{18}O-labeled product **2a'** was

the dominant product detected by HRMS (abundance ratio: **2a**/**2a'** = 7:93), suggesting the hydroxyl group in product **2a** originated from H_2O (Figure S3).

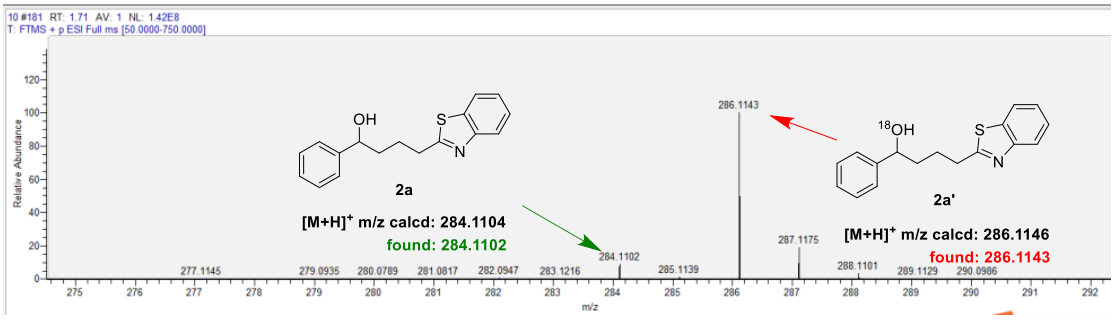
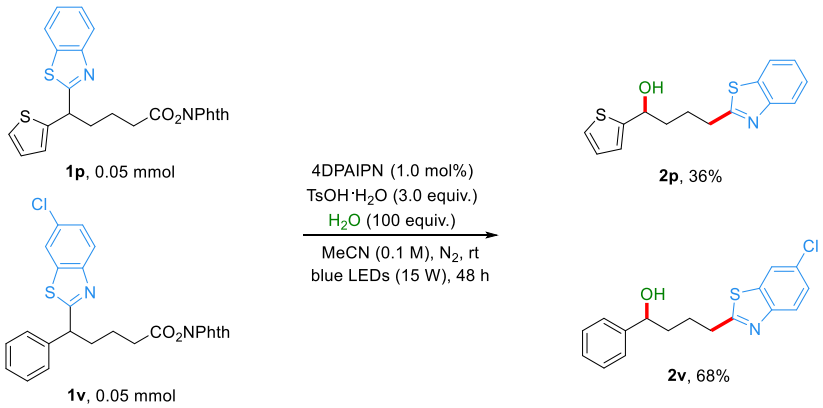


Figure S3. HRMS analysis of **2a** and the ^{18}O-labeled product **2a'**

5.3 Crossover experiment



To a 20 mL test tube flask equipped with a stirring bar was charged with **1p** (23.1 mg, 0.05 mmol), **1v** (24.5 mg, 0.05 mmol), 4DPAIPN (0.8 mg, 1.0 mol%) and TsOH•H_2O (57.1 mg, 3.0 equiv.) under N_2 atmosphere. Then, H_2O (180 mg, 10 mmol, 0.18 mL) and MeCN (1.0 mL) were added *via* a syringe. The reaction vessel was exposed to blue LED (450-455 nm, 15 W) irradiation at room temperature stirring for 48 h. After completion of the reaction, the reaction mixture was diluted with EtOAc (10 mL), and washed with saturated aq. $NaHCO_3$ (10 mL). The aqueous layer was extracted by EtOAc (10 mL×2). The combined organic phase was dried over anhydrous Na_2SO_4 and then concentrated in *vacuo*. The residue was further purified by flash chromatography (silica gel, petroleum ether/ethyl acetate/triethylamine = 10:1:0.1, V/V/V) to give the product **2p** (5.2 mg, 36%) and **2v** (10.8 mg, 68%), respectively.

5.4 Stern-Volmer fluorescence quenching experiments

The luminescence quenching experiment was taken using a FluoroMax-4

Spectrophotometer. The experiments were carried out in 3×10^{-5} mol/L of 4DPAIPN in MeCN at rt. The excitation wavelength was 425 nm and the emission intensity was collected at 573 nm (Figure S4). The concentrations of quenchers in MeCN were 1.0 mM, 2.0 mM, 3.0 mM, and 4.0 mM.

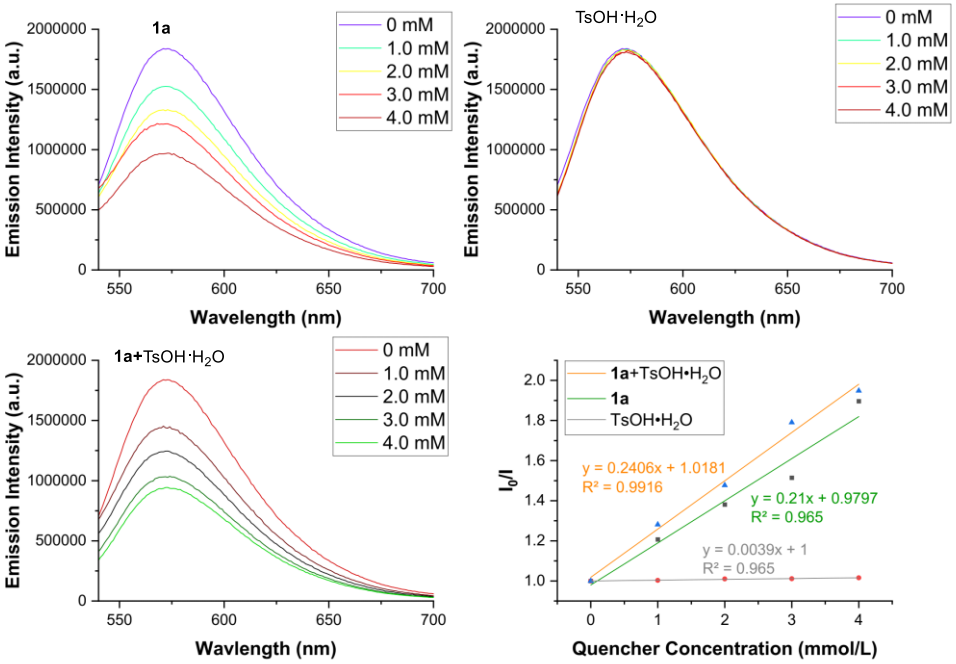


Figure S4 Stern-Volmer emission quenching experiments.

5.5 Cyclic voltammetry experiment

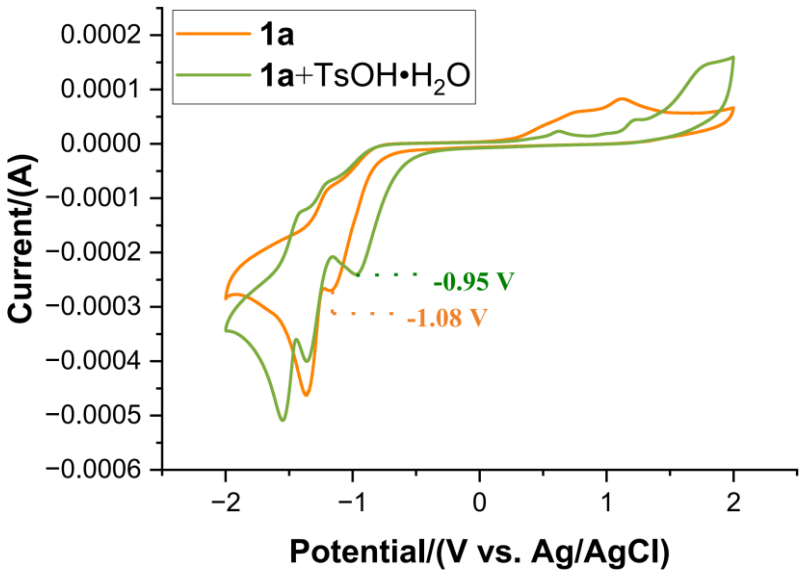


Figure S5 Cyclic voltammetry measurements.

Cyclic Voltammetry was performed on a CS2350M electrochemical workstation

(Wuhan Corrtest Instrument Co., Ltd). CV measurements of **1a** (1.0 mM) and **1a** (1.0 mM) + TsOH•H_2O (3.0 mM) were carried out in MeCN solutions with Bu_4NPF_6 (0.10 M) as the electrolyte at a scan rate of 50 mV/s under N_2 atmosphere. The working electrode is a glassy carbon, the counter electrode is a Pt wire, and the reference electrode is Ag/AgCl (3.5 M KCl). The reduction peak of **1a** and **1a** + TsOH•H_2O was shown in Figure S5.

5.6 Light on/off experiment

To a reaction tube equipped with a magnetic stir bar were added substrate **1a** (0.1 mmol), 4DPAIPN (0.8 mg, 1.0 mol%) and TsOH•H_2O (57.1 mg, 3.0 equiv.) under N_2 atmosphere. Then, H_2O (180 mg, 10 mmol, 0.18 mL) and MeCN (1.0 mL) were added *via* a syringe. The yields of **2a** were determined by ^1H NMR with 1,3,5-trimethoxybenzene as an internal standard with the light turned on and off at intervals (Figure S6).

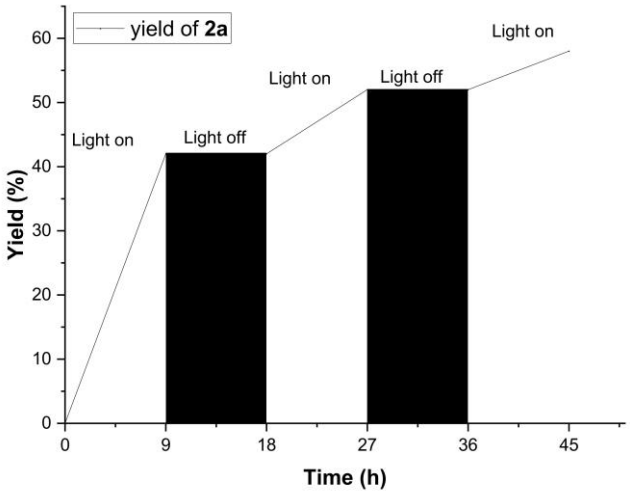


Figure S6 Reaction profile with the light on/off over time.

5.6 NMR analysis of NHPI ester and Brønsted acid mixture

The mixture of NHPI ester **1a** (22.8 mg, 0.05 mmol) and $MeSO_3H$ (4.8 mg, 0.05 mmol, 1.0 equiv) was dissolved in $CDCl_3$ (1.0 mL), and the sample was analyzed by a 500 MHz NMR spectrometer. The spectrum was than compared with that of **1a** alone. Upon the addition of 1.0 equiv of $MeSO_3H$, the signal of H_a which were adjacent to N

atom shifted from 8.02 to 8.24. And the signal of H_b at the benzylic position shifted from 4.43 to 4.96. These observations revealed the interaction between $MeSO_3H$ and the benzothiazole moiety.

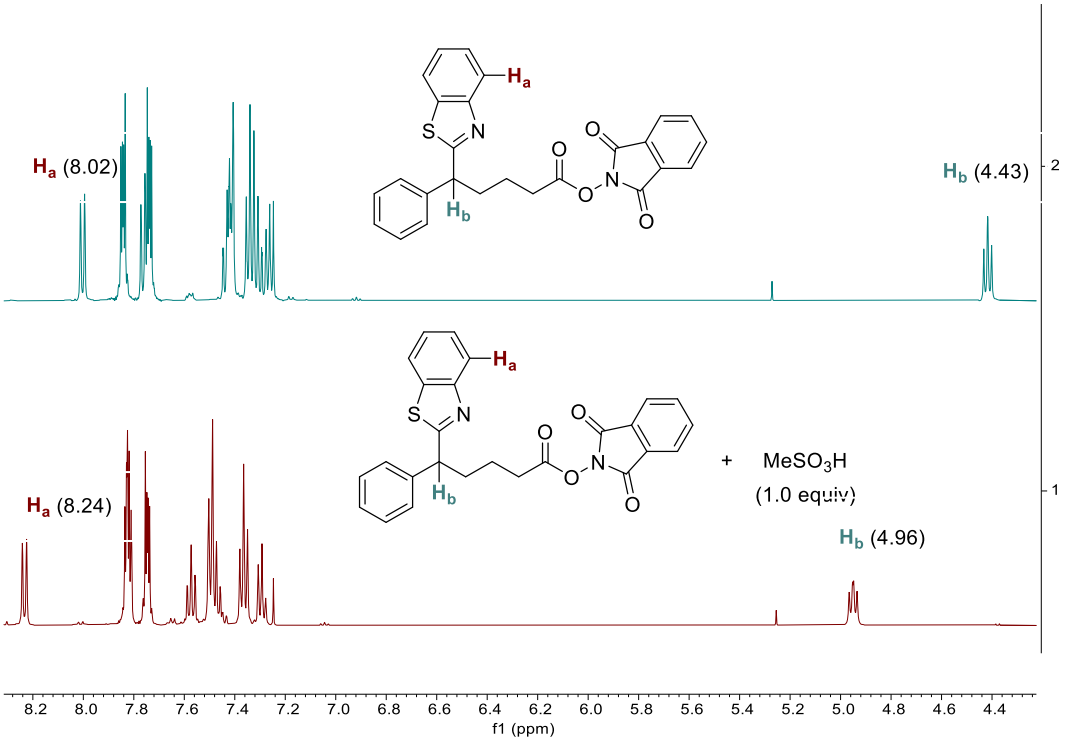
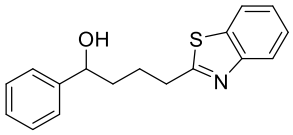


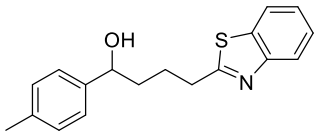
Figure S7 NMR spectra for the coordination of $MeSO_3H$ with benzothiazole moiety

6. Characterization data

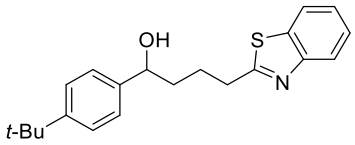


4-(Benzo[*d*]thiazol-2-yl)-1-phenylbutan-1-ol (**2a**, white solid, 21.8 mg, 77%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 5H), 7.28 – 7.25 (m, 1H), 4.74 (t, J = 6.3 Hz, 1H), 3.15 (t, J = 6.7 Hz, 2H), 2.43 (br, 1H), 2.08 – 2.01 (m, 1H), 1.96 – 1.91 (m, 2H), 1.88 – 1.84 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 153.0, 144.5, 135.0, 128.5, 127.6, 125.9, 125.8, 124.7, 122.4, 121.5, 73.9, 38.3, 33.9, 25.6. HRMS(ESI) m/z: $[M+H]^+$ cacld. for

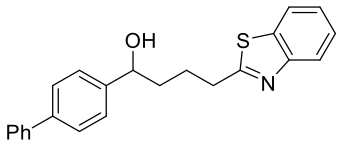
$C_{17}H_{18}NOS$ 284.1104, found 284.1098.



4-(benzo[*d*]thiazol-2-yl)-1-(*p*-tolyl)butan-1-ol (**2b**, white solid, 24.7 mg, 83%) ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.1 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 7.24 – 7.23 (m, 2H), 7.15 – 7.14 (m, 2H), 4.71 (t, J = 6.3 Hz, 1H), 3.15 (t, J = 6.5 Hz, 2H), 2.33 (s, 3H), 2.21 (br, 1H), 2.05 – 2.02 (m, 1H), 1.94 – 1.91 (m, 2H), 1.86 – 1.82 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 153.0, 141.5, 137.3, 135.0, 129.2, 125.9, 125.8, 124.7, 122.5, 121.5, 73.8, 38.2, 33.9, 25.7, 21.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{20}NOS$ 298.1260, found 298.1289.

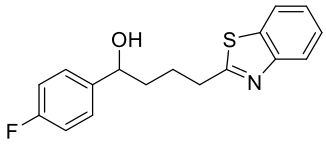


4-(Benzo[*d*]thiazol-2-yl)-1-(4-(tert-butyl)phenyl)butan-1-ol (**2c**, colorless oil, 22.7 mg, 67%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, J = 8.1 Hz, 1H), 7.82 (d, J = 7.9 Hz, 1H), 7.46 – 7.42 (m, 1H), 7.37 – 7.34 (m, 3H), 7.29 – 7.27 (m, 2H), 4.72 (t, J = 6.2 Hz, 1H), 3.15 (t, J = 7.1 Hz, 2H), 2.39 (br, 1H), 2.08 – 2.04 (m, 1H), 1.99 – 1.90 (m, 2H), 1.88 – 1.82 (m, 1H), 1.31 (s, 9H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 172.0, 153.1, 150.5, 141.5, 135.0, 125.9, 125.5, 125.4, 124.7, 122.5, 121.5, 73.8, 38.1, 34.5, 33.9, 31.3, 25.8. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{26}NOS$ 340.1730, found 340.1727.

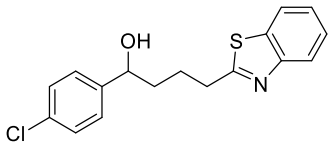


1-([1,1'-Biphenyl]-4-yl)-4-(benzo[*d*]thiazol-2-yl)butan-1-ol (**2d**, white solid, 26.6 mg, 74%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.59 – 7.56 (m, 4H), 7.47 – 7.41 (m, 5H), 7.37 – 7.33 (m, 2H), 4.83 – 4.77 (m, 1H), 3.19 (t, J = 6.7 Hz, 2H), 2.12 – 2.05 (m, 1H), 2.03 – 1.94 (m, 2H), 1.91 – 1.87 (m, 1H),

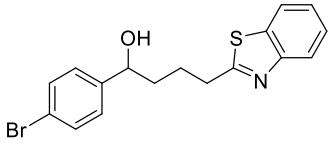
1.81 (br, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 170.4, 152.0, 143.5, 140.8, 140.5, 137.1, 135.0, 128.7, 127.2, 127.1, 126.3, 126.0, 124.8, 122.5, 121.5, 73.7, 38.2, 33.9, 25.6. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{23}H_{22}NOS$ 360.1417, found 360.1412.



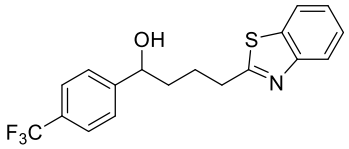
4-(Benzo[d]thiazol-2-yl)-1-(4-fluorophenyl)butan-1-ol (**2e**, pale yellow solid, 18.4 mg, 61%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, J = 8.1 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.45 – 7.42 (m, 1H), 7.36 – 7.33 (m, 1H), 7.31 – 7.28 (m, 2H), 7.02 – 6.98 (m, 2H), 4.72 (t, J = 6.4 Hz, 1H), 3.14 (t, J = 7.1 Hz, 2H), 2.56 (br, 1H), 2.04 – 1.99 (m, 1H), 1.92 – 1.89 (m, 2H), 1.84 – 1.79 (m, 1H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -114.98 – -115.05 (m, 1F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 162.1 (d, J = 250.7 Hz), 153.0, 140.3 (d, J = 3.0 Hz), 135.0, 127.4 (d, J = 7.9 Hz), 126.0, 124.8, 122.4, 121.5, 115.2 (d, J = 21.3 Hz), 73.2, 38.3, 33.8, 25.5. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}FNOS$ 302.1009, found 302.1009.



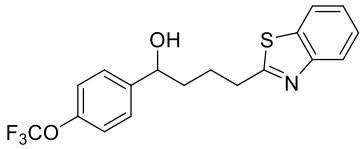
4-(Benzo[*d*]thiazol-2-yl)-1-(4-chlorophenyl)butan-1-ol (**2f**, white solid, 18.7 mg, 59%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 7.30 – 7.28 (m, 4H), 4.72 (t, J = 6.3 Hz, 1H), 3.17 – 3.13 (m, 2H), 2.67 (br, 1H), 2.04 – 2.00 (m, 1H), 1.96 – 1.87 (m, 2H), 1.83 – 1.79 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 153.0, 143.0, 135.0, 133.2, 128.6, 127.2, 126.0, 124.8, 122.5, 121.5, 73.2, 38.3, 33.7, 25.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}ClNOS$ 318.0714, found 318.0712.



4-(Benzo[*d*]thiazol-2-yl)-1-(4-bromophenyl)butan-1-ol (**2g**, white solid, 22.7 mg, 63%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 3H), 7.37 – 7.34 (m, 1H), 7.22 – 7.21 (m, 2H), 4.72 – 4.70 (m, 1H), 3.16 – 3.13 (m, 2H), 2.61 (br, 1H), 2.04 – 2.00 (m, 1H), 1.94 – 1.89 (m, 2H), 1.83 – 1.81 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 152.9, 143.6, 135.0, 131.5, 127.5, 126.0, 124.8, 122.4, 121.5, 121.2, 73.1, 38.2, 33.7, 25.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}BrNOS$ 362.0209, found 362.0211.

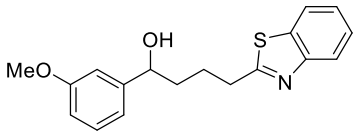


4-(Benzo[*d*]thiazol-2-yl)-1-(4-(trifluoromethyl)phenyl)butan-1-ol (**2h**, white solid, 14.4 mg, 41%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.2 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.60 – 7.58 (m, 2H), 7.47 – 7.46 (m, 3H), 7.37 – 7.34 (m, 1H), 4.83 (dd, J = 7.7, 5.0 Hz, 1H), 3.20 – 3.16 (m, 2H), 2.82 (br, 1H), 2.06 – 1.99 (m, 2H), 1.92 – 1.86 (m, 2H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -62.3 (s, 3F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.7, 152.9, 148.5, 134.9, 129.6 (q, J = 32.4 Hz), 126.04, 126.02, 125.4 (q, J = 4.0 Hz), 124.9, 124.1 (q, J = 272.5 Hz), 122.4, 121.5, 73.1, 38.3, 33.6, 25.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{17}F_3BNOS$ 352.0977, found 352.0979.

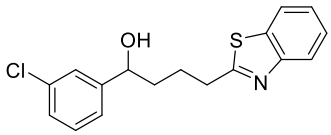


4-(Benzo[*d*]thiazol-2-yl)-1-(4-(trifluoromethoxy)phenyl)butan-1-ol (**2i**, colorless oil, 12.8 mg, 35%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.91 (d, J = 8.2 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.45 – 7.42 (m, 1H), 7.37 – 7.33 (m, 3H), 7.17 – 7.16 (m, 2H), 4.76 (t, J = 6.1 Hz, 1H), 3.15 (t, J = 7.2 Hz, 2H), 3.03 (br, 1H), 2.06 – 2.02 (m, 1H), 1.98 – 1.88 (m, 2H), 1.84 – 1.81 (m, 1H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -57.7 (s, 3F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 152.9, 148.4, 143.4, 134.9, 127.2, 126.0, 124.8, 122.4, 121.5, 120.9, 120.4 (q, J = 322.1 Hz), 73.0, 38.3, 33.7, 25.4. HRMS(ESI) m/z: $[M+H]^+$

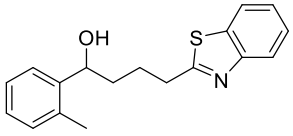
cacld. for $C_{18}H_{17}F_3NO_2S$ 368.0927, found 368.0930.



4-(Benzo[*d*]thiazol-2-yl)-1-(3-methoxyphenyl)butan-1-ol (**2j**, colorless oil. 20.7 mg, 66%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.84 (d, J = 8.4 Hz, 1H), 7.47 – 7.44 (m, 1H), 7.38 – 7.35 (m, 1H), 7.29 – 7.24 (m, 1H), 6.94 – 6.93 (m, 2H), 6.83 – 6.81 (m, 1H), 4.73 (t, J = 6.3 Hz, 1H), 3.81 (s, 3H), 3.15 (t, J = 7.1 Hz, 2H), 2.75 (br, 1H), 2.08 – 2.02 (m, 1H), 1.97 – 1.92 (m, 2H), 1.88 – 1.85 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.1, 141.2, 135.0, 128.9, 128.0, 127.5, 125.9, 124.8, 122.8, 121.5, 119.3, 61.1, 50.6, 41.2, 34.9, 33.8, 31.5, 23.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{20}NO_2S$ 314.1209, found 314.1209.

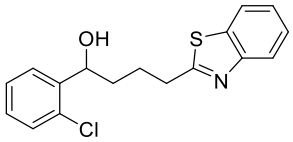


4-(Benzo[*d*]thiazol-2-yl)-1-(3-chlorophenyl)butan-1-ol (**2k**, yellow oil, 14.9 mg, 47%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.92 (d, J = 8.2 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.45 – 7.42 (m, 1H), 7.36 – 7.32 (m, 2H), 7.24 – 7.20 (m, 3H), 4.71 (dd, J = 7.7, 4.9 Hz, 1H), 3.18 (br, 1H), 3.14 (t, J = 7.4 Hz, 2H), 2.05 – 1.99 (m, 1H), 1.95 – 1.86 (m, 2H), 1.84 – 1.78 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 152.9, 146.8, 134.9, 134.3, 129.7, 127.5, 126.0, 124.8, 123.9, 122.4, 121.5, 73.1, 38.2, 33.7, 25.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}ClNOS$ 318.0714, found 318.0712.

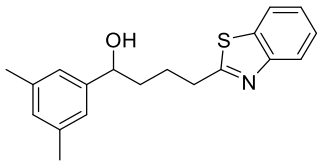


4-(Benzo[*d*]thiazol-2-yl)-1-(*o*-tolyl)butan-1-ol (**2l**, colorless oil, 25.6 mg, 86%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.84 (d, J = 8.0 Hz, 1H), 7.49 – 7.43 (m, 2H), 7.37 – 7.33 (m, 1H), 7.24 – 7.20 (m, 1H), 7.17 – 7.15 (m, 1H), 7.12 –

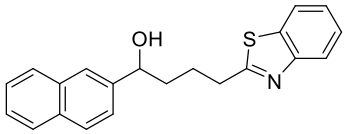
7.11 (m, 1H), 5.00 (dd, *J* = 7.9, 4.7 Hz, 1H), 3.18 (t, *J* = 7.5 Hz, 2H), 2.34 (br, 1H), 2.31 (s, 3H), 2.16 – 2.09 (m, 1H), 2.05 – 2.01 (m, 1H), 1.88 – 1.83 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 172.0, 152.9, 142.7, 134.8, 134.3, 130.4, 127.2, 126.3, 125.9, 125.1, 124.7, 122.5, 121.5, 70.1, 37.2, 33.9, 25.8, 19.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{20}NOS$ 298.1260, found 298.1257.



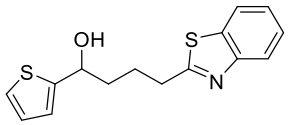
4-(Benzo[*d*]thiazol-2-yl)-1-(2-chlorophenyl)butan-1-ol (**2m**, pale yellow oil, 17.2 mg, 54%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.1 Hz, 1H), 7.83 (d, *J* = 8.0 Hz, 1H), 7.60 – 7.58 (m, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 7.31 – 7.28 (m, 2H), 7.20 – 7.17 (m, 1H), 5.19 (dd, *J* = 8.4, 4.0 Hz, 1H), 3.20 (td, *J* = 7.5, 2.5 Hz, 2H), 2.83 (br, 1H), 2.14 – 2.05 (m, 2H), 1.97 – 1.91 (m, 1H), 1.87 – 1.83 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 172.0, 153.0, 142.0, 135.0, 131.7, 129.3, 128.4, 127.1, 127.0, 125.9, 124.7, 122.5, 121.5, 70.0, 36.8, 33.7, 25.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}ClNOS$ 318.0714, found 318.0713.



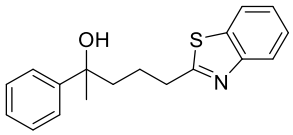
4-(Benzo[*d*]thiazol-2-yl)-1-(3,5-dimethylphenyl)butan-1-ol (**2n**, white solid, 28.3 mg, 91%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.1 Hz, 1H), 7.83 (d, *J* = 7.9 Hz, 1H), 7.46 – 7.42 (m, 1H), 7.36 – 7.32 (m, 1H), 6.95 (s, 2H), 6.90 (s, 1H), 4.66 (dd, *J* = 7.3, 5.2 Hz, 1H), 3.15 (t, *J* = 7.1 Hz, 2H), 2.46 (br, 1H), 2.30 (s, 6H), 2.07 – 2.00 (m, 1H), 1.97 – 1.89 (m, 2H), 1.87 – 1.80 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.0, 153.1, 144.5, 138.0, 135.0, 129.2, 125.9, 124.7, 123.6, 122.5, 121.4, 74.0, 38.2, 33.9, 25.8, 21.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{22}NOS$ 312.1417, found 312.1410.



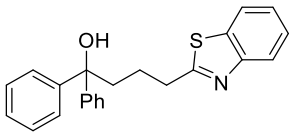
4-(Benzo[*d*]thiazol-2-yl)-1-(naphthalen-2-yl)butan-1-ol (**2o**, white solid, 23.3 mg, 70%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (d, J = 8.1 Hz, 1H), 7.82 – 7.76 (m, 5H), 7.48 – 7.43 (m, 3H), 7.41 – 7.39 (m, 1H), 7.34 – 7.31 (m, 1H), 4.87 (t, J = 5.7 Hz, 1H), 3.29 (br, 1H), 3.11 (t, J = 6.8 Hz, 2H), 2.07 – 1.88 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 172.0, 152.9, 141.9, 134.9, 133.2, 132.9, 128.2, 127.9, 127.6, 126.0, 125.9, 125.7, 124.7, 124.5, 124.0, 122.4, 121.4, 76.7, 38.1, 33.8, 25.6. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{20}NOS$ 334.1260, found 334.1252.



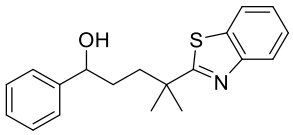
4-(Benzo[*d*]thiazol-2-yl)-1-(thiophen-2-yl)butan-1-ol (**2p**, yellow oil, 13.6 mg, 47%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 – 7.63 (m, 1H), 7.48 – 7.45 (m, 1H), 7.35 – 7.34 (m, 3H), 7.30 – 7.28 (m, 2H), 4.78 – 4.71 (m, 1H), 2.97 (td, J = 7.0, 3.0 Hz, 2H), 2.42 (br, 1H), 2.07 – 1.82 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 167.0, 150.7, 144.5, 141.2, 128.5, 127.6, 125.8, 124.5, 124.1, 119.5, 110.3, 73.9, 38.3, 28.3, 22.8. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{15}H_{16}NOS_2$ 290.0668, found 290.0667.



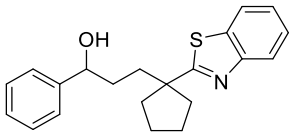
5-(Benzo[*d*]thiazol-2-yl)-2-phenylpentan-2-ol (**2q**, colorless oil, 24.4 mg, 82%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.2 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 3H), 7.36 – 7.32 (m, 3H), 7.25 – 7.22 (m, 1H), 3.08 (t, J = 7.2 Hz, 2H), 2.22 (br, 1H), 1.98 – 1.89 (m, 3H), 1.78 – 1.73 (m, 1H), 1.57 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 172.0, 153.0, 147.6, 135.0, 128.2, 126.6, 125.9, 124.73, 124.69, 122.5, 121.5, 74.4, 43.1, 34.1, 30.5, 24.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{20}NOS$ 298.1260, found 298.1253.



4-(Benzo[*d*]thiazol-2-yl)-1,1-diphenylbutan-1-ol (**2r**, white solid, 30.2 mg, 84%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.90 – 7.89 (m, 1H), 7.80 – 7.78 (m, 1H), 7.43 – 7.41 (m, 5H), 7.37 – 7.34 (m, 5H), 7.29 – 7.27 (m, 2H), 2.48 – 2.45 (m, 2H), 2.37 (t, J = 7.0 Hz, 2H), 2.24 (br, 1H), 1.71 – 1.68 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 168.0, 146.3, 134.3, 132.6, 128.3, 128.1, 127.2, 126.0, 125.9, 123.6, 119.7, 77.8, 40.5, 20.1, 17.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{23}H_{22}NOS$ 360.1417, found 360.1414.

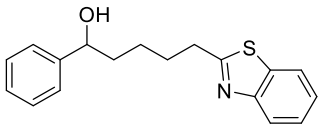


4-(Benzo[*d*]thiazol-2-yl)-4-methyl-1-phenylpentan-1-ol (**2s**, colorless oil, 13.4 mg, 43%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.84 – 7.80 (m, 2H), 7.73 – 7.71 (m, 1H), 7.43 – 7.39 (m, 1H), 7.32 – 7.29 (m, 1H), 7.27 – 7.26 (m, 2H), 7.22 – 7.19 (m, 1H), 4.60 (dd, J = 7.4, 5.5 Hz, 1H), 2.61 (br, 1H), 2.05 – 1.99 (m, 1H), 1.83 – 1.79 (m, 1H), 1.74 – 1.69 (m, 2H), 1.45 (s, 3H), 1.44 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 181.0, 152.8, 144.5, 134.3, 128.4, 127.4, 125.8, 124.6, 123.6, 122.6, 121.4, 74.4, 41.3, 39.2, 34.3, 28.9, 28.8. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{22}NOS$ 312.1417, found 312.1446.

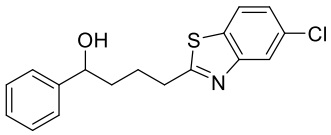


3-(1-(Benzo[*d*]thiazol-2-yl)cyclopentyl)-1-phenylpropan-1-ol (**2t**, white solid, 10.8 mg, 32%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.2 Hz, 1H), 7.82 (d, J = 8.1 Hz, 1H), 7.44 – 7.41 (m, 1H), 7.34 – 7.31 (m, 1H), 7.28 – 7.22 (m, 5H), 4.58 (t, J = 6.7 Hz, 1H), 2.30 – 2.25 (m, 2H), 2.10 – 2.04 (m, 1H), 1.87 – 1.82 (m, 4H), 1.73 – 1.72 (m, 6H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 180.6, 152.9, 144.5, 135.0, 128.4, 127.4, 125.8,

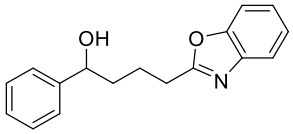
125.7, 124.6, 123.6, 122.6, 121.4, 74.5, 53.3, 39.7, 39.5, 37.5, 35.0, 24.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{24}NOS$ 338.1573, found 338.1578.



5-(Benzo[*d*]thiazol-2-yl)-1-phenylpentan-1-ol (**2u**, pale yellow oil, 10.7 mg, 36%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, J = 8.1 Hz, 1H), 7.75 (d, J = 8.0 Hz, 1H), 7.38 – 7.35 (m, 1H), 7.28 – 7.23 (m, 5H), 7.20 – 7.18 (m, 1H), 4.61 (dd, J = 7.7, 5.5 Hz, 1H), 3.01 (t, J = 7.7 Hz, 2H), 2.26 (br, 1H), 1.86 – 1.77 (m, 3H), 1.73 – 1.67 (m, 1H), 1.55 – 1.48 (m, 1H), 1.42 – 1.35 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 172.1, 153.1, 144.7, 135.0, 128.4, 127.5, 125.9, 125.8, 124.6, 122.4, 121.4, 74.2, 38.6, 34.0, 29.3, 25.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{20}NOS$ 298.1260, found 298.1258.

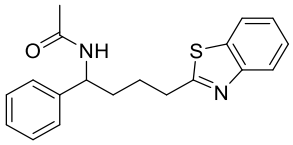


4-(5-Chlorobenzo[*d*]thiazol-2-yl)-1-phenylbutan-1-ol (**2v**, white solid, 25.1 mg, 79%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.89 (d, J = 2.0 Hz, 1H), 7.72 (d, J = 8.5 Hz, 1H), 7.34 – 7.27 (m, 6H), 4.74 (dd, J = 7.1, 5.1 Hz, 1H), 3.13 (t, J = 7.1 Hz, 2H), 2.52 (br, 1H), 2.06 – 1.82 (m, 4H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 174.0, 153.9, 144.5, 133.3, 131.9, 128.5, 127.6, 125.8, 125.2, 122.4, 122.1, 73.9, 38.2, 33.9, 25.6. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}ClNOS$ 318.0714, found 318.0713.

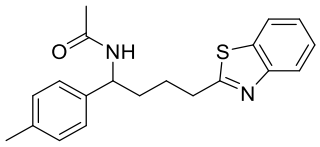


4-(Benzo[*d*]oxazol-2-yl)-1-phenylbutan-1-ol (**2w**, pale yellow oil, 11.2 mg, 42%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 – 7.63 (m, 1H), 7.48 – 7.44 (m, 1H), 7.36 – 7.31 (m, 4H), 7.30 – 7.28 (m, 3H), 4.76 – 4.73 (m, 1H), 3.00 – 2.95 (m, 2H), 2.43 (br, 1H), 2.08 – 2.02 (m, 1H), 1.99 – 1.91 (m, 2H), 1.89 – 1.82 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$)

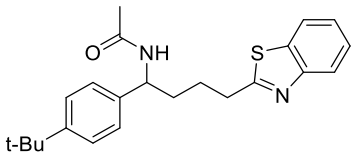
δ 167.0, 150.7, 144.5, 141.2, 128.5, 127.6, 125.8, 124.5, 124.1, 119.5, 110.3, 73.9, 38.3, 28.3, 22.8. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{18}NO_2$ 268.1332, found 268.1331.



***N*-(4-(benzo[*d*]oxazol-2-yl)-1-phenylbutyl)acetamide** (**3a**, white solid, 38.9 mg, 60%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 – 7.94 (m, 1H), 7.84 – 7.82 (m, 1H), 7.47 – 7.43 (m, 1H), 7.37 – 7.31 (m, 3H), 7.28 – 7.25 (m, 3H), 5.95 (d, J = 8.0 Hz, 1H), 5.02 (q, J = 7.3 Hz, 1H), 3.19 – 3.09 (m, 2H), 1.99 (s, 3H), 1.97 – 1.83 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.5, 169.3, 153.0, 141.8, 135.0, 128.8, 127.5, 126.5, 126.0, 124.8, 122.4, 121.5, 53.3, 35.1, 33.7, 26.1, 23.5. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{21}N_2OS$ 325.1369, found 325.1371.

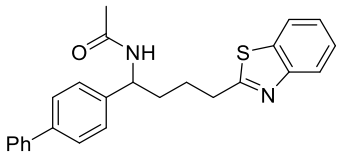


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(p-tolyl)butyl)acetamide** (**3b**, yellow solid, 39.9 mg, 59%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 – 7.83 (m, 2H), 7.44 – 7.34 (m, 2H), 7.15 – 7.13 (m, 4H), 5.97 (br, 1H), 4.98 (s, 1H), 3.13 (s, 2H), 2.31 (s, 3H), 1.97 (s, 3H), 1.95 – 1.71 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.5, 169.2, 153.1, 138.8, 137.2, 135.1, 129.4, 126.5, 125.9, 124.7, 122.4, 121.5, 53.0, 35.1, 33.7, 26.2, 23.4, 21.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{23}N_2OS$ 339.1526, found 339.1528.

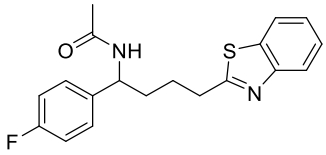


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-(tert-butyl)phenyl)butyl)acetamide** (**3c**, brown oil, 51.8 mg, 68%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, J = 8.0 Hz, 1H), 7.81 (d, J = 7.7 Hz, 1H), 7.44 – 7.42 (m, 1H), 7.35 – 7.31 (m, 3H), 7.20 – 7.18 (m, 2H), 6.11 (d, J = 8.0 Hz, 1H), 5.00 (q, J = 7.1 Hz, 1H), 3.15 – 3.08 (m, 2H), 1.95 (s, 3H), 1.94 – 1.83 (m,

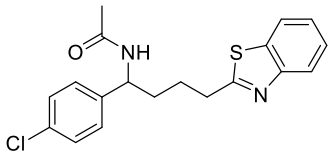
4H), 1.28 (s, 9H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.5, 169.3, 153.1, 150.3, 138.7, 135.0, 126.2, 125.9, 125.6, 124.7, 122.4, 121.5, 52.8, 35.1, 34.4, 33.7, 31.2, 26.2, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{23}H_{29}N_2OS$ 381.1995, found 381.1993.



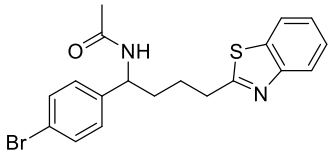
***N*-(1-([1,1'-biphenyl]-4-yl)-4-(benzo[d]thiazol-2-yl)butyl)acetamide** (**3d**, white solid, 49.7 mg, 62%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.56 – 7.53 (m, 4H), 7.47 – 7.41 (m, 3H), 7.37 – 7.32 (m, 4H), 6.15 (dd, J = 7.5, 4.4 Hz, 1H), 5.06 (q, J = 7.2 Hz, 1H), 3.19 – 3.12 (m, 2H), 2.01 (s, 3H), 1.98 – 1.88 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.4, 169.4, 153.1, 140.8, 140.6, 140.4, 135.0, 128.7, 127.4, 127.3, 127.0, 126.9, 125.9, 124.8, 122.4, 121.5, 53.0, 35.1, 33.7, 26.1, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{25}H_{25}N_2OS$ 401.1682, found 401.1690.



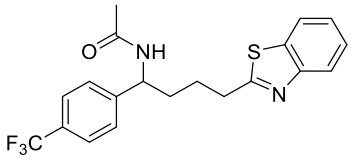
***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-fluorophenyl)butyl)acetamide** (**3e**, white solid, 52.7 mg, 77%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.37 – 7.34 (m, 1H), 7.24 – 7.21 (m, 2H), 7.00 – 6.97 (m, 2H), 6.17 (d, J = 7.7 Hz, 1H), 4.97 (q, J = 7.3 Hz, 1H), 3.18 – 3.08 (m, 2H), 1.97 (s, 3H), 1.95 – 1.77 (m, 4H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -114.94 (dt, J = 13.5, 6.0 Hz, 1F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.5, 169.6, 162.1 (d, J = 245.5 Hz), 153.1, 137.9 (d, J = 3.1 Hz), 135.1, 128.3 (d, J = 8.0 Hz), 126.1, 125.0, 122.5, 121.7, 115.6 (d, J = 21.4 Hz), 52.8, 35.2, 33.7, 26.1, 23.5. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}FN_2OS$ 343.1275, found 343.1281.



***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-chlorophenyl)butyl)acetamide** (**3f**, white solid, 50.2 mg, 70%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 7.26 – 7.25 (m, 2H), 7.19 – 7.17 (m, 2H), 6.31 (d, J = 7.7 Hz, 1H), 4.95 (q, J = 7.4 Hz, 1H), 3.17 – 3.06 (m, 2H), 1.97 (s, 3H), 1.93 – 1.82 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.4, 169.6, 153.1, 140.7, 135.1, 133.2, 128.9, 128.0, 126.1, 125.0, 122.5, 121.7, 52.8, 35.1, 33.7, 26.0, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}ClN_2OS$ 359.0979, found 359.0977.

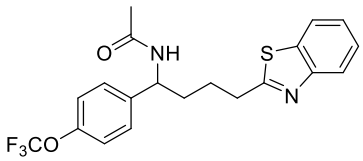


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-bromophenyl)butyl)acetamide** (**3g**, white solid, 54.0 mg, 67%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.84 (d, J = 7.9 Hz, 1H), 7.47 – 7.42 (m, 3H), 7.38 – 7.35 (m, 1H), 7.15 – 7.13 (m, 2H), 6.14 (d, J = 7.6 Hz, 1H), 4.95 (q, J = 7.4 Hz, 1H), 3.17 – 3.08 (m, 2H), 1.99 (s, 3H), 1.93 – 1.85 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.2, 169.4, 152.8, 141.0, 135.1, 131.8, 128.2, 126.0, 124.9, 122.4, 121.6, 121.2, 52.8, 34.9, 33.5, 25.9, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}BrN_2OS$ 403.0474, found 403.0475.

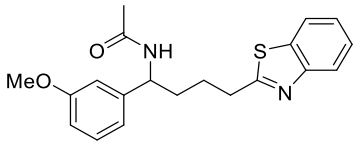


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-(trifluoromethyl)phenyl)butyl)acetamide** (**3h**, white solid, 24.3 mg, 31%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.0 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.55 – 7.53 (m, 2H), 7.46 – 7.43 (m, 1H), 7.37 – 7.33 (m, 3H), 6.55 (d, J = Hz, 1H), 5.02 (q, J = Hz, 1H), 3.18 – 3.06 (m, 2H), 1.99 (s, 3H), 1.98 – 1.82 (m, 4H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -62.4 (s, 3F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.1, 169.6, 153.0, 146.3, 135.0, 129.5 (q, J = 32.4 Hz), 126.8, 126.0, 125.6 (q, J =

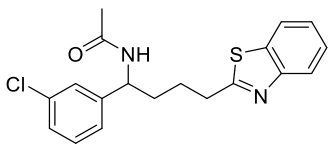
3.9 Hz), 124.9, 124.0 (q, J = 272.7 Hz), 122.4, 121.5, 53.0, 34.9, 33.4, 25.7, 23.2. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{20}F_3N_2OS$ 393.1243, found 393.1242.



***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-(trifluoromethoxy)phenyl)butyl)acetamide** (**3i**, white solid, 56.4 mg, 69%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.0 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.47 – 7.44 (m, 1H), 7.37 – 7.34 (m, 1H), 7.29 – 7.28 (m, 2H), 7.15 – 7.13 (m, 2H), 6.24 (d, J = 7.6 Hz, 1H), 5.00 (q, J = 7.0 Hz, 1H), 3.19 – 3.07 (m, 2H), 1.99 (s, 3H), 1.97 – 1.88 (m, 4H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -57.7 (s, 3F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.2, 169.5, 153.0, 148.3, 140.8, 135.0, 127.9, 126.0, 124.9, 122.4, 121.6, 121.1, 120.4 (q, J = 257.9 Hz), 52.7, 35.0, 33.5, 25.9, 23.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{20}F_3N_2O_2S$ 409.1192, found 409.1196.

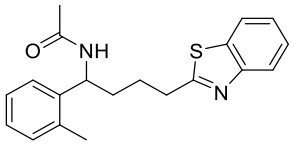


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(3-methoxyphenyl)butyl)acetamide** (**3j**, white solid, 44.0 mg, 62%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.93 (d, J = 8.1 Hz, 1H), 7.81 (d, J = 7.9 Hz, 1H), 7.44 – 7.41 (m, 1H), 7.34 – 7.31 (m, 1H), 7.23 – 7.20 (m, 1H), 6.85 – 6.76 (m, 3H), 6.25 (d, J = 7.6 Hz, 1H), 4.97 (d, J = 7.0 Hz, 1H), 3.75 (s, 3H), 3.14 – 3.07 (m, 2H), 1.95 (s, 3H), 1.92 – 1.82 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.4, 169.3, 159.8, 153.2, 143.5, 135.0, 133.3, 129.8, 125.9, 124.8, 122.4, 121.5, 118.7, 112.6, 55.2, 53.2, 35.2, 33.7, 26.1, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{23}N_2O_2S$ 355.1475, found 355.1477.

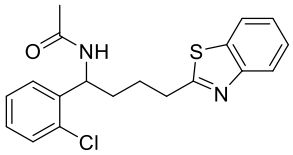


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(3-chlorophenyl)butyl)acetamide** (**3k**, white solid,

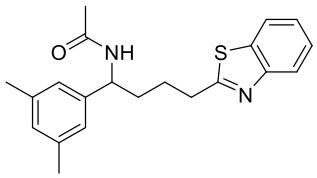
35.9 mg, 50%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.47 – 7.44 (m, 1H), 7.37 – 7.34 (m, 1H), 7.25 – 7.22 (m, 3H), 7.15 – 7.14 (m, 1H), 6.27 (d, J = 8.0 Hz, 1H), 4.97 (q, J = 7.3 Hz, 1H), 3.18 – 3.09 (m, 2H), 2.00 (s, 3H), 1.99 – 1.83 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.3, 169.6, 152.9, 144.2, 134.9, 134.5, 130.0, 127.6, 126.5, 126.0, 124.88, 124.86, 122.4, 121.6, 52.9, 35.0, 33.5, 25.8, 23.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}ClN_2OS$ 359.0979, found 359.0983.



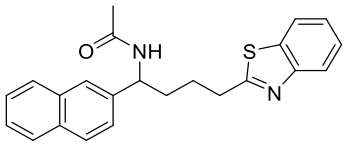
***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(o-tolyl)butyl)acetamide** (**3l**, brown oil, 46.0 mg, 68%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 7.9 Hz, 1H), 7.83 (d, J = 7.8 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 7.20 – 7.15 (m, 4H), 5.98 (d, J = 7.7 Hz, 1H), 5.25 (q, J = 7.6 Hz, 1H), 3.18 – 3.08 (m, 2H), 2.39 (s, 3H), 1.96 (s, 3H), 1.94 – 1.82 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.5, 169.2, 153.0, 140.0, 136.1, 135.0, 130.7, 127.3, 126.3, 125.9, 124.8, 124.7, 122.4, 121.5, 49.2, 34.8, 33.8, 26.2, 23.3, 19.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{23}N_2OS$ 339.1526, found 339.1532.



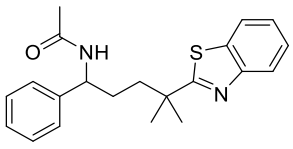
***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(2-chlorophenyl)butyl)acetamide** (**3m**, white solid, 33.0 mg, 46%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.0 Hz, 1H), 7.82 (d, J = 7.8 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.31 (m, 2H), 7.27 – 7.26 (m, 1H), 7.21 – 7.14 (m, 2H), 6.60 (d, J = 7.1 Hz, 1H), 5.33 (q, J = 5.8 Hz, 1H), 3.18 – 3.09 (m, 2H), 2.00 (s, 3H), 1.95 – 1.86 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.4, 169.5, 153.0, 139.3, 135.0, 132.8, 130.1, 128.4, 127.7, 127.0, 125.9, 124.8, 122.3, 121.5, 51.3, 34.0, 33.5, 26.0, 23.2. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}ClN_2OS$ 359.0979, found 359.0977.



***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(3,5-dimethylphenyl)butyl)acetamide** (**3n**, white solid, 47.9 mg, 68%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.2 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 6.88 – 6.87 (m, 3H), 5.95 (d, J = 8.2 Hz, 1H), 4.93 (q, J = 7.4 Hz, 1H), 3.17 – 3.07 (m, 2H), 2.28 (s, 6H), 1.97 (s, 3H), 1.95 – 1.78 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.6, 169.2, 153.1, 141.6, 138.3, 135.1, 129.2, 125.9, 124.7, 124.3, 122.4, 121.5, 53.2, 35.2, 33.8, 26.2, 23.5, 21.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{25}N_2OS$ 353.1682, found 353.1685.

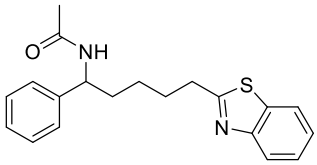


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(naphthalen-2-yl)butyl)acetamide** (**3o**, white solid, 48.7 mg, 65%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.0 Hz, 1H), 7.83 – 7.72 (m, 5H), 7.48 – 7.43 (m, 3H), 7.39 – 7.33 (m, 2H), 6.18 (d, J = 8.3 Hz, 1H), 5.18 (q, J = 7.3 Hz, 1H), 3.19 – 3.09 (m, 2H), 2.05 – 1.82 (m, 4H), 2.00 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.5, 169.5, 153.0, 139.1, 135.0, 133.3, 132.7, 128.6, 127.8, 127.6, 126.2, 125.93, 125.88, 125.3, 124.8, 124.6, 122.4, 121.5, 53.3, 35.0, 33.7, 26.1, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{23}H_{23}N_2OS$ 375.1526, found 375.1533.

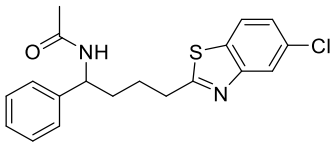


***N*-(4-(benzo[d]thiazol-2-yl)-4-methyl-1-phenylpentyl)acetamide** (**3p**, brown wax, 45.1 mg, 64%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.98 (d, J = 8.2 Hz, 1H), 7.85 (d, J = 7.9 Hz, 1H), 7.48 – 7.45 (m, 1H), 7.37 – 7.34 (m, 1H), 7.29 – 7.26 (m, 2H), 7.23 – 7.19 (m, 3H), 6.17 (d, J = 7.8 Hz, 1H), 4.90 (q, J = 7.2 Hz, 1H), 1.99 (s, 3H), 1.96 – 1.93 (m,

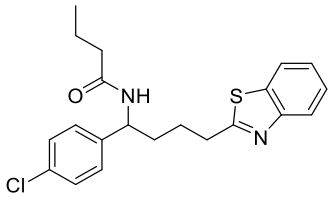
1H), 1.78 – 1.71 (m, 3H), 1.47 (s, 3H), 1.45 (s, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 180.7, 169.4, 152.9, 142.2, 134.9, 128.5, 127.2, 126.4, 125.8, 124.7, 122.5, 121.5, 53.6, 41.4, 39.5, 31.4, 29.3, 28.5, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{25}N_2OS$ 353.1682, found 353.1688.



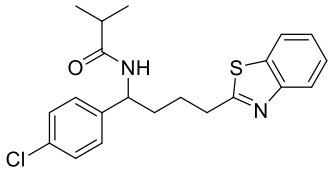
***N*-(5-(benzo[*d*]thiazol-2-yl)-1-phenylpentyl)acetamide** (**3q**, brown wax, 42.0 mg, 62%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (d, J = 8.1 Hz, 1H), 7.82 (d, J = 7.9 Hz, 1H), 7.46 – 7.42 (m, 1H), 7.36 – 7.33 (m, 1H), 7.31 – 7.28 (m, 2H), 7.25 – 7.22 (m, 3H), 5.96 (d, J = 8.2 Hz, 1H), 4.95 (q, J = 7.6 Hz, 1H), 3.07 (t, J = 7.7 Hz, 2H), 1.94 (s, 3H), 1.92 – 1.78 (m, 4H), 1.51 – 1.47 (m, 1H), 1.43 – 1.33 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 169.3, 153.0, 142.0, 135.0, 128.6, 127.4, 126.5, 125.9, 124.7, 122.4, 121.5, 53.2, 35.5, 33.9, 29.2, 25.5, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{23}N_2OS$ 339.1526, found 339.1540.



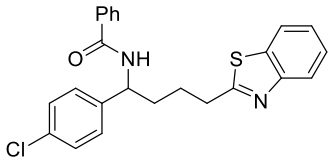
***N*-(4-(5-chlorobenzo[*d*]thiazol-2-yl)-1-phenylbutyl)acetamide** (**3r**, white solid, 23.7 mg, 33%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.72 (d, J = 8.4 Hz, 1H), 7.32 – 7.26 (m, 6H), 5.97 (d, J = 8.2 Hz, 1H), 5.01 (q, J = 7.2 Hz, 1H), 3.16 – 3.07 (m, 2H), 1.98 (s, 3H), 1.93 – 1.80 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.7, 169.3, 154.0, 141.7, 136.5, 131.9, 128.8, 127.6, 126.5, 125.2, 122.4, 122.2, 53.2, 35.1, 33.8, 26.0, 23.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}ClN_2OS$ 359.0979, found 359.0987.



***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-chlorophenyl)butyl)butyramide** (**3s**, white solid, 37.1 mg, 48%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.47 – 7.44 (m, 1H), 7.37 – 7.34 (m, 1H), 7.27 – 7.26 (m, 2H), 7.20 – 7.18 (m, 2H), 6.10 (d, J = 7.6 Hz, 1H), 4.98 (q, J = 7.2 Hz, 1H), 3.19 – 3.09 (m, 2H), 2.18 – 2.14 (m, 2H), 1.97 – 1.83 (m, 4H), 1.68 – 1.60 (m, 2H), 0.90 (t, J = 7.4 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 172.4, 171.3, 153.0, 140.7, 135.0, 133.0, 128.8, 127.8, 126.0, 124.8, 122.4, 121.5, 52.5, 38.6, 34.9, 33.5, 25.9, 19.1, 13.7. HRMS(ESI) m/z: $[M+Na]^+$ cacld. for $C_{21}H_{23}ClN_2NaOS$ 409.1112, found 409.1121.

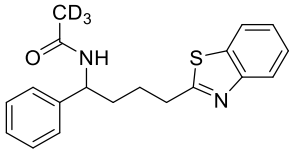


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-chlorophenyl)butyl)isobutyramide** (**3t**, white solid, 34.1 mg, 44%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 7.6 Hz, 1H), 7.84 (d, J = 7.3 Hz, 1H), 7.48 – 7.45 (m, 1H), 7.38 – 7.35 (m, 1H), 7.28 – 7.26 (m, 2H), 7.20 – 7.19 (m, 2H), 5.93 (d, J = 7.5 Hz, 1H), 4.97 (q, J = 7.0 Hz, 1H), 3.19 – 3.08 (m, 2H), 2.40 – 2.34 (m, 1H), 1.96 – 1.88 (m, 4H), 1.16 (d, J = 6.9 Hz, 3H), 1.13 (d, J = 6.9 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 176.4, 171.3, 159.2, 140.7, 135.0, 133.0, 128.8, 127.8, 126.0, 124.9, 122.4, 121.6, 52.4, 35.6, 35.0, 33.5, 26.0, 19.58, 19.55. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{24}ClN_2OS$ 387.1292, found 387.1302.

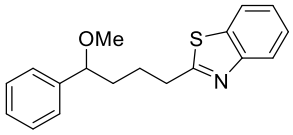


***N*-(4-(benzo[*d*]thiazol-2-yl)-1-(4-chlorophenyl)butyl)benzamide** (**3u**, white solid, 33.7 mg, 40%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.92 – 7.90 (m, 1H), 7.83 – 7.80 (m, 3H), 7.47 – 7.33 (m, 6H), 7.26– 7.24 (m, 3H), 6.90 – 6.89 (m, 1H), 5.16 – 5.15 (m, 1H), 3.21 – 3.12 (m, 2H), 2.03 – 1.90 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.2, 167.0, 153.0, 140.7, 135.0, 134.2, 133.1, 131.6, 128.8, 128.5, 127.9, 127.0, 126.0, 124.9, 122.4, 121.6, 53.3, 34.9, 33.4, 25.8. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{24}H_{22}ClN_2OS$

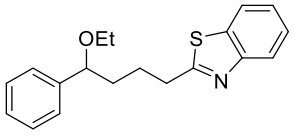
421.1136, found 421.1145.



***N*-(4-(benzo[*d*]thiazol-2-yl)-1-phenylbutyl)acetamide-2,2,2-d$_3$** (**3v**, white solid, 41.9 mg, 64%), ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.30 (m, 3H), 7.27 – 7.23 (m, 3H), 5.97 (d, J = 8.1 Hz, 1H), 5.02 (q, J = 7.3 Hz, 1H), 3.18 – 3.08 (m, 2H), 1.99 – 1.84 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.4, 169.4, 153.1, 141.8, 135.0, 128.7, 127.4, 126.5, 125.9, 124.7, 122.4, 121.5, 53.2, 35.2, 33.7, 26.1, 22.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{18}D_3N_2OS$ 328.1557, found 328.1560.

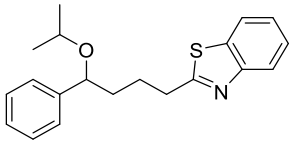


2-(4-Methoxy-4-phenylbutyl)benzo[*d*]thiazole (**5a**, colorless oil, 22.9 mg, 77%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.82 (d, J = 7.9 Hz, 1H), 7.46 – 7.42 (m, 1H), 7.36 – 7.32 (m, 3H), 7.29 – 7.27 (m, 3H), 4.15 (dd, J = 7.3, 5.3 Hz, 1H), 3.21 (s, 3H), 3.12 (t, J = 7.5 Hz, 2H), 2.05 – 2.00 (m, 1H), 1.96 – 1.86 (m, 2H), 1.82 – 1.76 (m, 1H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.8, 153.2, 141.9, 135. 1, 128.4, 127.6, 126.6, 125.8, 124.6, 122.5, 121.4, 83.5, 56.6, 37.5, 34.1, 26.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{18}H_{20}NOS$ 298.1260, found 298.1260.

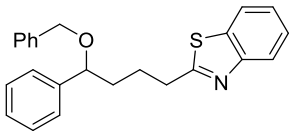


2-(4-Ethoxy-4-phenylbutyl)benzo[*d*]thiazole (**5b**, colorless oil, 23.0 mg, 74%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, J = 8.2 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.46 – 7.42 (m, 1H), 7.35 – 7.28 (m, 6H), 4.26 (dd, J = 7.4, 5.3 Hz, 1H), 3.42 – 3.27 (m, 2H), 3.12 (t, J = 7.4 Hz, 2H), 2.08 – 2.02 (m, 1H), 1.99 – 1.85 (m, 2H), 1.81 – 1.75 (m, 1H),

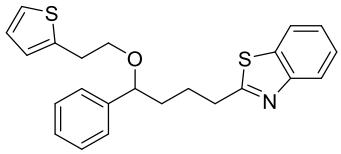
1.18 (t, J = 7.0 Hz, 3H); ^{13}C NMR (101 MHz, $CDCl_3$) δ 171.9, 153.2, 142.7, 135.1, 128.3, 127.4, 126.5, 125.8, 124.6, 122.4, 121.4, 81.6, 64.1, 37.7, 34.1, 26.1, 15.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{22}NOS$ 312.1417, found 12.1417.



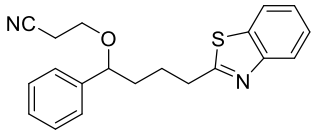
2-(4-Isopropoxy-4-phenylbutyl)benzo[*d*]thiazole (**5c**, colorless oil, 23.4 mg, 72%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.2 Hz, 1H), 7.82 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.35 – 7.31 (m, 5H), 7.27 – 7.24 (m, 1H), 4.40 – 4.37 (m, 1H), 3.50 – 3.46 (m, 1H), 3.14 – 3.11 (m, 2H), 2.08 – 2.02 (m, 1H), 1.91 – 1.85 (m, 2H), 1.77 – 1.71 (m, 1H), 1.16 (d, J = 6.0 Hz, 3H), 1.09 (d, J = 6.2 Hz, 3H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 153.2, 143.4, 135.1, 128.2, 127.3, 126.4, 125.8, 124.6, 122.4, 121.4, 78.6, 68.7, 38.1, 34.1, 26.3, 23.4, 21.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{24}NOS$ 326.1573, found 326.1568.



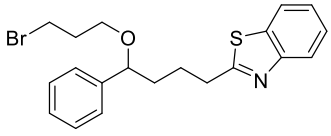
2-(4-(Benzyloxy)-4-phenylbutyl)benzo[d]thiazole (**5d**, colorless oil, 22.0 mg, 59%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.2 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.37 – 7.30 (m, 11H), 4.48 – 4.45 (m, 1H), 4.37 (dd, J = 7.8, 5.2 Hz, 1H), 4.27 – 4.24 (m, 1H), 3.12 – 3.08 (m, 2H), 2.09 – 1.98 (m, 2H), 1.93 – 1.86 (m, 1H), 1.83 – 1.79 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.8, 153.2, 142.2, 138.5, 135.1, 128.5, 128.3, 127.8, 127.7, 127.5, 126.7, 125.8, 124.6, 122.5, 121.5, 80.9, 70.4, 37.7, 34.1, 26.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{24}H_{24}NOS$ 374.1573, found 374.1566.



2-(4-Phenyl-4-(2-(thiophen-2-yl)ethoxy)butyl)benzo[*d*]thiazole (**5e**, colorless oil, 13.0 mg, 33%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 7.9 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.30 (m, 3H), 7.27 – 7.25 (m, 3H), 7.11 – 7.10 (m, 1H), 6.90 – 6.88 (m, 1H), 6.81 – 6.80 (m, 1H), 4.29 (dd, J = 7.5, 5.3 Hz, 1H), 3.59 – 3.54 (m, 1H), 3.48 – 3.43 (m, 1H), 3.13 – 3.05 (m, 4H), 2.05 – 2.00 (m, 1H), 1.97 – 1.91 (m, 1H), 1.90 – 1.84 (m, 1H), 1.80 – 1.75 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 153.3, 142.2, 141.4, 135.1, 133.5, 128.4, 127.6, 126.6, 125.9, 125.1, 124.7, 123.5, 122.4, 121.5, 82.1, 69.4, 37.6, 34.0, 30.6, 26.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{23}H_{24}NOS_2$ 394.1294, found 394.1302.

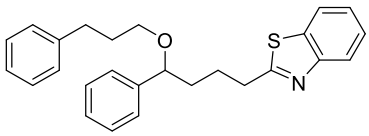


3-(4-(Benzo[*d*]thiazol-2-yl)-1-phenylbutoxy)propanenitrile (**5f**, colorless oil, 15.5 mg, 46%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.01 (d, J = 8.1 Hz, 1H), 7.78 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.41 – 7.39 (m, 2H), 7.36 – 7.33 (m, 3H), 7.29 – 7.27 (m, 1H), 4.39 (dd, J = 8.4, 7.1 Hz, 1H), 4.25 (t, J = 6.4 Hz, 2H), 2.68 (t, J = 6.4 Hz, 2H), 2.50 – 2.42 (m, 3H), 2.27 – 2.21 (m, 1H), 1.76 – 1.67 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 174.8, 172.6, 152.9, 141.1, 135.1, 128.9, 127.5, 126.0, 124.9, 122.8, 121.5, 116.7, 58.6, 50.6, 34.8, 33.5, 22.9, 18.0. HRMS(ESI) m/z: $[M+Na]^+$ cacld. for $C_{20}H_{20}N_2NaOS$ 359.1189, found 359.1179.

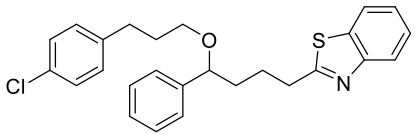


2-(4-(3-Bromopropoxy)-4-phenylbutyl)benzo[*d*]thiazole (**5g**, colorless oil, 24.6 mg, 61%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.32 (m, 3H), 7.28 – 7.27 (m, 3H), 4.26 (dd, J = 7.5, 5.1

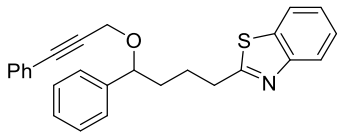
Hz, 1H), 3.56 – 3.48 (m, 2H), 3.43 – 3.36 (m, 2H), 3.14 – 3.11 (m, 2H), 2.08 – 2.05 (m, 3H), 1.94 – 1.87 (m, 2H), 1.79 – 1.74 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.7, 153.2, 141.9, 134.9, 128.4, 127.6, 126.5, 125.9, 124.7, 122.5, 121.5, 82.1, 66.1, 37.6, 34.1, 33.0, 30.8, 26.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{20}H_{23}BrNOS$ 404.0678, found 404.0672.



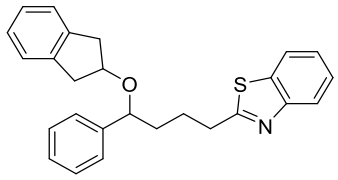
2-(4-Phenyl-4-(3-phenylpropoxy)butyl)benzo[*d*]thiazole (**5h**, colorless oil, 14.9 mg, 37%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.06 (d, J = 8.1 Hz, 1H), 7.93 (d, J = 8.0 Hz, 1H), 7.56 – 7.53 (m, 1H), 7.46 – 7.42 (m, 3H), 7.40 – 7.34 (m, 6H), 7.28 – 7.25 (m, 2H), 4.34 (dd, J = 7.6, 5.2 Hz, 1H), 3.48 – 3.34 (m, 2H), 3.29 – 3.20 (m, 2H), 2.84 – 2.72 (m, 2H), 2.21 – 2.14 (m, 1H), 2.07 – 1.96 (m, 4H), 1.92 – 1.86 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 153.2, 142.6, 142.0, 135.1, 128.41, 128.35, 128.2, 127.5, 126.5, 125.8, 125.7, 124.6, 122.5, 121.4, 81.9, 68.0, 37.7, 34.1, 32.4, 31.5, 26.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{26}H_{28}NOS$ 402.1886, found 402.1890.



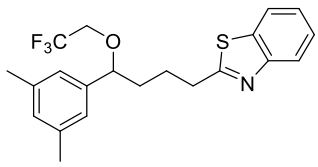
2-(4-(3-(4-Chlorophenyl)propoxy)-4-phenylbutyl)benzo[*d*]thiazole (**5i**, colorless oil, 14.8 mg, 34%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.01 (d, J = 8.3 Hz, 1H), 7.78 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.39 – 7.38 (m, 2H), 7.36 – 7.32 (m, 3H), 7.29 – 7.27 (m, 1H), 7.23 – 7.21 (m, 2H), 7.11 – 7.09 (m, 2H), 4.38 (t, J = 7.7 Hz, 1H), 4.23 (t, J = 6.9 Hz, 2H), 2.87 (t, J = 6.9 Hz, 2H), 2.46 – 2.40 (m, 1H), 2.37 – 2.33 (m, 2H), 2.22 – 2.18 (m, 1H), 1.69 – 1.62 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.1, 153.9, 142.9, 141.2, 139.0, 132.3, 130.2, 128.9, 128.6, 128.0, 127.5, 126.0, 124.9, 122.8, 121.5, 64.5, 50.6, 34.9, 34.4, 33.9, 29.7, 23.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{26}H_{27}ClNOS$ 436.1496, found 436.1498.



2-(4-Phenyl-4-((3-phenylprop-2-yn-1-yl)oxy)butyl)benzo[*d*]thiazole (**5j**, colorless oil, 19.9 mg, 50%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.95 (d, J = 8.1 Hz, 1H), 7.81 (d, J = 8.0 Hz, 1H), 7.46 – 7.42 (m, 3H), 7.38 – 7.34 (m, 5H), 7.32 – 7.27 (m, 4H), 4.61 (dd, J = 7.8, 5.4 Hz, 1H), 4.35 – 4.32 (m, 1H), 4.11 – 4.08 (m, 1H), 3.17 – 3.14 (m, 2H), 2.14 – 2.07 (m, 1H), 2.06 – 1.99 (m, 1H), 1.97 – 1.88 (m, 1H), 1.86 – 1.80 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.9, 153.2, 141.2, 135.1, 131.7, 128.5, 128.3, 128.2, 127.9, 126.9, 125.8, 124.6, 122.9, 122.5, 121.5, 86.0, 85.3, 80.4, 56.5, 37.2, 34.0, 26.0. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{26}H_{24}NOS$ 398.1573, found 398.1567.

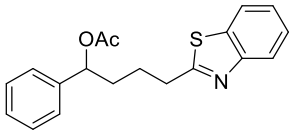


2-(4-((2,3-Dihydro-1*H*-inden-2-yl)oxy)-4-phenylbutyl)benzo[*d*]thiazole (**5k**, white solid, 12.0 mg, 30%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.00 (d, J = 8.2 Hz, 1H), 7.78 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.38 – 7.31 (m, 5H), 7.27 – 7.25 (m, 1H), 7.23 – 7.17 (m, 4H), 5.52 – 5.50 (m, 1H), 4.37 (t, J = 7.7 Hz, 1H), 3.29 (dd, J = 16.9, 6.5 Hz, 2H), 2.98 (dd, J = 16.9, 3.1 Hz, 2H), 2.45 – 2.40 (m, 1H), 2.35 – 2.32 (m, 2H), 2.24 – 2.18 (m, 1H), 1.70 – 1.65 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 173.2, 153.0, 141.3, 140.4, 135.2, 128.8, 128.0, 127.4, 126.7, 125.9, 124.8, 124.6, 122.8, 121.5, 75.2, 50.7, 39.6, 34.9, 34.1, 23.1. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{26}H_{26}NOS$ 400.1730, found 400.1732.

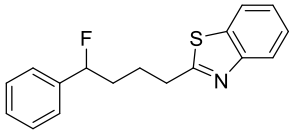


2-(4-(3,5-Dimethylphenyl)-4-(2,2,2-trifluoroethoxy)butyl)benzo[*d*]thiazole (**5l**,

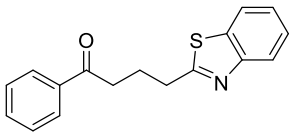
yellow oil, 11.0 mg, 28%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 7.9 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.33 (m, 1H), 6.94 (br, 1H), 6.88 (br, 2H), 4.36 (dd, J = 8.0, 5.2 Hz, 1H), 3.74 – 3.55 (m, 2H), 3.16 – 3.12 (m, 2H), 2.31 (s, 6H), 2.09 – 2.05 (m, 1H), 2.01 – 1.95 (m, 1H), 1.91 – 1.86 (m, 1H), 1.80 – 1.76 (m, 1H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -73.8 (t, J = 8.3 Hz, 3F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.7, 153.1, 140.2, 138.3, 135.1, 129.9, 125.9, 124.7, 124.42 (q, J = 213.4 Hz), 124.4, 122.5, 121.5, 83.4, 65.8 (q, J = 34.0 Hz), 37.2, 33.9, 25.9, 21.3. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{21}H_{23}F_3NOS$ 394.1447, found 394.1452.



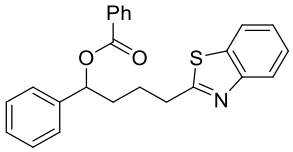
4-(Benzo[*d*]thiazol-2-yl)-1-phenylbutyl acetate (**5m**, colorless oil, 14.6 mg, 45%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, J = 8.1 Hz, 1H), 7.83 (d, J = 8.0 Hz, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.28 (m, 6H), 5.80 – 5.77 (m, 1H), 3.13 (t, J = 6.8 Hz, 2H), 2.07 (s, 3H), 2.05 – 1.82 (m, 4H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.4, 170.4, 153.1, 140.2, 135.0, 128.5, 128.0, 126.4, 125.9, 124.8, 122.5, 121.5, 75.5, 35.6, 33.8, 25.6, 21.2. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{19}H_{20}NO_2S$ 326.1209, found 326.1211.



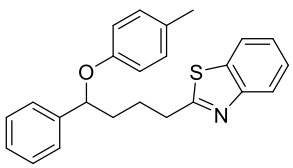
2-(4-Fluoro-4-phenylbutyl)benzo[*d*]thiazole (**5n**, colorless oil, 10.0 mg, 35%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 – 7.96 (m, 1H), 7.85 – 7.83 (m, 1H), 7.47 – 7.44 (m, 1H), 7.38 – 7.32 (m, 6H), 5.50 (ddd, J = 47.7, 7.7, 4.1 Hz, 1H), 3.23 – 3.14 (m, 2H), 2.17 – 2.06 (m, 2H), 2.05 – 1.92 (m, 2H); ^{19}F NMR (471 MHz, $CDCl_3$) δ -175.2 (ddd, J = 45.9, 29.0, 16.4 Hz, 1F); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.3, 153.1, 140.0 (d, J = 19.7 Hz), 135.1, 128.5, 128.3 (d, J = 1.3 Hz), 126.0, 125.5 (d, J = 6.9 Hz), 124.8, 122.5, 121.5, 94.10 (d, J = 171.1 Hz), 36.4 (d, J = 23.9 Hz), 33.8, 25.2 (d, J = 4.2 Hz). HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{17}FNS$ 286.1060, found 286.1059.



4-(benzo[d]thiazol-2-yl)-1-phenylbutan-1-one (**6**, white solid, 51.2 mg, 91%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 – 7.93 (m, 3H), 7.83 – 7.82 (m, 1H), 7.53 – 7.34 (m, 5H), 3.25 – 3.22 (m, 2H), 3.14 – 3.11 (m, 2H), 2.37 – 2.31 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 199.2, 171.2, 153.1, 136.7, 135.1, 133.0, 128.5, 128.0, 125.9, 124.7, 122.5, 121.5, 37.3, 33.4, 23.7. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{17}H_{16}NOS$ 282.0947, found 282.0950.



4-(Benzo[*d*]thiazol-2-yl)-1-phenylbutyl benzoate (**7**, white solid, 62.0 mg, 80%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 – 8.07 (m, 2H), 8.00 – 7.95 (m, 1H), 7.83 – 7.82 (m, 1H), 7.57 – 7.54 (m, 1H), 7.46 – 7.41 (m, 5H), 7.36 – 7.33 (m, 3H), 7.30 – 7.27 (m, 1H), 6.06 (dd, J = 7.6, 5.2 Hz, 1H), 3.17 (t, J = 7.3 Hz, 2H), 2.26 – 2.18 (m, 1H), 2.11 – 2.02 (m, 2H), 1.99 – 1.92 (m, 1H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.3, 165.8, 153.1, 140.3, 135.1, 133.0, 130.3, 129.7, 128.6, 128.4, 128.0, 126.4, 125.9, 124.8, 122.5, 121.5, 76.1, 35.8, 33.9, 25.6. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{24}H_{22}NO_2S$ 388.1366, found 388.1362.



2-(4-Phenyl-4-(p-tolyloxy)butyl)benzo[*d*]thiazole (**8**, white solid, 44.8 mg, 60%). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 – 7.95 (m, 1H), 7.84 – 7.82 (m, 1H), 7.46 – 7.43 (m, 1H), 7.36 – 7.29 (m, 5H), 7.24 – 7.22 (m, 1H), 6.97 – 6.95 (m, 2H), 6.74 – 6.72 (m, 2H), 5.11 (dd, J = 7.7, 4.5 Hz, 1H), 3.19 – 3.15 (m, 2H), 2.21 (s, 3H), 2.18 – 2.08 (m, 2H), 2.06 – 1.93 (m, 2H); ^{13}C NMR (126 MHz, $CDCl_3$) δ 171.7, 156.0, 153.1, 141.9,

135.1, 129.9, 129.7, 128.6, 127.9, 127.5, 125.9, 124.7, 122.5, 121.5, 115.7, 79.7, 38.0, 34.0, 25.9, 20.4. HRMS(ESI) m/z: $[M+H]^+$ cacld. for $C_{24}H_{24}NOS$ 374.1573, found 374.1570.

7. References

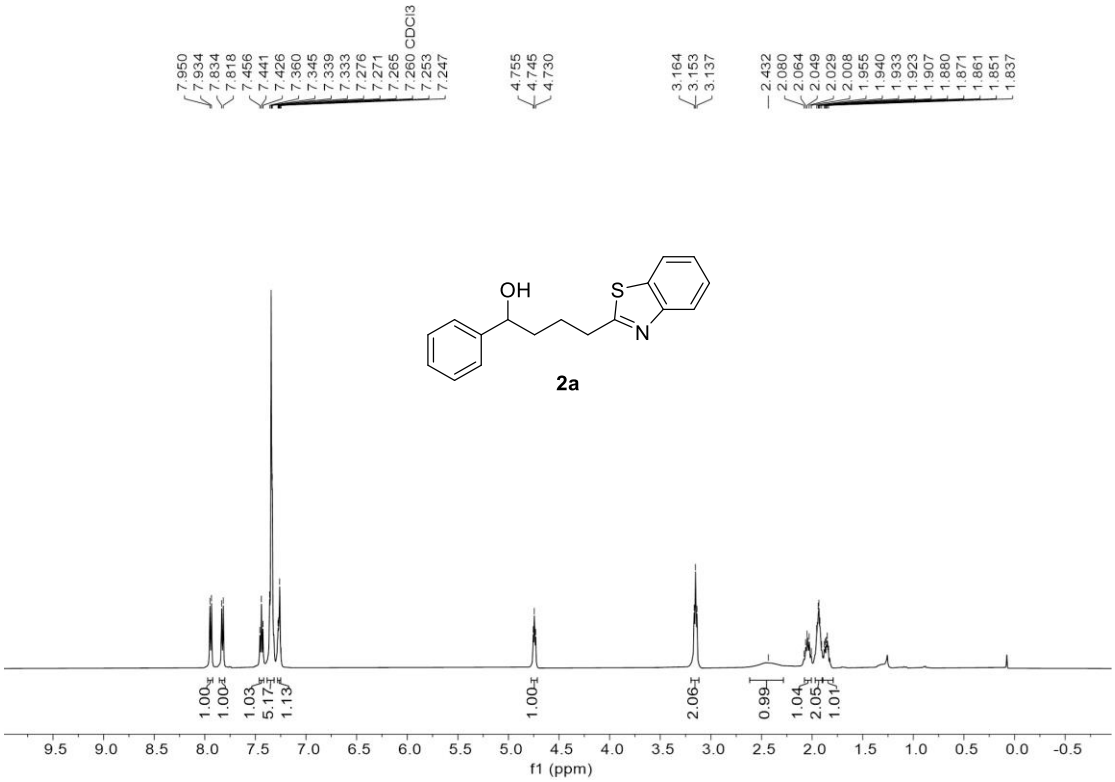
1. K. Guo, C. Han, X. Xie, B. Chen, S. Cao, W. Yuan, K. Chen, F. Liu and Y. Zhu, *Chem*. *Commun*., 2022, **58**, 13353–13356.

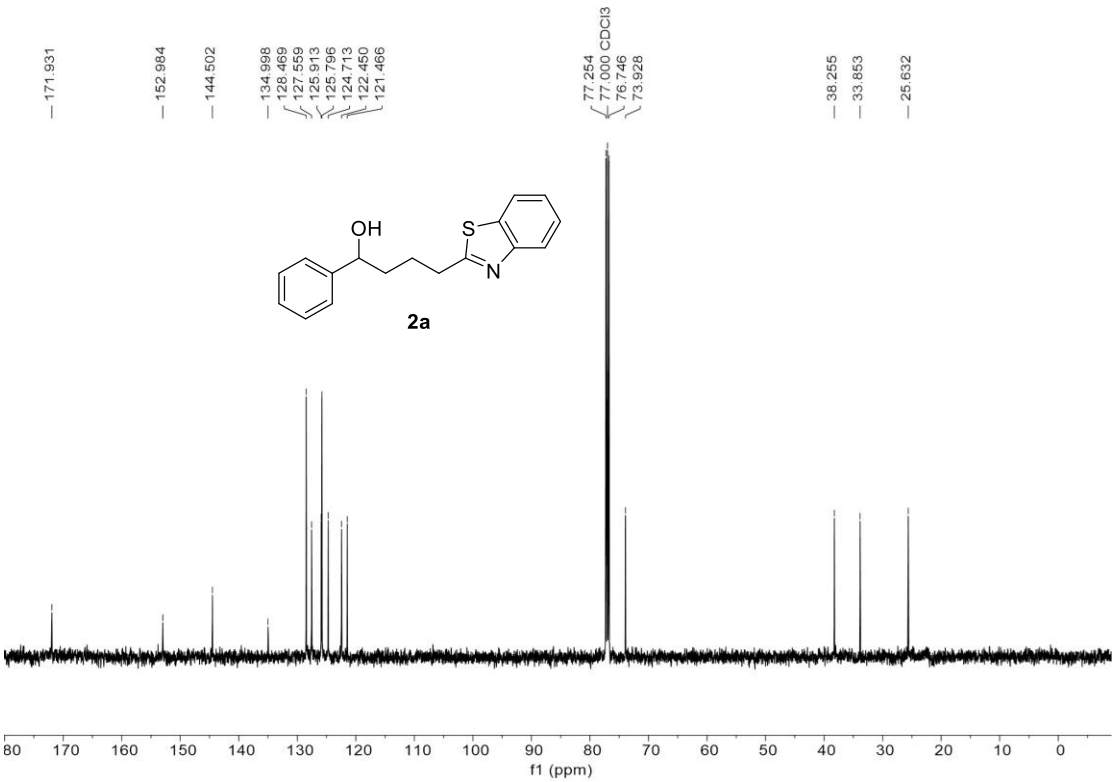
2. V. Pace and W. Holzer, *Tetrahedron Lett*., 2012, **53**, 5106–5109.

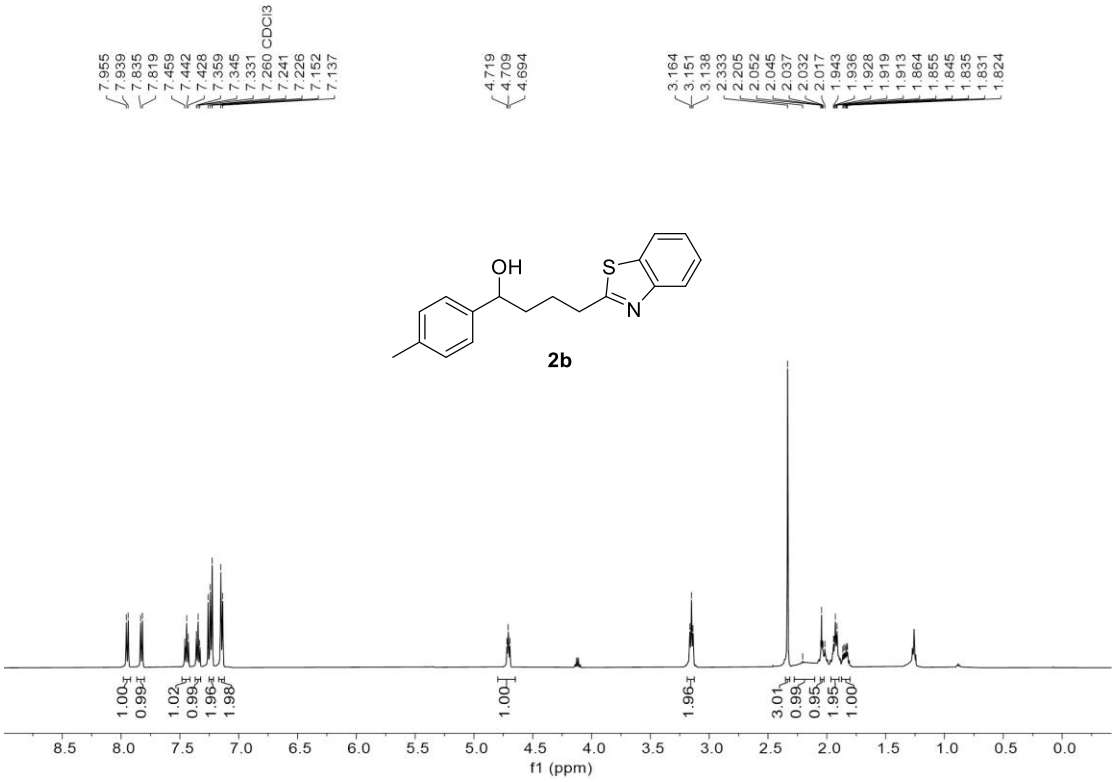
3. R. Tayebee, F. Cheravi, M. Mirzaee and M. M. Amini, *Chin*. *J. Chem*., 2010, **28**, 1247–1252.

4. R. A. Altman, A. Shafir, A. Choi, P. A. Lichtor and S. L. Buchwald, *J. Org*. *Chem*., 2008, **73**, 284–286.

8. NMR spectra



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3.164
3.151
3.138
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1.936
1.928
1.919
1.913
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1.855
1.845
1.835
1.831
1.824
OH
S
N
2b
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0.99
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1.98
1.00
1.96
3.01
0.99
0.95
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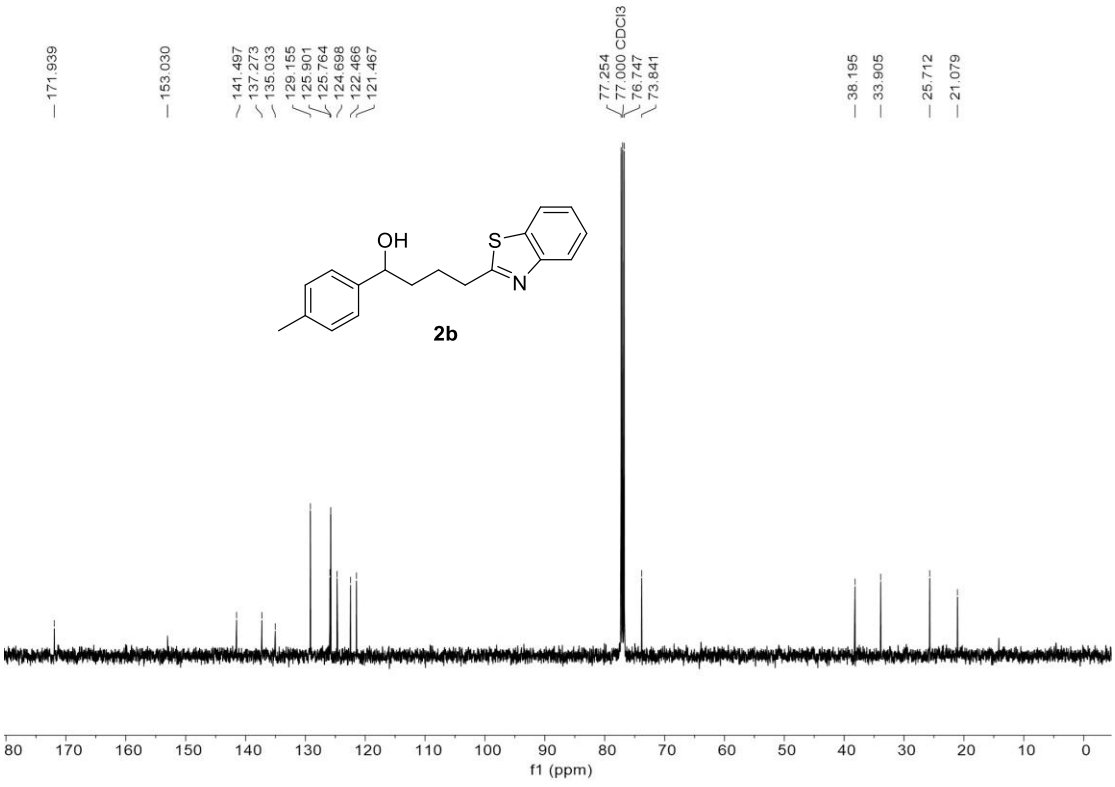
1.00
f1 (ppm)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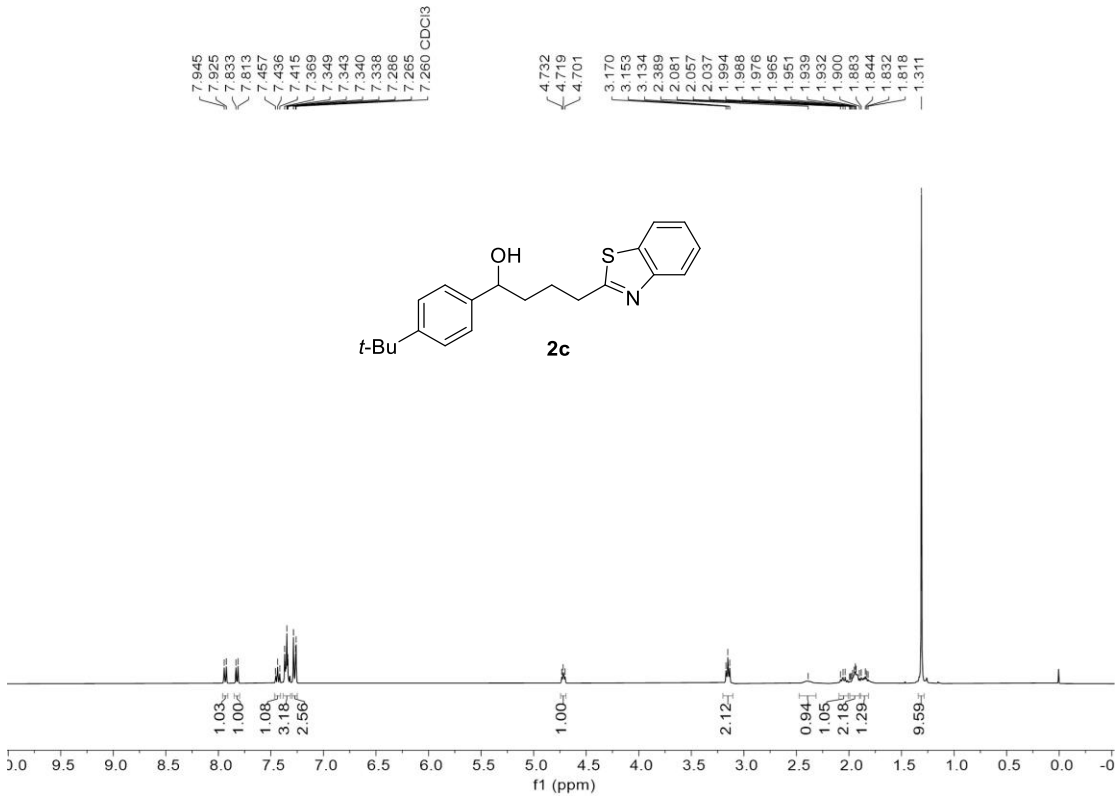
N
2b
f1 (ppm)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t-Bu
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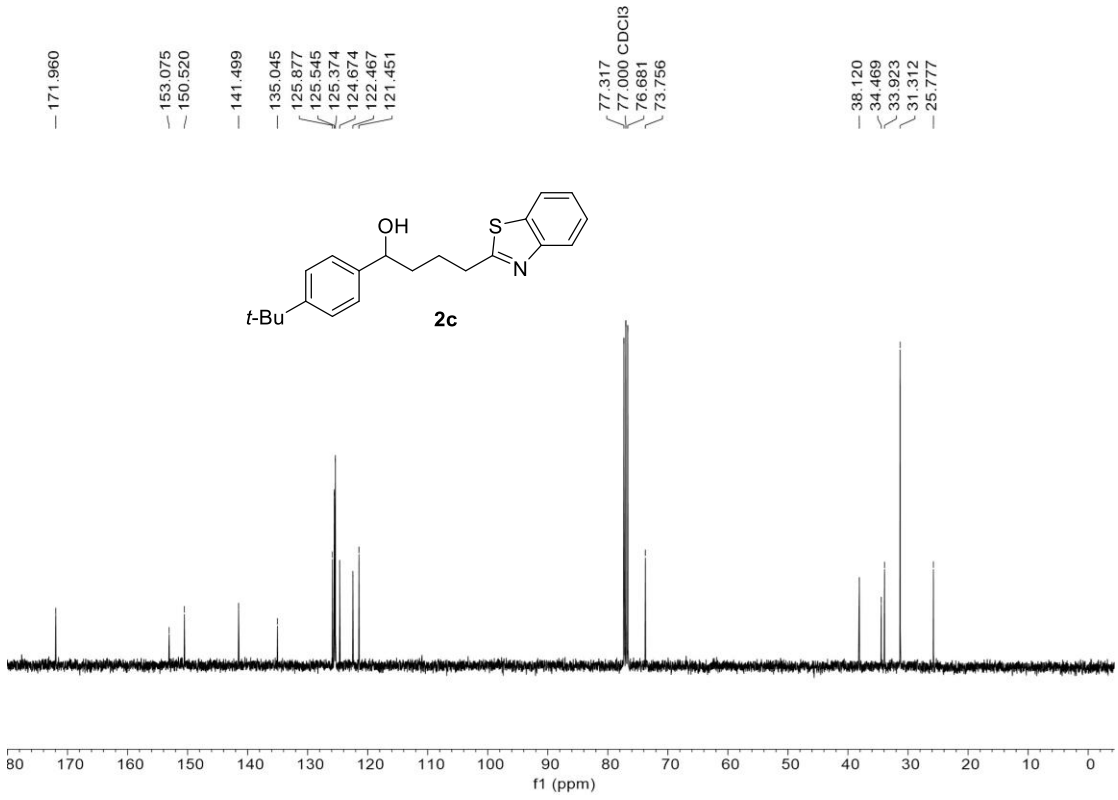
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N
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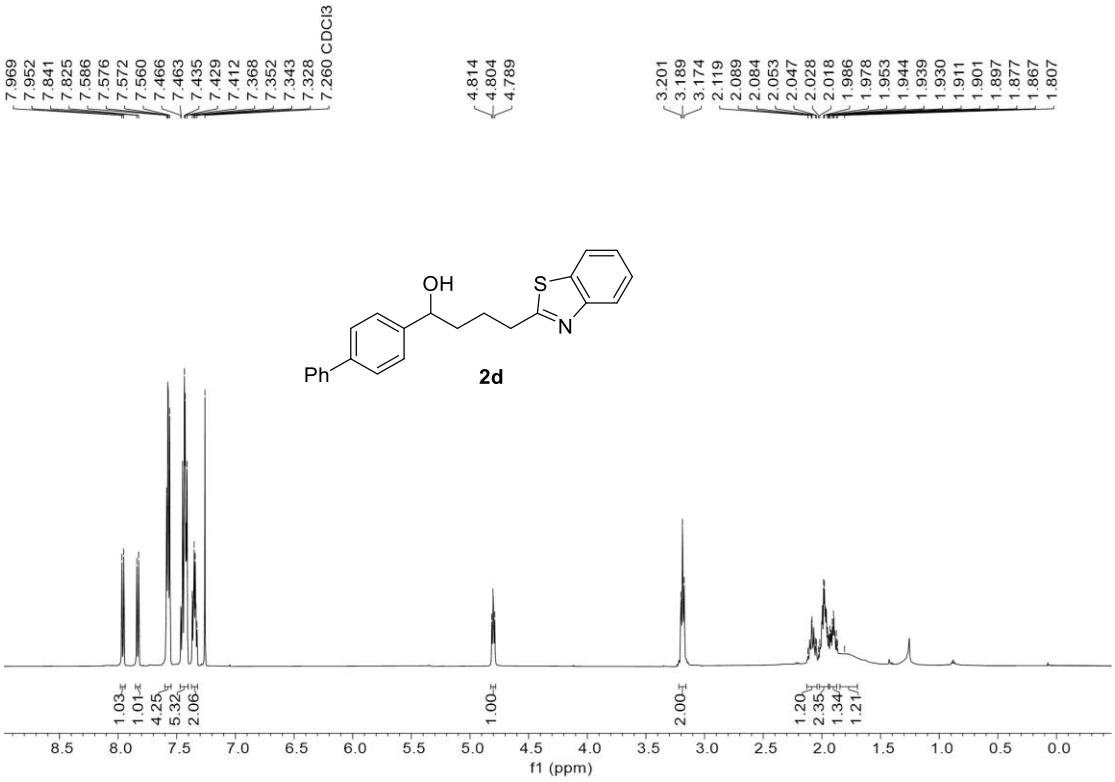
2c
f1 (ppm)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2.00
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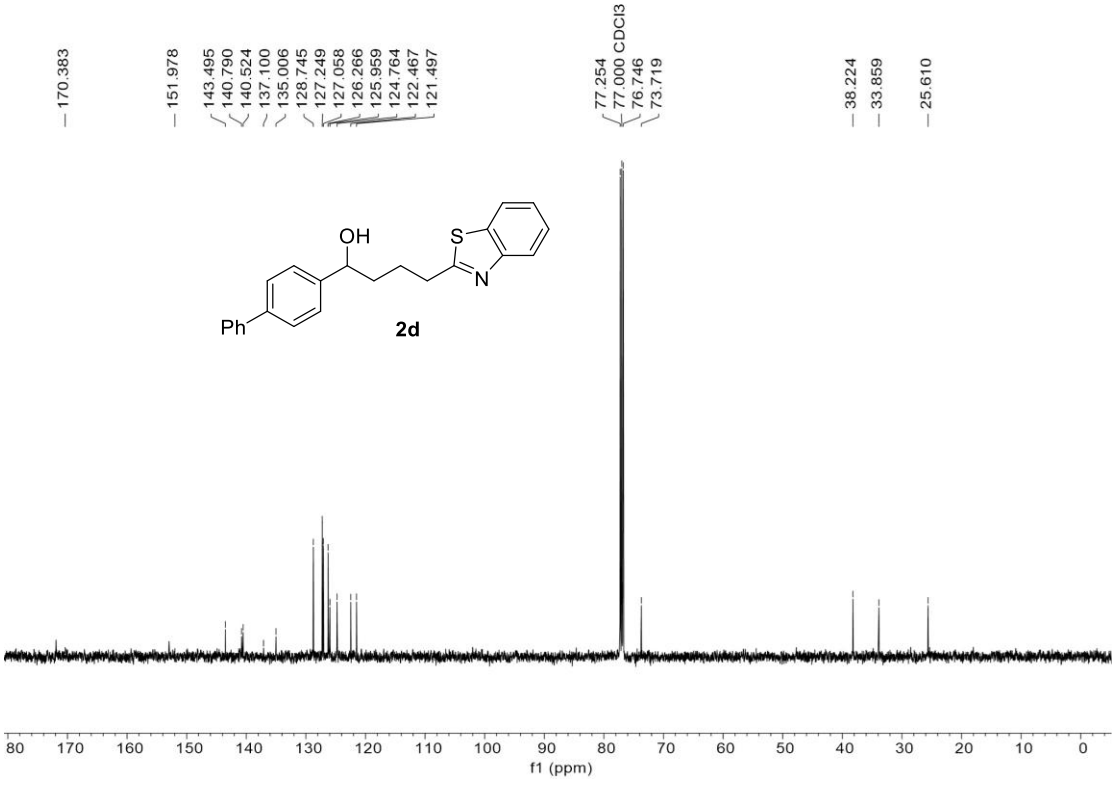
f1 (ppm)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Ph
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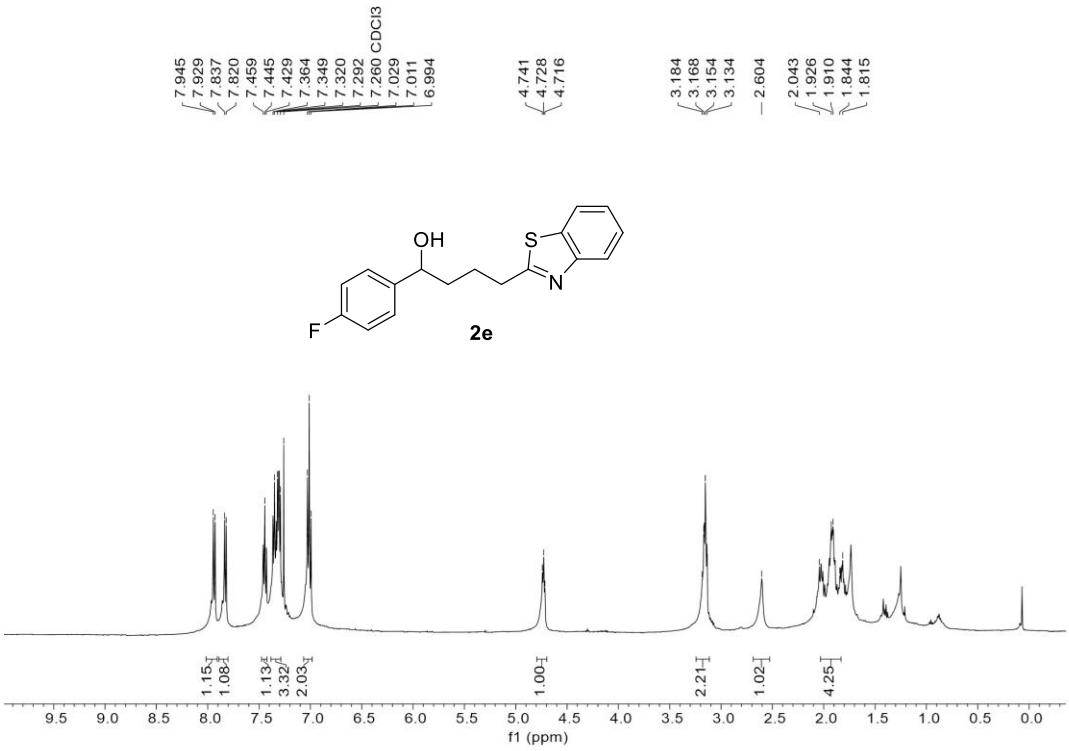
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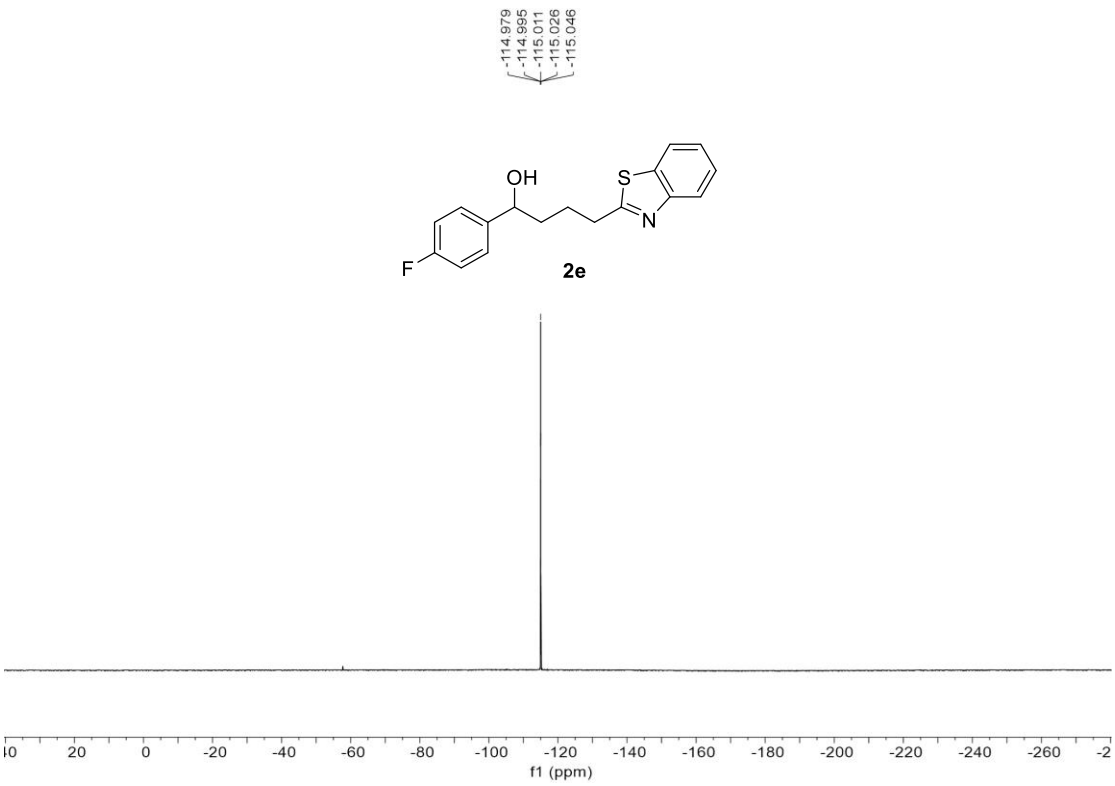
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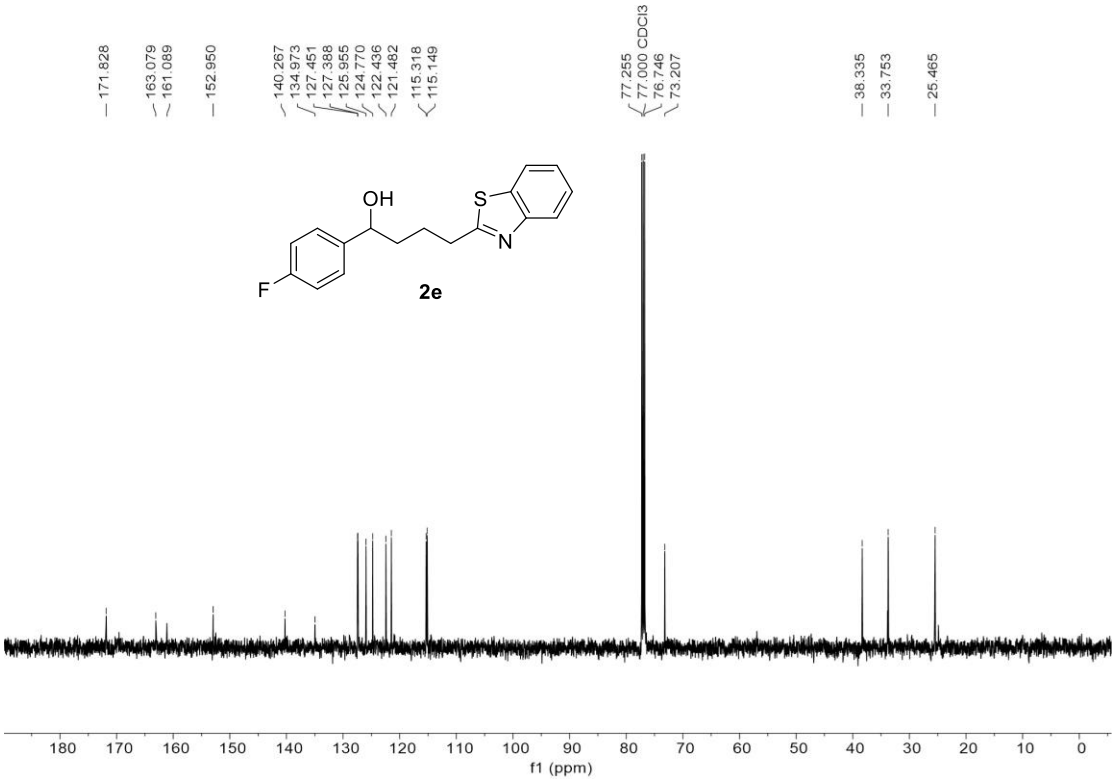
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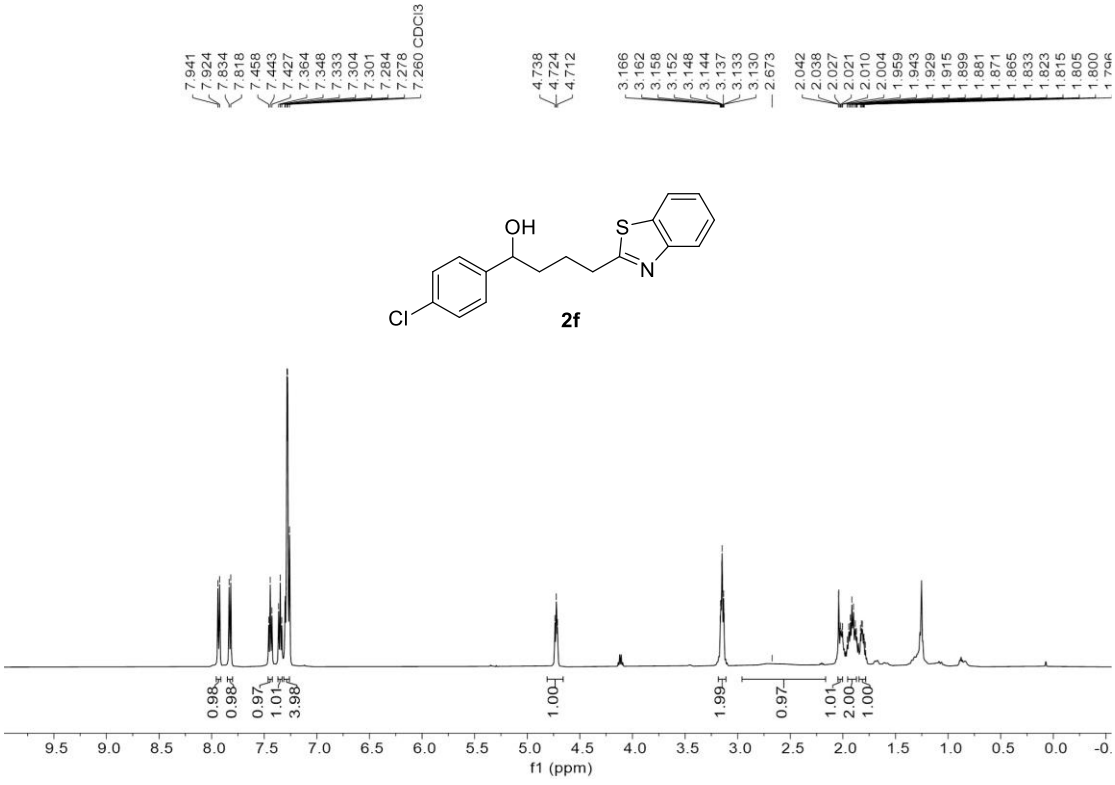
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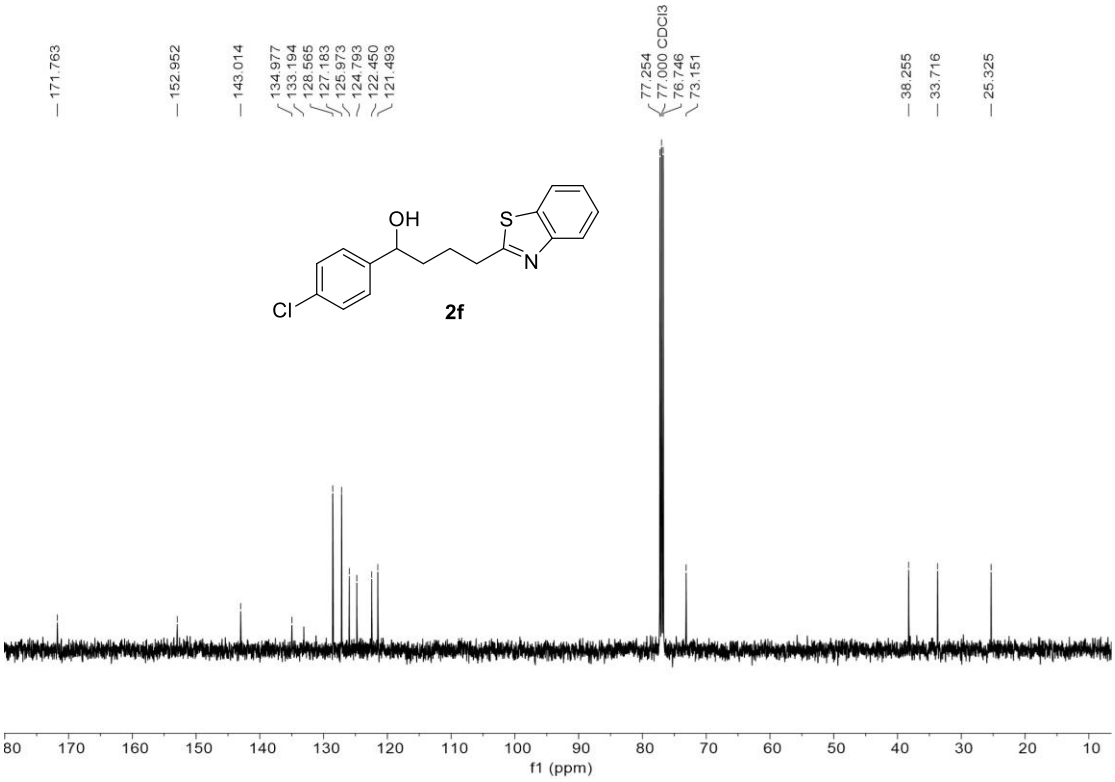
f1 (ppm)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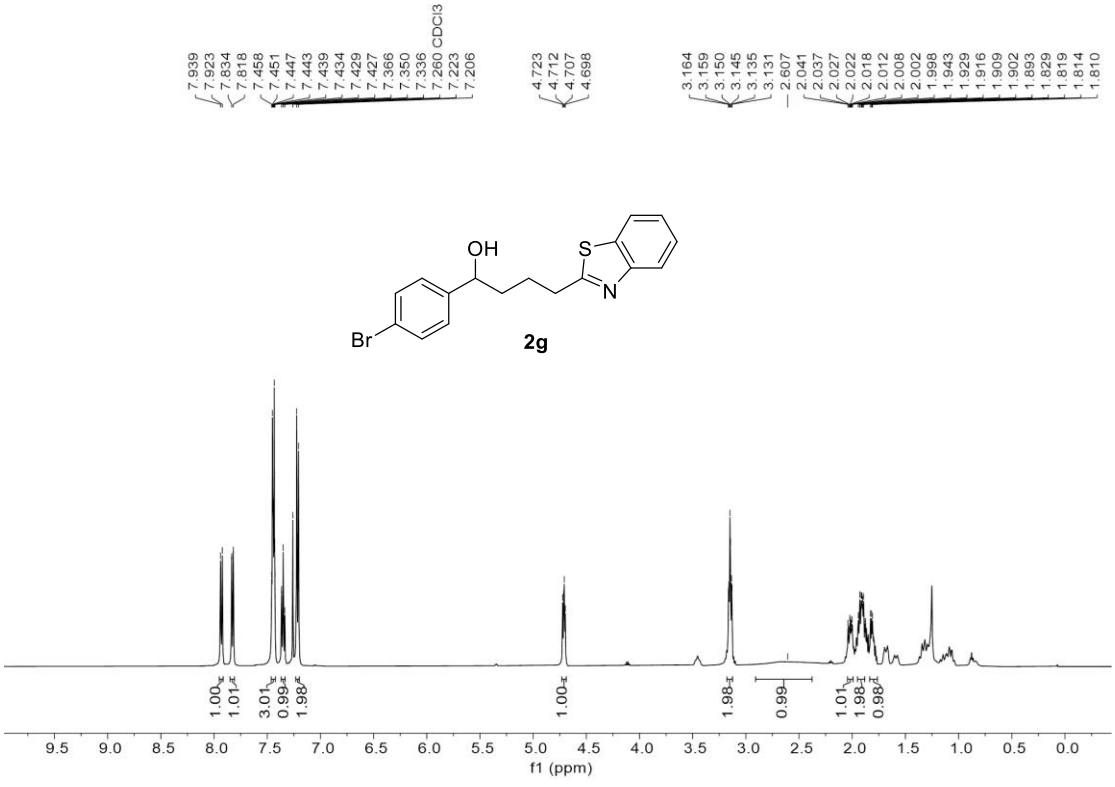
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Br
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0.98
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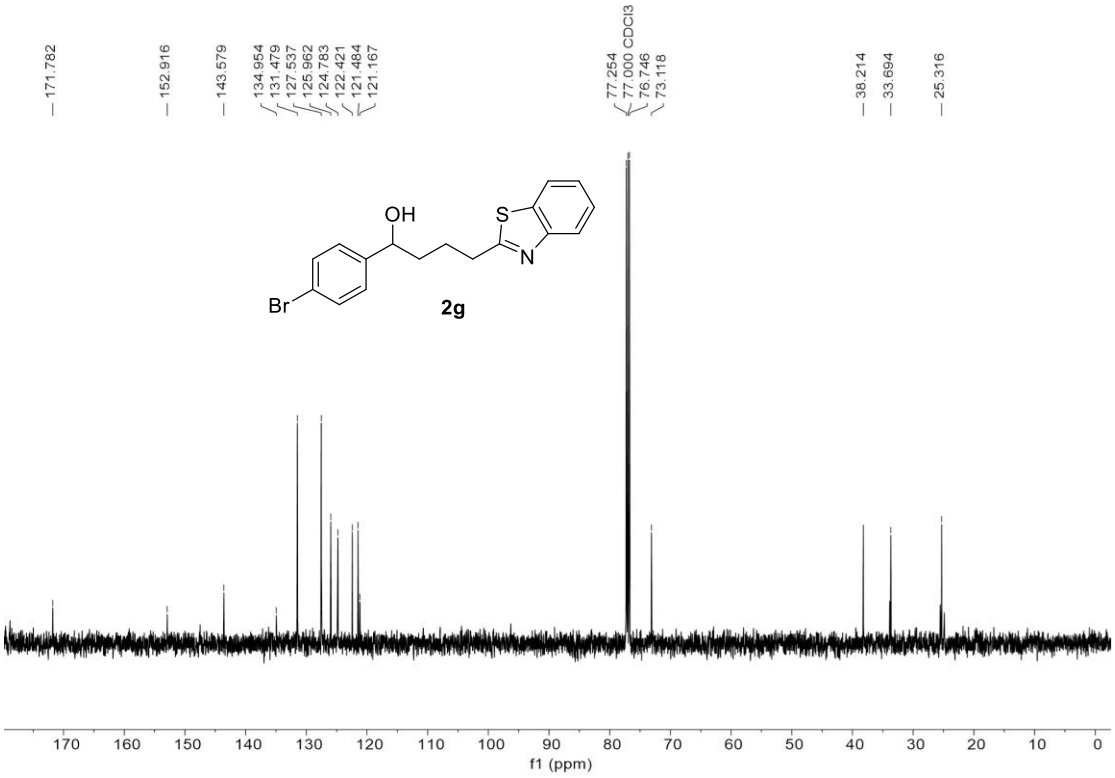
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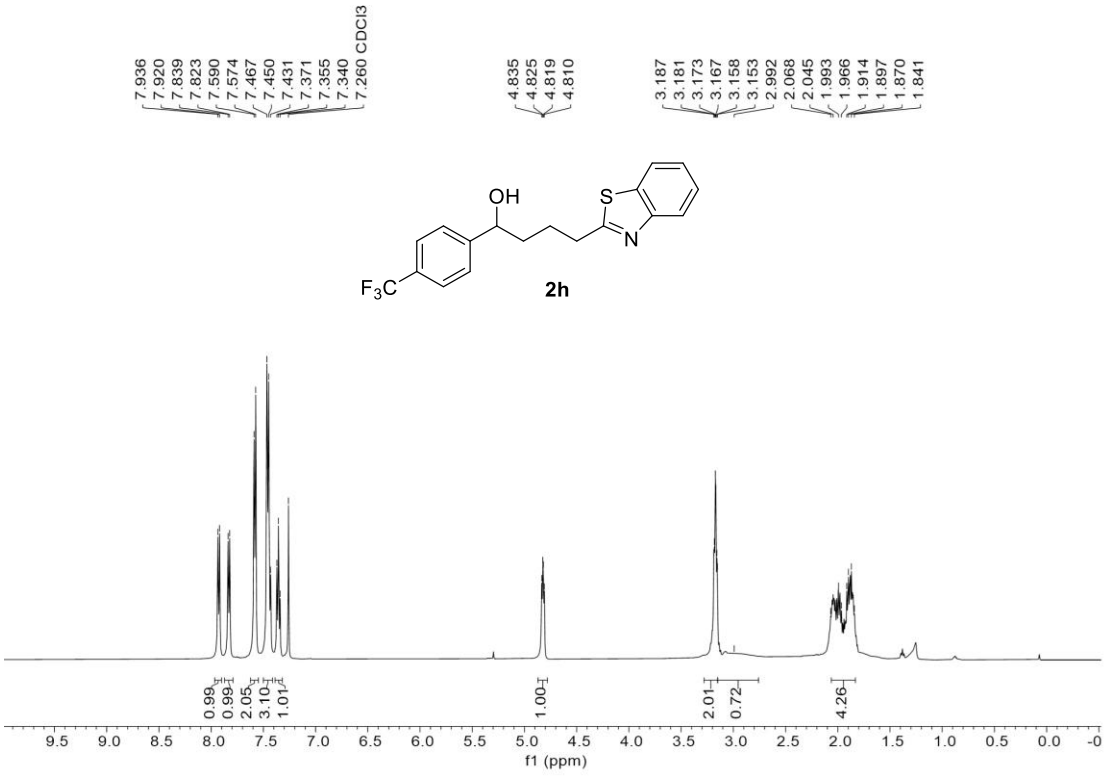
Br
2g
f1 (ppm)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N
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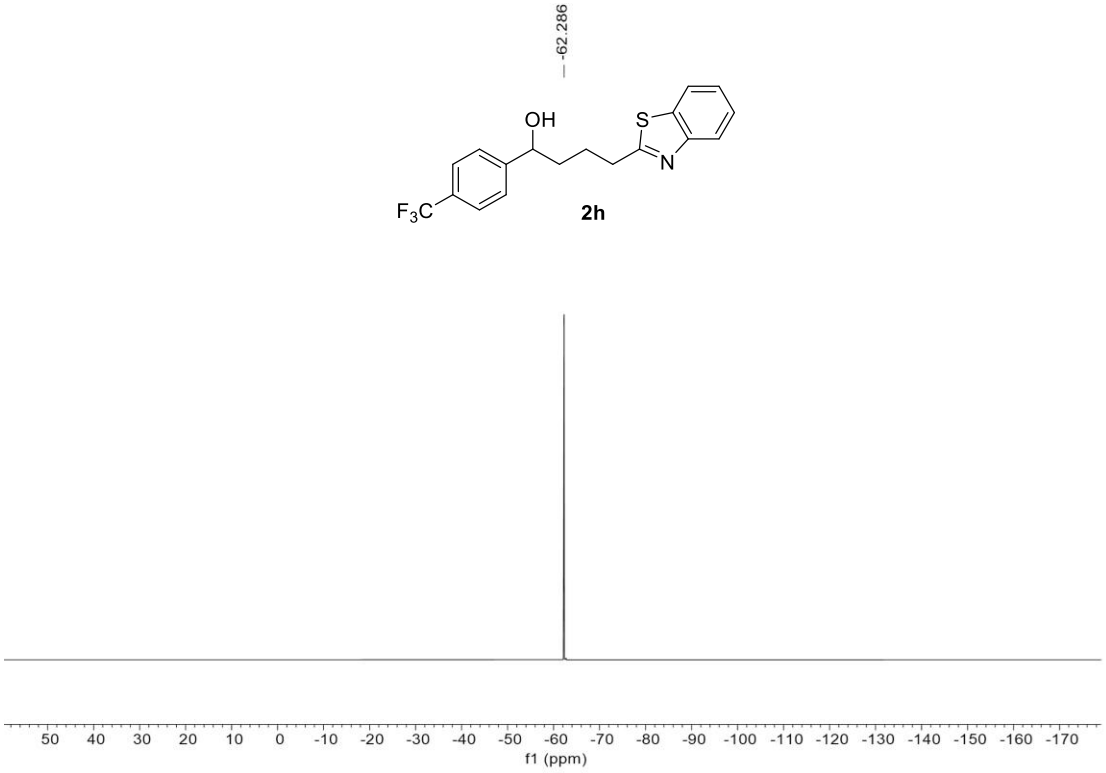
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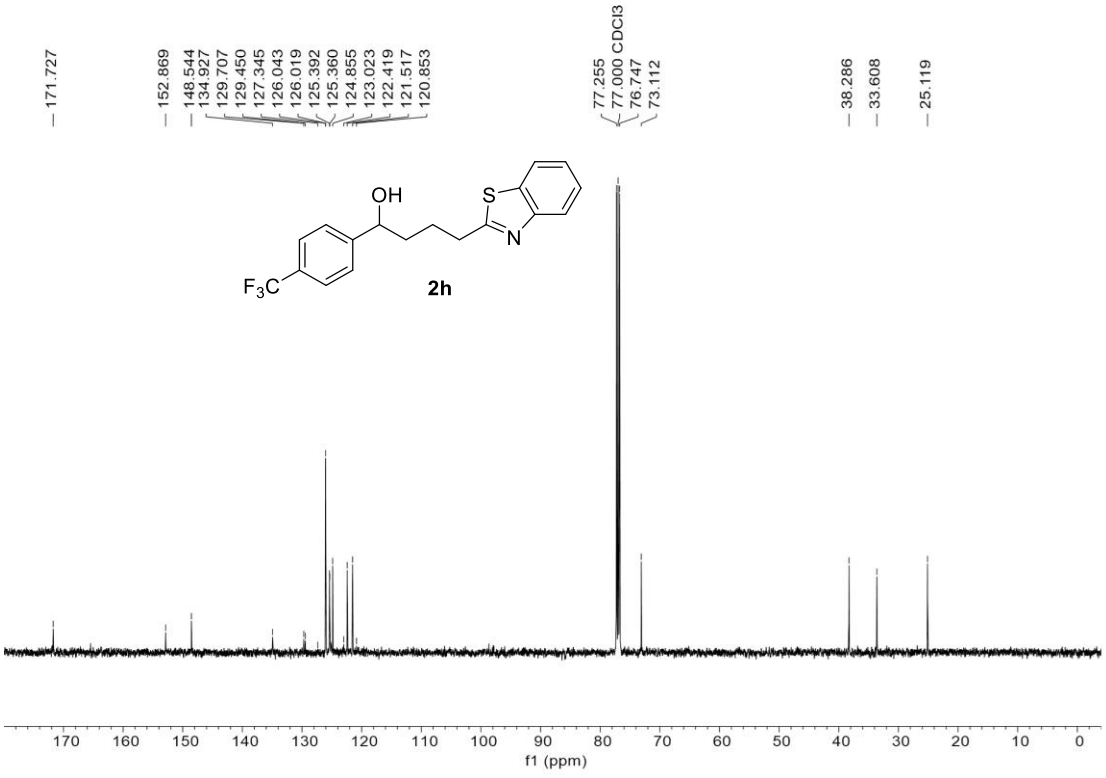
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F3C
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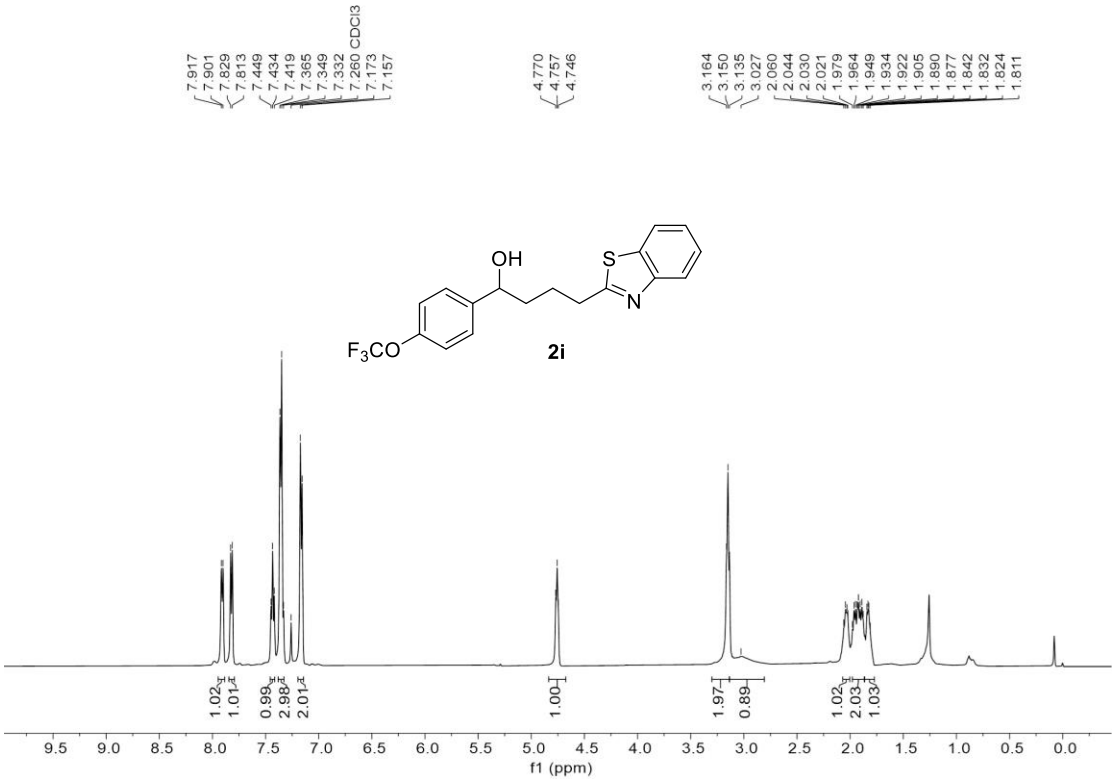
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7.157
4.770
4.757
4.746
3.164
3.150
3.135
3.027
2.060
2.044
2.030
2.021
1.979
1.964
1.949
1.934
1.922
1.905
1.890
1.877
1.842
1.832
1.824
1.811
OH
S
N
F3CO
2i
1.02
1.01
0.99
2.98
2.01
1.00
1.97
0.89
1.02
2.03
1.03
f1 (ppm)


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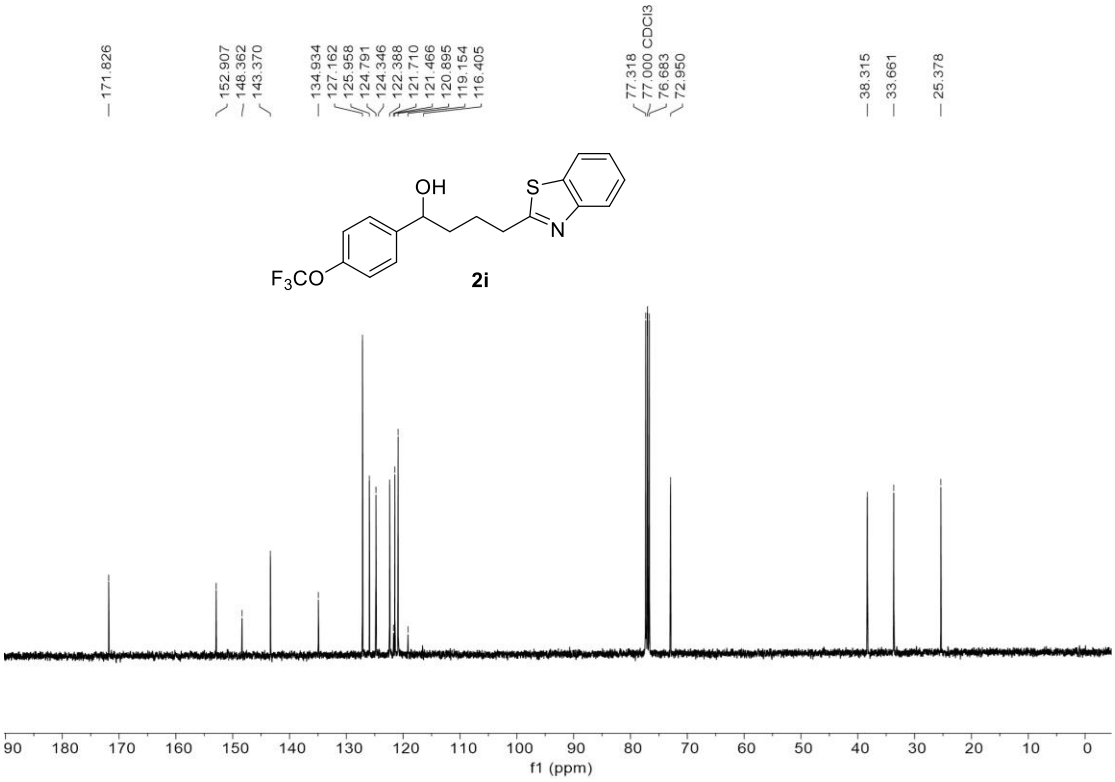
OH
S
N
F3CO
2i
f1 (ppm)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120.895
119.154
116.405
77.318
77.000 CDCl3
76.683
72.950
38.315
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OH
S
N
F3CO
2i
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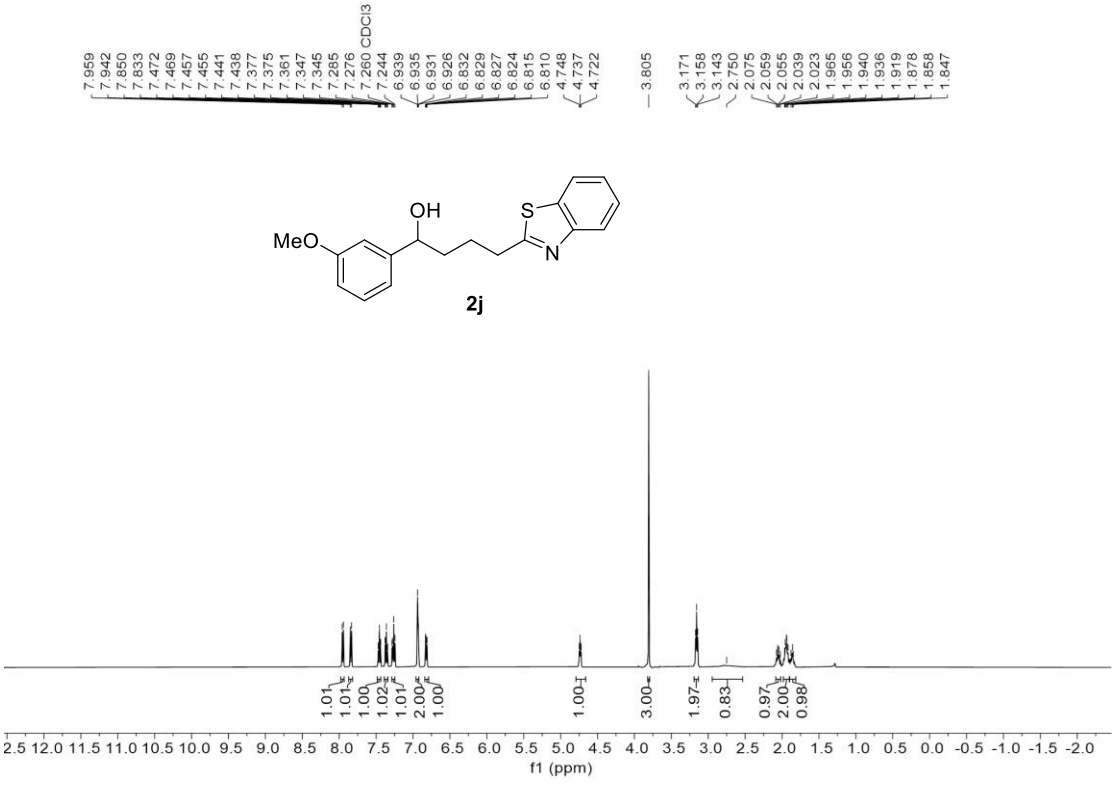
f1 (ppm)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7.455
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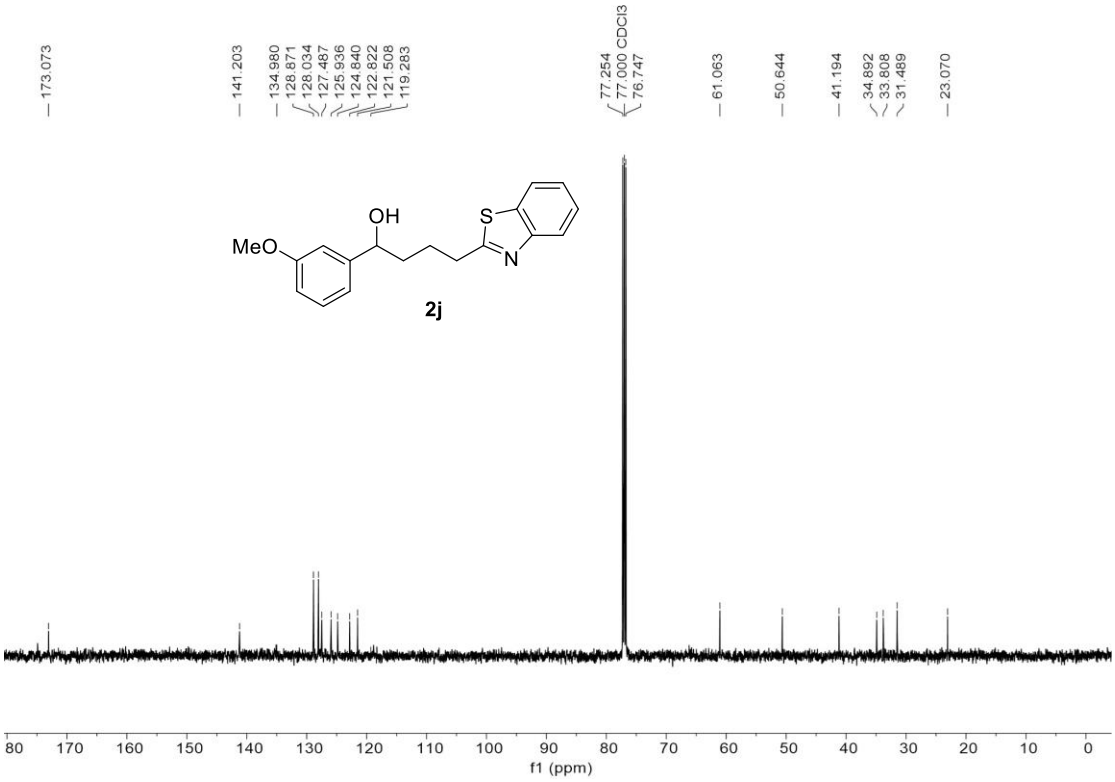
7.375
7.361
7.347
7.345
7.285
7.276
7.260 CDCl3
7.244
6.939
6.935
6.931
6.926
6.832
6.829
6.827
6.824
6.815
6.810
4.748
4.737
4.722
3.805
3.171
3.158
3.143
2.750
2.075
2.059
2.055
2.039
2.023
1.965
1.956
1.940
1.936
1.919
1.878
1.858
1.847
OH
S
N
MeO
2j
1.01
1.01
1.00
1.02
1.01
2.00
1.00
1.00
3.00
1.97
0.83
0.97
2.00
0.98
2.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0 -1.5 -2.0
f1 (ppm)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77.254
77.000 CDCl3
76.747
61.063
50.644
41.194
34.892
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23.070
OH
S
MeO
N
2j
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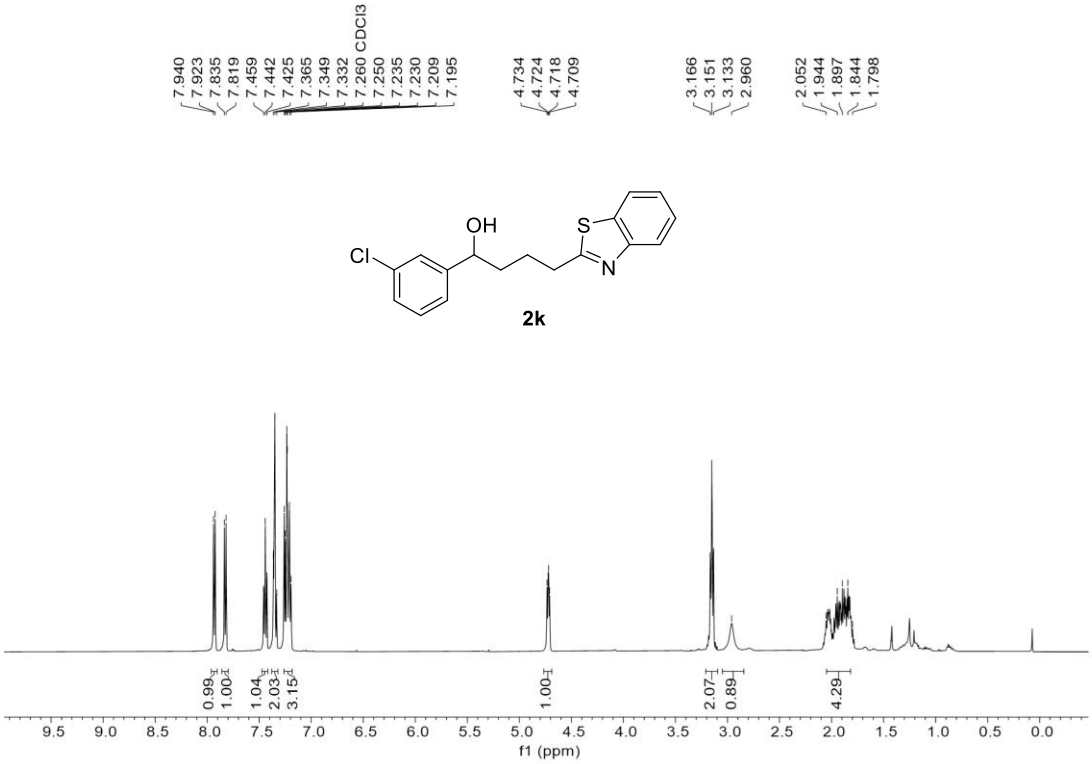
f1 (ppm)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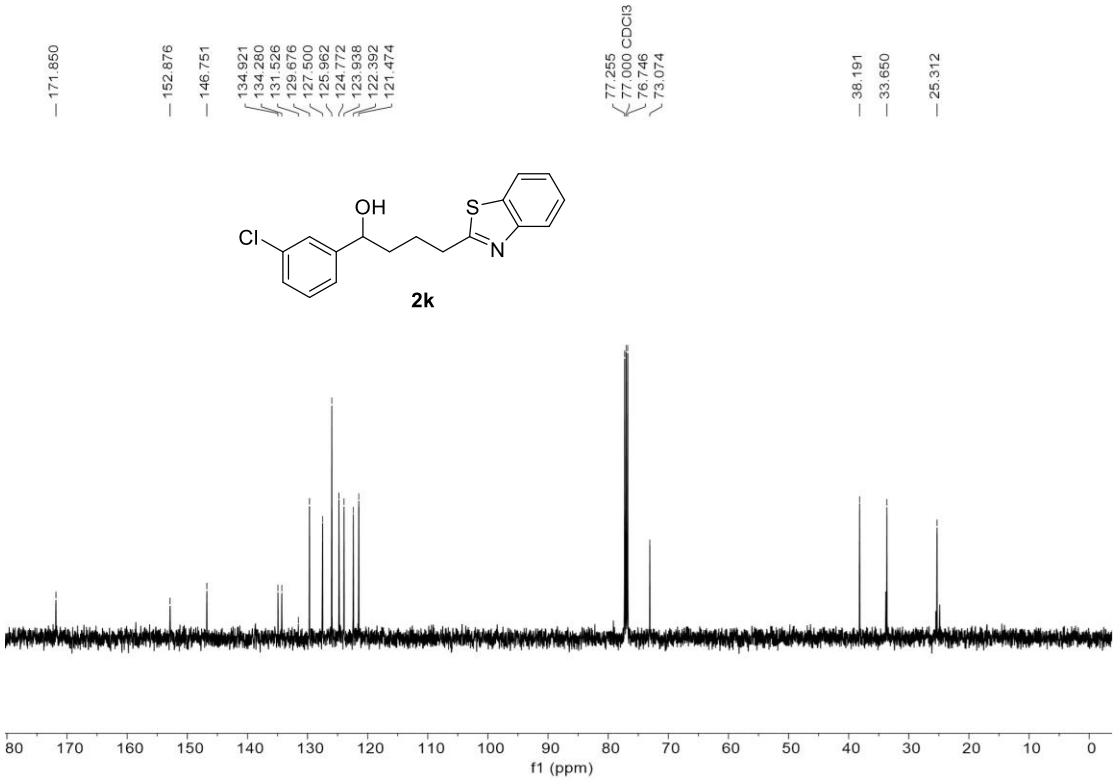
7.442
7.425
7.365
7.349
7.332
7.260 CDCl3
7.250
7.235
7.230
7.209
7.195
4.734
4.724
4.718
4.709
3.166
3.151
3.133
2.960
2.052
1.944
1.897
1.844
1.798
OH
S
Cl
N
2k
0.99
1.00
1.04
2.03
3.15
1.00
2.07
0.89
4.29
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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146.751
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127.500
125.962
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123.938
122.392
121.474
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76.746
73.074
38.191
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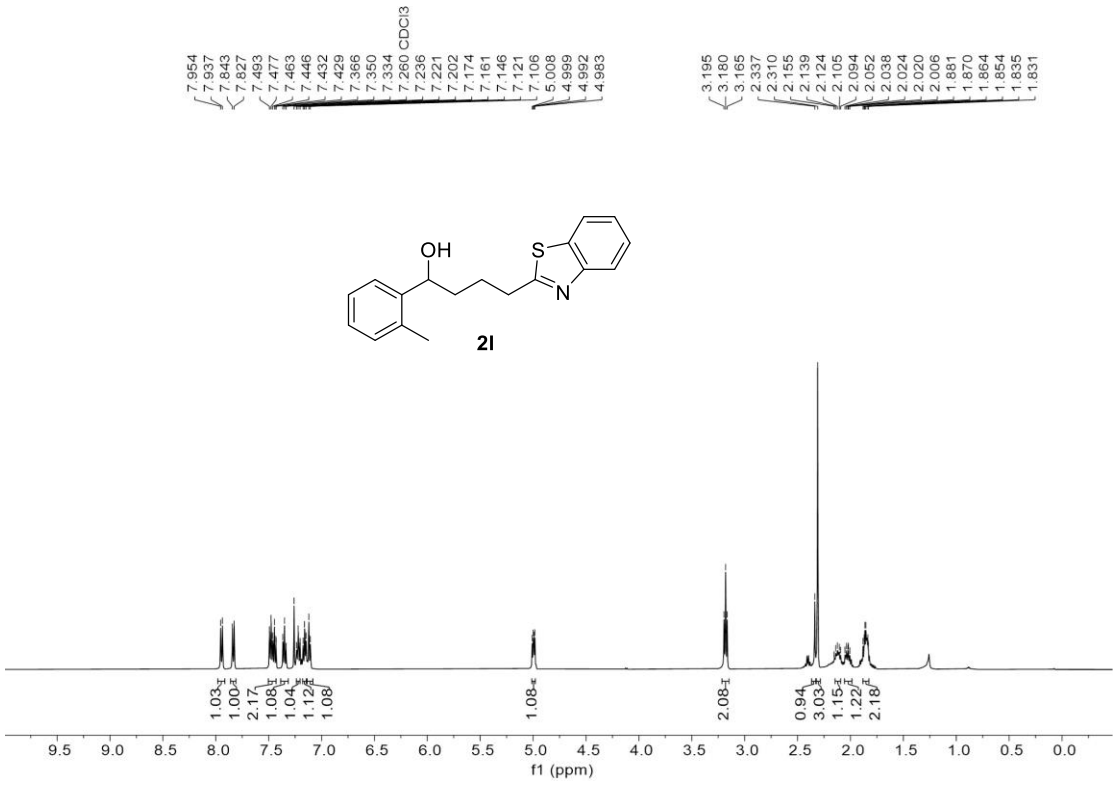
OH
S
Cl
N
2k
f1 (ppm)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7.477
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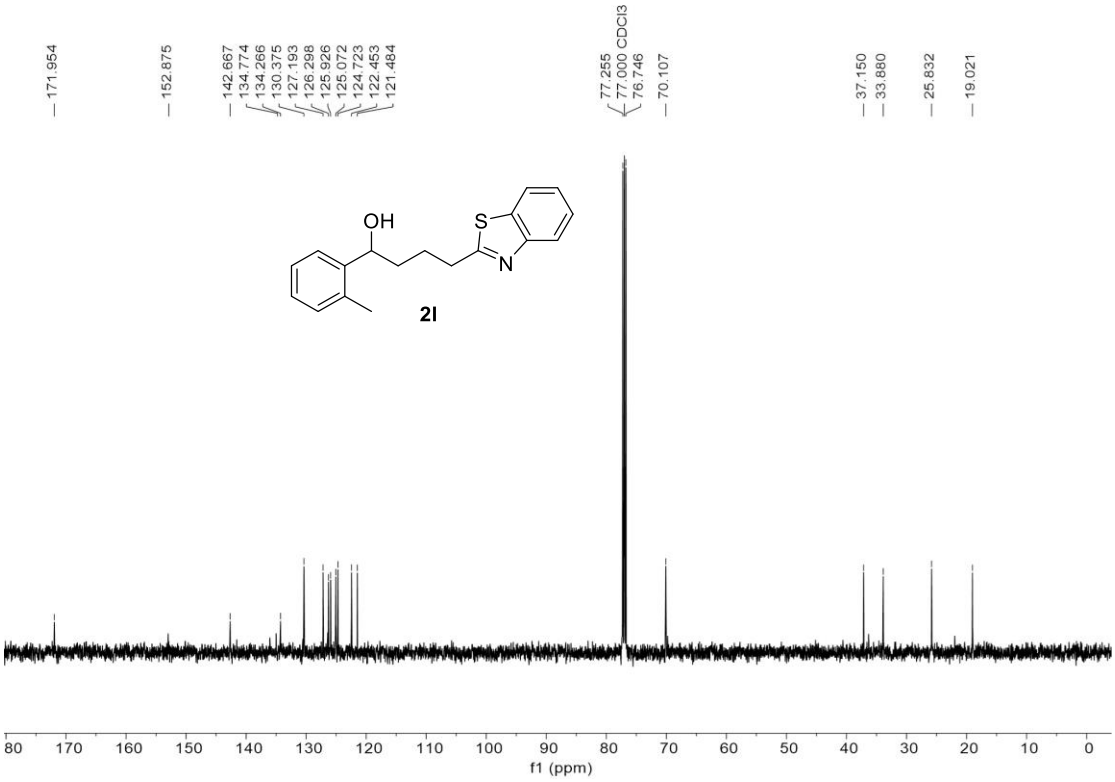
7.446
7.432
7.429
7.366
7.350
7.334
7.260 CDCl3
7.236
7.221
7.202
7.174
7.161
7.146
7.121
7.106
5.008
4.999
4.992
4.983
3.195
3.180
3.165
2.337
2.310
2.155
2.139
2.124
2.105
2.094
2.052
2.038
2.024
2.020
2.006
1.881
1.870
1.864
1.854
1.835
1.831
OH
S
N
2l
1.03
1.00
2.17
1.08
1.04
1.12
1.08
1.08
2.08
0.94
3.03
1.15
1.22
2.18
f1 (ppm)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152.875
142.667
134.774
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130.375
127.193
126.298
125.926
125.072
124.723
122.453
121.484
77.255
77.000 CDCl3
76.746
70.107
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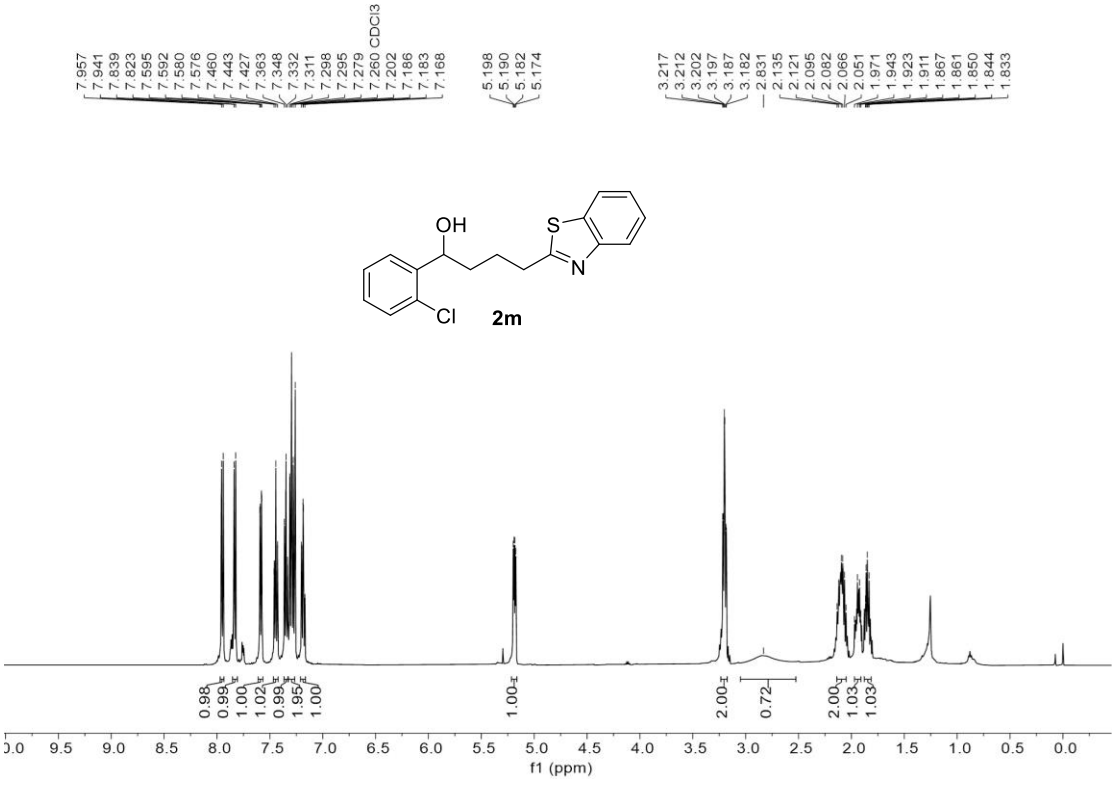
25.832
19.021
OH
S
N
2l
f1 (ppm)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7.839
7.823
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7.592
7.580
7.576
7.460
7.443
7.427
7.363
7.348
7.332
7.311
7.298
7.295
7.279
7.260 CDCl3
7.202
7.186
7.183
7.168
5.198
5.190
5.182
5.174
3.217
3.212
3.202
3.197
3.187
3.182
2.831
2.135
2.121
2.095
2.082
2.066
2.051
1.971
1.943
1.923
1.911
1.867
1.861
1.850
1.844
1.833
OH
S
N
Cl
2m
0.98
0.99
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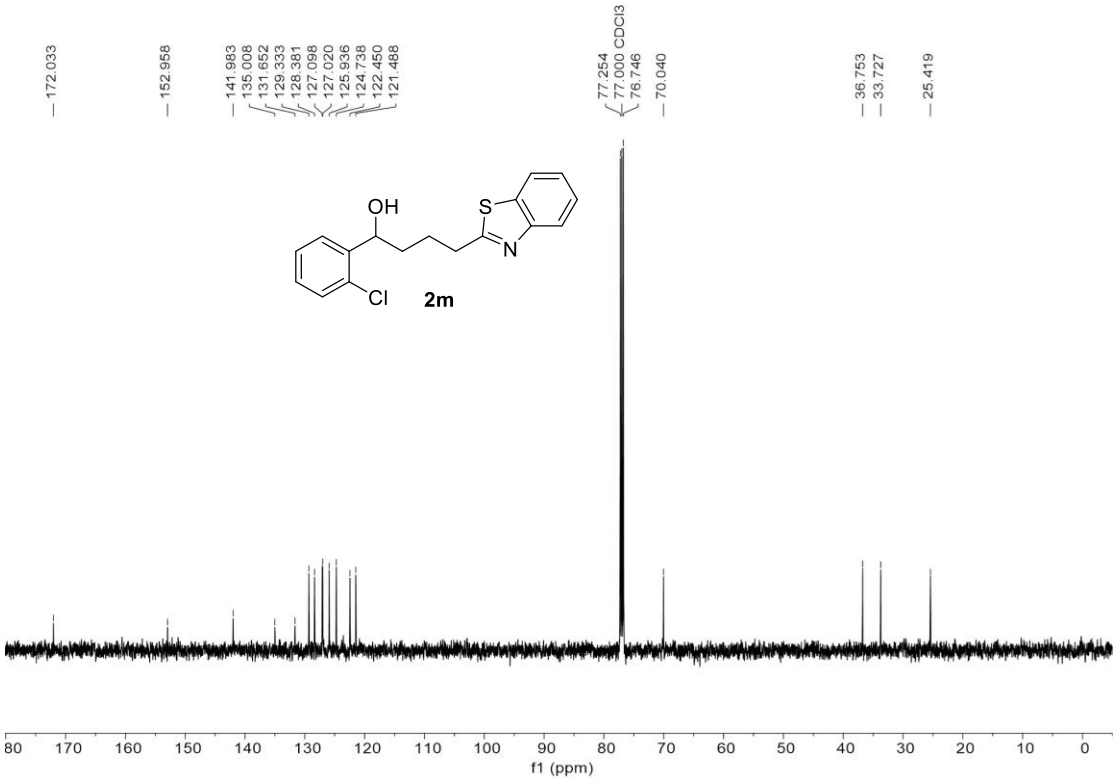
1.95
1.00
1.00
2.00
0.72
2.00
1.03
1.03
f1 (ppm)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122.450
121.488
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36.753
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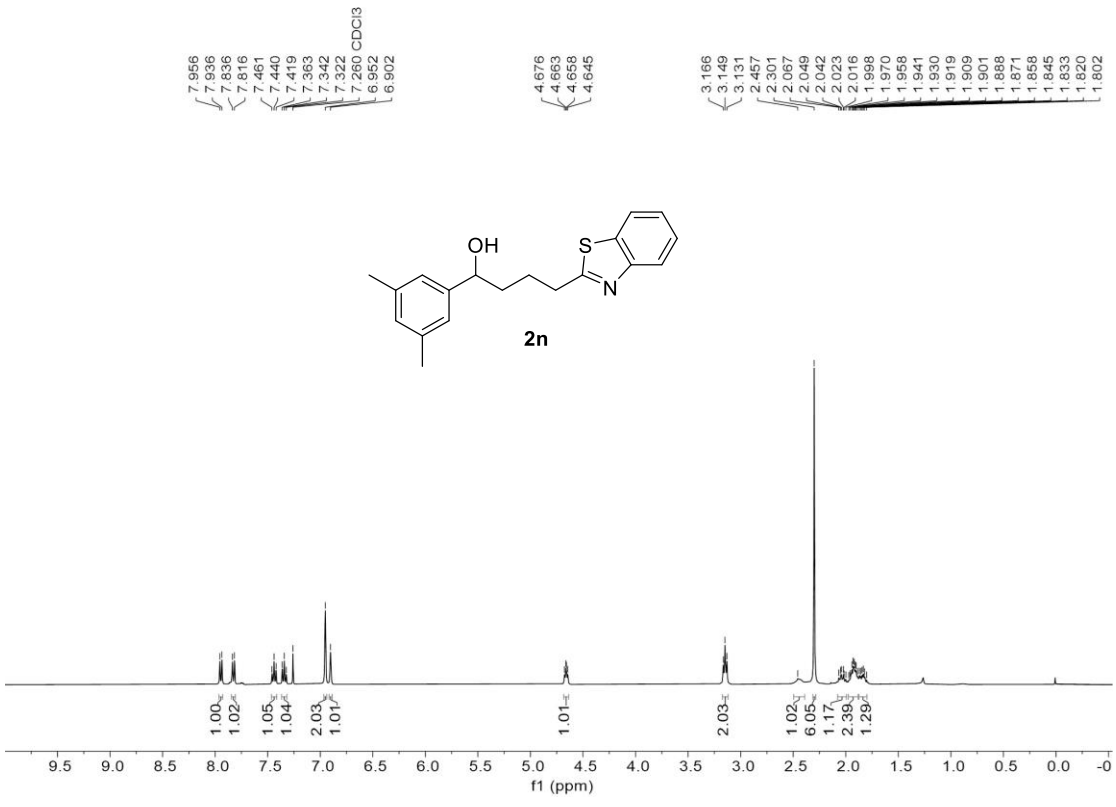
OH
S
N
Cl
2m
f1 (ppm)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7.816
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7.419
7.363
7.342
7.322
7.260 CDCl3
6.952
6.902
4.676
4.663
4.658
4.645
3.166
3.149
3.131
2.457
2.301
2.067
2.049
2.042
2.023
2.016
1.998
1.970
1.958
1.941
1.930
1.919
1.909
1.901
1.888
1.871
1.858
1.845
1.833
1.820
1.802
OH
S
N
2n
1.00
1.02
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2.03
1.01
1.01
2.03
1.02
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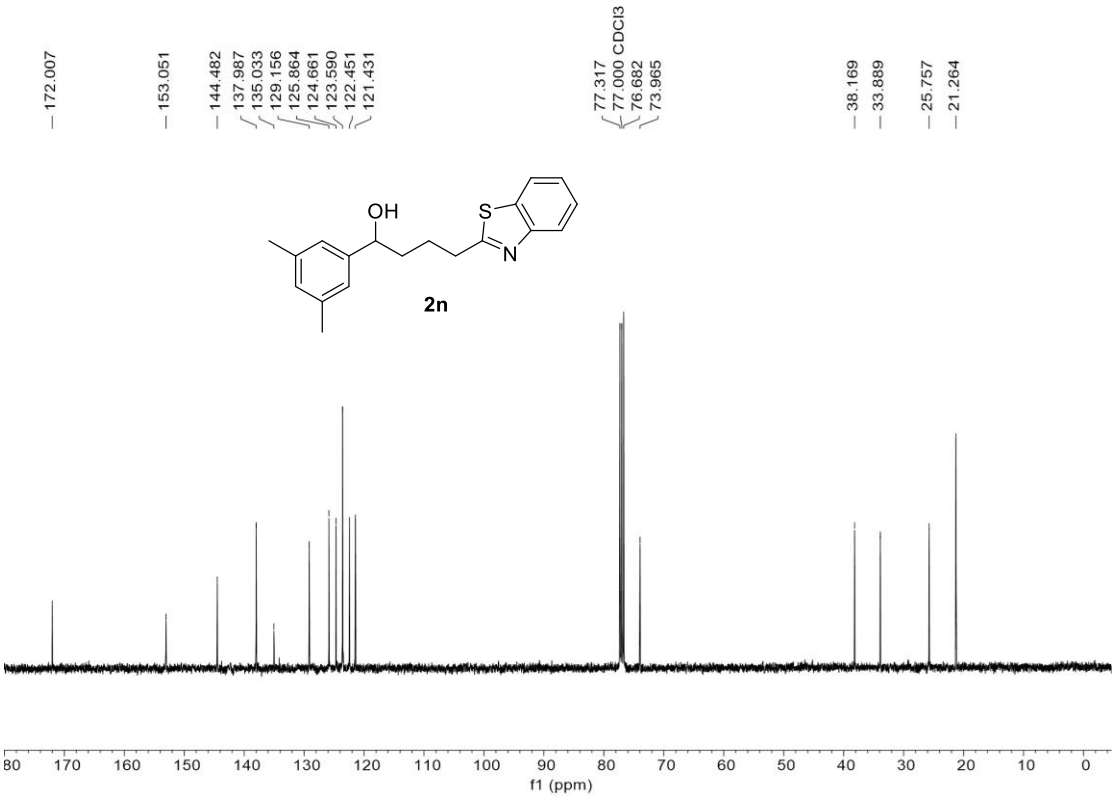
2.39
1.29
f1 (ppm)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137.987
135.033
129.156
125.864
124.661
123.590
122.451
121.431
77.317
77.000 CDCl3
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73.965
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33.889
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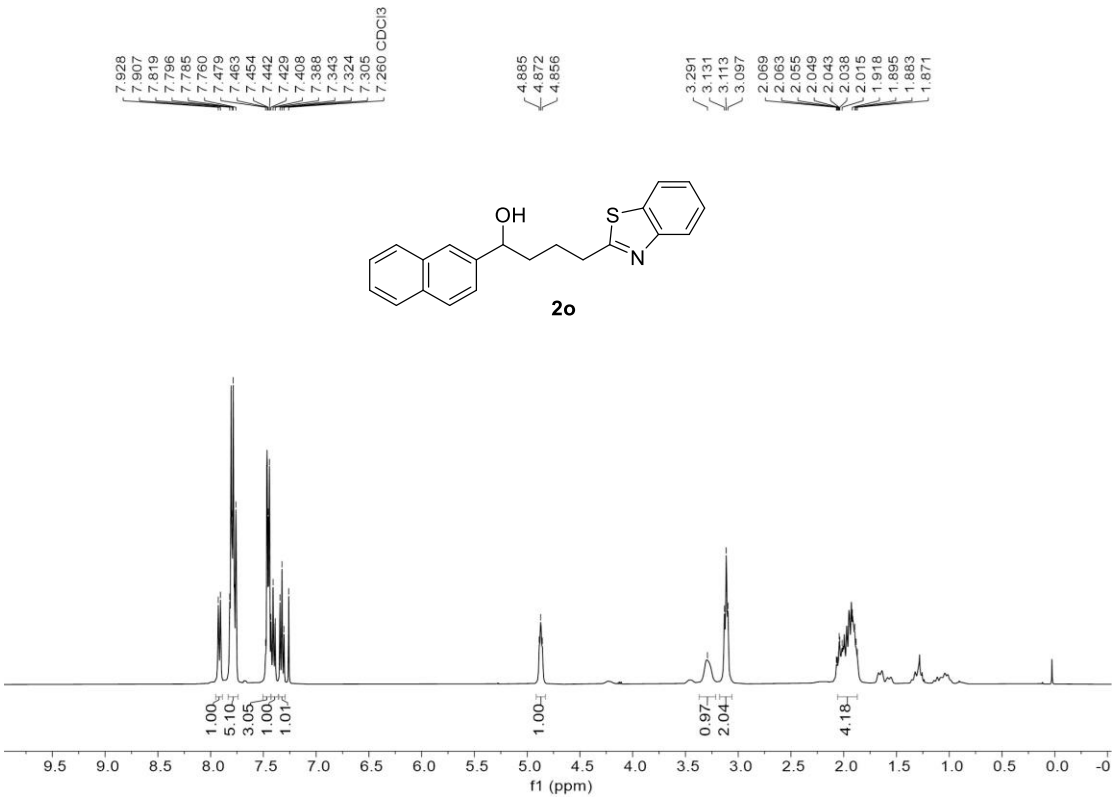
21.264
OH
S
N
2n
f1 (ppm)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7.463
7.454
7.442
7.429
7.408
7.388
7.343
7.324
7.305
7.260 CDCl3
4.885
4.872
4.856
3.291
3.131
3.113
3.097
2.069
2.063
2.055
2.049
2.043
2.038
2.015
1.918
1.895
1.883
1.871
OH
S
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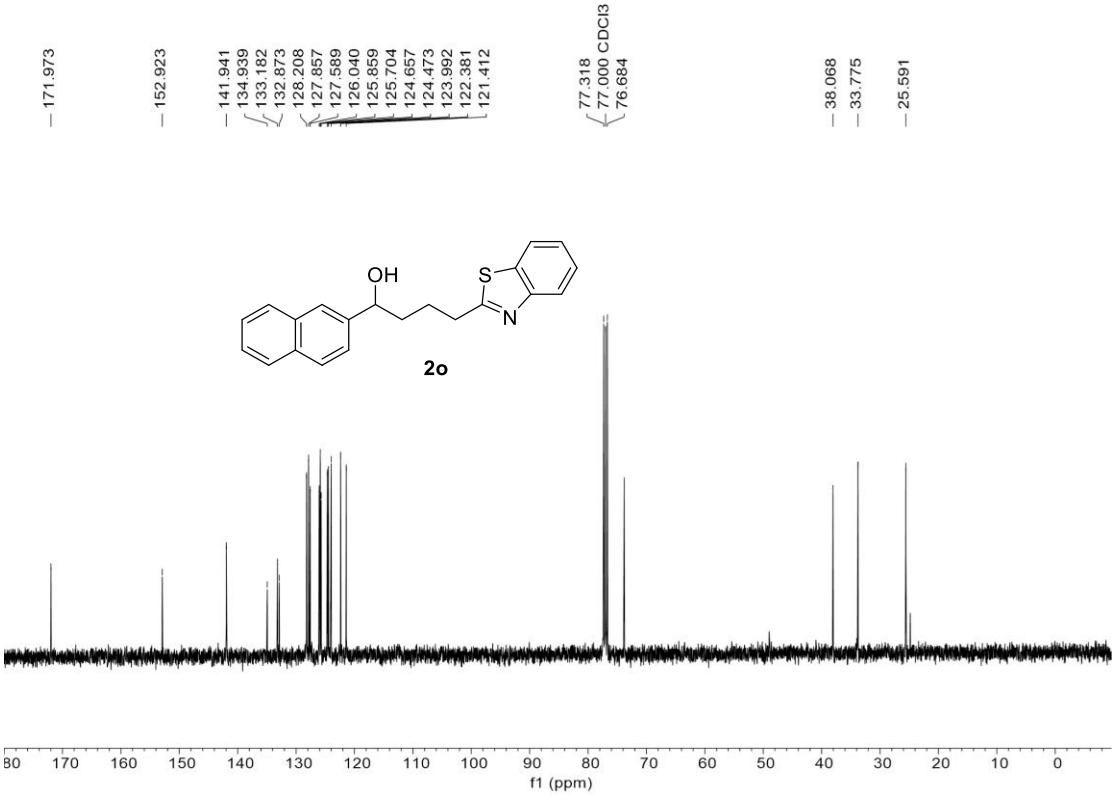
f1 (ppm)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127.589
126.040
125.859
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124.657
124.473
123.992
122.381
121.412
77.318
77.000 CDCl3
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38.068
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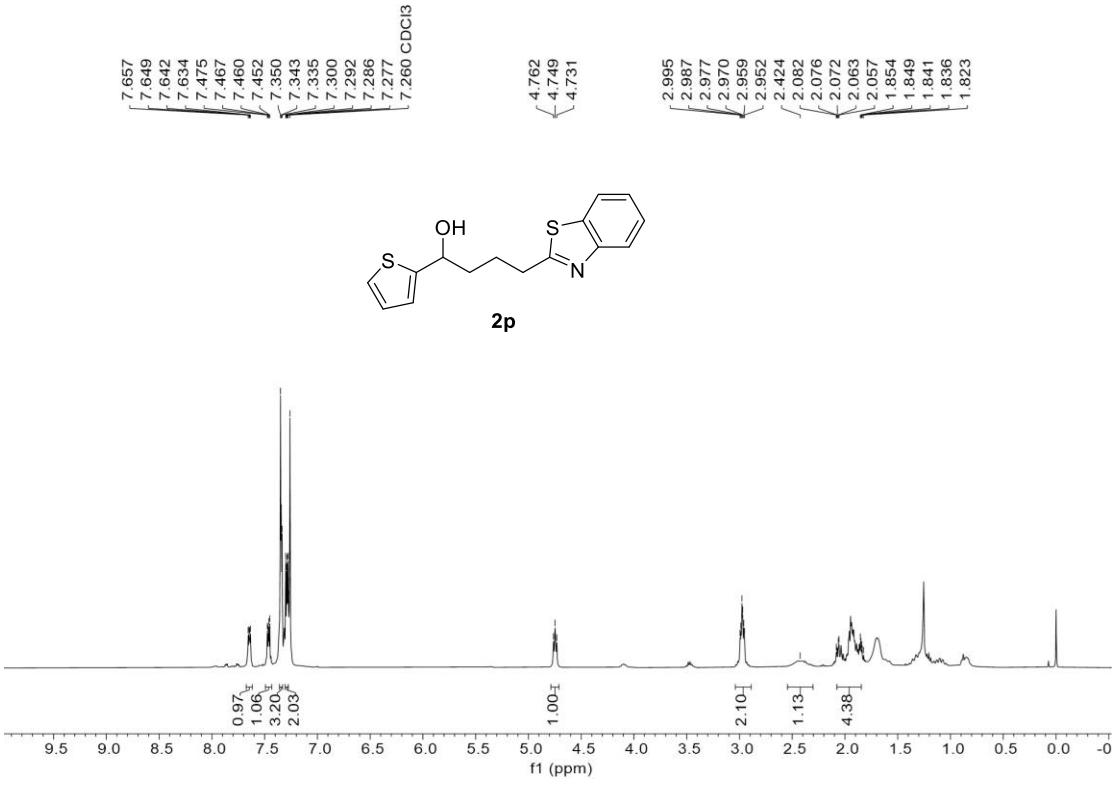
OH
S
N
2o
f1 (ppm)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7.286
7.277
7.260 CDCl3
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4.749
4.731
2.995
2.987
2.977
2.970
2.959
2.952
2.424
2.082
2.076
2.072
2.063
2.057
1.854
1.849
1.841
1.836
1.823
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N
2p
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3.20
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1.00
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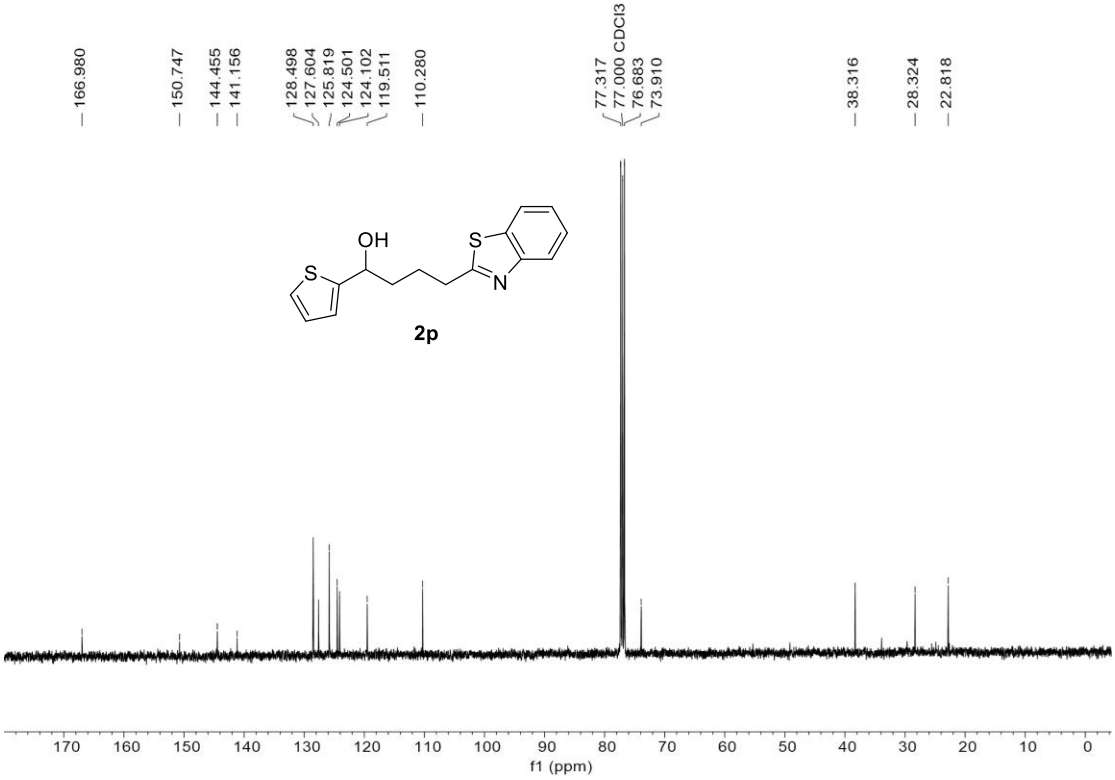
4.38
f1 (ppm)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119.511
110.280
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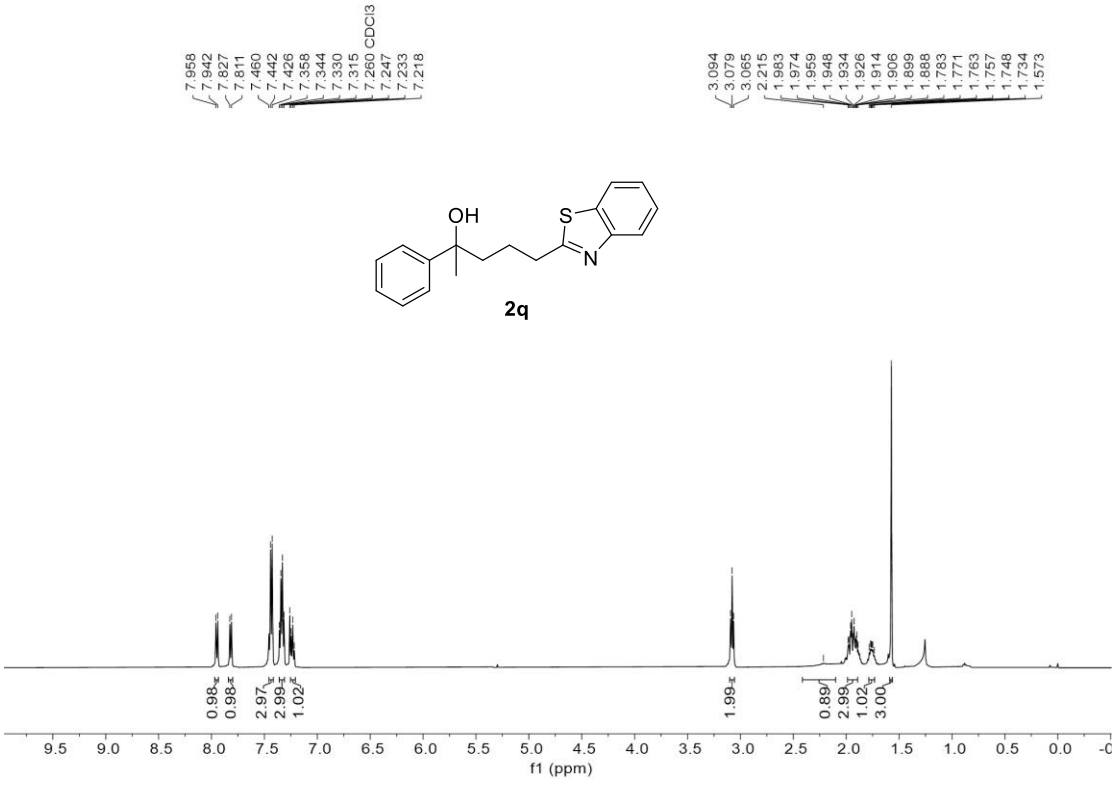
77.000 CDCl3
76.683
73.910
38.316
28.324
22.818
OH
S
S
N
2p
f1 (ppm)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7.426
7.358
7.344
7.330
7.315
7.260 CDCl3
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7.233
7.218
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3.079
3.065
2.215
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1.974
1.959
1.948
1.934
1.926
1.914
1.906
1.899
1.888
1.783
1.771
1.763
1.757
1.748
1.734
1.573
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S
N
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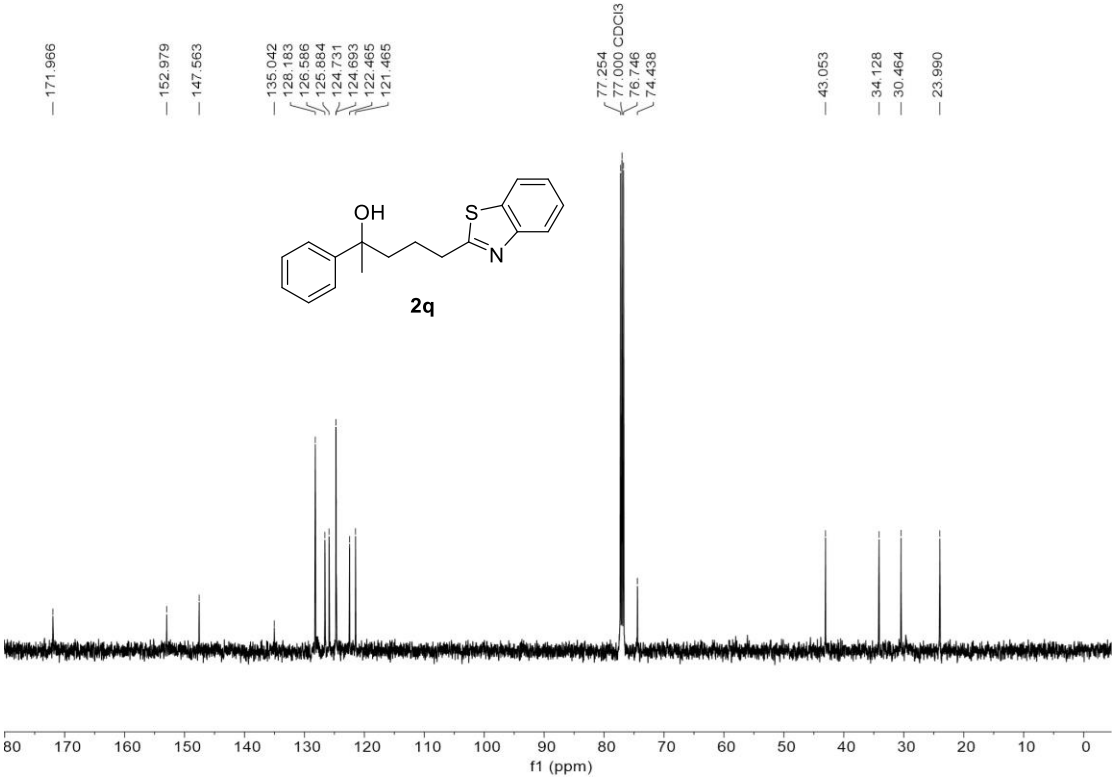
f1 (ppm)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124.731
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122.465
121.465
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74.438
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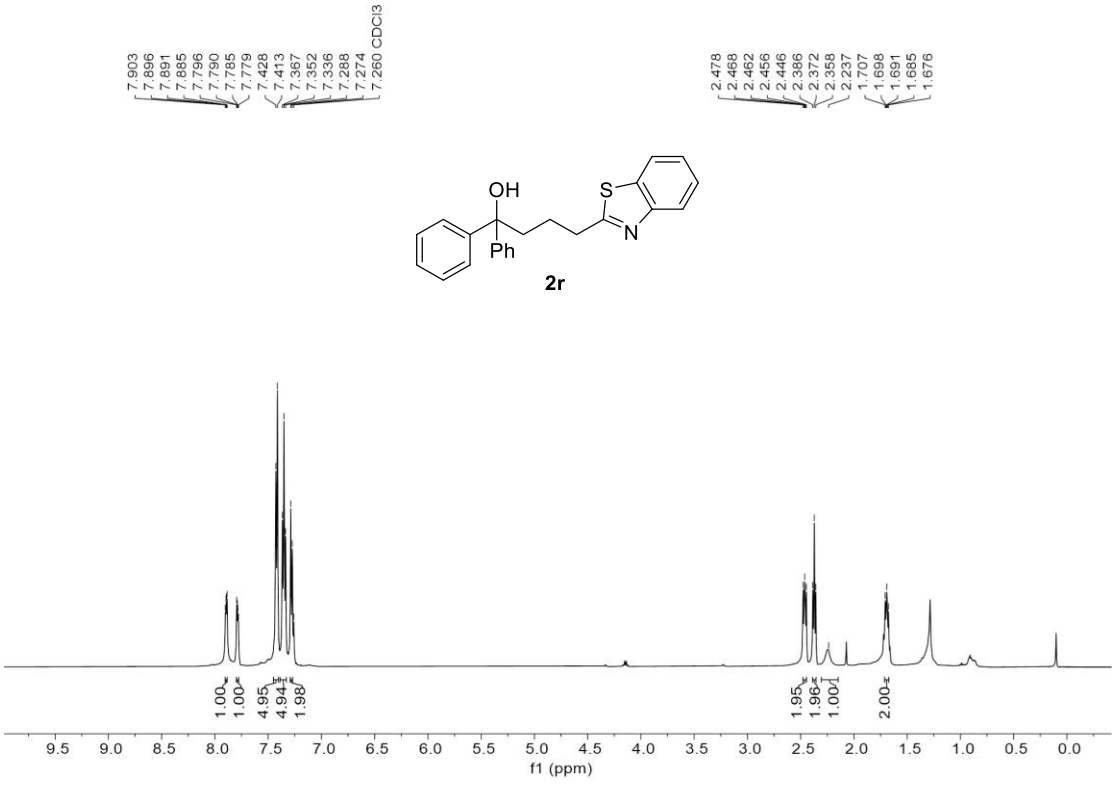
30.464
23.990
OH
S
N
2q
f1 (ppm)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7.336
7.288
7.274
7.260 CDCl3
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2.462
2.456
2.446
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2.358
2.237
1.707
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1.691
1.685
1.676
OH
S
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Ph
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1.00
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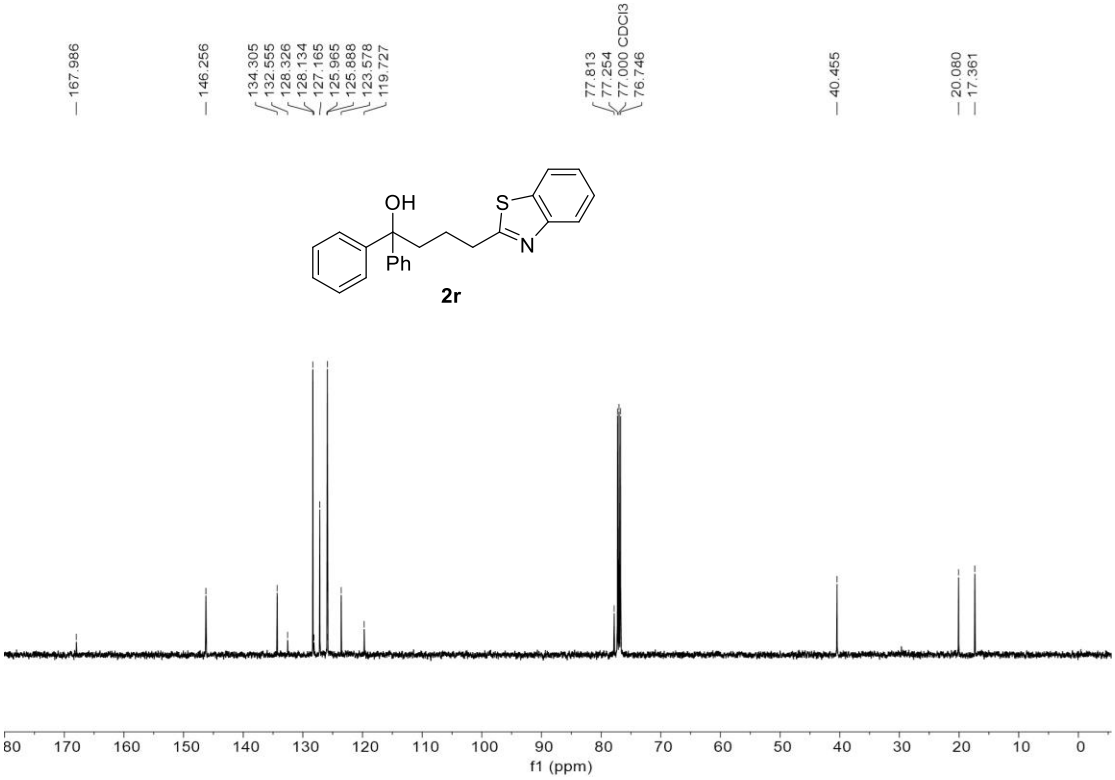
1.98
1.95
1.96
1.00
2.00
f1 (ppm)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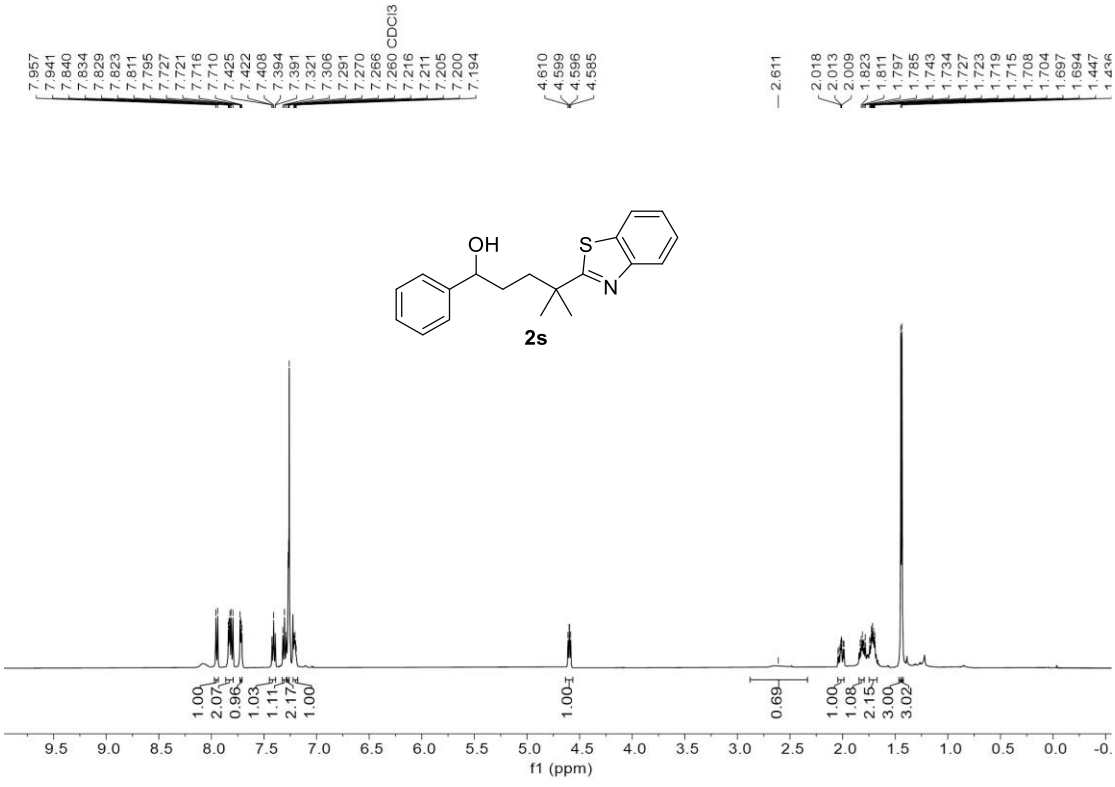
S
N
Ph
2r
f1 (ppm)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7.710
7.425
7.422
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7.291
7.270
7.266
7.260 CDCl3
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7.205
7.200
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4.596
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2.013
2.009
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1.811
1.797
1.785
1.743
1.734
1.727
1.723
1.719
1.715
1.708
1.704
1.697
1.694
1.447
OH
S
N
2s
1.00
2.07
0.96
1.03
1.11
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1.00
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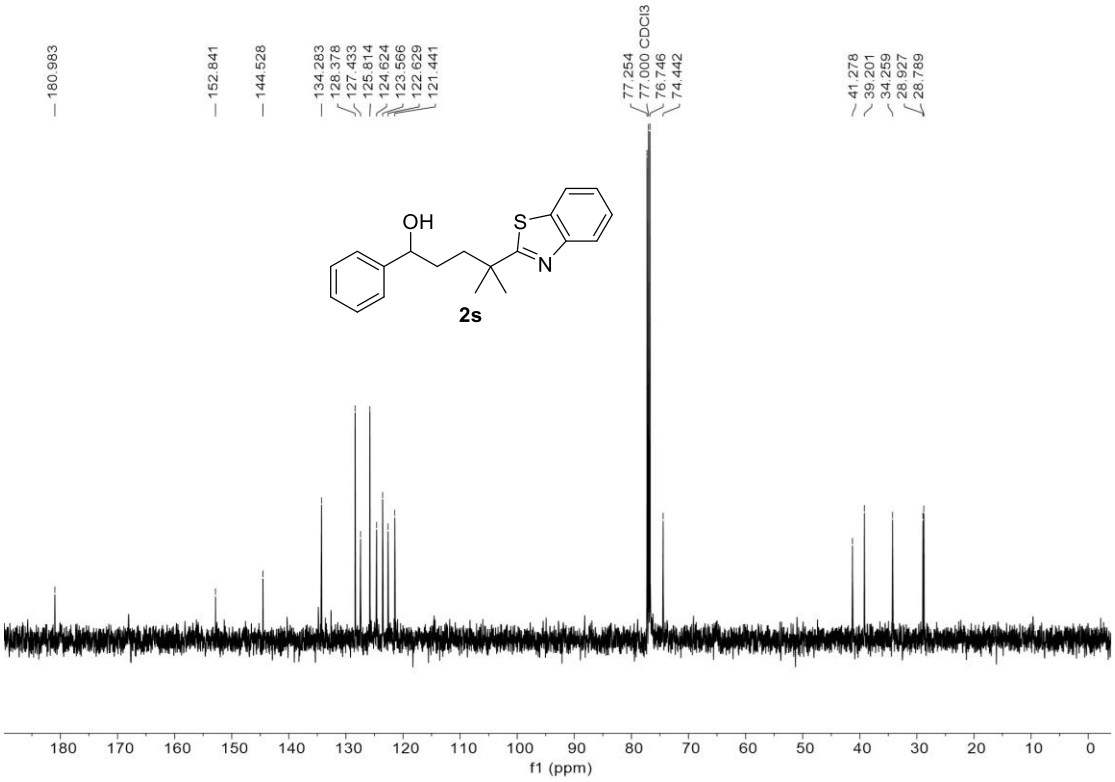
3.00
3.02
f1 (ppm)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125.814
124.624
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122.629
121.441
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77.000 CDCl3
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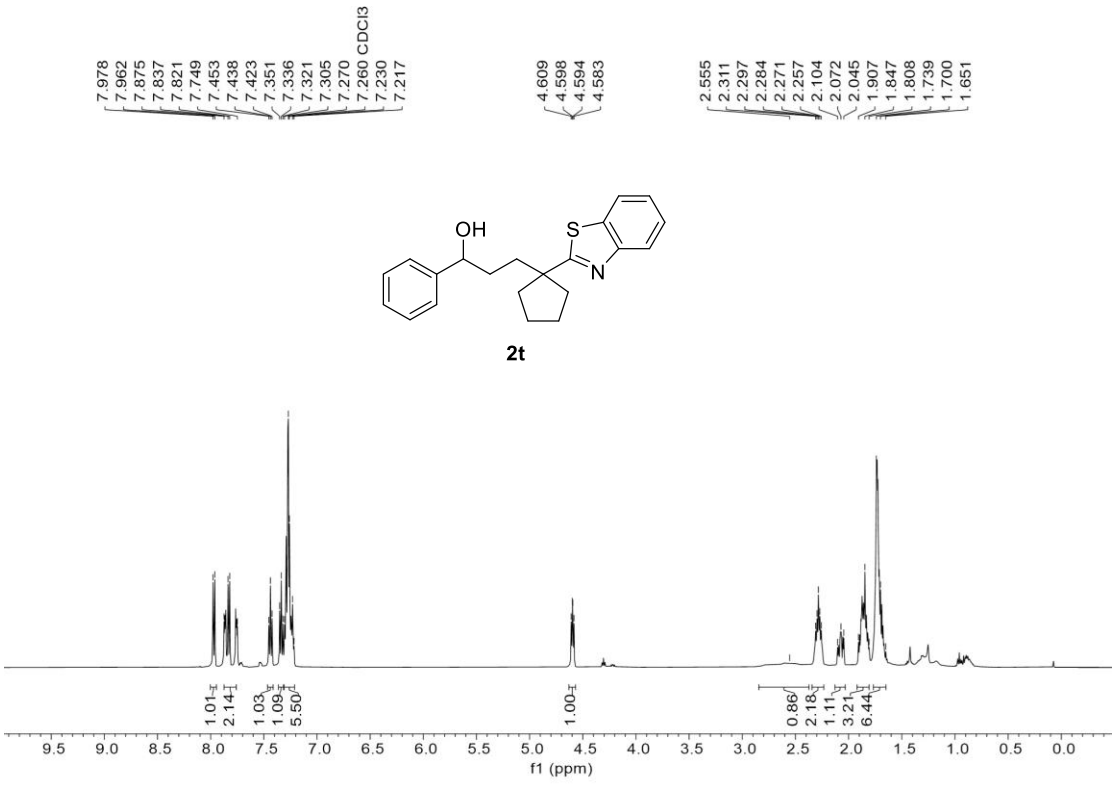
28.789
OH
S
N
2s
f1 (ppm)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7.321
7.305
7.270
7.260 CDCl3
7.230
7.217
4.609
4.598
4.594
4.583
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2.297
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2.271
2.257
2.104
2.072
2.045
1.907
1.847
1.808
1.739
1.700
1.651
OH
S
N
2t
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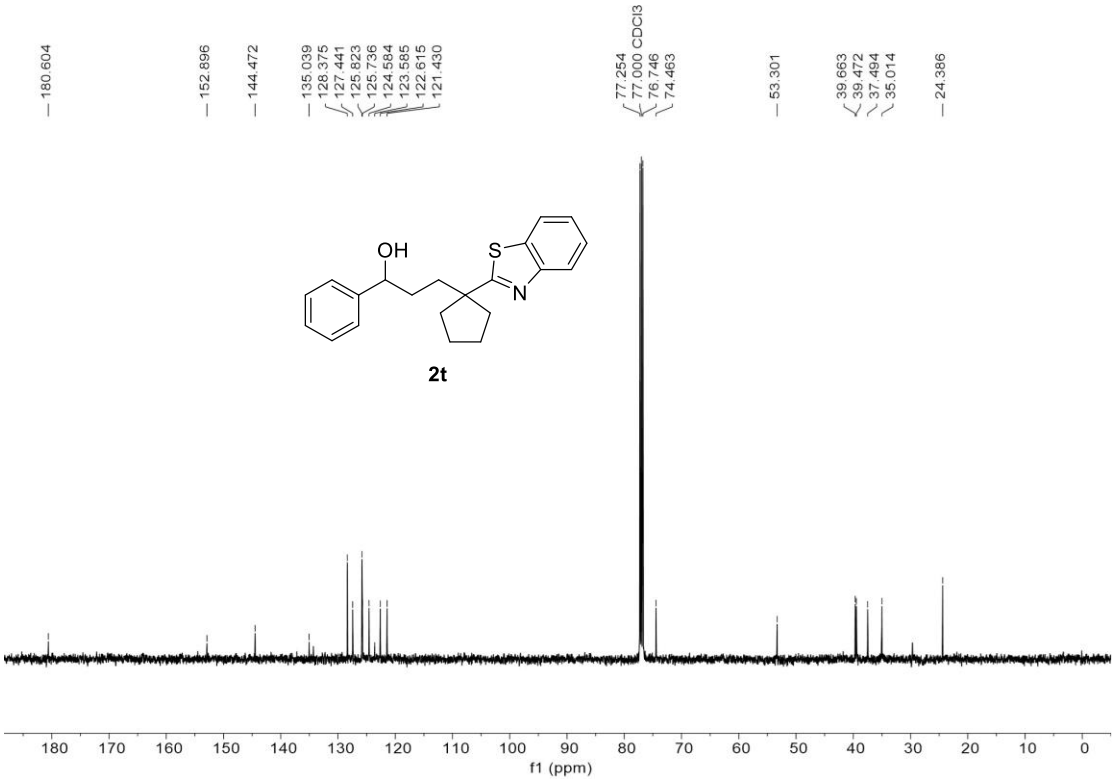
3.21
6.44
f1 (ppm)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135.039
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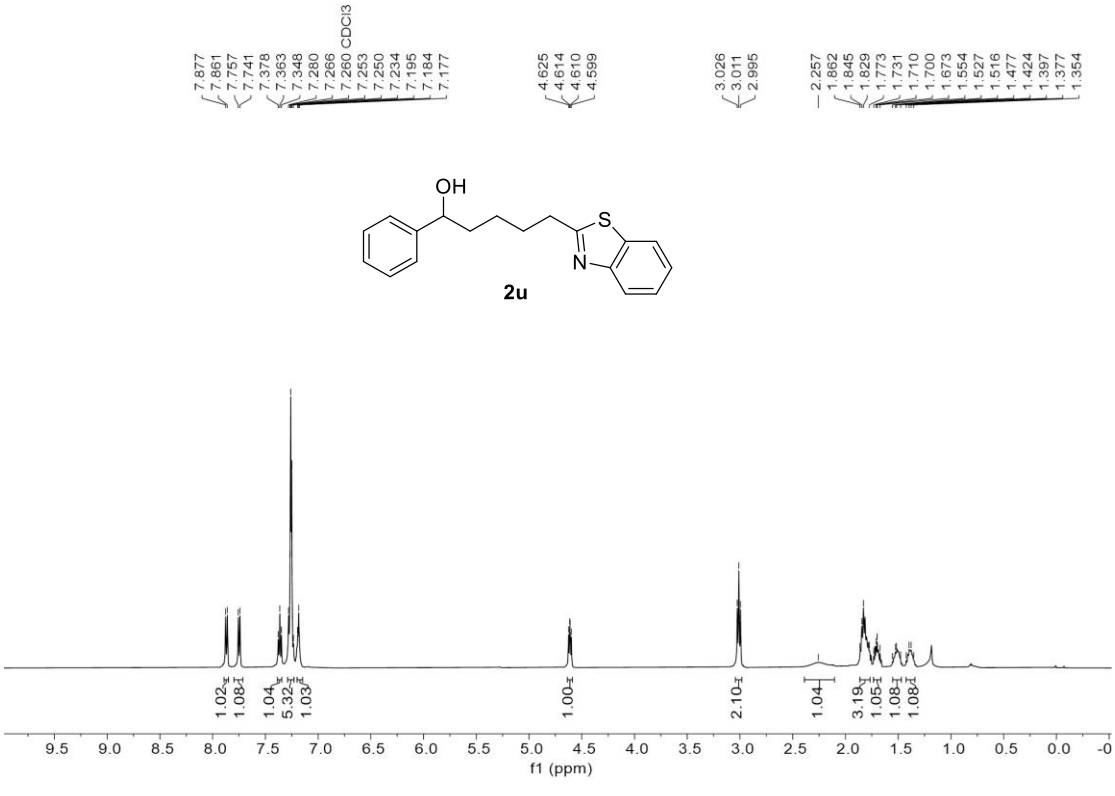
127.441
125.823
125.736
124.584
123.585
122.615
121.430
77.254
77.000 CDCl3
76.746
74.463
53.301
39.663
39.472
37.494
35.014
24.386
OH
S
N
2t
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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7.280
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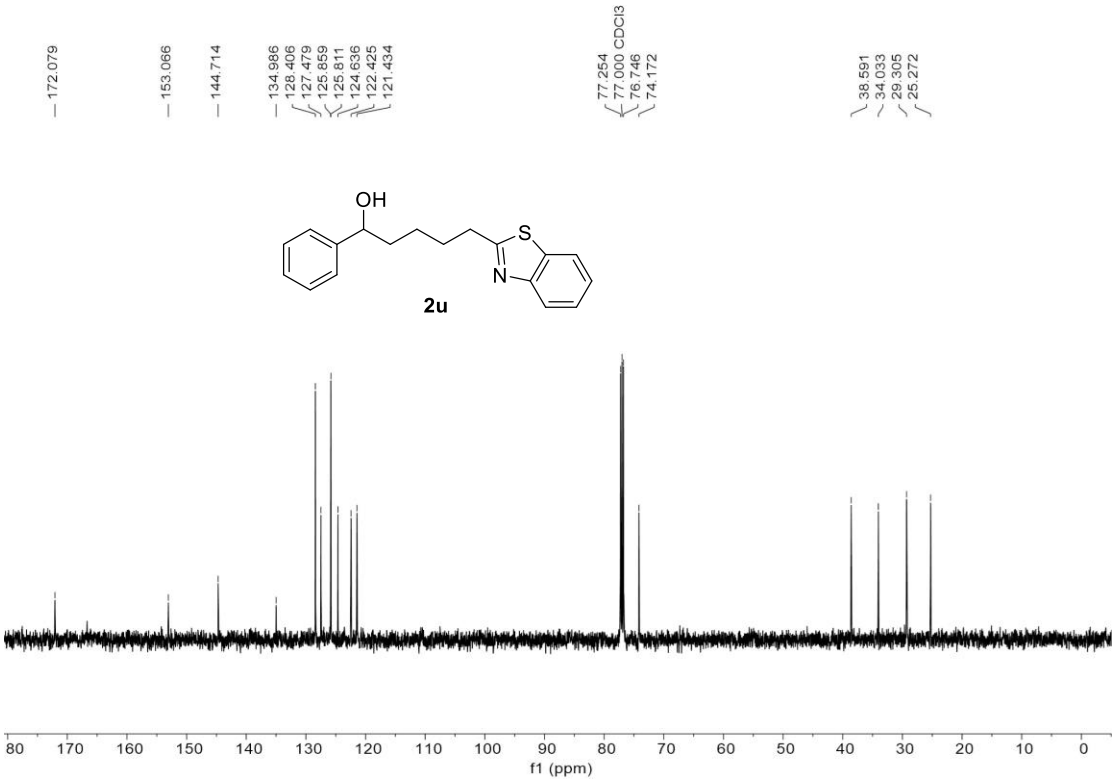
7.195
7.184
7.177
4.625
4.614
4.610
4.599
3.026
3.011
2.995
2.257
1.862
1.845
1.829
1.773
1.731
1.710
1.700
1.673
1.554
1.527
1.516
1.477
1.424
1.397
1.377
1.354
OH
S
N
2u
1.02
1.08
1.04
5.32
1.03
1.00
2.10
1.04
3.19
1.05
1.08
1.08
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)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121.434
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74.172
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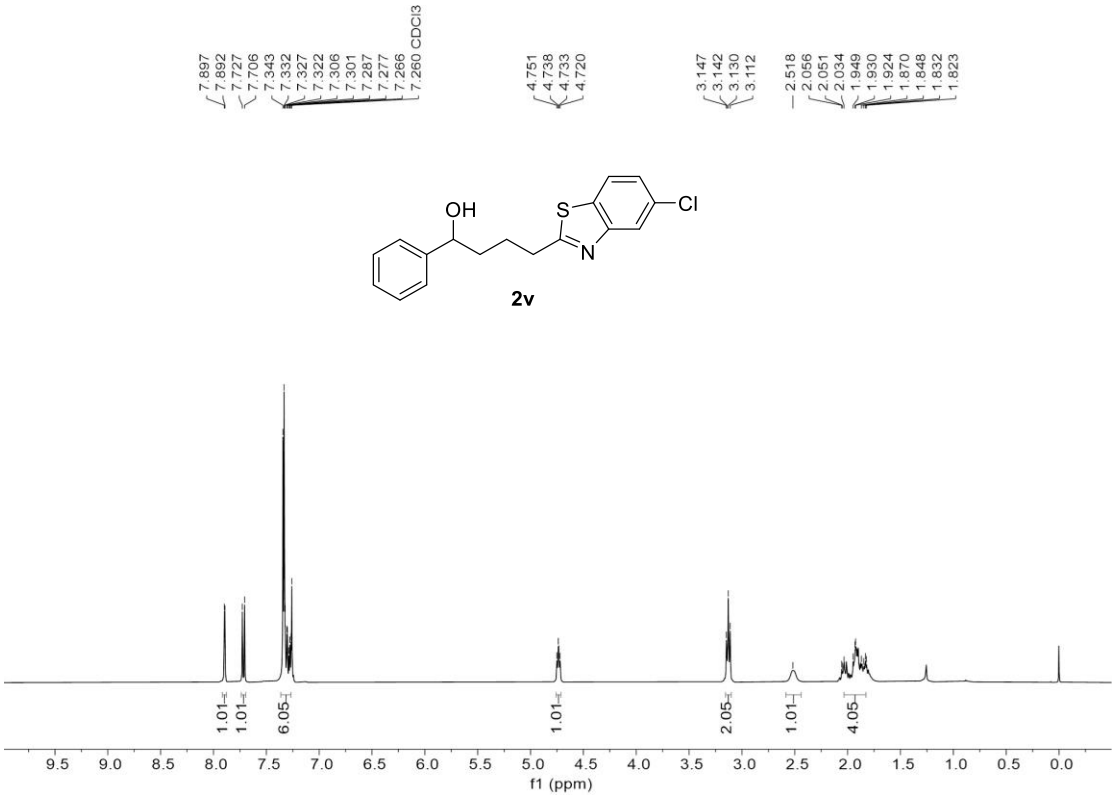
OH
S
N
2u
f1 (ppm)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7.322
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7.301
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7.277
7.266
7.260 CDCl3
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4.733
4.720
3.147
3.142
3.130
3.112
2.518
2.056
2.051
2.034
1.949
1.930
1.924
1.870
1.848
1.832
1.823
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N
Cl
2v
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1.01
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2.05
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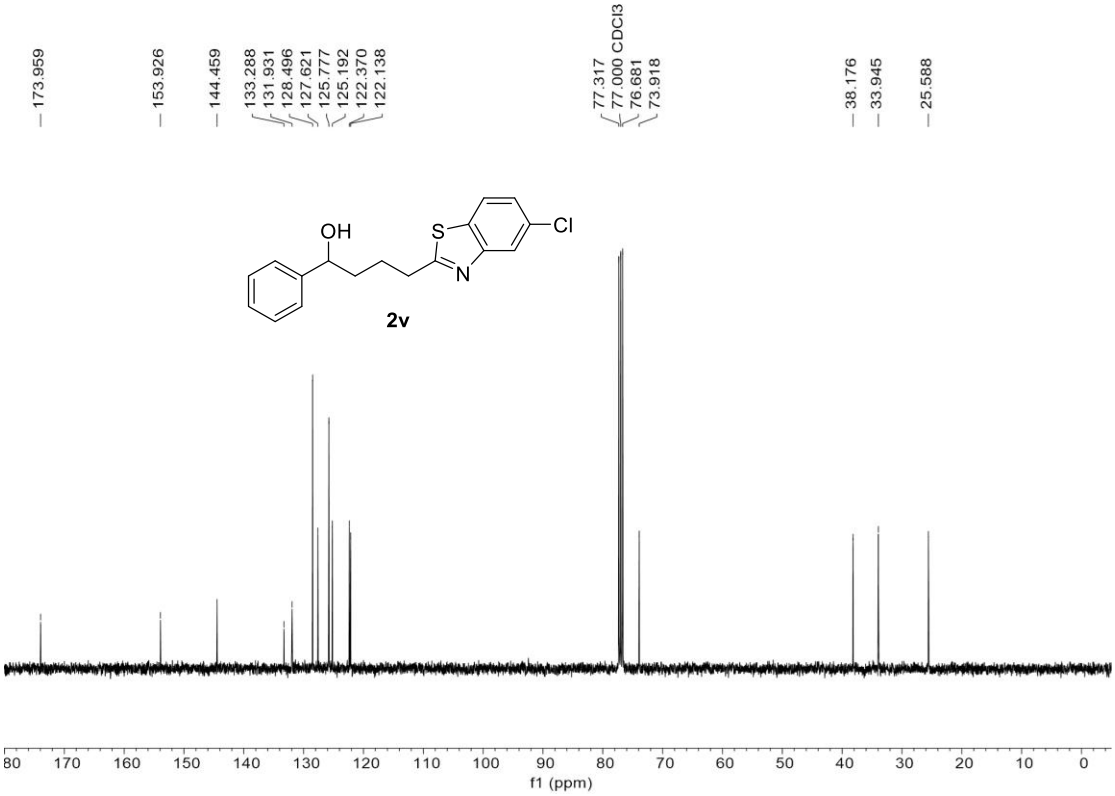
4.05
f1 (ppm)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OH
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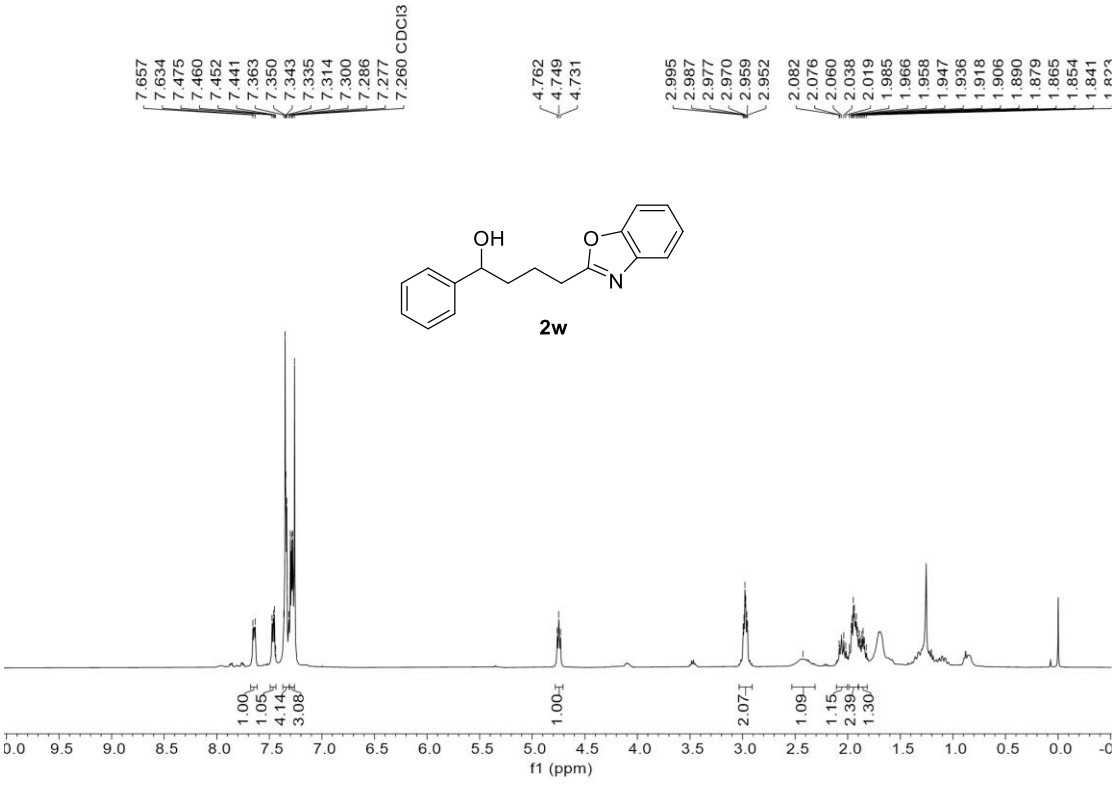
Cl
N
2v
f1 (ppm)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2.952
2.082
2.076
2.060
2.038
2.019
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1.966
1.958
1.947
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1.918
1.906
1.890
1.879
1.865
1.854
1.841
OH
O
N
2w
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3.08
1.00
2.07
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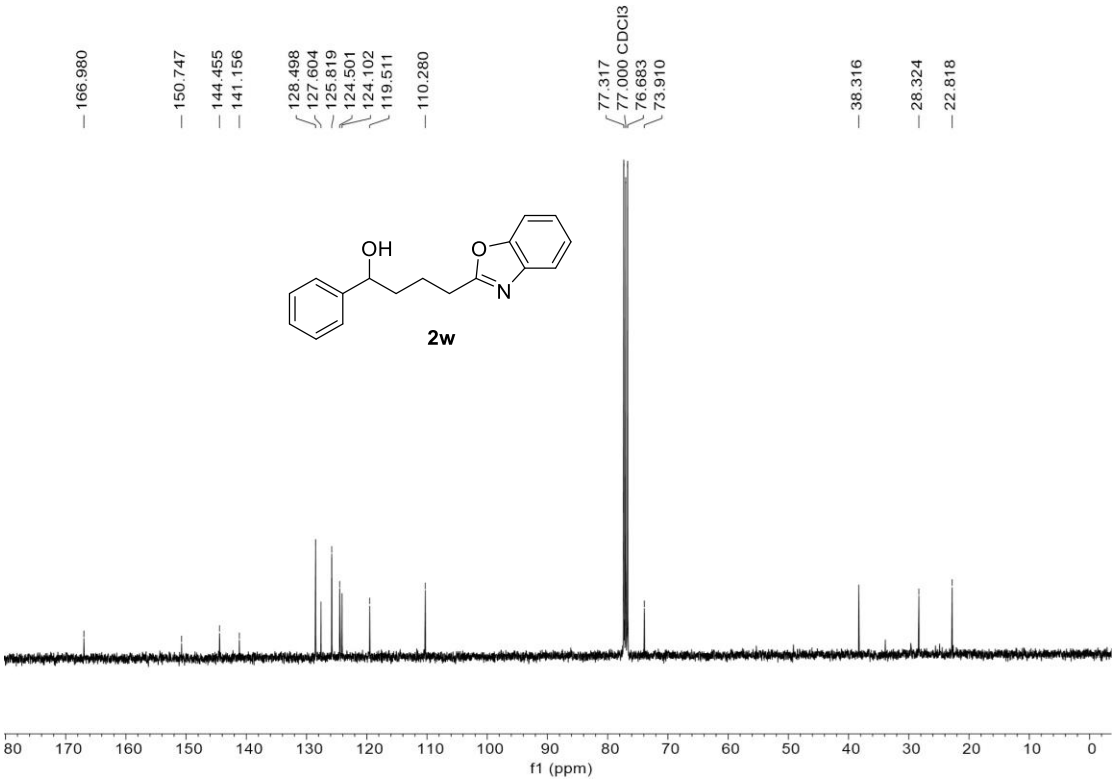
f1 (ppm)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77.000 CDCl3
76.683
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O
N
2w
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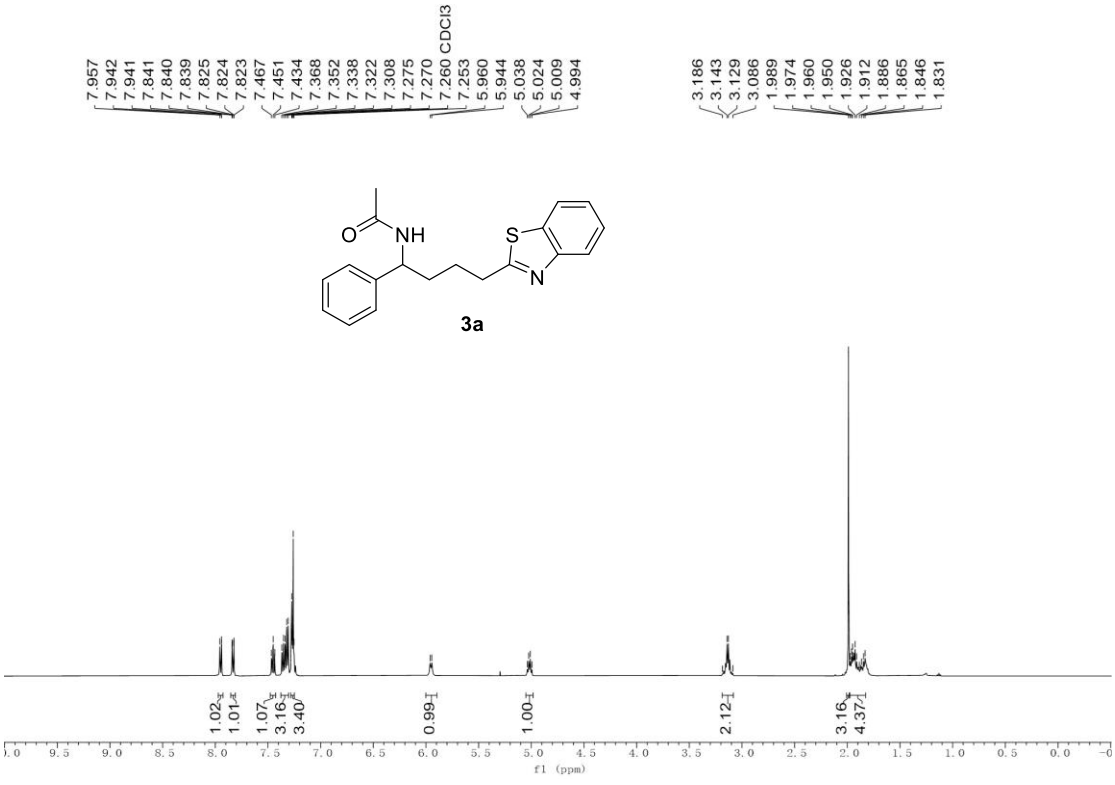
f1 (ppm)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7.823
7.467
7.451
7.434
7.368
7.352
7.338
7.322
7.308
7.275
7.270
7.260 CDCl3
7.253
5.960
5.944
5.038
5.024
5.009
4.994
3.186
3.143
3.129
3.086
1.989
1.974
1.960
1.950
1.926
1.912
1.886
1.865
1.846
1.831
O
NH
S
N
3a
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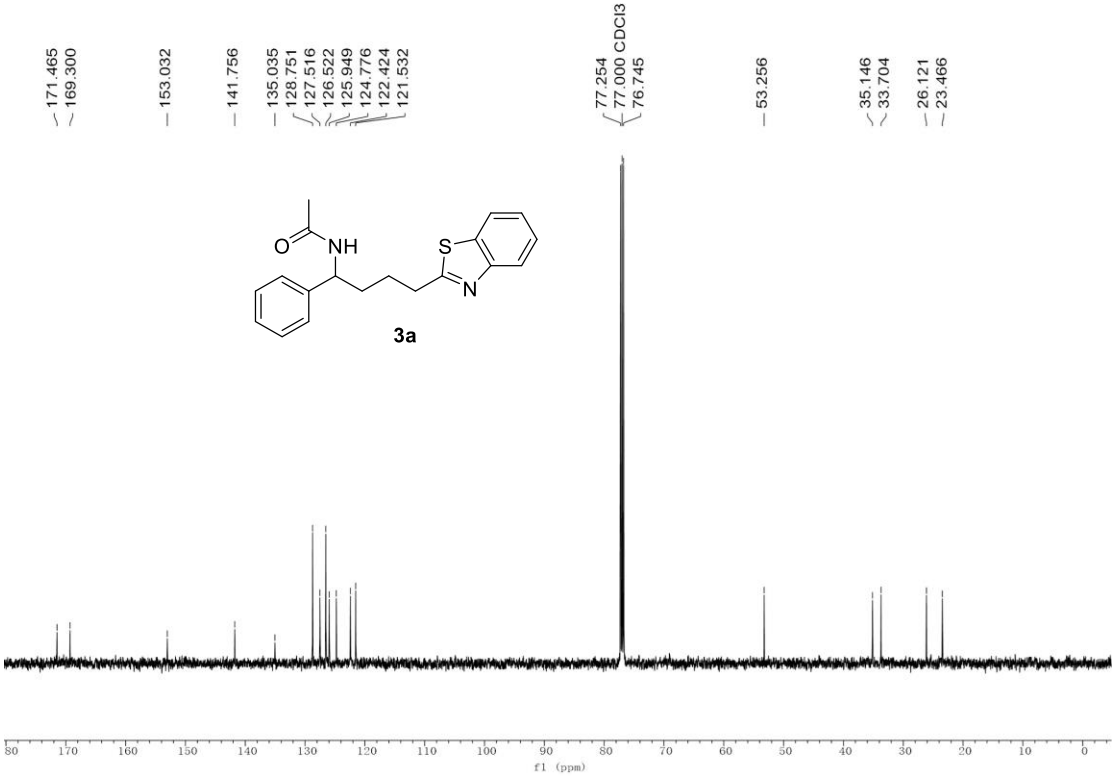
1.01
1.07
3.16
3.40
0.99
1.00
2.12
3.16
4.37
f1 (ppm)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126.522
125.949
124.776
122.424
121.532
77.254
77.000 CDCl3
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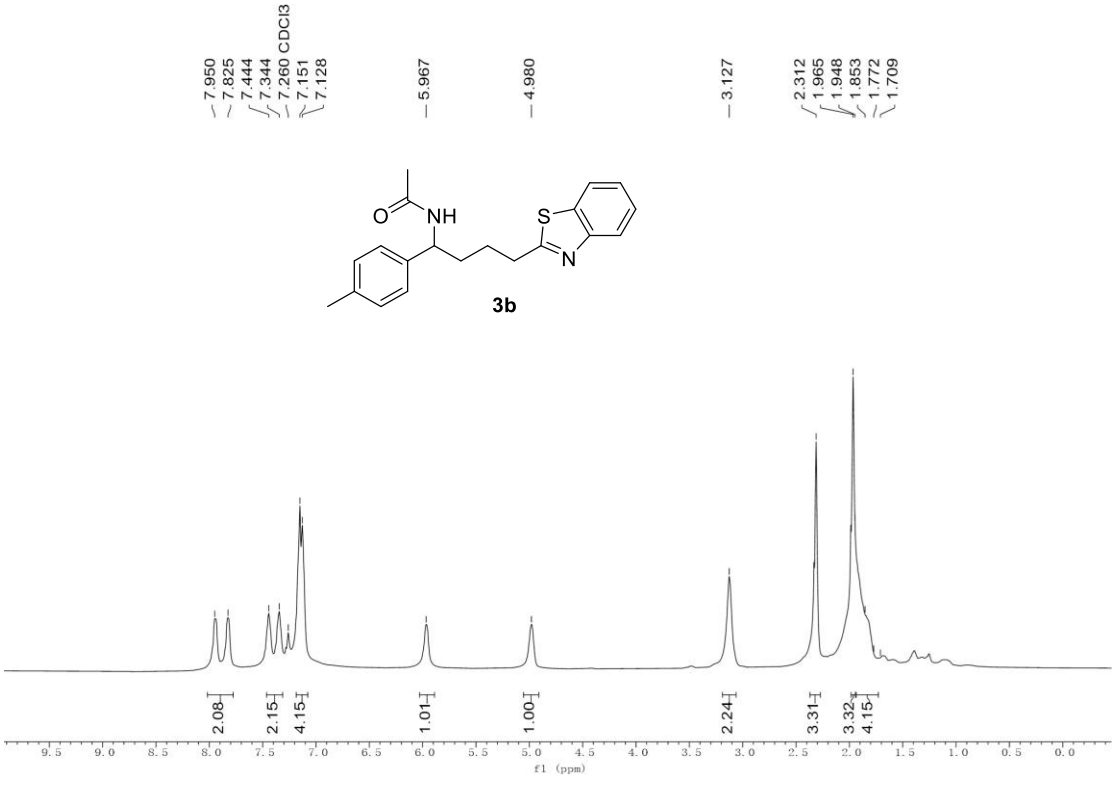
53.256
35.146
33.704
26.121
23.466
O
NH
S
N
3a
f1 (ppm)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7.444
7.344
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7.128
5.967
4.980
3.127
2.312
1.965
1.948
1.853
1.772
1.709
O
NH
S
N
3b
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2.15
4.15
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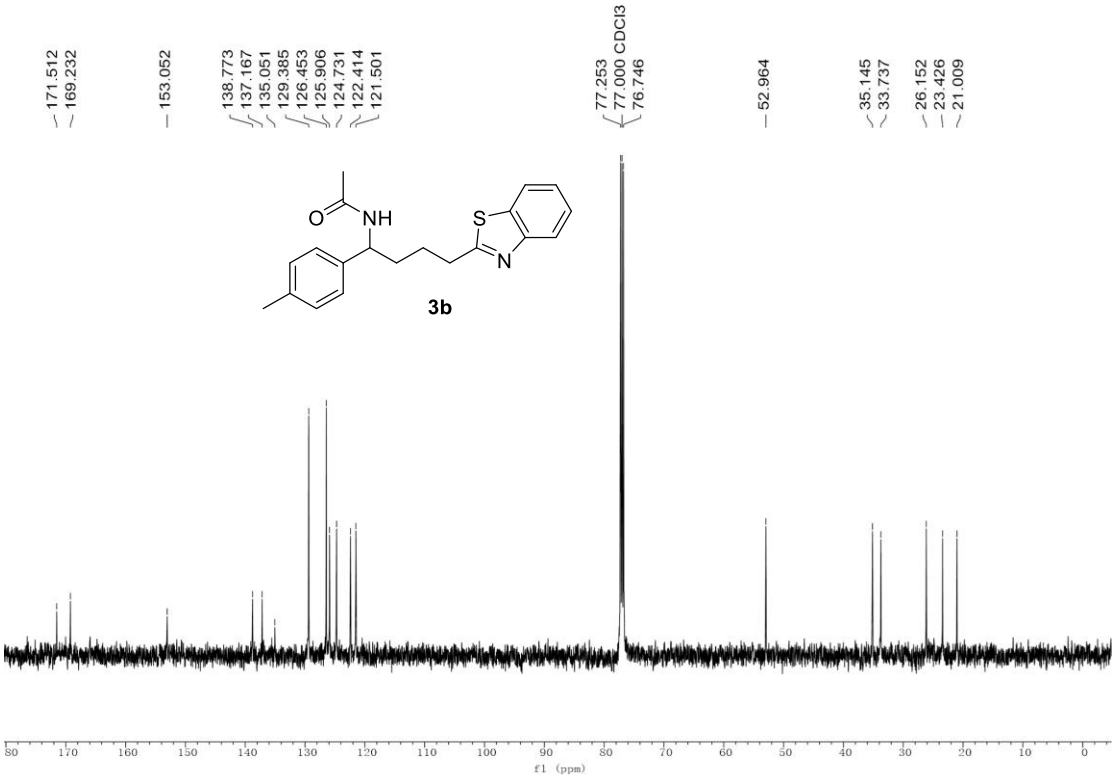
3.31
3.32
4.15
f1 (ppm)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122.414
121.501
77.253
77.000 CDCl3
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33.737
26.152
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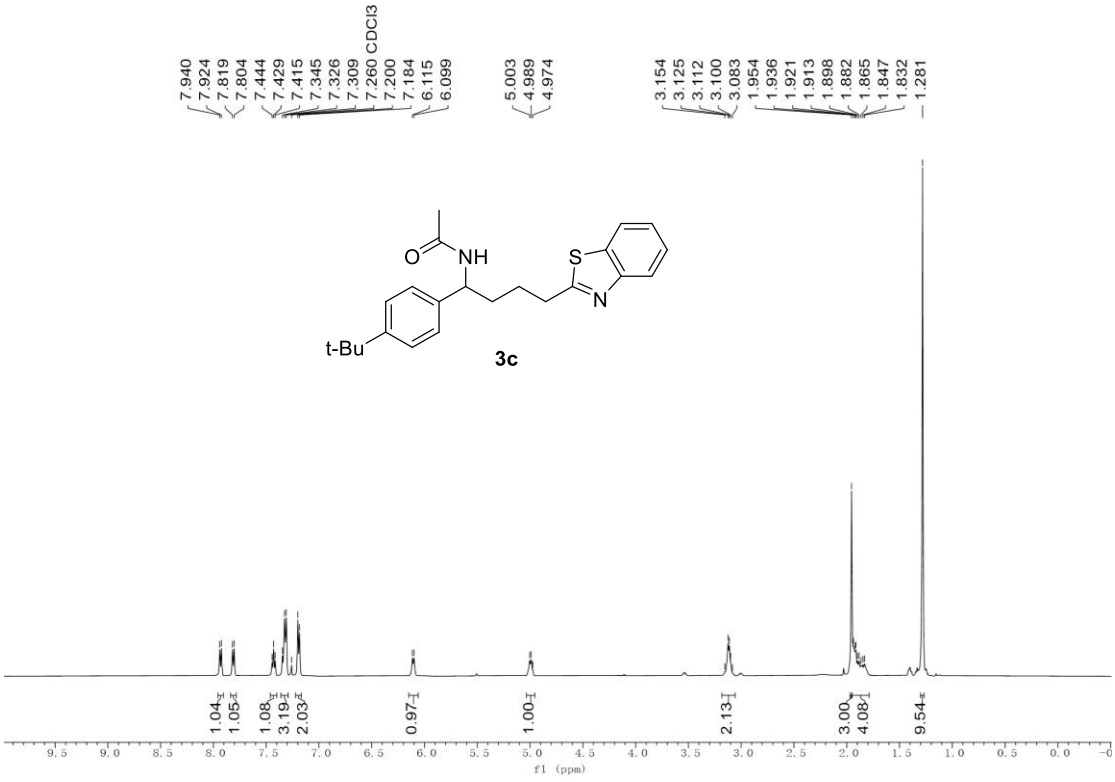
21.009
O
NH
S
N
3b
f1 (ppm)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7.345
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7.309
7.260 CDCl3
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7.184
6.115
6.099
5.003
4.989
4.974
3.154
3.125
3.112
3.100
3.083
1.954
1.936
1.921
1.913
1.898
1.882
1.865
1.847
1.832
1.281
O
NH
S
N
t-Bu
3c
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1.05
1.08
3.19
2.03
0.97
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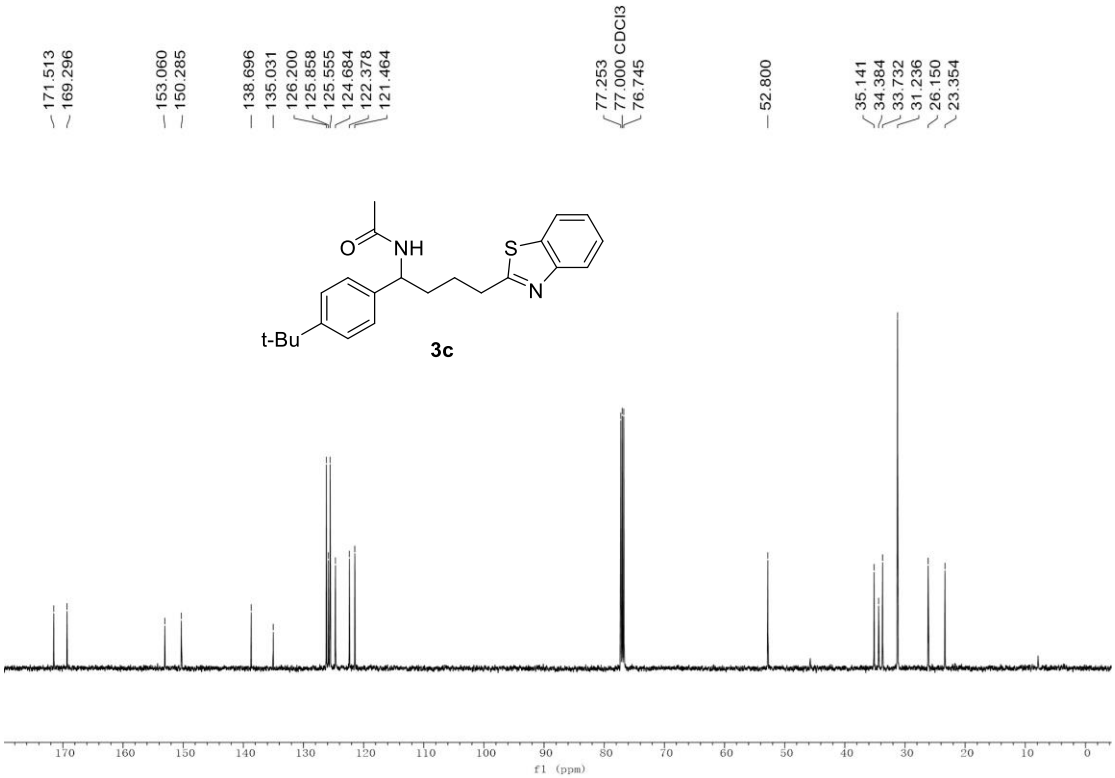
2.13
3.00
4.08
9.54
f1 (ppm)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125.858
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124.684
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121.464
77.253
77.000 CDCl3
76.745
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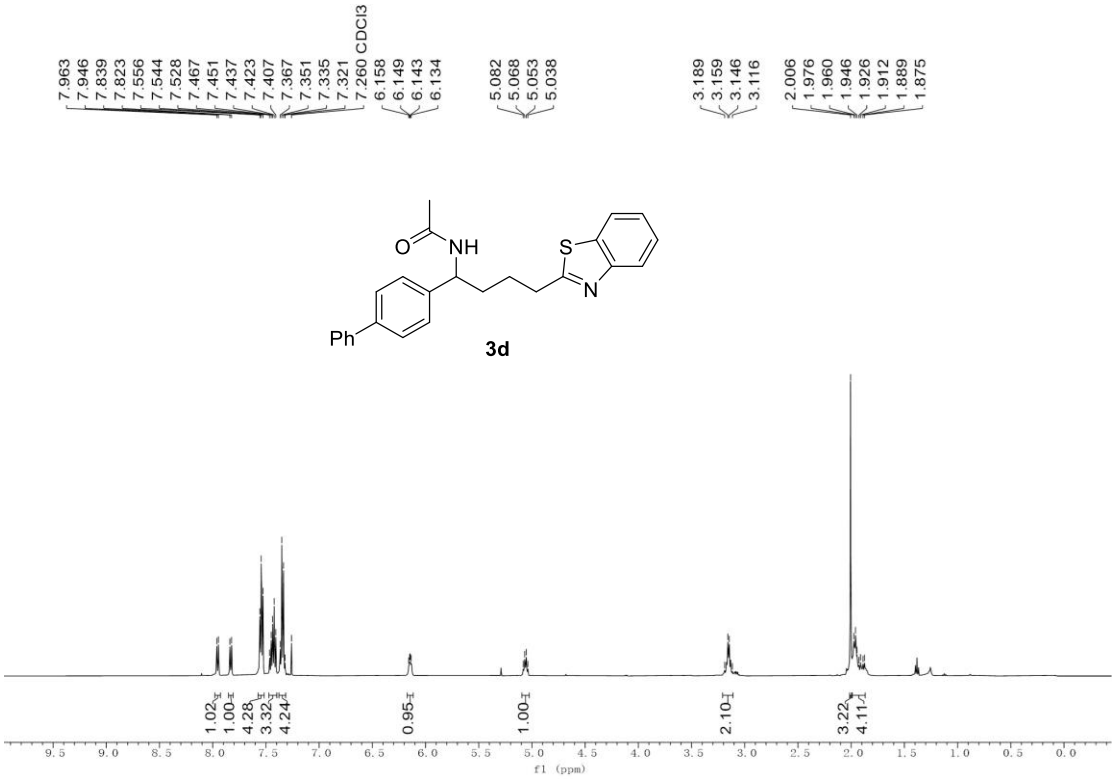
33.732
31.236
26.150
23.354
O
NH
S
N
t-Bu
3c
f1 (ppm)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7.437
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7.407
7.367
7.351
7.335
7.321
7.260 CDCl3
6.158
6.149
6.143
6.134
5.082
5.068
5.053
5.038
3.189
3.159
3.146
3.116
2.006
1.976
1.960
1.946
1.926
1.912
1.889
1.875
O
NH
S
N
Ph
3d
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3.32
4.24
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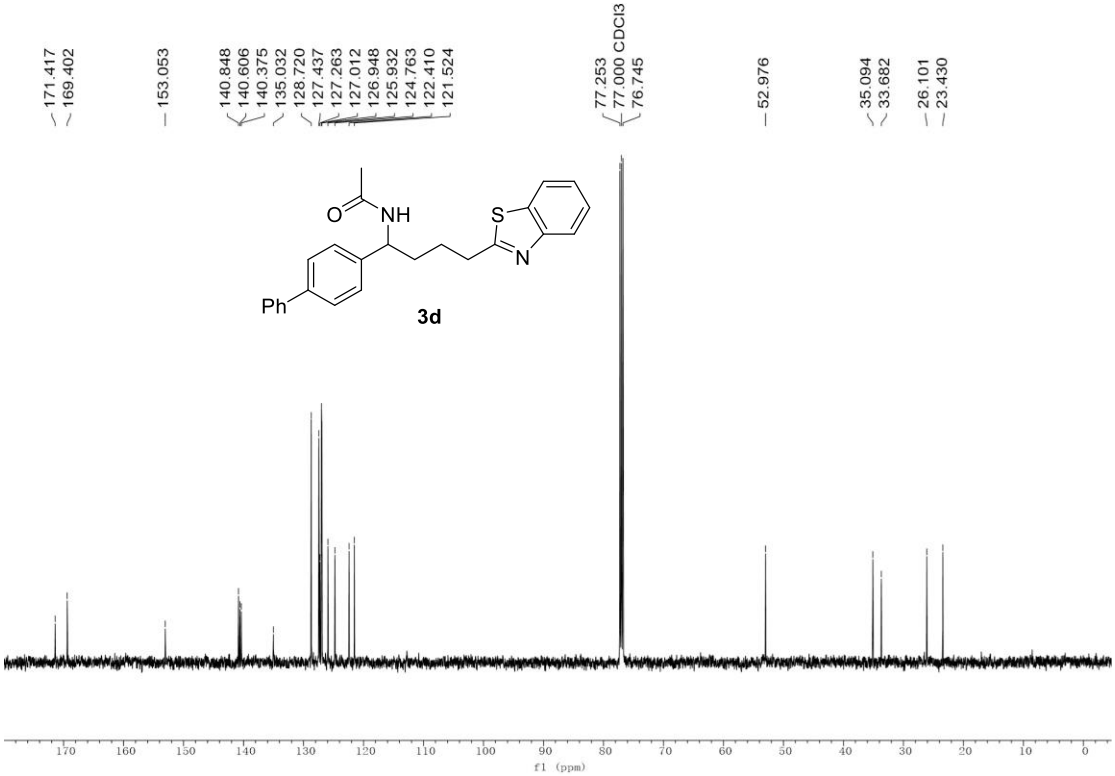
1.00
2.10
3.22
4.11
f1 (ppm)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127.263
127.012
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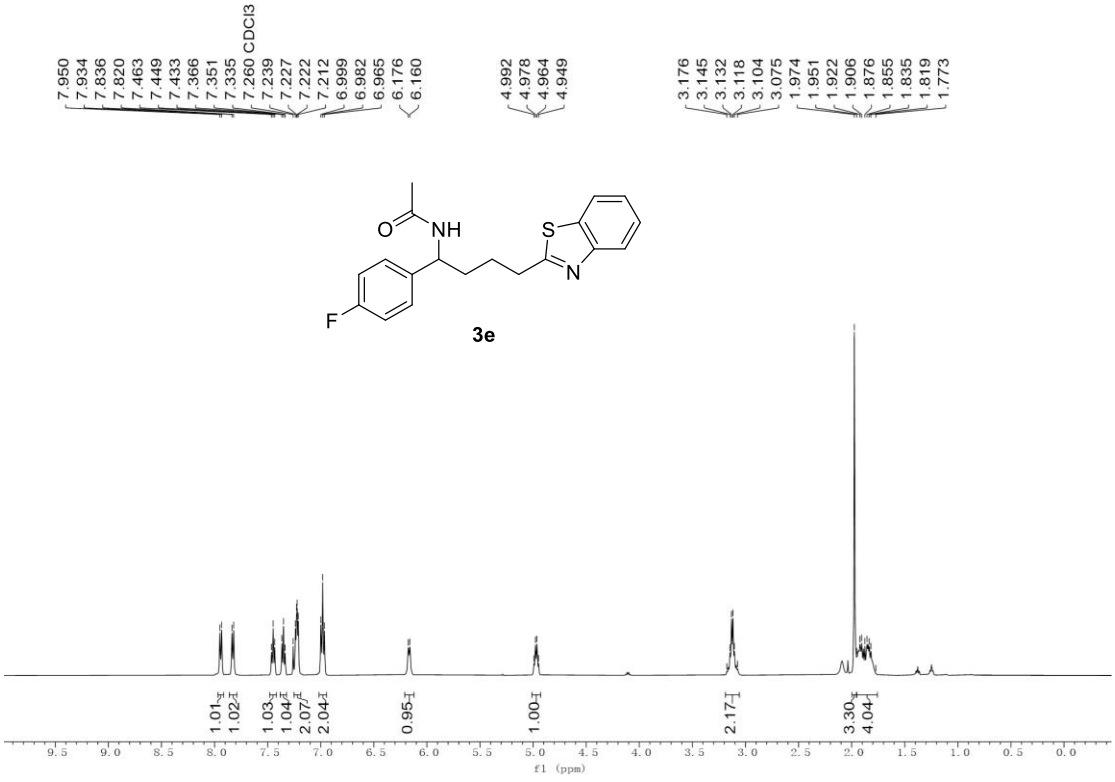
125.932
124.763
122.410
121.524
77.253
77.000 CDCl3
76.745
52.976
35.094
33.682
26.101
23.430
O
NH
S
N
Ph
3d
f1 (ppm)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7.335
7.260 CDCl3
7.239
7.227
7.222
7.212
6.999
6.982
6.965
6.176
6.160
4.992
4.978
4.964
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3.176
3.145
3.132
3.118
3.104
3.075
1.974
1.951
1.922
1.906
1.876
1.855
1.835
1.819
1.773
O
NH
S
N
F
3e
1.01
1.02
1.03
1.04
2.07
2.04
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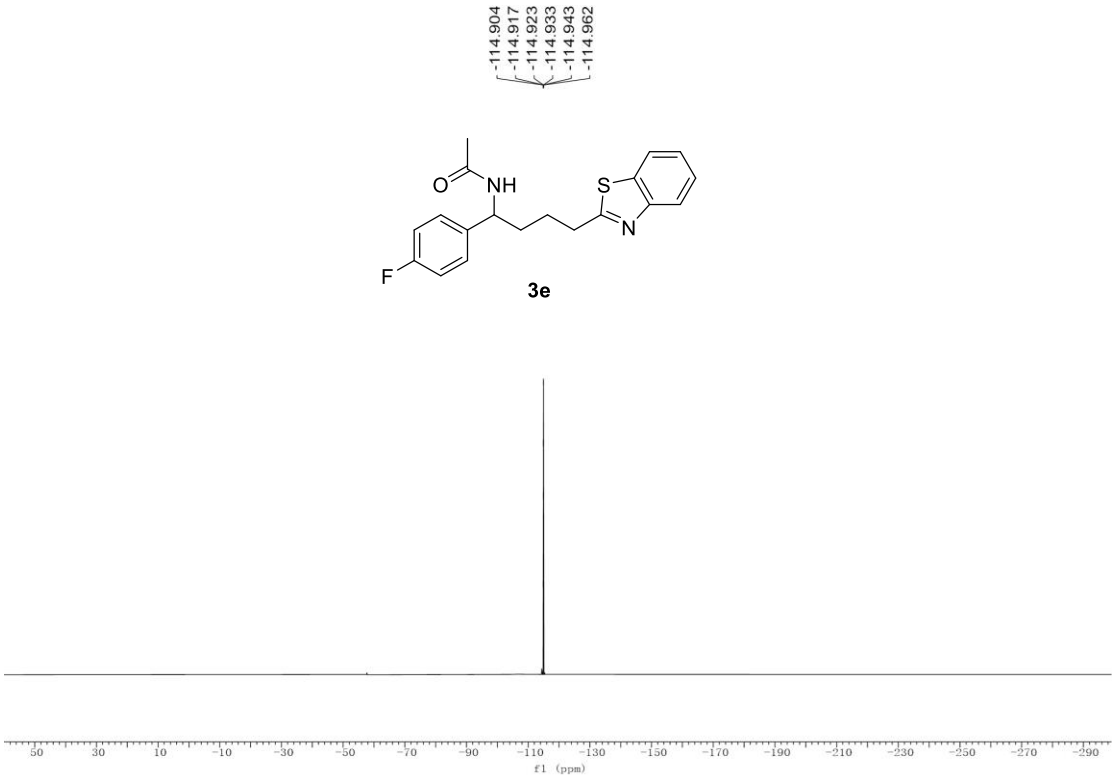
1.00
2.17
3.30
4.04
f1 (ppm)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-114.962
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NH
S
N
F
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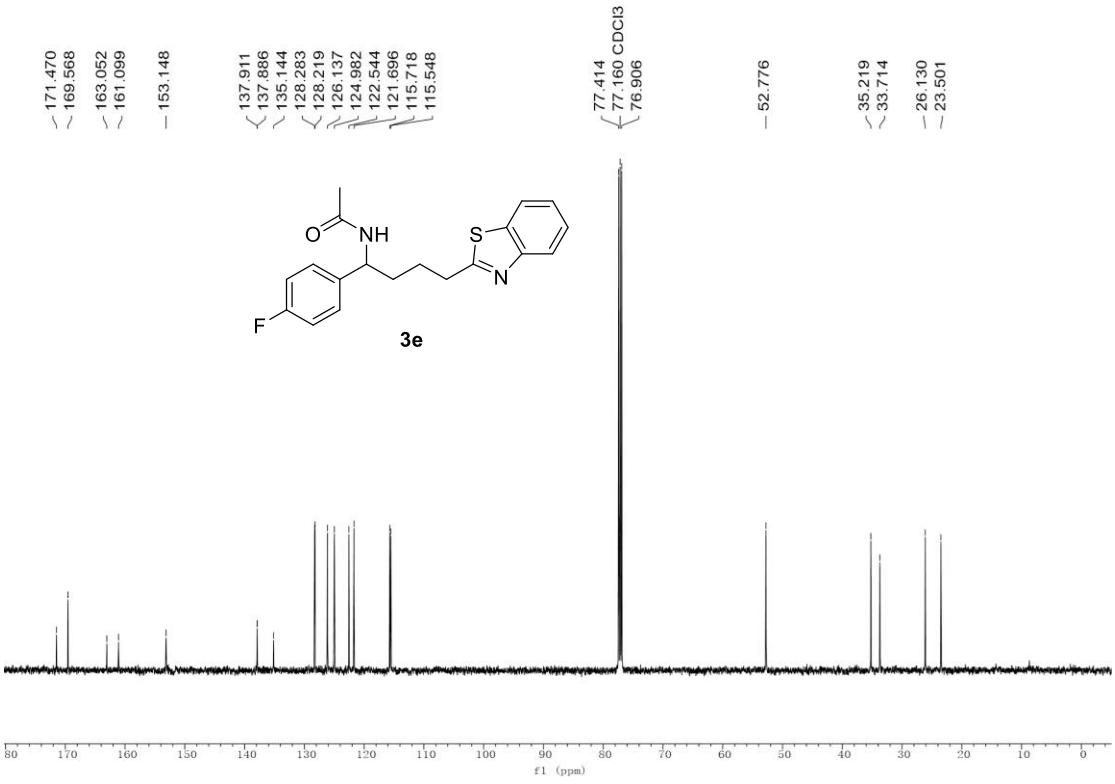
f1 (ppm)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122.544
121.696
115.718
115.548
77.414
77.160 CDCl3
76.906
52.776
35.219
33.714
26.130
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O
NH
S
N
F
3e
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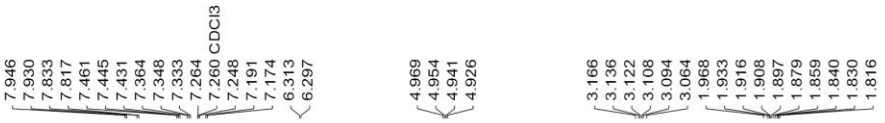
f1 (ppm)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7.174
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6.297
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4.941
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3.166
3.136
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3.108
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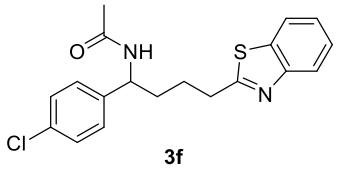
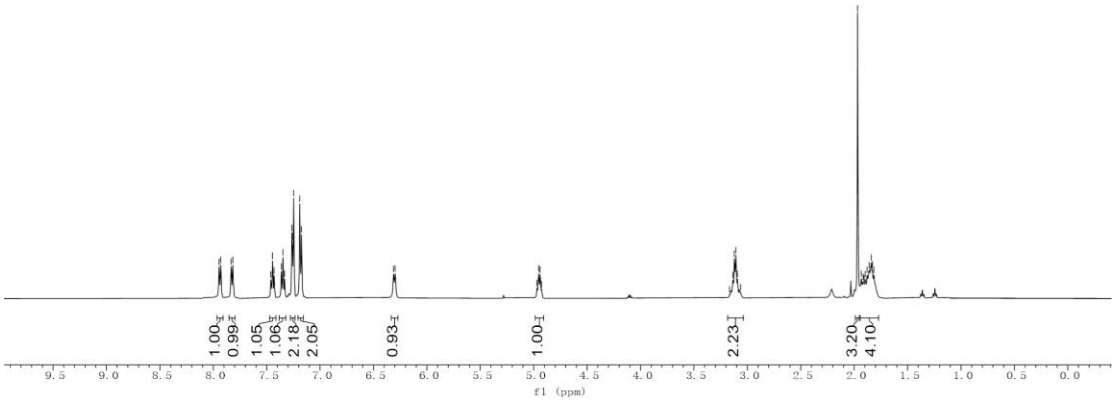
1.816


O
NH
S
N
Cl

3f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0.93
1.00
2.23
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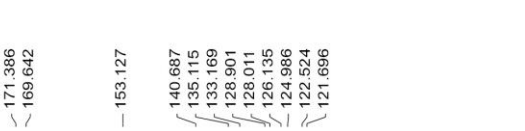
4.10
f1 (ppm)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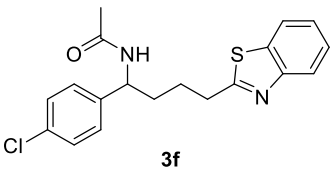
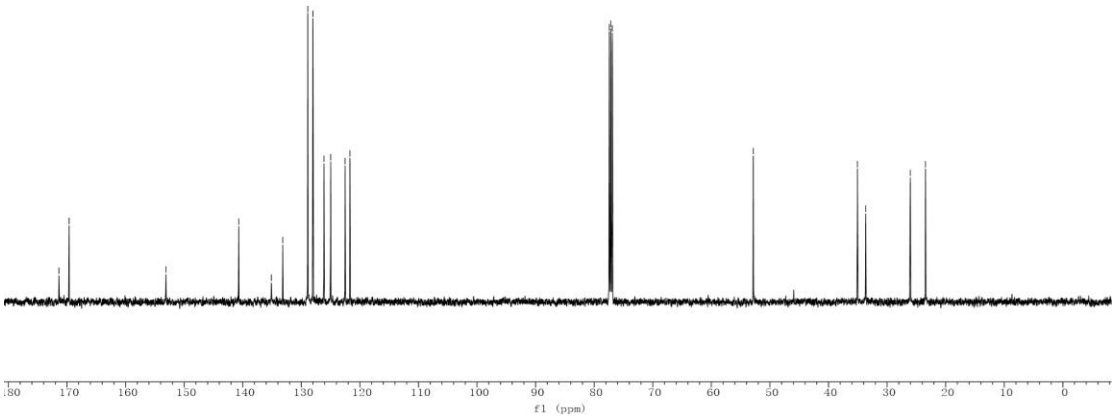
23.449


O
NH
S
N
Cl

3f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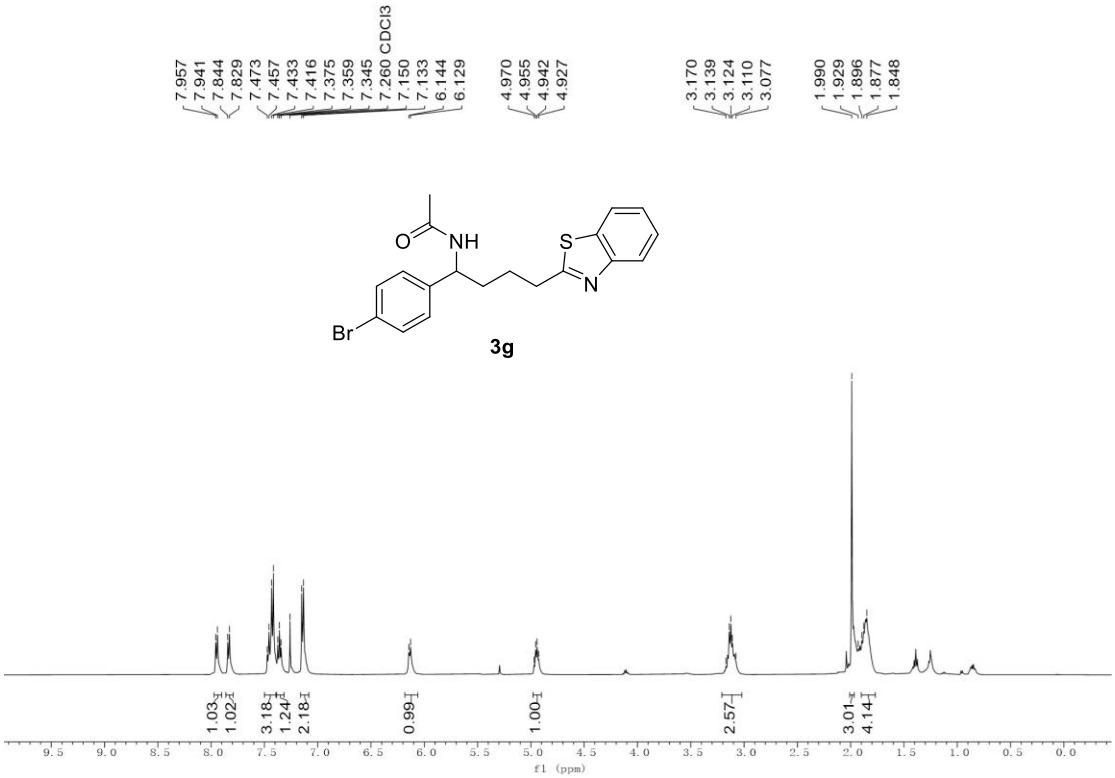
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7.345
7.260 CDCl3
7.150
7.133
6.144
6.129
4.970
4.955
4.942
4.927
3.170
3.139
3.124
3.110
3.077
1.990
1.929
1.896
1.877
1.848
O
NH
S
N
Br
3g
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3.18
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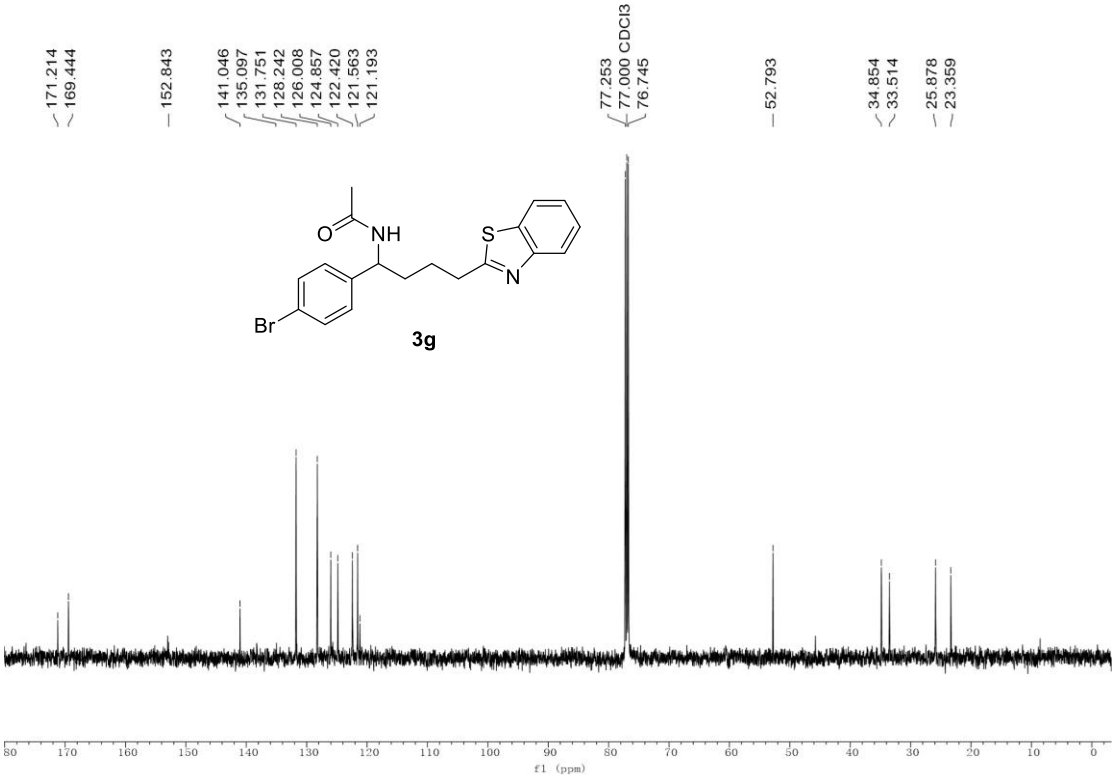
4.14
f1 (ppm)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77.000 CDCl3
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25.878
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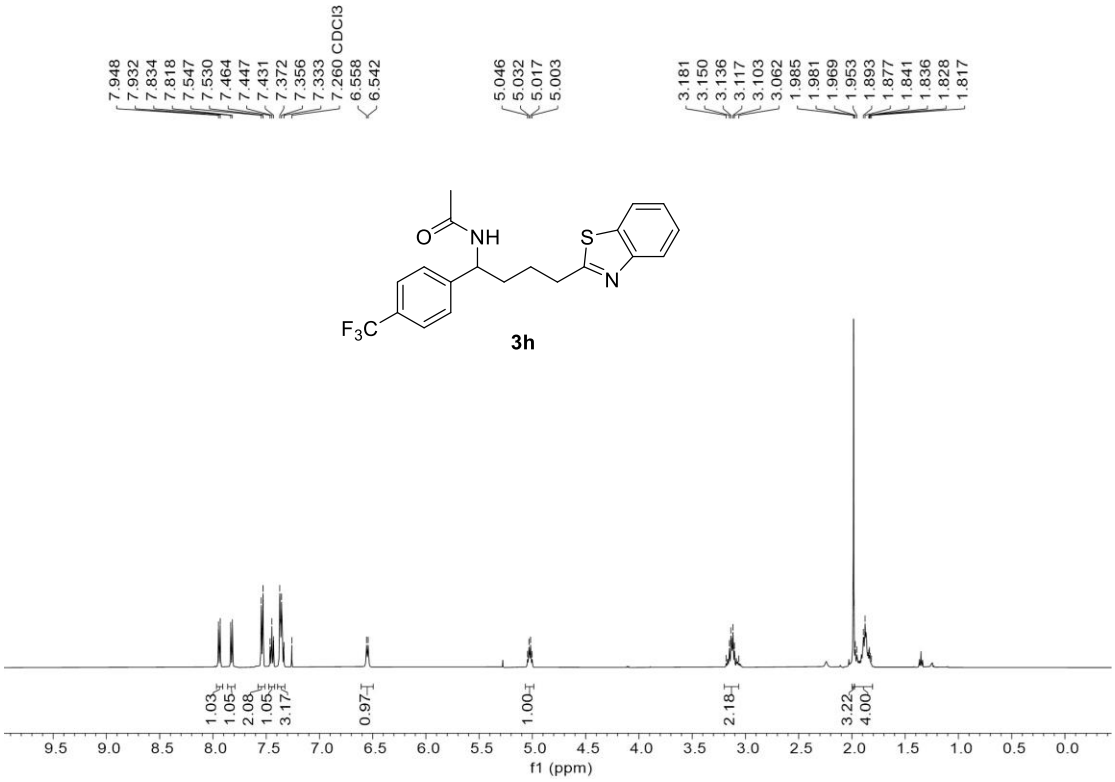
NH
S
N
Br
3g
f1 (ppm)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3.150
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3.117
3.103
3.062
1.985
1.981
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1.828
1.817
O
NH
S
N
F3C
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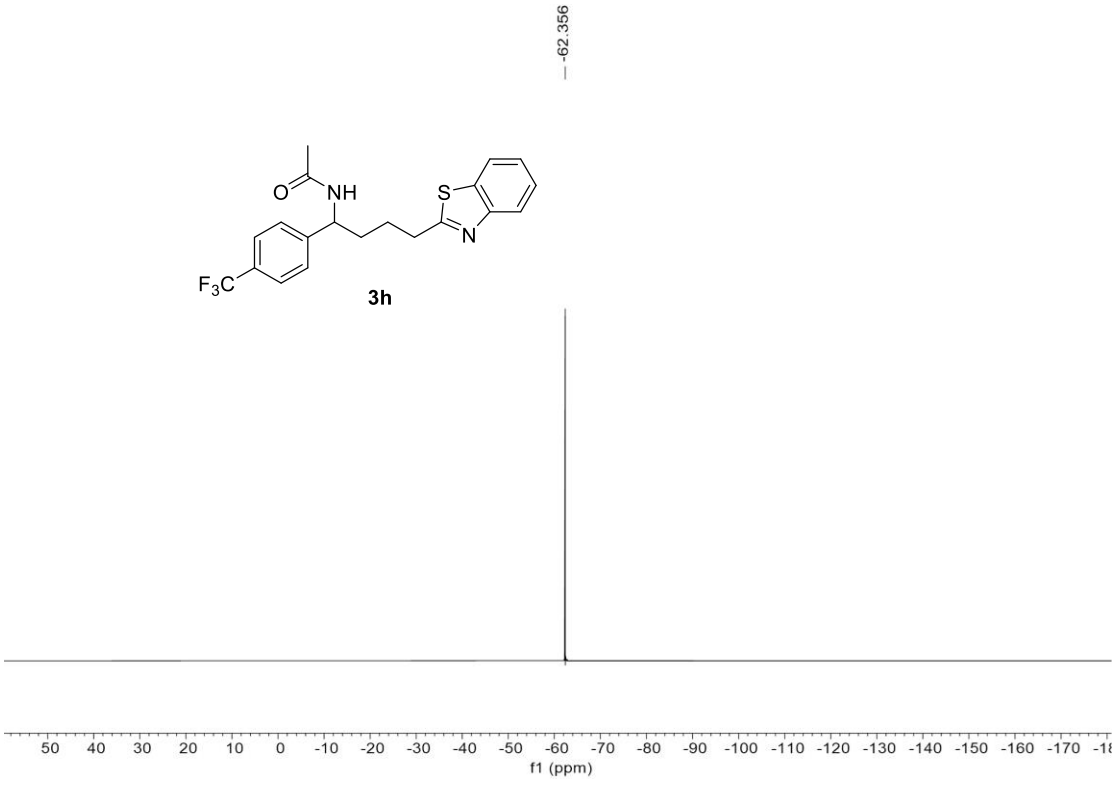
4.00
f1 (ppm)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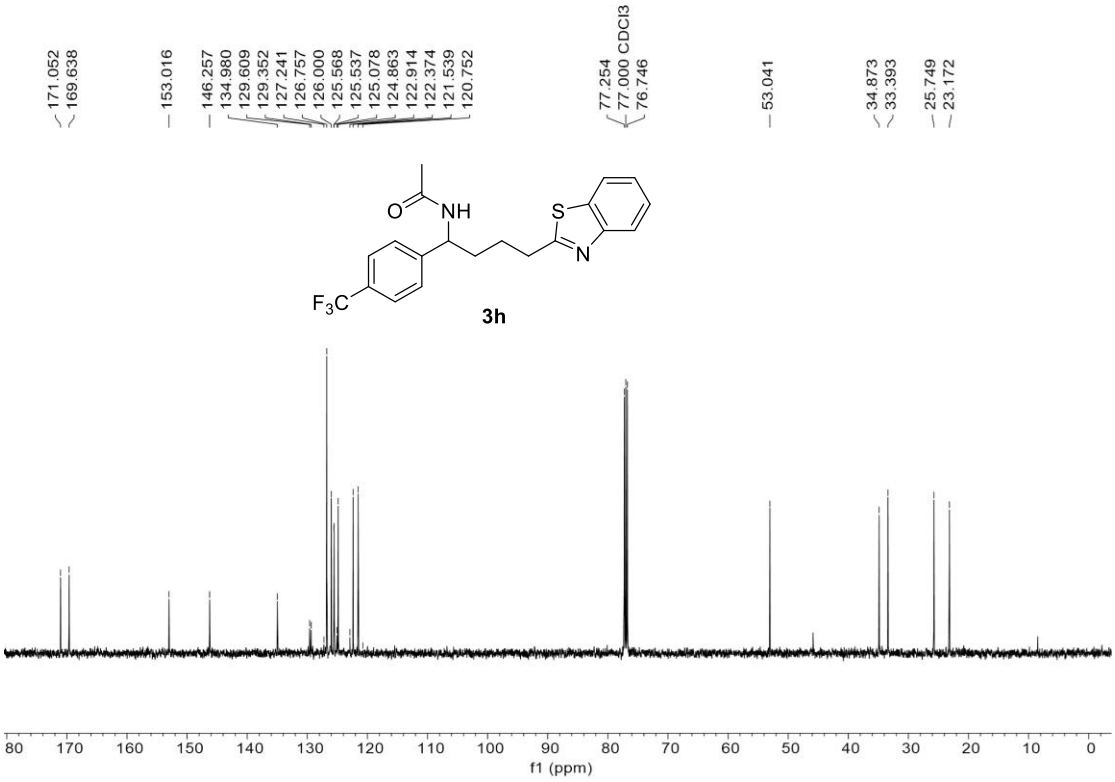
f1 (ppm)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127.241
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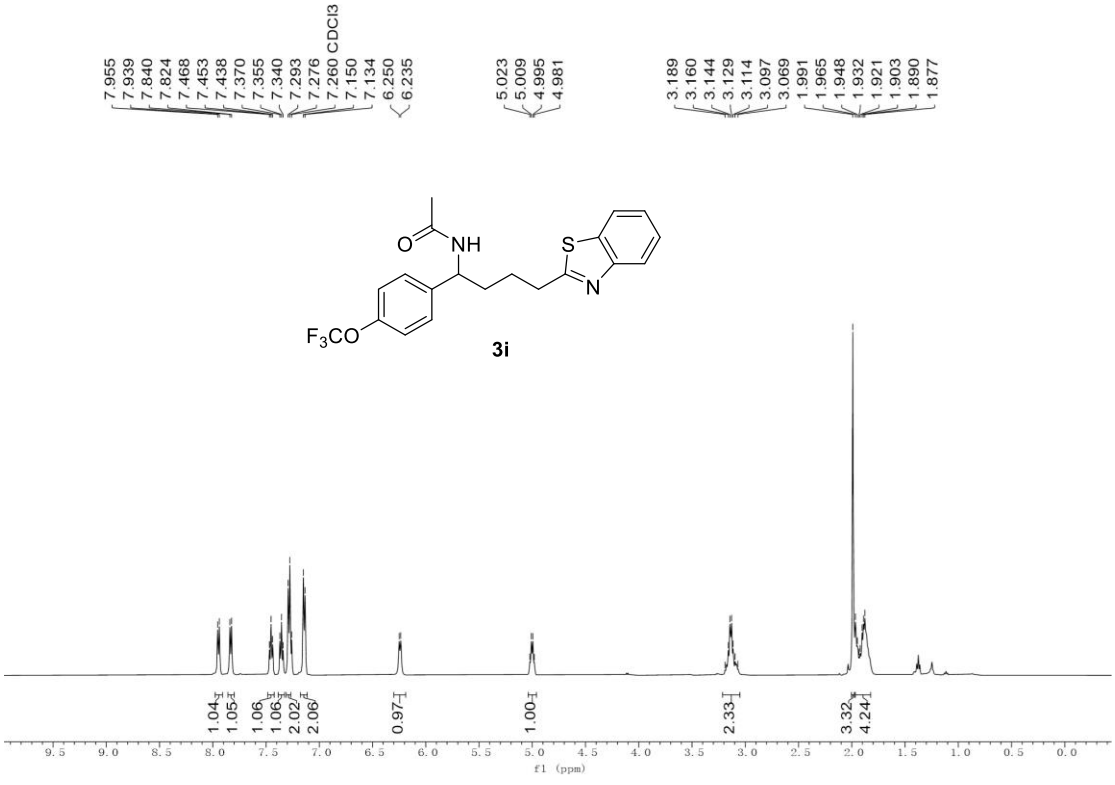
125.568
125.537
125.078
124.863
122.914
122.374
121.539
120.752
77.254
77.000 CDCl3
76.746
53.041
34.873
33.393
25.749
23.172
O
NH
S
N
F3C
3h
f1 (ppm)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7.840
7.824
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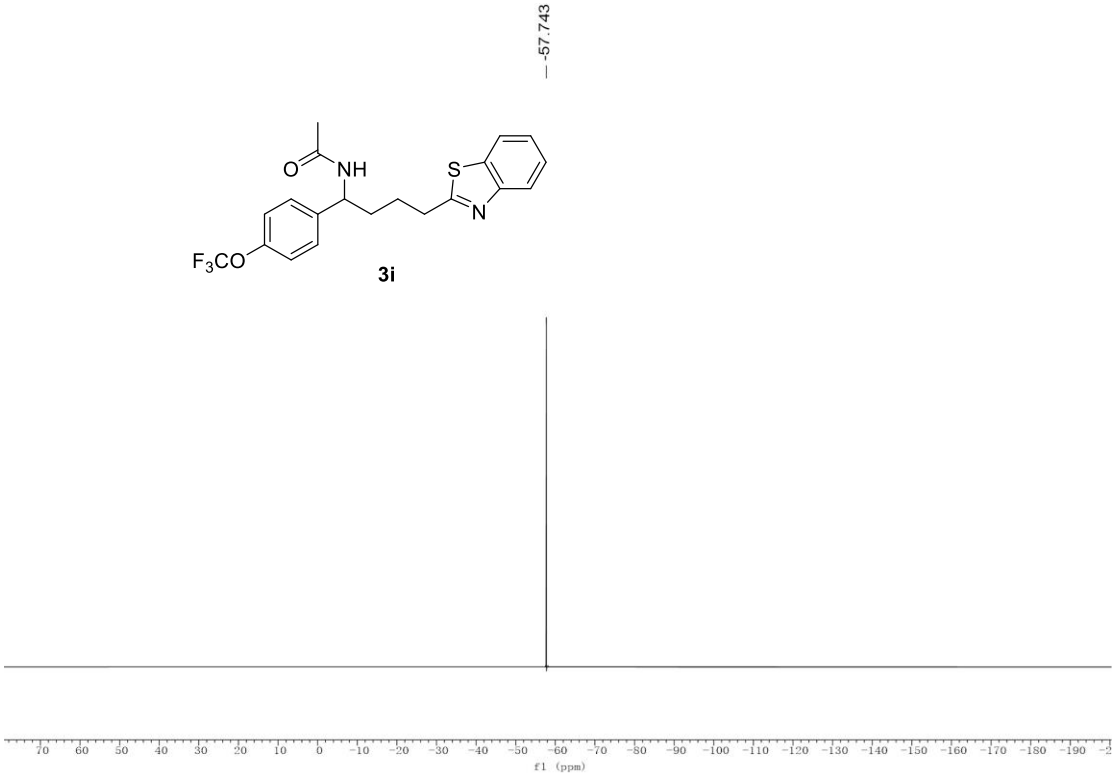
7.453
7.438
7.370
7.355
7.340
7.293
7.276
7.260 CDCl3
7.150
7.134
6.250
6.235
5.023
5.009
4.995
4.981
3.189
3.160
3.144
3.129
3.114
3.097
3.069
1.991
1.965
1.948
1.932
1.921
1.903
1.890
1.877
O
NH
S
N
F3CO
3i
1.04
1.05
1.06
1.06
2.02
2.06
0.97
1.00
2.33
3.32
4.24
f1 (ppm)


-57.743
O
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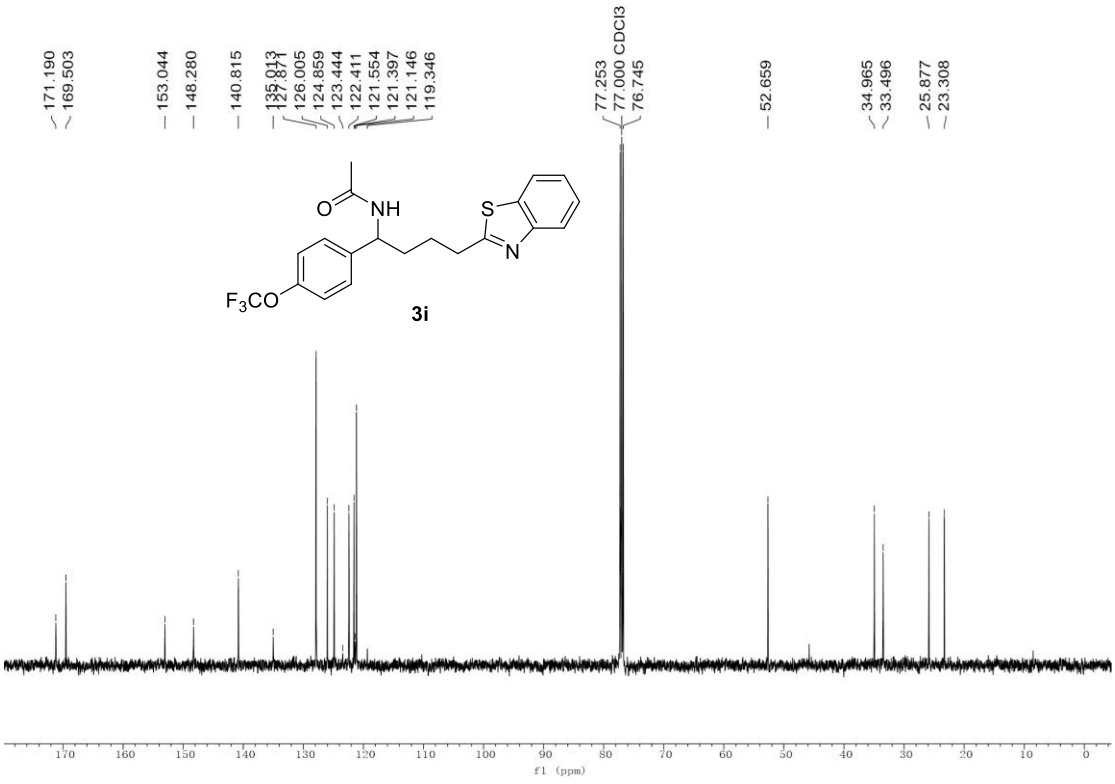
F3CO
3i
70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)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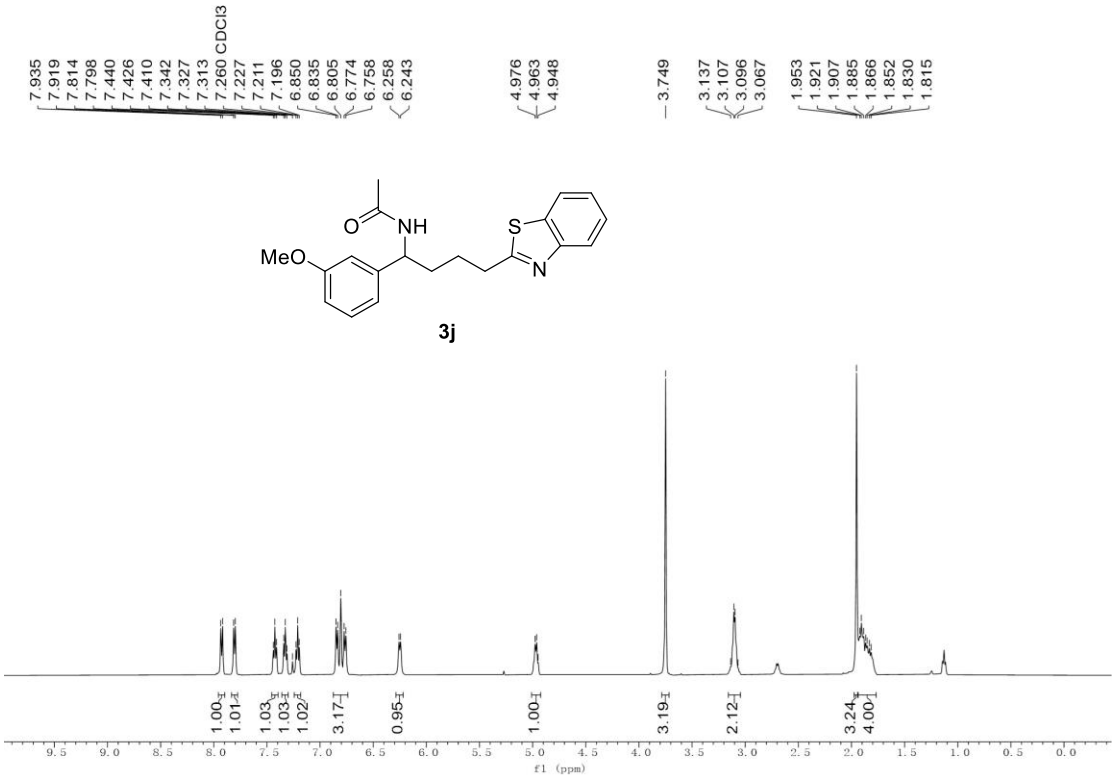
135.813
127.871
126.005
124.859
123.444
122.411
121.554
121.397
121.146
119.346
77.253
77.000 CDCl3
76.745
52.659
34.965
33.496
25.877
23.308
O
NH
S
N
F3CO
3i
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)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7.426
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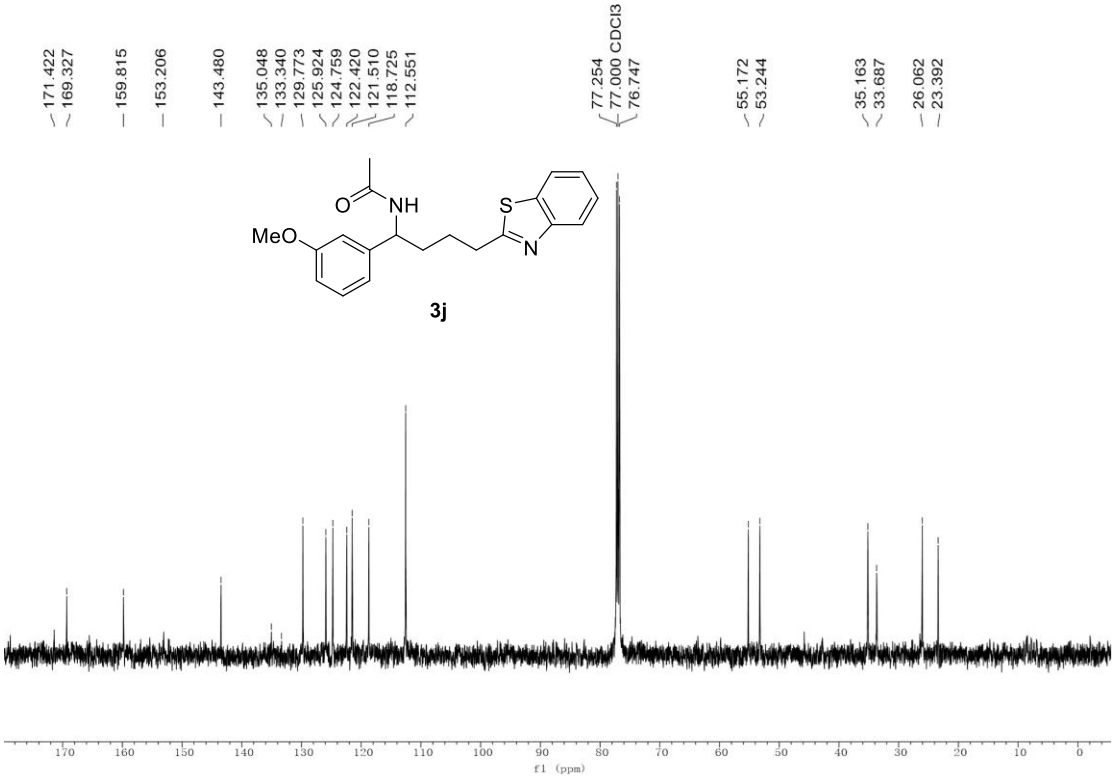
7.342
7.327
7.313
7.260 CDCl3
7.227
7.211
7.196
6.850
6.835
6.805
6.774
6.758
6.258
6.243
4.976
4.963
4.948
3.749
3.137
3.107
3.096
3.067
1.953
1.921
1.907
1.885
1.866
1.852
1.830
1.815
O
NH
S
N
MeO
3j
1.00
1.01
1.03
1.03
1.02
3.17
0.95
1.00
3.19
2.12
3.24
4.00
f1 (ppm)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133.340
129.773
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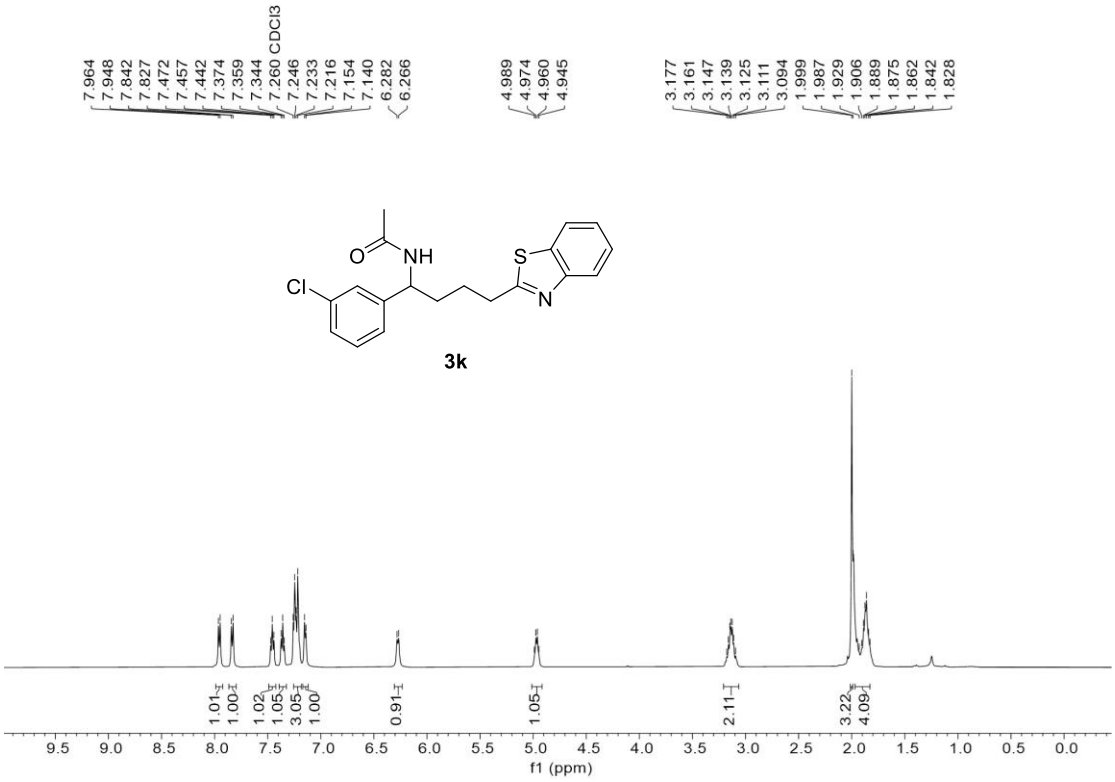
124.759
122.420
121.510
118.725
112.551
77.254
77.000 CDCl3
76.747
55.172
53.244
35.163
33.687
26.062
23.392
O
NH
S
N
MeO
3j
f1 (ppm)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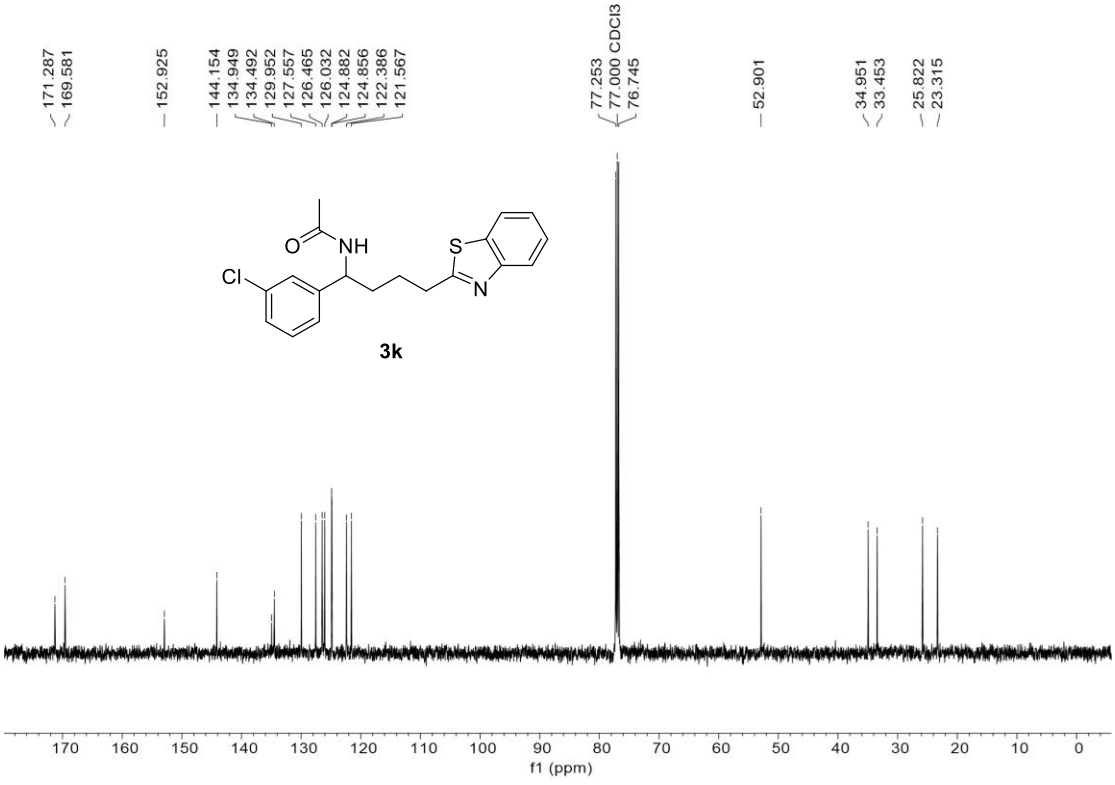
7.842
7.827
7.472
7.457
7.442
7.374
7.359
7.344
7.260 CDCl3
7.246
7.233
7.216
7.154
7.140
6.282
6.266
4.989
4.974
4.960
4.945
3.177
3.161
3.147
3.139
3.125
3.111
3.094
1.999
1.987
1.929
1.906
1.889
1.875
1.862
1.842
1.828
O
NH
S
Cl
N
3k
1.01
1.00
1.02
1.05
3.05
1.00
0.91
1.05
2.11
3.22
4.09
f1 (ppm)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169.581
152.925
144.154
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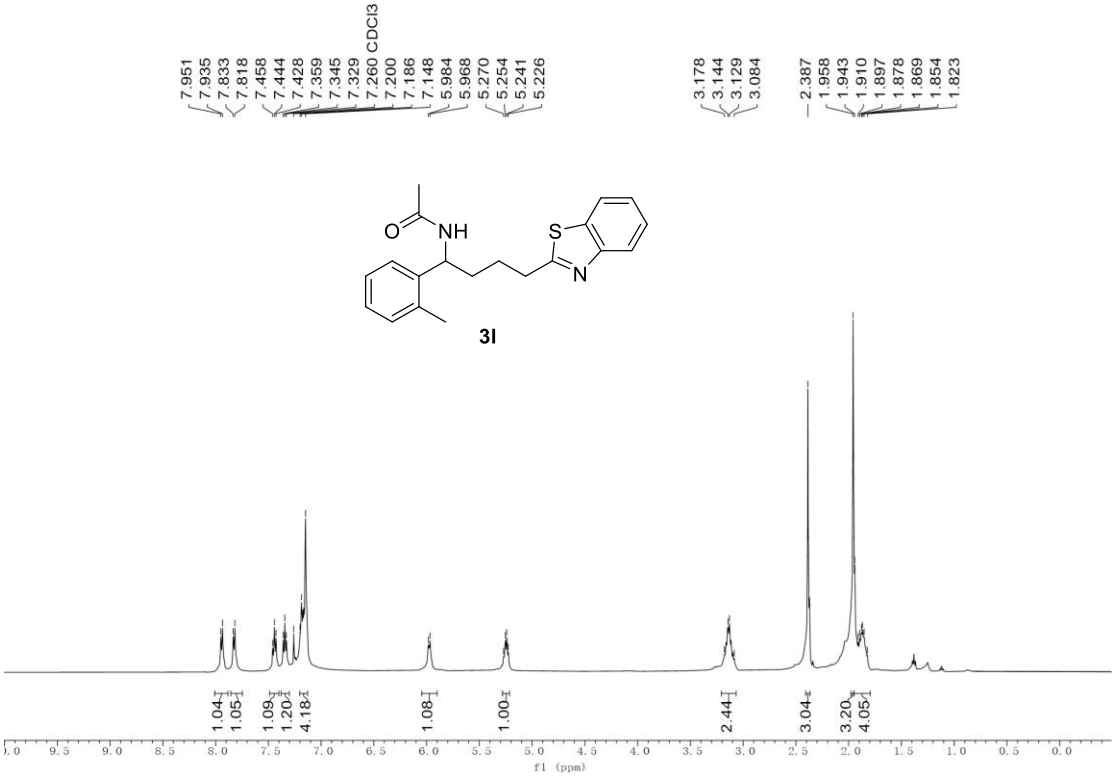
134.492
129.952
127.557
126.465
126.032
124.882
124.856
122.386
121.567
77.253
77.000 CDCl3
76.745
52.901
34.951
33.453
25.822
23.315
O
NH
S
Cl
N
3k
f1 (ppm)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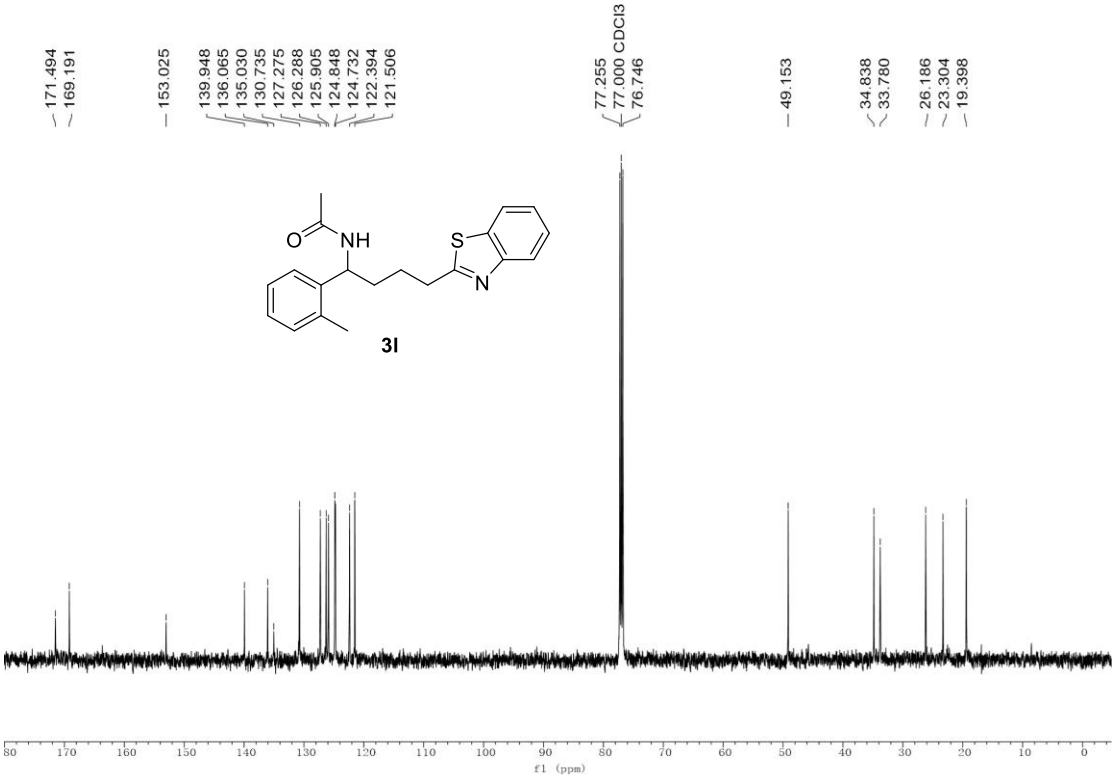
7.935
7.833
7.818
7.458
7.444
7.428
7.359
7.345
7.329
7.260 CDCl3
7.200
7.186
7.148
5.984
5.968
5.270
5.254
5.241
5.226
3.178
3.144
3.129
3.084
2.387
1.958
1.943
1.910
1.897
1.878
1.869
1.854
1.823
O
NH
S
N
3l
1.04
1.05
1.09
1.20
4.18
1.08
1.00
2.44
3.04
3.20
4.05
f1 (ppm)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136.065
135.030
130.735
127.275
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125.905
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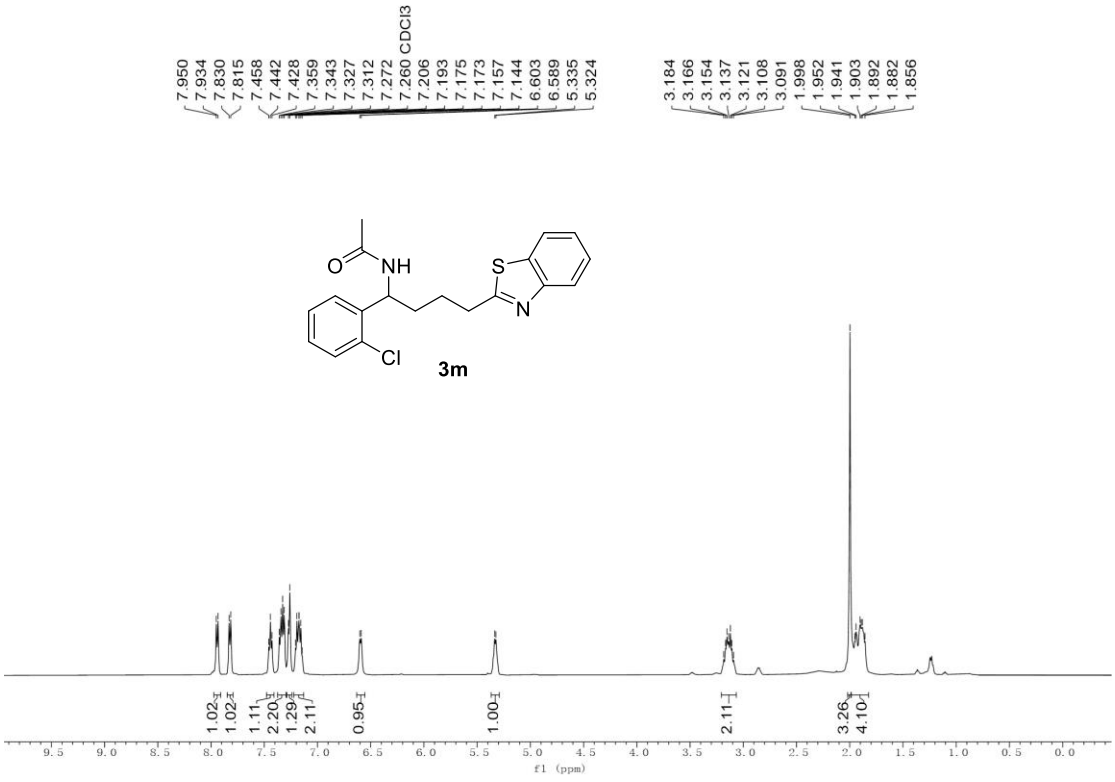
124.732
122.394
121.506
77.255
77.000 CDCl3
76.746
49.153
34.838
33.780
26.186
23.304
19.398
O
NH
S
N
3l
f1 (ppm)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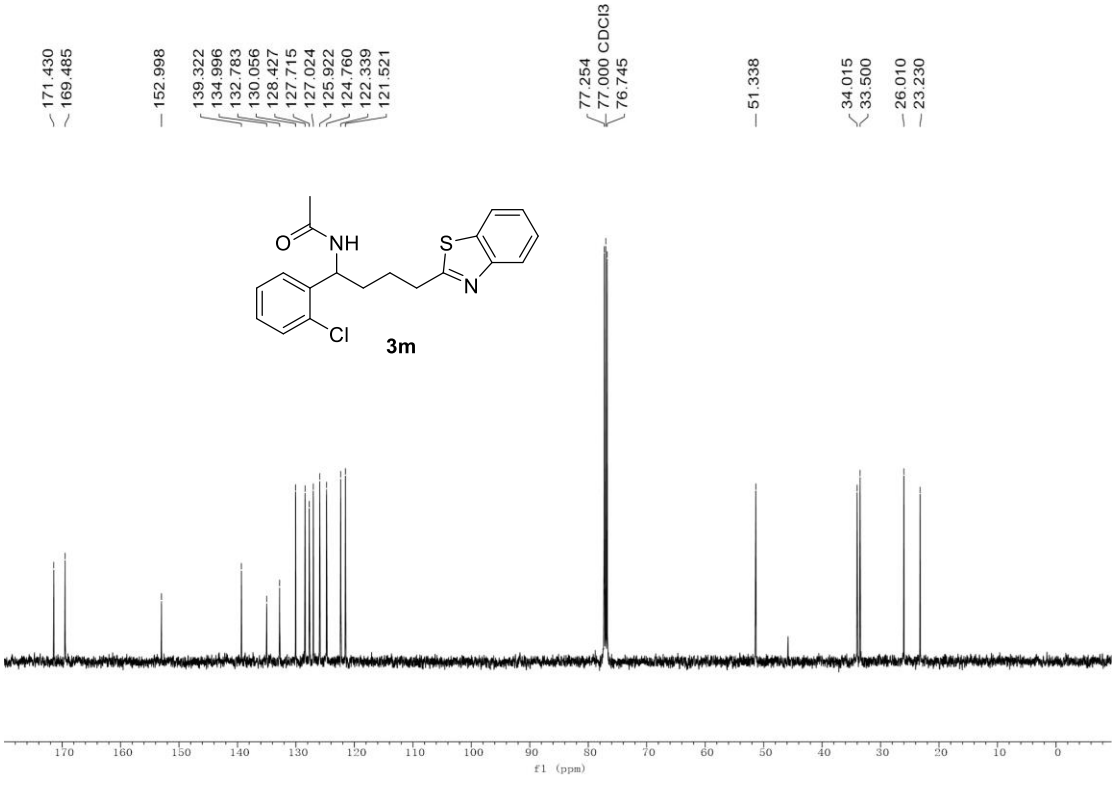
7.830
7.815
7.458
7.442
7.428
7.359
7.343
7.327
7.312
7.272
7.260 CDCl3
7.206
7.193
7.175
7.173
7.157
7.144
6.603
6.589
5.335
5.324
3.184
3.166
3.154
3.137
3.121
3.108
3.091
1.998
1.952
1.941
1.903
1.892
1.882
1.856
O
NH
S
N
Cl
3m
1.02
1.02
1.11
2.20
1.29
2.11
0.95
1.00
2.11
3.26
4.10
f1 (ppm)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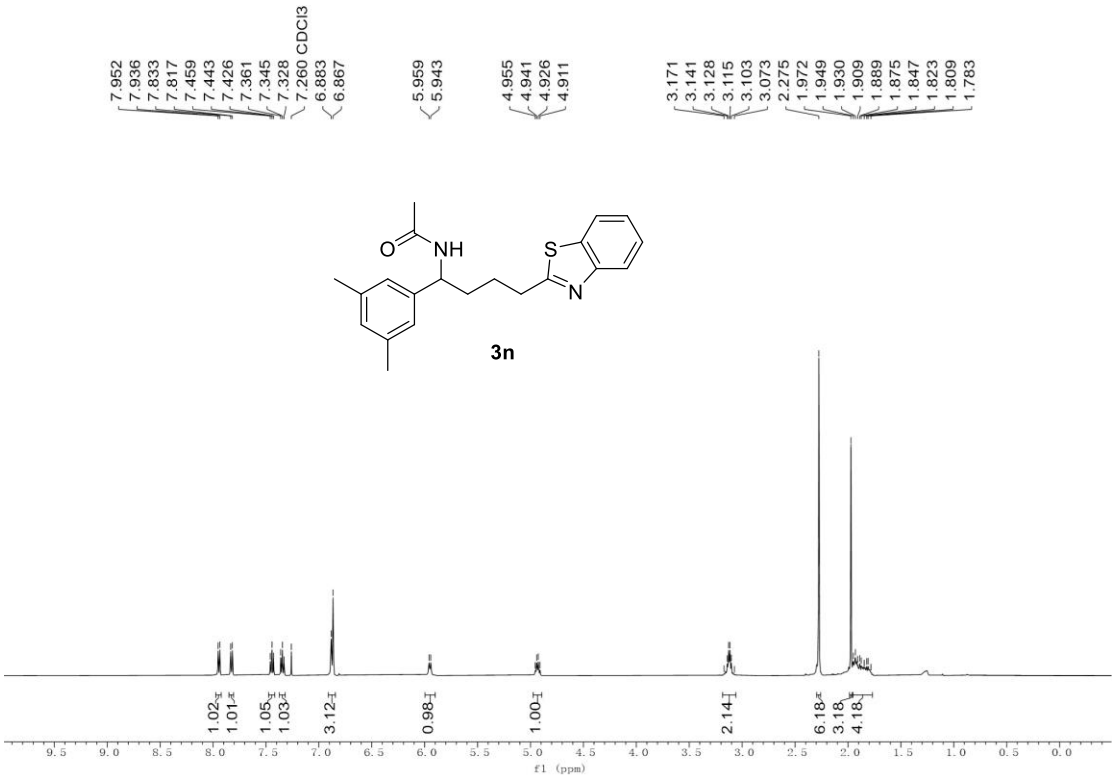
152.998
139.322
134.996
132.783
130.056
128.427
127.715
127.024
125.922
124.760
122.339
121.521
77.254
77.000 CDCl3
76.745
51.338
34.015
33.500
26.010
23.230
O
NH
S
N
Cl
3m
f1 (ppm)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7.833
7.817
7.459
7.443
7.426
7.361
7.345
7.328
7.260 CDCl3
6.883
6.867
5.959
5.943
4.955
4.941
4.926
4.911
3.171
3.141
3.128
3.115
3.103
3.073
2.275
1.972
1.949
1.930
1.909
1.889
1.875
1.847
1.823
1.809
1.783
O
NH
S
N
3n
1.02
1.01
1.05
1.03
3.12
0.98
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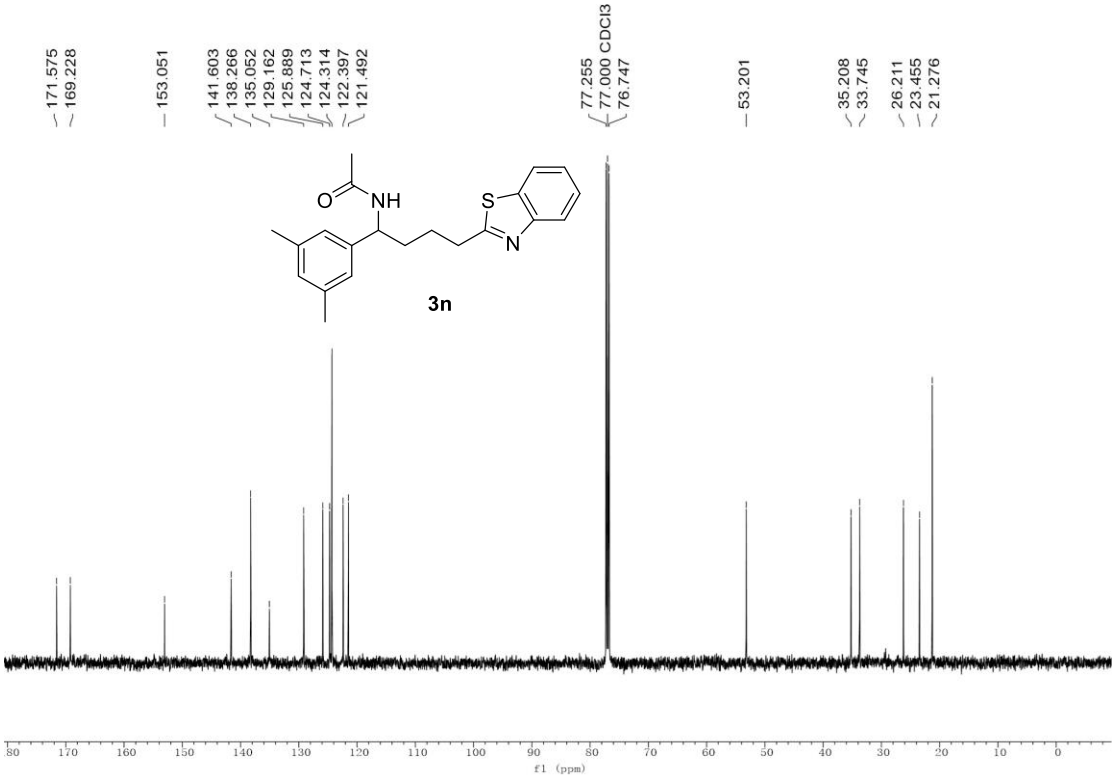
6.18
3.18
4.18
f1 (ppm)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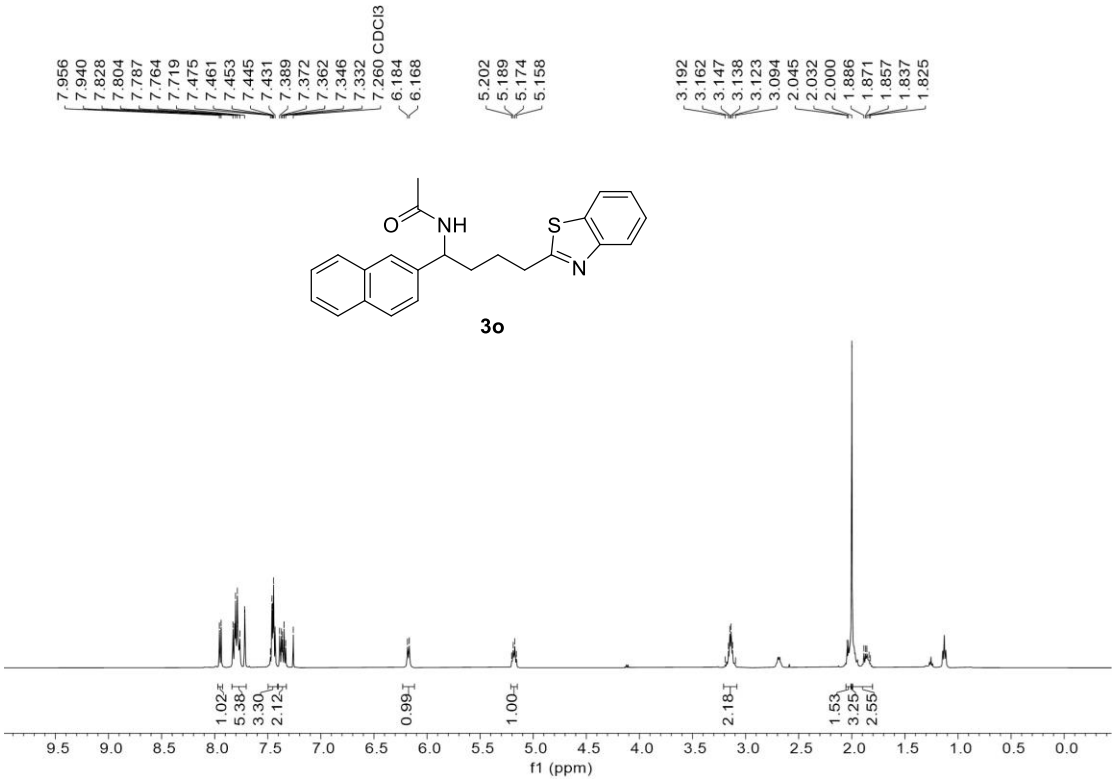
138.266
135.052
129.162
125.889
124.713
124.314
122.397
121.492
77.255
77.000 CDCl3
76.747
53.201
35.208
33.745
26.211
23.455
21.276
O
NH
S
N
3n
f1 (ppm)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7.461
7.453
7.445
7.431
7.389
7.372
7.362
7.346
7.332
7.260 CDCl3
6.184
6.168
5.202
5.189
5.174
5.158
3.192
3.162
3.147
3.138
3.123
3.094
2.045
2.032
2.000
1.886
1.871
1.857
1.837
1.825
O
NH
S
N
3o
1.02
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3.30
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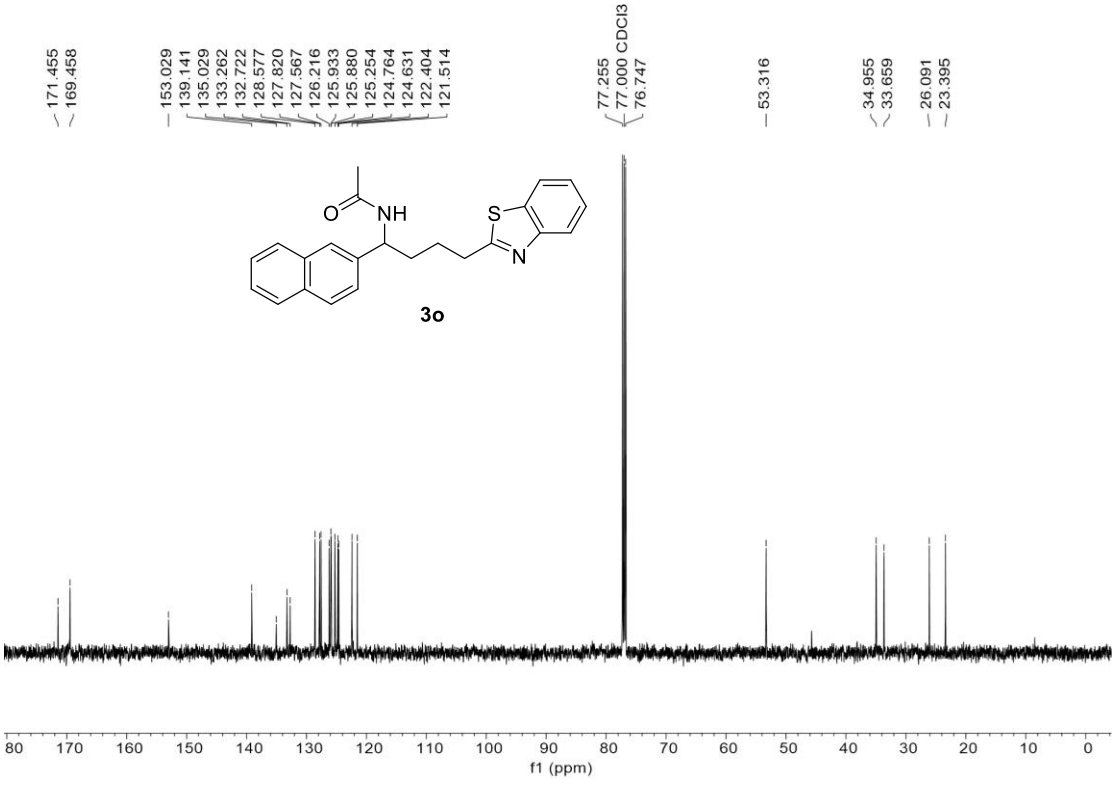
1.53
3.25
2.55
f1 (ppm)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135.029
133.262
132.722
128.577
127.820
127.567
126.216
125.933
125.880
125.254
124.764
124.631
122.404
121.514
77.255
77.000 CDCl3
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53.316
34.955
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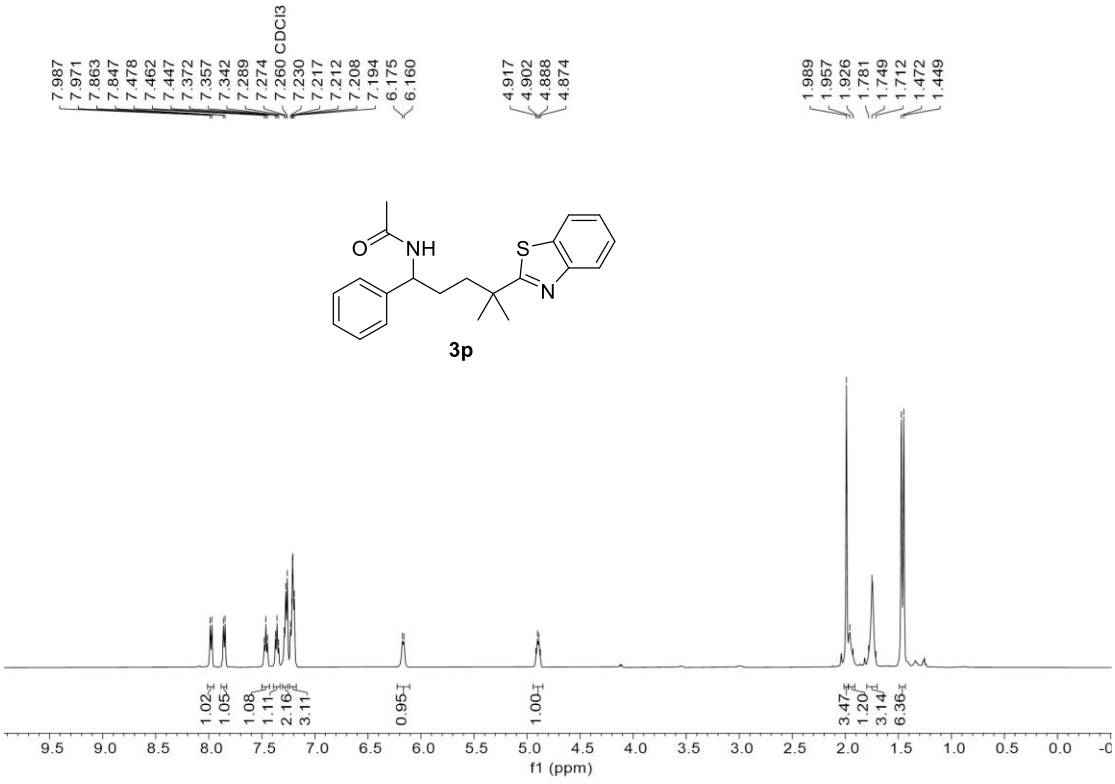
S
N
3o
f1 (ppm)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7.447
7.372
7.357
7.342
7.289
7.274
7.260 CDCl3
7.230
7.217
7.212
7.208
7.194
6.175
6.160
4.917
4.902
4.888
4.874
1.989
1.957
1.926
1.781
1.749
1.712
1.472
1.449
O
NH
S
N
3p
1.02
1.05
1.08
1.11
2.16
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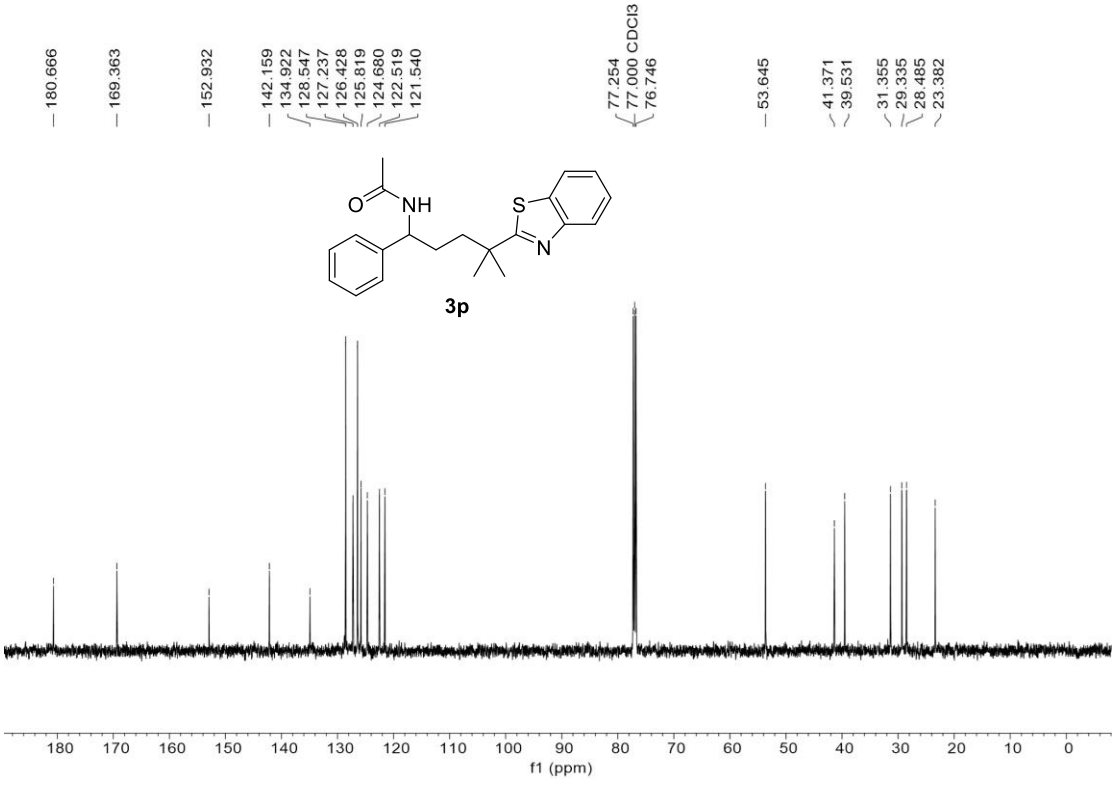
0.95
1.00
3.47
1.20
3.14
6.36
f1 (ppm)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142.159
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127.237
126.428
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122.519
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77.254
77.000 CDCl3
76.746
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31.355
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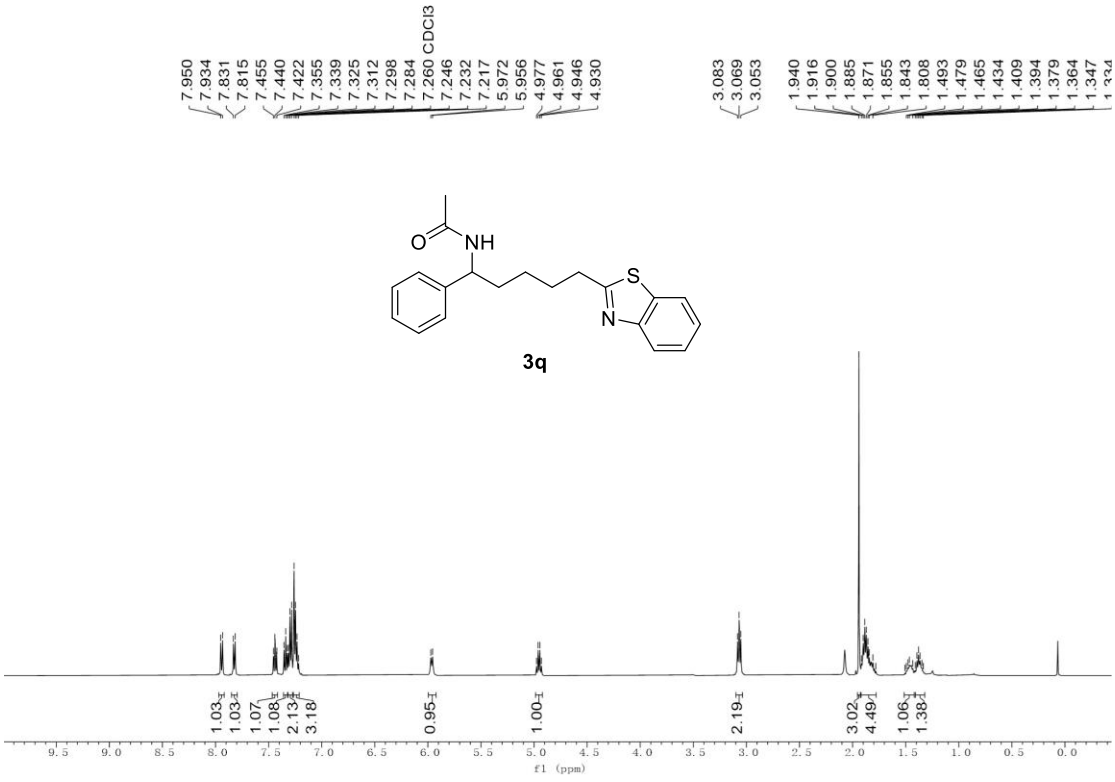
O
NH
S
N
3p
f1 (ppm)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7.339
7.325
7.312
7.298
7.284
7.260 CDCl3
7.246
7.232
7.217
5.972
5.956
4.977
4.961
4.946
4.930
3.083
3.069
3.053
1.940
1.916
1.900
1.885
1.871
1.855
1.843
1.808
1.493
1.479
1.465
1.434
1.409
1.394
1.379
1.364
1.347
O
NH
S
N
3q
1.03
1.03
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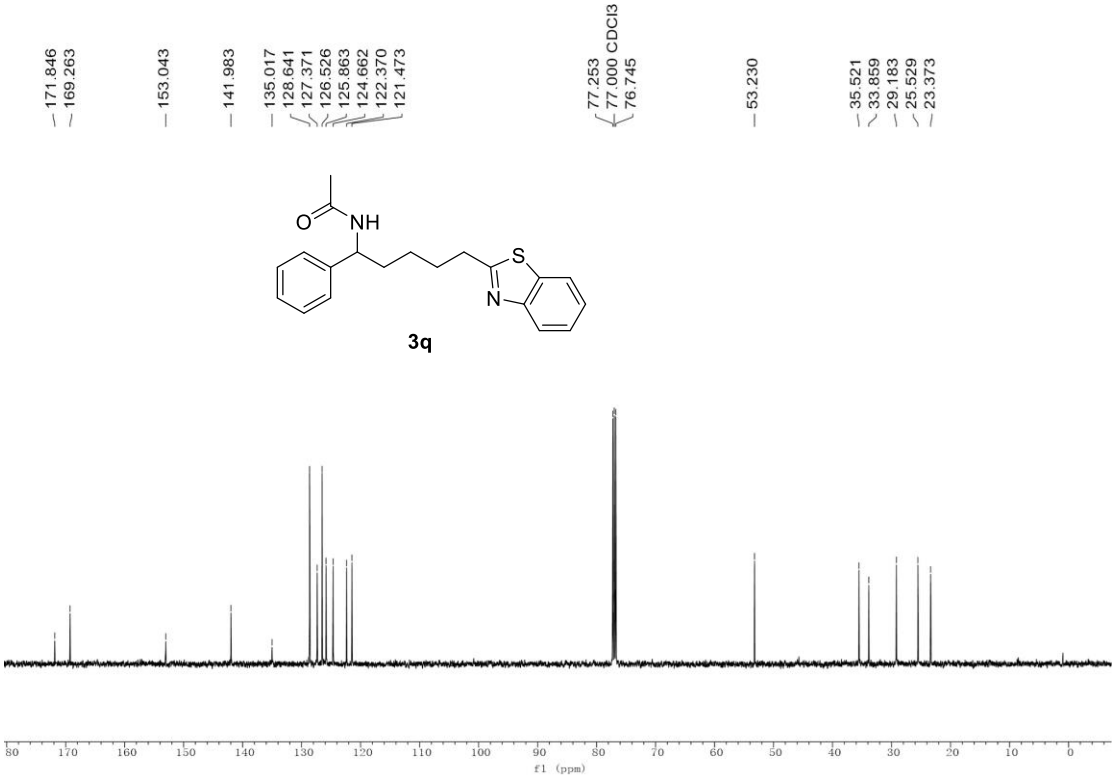
1.38
f1 (ppm)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122.370
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77.253
77.000 CDCl3
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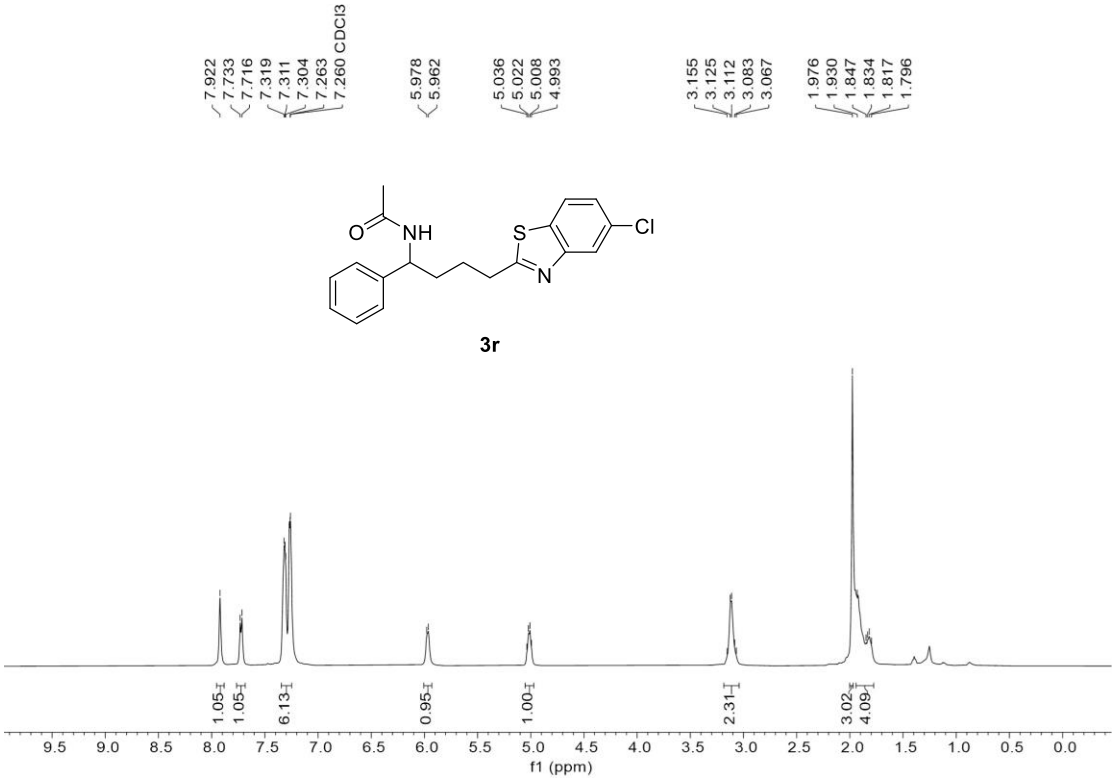
35.521
33.859
29.183
25.529
23.373
O
NH
S
N
3q
f1 (ppm)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7.260 CDCl3
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3.112
3.083
3.067
1.976
1.930
1.847
1.834
1.817
1.796
O
NH
S
N
Cl
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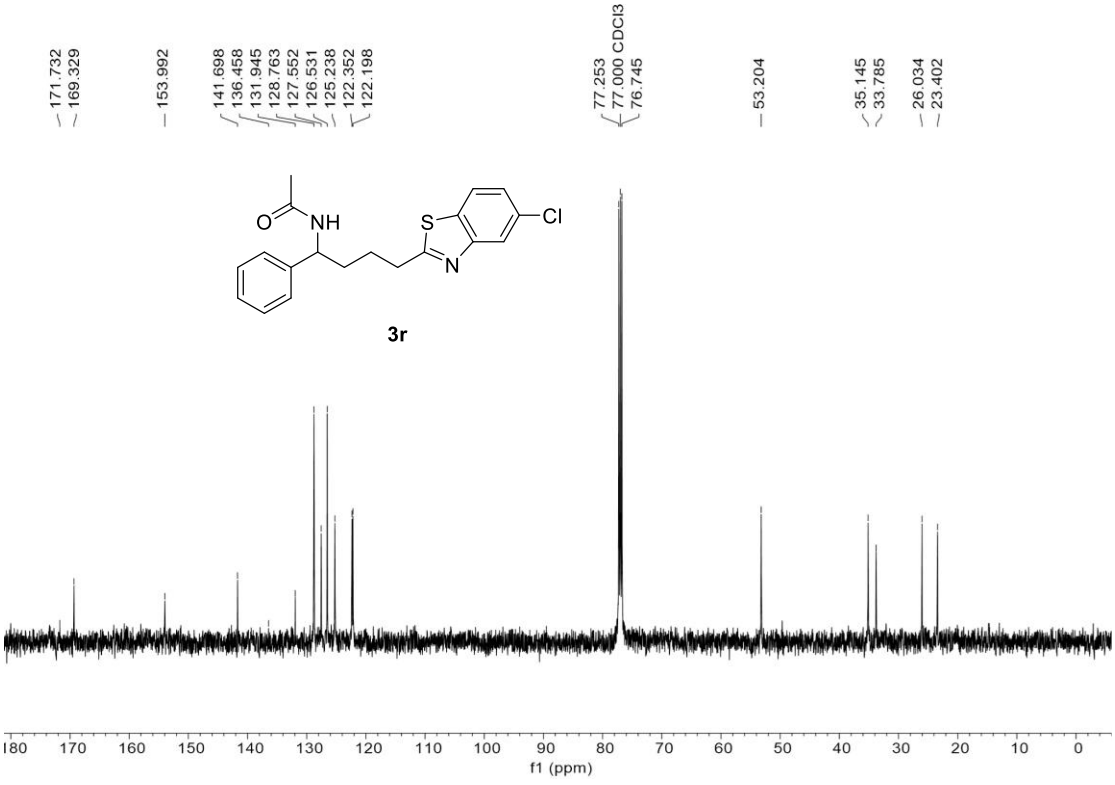
1.05
6.13
0.95
1.00
2.31
3.02
4.09
f1 (ppm)

3r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127.552
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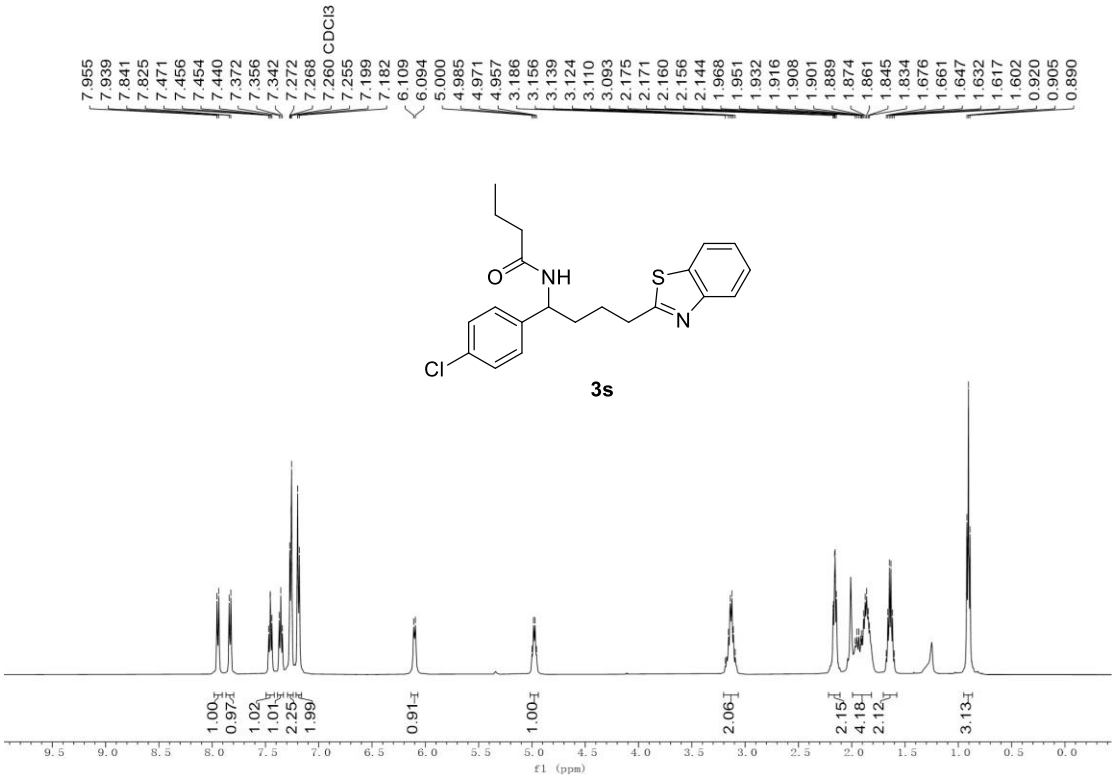
122.352
122.198
77.253
77.000 CDCl3
76.745
53.204
35.145
33.785
26.034
23.402
O
NH
S
N
Cl
f1 (ppm)

3r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7.342
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7.268
7.260 CDCl3
7.255
7.199
7.182
6.109
6.094
5.000
4.985
4.971
4.957
3.186
3.156
3.139
3.124
3.110
3.093
2.175
2.171
2.160
2.156
2.144
1.968
1.951
1.932
1.916
1.908
1.901
1.889
1.874
1.861
1.845
1.834
1.676
1.661
1.647
1.632
1.617
1.602
0.920
0.905
0.890
O
NH
S
N
Cl
3s
1.00
0.97
1.02
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1.99
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1.00
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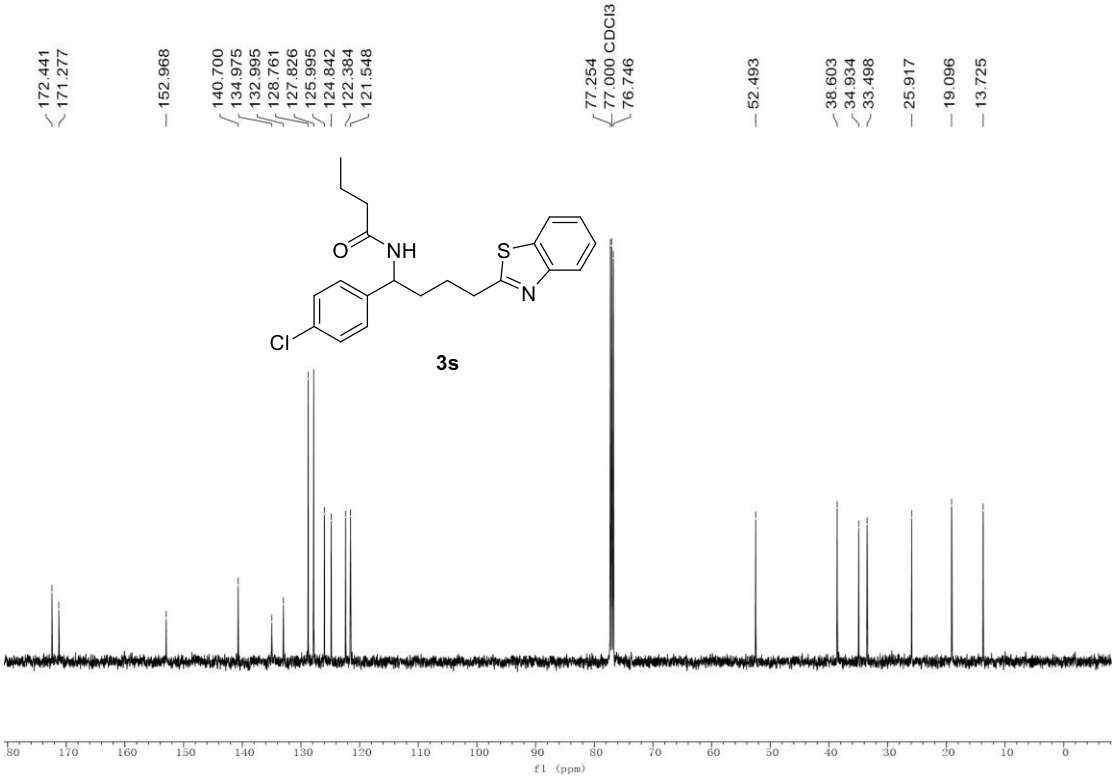
4.18
2.12
3.13
f1 (ppm)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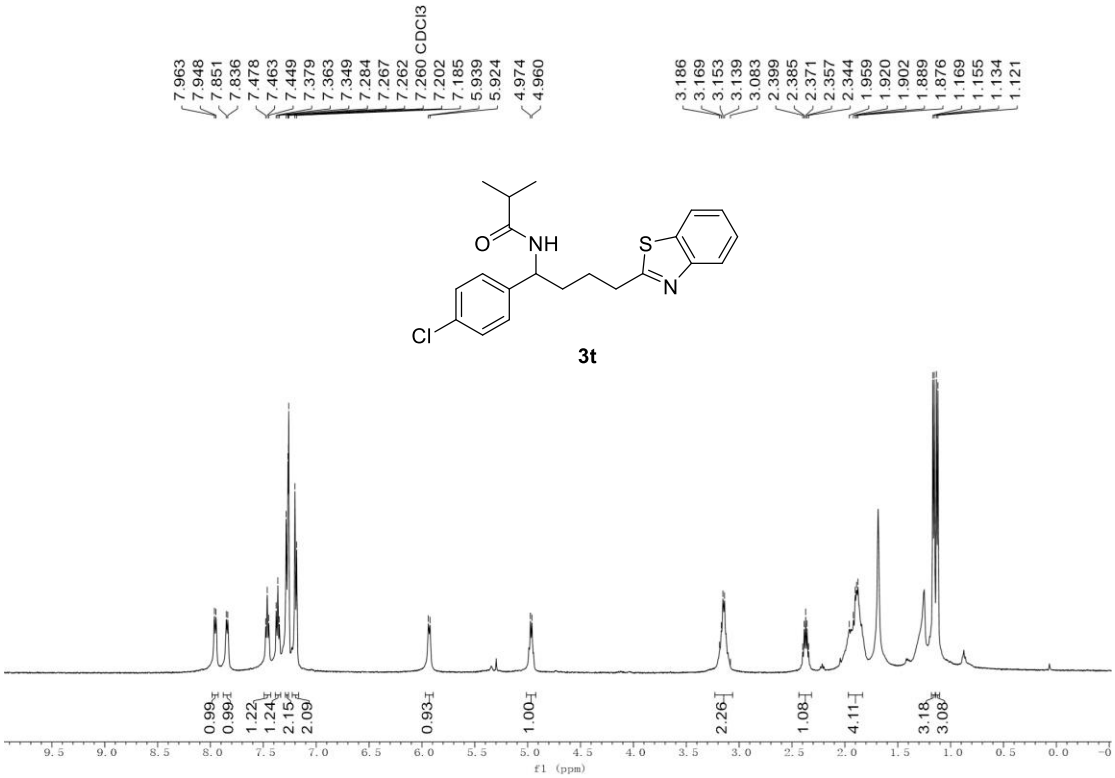
127.826
125.995
124.842
122.384
121.548
77.254
77.000 CDCl3
76.746
52.493
38.603
34.934
33.498
25.917
19.096
13.725
O
NH
S
N
Cl
3s
f1 (ppm)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7.267
7.262
7.260 CDCl3
7.202
7.185
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5.924
4.974
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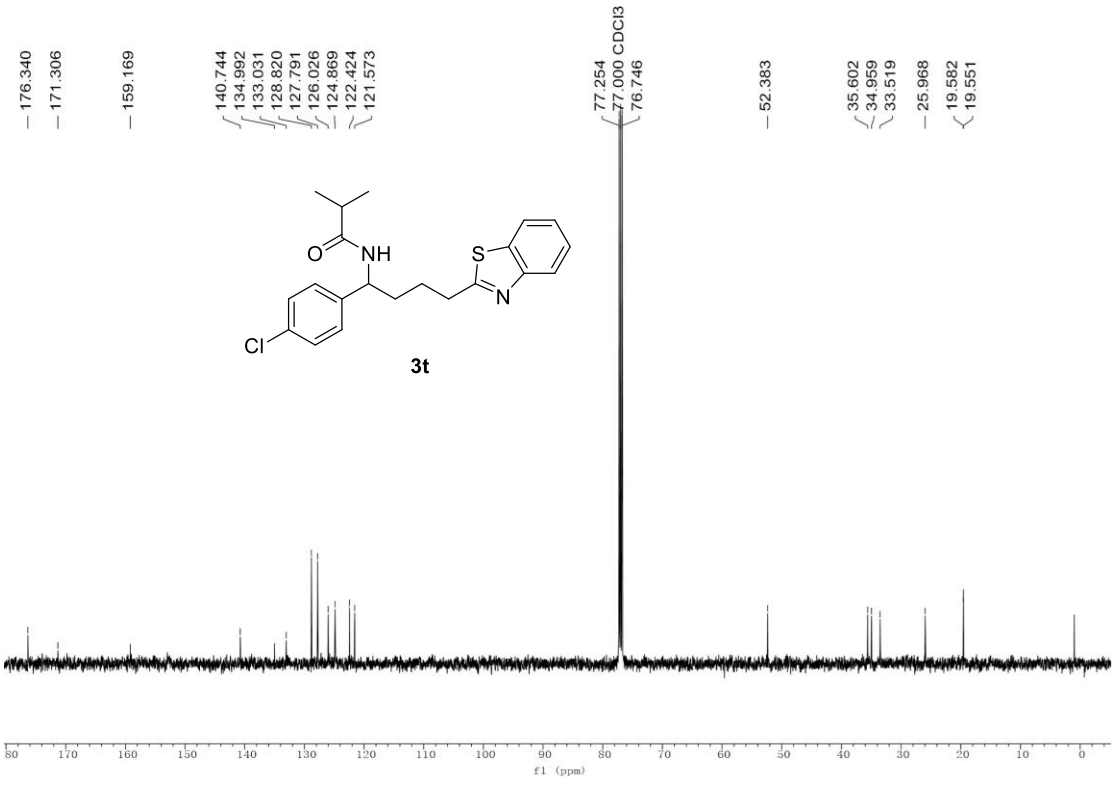
3.139
3.083
2.399
2.385
2.371
2.357
2.344
1.959
1.920
1.902
1.889
1.876
1.169
1.155
1.134
1.121
O
NH
S
N
Cl
0.99
0.99
1.22
1.24
2.15
2.09
0.93
1.00
2.26
1.08
4.11
3.18
3.08
f1 (ppm)

3t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121.573
77.254
77.000 CDCl3
76.746
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33.519
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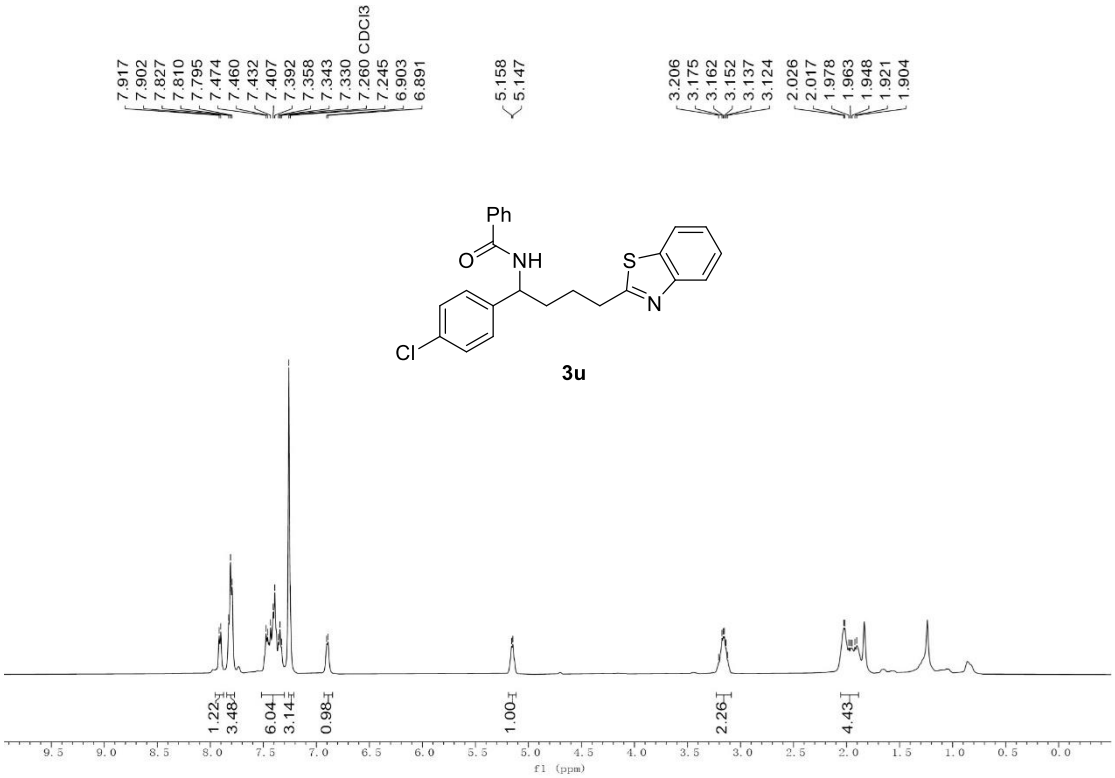
19.582
19.551
O
NH
S
N
Cl
f1 (ppm)

3t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7.343
7.330
7.260 CDCl3
7.245
6.903
6.891
5.158
5.147
3.206
3.175
3.162
3.152
3.137
3.124
2.026
2.017
1.978
1.963
1.948
1.921
1.904
Ph
O
NH
S
N
Cl
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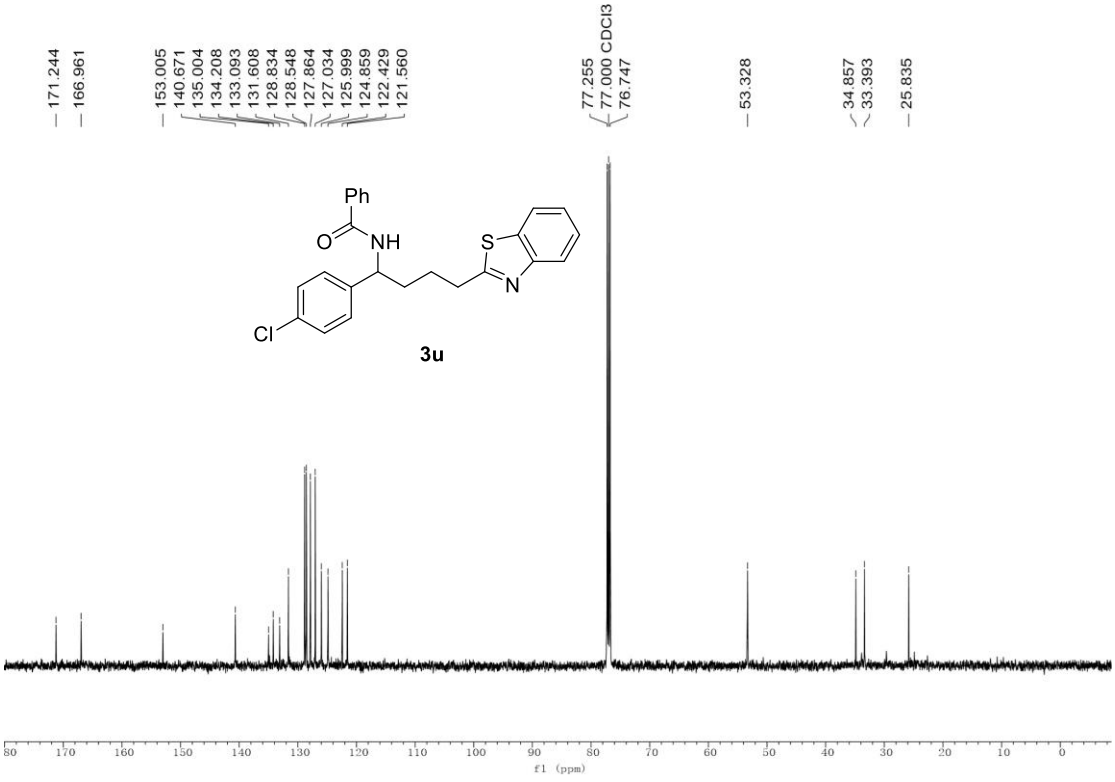
3.48
6.04
3.14
0.98
1.00
2.26
4.43
f1 (ppm)

3u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124.859
122.429
121.560
77.255
77.000 CDCl3
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Ph
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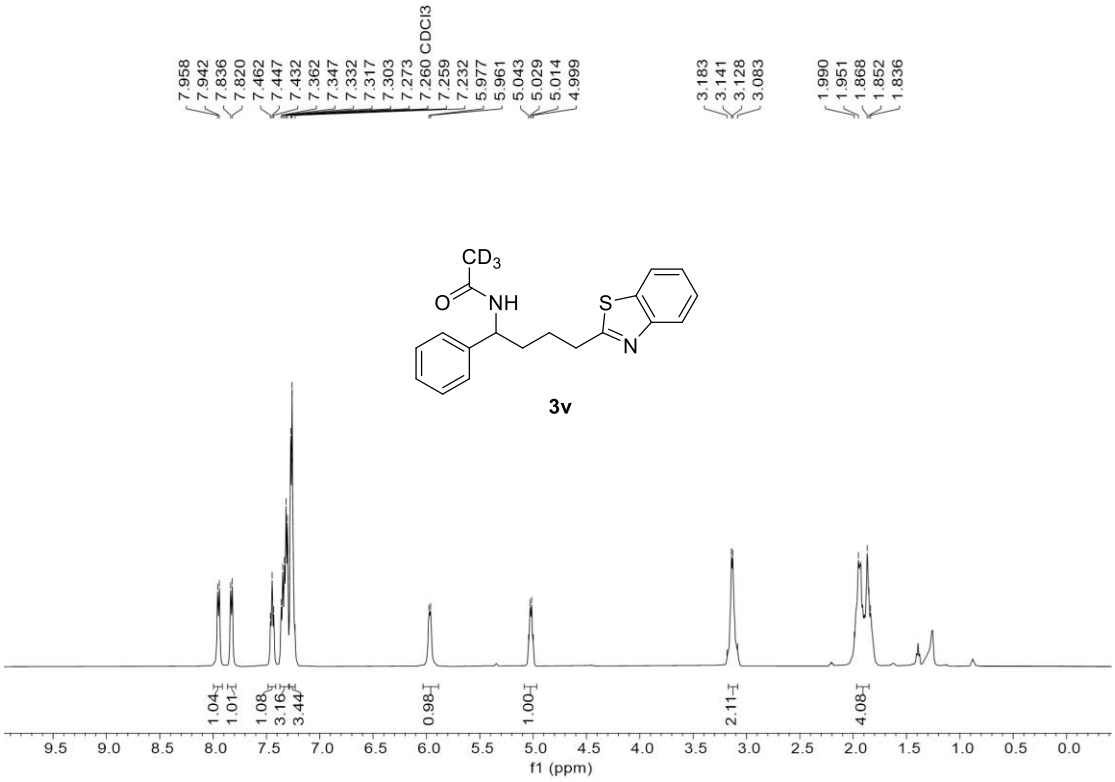
NH
S
N
Cl
f1 (ppm)

3u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7.347
7.332
7.317
7.303
7.273
7.260 CDCl3
7.259
7.232
5.977
5.961
5.043
5.029
5.014
4.999
3.183
3.141
3.128
3.083
1.990
1.951
1.868
1.852
1.836
CD3
O
NH
S
N
3v
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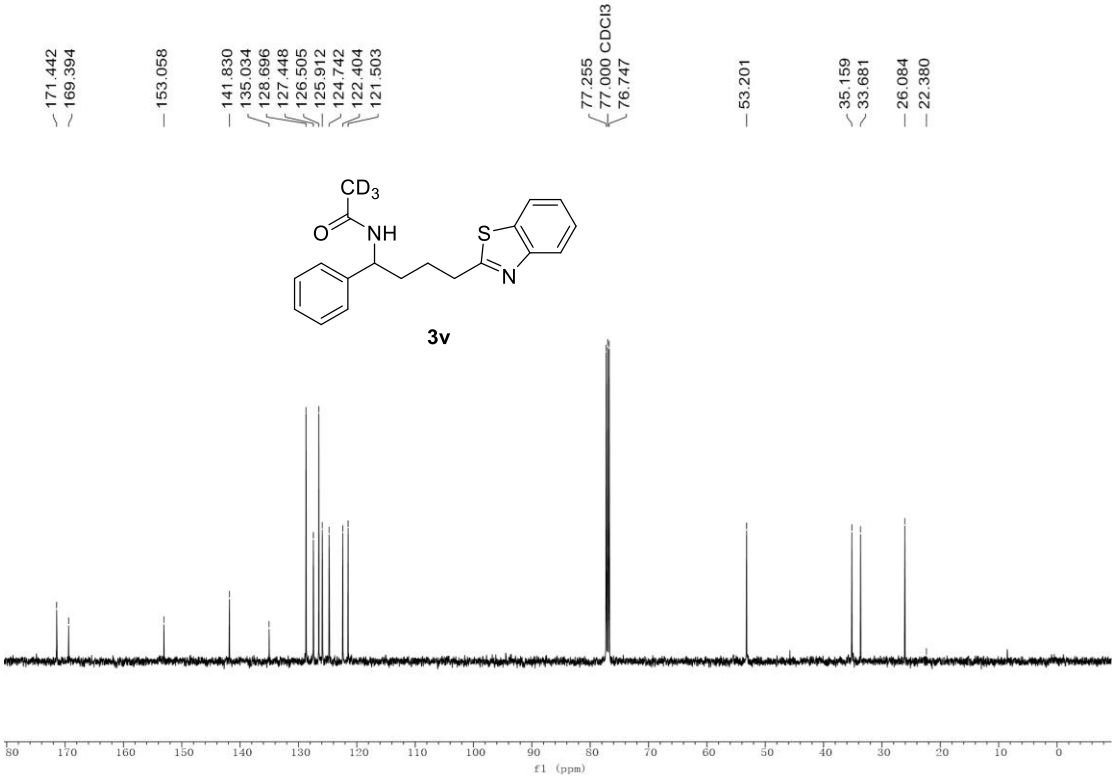
1.01
1.08
3.16
3.44
0.98
1.00
2.11
4.08
f1 (ppm)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77.255
77.000 CDCl3
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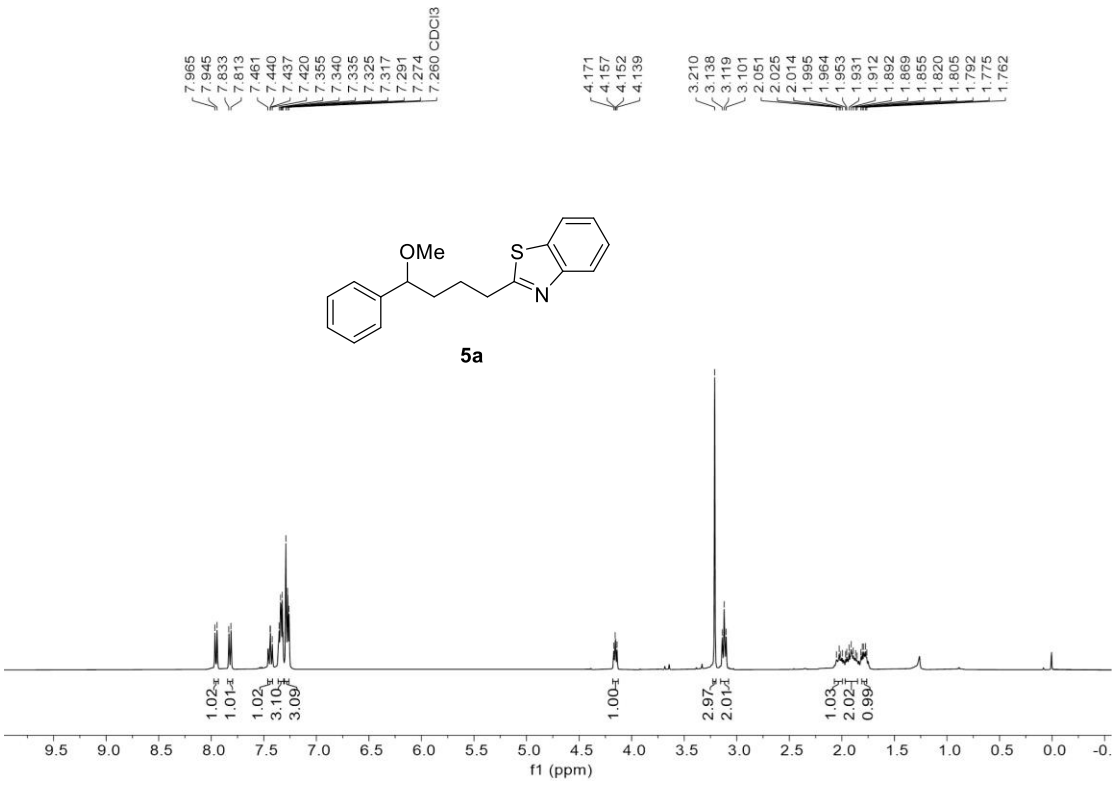
35.159
33.681
26.084
22.380
CD3
O
NH
S
N
3v
f1 (ppm)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7.420
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7.340
7.335
7.325
7.317
7.291
7.274
7.260 CDCl3
4.171
4.157
4.152
4.139
3.210
3.138
3.119
3.101
2.051
2.025
2.014
1.995
1.964
1.953
1.931
1.912
1.892
1.869
1.855
1.820
1.805
1.792
1.775
1.762
OMe
S
N
5a
1.02
1.01
1.02
3.10
3.09
1.00
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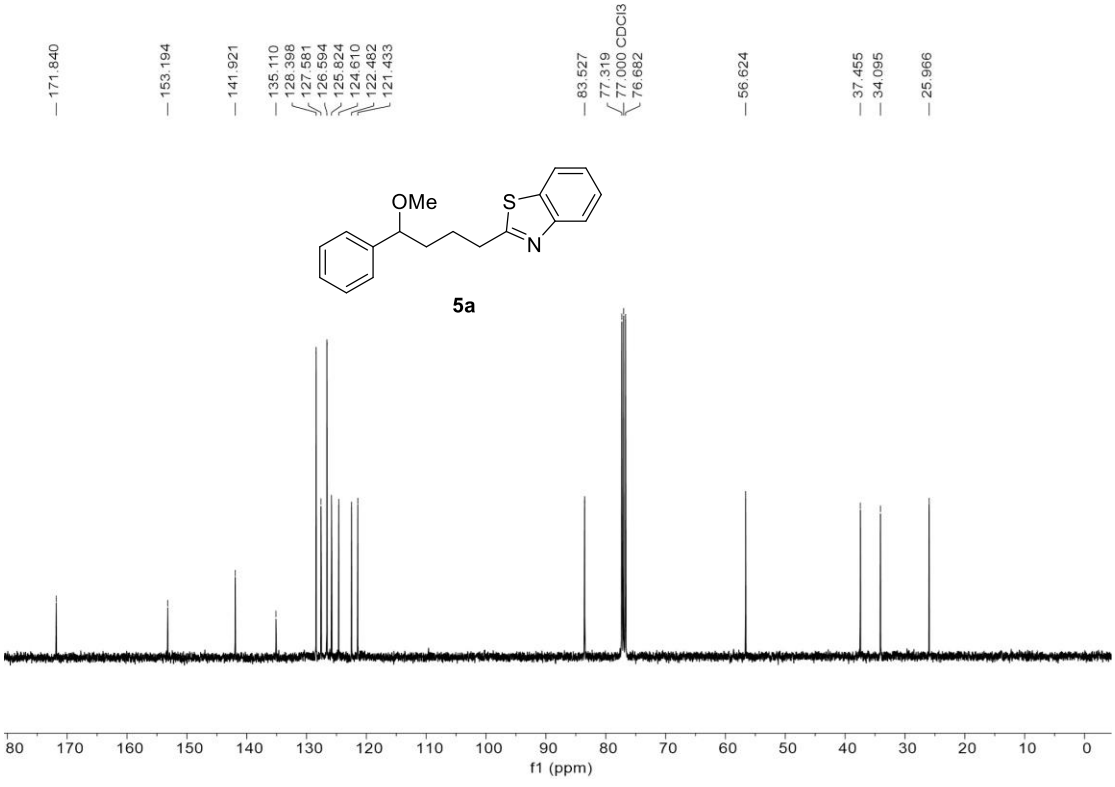
2.01
1.03
2.02
0.99
f1 (ppm)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127.581
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125.824
124.610
122.482
121.433
83.527
77.319
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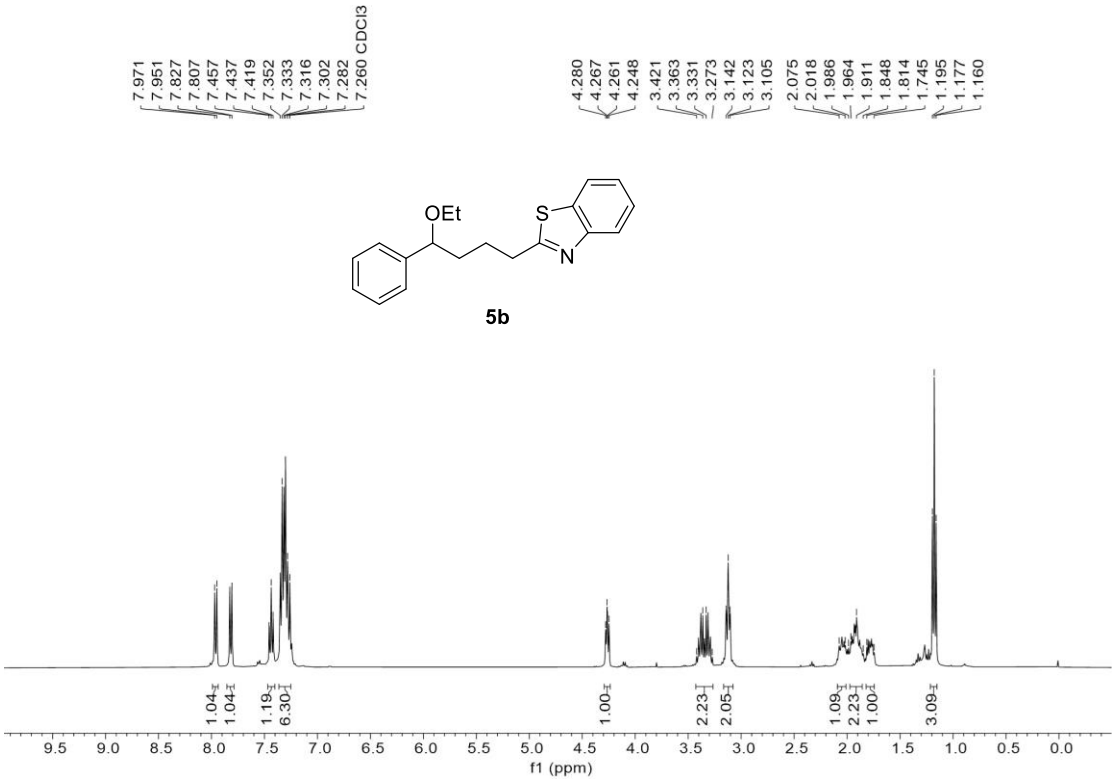
76.682
56.624
37.455
34.095
25.966
OMe
S
N
5a
f1 (ppm)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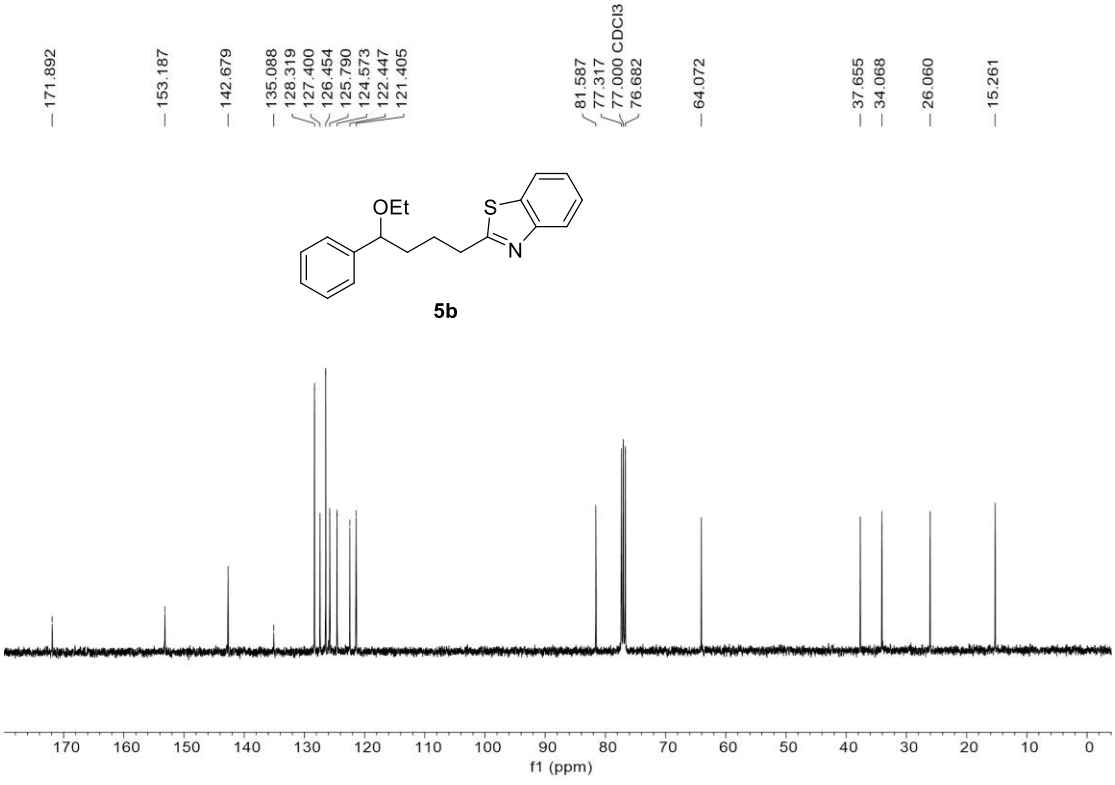
7.437
7.419
7.352
7.333
7.316
7.302
7.282
7.260 CDCl3
4.280
4.267
4.261
4.248
3.421
3.363
3.331
3.273
3.142
3.123
3.105
2.075
2.018
1.986
1.964
1.911
1.848
1.814
1.745
1.195
1.177
1.160
OEt
S
N
1.04
1.04
1.19
6.30
1.00
2.23
2.05
1.09
2.23
1.00
3.09
f1 (ppm)

5b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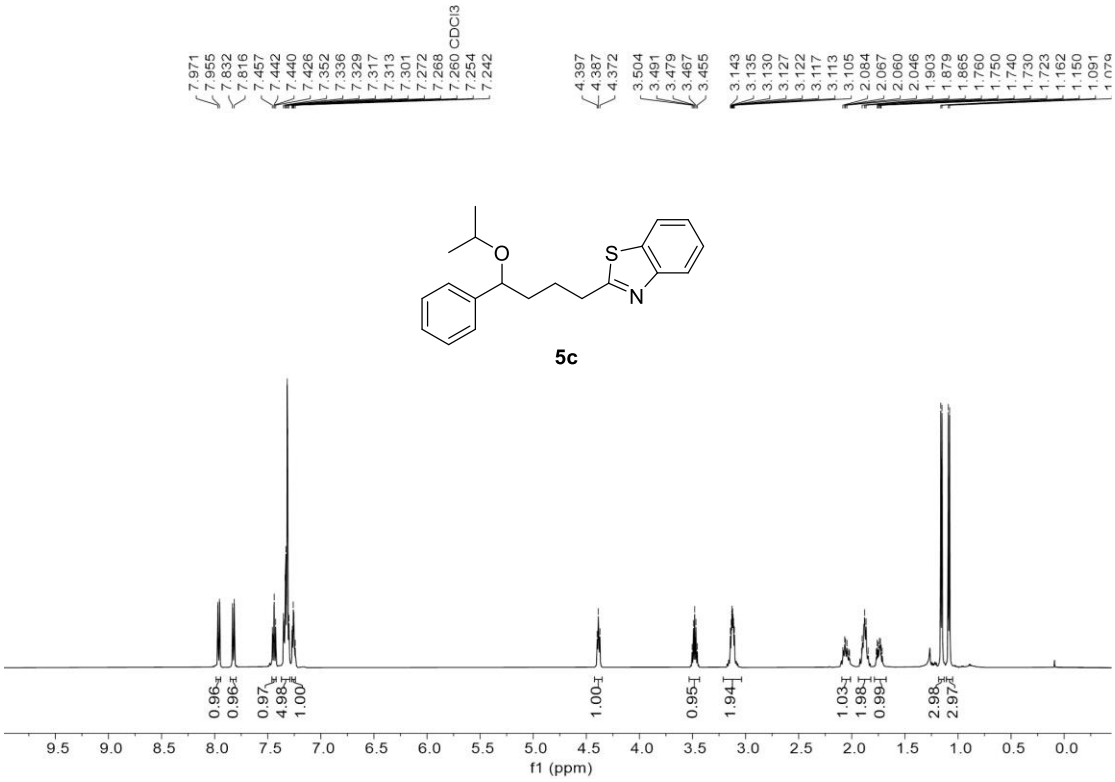
127.400
126.454
125.790
124.573
122.447
121.405
81.587
77.317
77.000 CDCl3
76.682
64.072
37.655
34.068
26.060
15.261
OEt
S
N
f1 (ppm)

5b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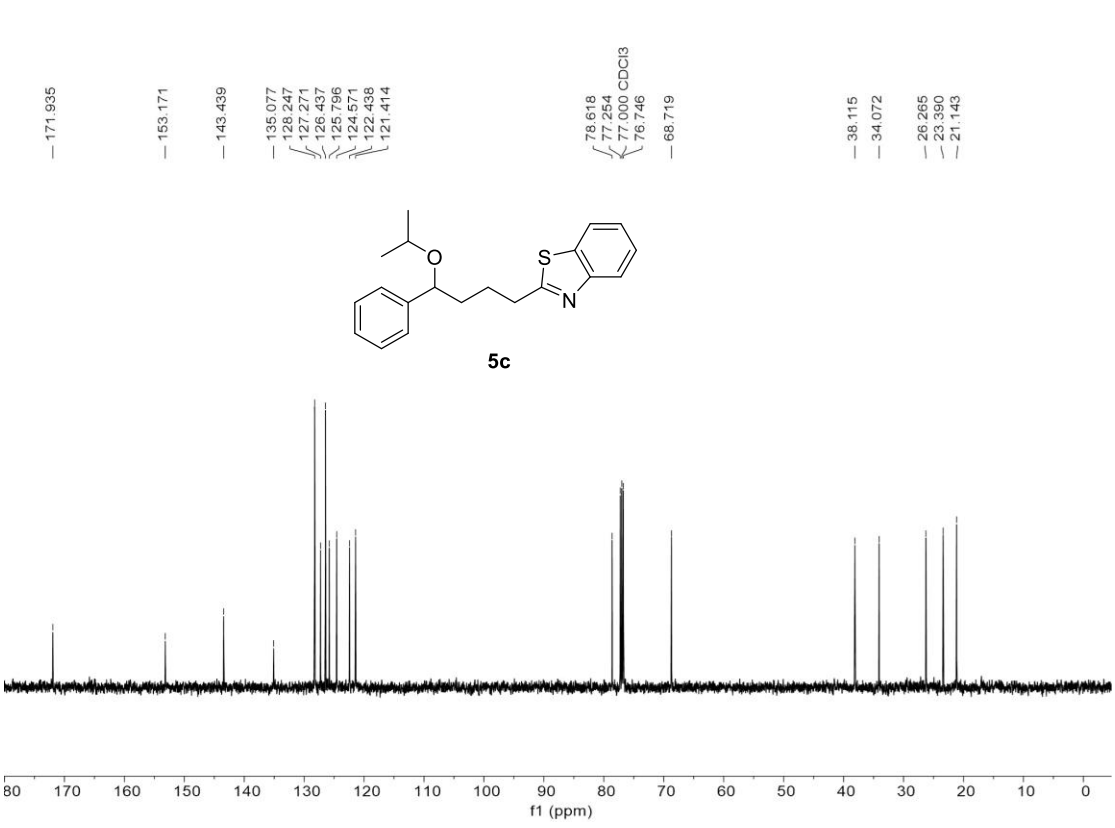
7.440
7.426
7.352
7.336
7.329
7.317
7.313
7.301
7.272
7.268
7.260 CDCl3
7.254
7.242
4.397
4.387
4.372
3.504
3.491
3.479
3.467
3.455
3.143
3.135
3.130
3.127
3.122
3.117
3.113
3.105
2.084
2.067
2.060
2.046
1.903
1.879
1.865
1.760
1.750
1.740
1.730
1.723
1.162
1.150
1.091
0.96
0.96
0.97
4.98
1.00
1.00
0.95
1.94
1.03
1.98
0.99
2.98
2.97
f1 (ppm)

5c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143.439
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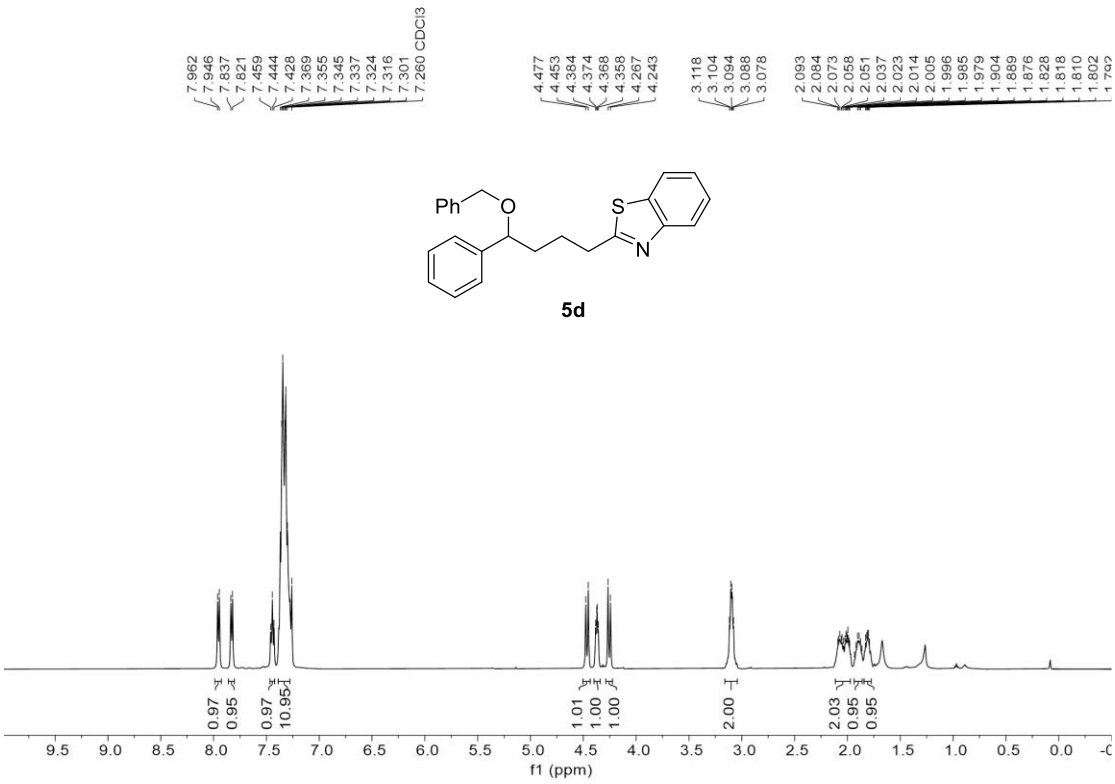
128.247
127.271
126.437
125.796
124.571
122.438
121.414
78.618
77.254
77.000 CDCl3
76.746
68.719
38.115
34.072
26.265
23.390
21.143
f1 (ppm)

5c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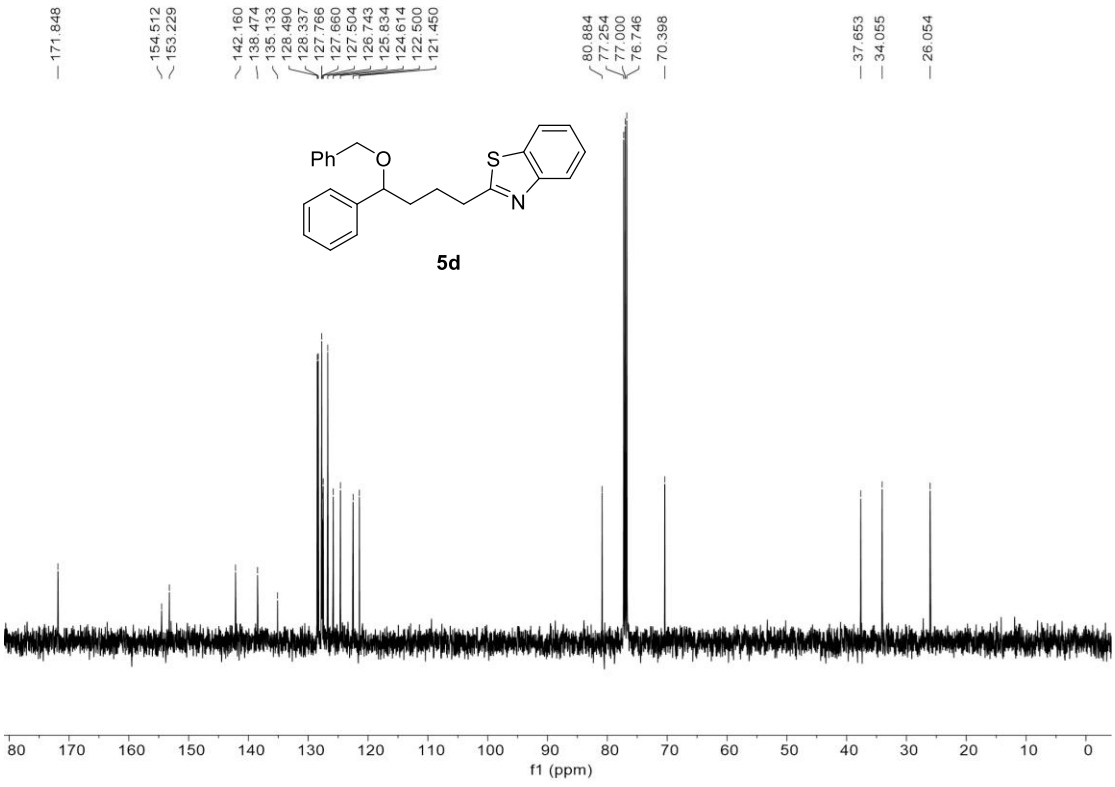
7.428
7.369
7.355
7.345
7.337
7.324
7.316
7.301
7.260 CDCl3
4.477
4.453
4.384
4.374
4.368
4.358
4.267
4.243
3.118
3.104
3.094
3.088
3.078
2.093
2.084
2.073
2.058
2.051
2.037
2.023
2.014
2.005
1.996
1.985
1.979
1.904
1.889
1.876
1.828
1.818
1.810
1.802
Ph
O
S
N
5d
0.97
0.95
0.97
10.95
1.01
1.00
1.00
2.00
2.03
0.95
0.95
f1 (ppm)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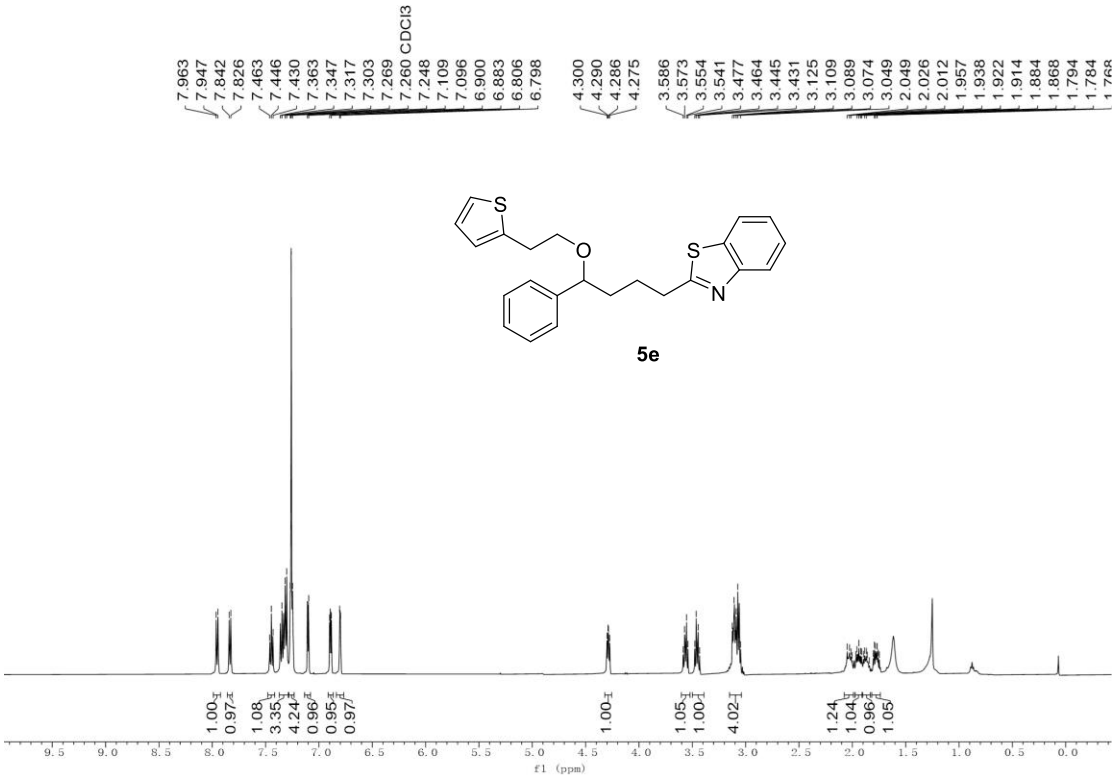
128.337
127.766
127.660
127.504
126.743
125.834
124.614
122.500
121.450
80.884
77.254
77.000
76.746
70.398
37.653
34.055
26.054
Ph
O
S
N
5d
f1 (ppm)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7.363
7.347
7.317
7.303
7.269
7.260 CDCl3
7.248
7.109
7.096
6.900
6.883
6.806
6.798
4.300
4.290
4.286
4.275
3.586
3.573
3.554
3.541
3.477
3.464
3.445
3.431
3.125
3.109
3.089
3.074
3.049
2.049
2.026
2.012
1.957
1.938
1.922
1.914
1.884
1.868
1.794
1.784
S
O
S
N
5e
1.00
0.97
1.08
3.35
4.24
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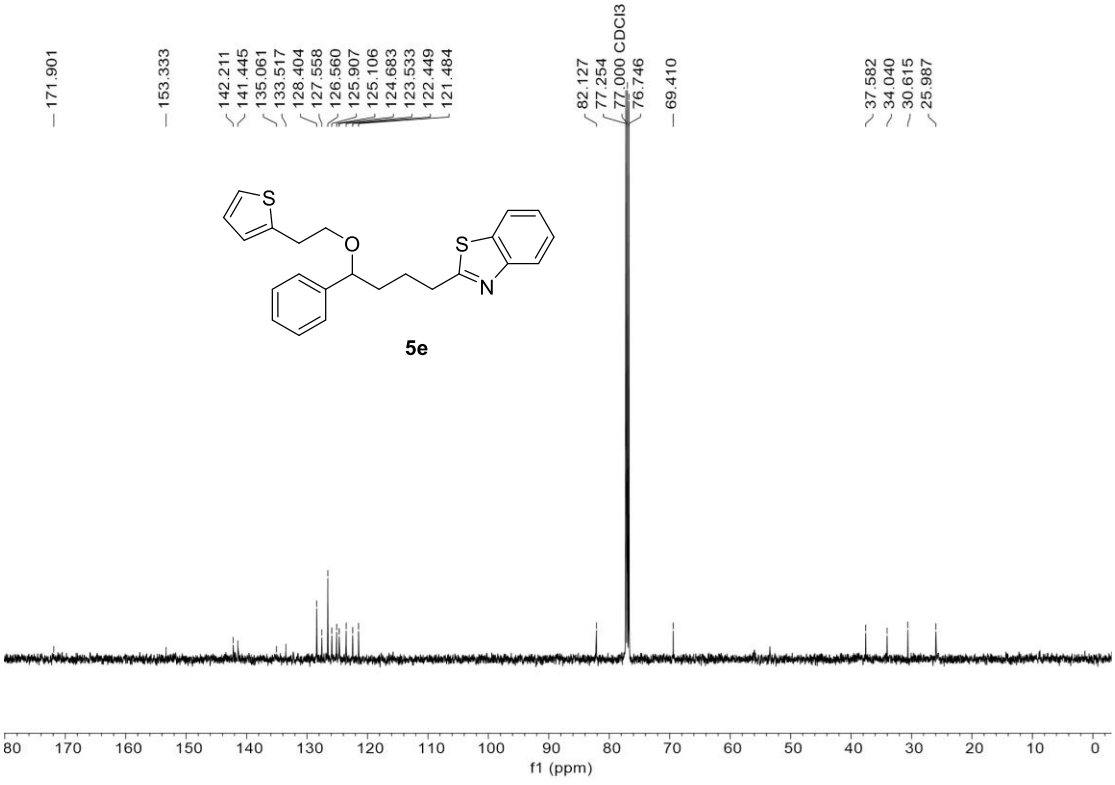
1.00
4.02
1.24
1.04
0.96
1.05
f1 (ppm)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127.558
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125.907
125.106
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123.533
122.449
121.484
82.127
77.254
77.000 CDCl3
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69.410
37.582
34.040
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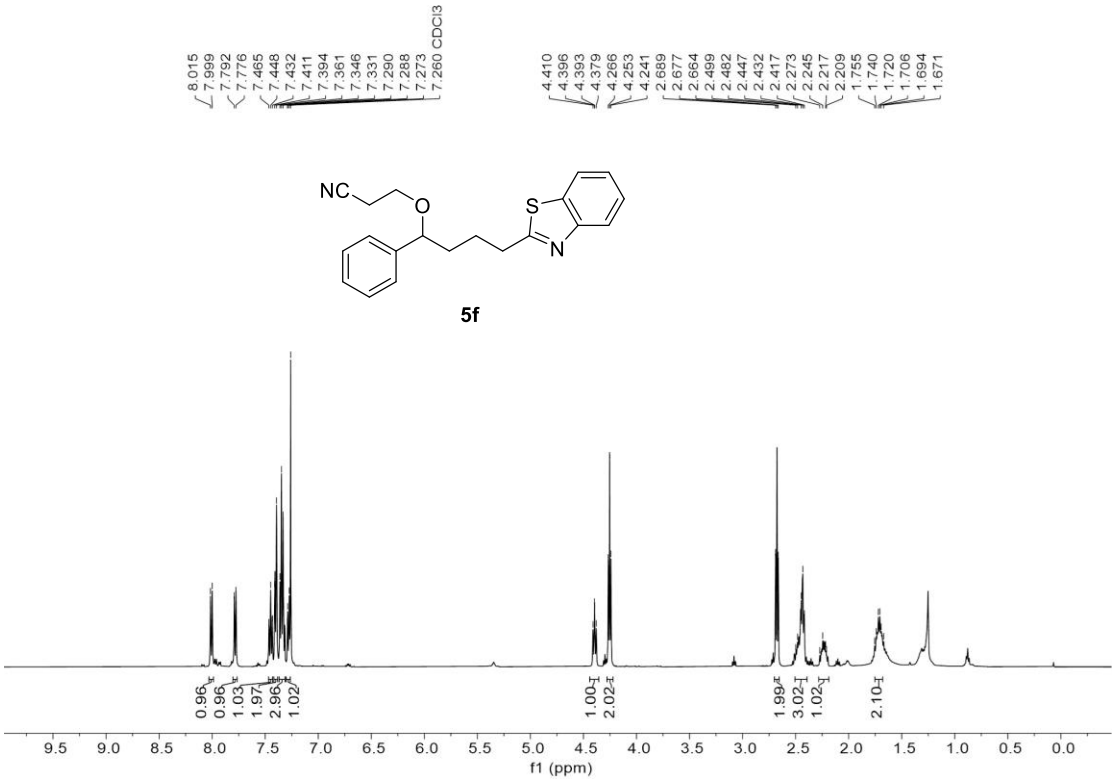
S
O
S
N
5e
f1 (ppm)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7.288
7.273
7.260 CDCl3
4.410
4.396
4.393
4.379
4.266
4.253
4.241
2.689
2.677
2.664
2.499
2.482
2.447
2.432
2.417
2.273
2.245
2.217
2.209
1.755
1.740
1.720
1.706
1.694
1.671
NC
O
S
N
5f
0.96
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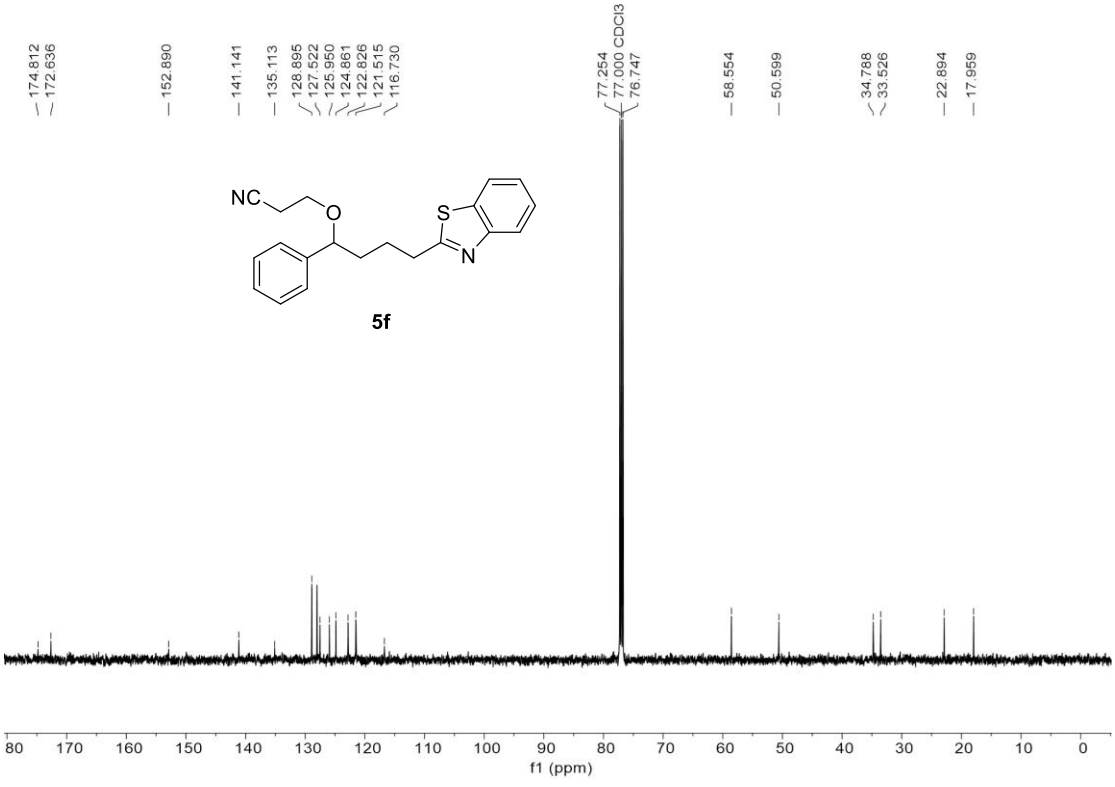
1.99
3.02
1.02
2.10
f1 (ppm)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125.950
124.861
122.826
121.515
116.730
77.254
77.000 CDCl3
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50.599
34.788
33.526
22.894
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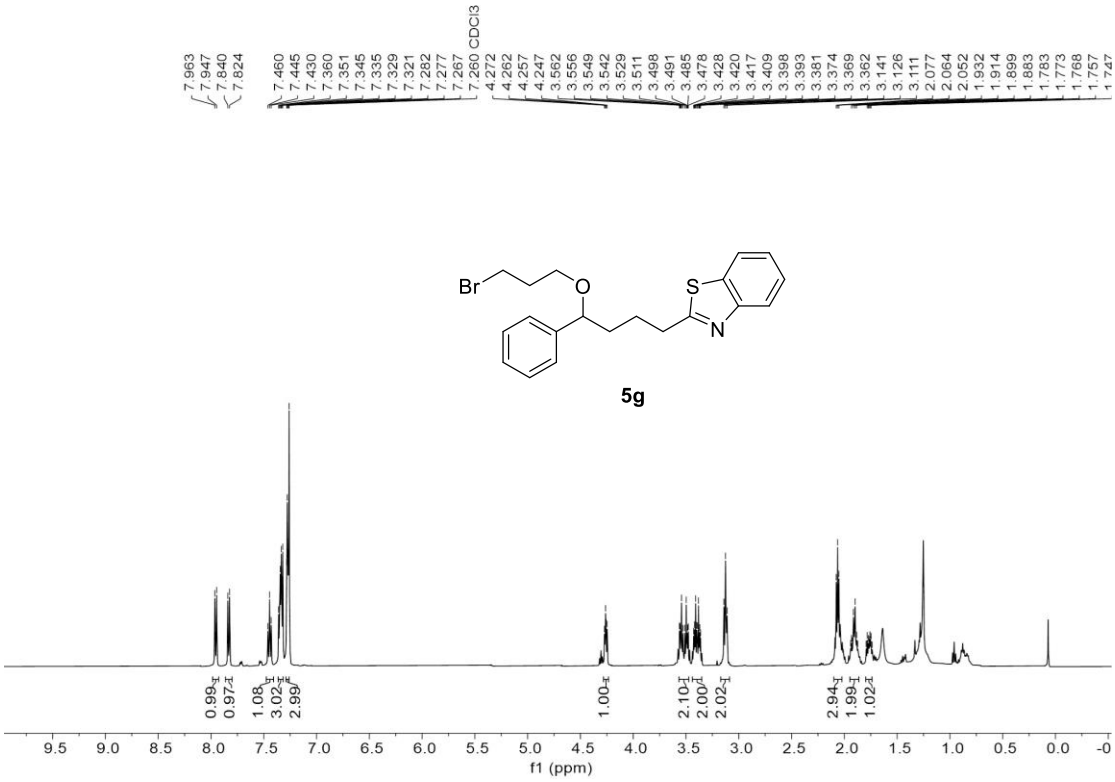
NC
O
S
N
5f
f1 (ppm)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7.329
7.321
7.282
7.277
7.267
7.260 CDCl3
4.272
4.262
4.257
4.247
3.562
3.556
3.549
3.542
3.529
3.511
3.498
3.491
3.485
3.478
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3.417
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3.398
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3.141
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1.899
1.883
1.783
1.773
1.768
1.757
1.747
Br
O
S
N
5g
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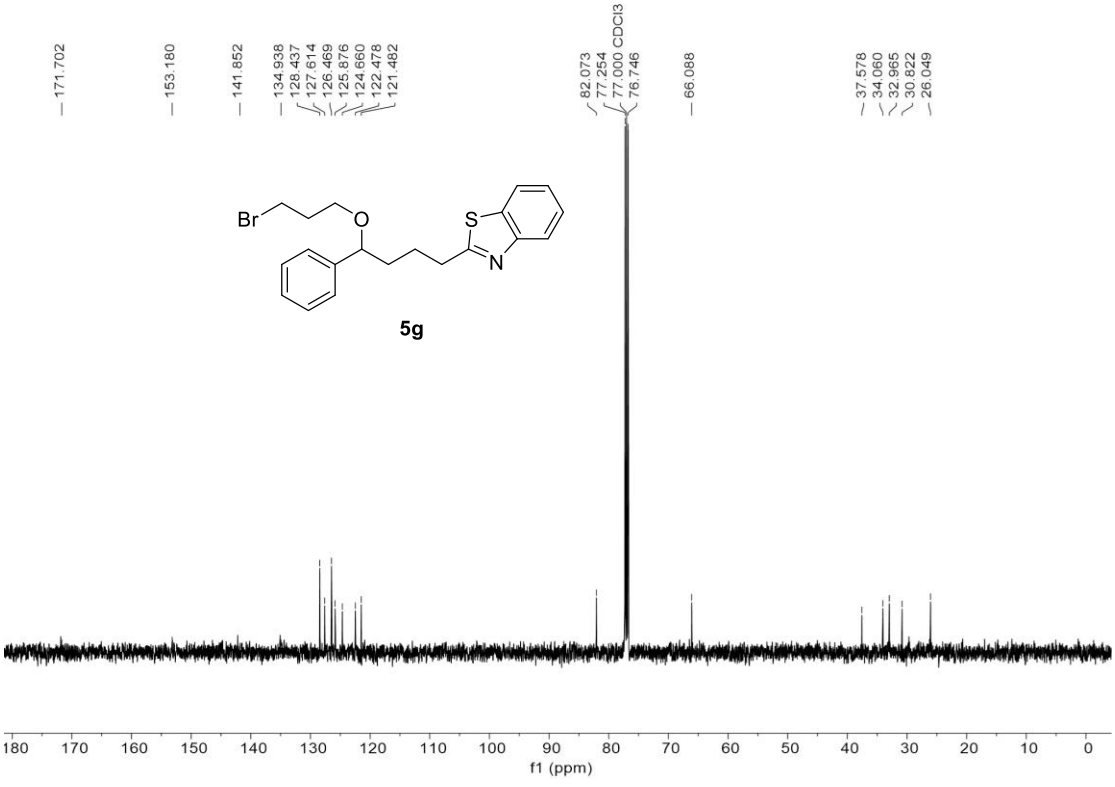
1.02
f1 (ppm)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125.876
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121.482
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77.254
77.000 CDCl3
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34.060
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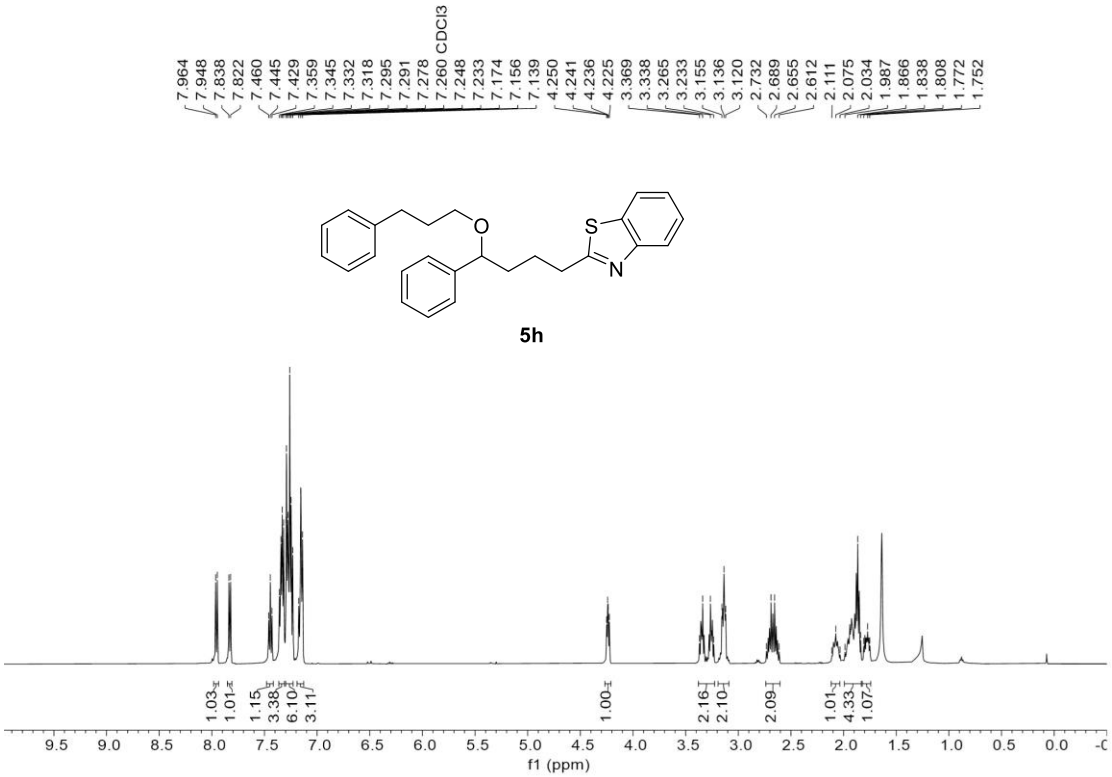
30.822
26.049
Br
O
S
N
5g
f1 (ppm)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7.291
7.278
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7.248
7.233
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7.156
7.139
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4.241
4.236
4.225
3.369
3.338
3.265
3.233
3.155
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3.120
2.732
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2.655
2.612
2.111
2.075
2.034
1.987
1.866
1.838
1.808
1.772
1.752
O
S
N
5h
1.03
1.01
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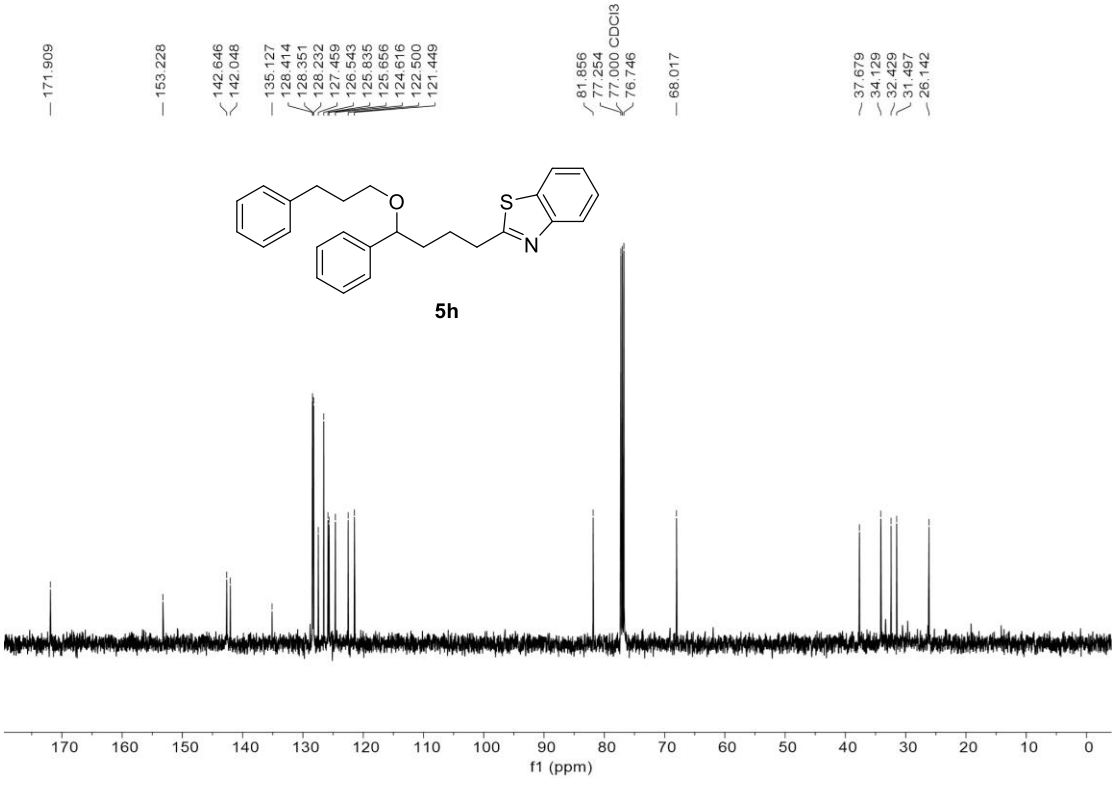
2.10
2.09
1.01
4.33
1.07
f1 (ppm)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128.232
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125.835
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122.500
121.449
81.856
77.254
77.000 CDCl3
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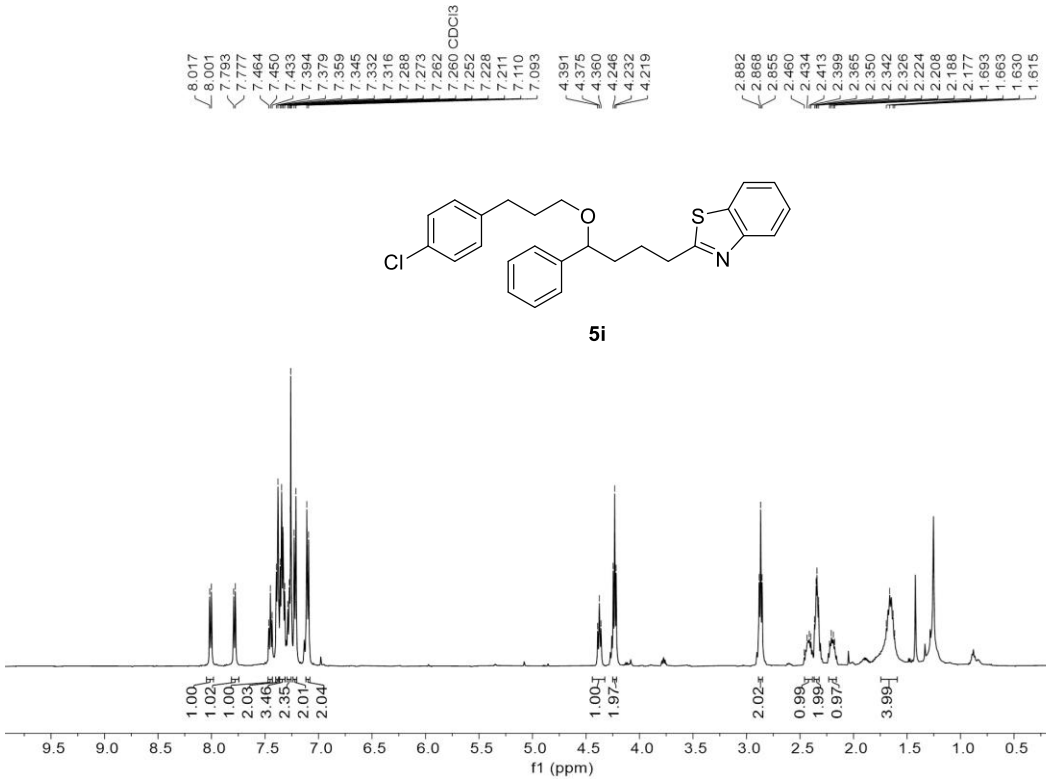
68.017
37.679
34.129
32.429
31.497
26.142
O
S
N
5h
f1 (ppm)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7.273
7.262
7.260 CDCl3
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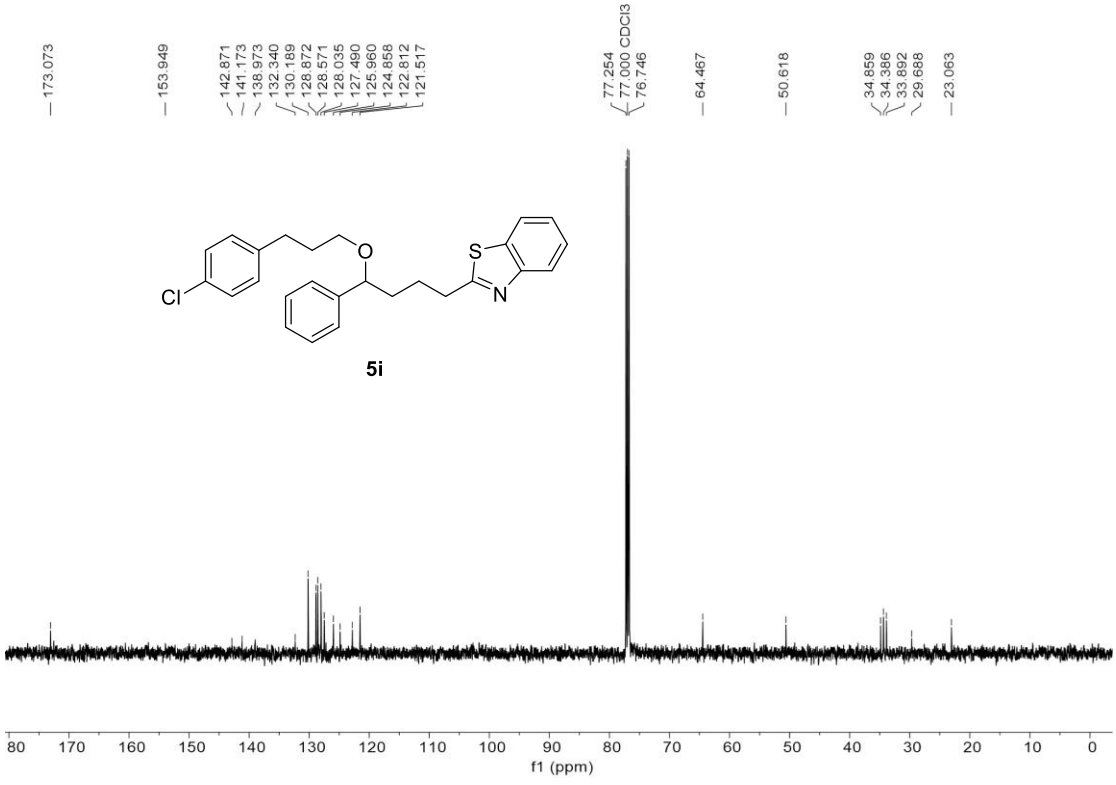
7.228
7.211
7.110
7.093
4.391
4.375
4.360
4.246
4.232
4.219
2.882
2.868
2.855
2.460
2.434
2.413
2.399
2.365
2.350
2.342
2.326
2.224
2.208
2.188
2.177
1.693
1.663
1.630
1.615
Cl
O
S
N
5i
1.00
1.02
1.00
2.03
3.46
2.35
2.01
2.04
1.00
1.97
2.02
0.99
1.99
0.97
3.99
f1 (ppm)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128.872
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127.490
125.960
124.858
122.812
121.517
77.254
77.000 CDCl3
76.746
64.467
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34.859
34.386
33.892
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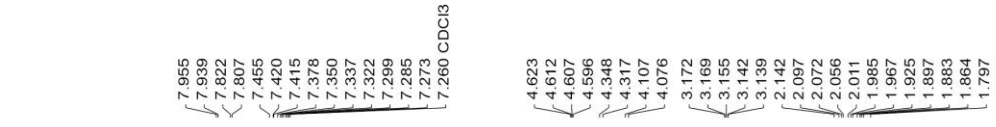
23.063
Cl
O
S
N
5i
f1 (ppm)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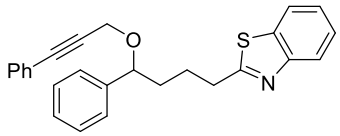
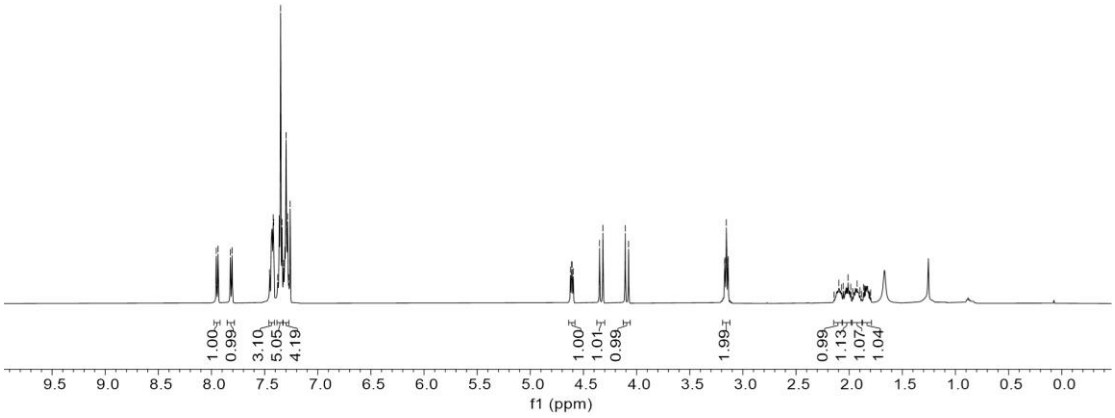
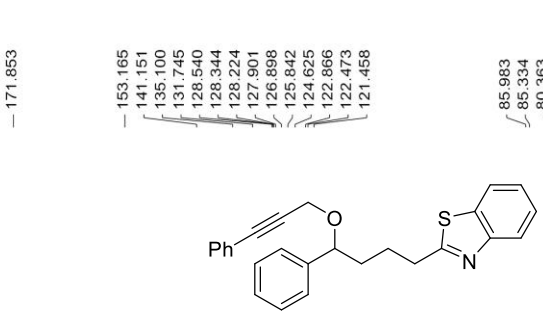
7.285
7.273
7.260 CDCl3
4.623
4.612
4.607
4.596
4.348
4.317
4.107
4.076
3.172
3.169
3.155
3.142
3.139
2.142
2.097
2.072
2.056
2.011
1.985
1.967
1.925
1.897
1.883
1.864
1.797


Ph
O
S
N

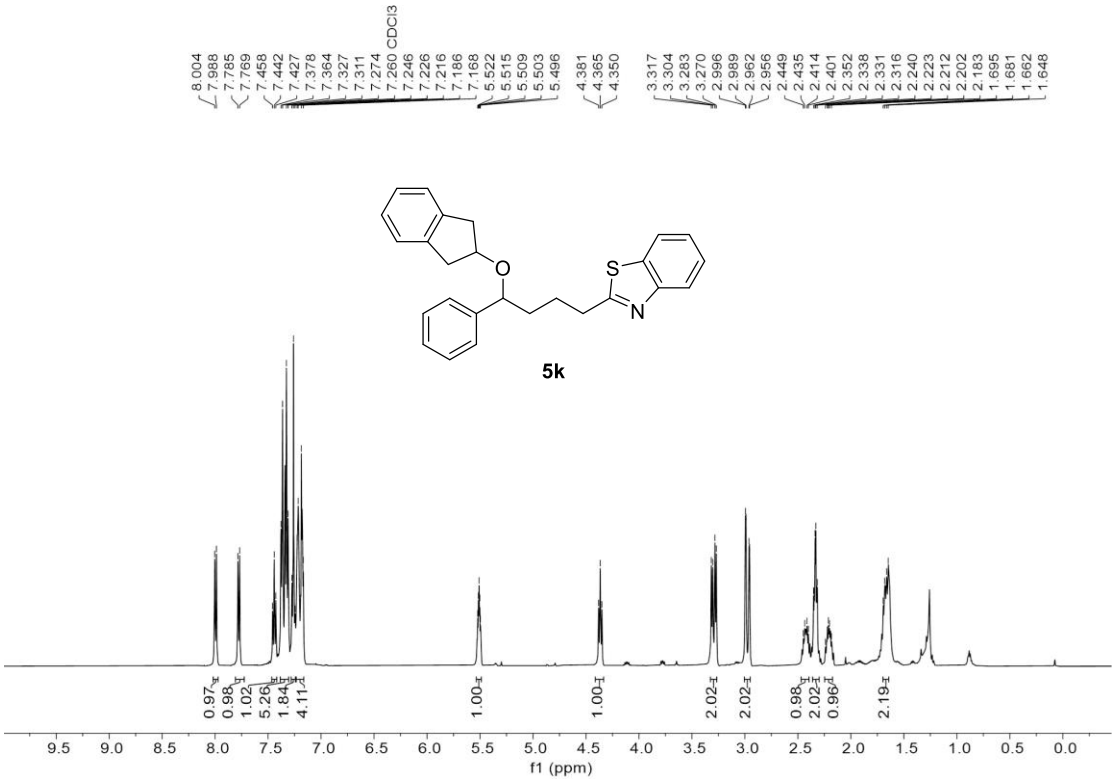
5j

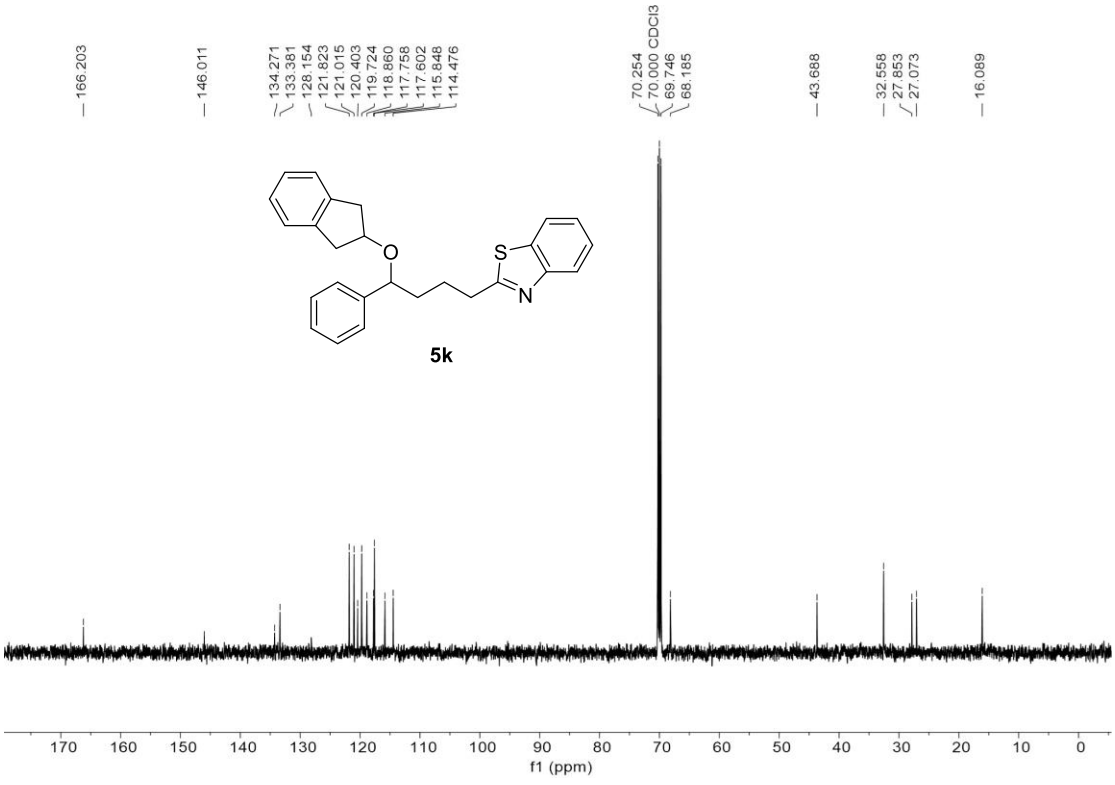

1.00
0.99
3.10
5.05
4.19
1.00
1.01
0.99
1.99
0.99
1.13
1.07
1.04
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


171.853
153.165
141.151
135.100
131.745
128.540
128.344
128.224
127.901
126.898
125.842
124.625
122.866
122.473
121.458
85.983
85.334
80.363
77.253
77.000 CDCl3
76.746
56.472
37.211
33.971
26.040
Ph
O
S
N

5j

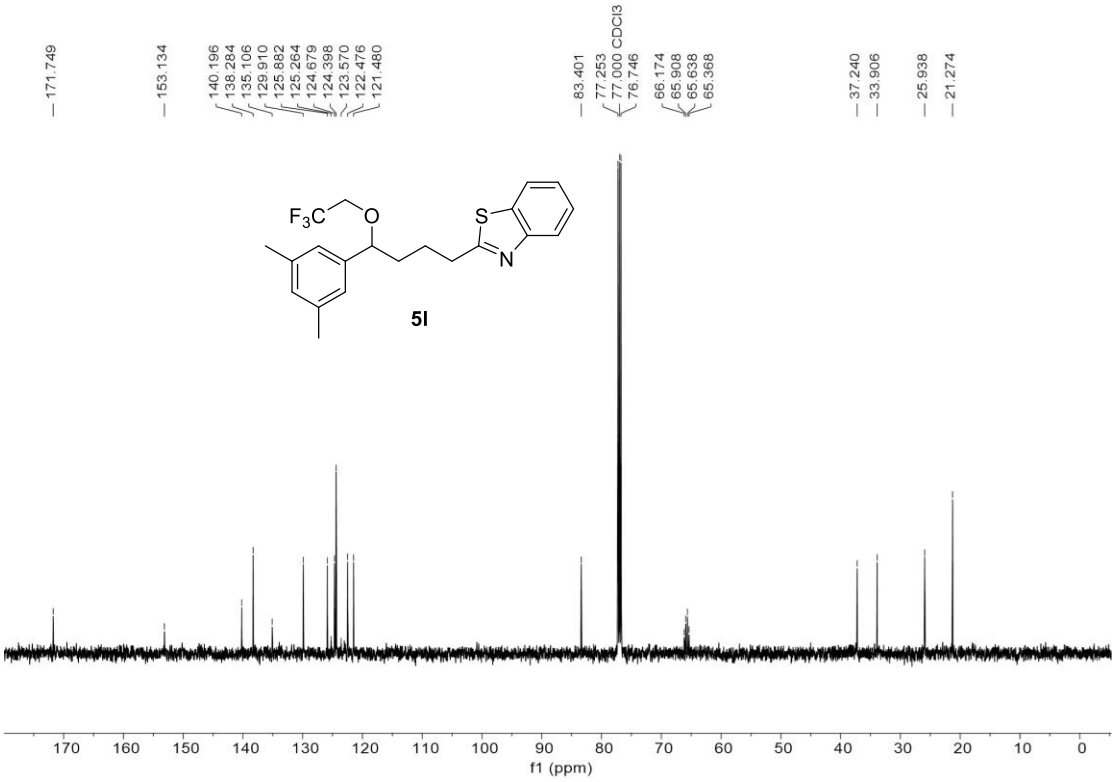
80 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

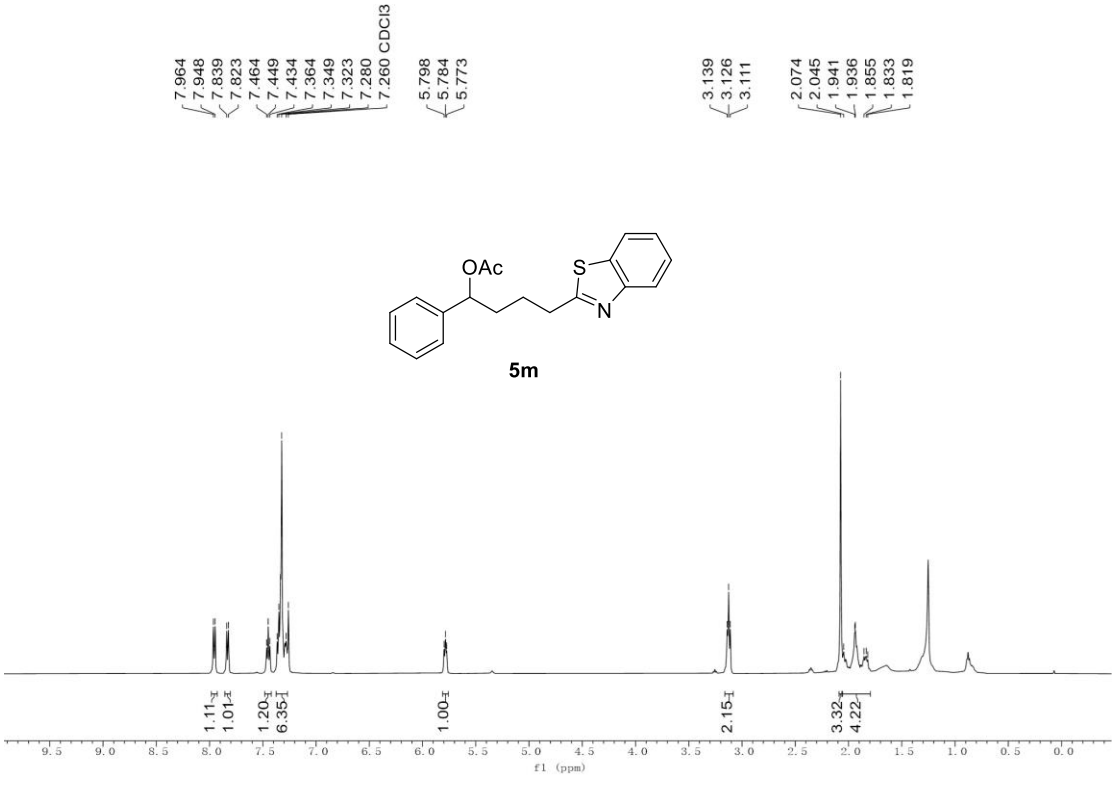

8.004
7.988
7.785
7.769
7.458
7.442
7.427
7.378
7.364
7.327
7.311
7.274
7.260 CDCl3
7.246
7.226
7.216
7.186
7.168
5.522
5.515
5.509
5.503
5.496
4.381
4.365
4.350
3.317
3.304
3.283
3.270
2.996
2.989
2.962
2.956
2.449
2.435
2.414
2.401
2.352
2.338
2.331
2.316
2.240
2.223
2.212
2.202
2.183
1.695
1.681
1.662
1.648
O
S
N
5k
0.97
0.98
1.02
5.26
1.84
4.11
1.00
1.00
2.02
2.02
0.98
2.02
0.96
2.19
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

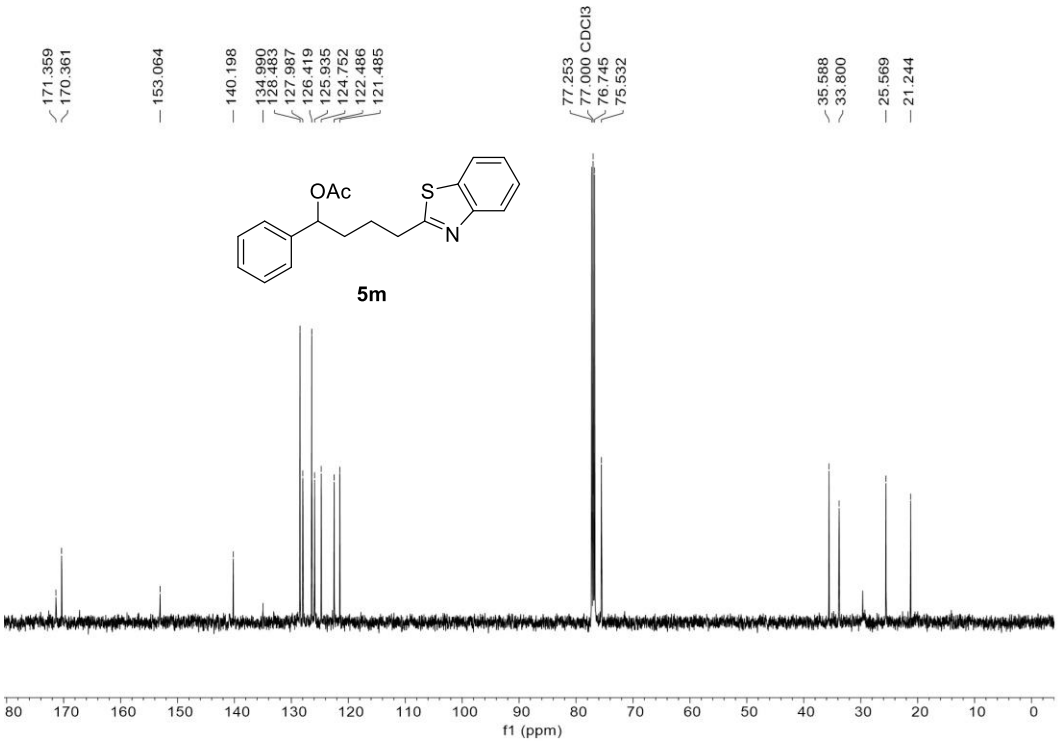

166.203
146.011
134.271
133.381
128.154
121.823
121.015
120.403
119.724
118.860
117.758
117.602
115.848
114.476
70.254
70.000 CDCl3
69.746
68.185
43.688
32.558
27.853
27.073
16.089
O
S
N
5k
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

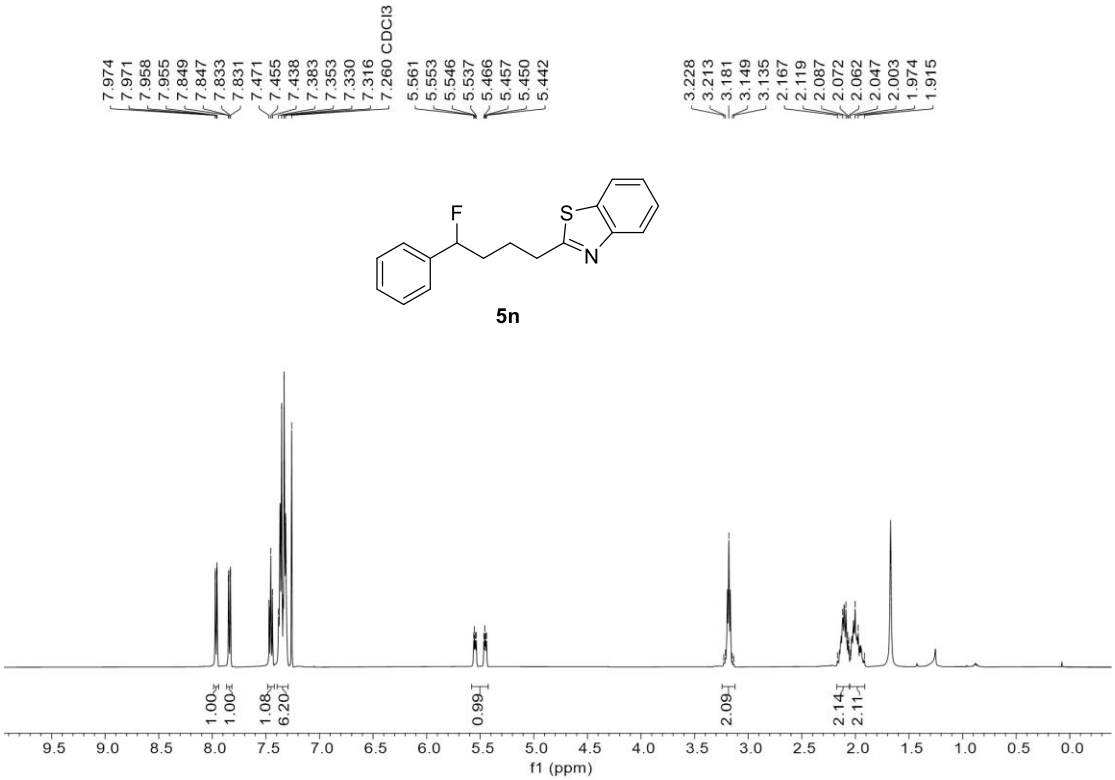

7.967
7.951
7.842
7.826
7.461
7.447
7.433
7.362
7.346
7.331
7.260 CDCl3
6.937
6.881
4.369
4.358
4.353
4.343
3.736
3.718
3.694
3.676
3.658
3.612
3.595
3.578
3.554
3.156
3.144
3.127
3.115
2.306
2.092
2.071
2.048
2.008
1.978
1.952
1.931
1.906
1.889
1.862
1.803
1.792
1.766
1.756
F3C
O
S
N
5l
0.97
0.98
0.99
0.99
1.03
1.98
1.00
2.02
1.95
6.01
1.04
0.95
1.01
0.96
f1 (ppm)

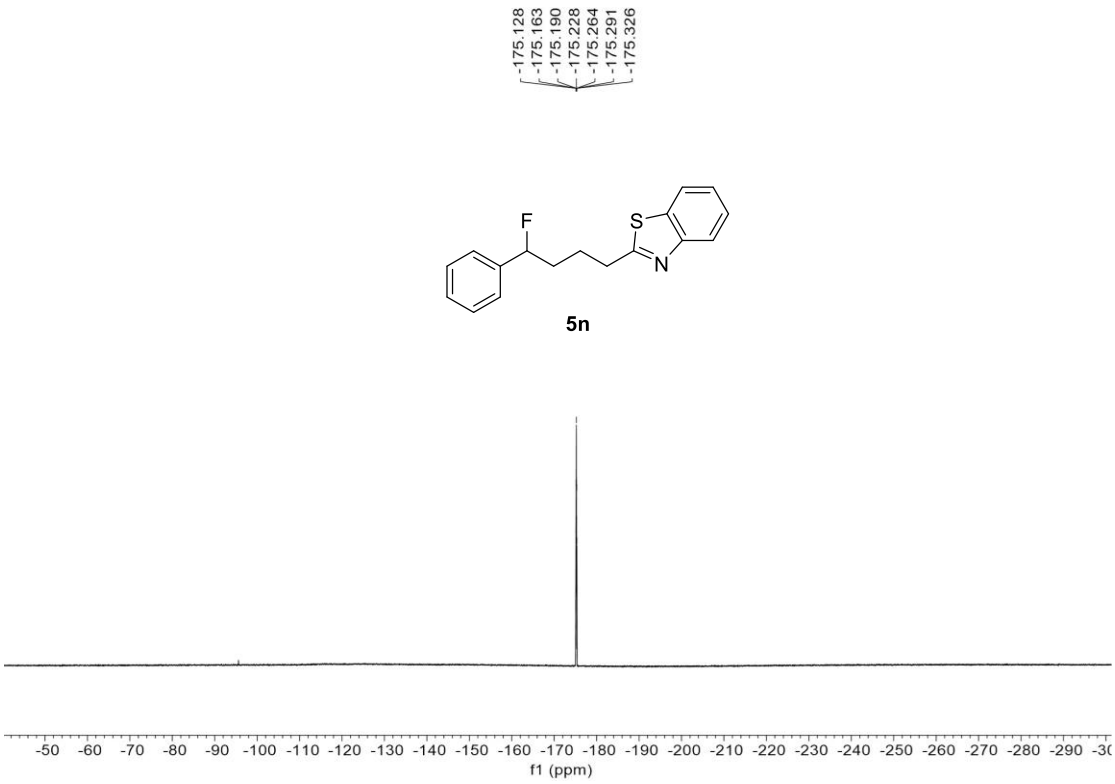

-73.806
-73.826
-73.845
F3C
O
S
N
5l
f1 (ppm)

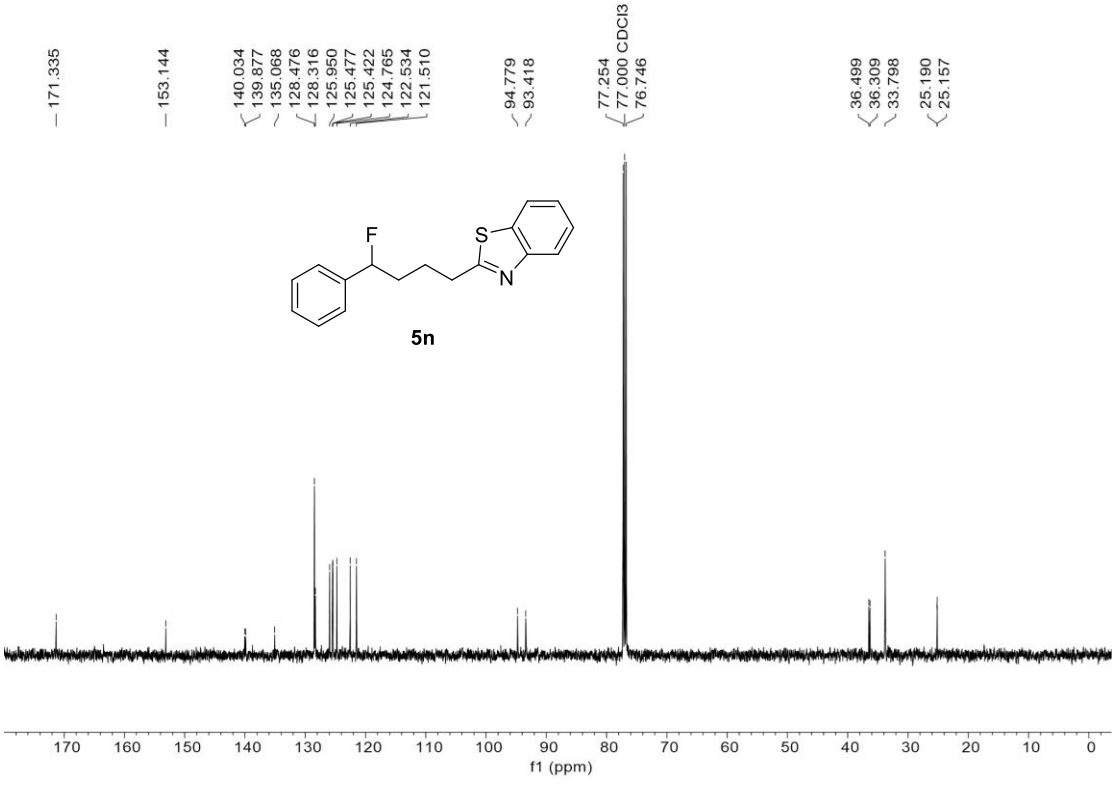

171.749
153.134
140.196
138.284
135.106
129.910
125.882
125.264
124.679
124.398
123.570
122.476
121.480
83.401
77.253
77.000 CDCl3
76.746
66.174
65.908
65.638
65.368
37.240
33.906
25.938
21.274
F3C
O
S
N
5l
f1 (ppm)

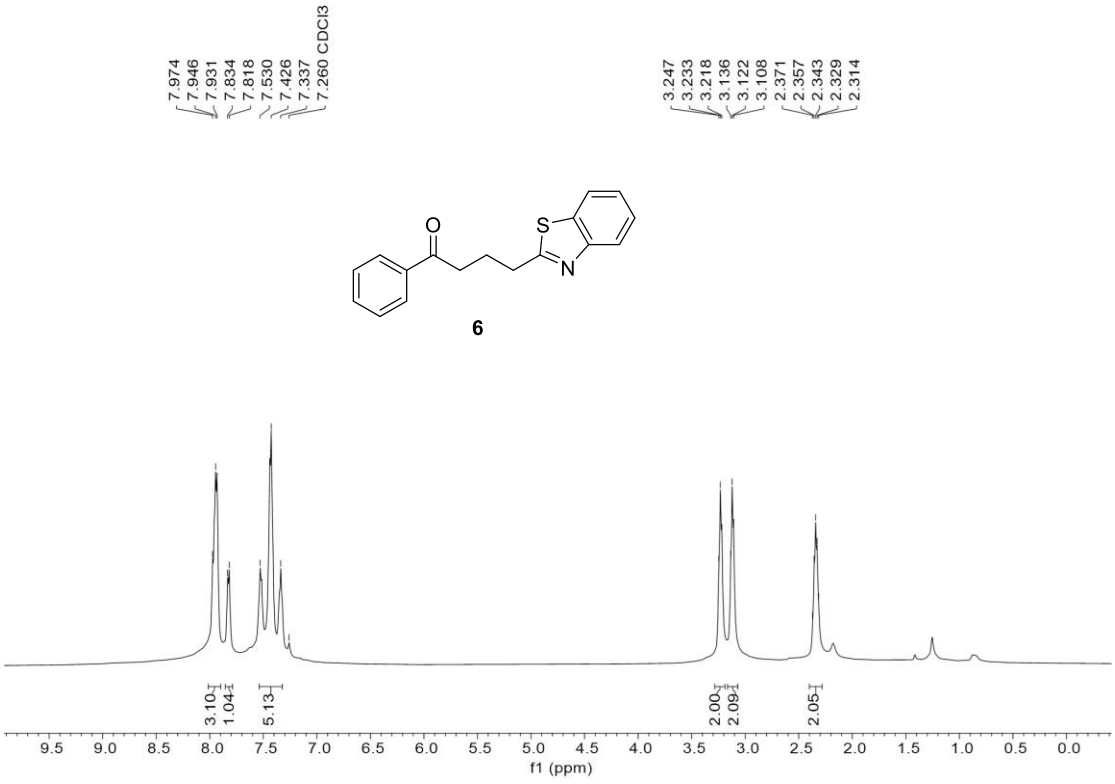

7.964
7.948
7.839
7.823
7.464
7.449
7.434
7.364
7.349
7.323
7.280
7.260 CDCl3
5.798
5.784
5.773
3.139
3.126
3.111
2.074
2.045
1.941
1.936
1.855
1.833
1.819
OAc
S
N
5m
1.11
1.01
1.20
6.35
1.00
2.15
3.32
4.22
f1 (ppm)

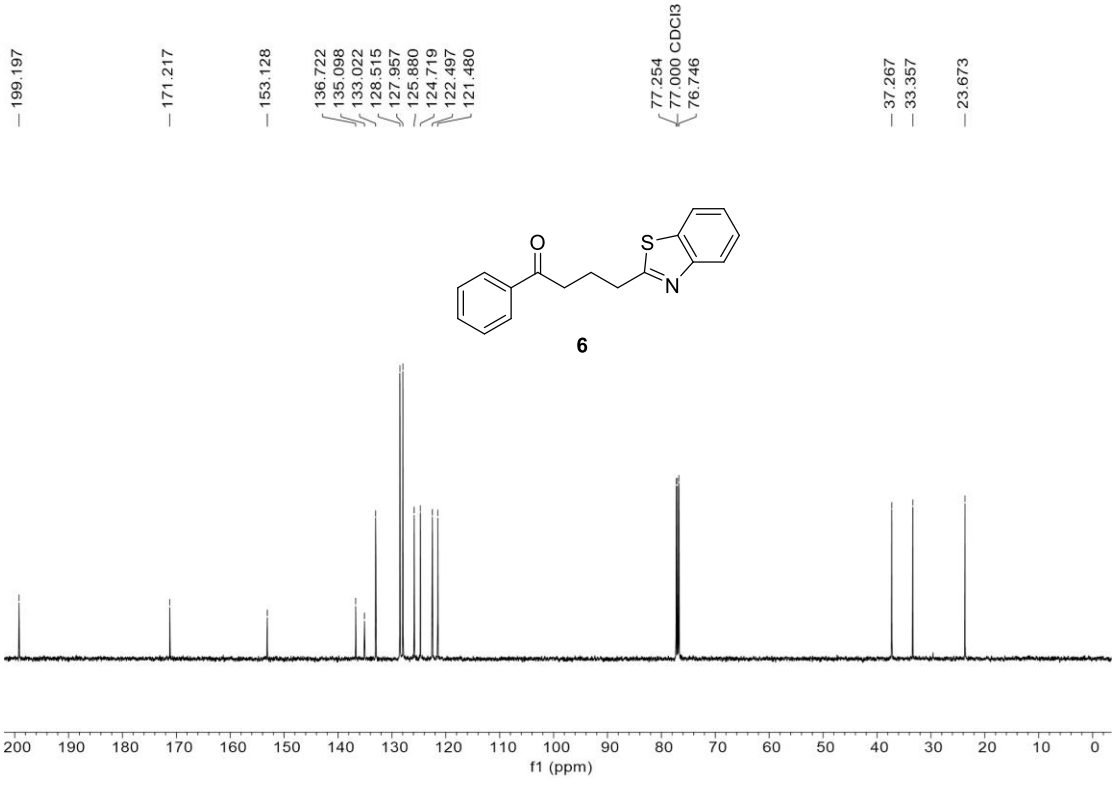

171.359
170.361
153.064
140.198
134.990
128.483
127.987
126.419
125.935
124.752
122.486
121.485
77.253
77.000 CDCl3
76.745
75.532
35.588
33.800
25.569
21.244
OAc
S
N
5m
f1 (ppm)


7.974
7.971
7.958
7.955
7.849
7.847
7.833
7.831
7.471
7.455
7.438
7.383
7.353
7.330
7.316
7.260 CDCl3
5.561
5.553
5.546
5.537
5.466
5.457
5.450
5.442
3.228
3.213
3.181
3.149
3.135
2.167
2.119
2.087
2.072
2.062
2.047
2.003
1.974
1.915
F
S
N
5n
1.00
1.00
1.08
6.20
0.99
2.09
2.14
2.11
f1 (ppm)

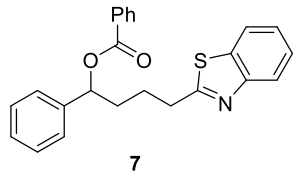

-175.128
-175.163
-175.190
-175.228
-175.264
-175.291
-175.326
F
S
N
5n
-50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210 -220 -230 -240 -250 -260 -270 -280 -290 -30
f1 (ppm)


171.335
153.144
140.034
139.877
135.068
128.476
128.316
125.950
125.477
125.422
124.765
122.534
121.510
94.779
93.418
77.254
77.000 CDCl3
76.746
36.499
36.309
33.798
25.190
25.157
F
S
N
5n
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

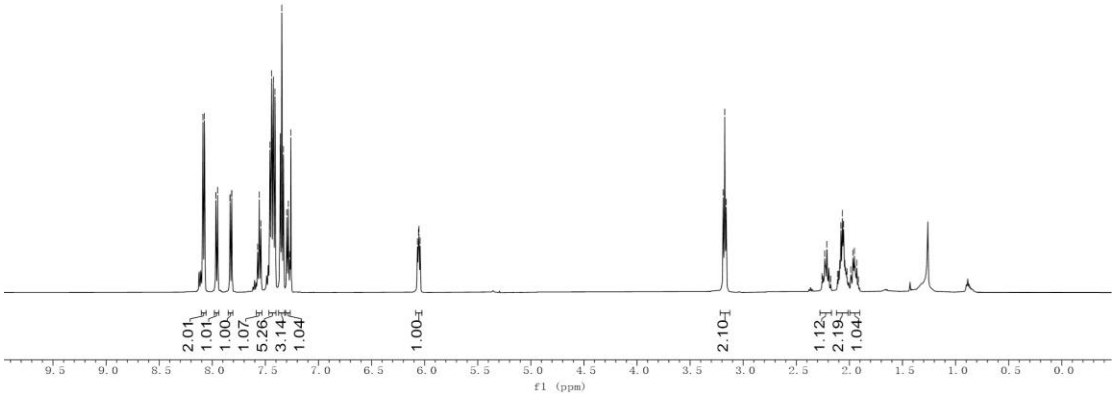

7.974
7.946
7.931
7.834
7.818
7.530
7.426
7.337
7.260 CDCl3
3.247
3.233
3.218
3.136
3.122
3.108
2.371
2.357
2.343
2.329
2.314
O
S
N
6
3.10
1.04
5.13
2.00
2.09
2.05
f1 (ppm)

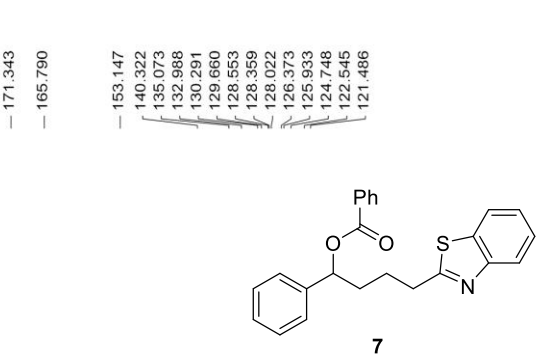

199.197
171.217
153.128
136.722
135.098
133.022
128.515
127.957
125.880
124.719
122.497
121.480
77.254
77.000 CDCl3
76.746
37.267
33.357
23.673
O
S
N
6
f1 (ppm)


8.089
8.074
7.966
7.950
7.833
7.832
7.817
7.816
7.558
7.543
7.457
7.441
7.424
7.409
7.361
7.345
7.330
7.298
7.284
7.260 CDCl3
6.058
6.053
6.043
3.189
3.174
3.160
2.258
2.232
2.213
2.177
2.111
2.080
2.067
2.055
2.023
1.987
1.967
1.952
1.931
1.916


Ph
O
O
S
N

7

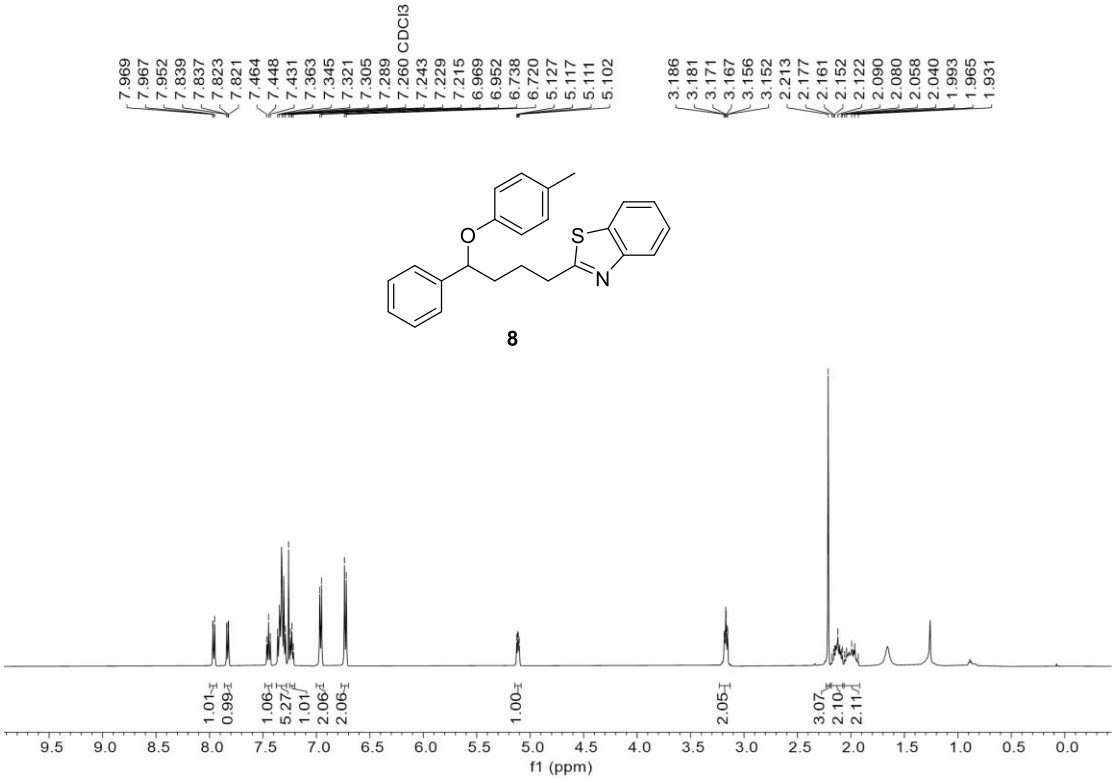

2.01
1.01
1.00
1.07
5.26
3.14
1.04
1.00
2.10
1.12
2.19
1.04
f1 (ppm)


171.343
165.790
153.147
140.322
135.073
132.988
130.291
129.660
128.553
128.359
128.022
126.373
125.933
124.748
122.545
121.486
77.255
77.000 CDCl3
76.746
76.114
35.846
33.860
25.623

Ph
O
O
S
N

7

f1 (ppm)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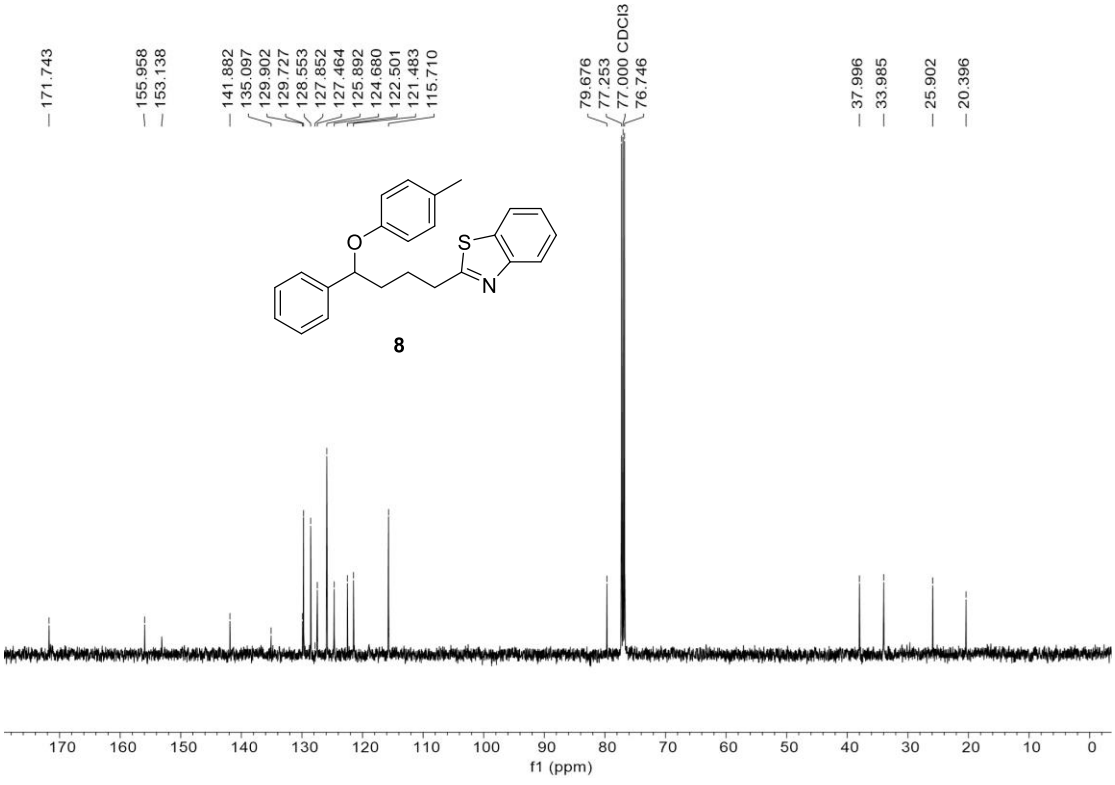
7.967
7.952
7.839
7.837
7.823
7.821
7.464
7.448
7.431
7.363
7.345
7.321
7.305
7.289
7.260 CDCl3
7.243
7.229
7.215
6.969
6.952
6.738
6.720
5.127
5.117
5.111
5.102
3.186
3.181
3.171
3.167
3.156
3.152
2.213
2.177
2.161
2.152
2.122
2.090
2.080
2.058
2.040
1.993
1.965
1.931
O
S
N
1.01
0.99
1.06
5.27
1.01
2.06
2.06
1.00
2.05
3.07
2.10
2.11
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

8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153.138
141.882
135.097
129.902
129.727
128.553
127.852
127.464
125.892
124.680
122.501
121.483
115.710
79.676
77.253
77.000 CDCl3
76.746
37.996
33.985
25.902
20.396
O
S
N
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

8