Supporting Information

Photoredox-Catalyzed Three-Component Alkylation of Glycine Derivatives and Peptides *via* a Site-Selective 1,5-Hydrogen Atom Transfer Cascade

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1. General Information

Unless otherwise specified, materials were purchased from commercial suppliers and used without further purification. All manipulations were performed in a dried sealed tube equipped with a magnetic stir bar under an argon atmosphere. Except for the specially mentioned dry solvent, all the solvents were treated according to general methods. All the reactions were monitored by TLC and were visualized using UV light. The product purification was done using silica gel column chromatography. TLC characterization was performed with precoated silica gel GF254 (0.2 mm), while column chromatography characterization was performed with silica gel (100-200 mesh). ^{1}H NMR and ^{13}C NMR spectra were recorded with tetramethylsilane (TMS, δ= 0.00 ppm) as the internal standard. ^{1}H NMR spectra were recorded at 400 Hz (Varian), and ^{13}C NMR spectra were recorded at 100 (Varian). ^{19}F NMR spectra were recorded at 376 MHz. Chemical shifts are reported in ppm downfield from $CDCl_3$ (δ= 7.26 ppm) for ^{1}H NMR, and chemical shifts for ^{13}C NMR spectra are reported in ppm relative to the central $CDCl_3$ (δ= 77.16 ppm). Coupling constants were given in Hz. The following notations were used: br-broad, s-singlet, ddoublet, t-triplet, q-quartet, m-multiplet, dd-doublet of doublet, dt-doublet of triplet, td-triplet of doublet, and ddd-doublet of doublet of doublet. Melting points were measured with a YRT-3 melting point apparatus (Shantou Keyi Instrument & Equipment Co., Ltd., Shantou, China). High-resolution mass spectra (HRMS) were recorded on a Bruker TOF Premier by the ESI method. Photochemical reaction was carried out under visible light irradiation by a blue LED at SSSTECH-LAL1CV 1.0 parallel reactor manufactured by Shanghai 3S Technology Co., Ltd was used in this system. The volume of the reaction tube is 10 ml. The blue LED's energy peak wavelength is 451 nm, peak width at half-height is 21 nm, irradiance@12 W is 49.2 mW/cm^2. The reaction vessel is a borosilicate glass test tube and the distance between it and the lamp is 0.5 cm, no filter applied. (Figure S1 and S2).

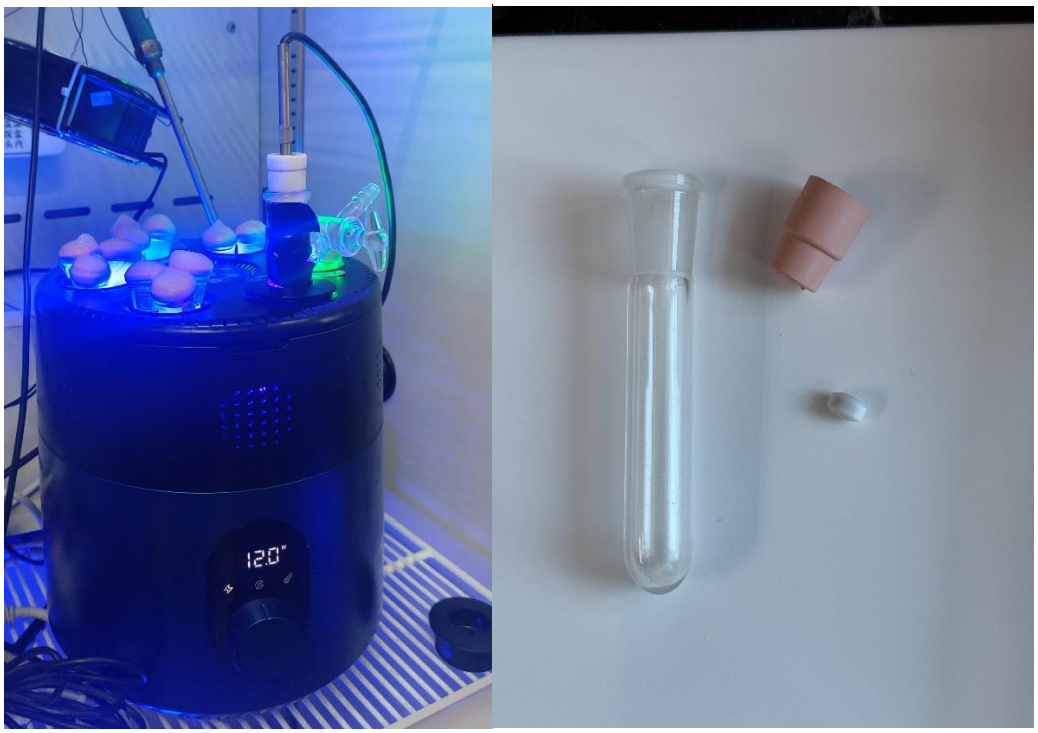


Figure S1. Photoreactor and reaction tube in this study

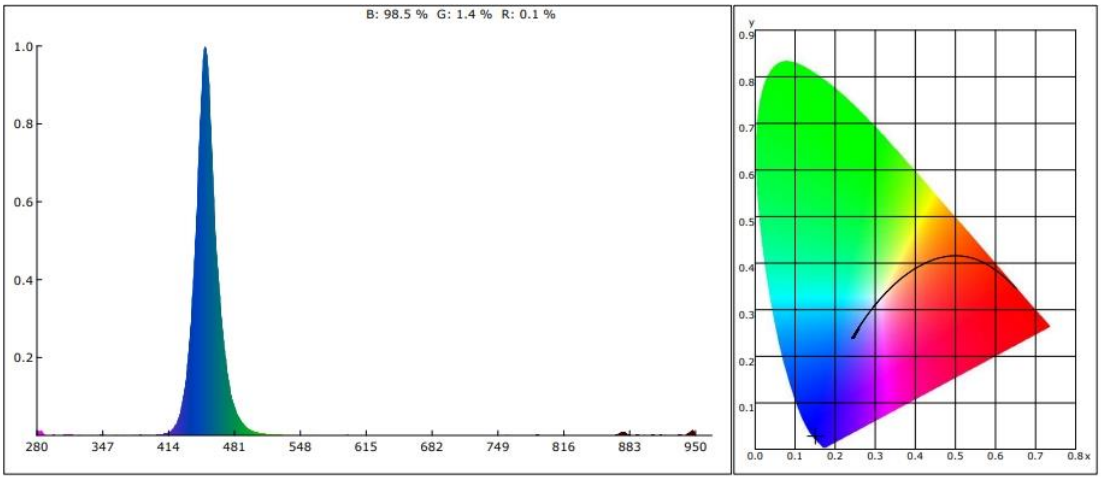
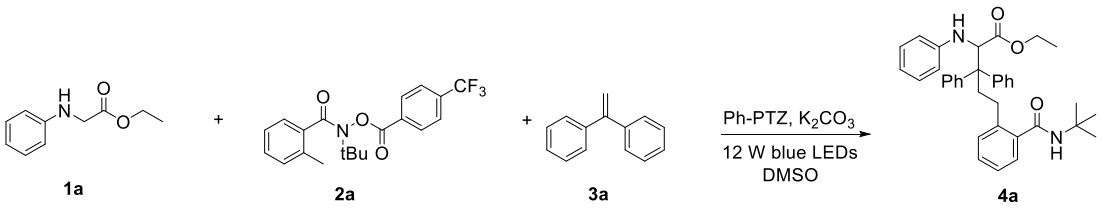


Figure S2. The spectrum of our lamp (blue LED)

2. Optimization of Reaction conditions

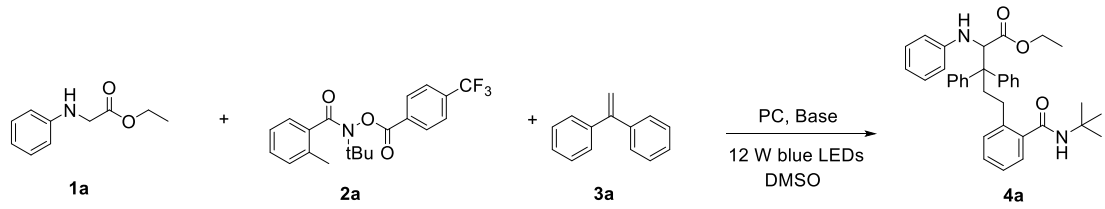
2.1 General Procedure for the synthesis of products 4 (4a as an example).



1a 2a 3a 4a

To an oven-dried 10 mL glass tube equipped with a stir bar, glycine derivative **1a** (0.05 mmol, 1.0 equiv.), hydroxamic acid **2a** (0.075 mmol, 1.5 equiv.), K_2CO_3 (0.1 mmol, 2 equiv.) and Ph-PTZ (5 mol%, 0.05 equiv.) were added. The tube was evacuated and back-filled with argon (three times), then sealed with rubber stopper and parafilm. Then, Ethene-1,1-diyldibenzene **3a** (0.15mmol, 3 equiv.) and anhydrous DMSO (1 mL, 0.05M) were added using syringes. The solution was then stirred at room temperature under the irradiation of 12 W blue LEDs (λ = 455 nm) for 24 h using electronic fan to cool the tube. After completion of the reaction, 10 mL water was added and extracted by ethyl acetate (3 ×10 mL). The combined organic layer was washed with brine (20 mL) and then dried over anhydrous Na_2SO_4 and evaporated in vacuum. The residue was purified by silica gel chromatography to obtain the products **4a**.

2.2 Optimization of the Reaction 1a, 2a, 3a

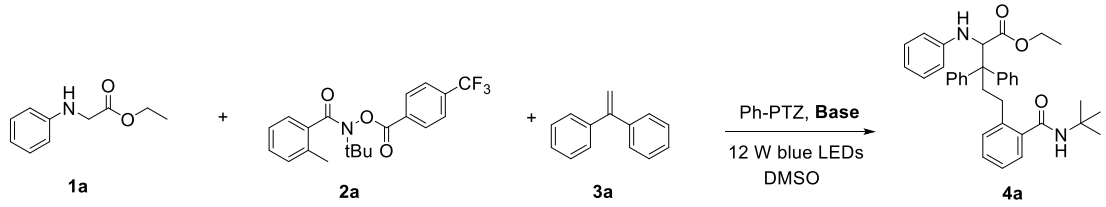


1a 2a 3a 4a

Entry [a]	Photocatalyst	Base	Solvent	Yields (%)[b]
1	**Ph-PTZ**	**DABCO**	**DMSO**	**57**
2	4CzIPN	DABCO	DMSO	trace
3	*fac*-Ir(ppy)$_3$	DABCO	DMSO	27
4	Ph-PTZ	none	DMSO	25

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (0.075 mmol, 1.5 equiv.), **3a** (0.15mmol, 3 equiv.), Slovent (0.05M, 1.0 mL), PC (5 mol%), Base (2.0 equiv), stirred at room temperature for 24 h irradiated with 12 W blue LEDs under argon atmosphere. [b] isolated yield.

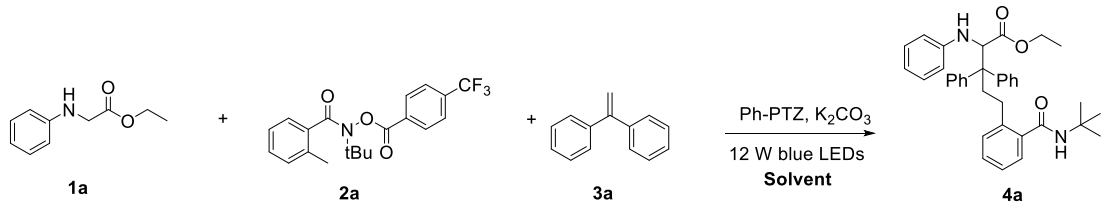
Table S1. Base screening.



Entry [a]	Base	Yields (%)[b]
1	$NaHCO_3$	58
2	Na_2CO_3	<10
3	**K_2CO_3**	**77**
4	Cs_2CO_3	trace
5	K_3PO_4	63
6	Et_3N	<10
7	DIPEA	trace
8	DBU	59
9	BTMG	25

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (0.075 mmol, 1.5 equiv.), **3a** (0.15mmol, 3 equiv.), DMSO (0.05M, 1.0 mL), Ph-PTZ (5 mol%), Base (2.0 equiv.), stirred at room temperature for 24 h irradiated with 12 W blue LEDs under argon atmosphere. [b] isolated yield.

Table S2. Solvent screening.

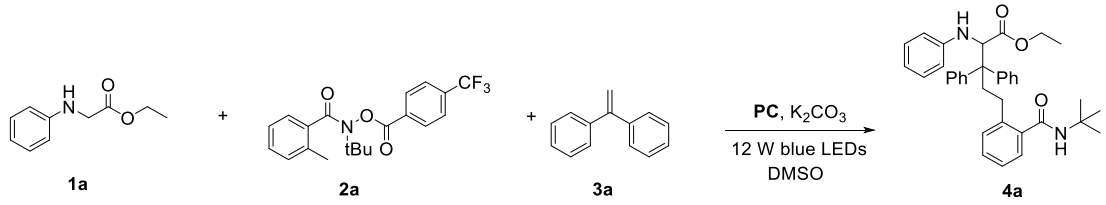


Entry [a]	Solvent	Yields (%)[b]
1	**DMSO**	**77**
2	DMF	53
3	DMA	53
4	DCE	0
5	MeCN	20
6	THF	<10

7	1,4-Dioxane	N.R.[c]
8	$PhCF_3$	N.R.
9[d]	DMSO	60

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (0.075 mmol, 1.5 equiv.), **3a** (0.15mmol, 3 equiv.), Slovent (0.05M, 1.0 mL), Ph-PTZ (5 mol%), K_2CO_3 (2.0 equiv.), stirred at room temperature for 24 h irradiated with 12 W blue LEDs under argon atmosphere. [b] isolated yield. [c] N.R. = No Reaction. [d] DMSO (0.1M, 0.5 mL).

Table S3. Photocatalyst screening.



1a 2a 3a 4a

Entry [a]	Photocatalyst	Yields (%)[b]
1	**Ph-PTZ**	**77**
2	*fac*-$Ir(ppy)_3$	26
3	$(Ir[dF(CF_3)ppy]_2(dtbbpy))PF_6$	N.R.[c]
4	$[Ir(dtbbpy)(ppy)_2]PF_6$	N.R.
5	$[Ru(bpy)_3]\ (PF_6)_2$	40
6	4CzIPN	<10
7	4CzTPN	<10
8	EosinY	64
9	$[Mes\text{-}Acr]^+\ ClO_4^-$	70
10	$[Ru(bpy)_3]Cl_2$	trace
11	4DPAIPN	N.R.
12[d]	Ph-PTZ	53

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (0.075 mmol, 1.5 equiv.), **3a** (0.15mmol, 3 equiv.), DMSO (0.05M, 1.0 mL), Photocatalyst (5 mol%), K_2CO_3 (2.0 equiv.), stirred at room temperature for 24 h irradiated with 12 W blue LEDs under argon atmosphere. [b] isolated yield. [c] N.R. = No Reaction. [d] Ph-PTZ (3 mol%).

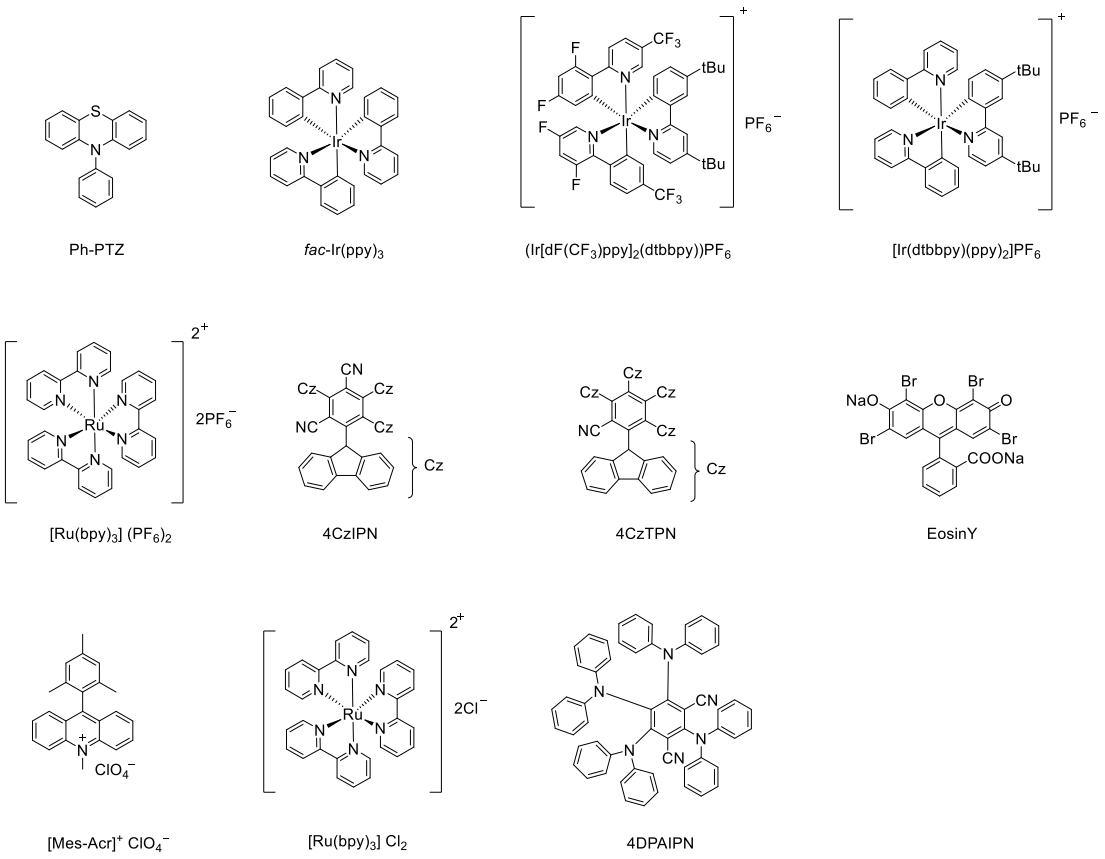
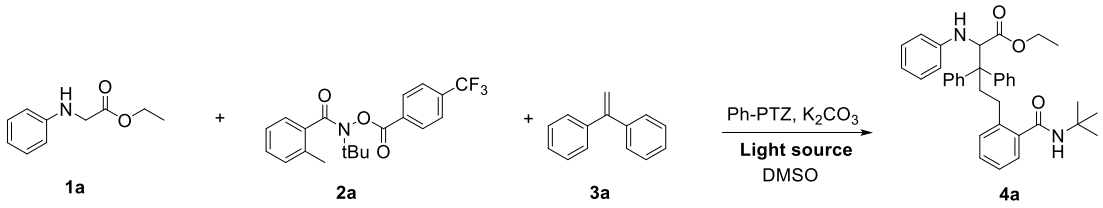


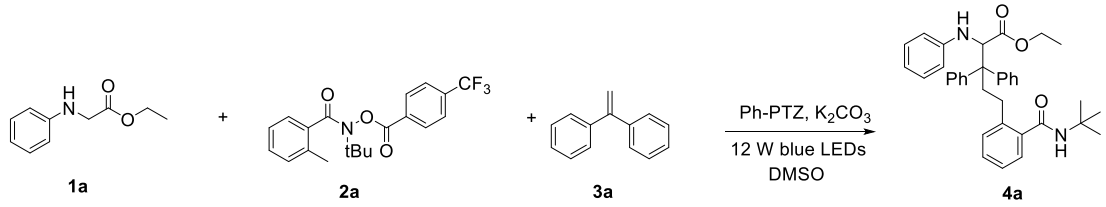
Table S4. Light source screening.



Entry [a]	Light source	Yields (%)[b]
1	390 nm purple LEDs	22
2	425 nm purple LEDs	57
3	**455 nm blue LEDs**	**77**
4	520 nm green LEDs	N.R.[c]
5	6500 K white LEDs	49

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (0.075 mmol, 1.5 equiv.), **3a** (0.15mmol, 3 equiv.), DMSO (0.05M, 1.0 mL), Ph-PTZ (5 mol%), K_2CO_3 (2.0 equiv.), stirred at room temperature for 24 h irradiated with Light source under argon atmosphere. [b] isolated yield. [c] N.R. = No Reaction.

Table S5. the dosage of substrates and base screening.

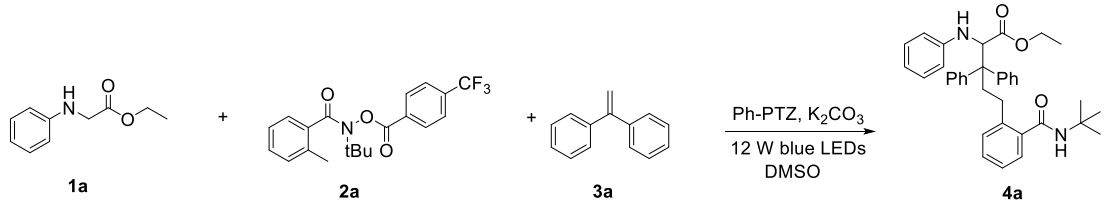


1a 2a 3a 4a

Entry [a]	1a (mmol)	2a (x mmol)	3a (mmol)	K_2CO_3 (y mmol)	Yields (%)[b]
1	**0.05**	**0.075**	**0.15**	**0.1**	**77**
2	0.05	0.01	0.15	0.1	65
3	0.05	0.075	0.15	0.05	69
4	0.05	0.075	0.15	0.125	74
5	0.05	0.075	0.15	0.15	63

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (x mmol), **3a** (0.15mmol, 3 equiv.), DMSO (0.05M, 1.0 mL), Ph-PTZ (5 mol%), K_2CO_3 (y mmol), stirred at room temperature for 24 h irradiated with 12 W blue LEDs under argon atmosphere. [b] isolated yield.

Table S6. Control experiments under the standard conditions.



1a 2a 3a 4a

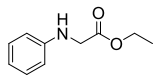
Entry [a]	changes from the standard conditions	Yields (%)[b]
1	**standard conditions**	**77**
2	In the dark	N.R.[c]
3	In the air	N.R.
4	without photocatalyst and base	20

[a] Reaction conditions: **1a** (0.05 mmol, 1.0 equiv.), **2a** (0.075 mmol, 1.5 equiv.), **3a** (0.15mmol, 3 equiv.), DMSO (0.05M, 1.0 mL), Ph-PTZ (5 mol%), K_2CO_3 (2.0 equiv.), stirred at room temperature for 24 h irradiated with 12 W blue LEDs under argon atmosphere. [b] isolated yield. [c] N.R. = No Reaction.

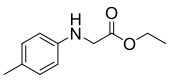
3. General experimental procedure

3.1 List of Substrates

N-aryl protected derivatives



1a



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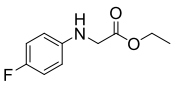

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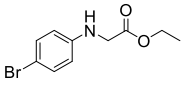

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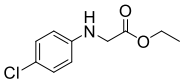

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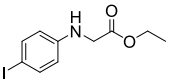

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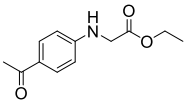

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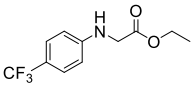

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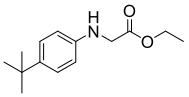

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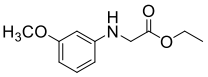

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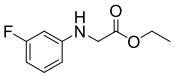

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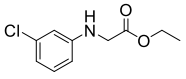

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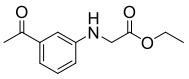

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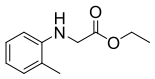

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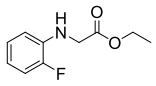

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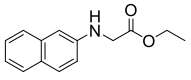

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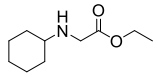

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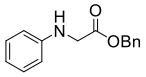

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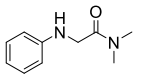

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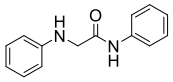

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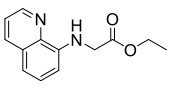

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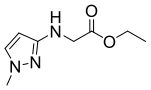
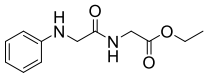


1v

Peptides



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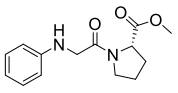

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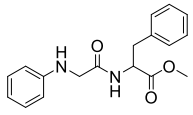

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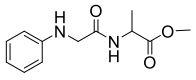
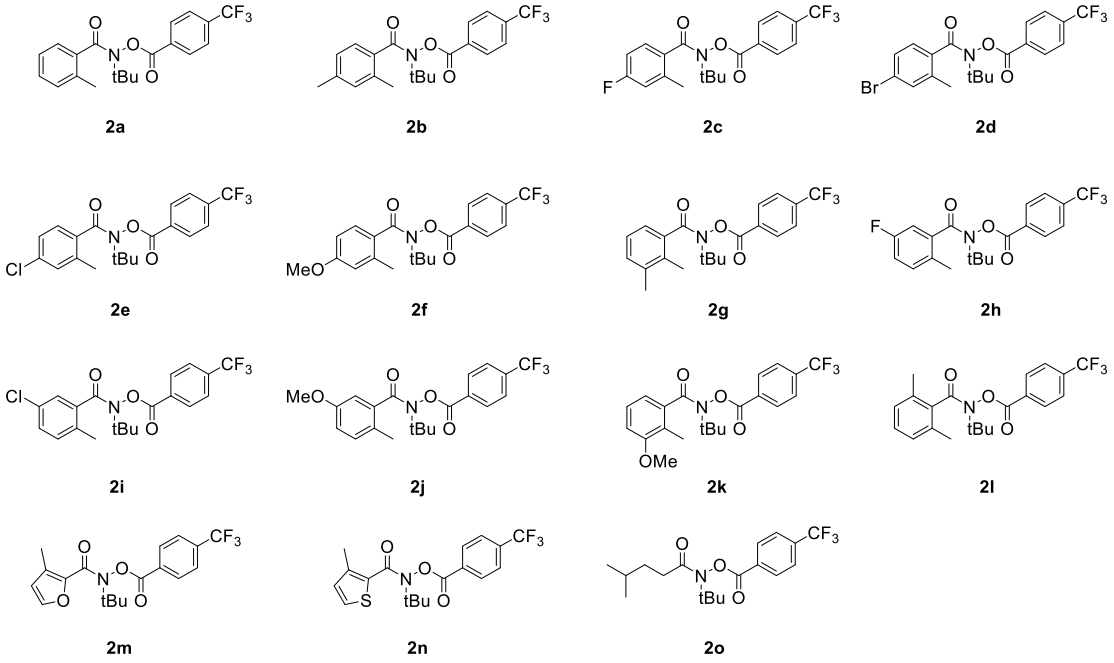
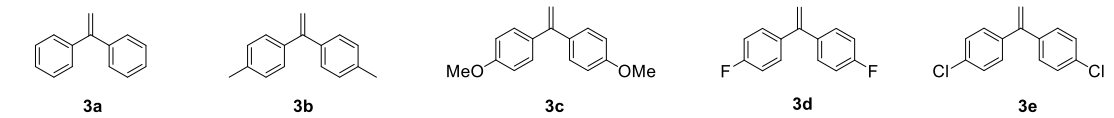


1ad

Hydroxamide

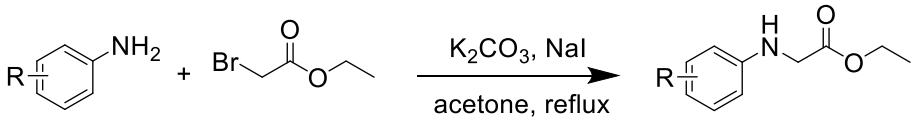


4,4'-(Ethene-1,1-diyl)bis(methylbenzene)



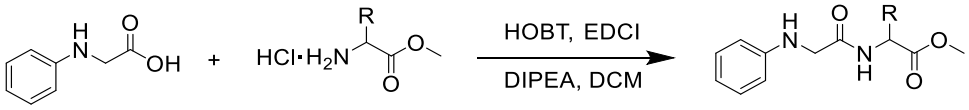
The Glycine Derivatives **1a-1ad** [1,2], hydroxamide compounds **2a-2o** [3,4] and **3a-3e** [5] were prepared according to reported literature procedures.

3.2 General procedure for preparation of Glycine Derivatives 1



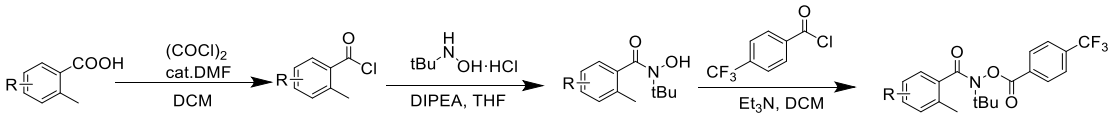
Following the reported literature procedure [1]: a mixture of aniline (10 mmol, 1.0 equiv.), the corresponding bromoacetate-ester (11 mmol, 1.1 equiv.), potassium carbonate anhydrous (12 mmol, 1.2 equiv.) and sodium iodide (12 mmol, 1.2 equiv.) was added in 30 mL (0.3 M) dry acetone and refluxed for 12 h. The resulting mixture was cooled to room temperature, and filtered through a celite. The celite was washed with CH_2Cl_2, the combined organic layer was evaporated to remove the solvent and the crude product was then purified by column chromatography on silica gel (PE/EA = 10:1). The pure product was obtained as solid or liquid.

3.3 General procedure for preparation of Peptides 1



Following the literature procedure [2]: In round-bottom flask, phenylglycine (10 mmol, 1.0 equiv.) were dissolved in 30 mL DCM (0.3 M), HOBT (14.5 mmol, 1.45 equiv.) and EDCI (16 mmol, 1.6 equiv.) were added in turn. The mixture was stirred at room temperature. After 30 min, DIPEA (40 mmol, 4.0 equiv.) and ester-protected amino acids (10 mmol, 1.0 equiv.) were added at 0 ℃. The reaction mixture was warmed to room temperature and stirred overnight. The resulting mixture was washed by citric acid solution, saturated sodium bicarbonate solution and brine. The organic layer was dried over Na_2SO_4 and concentrated in vacuo. The residue was purified by column chromatography on silica gel (PE/EA = 3:1). Peptides compounds were obtained.

3.4 General procedure for preparation of hydroxamide compounds 2



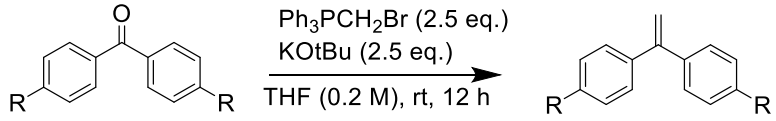
Step 1: Following the literature procedure[3]: To a solution of carboxylic acid (10 mmol, 1.0 equiv.) and 3-5 drops of anhydrous DMF in anhydrous CH_2Cl_2 (0.5 M) at 0 ℃, oxalyl chloride (15 mmol, 1.5 equiv.) was added dropwise over 10 minutes. The reaction was vigorously stirred at room temperature for 3 h. The solvent was removed in vacuum. Anhydrous CH_2Cl_2 was added to remove the residual of oxalyl chloride in vacuum. Then the resulting acyl chloride was redissolved in anhydrous acetonitrile and used directly for the next step without further purification.

Step 2: A solution of the N-(tert-butyl)hydroxylamine hydrochloride (10 mmol, 2.0 equiv.) in anhydrous THF (0.4 M) was cooled to 0 ℃, treated with DIPEA (20 mmol, 2.0 equiv.) and stirred for 15 minutes. The acyl chloride (1.0 equiv.) in anhydrous acetonitrile was added dropwise over 15 minutes and the mixture was allowed to warm to room temperature overnight. The mixture was diluted with saturated $NaHCO_3$ and EtOAc and the layers were separated. The aqueous layer was extracted twice with EtOAc and the combined organic layers were washed with 1 M HCl, saturated $NaHCO_3$

and brine, successively, and then evaporated. Purification by column chromatography on silica gel (PE/EA = 10:1) gave the hydroxylamine.

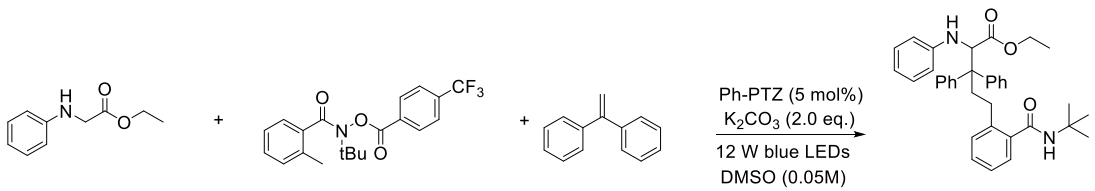
Step 3: To a solution of hydroxylamine (1.1 equiv.) in anhydrous CH_2Cl_2 (0.35 M) at 0 ℃, Et_3N (1.5 equiv.) was added dropwise. 4-trifluoromethyl-benzoyl chloride (1.0 equiv.) was then added dropwise over 5 minutes. The reaction was vigorously stirred at room temperature for 2 h. The mixture was diluted with saturated $NaHCO_3$ and CH_2Cl_2 and the layers were separated. The aqueous layer was extracted twice with CH_2Cl_2 and the combined organic layers were washed with 1 M HCl, saturated $NaHCO_3$ and brine, successively, and then evaporated. Purification by columnchromatography on silica gel (PE/EA = 20:1) gave the hydroxamide compounds **2**.

3.5 General procedure for preparation of 3



Following the literature procedure [5] with slight modifications: A 30 mL flask equipped with a magnetic stir bar were added Ph_3PCH_2Br (10 mmol, 2.5 equiv) and THF (20 mL, 0.2 M). After cooling to 0 °C, KO*t*Bu (10 mmol, 2.5 equiv) was added to the solution and the mixture was stirred for 30 min at the same temperature. To the mixture was added 4,4'-dimethylbenzophenone (4 mmol, 1 equiv). The mixture was warmed to room temperature and stirred for 12 h. Then, water was added and organic layer was separated. The mixture was extracted with ethyl acetate (3×30 mL). The organic layers were combined, washed with saturated brine solution (100 mL), dried over Na_2SO_4, and filtered. The filtrate was concentrated in vacuo. Purification by column chromatography on silica gel eluting with petroleum ether gave the compounds **3**.

3.6 Scale-up reaction



1a, 2 mmol, 358.4 mg **2a**, 3mmol, 1138.1 mg **3a**, 6 mmol,1.1 ml **4a**, 605.1mg, 55%

To a 100 mL Schlenk Tube with magnetic stirrer, glycine derivative **1a** (358.4 mg, 2

mmol), hydroxamide acid **2a** (1138.1 mg, 3 mmol), Ethene-1,1-diyldibenzene **3a** (1.1mL, 6 mmol), K_2CO_3 (552.8 mg, 4 mmol), Ph-PTZ (27.5 mg, 5 mol%), DMSO (40 ml, 0.05M) Then, the tube was evacuated and back-filled with argon (three times), The solution was then stirred at room temperature under the irradiation of 12 W Blue LEDs for 58 h. After completion of the reaction, 40 mL water was added and extracted by ethyl acetate (3 × 40 mL). The combined organic layer was washed with brine (40 mL) and then dried over anhydrous Na_2SO_4 and evaporated in vacuum. The residue was purified by silica gel chromatography (PE/EA from 15:1) to obtain the products **4a** as white solid in 55% yield (605.1 mg).

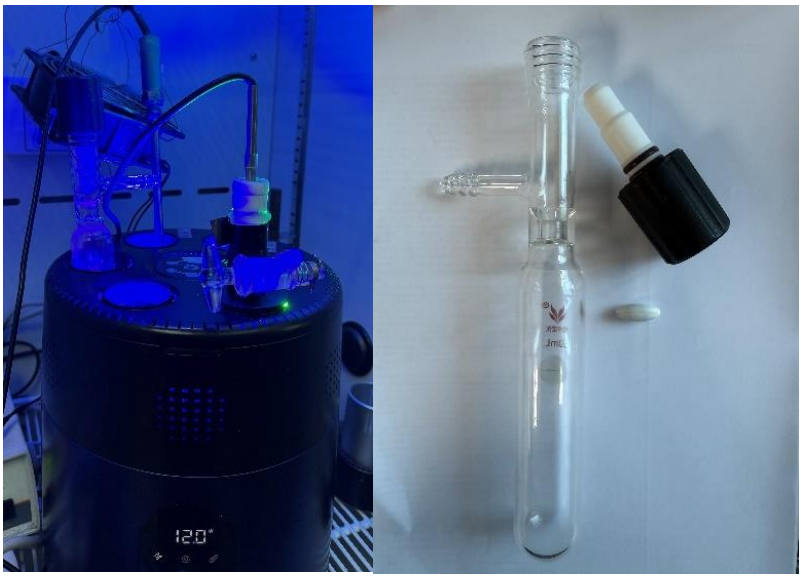
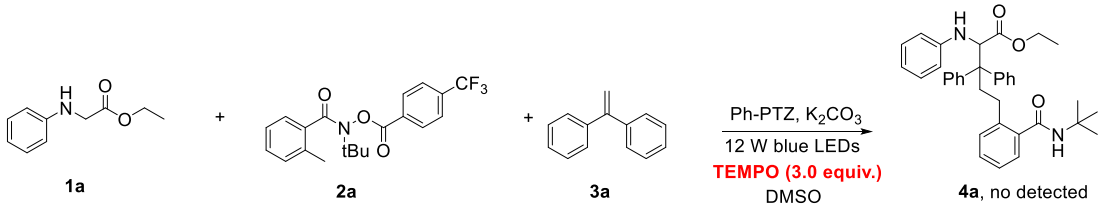


Figure S3. The photoreactor and reaction tube of scale-up experiment

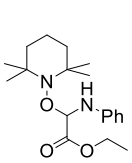
4. The mechanistic studies

4.1 Radical trapping experiments



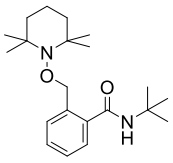
To an oven-dried 10 mL glass tube equipped with a stir bar, glycine derivative **1a** (9.0 mg, 0.05 mmol), hydroxamide acid **2a** (28.5 mg, 0.075 mmol), K_2CO_3 (14.5 mg, 0.1 mmol), Ph-PTZ (1 mg, 5 mol%) and TEMPO (23.4 mg, 0.15 mmol) were added. The tube was evacuated and back-filled with argon (three times), then sealed with

rubber stopper and parafilm. Then, Ethene-1,1-diyldibenzene **3a** (27 μL, 0.15mmol) and anhydrous DMSO (1 mL, 0.05M) were added using syringes. The solution was then stirred at room temperature under the irradiation of 12 W blue LEDs for 24 h using electronic fan to cool the tube. After 24 h, the reaction was completely inhibited as judged by TLC analysis. Then, the reaction mixture was analyzed by HRMS, which shows the exact molecular ion indicating the formation of the proposed TEMPO adduct to the stabilized α-alkyl radical intermediate, and benzyl radical intermediate.



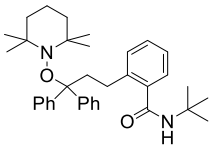
1

Calcd for $C_{19}H_{31}N_2O_3^+$ 335.2329, Found 335.2332.



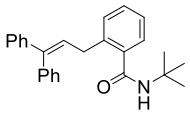
2

Calcd for $C_{21}H_{35}N_2O_2^+$ 347.2693, Found 347.2690.



3

Calcd for $C_{35}H_{47}N_2O_2^+$ 527.3632, Found 527.3632.



4

Calcd for $C_{26}H_{28}NO^+$ 370.2165, Found 370.2168.

1 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{19}H_{31}N_2O_3^+$ 335.2329; Found 335.2332.

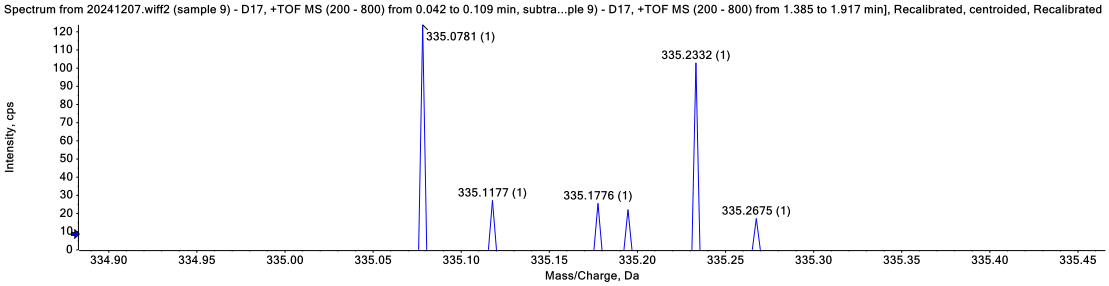


Figure S4. HRMS of 1.

2 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{21}H_{35}N_2O_2^+$ 347.2693; Found 347.2690.

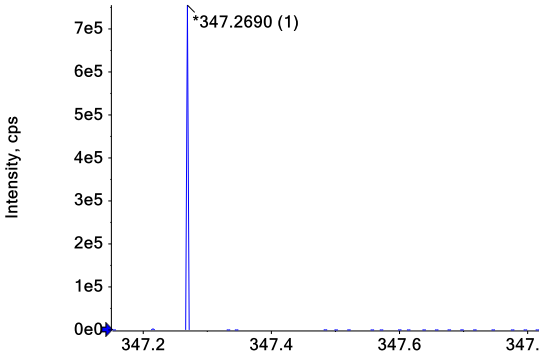


Figure S5. HRMS of 2.

3 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{35}H_{47}N_2O_2^+$ 527.3632; Found 527.3632.

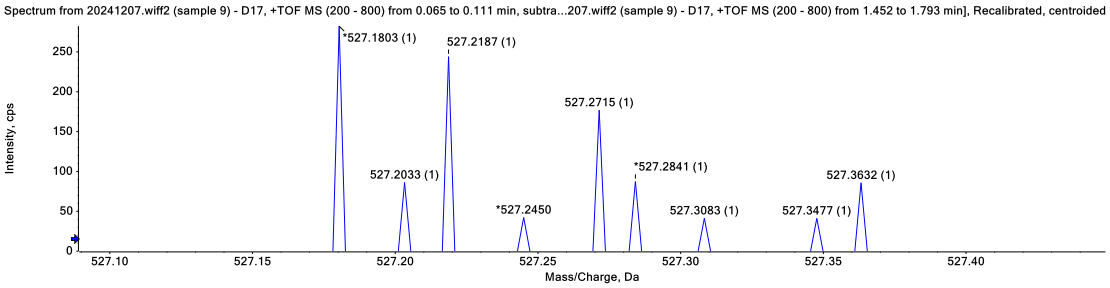


Figure S6. HRMS of 3.

4 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{26}H_{28}NO^+$ 370.2165; Found 370.2168.

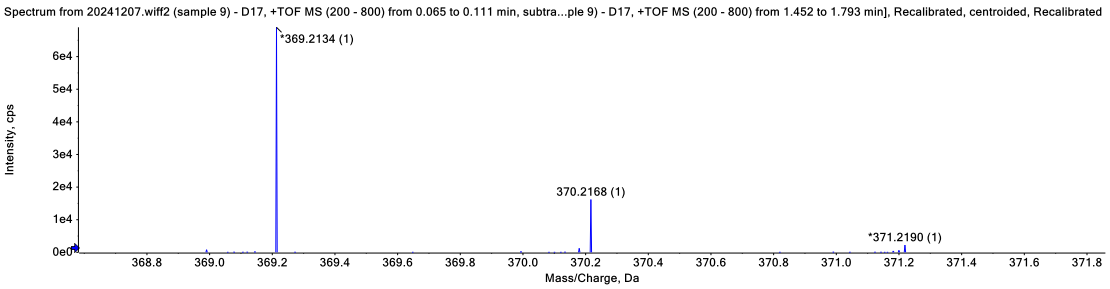
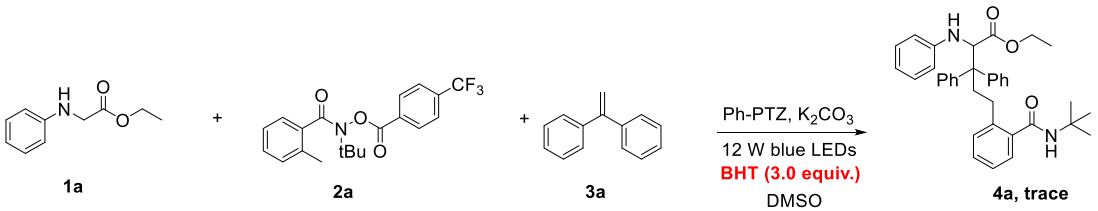
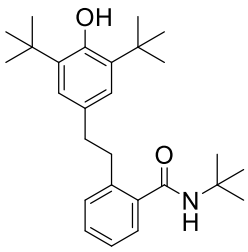


Figure S7. HRMS of 4.

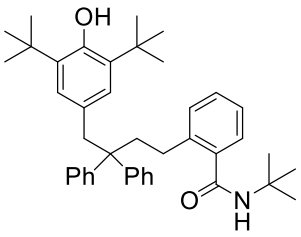


To an oven-dried 10 mL glass tube equipped with a stir bar, glycine derivative **1a** (9.0 mg, 0.05 mmol), hydroxamide acid **2a** (28.5 mg, 0.075 mmol), K_2CO_3 (14.5 mg, 0.1 mmol), Ph-PTZ (1 mg, 5 mol%) and BHT (33.1 mg, 0.15 mmol) were added. The tube was evacuated and back-filled with argon (three times), then sealed with rubber stopper and parafilm. Then, Ethene-1,1-diyldibenzene **3a** (27 μL, 0.15 mmol) and anhydrous DMSO (1 mL, 0.05M) were added using syringes. The solution was then stirred at room temperature under the irradiation of 12 W blue LEDs for 24 h using electronic fan to cool the tube. After 24 h, the reaction was completely inhibited as judged by TLC analysis. Then, the reaction mixture was analyzed by HRMS, which shows the exact molecular ion indicating the formation of the proposed BHT adduct to the stabilized alkyl radical intermediate, and benzyl radical intermediate.



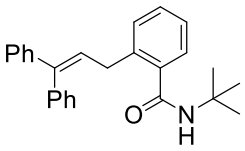
5

Calcd for $C_{27}H_{40}NO_2^+$ 410.3054, Found 410.3054.



6

Calcd for $C_{41}H_{52}NO_2^+$ 590.3993, Found 590.3998.



4

Calcd for $C_{26}H_{28}NO^+$ 370.2165, Found 370.2169.

5 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{27}H_{40}NO_2^+$ 410.3054; Found 410.3054.

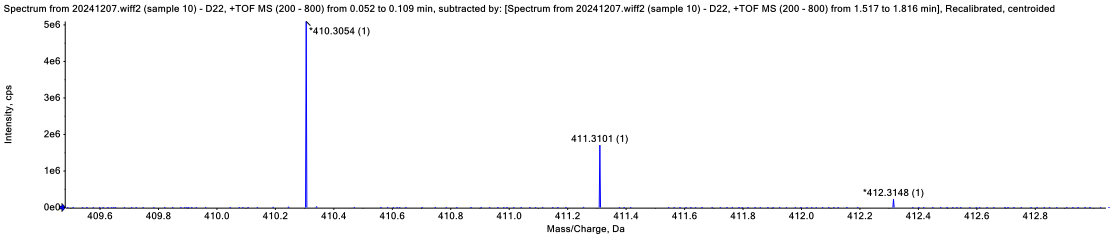


Figure S8. HRMS of 5.

6 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{41}H_{52}NO_2$+ 590.3993; Found 590.3998.

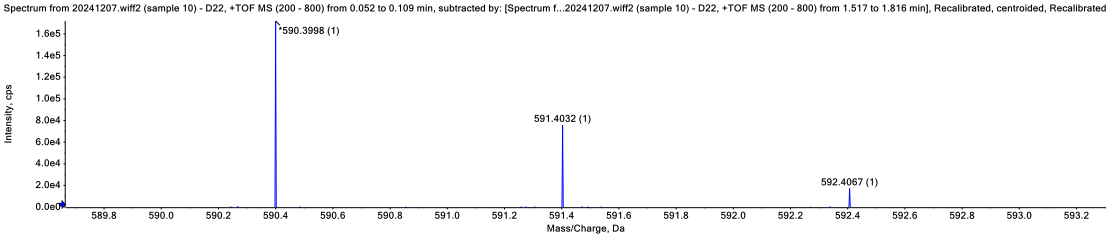


Figure S9. HRMS of 6.

4 HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{26}H_{28}NO^+$ 370.2165; Found 370.2169.

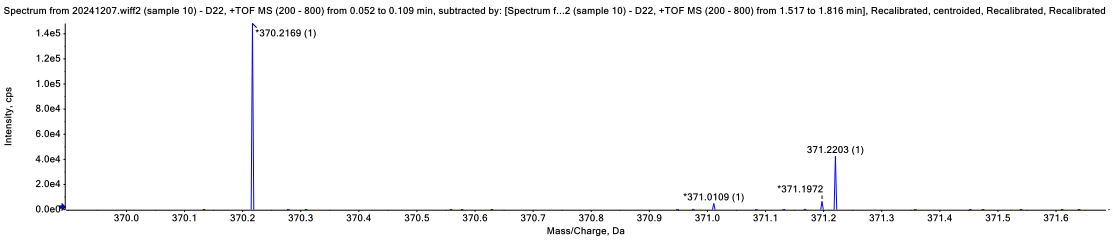


Figure S10. HRMS of 4.

4.2 Stern-Volmer fluorescence quenching studies

Stern-Volmer fluorescence quenching experiments were run with freshly prepared solutions of 4×10^{-5} M Ph-PTZ and varying concentrations of quencher **1a**, **2a** or **3a** in DMSO at room temperature. The solutions were irradiated at 320 nm and fluorescence was measured from 400 nm to 500 nm. Emission intensities were recorded by using a

SHIMADZU RF-5301PC spectrophotometer. Then, appropriate amount of quencher was added to the measured solution in a quartz cuvette and the emission spectrum of the sample was collected. I_0 and I represent the intensities of the emission in the absence and presence of the quencher at 447 nm.

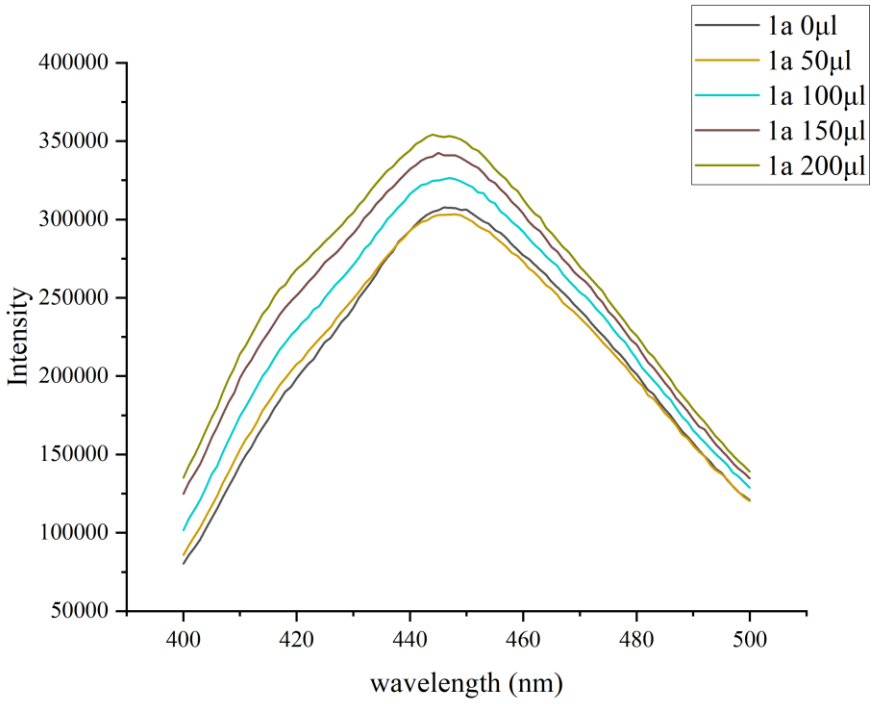


Figure S11. The emission quenching spectrum of Ph-PTZ by various concentrations of quencher **1a**.

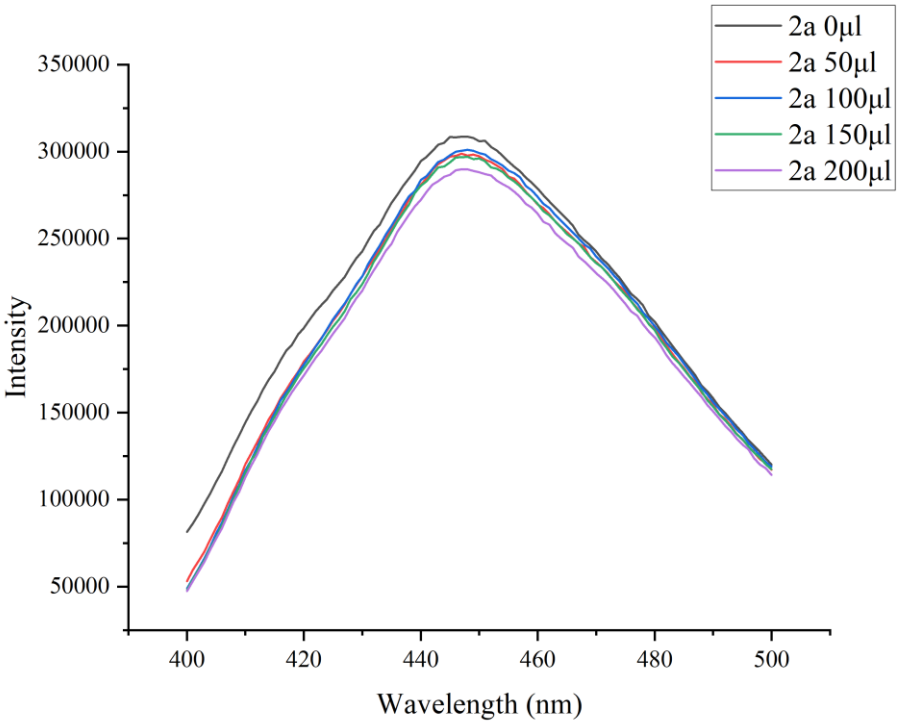


Figure S12. The emission quenching spectrum of Ph-PTZ by various concentrations of quencher **2a**.

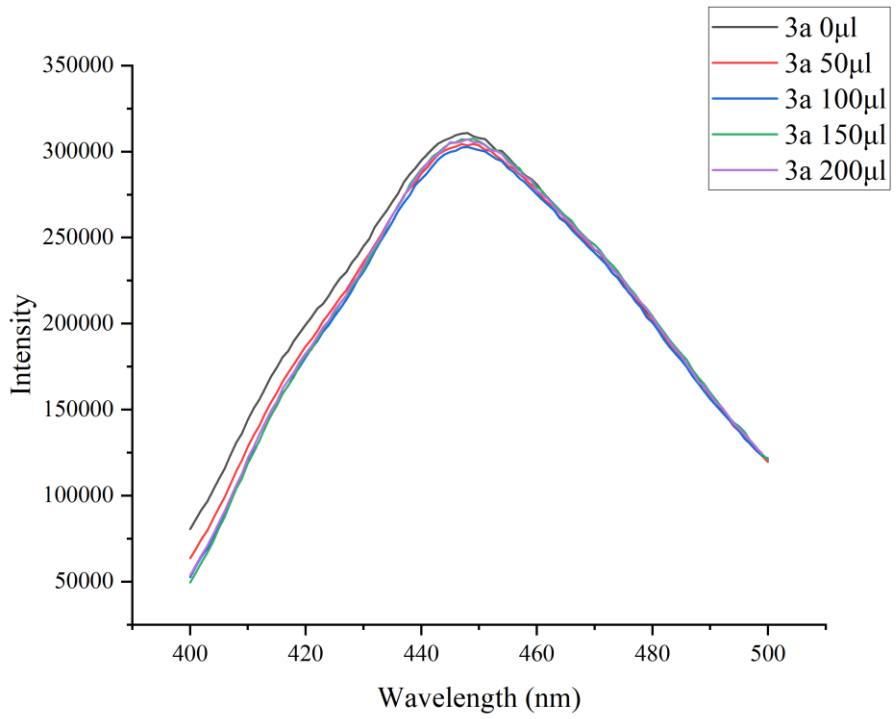


Figure S13. The emission quenching spectrum of Ph-PTZ by various concentrations of quencher **3a**.

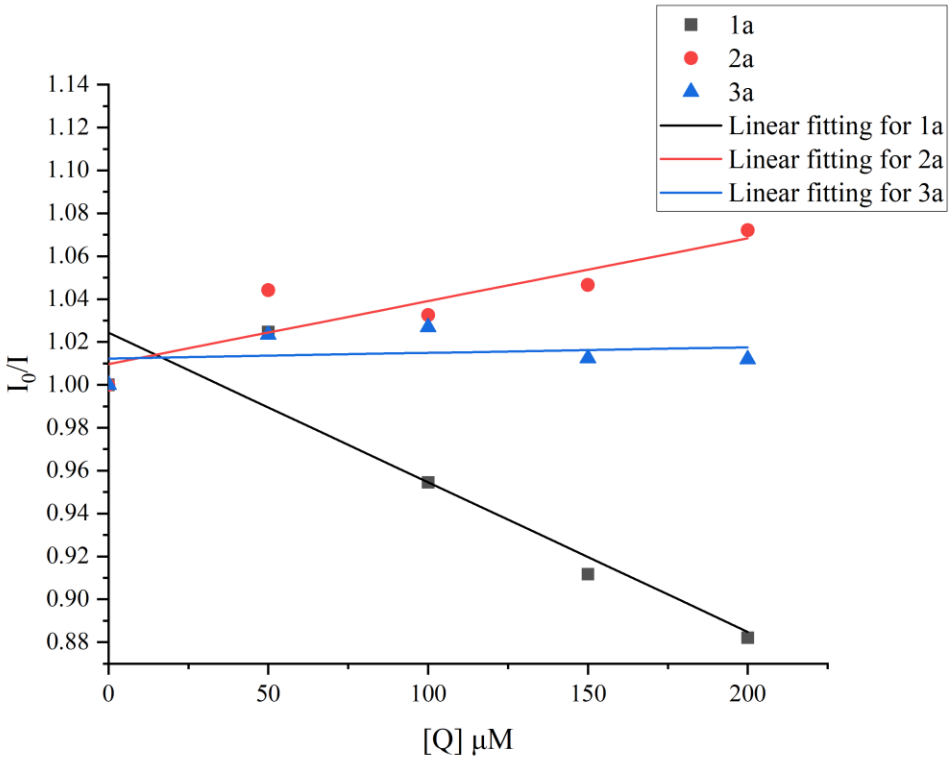


Figure S14. Stern-Volmer plot for the emission quenching of Ph-PTZ by various concentrations of quencher **1a** or **2a** or **3a**.

4.3 Cyclic Voltammetry Experiments

Cyclic voltammetry experiments were conducted on a "computercontrolled CH Instrument Electrochemical Analyzer [AUTOLABPGSTAT128N]" in a three-electrode cell (beaker-type cell) at room temperature (25 ± 2 ºC) using a Glassy carbon electrode working electrode, saturated calomel electrode (SCE) as reference electrode, Pt wire as the auxiliary electrode, and 0.1 M nBu_4NPF_4 as electrolyte with 10 mM solution of the sample in DMSO. The surface area of the glassy carbon electrode is 7.06 sq. mm and the surface of the electrode is round shaped. The electrode is polished with figure-eight motions on a cloth polishing pad in a water-alumina slurry. For the cyclic voltammetry measurement, IUPAC convention was followed. The starting point for the CV curve was at 0.0 volt and measured in the positive direction. For the CV experiments, initial potential was 0.0 V, switching potential was +2.5 V and the scan rate was 0.1 V/s. All solutions used for the voltametric experiments were deoxygenated by purging with high purity argon gas up to 5 mins and measurements were performed in open air at room

temperature (25 ± 2 ºC). The CV experiments of all the substrates were carried out following the aforementioned procedure and the diagrams are depicted as follows:

a) CV of Ph-PTZ:

Tetrabutylammonium hexafluorophosphate (1.55g, 4 mmol) and Ph-PTZ (11.0 mg, 0.001 mmol) were dissolved in dry DMSO (40 mL) and the solution was vigorously bubbled with N_2 for 5 minutes prior to the measurement. The oxidation potential was measured using a glassy carbon working electrode, a platinum wire counter electrode, and a saturated calomel electrode (SCE) at 0.1 V/s scan rate.

The photoluminescence maximum was estimated to be 447 nm (Supplementary **Figure 11**). Using the photoluminescence maximum and $E_{1/2}^{ox}$, the excited state reduction potential was determined for Ph-PTZ ($E_{1/2}$ (Ph-PTZ$^{+\cdot}$ / Ph-PTZ *) = −2.08 V) according to the following equations:

$$\text{Ph-PTZ } (E_{1/2}\,(\text{PTH}^{+\cdot} / \text{PTH}^*) = E^{ox} - E_{0,0}$$

$$\text{Where } E_{0,0} = hc / \lambda = 1240 \text{ nm} / \lambda_{max}$$

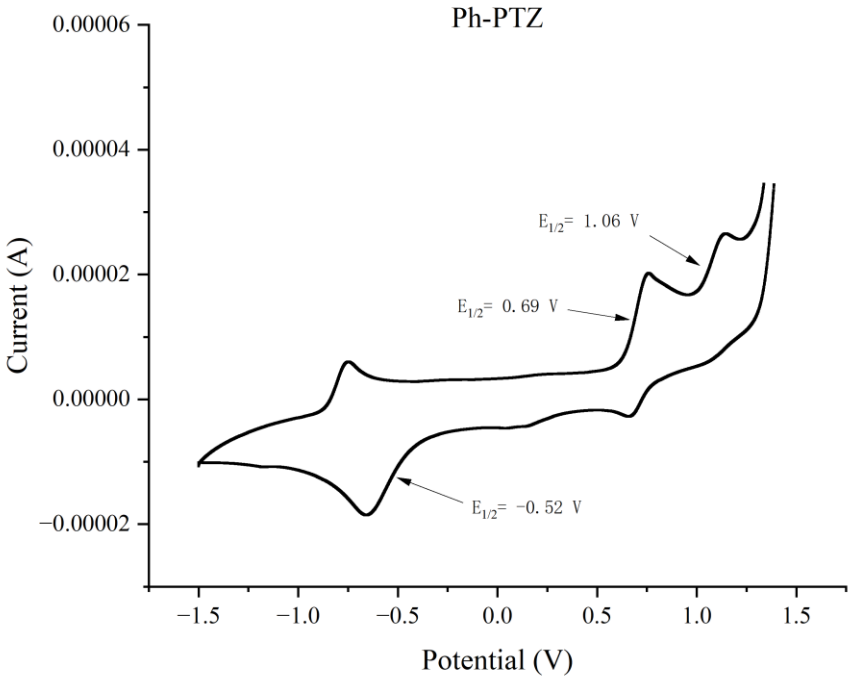


Figure S15. Cyclic voltammogram of Ph-PTZ in DMSO scan direction: from -1.5 V to 1.5 V, then back to -1.5 V

b) CV of 1a:

Tetrabutylammonium hexafluorophosphate (1.55 g, 4 mmol) and ethyl N-phenyl glycinate **1a** (71.7 mg, 0.4 mmol) were dissolved in dry DMSO (40 mL) and the solution was vigorously bubbled with N_2 for 5 minutes prior to the measurement. The oxidation potential was measured using a glassy carbon working electrode, a platinum wire counter electrode, and a saturated calomel electrode (SCE) at 0.1 V/s scan rate.

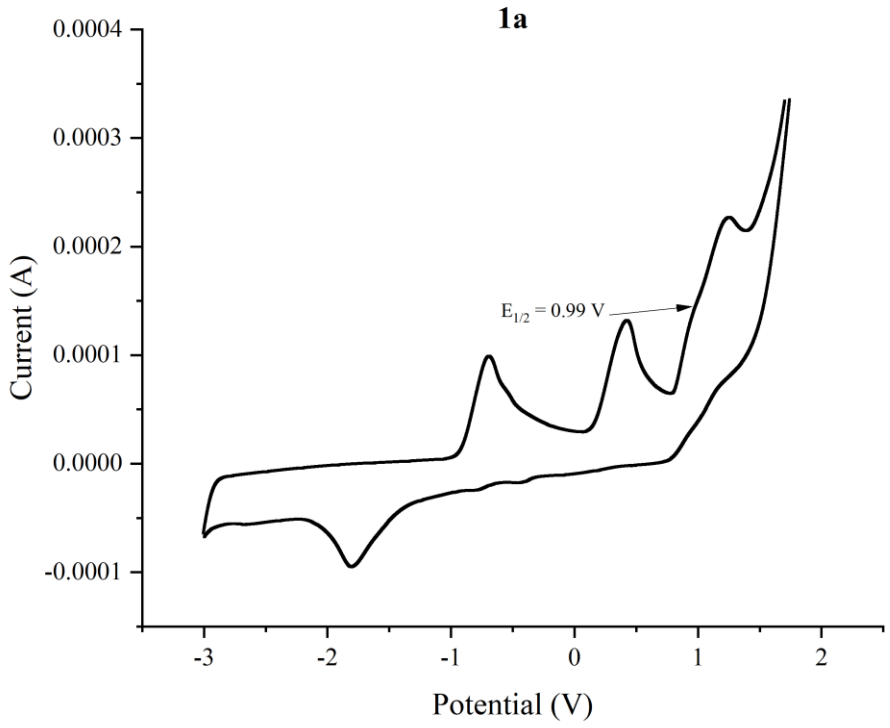


Figure S16. Cyclic voltammogram of ethyl N-phenyl glycinate **1a** in DMSO scan direction: from -3 V to 3 V, then back to -3 V

c) CV of 2a:

Tetrabutylammonium hexafluorophosphate (1.55 g, 4 mmol) and **2a** (151.8 mg, 0.4 mmol) were dissolved in dry DMSO (40 mL) and the solution was vigorously bubbled with N_2 for 5 minutes prior to the measurement. The oxidation potential was

measured using a glassy carbon working electrode, a platinum wire counter electrode, and a saturated calomel electrode (SCE) at 0.1 V/s scan rate.

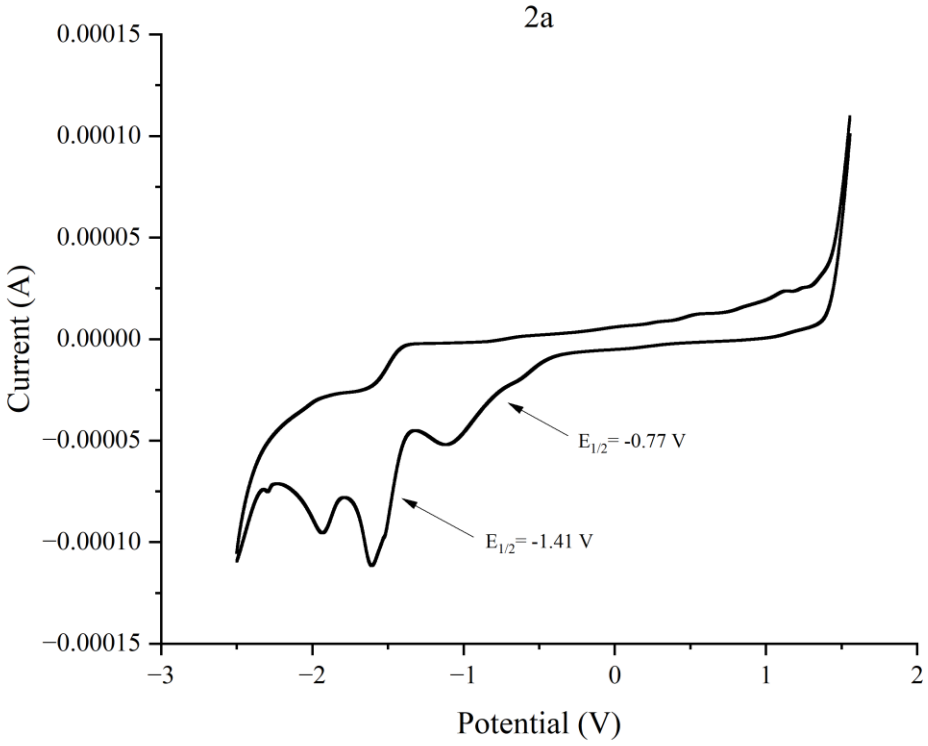
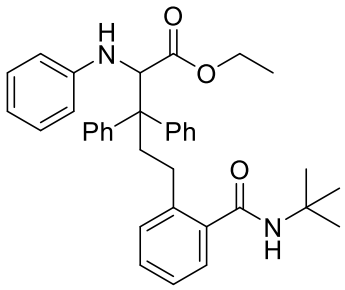
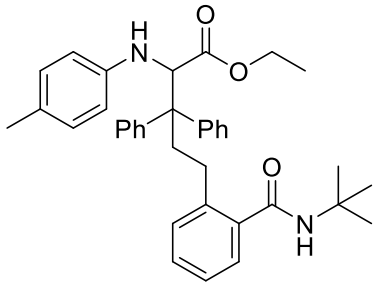


Figure S17. Cyclic voltammogram of 2**a** in DMSO scan direction: from -3 V to 2 V, then back to -3 V

5. Characterization data of products

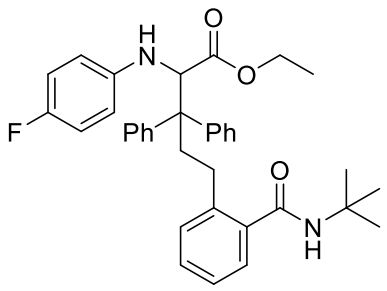


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4a): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White solid, 21.0 mg, 77% yield, M. p. 148-150 ℃. 1. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 - 7.27 (m, 10H), 7.25 - 7.13 (m, 6H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.69 (d, *J* = 8.1 Hz, 2H), 5.43 (s, 1H), 5.07 (s, 1H), 3.95 - 3.88 (m, 2H), 2.76 - 2.64 (m, 3H), 2.38 - 2.28 (m, 1H), 1.34 (s, 9H), 0.94 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 172.2, 169.6, 146.8 143.6, 143.3, 140.0, 138.2 130.1, 129.8, 129.6, 129.4, 127.9, 127.8, 127.1, 126.6, 126.6, 125.9, 118.8, 114.2, 61.1, 60.9, 54.1, 51.7, 40.8, 28.93, 28.68, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{41}N_2O_3^+$ 549.3112, found 549.3115.

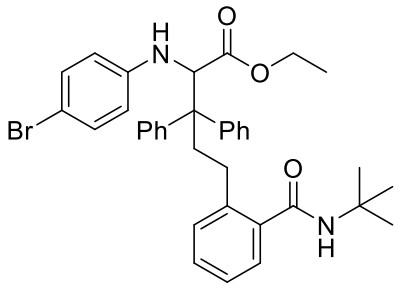


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(p-tolylamino)pentanoate (4b): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 20.7 mg, 74% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.32 - 7.28(m, 9H), 7.26 - 7.12 (m, 5H), 6.98 (d, *J* = 8.2 Hz, 2H), 6.61 (d, *J* = 8.4 Hz, 2H), 5.42 (s, 1H), 5.03 (s, 1H), 3.95 - 3.86 (m, 2H), 2.74 - 2.64 (m, 3H), 2.34 - 2.28 (m, 1H), 2.23 (s, 3H), 1.34 (s, 9H), 0.94 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.3, 169.6, 144.4, 130.0, 129.9, 129.8, 129.6, 129.4, 128.0, 127.9, 127.2, 127.0, 126.6, 126.5, 125.9, 114.3, 60.8, 54.0, 51.7, 40.7, 28.9, 28.6, 20.6,

14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_3^+$ 563.3268, found 563.3270.

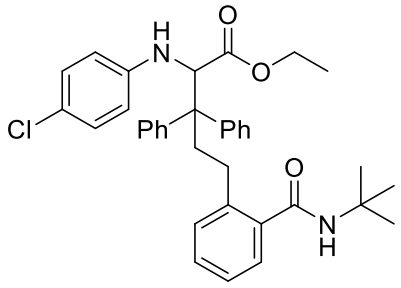


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((4-fluorophenyl)amino)-3,3-diphenyl-pentanoate (4c): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 18.9 mg, 67% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.32 - 7.27 (m, 9H), 7.26 - 7.20 (m, 3H), 7.18 - 7.15 (m, 2H), 6.87 (t, *J* = 8.7 Hz, 2H), 6.65 - 6.61 (m, 2H), 5.42 (s, 1H), 4.97 (s, 1H), 3.90 (q, *J* = 7.1 Hz, 2H), 2.67 (q, *J* = 6.5, 4.3 Hz, 3H), 2.37 - 2.30 (m, 1H), 1.34 (s, 9H), 0.93 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.0, 169.5, 156.5 (d, *J*=117.5 Hz), 143.1, 143.0 (d, *J*=1.0 Hz), 139.9, 138.0, 130.0, 129.6, 129.5, 129.3, 127.8, 127.7, 127.0, 126.5, 115.8 (d, *J*=11.0 Hz), 115.2, 115.2, 61.9, 60.4, 54.0, 51.6, 40.6, 28.8, 28.6, 13.9. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -126.47. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}FN_2O_3^+$ 567.3017, found 567.3020.

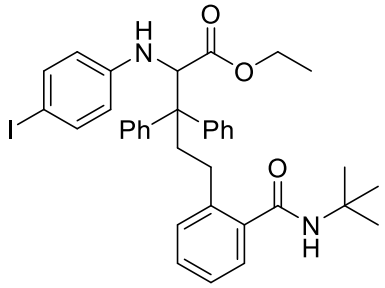


Ethyl 2-((4-bromophenyl)amino)-5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3 diphenyl pentanoate (4d): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 23.9 mg, 76% yield. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.35 - 7.06 (m, 16H), 6.54 (d, *J* = 8.8 Hz, 2H), 5.39 (s, 1H), 4.94 (s, 1H), 3.91 - 3.83 (m, 2H), 2.62 (d, *J* = 7.2 Hz, 3H), 2.30 - 2.26 (m, 1H), 1.30 (s, 9H), 0.91 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.9, 169.6, 145.8, 143.5, 143.1, 140.0, 138.1, 132.2, 130.1, 129.7, 129.3, 127.9, 127.2, 126.7, 126.6,

125.9, 115.8, 110.5, 61.2, 61.1, 54.1, 51.7, 40.8, 28.9, 28.8, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}BrN_2O_3^+$ 627.2217, found 627.2219.

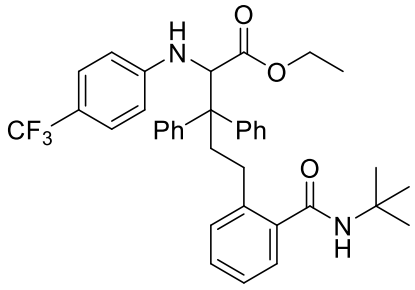


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((4-chlorophenyl)amino)-3,3-diphenylpentanoate (4e): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 21.6 mg, 74% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 - 7.27 (m, 8H), 7.23 (d, *J* = 7.4 Hz, 4H), 7.17 (d, *J* = 8.7 Hz, 2H), 7.12 (d, *J* = 8.7 Hz, 2H), 6.62 (d, *J* = 8.7 Hz, 2H), 5.43 (s, 1H), 4.99 (s, 1H), 3.95 - 3.87 (m, 2H), 2.67 (q, *J* = 6.2, 3.8 Hz, 3H), 2.37 - 2.29 (m, 1H), 1.34 (s, 9H), 0.94 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, $CDCl_3$)** δ 171.9, 169.6, 169.6, 145.4, 143.5, 143.2, 140.1, 138.1, 130.1, 129.7, 129.3, 129.3, 128.0, 127.8, 127.2, 126.7, 126.7, 125.9, 123.4, 115.3, 61.3, 61.0, 54.1, 51.7, 40.8, 28.9, 28.8, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}ClN_2O_3^+$ 583.2722, found 583.2722.

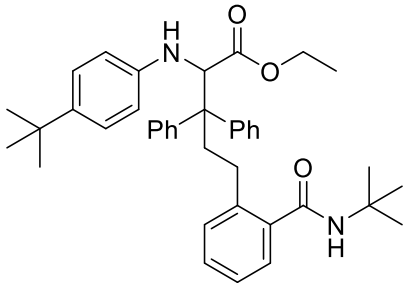


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((4-iodophenyl)amino)-3,3-diphenyl pentanoate (4f): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 18.8 mg, 56% yield. **^{1}H NMR (400 MHz, Chloroform-d)** δ 7.42 (d, *J* = 8.7 Hz, 2H), 7.34 - 7.26 (m, 8H), 7.25 - 7.19 (m, 4H), 7.16 (d, *J* = 7.5 Hz, 2H), 6.48 (d, *J* = 8.7 Hz, 2H), 5.42 (s, 1H), 4.98 (s, 1H), 3.96 - 3.87 (m, 2H), 2.66 (q, *J* = 6.4, 4.3 Hz, 3H), 2.37 - 2.29 (m, 1H), 1.34 (s, 9H), 0.95 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.8, 169.5, 146.4, 143.5, 138.1, 138.0, 130.1, 129.7, 129.3, 128.0, 127.9, 127.2, 126.7, 126.7, 126.0,

116.3,79.7, 61.1, 60.9, 54.1, 51.7, 40.8, 28.9, 28.8, 14.0. HRMS (ESI-TOF) m/z: [M + H]$^+$ Calcd for $C_{36}H_{40}IN_2O_3^+$ 675.2078, found 675.2081.

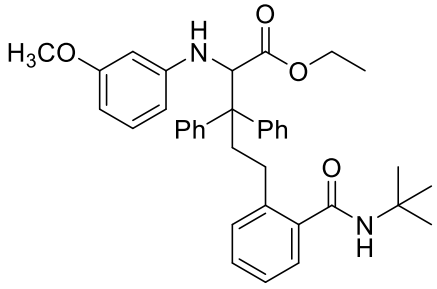


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-((4-(trifluoromethyl) phenyl)amino)pentanoate (4g): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White oil, 16.9 mg, 55% yield. **^{1}H NMR (400 MHz, Chloroform-d)** δ 7.31 (d, J = 8.5 Hz, 2H), 7.26 - 7.17 (m, 8H), 7.16 - 7.10 (m, 4H), 7.08 - 7.05 (m, 2H), 6.61 (d, J = 8.5 Hz, 2H), 5.34 (s, 1H), 4.97 (s, 1H), 3.87-3.79 (m, 2H), 2.64 - 2.52 (m, 3H), 2.28 - 2.21 (m, 1H), 1.24 (s, 9H), 0.85 (t, J = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-d)** δ 171.6, 169.6, 149.4, 143.3, 143.0, 140.1, 138.0, 130.1, 129.7, 129.6, 129.3, 128.1, 128.0, 127.3, 126.8 (q, *J* =1.0 Hz), 126.7, 126.0, 124.9 (q, *J* =134.5 Hz), 120.3 (q, *J* =16.5 Hz), 113.3, 61.2, 60.7, 54.2, 51.8, 40.8, 28.9, 28.8, 14.0. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -61.18. HRMS (ESI-TOF) m/z: [M + H]$^+$ Calcd for $C_{37}H_{40}F_3N_2O_3^+$ 617.2986, found 617.2987.

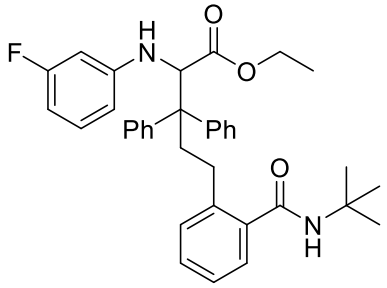


Ethyl 2-((4-(*tert*-butyl)phenyl)amino)-5-(2-(tert-butylcarbamoyl)phenyl)-3,3-diphenylpentanoate (4h): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White solid, 13.5mg, 45% yield, M. p. 106-109 ℃. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.32 (d, *J* = 6.4 Hz, 4H), 7.28 (d, *J* = 4.2 Hz, 5H), 7.26 - 7.20 (m, 3H), 7.17 (t, *J* = 7.9 Hz, 4H), 6.63 (d, *J* = 8.6 Hz, 2H), 5.41 (s, 1H), 5.04 (s, 1H), 3.95 - 3.86 (m, 2H), 2.73 - 2.63 (m, *J* = 12.9, 6.2 Hz,

3H), 2.37 - 2.28 (m, 1H), 1.34 (s, 9H), 1.27 (s, 9H), 0.93 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.4, 169.6, 144.3, 143.7, 140.0, 138.2, 130.0, 129.8, 129.6, 129.5, 127.90, 127.7, 127.0, 126.6, 126.5, 126.1, 125.9, 114.0, 61.5, 60.8, 54.2, 51.7, 40.7, 31.6, 28.9, 28.7, 13.9. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{40}H_{49}N_2O_3^+$ 605.3738, found 605.3741.

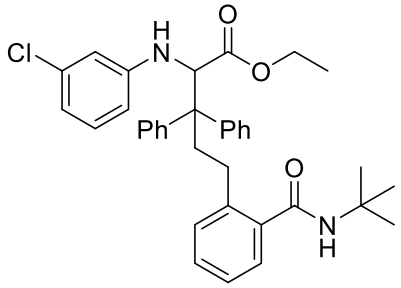


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((3-methoxyphenyl)amino)-3,3-diphenylpentanoate (4i): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 20.6 mg, 71% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 - 7.26 (m, 9H), 7.25 - 7.13 (m, 5H), 7.08 (t, *J* = 8.1 Hz, 1H), 6.33 - 6.29 (m, 2H), 6.23 (t, *J* = 2.2 Hz, 1H), 5.42 (s, 1H), 5.04 (s, 1H), 3.96 - 3.89 (m, 2H), 3.76 (s, 3H), 2.74 - 2.63 (m, 3H), 2.36 - 2.26 (m, 1H), 1.34 (s, 9H), 0.96 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.1, 169.6, 160.9, 148.2, 143.3, 130.2, 130.1, 129.8, 129.6, 129.4, 128.0, 127.8, 127.1 126.6, 126.6, 125.9, 107.0, 104.1, 100.2, 61.0, 60.9, 55.3, 54.1, 51.7, 40.8, 28.9, 28.7, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_4^+$ 579.3217, found 579.3218.

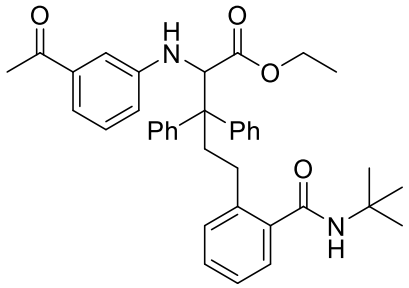


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((3-fluorophenyl)amino)-3,3-diphenylpentanoate (4j): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White oil, 20.0 mg, 71% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.40 - 7.27 (m, 12H), 7.20 (t, *J* = 7.5 Hz, 2H),

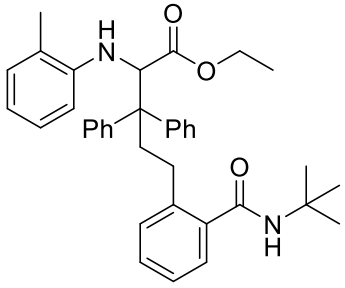
7.14 (q, *J* = 8.0 Hz, 1H), 6.53 - 6.42 (m, 3H), 5.48 (s, 1H), 5.05 (s, 1H),4.02 - 3.94 (m, 2H), 2.72 (d, *J* = 7.9 Hz, 3H), 2.45 - 2.33 (m, 1H), 1.40 (s, 9H), 1.01 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.8, 169.6, 164.1 (d, *J* = 121.0 Hz), 148.6 (d, *J* = 5.0 Hz), 143.3 (d, *J* =16.0 Hz), 140.0, 138.0, 130.5 (d, *J* = 5.0 Hz), 130.1, 129.7, 129.3, 128.0, 127.9, 127.2, 126.7, 126.6, 125.9, 109.9 (d, *J* = 1.0 Hz), 105.2 (d, *J* = 10.5 Hz), 100.9 (d, *J* = 12.5 Hz), 61.1, 60.9, 54.1, 51.7, 40.8, 28.9, 28.8, 14.0. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -112.66. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}FN_2O_3^+$ 567.3017, found 567.3019.



Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((3-chlorophenyl)amino)-3,3-diphenylpentanoate (4k): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White oil, 19.0 mg, 65% yield. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.36 - 7.27 (m, 8H), 7.24 (d, *J* = 7.4 Hz, 4H), 7.16 (t, *J* = 7.4 Hz, 2H), 7.07 (t, *J* = 8.0 Hz, 1H), 6.75 - 6.65 (m, 2H), 6.57 - 6.54 (m, 1H), 5.44 (s, 1H), 5.00 (s, 1H), 4.00 - 3.87 (m, 2H), 2.67 (q, *J* = 6.2, 4.5 Hz, 3H), 2.40 - 2.28 (m, 1H), 1.35 (s, 9H), 0.96 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.8, 169.6, 147.9, 143.4, 143.1, 140.0, 138.0, 135.1, 130.4, 130.1, 129.7, 129.6, 129.3, 128.0, 127.9, 127.2, 126.7, 126.7, 126.0, 118.7, 113.9, 112.3, 61.1, 60.8, 54.0, 51.8, 40.8, 28.9, 28.8, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}ClN_2O_3^+$ 583.2722, found 583.2725.

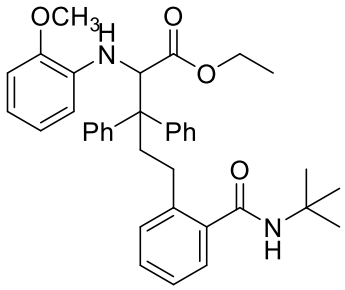


Ethyl 2-((3-acetylphenyl)amino)-5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenylpentanoate (4l): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 21.0 mg, 71% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 (d, *J* = 4.0 Hz, 5H), 7.30 - 7.26 (m, 6H), 7.26 - 7.21 (m, 4H), 7.18 - 7.13 (m, 2H), 6.90 - 6.88 (m, 1H), 5.43 (s, 1H), 5.09 (s, 1H), 3.99 - 3.88 (m, 2H), 2.74 - 2.65 (m, 3H), 2.56 (s, 3H), 2.39 - 2.30 (m, 1H), 1.34 (s, 9H), 0.96 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 198.6, 171.9, 169.6, 147.1, 140.0, 138.3, 130.1, 129.7, 129.7, 129.6, 129.4, 128.0, 127.9, 127.2, 126.7, 126.6, 125.9, 119.2, 118.6, 113.3, 61.1, 61.0, 54.2, 51.7, 40.9, 28.9, 28.8, 26.9, 14.0. RMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{38}H_{43}N_2O_4^+$ 591.3217, found 591.3218.

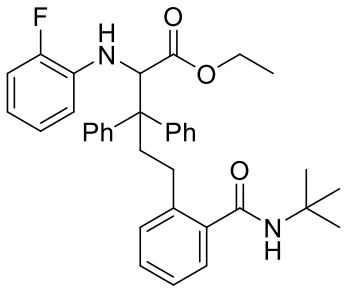


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(o-tolylamino)pentanoate (4m): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White solid, 13.0 mg, 46% yield, M. p. 104-108 °C. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.32 (d, *J* = 4.5 Hz, 4H), 7.30 - 7.26 (m, 6H), 7.25 -7.19 (m, 3H), 7.18 - 7.10 (m, 2H), 7.00 (d, *J* = 7.1 Hz, 1H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.68 (t, *J* = 7.3 Hz, 1H), 5.40 (s, 1H), 5.20 -5.09 (m, 1H), 3.97 - 3.90 (m, 2H), 2.82 - 2.64 (m, 3H), 2.32 - 2.24 (m, 1H), 1.89 (s, 3H), 1.33 (s, 9H), 0.94 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.3, 169.6, 147.8, 144.0, 143.4, 139.9, 138.3,

137.0, 130.0, 129.8, 129.6, 129.3, 127.9, 127.6, 127.0, 126.6, 126.5, 125.9, 121.4, 117.6, 110.5, 110.4, 60.8, 60.5, 55.9, 54.0, 51.7, 40.6, 28.9, 28.6, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_3^+$ 563.3268, found 563.3270.

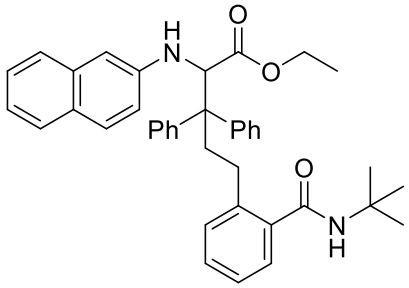


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((2-methoxyphenyl)amino)-3,3-diphenylpentanoate (4n): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow solid, 18.4 mg, 64% yield, M. p. 137-141 ℃. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 (t, *J* = 7.7 Hz, 4H), 7.30 - 7.25 (m, 6H), 7.22 (d, *J* = 7.7 Hz, 3H), 7.15 (t, *J* = 7.3 Hz, 1H), 6.89 - 6.85 (m, 1H), 6.78 - 6.65 (m, 3H), 5.40 (s, 1H), 5.07 (s, 1H), 3.94 - 3.86 (m, 2H), 3.68 (s, 3H), 2.79 - 2.64 (m, 3H), 2.37 - 2.26 (m, 1H), 1.33 (s, 9H), 0.92 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.3, 169.6, 147.8, 138.3, 137.0, 130.0, 129.8, 129.6, 129.3, 127.9, 127.6, 127.0, 126.6, 126.5, 125.9, 121.4, 117.6, 110.5, 110.4, 60.8, 60.5, 55.9, 54.0, 51.7, 40.6, 28.9, 28.6, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_4^+$ 579.3217, found 579.3217.

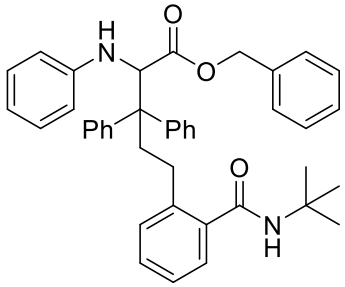


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-((2-fluorophenyl)amino)-3,3-diphenylpentanoate (4o): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 20.0 mg, 74% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.3 4 (d, *J* = 4.2 Hz, 4H), 7.32 - 7.28 (m, 3H), 7.27 (d, *J* = 2.3 Hz, 3H), 7.24 - 7.18 (m, 3H), 7.17 - 7.13 (m, 1H), 7.01 (t, *J* = 7.7 Hz,

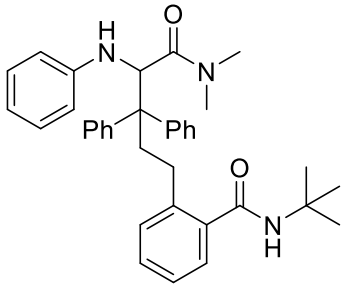
1H), 6.95 - 6.90 (m, 1H), 6.87 - 6.82 (m, 1H), 6.72 - 6.63 (m, 1H), 5.41 (s, 1H), 5.07 (s, 1H), 3.95 - 3.87 (m, 2H), 2.76 - 2.66 (m, 3H), 2.35 - 2.26 (m, 1H), 1.33 (s, 9H), 0.92 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.7, 169.6, 152.2 (d, *J* = 119.0 Hz),143.4, 142.8, 139.9, 138.3, 135.4 (d, *J* = 6.0 Hz), 129.8 (d, *J* = 21.0 Hz), 129.70, 129.3, 128.0, 127.8, 127.2, 126.7, 126.6, 125.9, 124.7 (d, *J* = 1.5 Hz), 118.1 (d, *J* = 4.0 Hz), 115.0, 114.8, 113.0 (d, *J* = 1.5 Hz), 61.0, 60.5, 54.3, 51.7, 40.9, 28.9, 28.6, 13.9. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -134.66. HRMS (ESI-TOF) m/z: [M + H]$^+$ Calcd for $C_{36}H_{40}FN_2O_3^+$ 567.3017, found 567.3020.



Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-(naphthalen-2-ylamino)-3,3-diphenylpentanoate (4p): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 17.5 mg, 59% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.66 (d, *J* = 8.6 Hz, 2H), 7.60 (d, *J* = 8.8 Hz, 1H), 7.40 - 7.35 (m, 1H), 7.33 (d, *J* = 4.1 Hz, 4H), 7.31 - 7.26 (m, 5H), 7.25 - 7.18 (m, 5H), 7.15 (t, *J* = 7.3 Hz, 1H), 6.97 (d, *J* = 2.0 Hz, 1H), 6.87 - 6.84 (m, 1H), 5.44 (s, 1H), 5.18 (s, 1H), 3.99 - 3.84 (m, 2H), 2.81 - 2.69 (m, 3H), 2.40 - 2.31 (m, 1H), 1.35 (s, 9H), 0.93 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.2, 169.6, 144.4, 143.8, 143.3, 140.0, 138.2, 130.1, 129.8, 129.6, 129.3, 129.1, 128.3, 128.0, 127.9, 127.7, 127.2, 126.7, 126.6, 126.5, 126.3, 125.9, 122.6, 119.1, 105.7, 61.0, 60.6, 54.1, 51.8, 40.8, 29.0, 28.7, 14.0. HRMS (ESI-TOF) m/z: [M + H]$^+$ Calcd for $C_{40}H_{43}N_2O_3^+$ 599.3268, found 599.3269.

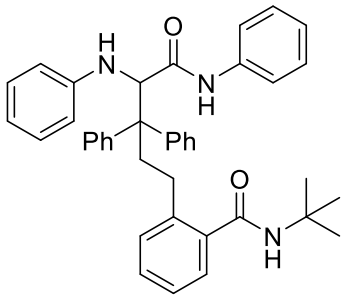


Benzyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino)pentanoate (4q): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 20.6 mg, 68% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.29 - 7.26 (m, 6H), 7.25 -7.10 (m, 13H), 6.96 (d, *J* = 7.0 Hz, 2H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.68 (d, *J* = 7.7 Hz, 2H), 5.37 (s, 1H), 5.14 (s, 1H), 4.91 (d, *J* = 2.7 Hz, 2H), 2.76 - 2.59 (m, 3H), 2.34 - 2.29 (td, *J* = 11.4, 4.2 Hz, 1H), 1.33 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.1, 169.6, 146.7, 143.4, 143.1, 139.9, 138.2, 135.4, 130.0, 129.7, 129.6, 129.5, 129.4, 128.6, 128.4, 128.2, 128.0, 127.8, 127.1, 126.6, 126.6, 125.9, 118.9, 114.3, 66.8, 61.1, 54.2, 51.7, 40.7, 28.9, 28.6. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{41}H_{43}N_2O_3^+$ 611.3268, found 599.3270.

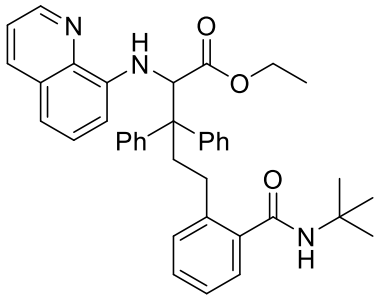


N-(*tert*-butyl)-2-(5-(dimethylamino)-5-oxo-3,3-diphenyl-4-(phenylamino)pentyl) benzamide (4r): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 9.3 mg, 40% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.52 (d, *J* = 7.5 Hz, 2H), 7.35 - 7.27 (m, 8H), 7.24 - 7.12 (m, 6H), 6.76 (t, *J* = 8.7 Hz, 3H), 5.49 (s, 1H), 5.16 (s, 1H), 2.96 - 2.85 (m, 2H), 2.57 (d, *J* = 8.4 Hz, 2H), 2.53 (s, 3H), 2.35 (s, 3H), 1.33 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.2, 170.1, 147.3, 145.4, 144.7, 140.8, 138.4, 130.5, 130.2, 130.1, 130.0, 129.8, 128.5, 128.3, 128.1, 127.0, 126.1, 119.2, 114.9, 61.2, 54.9, 53.9, 52.1,

37.6, 36.2, 29.2. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{42}N_3O_2^+$ 548.3272, found 548.3275.

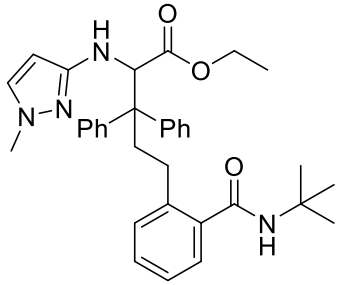


N-(*tert*-butyl)-2-(5-oxo-3,3-diphenyl-4,5-bis(phenylamino)pentyl)benzamide (4s): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 12.1 mg, 41% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.19 (s, 1H), 7.36 - 7.27 (m, 10H), 7.24 - 7.13 (m, 8H), 7.13 - 7.08 (m, 2H), 7.03 - 6.97 (m, 1H), 6.83 (t, *J* = 7.4 Hz, 1H), 6.75 - 6.69 (m, 2H), 5.58 (s, 1H), 4.74 (s, 1H), 2.81 - 2.64 (m, 3H), 2.23 - 2.13 (m, 1H), 1.37 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 170.1, 170.0, 151.6, 146.7, 143.0, 139.9, 137.9, 137.5, 130.3, 129.8, 129.6, 129.6, 129.5, 128.7, 128.4, 128.0, 127.4, 126.9, 126.4, 125.9, 124.2, 120.3, 119.8, 114.43, 63.9, 55.5, 53.6, 51.9, 41.1, 28.9. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{40}H_{42}N_3O_2^+$ 596.3272, found 596.3273.

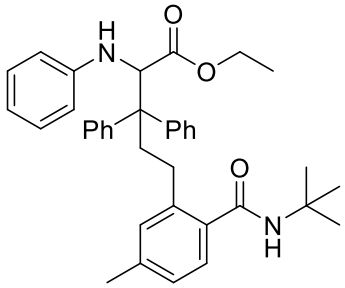


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(quinolin-8-ylamino)pentanoate (4t): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 22.6 mg, 80% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 8.62 (dd, *J* = 4.2, 1.6 Hz, 1H), 8.01 (dd, *J* = 8.3, 1.5 Hz, 1H), 7.49 (d, *J* = 7.5 Hz, 2H), 7.41 - 7.36 (m, 3H), 7.33 - 7.27 (m, 6H), 7.25 - 7.12 (m, 4H), 7.09 (d, *J* = 7.9 Hz, 1H), 6.93 (d, *J* = 10.5 Hz, 1H), 6.84 (d, *J* = 7.5 Hz, 1H), 5.44 (s, 1H), 5.25 (d, *J* = 10.3 Hz, 1H), 3.93 -3.82 (m, 2H), 2.88 - 2.76 (m, 3H),

2.46 - 2.37 (m, 1H), 1.33 (s, 9H), 0.87 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.1, 169.6, 147.3, 144.0, 143.6, 143.5, 140.0, 138.3, 135.8, 130.1, 129.8, 129.6, 129.3, 128.7, 128.0, 127.8, 127.6, 127.0, 126.6, 126.5, 125.8, 121.5, 115.1, 105.2, 61.0, 60.8, 54.2, 51.7, 40.6, 28.9, 28.7, 13.9. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{39}H_{41}N_3O_3^+$ 599.3148, found 599.3152.

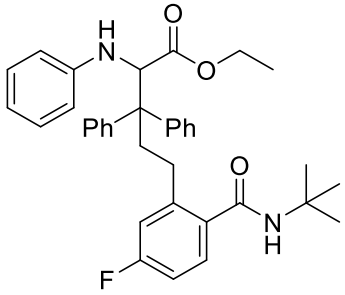


Ethyl 5-(2-*(tert*-butylcarbamoyl)phenyl)-2-((1-methyl-*1H*-pyrazol-3-yl)amino)-3,3-diphenylpentanoate (4u): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 1:1, v/v) to give the desired product: Yellow oil, 8.6 mg, 31% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.35 - 7.27 (m, 8H), 7.26 - 7.24 (m, 2H), 7.23 - 7.10 (m, 5H), 7.07 (d, *J* = 2.2 Hz, 1H), 5.54 (d, *J* = 2.3 Hz, 1H), 5.44 (s, 1H), 5.17 (s, 1H), 3.93 (q, *J* = 7.1 Hz, 2H), 3.70 (s, 3H), 2.72 - 2.62 (m, 3H), 2.34 - 2.27 (m, 1H), 1.34 (s, 9H), 0.97 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.6, 169.6, 155.7, 143.9, 143.3, 140.0, 138.3, 131.1, 129.9, 129.8, 129.5, 129.5, 127.8, 127.6, 126.9, 126.6, 126.4, 125.8, 91.7, 61.8, 60.8, 54.3, 51.7, 40.8, 38.7, 28.9, 28.4, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{34}H_{41}N_4O_3^+$ 553.3173, found 553.3177.

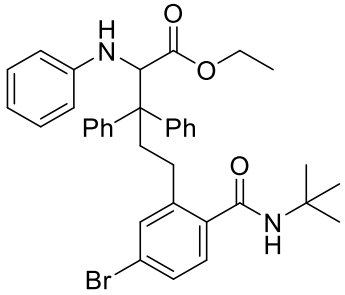


Ethyl 5-(2-(*tert*-butylcarbamoyl)-5-methylphenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4v): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 16.0 mg, 57% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.35 - 7.30 (m, 4H), 7.27 (d, *J* = 6.2 Hz, 5H), 7.23 - 7.21

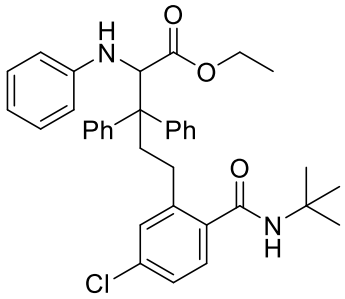
(m, 1H), 7.20 - 7.14 (m, 2H), 7.13 (d, *J* = 7.6 Hz, 1H), 6.95 (d, *J* = 10.0 Hz, 2H), 6.75 (t, *J* = 7.3 Hz, 1H), 6.70 (d, *J* = 7.8 Hz, 2H), 5.40 (s, 1H), 5.06 (s, 1H), 3.96 - 3.88(m, 2H), 2.72 - 2.63 (m, 3H), 2.35 - 2.28(m, 1H), 2.30 (s, 3H), 1.33 (s, 9H), 0.95 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-d)** δ 172.2, 169.7, 146.8, 143.7, 143.4, 140.1, 139.5, 135.4, 130.8, 129.8, 129.5, 129.4, 127.9, 127.8, 127.0, 126.7, 126.6, 126.5, 118.8, 114.2, 61.1, 60.9, 54.2, 51.6, 40.7, 29.0, 28.7, 21.4, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_3^+$ 563.3268, found 563.3269.



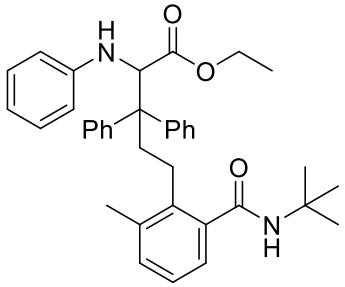
Ethyl 5-(2-(*tert*-butylcarbamoyl)-5-fluorophenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4w): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 17.3 mg, 61% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.30 (q, *J* = 5.8, 5.4 Hz, 6H), 7.26 (d, *J* = 2.7 Hz, 2H), 7.24 - 7.21 (m, 2H), 7.20 - 7.15 (m, 2H), 6.91 - 6.80 (m, 2H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.68 (d, *J* = 7.9 Hz, 2H), 5.39 (s, 1H), 5.05 (s, 1H), 3.97 - 3.89 (m, 2H), 2.75 - 2.62(m, 3H), 2.34 - 2.26 (m, 1H), 1.33 (s, 9H), 0.95 (t, *J* = 7.1 Hz, 3H).^{13}C NMR (101 MHz, Chloroform-*d*) δ 172.2, 168.7, 163.2 (d, *J*=123.5), 146.7, 143.5, 143.2 (d, *J*=4.0 Hz), 143.1, 134.3 (d, *J*=1.5 Hz), 129.7, 129.4, 129.3, 128.6, 128.5, 128.0, 127.8, 126.9 (d, *J*=25.5 Hz), 118.8, 116.7 (d, *J*=11.0 Hz), 114.2, 112.9(d, *J*=4.0 Hz),61.0, 60.8, 54.0, 51.8, 40.6, 28.9, 28.8, 14.0. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -111.43. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}FN_2O_3^+$ 567.3017, found 567.3017.



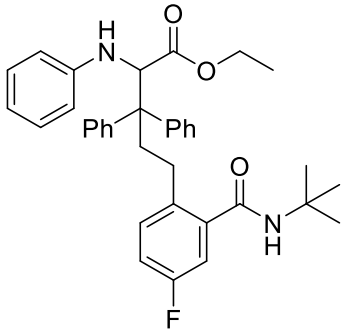
Ethyl 5-(5-bromo-2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4x): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 24.8 mg, 79% yield. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.35 - 7.26 (m, 9H), 7.26 - 7.21 (m, 3H), 7.21 - 7.15 (m, 2H), 7.10 (d, *J* = 8.0 Hz, 1H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.68 (d, *J* = 7.8 Hz, 2H), 5.39 (s, 1H), 5.05 (s, 1H), 4.00 - 3.92 (m, 2H), 2.70 - 2.62 (m, 3H), 2.32 - 2.23 (m, 1H), 1.33 (s, 9H), 0.98 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.1, 168.6, 146.7, 143. 5, 143.1, 142.5, 136.9, 133.0, 129.7, 129.5, 129.3, 129.0, 128.2, 128.3, 127.8, 127.2, 127.0, 126.7, 123.6, 118.9, 114.2, 61.0, 60.8, 54.0, 51.9, 40.6, 28.9, 28.6, 14.1. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}BrN_2O_3^+$ 627.2217, found 627.2220.



Ethyl 5-(2-(*tert*-butylcarbamoyl)-5-chlorophenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4y): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 21.7 mg, 74% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.30 (q, *J* = 7.2, 6.0 Hz, 6H), 7.26 (d, *J* = 3.0 Hz, 2H), 7.25 - 7.10 (m, 7H), 6.76 (t, *J* = 7.3 Hz, 1H), 6.69 (d, *J* = 7.9 Hz, 2H), 5.40 (s, 1H), 5.05 (s, 1H), 3.99 - 3.91 (m, 2H), 2.74 - 2.61 (m, *J* = 5.2, 4.3 Hz, 3H), 2.33 - 2.25 (m, 1H), 1.33 (s, 9H), 0.97 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.1, 168.6, 146.7, 143.1, 142.3, 136.5, 135.3, 130.1, 129.7, 129.4, 129.3, 128.1, 128.0, 127.8, 127.2, 126.7, 126.1, 118.9, 114.2, 61.0, 60.8, 54.0, 51.9, 40.6, 28.9, 28.7, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}ClN_2O_3^+$ 583.2722, found 583.2723.

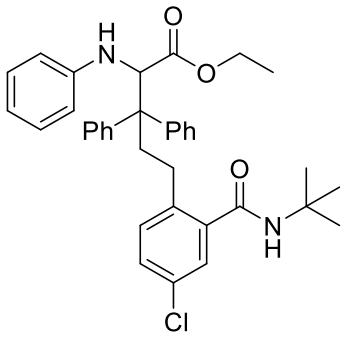


Ethyl 5-(2-(*tert*-butylcarbamoyl)-6-methylphenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4z): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 23.4 mg, 83% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.56 - 7.50 (m, 2H), 7.39 - 7.26 (m, 8H), 7.18 - 7.12 (m, 2H), 7.10 - 7.00 (m, 3H), 6.77 - 6.66 (m, 3H), 5.50 (s, 1H), 4.94 (s, 1H), 3.86 - 3.74 (m, 2H), 2.71 - 2.62 (m, 1H), 2.61 - 2.48 (m, 3H), 1.73 (s, 3H), 1.44 (s, 9H), 0.87 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.0, 170.4, 147.0, 142.7, 142.5, 138.7 138.5, 131.7, 130.2, 129.9, 129.3, 127.8, 127.7, 126.9, 126.7, 125.7, 124.5, 118.7, 114.4, 63.4, 60.8, 55.3, 51.8, 39.0, 29.1, 25.4, 18.8, 13.8. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_3^+$ 563.3268, found 563.3268.

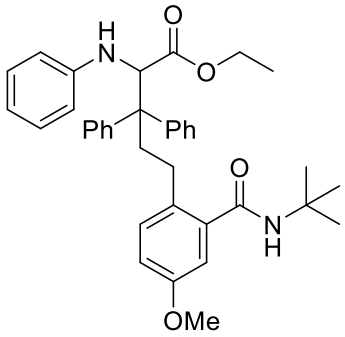


Ethyl 5-(2-(*tert*-butylcarbamoyl)-4-fluorophenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4aa): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 23.9 mg, 84% yield. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.24 - 7.06 (m, 13H), 6.94 - 6.82 (m, 2H), 6.67 (t, *J* = 7.3 Hz, 1H), 6.60 (d, *J* = 7.8 Hz, 2H), 5.32 (s, 1H), 4.98 (s, 1H), 3.83 (q, *J* = 7.1 Hz, 2H), 2.64 - 2.53 (m, 3H), 2.24 - 2.12 (m, 1H), 1.25 (s, 9H), 0.85 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.2, 168.2, 160.7 (d, *J* = 122.5 Hz), 146.7, 143.6, 143.2, 139.4 (d, *J* = 3.0 Hz), 135.7 (d, *J* = 1.5 Hz), 131.8 (d, *J* = 3.5 Hz), 129.7, 129.4,

129.4, 128.0, 127.8, 127.1, 126.6, 118.8, 116.4 (d, J = 10.0 Hz), 114.2, 113.6 (d, J = 16.0 Hz), 61.0, 54.1, 52.0, 41.0, 28.9, 28.0, 14.0. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -116.77. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}FN_2O_3^+$ 567.3017, found 567.3019.

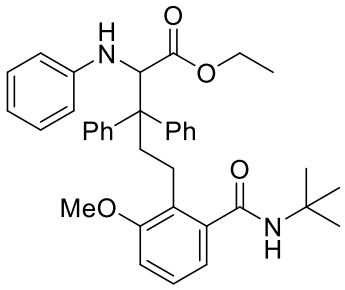


Ethyl 5-(2-(*tert*-butylcarbamoyl)-4-chlorophenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4ab): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 25.5 mg, 87% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.36 - 7.27 (m, 7H), 7.26 - 7.11 (m, 8H), 6.75 (t, J = 7.3 Hz, 1H), 6.67 (d, J = 8.0 Hz, 2H), 5.40 (s, 1H), 5.05 (s, 1H), 3.91 (q, J = 7.1 Hz, 2H), 2.73 - 2.60 (m, 3H), 2.30 - 2.21 (m, 1H), 1.33 (s, 9H), 0.93 (t, J = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.2, 168.0, 146.7, 143.5, 143.1, 139.5, 138.6, 131.7, 131.5, 129.7, 129.6, 129.4, 129.3, 128.0, 127.8, 127.2, 126.7, 126.6, 118.9, 114.2, 60.9, 60.9, 54.1, 52.0, 40.8, 28.9, 28.2, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{40}ClN_2O_3^+$ 583.2722, found 583.2726.

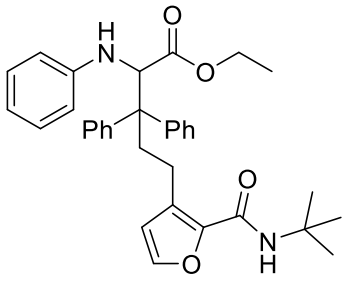


Ethyl 5-(2-(*tert*-butylcarbamoyl)-4-methoxyphenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4ac): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 18.0 mg, 62% yield. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.32 - 7.26 (m, 8H), 7.25 - 7.14 (m, 4H), 7.11 (d, J = 8.5

Hz, 1H), 6.85 - 6.82 (m, 1H), 6.78 - 6.72 (m, 2H), 6.68 (d, *J* = 7.8 Hz, 2H), 5.40 (s, 1H), 5.06 (s, 1H), 3.94 - 3.88 (m, 2H), 3.78 (s, 3H), 2.71 - 2.59 (m, 3H), 2.28 - 2.20 (m, 1H), 1.33 (s, 9H), 0.94 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.2, 169.3, 157.6, 146.8, 143.3, 131.7, 131.2, 129.8, 129.4, 129.4, 127.9, 127.8, 127.1, 126.6, 118.8, 115.2, 114.2, 112.2, 61.0, 60.9, 55.6, 54.1, 51.8, 41.0, 28.9, 27.8, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_4^+$ 579.3217, found 579.3217.

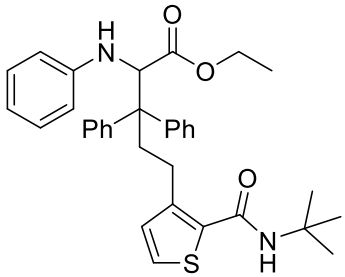


Ethyl 5-(2-(*tert*-butylcarbamoyl)-6-methoxyphenyl)-3,3-diphenyl-2-(phenylamino) pentanoate (4ad): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 25.0 mg, 86% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.43 (d, *J* = 7.5 Hz, 2H), 7.32 - 7.26 (m, 3H), 7.26 - 7.12 (m, 8H), 6.90 - 6.83 (m, 2H), 6.78 - 6.73 (dd, *J* = 7.5, 3.7 Hz, 3H), 5.40 (s, 1H), 4.93 (s, 1H), 3.83 (s, 3H), 3.78 - 3.70 (m, 2H), 3.65 - 3.56 (m, 1H), 2.95 - 2.84 (m, 1H), 2.72 - 2.58 (m, 2H), 2.42 - 2.31 (m, 1H), 1.33 (s, 9H), 0.82 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.5, 169.4, 158.0, 147.1, 144.9, 129.5, 129.4, 128.6, 127.8, 127.6, 127.0, 126.5, 126.4, 118.8, 118.5, 114.1, 111.4, 63.8, 60.6, 55.7, 53.7, 51.7, 36.7, 29.0, 24.8, 13.8. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{37}H_{43}N_2O_4^+$ 579.3217, found 579.3221.

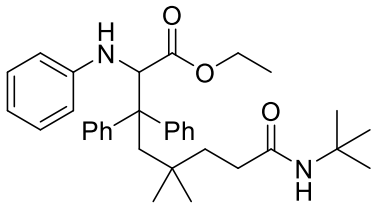


Ethyl 5-(2-(*tert*-butylcarbamoyl)furan-3-yl)-3,3-diphenyl-2-(phenylamino)pentanoate (4ae): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 12.7 mg,

47% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.32 (d, *J* = 4.3 Hz, 4H), 7.27 - 7.22 (m, 5H), 7.22 - 7.14 (m, 4H), 6.80 (d, *J* = 8.0 Hz, 2H), 6.75 (t, *J* = 7.3 Hz, 1H), 6.19 (d, *J* = 1.4 Hz, 1H), 6.11 (s, 1H), 5.05 (s, 1H), 3.88 (p, *J* = 7.0 Hz, 2H), 2.81 (t, *J* = 10.3 Hz, 1H), 2.67 - 2.57 (m, 3H), 1.45 (s, 9H), 0.96 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.3, 172.3, 158.9, 146.9, 144.6, 143.8, 142.7, 141.7, 131.0, 129.7, 129.4, 127.9, 127.8, 126.9, 126.6, 118.6, 114.4, 113.9, 61.4, 60.8, 53.6, 51.3, 38.8, 29.2, 21.2, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{34}H_{39}N_2O_4^+$ 539.2904, found 539.2905.

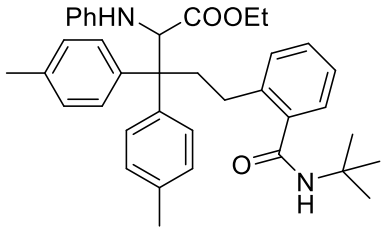


Ethyl 5-(2-(*tert*-butylcarbamoyl)thiophen-3-yl)-3,3-diphenyl-2-(phenylamino) pentanoate (4af): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow solid, 18.4 mg, 66% yield, M. p. 179-181 ℃. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.26 - 7.16 (m, 10H), 7.14 - 7.09 (m, 3H), 6.74 – 6.65 (m, 4H), 5.53 (s, 1H), 4.97 (s, 1H), 3.86 - 3.79 (m, 2H), 2.80 - 2.72 (m, 1H), 2.67 - 2.54(m, 2H), 2.50 - 2.43 (m, 1H), 1.32 (s, 9H), 0.85 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.2, 162.4, 146.8, 144.2, 143.8, 143.5, 133.2 130.3, 129.6, 129.4, 129.3 128.0, 127.9, 127.1, 126.7, 126.1, 118.8, 114.3, 61.1, 60.9, 53.7, 52.1, 39.6, 29.0, 25.2, 13.9. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{34}H_{39}N_2O_3S^+$ 555.2676, found 555.2676.

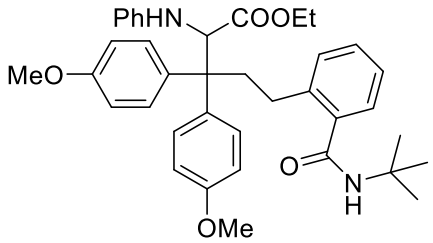


Ethyl 8-(*tert*-butylamino)-5,5-dimethyl-8-oxo-3,3-diphenyl-2-(phenylamino)octanoate (4ag): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: White solid, 13.2 mg,

50% yield, M. p. 128-131 °C. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.37 - 7.27 (m, 5H), 7.25 - 7.08 (m, 7H), 6.74 (t, *J* = 7.3 Hz, 1H), 6.62 (d, *J* = 7.8 Hz, 2H), 5.34 (s, 1H), 5.15 (s, 1H), 3.96 - 3.77 (m, 2H), 2.58 (d, *J* = 14.7 Hz, 1H), 2.22 (d, *J* = 14.7 Hz, 1H), 2.08 - 1.94 (m, 2H), 1.32 (s, 9H), 1.25 - 1.18 (m, 2H), 0.95 - 0.88 (m, 6H), 0.56 (s, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 173.0, 172.3, 146.8, 144.9, 129.6, 129.5, 127.5, 127.5, 127.1, 126.7, 118.8, 114.1, 60.8, 60.4, 53.6, 51.1, 47.5, 34.6, 33.0, 28.9, 28.1, 27.7, 13.9. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{34}H_{45}N_2O_3^+$ 529.3425, found 529.3426.

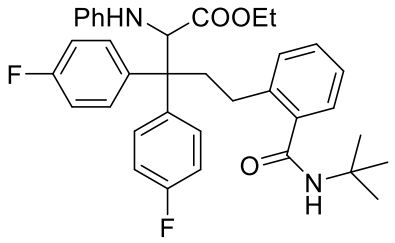


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-2-(phenylamino)-3,3-di-*p*-tolylpentanoate (4ah): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow solid, 23.2 mg, 80% yield, M. p. 178-180 °C. ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.32 - 7.26 (m, 1H), 7.26 - 7.05 (m, 13H), 6.74 (t, *J* = 7.3 Hz, 1H), 6.67 (d, *J* = 7.8 Hz, 2H), 5.40 (s, 1H), 5.02 (s, 1H), 3.94 (q, *J* = 7.1 Hz, 2H), 2.76 - 2.54 (m, 3H), 2.35 (s, 3H), 2.31 (s, 3H), 2.33 - 2.27 (m, 1H), 1.33 (s, 9H), 0.96 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.3, 169.6, 146.8, 140.6, 140.2, 140.0, 138.3, 136.5, 136.0, 130.0, 129.6, 129.5, 129.4, 129.2, 128.6, 128.5, 126.6, 125.8, 118.6, 114.1, 60.9, 60.9, 53.5, 51.7, 40.9, 28.8, 28.6, 21.1, 21.0, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{38}H_{45}N_2O_3^+$ 577.3425, found 577.3426.

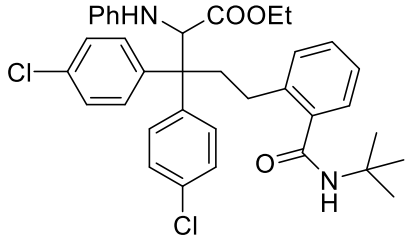


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-bis(4-methoxyphenyl)-2-(phenylamino)pentanoate (4ai): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Brown oil, 20.6 mg,

68% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.31 -7.26 (m, 1H), 7.25 - 7.12 (m, 9H), 6.83 (t, *J* = 8.9 Hz, 4H), 6.74 (t, *J* = 7.3 Hz, 1H), 6.67 (d, *J* = 7.8 Hz, 2H), 5.42 (s, 1H), 4.99 (s, 1H), 3.94 (q, *J* = 7.1 Hz, 2H), 3.81 (s, 3H), 3.79 (s, 3H), 2.76 - 2.54 (m, 3H), 2.34 - 2.27 (m, 1H), 1.34 (s, 9H), 0.97 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.4, 169.6, 158.4, 158.0, 146.8, 140.1, 138.2, 135.4, 130.8, 130.4, 130.0, 129.6, 129.4, 126.6, 125.9, 118.7, 114.2, 113.2, 113.0, 61.3, 60.9, 55.3, 55.3, 53.0, 51.7, 41.2, 28.9, 14.1. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{38}H_{45}N_2O_5^+$ 609.3323, found 609.3326.

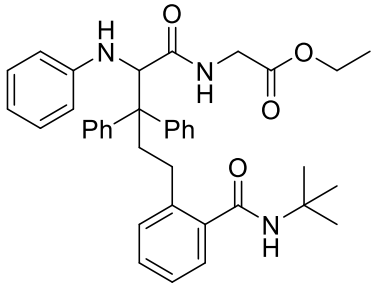


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-bis(4-fluorophenyl)-2-(phenylamino) pentanoate (4aj): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow oil, 18 mg, 62% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 - 7.26 (m, 3H), 7.26 - 7.14 (m, 7H), 7.00 (q, *J* = 8.7 Hz, 4H), 6.78 (t, *J* = 7.3 Hz, 1H), 6.70 (d, *J* = 7.8 Hz, 2H), 5.43 (s, 1H), 5.02 (s, 1H), 3.99 - 3.91 m, 2H), 2.71 - 2,61 (m, 3H), 2.30 - 2.22 (m, 1H), 1.34 (s, 9H), 0.98 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.0, 169.5, 161.9 (d, *J* = 123.0 Hz), 161.5 (d, *J* = 122.5 Hz) 146.5, 139.9, 139.2 (d, *J* = 2.0 Hz), 139.0 (d, *J* = 1.5 Hz), 138.1, 131.4 (d, *J* = 4.0 Hz), 131.0 (d, *J* = 4.0 Hz), 130.0 (d, *J* = 25.5 Hz), 129.5, 126.3 (d, *J* = 26.5 Hz), 119.2, 114.0, 114.7, 114.7, 114.5, 114.4, 61.1, 61.1, 53.2, 51.8, 41.2, 29.2, 28.9, 14.0. **^{19}F NMR (376 MHz, Chloroform-*d*)** δ -115.69, -116.41. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{39}F_2N_2O_3^+$ 585.2923, found 585.2923.

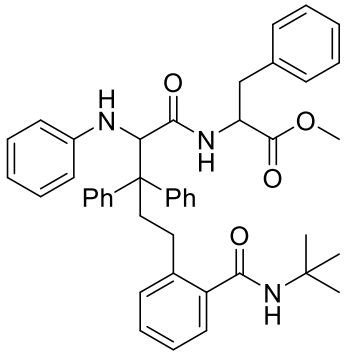


Ethyl 5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-bis(4-chlorophenyl)-2-(phenylamino)pentanoate (4ak): Purified by flash chromatography (silica gel,

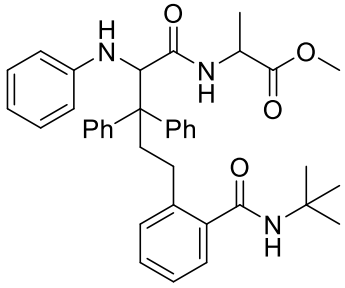
petroleum ether/ethyl acetate 5:1, v/v) to give the desired product: Yellow solid, 24.7 mg, 80% yield, M. p. 122-126 ℃. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 - 7.27 (m, 4H), 7.25 -7.22 (m, 3H), 7.23 - 7.15 (m, 7H), 6.79 (t, *J* = 7.3 Hz, 1H), 6.70 (d, *J* = 7.9 Hz, 2H), 5.42 (s, 1H), 5.02 (d, *J* = 11.7 Hz, 1H), 3.98 - 3.93 (m, 3H), 2.64 (q, *J* = 7.4 Hz, 3H), 2.28 - 2.21 (m, 1H), 1.34 (s, 9H), 0.98 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.8, 169.5, 146.4, 141.5, 139.7, 138.0, 133.2, 132.6, 131.1, 130.8, 130.3, 129.8, 129.5, 128.2, 128.0, 126.6, 126.1, 119.3, 114.4, 61.2, 60.8, 53.4, 51.8, 40.9, 29.8, 28.8, 14.0. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{36}H_{39}Cl_2N_2O_3^+$ 617.2332, found 617.2335.



Ethyl (5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino)pentanoyl) glycinate (4al): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 6.0 mg, 20% yield. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.36 - 7.27 (m, 8H), 7.24 - 7.10 (m, 7H), 6.90 (t, *J* = 5.1 Hz, 1H), 6.82 (t, *J* = 7.3 Hz, 1H), 6.64 (d, *J* = 7.9 Hz, 2H), 5.52 (s, 1H), 4.65 (s, 1H), 4.06 - 3.98 (m, 2H), 3.90 - 3.85 (m, 1H), 3.52 - 3.47 (m, 1H), 2.96 - 2.86 (m, 1H), 2.77 - 2.61 (m, 2H), 2.23 - 2.14 (m, 1H), 1.34 (s, 9H), 1.13 (t, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.9, 169.1, 146.7, 143.1, 139.9, 130.3, 129.7, 129.6, 129.5, 129.5, 128.4, 127.9, 127.2, 126.8, 126.4, 125.8, 119.4, 114.3, 63.2, 61.2, 55.5, 51.8, 41.4, 41.1, 28.9, 28.4, 14.2. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{38}H_{44}Cl_2N_3O_4^+$ 606.3326, found 606.3329.

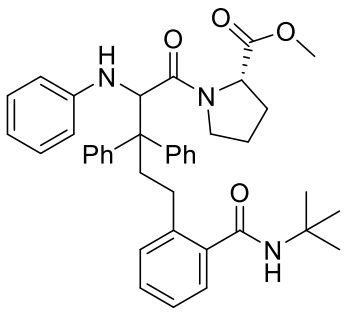


Methyl (5-(2-(tert-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino)pentanoyl)phenylalaninate (4am): Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 6.5 mg, 19% yield, dr. = 1.7 : 1. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 (d, *J* = 4.4 Hz, 4H), 7.22 -7.19 (m, 8H), 7.12 (d, *J* = 7.9 Hz, 7H), 6.96 (t, *J* = 7.6 Hz, 2H), 6.62 (t, *J* = 7.1 Hz, 3H), 5.57 (s, 1H), 4.71 (s, 1H), 4.56 (q, *J* = 6.9 Hz, 1H), 4.16 - 4.03 (m, 1H), 3.51 (s, 3H), 2.78 - 2.67 (m, 4H), 1.37 (s, 9H), 1.21 (s, 2H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 171.6, 171.4, 171.3, 171.0, 170.1, 169.9, 146.7, 146.6, 143.4, 143.4, 143.0, 140.1, 140.1, 137.8, 136.2, 136.0, 130.4, 130.3, 129.7, 129.5, 129.4, 129.3, 129.3, 129.0, 128.5, 128.5, 128.3, 128.3, 128.2, 127.9, 127.8, 127.3, 127.0, 126.9, 126.8, 126.7, 126.6, 126.4, 126.4, 125.9, 125.8, 119.3, 119.2, 114.5, 114.1, 62.8, 62.4, 55.2, 54.9, 53.5, 53.2, 52.0, 51.9, 51.3, 41.3, 40.9, 38.3, 37.5, 29.5, 28.9, 28.7, 28.5, 28.4, 27.4. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{44}H_{48}Cl_2N_3O_4^+$ 682.3639, found 682.3640.



Methyl (5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino)pentanoyl)alaninate (4an)： Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 6.9 mg, 23% yield, dr. = 3 : 1. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.33 - 7.28 (m, 9H),

7.23 - 7.17 (m, 6H), 6.81 (t, *J* = 7.3 Hz, 2H), 6.63 (d, *J* = 7.8 Hz, 2H), 5.51 (s, 1H), 4.66 (s, 1H), 4.31 - 4.27 (m, 1H), 3.57 (s, 3H), 2.76 - 2.63 (m, 3H), 2.20 - 2.13 (m, 1H), 1.34 (s, 3H), 1.33 (s, 9H), 1.08 (d, *J* = 7.1 Hz, 3H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.8, 172.4, 171.2, 169.9, 169.9, 146.8, 146.7, 143.2, 143.1, 142.9, 142.8, 140.0, 139.9, 138.0, 137.9, 130.3, 130.3, 129.7, 129.7, 129.6, 129.6, 129.5, 129.5, 129.4, 128.4, 127.9, 127.2, 127.1, 126.8, 126.7, 126.4, 125.8, 119.5,119.3, 114.6, 114.1, 63.3, 63.1, 55.4, 55.1, 52.2, 52.1, 51.8, 51.8, 48.1, 47.7, 41.1, 41.1, 29.8, 29.5, 28.9, 28.3, 18.0, 17.3. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{38}H_{44}Cl_2N_3O_4^+$ 606.3326, found 606.3327.



Methyl (5-(2-(*tert*-butylcarbamoyl)phenyl)-3,3-diphenyl-2-(phenylamino)pentanoyl)-*L*-prolinate (4ao) : Purified by flash chromatography (silica gel, petroleum ether/ethyl acetate 3:1, v/v) to give the desired product: Yellow oil, 11.3 mg, 36% yield, dr. = 3.2 : 1. **^{1}H NMR (400 MHz, Chloroform-*d*)** δ 7.57 (d, *J* = 5.9 Hz, 2H), 7.39 - 7.27 (m, 7H), 7.23 - 7.13 (m, 7H), 6.85 - 6.68 (m, 3H), 5.49 (s, 1H), 5.06 (s, 1H), 4.18 - 4.09 (m, 1H), 3.68 (s, 1H), 3.57 (s, 3H), 2.85 - 2.67 (m, 4H), 2.35 - 2.21 (m, 2H), 1.74 - 1.61 (m, 2H), 1.60 - 1.46 (m, 2H), 1.35 (s, 2H), 1.31 (s, 9H). **^{13}C NMR (101 MHz, Chloroform-*d*)** δ 172.9, 172.7, 170.9, 170.7, 169.8, 169.7, 146.6, 146.4, 144.9, 144.3, 144.3, 144.0, 143.4, 140.3, 139.7, 139.5, 139.3, 138.3, 138.1, 130.5, 130.3, 129.9, 129.9, 129.5, 129.4, 128.2, 128.2, 128.1, 128.0, 127.0, 126.9, 126.7, 126.6, 126.5, 126.5, 125.7, 125.7, 118.7, 118.6, 113.8, 113.7, 65.3, 64.5, 62.9, 62.7, 60.1, 59.0, 55.5, 54.1, 52.0, 51.9, 51.7, 51.6, 48.7, 46.9, 46.5, 28.9, 28.8, 27.9, 25.7, 25.3. HRMS (ESI-TOF) m/z: $[M + H]^+$ Calcd for $C_{40}H_{46}Cl_2N_3O_4^+$ 632.3483, found 632.3483.

6. References

1. J. Y. Hou, H. F. Fan, X. Zhang, X. Y. Liu, J. Chen, G. H. Lv, S. Y. He, L. Hai, Z. Z. Yang, and Y. Wu, Organic Photoredox-Catalyzed Site-Selective Alkylation of Glycine Derivatives and Peptides via Infrequent 1,2-Hydrogen Atom Transfer of Amidyl Radicals, *Org. Lett*., 2024, **26**, 7638-7643.
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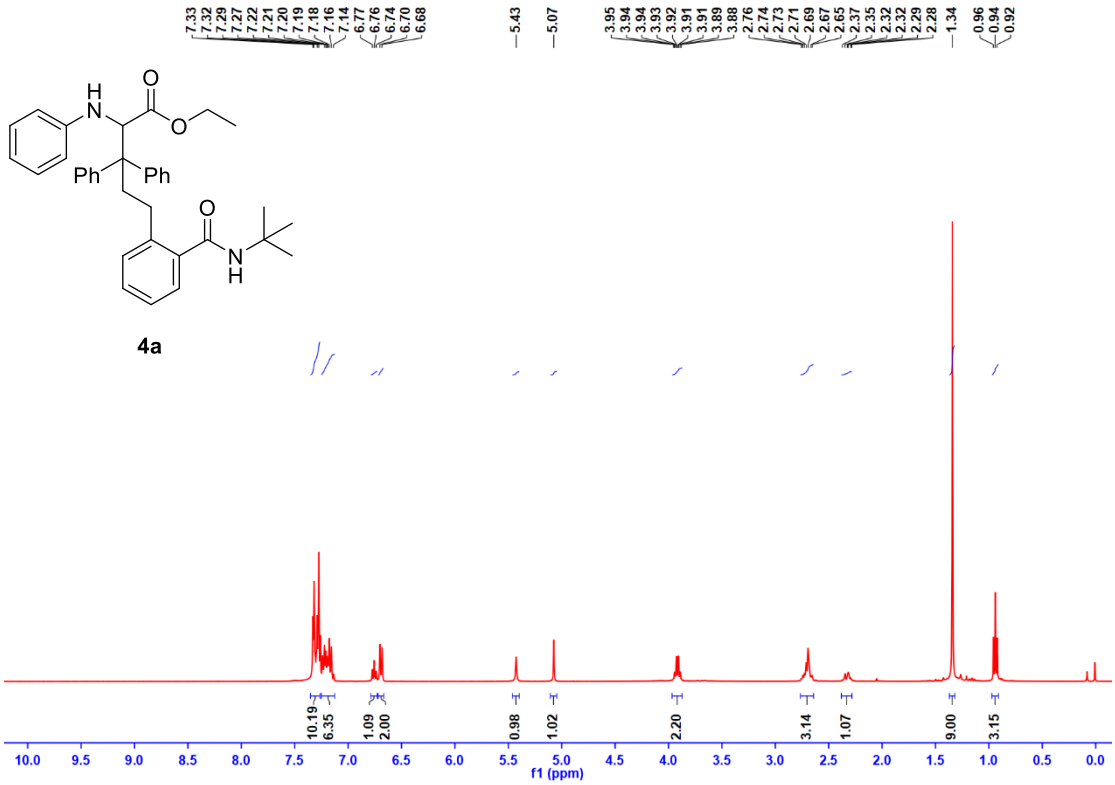
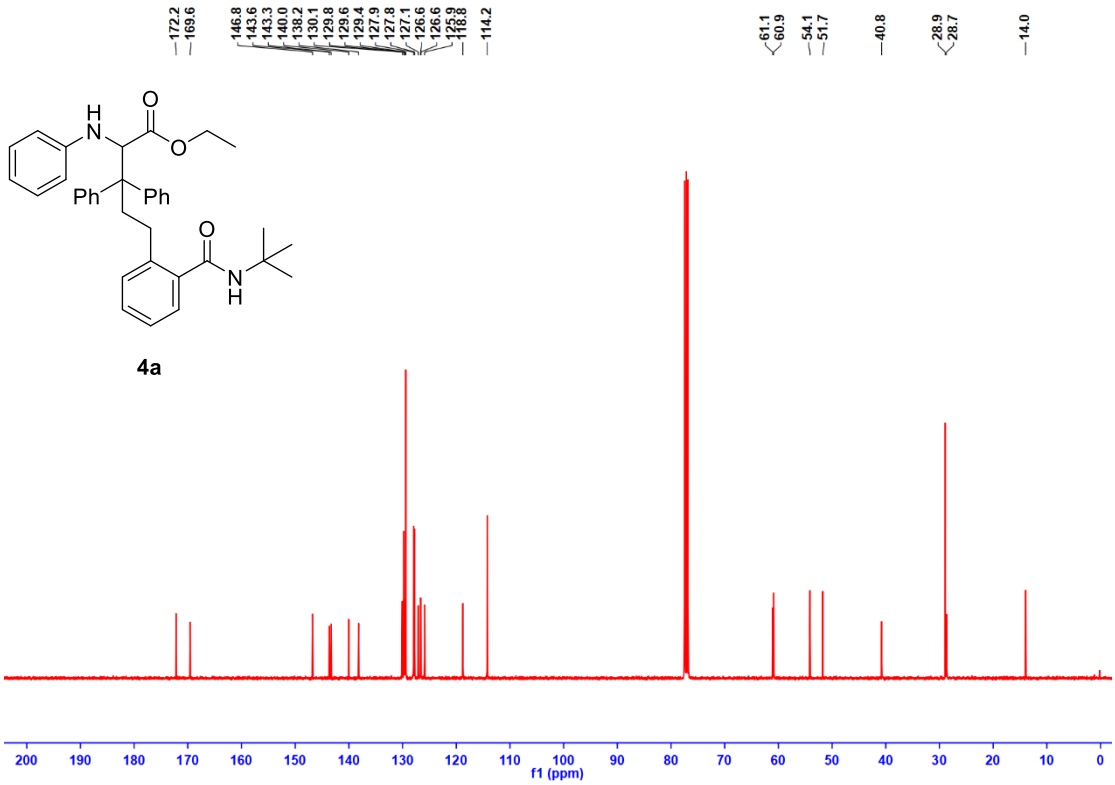
3. H. Chen, L. Guo, S. Yu. Primary, Secondary, and Tertiary gamma-C(sp^3)-H Vinylation of Amides via Organic Photoredox-Catalyzed Hydrogen Atom Transfer, *Org Lett.*, 2018, **20 (19)**, 6255-6259.
4. W. K. Li, B. Q. Sun, L. Zhang and F. Y. Mo, Photocarboxyla-tion of remote C–H bonds through nitrogen-centred radical 1,5-hydrogen atom transfer, *Green Chem.*, 2023, **25**, 5030-5034.
5. L. Cardinale, M. O. Konev, A. J. von Wangelin, Photoredox-Catalyzed Addition of Carbamoyl Radicals to Olefins:A 1,4-Dihydropyridine Approach. *Chem. Eur. J.*, 2020, **26**, 8239-8243.

7. NMR spectra

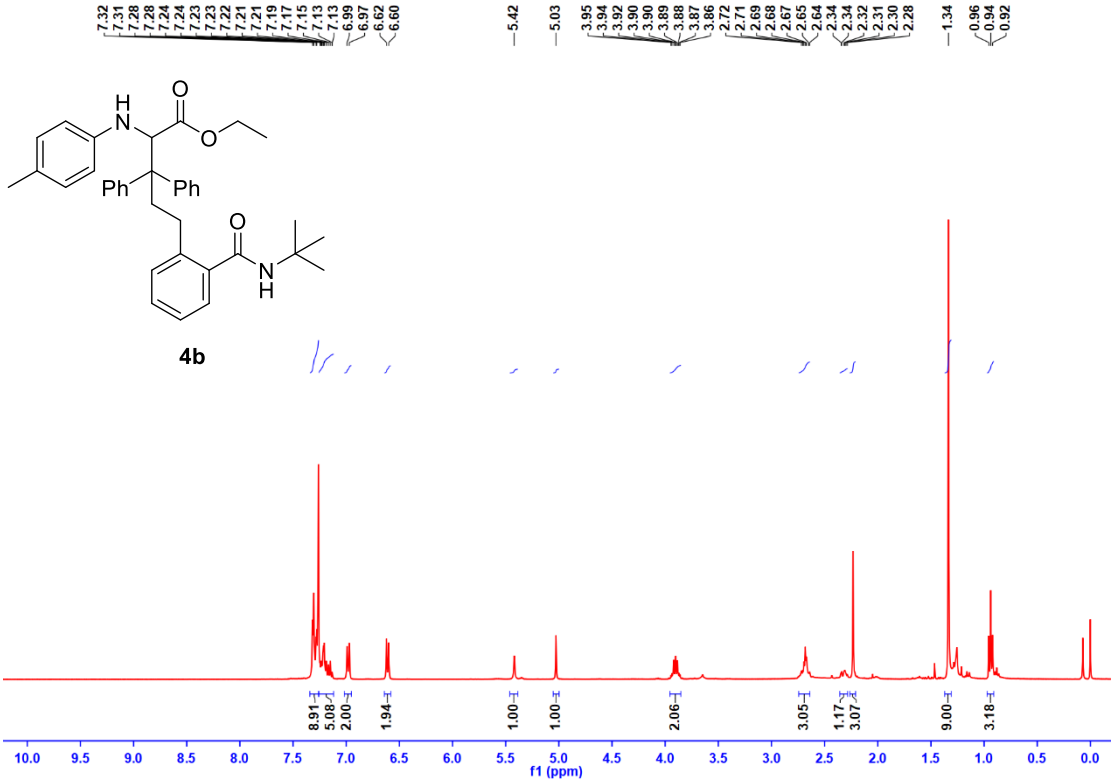
^{1}H NMR (400 MHz, CDCl3) of 4a



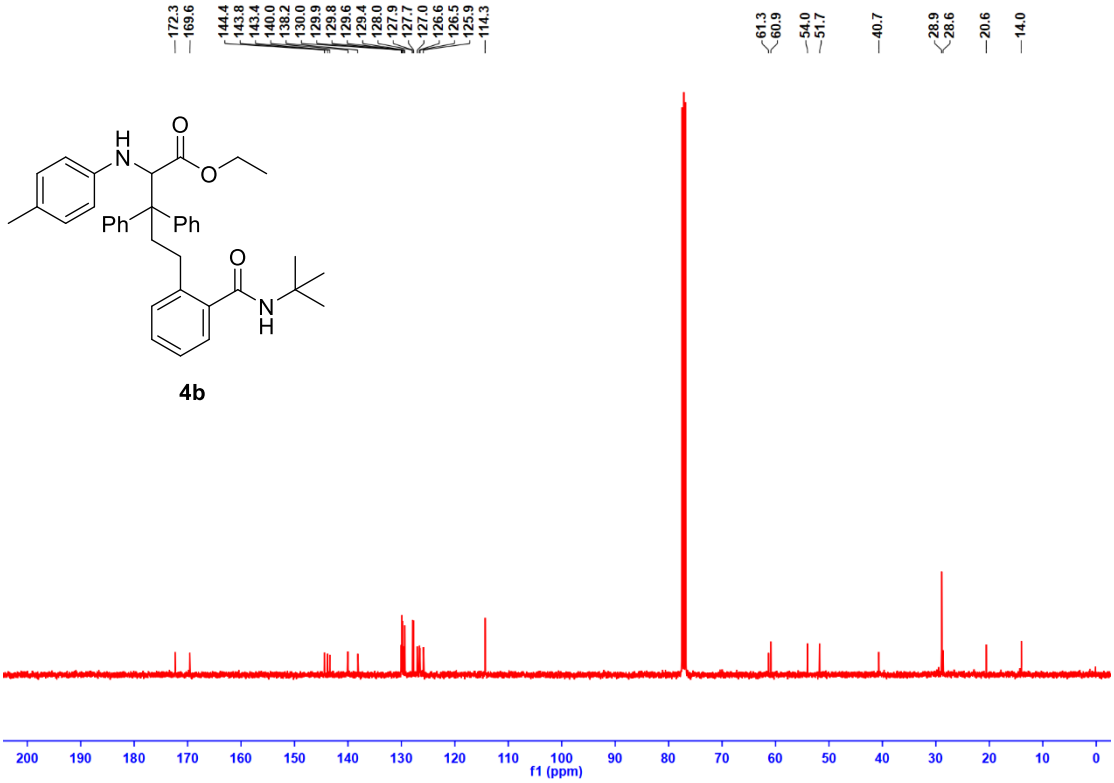
^{13}C NMR (100 MHz, CDCl3) of 4a



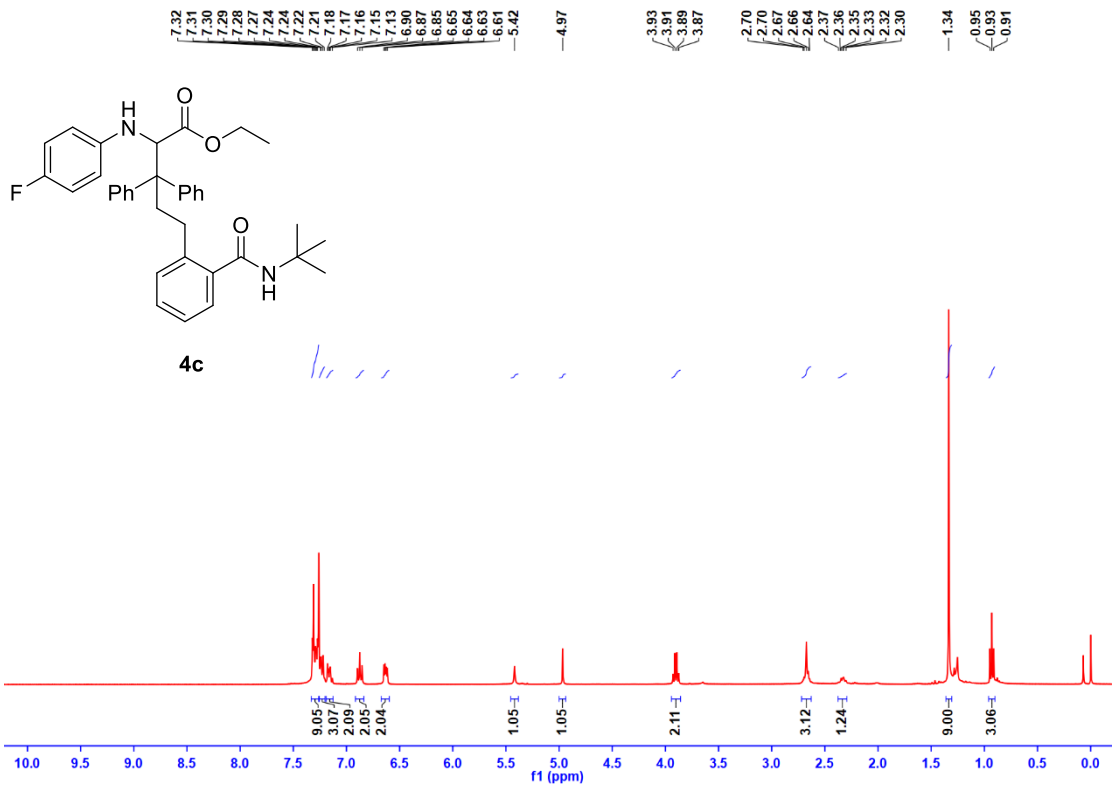
^{1}H NMR (400 MHz, CDCl3) of 4b



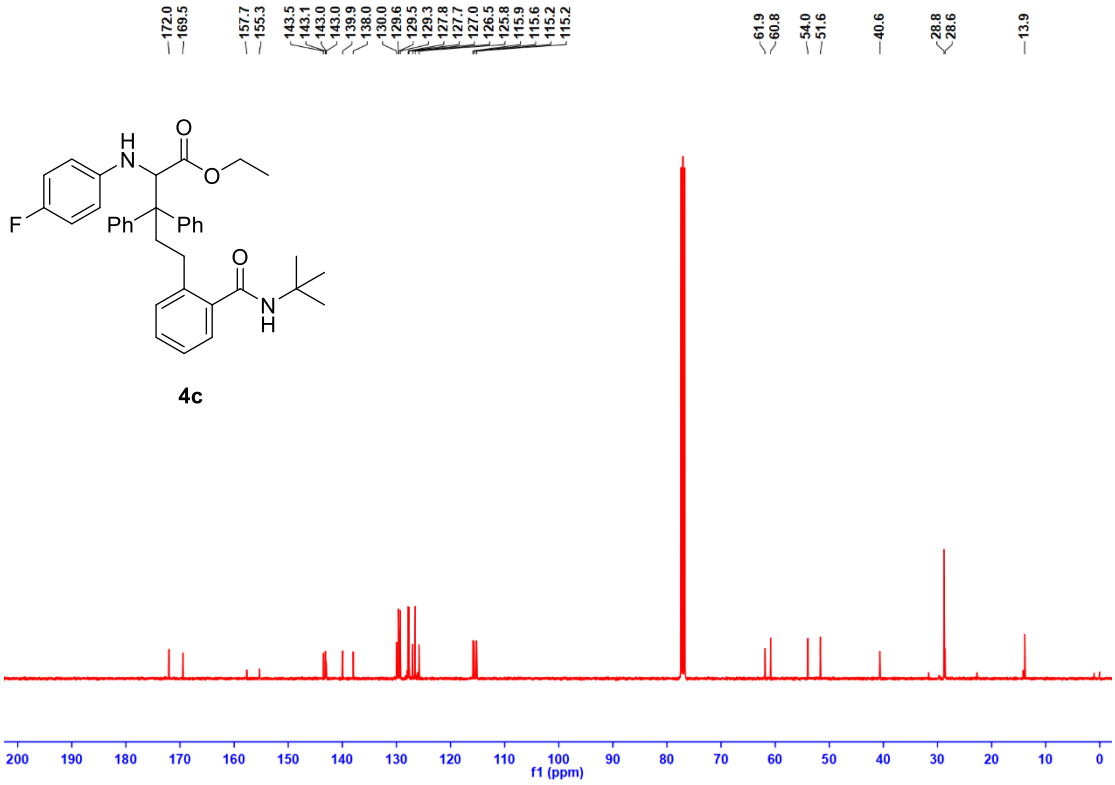
^{13}C NMR (100 MHz, CDCl3) of 4b



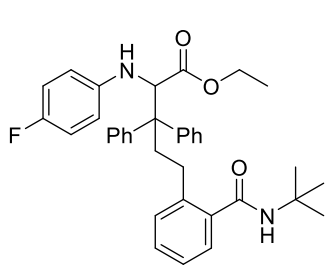
^{1}H NMR (400 MHz, CDCl3) of 4c



^{13}C NMR (100 MHz, CDCl3) of 4c

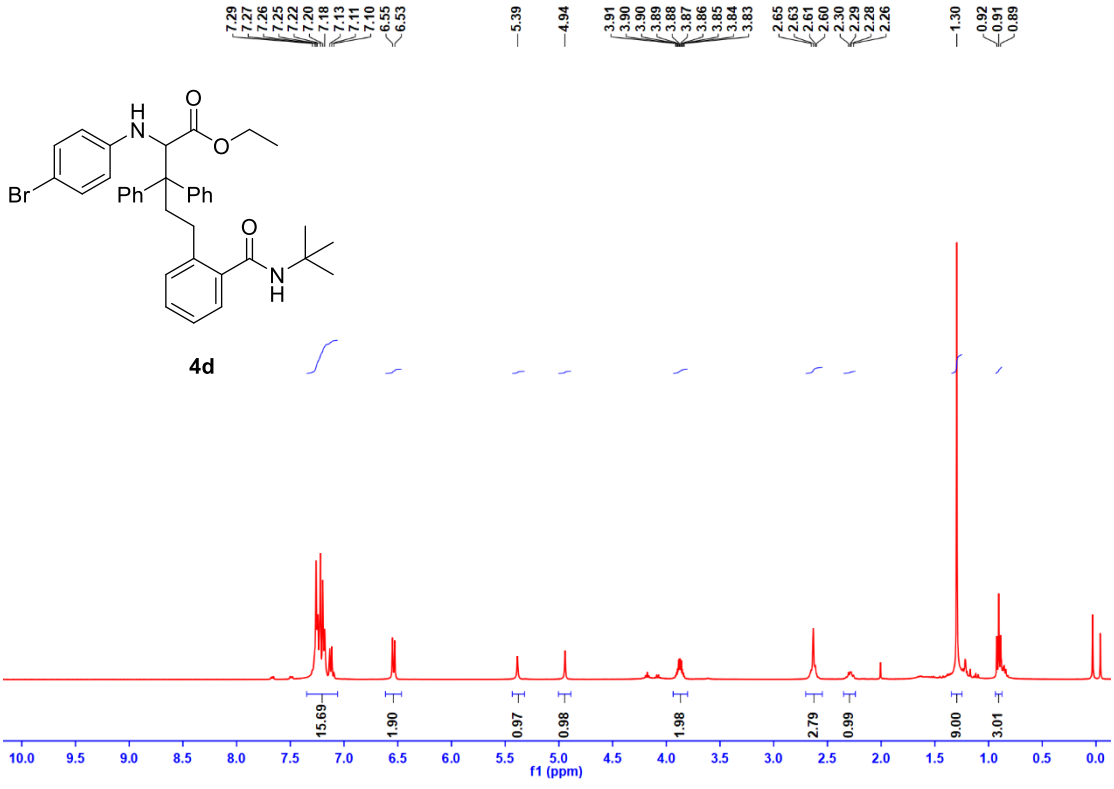


^{19}F NMR (376 MHz, CDCl3) of 4d



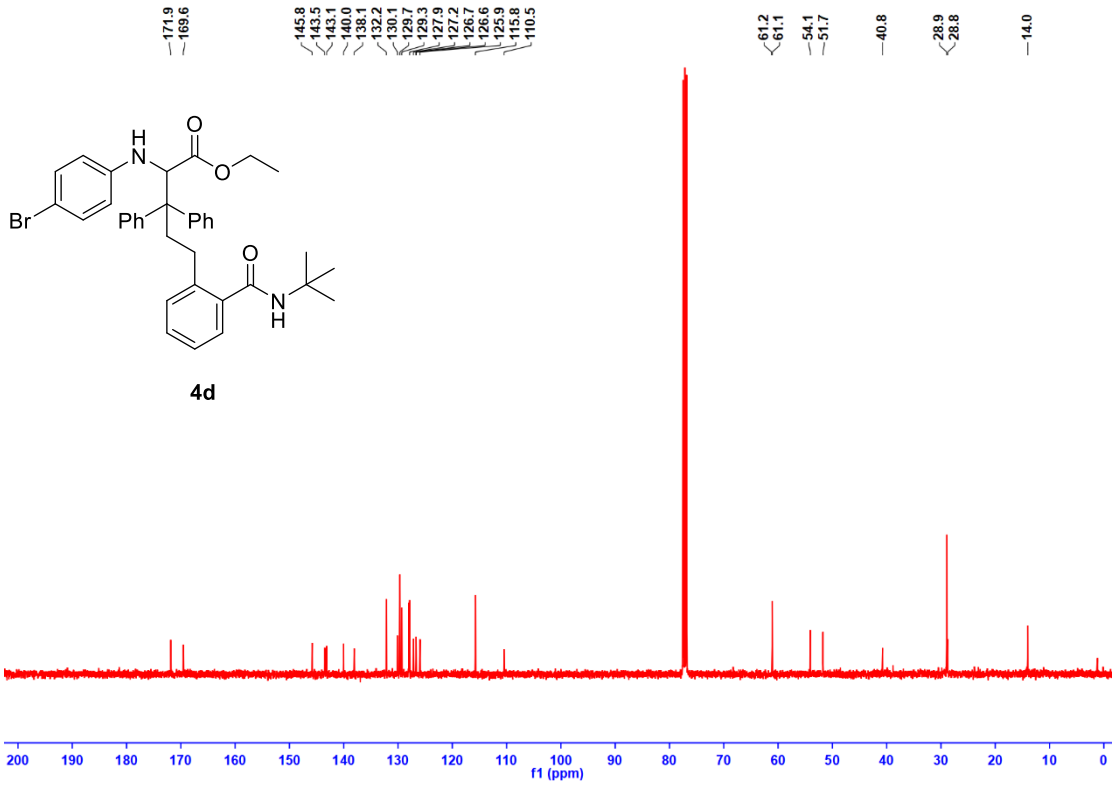
4c

^{1}H NMR (400 MHz, CDCl3) of 4d

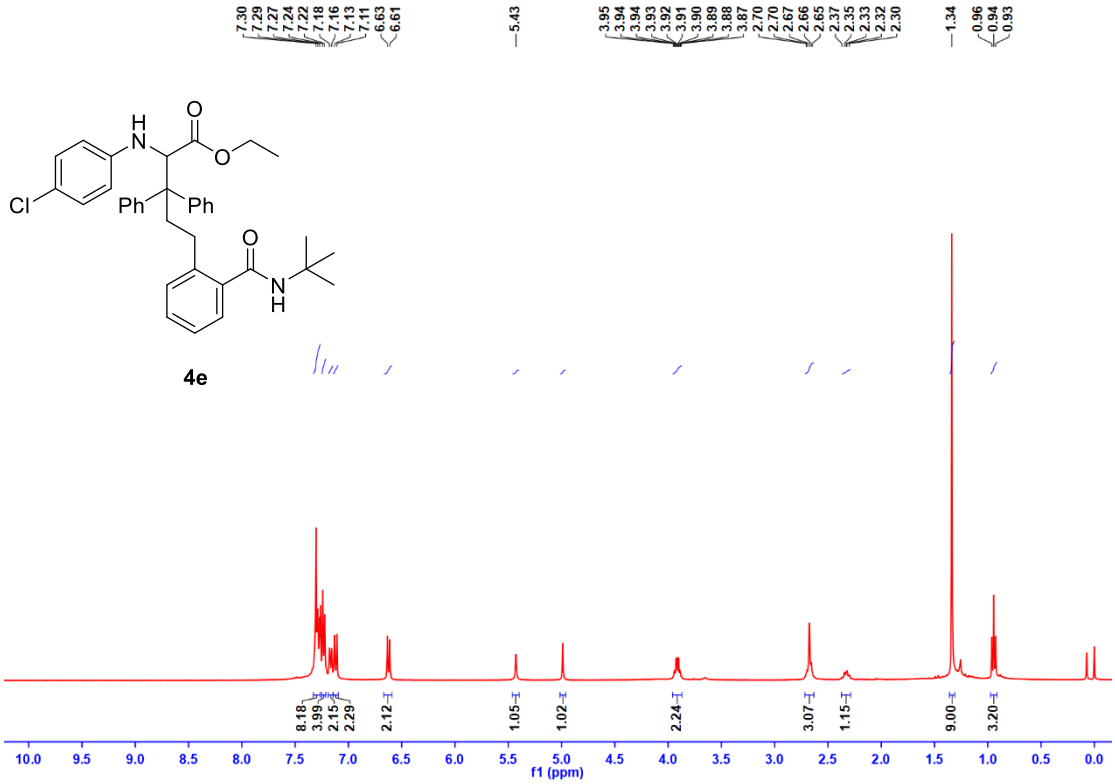


4d

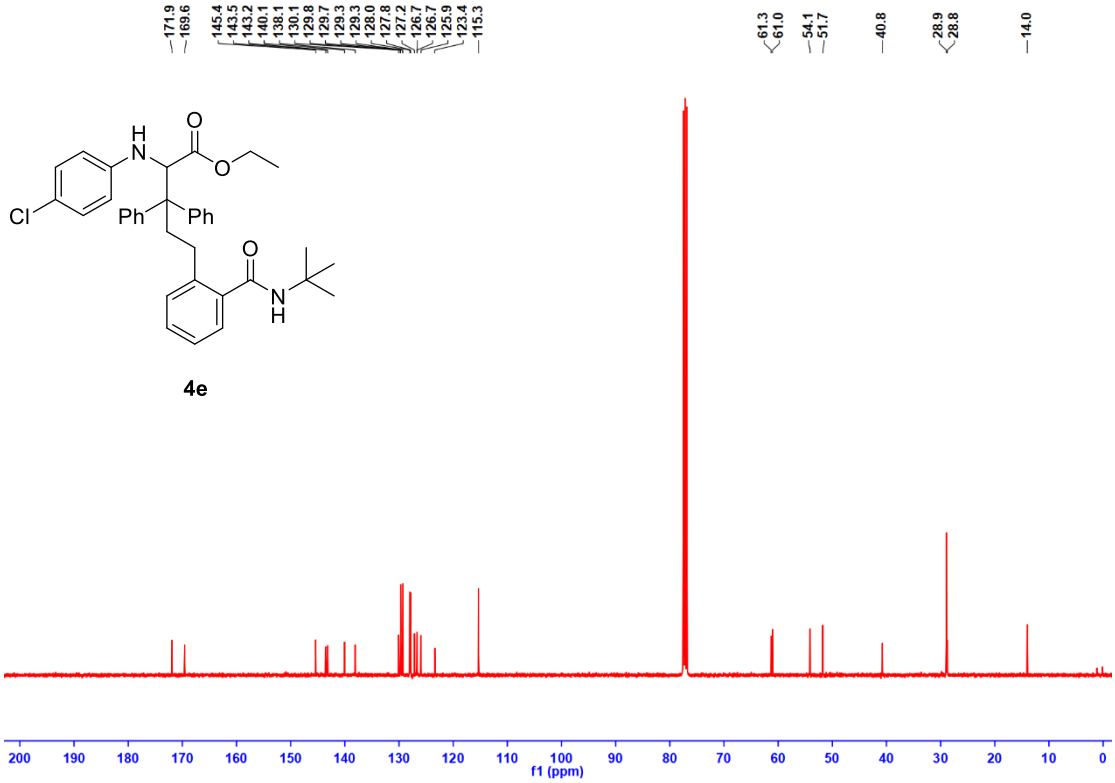
^{13}C NMR (100 MHz, CDCl3) of 4d



^{1}H NMR (400 MHz, CDCl3) of 4e

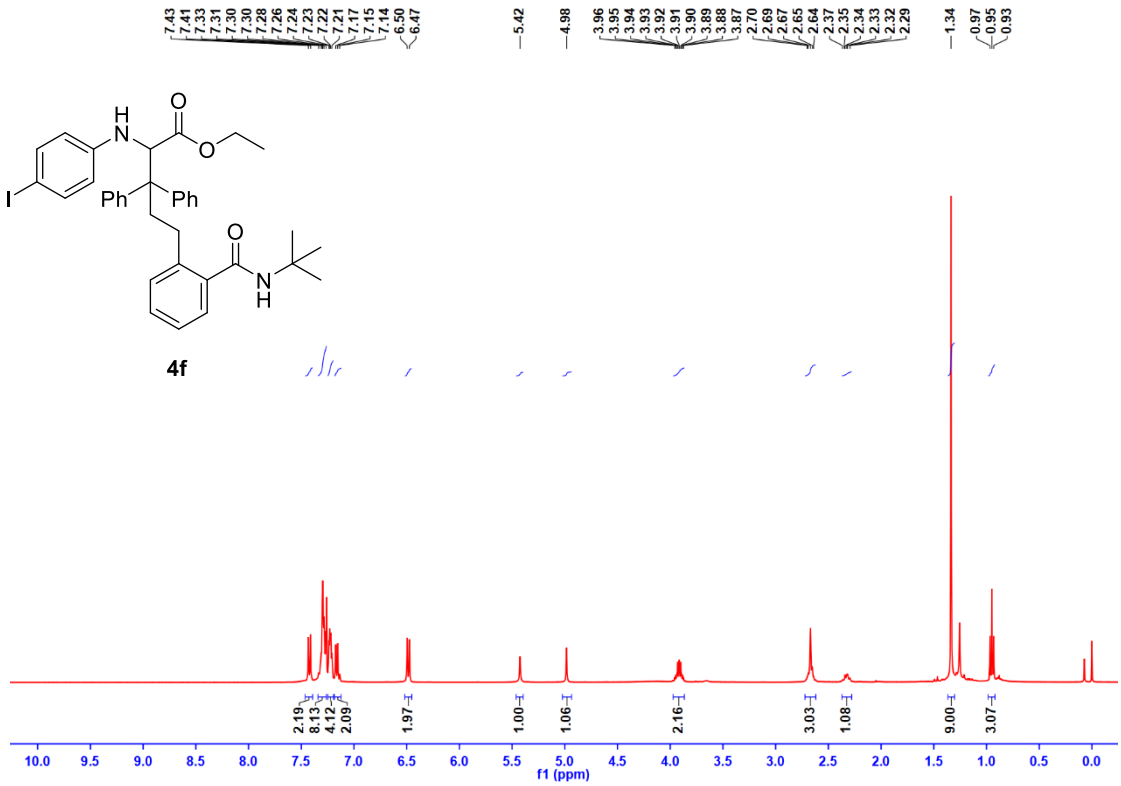


^{13}C NMR (100 MHz, CDCl3) of 4e



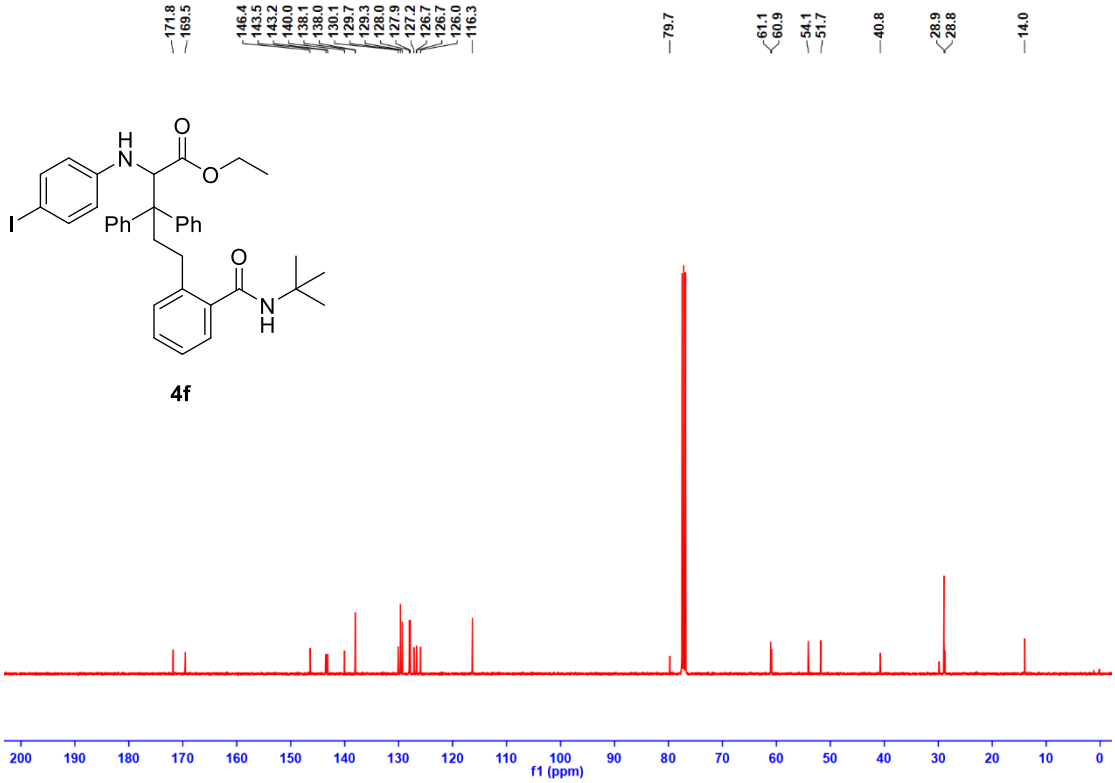
4e

^{1}H NMR (400 MHz, CDCl3) of 4f

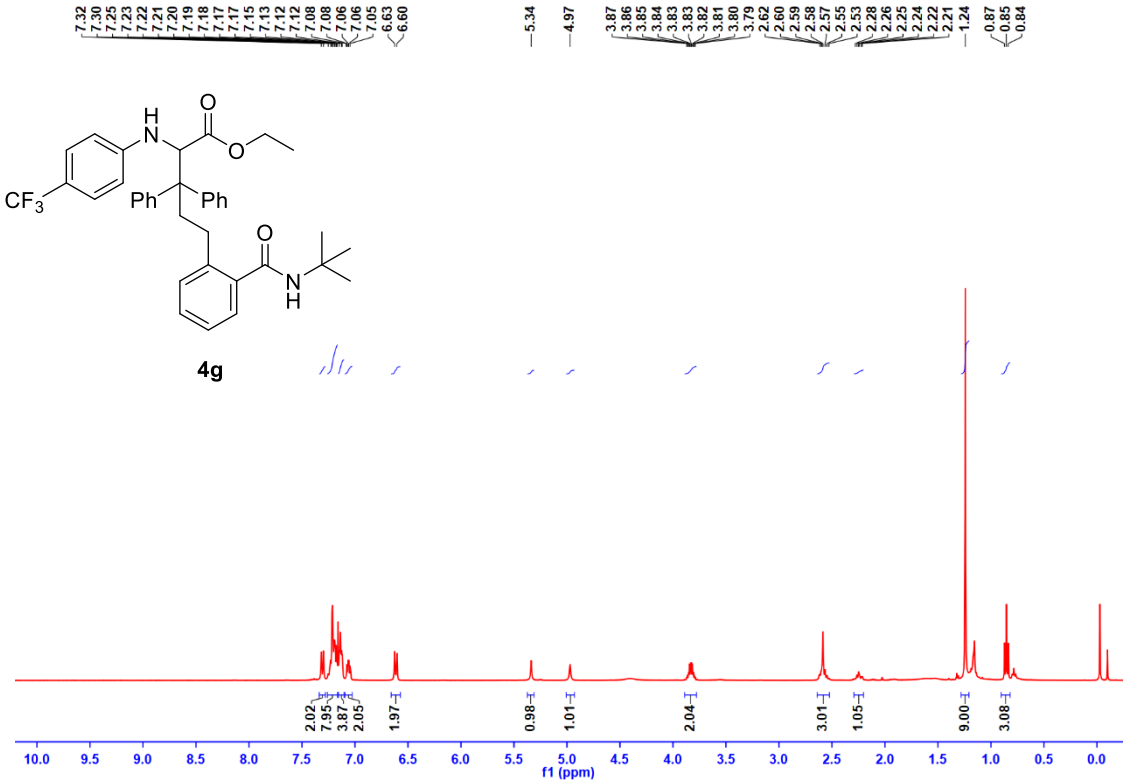


4f

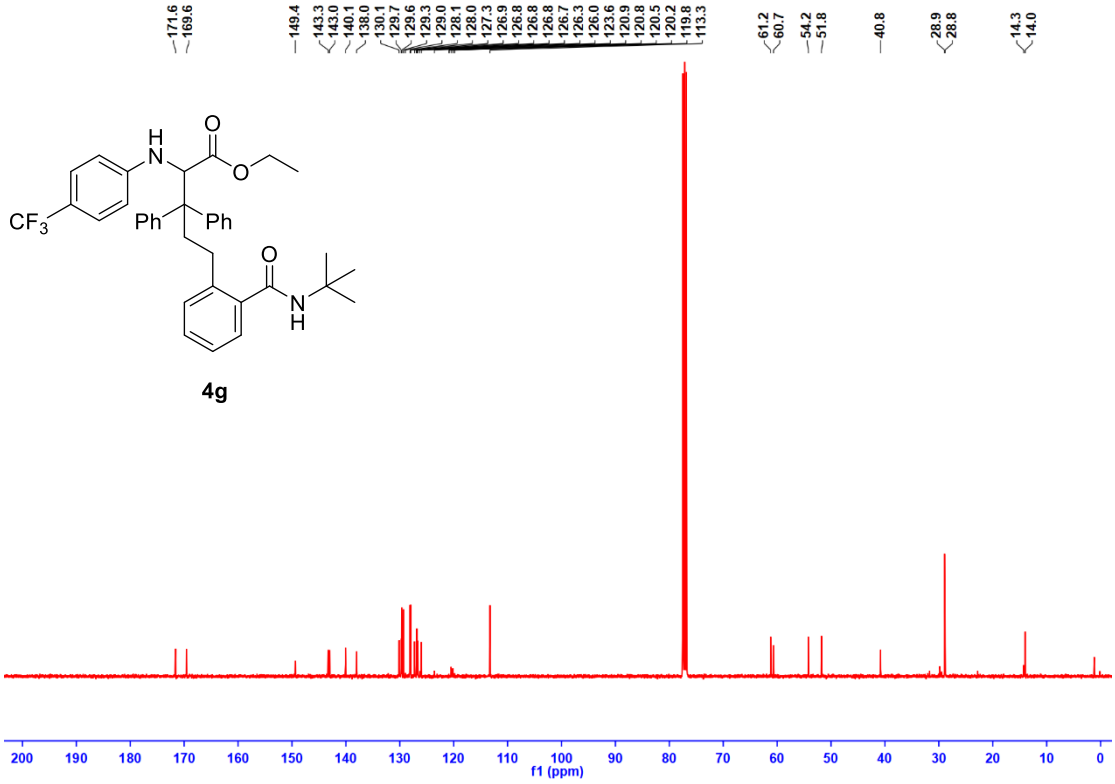
^{13}C NMR (100 MHz, CDCl3) of 4f



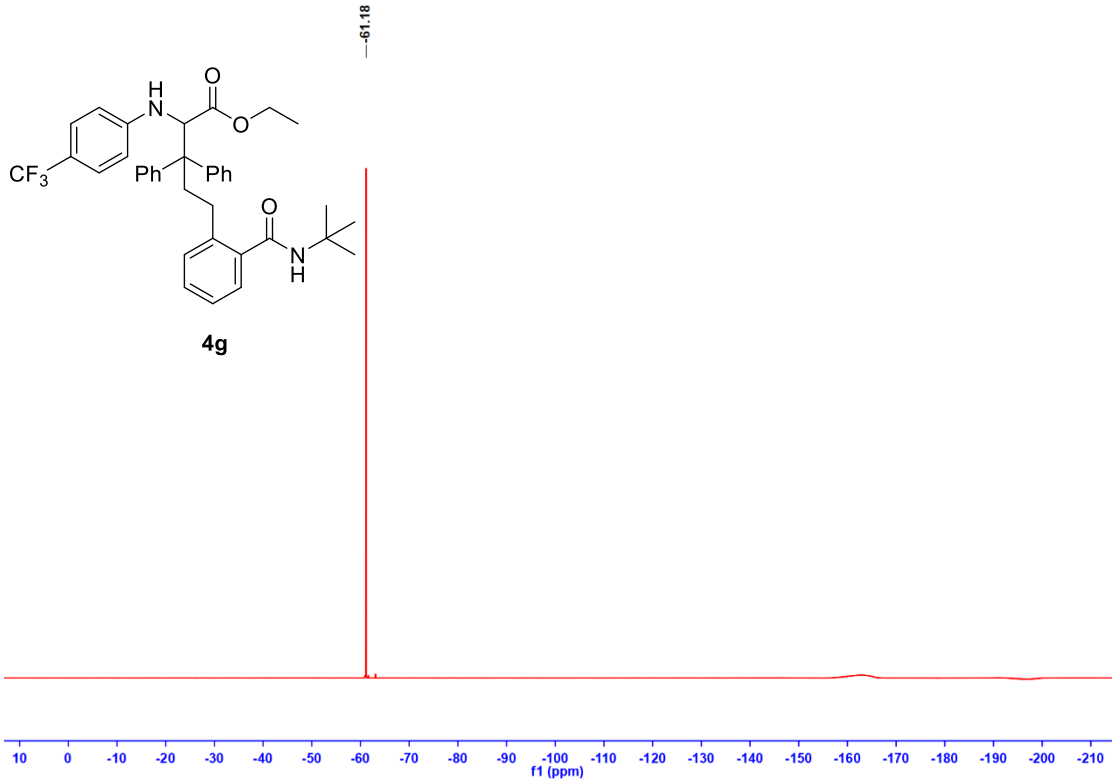
^{1}H NMR (400 MHz, CDCl3) of 4g



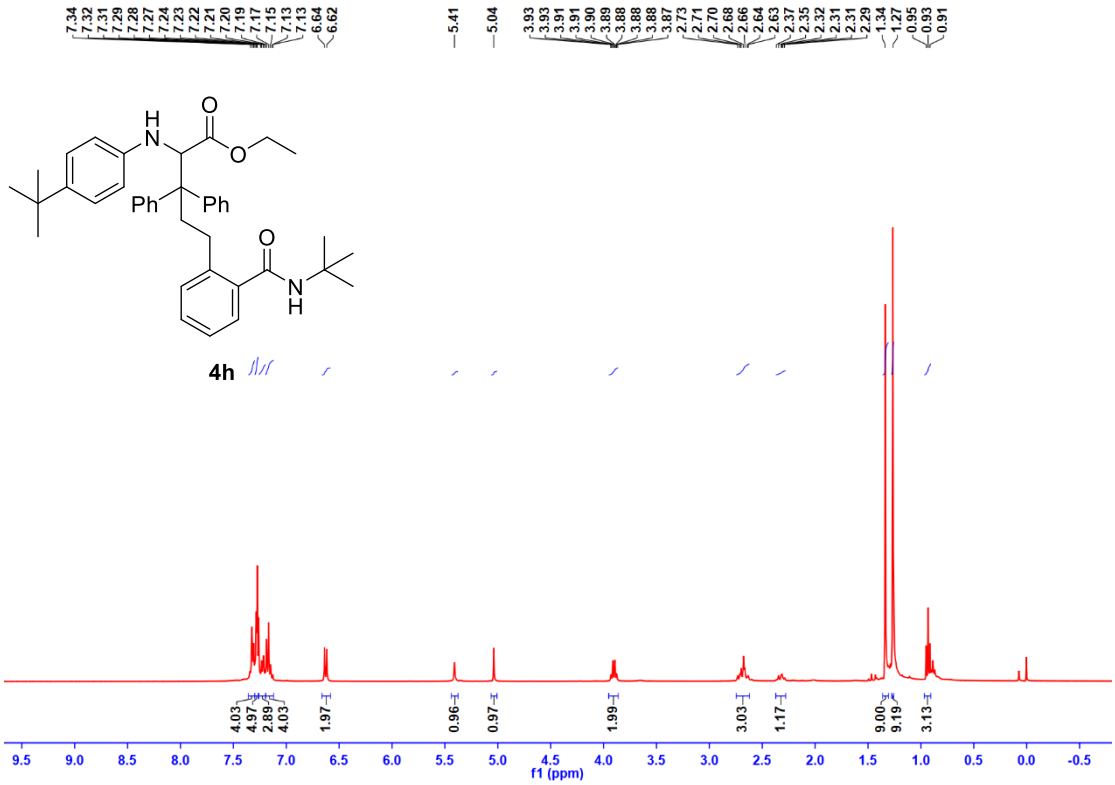
^{13}C NMR (100 MHz, CDCl3) of 4g



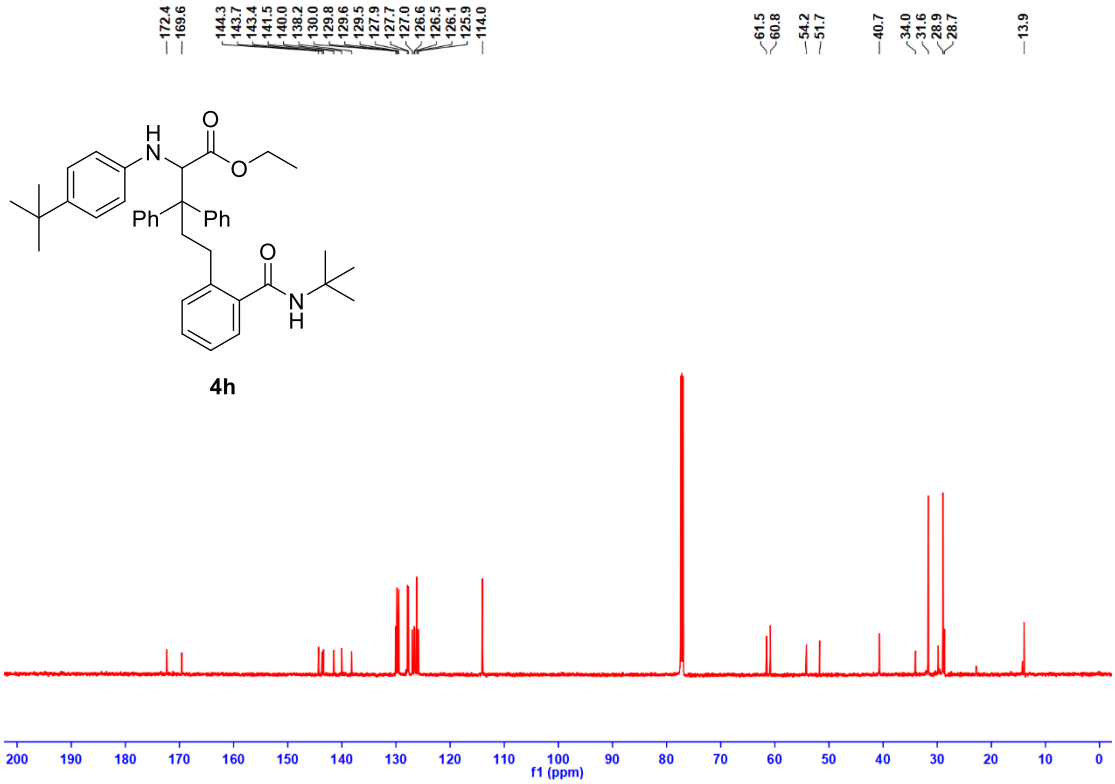
^{19}F NMR (376 MHz, CDCl3) of 4g



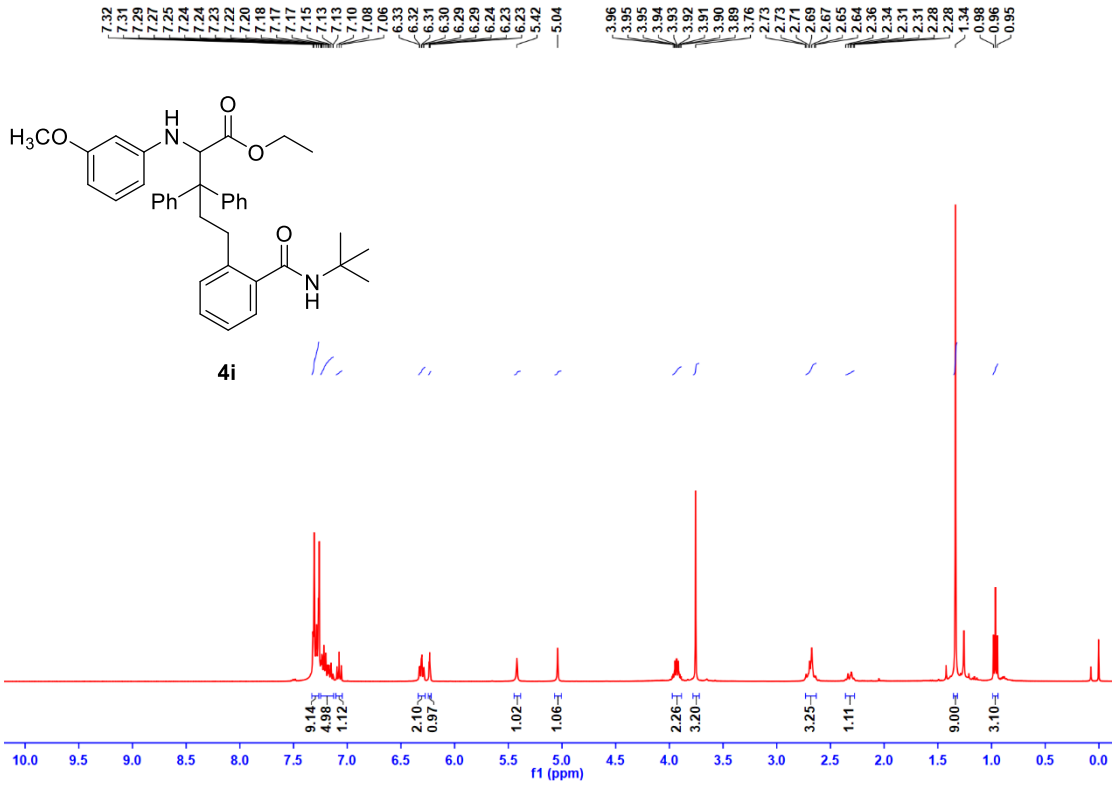
^{1}H NMR (400 MHz, CDCl3) of 4h



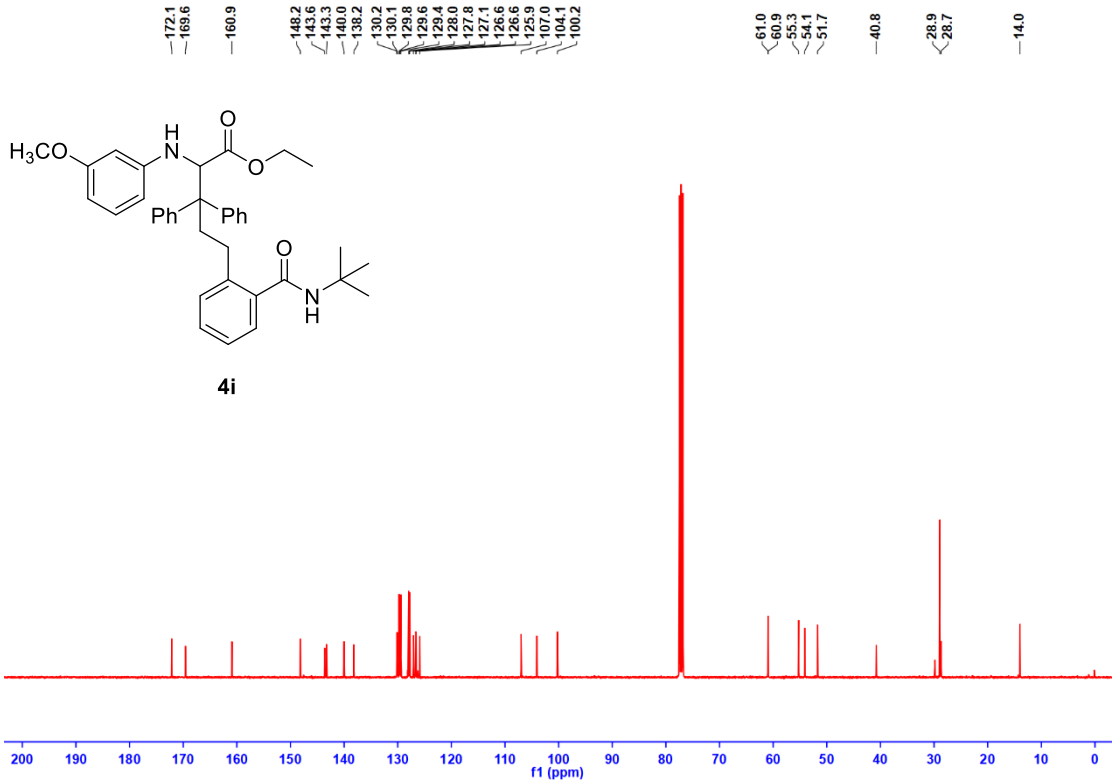
^{13}C NMR (100 MHz, CDCl3) of 4h



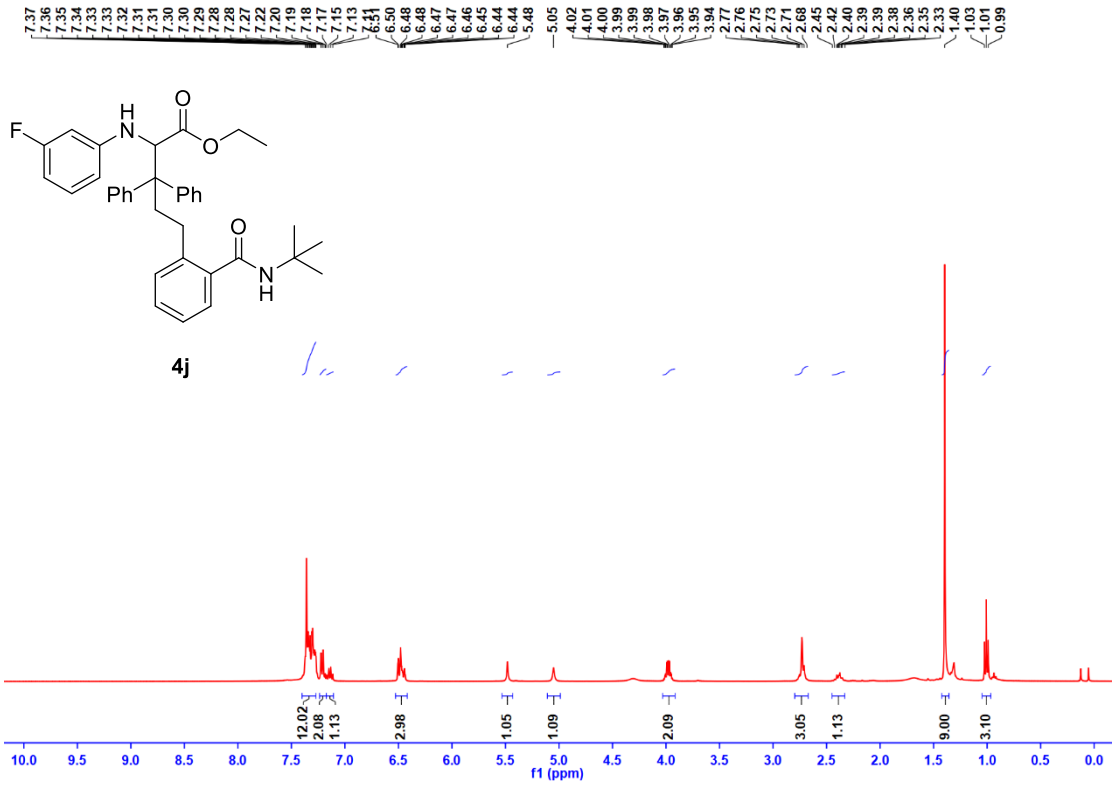
^{1}H NMR (400 MHz, CDCl3) of 4i



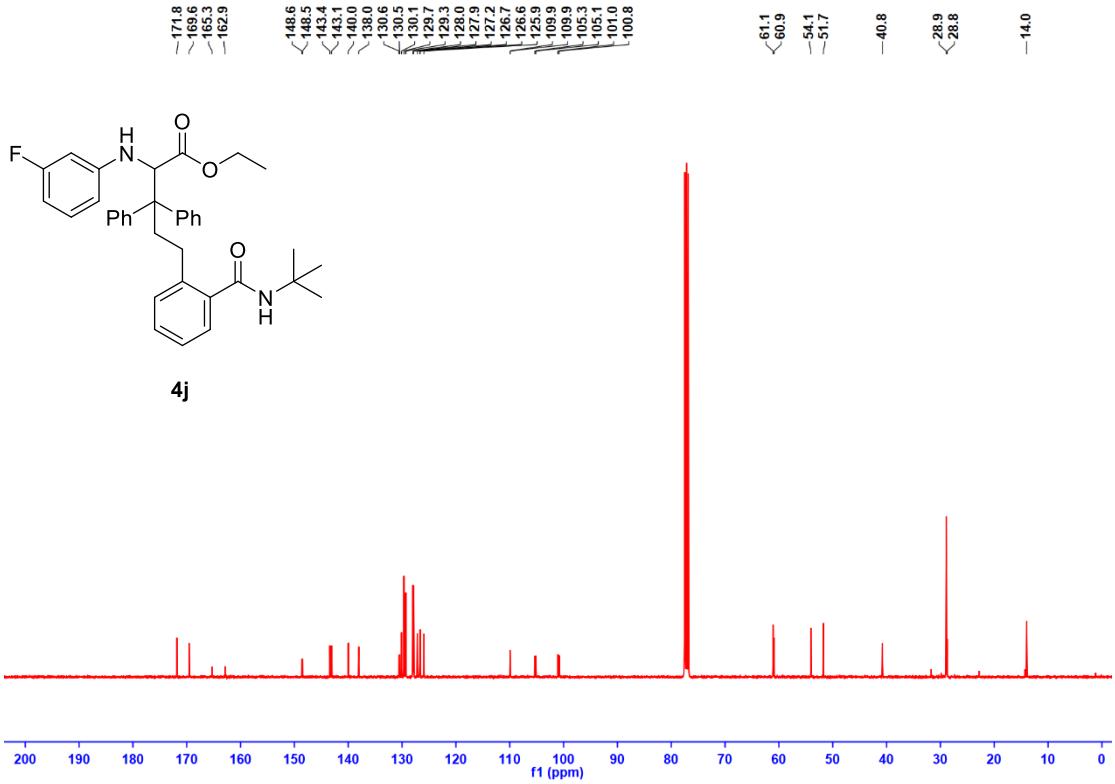
^{13}C NMR (100 MHz, CDCl3) of 4i



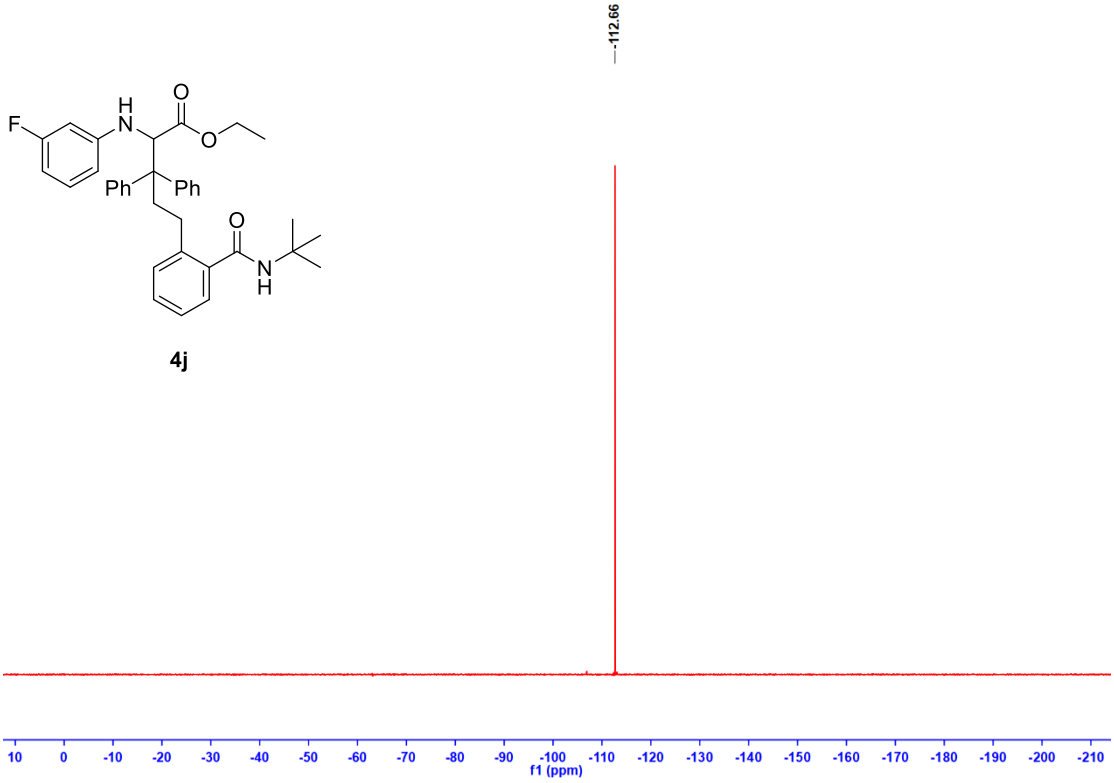
^{1}H NMR (400 MHz, CDCl3) of 4j



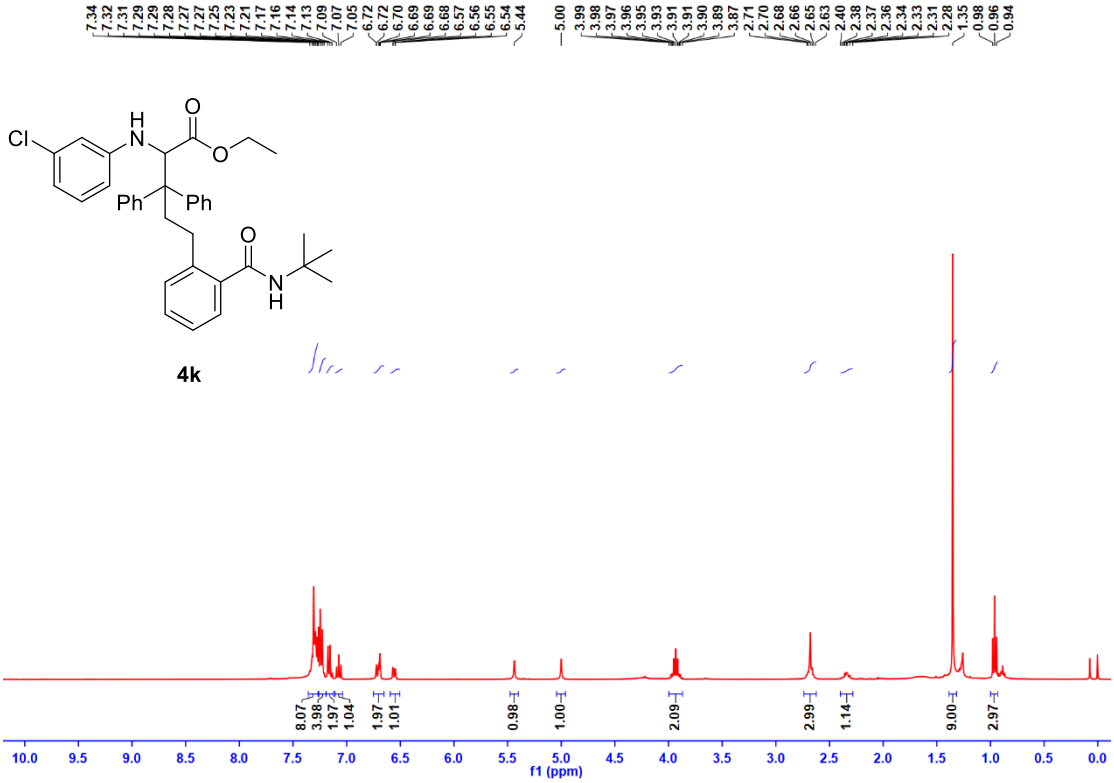
^{13}C NMR (100 MHz, CDCl3) of 4j



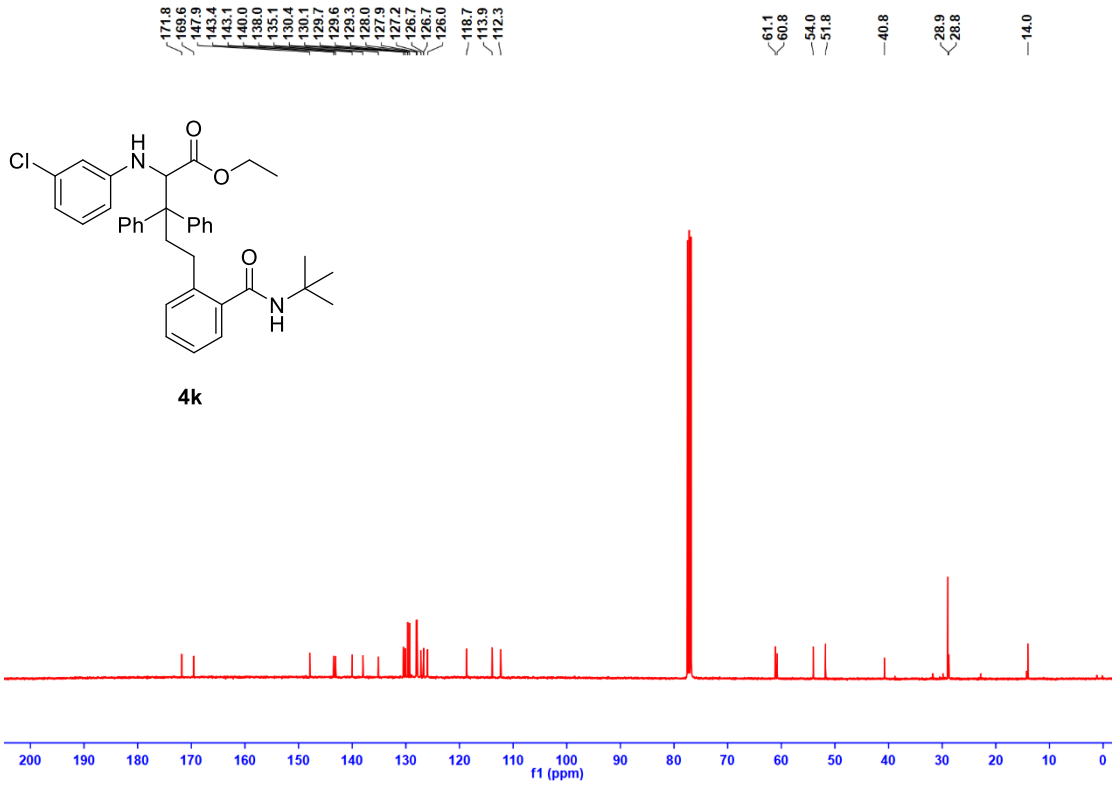
^{19}F NMR (376 MHz, CDCl3) of 4j



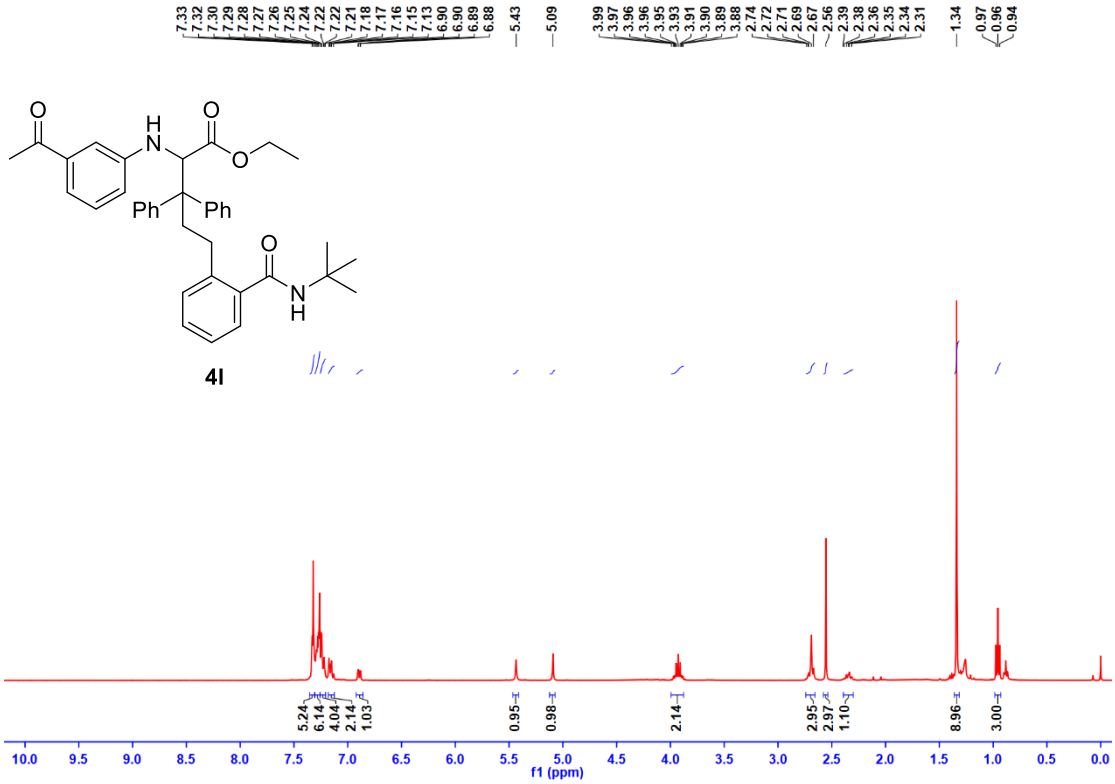
^{1}H NMR (400 MHz, CDCl3) of 4k



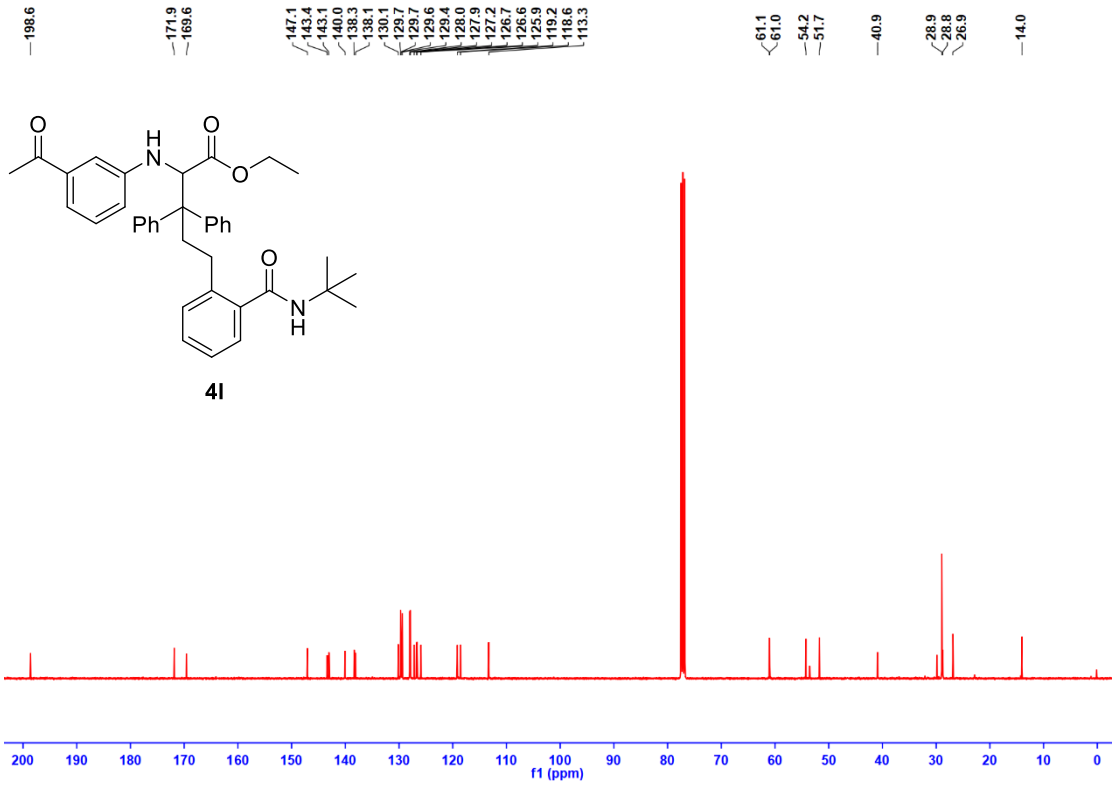
^{13}C NMR (100 MHz, CDCl3) of 4k



^{1}H NMR (400 MHz, CDCl3) of 4l

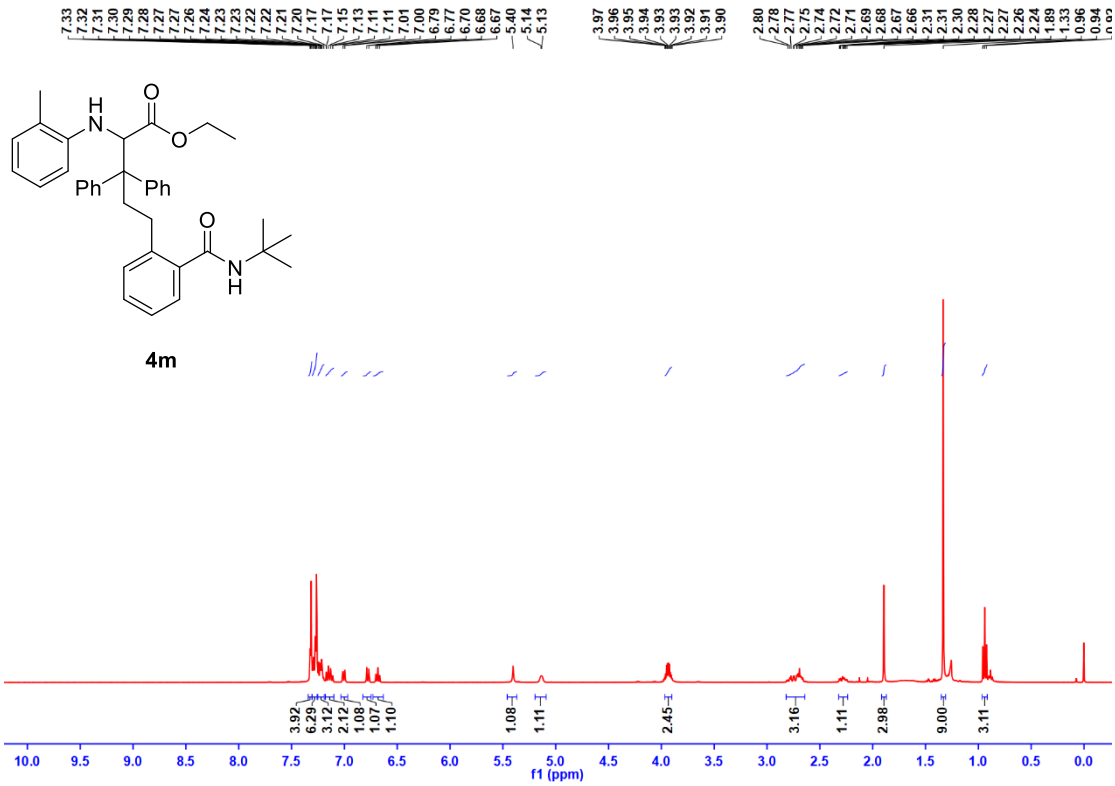


^{13}C NMR (100 MHz, CDCl3) of 4l



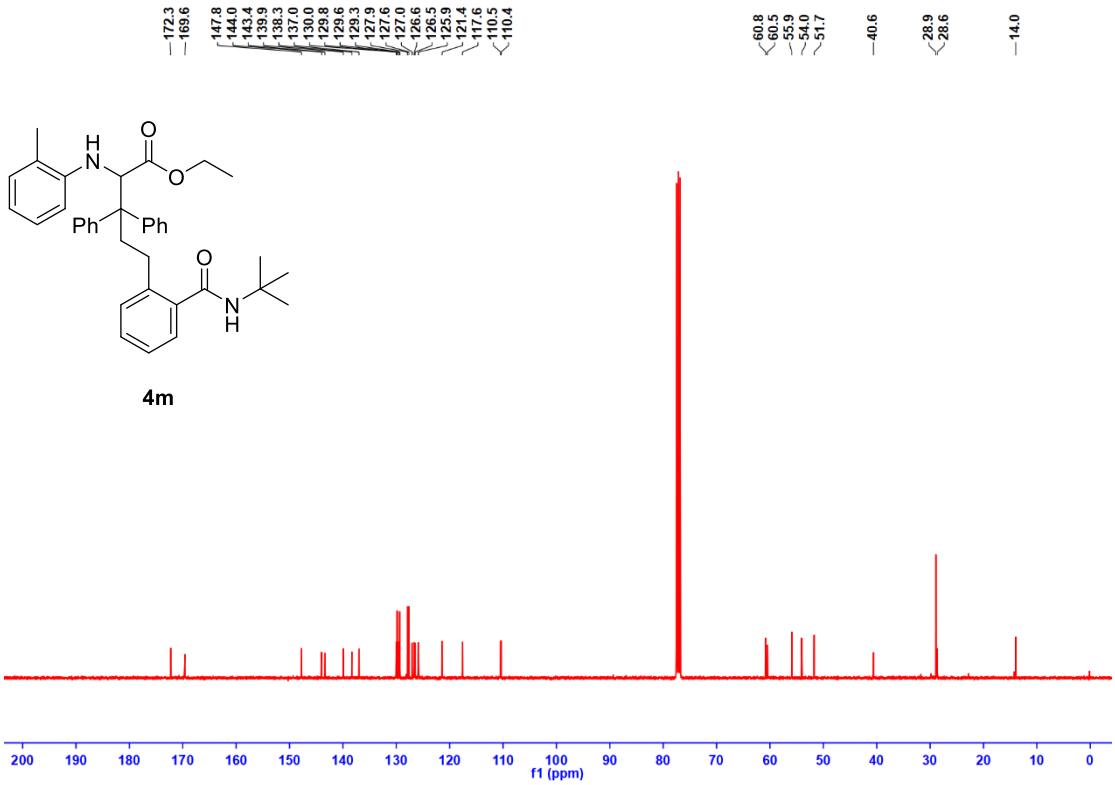
4l

^{1}H NMR (400 MHz, CDCl3) of 4m



4m

^{13}C NMR (100 MHz, CDCl3) of 4m



4m

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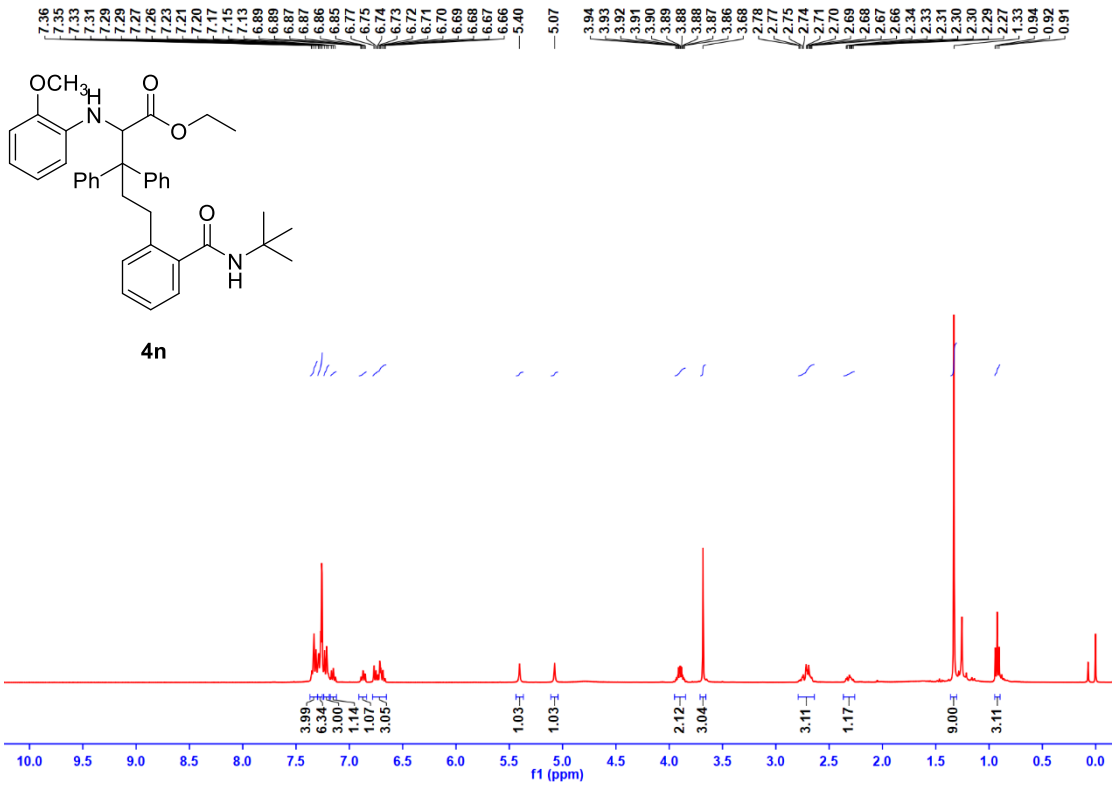
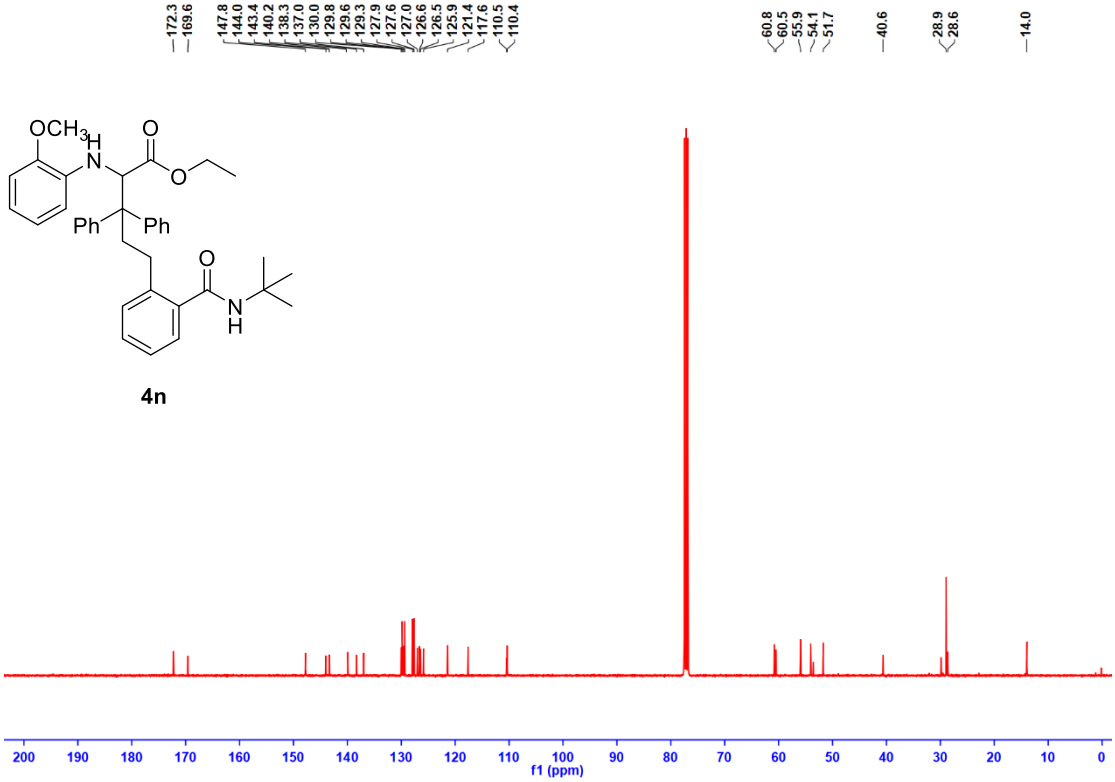
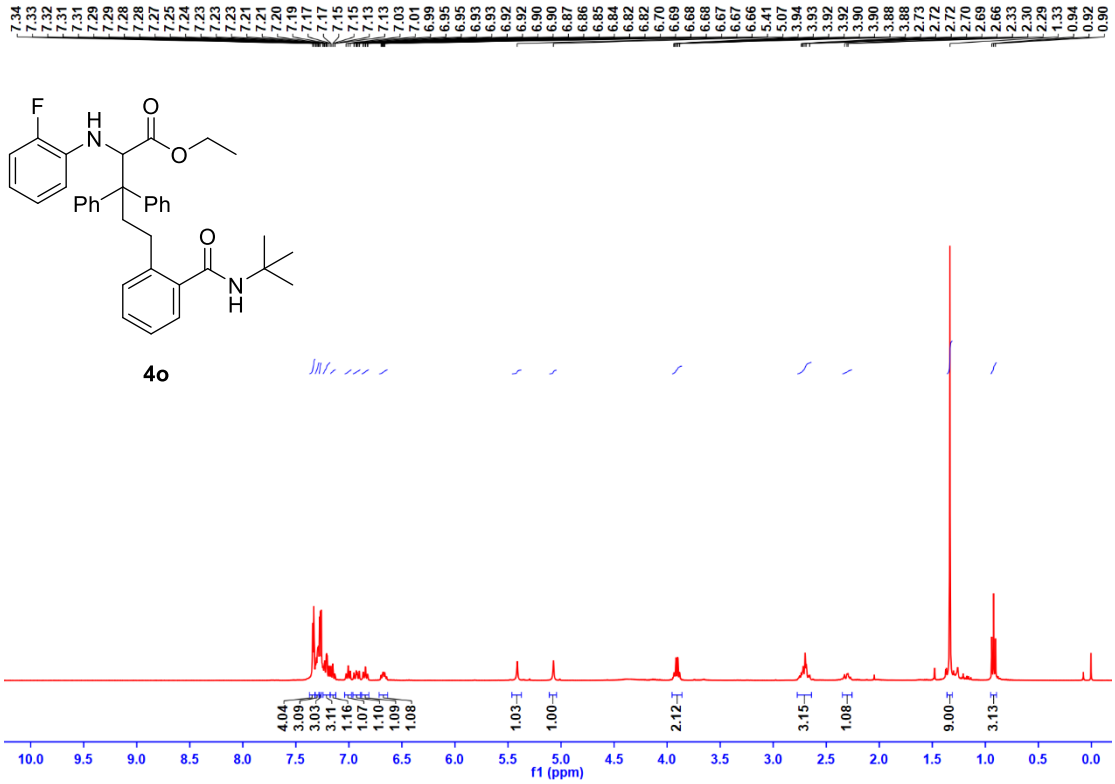


4n

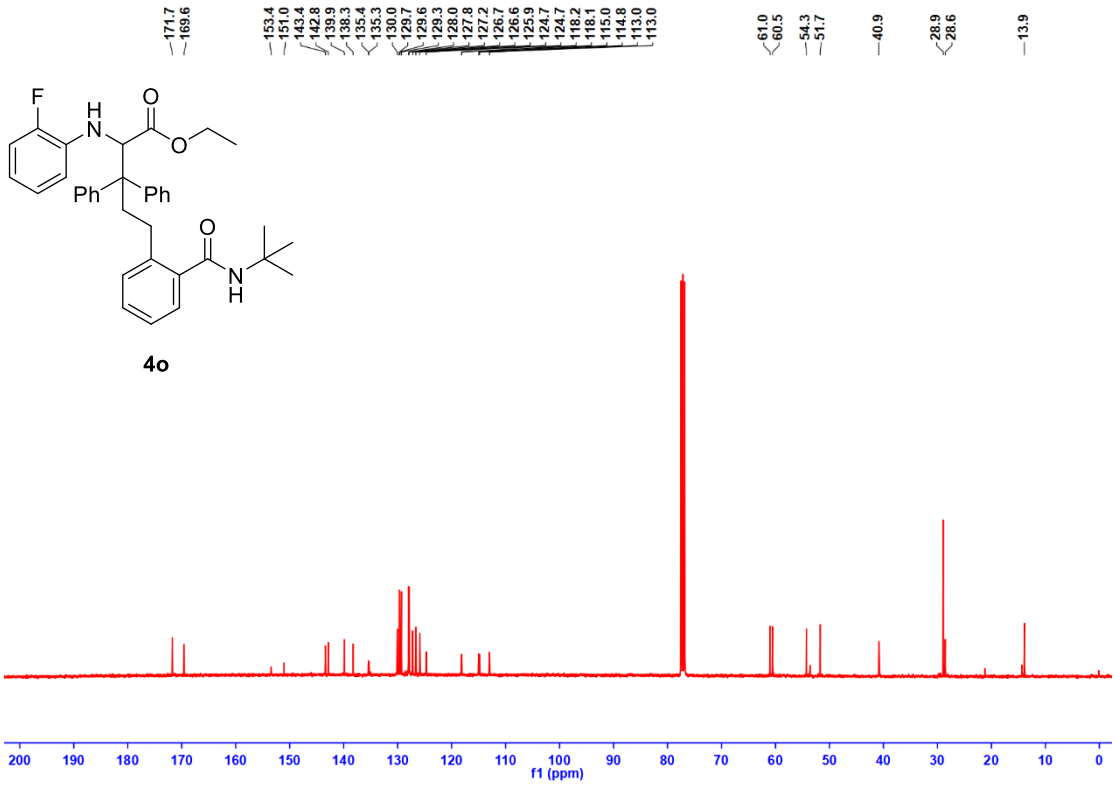
^{13}C NMR (100 MHz, CDCl3) of 4n



^{1}H NMR (400 MHz, CDCl3) of 4o

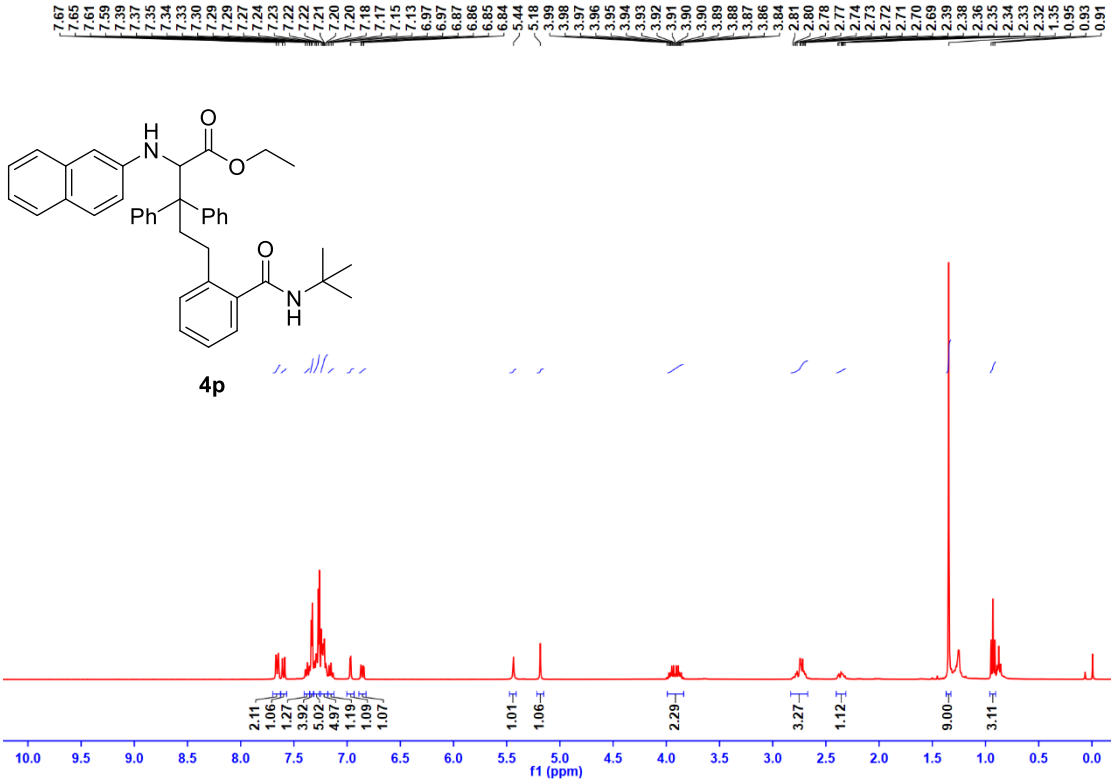


^{13}C NMR (100 MHz, CDCl3) of 4o

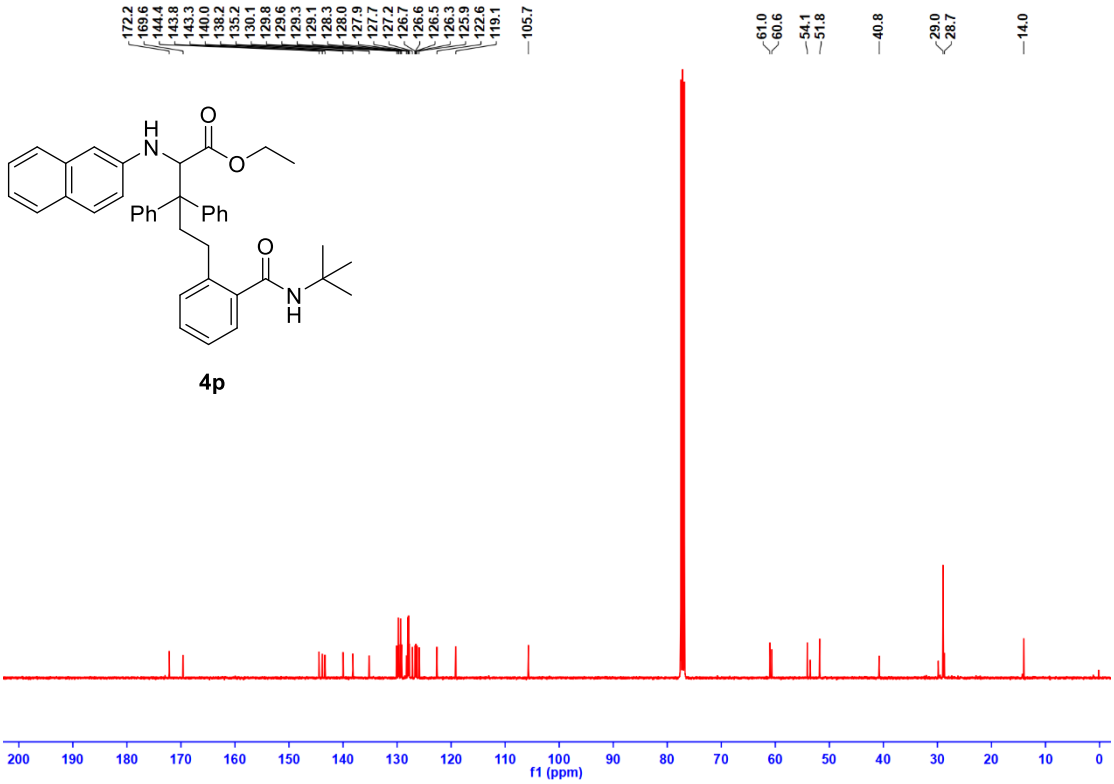


^{19}F NMR (376 MHz, CDCl3) of 4o

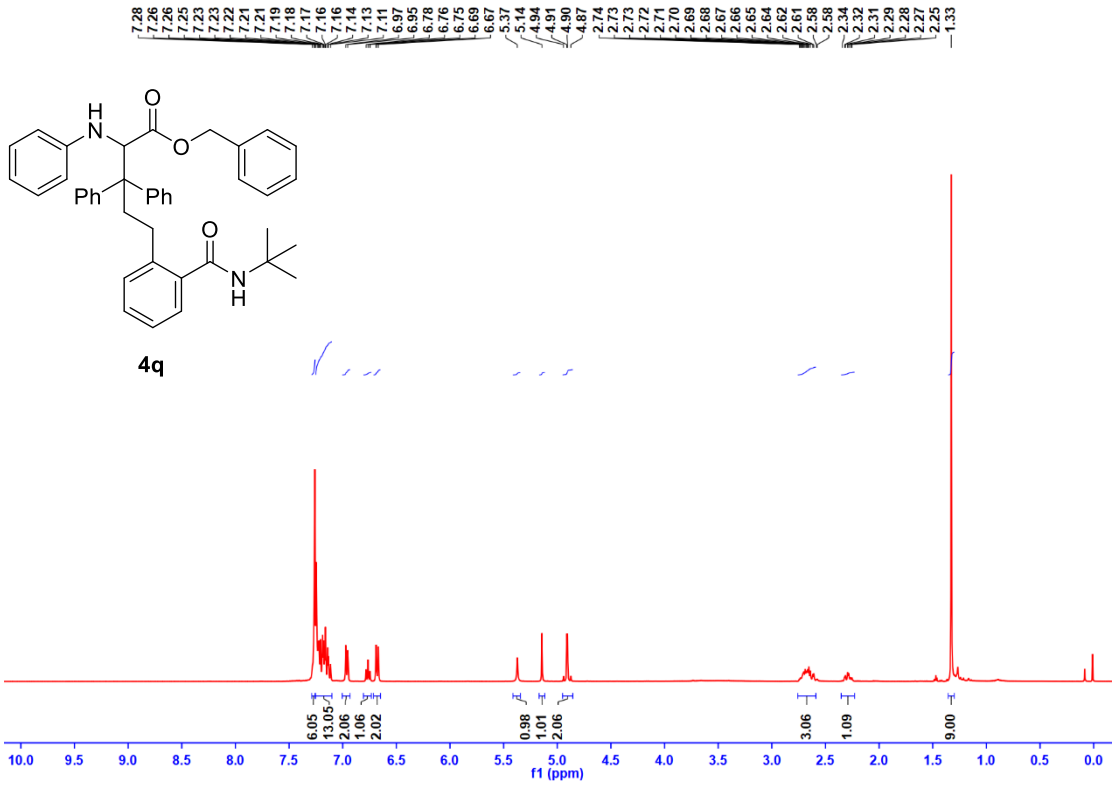
^{1}H NMR (400 MHz, CDCl3) of 4p



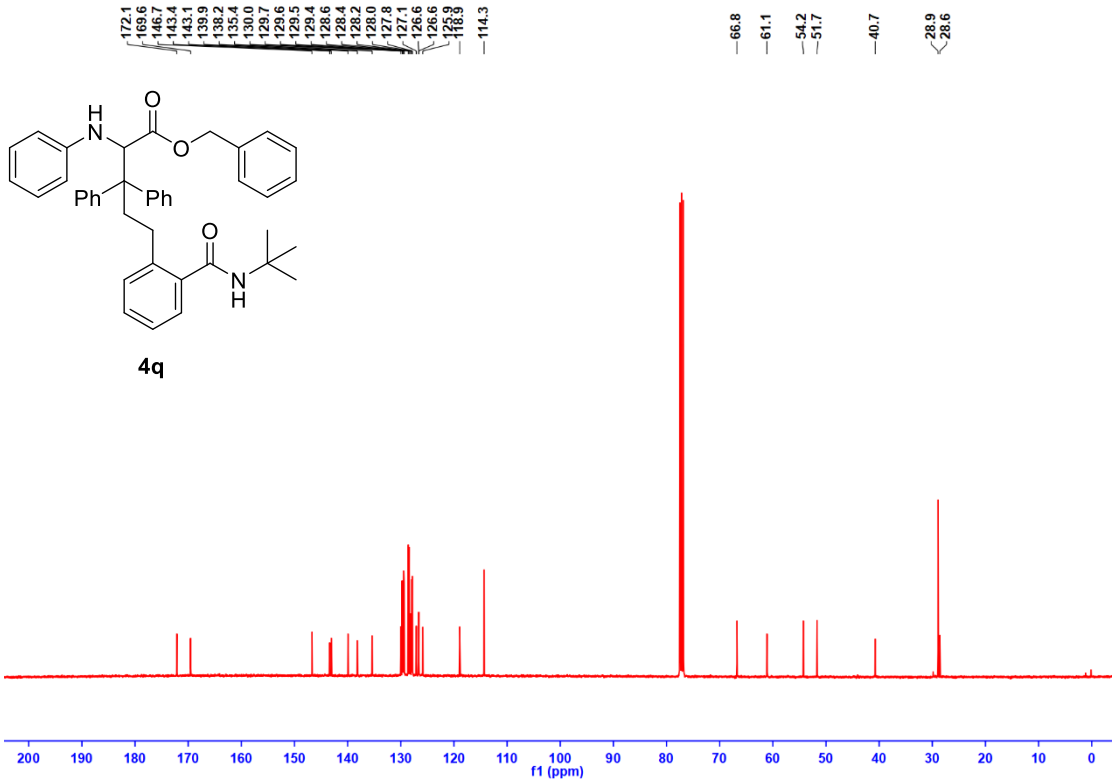
^{13}C NMR (100 MHz, CDCl3) of 4p



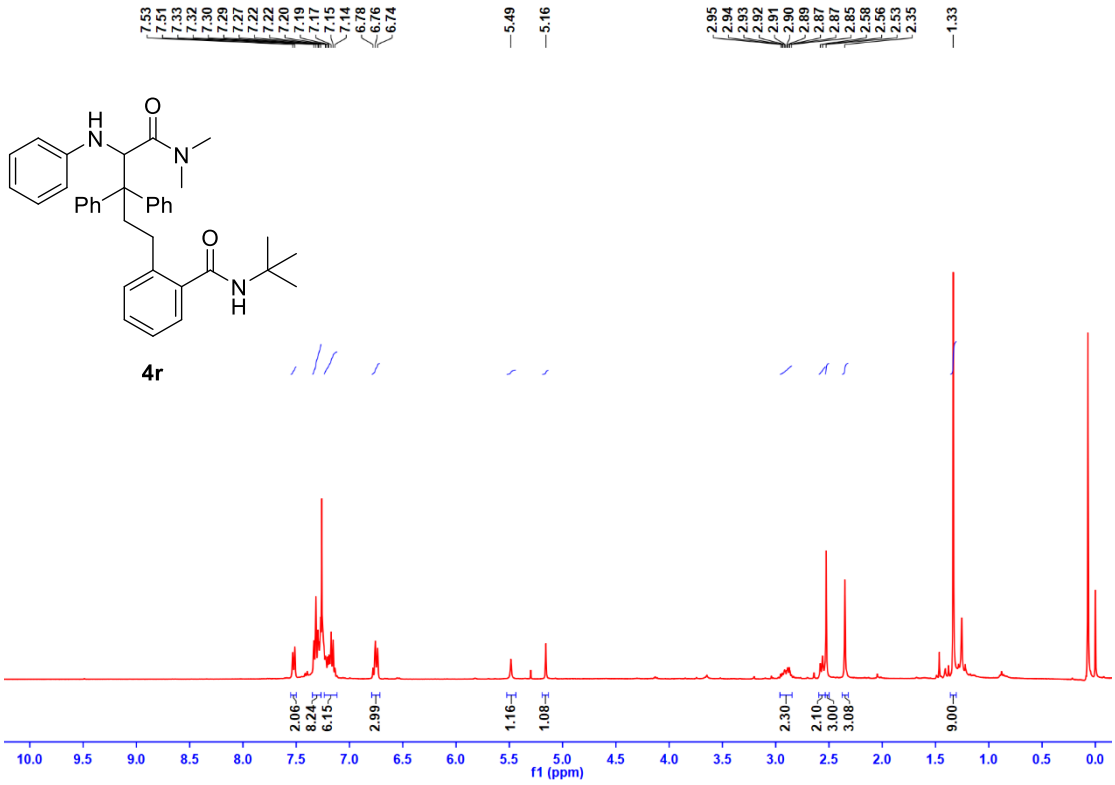
^{1}H NMR (400 MHz, CDCl3) of 4q



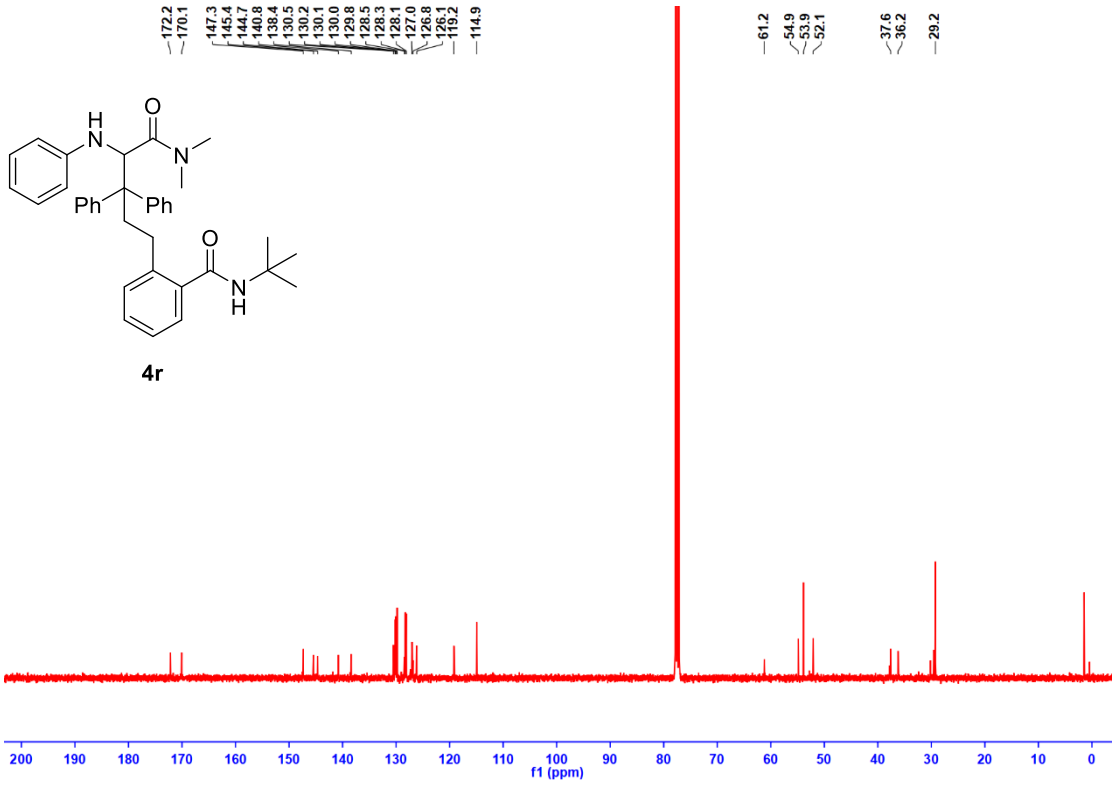
^{13}C NMR (100 MHz, CDCl3) of 4q



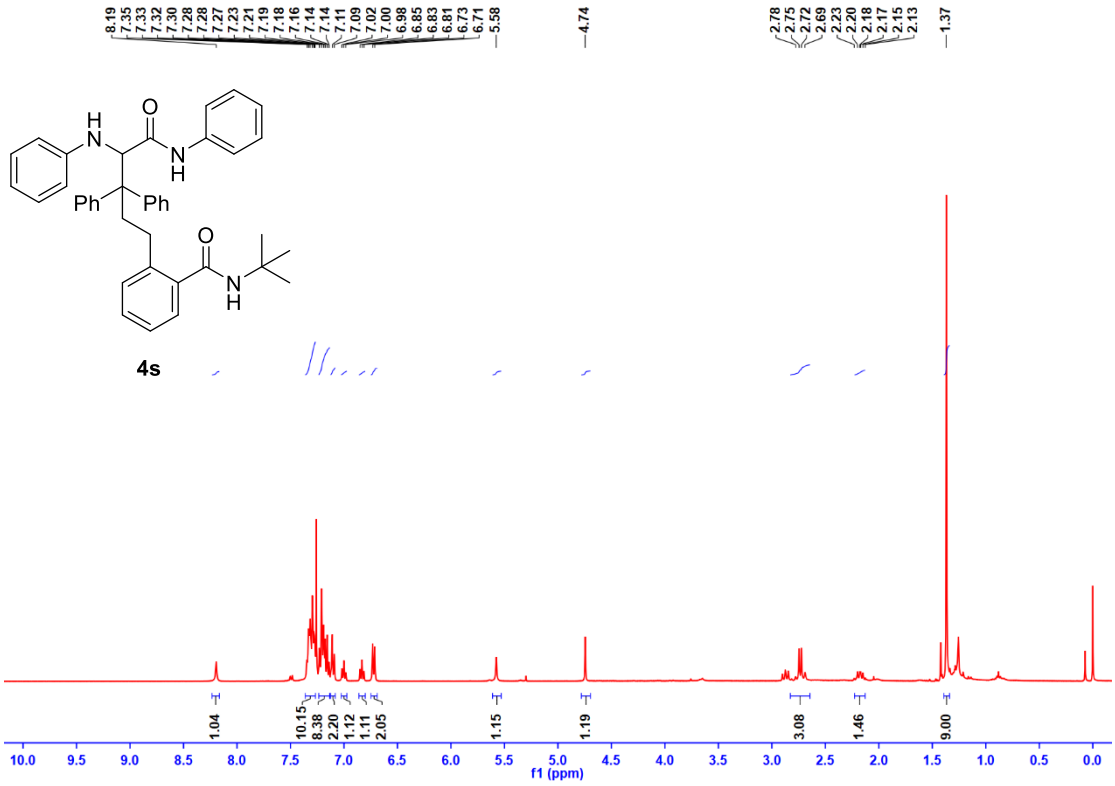
^{1}H NMR (400 MHz, CDCl3) of 4r



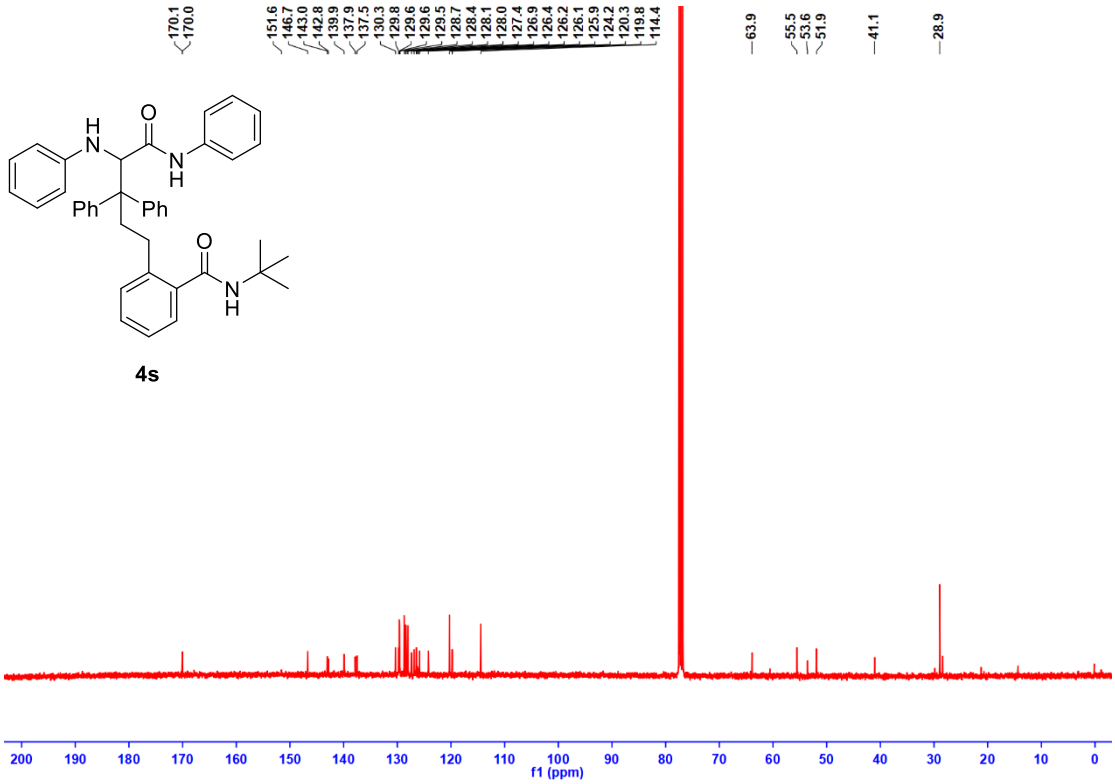
^{13}C NMR (100 MHz, CDCl3) of 4r



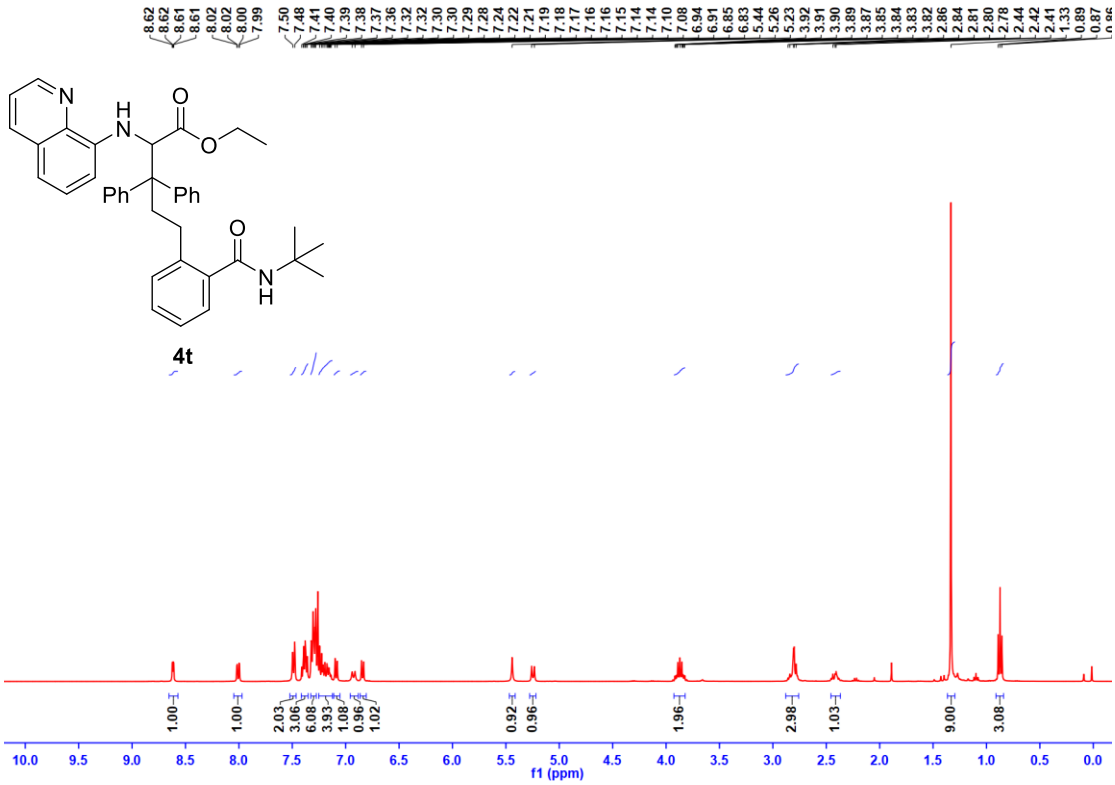
^{1}H NMR (400 MHz, CDCl3) of 4s



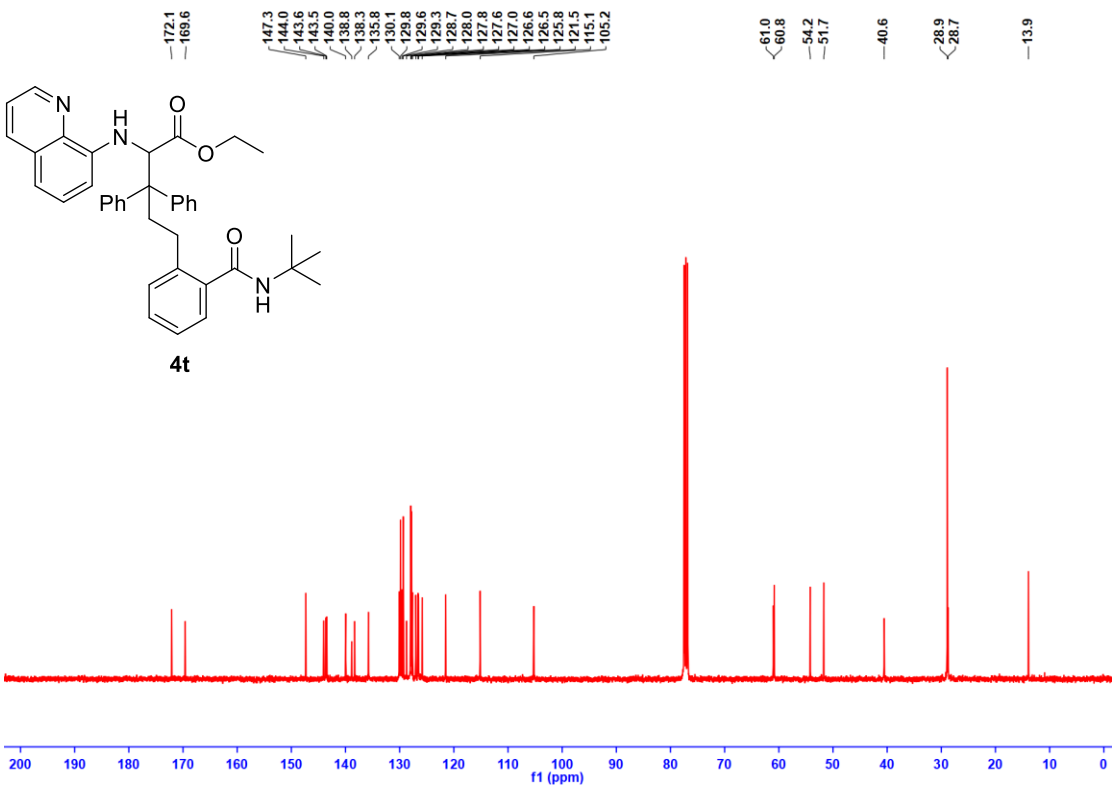
^{13}C NMR (100 MHz, CDCl3) of 4s



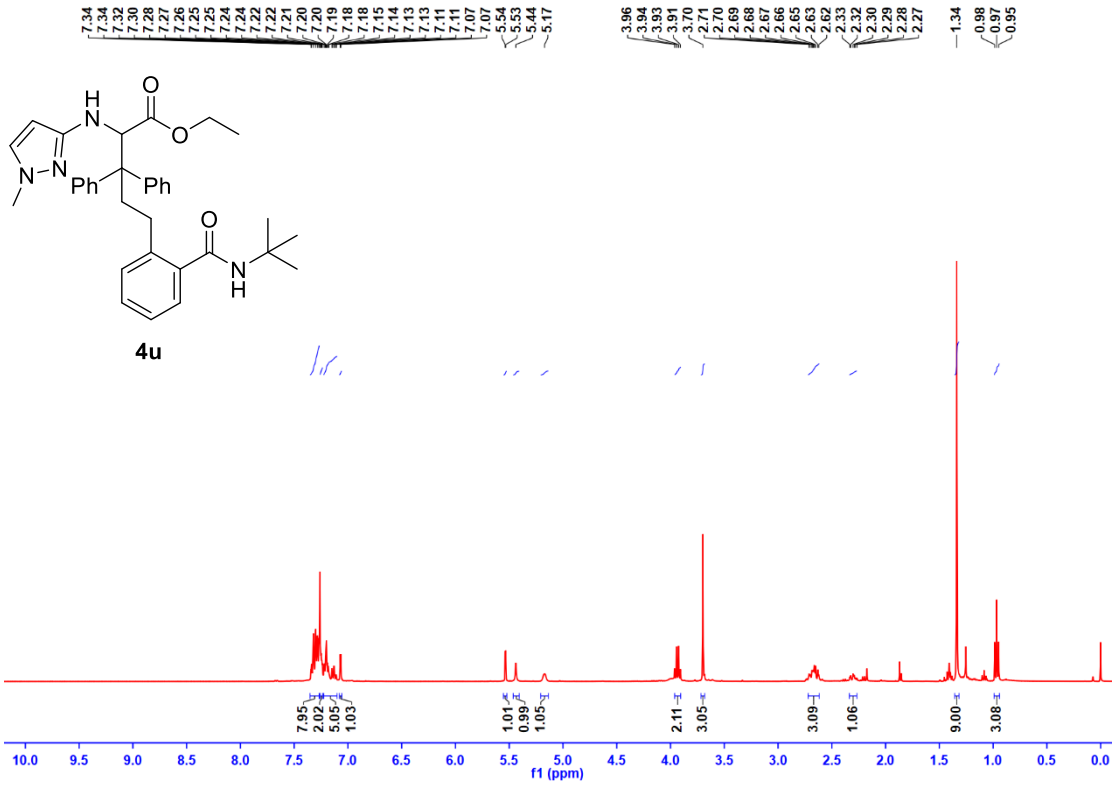
^{1}H NMR (400 MHz, CDCl3) of 4t



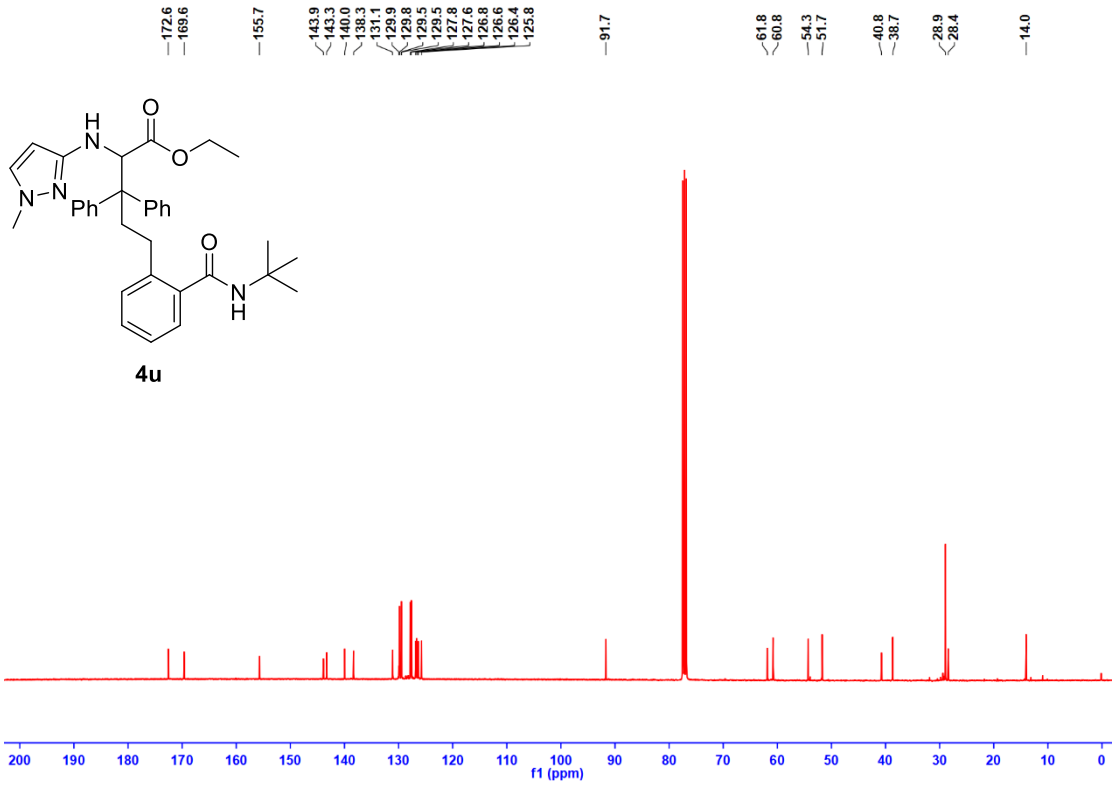
^{13}C NMR (100 MHz, CDCl3) of 4t



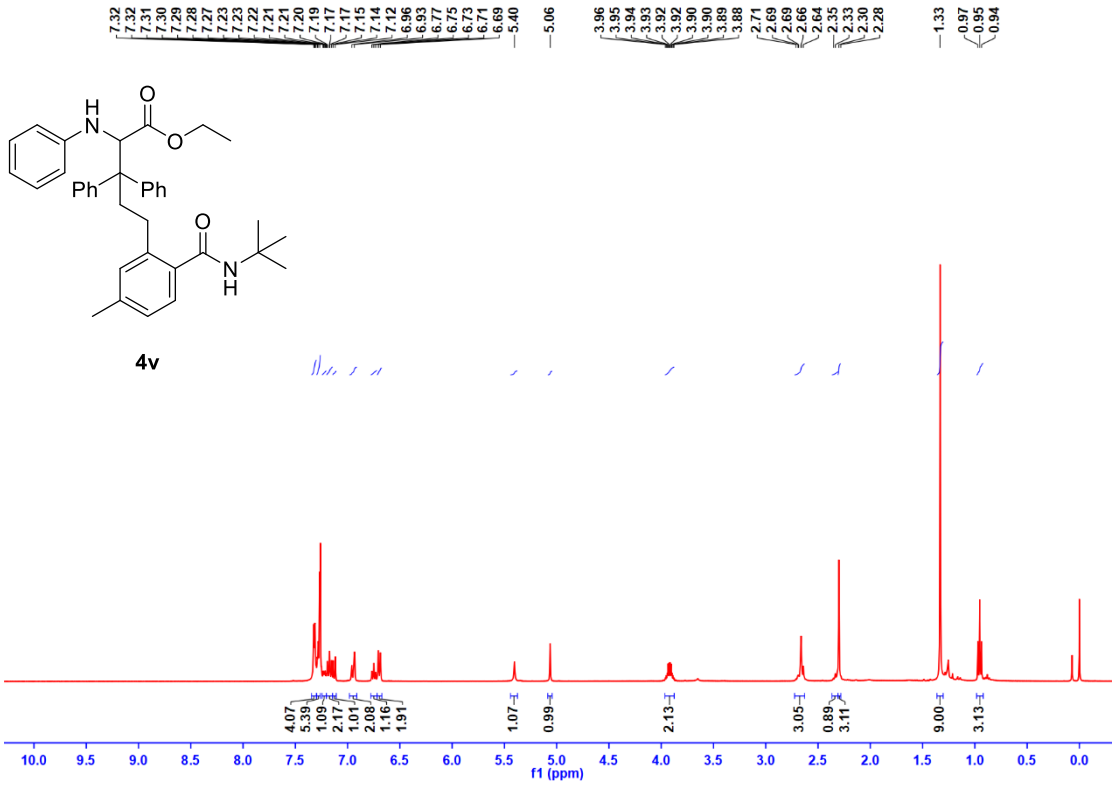
^{1}H NMR (400 MHz, CDCl3) of 4u



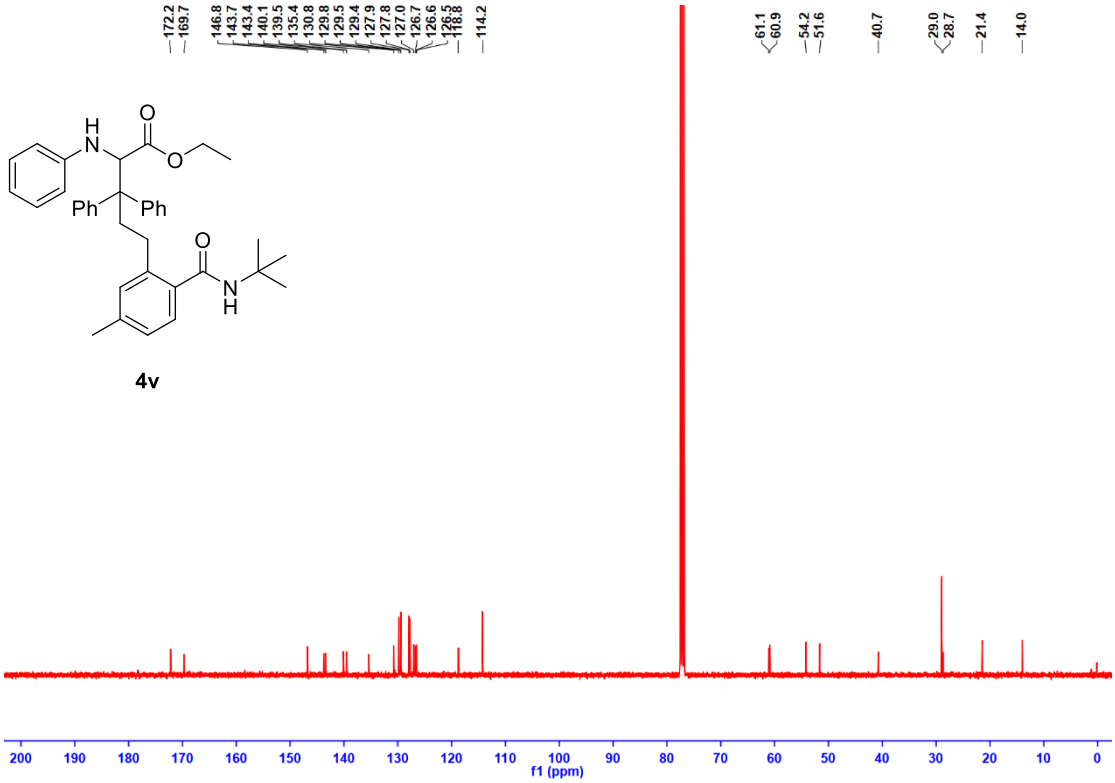
^{13}C NMR (100 MHz, CDCl3) of 4u



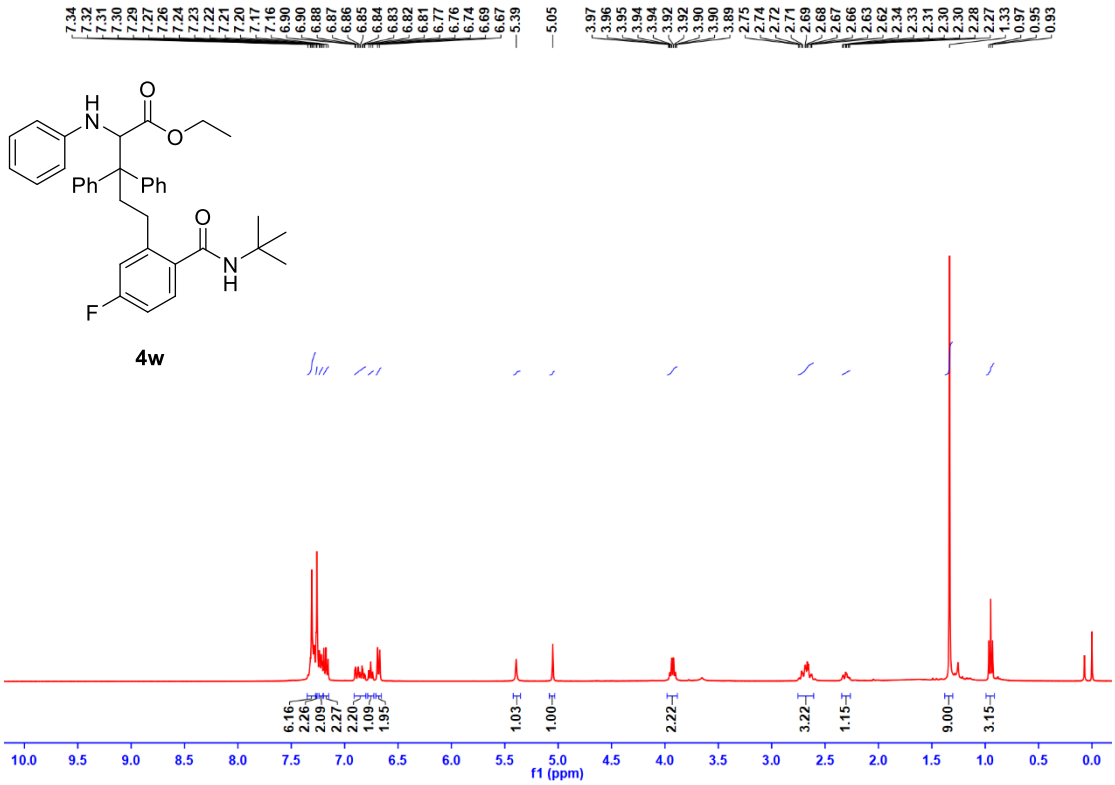
^{1}H NMR (400 MHz, CDCl3) of 4v



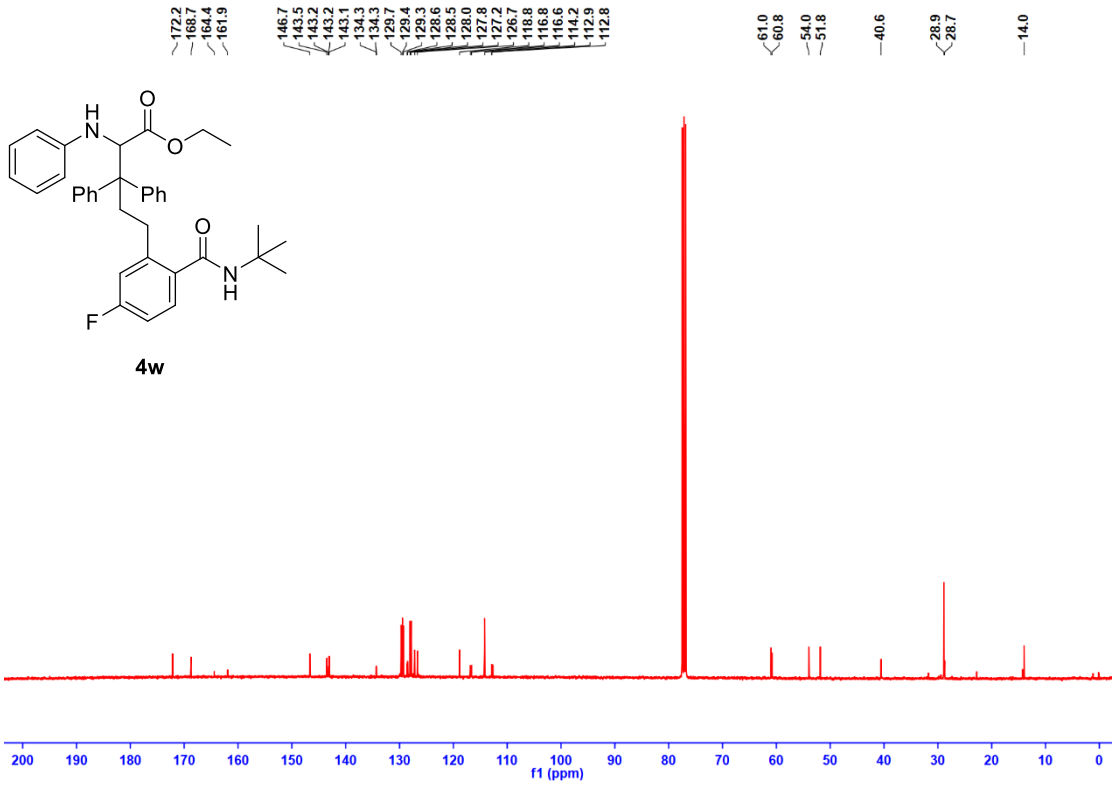
^{13}C NMR (100 MHz, CDCl3) of 4v



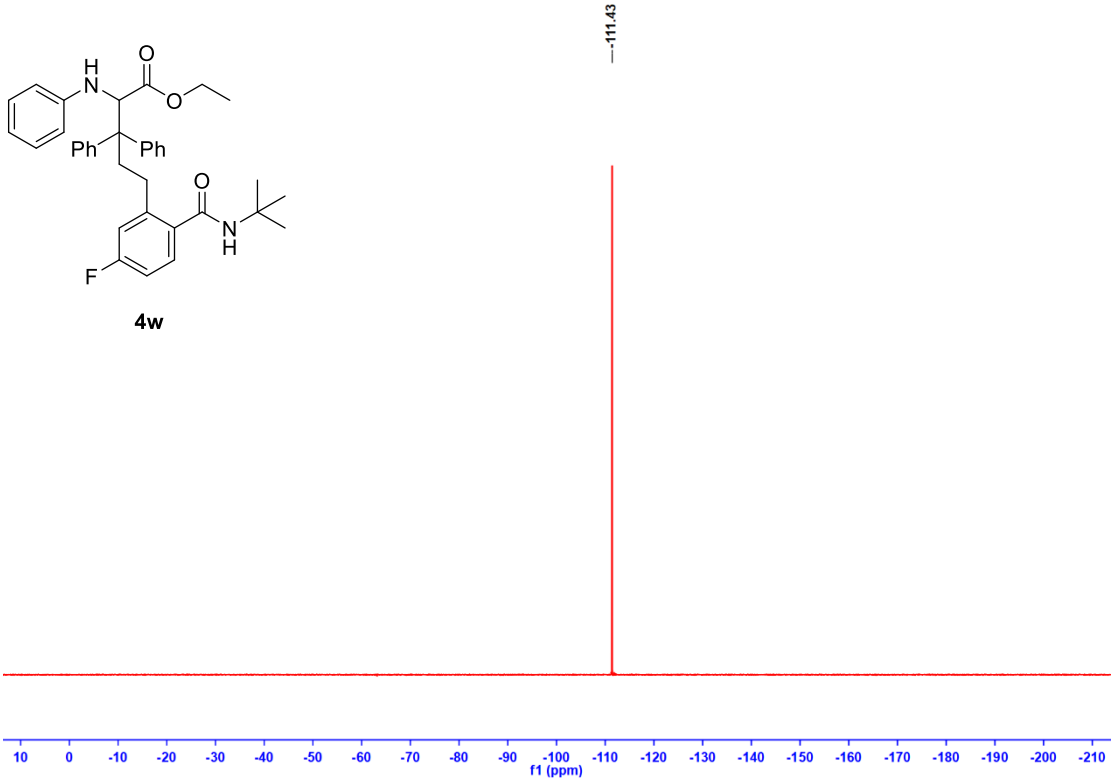
^{1}H NMR (400 MHz, CDCl3) of 4w



^{13}C NMR (100 MHz, CDCl3) of 4w

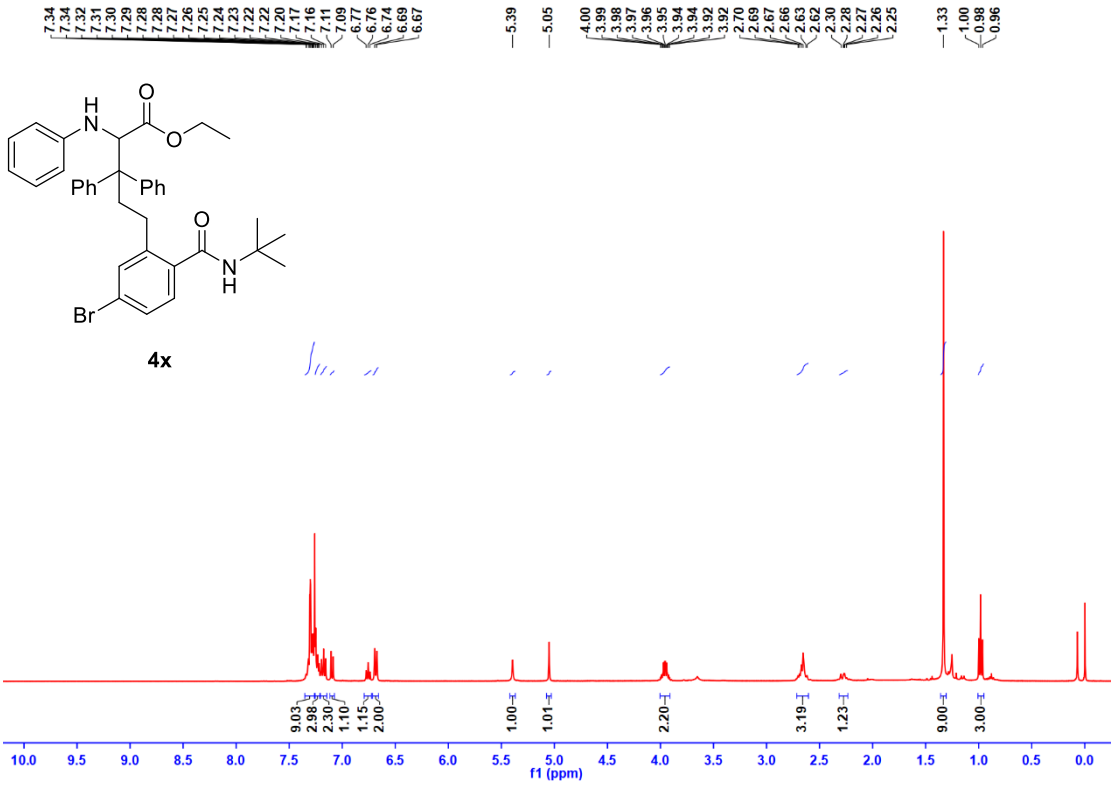


^{19}F NMR (376 MHz, CDCl3) of 4w



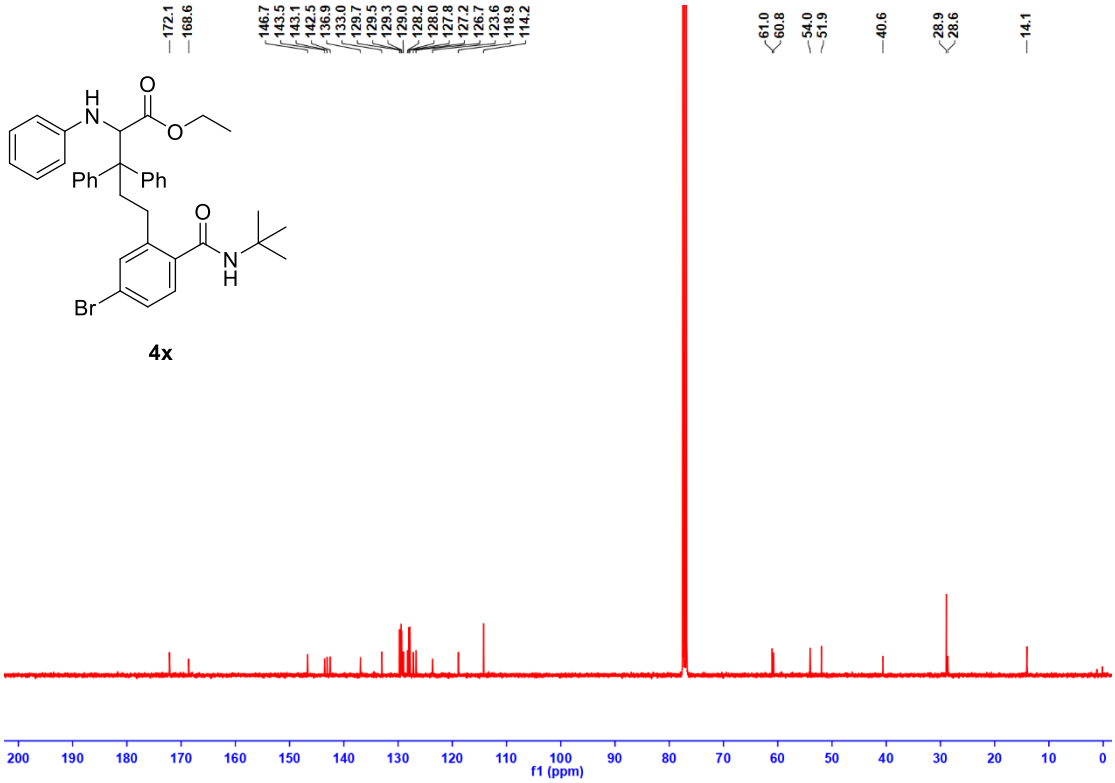
4w

^{1}H NMR (400 MHz, CDCl3) of 4x



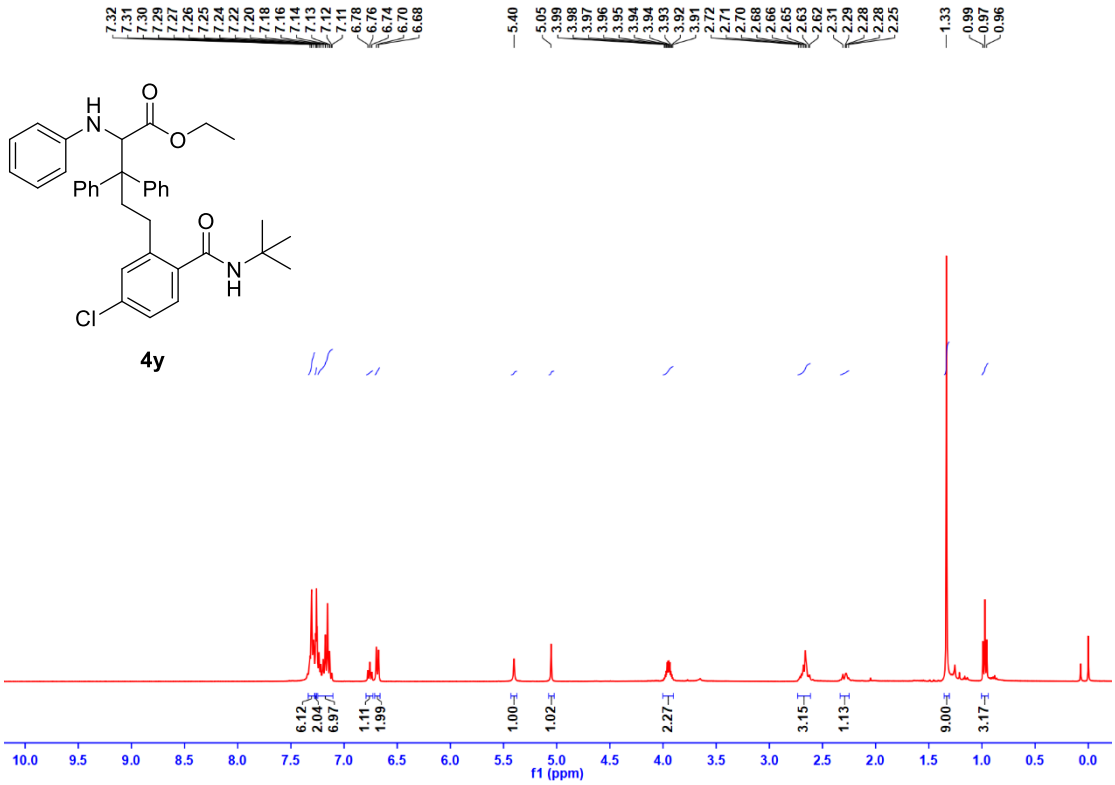
4x

^{13}C NMR (100 MHz, CDCl3) of 4x



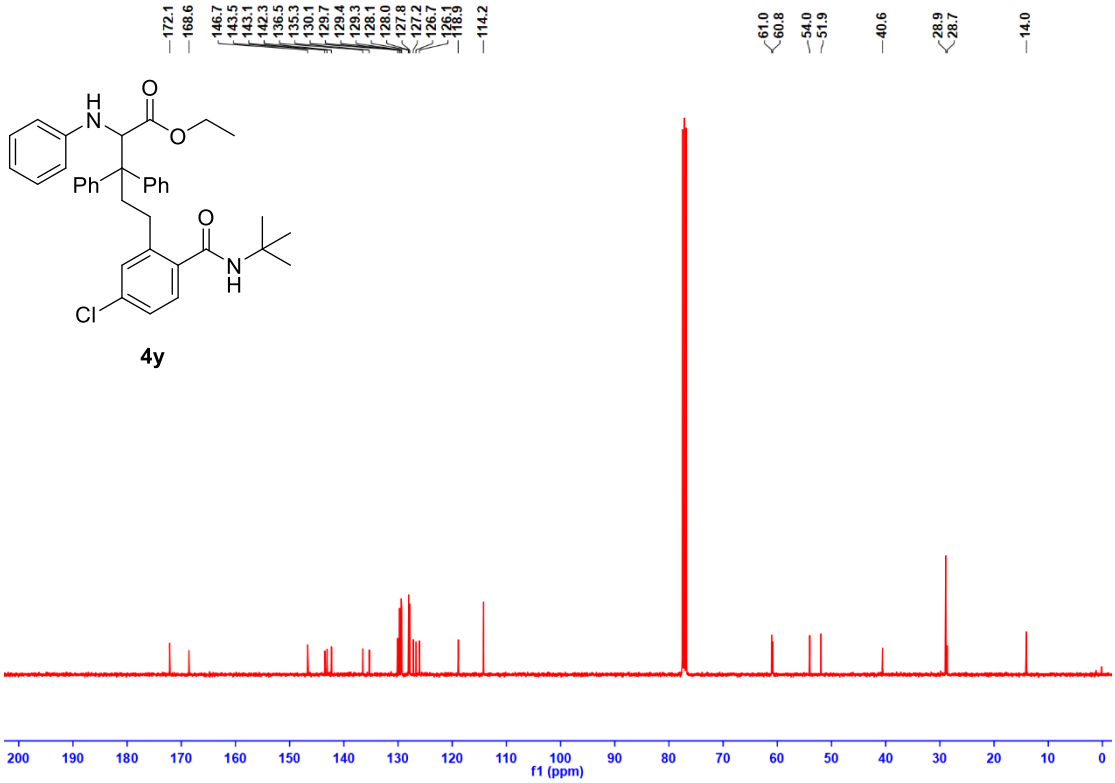
4x

^{1}H NMR (400 MHz, CDCl3) of 4y

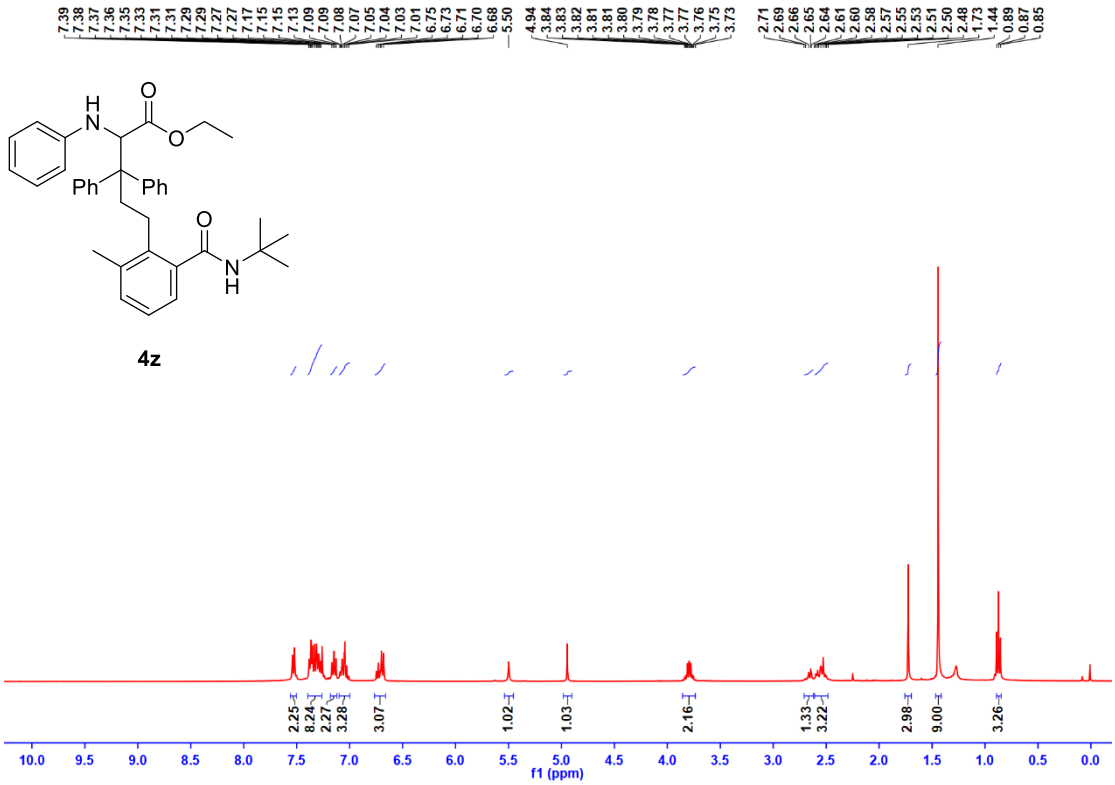


4y

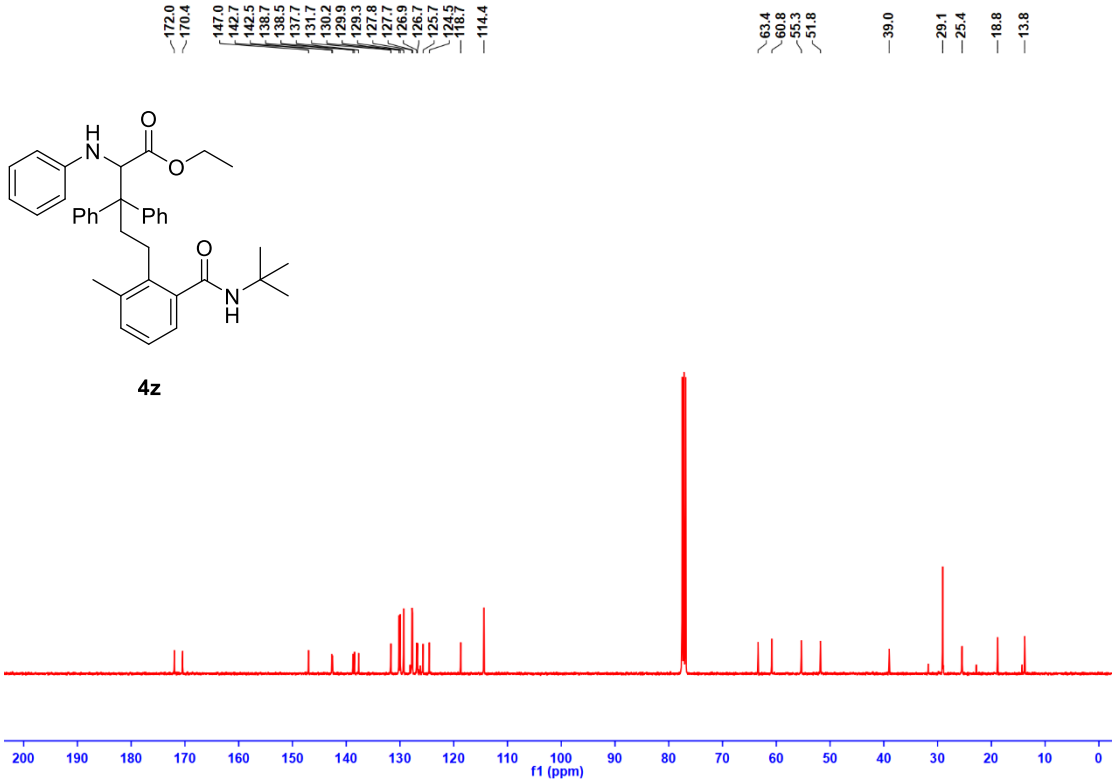
^{13}C NMR (100 MHz, CDCl3) of 4y



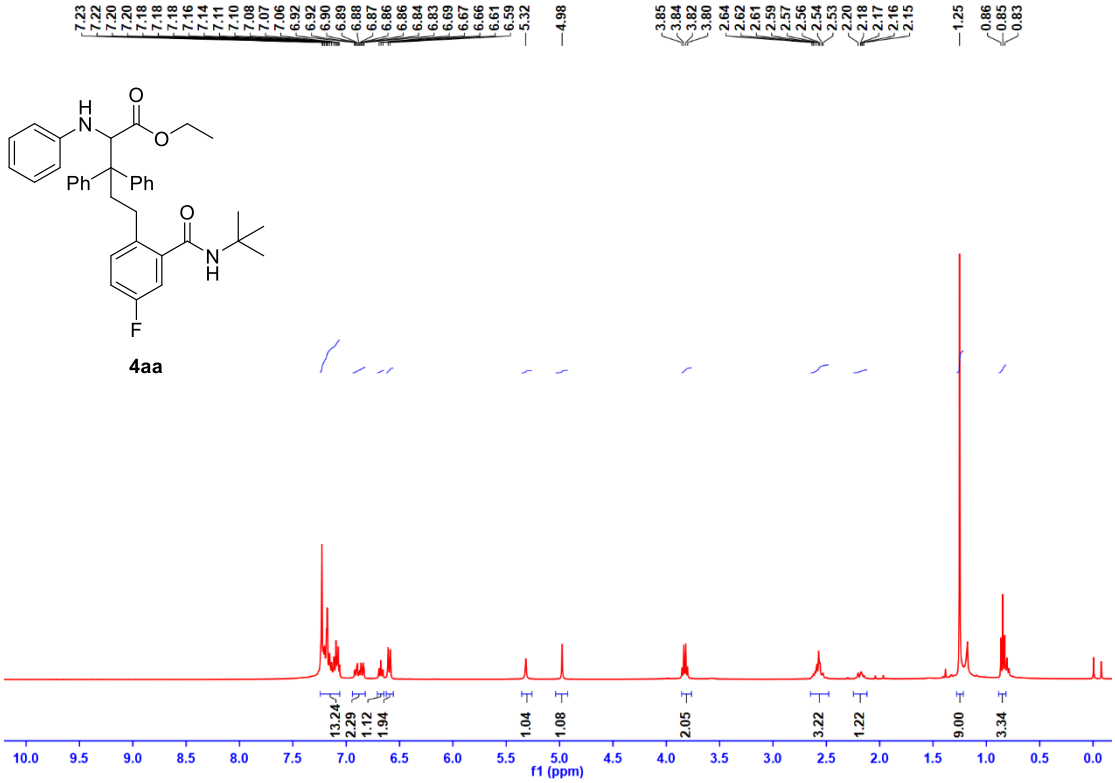
^{1}H NMR (400 MHz, CDCl3) of 4z



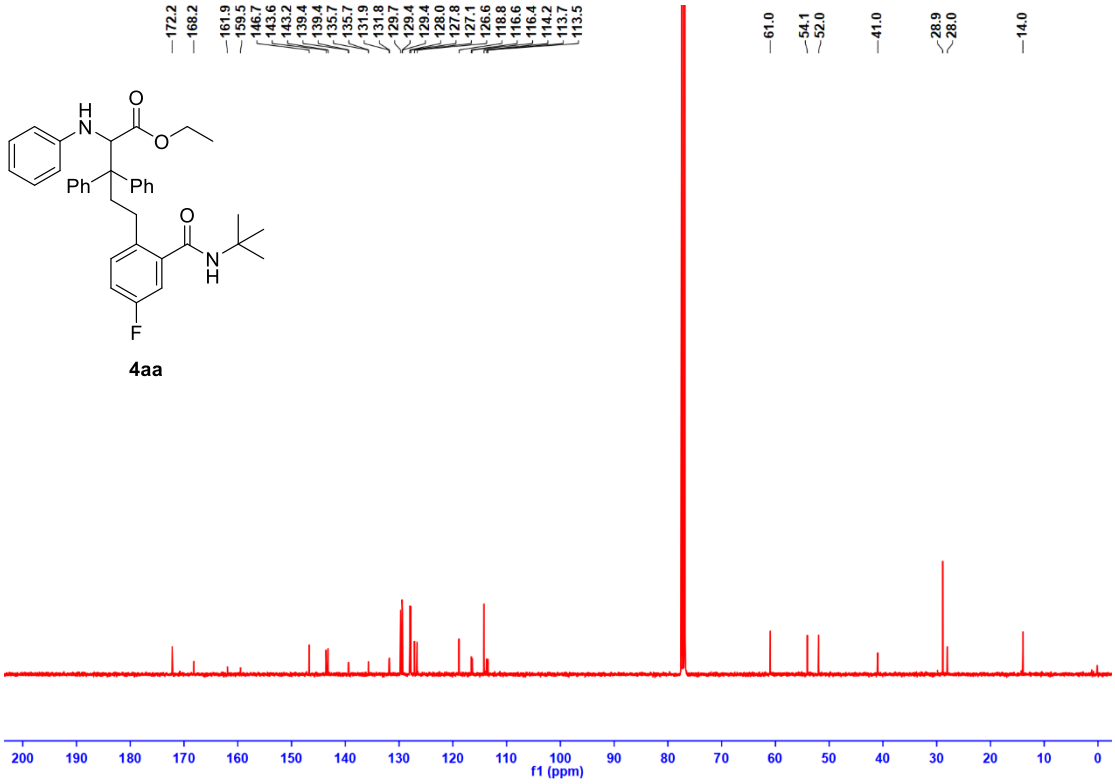
^{13}C NMR (100 MHz, CDCl3) of 4z



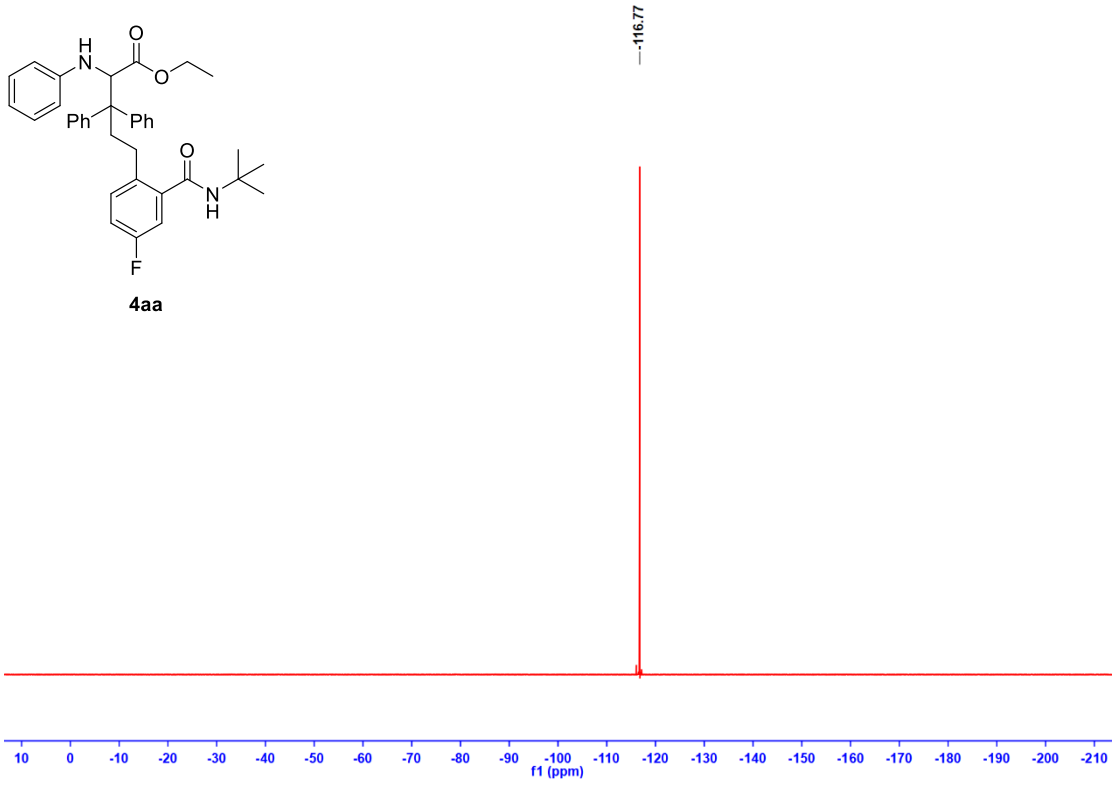
^{1}H NMR (400 MHz, CDCl3) of 4aa



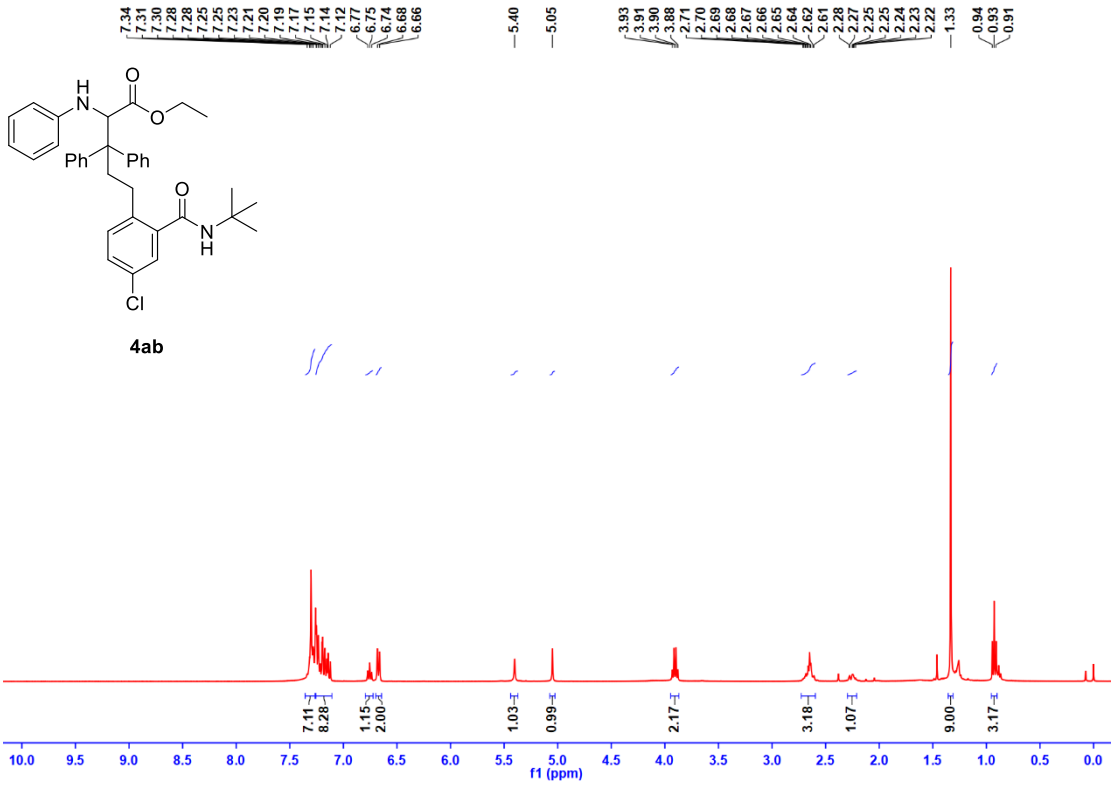
^{13}C NMR (100 MHz, CDCl3) of 4aa



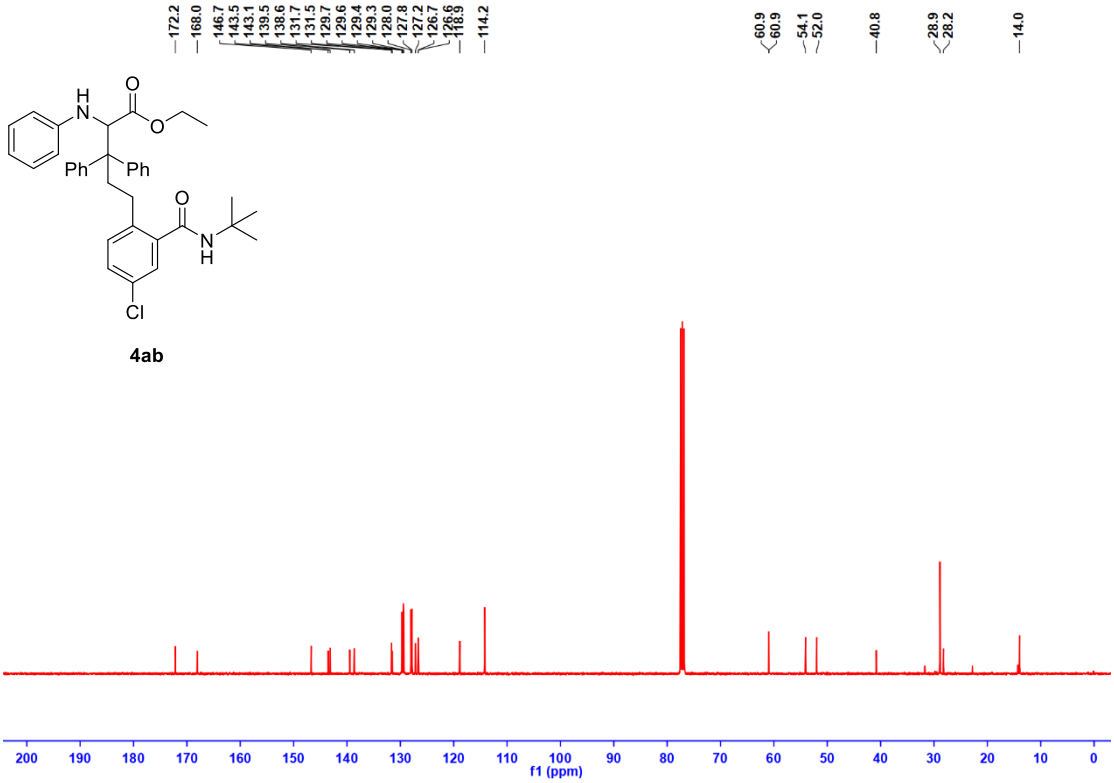
^{19}F NMR (376 MHz, CDCl3) of 4aa



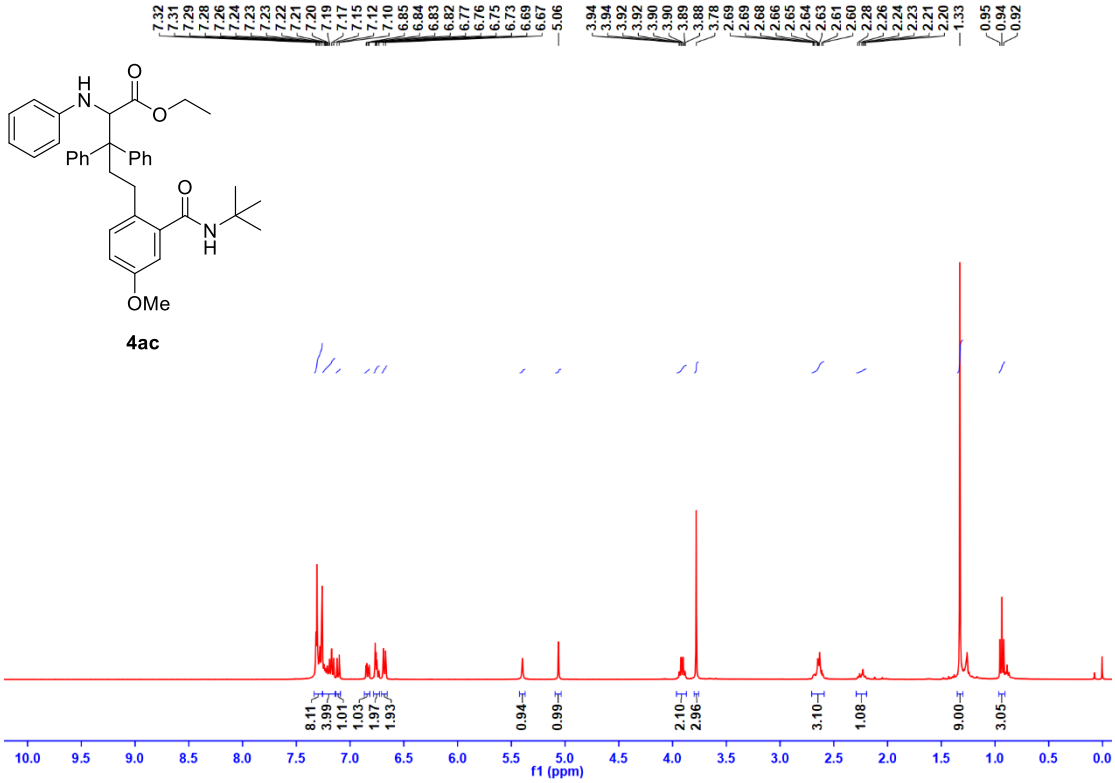
^{1}H NMR (400 MHz, CDCl3) of 4ab



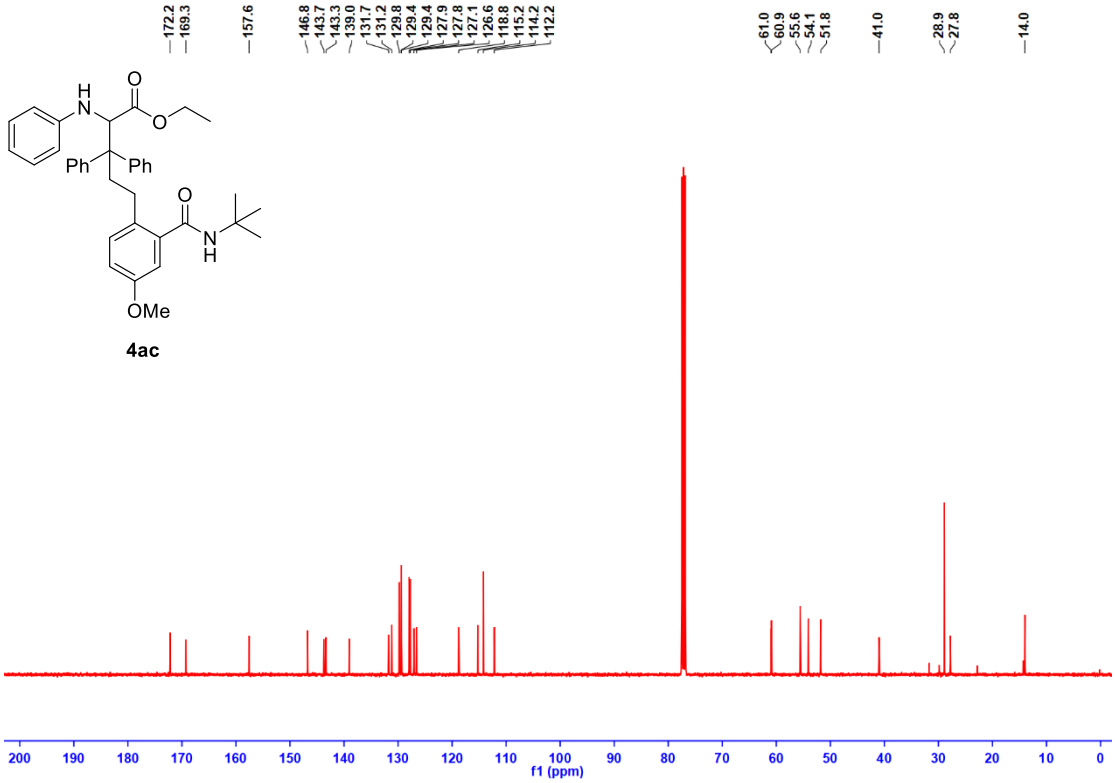
^{13}C NMR (100 MHz, CDCl3) of 4ab



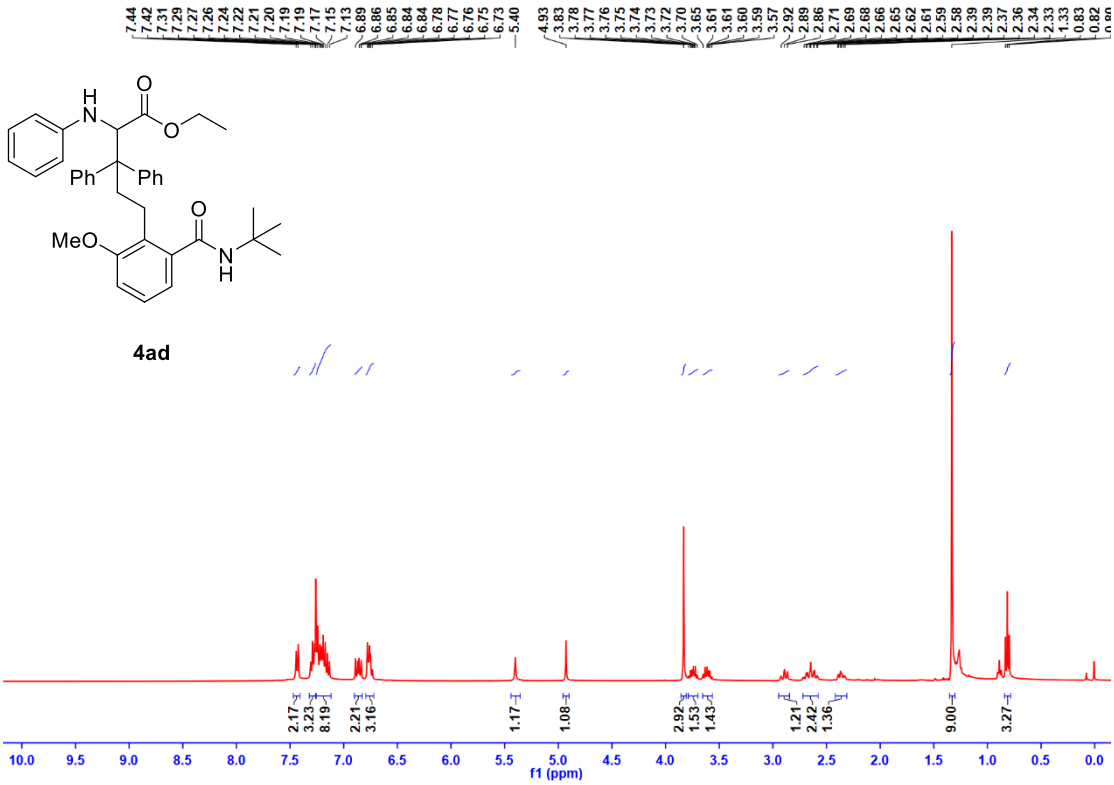
^{1}H NMR (400 MHz, CDCl3) of 4ac



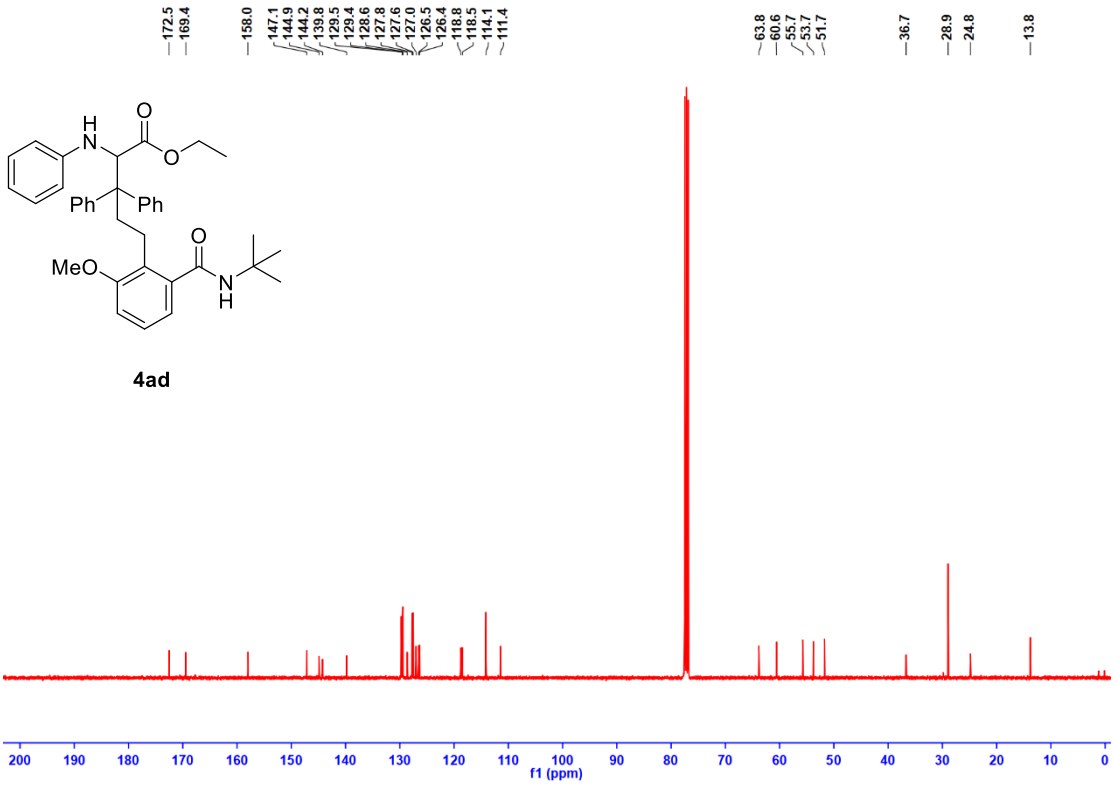
^{13}C NMR (100 MHz, CDCl3) of 4ac



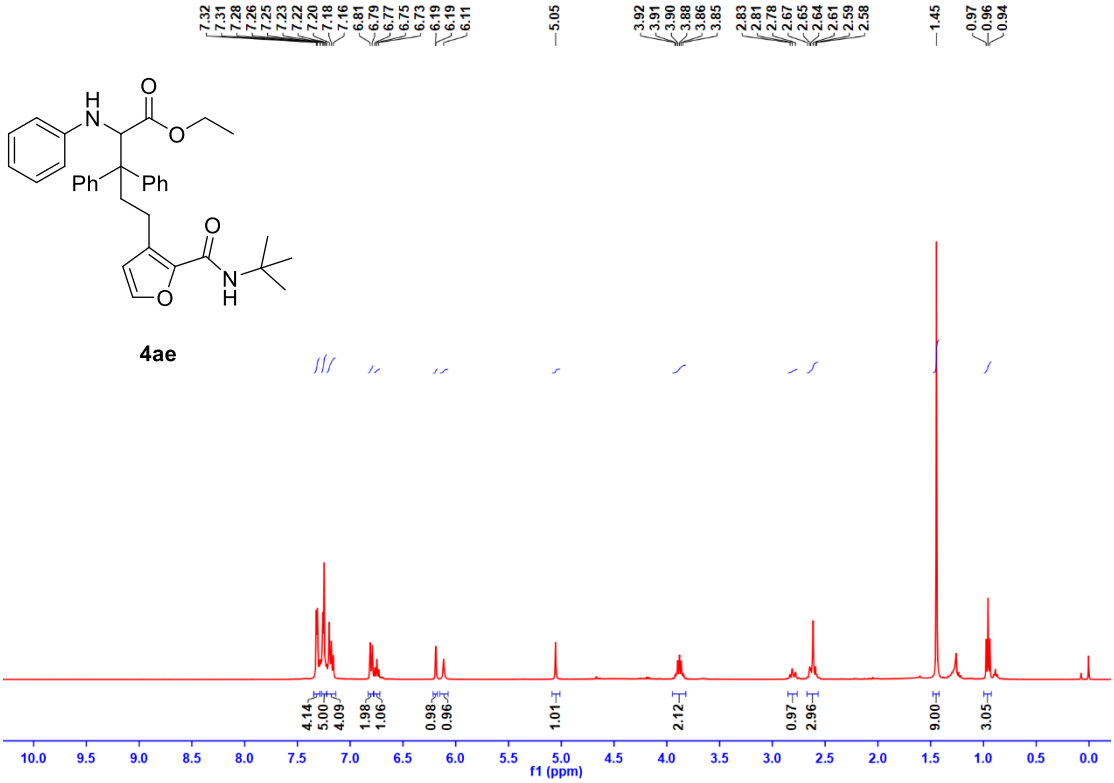
^{1}H NMR (400 MHz, CDCl3) of 4ad



^{13}C NMR (100 MHz, CDCl3) of 4ad

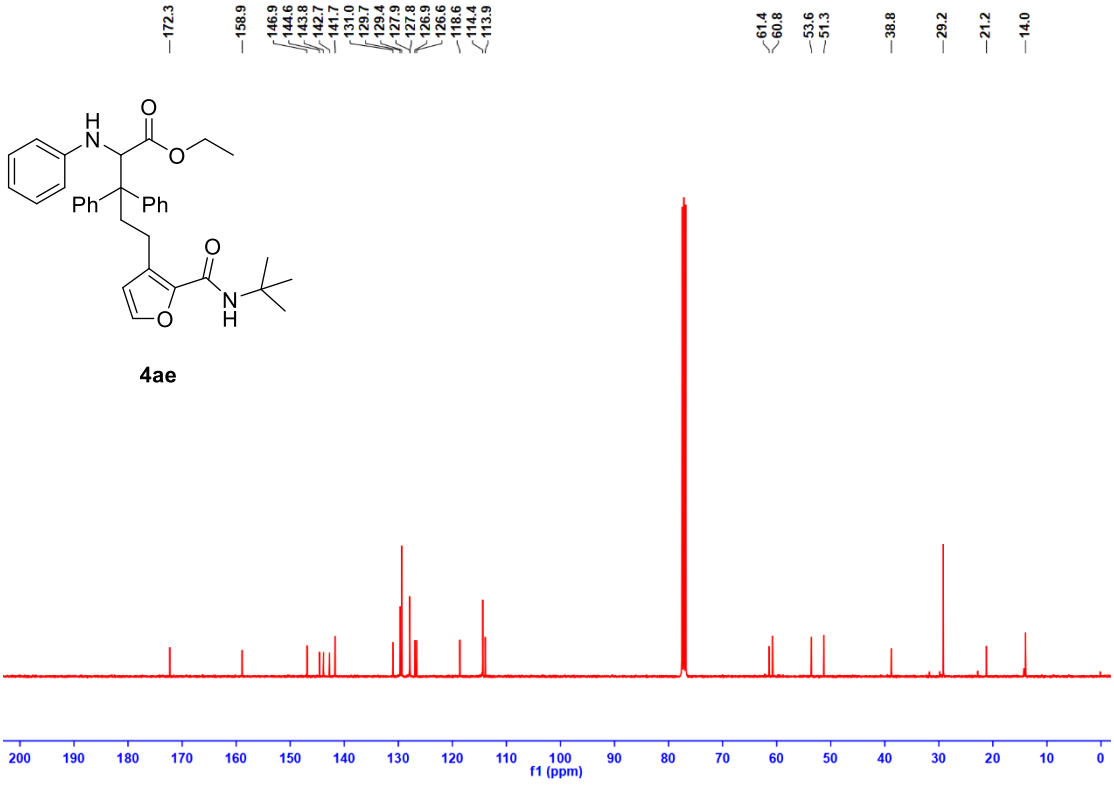


^{1}H NMR (400 MHz, CDCl3) of 4ae



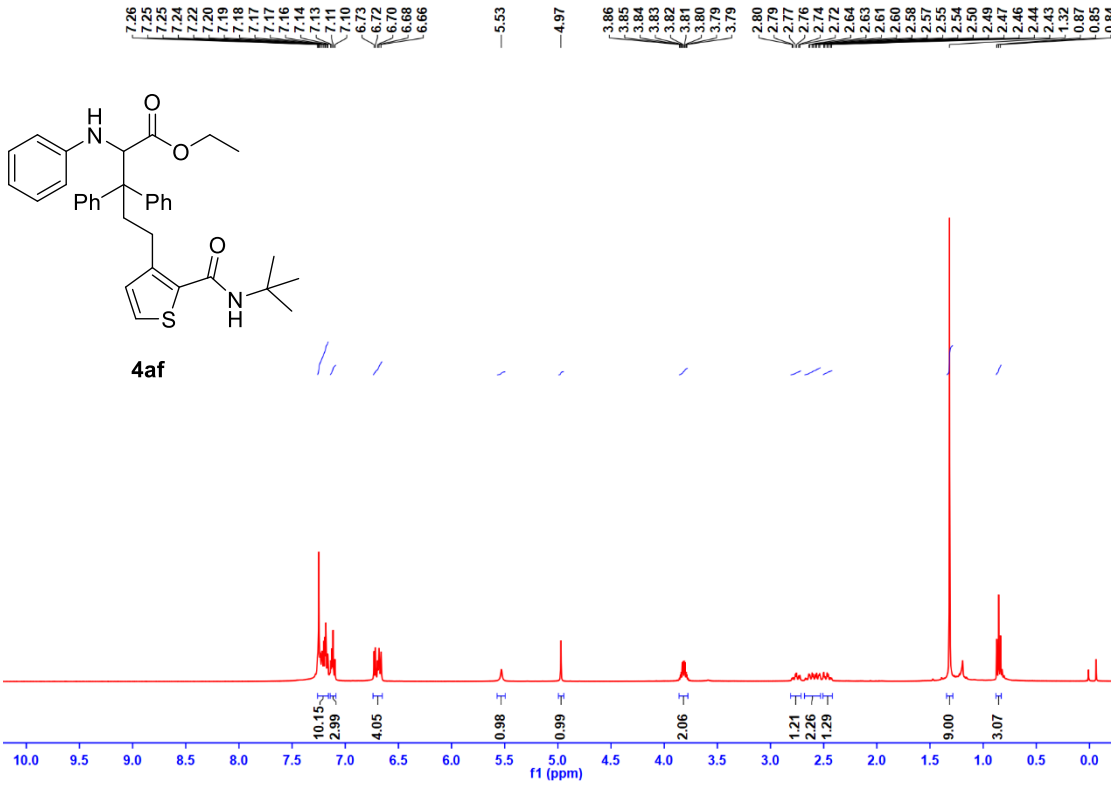
4ae

^{13}C NMR (100 MHz, CDCl3) of 4ae



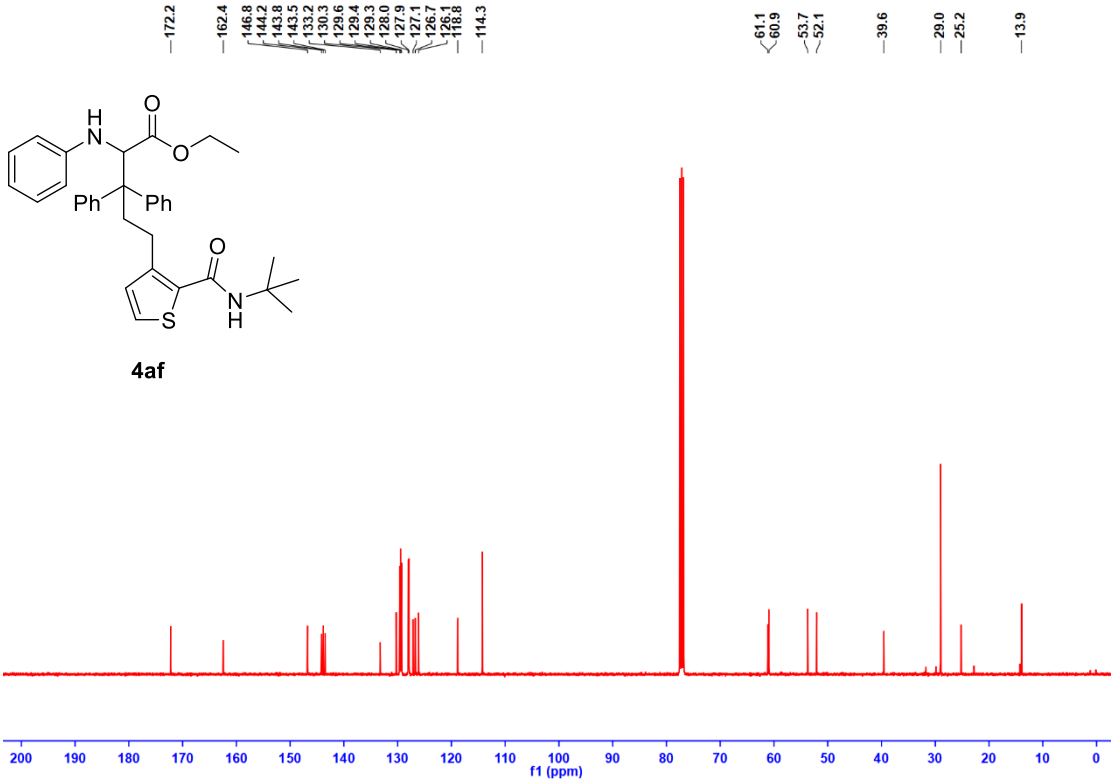
4ae

^{1}H NMR (400 MHz, CDCl3) of 4af



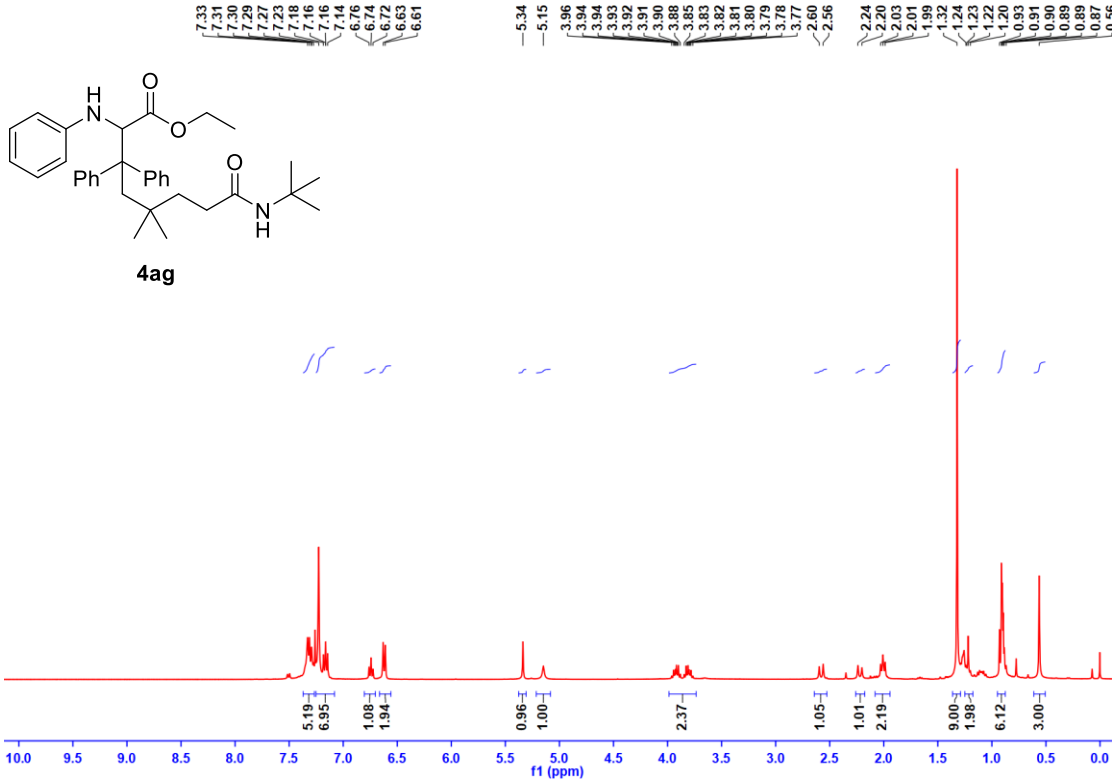
4af

^{13}C NMR (100 MHz, CDCl3) of 4af

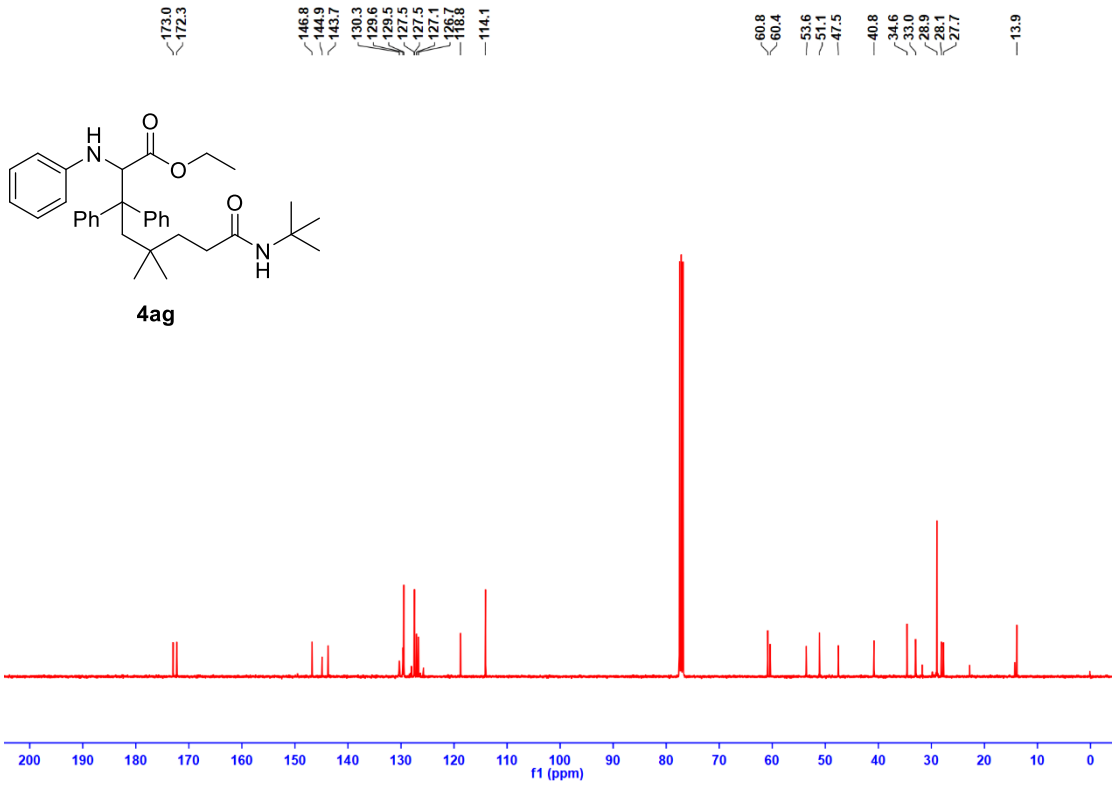


4af

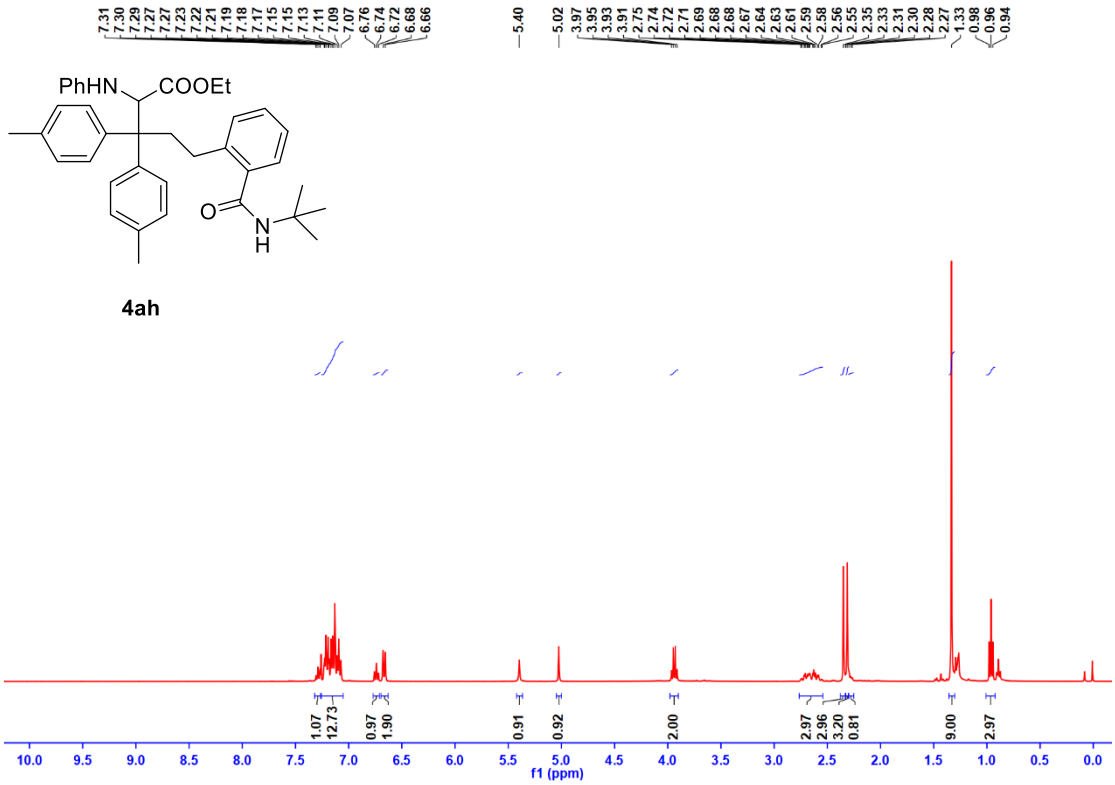
^{1}H NMR (400 MHz, CDCl3) of 4ag



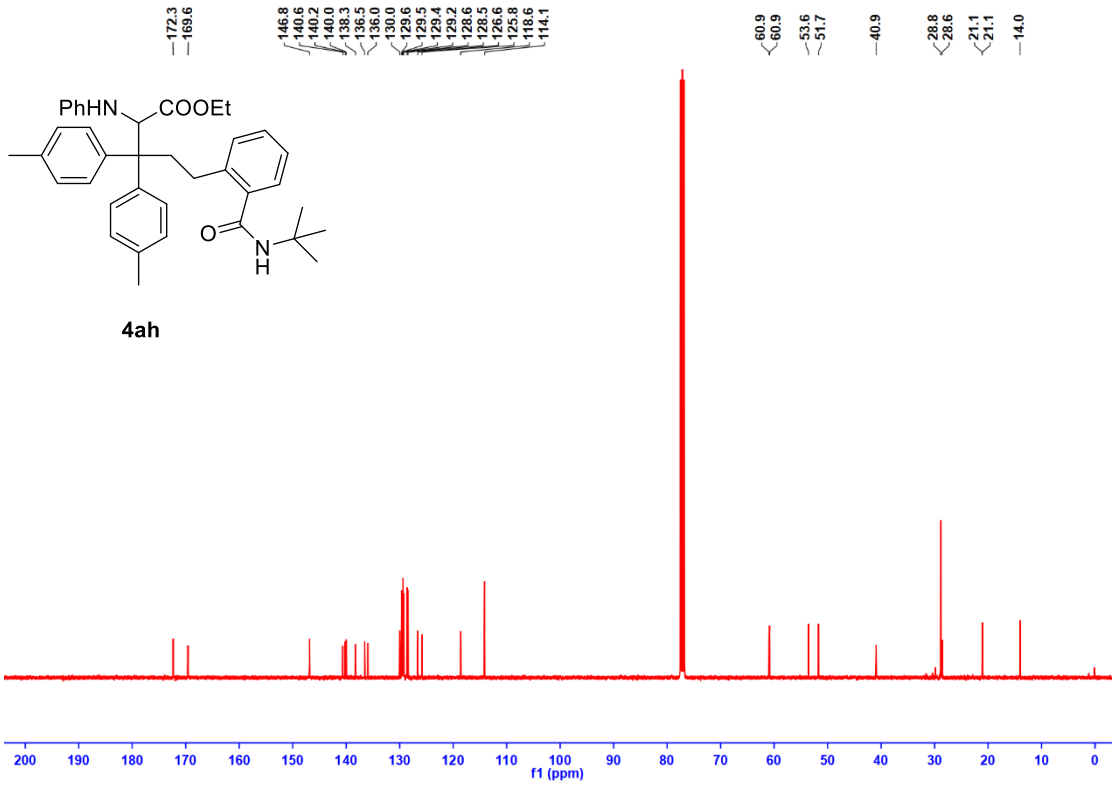
^{13}C NMR (100 MHz, CDCl3) of 4ag



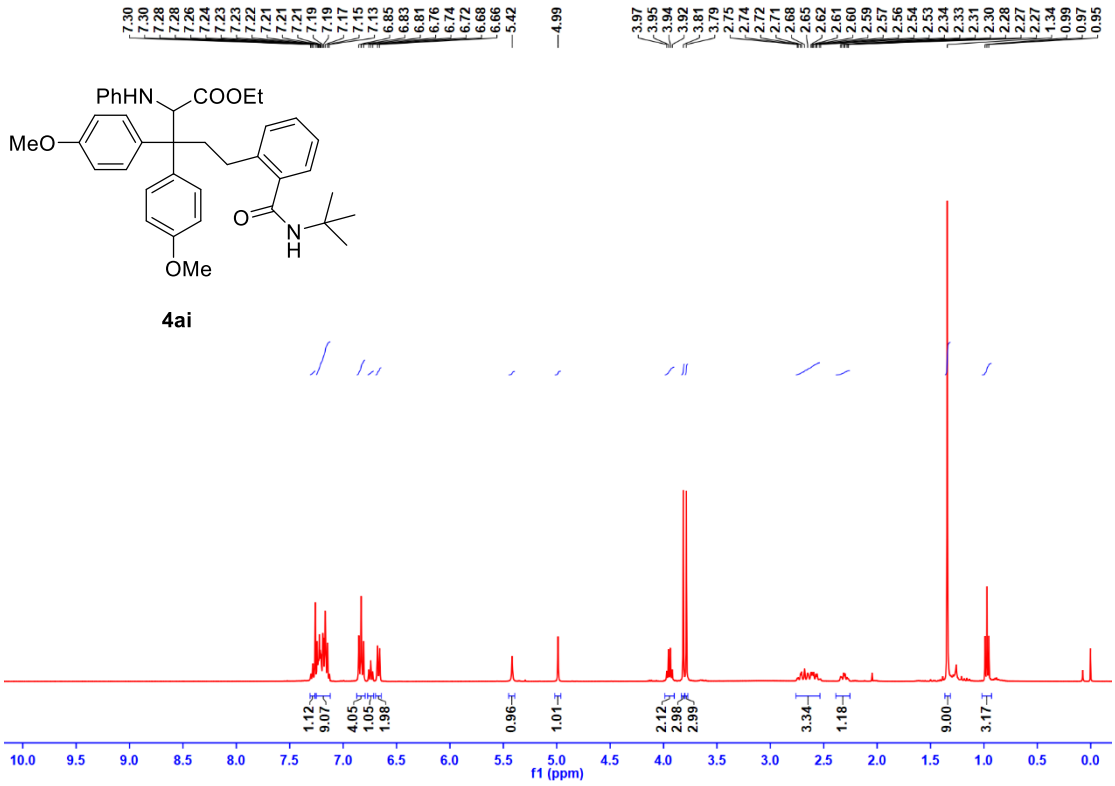
^{1}H NMR (400 MHz, CDCl3) of 4ah



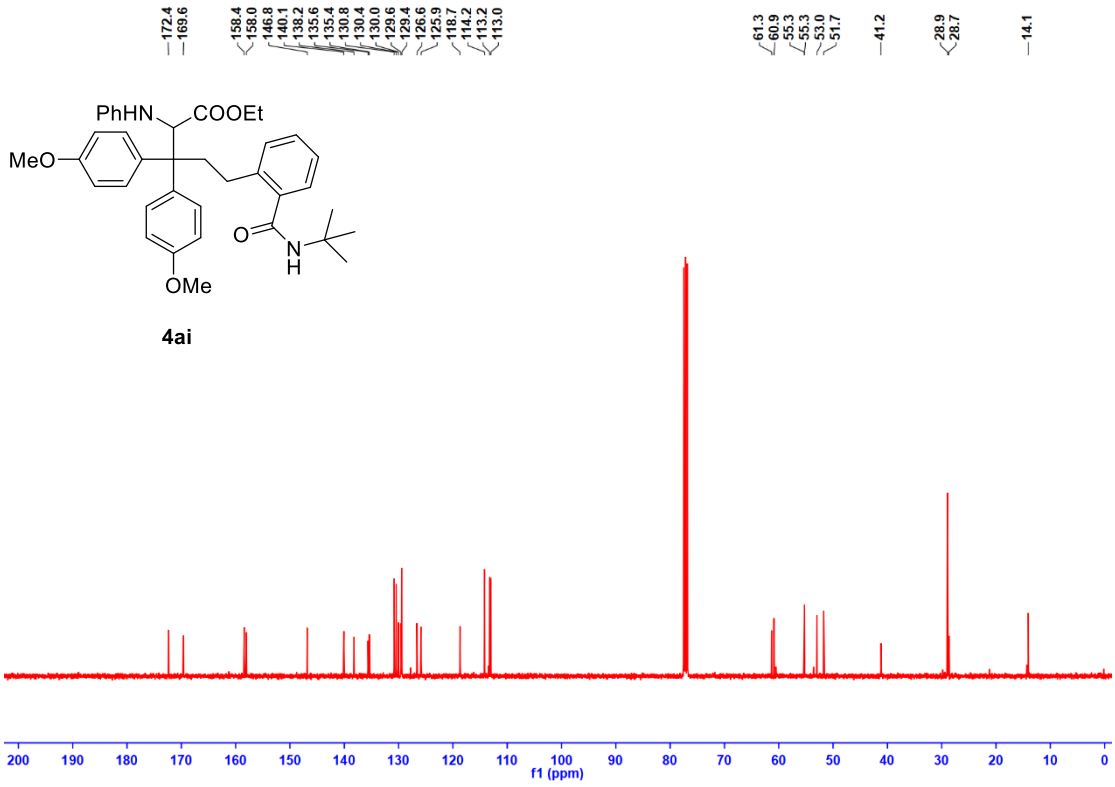
^{13}C NMR (100 MHz, CDCl3) of 4ah



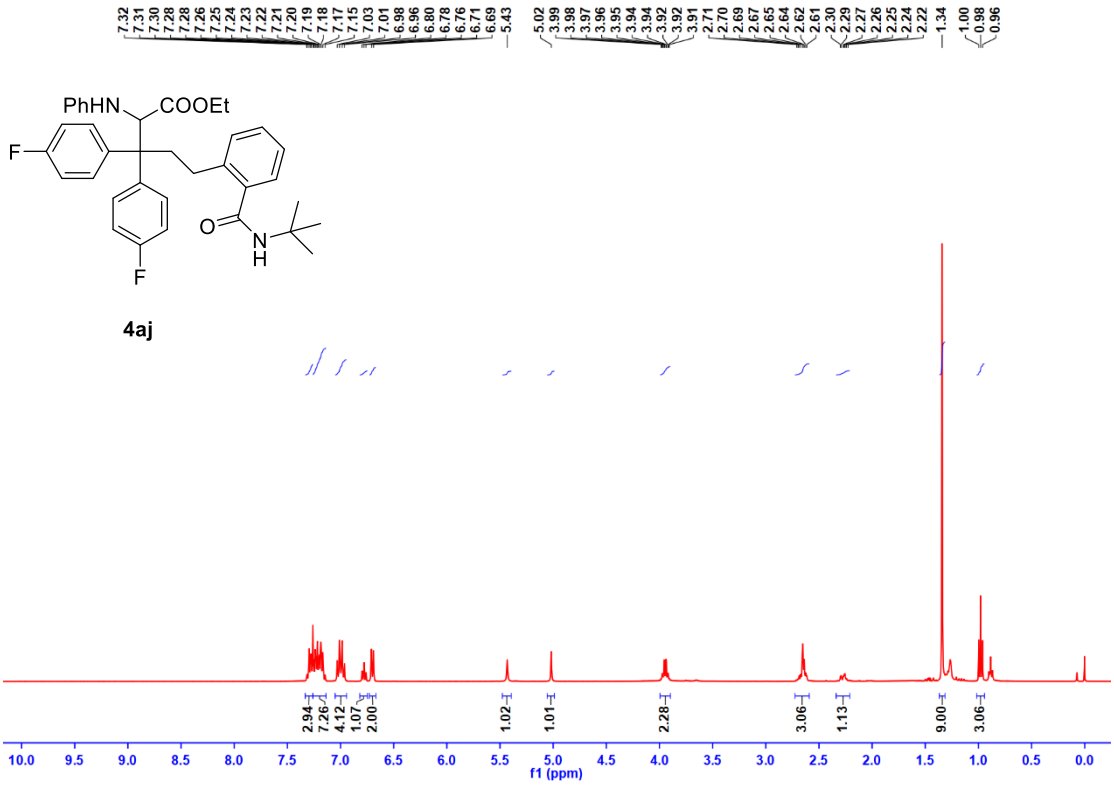
^{1}H NMR (400 MHz, CDCl3) of 4ai



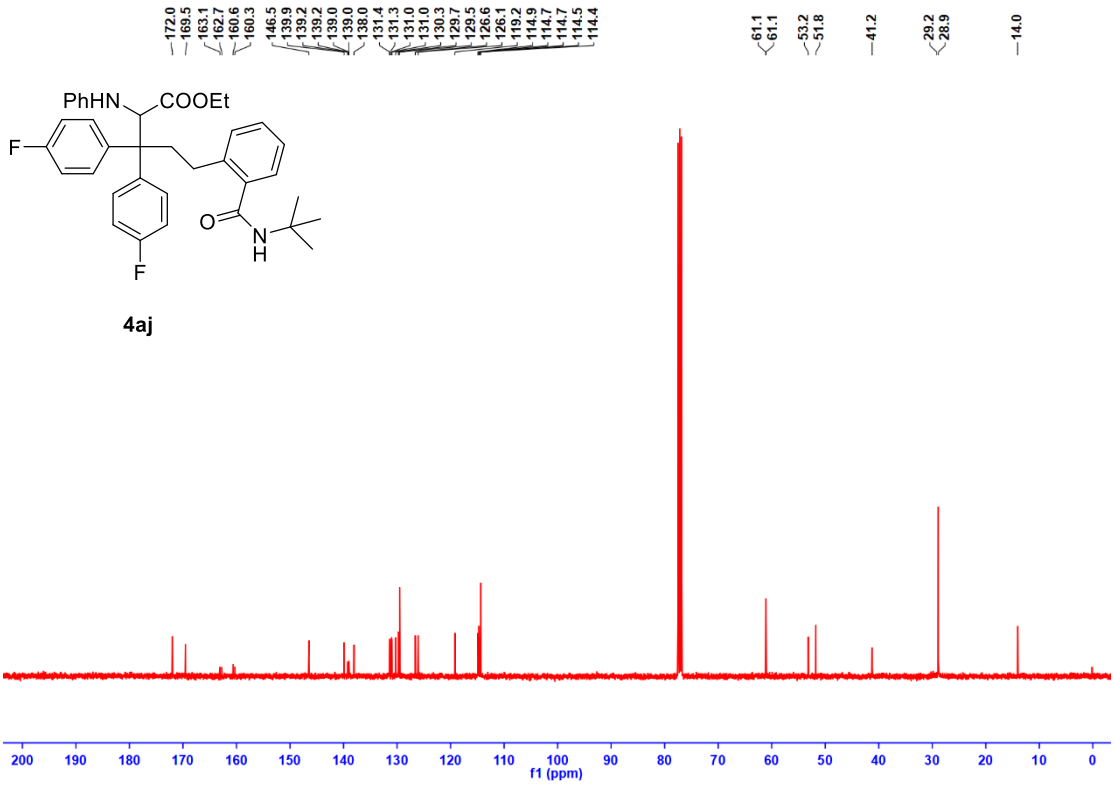
^{13}C NMR (100 MHz, CDCl3) of 4ai



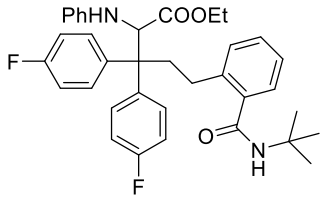
^{1}H NMR (400 MHz, CDCl3) of 4aj



^{13}C NMR (100 MHz, CDCl3) of 4aj

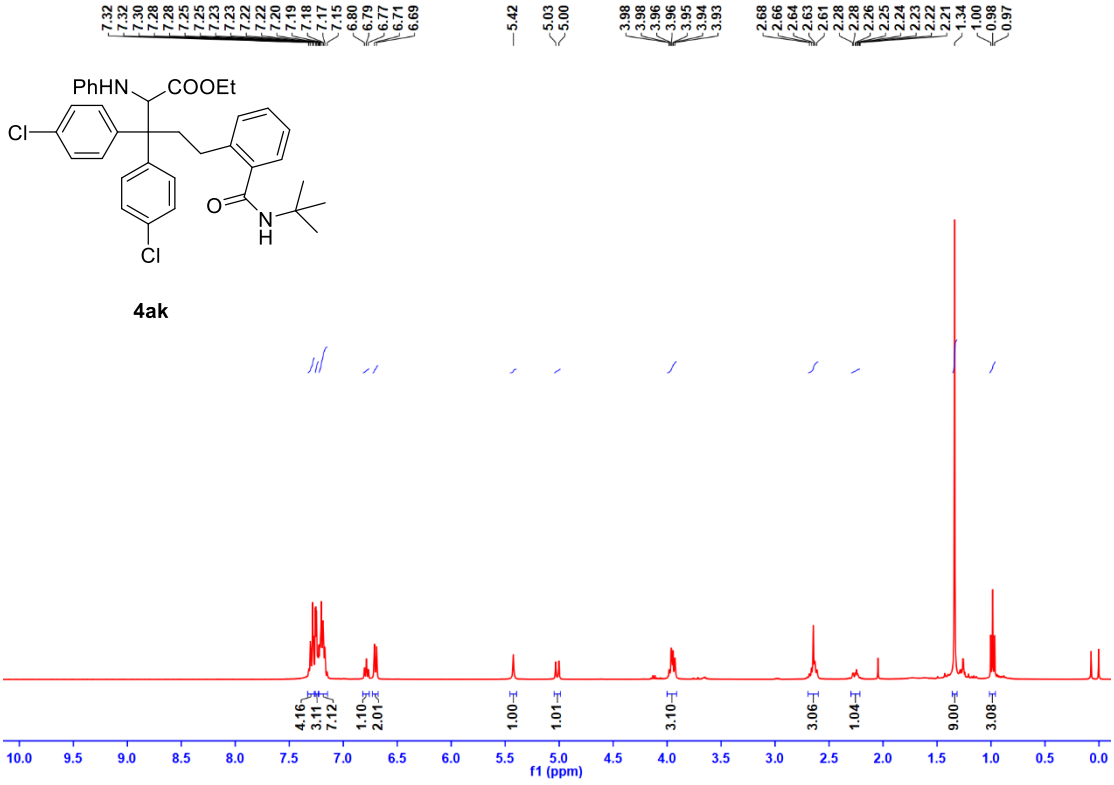


^{19}F NMR (376 MHz, CDCl3) of 4aj



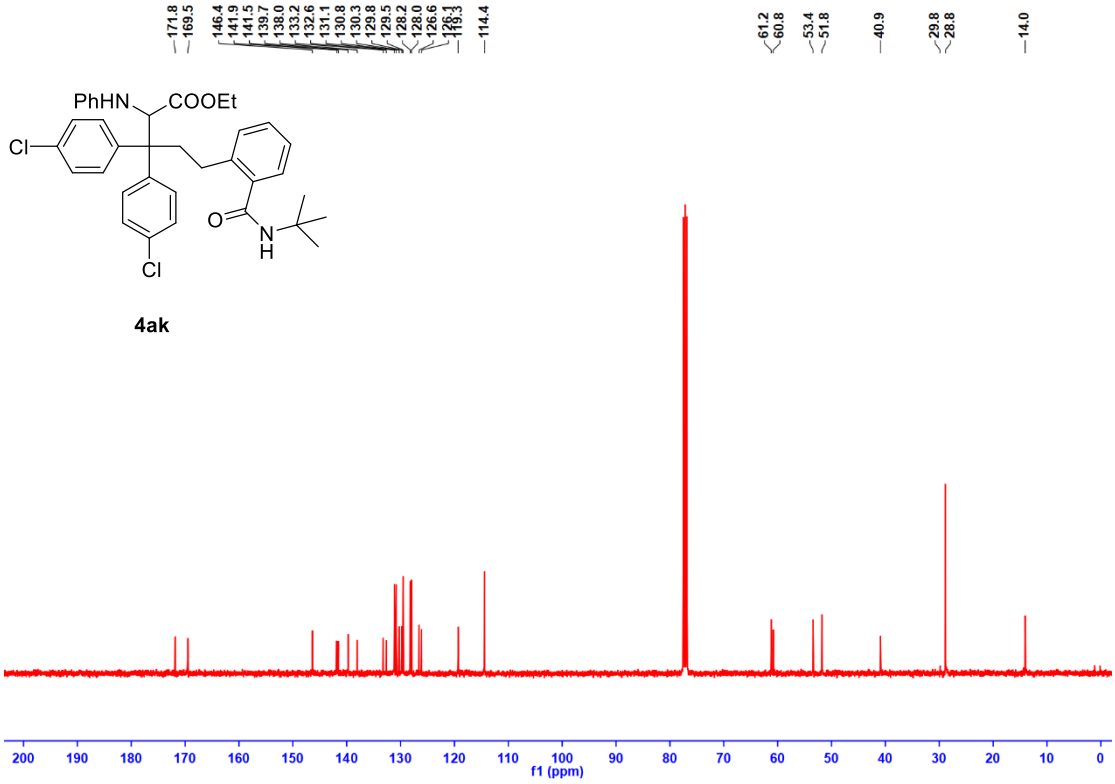
4aj

^{1}H NMR (400 MHz, CDCl3) of 4ak

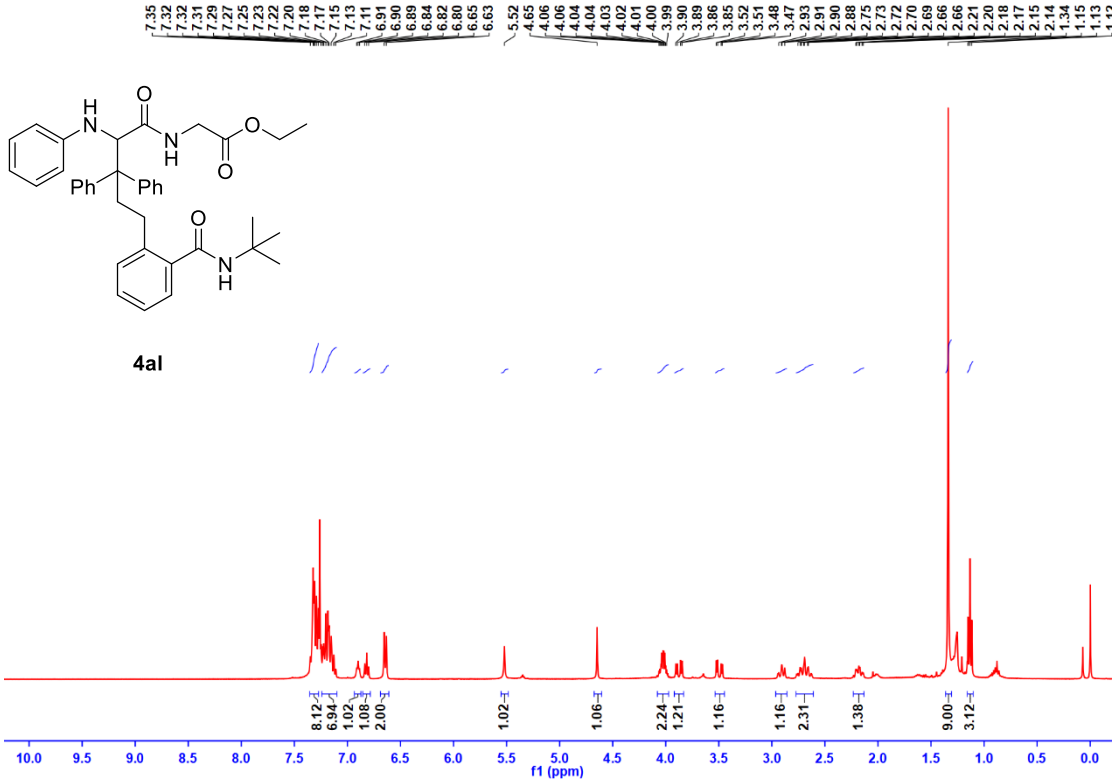


4ak

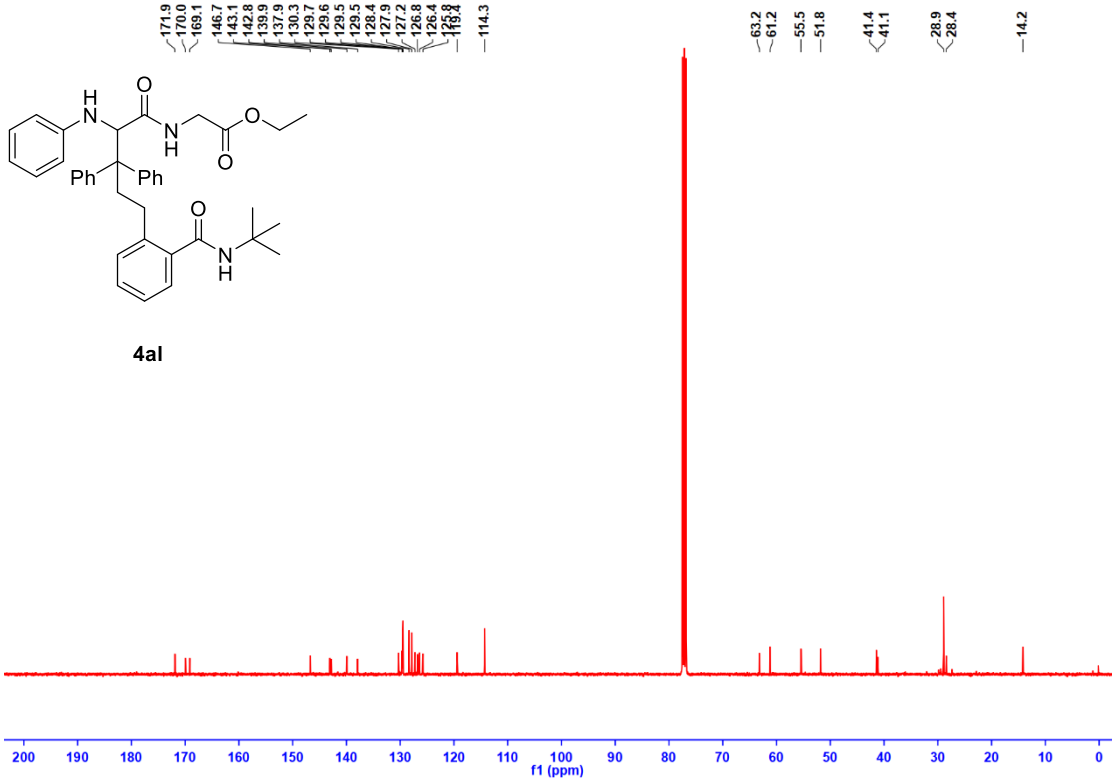
^{13}C NMR (100 MHz, CDCl3) of 4ak



^{1}H NMR (400 MHz, CDCl3) of 4al

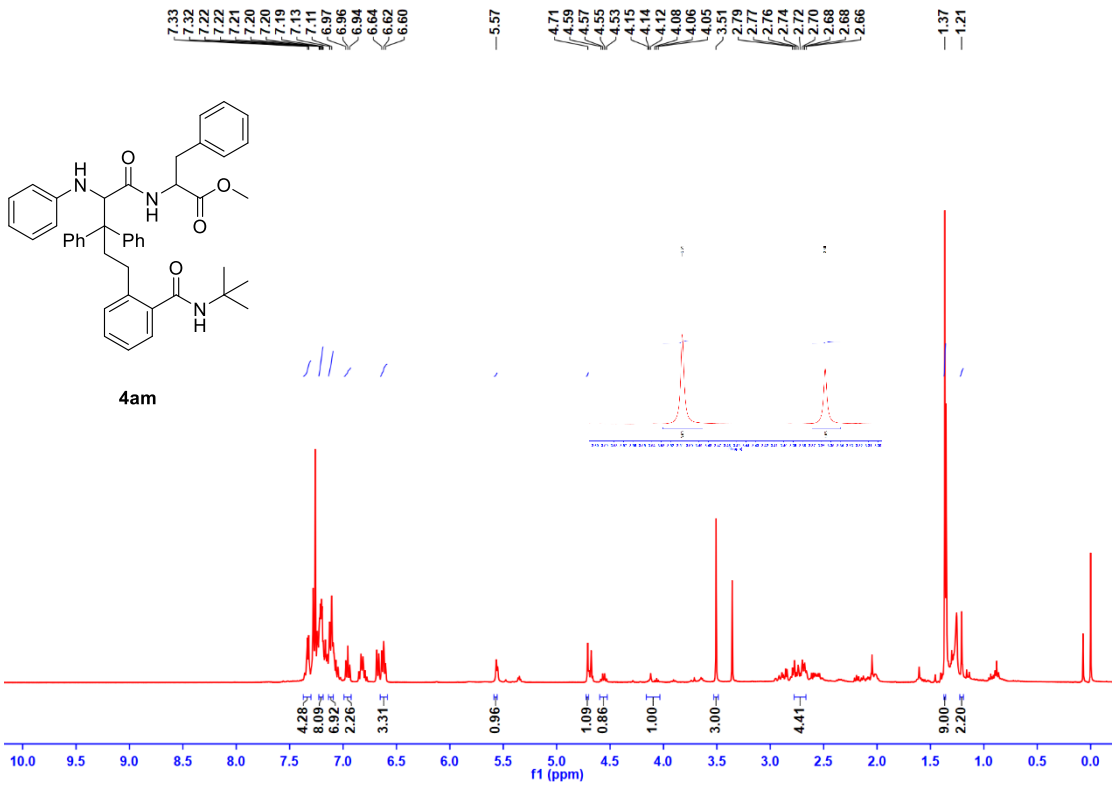


^{13}C NMR (100 MHz, CDCl3) of 4al



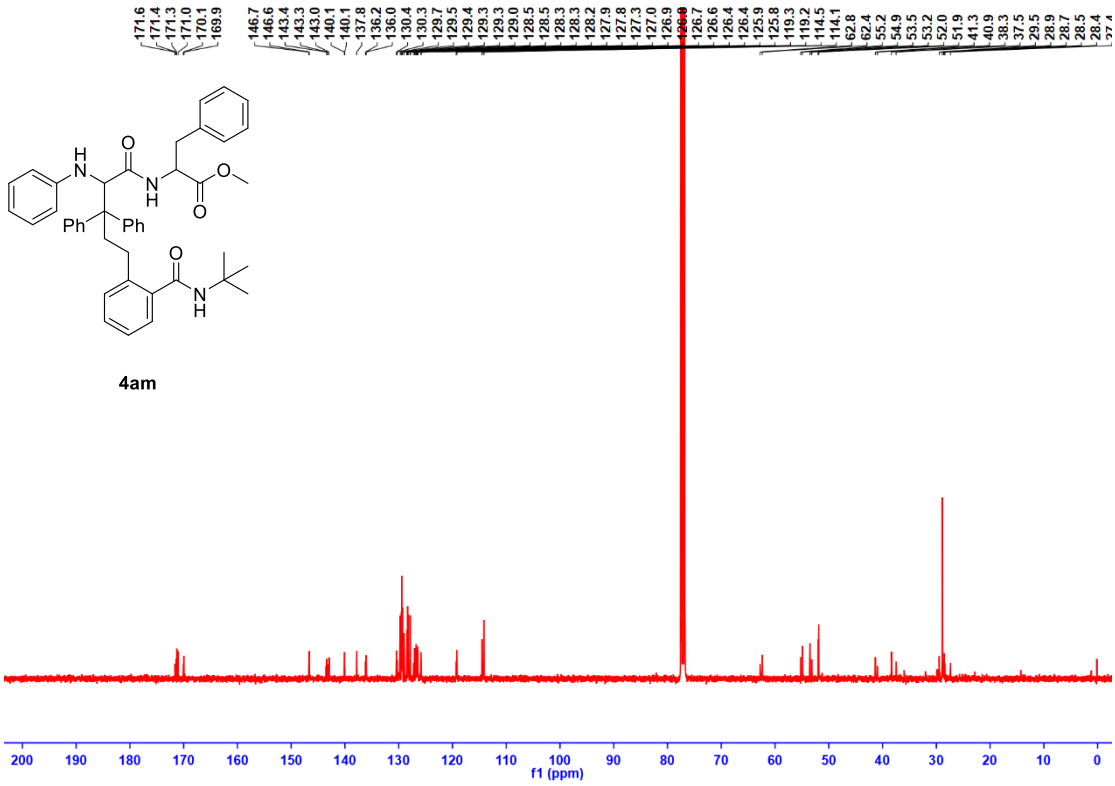
4al

^{1}H NMR (400 MHz, CDCl3) of 4am

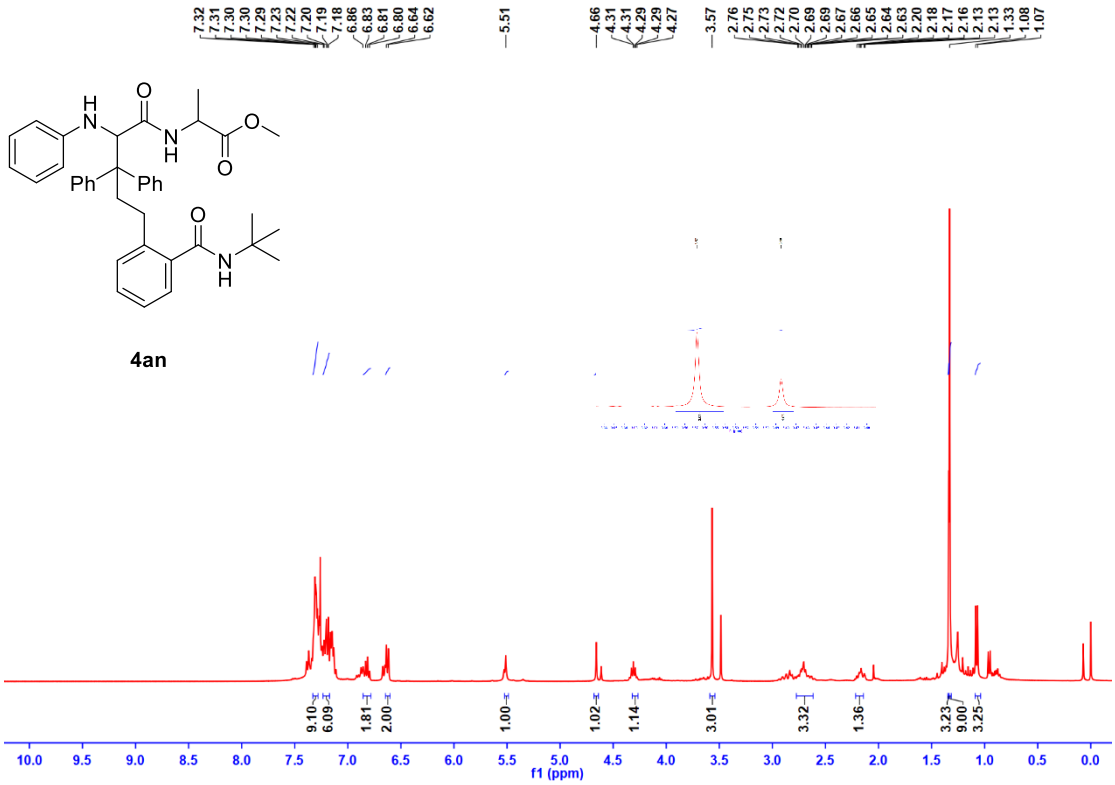


4am

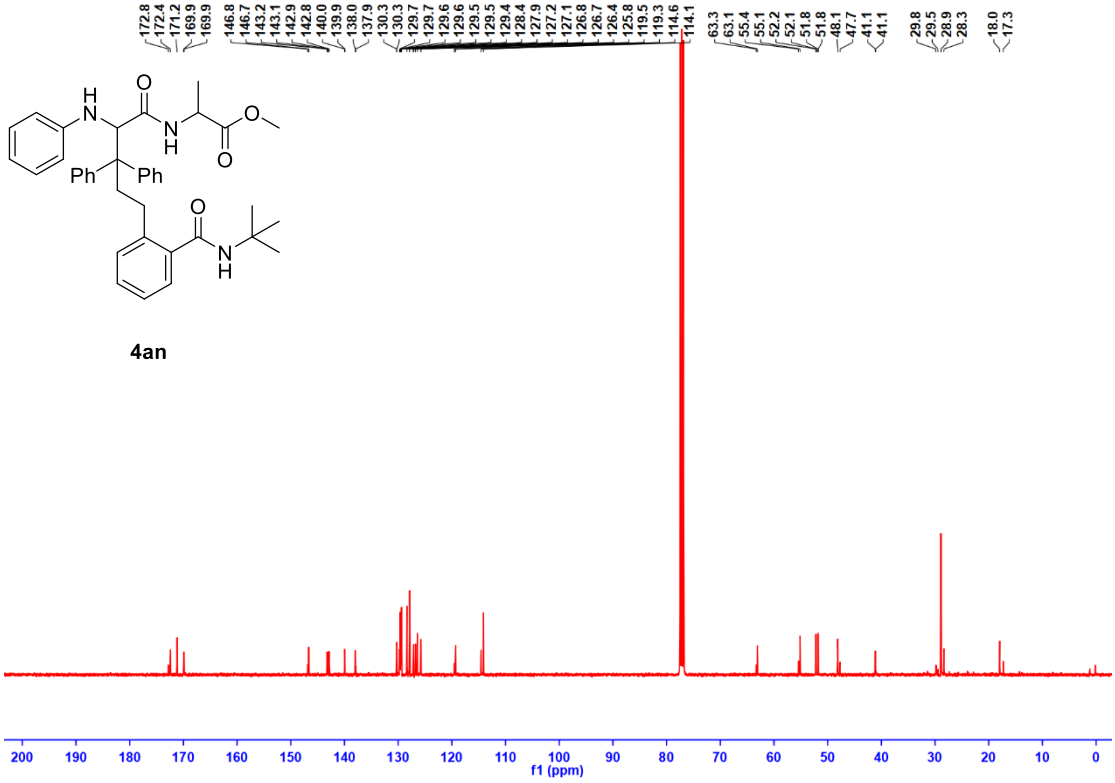
^{13}C NMR (100 MHz, CDCl3) of 4am



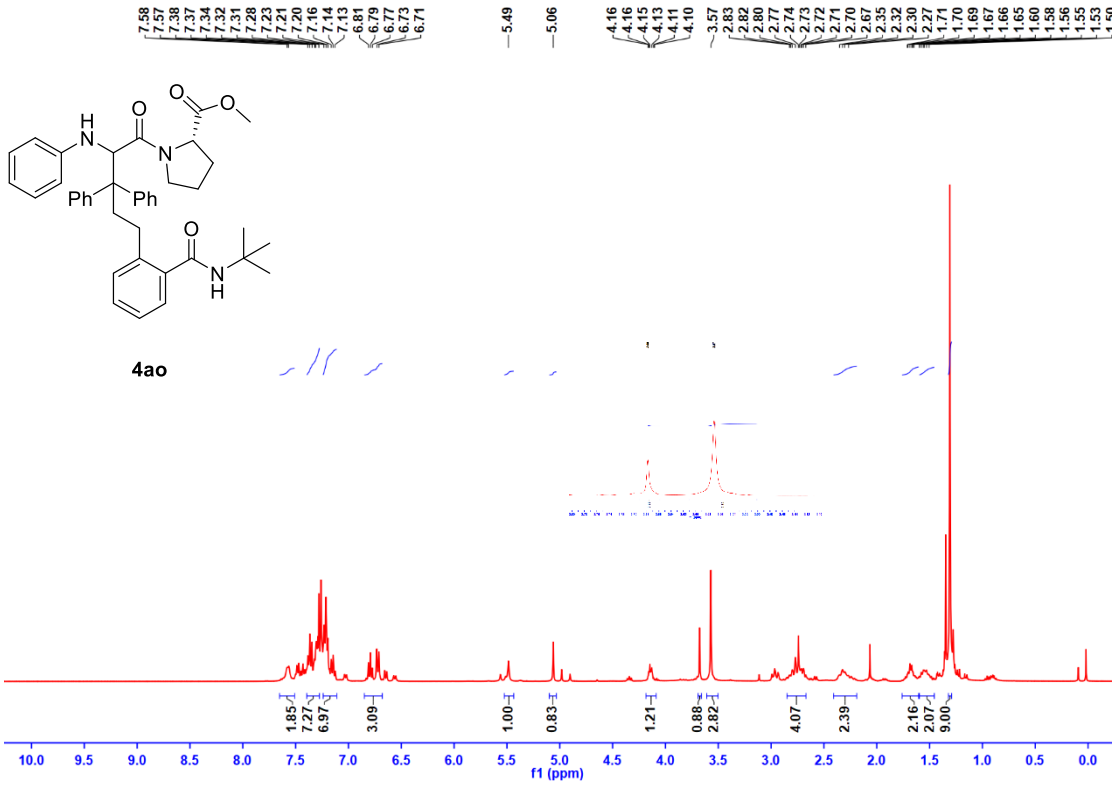
^{1}H NMR (400 MHz, CDCl3) of 4an



^{13}C NMR (100 MHz, CDCl3) of 4an



^{1}H NMR (400 MHz, CDCl3) of 4ao



^{13}C NMR (100 MHz, CDCl3) of 4ao