Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Cu-Catalyzed Arylalkylation of Alkenes *via* *N*-Directed Remote C(sp^3)-H Functionalization

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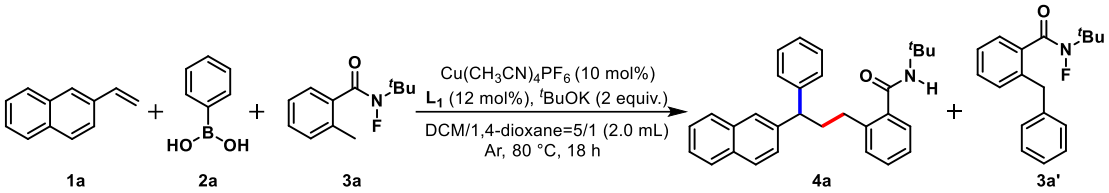
I. General Information

All reactions were carried out under argon unless noted specifically. The various alkenes **1a-1l** and arylboronic acids **2a-2q** were commercially available without further purification. The raw materials **1m**, **1n**, **3a-3p** were prepared according to the method reported in the literature, and the copper catalysts, ligands, and bases were purchased from chemical companies and used directly without further purification. The products were purified by column chromatography on silica gel (300-400 mesh) using thin-layer chromatography observed under UV radiation at 254 nm. All solvents are commercially available and anhydrous.

^{1}H NMR spectra were recorded at 400 MHz in $CDCl_3$, **^{13}C NMR** spectra were recorded at 101 MHz in $CDCl_3$, and **^{19}F NMR** spectra were recorded at 376 MHz in $CDCl_3$. Chemical shifts (ppm) were recorded with TMS (tetramethylsilane) as the internal reference standard. The following abbreviations were used to describe peak splitting patterns when appropriate: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, dd = doublet of doublet. Coupling constants J were reported in hertz unit (Hz). High-resolution mass-spectral analysis was performed on Bruker APEXII. **HRMS** was obtained using a Q-TOF instrument equipped with an ESI source. The date of crystal structure was collected by Mo Kα radiation on a Bruker APEX II diffractometer. Melting points were measured with a micro melting point apparatus.

II. Optimization of the Reaction Conditions

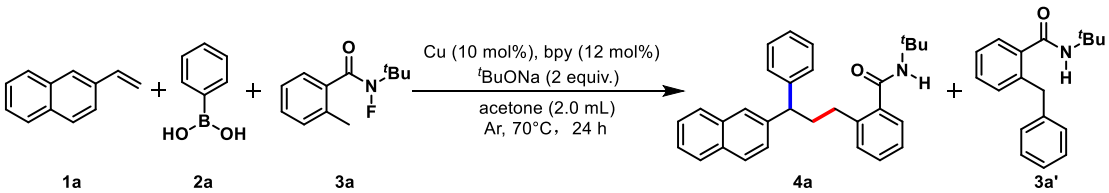
Table 1 Control Experiments.



entry	conditions	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	standard[a]	74	15
2	No Cu	0	trace
3	No $\mathbf{L_1}$	trace	trace
4	No ^{t}BuOK	0	trace

[a]Standard conditions was used. [b]Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

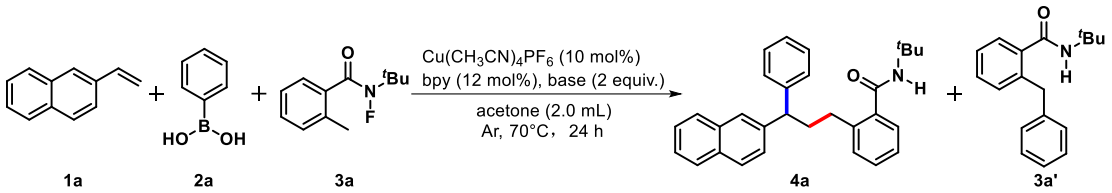
Table 2 Optimization of Copper Catalysts.



entry	conditions	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	$Cu(ClO_4)_2$	22	15
2	CuTc	20	18
3	$CuBr_2$	28	12
4	CuI	18	trace
5	CuOAc	31	trace
6	$Cu(pph_3)_2BH_4$	25	trace
7	**$Cu(CH_3CN)_4PF_6$**	**36**	**17**

Reaction conditions: **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.4 mmol, 2.0 equiv.), **3a** (0.2 mmol, 1.0 equiv.), catalyst (10 mol%), bpy (12 mol%), and ^{t}BuONa (0.4mmol 2 equiv.) in acetone (2.0 mL) at 70 °C for 24 h under an Ar atmosphere. [b]Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

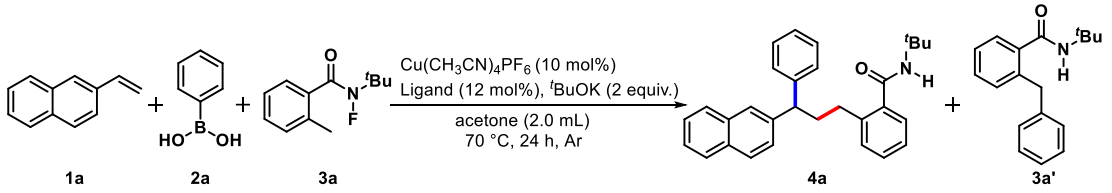
Table 3 Optimization of Bases.

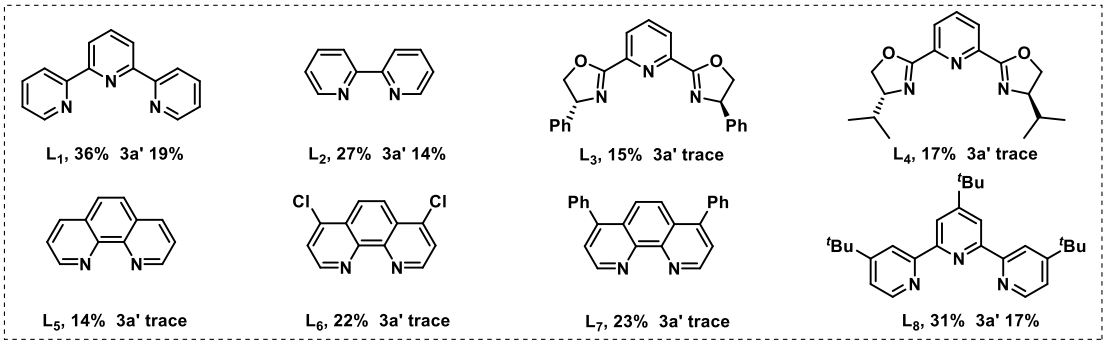


entry	conditions	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	Sodium phenol	11	19
2	^{t}BuOLi	16	23
3	^{t}BuONa	13	15
4	Cs_2CO_3	15	21
5	CsOPiv	7	trace
6	**2.0 eq. ^{t}BuOK**	**23**	**16**
7	3.0 eq. ^{t}BuOK	19	12

Reaction conditions: **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.4 mmol, 2.0 equiv.), **3a** (0.2 mmol, 1.0 equiv.), $Cu(CH_3CN)_4PF_6$ (10 mol%), bpy (12 mol%), and base (0.4mmol 2 equiv.) in acetone (2.0 mL) at 70 °C for 24 h under an Ar atmosphere. [b]Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

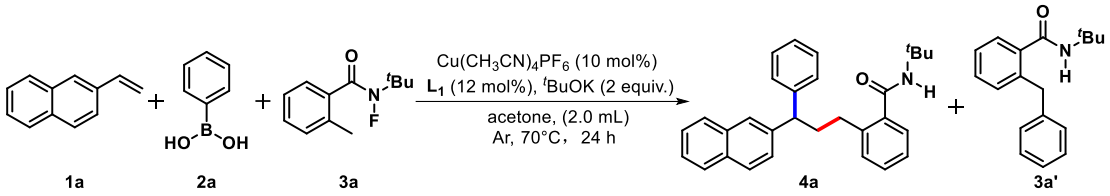
Table 4 Optimization of Ligands.





Reaction conditions: **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.4 mmol, 2.0 equiv.), **3a** (0.2 mmol, 1.0 equiv.), $Cu(CH_3CN)_4PF_6$ (10 mol%), ligand (12 mol%), and ^{t}BuOK (0.4mmol 2 equiv.) in acetone (2.0 mL) at 70 °C for 24 h under an Ar atmosphere. Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

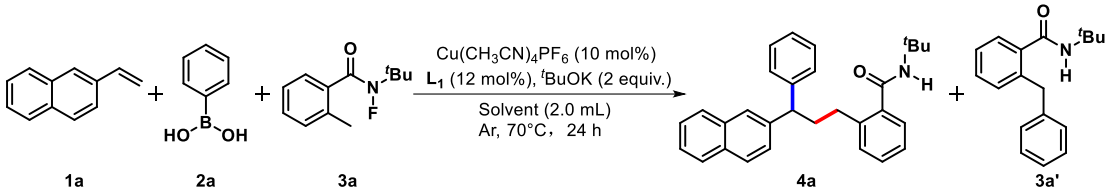
Table 5 Optimization of Ratios of Reactants.



entry	Conditions (1a:2a:3a)	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	2:1.5:2	18	13
2	1:1:1	22	trace
3	1:1.5:2.5	32	14
4	1:3:2.5	46	18
5	1:2:1	29	13
6	**1:2.5:2.5**	**51**	**22**

Reaction conditions: **1a**, **2a**, **3a**, $Cu(CH_3CN)_4PF_6$ (10 mol%), **L1** (12 mol%), and ^{t}BuOK (0.4mmol 2 equiv.) in acetone (2.0 mL) at 70 °C for 24 h under an Ar atmosphere. [b]Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

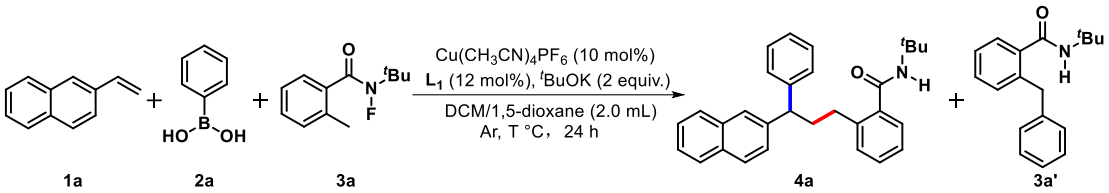
Table 6 Optimization of Solvents.



entry	conditions	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	DCM	47	25
2	$PhCF_3$	29	11
3	THF	35	trace
4	1,4-dioxane	28	trace
5	MTBE	25	15
6	Acetone	43	trace
7	CH_3CN	37	17
8	DCE	23	19
9	DCM: 1,4-dioxane 9:1	57	23
10	DCM: 1,4-dioxane 7:1	51	18
11	**DCM: 1,4-dioxane 5:1**	**65**	**16**
12	DCM: 1,4-dioxane 3:1	60	22
13	DCM: 1,4-dioxane 1:1	43	19
14	DCM: 1,4-dioxane 1:3	53	17
15	DCM: 1,4-dioxane 1:5	49	14

Reaction conditions: **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.5 mmol, 2.5 equiv.), **3a** (0.5 mmol, 2.5 equiv.), $Cu(CH_3CN)_4PF_6$ (10 mol%), **L1** (12 mol%), and ^{t}BuOK (0.4mmol 2 equiv.) in solvent (2.0 mL) at 70 °C for 24 h under an Ar atmosphere. [b]Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

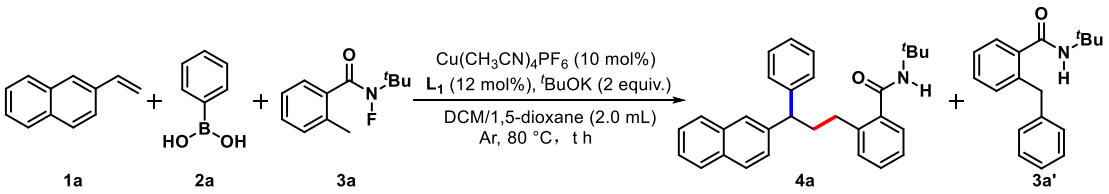
Table 7 Optimization of Temperature.



entry	Conditions (℃)	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	40	21	29
2	60	35	17
3	70	57	14
4	**80**	**69**	**19**
5	100	43	26

Reaction conditions: **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.5 mmol, 2.5 equiv.), **3a** (0.5 mmol, 2.5 equiv.), $Cu(CH_3CN)_4PF_6$ (10 mol%), **L1** (12 mol%), and ^{t}BuOK (0.4mmol 2 equiv.) in solvent (2.0 mL) at T ºC for 24 h under an Ar atmosphere. Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

Table 8 Optimization of Time.

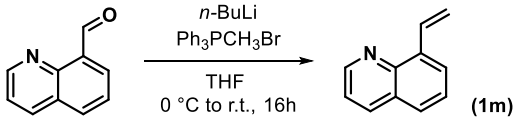


entry	Conditions (h)	**4a** yield(%)[b]	**3a'** yield(%)[b]
1	16	63	26
2	**18**	**74**	**15**
3	20	69	18
4	24	68	13
5	36	65	20

Reaction conditions: **1a** (0.2 mmol, 1.0 equiv.), **2a** (0.5 mmol, 2.5 equiv.), **3a** (0.5 mmol, 2.5 equiv.), $Cu(CH_3CN)_4PF_6$ (10 mol%), **L1** (12 mol%), and ^{t}BuOK (0.4mmol 2 equiv.) in solvent (2.0 mL) at 80 ℃ for t h under an Ar atmosphere. [b]Yields were determined by ^{1}H NMR analysis of crude reaction mixture after work-up by using 1,3,5-trimethoxybenzene as an internal standard.

III. Synthesis of Substrates

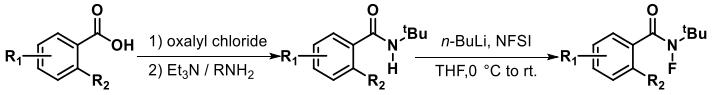
a) Preparation of 8-vinylquinoline[1]

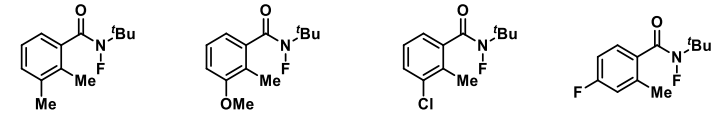


To a solution of methyltriphenylphosphonium bromide (3.93 g, 11 mmol, 1.1 equiv.) in anhydrous THF (40 mL) was added dropwise *n*-BuLi (6.9 mL, 1.6 M in hexanes, 11 mmol, 1.1 equiv.) at 0 ºC under a N_2 atmosphere. The solution was stirred at room temperature for 2 hours and then a solution of the quinoline-8-carboxaldehyde (10 mmol, 1 equiv.) in anhydrous THF (10 mL) was added dropwise at 0 ºC. The reaction was stirred for 16 hours at room temperature and then quenched by additing saturated aqueous NH_4Cl solution. The aqueous layer was extracted with EtOAc, and the combined organic layers were washed with brine and then dried over Na_2SO_4. After filtration, the solvents were removed under reduced pressure, and the residue was purified by flash column chromatography (65% yield).

b) Preparation of *N*-fluorocarboxamide substrates[2]

According to previous reports, all *N*-fluorocarboxamide substrates **(3a-3p)** were synthesized as described in the literature, and were proved as identified known compounds with reported NMR spectra and HRMS analysis data. And the brief description of the synthesis method and properties of *N*-fluorocarboxamide substrates were illustrated in a 10 mmol scale reaction as below.

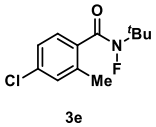



3a

3b

3c

3d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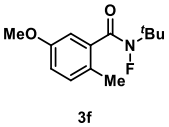
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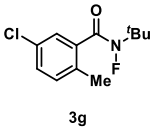
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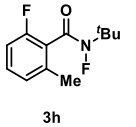
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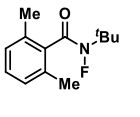
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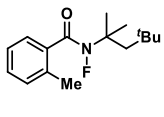
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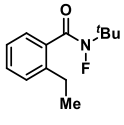
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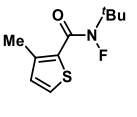
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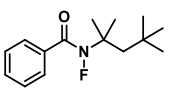
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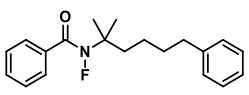
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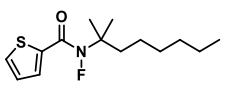
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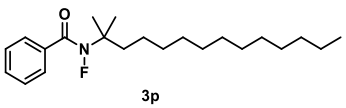
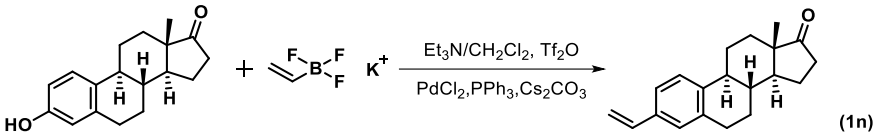

3p

Oxalyl chloride (1.5 equiv.) was added dropwise to a DCM (0.3M, 33 mL) solution of substituted 2-methylbenzoic acid (10 mmol, 1.0 equiv.) and DMF (0.05 equiv.), and the mixture was stirred at room temperature until the bubbling stopped. Then, the crude reaction product was concentrated by vacuum distillation to remove volatiles and dissolved in DCM (0.3 M, 33 mL). After that, *tert*-butylamine (1.5 equiv.) and triethylamine (2.0 equiv.) were sequentially added at room temperature in this solution. After stirring for 1 to 3 h, this reaction was quenched with 1.0 M aqueous HCl. The crude mixture was extracted with DCM and saturated with aqueous $NaHCO_3$ three times, then dried with anhydrous Na_2SO_4 and concentrated by vacuum distillation. The product was purified by silica gel column chromatography with petroleum ether/ethyl acetate as eluent. All the *N*-fluorocarboxamides were prepared by *N*-fluorination of their parent carboxamides according to conventional methods. Amide (1.0 equiv.) was added to a pre-dried round-bottom flask with a stir bar, and the flask was charged with argon (repeated five times). Then anhydrous THF (0.13 M) was injected and was cooled on an ice bath for 15 minutes. *n*-butyllithium (1.1 equiv., 2.4 M in hexanes) was added dropwise, and the reaction was conducted at 0 ℃. After stirring for 1.5 h, NFSI (1.5 equiv., 0.6 M in THF) was added dropwise. The reaction was left overnight in the ice bath and warmed to room temperature. After 10 to 14 h, the reaction was quenched with 1 M aqueous HCl. The crude mixture was extracted with DCM and saturated with aqueous $NaHCO_3$ three times, then dried with anhydrous Na_2SO_4 and concentrated by vacuum distillation. The fluoroamides were purified by silica gel column chromatography with petroleum ether/ethyl acetate as eluent.

c) Preparation of estrone-derived substrates[3]



(1n)

A 100 ml flask was flame-dried and charged with estrone (1.35 g, 5 mmol, 1.0 equiv.), CH_2Cl_2 (20 mL) and Et_3N (1.01 g, 10 mmol, 2.0 equiv.). The mixture was cooled to 0 ℃ in an ice water bath. Tf_2O (1.55 g, 5.5 mmol, 1.1 equiv.) was added for more than 10 minutes. The mixture was heated to room temperature and stirred with nitrogen at room temperature for 3 h. The resulting brown mixture was diluted with CH_2Cl_2, washed with saturated NH_4Cl, and the aqueous layer extracted with CH_2Cl_2. The complex organic layer was dried over $MgSO_4$, and the filtrate was concentrated. The above products, potassium vinyltrifluoroborate (0.74 g, 5.5 mmol, 1.1 equiv.) and $PdCl_2$ (17.7 mg, 0.1 mmol, 0.02 equiv.) were loaded into threaded tubes, and the tubes were placed in a nitrogen-filled glove box. PPh_3 (78.6 mg, 0.3 mmol, 0.06 equiv.), Cs_2CO_3 (4.89 g, 15 mmol, 3.0 equiv.) and THF (18 mL) were added, and the tube was sealed and removed from the glove box. 2.0 mL H_2O was added and stirred at 85 °C for 19 h. The resulting dark brown mixture was cooled to room temperature, diluted with CH_2Cl_2 and washed with H_2O. The aqueous layer was extracted with CH_2Cl_2. The complex organic layer was dried over $MgSO_4$, and the filtrate was concentrated. The crude product was purified by column chromatography (petroleum ether/ethyl acetate 10/1) to give white solid (70% yield).

All of the NMR spectra of the know compounds were in full accordance with the data in the literatures.

References:

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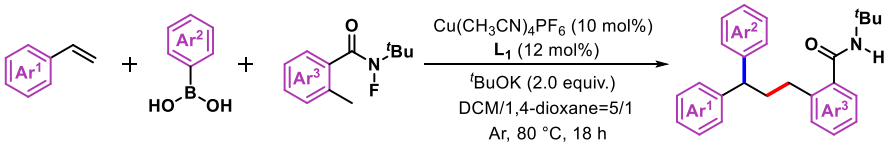
2. Y.-T. Wen, X.-T. Kong, H.-C. Liu, C.-T. Wang, W.-X. Wei, B. Wang, X.-Y. Liu and Y.-M. Liang, Ni-Catalyzed Remote Radical/Cross-Electrophile Coupling Cascade for Selective C(sp^3)–H Arylation, *Org. Lett.*, 2022, **24**, 2399-2403.
3. W. Lu, C. Li, X. Wu, X. Xie and Z. Zhang, $[Rh(COD)Cl]_2/PPh_3$-Catalyzed Dehydrogenative Silylation of Styrene Derivatives with NBE as a Hydrogen Acceptor, *Organometallics*, 2020, **39**, 3780-3788.

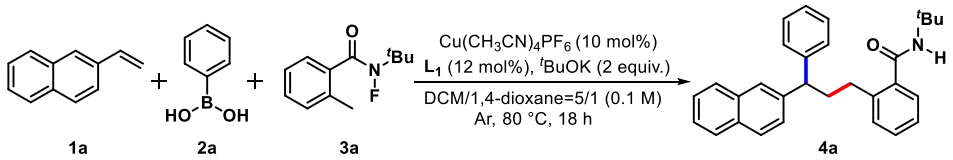
IV. Experimental procedures

d) General procedures for Alkylarylation of Vinylaromatics, *N*-fluoroamides, and Arylboronic acids.



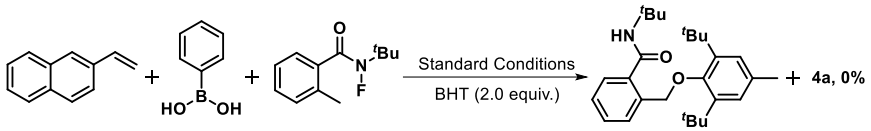
The reaction is operated in a glove box and the sealing tube is pre-dried before use. Vinylaromatics (0.2 mmol, 1.0 equiv.), *N*-fluoroamides (0.5 mmol, 2.5 equiv.), Arylboronic acids (0.5 mmol, 2.5 equiv.), $Cu(CH_3CN)_4PF_6$ (10 mol%, 0.02 mmol), 2,2':6',2"-terpyridine as ligand (12 mol%, 0.024 mmol), and ^{t}BuOK as base (0.4 mmol, 2 equiv.) were added in a 15 mL pre-dried sealing tube with stir bar. And then the solvent (DCM/1,4-dixane = 5/1, v/v, 2.0 mL in total) was injected. The resulting mixture was stirred at room temperature for about 15 minutes in advance and was carried out at 80 ºC (oil bath) for 18 h subsequently. The completed reaction mixture was concentrated by vacuum distillation. Afterward, the product was purified by silica gel column chromatography using petroleum ether/ethyl acetate as eluent.

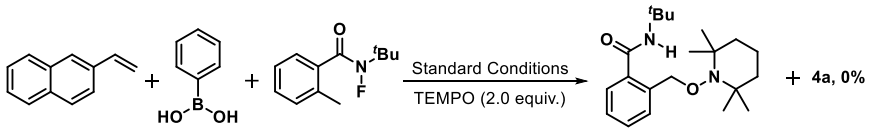
e) Amplification reaction with 1.0 mmol scale



2-vinylnaphthalene (**1a**, 1.0 mmol 154.2 mg), *N*-(*tert*-butyl)-*N*-fluoro-2-methylbenzamide (**2a**, 2.5 mmol, 703.2 mg), phenylboronic acid (**3a**, 2.5 mmol, 304.8 mg), $Cu(CH_3CN)_4PF_6$ (10 mol%, 0.1 mmol, 37.3 mg), 2,2':6',2"-terpyridine (**L1**) as ligand (12 mol%, 0.12 mmol, 28 mg), and base (2 mmol, 224 mg.) were added in a 25 mL pre-dried round-bottom flask with stir bar. And then the solvent (DCM/1,4-dixane = 5/1, v/v, 10.0 mL in total) was injected. The resulting mixture was stirred at room temperature for about 15 minutes in advance and was carried out at 80 ºC (oil bath) for 18 h subsequently. The completed reaction mixture was concentrated by vacuum distillation. Afterward, the product was purified by silica gel column chromatography using petroleum ether/ethyl acetate as eluent. The pure product was obtained using petroleum ether/ethyl acetate=20/1 as eluent, and 53% isolated yield of **4a** (235.4 mg) has been obtained.

V. Radical trapping experiments

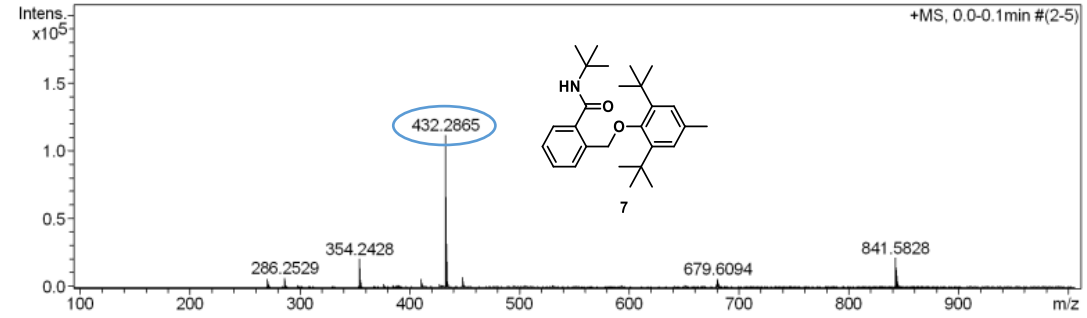




Under standard conditions, the radical trapping agent was added separately, and then the experimental results were observed. when adding 2.0 equivalents 2,6-di-*tert*-butyl-4-methylphenol (BHT) into the standard conditions, the HRMS captured product **7** while no target product **4a** was detected. Subsequently, the reaction was completely inhibited using 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO) as a scavenger, but the corresponding trap product **8** was isolated in 25% yield. These results suggested that the alkylarylation may proceed through a radical pathway.

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	0.4 Bar
Focus	Active	Set Capillary	4500 V	Set Dry Heater	180 ¡ãC
Scan Begin	100 m/z	Set End Plate Offset	-500 V	Set Dry Gas	4.0 l/min
Scan End	1000 m/z	Set Collision Cell RF	600.0 Vpp	Set Divert Valve	Waste

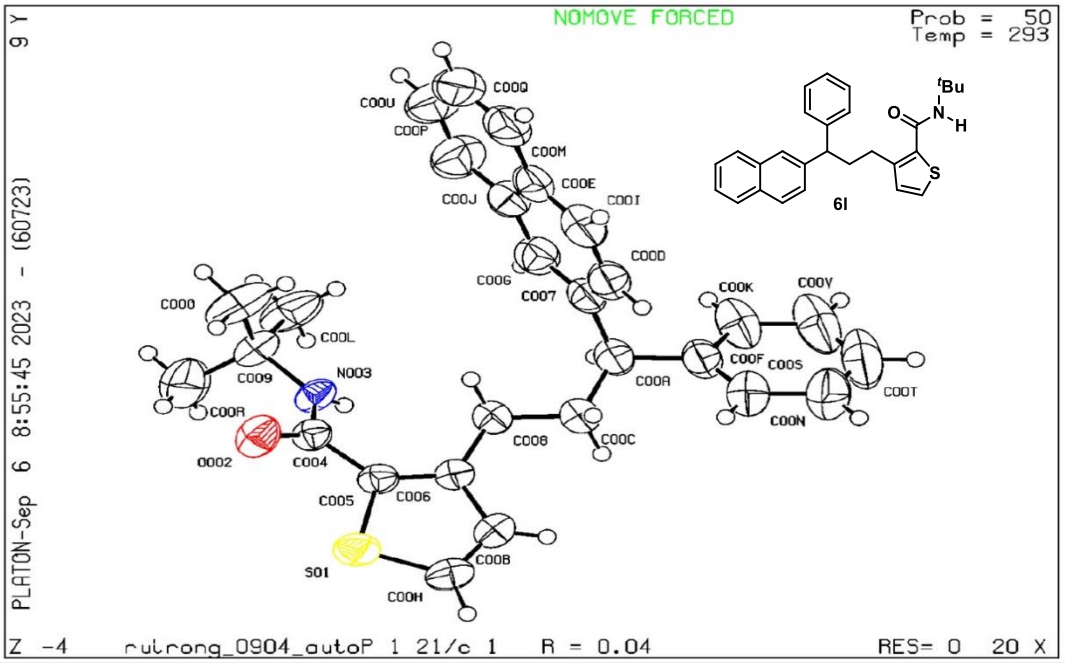


Meas. m/z	#	Formula	m/z	err [ppm]	Mean err [ppm]	rdb	N-Rule	e¡¥ Conf	mSigma	Std I	Std Mean m/z	Std I Var Norm	Std m/z Diff	Std Comb Dev
432.2865	1	C 27 H 39 N Na O 2	432.2873	1.8	1.9	8.5	ok	even	9.3	16.8	0.9	6.0	1.1	842.7

VI. X-ray Crystallographic Information

Sample preparation: The crystal **6l** was grown by slowly evaporating with a mixture of acetonitrile and dichloromethane at the refrigerator under the air conditions. (CCDC: 2293192)

Crystal measurement: X-ray crystal structures of **6l** were determined at room temperature (293 K). Thermal ellipsoids are drawn at 50% probability level.



Bond precision:	C-C = 0.0031 A	Wavelength=1.54184	
Cell:	a=14.9942(3)	b=18.3169(3)	c=9.1364(1)
	alpha=90	beta=104.366(2)	gamma=90
Temperature:	293 K		

	Calculated	Reported
Volume	2430.82(7)	2430.82(7)
Space group	P 21/c	P 1 21/c 1
Hall group	-P 2ybc	-P 2ybc
Moiety formula	C28 H29 N O S	C28 H29 N O S
Sum formula	C28 H29 N O S	C28 H29 N O S
Mr	427.58	427.58
Dx,g cm-3	1.168	1.168
Z	4	4
Mu (mm-1)	1.314	1.314
F000	912.0	912.0
F000'	915.57	
h,k,lmax	18,23,11	18,22,11
Nref	5078	4863
Tmin,Tmax	0.810,0.854	0.640,1.000
Tmin'	0.810	

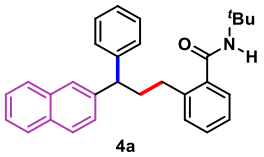
Correction method= # Reported T Limits: Tmin=0.640 Tmax=1.000
AbsCorr = MULTI-SCAN

Data completeness= 0.958 Theta(max)= 76.042

R(reflections)= 0.0434(4116) wR2(reflections)= 0.1190(4863)

S = 1.034 Npar= 287

VII. Spectra Date of Products



4a

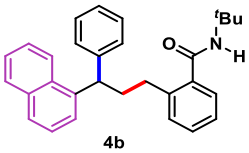
***N*-(*tert*-butyl)-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (55.6 mg, 66% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 98-100 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.72 (m, 4H), 7.45 – 7.37 (m, 2H), 7.35 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.31– 7.28 (m, 4H), 7.26 – 7.24 (m, 2H), 7.18 – 7.15 (m, 3H), 5.46 (s, 1H), 4.13 (t, *J* = 7.6 Hz, 1H), 2.79 – 2.75 (m, 2H), 2.54 – 2.45 (m, 2H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.6, 142.2, 139.9, 137.8, 133.5, 132.2, 130.0, 129.4, 128.4, 128.1, 128.0, 127.7, 127.5, 126.8, 126.6, 126.2, 125.9, 125.8, 125.3, 51.6, 51.5, 37.1, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{31}NNaO^+$ $[M + Na]^+$: 444.2303; Found 444.2314.



4b

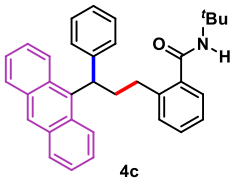
***N*-(*tert*-butyl)-2-(3-(naphthalen-1-yl)-3-phenylpropyl)benzamide**

White solid (53.9 mg, 64% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 113-116 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 – 8.00 (m, 1H), 7.83 – 7.79 (m, 1H), 7.71 (d, *J* = 8.0 Hz, 1H), 7.54 (dd, *J* = 7.2, 1.2 Hz, 1H), 7.48 – 7.44 (m, 1H), 7.42 – 7.38 (m, 2H), 7.32 – 7.27 (m, 3H), 7.26 – 7.22 (m, 3H), 7.19 – 7.12 (m, 3H), 5.43 (s, 1H), 4.78 (t, *J* = 7.2 Hz, 1H), 2.90 – 2.74 (m, 2H), 2.58 – 2.43 (m, 2H), 1.32 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.6, 140.1, 139.8, 137.9, 134.0, 131.9, 130.1, 129.4, 128.8, 128.4, 128.1, 126.9, 126.6, 126.1, 125.83, 125.79, 125.5, 125.2, 124.5, 123.6, 51.6, 46.2, 37.9, 32.1, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{31}NNaO^+$ $[M + Na]^+$: 444.2298; Found 444.2298.



4c

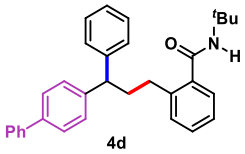
2-(3-(anthracen-9-yl)-3-phenylpropyl)-*N*-(*tert*-butyl)benzamide

Light yellow liquid (21.7 mg, 23% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.54 (m, 2H), 7.32 – 7.31 (m, 4H), 7.25– 7.14 (m, 6H), 7.09 – 7.05 (m, 3H), 6.94 – 6.92 (m, 1H), 6.40 (dd, *J* = 7.6, 1.2 Hz, 1H), 6.27 (dd, *J* = 8.8, 6.0 Hz, 1H), 5.50 (s, 1H), 4.39 (t, *J* = 7.6 Hz, 1H), 4.08 – 4.02 (m, 1H), 3.96 – 3.91(m, 1H), 3.03 (dd, *J* = 7.6, 1.2 Hz, 2H), 1.48 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.9, 141.2, 140.9, 138.8, 138.5, 138.3, 137.4, 135.8, 134.2, 131.9, 128.7, 128.6, 128.43, 128.41, 127.8, 127.4, 126.8, 126.5, 126.3, 126.2, 126.14, 126.07, 125.6, 124.0, 51.7, 49.4, 42.6, 36.0, 28.9.

HRMS (ESI) *m/z*: Calcd for $C_{34}H_{33}NNaO^+$ $[M + Na]^+$: 494.2454; Found 494.2464.



4d

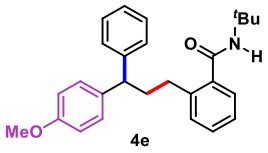
2-(3-([1,1'-biphenyl]-4-yl)-3-phenylpropyl)-*N*-(*tert*-butyl)benzamide

White solid (57.2 mg, 64% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 136-138 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.49 (m, 4H), 7.43 – 7.39 (m, 2H), 7.35 – 7.25 (m, 9H), 7.20 – 7.16 (m, 3H), 5.48 (s, 1H), 4.00 (t, *J* = 8.0 Hz, 1H), 2.78 – 2,74 (m, 2H), 2.46 – 2.40 (m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.7, 143.9, 141.0, 139.8, 139.0, 137.9, 130.0, 129.4, 128.7, 128.5, 128.3, 127.9, 127.2, 126.99, 126.96, 126.6, 126.2, 125.8, 51.7, 51.2, 37.4, 32.1, 28.8.

HRMS (ESI) *m/z*: Calcd for $C_{32}H_{33}NNaO^+$ $[M + Na]^+$: 470.2454; Found 470.2464.



4e

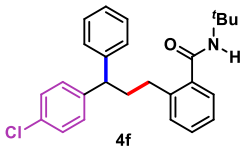
***N*-(*tert*-butyl)-2-(3-(4-methoxyphenyl)-3-phenylpropyl)benzamide**

White solid (43.3 mg, 54% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 100-102 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.27 (m, 1H), 7.26 – 7.20 (m, 5H), 7.19 – 7.12 (m, 5H), 6.83 – 6.79 (m, 2H), 5.47 (s, 1H), 3.91 (t, *J* = 7.6 Hz, 1H), 3.76 (s, 3H), 2.75 – 2.66 (m, 2H), 2.38 – 2.32 (m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.7, 157.9, 145.2, 139.9, 137.9, 136.9, 130.0, 129.4, 128.8, 128.4, 127.8, 126.6, 126.0, 125.8, 113.8, 55.2, 51.7, 50.6, 37.6, 32.0, 28.8.

HRMS (ESI) *m/z*: Calcd for $C_{27}H_{31}NNaO_2^+$ $[M + Na]^+$: 424.2247; Found 424.2249.



4f

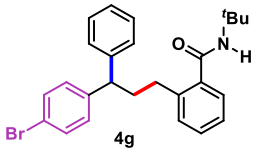
***N*-(*tert*-butyl)-2-(3-(4-chlorophenyl)-3-phenylpropyl)benzamide**

Light yellow liquid (39.7 mg, 49% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.25 (m, 5H), 7.24 – 7.21 (m, 4H), 7.20 – 7.17 (m, 3H), 7.15 – 7.12 (m, 1H), 5.49 (s, 1H), 3.93 (t, *J* = 7.6 Hz, 1H), 2.75 – 2.64 (m, 2H), 2.41 – 2.32 (m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.2, 143.3, 139.7, 137.8, 131.8, 130.0, 129.5, 129.3, 128.50, 128.46, 127.8, 126.6, 126.3, 125.9, 51.7, 50.8, 37.3, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{26}H_{28}ClNNaO^+$ $[M + Na]^+$: 428.1752; Found 428.1766.



4g

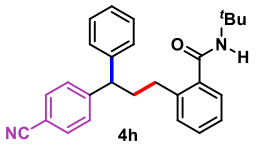
***N*-(*tert*-butyl)-2-(3-(4-chlorophenyl)-3-phenylpropyl)benzamide**

White solid (49.4 mg, 55% yield)；silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 102-104 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.36 (m, 2H), 7.30 – 7.27 (m, 3H), 7.25 (s, 1H), 7.23 – 7.21 (m, 2H), 7.19 – 7.12 (m, 5H), 5.48 (s, 1H), 3.92 (t, *J* = 7.8 Hz, 1H), 2.75 – 2.64 (m, 2H), 2.40 – 2.31 (m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.1, 143.8, 139.7, 137.8, 131.5, 130.0, 129.7, 129.5, 128.5, 127.8, 126.6, 126.3, 125.9, 119.9, 51.7, 50.9, 37.2, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{26}H_{28}BrNNaO^+$ $[M + Na]^+$: 472.1246; Found 472.1238.



4h

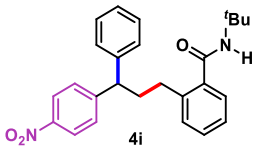
***N*-(*tert*-butyl)-2-(3-(4-cyanophenyl)-3-phenylpropyl)benzamide**

Light yellow solid (38.0 mg, 48% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 99-101 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.54 (m, 2H), 7.39 – 7.37 (m, 2H), 7.31 – 7.27 (m, 4H), 7.24 – 7.17 (m, 4H), 7.12 (dd, *J* = 7.6, 2.0 Hz, 1H), 5.51 (s, 1H), 4.02 (t, *J* = 8.0 Hz, 1H), 2.71 – 2.67 (m, 2H), 2.45 – 2.36 (m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 150.4, 143.1, 139.5, 137.7, 132.3, 130.1, 129.5, 128.8, 128.7, 127.9, 126.7, 126.6, 126.1, 119.0, 109.9, 51.7, 51.6, 37.1, 32.1, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{27}H_{28}N_2NaO^+$ $[M + Na]^+$: 419.2094; Found 419.2104.



4i

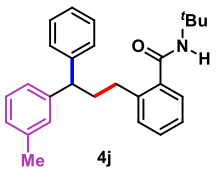
***N*-(*tert*-butyl)-2-(3-(4-nitrophenyl)-3-phenylpropyl)benzamide**

Light yellow solid (21.6 mg, 26% yield,); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 106-108 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.15 – 8.11 (m, 2H), 7.46 – 7.42 (m, 2H), 7.33 – 7.28 (m, 4H), 7.26 – 7.17 (m, 4H), 7.13 (dd, *J* = 7.6, 1.6 Hz, 1H), 5.51 (s, 1H), 4.08 (t, *J* = 8.0 Hz, 1H), 2.72 – 2.68 (m, 2H), 2.47 – 2.41(m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 152.6, 146.4, 143.0, 139.5, 137.7, 130.1, 129.6, 128.8, 127.9, 126.8, 126.6, 126.1, 123.7, 51.7, 51.4, 37.1, 32.1, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{26}H_{28}N_2NaO_3^+$ $[M + Na]^+$: 439.1992; Found 439.1992.



4j

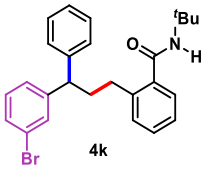
***N*-(*tert*-butyl)-2-(3-phenyl-3-(m-tolyl)propyl)benzamide**

White solid (28.5 mg, 37% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 96-98 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.27 (m, 3H), 7.26 – 7.26 (m, 3H), 7.19 – 7.14 (m, 4H), 7.07 – 7.05 (m, 2H), 6.97 (d, *J* = 7.2 Hz, 1H), 5.46 (s, 1H), 3.91 (t, *J* = 7.6 Hz, 1H), 2.74 – 2.70 (m, 2H), 2.40 – 2.34 (m, 2H), 2.30 (s, 3H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.7, 144.9, 144.7, 139.9, 137.87, 137.86, 130.0, 129.4, 128.7, 128.4, 128.3, 127.9, 126.9, 126.6, 126.0, 125.8, 124.9, 51.7, 51.5, 37.3, 32.0, 28.7, 21.5.

HRMS (ESI) *m/z*: Calcd for $C_{27}H_{31}NNaO^+$ $[M + Na]^+$: 408.2298; Found 408.2307.



4k

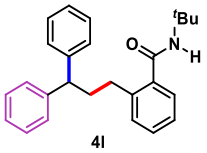
2-(3-(3-bromophenyl)-3-phenylpropyl)-*N*-(*tert*-butyl)benzamide

White solid (24.3 mg, 27% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 78-81 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.39 – 7.38 (m, 1H), 7.30 – 7.27 (m, 4H), 7.25 – 7.22 (m, 3H), 7.26 –7.17 (m, 3H), 7.15 – 7.11 (m, 2H), 5.49 (s, 1H), 3.92 (t, *J* = 7.6 Hz, 1H), 2.73 – 2.69 (m, 2H), 2.41 – 2.32 (m, 2H), 1.38 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 147.2, 143.8, 139.6, 137.7, 130.9, 130.01, 129.99, 129.5, 129.2, 128.6, 127.9, 126.6, 126.4, 125.9, 122.5, 51.7, 51.2, 37.1, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{26}H_{28}BrNNaO^+$ $[M + Na]^+$: 472.1246; Found 472.1242.



4l

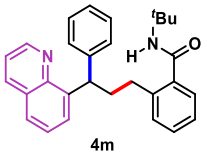
***N*-(*tert*-butyl)-2-(3,3-diphenylpropyl)benzamide**

White solid (23.0 mg, 31% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 70-73 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 – 7.24 (m, 10H), 7.19 – 7.16 (m, 2H), 7.15 – 7.13 (m, 2H), 5.47 (s, 1H), 3.95 (t, *J* = 7.6 Hz, 1H), 2.74 – 2.70 (m, 2H), 2.42 – 2.36 (m, 2H), 1.37 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.7, 139.8, 137.8, 130.0, 129.4, 128.44, 128.40, 128.28, 128.25, 127.9, 127.6, 126.6, 126.1, 125.8, 51.7, 51.5, 37.3, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{26}H_{29}NNaO^+$ $[M + Na]^+$: 394.2141; Found 394.2151.

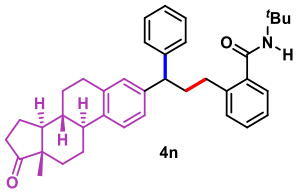


4m

***N*-(*tert*-butyl)-2-(3-phenyl-3-(quinolin-7-yl)propyl)benzamide**

White solid (29.6 mg, 35% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1. m.p: 153-156 ºC.

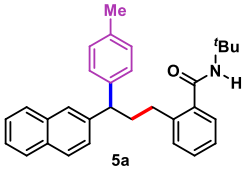
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.93 – 8.91 (m, 1H), 8.09 – 8.07 (m, 1H), 7.68 (dd, *J* = 7.2, 1.6 Hz, 1H), 7.62 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.49 – 7.45 (m, 3H), 7.36 – 7.33 (m, 1H), 7.26 – 7.22 (m, 4H), 7.17 – 7.10 (m, 3H), 5.69 (t, *J* = 8.0 Hz, 1H), 5.50 (s, 1H), 2.86 – 2.72 (m, 2H), 2.58 – 2.49 (m, 2H), 1.33 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.7, 149.2, 146.3, 145.1, 143.7, 139.9, 137.9, 136.2, 130.0, 129.2, 128.4, 128.3, 128.2, 127.4, 126.4, 125.9, 125.8, 125.6, 120.8, 51.6, 43.4, 37.5, 32.2, 28.7.
HRMS (ESI) *m/z*: Calcd for $C_{29}H_{30}N_2NaO^+$ $[M + Na]^+$: 445.2250; Found 445.2252.



4n

***N*-(*tert*-butyl)-2-(3-((8*R*,9*S*,13*S*,14*S*)-13-methyl-17-oxo-7,8,9,11,12,13,14,15,16,17-decahydro-*6H*-cyclopenta[a]phenanthren-3-yl)-3-phenylpropyl)benzamide**

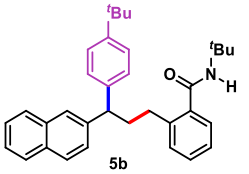
Light yellow liquid (39.4 mg, 36% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1. dr = 2.8:1
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.27 (m, 3H), 7.26 – 7.24 (m, 3H), 7.19 – 7.13 (m, 4H), 7.10 – 7.03 (m, 1H), 6.98 – 6.98 (m, 1H), 5.48 – 5.28 (s, 1H), 3.89 (t, *J* = 7.6 Hz, 1H), 2.86 (dd, *J* = 9.2, 4.4 Hz, 2H), 2.73 – 2.69 (m, 2H), 2.48 (dd, *J* = 19.2, 9.2 Hz, 1H), 2.41 – 2.33 (m, 3H), 2.28 – 2.21 (m, 1H), 2.17 – 2.07 (m, 1H), 2.02 – 1.91 (m, 2H), 1.64 – 1.55 (m, 2H), 1.54 – 1.42 (m, 5H), 1.37 (s, 9H), 0.88 (s, 3H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 144.87, 144.83, 142.23, 142.18, 139.8, 137.8, 137.4, 136.31, 136.30, 129.9, 129.3, 128.39, 128.37, 127.9, 126.5, 126.0, 125.8, 125.32, 125.30, 125.17, 125.15, 51.6, 51.1, 50.5, 48.0, 44.3, 38.1, 37.38, 37.35, 35.8, 32.0, 31.6, 29.4, 28.8, 28.7, 26.5, 25.6, 21.5, 13.8.
HRMS (ESI) *m/z*: Calcd for $C_{38}H_{45}NNaO_2^+$ $[M + Na]^+$: 570.3343; Found 570.3335.



5a

***N*-(*tert*-butyl)-2-(3-(naphthalen-2-yl)-3-(*p*-tolyl)propyl)benzamide**

White solid (58.3 mg, 67% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 114-116 ºC.
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.70 (m, 4H), 7.43 – 7.33 (m, 3H), 7.28 – 7.24 (m, 2H), 7.20 – 7.13 (m, 4H), 7.08 – 7.04 (m, 2H), 5.46 (s, 1H), 4.08 (t, *J* = 7.6 Hz, 1H), 2.79 – 2.72 (m, 2H), 2.53 – 2.40 (m, 2H), 2.27 (s, 3H), 1.32 (s, 9H).
^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 142.4, 141.5, 139.8, 137.8, 135.6, 133.5, 132.1, 130.0, 129.4, 129.1, 128.0, 127.9, 127.7, 127.4, 126.8, 126.5, 125.80, 125.76, 125.2, 51.6, 51.0, 37.1, 32.0, 28.6, 20.9.
HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO^+$ $[M + Na]^+$: 458.2460; Found 458.2452.



5b

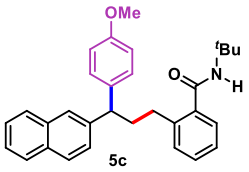
***N*-(*tert*-butyl)-2-(3-(4-(*tert*-butyl)phenyl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (67.8 mg, 71% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 115-118 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.72 (m, 4H), 7.44 – 7.36 (m, 4H), 7.30 – 7.27 (m, 2H), 7.23 – 7.21(m, 3H), 7.18 – 7.14 (m, 2H), 5.44 (s, 1H), 4.09 (t, *J* = 8.0 Hz, 1H), 2.78 – 2.74 (m, 2H), 2.52 – 2.46 (m, 2H), 1.32 (s, 9H), 1.27 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 148.8, 142.4, 141.5, 139.9, 137.9, 133.6, 132.2, 129.9, 129.4, 128.0, 127.7, 127.54, 127.49, 126.8, 126.6, 126.0, 125.8, 125.3, 125.2, 51.6, 51.1, 37.2, 34.3, 32.0, 31.4, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{34}H_{39}NNaO^+$ $[M + Na]^+$: 500.2929; Found 500.2944.



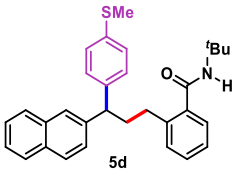
***N*-(*tert*-butyl)-2-(3-(4-methoxyphenyl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (60.5 mg, 67% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 98-101 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.45 – 7.37 (m, 2H), 7.33 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.30 – 7.26 (m, 2H), 7.23 – 7.20 (m, 2H), 7.18 – 7.14 (m, 2H), 6.83 – 6.79 (m, 2H), 5.47 (s, 1H), 4.07 (t, *J* = 7.6 Hz, 1H), 3.75 (s, 3H), 2.79 – 2.71 (m, 2H), 2.51 – 2.41 (m, 2H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 157.9, 142.6, 139.9, 137.8, 136.7, 133.5, 132.1, 130.0, 129.4, 128.9, 128.0, 127.7, 127.5, 126.7, 126.5, 125.8, 125.7, 125.2, 113.8, 55.2, 51.6, 50.6, 37.3, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO_2^+$ $[M + Na]^+$: 474.2404; Found 474.2409.



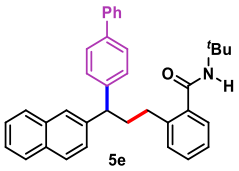
***N*-(*tert*-butyl)-2-(3-(4-(methylthio)phenyl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (59.8 mg, 64% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 25/1, m.p: 137-140 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.45 – 7.37 (m, 2H), 7.34 – 7.23 (m, 4H), 7.22 – 7.21 (m, 1H), 7.18 – 7.13 (m, 4H), 5.48 (s, 1H), 4.08 (t, *J* = 7.6 Hz, 1H), 2.81 – 2.69 (m, 2H), 2.51 – 2.43 (m, 2H), 2.41 (s, 3H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 142.0, 141.6, 139.8, 137.8, 135.7, 133.5, 132.1, 130.0, 129.4, 128.5, 128.1, 127.7, 127.5, 127.0, 126.7, 126.5, 125.9, 125.84, 125.82, 125.8, 125.3, 51.6, 50.9, 37.0, 32.0, 28.6, 16.0.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaOS^+$ $[M + Na]^+$: 490.2175; Found 490.2187.



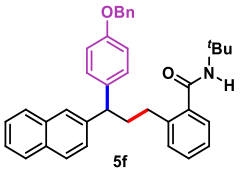
2-(3-([1,1'-biphenyl]-4-yl)-3-(naphthalen-2-yl)propyl)-*N*-(*tert*-butyl)benzamide

White solid (65.6 mg, 66% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 118-120 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 – 7.75 (m, 4H), 7.55 – 7.50 (m, 4H), 7.46– 7.40 (m, 4H), 7.39 – 7.37 (m, 3H), 7.31 – 7.28 (m, 3H), 7.19 – 7.17 (m, 2H), 5.47 (s, 1H), 4.17 (s, 1H), 2.84 – 2.76 (m, 2H), 2.58 – 2.49 (m, 2H),1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 143.7, 142.1, 140.9, 139.8, 139.0, 137.8, 133.5, 132.2, 130.0, 129.4, 128.7, 128.4, 128.1, 127.7, 127.5, 127.2, 127.00, 126.95, 126.8, 126.6, 126.0, 125.89, 125.87, 125.4, 51.6, 51.2, 37.2 32.1, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{36}H_{35}NNaO^+$ [M + Na]$^+$: 520.2611; Found 520.2621.



5f

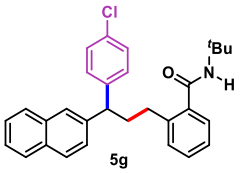
2-(3-(4-(benzyloxy)phenyl)-3-(naphthalen-2-yl)propyl)-*N*-(*tert*-butyl)benzamide

White solid (71.7 mg, 68% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 145-147 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.46 – 7.38 (m, 5H), 7.36 – 7.34 (m, 2H), 7.33 – 7.29 (m, 3H), 7.25 (s, 1H), 7.23 – 7.20 (m, 2H), 7.18 – 7.17 (m, 1H), 6.91 – 6.87 (m, 2H), 5.46 (s, 1H), 5.01 (s, 2H), 4.08 (t, *J* = 7.6 Hz, 1H), 2.81 – 2.70 (m, 2H), 2.51 – 2.40 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 157.2, 142.5, 139.9, 137.9, 137.14, 137.06, 133.5, 132.1, 130.0, 129.4, 129.0, 128.5, 128.1, 127.9, 127.7, 127.50, 127.47, 126.8, 126.6, 125.83, 125.79, 125.3, 114.8, 70.0, 51.6, 50.6, 37.3, 32.1, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{37}H_{37}NNaO_2^+$ [M + Na]$^+$: 550.2717; Found 550.2736.



5g

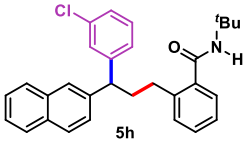
***N*-(*tert*-butyl)-2-(3-(4-chlorophenyl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (60.1 mg, 66% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 25/1, m.p: 127-130 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.46 – 7.39 (m, 2H), 7.32 – 7.26 (m, 3H), 7.23 (s, 4H), 7.19 – 7.13 (m, 2H), 5.48 (s, 1H), 4.10 (t, *J* = 7.6 Hz, 1H), 2.79 – 2.68 (m, 2H), 2.53 – 2.40 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 143.1, 141.6, 139.7, 137.8, 133.5, 132.2, 131.9, 130.0, 129.5, 129.4, 128.5, 128.2, 127.7, 127.5, 126.6, 126.0, 125.93, 125.91, 125.5, 51.6, 50.8, 37.1, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}ClNNaO^+$ [M + Na]$^+$: 478.1908; Found 478.1917.



5h

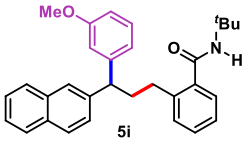
***N*-(*tert*-butyl)-2-(3-(3-chlorophenyl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (53.7 mg, 59% yield); silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 25/1, m.p: 98-100 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 – 7.73 (m, 4H), 7.47 – 7.39 (m, 2H), 7.33 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.31 – 7.27 (m, 3H), 7.20 – 7.11 (m, 5H), 5.48 (s, 1H), 4.10 (t, *J* = 8.0 Hz, 1H), 2.77 – 2,71 (m, 2H), 2.55 – 2.41 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 146.8, 141.3, 139.7, 137.8, 134.2, 133.5, 132.2, 130.1, 129.7, 129.5, 128.3, 128.1, 127.8, 127.5, 126.6, 126.5, 126.4, 126.3, 126.1, 125.99, 125.95, 125.5, 51.6, 51.2, 36.9, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}ClNNaO^+$ $[M + Na]^+$: 478.1908; Found 478.1924.



5i

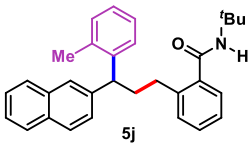
***N*-(*tert*-butyl)-2-(3-(3-methoxyphenyl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (49.6 mg, 55% yield,); silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 25/1, m.p: 108-110 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.70 (m, 4H), 7.43 – 7.34 (m, 3H), 7.28 – 7.24 (m, 2H), 7.20 – 7.12 (m, 3H), 6.92 – 6.84 (m, 2H), 6.69 (dd, *J* = 8.0, 2.4 Hz, 1H), 5.48 (s, 1H), 4.09 (t, *J* = 8.0 Hz, 1H), 3.73 (s, 3H), 2.78 – 2.74 (m, 2H), 2.52 – 2.43 (m, 2H), 1.31 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 159.6, 146.2, 142.0, 139.8, 137.8, 133.5, 132.1, 129.9, 129.4, 129.3, 128.0, 127.7, 127.4, 126.7, 126.5, 125.84, 125.78, 125.3, 120.4, 114.0, 111.2, 55.0, 51.5, 51.4, 36.9, 31.9, 28.6.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO_2^+$ $[M + Na]^+$: 474.2404; Found 474.2425.



5j

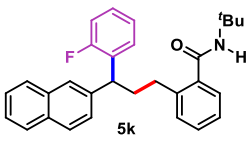
***N*-(*tert*-butyl)-2-(3-(naphthalen-2-yl)-3-(o-tolyl)propyl)benzamide**

Light yellow solid (30.5 mg, 35% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 25/1, m.p: 107-110 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 – 7.70 (m, 3H), 7.65 – 7.65 (m, 1H), 7.44 – 7.37 (m, 3H), 7.32 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.30 – 7.25 (m, 2H), 7.25 – 7.14 (m, 3H), 7.12 – 7.10 (m, 2H), 5.46 (s, 1H), 4.31 (t, *J* = 7.6 Hz, 1H), 2.88 – 2.74 (m, 2H), 2.49 – 2.40 (m, 2H), 2.26 (s, 3H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 142.2, 141.9, 139.9, 137.9, 136.4, 133.5, 132.1, 130.5, 130.0, 129.4, 127.9, 127.7, 127.5, 127.1, 126.9, 126.6, 126.4, 126.11, 126.10, 125.84, 125.77, 125.2, 51.6, 47.1, 37.7, 32.0, 28.7, 19.9.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO^+$ $[M + Na]^+$: 458.2454; Found 458.2454.



5k

***N*-(*tert*-butyl)-2-(3-(2-fluorophenyl)-3-(naphthalen-2-yl)propyl)benzamide**

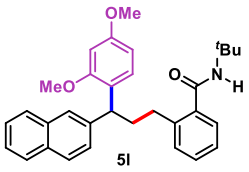
White solid (31.6 mg, 36% yield); silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 25/1, m.p: 96-98 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.73 (m, 4H), 7.46 – 7.35 (m, 4H), 7.29 – 7.25 (m, 2H), 7.20 –7.12 (m, 3H), 7.09 – 7.05 (m, 1H), 7.01 – 6.96 (m, 1H), 5.48 (s, 1H), 4.49 (t, *J* = 7.6 Hz, 1H), 2.85 – 2.73 (m, 2H), 2.57 – 2.43 (m, 2H), 1.35 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 160.7 (d, *J* = 249.5 Hz), 140.9, 139.7, 137.9, 133.5, 132.2, 131.6 (d, *J* = 14.1 Hz), 130.1, 129.5, 128.8 (d, *J* = 5.1 Hz), 128.1, 127.79, 127.75, 127.7, 127.5, 126.8, 126.6, 126.2, 125.91, 125.87, 125.4, 124.2 (d, *J* = 3.0 Hz), 115.4 (d, *J* = 23.2 Hz), 51.7, 43.6 (d, *J* = 2.0 Hz), 36.3, 32.0, 28.7.

^{19}F NMR (376 MHz, $CDCl_3$) δ -117.77 (s, 1F).

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}FNNaO^+$ $[M + Na]^+$: 462.2204; Found 462.2217.



5l

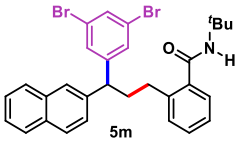
***N*-(*tert*-butyl)-2-(3-(2,4-dimethoxyphenyl)-3-(naphthalen-2-yl)propyl)benzamide**

Light yellow solid (47.2 mg, 49% yield). silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 92-94 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.69 (m, 4H), 7.43 – 7.36 (m, 3H), 7.30 – 7.28 (m, 1H), 7.26 –7.25 (m, 1H), 7.21 – 7.14 (m, 3H), 6.47 – 6.40 (m, 2H), 5.45 (s, 1H), 4.52 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 3H), 3.74 (s, 3H), 2.82 – 2.71 (m, 2H), 2.47 – 2.34 (m, 2H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.7, 159.1, 158.0, 142.7, 140.0, 137.9, 133.5, 132.0, 130.0, 129.3, 128.3, 127.7, 127.6, 127.4, 127.3, 126.5, 125.9, 125.7, 125.61, 125.57, 125.0, 104.2, 98.7, 55.5, 55.3, 51.6, 43.0, 36.8, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{32}H_{35}NNaO_3^+$ $[M + Na]^+$: 504.2509; Found 504.2525.



5m

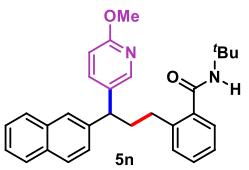
***N*-(*tert*-butyl)-2-(3-(3,5-dibromophenyl)-3-(naphthalen-2-yl)propyl)benzamide**

Light yellow liquid (35.8 mg, 31% yield). silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 30/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 – 7.77 (m, 3H), 7.72 – 7.72 (m, 1H), 7.49 – 7.42 (m, 3H), 7.36 (d, *J* = 1.6 Hz, 1H), 7.32 – 7.28 (m, 3H), 7.25 (s, 1H), 7.21 – 7.17 (m, 1H), 7.14 – 7.12 (m, 1H), 5.50 (s, 1H), 4.06 (t, *J* = 7.6 Hz, 1H), 2.77 – 2.70 (m, 2H), 2.54 – 2.38 (m, 2H), 1.36 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.5, 148.9, 140.3, 139.6, 137.7, 133.5, 132.4, 131.9, 130.1, 129.9, 129.6, 128.5, 127.8, 127.6, 126.6, 126.31, 126.25, 126.2, 126.1, 125.7, 122.9, 51.7, 51.0, 36.8, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{29}Br_2NNaO^+$ $[M + Na]^+$: 600.0508; Found 600.0526.



5n

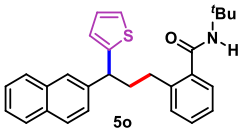
***N*-(*tert*-butyl)-2-(3-(6-methoxypyridin-3-yl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (32.6 mg, 36% yield). silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 82-84 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 (d, *J* = 2.4 Hz, 1H), 7.79 – 7.71 (m, 4H), 7.49 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.46 – 7.39 (m, 2H), 7.33 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.29 – 7.25 (m, 2H), 7.20 – 7.14 (m, 2H), 6.66 (d, *J* = 8.4 Hz, 1H), 5.50 (s, 1H), 4.07 (t, *J* = 7.2 Hz, 1H), 3.89 (s, 3H), 2.81 – 2.70 (m, 2H), 2.55 – 2.39 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 162.8, 145.9, 141.6, 139.7, 138.3, 137.8, 133.5, 132.7, 132.2, 130.1, 129.5, 128.2, 127.7, 127.5, 126.6, 126.5, 126.0, 125.9, 125.8, 125.5, 110.8, 53.3, 51.6, 48.1, 36.9, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{32}N_2NaO_2^+$ [M + Na]$^+$: 475.2356; Found 475.2379.



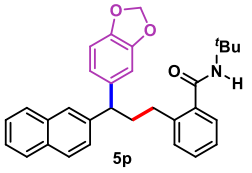
***N*-(*tert*-butyl)-2-(3-(naphthalen-2-yl)-3-(thiophen-2-yl)propyl)benzamide**

Light yellow liquid (20.5 mg, 24% yield). silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 20/1.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.75 (m, 3H), 7.69 – 7.69 (m, 1H), 7.46 – 7.38 (m, 2H), 7.35 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.32 – 7.28 (m, 1H), 7.25 – 7.24 (m, 1H), 7.22 – 7.13 (m, 3H), 7.10 – 7.09 (m, 1H), 6.94 (dd, *J* = 5.0, 1.3 Hz, 1H), 5.47 (s, 1H), 4.18 (t, *J* = 8.0 Hz, 1H), 2.85 – 2,67 (m, 2H), 2.58 – 2.37 (m, 2H), 1.35 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 145.6, 141.9, 139.8, 137.8, 133.5, 132.3, 130.0, 129.4, 128.2, 127.9, 127.7, 127.5, 126.6, 126.4, 126.2, 125.88, 125.86, 125.4, 125.37, 120.4, 51.6, 47.2, 37.5, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{28}H_{29}NNaOS^+$ [M + Na]$^+$: 450.1862; Found 450.1873.



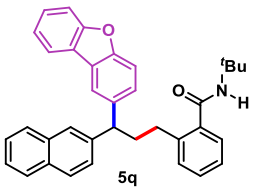
2-(3-(benzo[d][1,3]dioxol-5-yl)-3-(naphthalen-2-yl)propyl)-*N*-(*tert*-butyl)benzamide

White solid (59.5 mg, 64% yield); silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 112-114 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.45 – 7.37 (m, 2H), 7.33 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.30 – 7.26 (m, 2H), 7.19 – 7.15 (m, 2H), 6.79 – 6.77 (m, 2H), 6.73 – 6.70 (m, 1H), 5.87 (s, 2H), 5.48 (s, 1H), 4.04 (t, *J* = 7.6 Hz, 1H), 2.81 – 2.70 (m, 2H), 2.51 – 2.37 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 147.7, 145.8, 142.3, 139.9, 138.7, 137.9, 133.5, 132.2, 130.0, 129.4, 128.1, 127.7, 127.5, 126.7, 126.6, 125.9, 125.8, 125.7, 125.3, 121.0, 108.5, 108.1, 100.8, 51.6, 51.1, 37.2, 32.0, 28.7.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{31}NNaO_3^+$ [M + Na]$^+$: 488.2196; Found 488.2209.



5q

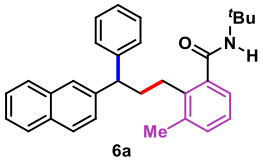
***N*-(*tert*-butyl)-2-(3-(dibenzo[b,d]furan-2-yl)-3-(naphthalen-2-yl)propyl)benzamide**

White solid (13.3 mg, 13% yield). silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 140-143 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 – 7.91 (m, 2H), 7.82 – 7.73 (m, 4H), 7.53 – 7.51 (m, 1H), 7.47 – 7.37 (m, 6H), 7.32 – 7.28 (m, 3H), 7.20 – 7.16 (m, 2H), 5.47 (s, 1H), 4.31 (t, *J* = 7.6 Hz, 1H), 2.87 – 2.76 (m, 2H), 2.63 – 2.57 (m, 2H), 1.30 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.6, 156.5, 154.8, 142.5, 139.9, 139.3, 137.8, 133.6, 132.2, 130.1, 129.5, 128.2, 127.8, 127.5, 126.9, 126.8, 126.6, 125.91, 125.90, 125.86, 125.4, 124.29, 124.27, 122.5, 120.7, 119.8, 111.6, 111.5, 51.6, 51.3, 37.6, 32.2, 28.6.

HRMS (ESI) *m/z*: Calcd for $C_{36}H_{33}NNaO_2^+$ [M + Na]$^+$: 534.2404; Found 534.2403.



6a

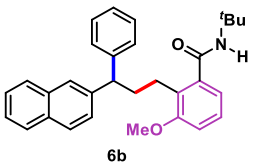
***N*-(*tert*-butyl)-3-methyl-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (57.5 mg, 66% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 104-106 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.72 (m, 4H), 7.45 – 7.37 (m, 3H), 7.34 – 7.32 (m, 2H), 7.28 – 7.24 (m, 2H), 7.19 – 7.04 (m, 4H), 5.46 (s, 1H), 4.16 (t, *J* = 8.0 Hz, 1H), 2.72 – 2.65 (m, 2H), 2.51 – 2.33 (m, 2H), 2.18 (s, 3H), 1.37 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 170.3, 144.6, 142.2, 138.7, 138.0, 137.1, 133.5, 132.2, 131.3, 128.4, 128.1, 128.0, 127.7, 127.5, 126.8, 126.2, 125.9, 125.8, 125.7, 125.3, 124.2, 52.3, 51.6, 36.0, 29.4, 28.8, 19.3.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO^+$ [M + Na]$^+$: 458.2454; Found 458.2455.



6b

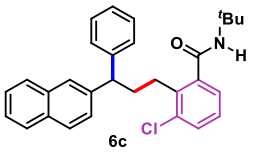
***N*-(*tert*-butyl)-3-methoxy-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (56.9 mg, 63% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 118-121 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.70 (m, 4H), 7.43 – 7.32 (m, 5H), 7.27 – 7.22 (m, 2H), 7.16 – 7.10 (m, 2H), 6.86 – 6.80 (m, 2H), 5.43 (s, 1H), 4.17 (t, *J* = 7.6 Hz, 1H), 3.76 (s, 3H), 2.72 – 2.68 (m, 2H), 2.51 – 2.36 (m, 2H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.4, 157.7, 145.0, 142.5, 139.4, 133.5, 132.1, 128.5, 128.3, 128.1, 127.8, 127.7, 127.5, 127.1, 126.8, 126.0, 125.9, 125.7, 125.1, 118.4, 111.1, 55.5, 52.1, 51.6, 35.7, 28.7, 26.4.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO_2^+$ [M + Na]$^+$: 474.2404; Found 474.2418.



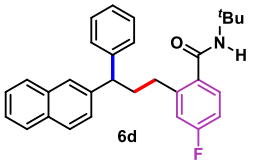
***N*-(*tert*-butyl)-3-chloro-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (64.6 mg, 71% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 52-54 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.43 – 7.31 (m, 6H), 7.25 (t, *J* = 7.6 Hz, 2H), 7.16 – 7.04 (m, 3H), 5.45 (s, 1H), 4.19 (t, *J* = 7.6 Hz, 1H), 2.83 – 2.76 (m, 2H), 2.55 – 2.39 (m, 2H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.6, 144.4, 142.0, 140.0, 137.6, 135.1, 133.5, 132.2, 130.5, 128.4, 128.04, 127.96, 127.7, 127.5, 127.0, 126.9, 126.1, 125.9, 125.8, 125.2, 124.8, 52.2, 51.8, 35.3, 30.2, 28.6.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}ClNNaO^+$ $[M + Na]^+$: 478.1914; Found 478.1915.



***N*-(*tert*-butyl)-4-fluoro-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

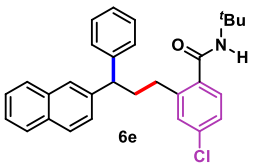
White solid (51.0 mg, 58% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 123-125 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.70 (m, 4H), 7.43 – 7.29 (m, 4H), 7.28 – 7.27 (m, 1H), 7.25 – 7.11 (m, 4H), 6.85 – 6.78 (m, 2H), 5.50 (s, 1H), 4.09 (t, *J* = 8.0 Hz, 1H), 2.75 – 2.71 (m, 2H), 2.52 – 2.39 (m, 2H), 1.29 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.7, 162.9 (d, *J* = 249.5 Hz), 144.3, 142.9 (d, *J* = 7.1 Hz), 141.9, 133.9 (d, *J* = 3.0 Hz), 133.4, 132.1, 128.4, 128.1, 127.9, 127.6, 127.4, 126.6, 126.2, 125.8, 125.3, 116.6 (d, *J* = 21.2 Hz), 112.5 (d, *J* = 21.2 Hz), 51.6, 51.3, 36.7, 32.0, 28.5.

^{19}F NMR (376 MHz, $CDCl_3$) δ -111.39 (s, 1F).

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}FNNaO^+$ $[M + Na]^+$: 462.2204; Found 462.2216.



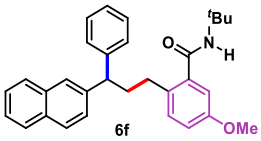
***N*-(*tert*-butyl)-4-chloro-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (45.5 mg, 50% yield). silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 102-104 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.44 – 7.35 (m, 2H), 7.33 (dd, *J* = 8.4, 1.6 Hz, 1H), 7.30 – 7.23 (m, 4H), 7.17 – 7.10 (m, 4H), 5.49 (s, 1H), 4.09 (t, *J* = 7.6 Hz, 1H), 2.73 – 2.68 (m, 2H), 2.51 – 2.38 (m, 2H), 1.30 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.6, 144.3, 142.0, 141.8, 136.1, 135.0, 133.5, 132.1, 129.9, 128.5, 128.1, 127.9, 127.7, 127.5, 126.6, 126.2, 125.91, 125.87, 125.3, 51.7, 51.4, 36.7, 31.9, 28.6.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}ClNNaO^+$ $[M + Na]^+$: 478.1908; Found 478.1910.



6f

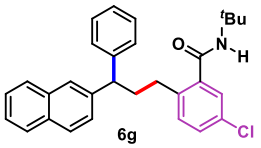
***N*-(*tert*-butyl)-5-methoxy-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (51.4 mg, 57% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 112-114 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.45 – 7.37 (m, 2H), 7.34 (dd, *J* = 8.6, 1.6 Hz, 1H), 7.31 – 7.23 (m, 4H), 7.19 – 7.13 (m, 1H), 7.07 – 7.04 (m, 1H), 6.84 – 6.81(m, 2H), 5.44 (s, 1H), 4.10 (t, *J* = 7.6 Hz, 1H), 3.77 (s, 3H), 2.71 – 2.65 (m, 2H), 2.52 – 2.39 (m, 2H), 1.32 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.3, 157.5, 144.6, 142.2, 138.7, 133.5, 132.1, 131.5, 131.1, 128.4, 128.04, 128.01, 127.7, 127.5, 126.8, 126.1, 125.9, 125.8, 125.3, 114.8, 112.3, 55.4, 51.6, 51.4, 37.2, 31.2, 28.6.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO_2^+$ $[M + Na]^+$: 474.2404; Found 474.2417.



6g

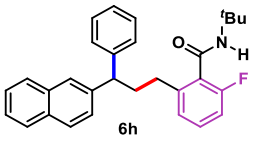
***N*-(*tert*-butyl)-5-chloro-2-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (32.8 mg, 36% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, m.p: 141-144 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.71 (m, 4H), 7.46 – 7.38 (m, 2H), 7.34 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.30 – 7.23 (m, 6H), 7.18 – 7.14 (m, 1H), 7.08 – 7.06 (m, 1H), 5.44 (s, 1H), 4.09 (t, *J* = 7.6 Hz, 1H), 2.75 – 2.68 (m, 2H), 2.52 – 2.39 (m, 2H), 1.32 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.1, 144.4, 142.0, 139.2, 138.4, 133.5, 132.2, 131.49, 131.47, 129.4, 128.5, 128.1, 128.0, 127.7, 127.5, 126.7, 126.6, 126.3, 125.94, 125.91, 125.4, 51.9, 51.4, 36.9, 31.5, 28.6.

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}ClNNaO^+$ $[M + Na]^+$: 478.1908; Found 478.1919.



6h

***N*-(*tert*-butyl)-2-fluoro-6-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

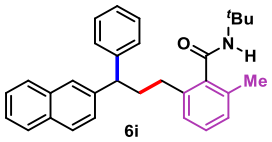
White solid (52.7 mg, 60% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 145-147 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.72 (m, 4H), 7.46 – 7.39 (m, 2H), 7.35 (dd, *J* = 8.4, 2.0 Hz, 1H), 7.31 – 7.27 (m, 3H), 7.27 – 7.14 (m, 3H), 6.96 – 6.87 (m, 2H), 5.47 (s, 1H), 4.12 (t, *J* = 8.0 Hz, 1H), 2.76 – 2.63 (m, 2H), 2.56 – 2.44 (m, 2H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.2, 158.9 (d, *J* = 246.4 Hz), 144.4, 142.4 (d, *J* = 3.0 Hz), 142.0, 133.5, 132.2, 130.1 (d, *J* = 8.1 Hz), 128.5, 128.2, 128.0, 127.7, 127.5, 126.7, 126.3, 125.9 (d, *J* = 2.0 Hz), 125.4, 125.2 (d, *J* = 2.0 Hz), 113.3, 113.1, 52.1, 51.5, 36.9, 31.8 (d, *J* = 2.0 Hz), 28.7

^{19}F NMR (376 MHz, $CDCl_3$) δ -117.22 (s, 1F).

HRMS (ESI) *m/z*: Calcd for $C_{30}H_{30}FNNaO^+$ $[M + Na]^+$: 462.2204; Found 462.2210.



6i

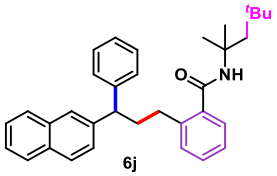
***N*-(*tert*-butyl)-2-methyl-6-(3-(naphthalen-2-yl)-3-phenylpropyl)benzamide**

White solid (41.8 mg, 48% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 117-119 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.72 (m, 4H), 7.45 – 7.34 (m, 3H), 7.32 – 7.23 (m, 4H), 7.18 – 7.13 (m, 2H), 7.00 (dd, *J* = 8.0, 2.4 Hz, 2H), 5.31 (s, 1H), 4.12 (t, *J* = 7.6 Hz, 1H), 2.69 – 2.58 (m, 2H), 2.56 – 2.46 (m, 2H), 2.32 (s, 3H), 1.27 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 169.2, 144.6, 142.2, 138.4, 138.3, 134.0, 133.5, 132.2, 128.47, 128.45, 128.1, 128.0, 127.72, 127.67, 127.5, 126.7, 126.4, 126.2, 125.89, 125.85, 125.3, 51.63, 51.61, 37.3, 32.0, 28.6, 19.0.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO^+$ $[M + Na]^+$: 458.2454; Found 458.2441.



6j

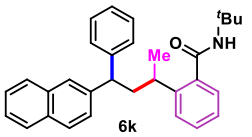
2-(3-(naphthalen-2-yl)-3-phenylpropyl)-*N*-(2,4,4-trimethylpentan-2-yl)benzamide

White solid (35.4 mg, 37% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 25/1， m.p: 130-132 ºC.

^{1}H NMR (400 MHz, Chloroform-*d*) ^{1}H NMR (400 MHz, Chloroform-d) δ 7.80 – 7.72 (m, 4H), 7.45 – 7.39 (m, 2H), 7.37 – 7.35 (m, 1H), 7.32 – 7.28 (m, 4H), 7.27 – 7.25 (m, 2H), 7.19 – 7.13 (m, 3H), 5.48 (s, 1H), 4.13 (t, J = 7.6 Hz, 1H), 2.80 – 2.76 (m, 2H), 2.55 – 2.44 (m, 2H), 1.76 (s, 2H), 1.38 (s, 6H), 0.98 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) ^{13}C NMR (101 MHz, Chloroform-d) δ 169.2, 144.6, 142.2, 140.1, 137.9, 133.5, 132.2, 130.1, 129.4, 128.4, 128.1, 128.0, 127.7, 127.5, 126.8, 126.3, 126.2, 126.0, 125.9, 125.8, 125.3, 55.7, 51.9, 51.5, 37.2, 32.0, 31.6, 31.5, 28.94, 28.92.

HRMS (ESI) *m/z*: Calcd for $C_{34}H_{40}NO^+$ $[M + H]^+$: 478.3104; Found 478.3080.



6k

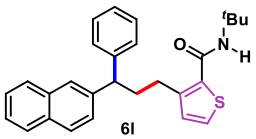
***N*-(*tert*-butyl)-2-(4-(naphthalen-2-yl)-4-phenylbutan-2-yl)benzamide**

Light yellow liquid (49.6 mg, 57% yield). silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 15/1. dr = 1.5:1

^{1}H NMR (400 MHz, Chloroform-d) δ 7.77 – 7.66 (m, 4H), 7.43 – 7.36 (m, 4H), 7.25 – 7.18(m, 1H), 7.25 – 7.18 (m, 6H), 7.15 – 7.10 (m, 1H), 5.20 – 5.08 (s, 1H), 4.08 – 3.99 (m, 1H), 3.11 – 3.00 (m, 1H), 2.64 – 2.39 (m, 2H), 1.34 (d, J = 6.8 Hz, 3H), 1.09 (s, 5H), 0.99 (s, 4H).

^{13}C NMR (101 MHz, Chloroform-d) δ 169.5, 169.4, 144.8, 144.5, 144.4, 144.2, 142.2, 141.7, 138.3, 138.1, 133.53, 133.47, 132.2, 132.1, 129.6, 128.5, 128.4, 128.10, 128.06, 127.9, 127.8, 127.7, 127.6, 127.5, 127.4, 126.64, 126.60, 126.5, 126.2, 126.1, 125.9, 125.8, 125.7, 125.4, 125.3, 51.4, 51.2, 49.1, 49.0, 42.7, 42.4, 33.82, 33.78, 28.3, 28.2, 23.6, 23.3.

HRMS (ESI) *m/z*: Calcd for $C_{31}H_{33}NNaO^+$ [M + Na]$^+$: 458.2454; Found 458.2450.



6l

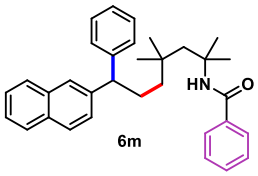
***N*-(*tert*-butyl)-3-(3-(naphthalen-2-yl)-3-phenylpropyl)thiophene-2-carboxamide**

Light pink solid (44.4 mg, 52% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 160-163 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80 – 7.72 (m, 4H), 7.46 – 7.38 (m, 2H), 7.34 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.31 – 7.27 (m, 3H), 7.27 – 7.24 (m, 1H), 7.21 – 7.14 (m, 2H), 6.86 (d, *J* = 5.1 Hz, 1H), 5.53 (s, 1H), 4.12 (t, *J* = 7.6 Hz, 1H), 2.93 – 2.86 (m, 2H), 2.57 – 2.43 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 162.3, 144.5, 144.4, 142.0, 133.5, 132.5, 132.2, 130.5, 128.5, 128.1, 128.0, 127.7, 127.5, 126.7, 126.2, 125.93, 125.91, 125.7, 125.4, 51.8, 51.1, 36.1, 28.8, 28.0.

HRMS (ESI) *m/z*: Calcd for $C_{28}H_{29}NNaOS^+$ [M + Na]$^+$: 450.1862; Found 450.1860.



6m

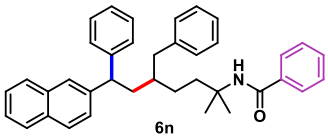
***N*-(2,4,4-trimethyl-7-(naphthalen-2-yl)-7-phenylheptan-2-yl)benzamide**

Colourless liquid (25.1 mg, 27% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 20/1.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.79 – 7.71 (m, 3H), 7.67 (d, *J* = 2.0 Hz, 1H), 7.64 – 7.61 (m, 2H), 7.47 – 7.31 (m, 7H), 7.26 (s, 1H), 7.25 (s, 2H), 7.19 – 7.13 (m, 1H), 5.85 (s, 1H), 3.92 (t, *J* = 7.6 Hz, 1H), 2.21 – 2.07 (m, 2H), 1.864 – 1.861 (m, 2H), 1.46 (s, 6H), 1.35 – 1.31 (m, 2H), 1.02 (s, 6H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.5, 145.0, 142.5, 136.0, 133.5, 132.1, 131.0, 128.5, 128.4, 128.0, 127.9, 127.7, 127.5, 126.6, 126.52, 126.49, 126.1, 125.9, 125.8, 125.3, 55.4, 52.2, 49.5, 43.1, 34.2, 30.0, 29.40, 29.37, 28.6, 28.5.

HRMS (ESI) *m/z*: Calcd for $C_{33}H_{37}NNaO$ [M + Na]$^+$: 486.2767; Found 486.2787.



6n

***N*-benzyl-2-methyl-7-(naphthalen-2-yl)-7-phenylheptan-2-yl)benzamide**

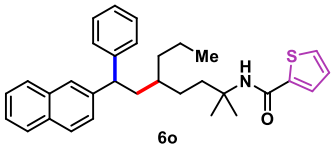
Colourless liquid (26.3 mg, 25% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, dr=1:1.05.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.77 – 7.71 (m, 2H), 7.68 – 7.63 (m, 3H), 7.51 – 7.31 (m, 6H), 7.25 – 7.12 (m, 9H), 7.05 – 7.02 (m, 2H), 5.74 (d, *J* = 7.6 Hz, 1H), 4.20 – 4.14 (m, 1H), 2.70 – 2.57 (m, 2H), 2.21 – 1.99 (m, 2H), 1.93 – 1.76 (m, 2H), 1.67 (dt, *J* = 12.8, 6.4 Hz, 1H), 1.41 – 1.30 (m, 8H).

^{13}C NMR (101 MHz, Chloroform-d) δ 166.7, 145.2, 144.4, 142.5, 141.7, 140.9, 140.9, 135.8, 133.5, 133.4, 132.1, 131.09, 131.06, 129.20, 129.18, 128.49, 128.46, 128.42, 128.37, 128.17, 128.15, 128.06, 128.0, 127.95, 127.89, 127.70, 127.67, 127.50, 127.46, 126.9, 126.68, 126.66, 126.10, 126.09, 125.91,

125.90, 125.86, 125.78, 125.74, 125.72, 125.30, 125.28, 54.1, 48.7, 48.5, 40.4, 40.3, 39.4, 39.1, 37.1, 36.0, 35.7, 27.22, 27.17, 27.14, 27.10, 27.0, 26.8.

HRMS (ESI) *m/z*: Calcd for $C_{38}H_{39}NNaO$ $[M + Na]^+$: 548.2924; Found 548.2912.



6o

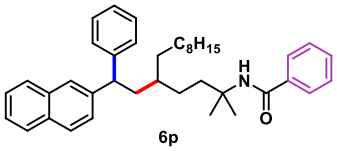
***N*-(2-methyl-5-(2-(naphthalen-2-yl)-2-phenylethyl)octan-2-yl)thiophene-2-carboxamide**

Colourless liquid (32.9 mg, 34% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 15/1, dr = 1:1.07.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.79 – 7.65 (m, 4H), 7.45 – 7.34 (m, 5H), 7.32 – 7.23 (m, 2H), 7.24 (dd, *J* = 4.8, 2.0 Hz, 2H), 7.18 – 7.12 (m, 1H), 7.05 (td, *J* = 5.2, 3.6 Hz, 1H), 5.66 (s, 1H), 4.17 (td, *J* = 8.0, 5.2 Hz, 1H), 2.22 – 1.97 (m, 2H), 1.85 – 1.66 (m, 2H), 1.42 – 1.38 (m, 6H), 1.34 – 1.23 (m, 7H), 0.83 (td, *J* = 7.2, 2.4 Hz, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 161.0, 145.3, 144.8, 142.7, 142.3, 140.5, 133.5, 132.1, 129.38, 129.36, 128.4, 128.01, 127.97, 127.94, 127.68, 127.66, 127.48, 127.45, 127.36, 127.3, 126.8, 126.7, 126.1, 126.0, 125.8, 125.3, 54.5, 48.64, 48.57, 39.7, 39.6, 36.4, 36.0, 35.9, 35.8, 34.7, 34.5, 27.17, 27.15, 27.12, 27.05, 26.9, 19.6, 19.5, 14.5.

HRMS (ESI) *m/z*: Calcd for $C_{32}H_{37}NNaOS$ $[M + Na]^+$: 506.2488; Found 506.2510.



6p

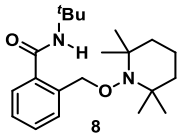
***N*-(2-methyl-5-(2-(naphthalen-2-yl)-2-phenylethyl)tetradecan-2-yl)benzamide**

Colourless liquid (23.6 mg, 21% yield); silica gelcolumn chromatography with eluent of petroleum ether/ethyl acetate = 25/1, dr=1:1.05.

^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.79 – 7.65 (m, 6H), 7.51 – 7.39 (m, 5H), 7.37 – 7.27 (m, 3H), 7.25 – 7.22 (m, 2H), 7.18 – 7.13 (m, 1H), 5.80 (s, 1H), 4.17 (td, *J* = 7.6, 4.0 Hz, 1H), 2.16 – 1.98 (m, 2H), 1.86 – 1.66 (m, 2H), 1.43 – 1.40 (m, 6H), 1.35 – 1.20 (m, 19H), 0.90 – 0.86 (m, 3H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 166.7, 145.2, 144.9, 142.7, 142.4, 136.0, 133.5, 132.0, 131.07, 131.05, 128.50, 128.48, 128.4, 128.01, 127.98, 127.96, 127.7, 127.6, 127.5, 126.80, 126.75, 126.7, 126.6, 126.1, 126.03, 126.01, 125.9, 125.8, 125.3, 54.1, 48.7, 48.6, 39.72, 39.65, 36.3, 35.9, 34.8, 34.7, 33.5, 33.3, 31.9, 30.0, 30.0, 29.7, 29.62, 29.61, 29.3, 27.3, 27.2, 27.1, 27.03, 26.98, 26.4, 26.3, 22.7, 14.1.

HRMS (ESI) *m/z*: Calcd for $C_{40}H_{51}NNaO$ $[M + Na]^+$: 584.3863; Found 584.3880.



8

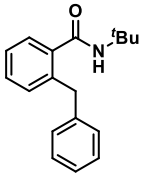
***N*-(*tert*-butyl)-2-(((2,2,6,6-tetramethylpiperidin-1-yl)oxy)methyl)benzamide**

White solid (17.3 mg, 25% yield); silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 20/1, m.p: 113-115 ºC.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 7.6 Hz, 1H), 7.40 – 7.35 (m, 2H), 7.28 – 7.24 (m, 1H), 5.80 (s, 1H), 5.00 (s, 2H), 1.45 (s, 15H), 1.19 – 1.15 (m, 12H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 168.9, 136.5, 136.2, 129.4, 128.7, 127.0, 126.6, 76.0, 59.8, 51.7, 39.7, 33.1, 28.8, 20.4, 17.1.

HRMS (ESI) *m/z*: Calcd for $C_{21}H_{35}N_2O_2^+$ $[M + H]^+$: 347.2693; Found 347.2682.



3a'

2-benzyl-*N*-(*tert*-butyl)benzamide

Yellow oil; silica gel column chromatography with eluent of petroleum ether/ethyl acetate = 25/1.

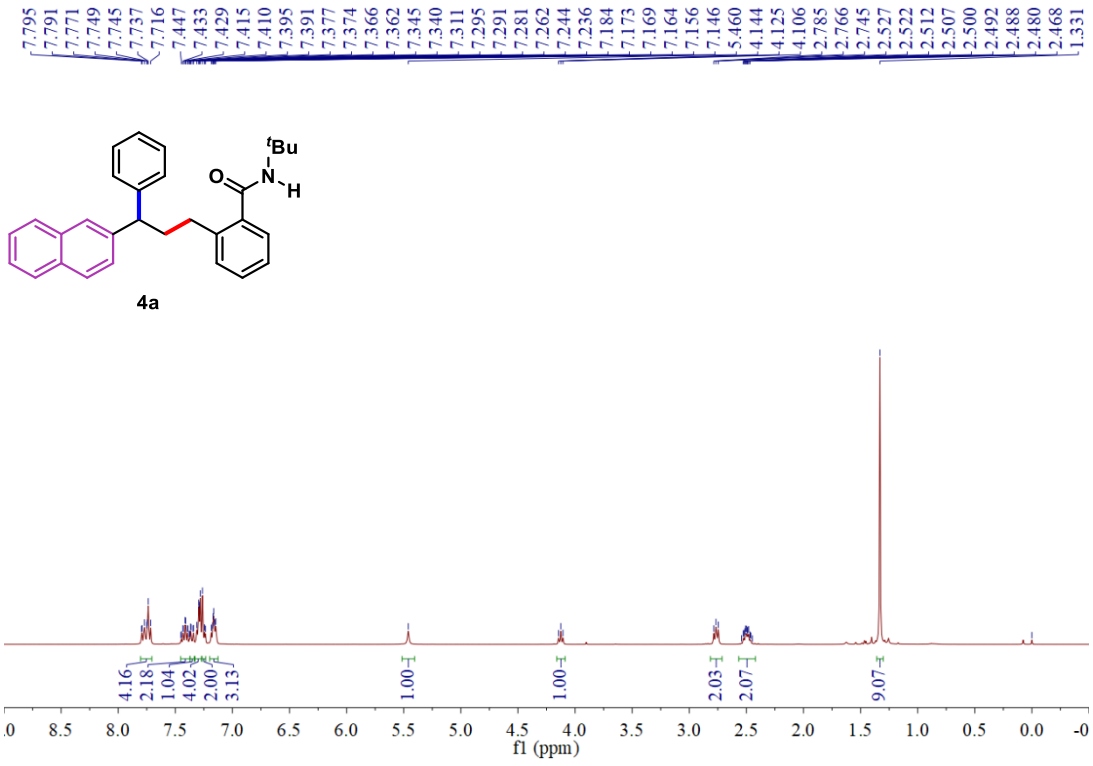
^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.35 – 7.20 (m, 5H), 7.18 – 7.13 (m, 4H), 5.47 (s, 1H), 4.17 (s, 2H), 1.28 (s, 9H).

^{13}C NMR (101 MHz, Chloroform-*d*) δ 169.3, 140.9, 137.9, 137.8, 130.9, 129.5, 128.7, 128.3, 127.1, 126.2, 125.9, 51.5, 38.6, 28.5.

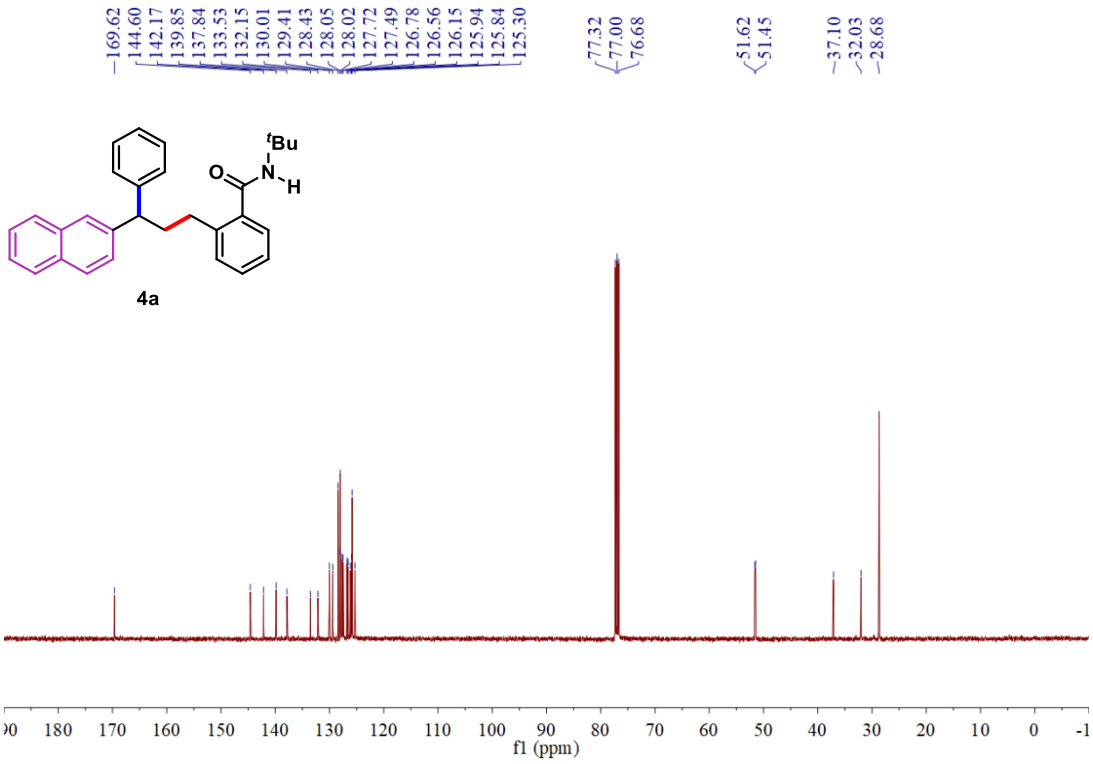
HRMS (ESI) *m/z*: Calcd for $C_{21}H_{35}N_2O_2^+$ $[M + H]^+$: 290.1515; Found 290.1519.

VIII. NMR Spectra of Products

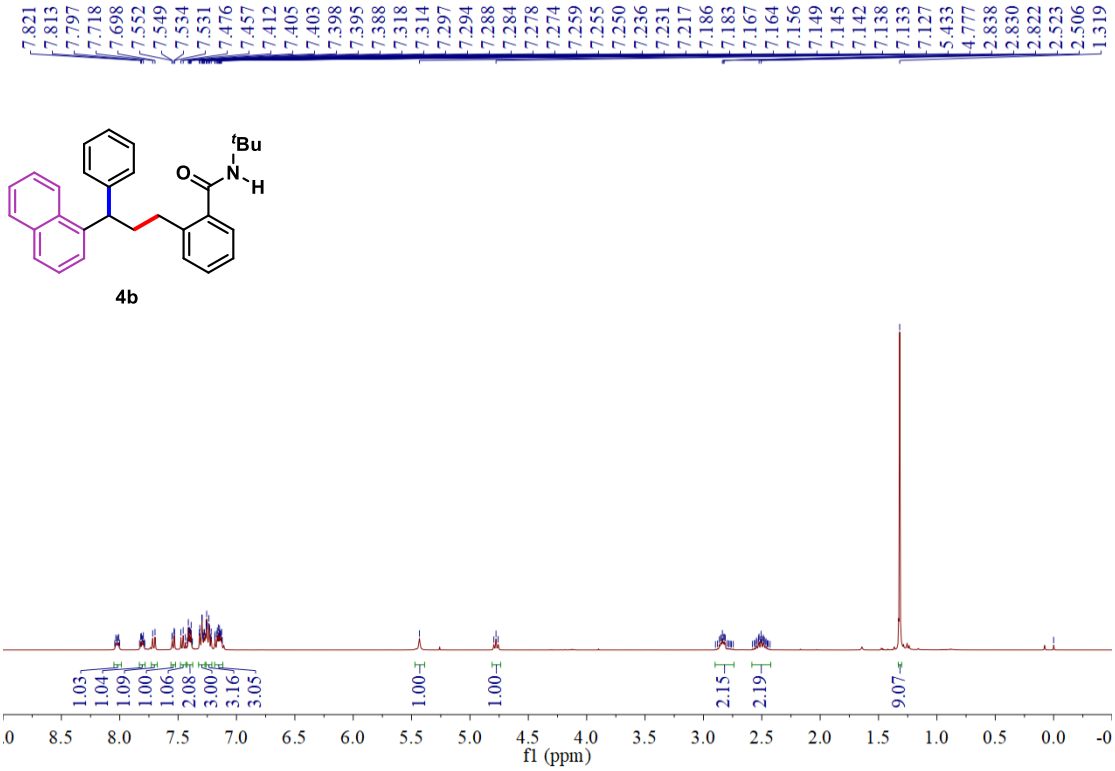
^{1}H NMR (400 MHz, $CDCl_3$) of 4a



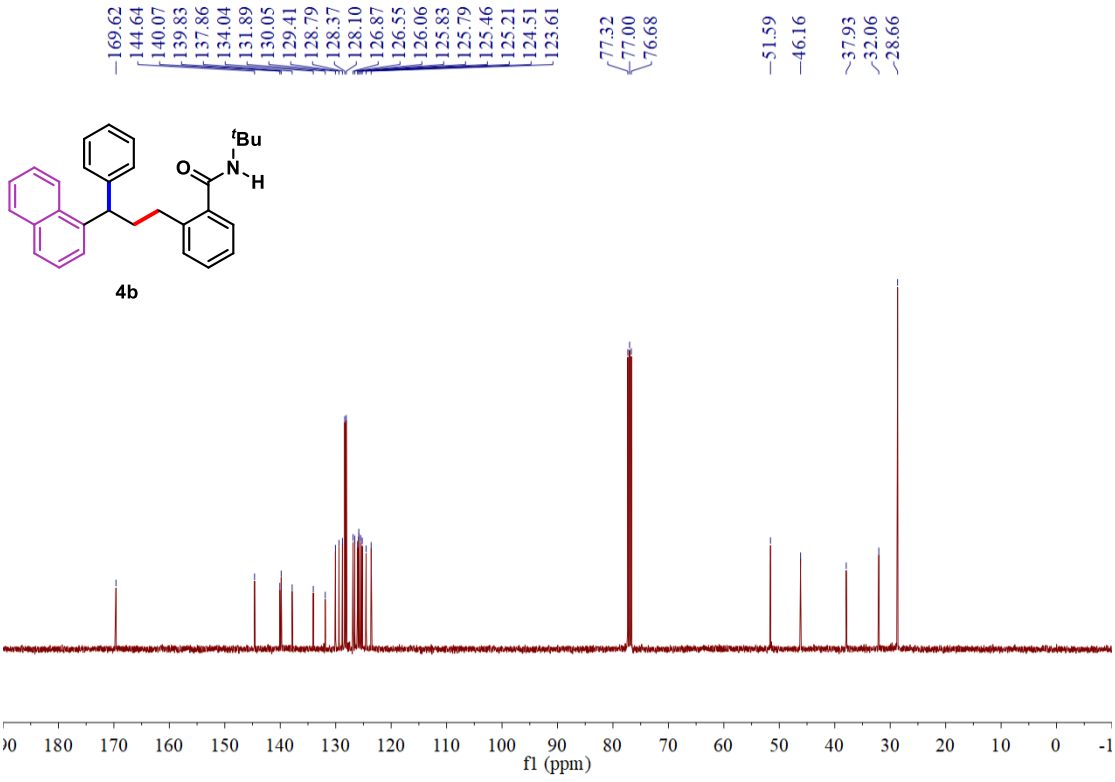
^{13}C NMR (101 MHz, $CDCl_3$) of 4a



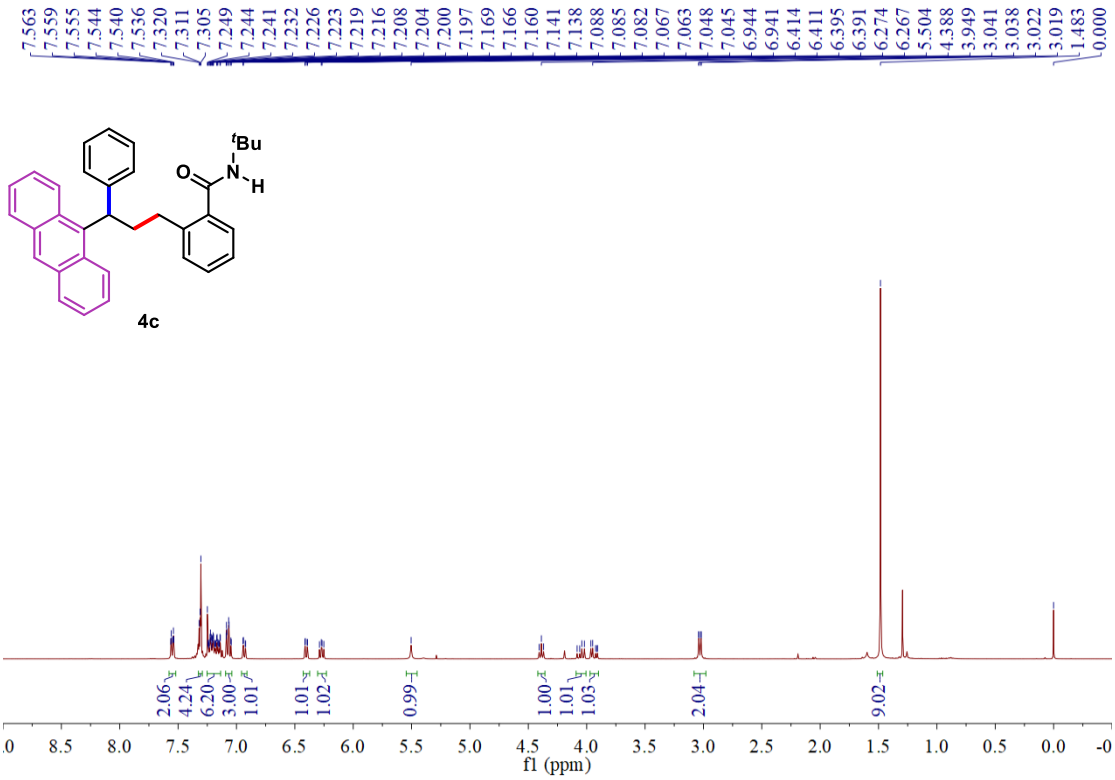
^{1}H NMR (400 MHz, $CDCl_3$) of 4b



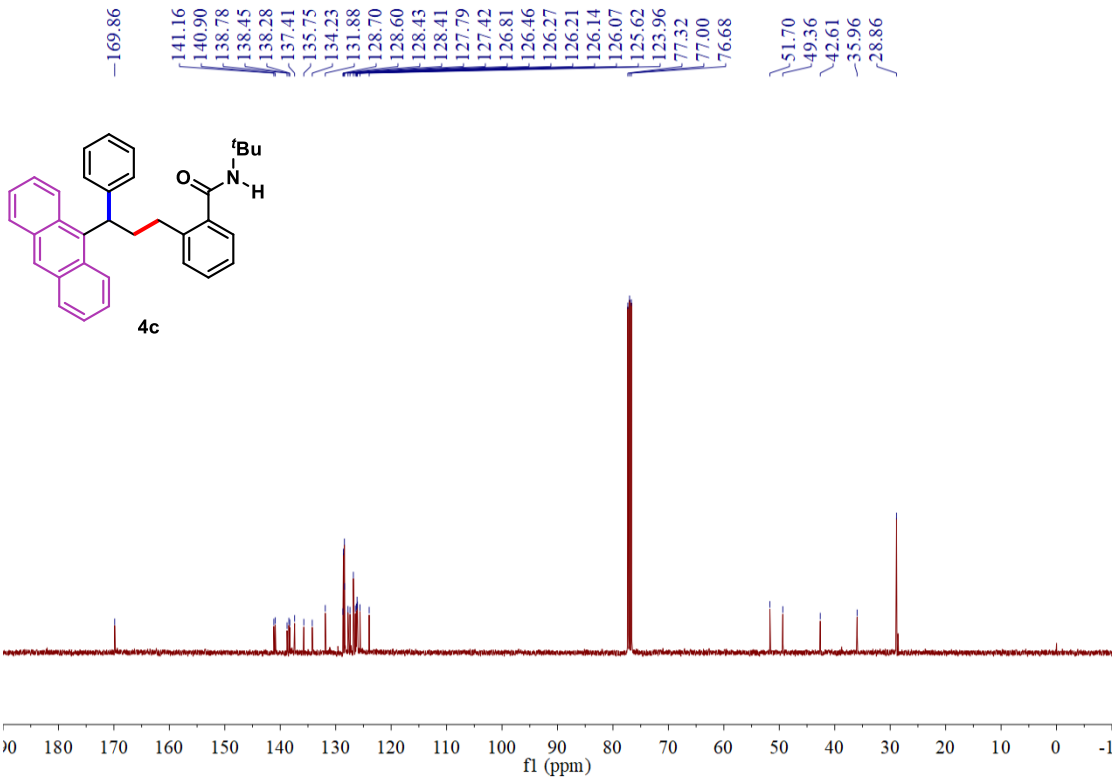
^{13}C NMR (101 MHz, $CDCl_3$) of 4b



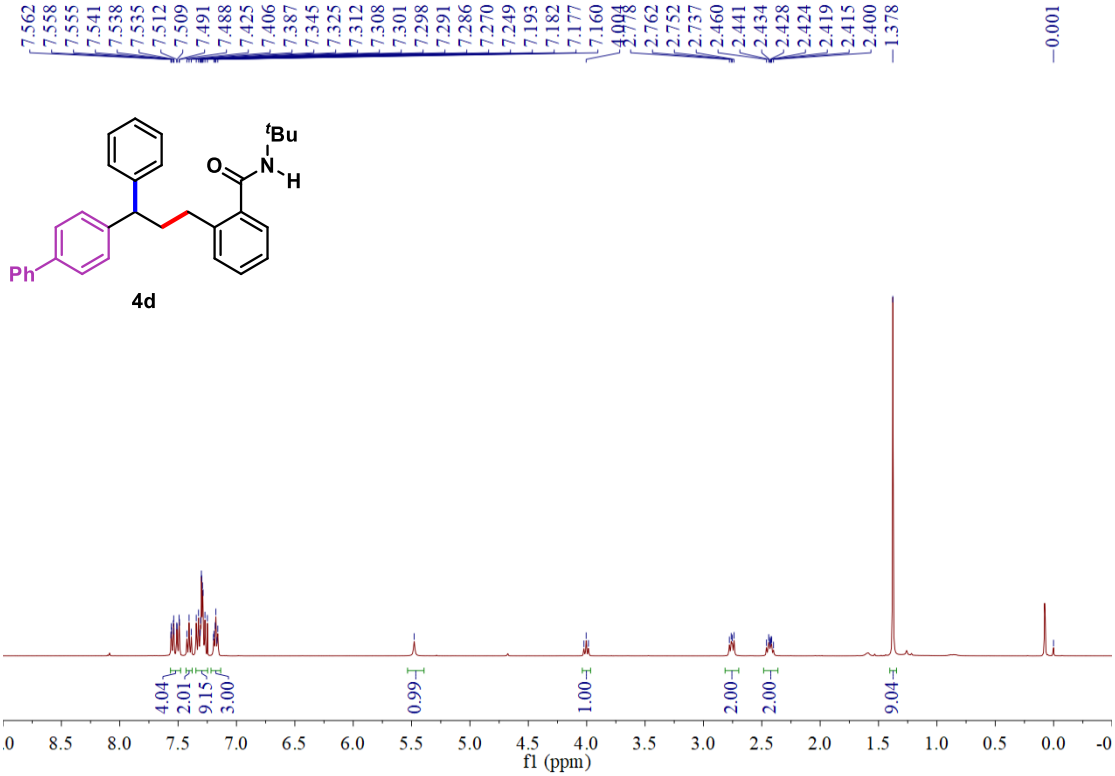
^{1}H NMR (400 MHz, $CDCl_3$) of 4c



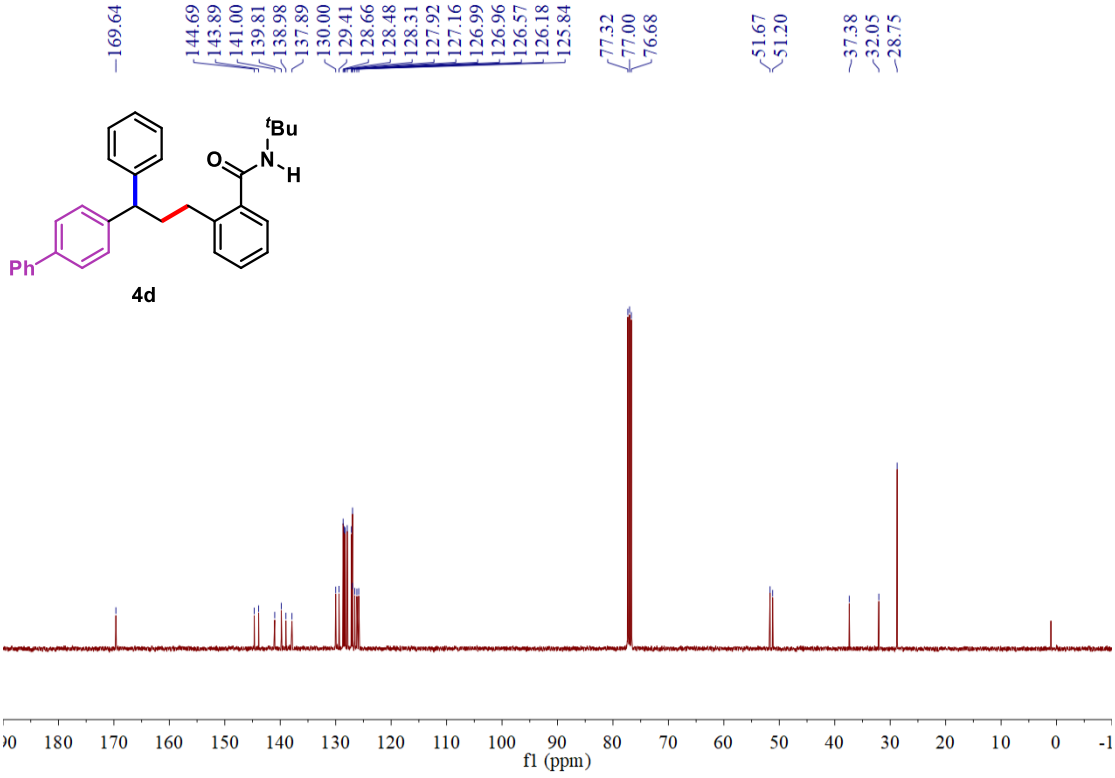
^{13}C NMR (101 MHz, $CDCl_3$) of 4c



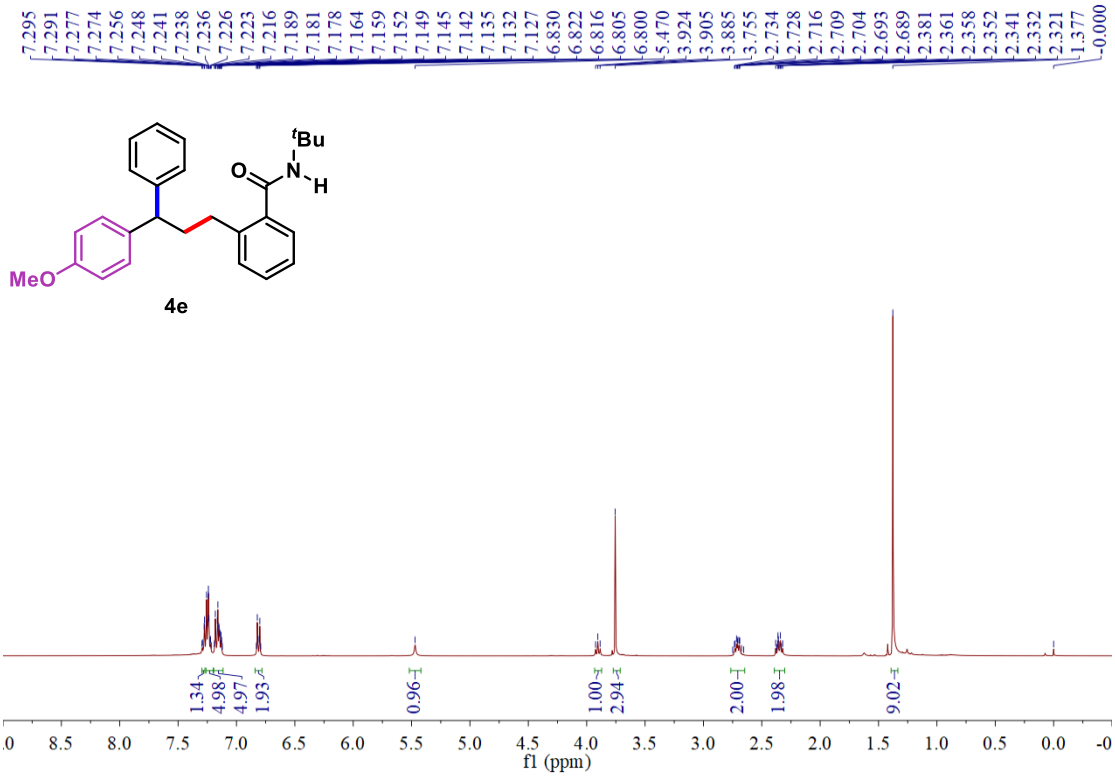
^{1}H NMR (400 MHz, $CDCl_3$) of 4d



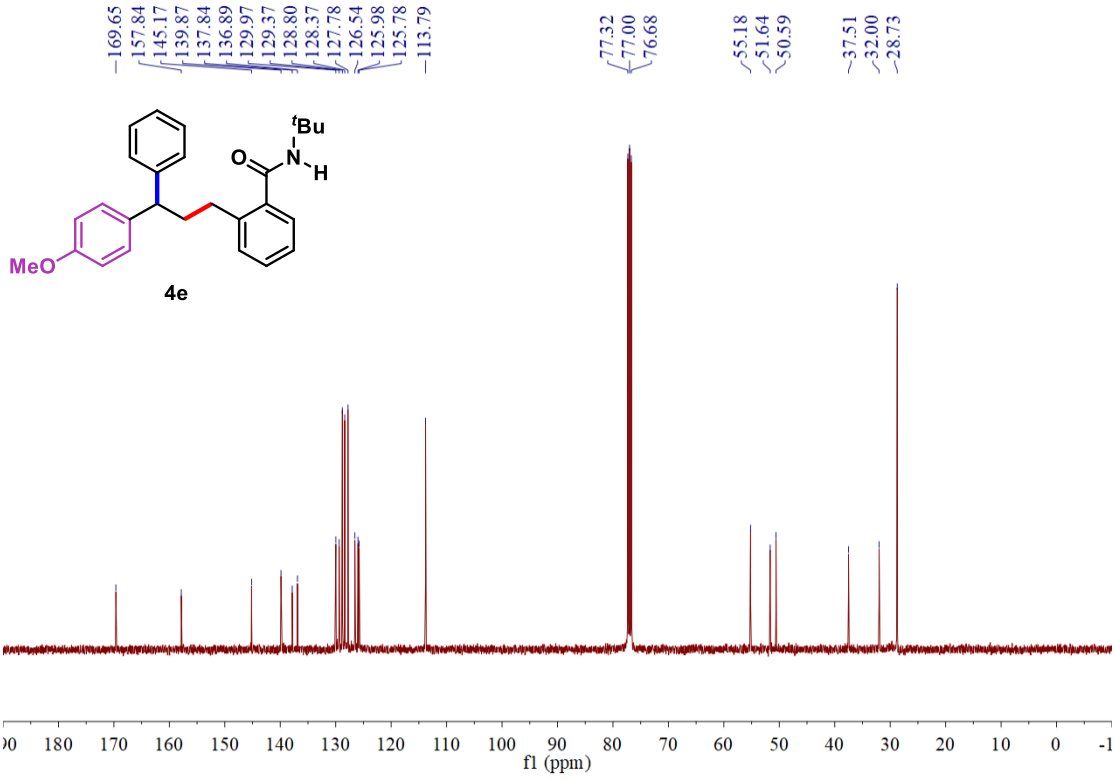
^{13}C NMR (101 MHz, $CDCl_3$) of 4d



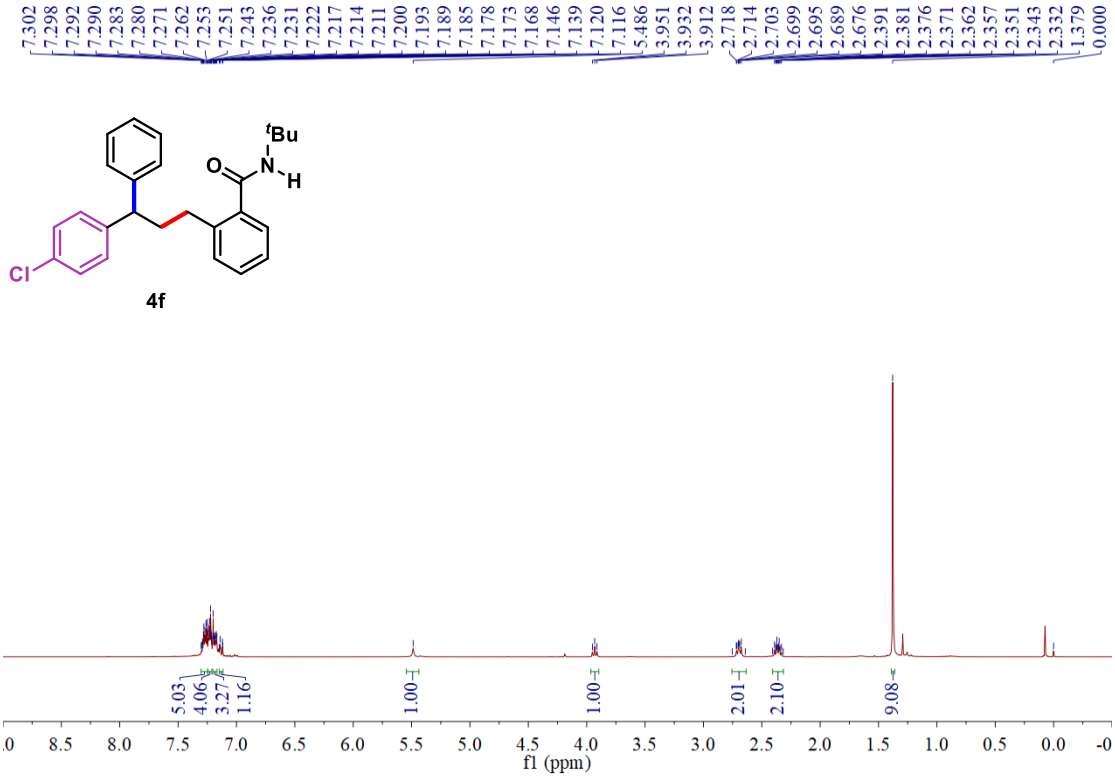
^{1}H NMR (400 MHz, $CDCl_3$) of 4e



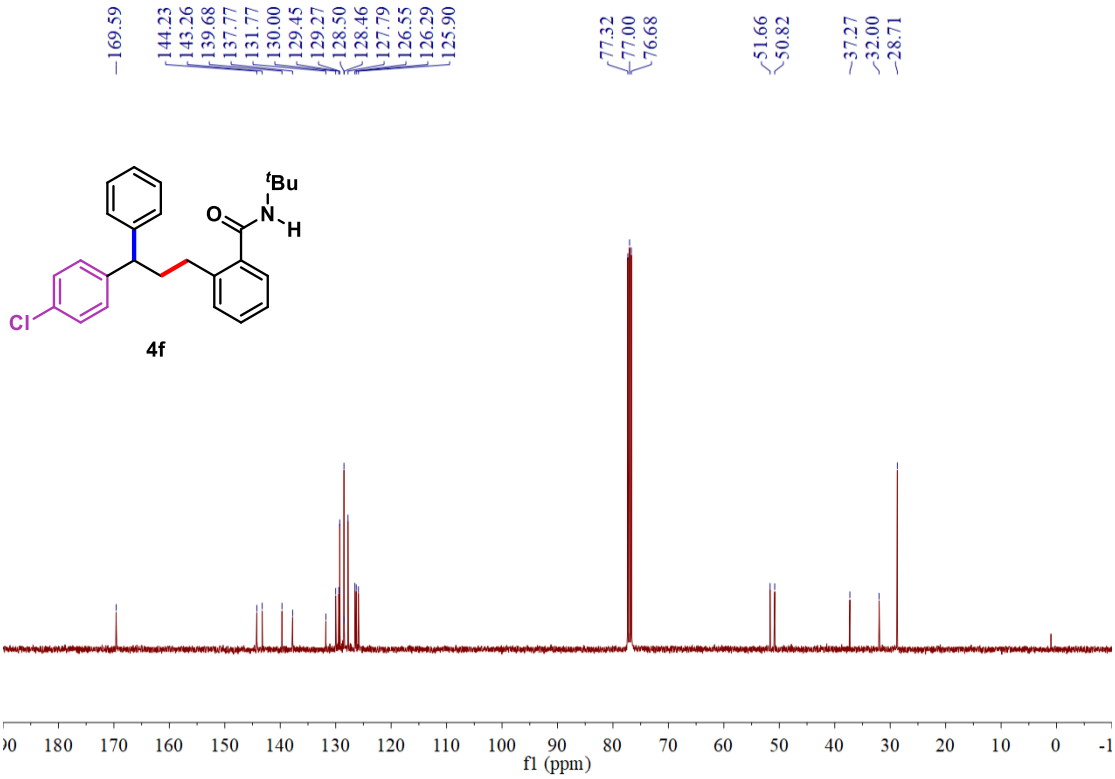
^{13}C NMR (101 MHz, $CDCl_3$) of 4e



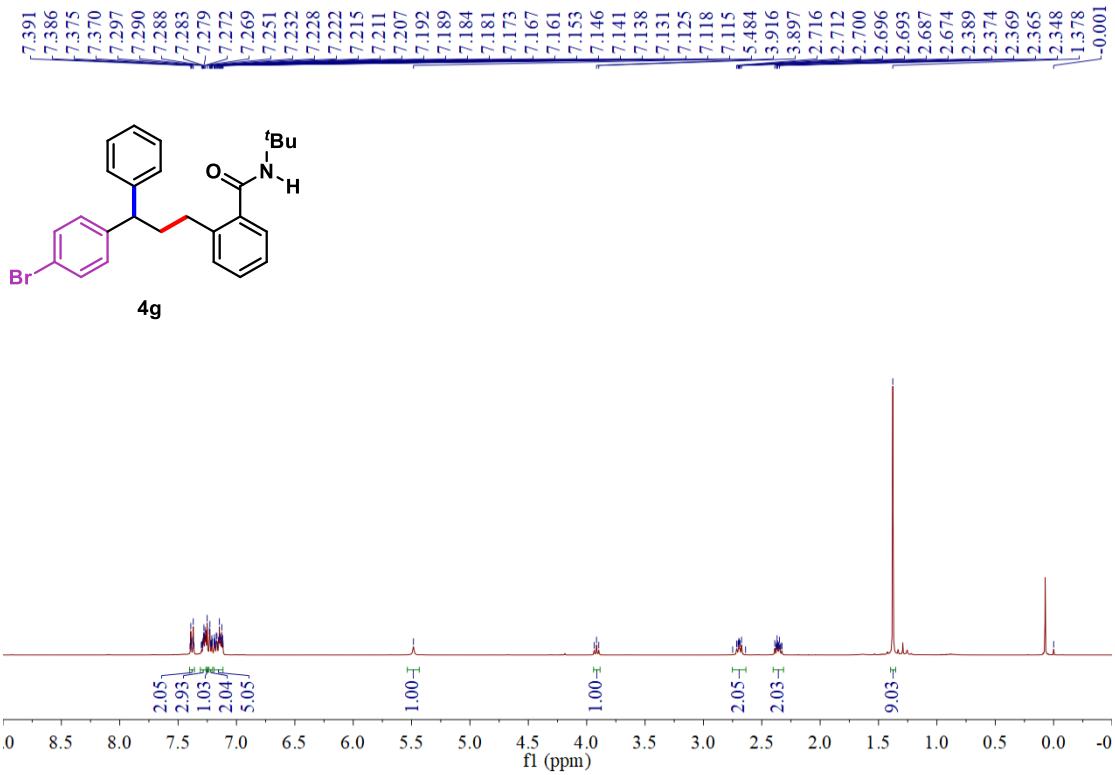
^{1}H NMR (400 MHz, $CDCl_3$) of 4f



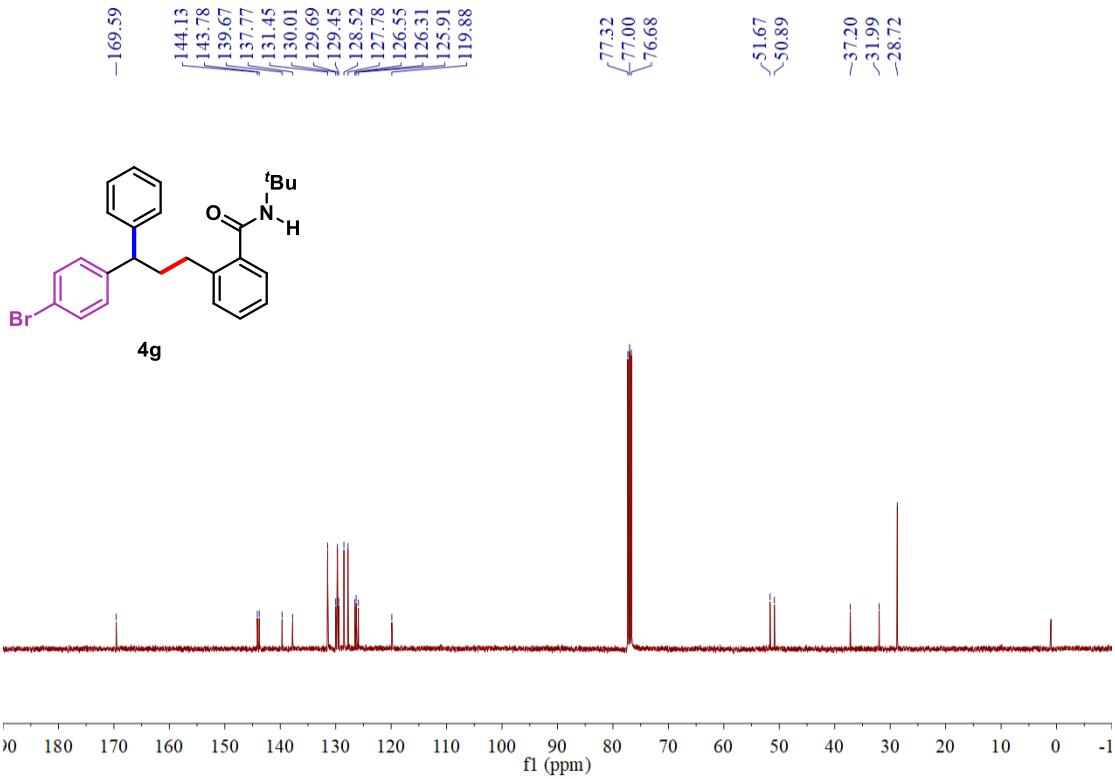
^{13}C NMR (101 MHz, $CDCl_3$) of 4f



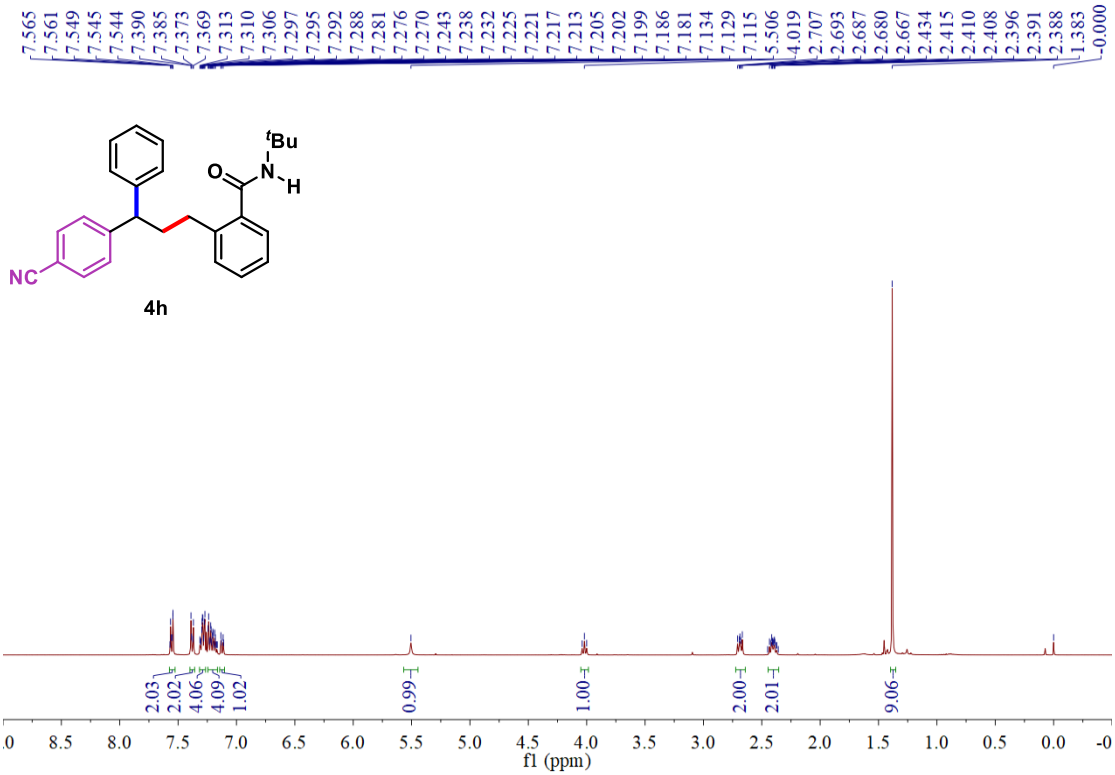
^{1}H NMR (400 MHz, $CDCl_3$) of 4g



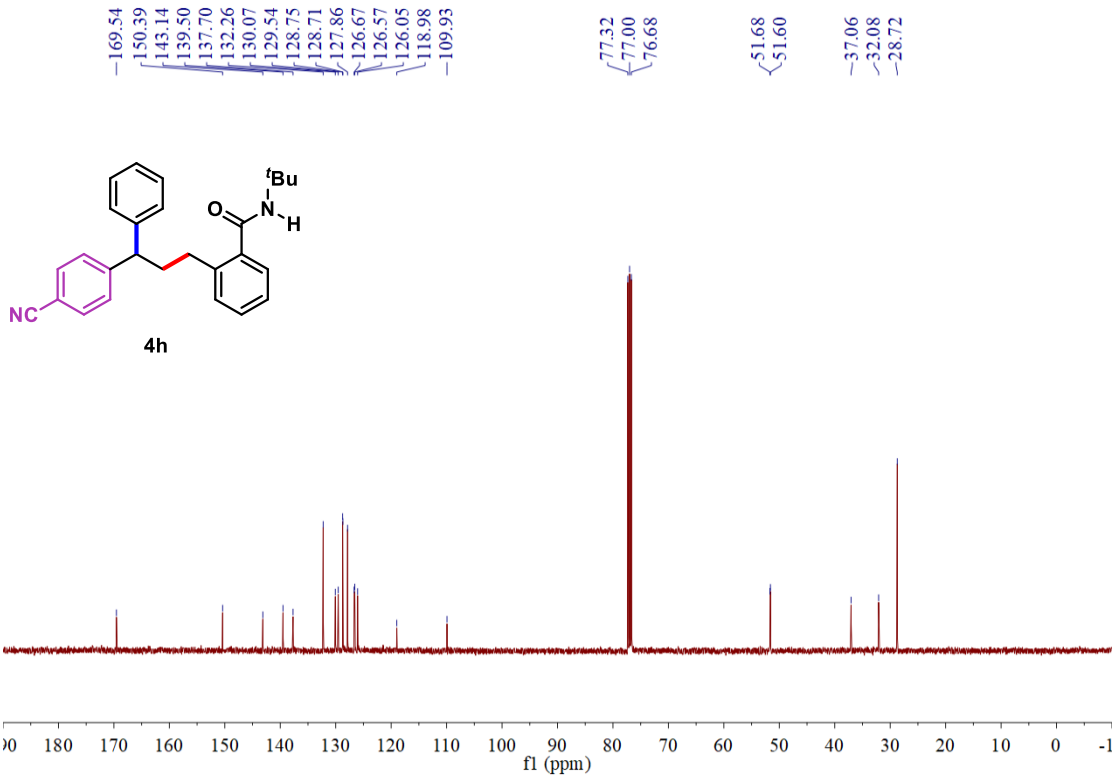
^{13}C NMR (101 MHz, $CDCl_3$) of 4g



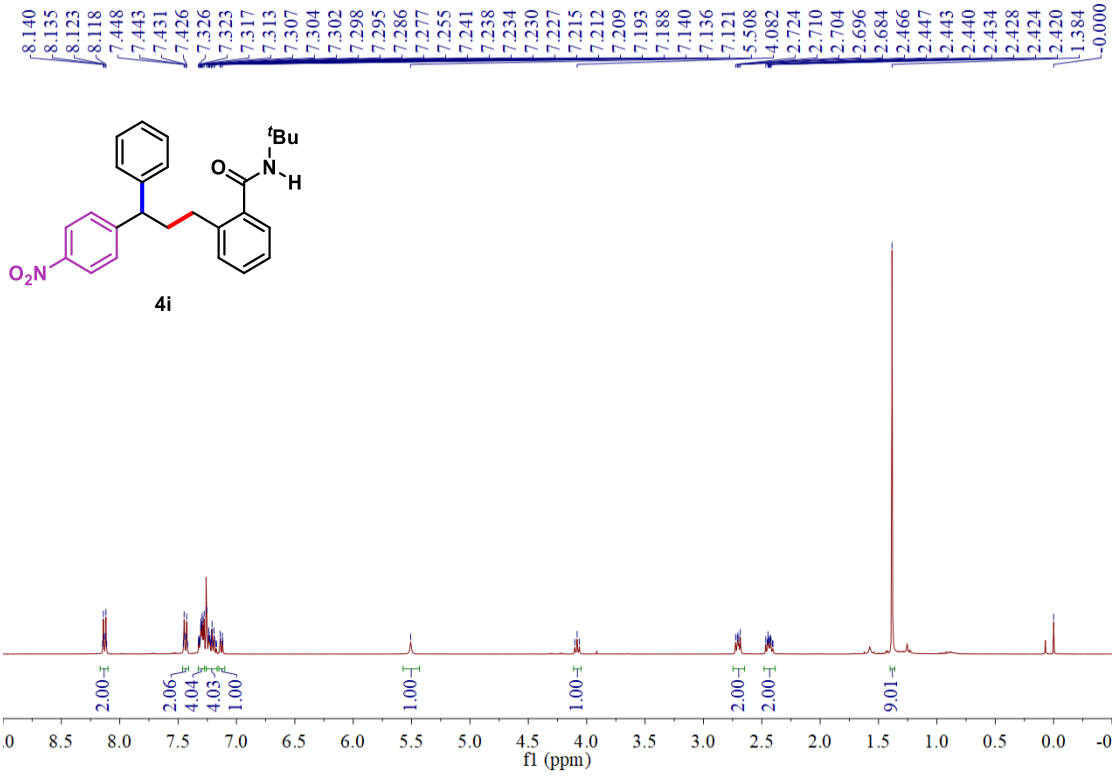
^{1}H NMR (400 MHz, $CDCl_3$) of 4h



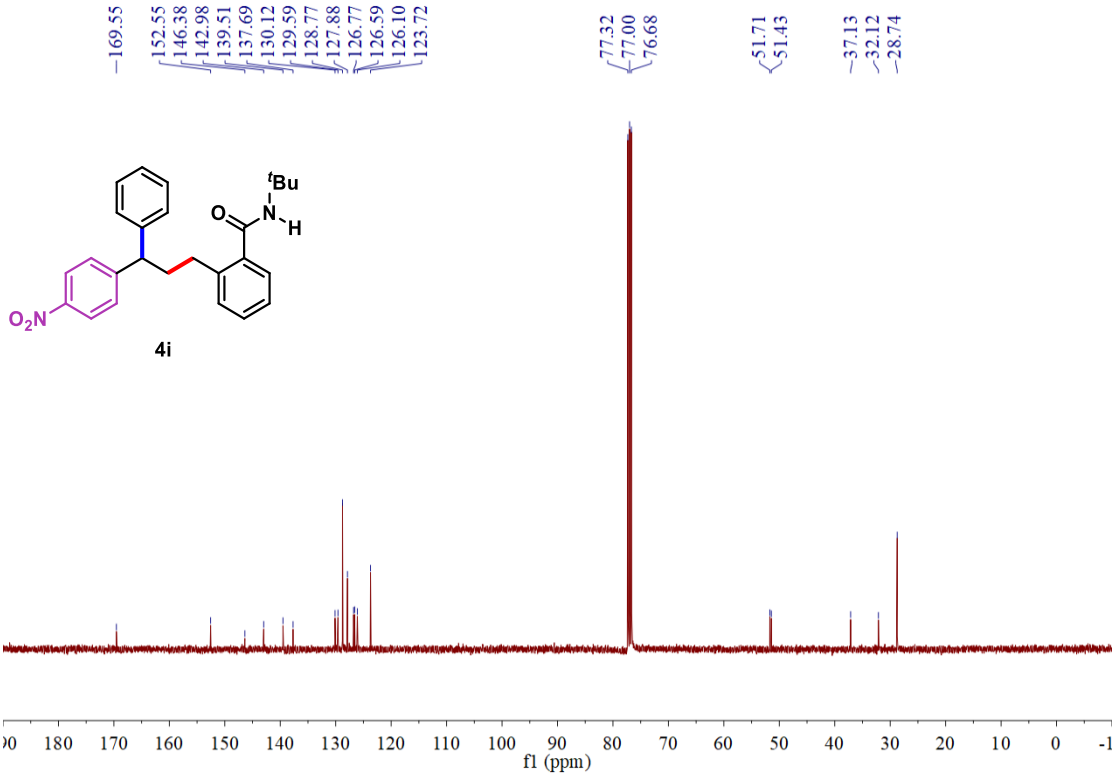
^{13}C NMR (101 MHz, $CDCl_3$) of 4h



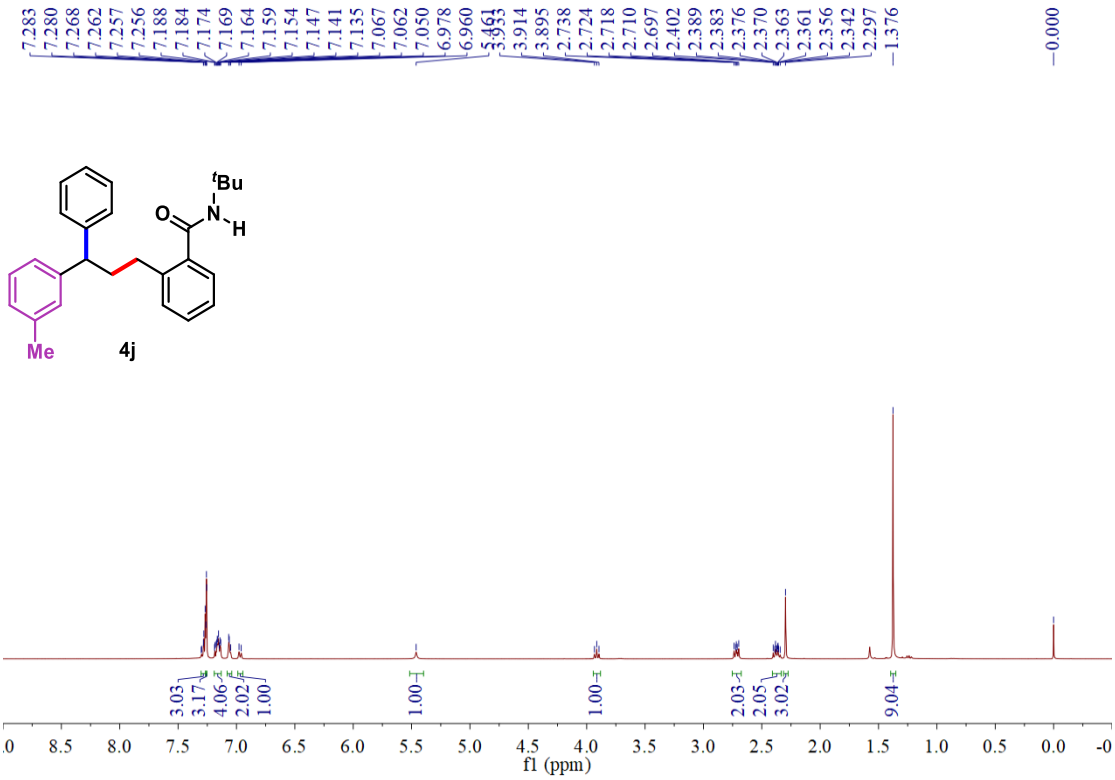
^{1}H NMR (400 MHz, $CDCl_3$) of 4i



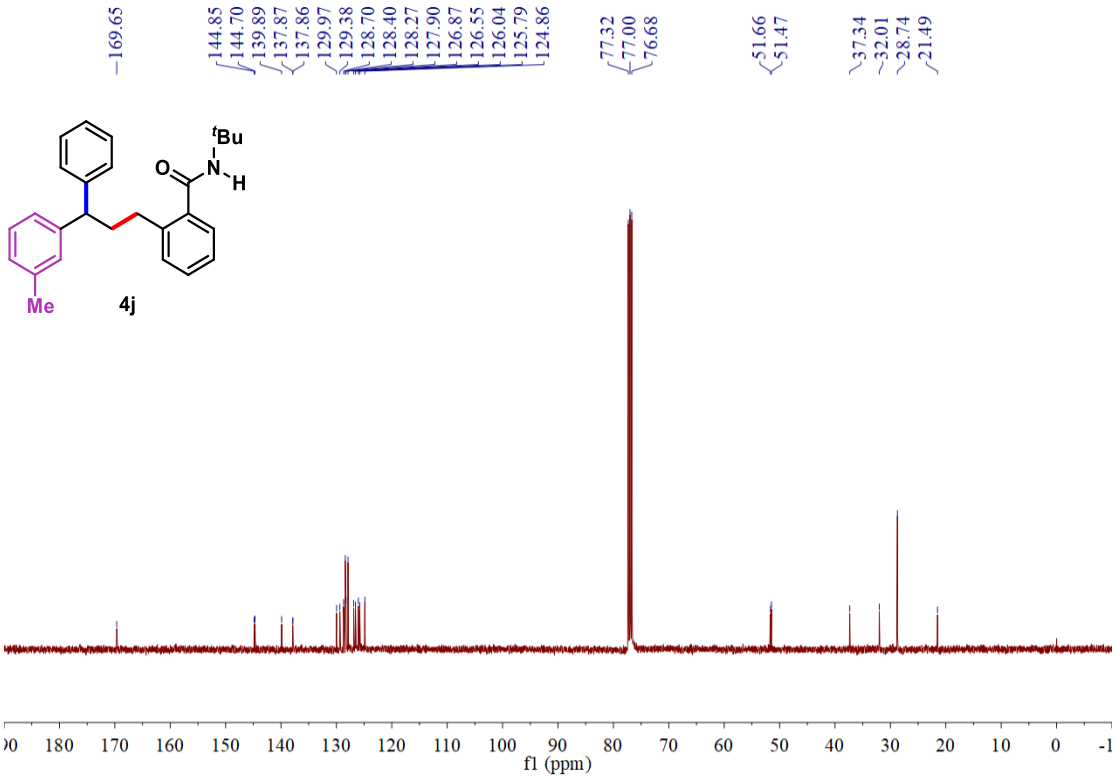
^{13}C NMR (101 MHz, $CDCl_3$) of 4i



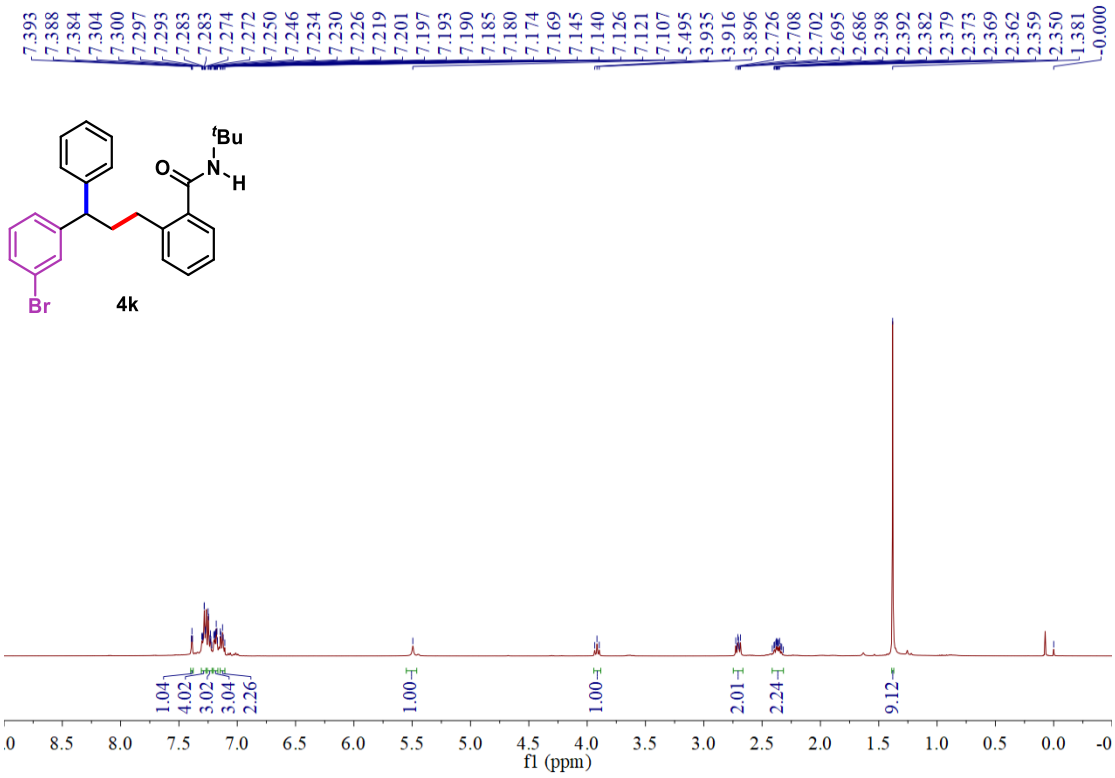
^{1}H NMR (400 MHz, $CDCl_3$) of 4j



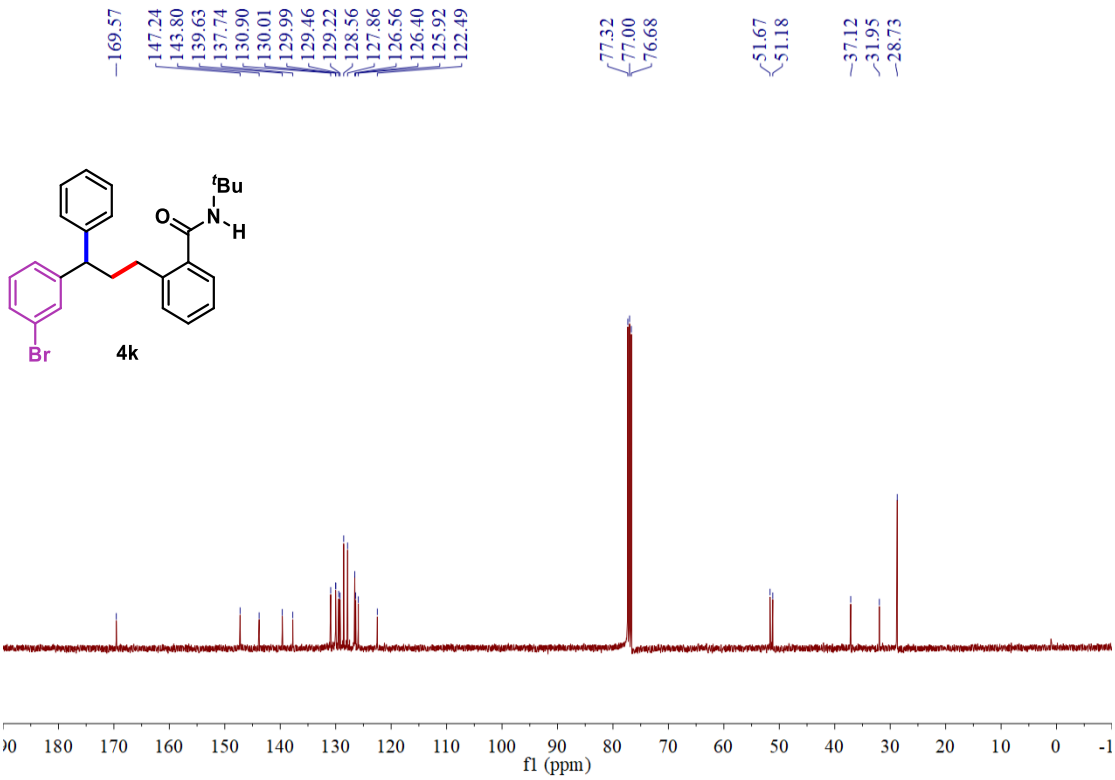
^{13}C NMR (101 MHz, $CDCl_3$) of 4j



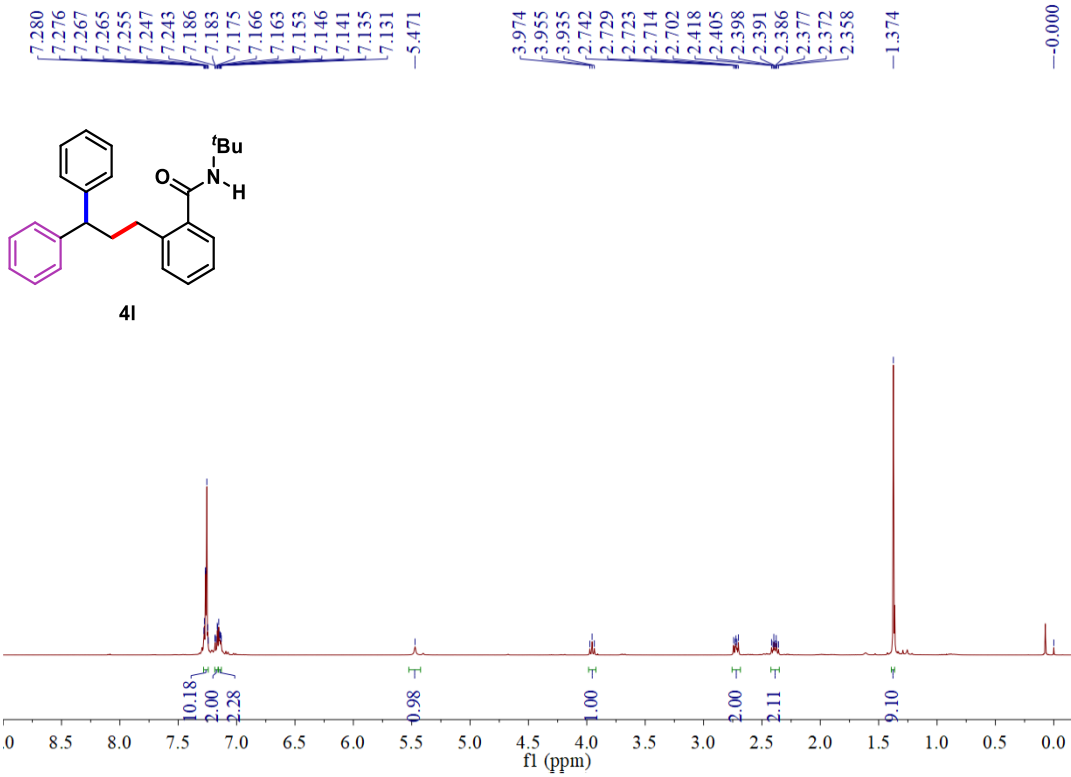
^{1}H NMR (400 MHz, $CDCl_3$) of 4k



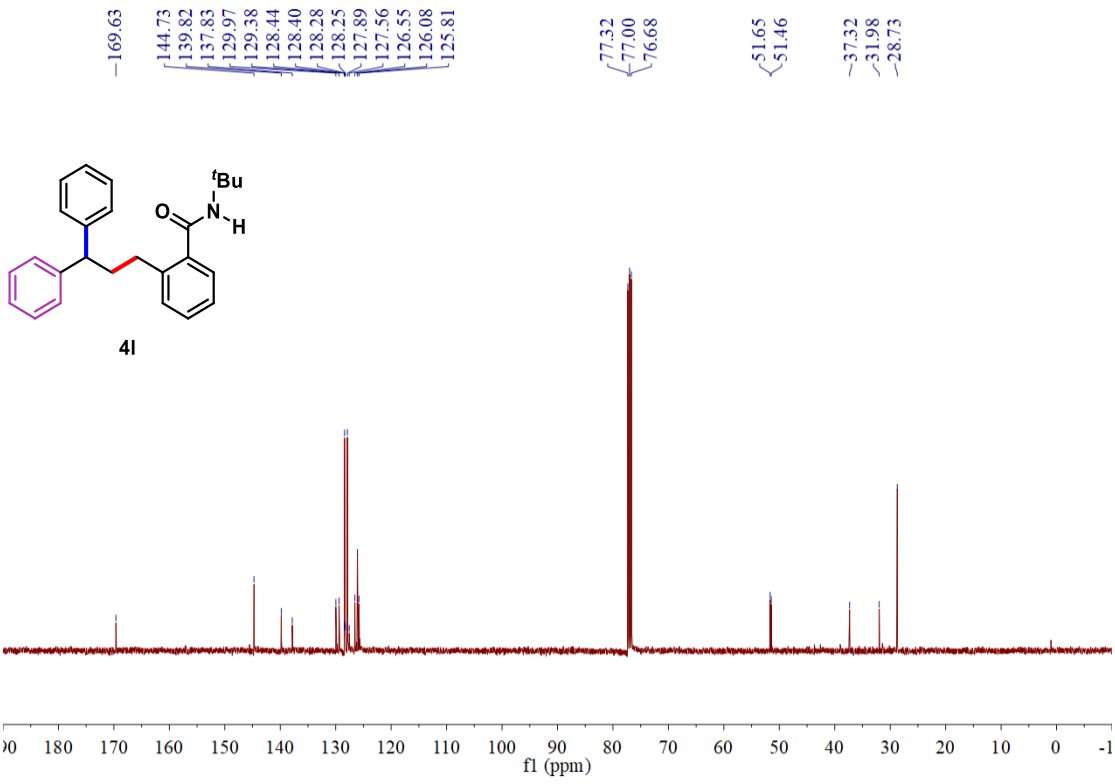
^{13}C NMR (101 MHz, $CDCl_3$) of 4k



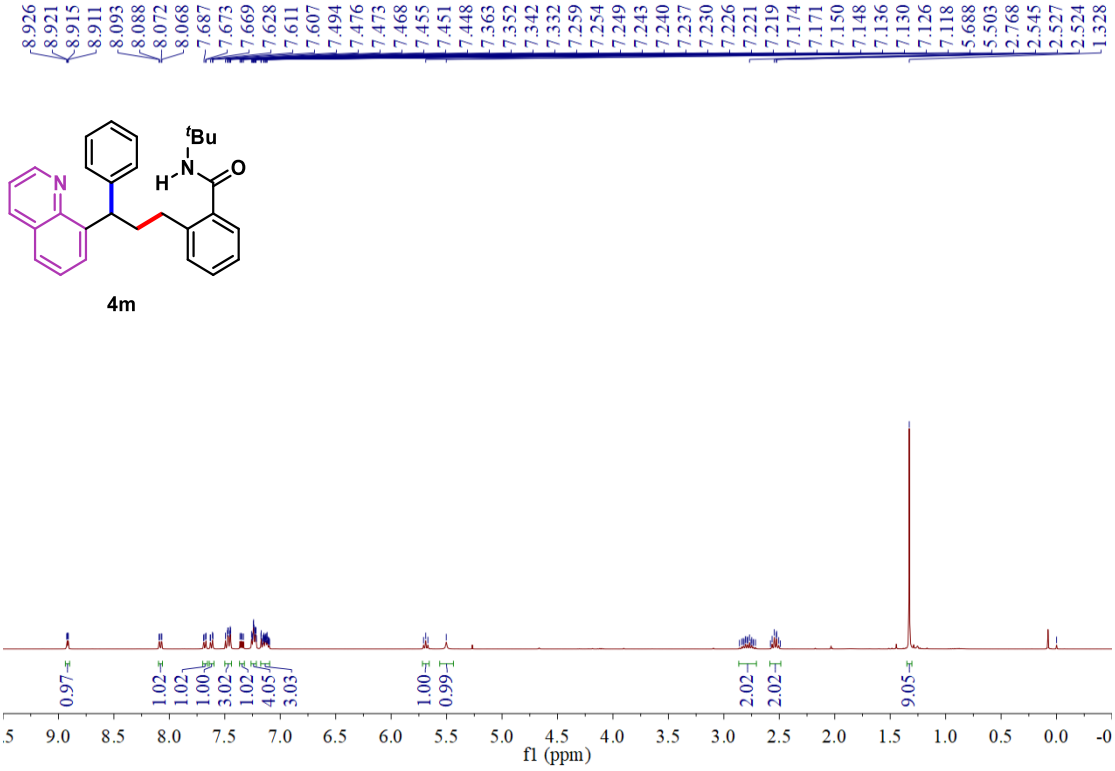
^{1}H NMR (400 MHz, $CDCl_3$) of 4l



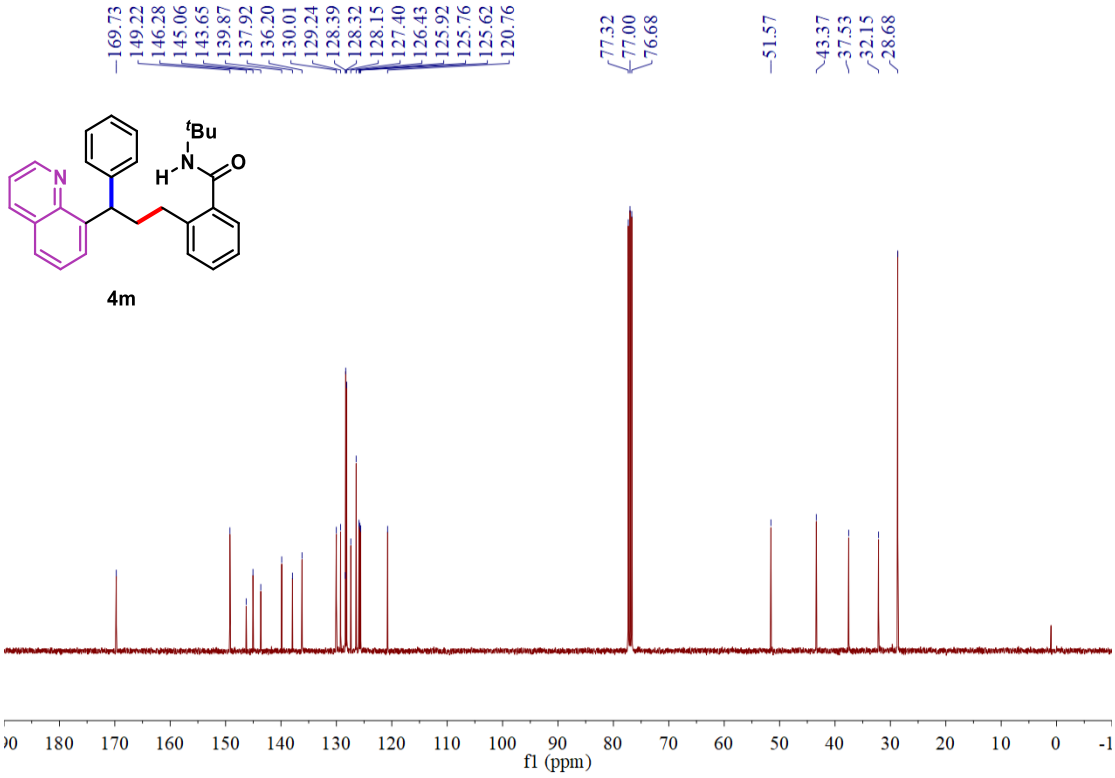
^{13}C NMR (101 MHz, $CDCl_3$) of 4l



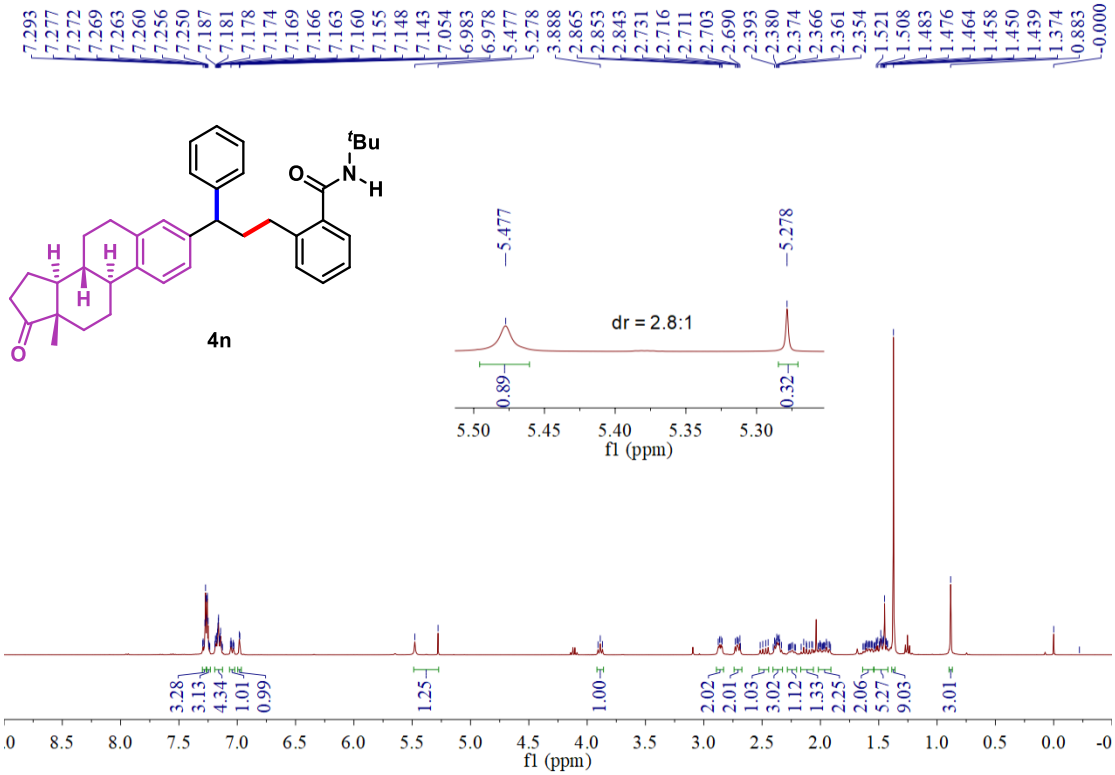
^{1}H NMR (400 MHz, $CDCl_3$) of 4m



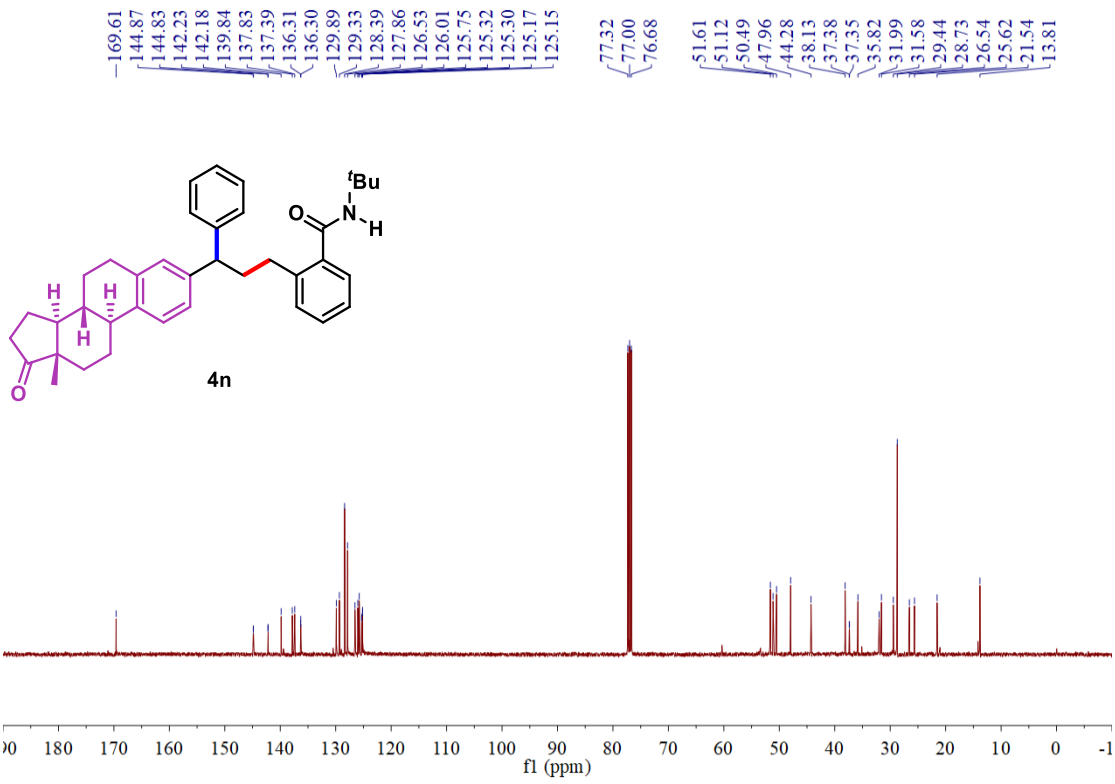
^{13}C NMR (101 MHz, $CDCl_3$) of 4m



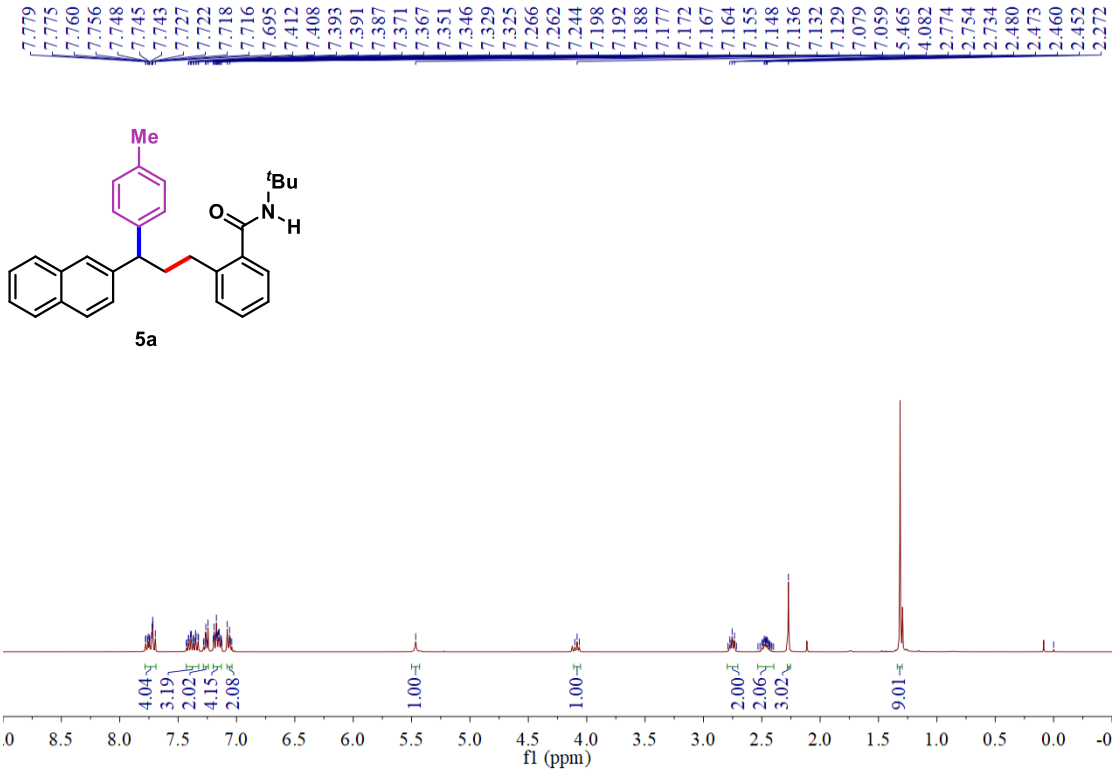
^{1}H NMR (400 MHz, $CDCl_3$) of 4n



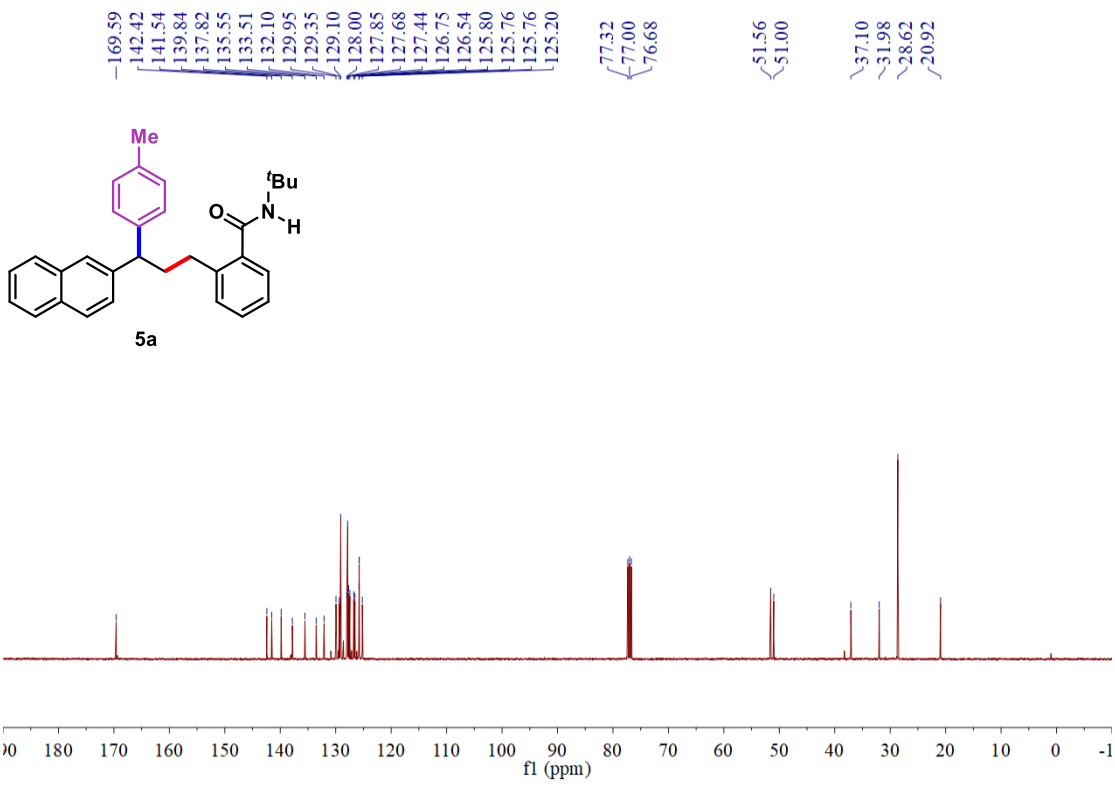
^{13}C NMR (101 MHz, $CDCl_3$) of 4n



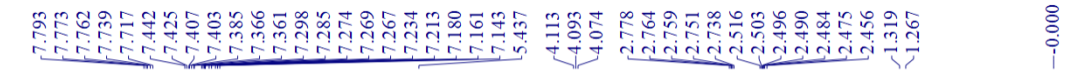
^{1}H NMR (400 MHz, $CDCl_3$) of 5a

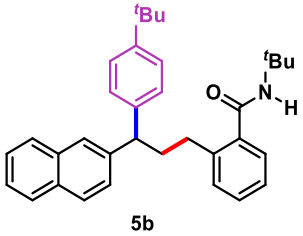


^{13}C NMR (101 MHz, $CDCl_3$) of 5a

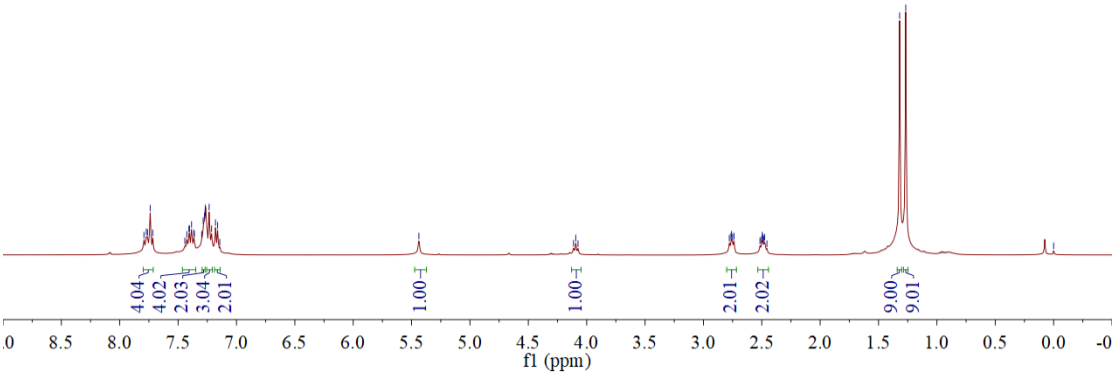


^{1}H NMR (400 MHz, $CDCl_3$) of 5b

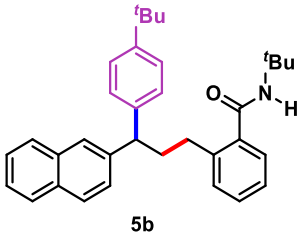




5b



^{13}C NMR (101 MHz, $CDCl_3$) of 5b



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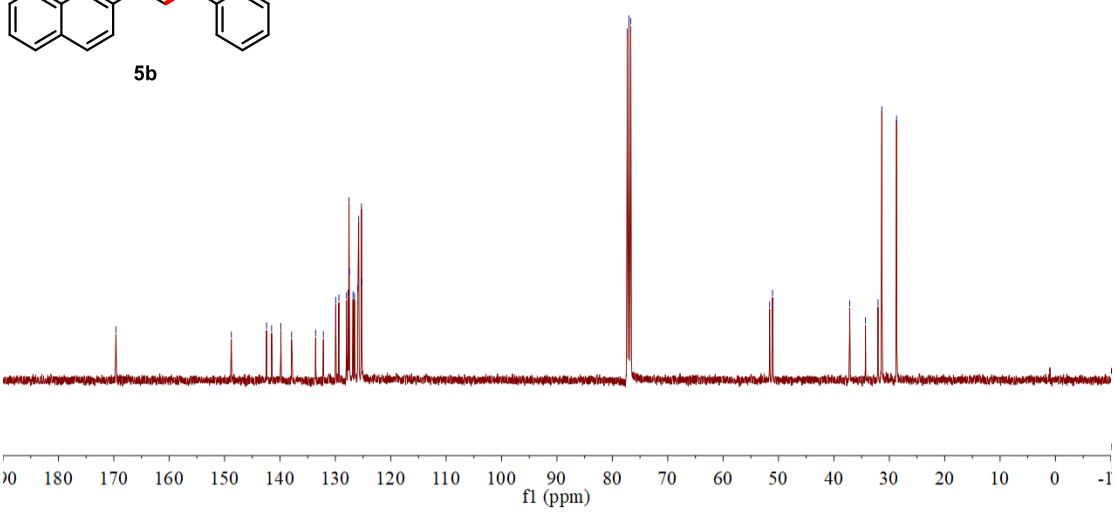
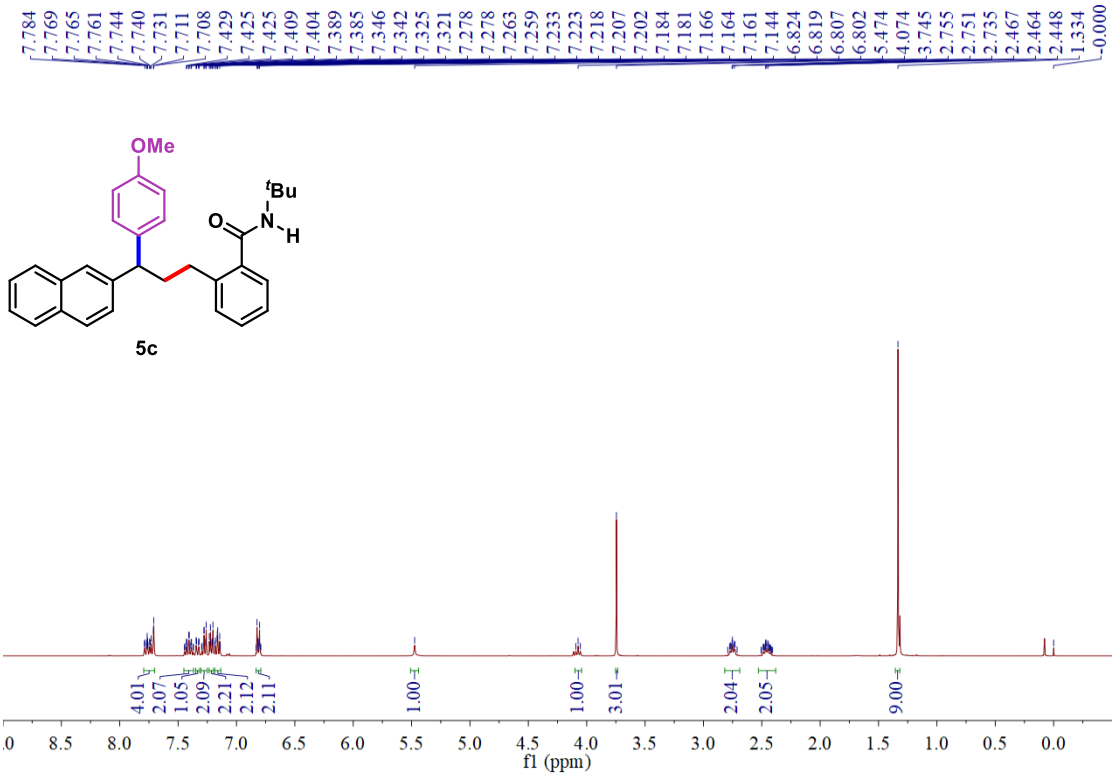


^{1}H NMR (400 MHz, $CDCl_3$) of 5c



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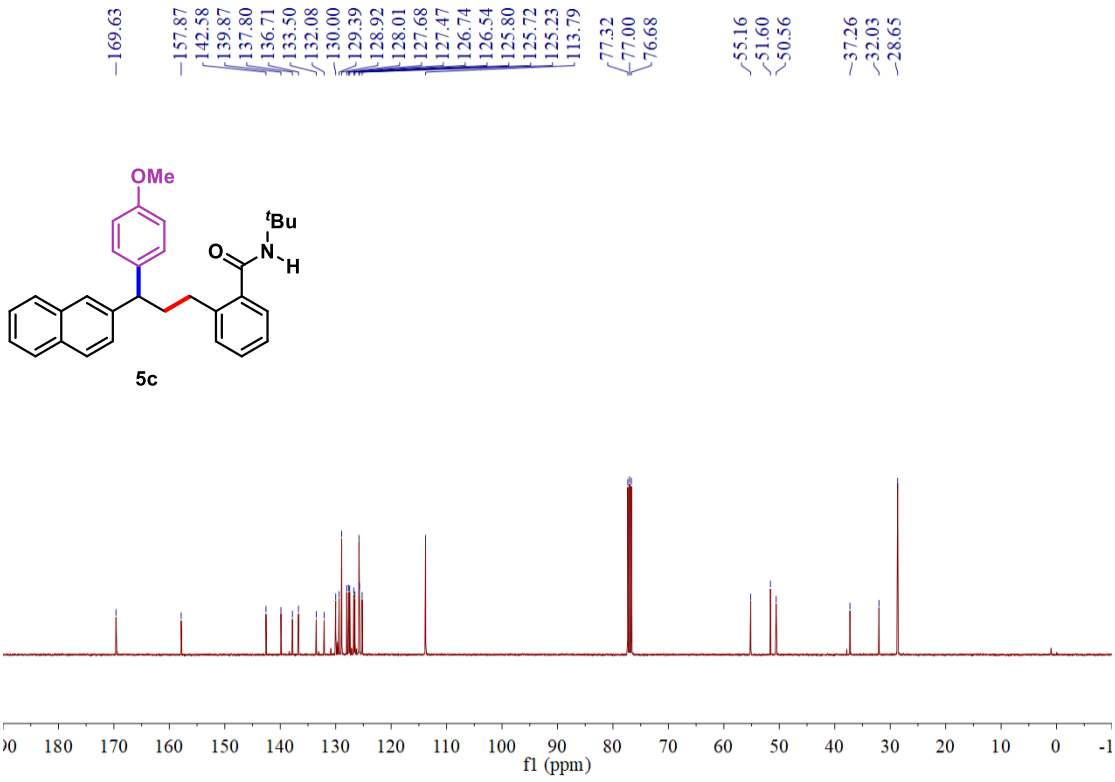
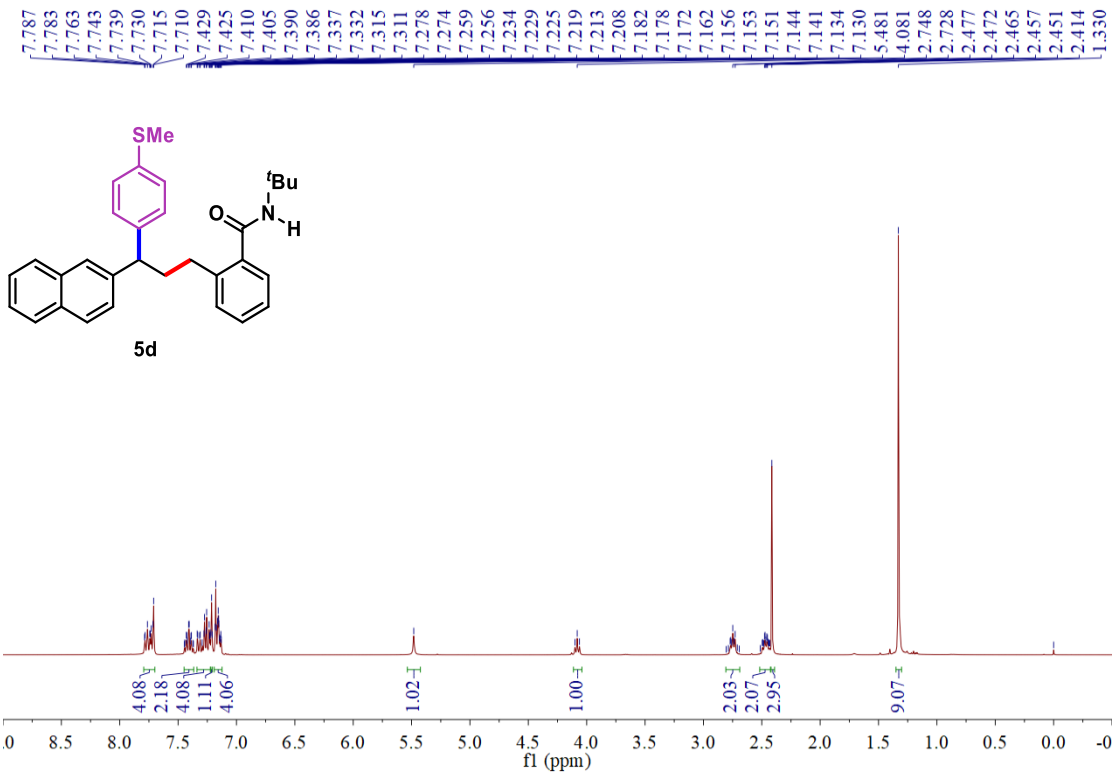
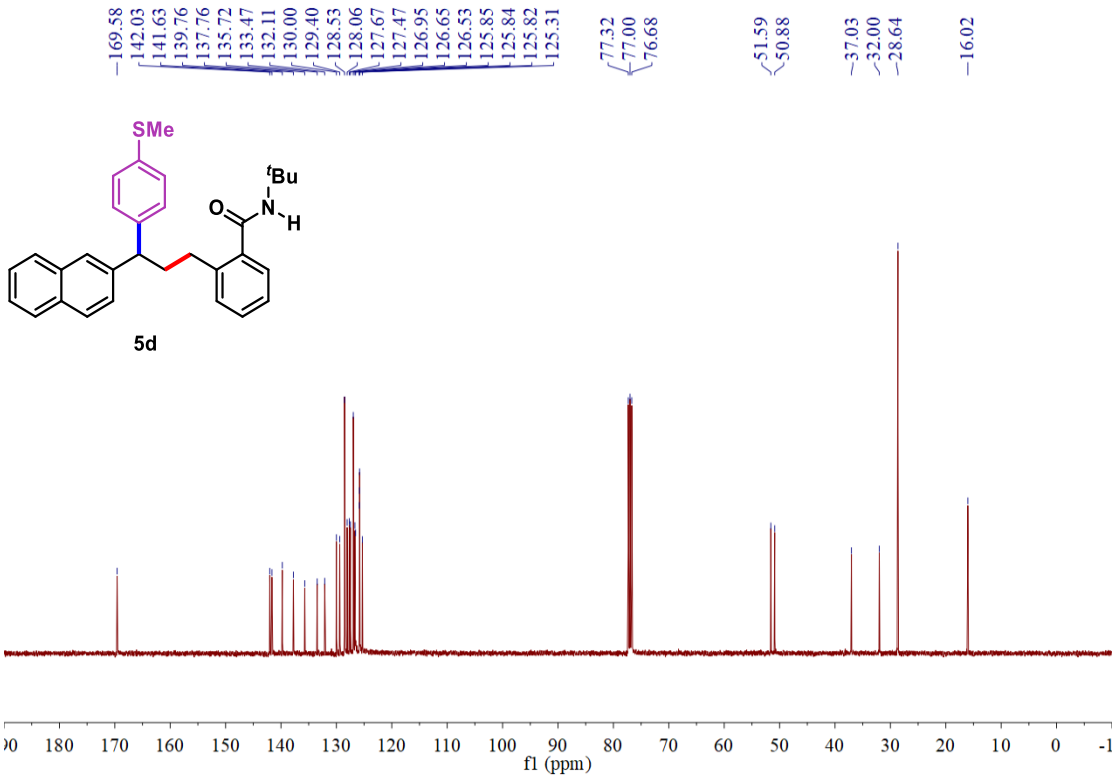


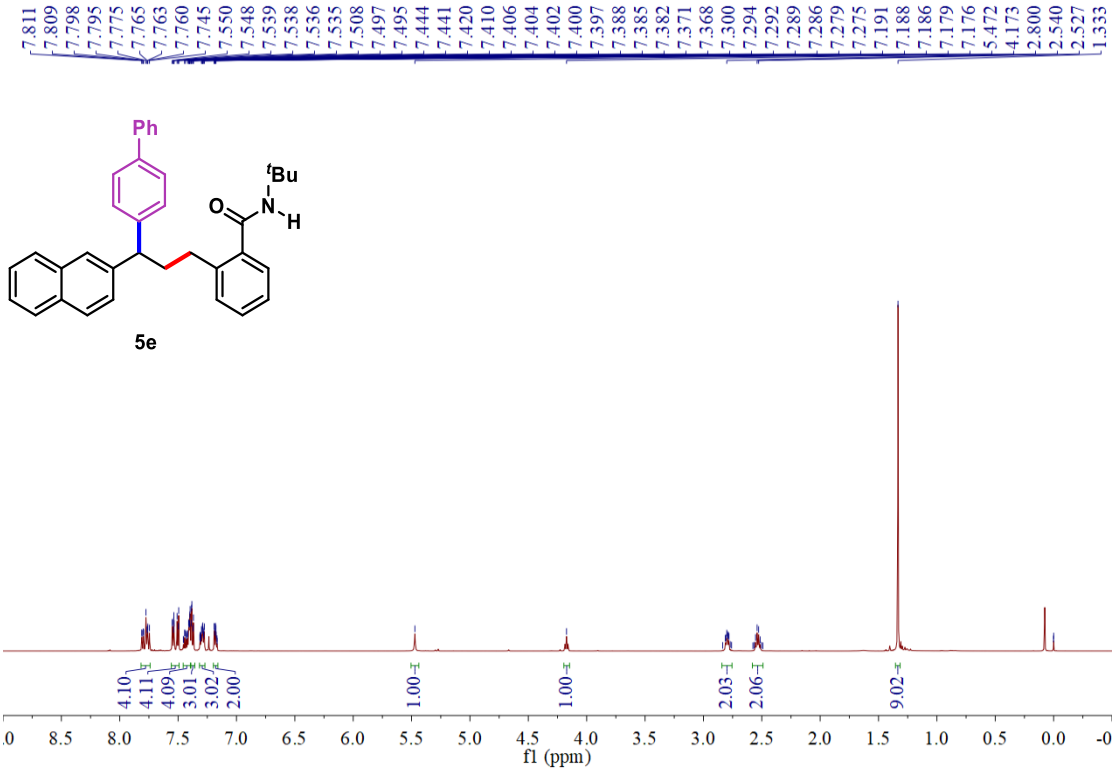
^{1}H NMR (400 MHz, $CDCl_3$) of 5d



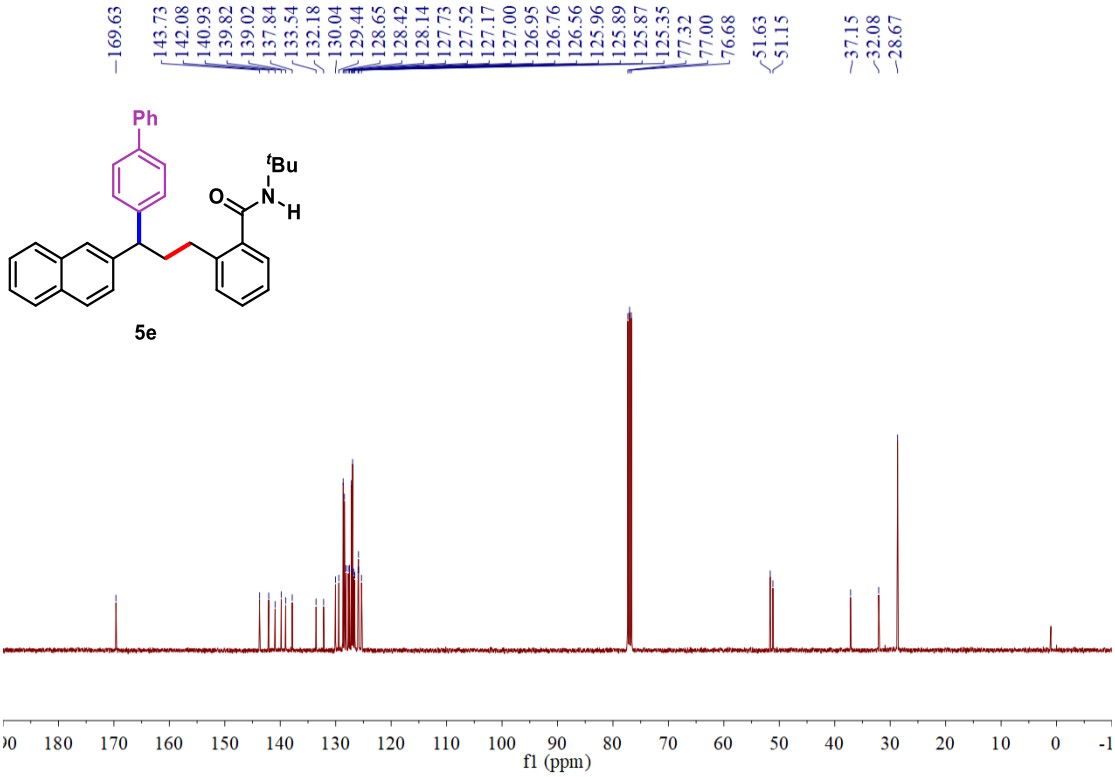
^{13}C NMR (101 MHz, $CDCl_3$) of 5d



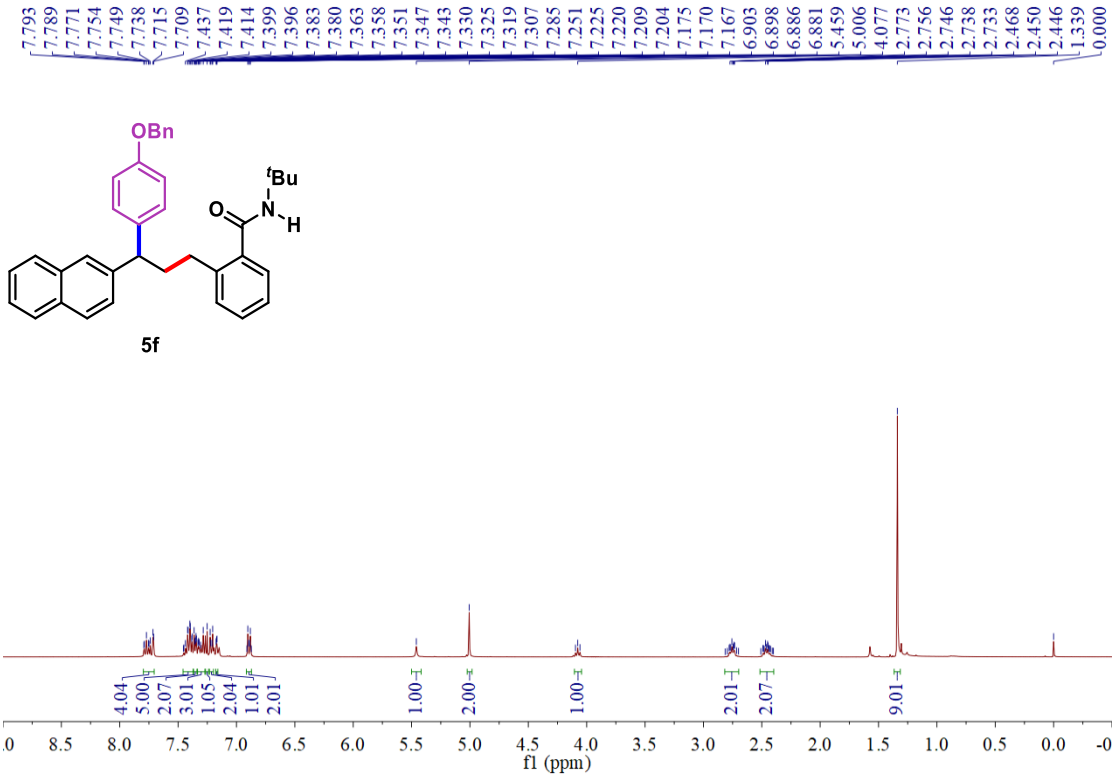
^{1}H NMR (400 MHz, $CDCl_3$) of 5e



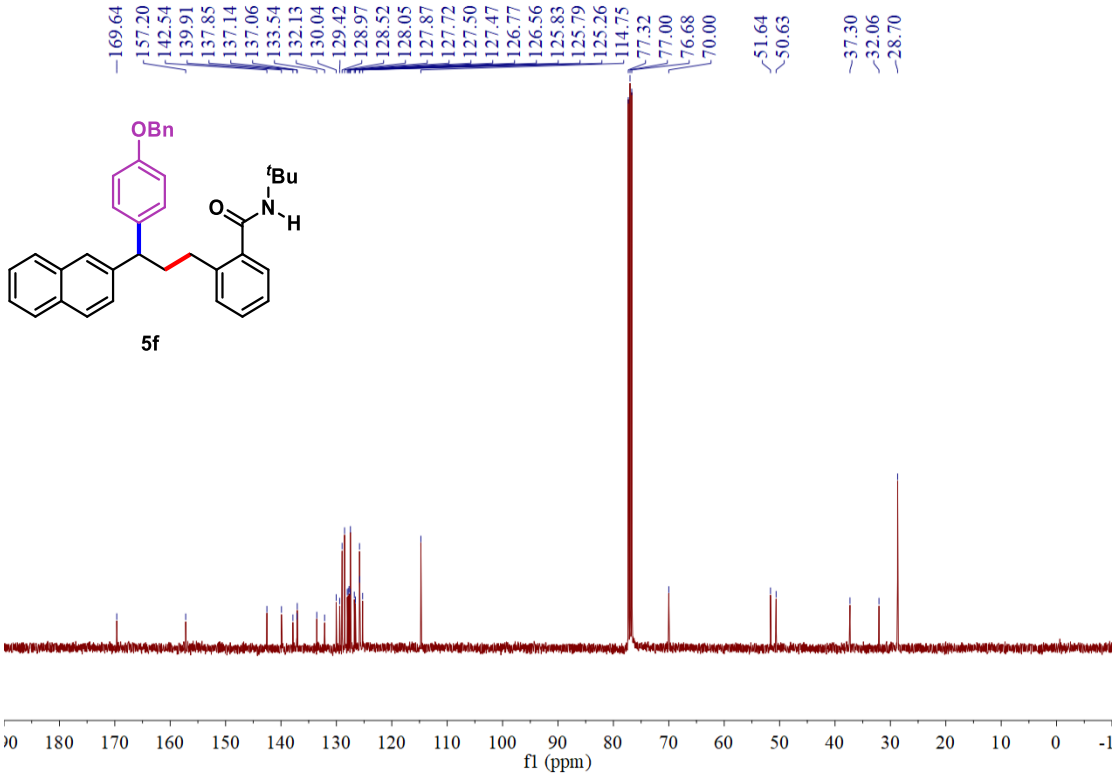
^{13}C NMR (101 MHz, $CDCl_3$) of 5e



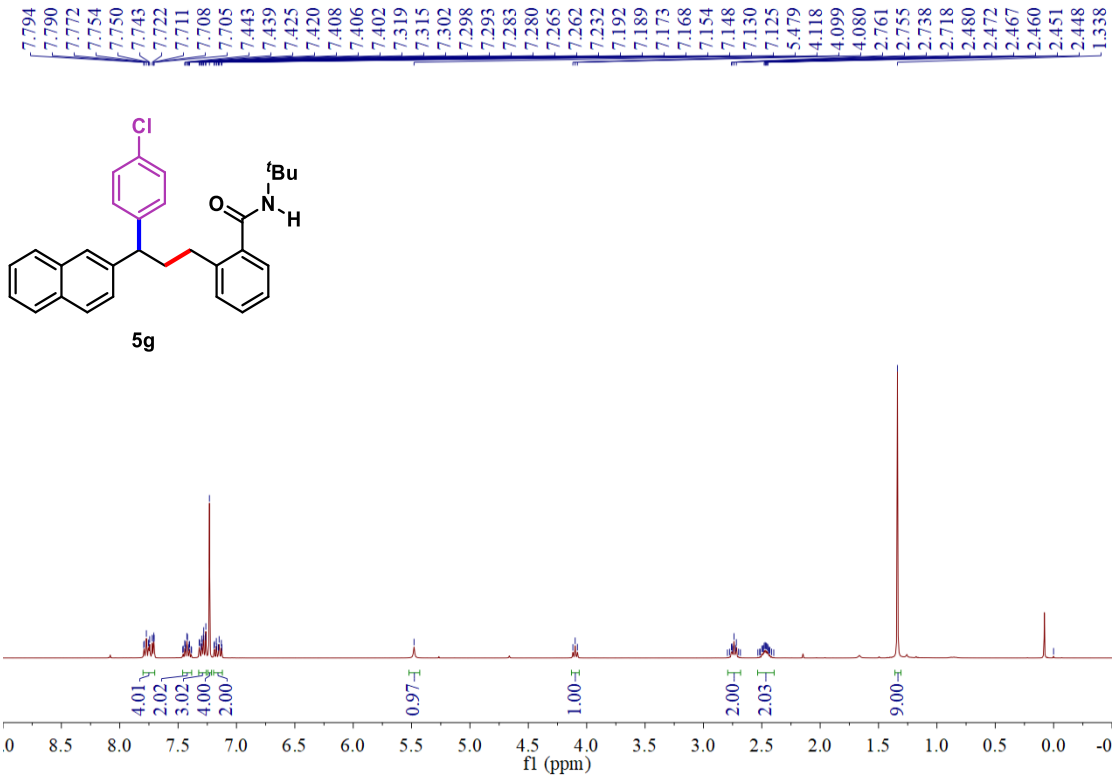
^{1}H NMR (400 MHz, $CDCl_3$) of 5f



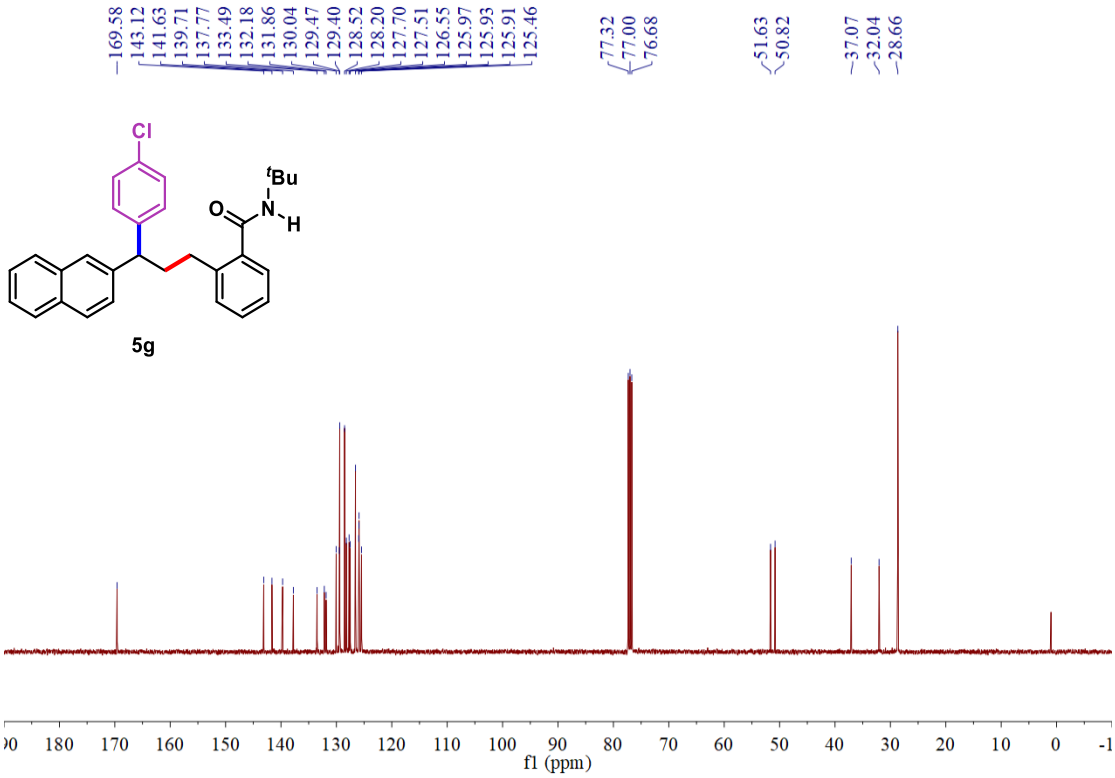
^{13}C NMR (101 MHz, $CDCl_3$) of 5f



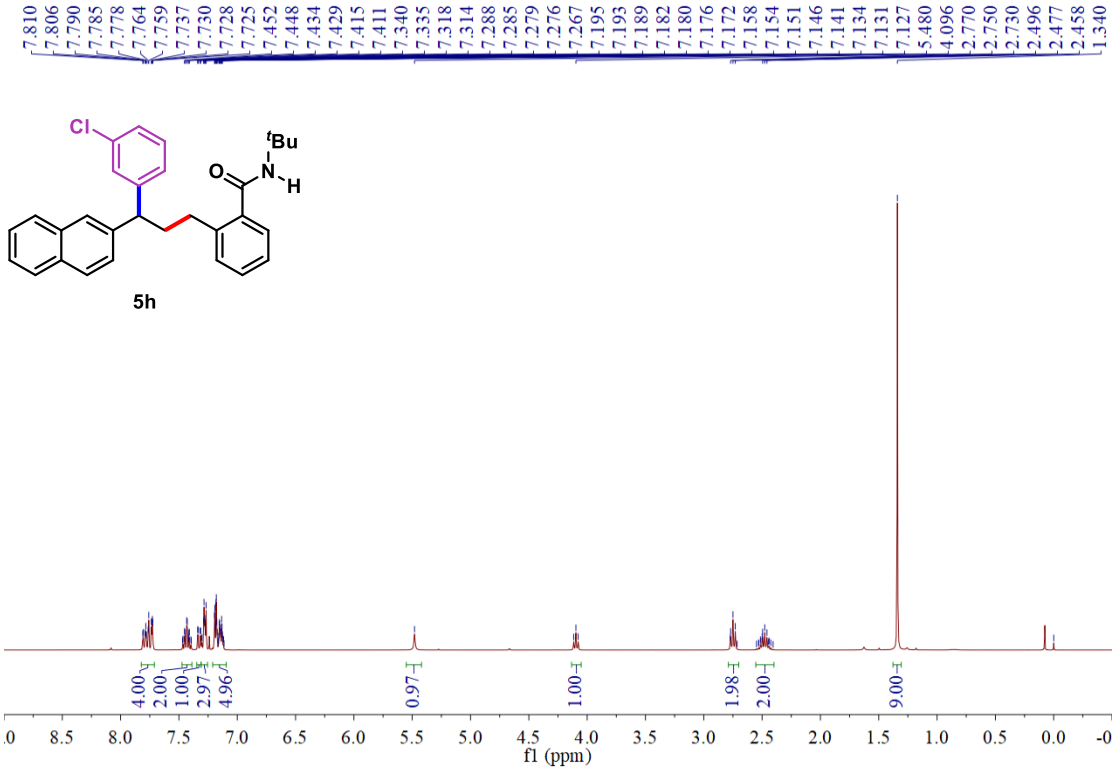
^{1}H NMR (400 MHz, $CDCl_3$) of 5g



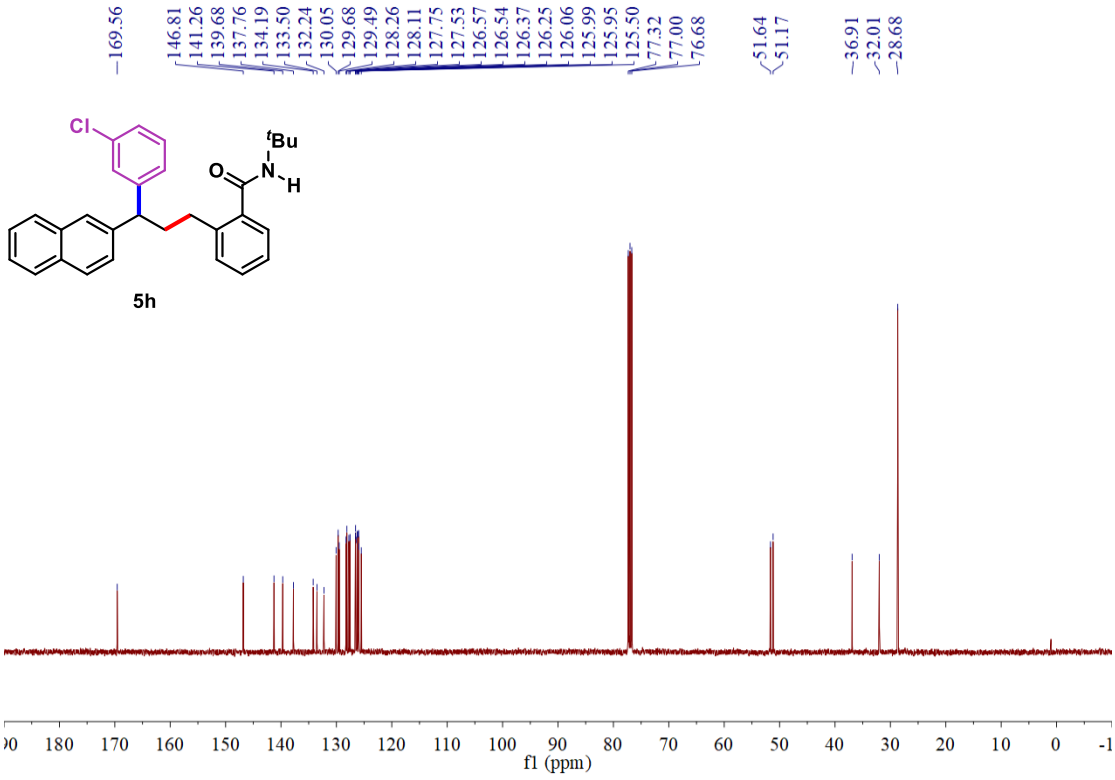
^{13}C NMR (101 MHz, $CDCl_3$) of 5g



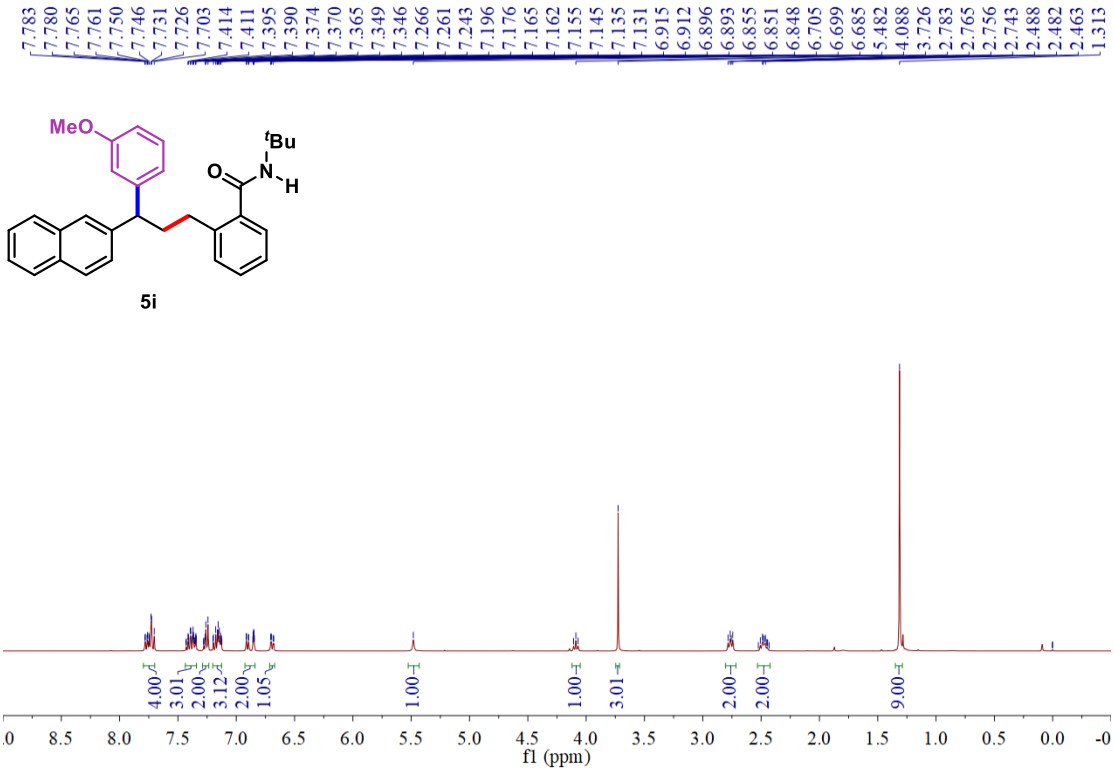
^{1}H NMR (400 MHz, $CDCl_3$) of 5h



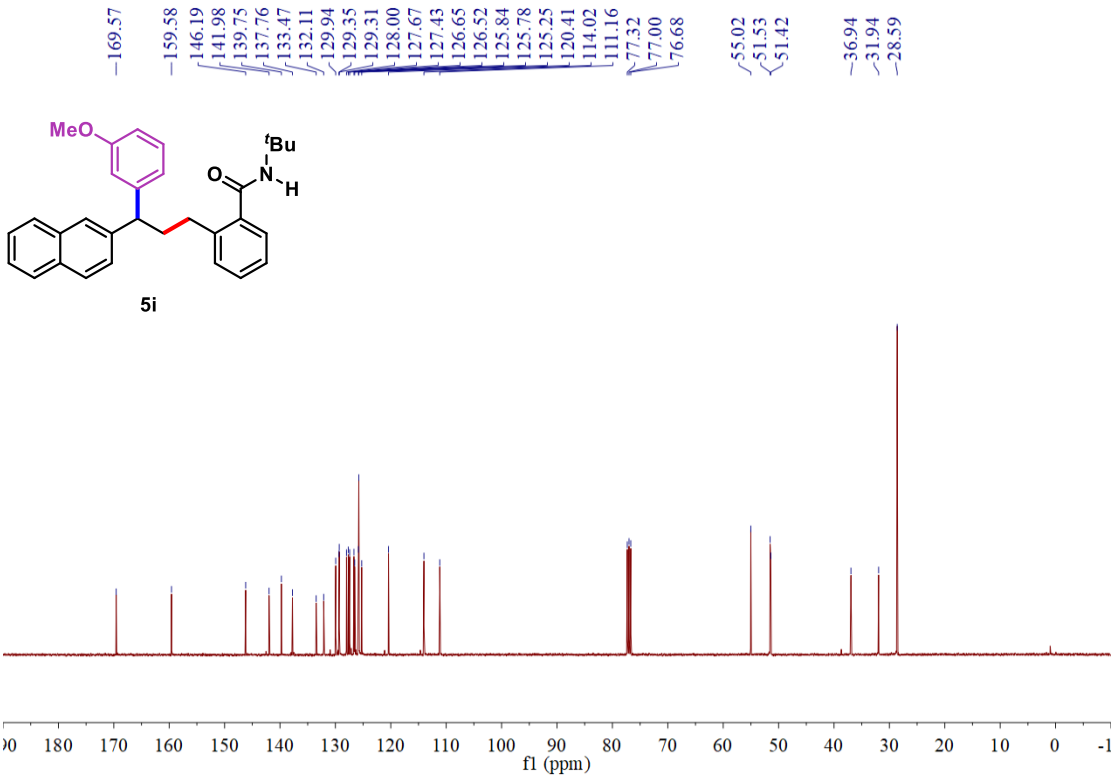
^{13}C NMR (101 MHz, $CDCl_3$) of 5h



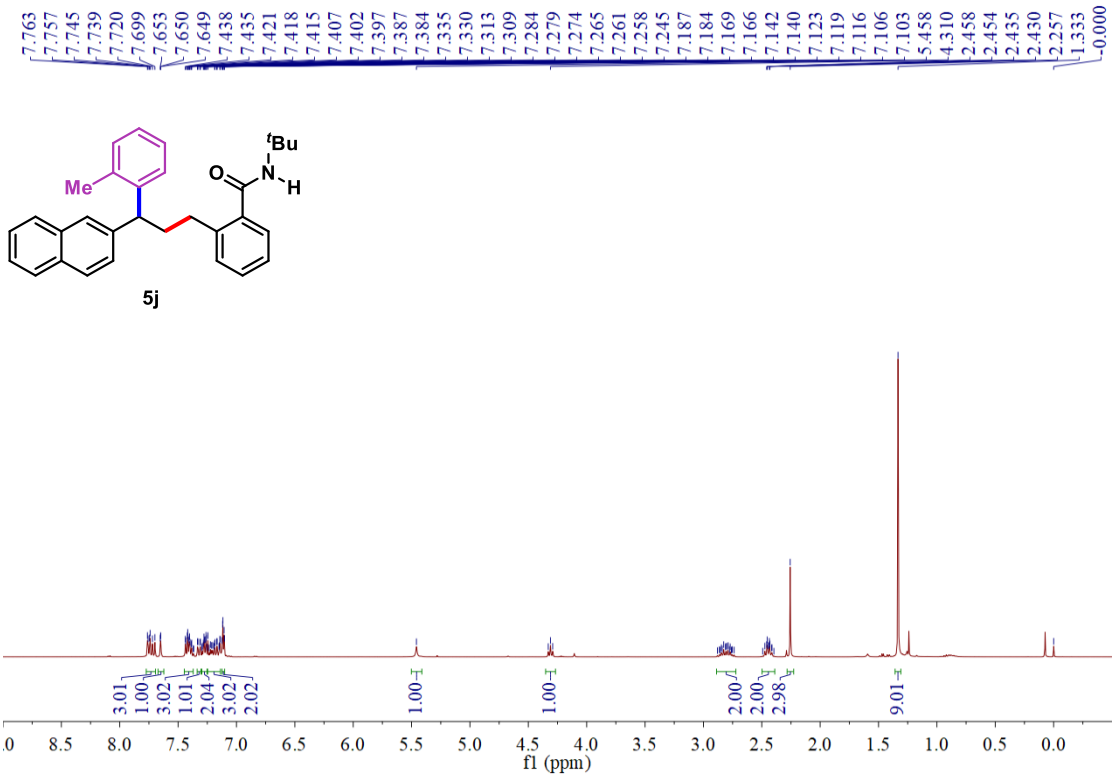
^{1}H NMR (400 MHz, $CDCl_3$) of 5i



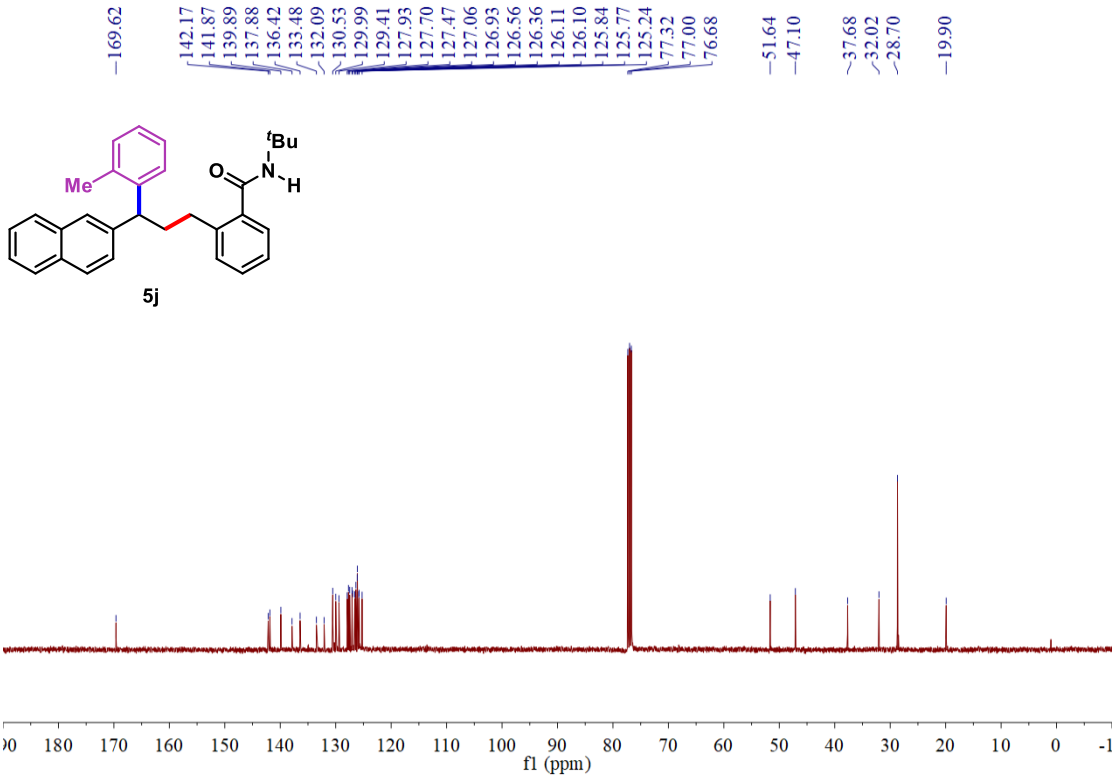
^{13}C NMR (101 MHz, $CDCl_3$) of 5i



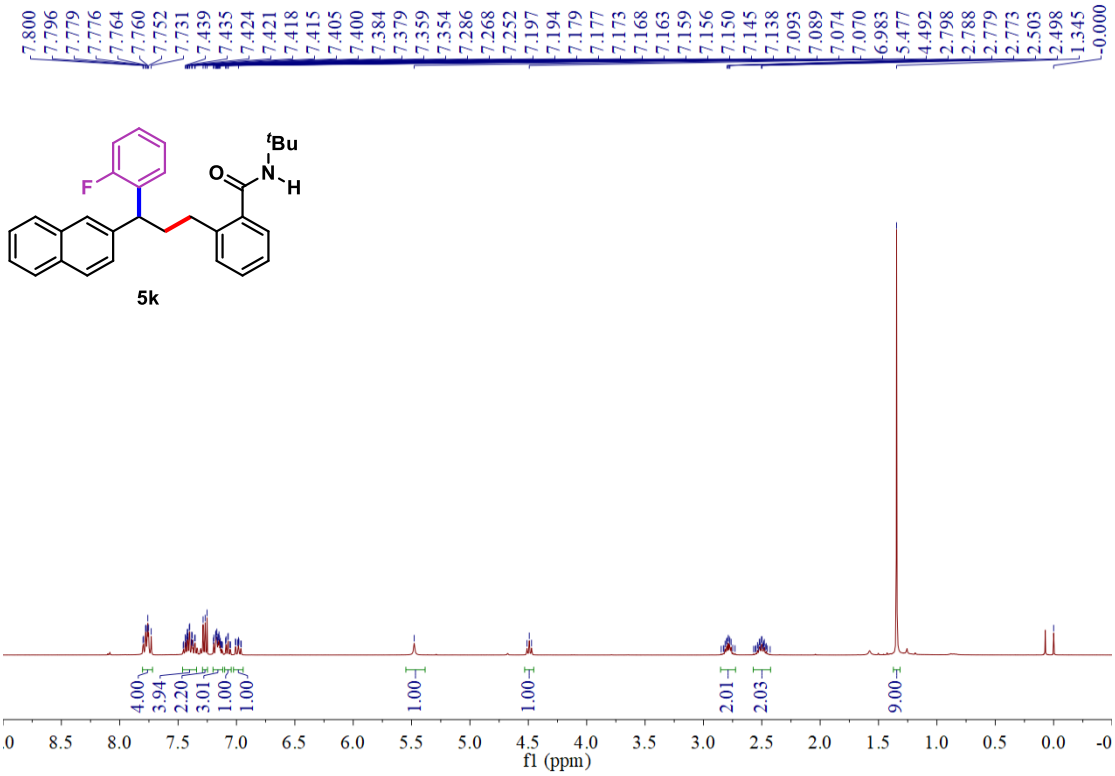
^{1}H NMR (400 MHz, $CDCl_3$) of 5j



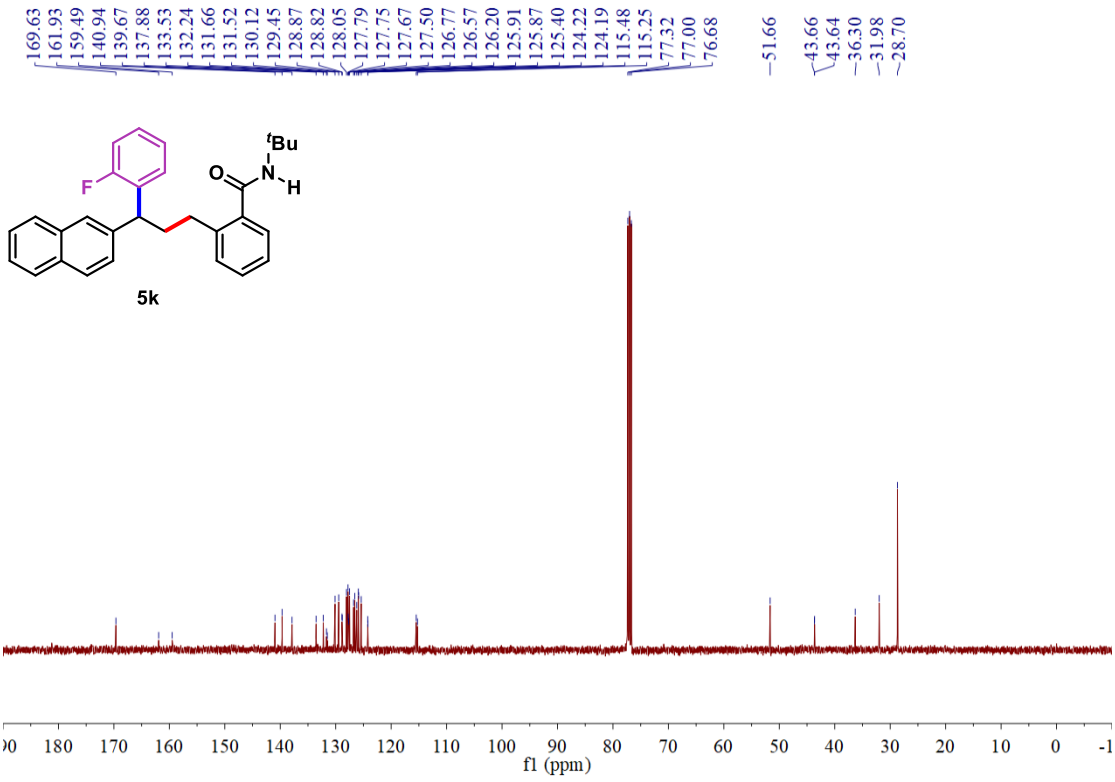
^{13}C NMR (101 MHz, $CDCl_3$) of 5j



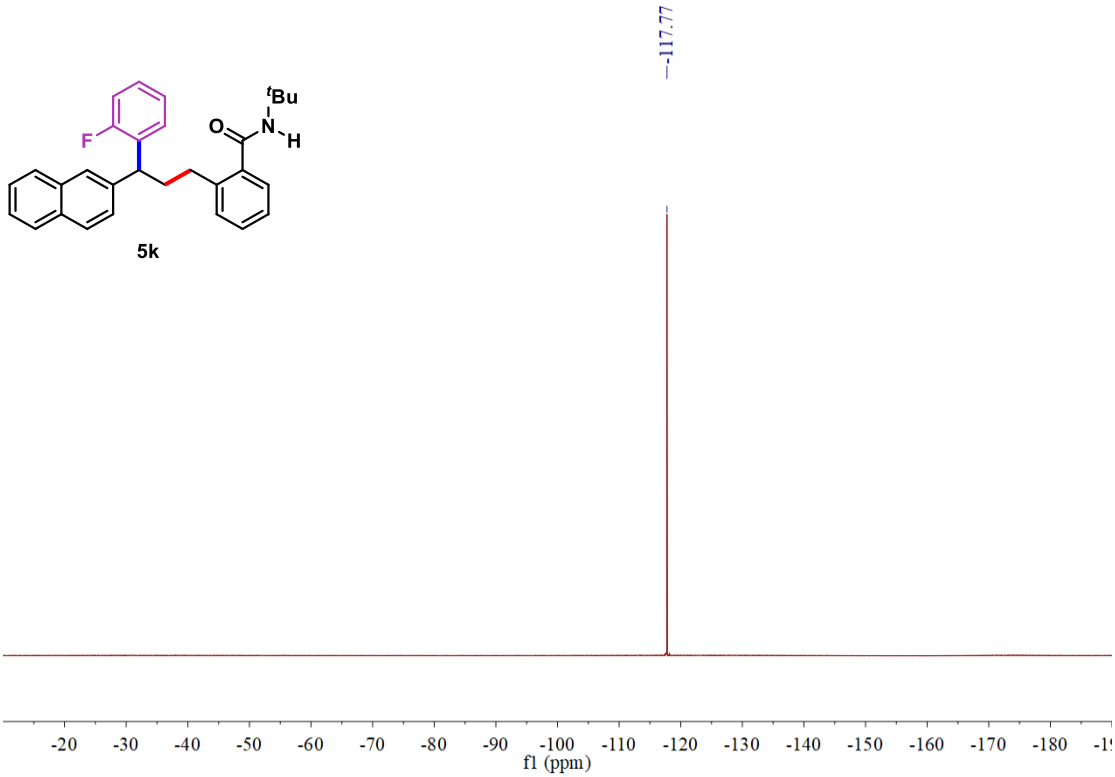
^{1}H NMR (400 MHz, $CDCl_3$) of 5k



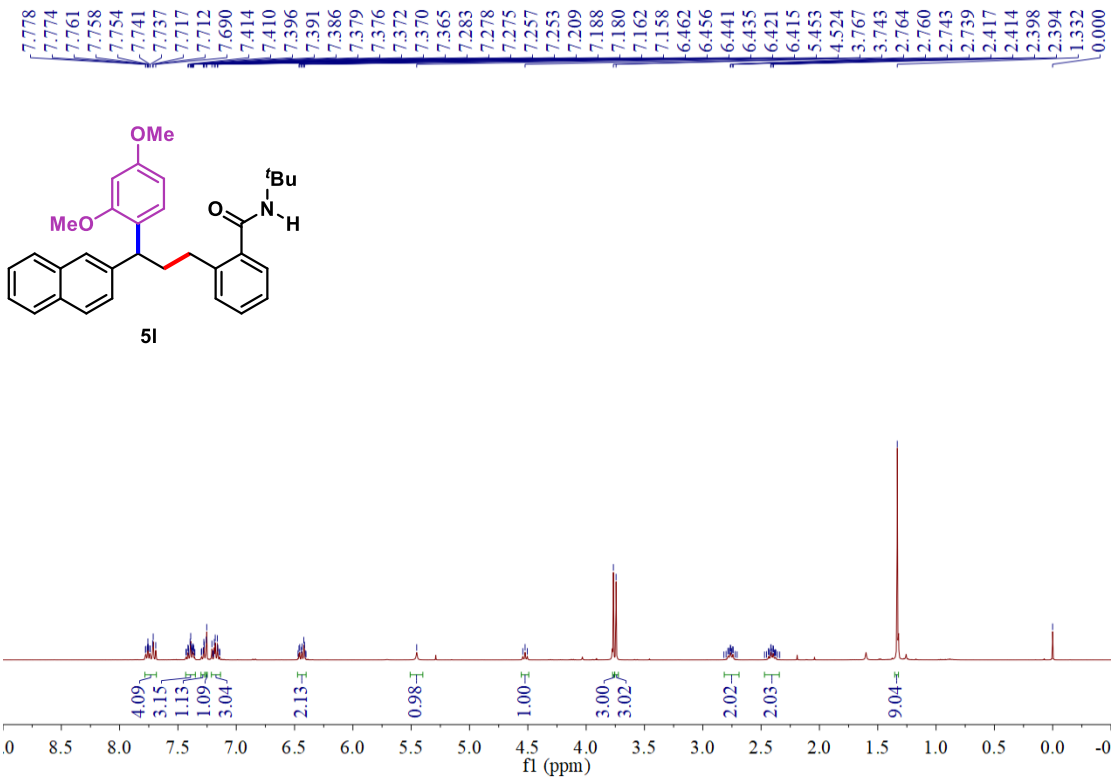
^{13}C NMR (101 MHz, $CDCl_3$) of 5k



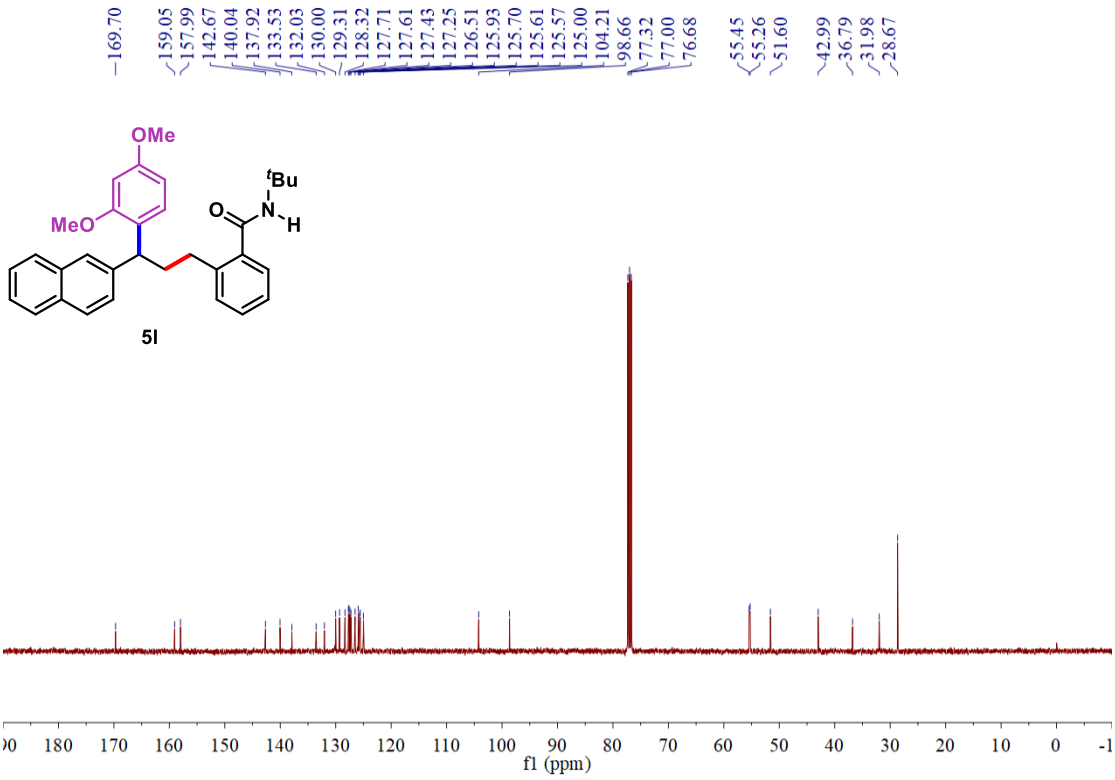
^{19}F NMR (376 MHz, $CDCl_3$) of 5k



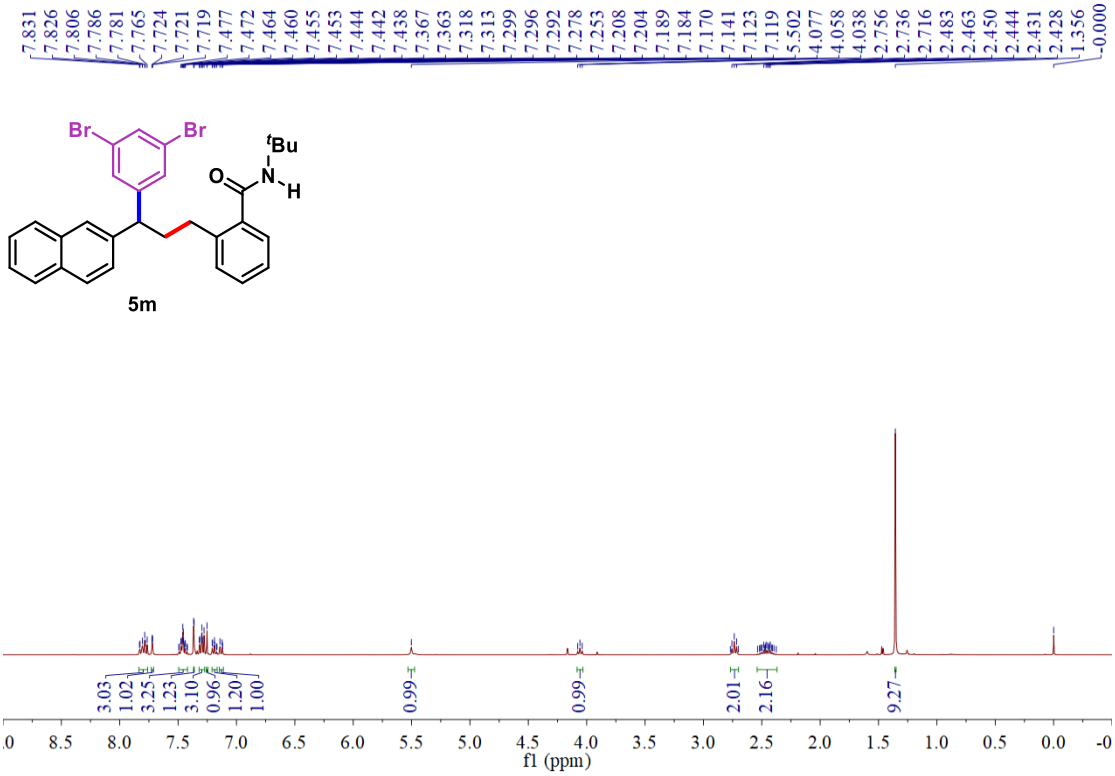
^{1}H NMR (400 MHz, $CDCl_3$) of 5l



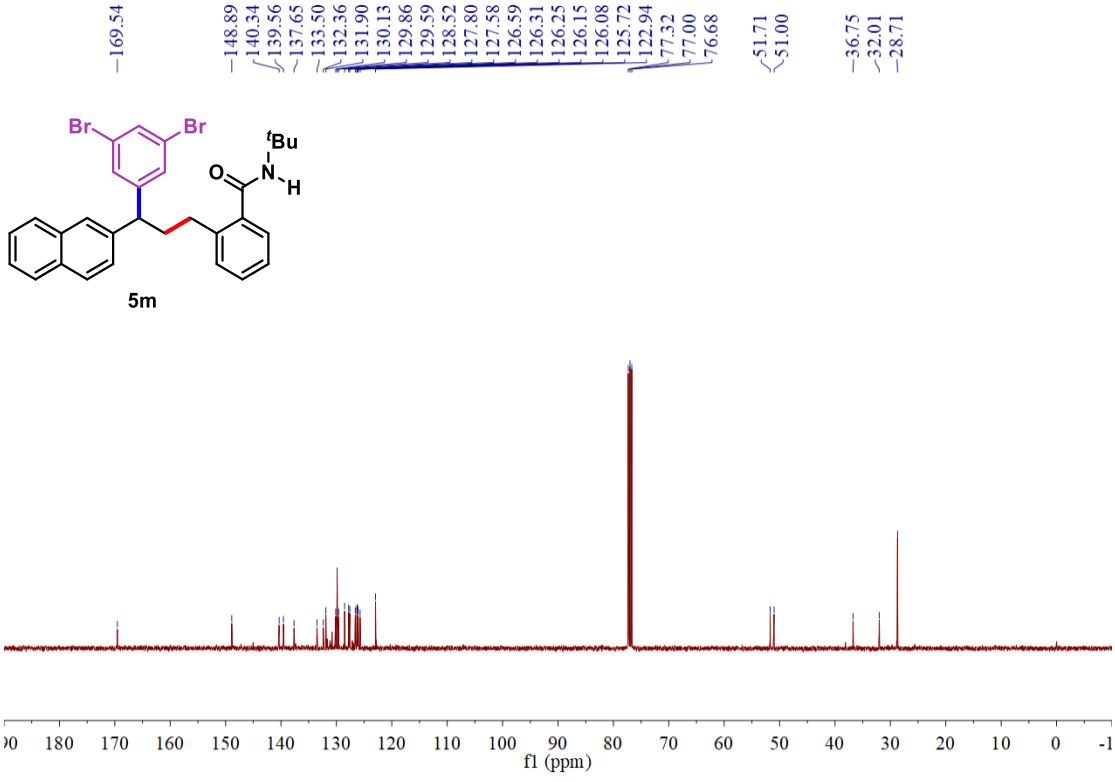
^{13}C NMR (101 MHz, $CDCl_3$) of 5l



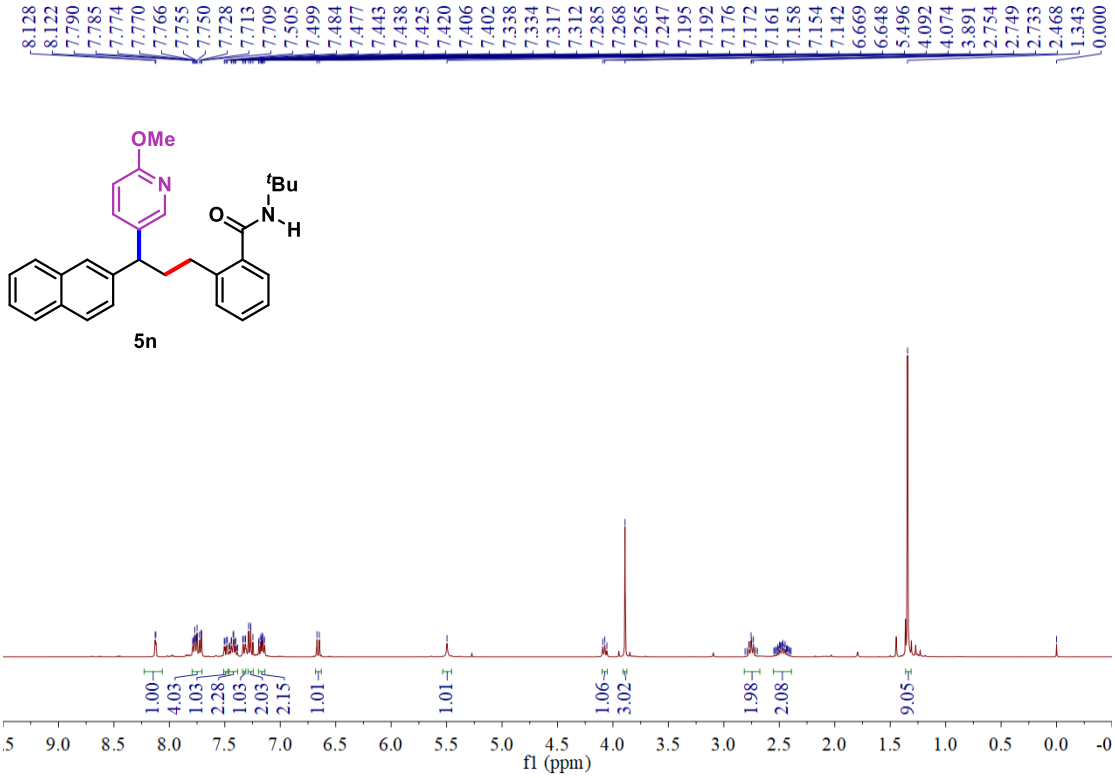
^{1}H NMR (400 MHz, $CDCl_3$) of 5m



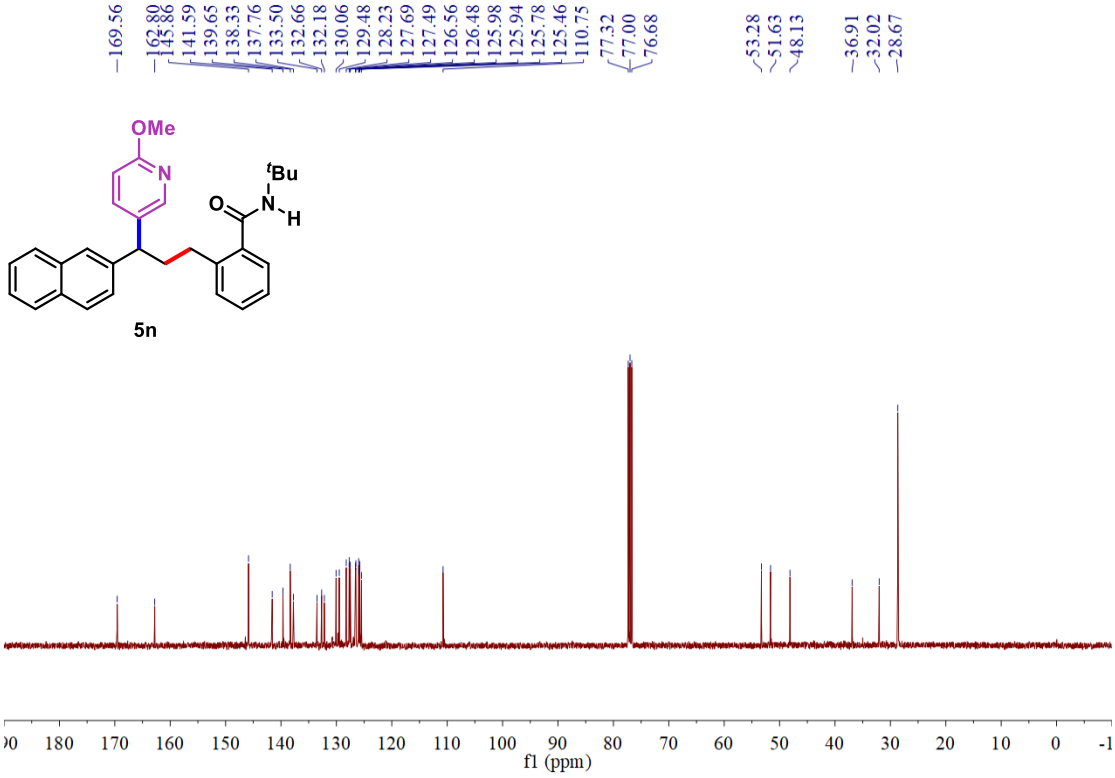
^{13}C NMR (101 MHz, $CDCl_3$) of 5m



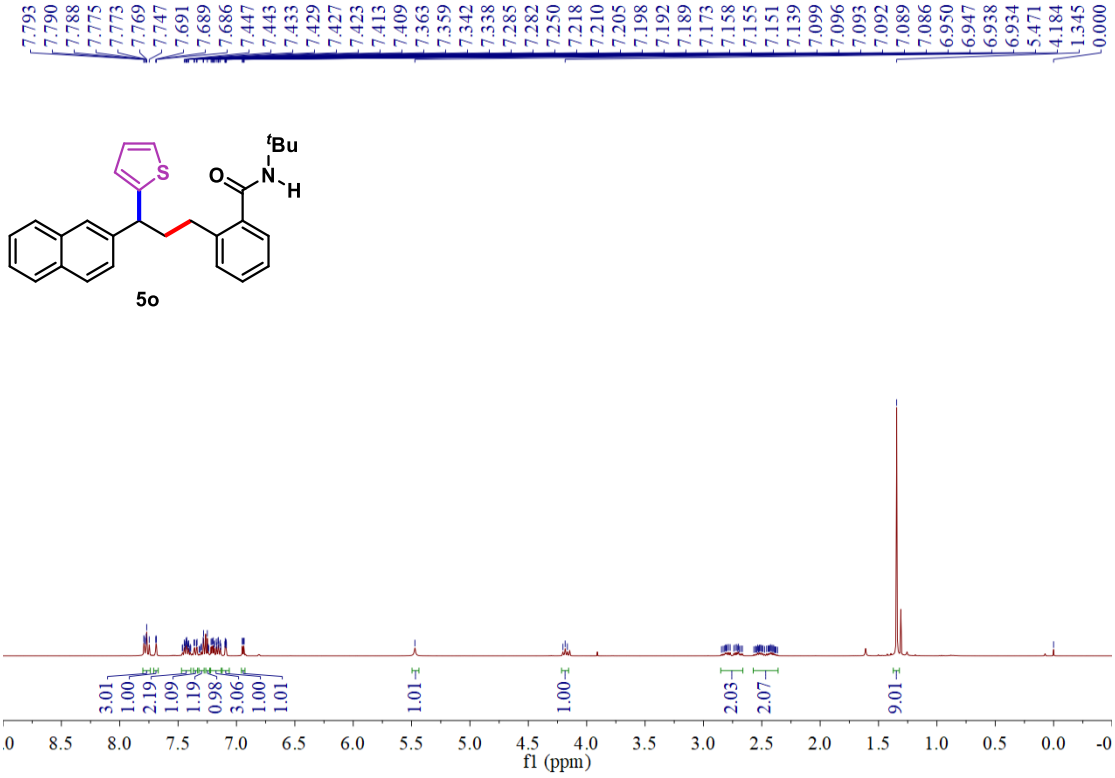
^{1}H NMR (400 MHz, $CDCl_3$) of 5n



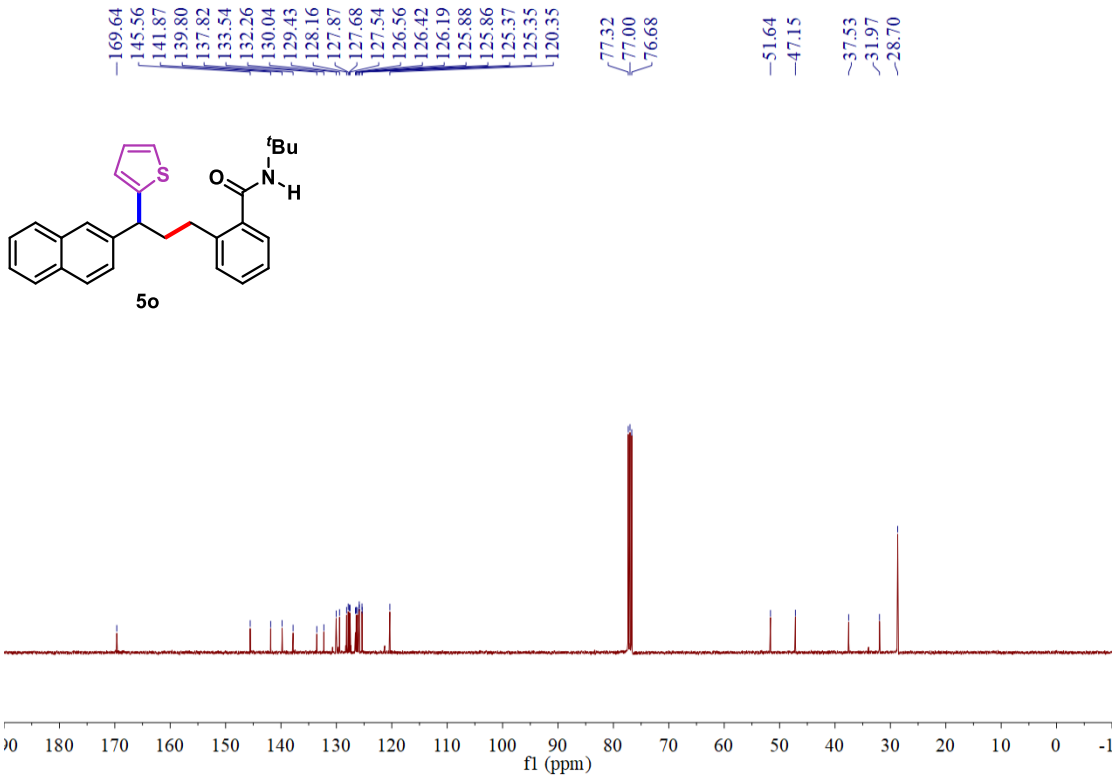
^{13}C NMR (101 MHz, $CDCl_3$) of 5n



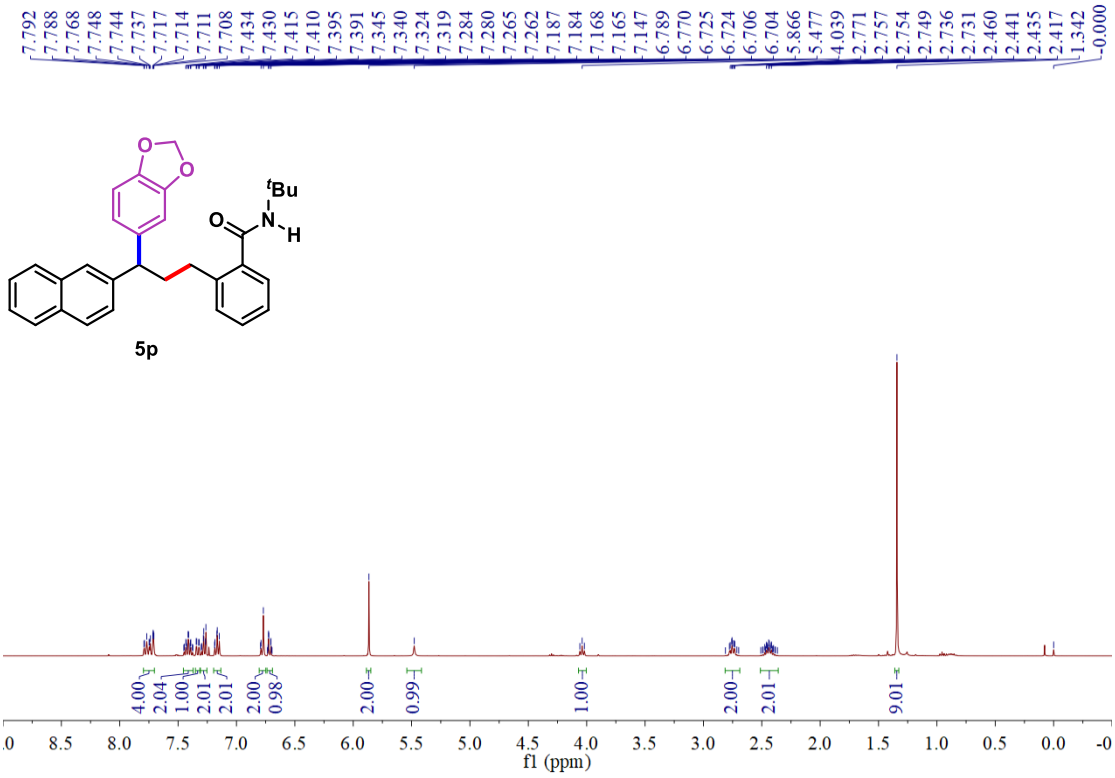
^{1}H NMR (400 MHz, $CDCl_3$) of 5o



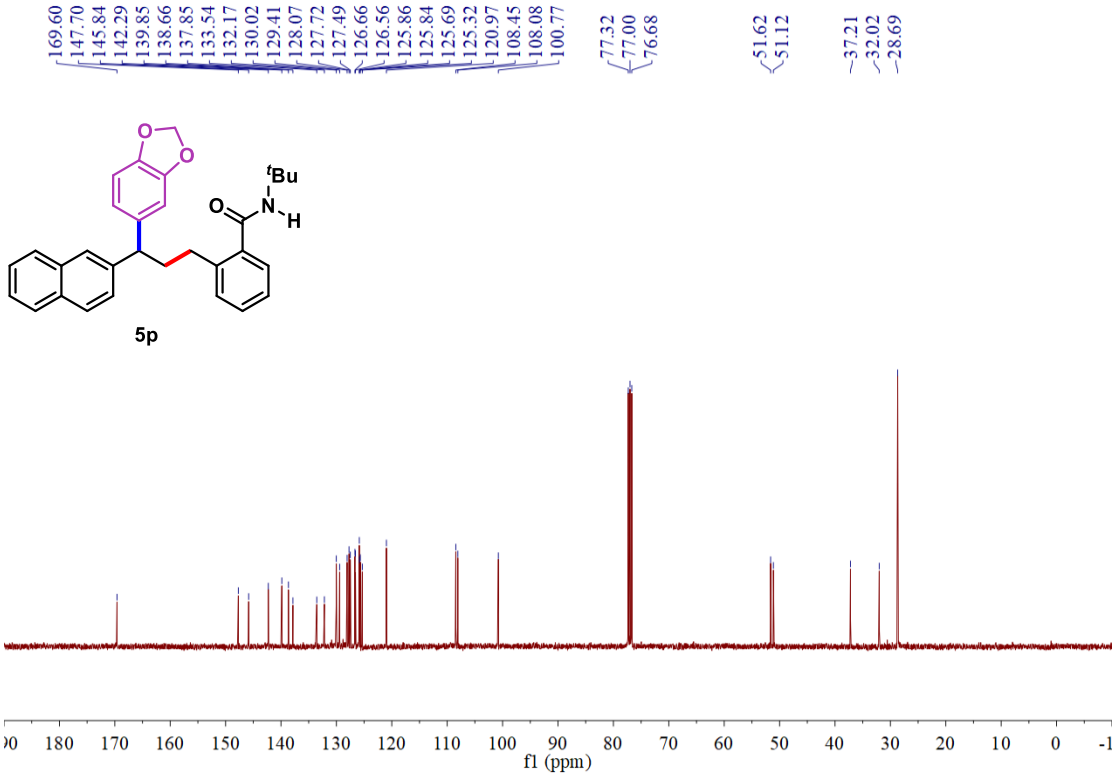
^{13}C NMR (101 MHz, $CDCl_3$) of 5o



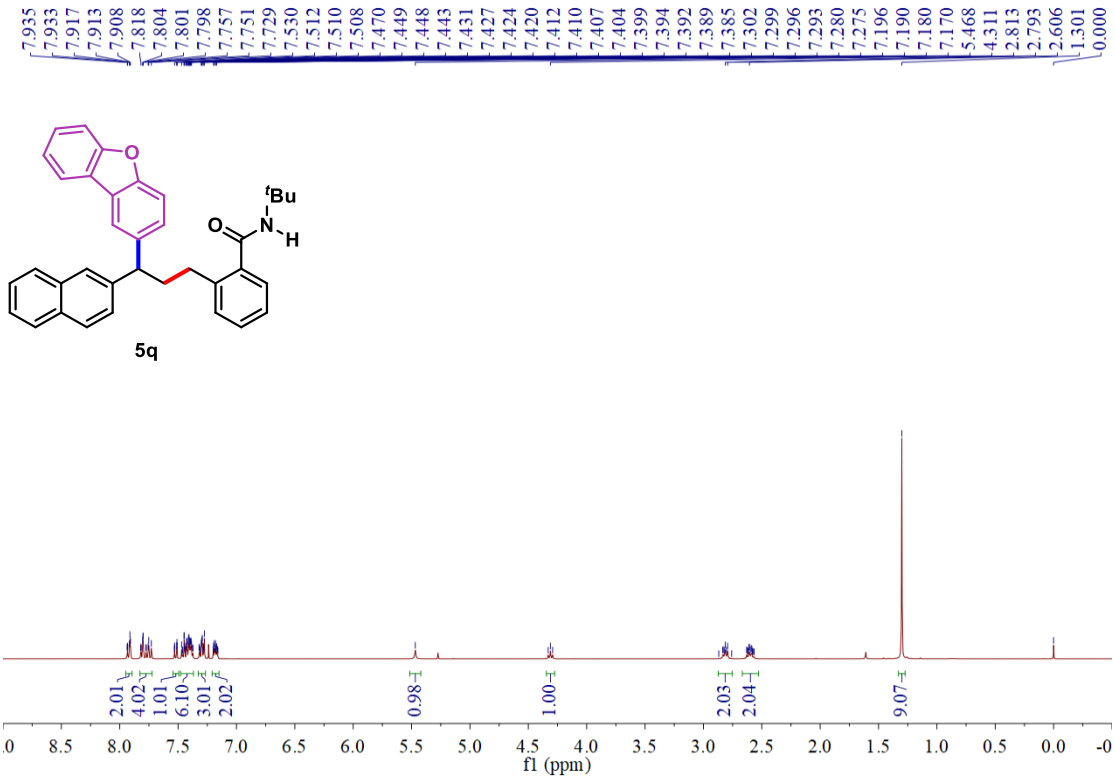
^{1}H NMR (400 MHz, $CDCl_3$) of 5p



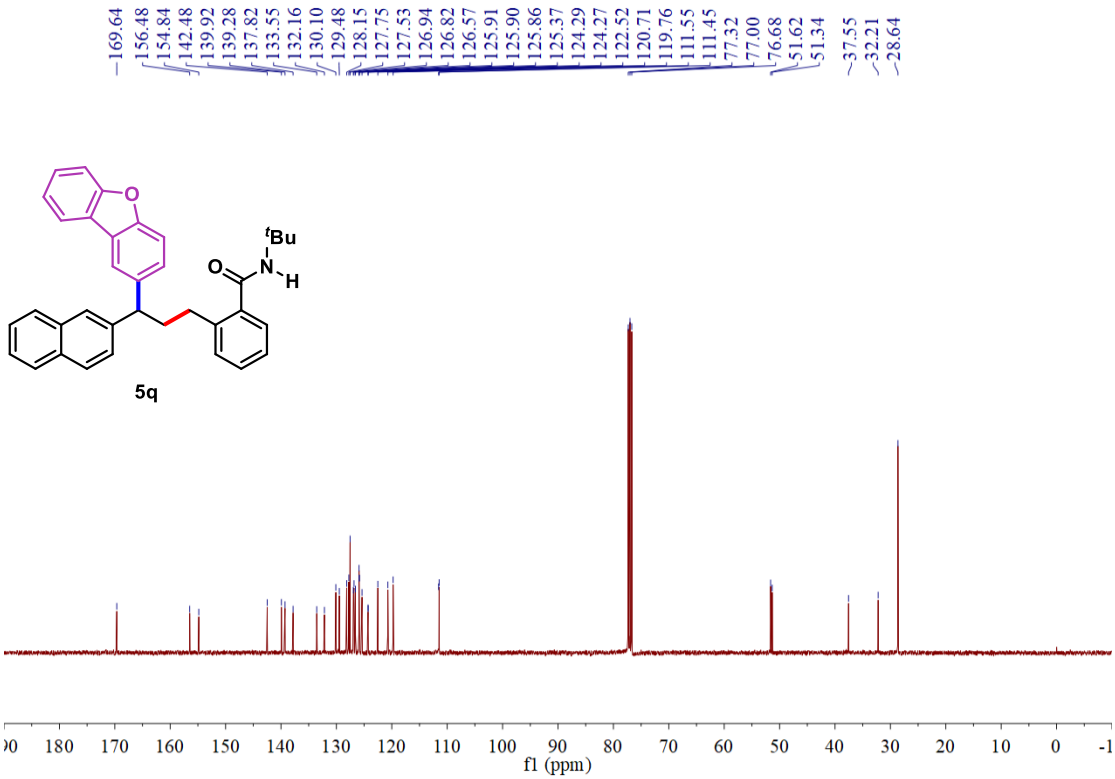
^{13}C NMR (101 MHz, $CDCl_3$) of 5p



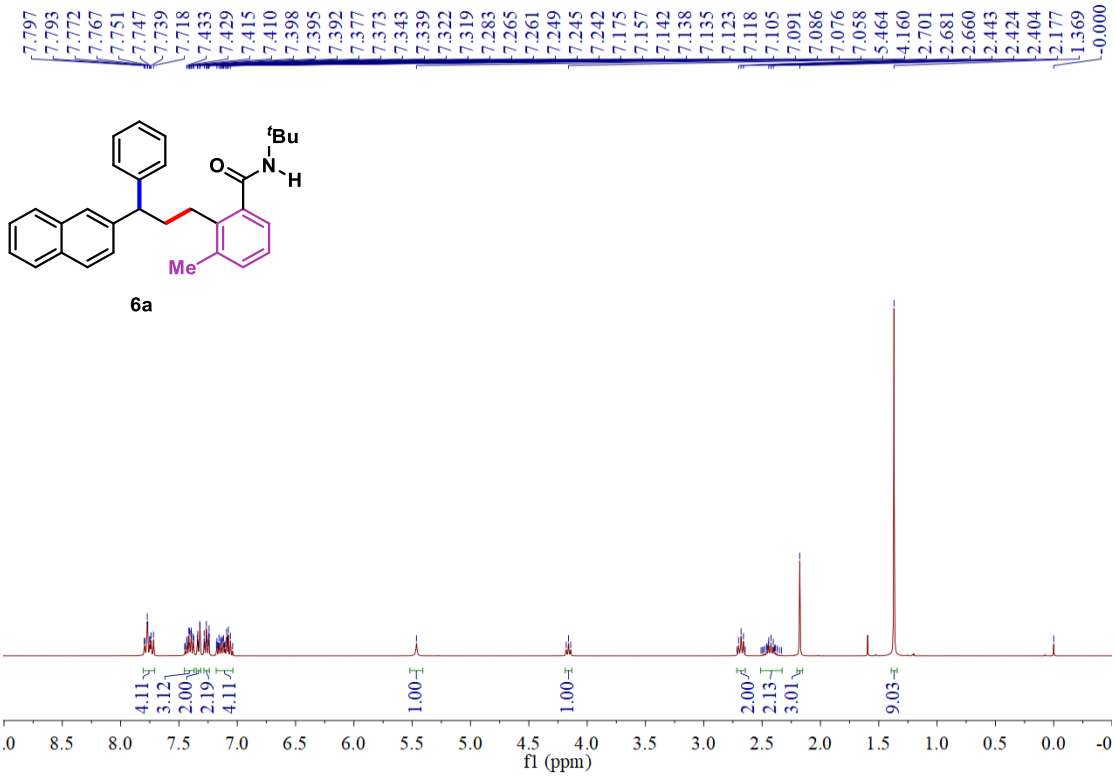
^{1}H NMR (400 MHz, $CDCl_3$) of 5q



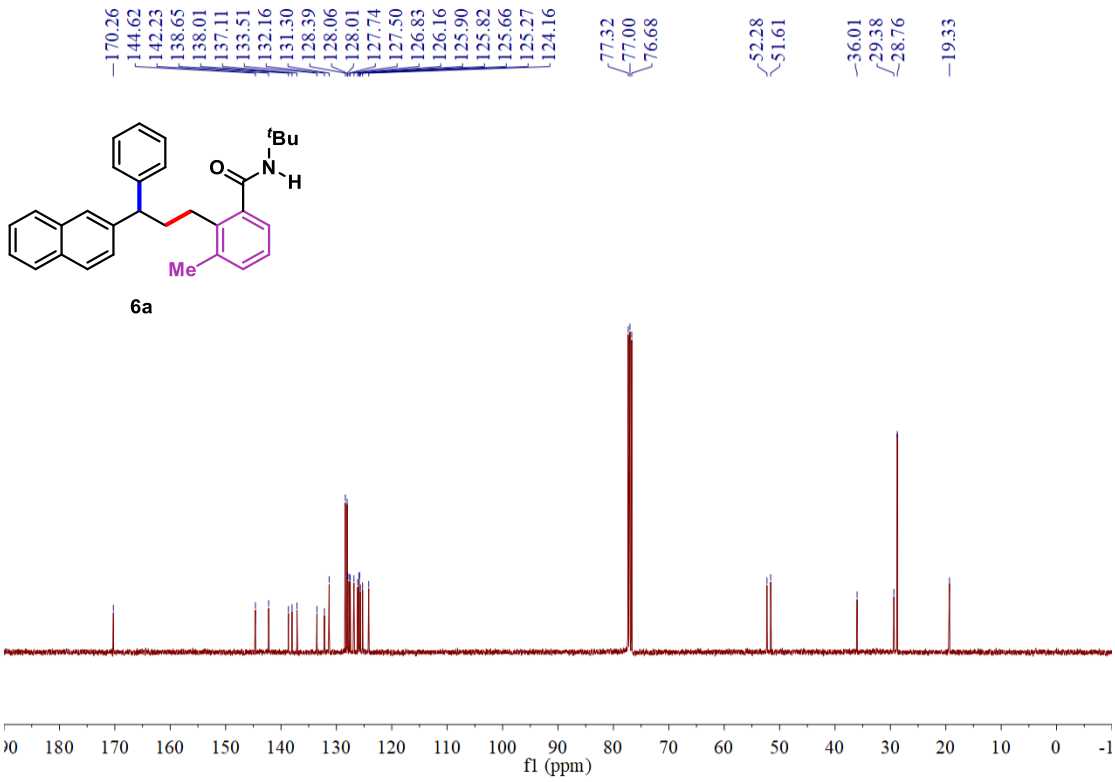
^{13}C NMR (101 MHz, $CDCl_3$) of 5q



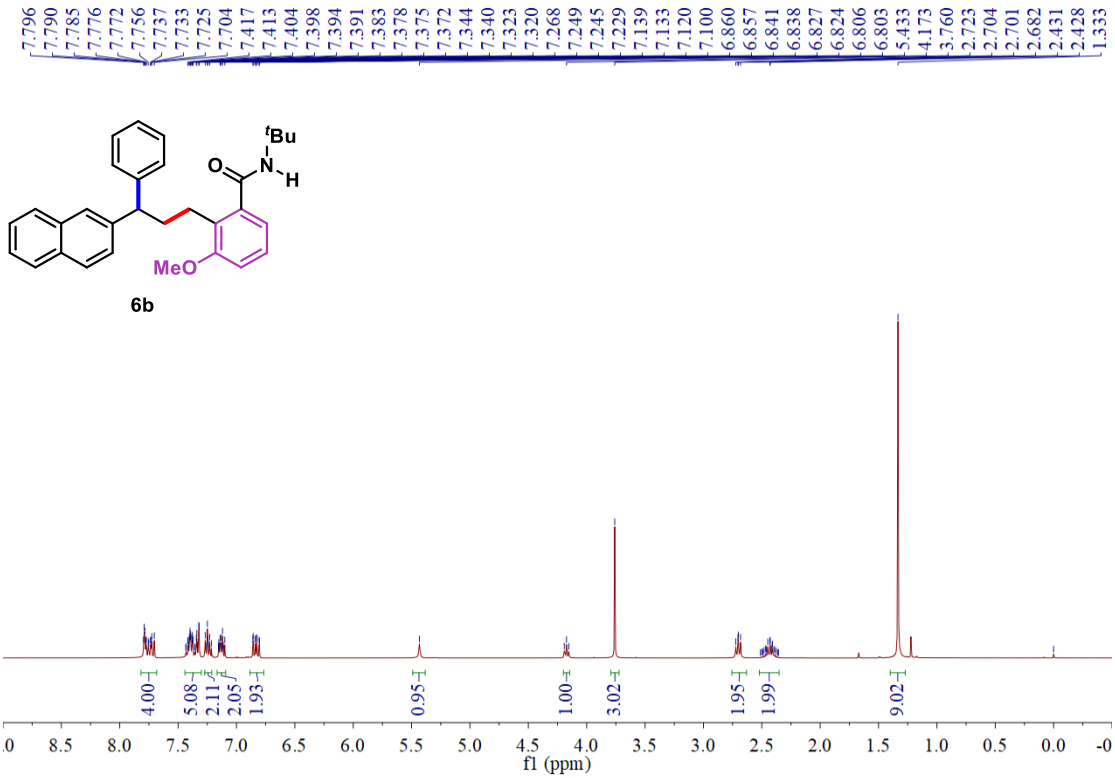
^{1}H NMR (400 MHz, $CDCl_3$) of 6a



^{13}C NMR (101 MHz, $CDCl_3$) of 6a

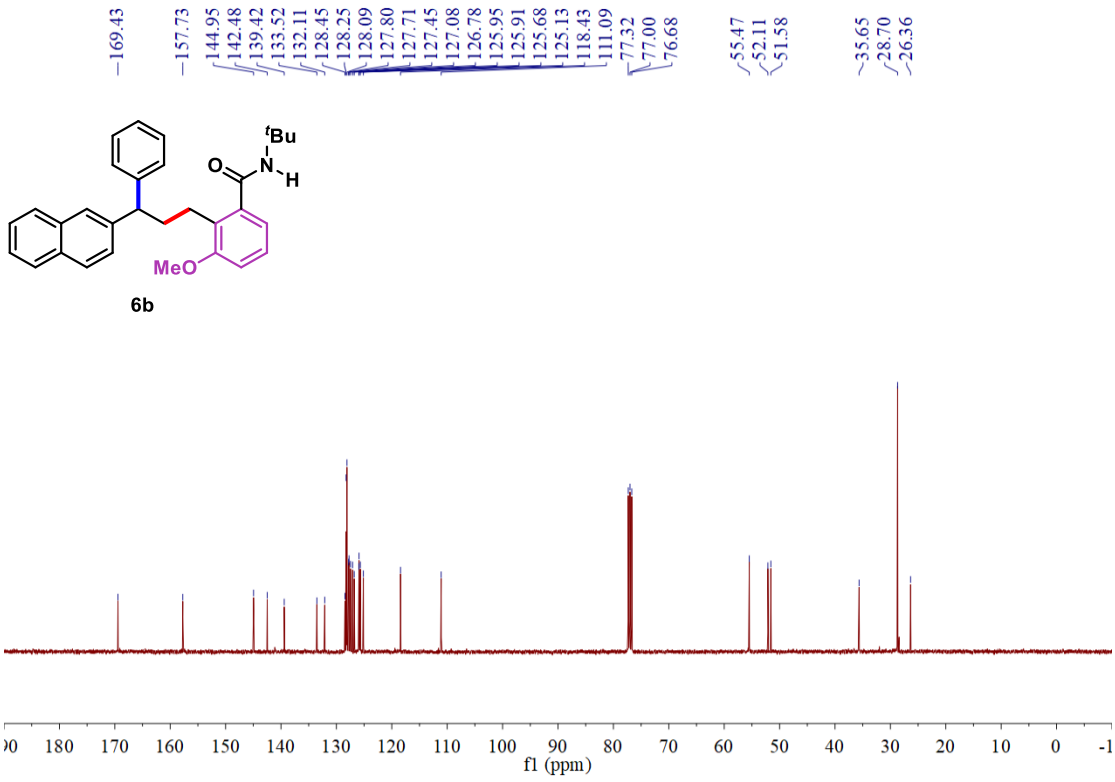


^{1}H NMR (400 MHz, $CDCl_3$) of 6b



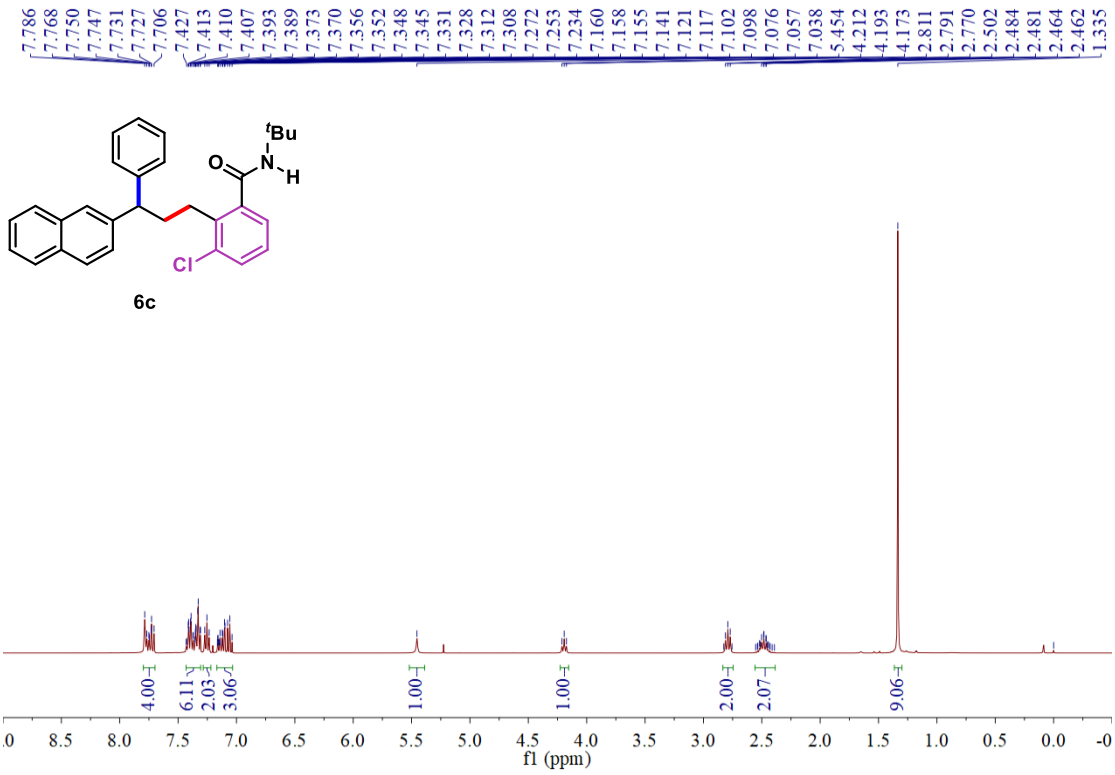
6b

^{13}C NMR (101 MHz, $CDCl_3$) of 6b

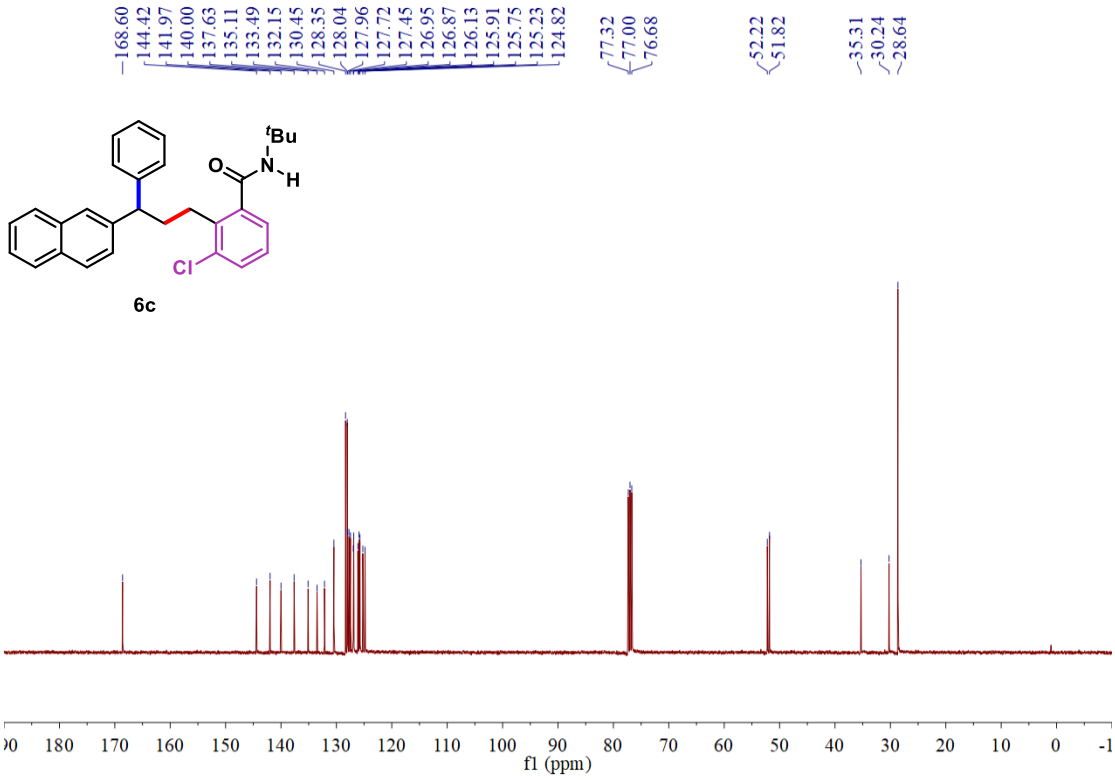


6b

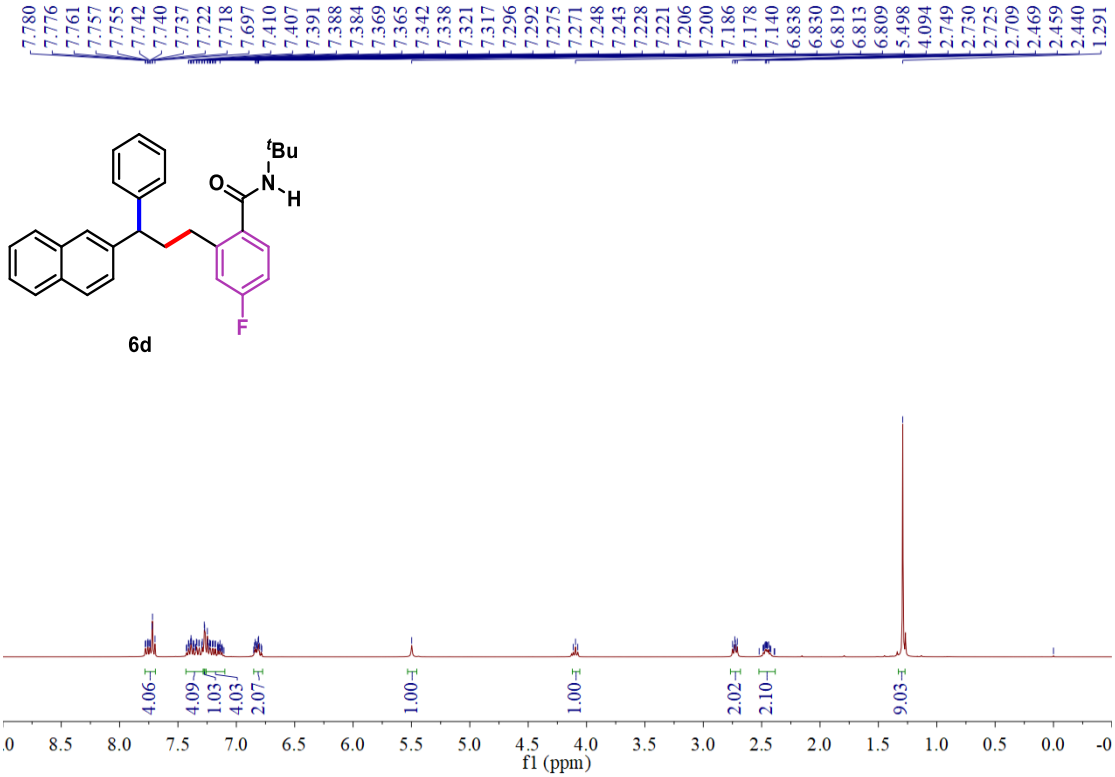
^{1}H NMR (400 MHz, $CDCl_3$) of 6c



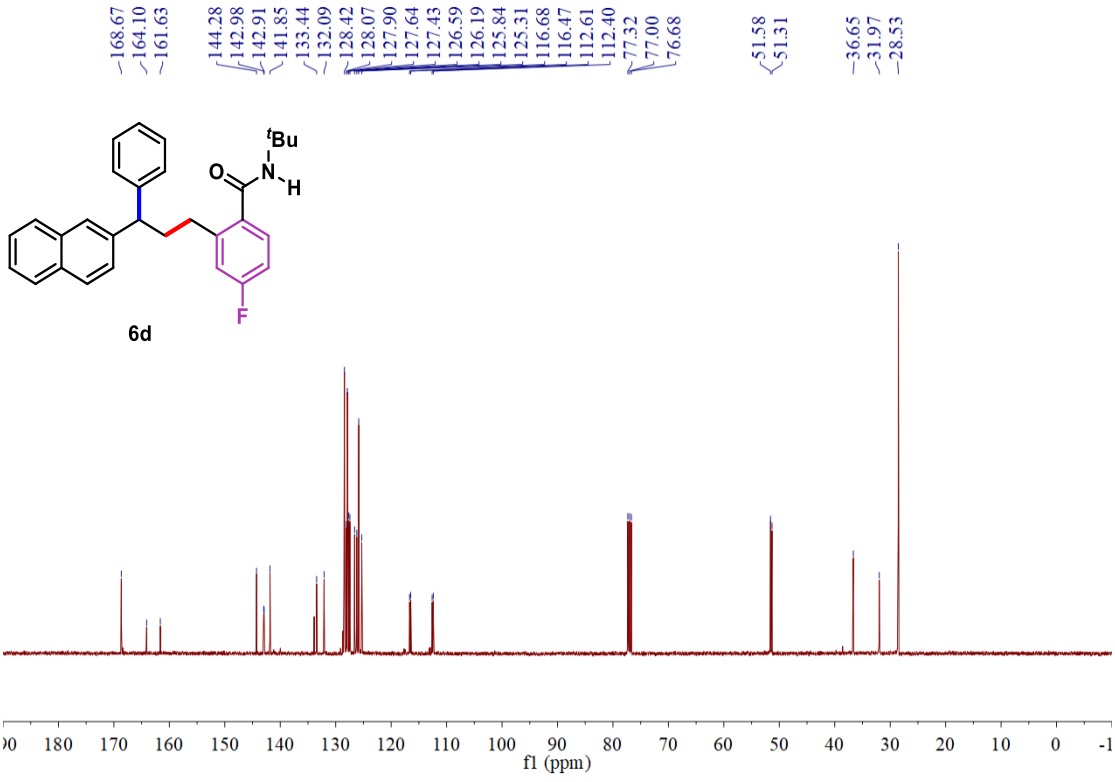
^{13}C NMR (101 MHz, $CDCl_3$) of 6c



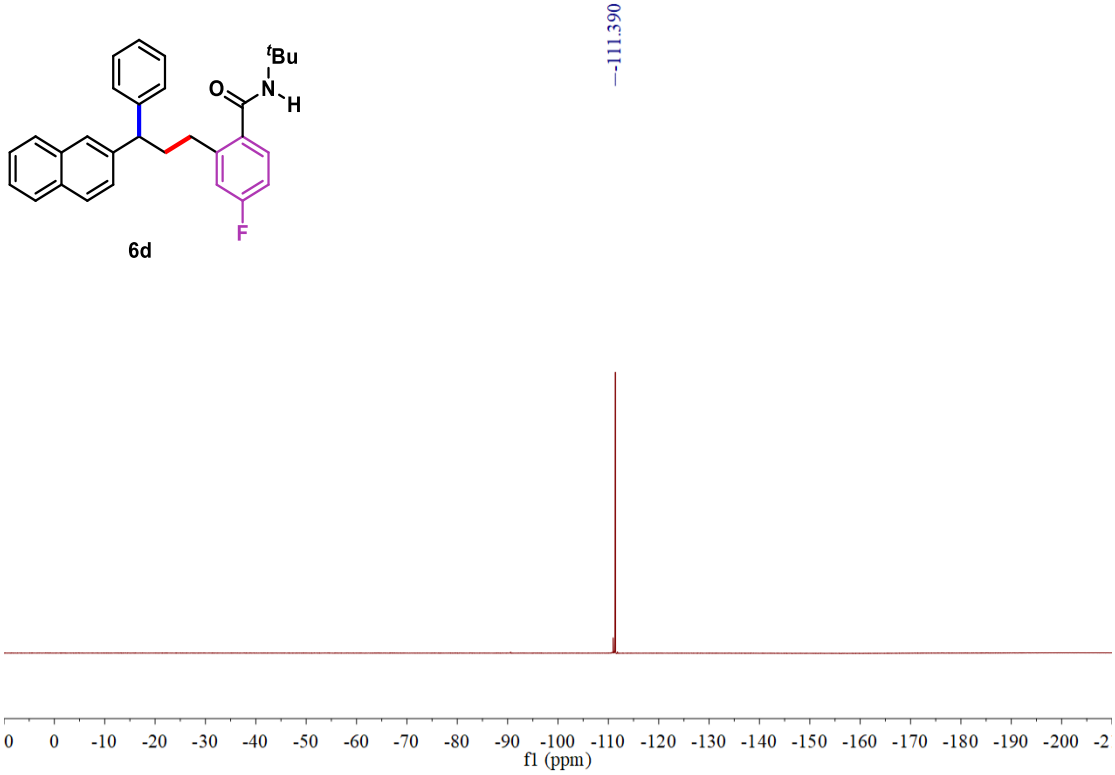
^{1}H NMR (400 MHz, $CDCl_3$) of 6d



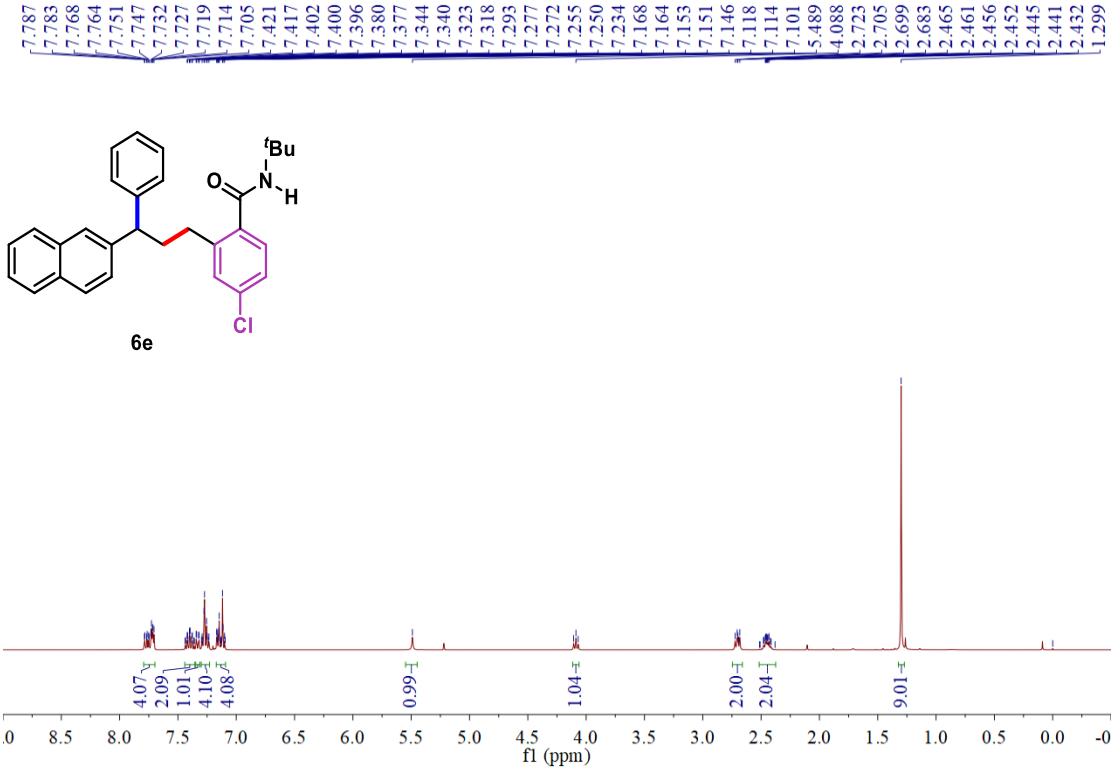
^{13}C NMR (101 MHz, $CDCl_3$) of 6d



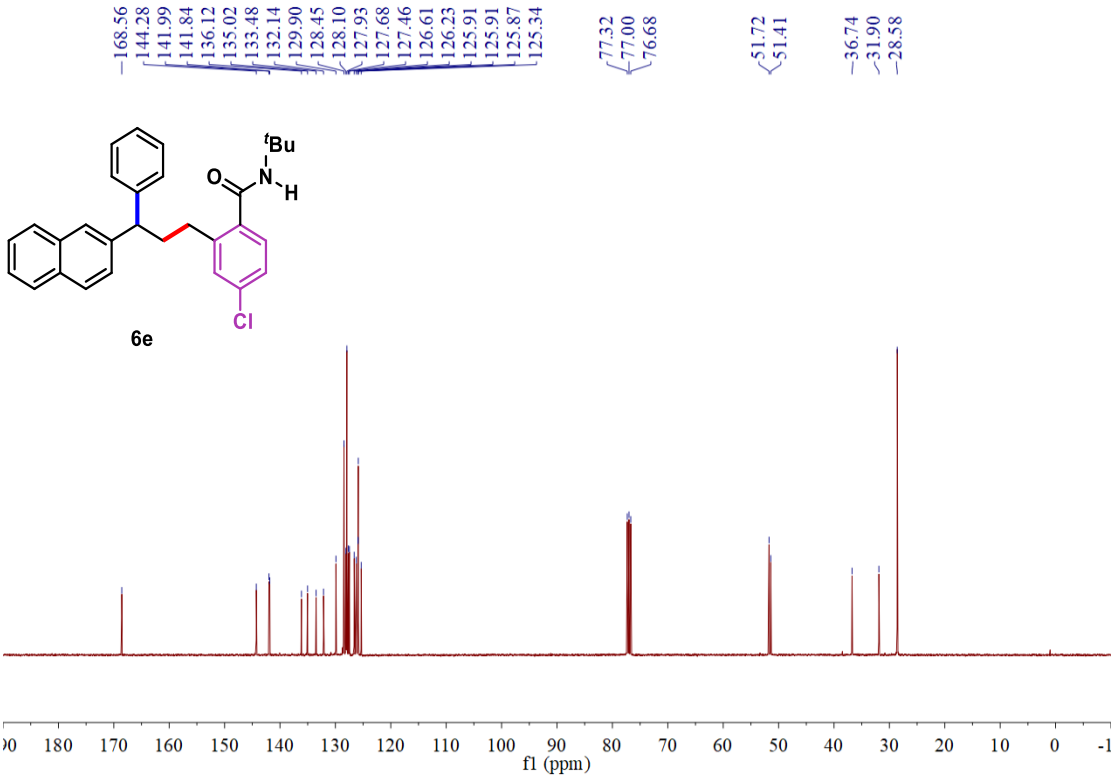
^{19}F NMR (376 MHz, $CDCl_3$) of 6d



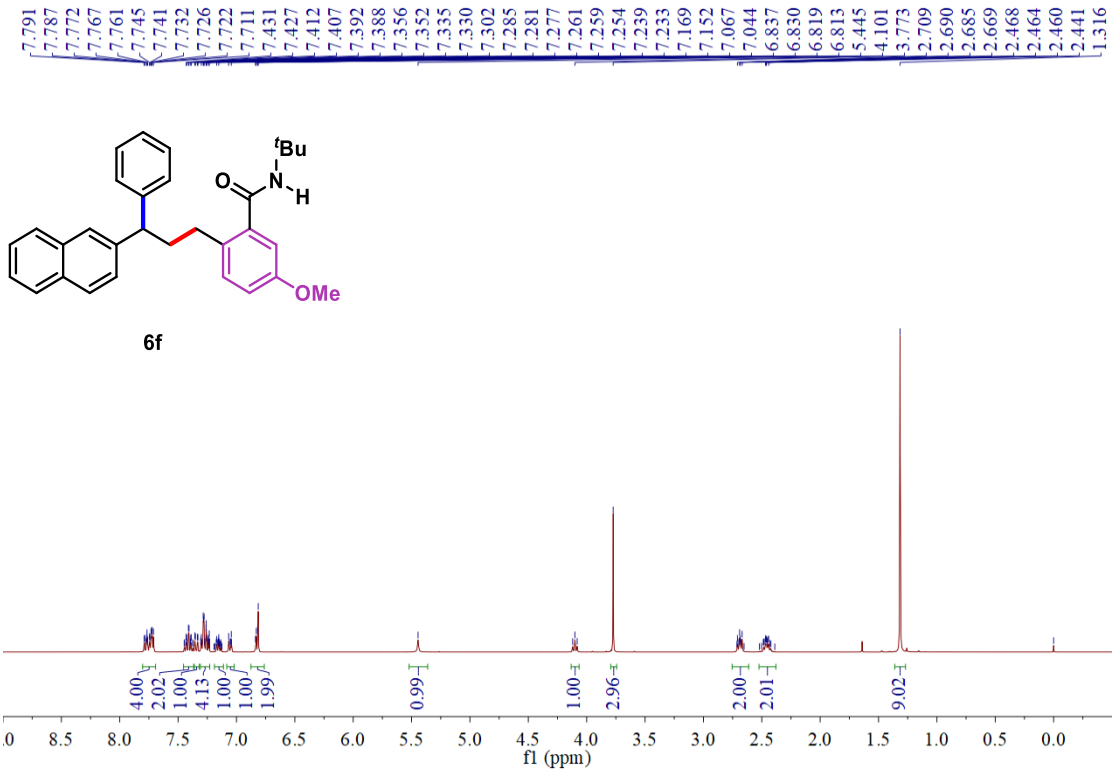
^{1}H NMR (400 MHz, $CDCl_3$) of 6e



^{13}C NMR (101 MHz, $CDCl_3$) of 6e

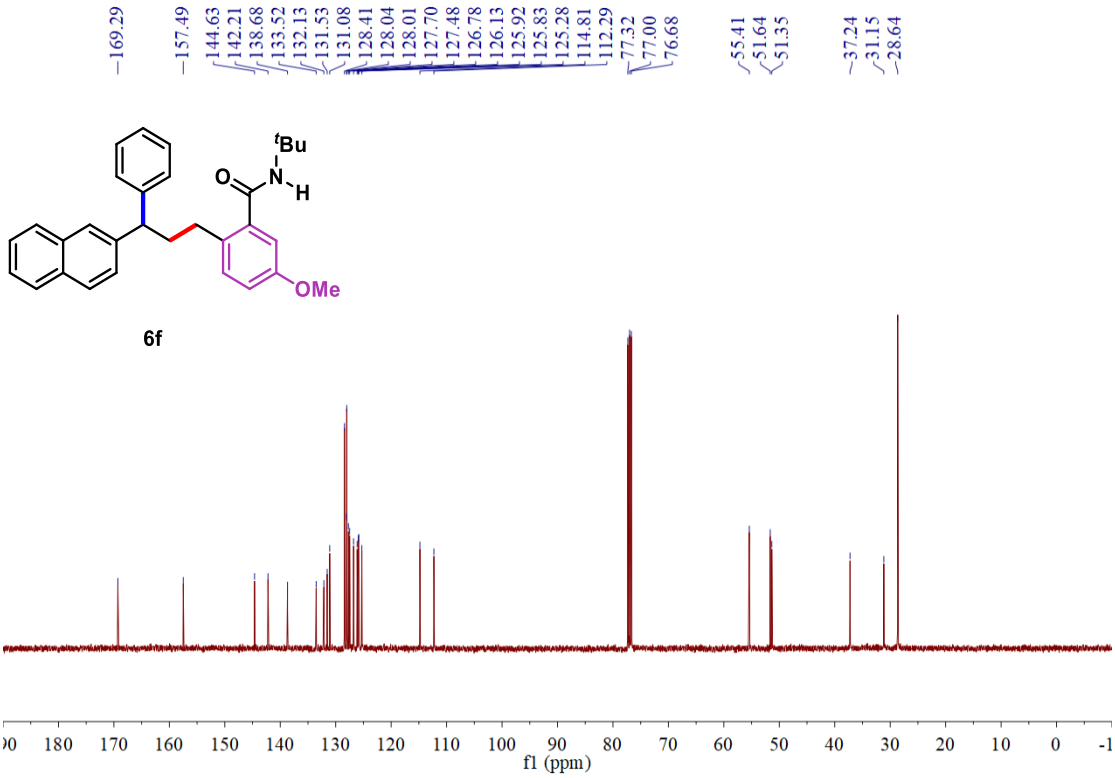


^{1}H NMR (400 MHz, $CDCl_3$) of 6f



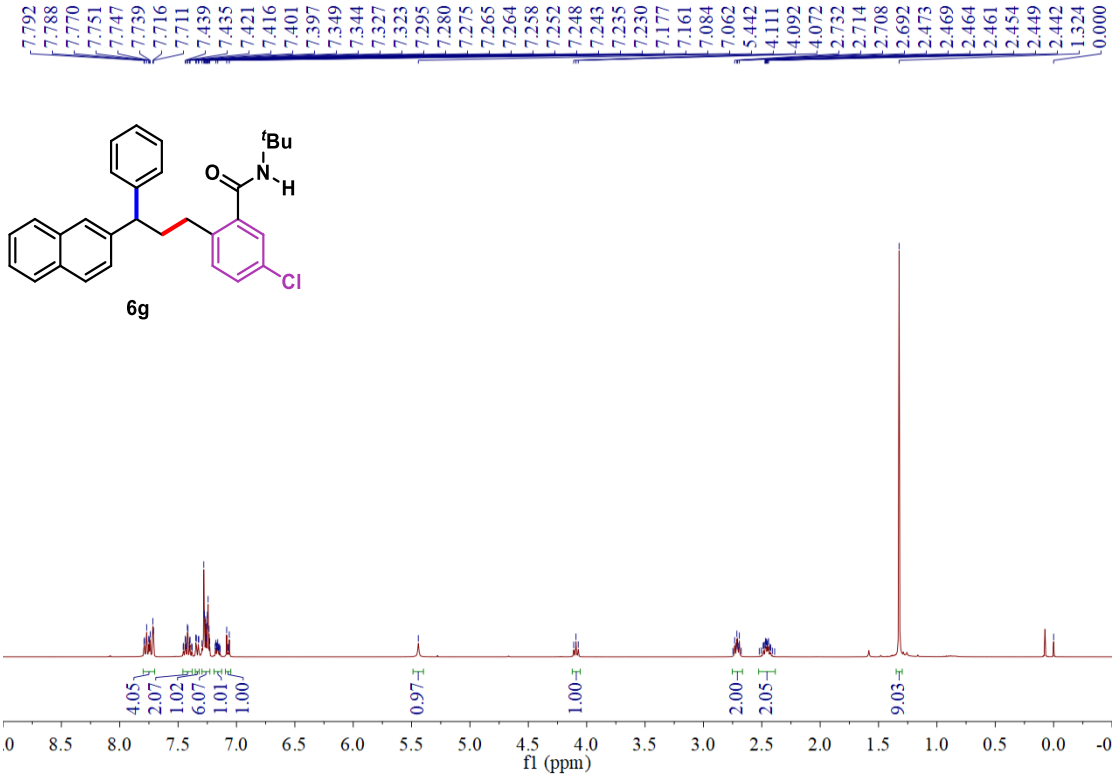
6f

^{13}C NMR (101 MHz, $CDCl_3$) of 6f

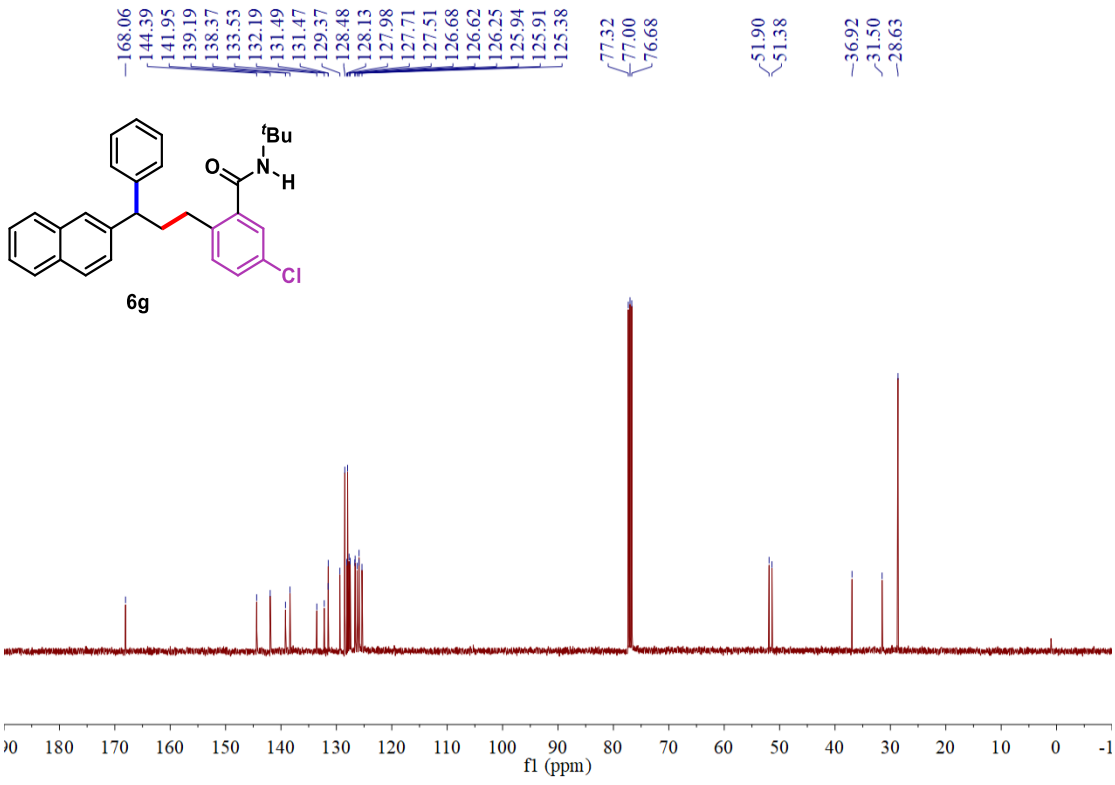


6f

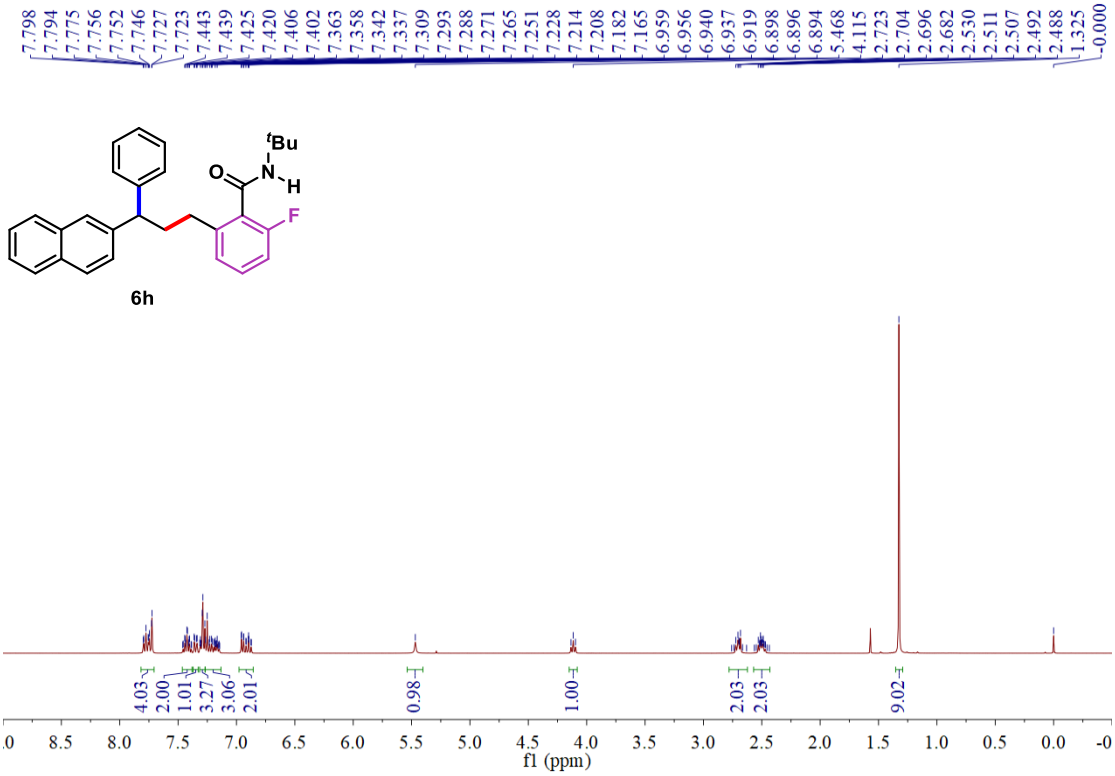
^{1}H NMR (400 MHz, $CDCl_3$) of 6g



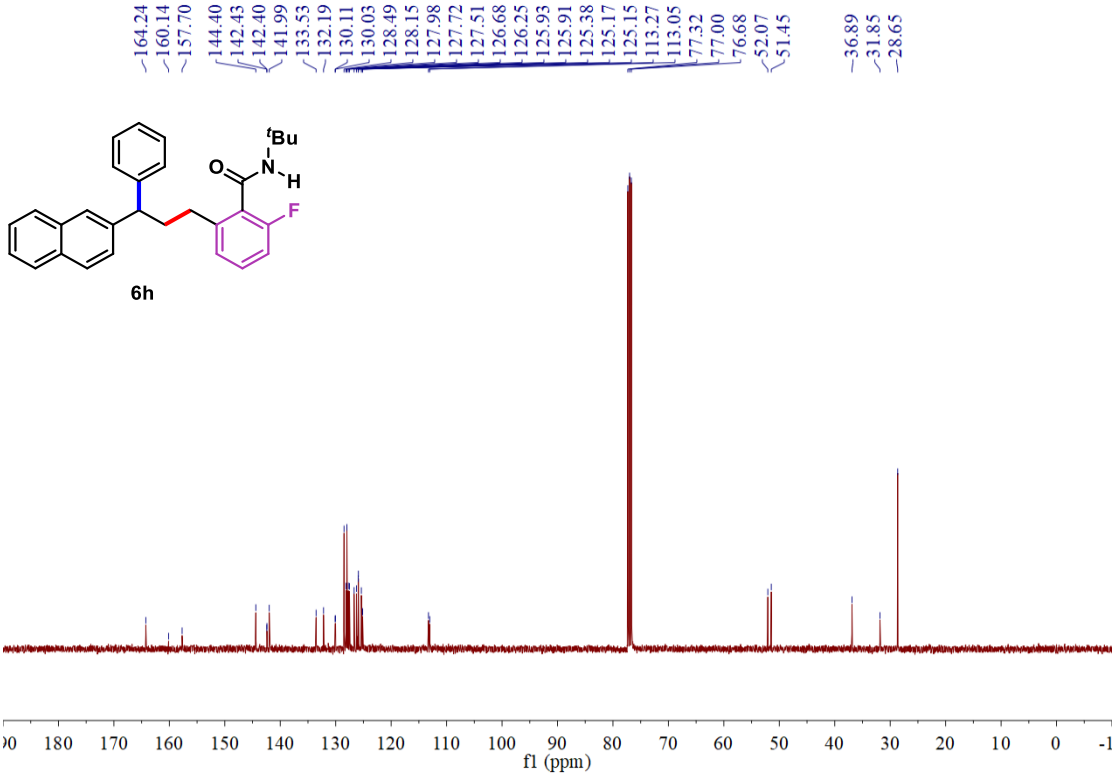
^{13}C NMR (101 MHz, $CDCl_3$) of 6g



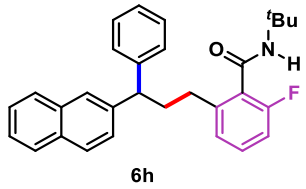
^{1}H NMR (400 MHz, $CDCl_3$) of 6h



^{13}C NMR (101 MHz, $CDCl_3$) of 6h

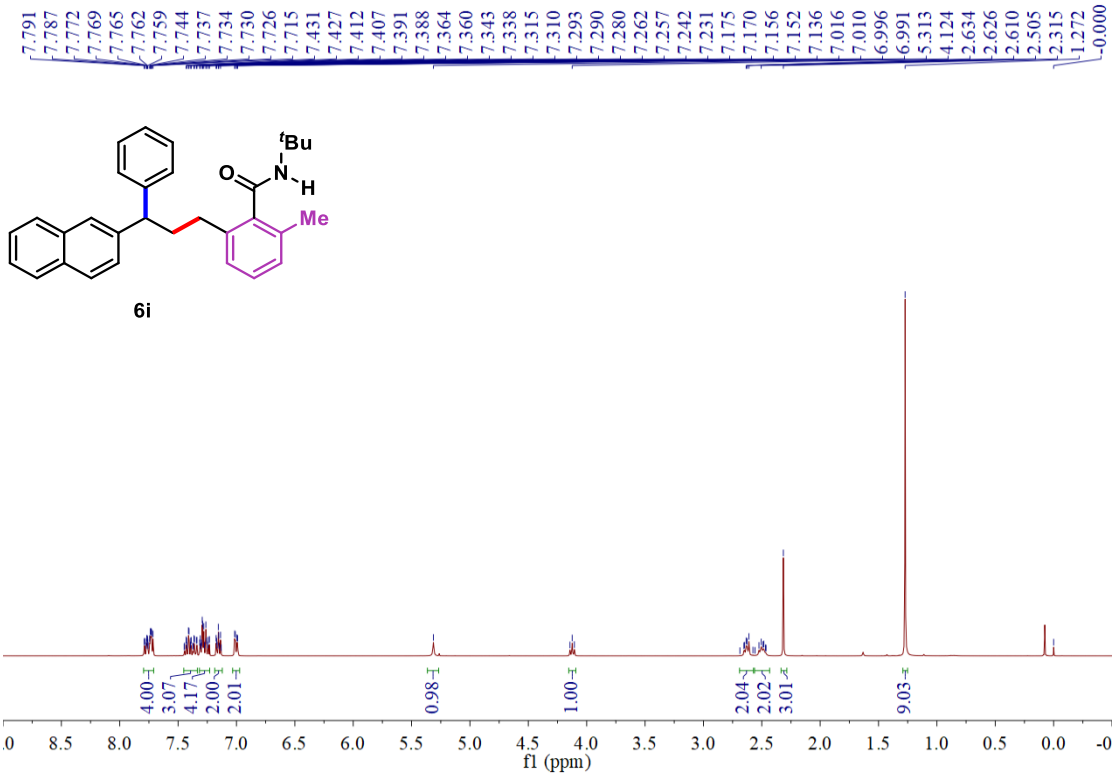


^{19}F NMR (376 MHz, $CDCl_3$) of 6h

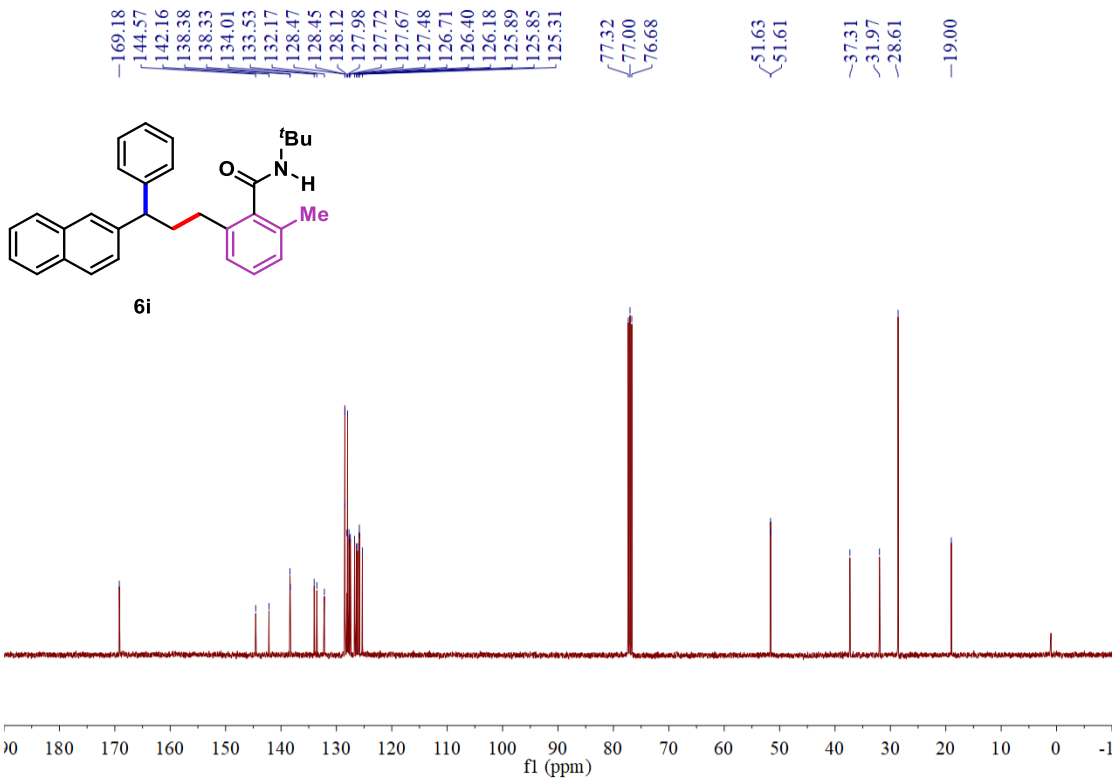


6h

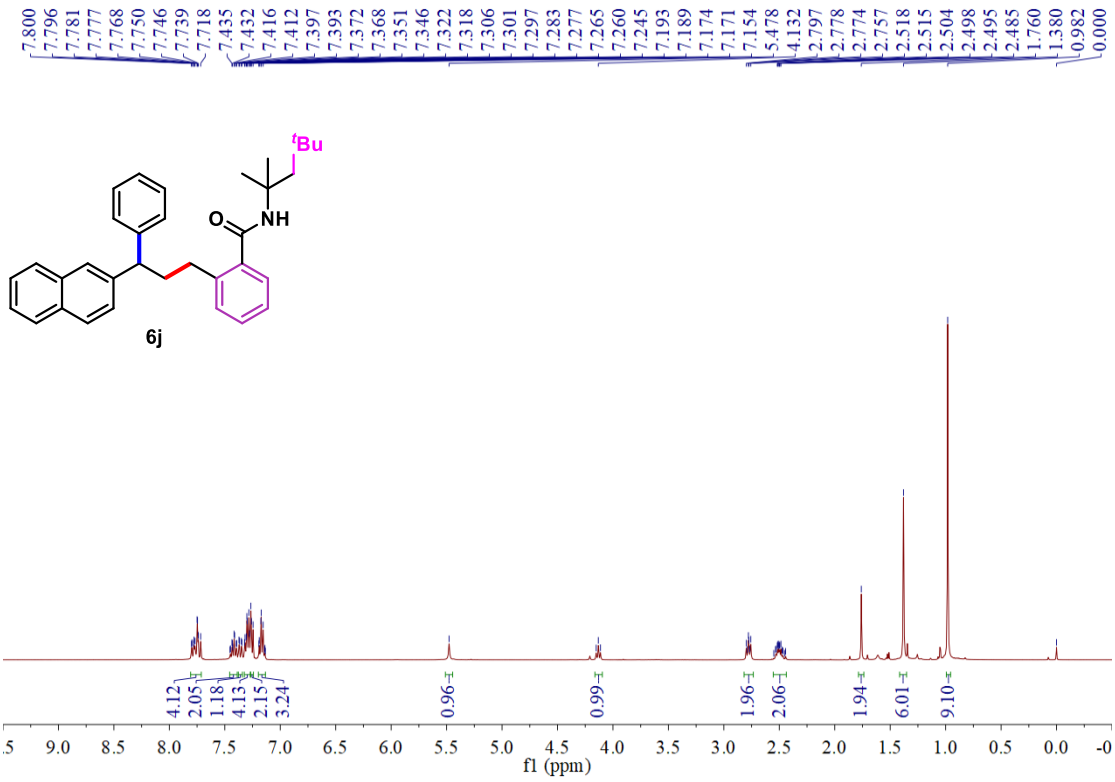
^{1}H NMR (400 MHz, $CDCl_3$) of 6i



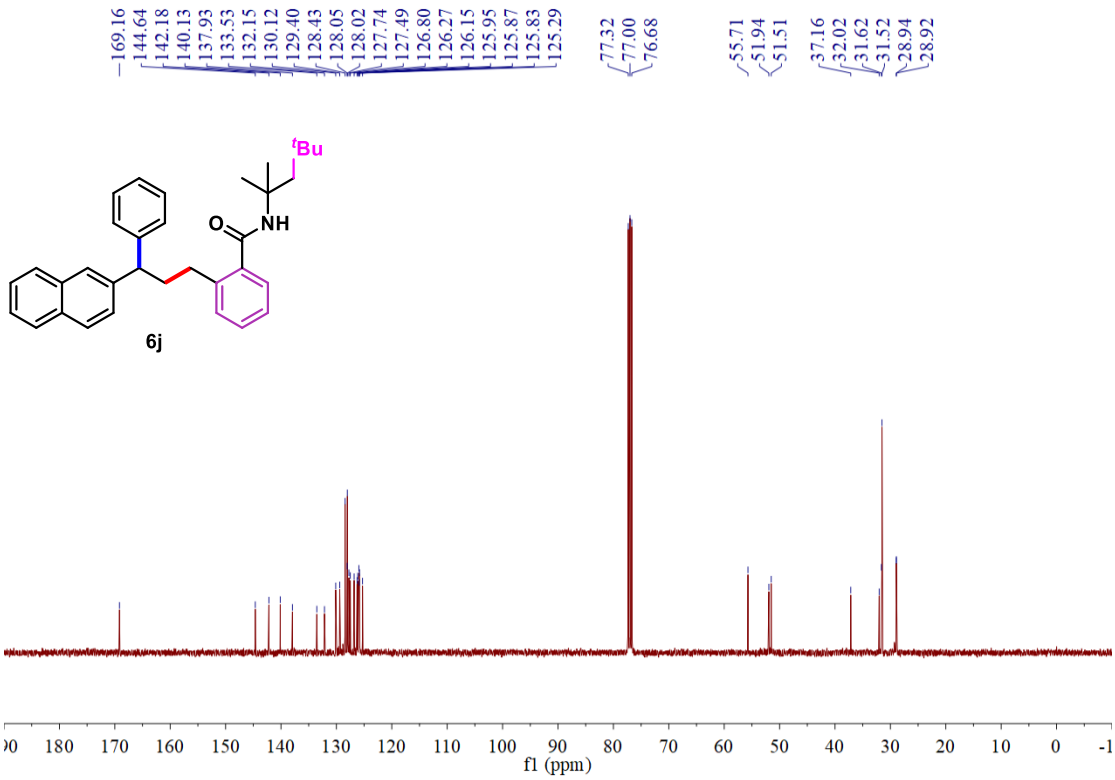
^{13}C NMR (101 MHz, $CDCl_3$) of 6i



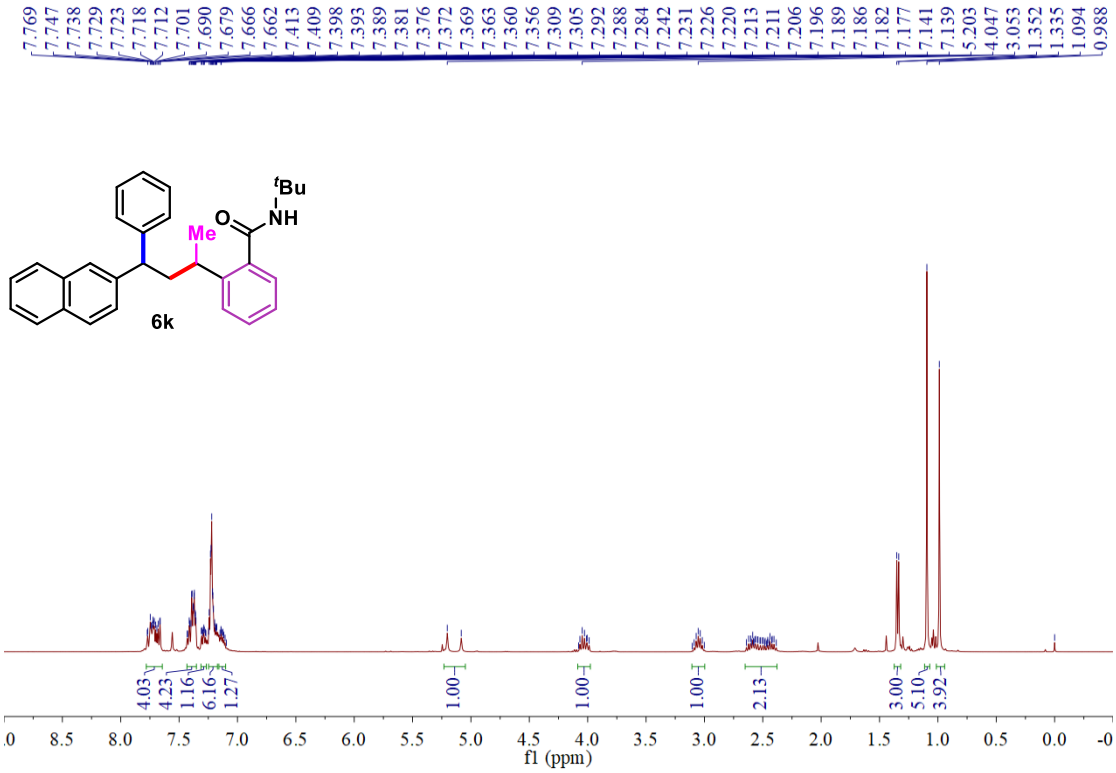
^{1}H NMR (400 MHz, $CDCl_3$) of 6j



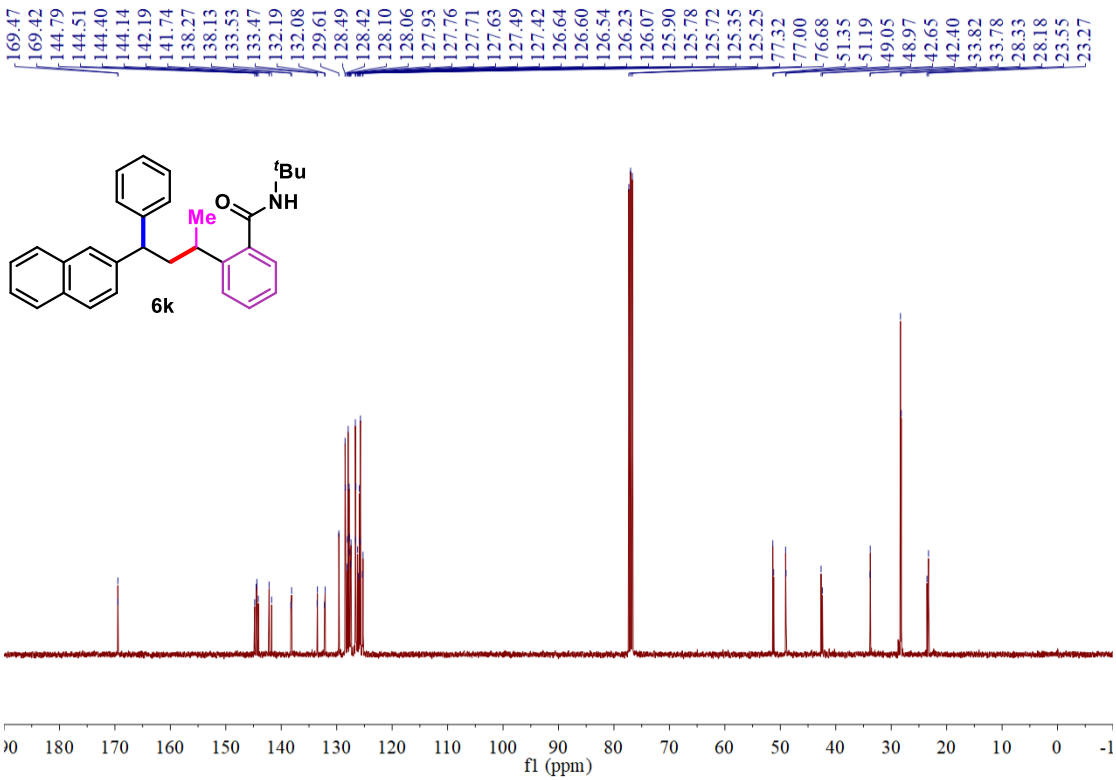
^{13}C NMR (101 MHz, $CDCl_3$) of 6j



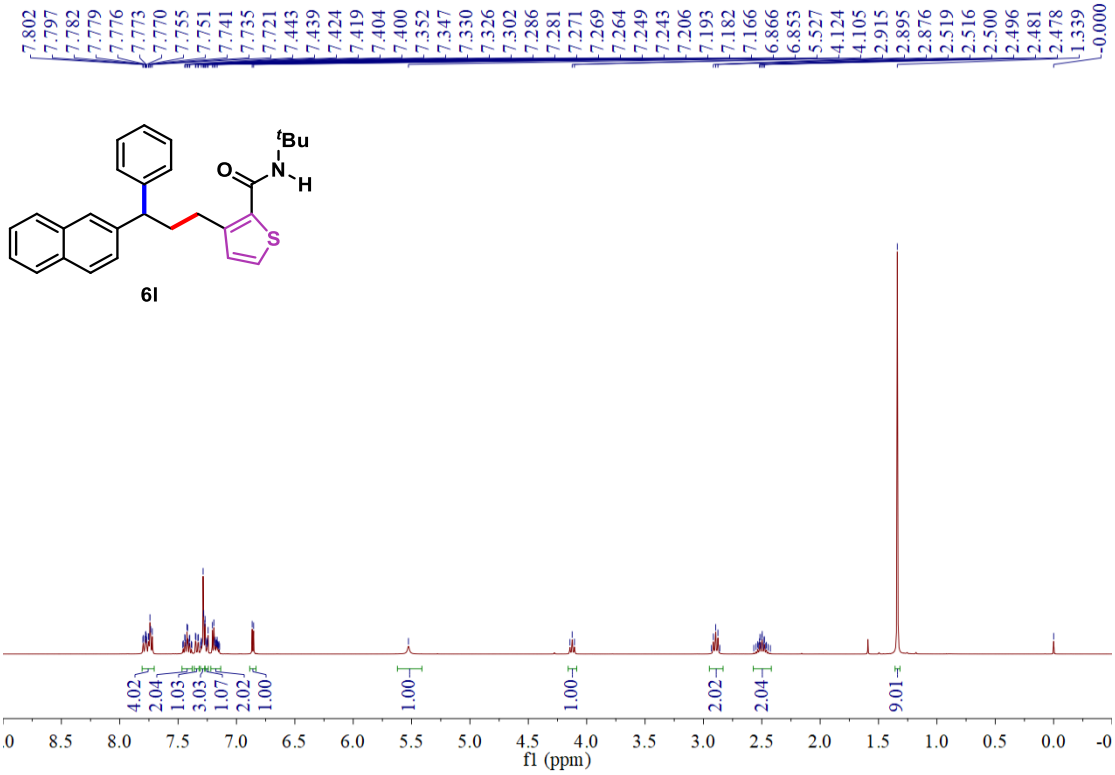
^{1}H NMR (400 MHz, CDCl3) of 6k



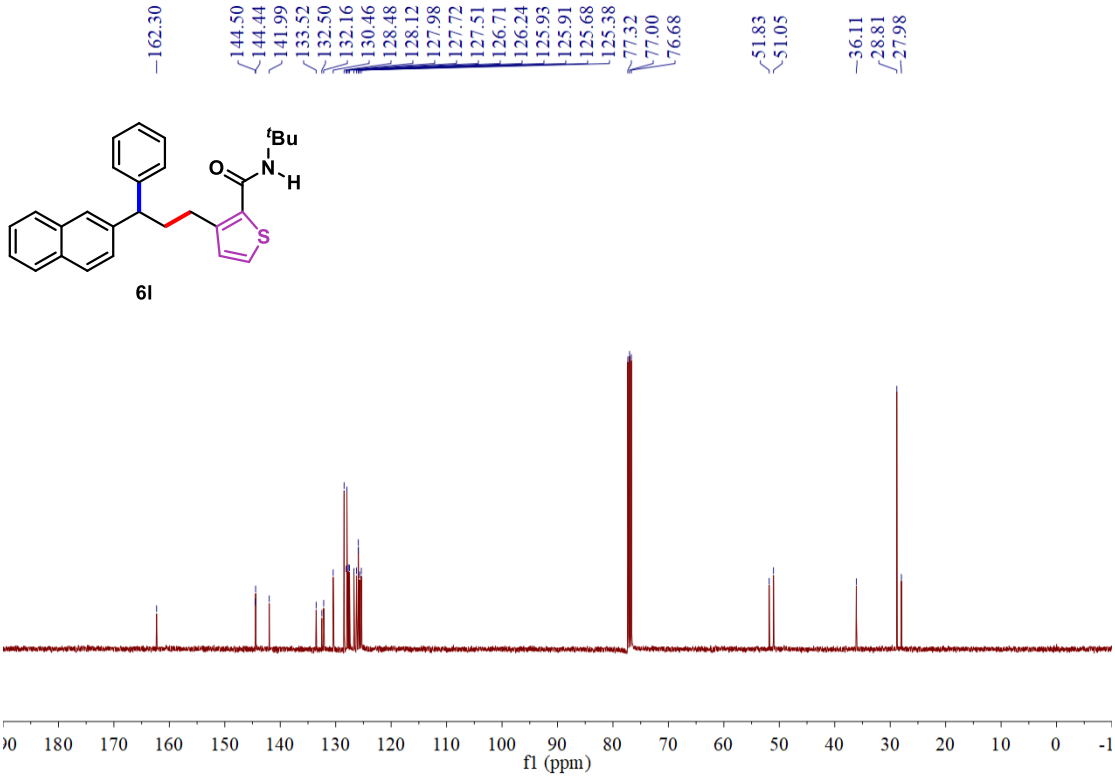
^{13}C NMR (101 MHz, CDCl3) of 6k



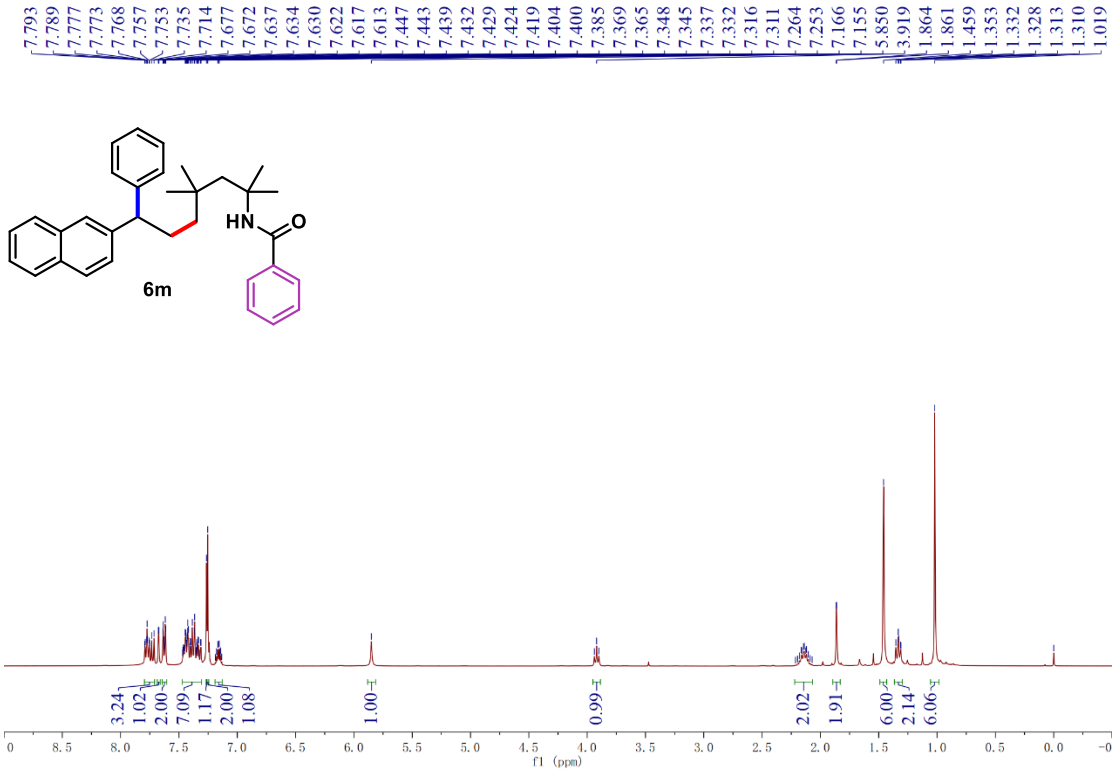
^{1}H NMR (400 MHz, $CDCl_3$) of 6l



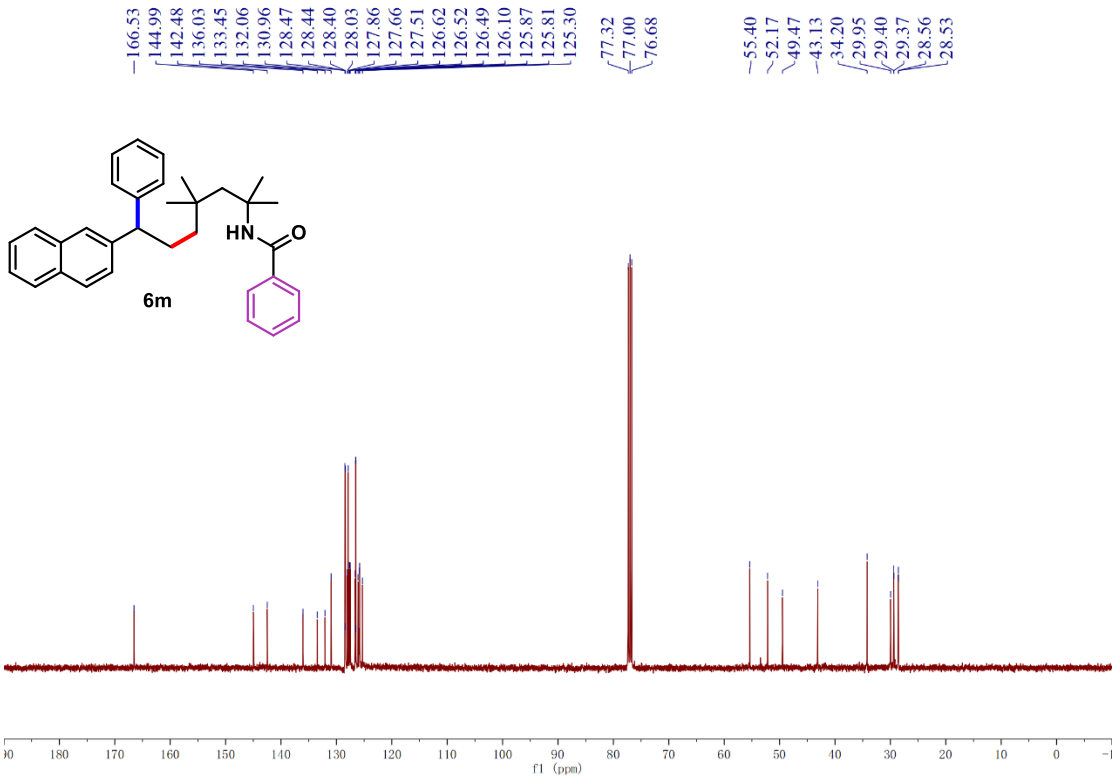
^{13}C NMR (101 MHz, $CDCl_3$) of 6l



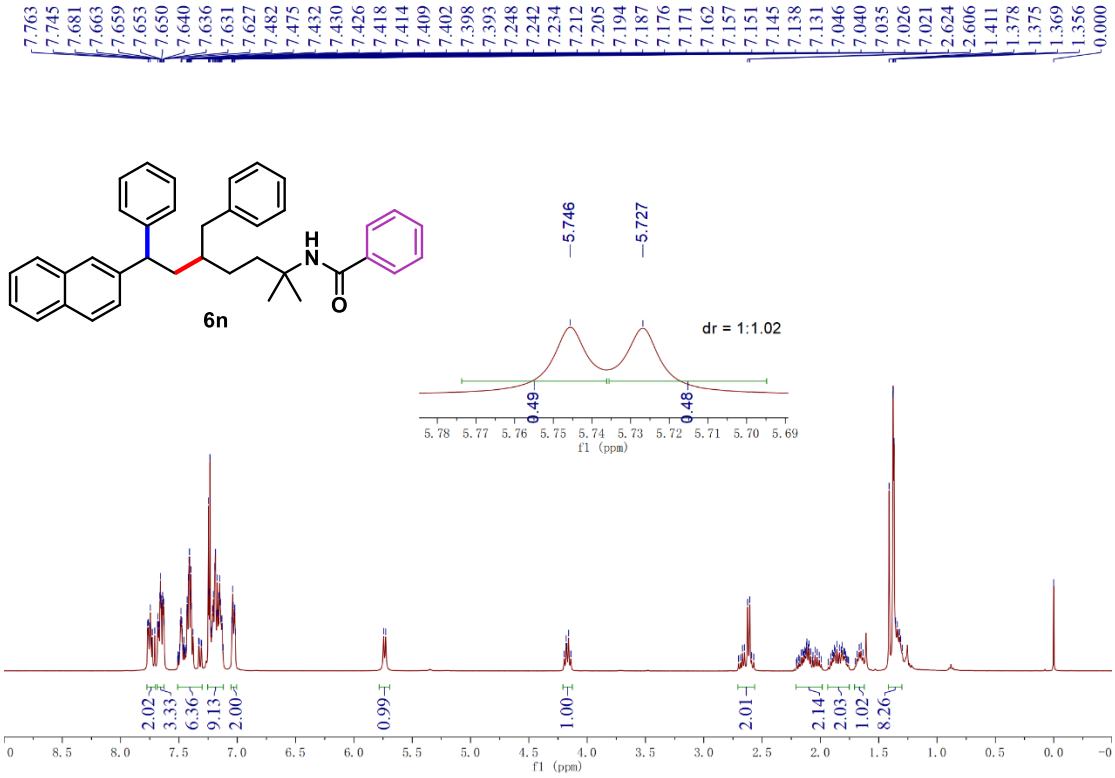
^{1}H NMR (400 MHz, $CDCl_3$) of 6m



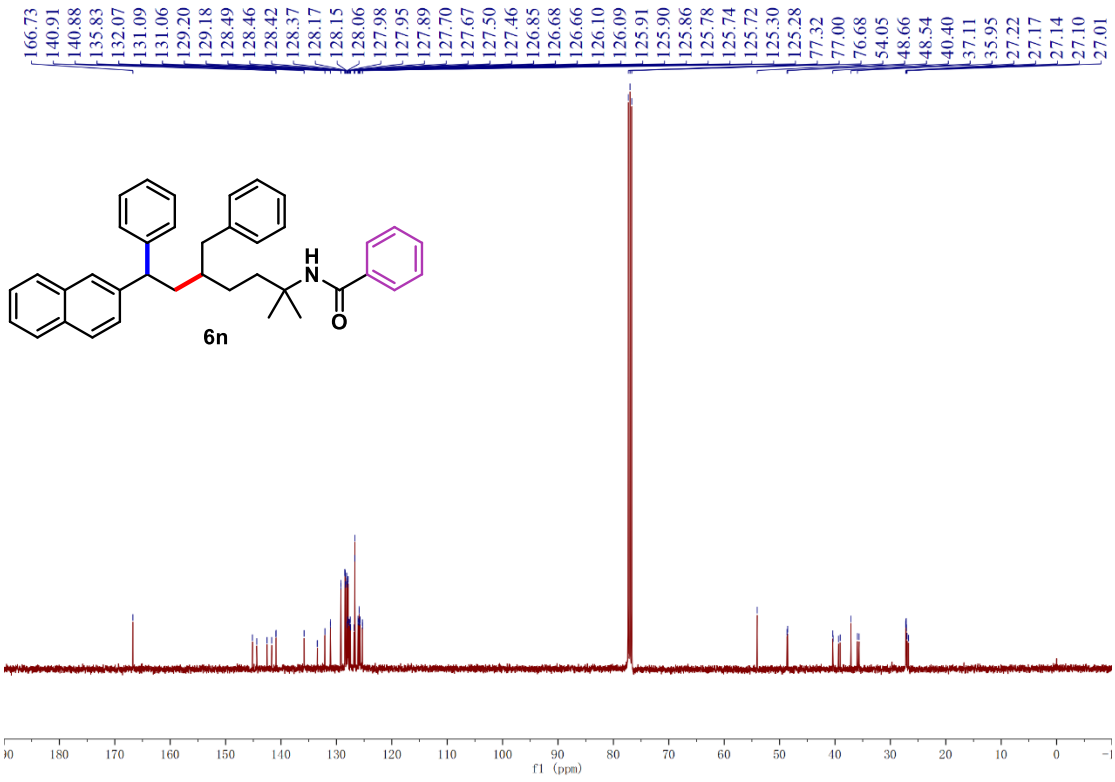
^{13}C NMR (101 MHz, $CDCl_3$) of 6m



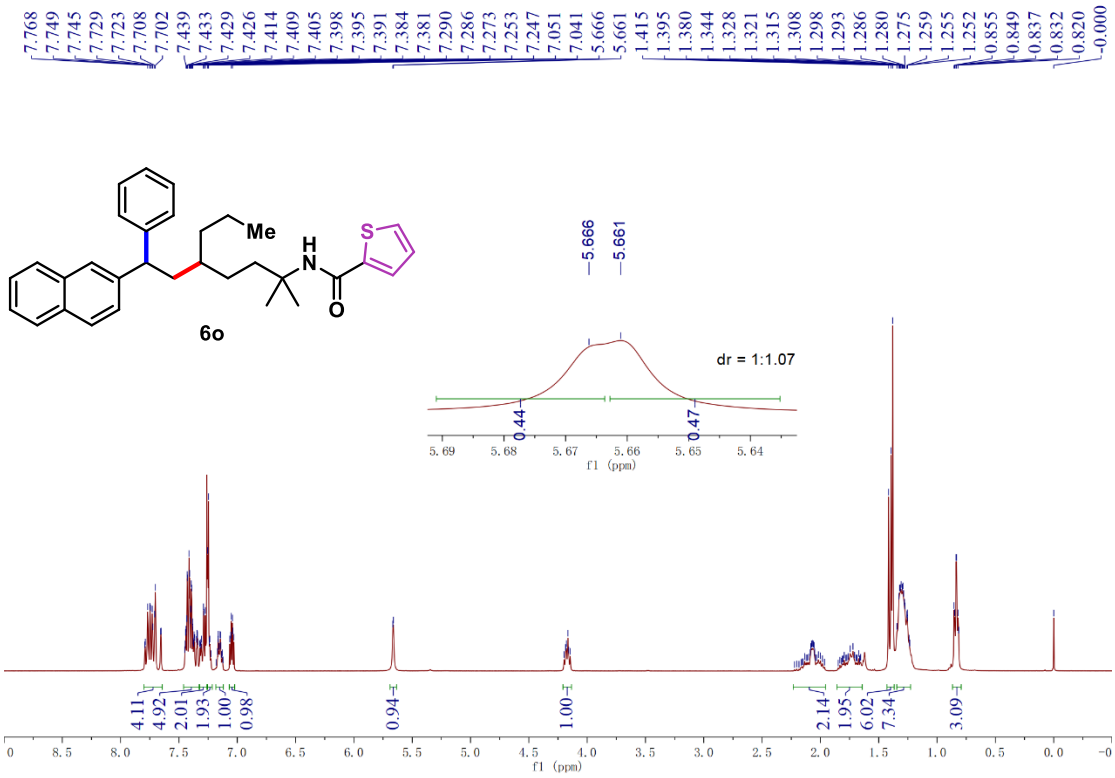
^{1}H NMR (400 MHz, $CDCl_3$) of 6n



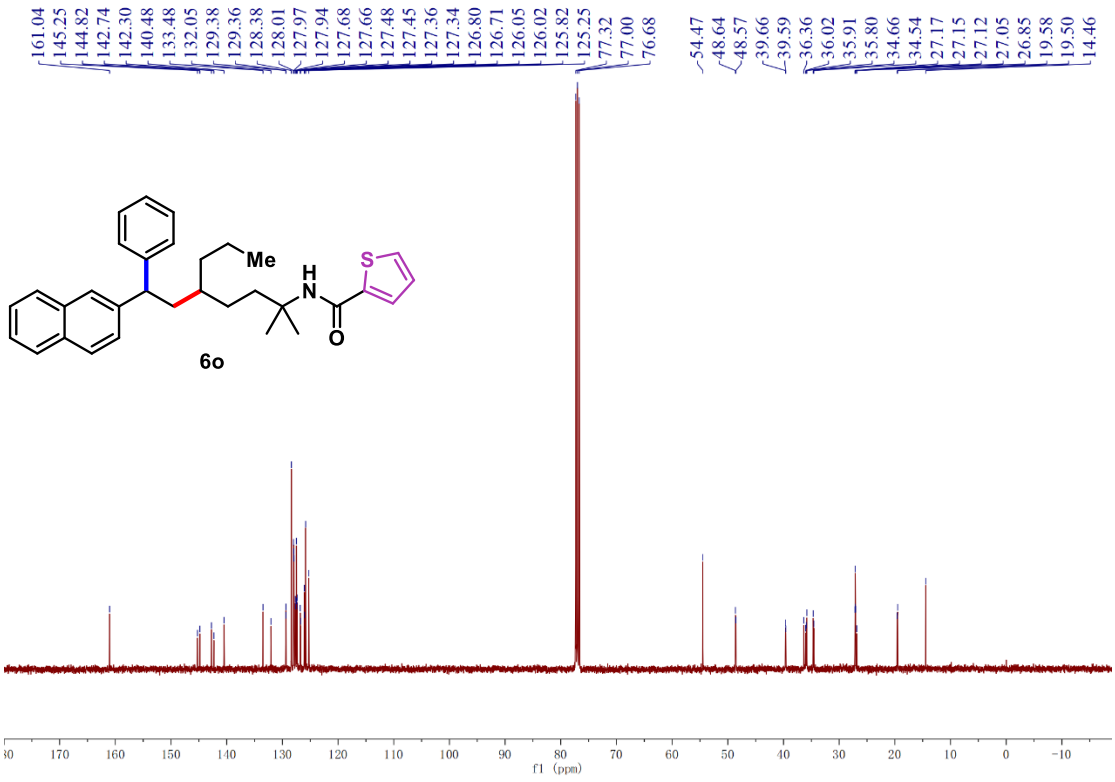
^{13}C NMR (101 MHz, $CDCl_3$) of 6n



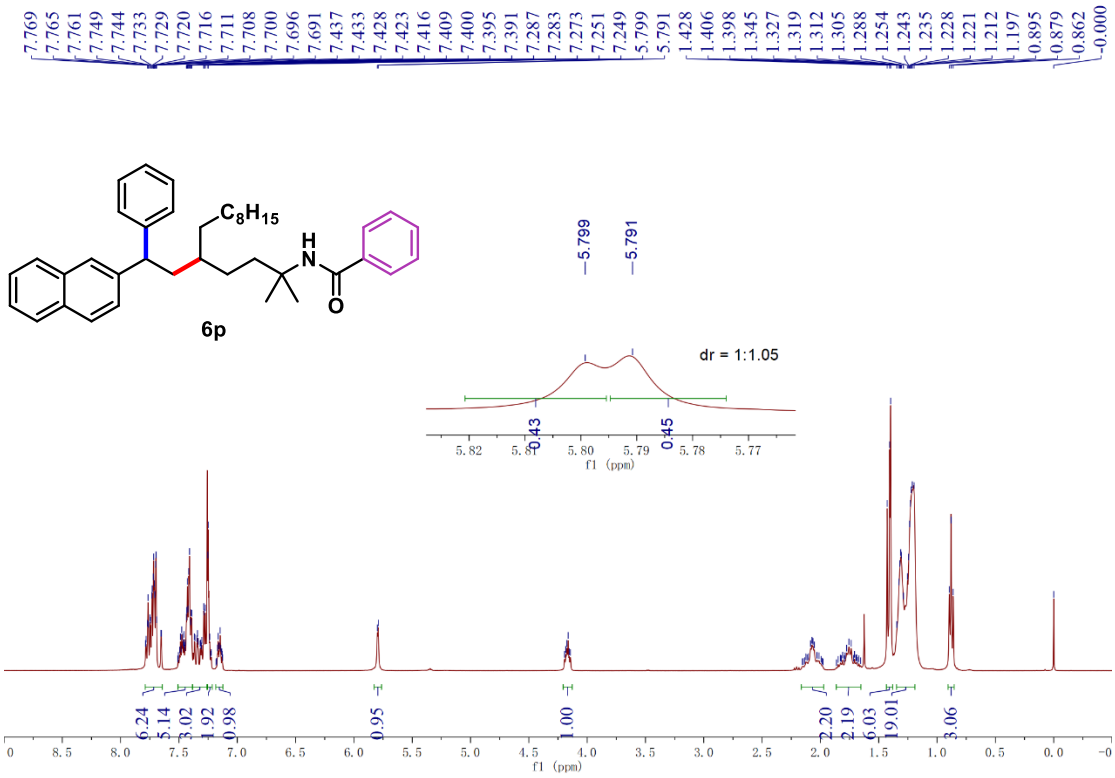
^{1}H NMR (400 MHz, $CDCl_3$) of 6o



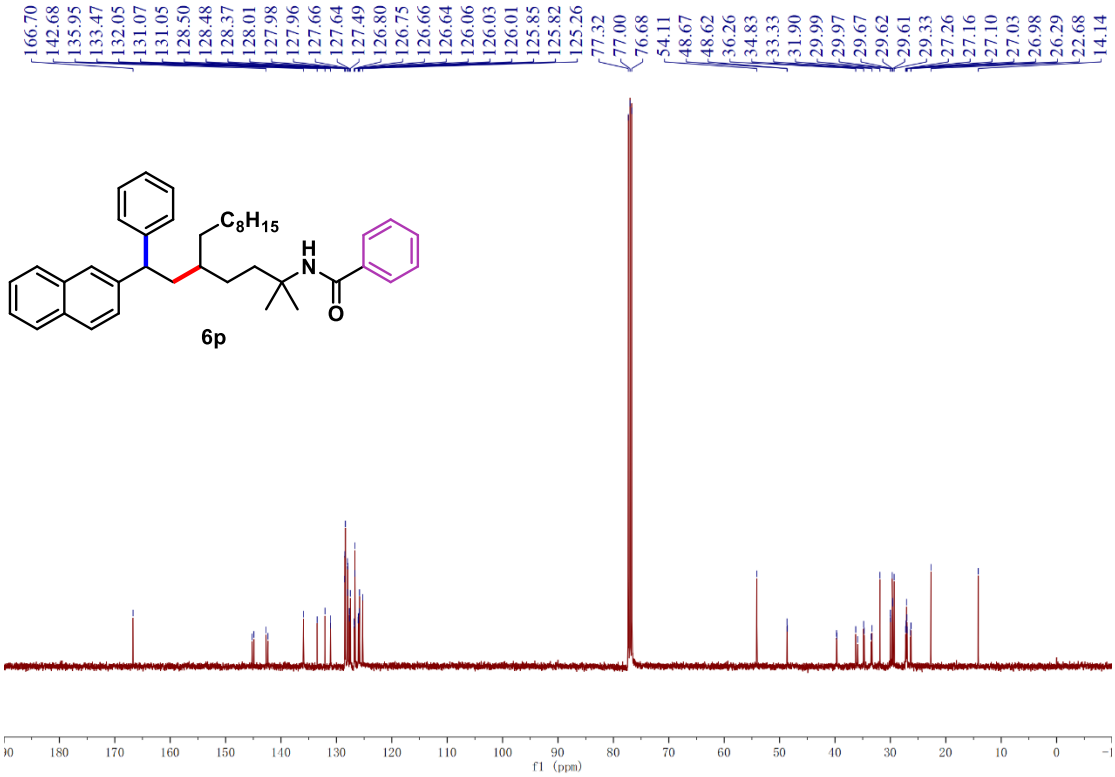
^{13}C NMR (101 MHz, $CDCl_3$) of 6o



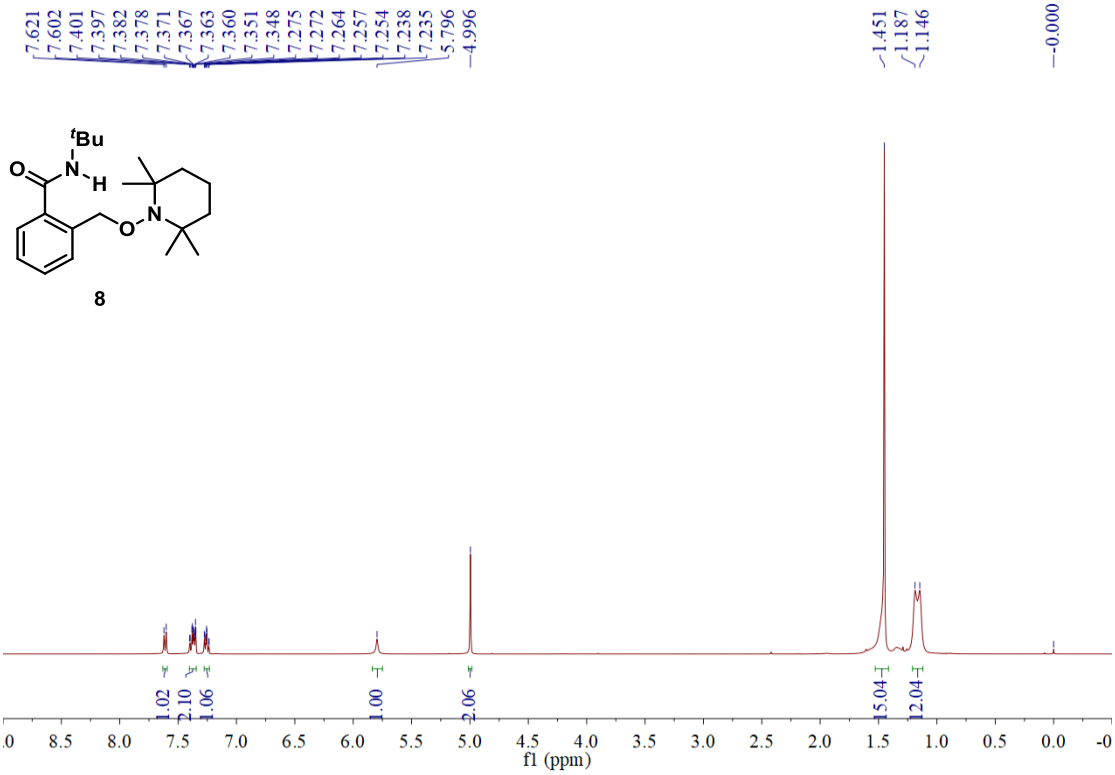
^{1}H NMR (400 MHz, $CDCl_3$) of 6p



^{13}C NMR (101 MHz, $CDCl_3$) of 6p

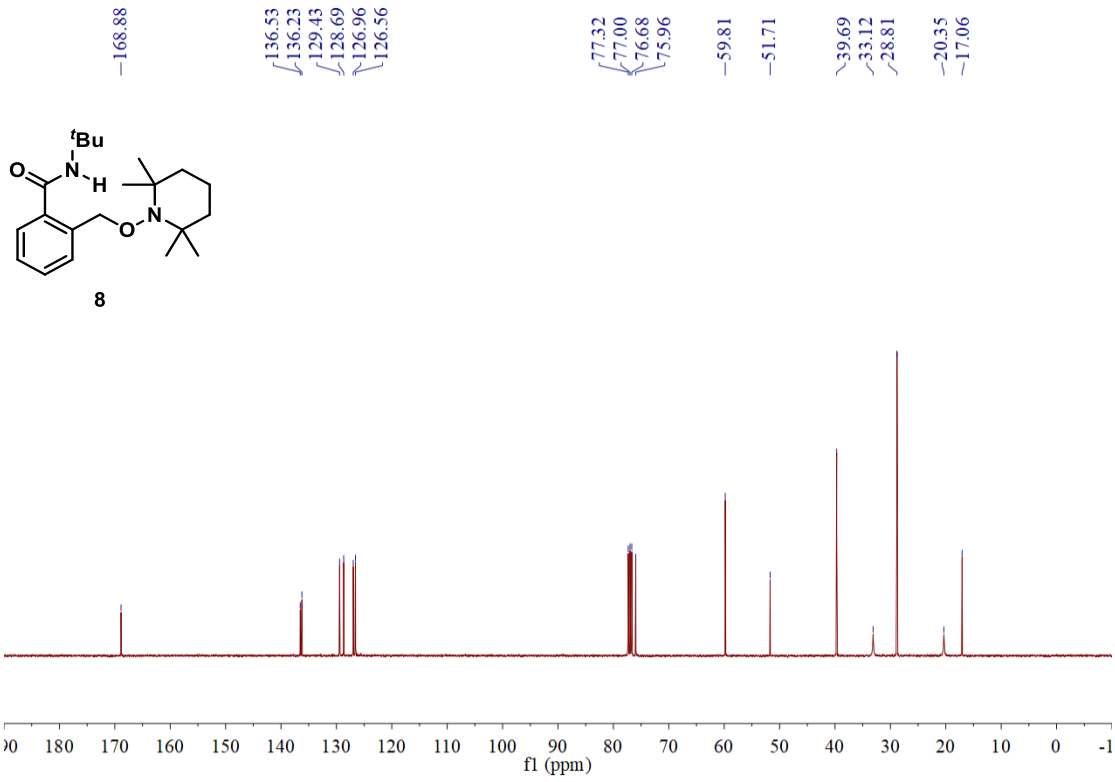


^{1}H NMR (400 MHz, $CDCl_3$) of 8



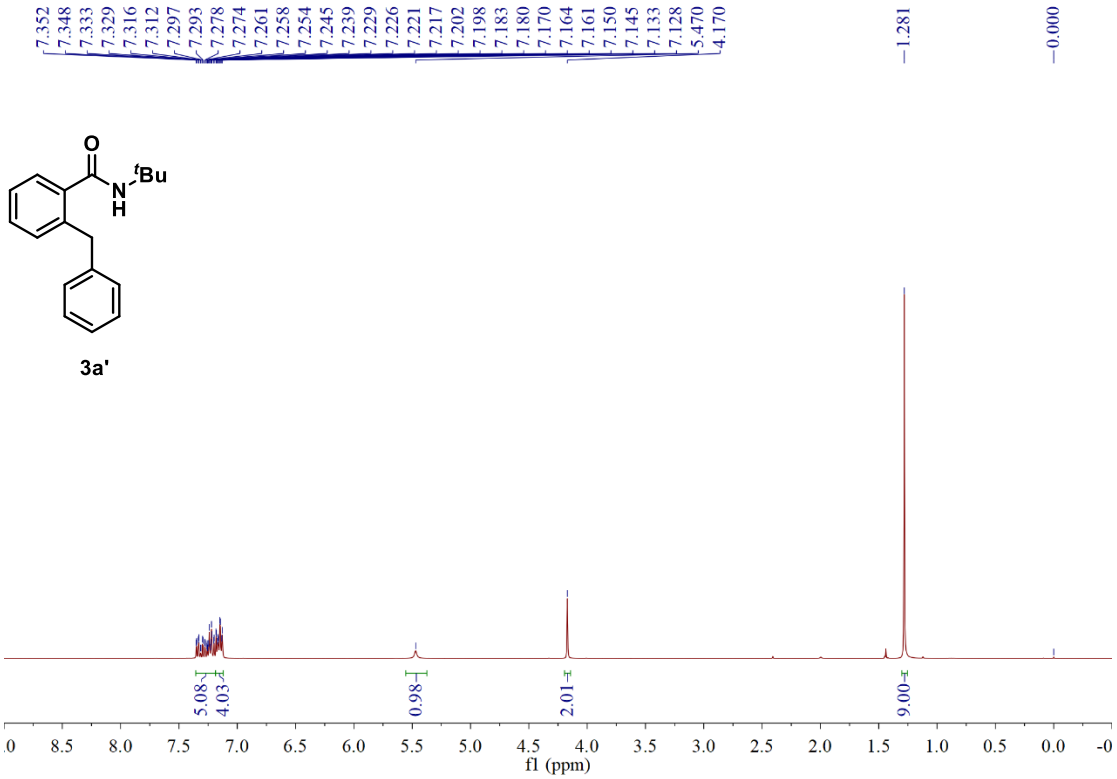
8

^{13}C NMR (101 MHz, $CDCl_3$) of 8



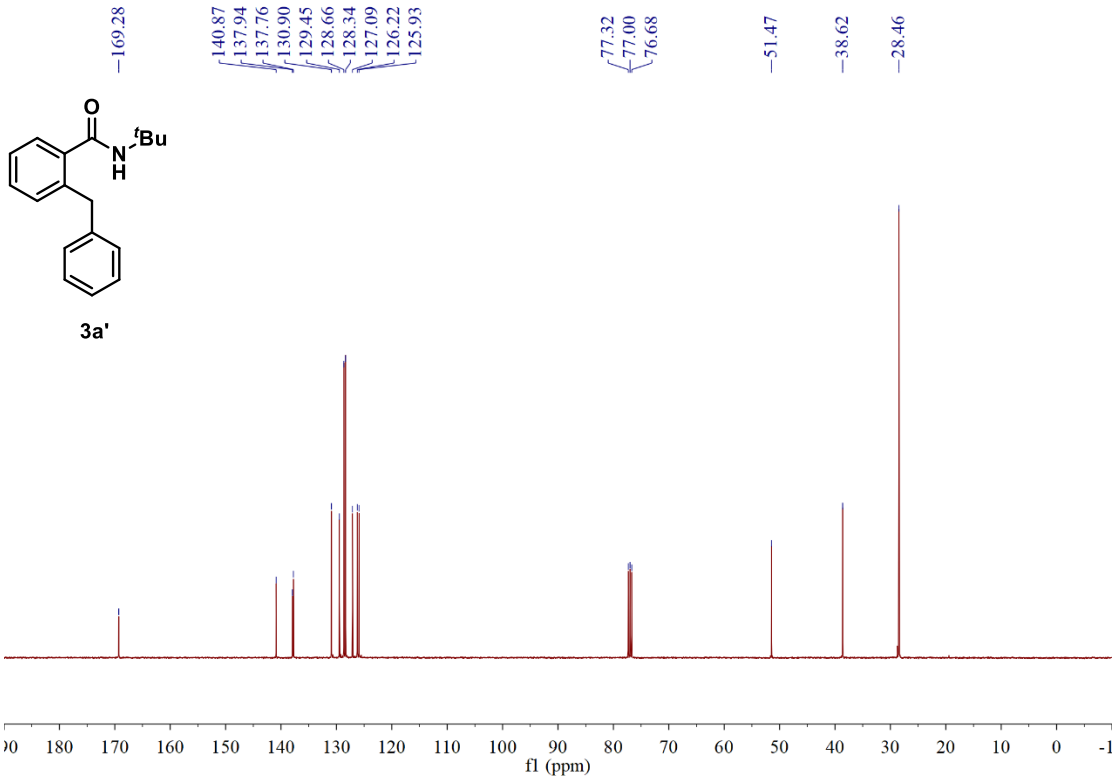
8

^{1}H NMR (400 MHz, $CDCl_3$) of 3a'



3a'

^{13}C NMR (101 MHz, $CDCl_3$) of 3a'



3a'