Supporting Information

Metal-free four-component coupling of cyclic diarylchloronium salts, tetrahydrothiophene, amines and carbon dioxide

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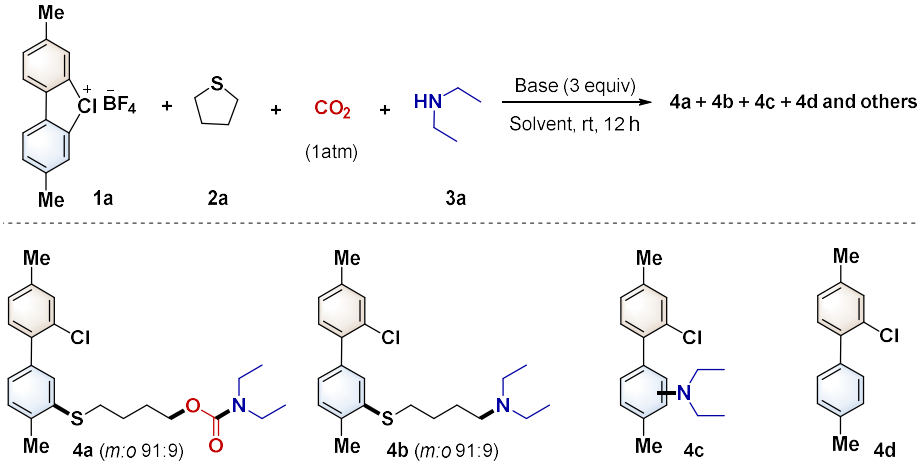
A. General methods

All cyclic diarylchloronium salts were synthesized according to previously described methods.[1] Other reagents were obtained from commercial suppliers and used without further purification. ^{1}H and ^{13}C NMR spectra were recorded with a Bruker AV 400 spectrometer using $CDCl_3$ or DMSO-*d6* as solvent and TMS as an internal standard. Reference values for residual solvents were taken as δ = 7.26 ppm ($CDCl_3$), 2.50 ppm (DMSO-*d6*) for ^{1}H NMR; δ = 77.00 ppm ($CDCl_3$), δ = 40.00 ppm (DMSO-*d6*) for ^{13}C NMR. Multiplicity was indicated as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet). Coupling constants were given in Hertz (Hz). IR spectra were obtained as potassium bromide pellets between two potassium bromide pellets with a spectrometer. The data of HRMS was determined on a high-resolution mass spectrometer (LCMS-IT-TOF). X-ray structural analyses were conducted on an x-ray analysis instrument. Reactions were monitored by thin-layer chromatography (TLC) using UV light.

B. Optimization of reaction conditions

Table S1. The influence of solvent, base, reaction time and temperature on the reaction[a]

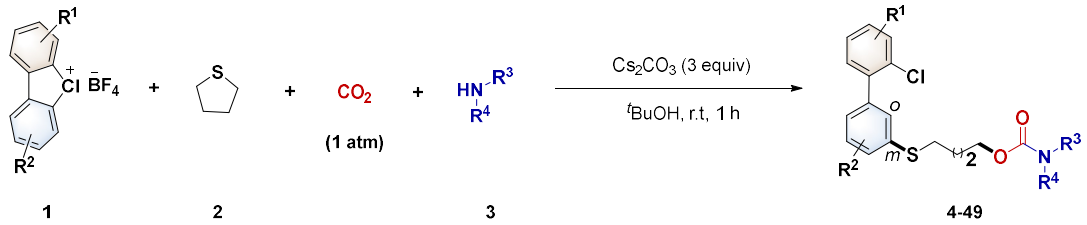


Entry	Base	Solvent	Yield (%)[b] 4a/4b/4c/4d and others
1	K_2CO_3	DCM	13/74/8/3
2	Na_2CO_3	DCM	1/89/6/1
3	K_3PO_4	DCM	73/11/12/2
4	Cs_2CO_3	DCM	72/5/15/3
5	DBU	DCM	65/1/1/14

6[c]	K_3PO_4	DCM	67/16/12/1
7	K_3PO_4	THF	62/6/17/3
8	K_3PO_4	MeCN	1/89/7/1
9	K_3PO_4	DMC	61/21/15/0
10	K_3PO_4	$CHCl_3$	89/6/3/1
11	K_3PO_4	^{t}BuOH	93/4/2/0
12[d]	K_3PO_4	^{t}BuOH	85/12/1/0
13[d]	Cs_2CO_3	^{t}BuOH	99/0/1/0
14[e]	Cs_2CO_3	^{t}BuOH	99/0/1/0
15[f]	**Cs_2CO_3**	**^{t}BuOH**	**99(92)/0/1/0**
16	Cs_2CO_3	MeOH	Complex mixture
17	Cs_2CO_3	EtOH	Complex mixture
18[g]	Cs_2CO_3	^{t}BuOH	97/2/0/1

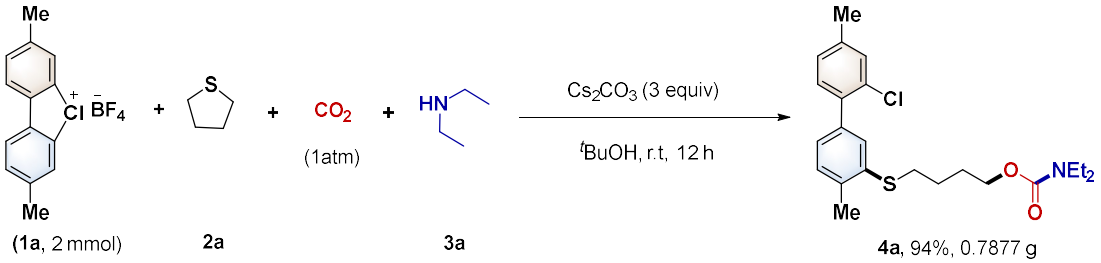
[a] Reaction conditions: **1a** (0.10 mmol), **2a** (0.20 mmol), **3a** (0.20 mmol), CO_2 (1 atm), base (0.30 mmol), solvent (2.0 mL), room temperature, 12 h. [b]The ratio was determined by GC–MS; the number in parentheses was isolated yield. [c]K_3PO_4 (2 equiv). [d] 6 h. [e]3 h. [f] 1 h. [g] 60 °C.

C. General procedure for synthesis of carbamates



To a 25 mL oven-dried Schlenk tube equipped with a magnetic stirring bar was added **1** (0.10 mmol, 1 equiv), Cs_2CO_3 (97.8 mg, 0.30 mmol, 3 equiv) successively. The tube was capped with a rubber septum, evacuated and backfilled with 1 atm CO_2. This evacuation/backfill sequence was repeated three times. Then, a solution of **2** (0.20 mmol, 2 equiv) in *tert*-butanol (1.0 mL) and **3** (0.20 mmol, 2 equiv) in *tert*-butanol (1.0 mL) was added to the vessel by syringe through the rubber septum cap respectively. The mixture was then stirred at room temperature for 1 h. After the reaction was completed, the reaction mixture was quenched with water, and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum and the residue was purified by column chromatography on silica gel using petroleum ether/ethyl acetate as the eluent to give the desired product.

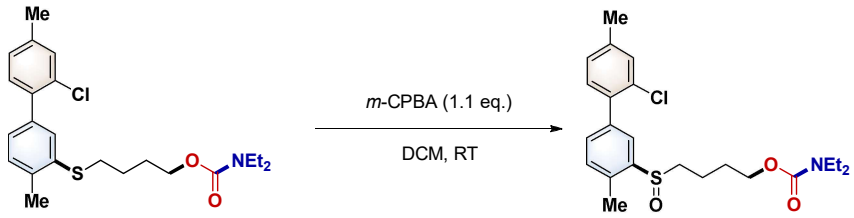
D. Gram-scale synthesis of 4a



To a 50 mL oven-dried two-necked round flask containing a magnetic stir bar was added **1a** (0.604 g, 2.0 mmol, 1 equiv), Cs_2CO_3 (1.9549 g, 6.0 mmol, 3 equiv) successively. The side-neck was capped with a rubber septum and the central neck is connected with a CO_2 balloon via a 3-way value. Then, the flask was evacuated and backfilled with CO_2 through the 3-way value. Subsequently, a solution of **2a** (353 μL, 4.0 mmol, 2 equiv) in *tert*-butanol (5 mL) and **3a** (412 μL, 4.0 mmol, 2 equiv) in *tert*-butanol (5 mL) was added to the vessel by syringe through the rubber septum cap on the side-neck respectively. The mixture was stirred at room temperature for 12 h. After the reaction was completed, the reaction mixture was quenched with water, and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum and the residue was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (30:1) as the eluent to give the product **4a** as a pale yellow oil (0.7877g, 94%, *m*:*o* = 91:9).

E. Procedures for the synthesis of compounds 50-53

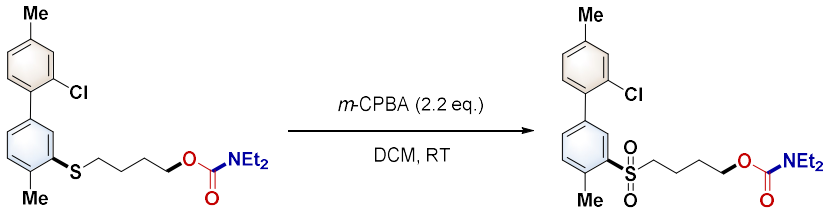
a) Procedure for the synthesis of compound 50 *ref.2*



To a 50 mL flame-dried round bottom flask was added **4a** (41.9 mg, 0.1 mmol, 1 equiv) and dry DCM (3 mL) and a magnetic stir bar. Then, a solution of *m*-CPBA (19 mg, 0.11 mmol) in 2 mL DCM was added dropwise to the reaction mixture at room temperature under stirring for 2 h. After the reaction was completed, the reaction mixture was quenched with $NaHCO_3$ (aq.), and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous

Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (3:1) as the eluent to give the desired product **50** as a light yellow oil (37.0 mg, 85%).

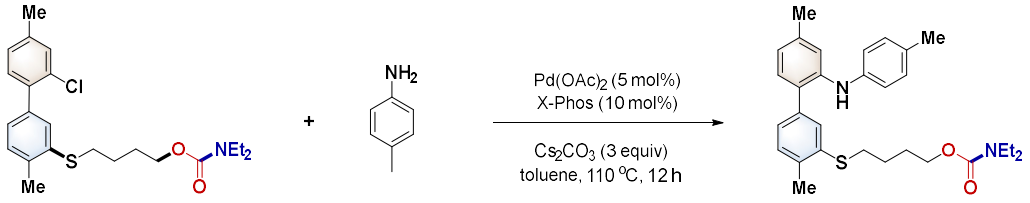
b) Procedure for the synthesis of compound 51 *ref.2*



4a **51**, 92%

To a 50 mL flame-dried round bottom flask with a magnetic stir bar was added *m*-CPBA (38 mg, 0.22 mmol) and dry DCM (2 mL) as solvent. Then, a solution of **4a** (41.9 mg, 0.1 mmol) in 3 mL DCM was added dropwise under stirring at room temperature for 4 h. After the reaction was completed, the reaction mixture was quenched with $NaHCO_3$ (aq.), and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (5:1) as the eluent to give the desired product **51** as a light yellow oil (41.5 mg, 92%).

c) Procedure for the synthesis of compound 52 *ref.3*

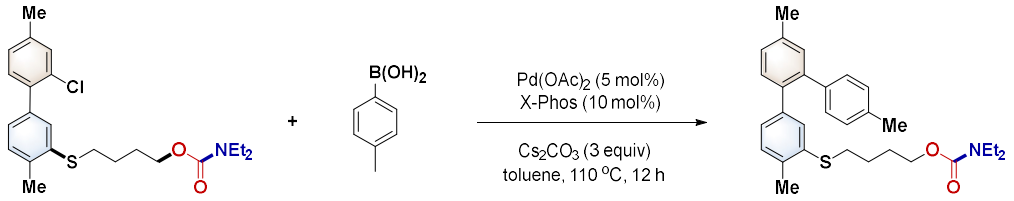


4a **52**, 90%

To a 25 mL tube with a magnetic stir bar was added $Pd(OAc)_2$ (1.2 mg, 5 mol%), X-Phos (14.3 mg, 10 mol%), Cs_2CO_3 (97.8 mg, 0.30 mmol, 3 equiv) and **4a** (41.9 mg, 0.1 mmol, in 1 mL toluene) under a N_2 atmosphere, and the resultant solution was stirred at room temperature for 10 mins. Then, *p*-toluidine (16.1 mg, 0.15 mmol, 1.5 equiv, in 1 mL toluene) was added to the reaction mixture and stirred at 110 °C for 12 h under an N_2 atmosphere. After the reaction was completed, the mixture was cooled to room temperature, washed with water and then extracted with ethyl acetate (10 mL×3). The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (30:1) as the eluent to give the

desired product **52** as a light yellow oil (44.1 mg, 90%).

d) Procedure for the synthesis of compound 53 *ref.3*

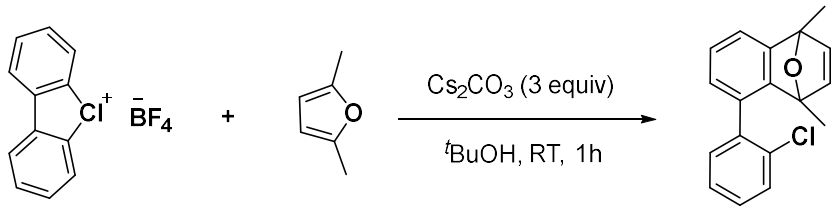


4a **53**, 86%

To a 25 mL tube with a magnetic stir bar was added $Pd(OAc)_2$ (1.2 mg, 5 mol%), X-Phos (14.3 mg, 10 mol%), Cs_2CO_3 (97.8 mg, 0.30 mmol, 3 equiv) and **4a** (41.9 mg, 0.1 mmol, in 1 mL toluene) under a N_2 atmosphere, and the resultant solution was stirred at room temperature for 10 mins. Then, 4-Tolylboronic acid (20.4 mg, 0.15 mmol, 1.5 equiv, in 1 mL toluene) was added to the reaction mixture and stirred at 110 °C for 12 h under an N_2 atmosphere. After the reaction was completed, the mixture was cooled to room temperature, washed with water and then extracted with ethyl acetate (10 mL×3). The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under reduced pressure. The crude product was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (20:1) as the eluent to give the desired product **53** as a light yellow oil (40.8 mg, 86%).

F. Mechanistic Investigations

a) Cycloadditions with cyclic diarylchlorodonium salts (aryne capture experiment) *ref.1*

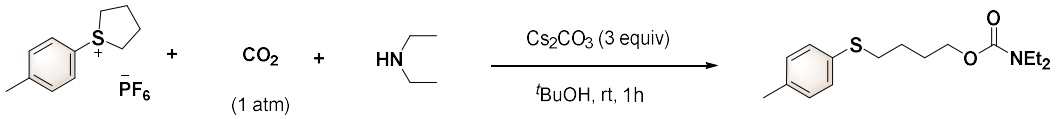


(**1b**, 0.1 mmol) (**54**, 1.5 equiv) **55**, 92%

A 25 mL oven-dried Schlenk tube was charged with **1b-BF_4** (27.4 mg, 0.10 mmol, 1 equiv.) and Cs_2CO_3 (97.8 mg, 0.30 mmol, 3 equiv). The Schlenk tube was evacuated and back refilled with Nitrogen three times. Subsequently, under Nitrogen, 2,5-dimethylfuran (16 μL, 0.15 mmol, 1.5 equiv) was added followed by *tert*-butanol (2.0 mL). The resulting heterogeneous mixture was stirred at room temperature for 1 hours. The conversion was controlled by GC-MS and TLC. After the reaction was completed, the reaction mixture was quenched with water, and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum and the residue was purified by column chromatography

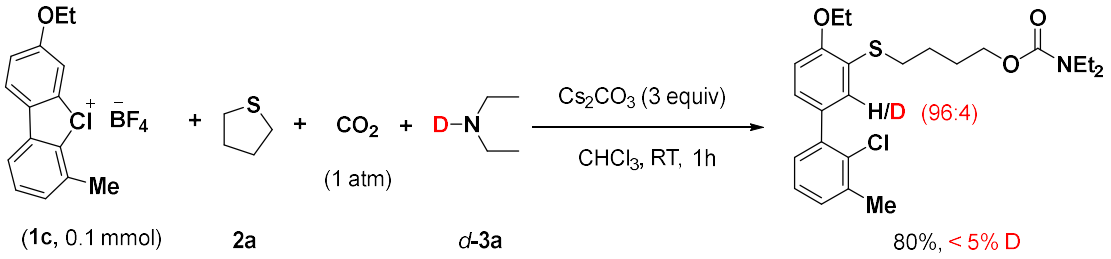
on silica gel using petroleum ether/ethyl acetate (50:1) as the eluent to afford the desired product **100** as colorless oil (92%, 25.9 mg). ^{1}H NMR ratio of 70:30. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 – 7.42 (m, 1H), 7.33 – 7.25 (m, 3H), 7.15 (d, *J* = 7.2 Hz, 1H), 7.06 – 7.01 (m, 2H), 6.86 – 6.75 (m, 2H), 1.92 (d, *J* = 5.2 Hz, 3H), 1.33 (d, *J* = 12.0 Hz, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.0, 152.7, 150.7, 149.9, 147.3, 146.6, 146.5, 145.8, 139.0, 138.6, 133.5, 133.3, 132.0, 131.9, 131.4, 131.1, 129.6, 129.0(2), 129.0(0), 128.9, 126.6(8), 126.6(6), 126.5, 126.1, 125.1, 124.2, 117.7, 117.6, 89.6(4), 89.6(0), 88.1, 87.9, 16.4, 16.0, 15.4, 15.2.

b) Intermediate validation experiment: synthesis of aryl sulfide carbamates with cyclic sulfonium salts, diethylamine, and CO_2

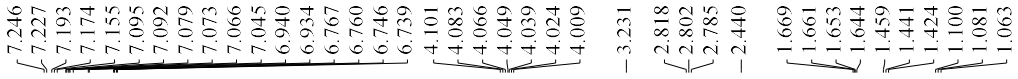


To a 25 mL oven-dried Schlenk tube equipped with a magnetic stirring bar was added **56** (32.4 mg, 0.10 mmol, 1 equiv.), Cs_2CO_3 (97.8 mg, 0.30 mmol) successively. The Schlenk tube was capped with a rubber septum, evacuated and backfilled with 1 atm CO_2. This evacuation/backfill sequence was repeated three times. Then, a solution of diethylamine (20 μL, 0.20 mmol) in *tert*-butanol (2.0 mL) was added to the vessel by syringe through the rubber septum cap. The mixture was then stirred at room temperature for 1 h. After the reaction was completed, the reaction mixture was quenched with water, and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum and the residue was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (30:1) as the eluent to afford the desired product **57** as a pale yellow oil (95%, 28.0 mg). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24 (d, *J* = 8.4 Hz, 2H), 7.08 (d, *J* = 8.0 Hz, 2H), 4.06 (t, *J* = 6.0 Hz, 2H), 3.24 (s, 4H), 2.90 (t, *J* = 7.2 Hz, 2H), 2.31 (s, 3H), 1.77 – 1.65 (m, 4H), 1.08 (t, *J* = 7.2 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 136.1, 132.5, 130.1, 129.6, 64.4, 41.7, 41.2, 34.1, 28.2, 25.8, 20.9, 14.0, 13.6. HRMS-ESI (m/z): calcd for $C_{16}H_{26}NO_2S$ $[M + H]^+$: 296.1679, found 296.1673.

c) Deuterated amine: synthesis of aryl sulfide carbamates with cyclic diarylchlorodonium salts, deuterated diethylamine, tetrahydrothiophene and CO_2



To a 25 mL oven-dried Schlenk tube equipped with a magnetic stirring bar was added **1c** (33.2 mg, 0.10 mmol, 1 equiv.), Cs_2CO_3 (97.8 mg, 0.30 mmol) successively. The Schlenk tube was capped with a rubber septum, evacuated and backfilled with 1 atm CO_2. This evacuation/backfill sequence was repeated three times. Then, a solution of **2a** (19 μL, 0.20 mmol) in $CHCl_3$ (1.0 mL) and *d*-**3a** (20 μL, 0.20 mmol) in $CHCl_3$ (1.0 mL) was added to the vessel by syringe through the rubber septum cap respectively. The mixture was then stirred at room temperature for 1 h. After the reaction was completed, the reaction mixture was quenched with water, and extracted with ethyl acetate (3×10 mL) three times. The organic layer was then dried over anhydrous Na_2SO_4, filtered and concentrated under vacuum and the residue was purified by column chromatography on silica gel using petroleum ether/ethyl acetate (30:1) as the eluent to afford the desired product as a pale yellow oil (80%, 35.9 mg). Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24 (d, *J* = 7.6 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 7.10 – 7.04 (m, 2H), 6.94 (d, *J* = 2.4 Hz, 1H), 6.75 (dd, *J* = 8.4, 2.5 Hz, 1H), 4.10 – 4.01 (m, 4H), 3.23 (s, 4H), 2.80 (t, *J* = 6.4 Hz, 2H), 2.44 (s, 3H), 1.67 – 1.64 (m, 4H), 1.44 (t, *J* = 7.2 Hz, 3H), 1.08 (t, *J* = 7.6 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 158.7, 155.9, 139.5, 137.1, 136.5, 134.2, 133.0, 131.0, 130.1, 129.4, 125.8, 114.5, 110.9, 64.4, 63.5, 41.5, 41.2, 32.9, 28.3, 25.5, 20.8, 14.8, 13.9, 13.5.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1.441
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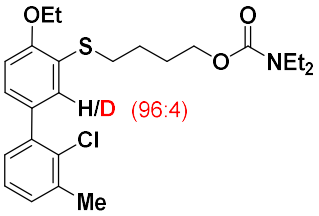
1.100
1.081
1.063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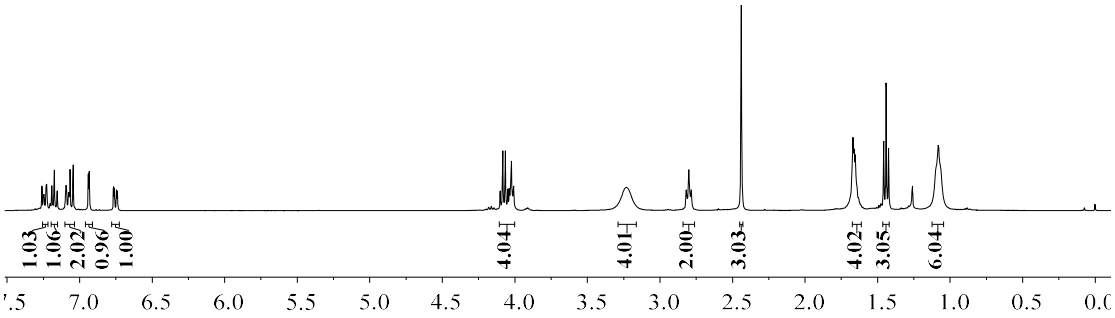
O
O
NEt2
H/D (96:4)
Cl
Me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0.96
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2.00
3.03
4.02
3.05
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7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0


158.703
155.930
139.484
137.089
136.481
134.191
132.988
130.954
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129.377
125.767
114.501
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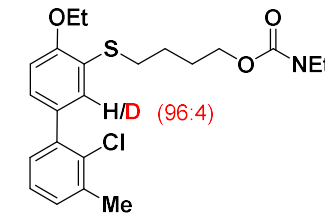
13.926
13.533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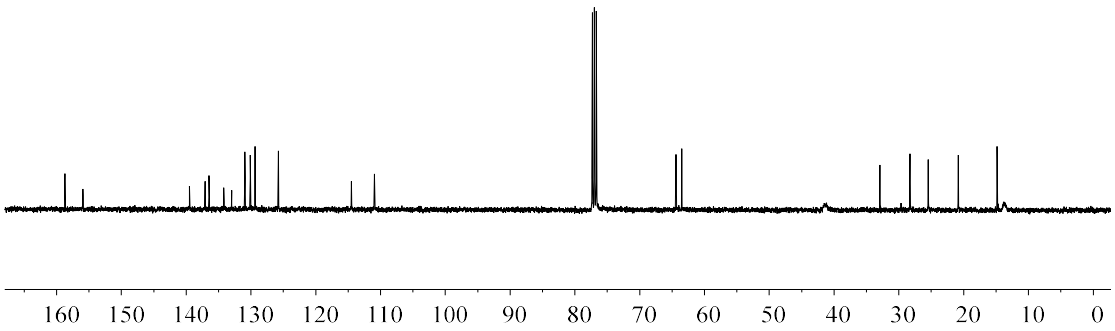
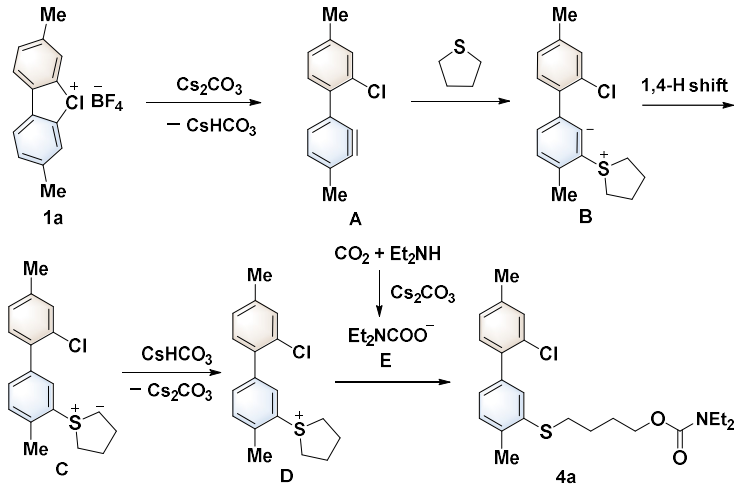
O
O
NEt2
H/D (96:4)
Cl
Me


160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

d) Proposed mechanism

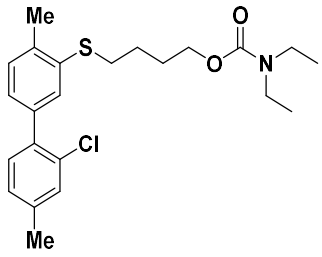
On the basis of the above-mentioned observations and previous literatures,[ref.5] a plausible mechanism for the formation of **4a** is proposed in Scheme S1. Initially, deprotonation of cyclic diarylchloronium salt **1a** in the presence of the base Cs_2CO_3 occurs to give an aryne intermediate **A**. Then, tetrahydrothiophene (**2a**) undergoes a *meta*-selective nucleophilic attack on the aryne intermediate **A**, generating an aryl anion **B**. Subsequently, intramolecular 1,4-proton shift of **B** will form a sulfur ylide intermediate **C**, which can undergo protonation to give a sulfonium ion **D**. Finally, the carbamate anion **E**, which is generated in situ from CO_2 and diethylamine (**3a**) in the presence of base, will readily interact with intermediate **D** to afford the carbamate product **4a**.



Scheme S1

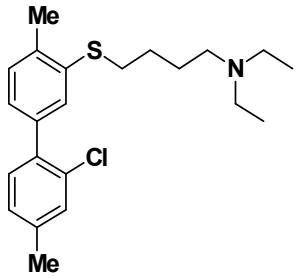
G. Analytical data

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (4a)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **4a** (41.4 mg, 99% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 91:9. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.29 (m, 2H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.14 – 7.05 (m, 2H), 4.09 (t, *J* = 6.0 Hz, 2H), 3.23 (d, *J* = 20.8 Hz, 4H), 2.96 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.37 (s, 3H), 1.81 – 1.76 (m, 4H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 138.7, 137.5, 137.0, 136.4, 135.6, 132.1, 131.0, 130.4, 129.7, 128.3, 127.7, 126.4, 64.4, 41.6, 41.1, 32.5, 28.4, 25.6, 20.8, 20.1, 13.9, 13.5. HRMS-ESI (*m/z*): calcd for $C_{23}H_{31}ClNO_2S$ $[M + H]^+$: 420.1759, found 420.1750.

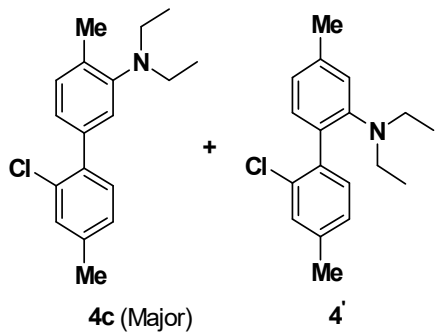
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)-N,N-diethylbutan-1-amine (4b)



The crude product was purified by silica gel chromatography (PE: EA = 2:1 as the eluent) to give **4b** as a colorless oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 91:9. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 (dd, *J* = 8.4, 2.0 Hz, 2H), 7.21 (dd, *J* = 7.6, 3.2 Hz, 2H), 7.14 – 7.10 (m, 2H), 2.94 (t, *J* = 7.2 Hz, 2H), 2.54 (q, *J* = 7.2 Hz, 4H), 2.46 (t, *J* = 7.2 Hz, 2H), 2.39 (d, *J* = 10.0 Hz, 6H), 1.72 – 1.60 (m, 4H), 1.02 (t, *J* = 7.2 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 138.7, 137.5, 137.1, 136.3, 135.8, 132.1, 131.0, 130.4, 129.7, 128.3, 127.7, 126.3, 52.3, 46.8, 32.7, 29.7, 29.3, 27.0, 26.0, 20.8, 20.1, 11.4. HRMS-ESI (*m/z*): calcd for $C_{22}H_{31}ClNS$ $[M + H]^+$: 376.1860, found 376.1861.

2'-chloro-N,N-diethyl-4,4'-dimethyl-[1,1'-biphenyl]-3-amine (4c) and

2'-chloro-N,N-diethyl-4,4'-dimethyl-[1,1'-biphenyl]-2-amine (4c')

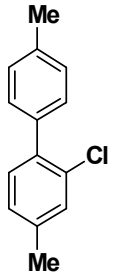


The crude product was purified by silica gel chromatography (PE as the eluent) to give **4c** and **4c'** as a yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 75:25. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 (d, *J* = 6.4 Hz, 1H), 7.28 – 7.22 (m, 2H), 7.17 – 6.87 (m, 3H), 3.04 (q, *J* = 7.2 Hz, 3H), 2.91 – 2.85 (m, 1H), 2.38 (m, 6H), 1.05 (t, *J* = 7.2 Hz, 4.5H), 0.89 (t, *J* = 7.2 Hz, 1.5H).

$^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 149.2, 138.3, 137.8, 137.1, 134.4, 132.2, 132.1, 131.7, 131.1, 130.5, 130.4, 129.9, 127.6, 127.1, 124.0, 123.7, 122.2, 121.6, 47.4, 46.3, 20.8, 18.1, 12.5, 12.3.

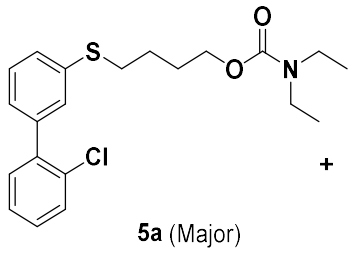
HRMS-ESI (*m/z*): calcd for $C_{18}H_{23}ClN$ $[M + H]^+$: 288.1514, found 288.1513.

2-chloro-4,4'-dimethyl-1,1'-biphenyl (4d)



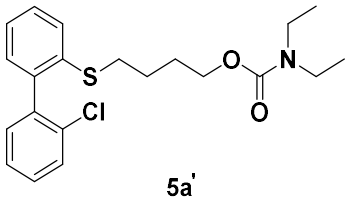
The crude product was purified by silica gel chromatography (PE as the eluent) to give **4d** as a colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.44 (d, *J* = 8.0 Hz, 2H), 7.39 (d, *J* = 2.0 Hz, 1H), 7.33 (dd, *J* = 8.0, 5.6 Hz, 3H), 7.20 (dd, *J* = 7.6, 2.0 Hz, 1H), 2.51 (s, 3H), 2.46 (s, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 138.4, 137.5, 137.1, 136.5, 132.1, 131.1, 130.3, 129.3, 128.7, 127.6, 21.2, 20.7. HRMS-ESI (*m/z*): calcd for $C_{14}H_{14}Cl$ $[M + H]^+$: 217.0779, found 217.0778.

4-((2'-chloro-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (5a-BF_4) and 4-((2'-chloro-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (5a-BF_4')



5a (Major)

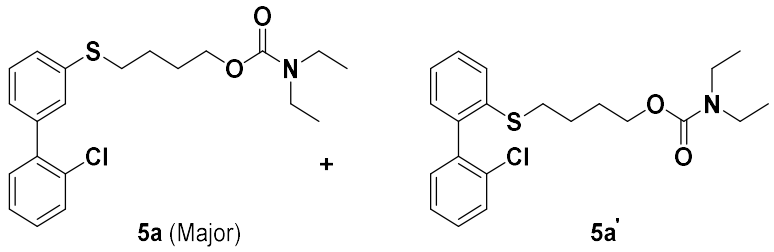
+



5a'

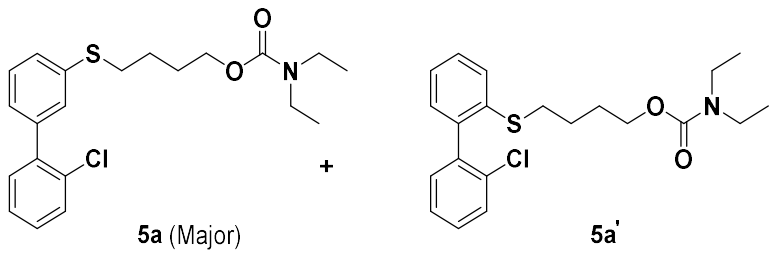
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **5a-BF_4** and **5a-BF_4'** (38.3 mg, 98% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 75:25. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47 – 7.44 (m, 1H), 7.43 – 7.39 (m, 1H), 7.35 – 7.28 (m, 4H), 7.27 – 7.15 (m, 2H), 4.09 (t, *J* = 6.0 Hz, 1.5H), 4.02 (t, *J* = 6.4 Hz, 0.5H), 3.23 (s, 4H), 2.99 (t, *J* = 6.8 Hz, 1.5H), 2.80 (t, *J* = 6.8 Hz, 0.5H), 1.81 – 1.74 (m, 3H), 1.69 – 1.60 (m, 1H), 1.08 (s, 6H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 155.8, 139.9(3), 139.9(0), 139.7, 139.3, 136.3, 135.8, 133.4, 132.2, 131.3, 131.1, 130.1, 129.8, 129.7, 129.2, 128.8, 128.6, 128.3, 128.2, 128.0, 126.8, 126.7, 126.2, 125.3, 64.2(0), 64.1(7), 41.5, 41.1, 33.1, 32.9, 28.1(0), 28.0(8), 25.6, 25.3, 13.8, 13.4. HRMS-ESI (*m/z*): calcd for $C_{21}H_{27}ClNO_2S$ $[M + H]^+$: 392.1446, found 392.1440.

4-((2'-chloro-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (5a-OMs) and 4-((2'-chloro-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (5a-OMs')



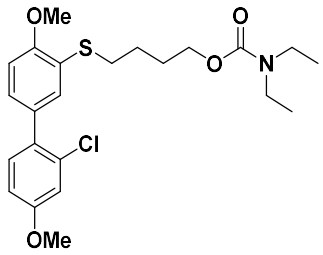
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **5a-OMs** and **5a-OMs'** (37.5 mg, 96% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 75:25. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47 – 7.44 (m, 1H), 7.43 – 7.39 (m, 1H), 7.35 – 7.28 (m, 4H), 7.27 – 7.15 (m, 2H), 4.09 (t, *J* = 6.0 Hz, 1.5H), 4.02 (t, *J* = 6.4 Hz, 0.5H), 3.23 (s, 4H), 2.99 (t, *J* = 6.8 Hz, 1.5H), 2.80 (t, *J* = 6.8 Hz, 0.5H), 1.81 – 1.74 (m, 3H), 1.69 – 1.60 (m, 1H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.8, 139.9(3), 139.9(0), 139.7, 139.3, 136.3, 135.8, 133.4, 132.2, 131.3, 131.1, 130.1, 129.8, 129.7, 129.2, 128.8, 128.6, 128.3, 128.2, 128.0, 126.8, 126.7, 126.2, 125.3, 64.2(0), 64.1(7), 41.5, 41.1, 33.1, 32.9, 28.1(0), 28.0(8), 25.6, 25.3, 13.8, 13.4. HRMS-ESI (*m/z*): calcd for $C_{21}H_{27}ClNO_2S$ $[M + H]^+$: 392.1446, found 392.1440.

4-((2'-chloro-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (5a-OTf) and 4-((2'-chloro-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (5a-OTf')



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **5a-OTf** and **5a-OTf'** (20.3 mg, 52% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 75:25. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.47 – 7.44 (m, 1H), 7.43 – 7.39 (m, 1H), 7.35 – 7.28 (m, 4H), 7.27 – 7.15 (m, 2H), 4.09 (t, *J* = 6.0 Hz, 1.5H), 4.02 (t, *J* = 6.4 Hz, 0.5H), 3.23 (s, 4H), 2.99 (t, *J* = 6.8 Hz, 1.5H), 2.80 (t, *J* = 6.8 Hz, 0.5H), 1.81 – 1.74 (m, 3H), 1.69 – 1.60 (m, 1H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.8, 139.9(3), 139.9(0), 139.7, 139.3, 136.3, 135.8, 133.4, 132.2, 131.3, 131.1, 130.1, 129.8, 129.7, 129.2, 128.8, 128.6, 128.3, 128.2, 128.0, 126.8, 126.7, 126.2, 125.3, 64.2(0), 64.1(7), 41.5, 41.1, 33.1, 32.9, 28.1(0), 28.0(8), 25.6, 25.3, 13.8, 13.4. HRMS-ESI (*m/z*): calcd for $C_{21}H_{27}ClNO_2S$ $[M + H]^+$: 392.1446, found 392.1440.

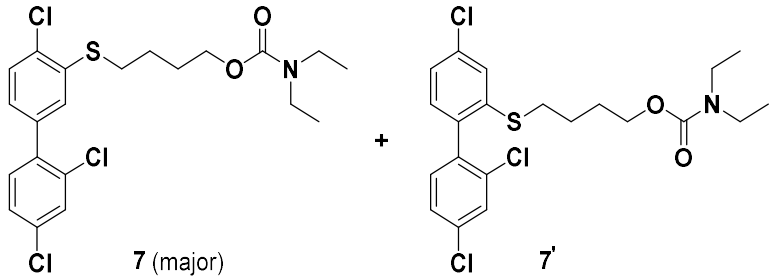
4-((2'-chloro-4,4'-dimethoxy-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (6)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **6** (44.2 mg, 98% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.15 (d, *J* = 8.4 Hz, 1H), 7.07 (d, *J* = 8.4 Hz, 1H), 7.01 (d, *J* = 2.4 Hz, 1H), 6.92 (d, *J* = 2.4 Hz, 1H), 6.84 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.75 (dd, *J* = 8.4, 2.6 Hz, 1H), 4.02 (t, *J* = 6.0 Hz, 2H), 3.83 (d, *J* = 3.6 Hz, 6H), 2.80 (t, *J* = 6.8 Hz, 2H), 1.70 – 1.64 (m, 4H), 1.07 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 159.5, 159.3, 155.8, 137.7, 134.4, 132.3, 131.9, 131.4, 131.3, 114.5, 113.7, 112.5, 110.2, 64.3, 55.4, 55.2, 41.6, 41.1, 32.7, 28.2, 25.3, 13.9, 13.4. HRMS-ESI (*m/z*): calcd for $C_{23}H_{31}ClNO_4S$ $[M + H]^+$: 452.1657, found 452.1653.

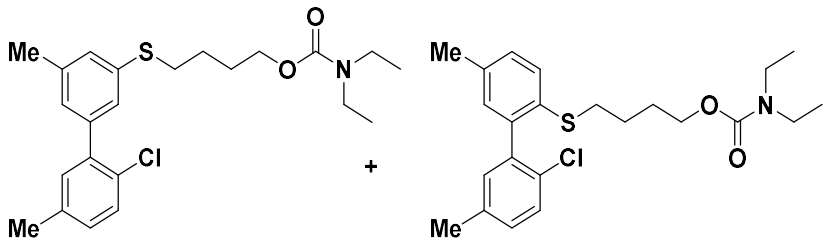
4-((2',4,4'-trichloro-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (7) and

4-((2',4,4'-trichloro-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (7')



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **7** and **7'** (32.1 mg, 70% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 60:40. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (t, *J* = 2.0 Hz, 1H), 7.42 – 7.32 (m, 1H), 7.31 – 7.26 (m, 2H), 7.24 – 7.16 (m, 1H), 7.13 – 7.04 (m, 1H), 4.10 (t, *J* = 5.6 Hz, 1.2H), 4.05 (t, *J* = 6.0 Hz, 0.8H), 3.24 (d, *J* = 16.0 Hz, 4H), 2.99 (t, *J* = 6.8 Hz, 1.2H), 2.85 (t, *J* = 7.2 Hz, 0.8H), 1.82 – 1.79 (m, 2.4H), 1.72 – 1.65 (m, 1.6H), 1.09 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.7(8), 155.7(7), 138.5, 137.5, 137.2, 136.6, 136.4, 136.0, 134.5, 134.4, 134.3, 134.1, 133.0, 132.8, 132.1, 131.8, 131.1, 129.8, 129.3, 128.6, 127.2, 127.0, 126.9(4), 126.8(8), 125.3, 64.2, 64.1, 41.6, 41.1, 32.6, 32.0, 28.3, 28.1, 25.1(4), 25.1(1), 14.0, 13.9. HRMS-ESI (*m/z*): calcd for $C_{21}H_{25}Cl_3NO_2S$ $[M + H]^+$: 460.0666, found 460.0663.

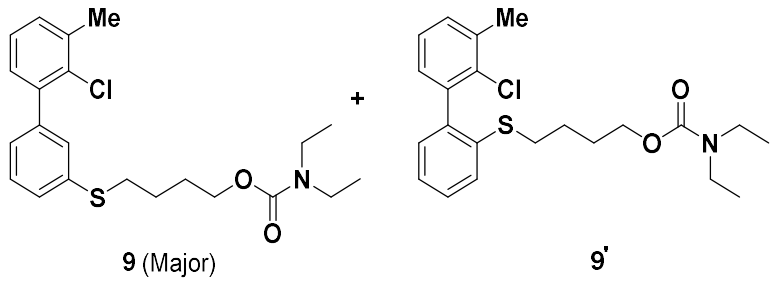
4-((2'-chloro-5,5'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (8) and 4-((2'-chloro-5,5'-dimethyl-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (8')



8 (Major) **8'**

Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **8** and **8'** (37.7 mg, 90% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 76:24. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.31 (m, 1H), 7.20 (d, *J* = 2.0 Hz, 1H), 7.15 – 7.11 (m, 2H), 7.10 – 7.05 (m, 1H), 7.03 – 6.99 (m, 1H), 4.09 (t, *J* = 6.0 Hz, 1.52H), 4.01 (t, *J* = 5.6 Hz, 0.48H), 3.23 (t, *J* = 18.4 Hz, 4H), 2.98 (t, *J* = 6.8 Hz, 1.52H), 2.76 (t, *J* = 7.2 Hz, 0.48H), 2.36 (s, 2.3H), 2.34 (s, 3.7H), 1.79 – 1.75 (m, 3H), 1.68 – 1.57 (m, 1H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.8, 140.6, 139.9, 139.5, 139.3, 138.1, 136.5, 136.0, 135.9, 135.5, 131.9, 131.8, 130.8, 130.2, 129.5(0), 129.4(8), 129.4, 129.2, 129.1, 129.0, 128.8, 128.7, 127.7, 126.8, 64.2(9), 64.2(8), 41.5, 41.0, 33.4, 33.1, 28.1(4), 28.1(0), 25.7, 25.4, 21.2, 20.8, 20.7(1), 20.7(0), 13.9, 13.4. HRMS-ESI (*m/z*): calcd for $C_{23}H_{31}ClNO_2S$ $[M + H]^+$: 420.1759, found 420.1753.

4-((2'-chloro-3'-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (9) and 4-((2'-chloro-3'-methyl-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (9')

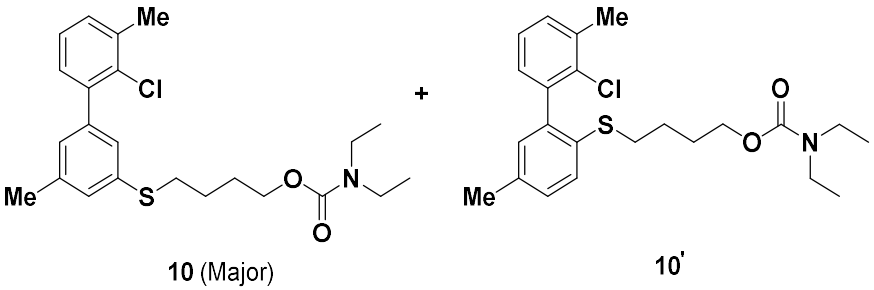


9 (Major) **9'**

Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **9** and **9'** (38.9 mg, 96% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 73:27. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 – 7.37 (m, 1H), 7.35 – 7.27 (m, 2H), 7.25 – 7.21 (m, 2H), 7.20 – 7.08 (m, 2H), 4.09 (t, *J* = 6.0 Hz, 1.44H), 4.03 (t, *J* = 6.0 Hz, 0.56H), 3.24 (s, 4H), 2.99 (t, *J* = 6.8 Hz, 1.44H), 2.82 (d, *J* = 6.8 Hz, 0.56H), 2.45 (s, 3H), 1.82 – 1.75 (m, 3H), 1.69 – 1.63 (m, 1H), 1.09 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 140.7, 140.6, 140.3, 139.7, 136.9, 136.5, 136.2, 135.8, 133.6, 132.6, 130.2, 130.1, 130.0, 129.8, 128.8, 128.7, 128.4, 128.2, 128.1, 128.0, 127.0, 126.1,

125.8, 125.3, 64.3(3), 64.3(0), 41.6, 41.1, 33.2, 32.9, 28.2, 25.7, 25.4, 20.9, 20.8, 14.0, 13.5. HRMS-ESI (*m/z*): calcd for $C_{22}H_{29}ClNO_2S$ $[M + H]^+$: 406.1602, found 406.1598.

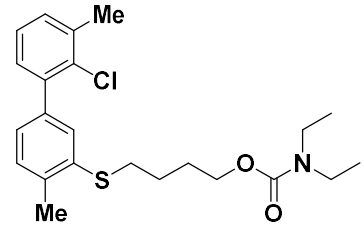
4-((2'-chloro-3',5-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (10) and 4-((2'-chloro-3',5-dimethyl-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (10')



10 (Major) **10'**

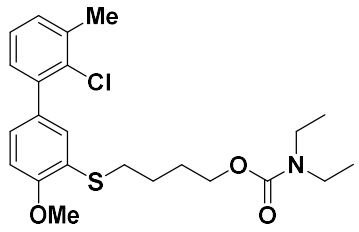
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **10** and **10'** (41.1 mg, 98% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 76:24. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.06 (m, 5H), 7.02 – 7.00 (m, 1H), 4.09 (t, *J* = 5.6 Hz, 1.52H), 4.01 (t, *J* = 6.0 Hz, 0.48H), 3.24 (s, 4H), 2.98 (t, *J* = 6.8 Hz, 1.52H), 2.98 (t, *J* = 6.8 Hz, 0.48H), 2.45 (s, 3H), 2.36 (d, *J* = 8.0 Hz, 3H), 1.79 – 1.73 (m, 3H), 1.67 – 1.57 (m, 1H), 1.09 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 141.2, 140.6, 140.5, 140.0, 138.1, 136.9, 136.4, 135.9, 135.6, 133.6, 132.6, 131.9, 130.9, 130.1, 129.9, 129.4, 129.0, 128.8, 128.6(9), 128.6(5), 127.8, 126.9, 126.1, 125.7, 64.4, 64.3, 41.6, 41.1, 33.5, 33.2, 28.2, 28.1, 25.7, 25.5, 21.3, 20.9, 20.8(4), 20.8(0), 14.0, 13.5. HRMS-ESI (*m/z*): calcd for $C_{23}H_{31}ClNO_2S$ $[M + H]^+$: 420.1759, found 420.1752.

4-((2'-chloro-3',4-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (11)



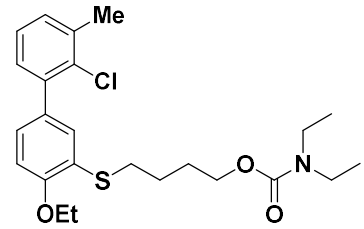
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **11** (41.1 mg, 98% yield) as a pale yellow oil. Regioselective ratio determined by 1H NMR m:o = 85:15. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 (d, *J* = 1.6 Hz, 1H), 7.24 – 7.16 (m, 4H), 7.12 (dd, *J* = 8.0, 2.0 Hz, 1H), 4.10 (t, *J* = 6.0 Hz, 2H), 3.24 (d, *J* = 11.6 Hz, 4H), 2.96 (t, *J* = 6.8 Hz, 2H), 2.46 (s, 3H), 2.42 (s, 3H), 1.83 – 1.76 (m, 4H), 1.09 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 140.4, 138.2, 136.9, 136.3, 135.5, 132.7, 129.9, 129.6, 128.8, 128.3, 126.4, 126.1, 64.4, 41.6, 41.2, 32.4, 28.3, 25.6, 21.0, 20.0, 13.9, 13.5. HRMS-ESI (m/z): calcd for $C_{23}H_{31}ClNO_2S$ $[M + H]^+$: 420.1759, found 420.1753.

4-((2'-chloro-4-methoxy-3'-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (12)



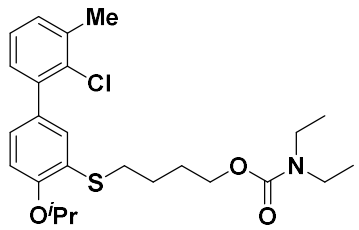
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **12** (43.1 mg, 99% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 – 7.23 (m, 1H), 7.18 (t, *J* = 7.6 Hz, 1H), 7.10 – 7.06 (m, 2H), 6.94 (d, *J* = 2.8 Hz, 1H), 6.76 (dd, *J* = 8.4, 2.8 Hz, 1H), 4.03 (t, *J* = 5.6 Hz, 2H), 3.83 (s, 3H), 3.23 (d, *J* = 21.6 Hz, 4H), 2.81 (t, *J* = 6.8 Hz, 2H), 2.44 (s, 3H), 1.67 – 1.65 (m, 4H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 159.1, 155.7, 139.2, 137.0, 136.3, 134.0, 132.9, 130.8, 130.0, 129.2, 125.7, 113.7, 110.2, 64.2, 55.1, 41.5, 41.0, 32.7, 28.1, 25.3, 20.7, 13.9, 13.4. HRMS-ESI (*m/z*): calcd for $C_{23}H_{31}ClNO_3S$ $[M + H]^+$: 436.1708, found 436.1704.

4-((2'-chloro-4-ethoxy-3'-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (13)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **13** (42.2 mg, 94% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 – 7.23 (m, 1H), 7.18 (t, *J* = 7.6 Hz, 1H), 7.10 – 7.04 (m, 2H), 6.93 (d, *J* = 2.4 Hz, 1H), 6.75 (dd, *J* = 8.4, 2.4 Hz, 1H), 4.10 – 4.01 (m, 4H), 3.23 (d, *J* = 20.4 Hz, 4H), 2.81 (t, *J* = 6.8 Hz, 2H), 2.44 (s, 3H), 1.67 – 1.65 (m, 4H), 1.44 (t, *J* = 6.8 Hz, 3H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 158.6, 155.9, 139.4, 137.0, 136.4, 134.1, 132.8, 130.9, 130.1, 129.3, 125.7, 114.3, 110.8, 64.3, 63.4, 41.6, 41.1, 32.8, 28.2, 25.4, 20.8, 14.8, 14.0, 13.5. HRMS-ESI (*m/z*): calcd for $C_{24}H_{33}ClNO_3S$ $[M + H]^+$: 450.1864, found 450.1859.

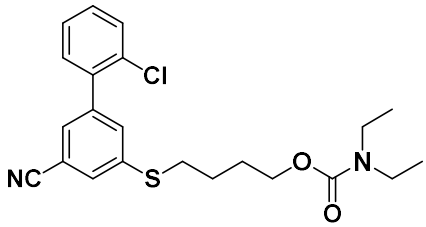
4-((2'-chloro-4-isopropoxy-3'-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (14)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **14** (44.4 mg, 96% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.24 (d, *J* = 6.8 Hz, 1H), 7.17 (t, *J* = 7.6 Hz, 1H), 7.10 – 7.03 (m, 2H), 6.91 (d, *J* = 2.0 Hz, 1H), 6.74 (dd, *J* = 8.4, 2.4 Hz, 1H), 4.61 – 4.55 (m, 1H), 4.02 (t, *J* = 5.2 Hz, 2H), 3.23 (d, *J* = 24.0 Hz, 4H), 2.80 (t, *J* = 6.8 Hz, 2H), 2.44

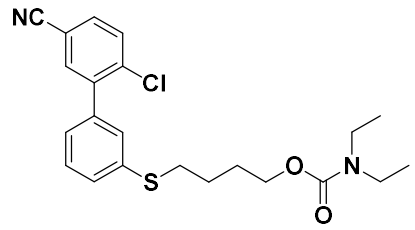
(s, 3H), 1.67 – 1.64 (m, 4H), 1.37 (d, J = 6.0 Hz, 6H), 1.08 (s, 6H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$): δ 157.6, 155.8, 139.4, 137.0, 136.4, 134.1, 132.7, 130.9, 130.0, 129.3, 125.7, 115.5, 111.9, 69.8, 64.3, 41.1(2), 41.1(0), 32.8, 28.2, 25.4, 22.1, 22.0, 20.8, 13.9, 13.5. HRMS-ESI (*m/z*): calcd for $C_{25}H_{36}ClNO_3S$ $[M + H]^+$: 464.2021, found 464.2017.

4-((2'-chloro-5-cyano-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (15a)



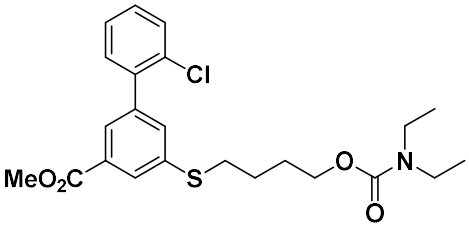
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **15a** (26.2 mg, 63% yield) as a pale yellow oil. Regioselective ratio determined by ^1H NMR *m:o* = 99:1. ^1H NMR (400 MHz, $CDCl_3$): δ 7.63 – 7.48 (m, 4H), 7.38 – 7.30 (m, 3H), 4.11 (t, J = 5.2 Hz, 2H), 3.22 (s, 4H), 3.01 (t, J = 6.4 Hz, 2H), 1.83 – 1.77 (m, 4H), 1.09 (s, 6H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$): δ 155.8, 140.8, 139.1, 137.6, 133.1, 132.1, 130.9, 130.1, 129.9, 129.8, 129.6, 127.1, 118.1, 112.9, 64.0, 41.7, 41.1, 32.6, 28.1, 25.4, 13.9, 13.4. HRMS-ESI (m/z): calcd for $C_{22}H_{26}ClN_2O_2S$ $[M + H]^+$: 417.1398, found 417.1393.

4-((2'-chloro-5'-cyano-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (15b)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **15b** (10.4 mg, 25% yield) as a pale yellow oil. Regioselective ratio determined by ^1H NMR *m:o* = 99:1. ^1H NMR (400 MHz, $CDCl_3$): δ 7.59 (d, J = 8.4 Hz, 1H), 7.49 (d, J = 7.6 Hz, 1H), 7.39 – 7.32 (m, 4H), 7.22 (d, J = 6.8 Hz, 1H), 4.06 (t, J = 5.6 Hz, 2H), 3.23 (d, J = 6.8 Hz, 4H), 2.97 – 2.87 (m, 2H), 1.72 (t, J = 3.6 Hz, 4H), 1.08 (s, 6H). $^{13}C\{^1H\}$ NMR (100 MHz, $CDCl_3$): δ 155.8, 144.6, 139.0, 136.9, 133.3, 133.1, 131.6, 131.1, 129.9, 129.8, 126.8, 125.5, 118.7, 107.8, 64.0, 41.7, 41.2, 31.6, 28.3, 24.9, 13.9, 13.5. HRMS-ESI (m/z): calcd for $C_{22}H_{26}ClN_2O_2S$ $[M + H]^+$: 417.1398, found 417.1394.

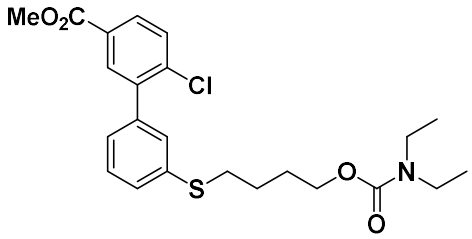
Methyl 2'-chloro-5-((4-((diethylcarbamoyl)oxy)butyl)thio)-[1,1'-biphenyl]-3-carboxylate (16a)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **16a** (32.7 mg, 73% yield) as a pale yellow oil. Regioselective ratio determined by

^{1}H NMR *m:o* = 91:9. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.01 – 7.98 (m, 1H), 7.96 – 7.88 (m, 1H), 7.57 – 7.53 (m, 1H), 7.49 – 7.38 (m, 1H), 7.36 – 7.33 (m, 2H), 7.24 – 7.14 (m, 1H), 4.09 (t, *J* = 5.6 Hz, 2H), 3.92 (d, *J* = 1.6 Hz, 3H), 3.23 (d, *J* = 17.2 Hz, 4H), 3.01 (dt, *J* = 16.0, 6.8 Hz, 2H), 1.81 – 1.76 (m, 4H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 166.4, 166.1, 155.9, 140.2, 140.1, 139.1, 138.9, 137.5, 137.4, 136.7, 133.7, 132.4, 132.3, 131.1, 130.7, 130.2, 130.0, 129.7, 129.6, 129.2, 128.9, 128.6(4), 128.6(0), 128.4, 127.9, 127.0, 126.9, 64.3, 64.3, 52.3(2), 52.3(0), 41.7, 41.1, 33.2, 33.1, 28.2(3), 28.2(1), 25.7, 25.6, 14.0, 13.5. HRMS-ESI (m/z): calcd for $C_{23}H_{29}ClNO_4S$ $[M + H]^+$: 450.1500, found 450.1494.

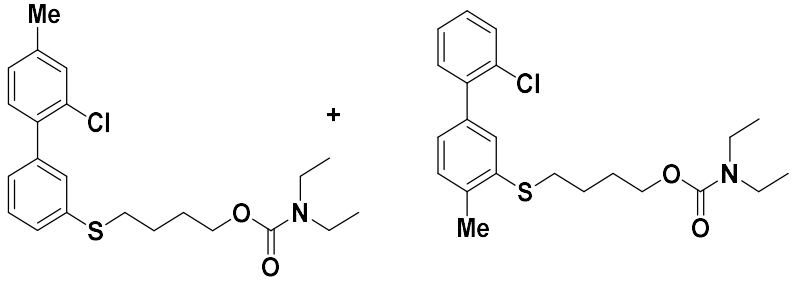
Methyl 6-chloro-3'-((4-((diethylcarbamoyl)oxy)butyl)thio)-[1,1'-biphenyl]-3-carboxylate (16b)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **16b** (9.0 mg, 20% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m:o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.00 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.81 (d, *J* = 2.0 Hz, 1H), 7.50 – 7.47 (m, 1H), 7.38 – 7.31 (m, 3H), 7.24 (d, *J* = 2.0 Hz, 1H), 4.06 (t, *J* = 6.0 Hz, 2H), 3.90 (s, 3H), 3.23 (d, *J* = 23.6 Hz, 4H), 2.98 – 2.89 (m, 2H), 1.74 – 1.70 (m, 4H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 166.7, 155.9, 143.6, 138.4, 138.3, 133.6, 131.3, 131.0, 129.6, 129.5, 129.4, 126.7, 126.4, 125.3, 64.2, 52.1, 41.7, 41.3, 31.9, 28.4, 25.2, 14.0, 13.5. HRMS-ESI (m/z): calcd for $C_{23}H_{29}ClNO_4S$ $[M + H]^+$: 450.1500, found 450.1497.

4-((2'-chloro-4'-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (17a) and 4-((2'-chloro-4-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (17b)

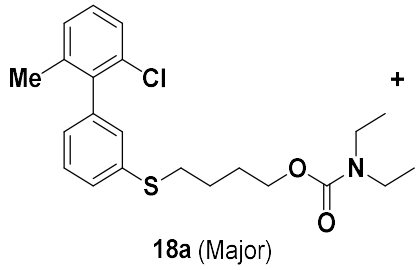
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **17a** and **17b** (38.9 mg, 96% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR



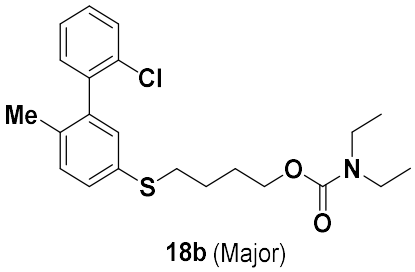
m:*o* = 85:15. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.46 – 7.38 (m, 1H), 7.33 – 7.27 (m, 3H), 7.25 – 7.05 (m, 3H), 4.10 – 4.01 (m, 2H), 3.22 (d, *J* = 18.0 Hz, 4H), 2.99 – 2.77 (m, 2H), 2.40 – 2.35 (m, 3H),

1.80 – 1.61 (m, 4H), 1.07 (s, 6H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 155.8, 139.9, 138.8, 137.4, 136.8, 136.5, 135.6, 132.3, 131.9, 131.1, 130.8, 130.3, 129.8(2), 129.8(0), 129.6, 128.4, 128.3, 128.2, 127.8, 127.6, 126.7, 126.3, 64.3, 41.6, 41.0, 33.1, 32.4, 28.2, 28.1, 25.6, 25.5, 20.7, 20.0, 13.9, 13.4. HRMS-ESI (*m/z*): calcd for $C_{22}H_{29}ClNO_2S$ $[M + H]^+$: 406.1602, found 406.1597.

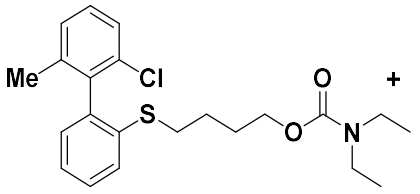
4-((2'-chloro-6'-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (18a) and 4-((2'-chloro-6-methyl-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (18b) and 4-((2'-chloro-6'-methyl-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (18a') and 4-((2'-chloro-6-methyl-[1,1'-biphenyl]-2-yl)thio)butyl diethylcarbamate (18b') and



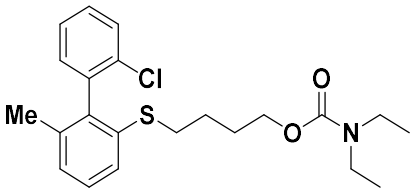
18a (Major)



18b (Major)



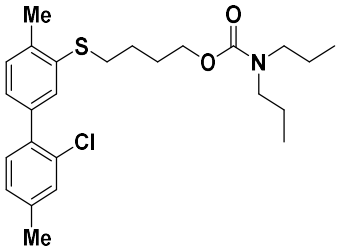
18a'



18b'

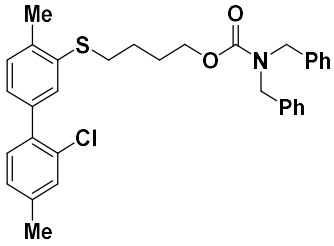
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **18** and **18'** (38.5 mg, 95% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 67:33. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.50 – 7.29 (m, 3H), 7.25 – 7.15 (m, 3H), 7.13 – 6.98 (m, 1H), 4.09 – 4.02 (m, 2H), 3.22 (d, *J* = 14.0 Hz, 4H), 2.99 – 2.80 (m, 2H), 2.08 – 1.99 (m, 3H), 1.77 – 1.67 (m, 4H), 1.09 (s, 6H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 155.9, 139.9, 139.8, 139.5, 138.9, 138.7, 138.6, 138.3, 137.1, 136.6, 136.2, 136.0, 134.3, 133.8, 133.6, 133.4, 133.2, 132.9, 131.2, 130.9, 130.5, 130.3, 129.7, 129.5, 129.3, 129.1, 128.9, 128.7(3), 128.7(0), 128.6, 128.3, 128.2, 128.1, 127.9, 127.1, 126.9, 126.8(3), 126.8(0), 126.7, 126.6(5), 126.6(0), 125.5, 124.6, 64.3, 64.3, 41.6, 41.2, 33.7, 33.2, 32.6, 31.9, 28.3, 28.2(5), 28.2(0), 28.1, 25.7, 25.6, 25.5, 25.4, 21.0, 20.5, 20.1, 19.2. HRMS-ESI (*m/z*): calcd for $C_{22}H_{29}ClNO_2S$ $[M + H]^+$: 406.1602, found 406.1596.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl dipropylcarbamate (19)



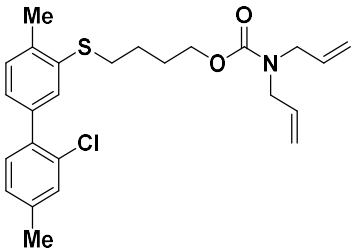
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **19** (41.1 mg, 92% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.29 (m, 2H), 7.21 (dd, *J* = 7.6, 1.6 Hz, 2H), 7.15 – 7.05 (m, 2H), 4.08 (t, *J* = 6.0 Hz, 2H), 3.17 – 3.10 (m, 4H), 2.96 (t, *J* = 6.0 Hz, 2H), 2.40 (s, 3H), 2.37 (s, 3H), 1.80 – 1.76 (m, 4H), 1.57 – 1.47 (m, 4H), 0.90 – 0.82 (m, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.4, 138.7, 137.5, 137.0, 136.3, 135.6, 132.0, 131.0, 130.4, 129.7, 128.3, 127.6, 126.4, 64.4, 49.1, 48.5, 32.4, 28.3, 25.6, 21.8, 21.3, 20.8, 20.0, 11.2. HRMS-ESI (*m/z*): calcd for $C_{25}H_{35}ClNO_2S$ $[M + H]^+$: 448.2072, found 448.2066.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl dibenzylcarbamate (20)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **20** (46.1 mg, 85% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 89:11. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 – 7.30 (m, 10H), 7.25 – 7.23 (m, 2H), 7.21 – 7.18 (m, 2H), 7.16 – 7.09 (m, 2H), 4.51 (s, 2H), 4.40 (s, 2H), 4.26 (t, *J* = 6.4 Hz, 2H), 2.96 (t, *J* = 7.2 Hz, 2H), 2.44 (s, 3H), 2.40 (s, 3H), 1.90 – 1.73 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.7, 138.6, 137.4, 137.4, 137.0, 136.3, 135.5, 132.0, 130.9, 130.3, 129.7, 128.5, 128.3, 128.0, 127.6, 127.3, 126.4, 65.1, 49.5, 48.9, 32.3, 28.2, 25.3, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{33}H_{35}ClNO_2S$ $[M + H]^+$: 544.2072, found 544.2069.

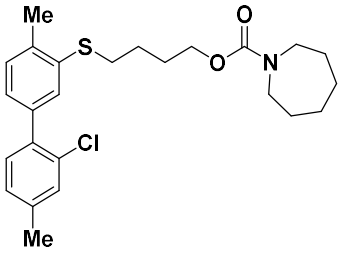
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl diallylcarbamate (21)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **21** (41.2 mg, 93% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 91:9. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33 – 7.30 (m, 2H), 7.23 – 7.21 (m, 2H), 7.15 – 7.11 (m, 2H), 5.74 (s, 2H), 5.11 (t, *J* = 18.0 Hz, 4H), 4.12 (t, *J* = 6.0 Hz, 2H), 3.83 (d, *J* = 36.8 Hz, 4H), 2.95 (t, *J* = 7.2 Hz, 2H), 2.41 (s, 3H), 2.38 (s, 3H), 1.82 – 1.76 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.1, 138.7, 137.4, 137.0, 136.3, 135.5, 133.5,

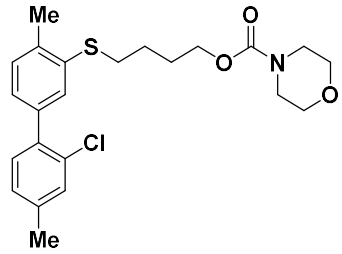
132.0, 131.0, 130.3, 129.7, 128.3, 127.6, 126.4, 117.0, 116.4, 64.8, 49.0, 48.4, 32.4, 28.2, 25.5, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{25}H_{31}ClNO_2S$ [M + H]$^+$: 444.1759, found 444.1756.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl azepane-1-carboxylate (22)



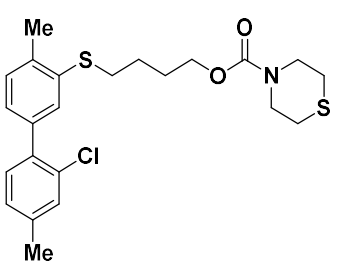
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **22** (42.3 mg, 95% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 (d, *J* = 1.6 Hz, 1H), 7.29 (s, 1H), 7.21 (dd, *J* = 8.0, 2.4 Hz, 2H), 7.14 – 7.10 (m, 2H), 4.10 (t, *J* = 6.0 Hz, 2H), 3.41 (t, *J* = 6.0 Hz, 2H), 3.31 (t, *J* = 6.0 Hz, 2H), 2.96 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.37 (s, 3H), 1.82 – 1.76 (m, 4H), 1.68 – 1.65 (m, 2H), 1.62 – 1.59 (m, 2H), 1.52 – 1.50 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.2, 138.6, 137.4, 137.0, 136.3, 135.5, 132.0, 130.9, 130.3, 129.6, 128.2, 127.6, 126.3, 64.4, 46.8, 46.4, 32.4, 28.4, 28.3, 28.2, 27.3, 26.8, 25.6, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{25}H_{33}ClNO_2S$ [M + H]$^+$: 446.1915, found 446.1910.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl morpholine-4-carboxylate (2 3)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 10:1 as the eluent) to give **23** (39.0 mg, 90% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 90:10. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.29 (m, 2H), 7.21 (d, *J* = 7.6 Hz, 2H), 7.14 – 7.11 (m, 2H), 4.12 (t, *J* = 5.6 Hz, 2H), 3.61 (s, 4H), 3.41 (s, 4H), 2.95 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.37 (s, 3H), 1.83 – 1.75 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.3, 138.7, 137.4, 137.0, 136.3, 135.4, 132.0, 130.9, 130.4, 129.7, 128.3, 127.7, 126.4, 66.5, 65.0, 44.0, 43.8, 32.3, 28.1, 25.5, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{23}H_{29}ClNO_3S$ [M + H]$^+$: 434.1551, found 434.1547.

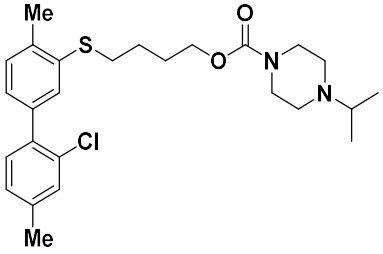
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl thiomorpholine-4-carboxylate (24)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give

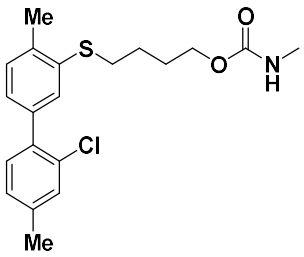
24 (42.6 mg, 95% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 90:10. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 (d, *J* = 10.0 Hz, 2H), 7.21 (d, *J* = 7.6 Hz, 2H), 7.14 – 7.11 (m, 2H), 4.11 (t, *J* = 5.6 Hz, 2H), 3.68 (s, 4H), 2.95 (t, *J* = 6.8 Hz, 2H), 2.56 – 2.53 (m, 4H), 2.40 (s, 3H), 2.37 (s, 3H), 1.82 – 1.75 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.0, 138.7, 137.4, 136.9, 136.3, 135.4, 132.0, 130.9, 130.3, 129.7, 128.3, 127.6, 126.4, 65.0, 46.2, 32.3, 28.1, 27.1, 25.5, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{23}H_{29}ClNO_2S_2$ $[M + H]^+$: 450.1323, found 450.1319.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl-4-isopropylpiperazine-1-carboxylate (25)



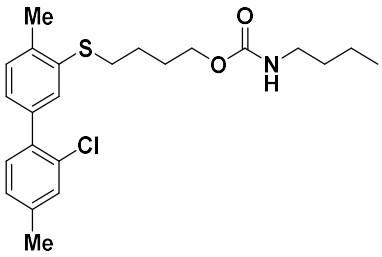
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 5:1 as the eluent) to give **25** (40.7 mg, 86% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 89:11. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 (d, *J* = 13.2 Hz, 2H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.12 (t, *J* = 7.2 Hz, 2H), 4.09 (t, *J* = 5.6 Hz, 2H), 3.44 (s, 4H), 2.95 (t, *J* = 6.8 Hz, 2H), 2.68 (q, *J* = 6.4 Hz, 1H), 2.43 (s, 4H), 2.40 (s, 3H), 2.37 (s, 3H), 1.80 – 1.77 (m, 4H), 1.03 (d, *J* = 6.4 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.3, 138.7, 137.5, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.7, 128.4, 127.7, 126.4, 64.8, 54.5, 48.3, 43.9, 32.4, 28.2, 25.5, 20.8, 20.0, 18.3. HRMS-ESI (*m/z*): calcd for $C_{26}H_{36}ClNO_2S$ $[M + H]^+$: 475.2181, found 475.2177.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl methylcarbamate (26)



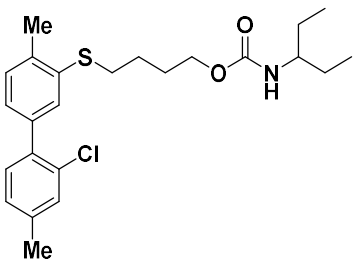
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 10:1 as the eluent) to give **26** (15.1 mg, 40% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 94:6. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 (dd, *J* = 8.4, 2.0 Hz, 2H), 7.22 (dd, *J* = 8.0, 2.0 Hz, 2H), 7.14 – 7.11 (m, 2H), 4.52 (s, 1H), 4.07 (t, *J* = 5.2 Hz, 2H), 2.94 (t, *J* = 4.0 Hz, 2H), 2.76 (d, *J* = 4.4 Hz, 3H), 2.40 (s, 3H), 2.37 (s, 3H), 1.78 – 1.75 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 157.2, 138.7, 137.5, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.7, 128.3, 127.7, 126.4, 64.2, 32.3, 28.2, 27.4, 25.4, 20.8, 20.0. HRMS-ESI (*m/z*): calcd for $C_{20}H_{25}ClNO_2S$ $[M + H]^+$: 378.1289, found 378.1288.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl butylcarbamate (27)



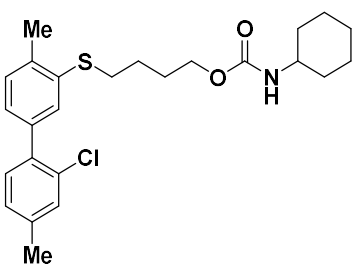
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **27** (40.6 mg, 97% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33 – 7.30 (m, 2H), 7.22 (dd, *J* = 7.6, 4.0 Hz, 2H), 7.15 – 7.11 (m, 2H), 4.64 (s, 1H), 4.07 (t, *J* = 5.6 Hz, 2H), 3.15 (q, *J* = 6.8 Hz, 2H), 2.95 (t, *J* = 6.4 Hz, 2H), 2.39 (d, *J* = 12.0 Hz, 6H), 1.79 – 1.75 (m, 4H), 1.49 – 1.30 (m, 4H), 0.92 (t, *J* = 7.2 Hz, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.5, 138.7, 137.4, 137.0, 136.3, 135.5, 132.0, 131.0, 130.3, 129.7, 128.3, 127.6, 126.4, 64.0, 40.6, 32.3, 32.0, 28.2, 25.4, 20.7, 20.0, 19.8, 13.7. HRMS-ESI (*m/z*): calcd for $C_{23}H_{31}ClNO_2S$ [M + H]$^+$: 420.1759, found 420.1758.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl pentan-3-ylcarbamate (28)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **28** (42.0 mg, 97% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33 – 7.30 (m, 2H), 7.22 (dd, *J* = 8.0, 3.6 Hz, 2H), 7.15 – 7.11 (m, 2H), 4.39 (d, *J* = 8.4 Hz, 1H), 4.07 (t, *J* = 5.2 Hz, 2H), 3.50 – 3.41 (m, 1H), 2.95 (t, *J* = 6.0 Hz, 2H), 2.39 (d, *J* = 12.8 Hz, 6H), 1.79 – 1.76 (m, 4H), 1.57 – 1.47 (m, 2H), 1.40 – 1.30 (m, 2H), 0.89 (t, *J* = 7.2 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.4, 138.7, 137.4, 137.0, 136.3, 135.5, 132.0, 131.0, 130.3, 129.7, 128.3, 127.6, 126.4, 64.0, 53.8, 32.4, 28.3, 27.5, 25.5, 20.7, 20.0, 10.1. HRMS-ESI (*m/z*): calcd for $C_{24}H_{33}ClNO_2S$ [M + H]$^+$: 434.1915, found 434.1910.

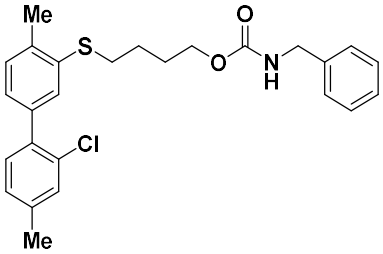
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl cyclohexylcarbamate (29)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **29** (40.5 mg, 91% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33 – 7.30 (m, 2H), 7.22 (dd, *J* = 8.0, 3.2 Hz, 2H), 7.15 – 7.11 (m, 2H), 4.55 (d, *J* = 10.4 Hz, 1H), 4.06 (t, *J* = 5.6 Hz, 2H), 3.46 (d, *J* = 7.6 Hz, 1H), 2.95 (t, *J* = 5.8 Hz, 2H), 2.39 (d, *J* = 12.0 Hz, 6H), 1.91 (d, *J* =

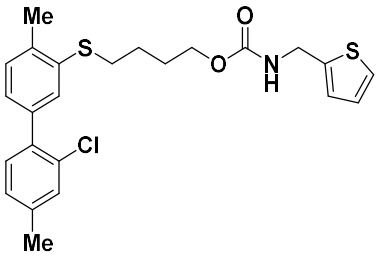
10.0 Hz, 2H), 1.77 (s, 4H), 1.71 – 1.66 (m, 2H), 1.61 – 1.57 (m, 1H), 1.38 – 1.29 (m, 2H), 1.20 – 1.05 (m, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 155.7, 138.7, 137.4, 137.0, 136.3, 135.5, 132.0, 131.0, 130.4, 129.7, 128.3, 127.7, 126.4, 63.9, 49.6, 33.3, 32.4, 28.2, 25.5, 25.4, 24.7, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{25}H_{33}ClNO_2S$ $[M + H]^+$: 446.1915, found 446.1910.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl benzylcarbamate (30)



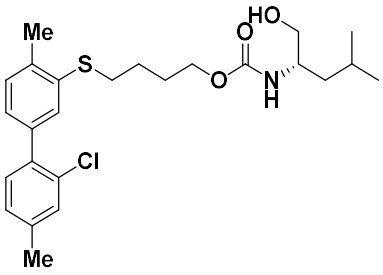
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **30** (39.4 mg, 87% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 – 7.19 (m, 9H), 7.10 (t, *J* = 8.4 Hz, 2H), 4.96 (s, 1H), 4.32 (d, *J* = 4.4 Hz, 2H), 4.10 (t, *J* = 5.6 Hz, 2H), 2.92 (t, *J* = 6.8 Hz, 2H), 2.37 (d, *J* = 16.8 Hz, 6H), 1.77 – 1.75 (m, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 156.5, 138.7, 138.5, 137.4, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.7, 128.6, 128.3, 127.7, 127.4, 126.4, 64.4, 45.0, 32.3, 28.2, 25.4, 20.8, 20.0. HRMS-ESI (*m/z*): calcd for $C_{26}H_{29}ClNO_2S$ $[M + H]^+$: 454.1602, found 454.1596.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl(thiophen-2-ylmethyl)carbamate (31)



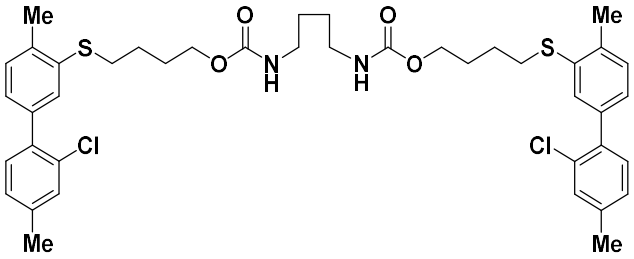
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **31** (42.2 mg, 92% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.29 (m, 2H), 7.24 – 7.20 (m, 3H), 7.15 – 7.06 (m, 2H), 6.95 – 6.93 (m, 2H), 5.05 (s, 1H), 4.53 (d, *J* = 5.2 Hz, 2H), 4.12 (t, *J* = 5.2 Hz, 2H), 2.95 (t, *J* = 6.8 Hz, 2H), 2.42 (d, *J* = 14.8 Hz, 6H), 1.79 – 1.64 (m, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 156.2, 141.3, 138.7, 137.4, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.7, 128.4, 127.7, 126.8, 126.4, 125.6, 125.0, 64.5, 39.8, 32.3, 28.2, 25.4, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{24}H_{27}ClNO_2S_2$ $[M + H]^+$: 460.1166, found 460.1161.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl-(S)-(1-hydroxy-4-methylpentan-2-yl)carbamate (32)



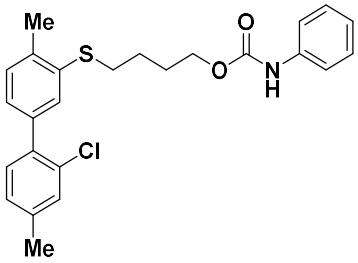
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 5:1 as the eluent) to give **32** (40.7 mg, 88% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 90:10. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.35 – 7.29 (m, 2H), 7.23 – 7.19 (m, 2H), 7.14 – 7.11 (m, 2H), 4.78 (d, *J* = 6.8 Hz, 1H), 4.07 (d, *J* = 5.6 Hz, 2H), 3.74 (s, 1H), 3.64 (d, *J* = 9.2 Hz, 1H), 3.50 (s, 1H), 2.94 (t, *J* = 6.8 Hz, 2H), 2.61 (s, 1H), 2.39 (d, *J* = 12.4 Hz, 6H), 1.77 (t, *J* = 3.6 Hz, 3H), 1.68 – 1.62 (m, 2H), 1.34 – 1.30 (m, 2H), 0.92 (d, *J* = 6.4 Hz, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 157.0, 138.7, 137.4, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.7, 128.4, 127.7, 126.4, 66.0, 64.4, 51.2, 40.4, 32.3, 28.2, 25.4, 24.7, 23.0, 22.1, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{25}H_{35}ClNO_3S$ [M + H]$^+$: 464.2021, found 464.2019.

bis(4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl)butane-1,4-diyldicarbamate (33)



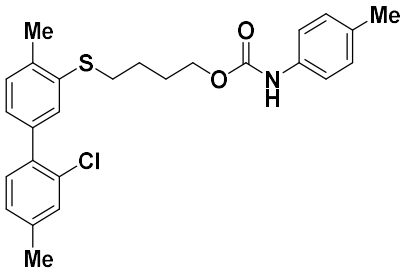
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 2:1 as the eluent) to give **33** (71.0 mg, 91% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 96:4. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.30 (d, *J* = 9.6 Hz, 4H), 7.21 (dd, *J* = 8.0, 2.4 Hz, 4H), 7.14 – 7.10 (m, 4H), 4.70 (s, 2H), 4.06 (t, *J* = 5.2 Hz, 4H), 3.14 (d, *J* = 6.0 Hz, 4H), 2.94 (t, *J* = 6.0 Hz, 4H), 2.38 (d, *J* = 10.8 Hz, 12H), 1.77 – 1.74 (m, 8H), 1.48 (s, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.6, 138.7, 137.4, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.7, 128.3, 127.7, 126.4, 64.2, 40.5, 32.3, 28.2, 27.2, 25.4, 20.8, 20.0. HRMS-ESI (*m/z*): calcd for $C_{42}H_{51}Cl_2N_2O_4S_2$ [M + H]$^+$: 781.2662, found 781.2661.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl phenylcarbamate (34)



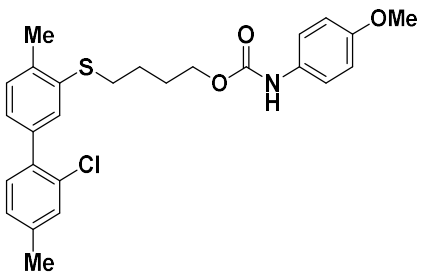
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **34** (17.5 mg, 40% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.38 – 7.28 (m, 6H), 7.24 (d, *J* = 7.6 Hz, 2H), 7.16 – 7.05 (m, 3H), 6.66 (s, 1H), 4.20 (t, *J* = 5.2 Hz, 2H), 2.98 (t, *J* = 6.8 Hz, 2H), 2.43 (s, 3H), 2.37 (s, 3H), 1.87 – 1.80 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.5, 138.7, 137.8, 137.5, 137.0, 136.4, 135.4, 132.0, 131.0, 130.4, 129.8, 128.9, 128.4, 127.7, 126.5, 123.3, 118.6, 64.6, 32.3, 28.1, 25.4, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{25}H_{27}ClNO_2S$ $[M + H]^+$: 440.1446, found 440.1441.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl p-tolylcarbamate (35)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **35** (28.5 mg, 63% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 (s, 1H), 7.27 (s, 1H), 7.23 – 7.20 (m, 4H), 7.14 – 7.07 (m, 4H), 6.52 (s, 1H), 4.16 (t, *J* = 5.2 Hz, 2H), 2.95 (t, *J* = 6.4 Hz, 2H), 2.40 (s, 3H), 2.35 (s, 3H), 2.29 (s, 3H), 1.82 – 1.79 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.6, 138.7, 137.5, 137.0, 136.5, 135.4, 135.2, 132.9, 132.0, 131.0, 130.4, 129.8, 129.5, 128.5, 127.7, 126.5, 118.8, 64.5, 32.4, 28.1, 25.5, 20.8, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{26}H_{29}ClNO_2S$ $[M + H]^+$: 454.1602, found 454.1593.

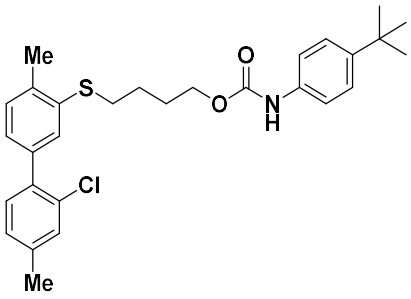
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl (4-methoxyphenyl)carbamate (36)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **36** (28.1 mg, 60% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 86:14. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.28 (m, 3H), 7.25 – 7.21 (m, 3H), 7.15 – 7.10 (m, 2H), 6.84 (d, *J* = 8.8 Hz, 2H), 6.47 (s, 1H), 4.17 (t, *J* = 5.6 Hz, 2H), 3.78 (s, 3H), 2.96 (t, *J* = 6.8 Hz, 2H), 2.41 (s, 3H), 2.36 (s, 3H), 1.84 – 1.81 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 153.9, 138.7, 137.5,

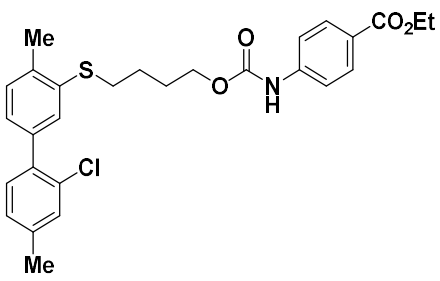
137.0, 136.5, 135.4, 132.0, 131.0, 130.4, 129.8(1), 129.8(0), 128.4, 127.7, 126.5, 120.7, 114.2, 64.5, 55.5, 32.3, 28.1, 25.5, 20.8, 20.1. HRMS-ESI (*m/z*): calcd for $C_{26}H_{29}ClNO_3S$ [M + H]$^+$: 470.1551, found 470.1541.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl(4-(tert-butyl)phenyl)carbamate (37)



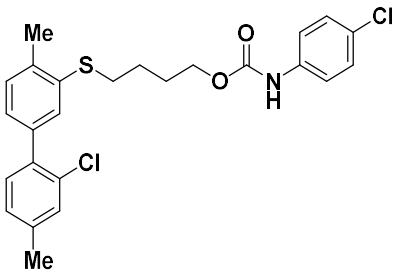
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **37** (32.2 mg, 65% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.34 – 7.29 (m, 6H), 7.22 (d, *J* = 8.0 Hz, 2H), 7.13 (dd, *J* = 13.2, 8.0 Hz, 2H), 6.51 (s, 1H), 4.18 (t, *J* = 5.2 Hz, 2H), 2.97 (t, *J* = 6.8 Hz, 2H), 2.41 (s, 3H), 2.36 (s, 3H), 1.86 – 1.80 (m, 6H), 1.31 (s, 9H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.6, 146.3, 138.8, 137.5, 137.0, 136.4, 135.5, 135.1, 132.0, 131.0, 130.4, 129.8, 128.4, 127.7, 126.5, 125.8, 118.5, 64.6, 34.2, 32.3, 31.3, 28.1, 25.5, 20.8, 20.1. HRMS-ESI (*m/z*): calcd for $C_{29}H_{35}ClNO_2S$ [M + H]$^+$: 496.2072, found 496.2067.

Ethyl-4-(((4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butoxy)carbonyl)amino)benzoate (38)



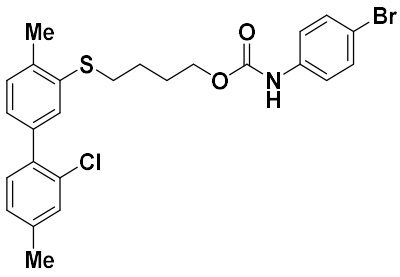
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 20:1 as the eluent) to give **38** (19.4 mg, 38% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 82:18. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.99 (d, *J* = 8.8 Hz, 2H), 7.43 (d, *J* = 8.4 Hz, 2H), 7.33 (d, *J* = 1.5 Hz, 1H), 7.28 (d, *J* = 4.0 Hz, 1H), 7.22 (d, *J* = 7.6 Hz, 2H), 7.14 – 7.09 (m, 2H), 6.84 (s, 1H), 4.36 (q, *J* = 7.2 Hz, 2H), 4.20 (t, *J* = 5.6 Hz, 2H), 2.96 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.36 (s, 3H), 1.86 – 1.78 (m, 4H), 1.39 (t, *J* = 7.2 Hz, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 166.2, 153.0, 142.1, 138.8, 137.5, 137.0, 136.5, 135.3, 132.0, 131.0, 130.8, 130.4, 129.8, 128.4, 127.7, 126.5, 125.1, 117.5, 65.0, 60.8, 32.3, 28.0, 25.4, 20.8, 20.1, 14.3. HRMS-ESI (*m/z*): calcd for $C_{28}H_{31}ClNO_4S$ [M + H]$^+$: 512.1657, found 512.1648.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl (4-chlorophenyl)carbamate (39)



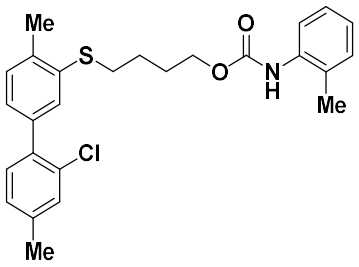
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **39** (21.3 mg, 45% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99: 1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.29 (d, *J* = 7.6 Hz, 2H), 7.25 – 7.18 (m, 6H), 7.11 – 7.06 (m, 2H), 6.55 (s, 1H), 4.15 (t, *J* = 5.6 Hz, 2H), 2.93 (t, *J* = 6.8 Hz, 2H), 2.37 (s, 3H), 2.33 (s, 3H), 1.84 – 1.76 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.3, 138.8, 137.5, 137.0, 136.6, 136.5, 135.4, 132.0, 131.0, 130.4, 129.8, 129.0, 128.6, 128.4, 127.7, 126.6, 119.9, 64.9, 32.4, 28.1, 25.5, 20.8, 20.1. HRMS-ESI (*m/z*): calcd for $C_{25}H_{26}Cl_2NO_2S$ $[M + H]^+$: 474.1056, found 474.1052.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl (4-bromophenyl)carbamate (40)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **40** (20.7 mg, 40% yield) as a white solid. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.39 (d, *J* = 8.4 Hz, 2H), 7.33 (s, 1H), 7.27 – 7.20 (m, 5H), 7.14 – 7.09 (m, 2H), 6.57 (s, 1H), 4.17 (t, *J* = 5.2 Hz, 2H), 2.95 (t, *J* = 6.8 Hz, 2H), 2.38 (d, *J* = 17.6 Hz, 6H), 1.83 – 1.79 (m, 2H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.3, 138.8, 137.5, 137.0(2), 137.0(0), 136.6, 135.4, 132.0, 131.9, 131.0, 130.4, 129.8, 128.6, 127.7, 126.6, 120.2, 115.9, 64.9, 32.4, 28.1, 25.5, 20.8, 20.1. HRMS-ESI (*m/z*): calcd for $C_{25}H_{26}BrClNO_2S$ $[M + H]^+$: 518.0551, found 518.0546.

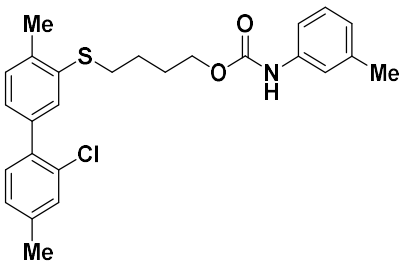
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl o-tolylcarbamate (41)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **41** (22.6 mg, 50% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 85:15. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.77 (s, 1H), 7.36 (d, *J* = 1.6 Hz, 1H), 7.29 (d, *J* = 1.6 Hz, 1H), 7.24 – 7.19 (m, 3H), 7.17 – 7.13 (m, 3H), 7.04 (t, *J* = 6.8 Hz, 1H), 6.37 (s, 1H), 4.20 (t, *J* = 5.6 Hz, 2H), 2.98 (t, *J* = 6.8 Hz, 2H),

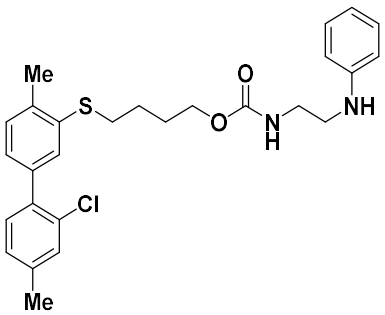
2.43 (s, 3H), 2.37 (s, 3H), 2.24 (s, 3H), 1.88 – 1.82 (m, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 153.8, 138.7, 137.5, 137.0, 136.4, 135.8, 135.4, 132.0, 131.0, 130.4, 130.3, 129.8, 128.4, 127.7, 126.8, 126.5, 124.0, 64.7, 32.3, 28.1, 25.5, 20.8, 20.0, 17.6. HRMS-ESI (*m/z*): calcd for $C_{26}H_{29}ClNO_2S$ $[M + H]^+$: 454.1602, found 454.1597.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl m-tolylcarbamate (42)



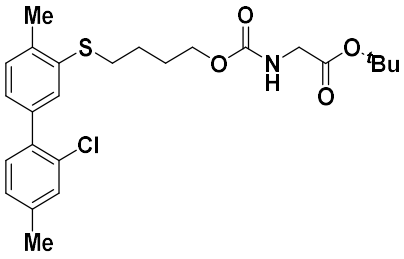
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **42** (27.2 mg, 60% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 99:1. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 (s, 1H), 7.30 (s, 1H), 7.23 (t, *J* = 8.0 Hz, 3H), 7.19 – 7.11 (m, 4H), 6.89 (d, *J* = 6.8 Hz, 1H), 6.59 (s, 1H), 4.19 (t, *J* = 5.6 Hz, 2H), 2.98 (t, *J* = 6.8 Hz, 2H), 2.43 (s, 3H), 2.37 (s, 3H), 2.34 (s, 3H), 1.87 – 1.81 (m, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 153.5, 138.9, 138.7, 137.7, 137.5, 137.0, 136.5, 135.4, 132.0, 131.0, 130.4, 129.8, 128.8, 128.6, 127.7, 126.5, 124.2, 119.3, 115.8, 64.6, 32.4, 28.1, 25.5, 21.4, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{26}H_{29}ClNO_2S$ $[M + H]^+$: 454.1602, found 454.1595.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl(2-(phenylamino)ethyl)carbamate (43)



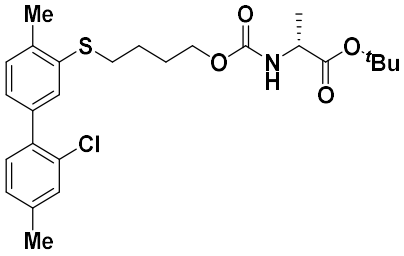
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 10:1 as the eluent) to give **43** (20.2 mg, 42% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 86:14. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 (d, *J* = 14.0 Hz, 2H), 7.23 – 7.11 (m, 6H), 6.72 (t, *J* = 7.6 Hz, 1H), 6.62 (d, *J* = 7. 6 Hz, 2H), 4.90 (s, 1H), 4.09 (t, *J* = 5.2 Hz, 2H), 3.39 (t, *J* = 6.0 Hz, 2H), 3.26 (d, *J* = 6.0 Hz, 2H), 2.94 (t, *J* = 6.8 Hz, 2H), 2.39 (d, *J* = 14.0 Hz, 6H), 1.77 (d, *J* = 5.2 Hz, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 157.0, 147.6, 138.8, 137.5, 137.0, 136.4, 135.5, 132.0, 131.0, 130.4, 129.8, 129.3, 128.4(0), 128.3(7), 127.7, 126.5, 117.8, 112.9, 64.5, 44.2, 40.3, 32.3, 28.2, 25.4, 20.8, 20.1. HRMS-ESI (*m/z*): calcd for $C_{27}H_{32}ClN_2O_2S$ $[M + H]^+$: 483.1868, found 483.1865.

tert-butyl((4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butoxy)carbonyl)glycinate (44)



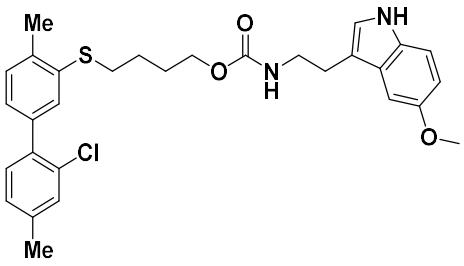
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **44** (45.3 mg, 95% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 84:16. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.32 – 7.29 (m, 2H), 7.21 (dd, *J* = 7.6, 3.2 Hz, 2H), 7.14 – 7.10 (m, 2H), 5.13 (s, 1H), 4.09 (t, *J* = 5.6 Hz, 2H), 3.82 (d, *J* = 5.2 Hz, 2H), 2.94 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.37 (s, 3H), 1.78 – 1.75 (m, 2H), 1.47 (s, 9H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 169.1, 156.4, 138.7, 137.5, 137.0, 136.4, 135.5, 132.0, 131.0, 130.3, 129.7, 128.5, 127.6, 126.4, 82.0, 64.6, 43.3, 32.4, 28.1, 28.0, 25.4, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{25}H_{33}ClNO_4S$ $[M + H]^+$: 478.1813, found 478.1809.

tert-butyl((4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butoxy)carbonyl)-D-alaninate (45)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **45** (48.1 mg, 98% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 83:17. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33 – 7.29 (m, 2H), 7.21 (dd, *J* = 7.6, 2.8 Hz, 2H), 7.14 – 7.10 (m, 2H), 5.22 (s, 1H), 4.23 – 4.19 (m, 1H), 4.08 (t, *J* = 5.6 Hz, 2H), 2.94 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.37 (s, 3H), 1.79 – 1.76 (m, 4H), 1.46 (s, 9H), 1.36 (t, *J* = 7.2 Hz, 3H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 172.2, 155.7, 138.6, 137.5, 137.0, 136.4, 135.5, 132.0, 131.0, 130.3, 129.7, 128.5, 127.6, 126.4, 81.8, 64.4, 50.0, 32.4, 28.2, 27.9, 25.4, 20.7, 20.0, 18.8. HRMS-ESI (*m/z*): calcd for $C_{26}H_{35}ClNO_4S$ $[M + H]^+$: 492.1970, found 492.1966.

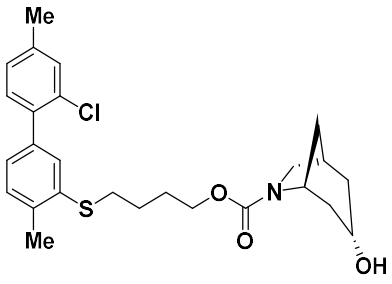
4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl(2-(5-methoxy-1H-indol-3-yl)ethyl)carbamate (46)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 5:1 as the eluent) to give **46** (42.9 mg, 80% yield) as a

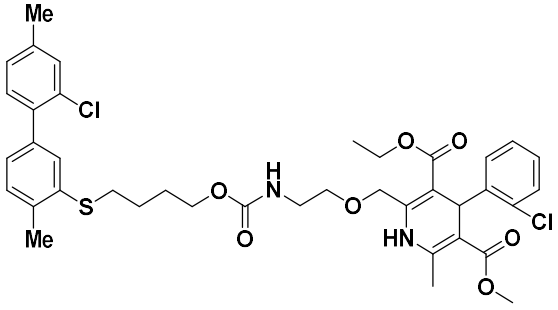
pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 91:9. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.97 (s, 1H), 7.32 – 7.28 (m, 2H), 7.25 – 7.20 (m, 2H), 7.14 – 7.10 (m, 2H), 7.00 (d, *J* = 19.5 Hz, 2H), 6.87 (dd, *J* = 9.6, 2.4 Hz, 1H), 4.73 (s, 1H), 4.08 (t , *J* = 5.6 Hz, 2H), 3.86 (s, 3H), 3.51 – 3.46 (m, 2H), 2.95 – 2.90 (m, 4H), 2.40 (s, 3H), 2.37 (s, 3H), 1.77 – 1.73 (m, 4H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 156.6, 154.0, 138.7, 137.5, 137.0, 136.3, 135.5, 132.0, 131.5, 131.0, 130.4, 129.7, 128.3, 127.7, 127.6, 126.4, 122.8, 112.3, 111.9, 100.5, 64.2, 55.9, 41.0, 32.3, 28.2, 25.7, 25.4, 20.8, 20.0. HRMS-ESI (*m/z*): calcd for $C_{30}H_{34}ClN_2O_3S$ $[M + H]^+$: 537.1973, found 537.1964.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl-(1R,3S,5S)-3-hydroxy-6-azabicyclo[3.2.1]octane-6-carboxylate (47)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 3:1 as the eluent) to give **47** (31.2 mg, 66% yield) as a pale yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 85:15. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.33 (d, *J* = 10.0 Hz, 2H), 7.24 (d, *J* = 7.6 Hz, 2H), 7.15 (t, *J* = 6.8 Hz, 2H), 4.27 (s, 1H), 4.16 (s, 1H), 4.11 (t, *J* = 6.0 Hz, 3H), 2.98 (t, J = 6.4 Hz, 2H), 2.41 (d, *J* = 11.6 Hz, 6H), 2.19 – 2.11 (m, 3H), 1.99 – 1.91 (m, 4H), 1.82 – 1.80 (m, 4H), 1.73 – 1.68 (m, 2H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 153.6, 138.7, 137.4, 137.0, 136.3, 135.5, 132.0, 131.0, 130.4, 129.7, 128.3, 127.7, 126.4, 65.0, 64.3, 52.6, 38.7, 38.1, 32.4, 28.4, 28.3, 27.7, 25.6, 20.7, 20.0. HRMS-ESI (*m/z*): calcd for $C_{26}H_{33}ClNO_3S$ $[M + H]^+$: 474.1864, found 474.1865.

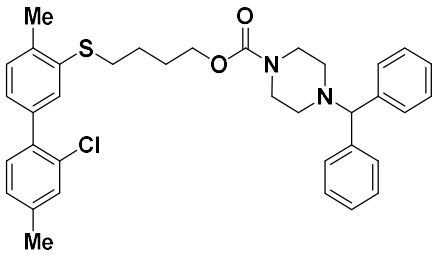
3-ethyl-5-methyl-2-((2-(((4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butoxy)carbonyl)amino)ethoxy)methyl)-4-(2-chlorophenyl)-6-methyl-1,4-dihydropyridine-3,5-dicarboxylate (48)



Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 5:1 as the eluent) to give **48** (40.7 mg, 54% yield) as a yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 85:15. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37 (d, *J* = 7.6 Hz, 1H), 7.30 (d, *J* = 14.8 Hz, 2H), 7.22 (d, *J* = 7.6 Hz, 3H), 7.14 – 7.01 (m, 5H), 5.41 (s, 1H), 4.91 (t, *J* = 6.0 Hz, 1H), 4.77 –

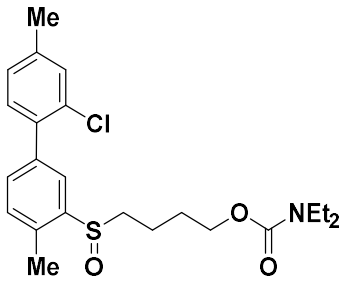
4.64 (m, 2H), 4.10 – 4.01 (m, 4H), 3.62 – 3.60 (m, 5H), 3.46 – 3.42 (m, 2H), 2.94 (t, *J* = 6.8 Hz, 2H), 2.40 (s, 3H), 2.36 (d, *J* = 6.8 Hz, 6H), 1.80 – 1.75 (m, 4H), 1.18 (t, *J* = 7.2 Hz, 3H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 168.0, 167.1, 156.9, 145.8, 145.1, 144.2, 138.8, 137.5, 137.0, 136.5, 135.4, 132.3, 132.0, 131.4, 131.0, 130.4, 129.8, 129.2, 128.4, 127.7, 127.3, 126.8, 126.5, 103.8, 101.4, 70.8, 68.0, 64.6, 59.7, 50.7, 40.7, 37.1, 32.4, 28.2, 25.5, 20.8, 20.0, 19.3, 14.2. HRMS-ESI (*m/z*): calcd for $C_{39}H_{45}Cl_2N_2O_7S$ $[M + H]^+$: 755.2319, found 755.2314.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)thio)butyl-4-benzhydrylpiperazine-1-carboxylate (49)



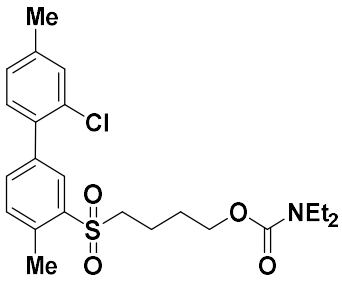
Following the general procedure, the crude product was purified by silica gel chromatography (PE: EA = 30:1 as the eluent) to give **49** (53.8 mg, 90% yield) as a yellow oil. Regioselective ratio determined by ^{1}H NMR *m*:*o* = 90:10. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.42 (d, *J* = 7.6 Hz, 4H), 7.33 – 7.27 (m, 6H), 7.23 – 7.19 (m, 4H), 7.12 (d, *J* = 8.0 Hz, 2H), 4.23 (s, 1H), 4.10 (t, *J* = 5.8 Hz, 2H), 4.42 (s, 4H), 2.95 (t, *J* = 5.8 Hz, 2H), 2.41 (s, 3H), 2.37 (d, *J* = 19.2 Hz, 7H), 1.80 – 1.75 (m, 4H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 155.3, 142.3, 138.7, 137.4, 137.0, 136.3, 135.4, 132.0, 131.0, 130.4, 129.7, 128.5, 127.8, 127.6, 127.0, 126.4, 64.7, 51.5, 43.8, 32.3, 28.1, 25.5, 20.8, 20.0. HRMS-ESI (*m/z*): calcd for $C_{36}H_{40}ClN_2O_2S$ $[M + H]^+$: 599.2494, found 599.2490.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)sulfinyl)butyl diethylcarbamate (50)



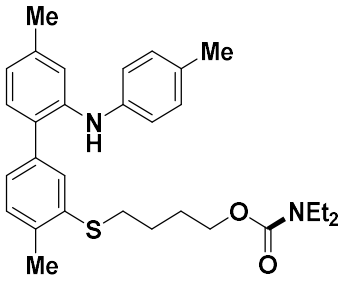
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.95 (d, *J* = 2.0 Hz, 1H), 7.48 (dd, *J* = 7.6, 2.0 Hz, 1H), 7.29 – 7.23 (m, 3H), 7.12 (d, *J* = 6.0 Hz, 1H), 4.09 (t, *J* = 6.0 Hz, 2H), 3.23 (d, *J* = 16.8 Hz, 4H), 2.93 – 2.76 (m, 2H), 2.42 (s, 3H), 2.37 (s, 3H), 1.95 – 1.76 (m, 4H), 1.08 (s, 6H). $^{13}C\{^{1}H\}$ NMR (100 MHz, $CDCl_3$): δ 155.8, 141.7, 139.2, 138.5, 136.1, 133.4, 132.0, 131.8, 131.0, 130.4, 130.3, 127.7, 124.9, 64.0, 54.6, 41.7, 41.1, 28.2, 20.8, 19.0, 17.9, 14.0, 13.5. HRMS-ESI (m/z): calcd for $C_{23}H_{31}ClNO_3S$ $[M + H]^+$: 436.1708, found 436.1702.

4-((2'-chloro-4,4'-dimethyl-[1,1'-biphenyl]-3-yl)sulfonyl)butyl diethylcarbamate (51)



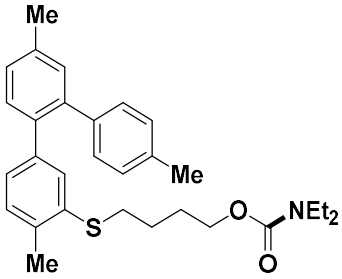
^{1}H NMR (400 MHz, $CDCl_3$): δ 8.05 (d, *J* = 1.6 Hz, 1H), 7.60 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.38 (d, *J* = 8.0 Hz, 1H), 7.29 (s, 1H), 7.21 (d, *J* = 7.6 Hz, 1H), 7.13 (d, *J* = 7.6 Hz, 1H), 4.05 (t, *J* = 6.0 Hz, 2H), 3.22 – 3.18 (m, 6H), 2.73 (s, 3H), 2.37 (s, 3H), 1.88 – 1.81 (m, 2H), 1.78 – 1.73 (m, 2H), 1.06 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.7, 139.6, 137.9, 136.9, 136.8, 135.3, 134.5, 132.5, 132.0, 131.1, 130.9, 130.5, 127.9, 63.7, 54.9, 41.7, 41.2, 27.8, 20.8, 20.1, 19.4, 14.0, 13.4. HRMS-ESI (m/z): calcd for $C_{23}H_{31}ClNO_4S$ $[M + H]^+$: 452.1657, found 452.1651.

4-((4,4'-dimethyl-2'-(p-tolylamino)-[1,1'-biphenyl]-3-yl)thio)butyl diethylcarbamate (52)



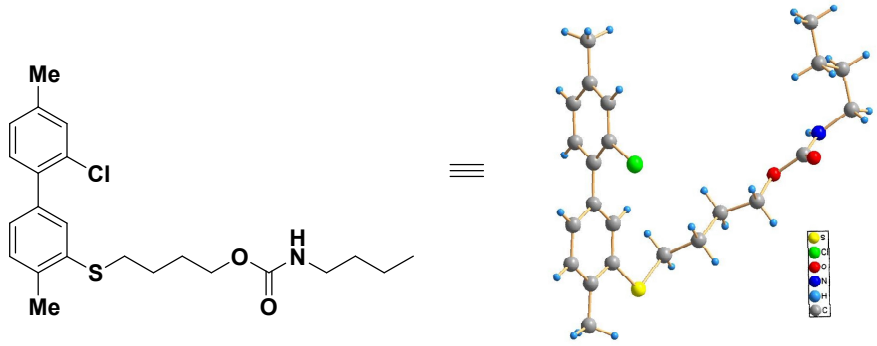
^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25 (s, 1H), 7.19 (d, *J* = 7.6 Hz, 1H), 7.14 – 7.10 (m, 3H), 7.06 (t, *J* = 8.0 Hz, 2H), 6.95 (d, *J* = 8.4 Hz, 2H), 6.79 (d, *J* = 7.6 Hz, 1H), 4.03 (t, *J* = 5.2 Hz, 2H), 3.23 (s, 5H), 2.83 (t, *J* = 6.4 Hz, 2H), 2.37 (s, 3H), 2.30 (d, *J* = 8.4 Hz, 6H), 1.71 – 1.69 (m, 4H), 1.08 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 140.7, 140.5, 138.2, 137.1, 136.8, 135.7, 130.9, 130.5, 130.4, 129.8, 128.0, 127.2, 125.9, 121.6, 119.0, 117.6, 64.3, 41.6, 41.2, 32.0, 28.3, 25.4, 21.4, 20.6, 19.9, 13.9, 13.6. HRMS-ESI (m/z): calcd for $C_{30}H_{39}N_2O_2S$ $[M + H]^+$: 491.2727, found 491.2721.

4-((4,4',4''-trimethyl-[1,1':2',1''-terphenyl]-3-yl)thio)butyl diethylcarbamate (53)



^{1}H NMR (400 MHz, $CDCl_3$): δ 7.31 (d, *J* = 7.6 Hz, 1H), 7.22 (d, *J* = 8.4 Hz, 2H), 7.06 (d, *J* = 6.8 Hz, 1H), 6.97 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.92 (d, *J* = 1.6 Hz, 1H), 4.07 (t, *J* = 6.4 Hz, 2H), 3.26 (d, *J* = 24.4 Hz, 4H), 2.55 (t, *J* = 7.2 Hz, 2H), 2.43 (s, 3H), 2.31 (s, 6H), 1.74 – 1.67 (m, 2H), 1.54 (p, *J* = 7.2 Hz, 2H), 1.11 (s, 6H). ^{13}C{^{1}H} NMR (100 MHz, $CDCl_3$): δ 155.9, 140.2, 139.5, 138.8, 137.1, 137.0, 135.9, 135.3, 134.9, 131.4, 130.4, 129.7, 129.2, 128.7, 128.0, 126.5, 64.4, 41.7, 41.1, 32.4, 28.3, 25.4, 21.0, 19.9, 14.0, 13.5. HRMS-ESI (m/z): calcd for $C_{30}H_{38}NO_2S$ $[M + H]^+$: 476.2618, found 476.2610.

H. Crystal data and structure refinement



X-ray structure of **27**

Table S2. Crystal data and structure refinements for **27**

Compound	**27**
Empirical formula	$C_{23}H_{30}ClNO_2S$
Formula weight	419.99
Temperature/K	100
Crystal system	triclinic
Space group	P-1
a/Å	14.5277(6)
b/Å	14.8392(6)
c/Å	32.2982(14)
α/°	98.541(2)
β/°	98.294(2)
γ/°	90.455(2)
Volume/Å^3	6810.5(5)
Z	12
Density (calculated)/g•cm^{-3}	1.229
μ/mm^{-1}	2.481
F(000)	2688.0
Crystal size/mm^3	0.16 × 0.04 × 0.02
Radiation	CuKα (λ = 1.54178)
2Θ range for data collection/°	5.594 to 127.966
Index ranges	-16 ≤ h ≤ 16, -17 ≤ k ≤ 17, 0 ≤ l ≤ 37
Reflections collected	21724
Independent reflections	21724 [Rint = ?, Rsigma = 0.1196]
Data/restraints/parameters	21724/0/1532
Goodness-of-fit on F^2	1.023
Final R indexes [I>=2σ (I)]	R_1 = 0.1021, wR_2 = 0.2603
Final R indexes [all data]	R_1 = 0.1397, wR_2 = 0.2948
Largest diff. peak/hole/e Å^{-3}	0.76/-0.56

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(1) Lanzi, M.; Rogge, T.; Truong, T. S.; K. N. Houk and Wencel-Delord, J. *J. Am. Chem. Soc.* 2023, **145**, 345-358.

(2) Youcan Zhang, Zhi-Peng Bao , Chang-Sheng Kuai, Xiao-Feng Wu. *J. Catal.* 2023, **426**, 1-5.

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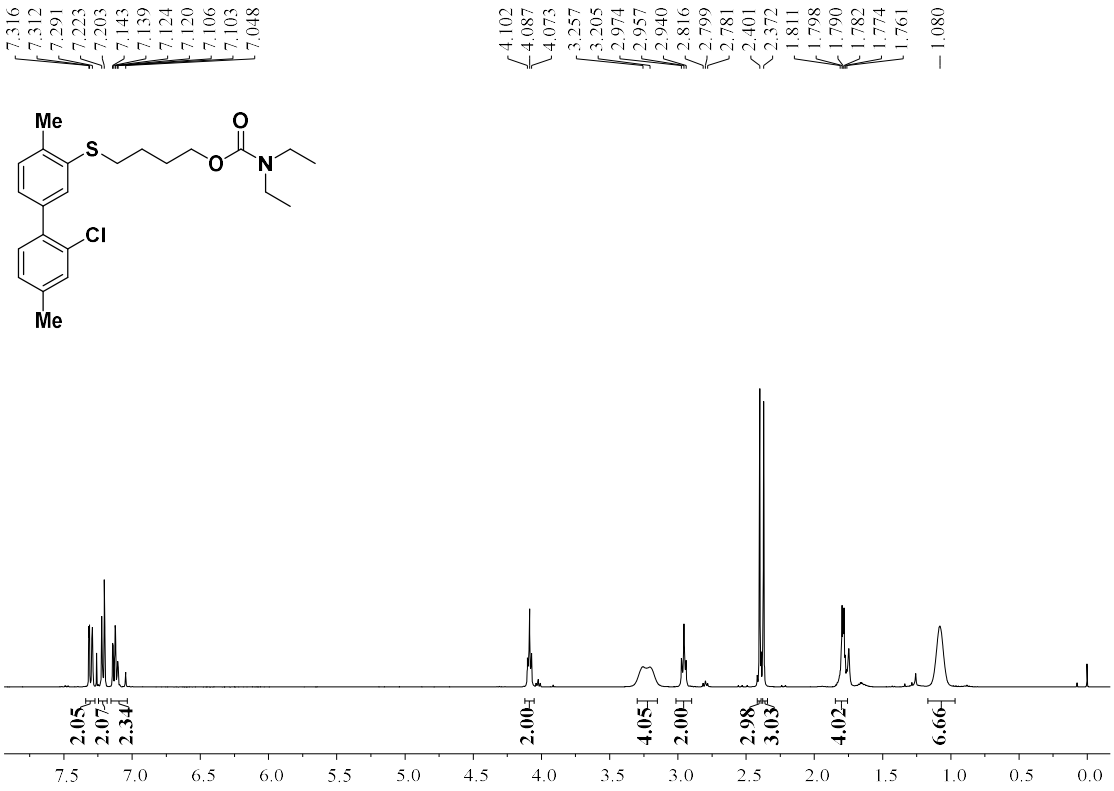
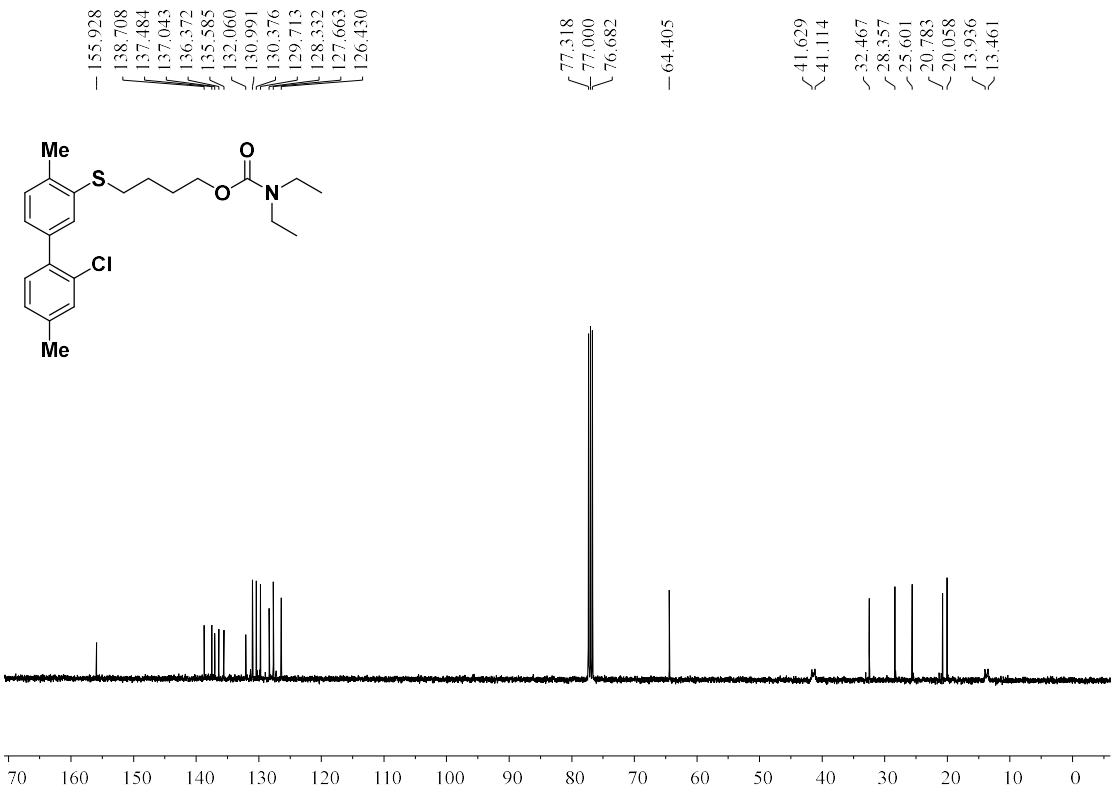
(5) (a) M. Lanzi, Q. Dherbassy and J. Wencel-Delord, *Angew. Chem. Int. Ed.,* 2021, **60**, 14852-14857; (b) M. Lanzi, T. Rogge, T. S. Truong, K. N. Houk and J. Wencel-Delord, *J. Am. Chem. Soc.*, 2022, **145**, 345-358; (c) H.-D. Xu, M.-Q. Cai, W.-J. He, W.-H. Hua and M.-H. Shen, *RSC Adv.* 2014, **4**, 7623-7626; (d) J. Chen, V. Palani and T. R. Hoye, *J. Am. Chem. Soc.* 2016, **138**, 4318-4321; (e) X.-B. Xu, Z.-H. Lin, Y. Liu, J. Guo and Y. He, *Org. Biomol. Chem.* 2017, **15**, 2716-2720; (f) D. Kaiser, I. Klose, R. Oost, J. Neuhaus and N. Maulide, *Chem. Rev.* 2019, **119**, 8701-8780.

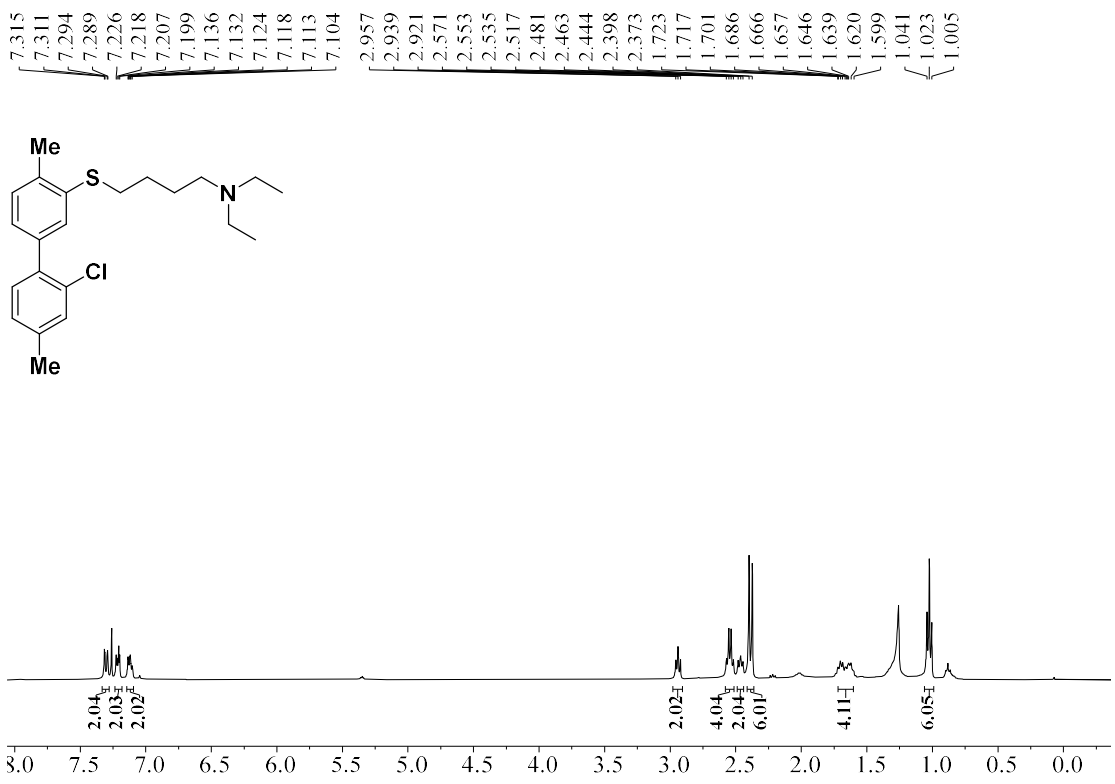
I. Copies of NMR Spectroscopies



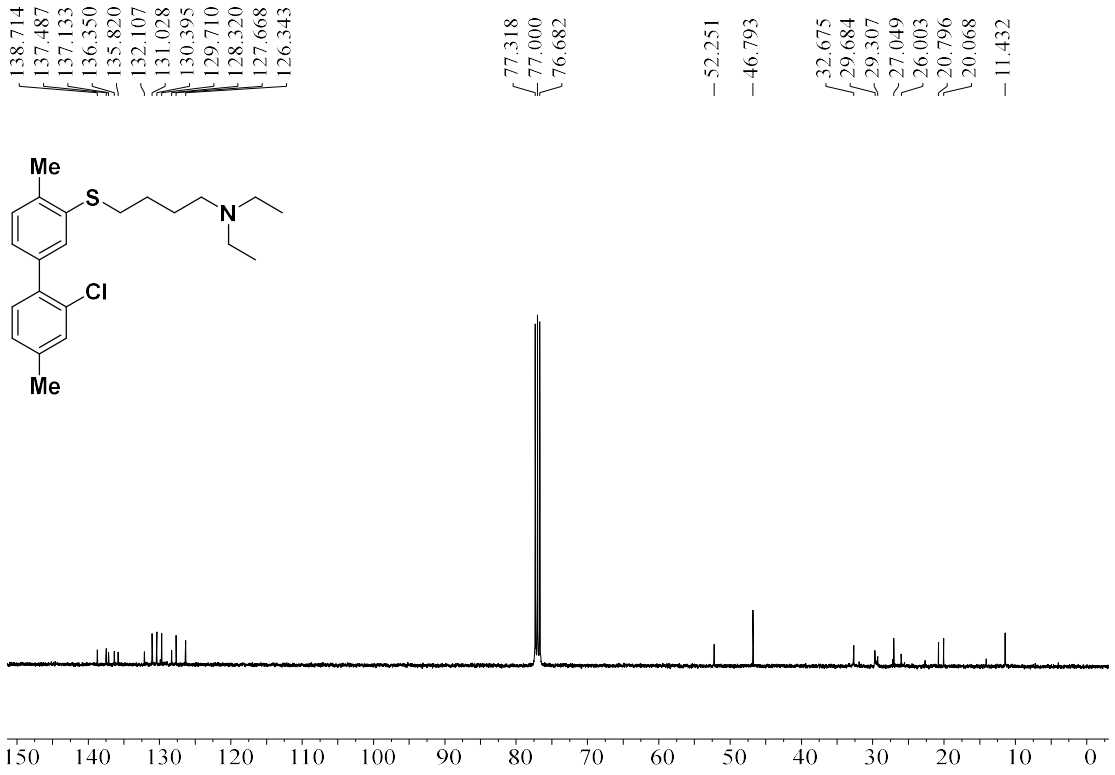
^{1}H NMR Spectrum of **4a**



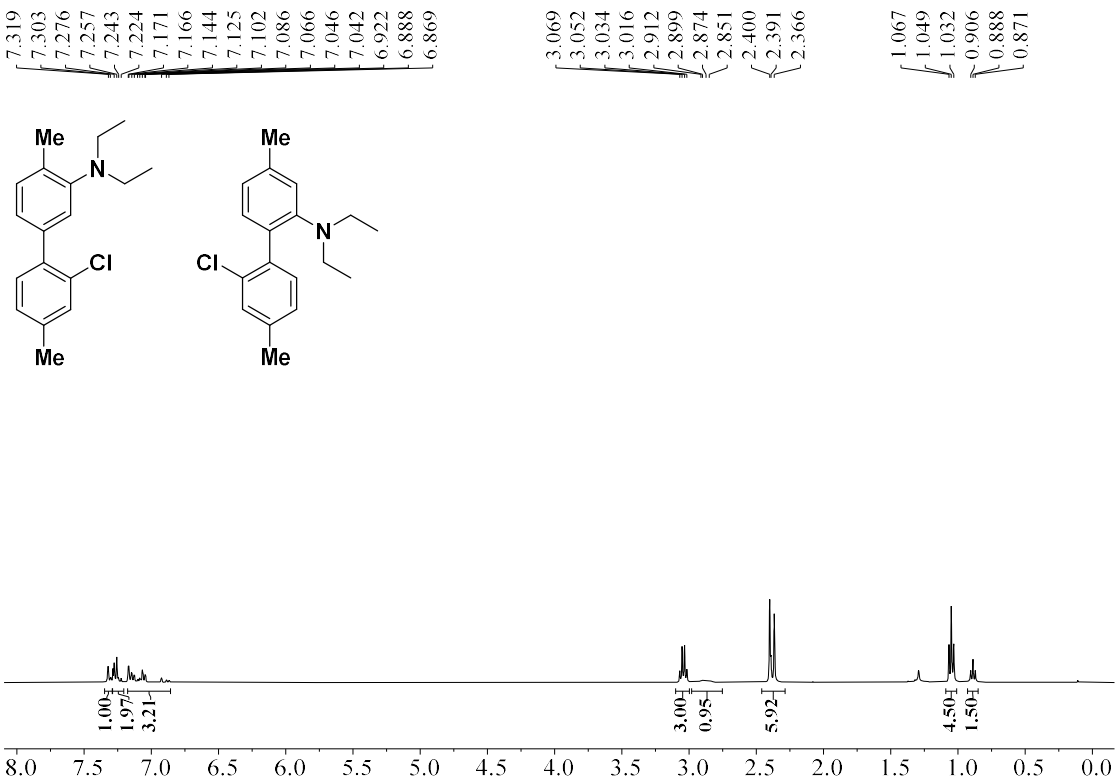
^{13}C NMR Spectrum of **4a**



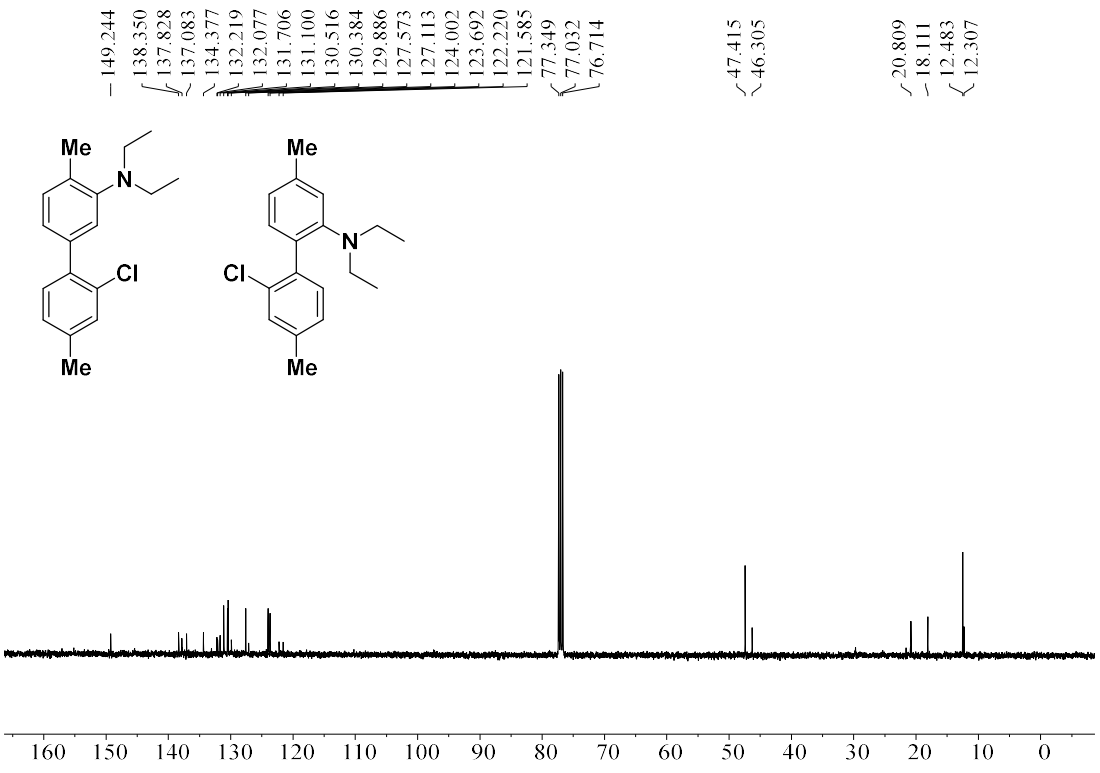
^{1}H NMR Spectrum of **4b**



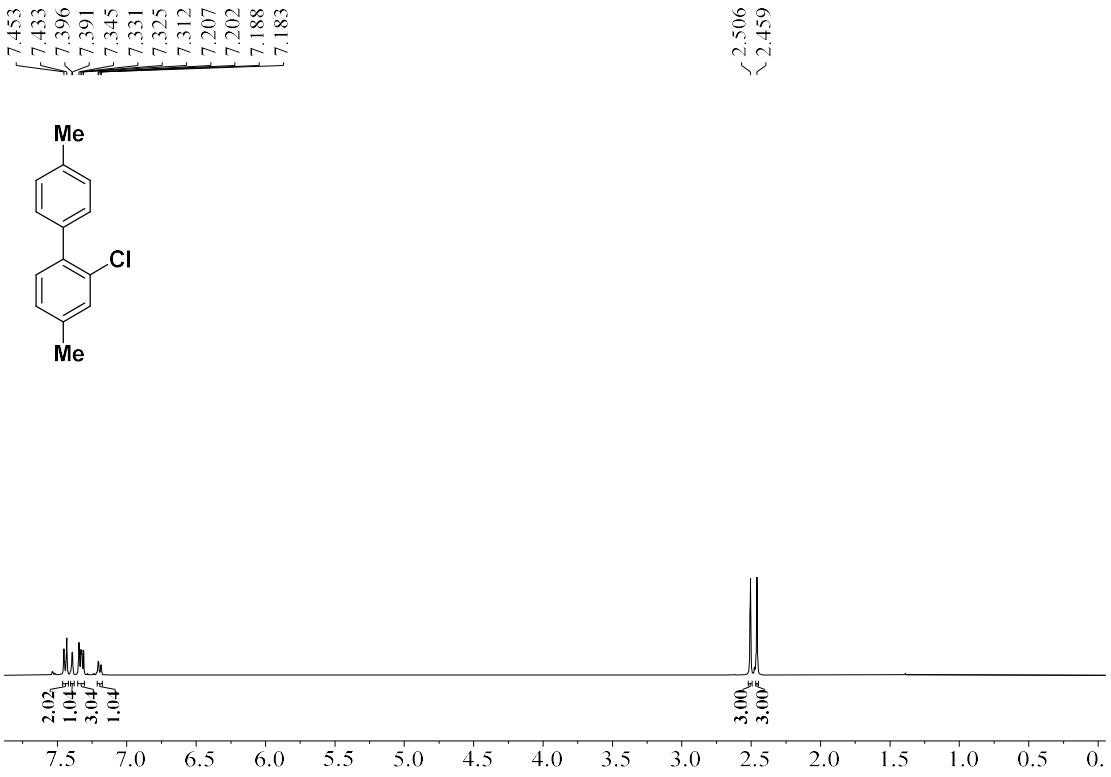
^{13}C NMR Spectrum of **4b**



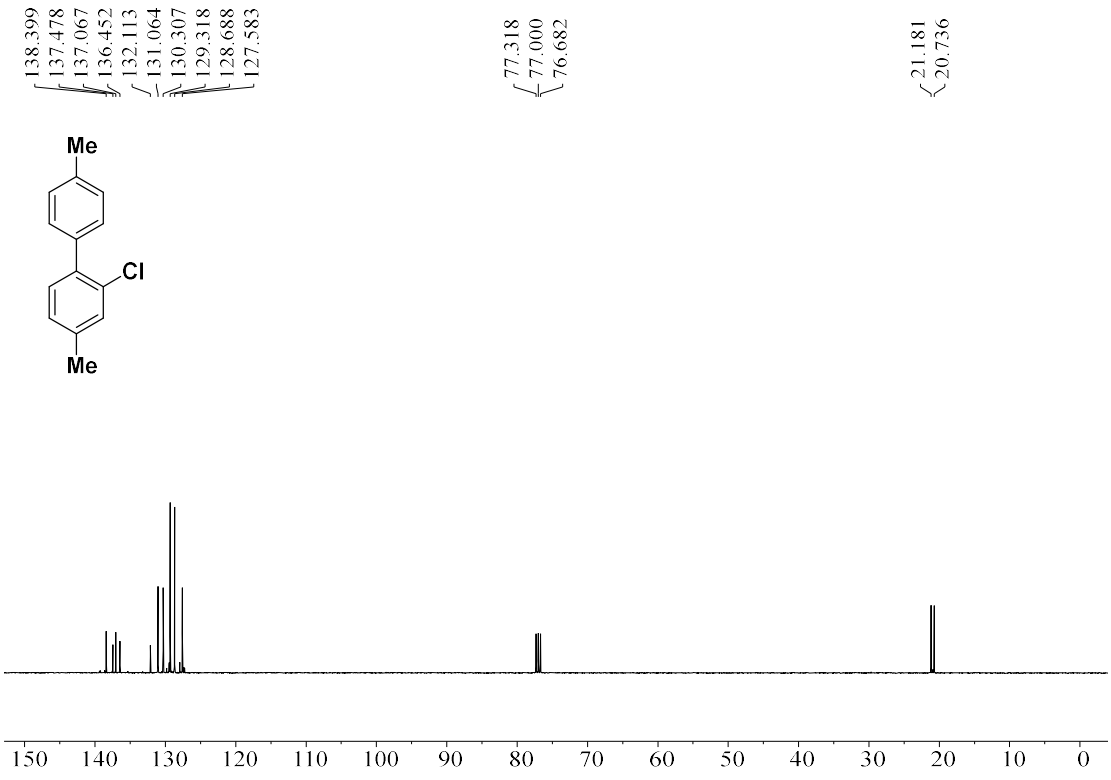
^{1}H NMR Spectrum of **4c**



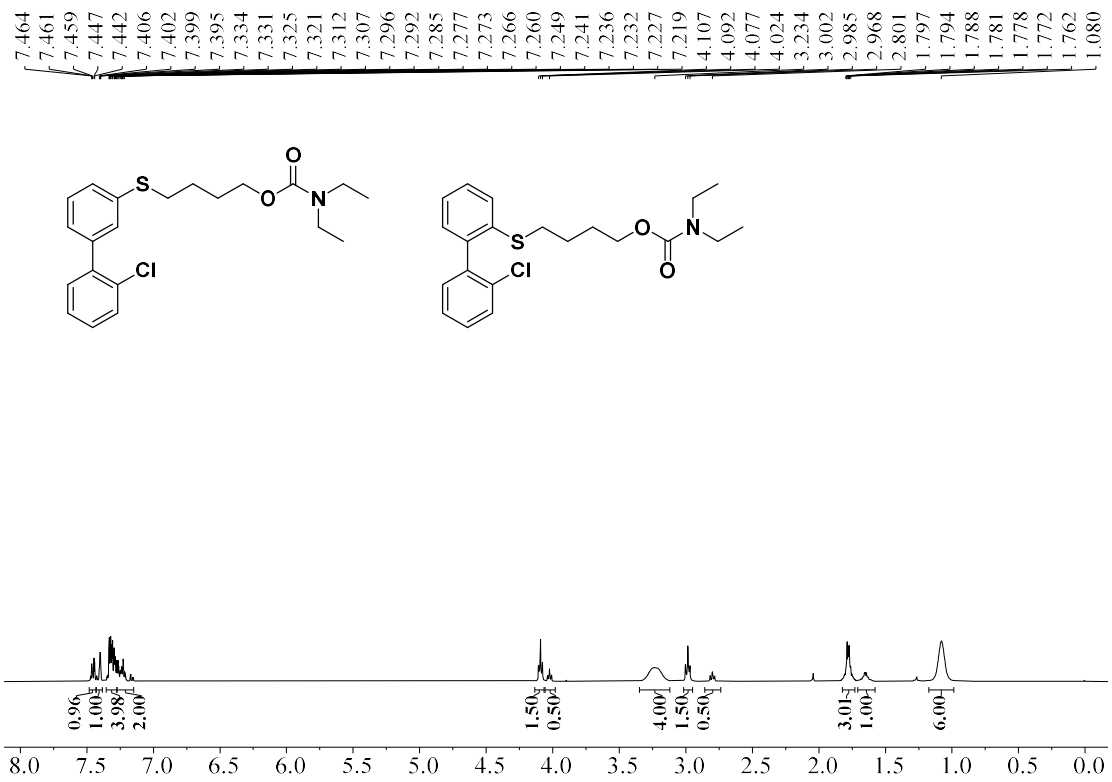
^{13}C NMR Spectrum of **4c**



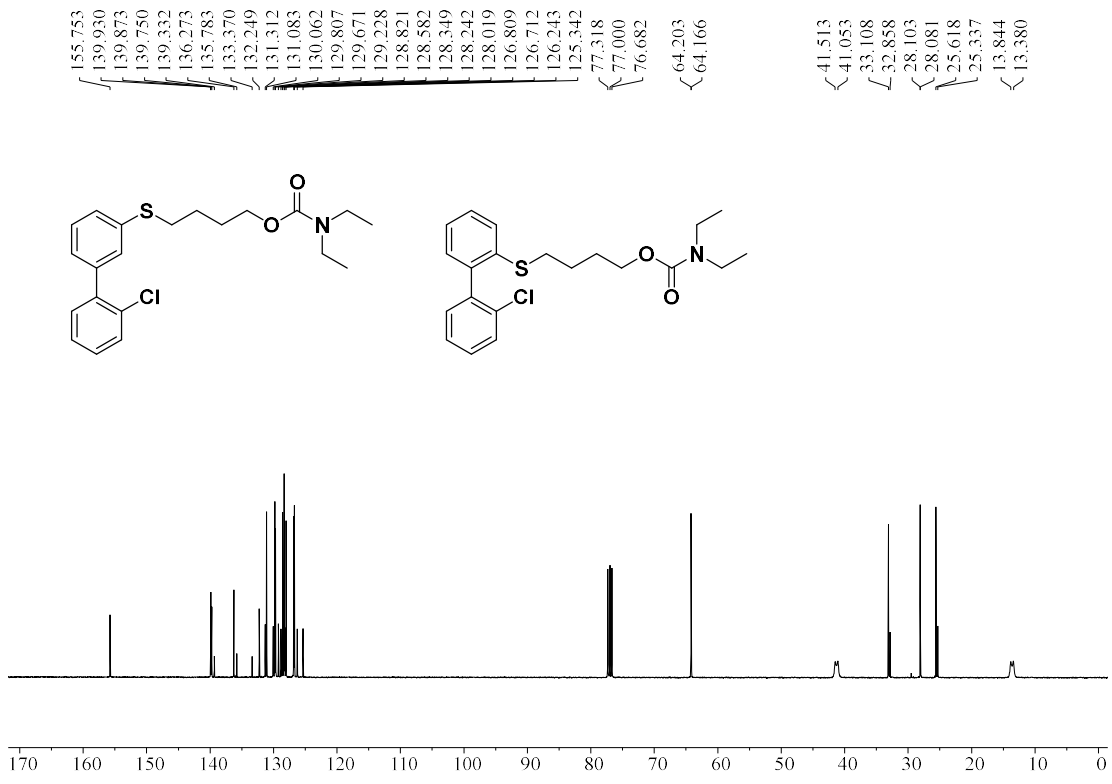
^{1}H NMR Spectrum of **4d**



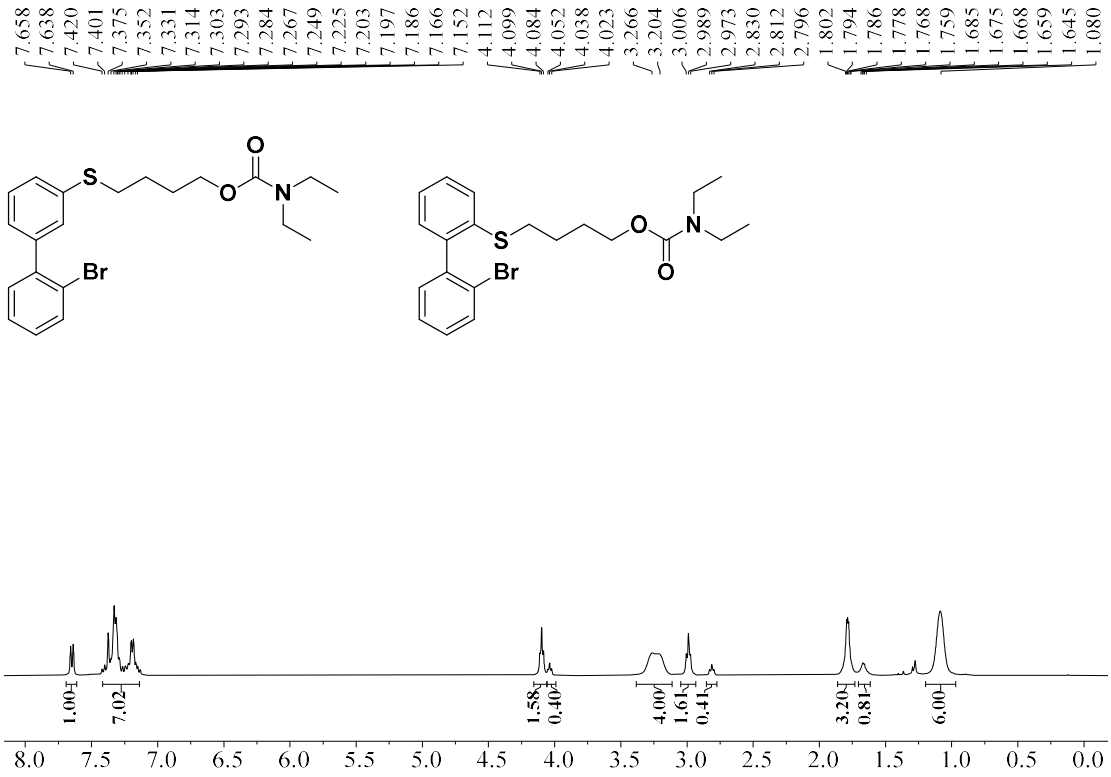
^{13}C NMR Spectrum of **4d**



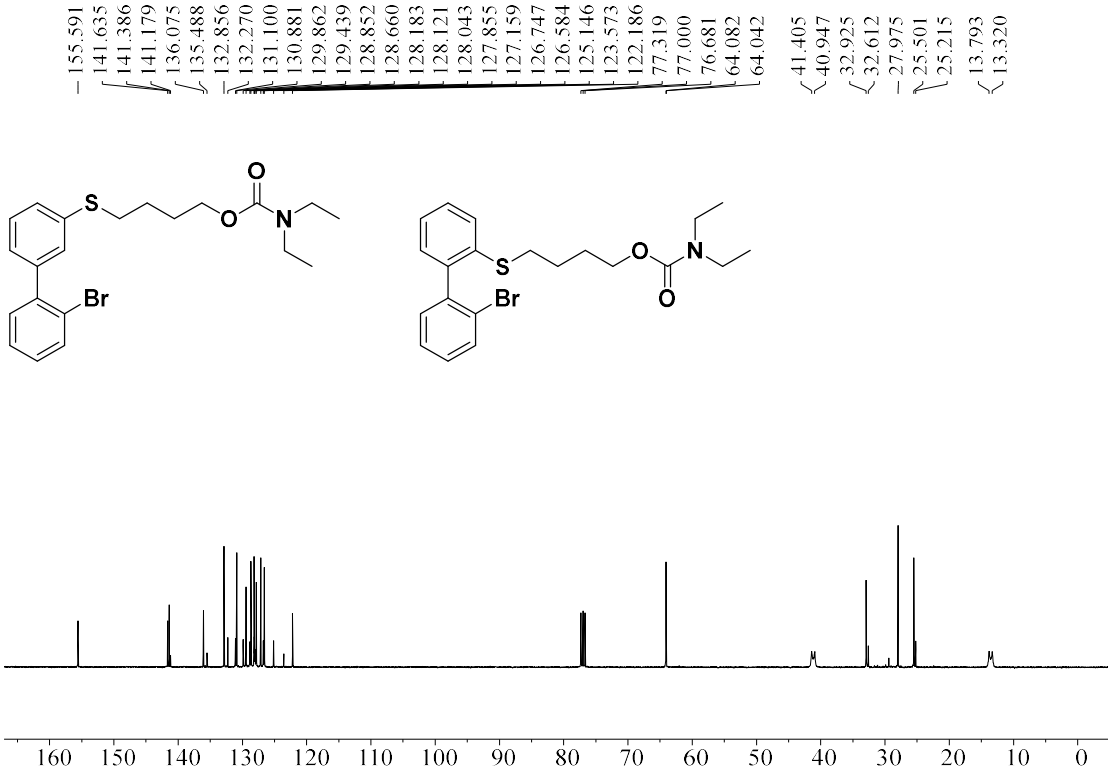
^{1}H NMR Spectrum of **5a** and **5a'**



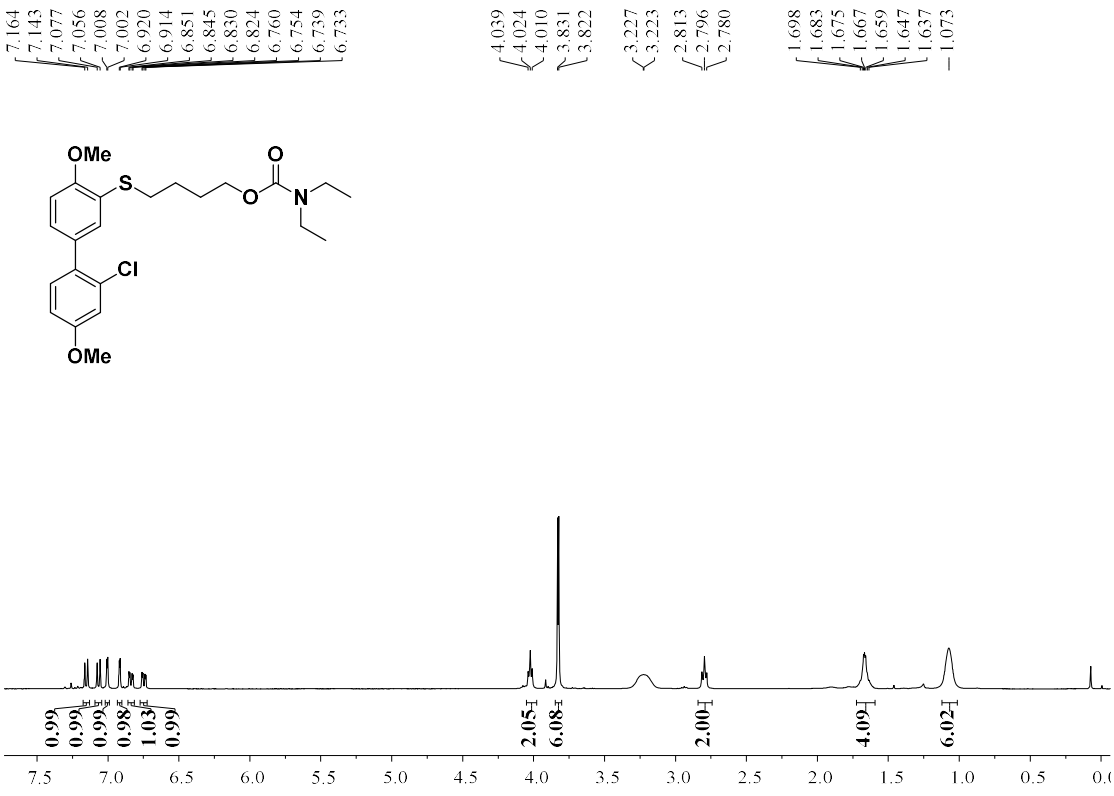
^{13}C NMR Spectrum of **5a** and **5a'**



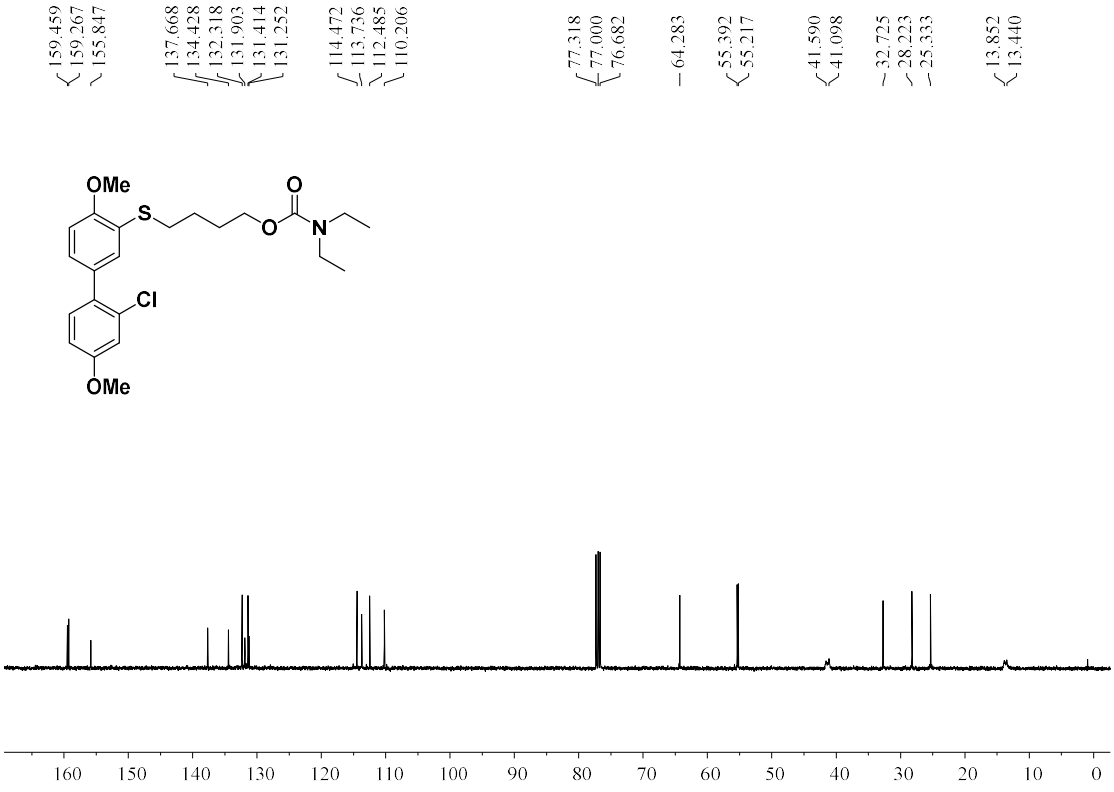
^{1}H NMR Spectrum of **5b** and **5b'**



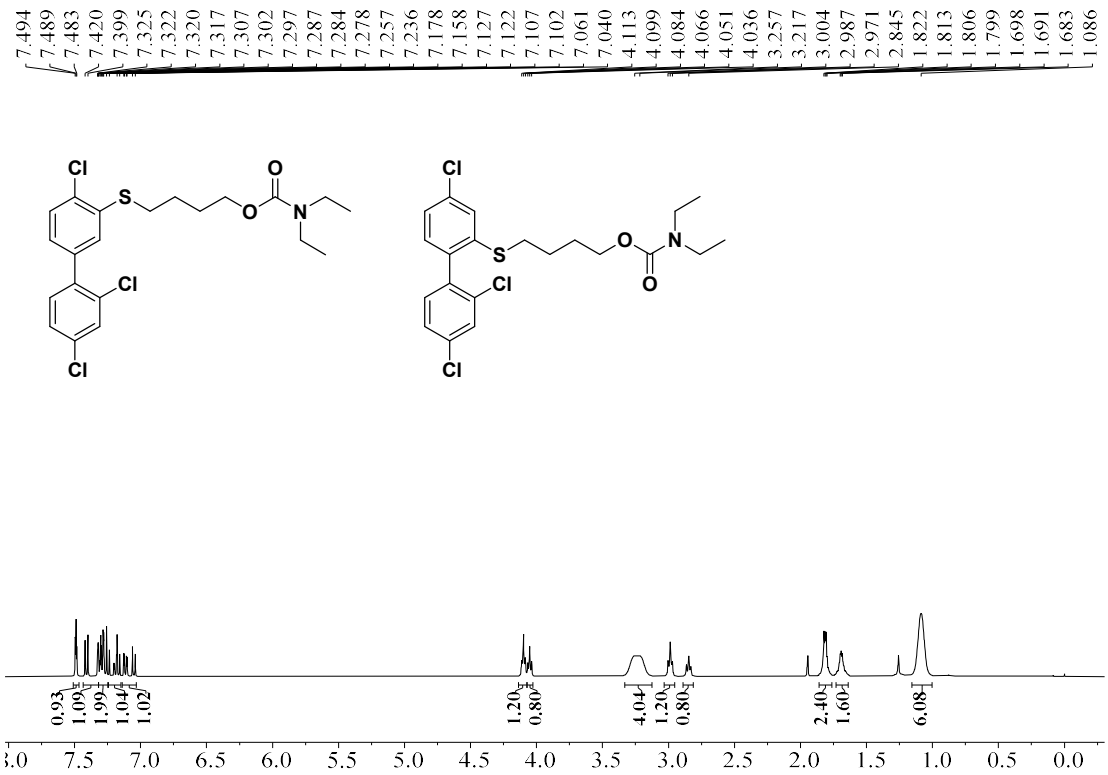
^{13}C NMR Spectrum of **5b** and **5b'**



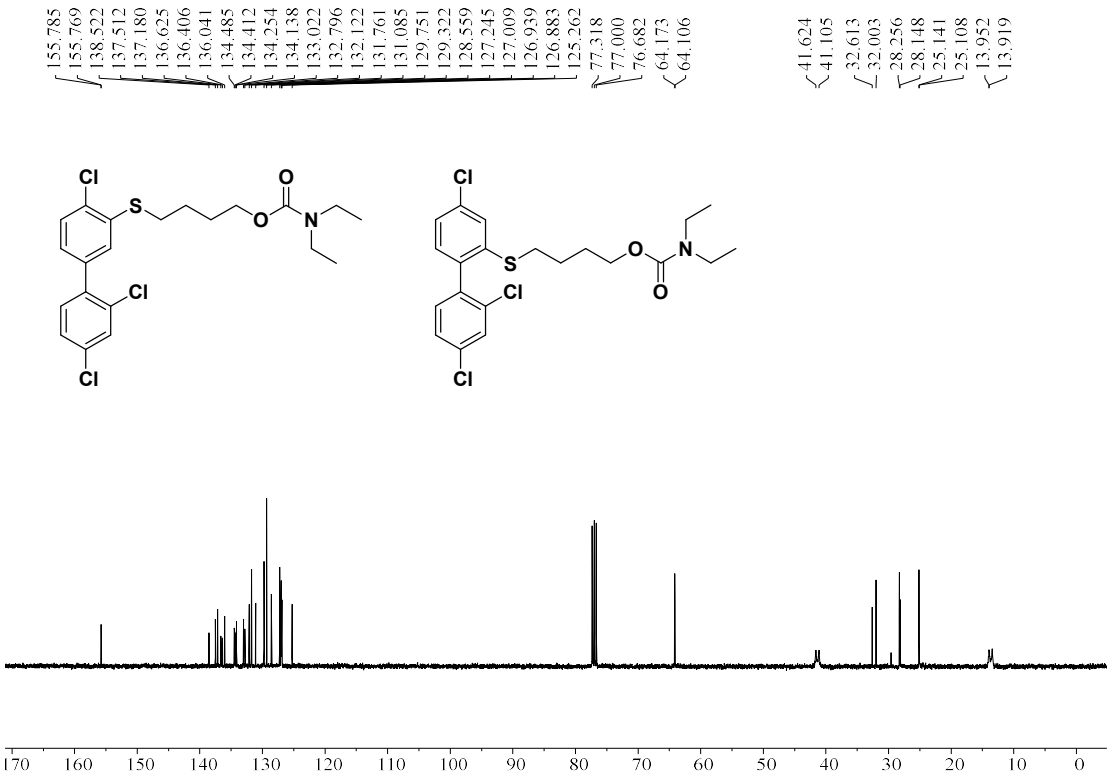
^{1}H NMR Spectrum of **6**



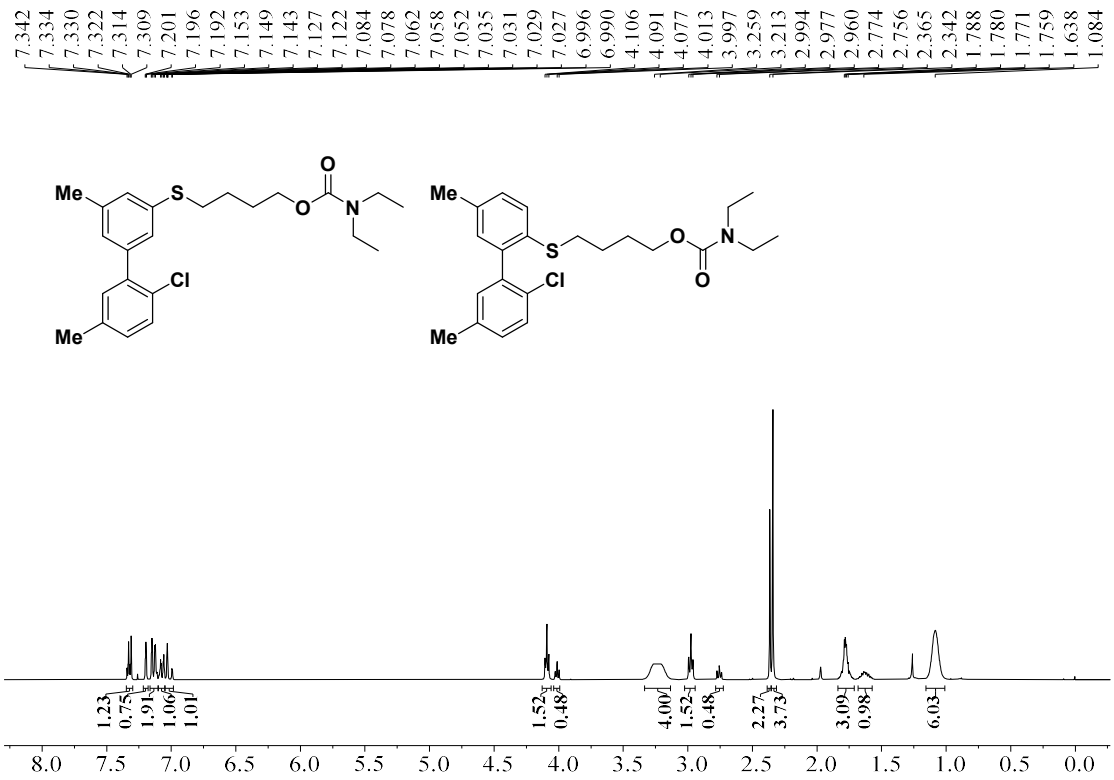
^{13}C NMR Spectrum of **6**



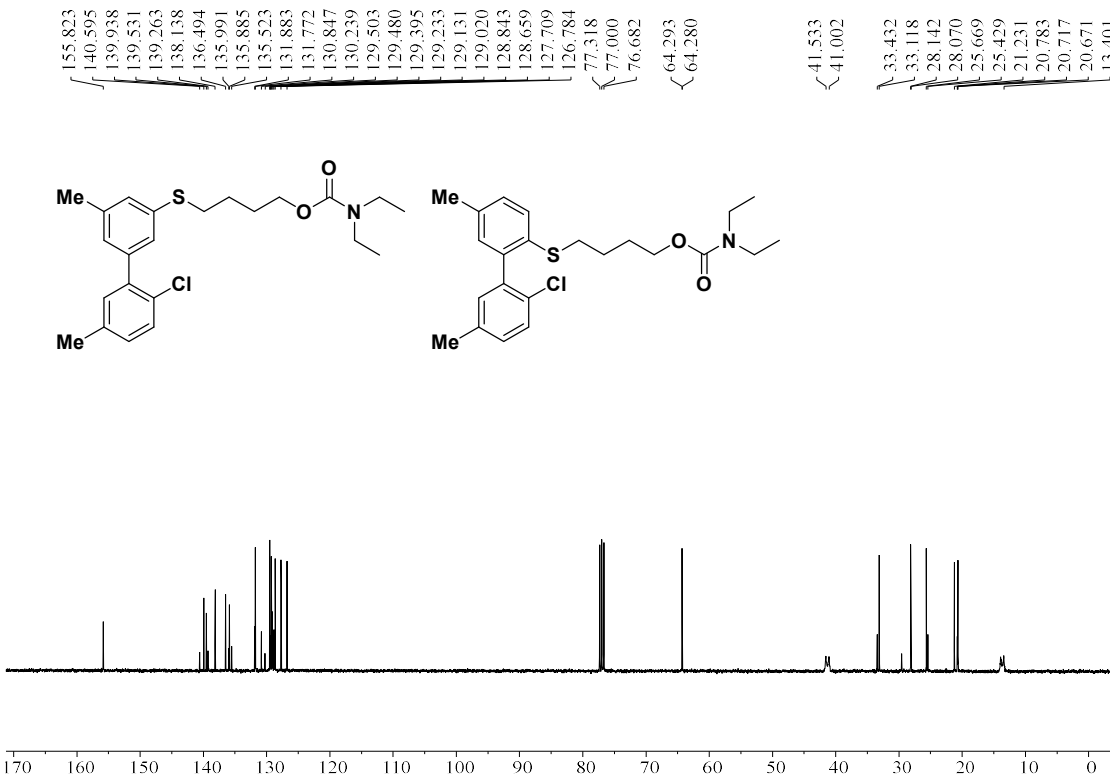
^{1}H NMR Spectrum of **7** and **7'**



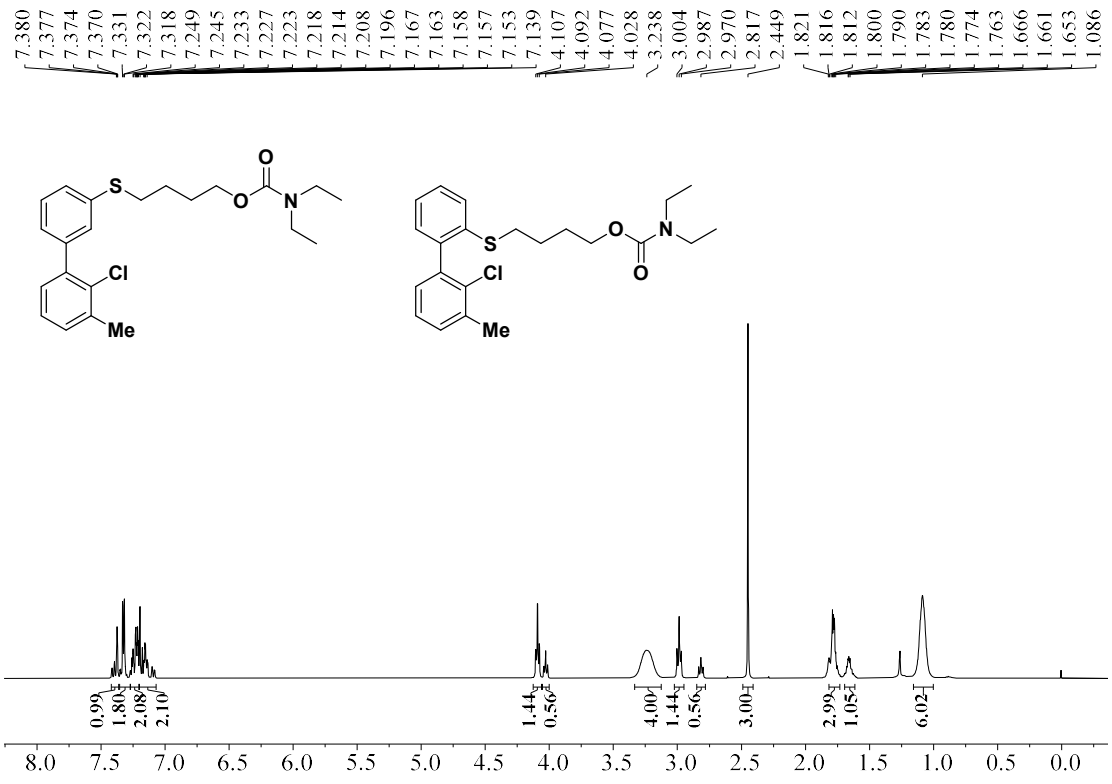
^{13}C NMR Spectrum of **7** and **7'**



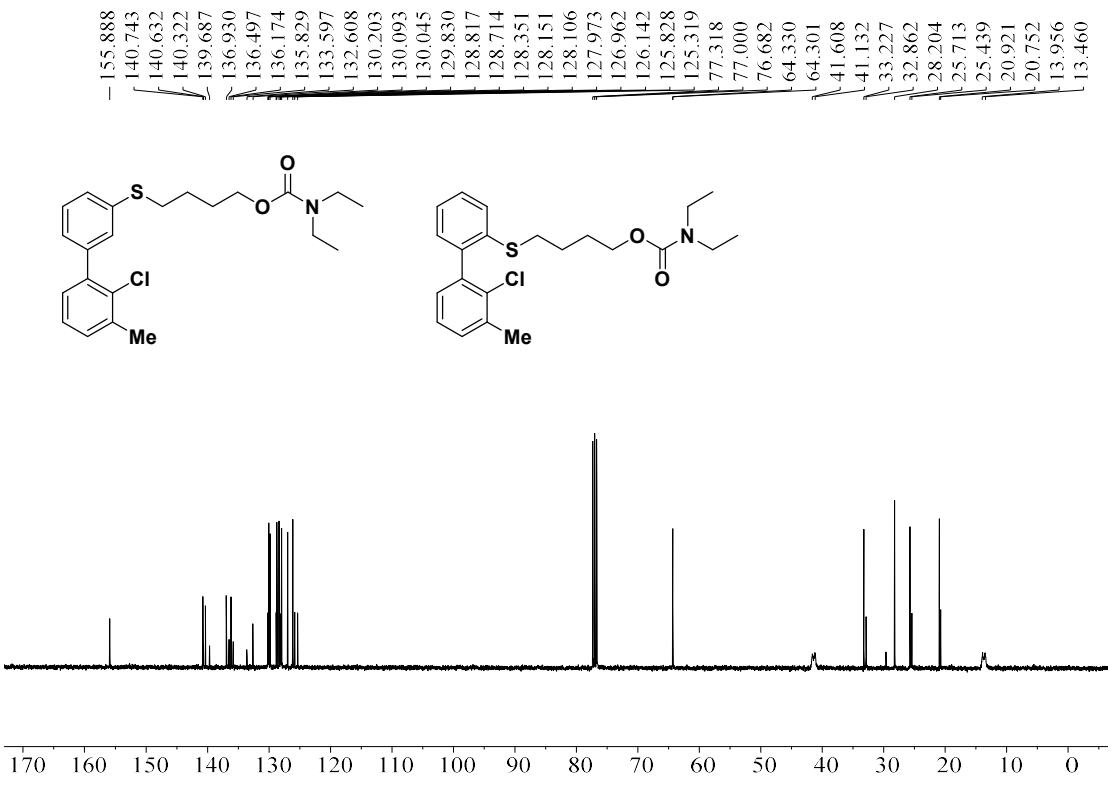
^{1}H NMR Spectrum of **8** and **8'**



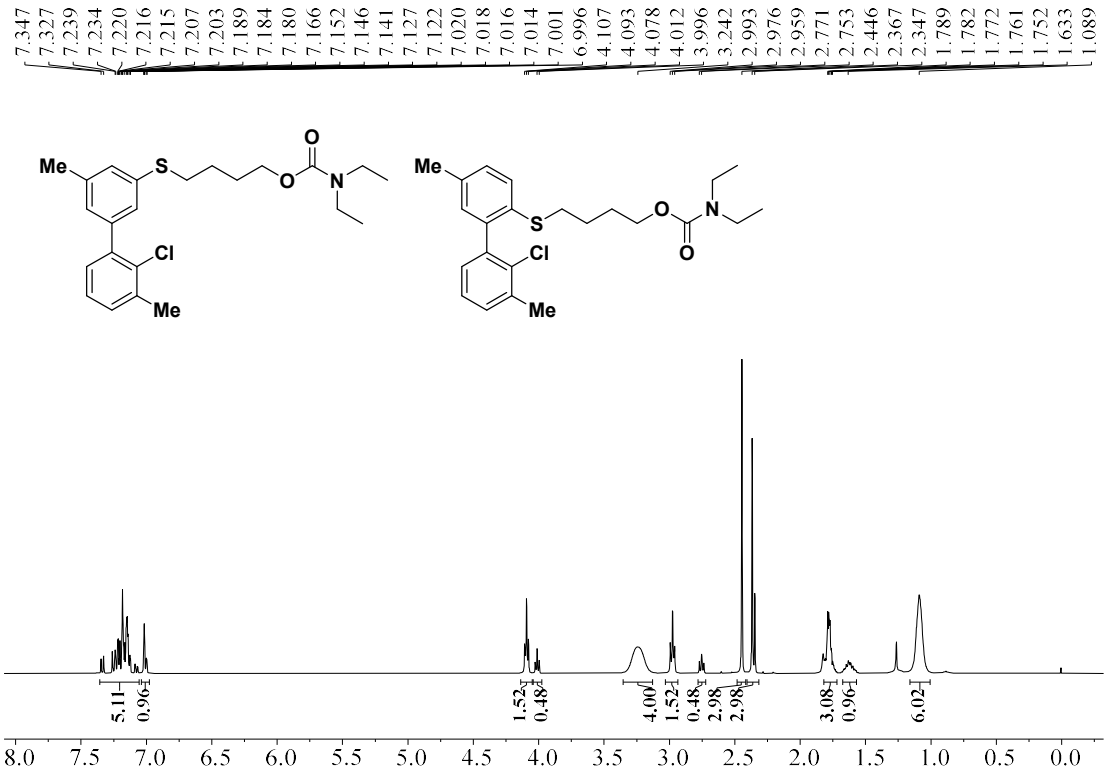
^{13}C NMR Spectrum of **8** and **8'**



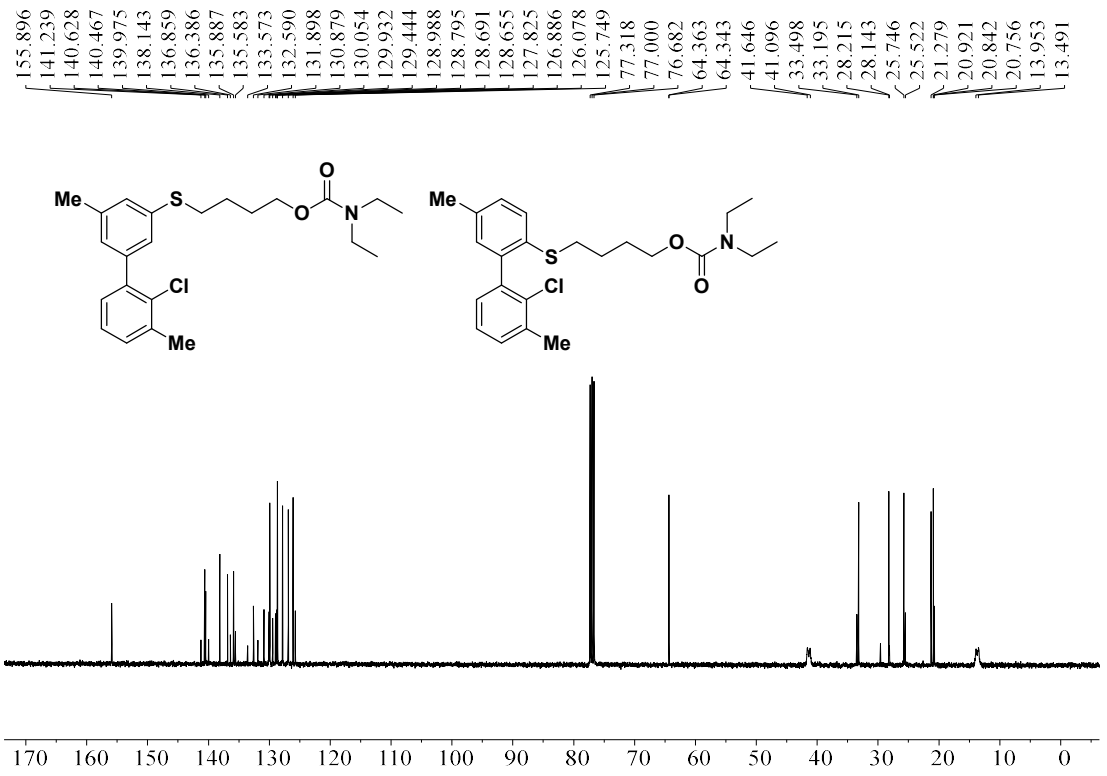
^{1}H NMR Spectrum of **9** and **9'**



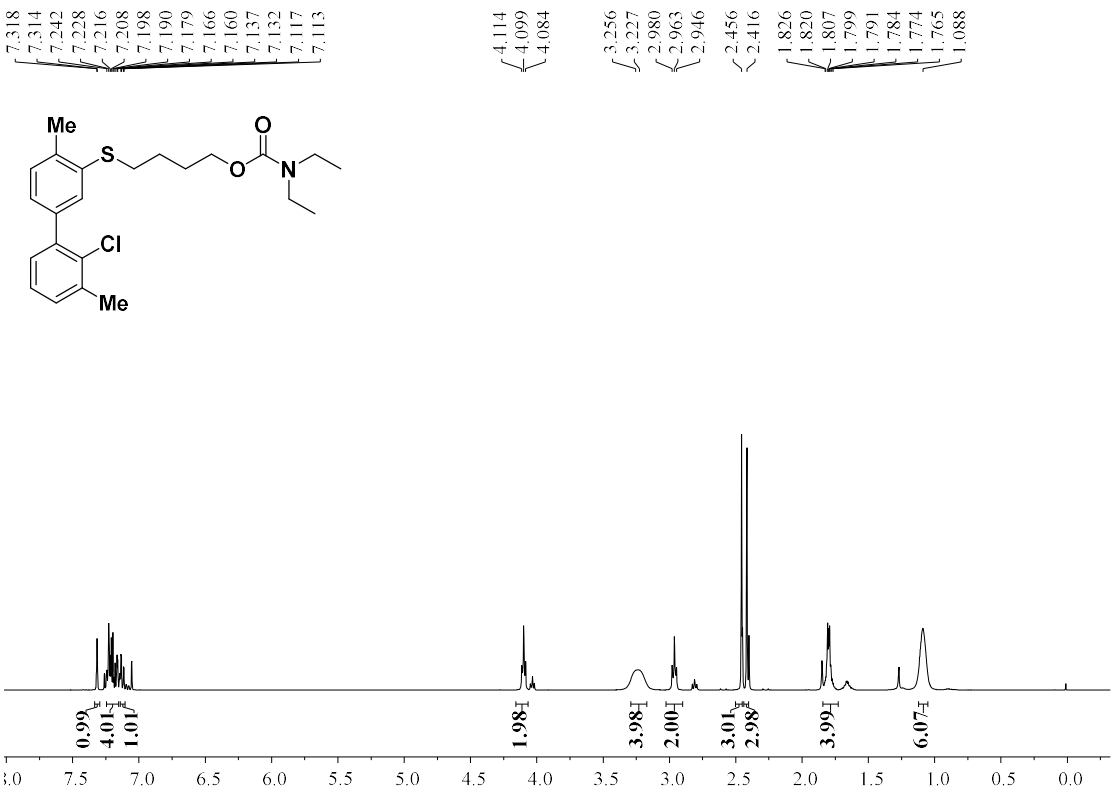
^{13}C NMR Spectrum of **9** and **9'**



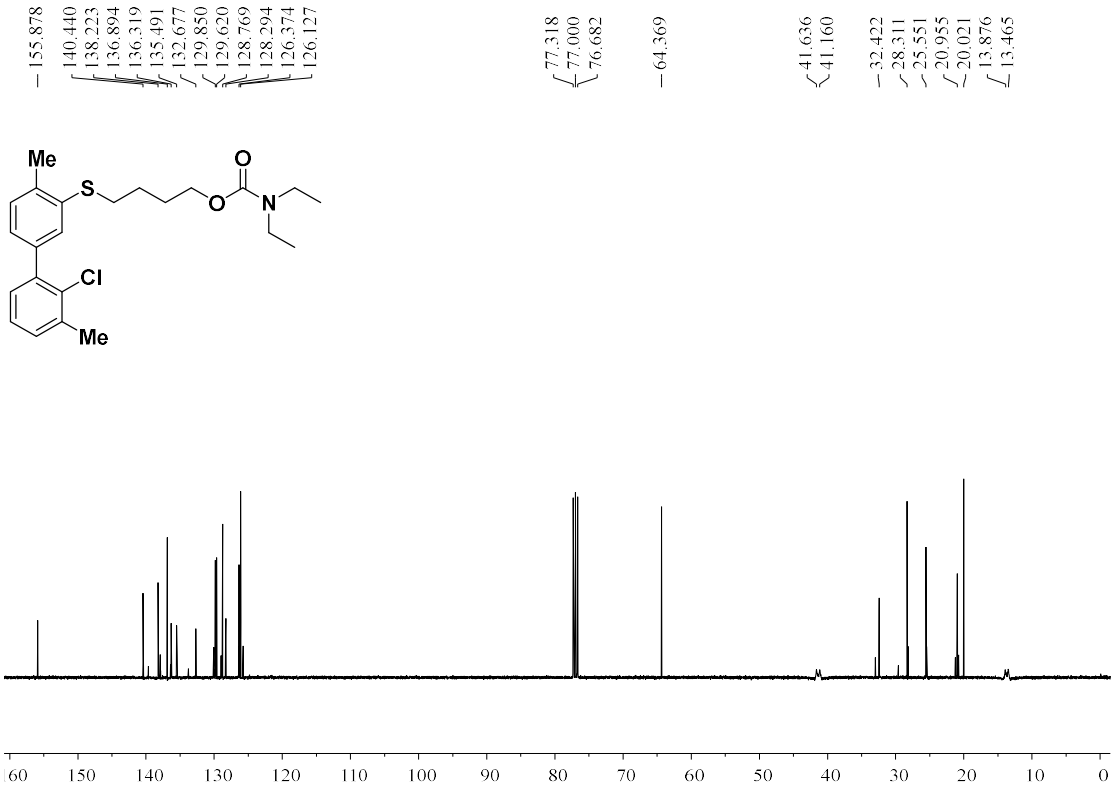
^{1}H NMR Spectrum of **10** and **10'**



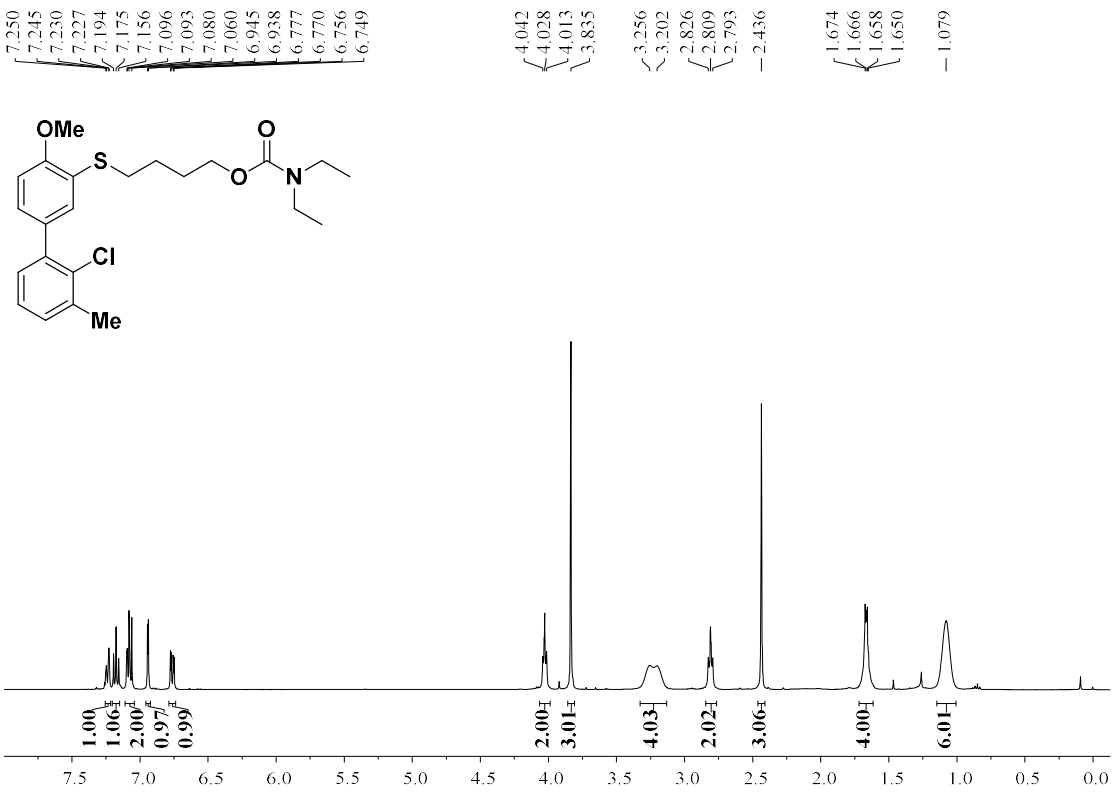
^{13}C NMR Spectrum of **10** and **10'**



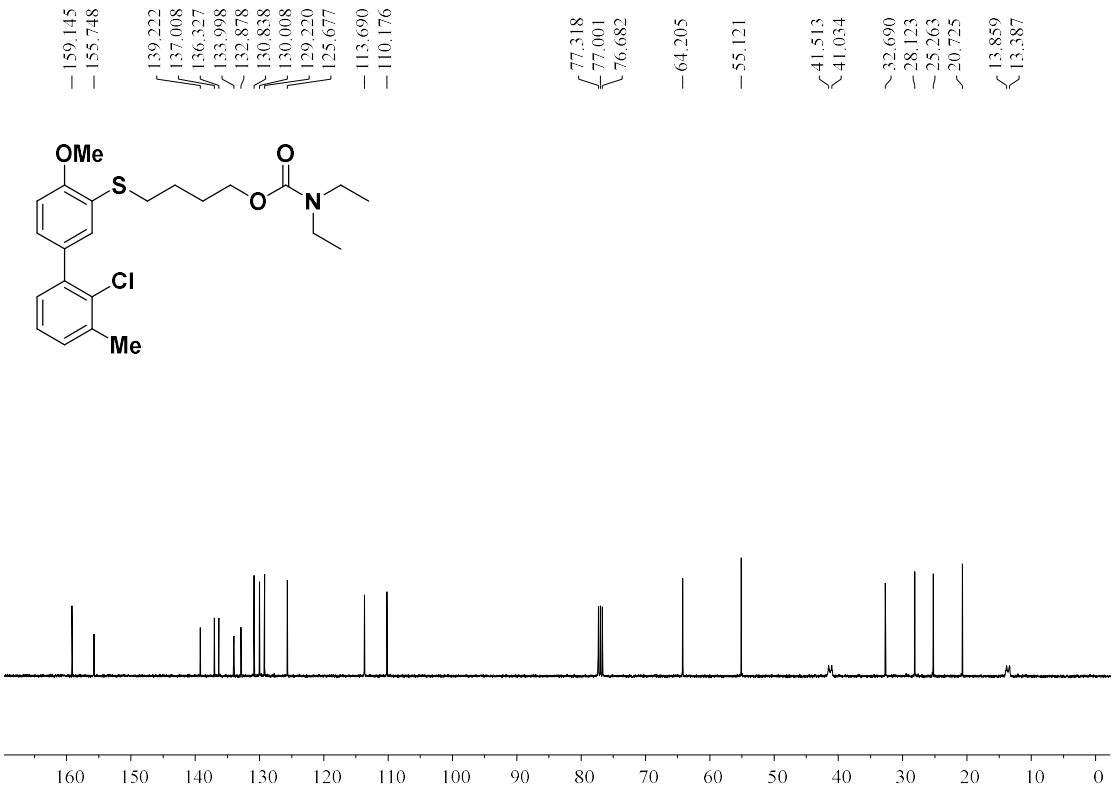
^{1}H NMR Spectrum of **11**



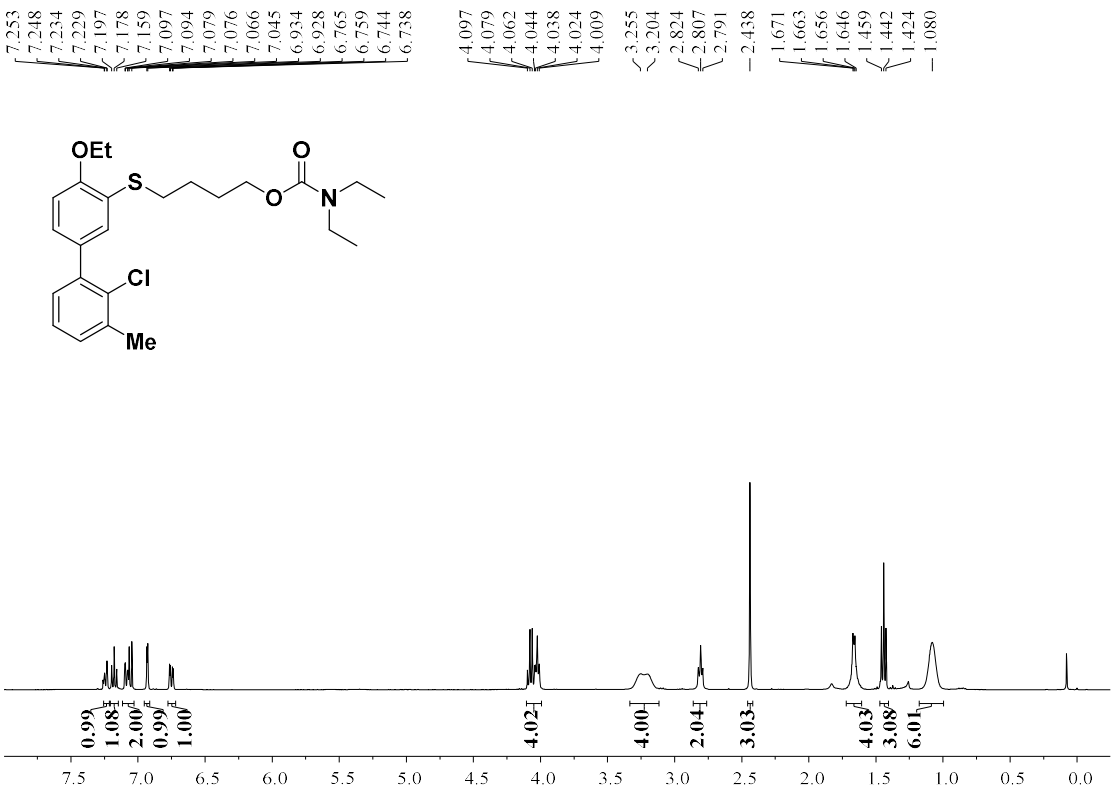
^{13}C NMR Spectrum of **11**



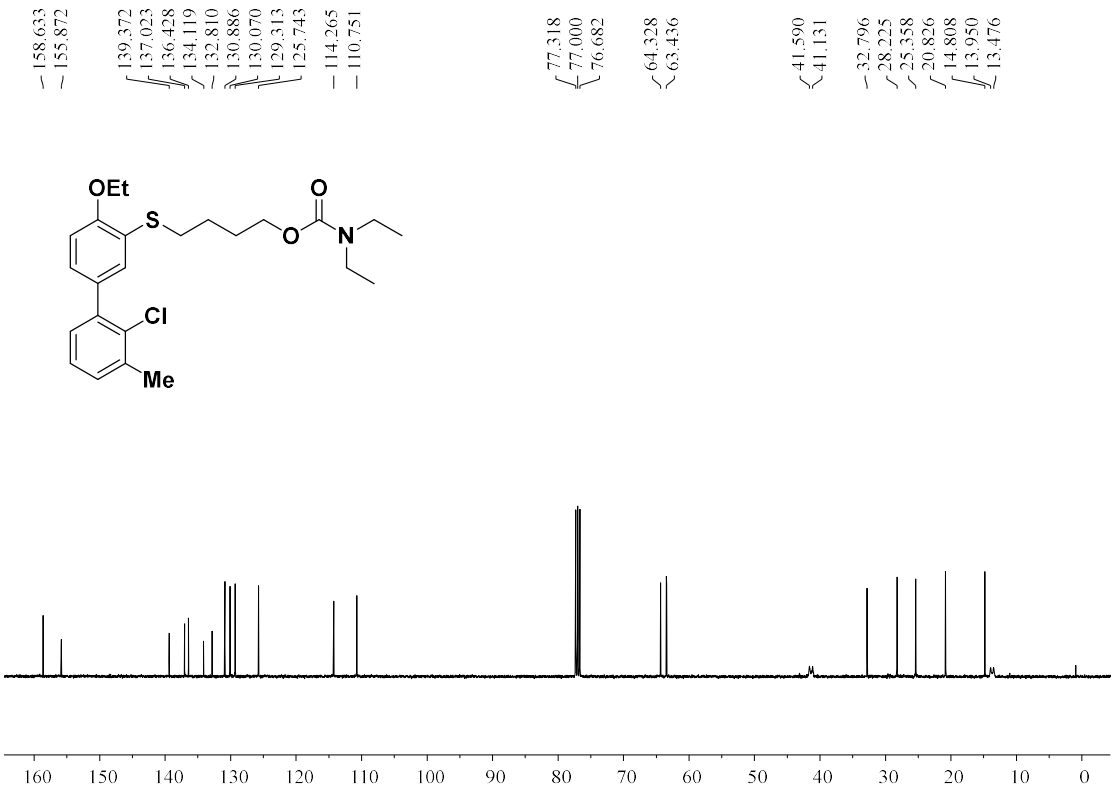
^{1}H NMR Spectrum of **12**



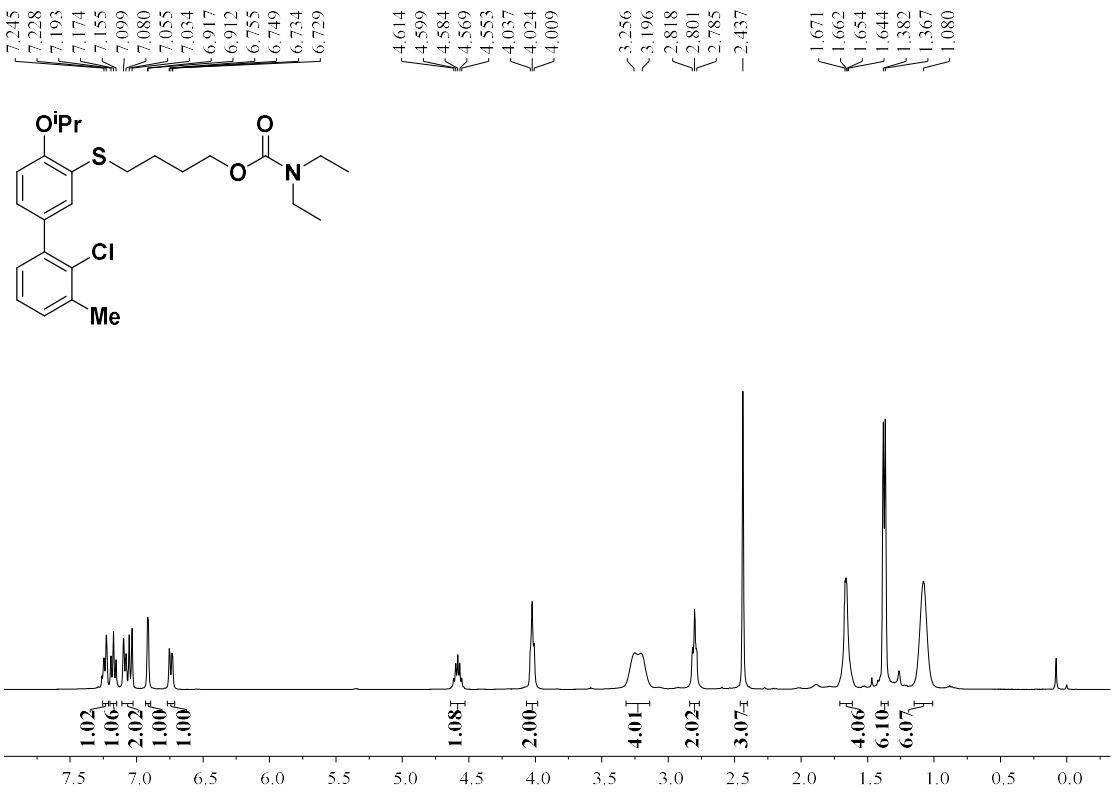
^{13}C NMR Spectrum of **12**



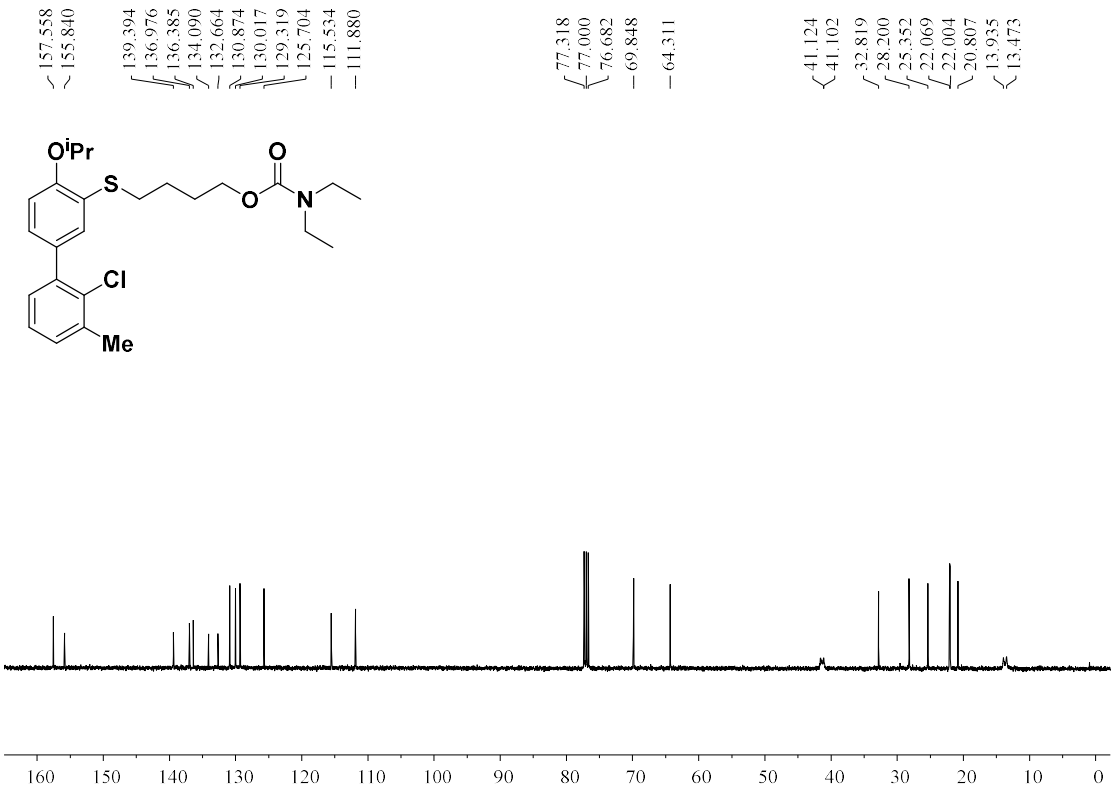
^{1}H NMR Spectrum of **13**



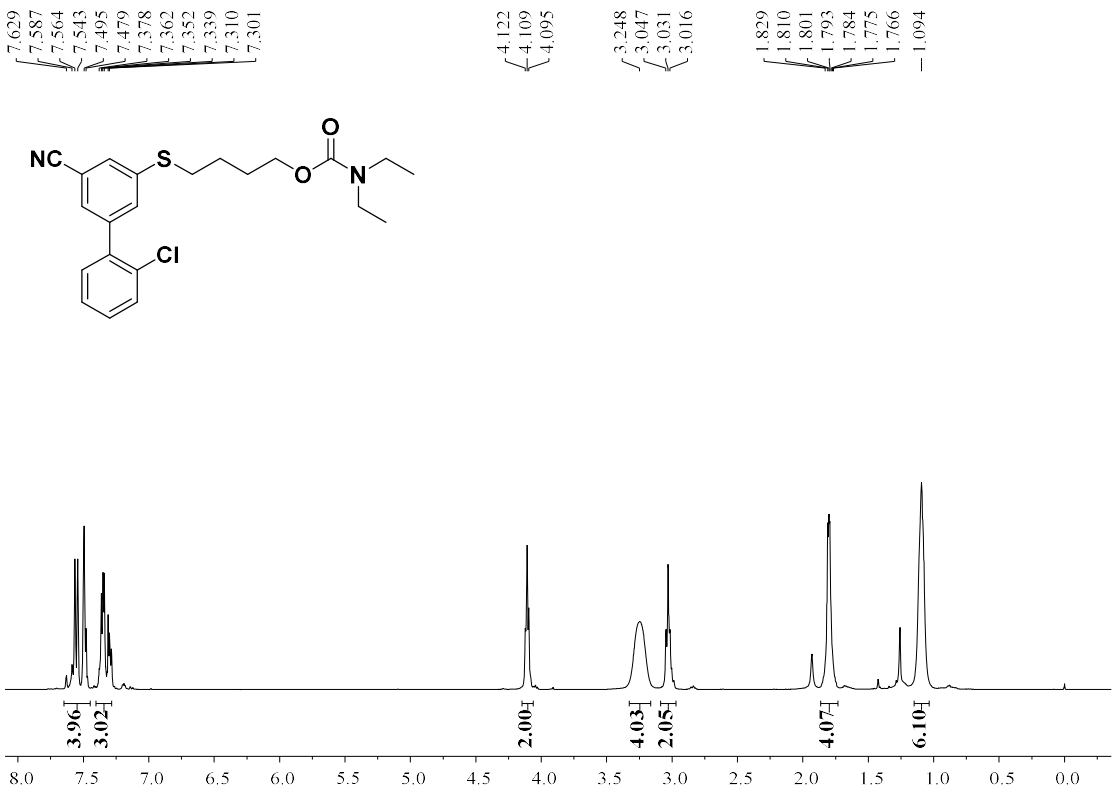
^{13}C NMR Spectrum of **13**



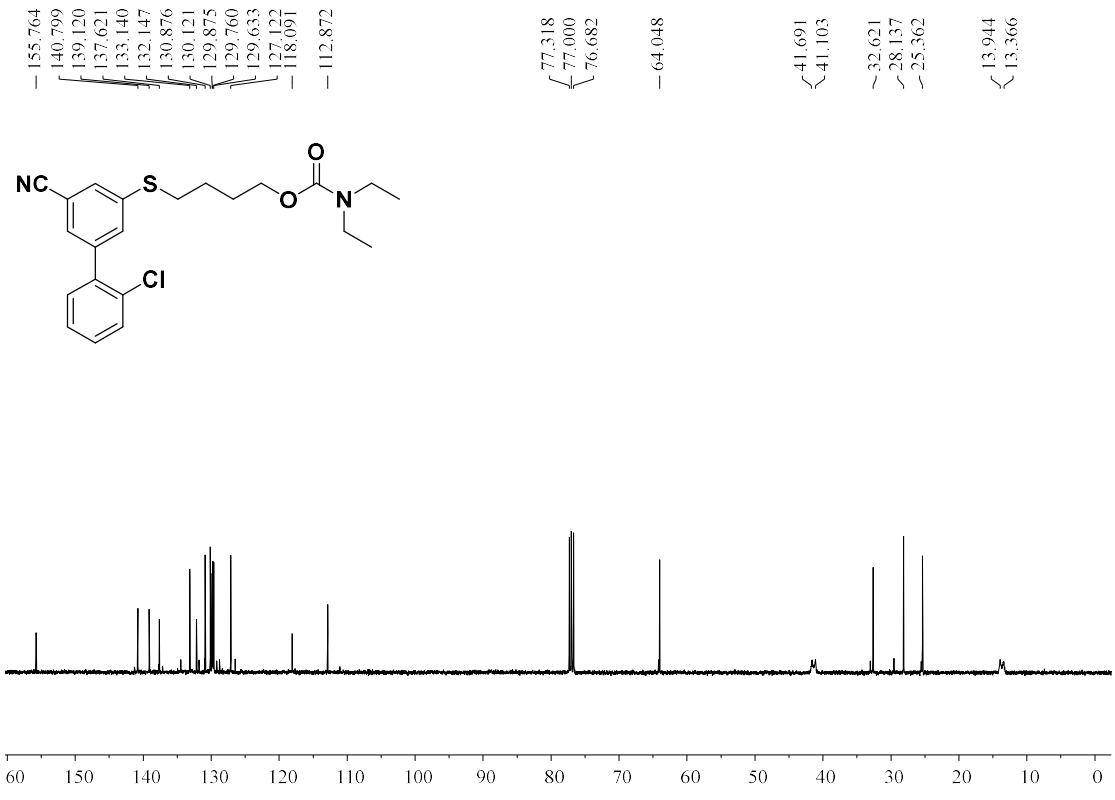
^{1}H NMR Spectrum of **14**



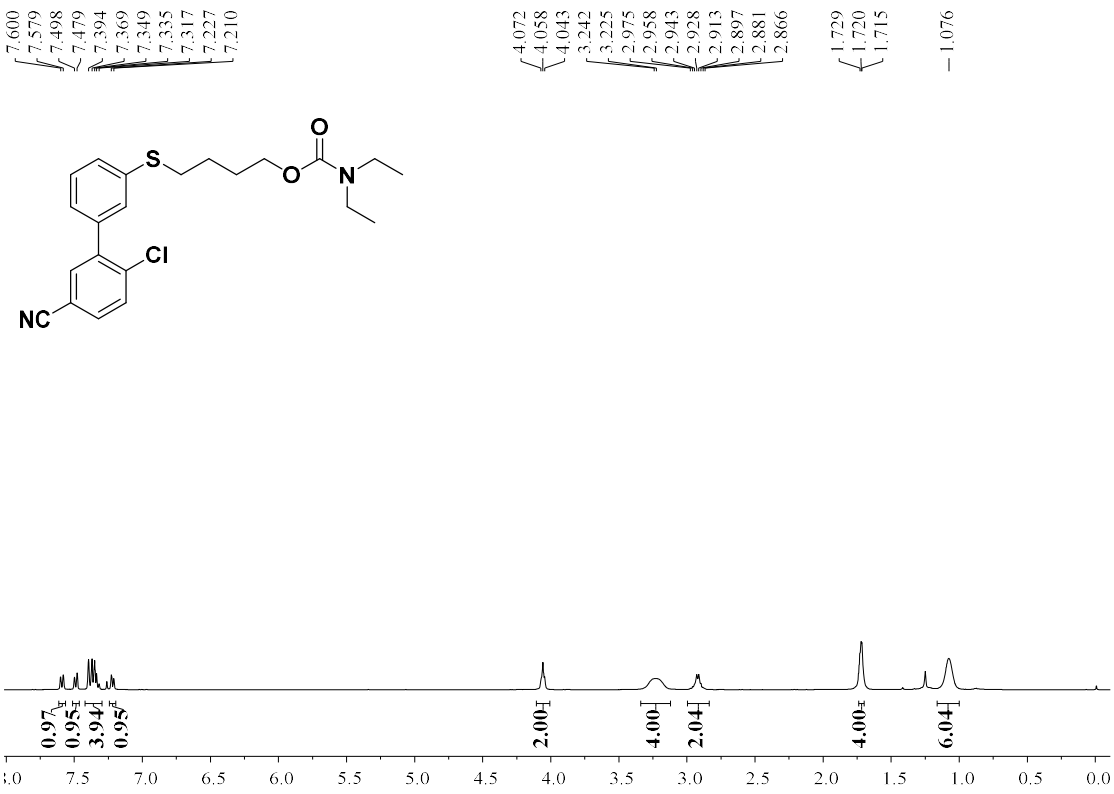
^{13}C NMR Spectrum of **14**



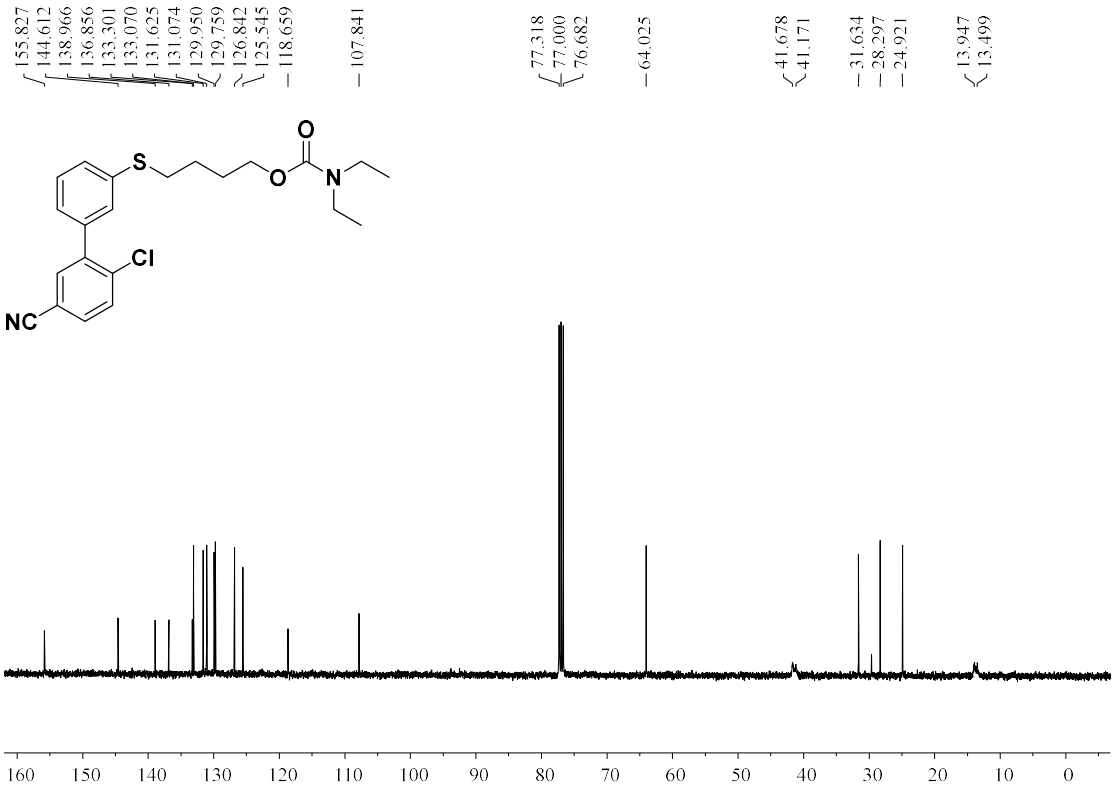
^{1}H NMR Spectrum of **15**



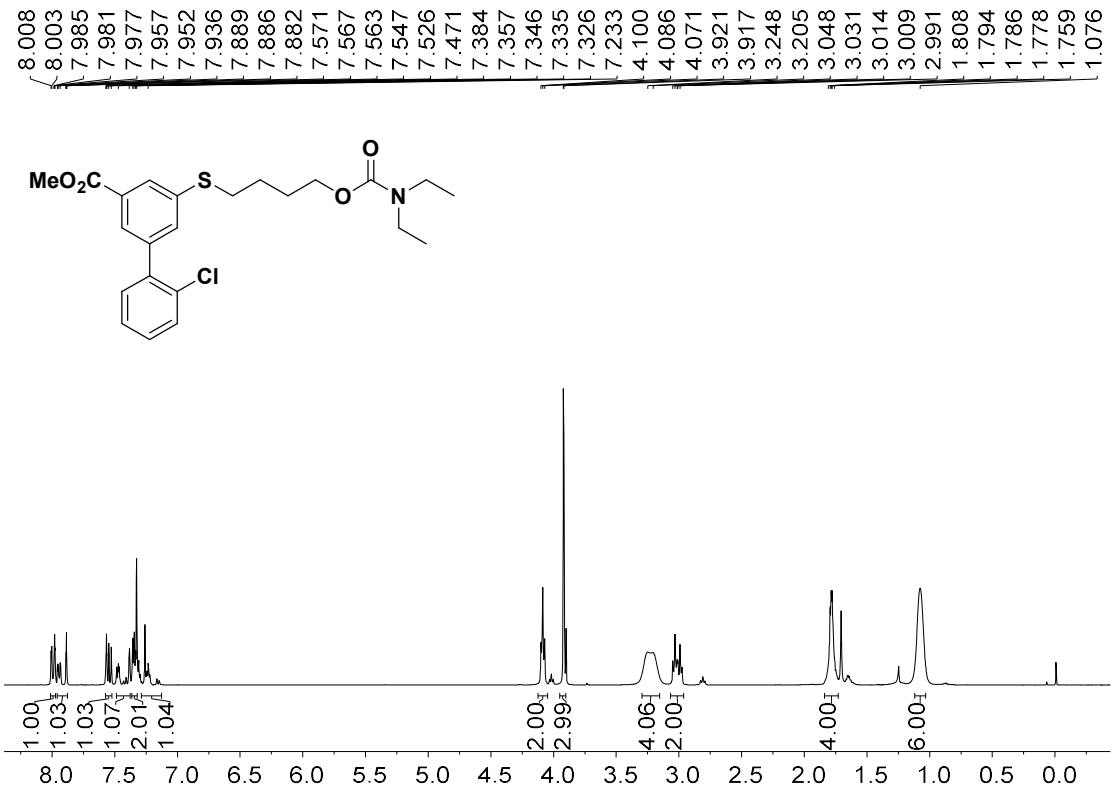
^{13}C NMR Spectrum of **15**



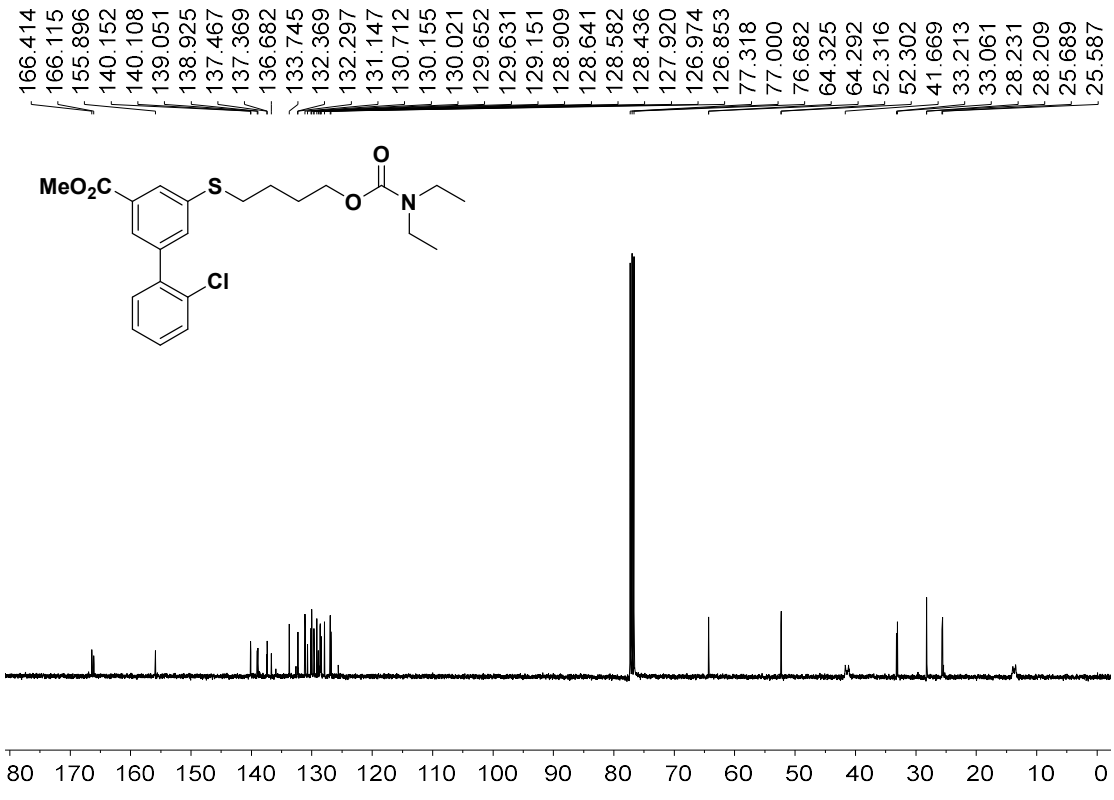
^{1}H NMR Spectrum of **15'**



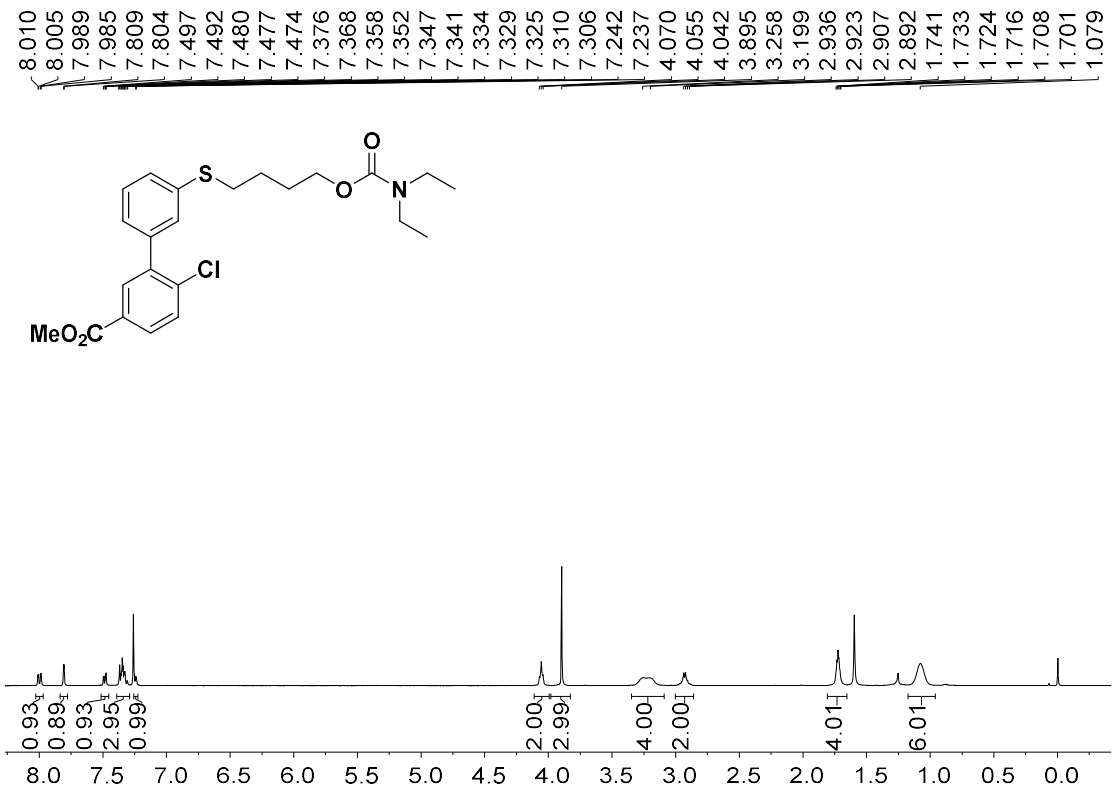
^{13}C NMR Spectrum of **15'**



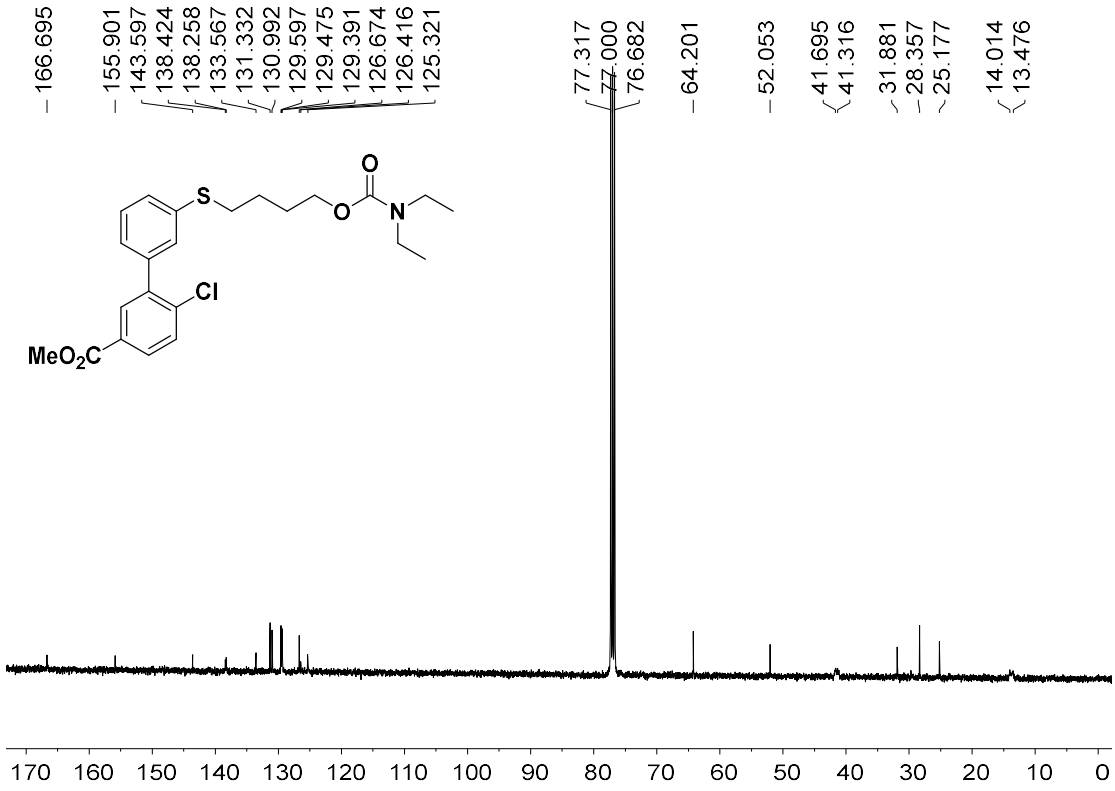
^{1}H NMR Spectrum of **16**



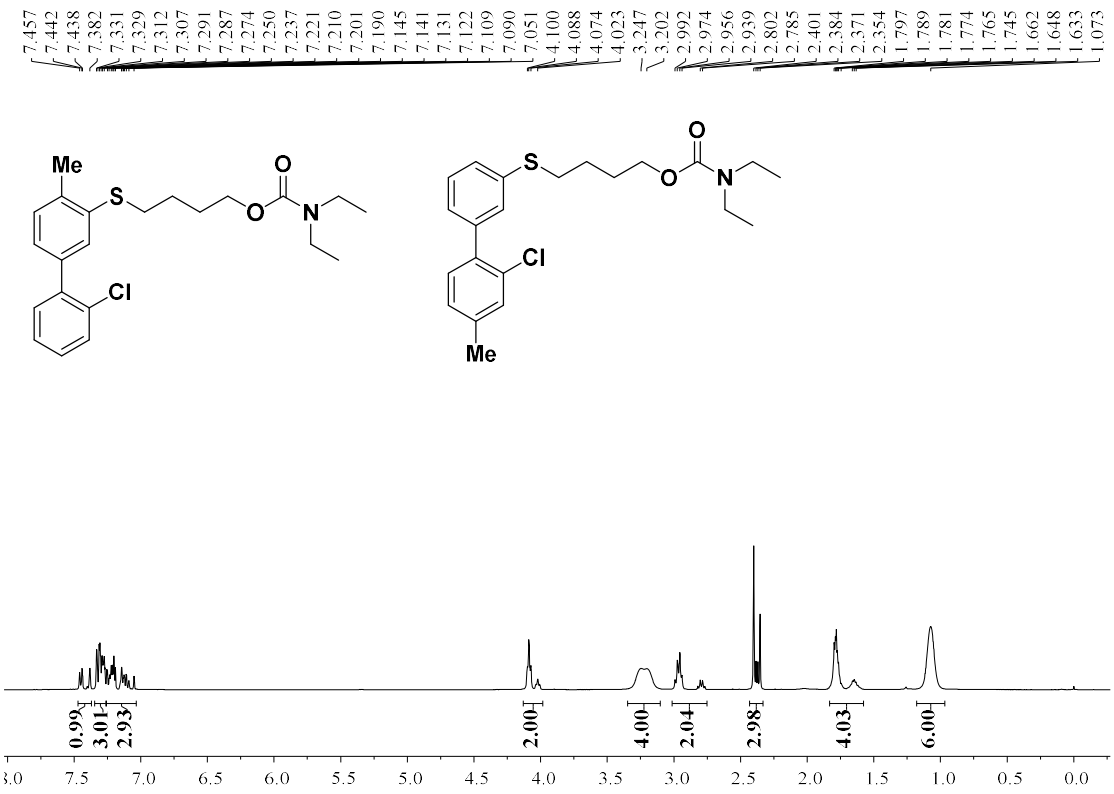
^{13}C NMR Spectrum of **16**



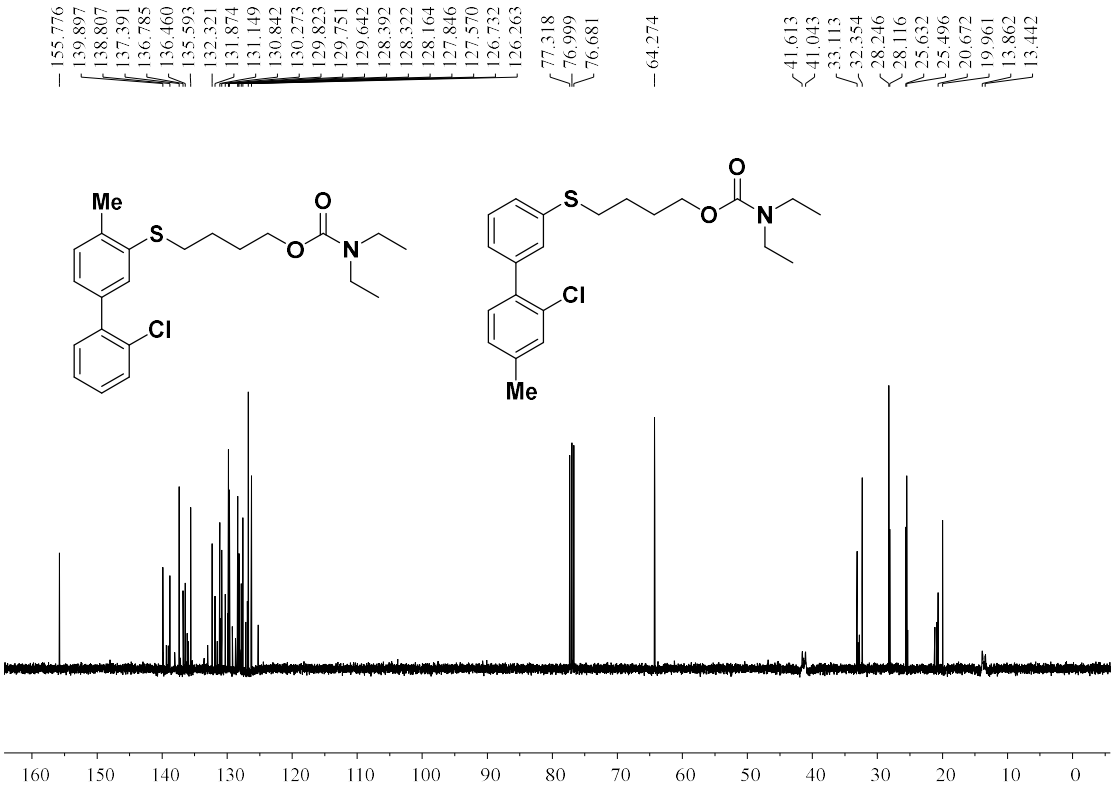
^{1}H NMR Spectrum of **16'**



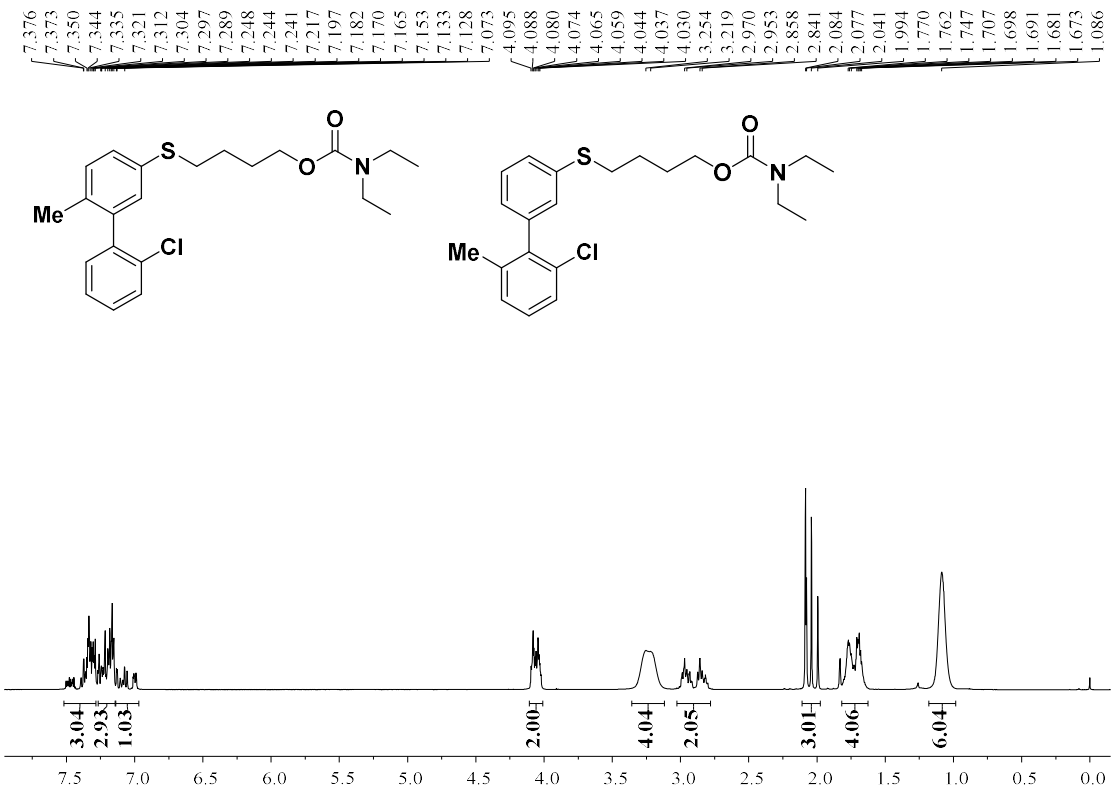
^{13}C NMR Spectrum of **16'**



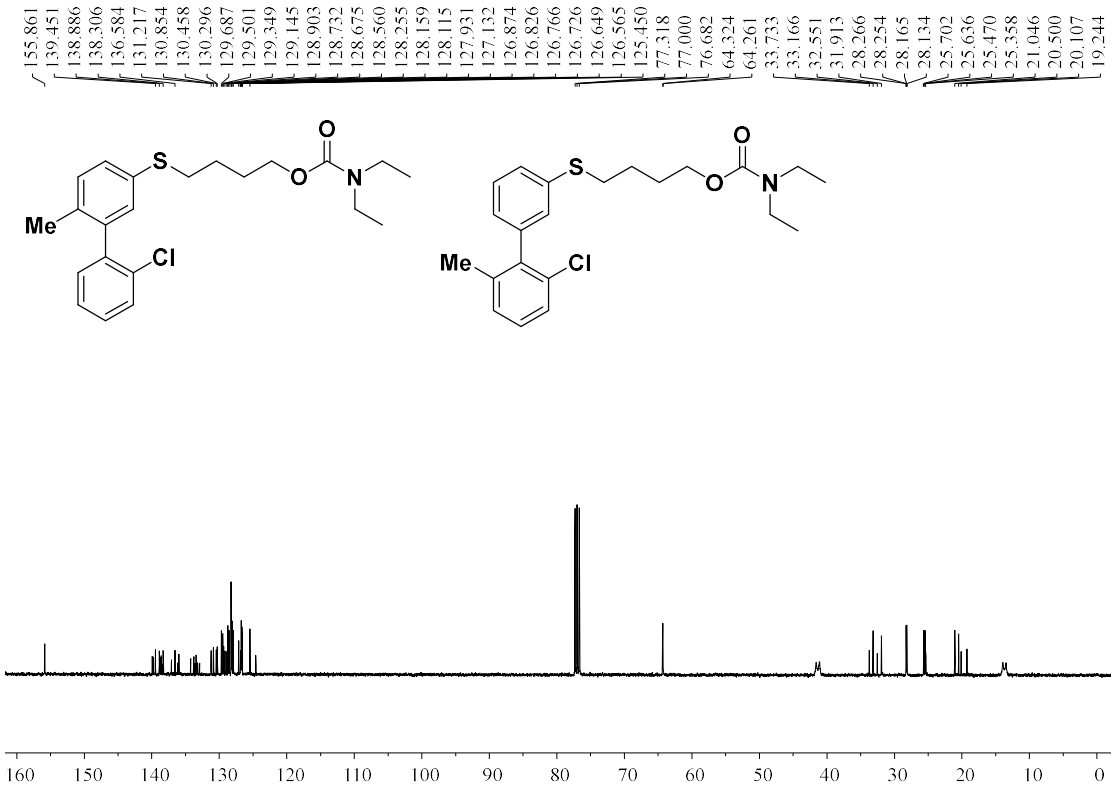
^{1}H NMR Spectrum of **17 and 17'**



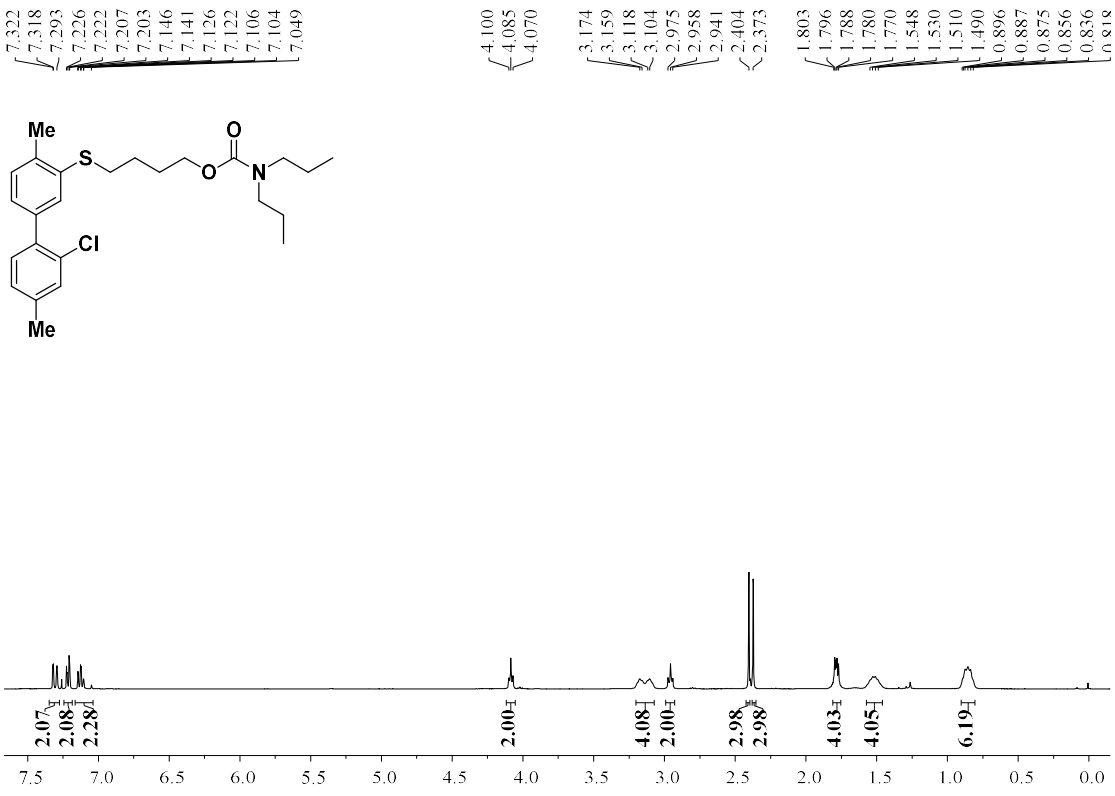
^{13}C NMR Spectrum of **17 and 17'**



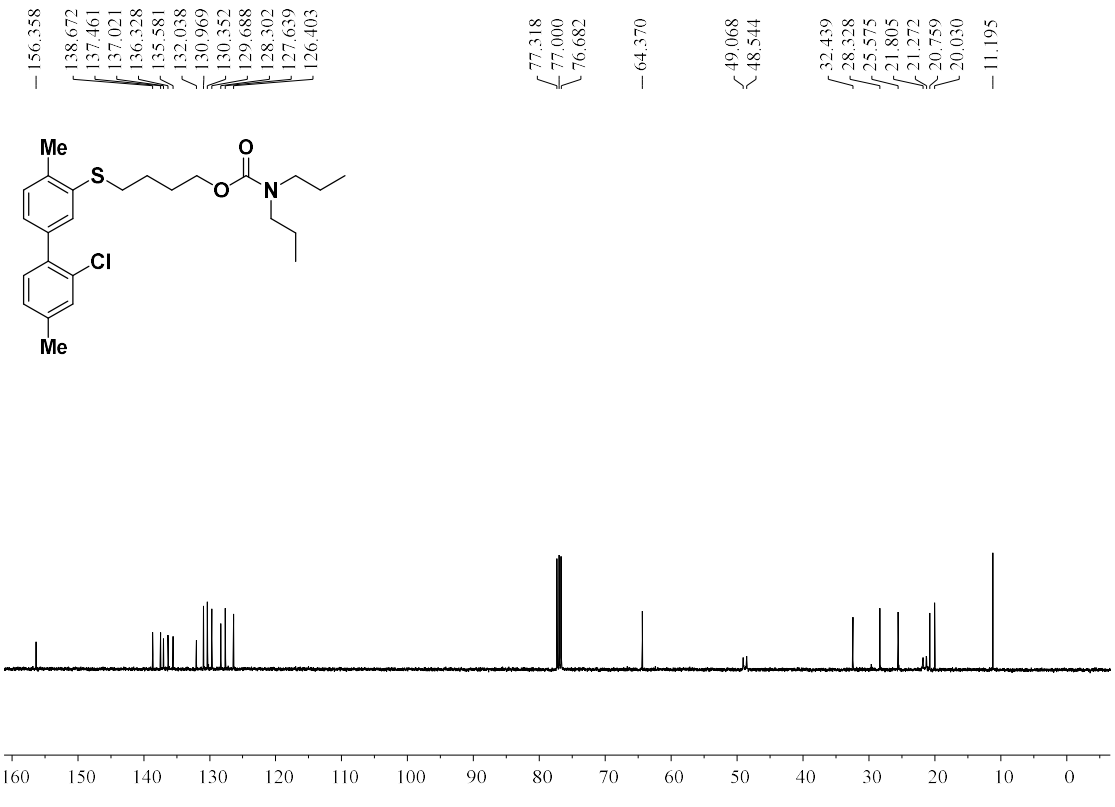
^{1}H NMR Spectrum of **18 and 18'**



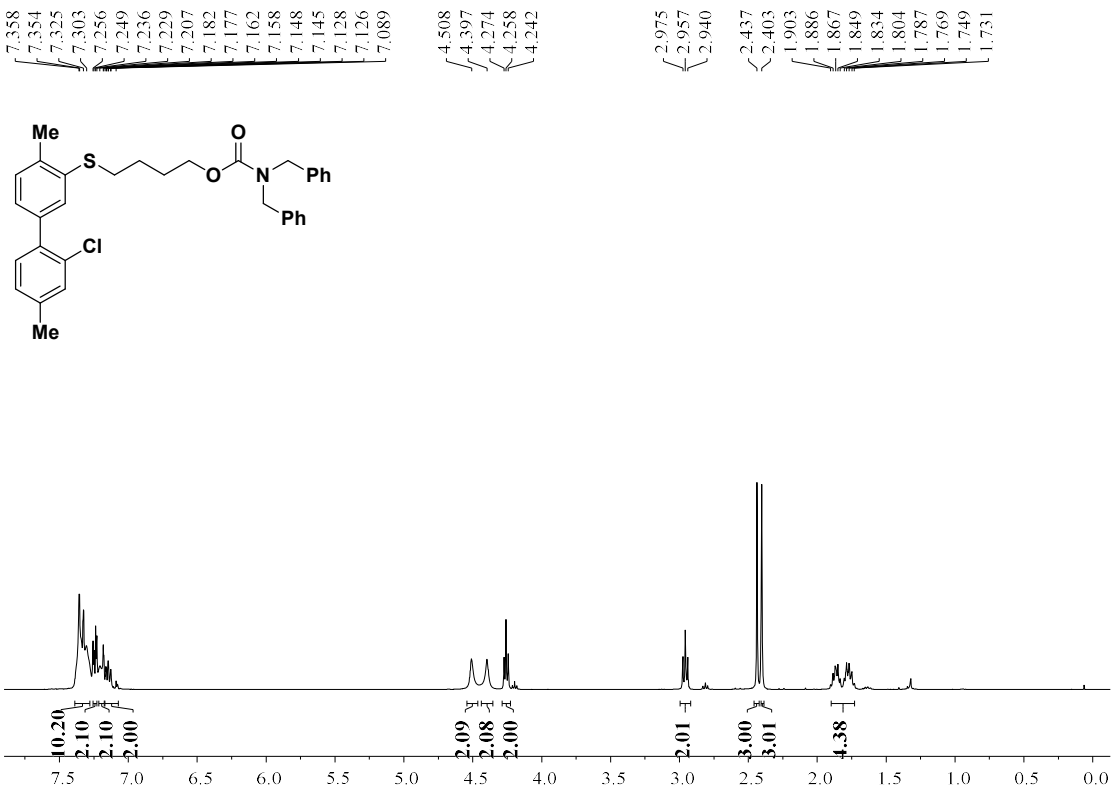
^{13}C NMR Spectrum of **18 and 18'**



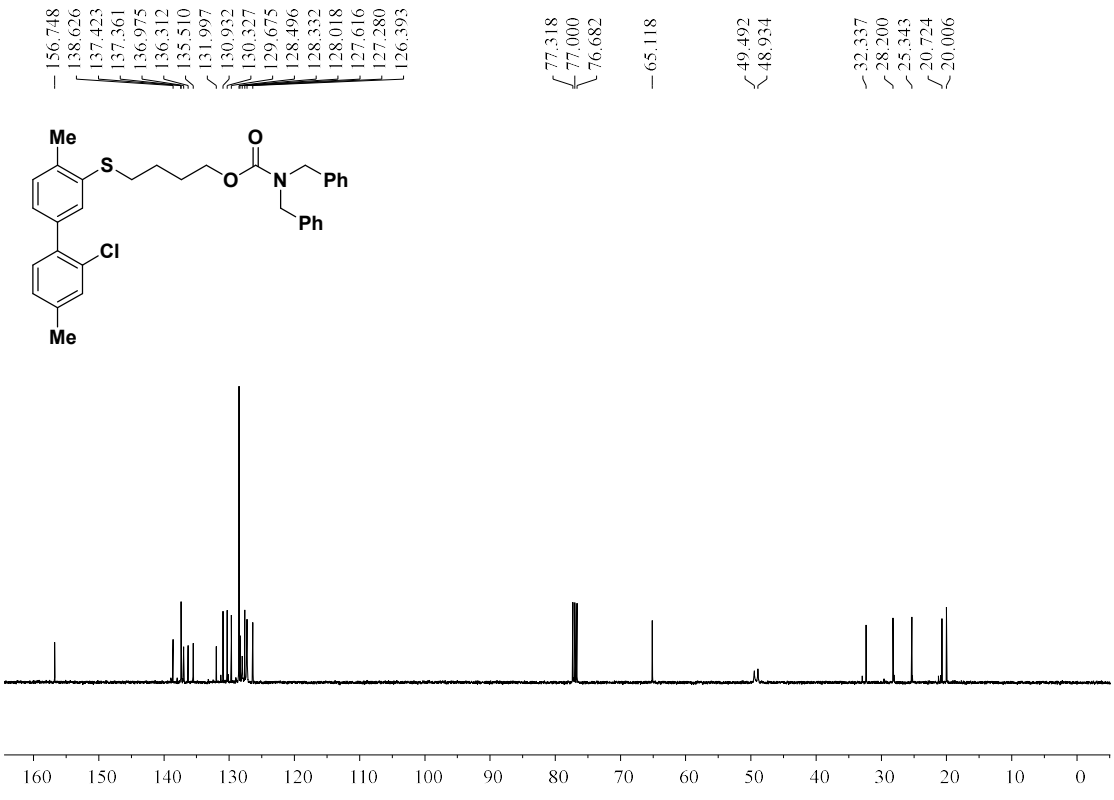
^{1}H NMR Spectrum of **19**



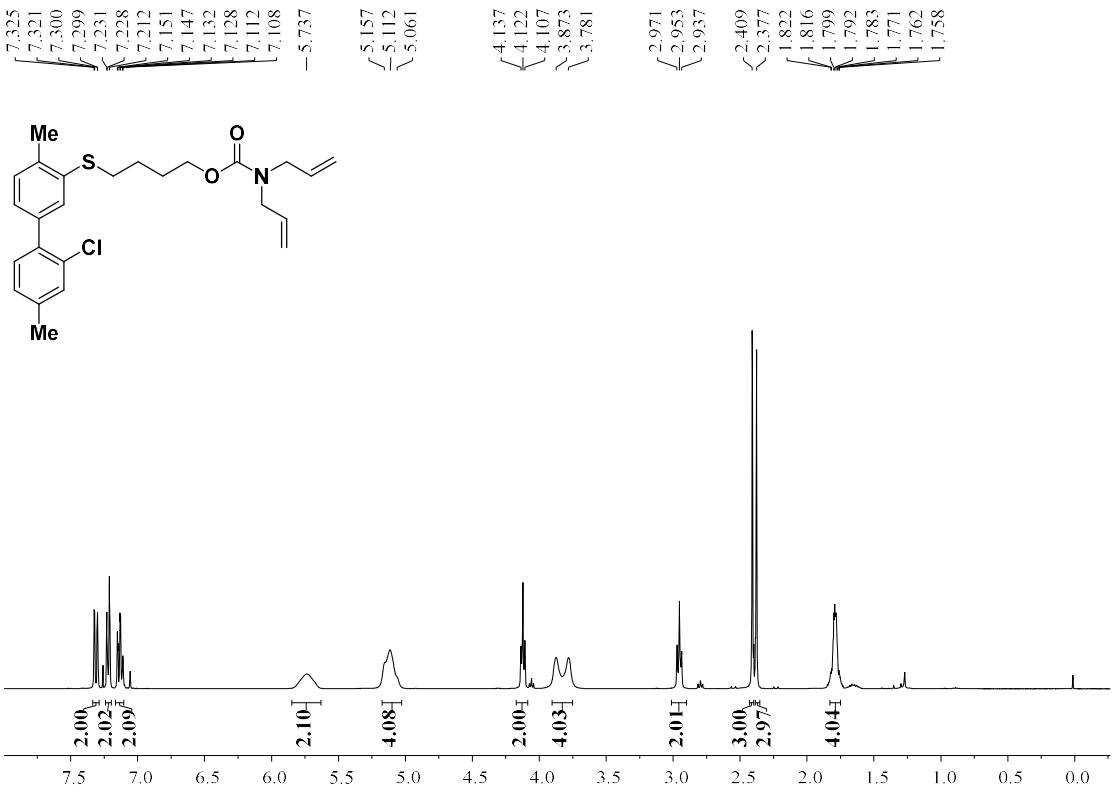
^{13}C NMR Spectrum of **19**



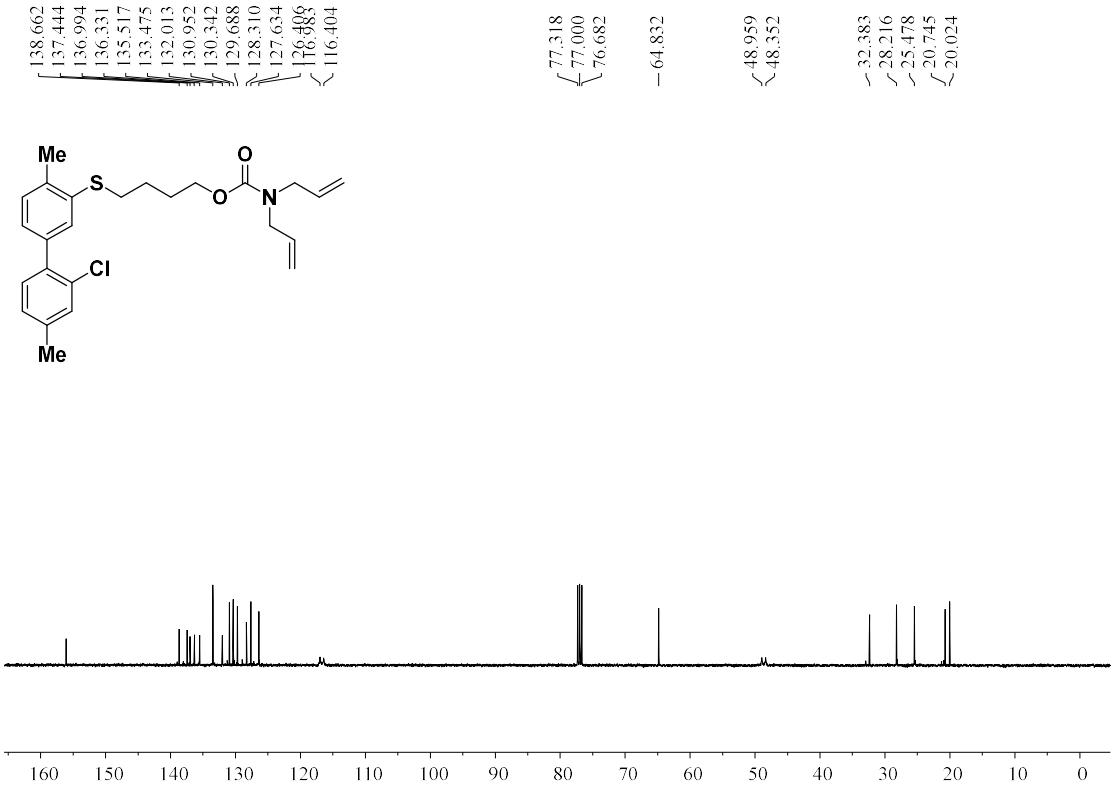
^{1}H NMR Spectrum of **20**



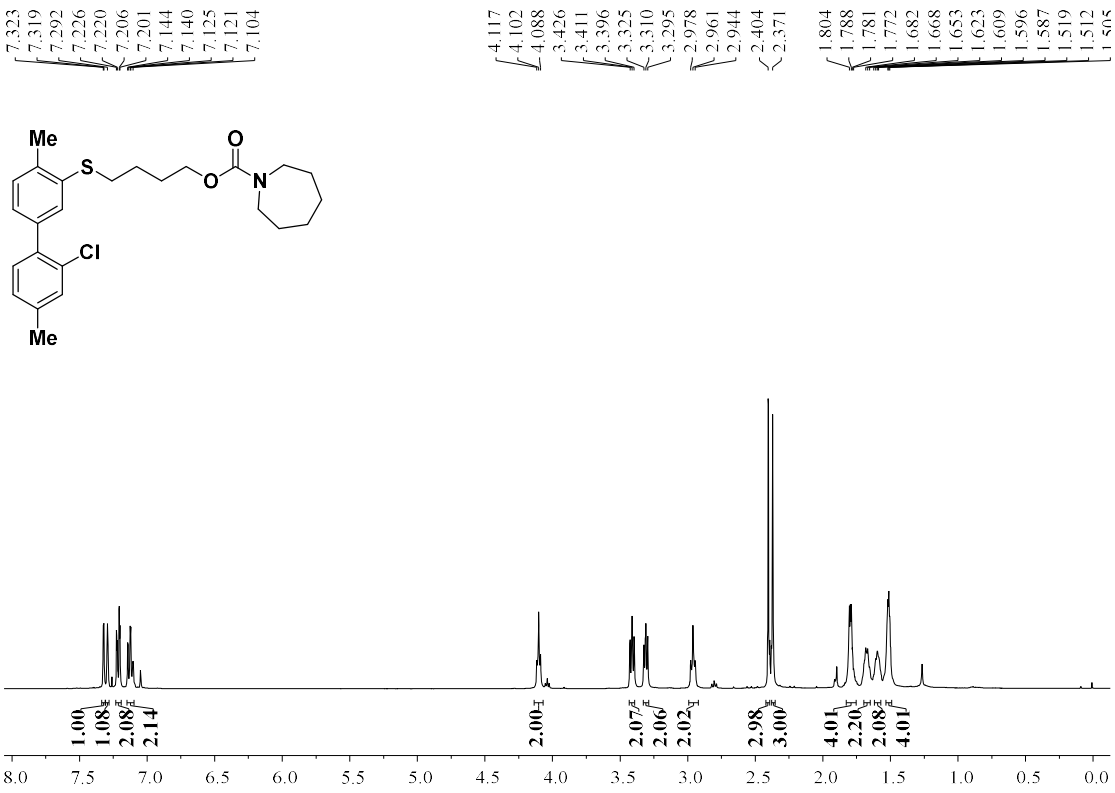
^{13}C NMR Spectrum of **20**



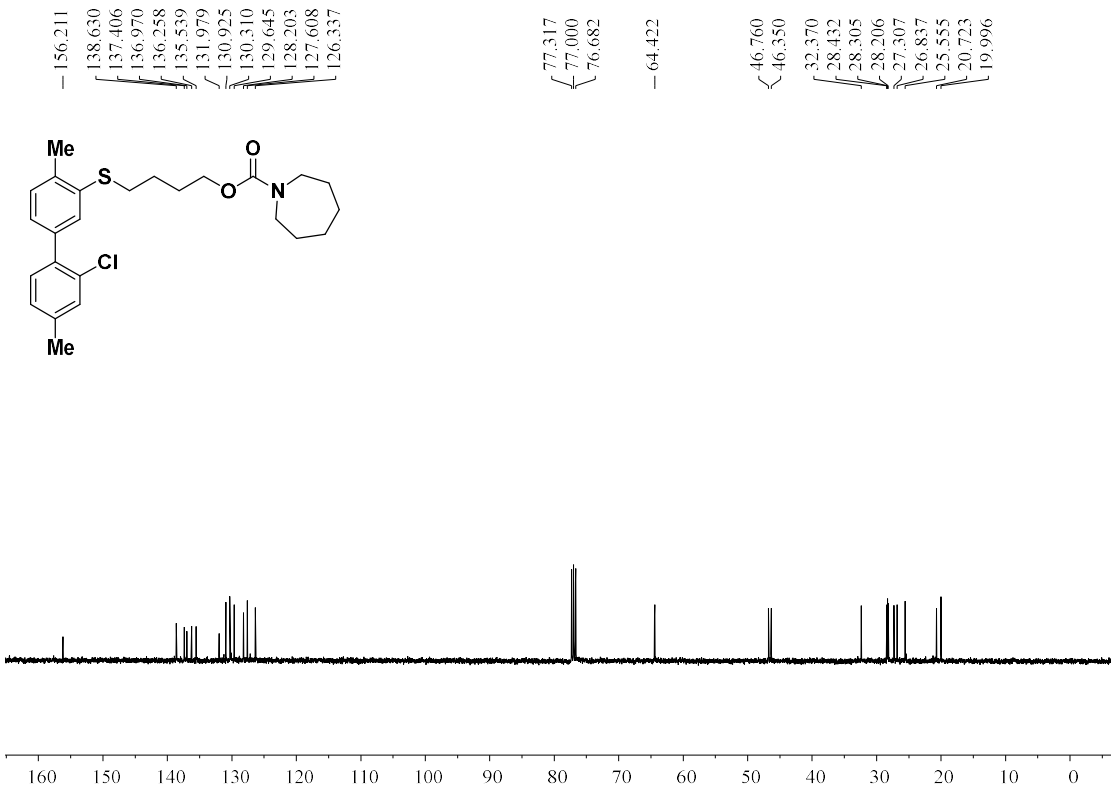
^{1}H NMR Spectrum of **21**



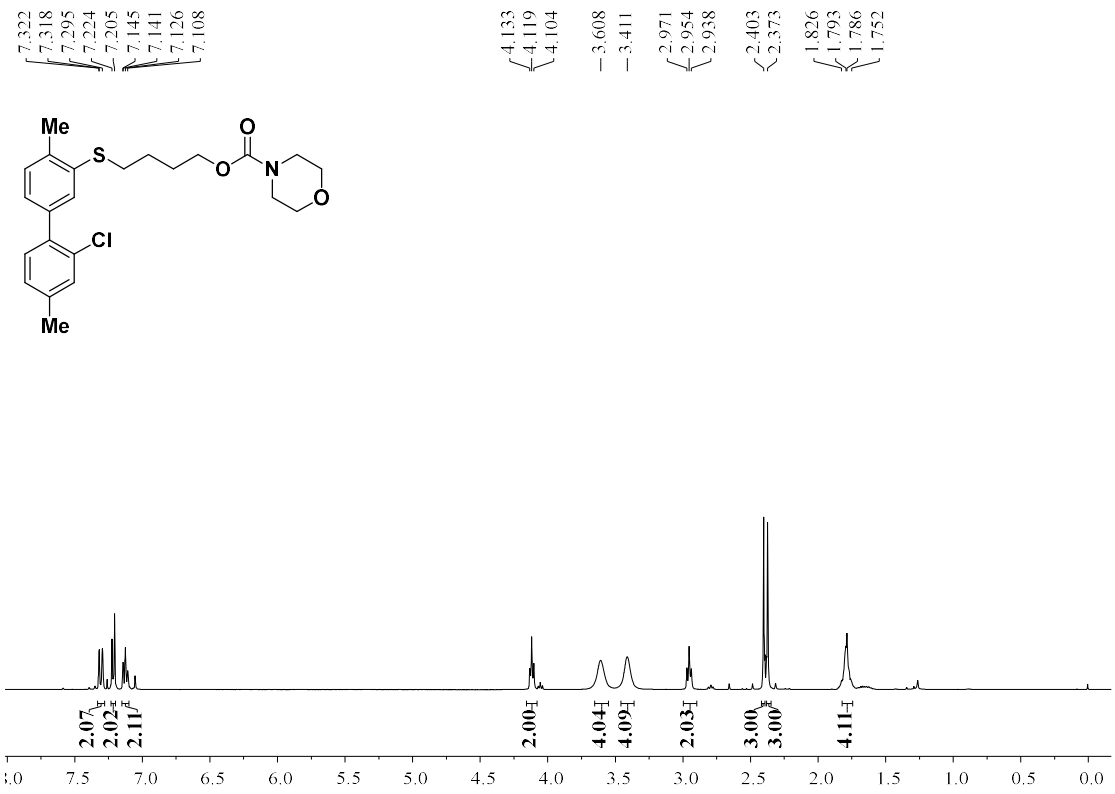
^{13}C NMR Spectrum of **21**



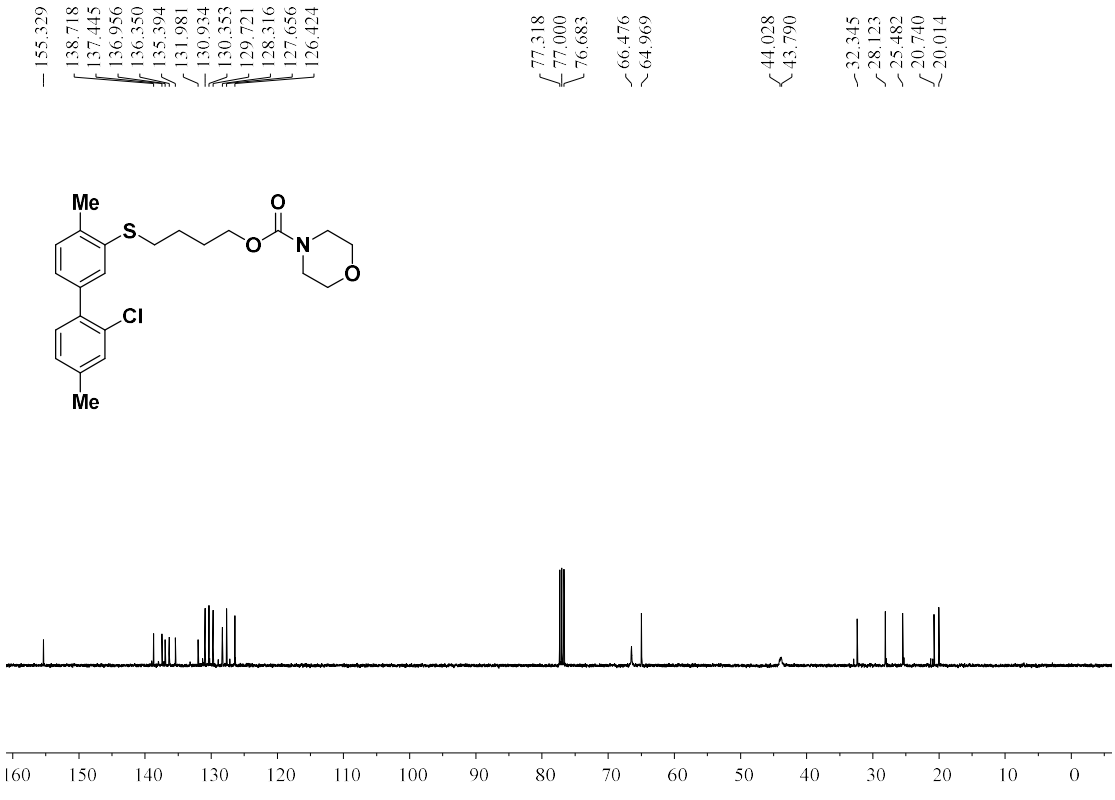
^{1}H NMR Spectrum of **22**



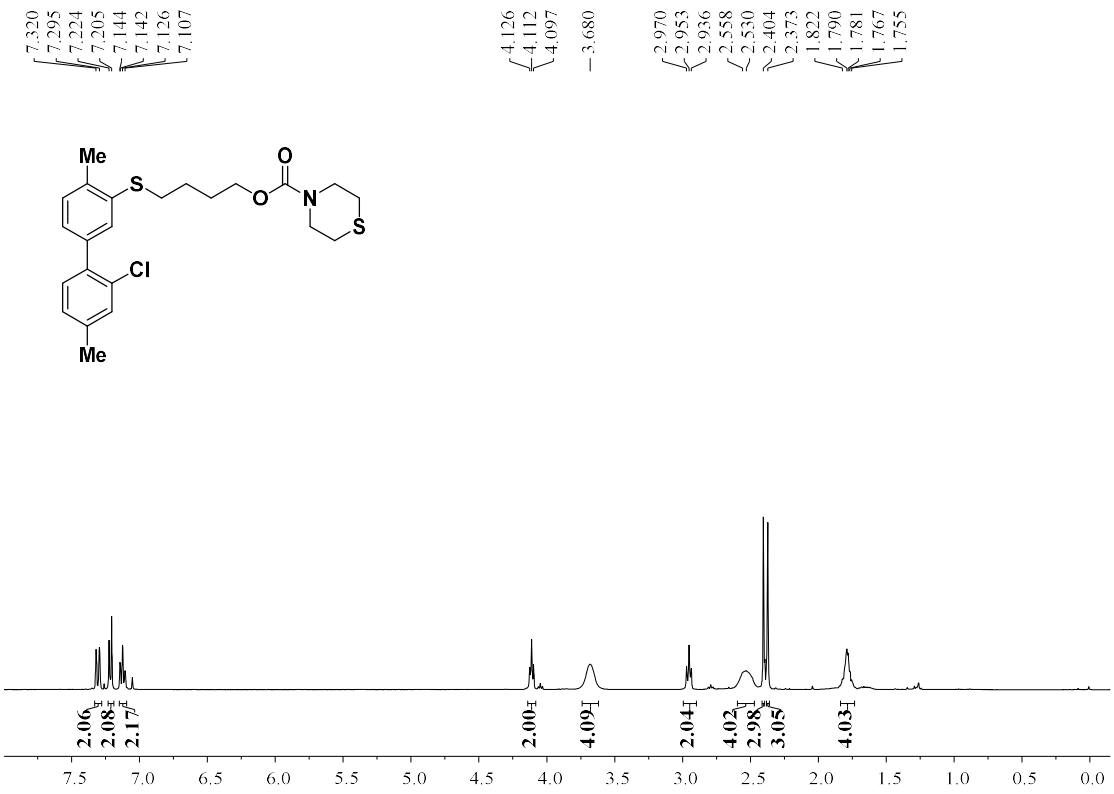
^{13}C NMR Spectrum of **22**



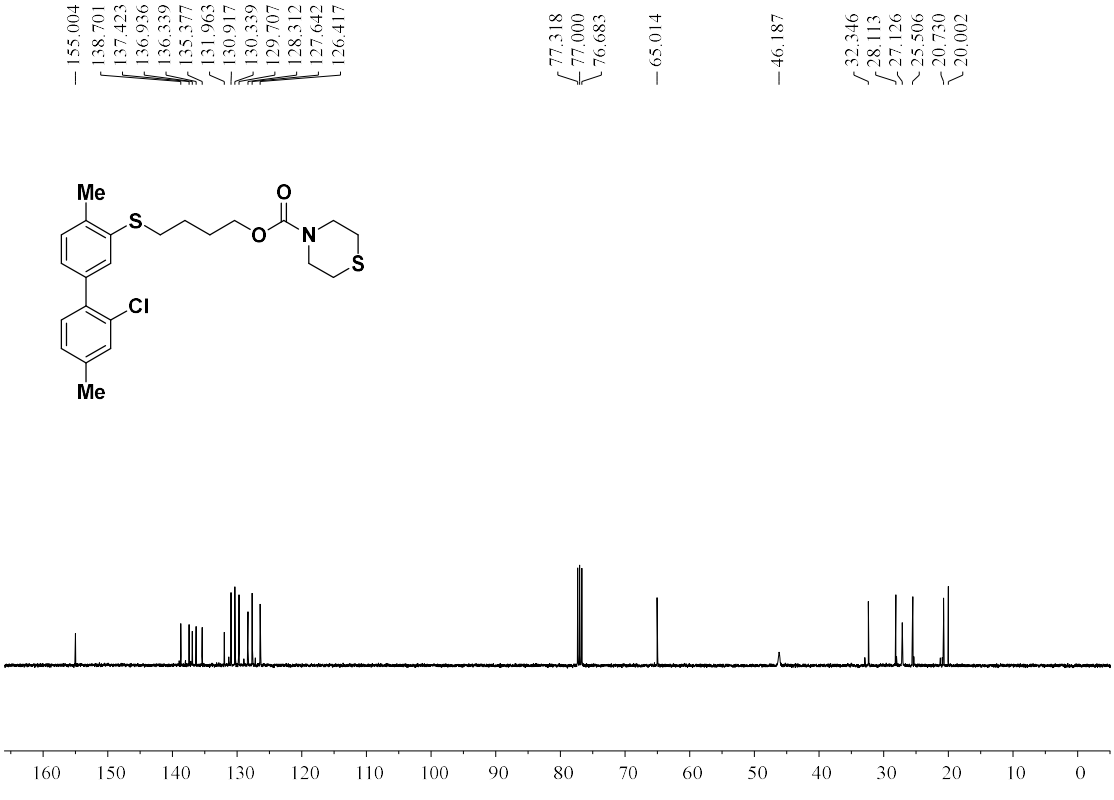
^{1}H NMR Spectrum of **23**



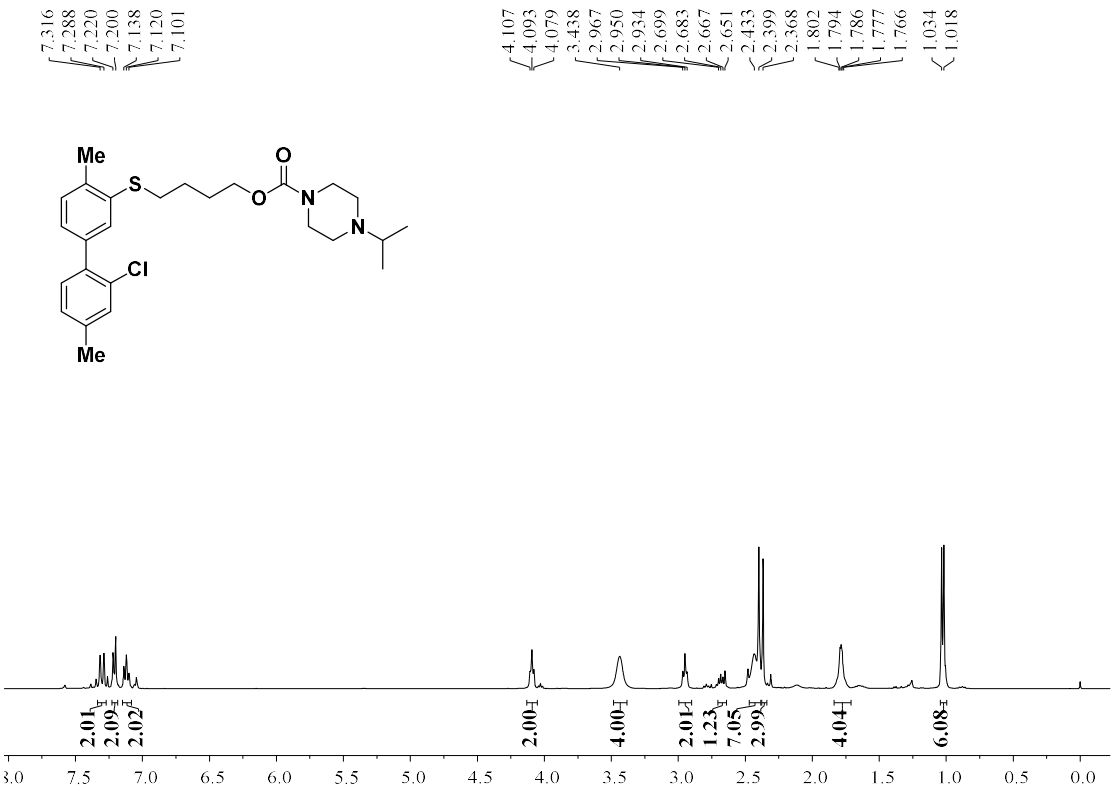
^{13}C NMR Spectrum of **23**



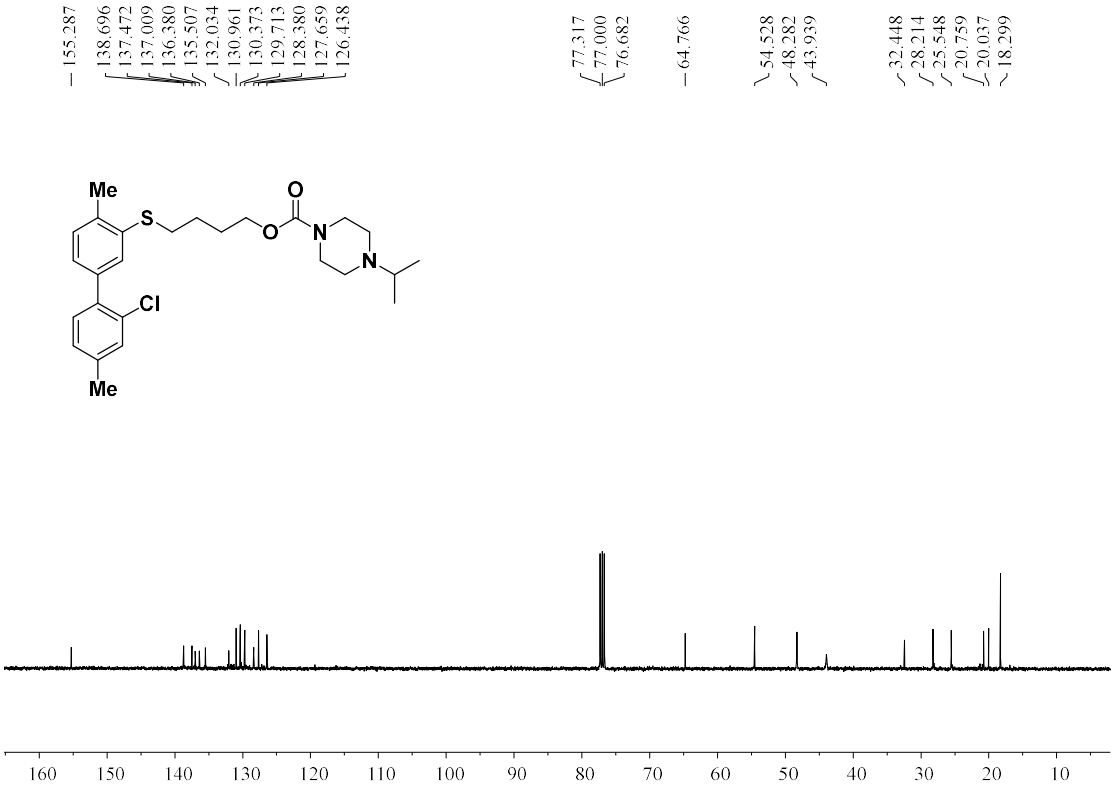
^{1}H NMR Spectrum of **24**



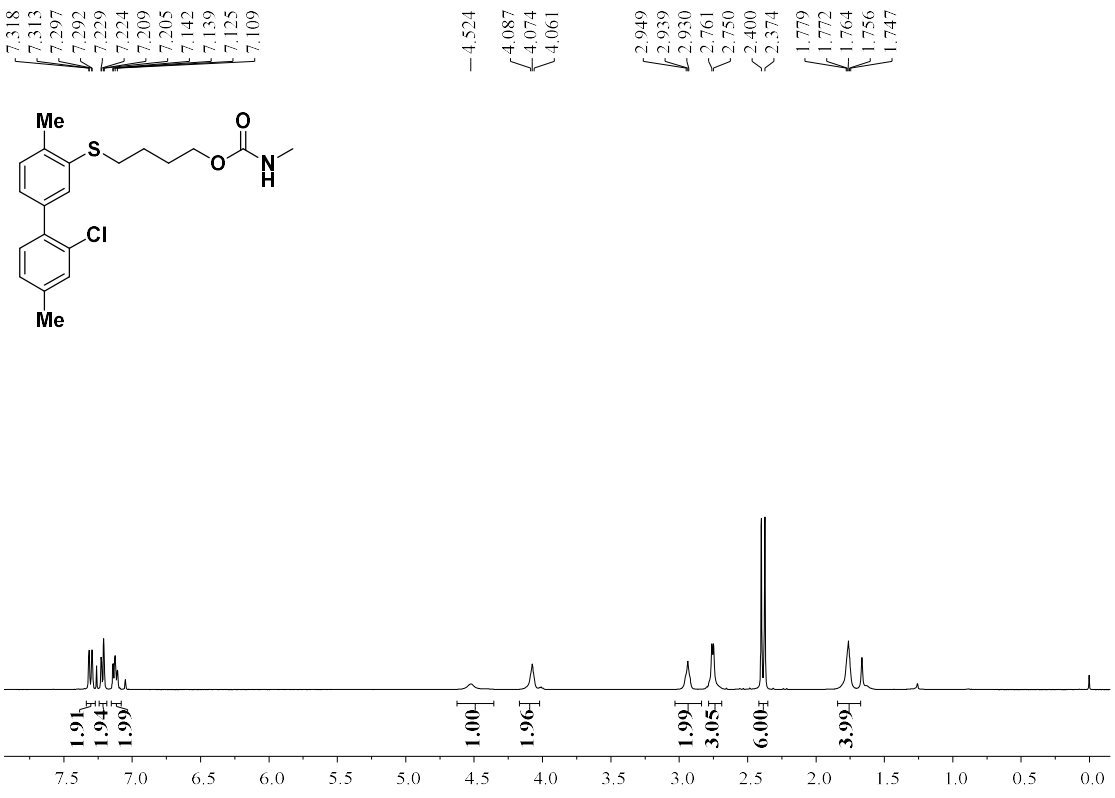
^{13}C NMR Spectrum of **24**



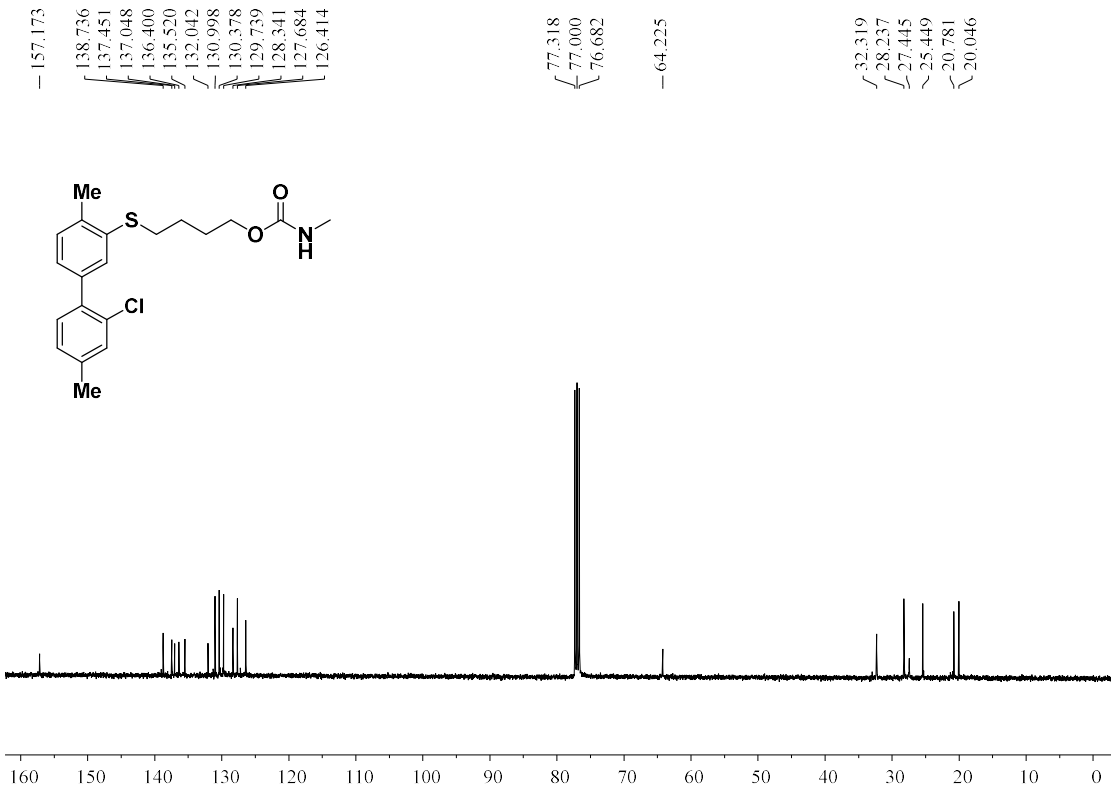
^{1}H NMR Spectrum of **25**



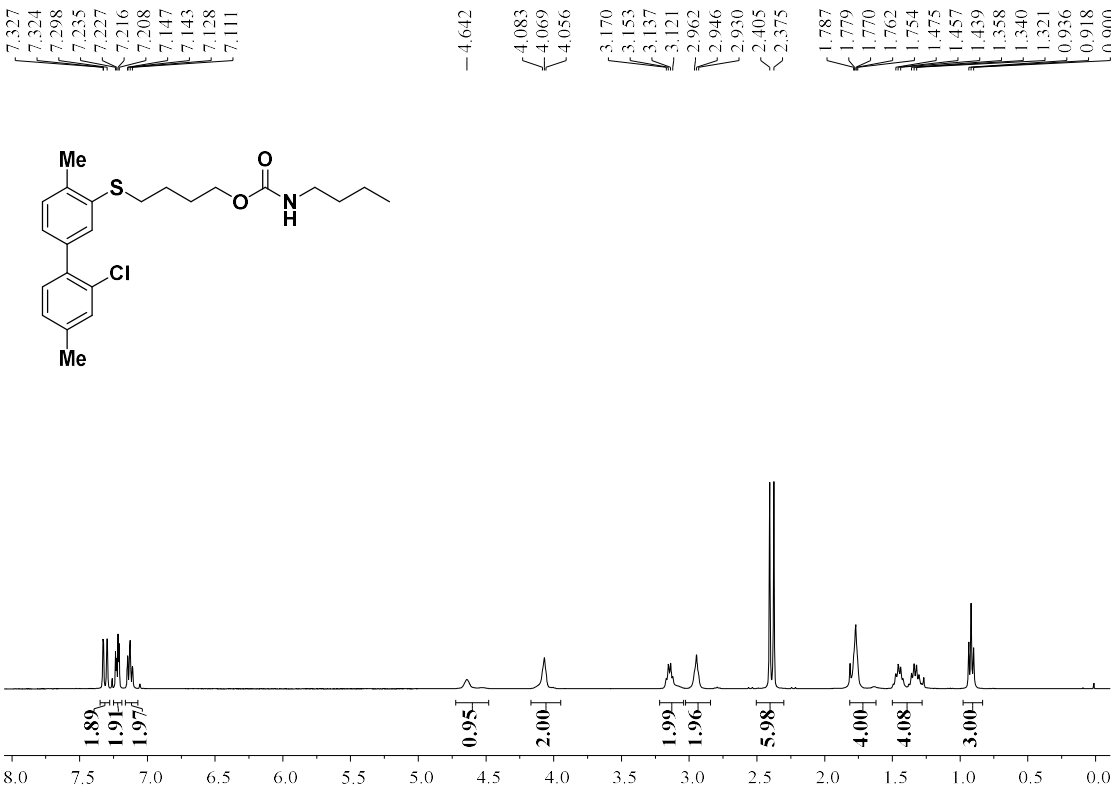
^{13}C NMR Spectrum of **25**



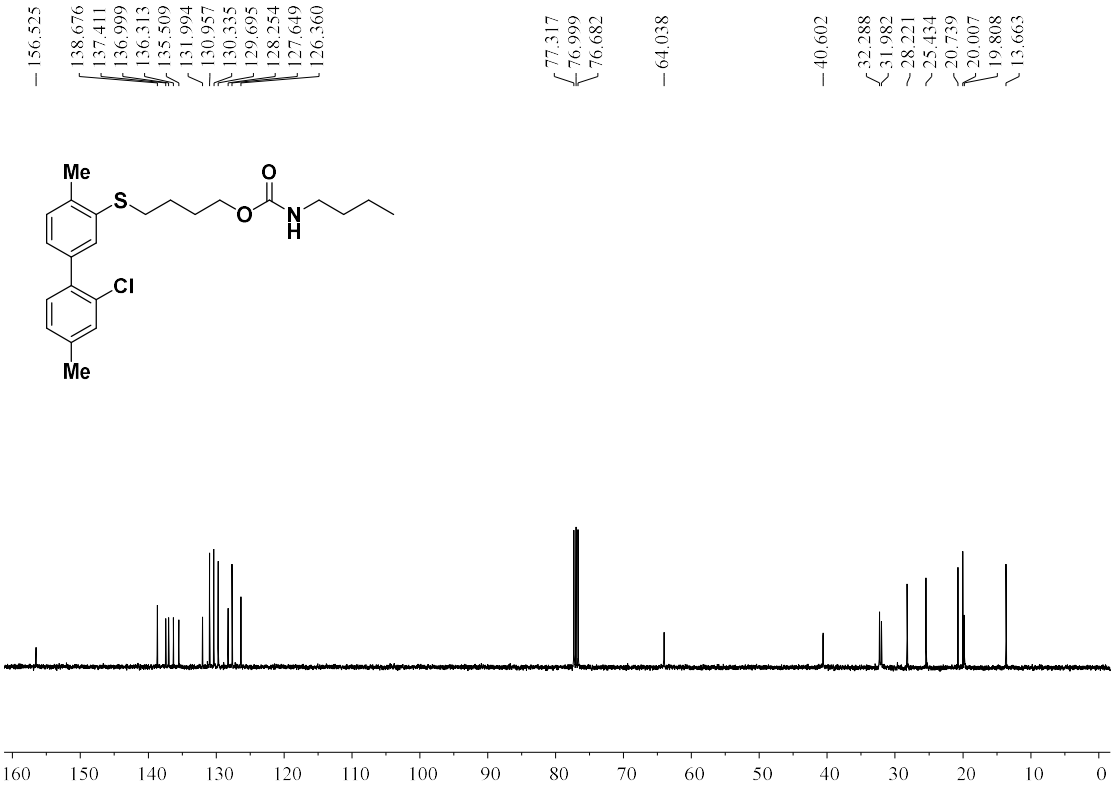
^{1}H NMR Spectrum of **26**



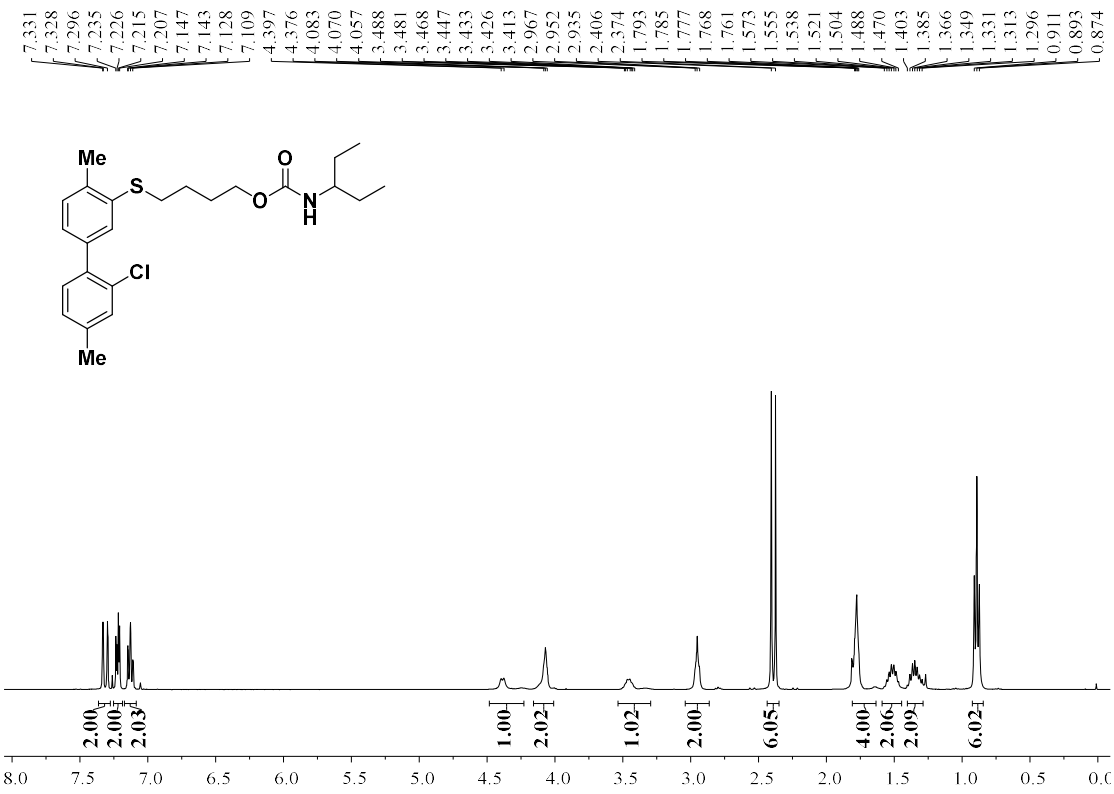
^{13}C NMR Spectrum of **26**



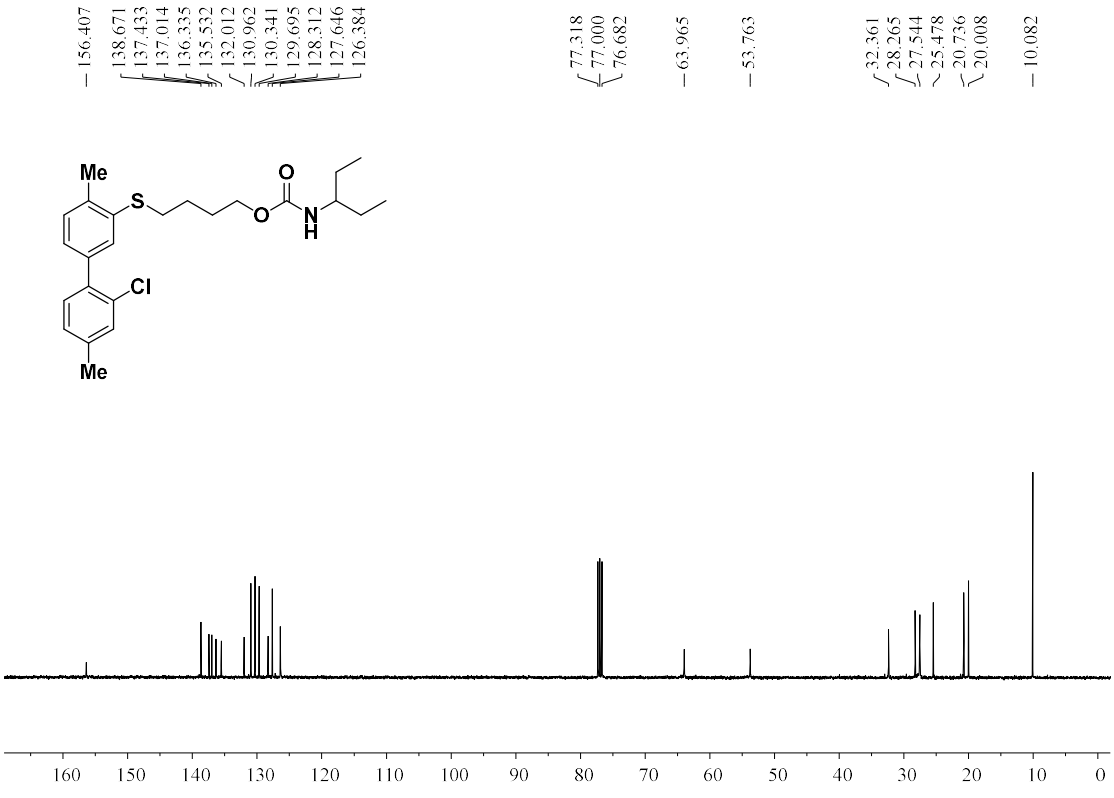
^{1}H NMR Spectrum of **27**



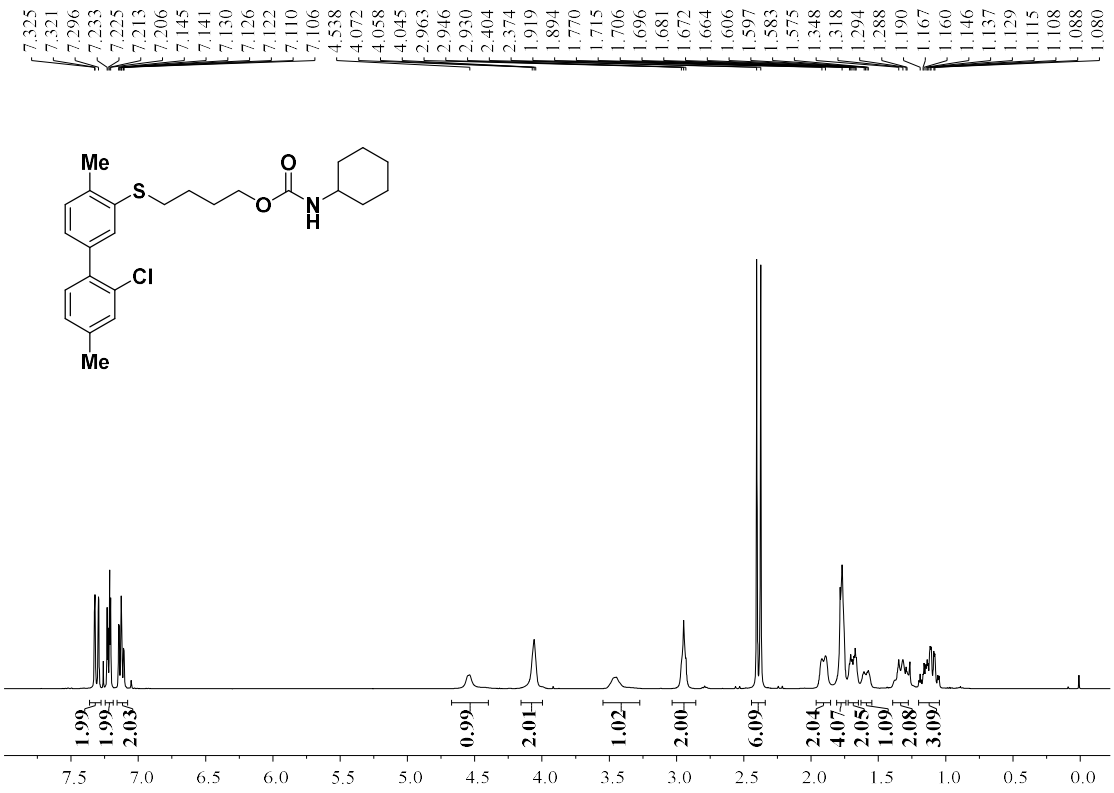
^{13}C NMR Spectrum of **27**



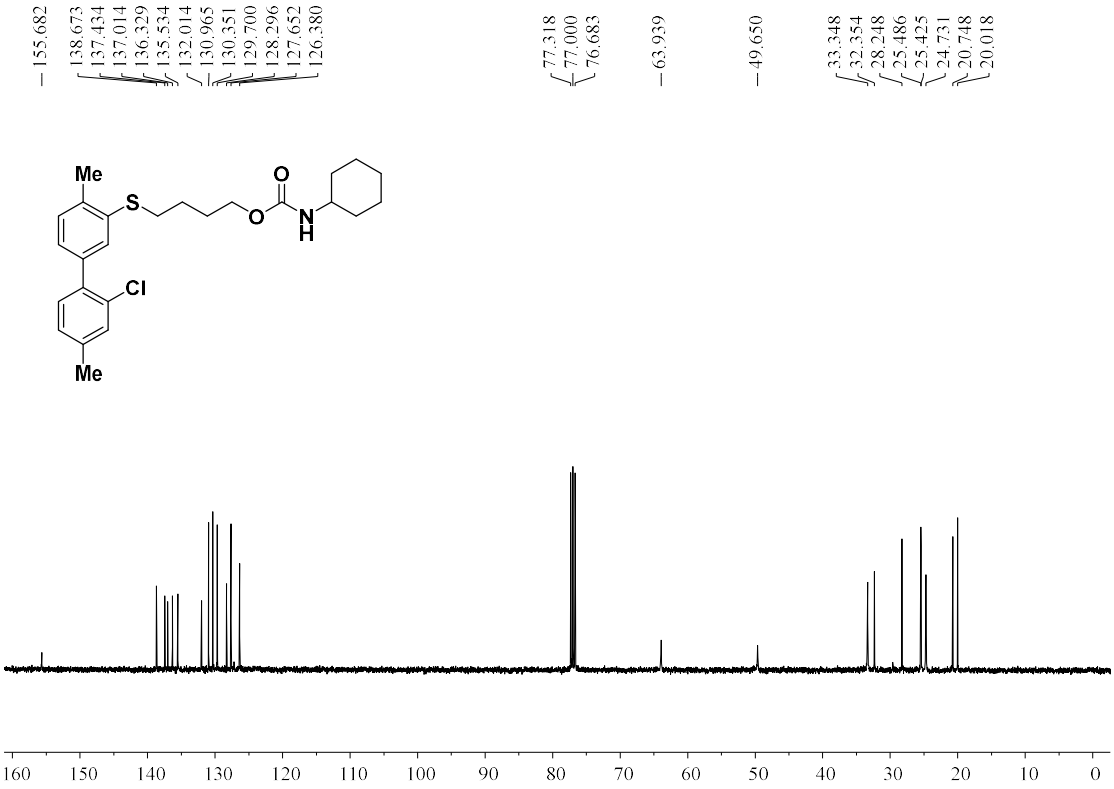
^{1}H NMR Spectrum of **28**



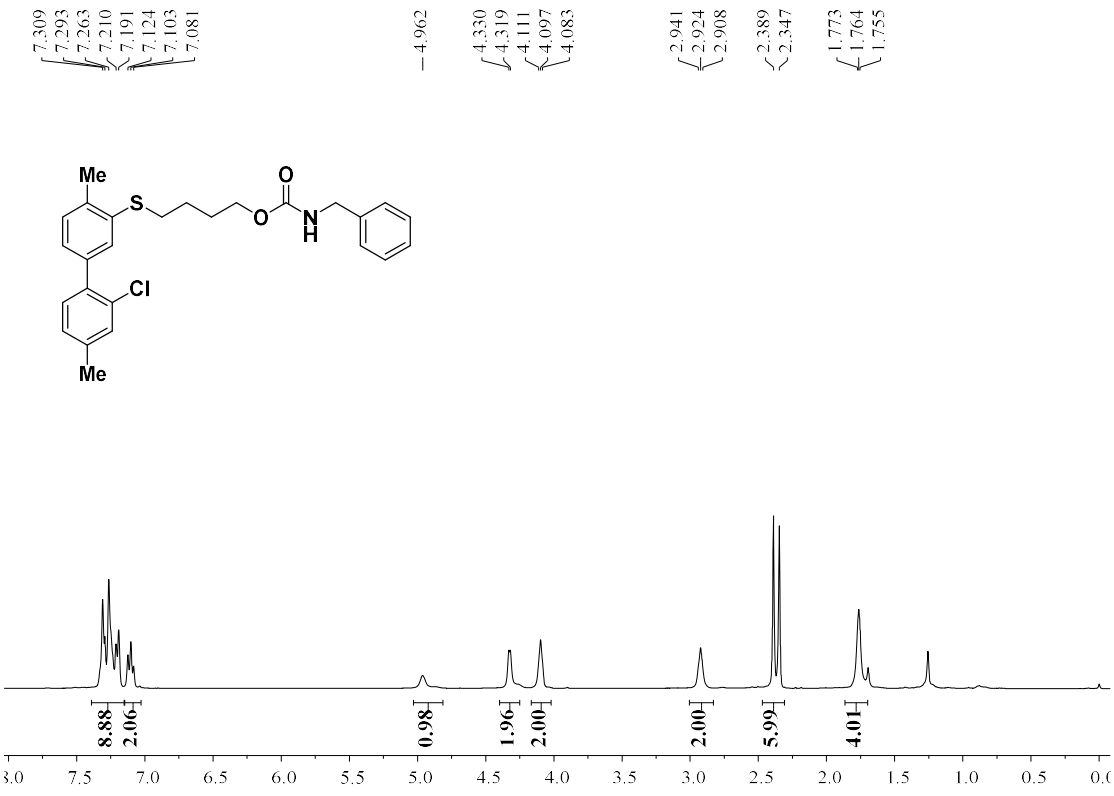
^{13}C NMR Spectrum of **28**



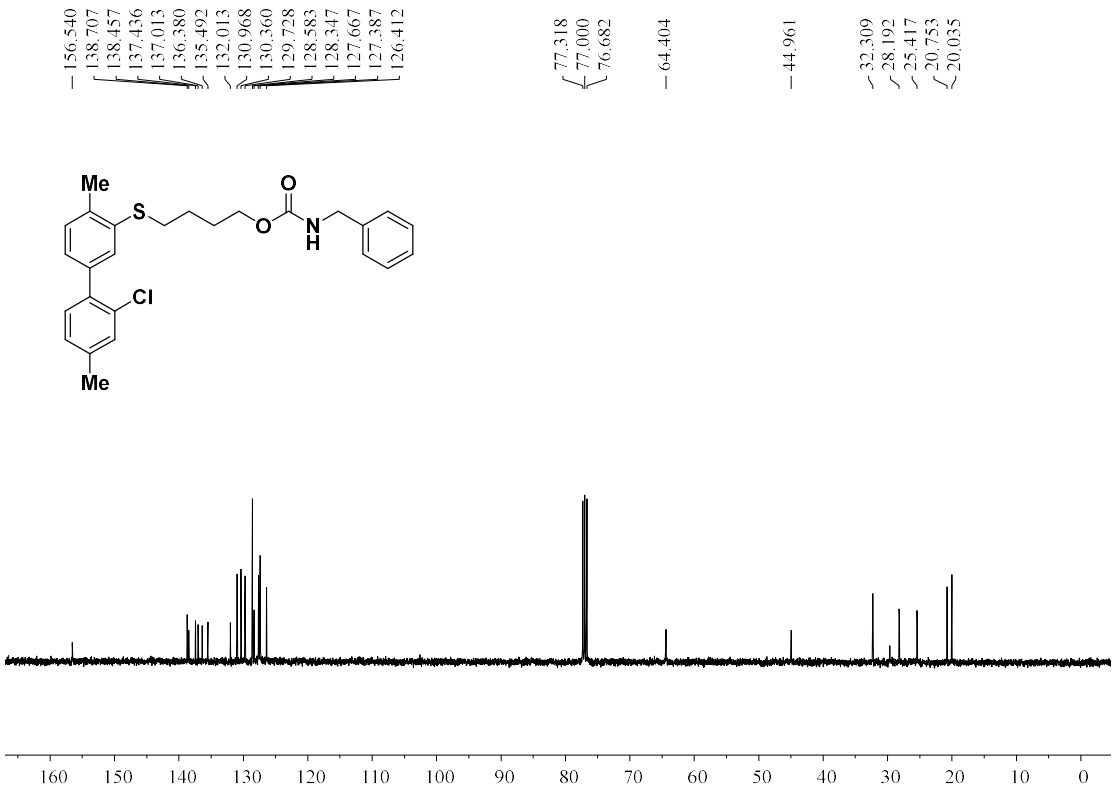
^{1}H NMR Spectrum of **29**



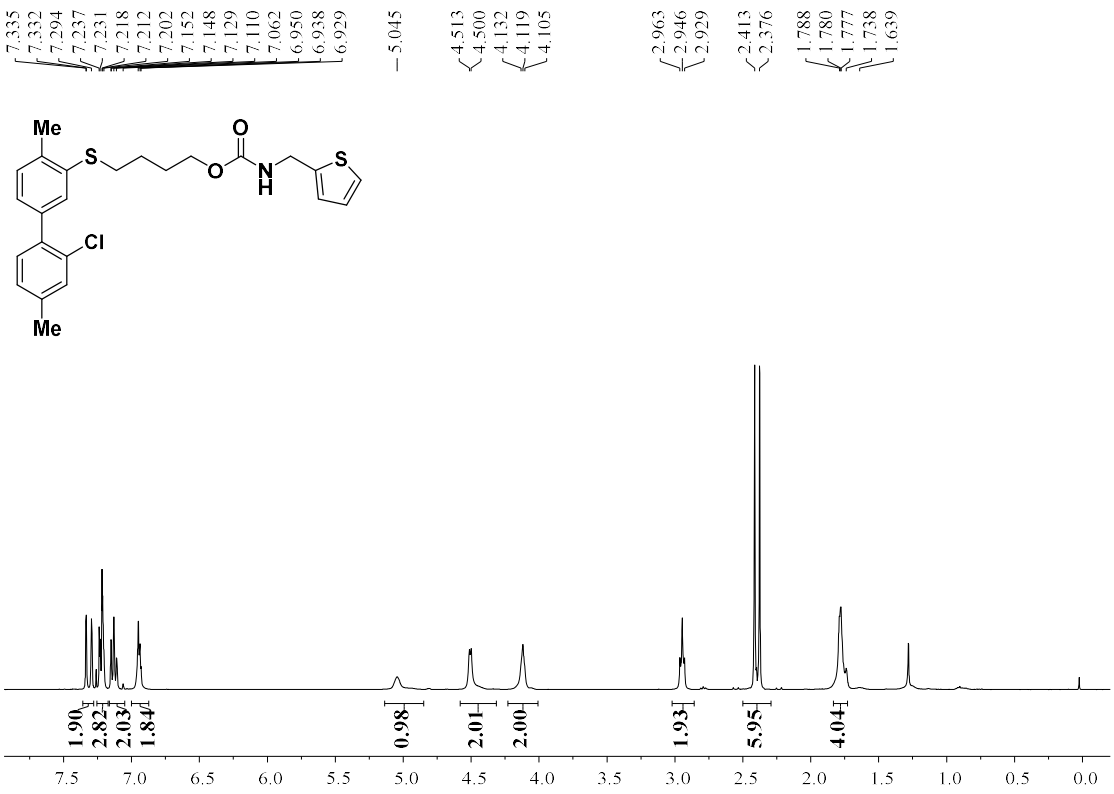
^{13}C NMR Spectrum of **29**



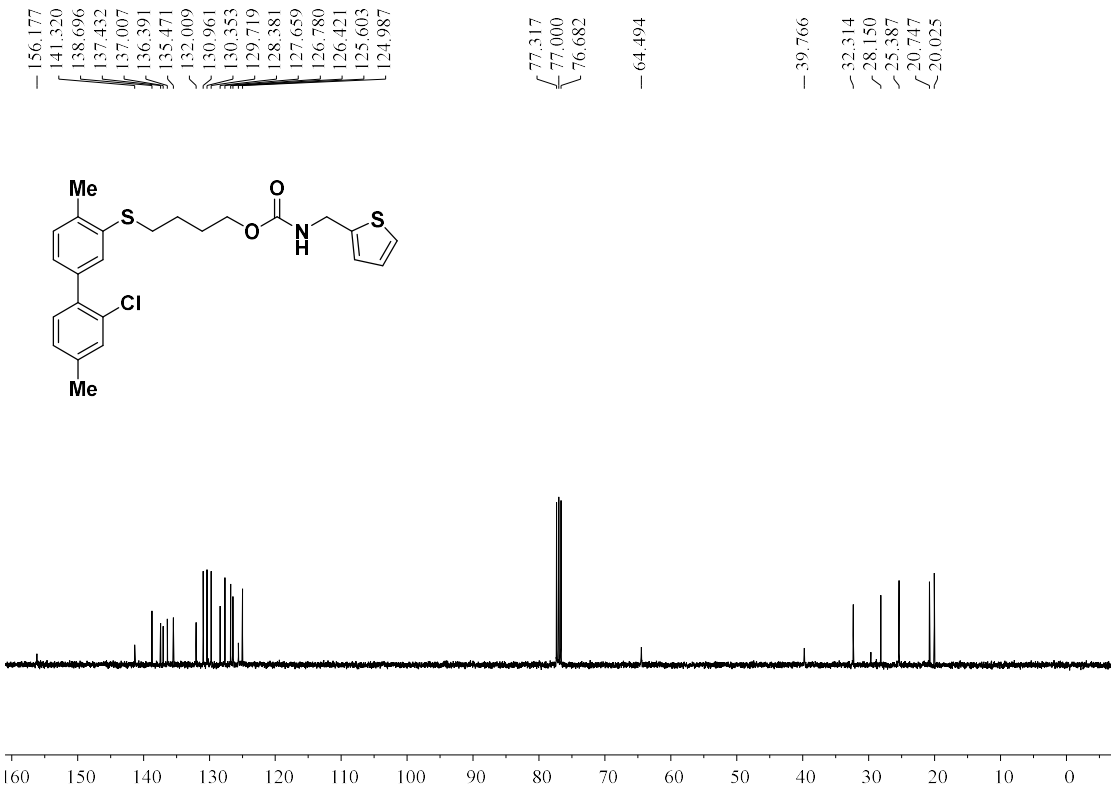
^{1}H NMR Spectrum of **30**



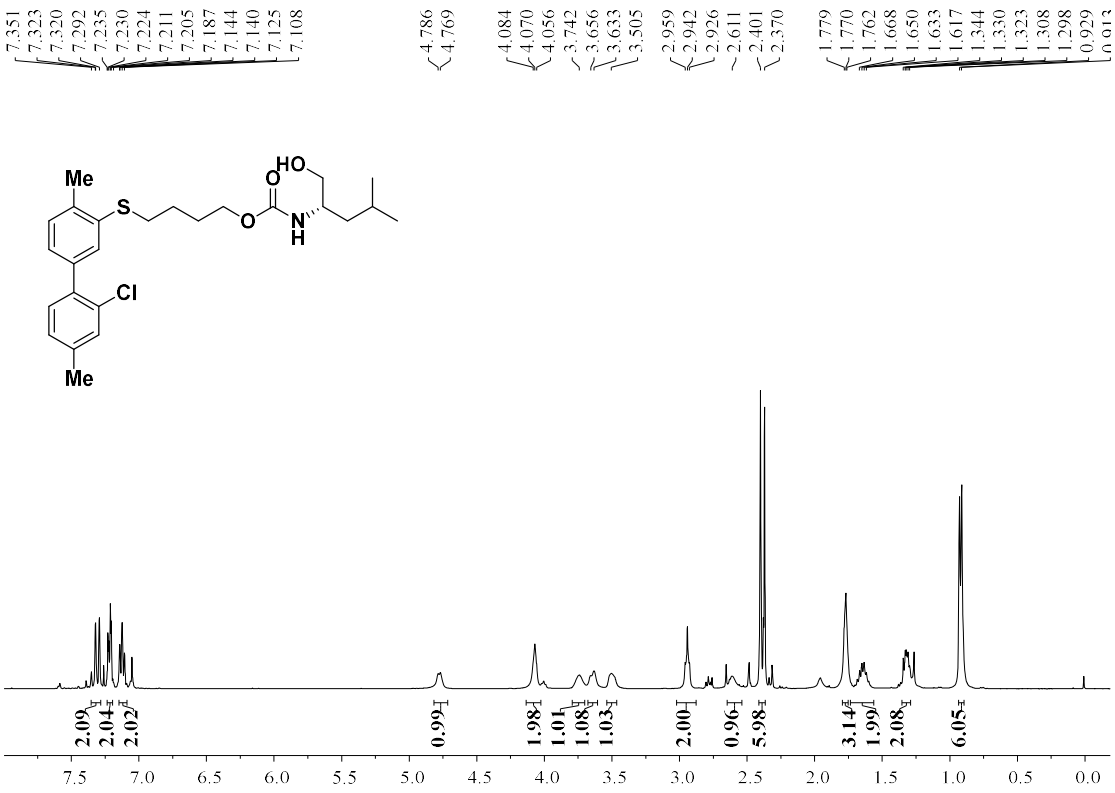
^{13}C NMR Spectrum of **30**



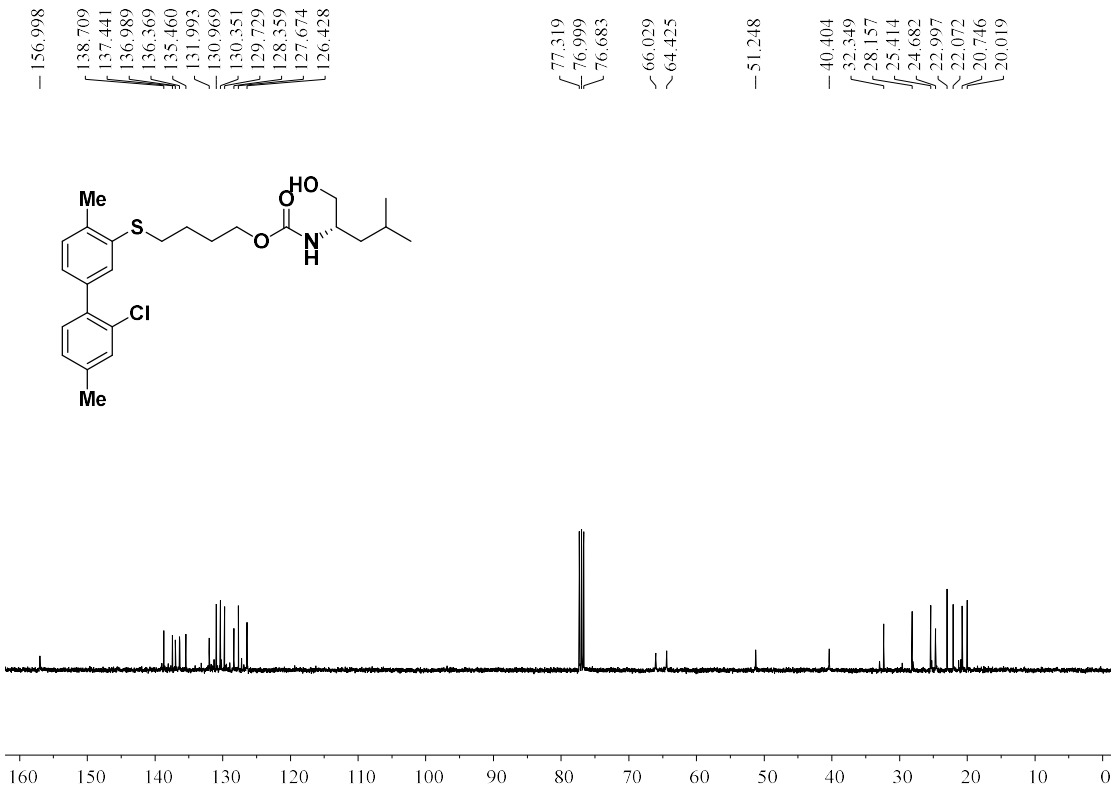
^{1}H NMR Spectrum of **31**



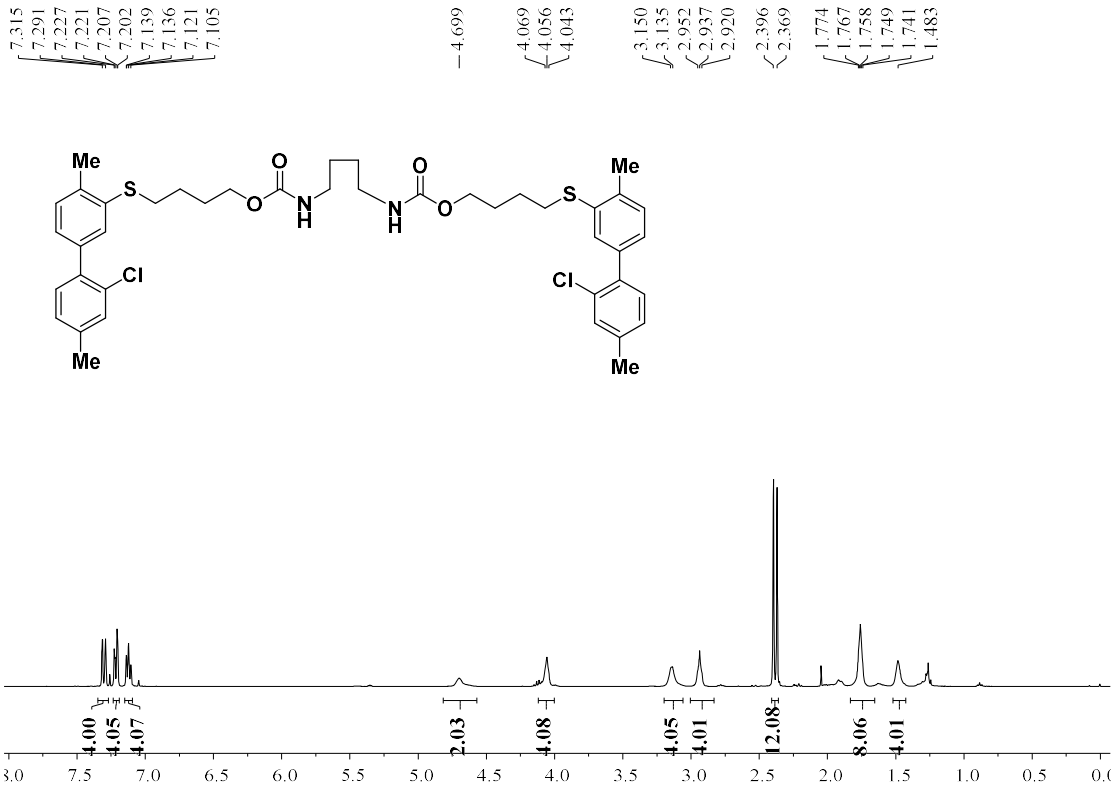
^{13}C NMR Spectrum of **31**



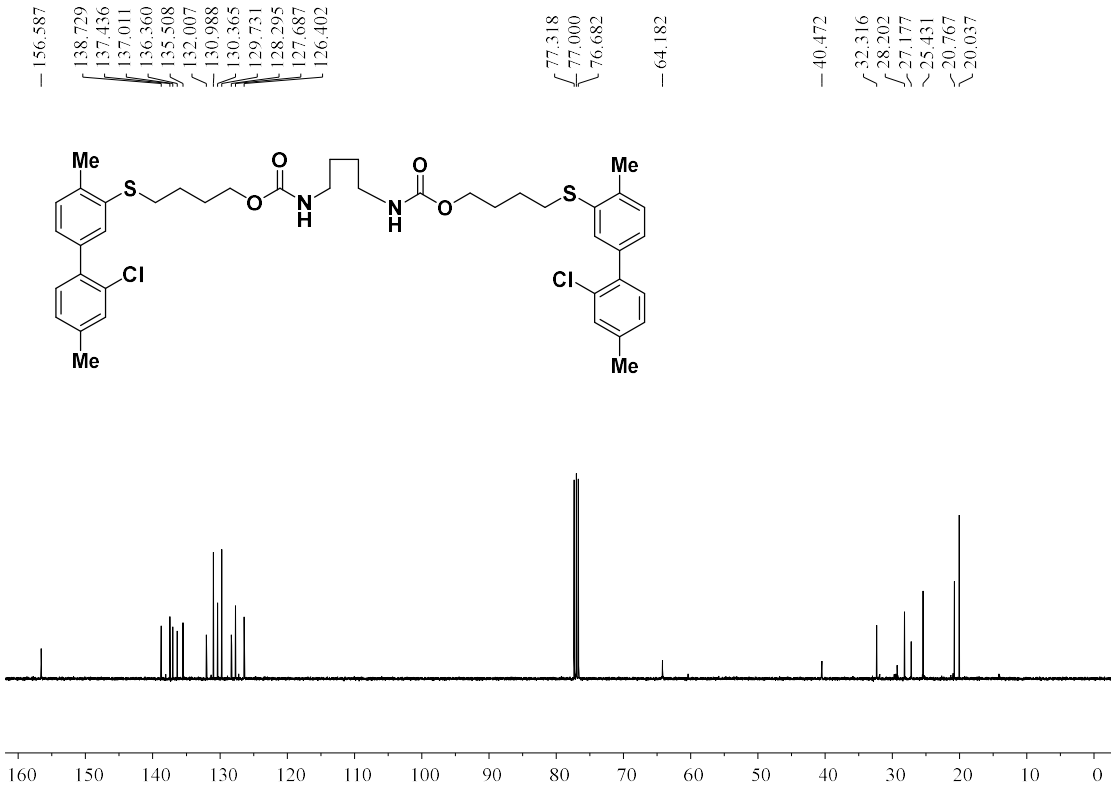
^{1}H NMR Spectrum of **32**



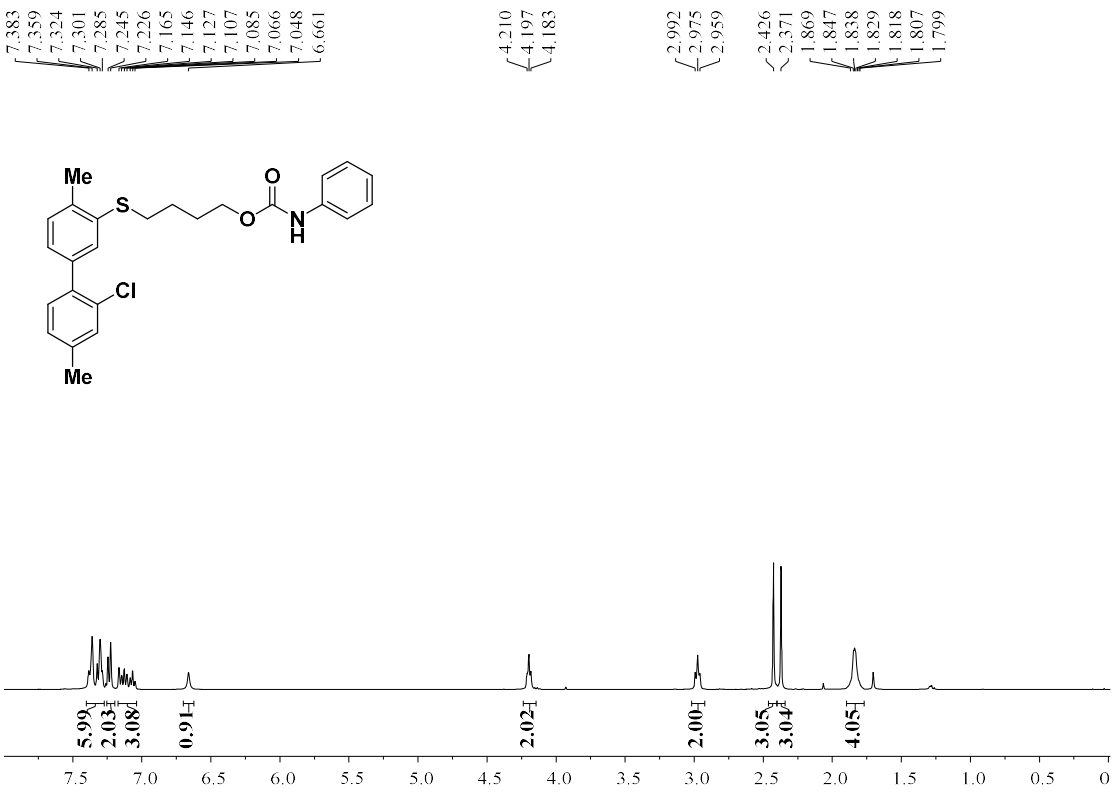
^{13}C NMR Spectrum of **32**



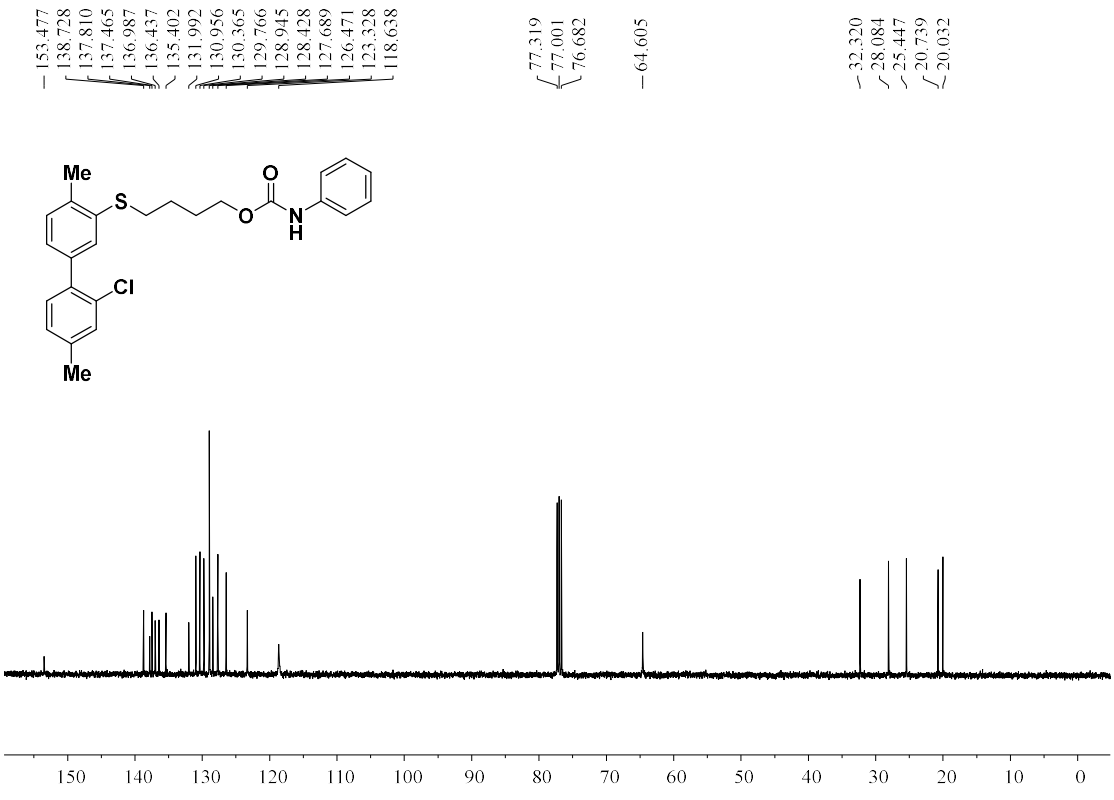
^{1}H NMR Spectrum of **33**



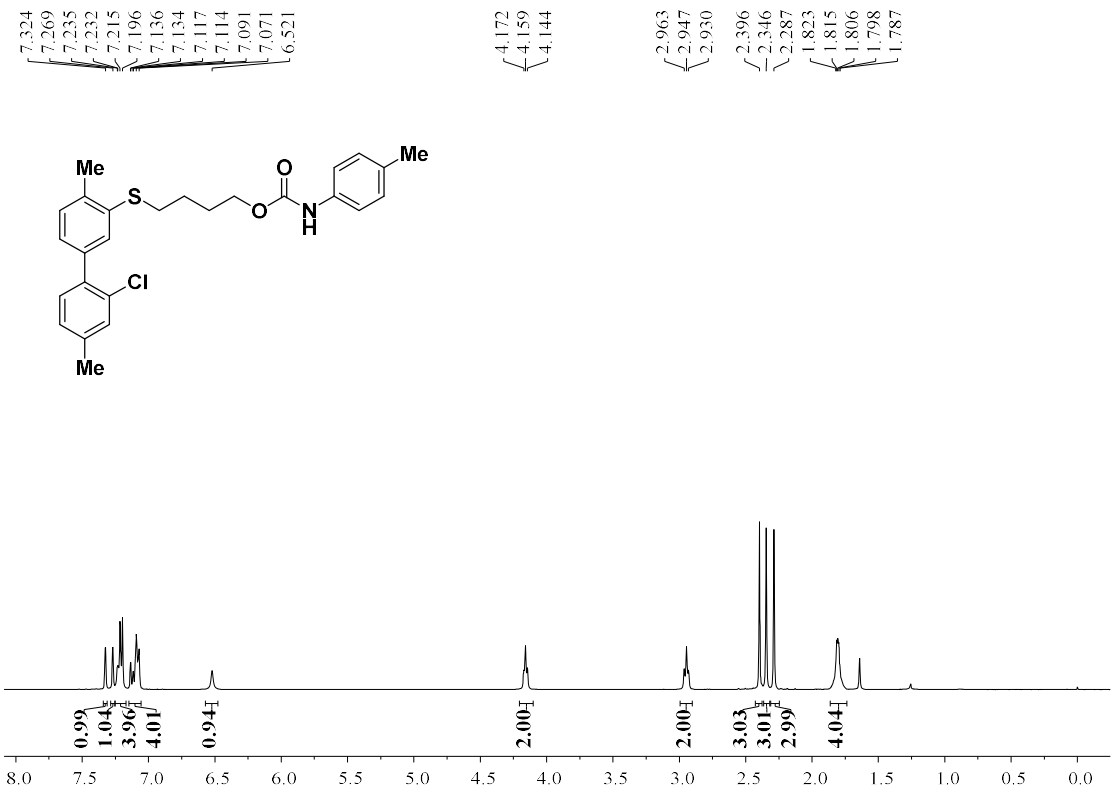
^{13}C NMR Spectrum of **33**



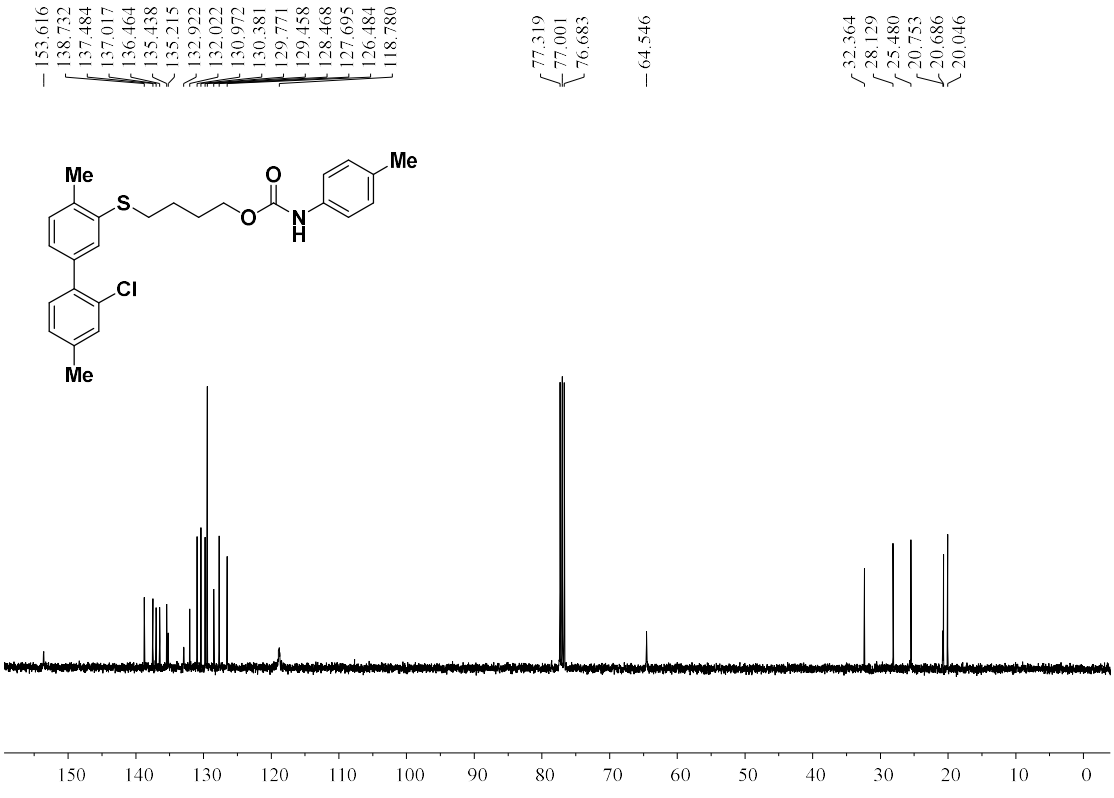
^{1}H NMR Spectrum of **34**



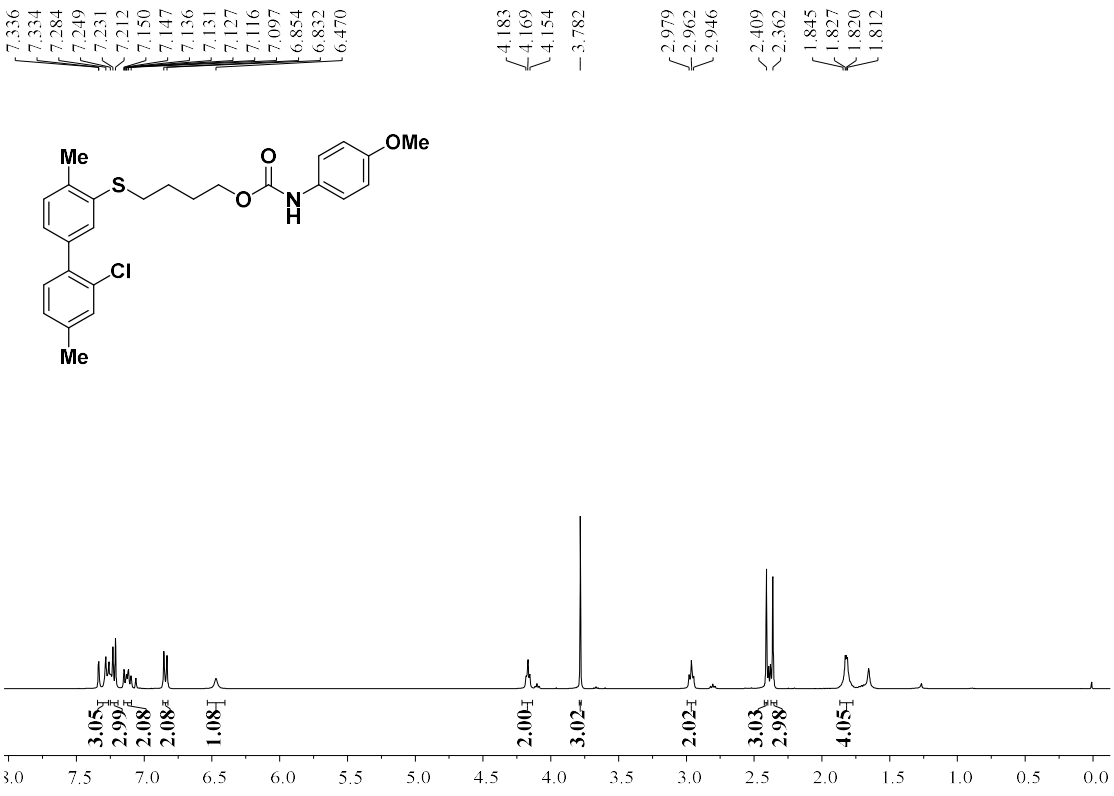
^{13}C NMR Spectrum of **34**



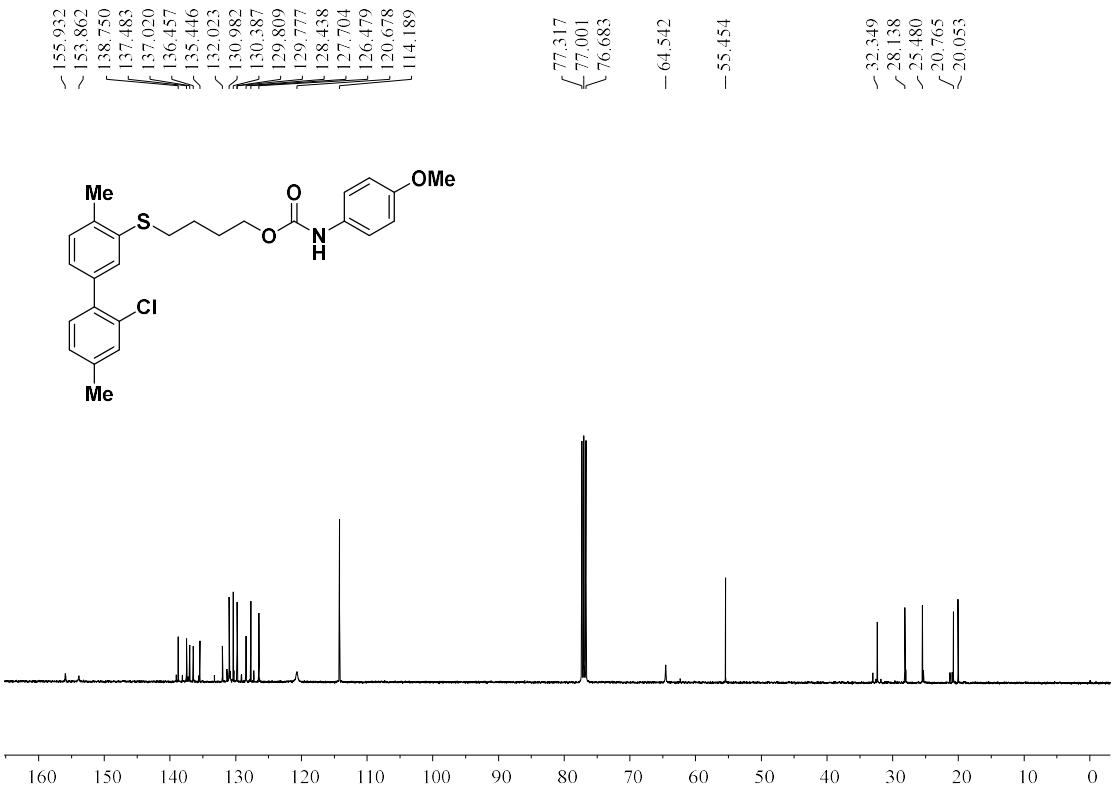
^{1}H NMR Spectrum of **35**



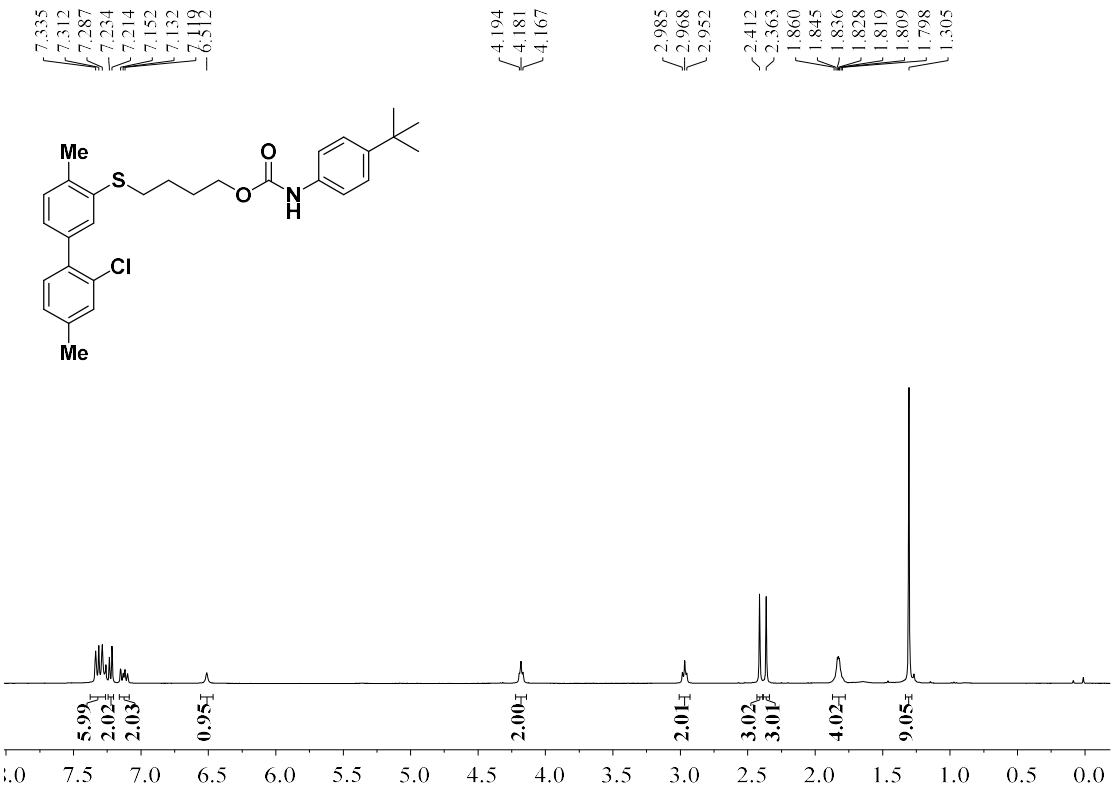
^{13}C NMR Spectrum of **35**



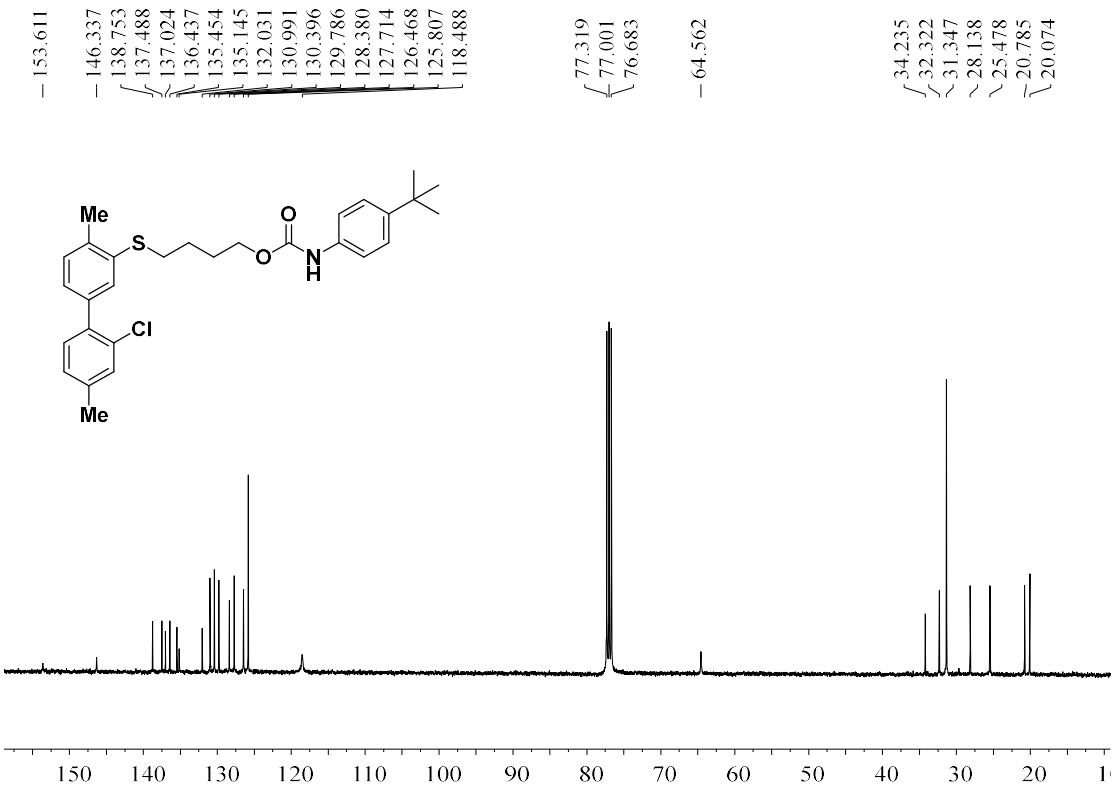
^{1}H NMR Spectrum of **36**



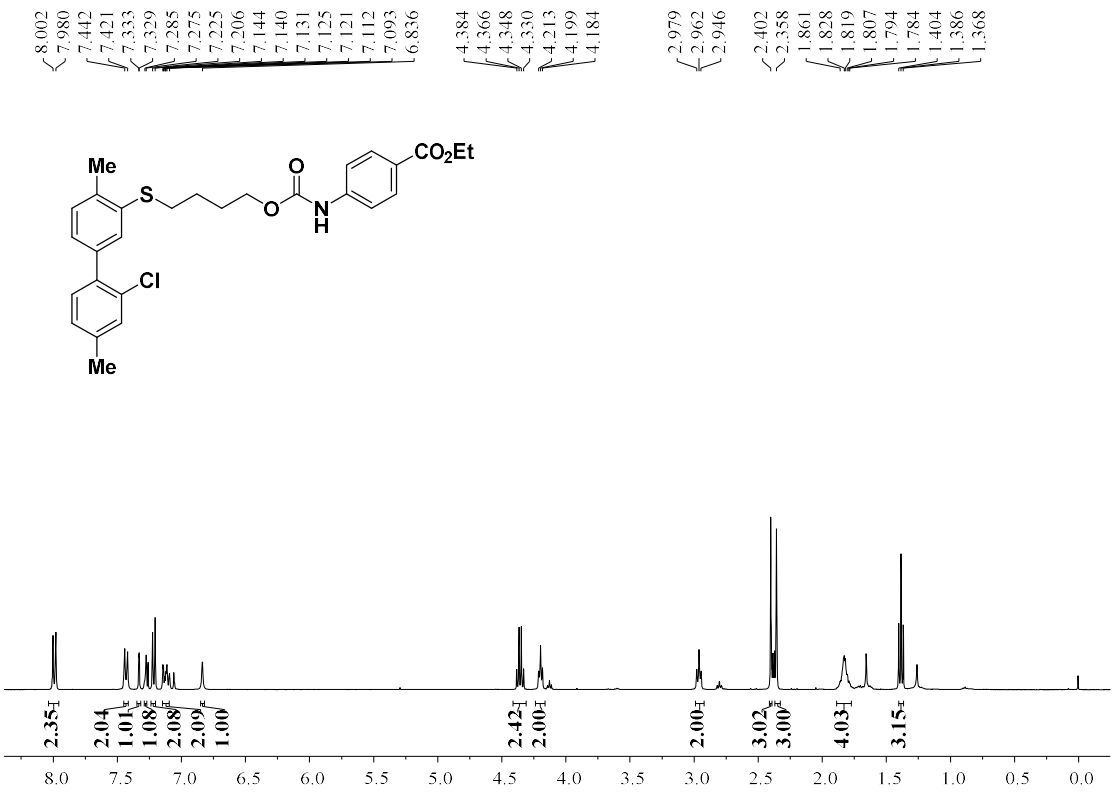
^{13}C NMR Spectrum of **36**



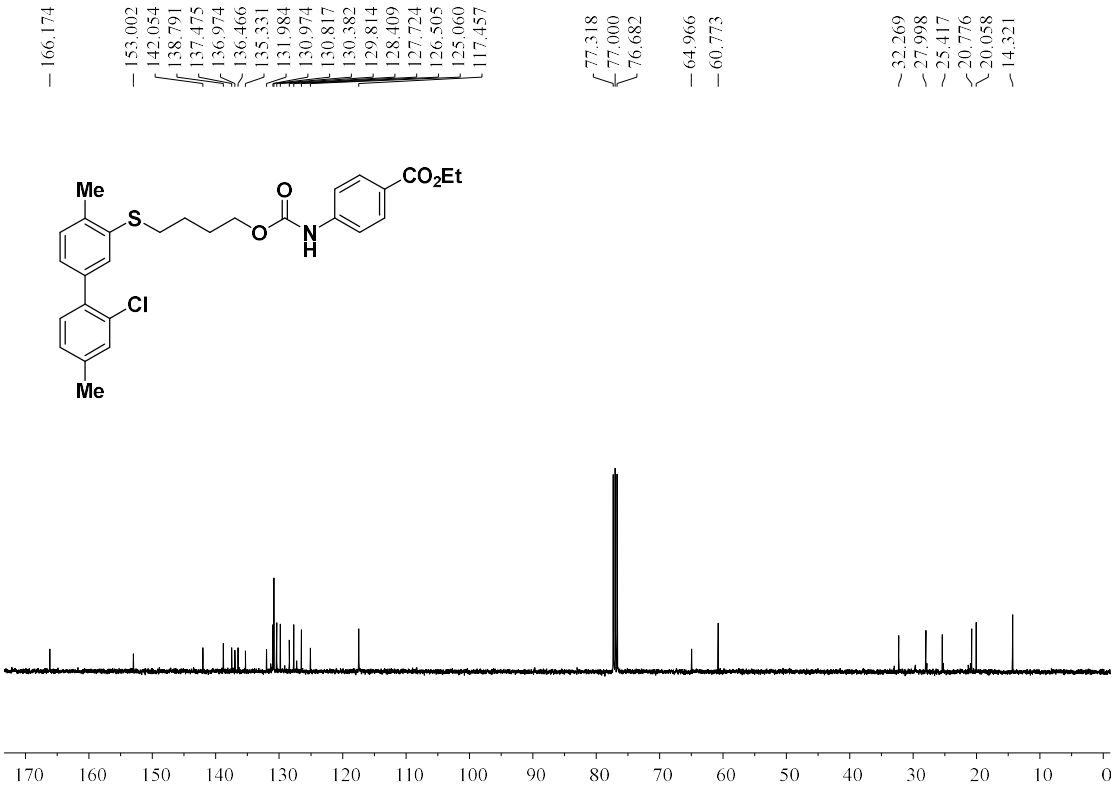
^{1}H NMR Spectrum of **37**



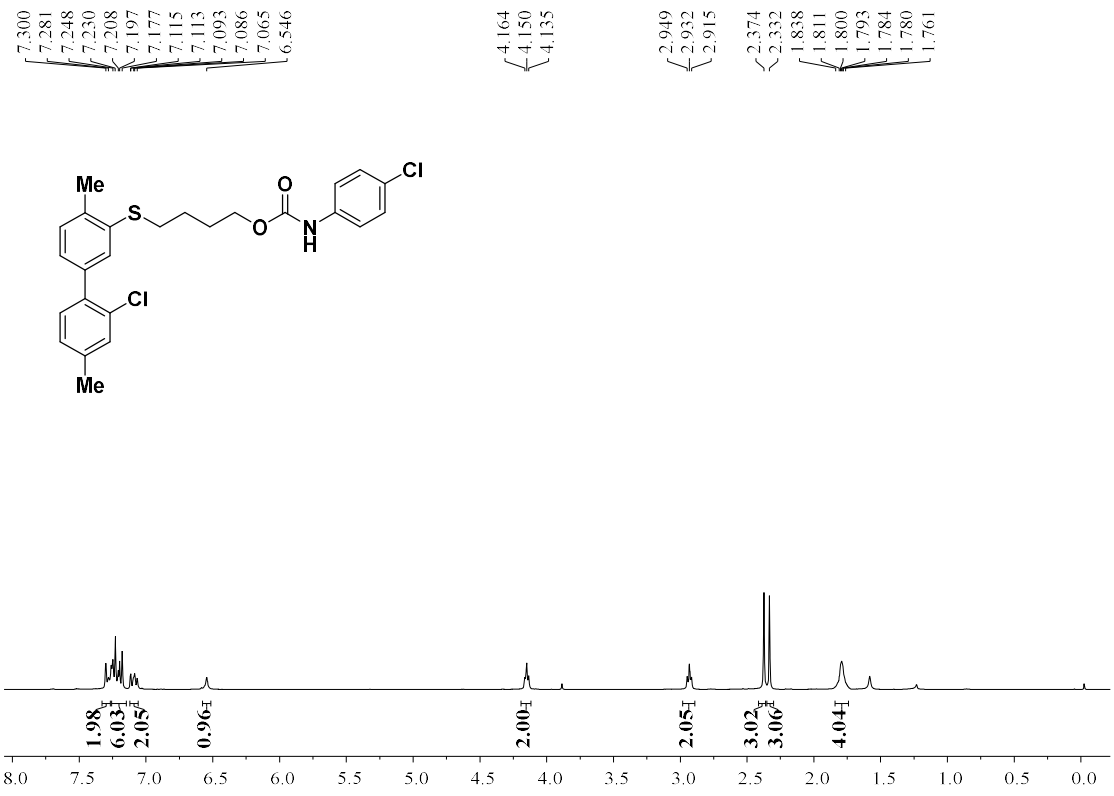
^{13}C NMR Spectrum of **37**



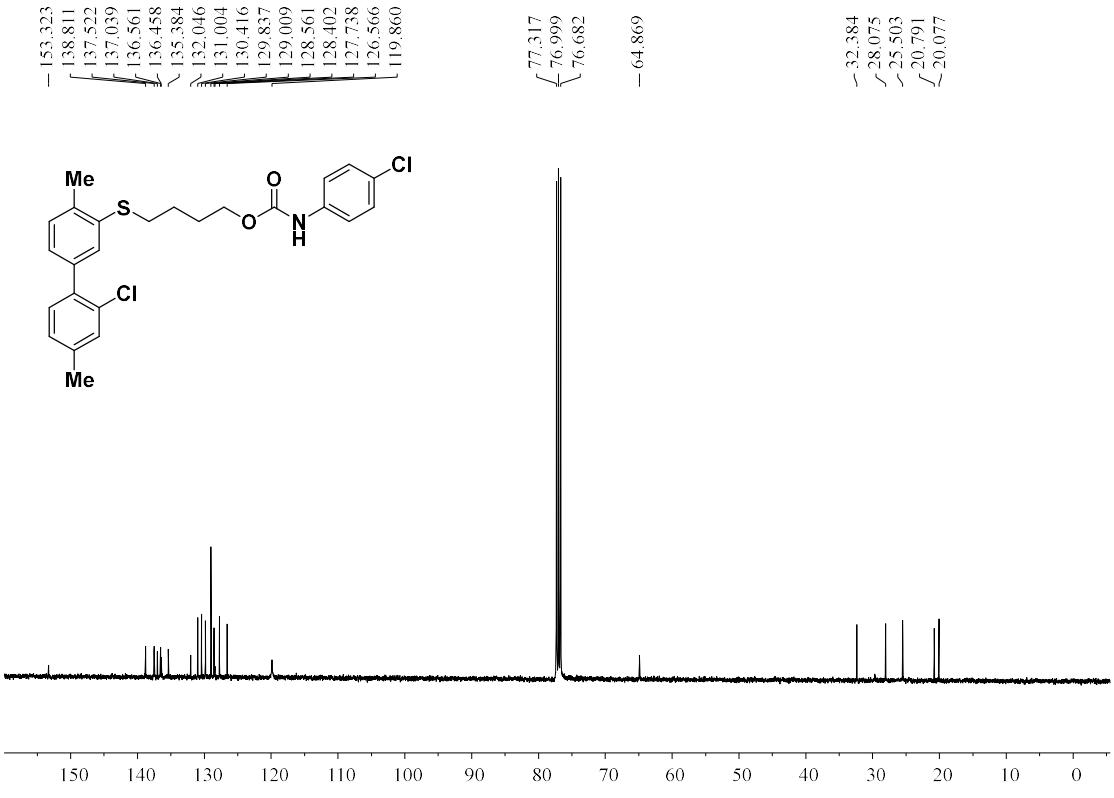
^{1}H NMR Spectrum of **38**



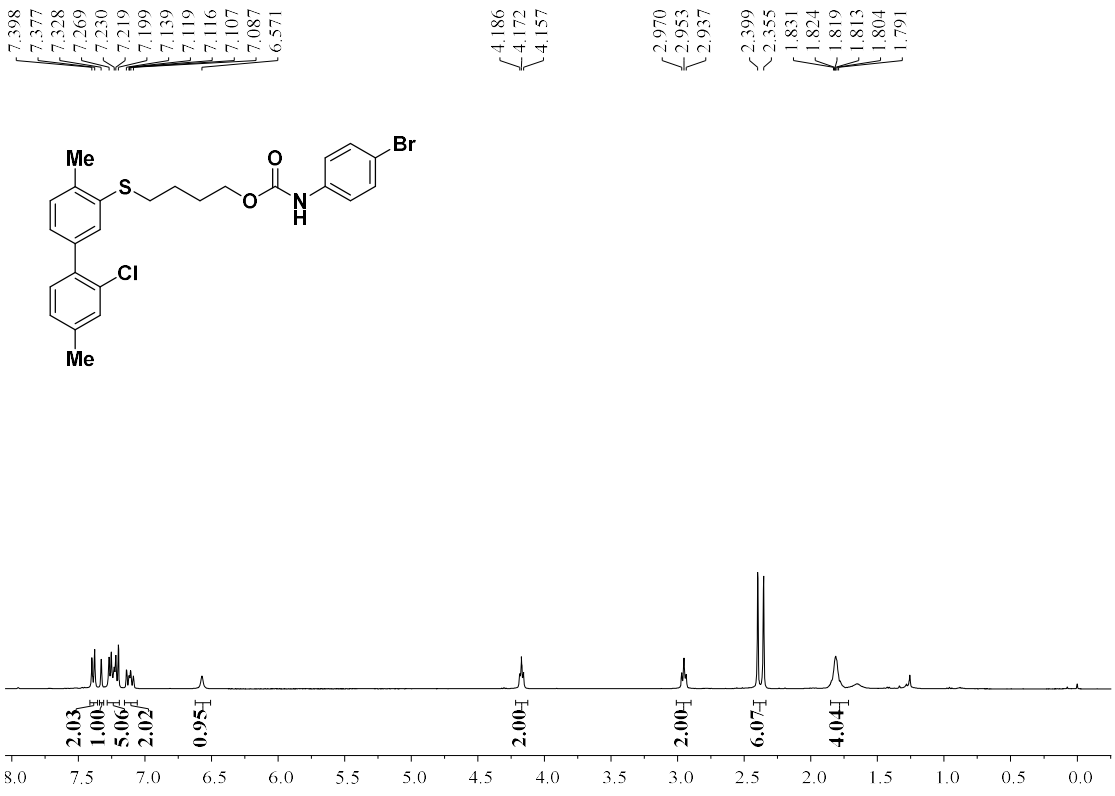
^{13}C NMR Spectrum of **38**



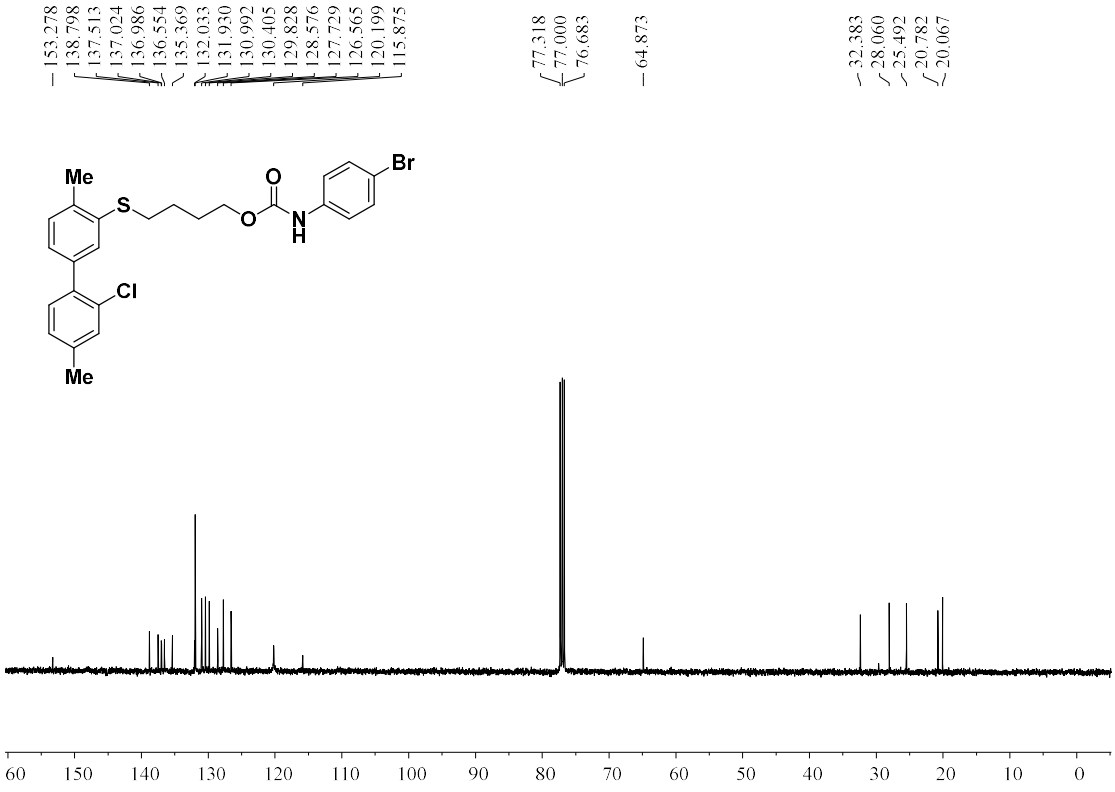
^{1}H NMR Spectrum of **39**



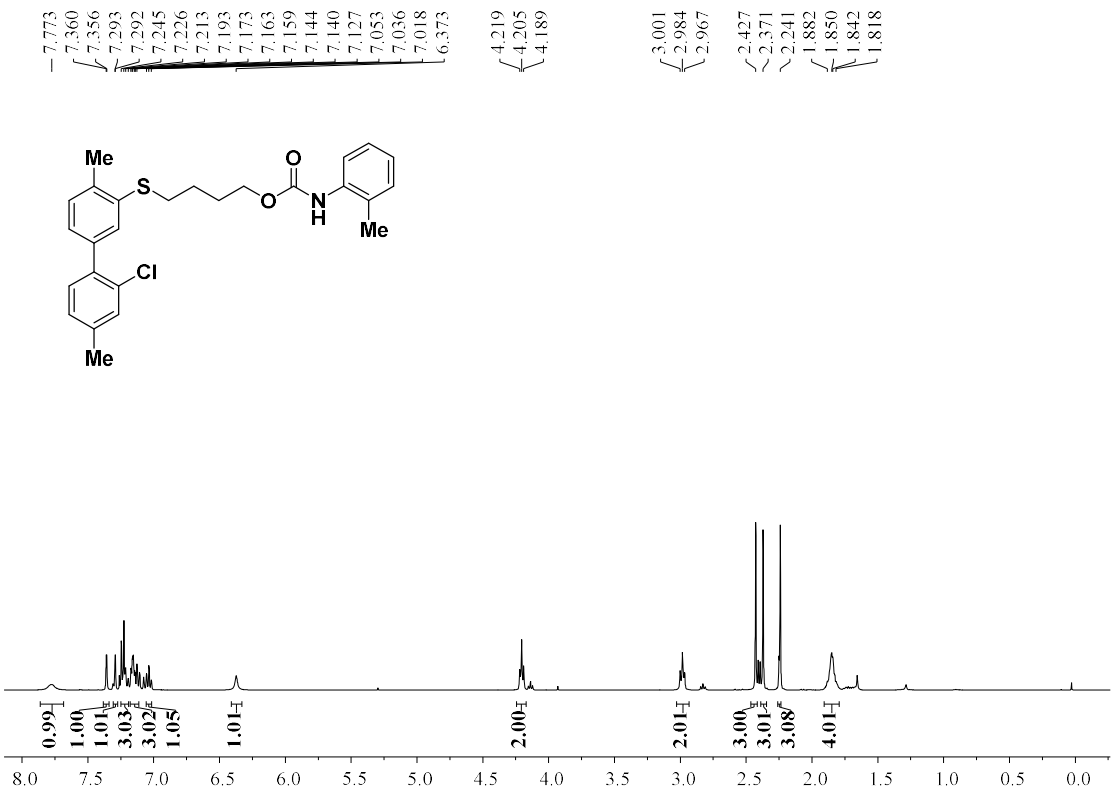
^{13}C NMR Spectrum of **39**



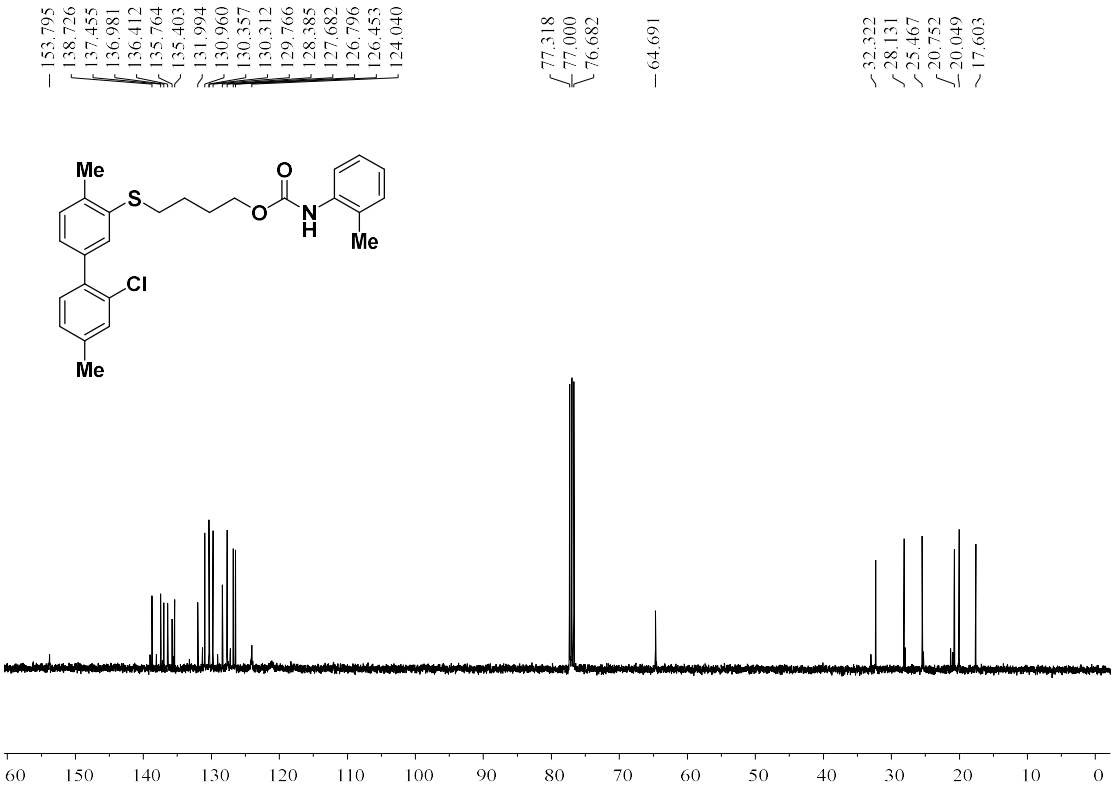
^{1}H NMR Spectrum of **40**



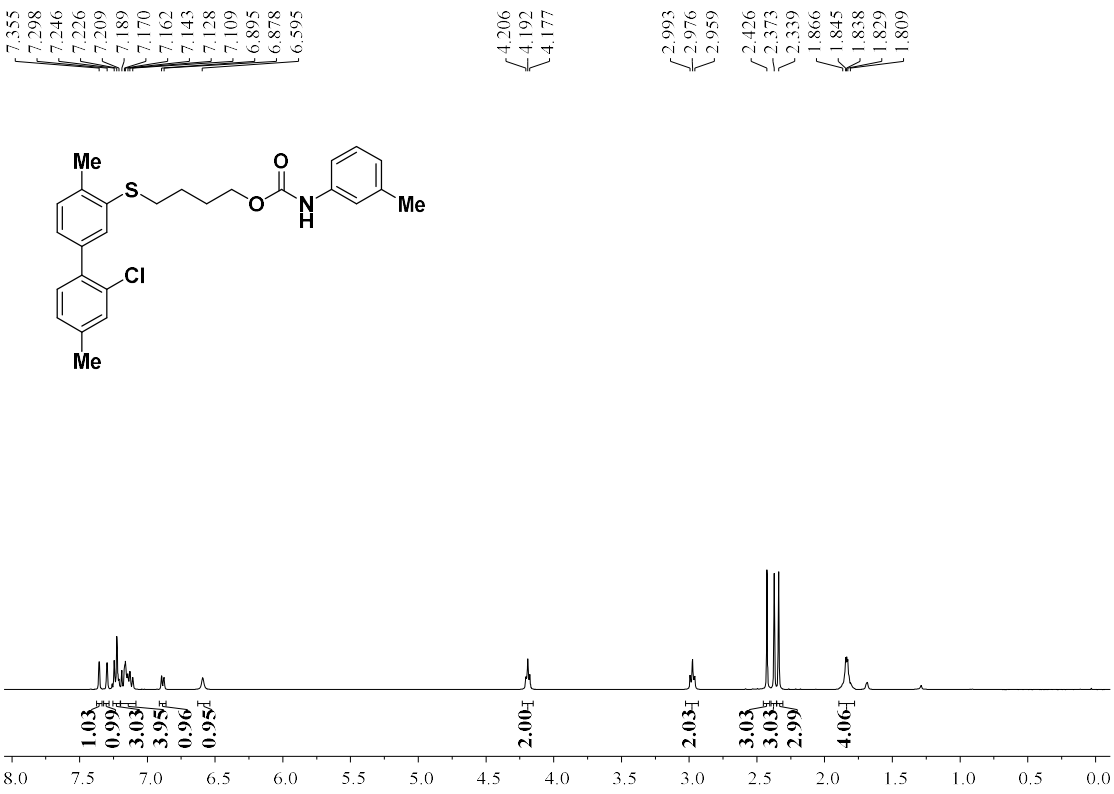
^{13}C NMR Spectrum of **40**



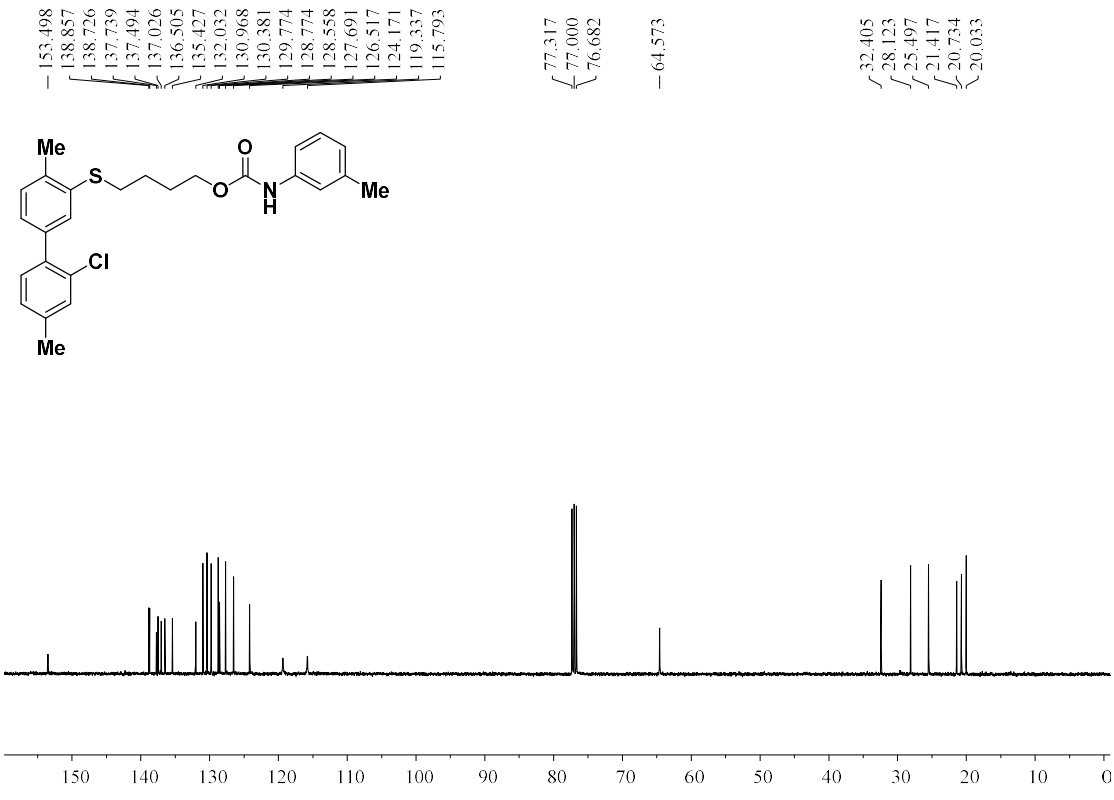
^{1}H NMR Spectrum of **41**



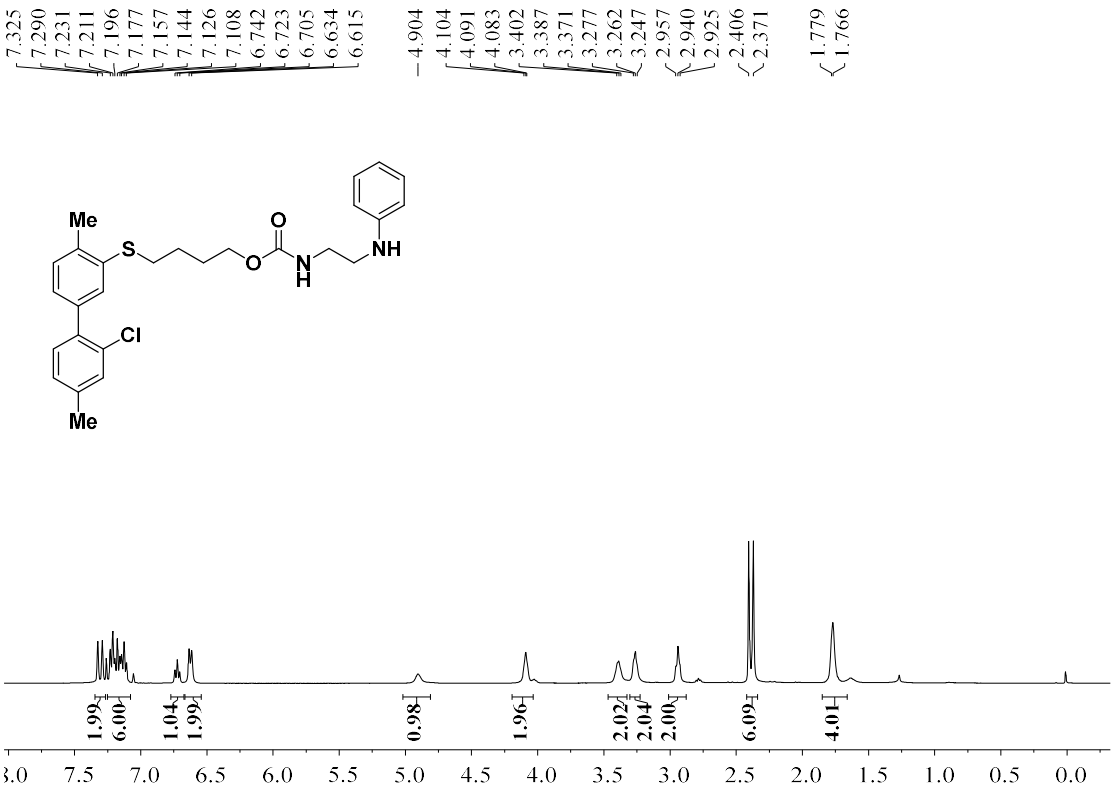
^{13}C NMR Spectrum of **41**



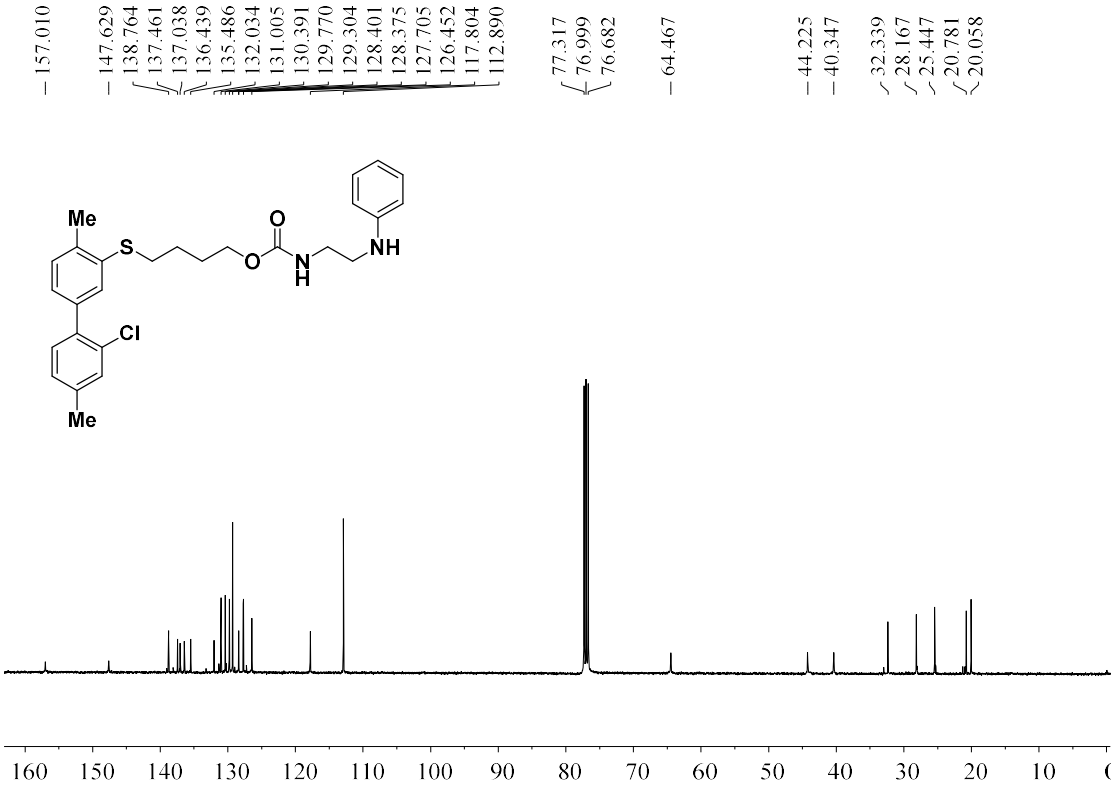
^{1}H NMR Spectrum of **42**



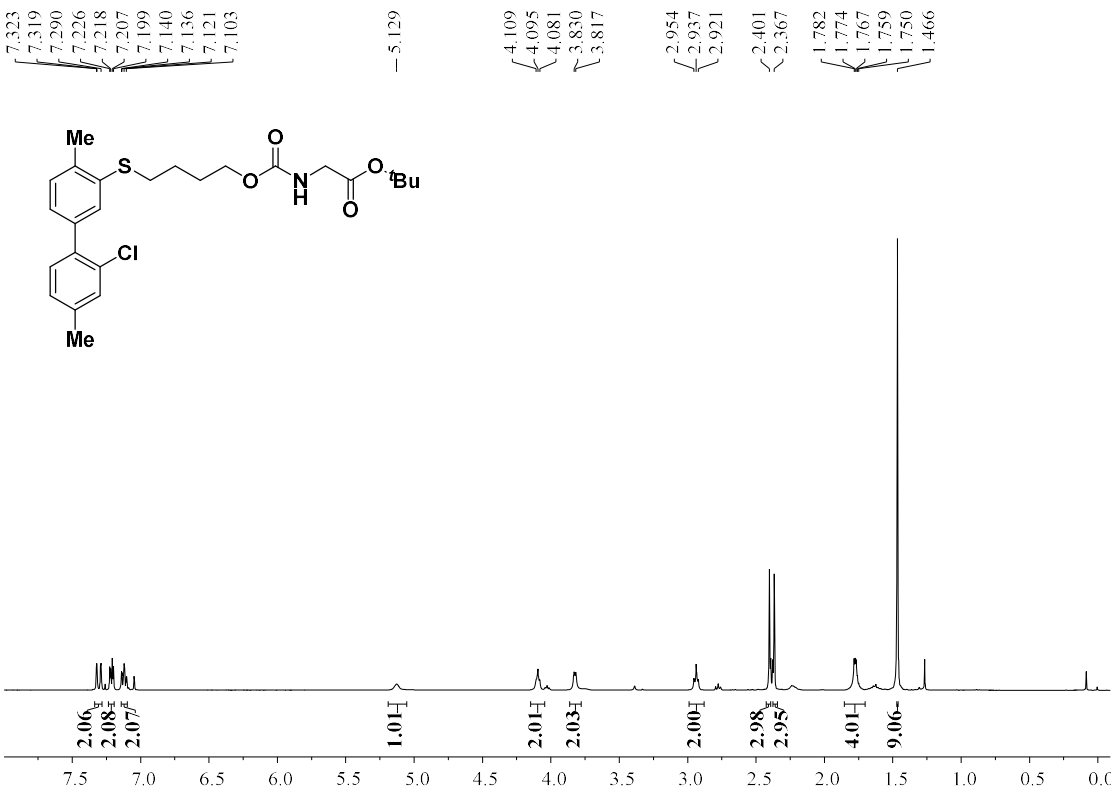
^{13}C NMR Spectrum of **42**



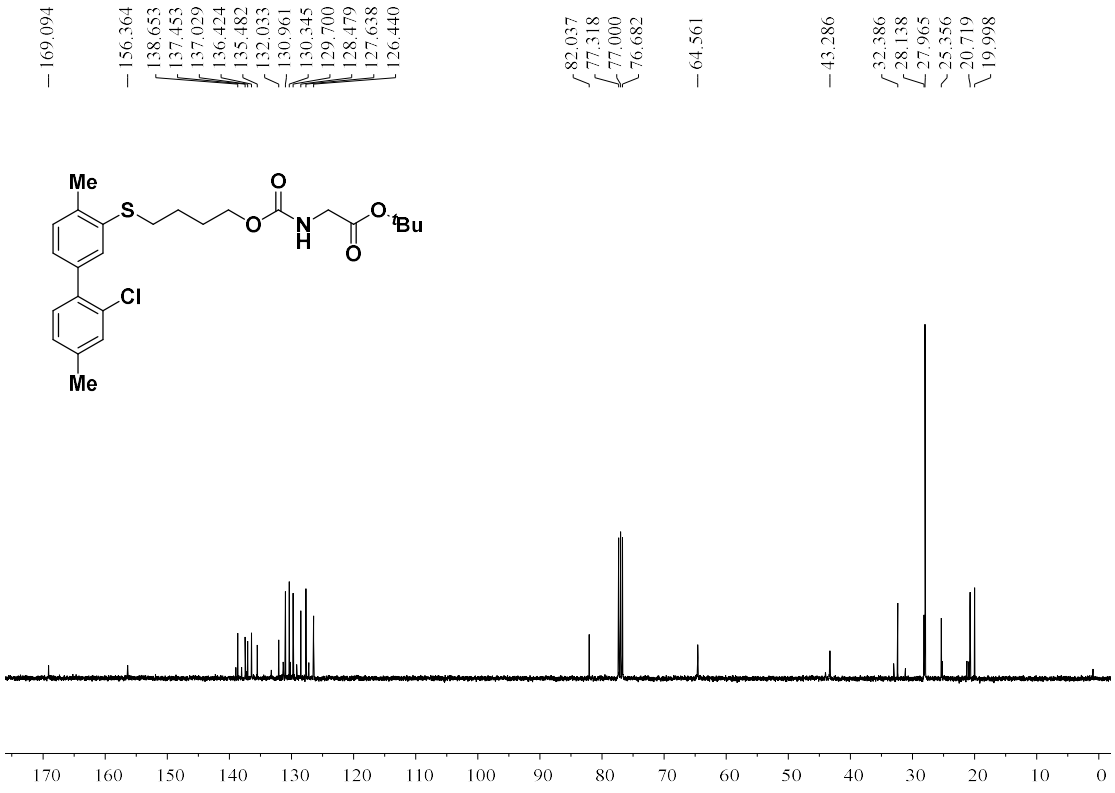
^{1}H NMR Spectrum of **43**



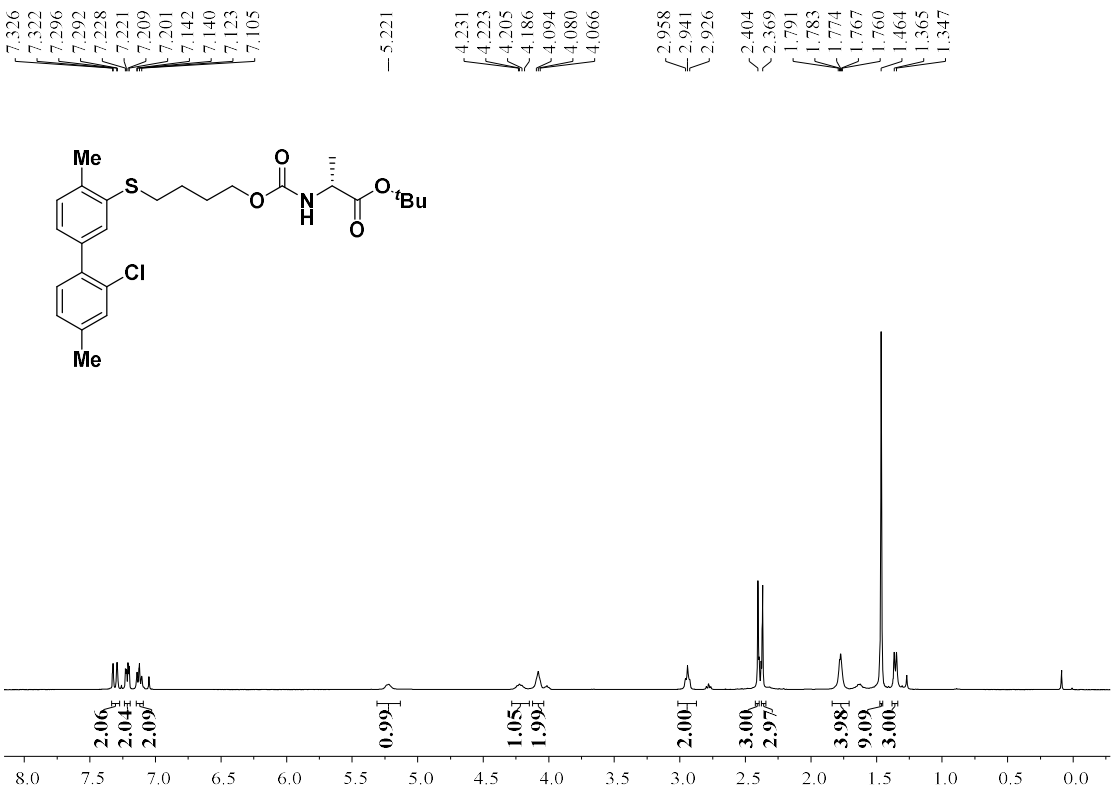
^{13}C NMR Spectrum of **43**



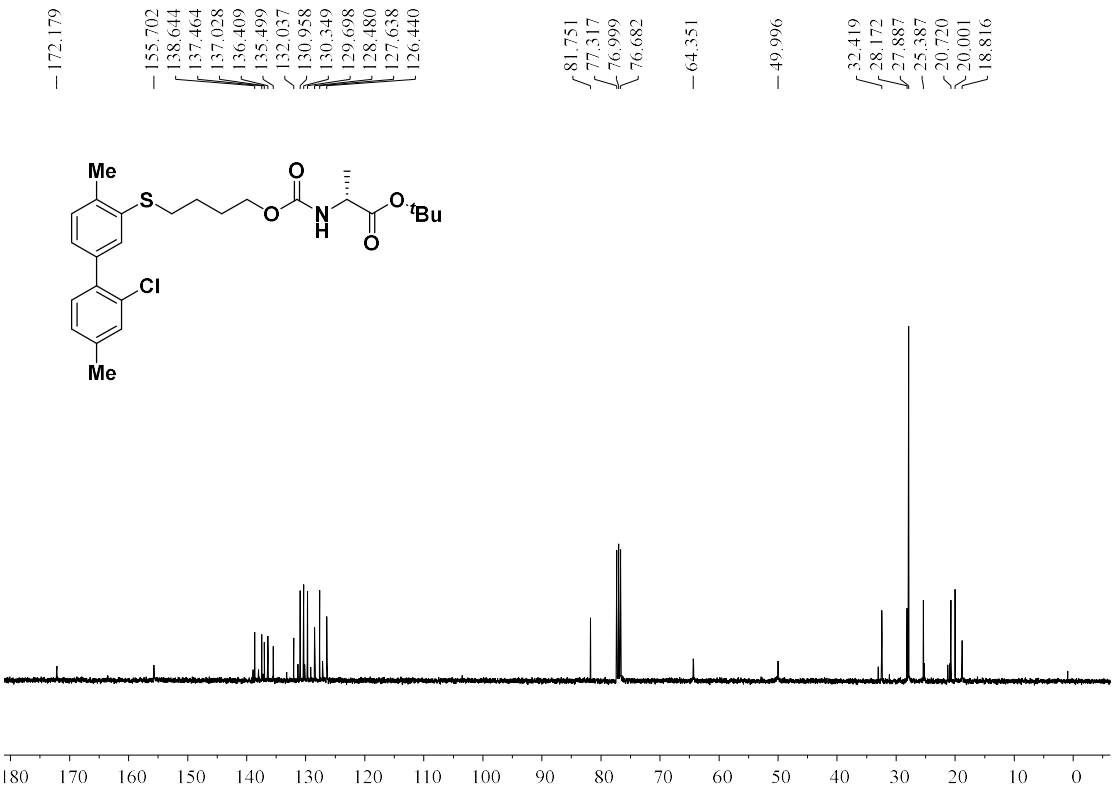
^{1}H NMR Spectrum of **44**



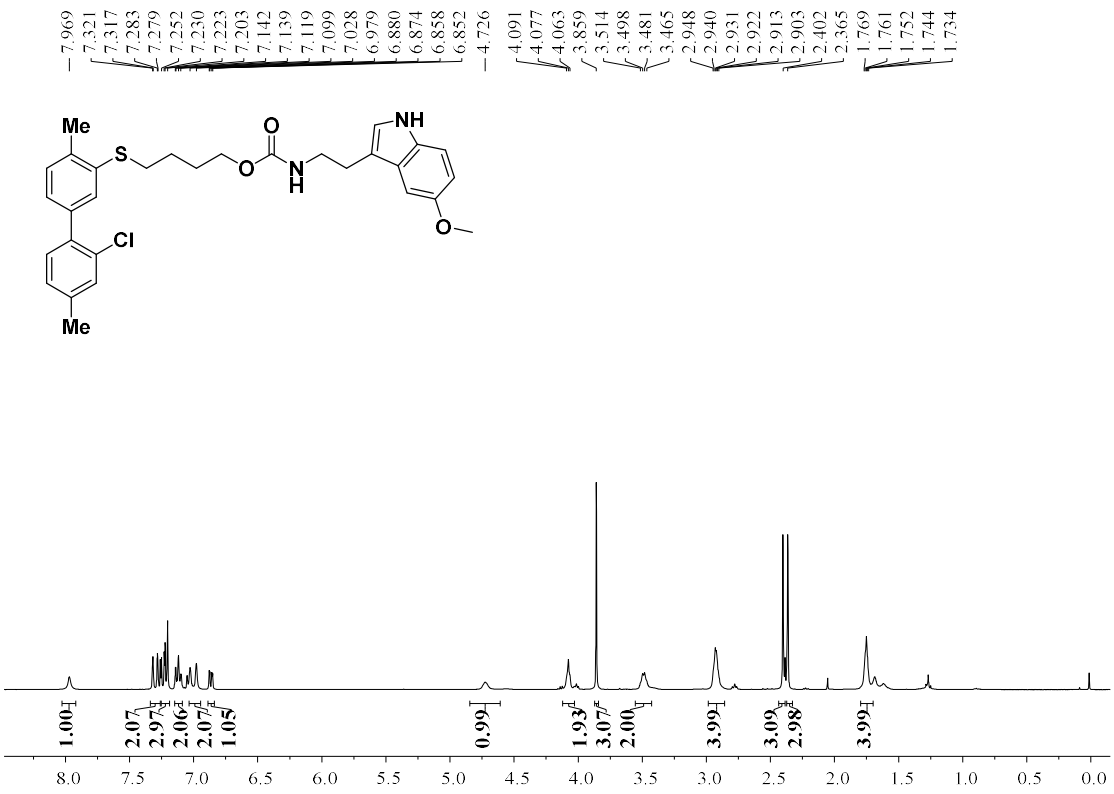
^{13}C NMR Spectrum of **44**



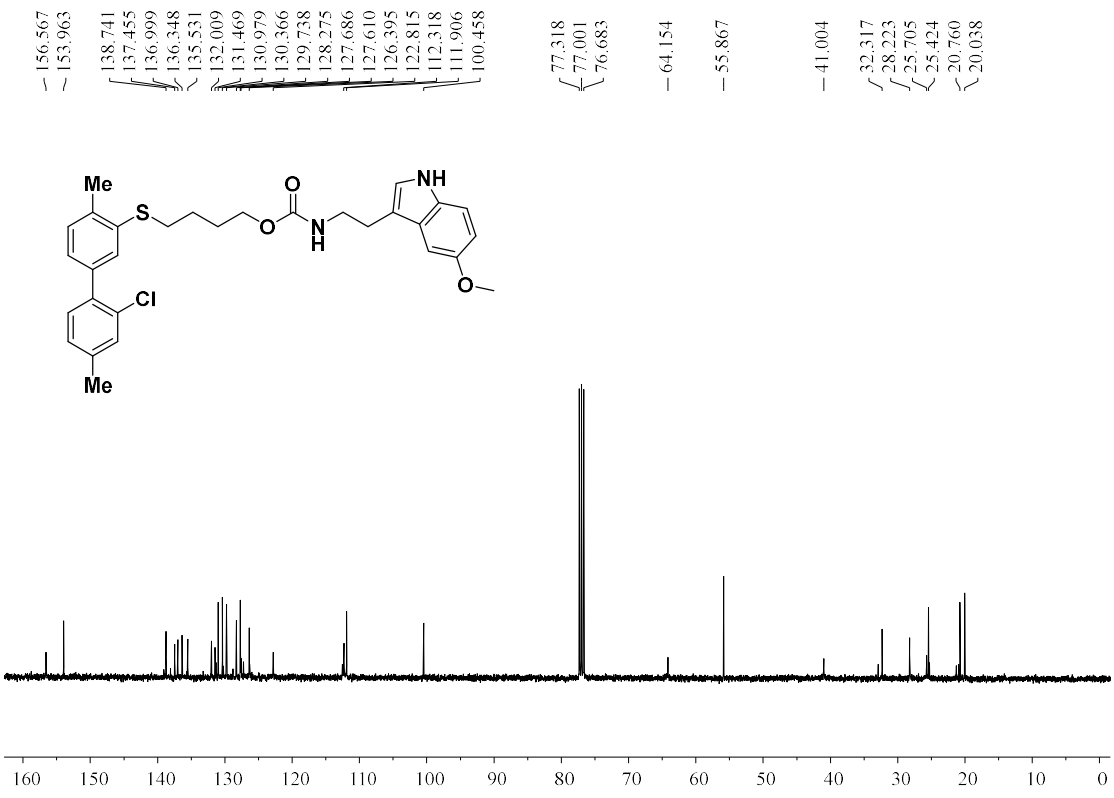
^{1}H NMR Spectrum of **45**



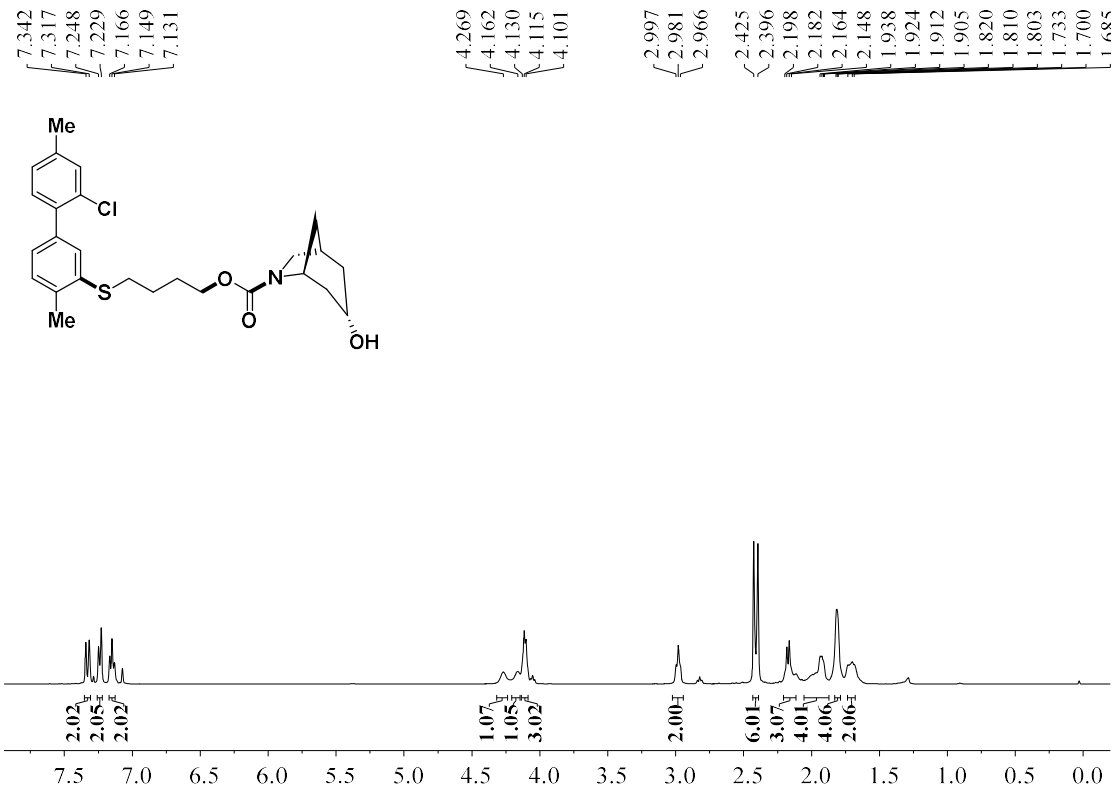
^{13}C NMR Spectrum of **45**



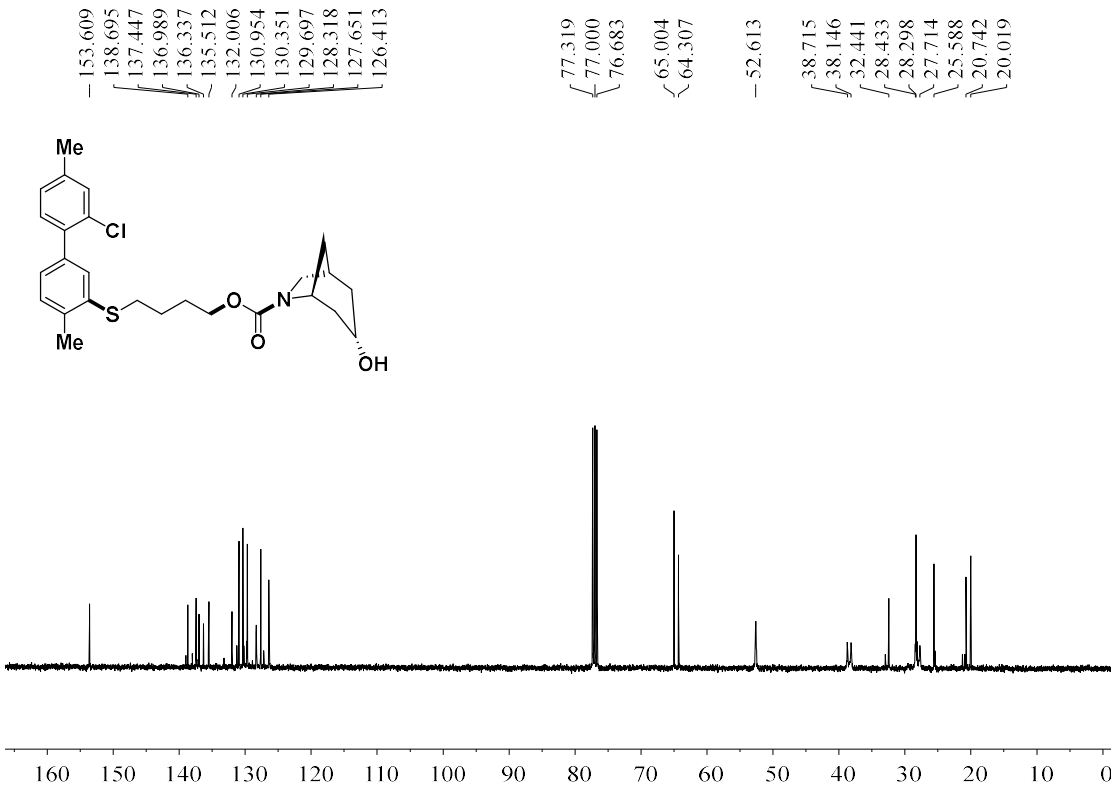
^{1}H NMR Spectrum of **46**



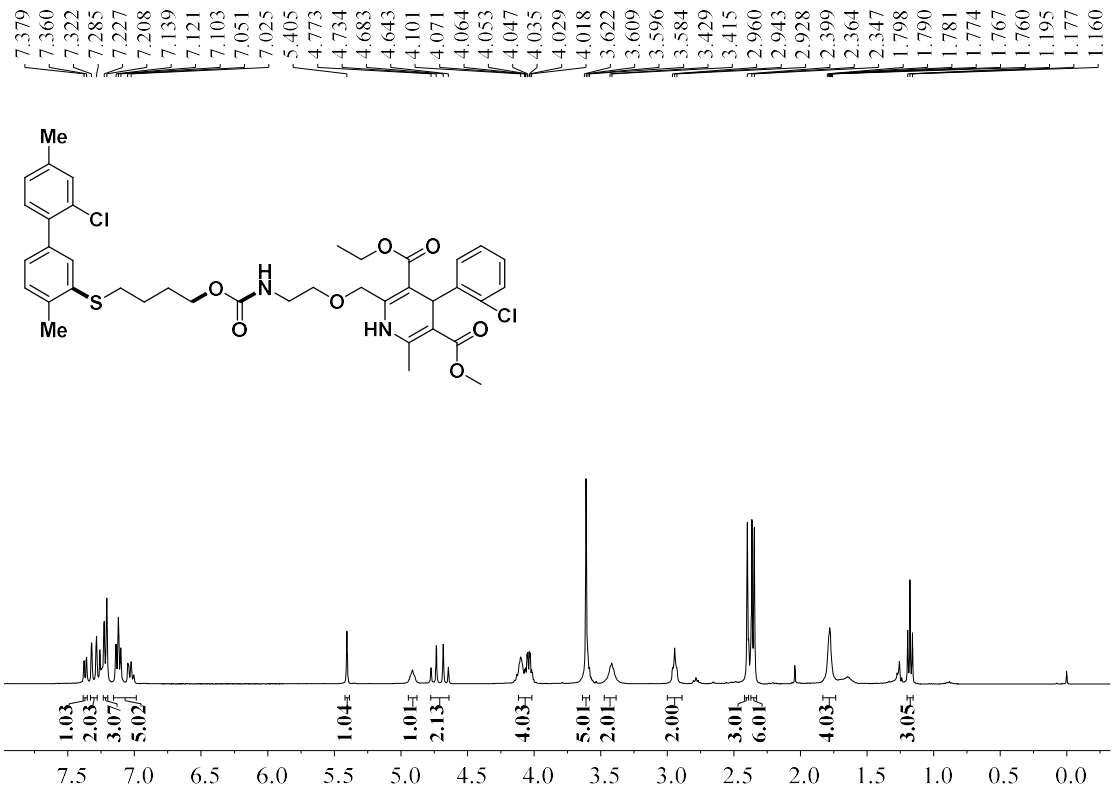
^{13}C NMR Spectrum of **46**



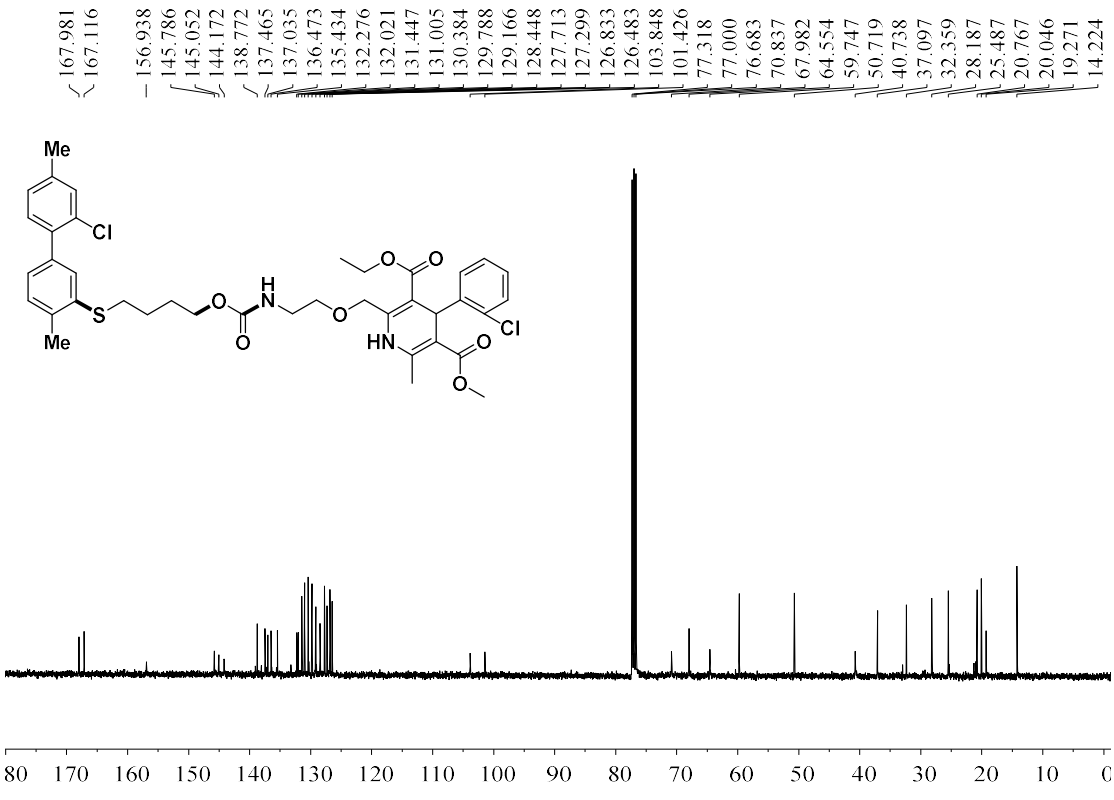
^{1}H NMR Spectrum of **47**



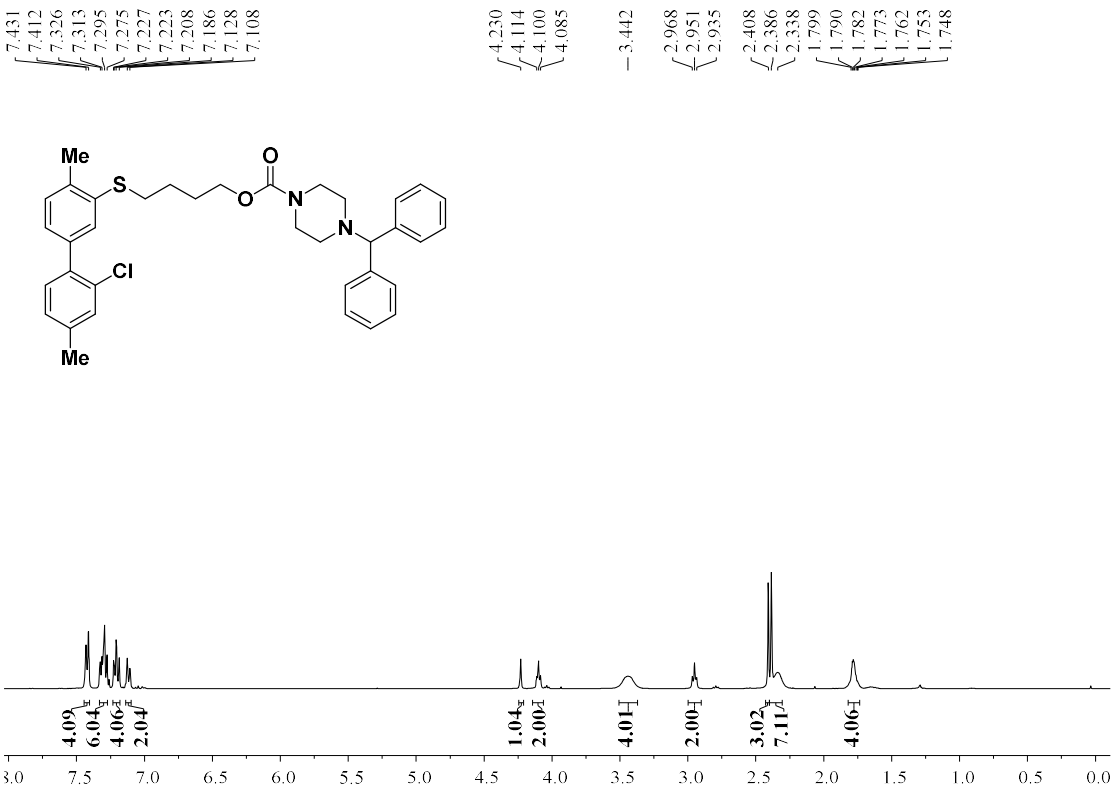
^{13}C NMR Spectrum of **47**



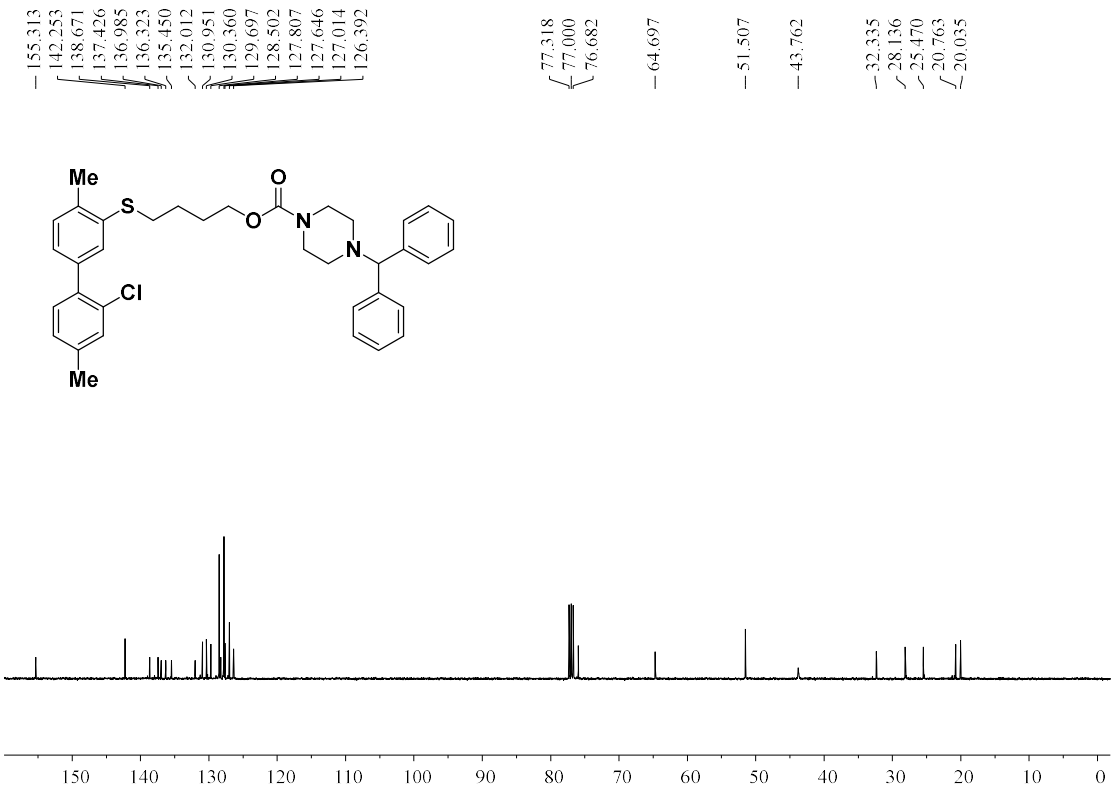
^{1}H NMR Spectrum of **48**



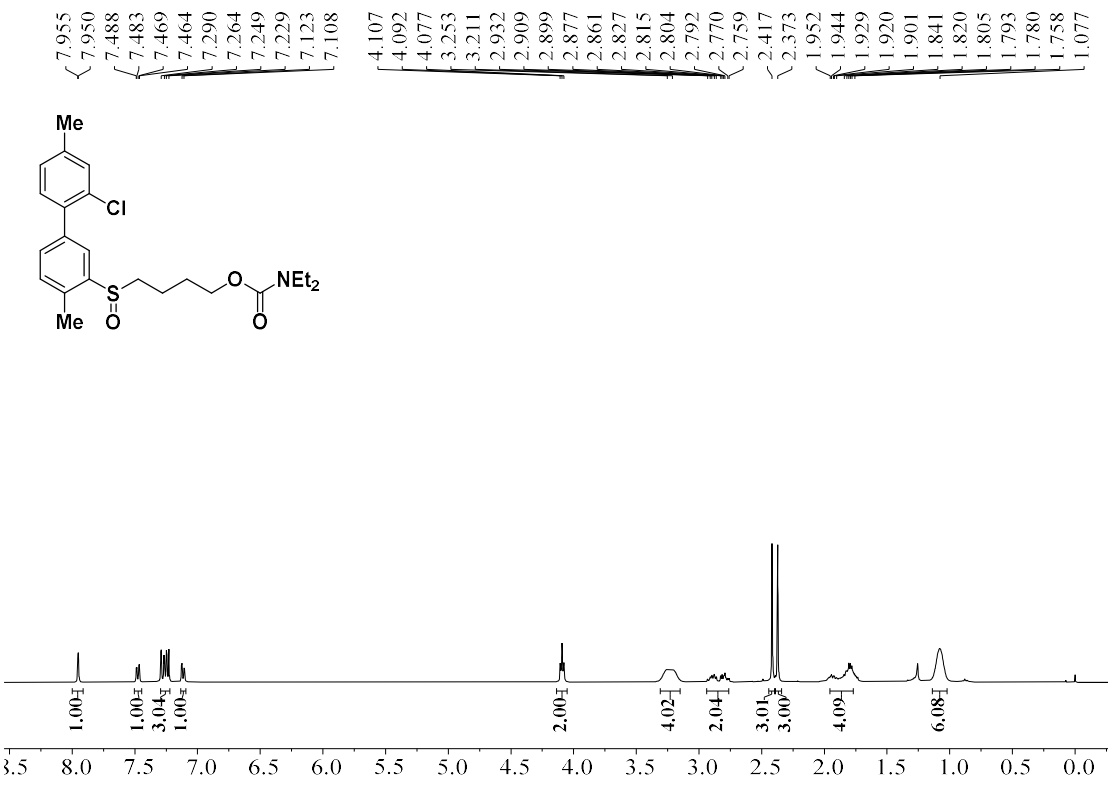
^{13}C NMR Spectrum of **48**



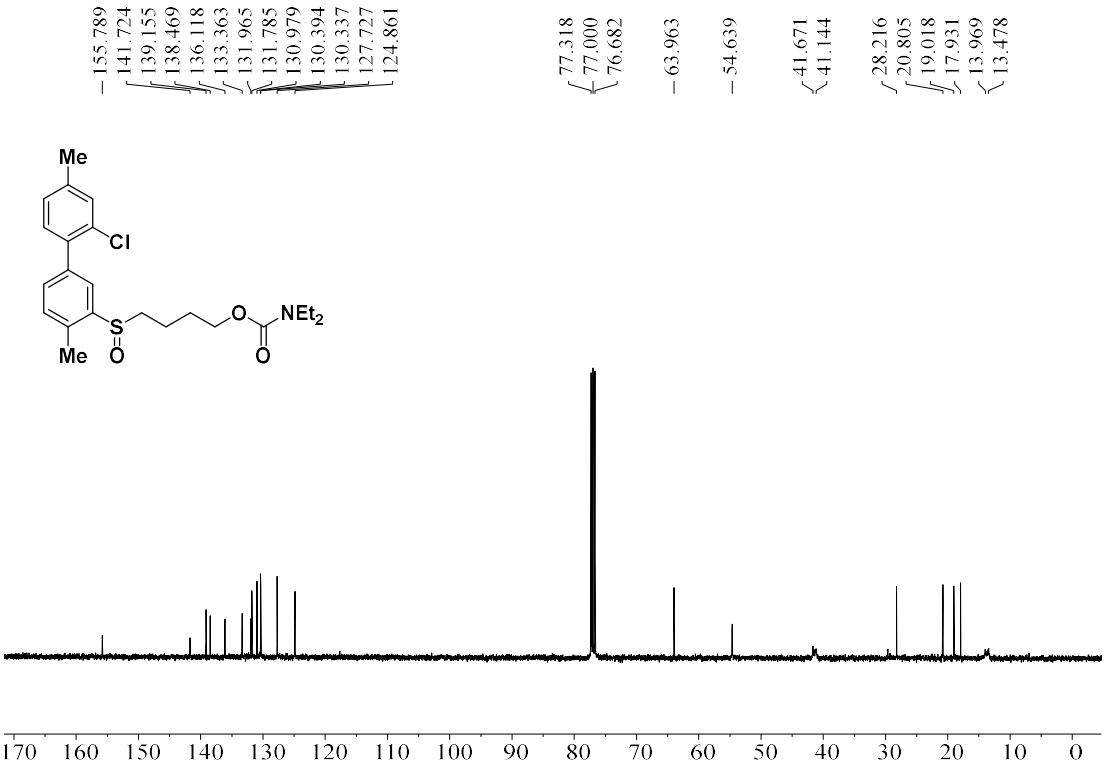
^{1}H NMR Spectrum of **49**



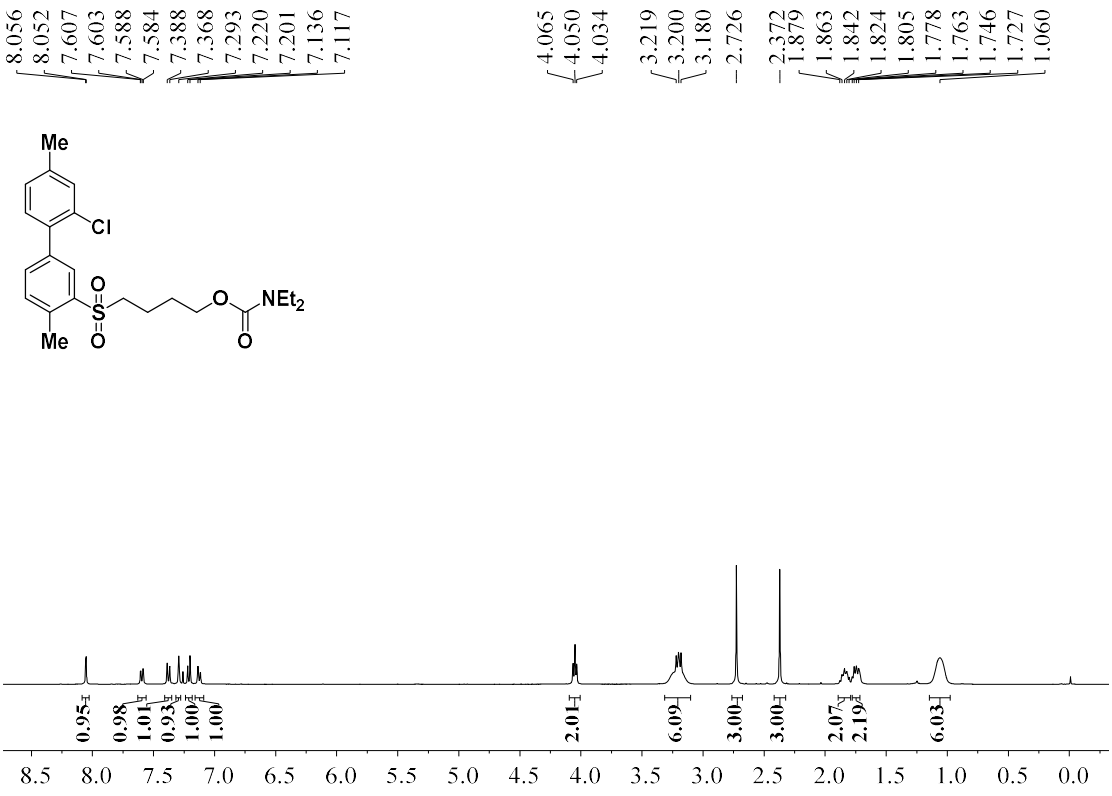
^{13}C NMR Spectrum of **49**



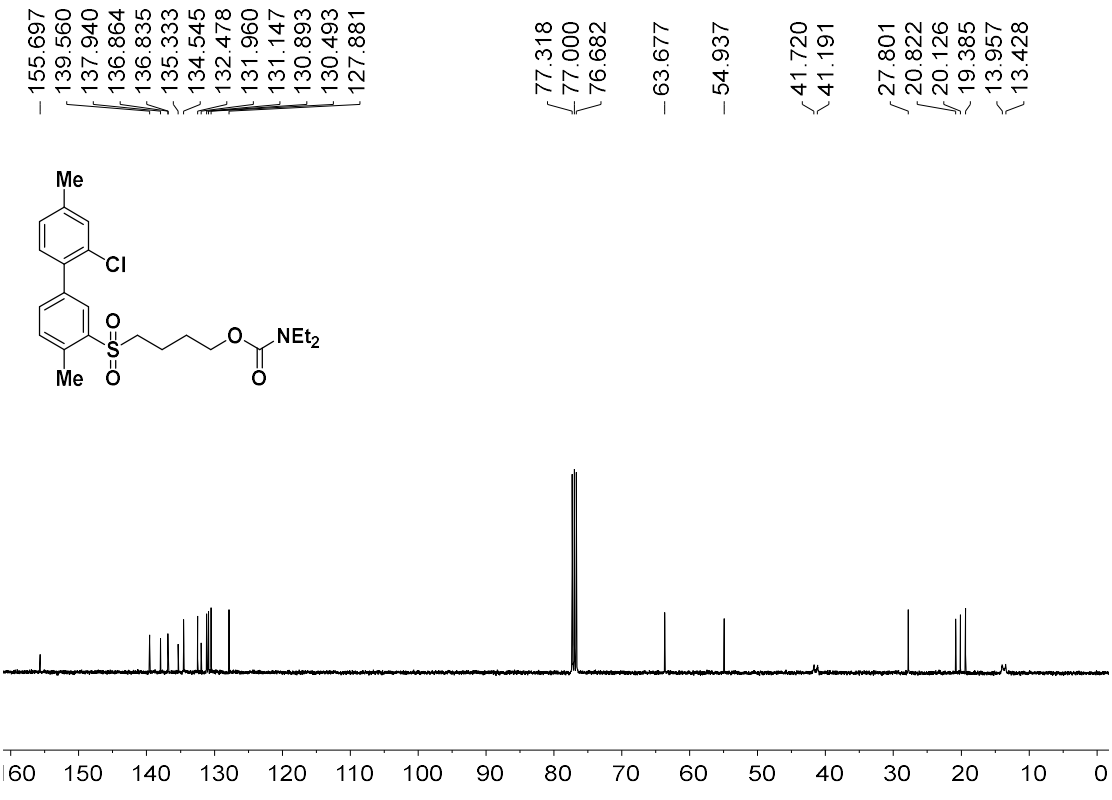
^{1}H NMR Spectrum of **50**



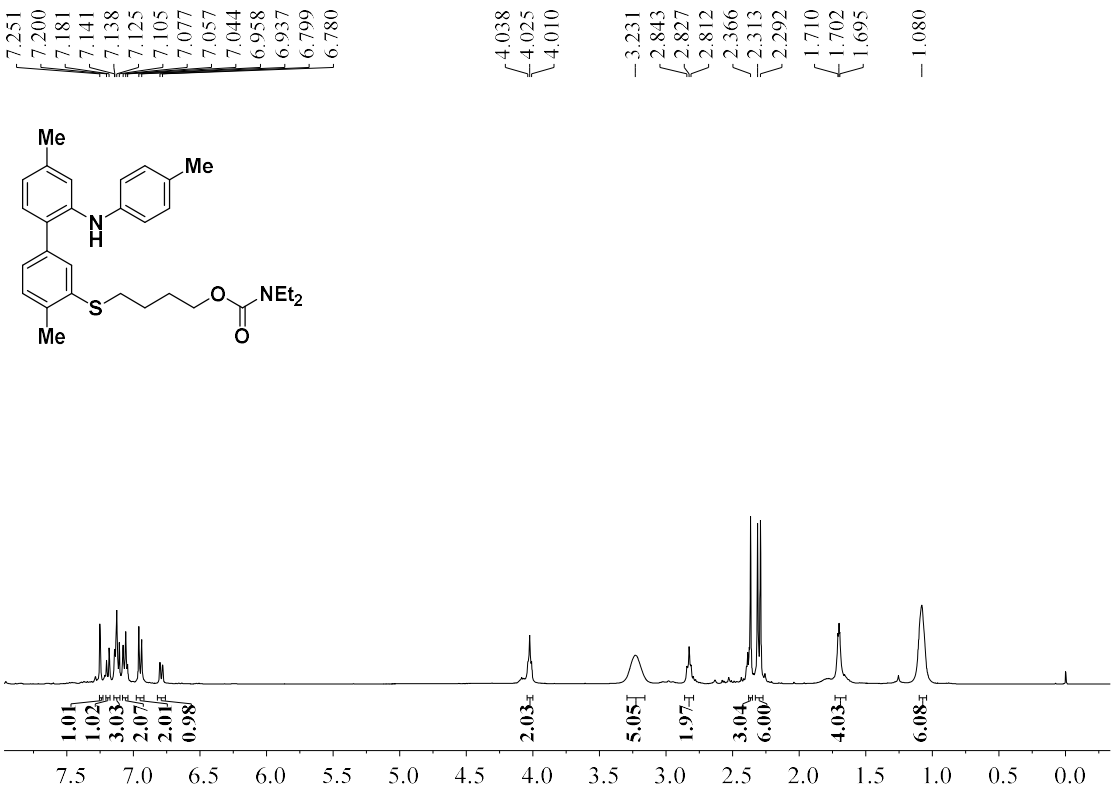
^{13}C NMR Spectrum of **50**



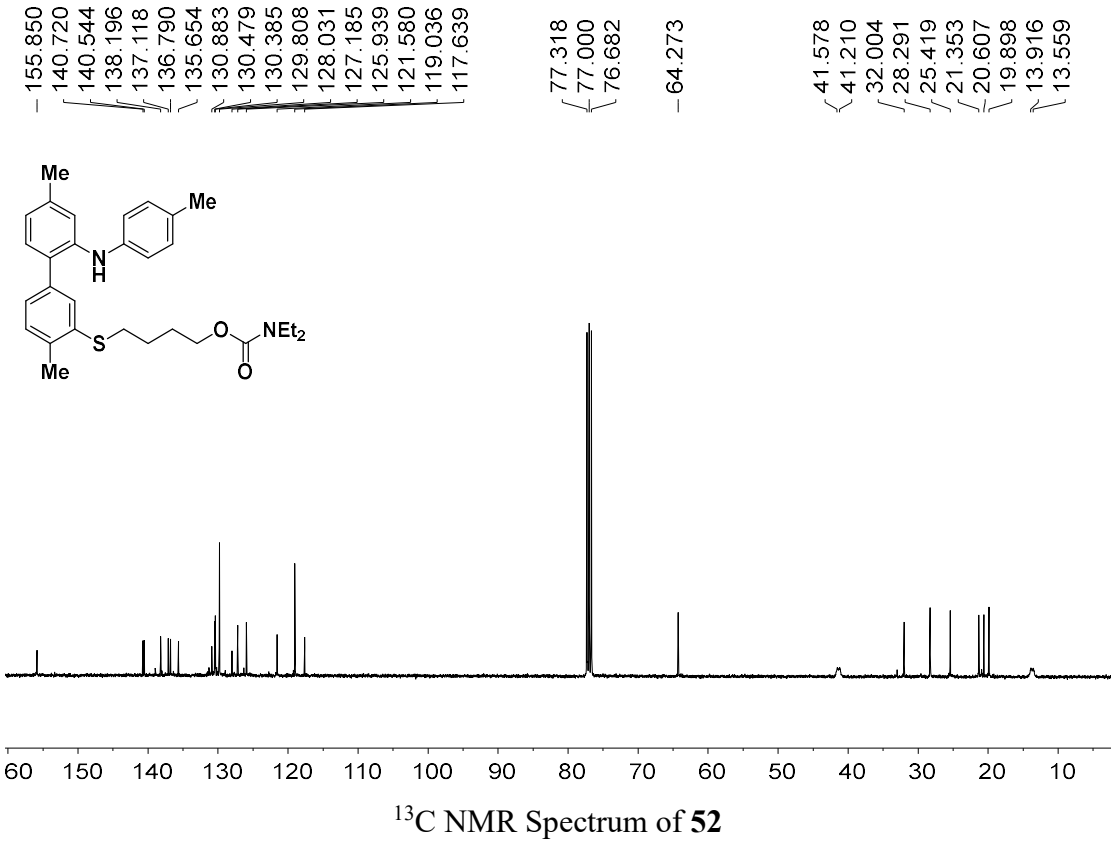
^{1}H NMR Spectrum of **51**



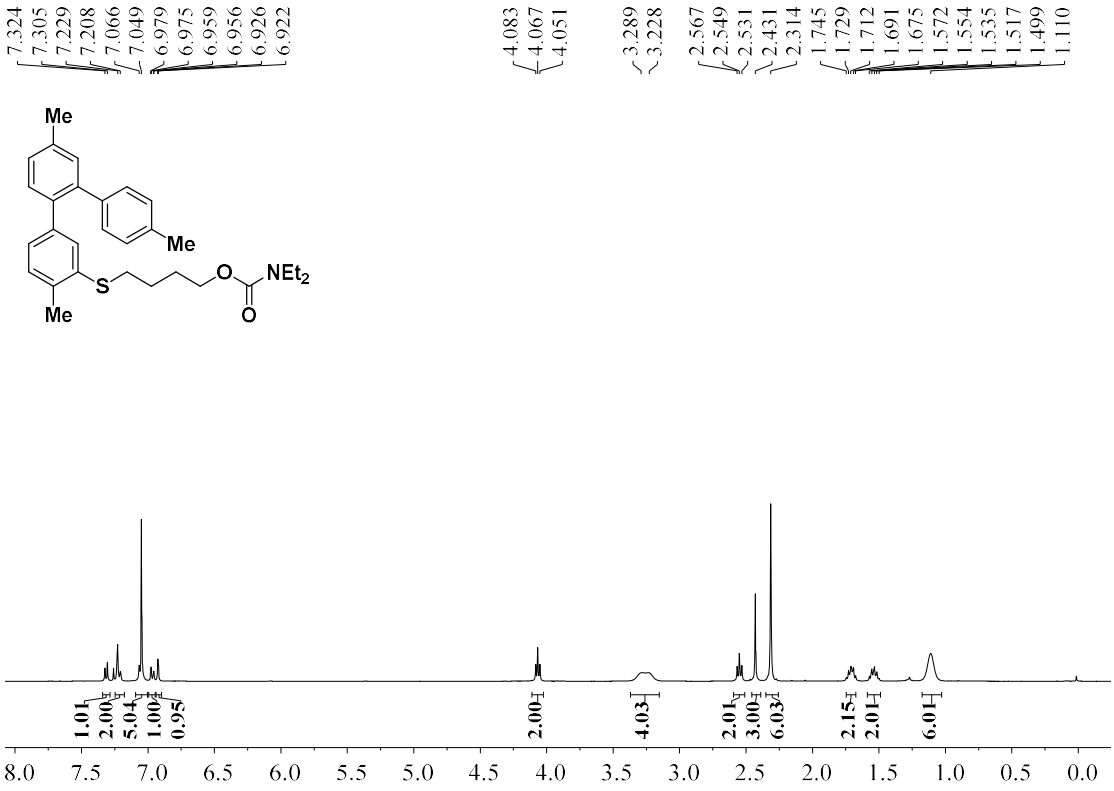
^{13}C NMR Spectrum of **51**



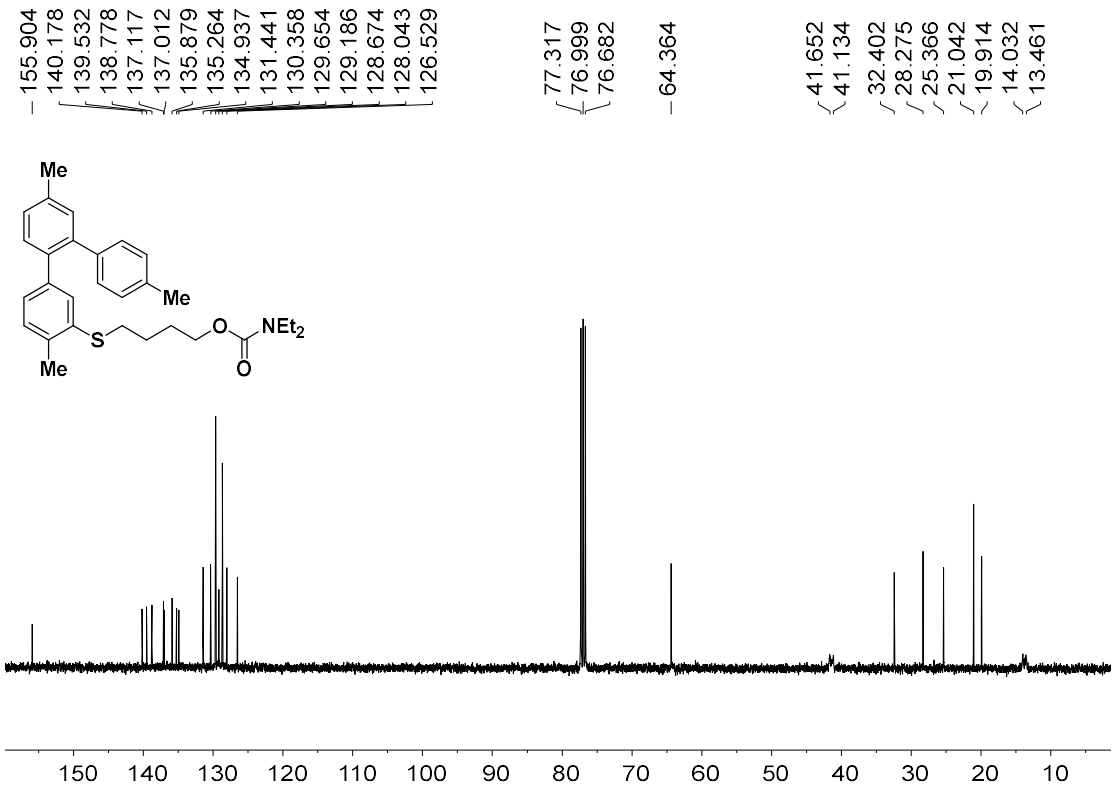
^{1}H NMR Spectrum of **52**



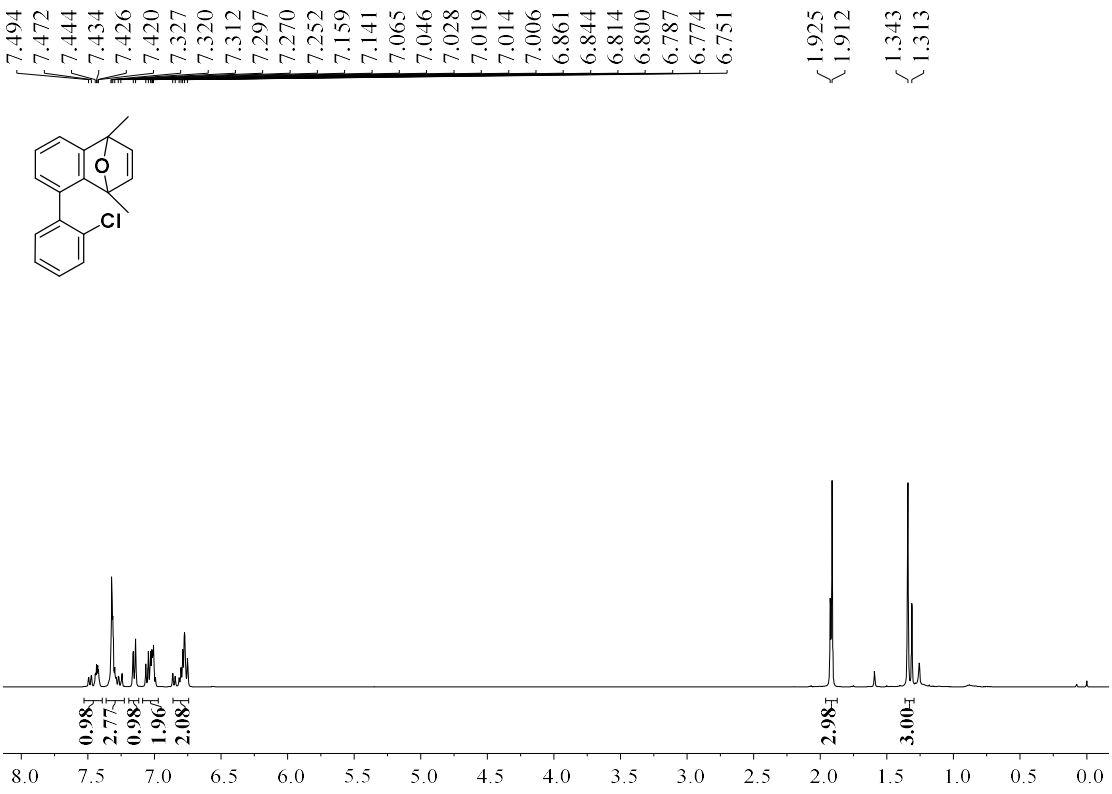
^{13}C NMR Spectrum of **52**



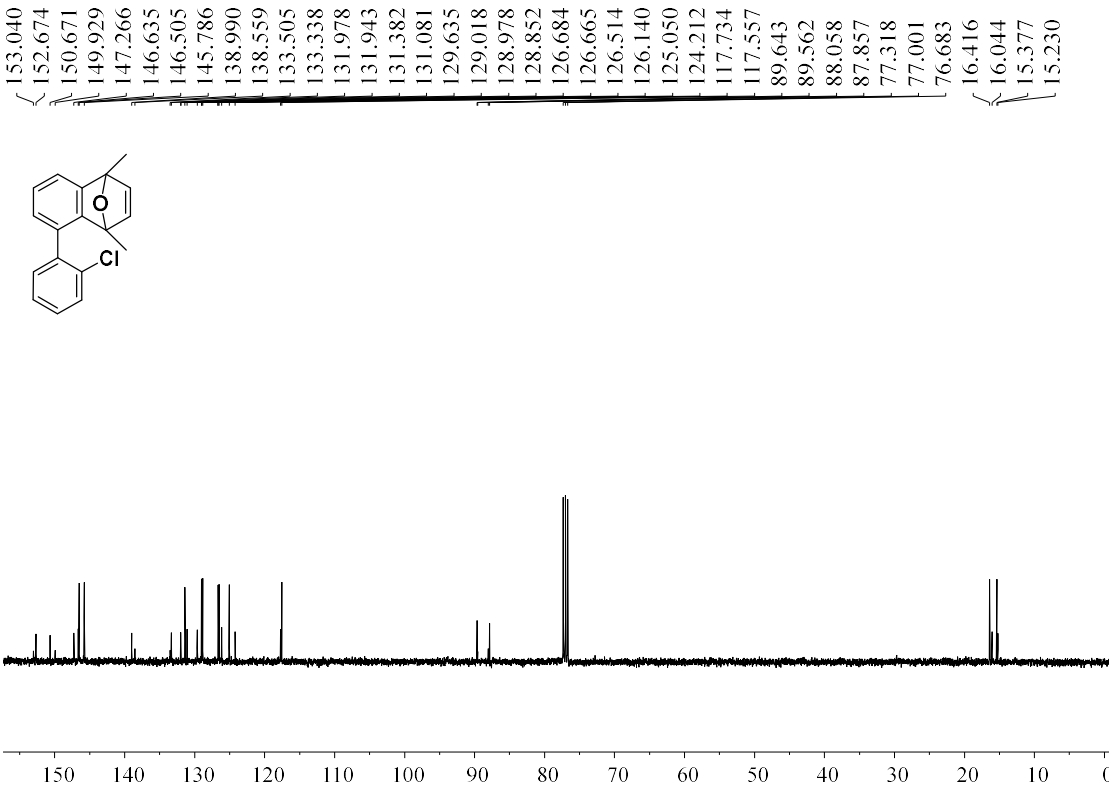
^{1}H NMR Spectrum of **53**



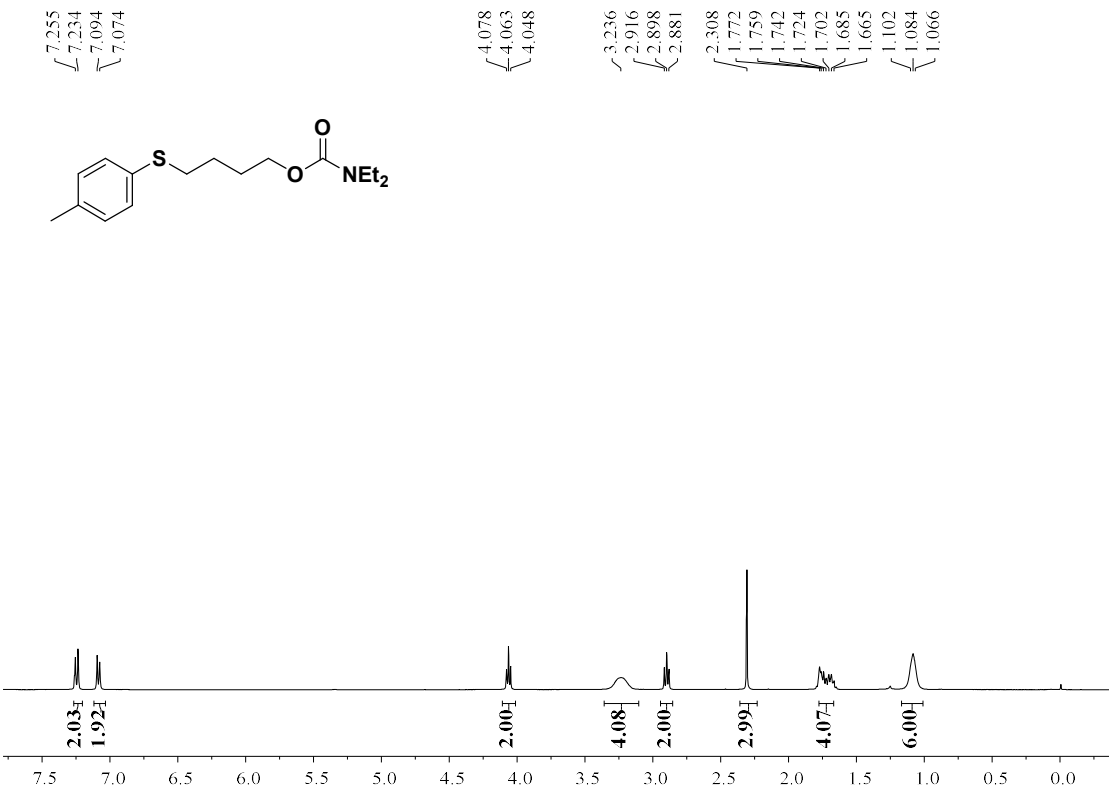
^{13}C NMR Spectrum of **53**



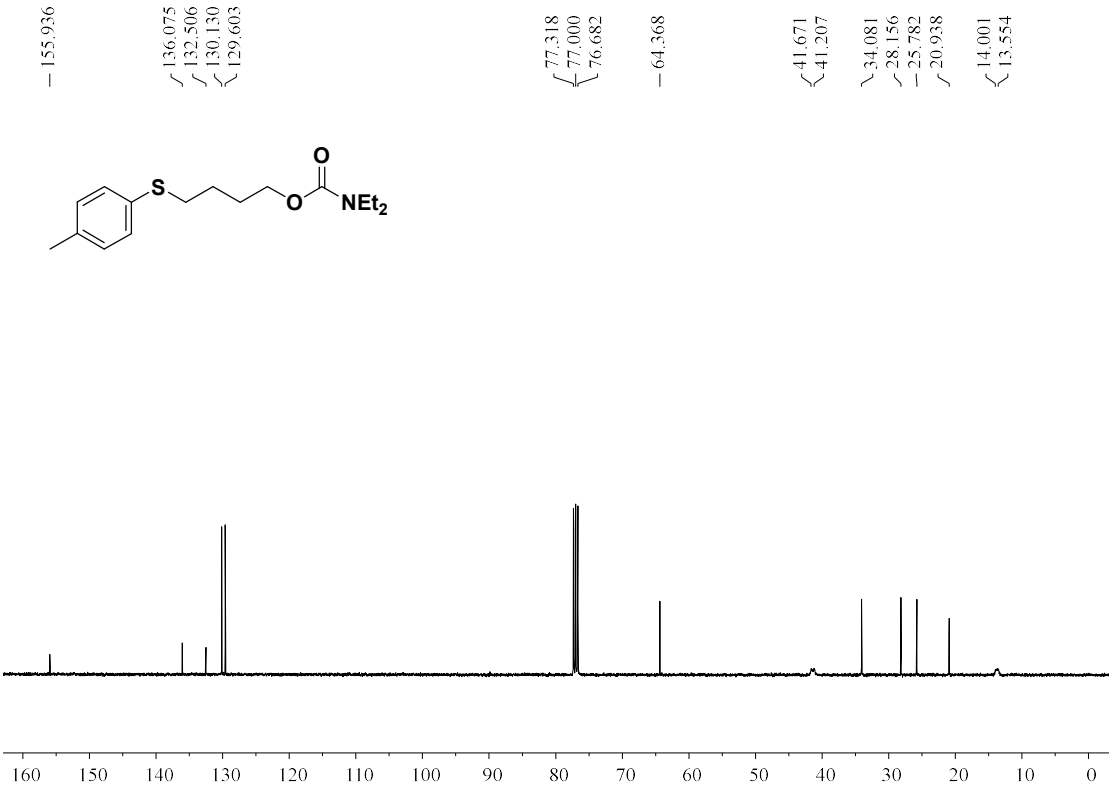
^{1}H NMR Spectrum of **55**



^{13}C NMR Spectrum of **55**



^{1}H NMR Spectrum of **57**



^{13}C NMR Spectrum of **57**