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Supporting Information

Visible-Light Photoredox-Catalyzed Dual C-C Bond Cleavage: Synthesis of 2-Cyanoalkylsulfonylated 3,4-Dihydronaphthalenes through the Insertion of Sulfur Dioxide

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1. General Information

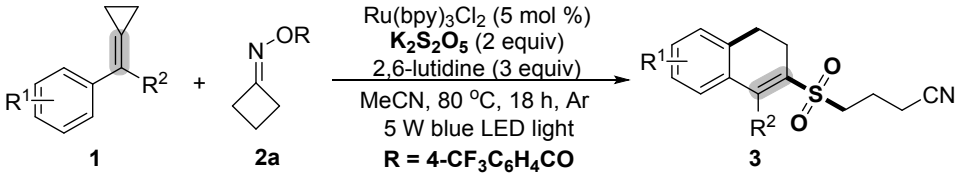
All reactions were carried out with magnetic stirring and in dried glassware. Standard syringe techniques were applied for transfer of dry solvents. All reagents and solvents were commercially available and used without any further purification unless specified. Proton (^{1}H NMR) and carbon (^{13}C NMR) nuclear magnetic resonance spectra were recorded at 400 MHz and 100MHz, respectively. The chemical shifts are given in parts per million (ppm) on the delta (δ) scale. The solvent peak was used as a reference value, for ^{1}H NMR: TMS = 0.00 ppm, for ^{13}C NMR: $CDCl_3$ = 77.00 ppm. The following abbreviations were used to explain multiplicities: s = singlet, d = doublet, dd = doublet of doublet, t = triplet, td = triplet of doublet, q = quartet, m = multiplet, and br = broad. Analytical TLC was performed on precoated silica gel plates. High-resolution mass spectra (HRMS) were obtained on an Agilent mass spectrometer using ESI-TOF (electrospray ionization-time of flight).

2. Experiment Section

2.1 General procedure for the synthesis of MCPs (1) and cyclobutanone oxime esters (2):

All of the MCPs (**1**)[1] and cyclobutanone oxime esters (**2**)[2-4] were synthesized according to the known methods.

2.2 Typical experimental procedure for the synthesis of 2-cyanoalkylsulfonylated 3,4-dihydronaphthalenes



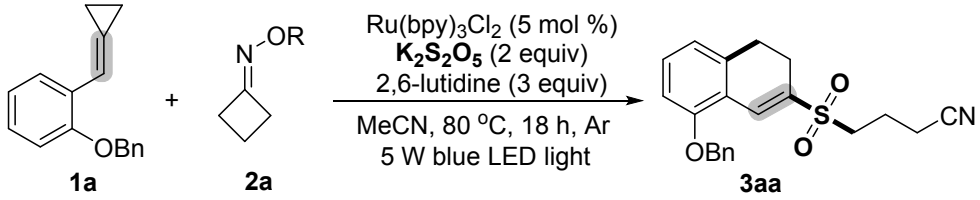
To a Schlenk tube were added **1** (0.2 mmol), **2** (0.3 mmol, 1.5 eqiuv), $K_2S_2O_5$ (0.4 mmol, 2 equiv), $Ru(bpy)_3Cl_2$ (5 mol %), 2,6-lutidine (0.6 mmol, 3 eqiuv), CH_3CN (2 mL). Then the mixture was stirred at 80 °C (oil bath temperature) in argon atmosphere (1 atm) under 5 W blue LED light for 18 h until complete consumption of starting material as monitored by TLC and GC-MS analysis. After the reaction was finished, the reaction mixture was washed with brine. The aqueous phase was re-extracted with

EtOAc (3 × 10 mL). The combined organic extracts were dried over Na_2SO_4 and concentrated in vacuum. The residue was purified by silica gel flash column chromatography (hexane/ethyl acetate = 5 : 1 to 2 : 1) to afford the desired products **3**.

2.3 Table S1: Screening the optimal conditions

To identify the best reaction conditions, we began to investigate the ring-opening/cyclization of 1-(benzyloxy)-2-(cyclopropyli-denemethyl)benzene (**1a,** 0.2 mmol) with cyclobutylidenemethyl 4-(trifluoromethyl)benzoate (**2a**, 1.5 equiv) in the presence of $Ru(bpy)_3Cl_2$ (0.01 mmol, 5 mol %), $K_2S_2O_5$ (0.4 mmol, 2 equiv), 2,6-lutidine (0.6 mmol, 3 eqiuv), CH_3CN (2 mL) as solvent at 80 ^oC under 5 W blue LED irradiation for 18 h (Table S1). To our surprise, the product **3aa** could be obtained in 81% yield (entry 1). Initially, two other sulfur dioxide sources, including DABSO and thiourea dioxide, were investigated. $K_2S_2O_5$ was the best sulfur dioxide source according to the reaction yields (entries 2-3). Then, a variety of cyclobutanone *O*-acyloximes **2**, such as cyclobutanone *O*-acetyl oxime (**2a-1**), cyclobutanone *O*-benzoyl oxime (**2a-2**), cyclobutanone *O*-(4-fluorobenzoyl) oxime (**2a-3**), cyclobutanone *O*-(4-nitrobenzoyl) oxime (**2a-4**), cyclobutanone *O*-(2-nitrobenzoyl) oxime (**2a-5**) and cyclobutanone *O*-perfluorobenzoyl oxime (**2a-6**) were examined. We found that structural modification of the acyl moiety on the oxime had remarkable effect on the reaction. All of them could afford the sulfonylation products and none of them gave higher yield than that of cyclobutanone oxime **2a** (entries 4-9). Conducting the reaction without photocatalyst or additional light could not give the target product (entries 10-11). It proved that the visible light and visible-light catalyst were indispensable for this transformation. Other phtotocatalysts and the amount of catalyst were screened. The results showed that 5 mol % of $Ru(bpy)_3Cl_2$ was suitable (entries 12-15). Subsequently, several kinds of other solvents, including THF, DCE, dioxane, DMF and DMSO were tested. None of them afforded higher yields than that of CH_3CN (entries 16-20). Using 36 W compact fluorescent light, 12 W blue LED light or 3 W blue LED light instead of 5 W bule LED light could not deliver higher reaction yields (entries 21-23). Decreasing the temperature to 70 ^oC or increasing the temperature to 90 ^oC did not give satisfactory reaction yields (entries 24-25).

Table S1. Screening of optimal reaction conditions[a]



1a **2a** **3aa**

2a, R = *p*-$CF_3C_6H_4CO$
2a-1, R = Ac
2a-2, R = C_6H_5CO
2a-3, R = *p*-FC_6H_4CO
2a-4, R = *p*-$NO_2C_6H_4CO$
2a-5, R = *o*-$NO_2C_6H_4CO$
2a-6, R =C_6F_5CO

entry	variation from the standard conditions	yield (%)[b]
1	none	81
2	DABSO instead of $K_2S_2O_5$	25
3	thiourea dioxide instead of $K_2S_2O_5$	58
4	**2a-1** instead of **2a**	27
5	**2a-2** instead of **2a**	42
6	**2a-3** instead of **2a**	63
7	**2a-4** instead of **2a**	68
8	**2a-5** instead of **2a**	54
9	**2a-6** instead of **2a**	52
10[c]	without $Ru(bpy)_3Cl_2$	0
11[c]	without additional light	0
12	$Ir(ppy)_3$ (5 mol %) instead of $Ru(bpy)_3Cl_2$	75
13	Eosin Y instead of $Ru(bpy)_3Cl_2$	41
14	$Ru(bpy)_3Cl_2$ (2 mol %)	65
15	$Ru(bpy)_3Cl_2$ (10 mol %)	82
16	THF instead of CH_3CN	54
17	DCE instead of CH_3CN	63
18	dioxane instead of CH_3CN	30
19[c]	DMF instead of CH_3CN	0
20[c]	DMSO instead of CH_3CN	0
21	36 W compact fluorescent light instead of 5 W blue LED light	59
22	12 W blue LED light instead of 5 W bule LED light	66
23	3 W blue LED light instead of 5 W bule LED light	70
24	at 70 °C	55
25	at 90 °C	77
26	for 30 h	82
27[d]	none	64

[a] Reaction conditions: **1a** (0.2 mmol), **2a** (0.3 mmol, 1.5 equiv), $K_2S_2O_5$ (0.4 mmol, 2 equiv), $Ru(bpy)_3Cl_2$ (5 mol %), 2,6-lutidine (0.6 mmol, 3 equiv), CH_3CN (2 mL) at 80 °C and 5 W blue LED irradiation for 18 h. [b] Isolated yield. [c] The rest of substrate **1a** was recovered. [d] **1a** (1.0 g, 4.24 mmol) and CH_3CN (20 mL) for 60 h.

A longer reaction time (30 h) furnished the desired product in a similar yield (entry 26). However, 1 gram (4.24 mmol) of substrate **1a** could also construct the target product **3aa** in good yield (entry 27).

2.4 Figure S1: Profile of 3aa with Light on or off over Time

The light on/off experiment verified the necessity of continuous irradiation of visible light and suggested that chain propagation is not the predominant mechanistic pathway (Figure S1).

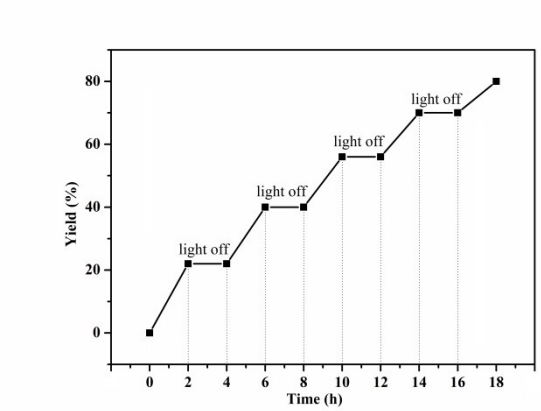
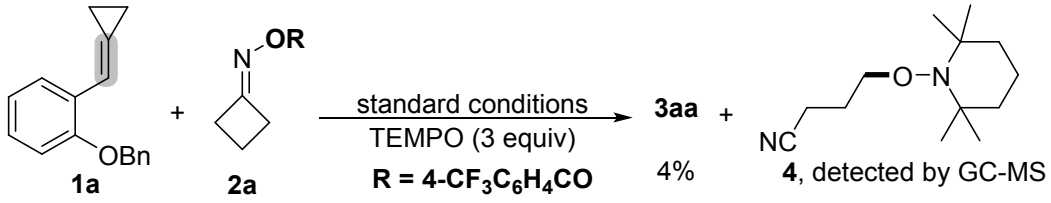
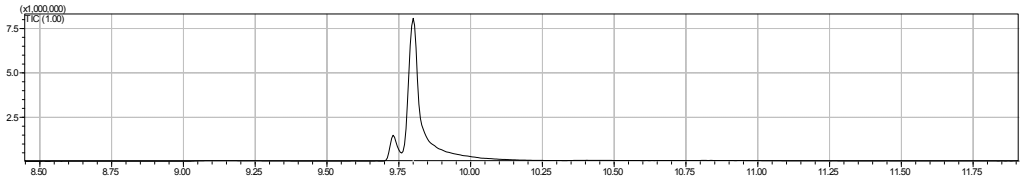
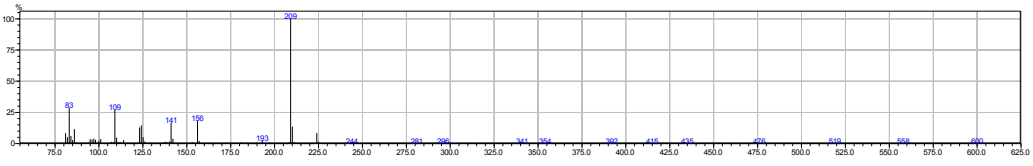


Figure S1. Profile of **3aa** with Light on or off over Time. GC yield using biphenyl as an internal standard.

2.5 GC-MS analysis of product 4







[MS Spectrum]

# of Peaks512

Raw Spectrum 9.800 (scan : 1161)

Background No Background Spectrum

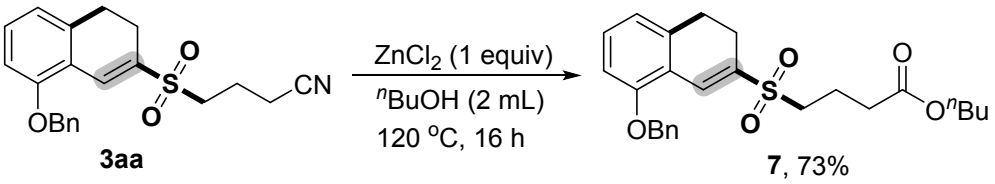
Base Peakm/z 209.10 (Inten : 2,430,007)

Event# 1

m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity	m/z	Absolute Intensity	Relative Intensity
80.00	10556	0.43	122.15	10306	0.42	164.05	627	0.03
81.00	197318	8.12	123.10	308226	12.68	165.00	974	0.04
82.00	120729	4.97	124.10	347102	14.28	166.05	587	0.02
83.05	685244	28.20	125.10	118412	4.87	167.05	11170	0.05
84.05	143745	5.92	126.10	33866	1.39	168.05	36440	0.15
85.00	62862	2.59	127.10	43130	0.18	169.05	581	0.02
86.00	277828	11.43	128.05	18290	0.08	170.10	127	0.01
87.00	14692	0.60	129.00	254	0.01	171.10	22	0.00
88.00	87980	0.36	130.00	98	0.00	171.90	76	0.00
89.05	644	0.03	131.00	127	0.01	172.95	26940	0.11
90.00	185	0.01	132.00	257	0.01	174.00	489	0.02
91.00	82250	0.34	133.10	490	0.02	175.00	180	0.01
92.00	15540	0.06	134.05	710	0.03	176.10	606	0.02
93.00	17514	0.72	135.05	42090	0.17	177.05	470	0.02
94.00	14207	0.58	136.05	67400	0.28	178.10	14440	0.06
95.00	79178	3.26	137.05	24650	1.01	179.05	36210	0.15
96.00	73892	3.04	138.05	31009	1.28	180.05	724	0.03
97.05	89185	3.67	139.05	14113	0.58	181.05	19538	0.80
98.05	66706	2.75	140.15	32102	1.32	182.00	23270	0.10
99.05	92190	0.38	141.05	396680	16.32	183.00	343	0.01
100.00	48326	1.99	142.10	87362	3.60	184.00	260	0.01
101.00	81482	3.35	143.10	69750	0.29	185.00	50	0.00
102.05	46010	0.19	144.05	496	0.02	186.00	19	0.00
103.00	791	0.03	144.95	13210	0.05	187.00	271	0.01
104.05	267	0.01	146.00	209	0.01	188.00	57	0.00
105.00	57350	0.24	147.00	270	0.01	189.00	71	0.00
106.00	27480	0.11	148.05	532	0.02	190.00	86	0.00
107.05	28374	1.17	149.05	12720	0.05	191.10	750	0.03
108.15	17802	0.73	150.00	23910	0.10	192.15	911	0.04
109.05	648704	26.70	151.05	38310	0.16	193.05	47583	1.96
110.05	110301	4.54	152.05	14610	0.06	194.05	69050	0.28
111.05	25969	1.07	153.05	22120	0.91	195.05	10160	0.04
112.00	15297	0.63	154.10	48470	0.20	196.00	127	0.01
113.00	16503	0.68	155.15	32120	0.13	197.00	52	0.00
114.05	63234	2.60	156.10	436730	17.97	198.00	74	0.00
115.05	46320	0.19	157.10	45402	1.87	199.00	71	0.00
116.05	478	0.02	158.05	32240	0.13	200.00	44	0.00
117.00	206	0.01	159.10	276	0.01	201.00	58	0.00
118.10	198	0.01	160.10	138	0.01	202.00	79	0.00
119.05	774	0.03	161.10	100	0.00	203.00	19	0.00
120.05	833	0.03	162.05	418	0.02	204.00	29	0.00
121.05	70790	0.29	163.05	449	0.02	205.00	55	0.00

206.10	52	0.00	250.00	44	0.00	293.00	33	0.00
207.05	960	0.04	251.00	38	0.00	294.00	55	0.00
208.15	17413	0.72	252.00	29	0.00	295.00	16	0.00
209.10	2430007	100.00	253.00	50	0.00	296.00	63	0.00
210.10	323463	13.31	254.00	24	0.00	297.00	50	0.00
211.10	26449	1.09	255.00	27	0.00	298.00	36	0.00
212.05	16560	0.07	256.00	41	0.00	299.00	41	0.00
213.10	113	0.00	257.00	27	0.00	300.00	34	0.00
214.10	44	0.00	258.00	55	0.00	301.00	19	0.00
215.00	44	0.00	259.00	66	0.00	302.00	31	0.00
215.95	517	0.02	260.00	47	0.00	303.00	10	0.00
217.00	161	0.01	261.00	33	0.00	304.00	33	0.00
218.00	60	0.00	262.00	22	0.00	305.00	14	0.00
219.00	52	0.00	263.00	24	0.00	306.00	19	0.00
220.00	27	0.00	264.00	22	0.00	307.00	47	0.00
221.00	52	0.00	265.00	60	0.00	308.00	29	0.00
222.00	44	0.00	266.00	29	0.00	309.00	42	0.00
223.15	1882	0.08	267.00	78	0.00	310.00	14	0.00
224.05	**199654**	**8.22**	268.00	16	0.00	311.00	13	0.00
225.10	33860	1.39	269.00	13	0.00	312.00	41	0.00
226.05	3226	0.13	270.00	27	0.00	313.00	34	0.00
227.10	278	0.01	271.00	34	0.00	314.00	38	0.00
228.10	14	0.00	272.00	33	0.00	315.00	55	0.00
229.10	19	0.00	273.00	33	0.00	316.00	57	0.00
230.10	71	0.00	274.00	38	0.00	317.00	11	0.00
231.10	27	0.00	275.00	36	0.00	318.00	36	0.00
232.10	47	0.00	276.00	29	0.00	319.00	27	0.00
233.10	13	0.00	277.00	24	0.00	320.00	6	0.00
234.10	38	0.00	278.00	54	0.00	321.00	18	0.00
235.10	49	0.00	279.00	73	0.00	322.00	34	0.00
236.10	31	0.00	280.00	39	0.00	323.00	3	0.00
237.10	52	0.00	281.00	135	0.01	324.00	24	0.00
238.10	57	0.00	282.00	58	0.00	326.00	44	0.00
239.10	19	0.00	283.00	46	0.00	327.00	52	0.00
240.10	46	0.00	284.00	30	0.00	328.00	44	0.00
241.10	30	0.00	285.00	24	0.00	329.00	31	0.00
243.00	26	0.00	286.00	26	0.00	330.00	33	0.00
244.00	828	0.03	287.00	3	0.00	331.00	49	0.00
245.00	316	0.01	288.00	47	0.00	332.00	11	0.00
246.00	57	0.00	289.00	54	0.00	333.00	34	0.00
247.00	13	0.00	290.00	14	0.00	334.00	58	0.00
248.00	11	0.00	291.00	33	0.00	335.00	16	0.00
249.00	41	0.00	292.00	34	0.00	336.00	31	0.00

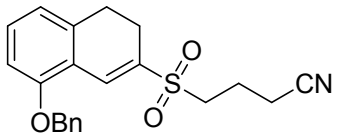
2.6 The experimental procedure for the synthesis of product 7



To a Schlenk tube were added **3aa** (0.3 mmol), $ZnCl_2$ (0.3 mmol, 1 eqiuv), ^{t}BuOH (2 mL). Then the mixture was stirred at 120 °C (oil bath temperature) in argon atmosphere (1 atm) for 16 h until complete consumption of starting material as monitored by TLC and GC-MS analysis. After the reaction was finished, the reaction mixture was washed with brine. The aqueous phase was re-extracted with EtOAc (3 × 10 mL). The combined organic extracts were dried over Na_2SO_4 and concentrated in vacuum. The residue was purified by silica gel flash column chromatography (hexane/ethyl acetate = 5 : 1) to afford the desired product **7**.

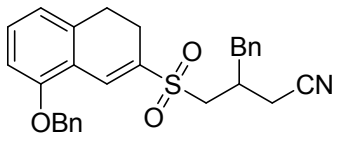
3. Analytical data

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3aa): yield: 59.5 mg, 81%;



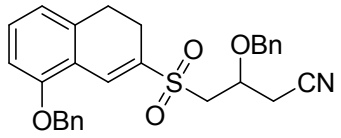
yellow solid; mp 96.2-97.6 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.95 (s, 1H), 7.41-7.37 (m, 4H), 7.35-7.30 (m, 1H), 7.24 (t, *J* = 8.0 Hz, 1H), 6.80 (t, *J* = 8.0 Hz, 2H), 5.13 (s, 2H), 3.12 (t, *J* = 7.6 Hz, 2H), 2.96 (t, *J* = 8.0 Hz, 2H), 2.66-2.57 (m, 4H), 2.20-2.12 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 137.4, 136.3, 133.9, 132.4, 131.7, 128.6, 128.0, 127.1, 120.3, 119.8, 118.3, 110.8, 70.3, 50.7, 27.9, 21.6, 18.8, 16.1; HRMS (ESI-TOF) *m/z*: $C_{21}H_{22}NO_3S$ $(M + H)^+$ calcd for 368.1315, found 368.1320.

3-Benzyl-4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ab): yield: 73.1

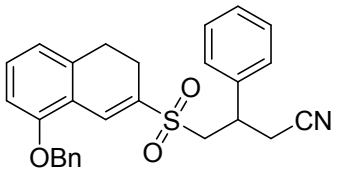


mg, 80%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.93 (s, 1H), 7.42-7.32 (m, 5H), 7.26-7.22 (m, 4H), 7.16-7.14 (m, 2H), 6.82-6.76 (m, 2H), 5.14 (s, 2H), 3.07-3.06 (m, 2H), 2.89-2.79 (m, 5H), 2.62-2.52 (m, 3H), 2.31-2.25 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 137.4, 136.8, 136.4, 134.2, 132.2, 131.7, 129.0, 128.9, 128.6, 128.0, 127.1, 127.1, 120.3, 119.8, 117.5, 110.8, 70.3, 53.8, 39.5, 32.5, 27.8, 21.4, 21.3; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_3S$ $(M + H)^+$ calcd for 458.1784, found 458.1790.

3-(Benzyloxy)-4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ac): yield:

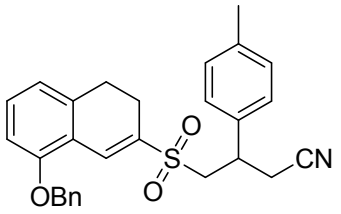


71.9 mg, 76%; yellow solid; mp 185-186 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.94 (s, 1H), 7.39-7.37 (m, 4H), 7.26-7.21 (m, 6H), 6.81-6.75 (m, 2H), 5.12 (m, 2H), 4.60-4.51 (m, 2H), 4.25-4.23 (m, 1H), 3.49-3.44 (m, 1H), 3.21-3.16 (m, 1H), 2.92-2.78 (m, 3H), 2.74-2.67 (m, 2H), 2.65-2.59 (m, 1H), 2.57-2.51 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 137.5, 136.4, 136.2, 134.8, 131.8, 131.7, 128.7, 128.5, 128.2, 128.1, 128.0, 127.2, 120.4, 119.8, 116.3, 110.7, 72.6, 70.3, 69.4, 56.0, 27.8, 23.6, 21.6; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_4S$ $(M + H)^+$ calcd for 474.1734, found 474.1739.



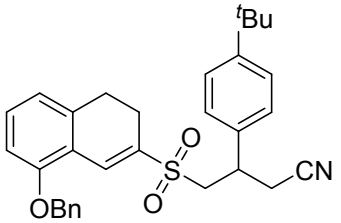
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-phenylbutanenitrile (3ad): yield: 75.3 mg, 85%; yellow solid; mp 185-186 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.92 (s, 1H), 7.43-7.38 (m, 4H), 7.36-7.30 (m, 3H), 7.27-7.21 (m, 4H), 6.81-6.75 (m, 2H), 5.15 (s, 2H), 3.70-3.64 (m, 1H), 3.51-3.44 (m, 1H), 3.39-3.35 (m, 1H), 3.01-2.99 (m, 2H), 2.94-2.82 (m, 2H), 2.63-2.57 (m, 1H), 2.54-2.48 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.1, 139.3, 137.4, 136.4, 134.2, 132.7, 131.8, 129.2, 128.7, 128.3, 128.1, 127.2, 127.1, 120.3, 119.8, 117.4, 110.8, 70.3, 56.0, 36.4, 27.9, 24.6, 21.6; HRMS (ESI-TOF) *m/z*: $C_{27}H_{26}NO_3S$ $(M + H)^+$ calcd for 444.1628, found 444.1633.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(*p*-tolyl)butanenitrile (3ae): yield: 75.0



mg, 82%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.72 (s, 1H), 7.41-7.37 (m, 4H), 7.36-7.28 (m, 5H), 7.25-7.17 (m, 2H), 6.77 (d, J = 8.4 Hz, 1H), 6.72 (d, J = 7.2 Hz, 1H), 5.12 (s, 2H), 3.4-3.35 (m, 2H), 3.32-3.20 (m, 2H), 2.83 (t, J = 8.0 Hz, 2H), 2.51 (t, J = 8.0 Hz, 2H), 1.83 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 155.9, 141.9, 137.2, 136.4, 135.5, 131.8, 131.6, 128.9, 128.7, 128.0, 127.7, 127.1, 125.4, 120.2, 119.9, 117.6, 110.6, 70.2, 61.6, 40.0, 29.0, 27.8, 26.1, 21.5; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_3S$ $(M + H)^+$ calcd for 458.1784, found 458.1790.

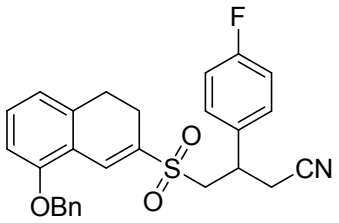
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-(*tert*-butyl)phenyl)butanenitrile (3af):



yield: 84.9 mg, 85%; yellow solid; mp 119.7-121.1 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.87 (s, 1H), 7.45-7.41 (s, 4H), 7.39-7.34 (m, 1H), 7.27 (t, J = 7.2 Hz, 2H), 7.23-7.15 (m, 3H), 6.79 (d, J = 8.0 Hz, 1H), 6.72 (d, J = 7.6 Hz, 1H), 5.14 (s, 2H), 3.68-3.61 (m, 1H),

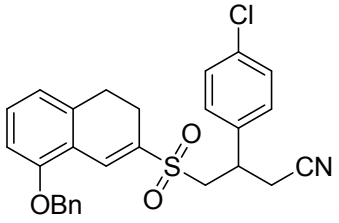
3.51-3.38 (m, 2H), 2.97-2.94 (m, 2H), 2.84-2.80 (m, 1H), 2.75-2.71 (s, 1H), 2.56-2.53 (m, 1H), 2.43-2.37 (m, 1H), 1.20 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 151.3, 137.4, 136.4, 136.1, 134.1, 132.6, 131.7, 128.7, 128.1, 127.2, 126.8, 126.0, 120.3, 119.8, 117.5, 110.7, 70.3, 56.2, 36.1, 34.4, 31.1, 27.8, 24.7, 21.6; HRMS (ESI-TOF) *m/z*: $C_{31}H_{34}NO_3S$ $(M + H)^+$ calcd for 500.2254, found 500.2259.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-fluorophenyl)butanenitrile (3ag):



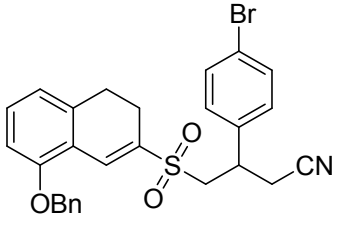
yield: 71.9 mg, 78%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.86 (s, 1H), 7.42-7.34 (m, 5H), 7.24-7.20 (m, 3H), 6.97 (t, *J* = 7.6 Hz, 2H), 6.81 (d, *J* = 7.6 Hz, 1H), 6.76 (d, *J* = 7.6 Hz, 1H), 5.14 (s, 2H), 3.70-3.64 (m, 1H), 3.49-3.41 (m, 1H), 3.36-3.31 (m, 1H), 2.96-2.84 (m, 4H), 2.64-2.58 (m, 1H), 2.54-2.50 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 162.3 (d, *J* = 246.2 Hz, 1C), 156.0, 137.3, 136.3, 135.0 (d, *J* = 3.3 Hz, 1C), 134.0, 132.7, 131.9, 128.9, 128.8, 128.7, 128.1, 127.2, 120.3, 119.7, 116.1 (d, *J* = 21.5 Hz, 1C), 110.7, 70.3, 56.0, 35.8, 27.8, 24.7, 21.5; ^{19}F NMR (282 MHz, $CDCl_3$) δ: -113.2; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}{}^{19}FNO_3S$ $(M + H)^+$ calcd for 462.1534, found 462.1539.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-chlorophenyl)butanenitrile (3ah):



yield: 67.8 mg, 71%; yellow solid; mp 115.7-116.9 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.83 (s, 1H), 7.43-7.33 (m, 5H), 7.25-7.22 (m, 3H), 7.17 (d, *J* = 8.4 Hz, 2H), 6.82-6.75 (m, 2H), 5.14 (s, 2H), 3.68-3.62 (m, 1H), 3.49-3.40 (m, 1H), 3.35-3.30 (m, 1H), 2.97-2.84 (m, 4H), 2.63-2.57 (m, 1H), 2.53-2.47 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 137.5, 137.2, 136.3, 134.2, 133.9, 132.8, 131.9, 129.3, 128.7, 128.5, 128.1, 127.2, 120.3, 119.6, 117.1, 110.7, 70.3, 55.7, 35.9, 27.8, 24.5, 21.5; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}{}^{35}ClNO_3S$ $(M + H)^+$ calcd for 478.1238, found 478.1244.

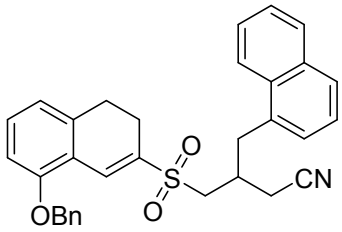
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-bromophenyl)butanenitrile (3ai):



yield: 69.8 mg, 67%; yellow solid; mp 110.4-112.0 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.83 (s, 1H), 7.44-7.36 (m, 7H), 7.24 (t, *J* = 8.0 Hz, 1H), 7.11 (d, *J* = 8.4 Hz, 2H), 6.82 (d, *J* = 8.4 Hz, 1H), 6.77 (d, *J* = 7.6 Hz, 1H), 5.15 (s, 2H), 3.67-3.60 (m, 1H), 3.45-3.40 (m, 1H), 3.35-3.30 (m, 1H), 2.96-2.82 (m, 4H), 2.63-2.57 (m, 1H), 2.53-2.47 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 138.0, 137.3, 136.3, 133.8, 132.8, 132.3, 131.9, 128.8, 128.7 (2C), 128.1, 127.2,

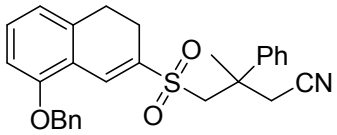
122.4, 120.3, 119.6, 110.8, 70.3, 55.7, 36.0, 27.8, 24.4, 21.5; HRMS (ESI-TOF) *m/z*: $C_{27}H_{25}{}^{79}BrNO_3S$ $(M + H)^+$ calcd for 522.0733, found 522.0739.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(naphthalen-1-ylmethyl)butanenitrile



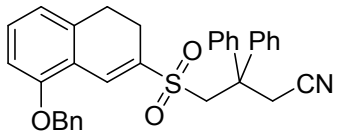
(3aj) : yield: 70.0 mg, 71%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.95 (d, *J* = 8.0 Hz, 1H), 7.87 (s, 1H), 7.79-7.75 (m, 2H), 7.40-7.31 (m, 9H), 7.22 (t, *J* = 8.0 Hz, 1H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.70 (d, *J* = 7.6 Hz, 1H), 5.13 (s, 2H), 3.42-3.37 (m, 1H), 3.31-3.26 (m, 1H), 3.16-3.10 (m, 2H), 2.82-2.71 (m, 3H), 2.62-2.51 (m, 2H), 2.48-2.42 (m, 1H), 2.00-1.94 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 137.4, 136.4, 134.0, 133.5, 132.9, 132.5, 131.7, 131.3, 128.9, 128.7, 128.2, 128.1, 127.8, 127.2, 126.6, 126.0, 125.3, 123.1, 120.3, 119.7, 117.6, 110.7, 70.3, 54.2, 37.2, 31.6, 27.6, 21.9, 21.3; HRMS (ESI-TOF) *m/z*: $C_{32}H_{30}NO_3S$ $(M + H)^+$ calcd for 508.1941, found 508.1946.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-methyl-3-phenylbutanenitrile (3ak):



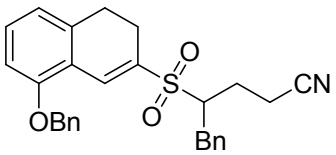
yield: 72.2 mg, 79%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.72 (s, 1H), 7.41-7.38 (m, 4H), 7.36-7.25 (m, 5H), 7.22-7.17 (m, 2H), 6.79-6.72 (m, 2H), 5.12 (s, 2H), 3.51-3.35 (m, 2H), 3.32-3.20 (m, 2H), 2.83 (t, *J* = 8.0 Hz, 2H), 2.51 (t, *J* = 7.6 Hz, 2H), 1.83 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 155.9, 141.9, 137.2, 136.4, 135.5, 131.8, 131.6, 128.9, 128.7, 128.0, 127.7, 127.1, 125.4, 120.2, 119.9, 117.6, 110.6, 70.2, 61.6, 40.0, 29.0, 27.8, 26.1, 21.5; HRMS (ESI-TOF99) *m/z*: $C_{28}H_{28}NO_3S$ $(M + H)^+$ calcd for 458.1784, found 458.1790.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3,3-diphenylbutanenitrile (3al): yield:



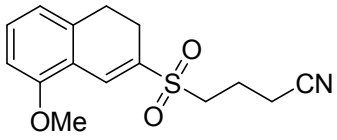
74.8 mg, 72%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.44-7.43 (m, 4H), 7.40-7.35 (m, 1H), 7.31 (s, 1H), 7.26-7.17 (m, 5H), 7.16-7.10 (m, 6H), 6.75 (d, *J* = 8.0 Hz, 1H), 6.68 (d, *J* = 8.0 Hz, 1H),5.13 (s, 2H), 4.04 (s, 2H), 3.75 (s, 2H), 2.77 (t, *J* = 8.0 Hz, 2H), 2.43 (t, *J* = 8.4 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 155.7, 142.6, 137.0, 136.5, 134.2, 131.3, 130.5, 128.7, 128.5, 128.1, 127.8, 127.4, 127.1, 120.1, 119.9, 117.5, 110.4, 70.2, 59.6, 47.1, 29.1, 27.8, 21.3; HRMS (ESI-TOF) *m/z*: $C_{34}H_{30}NO_3S$ $(M + H)^+$ calcd for 520.1941, found 520.1946.

4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-5-phenylpentanenitrile (3am): yield: 63.1 mg, 69%; yellow solid; mp 140.5-142.6 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.99 (s, 1H),

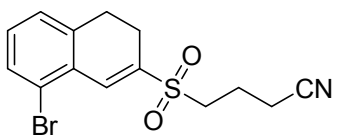


7.42-7.36 (m, 4H), 7.34-7.28 (m, 3H), 7.27-7.23 (m, 2H), 7.16 (d, *J* = 8.4 Hz, 2H), 6.81 (t, *J* = 8.4 Hz, 2H), 5.15 (s, 2H), 3.37-3.31 (m, 2H), 3.00-2.91 (m, 2H), 2.76-2.70 (m, 2H), 2.65-2.59 (m, 2H), 2.44-2.38 (m, 1H), 2.30-2.23 (m, 1H), 2.04-1.96 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.0, 137.5, 136.4, 136.0, 133.7, 132.5, 131.8, 129.1, 128.9, 128.7, 128.1, 127.4, 127.1, 120.3, 119.9, 118.6, 110.8, 70.3, 60.2, 34.5, 27.9, 23.1, 22.2, 15.4; HRMS (ESI-TOF) *m/z*: $C_{28}H_{28}NO_3S$ $(M + H)^+$ calcd for 458.1784, found 458.1790.

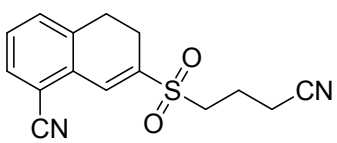
4-((8-Methoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ba): yield: 47.7 mg, 82%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.90 (s, 1H), 7.29 (t, *J* = 8.0 Hz, 1H), 6.80-6.77 (m, 2H), 3.86 (s, 3H), 3.14 (t, *J* = 7.6 Hz, 2H), 2.96 (t, *J* = 7.6 Hz, 2H), 2.66-2.61 (m, 4H), 2.22-2.15 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.9, 137.2, 133.6, 132.5, 131.9, 120.0, 119.4, 118.3, 109.2, 55.5, 50.7, 27.9, 21.6, 18.9, 16.2; HRMS (ESI-TOF) *m/z*: $C_{15}H_{18}NO_3S$ $(M + H)^+$ calcd for 292.1002, found 292.1007.



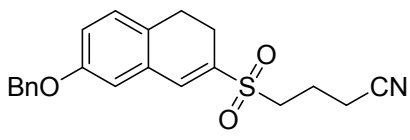
4-((8-Bromo-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ca): yield: 50.8 mg, 75%; yellow solid; mp 103.0-104.7 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.84 (s, 1H), 7.50-7.48 (m, 1H), 7.20-7.16 (m, 2H), 3.18 (t, *J* = 7.2 Hz, 2H), 3.01 (t, *J* = 8.0 Hz, 2H), 2.70-2.64 (m, 4H), 2.25-2.18 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 138.3, 137.8, 136.0, 131.6, 131.6, 130.0, 127.1, 124.8, 118.2, 50.6, 28.5, 21.7, 18.8, 16.2; HRMS (ESI-TOF) *m/z*: $C_{14}H_{15}{}^{79}BrNO_2S$ $(M + H)^+$ calcd for 340.0001, found 340.0007.



7-((3-Cyanopropyl)sulfonyl)-5,6-dihydronaphthalene-1-carbonitrile (3da): yield: 38.9 mg, 68%; yellow solid; mp 114.6-116.2 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.78 (s, 2H), 7.60-7.58 (m, 1H), 7.48-7.41 (m, 2H), 3.21 (t, *J* = 7.2 Hz, 2H), 3.71 (t, *J* = 7.6 Hz, 2H), 2.79-2.75 (m, 2H), 2.67 (t, *J* = 6.8 Hz, 2H), 2.27-2.19 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 140.4, 137.0, 132.9, 132.8, 132.3, 131.5, 130.8, 118.1, 116.5, 111.9, 50.7, 27.5, 21.7, 18.7, 16.3; HRMS (ESI-TOF) *m/z*: $C_{15}H_{15}N_2O_2S$ $(M + H)^+$ calcd for 287.0849, found 287.0854.

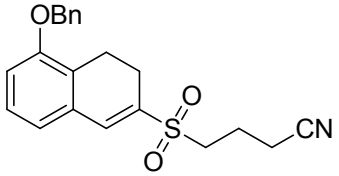


4-((7-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ea): yield: 45.7 mg, 62%; yellow solid; mp 70.3-72.1 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.44-7.38 (m, 5H), 7.36-7.32 (m, 1H), 7.21 (t,



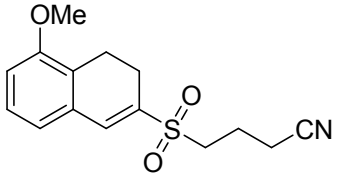
J = 8.0 Hz, 1H), 7.00 (d, *J* = 8.0 Hz, 1H), 6.92(d, *J* = 7.6 Hz, 1H), 5.10 (s, 2H), 3.14 (t, *J* = 7.6 Hz, 2H), 3.08 (t, *J* = 8.4 Hz, 2H), 2.67-2.60 (m, 4H), 2.21-2.14 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 155.4, 137.6, 136.7, 135.6, 131.4, 128.6, 128.0, 127.6, 127.2, 124.0, 122.0, 118.2, 114.7, 70.3, 50.5, 21.4, 20.3, 18.8, 16.2; HRMS (ESI-TOF) *m/z*: $C_{21}H_{22}NO_3S$ $(M + H)^+$ calcd for 368.1315, found 368.1320.

4-((5-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ea') yield: 15.2 mg, 21%;



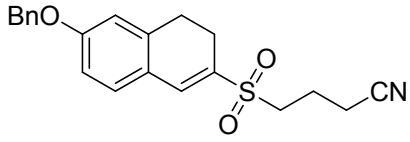
yellow solid; mp 74.5-75.8 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.44-7.38 (m, 5H), 7.36-7.26 (m, 1H), 7.12 (d, *J* = 8.4 Hz, 1H), 6.96-6.93 (m, 1H), 6.89 (s, 1H), 5.07 (s, 2H), 3.15 (t, *J* = 7.6 Hz, 2H), 2.94 (t, *J* = 8.0 Hz, 2H), 2.69-2.61 (m, 4H), 2.22-2.15 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 155.8, 137.8, 136.6, 136.1, 131.3, 128.8, 128.6, 128.1, 128.0, 127.4, 118.2, 117.3, 115.5, 70.2, 50.6, 26.7, 22.4, 18.8, 16.3; HRMS (ESI-TOF) *m/z*: $C_{21}H_{22}NO_3S$ $(M + H)^+$ calcd for 368.1315, found 368.1320.

4-((5-Methoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3fa): yield: 49.5 mg, 85%;



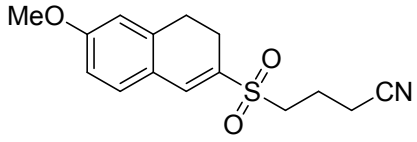
yellow solid; mp 112.9-114.6 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.44 (s, 1H), 7.13 (d, *J* = 7.6 Hz, 1H), 6.90-6.87 (m, 1H), 6.83 (s, 1H), 3.82 (s, 3H), 3.16 (t, *J* = 7.6 Hz, 2H), 2.95 (t, *J* = 8.0 Hz, 2H), 2.70-2.63 (m, 4H), 2.24-2.16 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.2, 137.7, 135.5, 131.3, 127.6, 123.5, 121.7, 118.2, 113.2, 55.6, 50.5, 21.5, 20.1, 18.8, 16.3; HRMS (ESI-TOF) *m/z*: $C_{15}H_{18}NO_3S$ $(M + H)^+$ calcd for 292.1002, found 292.1007.

4-((6-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ga): yield: 63.1 mg, 86%;



yellow solid; mp 99.5-101.6 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.44-7.33 (m, 6H), 7.21-7.19 (m, 1H), 6.86-6.83 (m, 2H), 5.10 (m, 2H), 3.13 (t, *J* = 7.6 Hz, 2H), 2.98 (t, *J* = 8.0 Hz, 2H), 2.68-2.61 (m, 4H), 2.21-2.14 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 160.9, 137.9, 137.6, 136.3, 132.3, 130.9, 128.6, 128.2, 127.4, 123.7, 118.3, 115.0, 112.9, 70.0, 50.7, 28.1, 21.9, 18.9, 16.3; HRMS (ESI-TOF) *m/z*: $C_{21}H_{22}NO_3S$ $(M + H)^+$ calcd for 368.1315, found 368.1320.

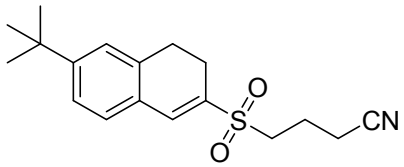
4-((6-Methoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ha): yield: 51.8 mg, 89%;



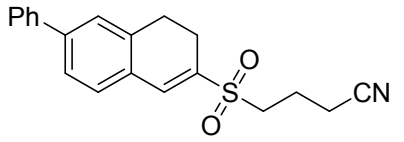
yellow solid; mp 72.0-74.1 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.43 (s, 1H), 7.21 (d, *J* = 7.6 Hz, 1H), 6.79-6.75 (m, 2H), 3.83 (s, 3H), 3.14 (t, *J* = 7.6 Hz, 2H), 2.98 (t, *J*

= 8.0 Hz, 2H), 2.67-2.61 (m, 4H), 2.21-2.14 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 161.6, 137.8, 137.6, 132.0, 130.8, 123.4, 118.3, 114.0, 111.9, 55.3, 50.6, 28.0, 21.8, 18.9, 16.1; HRMS (ESI-TOF) *m/z*: $C_{15}H_{18}NO_3S$ $(M + H)^+$ calcd for 292.1002, found 292.1007.

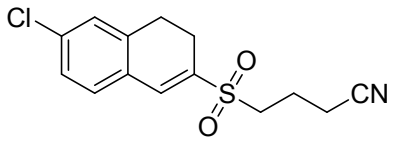
4-((6-(*tert*-Butyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ia): yield: 55.2 mg, 87%; yellow solid; mp 117.4-118.7 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.46 (s, 1H), 7.30-7.27 (m, 1H), 7.23-7.21 (m, 2H), 3.15 (t, *J* = 7.6 Hz, 2H), 3.01 (t, *J* = 7.6 Hz, 2H), 2.7-2.67 (m, 2H), 2.63 (t, *J* = 7.2 Hz, 2H), 2.22-2.15 (m, 2H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 154.7, 137.7, 135.4, 134.3, 129.1, 127.8, 125.1, 124.2, 118.2, 50.6, 34.9, 31.1, 27.9, 22.2, 18.9, 16.2; HRMS (ESI-TOF) *m/z*: $C_{18}H_{24}NO_2S$ $(M + H)^+$ calcd for 318.1522, found 318.1528.



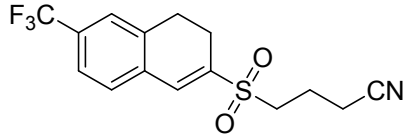
4-((6-Phenyl-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ja): yield: 58.0 mg, 86%; yellow solid; mp 99.6-101.3 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.61-7.59 (m, 2H), 7.53-7.44 (m, 5H), 7.41-7.34 (m, 2H), 3.18 (t, *J* = 7.6 Hz, 2H), 3.09 (t, *J* = 8.0 Hz, 2H), 2.74 (t, *J* = 8.0 Hz, 2H), 2.65 (t, *J* = 6.8 Hz, 2H), 2.25-2.18 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 143.8, 140.0, 137.5, 136.2, 135.2, 129.7, 129.5, 128.9, 128.0, 127.0, 126.7, 126.0, 118.2, 50.6, 27.8, 22.1, 18.9, 16.3; HRMS (ESI-TOF) *m/z*: $C_{20}H_{20}NO_2S$ $(M + H)^+$ calcd for 338.1209, found 338.1215.



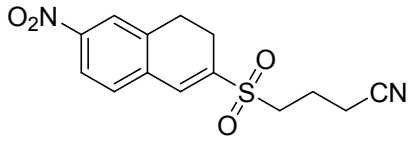
4-((6-Chloro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ka): yield: 47.2 mg, 80%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.45 (s, 1H), 7.27-7.20 (m, 3H), 3.16 (t, *J* = 7.2 Hz, 2H), 3.00 (t, *J* = 8.0 Hz, 2H), 2.71-2.63 (m, 4H), 2.24-2.17 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 137.4, 136.7, 136.6, 135.9, 130.3, 128.9, 128.2, 127.5, 118.1, 50.6, 27.5, 21.8, 18.8, 16.3; HRMS (ESI-TOF) *m/z*: $C_{14}H_{15}{}^{35}ClNO_2S$ $(M + H)^+$ calcd for 296.0507, found 296.0512.



4-((6-(Trifluoromethyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3la): yield: 51.3 mg, 78%; yellow solid; mp 80.2-81.9 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.55-7.47 (m, 3H), 7.39 (d, *J* = 8.0 Hz, 1H), 3.18 (t, *J* = 7.2 Hz, 2H), 3.09 (t, *J* = 8.0 Hz, 2H), 2.75 (t, *J* = 8.0 Hz, 2H), 2.66 (t, *J* = 7.2 Hz, 2H), 2.27-2.18 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 138.4, 136.3, 136.1, 133.6, 129.3, 127.4, 123.6 (q, *J* = 270.8 Hz, 1C), 124.7 (q, *J* = 3.6 Hz, 1C), 124.3 (q, *J* = 3.8 Hz, 1C), 118.1, 50.5, 27.4, 21.8, 18.7, 16.3; ^{19}F NMR (282 MHz, $CDCl_3$) δ: -62.9 (s, 3F); HRMS (ESI-TOF) *m/z*: $C_{15}H_{15}{}^{19}F_3N_2O_2S$ $(M + H)^+$ calcd for 330.0770, found 330.0776.

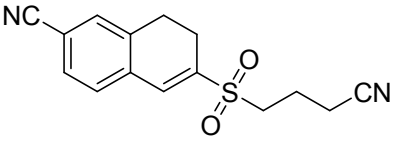


4-((6-Nitro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ma): yield: 45.9 mg, 75%; yellow solid; mp 115.4-117.1 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.16-8.13 (m, 1H), 8.10 (s, 1H),



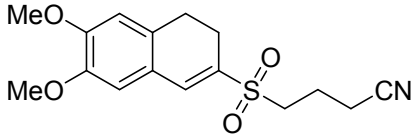
7.54 (s, 1H), 7.45 (d, *J* = 8.0 Hz, 1H), 3.22-3.13 (m, 4H), 2.79 (t, *J* = 8.0 Hz, 2H), 2.67 (t, *J* = 7.2 Hz, 2H), 2.27-2.20 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 148.7, 140.3, 137.1, 136.1, 135.2, 129.7, 122.9, 122.7, 118.0, 50.5, 27.4, 21.7, 18.6, 16.3; HRMS (ESI-TOF) *m/z*: $C_{14}H_{15}N_2O_4S$ $(M + H)^+$ calcd for 307.0747, found 307.0753.

6-((3-Cyanopropyl)sulfonyl)-7,8-dihydronaphthalene-2-carbonitrile (3na): yield: 42.3 mg, 74%;



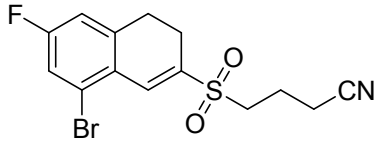
white solid; mp 75.2-77.0 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.59-7.57 (m, 1H), 7.50 (d, *J* = 8.8 Hz, 2H), 7.38 (d, *J* = 7.6 Hz, 1H), 3.19 (t, *J* = 7.6 Hz, 2H), 3.07 (t, *J* = 8.0 Hz, 2H), 2.78-2.73 (m, 2H), 2.66 (t, *J* = 7.2 Hz, 2H), 2.26-2.19 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 139.5, 136.6, 135.7, 134.5, 131.3, 131.2, 129.4, 118.2, 118.1, 113.9, 50.5, 27.1, 21.7, 18.6, 16.3; HRMS (ESI-TOF) *m/z*: $C_{15}H_{15}N_2O_2S$ $(M + H)^+$ calcd for 287.0849, found 278.0854.

4-((6,7-Dimethoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3oa): yield: 51.4 mg, 80%;



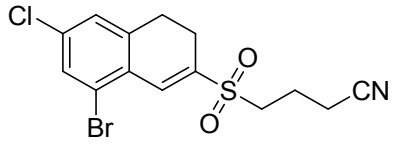
yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.41 (s, 1H), 6.80 (s, 1H), 6.74 (s, 1H), 3.93 (s, 3H), 3.89 (s, 3H), 3.15 (t, *J* = 7.6 Hz, 2H), 2.96 (t, *J* = 7.6 Hz, 2H), 2.68-2.63 (m, 4H), 2.23-2.16 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 151.0, 147.8, 137.8, 132.5, 129.2, 123.0, 118.3, 112.1, 111.0, 56.1, 56.0, 50.7, 27.5, 22.1, 18.9, 16.3; HRMS (ESI-TOF) *m/z*: $C_{16}H_{20}NO_4S$ $(M + H)^+$ calcd for 322.1108, found 322.1103.

4-((8-Bromo-6-fluoro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3pa): yield: 55.7 mg,

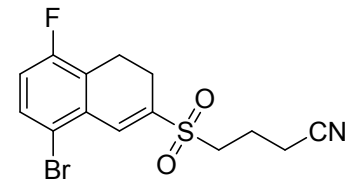


78%; yellow solid; mp 77.7-79.6 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.78 (s, 1H), 7.27-7.24 (m, 1H), 6.94-6.91 (m, 1H), 3.18 (t, *J* = 7.6 Hz, 2H), 3.02 (t, *J* = 8.0 Hz, 2H), 2.70-2.64 (m, 4H), 2.25-2.18 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 163.0 (d, *J* = 255.1 Hz, 1C), 140.4 (d, *J* = 8.7 Hz, 1C), 137.1 (d, *J* = 2.7 Hz, 1C), 135.1 (d, *J* = 1.5 Hz, 1C), 126.5 (d, *J* = 3.3 Hz, 1C), 125.3, 118.9 (d, *J* = 24.5 Hz, 1C), 118.2, 114.8 (d, *J* = 21.8 Hz, 1C), 50.7, 28.8, 21.4, 18.7, 16.2; ^{19}F NMR (282 MHz, $CDCl_3$) δ: -106.7 (s, 1F); HRMS (ESI-TOF) *m/z*: $C_{14}H_{14}{}^{79}Br^{19}FNO_2S$ $(M + H)^+$ calcd for 357.9907, found 357.9913.

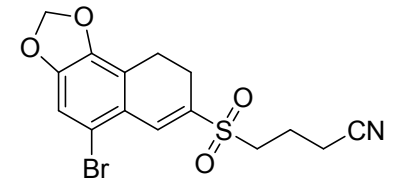
4-((8-Bromo-6-chloro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3qa): yield: 57.4 mg, 77%; yellow solid; mp 80.5-82.0 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.77 (s, 1H), 7.52-7.51 (m, 1H), 7.17 (s, 1H), 3.18 (t, *J* = 7.6 Hz, 2H), 3.02-2.97 (m, 2H), 2.70-2.64 (m, 4H), 2.25-2.17 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 139.3, 138.1, 136.6, 135.0, 131.2, 128.6, 127.4, 124.9, 118.1, 50.6, 28.4, 21.5, 18.7, 16.2; HRMS (ESI-TOF) *m/z*: $C_{14}H_{14}{}^{79}Br^{35}ClNO_2S$ $(M + H)^+$ calcd for 373.9612, found 373.9617.



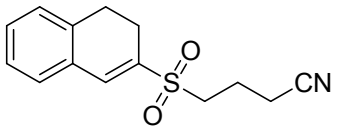
4-((8-Bromo-5-fluoro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ra): yield: 53.5 mg, 75%; yellow solid; mp 104.3-106.0 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.79 (s, 1H), 7.27-7.24 (m, 1H), 6.94-6.91 (m, 1H), 3.18 (t, *J* = 7.6 Hz, 2H), 3.02 (t, *J* = 8.0 Hz, 2H), 2.70-2.64 (m, 4H), 2.25-2.18 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 163.0 (d, *J* = 285.1 Hz, 1C), 140.4 (d, *J* = 8.7 Hz, 1C), 137.1 (d, *J* = 2.7 Hz, 1C), 135.1 (d, *J* = 1.6 Hz, 1C), 126.5 (d, *J* = 3.5 Hz, 1C), 125.2 (d, *J* = 10.2 Hz, 1C), 118.9 (d, *J* = 24.5 Hz, 1C), 118.2, 114.8 (d, *J* = 21.8 Hz, 1C), 50.7, 28.8, 21.4, 18.7, 16.2; ^{19}F NMR (282 MHz, $CDCl_3$) δ: -106.6 (s, 1F); HRMS (ESI-TOF) *m/z*: $C_{14}H_{14}{}^{79}Br^{19}FNO_2S$ $(M + H)^+$ calcd for 357.9907, found 357.9913.



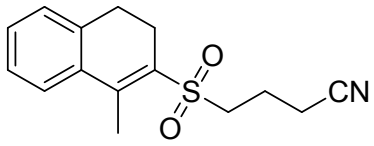
4-((5-Bromo-8,9-dihydronaphtho[1,2-*d*][1,3]dioxol-7-yl)sulfonyl)butanenitrile (3sa): yield: 53.6 mg, 70%; yellow solid; mp 127.3-129.4 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.77 (t, *J* = 8.8 Hz, 1H), 6.96 (s, 1H), 6.05 (s, 2H), 3.16 (t, *J* = 7.6 Hz, 2H), 2.94 (t, *J* = 8.0 Hz, 2H), 2.67-2.62 (m, 4H), 2.24-2.17 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 150.0, 144.5, 136.2, 134.9, 124.0, 118.2, 117.9, 117.3, 111.3, 102.3, 50.7, 21.5, 20.9, 18.8, 16.3; HRMS (ESI-TOF) *m/z*: $C_{15}H_{15}{}^{79}BrNO_4S$ $(M + H)^+$ calcd for 383.9900, found 383.9905.



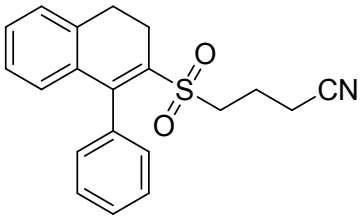
4-((3,4-Dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ta): yield: 41.8 mg, 80%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.48 (s, 1H), 7.36-7.31 (m, 1H), 7.27 (d, *J* = 8.0 Hz, 2H), 7.21 (d, *J* = 7.2 Hz, 1H), 3.16 (t, *J* = 7.2 Hz, 2H), 3.04-2.97 (m, 2H), 2.72-2.62 (m, 4H), 2.23-2.16 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 137.8, 135.7, 135.4, 130.9, 130.4, 129.2, 127.9, 127.3, 118.2, 50.5, 27.5, 22.0, 18.8, 16.2; HRMS (ESI-TOF) *m/z*: $C_{14}H_{16}NO_2S$ $(M + H)^+$ calcd for 262.0896, found 262.0902.



4-((1-Methyl-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3va): yield: 39.6 mg, 72%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.54-7.51 (m, 1H), 7.36-7.29 (m, 2H), 7.22-7.20 (m, 1H), 3.23 (t, *J* = 7.2 Hz, 2H), 2.86 (t, *J* = 7.6 Hz, 2H), 2.72-2.64 (m, 4H), 2.62 (s, 3H), 2.27-2.20 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 144.7, 136.8, 134.5, 133.1, 130.1, 127.6, 127.1, 125.4, 118.2, 52.8, 28.2, 24.5, 18.7, 16.4, 15.9; HRMS (ESI-TOF) *m/z*: $C_{15}H_{18}NO_2S$ $(M + H)^+$ calcd for 276.1053, found 276.1058.

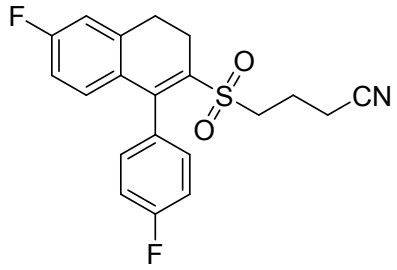


4-((3,4-Dihydrophenanthren-2-yl)sulfonyl)butanenitrile (3wa): yield: 41.7 mg, 67%; yellow solid; mp 90.2-91.6 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 8.06 (d, *J* = 8.0 Hz, 1H), 7.85 (d, *J* = 7.6 Hz, 1H), 7.77 (d, *J* = 8.4 Hz, 1H), 7.58-7.54 (m, 3H), 7.37 (d, *J* = 8.4 Hz, 1H), 3.46 (t, *J* = 8.8 Hz, 2H), 3.21 (t, *J* = 7.2 Hz, 2H), 2.86-2.82 (m, 2H), 2.67-2.64 (m, 2H), 2.26-2.19 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 138.4, 134.9, 134.6, 132.5, 130.8, 128.8, 127.6, 127.4, 127.0, 126.9, 126.3, 124.0, 118.2, 50.7, 23.3, 21.8, 18.9, 16.3; HRMS (ESI-TOF) *m/z*: $C_{18}H_{18}NO_2S$ $(M + H)^+$ calcd for 312.1053, found 312.1058.

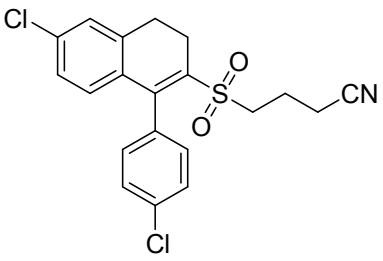


4-((1-Phenyl-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3xa): yield: 56.6 mg, 84%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.49-7.46 (m, 3H), 7.30-7.26 (m, 4H), 7.11 (t, *J* = 7.6 Hz, 1H), 6.73 (d, *J* = 8.0 Hz, 1H), 3.05-3.00 (m, 2H), 2.95-2.91 (m, 2H), 2.82 (t, *J* = 7.2 Hz, 2H), 2.44 (t, *J* = 6.8 Hz, 2H), 2.09-2.02 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 147.6, 136.4, 135.3, 134.5, 130.3, 129.6, 128.7 (2C), 128.6, 128.2, 127.6, 126.9, 118.2, 52.8, 28.1, 23.8, 18.8, 16.2; HRMS (ESI-TOF) *m/z*: $C_{20}H_{20}NO_2S$ $(M + H)^+$ calcd for 338.1209, found 338.1215.

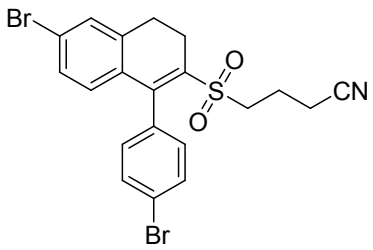
4-((6-Fluoro-1-(4-fluorophenyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ya): yield: 59.7 mg, 80%; yellow solid; mp 107.8-109.4 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.27-7.23 (m, 2H), 7.17 (t, *J* = 8.4 Hz, 2H), 6.98-6.95 (m, 1H), 6.80-6.78 (m, 1H), 6.70-6.66 (m, 1H), 3.03-2.99 (m, 2H), 2.93-2.88 (m, 4H), 2.49 (d, *J* = 6.8 Hz, 2H), 2.11-2.04 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 164.3 (d, *J* = 86.7 Hz, 1C), 161.9 (d, *J* = 82.7 Hz, 1C), 146.3, 139.3 (d, *J* = 8.5 Hz, 1C), 134.0, 131.3, 131.2, 130.9 (q, *J* = 3.5 Hz, 1C), 130.7, 118.2, 115.5 (d, *J* = 21.6 Hz, 1C), 114.9 (d, *J* = 22.0 Hz, 1C), 113.7 (d, *J* = 21.5 Hz, 1C), 52.7, 28.1, 23.8, 18.7, 16.2; ^{19}F NMR (282 MHz, $CDCl_3$) δ: -109.2, -112.1; HRMS (ESI-TOF) *m/z*: $C_{20}H_{18}{}^{19}F_2NO_2S$ $(M + H)^+$ calcd for 374.1021, found 374.1026.



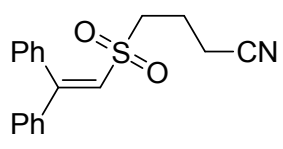
4-((6-Chloro-1-(4-chlorophenyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3za): yield: 63.2 mg, 78%; yellow solid; mp 144.5-146.7 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.47-7.43 (m, 2H), 7.25-7.24 (m, 1H), 7.21-7.18 (m, 2H), 7.10-7.07 (m, 1H), 6.61 (d, *J* = 8.4 Hz, 1H), 3.01-2.98 (m, 2H), 2.94-2.88 (m, 4H), 2.50 (t, *J* = 6.8 Hz, 2H), 2.12-2.05 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 146.1, 138.1, 136.4, 134.9, 134.8, 133.3, 132.8, 130.8, 129.9, 128.6, 127.8, 127.1, 118.1, 52.8, 27.8, 23.9, 18.6, 16.2; HRMS (ESI-TOF) *m/z*: $C_{20}H_{18}{}^{35}Cl_2NO_2S$ $(M + H)^+$ calcd for 406.0430, found 406.0435.



4-((6-Bromo-1-(4-bromophenyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3aaa): yield: 70.0 mg, 71%; white solid; mp 155.3-157.0 °C (uncorrected); ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.60 (d, *J* = 8.4 Hz, 2H), 7.40 (s, 1H), 7.27-7.23 (m, 1H), 7.13 (d, *J* = 8.4 Hz, 2H), 6.54 (d, *J* = 8.4 Hz, 1H), 3.02-2.95 (m, 2H), 2.95-2.86 (m,, 4H), 2.50 (t, *J* = 6.8 Hz, 2H), 2.11-2.04 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 146.1, 138.2, 134.8, 133.7, 133.1, 131.5, 131.0, 130.7, 130.1, 130.0, 124.9, 123.0, 118.1, 52.7, 27.6, 23.9, 18.6, 16.2; HRMS (ESI-TOF) *m/z*: $C_{20}H_{18}{}^{79}Br_2NO_2S$ $(M + H)^+$ calcd for 493.9420, found 495.9405.

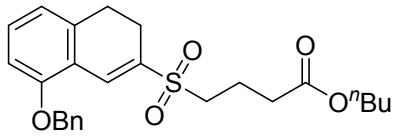


6,6-diphenylhex-5-enenitrile (5): yield: 5.1 mg, 11%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.41-7.37 (m, 2H), 7.34-7.33 (m, 1H), 7.27-7.20 (m, 5H), 7.16 (t, *J* = 8.0 Hz, 2H), 6.02 (t, *J* = 7.6 Hz, 1H), 2.33-2.24 (m, 4H), 1.83-1.77 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 143.7, 142.1, 139.6, 129.7, 128.3, 128.1, 127.2, 127.2, 126.6, 119.5, 28.7, 25.7, 16.7; HRMS (ESI-TOF) *m/z*: $C_{18}H_{18}N$ $(M + H)^+$ calcd for 234.1277, found 234.1283.



4-((2,2-diphenylvinyl)sulfonyl)butanenitrile (6): yield: 16.8 mg, 27%; yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.50-7.43 (m, 4H), 7.40-7.37 (m, 4H), 7.30-7.26 (m, 2H), 6.79 (s, 1H), 2.86 (t, *J* = 7.6 Hz, 2H), 2.48 (t, *J* = 7.2 Hz, 2H), 2.13-2.03 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 156.7, 138.8, 135.3, 130.7, 129.8, 129.7, 128.8, 128.4, 125.7, 118.1, 52.7, 18.8, 16.2; HRMS (ESI-TOF) *m/z*: $C_{18}H_{18}NO_2S$ $(M + H)^+$ calcd for 312.1053, found 312.1058.

Butyl 4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanoate (7): yield: 64.6 mg, 73%;



yellow oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.95 (s, 1H), 7.42-7.31 (m, 5H), 7.26-7.20 (m, 1H), 6.81-6.78 (m, 2H), 5.14 (s, 2H), 4.06 (t, *J* = 6.8 Hz, 2H), 3.10 (t, *J* = 8.0 Hz, 2H), 2.96 (t, *J* = 8.0 Hz, 2H), 2.65 (t, *J* = 8.0 Hz, 2H), 2.50 (t, *J* = 6.8 Hz, 2H), 2.12-2.05 (m, 2H), 1.63-1.55 (m, 3H), 1.40-1.30 (m, 2H), 0.91 (t, *J* = 7.6 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 172.3, 155.9, 137.5, 136.5, 134.2, 131.9, 131.4, 128.7, 158.0, 127.1, 120.3, 120.1, 110.8, 70.3, 64.6, 51.6, 32.1, 30.5, 28.0, 21.8, 19.1, 18.2, 13.7; HRMS (ESI-TOF) *m/z*: $C_{25}H_{31}NO_5S$ $(M + H)^+$ calcd for 443.1887, found 443.1892.

4. Reference

[1] Z.-Z. Zhu, K. Chen, L.-Z. Yu, X.-Y. Tang, and M. Shi, *Org. Lett.* 2015, **17**, 5994.

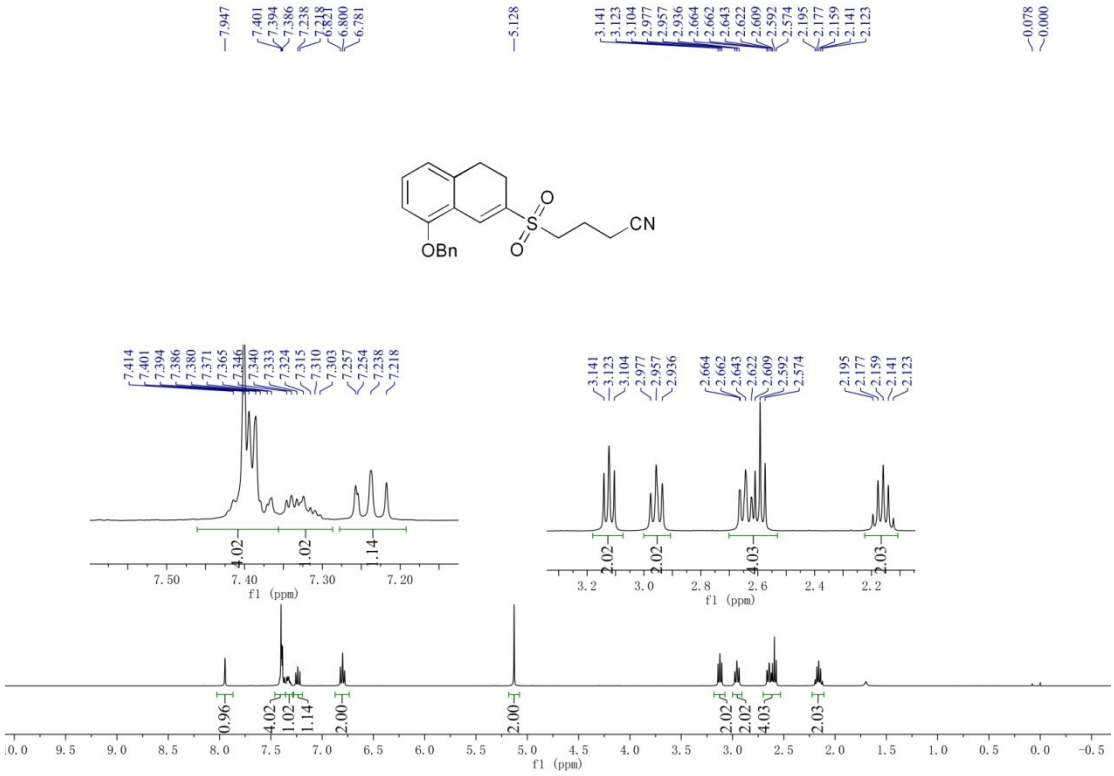
[2] J. Chen, B.-Q. He, P.-Z. Wang, X.-Y.Yu, Q.-Q. Zhao, J.-R. Chen and W.-J. Xiao, *Org. Lett.* **2019**, 21, 4359.

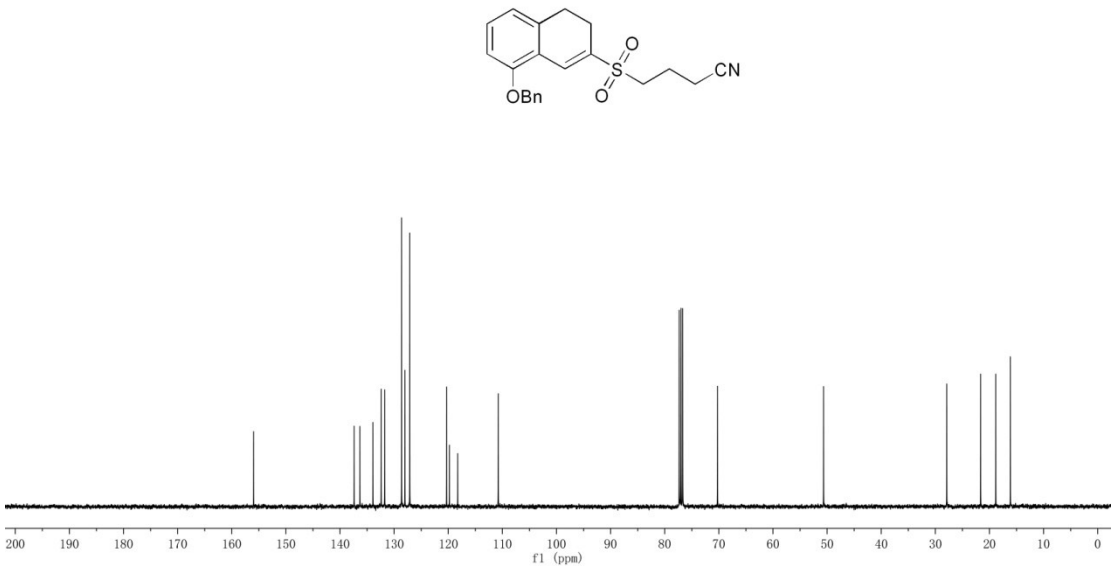
[3] J.-X. Yu, F. Teng, J.-N. Xiang, W. Deng and J.-H. Li, *Org. Lett.* **2019**, 21, 9434.

[4] J.-J. Zhang, X.-D. Hua. Y. Wu, J.-C. Yang and L.-N. Guo, *Chem. Sci.* **2019**, 10, 161.

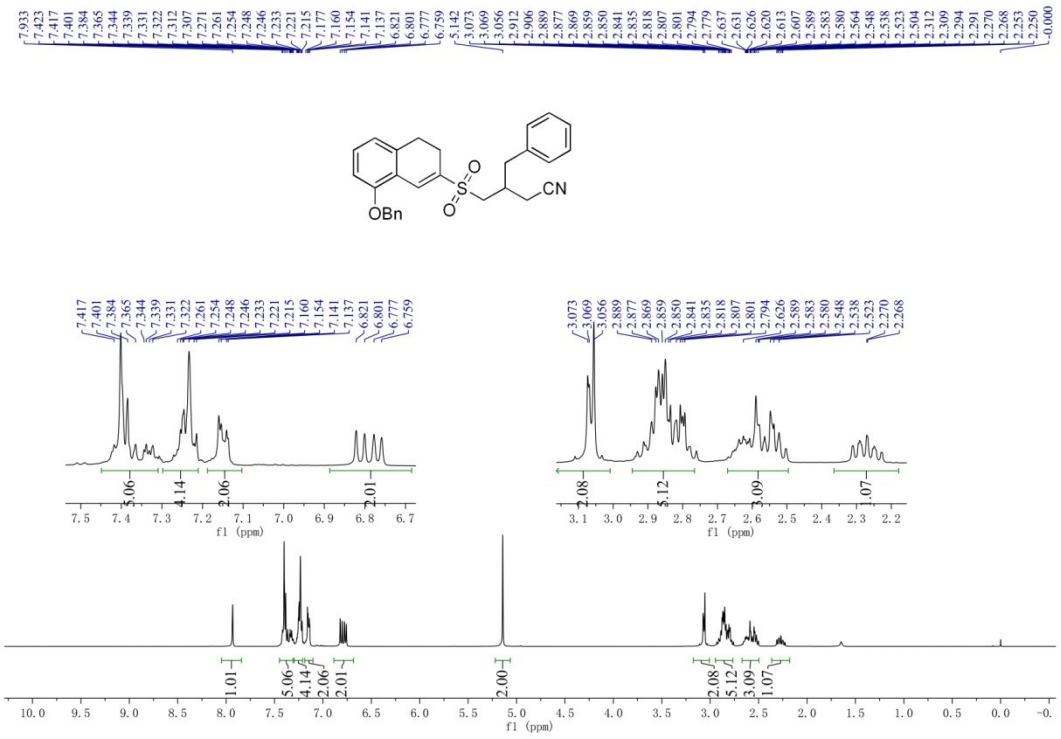
(5) Spectra

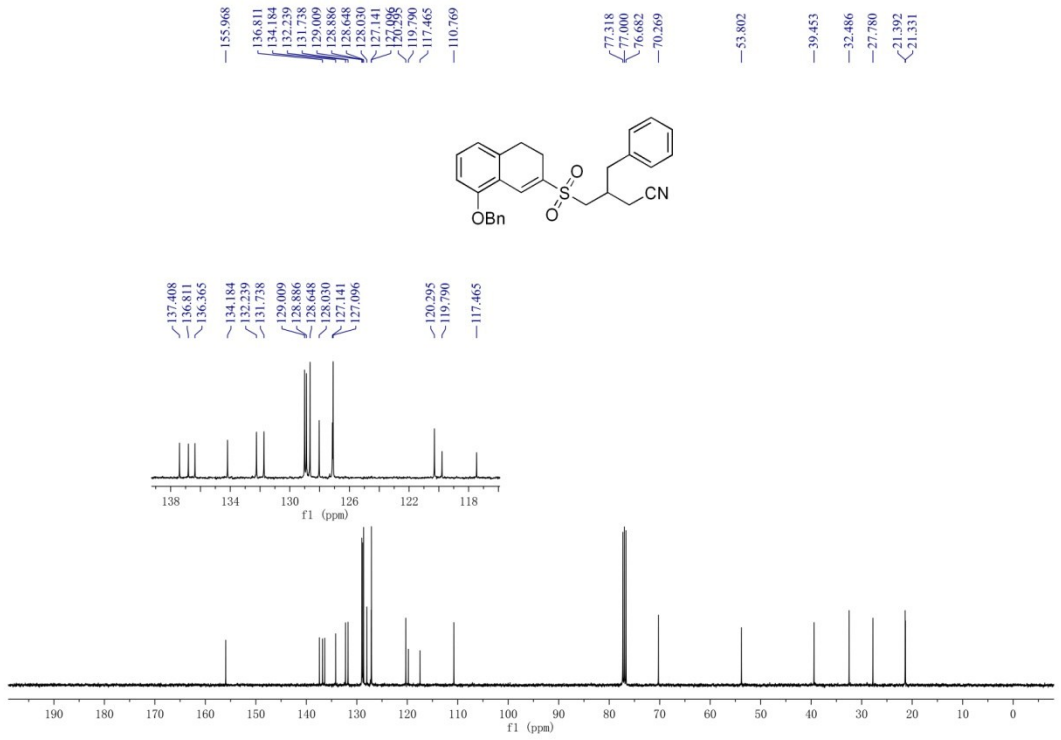
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3aa)



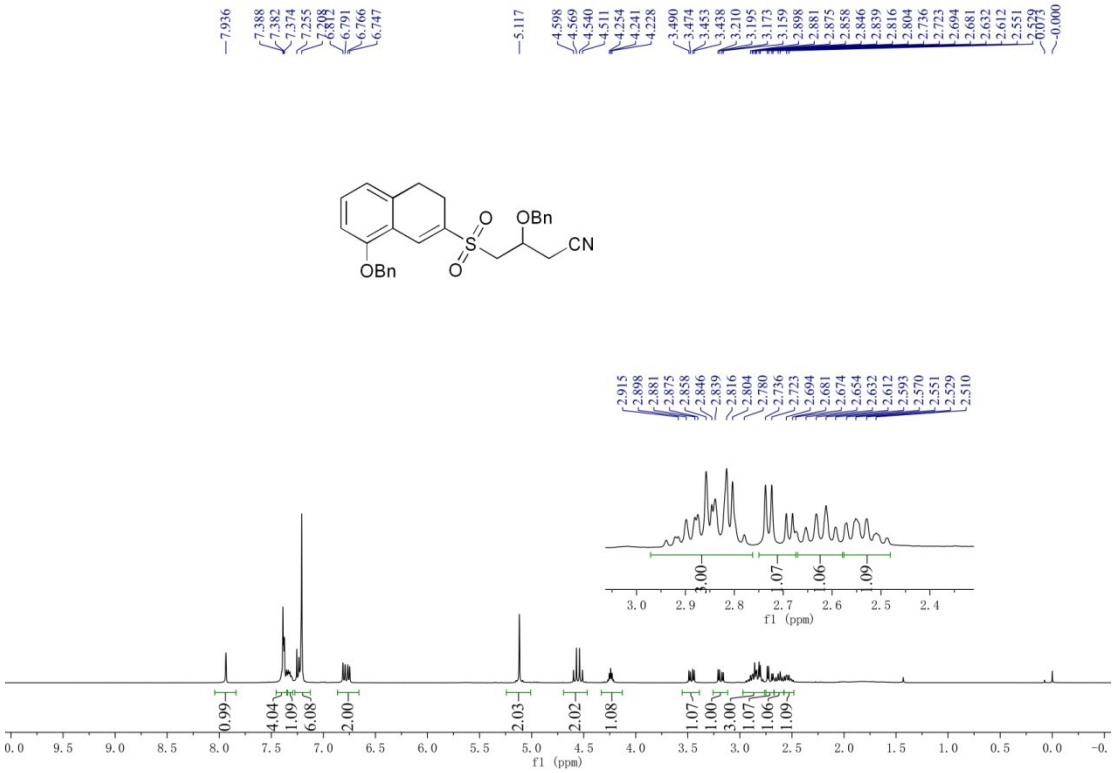


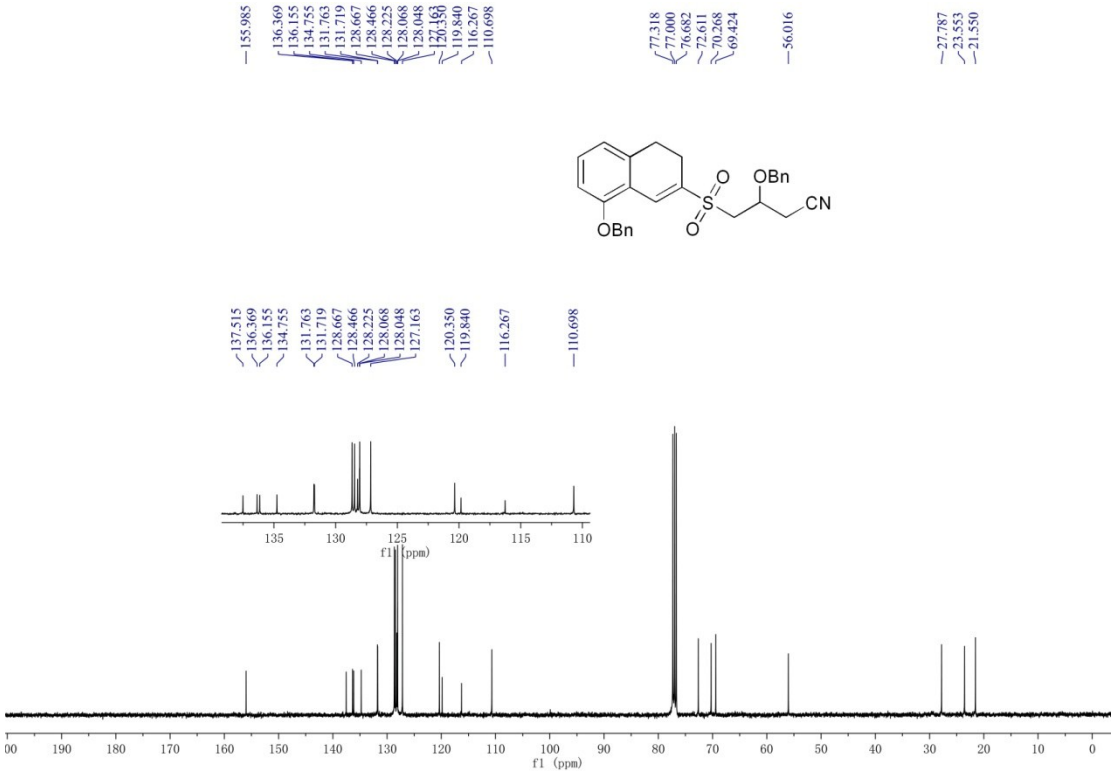
3-Benzyl-4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ab)



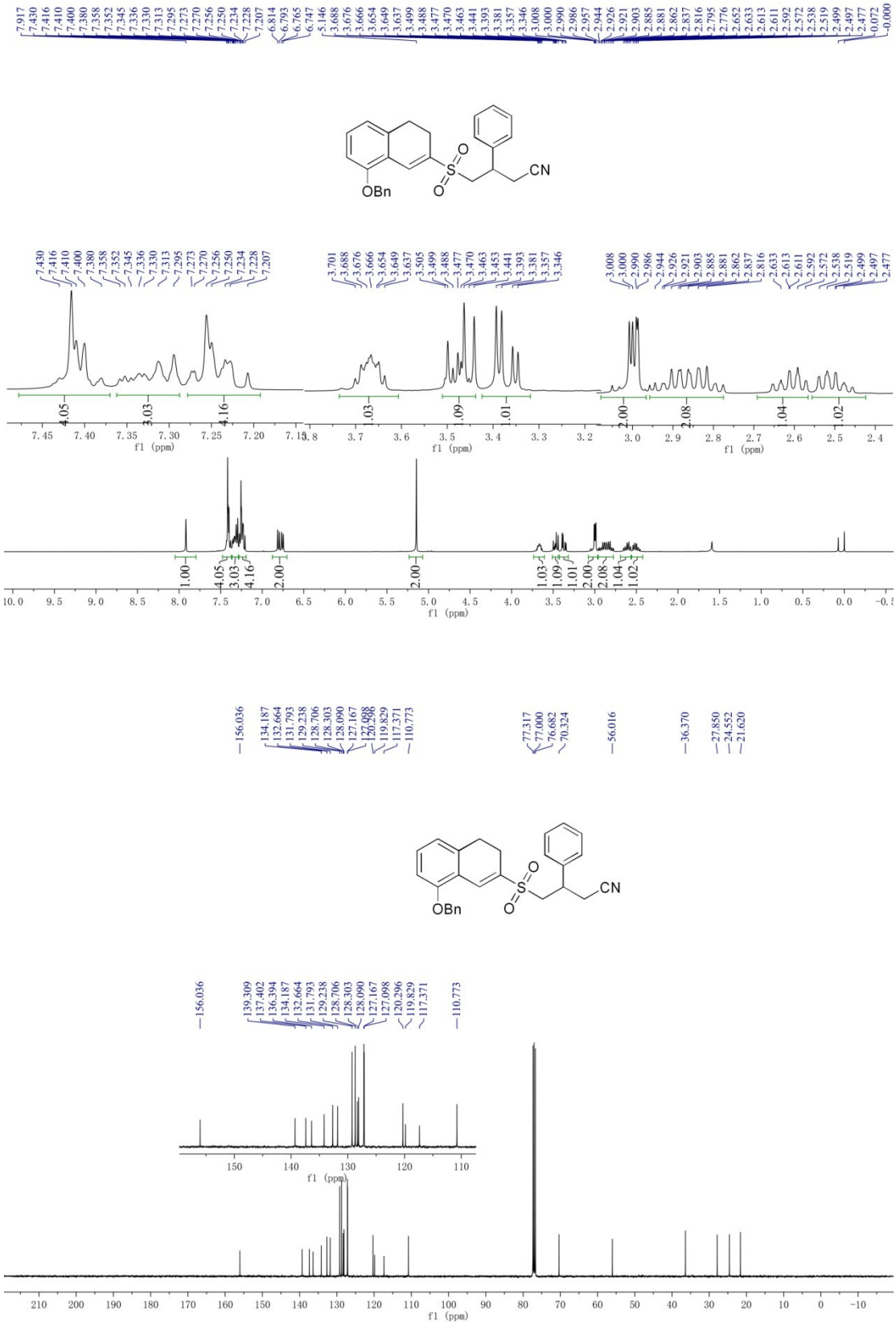


3-(Benzyloxy)-4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ac)

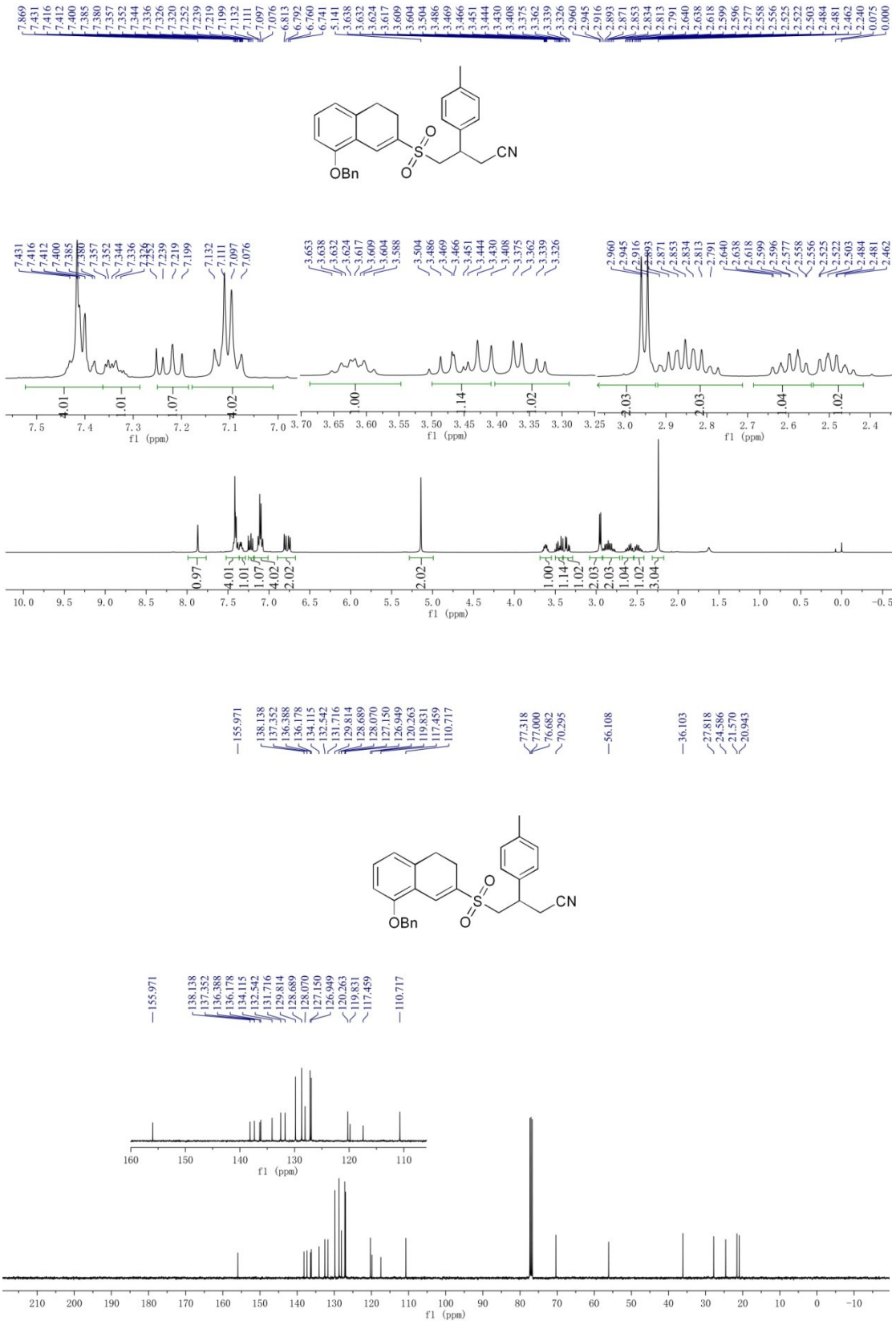




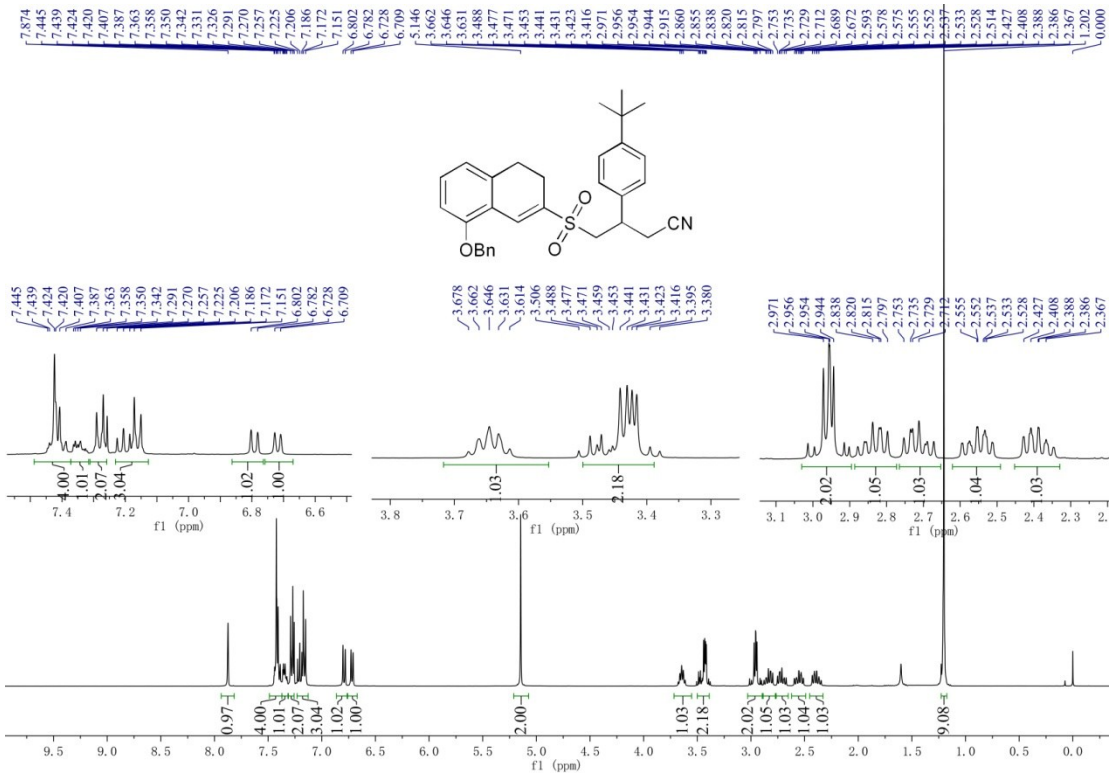
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-phenylbutanenitrile (3ad)

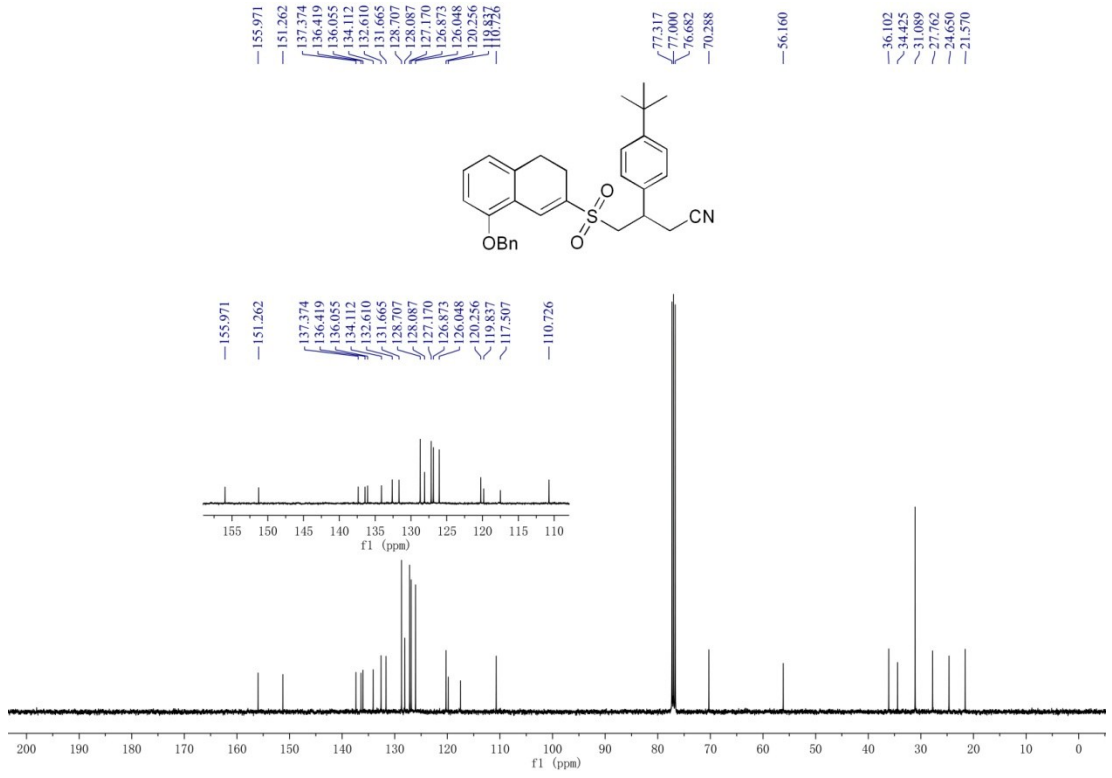


4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(p-tolyl)butanenitrile (3ae)

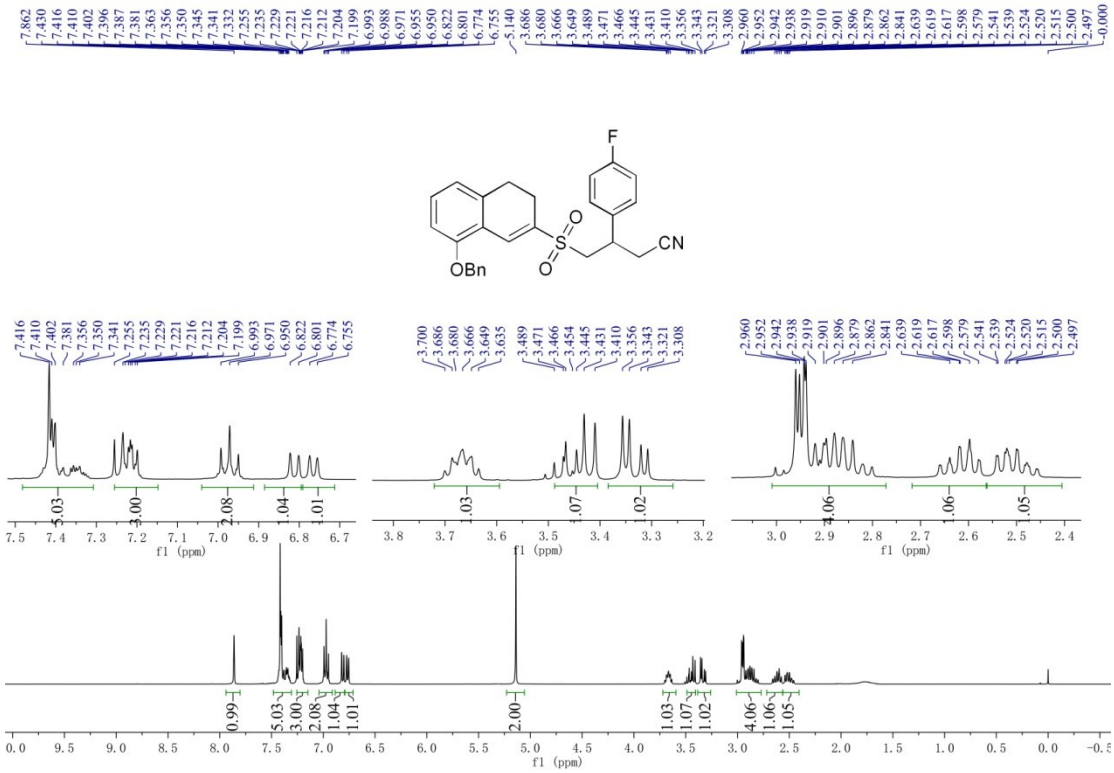


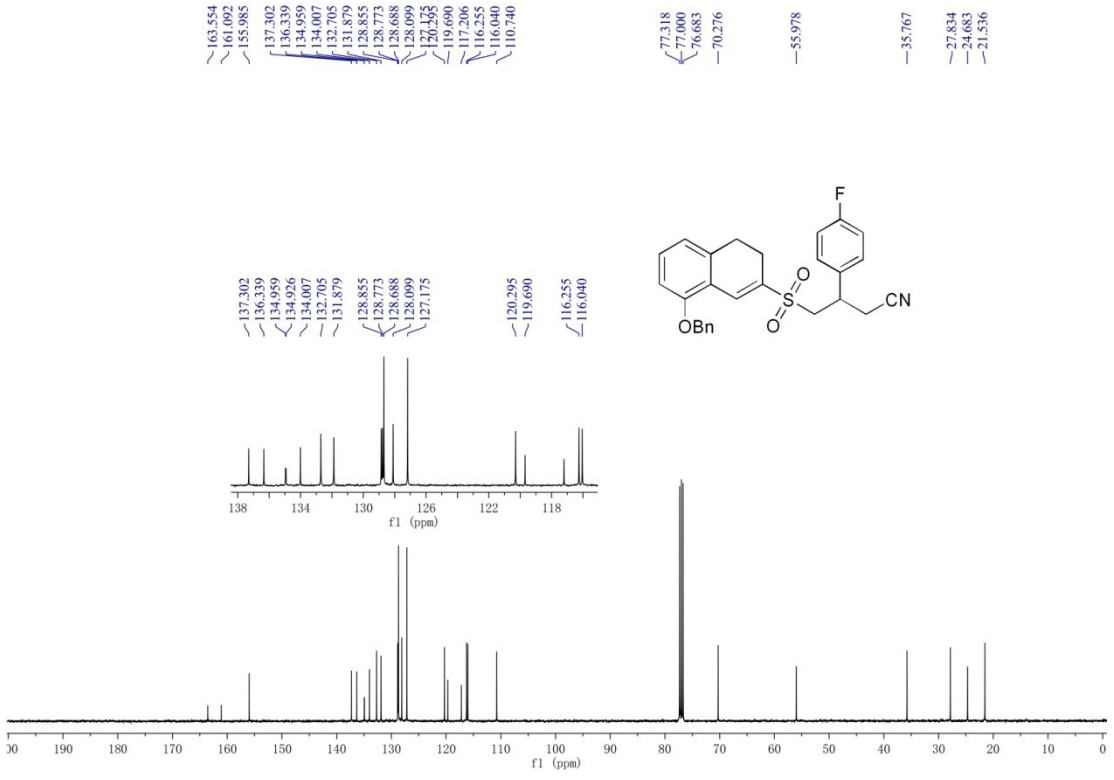
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-(tert-butyl)phenyl)butanenitrile (3af)

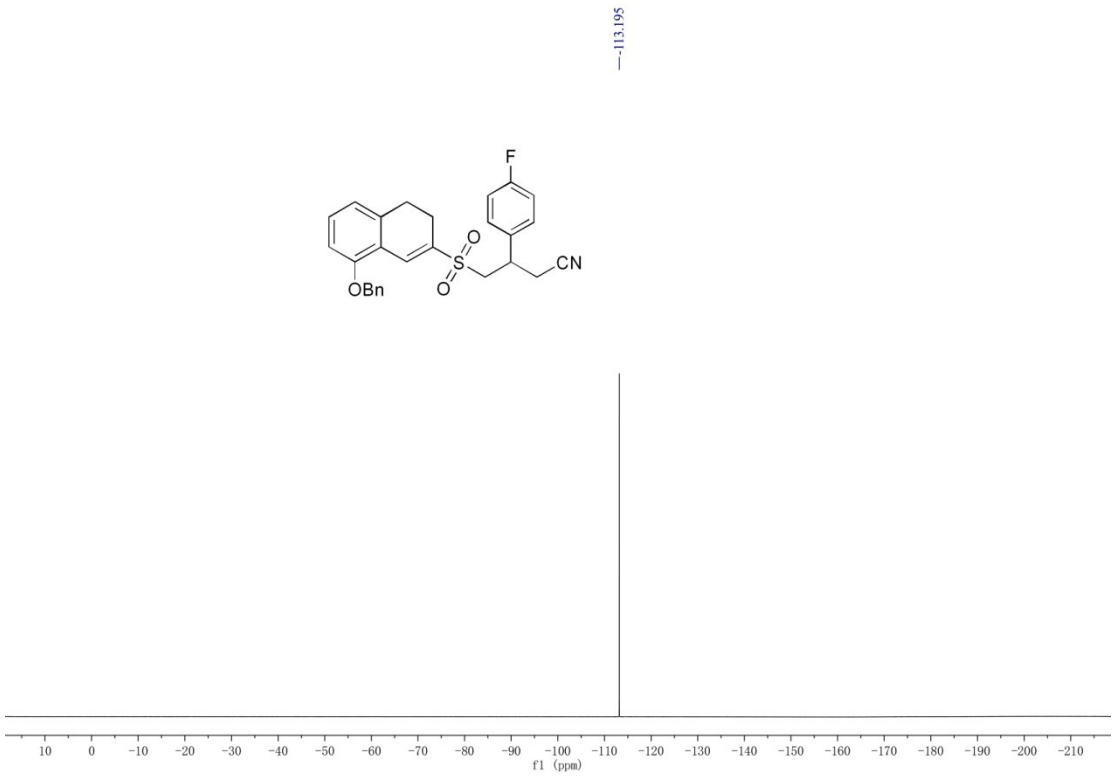




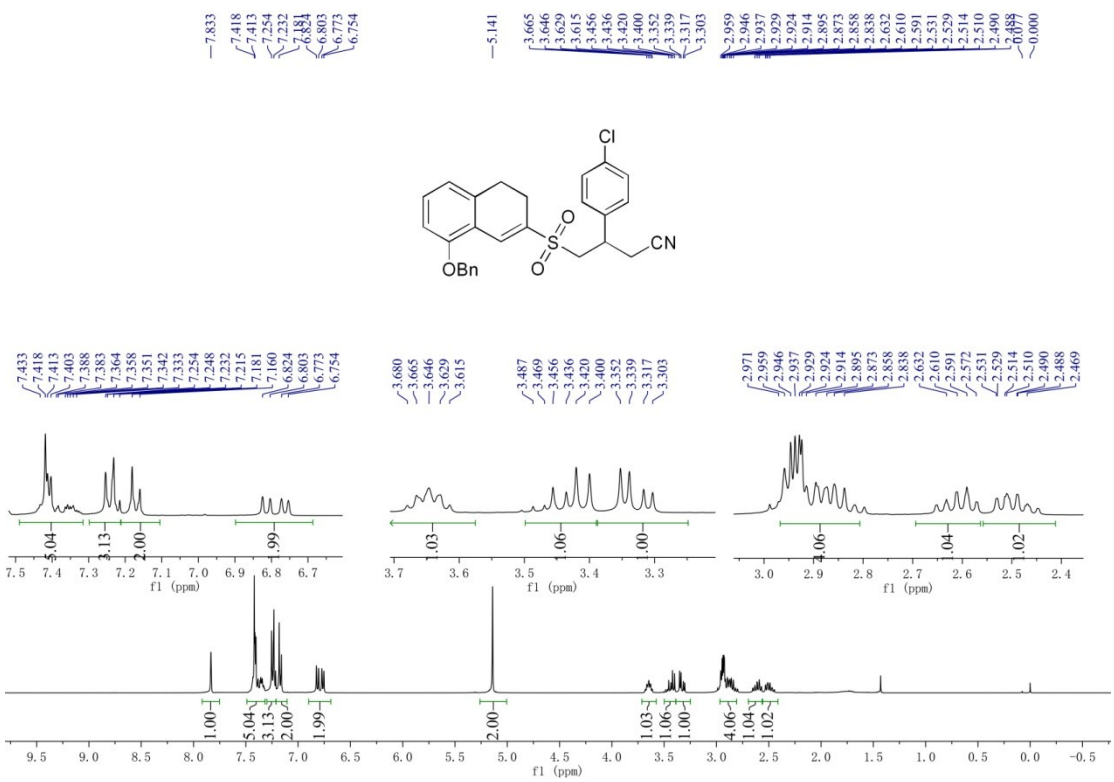
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-fluorophenyl)butanenitrile (3ag)

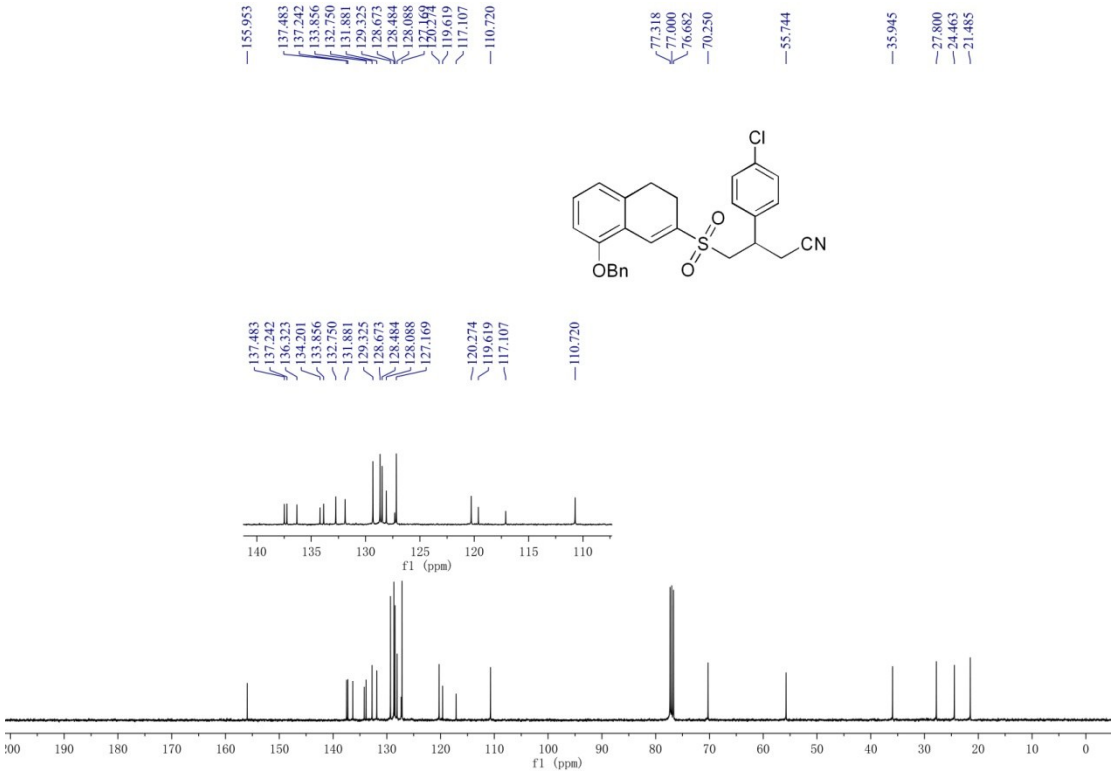




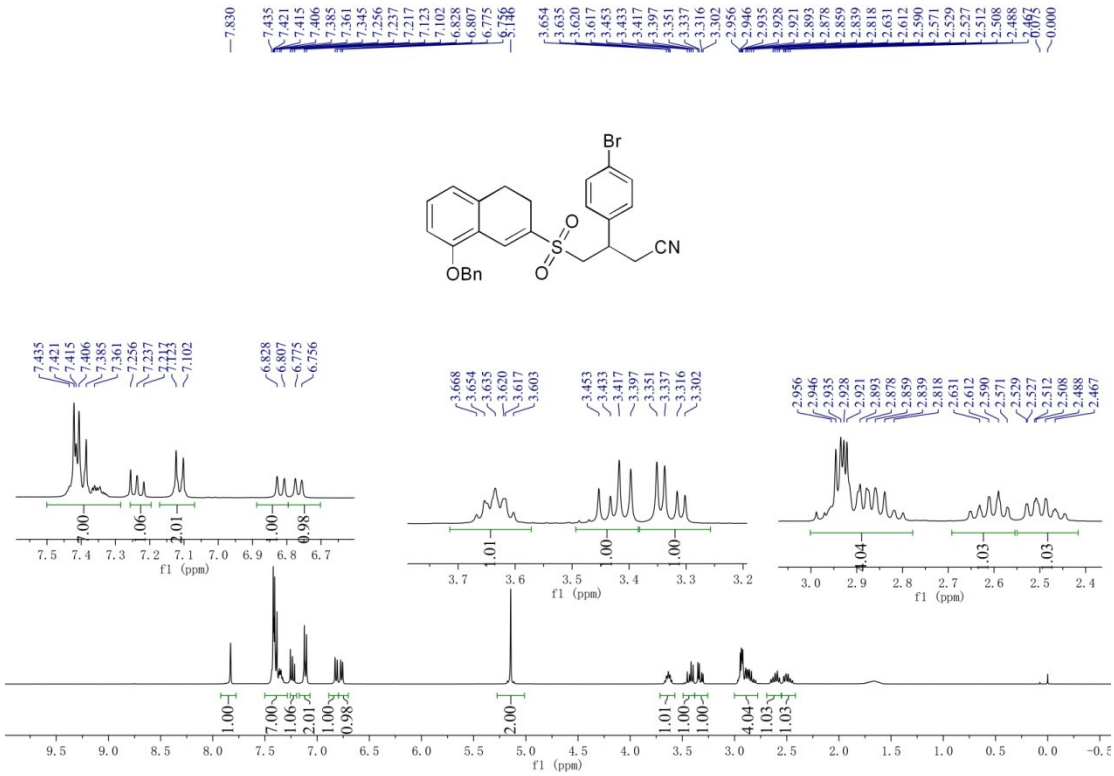

-113.195
F
O
S
O
CN
OBn
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

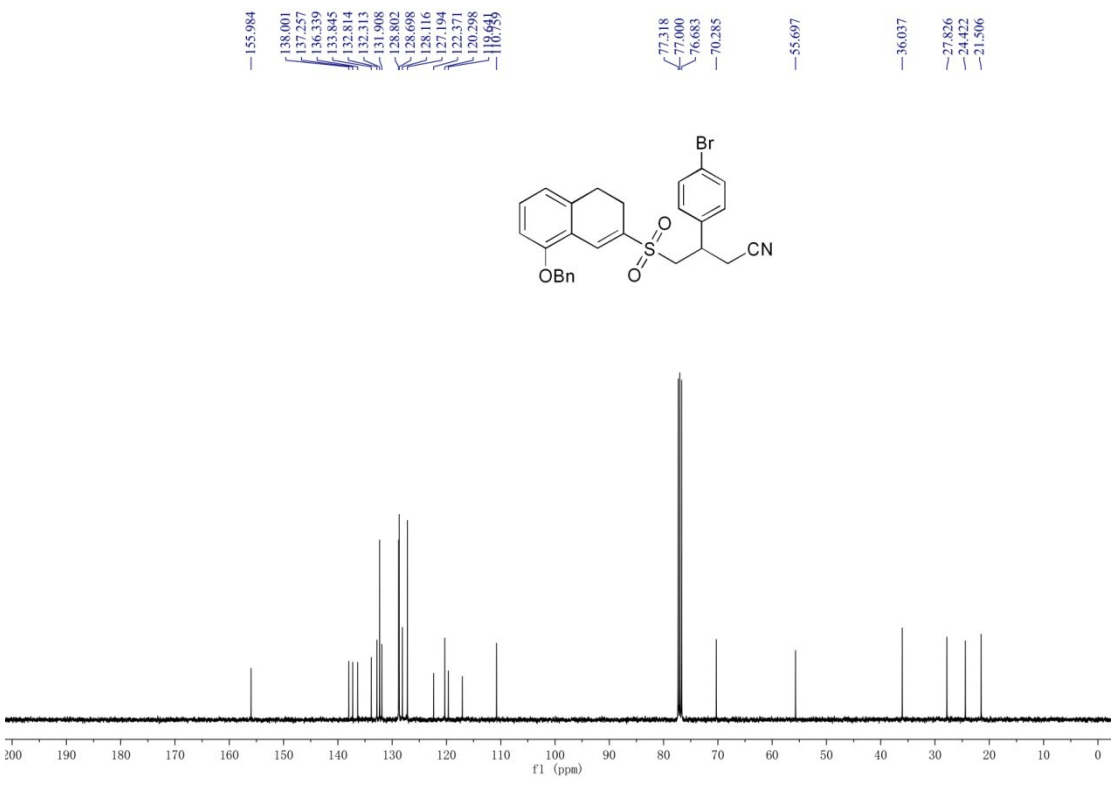
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-chlorophenyl)butanenitrile (3ah)



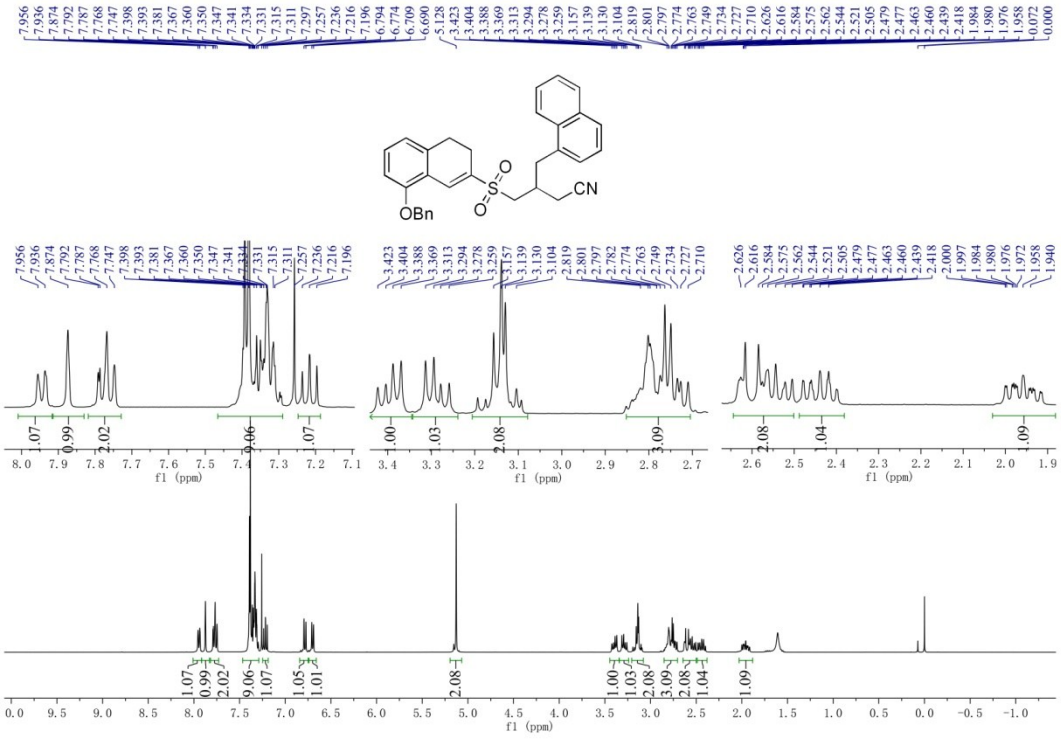


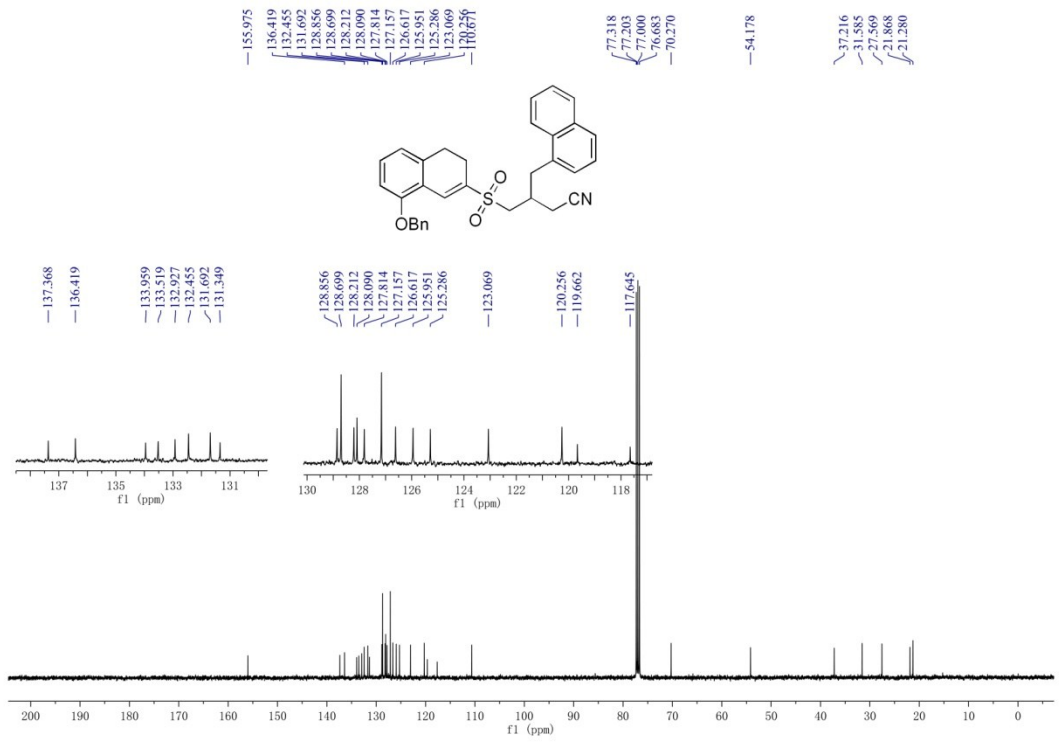
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(4-bromophenyl)butanenitrile (3ai)



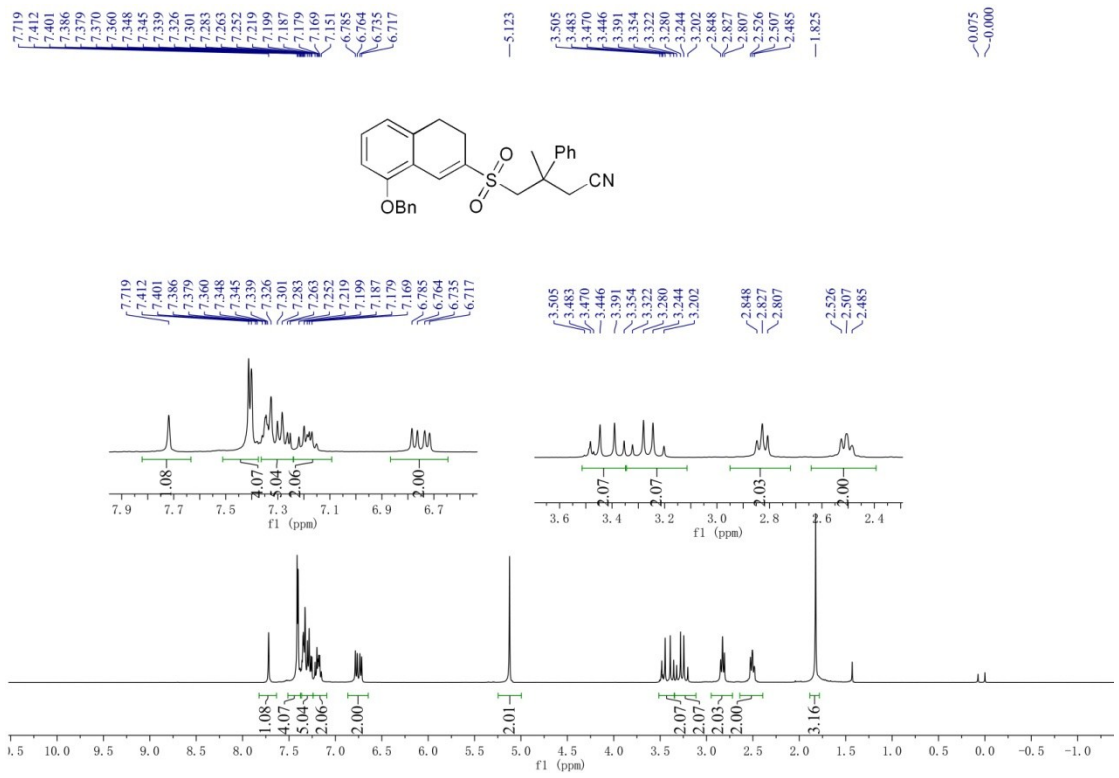


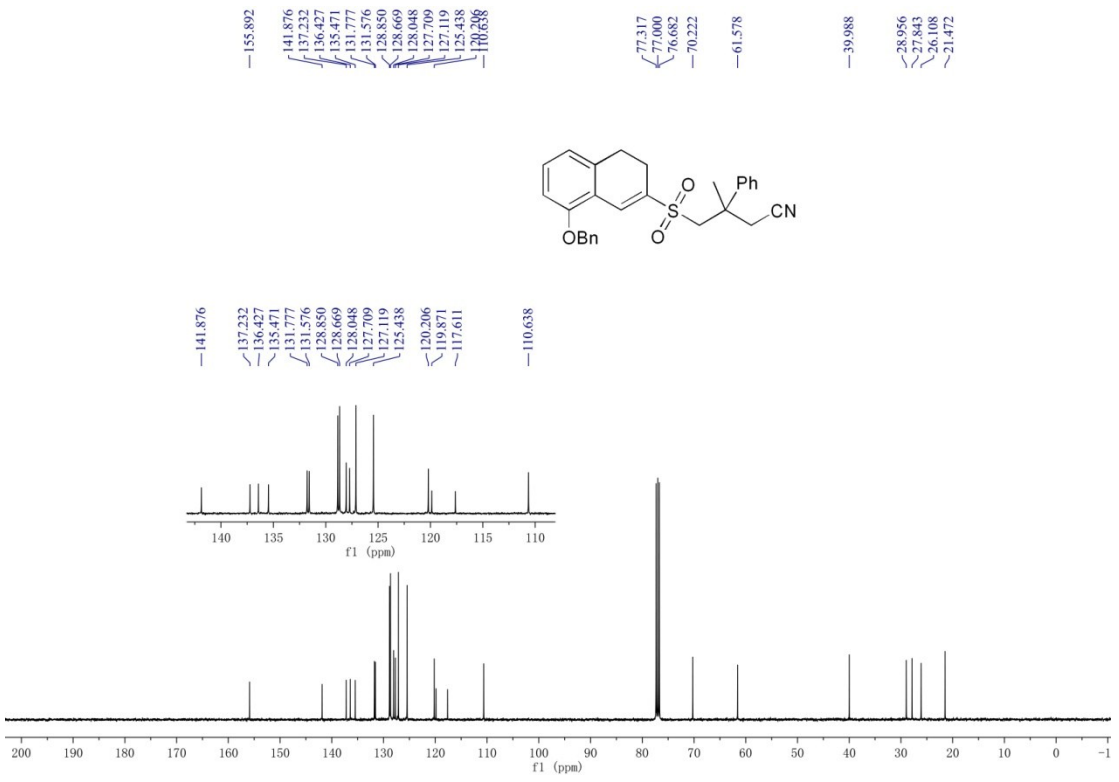
4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-(naphthalen-1-yl)butanenitrile (3aj)



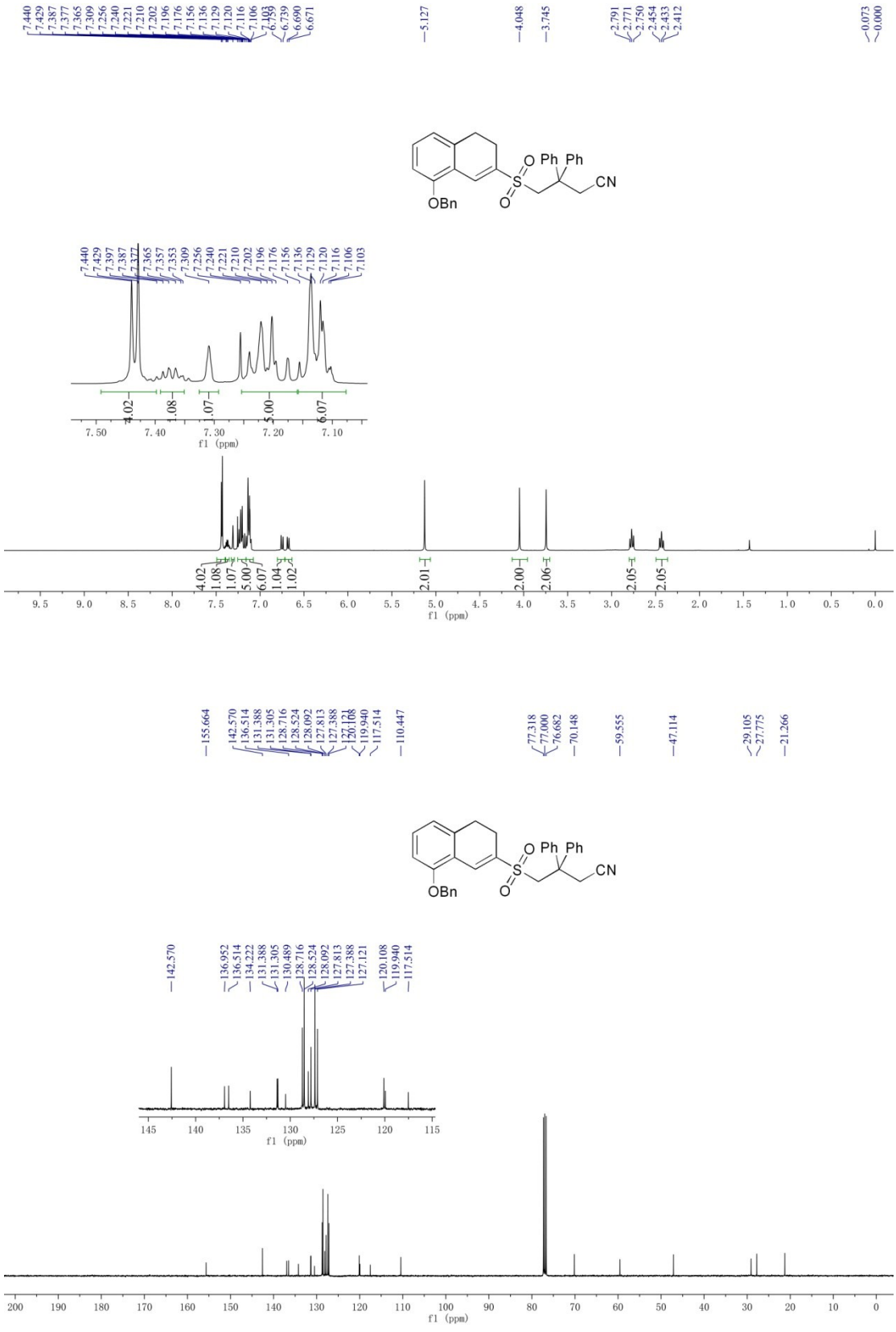


4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3-methyl-3-phenylbutanenitrile (3ak)

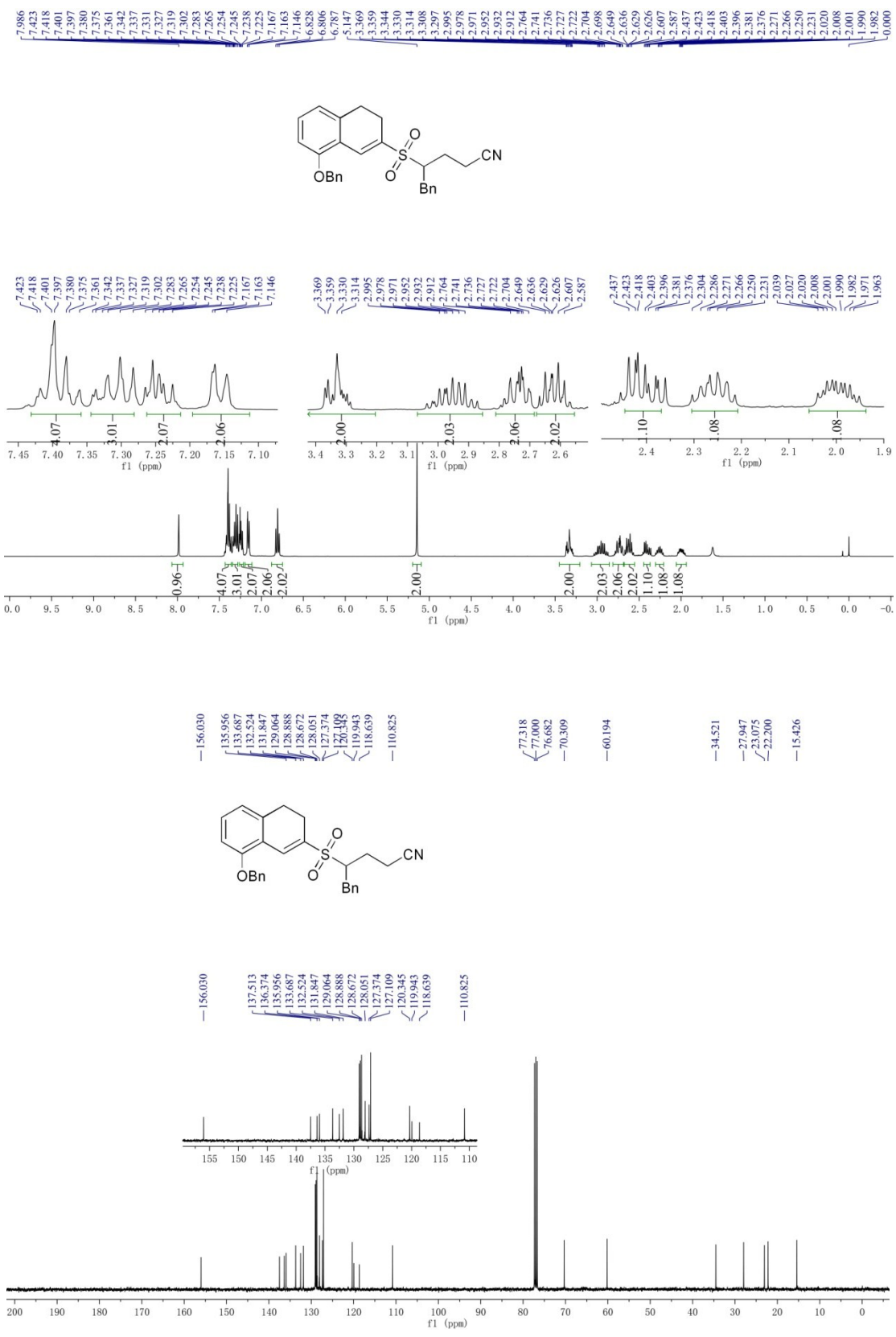




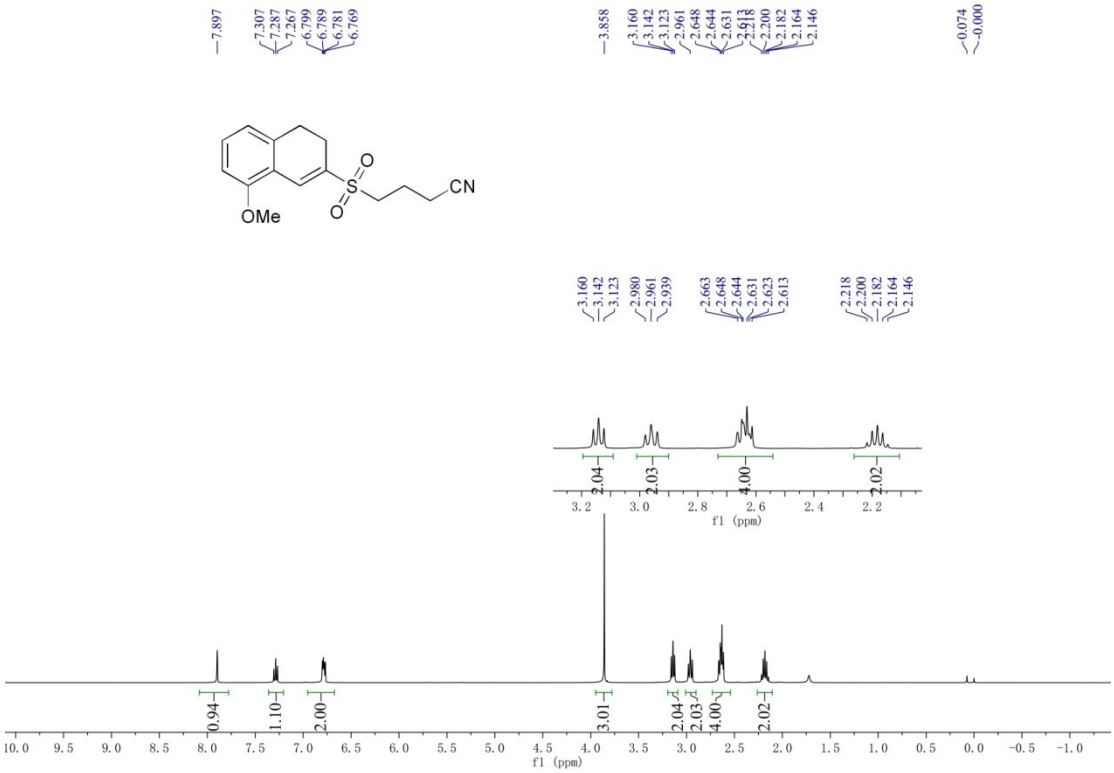
4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-3,3-diphenylbutanenitrile (3al)

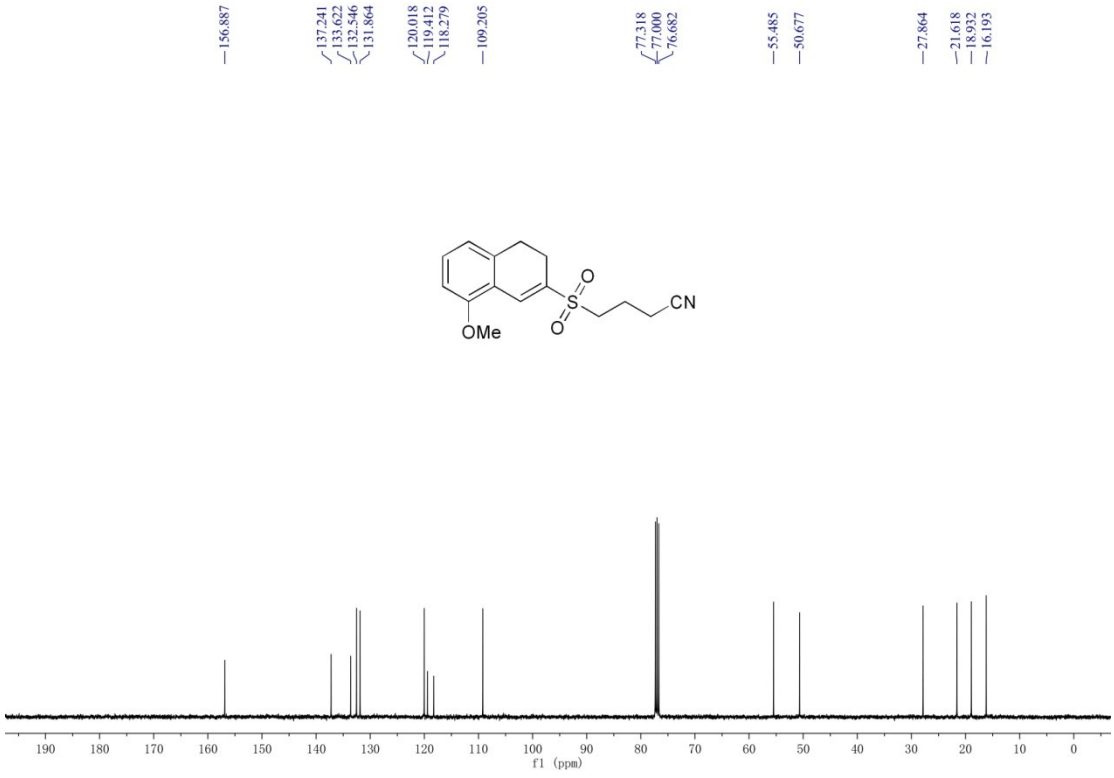


4-((8-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)-5-phenylpentanenitrile (3am)

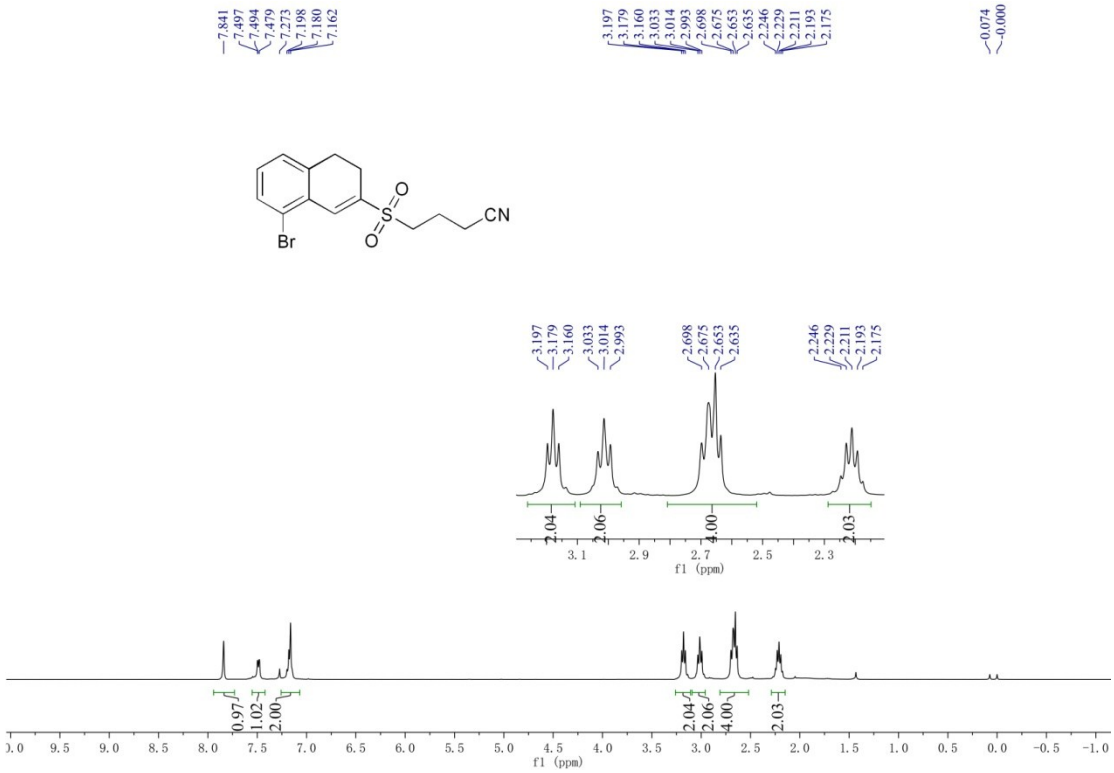


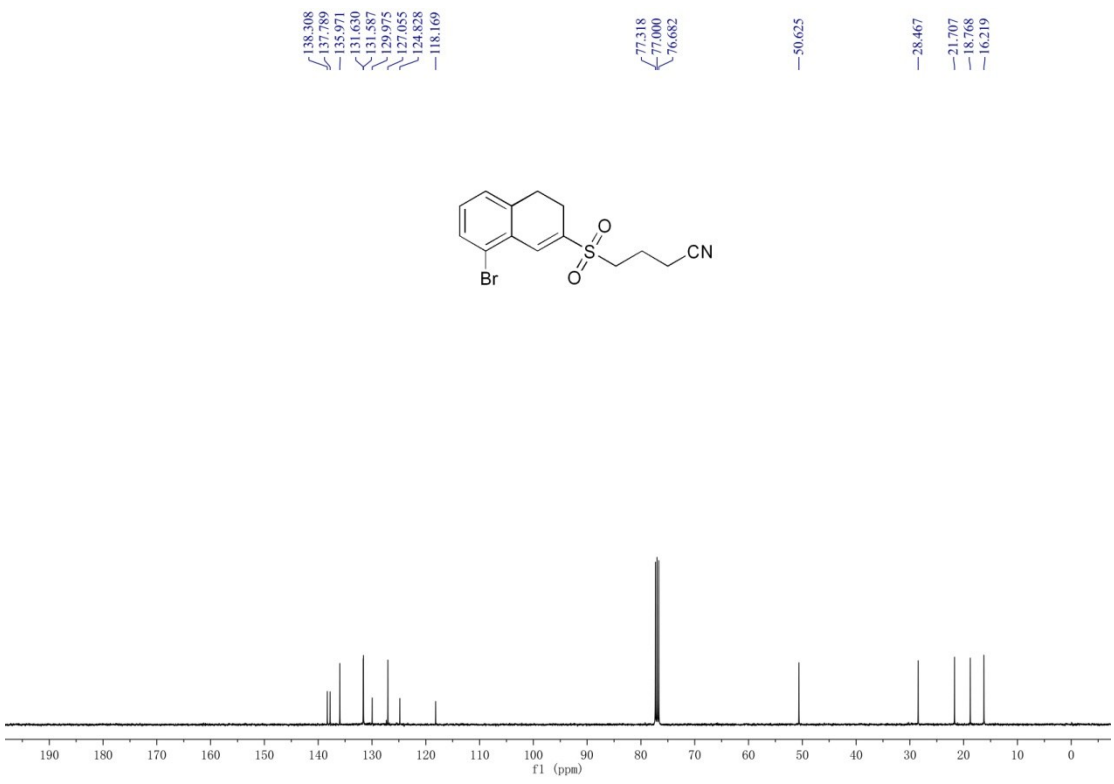
4-((8-Methoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ba)



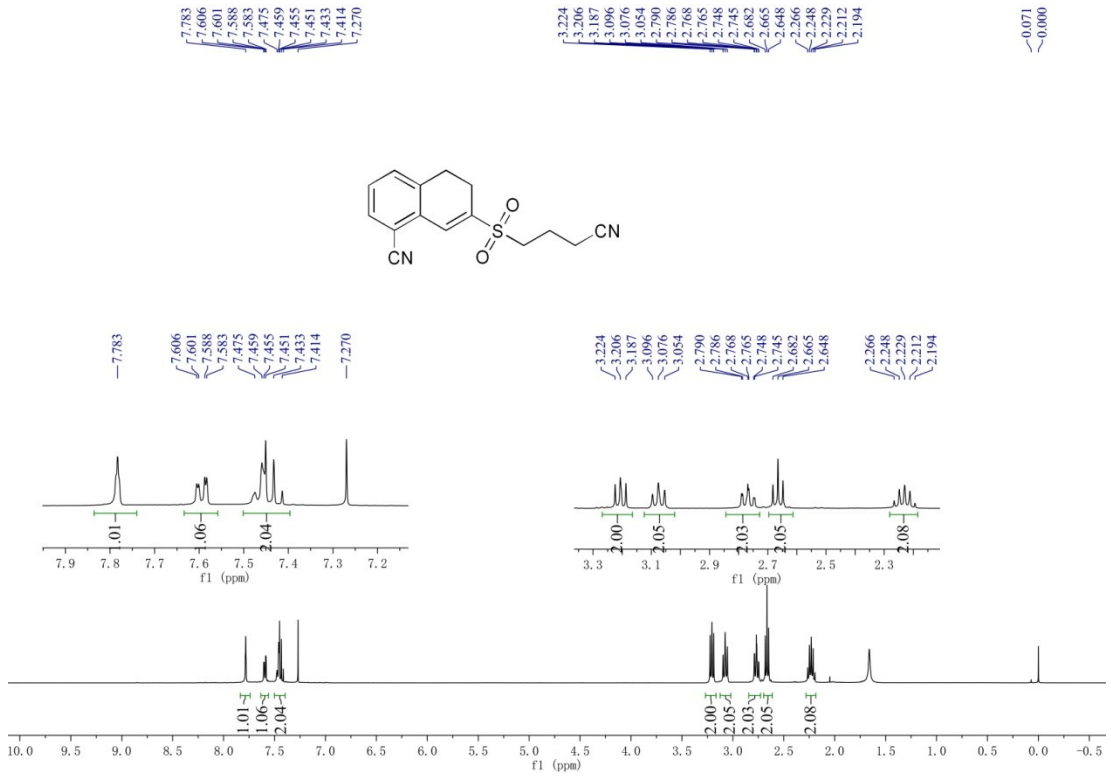


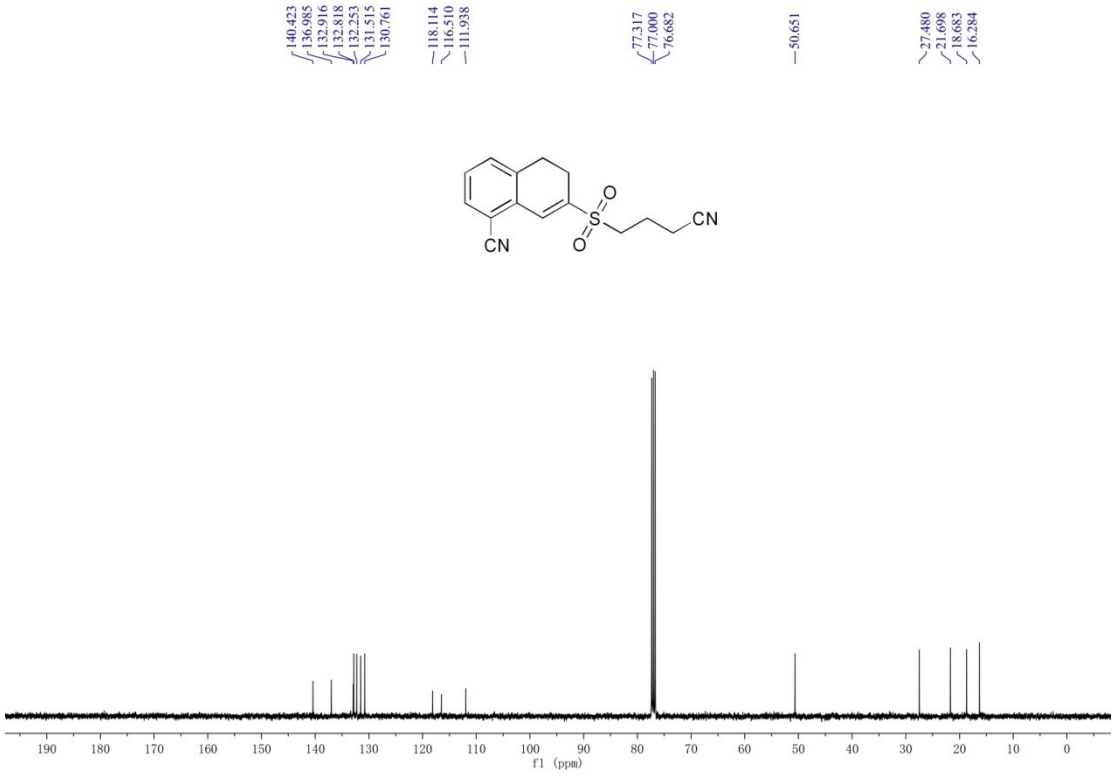
4-((8-Bromo-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ca)



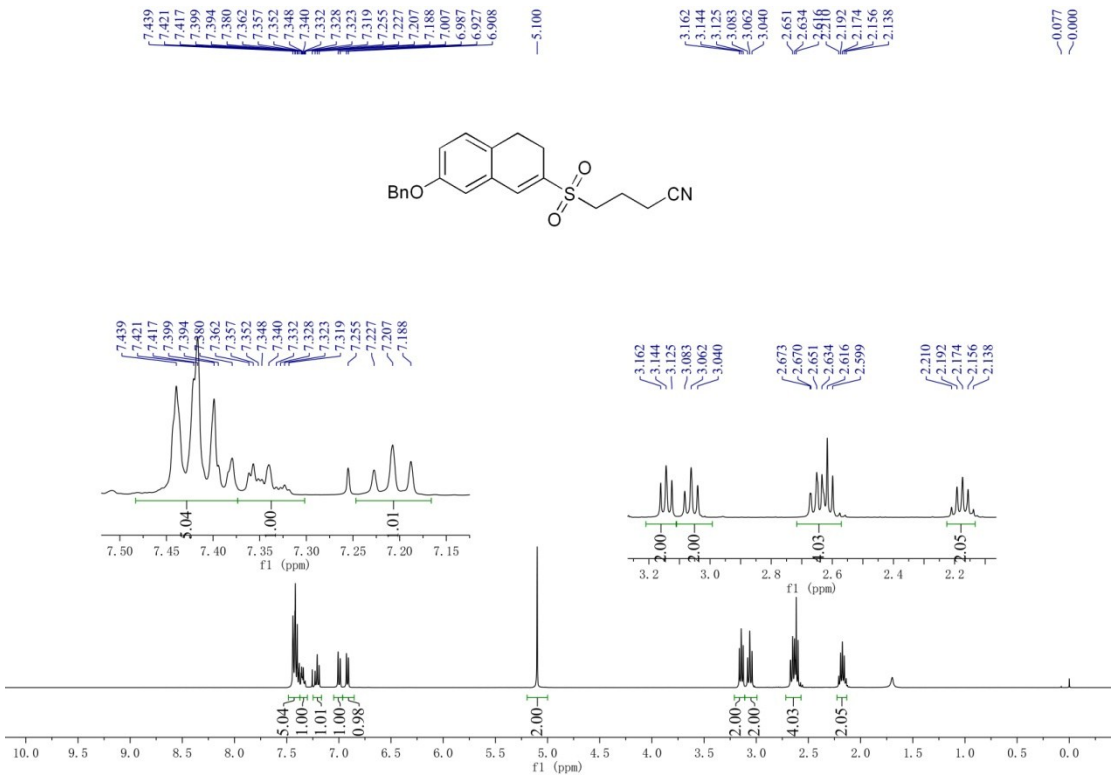


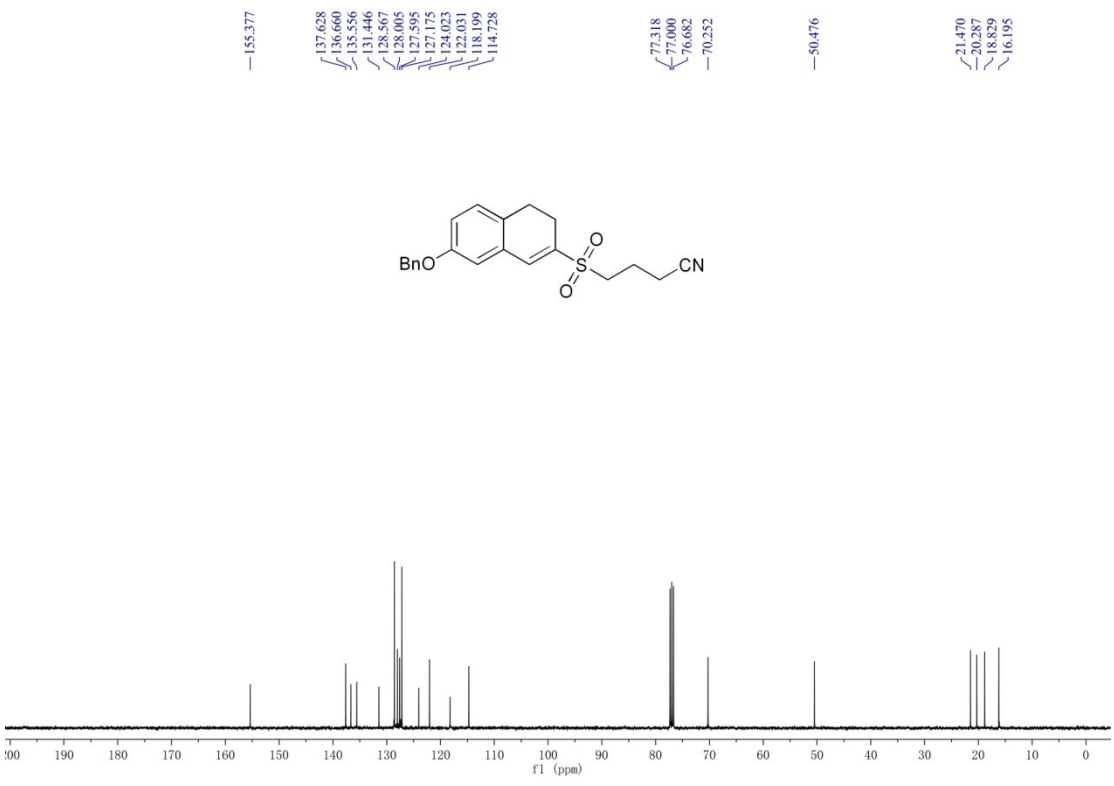
7-((3-Cyanopropyl)sulfonyl)-5,6-dihydronaphthalene-1-carbonitrile (3da)



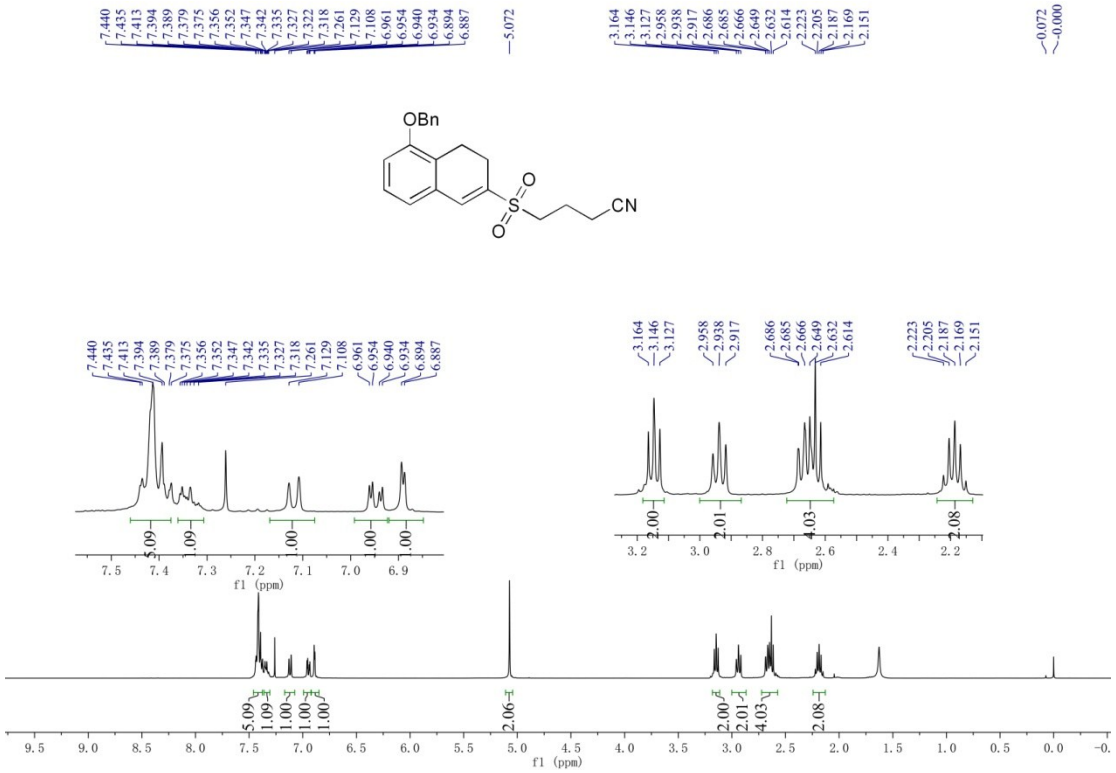


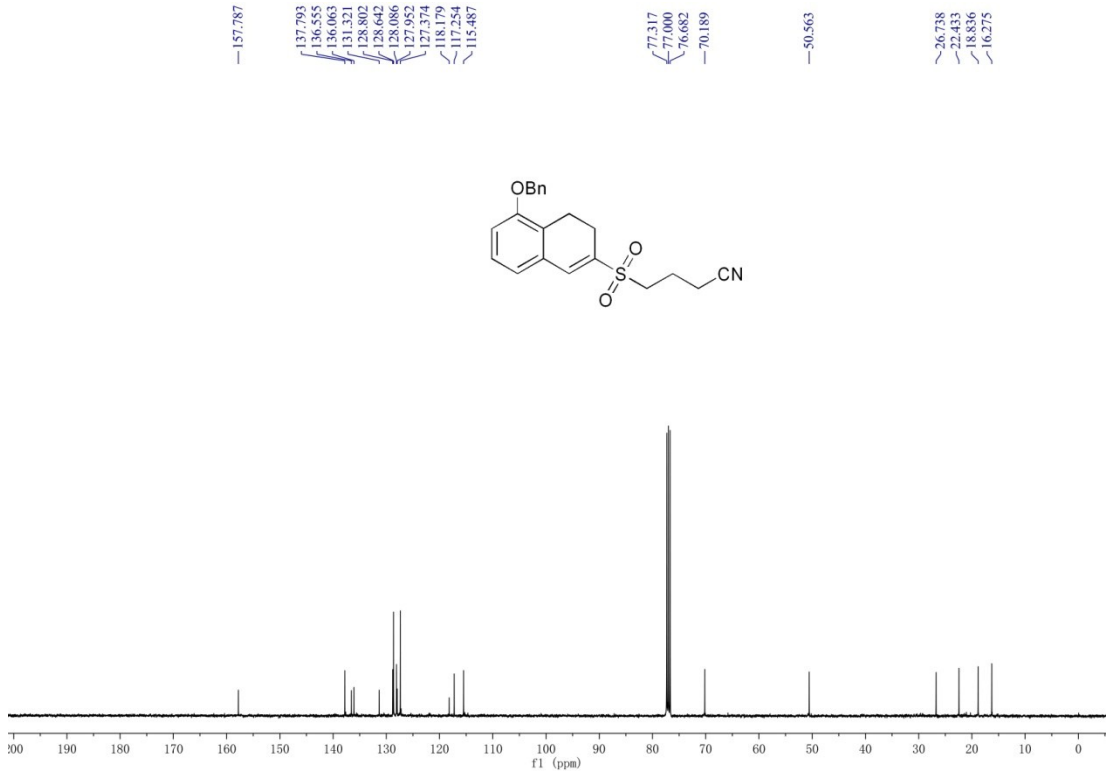
4-((7-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ea)



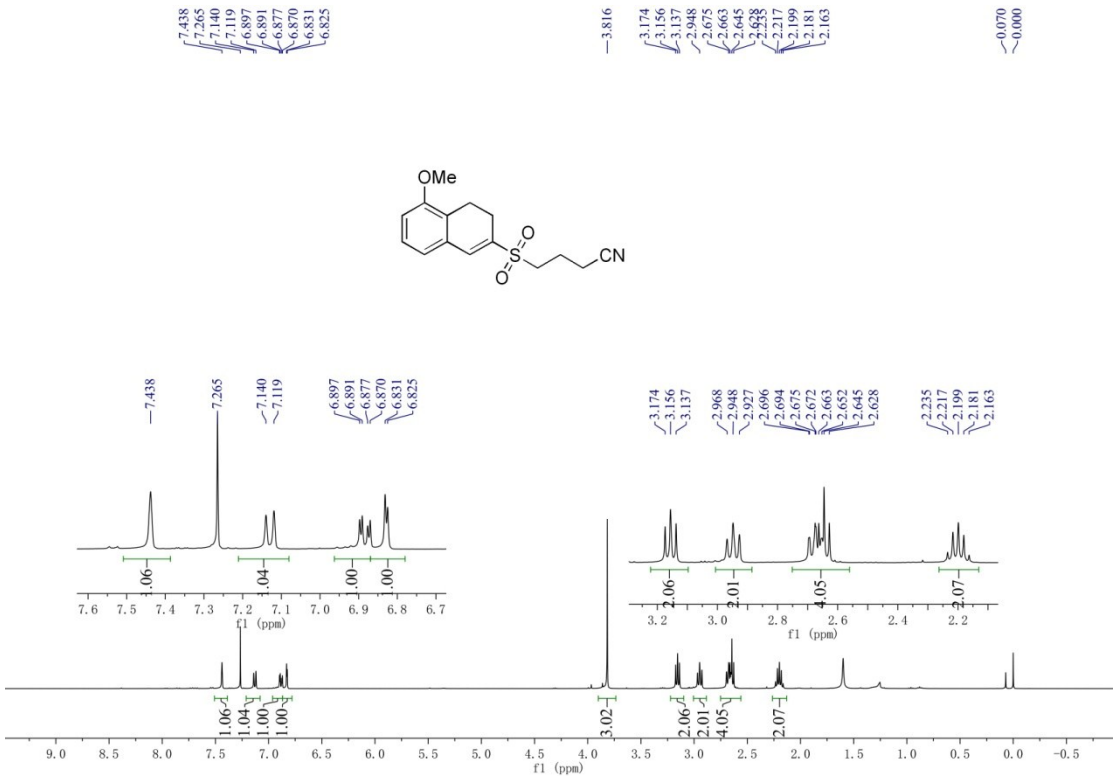


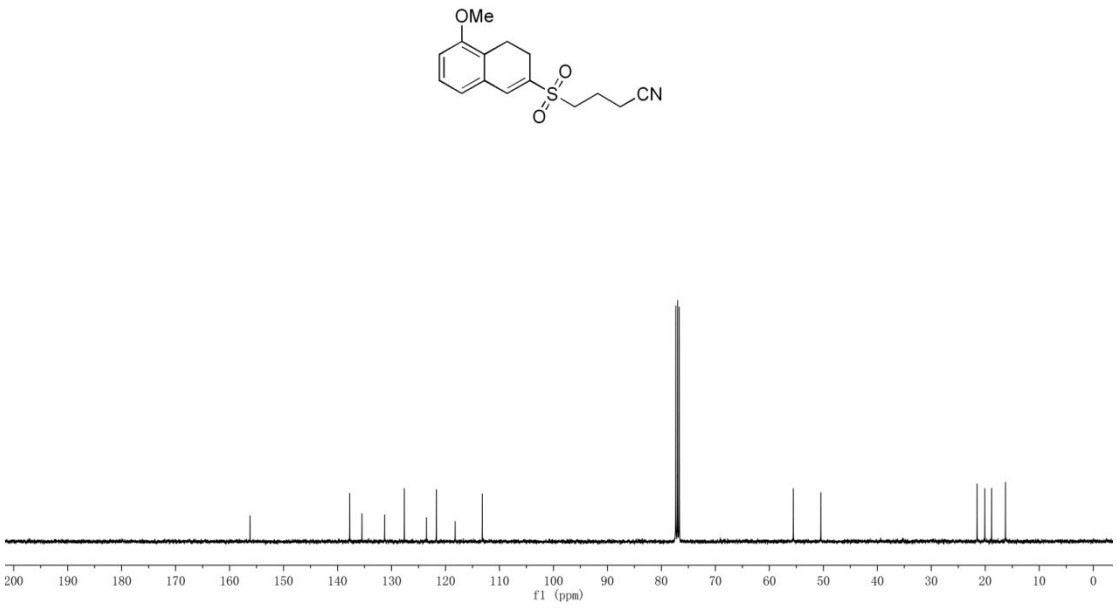
4-((5-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ea')



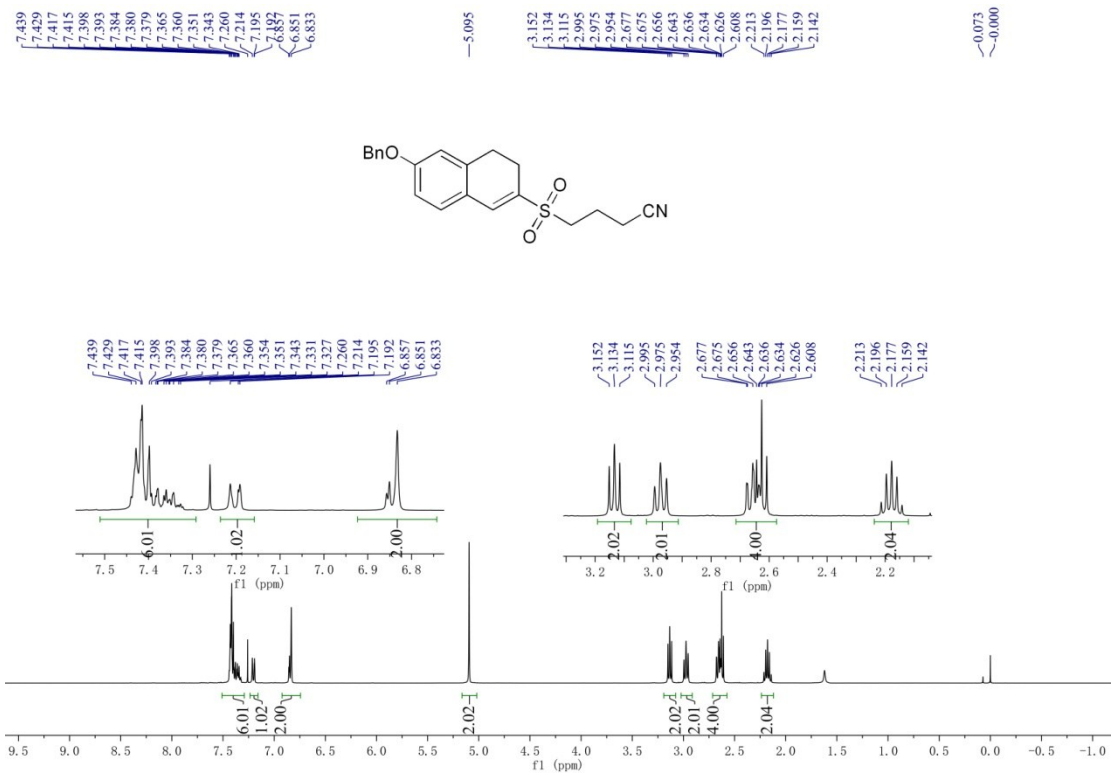


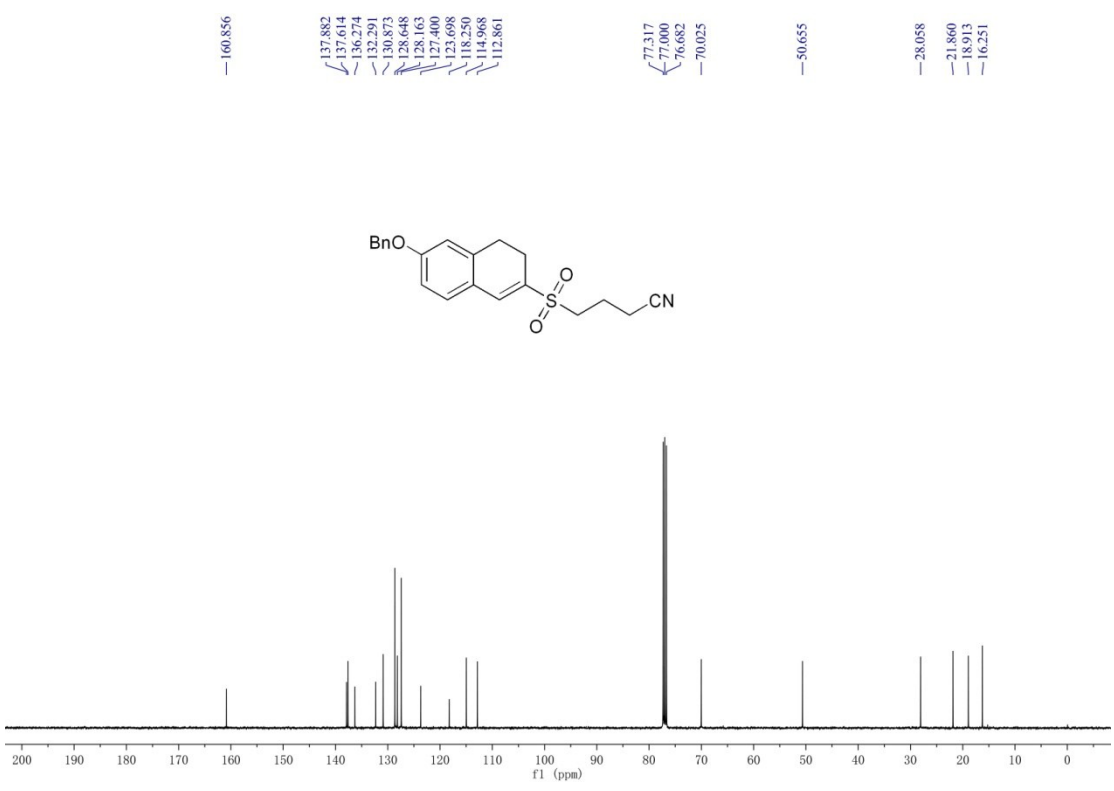
4-((5-methoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3fa)



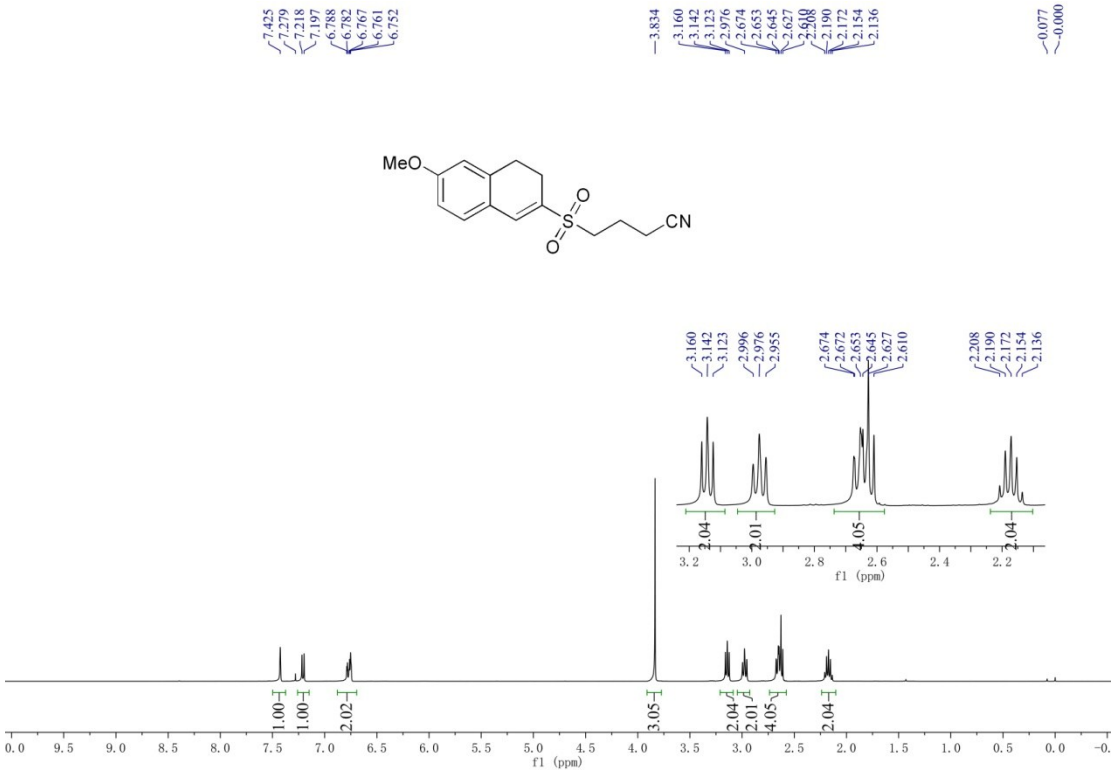


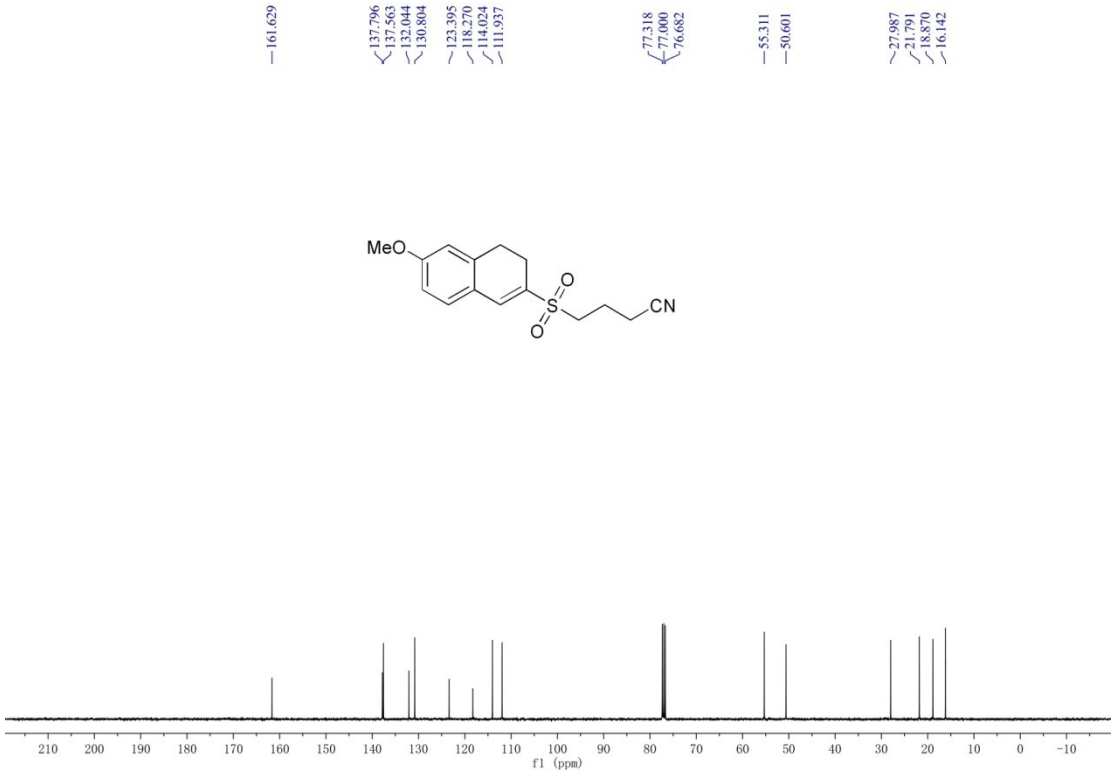
4-((6-(Benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ga)



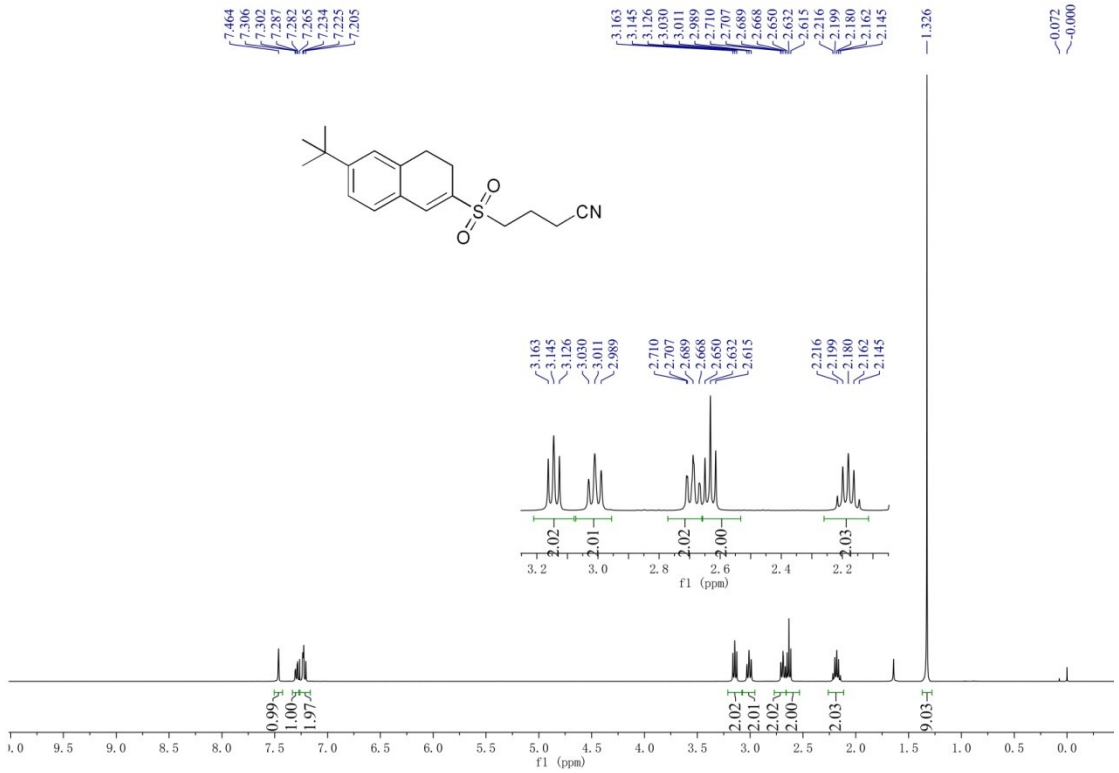


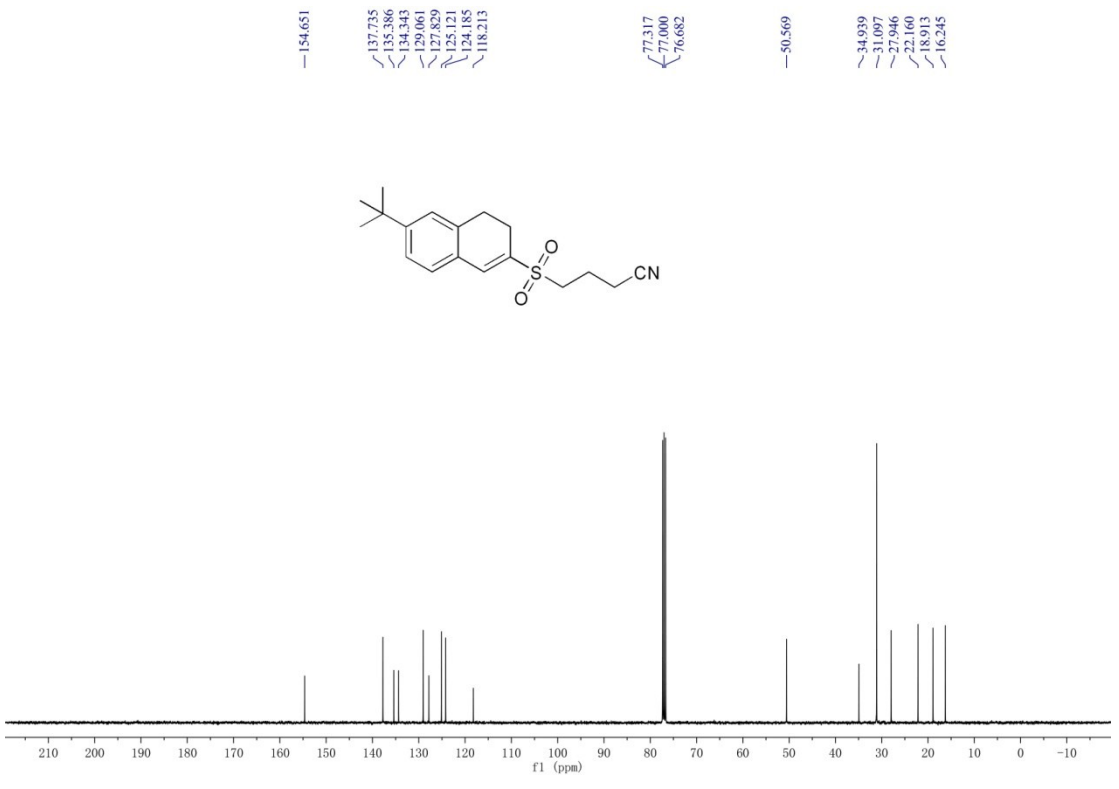
4-((6-Methoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ha)



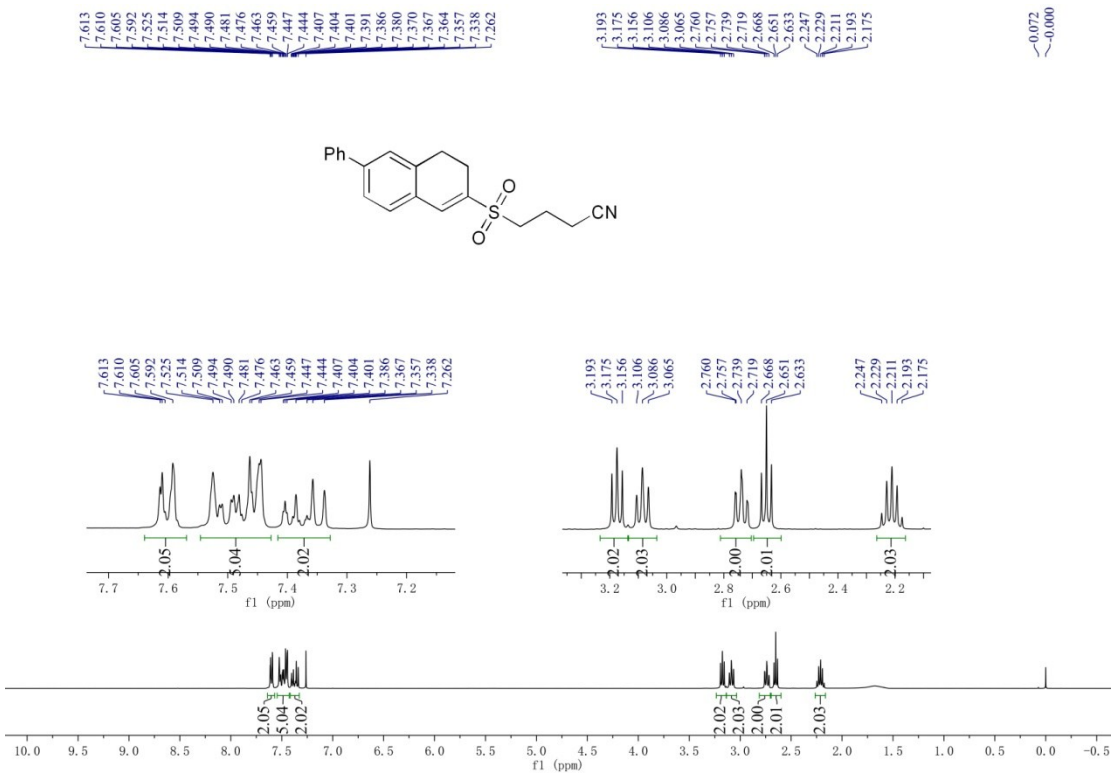


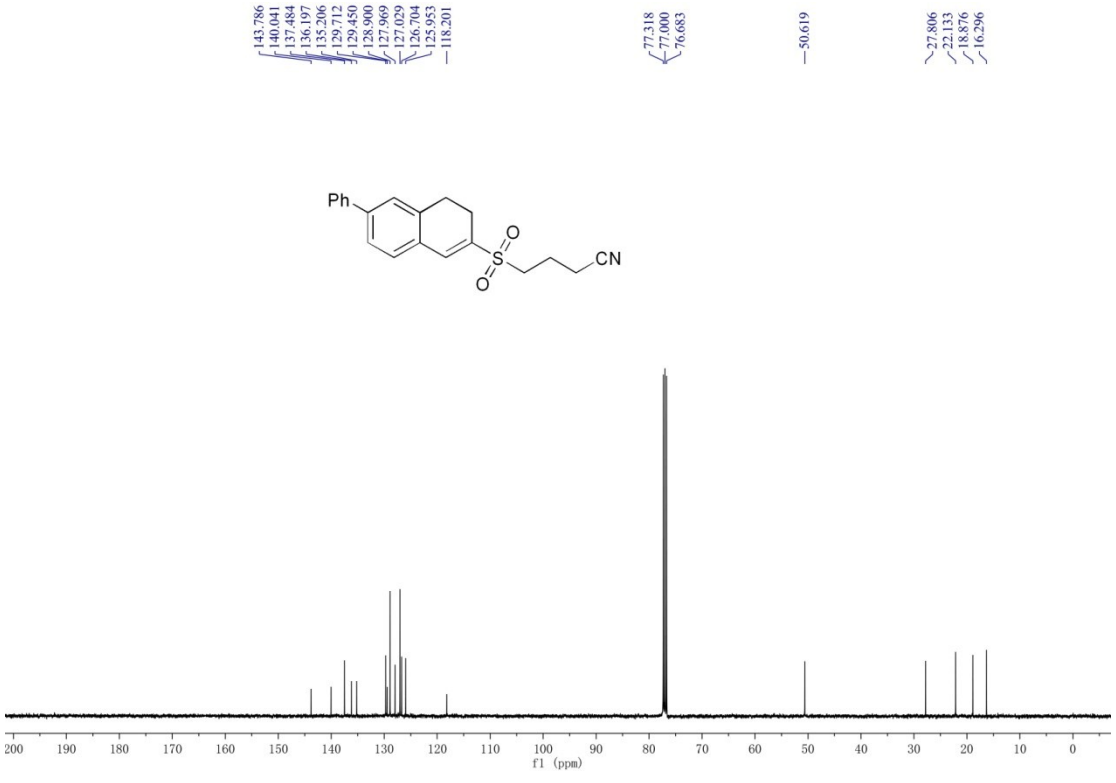
4-((6-(*tert*-Butyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ia)



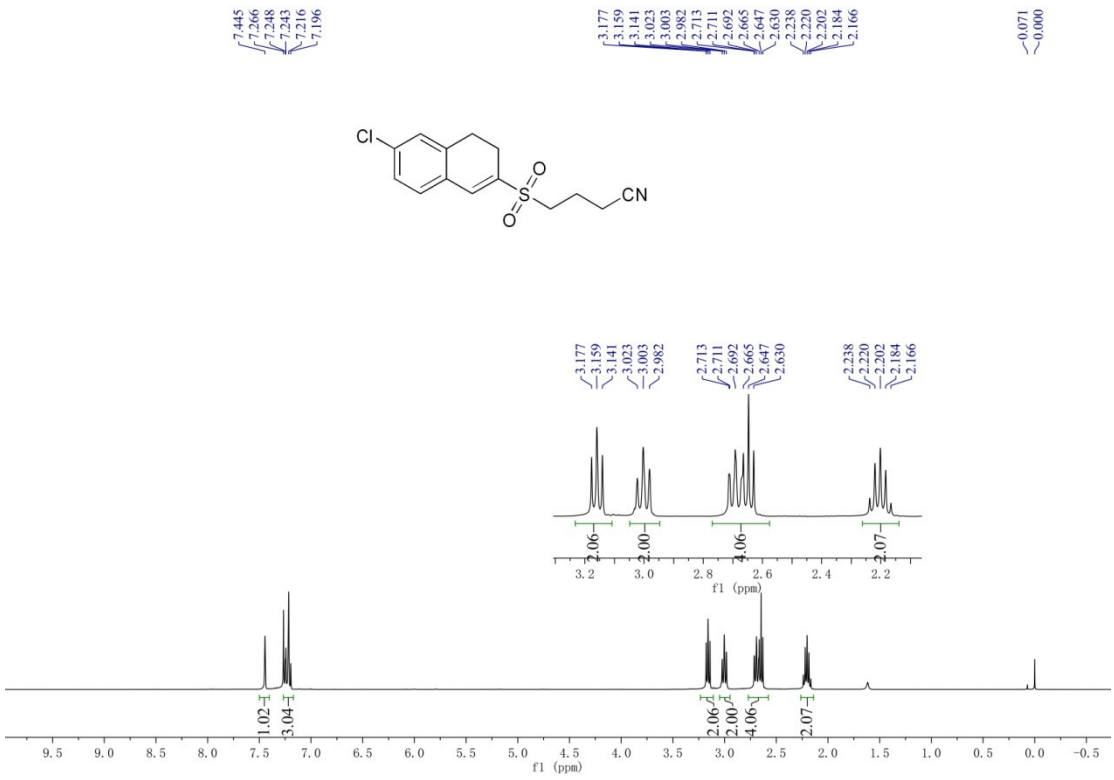


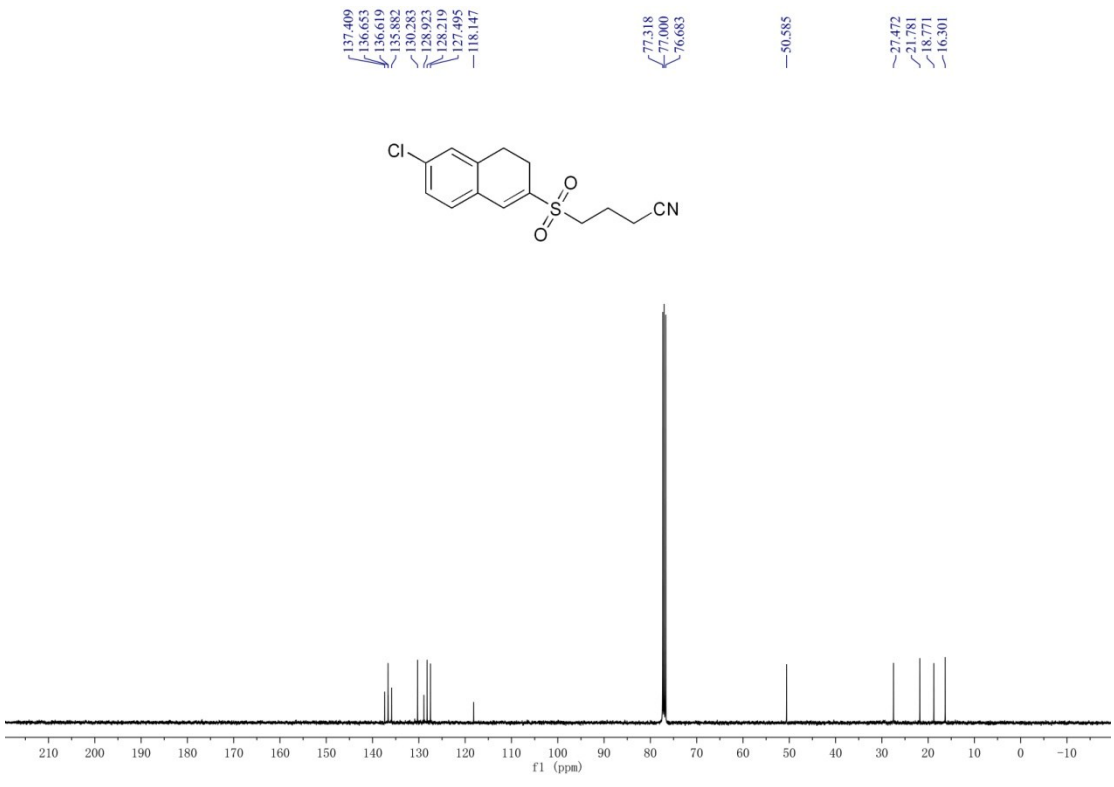
4-((6-Phenyl-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ja)



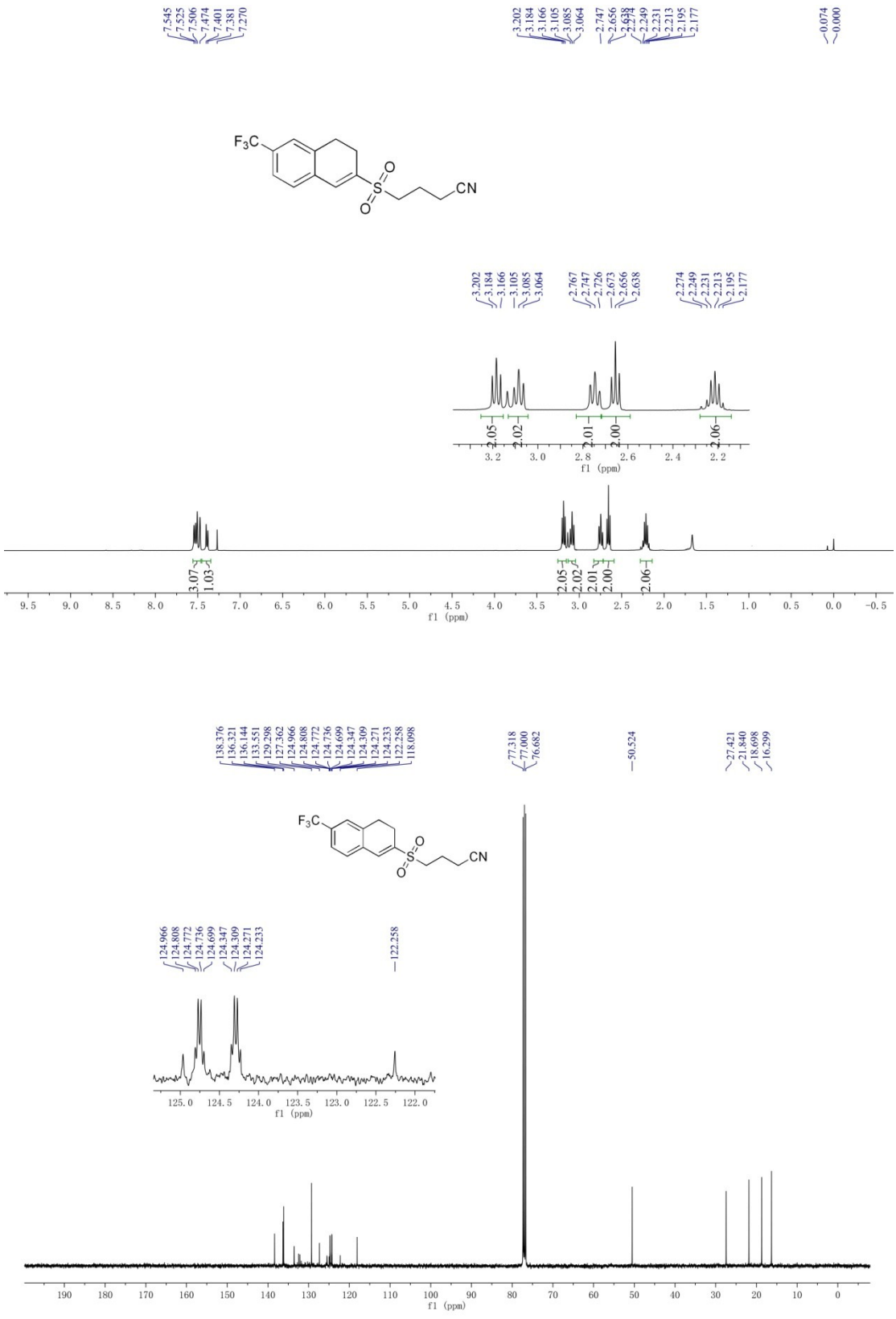


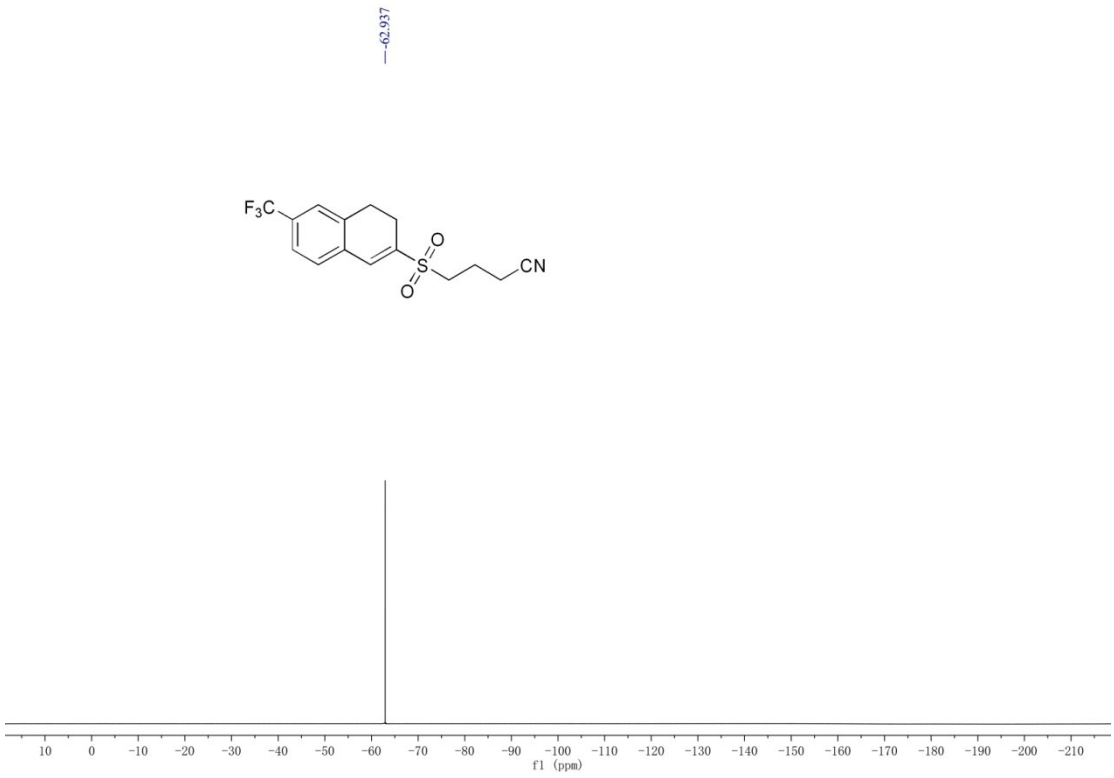
4-((6-Chloro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ka)



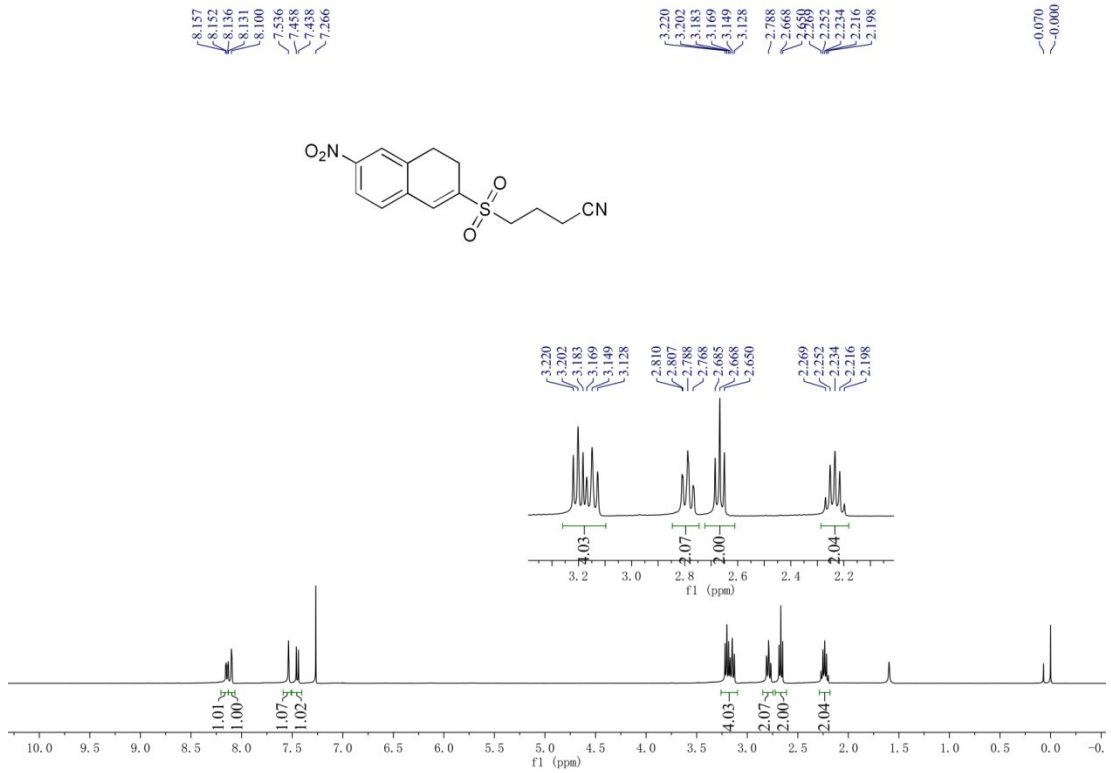


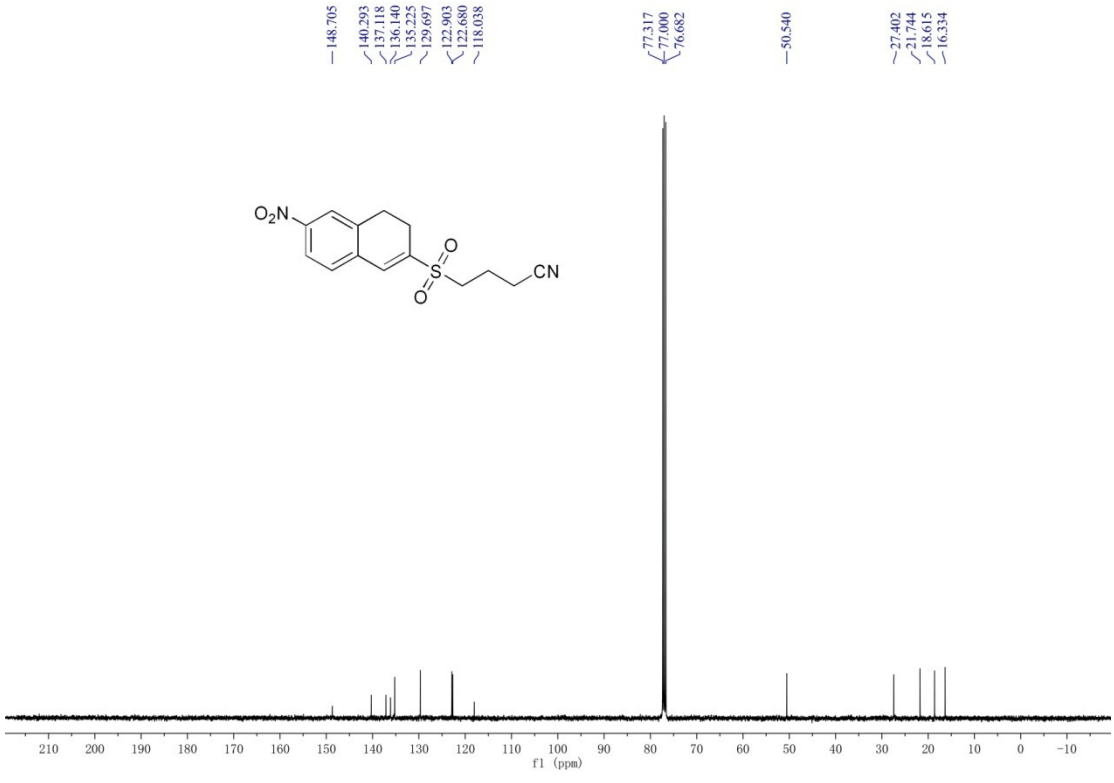
4-((6-(Trifluoromethyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3la)



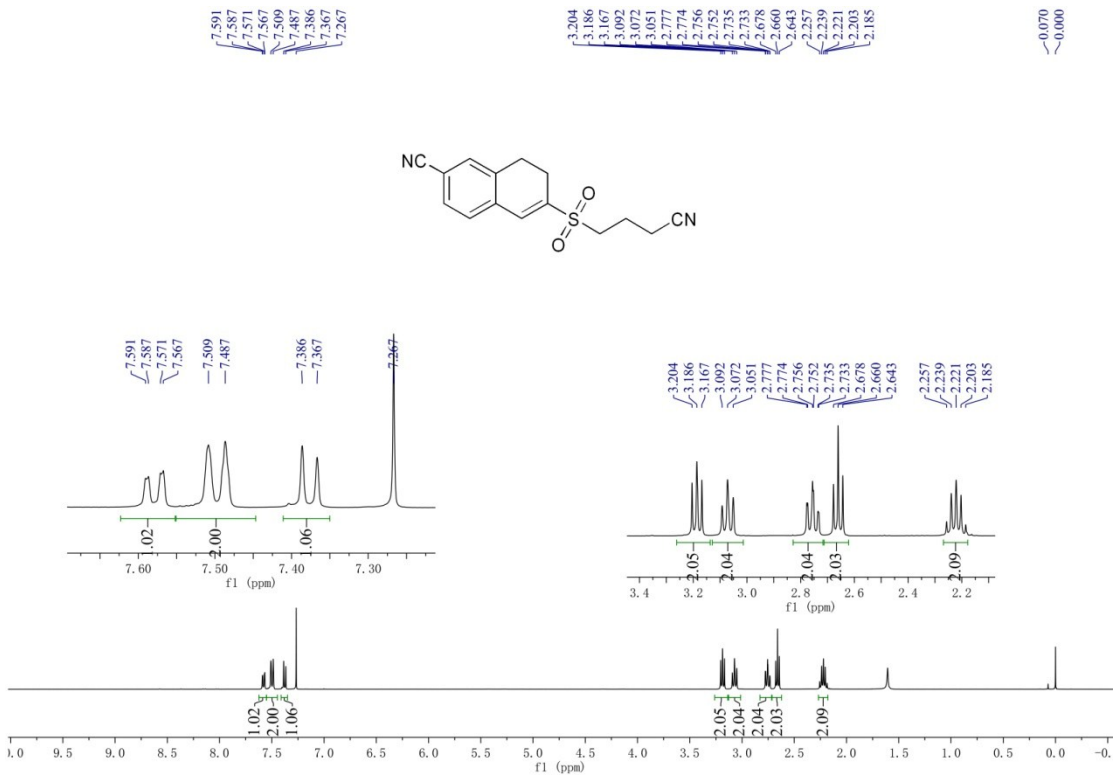

-62.937
F3C
O
S
O
CN
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

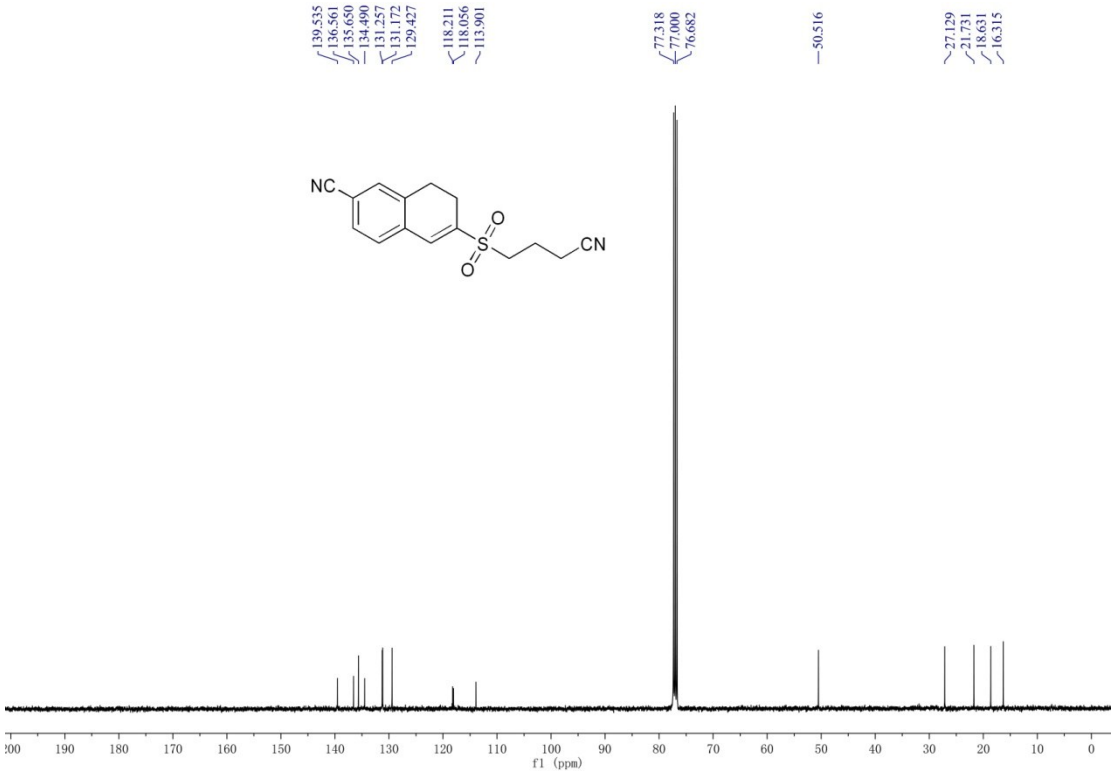
4-((6-Nitro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ma)



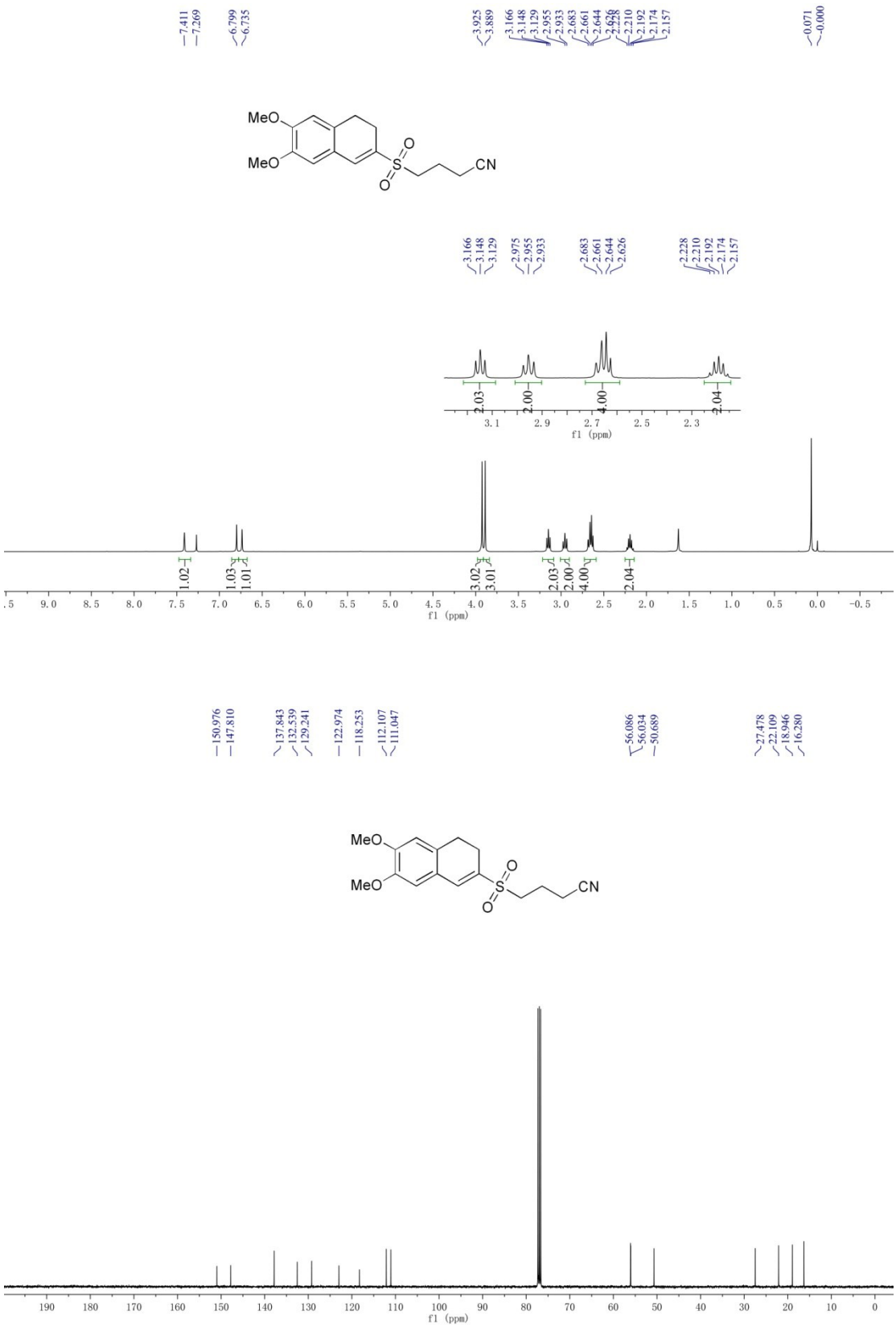


6-((3-Cyanopropyl)sulfonyl)-7,8-dihydronaphthalene-2-carbonitrile (3na)

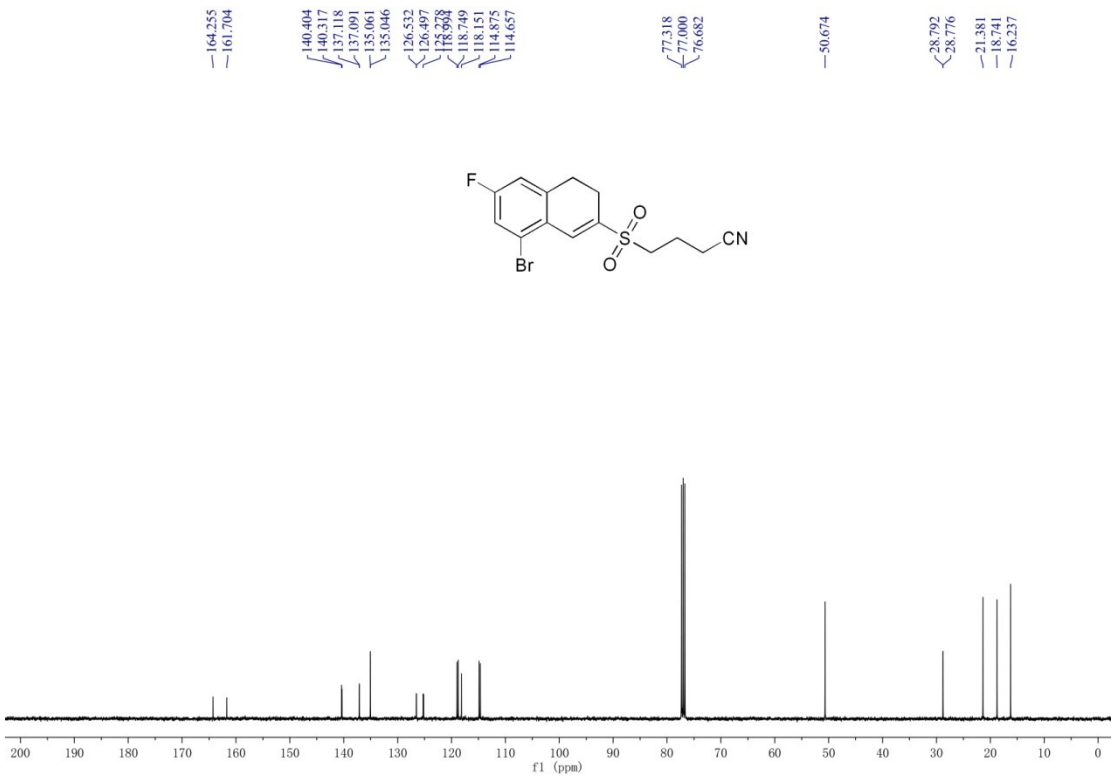


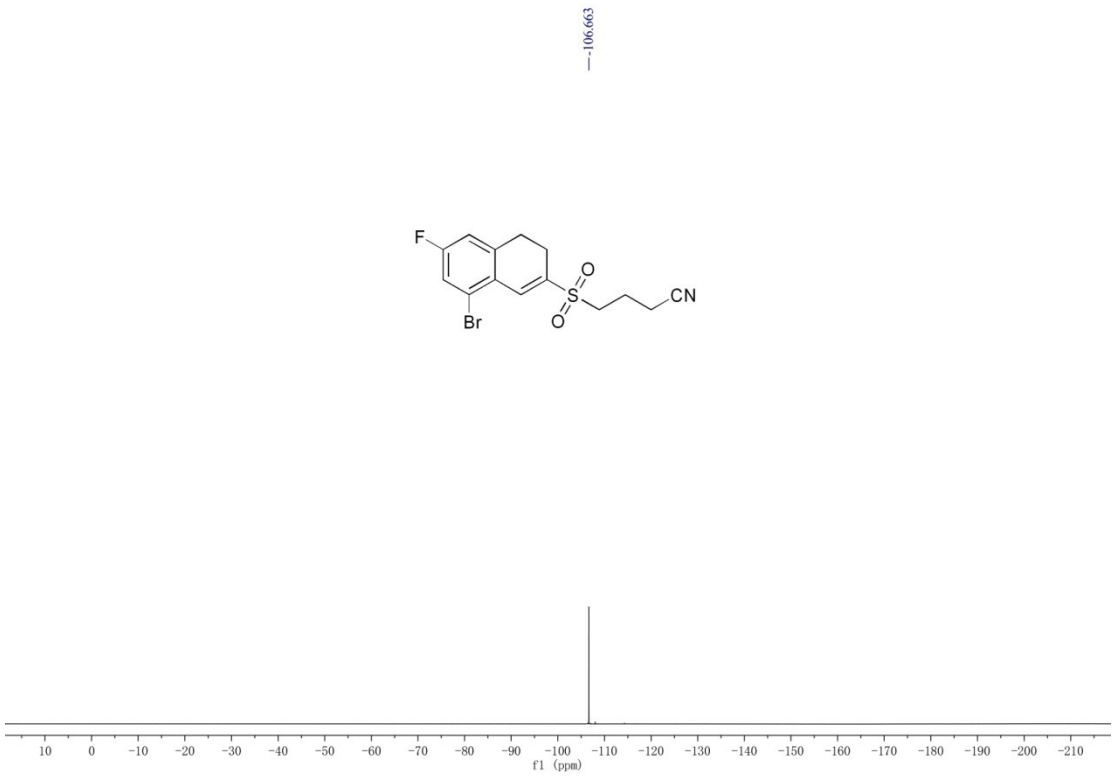


4-((6,7-Dimethoxy-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3oa)

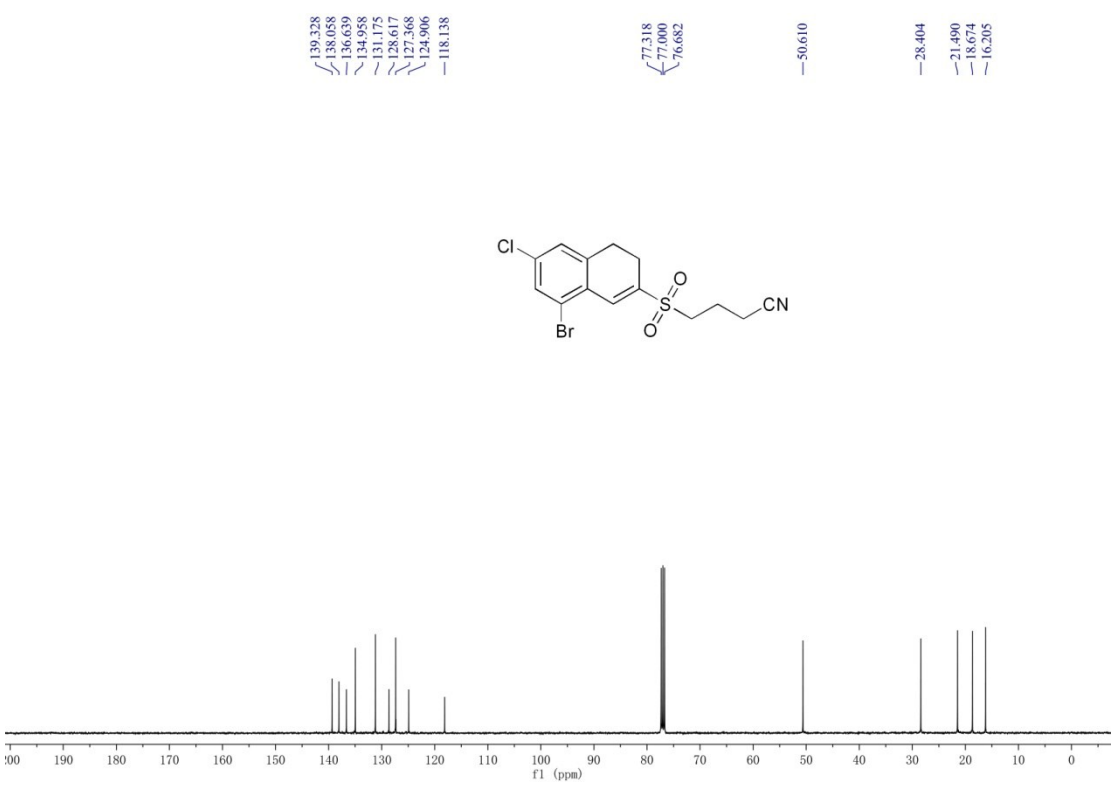


4-((8-Bromo-6-fluoro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3pa)

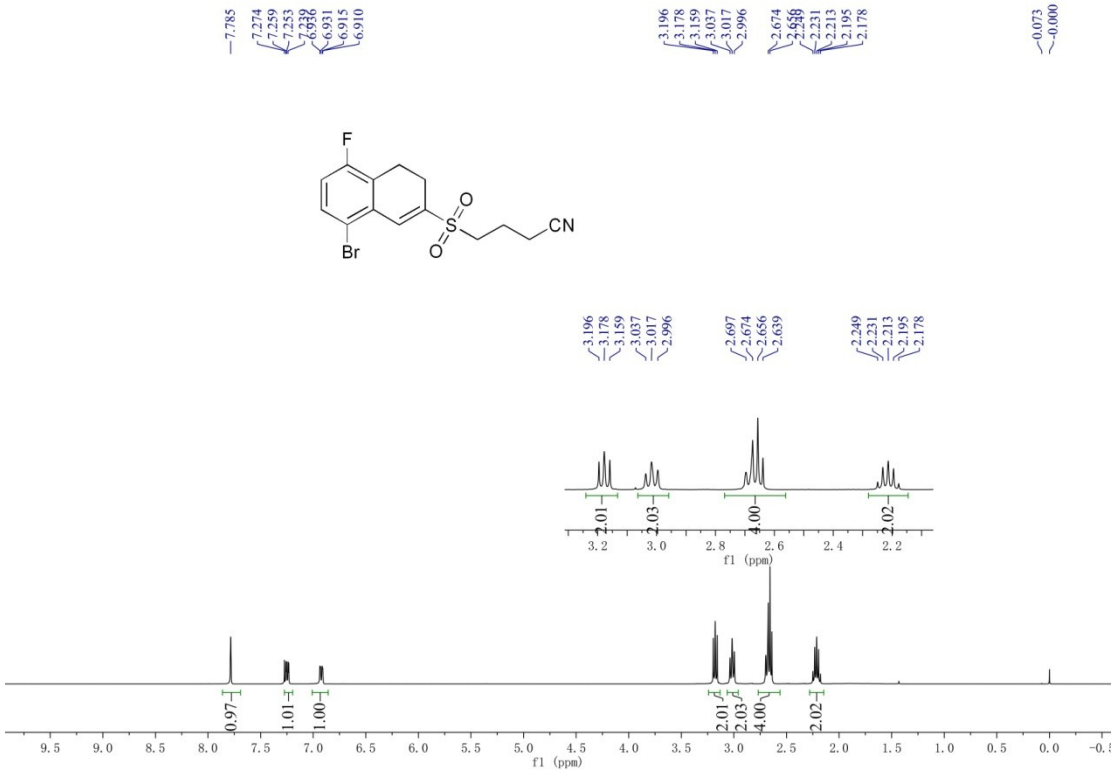


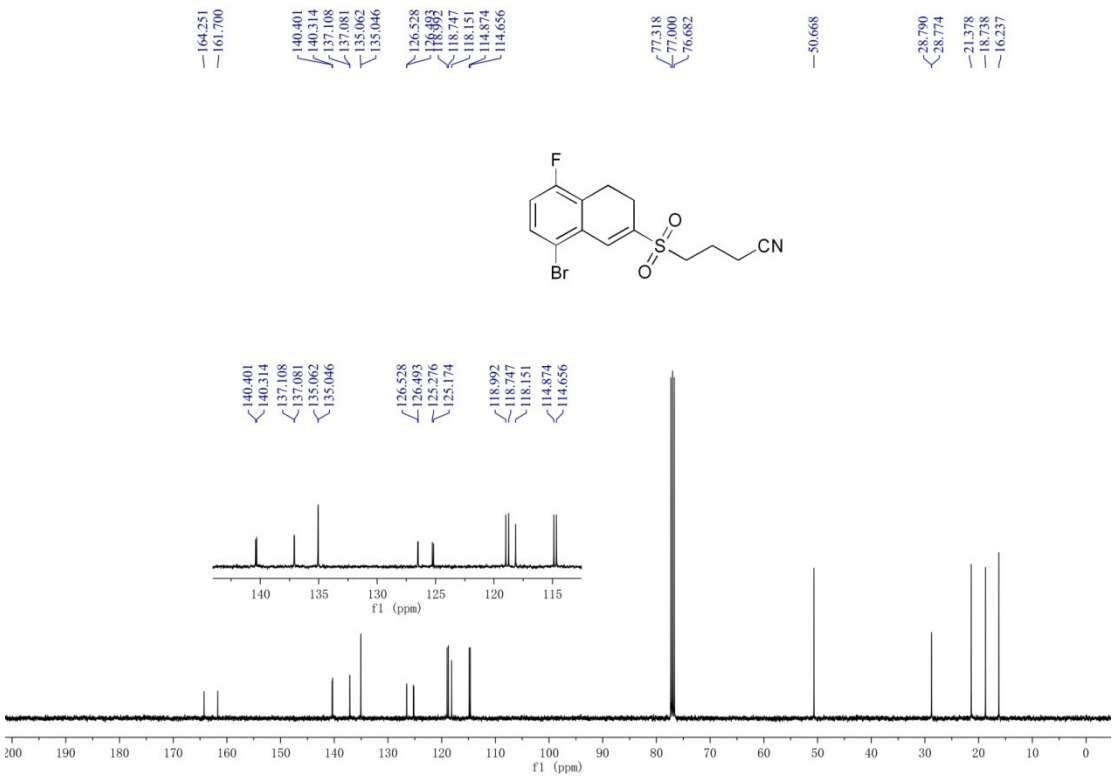

-106.663
F
Br
O
S
O
CN
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

4-((8-Bromo-6-chloro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3qa)

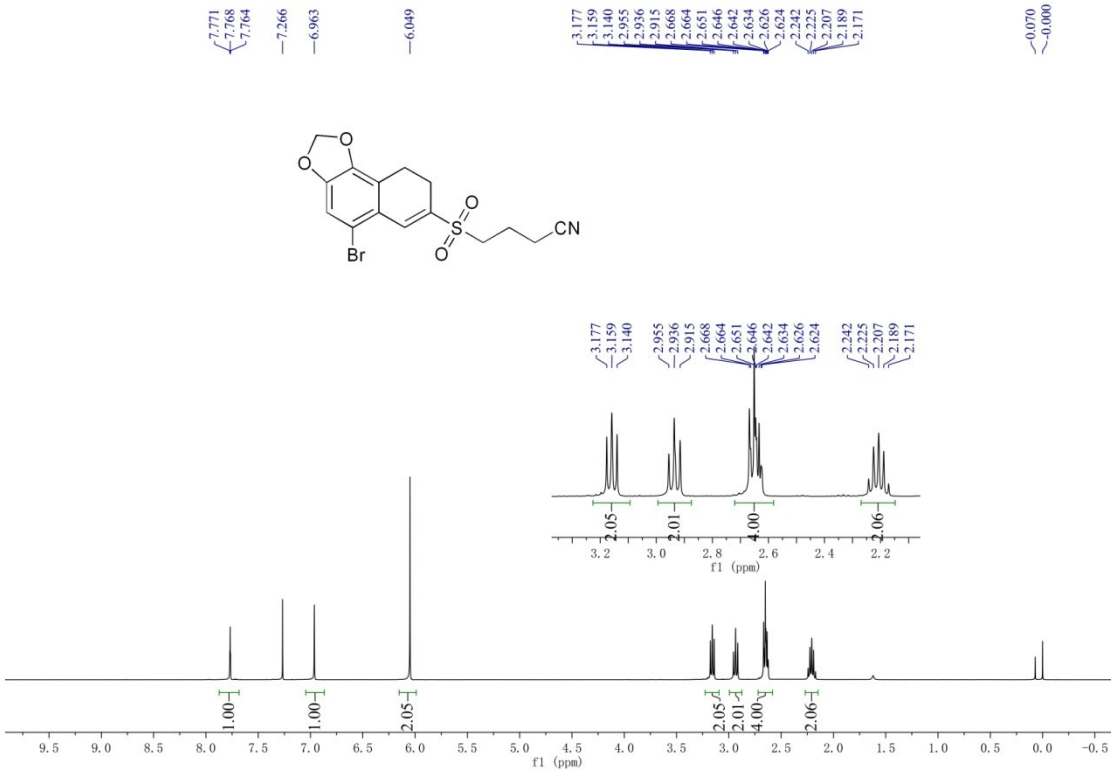


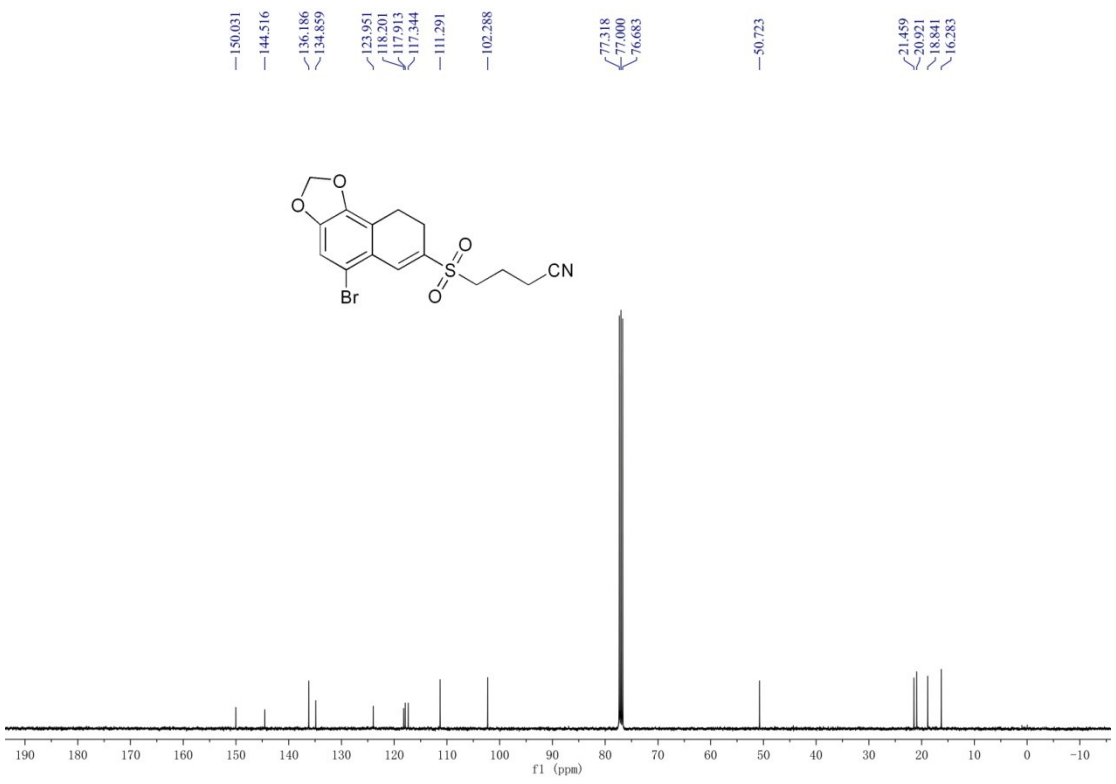
4-((8-Bromo-5-fluoro-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ra)



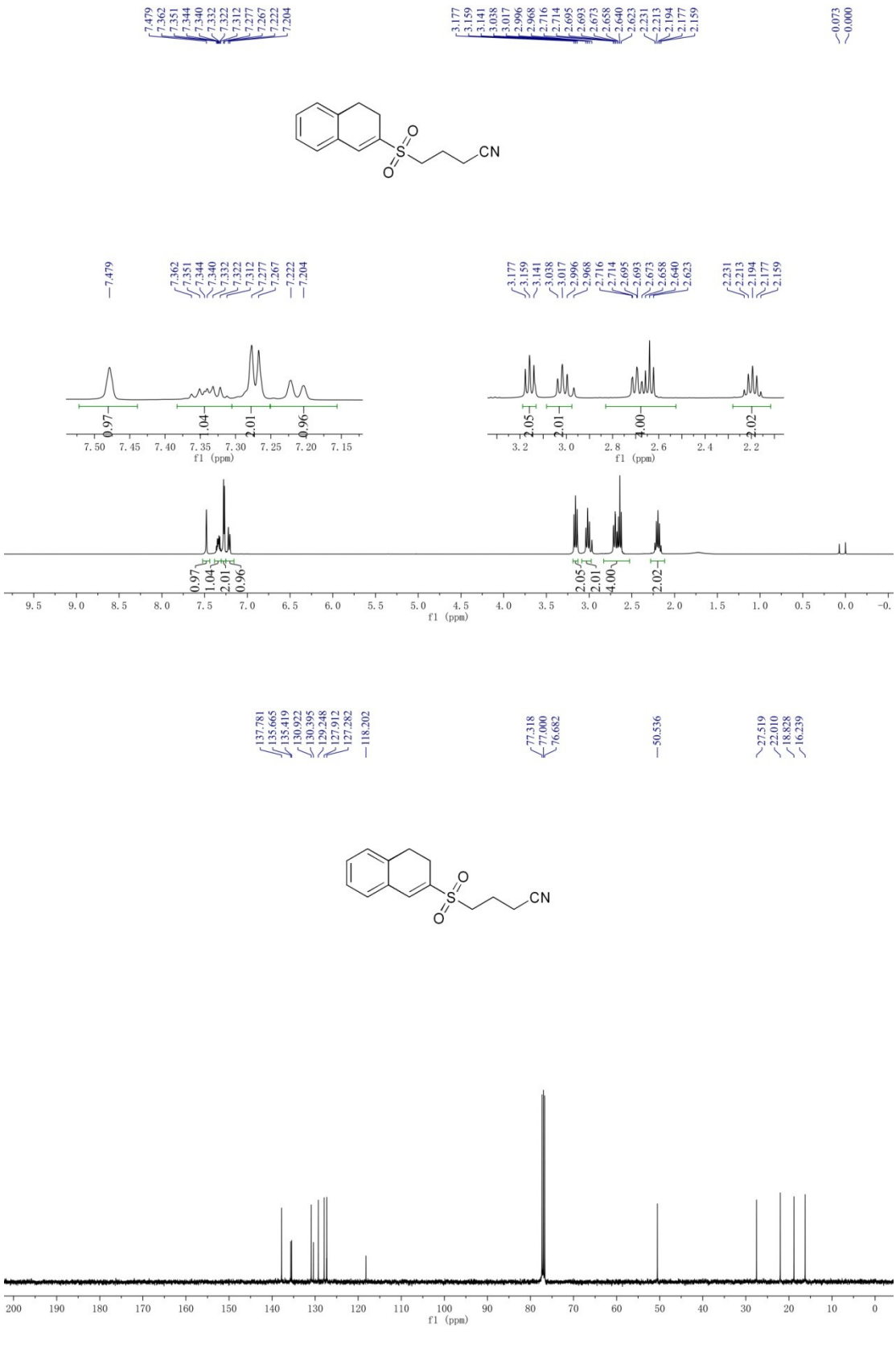


4-((5-Bromo-8,9-dihydronaphtho[1,2-d][1,3]dioxol-7-yl)sulfonyl)butanenitrile (3sa)

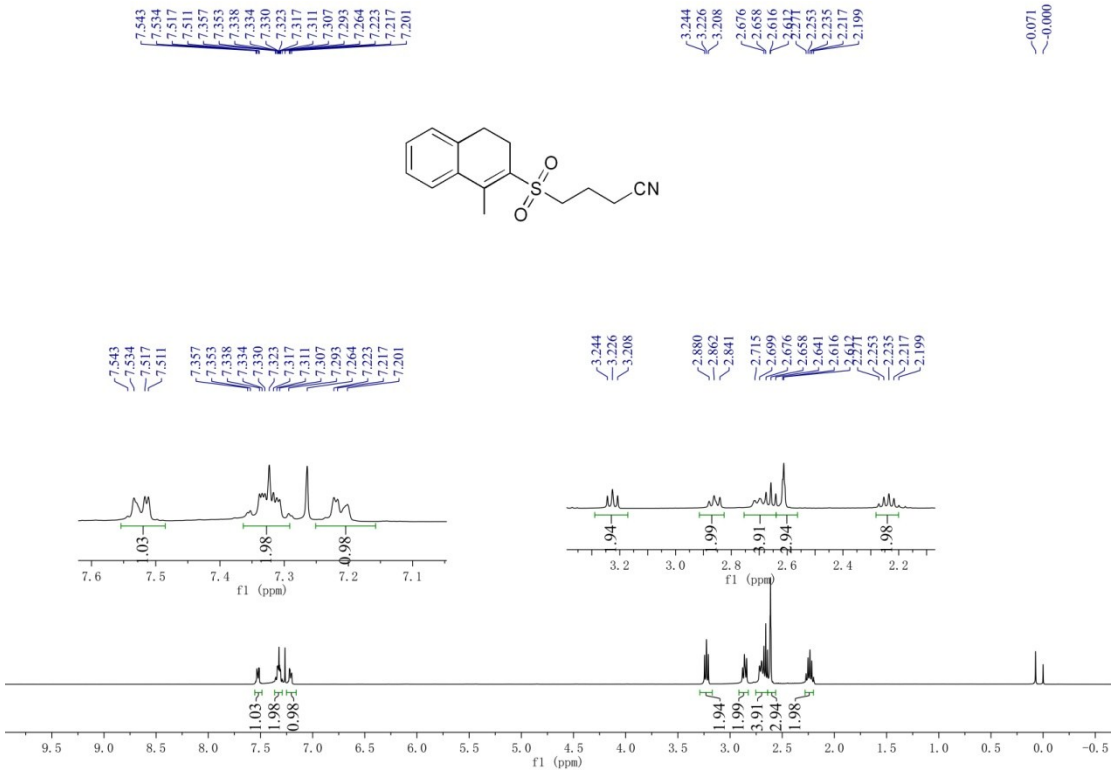


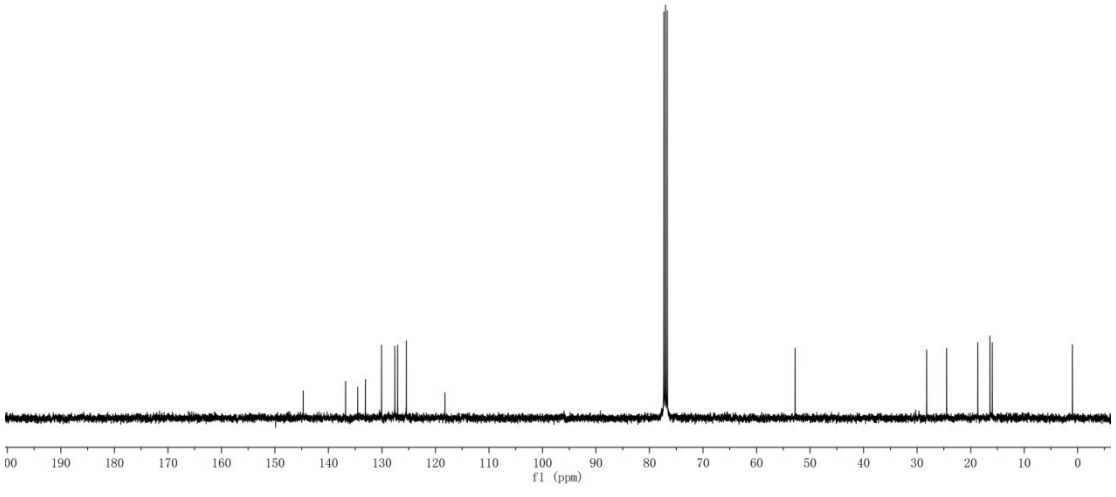


4-((3,4-Dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ta)

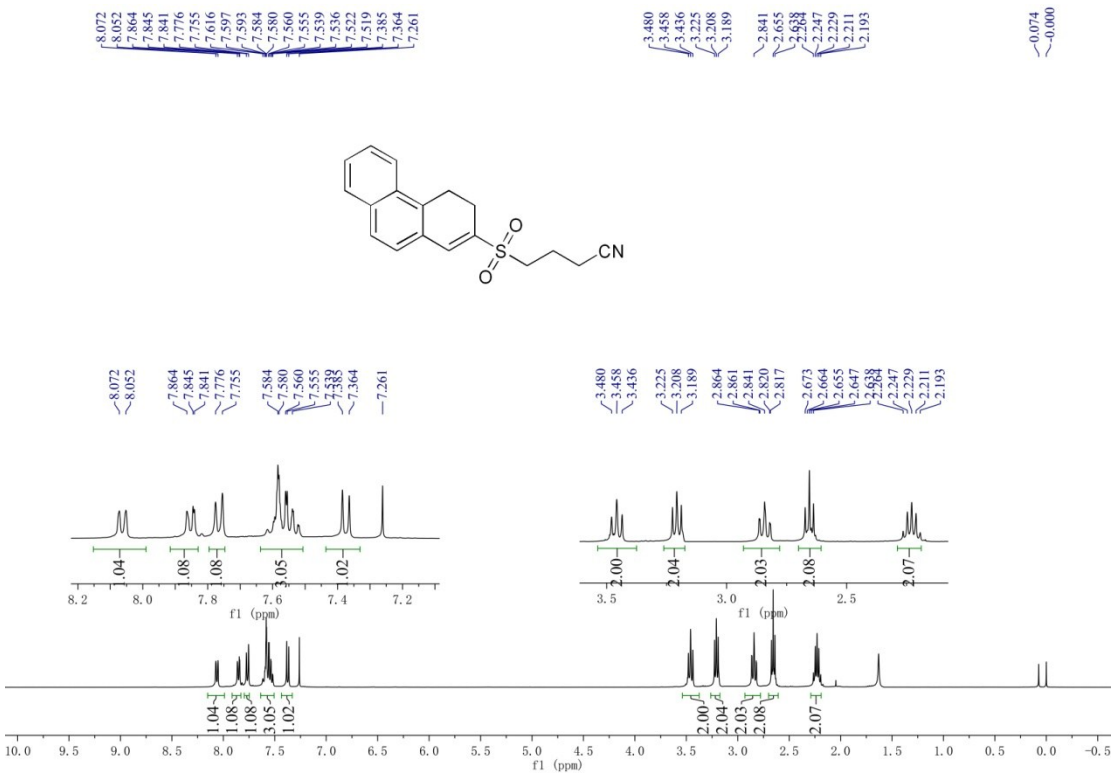


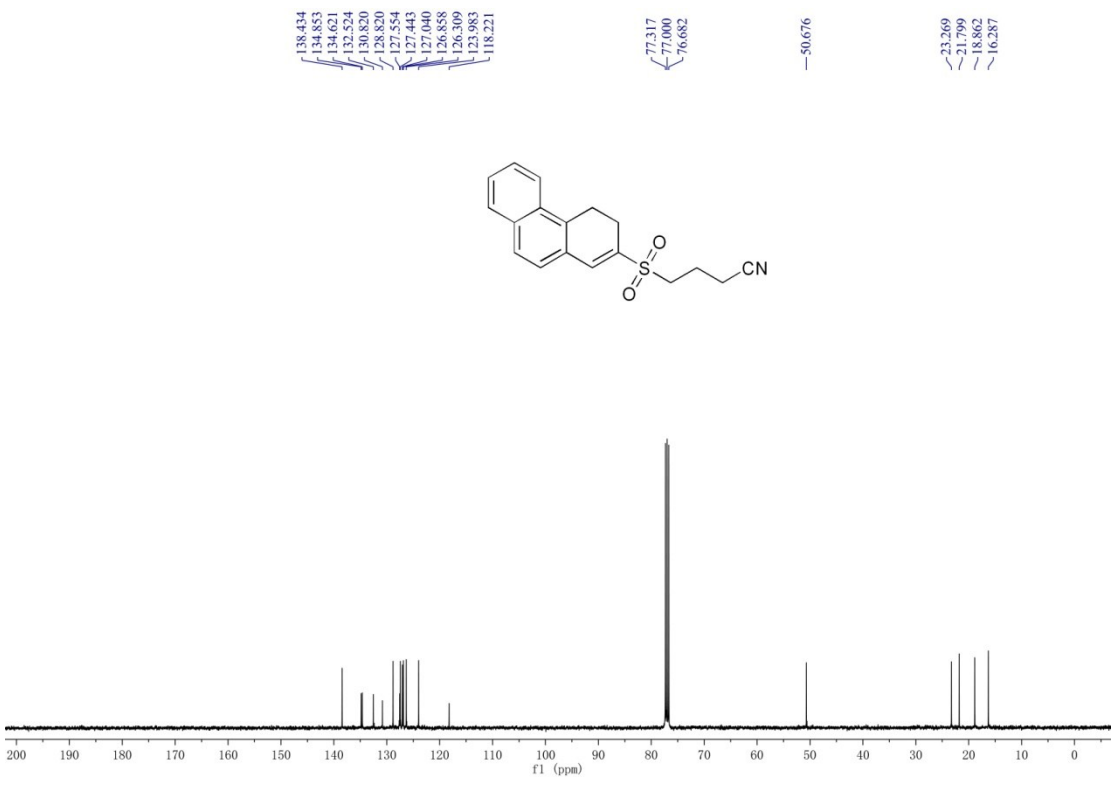
4-((1-Methyl-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3va)



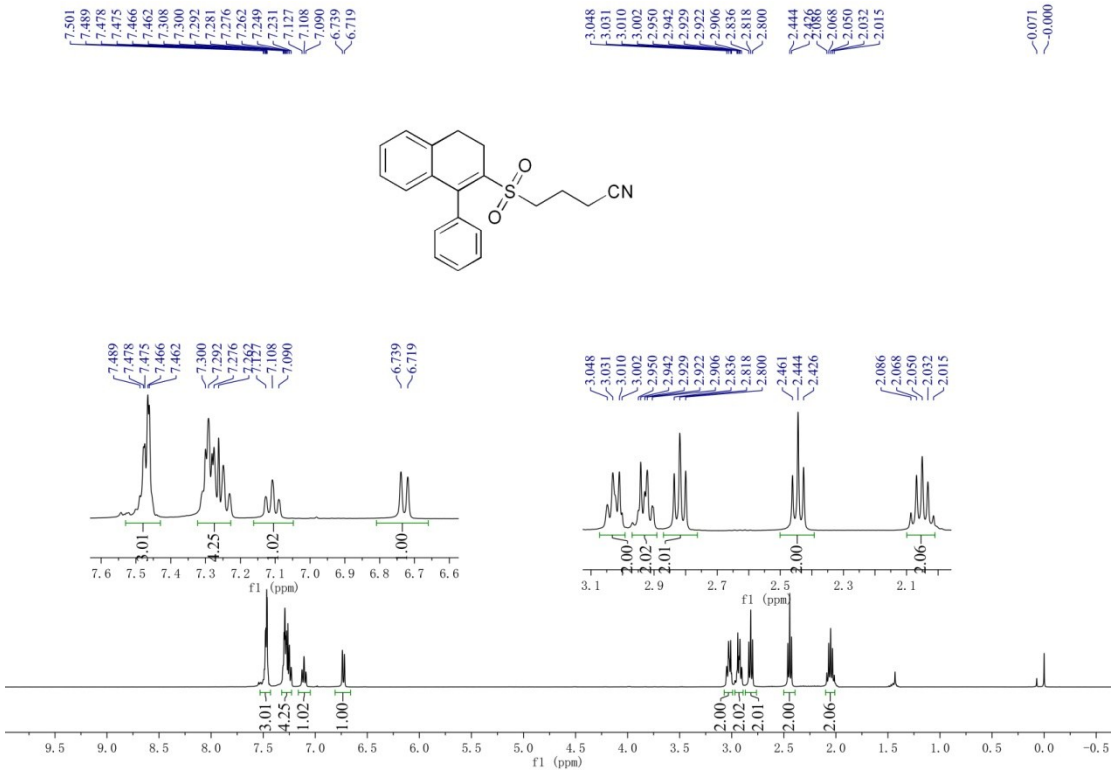


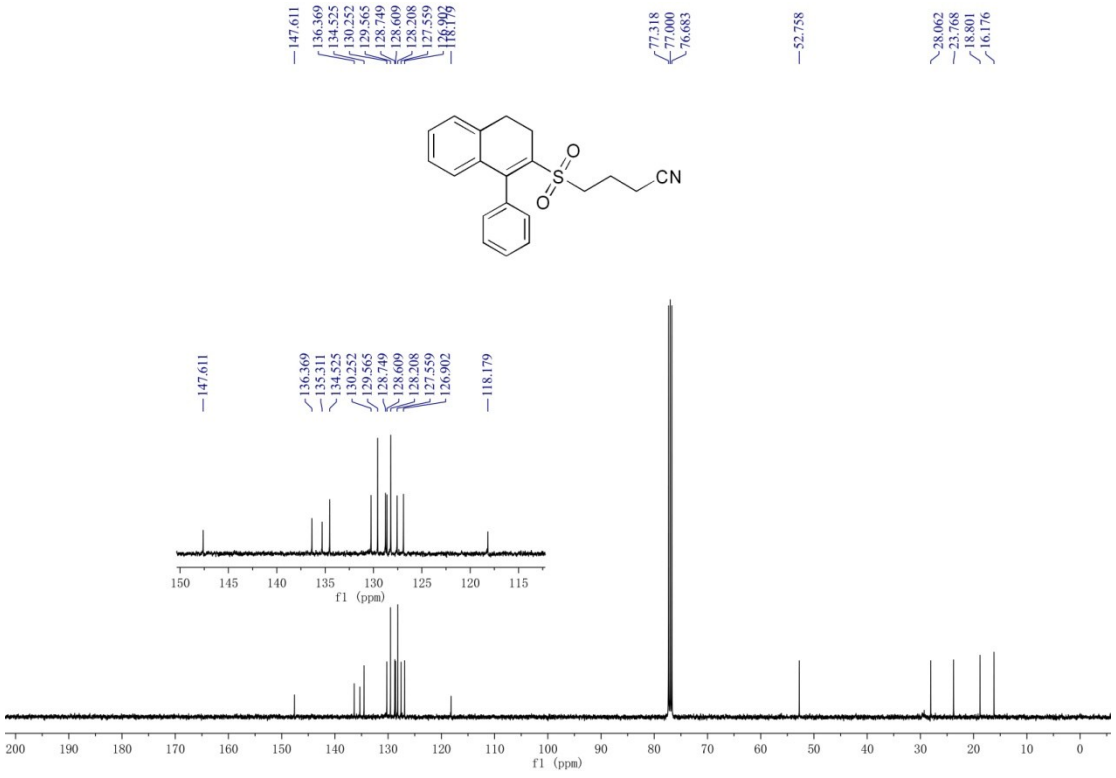
4-((3,4-dihydrophenanthren-2-yl)sulfonyl)butanenitrile (3wa)



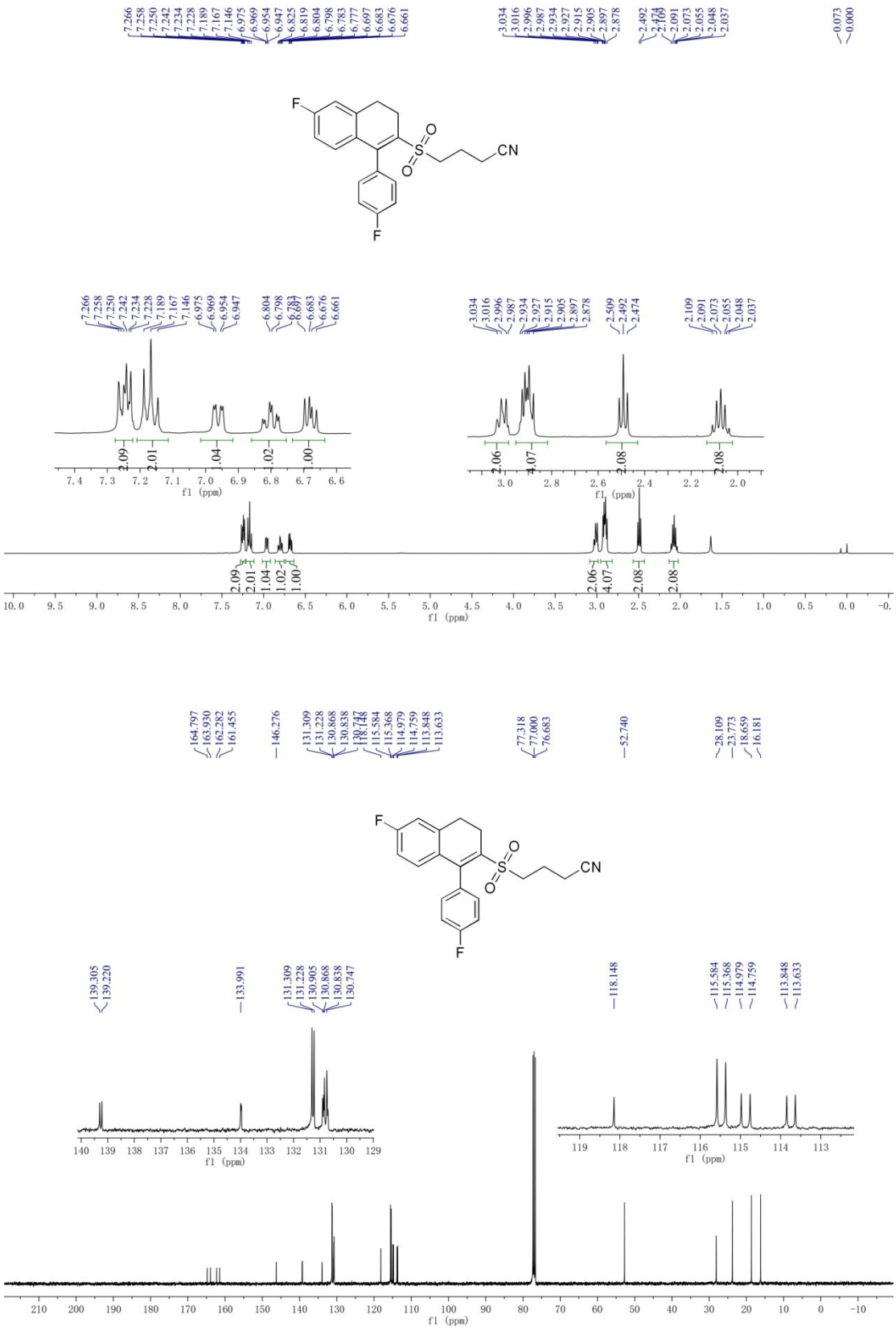


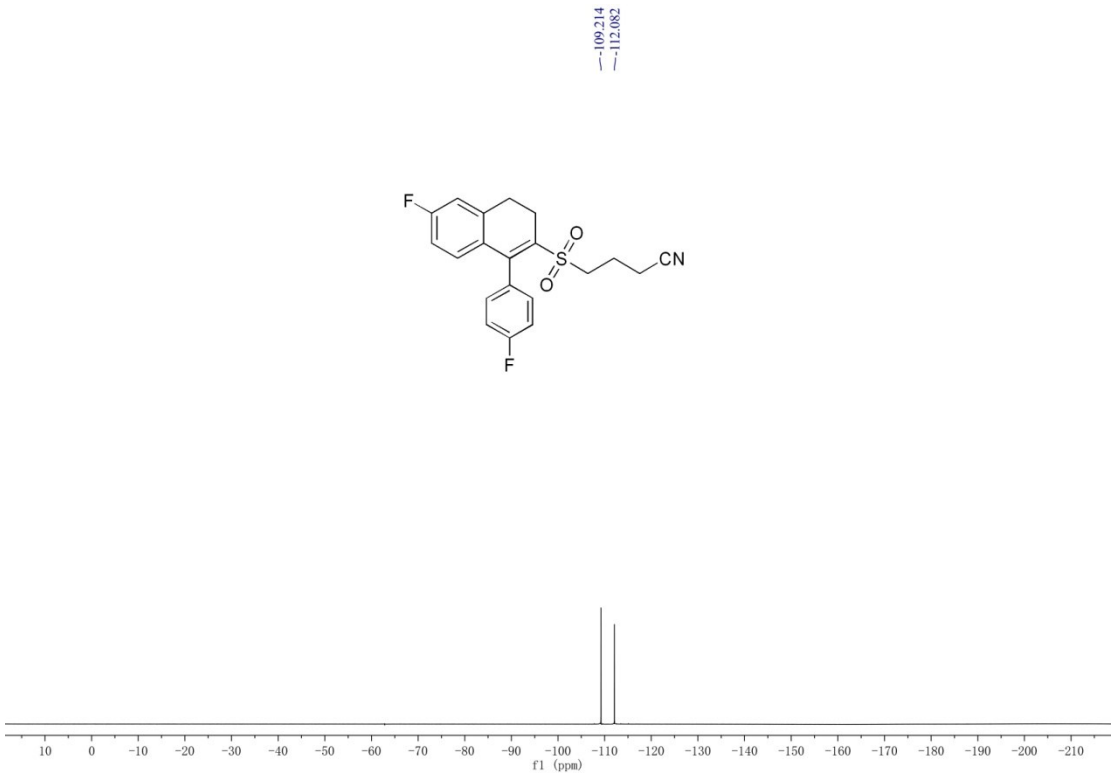
4-((1-Phenyl-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3xa)



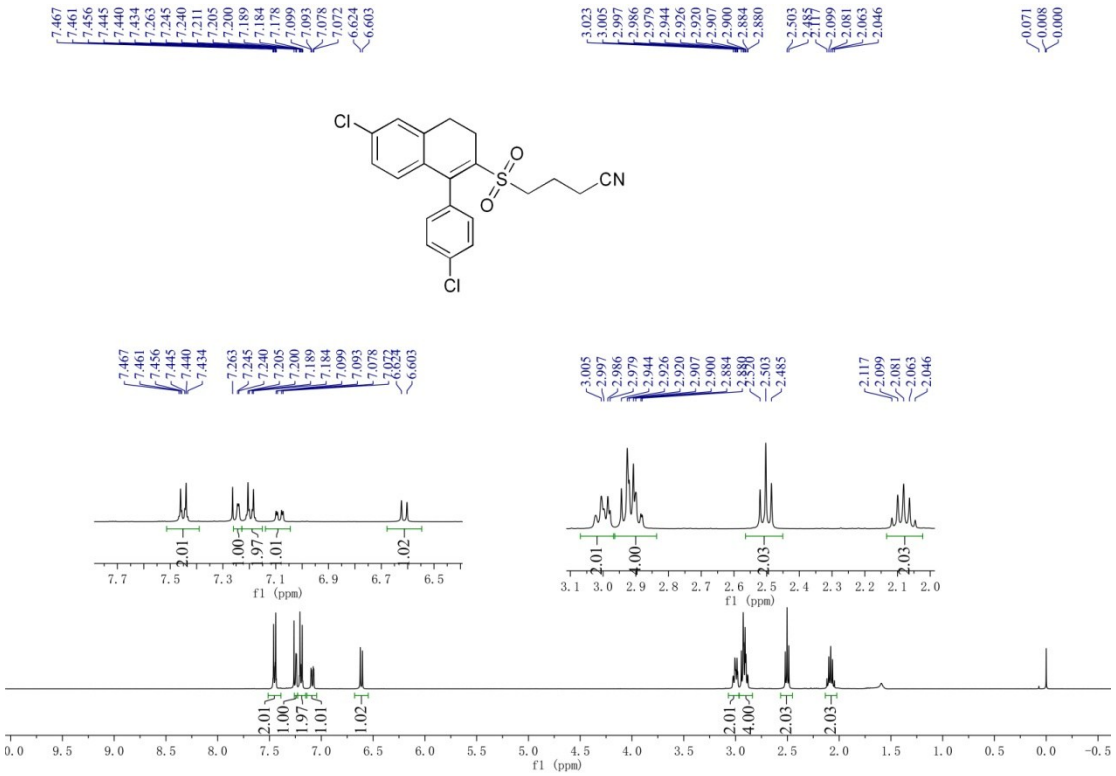


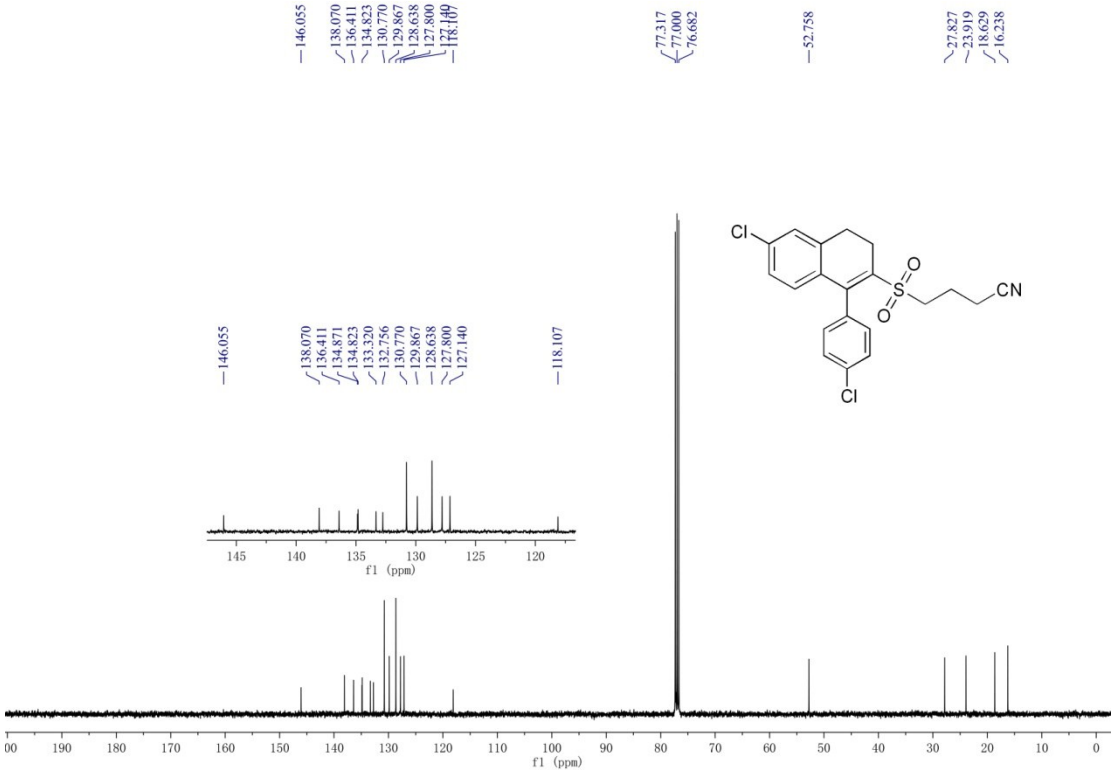
4-((6-Fluoro-1-(4-fluorophenyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3ya)



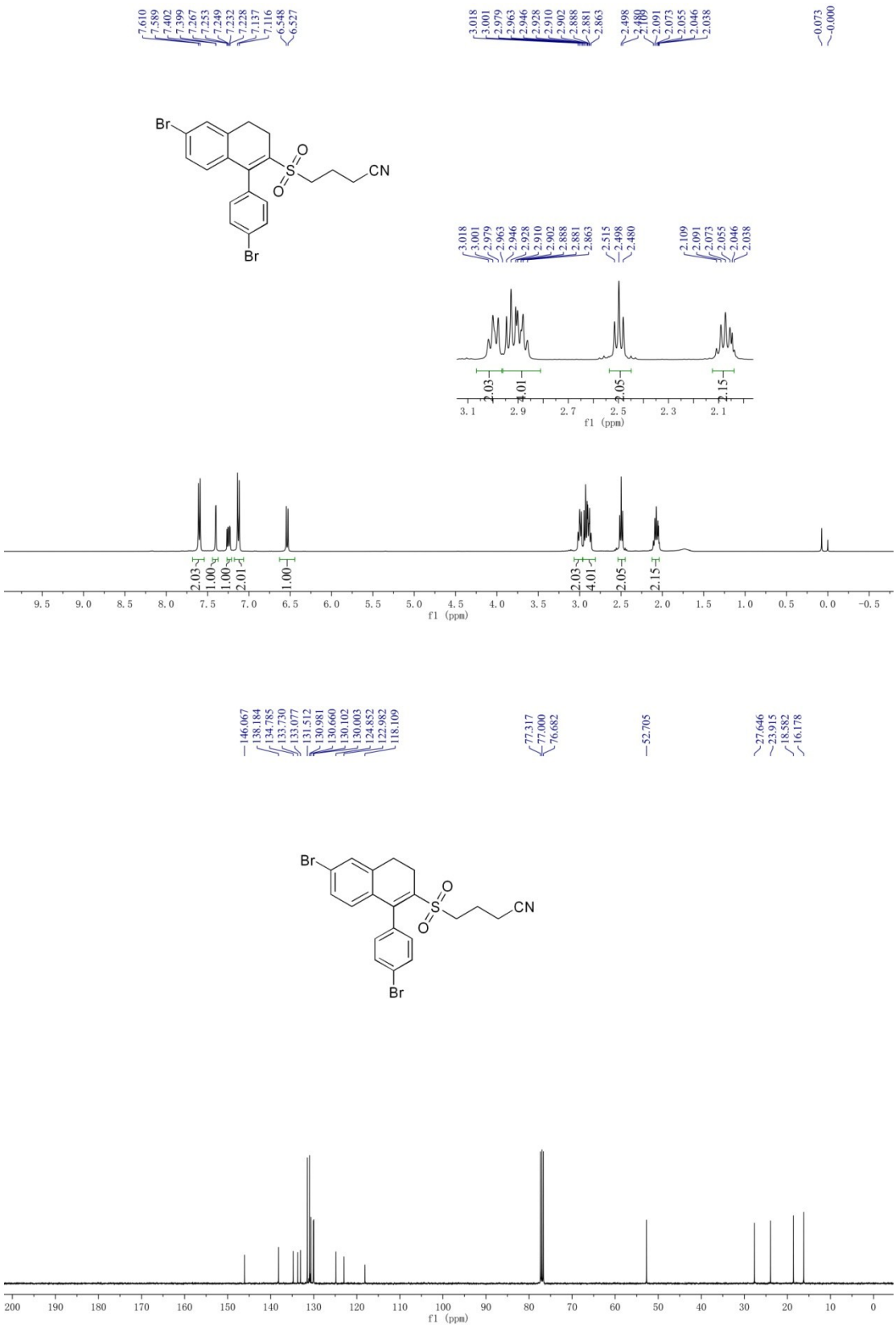

-109.214
-112.082
F
O
S
O
CN
F
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

4-((6-Chloro-1-(4-chlorophenyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3za)

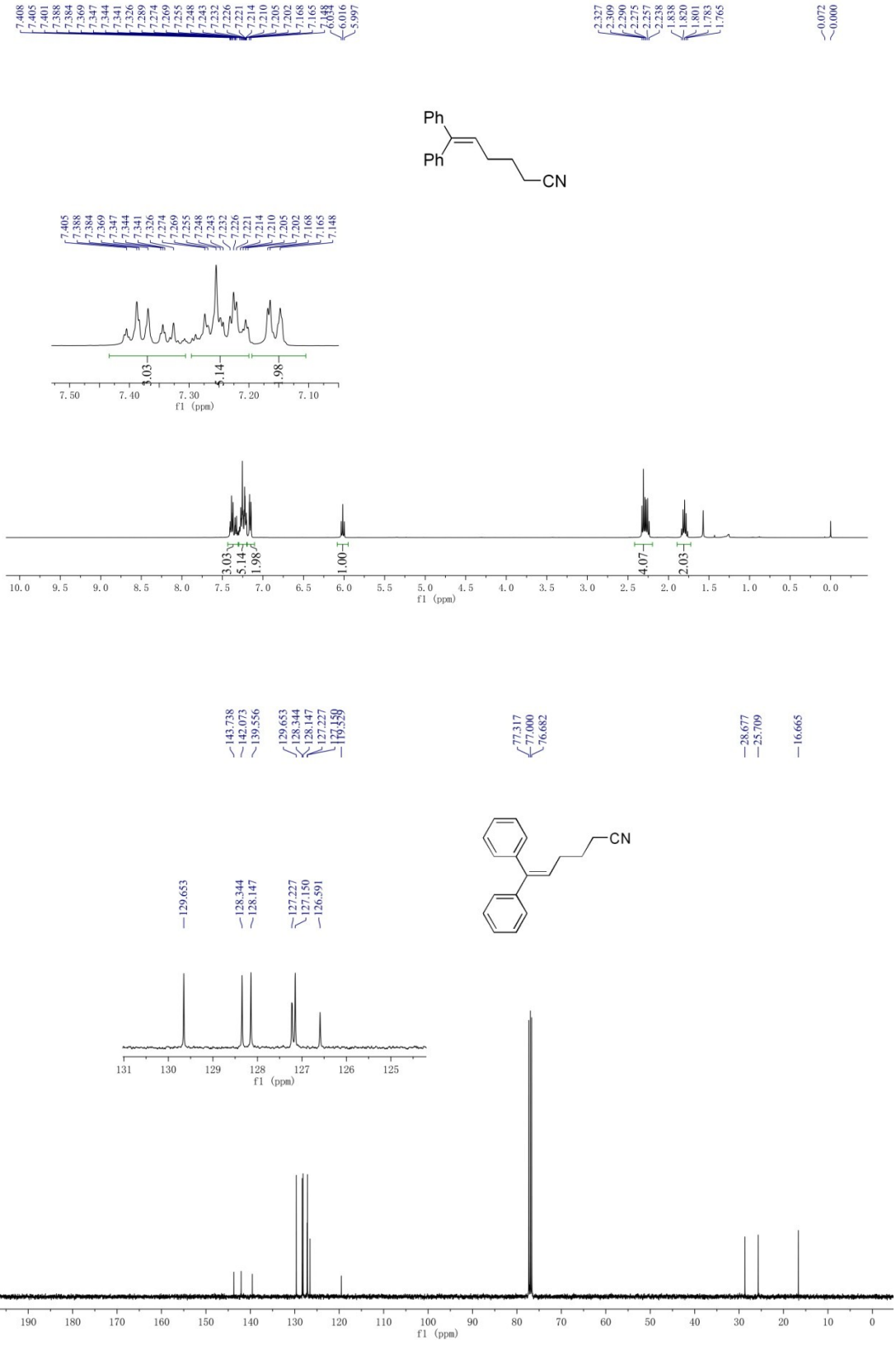




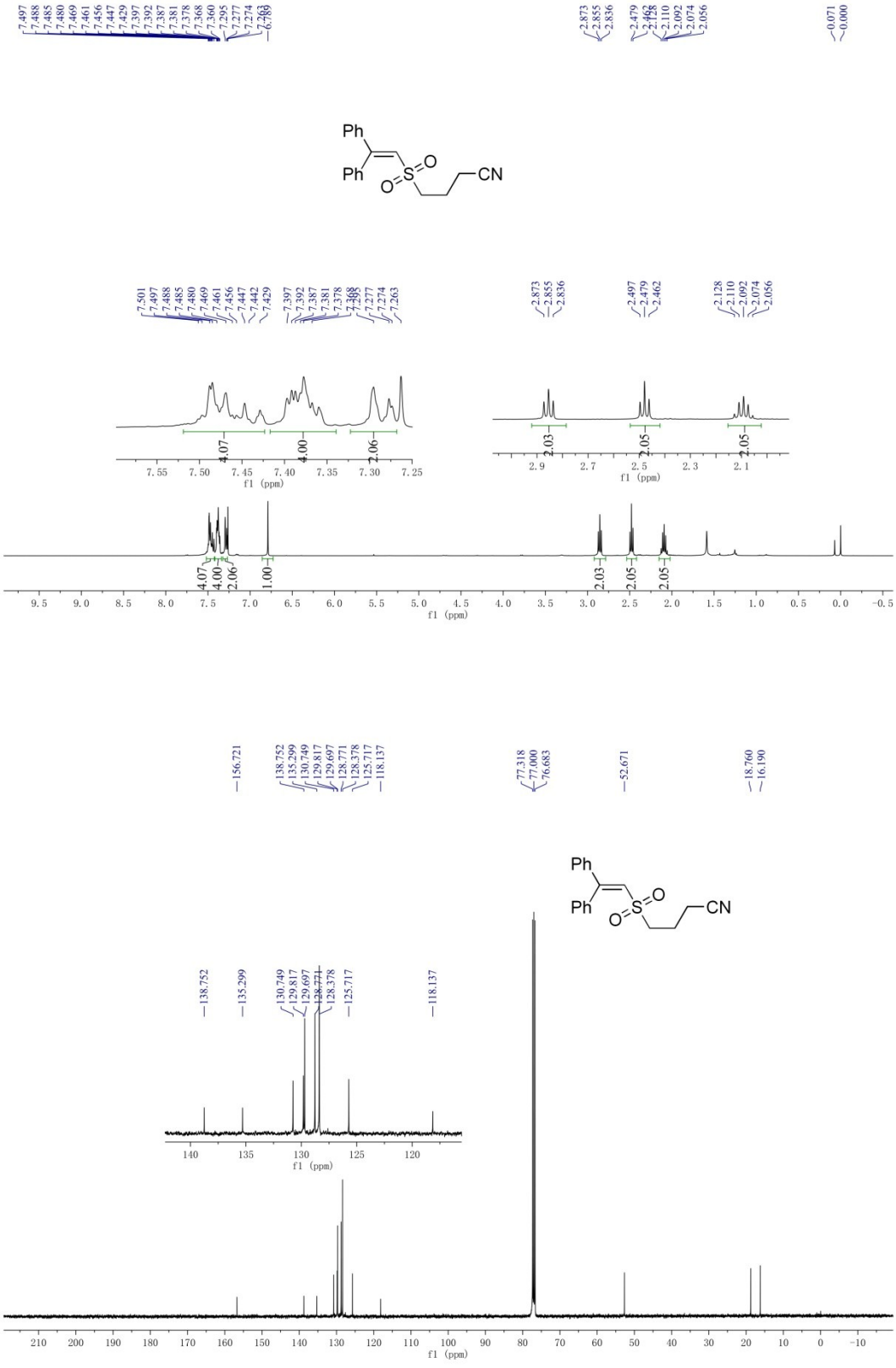
4-((6-Bromo-1-(4-bromophenyl)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanenitrile (3aaa)



5,5-diphenylpent-4-enenitrile (5)



4-((2,2-diphenylvinyl)sulfonyl)butanenitrile (6)



Butyl 4-((8-(benzyloxy)-3,4-dihydronaphthalen-2-yl)sulfonyl)butanoate (7)