

Supporting Information

Metal-free electrochemical decarboxylative cyclization of *N*-aryl glycines with azobenzenes

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Table of Contents

I. General Information	2
II. Substrates Synthesis and Characterization.....	3
III. Investigation of Reaction Conditions	13
IV. Experimental Procedures and Compound Characterization	16
V. Mechanism Research	38
VI. References	40
VII. Spectra	42

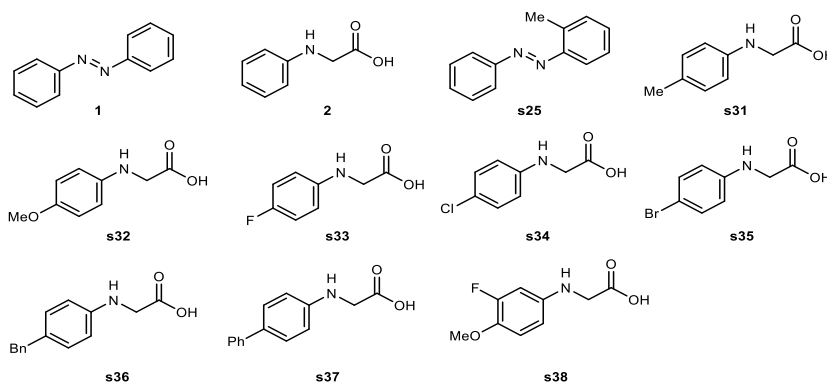
I. General Information

All reactions were performed under air atmosphere, using round bottom flasks. All substrates were obtained from the commercial sources or synthesized following literature procedures. All reagents were commercial and were used without further purification. The electrochemical reaction device follows our previous work.¹ The instrument for electrolysis is Single Output DC Power Supply (KRP-305DM) (made in China). Chromatography was carried on flash silica gel (200-300 mesh). All reactions were monitored by TLC, which was performed on percolated aluminum sheets of silica gel 60 (F254). Melting points were uncorrected. The ¹H and ¹³C NMR data were obtained on a 400 MHz NMR spectrometer with TMS as the internal standard and CDCl₃ as solvent. Multiplicities are indicated as it follows: s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; dd, doubled doublet; br, broad. Coupling constants (*J* values) where noted are quoted in Hertz. High-resolution mass spectra (HRMS) were obtained with a time-of-flight (TOF) mass spectrometer (ESI).

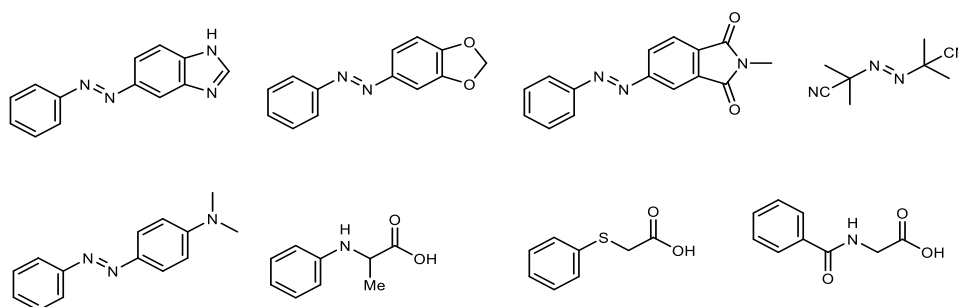
Electrode materials/dimensions:

The graphite electrode and platinum electrode are purchased from Zhongnuotansu (Tianjin). The dimension of the graphite rod electrode is 5 mm × 50 mm and the platinum electrode is 5 mm × 5 mm × 0.1 mm. (The submerged height of the electrode is approximately 5 mm).

List of commercially available substrates :

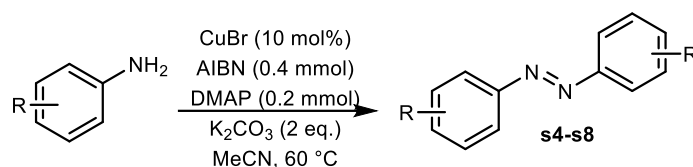


List of unsuccessful substrates:



II. Substrates Synthesis and Characterization

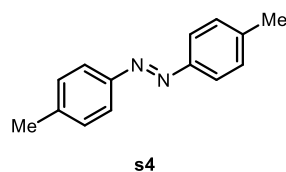
Synthesis of compounds **s4-s8**.



At room temperature, aniline derivatives (10 mmol, 1.0 eq.), CuBr (144 mg, 1 mmol, 0.1 eq.), AIBN (657 mg, 4 mmol, 0.4 eq.), DMAP (244 mg, 2 mmol, 0.2 eq.), K₂CO₃ (2.77 g, 20 mmol, 2 eq.) and MeCN (30 mL) were added to a 100 mL round bottom flask, and then the resulting solution was stirred at 60 °C for 6 h. The solution was diluted with EtOAc (30 mL). The aqueous layer was extracted with EtOAc (3 × 30 mL). The combined EtOAc layers were washed with brine (3 × 30 mL), dried with Na₂SO₄, and concentrated *in vacuo*. The desired product **s4-s8** was purified by flash column chromatography using PE/EtOAc as eluent.

(*E*)-1,2-Di-*p*-tolylidiazene (**s4**)

The ¹H spectra data matched with values reported in the literature.²

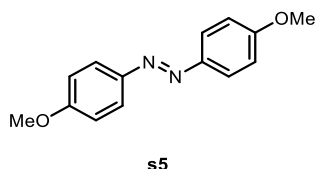


Yellow solid (0.96 g, 91% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.84 (d, $J = 8.1$ Hz, 4H), 7.34 (d, $J = 7.9$ Hz, 4H), 2.46 (m, 6H).

(E)-1-(4-Methoxyphenyl)-2-phenyldiazene (s5)

The ^1H spectra data matched with values reported in the literature.²

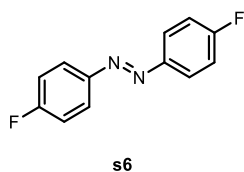


Yellow solid (1.06 g, 88% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.91 (d, $J = 9.0$ Hz, 4H), 7.03 (d, $J = 9.0$ Hz, 4H), 3.91 (s, 6H).

(E)-1,2-Bis(4-fluorophenyl)diazene (s6)

The ^1H spectra data matched with values reported in the literature.²

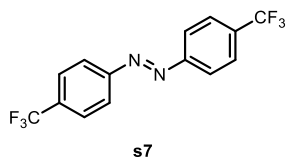


Yellow solid (0.95 g, 83% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.95 (dd, $J = 8.8, 5.2$ Hz, 4H), 7.23 (t, $J = 8.6$ Hz, 4H).

(E)-1,2-Bis(4-(trifluoromethyl)phenyl)diazene (s7)

The ^1H spectra data matched with values reported in the literature.²

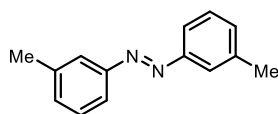


Yellow solid (1.27 g, 80% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.07 (d, $J = 8.2$ Hz, 4H), 7.84 (d, $J = 8.4$ Hz, 4H).

(E)-1,2-Di-*m*-tolylidiazene (s8)

The ^1H spectra data matched with values reported in the literature.²

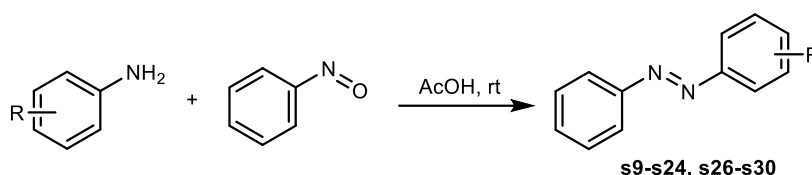


s8

Yellow solid (0.89 g, 85% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.76 (s, 4H), 7.44 (t, $J = 7.9$ Hz, 2H), 7.33 (d, $J = 7.3$ Hz, 2H), 2.49 (s, 6H).

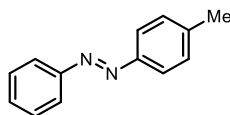
Synthesis of compounds **s9-s24**, **s26-s30**.



At room temperature, nitrosobenzene (558.6 mg, 6 mmol, 1.2 eq.) was added to a 50 mL round bottom flask, followed by AcOH (10 mL, 2 mL/mmol), and then the corresponding anilines (5 mmol, 1.0 eq.) was added dropwise to the above solution, and the resulting solution was stirred at room temperature for 24 h. The solution was diluted with EtOAc (30 mL) and quenched with NaHCO_3 aqueous solution (30 mL). The aqueous layer was extracted with EtOAc (3×30 mL). The combined EtOAc layers were washed with brine (3×30 mL), dried with Na_2SO_4 , and concentrated *in vacuo*. The desired product **s9-s24**, **s26-s30** was purified by flash column chromatography using PE/EtOAc as eluent.

(E)-1-Phenyl-2-(p-tolyl)diazene (s9)

The ^1H spectra data matched with values reported in the literature.³



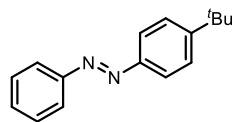
s9

Yellow solid (0.92 g, 94% yield);

¹H NMR (400 MHz, CDCl₃): δ 7.93 (d, *J* = 7.4 Hz, 2H), 7.87 (d, *J* = 8.0 Hz, 2H), 7.52 (dt, *J* = 15.4, 7.0 Hz, 3H), 7.35 (d, *J* = 8.0 Hz, 2H), 2.47 (s, 3H).

(*E*)-1-(4-(*tert*-Butyl)phenyl)-2-phenyldiazene (s10)

The ¹H spectra data matched with values reported in the literature.⁴

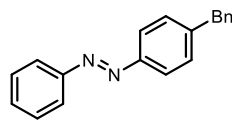


s10

Yellow solid (1.13 g, 95% yield);

¹H NMR (400 MHz, CDCl₃): δ 7.94 (d, *J* = 7.8 Hz, 2H), 7.90 (d, *J* = 8.3 Hz, 2H), 7.61 – 7.46 (m, 5H), 1.41 (s, 9H).

(*E*)-1-(4-Benzylphenyl)-2-phenyldiazene (s11)



s11

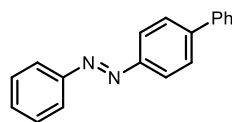
Yellow solid (1.26g, 93% yield);

¹H NMR (400 MHz, CDCl₃): δ 7.93 (d, *J* = 7.2 Hz, 2H), 7.89 (d, *J* = 8.2 Hz, 2H), 7.53 (dt, *J* = 13.7, 7.0 Hz, 3H), 7.35 (dd, *J* = 13.8, 7.7 Hz, 4H), 7.26 (t, *J* = 7.0 Hz, 3H), 4.10 (s, 2H).

HRMS (ESI): Calcd. for C₁₉H₁₇N₂⁺ [M + H]⁺ 273.1386, found 273.1381.

(*E*)-1-([1,1'-Biphenyl]-4-yl)-2-phenyldiazene (s12)

The ¹H spectra data matched with values reported in the literature.⁶



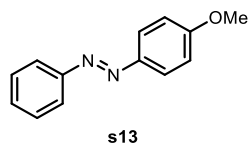
s12

Yellow solid (1.16 g, 90% yield);

¹H NMR (400 MHz, CDCl₃): δ 8.04 (d, *J* = 8.2 Hz, 2H), 7.98 (d, *J* = 7.8 Hz, 2H), 7.79 (d, *J* = 8.4 Hz, 2H), 7.71 (d, *J* = 7.4 Hz, 2H), 7.54 (dt, *J* = 21.8, 7.3 Hz, 5H), 7.43 (t, *J* = 7.3 Hz, 1H).

(E)-1-(4-Methoxyphenyl)-2-phenyldiazene (s13)

The ^1H spectra data matched with values reported in the literature.³

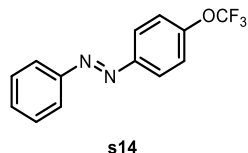


Yellow solid (1.02 g, 96% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.96 (d, $J = 8.9$ Hz, 2H), 7.91 (d, $J = 7.4$ Hz, 2H), 7.53 (t, $J = 7.4$ Hz, 2H), 7.47 (t, $J = 7.2$ Hz, 1H), 7.05 (d, $J = 8.9$ Hz, 2H), 3.92 (s, 3H).

(E)-1-Phenyl-2-(4-(trifluoromethoxy)phenyl)diazene (s14)

The ^1H spectra data matched with values reported in the literature.⁸

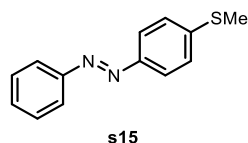


Yellow solid (1.06 g, 80% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.00 (d, $J = 8.9$ Hz, 2H), 7.95 (d, $J = 6.8$ Hz, 2H), 7.55 (q, $J = 8.0, 7.1$ Hz, 3H), 7.39 (d, $J = 8.4$ Hz, 2H).

(E)-1-(4-(Methylthio)phenyl)-2-phenyldiazene (s15)

The ^1H spectra data matched with values reported in the literature.⁶

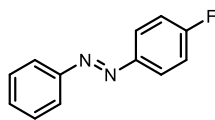


Yellow solid (0.86 g, 85% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.99 – 7.86 (m, 4H), 7.53 (q, $J = 7.2$ Hz, 3H), 7.38 (d, $J = 8.5$ Hz, 2H), 2.59 (s, 3H).

(E)-1-(4-Fluorophenyl)-2-phenyldiazene (s16)

The ^1H spectra data matched with values reported in the literature.³



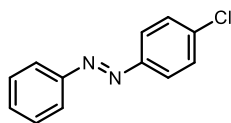
s16

Yellow solid (0.93 g, 93% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.05 – 7.88 (m, 4H), 7.54 (dt, $J = 11.5, 6.8$ Hz, 3H), 7.23 (t, $J = 8.6$ Hz, 2H).

(E)-1-(4-Chlorophenyl)-2-phenyldiazene (s17)

The ^1H spectra data matched with values reported in the literature.³



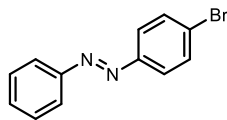
s17

Yellow solid (0.97 g, 90% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.93 (dd, $J = 15.0, 8.3$ Hz, 4H), 7.60 – 7.46 (m, 5H).

(E)-1-(4-Bromophenyl)-2-phenyldiazene (s18)

The ^1H spectra data matched with values reported in the literature.³



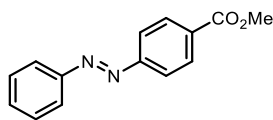
s18

Yellow solid (1.24 g, 95% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.94 (d, $J = 9.4$ Hz, 2H), 7.83 (d, $J = 8.6$ Hz, 2H), 7.68 (d, $J = 8.6$ Hz, 2H), 7.54 (q, $J = 7.1, 6.6$ Hz, 3H).

Methyl (E)-4-(phenyldiazenyl)benzoate (s19)

The ^1H spectra data matched with values reported in the literature.⁴



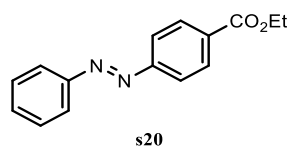
s19

Yellow solid (0.84 g, 70% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.22 (d, $J = 8.6$ Hz, 2H), 7.98 (d, $J = 8.4$ Hz, 4H), 7.56

(d, $J = 7.5$ Hz, 3H), 3.99 (s, 3H).

Ethyl (*E*)-4-(phenyldiazenyl)benzoate (s20)



Yellow solid (0.91 g, 72% yield);

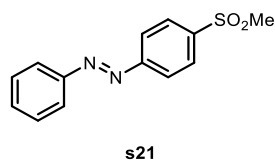
$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.30 – 8.16 (m, 2H), 8.05 – 7.88 (m, 4H), 7.64 – 7.51 (m, 3H), 4.56 – 4.39 (m, 2H), 1.45 (d, $J = 7.0$ Hz, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 166.1, 155.1, 152.5, 132.2, 131.6, 130.5, 129.1, 123.1, 122.6, 61.2, 14.3.

HRMS (ESI): Calcd. for $\text{C}_{15}\text{H}_{15}\text{N}_2\text{O}_2^+$ $[\text{M} + \text{H}]^+$ 255.1128, found 255.1145.

(*E*)-1-(4-(Methylsulfonyl)phenyl)-2-phenyldiazenes (s21)

The ^1H spectra data matched with values reported in the literature.⁷

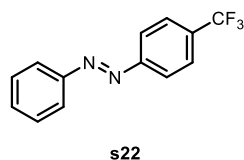


Yellow solid (1.0 g, 77% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.11 (q, $J = 8.7$ Hz, 4H), 8.00 (dd, $J = 7.0, 2.5$ Hz, 2H), 7.58 (d, $J = 4.8$ Hz, 3H), 3.14 (s, 3H).

(*E*)-1-Phenyl-2-(4-(trifluoromethyl)phenyl)diazene (s22)

The ^1H spectra data matched with values reported in the literature.³

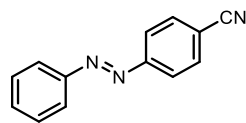


Yellow solid (0.79 g, 63% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.04 (d, $J = 8.3$ Hz, 2H), 8.01 – 7.95 (m, 2H), 7.81 (d, $J = 8.3$ Hz, 2H), 7.57 (d, $J = 7.0$ Hz, 3H).

(*E*)-4-(Phenyldiazenyl)benzotrile (s23)

The ^1H spectra data matched with values reported in the literature.⁵



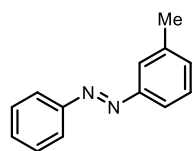
s23

Yellow solid (0.69 g, 67% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.02 (d, $J = 8.4$ Hz, 2H), 7.98 (dd, $J = 6.5, 3.1$ Hz, 2H), 7.85 (d, $J = 8.3$ Hz, 2H), 7.62 – 7.52 (m, 3H).

(E)-1-Phenyl-2-(*m*-tolyl)diazene (s24)

The ^1H spectra data matched with values reported in the literature.³



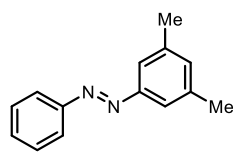
s24

Yellow solid (0.77 g, 79% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.96 (d, $J = 8.3$ Hz, 2H), 7.78 (s, 2H), 7.54 (dt, $J = 13.7, 6.9$ Hz, 3H), 7.45 (t, $J = 8.0$ Hz, 1H), 7.34 (d, $J = 7.4$ Hz, 1H), 2.50 (s, 3H).

(E)-1-(3,5-Dimethylphenyl)-2-phenyldiazene (s26)

The ^1H spectra data matched with values reported in the literature.⁵

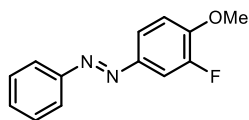


s26

Yellow solid (0.68 g, 65% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.02 (d, $J = 7.3$ Hz, 2H), 7.66 (s, 2H), 7.57 (dd, $J = 16.6, 7.3$ Hz, 3H), 7.19 (s, 1H), 2.50 (s, 6H).

(E)-1-(3-Fluoro-4-methoxyphenyl)-2-phenyldiazene (s27)



s27

Yellow solid (1.05 g, 91% yield);

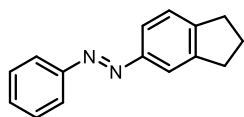
$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.92 (d, $J = 8.4$ Hz, 2H), 7.82 (d, $J = 9.9$ Hz, 1H), 7.74 (d, $J = 14.4$ Hz, 1H), 7.51 (dd, $J = 14.3, 7.3$ Hz, 3H), 7.12 (t, $J = 8.6$ Hz, 1H), 4.01 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 153.9, 152.4, 151.4, 150.3, 146.7, 130.8, 129.1, 122.7, 112.4, 107.7, 56.3.

HRMS (ESI): Calcd. for $\text{C}_{13}\text{H}_{12}\text{FN}_2\text{O}^+$ [$\text{M} + \text{H}$] $^+$ 231.1128, found 231.0925.

(E)-1-(2,3-Dihydro-1H-inden-5-yl)-2-phenyldiazene (s28)

The ^1H spectra data matched with values reported in the literature.⁶

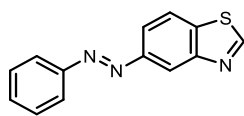


s28

Yellow solid (1.03 g, 93% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.93 (d, $J = 7.2$ Hz, 2H), 7.84 – 7.72 (m, 2H), 7.54 (t, $J = 7.3$ Hz, 2H), 7.48 (t, $J = 7.2$ Hz, 1H), 7.39 (d, $J = 7.8$ Hz, 1H), 3.02 (q, $J = 7.3$ Hz, 4H), 2.18 (p, $J = 7.4$ Hz, 2H).

(E)-5-(Phenyldiazenyl)benzo[d]thiazole (s29)



s29

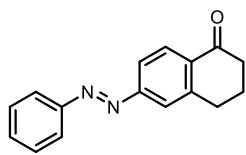
Yellow solid (1.06 g, 89% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 9.12 (s, 1H), 8.73 (s, 1H), 8.14 – 8.06 (m, 2H), 8.01 (d, $J = 7.0$ Hz, 2H), 7.56 (dt, $J = 12.5, 6.9$ Hz, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 155.4, 153.9, 152.5, 151.6, 136.2, 131.2, 129.1, 123.0, 122.1, 120.5, 119.8, 118.8.

HRMS (ESI): Calcd. for $\text{C}_{13}\text{H}_{10}\text{N}_3\text{S}^+$ [$\text{M} + \text{H}$] $^+$ 240.0590, found 240.0583.

(E)-6-(Phenyldiazenyl)-3,4-dihydronaphthalen-1(2H)-one (s30)



s30

Yellow solid (1.10 g, 88% yield);

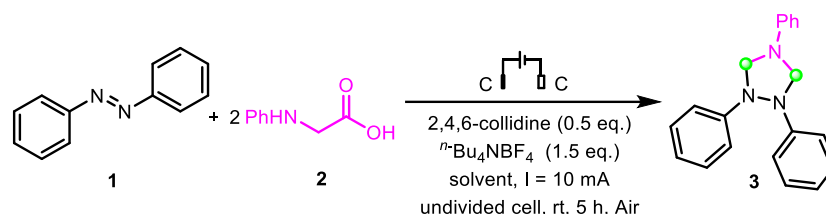
¹H NMR (400 MHz, CDCl₃): δ 8.22 (d, *J* = 8.3 Hz, 1H), 7.98 (d, *J* = 8.0 Hz, 2H), 7.85 (d, *J* = 8.3 Hz, 1H), 7.80 (s, 1H), 7.56 (d, *J* = 7.1 Hz, 3H), 3.12 (t, *J* = 6.0 Hz, 2H), 2.79 – 2.70 (m, 2H), 2.23 (dt, *J* = 12.3, 6.2 Hz, 2H).

¹³C NMR (101 MHz, CDCl₃): δ 197.7, 155.0, 152.6, 145.5, 133.8, 131.7, 129.2, 128.4, 123.1, 123.0, 120.8, 39.1, 29.9, 23.2.

HRMS (ESI): Calcd. for C₁₆H₁₅N₂O⁺ [M + H]⁺ 251.1179, found 251.1216.

III. Investigation of Reaction Conditions

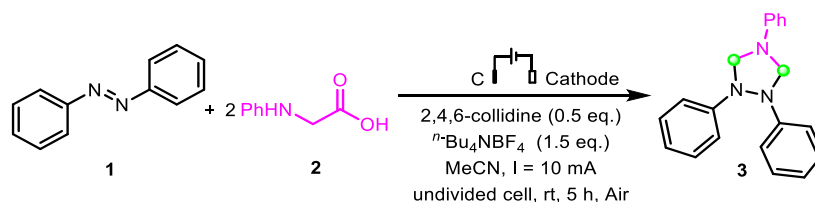
Table S1. Investigation of solvents^a:



entry	variation of solvents	Yield (%) ^b
1	DCM	8
2	DMF	30
3	EtOH	trace
4	MeCN	42

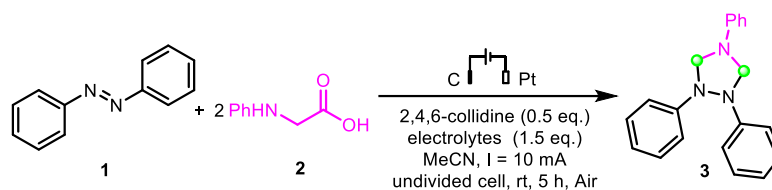
^aStandard conditions: graphite rod anode ($d = 5 \text{ mm}$), graphite rod anode ($d = 5 \text{ mm}$), **1** (0.2 mmol), **2** (0.8 mmol), $n\text{-Bu}_4\text{NBF}_4$ (1.5 eq.), 2,4,6-collidine (0.5 eq.), solvent (3 mL), undivided cell, constant current = 10 mA, room temperature, air atmosphere, 5 h. ^bIsolated yield.

Table S2. Investigation of cathodes^a:



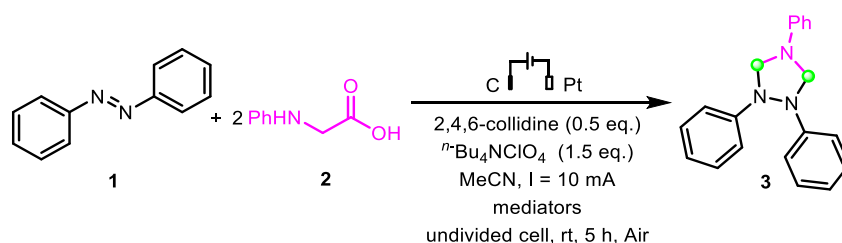
entry	variation of cathodes	Yield (%) ^b
1	steel	20
2	Pt	55
3	RVC	38
4	Ni	29

^aStandard conditions: graphite rod anode ($d = 5 \text{ mm}$), cathodes, **1** (0.2 mmol), **2** (0.8 mmol), $n\text{-Bu}_4\text{NBF}_4$ (1.5 eq.), 2,4,6-collidine (0.5 eq.), MeCN (3 mL), undivided cell, constant current = 10 mA, room temperature, air atmosphere, 5 h. ^bIsolated yield.

Table S3. Investigation of electrolytes^a:

entry	variation of electrolytes	Yield (%) ^b
1	<i>n</i> -Bu ₄ NPF ₆ (1.5 eq.)	60
2	<i>n</i> -Bu ₄ NBr (1.5 eq.)	58
3	Et ₄ NOTs (1.5 eq.)	60
4	<i>n</i> -Bu ₄ NClO ₄ (1.5 eq.)	70
5	K ₃ PO ₄ (1.5 eq.)	trace

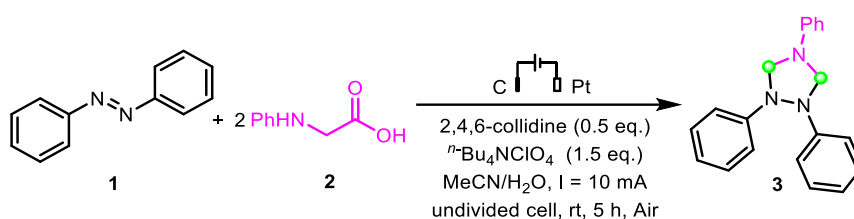
^aStandard conditions: graphite rod anode (d = 5 mm), Pt plate cathode (0.5 cm × 0.5 cm), **1** (0.2 mmol), **2** (0.8 mmol), electrolytes (1.5 eq.), 2,4,6-collidine (0.5 eq.), MeCN (3 mL), undivided cell, constant current = 10 mA, room temperature, air atmosphere, 5 h. ^bIsolated yield.

Table S4. Investigation of mediators^a:

entry	variation of mediators	Yield (%) ^b
1	Ferrocene (0.2 eq.)	47
2	NHPI (0.2 eq.)	13
3	H ₂ O (0.2 mL)	80
4	H ₂ O (0.5 mL)	90

^aStandard conditions: graphite rod anode (d = 5 mm), Pt plate cathode (0.5 cm × 0.5 cm), **1** (0.2 mmol), **2** (0.8 mmol), *n*-Bu₄NClO₄ (1.5 eq.), 2,4,6-collidine (0.5 eq.), mediators, MeCN (3 mL), undivided cell, constant current = 10 mA, room temperature, air atmosphere, 5 h. ^bIsolated yield.

Table S5. Investigation of other conditions^a:



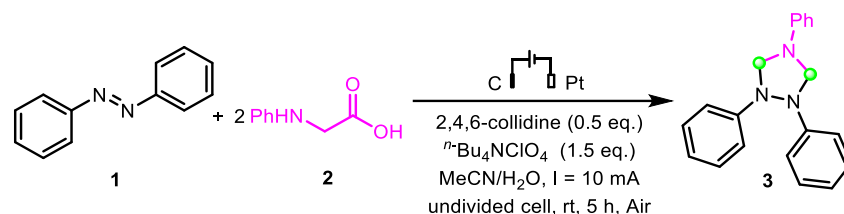
entry	variation from standard conditions	Yield (%) ^b
1	none	90
2	no H ₂ O	25
3	no 2,4,6-collidine	47
4	Et ₃ N instead of 2,4,6-collidine	28
5	1.0 mL H ₂ O instead of 0.5 mL H ₂ O	65
6	5 mA instead of 10 mA	5
7	7 mA instead of 10 mA	70
8	15 mA instead of 10 mA	67
9	no electric current	0

^aStandard conditions: graphite rod anode (d = 5 mm), Pt plate cathode (0.5 cm × 0.5 cm), **1** (0.2 mmol), **2** (0.8 mmol), ^tBu₄NClO₄ (1.5 eq.), 2,4,6-collidine (0.5 eq.), MeCN/H₂O (v/v, 6/1, 3.5 mL), undivided cell, constant current = 10 mA, room temperature, air atmosphere, 5 h. ^bIsolated yield.

IV. Experimental Procedures and Compound Characterization

General procedure for electrochemical decarboxylative cyclization reaction

(Procedure A):



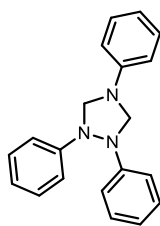
To a 10 mL distillation flask equipped with a magnetic stirring rod, azobenzene **1** (36.5 mg, 0.2 mmol, 1.0 eq.), *N*-phenyl glycine **2** (121 mg, 0.8 mmol, 4.0 eq.), 2,4,6-collidine (12.1 mg, 0.04 mmol, 0.5 eq.), $n\text{-Bu}_4\text{NClO}_4$ (103 mg, 0.3 mmol, 1.5 eq.), H₂O (0.5 mL) and CH₃CN (3.0 mL) were added. The flask was equipped with a graphite rod anode ($d = 5$ mm) and a platinum cathode. The resulting solution was stirred and electrolyzed at a constant current of 10 mA (Single Output DC Power Supply: KRP-305DM, the voltage range is 2.0 V – 3.3 V) for 5 h (4.7 F/mol) at room temperature. The solution was diluted with EtOAc (5 mL) and brine (20 mL) and extracted with EtOAc (3×20 mL). The combined organic layers were washed with brine (3×20 mL), dried with Na₂SO₄, and concentrated *in vacuo*. Purification by flash column chromatography using PE/EtOAc ($v/v = 100/1$) as eluent afforded the desired product **3** (Fig.S1).



Fig.S1 Experiment setup for the synthesis of **3**

1,2,4-Triphenyl-1,2,4-triazolidine (3)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



3

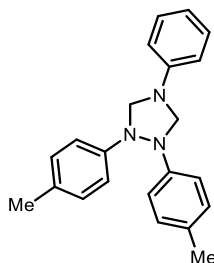
White solid (54.2 mg, 90% yield); mp: 134.5-135.1 °C;

^1H NMR (400 MHz, CDCl_3): δ 7.32 – 7.15 (m, 10H), 6.97 – 6.93 (t, $J = 7.2$ Hz, 2H), 6.77 (t, $J = 7.4$ Hz, 1H), 6.59 (d, $J = 8.0$ Hz, 2H), 4.87 (s, 2H), 4.69 (s, 2H).

^{13}C NMR (101 MHz, CDCl_3): δ 150.2, 145.1, 129.4, 129.3, 121.6, 118.4, 115.0, 113.3, 67.1.

4-Phenyl-1,2-di-*p*-tolyl-1,2,4-triazolidine (4)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



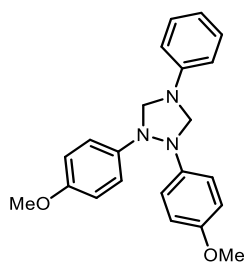
4

White solid (59.8 mg, 91% yield); mp: 130.1-131.2 °C;

^1H NMR (400 MHz, CDCl_3): δ 7.29 – 7.23 (dd, $J = 15.5, 7.9$ Hz, 2H), 7.12 (s, 8H), 6.81 – 6.77 (t, $J = 7.3$ Hz, 1H), 6.61 – 6.59 (d, $J = 8.4$ Hz, 2H), 4.85 (s, 2H), 4.68 (s, 2H), 2.31 (s, 6H).

^{13}C NMR (101 MHz, CDCl_3): δ 148.0, 145.2, 130.9, 129.7, 129.3, 118.2, 115.1, 113.2, 67.1, 20.5.

1,2-Bis(4-methoxyphenyl)-4-phenyl-1,2,4-triazolidine (5)



5

Colorless oil (51.2 mg, 71% yield);

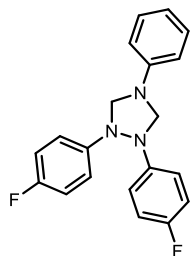
$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.29 – 7.23 (dd, $J = 14.9, 6.7$ Hz, 2H), 7.18 – 7.16 (d, $J = 9.0$ Hz, 4H), 6.88 – 6.86 (d, $J = 9.0$ Hz, 4H), 6.81 – 6.78 (t, $J = 7.3$ Hz, 1H), 6.61 – 6.59 (d, $J = 8.0$ Hz, 2H), 4.78 (s, 2H), 4.70 (s, 2H), 3.80 (s, 6H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 154.8, 145.1, 144.1, 129.3, 129.1, 124.3, 120.9, 118.1, 117.6, 116.7, 114.4, 114.1, 113.1, 68.6, 67.5, 55.6, 55.5.

HRMS (ESI): Calcd. for $\text{C}_{23}\text{H}_{28}\text{N}_3\text{O}_3^+$ [$\text{M} + \text{MeOH} + \text{H}$] $^+$ 394.2125, found 394.2119.

1,2-Bis(4-fluorophenyl)-4-phenyl-1,2,4-triazolidine (6)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



6

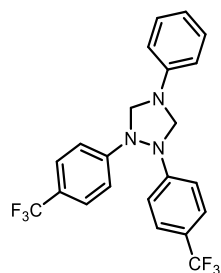
White solid (57.8 mg, 86% yield); mp: 118.2-119.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.21 (s, 2H), 7.09 (s, 4H), 6.96 (s, 4H), 6.77 (t, $J = 7.4$ Hz, 1H), 6.59 – 6.54 (m, 2H), 4.70 (d, $J = 23.0$ Hz, 4H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 158.3 (d, $J = 242.4$ Hz), 146.5 (d, $J = 2.0$ Hz), 145.0, 129.5, 118.7, 116.6 (d, $J = 8.2$ Hz), 115.8 (d, $J = 22.4$ Hz), 113.4, 67.8.

4-Phenyl-1,2-bis(4-(trifluoromethyl)phenyl)-1,2,4-triazolidine (7)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



7

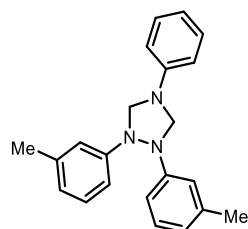
White solid (49.0 mg, 56% yield); mp: 83.5-85.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.58 – 7.56 (d, $J = 8.5$ Hz, 4H), 7.31 – 7.20 (m, 2H), 7.22 – 7.20 (d, $J = 8.4$ Hz, 4H), 6.89 – 6.86 (t, $J = 7.3$ Hz, 1H), 6.67 – 6.65 (d, $J = 7.9$ Hz, 2H), 4.94 (s, 2H), 4.78 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 152.2, 144.6, 129.5, 126.7 (q, $J = 3.8$ Hz), 125.7 (m), 123.3 (d, $J = 30.0$ Hz), 119.4, 114.5, 114.4, 113.7, 67.1.

4-Phenyl-1,2-di-*m*-tolyl-1,2,4-triazolidine (8)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



8

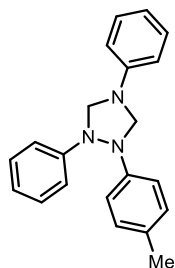
White solid (56.0 mg, 85% yield); mp: 56.2-58.0 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.29 – 7.19 (m, 4H), 7.05 – 7.00 (m, 4H), 6.82 – 6.80 (d, $J = 6.7$ Hz, 3H), 6.63 – 6.61 (d, $J = 7.2$ Hz, 2H), 4.89 (s, 2H), 4.70 (s, 2H), 2.36 (s, 6H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.2, 145.1, 139.1, 129.3, 129.1, 122.4, 118.2, 115.6, 113.2, 112.1, 67.0, 21.7.

1,4-Diphenyl-2-(*p*-tolyl)-1,2,4-triazolidine (9)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



9

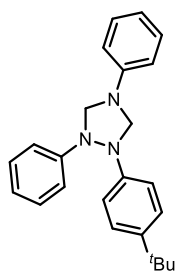
White solid (54.2 mg, 86% yield); mp: 104.2-106.5 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.29 – 7.15 (ddd, $J = 32.9, 16.4, 8.1$ Hz, 6H), 7.08 (s, 4H), 6.95 – 6.91 (t, $J = 7.2$ Hz, 1H), 6.78 – 6.74 (t, $J = 7.3$ Hz, 1H), 6.58 – 7.56 (d, $J = 7.8$ Hz, 2H), 4.83 (s, 2H), 4.70 – 4.61 (d, $J = 36.2$ Hz, 2H), 2.27 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.2, 148.0, 145.2, 131.1, 129.7, 129.4, 129.2, 121.4, 118.3, 115.3, 114.9, 113.2, 67.4, 66.9, 20.6.

1-(4-(*tert*-Butyl)phenyl)-2,4-diphenyl-1,2,4-triazolidine (10)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



10

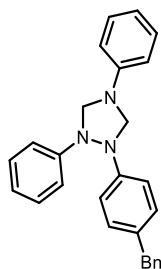
White solid (55.7 mg, 78% yield); mp: 119.2-121.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 – 7.32 (d, $J = 8.6$ Hz, 2H), 7.31 – 7.29 (d, $J = 7.9$ Hz, 2H), 7.27 – 7.23 (m, 2H), 7.22 – 7.20 (d, $J = 7.9$ Hz, 2H), 7.16 – 7.14 (d, $J = 8.7$ Hz, 2H), 6.99 – 6.95 (t, $J = 7.2$ Hz, 1H), 6.81 – 6.77 (t, $J = 7.3$ Hz, 1H), 6.61 – 6.59 (d, $J = 7.9$ Hz, 2H), 4.89 (s, 2H), 4.74 – 4.67 (d, $J = 25.2$ Hz, 2H), 1.32 (s, 9H).

^{13}C NMR (101 MHz, CDCl_3): δ 150.1, 147.8, 145.1, 144.5, 129.4, 129.2, 126.0, 121.4, 118.2, 115.0, 114.9, 113.2, 67.2, 67.0, 34.1, 31.5.

1-(4-Benzylphenyl)-2,4-diphenyl-1,2,4-triazolidine (11)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



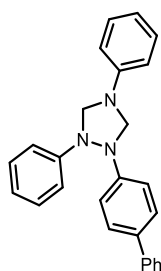
11

White solid (62.4 mg, 80% yield); mp: 118.2-119.1 °C;

^1H NMR (400 MHz, CDCl_3): δ 7.31 – 7.29 (d, $J = 10.3$ Hz, 5H), 7.22 – 7.18 (m, 6H), 7.12 (s, 4H), 6.98 – 6.95 (t, $J = 7.1$ Hz, 1H), 6.81 – 6.77 (t, $J = 7.3$ Hz, 1H), 6.61 – 6.59 (d, $J = 8.0$ Hz, 2H), 4.86 (s, 2H), 4.72 – 4.66 (d, $J = 23.5$ Hz, 2H), 3.94 (m, 2H).

^{13}C NMR (101 MHz, CDCl_3): δ 150.1, 148.4, 145.0, 141.4, 134.4, 129.6, 129.3, 129.1, 128.8, 128.4, 125.9, 121.4, 118.2, 115.2, 114.8, 113.2, 67.2, 67.0, 41.0.

1-([1,1'-Biphenyl]-4-yl)-2,4-diphenyl-1,2,4-triazolidine (12)



12

White solid (61.7 mg, 82% yield); mp: 126.2-128.1 °C;

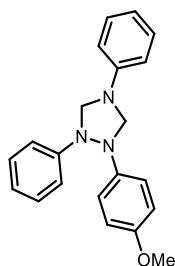
^1H NMR (400 MHz, CDCl_3): δ 7.64 – 7.60 (t, $J = 8.0$ Hz, 4H), 7.51 – 7.47 (t, $J = 7.5$ Hz, 2H), 7.40 – 7.36 (m, 3H), 7.34 – 7.27 (m, 6H), 7.07 – 7.04 (t, $J = 6.8$ Hz, 1H), 6.89 – 6.85 (t, $J = 7.0$ Hz, 1H), 6.69 – 6.67 (m, 2H), 4.97 (s, 2H), 4.79 (s, 2H).

^{13}C NMR (101 MHz, CDCl_3): δ 150.1, 149.5, 145.1, 140.9, 134.6, 129.4, 129.3, 128.8, 128.0, 126.7, 121.7, 118.5, 115.3, 115.1, 113.3, 67.2, 67.0.

HRMS (ESI): Calcd. for $\text{C}_{26}\text{H}_{23}\text{N}_3\text{Na}^+$ $[\text{M} + \text{Na}]^+$ 400.1784, found 400.1719.

1-(4-Methoxyphenyl)-2,4-diphenyl-1,2,4-triazolidine (13)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



13

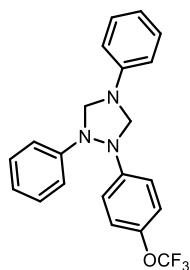
White solid (47 mg, 71% yield); mp: 91.4-93.1 °C;

^1H NMR (400 MHz, CDCl_3): δ 7.29 – 7.25 (t, J = 7.8 Hz, 2H), 7.23 – 7.19 (m, 2H), 7.17 – 7.15 (d, J = 8.1 Hz, 2H), 7.14 – 7.12 (d, J = 9.0 Hz, 2H), 6.94 – 6.91 (t, J = 7.3 Hz, 1H), 6.84 – 6.82 (d, J = 9.0 Hz, 2H), 6.78 – 6.74 (t, J = 7.4 Hz, 1H), 6.58 – 6.56 (d, J = 8.0 Hz, 2H), 4.77 (s, 3H), 4.57 (s, 1H), 3.75 (s, 3H).

^{13}C NMR (101 MHz, CDCl_3): δ 155.1, 150.1, 145.1, 144.1, 129.4, 129.2, 121.2, 118.2, 117.0, 114.7, 114.5, 113.2, 67.8, 67.0, 55.6.

1,4-Diphenyl-2-(4-(trifluoromethoxy)phenyl)-1,2,4-triazolidine (14)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



14

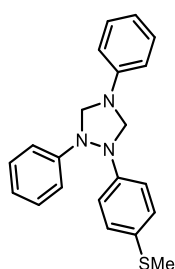
Colorless oil (53.9 mg, 70% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.35 – 7.31 (t, $J = 7.9$ Hz, 2H), 7.29 – 7.25 (m, 2H), 7.20 – 7.16 (m, 6H), 7.03 – 7.00 (t, $J = 7.3$ Hz, 1H), 6.85 – 6.82 (t, $J = 7.4$ Hz, 1H), 6.64 – 6.62 (d, $J = 7.8$ Hz, 2H), 4.90 – 4.85 (d, $J = 18.9$ Hz, 2H), 4.73 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 149.9, 148.8, 144.9, 143.6 (d, $J = 2.0$ Hz), 129.4 (d, $J = 17.2$ Hz) 122.1, 122.0, 120.6 (d, $J = 262.6$ Hz), 118.7, 115.8, 115.0, 113.4, 67.4, 67.3.

1-(4-(Methylthio)phenyl)-2,4-diphenyl-1,2,4-triazolidine (15)

The ^1H and ^{13}C spectra data matched with values reported in the literature.⁹



15

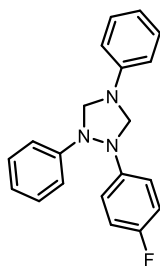
White solid (57.6 mg, 83% yield); mp: 102.2-103.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 – 7.24 (dq, $J = 15.3, 8.0$ Hz, 6H), 7.20 – 7.18 (d, $J = 8.2$ Hz, 2H), 7.16 – 7.14 (d, $J = 8.6$ Hz, 2H), 7.01 – 6.97 (t, $J = 7.2$ Hz, 1H), 6.83 – 6.80 (t, $J = 7.2$ Hz, 1H), 6.63 – 6.61 (d, $J = 8.0$ Hz, 2H), 4.86 (s, 2H), 4.71 (s, 2H), 2.47 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.0, 148.5, 145.0, 129.9, 129.7, 129.4, 129.2, 121.6, 118.5, 115.7, 115.0, 113.3, 67.2, 67.1, 17.8.

1-(4-Fluorophenyl)-2,4-diphenyl-1,2,4-triazolidine (16)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



16

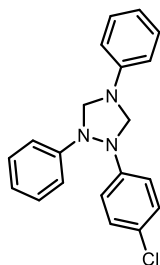
White solid (52.8 mg, 83% yield); mp: 97.2-99.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 – 7.25 (m, 4H), 7.20 – 7.14 (m, 4H), 7.03 – 6.97 (m, 3H), 6.84 – 6.80 (t, $J = 7.4$ Hz, 1H), 6.64 – 6.62 (d, $J = 8.0$ Hz, 2H), 4.84 (s, 1H), 4.78 – 4.68 (d, $J = 40.8$ Hz, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 158.5 (d, $J = 242.4$ Hz), 150.0, 146.6 (d, $J = 1.4$ Hz), 145.0, 129.4, 129.2, 121.6, 118.5, 116.7 (d, $J = 7.4$ Hz), 115.8 (d, $J = 24.4$ Hz), 114.9, 113.3, 67.7, 67.2.

1-(4-Chlorophenyl)-2,4-diphenyl-1,2,4-triazolidine (17)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



17

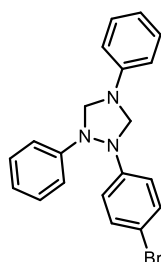
White solid (56.2 mg, 84% yield); mp: 119.9-122.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.35 – 7.31 (t, $J = 8.0$ Hz, 2H), 7.28 – 7.26 (d, $J = 6.9$ Hz, 4H), 7.20 – 7.18 (d, $J = 7.8$ Hz, 2H), 7.15 – 7.13 (d, $J = 8.9$ Hz, 2H), 7.03 – 6.99 (t, $J = 7.3$ Hz, 1H), 6.86 – 6.82 (t, $J = 7.7$ Hz, 1H), 6.64 – 6.62 (d, $J = 8.3$ Hz, 2H), 4.89 – 4.84 (d, $J = 20.3$ Hz, 2H), 4.72 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 149.9, 148.8, 145.0, 129.5, 129.3, 129.1, 126.5, 121.9, 118.7, 116.3, 115.1, 113.4, 67.3, 67.2.

1-(4-Bromophenyl)-2,4-diphenyl-1,2,4-triazolidine (18)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



18

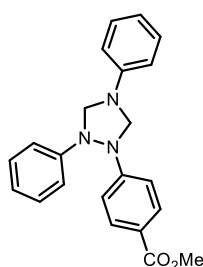
White solid (62.0 mg, 82% yield); mp: 156.2-158.5 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.41 – 7.39 (d, $J = 8.8$ Hz, 2H), 7.34 – 7.24 (dt, $J = 22.5, 7.9$ Hz, 4H), 7.18 – 7.16 (d, $J = 7.8$ Hz, 2H), 7.09 – 7.07 (d, $J = 8.9$ Hz, 2H), 7.02 – 6.98 (t, $J = 7.3$ Hz, 1H), 6.84 – 6.81 (t, $J = 7.4$ Hz, 1H), 6.63 – 6.61 (d, $J = 7.9$ Hz, 2H), 4.89 – 4.82 (d, $J = 28.8$ Hz, 2H), 4.71 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 149.8, 149.2, 144.9, 132.0, 129.4, 129.2, 121.9, 118.7, 116.6, 115.0, 113.8, 113.3, 67.3, 67.0.

Methyl 4-(2,4-diphenyl-1,2,4-triazolidin-1-yl)benzoate (19)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



19

Colorless oil (43.0 mg, 60% yield);

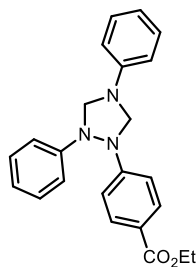
$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.00 – 7.98 (d, $J = 8.8$ Hz, 2H), 7.35 – 7.25 (dq, $J = 15.4, 8.1$ Hz, 4H), 7.18 – 7.13 (m, 4H), 7.05 – 7.01 (t, $J = 7.3$ Hz, 1H), 6.86 – 6.82 (t, $J = 7.3$ Hz, 1H), 6.66 – 6.64 (d, $J = 7.9$ Hz, 2H), 4.98 (s, 1H), 4.88 (s, 2H), 4.61 (s, 1H),

3.90 (s, 3H).

^{13}C NMR (101 MHz, CDCl_3): δ 166.9, 153.1, 149.8, 144.8, 131.2, 129.4, 129.3, 122.5, 122.4, 118.9, 115.4, 113.5, 113.3, 67.9, 66.0, 51.8.

Ethyl 4-(2,4-diphenyl-1,2,4-triazolidin-1-yl)benzoate (**20**)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



20

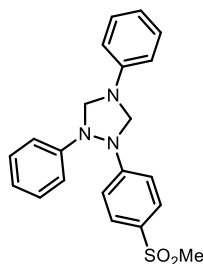
Colorless oil (44.8 mg, 60% yield);

^1H NMR (400 MHz, CDCl_3): δ 8.03 (d, $J = 8.8$ Hz, 2H), 7.32 (dt, $J = 23.3, 7.8$ Hz, 4H), 7.18 (dd, $J = 11.2, 8.4$ Hz, 4H), 7.05 (t, $J = 7.3$ Hz, 1H), 6.86 (t, $J = 7.3$ Hz, 1H), 6.66 (d, $J = 7.9$ Hz, 2H), 4.99 (s, 1H), 4.89 (s, 2H), 4.63 (s, 1H), 4.39 (q, $J = 7.1$ Hz, 2H), 1.42 (t, $J = 7.1$ Hz, 3H).

^{13}C NMR (101 MHz, CDCl_3) δ 153.11, 149.8, 144.9, 131.2, 129.4, 122.8, 122.4, 118.9, 115.5, 113.4, 67.9, 66.1, 60.6, 14.5.

1-(4-(Methylsulfonyl)phenyl)-2,4-diphenyl-1,2,4-triazolidine (**21**)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹¹



21

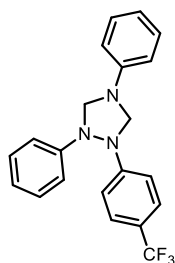
White solid (51.5 mg, 68% yield); mp: 181.2-183.1 °C;

¹H NMR (400 MHz, CDCl₃): δ 7.86 – 7.84 (d, *J* = 8.8 Hz, 2H), 7.36 – 7.32 (t, *J* = 7.9 Hz, 2H), 7.30 – 7.26 (t, *J* = 7.8 Hz, 2H), 7.23 – 7.21 (d, *J* = 8.8 Hz, 2H), 7.16 – 7.14 (d, *J* = 8.2 Hz, 2H), 7.07 – 7.04 (t, *J* = 7.3 Hz, 1H), 6.88 – 6.84 (t, *J* = 7.3 Hz, 1H), 6.67 – 6.65 (d, *J* = 8.1 Hz, 2H), 5.01 (s, 1H), 4.93 – 4.88 (d, *J* = 18.9 Hz, 2H), 4.61 (s, 1H), 3.04 (s, 3H).

¹³C NMR (101 MHz, CDCl₃): δ 153.4, 149.4, 144.7, 131.6, 129.5, 129.4, 129.1, 122.8, 119.2, 115.6, 113.7, 113.6, 68.3, 65.9, 44.9.

1,4-Diphenyl-2-(4-(trifluoromethyl)phenyl)-1,2,4-triazolidine (22)

The ¹H and ¹³C spectra data matched with values reported in the literature.⁹



22

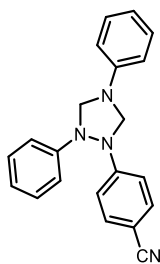
Colorless oil (47.0 mg, 64% yield);

¹H NMR (400 MHz, CDCl₃): δ 7.56 – 7.54 (d, *J* = 8.6 Hz, 2H), 7.35 – 7.31 (t, *J* = 8.0 Hz, 2H), 7.29 – 7.25 (m, 2H), 7.23 – 7.21 (d, *J* = 8.5 Hz, 2H), 7.18 – 7.16 (d, *J* = 7.8 Hz, 2H), 7.05 – 7.01 (t, *J* = 7.3 Hz, 1H), 6.86 – 6.82 (t, *J* = 7.3 Hz, 1H), 6.65 – 6.63 (m, 2H), 4.97 (s, 1H), 4.86 (s, 2H), 4.65 (s, 1H).

¹³C NMR (101 MHz, CDCl₃): δ 152.3, 149.7, 144.8, 129.4, 129.3, 126.6 (q, *J* = 4.0 Hz), 124.9 (d, *J* = 271.7 Hz), 122.8, 122.3, 118.9, 115.3, 114.0, 113.4, 67.7, 66.4.

4-(2,4-Diphenyl-1,2,4-triazolidin-1-yl)benzotrile (23)

The ¹H and ¹³C spectra data matched with values reported in the literature.¹¹



23

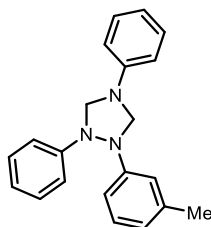
White solid (46.0 mg, 71% yield); mp: 144.2-145.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.58 – 7.56 (d, $J = 8.8$ Hz, 2H), 7.35 – 7.26 (m, 4H), 7.16 – 7.14 (d, $J = 8.9$ Hz, 4H), 7.07 – 7.03 (t, $J = 7.3$ Hz, 1H), 6.88 – 6.84 (t, $J = 7.4$ Hz, 1H), 6.66 – 6.64 (d, $J = 7.9$ Hz, 2H), 4.99 (s, 1H), 4.90 – 4.85 (d, $J = 20.3$ Hz, 2H), 4.59 (s, 1H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 152.5, 149.5, 144.7, 133.6, 129.5, 129.4, 122.7, 119.6, 119.2, 115.6, 114.0, 113.6, 103.2, 68.3, 65.8.

1,4-Diphenyl-2-(*m*-tolyl)-1,2,4-triazolidine(24)

The ^1H and ^{13}C spectra data matched with values reported in the literature.⁹



24

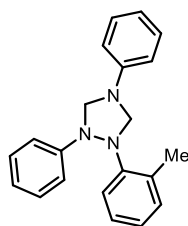
White solid (45.4 mg, 72% yield); mp: 110.2-112.7 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 – 7.30 (t, $J = 7.8$ Hz, 2H), 7.28 – 7.19 (dq, $J = 14.2, 7.8, 6.8$ Hz, 5H), 7.05 (s, 1H), 7.02 – 6.97 (m, 2H), 6.82 – 6.79 (t, $J = 6.8$ Hz, 2H), 6.63 – 6.61 (d, $J = 8.1$ Hz, 2H), 4.90 (s, 2H), 4.71 (s, 2H), 2.36 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.2, 145.1, 139.1, 129.4, 129.2, 129.1, 122.5, 121.5, 118.3, 115.7, 115.1, 115.0, 113.2, 112.2, 67.1, 67.1, 21.8.

1,4-diphenyl-2-(*o*-tolyl)-1,2,4-triazolidine (25)

The ^1H and ^{13}C spectra data matched with values reported in the literature.⁹



25

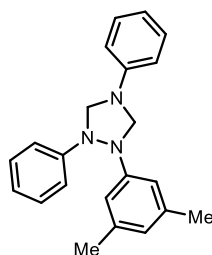
White solid (54.2 mg, 86% yield); mp: 104.2-105.5 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.31 (dt, $J = 28.8, 8.4$ Hz, 8H), 7.16 (t, $J = 7.8$ Hz, 1H), 7.08 (d, $J = 7.4$ Hz, 1H), 6.98 (t, $J = 7.3$ Hz, 1H), 6.84 (t, $J = 7.4$ Hz, 1H), 6.63 (d, $J = 8.0$ Hz, 2H), 4.93 (s, 2H), 4.64 (s, 2H), 2.54 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.1, 149.3, 144.9, 131.3, 130.4, 129.4, 129.2, 129.1, 126.4, 124.2, 121.0, 118.4, 118.2, 115.0, 114.9, 113.1, 68.5, 67.9, 19.1.

1-(3,5-Dimethylphenyl)-2,4-diphenyl-1,2,4-triazolidine (26)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



26

Yellow oil (52.0 mg, 79% yield);

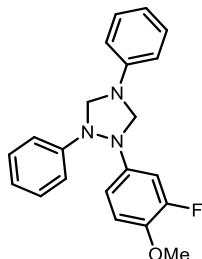
$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 – 7.20 (ddd, $J = 33.0, 15.0, 7.4$ Hz, 6H), 7.01 – 6.97 (t, $J = 7.2$ Hz, 1H), 6.85 (s, 2H), 6.83 – 6.79 (t, $J = 7.3$ Hz, 1H), 6.65 – 6.6 (m, 3H), 4.90 (s, 2H), 4.72 (s, 2H), 2.32 (s, 6H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.2, 145.1, 138.9, 129.3, 129.2, 123.4, 121.4, 118.2,

115.0, 114.9, 113.2, 112.8, 67.1, 67.0, 21.6.

1-(3-Fluoro-4-methoxyphenyl)-2,4-diphenyl-1,2,4-triazolidine(27)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



27

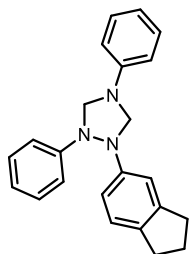
White solid (52.2 mg, 75% yield); mp: 67.4-69.1 °C;

^1H NMR (400 MHz, CDCl_3): δ 7.34 – 7.24 (m, 4H), 7.19 – 7.17 (d, $J = 7.8$ Hz, 2H), 7.07 – 7.03 (d, $J = 13.0$ Hz, 1H), 7.00 – 6.97 (t, $J = 7.3$ Hz, 1H), 6.94 – 6.87 (q, $J = 11.4, 10.1$ Hz, 2H), 6.83 – 6.80 (t, $J = 7.3$ Hz, 1H), 6.62 – 6.61 (d, $J = 7.8$ Hz, 2H), 4.82 – 4.77 (d, $J = 19.7$ Hz, 3H), 4.63 (s, 1H), 3.86 (s, 3H).

^{13}C NMR (101 MHz, CDCl_3): δ 153.2 (d, $J = 252.5$ Hz), 149.9, 144.9 (d, $J = 8.1$ Hz), 144.8, 142.6 (d, $J = 11.1$ Hz), 129.4, 129.2, 121.6, 118.5, 114.9, 114.7 (d, $J = 3.0$ Hz), 113.3, 110.6 (d, $J = 3.0$ Hz), 104.8 (d, $J = 22.2$ Hz), 67.7, 67.2, 57.0.

1-(2,3-Dihydro-1H-inden-5-yl)-2,4-diphenyl-1,2,4-triazolidine (28)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



28

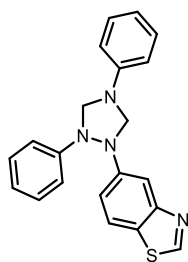
Yellow oil (60.0 mg, 88% yield);

^1H NMR (400 MHz, CDCl_3): δ 7.35 – 7.31 (t, $J = 7.7$ Hz, 2H), 7.29 – 7.27 (d, $J = 7.3$

Hz, 1H), 7.23 – 7.21 (d, $J = 8.1$ Hz, 3H), 7.19 – 7.15 (m, 2H), 7.03 – 6.99 (m, 2H), 6.83 – 6.80 (d, $J = 7.2$ Hz, 1H), 6.64 – 6.62 (d, $J = 7.9$ Hz, 2H), 4.90 (s, 2H), 4.79 – 4.68 (d, $J = 43.4$ Hz, 2H), 2.94 – 2.87 (dt, $J = 13.9, 7.2$ Hz, 4H), 2.14 – 2.07 (p, $J = 7.2$ Hz, 2H).

^{13}C NMR (101 MHz, CDCl_3): δ 150.2, 149.0, 145.5, 145.2, 137.7, 129.4, 129.2, 124.7, 121.3, 118.3, 114.8, 113.5, 113.3, 111.5, 67.7, 66.9, 33.2, 32.1, 25.8.

5-(2,4-Diphenyl-1,2,4-triazolidin-1-yl)benzo[d]thiazole (29)



29

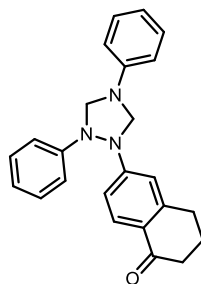
Yellow oil (43.0 mg, 60% yield);

^1H NMR (400 MHz, CDCl_3): δ 8.98 (s, 1H), 7.98 (s, 1H), 7.86 – 7.84 (d, $J = 8.8$ Hz, 1H), 7.41 – 7.38 (d, $J = 10.8$ Hz, 1H), 7.35 – 7.31 (t, $J = 7.8$ Hz, 2H), 7.28 – 7.24 (m, 4H), 7.02 – 6.98 (t, $J = 7.2$ Hz, 1H), 6.83 – 6.79 (t, $J = 7.4$ Hz, 1H), 6.65 – 6.63 (d, $J = 8.2$ Hz, 2H), 4.92 (s, 2H), 4.80 (s, 2H).

^{13}C NMR (101 MHz, CDCl_3): δ 155.0, 154.5, 149.9, 149.6, 145.0, 129.4, 129.2, 126.6, 122.1, 121.7, 118.6, 115.1, 115.0, 113.4, 108.9, 67.7, 67.4.

HRMS (ESI): Calcd. for $\text{C}_{21}\text{H}_{18}\text{KN}_4\text{S}^+$ [$\text{M} + \text{K}$] $^+$ 397.0884, found 397.0967.

6-(2,4-Diphenyl-1,2,4-triazolidin-1-yl)-3,4-dihydronaphthalen-1(2H)-one (30)



30

Yellow oil (44.3 mg, 60% yield);

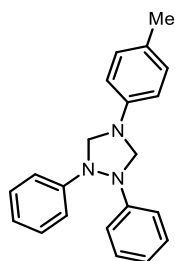
$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 8.03 – 8.01 (d, $J = 8.7$ Hz, 1H), 7.35 – 7.31 (t, $J = 7.9$ Hz, 2H), 7.29 – 7.25 (m, 2H), 7.17 – 7.15 (d, $J = 7.9$ Hz, 2H), 7.06 – 7.01 (q, $J = 7.1$ Hz, 2H), 6.94 (s, 1H), 6.86 – 6.83 (t, $J = 7.3$ Hz, 1H), 6.66 – 6.64 (d, $J = 7.9$ Hz, 2H), 4.99 (s, 1H), 4.88 (s, 2H), 4.59 (s, 1H), 2.94 – 2.91 (t, $J = 5.8$ Hz, 2H), 2.63 – 2.60 (t, $J = 6.4$ Hz, 2H), 2.15 – 2.09 (p, $J = 6.2$ Hz, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 197.1, 153.1, 149.7, 146.6, 144.8, 129.5, 129.4, 129.3, 126.1, 122.4, 118.9, 115.4, 113.4, 112.3, 112.2, 68.0, 65.7, 38.9, 30.2, 23.3.

HRMS (ESI): Calcd. for $\text{C}_{24}\text{H}_{23}\text{N}_3\text{NaO}^+$ $[\text{M} + \text{Na}]^+$ 392.1733, found 392.1764.

1,2-Diphenyl-4-(*p*-tolyl)-1,2,4-triazolidine (31)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



31

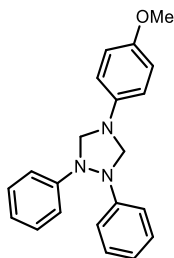
White solid (56.8 mg, 90% yield); mp: 94.2-96.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.33 – 7.29 (m, 4H), 7.10 – 7.18 (d, $J = 7.8$ Hz, 4H), 7.08 – 7.06 (d, $J = 8.2$ Hz, 2H), 7.00 – 6.96 (t, $J = 7.3$ Hz, 2H), 6.57 – 6.55 (d, $J = 8.4$ Hz, 2H), 4.86 (s, 2H), 4.70 (s, 2H), 2.27 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.2, 143.2, 130.3, 129.2, 127.4, 121.5, 115.0, 113.6, 67.6, 20.4.

4-(4-Methoxyphenyl)-1,2-diphenyl-1,2,4-triazolidine (32)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



32

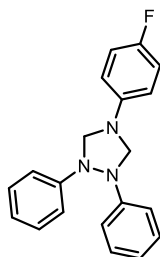
White solid (47.1 mg, 71% yield); mp: 72.9-74.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.32 – 7.29 (m, 4H), 7.18 – 7.16 (d, $J = 7.7$ Hz, 4H), 6.99 – 6.95 (t, $J = 6.7$ Hz, 2H), 6.84 – 6.82 (d, $J = 6.8$ Hz, 2H), 6.63 – 6.61 (m, 2H), 4.82 (s, 2H), 4.71 (s, 2H), 3.76 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 152.9, 150.3, 139.9, 129.1, 121.4, 115.32 – 114.61 (m), 68.4, 55.7.

4-(4-Fluorophenyl)-1,2-diphenyl-1,2,4-triazolidine (33)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



33

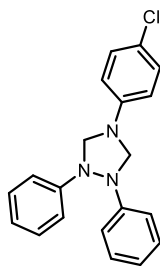
White solid (51.6 mg, 81% yield); mp: 113.7-115.1 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.35 – 7.29 (t, $J = 7.8$ Hz, 4H), 7.21 – 7.19 (d, $J = 8.3$ Hz, 4H), 7.02 – 6.95 (m, 4H), 6.59 – 6.56 (m, 2H), 4.84 (s, 2H), 4.71 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 157.6 (d, $J = 238.4$ Hz), 150.1, 142.0 (d, $J = 4.0$ Hz), 129.2, 121.6, 116.0 (d, $J = 22.2$ Hz), 115.0, 114.5 (d, $J = 7.1$ Hz), 67.9.

4-(4-Chlorophenyl)-1,2-diphenyl-1,2,4-triazolidine (34)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



34

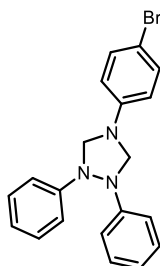
White solid (54.8 mg, 82% yield); mp: 132.2-133.8 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.35 – 7.31 (m, 5H), 7.24 – 7.19 (t, $J = 9.2$ Hz, 5H), 7.04 – 7.00 (m, 2H), 6.57 – 6.52 (t, $J = 9.4$ Hz, 2H), 4.88 (s, 2H), 4.71 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 149.9, 143.6, 129.3, 129.2, 121.7, 115.0, 114.3, 67.1.

4-(4-Bromophenyl)-1,2-diphenyl-1,2,4-triazolidine (35)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



35

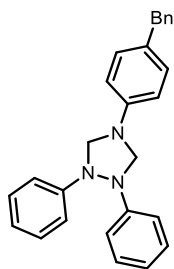
White solid (54.6 mg, 72% yield); mp: 138.2-139.7 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.35 – 7.29 (m, 6H), 7.22 – 7.20 (d, $J = 8.0$ Hz, 4H), 7.02 – 6.99 (t, $J = 7.2$ Hz, 2H), 6.49 – 6.47 (d, $J = 8.4$ Hz, 2H), 4.86 (s, 2H), 4.68 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 149.9, 143.9, 132.1, 129.2, 121.7, 115.0, 114.7, 110.3, 67.0.

4-(4-Benzylphenyl)-1,2-diphenyl-1,2,4-triazolidine (36)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



36

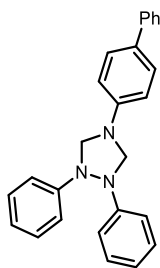
Yellow oil (54.7 mg, 70% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.33 – 7.27 (q, $J = 7.8, 7.4$ Hz, 6H), 7.20 – 7.16 (m, 7H), 7.09 – 7.07 (d, $J = 8.3$ Hz, 2H), 7.00 – 6.97 (t, $J = 7.2$ Hz, 2H), 6.58 – 6.56 (d, $J = 8.3$ Hz, 2H), 4.87 (s, 2H), 4.70 (s, 2H), 3.91 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.2, 143.6, 141.8, 131.1, 129.9, 129.2, 128.8, 128.5, 126.0, 121.6, 115.0, 113.6, 67.4, 41.0.

4-([1,1'-Biphenyl]-4-yl)-1,2-diphenyl-1,2,4-triazolidine (37)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



37

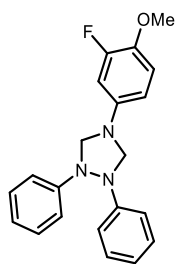
White solid (53.5 mg, 71% yield); mp: 113.8-115.6 °C;

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.57 – 7.51 (dd, $J = 15.2, 8.0$ Hz, 4H), 7.45 – 7.41 (t, $J = 7.6$ Hz, 2H), 7.35 – 7.31 (t, $J = 7.8$ Hz, 5H), 7.24 – 7.22 (d, $J = 8.0$ Hz, 4H), 7.02 – 6.98 (t, $J = 7.2$ Hz, 2H), 6.70 – 6.68 (d, $J = 8.5$ Hz, 2H), 4.95 (s, 2H), 4.76 (s, 2H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 150.0, 144.3, 140.8, 131.2, 129.2, 128.7, 128.0, 126.4, 121.6, 115.0, 114.1, 113.5, 67.0.

4-(3-Fluoro-4-methoxyphenyl)-1,2-diphenyl-1,2,4-triazolidine (38)

The ^1H and ^{13}C spectra data matched with values reported in the literature.¹⁰



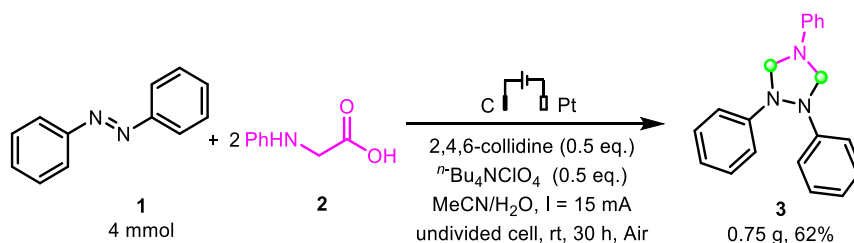
38

Yellow oil (52.3 mg, 75% yield);

$^1\text{H NMR}$ (400 MHz, CDCl_3): δ 7.34 – 7.29 (m, 4H), 7.19 – 7.17 (d, $J = 7.9$ Hz, 4H), 7.01 – 6.97 (t, $J = 7.3$ Hz, 2H), 6.91 – 6.86 (t, $J = 9.1$ Hz, 1H), 6.46 – 6.42 (d, $J = 13.2$ Hz, 1H), 6.33 – 6.31 (d, $J = 8.8$ Hz, 1H), 4.81 (s, 2H), 4.67 (s, 2H), 3.84 (s, 3H).

$^{13}\text{C NMR}$ (101 MHz, CDCl_3): δ 154.4 (d, $J = 246.4$ Hz), 150.0, 140.4, 140.3 (d, $J = 8.1$ Hz), 129.2 (d, $J = 11.1$ Hz), 122.8, 121.6, 115.7 (d, $J = 4.0$ Hz), 114.9, 108.7 (d, $J = 4.0$ Hz), 102.9 (d, $J = 23.2$ Hz), 77.2, 67.9, 57.3.

Procedure for gram-scale experiment (Procedure B):

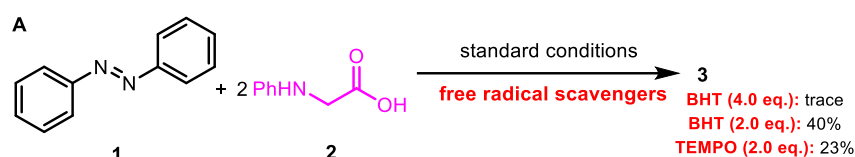


To a 50 mL distillation flask equipped with a magnetic stirring rod, azobenzene **1** (0.73 g, 4 mmol, 1.0 eq.), *N*-phenyl glycine **2** (2.4 g, 16 mmol, 4.0 eq.), 2,4,6-collidine (0.24 g, 2 mmol, 0.5 eq.), $n\text{-Bu}_4\text{NClO}_4$ (0.68 g, 2 mmol, 0.5 eq.), CH_3CN (15 mL) and H_2O (2.5 mL) were added. The flask was equipped with a graphite rod anode ($d = 5$ mm) and a platinum cathode. The resulting solution was stirred and electrolyzed at a constant current of 15 mA (Single Output DC Power Supply: KRP-305DM, the voltage range is 1.9 V - 3.3 V) for 30 h at room temperature. The solution was diluted with EtOAc (20 mL) and brine (20 mL) and extracted with EtOAc (3×30 mL). The combined organic

layers were washed with brine (3×20 mL), dried with Na_2SO_4 , and concentrated in vacuo. Purification by flash column chromatography using PE/EtOAc ($v/v = 100/1$) as eluent afforded the desired product **3** (0.75 g, 62%).

V. Mechanism Research

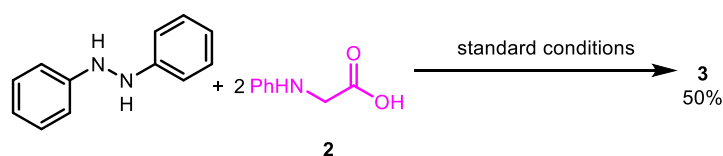
5.1 Radical-trapping experiments.



To a 10 mL distillation flask equipped with a magnetic stirring rod, azobenzene **1** (36.5 mg, 0.2 mmol, 1.0 eq.), *N*-phenyl glycine **2** (121 mg, 0.8 mmol, 4.0 eq.), BHT (176 mg, 0.8 mmol, 4.0 eq.), 2,4,6-collidine (12.1 mg, 0.04 mmol, 0.5 eq.), n -Bu₄NClO₄ (103 mg, 0.3 mmol, 1.5 eq.), H₂O (0.5 mL) and CH₃CN (3.0 mL) were added. The flask was equipped with a graphite rod anode (d = 5 mm) and a platinum cathode. The resulting solution was stirred and electrolyzed at a constant current of 10 mA (Single Output DC Power Supply: KRP-305DM, the voltage range is 2.1 V – 3.2 V) for 5 h at room temperature. The solution was diluted with EtOAc (5 mL) and brine (20 mL) and extracted with EtOAc (3 × 20 mL). The combined organic layers were washed with brine (3 × 20 mL), dried with Na₂SO₄, and concentrated *in vacuo*. Purification by flash column chromatography using PE/EtOAc (v/v = 100/1) as eluent afforded the desired product **3** (trace) and recovery of starting materials **1** (32.9 mg, 90%).

When the reaction was conducted with BHT (2.0 eq.) as the radical scavenger, the yield of **3** decreased to 40%. Similarly, upon employing TEMPO (2.0 eq.) as an alternative radical scavenger, the yield of **3** further dropped to 23%, indicating significant inhibition of the electrochemical decarboxylative cyclization reaction.

5.2 1,2-Diphenylhydrazine experiment.



To a 10 mL distillation flask equipped with a magnetic stirring rod, 1,2-diphenylhydrazine (36.8 mg, 0.2 mmol, 1.0 eq.), *N*-phenyl glycine **2** (121 mg, 0.8 mmol,

4.0 eq.), 2,4,6-collidine (12.1 mg, 0.04 mmol, 0.5 eq.), *n*-Bu₄NClO₄ (103 mg, 0.3 mmol, 1.5 eq.), H₂O (0.5 mL) and CH₃CN (3.0 mL) were added. The flask was equipped with a graphite rod anode (d = 5 mm) and a platinum cathode. The resulting solution was stirred and electrolyzed at a constant current of 10 mA (Single Output DC Power Supply: KRP-305DM, the voltage range is 2.3 V – 3.6 V) for 5 h at room temperature. The solution was diluted with EtOAc (5 mL) and brine (20 mL) and extracted with EtOAc (3 × 20 mL). The combined organic layers were washed with brine (3 × 20 mL), dried with Na₂SO₄, and concentrated *in vacuo*. Purification by flash column chromatography using PE/EtOAc (v/v = 100/1) as eluent afforded the desired product **3** (30.0 mg, 50%).

5.3 Cyclic voltammetry experiments.

Cyclic voltammetry (CV) measurements were performed on a conventional three-electrode electrochemical workstation at room temperature (Fig.S2). A glassy carbon electrode was employed as the working electrode, an Ag/AgCl electrode served as the reference electrode, and a platinum wire was used as the counter electrode. All CV tests were carried out under the optimized standard reaction conditions, with deionized water added as the proton source, and the potential scanning range was set from 0 to 3.0 V vs. Ag/AgCl at a scan rate of 100 mV · s⁻¹. The cyclic voltammograms recorded in MeCN with 0.1 M *n*-Bu₄NBF₄ as the supporting electrolyte [**2** (0.01 mM), **3** (0.01 mM), H₂O (0.01 mM), **2**+H₂O (0.01 mM), **3**+H₂O (0.01 mM)].

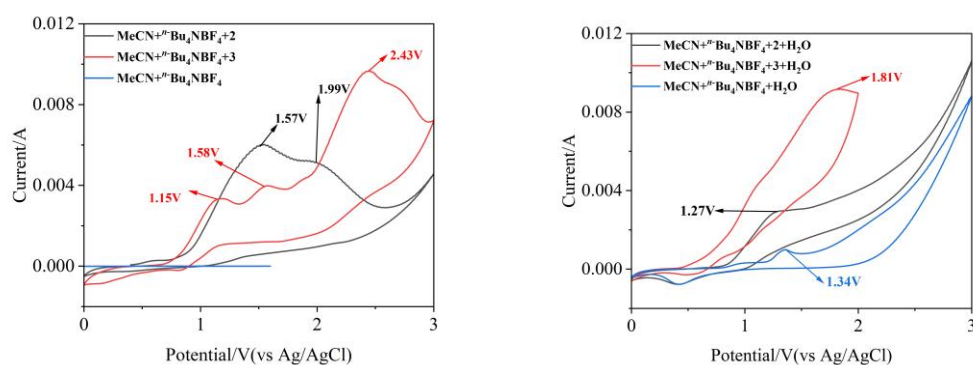


Fig.S2 Cyclic voltammetry experiments

VI. References

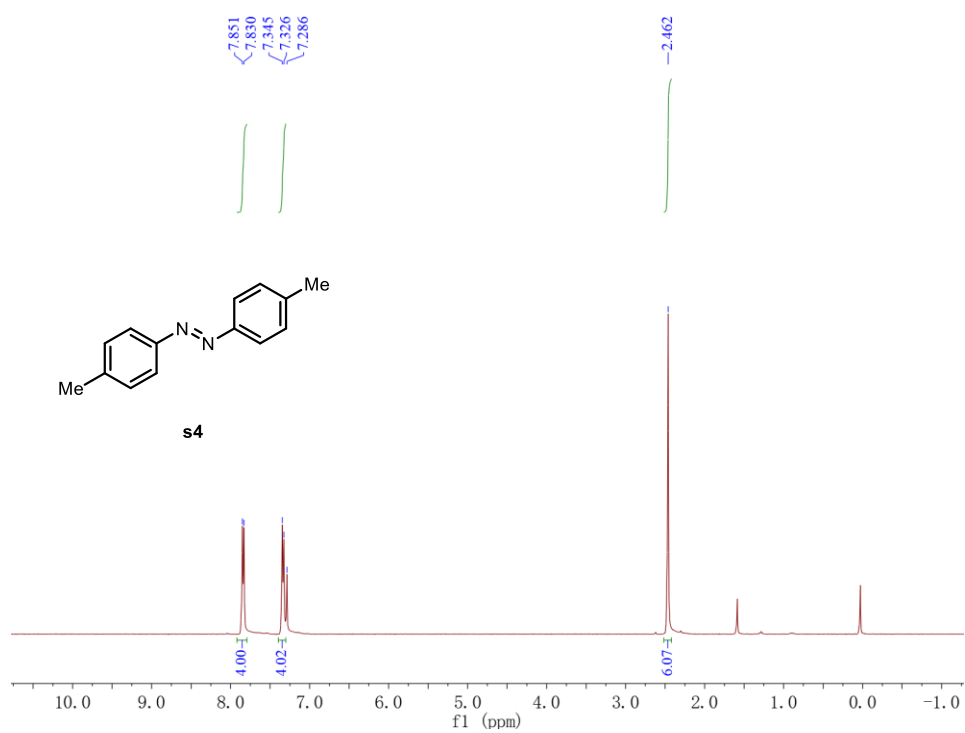
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- 3 L. Wang, A. Ishida, Y. Hashidoko and M. Hashimoto, Dehydrogenation of the NH–NH bond triggered by potassium *tert*-butoxide in liquid ammonia, *Angew. Chem. Int. Ed.*, 2016, **56**, 870–873.
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2022, **9**, 3769–3774.

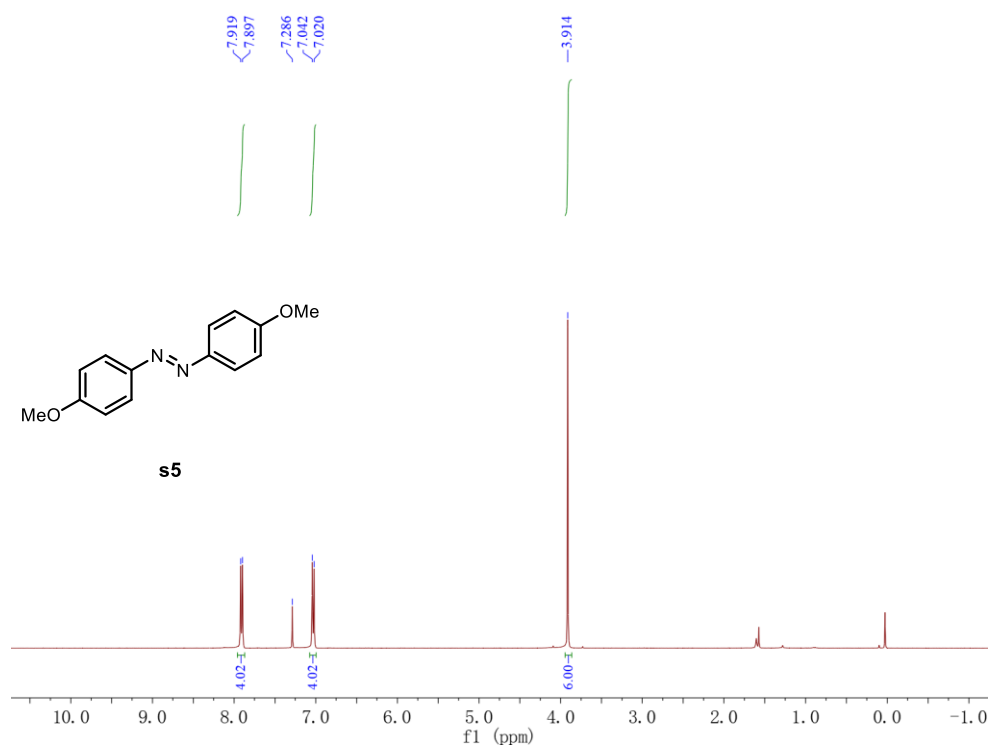
- 10 J. Wen, J. Ma, K. Yan, X. Zhang, K. Huang, L. Wu, D. Li and J. Yang, Electrochemical silver-catalyzed [2 + 2 + 1] decarboxylation of *N*-aryl glycines with azobenzenes access to 1,2,4-triazolidines, *ACS Sustainable Chem. Eng.*, 2023, **11**, 16785–16792.
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VII. Spectra

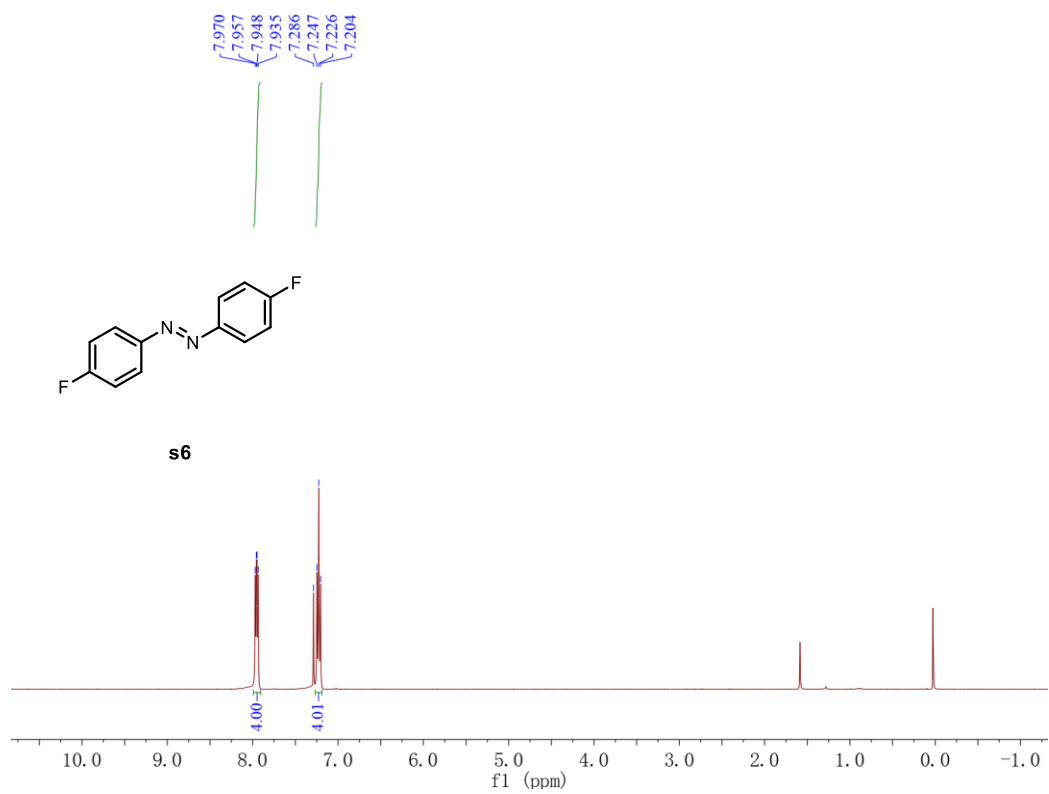
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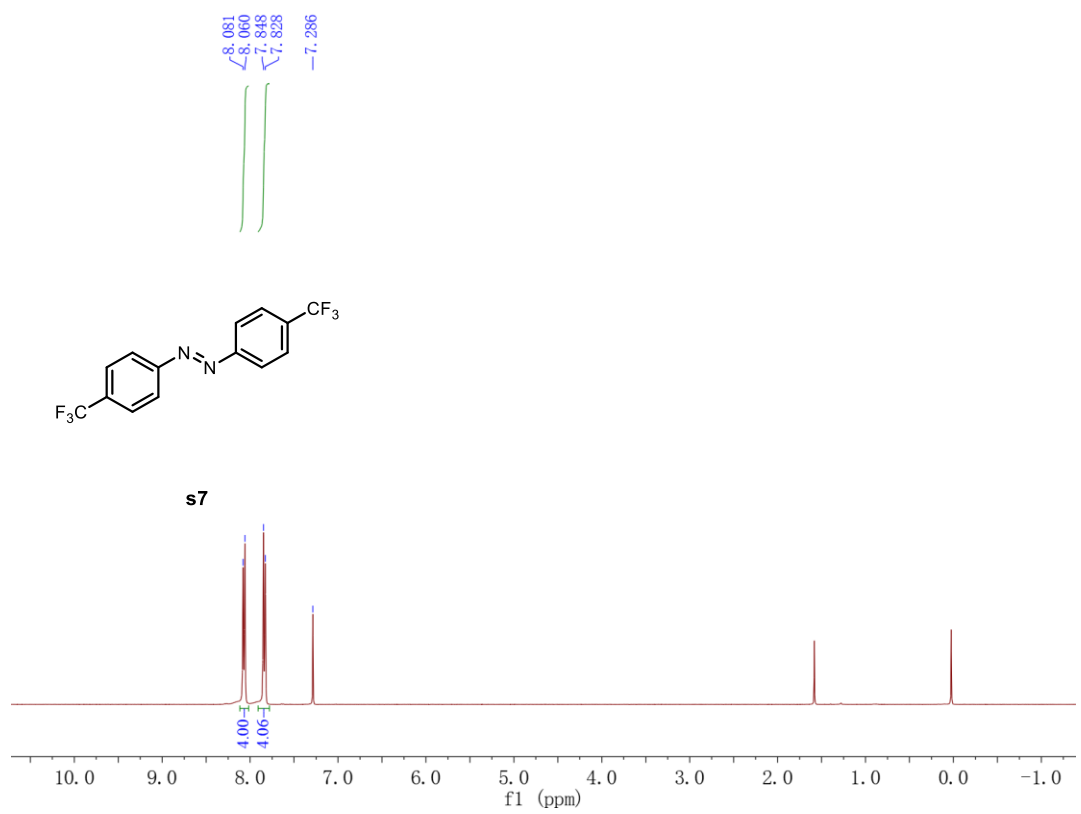
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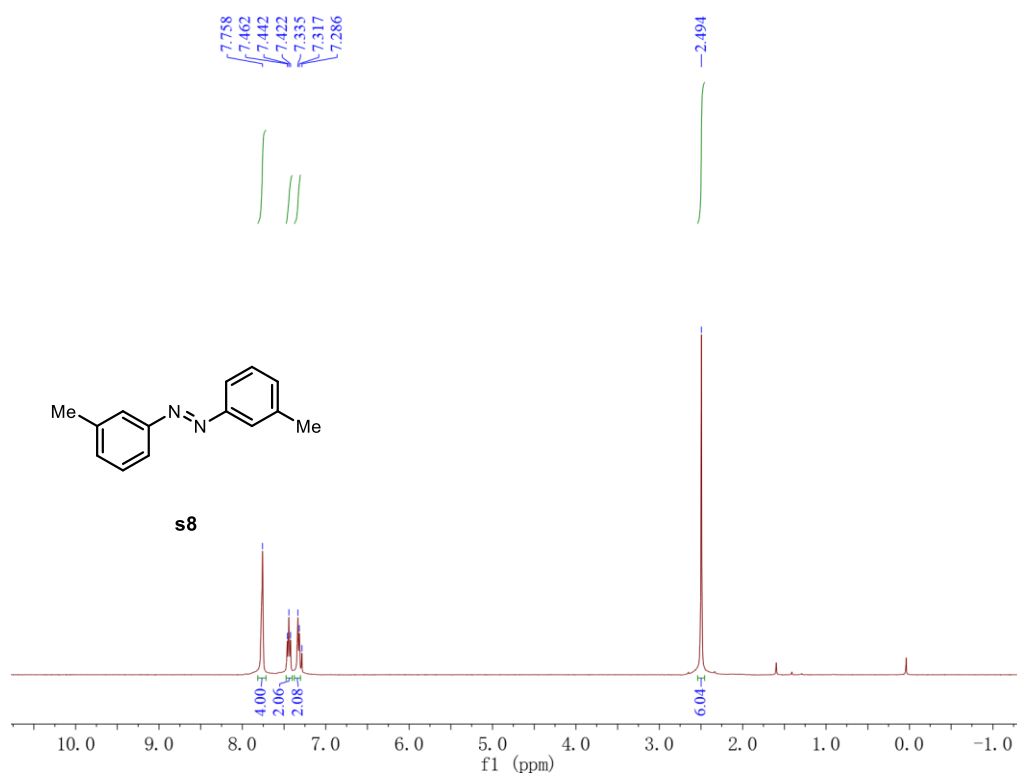
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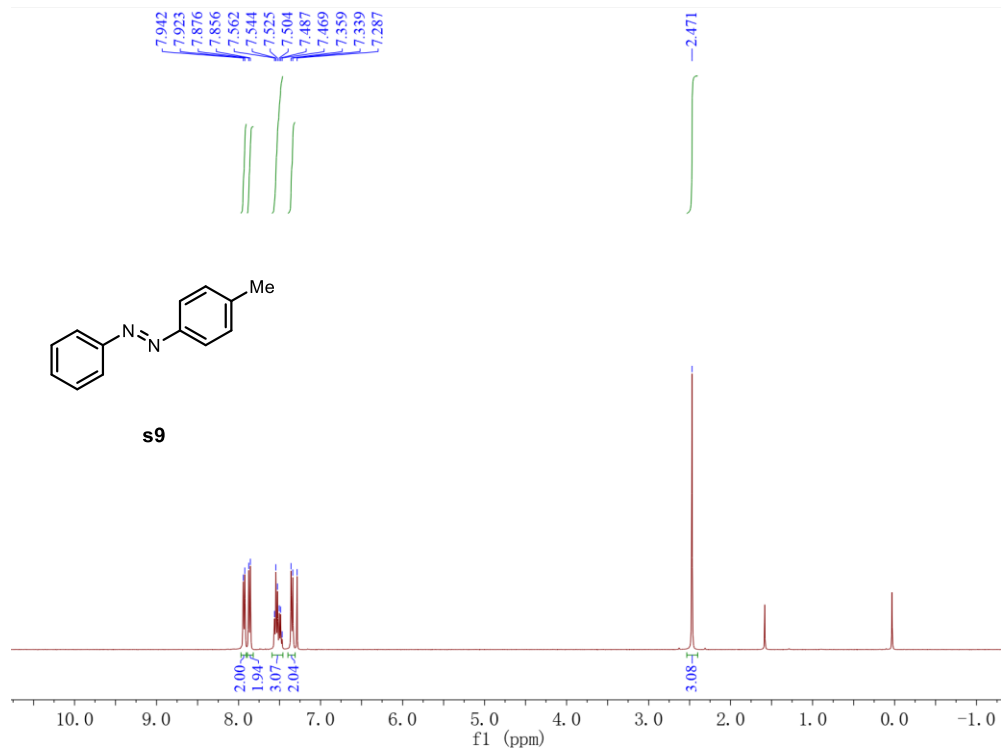
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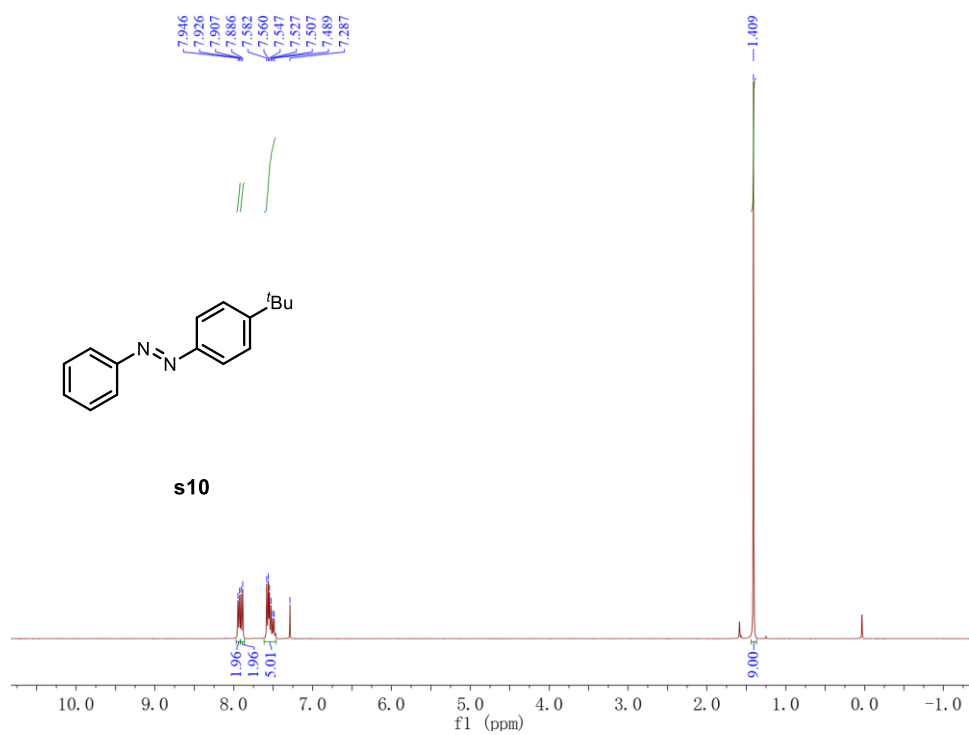
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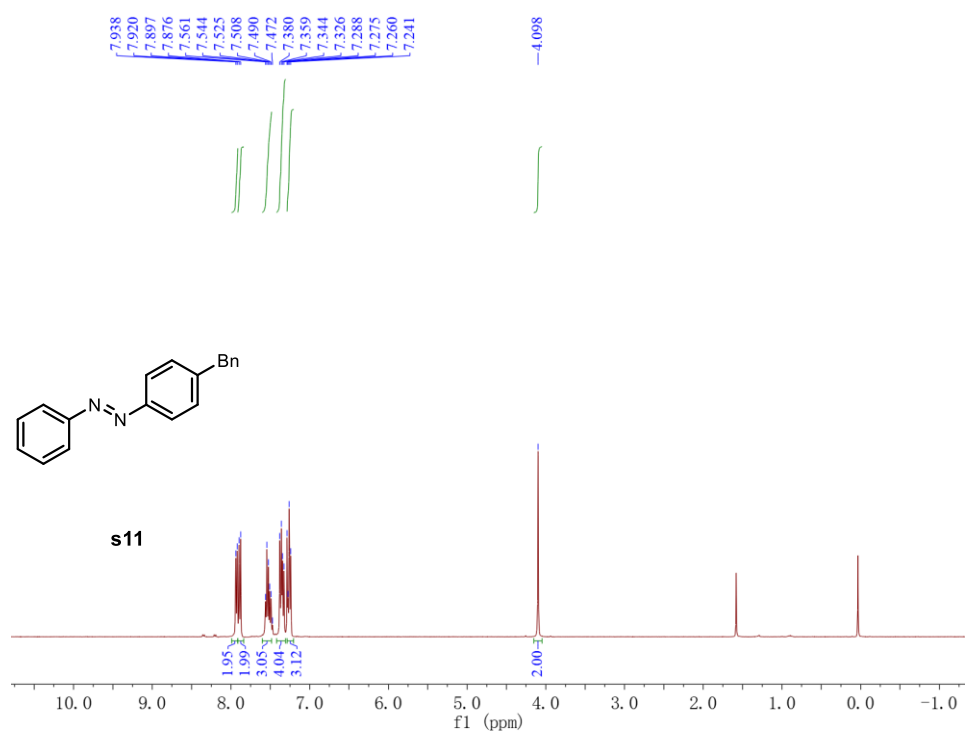
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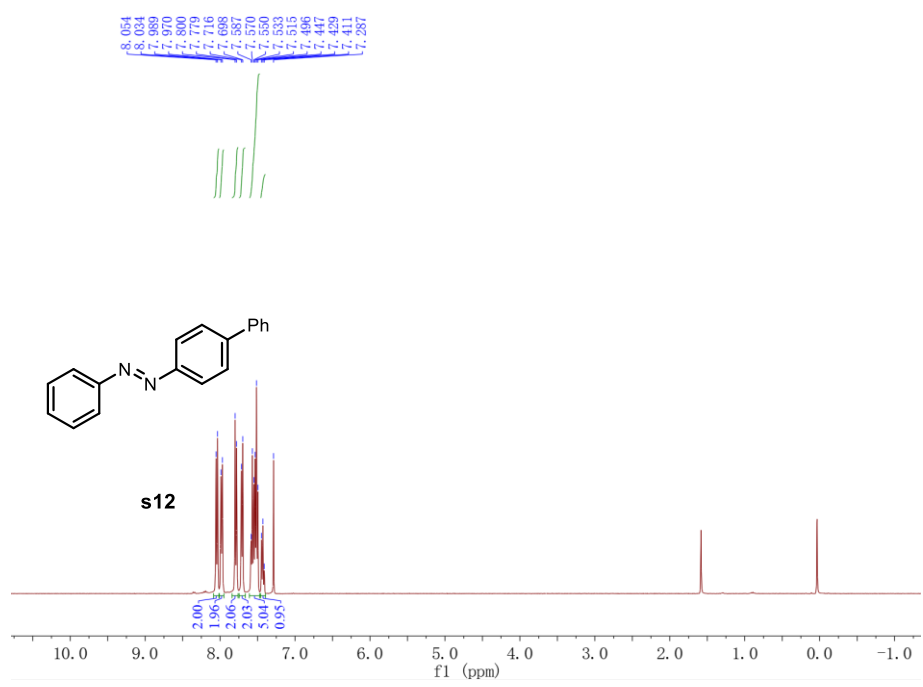
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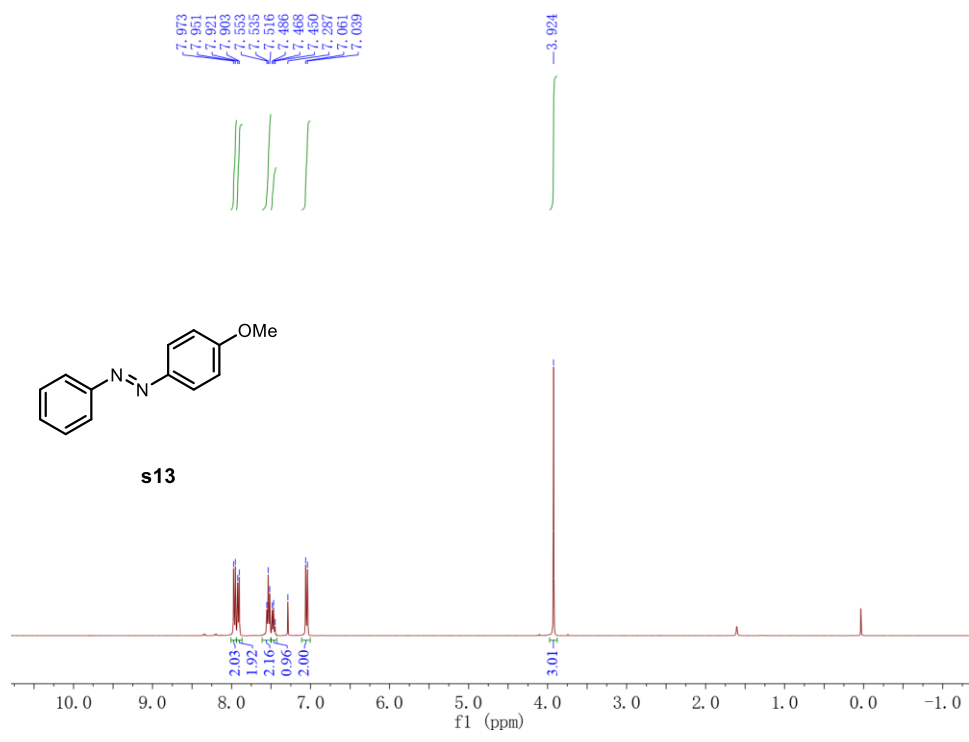
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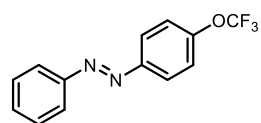
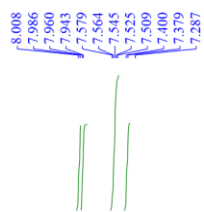
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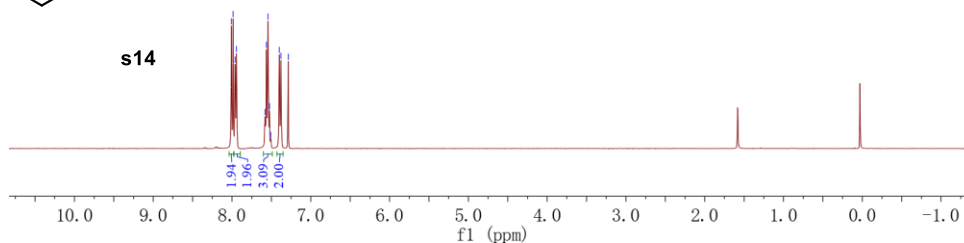
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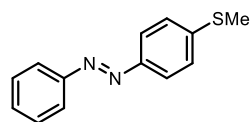
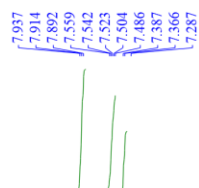
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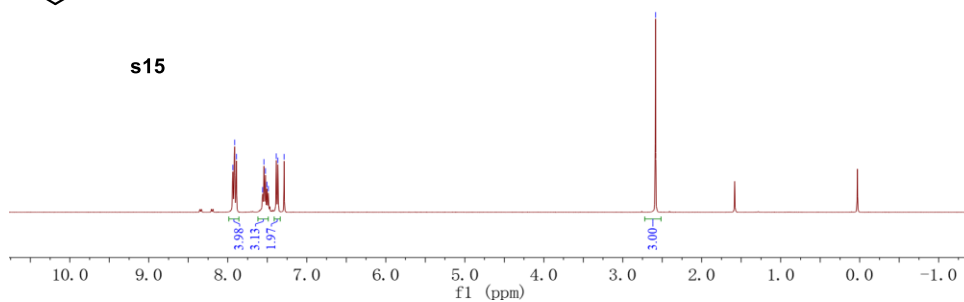
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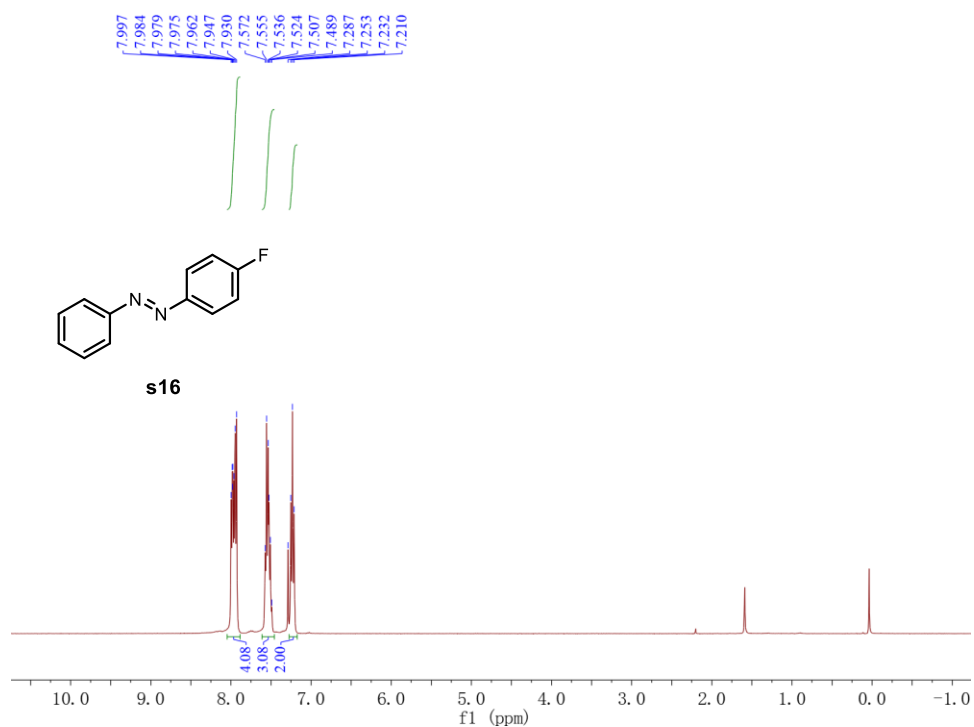
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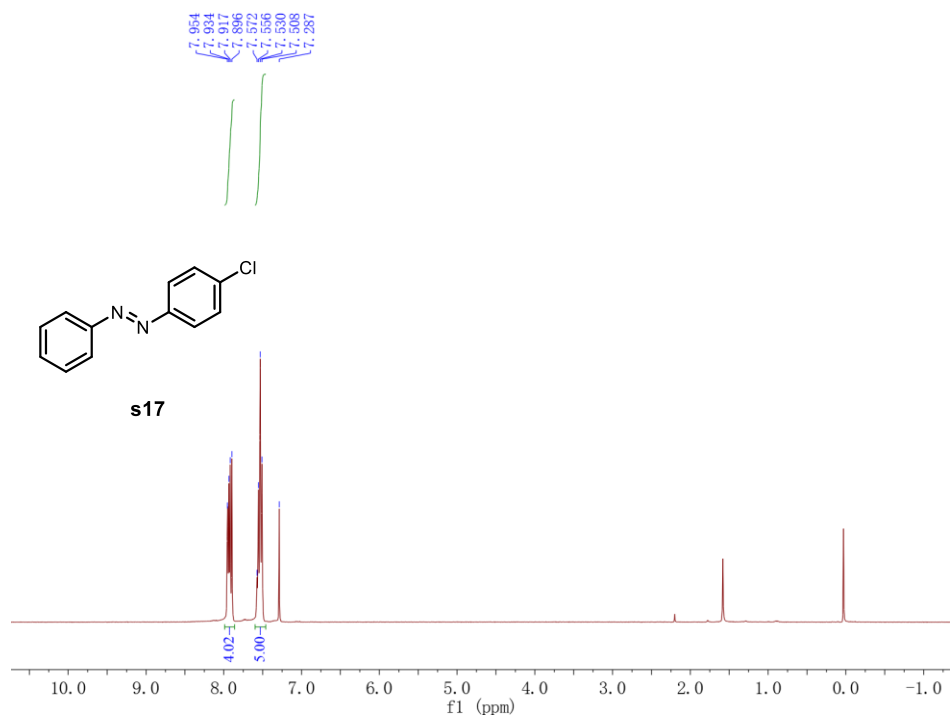
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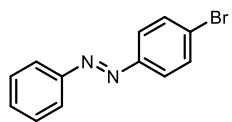
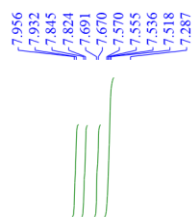
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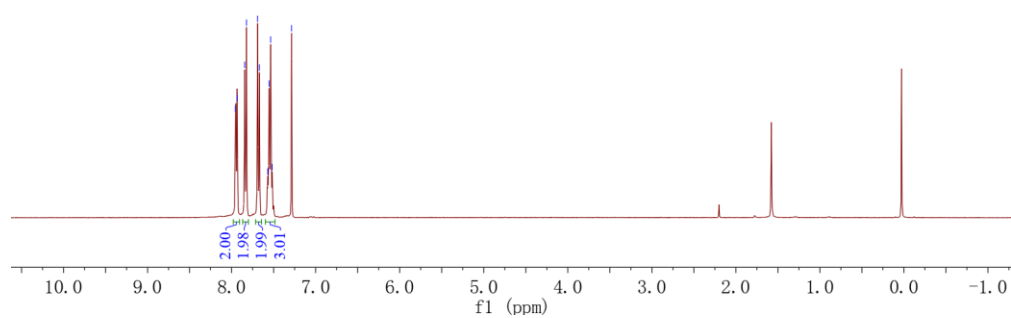
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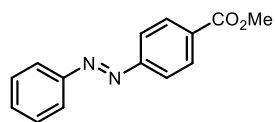
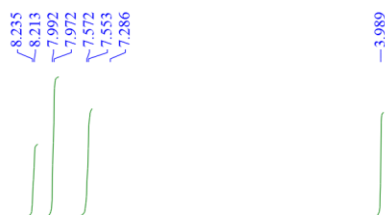
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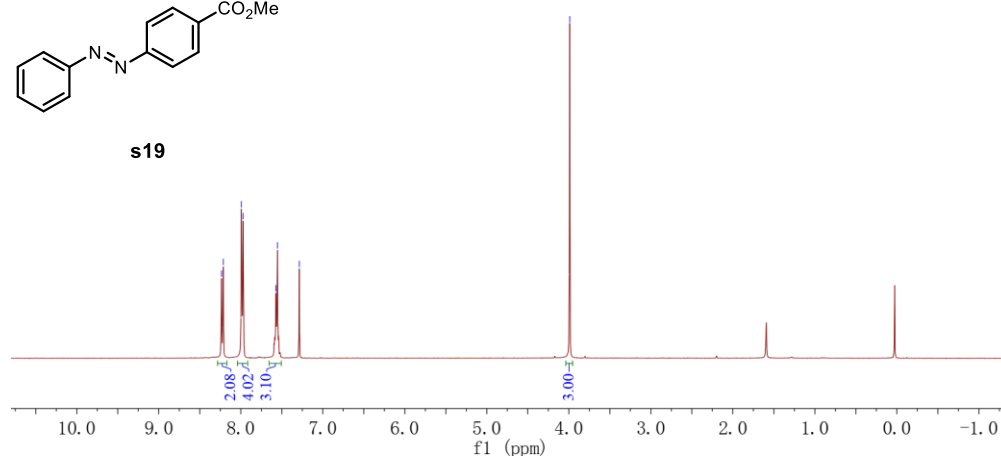
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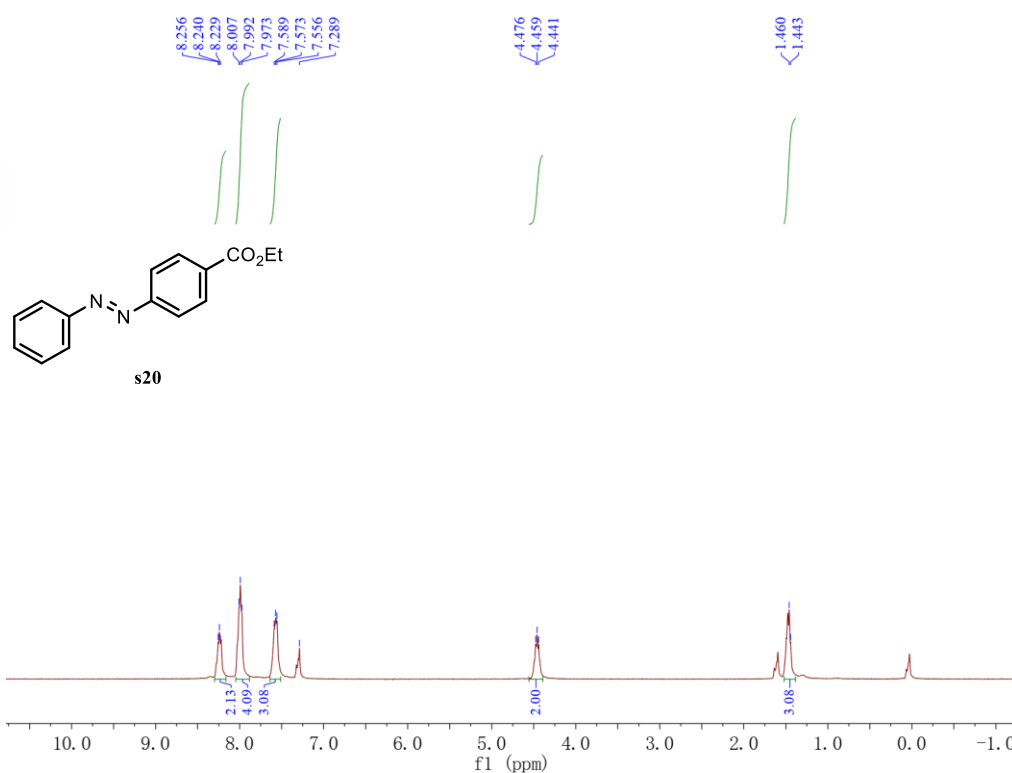
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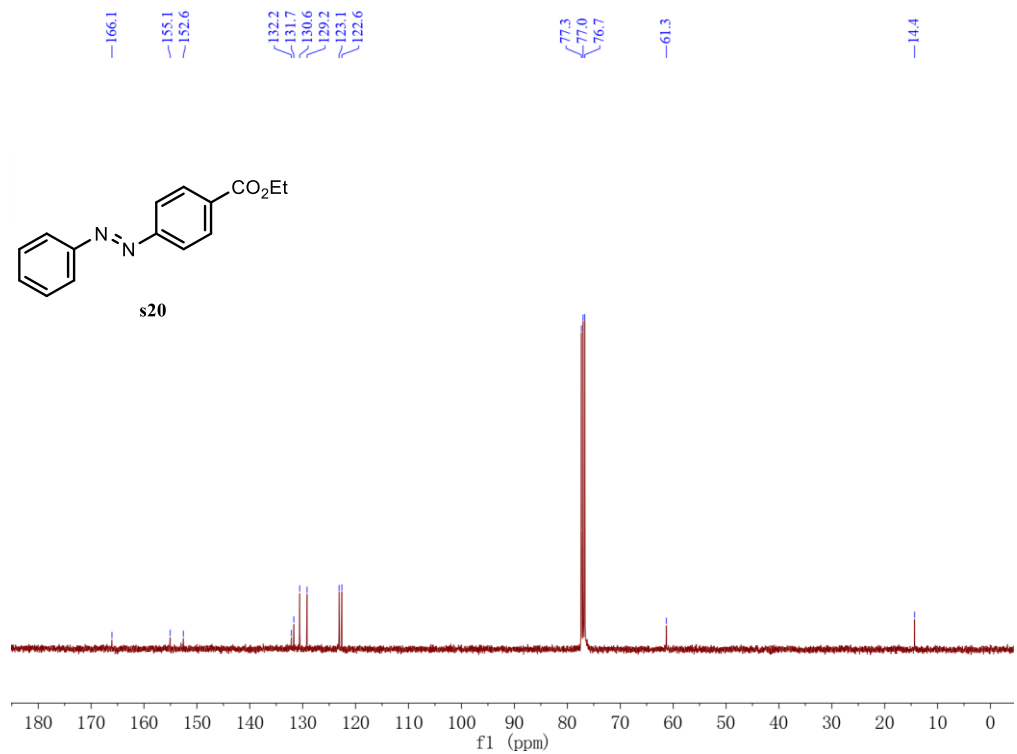
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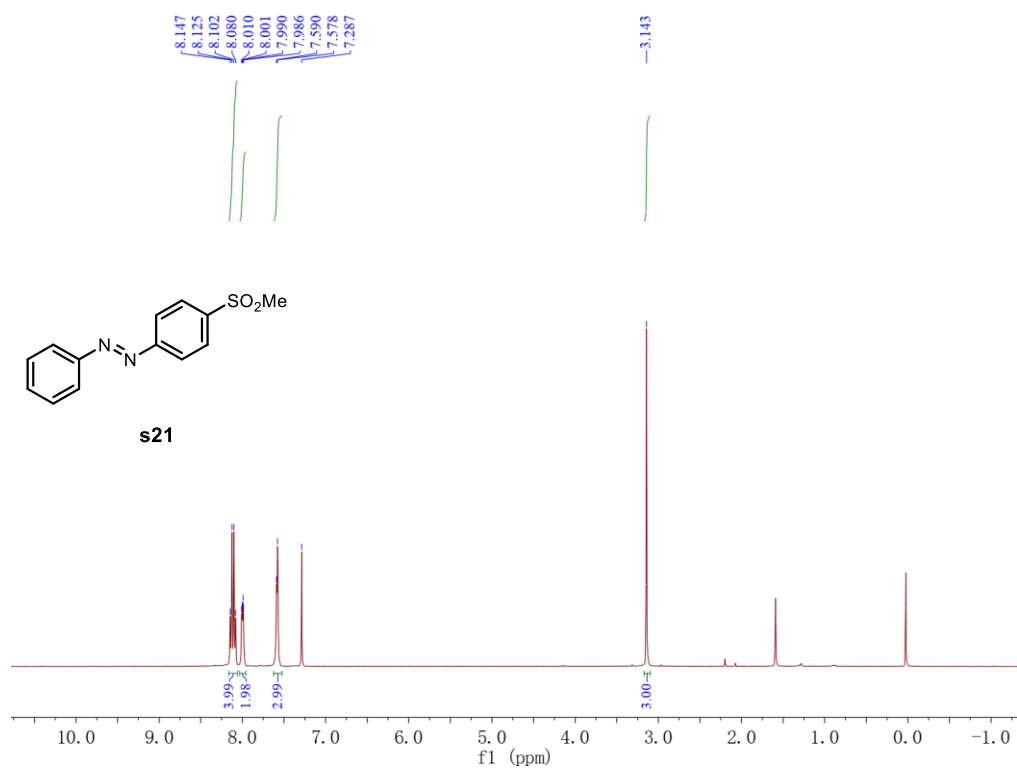
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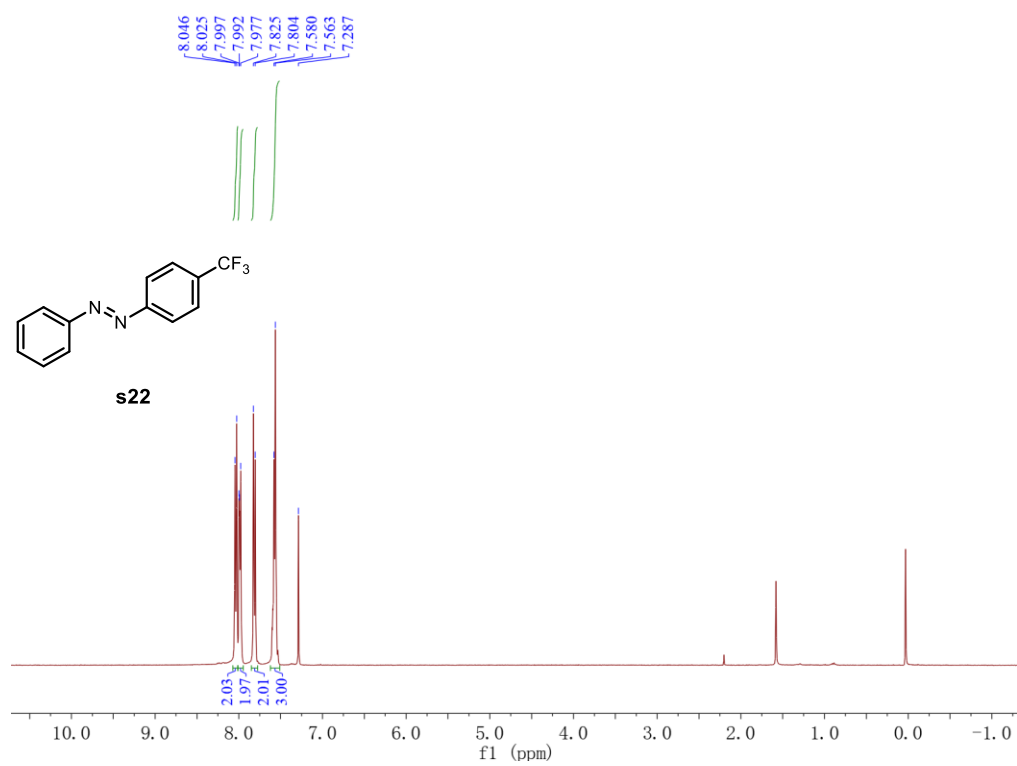
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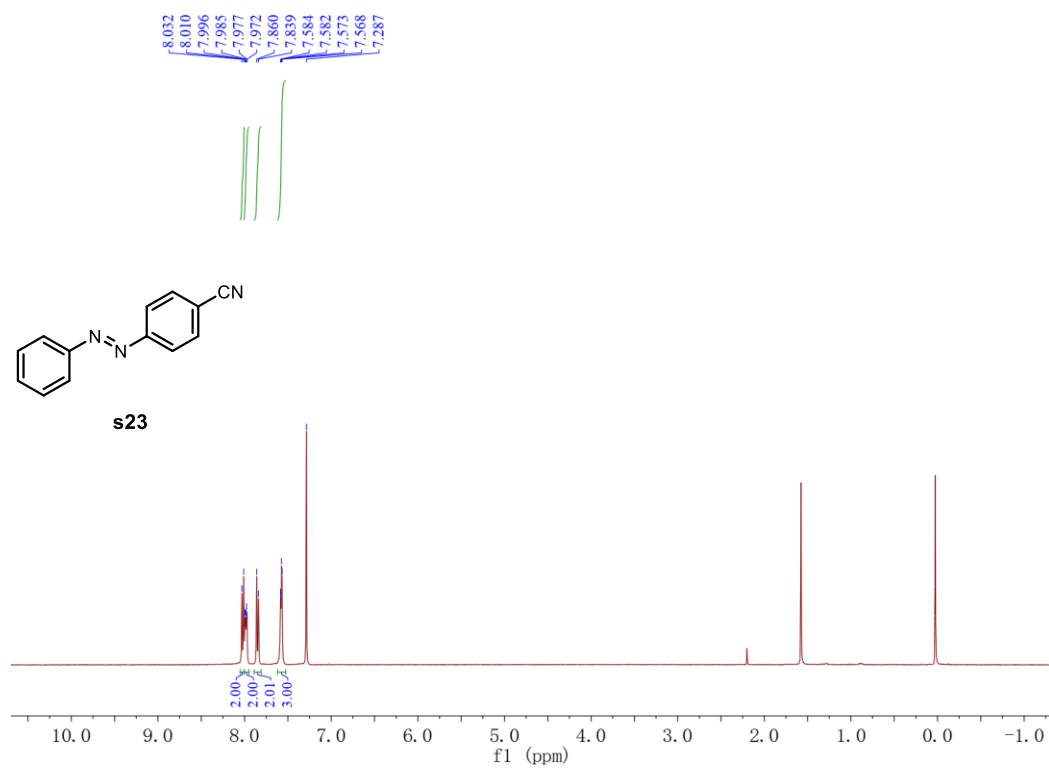
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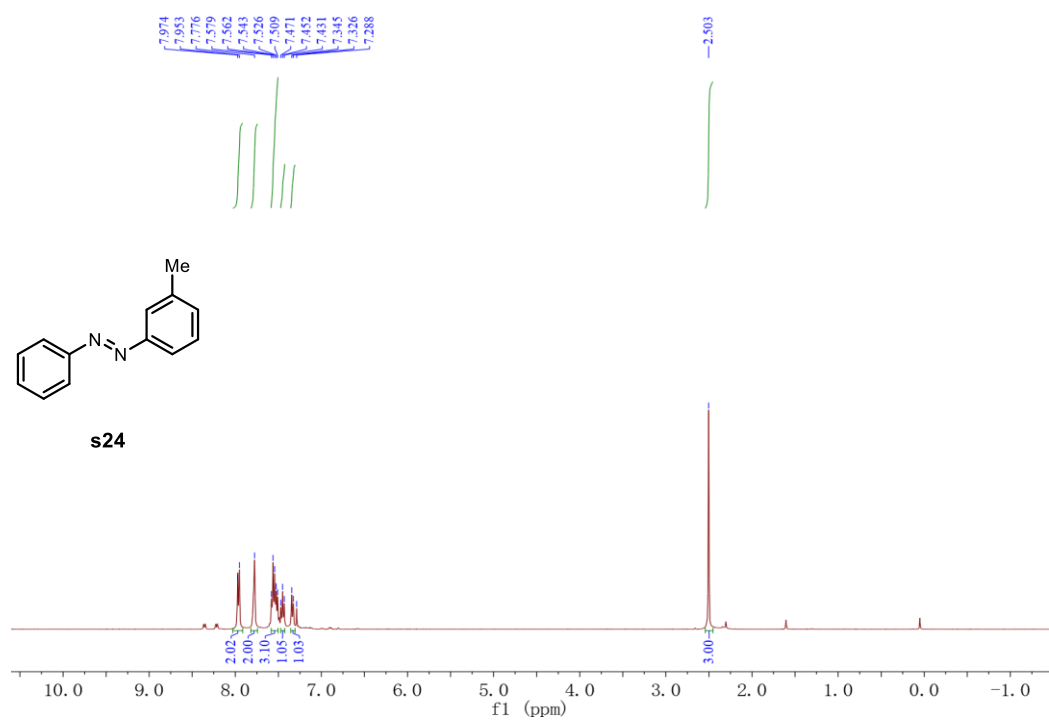
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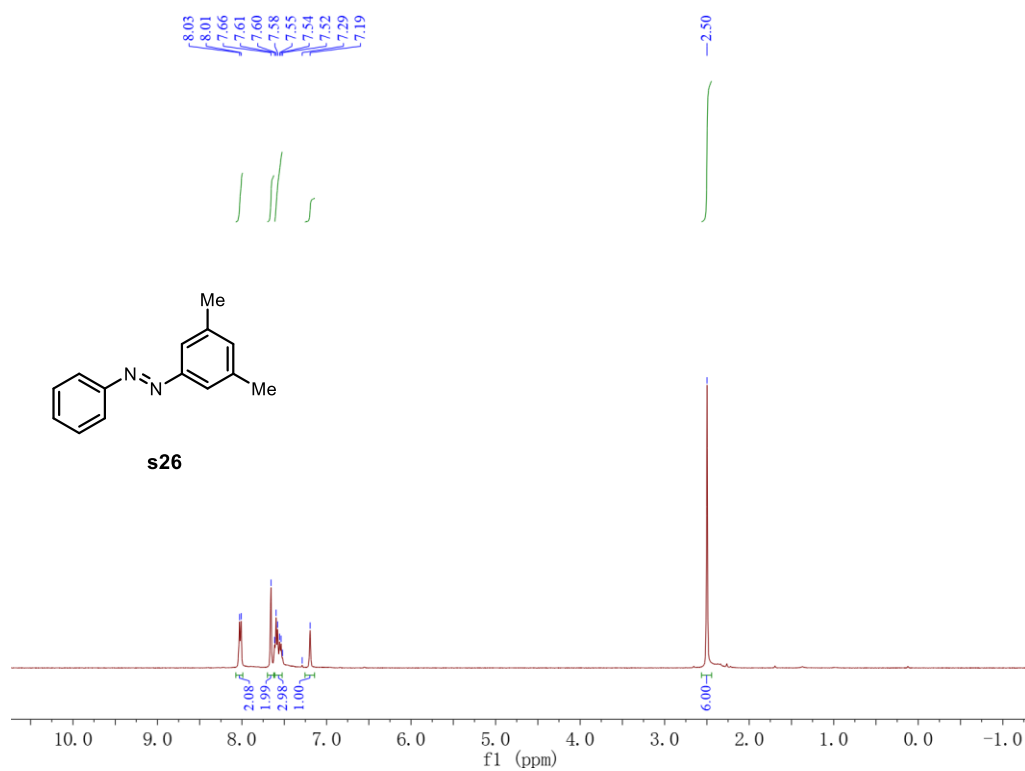
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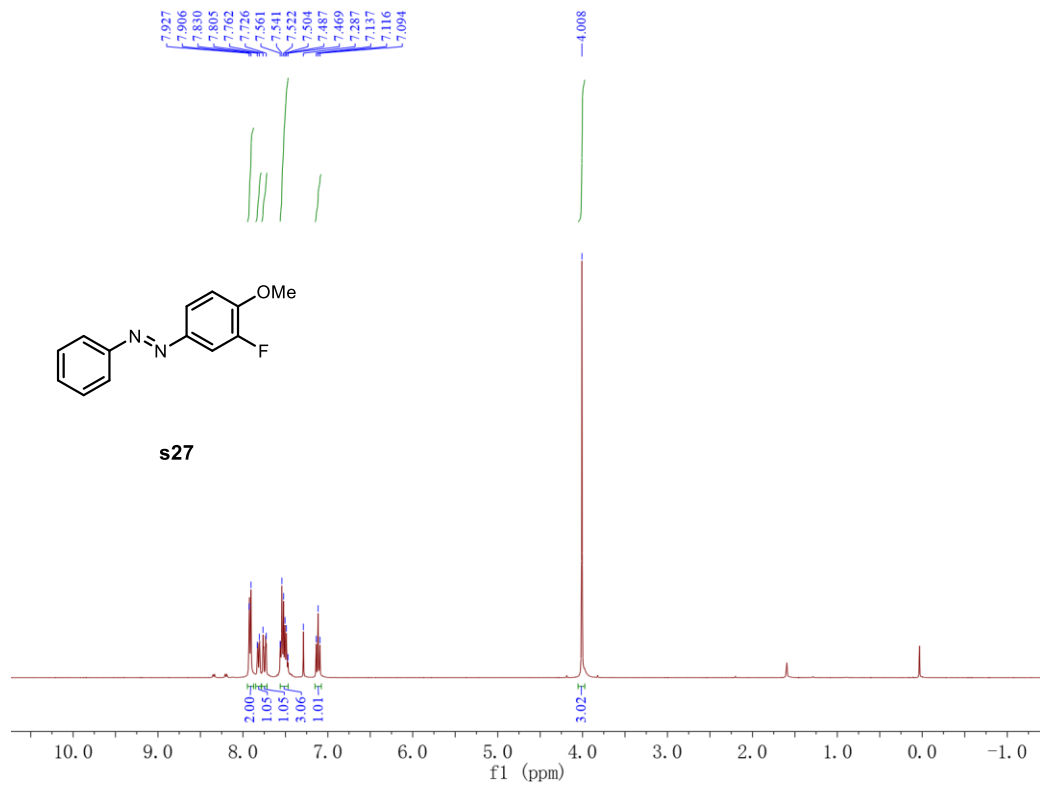
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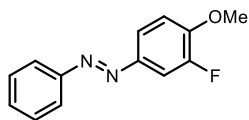


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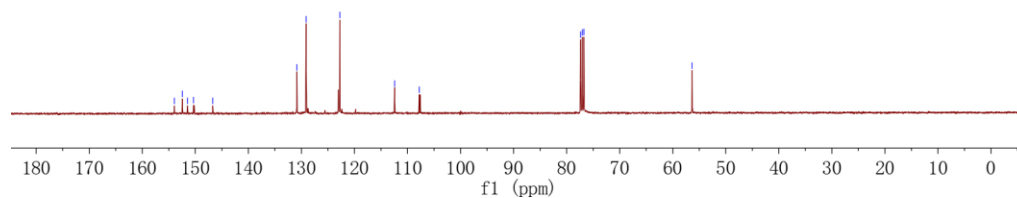


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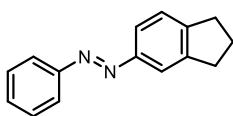


s27

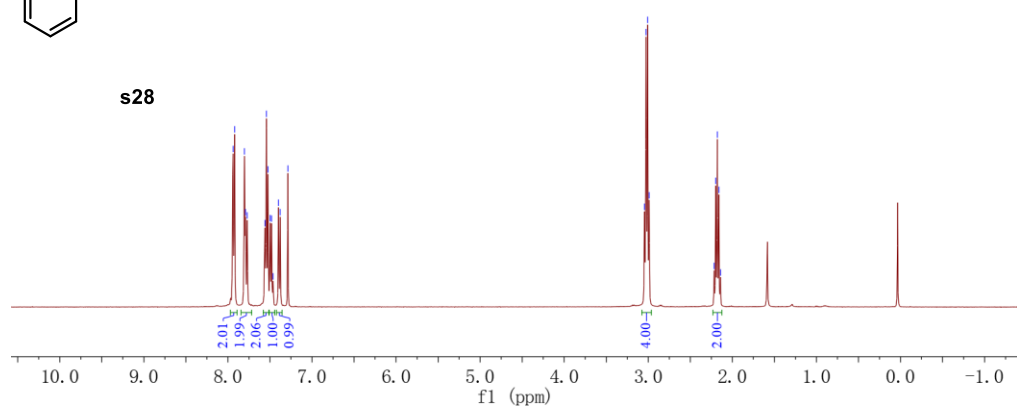


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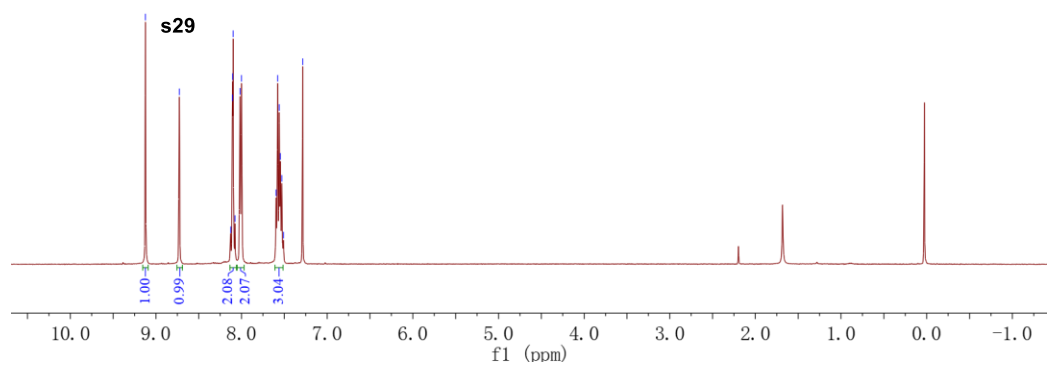
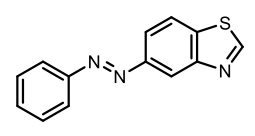
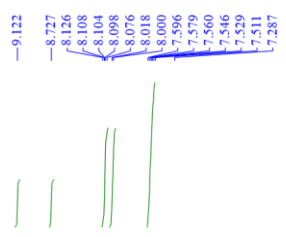
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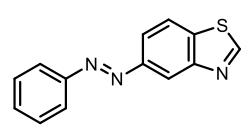
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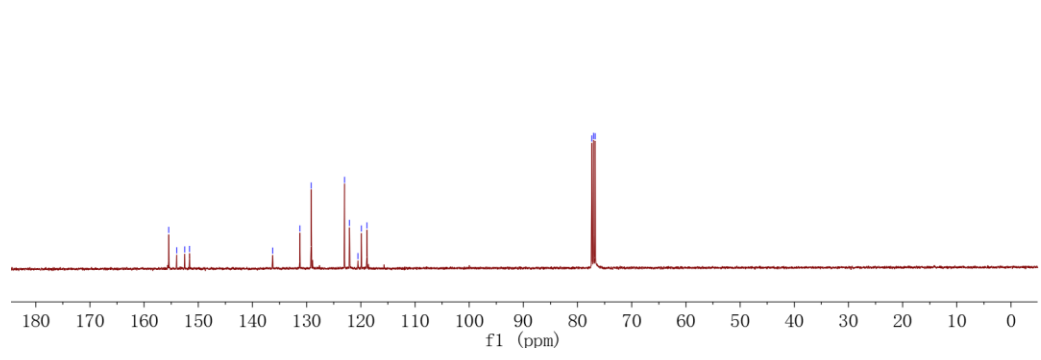
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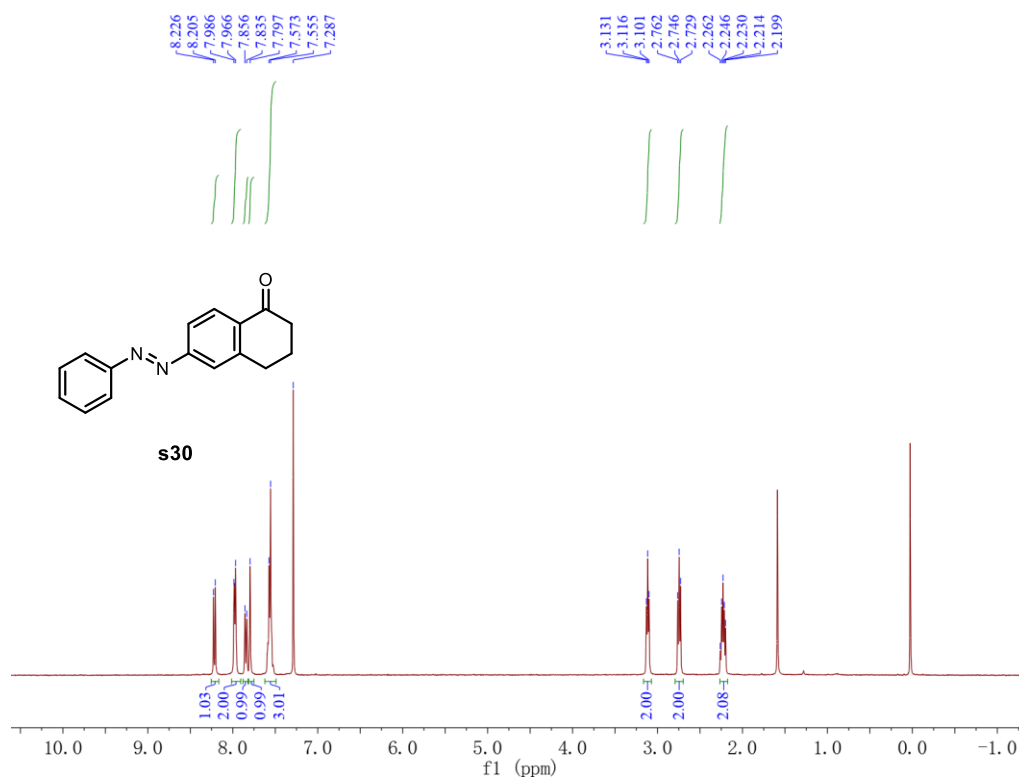
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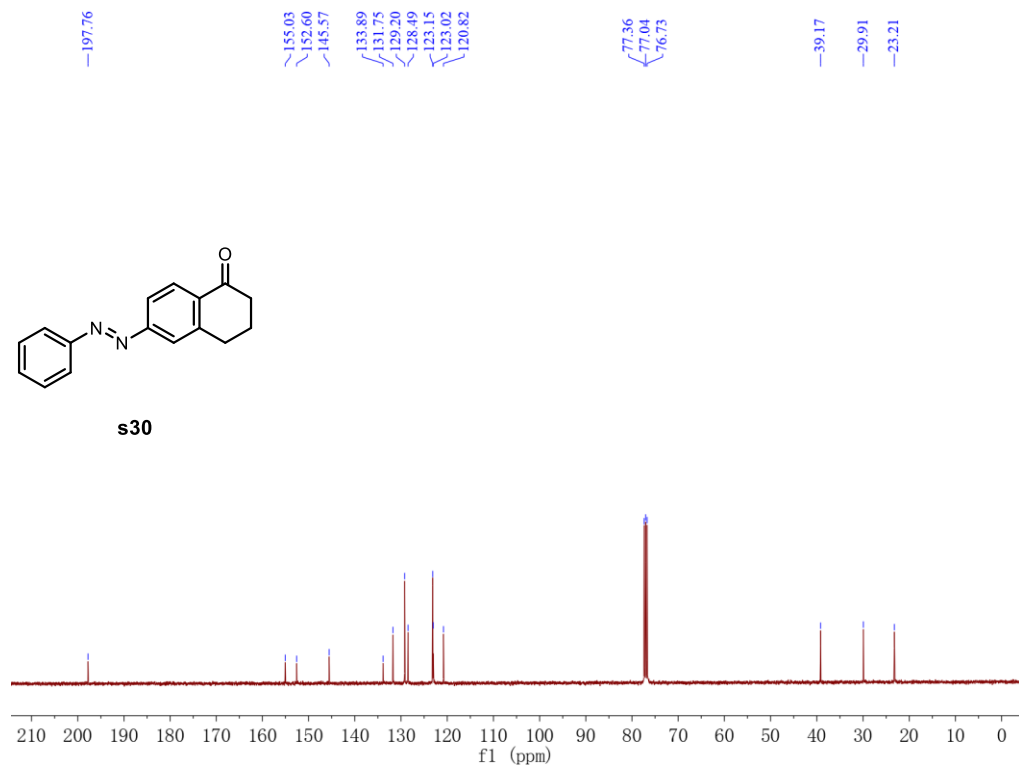
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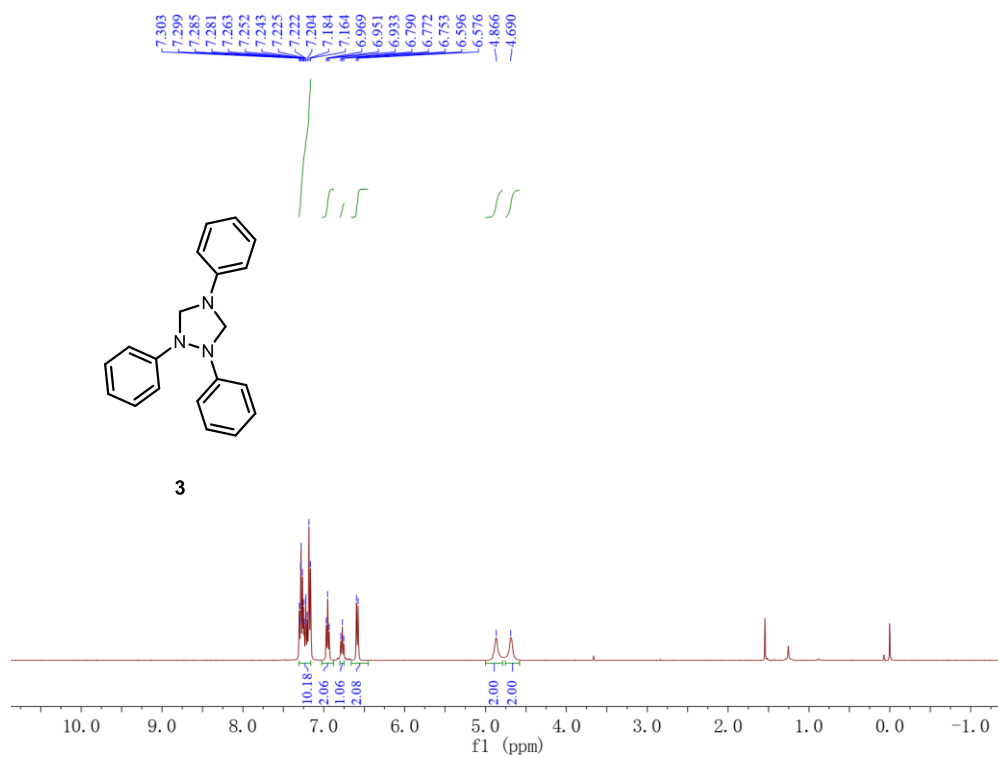
¹H NMR (400 MHz, CDCl₃):



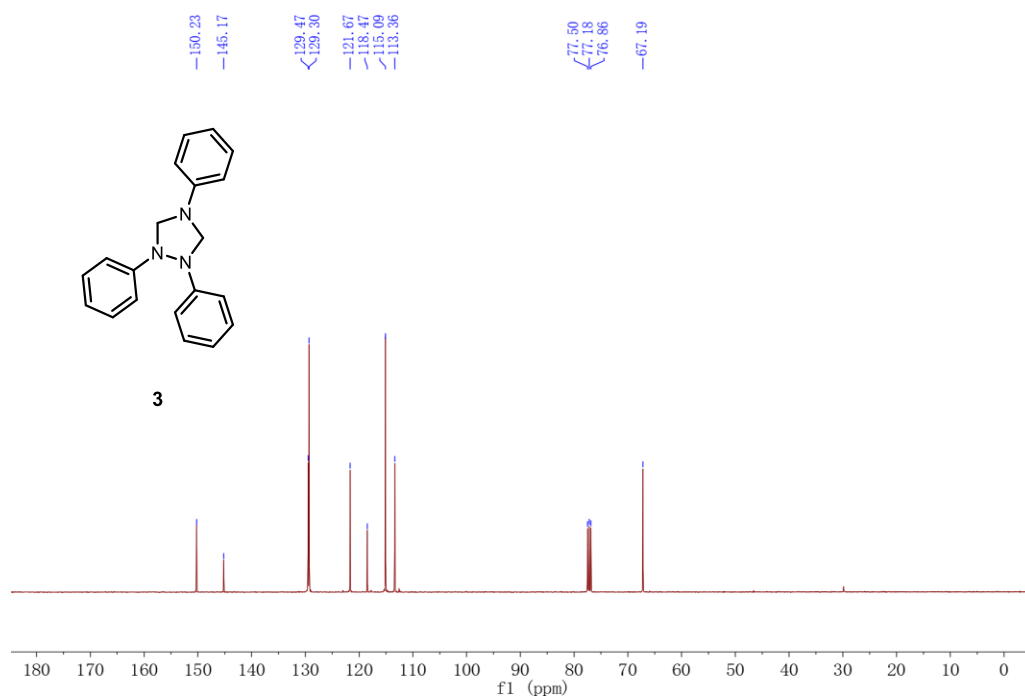
¹³C NMR (101 MHz, CDCl₃):



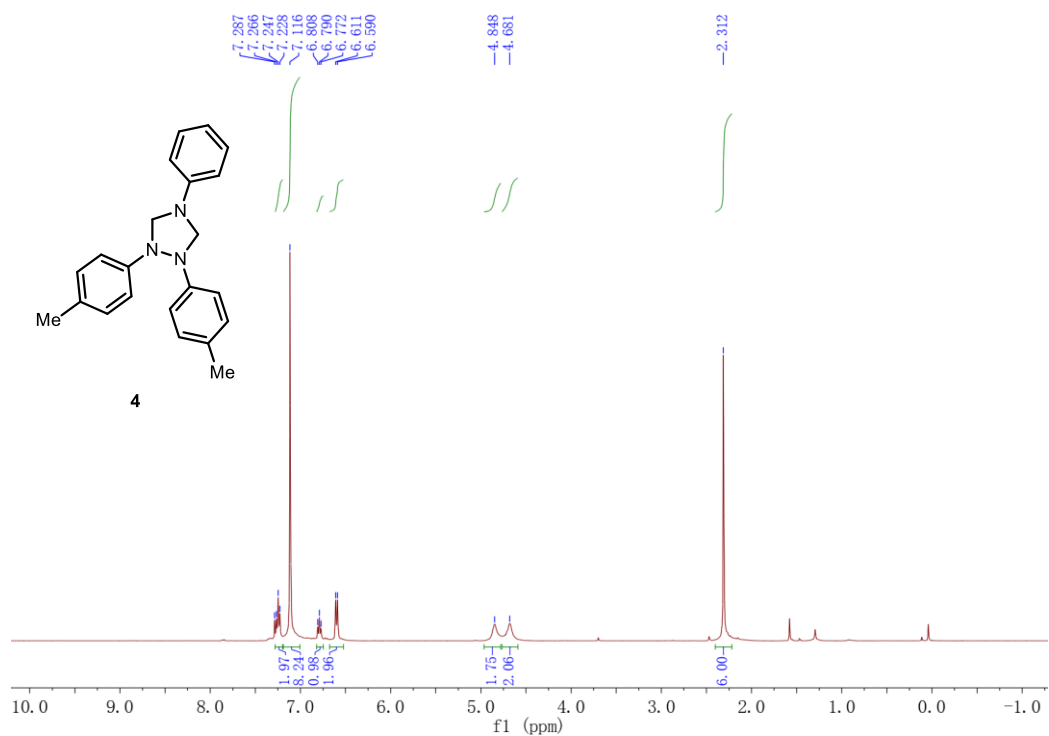
¹H NMR (400 MHz, CDCl₃):



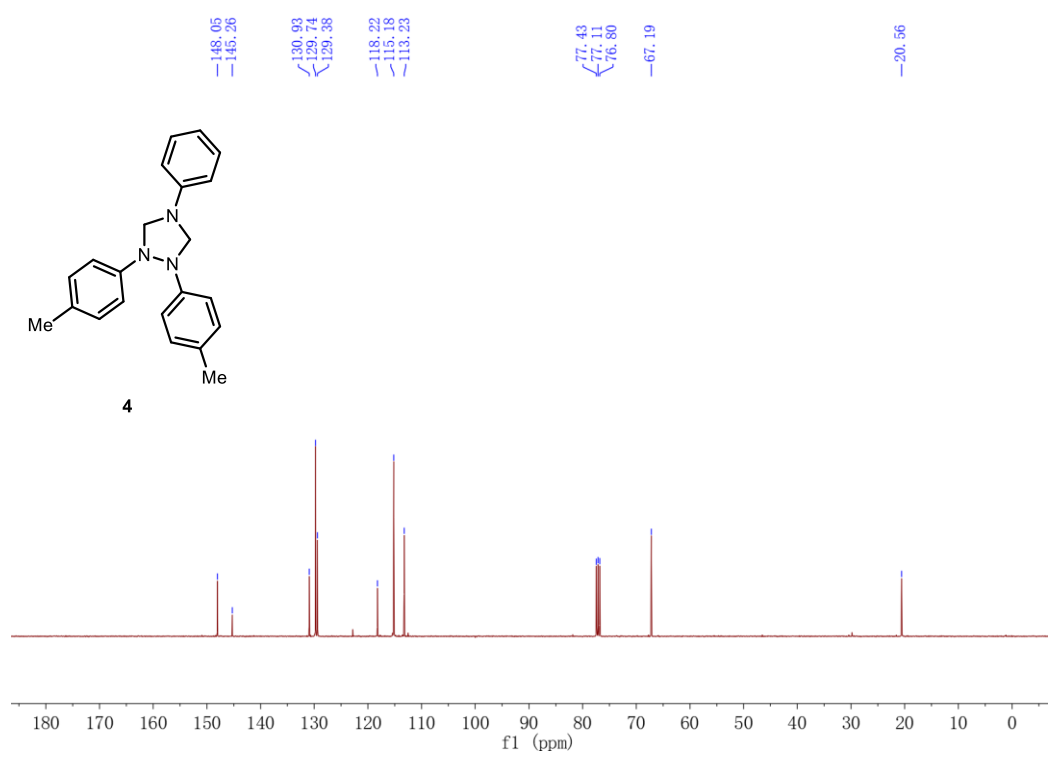
¹³C NMR (101 MHz, CDCl₃):



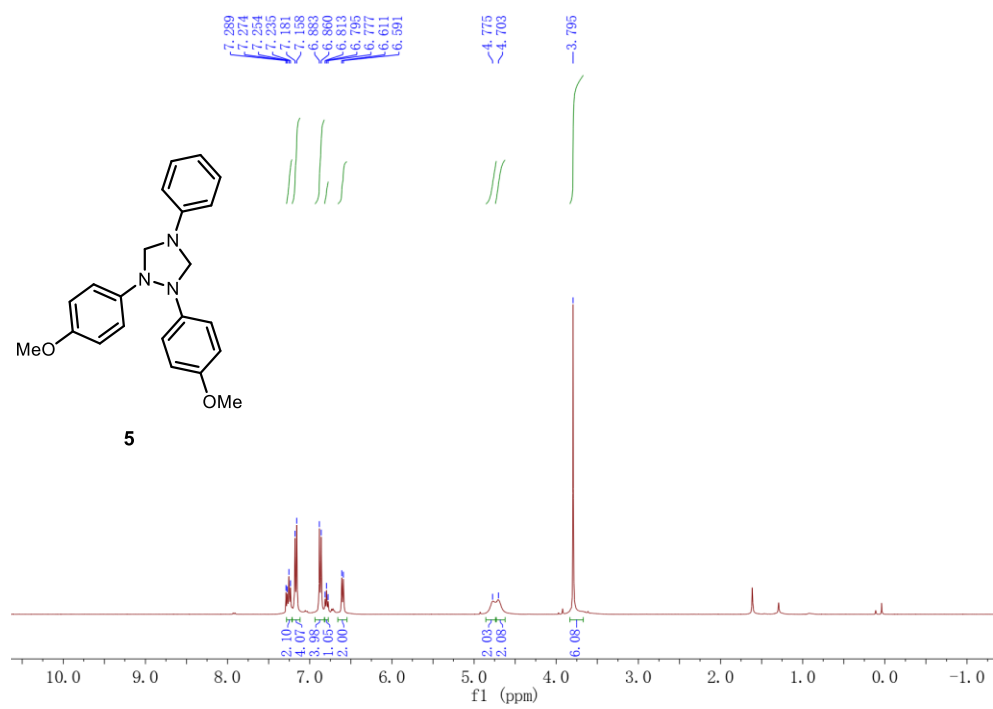
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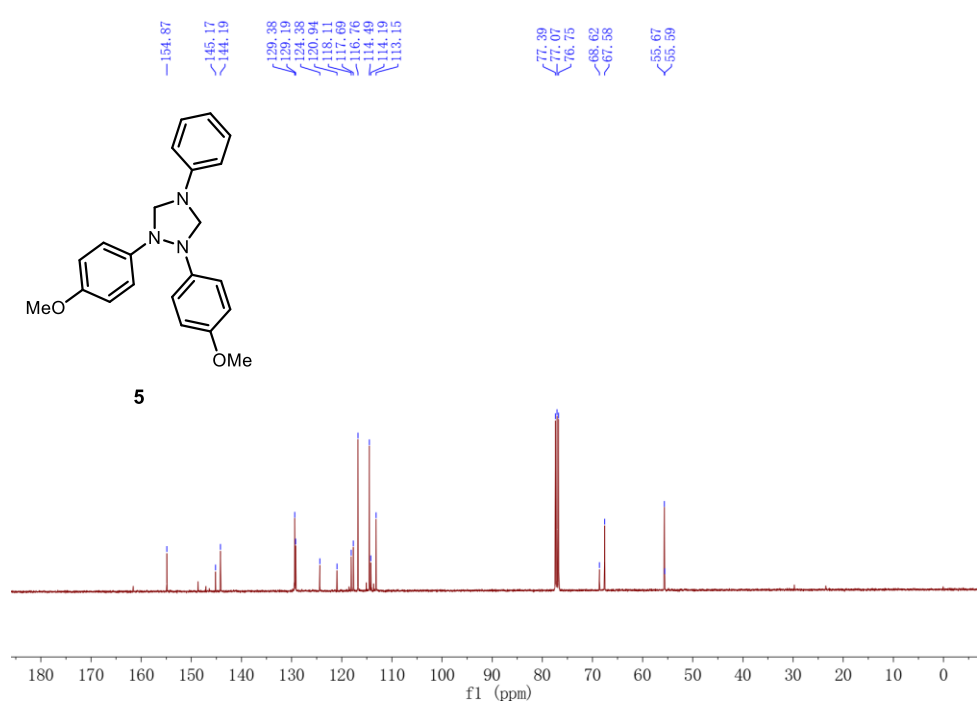
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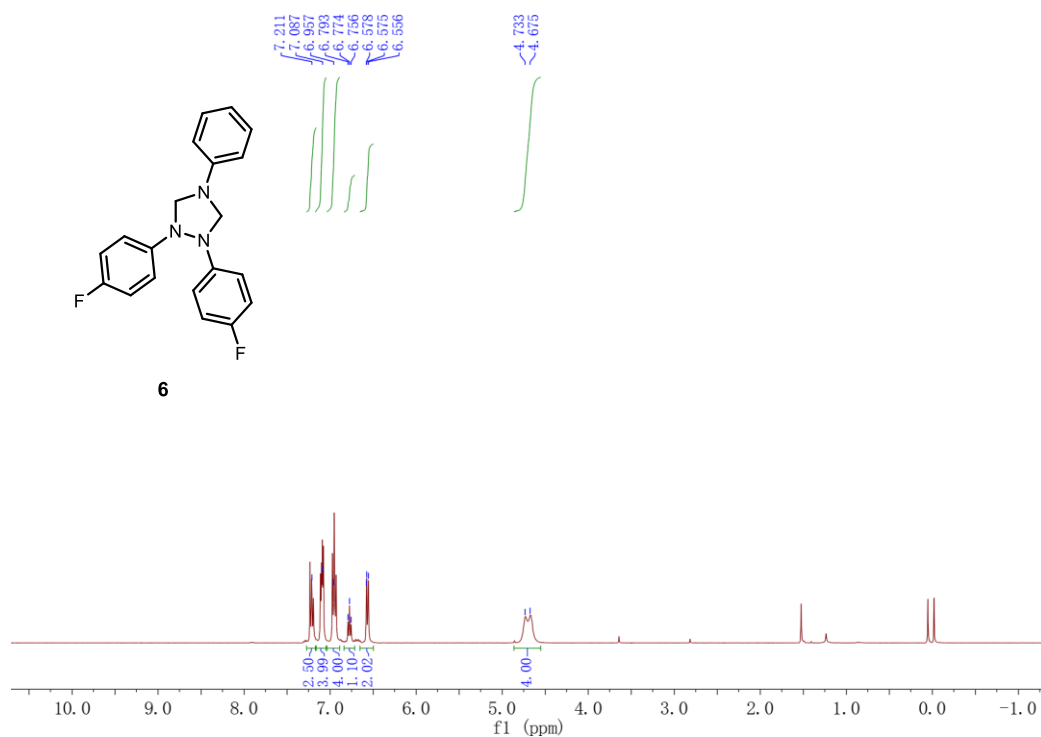
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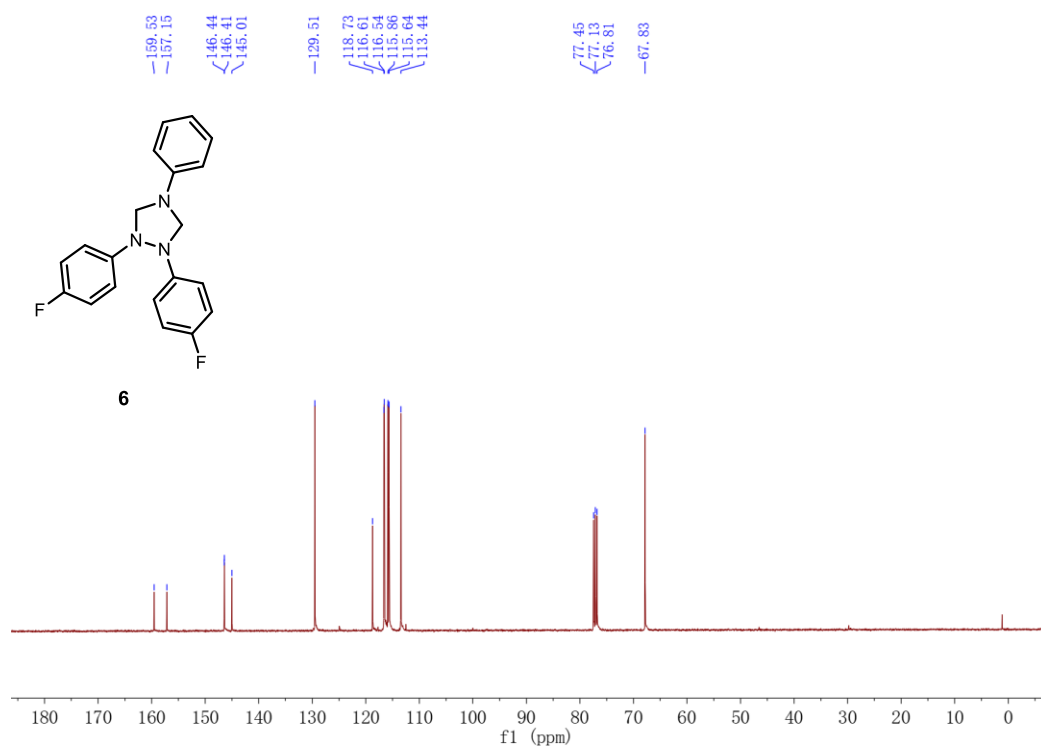
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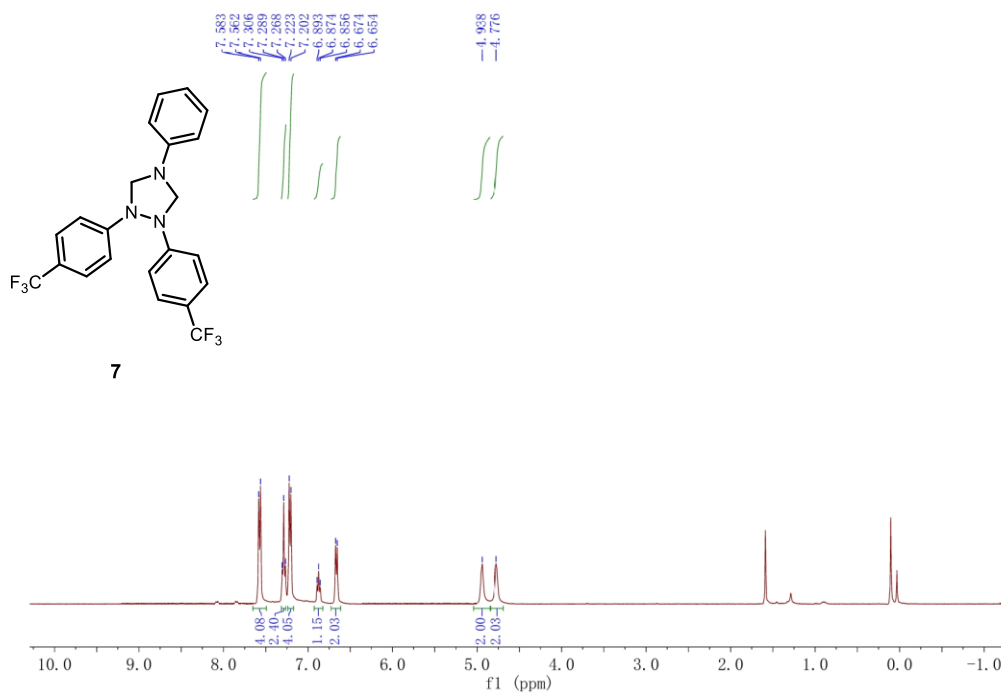
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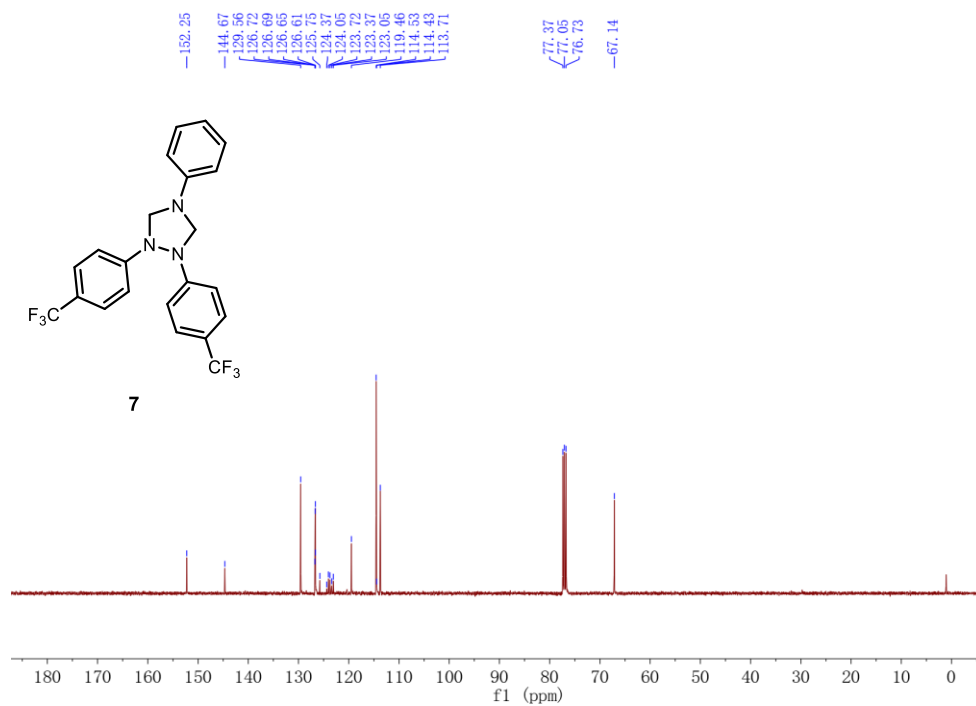
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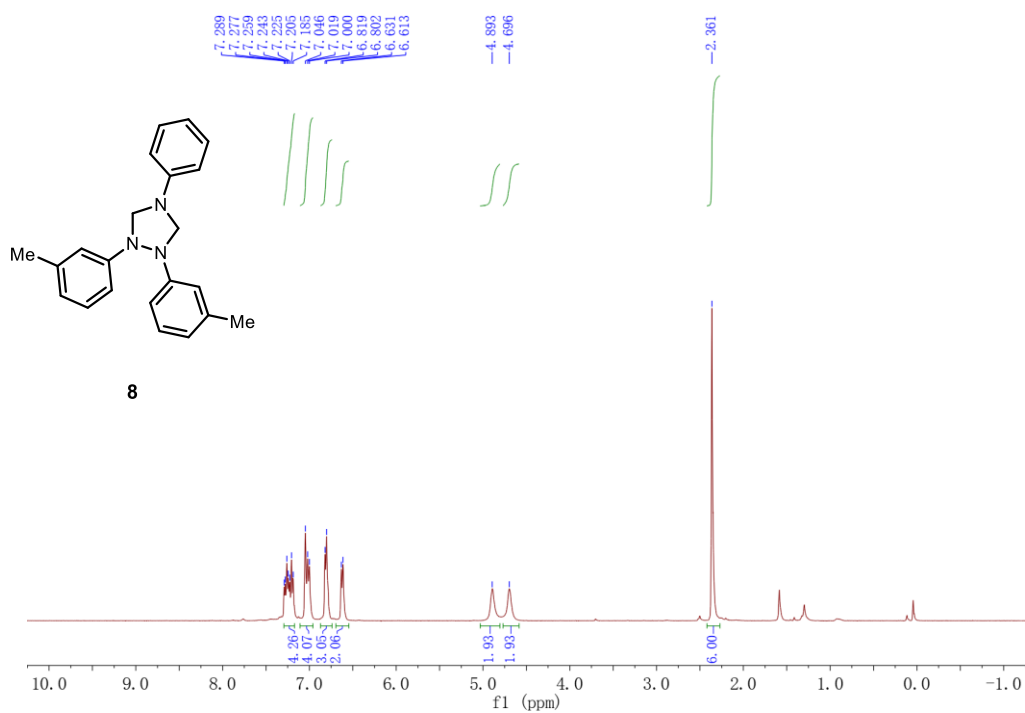
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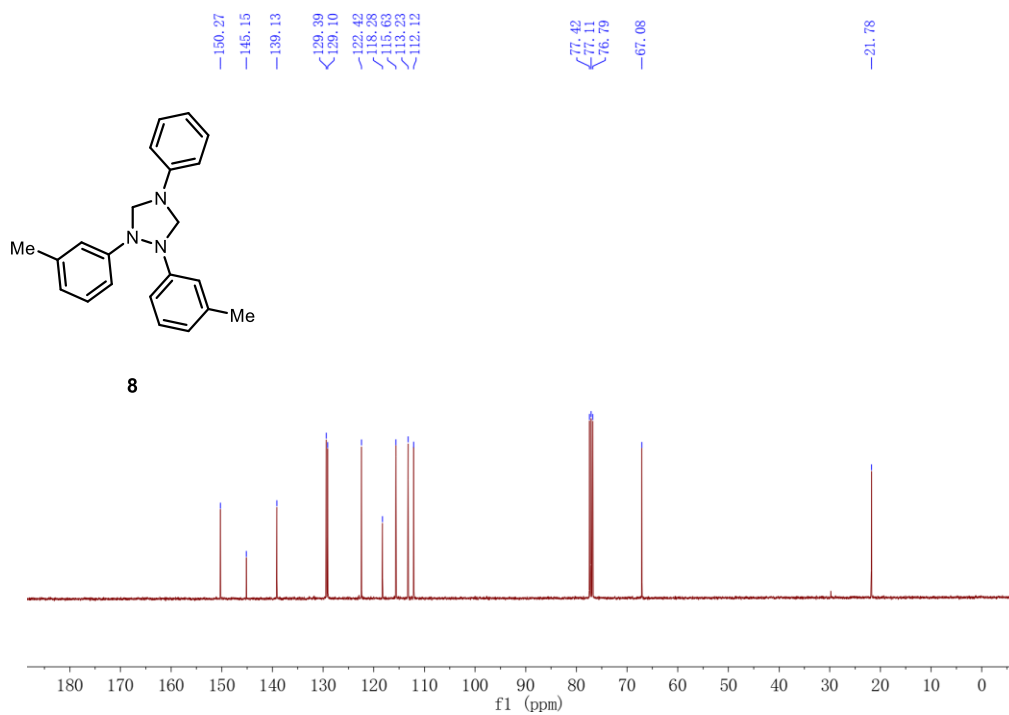
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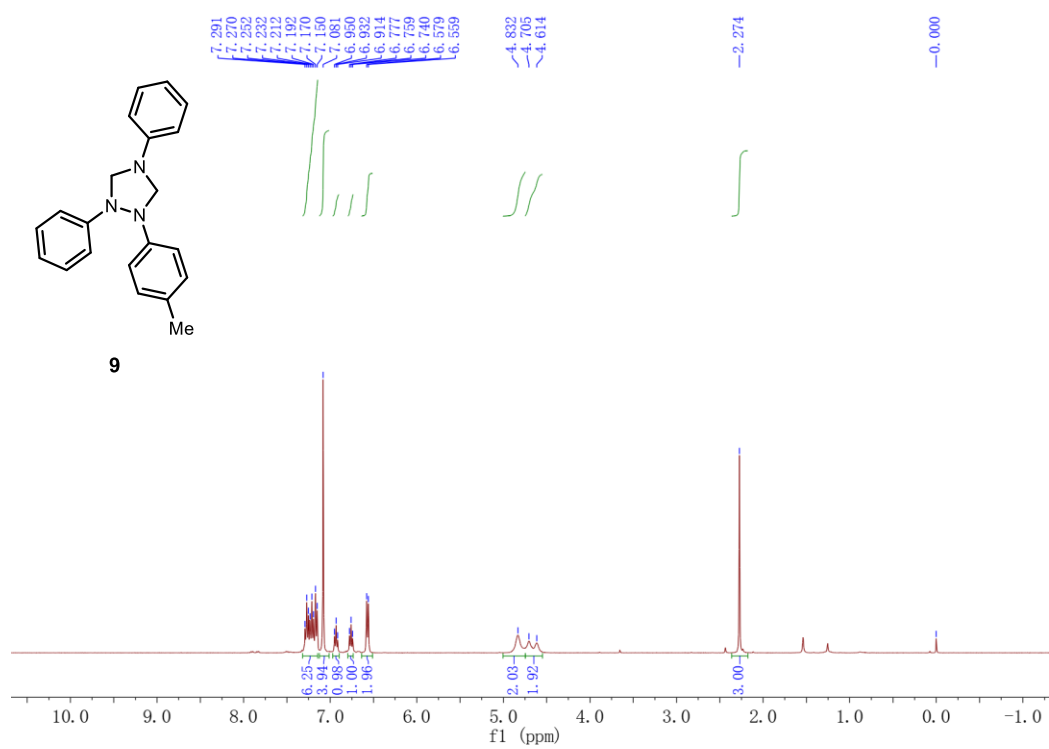
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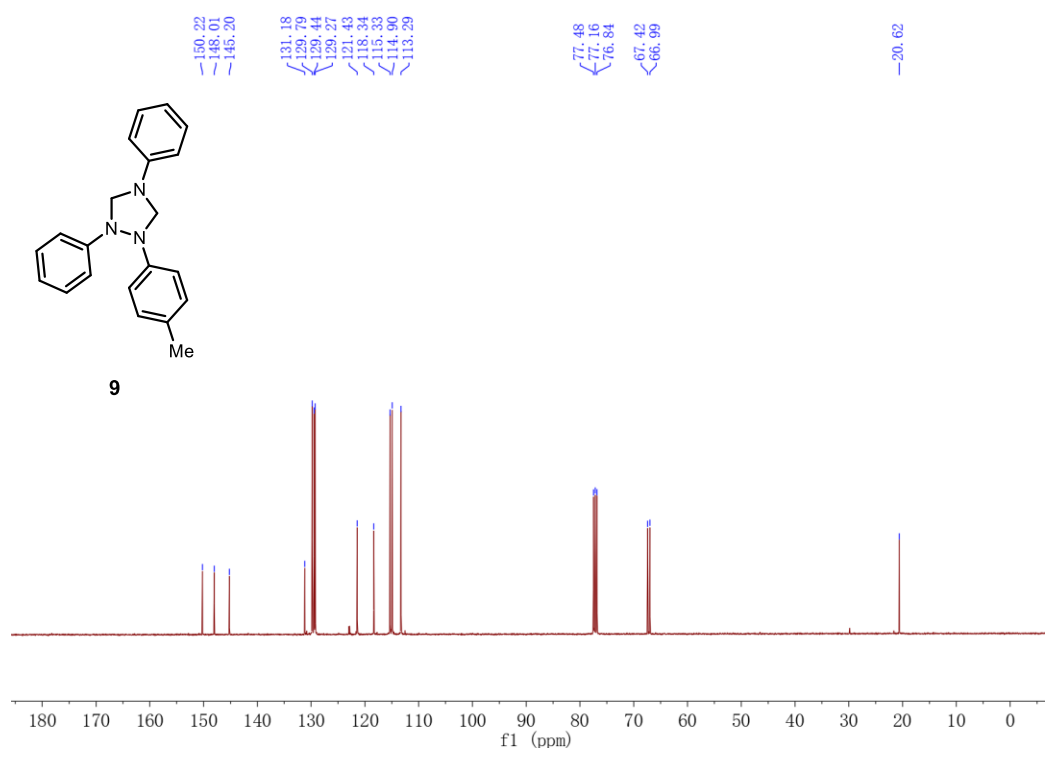
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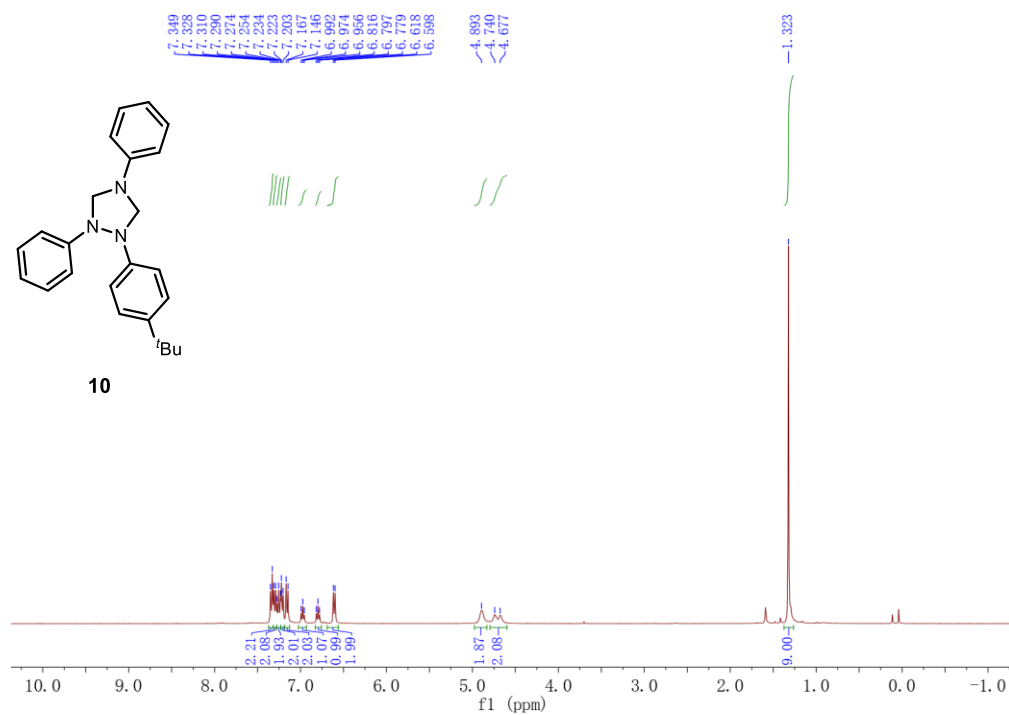
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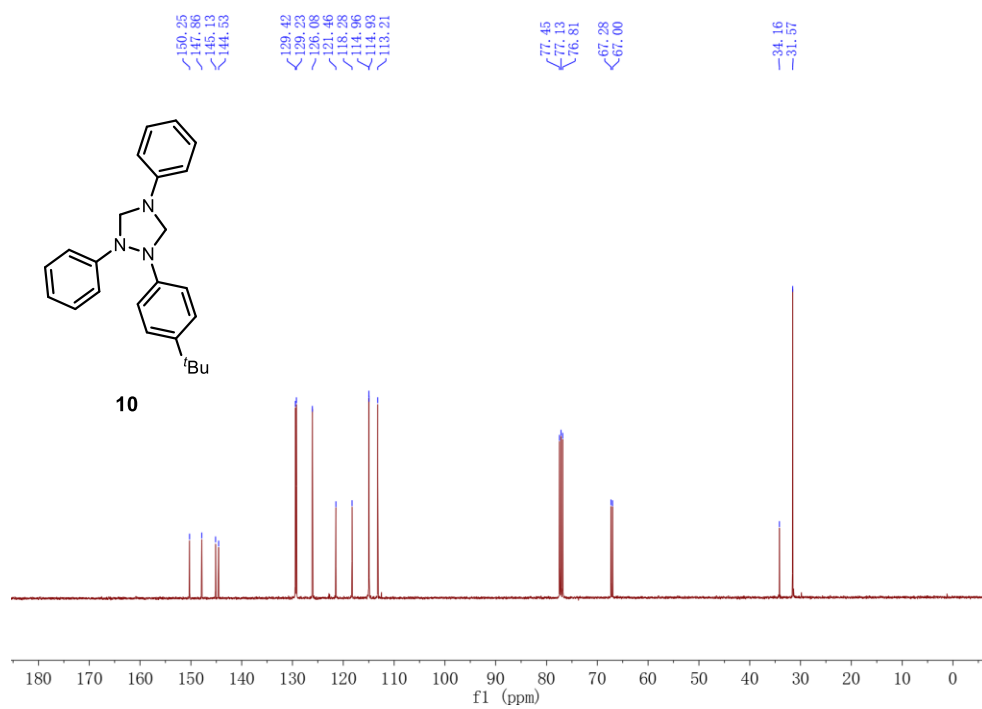
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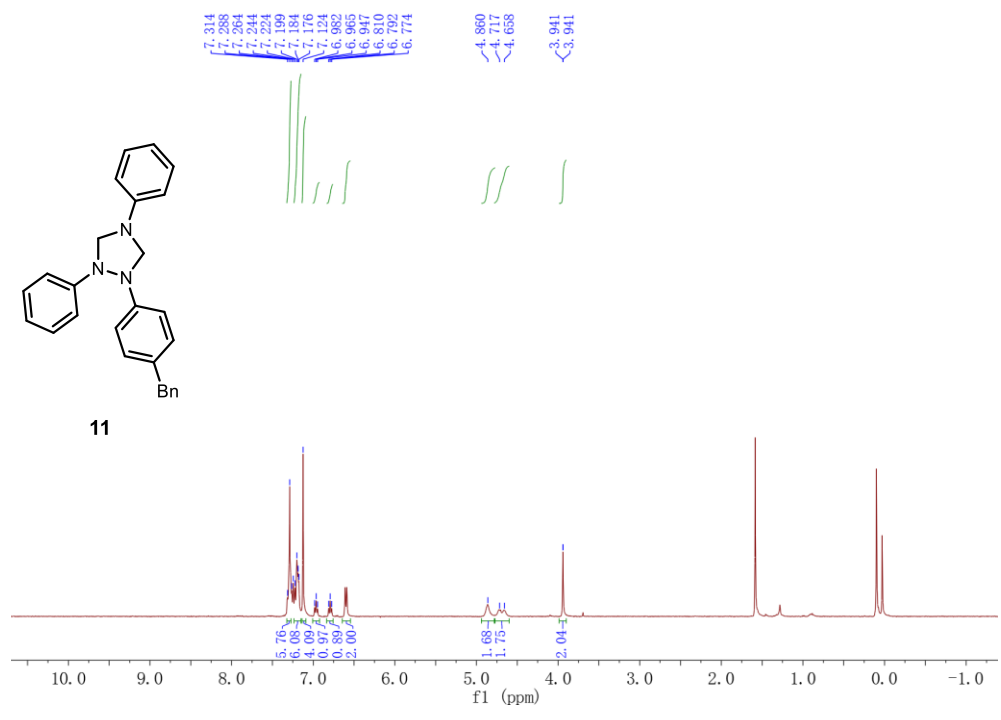
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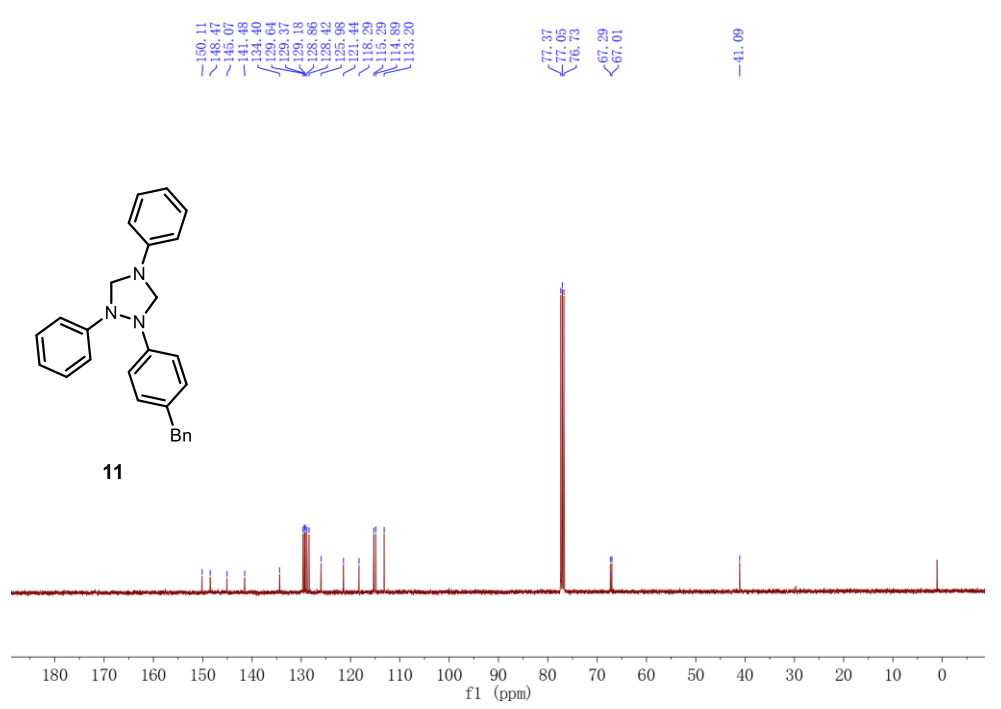
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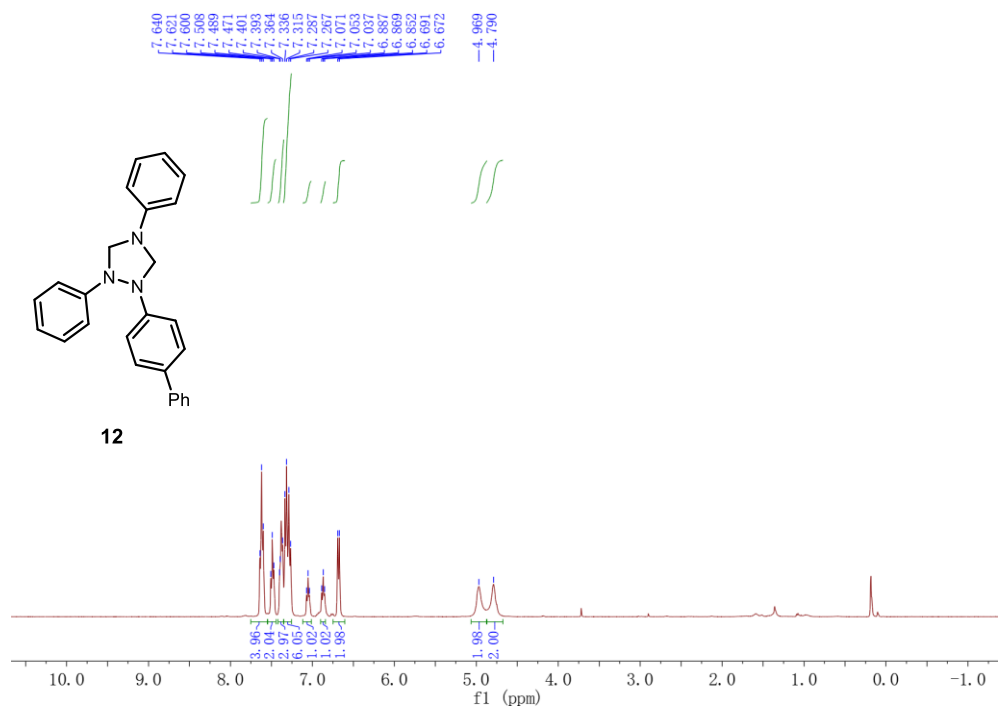
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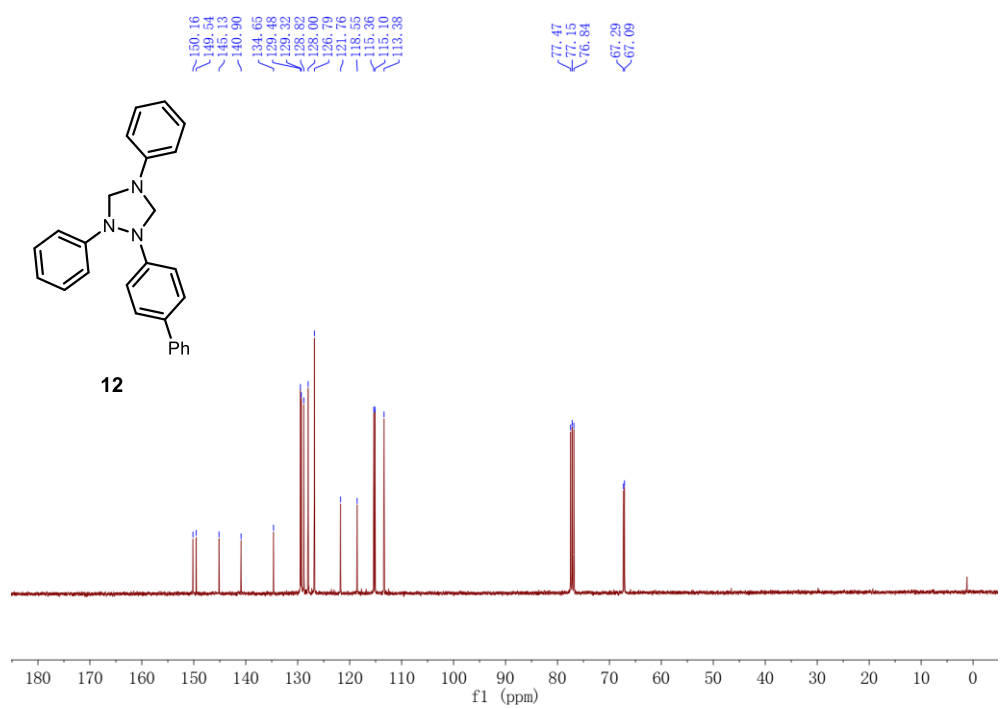
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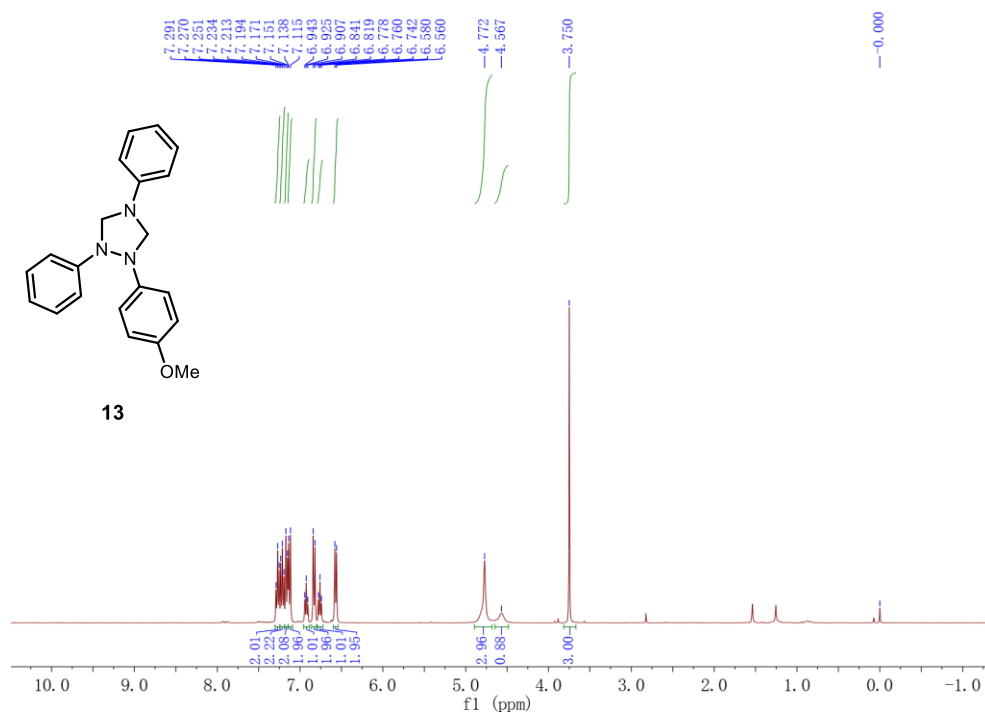
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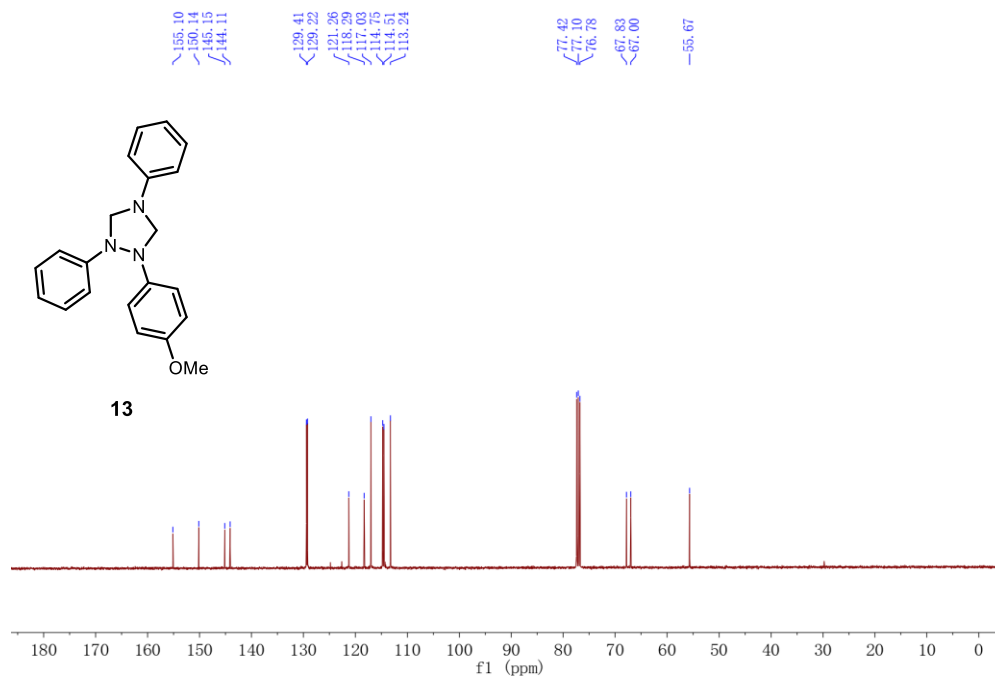
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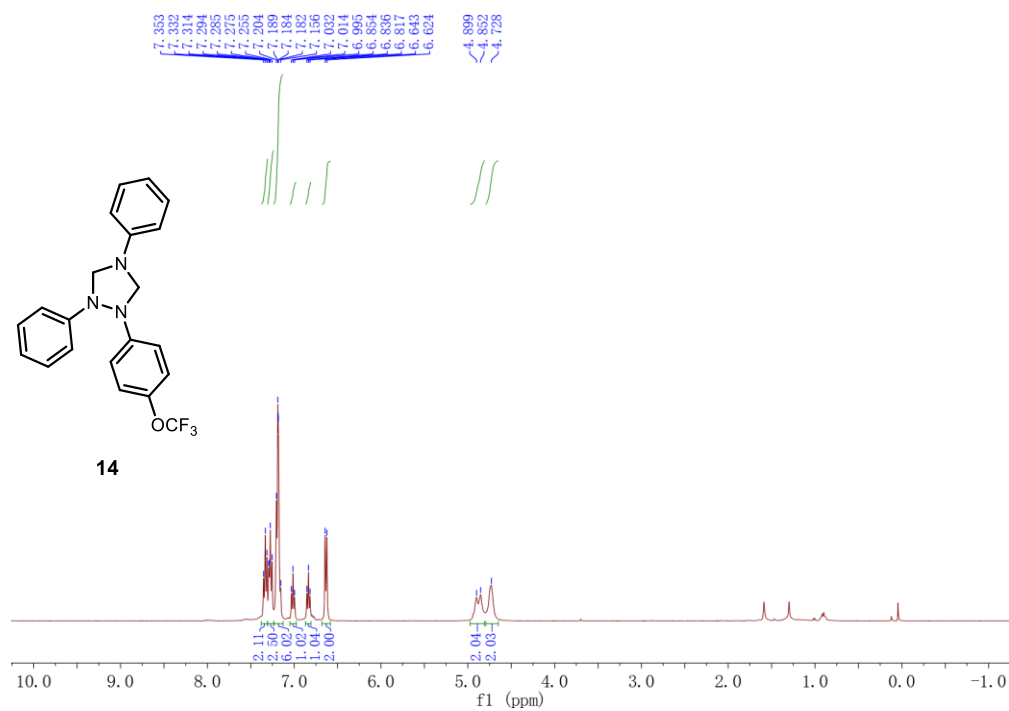
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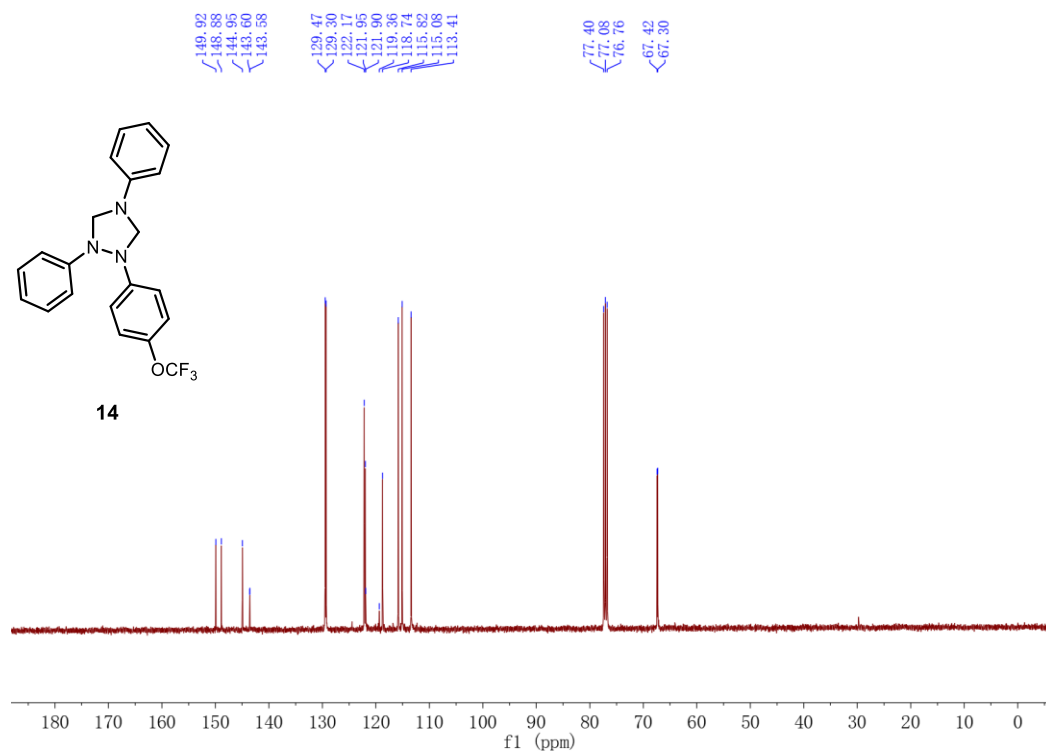
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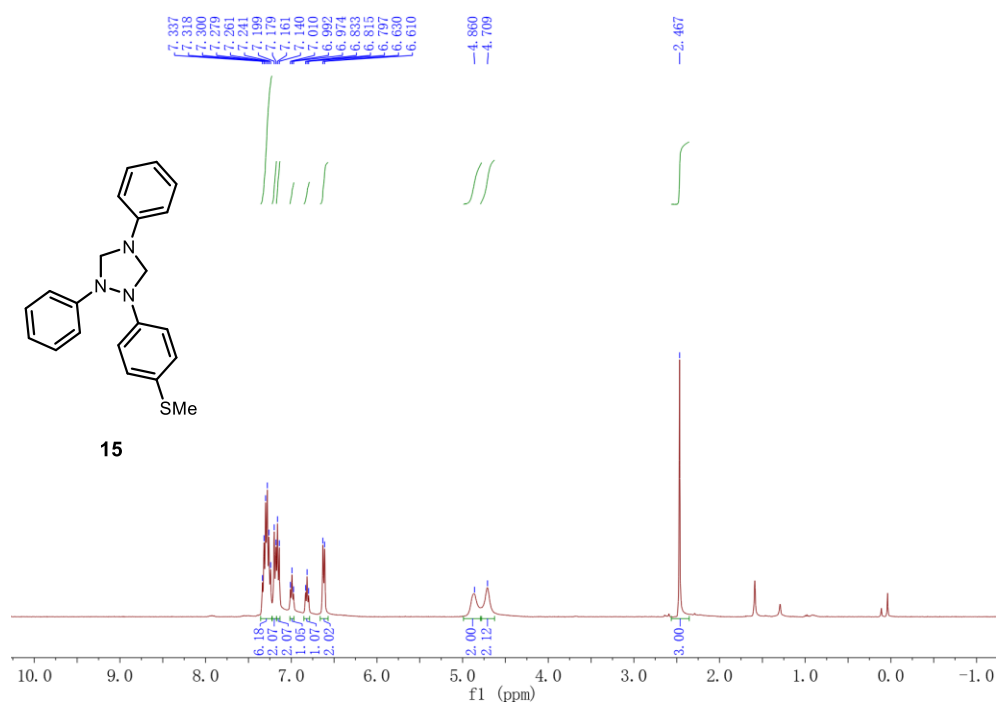
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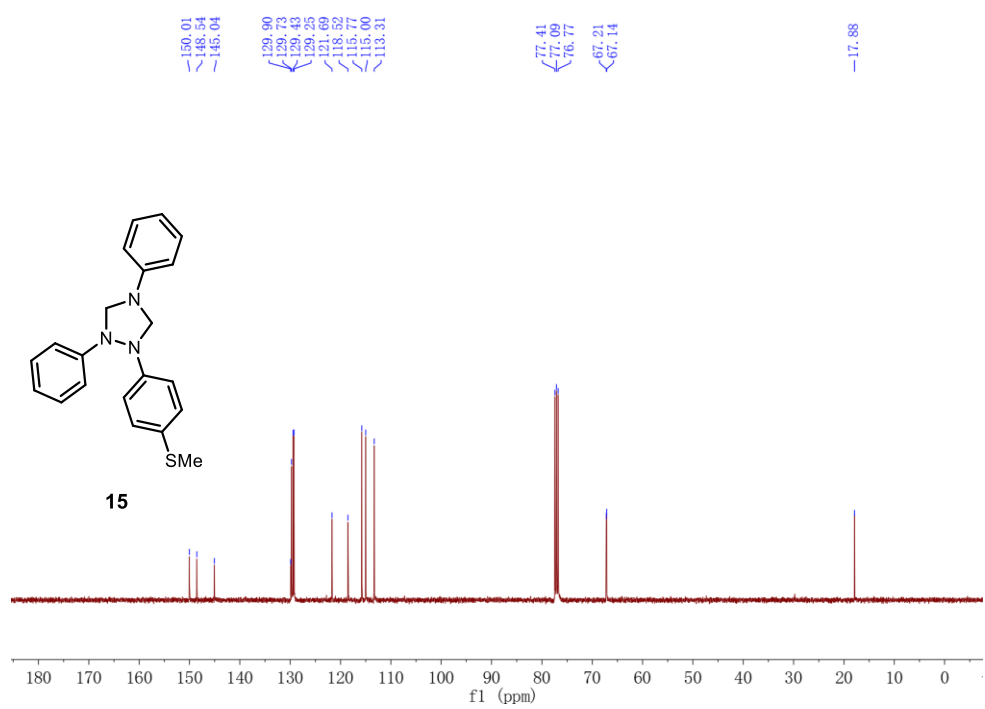
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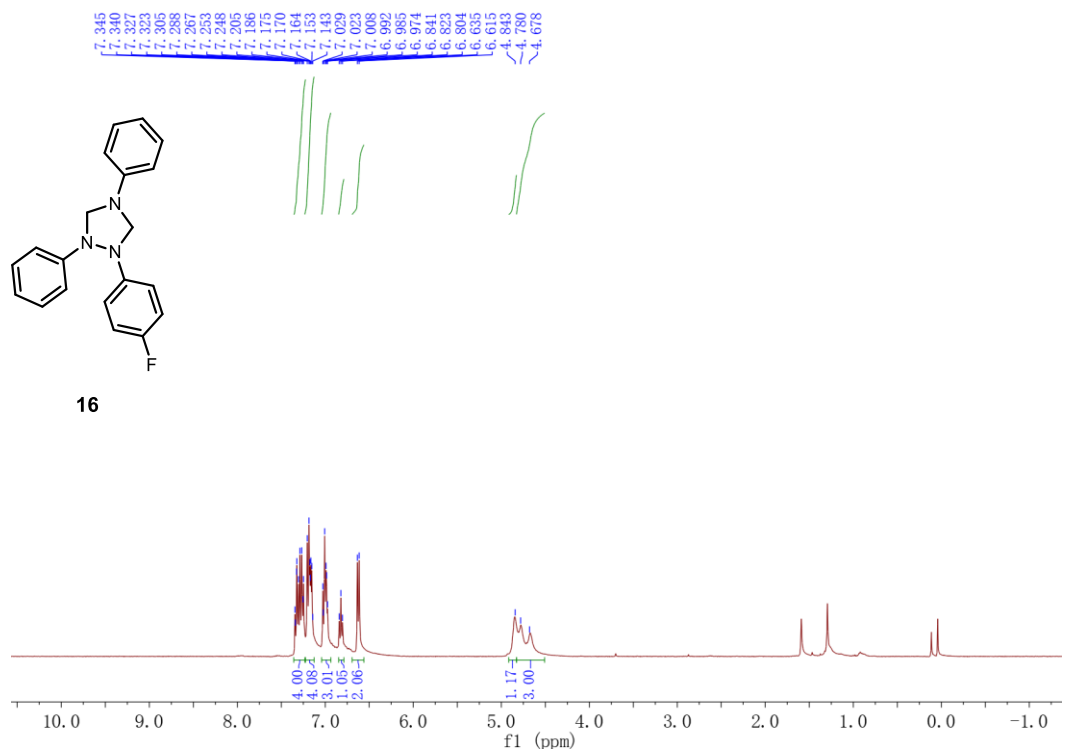
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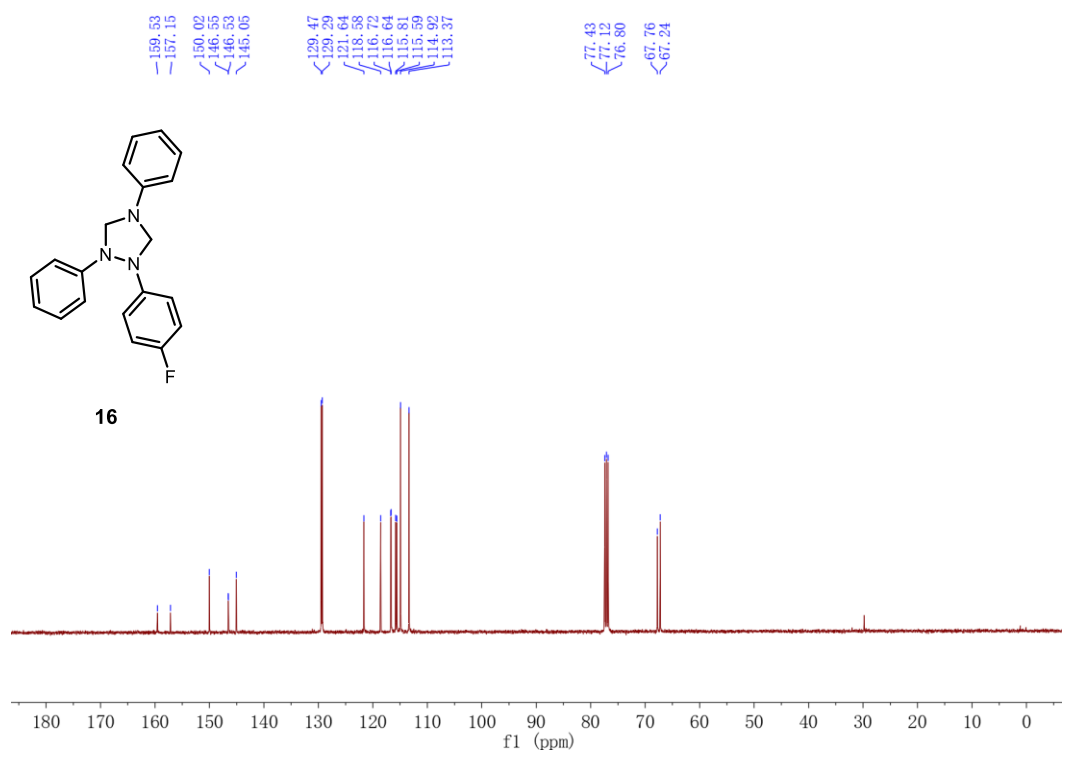
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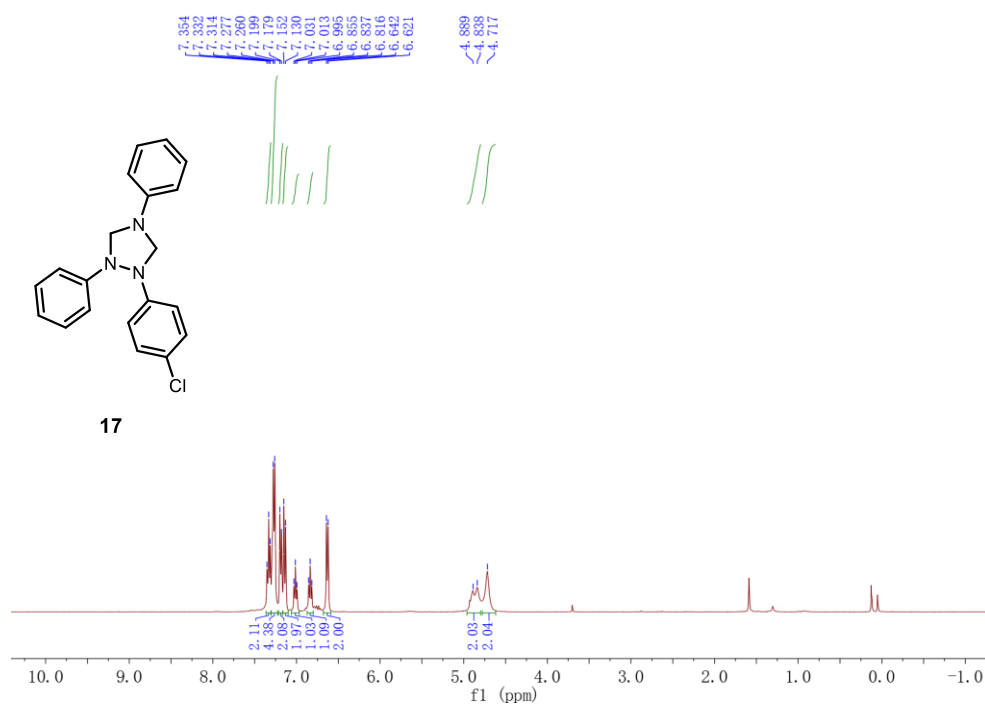
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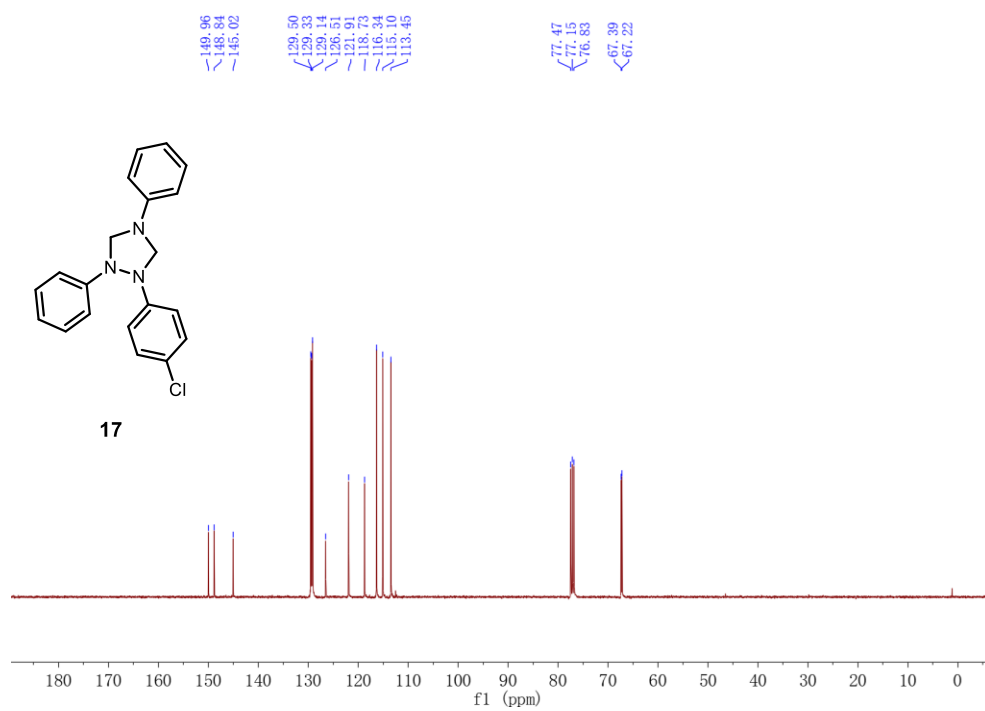
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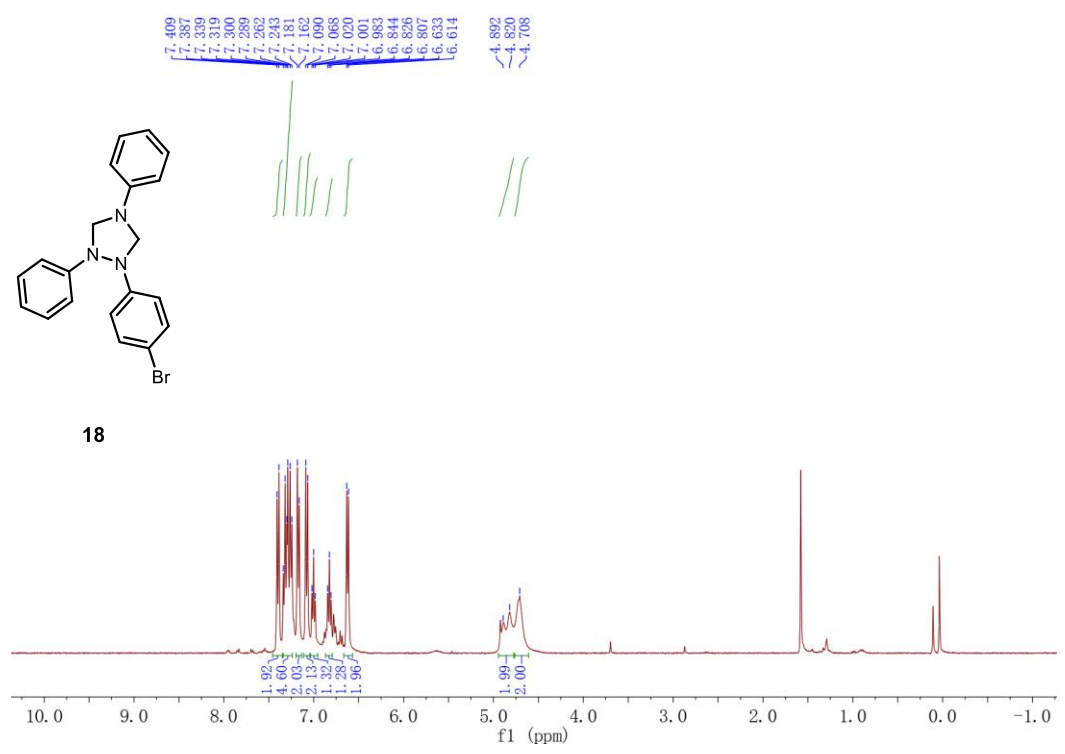
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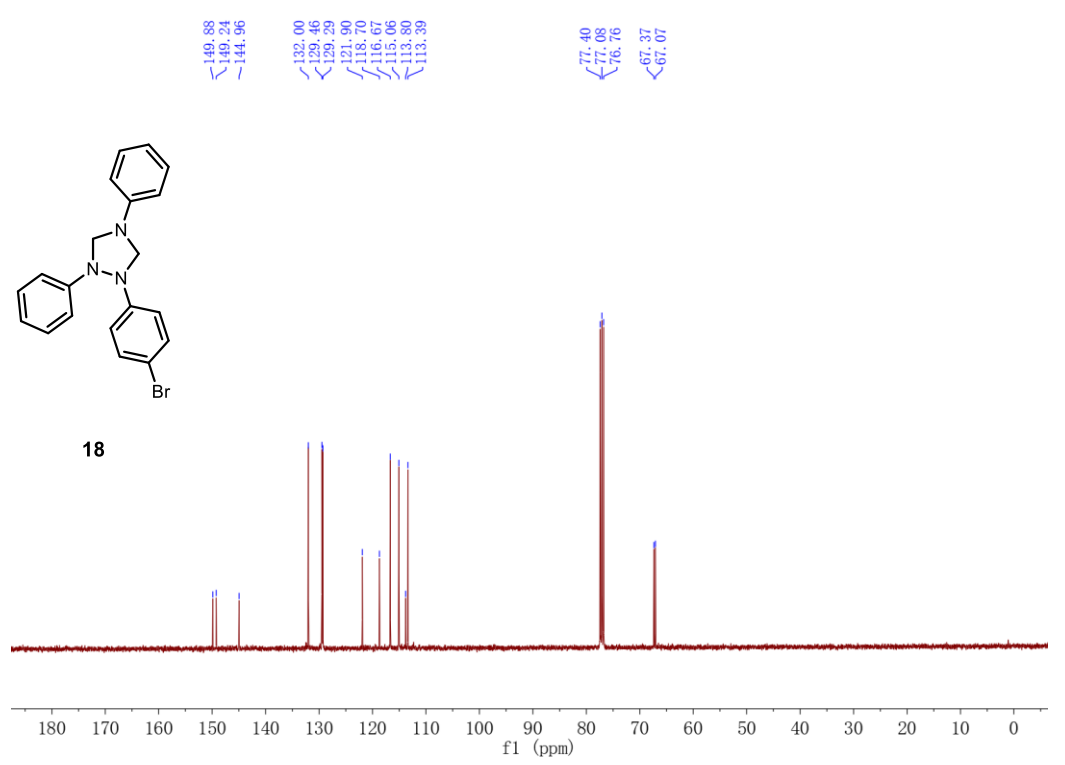
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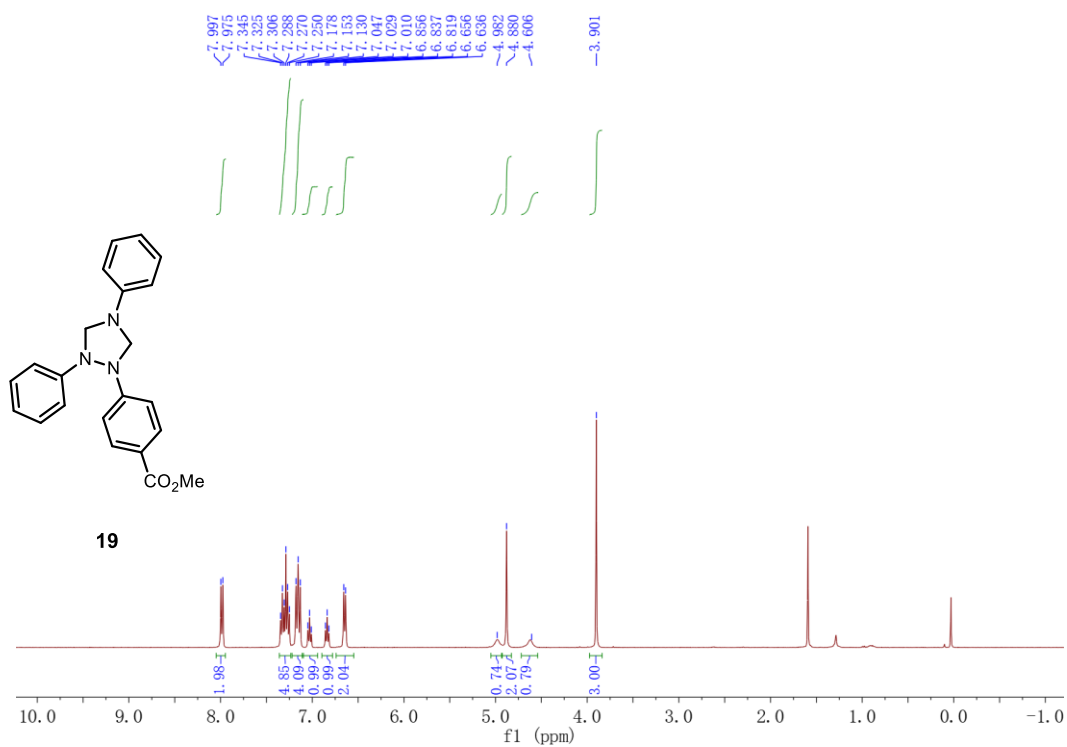
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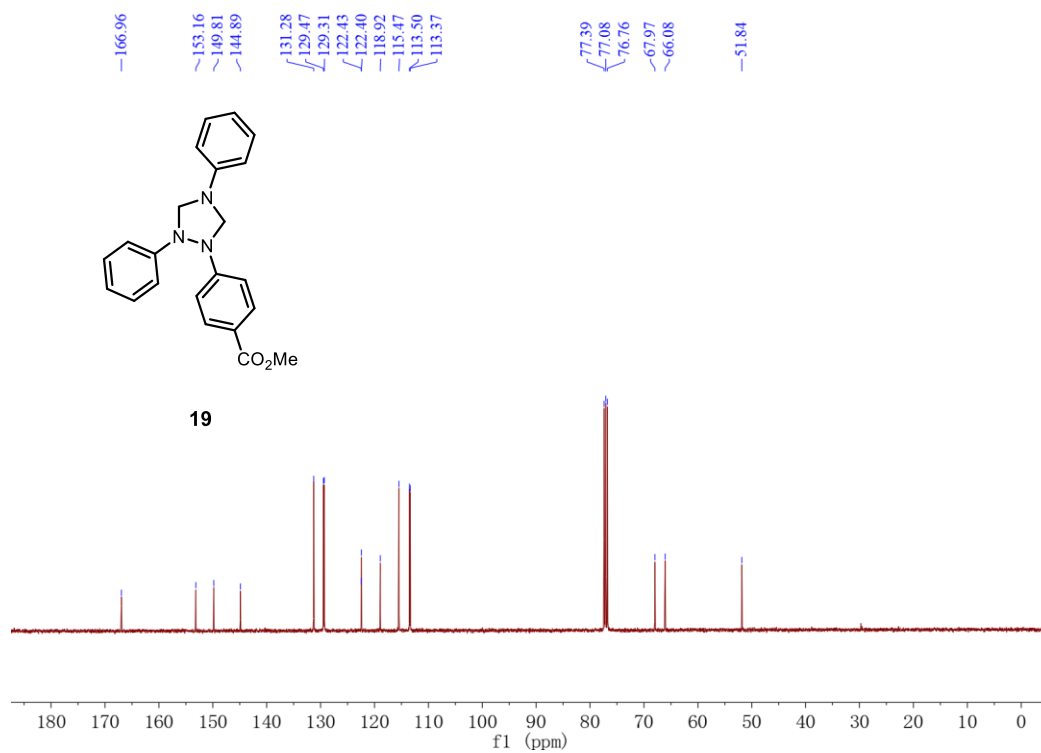
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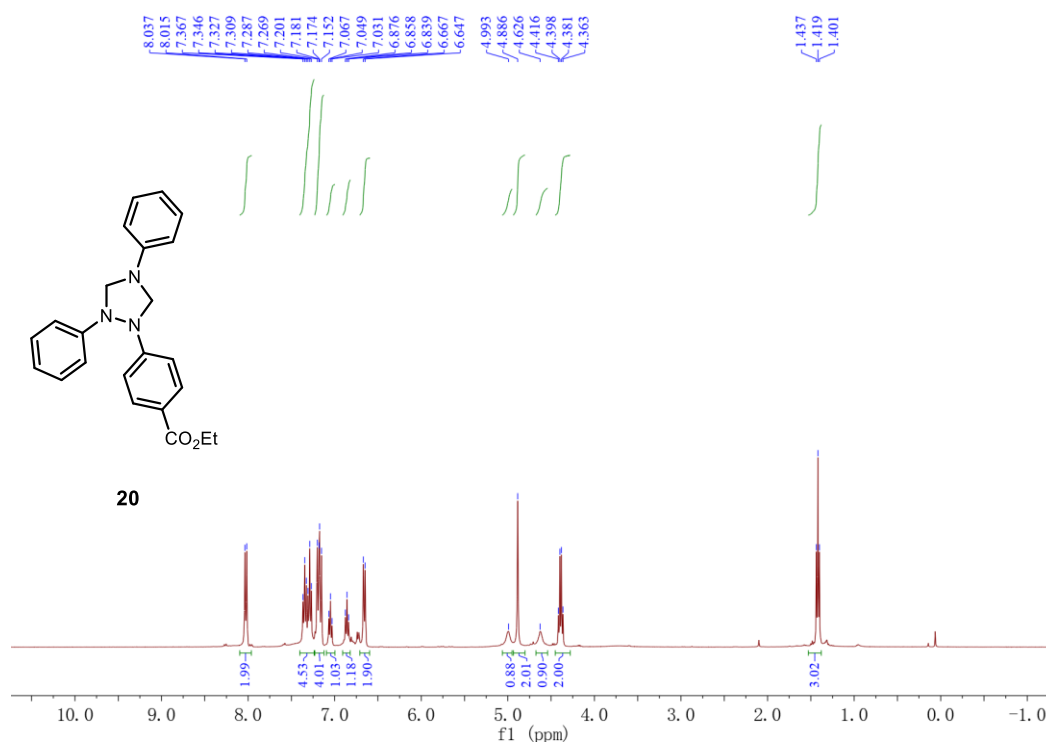
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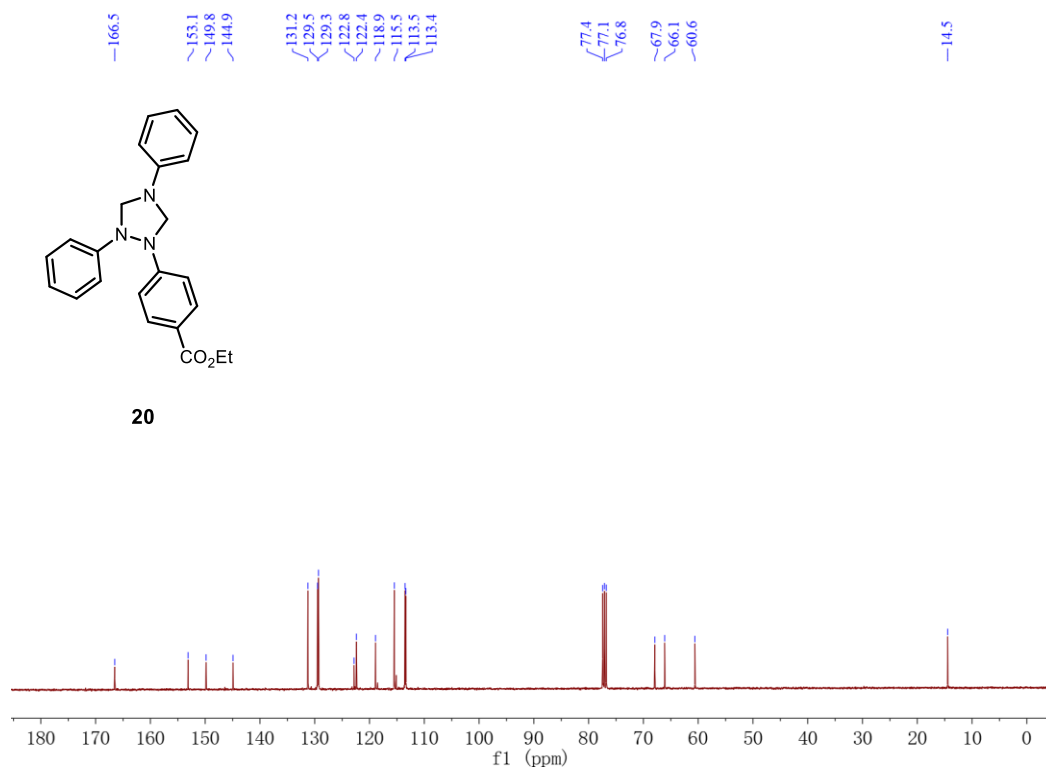
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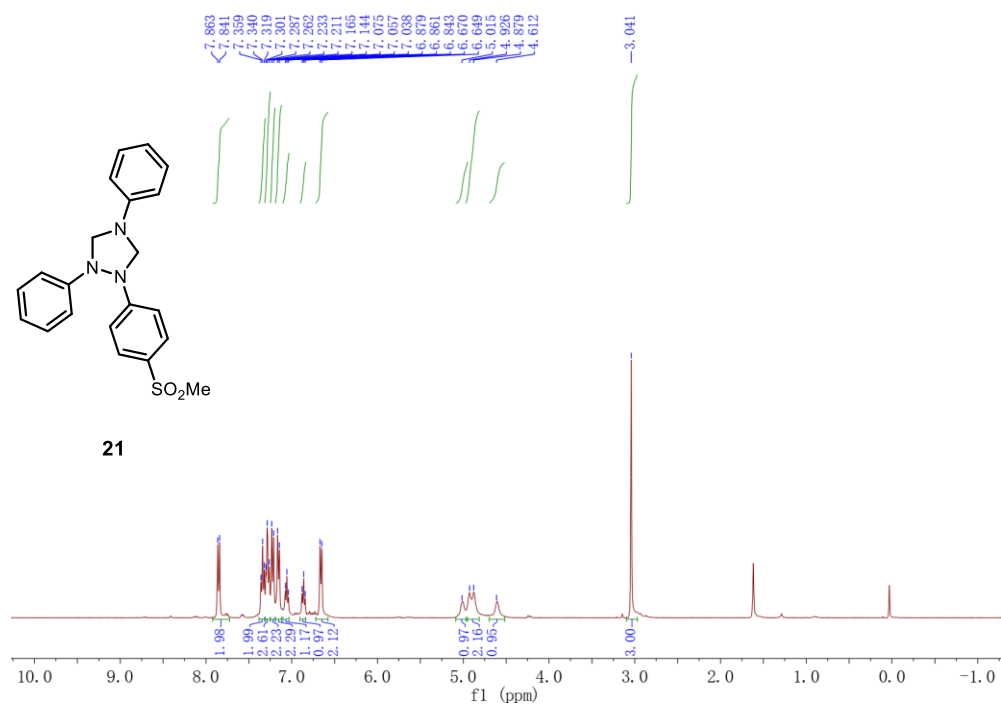
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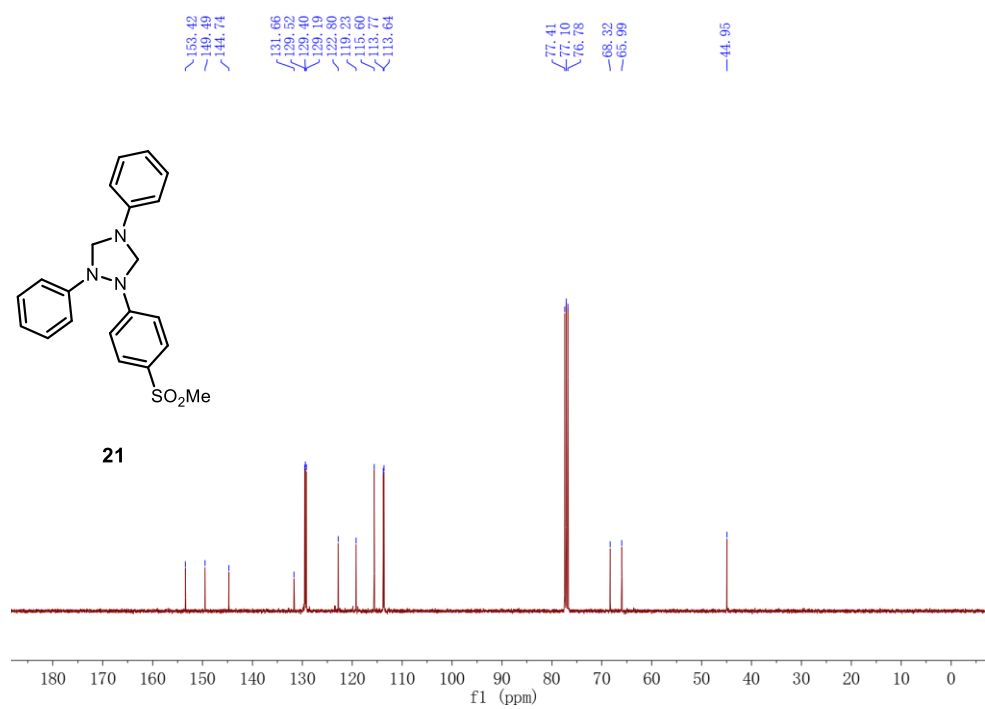
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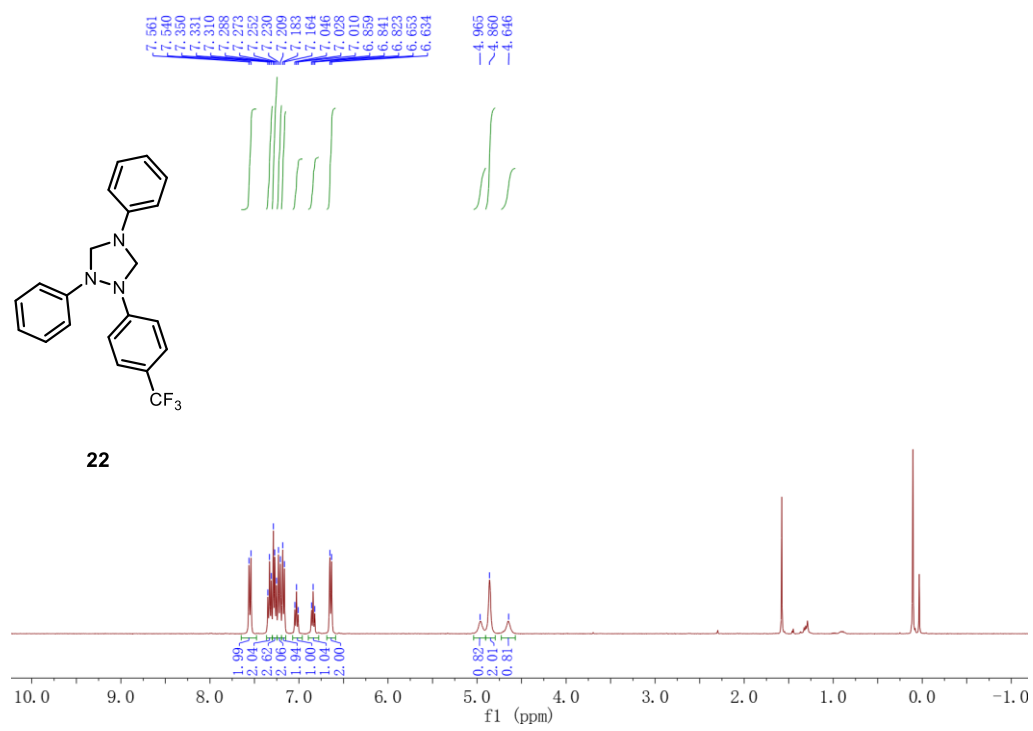
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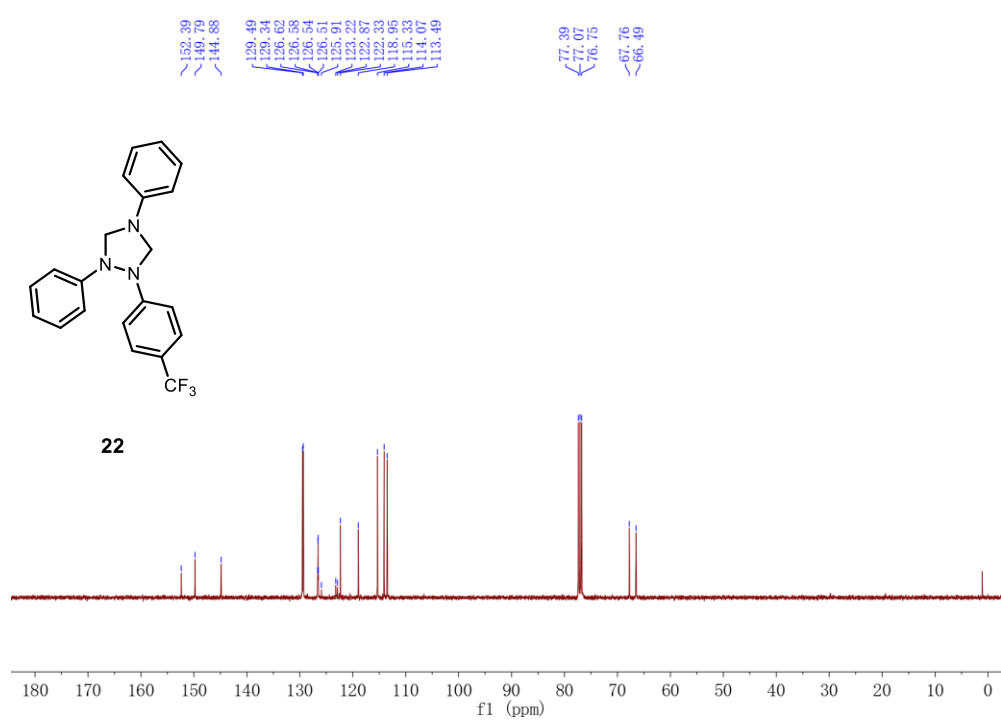
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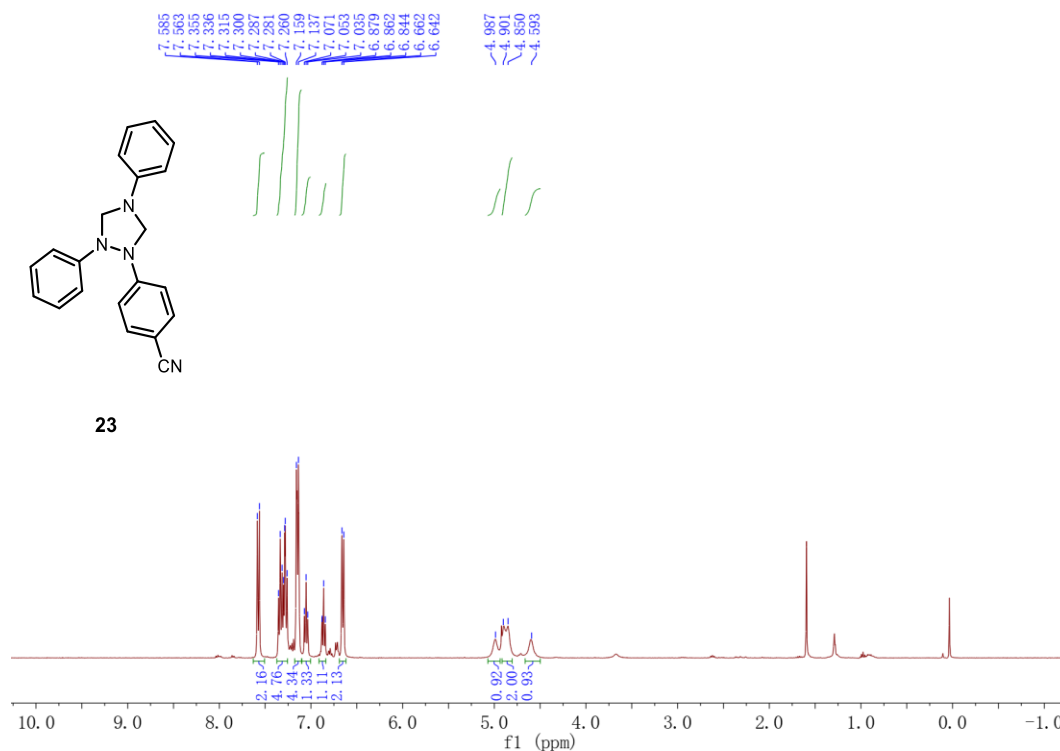
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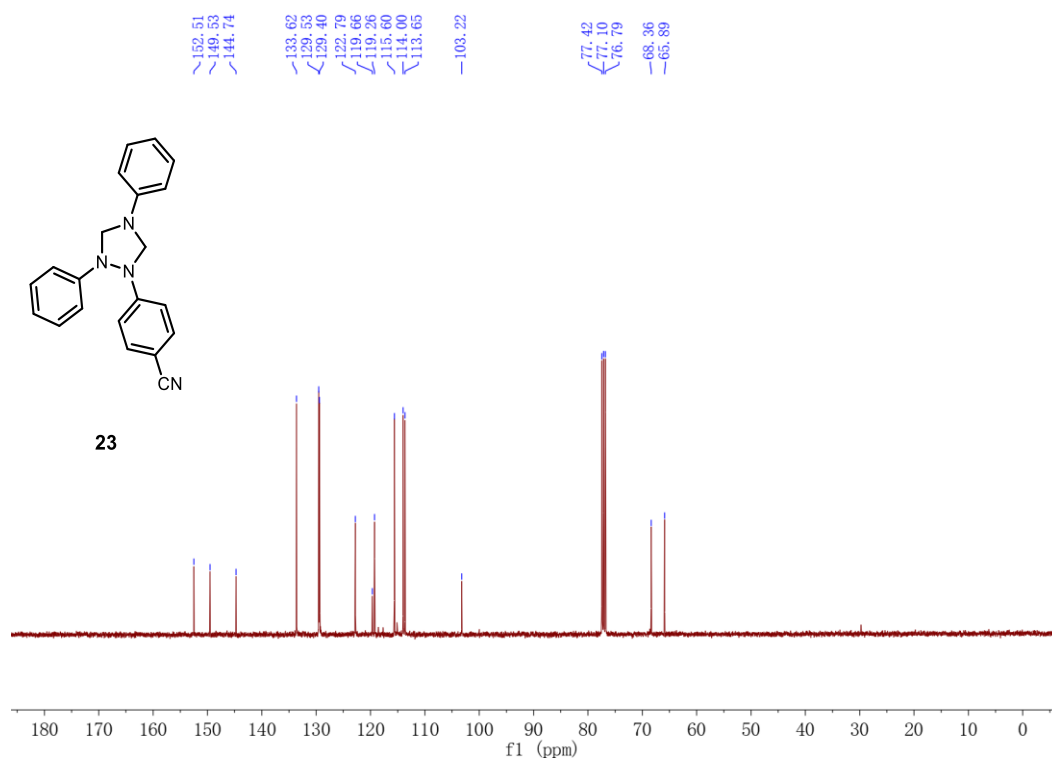
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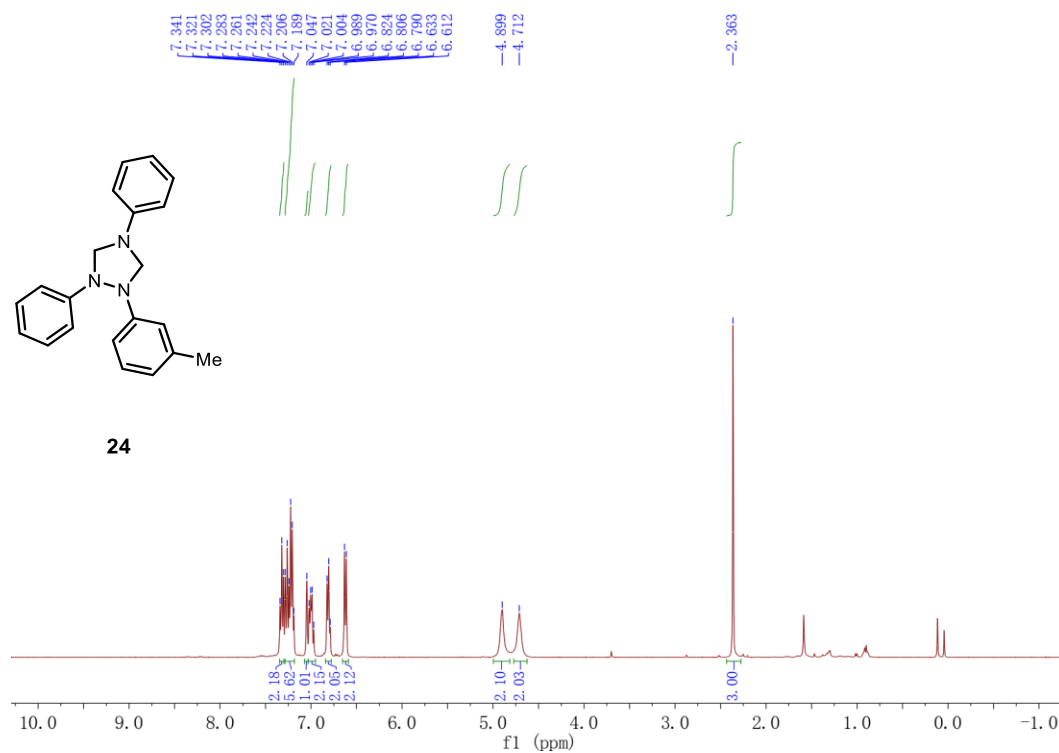
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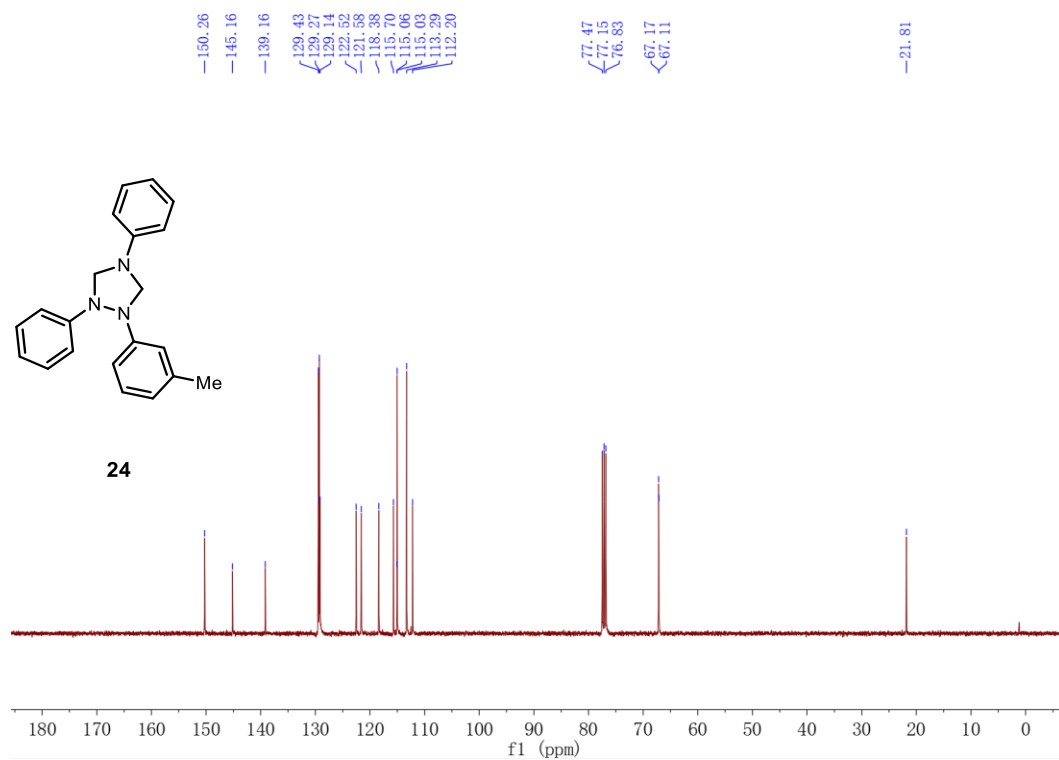
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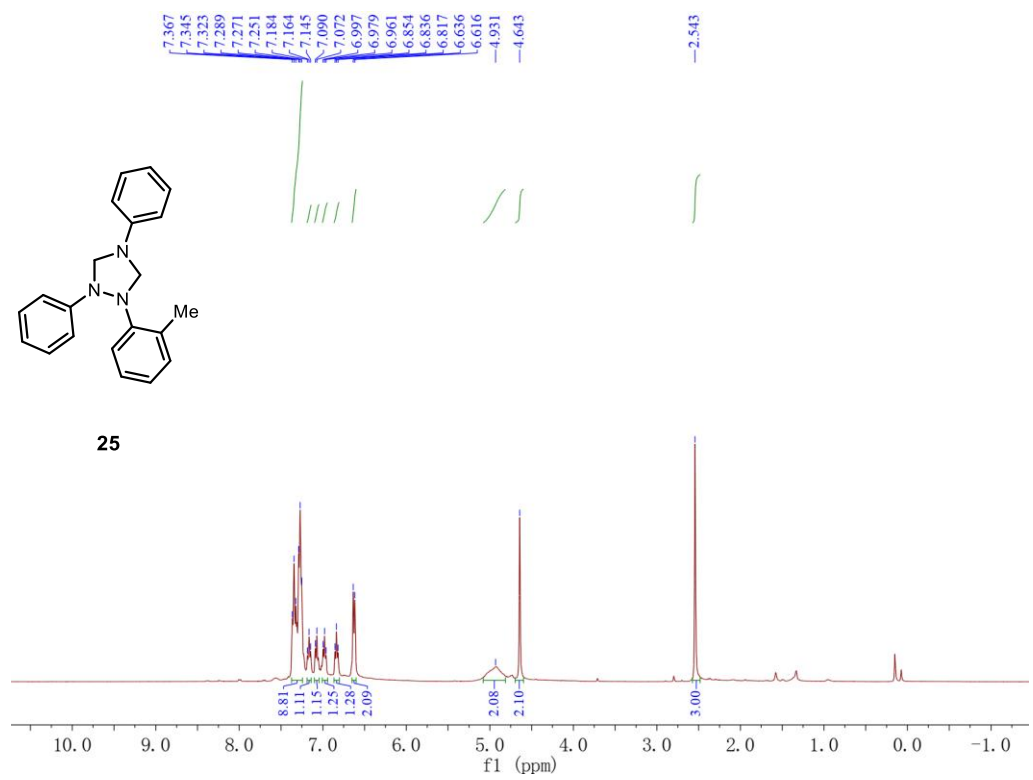
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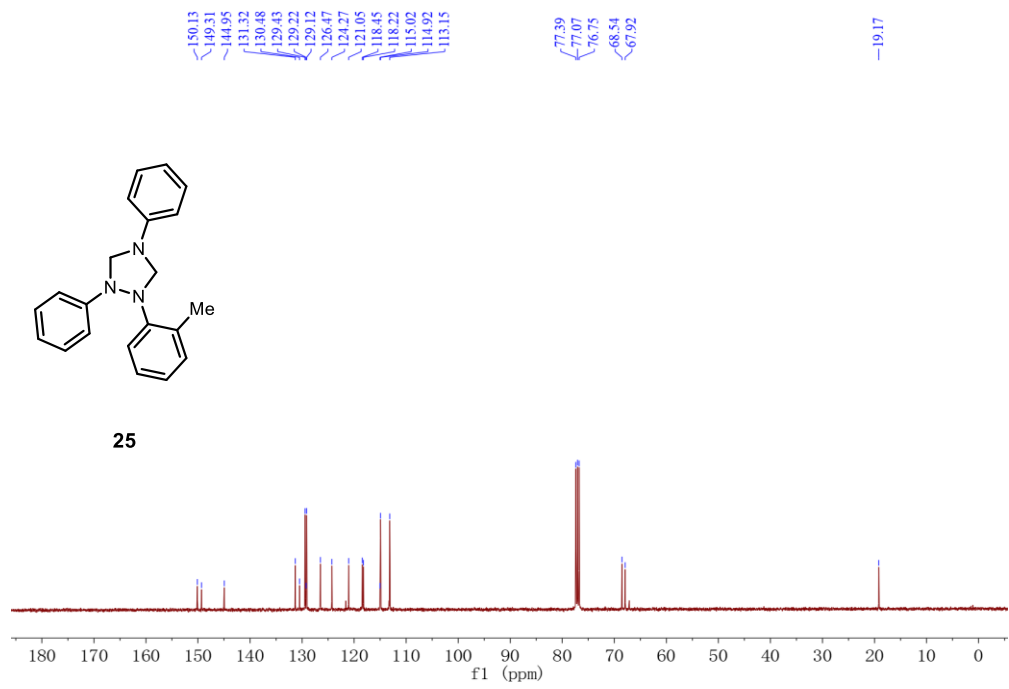
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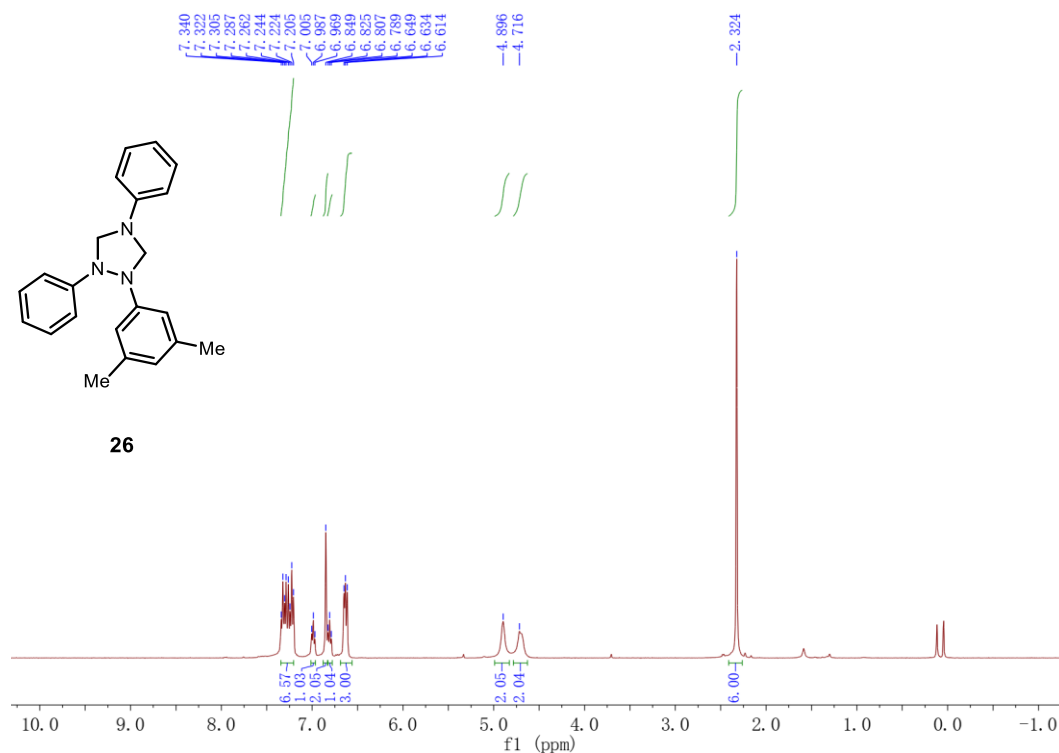
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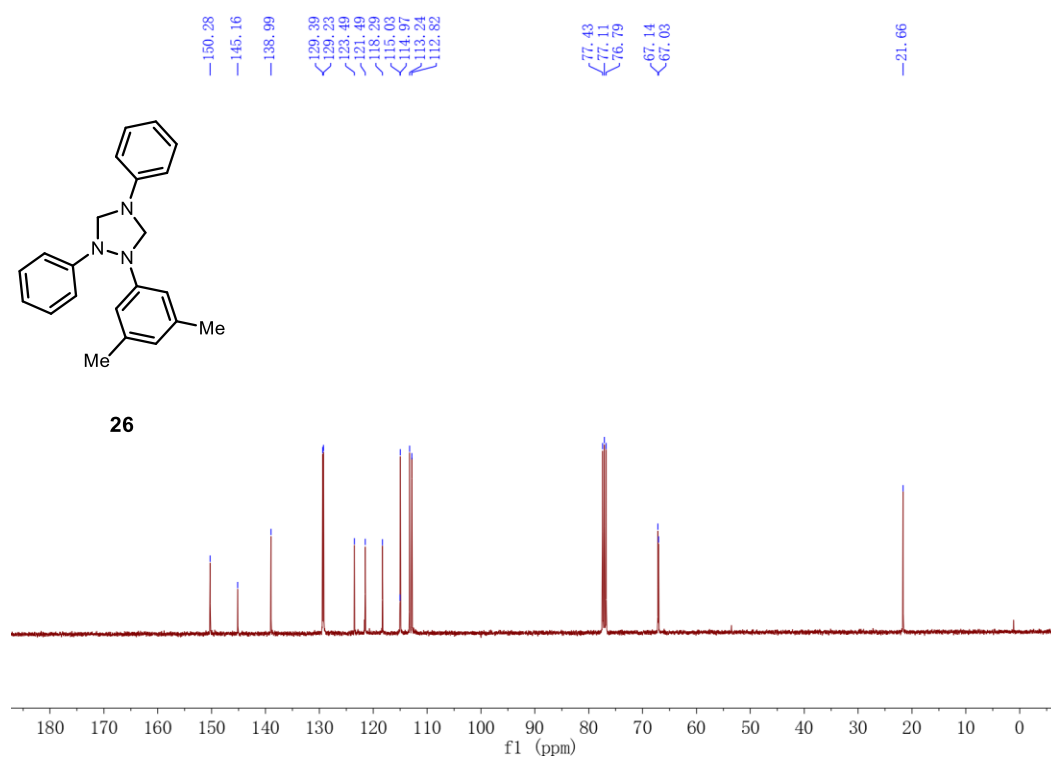
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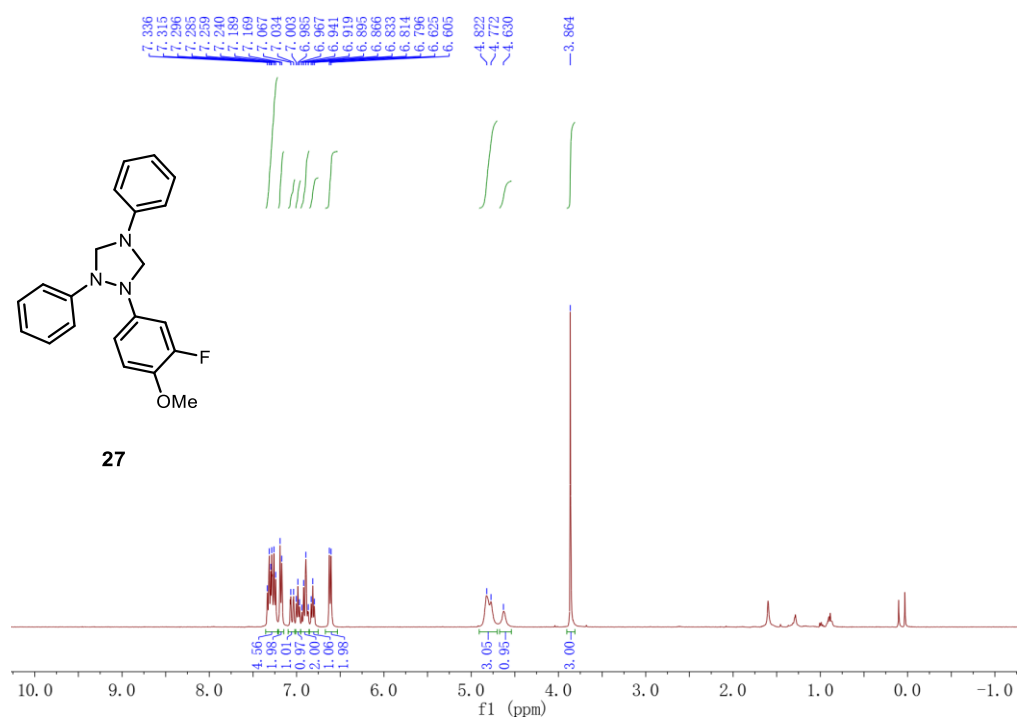
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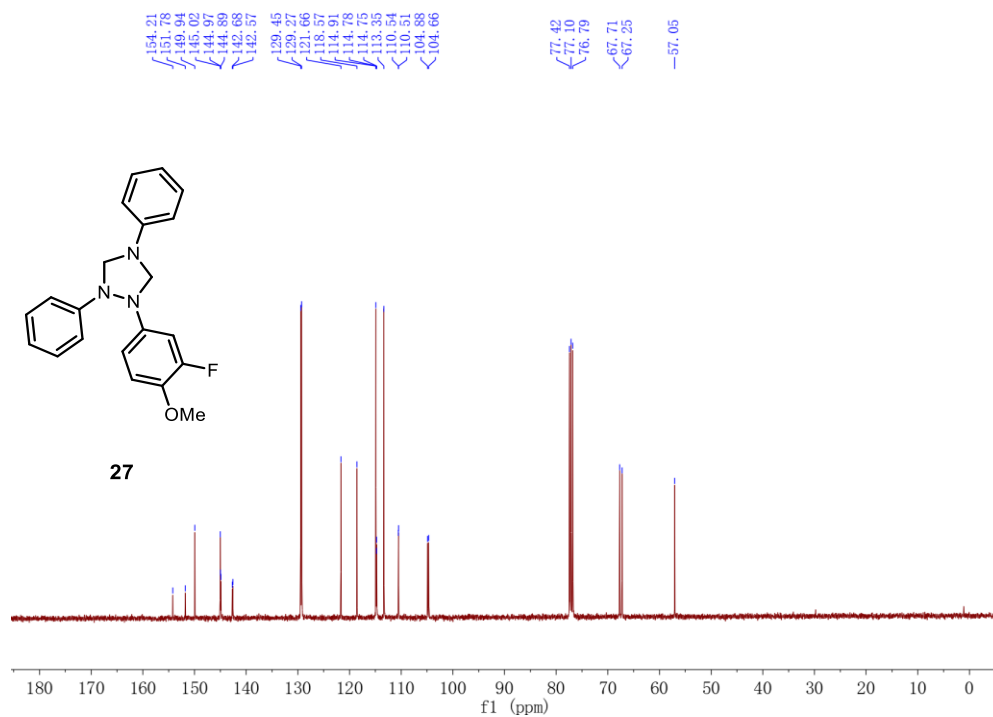
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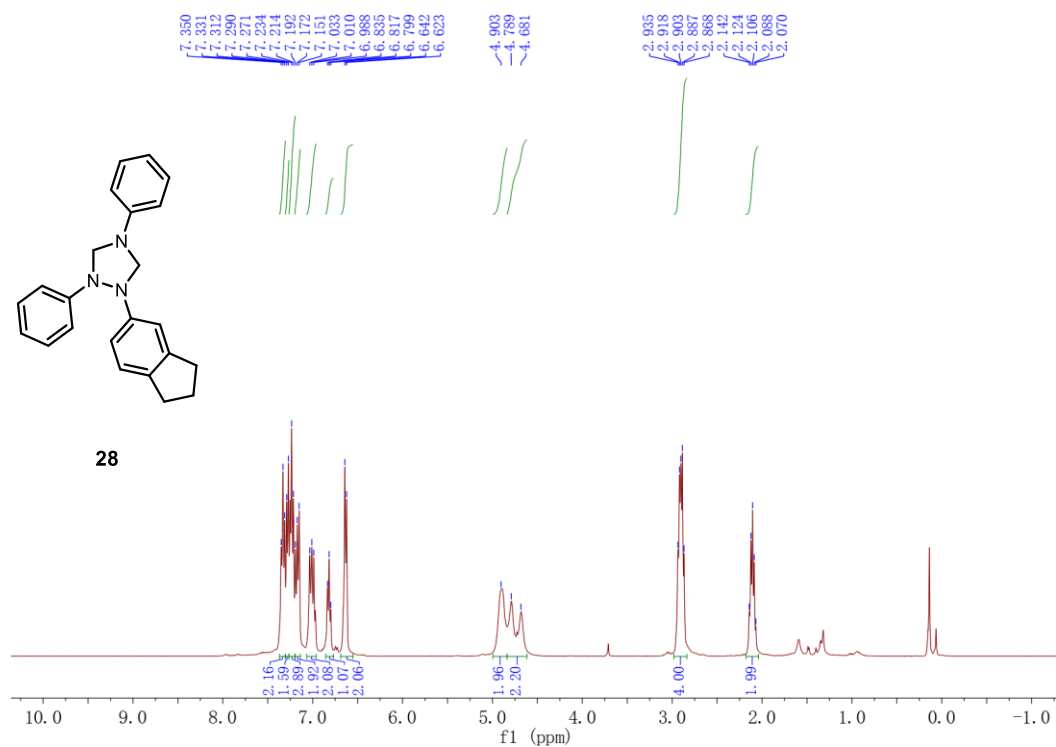
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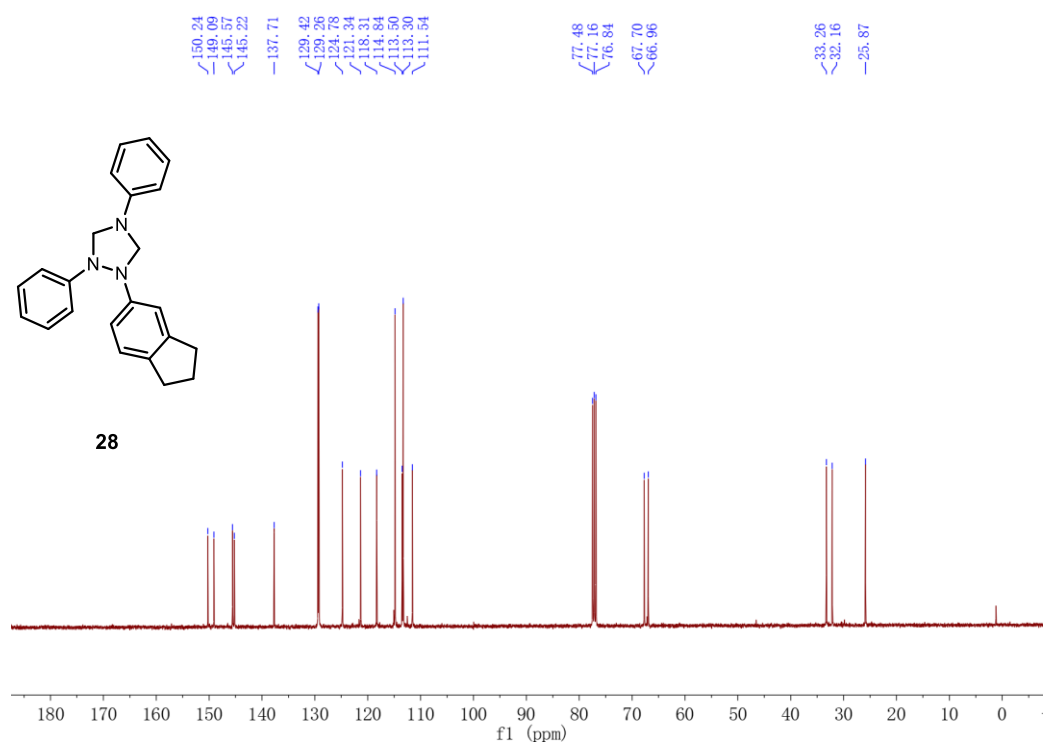
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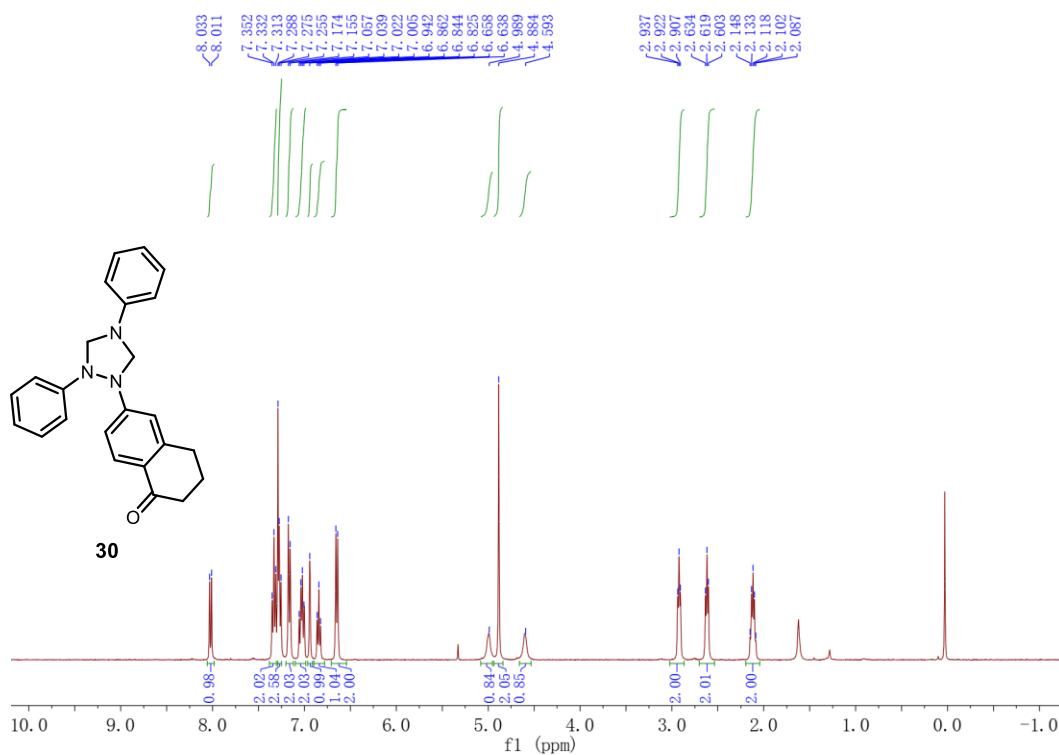
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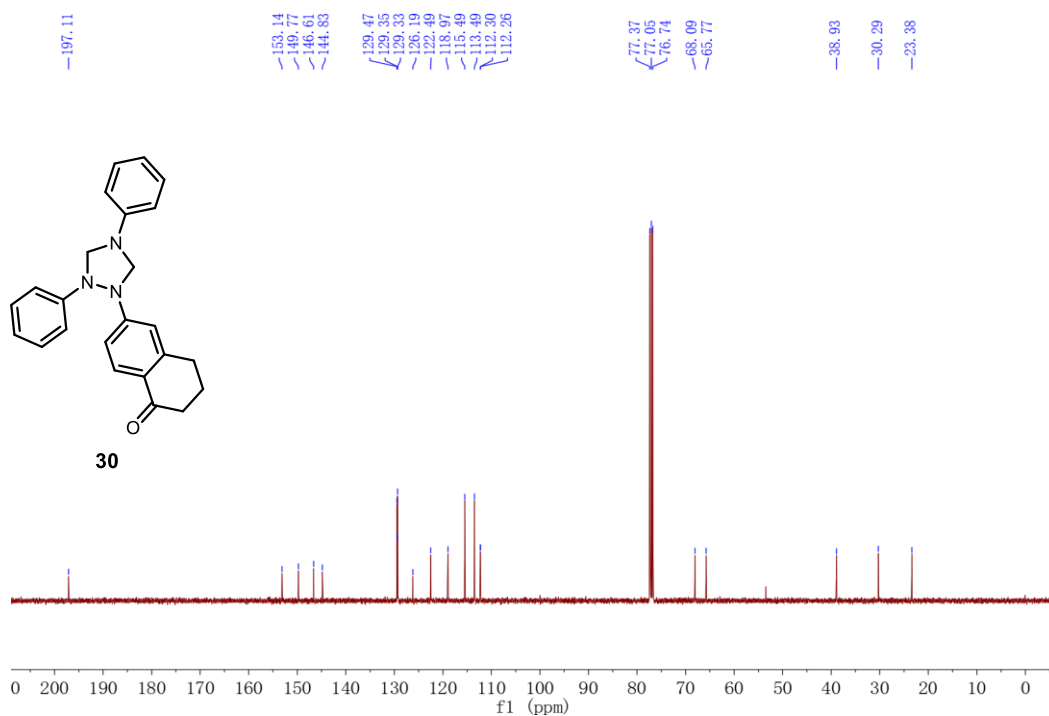
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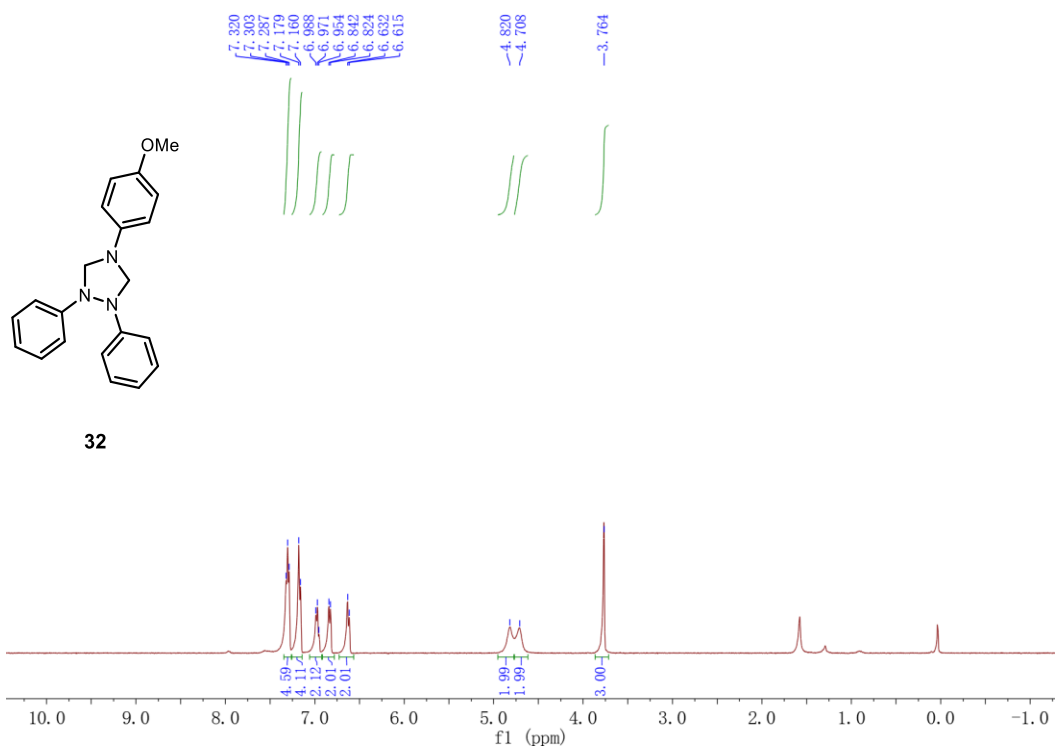
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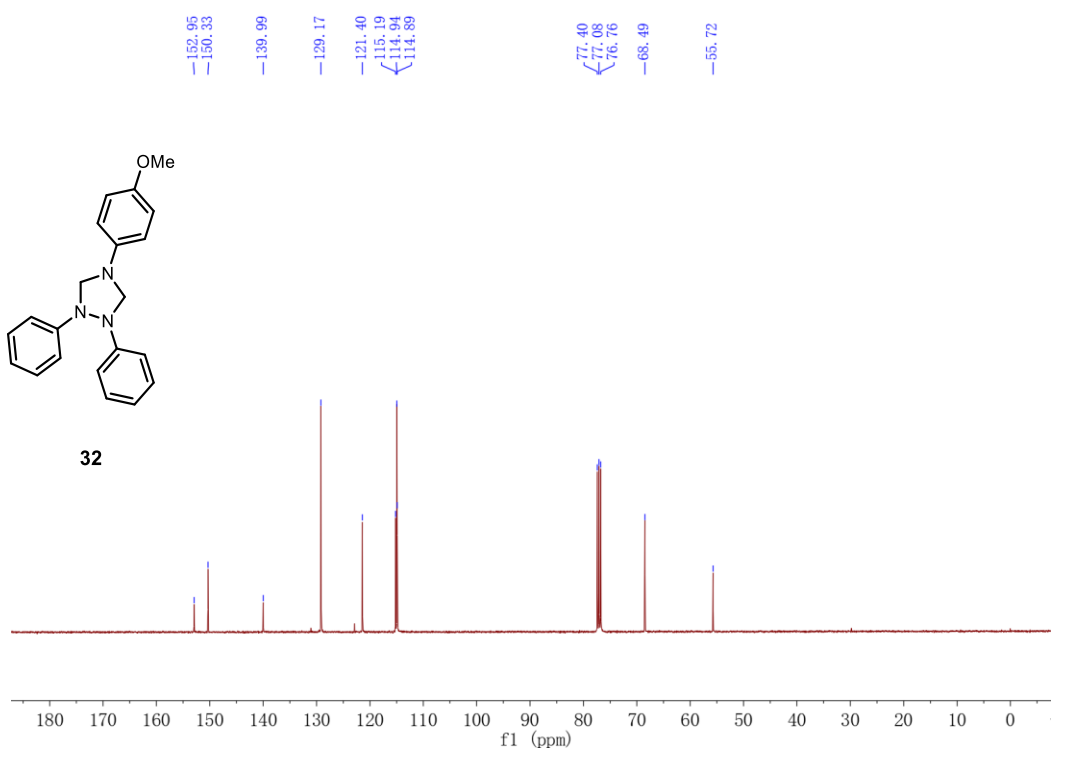
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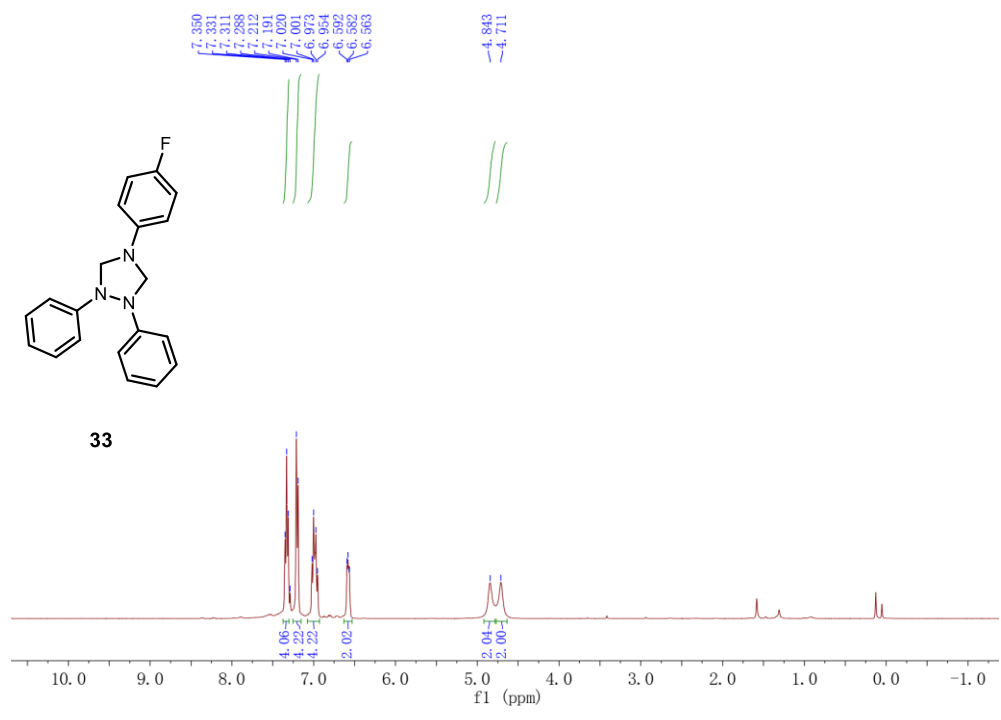
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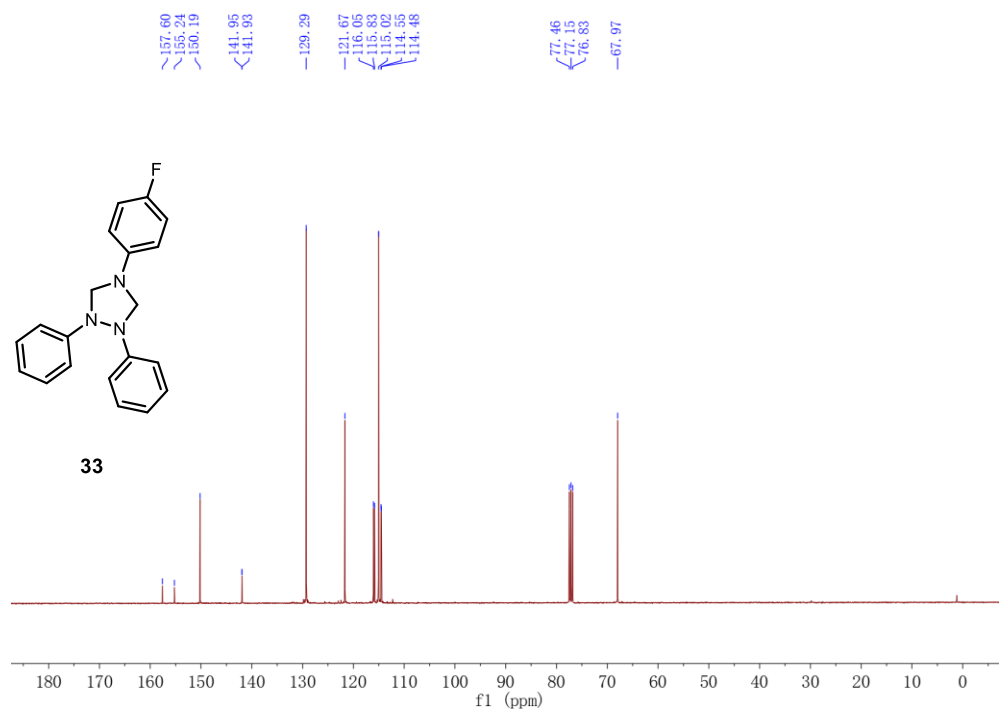
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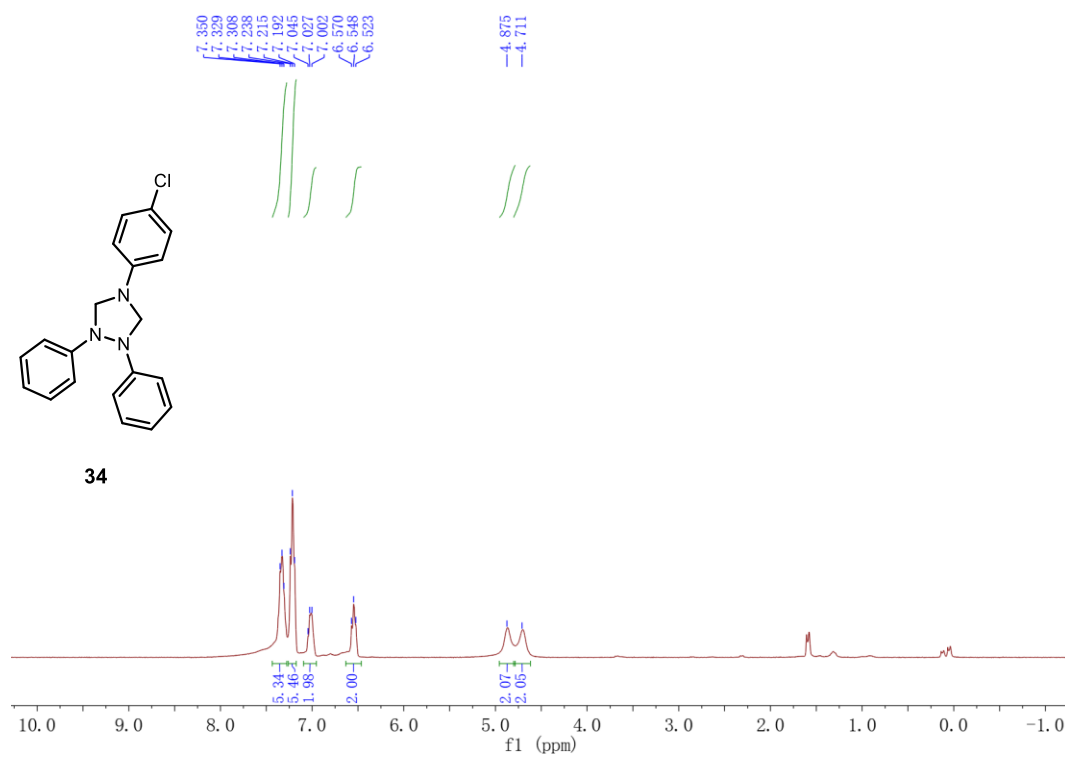
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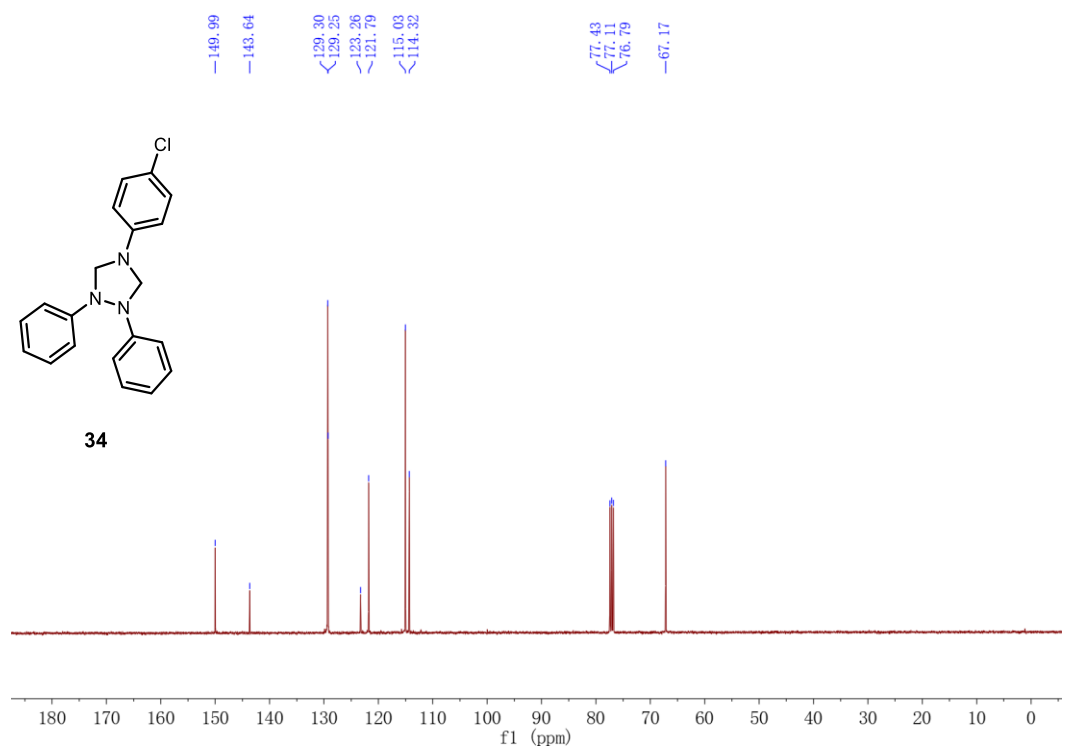
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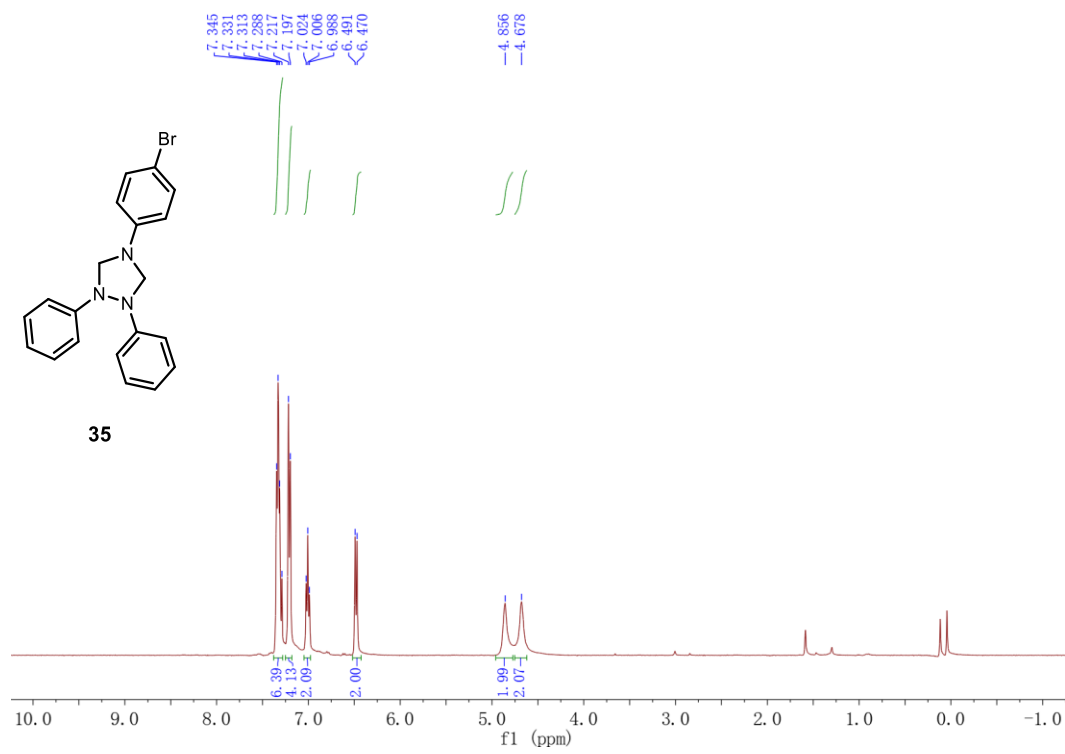
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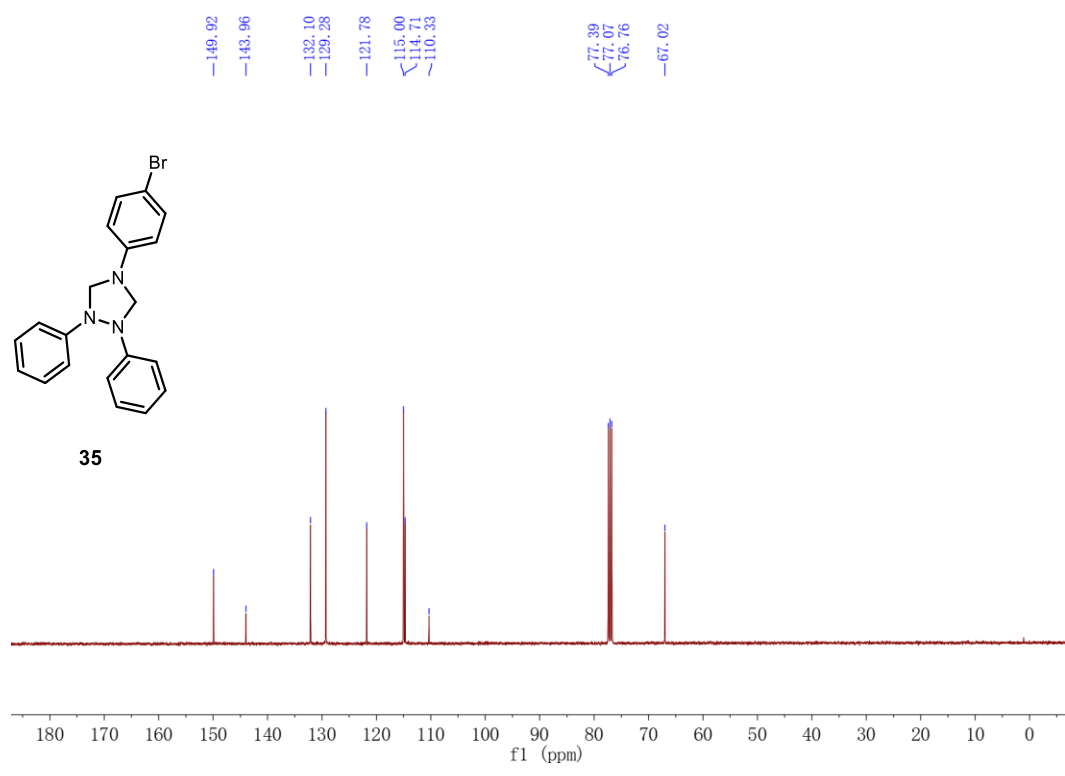
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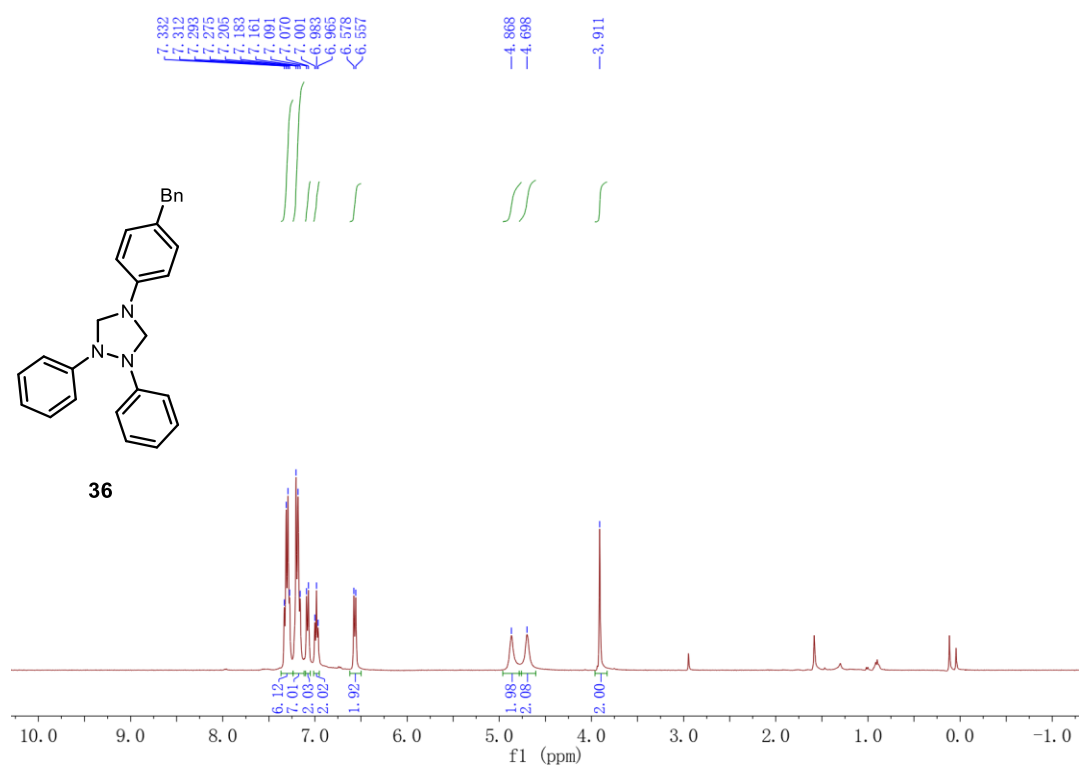
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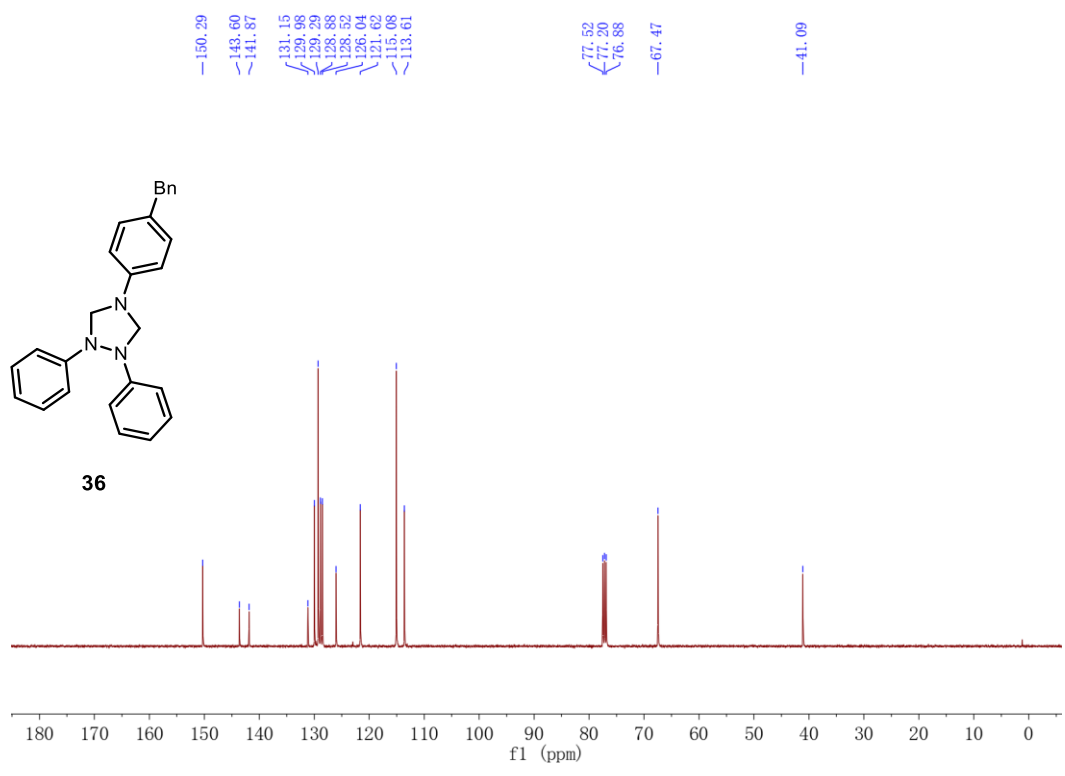
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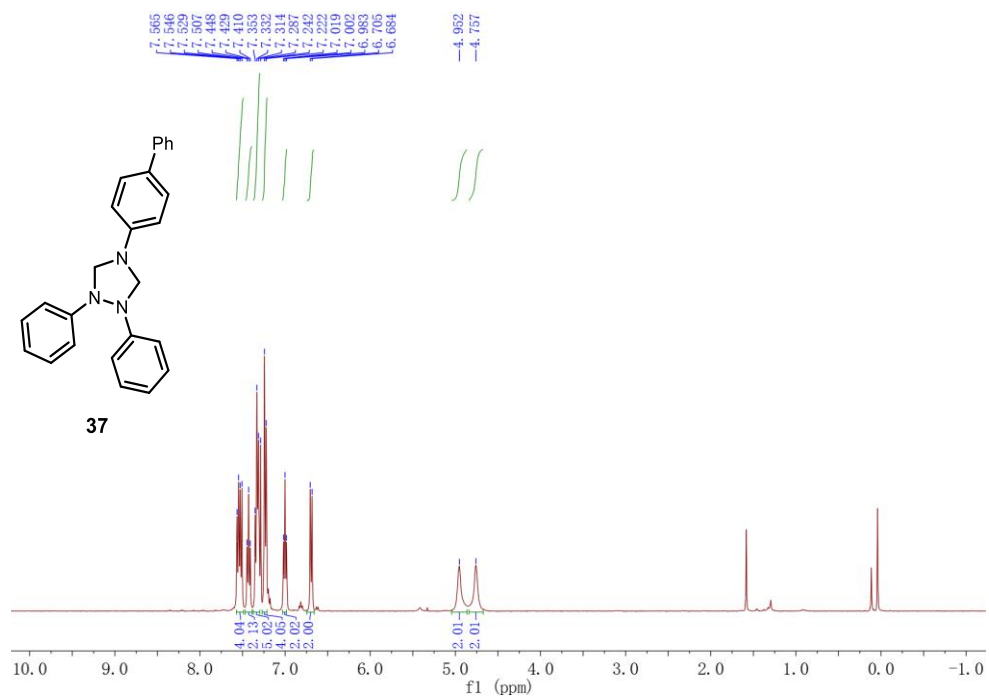
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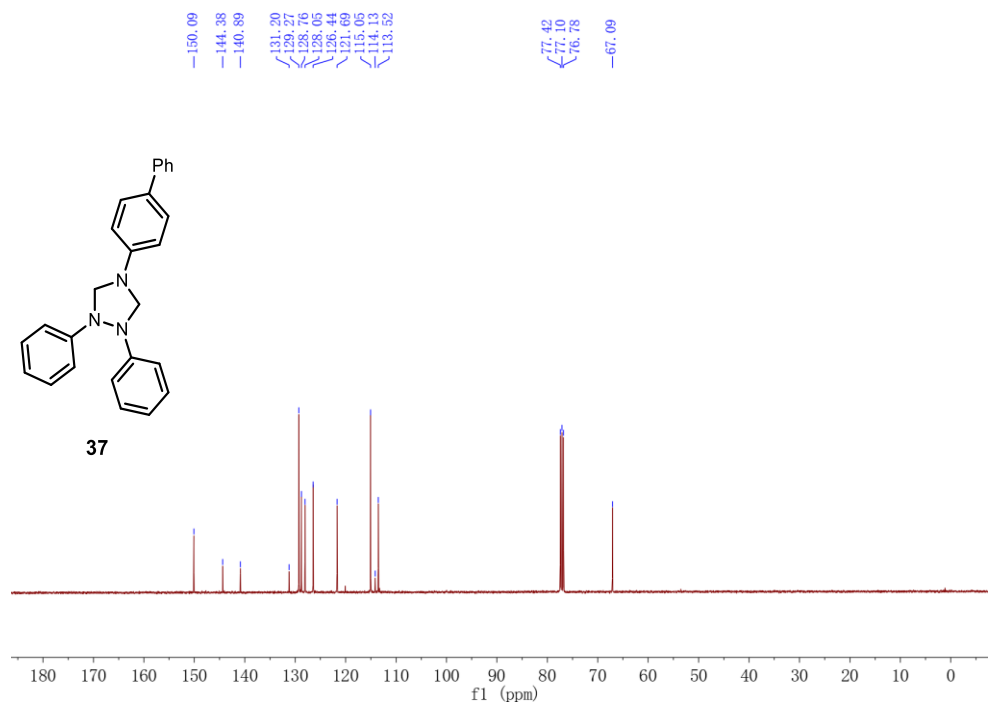
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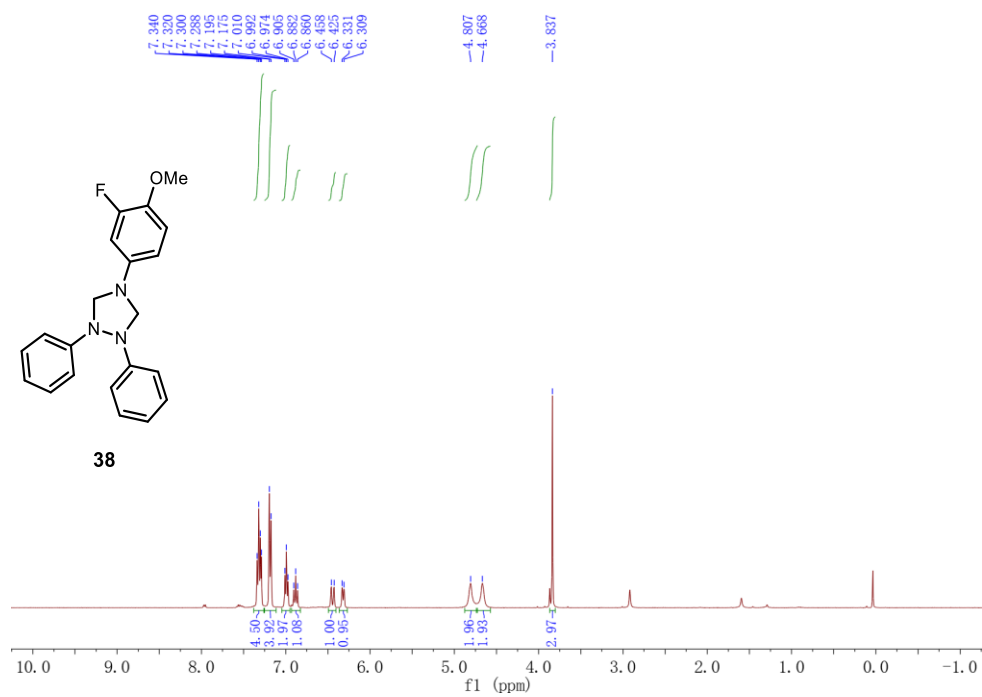
¹H NMR (400 MHz, CDCl₃):



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¹³C NMR (101 MHz, CDCl₃):

