Electronic Supplementary Material (ESI) for Chemical Communications.

Supporting Information

Palladium Catalyzed Allylation and Carbonylation: Access to Allylhydrazones and Allyl Acylhydrazones

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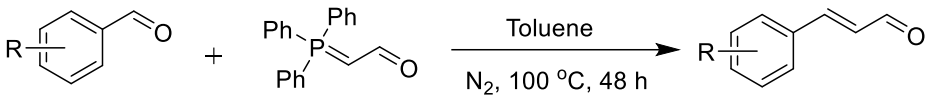
Contents

1. General

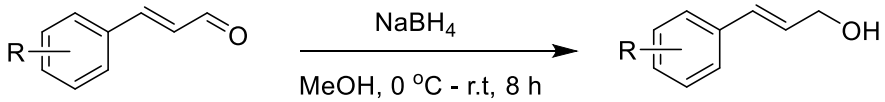
Experimental: All reactions and manipulations with air sensitive compounds being present were performed under dry argon (Ar 5.0) or nitrogen (N_2 5.0), using Schlenk and glove box techniques. Deuterated solvents were bought from Cambridge Isotope Laboratories, distilled accordingly, and stored over molecular sieves (3 Å). Other chemicals were purchased from commercial vendors and used without further purification. NMR spectra were collected on a Varian INOVA 300 and 400 MHz spectrometer. Chemical shifts (δ) are reported in ppm relative to residual solvent signal. Coupling constants (J) are given in Hz (coupling patterns: s: singlet, s_br: broad singlet, d: doublet, t: triplet, q: quartet, m: multiplet). GC analyses were carried out using an Agilent Technologies 6890N system equipped with a Machinery-Nagel (MN) Optima 5 HT column (30 m, 320 µm, 0.25 µm) or an Agilent Technologies 6850 system equipped with a MN Optima 17 column (30 m, 320 µm, 0.25 µm). GC/MS analyses were carried out on an Agilent 7890A/MSD 5975C system equipped with a HP-5MS column (30 m, 320 µm, 0.25 µm). High resolution mass spectra (HRMS) were recorded on Bruker MicroTOF-QII mass (ESI). MN silica gel 60 (0.040 – 0.063 mm particle size) was used for flash column chromatography.

2. Synthesis of Starting Materials[1]



m **n**

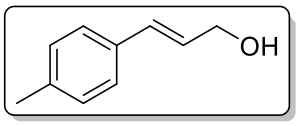
General procedure 1: (Triphenylphosphoranylidene) acetaldehyde **m** (18.26 g, 60 mmol) and aldehyde (20 mmol) were added to a 250 mL dry flask blocked with nitrogen. The reaction mixture was stirred at 100 °C for 48 h in toluene. After completion of the reaction, the reaction was confirmed by TLC and GC-MS. Thereafter, the reaction solvent was evaporated under reduced pressure in a rotary evaporator to obtain a residue. The residue was purified by flash column chromatography with a mixture of petroleun ether and ethyl acetate as eluent to obtain the desired compound **n**.



n **A**

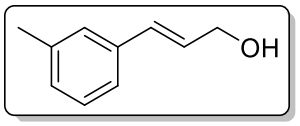
General procedure 2: Aldehyde **n** (5 mmol) was dissolved in 50 mL of methanol and cooled down to 0 °C. $NaBH_4$ (567.5 mg, 15 mmol) was added in batches, then the reaction mixture was slowly warmed to room temperature and stirred for 8 h. After completion of the reaction, the reaction was confirmed by TLC and GC-MS. The reaction was quenched with 0.1 N NaOH (50 mL) and extracted with ethyl acetate three times. The organic layer was washed with brine and dried over Na_2SO_4. The solvent was removed under reduced pressure and the resulting yellow oil was subjected to flash chromatography to give the product **A** in the reported yields.

Preparation of (E)-3-(p-tolyl)prop-2-en-1-ol (A2)



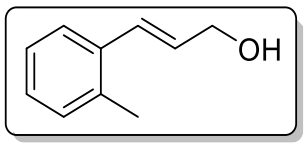
A2 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ethyl acetate =5:1) to give product as a white solid in 90% yield (666 mg).**^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.20 – 7.06 (m, 2H), 6.97 (d, J = 8.0 Hz, 2H), 6.41 (m, 1H), 6.15 (m, 1H), 4.12 (m, 2H), 2.83 (s, 1H), 2.20 (s, 3H).

Preparation of (E)-3-(m-tolyl)prop-2-en-1-ol (A3)



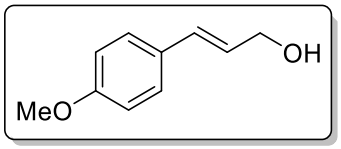
A3 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ethyl acetate =5:1) to give product as the light-yellow oil in 89% yield (659 mg).**^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.14 – 6.99 (m, 3H), 6.92 (m, 1H), 6.41 (d, *J* = 16.0 Hz, 1H), 6.18 (m, 1H), 4.13 (m, 2H), 2.94 (s, 1H), 2.19 (s, 3H).

Preparation of (E)-3-(o-tolyl)prop-2-en-1-ol (A4)



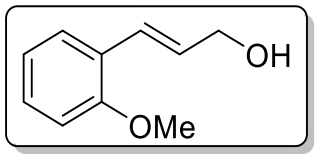
The **n4** was prepared according to the general procedure1and purified by column chromatography (petroleum ether/ ethyl acetate =20:1) to give product as the light-yellow oil in 37% yield (1096 mg). Then **A4** was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product as the light-yellow oil in 89% yield (659 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.40 (m, 1H), 7.18 – 7.07 (m, 3H), 6.78 (m, 1H), 6.20 (m, 1H), 4.28 (m, 2H), 2.56 (s, 1H), 2.31 (s, 3H).

Preparation of (E)-3-(4-methoxyphenyl)prop-2-en-1-ol (A5)



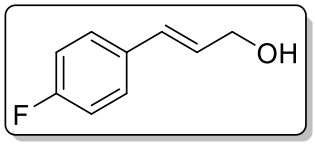
A5 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product as a white solid in 85% yield (697mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.32 – 7.18 (m, 2H), 6.87 – 6.72 (m, 2H), 6.47 (m, 1H), 6.16 (m, 1H), 4.21 (m, 2H), 3.73 (s, 3H), 3.25 (s, 1H).

Preparation of (E)-3-(2-methoxyphenyl)prop-2-en-1-ol (A6)



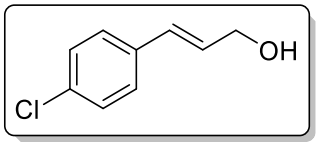
A6 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product as the light-yellow oil in 87% yield (714 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.35 (m, 1H), 7.18 – 7.10 (m, 1H), 6.94 – 6.79 (m, 2H), 6.75 (m, 1H), 6.30 (m, 1H), 4.23 (m, 2H), 3.68 (s, 3H), 3.59 (s, 1H).

Preparation of (E)-3-(4-fluorophenyl)prop-2-en-1-ol (A7)



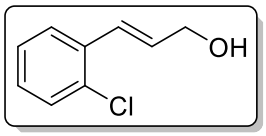
A7 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product as the light-yellow oil in 86% yield (654 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.43 – 7.18 (m, 2H), 7.11 – 6.88 (m, 2H), 6.54 (d, J = 16.0 Hz, 1H), 6.24 (m, 1H), 4.41 – 4.13 (m, 2H), 2.62 (s, 1H).

Preparation of (E)-3-(4-chlorophenyl)prop-2-en-1-ol (A8)



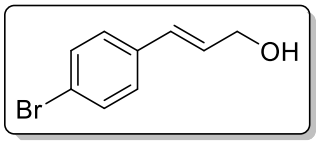
A8 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product as a white solid in 87% yield (731 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.08 (m, 4H), 6.35 (d, *J* = 16.0 Hz, 1H), 6.12 (m, 1H), 4.12 (m, 2H), 3.48 (s, 1H).

Preparation of (E)-3-(2-chlorophenyl)prop-2-en-1-ol (A9)



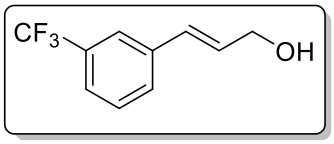
A9 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product l as the light-yellow oil in 86% yield (723 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.33 (m, 1H), 7.22 – 7.13 (m, 1H), 7.08 – 6.93 (m, 2H), 6.85 (m, 1H), 6.17 (m, 1H), 4.18 (m, 2H), 3.38 (s, 1H).

Preparation of (E)-3-(4-bromophenyl)prop-2-en-1-ol (A10)



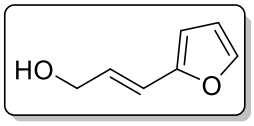
A10 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give t product a white solid oil in 87% yield (922 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.28 (d, *J* = 8.0 Hz, 2H), 7.04 (d, *J* = 8.0 Hz, 2H), 6.37 (d, *J* = 16.0 Hz, 1H), 6.17 (m, 1H), 4.15 (m, 2H), 3.06 (s, 1H).

Preparation of (E)-3-(3-(trifluoromethyl)phenyl)prop-2-en-1-ol (A11)



A11 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give product as the light-yellow oil in 88% yield (889 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.42 (s, 1H), 7.31 (m, 2H), 7.20 (m, 1H), 6.46 (d, *J* = 16.0 Hz, 1H), 6.33 – 6.14 (m, 1H), 4.26 – 4.05 (m, 2H), 3.68 – 3.26 (m, 1H).

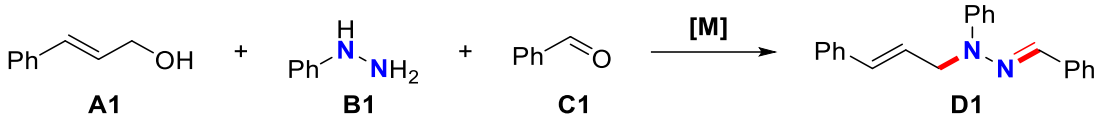
Preparation of (E)-3-(furan-2-yl)prop-2-en-1-ol(A12)



A12 was prepared according to the general procedure 2 and purified by column chromatography (petroleum ether/ ethyl acetate =5:1) to give t product as the light-yellow oil in 71% yield (440 mg). **^{1}H NMR** (400 MHz, $CDCl_3$) δ 7.32 (m, 1H), 6.40 (m, 1H), 6.34 (m, 1H), 6.30 – 6.16 (m, 2H), 4.23 (m, 2H), 3.16 – 2.92 (m, 1H).

3. Screening of reaction parameters

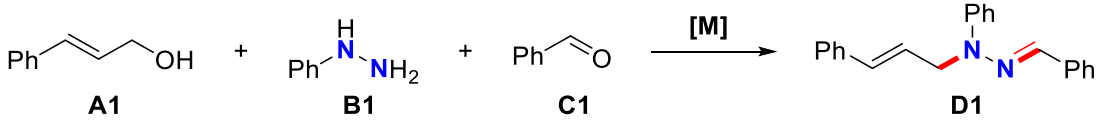
3.1 Screening of tandem allylation reaction parameters



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, solvent, benzaldehyde (**C1**), phenyl hydrazine (**B1**), catalyst and cinnamyl alcohol (**A1**). Then the seal tube was closed tightly with a teflon cap, removed from the glove box and immersed into a pre-heated metal bath (design temperature) for design time. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in the reported yields.

Entry	Parameter
Table S1	The difference of catalyst screening
Table S2	The difference ligand screening
Table S3	The difference of solvent screening
Table S4	The ratio of substrates screening
Table S5	The loading of solvent screening
Table S6	The Pd-catalyst loading screening
Table S7	Reaction temperature screening
Table S8	Reaction time screening
Table S9	The reaction system screening

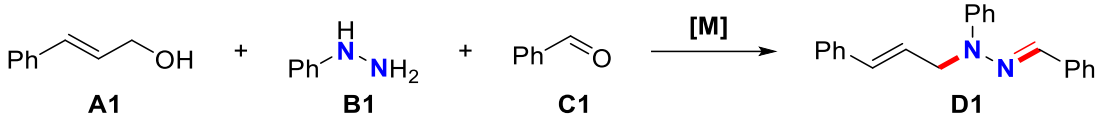
Table S1. The difference of catalyst screening [a]



Entry	Catalyst	**D1** (%)
1	-	0
2	$PdCl_2$	72
3	$PdBr_2$	<5
4	PdI_2	<5
5	**$PdCl_2(CH_3CN)_2$**	**95**
6	$PdBr_2(CH_3CN)_2$	43
7	$Pd(OAc)_2$	70
8	$Pd(TFA)_2$	87
9	$PdCl_2(COD)$	63
10	$PdBr_2(COD)$	39
11	Pd/C	0
12[b]	$[Pd(Cl)(C_3H_5)]_2$	81
13[b]	$[Pd(Cl)(C_9H_9)]_2$	88
14	$NiCl_2$	0
15	$CoCl_2$	0
16	$MnCl_2$	0
17	$CuCl_2$	0
18	$FeCl_2$	0

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), catalyst (0.01 mmol, 2 mol%), Xantphos (0.011 mmol, 2.2 mol%), toluene (2.0 mL), 60 °C (extern temperature), 4 h, N_2. Isolated yield. [b] Catalyst (0.005 mmol, 1 mol%).

Table S2. The difference of ligand screening [a]

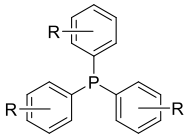


Entry	Ligand	**D1** (%)
1	-	0
2	**L1**	3
3	**L2**	4
4	**L3**	5
5	**L4**	4
6	**L5**	5
7	**L6**	3
8	**L7**	4
9	**L8**	4
10	**L9**	5
11	**L10**	3
12	**L11**	4
13	**L12**	2
14	**L13**	1
15	**L14**	2
16	**L15**	2
17	**L16**	4
18	**L17**	**95**
19	**L18**	52
20	**L19**	73
21	**L20**	90
22	**L21**	26

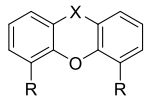
Entry	Ligand	**D1** (%)
23	**L22**	12
24	**L23**	4
25	**L24**	5
26	**L25**	11
27	**L26**	8
28	**L27**	12
29	**L28**	6
30	**L29**	7
31	**L30**	61
32	**L31**	18
33	**L32**	5
34	**L33**	3
35	**L34**	13
36	**L35**	12
37[b]	**$PdCl_2$(Xantphos)**	**95**
38[b]	**Pd(Xantphos)$(OTf)_2(CH_3CN)_2$**	93

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2(CH_3CN)_2$ (0.01 mmol, 2 mol%), Ligand (**L1-L7** 0.021 mmol, 4.2 mol%; **L8-L20** 0.012 mmol, 2.2 mol%), toluene (2.0 mL), 60 ºC (extern temperature), 4 h, N_2. Isolated yield. [b] Catalyst (0.01 mmol, 2 mol%).

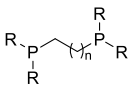
L1, $^{n}Bu_3P$
L2, $^{t}Bu_3P{\bullet}HBF_4$
L3, P(cyclohexyl)$_3$
L4, P(cyclopentyl)$_3$
L5, $P(CH_2CHCH_2)_3$
L6, $P(CH_2CH_2CN)_3$
L7, $P(^{n}Bu)Ad_2$
L8, PPh_2(2-Py)
L9, PPh_2(3,5-Me_2Ph)
L10, PPh_2(3,5-F_2Ph)



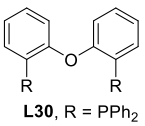
L11, R = H
L12, R = 4-Me
L13, R = 2-Me
L14, R = 4-F
L15, R = 3,5-F_2
L16, R = 3,5-Me_2



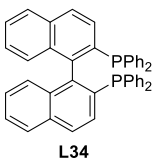
L17, X = CMe_2, R = PPh_2
L18, X = NH, R = PPh_2
L19, X = $SiMe_2$, R = PPh_2
L20, X = CMe_2, R = PPh(2-MePh)
L21, X = CMe_2, R = PCy_2
L22, X = CMe_2, R = P$^{t}Bu_2$



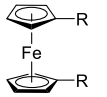
L23, n = 1, R = Ph
L24, n = 2, R = Ph
L25, n = 3, R = Ph
L26, n = 4, R = Ph
L27, n = 5, R = Ph
L28, n = 2, R = Cy
L29, n = 3, R = Cy



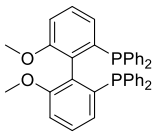
L30, R = PPh_2
L31, R = PCy_2



L34

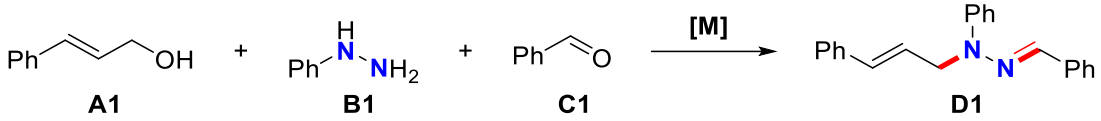


L32, R = PPh_2
L33, R = PCy_2



L35

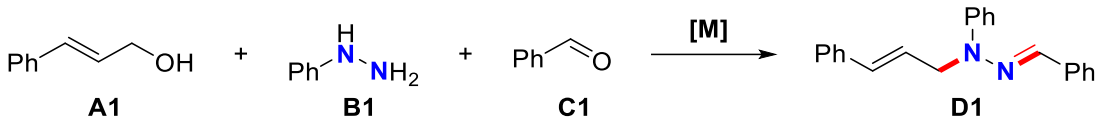
Table S3. The difference of solvent screening [a]



Entry	Solvent (2 mL)	**D1** (%)
1	anisole	88
2	THF	44
3	1,4-dioxane	10
4	DME	36
5	**toluene**	**95**
6	xylene	72
7	mesitylene	83
8	DCM	0
9	CH_3CN	0
10	pyridine	39
11	methanol	0
12	ethanol	6
13	isopropanol	<5
14	*t*-AmOH	70
15	DMF	<5
16	DMAc	<5
17	NMP	<5
18	DMSO	31

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), solvent (2.0 mL), 60 °C (extern temperature), 4 h, N_2. Isolated yield.

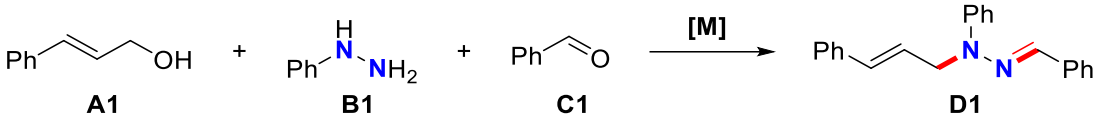
Table S4. The ratio of substrates screening [a]



Entry	**A1**	**B1**	**C1**	**D1** (%)
1	0.5	0.5	0	0
2	0.5	0.5	0.5	70
3	0.5	0.5	0.65	82
4	0.5	0.5	0.75	86
5	0.5	0.5	0.85	85
6	0	0.5	0.5	0
7	0.65	0.5	0.5	88
8	0.75	0.5	0.5	90
9	0.85	0.5	0.5	90
10	0.5	0	0.5	0
11	0.5	0.65	0.5	51
12	0.5	0.75	0.5	43
13	0.5	0.85	0.5	42
14	0.75	0.5	0.6	92
15	**0.75**	**0.5**	**0.7**	**95**
16	0.75	0.5	0.75	95
17	0.75	0.5	0.8	95

[a] Reaction conditions: **A1** (x mmol), **B1** (x mmol), **C1** (x mmol), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 60 ºC (extern temperature), 4 h, N_2. Isolated yield.

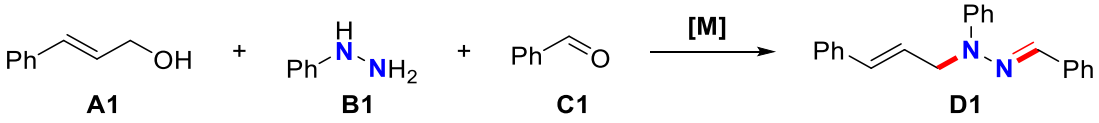
Table S5. The loading of solvent screening [a]



Entry	toluene (mL)	**D1** (%)
1	0	<5
2	0.5	85
3	1.0	89
4	1.5	93
5	**2.0**	**95**
6	3.0	95
7	4.0	95

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (x mL), 60 °C (extern temperature), 4 h, N_2. Isolated yield.

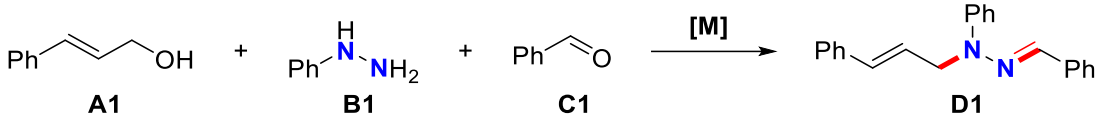
Table S6. The Pd-catalyst loading screening [a]



Entry	Pd-catalyst	**D1** (%)
1	0	0
2	0.0005	9
3	0.001	43
4	0.002	78
5	0.005	92
6	**0.01**	**95**
7	0.02	95

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (x mmol), toluene (2.0 mL), 60 °C (extern temperature), 4 h, N_2. Isolated yield.

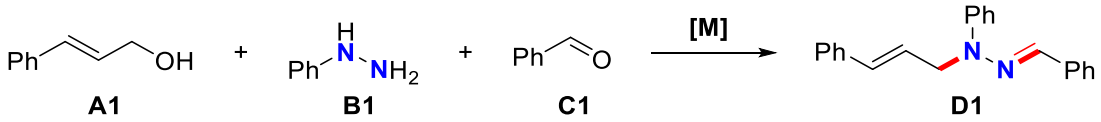
Table S7. Reaction temperature screening [a]



Entry	T (° C)	**D1** (%)
1	RT	51
2	40	70
3	50	90
4	**60**	**95**
5	70	95

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), T (extern temperature), 4 h, N_2. Isolated yield.

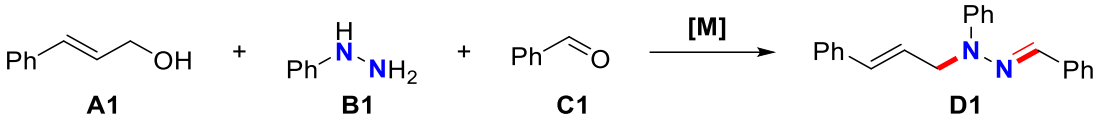
Table S8. Reaction time screening [a]



Entry	t (h)	**D1** (%)
1	1	65
2	2	89
3	3	93
4	**4**	**95**
5	5	95

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 60 °C (extern temperature), t h, N_2. Isolated yield.

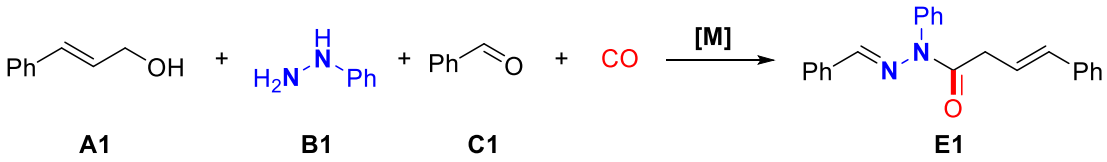
Table S9. The reaction system screening [a]



Entry	System	atmosphere	D1 (%)
1	open	N_2	93
2	open	O_2	<5
3	open	air	28
4	**seal**	**N_2**	**95**
5	seal	O_2	<5
6	seal	air	26

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 60 ºC (extern temperature), 4 h, Isolated yield.

3.2 Screening of tandem allylation/carbonylation parameters

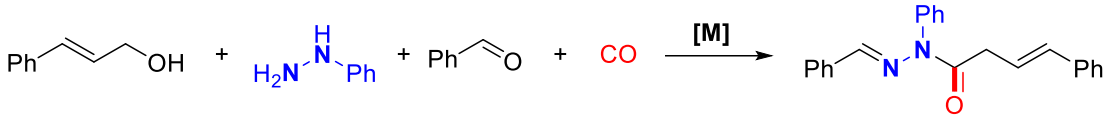


A1 **B1** **C1** **E1**

Using a nitrogen-filled glove box, an oven-dried glass bottle (10 mL volume) was charged with a magnetic stirring bar, catalyst (ligand), solvent, benzaldehyde (**C1**), phenyl hydrazine (**B1**) and cinnamyl alcohol (**A1**). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO and immersed into a pre-heated metal bath for desired time. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. Then a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) on silica gel to give the product **E1** in the reported yields.

Entry	Parameter
Table S10	The difference of catalyst screening
Table S11	The difference ligand screening
Table S12	The difference of solvent screening
Table S13	The ratio of substrates screening
Table S14	The loading of solvent screening
Table S15	The Pd-catalyst loading screening
Table S16	Reaction pressure screening
Table S17	Reaction temperature screening
Table S18	Reaction time screening

Table S10. The difference of catalyst screening [a]

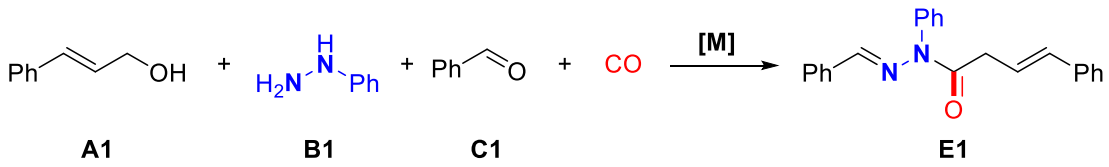


A1 **B1** **C1** **E1**

Entry	Catalyst	**D1** (%)
1	-	0
2	$PdCl_2$	33
3	$PdBr_2$	20
4	PdI_2	trace
5	**$PdCl_2(CH_3CN)_2$**	**46**
6	$Pd(OAc)_2$	12
7	$Pd(TFA)_2$	27
8	Pd/C	0
9[b]	$[Pd(Cl)(C_3H_5)]_2$	38
10[b]	$[Pd(Cl)(C_9H_9)]_2$	42
11	$NiCl_2$	0
12	$CoCl_2$	0
13	$MnCl_2$	0
14	$CuCl_2$	0
15	$FeCl_2$	0

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), catalyst (0.01 mmol, 2 mol%), Xantphos (0.01 mmol, 2 mol%), toluene (2.0 mL), 120 °C (extern temperature),12 h, CO (2 MPa), GC yield. [b] Catalyst (0.005 mmol, 2 mol%).

Table S11. The difference ligand screening [a]



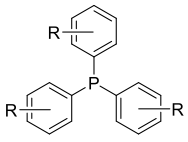
A1 B1 C1 E1

Entry	Ligand	**D1** (%)
1	-	0
2	**L1**	1
3	**L2**	2
4	**L3**	1
5	**L4**	2
6	**L5**	1
7	**L6**	1
8	**L7**	1
9	**L8**	1
10	**L9**	1
11	**L10**	1
12	**L11**	1
13	**L12**	3
14	**L13**	3
15	**L14**	3
16	**L15**	2
17	**L16**	2
18	**L17**	**46**
19	**L18**	12
20	**L19**	31
21	**L20**	15

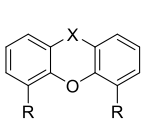
Entry	Ligand	**D1** (%)
22	**L21**	6
23	**L22**	5
24	**L23**	2
25	**L24**	2
26	**L25**	5
27	**L26**	2
28	**L27**	5
29	**L28**	2
30	**L29**	2
31	**L30**	26
32	**L31**	6
33	**L32**	1
34	**L33**	1
35	**L34**	1
36	**L35**	12
37[b]	**$PdCl_2$(Xantphos)**	**46**
38[b]	**Pd(Xantphos)(OTf)$_2$(CH_3CN)$_2$**	43

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2(CH_3CN)_2$ (0.01 mmol, 2 mol%), Ligand (**L1-L16** 0.021 mmol, 4.2 mol%; **L17-L35** 0.011 mmol, 2.2 mol%), toluene (2.0 mL), 120 ºC (extern temperature), 12 h, CO (2 MPa), GC yield. [b] ccatalyst (0.01 mmol, 2 mol%).

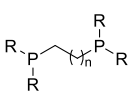
L1, $^{n}Bu_3P$
L2, $^{t}Bu_3P$•HBF_4
L3, P(cyclohexyl)$_3$
L4, P(cyclopentyl)$_3$
L5, P(CH_2CHCH_2)$_3$
L6, P(CH_2CH_2CN)$_3$
L7, P(^{n}Bu)Ad$_2$
L8, PPh_2(2-Py)
L9, PPh_2(3,5-Me_2Ph)
L10, PPh_2(3,5-F_2Ph)



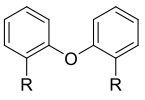
L11, R = H
L12, R = 4-Me
L13, R = 2-Me
L14, R = 4-F
L15, R = 3,5-F_2
L16, R = 3,5-Me_2



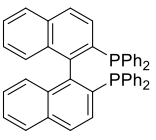
L17, X = CMe_2, R = PPh_2
L18, X = NH, R = PPh_2
L19, X = $SiMe_2$, R = PPh_2
L20, X = CMe_2, R = PPh(2-MePh)
L21, X = CMe_2, R = PCy_2
L22, X = CMe_2, R = P^{t}Bu_2



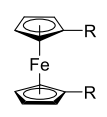
L23, n = 1, R = Ph
L24, n = 2, R = Ph
L25, n = 3, R = Ph
L26, n = 4, R = Ph
L27, n = 5, R = Ph
L28, n = 2, R = Cy
L29, n = 3, R = Cy



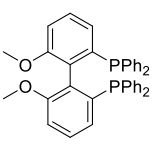
L30, R = PPh_2
L31, R = PCy_2



L34

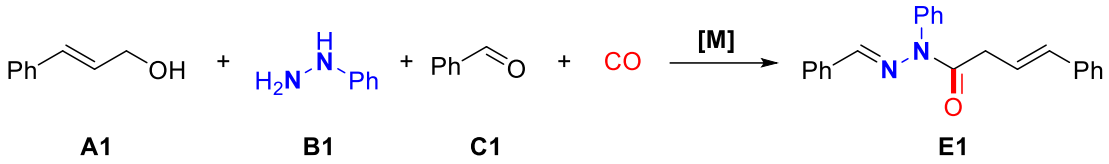


L32, R = PPh_2
L33, R = PCy_2



L35

Table S12. The difference of solvent screening [a]

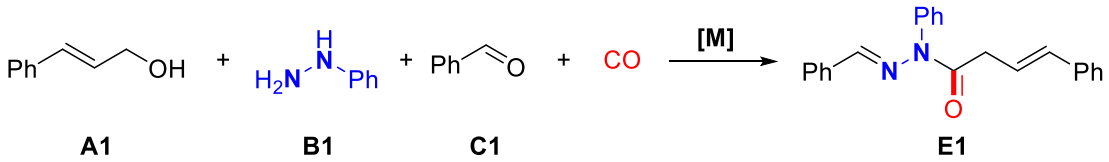


A1 **B1** **C1** **E1**

Entry	Solvent (2 mL)	**D1** (%)
1	anisole	42
2	THF	trace
3	1,4-dioxane	30
4	DME	23
5	**toluene**	**46**
6	xylene	38
7	mesitylene	41
8	DCM	10
9	CH_3CN	0
10	pyridine	8
11	methanol	0
12	ethanol	0
13	isopropanol	0
14	*t*-AmOH	6
15	DMF	0
16	DMAc	0
17	DMSO	0

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), solvent (2.0 mL), 120 °C (extern temperature), 12 h, CO (2 MPa), GC yield.

Table S13. The ratio of substrates screening [a]

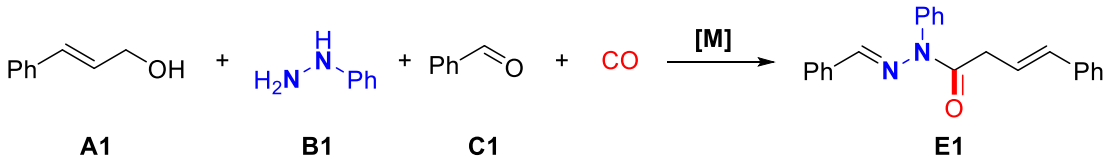


A1 **B1** **C1** **E1**

Entry	**A1**	**B1**	**C1**	**D1** (%)
1	0.5	0.5	0	0
2	0.5	0.5	0.5	26
3	0.5	0.5	0.65	35
4	0.5	0.5	0.75	41
5	0.5	0.5	0.85	39
6	0	0.5	0.5	0
7	0.65	0.5	0.5	37
8	0.75	0.5	0.5	40
9	0.85	0.5	0.5	41
10	0.5	0	0.5	0
11	0.5	0.65	0.5	25
12	0.5	0.75	0.5	21
13	0.5	0.85	0.5	18
14	0.75	0.5	0.6	43
15	**0.75**	**0.5**	**0.7**	**46**
16	0.75	0.5	0.75	46
17	0.75	0.5	0.8	44

[a] Reaction conditions: **A1** (x mmol), **B1** (x mmol), **C1** (x mmol), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 120 °C (extern temperature), 12 h, CO (2 MPa), GC yield.

Table S14. The loading of solvent screening [a]

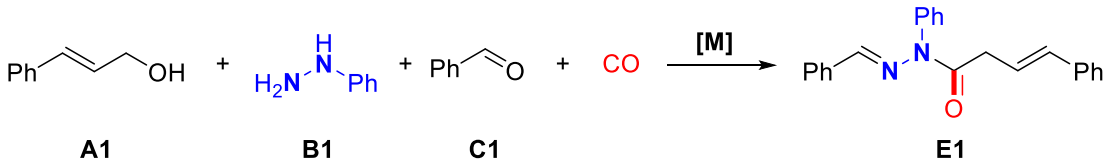


A1 B1 C1 E1

Entry	toluene (mL)	**D1** (%)
1	0.5	29
2	1.0	36
3	1.5	43
4	**2.0**	**46**
5	3.0	46

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (x mL), 120 °C (extern temperature), 12 h, CO (2 MPa), GC yield.

Table S15. The Pd-catalyst loading screening [a]

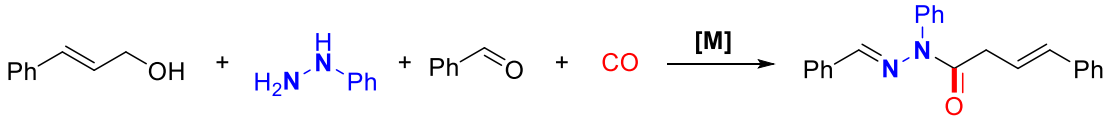


A1 B1 C1 E1

Entry	Pd-catalyst	D1 (%)
1	0	0
2	0.001	7
3	0.002	15
4	0.005	33
5	**0.01**	**46**
6	0.02	46

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (x mmol), toluene (2.0 mL), 120 °C (extern temperature), 12 h, CO (2 MPa), GC yield.

Table S16. Reaction pressure screening [a]

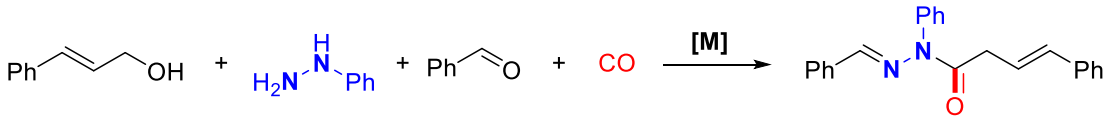


A1 **B1** **C1** **E1**

Entry	CO (MPa)	D1 (%)
1	1	21
2	2	46
3	3	72
4	**4**	**85**
5	5	85

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 120 °C (extern temperature), 12 h, CO (x MPa), GC yield.

Table S17. Reaction temperature screening [a]

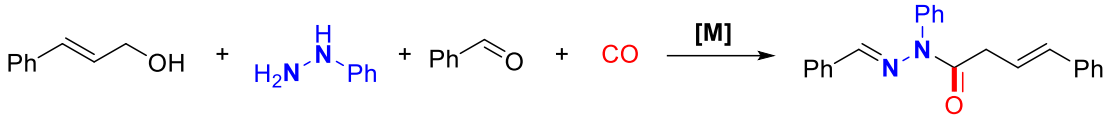


A1 **B1** **C1** **E1**

Entry	T (° C)	**D1** (%)
1	40	0
2	60	32
3	80	48
4	100	73
5	**120**	**85**
6	140	85

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), T (extern temperature), 12 h, CO (4 MPa), GC yield.

Table S18. Reaction time screening [a]



A1 **B1** **C1** **E1**

Entry	t (h)	**D1** (%)
1	2	6
2	4	41
3	6	58
4	8	72
5	10	80
6	**12**	**85 (78[b])**
7	15	85

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), T (extern temperature), x h, CO (4 MPa), GC yield. [b] Isolated yield.

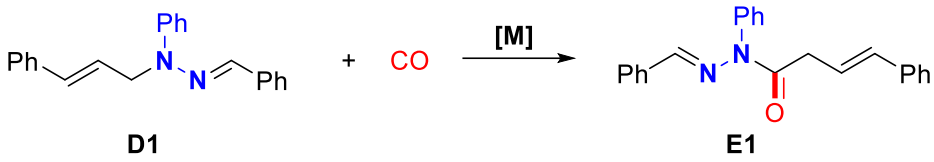
3.3 Screening of carbonylation from allyhydrazones parameters

D1 **E1**

Using a nitrogen-filled glove box, an oven-dried glass bottle (10 mL volume) was charged with a magnetic stirring bar, catalyst, solvent and allylhydrazone (**D1**). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO and immersed into a pre-heated metal bath for desired time. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. Then a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) on silica gel to give the product **E1** in the reported yields.

Entry	Parameter
Table S19	The difference of catalyst screening
Table S20	The difference ligand screening
Table S21	The difference of solvent screening
Table S22	The loading of solvent screening
Table S23	The Pd-catalyst loading screening
Table S24	Reaction pressure screening
Table S25	Reaction temperature screening
Table S26	Reaction time screening

Table S19. **The difference of catalyst screening** [a]

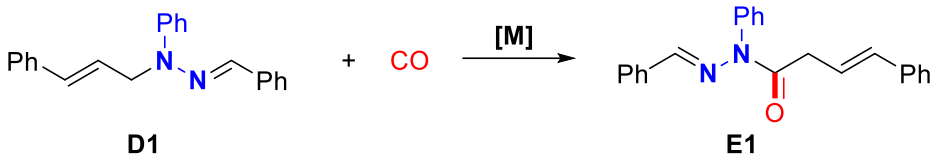


D1 **E1**

Entry	Catalyst	**D1** (%)
1	-	0
2	$PdCl_2$	23
3	$PdBr_2$	16
4	PdI_2	trace
5	**$PdCl_2(CH_3CN)_2$**	**39**
6	$Pd(OAc)_2$	7
7	$Pd(TFA)_2$	21
8	Pd/C	0
9[b]	$[Pd(Cl)(C_3H_5)]_2$	31
10[b]	$[Pd(Cl)(C_9H_9)]_2$	36
11	$NiCl_2$	0
12	$CoCl_2$	0
13	$MnCl_2$	0
14	$CuCl_2$	0
15	$FeCl_2$	0

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), catalyst (0.01 mmol, 2 mol%), Xantphos (0.01 mmol, 2 mol%), toluene (2.0 mL), 120 °C (extern temperature), 12 h, CO (2 MPa), GC yield. [b] Catalyst (0.005 mmol, 1 mol%).

Table S20. **The difference ligand screening** [a]



D1 **E1**

Entry	Ligand	**D1** (%)
1	-	0
2	**L1**	1
3	**L2**	2
4	**L3**	1
5	**L4**	2
6	**L5**	1
7	**L6**	1
8	**L7**	1
9	**L8**	2
10	**L9**	2
11	**L10**	2
12	**L11**	2
13	**L12**	1
14	**L13**	1
15	**L14**	2
16	**L15**	2
17	**L16**	0
18	**L17**	**39**
19	**L18**	10
20	**L19**	25
21	**L20**	11
22	**L21**	5

Entry	Ligand	**D1** (%)
23	**L22**	6
24	**L23**	0
25	**L24**	0
26	**L25**	0
27	**L26**	3
28	**L27**	2
29	**L28**	3
30	**L29**	2
31	**L30**	10
32	**L31**	8
33	**L32**	2
34	**L33**	2
35	**L34**	0
36	**L35**	5
37[b]	**$PdCl_2$(Xantphos)**	**39**
38[b]	**Pd(Xantphos)$(OTf)_2(CH_3CN)_2$**	36

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2(CH_3CN)_2$ (0.01 mmol, 2 mol%), Ligand (**L1-L16** 0.021 mmol, 4.2 mol%; **L17-L35** 0.011 mmol , 2.2 mol%), toluene (2.0 mL), 120 °C (extern temperature), 12 h, CO (2 MPa). GC yield. [b] catalyst (0.01 mmol, 2 mol%).

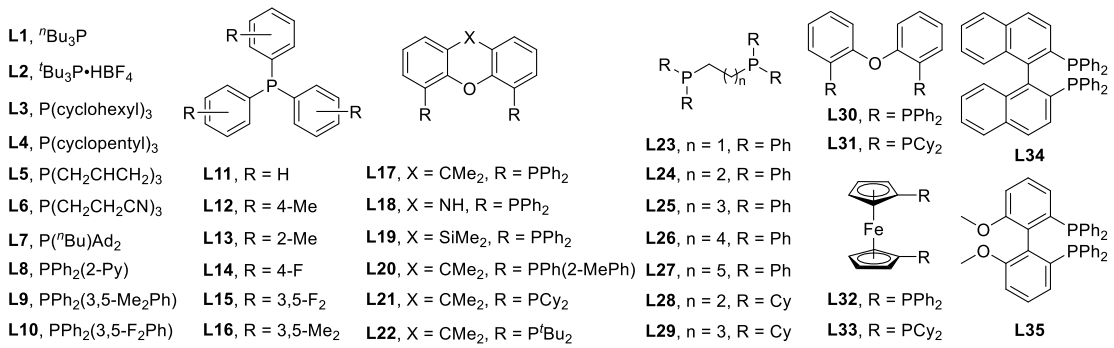
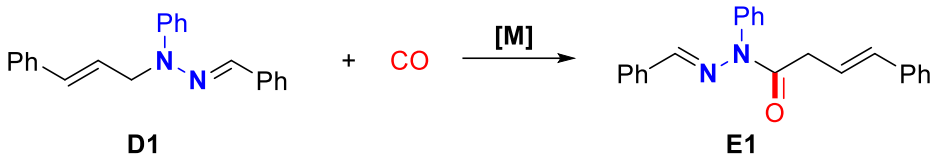


Table S21. The difference of solvent screening [a]

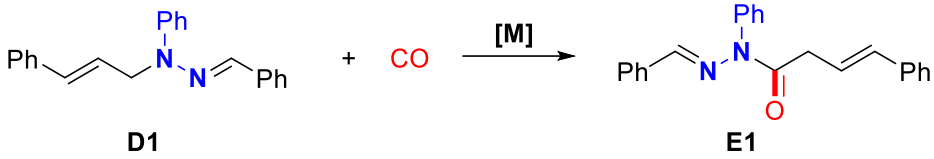


D1 **E1**

Entry	Solvent (2 mL)	**D1** (%)
1	anisole	35
2	THF	<5
3	1,4-dioxane	23
4	DME	12
5	**toluene**	**39**
6	xylene	19
7	mesitylene	33
8	DCM	5
9	CH_3CN	0
10	pyridine	<5
11	methanol	0
12	ethanol	0
13	isopropanol	0
14	*t*-AmOH	<5
15	DMF	0
16	DMAc	0
17	NMP	0
18	DMSO	0

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), solvent (2.0 mL), 120 °C (extern temperature),12 h, CO (2 MPa), GC yield.

Table S22. The loading of solvent screening [a]

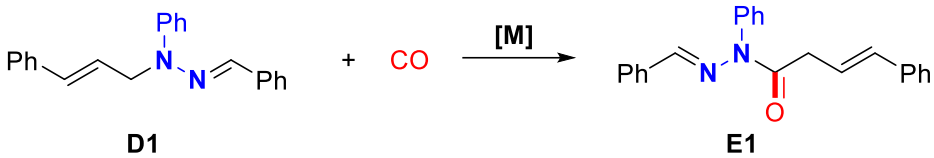


D1 **E1**

Entry	toluene (mL)	**D1** (%)
1	0.5	11
2	1.0	27
3	1.5	35
4	**2.0**	**39**
5	3.0	39

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (x mL), 120 °C (extern temperature), 12 h, CO (2 MPa), GC yield.

Table S23. The Pd-catalyst loading screening [a]

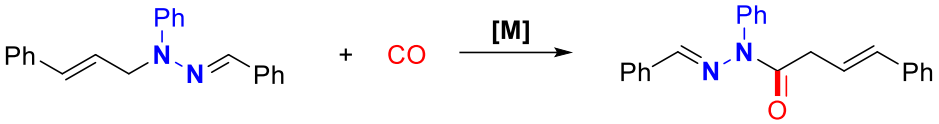


D1 **E1**

Entry	Pd-catalyst	D1 (%)
1	0	0
2	0.001	5
3	0.002	13
4	0.005	28
5	**0.01**	**39**
6	0.02	39

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2$(Xantphos) (x mol%), toluene (2.0 mL), 120 °C (extern temperature),12 h, CO (2 MPa), GC yield.

Table S24. Reaction pressure screening [a]



D1 **E1**

Entry	CO (MPa)	D1 (%)
1	1	23
2	2	39
3	3	59
4	**4**	**68**
5	5	68

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 120 °C (extern temperature), 12 h, CO (x MPa), GC yield.

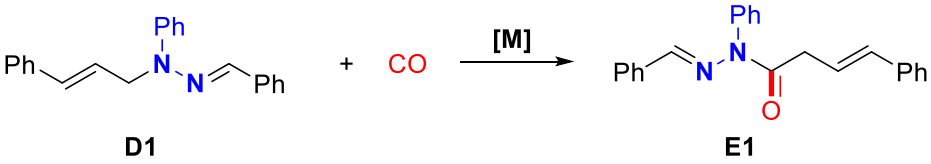
Table S25. Reaction temperature screening [a]

D1 **E1**

Entry	T (° C)	**D1** (%)
1	40	0
2	60	29
3	80	45
4	100	62
5	**120**	**68**
6	140	68

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), T °C (extern temperature), 12 h, CO (4 MPa), GC yield.

Table S26. Reaction time screening [a]

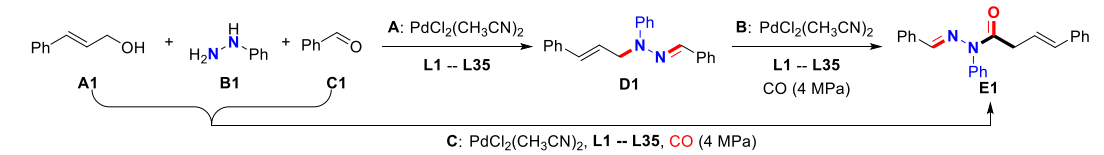


D1 **E1**

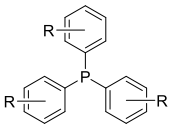
Entry	t (h)	**D1** (%)
1	3	15
2	6	33
3	9	54
4	12	68
5	14	77
6	16	81
7	**18**	**83 (76[b])**
8	21	83

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%), toluene (2.0 mL), 120 °C (extern temperature), x h, CO (4 MPa), GC yield. [b] Isolated yield.

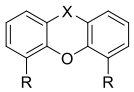
Table S27. Optimization of Reaction Conditions [a]



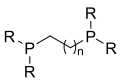
L1, $^{n}Bu_3P$
L2, $^{t}Bu_3P{\cdot}HBF_4$
L3, P(cyclohexyl)$_3$
L4, P(cyclopentyl)$_3$
L5, P(CH$_2$CHCH$_2$)$_3$
L6, P(CH$_2$CH$_2$CN)$_3$
L7, P(^{n}Bu)Ad$_2$
L8, PPh$_2$(2-Py)
L9, PPh$_2$(3,5-Me$_2$Ph)
L10, PPh$_2$(3,5-F$_2$Ph)



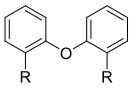
L11, R = H
L12, R = 4-Me
L13, R = 2-Me
L14, R = 4-F
L15, R = 3,5-F$_2$
L16, R = 3,5-Me$_2$



L17, X = CMe$_2$, R = PPh$_2$
L18, X = NH, R = PPh$_2$
L19, X = SiMe$_2$, R = PPh$_2$
L20, X = CMe$_2$, R = PPh(2-MePh)
L21, X = CMe$_2$, R = PCy$_2$
L22, X = CMe$_2$, R = P^{t}Bu$_2$

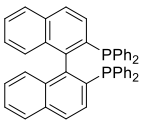


L23, n = 1, R = Ph
L24, n = 2, R = Ph
L25, n = 3, R = Ph
L26, n = 4, R = Ph
L27, n = 5, R = Ph
L28, n = 2, R = Cy
L29, n = 3, R = Cy

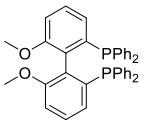


L30, R = PPh$_2$
L31, R = PCy$_2$

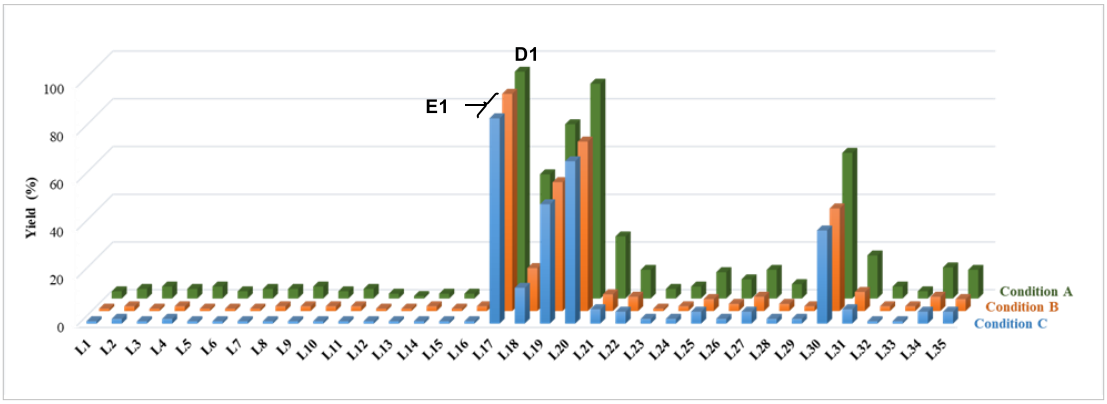
L32, R = PPh$_2$
L33, R = PCy$_2$



L34



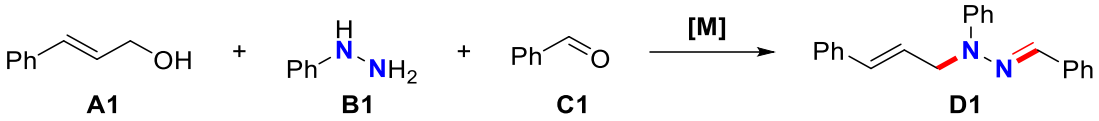
L35



[a]Conditions A: **A1** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol), $PdCl_2(CH_3CN)_2$ (2 mol.%), **L** (2.2 mol.% or 4.2 mol.%), toluene (2.0 mL), 60 °C, N_2, 4 h. Conditions B: **D1** (0.5 mmol), $PdCl_2(CH_3CN)_2$ (2 mol.%), L (2.2 mol.% or 4.2 mol.%), toluene (2.0 mL), 120 °C, CO (4 MPa), 18 h. Conditions C: **A1** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol), $PdCl_2(CH_3CN)_2$ (2 mol.%), L (2.2 mol.% or 4.2 mol.%), toluene (2.0 mL), 120 °C, CO (4 MPa), 12 h.

3.4 Screening of parameters with nickel salts

Table R1 Screening of allylation parameters with nickel salts [a]

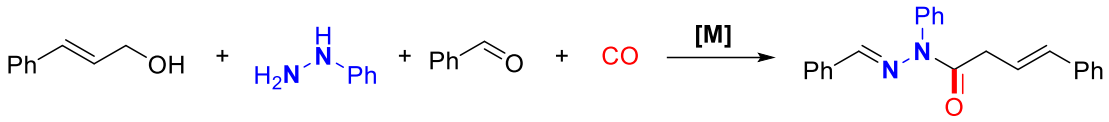


Entry	Catalyst	Ligand	Solvent (2 mL)	T (°C)	t (h)	**D1** (%)
1	$NiCl_2$	-	anisole	60	4	0
2	$NiBr_2$	-	anisole	60	4	0
3	NiI_2	-	anisole	60	4	0
4	$Ni(OAc)_2{\cdot}4H_2O$	-	anisole	60	4	0
5	$NiCl_2{\cdot}DME$	-	anisole	60	4	0
6	$Ni(COD)_2$	-	anisole	60	4	0
7	$Ni(acac)_2$	-	anisole	60	4	0
8	$NiCl_2{\cdot}DME$	DPPM	anisole	60	4	0
9	$NiCl_2{\cdot}DME$	DPPF	anisole	60	4	0
10	$NiCl_2{\cdot}DME$	PPh_3	anisole	60	4	0
11	$NiCl_2{\cdot}DME$	Xantphos	anisole	60	4	0(0)[b]
12	$NiCl_2{\cdot}DME$	1,10-phen	anisole	60	4	0
13	$NiCl_2{\cdot}DME$	bpy	anisole	60	4	0
14	$NiCl_2{\cdot}DME$	-	DMSO	60	4	0
15	$NiCl_2{\cdot}DME$	-	CH_3CN	60	4	0
16	$NiCl_2{\cdot}DME$	-	DCE	60	4	0
17	$NiCl_2{\cdot}DME$	-	anisole	120	4	0
18	$NiCl_2{\cdot}DME$	-	anisole	120	12	0

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), catalyst (0.01 mmol, 5 mol%), ligand (5 mol% / 10 mol%), solvent (2.0 mL), T (extern temperature),

x h, N_2. Isolated yield. [b] AgOTf (0.02 mmol, 10 mol%).

Table R2 Screening of tandem carbonylation parameters with nickel salts [a]

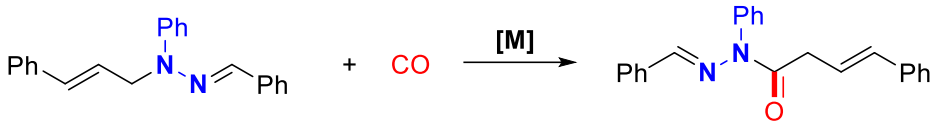


A1 **B1** **C1** **E1**

Entry	Catalyst	Ligand	Solvent (2 mL)	T (°C)	t (h)	**D1** (%)
1	$NiCl_2$	-	anisole	120	12	0
2	$NiBr_2$	-	anisole	120	12	0
3	NiI_2	-	anisole	120	12	0
4	$Ni(OAc)_2{\cdot}4H_2O$	-	anisole	120	12	0
5	$NiCl_2{\cdot}DME$	-	anisole	120	12	0
6	$Ni(COD)_2$	-	anisole	120	12	0
7	$Ni(acac)_2$	-	anisole	120	12	0
8	$NiCl_2{\cdot}DME$	DPPM	anisole	120	12	0
9	$NiCl_2{\cdot}DME$	DPPF	anisole	120	12	0
10	$NiCl_2{\cdot}DME$	PPh_3	anisole	120	12	0
11	$NiCl_2{\cdot}DME$	Xantphos	anisole	120	12	0(0)[b]
12	$NiCl_2{\cdot}DME$	1,10-phen	anisole	120	12	0
13	$NiCl_2{\cdot}DME$	bpy	anisole	120	12	0
14	$NiCl_2{\cdot}DME$	-	DMSO	120	12	0
15	$NiCl_2{\cdot}DME$	-	CH_3CN	120	12	0
16	$NiCl_2{\cdot}DME$	-	DCE	120	12	0
17	$NiCl_2{\cdot}DME$	-	anisole	120	24	0

[a] Reaction conditions: **A1** (0.75 mmol, 100.6 mg), **B1** (0.5 mmol, 49 μL), **C1** (0.7 mmol, 72 μL), catalyst (0.01 mmol, 5 mol%), ligand (5 mol% / 10 mol%), solvent (2.0 mL), 120 °C, x h, CO (2.0 MPa), GC yield. [b] AgOTf (0.02 mmol, 10 mol%).

Table R3 Screening of carbonylation from allylhydrazone parameters with nickel salts [a]



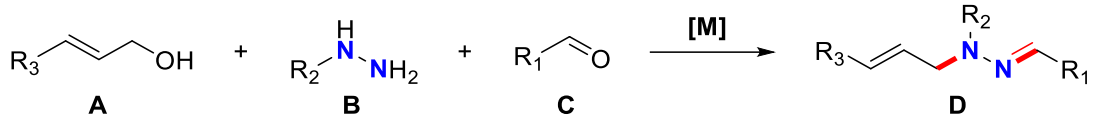
D1 **E1**

Entry	Catalyst	Ligand	Solvent (2 mL)	T (°C)	t (h)	**D1** (%)
1	$NiCl_2$	-	anisole	120	12	0
2	$NiBr_2$	-	anisole	120	12	0
3	NiI_2	-	anisole	120	12	0
4	$Ni(OAc)_2{\cdot}4H_2O$	-	anisole	120	12	0
5	$NiCl_2{\cdot}DME$	-	anisole	120	12	0
6	$Ni(COD)_2$	-	anisole	120	12	0
7	$Ni(acac)_2$	-	anisole	120	12	0
8	$NiCl_2{\cdot}DME$	DPPM	anisole	120	12	0
9	$NiCl_2{\cdot}DME$	DPPF	anisole	120	12	0
10	$NiCl_2{\cdot}DME$	PPh_3	anisole	120	12	0
11	$NiCl_2{\cdot}DME$	Xantphos	anisole	120	12	0(0)[b]
12	$NiCl_2{\cdot}DME$	1,10-phen	anisole	120	12	0
13	$NiCl_2{\cdot}DME$	bpy	anisole	120	12	0
14	$NiCl_2{\cdot}DME$	-	DMSO	120	12	0
15	$NiCl_2{\cdot}DME$	-	CH_3CN	120	12	0
16	$NiCl_2{\cdot}DME$	-	DCE	120	12	0
17	$NiCl_2{\cdot}DME$	-	anisole	120	24	0

[a] Reaction conditions: **D1** (0.5 mmol, 156.1 mg), catalyst (0.01 mmol, 5 mol%), ligand (5 mol% / 10 mol%), solvent (2.0 mL), 120 °C, x h, CO (2.0 MPa), GC yield. [b] AgOTf (0.02 mmol, 10 mol%).

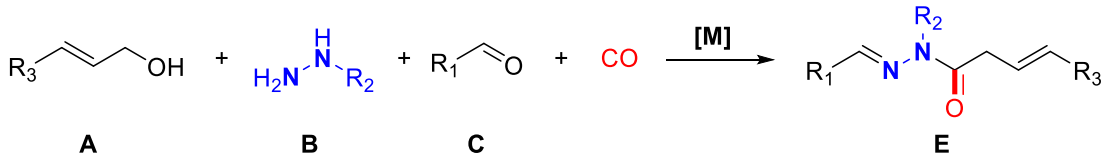
4. General Procedure for the products

4.1 Screening of tandem allylation reaction parameters



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), hydrazines (**B** 0.5 mmol), aldehydes (**C** 0.7 mmol), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%) and allyl alcohol (**A** 0.75 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the products **D1-D61** in the reported yields.

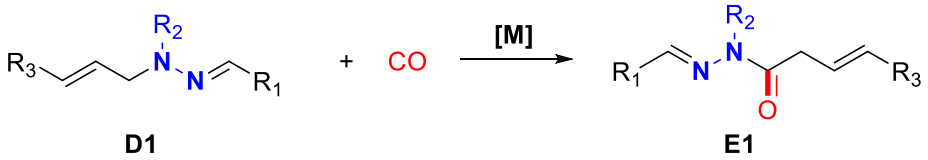
4.2 Screening of allylation/ carbonylation parameters



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, hydrazines (**B** 0.5 mmol), aldehydes (**C** 0.7 mmol), toluene (2.0 mL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%) and allyl alcohol (**A** 0.75 mmol). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 °C) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. Then a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum

ether/ ethyl acetate = 20:1 – 5:1) on silica gel to give the products **E1-E25** in the reported yields.

4.3 Screening of carbonylation of allyhydrazones parameters

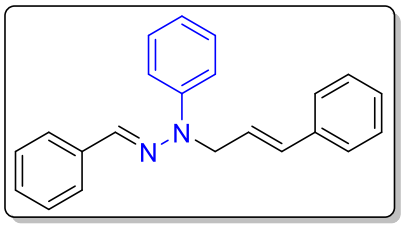


D1 **E1**

Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, allyl hydrazones (**D** 0.5 mmol), toluene (2.0 mL) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4 MPa) and immersed into a pre-heated metal bath (120 ℃) for 18 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. Then a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/ethyl acetate = 20:1 – 5:1) on silica gel to give the products **E1-E25** in the reported yields.

5. Characterization data

2-((*E*)-benzylidene)-1-cinnamyl-1-phenylhydrazine (D1)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 95% yield (148.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.65 (m, 2H), 7.57 – 7.16 (m, 13H), 6.95 (t, *J* = 7.2 Hz, 1H), 6.52 – 6.40 (m, 1H), 6.31 – 6.22 (m, 1H), 4.71 (dd, *J* = 4.0, 2.0 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 136.6, 136.3, 132.4, 131.3, 129.1, 128.6, 127.9, 127.7, 126.4, 126.2, 121.7, 120.7, 114.9, 48.5.

HRMS (ESI) calcd. for $C_{22}H_{21}N_2$ [M+H]: 313.1699, found: 313.1695.

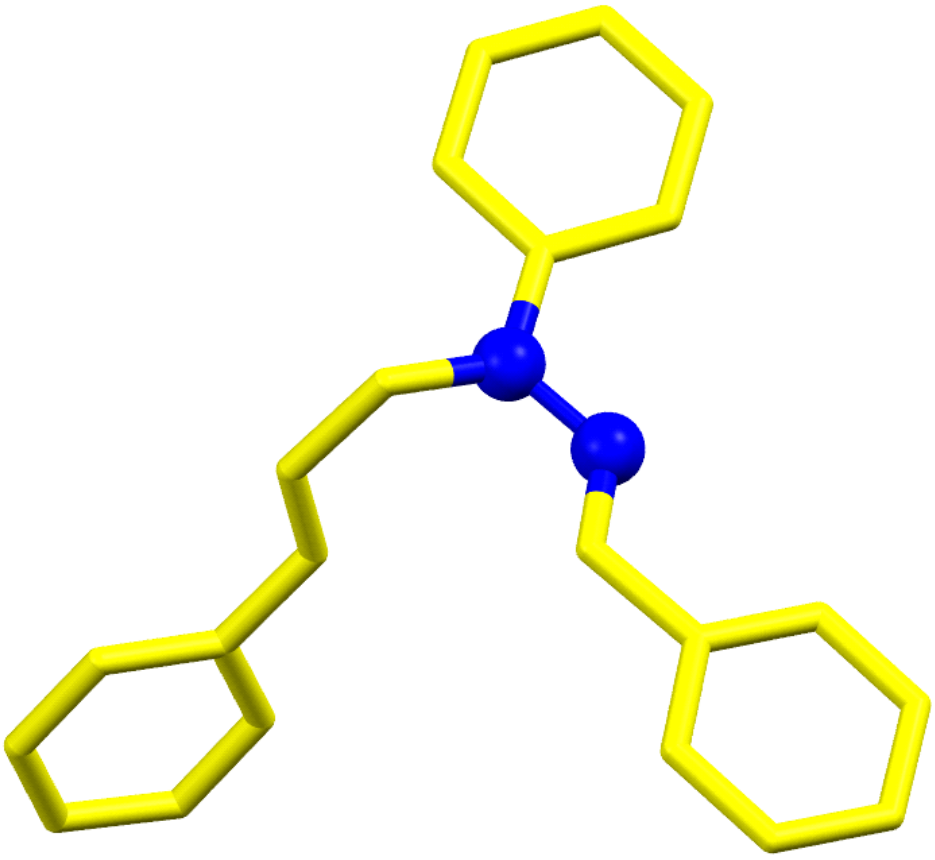
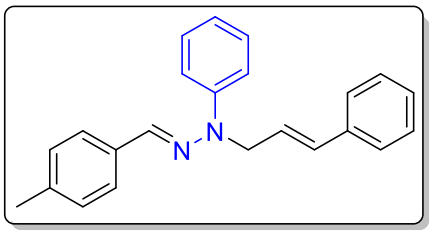


Figure S1 X-ray of D1 (CCDC 2249897)

1-cinnamyl-2-((*E*)-4-methylbenzylidene)-1-phenylhydrazine (D2)



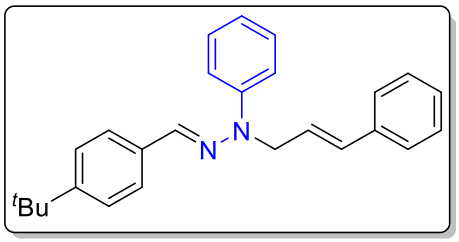
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 94 % yield (153.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (d, *J* = 8.0 Hz, 2H), 7.45 (s, 1H), 7.43 – 7.36 (m, 2H), 7.35 – 7.27 (m, 4H), 7.23 (t, *J* = 7.2 Hz, 2H), 7.20 – 7.09 (m, 3H), 6.92 (t, *J* = 7.2 Hz, 1H), 6.46 – 6.37 (m,1H), 6.26 – 6.16 (m,1H), 4.69 – 4.53 (m, 2H), 2.32 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 137.9, 136.5, 134.0, 132.7, 131.3, 129.4, 129.2, 128.7, 127.8, 126.5, 126.3, 122.0, 120.6, 114.9, 48.5, 21.5.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1853.

2-((*E*)-4-(tert-butyl)benzylidene)-1-cinnamyl-1-phenylhydrazine (D3)



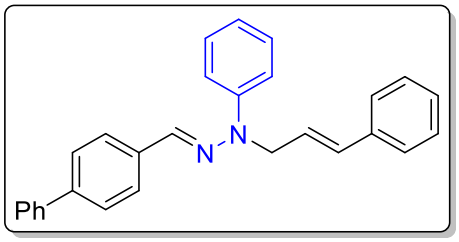
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 81% yield (149.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 – 7.57 (m, 2H), 7.49 – 7.11 (m, 13H), 6.95 – 6.86 (m, 1H), 6.45 – 6.34 (m,1H), 6.28 – 6.14 (m, 1H), 4.60 (s, 1H), 1.37 – 1.19 (m, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 151.2, 147.8, 136.5, 134.1, 132.6, 131.3, 129.3, 128.7, 127.8, 126.5, 126.1, 125.7, 121.9, 120.6, 114.9, 48.5, 34.8, 31.5.

HRMS (ESI) calcd. for $C_{26}H_{29}N_2$ [M+H]: 369.2325, found: 369.2330.

(*E*)-2-([1,1'-biphenyl]-4-ylmethylene)-1-cinnamyl-1-phenylhydrazine (D4)



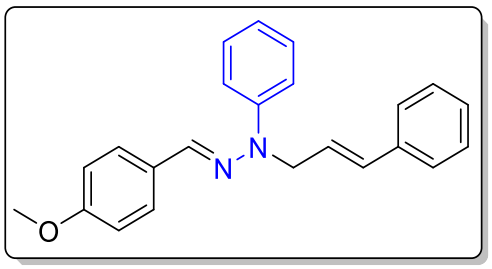
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 96 % yield (186.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.65 (m, 2H), 7.63 – 7.09 (m, 17H), 6.94 (t, *J* = 7.2 Hz, 1H), 6.40 (d, *J* = 16.0 Hz, 1H), 6.22 – 6.12 (m,1H), 4.68 – 4.47 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.7, 140.9, 140.6, 136.5, 135.9, 132.2, 131.5, 129.4, 129.0, 128.8, 127.9, 127.5, 127.1, 126.8, 126.6, 121.9, 121.0, 115.1, 48.57.

HRMS (ESI) calcd. for $C_{28}H_{25}N_2$ [M+H]: 389.2012, found: 389.2013.

1-cinnamyl-2-((*E*)-4-methoxybenzylidene)-1-phenylhydrazine (D5)



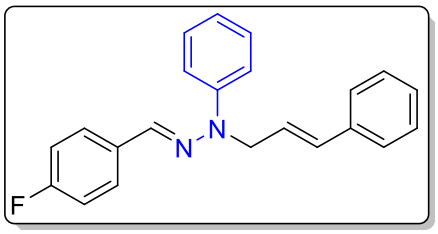
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 88 % yield (150.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.57 (m, 2H), 7.45 – 7.10 (m, 10H), 6.95 – 6.82 (m, 3H), 6.44 – 6.35 (m, 1H), 6.22 – 6.13 (m, 1H), 4.61 – 4.51 (m, 2H), 3.72 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.8, 147.8, 136.6, 132.5, 131.3, 129.7, 129.3, 128.7, 127.8, 127.7, 126.5, 122.2, 120.5, 114.8, 114.2, 55.4, 48.5.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2O$ [M+H]: 343.1805, found: 343.1804.

1-cinnamyl-2-((*E*)-4-fluorobenzylidene)-1-phenylhydrazine (D6)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 92% yield (151.9 mg).

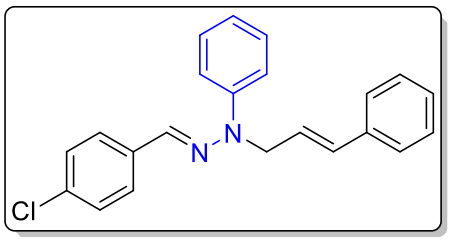
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (dd, *J* = 8.8, 5.6 Hz, 2H), 7.48 – 7.16 (m, 10H), 7.08 – 6.88 (m, 3H), 6.49 – 6.37 (m, 1H), 6.31 – 6.18 (m,1H), 4.71 – 4.62 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 162.6 (d, *J* = 248.46 Hz), 147.6, 136.4, 132.9, 131.4, 131.3, 129.2, 128.6, 127.8, 127.7, 126.4, 121.3 (d, *J* = 91.91 Hz), 115.6 (d, *J* = 22.22 Hz), 48.6.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -113.7.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1600.

1-((*E*)-4-chlorobenzylidene)-1-cinnamyl-1-phenylhydrazine (D7)



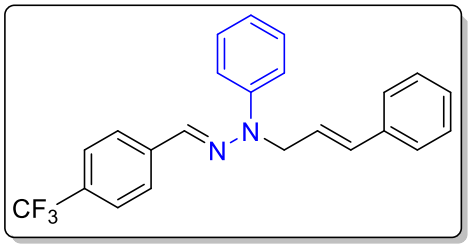
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 90% yield (155.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.55 (d, *J* = 8.4 Hz, 2H), 7.43 – 7.11 (m, 12H), 6.93 (t, *J* = 7.2 Hz, 1H), 6.43 – 6.33 (m, 1H), 6.22 – 6.10 (m, 1H), 4.65 – 4.49 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 136.4, 135.4, 133.4, 131.5, 131.1, 129.4, 128.9, 128.8, 128.0, 127.5, 126.6, 121.7, 121.2, 115.1, 48.6.

HRMS (ESI) calcd. for $C_{22}H_{20}ClN_2$ [M+H]: 347.1309, found: 347.1313.

1-cinnamyl-1-phenyl-2-((*E*)-4-(trifluoromethyl)benzylidene)hydrazine (D8)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 86% yield (163.5 mg).

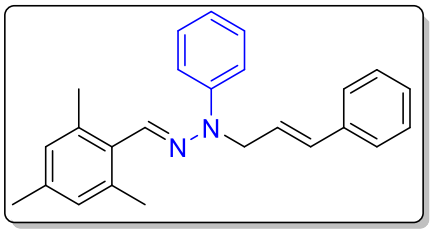
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.0 Hz, 2H), 7.55 (d, *J* = 8.0 Hz, 2H), 7.47 – 7.14 (m, 10H), 7.02 – 6.91 (m, 1H), 6.45 – 6.36 (m,1H), 6.24 – 6.15 (m,1H), 4.68 – 4.56 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.4, 140.2, 136.3, 131.6, 130.5, 129.4, 128.7, 128.0, 126.5, 126.2, 125.6 (q, *J* = 8.08, 4.04 Hz), 124.5 (q, *J* = 490.86, 272.70 Hz), 121.6, 121.3, 115.4, 48.7.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -62.1.

HRMS (ESI) calcd. for $C_{23}H_{20}F_3N_2$ [M+H]: 381.1573, found: 381.1576.

1-cinnamyl-1-phenyl-2-((*E*)-2,4,6-trimethylbenzylidene)hydrazine (D9)



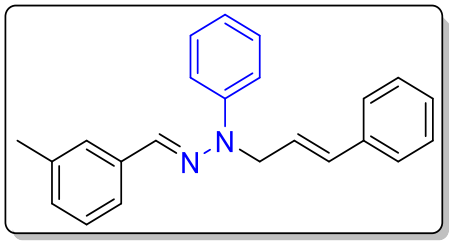
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 73 % yield (129.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 (s, 1H), 7.38 – 7.13 (m, 9H), 6.94 – 6.82 (m, 3H), 6.51 – 6.39 (m, 1H), 6.28 – 6.17 (m, 1H), 4.73 – 4.62 (m, 2H), 2.43 (s, 6H), 2.25 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 137.1, 136.6, 136.5, 133.3, 131.7, 130.3, 129.6, 129.3, 128.7, 127.8, 126.4, 121.7, 120.4, 114.6, 48.2, 21.9, 21.2.

HRMS (ESI) calcd. for $C_{25}H_{27}N_2$ [M+H]: 355.2168, found: 355.2162.

1-cinnamyl-2-((*E*)-3-methylbenzylidene)-1-phenylhydrazine (D10)



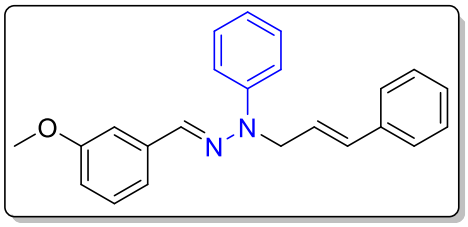
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 93 % yield (151.7 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 – 7.38 (m, 5H), 7.36 – 7.26 (m, 4H), 7.26 – 7.19 (m, 3H), 7.19 – 7.13 (m, 1H), 7.04 (d, *J* = 7.6 Hz, 1H), 6.96 – 6.89 (m,1H), 6.44 – 6.35 (m, 1H), 6.24 – 6.15 (m, 1H), 4.67 – 4.56 (m, 2H), 2.34 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 175.6, 147.9, 147.2, 142.9, 142.1, 136.3, 130.2, 129.2, 129.2, 128.7, 127.6, 126.8, 126.6, 122.5, 114.6, 108.1, 56.0, 43.3, 19.7.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1858.

1-cinnamyl-2-((*E*)-3-methoxybenzylidene)-1-phenylhydrazine (D11)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 85% yield (145.4 mg).

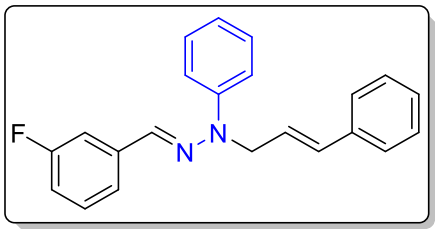
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 – 7.38 (m, 3H), 7.37 – 7.12 (m, 10H), 6.97 – 6.90 (m, 1H), 6.84 – 6.76 (m, 1H), 6.46 – 6.38 (m, 1H), 6.26 – 6.16 (m, 1H), 4.67 – 4.60 (m,

2H), 3.81 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.0, 147.6, 138.2, 136.4, 132.3, 131.4, 129.7, 129.3, 128.7, 127.8, 126.5, 121.7, 120.9, 119.4, 115.0, 114.0, 110.8, 55.4, 48.6.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2O$ [M+H]: 343.1805, found: 343.1805.

2-cinnamyl-2-((*E*)-3-fluorobenzylidene)-1-phenylhydrazine (D12)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 90% yield (148.6 mg).

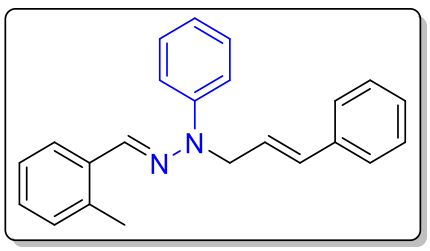
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.09 (m, 13H), 7.00 – 6.83 (m, 2H), 6.41 (d, *J* = 16.0 Hz, 1H), 6.26 – 6.13 (m, 1H), 4.67 – 4.56 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 163.3 (d, *J* = 246.44 Hz), 147.5, 139.2 (d, *J* = 7.07 Hz), 136.3, 131.5, 131.0, 130.1 (d, *J* = 95.95 Hz), 129.3, 128.7, 128.0, 126.5, 122.4, 121.5, 121.2, 115.2, 114.7 (d, *J* = 21.21 Hz), 112.2 (d, *J* = 22.22 Hz), 48.6.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -113.1.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1605.

1-cinnamyl-2-((*E*)-2-methylbenzylidene)-1-phenylhydrazine (D13)



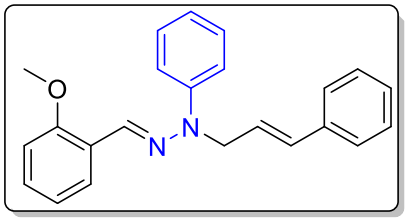
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 91 % yield (148.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 7.6 Hz, 1H), 7.70 (s, 1H), 7.46 – 7.07 (m, 11H), 6.97 – 6.89 (m, 1H), 6.50 – 6.40 (m, 2H), 6.25 – 6.15 (m, 1H), 4.69 – 4.58 (m, 2H), 2.40 (d, *J* = 1.2 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 136.5, 135.4, 134.6, 131.8, 131.6, 130.8, 129.3, 128.7, 127.8, 126.5, 126.3, 126.0, 121.7, 120.8, 115.0, 48.6, 20.2.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1857.

1-cinnamyl-2-((*E*)-2-methoxybenzylidene)-1-phenylhydrazine (D14)



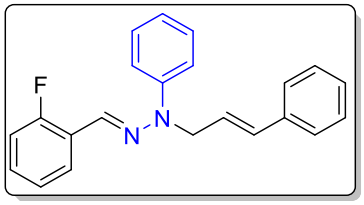
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 81% yield (138.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (dd, *J* = 8.0, 2.0 Hz, 1H), 7.90 (s, 1H), 7.46 – 7.36 (m, 2H), 7.35 – 7.09 (m, 8H), 7.01 – 6.84 (m, 2H), 7.01 – 6.86 (m,1H), 6.43 (d, *J* = 16.0 Hz, 1H), 6.24 – 6.13 (m, 1H), 4.68 – 4.57 (m, 2H), 3.72 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 157.1, 147.9, 136.7, 131.5, 129.3, 129.1, 128.7, 128.5, 127.7, 126.6, 125.6, 125.4, 122.1, 120.6, 114.9, 111.2, 55.7, 48.4.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2O$ [M+H]: 343.1805, found: 343.1800.

1-cinnamyl-2-((*E*)-2-fluorobenzylidene)-1-phenylhydrazine (D15)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 87% yield (143.6 mg).

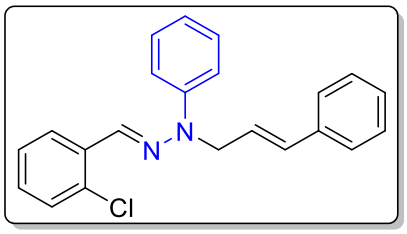
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 – 8.01 (m, 1H), 7.70 (s, 1H), 7.48 – 7.07 (m, 11H), 7.06 – 6.90 (m, 2H), 6.51 – 6.41 (m,1H), 6.28 – 6.19 (m,1H), 4.75 – 4.63 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.6 (d, *J* = 249.47 Hz), 147.5, 136.4, 131.7, 129.2, 129.1 (d, *J* = 8.08 Hz), 128.9, 128.6, 127.8, 126.5, 125.9, 125.3, 124.4 (d, *J* = 10.10 Hz), 124.3, 124.2, 121.3, 121.1 (d, *J* = 26.26 Hz), 115.6 (d, *J* = 21.21 Hz), 115.1, 48.5.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -122.5.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1605.

3-((*E*)-2-chlorobenzylidene)-1-cinnamyl-1-phenylhydrazine (D16)



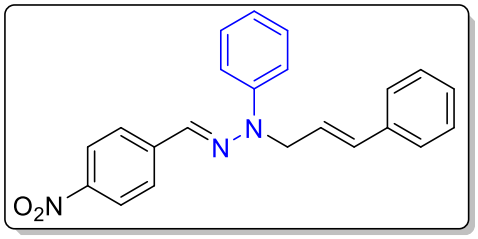
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 85% yield (147.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12 – 8.04 (m, 1H), 7.87 (s, 1H), 7.48 – 7.03 (m, 12H), 6.95 (t, *J* = 7.2 Hz, 1H), 6.47 (d, *J* = 16.0 Hz, 1H), 6.21 – 6.10 (m, 1H), 4.69 – 4.56 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.5, 136.5, 134.0, 133.0, 132.3, 129.8, 129.4, 129.3, 128.7, 127.9, 127.0, 126.6, 126.5, 121.4, 121.3, 115.3, 48.8.

HRMS (ESI) calcd. for $C_{22}H_{20}ClN_2$ [M+H]: 347.1309, found: 347.1304.

1-cinnamyl-2-((*E*)-4-nitrobenzylidene)-1-phenylhydrazine (D17)



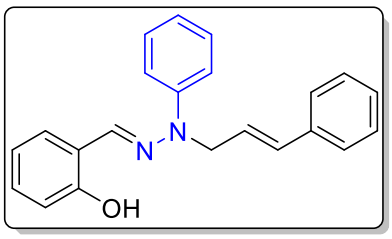
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give an orange-red solid in 86% yield (153.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 – 8.07 (m, 2H), 7.84 – 7.65 (m, 2H), 7.51 – 7.13 (m, 10H), 7.02 (t, *J* = 7.2 Hz, 1H), 6.49 – 6.36 (m, 1H), 6.30 – 6.17 (m, 1H), 4.76 – 4.62 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.0, 146.6, 143.1, 136.1, 131.8, 129.4, 128.7, 128.1, 126.5, 126.3, 124.1, 122.1, 120.9, 115.7, 49.0.

HRMS (ESI) calcd. for $C_{22}H_{20}N_3O_2$ [M+H]: 358.1550, found: 358.1546.

1-((*E*)-(2-cinnamyl-2-phenylhydrazineylidene)methyl)phenol (D18)



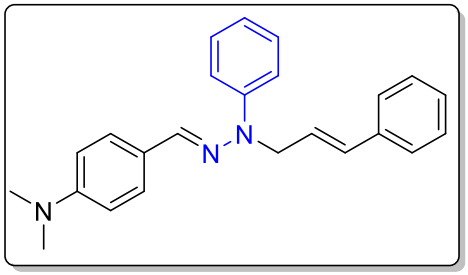
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 65% yield (106.7 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 11.45 (s, 1H), 7.62 (s, 1H), 7.43 – 7.09 (m, 11H), 7.04 – 6.95 (m, 2H), 6.88 – 6.81 (m, 1H), 6.53 – 6.42 (m, 1H), 6.30 – 6.18 (m, 1H), 4.70 – 4.63 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.8, 146.7, 137.3, 136.1, 131.9, 129.7, 129.6, 129.5, 128.7, 128.0, 126.5, 121.9, 121.2, 119.5, 119.4, 116.6, 115.4, 49.3.

HRMS (ESI) calcd. for $C_{22}H_{21}N_2O$ [M+H]: 329.1648, found: 329.1651.

4-((*E*)-(2-cinnamyl-2-phenylhydrazineylidene)methyl)-N,N-dimethylaniline (D19)



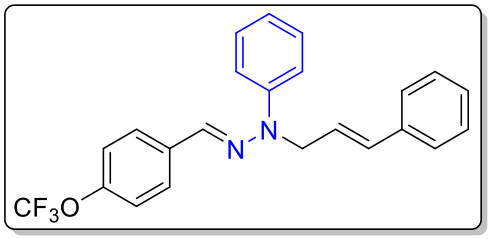
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 63% yield (111.9 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.54 (m, 2H), 7.48 (s, 1H), 7.44 – 7.15 (m, 9H), 6.93 – 6.86 (m, 1H), 6.77 – 6.64 (m, 2H), 6.51 – 6.40 (m, 1H), 6.34 – 6.22 (m, 1H), 4.72 – 4.62 (m, 2H), 2.97 (s, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 136.6, 133.6, 131.1, 129.1, 128.6, 127.6, 127.4, 126.4, 122.4, 119.8, 114.4, 112.3, 48.5, 40.5.

HRMS (ESI) calcd. for $C_{24}H_{26}N_3$ [M+H]: 356.2121, found: 356.2121.

1-cinnamyl-1-phenyl-2-((*E*)-4-(trifluoromethoxy)benzylidene)hydrazine (D20)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 85% yield (168.4 mg).

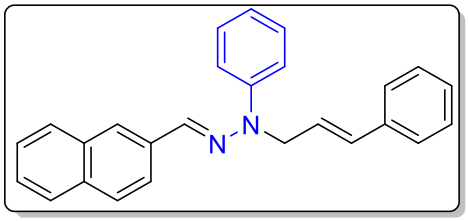
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (dd, *J* = 8.8, 2.4 Hz, 2H), 7.54 – 7.11 (m, 12H), 6.95 (t, *J* = 7.2 Hz, 1H), 6.39 (dd, *J* = 16.0, 2.4 Hz, 1H), 6.24 – 6.11 (m, 1H), 4.58 (t, *J* = 2.8 Hz, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.8, 148.7, 147.6, 136.0, 131.5, 130.8, 129.4, 128.8, 128.0, 127.4, 126.5, 121.5, 121.3, 121.2, 120.7 (q, *J* = 515.10, 257.55 Hz), 115.2, 48.6.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -57.5.

HRMS (ESI) calcd. for $C_{23}H_{20}F_3N_2O$ [M+H]: 397.1522, found: 397.1522.

(*E*)-1-cinnamyl-2-(naphthalen-2-ylmethylene)-1-phenylhydrazine (D21)



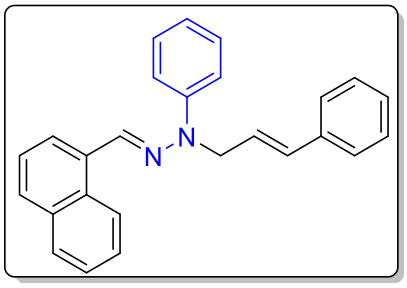
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 83% yield (150.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.64 – 8.51 (m, 1H), 8.19 (s, 1H), 8.01 – 7.93 (m, 1H), 7.89 – 7.71 (m, 2H), 7.58 – 7.15 (m, 12H), 7.02 – 6.93 (m, 1H), 6.61 – 6.49 (m, 1H), 6.36 – 6.25 (m, 1H), 4.85 – 4.70 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.7, 136.4, 134.1, 132.1, 131.8, 131.6, 130.7, 129.3, 128.8, 128.7, 128.4, 127.8, 126.5, 125.8, 125.7, 125.2, 124.0, 121.8, 120.9, 115.1, 48.7.

HRMS (ESI) calcd. for $C_{26}H_{23}N_2$ [M+H]: 363.1855, found: 363.1855.

(*E*)-1-cinnamyl-2-(naphthalen-1-ylmethylene)-1-phenylhydrazine (D22)



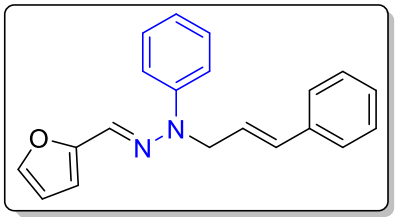
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 44% yield (79.7 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 – 8.04 (m, 1H), 7.90 – 7.75 (m, 4H), 7.67 (s, 1H), 7.53 – 7.12 (m, 11H), 7.03 – 6.93 (m, 1H), 6.55 – 6.45 (m, 1H), 6.36 – 6.27 (m, 1H), 4.81 – 4.68 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 136.4, 134.4, 133.6, 133.3, 132.6, 131.4, 129.2, 128.6, 128.3, 127.9, 127.8, 126.6, 126.4, 126.3, 125.9, 123.1, 121.8, 120.8, 115.0, 48.7.

HRMS (ESI) calcd. for $C_{26}H_{23}N_2$ [M+H]: 363.1855, found: 363.1852.

(*E*)-1-cinnamyl-2-(furan-2-ylmethylene)-1-phenylhydrazine (D23)



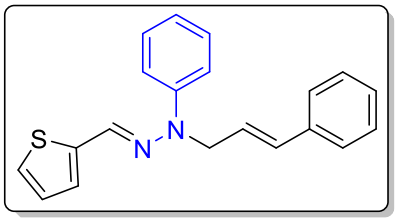
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 87% yield (131.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44 – 7.12 (m, 11H), 6.93 (t, *J* = 7.2 Hz, 1H), 6.49 (d, *J* = 3.2 Hz, 1H), 6.45 – 6.34 (m, 2H), 6.29 – 6.16 (m, 1H), 4.68 – 4.57 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 152.2, 147.4, 142.4, 136.4, 131.5, 129.2, 128.7, 127.8, 126.5, 123.4, 121.5, 121.1, 115.2, 111.6, 108.9, 48.7.

HRMS (ESI) calcd. for $C_{20}H_{19}N_2O$ [M+H]: 303.1491, found: 303.1488.

(*E*)-1-cinnamyl-1-phenyl-2-(thiophen-2-ylmethylene)hydrazine (D24)



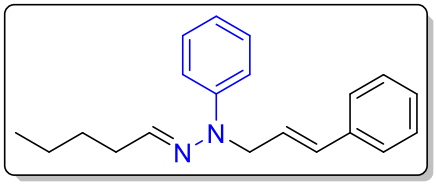
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 84% yield (133.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 (s, 1H), 7.50 – 7.13 (m, 10H), 7.07 – 6.87 (m, 3H), 6.51 – 6.39 (m, 1H), 6.29 – 6.15 (m, 1H), 4.69 – 4.58 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.3, 142.5, 136.4, 131.4, 129.2, 128.7, 127.8, 127.6, 127.3, 126.5, 125.9, 125.1, 121.6, 120.9, 114.9, 48.8.

HRMS (ESI) calcd. for $C_{20}H_{19}N_2S$ [M+H]: 319.1263, found: 319.1258.

***(E)*-1-cinnamyl-2-hexylidene-1-phenylhydrazine (D25)**



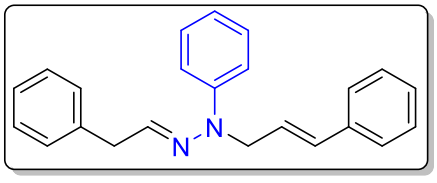
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 88% yield (128.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 – 7.22 (m, 8H), 7.22 – 7.15 (m, 1H), 6.90 – 6.77 (m, 2H), 6.40 – 6.31 (m, 1H), 6.20 – 6.10 (m, 1H), 4.52 – 4.41 (m, 2H), 2.41 – 2.28 (m, 2H), 1.59 – 1.46 (m, 2H), 1.36 (h, J = 7.2 Hz, 2H), 0.90 (t, J = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.1, 136.9, 136.7, 131.1, 129.1, 128.6, 127.6, 126.5, 126.4, 122.6, 119.8, 114.3, 48.5, 32.8, 29.7, 22.4, 14.1.

HRMS (ESI) calcd. for $C_{20}H_{25}N_2$ [M+H]: 293.2012, found: 293.2010.

(*E*)-1-phenyl-2-(2-phenylethylidene)-1-(3-phenylpropyl)hydrazine (D26)



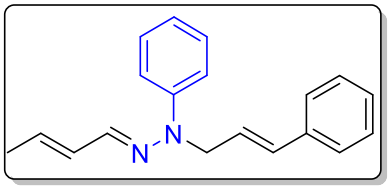
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 89% yield (145.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.05 (m, 14H), 6.93 – 6.79 (m, 2H), 6.40 – 6.25 (m, 1H), 6.12 – 5.97 (m, 1H), 4.50 – 4.34 (m, 2H), 3.72 – 3.60 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.0, 138.7, 136.7, 134.8, 131.4, 129.3, 129.1, 128.8, 128.7, 127.8, 126.6, 126.5, 122.5, 120.3, 114.7, 48.5, 39.7.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1853.

(*E*)-2-((*E*)-but-2-en-1-ylidene)-1-cinnamyl-1-phenylhydrazine (D27)



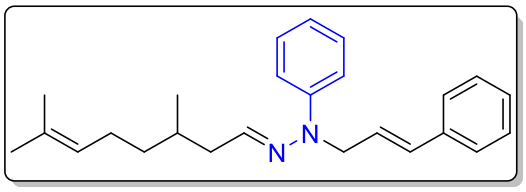
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 81% yield (121.5 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 – 7.07 (m, 12H), 6.97 – 6.84 (m, 1H), 6.48 – 6.24 (m, 2H), 6.23 – 6.13 (m, 1H), 5.93 – 5.76 (m, 1H), 4.59 – 4.49 (m, 2H), 1.87 – 1.76 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 136.5, 135.8, 131.7, 131.2, 130.4, 129.2, 128.7, 127.8, 127.7, 126.5, 122.2, 120.4, 115.0, 114.7, 48.5, 18.5.

HRMS (ESI) calcd. for $C_{19}H_{21}N_2$ [M+H]: 277.1699, found: 277.1697.

(*E*)-1-cinnamyl-2-(3,7-dimethyloct-6-en-1-ylidene)-1-phenylhydrazine (D28)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 80% yield (144.1 mg).

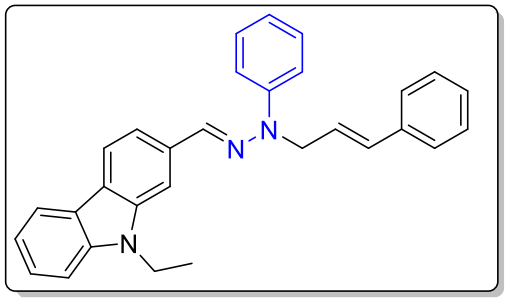
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.42 – 7.10 (m, 9H), 6.92 – 6.75 (m, 2H), 6.41 – 6.31 (m,1H), 6.19 – 6.08 (m,1H), 5.13 – 4.97 (m, 1H), 4.58 – 4.42 (m, 2H), 2.41 – 2.28 (m,1H), 2.25 – 2.13 (m, 1H), 2.08 – 1.89 (m, 2H), 1.79 – 1.62 (m, 4H), 1.57 (s, 2H),

1.46 – 1.12 (m, 3H), 0.92 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.1, 136.6, 135.9, 131.3, 131.1, 129.1, 128.6, 127.6, 126.4, 124.8, 122.4, 119.8, 114.4, 48.5, 40.2, 36.9, 31.8, 25.9, 25.6, 19.7, 17.8.

HRMS (ESI) calcd. for $C_{25}H_{33}N_2$ [M+H]: 361.2638, found: 361.2638.

2-((*E*)-(2-cinnamyl-2-phenylhydrazineylidene)methyl)-9-methyl-9H-carbazole (D29)



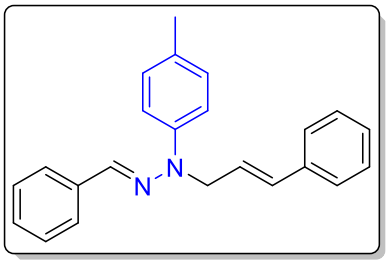
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 92 % yield (197.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35 – 8.29 (m, 1H), 8.15 – 8.08 (m, 1H), 7.96 – 7.88 (m, 1H), 7.73 (s, 1H), 7.51 – 7.41 (m, 3H), 7.41 – 7.32 (m, 6H), 7.31 – 7.15 (m, 4H), 6.89 – 7.00 (m, 1H), 6.56 – 6.46 (m, 1H), 6.40 – 6.26 (m, 1H), 4.79 – 4.65 (m, 2H), 4.32 (q, *J* = 7.2 Hz, 2H), 1.40 (t, *J* = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.9, 140.4, 140.0, 136.5, 134.2, 131.3, 129.2, 128.6, 127.9, 127.7, 126.5, 125.8, 124.1, 123.2, 122.3, 120.6, 120.2, 119.1, 118.9, 114.7, 108.7, 48.7, 37.7, 13.9.

HRMS (ESI) calcd. for $C_{30}H_{28}N_3$ [M+H]: 430.2278, found: 430.2276.

2-((*E*)-benzylidene)-1-cinnamyl-1-(p-tolyl)hydrazine (D30)



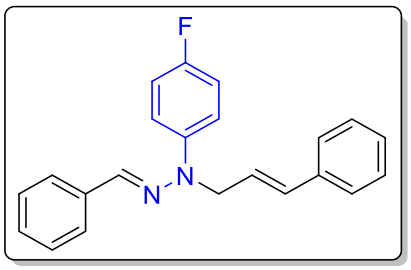
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 89% yield (145.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.61 (m, 2H), 7.40 (s, 1H), 7.35 – 7.07 (m, 12H), 6.45 – 6.32 (m, 1H), 6.22 – 6.11 (m, 1H), 4.62 – 4.48 (m, 2H), 2.28 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 145.7, 137.0, 136.6, 132.0, 131.4, 130.3, 129.9, 128.8, 127.9, 126.6, 126.3, 122.1, 115.3, 48.8, 20.8.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1856.

2-((*E*)-benzylidene)-1-cinnamyl-1-(4-fluorophenyl)hydrazine (D31)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 76% yield (125.5 mg).

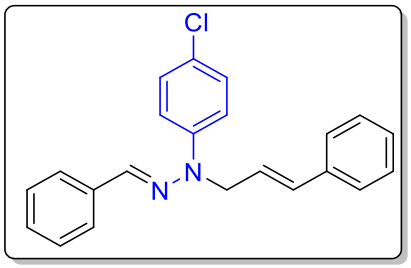
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.58 (m, 2H), 7.43 (s, 1H), 7.37 – 7.11 (m, 10H), 7.05 – 6.94 (m, 2H), 6.45 – 6.35 (m, 1H), 6.27 – 6.13 (m, 1H), 4.63 – 4.50 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 157.9 (d, *J* = 239.37 Hz), 144.2, 136.6, 136.4, 132.6, 131.5, 128.7, 128.6, 128.0, 126.5, 126.3, 121.7, 116.3 (d, *J* = 7.07 Hz), 115.7 (d, *J* = 22.22 Hz), 49.1.

^{19}F NMR (376 MHz, CDCl3) δ = -123.9.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1603.

2-((*E*)-benzylidene)-1-(4-chlorophenyl)-1-cinnamylhydrazine (D32)



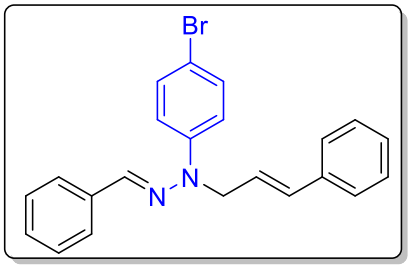
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 81% yield (140.2 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.61 (m, 2H), 7.47 (s, 1H), 7.38 – 7.13 (m, 12H), 6.38 (dt, *J* = 16.0, 2.0 Hz, 1H), 6.23 – 6.13 (m, 1H), 4.63 – 4.54 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 146.2, 136.4, 136.3, 133.2, 131.5, 129.1, 128.7, 128.3, 127.9, 126.5, 126.4, 125.6, 121.3, 116.0, 48.4.

HRMS (ESI) calcd. for $C_{22}H_{20}ClN_2$ [M+H]: 347.1309, found: 347.1306.

2-((*E*)-benzylidene)-1-(4-bromophenyl)-1-cinnamylhydrazine (D33)



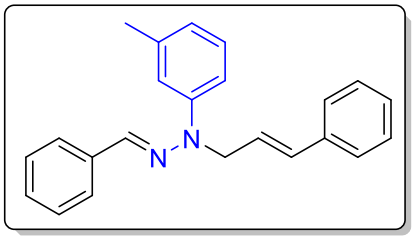
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a pink solid in 60% yield (117.0 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.60 (m, 2H), 7.54 – 7.11 (m, 13H), 6.42 – 6.30 (m, 1H), 6.20 – 6.12 (m, 1H), 4.62 – 4.50 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 146.7, 136.4, 136.3, 133.4, 132.0, 131.6, 128.8, 128.4, 128.0, 126.6, 126.5, 121.3, 116.4, 113.0, 48.2.

HRMS (ESI) calcd. for $C_{22}H_{20}BrN_2$ [M+H]: 391.0804, found: 391.0800.

2-((*E*)-benzylidene)-1-cinnamyl-1-(m-tolyl)hydrazine (D34)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 85% yield (138.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.60 (m, 2H), 7.45 (s, 1H), 7.40 – 7.08 (m, 11H), 6.81 – 6.73 (m, 1H), 6.48 – 6.38 (m, 1H), 6.28 – 6.16 (m, 1H), 4.67 – 4.58 (m, 2H), 2.37 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 139.0, 136.8, 136.5, 132.4, 131.4, 129.1, 128.7, 128.7, 127.9, 126.5, 126.3, 122.0, 121.8, 115.7, 112.3, 48.7, 22.0.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1855.

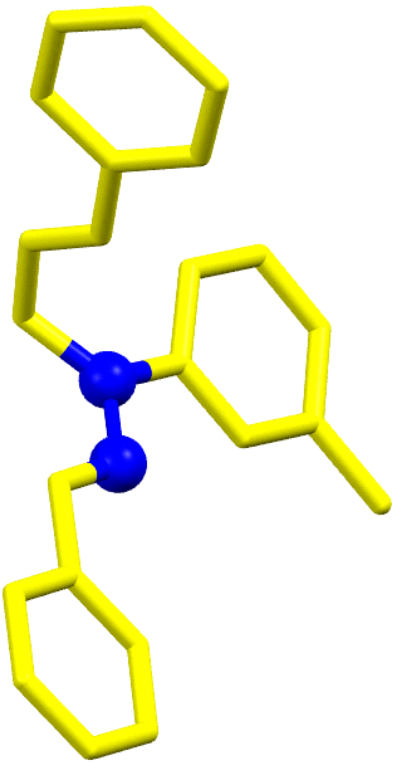
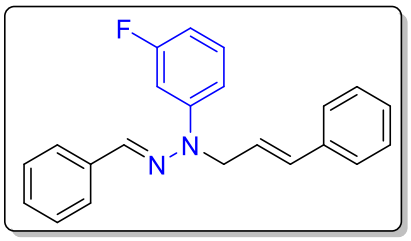


Figure S2 X-ray of D34 (CCDC 2249896)

2-((*E*)-benzylidene)-1-cinnamyl-1-(3-fluorophenyl)hydrazine (D35)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 71% yield (117.2 mg).

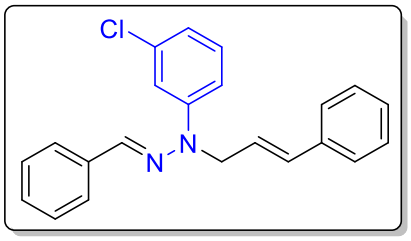
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.61 (m, 2H), 7.49 (s, 1H), 7.41 – 7.11 (m, 10H), 7.09 – 6.99 (m, 1H), 6.67 – 6.55 (m, 1H), 6.45 – 6.32 (m, 1H), 6.25 – 6.12 (m, 1H), 4.70 – 4.51 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 164.0 (d, *J* = 243.41 Hz), 149.3 (d, *J* = 11.11 Hz), 136.3, 133.6, 131.6, 130.3 (d, *J* = 9.09 Hz), 128.7, 128.4, 127.9, 126.5, 121.3, 109.9, 107.1 (d, *J* = 22.22 Hz), 102.2 (d, *J* = 27.27 Hz), 48.3.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -112.0.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1601.

2-((*E*)-benzylidene)-1-(3-chlorophenyl)-1-cinnamylhydrazine (D36)



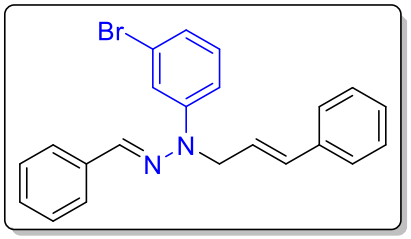
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 70% yield (121.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 – 7.60 (m, 2H), 7.53 – 7.42 (m, 2H), 7.40 – 7.13 (m, 10H), 6.94 – 6.83 (m, 1H), 6.45 – 6.32 (m, 1H), 6.22 – 6.12 (m, 1H), 4.68 – 4.52 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.7, 136.2, 135.1, 133.8, 131.6, 130.2, 128.7, 128.4, 128.0, 126.5, 121.2, 120.5, 114.9, 112.64, 48.2.

HRMS (ESI) calcd. for $C_{22}H_{20}ClN_2$ [M+H]: 347.1309, found: 347.1304.

2-((*E*)-benzylidene)-1-(3-bromophenyl)-1-cinnamylhydrazine (D37)



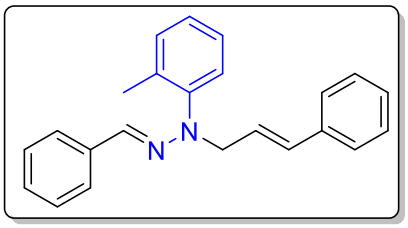
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a pink solid in 48% yield (93.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.64 (m, 2H), 7.63 – 7.59 (m, 1H), 7.51 (s, 1H), 7.40 – 7.11 (m, 10H), 7.08 – 6.99 (m, 1H), 6.46 – 6.33 (m, 1H), 6.28 – 6.14 (m, 1H), 4.70 – 4.58 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.7, 136.2, 136.1, 133.8, 131.5, 130.4, 128.7, 128.4, 127.9, 126.5, 123.4, 123.3, 121.1, 117.7, 113.1, 48.3.

HRMS (ESI) calcd. for $C_{22}H_{20}BrN_2$ [M+H]: 391.0804, found: 391.0801.

2-((*E*)-benzylidene)-1-cinnamyl-1-(o-tolyl)hydrazine (D38)



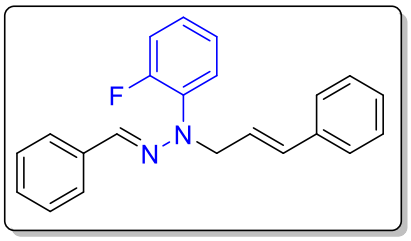
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 82% yield (133.7 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.46 (m, 2H), 7.36 – 7.30 (m, 2H), 7.29 – 7.22 (m, 5H), 7.22 – 7.11 (m, 5H), 7.08 (s, 1H), 6.59 – 6.47 (m, 1H), 6.43 – 6.29 (m, 1H), 4.51 – 4.39 (m, 2H), 2.27 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 145.1, 137.1, 136.9, 135.4, 133.4, 132.3, 131.3, 128.7, 128.6, 127.7, 127.6, 127.3, 126.7, 126.5, 126.3, 125.8, 125.6, 57.7, 18.8.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1853.

2-((*E*)-benzylidene)-1-cinnamyl-1-(2-fluorophenyl)hydrazine (D39)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 61% yield (100.7 mg).

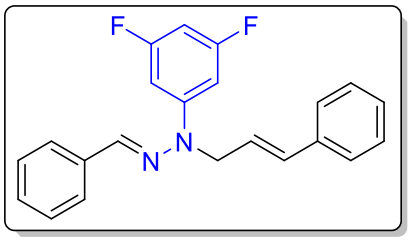
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.77 – 7.45 (m, 5H), 7.42 – 6.91 (m, 10H), 6.64 – 6.47 (m, 1H), 6.34 – 6.19 (m, 1H), 4.61 – 4.45 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 154.9 (d, *J* = 248.46 Hz), 136.7 (d, *J* = 39.39 Hz), 134.8, 132.2, 128.0 (d, *J* = 40.4 Hz), 126.5 (d, *J* = 24.24 Hz), 125.1, 125.0, 124.8, 124.2, 116.8 (d, *J* = 21.21 Hz), 54.7.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -122.1.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1600.

2-((*E*)-benzylidene)-1-cinnamyl-1-(3,5-difluorophenyl)hydrazine (D40)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 75% yield (130.6 mg).

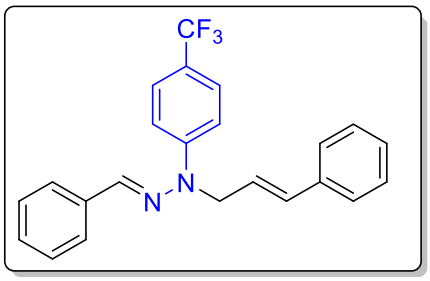
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.61 (m, 2H), 7.50 (s, 1H), 7.39 – 7.13 (m, 8H), 6.96 – 6.83 (m, 2H), 6.41 – 6.30 (m, 2H), 6.18 – 6.09 (m, 1H), 4.59 – 4.48 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 165.2 (d, *J* = 15.15 Hz), 162.8 (d, *J* = 16.16 Hz), 149.7 (t, *J* = 13.13 Hz), 136.1, 135.9, 134.7, 131.8, 128.8, 128.7, 128.1, 126.7, 126.6, 120.8, 97.5 (d, *J* = 30.3 Hz), 97.5 (d, *J* = 12.12 Hz), 95.4 (t, *J* = 26.26 Hz), 48.0.

^{19}F NMR (376 MHz, CDCl3) δ = -109.3.

HRMS (ESI) calcd. for $C_{22}H_{19}F_2N_2$ [M+H]: 349.1510, found: 349.1509.

2-((*E*)-benzylidene)-1-cinnamyl-1-(4-(trifluoromethyl)phenyl)hydrazine (D41)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 81% yield (154.0 mg).

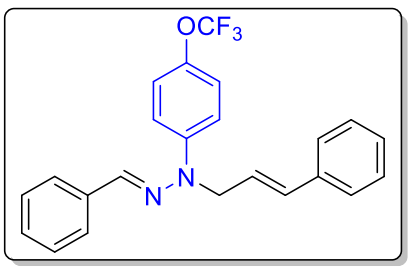
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 – 7.67 (m, 2H), 7.62 – 7.52 (m, 3H), 7.51 – 7.42 (m, 2H), 7.43 – 7.13 (m, 8H), 6.51 – 6.35 (m, 1H), 6.31 – 6.19 (m, 1H), 4.72 (s, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 149.7, 136.1, 136.0, 134.5, 131.7, 128.7, 128.6, 128.0, 126.5, 126.4, 124.9 (q, *J* = 543.38 Hz, 271.69 Hz), 122.0 (q, *J* = 65.65 Hz, 33.33 Hz), 120.8, 114.0, 47.9.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -61.3.

HRMS (ESI) calcd. for $C_{23}H_{20}F_3N_2$ [M+H]: 381.1573, found: 381.1569.

2-((*E*)-benzylidene)-1-cinnamyl-1-(4-(trifluoromethoxy)phenyl)hydrazine (D42)



The title compound was prepared according to the general procedure and purified by

column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 83% yield (164.4 mg).

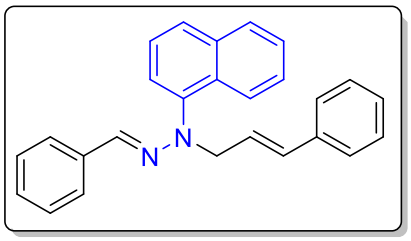
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (d, *J* = 8.0 Hz, 2H), 7.48 (s, 1H), 7.41 – 7.12 (m, 12H), 6.39 (d, *J* = 16.0 Hz, 1H), 6.25 – 6.13 (m, 1H), 4.67 – 4.54 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 146.3, 143.0, 136.3, 136.2, 133.4, 131.6, 128.7, 128.3, 128.0, 126.5, 126.4, 122.2, 122.1, 121.3, 120.8 (q, *J* = 513.08 Hz, 256.54 Hz), 115.4, 48.4.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -58.1.

HRMS (ESI) calcd. for $C_{23}H_{20}F_3N_2O$ [M+H]: 397.1522, found: 397.1518.

2-((*E*)-benzylidene)-1-cinnamyl-1-(naphthalen-1-yl)hydrazine (D43)



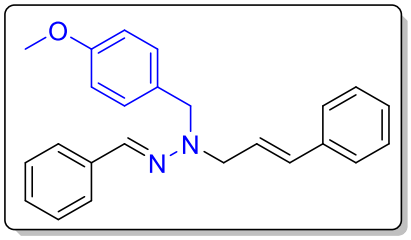
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 85% yield (153.9 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 – 8.01 (m, 1H), 7.88 – 7.76 (m, 1H), 7.69 (d, *J* = 8.0 Hz, 1H), 7.57 – 7.08 (m, 15H), 6.54 (d, *J* = 16.0 Hz, 1H), 6.46 – 6.34 (m, 1H), 4.64 – 4.49 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 143.6, 137.1, 136.8, 135.1, 135.0, 132.5, 130.1, 128.8, 128.7, 127.8, 127.1, 126.7, 126.6, 126.5, 126.2, 126.1, 125.7, 124.1, 123.7, 58.4.

HRMS (ESI) calcd. for $C_{26}H_{23}N_2$ [M+H]: 363.1855, found: 363.1852.

2-((*E*)-benzylidene)-1-cinnamyl-1-(4-methoxybenzyl)hydrazine (D44)



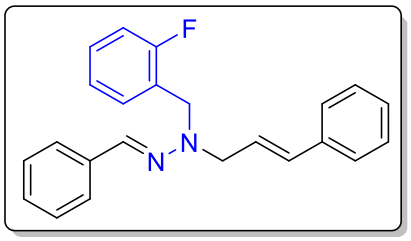
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 58% yield (103.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 – 7.47 (m, 2H), 7.38 – 7.11 (m, 11H), 6.87 – 6.78 (m, 2H), 6.52 – 6.39 (m, 1H), 6.28 – 6.15 (m, 1H), 4.45 (s, 2H), 4.08 – 3.98 (m, 2H), 3.72 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.0, 137.2, 137.0, 132.6, 132.1, 129.8, 129.1, 128.7, 128.6, 127.7, 127.4, 126.5, 125.7, 125.1, 114.1, 57.3, 55.5, 55.4.

HRMS (ESI) calcd. for $C_{24}H_{25}N_2O$ [M+H]: 357.1961, found: 357.1961.

2-((*E*)-benzylidene)-1-cinnamyl-1-(2-fluorobenzyl)hydrazine (D45)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 62% yield (107.0 mg).

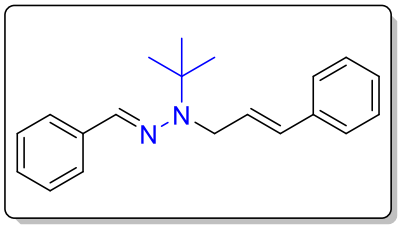
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.52 (d, *J* = 7.2 Hz, 2H), 7.39 – 7.21 (m, 8H), 7.20 – 7.10 (m, 3H), 7.08 – 6.95 (m, 2H), 6.49 (d, *J* = 16.0 Hz, 1H), 6.31 – 6.15 (m, 1H), 4.56 (s, 2H), 4.16 – 4.03 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 160.8 (d, *J* = 246.44 Hz), 137.1, 137.0, 132.8, 132.3, 130.2 (d, *J* = 4.04 Hz), 129.0 (d, *J* = 8.08 Hz), 128.8, 128.7, 127.8, 127.5, 126.6, 125.8, 125.0, 124.8, 124.4 (d, *J* = 4.04 Hz), 115.5 (d, *J* = 21.21 Hz), 56.5, 51.0.

^{19}F NMR (376 MHz, CDCl3) δ = -117.8.

HRMS (ESI) calcd. for $C_{23}H_{21}FN_2$ [M+H]: 345.1761, found: 345.1762.

2-((*E*)-benzylidene)-1-(tert-butyl)-1-cinnamylhydrazine (D46)



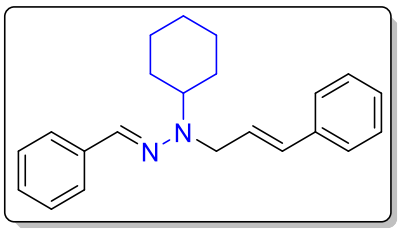
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 43% yield (62.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.56 – 7.47 (m, 2H), 7.34 – 7.29 (m, 2H), 7.28 – 7.19 (m, 5H), 7.18 – 7.09 (m, 2H), 6.49 (d, *J* = 16.0 Hz, 1H), 6.28 – 6.12 (m, 1H), 3.99 – 3.85 (m, 2H), 1.34 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 138.3, 137.3, 130.4, 129.4, 128.7, 128.6, 127.5, 126.8, 126.5, 126.2, 125.5, 60.0, 48.4, 28.5.

HRMS (ESI) calcd. for $C_{20}H_{25}N_2$ [M+H]: 293.2012, found: 293.2013.

2-((*E*)-benzylidene)-1-cinnamyl-1-cyclohexylhydrazine (D47)



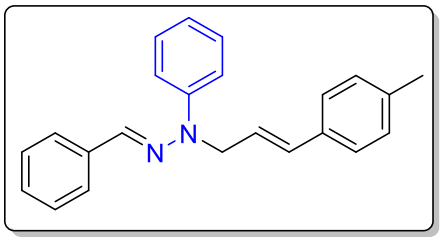
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a light yellow liquid in 33% yield (52.5 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.47 (m, 2H), 7.39 – 7.10 (m, 9H), 6.58 – 6.49 (m, 1H), 6.29 – 6.17 (m, 1H), 4.07 – 3.96 (m, 2H), 3.38 – 3.22 (m, 1H), 2.02 – 1.90 (m, 2H), 1.88 – 1.78 (m, 2H), 1.72 – 1.48 (m, 3H), 1.42 – 1.06 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 137.8, 137.0, 130.8, 129.4, 128.6, 128.4, 127.4, 126.6, 126.3, 125.3, 125.2, 65.7, 50.6, 31.3, 26.0.

HRMS (ESI) calcd. for $C_{22}H_{27}N_2$ [M+H]: 319.2169, found: 319.2170.

2-((*E*)-benzylidene)-1-phenyl-1-((*E*)-3-(p-tolyl)allyl)hydrazine (D48)



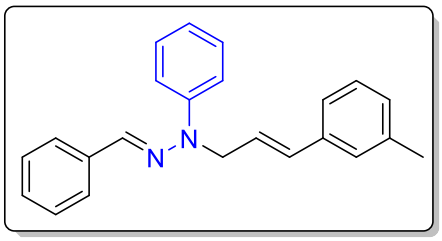
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 90% yield (146.8 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.61 (m, 2H), 7.47 (s, 1H), 7.44 – 7.38 (m, 2H), 7.37 – 7.27 (m, 4H), 7.26 – 7.17 (m, 3H), 7.09 – 6.89 (m, 3H), 6.40 (d, *J* = 16.0 Hz, 1H), 6.20 – 6.11 (m, 1H), 4.67 – 4.57 (m, 2H), 2.27 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.7, 137.6, 136.8, 133.7, 132.5, 131.3, 129.4, 129.2, 128.7, 128.0, 126.4, 126.3, 120.7, 115.0, 48.6, 21.3.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1855.

2-((*E*)-benzylidene)-1-phenyl-1-((*E*)-3-(o-tolyl)allyl)hydrazine (D49)



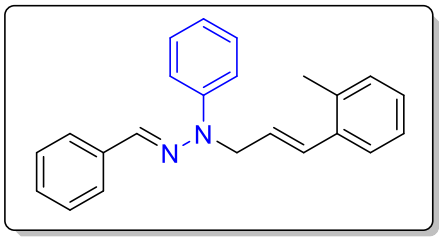
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 87% yield (141.9 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.61 (m, 2H), 7.48 – 7.35 (m, 3H), 7.35 – 7.24 (m, 4H), 7.24 – 7.15 (m, 1H), 7.15 – 7.03 (m, 3H), 7.00 – 6.86 (m, 2H), 6.36 (d, *J* = 16.0 Hz, 1H), 6.21 – 6.07 (m, 1H), 4.61 – 4.48 (m, 2H), 2.30 – 2.12 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.8, 138.3, 136.9, 136.5, 132.6, 131.6, 129.4, 128.8, 128.7, 128.1, 127.5, 126.4, 123.6, 121.7, 120.9, 115.1, 48.5, 21.6.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1856.

2-((*E*)-benzylidene)-1-phenyl-1-((*E*)-3-(m-tolyl)allyl)hydrazine (D50)



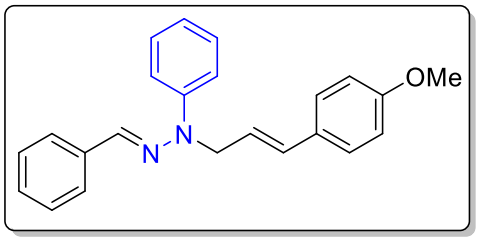
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 85% yield (138.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.65 (m, 2H), 7.54 (s, 1H), 7.46 – 7.39 (m, 3H), 7.38 – 7.30 (m, 4H), 7.28 – 7.21 (m, 1H), 7.18 – 7.04 (m, 3H), 6.97 – 6.88 (m, 1H), 6.72 – 6.60 (m, 1H), 6.11 – 5.98 (m, 1H), 4.74 – 4.53 (m, 2H), 2.18 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.7, 136.6, 135.8, 135.5, 132.6, 130.3, 129.9, 129.1, 128.6, 127.9, 127.6, 126.2, 126.1, 125.7, 123.2, 120.8, 115.1, 48.9, 19.8.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1855, found: 327.1855.

2-((*E*)-benzylidene)-1-((*E*)-3-(4-methoxyphenyl)allyl)-1-phenylhydrazine (D51)



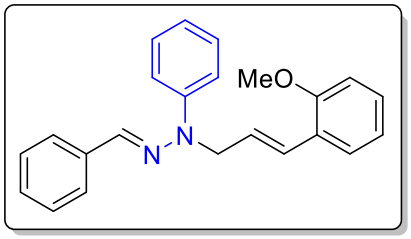
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 88% yield (150.6 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.64 (m, 2H), 7.44 (s, 1H), 7.42 – 7.37 (m, 2H), 7.35 – 7.27 (m, 4H), 7.23 – 7.16 (m, 3H), 6.95 – 6.87 (m, 1H), 6.75 (d, J = 8.4 Hz, 2H), 6.33 (d, J = 16.0 Hz, 1H), 6.07 – 5.96 (m, 1H), 4.60 – 4.51 (m, 2H), 3.66 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 159.4, 147.8, 136.8, 132.5, 130.8, 129.3, 128.7, 128.0, 127.7, 126.4, 120.8, 119.5, 115.0, 114.1, 55.4, 48.5.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2O$ [M+H]: 343.1805, found: 343.1802.

2-((*E*)-benzylidene)-1-((*E*)-3-(2-methoxyphenyl)allyl)-1-phenylhydrazine (D52)



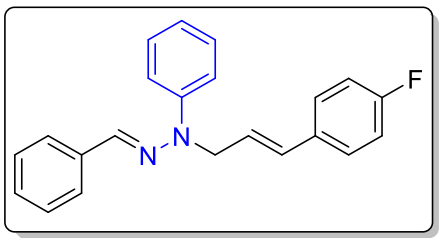
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 83% yield (142.0 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.65 (m, 2H), 7.55 (s, 1H), 7.45 – 7.40 (m, 2H), 7.38 – 7.28 (m, 5H), 7.26 – 7.12 (m, 2H), 6.98 – 6.75 (m, 4H), 6.35 – 6.23 (m, 1H), 4.73 – 4.63 (m, 2H), 3.73 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 156.8, 147.8, 136.8, 132.5, 129.2, 128.8, 128.6, 127.8, 127.4, 127.2, 126.3, 123.1, 120.7, 115.1, 111.0, 55.4, 49.2.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2O$ [M+H]: 343.1805, found: 343.1801.

2-((*E*)-benzylidene)-1-((*E*)-3-(4-fluorophenyl)allyl)-1-phenylhydrazine (D53)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 91% yield (150.2 mg).

^{1}H NMR (400 MHz, CDCl3) δ 7.73 – 7.61 (m, 2H), 7.46 – 7.13 (m, 10H), 6.97 – 6.80 (m, 3H), 6.38 – 6.27 (m, 1H), 6.12 – 6.02 (m, 1H), 4.63 – 4.47 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 162.5 (d, *J* = 247.45 Hz), 147.7, 136.7, 132.7 (d, *J* = 3.03 Hz), 132.5, 130.2, 129.3, 128.8, 128.1 (d, *J* = 4.04 Hz), 126.4, 121.6, 120.9, 115.6 (d, *J* = 22.22 Hz), 115.0, 48.3.

^{19}F NMR (376 MHz, CDCl3) δ = -113.9.

HRMS (ESI) calcd. for $C_{22}H_{20}FN_2$ [M+H]: 331.1605, found: 331.1601.

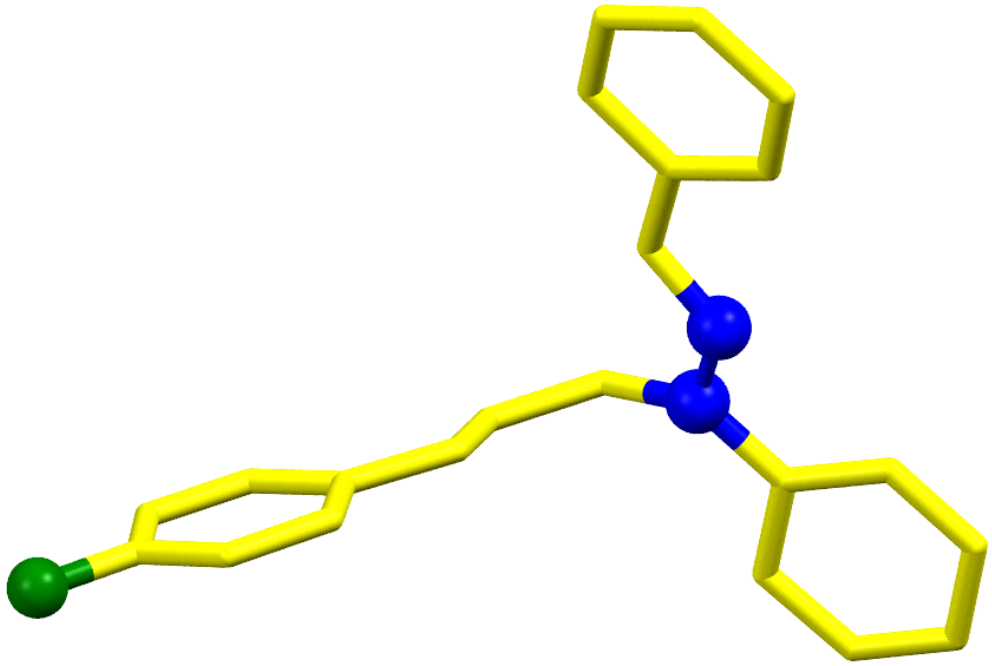
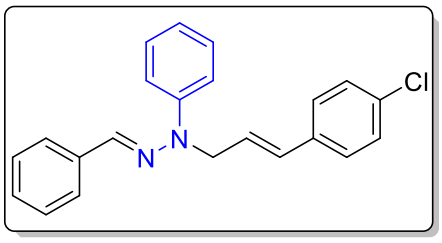


Figure S3 X-ray of D53 (CCDC 2249898)

2-((*E*)-benzylidene)-1-((*E*)-3-(4-chlorophenyl)allyl)-1-phenylhydrazine (D54)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 91% yield (157.5 mg).

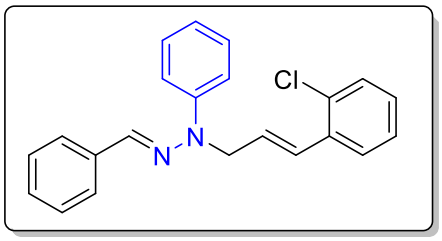
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.65 (m, 2H), 7.47 (s, 1H), 7.44 – 7.30 (m, 6H), 7.28 – 7.20 (m, 5H), 6.99 – 6.92 (m, 1H), 6.42 – 6.35 (m, 1H), 6.27 – 6.17 (m, 1H),

4.74 – 4.61 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.5, 136.6, 134.9, 133.4, 132.5, 130.1, 129.2, 128.7, 128.6, 128.0, 127.6, 126.2, 122.5, 120.8, 114.9, 48.4.

HRMS (ESI) calcd. for $C_{22}H_{20}ClN_2$ [M+H]: 347.1309, found: 347.1308.

2-((*E*)-benzylidene)-1-((*E*)-3-(2-chlorophenyl)allyl)-1-phenylhydrazine (D55)



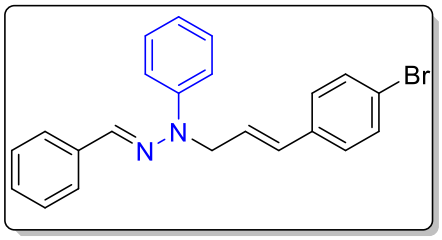
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 84% yield (145.3 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.65 (m, 2H), 7.46 (s, 1H), 7.43 – 7.21 (m, 9H), 7.21 – 7.13 (m, 2H), 6.99 – 6.91 (m, 1H), 6.41 – 6.32 (m, 1H), 6.29 – 6.19 (m, 1H), 4.72 – 4.58 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.5, 136.5, 135.3, 132.5, 131.7, 130.2, 129.2, 128.6, 128.0, 126.2, 122.6, 121.5, 120.8, 114.9, 48.4.

HRMS (ESI) calcd. for $C_{22}H_{20}ClN_2$ [M+H]: 347.1309, found: 347.1304.

2-((*E*)-benzylidene)-1-((*E*)-3-(4-bromophenyl)allyl)-1-phenylhydrazine (D56)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 86% yield (167.7 mg).

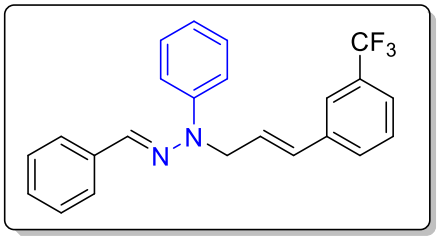
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.64 (m, 2H), 7.54 (s, 1H), 7.46 – 7.18 (m, 9H),

7.17 – 7.04 (m, 2H), 6.98 – 6.86 (m, 2H), 6.20 – 6.10 (m, 1H), 4.72 – 4.63 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 136.7, 134.9, 133.1, 132.7, 129.4, 129.2, 128.9, 128.8, 128.7, 128.0, 127.3, 127.0, 126.3, 125.6, 120.9, 115.2, 48.7.

HRMS (ESI) calcd. for $C_{22}H_{20}BrN_2$ [M+H]: 391.0804, found: 391.0799.

2-((E)-benzylidene)-1-phenyl-1-((E)-3-(3-(trifluoromethyl)phenyl)allyl)hydrazine (D57)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 90% yield (171.1 mg).

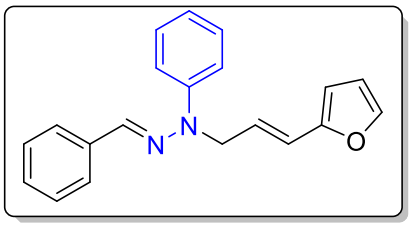
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.65 (m, 2H), 7.55 (s, 1H), 7.47 – 7.19 (m, 11H), 7.01 – 6.92 (m, 1H), 6.41 (dd, *J* = 16.0, 2.0 Hz, 1H), 6.33 – 6.22 (m, 1H), 4.70 – 4.56 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 137.2, 136.6, 132.5, 131.0 (d, *J* = 64.64 Hz, 32.32 Hz), 130.0, 129.8, 129.3, 129.1, 128.7, 128.1, 126.4, 124.3 (q, *J* = 8.08, 4.04 Hz), 124.2 (q, *J* = 546.41, 272.70 Hz), 123.9, 123.1 (q, *J* = 8.08, 4.04 Hz), 121.0, 114.9, 48.2.

^{19}F NMR (376 MHz, CDCl3) δ = -62.5.

HRMS (ESI) calcd. for $C_{23}H_{20}F_3N_2$ [M+H]: 381.1573, found: 381.1568.

2-((*E*)-benzylidene)-1-((*E*)-3-(furan-2-yl)allyl)-1-phenylhydrazine (D58)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the

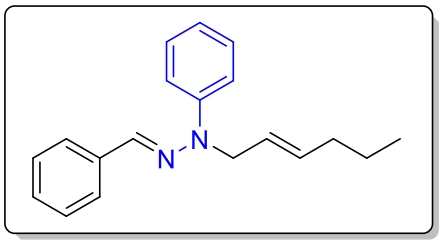
light-yellow oil in 48% yield (72.5 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.64 (m, 2H), 7.44 (s, 1H), 7.42 – 7.28 (m, 7H), 7.27 – 7.18 (m, 1H), 6.98 – 6.90 (m, 1H), 6.33 – 6.26 (m, 1H), 6.24 – 6.17 (m, 2H), 6.12 – 6.06 (m, 1H), 4.68 – 4.58 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 152.2, 147.6, 142.0, 136.6, 132.5, 129.2, 128.6, 128.0, 126.3, 120.8, 120.3, 119.6, 114.8, 111.4, 108.3, 48.1.

HRMS (ESI) calcd. for $C_{20}H_{19}N_2O$ [M+H]: 303.1491, found: 303.1486.

2-((*E*)-benzylidene)-1-((E)-hex-2-en-1-yl)-1-phenylhydrazine (D59)



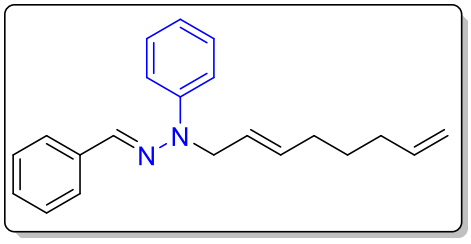
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 70% yield (97.4 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.52 (m, 2H), 7.37 (s, 1H), 7.32 – 7.18 (m, 6H), 7.18 – 7.12 (m, 1H), 6.90 – 6.75 (m, 1H), 5.52 – 5.27 (m, 2H), 4.53 – 4.31 (m, 2H), 1.97 – 1.85 (m, 2H), 1.31 – 1.11 (m, 2H), 0.84 – 0.66 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.7, 136.9, 133.2, 132.2, 129.1, 128.6, 127.8, 126.1, 121.7, 120.5, 114.8, 48.1, 34.3, 22.3, 13.6.

HRMS (ESI) calcd. for $C_{19}H_{23}N_2$ [M+H]: 279.1855, found: 279.1855.

2-((*E*)-benzylidene)-1-((*E*)-octa-2,7-dien-1-yl)-1-phenylhydrazine (D60)



The title compound was prepared according to the general procedure and purified by

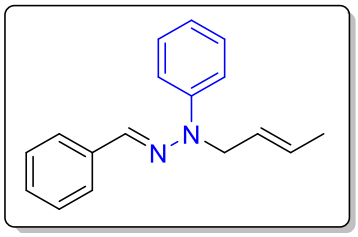
column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give the light-yellow oil in 52% yield (79.1 mg).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 – 7.61 (m, 2H), 7.48 – 7.41 (m, 1H), 7.39 – 7.16 (m, 7H), 6.99 – 6.83 (m, 1H), 5.81 – 5.64 (m, 1H), 5.59 – 5.27 (m, 2H), 4.98 – 4.85 (m, 2H), 4.53 – 4.39 (m, 2H), 2.11 – 1.91 (m, 4H), 1.58 – 1.33 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 138.6, 136.9, 133.0, 132.2, 129.1, 128.6, 127.8, 126.2, 121.9, 114.8, 114.7, 48.1, 48.0, 33.2, 31.6, 28.4.

HRMS (ESI) calcd. for $C_{21}H_{25}N_2$ [M+H]: 305.2012, found: 305.2013.

(*E*)-2-benzylidene-1-(but-3-en-2-yl)-1-phenylhydrazine (D61)



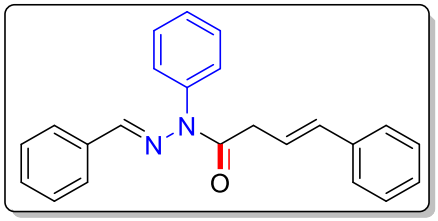
The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) to give a white solid in 76% yield (96.1 mg) from A15 and 71% yield (89 mg) from A16.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.79 – 7.58 (m, 2H), 7.55 – 7.15 (m, 8H), 6.93 – 6.87 (m, 1H), 5.73 – 5.27 (m, 2H), 4.61 – 4.29 (m, 2H), 1.84 – 1.58 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.6, 136.9, 132.0, 129.1, 128.6, 127.8, 127.7, 126.1, 126.1, 122.7, 120.4, 114.7, 47.8, 17.7.

HRMS (ESI) calcd. for $C_{17}H_{19}N_2$ [M+H]: 251.1542, found: 251.1539.

(*E*)-*N*'-((*E*)-benzylidene)-*N*,4-diphenylbut-3-enehydrazide (E1)



The title compound was prepared according to the general procedure and purified by

column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 78% yield (132.7 mg) based on reaction conditions C and 76% yield (129.3 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 – 7.58 (m, 2H), δ 7.58 – 7.51 (m, 2H), δ 7.50 – 7.43 (m, 1H), δ 7.42 – 7.34 (m, 5H), 7.32 – 7.25 (m, 3H), 7.24 – 7.14 (m, 3H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.60 – 6.49 (m, 1H), 4.05 – 3.89 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 141.8, 137.3, 135.8, 134.3, 133.2, 130.3, 130.0, 129.4, 129.3, 128.8, 128.5, 127.3, 127.2, 126.3, 123.4, 38.7.

MS (70 eV): m/z (%) = 340 $[M]^+$ (100), 210, 194, 117.

HRMS (ESI) calcd. for $C_{23}H_{21}N_2O$ [M+H]: 341.1609, found: 341.1610.

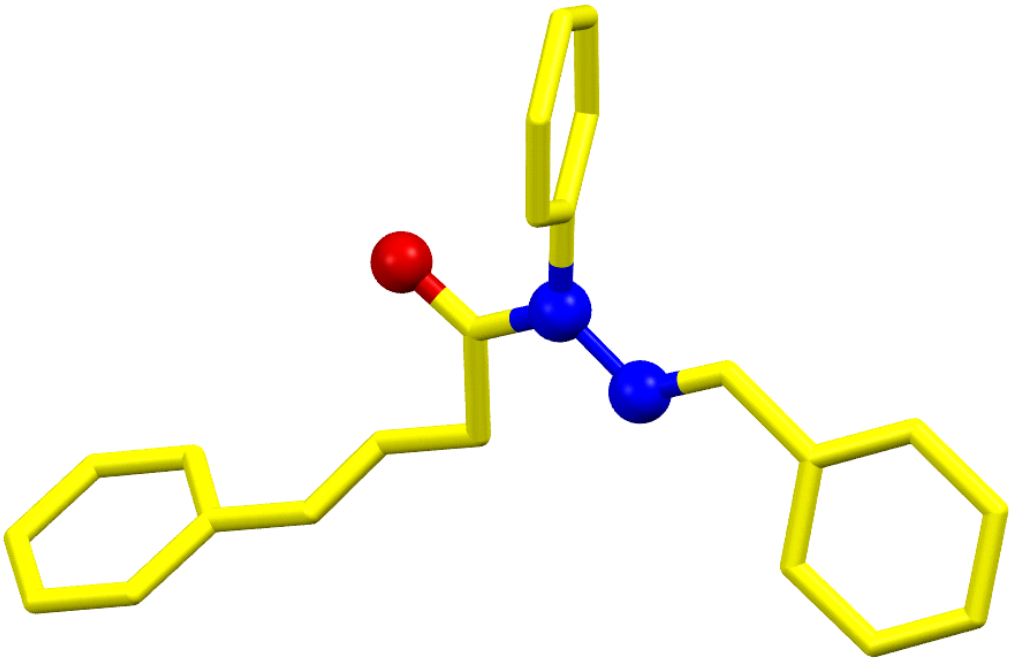
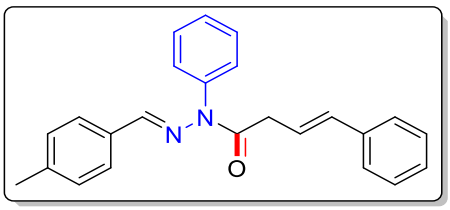


Figure S4 X-ray of E1 (CCDC 2249902)

(*E*)-*N*'-((*E*)-4-methylbenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E2)



The title compound was prepared according to the general procedure and purified by

column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 78% yield (138.1 mg) based on reaction conditions C and 76% yield (134.6 mg) based on reaction conditions B.

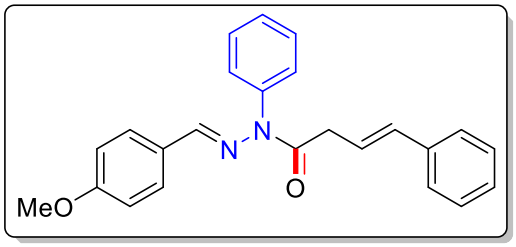
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 – 7.43 (m, 5H), 7.42 – 7.37 (m, 2H), 7.32 – 7.26 (m, 2H), 7.25 – 7.14 (m, 6H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.61 – 6.50 (m, 1H), 4.03 – 3.92 (m, 2H), 2.37 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 141.9, 140.3, 137.4, 135.9, 133.1, 131.6, 130.2, 129.5, 129.3, 128.5, 127.3, 127.2, 126.3, 123.5, 38.7, 21.5.

MS (70 eV): m/z (%) = 354 $[M]^+$ (100), 210, 194, 117.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O$ [M+H]: 355.1805, found: 355.1804.

(*E*)-*N*'-((*E*)-4-methoxybenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E3)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 73% yield (135.1 mg) based on reaction conditions C and 72% yield (131.4 mg) based on reaction conditions B.

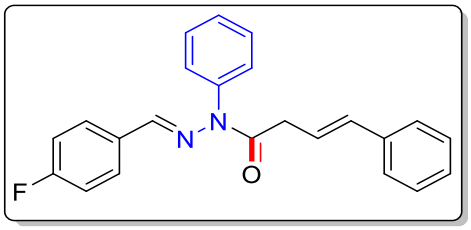
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 – 7.50 (m, 4H), 7.49 – 7.43 (m, 1H), 7.42 – 7.36 (m, 2H), 7.33 – 7.26 (m, 2H), 7.25 – 7.13 (m, 4H), 6.94 – 6.85 (m, 2H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.61 – 6.50 (m, 1H), 4.04 – 3.90 (m, 2H), 3.81 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.8, 161.1, 141.7, 137.4, 136.0, 133.1, 130.2, 129.3, 128.7, 128.5, 127.3, 127.1, 126.3, 123.5, 114.2, 55.4, 38.7.

MS (70 eV): m/z (%) = 370 $[M]^+$ (100), 273, 194, 117.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O_2$ [M+H]: 371.1754, found: 371.1757.

(*E*)-*N*'-((*E*)-4-fluorobenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E4)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 65% yield (116.4 mg) based on reaction conditions C and 61% yield (109.3 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.51 (m, 4H), 7.50 – 7.44 (m, 1H), 7.43 – 7.35 (m, 2H), 7.33 – 7.26 (m, 2H), 7.24 – 7.13 (m, 4H), 7.11 – 7.00 (m, 2H), 6.65 (d, *J* = 16.0 Hz, 1H), 6.59 – 6.48 (m, 1H), 4.09 – 3.83 (m, 2H).

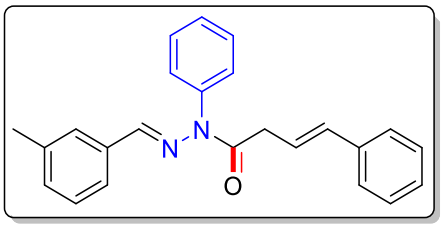
^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 163.7 (d, *J* = 251.49 Hz), 140.5, 137.3, 135.8, 133.2, 130.6 (d, *J* = 4.04 Hz), 130.3, 129.4, 129.3, 129.0 (d, *J* = 8.08 Hz), 128.5, 127.4, 126.3, 123.3. 115.9 (d, *J* = 22.22 Hz), 38.7.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -110.1.

MS (70 eV): m/z (%) = 358 $[M]^+$ (100), 214, 195, 117.

HRMS (ESI) calcd. for $C_{23}H_{20}FN_2O$ [M+H]: 359.1554, found: 359.1556.

(*E*)-*N*'-((*E*)-3-methylbenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E5)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 76% yield (134.6 mg) based on reaction conditions C and 75% yield (132.8 mg) based on reaction conditions B.

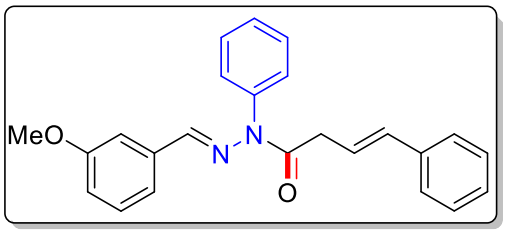
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.50 (m, 2H), 7.48 – 7.35 (m, 5H), 7.33 – 7.23 (m, 4H), 7.22 – 7.13 (m, 4H), 6.67 (d, *J* = 16.0 Hz, 1H), 6.60 – 6.50 (m, 1H), 4.06 – 3.88 (m, 2H), 2.35 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 142.1, 138.5, 137.4, 135.9, 134.3, 133.2, 130.9, 130.3, 129.4, 129.3, 128.7, 128.5, 127.9, 127.3, 126.3, 124.4, 123.4, 38.7, 21.4.

MS (70 eV): m/z (%) = 354 $[M]^+$ (100), 210, 194, 117.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O$ [M+H]: 355.1805, found: 355.1802.

(*E*)-*N*'-((*E*)-3-methoxybenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E6)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 73% yield (135.1 mg) based on reaction conditions C and 69% yield (127.7 mg) based on reaction conditions B.

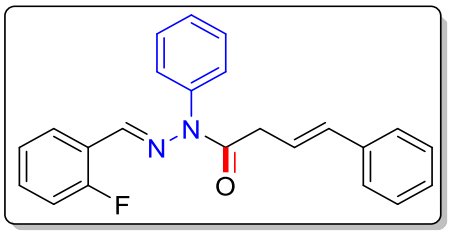
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 – 7.51 (m, 2H), 7.50 – 7.42 (m, 1H), 7.42 – 7.36 (m, 2H), 7.31 – 7.25 (m, 3H), 7.23 (d, *J* = 1.2 Hz, 1H), 7.22 – 7.10 (m, 5H), 6.95 – 6.87 (m, 1H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.61 – 6.49 (m, 1H), 4.03 – 3.92 (m, 2H), 3.80 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 160.0, 141.7, 137.4, 135.9, 135.7, 133.2, 130.3, 129.8, 129.4, 129.3, 128.5, 127.4, 126.3, 123.4, 120.2, 116.0, 111.8, 55.4, 38.7.

MS (70 eV): m/z (%) = 370 $[M]^+$ (100), 292, 194, 117.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O_2$ [M+H]: 371.1754, found: 371.1759.

(*E*)-*N*'-((*E*)-2-fluorobenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E7)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 59% yield (105.7 mg) based on reaction conditions C and 57% yield (102.1 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.02 – 7.95 (m, 1H), 7.61 – 7.45 (m, 4H), 7.43 – 7.27 (m, 5H), 7.26 – 7.15 (m, 4H), 7.07 – 6.98 (m, 1H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.61 – 6.5 (m, 1H), 4.08 – 3.82 (m, 2H).

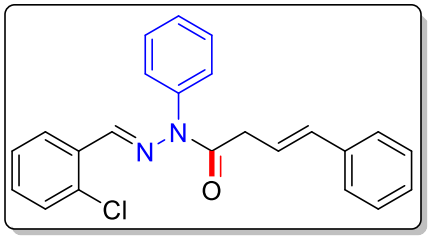
^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 161.4 (d, *J* = 253.51 Hz), 137.3, 133.2, 131.4 (d, *J* = 8.08 Hz), 130.3, 129.5, 129.1, 128.5, 127.3, 126.6, 126.3, 124.5 (d, *J* = 4.04 Hz), 123.2, 115.9 (d, *J* = 21.21 Hz), 38.7.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -120.7.

MS (70 eV): m/z (%) = 358 $[M]^+$ (100), 214, 195, 117.

HRMS (ESI) calcd. for $C_{23}H_{20}FN_2O$ [M+H]: 359.1554, found: 359.1557.

(*E*)-*N*'-((*E*)-2-chlorobenzylidene)-*N*,4-diphenylbut-3-enehydrazide (E8)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 53% yield (99.1 mg) based on reaction conditions C and 52% yield (92.3 mg) based on reaction conditions B.

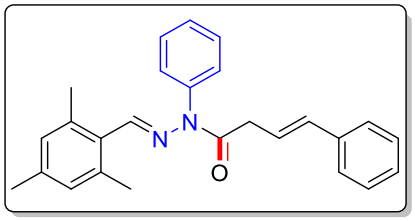
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 – 8.01 (m, 1H), 7.71 (s, 1H), 7.56 (t, *J* = 7.6 Hz, 2H), 7.51 – 7.44 (m, 1H), 7.39 (d, *J* = 7.2 Hz, 2H), 7.35 – 7.25 (m, 5H), 7.24 – 7.15 (m, 3H), 6.65 (d, *J* = 16.0 Hz, 1H), 6.60 – 6.48 (m, 1H), 4.03 – 3.89 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 138.7, 137.3, 135.7, 134.5, 133.3, 131.8, 130.8, 130.3, 129.9, 129.6, 129.0, 128.5, 127.4, 127.1, 127.0, 126.3, 123.2, 38.7.

MS (70 eV): m/z (%) = 374 $[M]^+$ (100), 230, 195, 117.

HRMS (ESI) calcd. for $C_{23}H_{20}ClN_2O$ [M+H]: 375.1259, found: 375.1261.

(*E*)-*N*,4-diphenyl-*N*'-((*E*)-2,4,6-trimethylbenzylidene)but-3-enehydrazide (E9)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 76% yield (145.2 mg) based on reaction conditions C and 73% yield (141.4 mg) based on reaction conditions B.

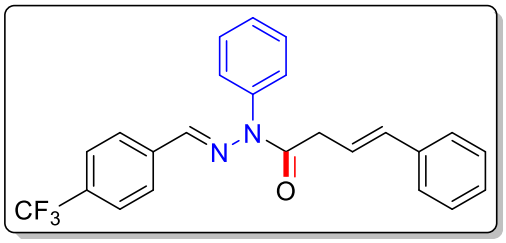
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 (s, 1H), 7.55 (t, *J* = 7.6 Hz, 2H), 7.49 – 7.43 (m, 1H), 7.41 – 7.35 (m, 2H), 7.32 – 7.26 (m, 2H), 7.26 – 7.16 (m, 3H), 6.86 (s, 2H), 6.63 – 6.48 (m, 2H), 3.97 – 3.82 (m, 2H), 2.29 (d, *J* = 13.6 Hz, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 142.8, 138.9, 137.5, 137.4, 136.1, 132.9, 130.3, 129.7, 129.3, 128.5, 128.1, 127.3, 126.3, 123.5, 38.4, 21.3, 21.1.

MS (70 eV): m/z (%) = 382 $[M]^+$ (100), 224, 194, 117.

HRMS (ESI) calcd. for $C_{26}H_{27}N_2O$ [M+H]: 383.2118, found: 383.2117.

(*E*)-*N*,4-diphenyl-*N*'-((*E*)-4-(trifluoromethyl)benzylidene)but-3-enehydrazide (E10)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 52% yield (106.1 mg) based on reaction conditions C and 51% yield (104.1 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.0 Hz, 2H), 7.63 (d, *J* = 8.4 Hz, 2H), 7.60 – 7.54 (m, 2H), 7.53 – 7.45 (m, 1H), 7.39 (d, *J* = 7.6 Hz, 2H), 7.34 – 7.25 (m, 3H), 7.25 – 7.15 (m, 3H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.59 – 6.46 (m, 1H), 4.11 – 3.80 (m, 2H).

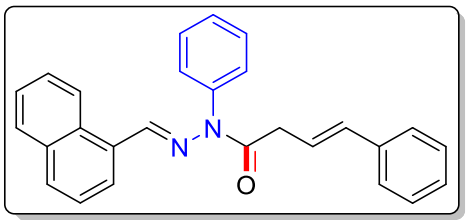
^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 139.9, 137.7, 137.2, 135.6, 133.4, 131.4 (q, *J* = 65.29, 32.61 Hz), 130.4, 129.6, 129.1, 128.5, 127.4, 127.3, 126.3, 125.7 (q, *J* = 546.41, 272.70 Hz), 123.9 (q, *J* = 7.07, 3.03 Hz), 123.0, 38.6.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -62.7.

MS (70 eV): m/z (%) = 408 $[M]^+$ (100), 264, 117, 91.

HRMS (ESI) calcd. for $C_{24}H_{20}F_3N_2O$ [M+H]: 409.1522, found: 409.1523.

(*E*)-*N*'-((*E*)-naphthalen-1-ylmethylene)-*N*,4-diphenylbut-3-enehydrazide (E11)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 63% yield (123.1 mg) based on reaction conditions C and 60% yield (117.1 mg) based on reaction conditions B.

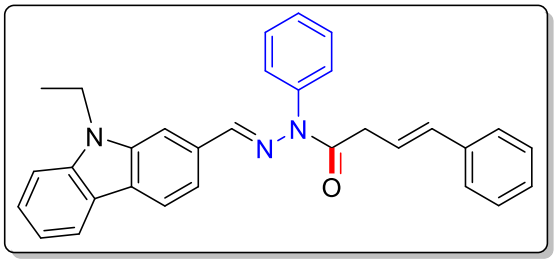
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.40 – 8.31 (m, 1H), 7.96 (s, 1H), 7.89 – 7.79 (m, 3H), 7.63 – 7.55 (m, 2H), 7.54 – 7.43 (m, 4H), 7.43 – 7.36 (m, 2H), 7.32 – 7.24 (m, 4H), 7.22 – 7.14 (m, 1H), 6.76 – 6.54 (m, 2H), 4.15 – 3.92 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 141.6, 137.4, 135.9, 134.0, 133.3, 130.8, 130.6, 130.4, 129.8, 129.5, 129.0, 128.6, 127.4, 127.1, 126.4, 126.2, 125.4, 123.7, 123.4, 38.8.

MS (70 eV): m/z (%) = 390 $[M]^+$ (100), 245, 117, 91.

HRMS (ESI) calcd. for $C_{27}H_{23}N_2O$ [M+H]: 391.1805, found: 391.1809.

(*E*)-*N*'-((*E*)-(9-ethyl-9H-carbazol-2-yl)methylene)-*N*,4-diphenylbut-3-enehydrazide (E12)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 47% yield (107.5 mg) based on reaction conditions C and 43% yield (98.3 mg) based on reaction conditions B.

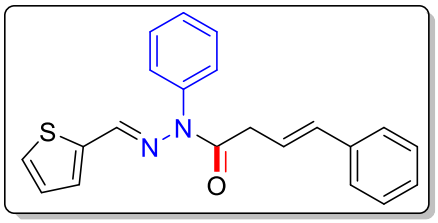
^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24 – 8.15 (m, 1H), 8.06 (d, *J* = 7.6 Hz, 1H), 7.90 – 7.82 (m, 1H), 7.62 – 7.52 (m, 2H), 7.52 – 7.45 (m, 3H), 7.44 – 7.37 (m, 4H), 7.33 – 7.14 (m, 6H), 6.77 – 6.54 (m, 2H), 4.34 (q, *J* = 7.2 Hz, 2H), 4.12 – 3.95 (m, 2H), 1.48 – 1.36 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.8, 143.3, 141.0, 140.4, 137.5, 133.1, 130.2, 129.5, 129.2, 128.5, 127.3, 126.3, 125.4, 124.5, 123.8, 123.1, 122.9, 120.6, 119.5, 108.9, 38.9, 37.8, 13.9.

MS (70 eV): m/z (%) = 457 $[M]^+$ (100), 312, 117, 91.

HRMS (ESI) calcd. for $C_{31}H_{28}N_3O$ [M+H]: 458.2227, found: 458.2225.

(*E*)-*N*,4-diphenyl-*N*'-((*E*)-thiophen-2-ylmethylene)but-3-enehydrazide (E13)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 33% yield (57.1 mg) based on reaction conditions C and 30% yield (51.9 mg) based on reaction conditions B.

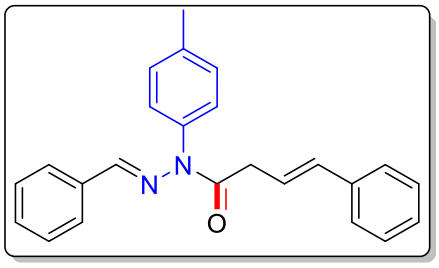
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60 – 7.51 (m, 2H), 7.51 – 7.45 (m, 1H), 7.41 (d, *J* = 8.0 Hz, 3H), 7.36 (d, *J* = 5.2 Hz, 1H), 7.34 – 7.24 (m, 2H), 7.24 – 7.15 (m, 3H), 7.07 – 7.03 (m, 1H), 7.03 – 6.97 (m, 1H), 6.70 (d, *J* = 16.0 Hz, 1H), 6.62 – 6.47 (m, 1H), 4.01 – 3.75 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.7, 139.7, 137.4, 136.2, 135.7, 133.3, 130.3, 129.7, 129.5, 129.2, 128.5, 127.8, 127.5, 127.3, 126.3, 123.3, 38.8.

MS (70 eV): m/z (%) = 346 $[M]^+$ (100), 202, 186, 117.

HRMS (ESI) calcd. for $C_{21}H_{19}N_2OS$ [M+H]: 347.1213, found: 347.1217.

(*E*)-*N*'-((*E*)-benzylidene)-4-phenyl-*N*-(p-tolyl)but-3-enehydrazide (E14)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 75% yield (132.8 mg) based on reaction conditions C and 73% yield (129.3 mg) based on reaction conditions B.

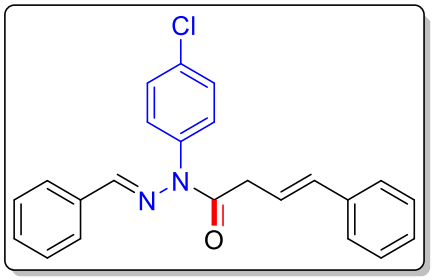
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.54 (m, 2H), 7.43 – 7.25 (m, 10H), 7.24 – 7.16 (m, 1H), 7.09 – 7.00 (m, 2H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.61 – 6.49 (m, 1H), 4.07 – 3.88 (m, 2H), 2.42 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 141.7, 139.4, 137.4, 134.4, 133.1, 130.9, 129.9, 129.0, 128.8, 128.5, 127.3, 126.3, 123.5, 38.8, 21.4.

MS (70 eV): m/z (%) = 354 $[M]^+$ (100), 250, 210, 106.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O$ [M+H]: 355.1805, found: 355.1809.

(*E*)-*N*'-((*E*)-benzylidene)-*N*-(4-chlorophenyl)-4-phenylbut-3-enehydrazide (E15)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 61% yield (114.1 mg) based on reaction conditions C and 58% yield (108.5 mg) based on reaction conditions B.

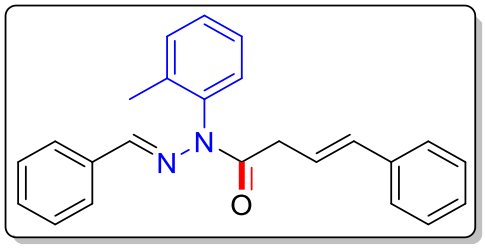
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 – 7.57 (m, 2H), 7.56 – 7.50 (m, 2H), 7.44 – 7.36 (m, 5H), 7.34 – 7.25 (m, 3H), 7.24 – 7.18 (m, 1H), 7.17 – 7.10 (m, 2H), 6.66 (d, *J* = 16.0 Hz, 1H), 6.59 – 6.47 (m, 1H), 4.04 – 3.85 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 142.0, 137.2, 135.4, 134.3, 134.0, 133.4, 130.7, 130.6, 130.2, 128.8, 128.5, 127.4, 127.2, 126.3, 123.0, 38.6.

MS (70 eV): m/z (%) = 374 $[M]^+$ (100), 230, 194, 117.

HRMS (ESI) calcd. for $C_{23}H_{20}ClN_2O$ [M+H]: 375.1259, found: 375.1258.

(*E*)-*N*'-((*E*)-benzylidene)-4-phenyl-*N*-(o-tolyl)but-3-enehydrazide (E16)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 70% yield (124.0 mg) based on reaction conditions C and 68% yield (120.4 mg) based on reaction conditions B.

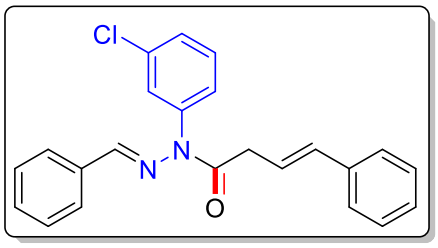
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 – 7.49 (m, 2H), 7.33 – 7.23 (m, 8H), 7.23 – 7.18 (m, 2H), 7.17 – 7.07 (m, 1H), 7.05 – 6.99 (m, 2H), 6.61 (d, *J* = 16.0 Hz, 1H), 6.55 – 6.42 (m, 1H), 3.98 – 3.83 (m, 2H), 2.00 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.6, 141.1, 137.4, 136.9, 134.6, 134.4, 133.3, 131.5, 130.0, 129.8, 129.3, 128.8, 128.5, 127.8, 127.3, 126.3, 123.3, 38.7, 17.4.

MS (70 eV): m/z (%) = 354 $[M]^+$ (100), 250, 210, 117.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O$ [M+H]: 355.1805, found: 355.1805.

(*E*)-*N*'-((*E*)-benzylidene)-*N*-(3-chlorophenyl)-4-phenylbut-3-enehydrazide (E17)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 53% yield (99.1 mg) based on reaction conditions C and 52% yield (97.3 mg) based on reaction conditions B.

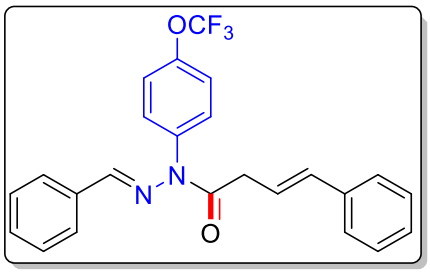
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 – 7.49 (m, 2H), 7.44 – 7.34 (m, 2H), 7.33 – 7.26 (m, 5H), 7.24 – 7.17 (m, 3H), 7.15 – 7.08 (m, 2H), 7.03 – 6.98 (m, 1H), 6.57 (d, *J* = 16.0 Hz, 1H), 6.51 – 6.38 (m, 1H), 4.02 – 3.71 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 171.8, 141.1, 136.2, 136.0, 134.7, 132.9, 132.4, 130.1, 129.1, 128.7, 128.6, 127.8, 127.5, 126.6, 126.3, 126.2, 125.2, 121.9, 37.5.

MS (70 eV): m/z (%) = 374 $[M]^+$ (100), 230, 180, 117.

HRMS (ESI) calcd. for $C_{23}H_{20}ClN_2O$ [M+H]: 375.1259, found: 375.1259.

(*E*)-*N*'-((*E*)-benzylidene)-4-phenyl-*N*-(4-(trifluoromethoxy)phenyl)but-3-enehydrazide (E18)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 58% yield (123.0 mg) based on reaction conditions C and 56% yield (118.8 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.58 (m, 2H), 7.47 – 7.36 (m, 7H), 7.35 – 7.17 (m, 6H), 6.67 (d, *J* = 16.0 Hz, 1H), 6.59 – 6.47 (m, 1H), 4.06 – 3.80 (m, 2H).

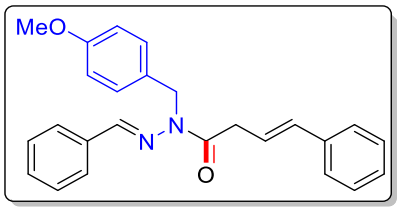
^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.0, 149.5, 142.0, 137.2, 134.1, 134.0, 133.4, 131.0, 130.2, 128.8, 128.5, 127.4, 127.3, 126.3, 122.9, 122.5, 120.4 (q, *J* = 517.12, 258.56 Hz), 38.6.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -57.8.

MS (70 eV): m/z (%) = 424 $[M]^+$ (100), 280, 176, 117.

HRMS (ESI) calcd. for $C_{24}H_{20}F_3N_2O_2$ [M+H]: 425.1471, found: 425.1469.

(*E*)-*N*'-((*E*)-benzylidene)-*N*-(4-methoxybenzyl)-4-phenylbut-3-enehydrazide (E19)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give a white solid in 86% yield (165.2 mg) based on reaction conditions C and 85% yield (163.3 mg) based on reaction conditions B.

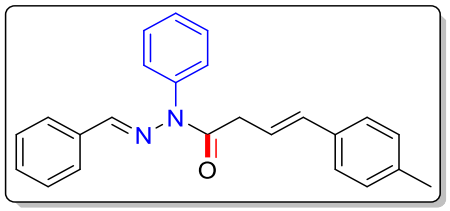
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.66 (s, 1H), 7.63 – 7.56 (m, 2H), 7.42 – 7.31 (m, 5H), 7.31 – 7.23 (m, 2H), 7.22 – 7.14 (m, 1H), 7.14 – 7.09 (m, 2H), 6.84 – 6.79 (m, 2H), 6.63 (d, *J* = 16.0 Hz, 1H), 6.59 – 6.49 (m, 1H), 5.18 (s, 2H), 3.92 (d, *J* = 6.8 Hz, 2H), 3.71 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.4, 158.9, 140.1, 137.4, 134.7, 133.2, 129.8, 128.8, 128.6, 127.9, 127.4, 127.1, 127.0, 126.4, 123.6, 114.4, 55.3, 44.2, 38.5.

MS (70 eV): m/z (%) = 384 $[M]^+$ (100), 280, 239, 117.

HRMS (ESI) calcd. for $C_{25}H_{25}N_2O_2$ [M+H]: 385.1911, found: 385.1911.

(*E*)-*N*'-((*E*)-benzylidene)-*N*-phenyl-4-(p-tolyl)but-3-enehydrazide (E20)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 77% yield (136.4 mg) based on reaction conditions C and 77% yield (136.4 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.58 (m, 2H), 7.54 (t, *J* = 7.6 Hz, 2H), 7.46 (t, *J* = 7.2 Hz, 1H), 7.41 – 7.33 (m, 3H), 7.32 – 7.23 (m, 3H), 7.22 – 7.13 (m, 2H), 7.10 (d,

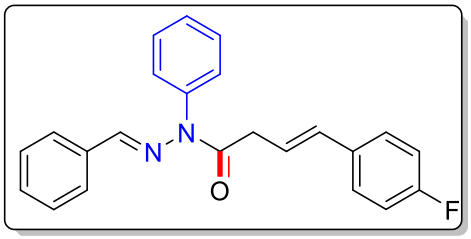
J = 8.0 Hz, 2H), 6.63 (d, *J* = 16.0 Hz, 1H), 6.56 – 6.44 (m, 1H), 4.03 – 3.82 (m, 2H), 2.31 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.1, 141.7, 137.1, 135.9, 134.6, 134.3, 133.1, 130.3, 130.0, 129.4, 129.3, 129.2, 128.8, 127.2, 126.2, 122.3, 38.7, 21.2.

MS (70 eV): m/z (%) = 354 $[M]^+$ (100), 250, 196, 131.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O$ [M+H]: 355.1805, found: 355.1807.

(*E*)-*N*'-((*E*)-benzylidene)-4-(4-fluorophenyl)-*N*-phenylbut-3-enehydrazide (E21)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 63% yield (112.8 mg) based on reaction conditions C and 62% yield (111.0 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.58 (m, 2H), 7.57 – 7.51 (m, 2H), 7.50 – 7.43 (m, 1H), 7.42 – 7.30 (m, 5H), 7.27 (s, 1H), 7.23 – 7.14 (m, 2H), 7.02 – 6.91 (m, 2H), 6.61 (d, *J* = 16.0 Hz, 1H), 6.52 – 6.38 (m, 1H), 4.08 – 3.82 (m, 2H).

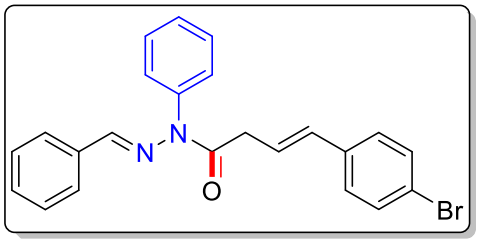
^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.9, 162.2 (d, *J* = 247.45 Hz), 141.9, 135.8, 134.3, 133.6, 132.0, 130.3, 130.0, 129.4, 129.3, 128.8, 127.8 (d, *J* = 7.07 Hz), 127.2, 123.1, 115.4 (d, *J* = 22.22 Hz), 38.6.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -114.9.

MS (70 eV): m/z (%) = 358 $[M]^+$ (100), 254, 196, 135.

HRMS (ESI) calcd. for $C_{23}H_{20}FN_2O$ [M+H]: 359.1554, found: 359.1554.

(*E*)-*N*'-((*E*)-benzylidene)-4-(4-bromophenyl)-*N*-phenylbut-3-enehydrazide (E22)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 53% yield (110.8 mg) based on reaction conditions C and 51% yield (106.6 mg) based on reaction conditions B.

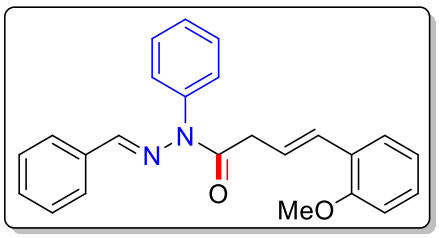
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.57 (m, 2H), 7.57 – 7.51 (m, 2H), 7.50 – 7.44 (m, 1H), 7.44 – 7.33 (m, 5H), 7.29 – 7.21 (m, 3H), 7.20 – 7.15 (m, 2H), 6.63 – 6.49 (m, 2H), 4.08 – 3.82 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.7, 141.9, 136.3, 135.8, 134.2, 132.0, 131.6, 130.3, 130.0, 129.4, 129.2, 128.8, 127.9, 127.2, 124.3, 121.0, 38.6.

MS (70 eV): m/z (%) = 418 $[M]^+$ (100), 293, 196, 104.

HRMS (ESI) calcd. for $C_{23}H_{20}BrN_2O$ [M+H]: 419.0754, found: 419.0750.

(*E*)-*N*'-((*E*)-benzylidene)-4-(2-methoxyphenyl)-*N*-phenylbut-3-enehydrazide (E23)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 66% yield (122.2 mg) based on reaction conditions C and 65% yield (120.3 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.65 – 7.58 (m, 2H), 7.57 – 7.51 (m, 2H), 7.51 – 7.41 (m, 2H), 7.40 – 7.30 (m, 3H), 7.25 (s, 1H), 7.23 – 7.14 (m, 3H), 7.00 (d, *J* = 16.0 Hz,

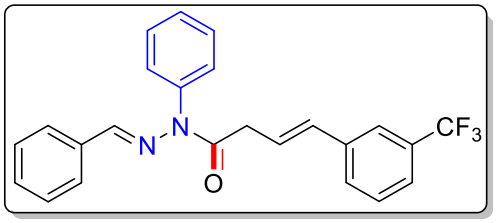
1H), 6.92 – 6.86 (m, 1H), 6.85 – 6.81 (m, 1H), 6.52 – 6.50 (m, 1H), 4.05 – 3.94 (m, 2H), 3.79 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.1, 156.6, 134.4, 130.2, 129.9, 129.3, 128.8, 128.4, 128.0, 127.3, 126.9, 126.5, 124.0, 120.7, 110.8, 55.5, 39.2.

MS (70 eV): m/z (%) = 370 $[M]^+$ (100), 237, 196, 104.

HRMS (ESI) calcd. for $C_{24}H_{23}N_2O_2$ [M+H]: 371.1754, found: 371.1755.

(*E*)-*N*'-((*E*)-benzylidene)-*N*-phenyl-4-(3-(trifluoromethyl)phenyl)but-3-enehydrazide (E24)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 58% yield (118.4 mg) based on reaction conditions C and 56% yield (114.3 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.53 (m, 6H), 7.52 – 7.44 (m, 2H), 7.43 – 7.35 (m, 4H), 7.29 (s, 1H), 7.23 – 7.16 (m, 2H), 6.75 – 6.57 (m, 2H), 4.16 – 3.84 (m, 2H).

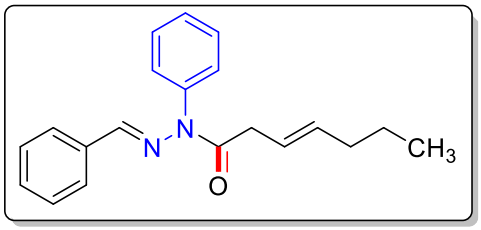
^{13}C NMR (101 MHz, $CDCl_3$) δ = 172.6, 142.1, 138.1, 134.2, 131.8, 130.9 (q, *J* = 64.64, 32.32 Hz), 130.3, 130.1, 129.4, 129.2, 128.9, 128.8, 127.2, 125.6, 124.2 (q, *J* = 547.42, 273.71 Hz), 123.8 (q, *J* = 7.07, 3.03 Hz), 123.0 (q, *J* = 7.07, 4.04 Hz), 38.4.

^{19}F NMR (376 MHz, $CDCl_3$) δ = -62.7.

MS (70 eV): m/z (%) = 408 $[M]^+$ (100), 248, 196, 165.

HRMS (ESI) calcd. for $C_{24}H_{20}F_3N_2O$ [M+H]: 409.1522, found: 409.1522.

(*E*)-*N*'-((*E*)-benzylidene)-*N*-phenylhept-3-enehydrazide (E25)



The title compound was prepared according to the general procedure and purified by column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) to give the light-yellow oil in 36% yield (58.2 mg) based on reaction conditions C and 35% yield (53.6 mg) based on reaction conditions B.

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 – 7.51 (m, 4H), 7.50 – 7.44 (m, 1H), 7.41 – 7.31 (m, 3H), 7.24 (d, *J* = 8.0 Hz, 1H), 7.20 – 7.12 (m, 2H), 5.85 – 5.55 (m, 2H), 3.90 – 3.66 (m, 2H), 2.25 – 1.98 (m, 2H), 1.52 – 1.33 (m, 2H), 1.02 – 0.84 (m, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 173.7, 141.4, 136.0, 134.4, 132.9, 130.2, 129.8, 129.3, 128.7, 127.2, 123.0, 122.3, 38.4, 34.8, 22.7, 22.5, 13.9, 13.7.

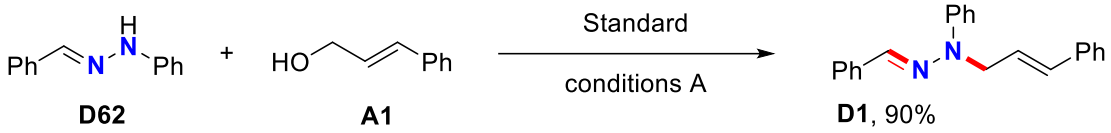
MS (70 eV): m/z (%) = 306 $[M]^+$ (100), 277, 196, 104.

HRMS (ESI) calcd. for $C_{20}H_{23}N_2O$ [M+H]: 307.1805, found: 307.1805.

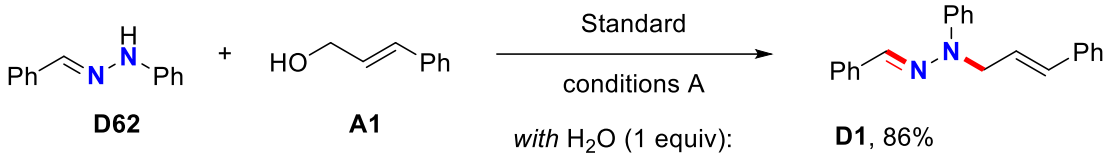
6. Mechanism investigations

6.1 Control experiments for tandem allylation reaction

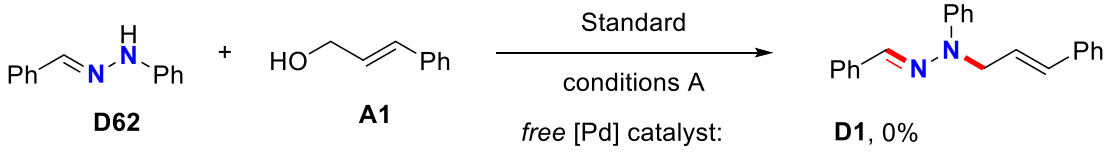
6.1.1 Control experiments with D62



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D62** (0.5 mmol), **A1** (0.75 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 90% yield.

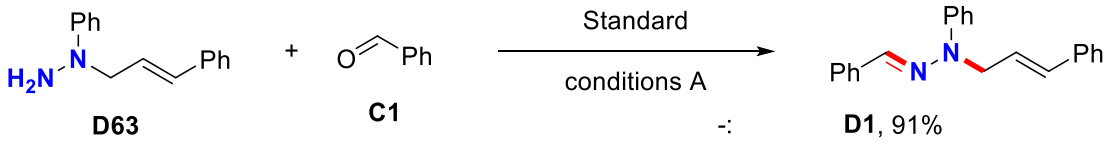


Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D62** (0.5 mmol), **A1** (0.75 mmol), H_2O (0.5 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 86% yield.

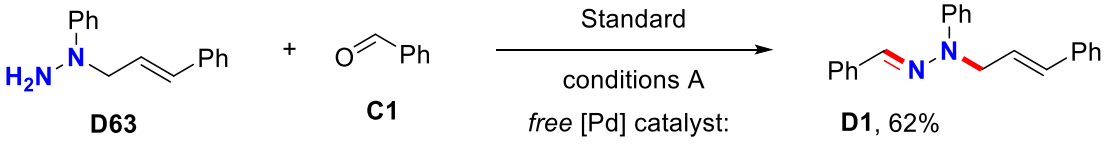


Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D62** (0.5 mmol), **A1** (0.75 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 0% yield and **D62** was recovered in 95% yield.

6.1.2 Control experiments with D63



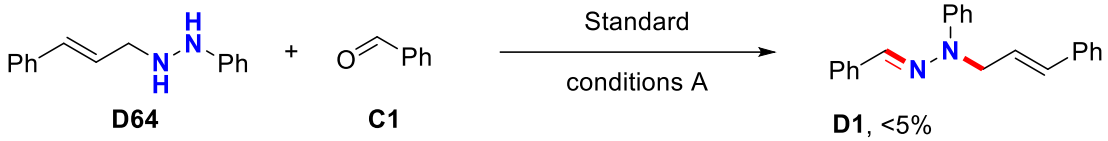
Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D63** (0.5 mmol), **C1** (0.7 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 91% yield.



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D63** (0.5 mmol) and **C1** (0.7 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography

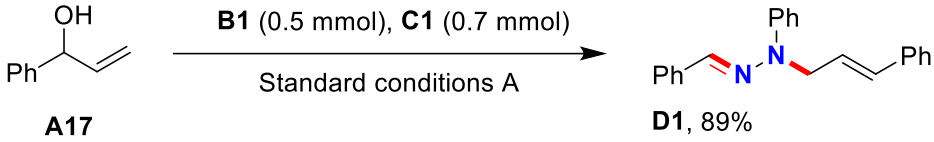
(petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 62% yield.

6.1.3 Control experiments with D64

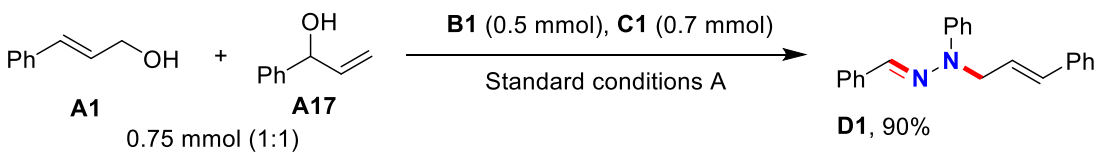


Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D64** (0.5 mmol), **C1** (0.7 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in <5% yield.

6.1.4 Control experiments with A17



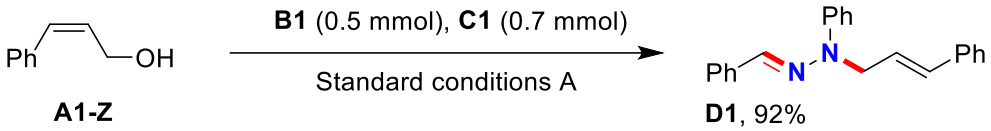
Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **A17** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 89% yield.



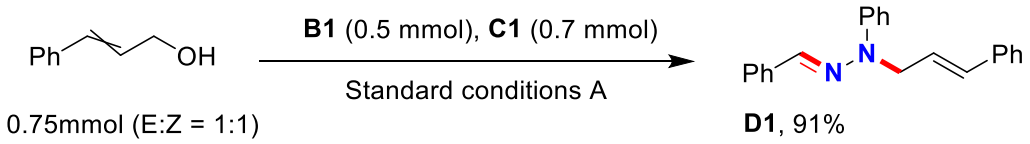
Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was

charged with a magnetic stirring bar, toluene (2.0 mL), **A1**+**A17** (0.75 mmol, **A1**:**A17** = 1:1), **B1** (0.5 mmol), **C1** (0.7 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 90% yield.

6.1.5 Control experiments with A1-Z



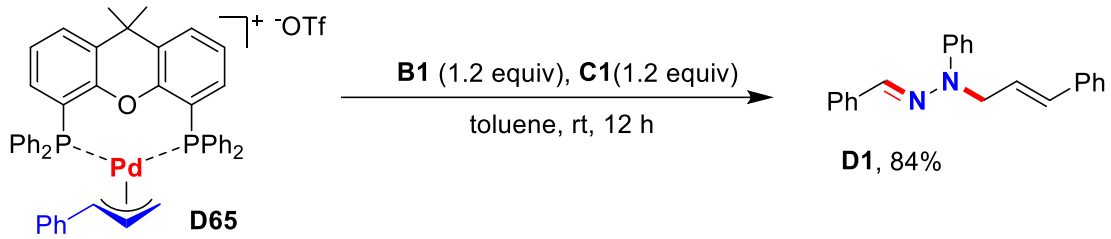
Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **A1-Z** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 92% yield.



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **A1**+**A1-Z** (0.75 mmol, **A1**:**A1-Z** = 1:1), **B1** (0.5 mmol), **C1** (0.7 mmol) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under

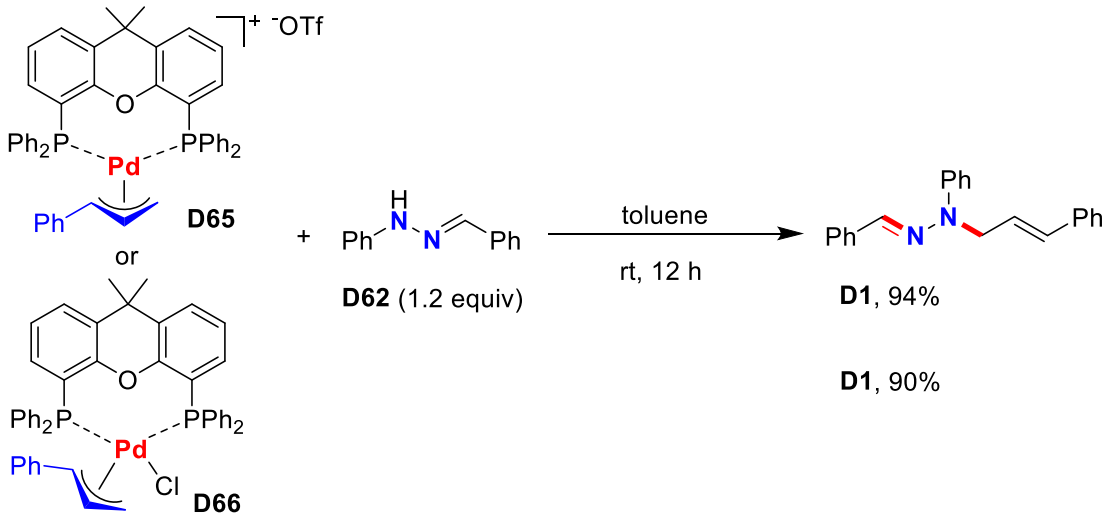
reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 91% yield.

6.1.6 Control experiments with D65



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D65** (0.5 mmol), **B1** (0.6 mmol) and **C1** (0.6 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at room temperature for 12 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 84% yield.

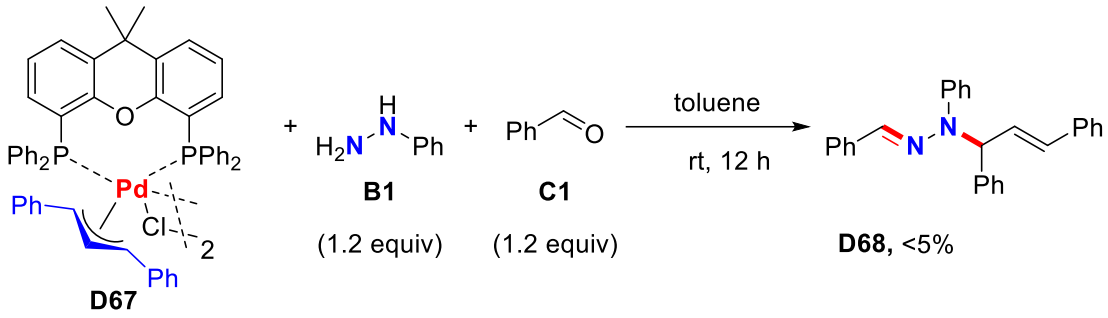
6.1.7 Control experiments with D65/D66 and D62



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D65/D66** (0.5 mmol) and **D62** (0.6 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at room temperature for 12 hours. After the reaction was finished,

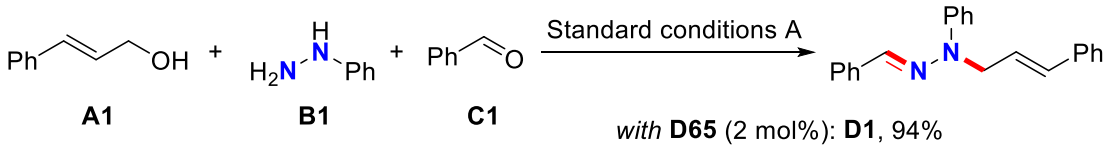
the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 94%/90% yield.

6.1.8 Control experiments with D67



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **D67** (0.5 mmol), **B1** (0.6 mmol), **C1** (0.6 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at room temperature for 12 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D68** in <5% yield.

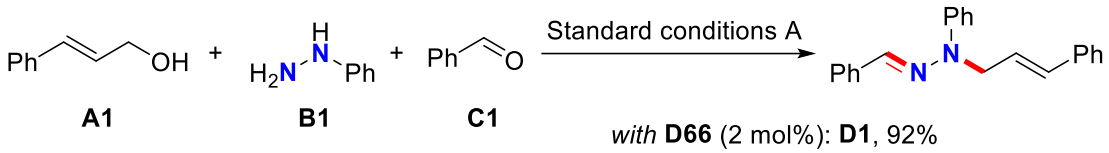
6.1.9 Control experiments with D65, A1, B1 and C1



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **A1** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol) and **D65** (0.01 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 ^{o}C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash

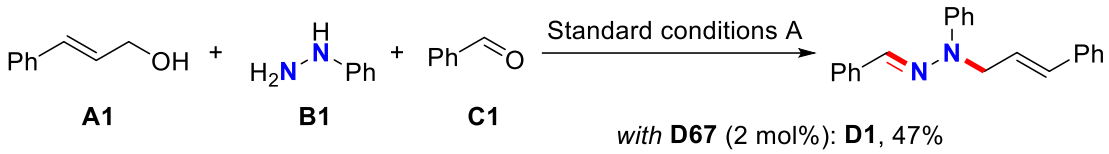
column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 94% yield.

6.1.10 Control experiments with D66, A1, B1 and C1



Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **A1** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol) and **D66** (0.01 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 92% yield.

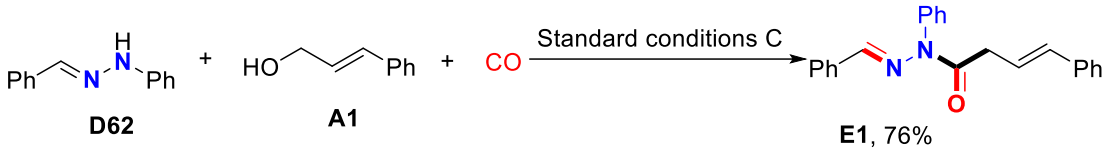
6.1.11 Control experiments with D67, A1, B1 and C1



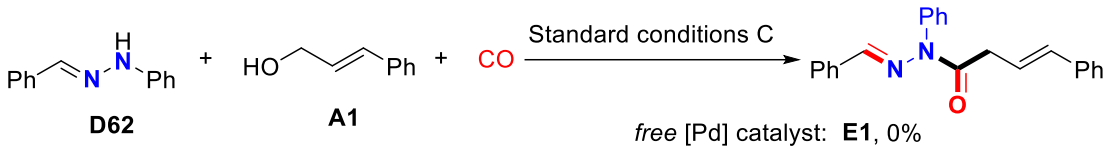
Using a nitrogen-filled glove box, an oven-dried pressure tube (38 mL volume) was charged with a magnetic stirring bar, toluene (2.0 mL), **A1** (0.75 mmol), **B1** (0.5 mmol), **C1** (0.7 mmol) and **D67** (0.01 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 60 °C for 4 hours. After the reaction was finished, the reaction was analyzed by TLC to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D1** in 47% yield.

6.2 Control experiments for carbonylation reaction

6.2.1 Control experiments with D62

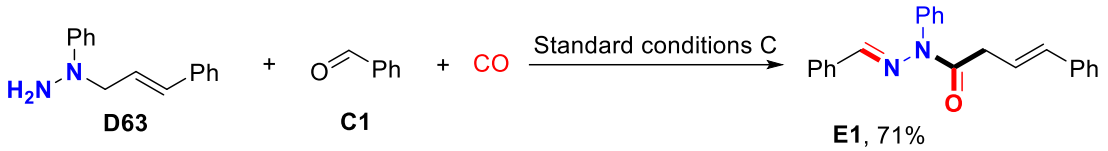


Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D62** (0.5 mmol), toluene (2.0 mL), $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%) and **A1** (0.75 mmol). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 ℃) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in 76% yield.

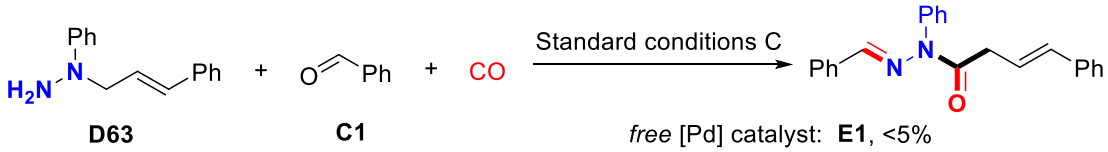


Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D62** (0.5 mmol), toluene (2.0 mL) and **A1** (0.75 mmol). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 ℃) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in 0% yield.

6.2.2 Control experiments with D63

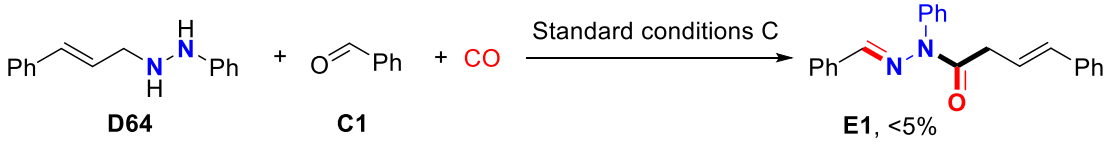


Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D63** (0.5 mmol), **C1** (0.75 mmol), toluene (2.0 mL) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 °C) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in 71% yield.



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D63** (0.5 mmol), **C1** (0.75 mmol) and toluene (2.0 mL). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 °C) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in <5% yield.

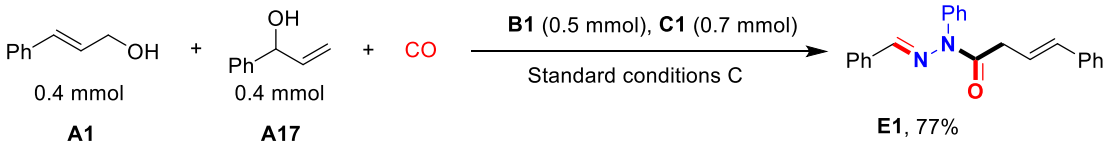
6.2.3 Control experiments with D64



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D64** (0.5 mmol), **C1** (0.75 mmol), toluene (2.0 mL) and

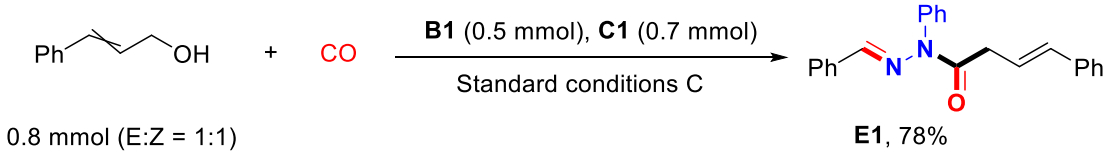
$PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 °C) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in <5% yield.

6.2.4 Control experiments with A1 and A17



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **B1** (0.5 mmol), **C1** (0.7 mmol), **A1** (0.4 mmol), **A17** (0.4 mmol), toluene (2.0 mL) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 °C) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in 77% yield.

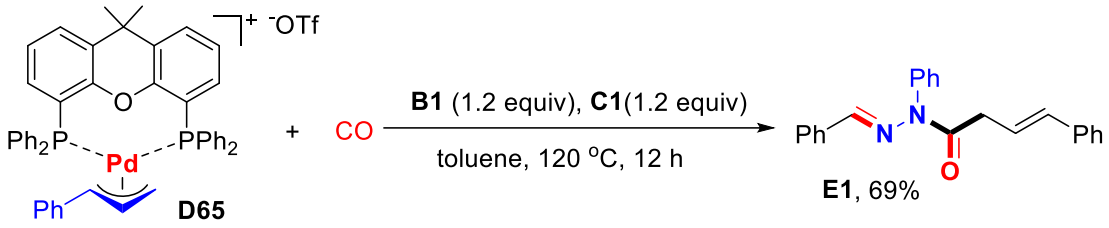
6.2.5 Control experiments with A1 and A17



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **B1** (0.5 mmol), **C1** (0.7 mmol), **A1** (0.4 mmol), **A1-Z** (0.4 mmol), toluene (2.0 mL) and $PdCl_2$(Xantphos) (0.01 mmol, 2 mol%). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 °C) for 12 hours. After the reaction was finished, the autoclave

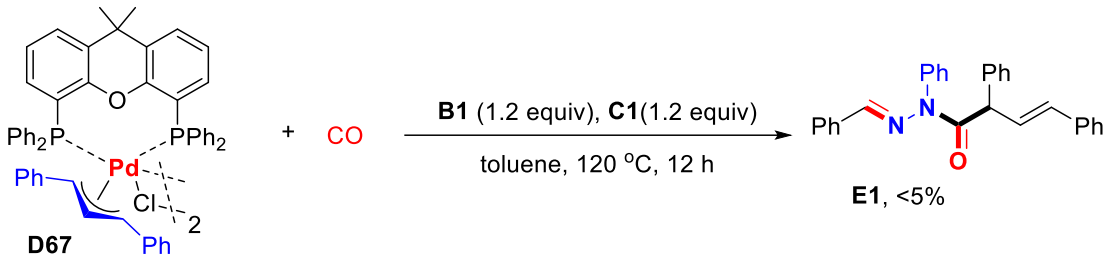
was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The result showed that desired product **E1** was generated in 78% yield.

6.2.6 Control experiments with D65



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D65** (0.5 mmol), **B1** (0.6 mmol), **C1** (0.6 mmol) and toluene (2.0 mL). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 ℃) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in 69% yield.

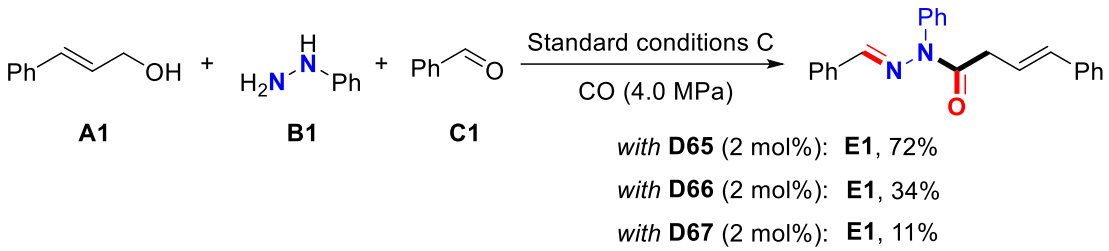
6.2.7 Control experiments with D67



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **D67** (0.5 mmol), **B1** (0.6 mmol), **C1** (0.6 mmol) and toluene (2.0 mL). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 ℃) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC

to monitor product formation. The result showed that desired product **E1** was generated in <5% yield.

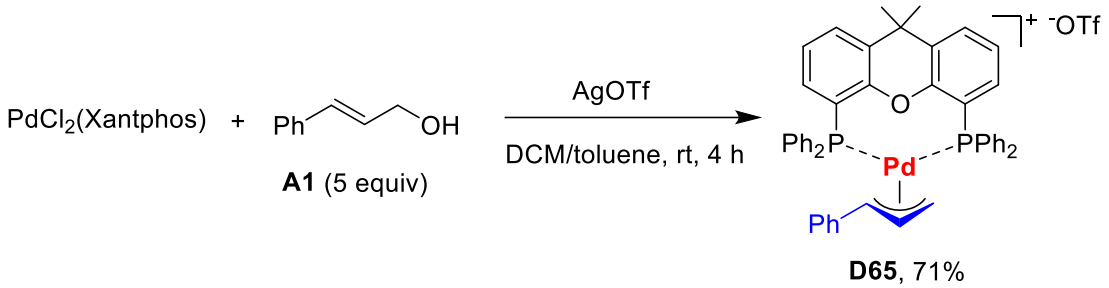
6.2.8 Control experiments with D65, D66 and D67



Using a nitrogen-filled glove box, an oven-dried glass bottle was charged with a magnetic stirring bar, **B1** (0.5 mmol), **C1** (0.7 mmol), **A1** (0.75 mmol), toluene (2.0 mL) and **D65/D66/D67**(0.01 mmol, 2 mol%). Then the glass bottle was placed in an autoclave which was closed tightly and removed from the glove box. Then the autoclave was purged and charged with CO (4.0 MPa) and immersed into a pre-heated metal bath (120 ℃) for 12 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released. Then a small aliquot of the organic phase was analyzed by GC to monitor product formation. The result showed that desired product **E1** was generated in 72%, 34% or 11% yield.

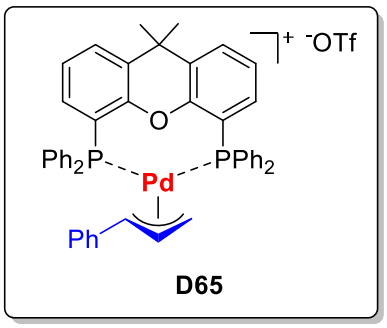
6.3 Synthesis of allyl metalated palladium complexes

6.3.1 Synthesis of D65



Using a nitrogen-filled glove box, an oven-dried pressure tube was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), AgOTf (0.42 mmol), **A1** (1 mmol) and DCM/Toluene. Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at room temperature for 4 hours. After the reaction was

finished, recrystallized in the DCM/Toluene under argon gave the ruby red clear crystal crystals **D65** in 71% yield.



D65

Elemental Analysis calcd for $C_{49}H_{44}F_3O_4P_2PdS$: C, 61.67; H, 4.65; F, 5.97; O, 6.71; P, 6.49; Pd, 11.15; S, 3.36, found: C, 61.61; H, 4.60; S, 3.39.

HRMS (ESI): calcd. for $C_{48}H_{43}OP_2Pd$ [**D65-OTf**]$^+$: 803.1824, found: 803.1822.

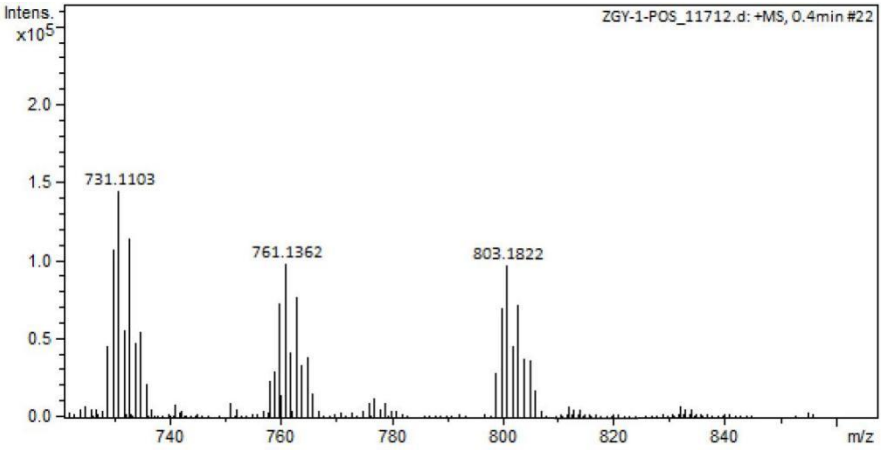


Figure S5 HRMS of D65-OTf

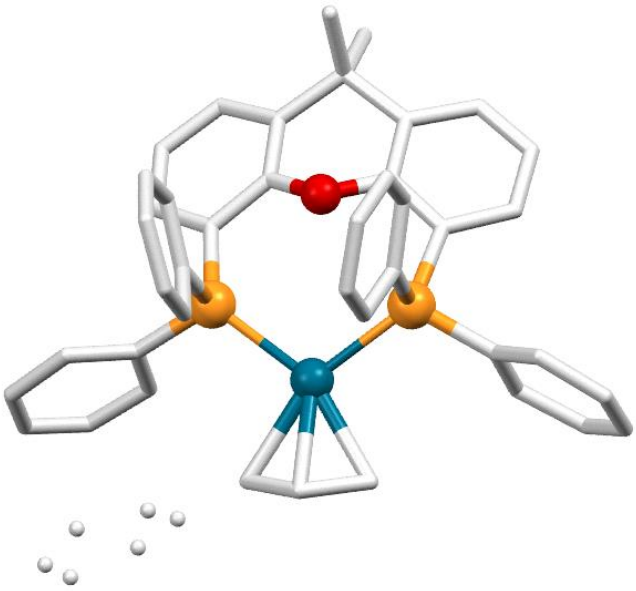
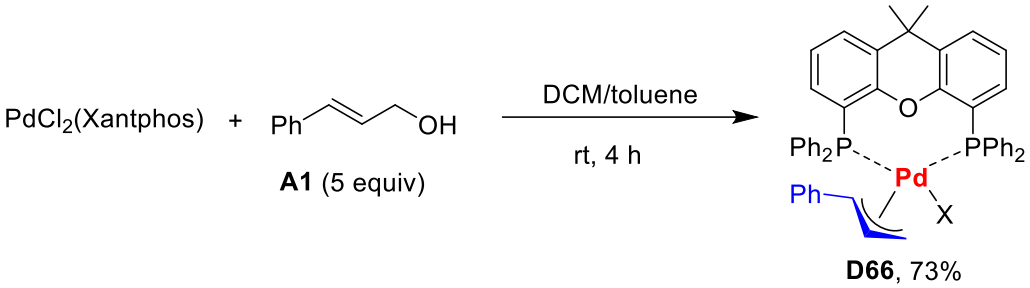
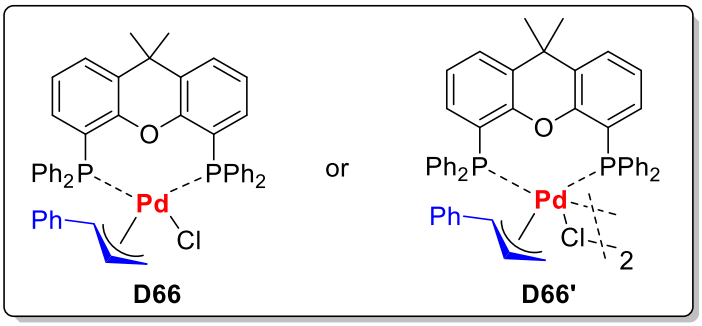


Figure S6 X-ray of D65 (CCDC 2249900)

6.3.2 Synthesis of D66



Using a nitrogen-filled glove box, an oven-dried pressure tube was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), **A1** (1 mmol) and DCM/Toluene. Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at room temperature for 4 hours. After the reaction was finished, recrystallized in the DCM/Toluene under argon gave the ruby red clear crystal crystals **D66** in 73% yield.



Elemental Analysis calcd for $C_{48}H_{43}ClOP_2Pd$: C, 68.66; H, 5.16; Cl, 4.22; O, 1.91; P, 7.38; Pd, 12.67, found: C, 68.69; H, 5.12.

HRMS (ESI): calcd. for $C_{48}H_{43}OP_2Pd$ [**D66-Cl**]$^+$: 803.1824, found: 803.1817.

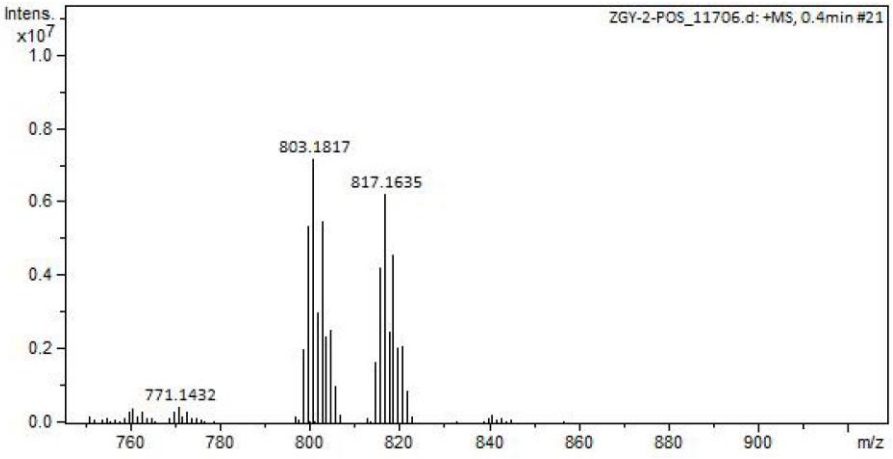
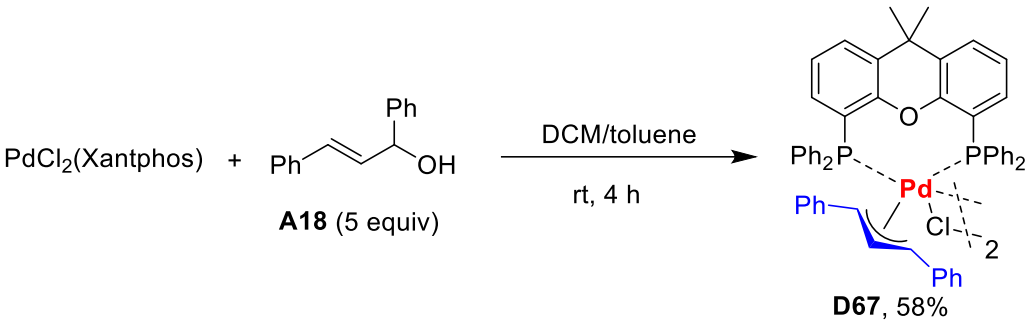
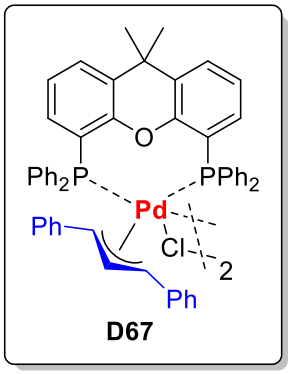


Figure S7 HRMS of D67

6.3.3 Synthesis of D67



Using a nitrogen-filled glove box, an oven-dried pressure tube was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), **A18** (1 mmol) and DCM/Toluene. Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at room temperature for 4 hours. After the reaction was finished, recrystallized in the DCM/Toluene under argon gave the ruby red clear crystal crystals **D67** in 58% yield.



Elemental Analysis calcd for $C_{54}H_{47}ClOP_2Pd$: C, 70.82; H, 5.17; Cl, 3.87; O, 1.75; P, 6.76; Pd, 11.62; found: C, 70.87; H, 5.14.

HRMS (ESI): calcd. for $C_{54}H_{47}OP_2Pd$ [**D67**-Cl]$^+$: 879.2137, found: 879.2139.

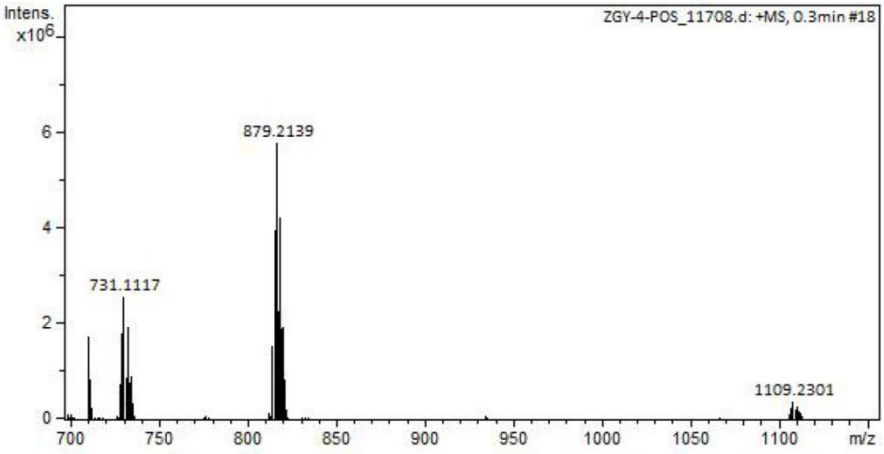


Figure S8 HRMS of D67

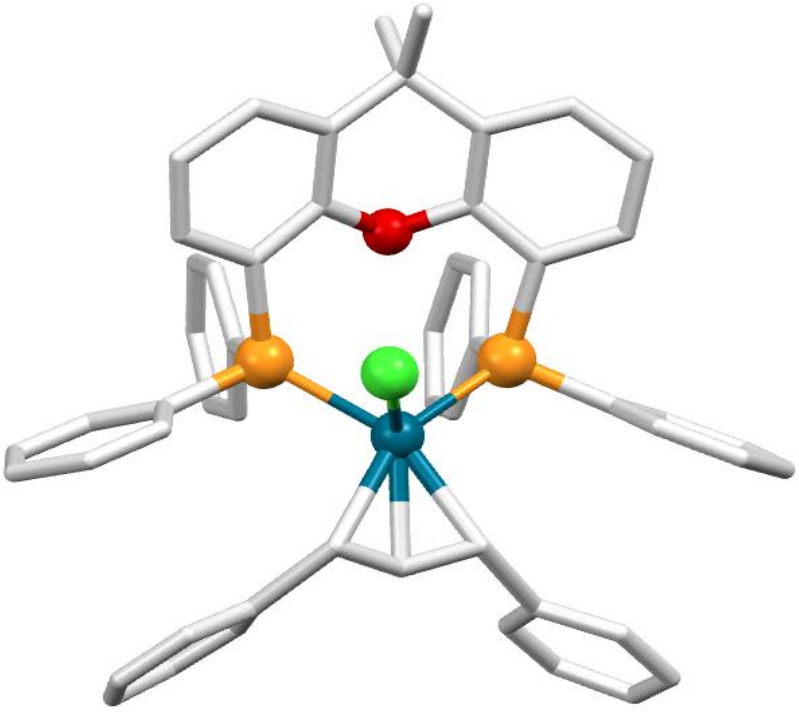


Figure S9 X-ray of D67 (CCDC 2249901)

6.4 Time conversion plot experiments on standard condition C

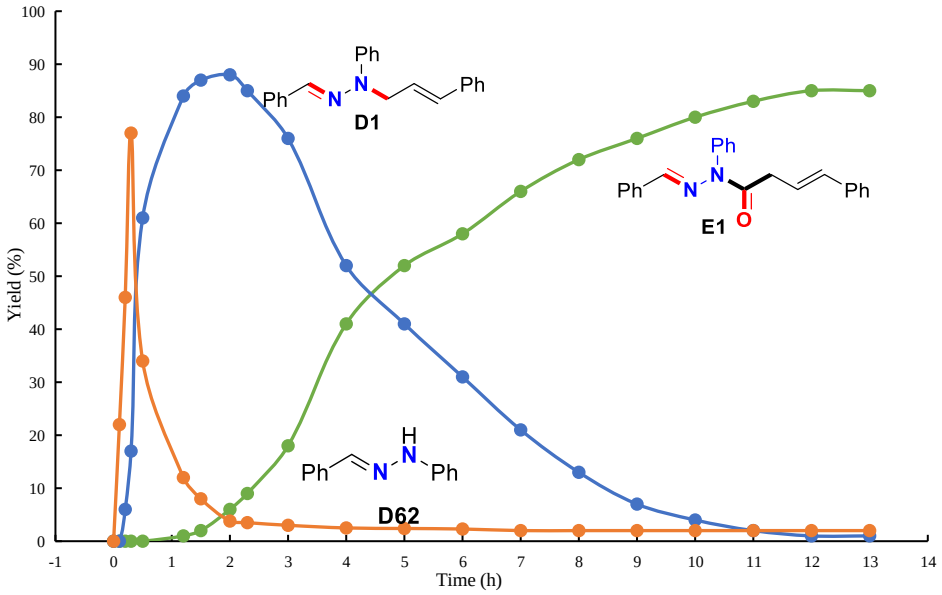
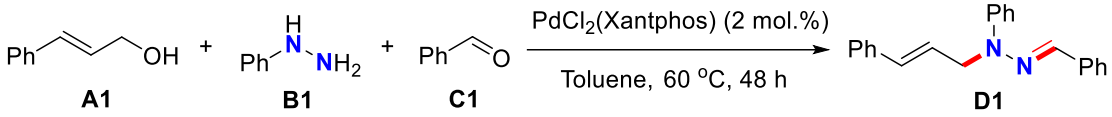


Figure S10 Time conversion plot

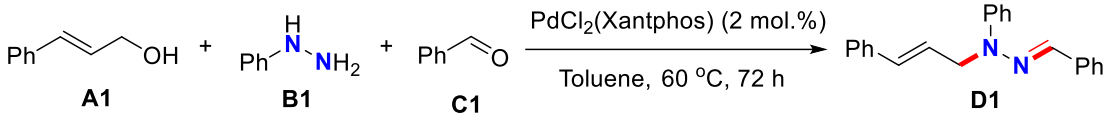
7. Gram-Scale Synthesis

7.1 Gram-Scale Synthesis of D1



10 mmol, 984 μL 88%, 2.75 g

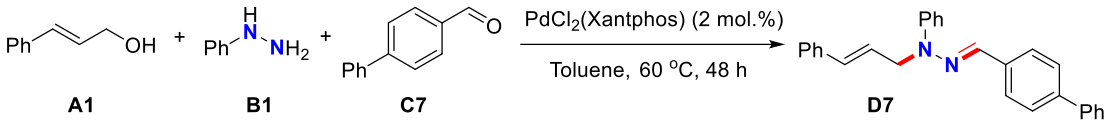
Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, toluene (30 mL), **C1** (14 mmol), **B1**(10 mmol), $PdCl_2$(Xantphos) (0.2 mmol) and **A1** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D1** 2.75 g, the yield is 88%.



100 mmol, 9840 μL 80%, 25.15 g

Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, toluene (50 mL), **C1** (140 mmol), **B1** (100 mmol), $PdCl_2$(Xantphos) (2 mmol) and **A1** (150 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 72 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D1** 25.15 g, the yield is 80%.

7.2 Gram-Scale Synthesis of D4

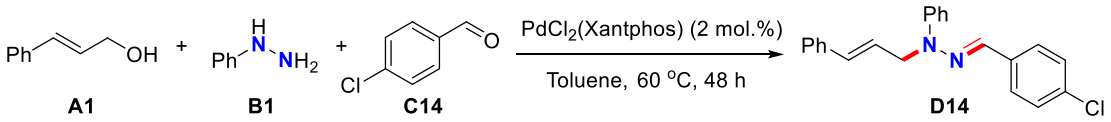


A1 **B1** **C7** **D7**

10 mmol, 984 μL 90%, 3.49 g

Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL), **C4** (14 mmol), **B1** (10 mmol) and **A1** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D4** 3.49 g, the yield is 90%.

7.3 Gram-Scale Synthesis of D7

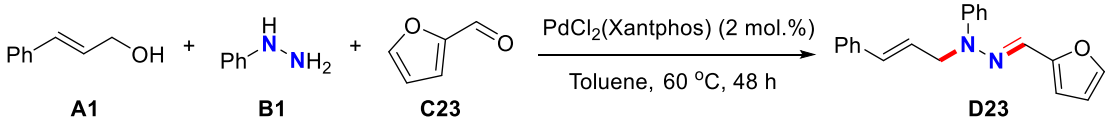


A1 **B1** **C14** **D14**

10 mmol, 984 μL 84%, 2.91 g

Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL), **C7** (14 mmol), **B1** (10 mmol) and **A1** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D7** 2.91 g, the yield is 84%.

7.4 Gram-Scale Synthesis of D23

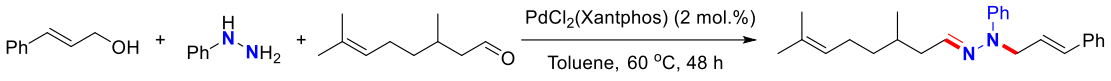


A1 **B1** **C23** **D23**

10 mmol, 984 μL 81%, 2.45 g

Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL), **C23** (14 mmol), **B1** (10 mmol) and **A1** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D23** 2.45 g, the yield is 81%.

7.5 Gram-Scale Synthesis of D28

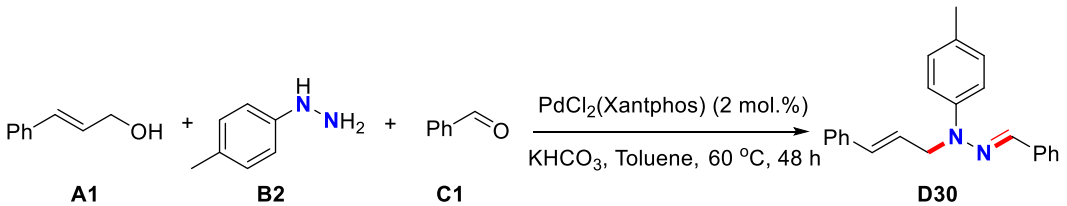


A1 **B1** **C28** **D28**

10 mmol, 984 μL 76%, 2.74 g

Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL), **C28** (14 mmol), **B1** (10 mmol) and **A1** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D28** 2.74 g, the yield is 76%.

7.6 Gram-Scale Synthesis of D30



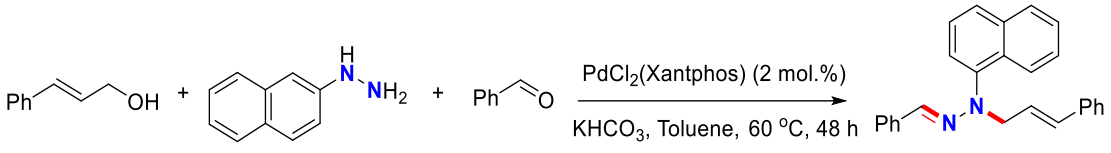
A1 **B2** **C1** **D30**

10 mmol, 1.45 g 82%, 2.67 g

Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, **B2** (10 mmol), $KHCO_3$ (10 mmol) and toluene

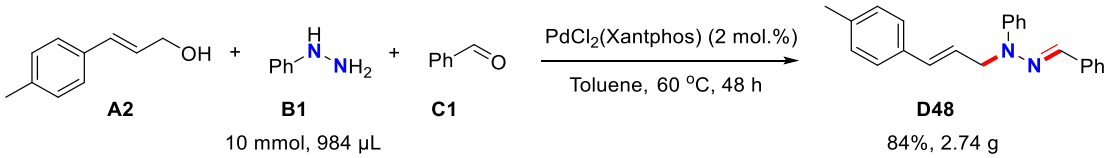
(30 mL). After the reaction mixture was stirred 15 min at room temperature, $PdCl_2$(Xantphos) (0.2 mmol), **C1** (14 mmol) and **A1** (15 mmol) were added in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D30** 2.67 g, the yield is 82%.

7.7 Gram-Scale Synthesis of D43



Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, **B15** (10 mmol), $KHCO_3$ (10 mmol) and toluene (30 mL). After the reaction mixture was stirred 15 min at room temperature, $PdCl_2$(Xantphos) (0.2 mmol), **C1** (14 mmol) and **A1** (15 mmol) were added in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D43** 2.90 g, the yield is 80%.

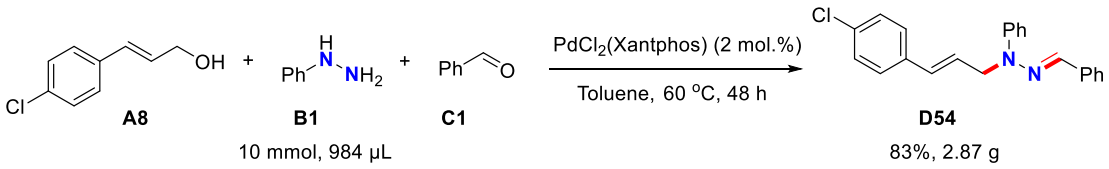
7.8 Gram-Scale Synthesis of D48



Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL),

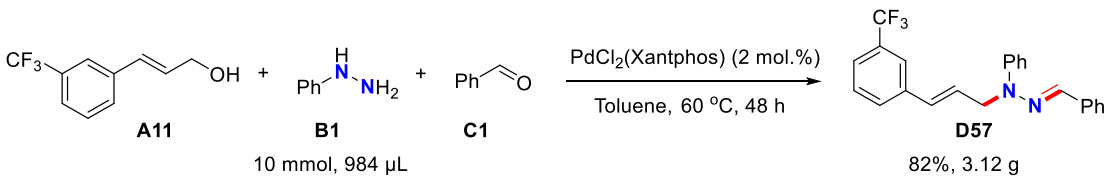
C1 (14 mmol), **B1** (10 mmol) and **A2** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D48** 2.74 g, the yield is 84%.

7.9 Gram-Scale Synthesis of D54



Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL), **C1** (14 mmol), **B1** (10 mmol) and **A8** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction mixture was stirred 24 hours at 48 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D54** 2.87 g, the yield is 83%.

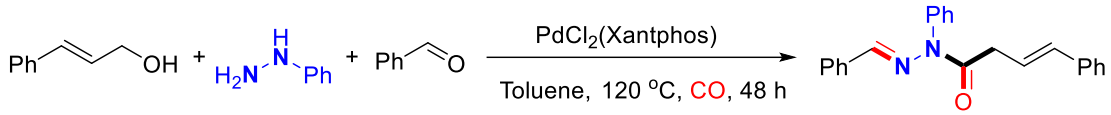
7.10 Gram-Scale Synthesis of D57



Using a nitrogen-filled glove box, an oven-dried Schlenk Flask (250 mL volume) was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (30 mL), **C1** (14 mmol), **B1** (10 mmol) and **A11** (15 mmol) in sequence. Then the Schlenk Flask was closed tightly with a rubber stopper, removed from the glove box. Then the reaction

mixture was stirred 48 hours at 60 °C under N_2 atmosphere in a metal bath. After the reaction was finished and the mixture was cooled to room temperature, the solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the desired product **D57** 3.12 g, the yield is 82%.

7.11 Gram-Scale Synthesis of E1



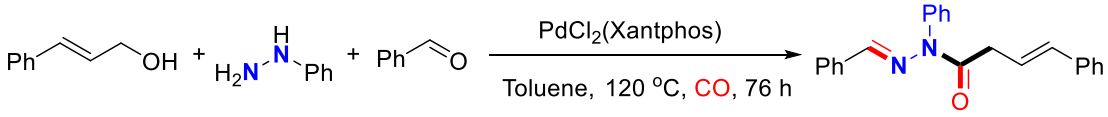
A1 **B1** **C1**

10 mmol, 984 μL

E1

61%, 2.07 g

An oven-dried autoclave liner pipe was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (0.2 mmol), toluene (20 mL), **C1** (14 mmol), **B1** (10 mmol) and **A1** (15 mmol). Then the liner pipe was placed in an autoclave which was closed tightly. After that, the autoclave was purged and charged with CO (4 MPa) and immersed into a pre-heated metal bath (120 ℃) for 48 hours. After the reaction was finished, the autoclave was cooled to room temperature and the pressure was carefully released, and a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) on silica gel to give desired product **E1** 2.07 g, the yield is 61%.



A1 **B1** **C1**

100 mmol, 9.84 mL

E1

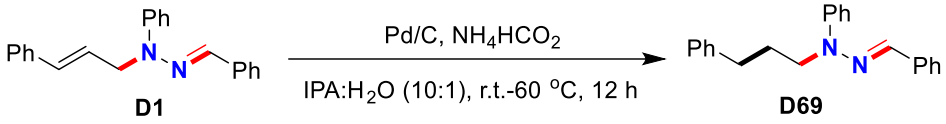
51%, 17.36 g

An oven-dried autoclave liner pipe was charged with a magnetic stirring bar, $PdCl_2$(Xantphos) (2 mmol), toluene (100 mL), **C1** (140 mmol), **B1** (100 mmol) and **A1** (150 mmol). Then the liner pipe was placed in an autoclave which was closed tightly. After that, the autoclave was purged and charged with CO (4 MPa) and immersed into a pre-heated metal bath (120 ℃) for 76 hours. After the reaction was finished, the

autoclave was cooled to room temperature and the pressure was carefully released, and a small aliquot of the organic phase was analyzed by GC and GC-MS to monitor product formation. The solvent was evaporated under reduced pressure and the residue was purified by flash column chromatography (petroleum ether/ ethyl acetate = 20:1 – 5:1) on silica gel to give desired product **E1** 17.36 g, the yield is 51%.

8. Further Transformation

8.1 Synthesis of (*E*)-2-benzylidene-1-phenyl-1-(3-phenylpropyl)hydrazine[2]



Isopropyl alcohol (3 mL) was added to a 20 mL dry glass bottle with a magnetic stirring bar and Pd/C (5.3 mg, 0.05 mmol). Ammonium formate (315.3 mg, 5 mmol) dissolved in water (0.3 mL) was transferred to the same bottle. The reaction mixture was stirred for 5 min at room temperature to activate Pd/C. Next, the primary 2-((*E*)-benzylidene)-1-cinnamyl-1-phenylhydrazine (**D1**) (156.2 mg, 0.5 mmol) was added, and the reaction mixture was heated to 60 ℃ and reacted 12 h. After completion of the reaction based on TLC monitoring, the Pd/C catalyst was filtered off on Celite and the solvent and the solvent was removed by rotary evaporation. The reaction mixture was washed with brine solution and extracted with ethyl acetate (3×5 mL), then the organic solvents were dried by Na_2SO_4 and concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D69** as a colorless oil in 73% yield (115.5 mg).

(*E*)-2-benzylidene-1-phenyl-1-(3-phenylpropyl)hydrazine (D69)

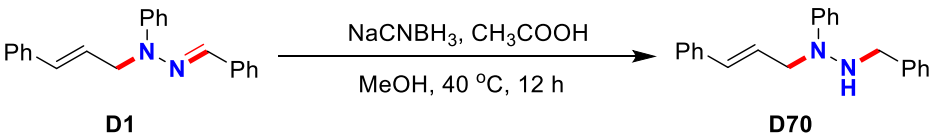
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.62 – 7.55 (m, 2H), 7.38 – 7.17 (m, 13H), 6.90 (m, 1H), 3.93 – 3.79 (m, 2H), 2.73 (m, 2H), 2.00 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 147.1, 141.1, 136.8, 131.2, 129.2, 128.7, 128.6, 127.7, 126.4, 126.1, 120.4, 114.8, 44.3, 33.1, 25.9.

MS (70 eV): m/z (%) = 314 $[M]^+$ (100), 209, 195, 106.

HRMS (ESI) calcd. for $C_{22}H_{23}N_2$ [M+H]: 315.1856, found: 315.1860.

8.2 Synthesis of 2-benzyl-1-cinnamyl-1-phenylhydrazine[3]



Methanol (3 mL) was added to a 20 mL dry glass bottle with a magnetic stirring bar,

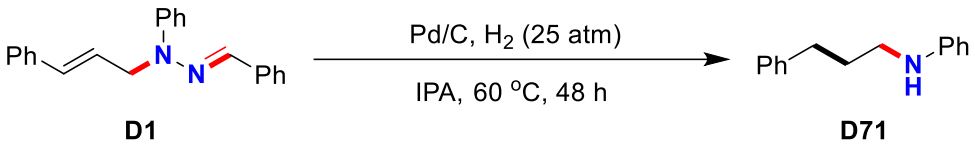
acetic acid (0.4 mL, 7 mmol), $NaCNBH_3$ (94.26 mg, 1.5 mmol) and 2-((*E*)-benzylidene)-1-cinnamyl-1-phenylhydrazine (**D1) (**156.2 mg, 0.5 mmol). The reaction mixture was stirred for 12 h at 40 ℃. After completion of the reaction based on TLC monitoring, the reaction mixture was washed with brine solution and extracted with ethyl acetate (3×5 mL), then the organic solvents were dried by Na_2SO_4 and concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1, with 1% (v/v) triethylamine) on silica gel to give the product **D70** as a colorless oil in 96% yield (150.8 mg).

2-benzyl-1-cinnamyl-1-phenylhydrazine (D70)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 – 7.36 (m, 2H), 7.35 – 7.22 (m, 9H), 7.21 – 7.16 (m, 1H), 7.11 – 7.05 (m, 2H), 6.78 (m, 1H), 6.55 (dd, *J* = 16.0, 1.5 Hz, 1H), 6.19 (m, 1H), 4.21 (m, 2H), 4.01 (s, 2H), 3.75 (s, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 150.3, 138.5, 136.8, 133.5, 129.4, 129.2, 128.8, 128.7, 127.9, 127.6, 126.7, 124.7, 118.6, 114.0, 53.5, 52.8.

8.3 Synthesis of *N*-(3-phenylpropyl)aniline



D1 **D71**

Isopropyl alcohol (2 mL) was added to a 10 mL dry glass bottle with a magnetic stirring bar, 2-((*E*)-benzylidene)-1-cinnamyl-1-phenylhydrazine (**D1**) (156.2 mg, 0.5 mmol) and Pd/C (5.3 mg, 0.05 mmol). Then the glass bottle was transferred into an autoclave under N_2 atmosphere. After flushing the autoclave three times with H_2 and adjusting the pressure to 25 atm, the reaction was performed for 48 h at 60 ℃. After completion of the reaction, the autoclave was cooled to room temperature, the reaction mixture was washed with brine solution and extracted with ethyl acetate (3×5 mL), then the organic solvents were dried by Na_2SO_4 and concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product **D71** as a colorless oil in 99% yield (104.0 mg).

***N*-(3-phenylpropyl)aniline (D71)**

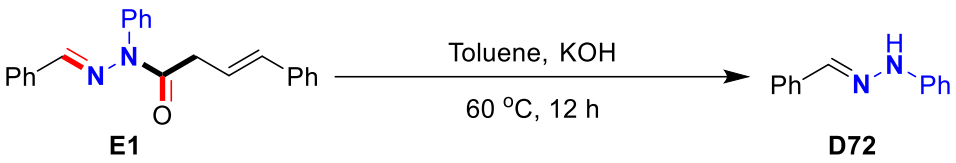
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 – 7.24 (m, 2H), 7.23 – 7.11 (m, 5H), 6.68 (m, 1H), 6.60 – 6.52 (m, 2H), 3.56 (s, 1H), 3.13 (m, 2H), 2.78 – 2.66 (m, 2H), 2.00 – 1.84 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 148.4, 141.7, 129.3, 128.5, 126.0, 117.3, 112.8, 43.4, 33.5, 31.1.

MS (70 eV): m/z (%) = 211 $[M]^+$ (100), 194, 106, 77.

HRMS (ESI) calcd. for $C_{15}H_{18}N$ [M+H]: 212.1434, found: 212.1436.

8.4 Synthesis of 1-benzylidene-2-phenylhydrazine



E1 D72

Toluene (3 mL) was added to a 20 mL dry glass bottle with a magnetic stirring bar, 2-((*E*)-benzylidene)-1-cinnamyl-1-phenylhydrazine (**E1**) (156.2 mg, 0.5 mmol) and KOH (56.1 mg, 1 mmol). The reaction mixture was heated to 60 ℃ and reacted 12 h. After completion of the reaction based on TLC monitoring, the reaction mixture was concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/ethyl acetate = 20:1 – 10:1) on silica gel to give the product as a colorless oil in 88% yield (86.2 mg).

1-benzylidene-2-phenylhydrazine (D72)

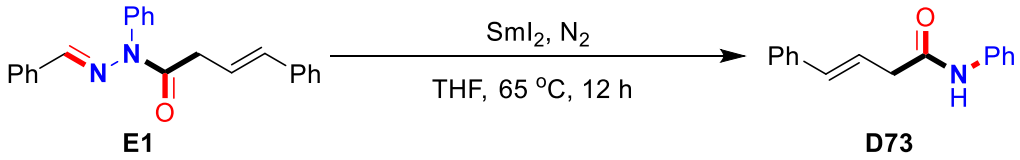
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.67 – 7.62 (m, 3H), 7.36 (t, *J* = 7.2 Hz, 2H), 7.31 – 7.23 (m, 3H), 7.11 (d, *J* = 7.6 Hz, 2H), 6.87 (t, *J* = 7.2 Hz, 1H)

^{13}C NMR (101 MHz, $CDCl_3$) δ 144.7, 137.3, 135.3, 129.3, 128.6, 128.5, 126.2, 120.1, 112.8

MS (70 eV): m/z (%) = 196 $[M]^+$ (100), 92, 65, 39.

HRMS (ESI) calcd. for $C_{13}H_{13}N_2$ [M+H]: 197.1073, found: 197.1070.

8.5 Synthesis of (*E*)-*N*,4-diphenylbut-3-enamide



Using a nitrogen-filled glove box, Samarium(II) Iodide solution (10 mL) was added to an oven-dried pressure tube (38 mL volume) with a magnetic stirring bar and (*E*)-*N*'-((*E*)-benzylidene)-*N*,4-diphenylbut-3-enehydrazide (**E1**) (170.1 mg, 0.5 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred at 65 °C for 12 hours. After completion of the reaction based on TLC monitoring, the reaction mixture was concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/ethyl acetate = 20:1 – 5:1) on silica gel to give the product as a colorless oil in 97% yield (115.0 mg).

(*E*)-*N*,4-diphenylbut-3-enamide (D73)

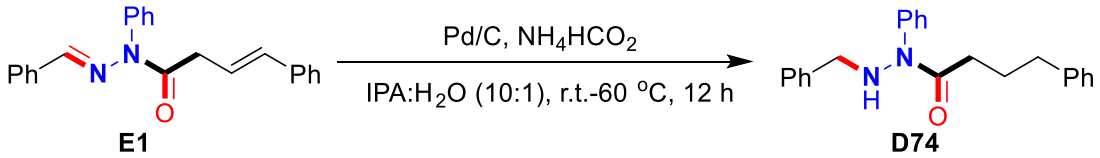
^{1}H NMR (400 MHz, DMSO-d_6) δ 10.04 (s, 1H), 7.66 – 7.57 (m, 2H), 7.48 – 7.40 (m, 2H), 7.38 – 7.26 (m, 4H), 7.28 – 7.19 (m, 1H), 7.09 – 7.00 (m, 1H), 6.55 (d, *J* = 16.0 Hz, 1H), 6.49 – 6.36 (m, 1H), 3.32 – 3.23 (m, 2H).

^{13}C NMR (101 MHz, DMSO) δ = 169.5, 139.6, 137.2, 132.7, 129.2, 129.1, 127.8, 126.5, 124.6, 123.6, 119.6, 41.1.

MS (70 eV): m/z (%) = 237 $[M]^+$ (100), 144, 118, 77.

HRMS (ESI) calcd. for $C_{16}H_{16}NO$ [M+H]: 238.1227, found: 238.1228.

8.6 Synthesis of *N*'-benzyl-*N*,4-diphenylbutanehydrazide



Isopropyl alcohol (3 mL) was added to a 20 mL dry glass bottle with a magnetic stirring bar and Pd/C (3.18 mg, 0.03 mmol). Ammonium formate (189.2 mg, 3 mmol) dissolved in water (0.3 mL) was transferred to the same bottle. The reaction mixture was stirred for 5 min at room temperature to activate Pd/C. Next, the primary (*E*)-*N*'-((*E*)-benzylidene)-*N*,4-diphenylbut-3-enehydrazidene (**E1**) (102 mg, 0.3 mmol) was added, and the reaction mixture was heated to 60 °C and reacted 12 h. After completion

of the reaction based on TLC monitoring, the Pd/C catalyst was filtered off on Celite and the solvent and the solvent was removed by rotary evaporation. The reaction mixture was washed with brine solution and extracted with ethyl acetate (3×5 mL), then the organic solvents were dried by Na_2SO_4 and concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/dichloromethane = 20:1 – 5:1) on silica gel to give the product as a colorless oil in 95% yield (98.1 mg).

***N*'-benzyl-*N*,4-diphenylbutanehydrazide (D74)**

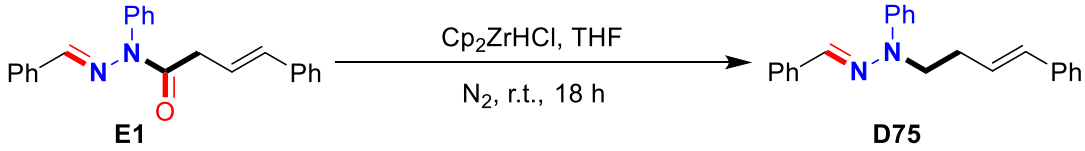
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 – 7.11 (m, 13H), 7.10 – 7.01 (m, 2H), 6.14 (s, 1H), 3.95 (s, 2H), 2.60 – 2.45 (m, 2H), 2.24 – 2.09 (m, 2H), 1.97 – 1.83 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 171.2, 141.5, 141.1, 137.1, 129.2, 129.1, 128.4, 128.3, 127.8, 127.5, 125.8, 54.1, 35.1, 32.9, 26.9.

MS (70 eV): m/z (%) = 344 $[M]^+$ (100), 239, 198, 107.

HRMS (ESI) calcd. for $C_{23}H_{25}N_2O$ [M+H]: 345.1962, found: 345.1965.

8.7 Synthesis of 2-((*E*)-benzylidene)-1-phenyl-1-((*E*)-4-phenylbut-3-en-1-yl)hydrazine



Using a nitrogen-filled glove box, THF (3 mL) was added to an oven-dried pressure tube (38 mL volume) with a magnetic stirring bar, Cp_2ZrHCl (154.7 mg, 0.6 mmol) and (*E*)-*N*'-((*E*)-benzylidene)-*N*,4-diphenylbut-3-enehydrazide (**E1**) (102 mg, 0.3 mmol). Then the seal tube was closed tightly with a teflon cap, removed from the glove box, and stirred for 18 hours at room temperature. After completion of the reaction based on TLC monitoring, the reaction mixture was concentrated under vacuum. The residue was purified by column chromatography (petroleum ether/ethyl acetate = 20:1 – 10:1) on silica gel to give the product as a colorless oil in 41% yield (40.1 mg).

2-((*E*)-benzylidene)-1-phenyl-1-((*E*)-4-phenylbut-3-en-1-yl)hydrazine (D75)

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.74 – 7.68 (m, 2H), 7.59 (s, 1H), 7.45 – 7.19 (m, 12H), 6.99 – 6.89 (m, 1H), 6.55 (d, *J* = 16.0 Hz, 1H), 6.33 – 6.20 (m, 1H), 4.16 – 3.99 (m, 2H), 2.67 – 2.48 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ = 147.0, 137.1, 136.7, 132.4, 131.5, 129.2, 128.6, 127.8, 127.4, 126.2, 126.1, 120.6, 115.0, 45.1, 28.7.

HRMS (ESI) calcd. for $C_{23}H_{23}N_2$ [M+H]: 327.1856, found: 327.1858.

9. References

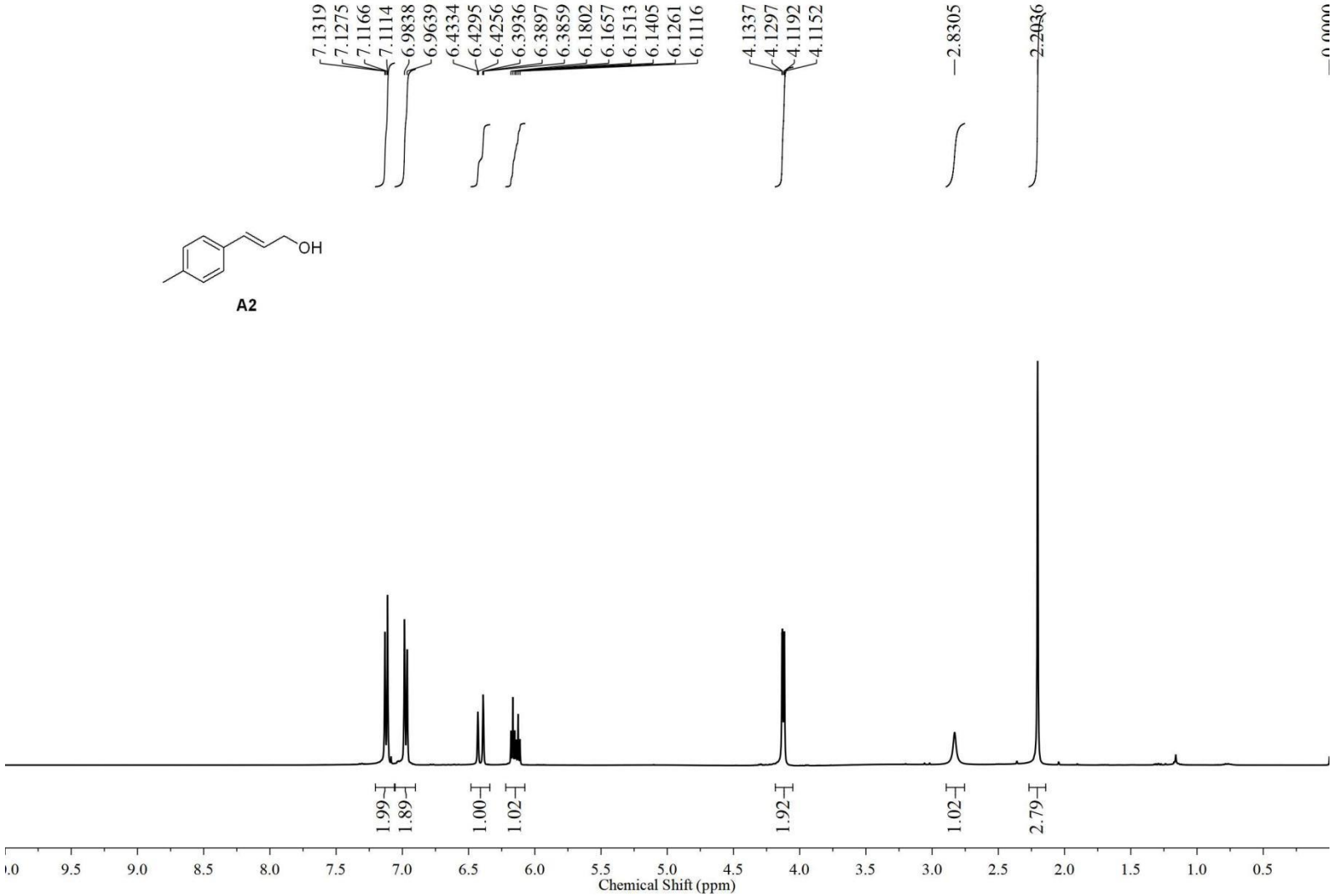
1 (a) G. S. Coelho, J. S. Andrade, V. F. Xavier, P. A. Sales Junior, B. C. Rodrigues de Araujo, K. S. Fonseca, M. S. Caetano, S. M. F. Murta, P. M. Vieira, C. M. Carneiro and J. G. Taylor, *Chem. Biol. Drug. Des.,* 2019, **93**, 337–350; (b) H. Wei, F. Mao, S. Ni, F. Chen, B. Li, X. Qiu, L. Hu, M. Wang, X. Zheng, J. Zhu, L. Lan and J. Li, *Eur. J. Med. Chem.,* 2018, **145**, 235-251.

2 E. Byun, B. Hong, K. A. De Castro, M. Lim and H. J. Rhee, *J. Org. Chem.,* 2007, **72**, 9815-9817.

3 G. Gros, L. Martinez, A. S. Gimenez, P. Adler, P. Maurin, R. Wolkowicz, P. Falso and J. Hasserodt, *Bioorg. Med. Chem.* 2013, **21**, 5407-5413.

10. NMR Spectra

2022-06-24 yy0032 616-lqq-ch-1.10.fid



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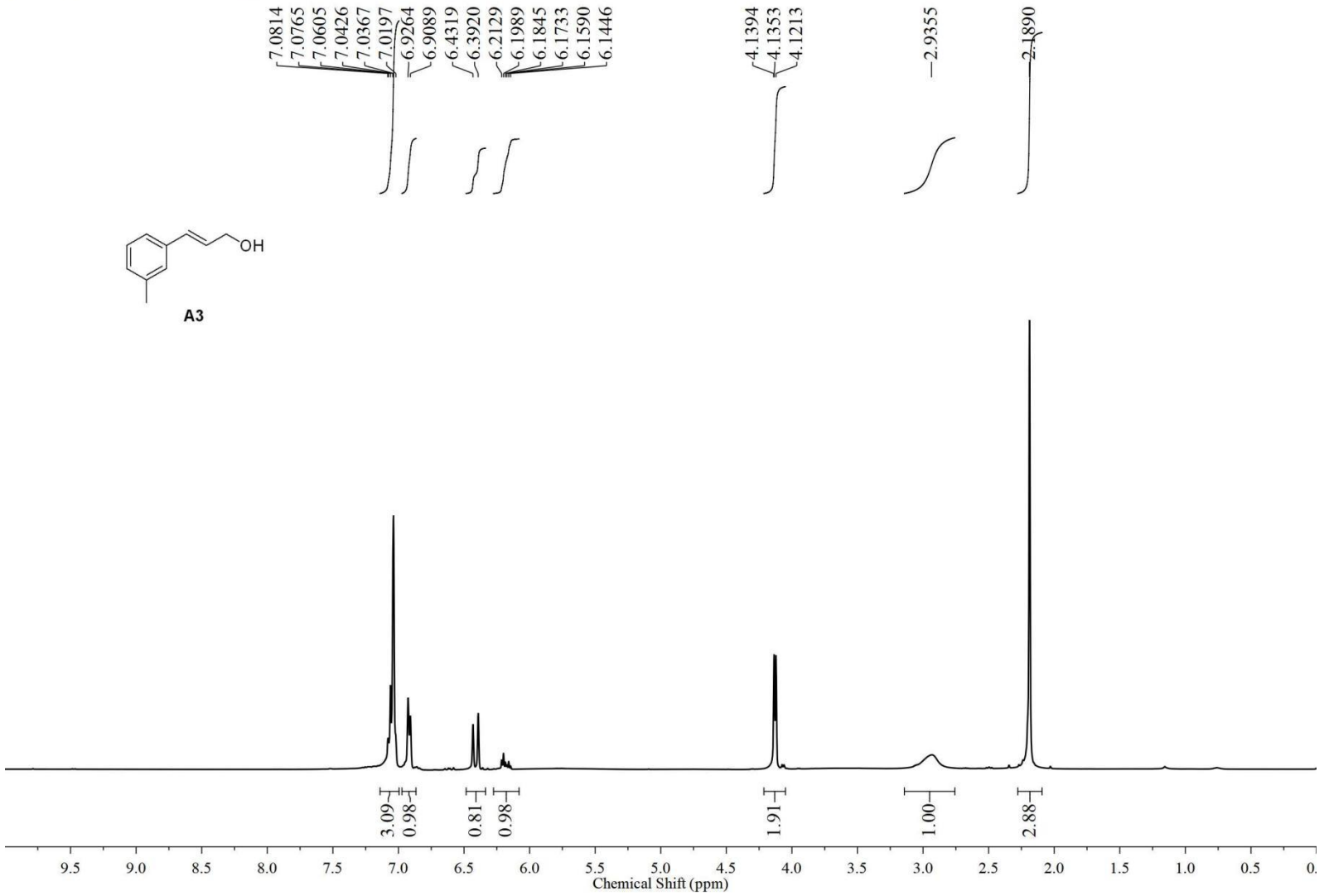

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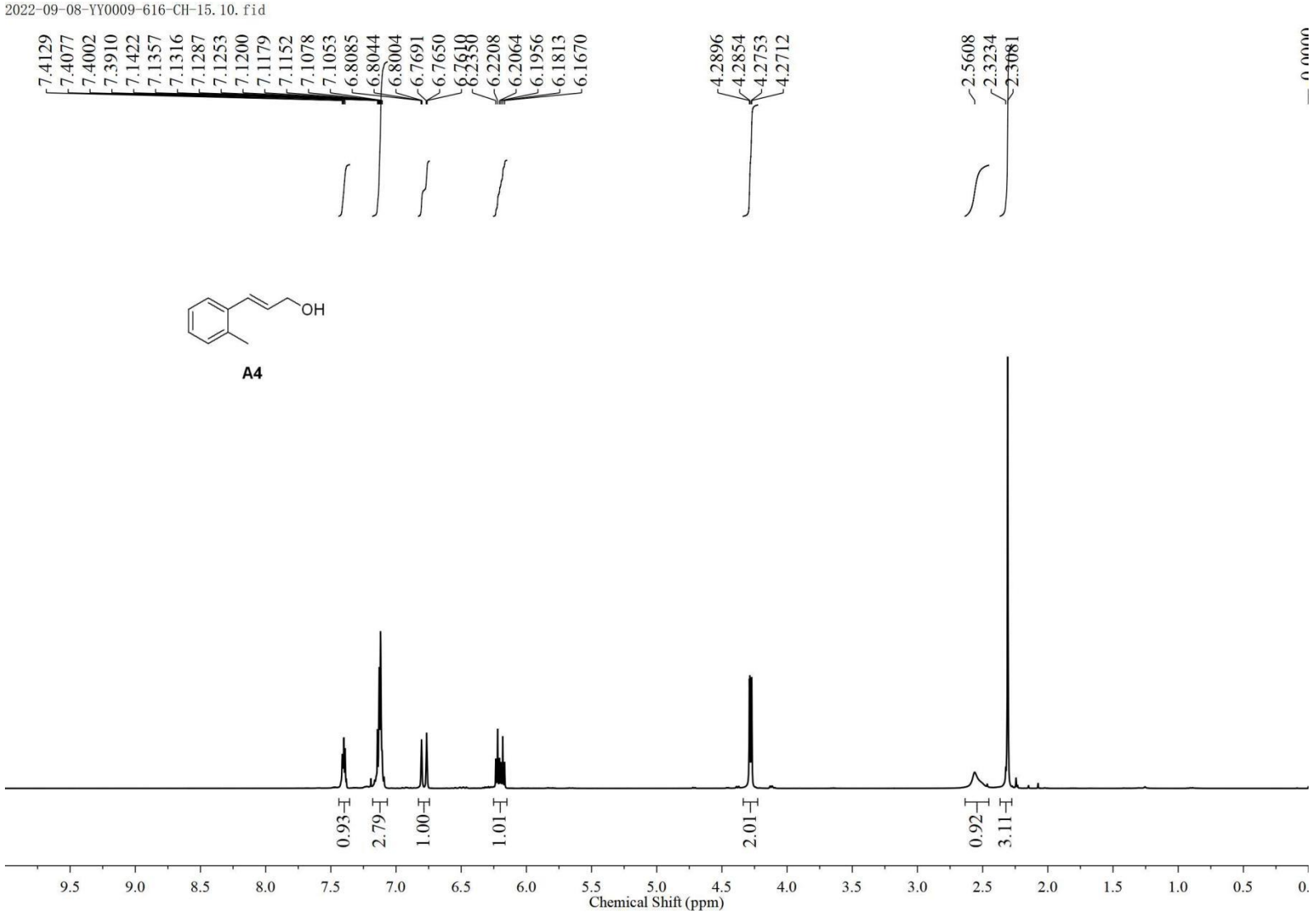
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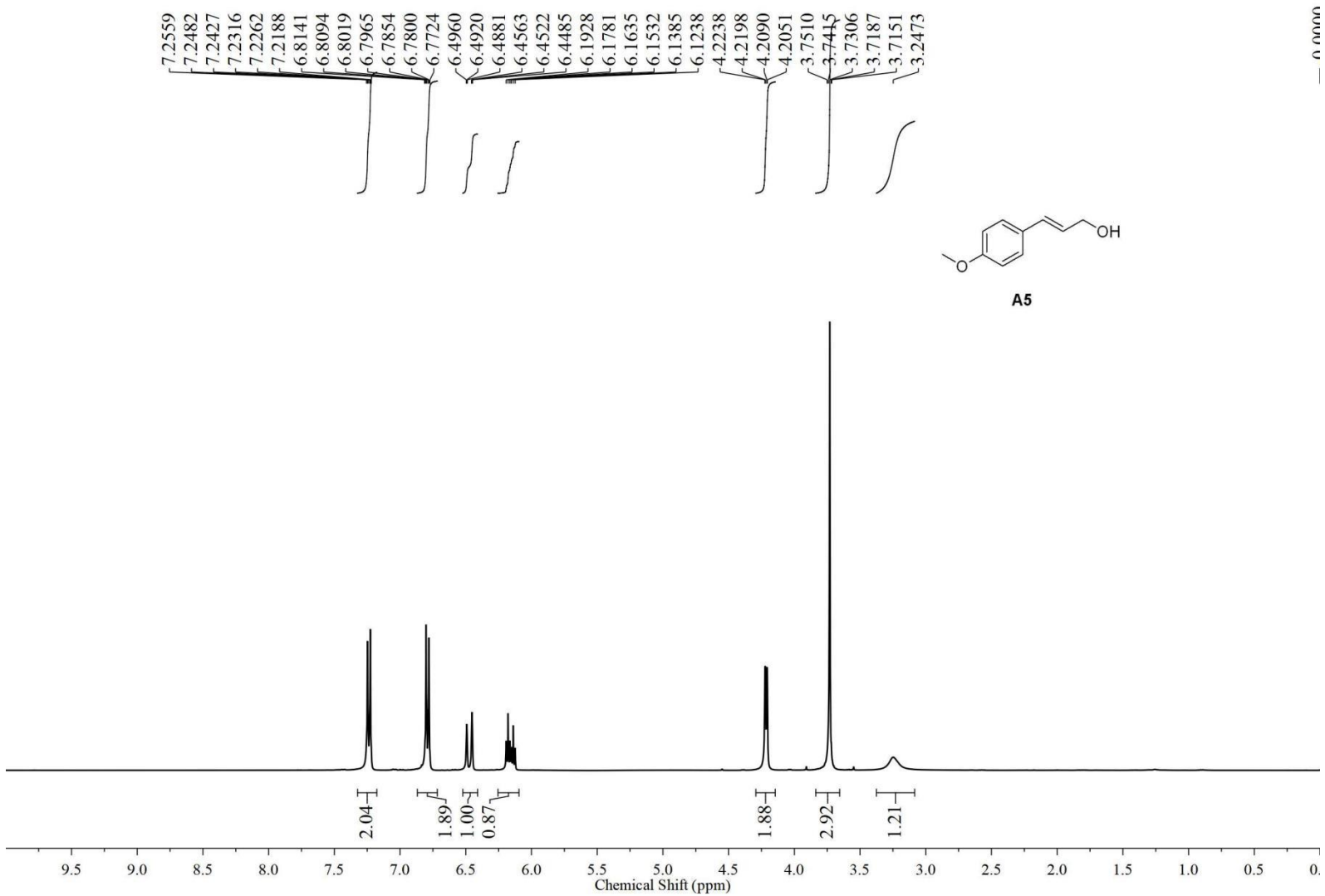

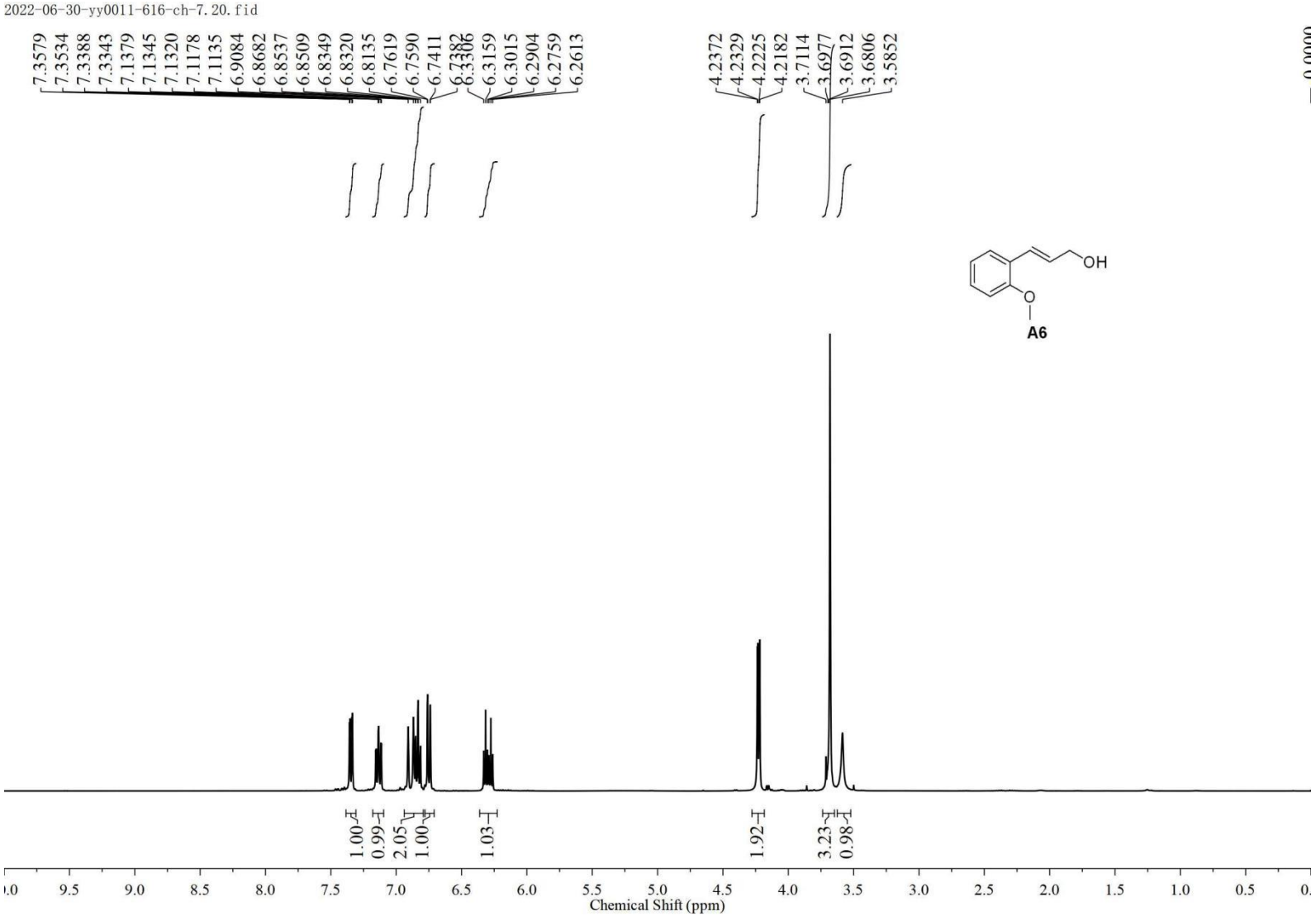
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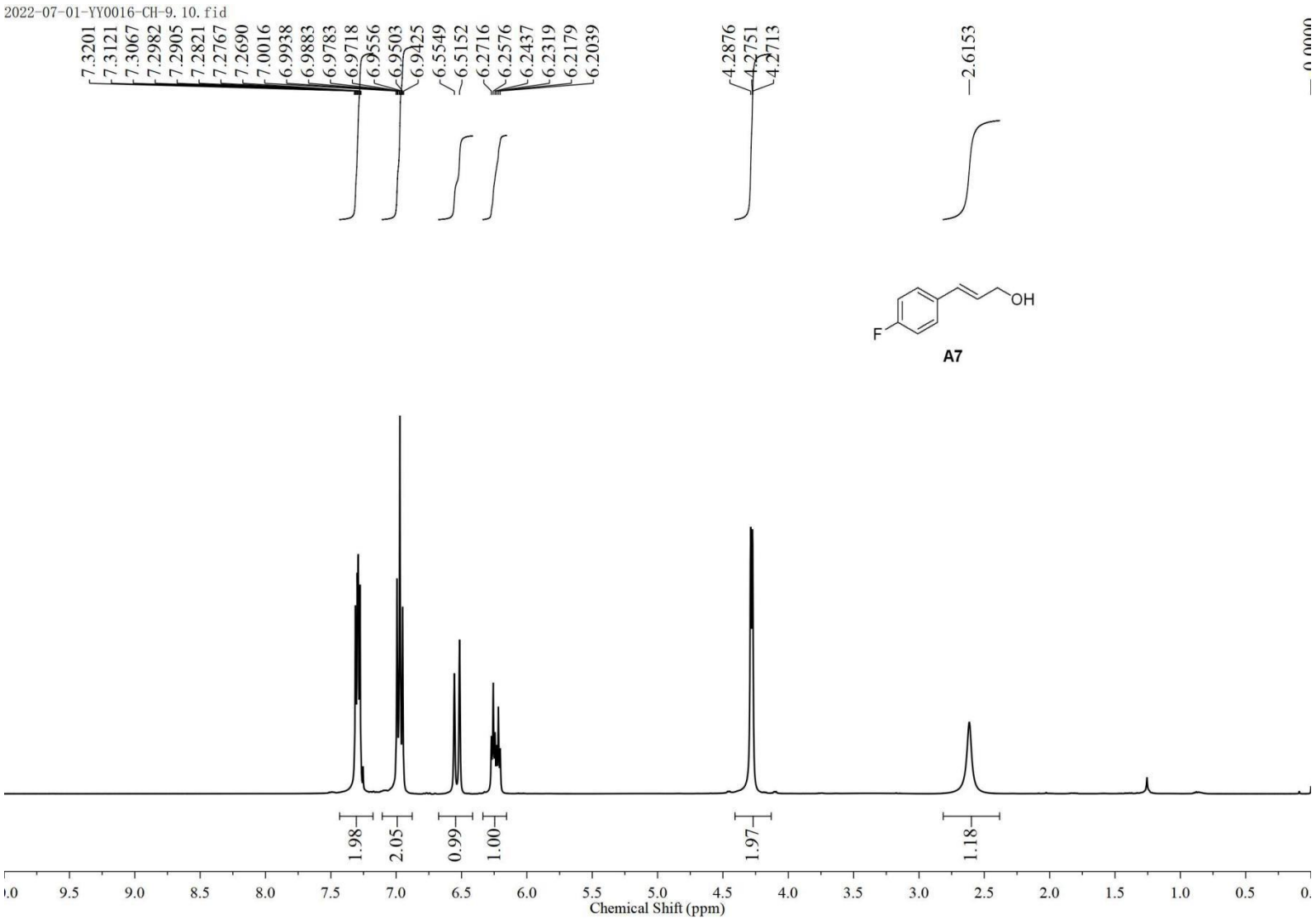
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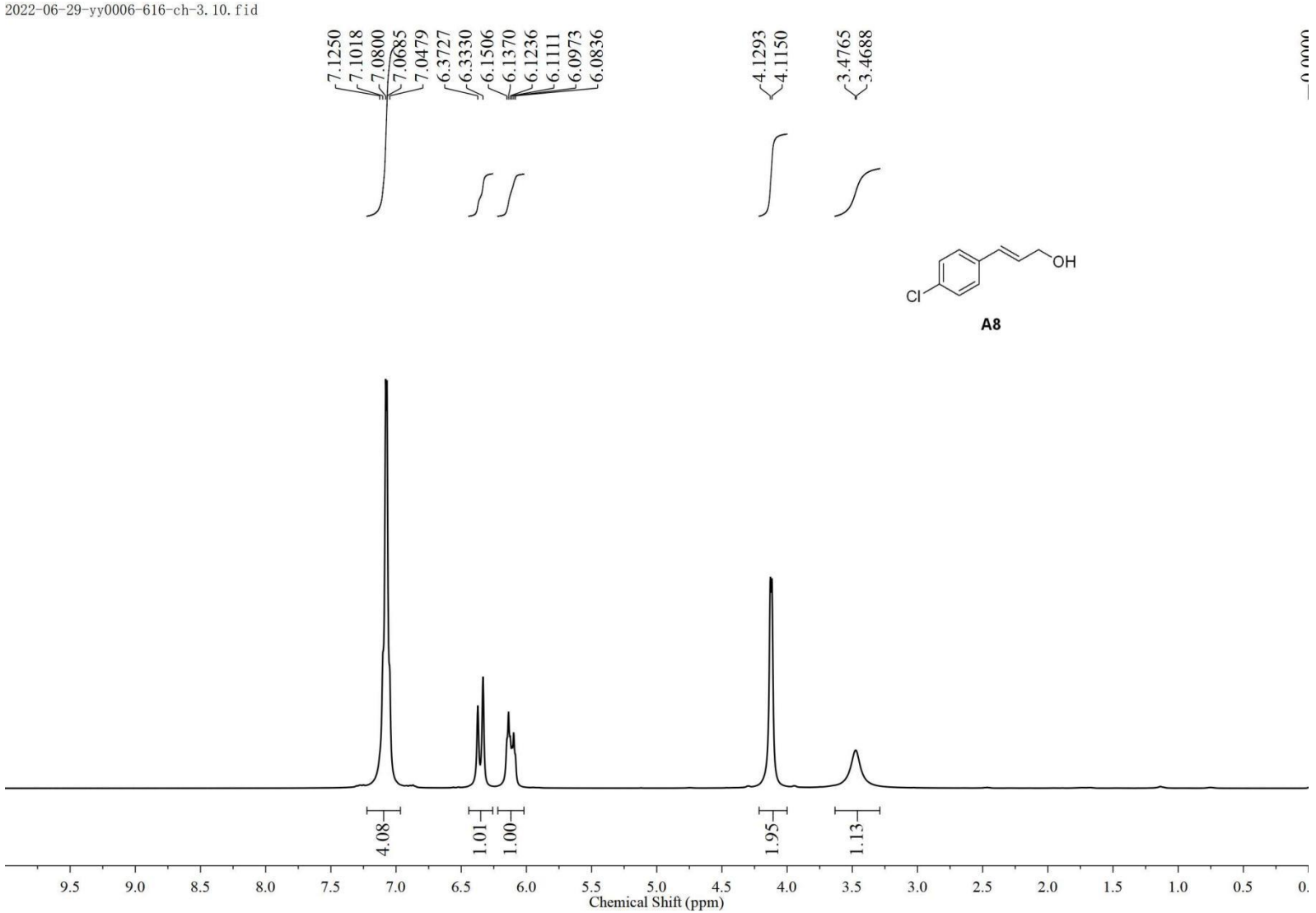
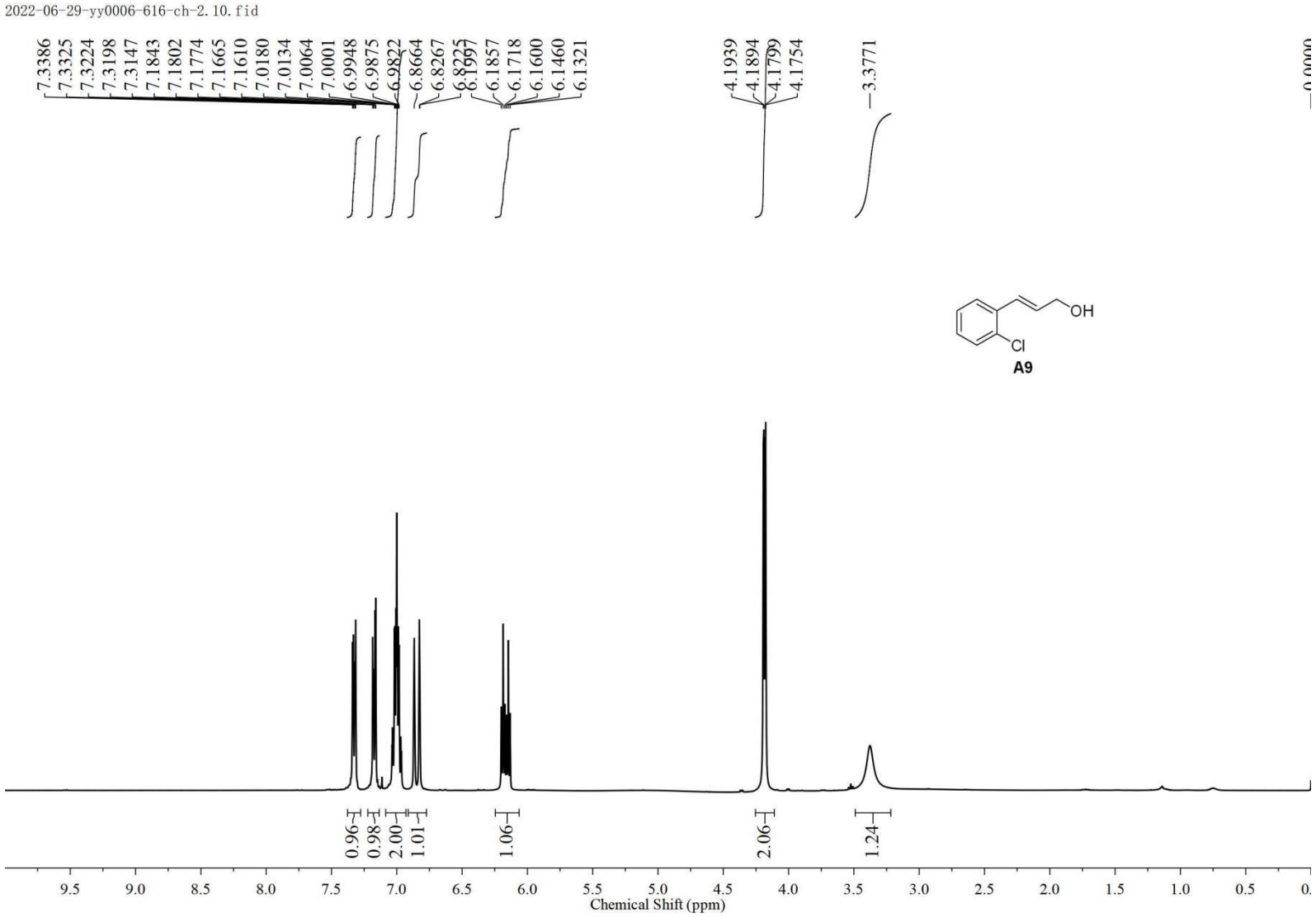
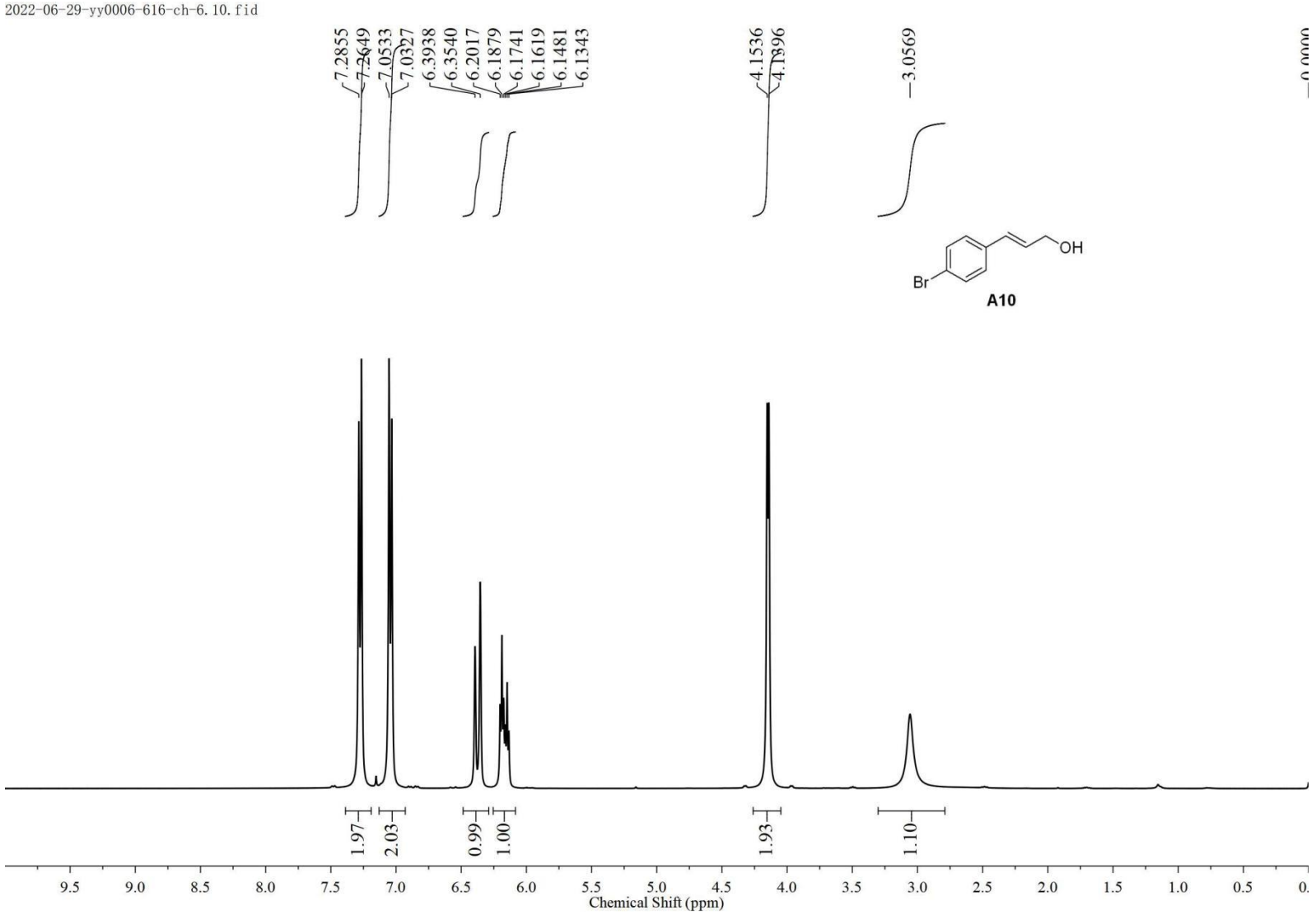
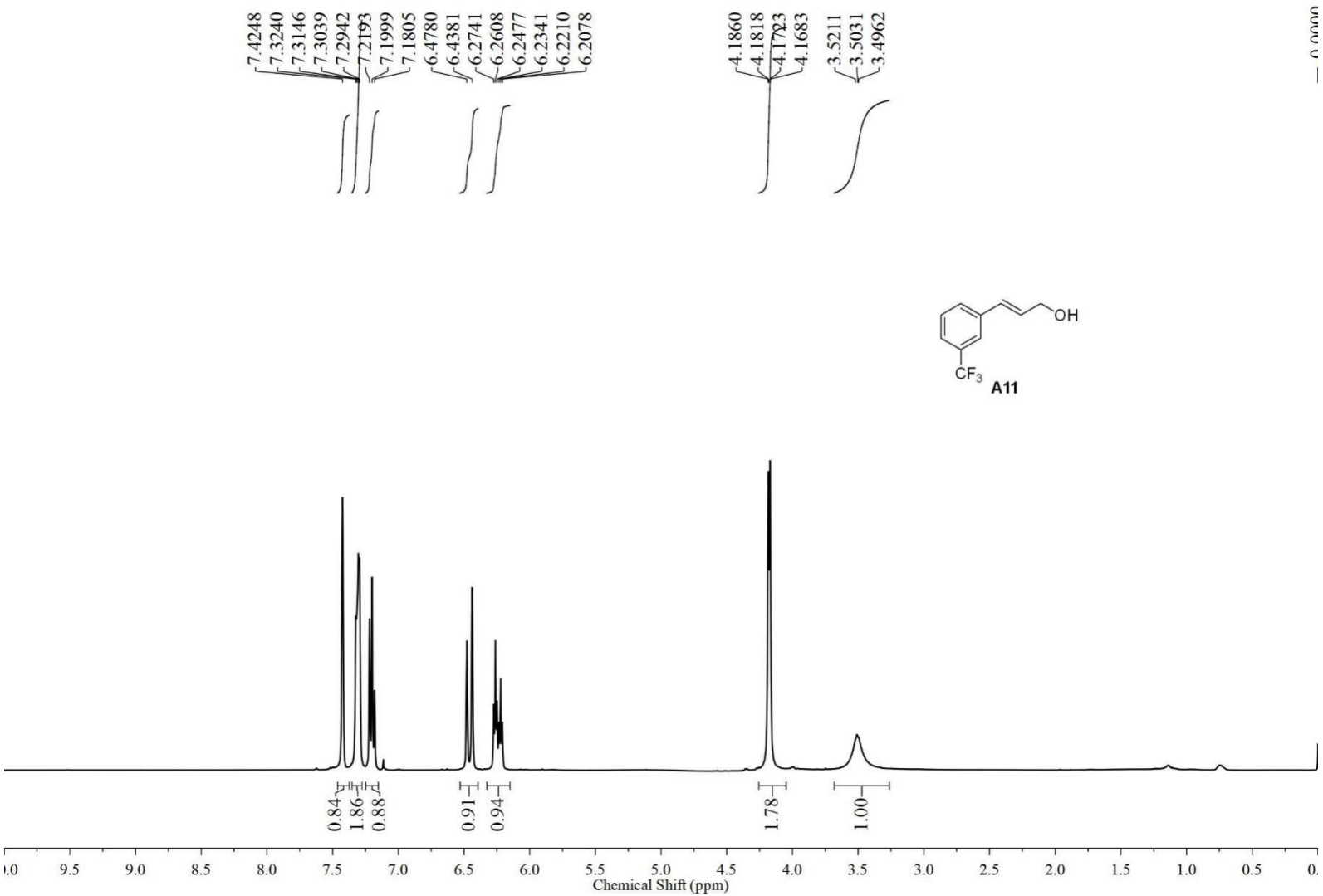
6.9718
6.9556
6.9503
6.9425
6.5549
6.5152
6.2716
6.2576
6.2437
6.2319
6.2179
6.2039
4.2876
4.2751
4.2713
2.6153
0.0000
OH
F
A7
1.98
2.05
0.99
1.00
1.97
1.18
Chemical Shift (ppm)


2022-06-29-yy0006-616-ch-3.10.fid
7.1250
7.1018
7.0800
7.0685
7.0479
6.3727
6.3330
6.1506
6.1370
6.1236
6.1111
6.0973
6.0836
4.1293
4.1150
3.4765
3.4688
0.0000
OH
Cl
A8
4.08
1.01
1.00
1.95
1.13
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

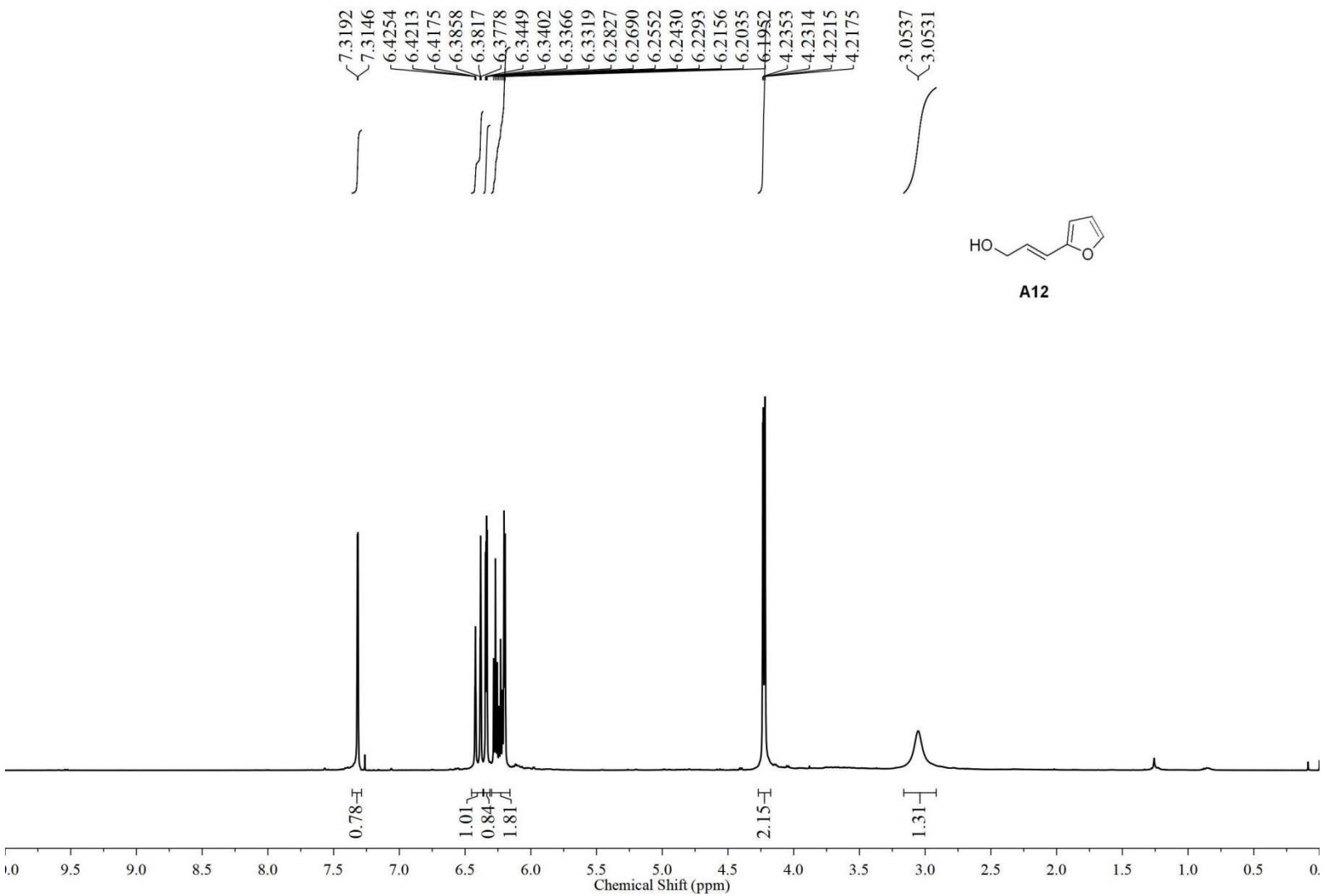

2022-06-29-yy0006-616-ch-2.10.fid
7.3386
7.3325
7.3224
7.3198
7.3147
7.1843
7.1802
7.1774
7.1665
7.1610
7.0180
7.0134
7.0064
7.0001
6.9948
6.9875
6.9822
6.8664
6.8267
6.8225
6.1857
6.1718
6.1600
6.1460
6.1321
4.1939
4.1894
4.1799
4.1754
3.3771
0.0000
OH
Cl
A9
0.96
0.98
2.00
1.01
1.06
2.06
1.24
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)


2022-06-29-yy0006-616-ch-6.10.fid
7.2855
7.2649
7.0533
7.0327
6.3938
6.3540
6.2017
6.1879
6.1741
6.1619
6.1481
6.1343
4.1536
4.1396
3.0569
OH
Br
A10
1.97
2.03
0.99
1.00
1.93
1.10
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

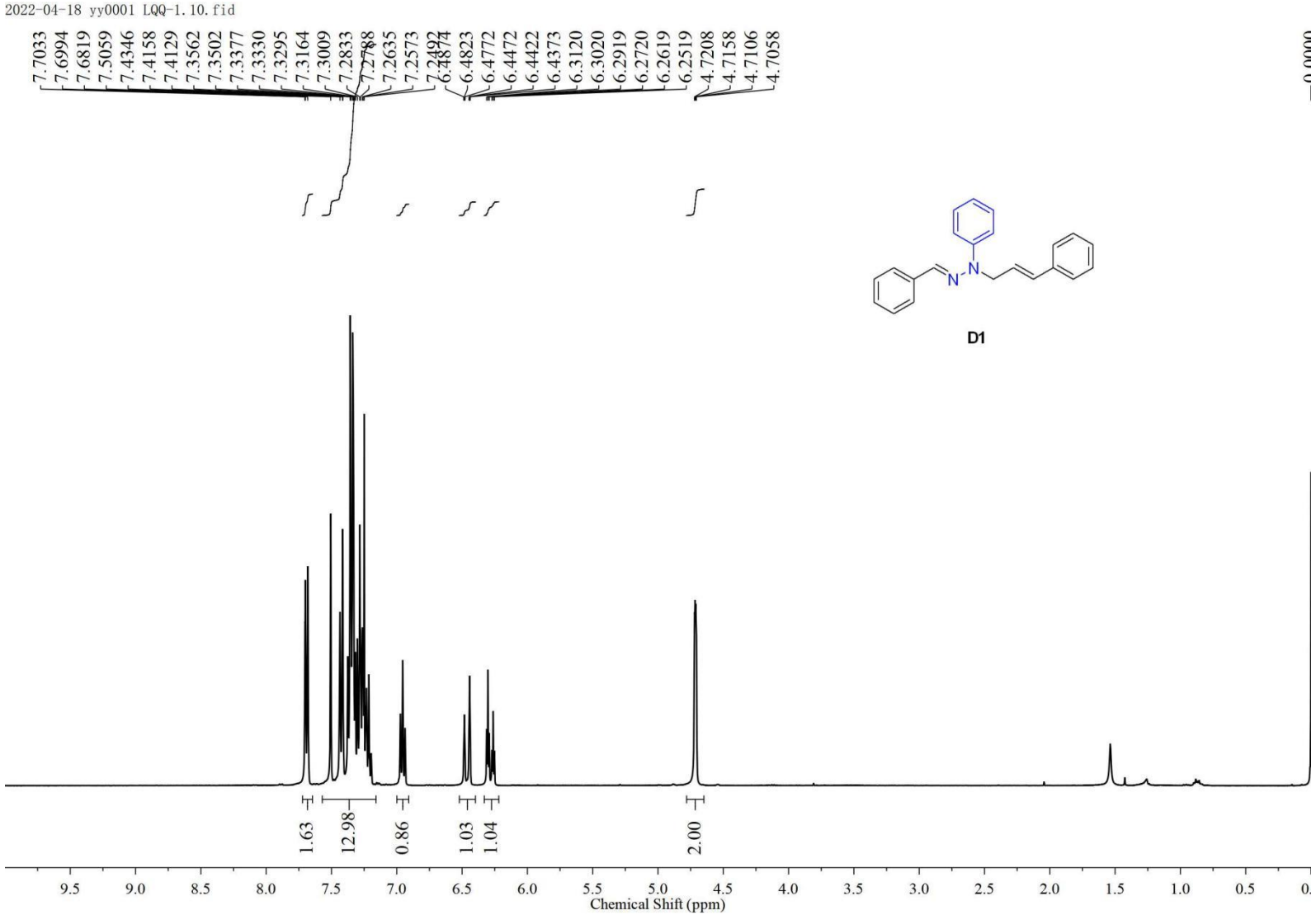
2022-06-30-yy0011-616-ch-5.10.fid

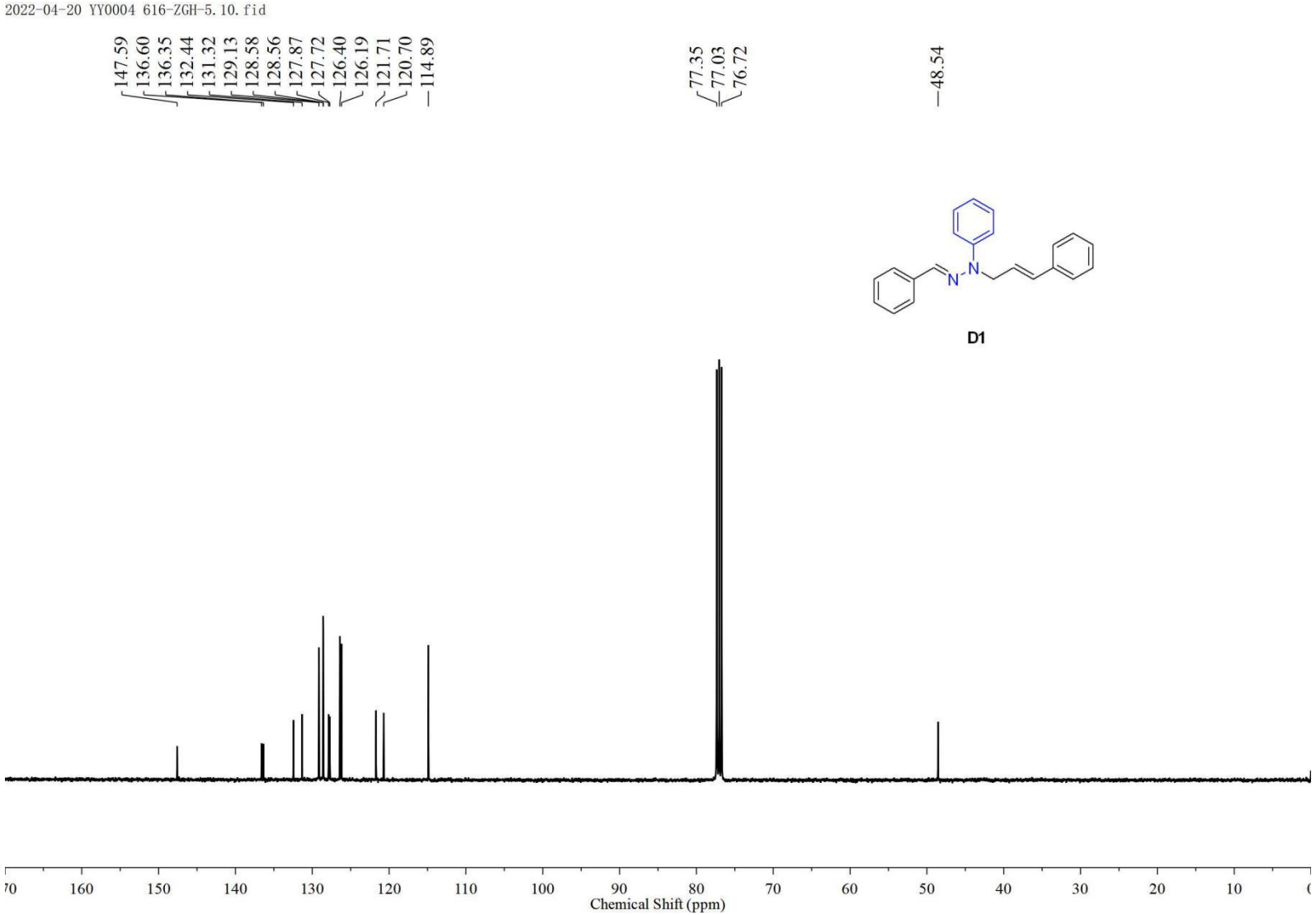


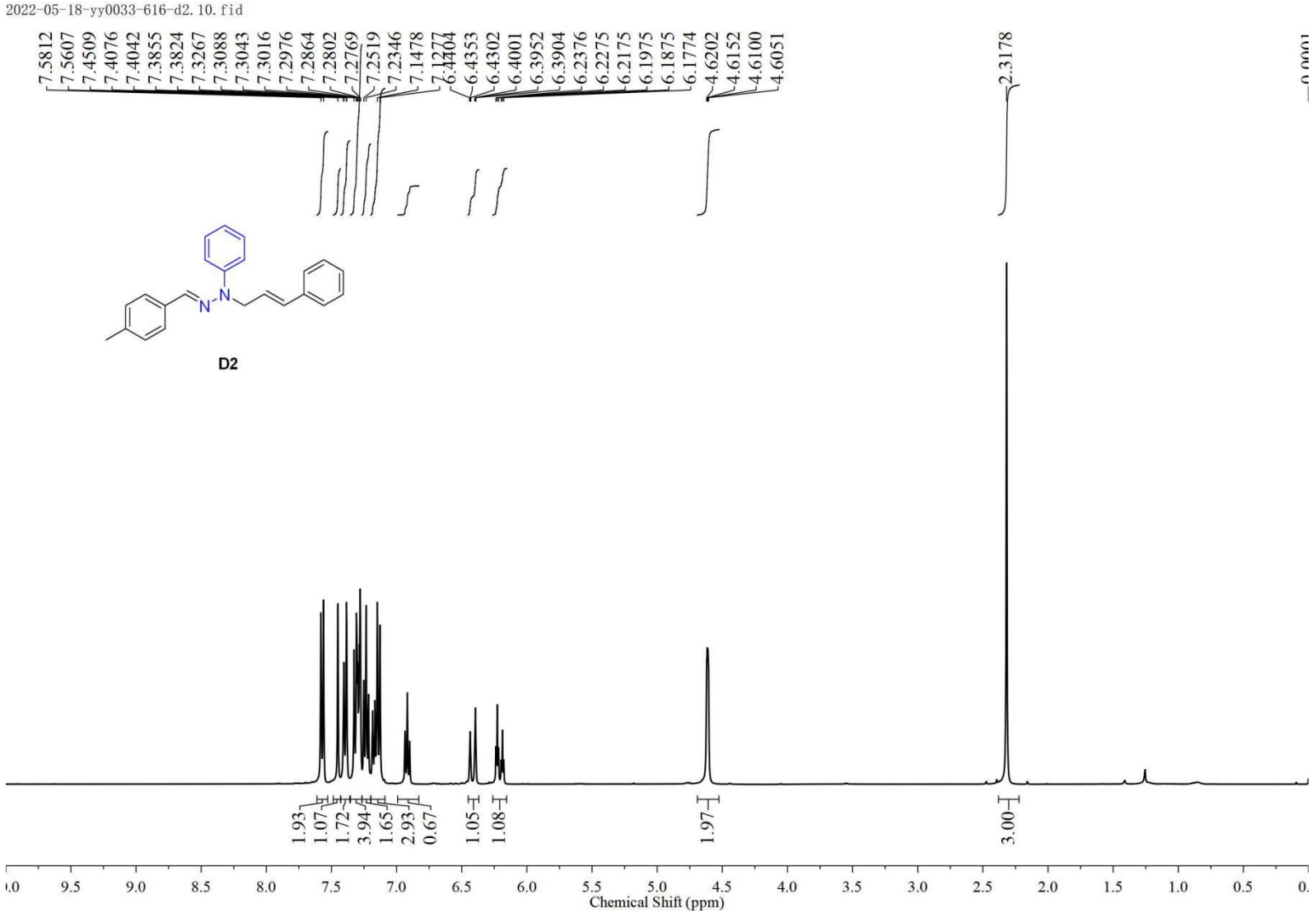
2022-07-01-YY0016-CH-4.10.fid

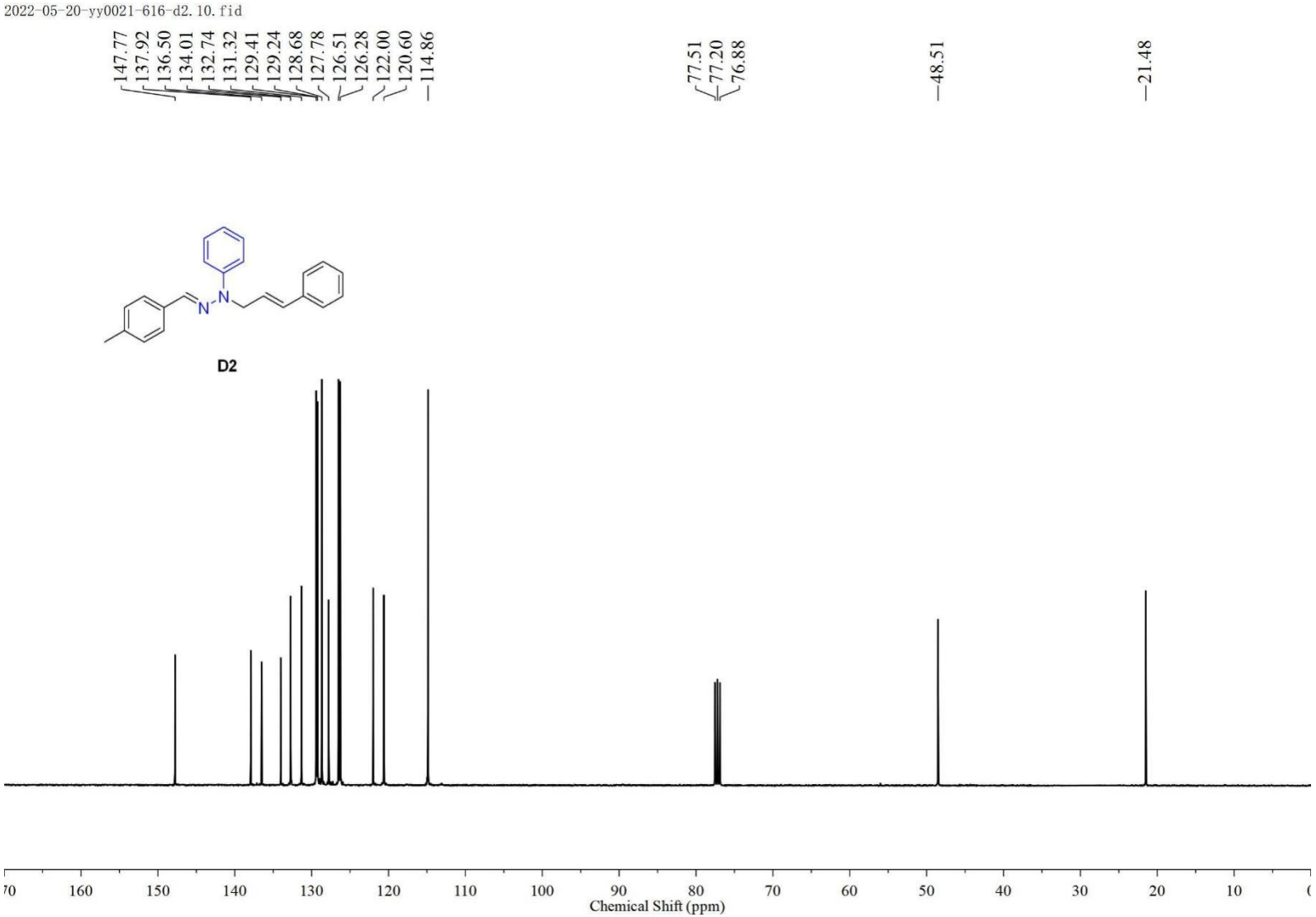


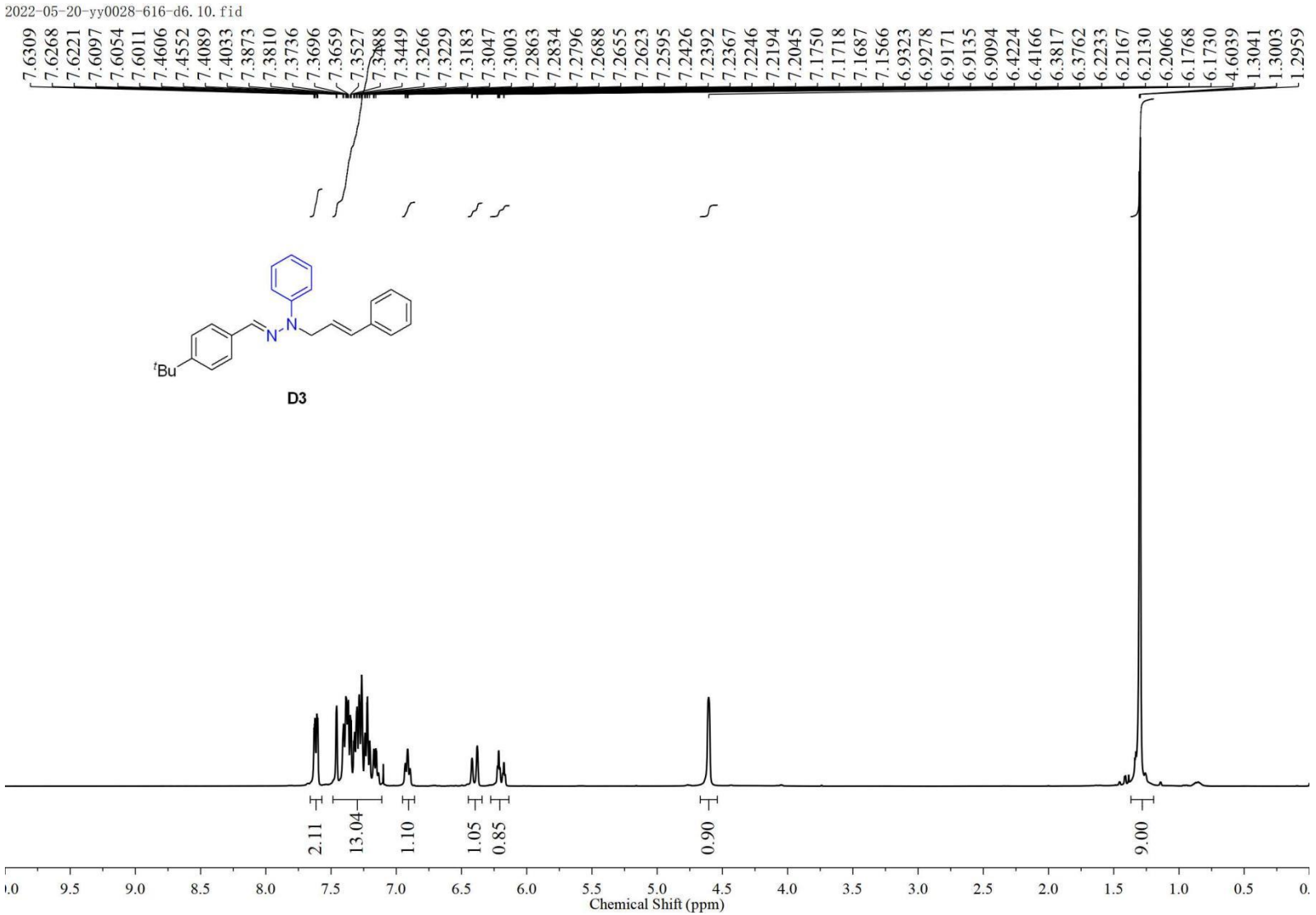
A12

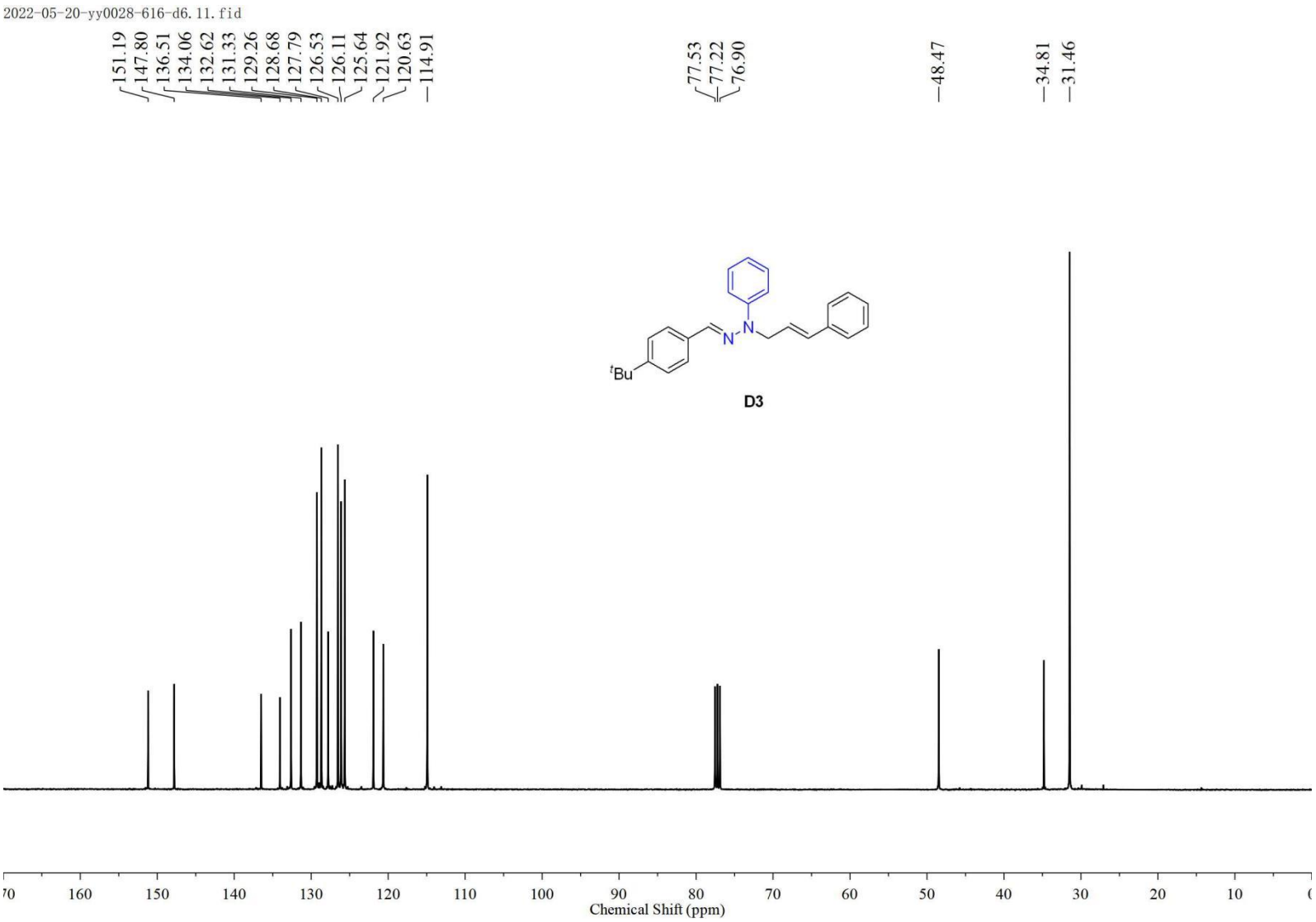

2022-04-18 yy0001 LQQ-1.10.fid
7.7033
7.6994
7.6819
7.5059
7.4346
7.4158
7.4129
7.3562
7.3502
7.3377
7.3330
7.3295
7.3164
7.3009
7.2833
7.2788
7.2635
7.2573
7.2492
6.4823
6.4772
6.4472
6.4422
6.4373
6.3120
6.3020
6.2919
6.2720
6.2619
6.2519
4.7208
4.7158
4.7106
4.7058
D1
1.63
12.98
0.86
1.03
1.04
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

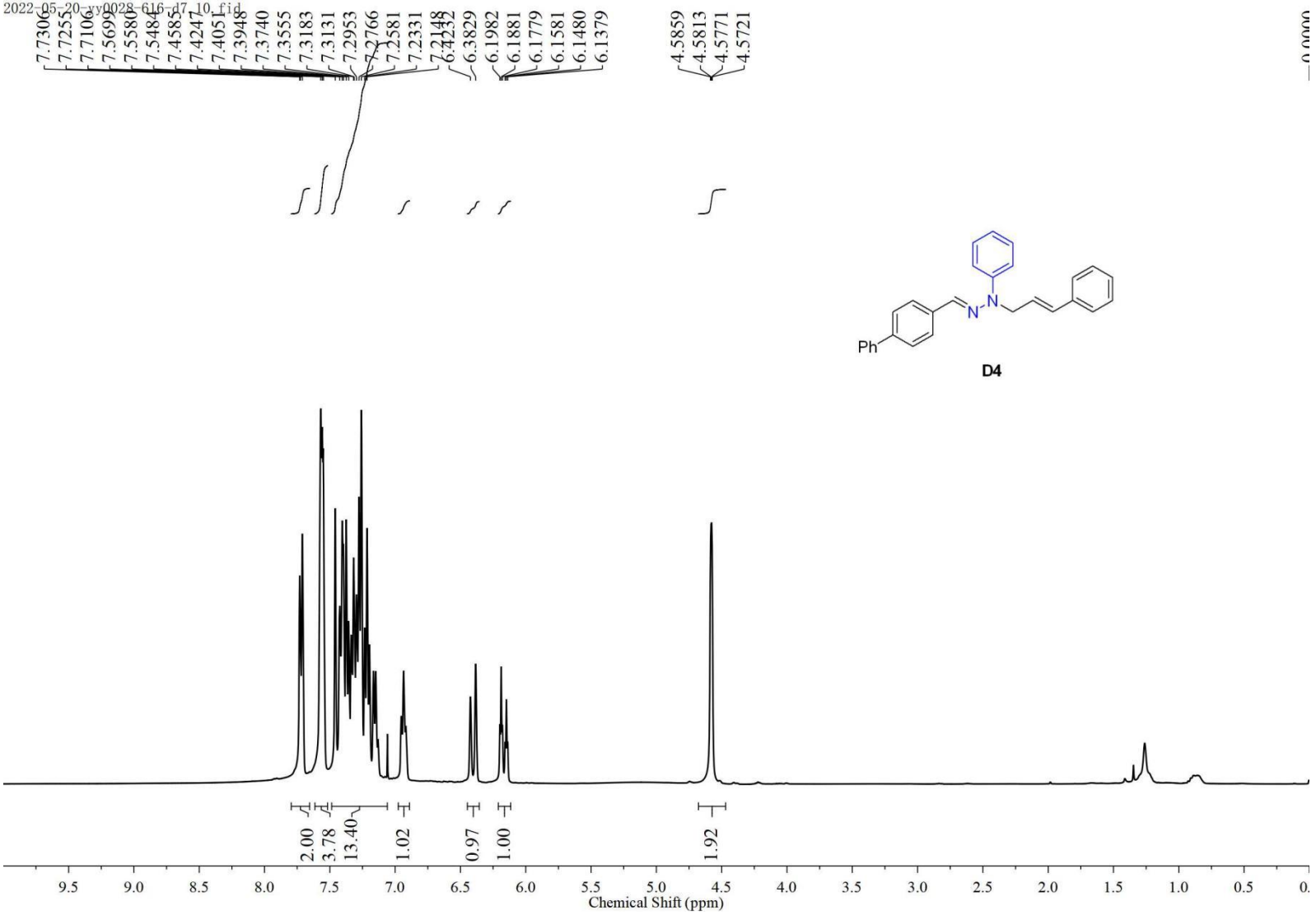

2022-04-20 YY0004 616-ZGH-5.10.fid
147.59
136.60
136.35
132.44
131.32
129.13
128.58
128.56
127.87
127.72
126.40
126.19
121.71
120.70
114.89
77.35
77.03
76.72
48.54
N
N
D1
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

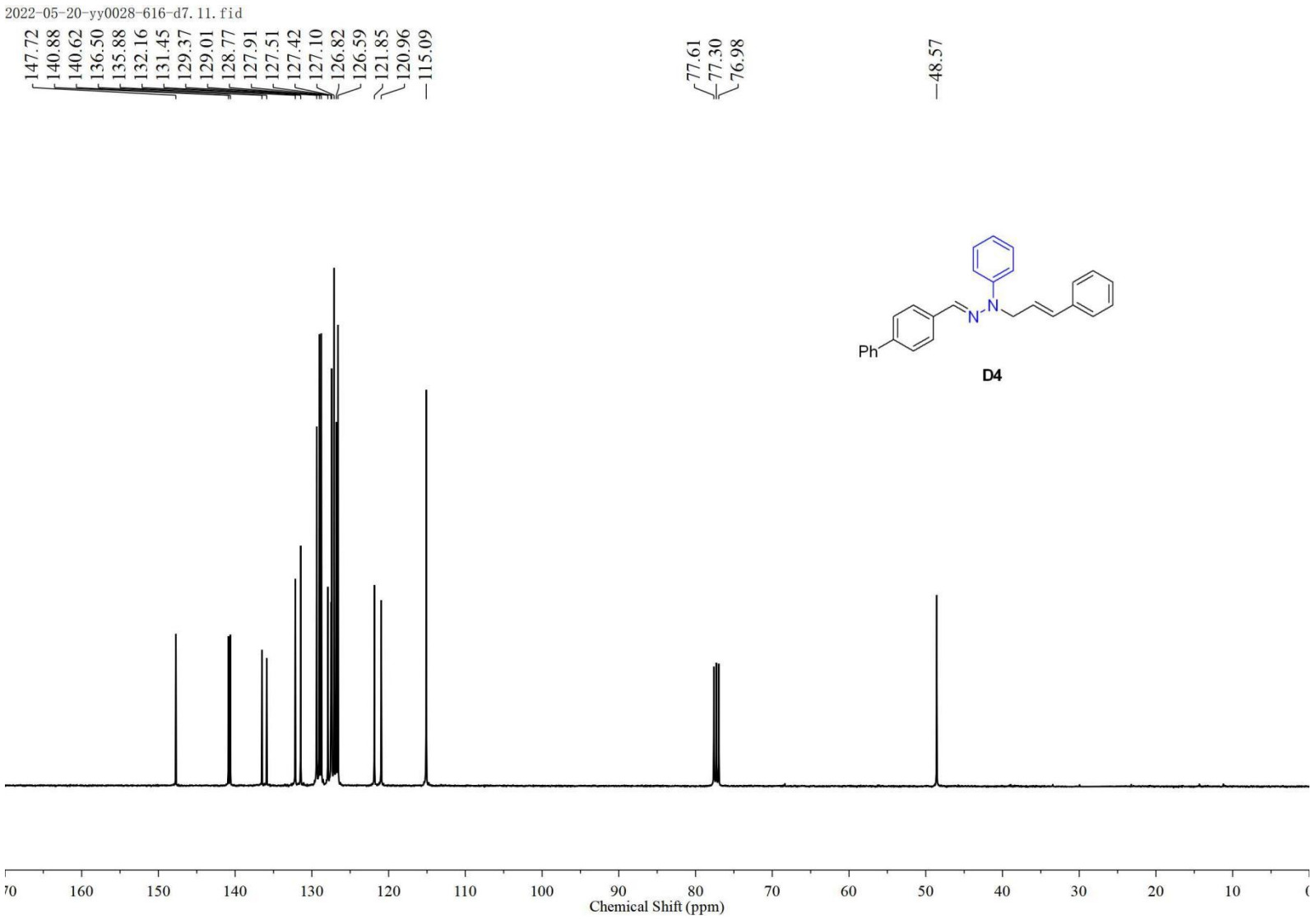

2022-05-18-yy0033-616-d2.10.fid
7.5812
7.5607
7.4509
7.4076
7.4042
7.3855
7.3824
7.3267
7.3088
7.3043
7.3016
7.2976
7.2864
7.2802
7.2769
7.2519
7.2346
7.1478
6.4404
6.4353
6.4302
6.4001
6.3952
6.3904
6.2376
6.2275
6.2175
6.1975
6.1875
6.1774
4.6202
4.6152
4.6100
4.6051
2.3178
0.0001
D2
1.93
1.07
1.72
3.94
1.65
2.93
0.67
1.05
1.08
1.97
3.00
Chemical Shift (ppm)

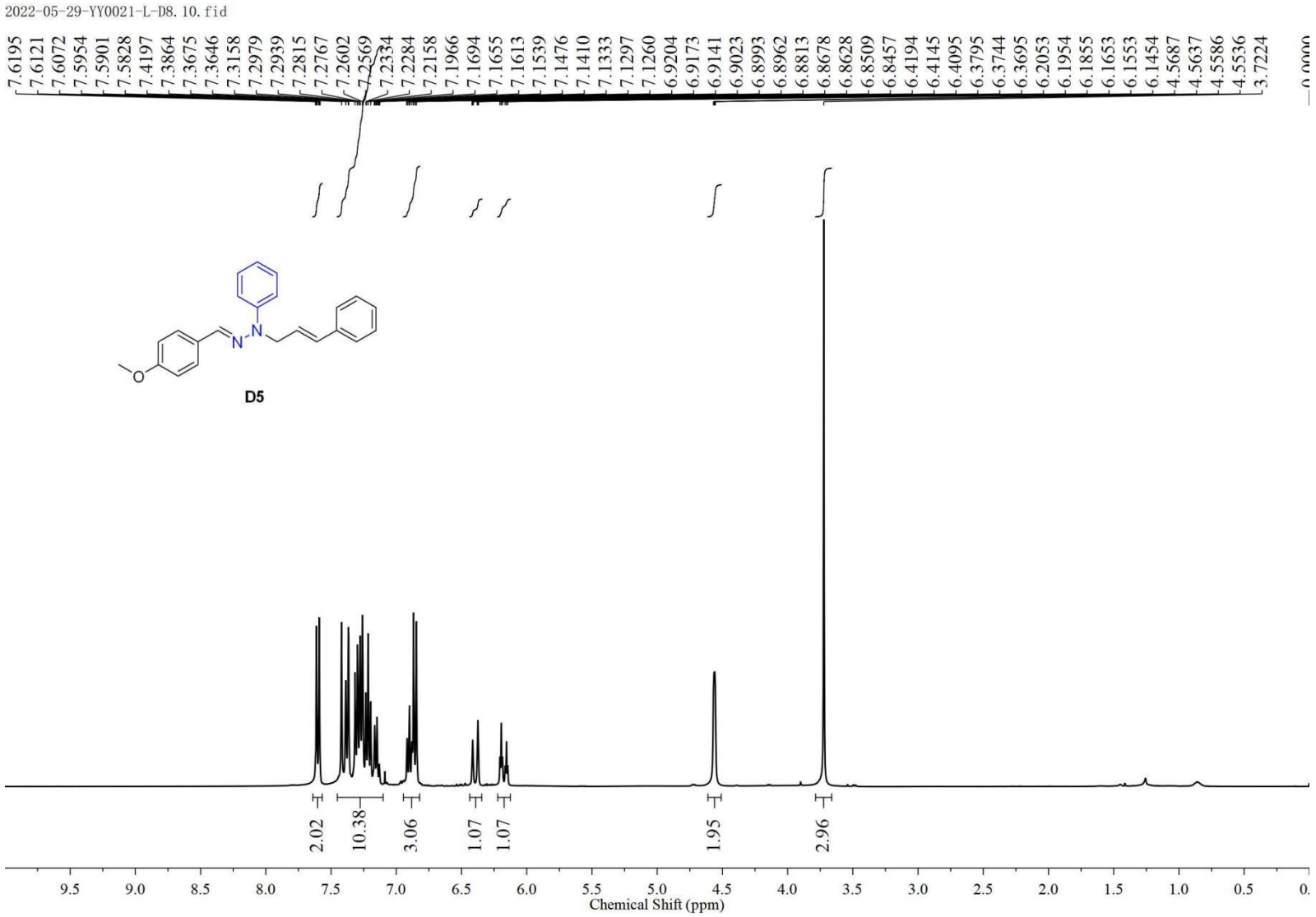

2022-05-20-yy0021-616-d2.10.fid
147.77
137.92
136.50
134.01
132.74
131.32
129.41
129.24
128.68
127.78
126.51
126.28
122.00
120.60
114.86
77.51
77.20
76.88
48.51
21.48
D2
Chemical Shift (ppm)


2022-05-20-yy0028-616-d6.10.fid
7.6309
7.6268
7.6221
7.6097
7.6054
7.6011
7.4606
7.4552
7.4089
7.4033
7.3873
7.3810
7.3736
7.3696
7.3659
7.3527
7.3488
7.3449
7.3266
7.3229
7.3183
7.3047
7.3003
7.2863
7.2834
7.2796
7.2688
7.2655
7.2623
7.2595
7.2426
7.2392
7.2367
7.2246
7.2194
7.2045
7.1750
7.1718
7.1687
7.1566
6.9323
6.9278
6.9171
6.9135
6.9094
6.4224
6.4166
6.3817
6.3762
6.2233
6.2167
6.2130
6.2066
6.1768
6.1730
4.6039
1.3041
1.3003
1.2959
tBu
N
N
D3
2.11
13.04
1.10
1.05
0.85
0.90
9.00
Chemical Shift (ppm)


2022-05-20-yy0028-616-d6.11.fid
151.19
147.80
136.51
134.06
132.62
131.33
129.26
128.68
127.79
126.53
126.11
125.64
121.92
120.63
114.91
77.53
77.22
76.90
48.47
34.81
31.46
tBu
N
N
D3
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-05-20-xy0028-616-d7-10.fid
7.7306
7.7255
7.7106
7.5699
7.5580
7.5484
7.4585
7.4247
7.4051
7.3948
7.3740
7.3555
7.3183
7.3131
7.2953
7.2766
7.2581
7.2331
7.2148
6.4232
6.3829
6.1982
6.1881
6.1779
6.1581
6.1480
6.1379
4.5859
4.5813
4.5771
4.5721
0.0000
Ph
N
N
D4
2.00
3.78
13.40
1.02
0.97
1.00
1.92
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

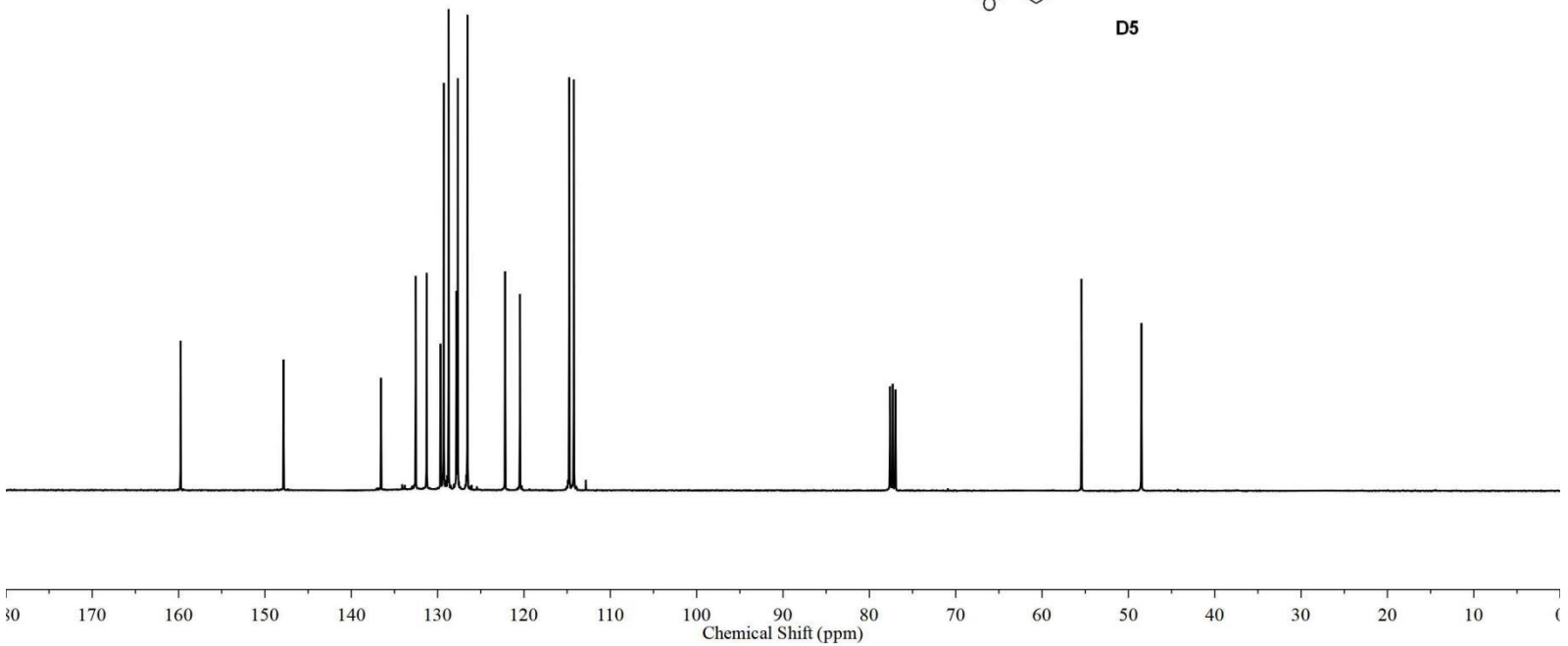

2022-05-20-yy0028-616-d7.11.fid
147.72
140.88
140.62
136.50
135.88
132.16
131.45
129.37
129.01
128.77
127.91
127.51
127.42
127.10
126.82
126.59
121.85
120.96
115.09
77.61
77.30
76.98
48.57
Ph
N
N
D4
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

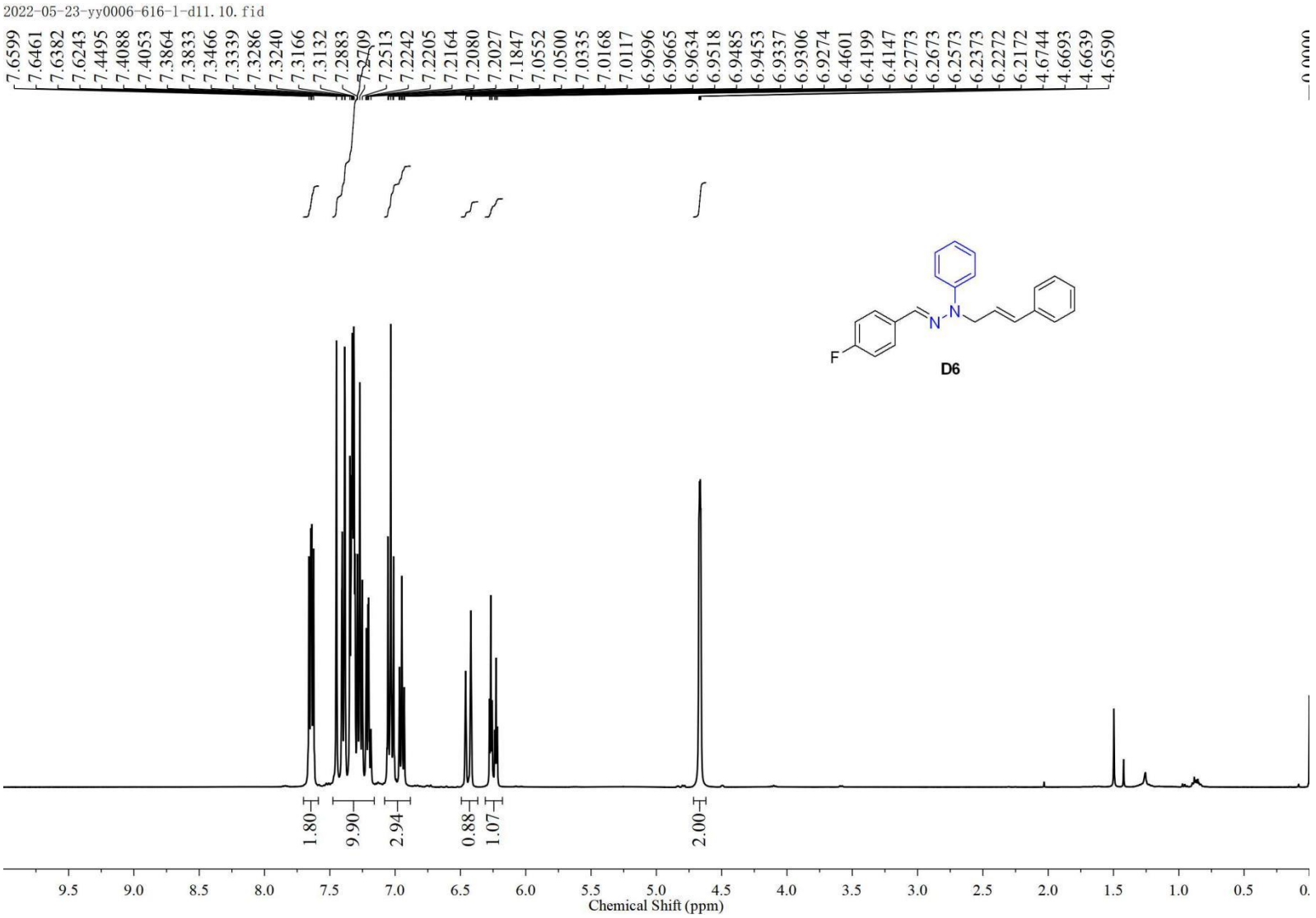

2022-05-29-YY0021-L-D8.10.fid
7.6195
7.6121
7.6072
7.5954
7.5901
7.5828
7.4197
7.3864
7.3675
7.3646
7.3158
7.2979
7.2939
7.2815
7.2767
7.2602
7.2569
7.2334
7.2284
7.2158
7.1966
7.1694
7.1655
7.1613
7.1539
7.1476
7.1410
7.1333
7.1297
7.1260
6.9204
6.9173
6.9141
6.9023
6.8993
6.8962
6.8813
6.8678
6.8628
6.8509
6.8457
6.4194
6.4145
6.4095
6.3795
6.3744
6.3695
6.2053
6.1954
6.1855
6.1653
6.1553
6.1454
4.5687
4.5637
4.5586
4.5536
3.7224
0.0000
N
N
O
D5
2.02
10.38
3.06
1.07
1.07
1.95
2.96
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

2022-05-29-YY0021-L-D8.11.fid

159.76
147.84
136.55
132.54
131.27
129.66
129.29
128.72
127.82
127.66
126.54
122.18
120.46
114.75
114.22
77.61
77.29
76.97
55.44
48.49

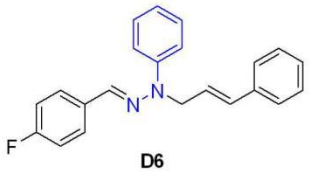
D5



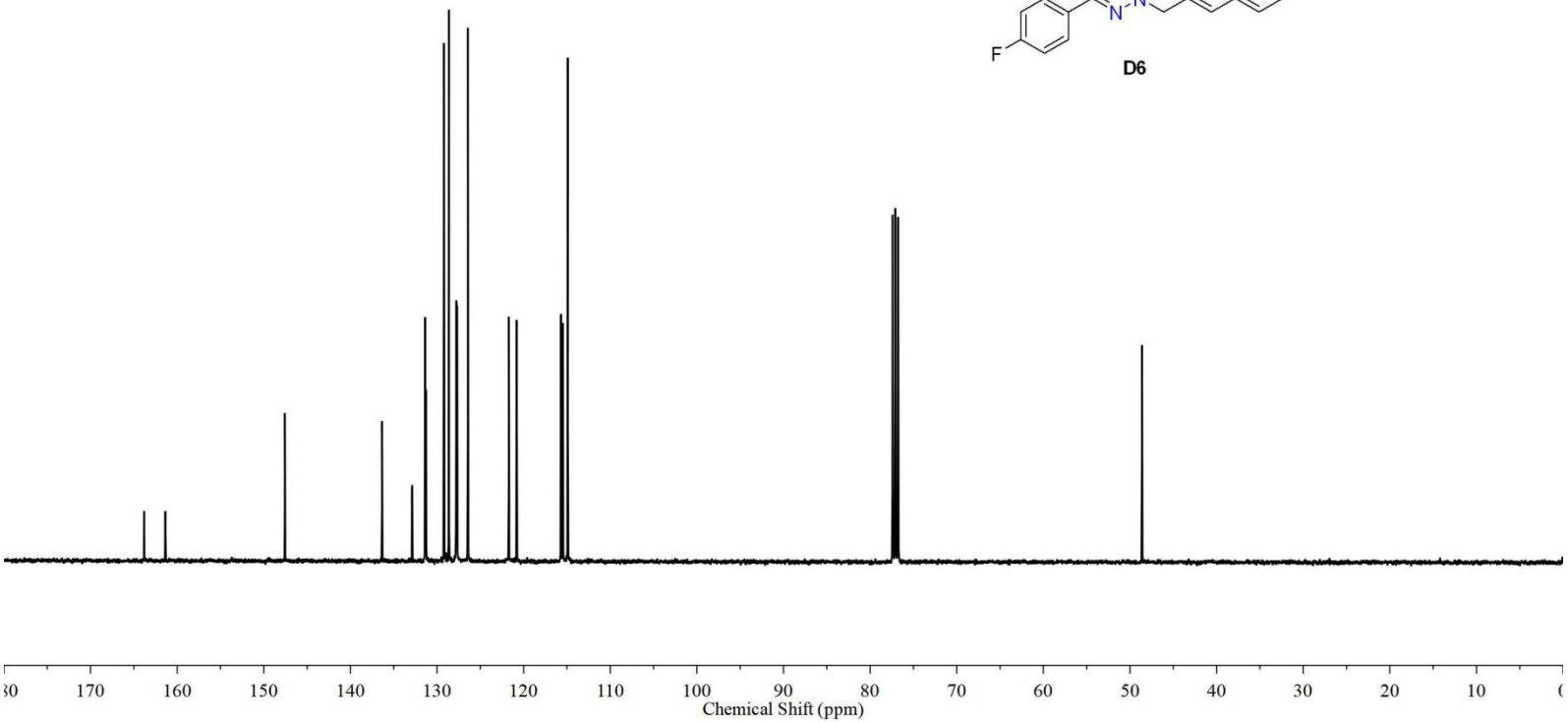

2022-05-23-yy0006-616-1-d11.10.fid
7.6599
7.6461
7.6382
7.6243
7.4495
7.4088
7.4053
7.3864
7.3833
7.3466
7.3339
7.3286
7.3240
7.3166
7.3132
7.2883
7.2709
7.2513
7.2242
7.2205
7.2164
7.2080
7.2027
7.1847
7.0552
7.0500
7.0335
7.0168
7.0117
6.9696
6.9665
6.9634
6.9518
6.9485
6.9453
6.9337
6.9306
6.9274
6.4601
6.4199
6.4147
6.2773
6.2673
6.2573
6.2373
6.2272
6.2172
4.6744
4.6693
4.6639
4.6590
F
N
N
D6
1.80
9.90
2.94
0.88
1.07
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

2022-05-23-yy0006-616-1-d11.11.fid

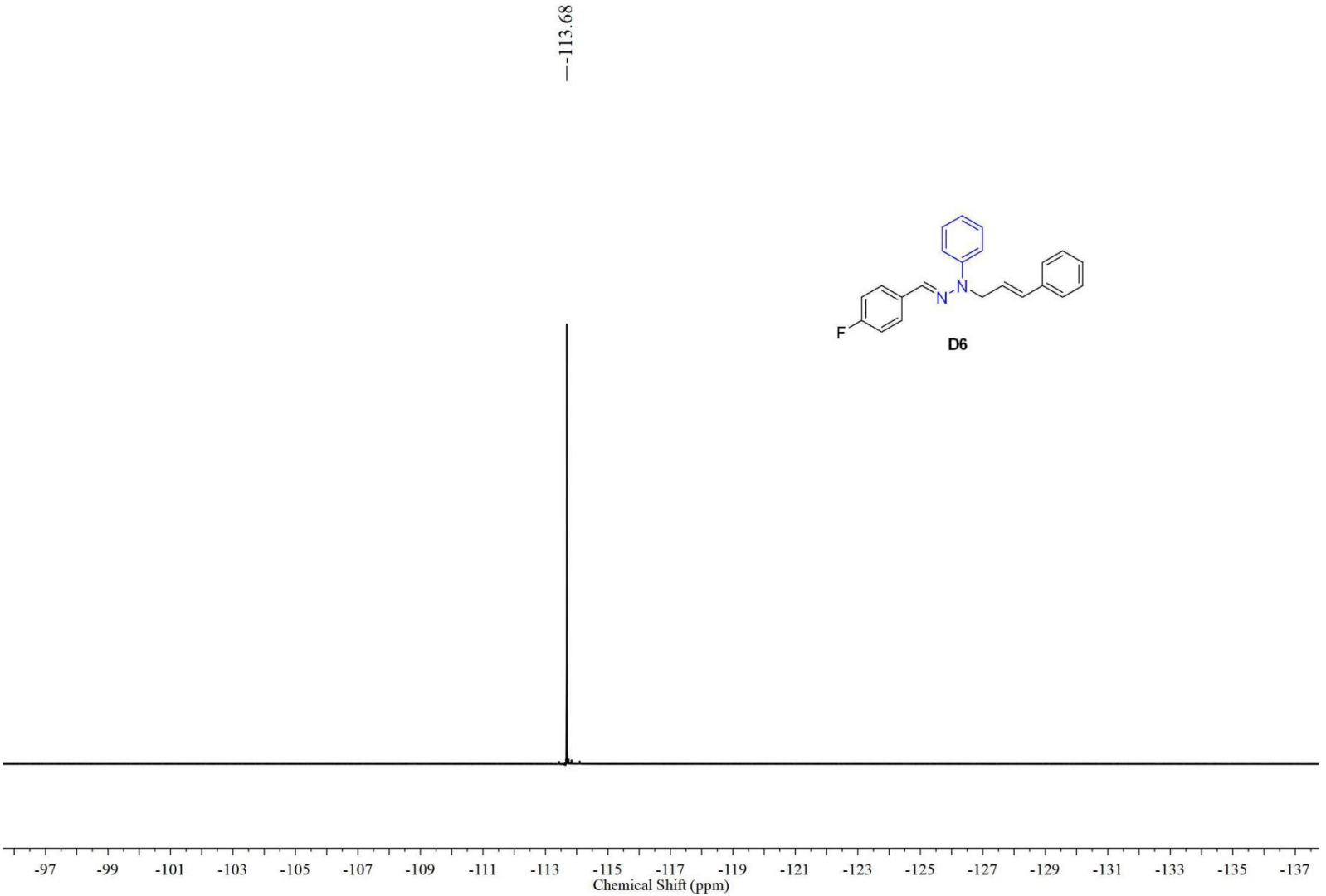
163.82
161.36
147.57
136.35
132.89
132.86
131.37
131.27
129.20
128.64
127.80
127.76
127.68
126.43
121.71
120.80
115.69
115.47
114.91
77.40
77.09
76.77
48.61



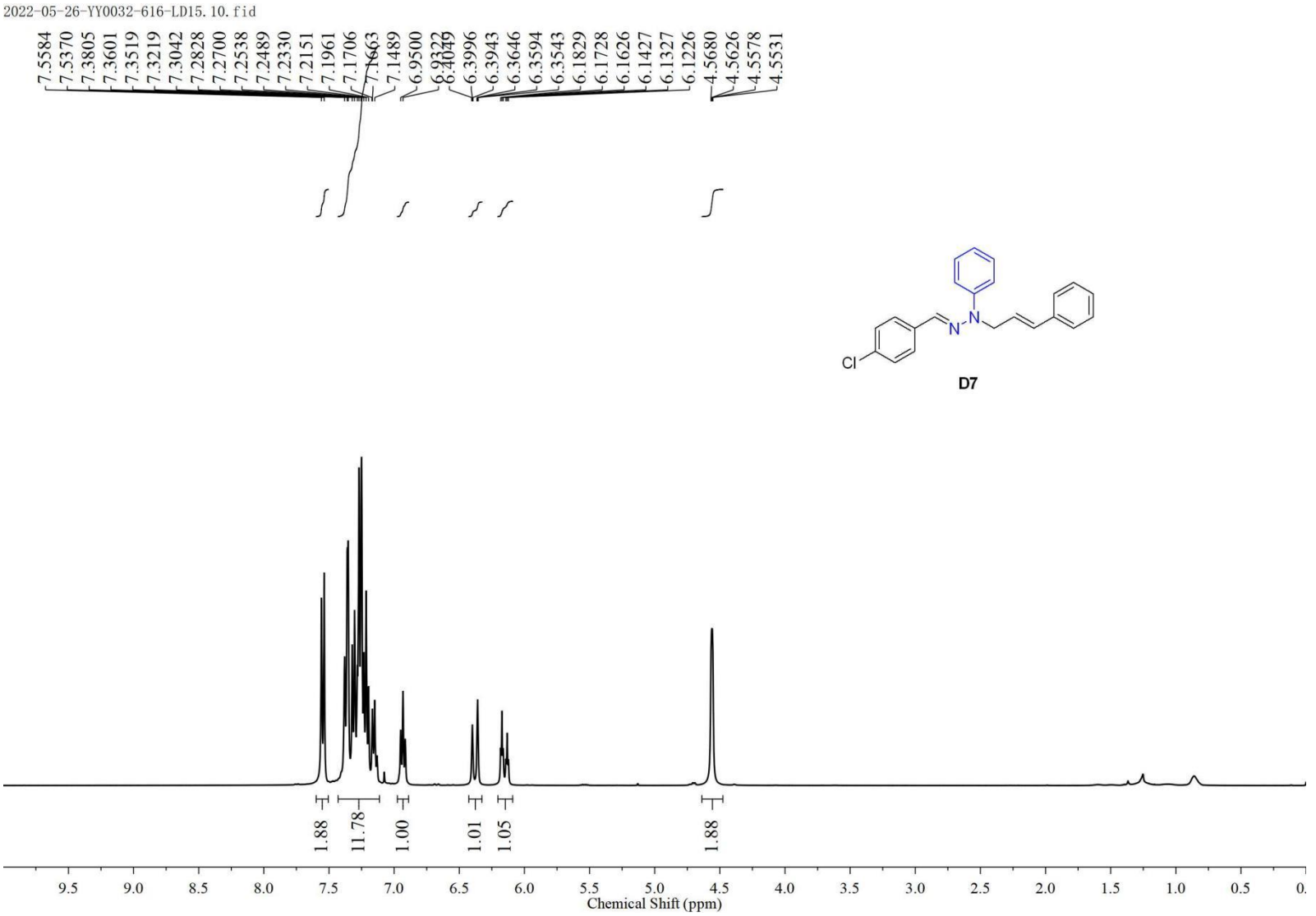
D6

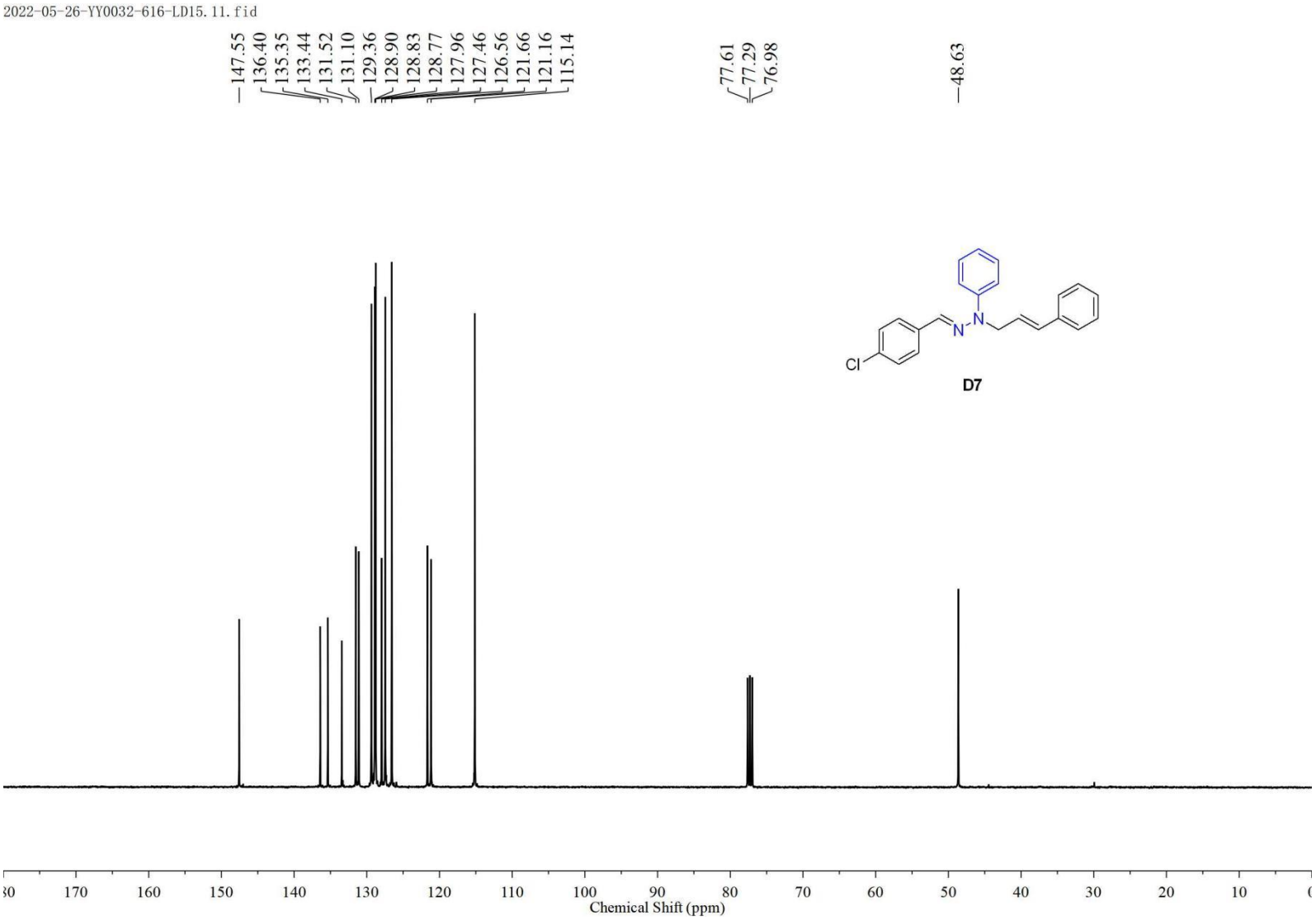


2022-05-23-yy0006-616-1-d11.12.fid



D6


2022-05-26-YY0032-616-LD15.10.fid
7.5584
7.5370
7.3805
7.3601
7.3519
7.3219
7.3042
7.2828
7.2700
7.2538
7.2489
7.2330
7.2151
7.1961
7.1706
7.1663
7.1489
6.9500
6.3996
6.3943
6.3646
6.3594
6.3543
6.1829
6.1728
6.1626
6.1427
6.1327
6.1226
4.5680
4.5626
4.5578
4.5531
Cl
N
N
D7
1.88
11.78
1.00
1.01
1.05
1.88
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)


2022-05-26-YY0032-616-LD15.11.fid
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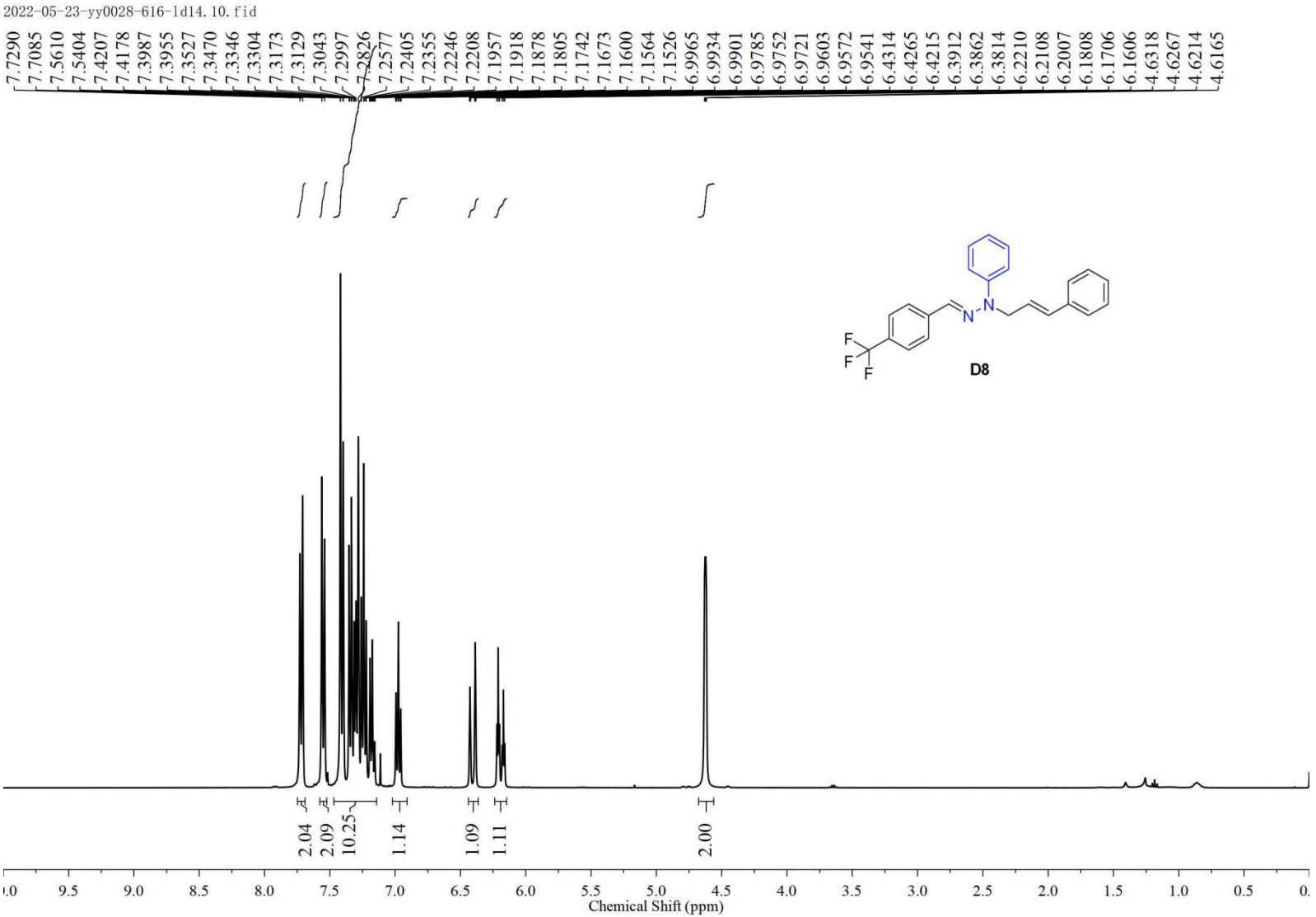
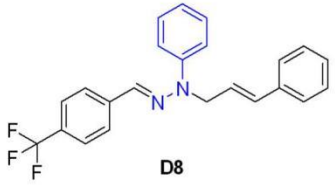
136.40
135.35
133.44
131.52
131.10
129.36
128.90
128.83
128.77
127.96
127.46
126.56
121.66
121.16
115.14
77.61
77.29
76.98
48.63
Cl
N
N
D7
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

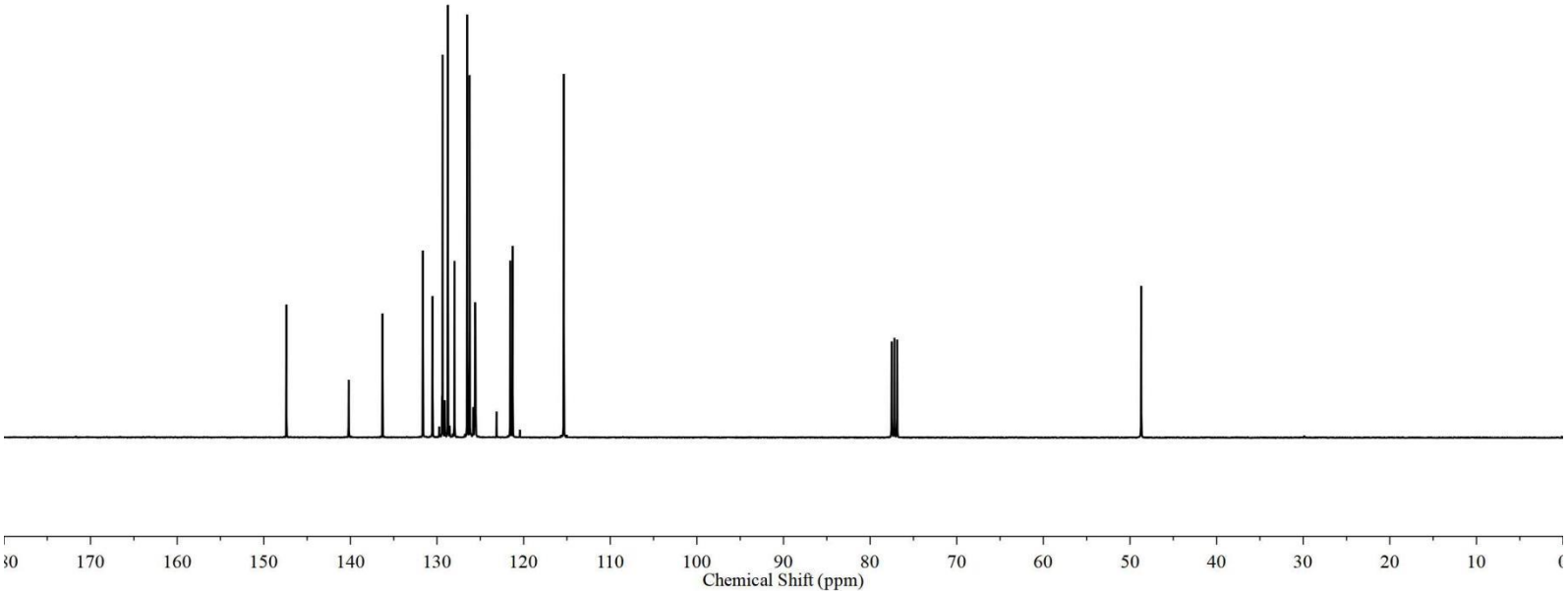

2022-05-23-yy0028-616-ld14.10.fid
7.7290
7.7085
7.5610
7.5404
7.4207
7.4178
7.3987
7.3955
7.3527
7.3470
7.3346
7.3304
7.3173
7.3129
7.3043
7.2997
7.2826
7.2577
7.2405
7.2355
7.2246
7.2208
7.1957
7.1918
7.1878
7.1805
7.1742
7.1673
7.1600
7.1564
7.1526
6.9965
6.9934
6.9901
6.9785
6.9752
6.9721
6.9603
6.9572
6.9541
6.4314
6.4265
6.4215
6.3912
6.3862
6.3814
6.2210
6.2108
6.2007
6.1808
6.1706
6.1606
4.6318
4.6267
4.6214
4.6165
F
F
F
N
N
D8
2.04
2.09
10.25
1.14
1.09
1.11
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

2022-05-23-yy0028-616-ld14.11.fid

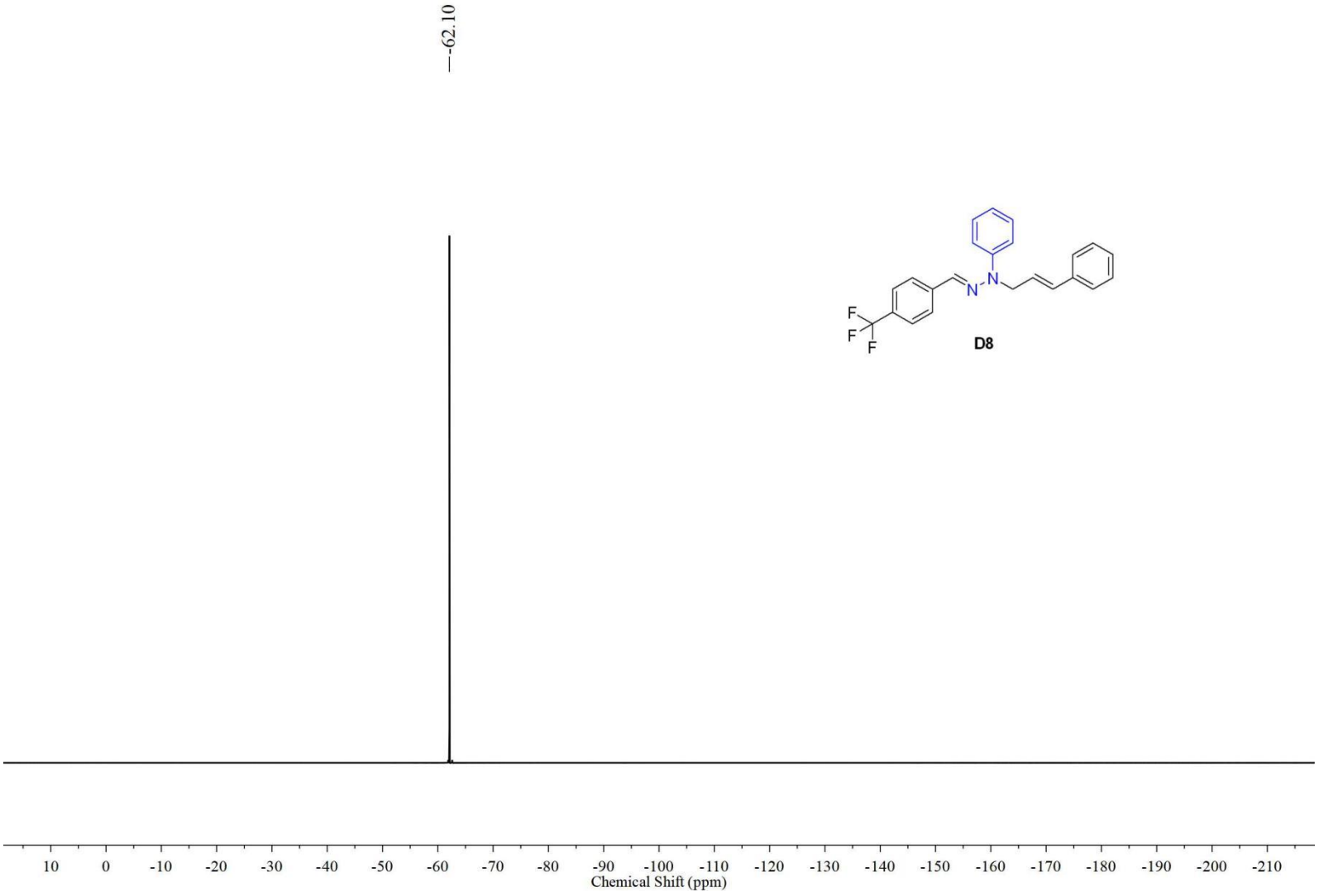
147.39
140.20
140.19
136.29
131.63
130.53
129.43
129.36
128.75
127.99
126.52
126.24
125.65
125.61
125.57
125.53
121.55
121.27
115.37
77.51
77.20
76.88
48.71



D8

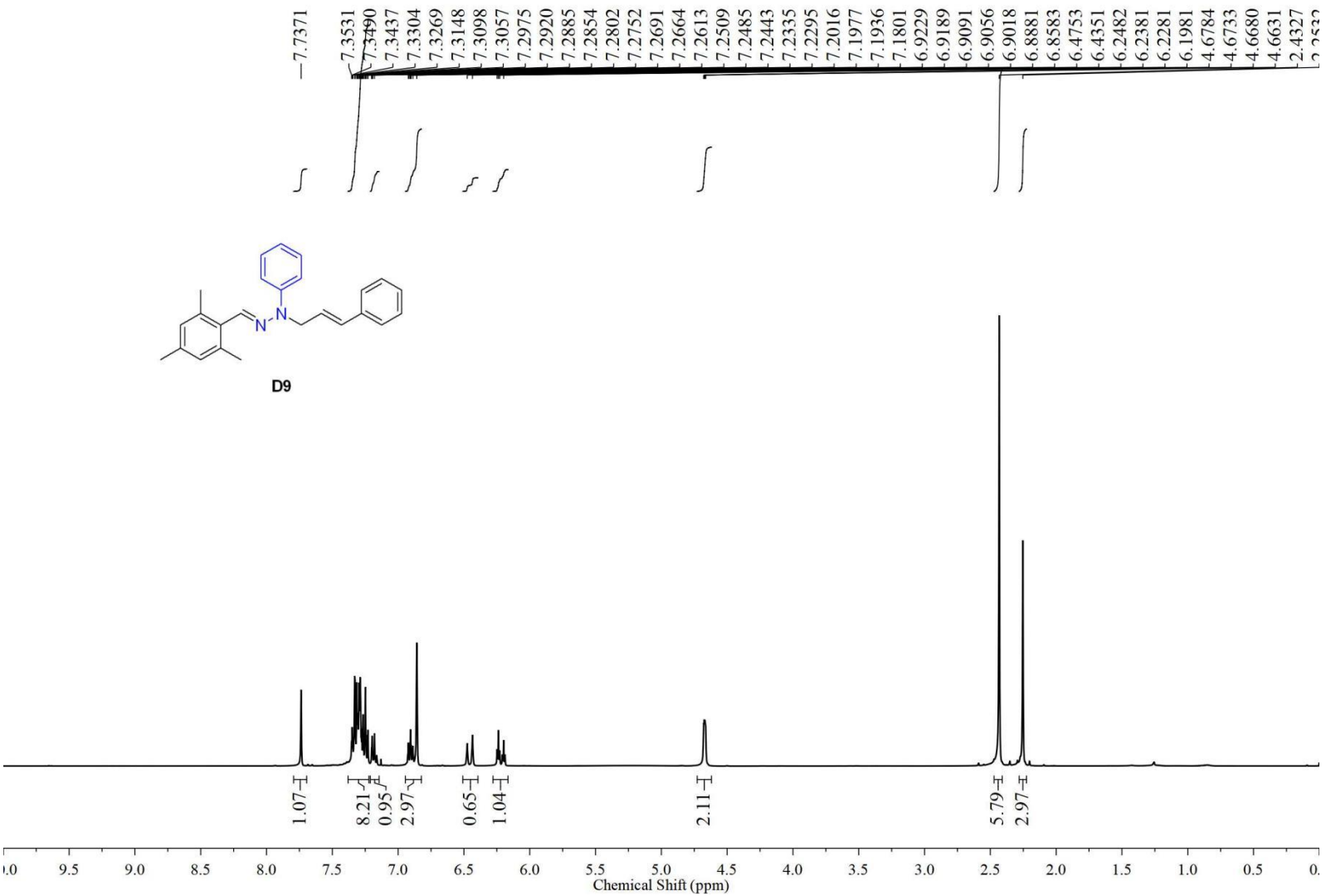


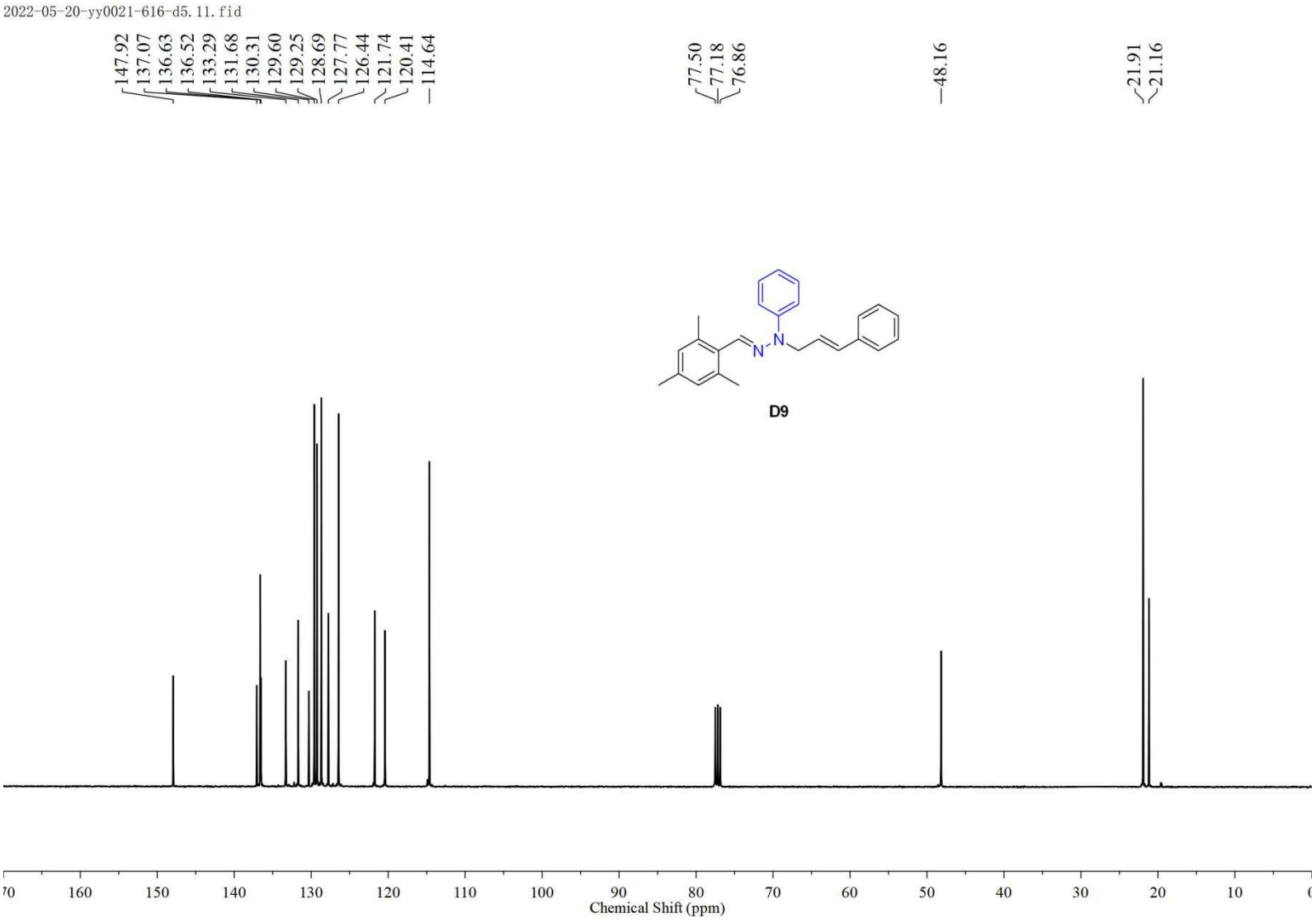
2022-05-23-yy0028-616-ld14.12.fid

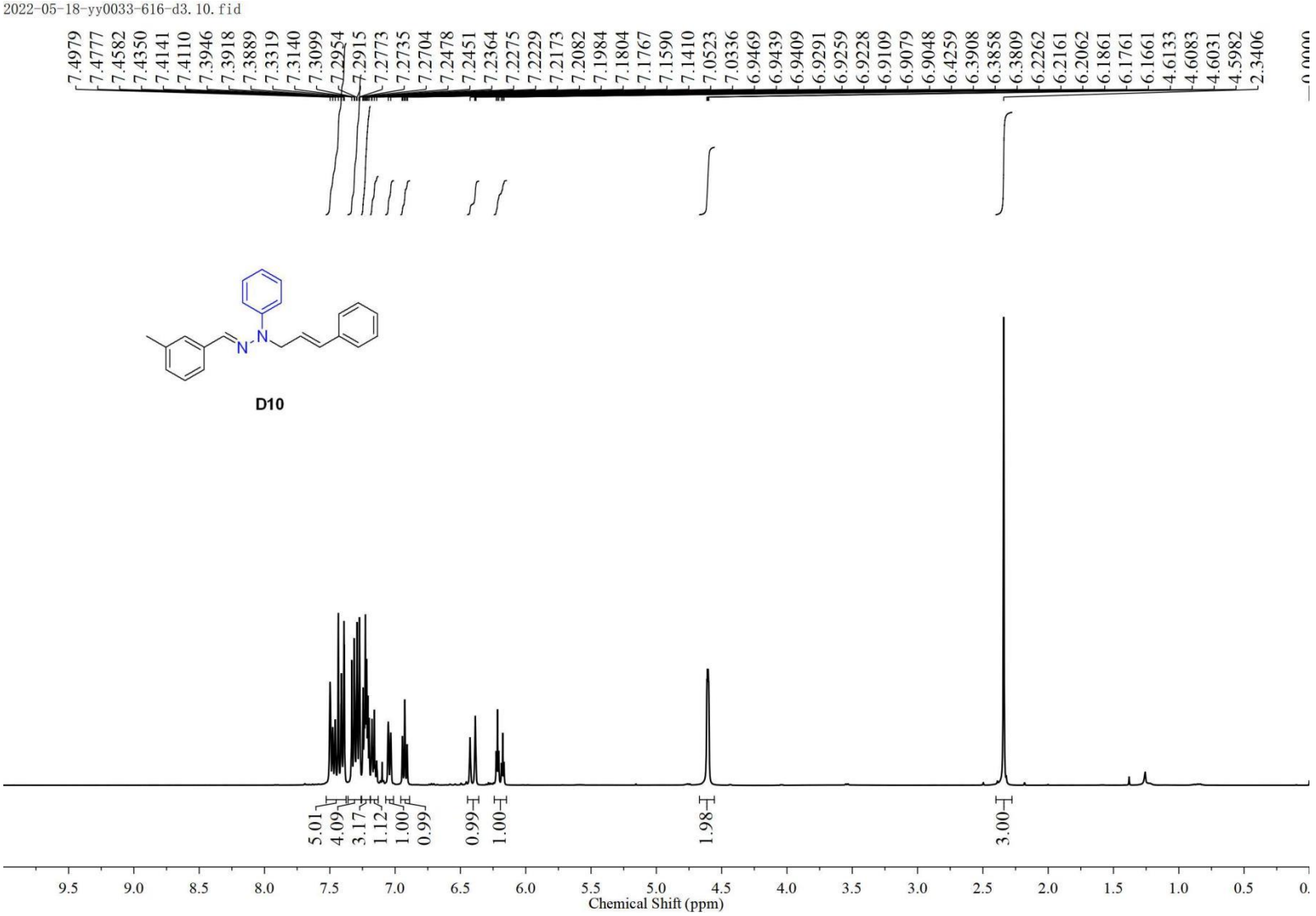


D8

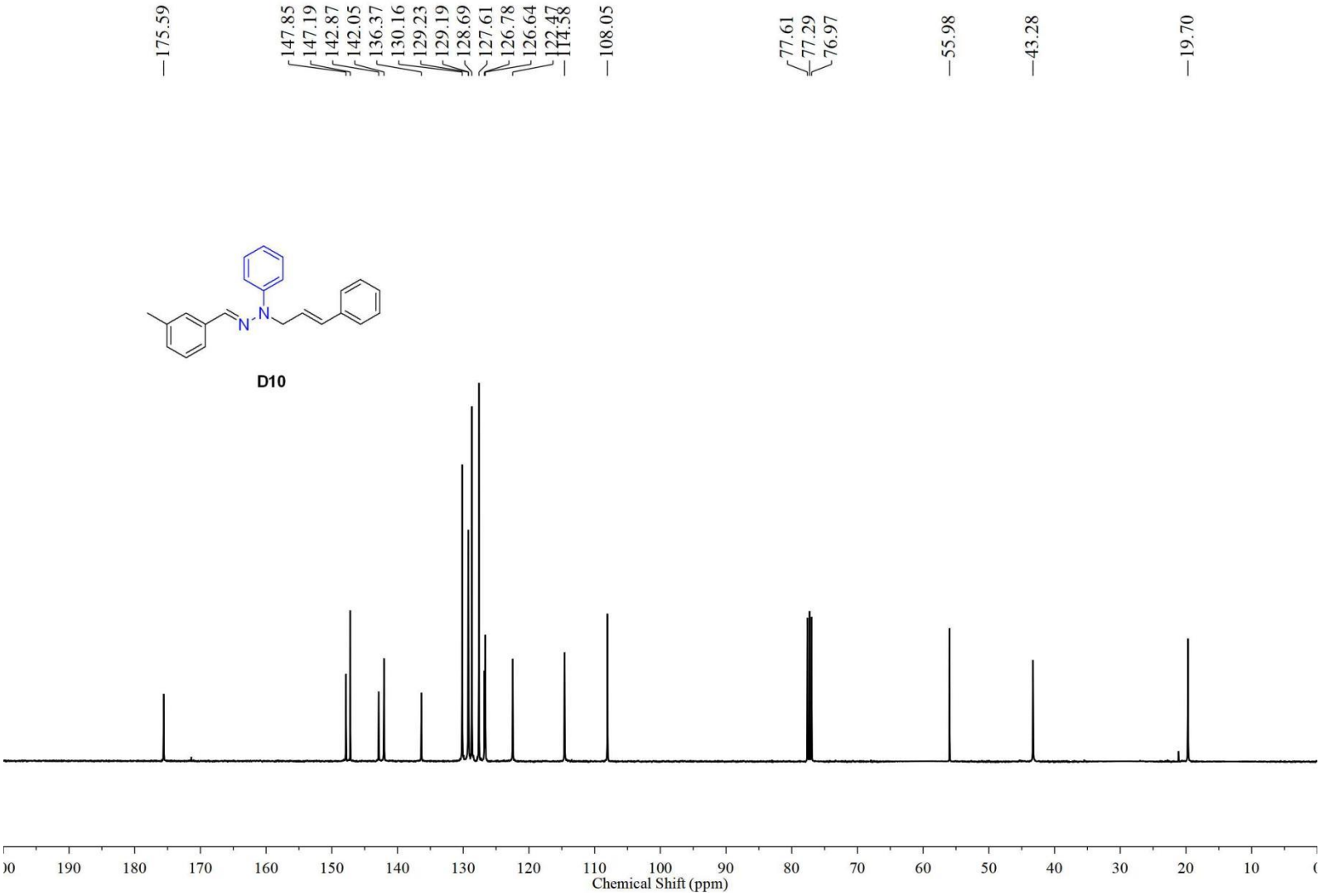
2022-05-20-yy0021-616-d5.10.fid

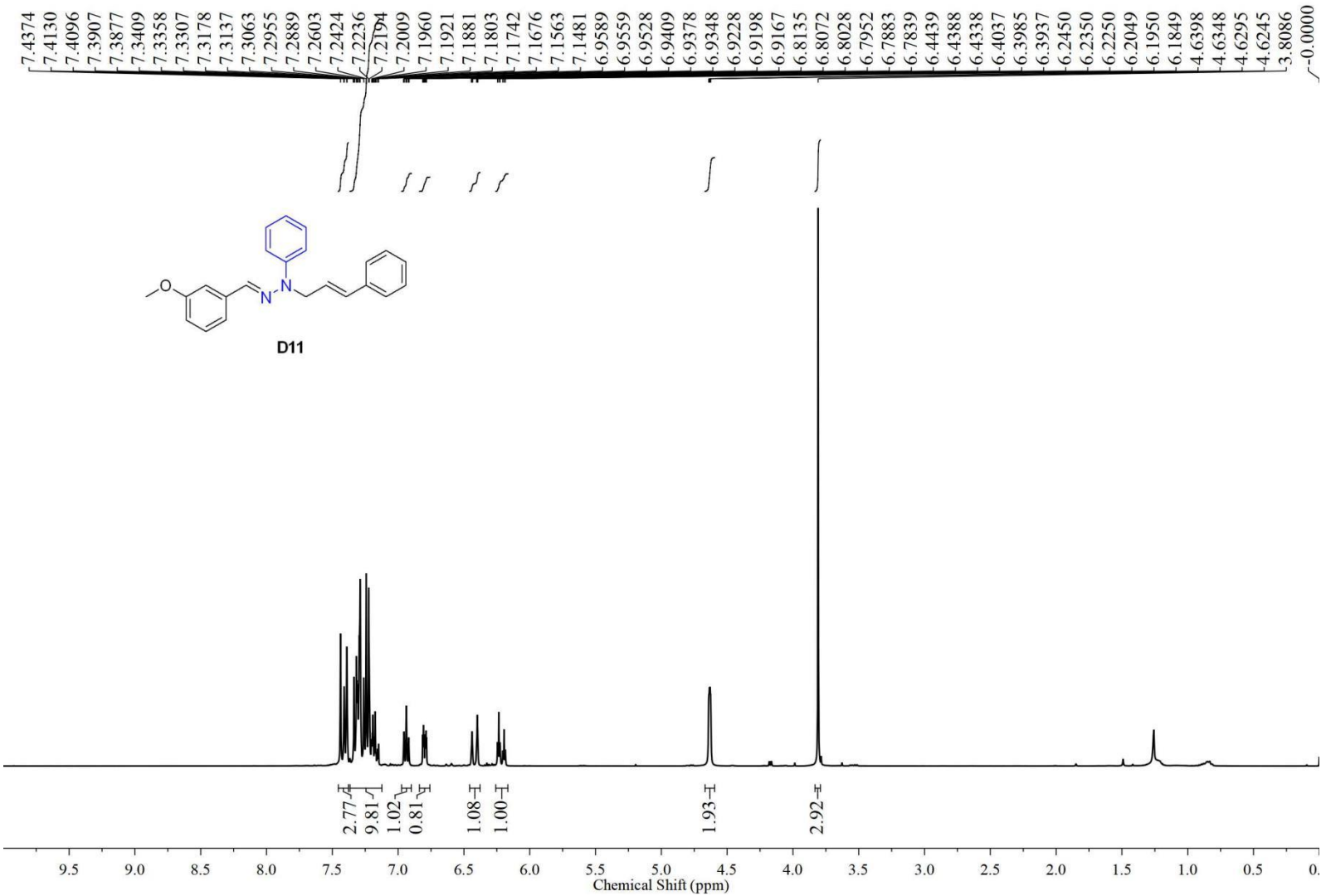



2022-05-20-yy0021-616-d5.11.fid
147.92
137.07
136.63
136.52
133.29
131.68
130.31
129.60
129.25
128.69
127.77
126.44
121.74
120.41
114.64
77.50
77.18
76.86
48.16
21.91
21.16
D9
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-05-18-yy0033-616-d3.10.fid
7.4979
7.4777
7.4582
7.4350
7.4141
7.4110
7.3946
7.3918
7.3889
7.3319
7.3140
7.3099
7.2954
7.2915
7.2773
7.2735
7.2704
7.2478
7.2451
7.2364
7.2275
7.2229
7.2173
7.2082
7.1984
7.1804
7.1767
7.1590
7.1410
7.0523
7.0336
6.9469
6.9439
6.9409
6.9291
6.9259
6.9228
6.9109
6.9079
6.9048
6.4259
6.3908
6.3858
6.3809
6.2262
6.2161
6.2062
6.1861
6.1761
6.1661
4.6133
4.6083
4.6031
4.5982
2.3406
N
N
D10
5.01
4.09
3.17
1.12
1.00
0.99
0.99
1.00
1.98
3.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

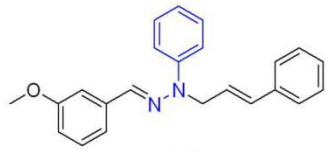
2022-05-20-yy0021-616-d3.10.fid



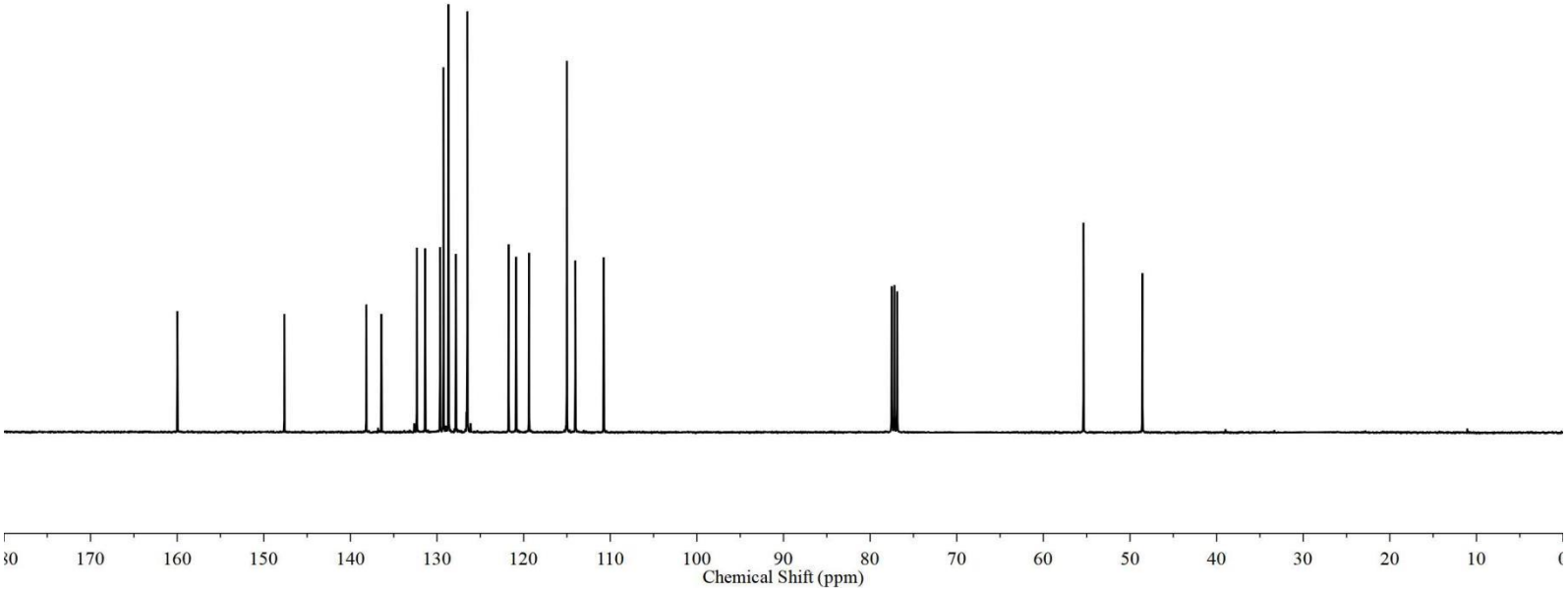

2022-05-23-yy0028-616-ld9.10.fid
7.4374
7.4130
7.4096
7.3907
7.3877
7.3409
7.3358
7.3307
7.3178
7.3137
7.3063
7.2955
7.2889
7.2603
7.2424
7.2236
7.2194
7.2009
7.1960
7.1921
7.1881
7.1803
7.1742
7.1676
7.1563
7.1481
6.9589
6.9559
6.9528
6.9409
6.9378
6.9348
6.9228
6.9198
6.9167
6.8135
6.8072
6.8028
6.7952
6.7883
6.7839
6.4439
6.4388
6.4338
6.4037
6.3985
6.3937
6.2450
6.2350
6.2250
6.2049
6.1950
6.1849
4.6398
4.6348
4.6295
4.6245
3.8086
-0.0000
O
N
N
D11
2.77
9.81
1.02
0.81
1.08
1.00
1.93
2.92
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

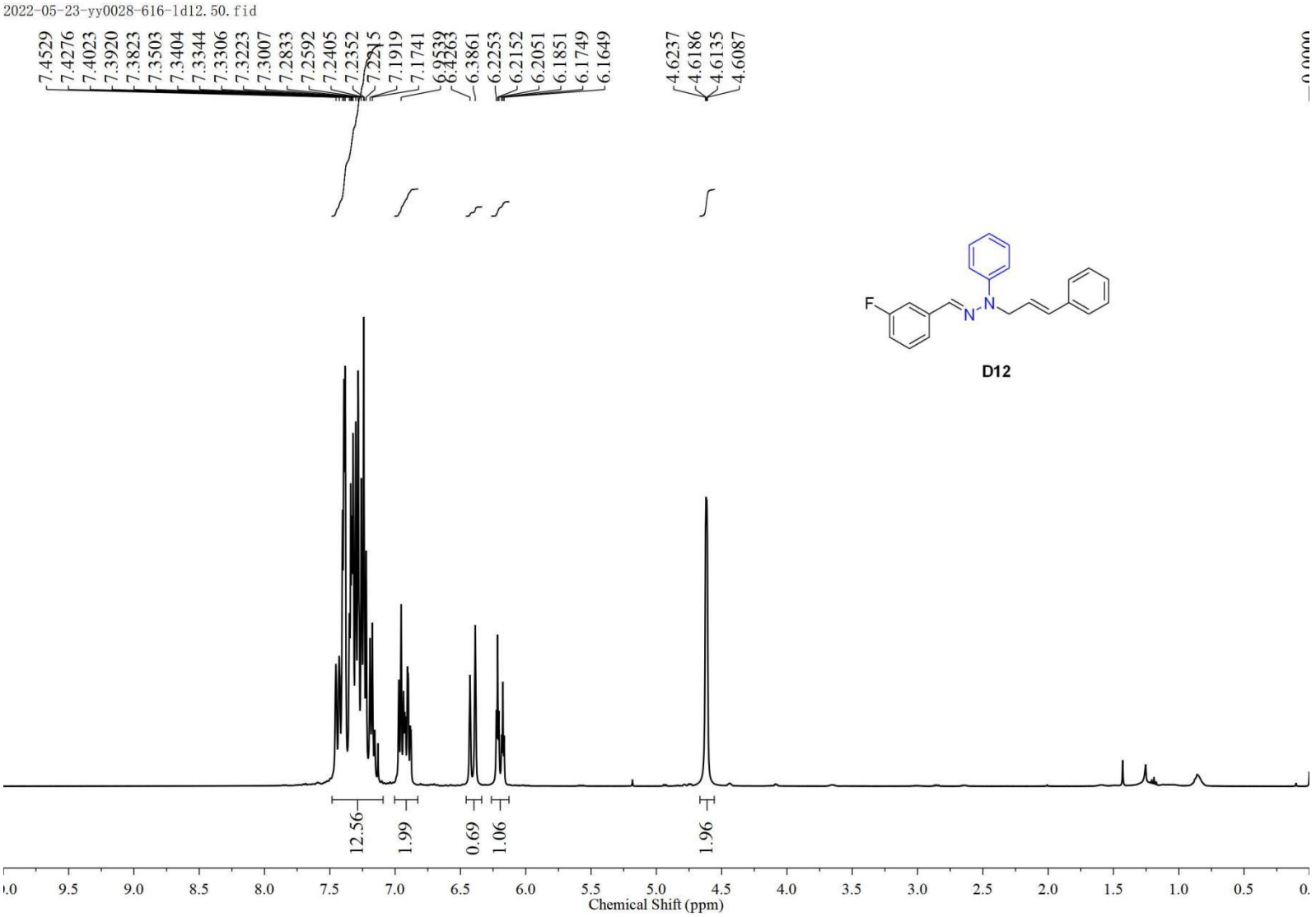
2022-05-23-yy0028-616-ld9.11.fid

159.97
147.62
138.17
136.42
132.33
131.37
129.65
129.25
128.68
127.82
126.50
121.74
120.87
119.38
115.00
114.03
110.76
77.51
77.19
76.88
55.36
48.57



D11




2022-05-23-yy0028-616-ld12.50.fid
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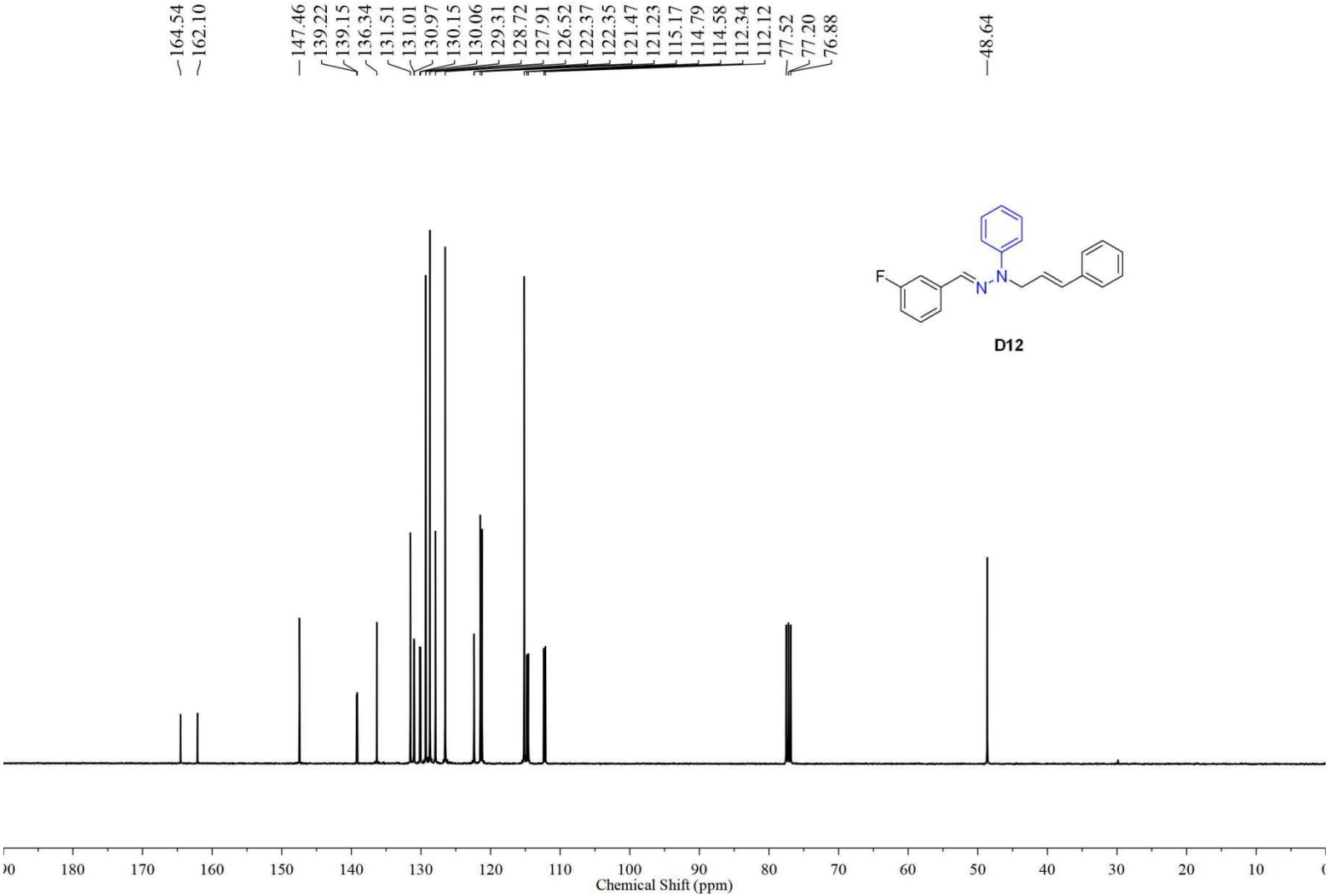
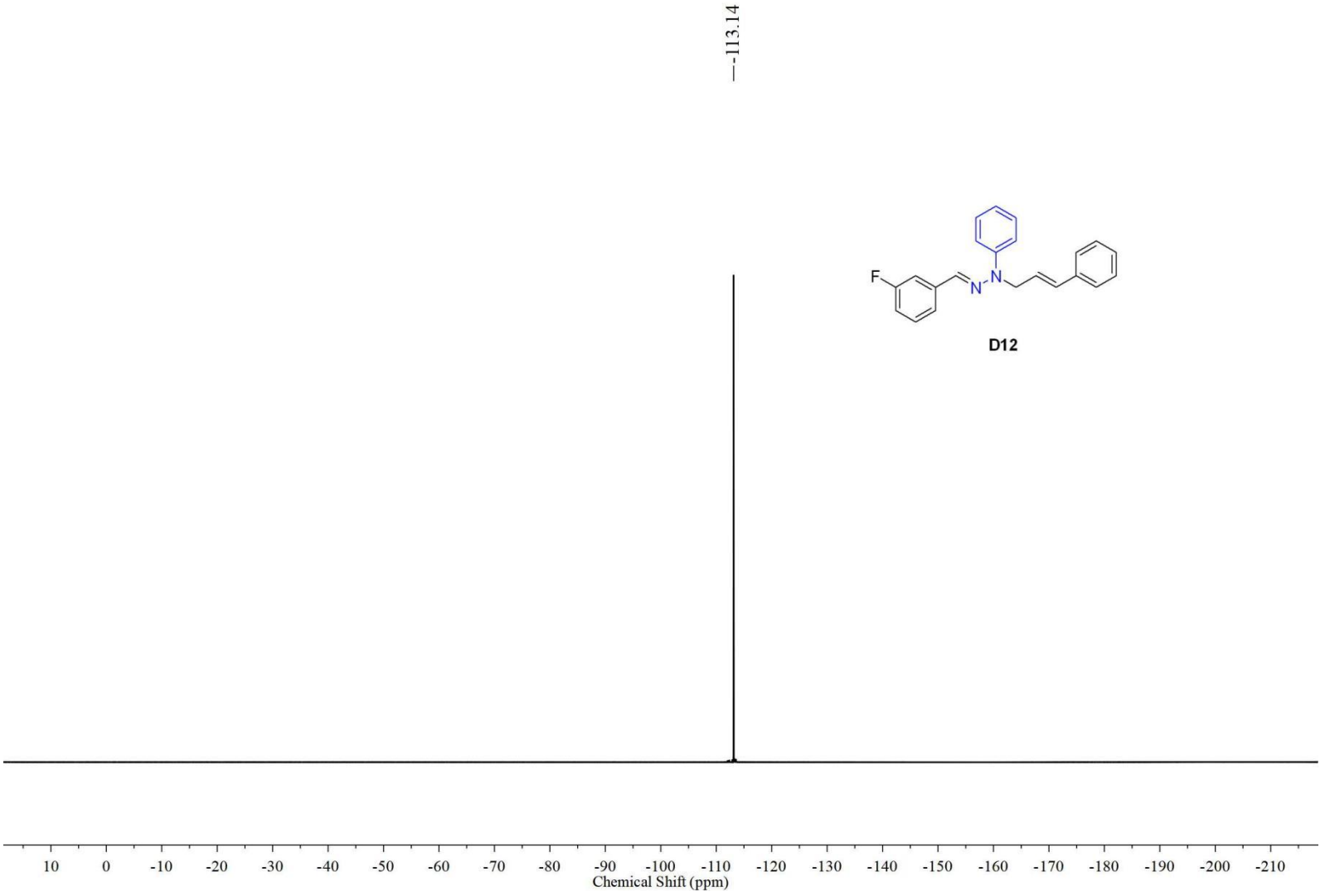
7.4276
7.4023
7.3920
7.3823
7.3503
7.3404
7.3344
7.3306
7.3223
7.3007
7.2833
7.2592
7.2405
7.2352
7.1919
7.1741
6.3861
6.2253
6.2152
6.2051
6.1851
6.1749
6.1649
4.6237
4.6186
4.6135
4.6087
F
N
N
D12
12.56
1.99
0.69
1.06
1.96
Chemical Shift (ppm)

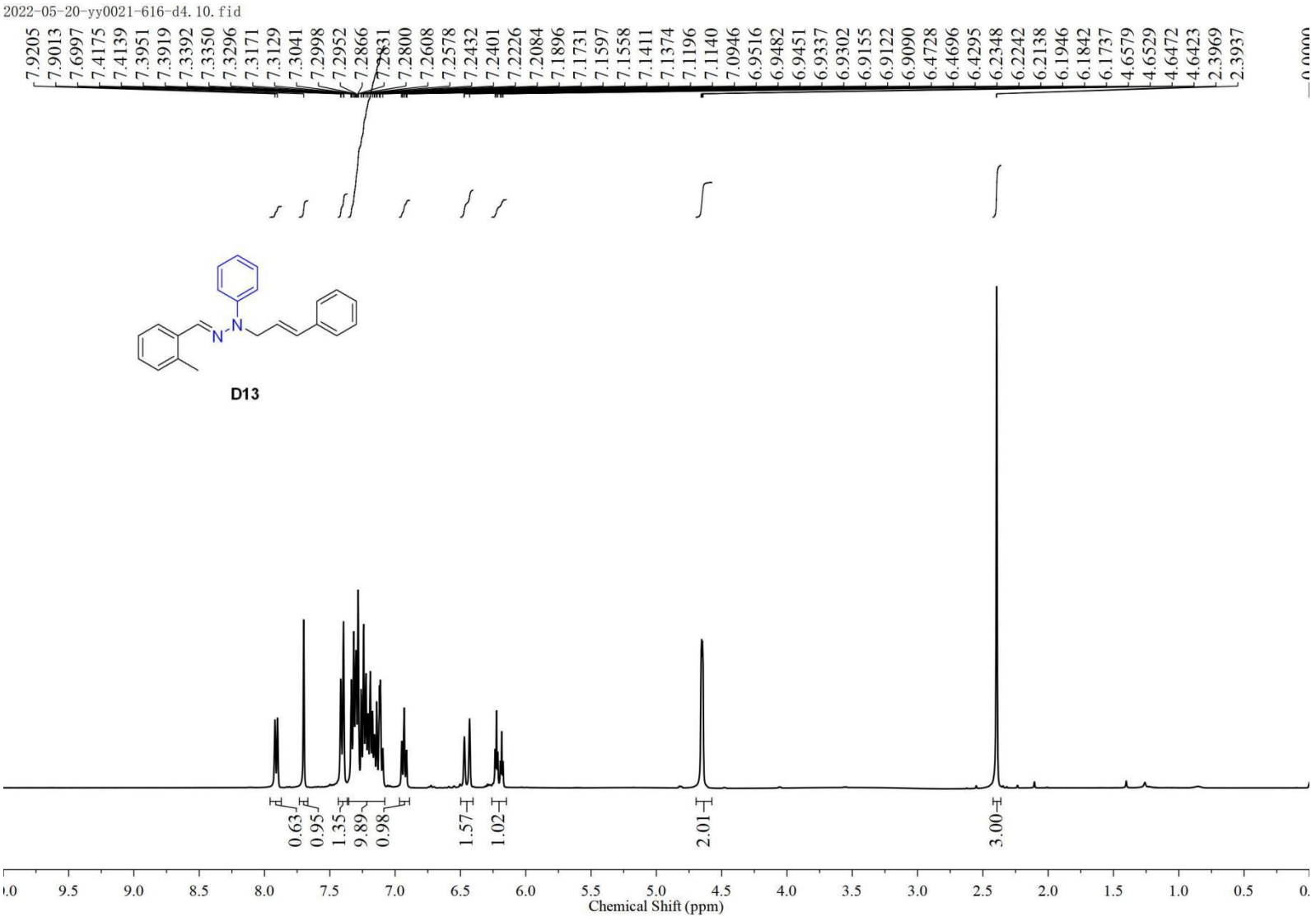
2022-05-23-yy0028-616-ld12.51.fid



2022-05-23-yy0028-616-1d12.52.fid



D12


2022-05-20-yy0021-616-d4.10.fid
7.9205
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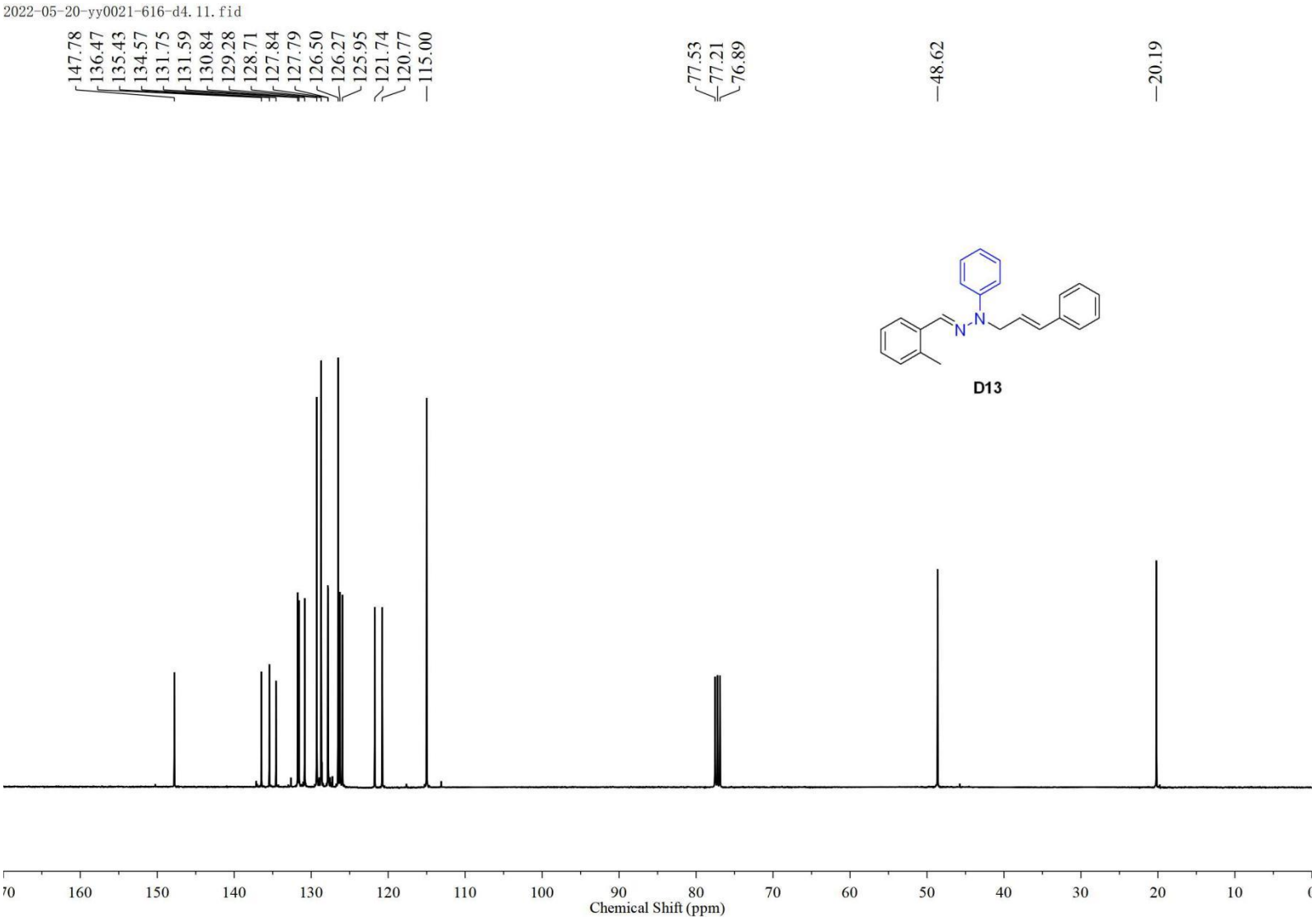
7.6997
7.4175
7.4139
7.3951
7.3919
7.3392
7.3350
7.3296
7.3171
7.3129
7.3041
7.2998
7.2952
7.2866
7.2831
7.2800
7.2608
7.2578
7.2432
7.2401
7.2226
7.2084
7.1896
7.1731
7.1597
7.1558
7.1411
7.1374
7.1196
7.1140
7.0946
6.9516
6.9482
6.9451
6.9337
6.9302
6.9155
6.9122
6.9090
6.4728
6.4696
6.4295
6.2348
6.2242
6.2138
6.1946
6.1842
6.1737
4.6579
4.6529
4.6472
4.6423
2.3969
2.3937
D13
0.63
0.95
1.35
9.89
0.98
1.57
1.02
2.01
3.00
Chemical Shift (ppm)


2022-05-20-yy0021-616-d4.11.fid
147.78
136.47
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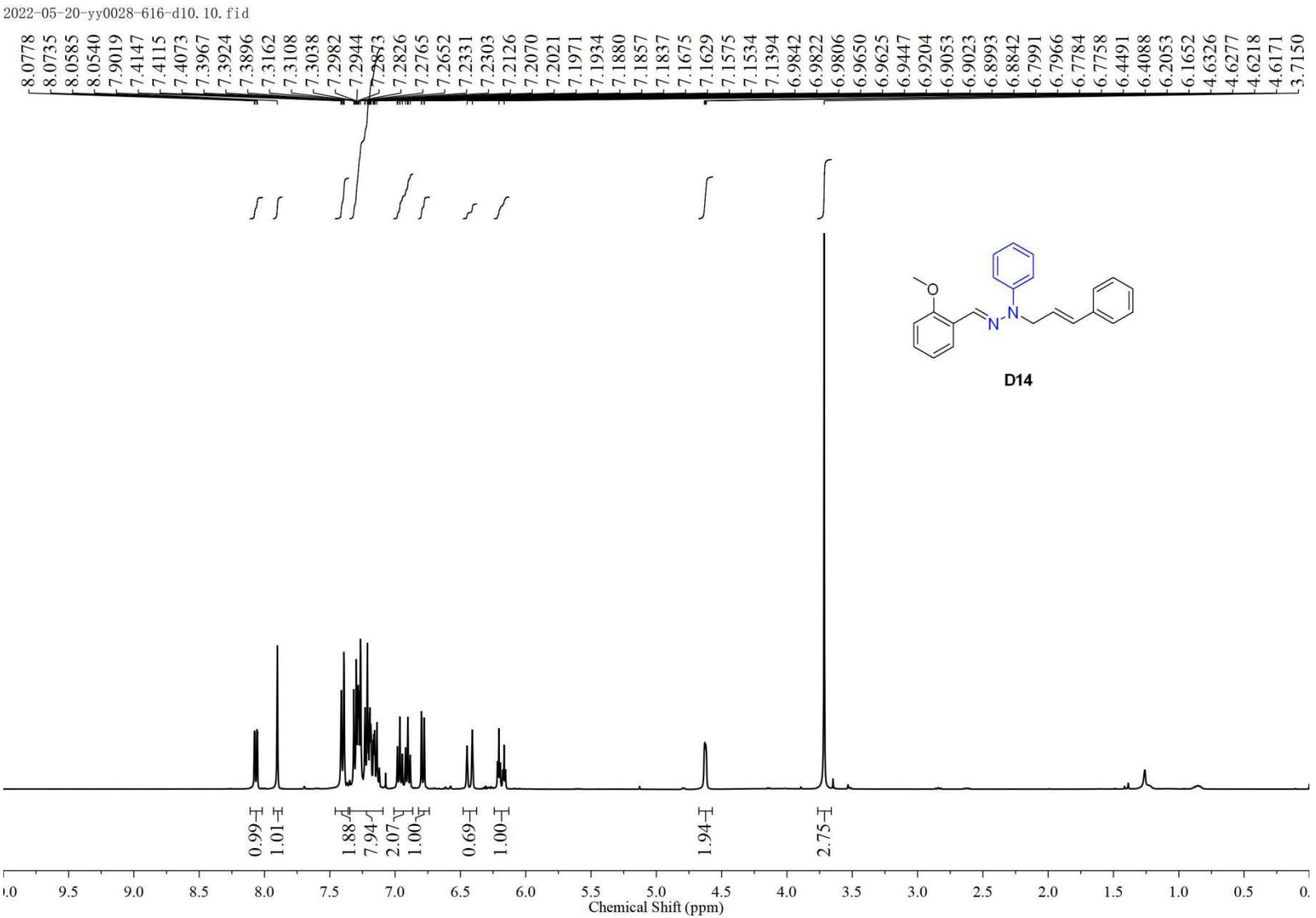
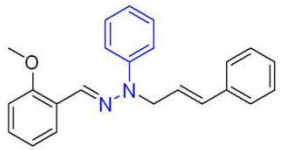
134.57
131.75
131.59
130.84
129.28
128.71
127.84
127.79
126.50
126.27
125.95
121.74
120.77
115.00
77.53
77.21
76.89
48.62
20.19
D13
Chemical Shift (ppm)

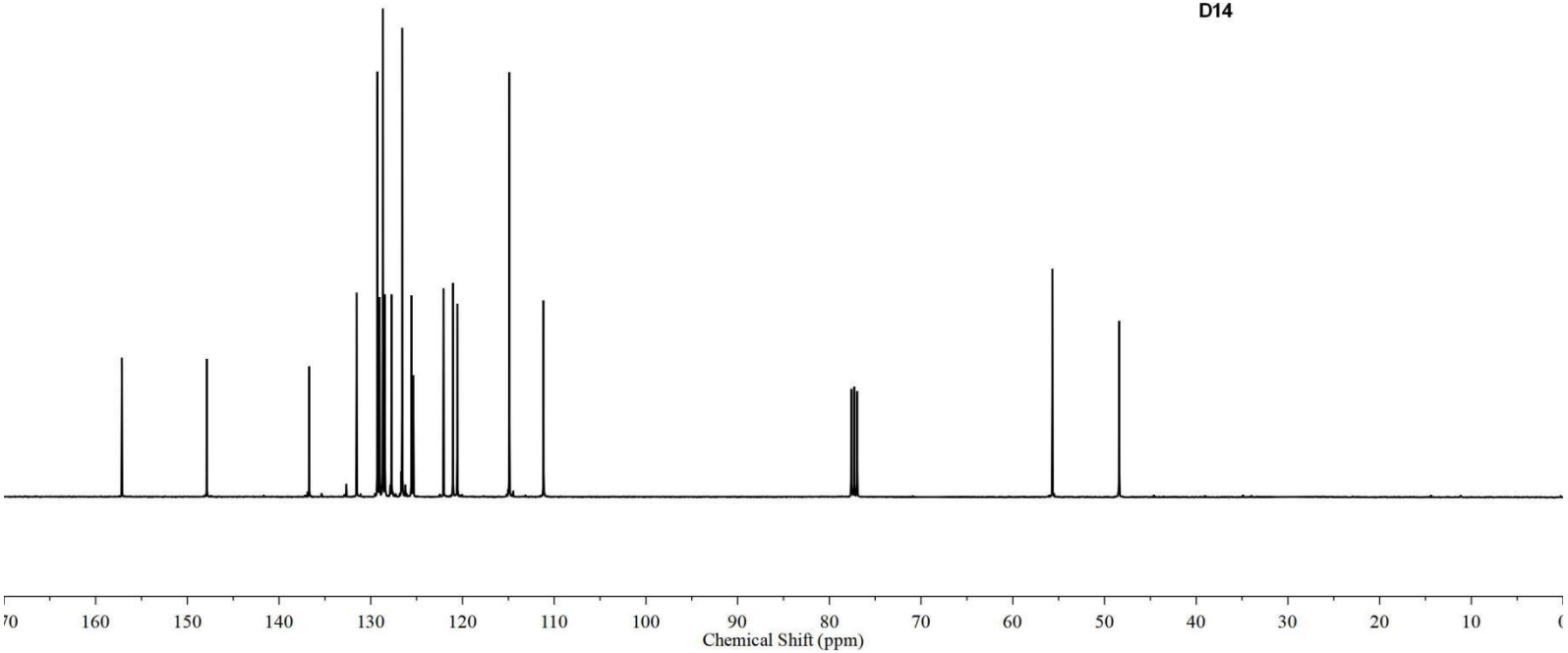

2022-05-20-yy0028-616-d10.10.fid
8.0778
8.0735
8.0585
8.0540
7.9019
7.4147
7.4115
7.4073
7.3967
7.3924
7.3896
7.3162
7.3108
7.3038
7.2982
7.2944
7.2873
7.2826
7.2765
7.2652
7.2331
7.2303
7.2126
7.2070
7.2021
7.1971
7.1934
7.1880
7.1857
7.1837
7.1675
7.1629
7.1575
7.1534
7.1394
6.9842
6.9822
6.9806
6.9650
6.9625
6.9447
6.9204
6.9053
6.9023
6.8993
6.8842
6.7991
6.7966
6.7784
6.7758
6.4491
6.4088
6.2053
6.1652
4.6326
4.6277
4.6218
4.6171
3.7150
O
N
N
D14
0.99
1.01
1.88
7.94
2.07
1.00
0.69
1.00
1.94
2.75
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

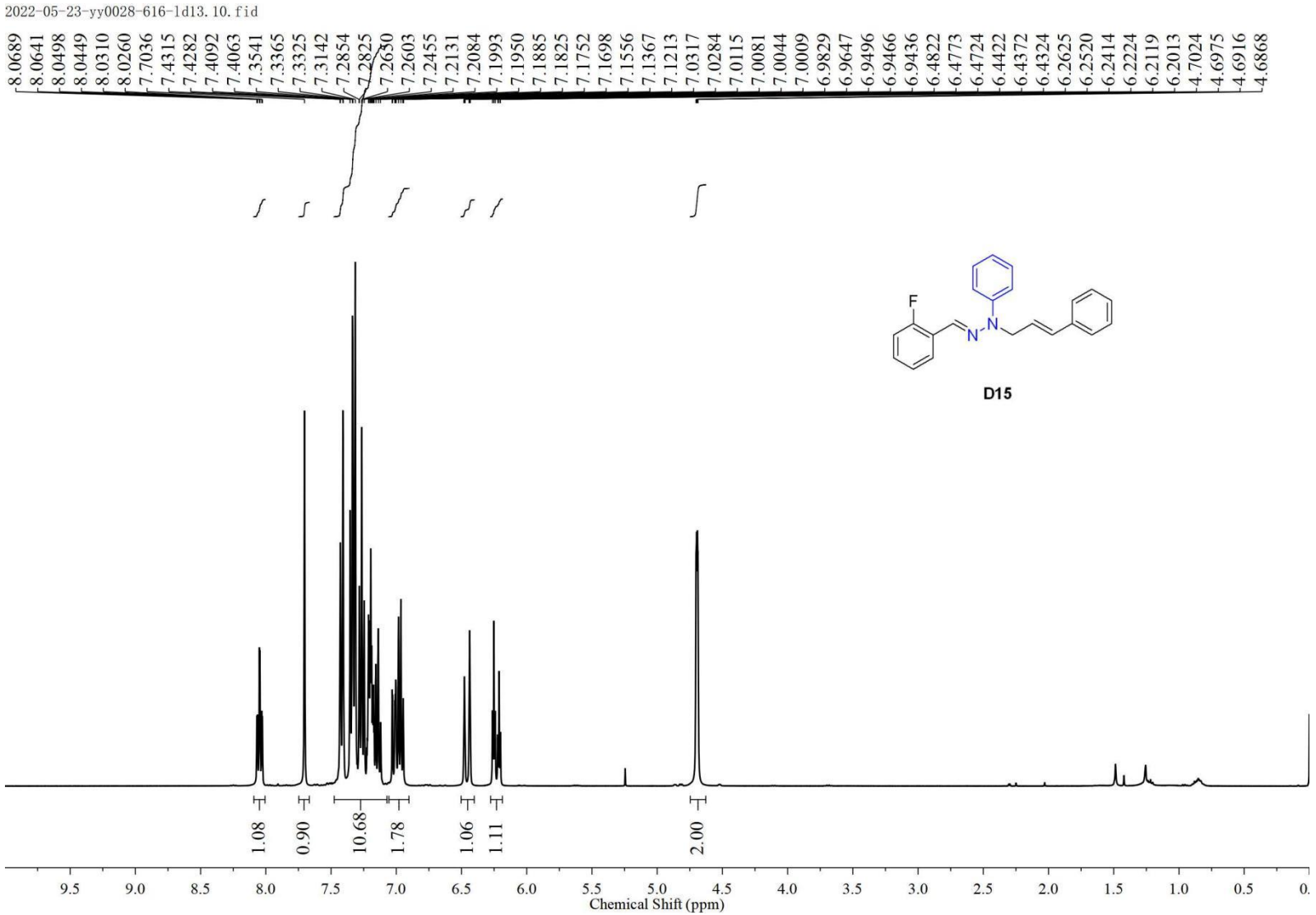
2022-05-20-yy0028-616-d10.11.fid

157.14
147.88
136.72
131.54
129.27
129.06
128.69
128.47
127.74
126.58
125.56
125.35
122.07
121.04
120.56
114.89
111.18
77.60
77.29
76.97
55.68
48.40



D14




2022-05-23-yy0028-616-ld13.10.fid
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8.0641
8.0498
8.0449
8.0310
8.0260
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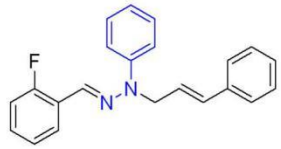
7.4315
7.4282
7.4092
7.4063
7.3541
7.3365
7.3325
7.3142
7.2854
7.2825
7.2630
7.2603
7.2455
7.2131
7.2084
7.1993
7.1950
7.1885
7.1825
7.1752
7.1698
7.1556
7.1367
7.1213
7.0317
7.0284
7.0115
7.0081
7.0044
7.0009
6.9829
6.9647
6.9496
6.9466
6.9436
6.4822
6.4773
6.4724
6.4422
6.4372
6.4324
6.2625
6.2520
6.2414
6.2224
6.2119
6.2013
4.7024
4.6975
4.6916
4.6868
F
N
N
D15
1.08
0.90
10.68
1.78
1.06
1.11
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

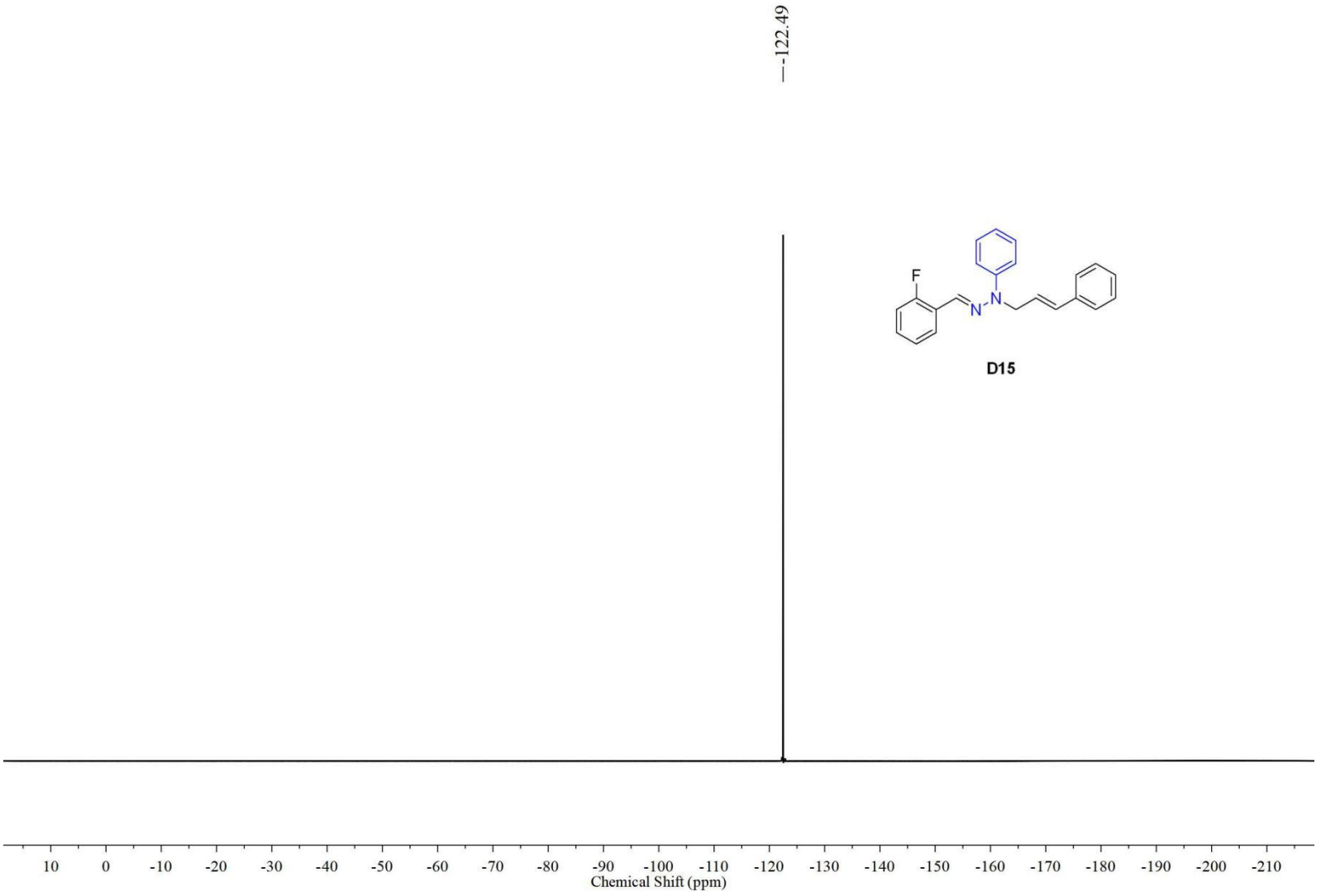
2022-05-23-yy0028-616-ld13.11.fid

161.86
159.39
147.51
136.38
131.68
129.22
129.18
128.99
128.91
128.61
127.77
126.49
125.93
125.90
125.30
125.25
124.47
124.37
124.28
124.24
121.33
121.07
115.71
115.50
115.08
77.42
77.30
77.10
76.78
48.51

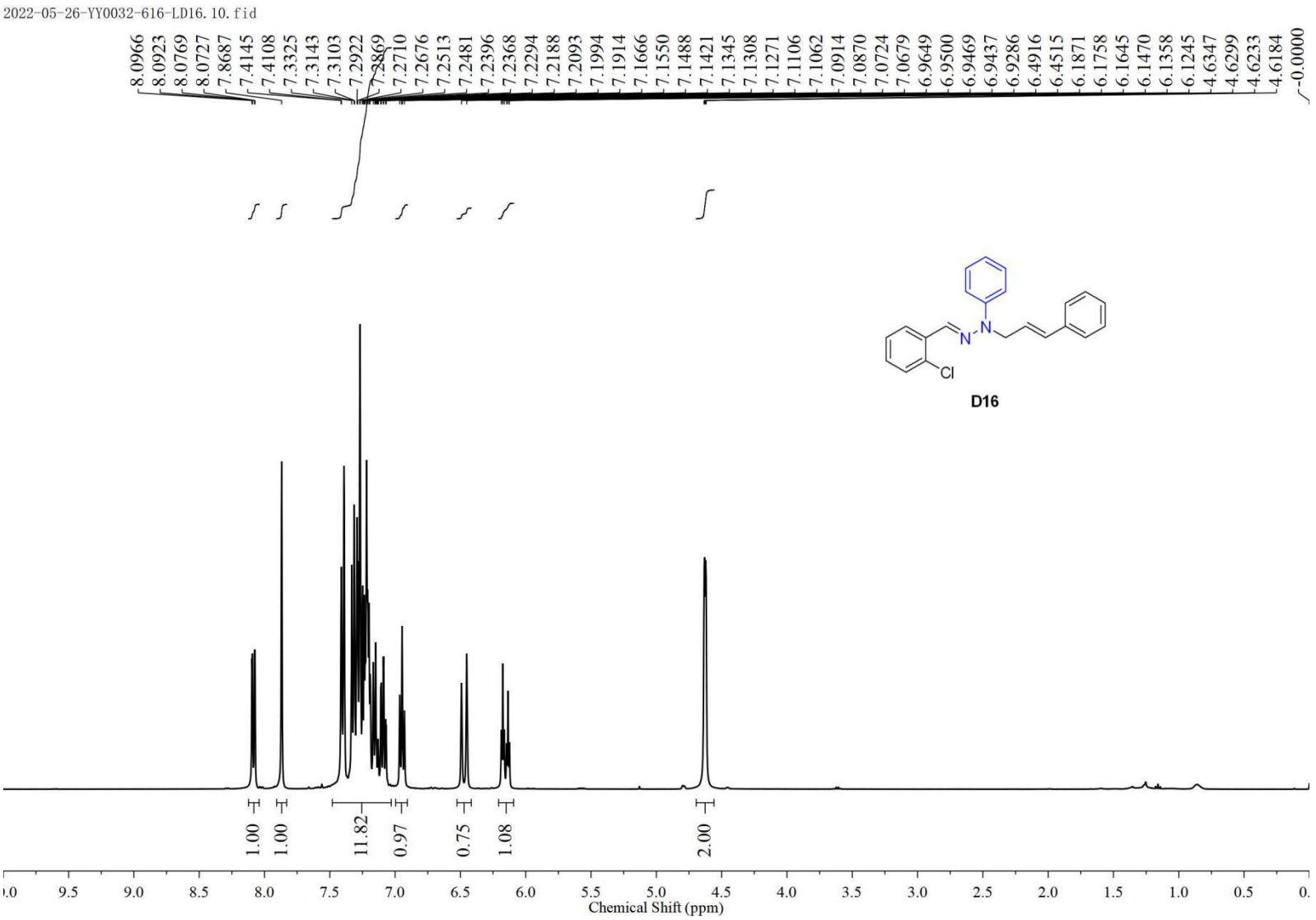


D15

2022-05-23-yy0028-616-ld13.12.fid

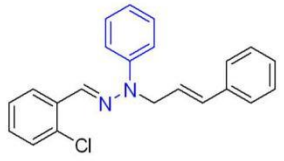


D15

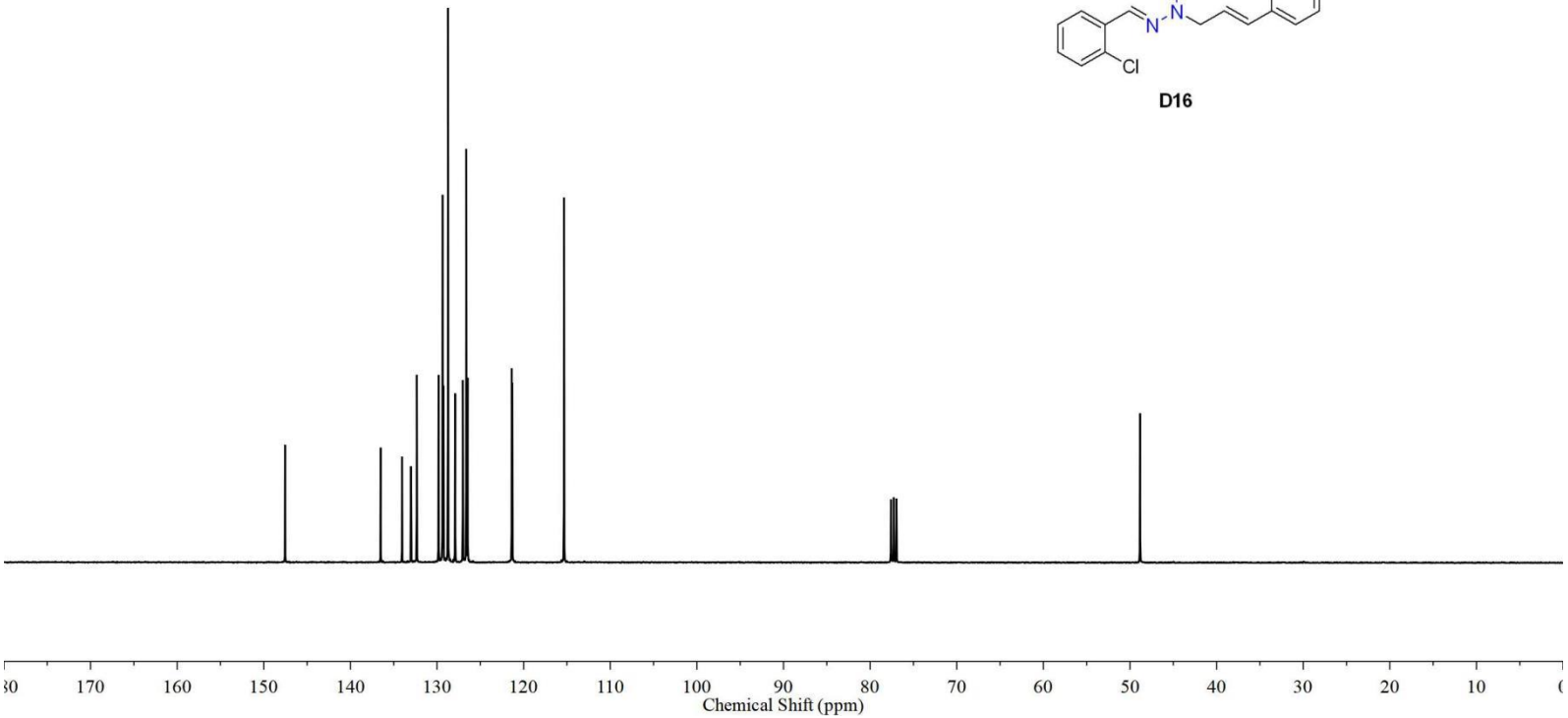

2022-05-26-YY0032-616-LD16.10.fid
8.0966
8.0923
8.0769
8.0727
7.8687
7.4145
7.4108
7.3325
7.3143
7.3103
7.2922
7.2869
7.2710
7.2676
7.2513
7.2481
7.2396
7.2368
7.2294
7.2188
7.2093
7.1994
7.1914
7.1666
7.1550
7.1488
7.1421
7.1345
7.1308
7.1271
7.1106
7.1062
7.0914
7.0870
7.0724
7.0679
6.9649
6.9500
6.9469
6.9437
6.9286
6.4916
6.4515
6.1871
6.1758
6.1645
6.1470
6.1358
6.1245
4.6347
4.6299
4.6233
4.6184
-0.0000
N
N
Cl
D16
1.00
1.00
11.82
0.97
0.75
1.08
2.00
Chemical Shift (ppm)

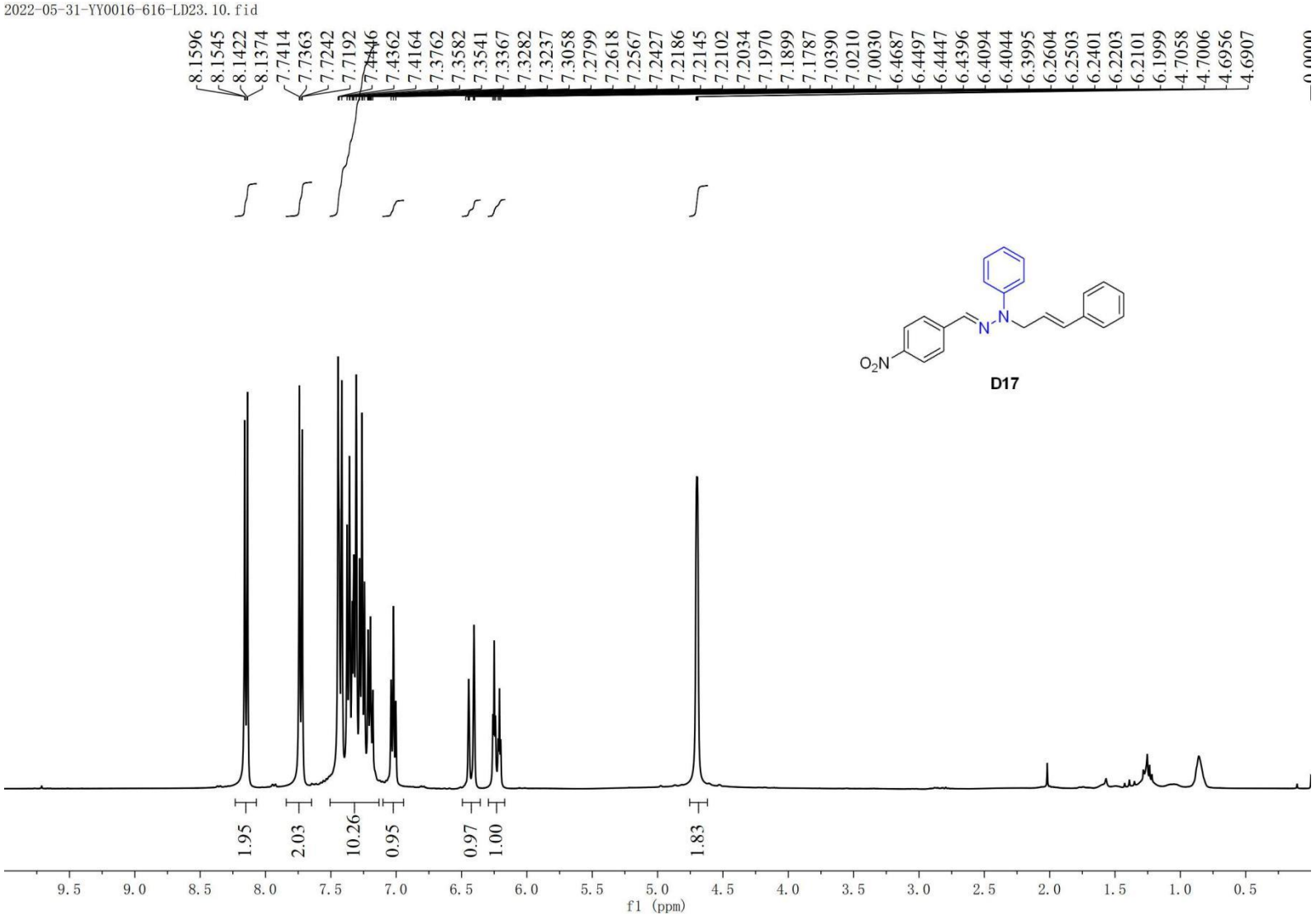
2022-05-26-YY0032-616-LD16.11.fid

147.54
136.51
134.03
133.00
132.34
129.82
129.36
129.26
128.73
127.91
127.02
126.62
126.47
121.37
121.31
115.33
77.59
77.28
76.96
48.84



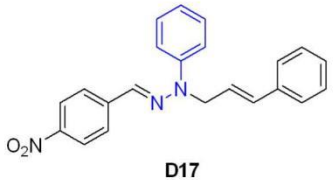
D16



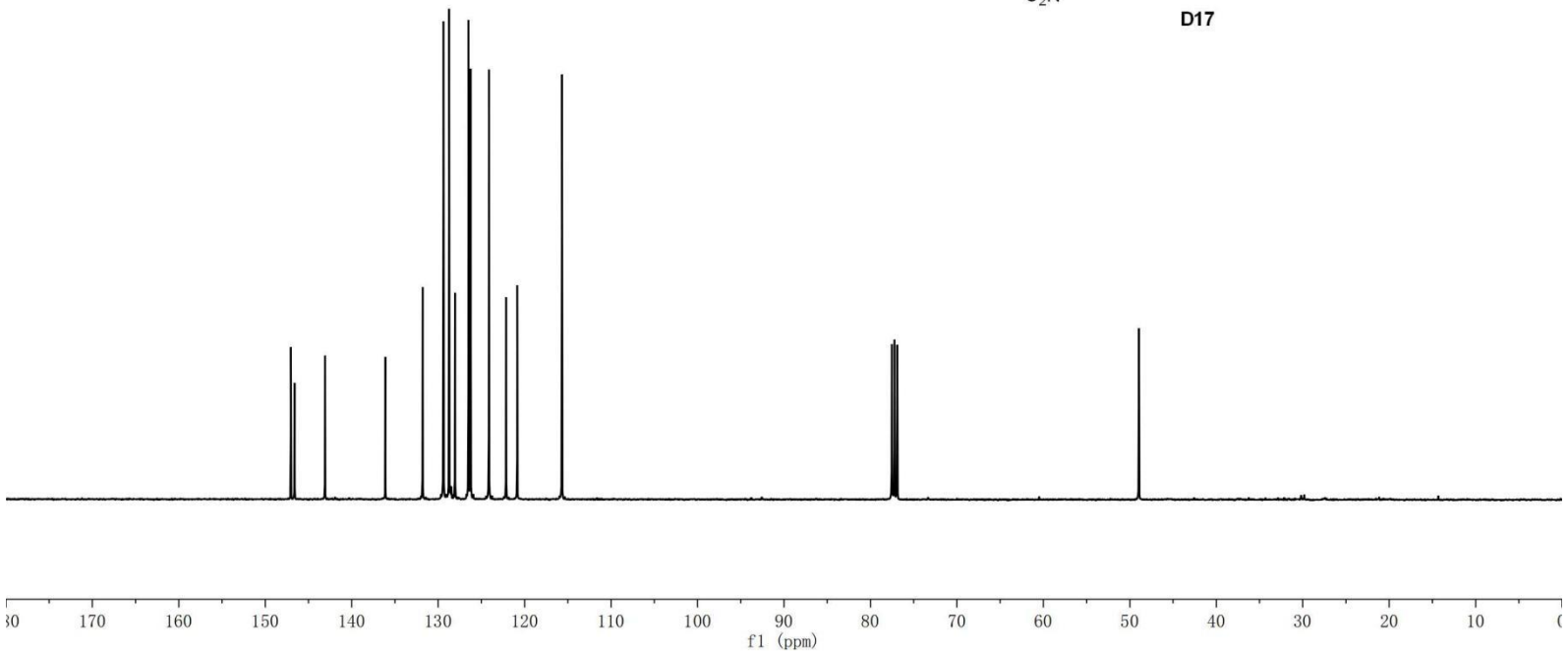

2022-05-31-YY0016-616-LD23.10.fid
8.1596
8.1545
8.1422
8.1374
7.7414
7.7363
7.7242
7.7192
7.4446
7.4362
7.4164
7.3762
7.3582
7.3541
7.3367
7.3282
7.3237
7.3058
7.2799
7.2618
7.2567
7.2427
7.2186
7.2145
7.2102
7.2034
7.1970
7.1899
7.1787
7.0390
7.0210
7.0030
6.4687
6.4497
6.4447
6.4396
6.4094
6.4044
6.3995
6.2604
6.2503
6.2401
6.2203
6.2101
6.1999
4.7058
4.7006
4.6956
4.6907
0.0000
O2N
N
N
D17
1.95
2.03
10.26
0.95
0.97
1.00
1.83
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

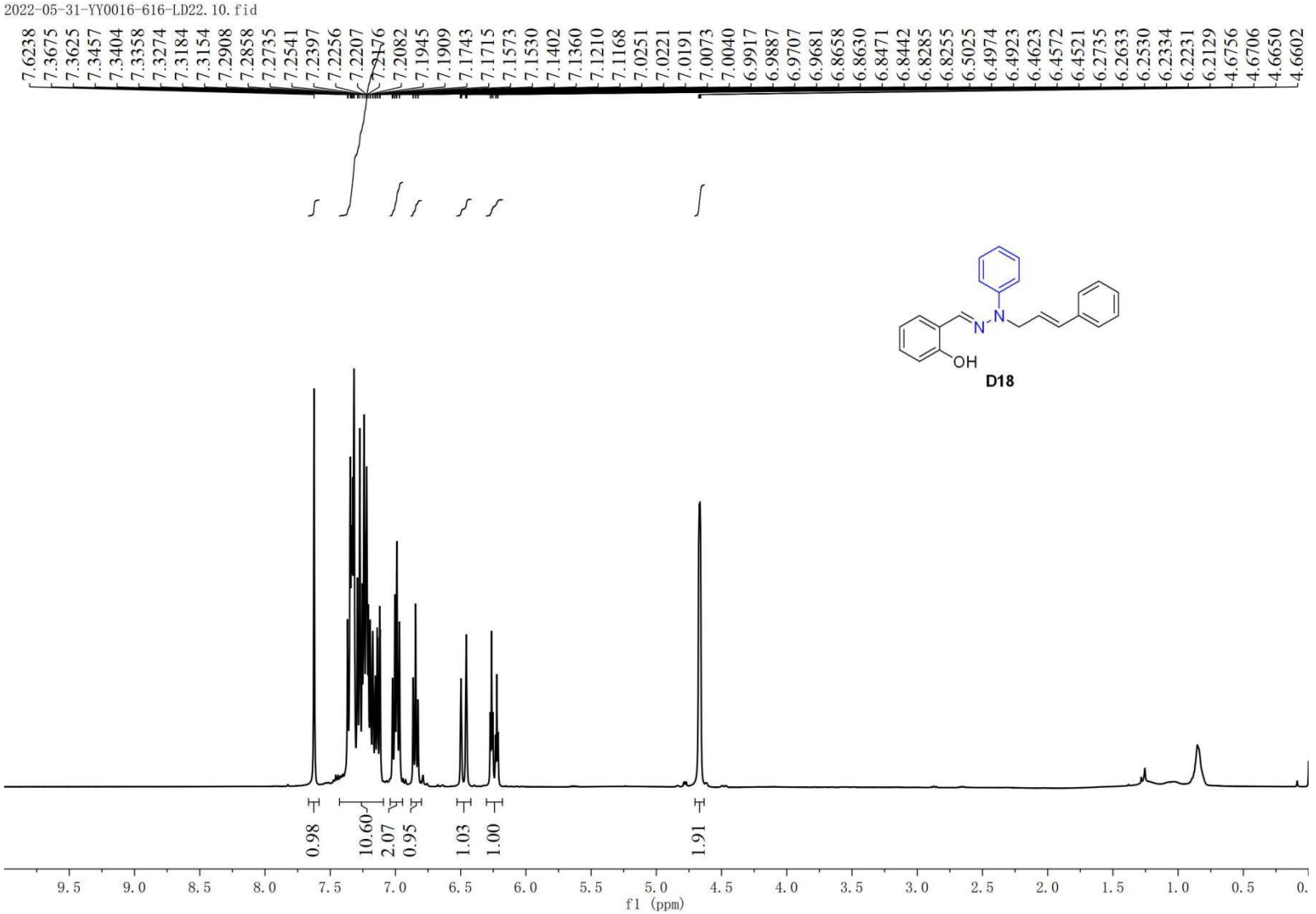
2022-06-01 YY0003 616-1-D23.10.fid

147.04
146.61
143.09
136.11
131.79
129.40
129.38
128.74
128.05
126.49
126.49
126.25
124.12
122.14
120.85
115.68
77.53
77.21
76.90
48.94



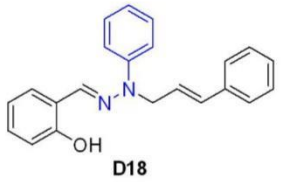
D17



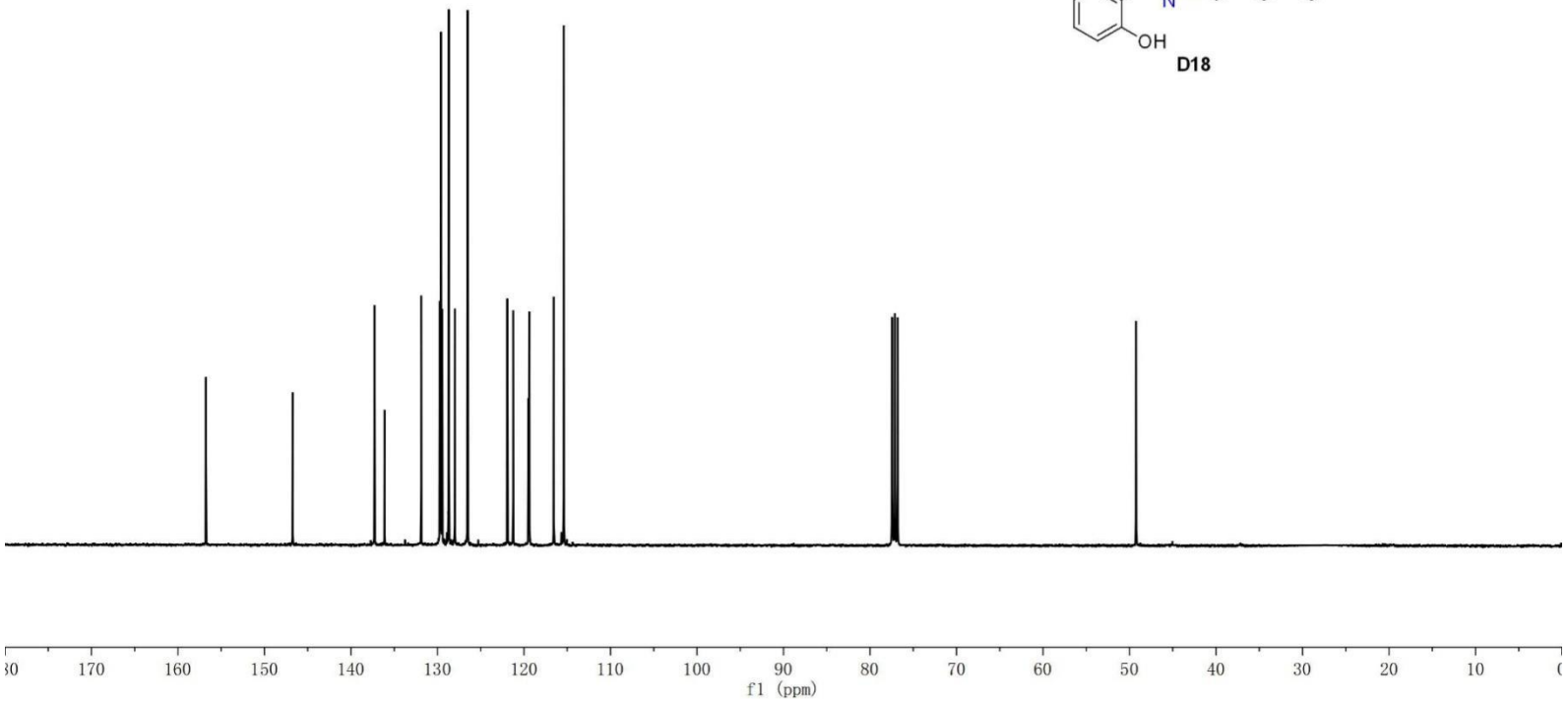

2022-05-31-YY0016-616-LD22.10.fid
7.6238
7.3675
7.3625
7.3457
7.3404
7.3358
7.3274
7.3184
7.3154
7.2908
7.2858
7.2735
7.2541
7.2397
7.2256
7.2207
7.2176
7.2082
7.1945
7.1909
7.1743
7.1715
7.1573
7.1530
7.1402
7.1360
7.1210
7.1168
7.0251
7.0221
7.0191
7.0073
7.0040
6.9917
6.9887
6.9707
6.9681
6.8658
6.8630
6.8471
6.8442
6.8285
6.8255
6.5025
6.4974
6.4923
6.4623
6.4572
6.4521
6.2735
6.2633
6.2530
6.2334
6.2231
6.2129
4.6756
4.6706
4.6650
4.6602
N
N
OH
D18
0.98
10.60
2.07
0.95
1.03
1.00
1.91
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
f1 (ppm)

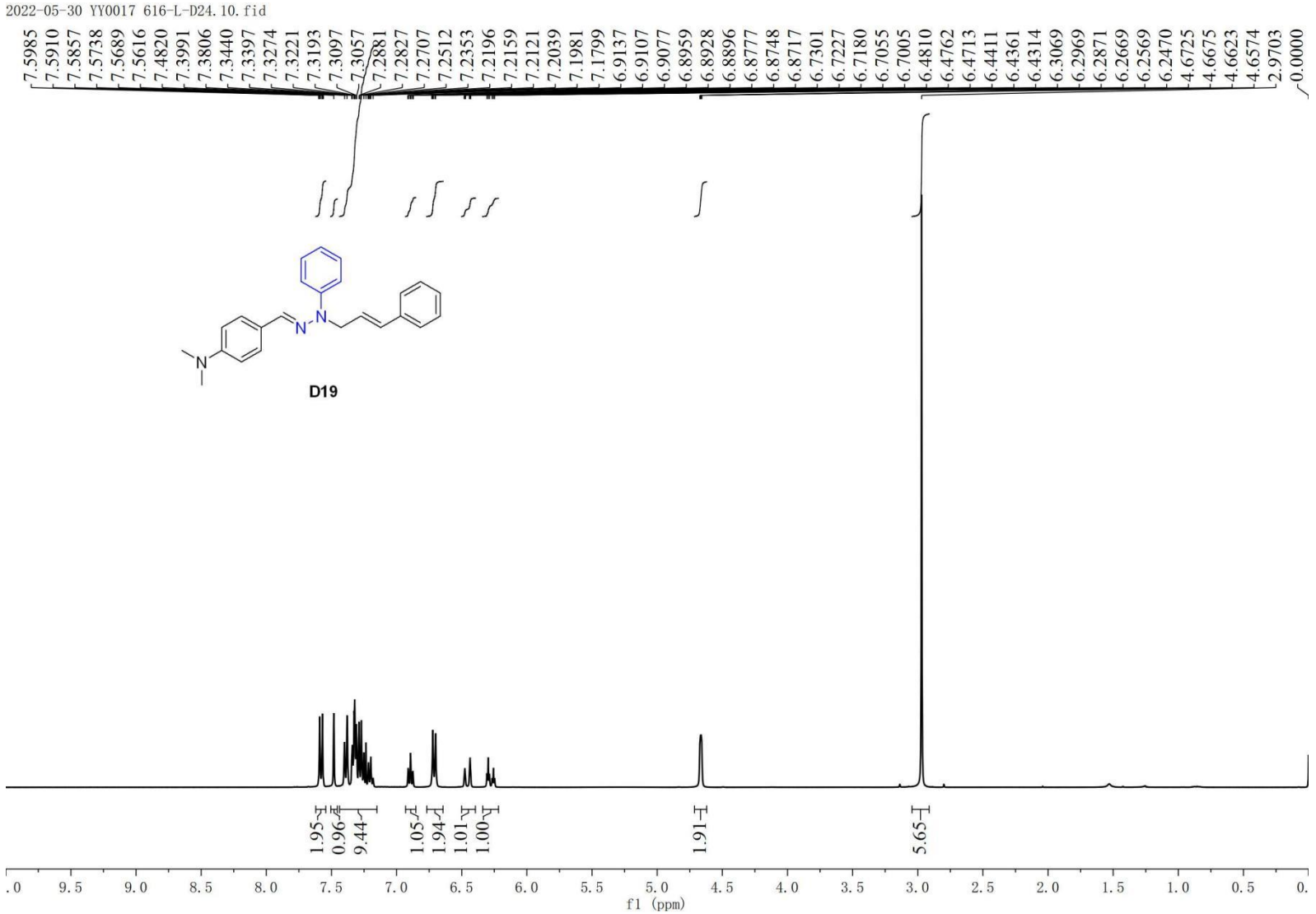
2022-06-01 YY0003 616-1-D22.10.fid

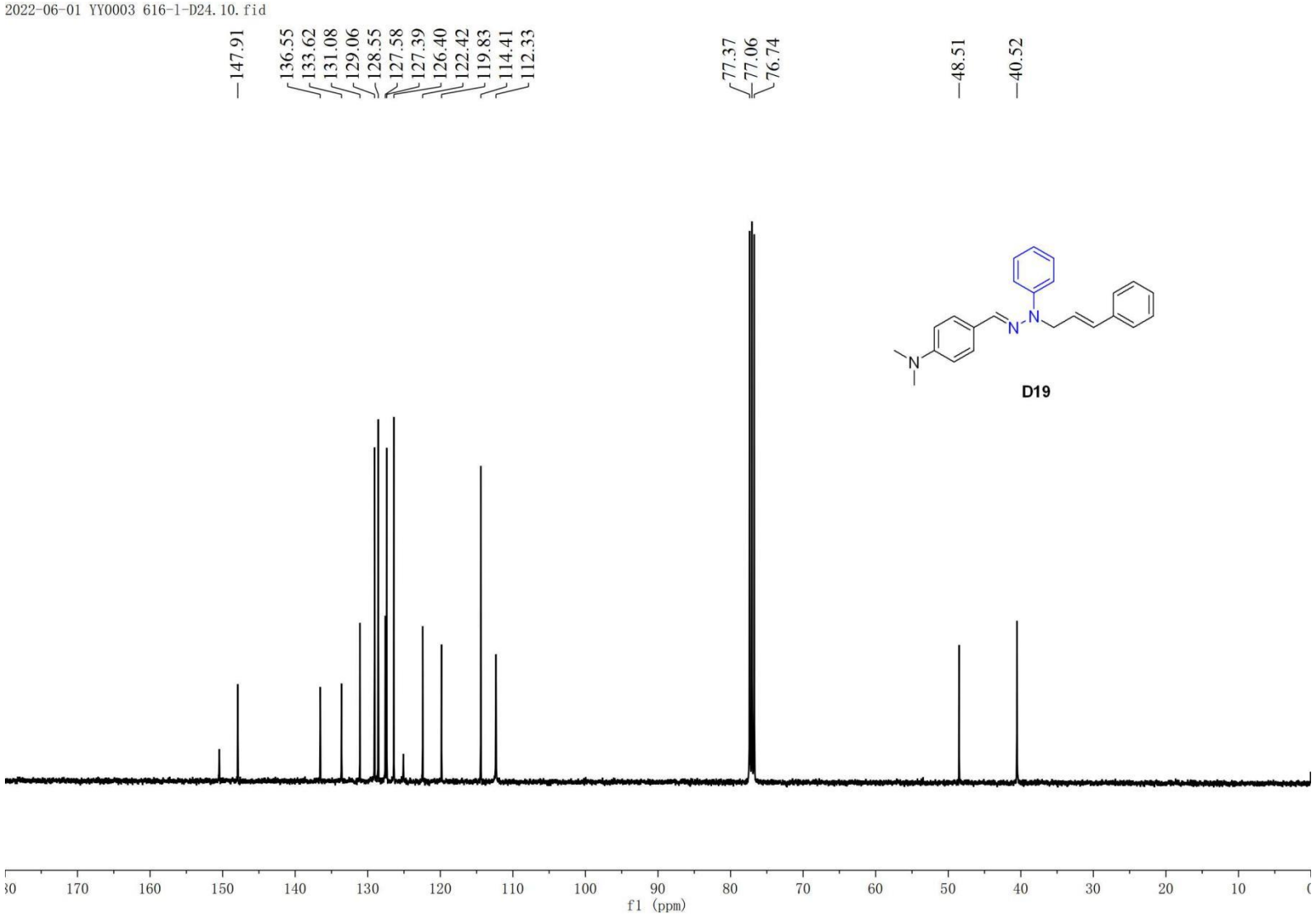
156.77
146.74
137.27
136.11
131.88
129.73
129.60
129.46
128.69
127.99
126.51
121.92
121.24
119.49
119.39
116.56
115.40
77.45
77.13
76.81
49.25

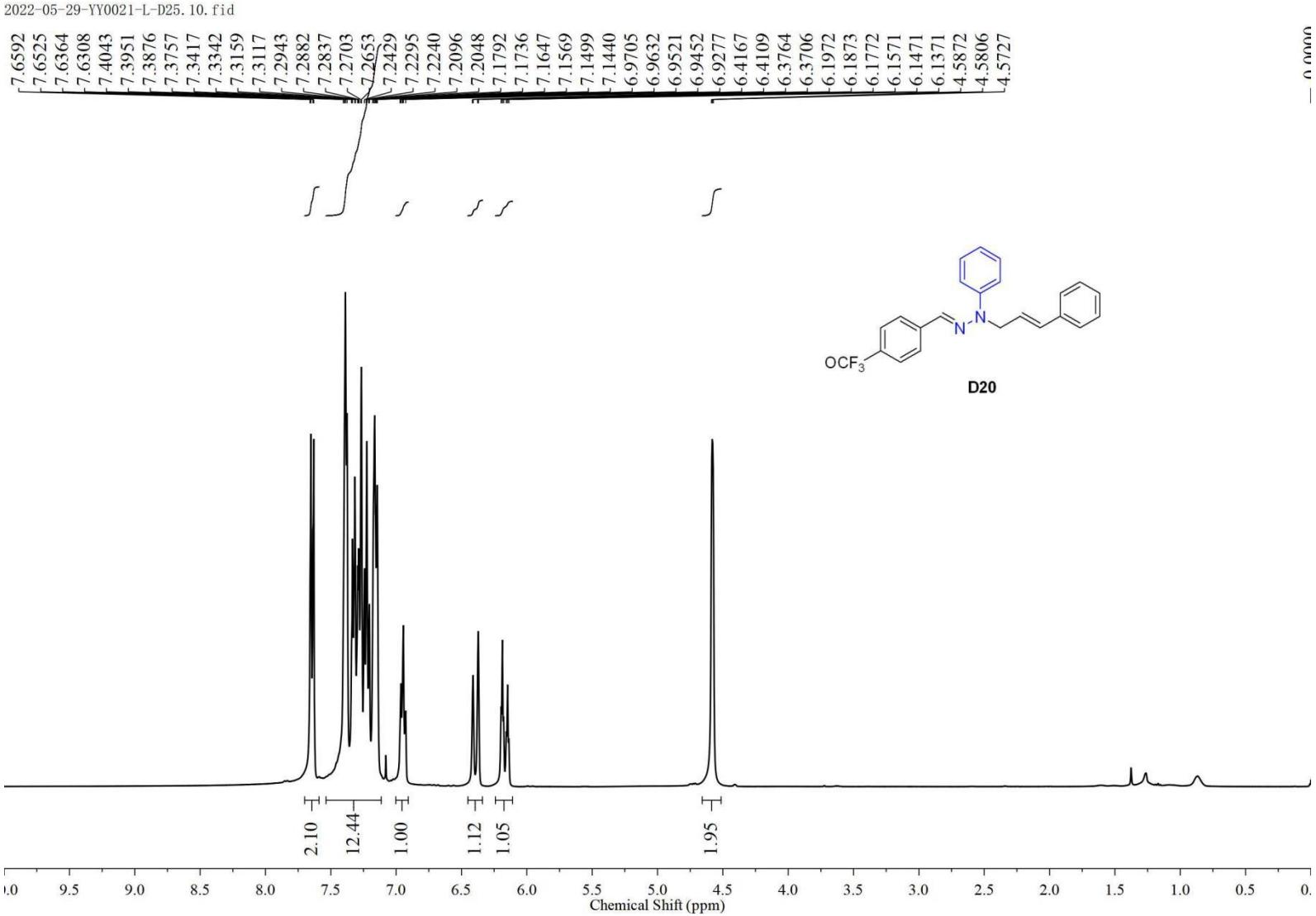


D18



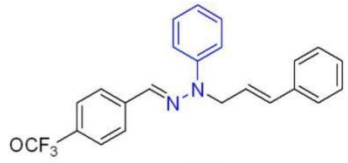

2022-05-30 YY0017 616-L-D24.10.fid
7.5985
7.5910
7.5857
7.5738
7.5689
7.5616
7.4820
7.3991
7.3806
7.3440
7.3397
7.3274
7.3221
7.3193
7.3097
7.3057
7.2881
7.2827
7.2707
7.2512
7.2353
7.2196
7.2159
7.2121
7.2039
7.1981
7.1799
6.9137
6.9107
6.9077
6.8959
6.8928
6.8896
6.8777
6.8748
6.8717
6.7301
6.7227
6.7180
6.7055
6.7005
6.4810
6.4762
6.4713
6.4411
6.4361
6.4314
6.3069
6.2969
6.2871
6.2669
6.2569
6.2470
4.6725
4.6675
4.6623
4.6574
2.9703
0.0000
N
N
N
D19
1.95
0.96
9.44
1.05
1.94
1.01
1.00
1.91
5.65
f1 (ppm)


2022-06-01 YY0003 616-1-D24.10.fid
147.91
136.55
133.62
131.08
129.06
128.55
127.58
127.39
126.40
122.42
119.83
114.41
112.33
77.37
77.06
76.74
48.51
40.52
D19
f1 (ppm)


2022-05-29-YY0021-L-D25.10.fid
7.6592
7.6525
7.6364
7.6308
7.4043
7.3951
7.3876
7.3757
7.3417
7.3342
7.3159
7.3117
7.2943
7.2882
7.2837
7.2703
7.2653
7.2429
7.2295
7.2240
7.2096
7.2048
7.1792
7.1736
7.1647
7.1569
7.1499
7.1440
6.9705
6.9632
6.9521
6.9452
6.9277
6.4167
6.4109
6.3764
6.3706
6.1972
6.1873
6.1772
6.1571
6.1471
6.1371
4.5872
4.5806
4.5727
OCF3
N
N
D20
2.10
12.44
1.00
1.12
1.05
1.95
Chemical Shift (ppm)

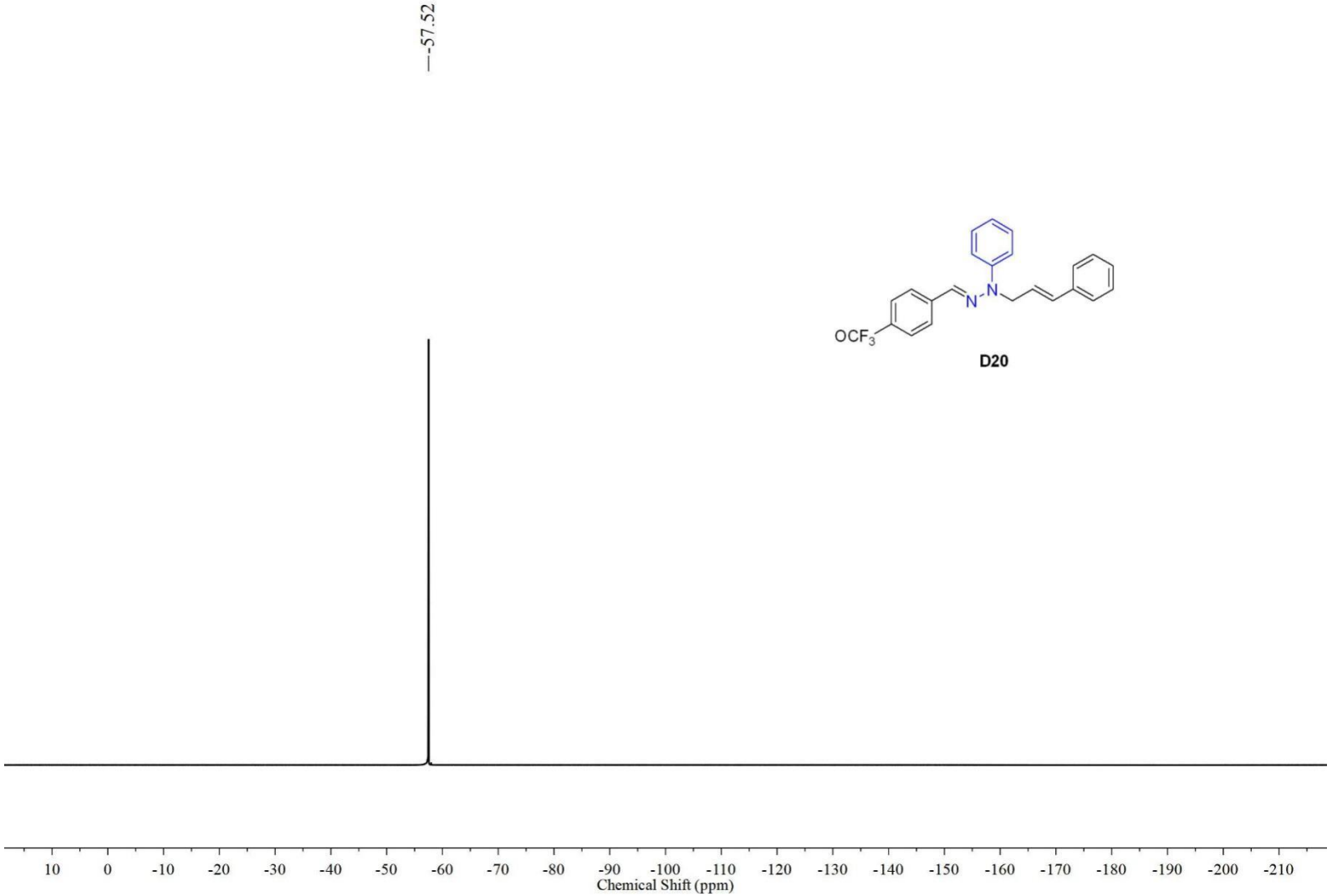
2022-05-29-YY0021-L-D25.11.fid

148.75
148.74
147.55
136.38
135.60
131.53
130.75
129.36
128.76
127.96
127.44
126.54
121.54
121.27
121.21
115.16
77.55
77.23
76.91
48.61

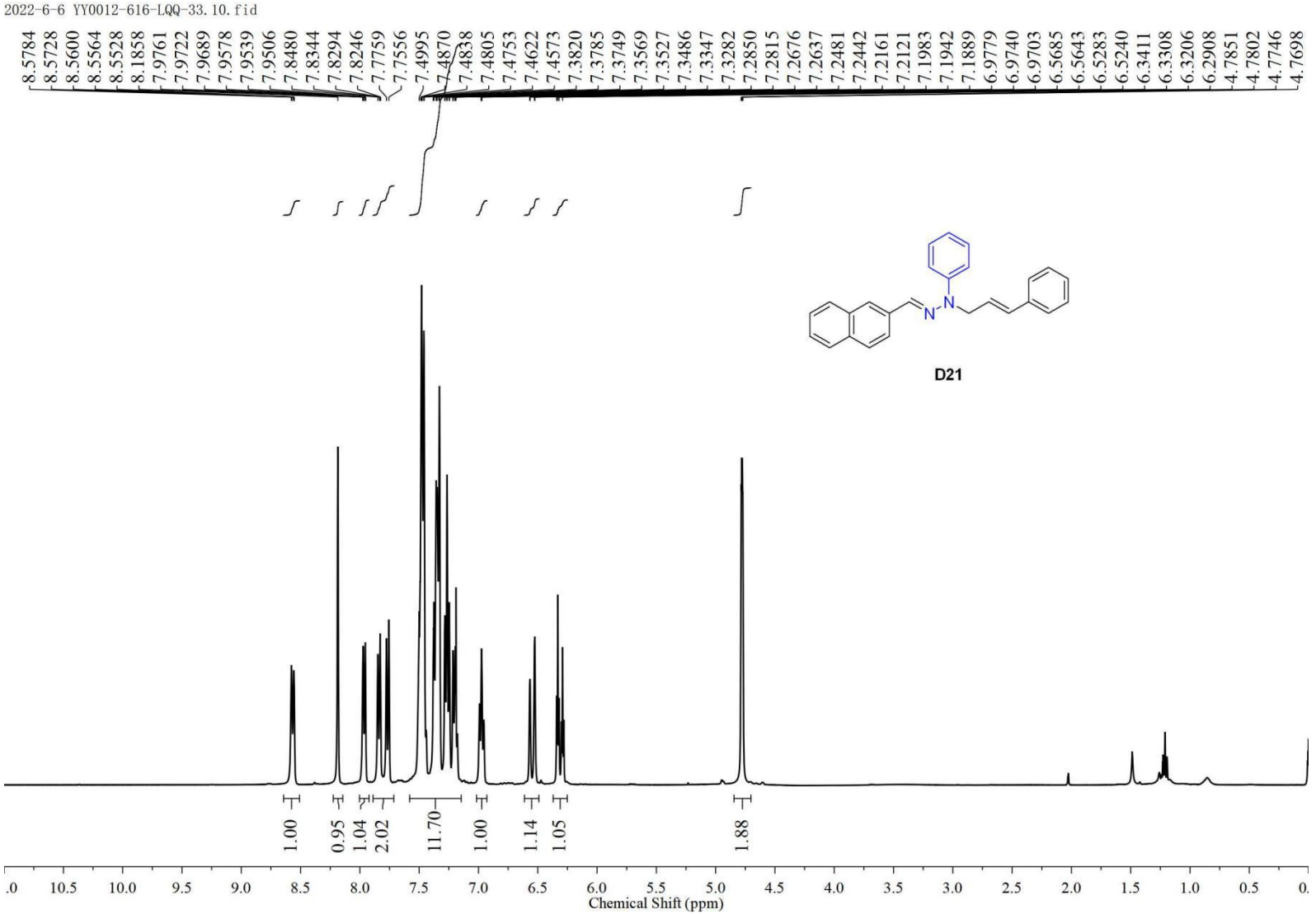


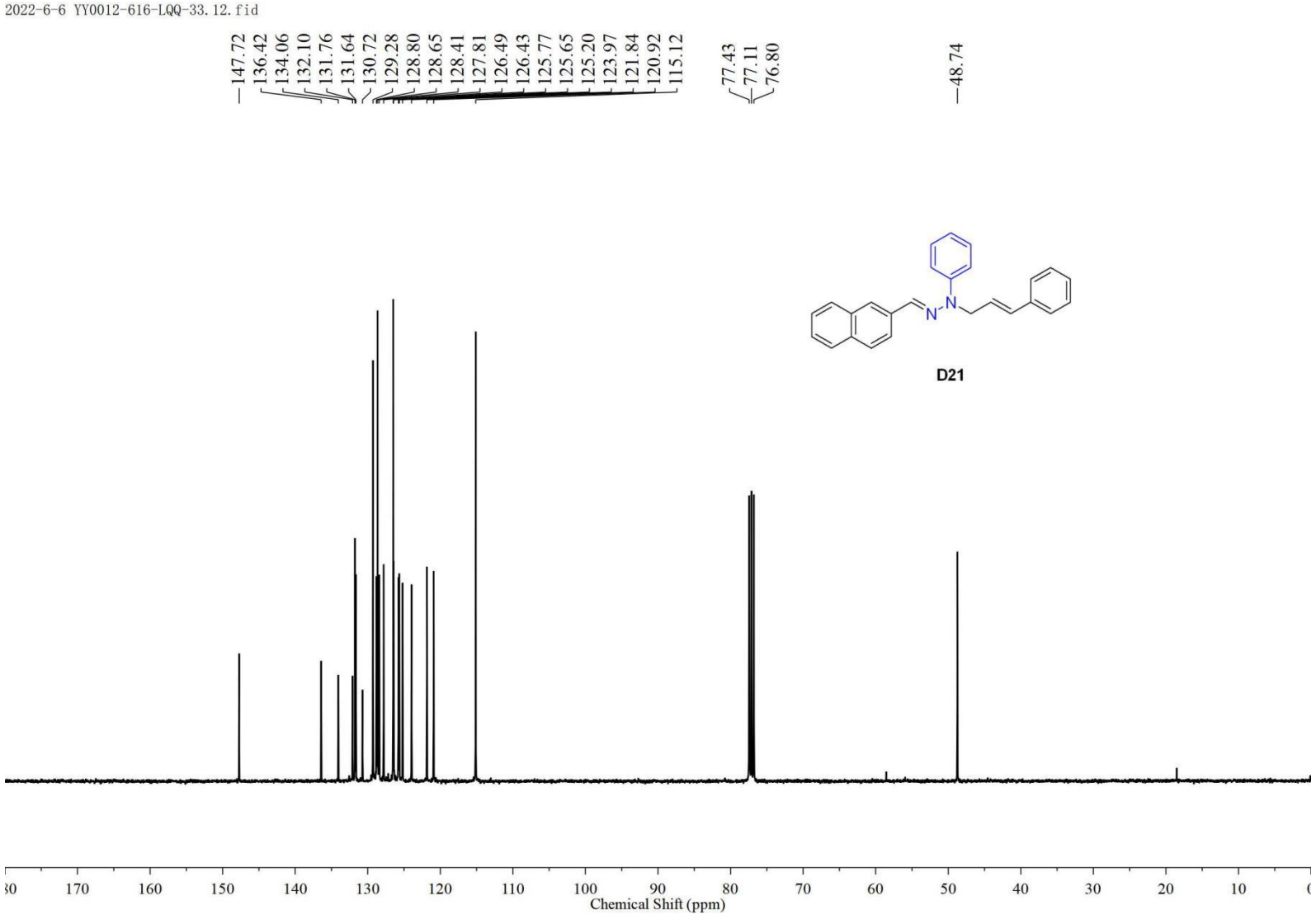
D20

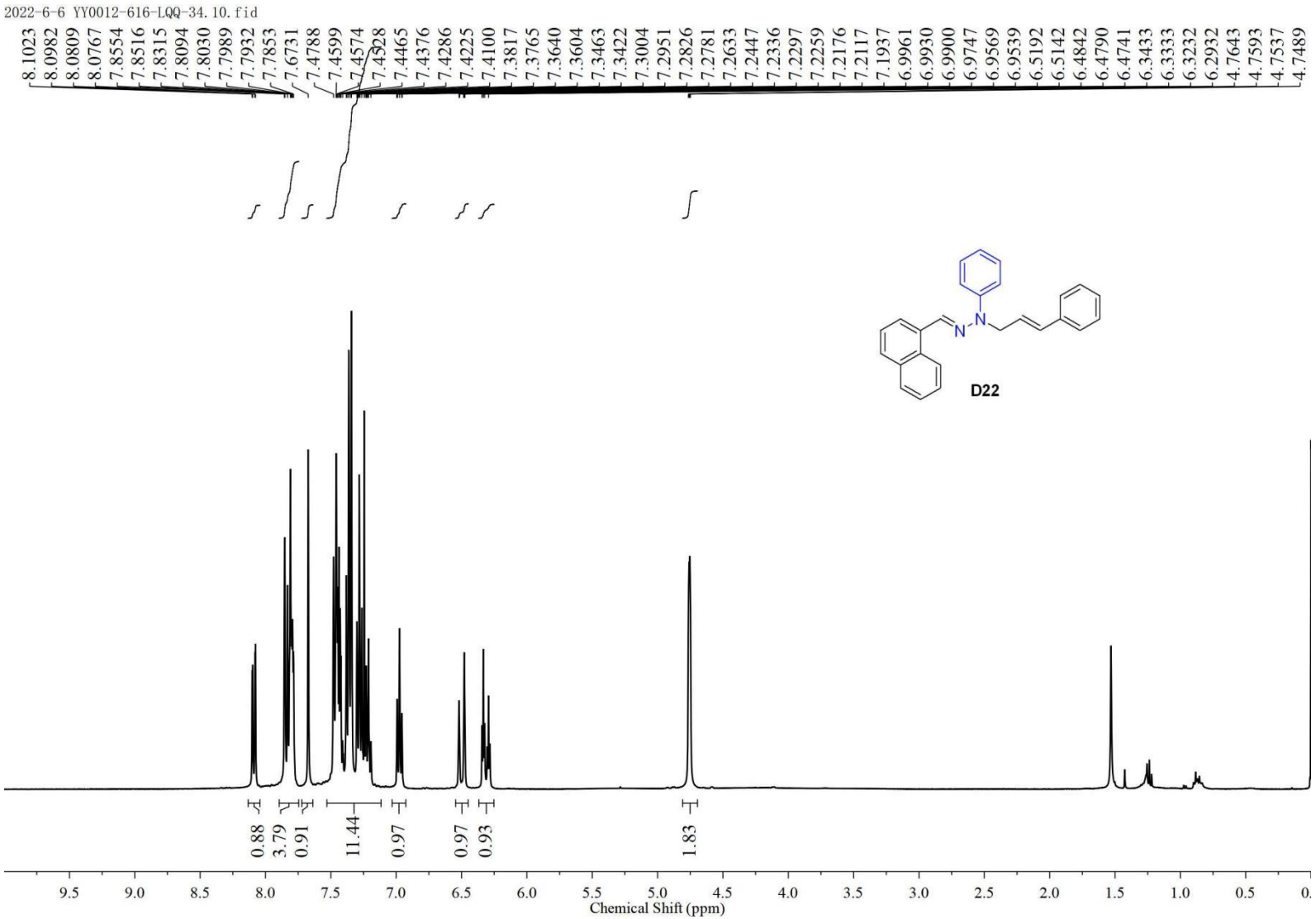
2022-05-31-YY0017-616-LD25.10.fid

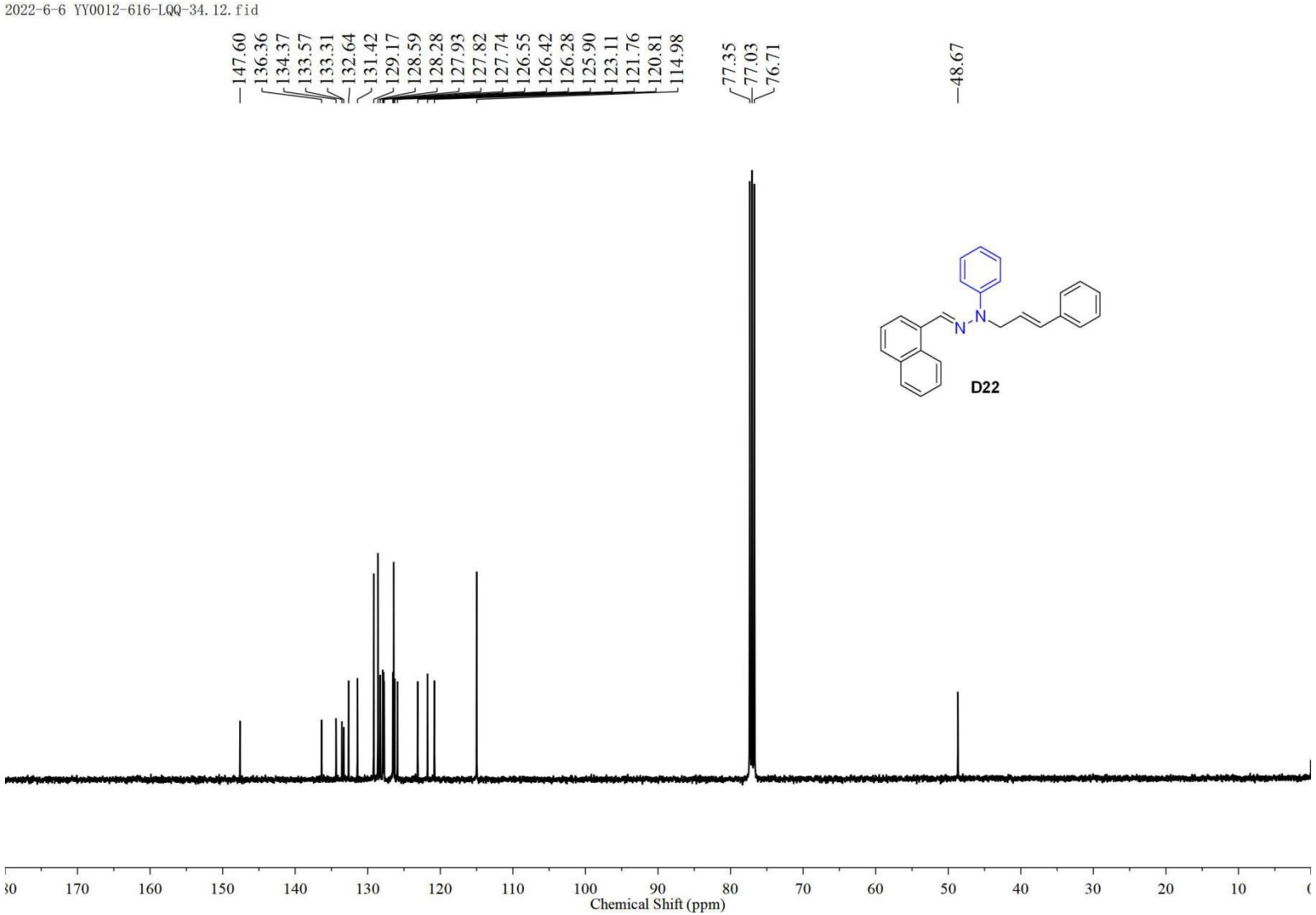


D20

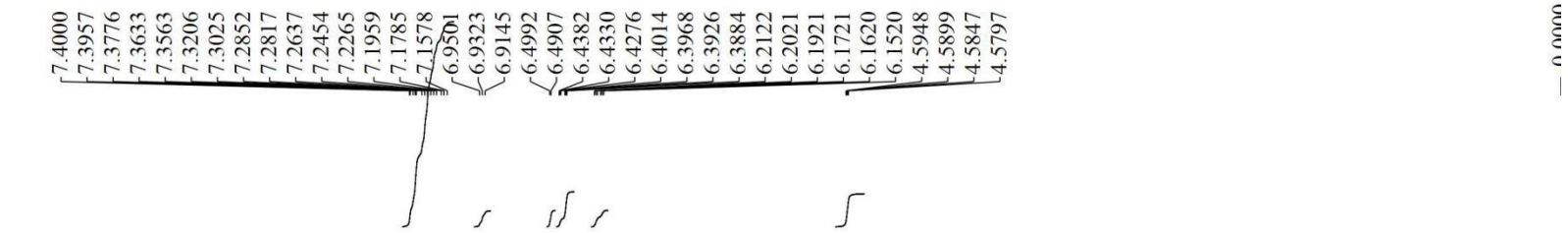

2022-6-6 YY0012-616-LQQ-33.10.fid
8.5784
8.5728
8.5600
8.5564
8.5528
8.1858
7.9761
7.9722
7.9689
7.9578
7.9539
7.9506
7.8480
7.8344
7.8294
7.8246
7.7759
7.7556
7.4995
7.4870
7.4838
7.4805
7.4753
7.4622
7.4573
7.3820
7.3785
7.3749
7.3569
7.3527
7.3486
7.3347
7.3282
7.2850
7.2815
7.2676
7.2637
7.2481
7.2442
7.2161
7.2121
7.1983
7.1942
7.1889
6.9779
6.9740
6.9703
6.5685
6.5643
6.5283
6.5240
6.3411
6.3308
6.3206
6.2908
4.7851
4.7802
4.7746
4.7698
N
N
D21
1.00
0.95
1.04
2.02
11.70
1.00
1.14
1.05
1.88
.0
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

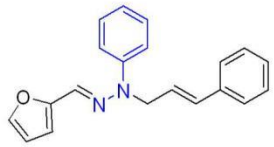

2022-6-6 YY0012-616-LQQ-33.12.fid
147.72
136.42
134.06
132.10
131.76
131.64
130.72
129.28
128.80
128.65
128.41
127.81
126.49
126.43
125.77
125.65
125.20
123.97
121.84
120.92
115.12
77.43
77.11
76.80
48.74
N
N
D21
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-6-6 YY0012-616-LQQ-34.10.fid
8.1023
8.0982
8.0809
8.0767
7.8554
7.8516
7.8315
7.8094
7.8030
7.7989
7.7932
7.7853
7.6731
7.4788
7.4599
7.4574
7.4528
7.4465
7.4376
7.4286
7.4225
7.4100
7.3817
7.3765
7.3640
7.3604
7.3463
7.3422
7.3004
7.2951
7.2826
7.2781
7.2633
7.2447
7.2336
7.2297
7.2259
7.2176
7.2117
7.1937
6.9961
6.9930
6.9900
6.9747
6.9569
6.9539
6.5192
6.5142
6.4842
6.4790
6.4741
6.3433
6.3333
6.3232
6.2932
4.7643
4.7593
4.7537
4.7489
D22
0.88
3.79
0.91
11.44
0.97
0.97
0.93
1.83
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

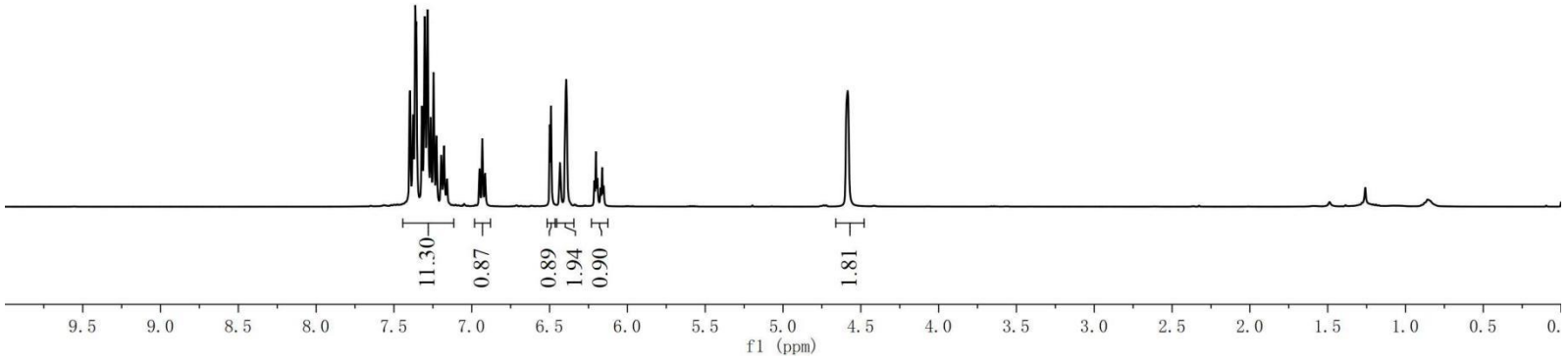

2022-6-6 YY0012-616-LQQ-34.12.fid
147.60
136.36
134.37
133.57
133.31
132.64
131.42
129.17
128.59
128.28
127.93
127.82
127.74
126.55
126.42
126.28
125.90
123.11
121.76
120.81
114.98
77.35
77.03
76.71
48.67
D22
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

2022-6-9 yy0012-616-1-37.10.fid



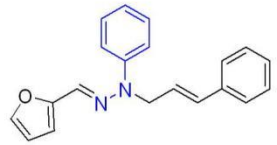


D23

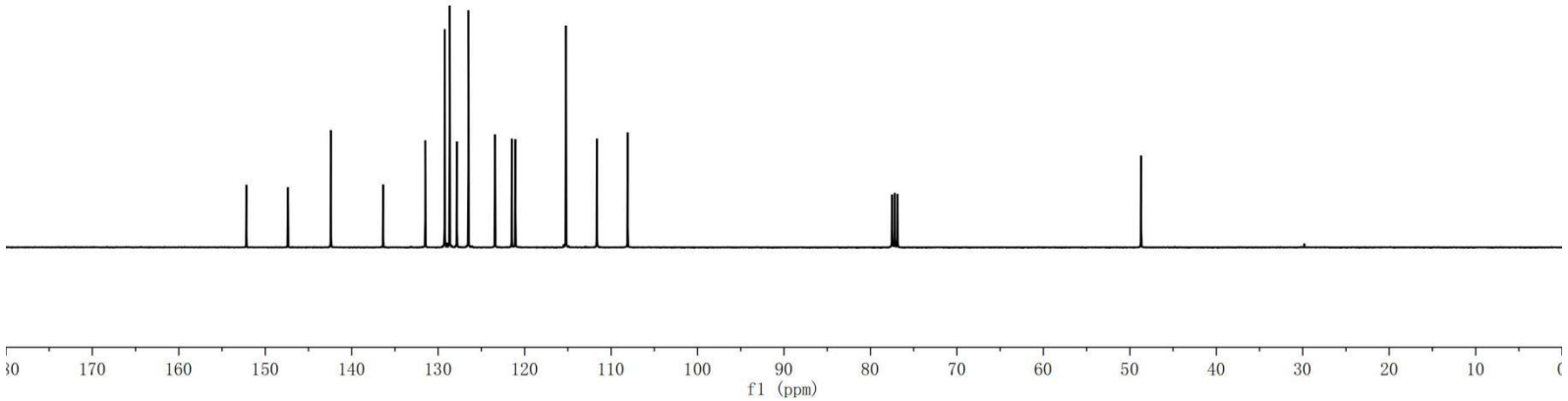


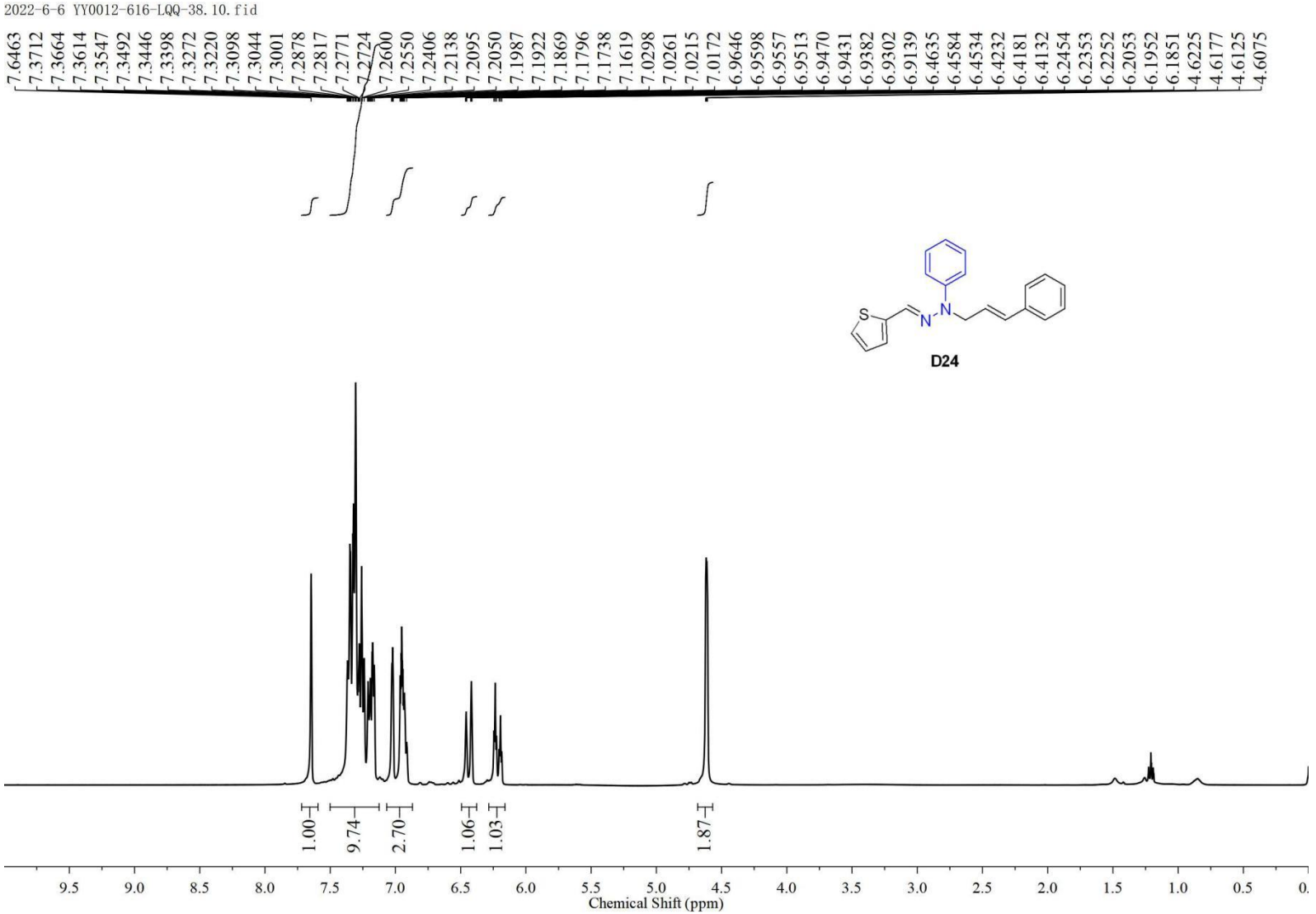
2022-6-11 yy0042-616-lqq-d37.10.fid

152.18
147.38
142.41
136.37
131.48
129.24
128.67
127.84
126.50
123.42
121.48
121.07
115.22
111.64
108.08
77.51
77.19
76.87
48.70



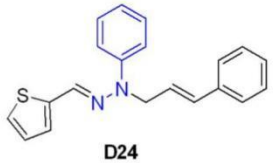
D23



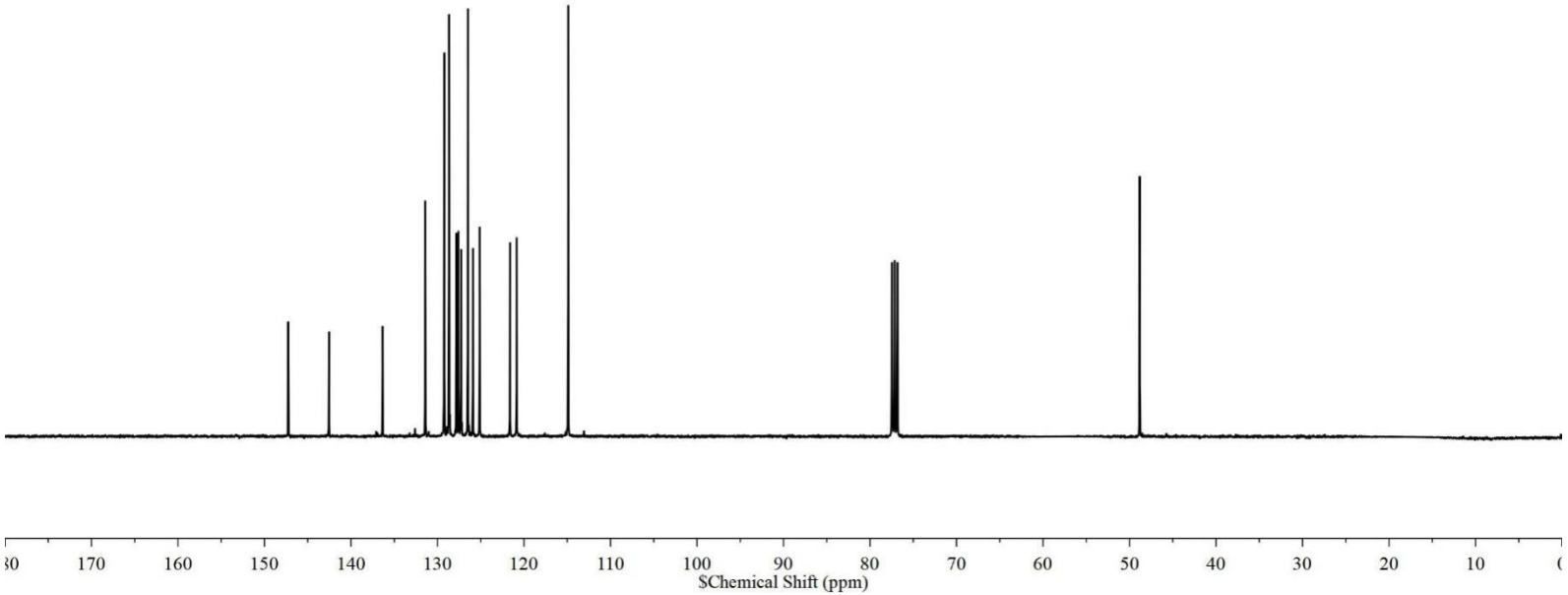

2022-6-6 YY0012-616-LQQ-38.10.fid
7.6463
7.3712
7.3664
7.3614
7.3547
7.3492
7.3446
7.3398
7.3272
7.3220
7.3098
7.3044
7.3001
7.2878
7.2817
7.2771
7.2724
7.2600
7.2550
7.2406
7.2138
7.2095
7.2050
7.1987
7.1922
7.1869
7.1796
7.1738
7.1619
7.0298
7.0261
7.0215
7.0172
6.9646
6.9598
6.9557
6.9513
6.9470
6.9431
6.9382
6.9302
6.9139
6.4635
6.4584
6.4534
6.4232
6.4181
6.4132
6.2454
6.2353
6.2252
6.2053
6.1952
6.1851
4.6225
4.6177
4.6125
4.6075
S
N
N
D24
1.00
9.74
2.70
1.06
1.03
1.87
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

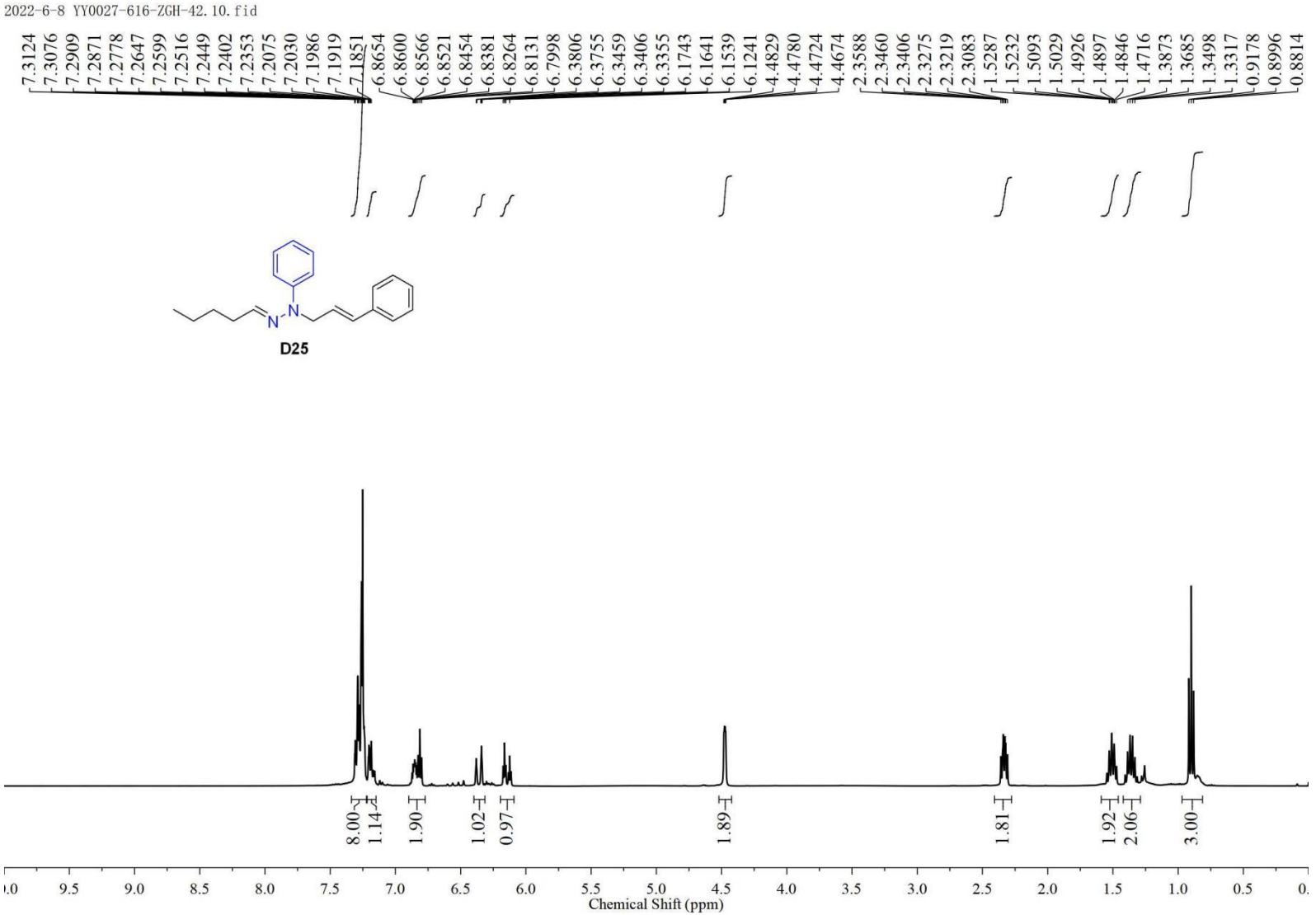
2022-6-6 YY0012-616-LQQ-38.12.fid

147.25
142.54
136.35
131.41
129.22
128.66
127.83
127.59
127.27
126.49
125.90
125.12
121.62
120.85
114.88
77.46
77.14
76.83
48.83



D24

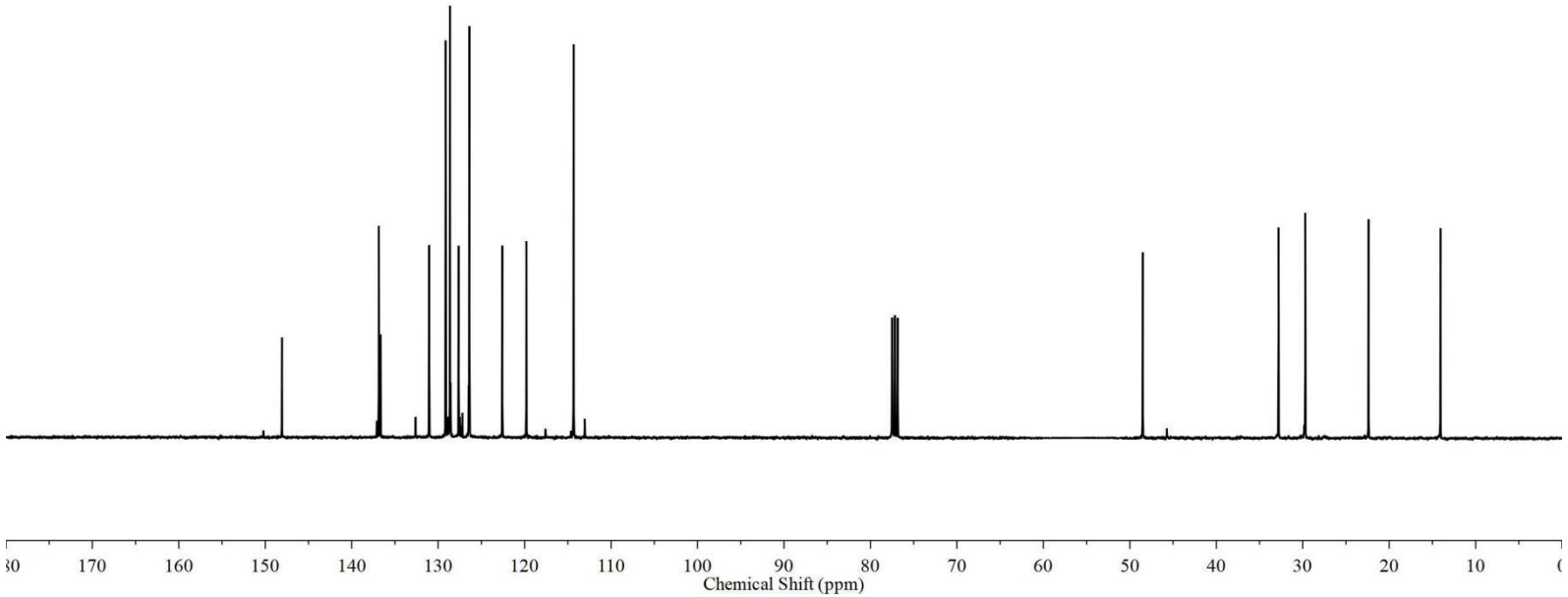


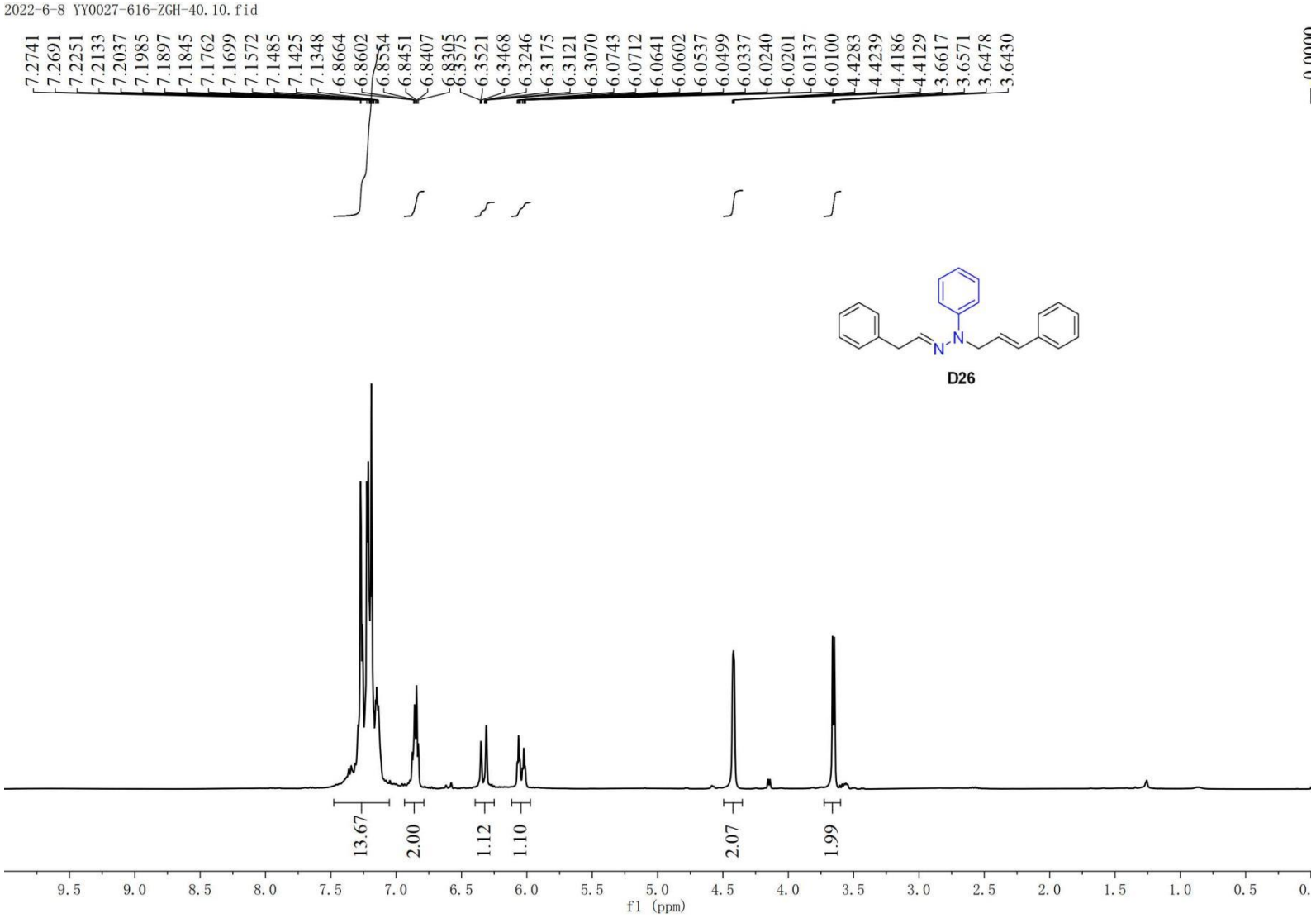

2022-6-8 YY0027-616-ZGH-42.10.fid
7.3124
7.3076
7.2909
7.2871
7.2778
7.2647
7.2599
7.2516
7.2449
7.2402
7.2353
7.2075
7.2030
7.1986
7.1919
7.1851
6.8654
6.8600
6.8566
6.8521
6.8454
6.8381
6.8264
6.8131
6.7998
6.3806
6.3755
6.3459
6.3406
6.3355
6.1743
6.1641
6.1539
6.1241
4.4829
4.4780
4.4724
4.4674
2.3588
2.3460
2.3406
2.3275
2.3219
2.3083
1.5287
1.5232
1.5093
1.5029
1.4926
1.4897
1.4846
1.4716
1.3873
1.3685
1.3498
1.3317
0.9178
0.8996
0.8814
D25
8.00
1.14
1.90
1.02
0.97
1.89
1.81
1.92
2.06
3.00
Chemical Shift (ppm)

2022-6-9 yy0011-616-1-42.10.fid

148.07
136.86
136.66
131.05
129.13
128.64
128.57
127.64
126.48
126.39
122.59
119.79
114.33
77.49
77.17
76.85
48.51
32.79
29.70
22.39
14.07

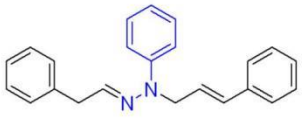
D25



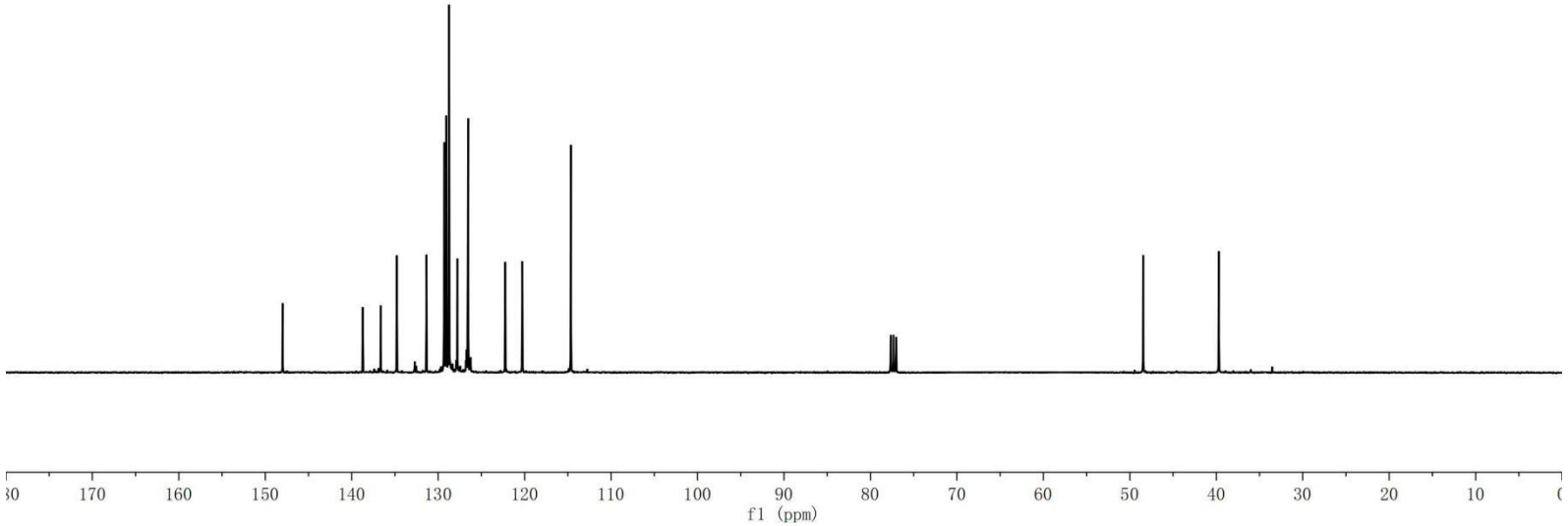

2022-6-8 YY0027-616-ZGH-40.10.fid
7.2741
7.2691
7.2251
7.2133
7.2037
7.1985
7.1897
7.1845
7.1762
7.1699
7.1572
7.1485
7.1425
7.1348
6.8664
6.8602
6.8534
6.8451
6.8407
6.8305
6.3575
6.3521
6.3468
6.3246
6.3175
6.3121
6.3070
6.0743
6.0712
6.0641
6.0602
6.0537
6.0499
6.0337
6.0240
6.0201
6.0137
6.0100
4.4283
4.4239
4.4186
4.4129
3.6617
3.6571
3.6478
3.6430
D26
13.67
2.00
1.12
1.10
2.07
1.99
f1 (ppm)

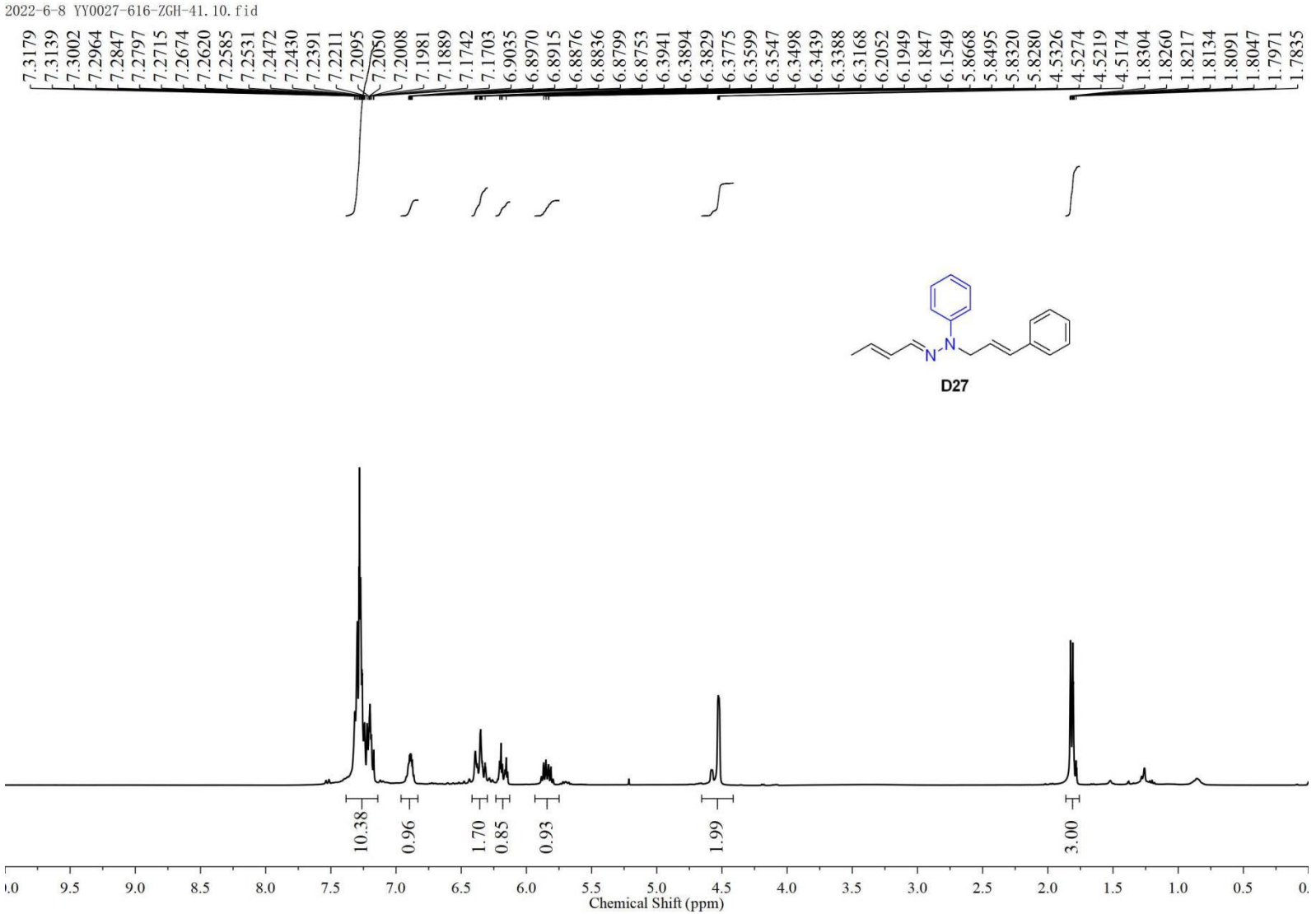
2022-6-9 yy0011-616-1-40.10.fid

147.99
138.72
136.65
134.78
131.36
129.34
129.30
129.11
129.06
128.78
128.74
128.71
127.78
126.57
126.53
122.25
120.27
114.65
77.65
77.34
77.02
48.45
39.71



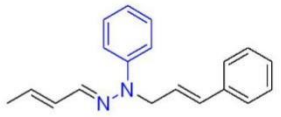
D26



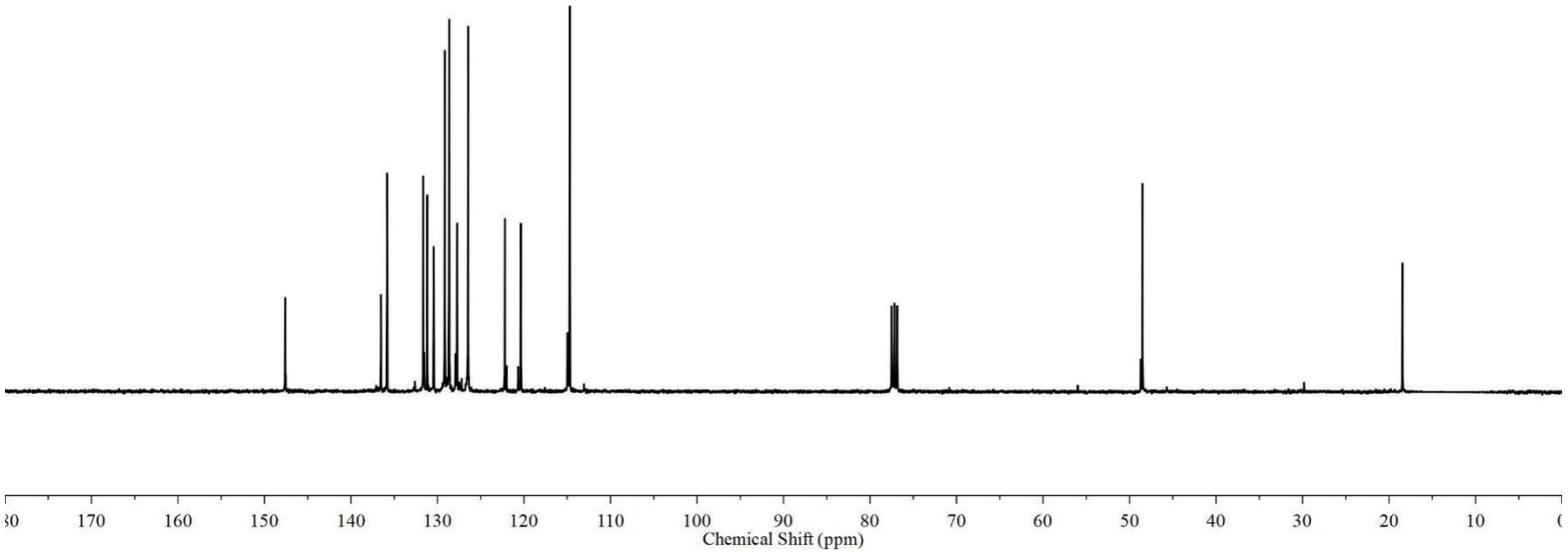

2022-6-8 YY0027-616-ZGH-41.10.fid
7.3179
7.3139
7.3002
7.2964
7.2847
7.2797
7.2715
7.2674
7.2620
7.2585
7.2531
7.2472
7.2430
7.2391
7.2211
7.2095
7.2050
7.2008
7.1981
7.1889
7.1742
7.1703
6.9035
6.8970
6.8915
6.8876
6.8836
6.8799
6.8753
6.3941
6.3894
6.3829
6.3775
6.3599
6.3547
6.3498
6.3439
6.3388
6.3168
6.2052
6.1949
6.1847
6.1549
5.8668
5.8495
5.8320
5.8280
4.5326
4.5274
4.5219
4.5174
1.8304
1.8260
1.8217
1.8134
1.8091
1.8047
1.7971
1.7835
D27
10.38
0.96
1.70
0.85
0.93
1.99
3.00
Chemical Shift (ppm)

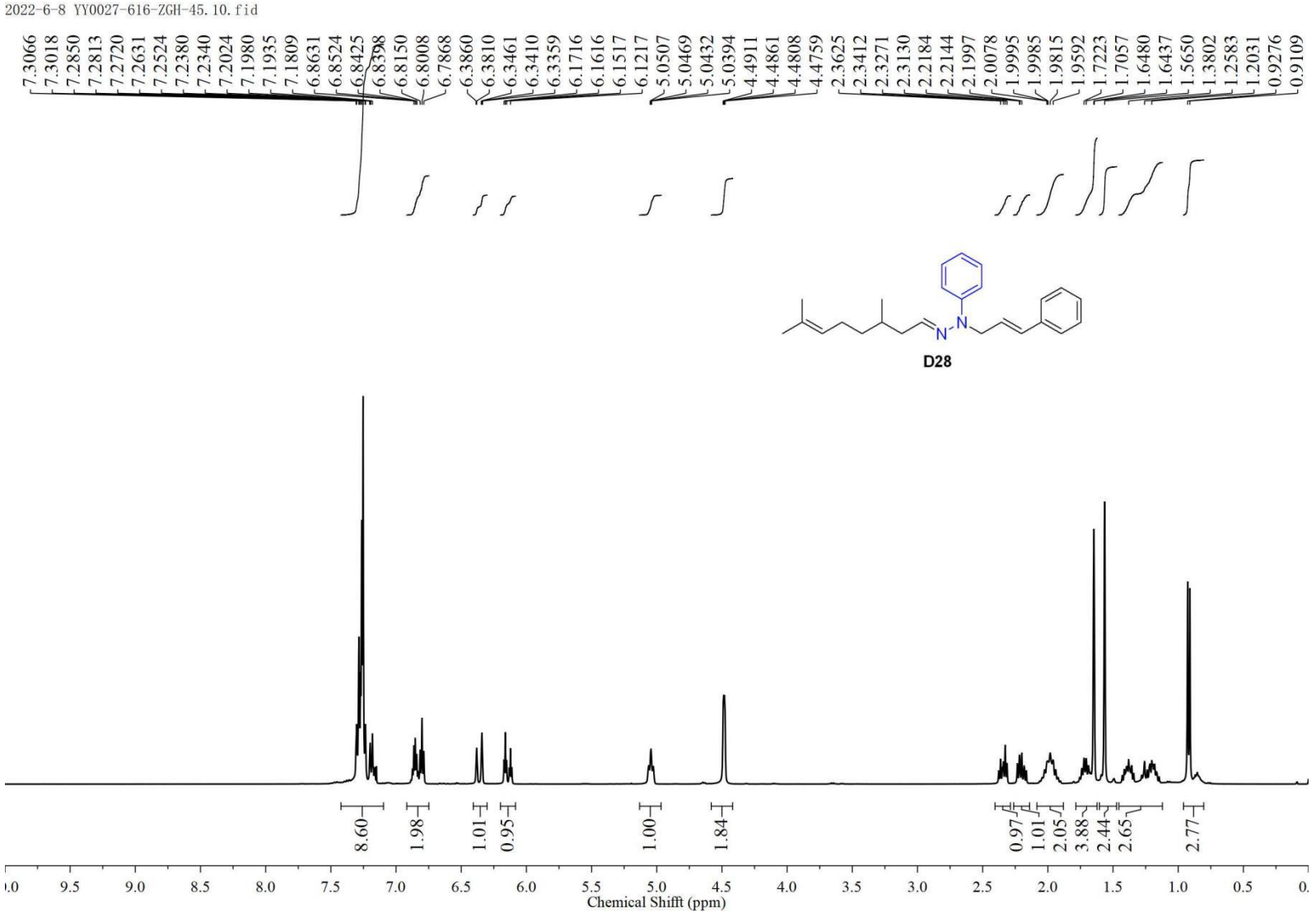
2022-6-9 yy0011-616-1-41.10.fid

147.61
136.54
135.82
131.65
131.19
130.44
130.43
129.15
128.65
127.77
127.73
126.49
126.46
122.21
120.36
114.96
114.71
77.50
77.18
76.86
48.51
18.46



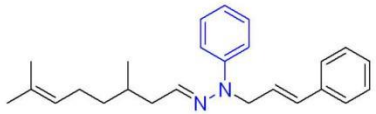
D27



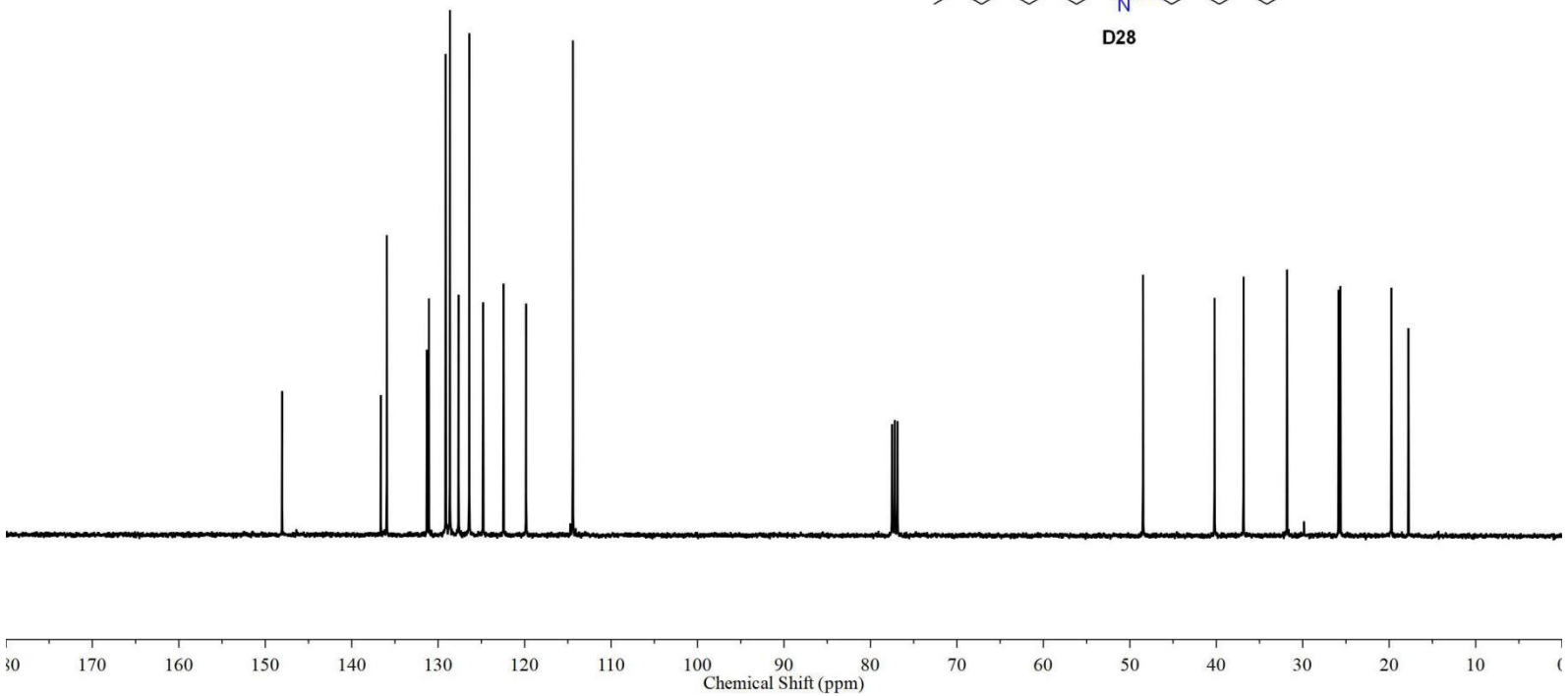

2022-6-8 YY0027-616-ZGH-45.10.fid
7.3066
7.3018
7.2850
7.2813
7.2720
7.2631
7.2524
7.2380
7.2340
7.2024
7.1980
7.1935
7.1809
6.8631
6.8524
6.8425
6.8398
6.8150
6.8008
6.7868
6.3860
6.3810
6.3461
6.3410
6.3359
6.1716
6.1616
6.1517
6.1217
5.0507
5.0469
5.0432
5.0394
4.4911
4.4861
4.4808
4.4759
2.3625
2.3412
2.3271
2.3130
2.2184
2.2144
2.1997
2.0078
1.9995
1.9985
1.9815
1.9592
1.7223
1.7057
1.6480
1.6437
1.5650
1.3802
1.2583
1.2031
0.9276
0.9109
N
N
D28
8.60
1.98
1.01
0.95
1.00
1.84
0.97
1.01
2.05
3.88
2.44
2.65
2.77
Chemical Shifft (ppm)

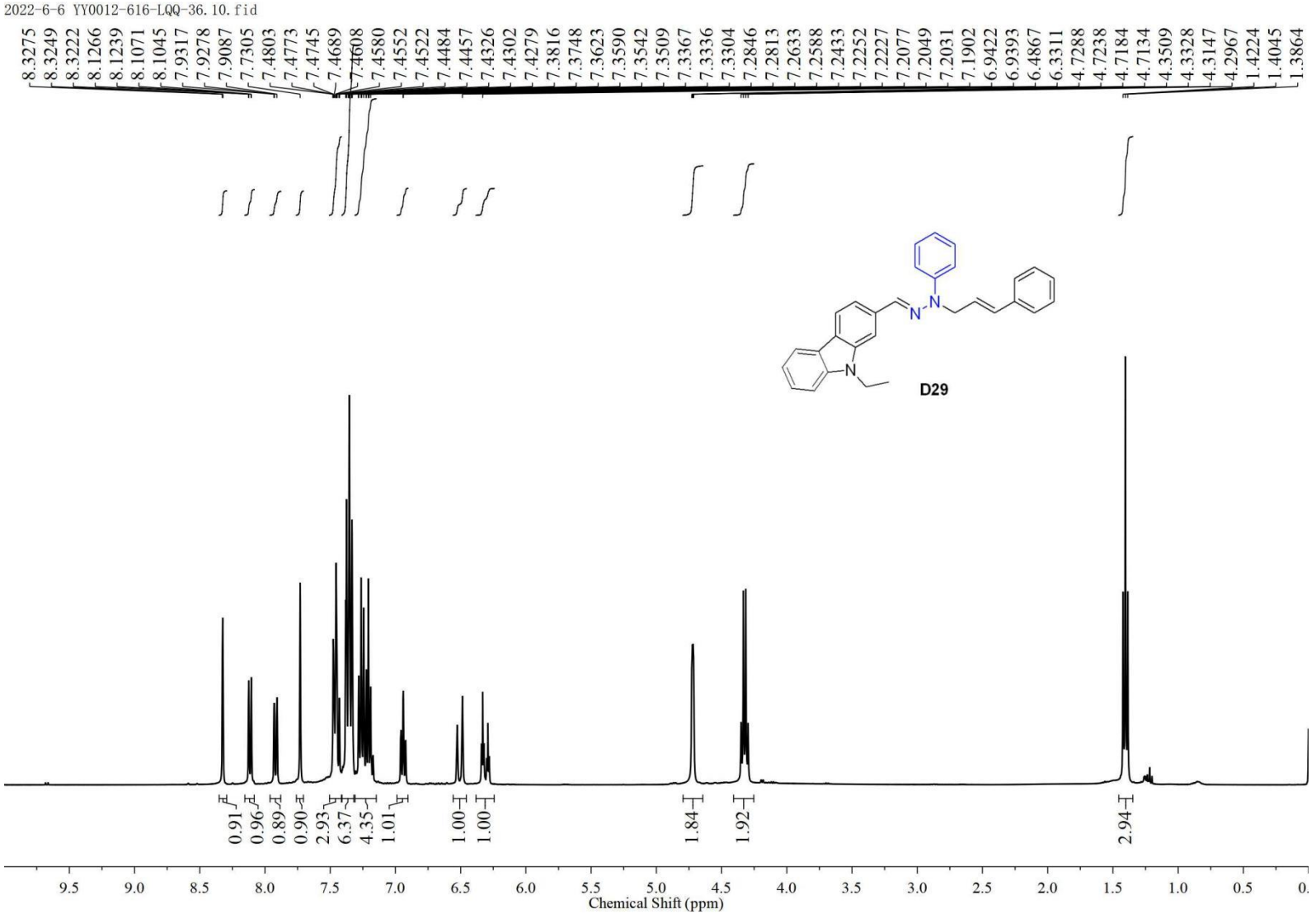
2022-6-9 yy0011-616-1-45.10.fid

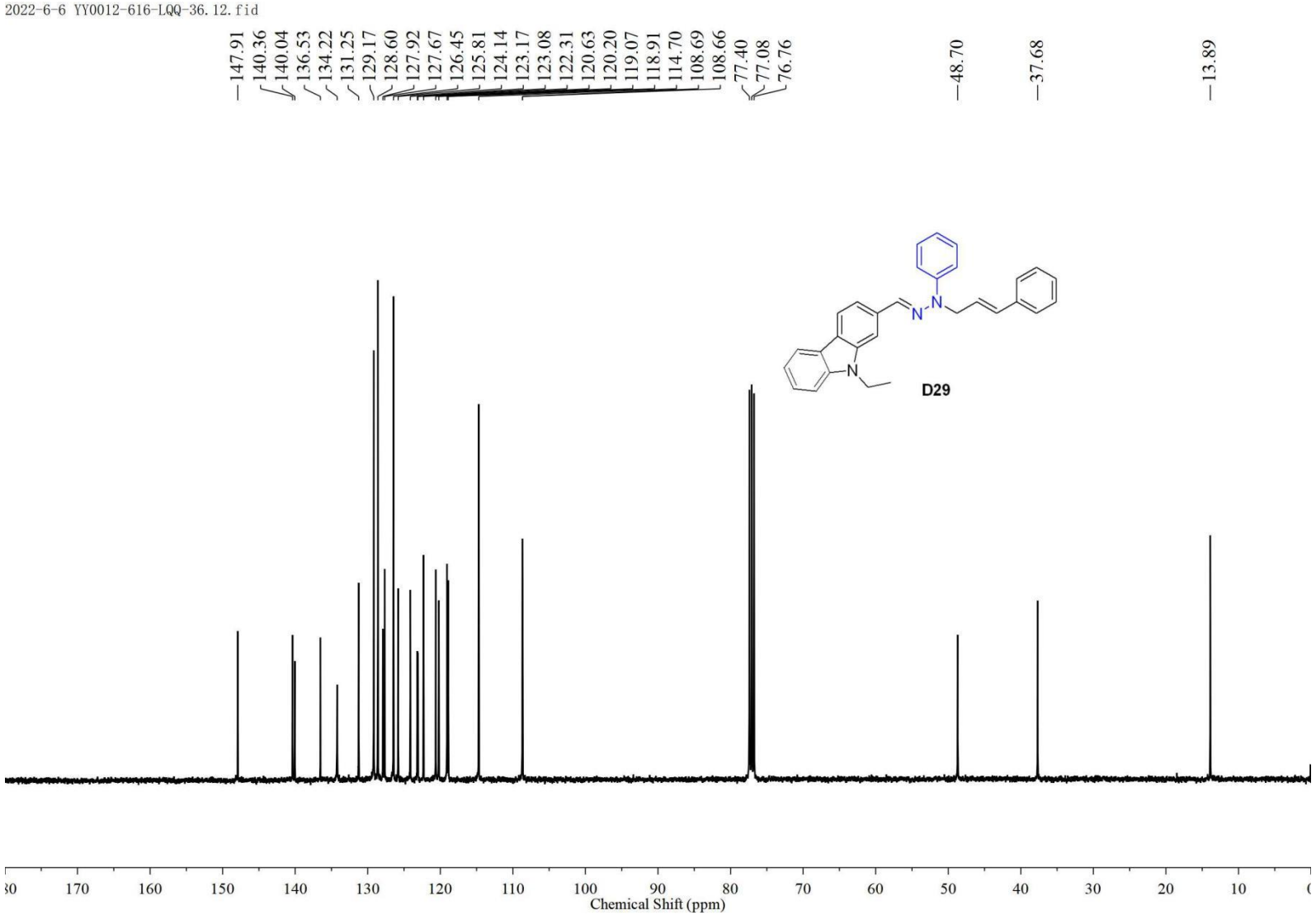
148.05
136.64
135.94
131.30
131.08
129.13
128.64
127.64
126.41
124.80
122.44
119.84
114.42
77.51
77.19
76.87
48.47
40.20
36.85
31.81
25.85
25.64
19.74
17.78

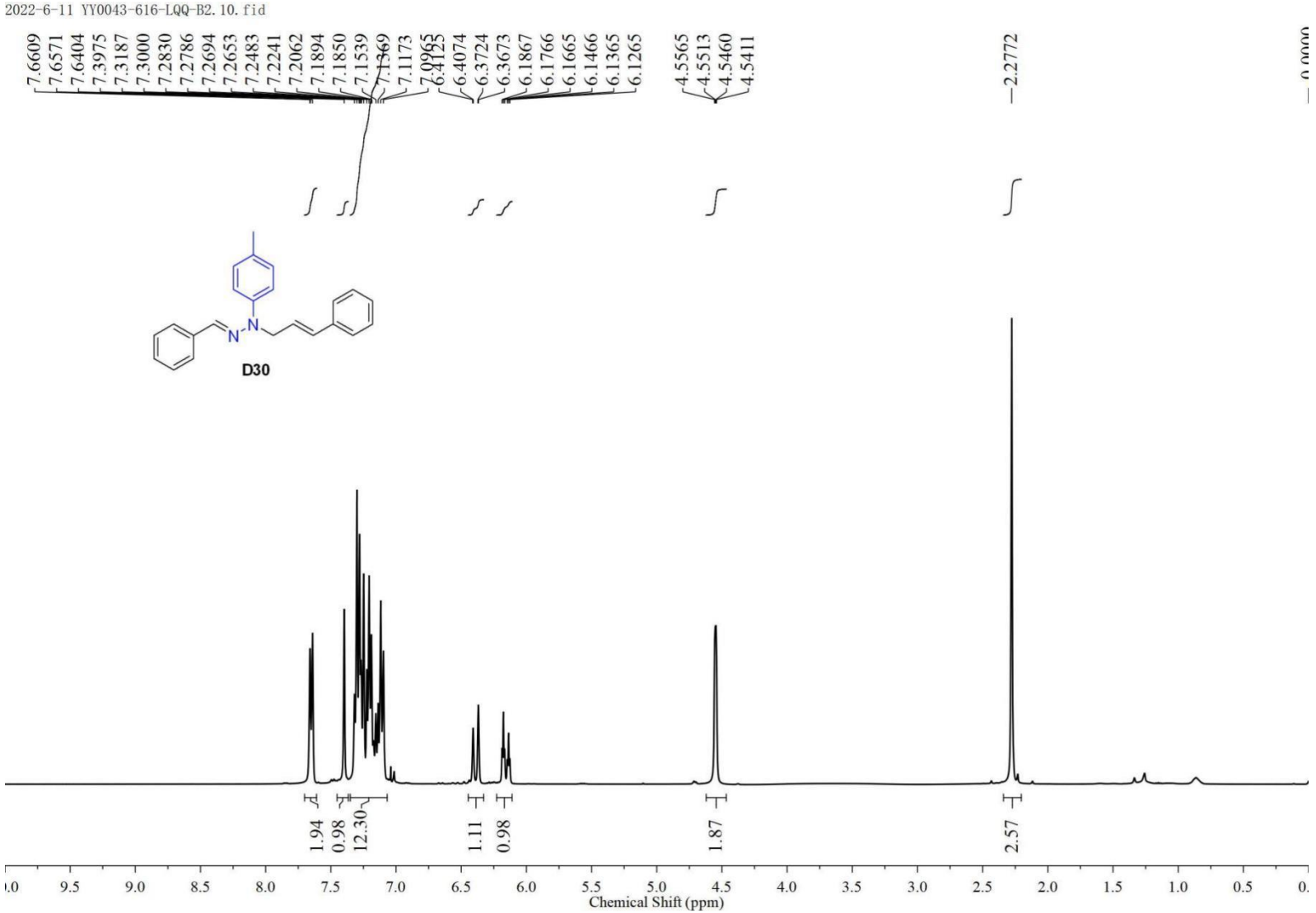


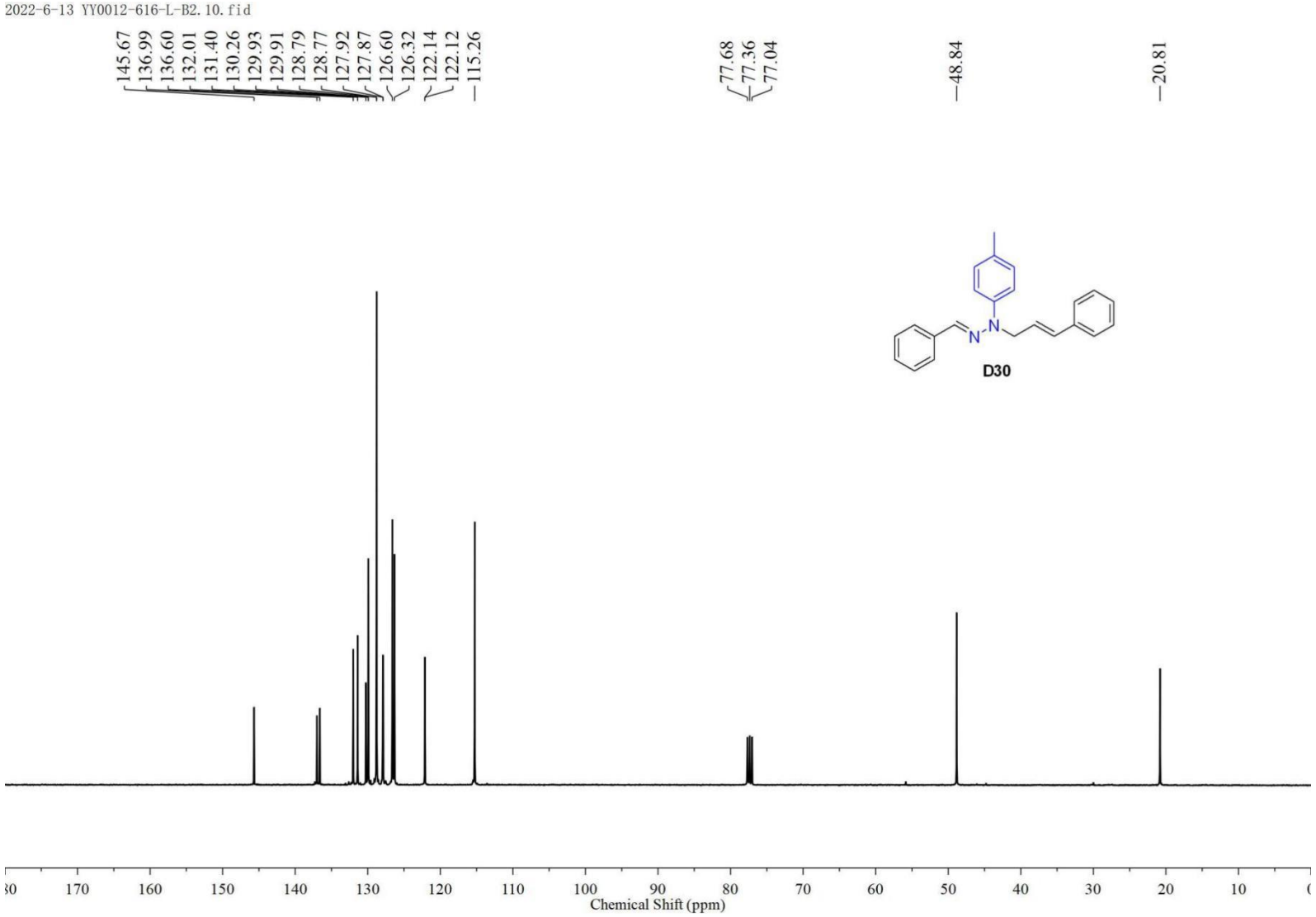
D28

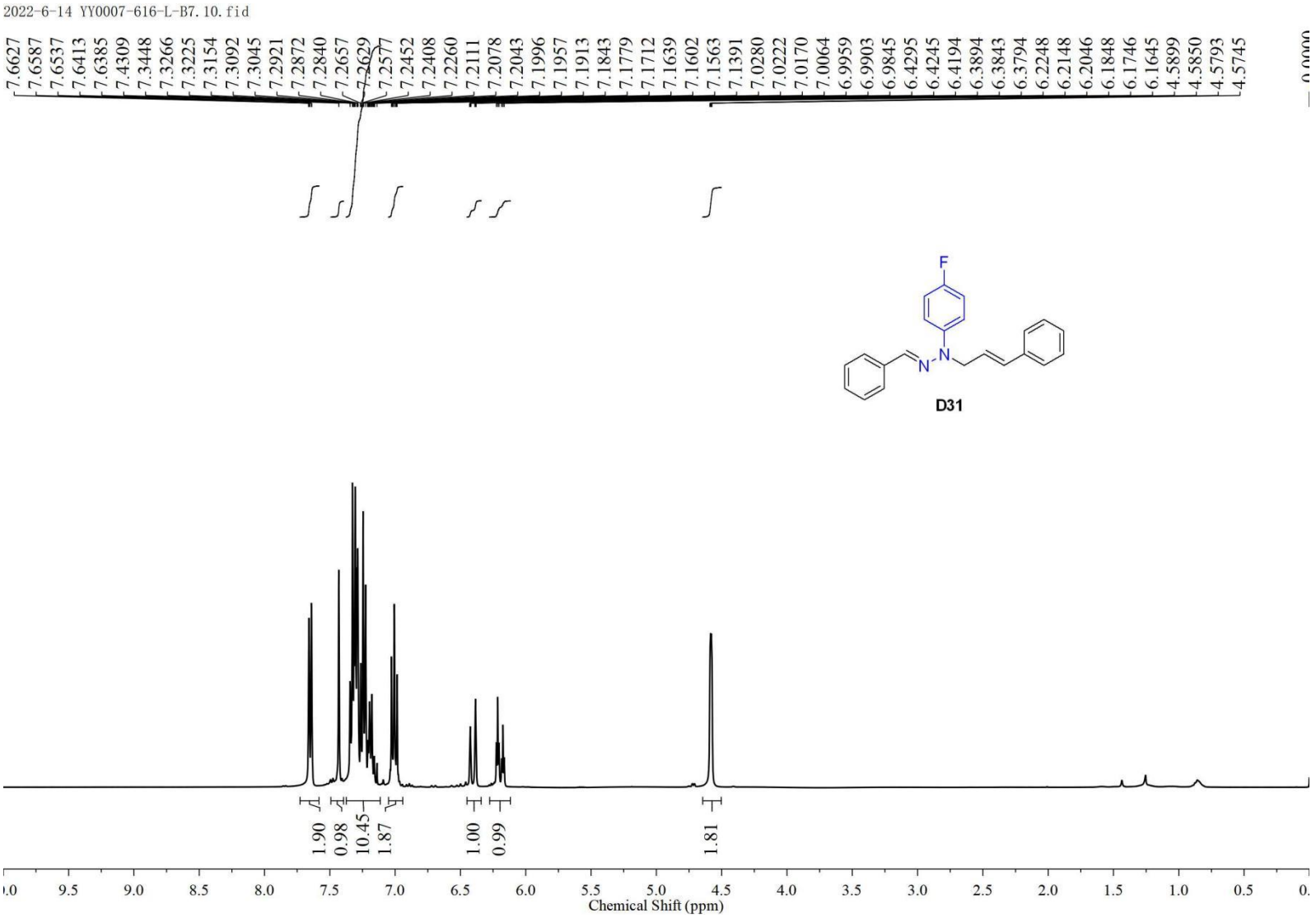



2022-6-6 YY0012-616-LQQ-36.10.fid
8.3275
8.3249
8.3222
8.1266
8.1239
8.1071
8.1045
7.9317
7.9278
7.9087
7.7305
7.4803
7.4773
7.4745
7.4689
7.4608
7.4580
7.4552
7.4522
7.4484
7.4457
7.4326
7.4302
7.4279
7.3816
7.3748
7.3623
7.3590
7.3542
7.3509
7.3367
7.3336
7.3304
7.2846
7.2813
7.2633
7.2588
7.2433
7.2252
7.2227
7.2077
7.2049
7.2031
7.1902
6.9422
6.9393
6.4867
6.3311
4.7288
4.7238
4.7184
4.7134
4.3509
4.3328
4.3147
4.2967
1.4224
1.4045
1.3864
D29
0.91
0.96
0.89
0.90
2.93
6.37
4.35
1.01
1.00
1.00
1.84
1.92
2.94
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)


2022-6-6 YY0012-616-LQQ-36.12.fid
147.91
140.36
140.04
136.53
134.22
131.25
129.17
128.60
127.92
127.67
126.45
125.81
124.14
123.17
123.08
122.31
120.63
120.20
119.07
118.91
114.70
108.69
108.66
77.40
77.08
76.76
48.70
37.68
13.89
D29
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

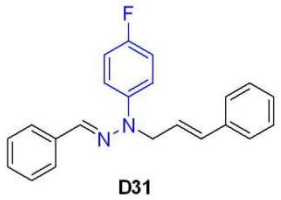

2022-6-11 YY0043-616-LQQ-B2.10.fid
7.6609
7.6571
7.6404
7.3975
7.3187
7.3000
7.2830
7.2786
7.2694
7.2653
7.2483
7.2241
7.2062
7.1894
7.1850
7.1539
7.1369
7.1173
6.4074
6.3724
6.3673
6.1867
6.1766
6.1665
6.1466
6.1365
6.1265
4.5565
4.5513
4.5460
4.5411
2.2772
0.0000
D30
1.94
0.98
12.30
1.11
0.98
1.87
2.57
Chemical Shift (ppm)


2022-6-13 YY0012-616-L-B2.10.fid
145.67
136.99
136.60
132.01
131.40
130.26
129.93
129.91
128.79
128.77
127.92
127.87
126.60
126.32
122.14
122.12
115.26
77.68
77.36
77.04
48.84
20.81
D30
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

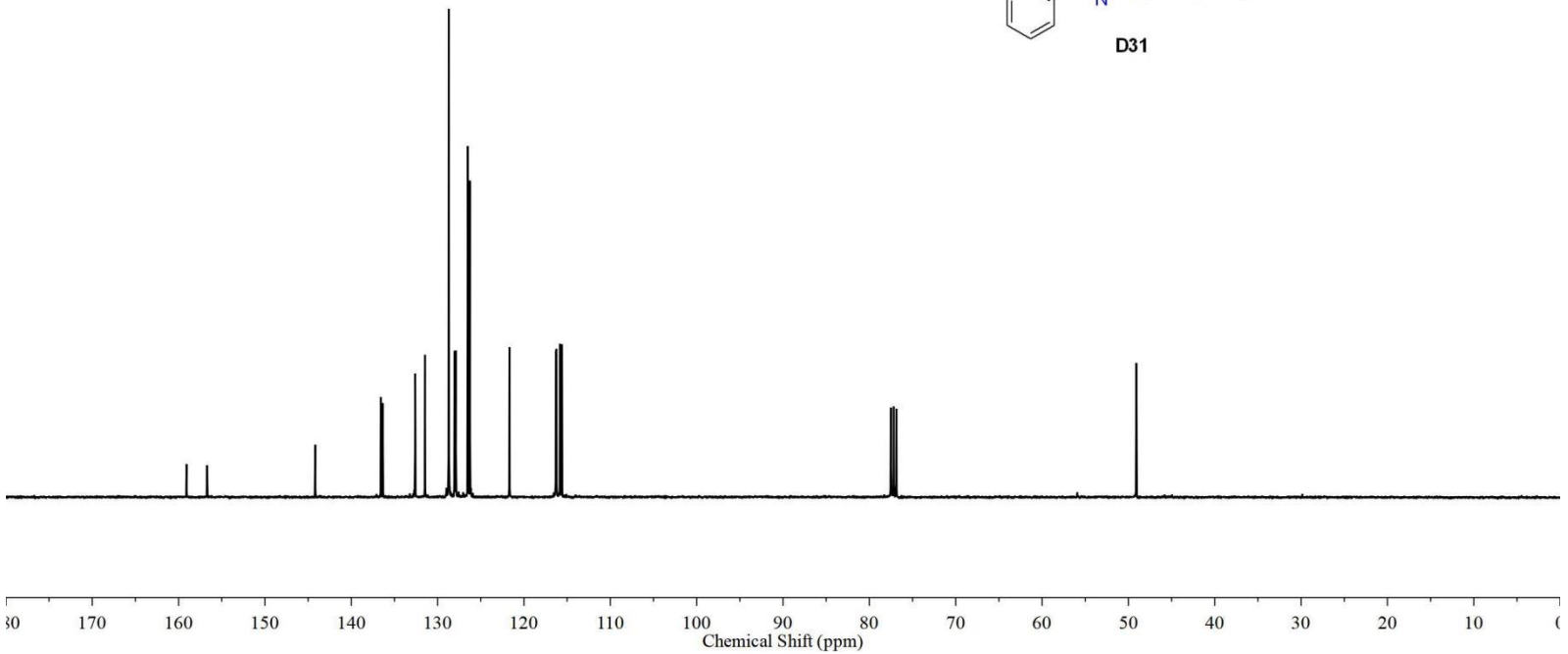

2022-6-14 YY0007-616-L-B7.10.fid
7.6627
7.6587
7.6537
7.6413
7.6385
7.4309
7.3448
7.3266
7.3225
7.3154
7.3092
7.3045
7.2921
7.2872
7.2840
7.2657
7.2629
7.2577
7.2452
7.2408
7.2260
7.2111
7.2078
7.2043
7.1996
7.1957
7.1913
7.1843
7.1779
7.1712
7.1639
7.1602
7.1563
7.1391
7.0280
7.0222
7.0170
7.0064
6.9959
6.9903
6.9845
6.4295
6.4245
6.4194
6.3894
6.3843
6.3794
6.2248
6.2148
6.2046
6.1848
6.1746
6.1645
4.5899
4.5850
4.5793
4.5745
F
N
N
D31
1.90
0.98
10.45
1.87
1.00
0.99
1.81
Chemical Shift (ppm)

2022-6-15 yy0008-616-lqq-b7.10.fid

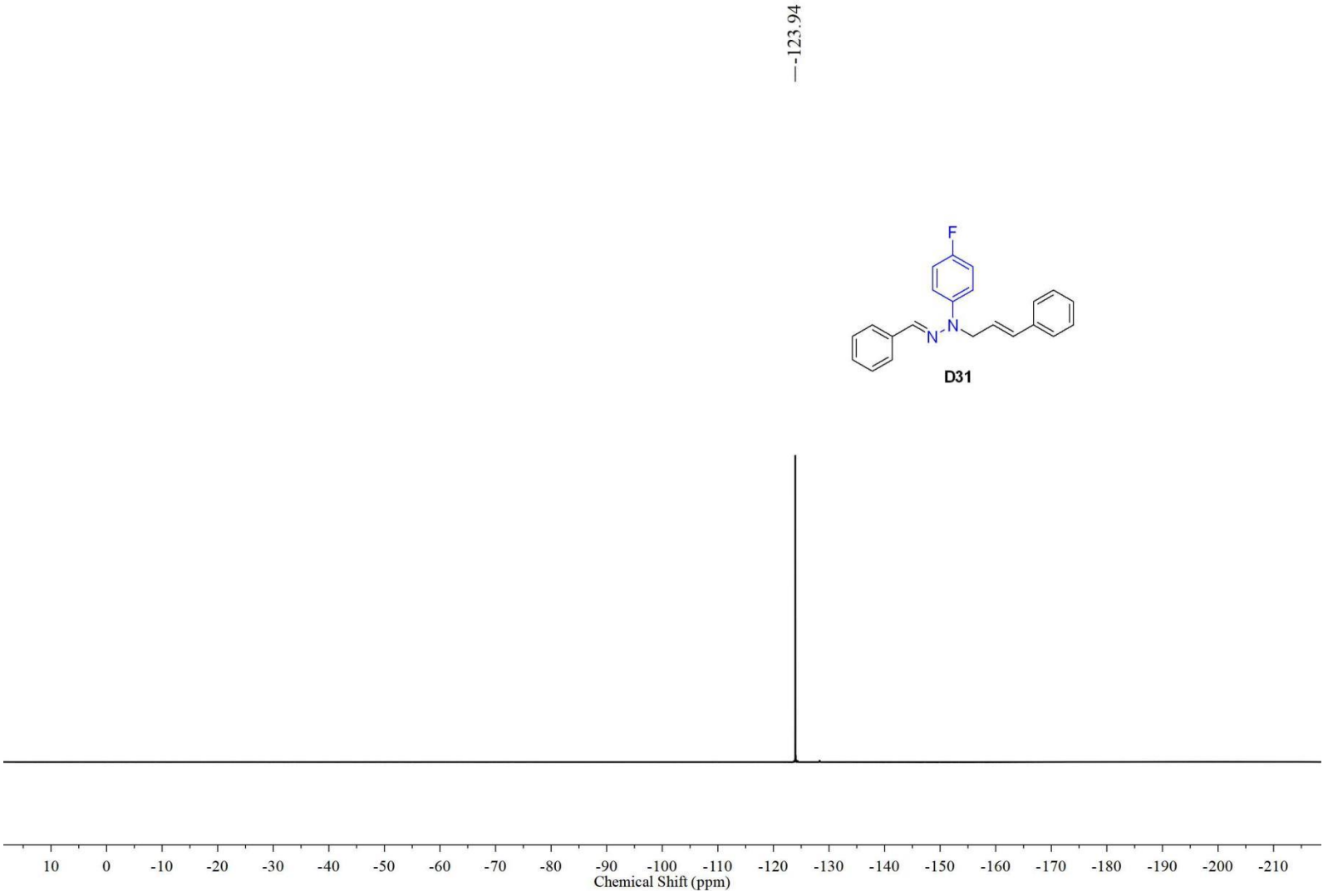
159.07
156.70
144.20
144.18
136.58
136.35
132.60
131.47
128.71
128.64
128.04
127.90
126.51
126.26
121.68
116.31
116.24
115.82
115.60
77.51
77.19
76.87
49.08

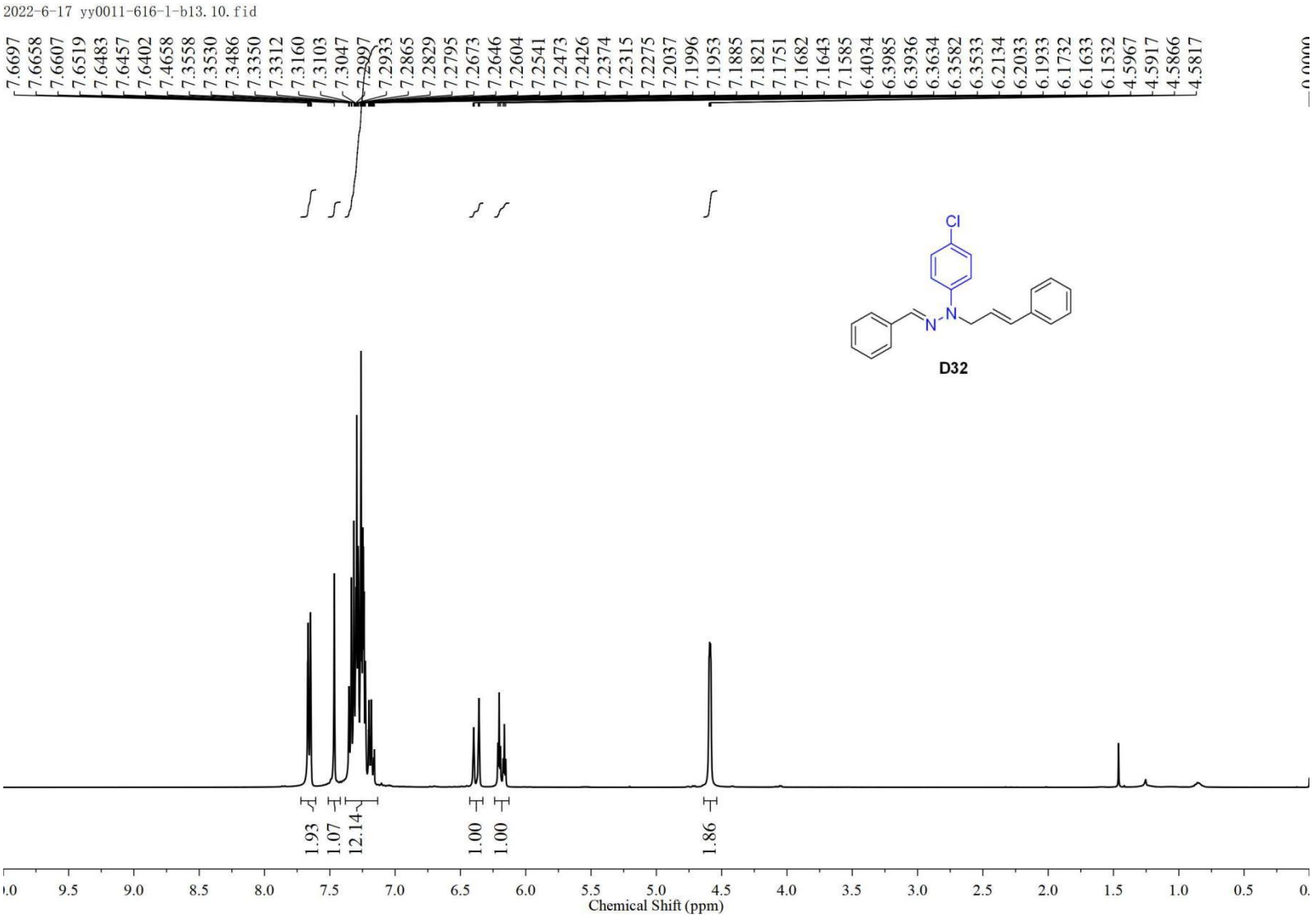


D31

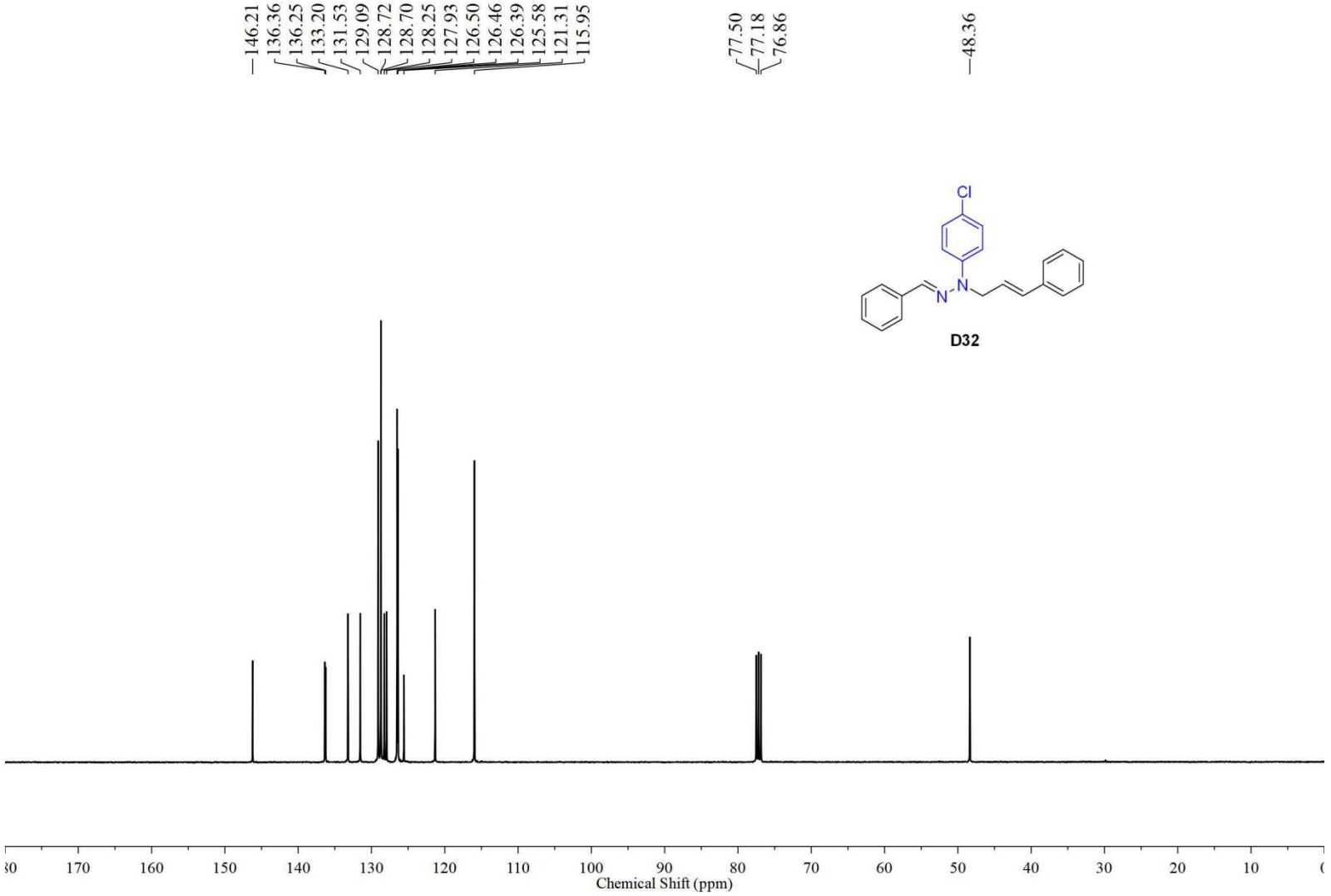


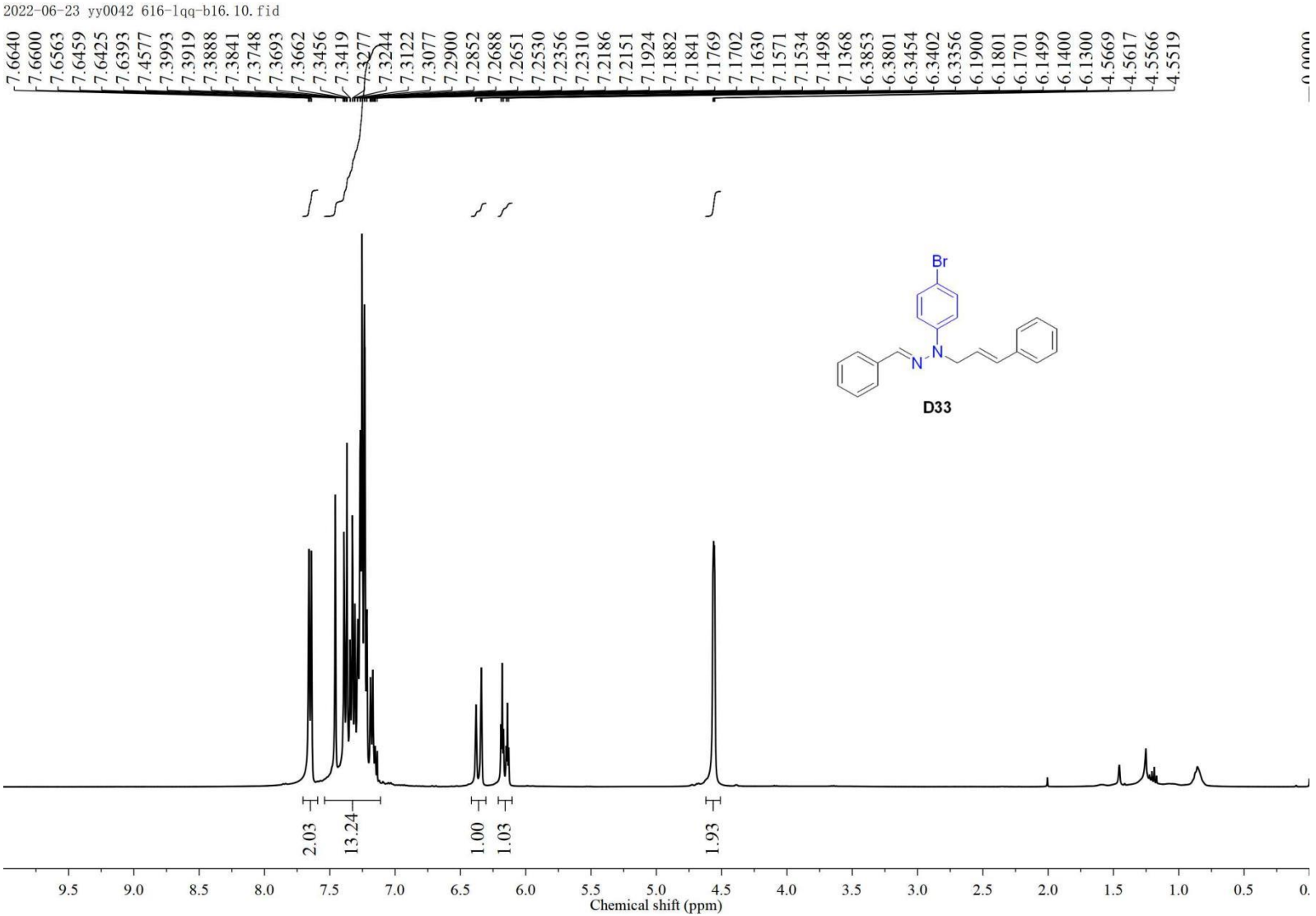
2022-6-15 yy0008-616-lqq-b7.11.fid



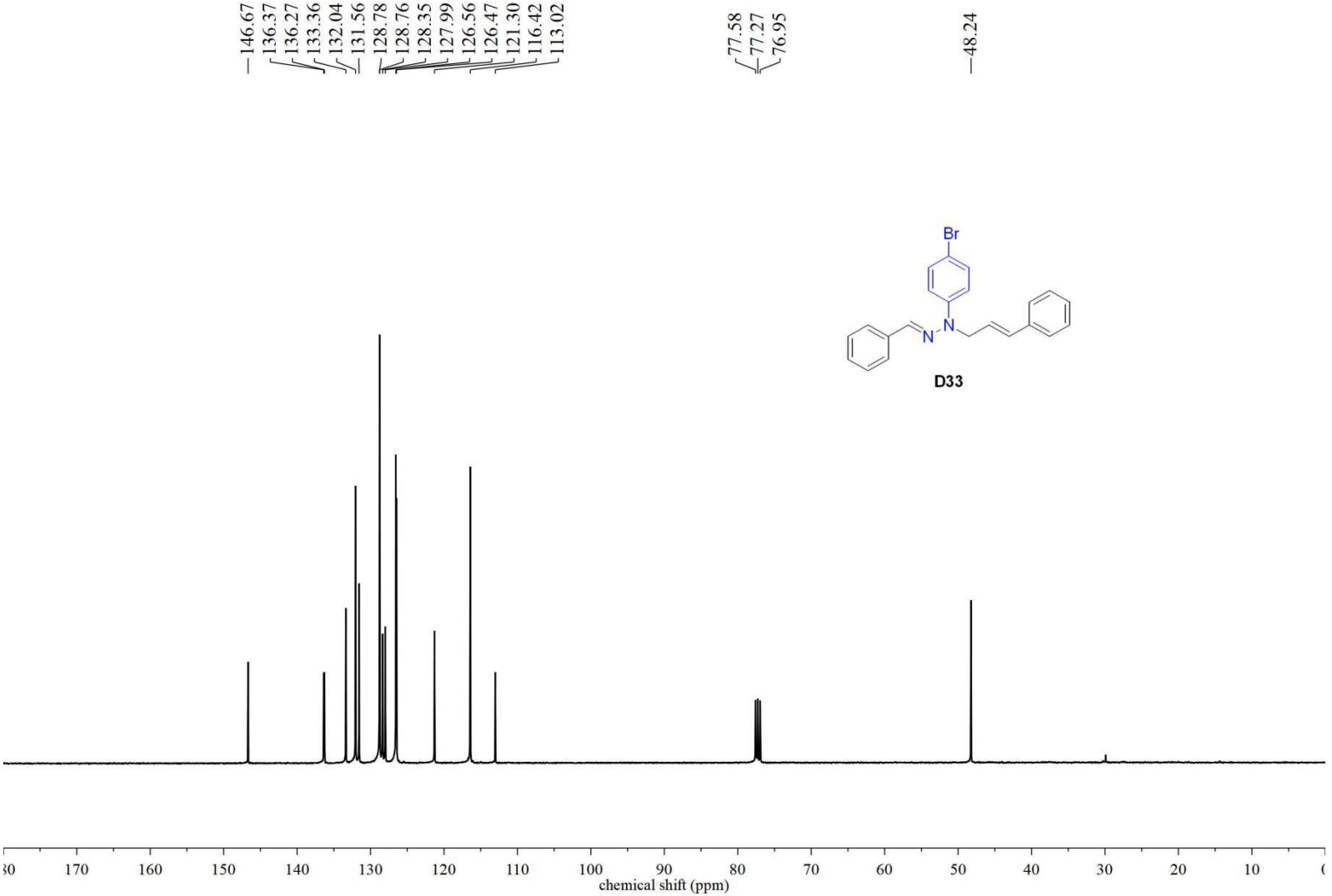

2022-6-17 yy0011-616-l-b13.10.fid
7.6697
7.6658
7.6607
7.6519
7.6483
7.6457
7.6402
7.4658
7.3558
7.3530
7.3486
7.3350
7.3312
7.3160
7.3103
7.3047
7.2997
7.2933
7.2865
7.2829
7.2795
7.2673
7.2646
7.2604
7.2541
7.2473
7.2426
7.2374
7.2315
7.2275
7.2037
7.1996
7.1953
7.1885
7.1821
7.1751
7.1682
7.1643
7.1585
6.4034
6.3985
6.3936
6.3634
6.3582
6.3533
6.2134
6.2033
6.1933
6.1732
6.1633
6.1532
4.5967
4.5917
4.5866
4.5817
0.0000
Cl
N
N
D32
1.93
1.07
12.14
1.00
1.00
1.86
Chemical Shift (ppm)

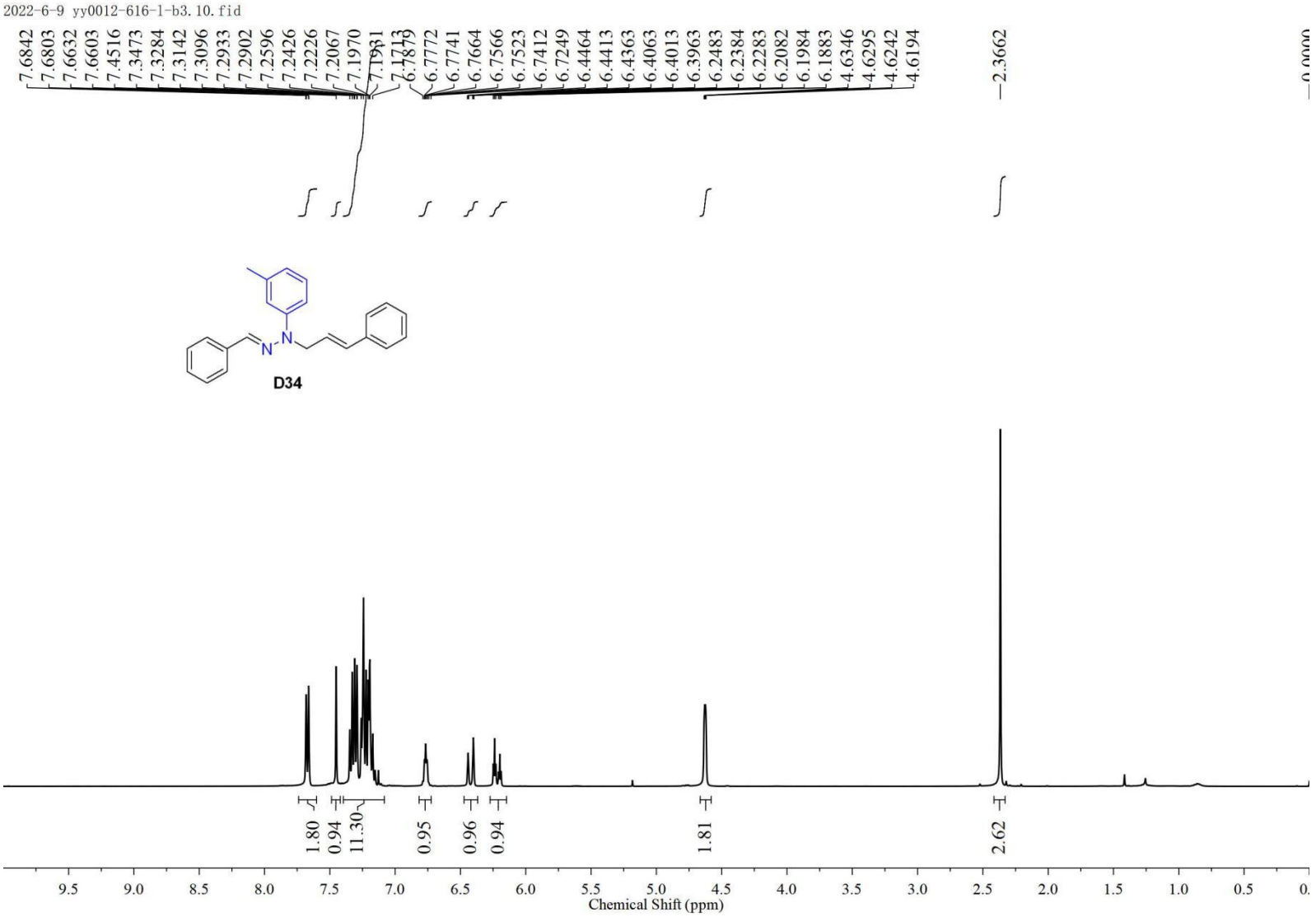
2022-06-20 yy0016-616-Lqq-B13.10.fid




2022-06-23 yy0042 616-lqq-b16.10.fid
7.6640
7.6600
7.6563
7.6459
7.6425
7.6393
7.4577
7.3993
7.3919
7.3888
7.3841
7.3748
7.3693
7.3662
7.3456
7.3419
7.3277
7.3244
7.3122
7.3077
7.2900
7.2852
7.2688
7.2651
7.2530
7.2356
7.2310
7.2186
7.2151
7.1924
7.1882
7.1841
7.1769
7.1702
7.1630
7.1571
7.1534
7.1498
7.1368
6.3853
6.3801
6.3454
6.3402
6.3356
6.1900
6.1801
6.1701
6.1499
6.1400
6.1300
4.5669
4.5617
4.5566
4.5519
Br
N
N
D33
2.03
13.24
1.00
1.03
1.93
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical shift (ppm)

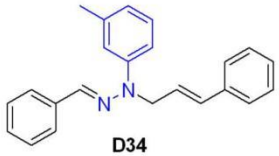
2022-06-27-yy0001-616-1-b-16



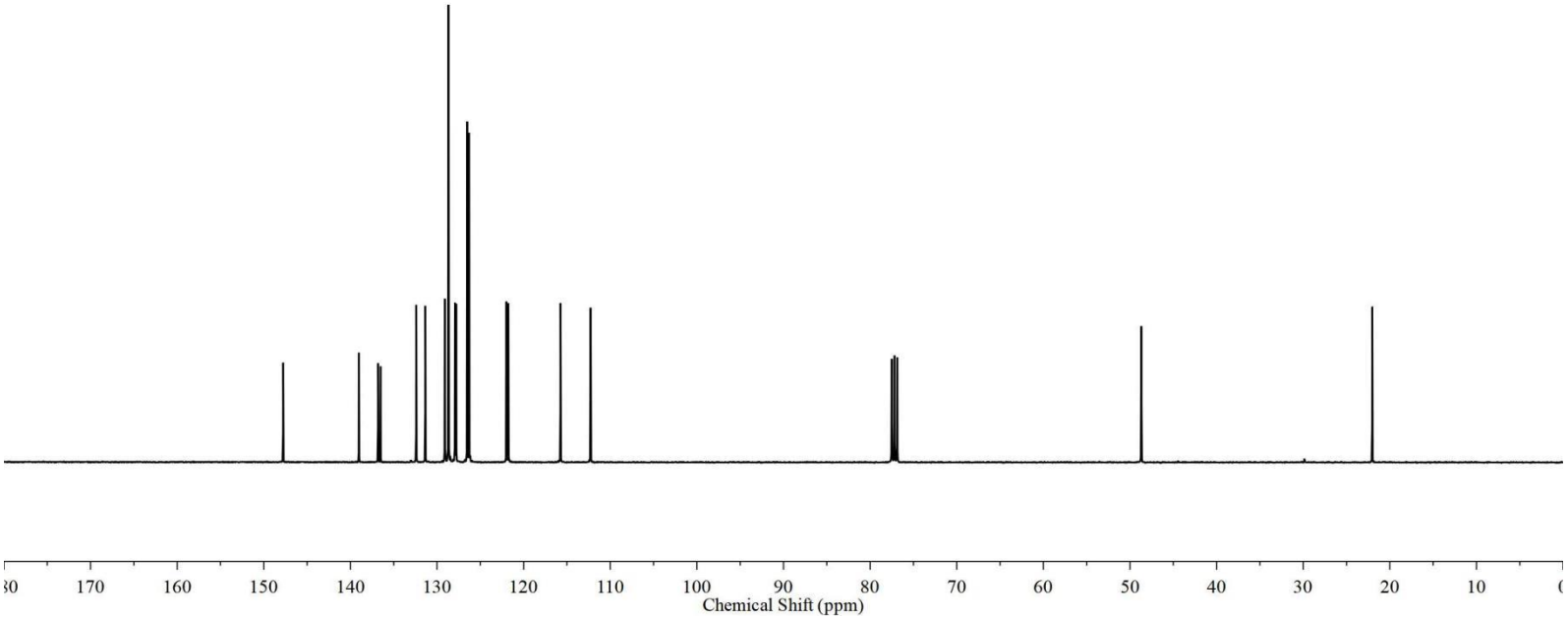

2022-6-9 yy0012-616-1-b3.10.fid
7.6842
7.6803
7.6632
7.6603
7.4516
7.3473
7.3284
7.3142
7.3096
7.2933
7.2902
7.2596
7.2426
7.2226
7.2067
7.1970
7.1931
7.1713
6.7879
6.7772
6.7741
6.7664
6.7566
6.7523
6.7412
6.7249
6.4464
6.4413
6.4363
6.4063
6.4013
6.3963
6.2483
6.2384
6.2283
6.2082
6.1984
6.1883
4.6346
4.6295
4.6242
4.6194
2.3662
0.0000
D34
1.80
0.94
11.30
0.95
0.96
0.94
1.81
2.62
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

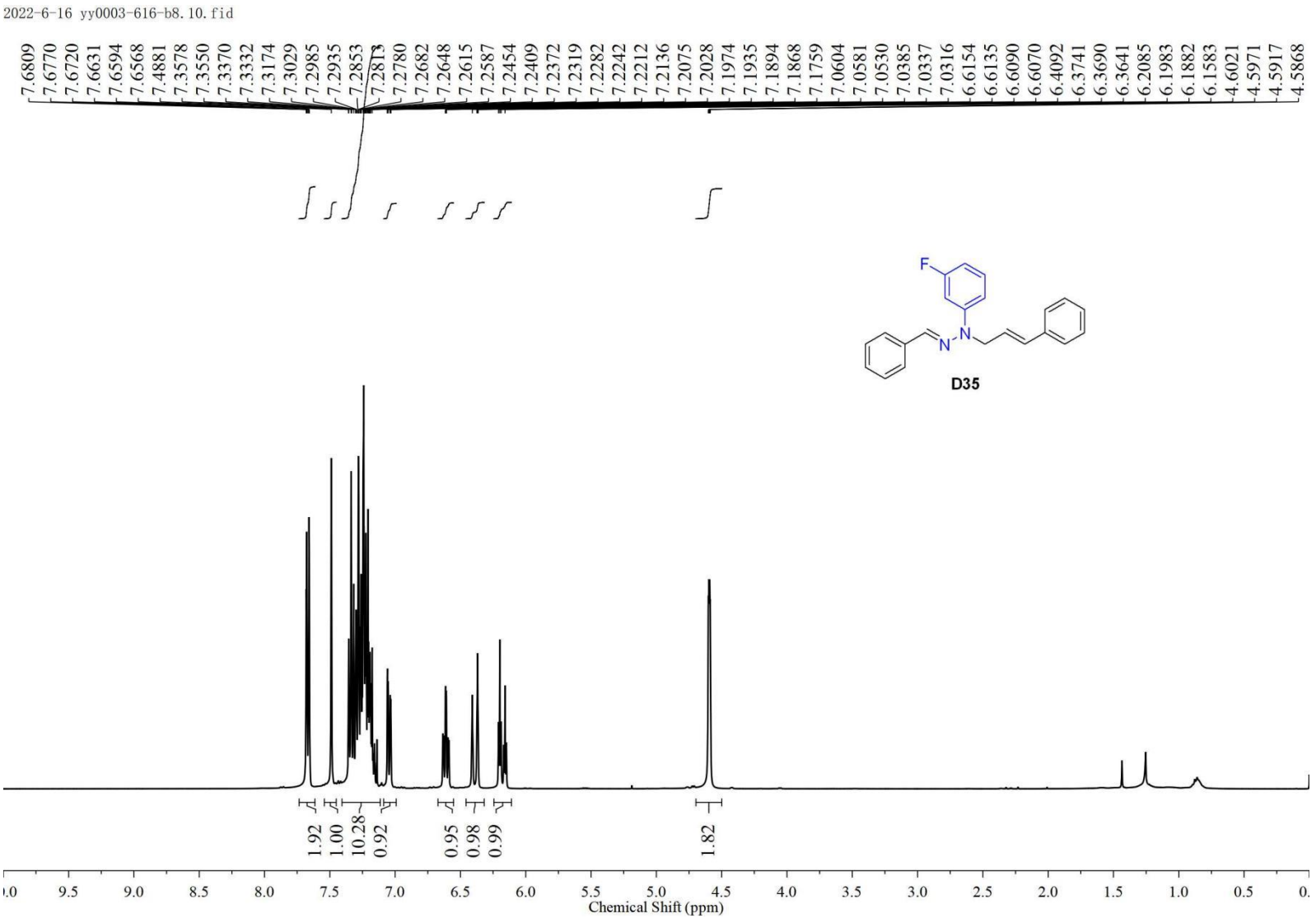
2022-6-11 yy0042-616-lqq-b3.10.fid

147.76
139.02
136.80
136.52
132.40
131.35
129.10
128.68
128.66
127.92
127.79
126.51
126.30
121.99
121.77
115.74
112.27
77.51
77.19
76.87
48.69
22.03



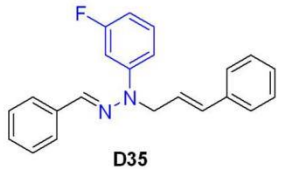
D34




2022-6-16 yy0003-616-b8.10.fid
7.6809
7.6770
7.6720
7.6631
7.6594
7.6568
7.4881
7.3578
7.3550
7.3370
7.3332
7.3174
7.3029
7.2985
7.2935
7.2853
7.2813
7.2780
7.2682
7.2648
7.2615
7.2587
7.2454
7.2409
7.2372
7.2319
7.2282
7.2242
7.2212
7.2136
7.2075
7.2028
7.1974
7.1935
7.1894
7.1868
7.1759
7.0604
7.0581
7.0530
7.0385
7.0337
7.0316
6.6154
6.6135
6.6090
6.6070
6.4092
6.3741
6.3690
6.3641
6.2085
6.1983
6.1882
6.1583
4.6021
4.5971
4.5917
4.5868
F
N
N
D35
1.92
1.00
10.28
0.92
0.95
0.98
0.99
1.82
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

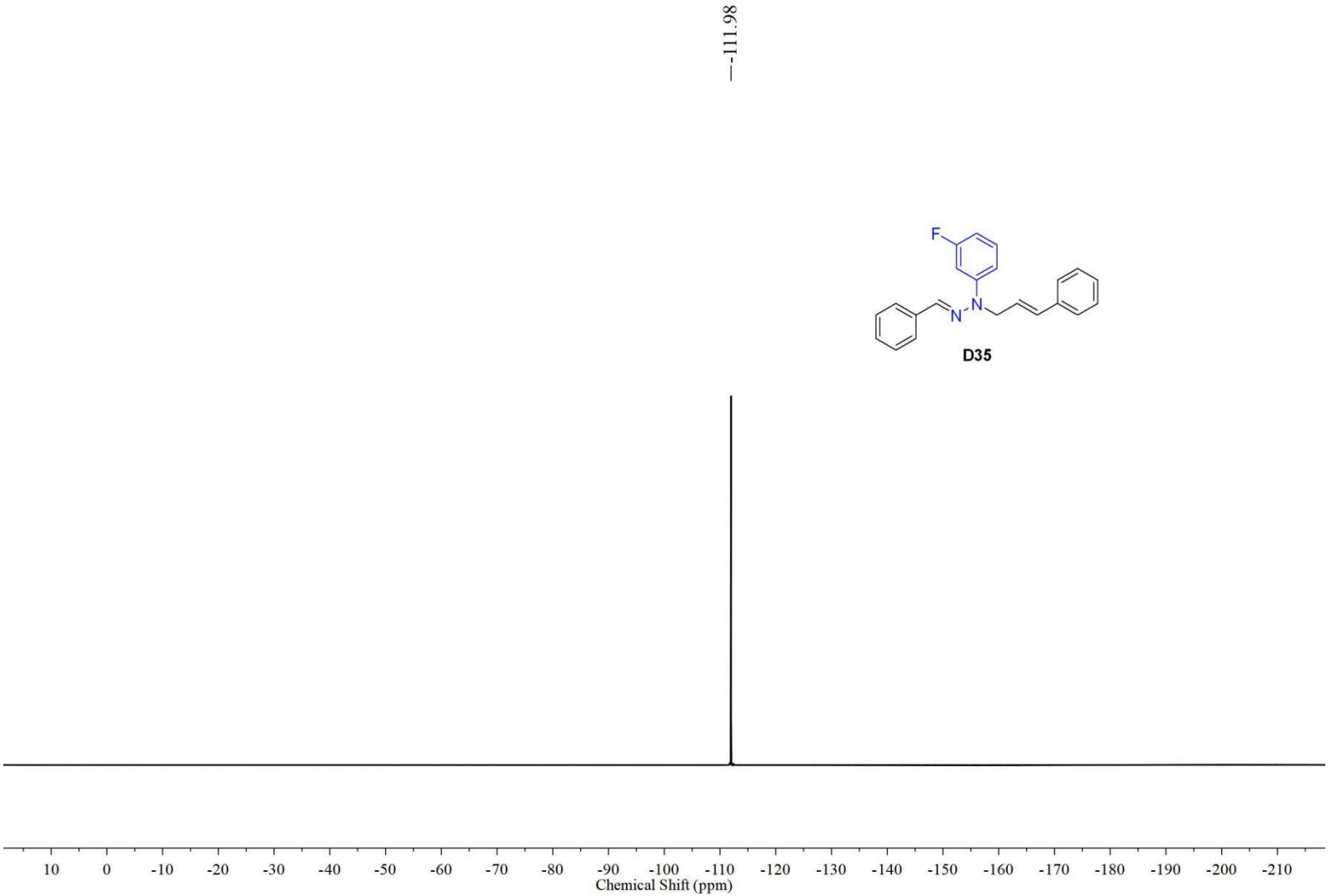
2022-6-17 yy0021-616-1-b8.10.fid

165.18
162.77
149.33
149.22
136.26
133.57
131.58
130.36
130.27
128.74
128.71
128.67
128.40
127.94
126.53
126.50
121.27
109.90
109.87
107.25
107.03
102.34
102.07
77.51
77.19
76.87
48.25

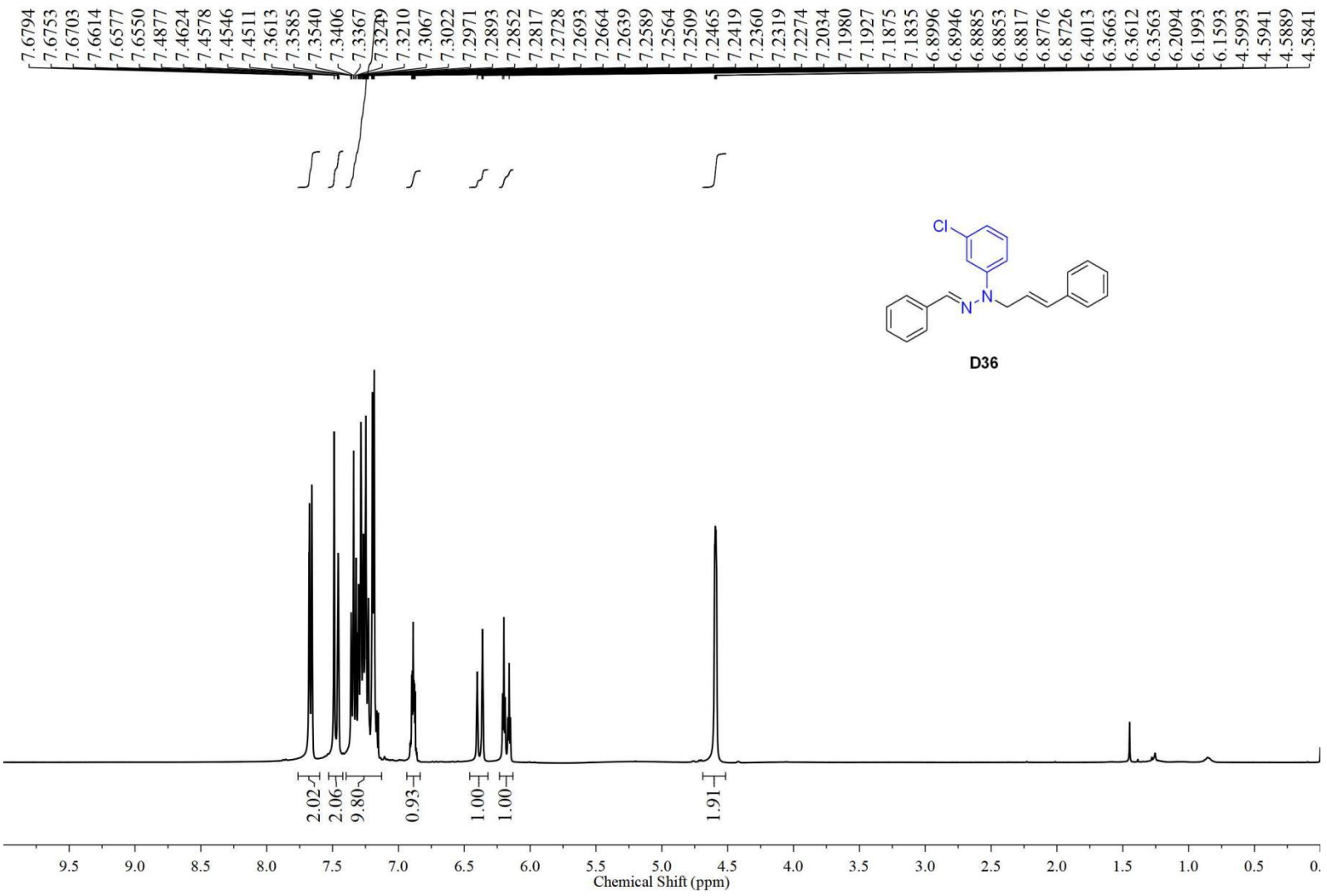


D35

2022-6-17 yy0021-616-1-b8.11.fid



2022-6-20 yy0027 616-lqq-14.10.fid

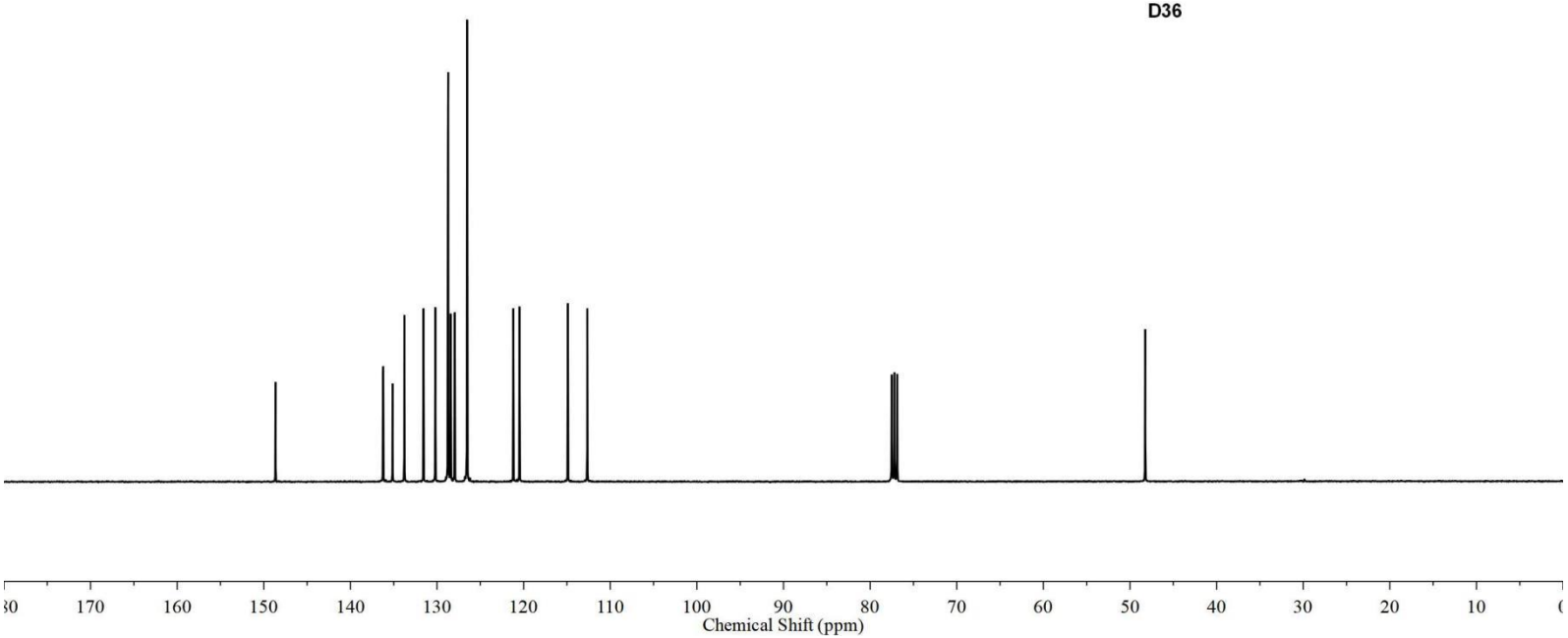


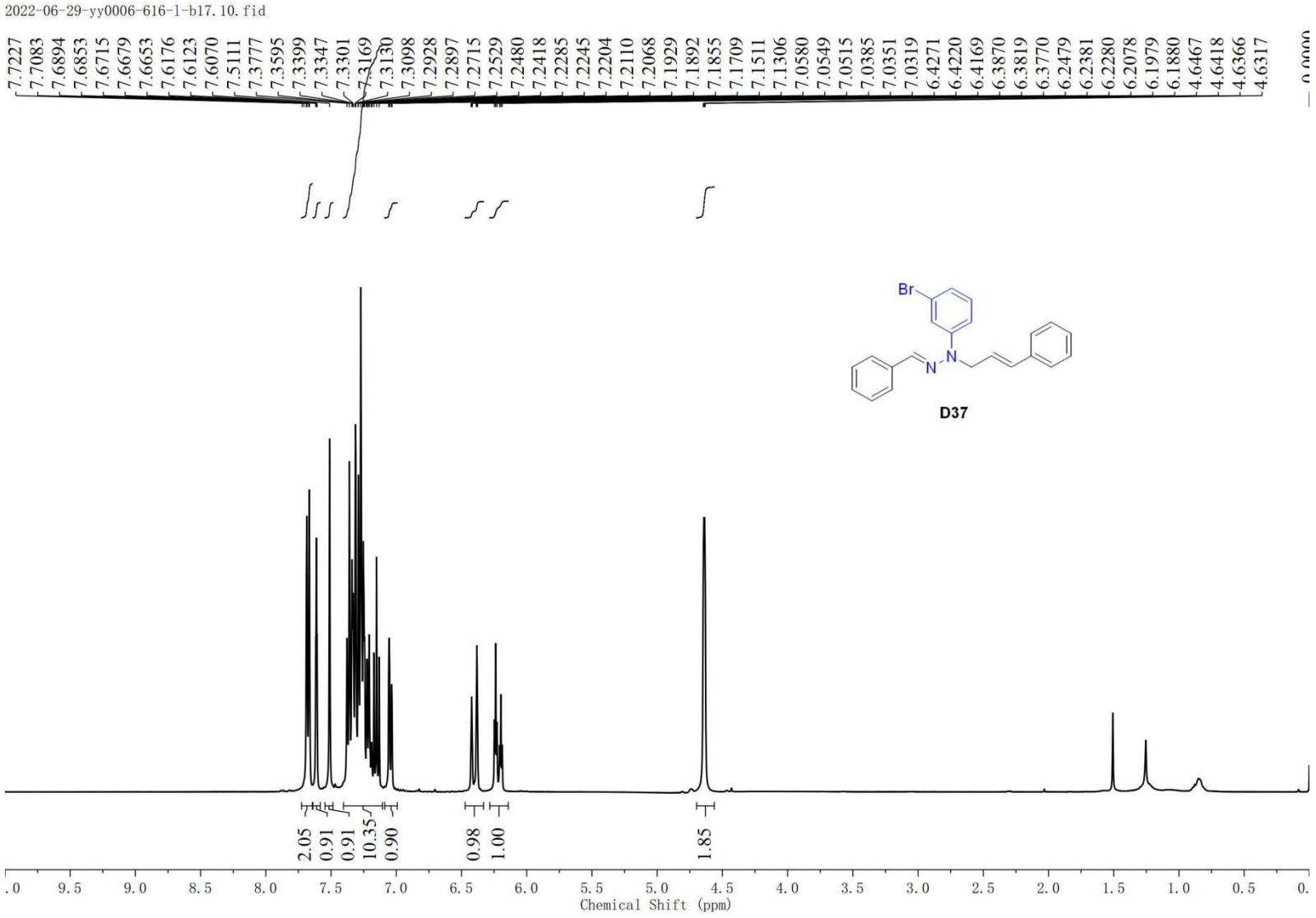
D36

2022-06-21 yy0025 616-lqq-14.10.fid

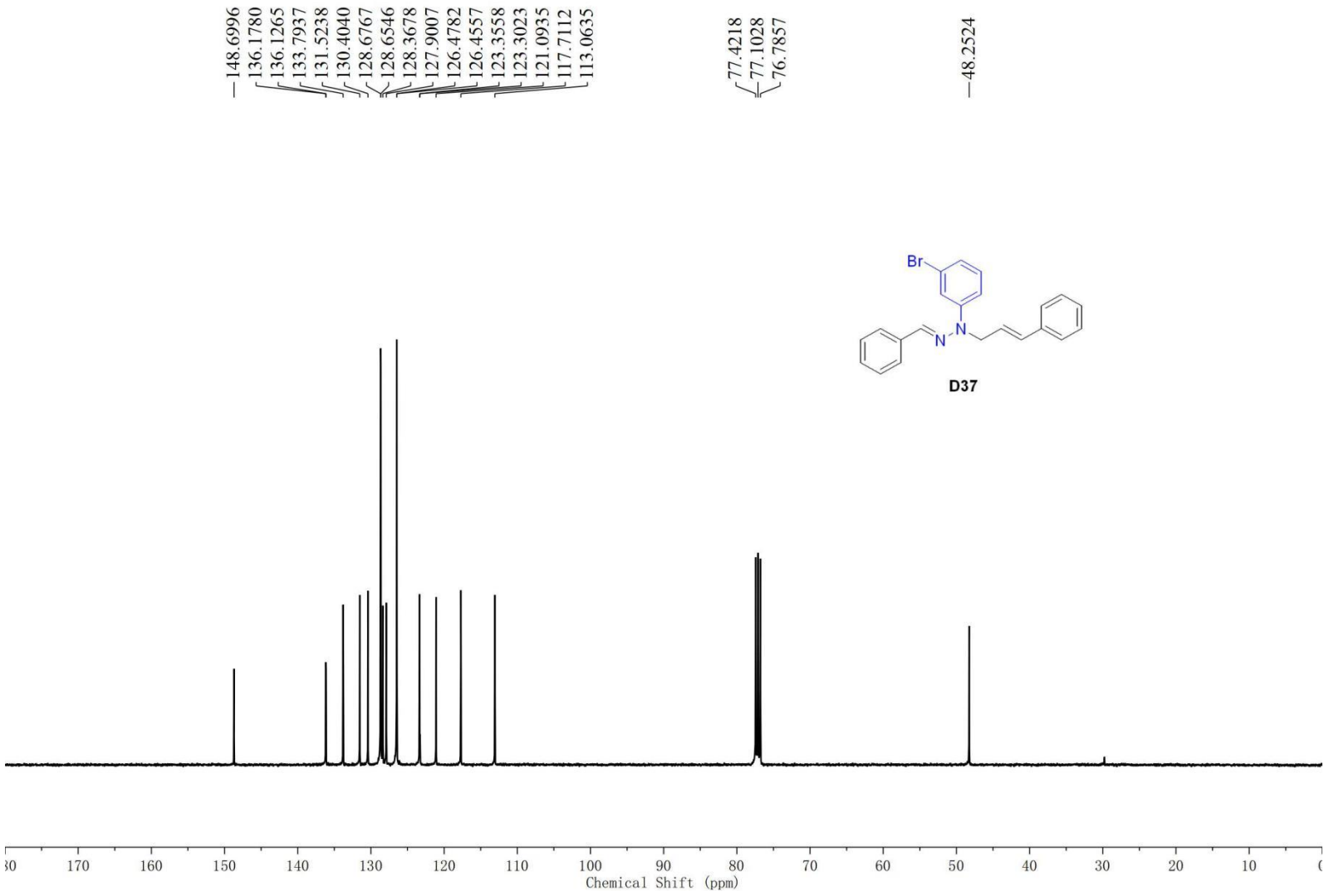
148.65
136.24
136.21
135.13
133.77
131.56
130.19
128.74
128.71
128.42
127.95
126.53
126.51
121.19
120.48
114.89
112.64
77.51
77.19
76.87
48.24

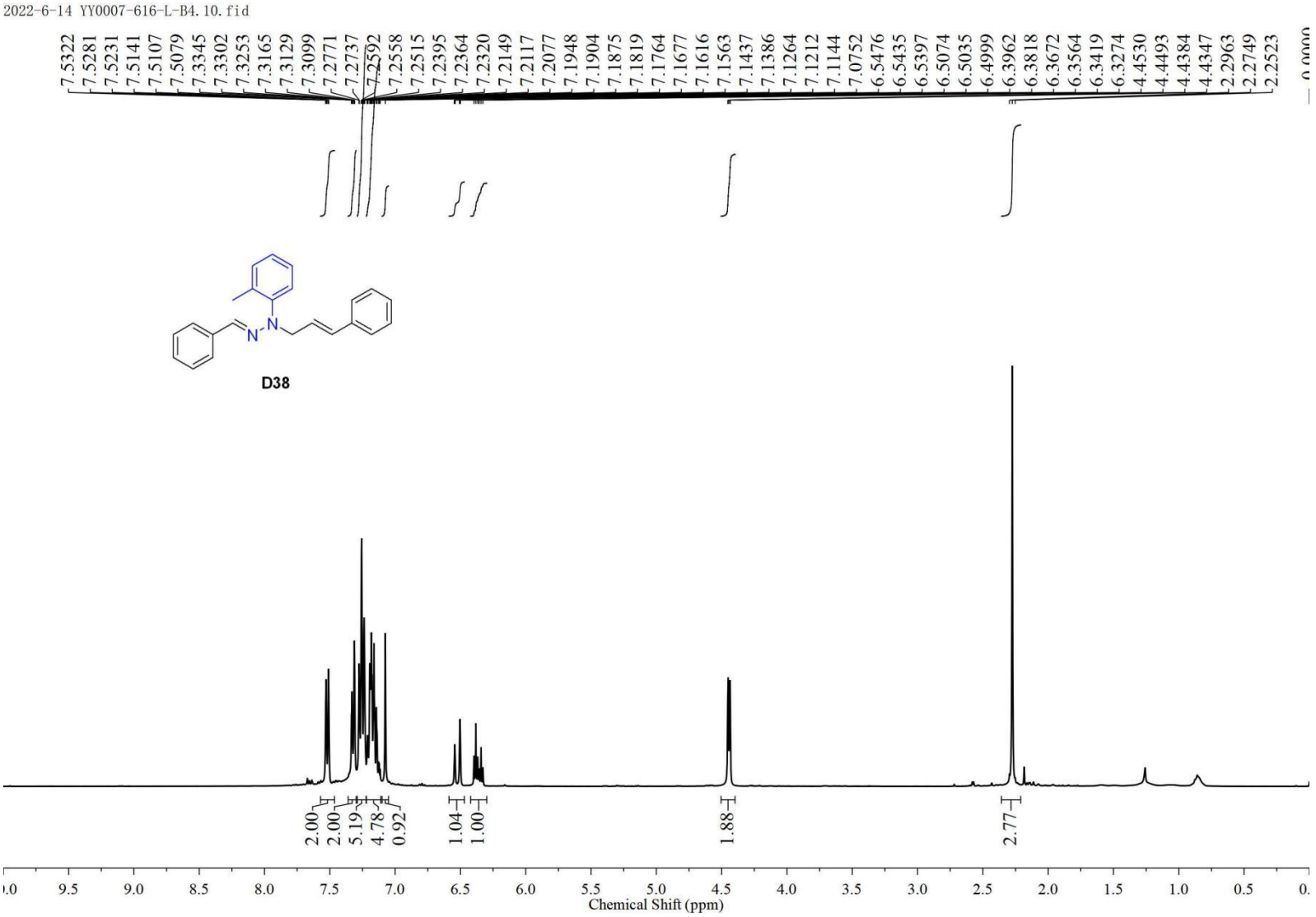
D36




2022-06-29-yy0006-616-1-b17.10.fid
7.7227
7.7083
7.6894
7.6853
7.6715
7.6679
7.6653
7.6176
7.6123
7.6070
7.5111
7.3777
7.3595
7.3399
7.3347
7.3301
7.3169
7.3130
7.3098
7.2928
7.2897
7.2715
7.2529
7.2480
7.2418
7.2285
7.2245
7.2204
7.2110
7.2068
7.1929
7.1892
7.1855
7.1709
7.1511
7.1306
7.0580
7.0549
7.0515
7.0385
7.0351
7.0319
6.4271
6.4220
6.4169
6.3870
6.3819
6.3770
6.2479
6.2381
6.2280
6.2078
6.1979
6.1880
4.6467
4.6418
4.6366
4.6317
Br
N
N
D37
2.05
0.91
0.91
10.35
0.90
0.98
1.00
1.85
.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

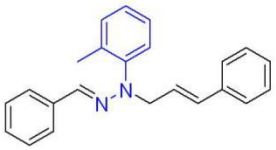
2022-06-30-yy0021-616-1-b17.10.fid



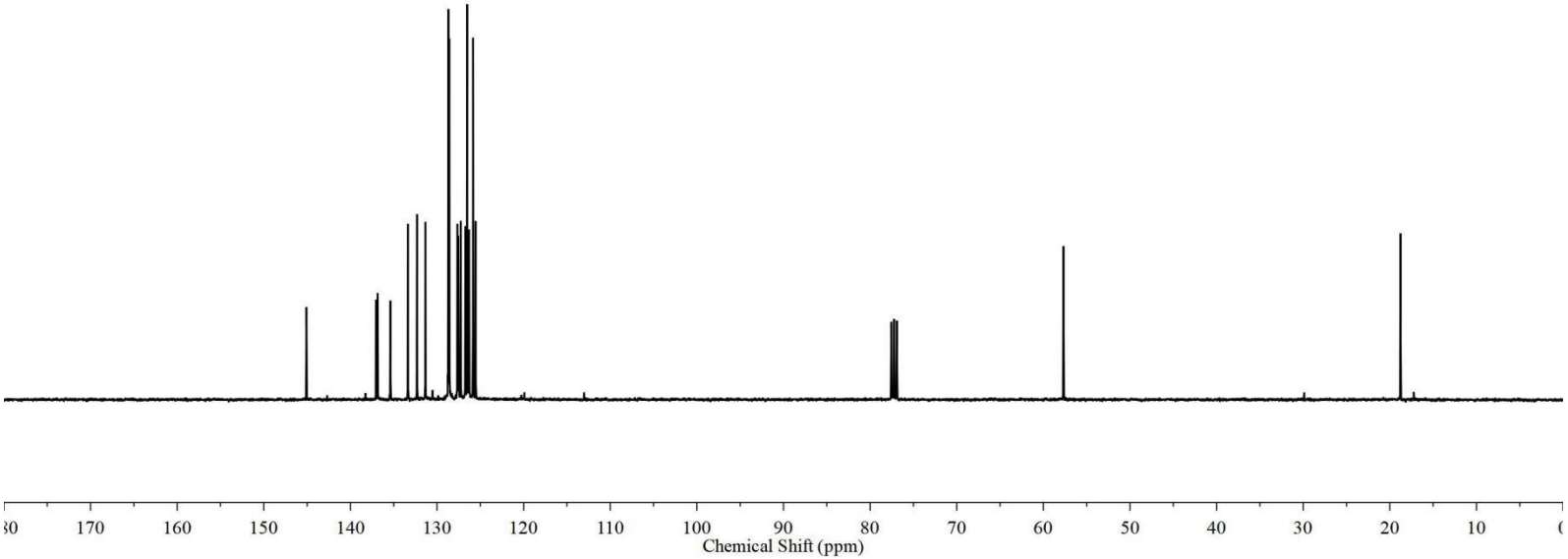

2022-6-14 YY0007-616-L-B4.10.fid
7.5322
7.5281
7.5231
7.5141
7.5107
7.5079
7.3345
7.3302
7.3253
7.3165
7.3129
7.3099
7.2771
7.2737
7.2592
7.2558
7.2515
7.2395
7.2364
7.2320
7.2149
7.2117
7.2077
7.1948
7.1904
7.1875
7.1819
7.1764
7.1677
7.1616
7.1563
7.1437
7.1386
7.1264
7.1212
7.1144
7.0752
6.5476
6.5435
6.5397
6.5074
6.5035
6.4999
6.3962
6.3818
6.3672
6.3564
6.3419
6.3274
4.4530
4.4493
4.4384
4.4347
2.2963
2.2749
2.2523
D38
2.00
2.00
5.19
4.78
0.92
1.04
1.00
1.88
2.77
Chemical Shift (ppm)

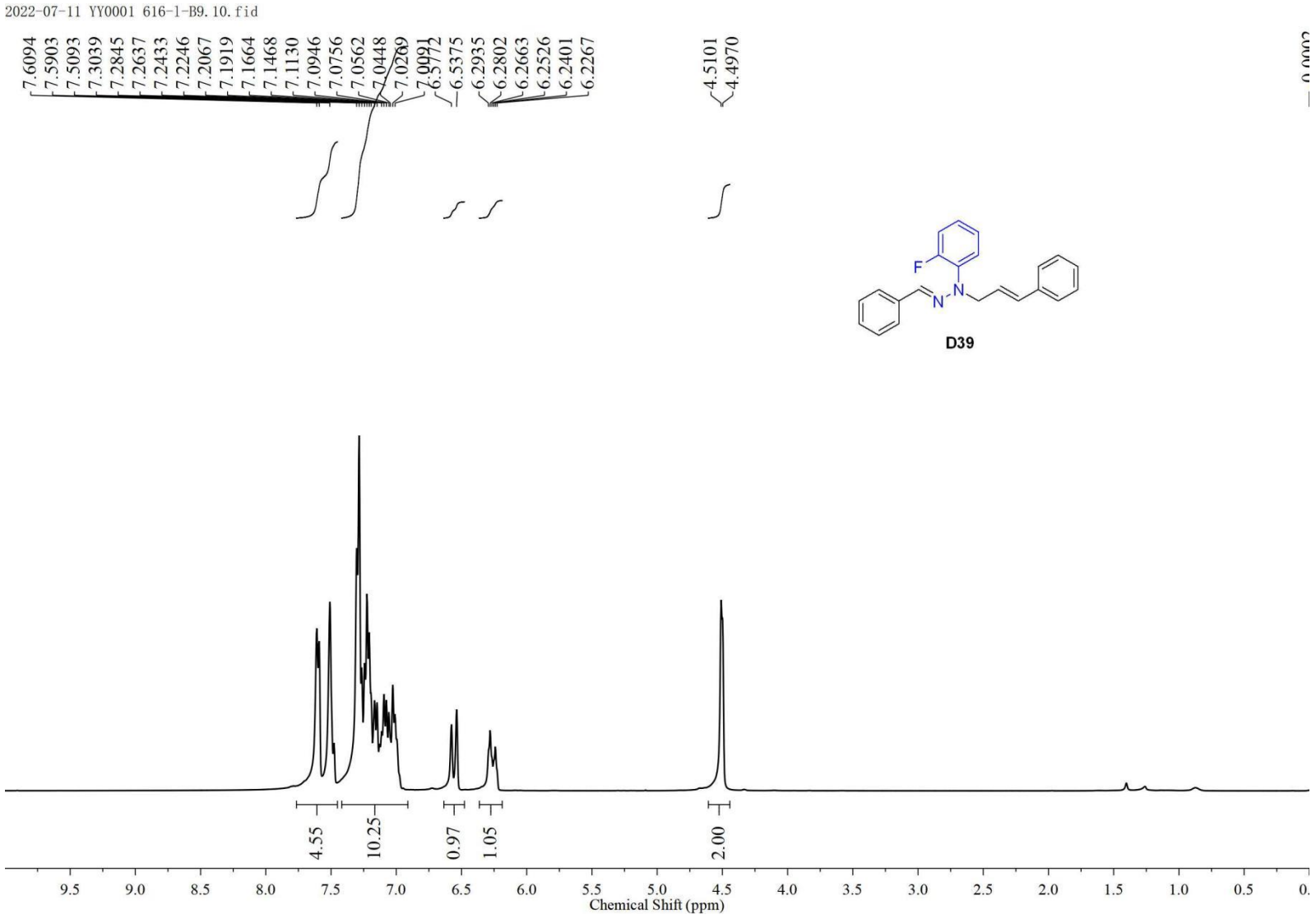
2022-6-15 yy0007-616-lqq-b4.10.fid

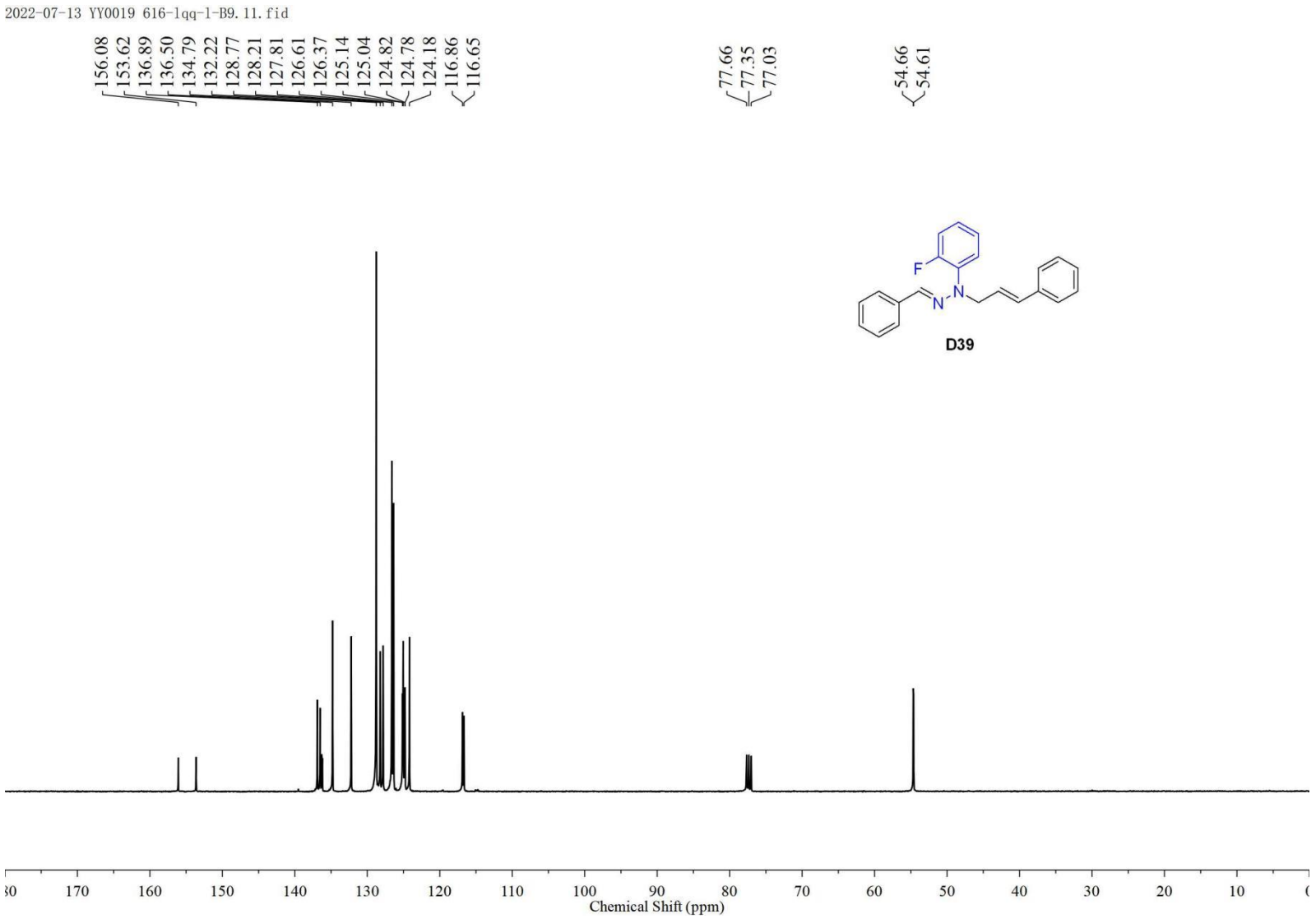
145.08
137.05
136.85
135.38
133.36
132.31
131.34
128.68
128.58
127.66
127.55
127.27
126.73
126.52
126.31
125.84
125.55
77.55
77.23
76.91
57.68
18.77



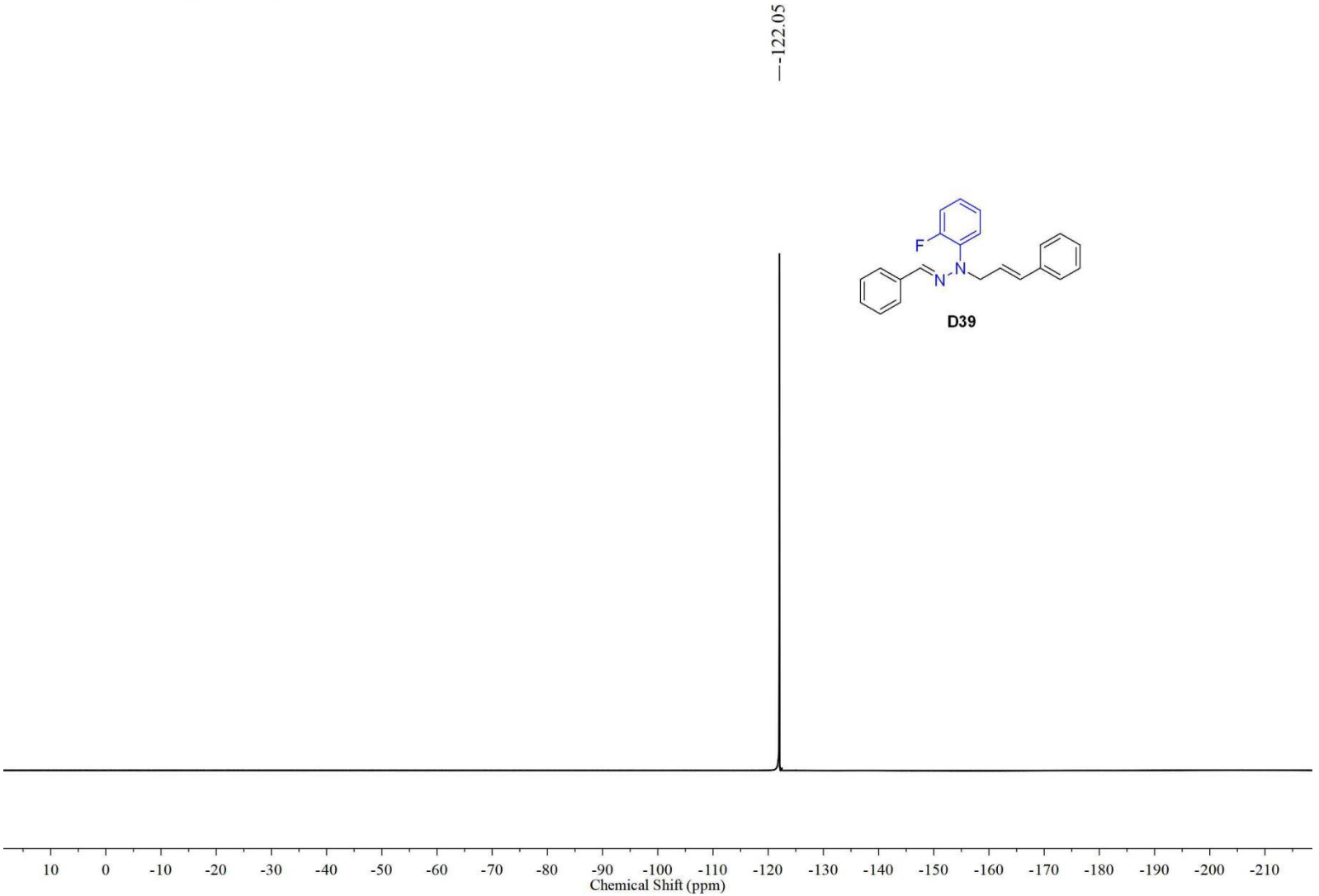
D38




2022-07-11 YY0001 616-1-B9.10.fid
7.6094
7.5903
7.5093
7.3039
7.2845
7.2637
7.2433
7.2246
7.2067
7.1919
7.1664
7.1468
7.1130
7.0946
7.0756
7.0562
7.0448
7.0269
7.0091
6.5375
6.2935
6.2802
6.2663
6.2526
6.2401
6.2267
4.5101
4.4970
F
N
N
D39
4.55
10.25
0.97
1.05
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

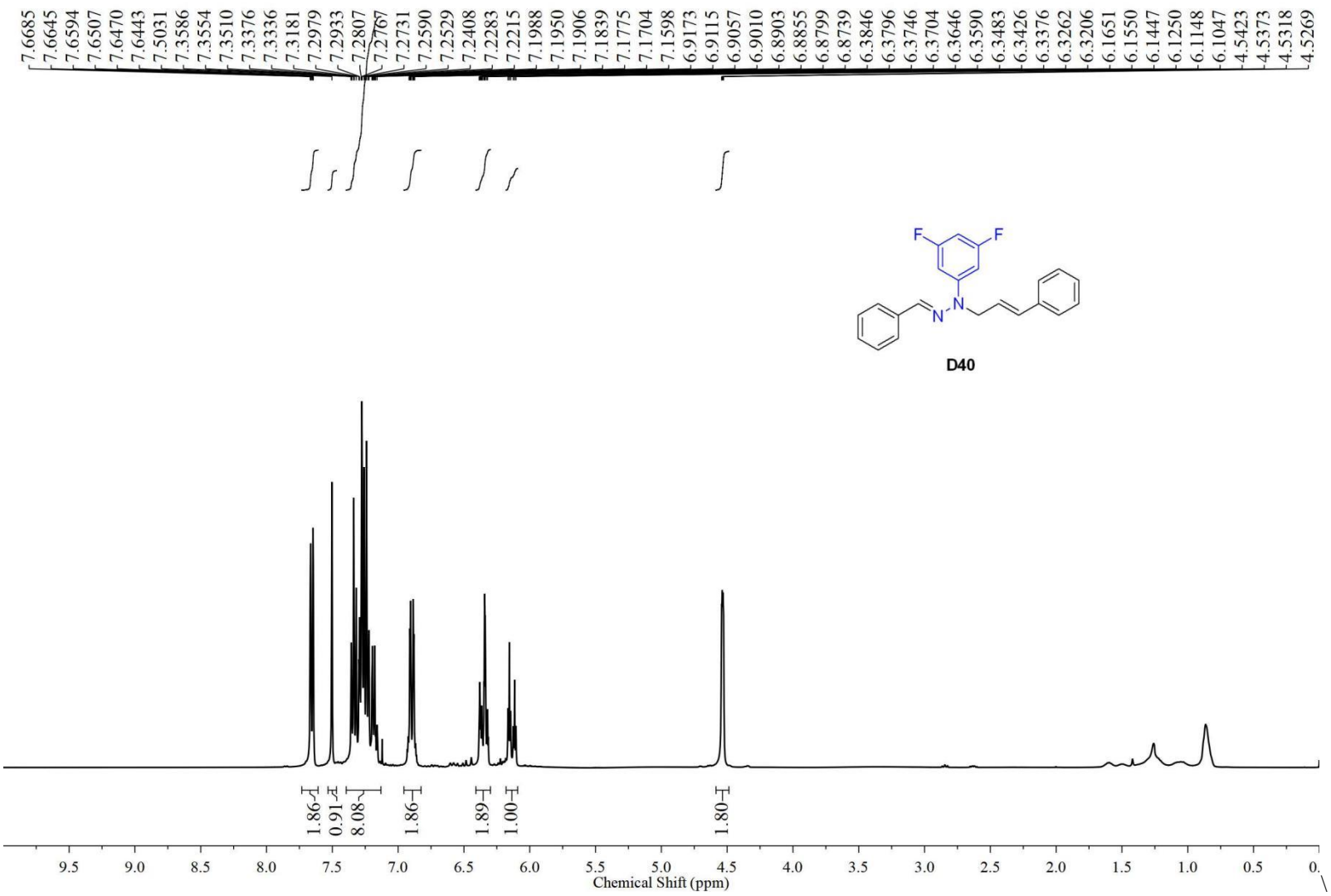

2022-07-13 YY0019 616-lqq-l-B9.11.fid
156.08
153.62
136.89
136.50
134.79
132.22
128.77
128.21
127.81
126.61
126.37
125.14
125.04
124.82
124.78
124.18
116.86
116.65
77.66
77.35
77.03
54.66
54.61
F
N
N
D39
Chemical Shift (ppm)

2022-07-13 YY0019 616-lqq-1-B9.10.fid



D39

2022-7-6 yy0028-616-lqq-32.10.fid

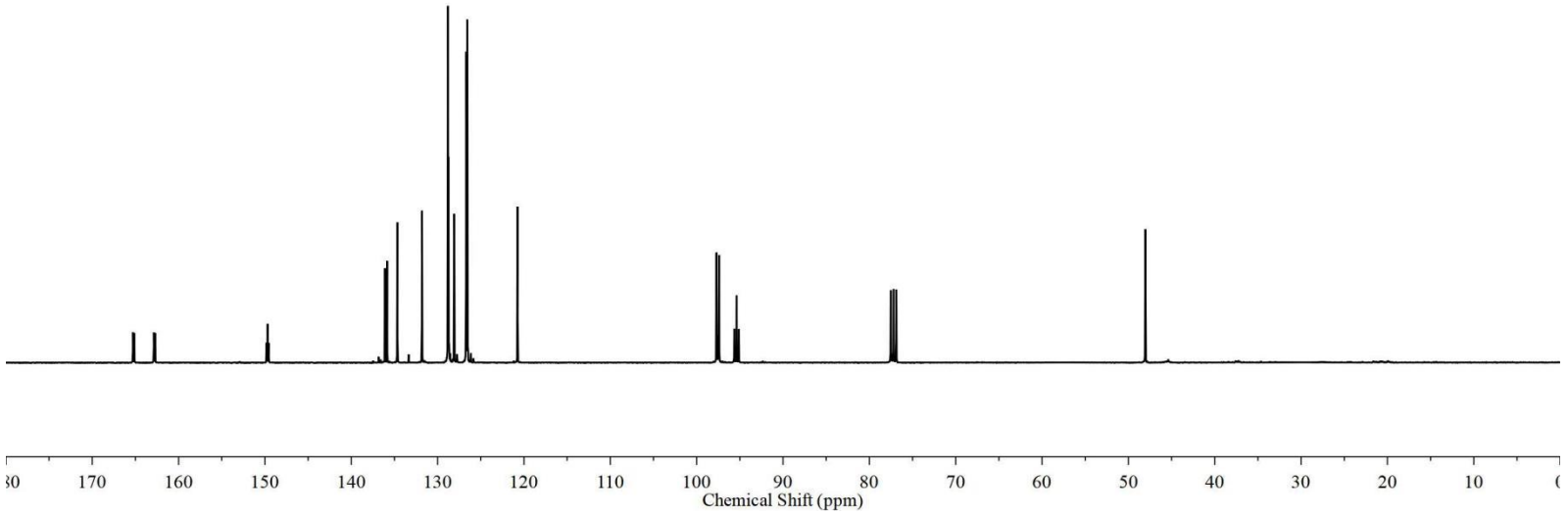


D40

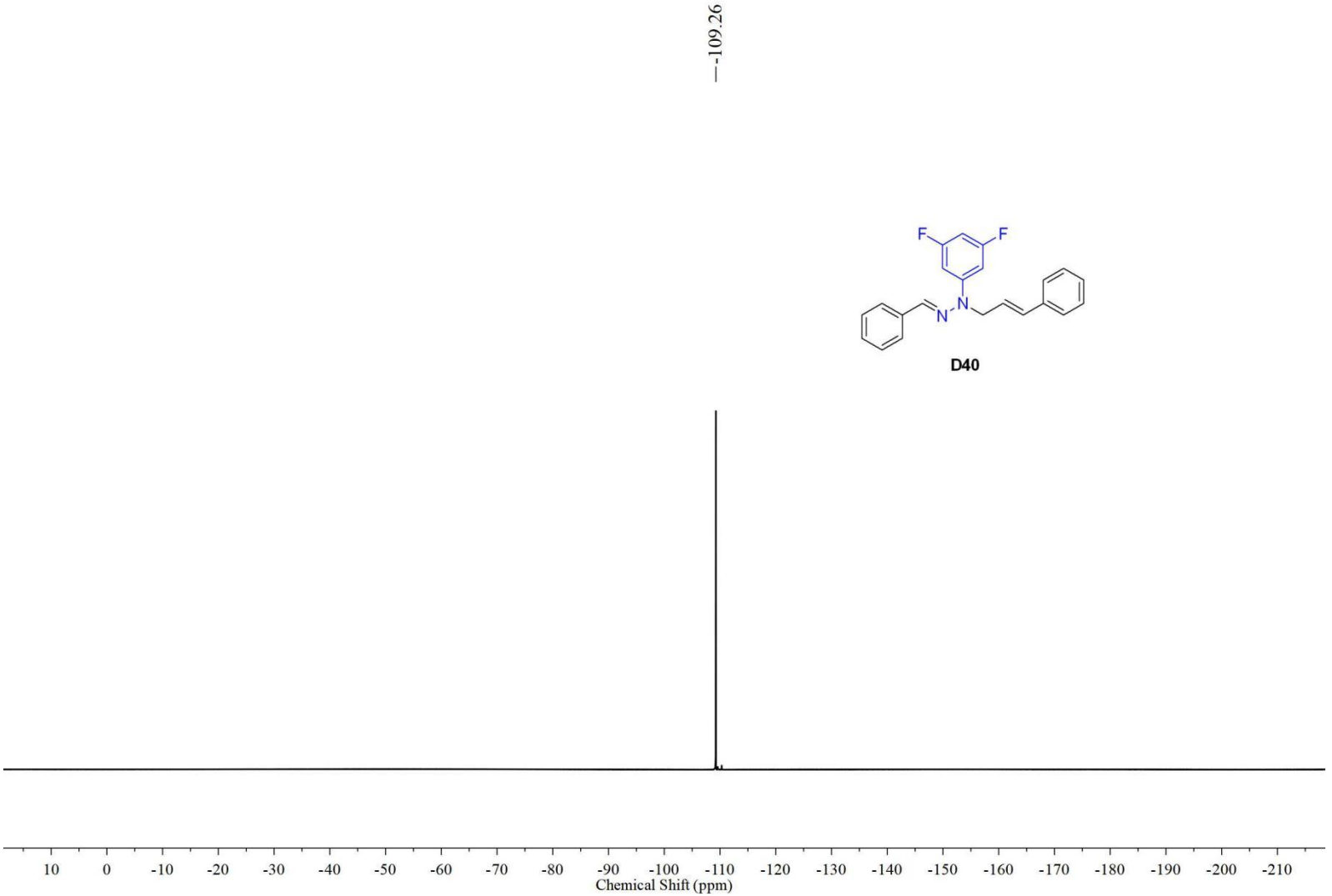
2022-7-6 yy0028-616-lqq-32.11.fid

165.28
165.13
162.86
162.70
149.82
149.69
149.56
136.10
135.85
134.66
131.81
128.80
128.74
128.08
126.69
126.56
120.75
97.70
97.61
97.49
97.40
95.64
95.38
95.12
77.52
77.20
76.88
48.03

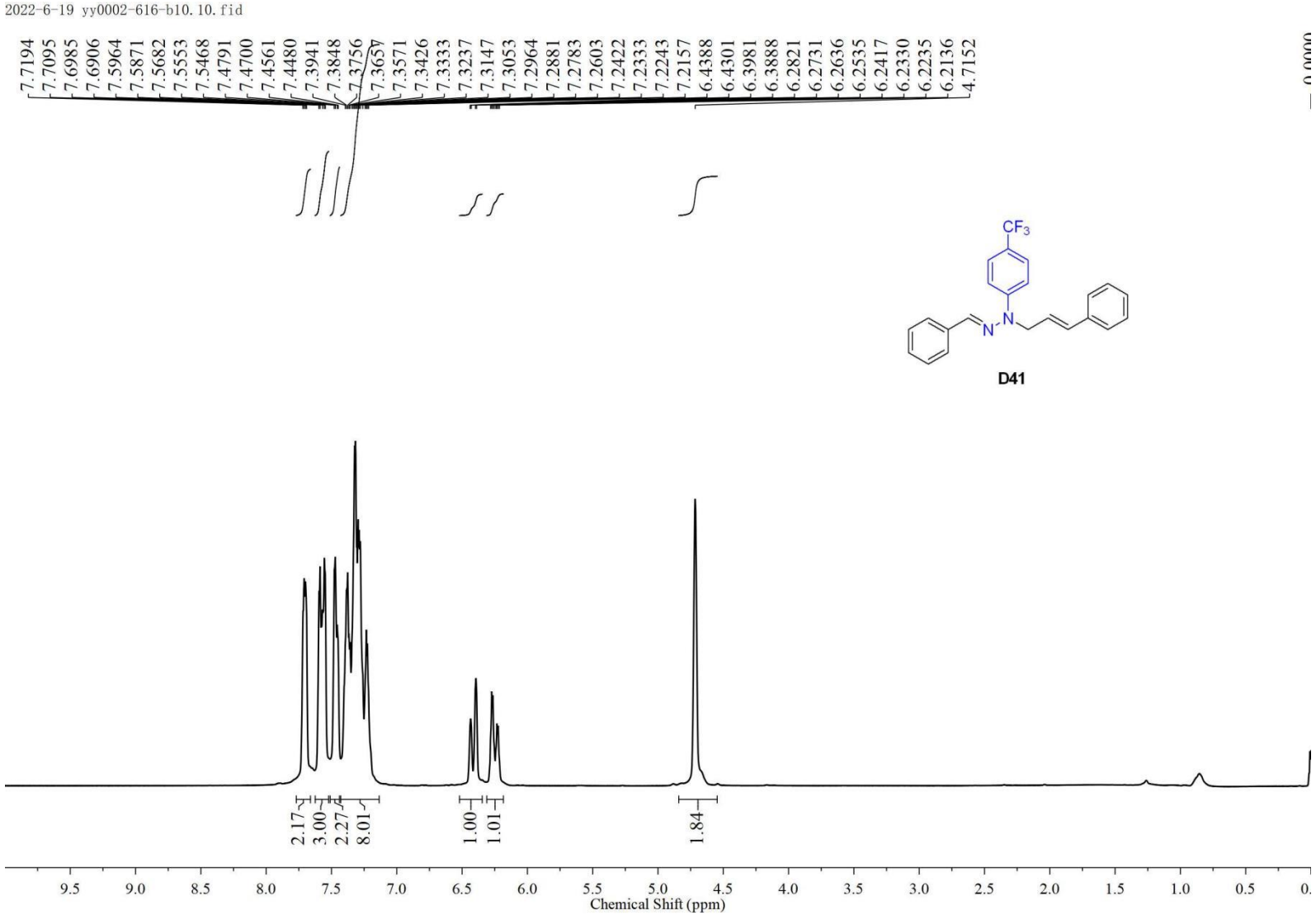
D40



2022-7-7 yy0036-616-b32.10.fid



D40

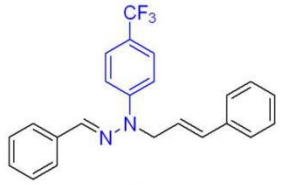

2022-6-19 yy0002-616-b10.10.fid
7.7194
7.7095
7.6985
7.6906
7.5964
7.5871
7.5682
7.5553
7.5468
7.4791
7.4700
7.4561
7.4480
7.3941
7.3848
7.3756
7.3657
7.3571
7.3426
7.3333
7.3237
7.3147
7.3053
7.2964
7.2881
7.2783
7.2603
7.2422
7.2333
7.2243
7.2157
6.4388
6.4301
6.3981
6.3888
6.2821
6.2731
6.2636
6.2535
6.2417
6.2330
6.2235
6.2136
4.7152
CF3
N
N
D41
2.17
3.00
2.27
8.01
1.00
1.01
1.84
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

2022-06-20 yy0016-616-Lqq-B10.10.fid

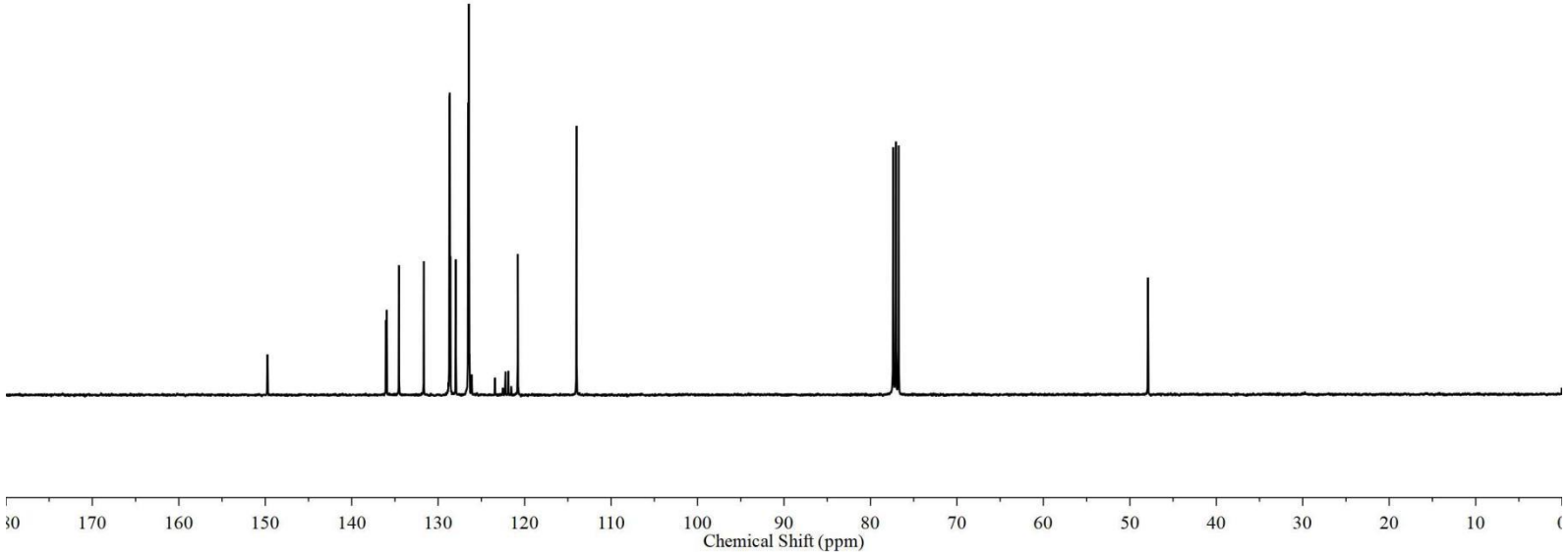
149.74
136.05
135.95
134.54
131.66
128.70
128.65
128.58
127.96
126.54
126.48
126.45
126.41
126.37
120.79
114.00

77.37
77.06
76.74

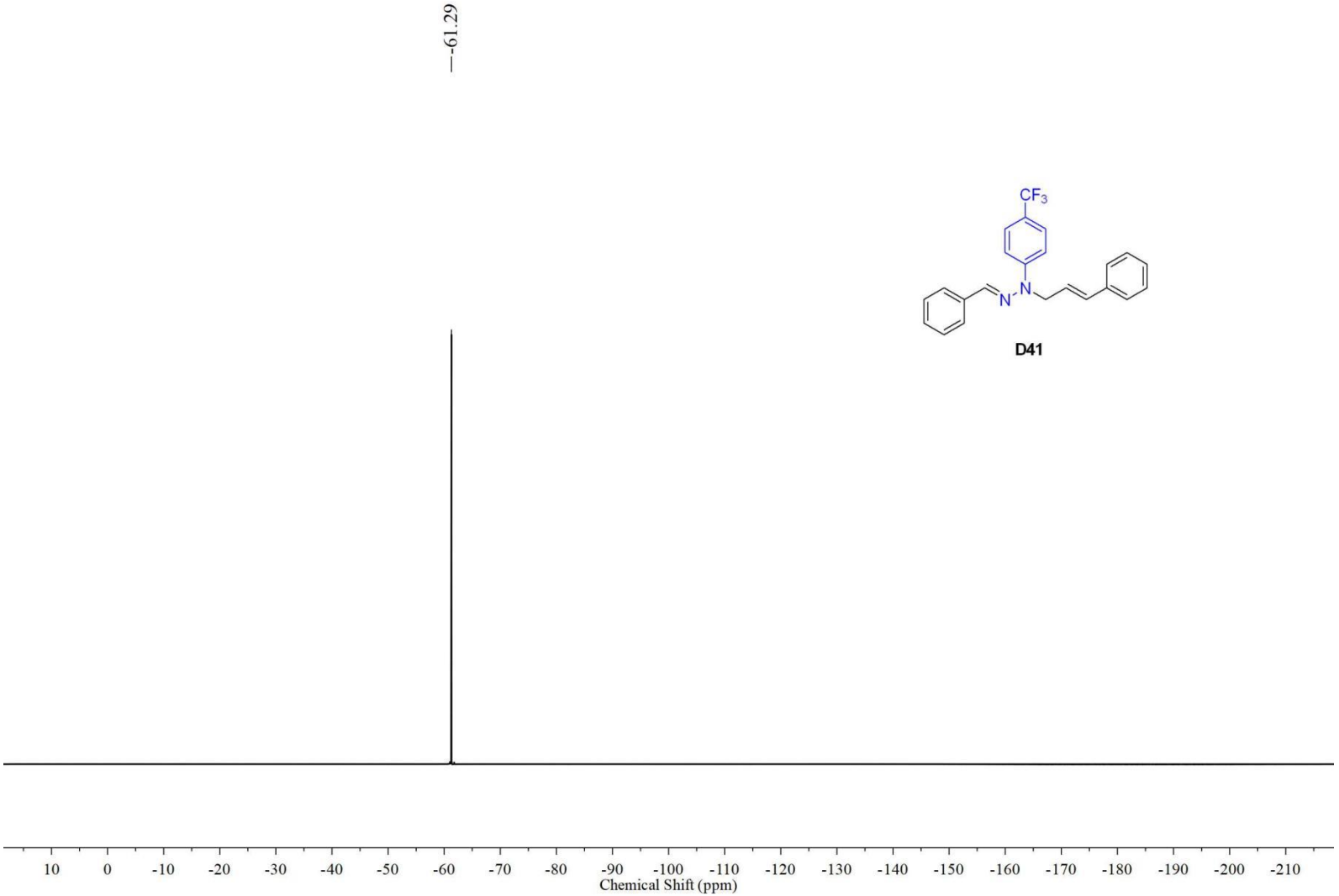
47.90



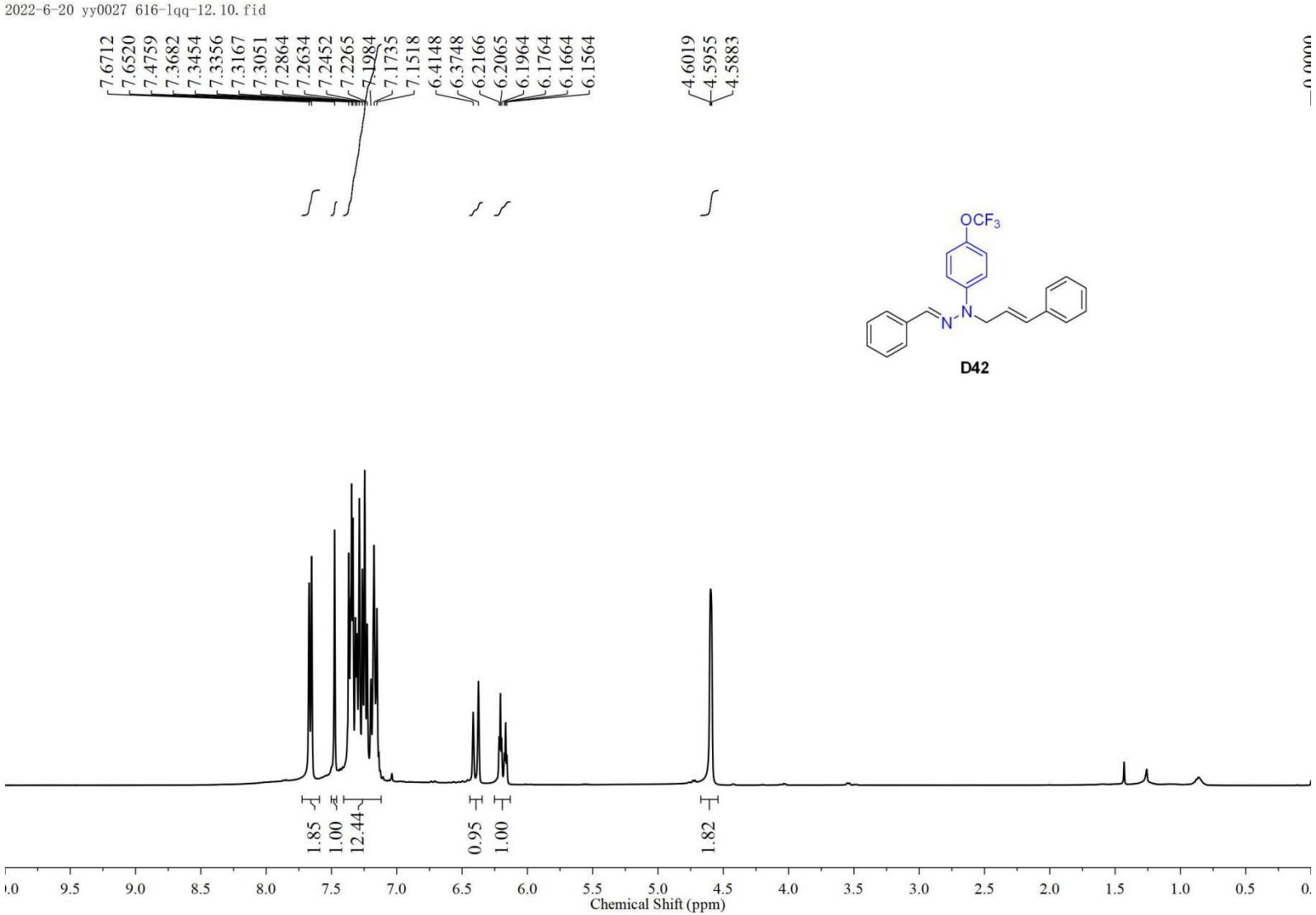
D41



2022-06-20 yy0016-616-Lqq-B10.11.fid

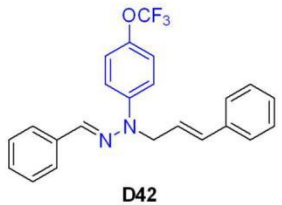


D41

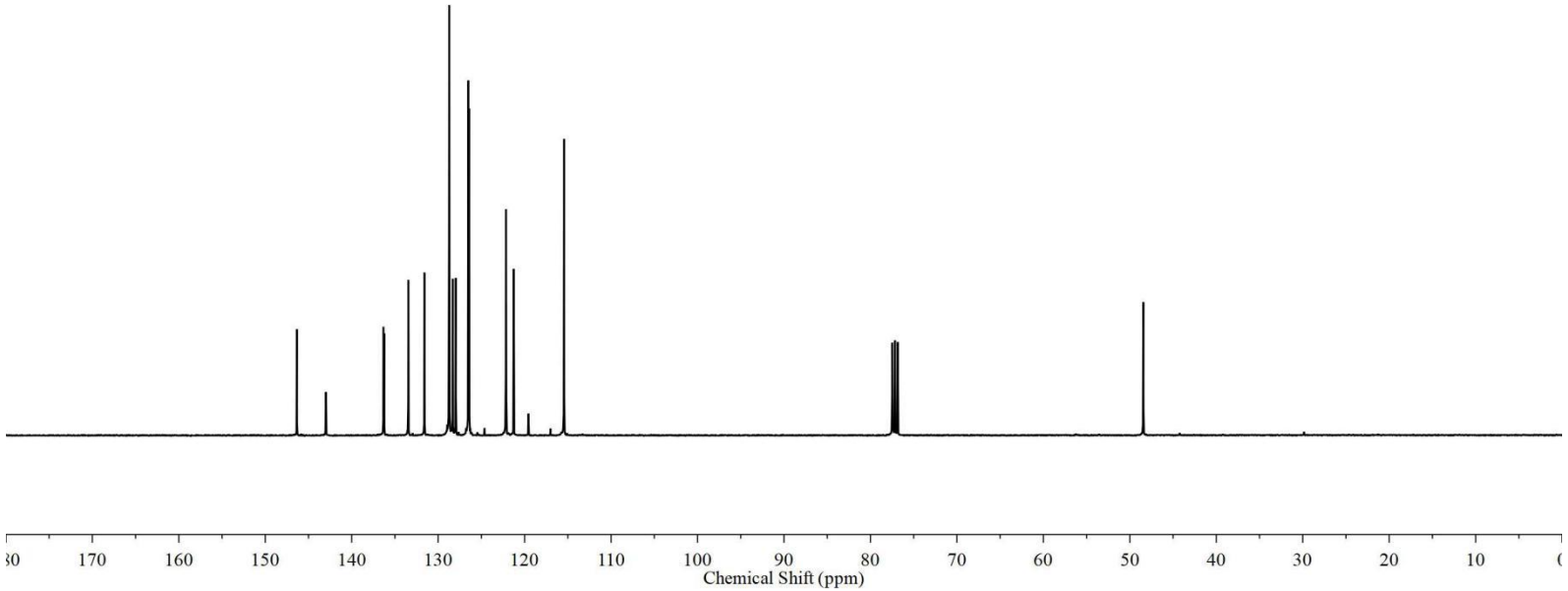

2022-6-20 yy0027 616-lqq-12.10.fid
7.6712
7.6520
7.4759
7.3682
7.3454
7.3356
7.3167
7.3051
7.2864
7.2634
7.2452
7.2265
7.1984
7.1735
7.1518
6.4148
6.3748
6.2166
6.2065
6.1964
6.1764
6.1664
6.1564
4.6019
4.5955
4.5883
OCF3
N
N
D42
1.85
1.00
12.44
0.95
1.00
1.82
Chemical Shift (ppm)

2022-06-21 yy0025 616-1qq-12.10.fid

146.34
142.99
142.98
136.33
136.24
133.44
131.59
128.73
128.72
128.32
127.97
126.51
126.41
122.16
121.26
115.44
77.48
77.16
76.84
48.44

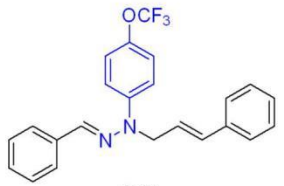


D42

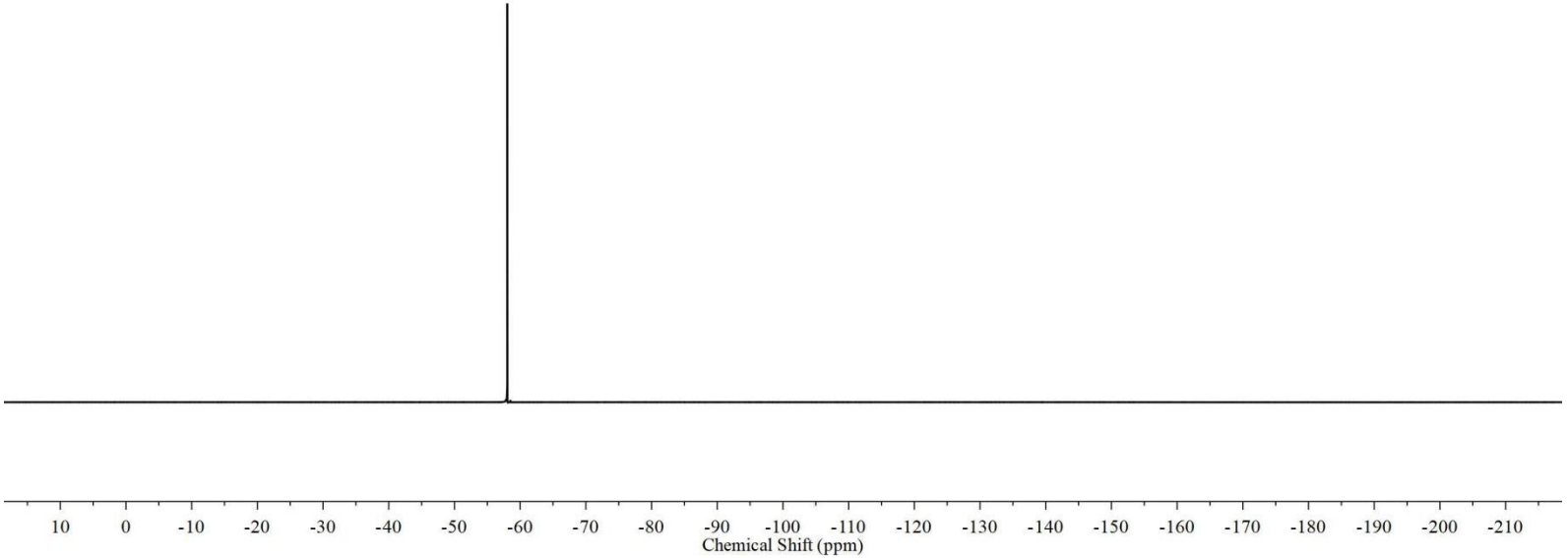


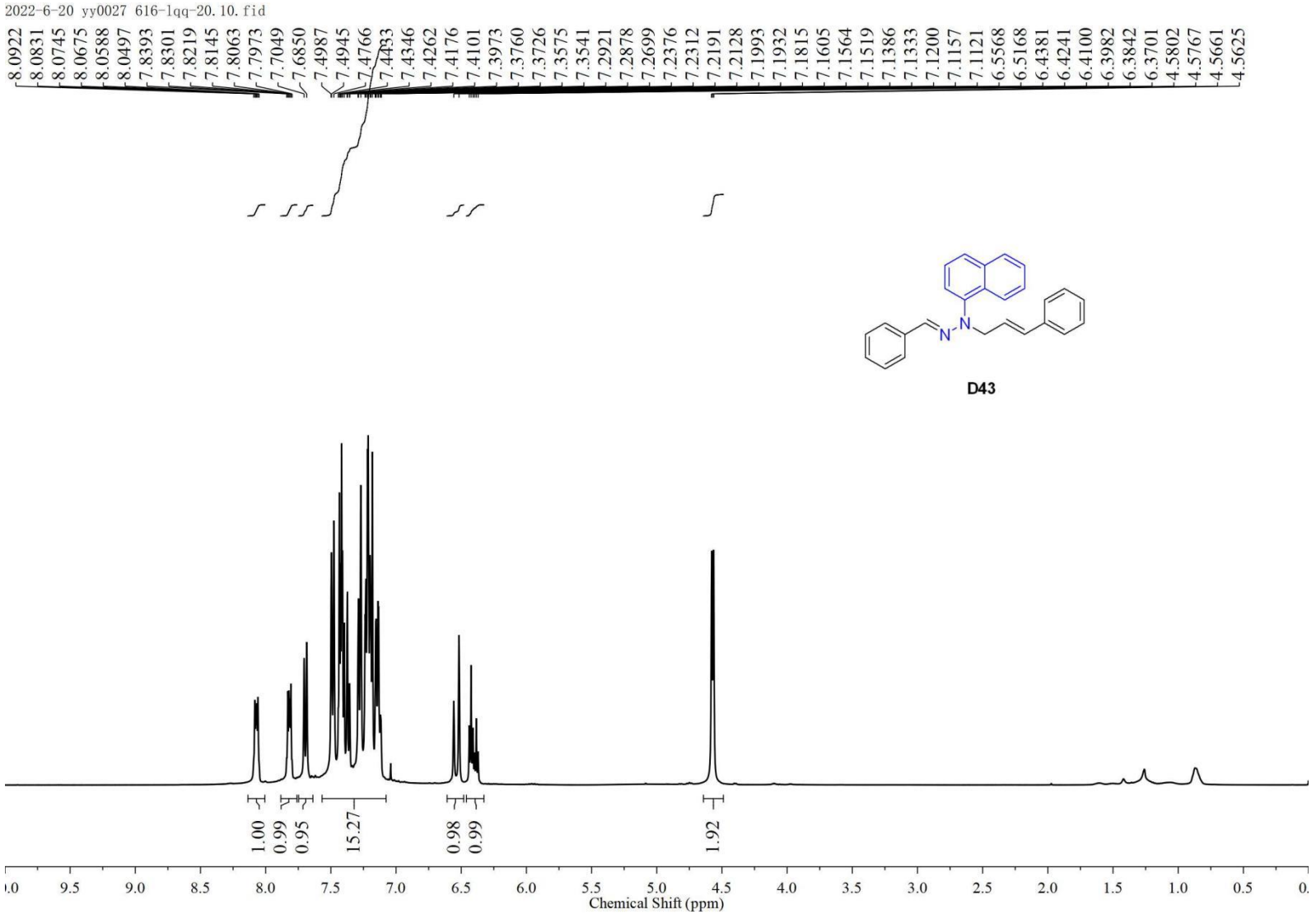
2022-06-21 yy0025 616-1qq-12.11.fid

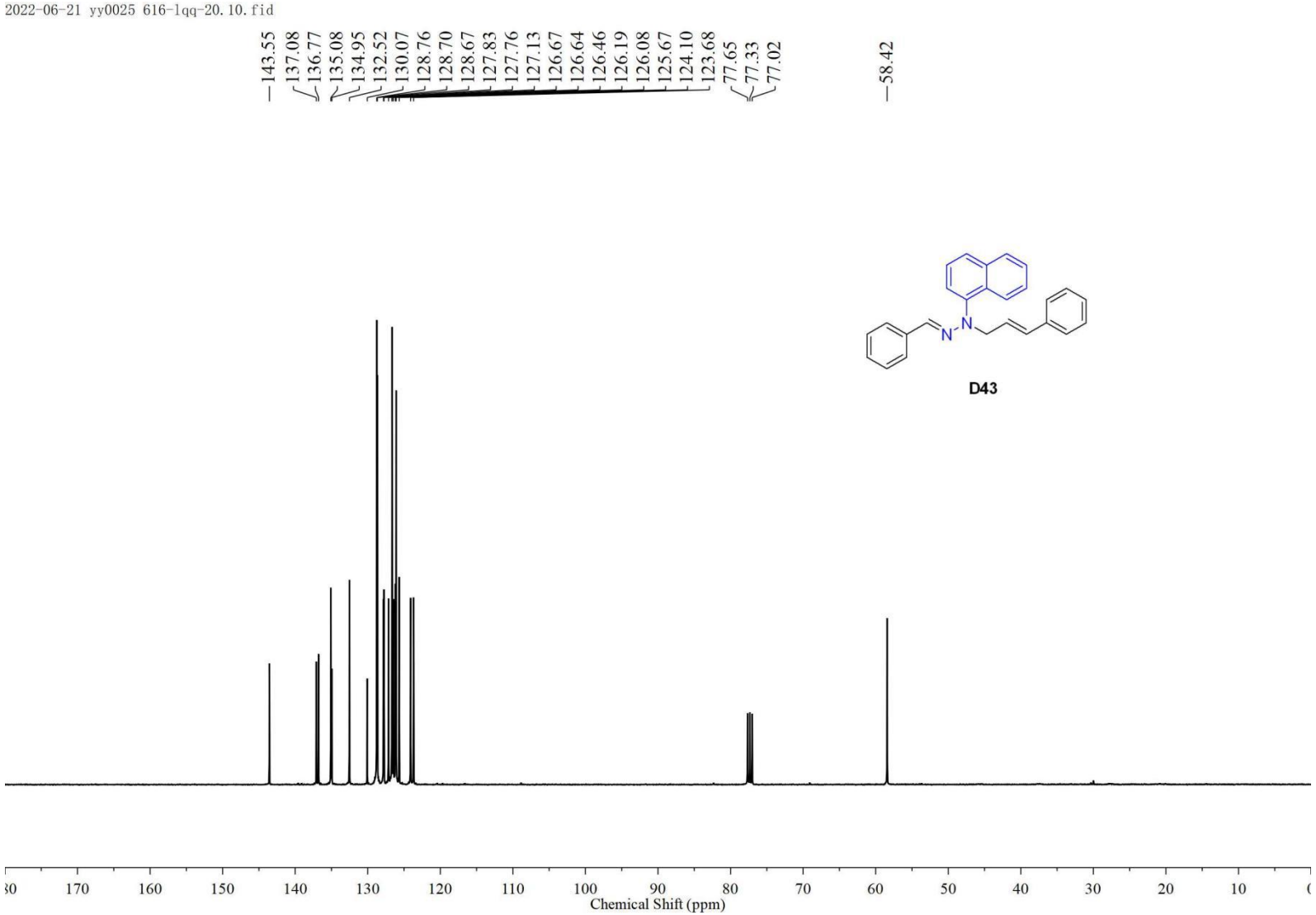
-58.05

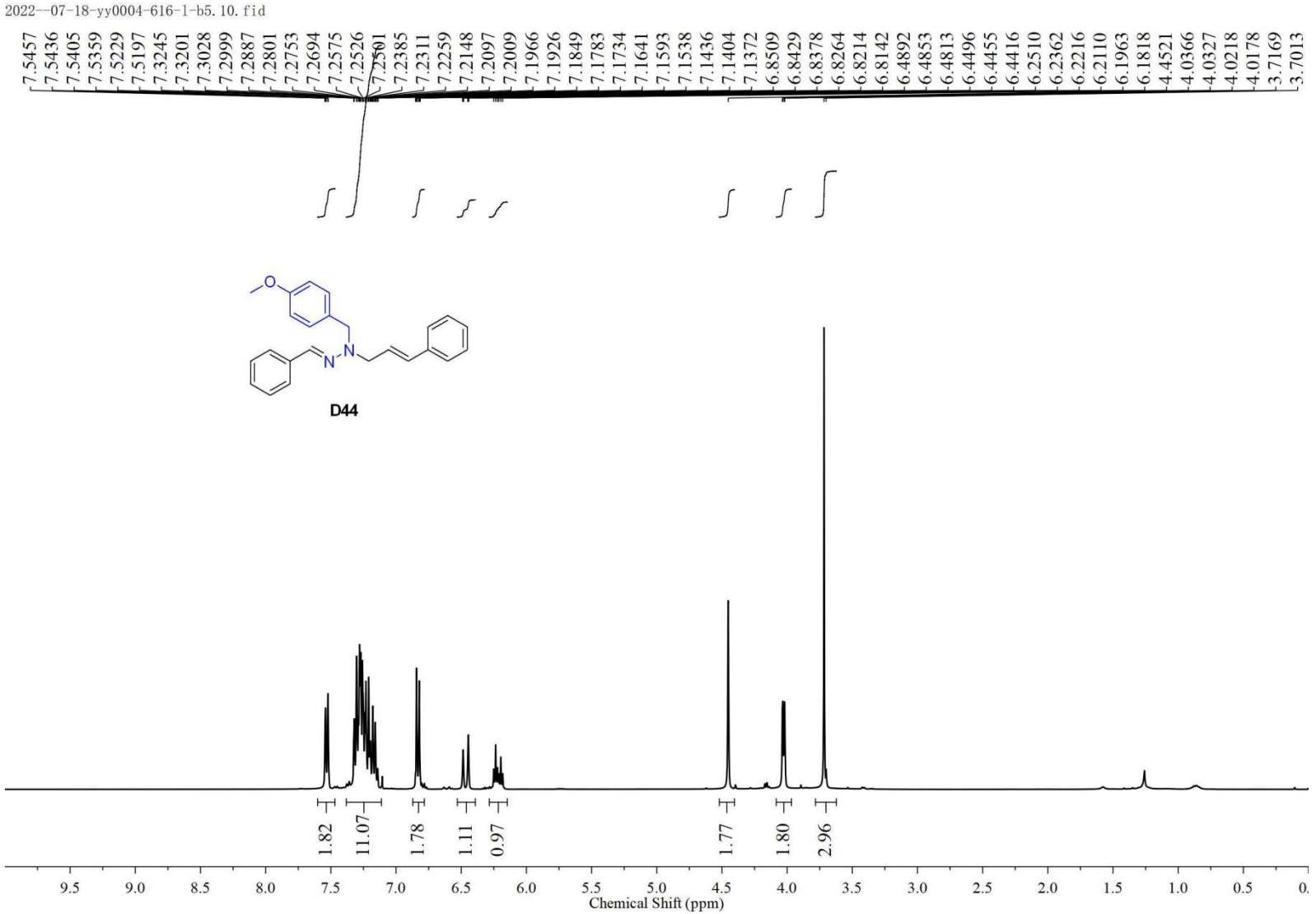


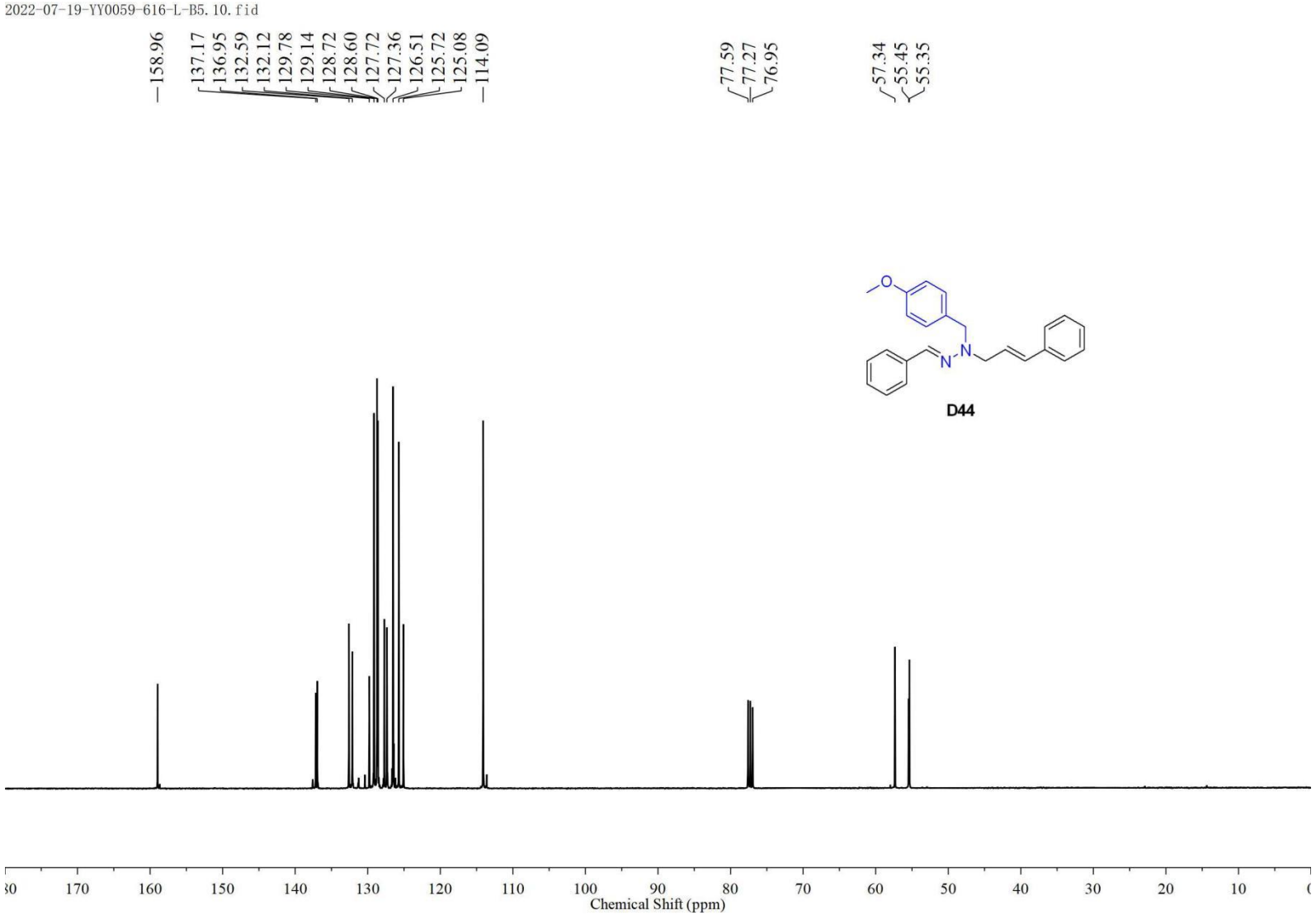
D42

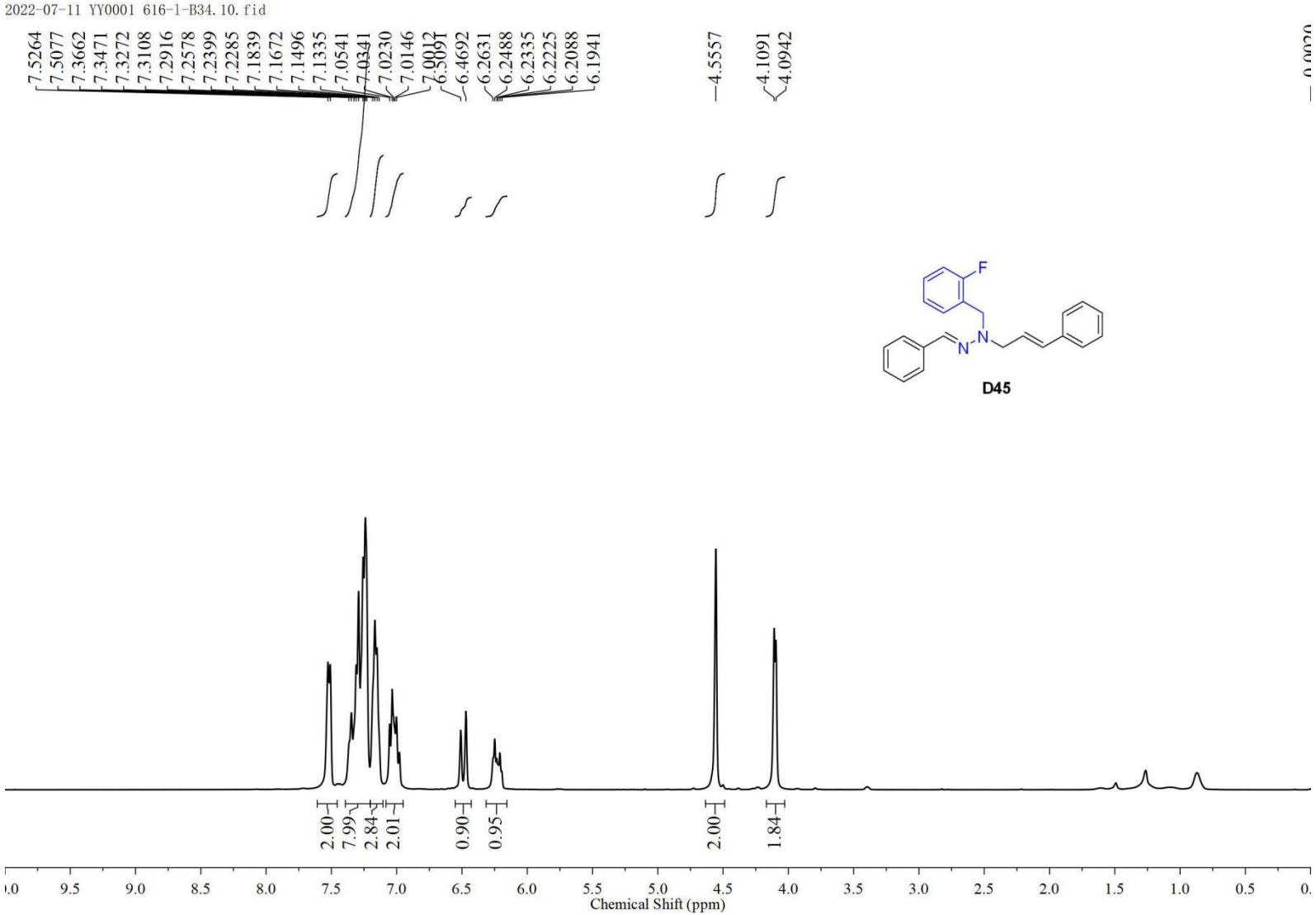


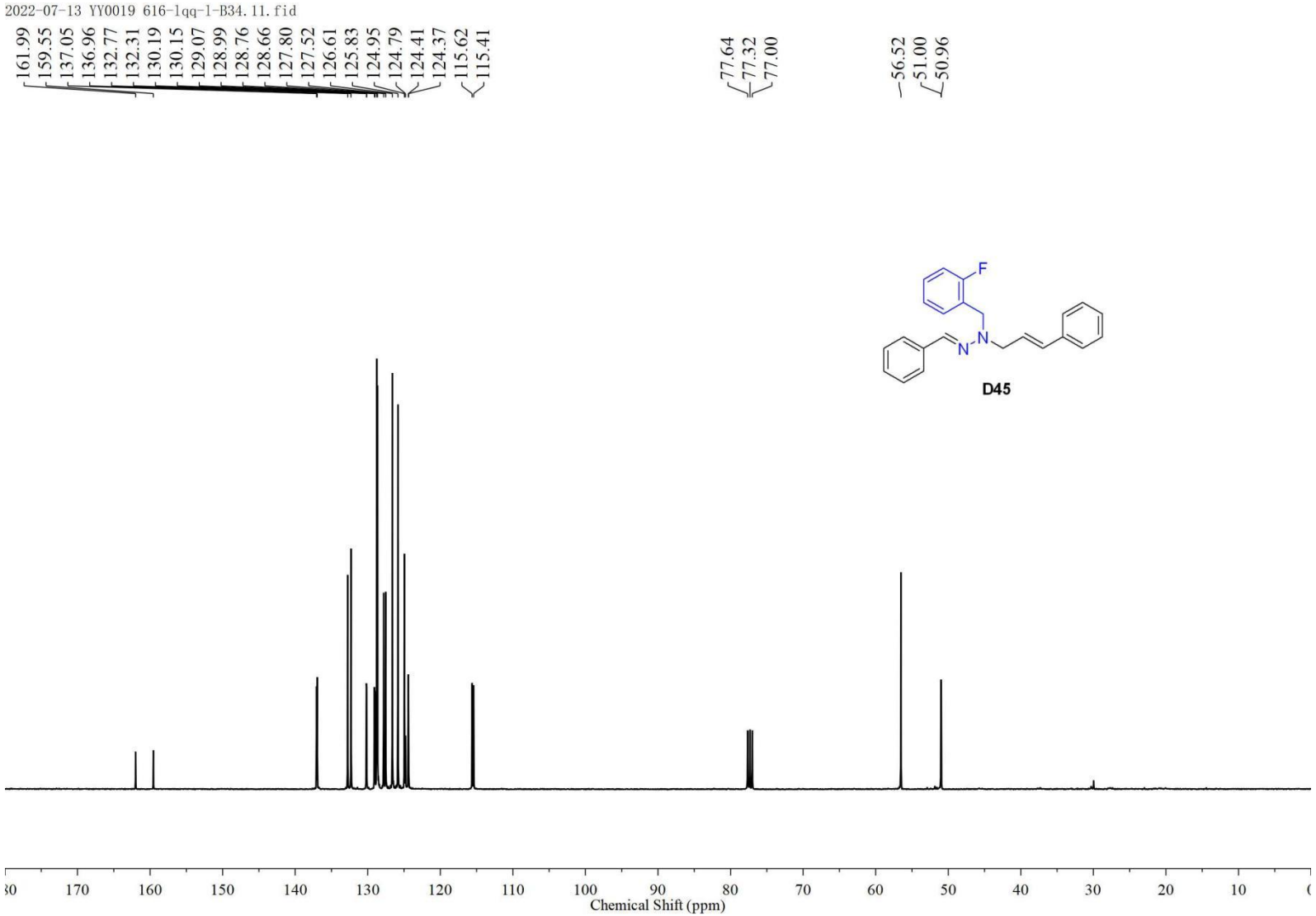

2022-6-20 yy0027 616-lqq-20.10.fid
8.0922
8.0831
8.0745
8.0675
8.0588
8.0497
7.8393
7.8301
7.8219
7.8145
7.8063
7.7973
7.7049
7.6850
7.4987
7.4945
7.4766
7.4433
7.4346
7.4262
7.4176
7.4101
7.3973
7.3760
7.3726
7.3575
7.3541
7.2921
7.2878
7.2699
7.2376
7.2312
7.2191
7.2128
7.1993
7.1932
7.1815
7.1605
7.1564
7.1519
7.1386
7.1333
7.1200
7.1157
7.1121
6.5568
6.5168
6.4381
6.4241
6.4100
6.3982
6.3842
6.3701
4.5802
4.5767
4.5661
4.5625
N
N
D43
1.00
0.99
0.95
15.27
0.98
0.99
1.92
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)


2022-06-21 yy0025 616-1qq-20.10.fid
143.55
137.08
136.77
135.08
134.95
132.52
130.07
128.76
128.70
128.67
127.83
127.76
127.13
126.67
126.64
126.46
126.19
126.08
125.67
124.10
123.68
77.65
77.33
77.02
58.42
D43
Chemical Shift (ppm)

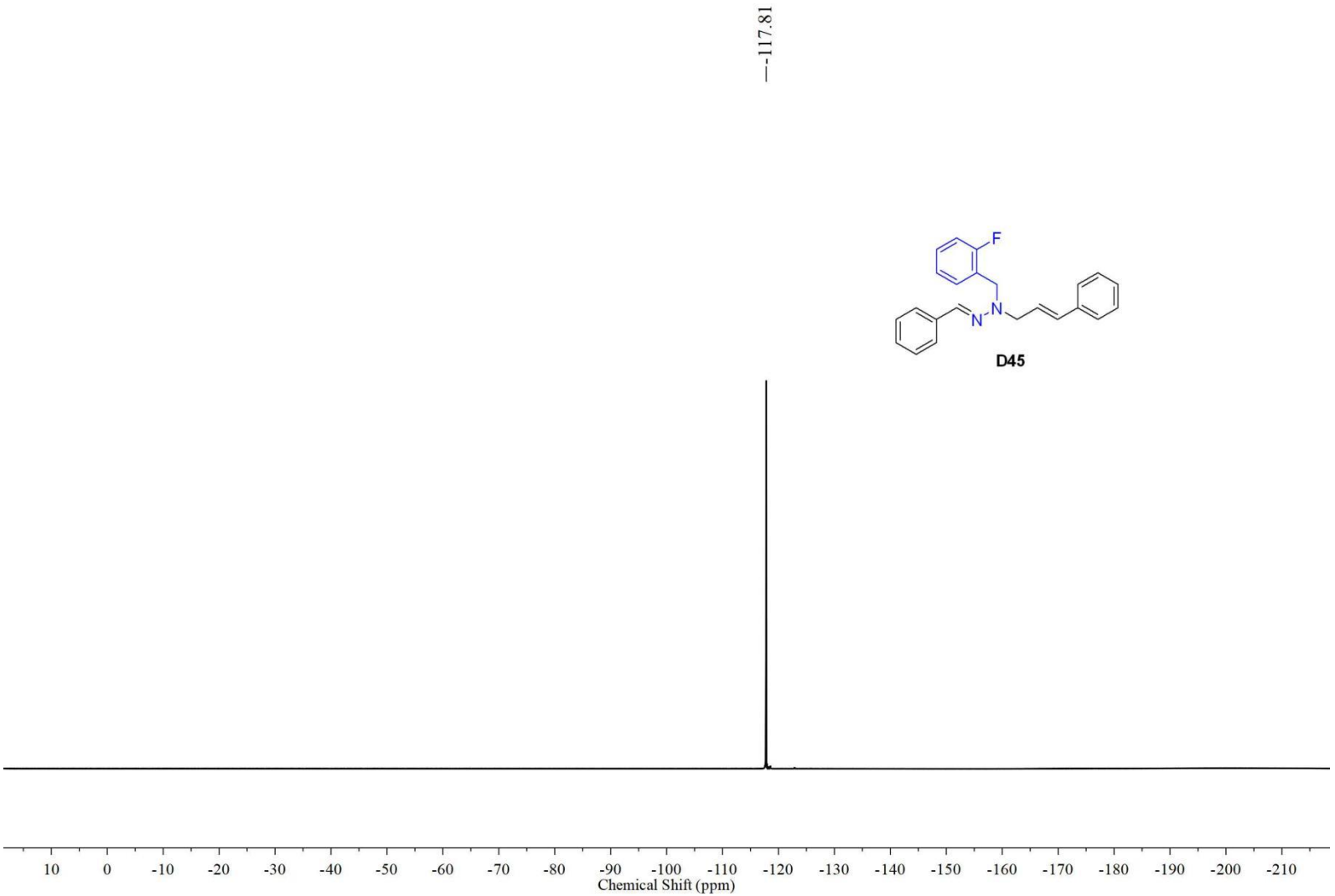

2022--07-18-yy0004-616-1-b5.10.fid
7.5457
7.5436
7.5405
7.5359
7.5229
7.5197
7.3245
7.3201
7.3028
7.2999
7.2887
7.2801
7.2753
7.2694
7.2575
7.2526
7.2501
7.2385
7.2311
7.2259
7.2148
7.2097
7.2009
7.1966
7.1926
7.1849
7.1783
7.1734
7.1641
7.1593
7.1538
7.1436
7.1404
7.1372
6.8509
6.8429
6.8378
6.8264
6.8214
6.8142
6.4892
6.4853
6.4813
6.4496
6.4455
6.4416
6.2510
6.2362
6.2216
6.2110
6.1963
6.1818
4.4521
4.0366
4.0327
4.0218
4.0178
3.7169
3.7013
O
N
N
D44
1.82
11.07
1.78
1.11
0.97
1.77
1.80
2.96
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

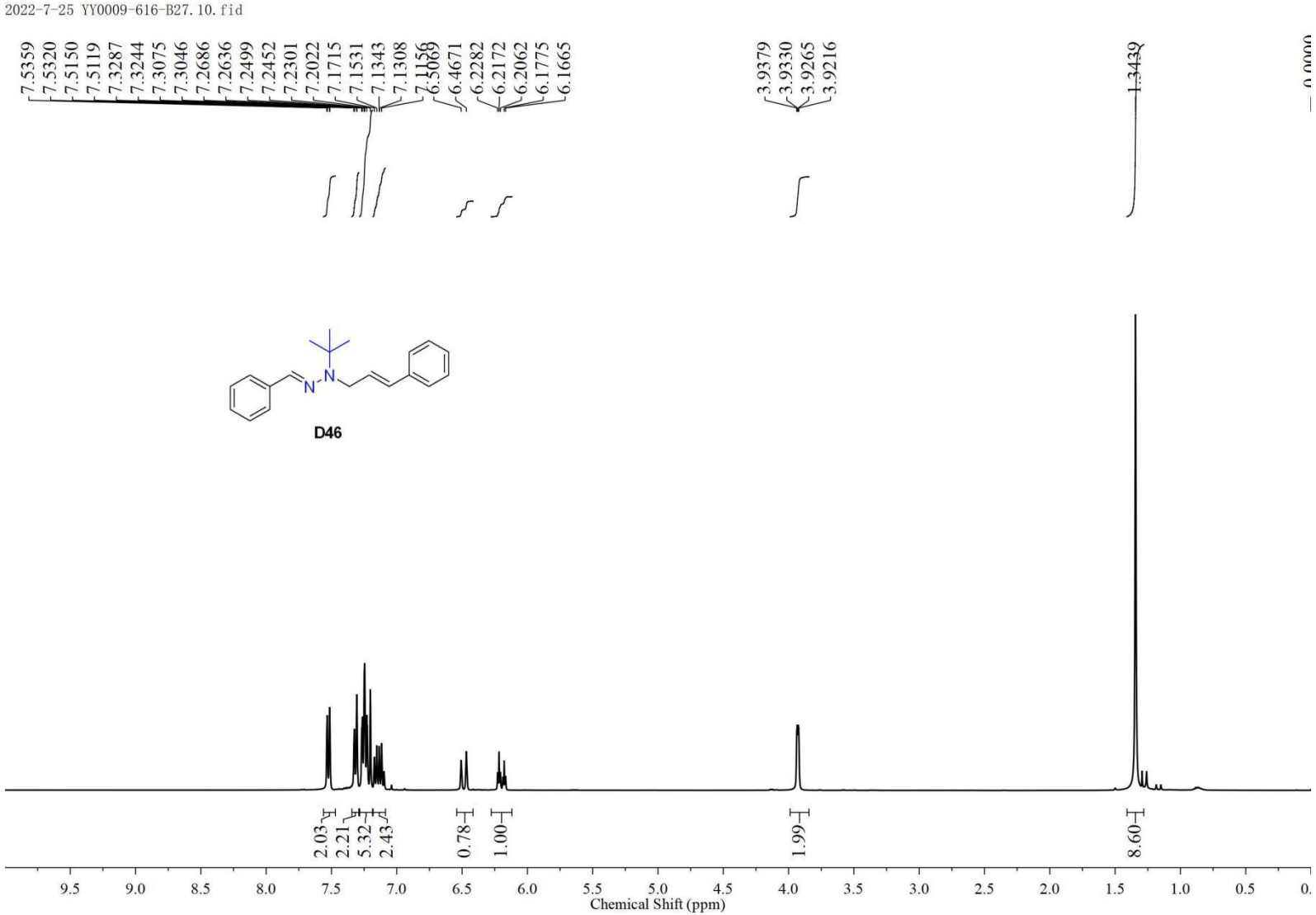

2022-07-19-YY0059-616-L-B5.10.fid
158.96
137.17
136.95
132.59
132.12
129.78
129.14
128.72
128.60
127.72
127.36
126.51
125.72
125.08
114.09
77.59
77.27
76.95
57.34
55.45
55.35
O
N
N
D44
Chemical Shift (ppm)


2022-07-11 YY0001 616-1-B34.10.fid
7.5264
7.5077
7.3662
7.3471
7.3272
7.3108
7.2916
7.2578
7.2399
7.2285
7.1839
7.1672
7.1496
7.1335
7.0541
7.0341
7.0230
7.0146
6.4692
6.2631
6.2488
6.2335
6.2225
6.2088
6.1941
4.5557
4.1091
4.0942
F
N
N
D45
2.00
7.99
2.84
2.01
0.90
0.95
2.00
1.84
Chemical Shift (ppm)

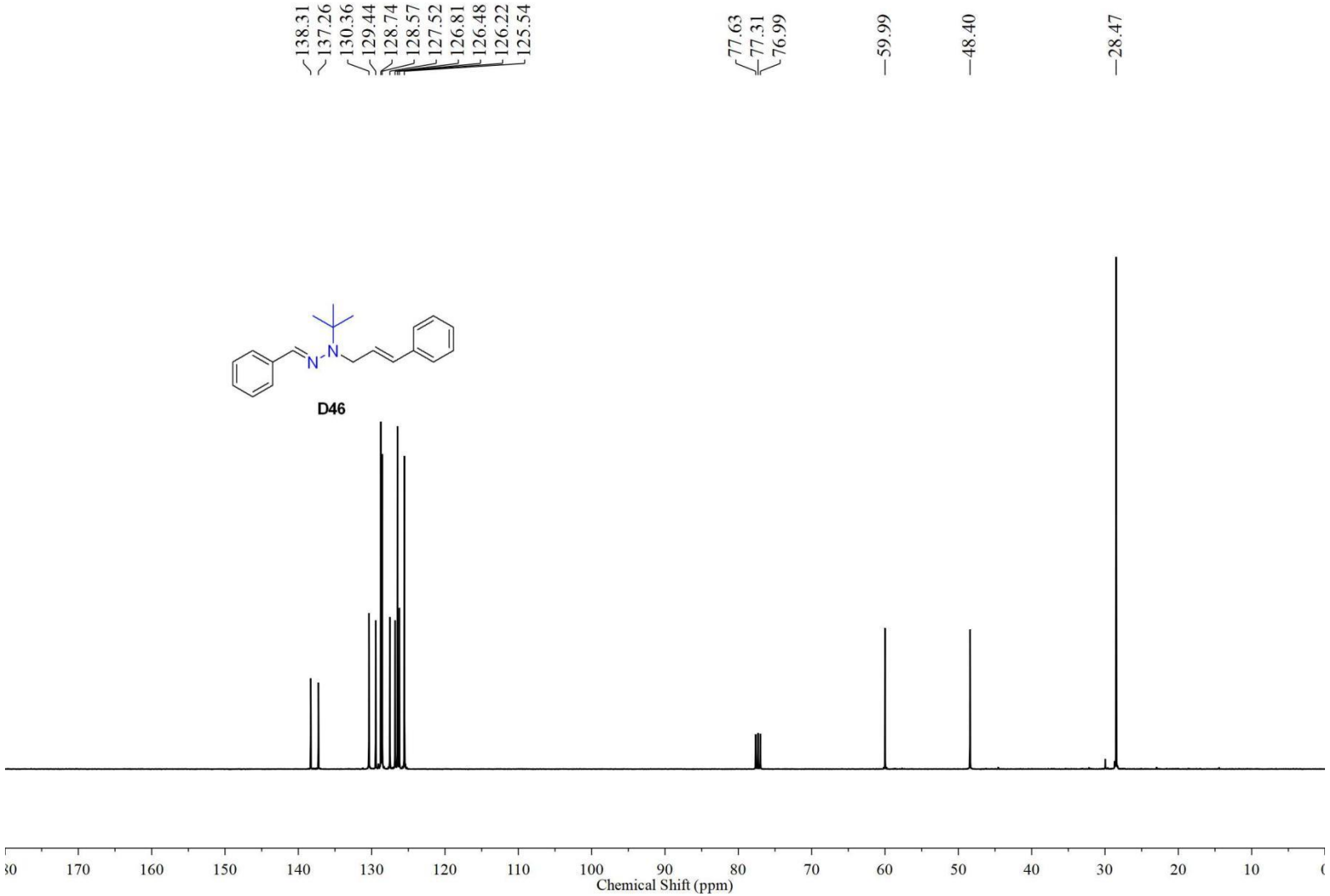

2022-07-13 YY0019 616-1qq-1-B34.11.fid
161.99
159.55
137.05
136.96
132.77
132.31
130.19
130.15
129.07
128.99
128.76
128.66
127.80
127.52
126.61
125.83
124.95
124.79
124.41
124.37
115.62
115.41
77.64
77.32
77.00
56.52
51.00
50.96
F
N
N
D45
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

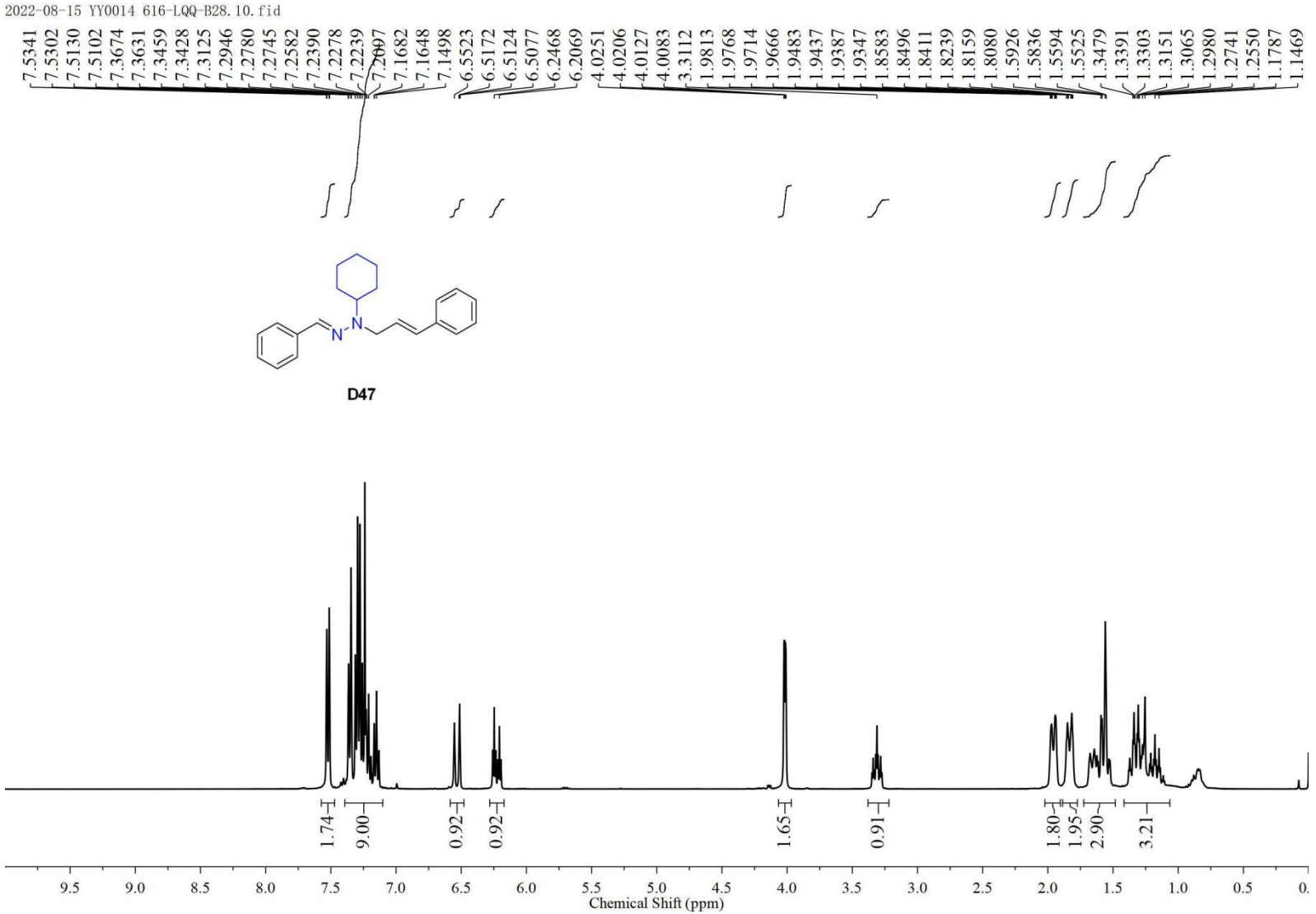
2022-07-13 YY0019 616-1qq-1-B34.10.fid




2022-7-25 YY0009-616-B27.10.fid
7.5359
7.5320
7.5150
7.5119
7.3287
7.3244
7.3075
7.3046
7.2686
7.2636
7.2499
7.2452
7.2301
7.2022
7.1715
7.1531
7.1343
7.1308
7.1156
7.1069
6.4671
6.2282
6.2172
6.2062
6.1775
6.1665
3.9379
3.9330
3.9265
3.9216
1.3439
0.0000
D46
2.03
2.21
5.32
2.43
0.78
1.00
1.99
8.60
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

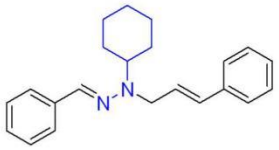
2022-07-26 yy0047 616-zxy-BZ7.10.fid



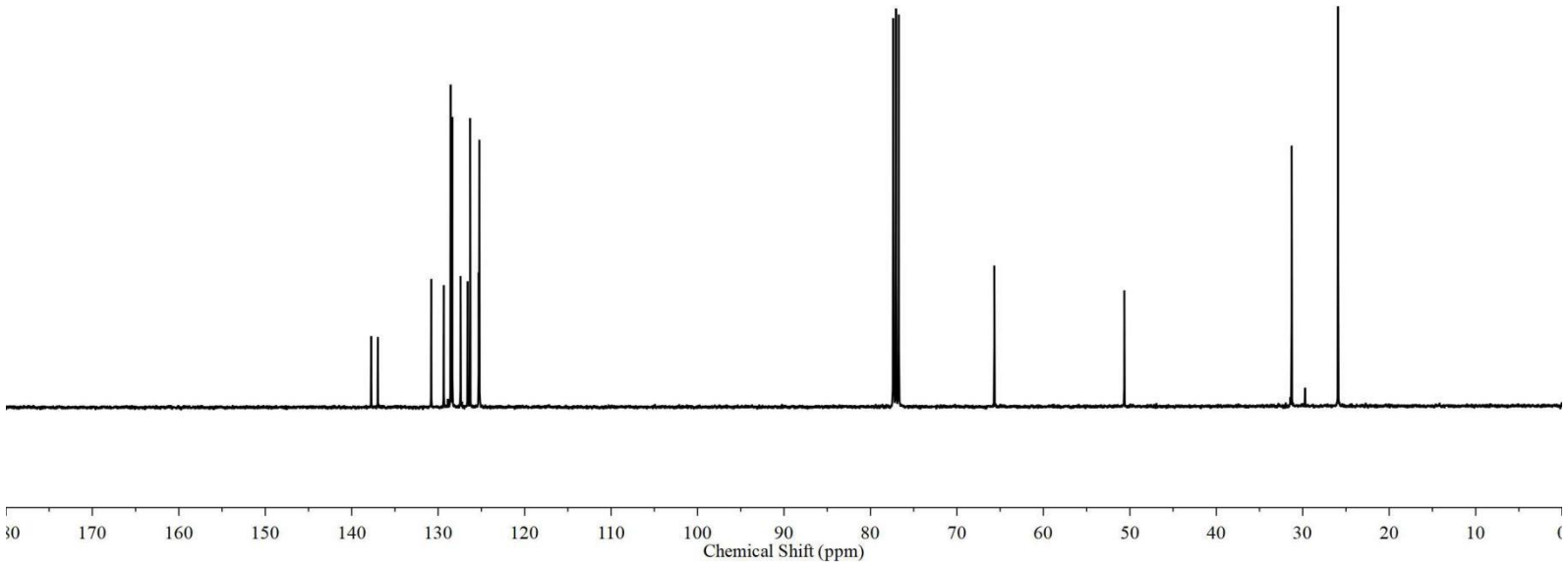

2022-08-15 YY0014 616-LQQ-B28.10.fid
7.5341
7.5302
7.5130
7.5102
7.3674
7.3631
7.3459
7.3428
7.3125
7.2946
7.2780
7.2745
7.2582
7.2390
7.2278
7.2239
7.2097
7.1682
7.1648
7.1498
6.5523
6.5172
6.5124
6.5077
6.2468
6.2069
4.0251
4.0206
4.0127
4.0083
3.3112
1.9813
1.9768
1.9714
1.9666
1.9483
1.9437
1.9387
1.9347
1.8583
1.8496
1.8411
1.8239
1.8159
1.8080
1.5926
1.5836
1.5594
1.5525
1.3479
1.3391
1.3303
1.3151
1.3065
1.2980
1.2741
1.2550
1.1787
1.1469
N
N
D47
1.74
9.00
0.92
0.92
1.65
0.91
1.80
1.95
2.90
3.21
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

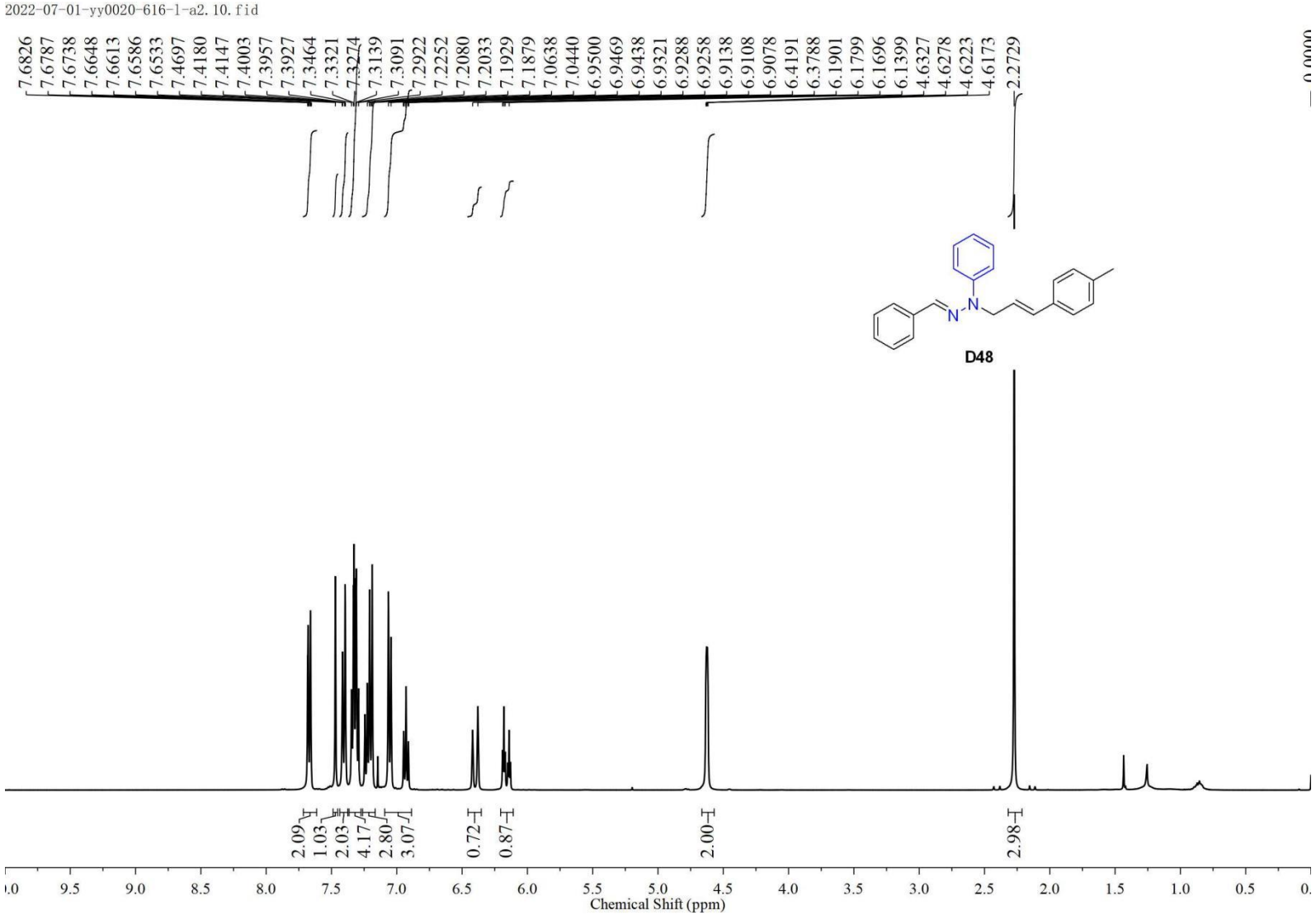
2022-08-15 YY0014 616-LQQ-B28.11.fid

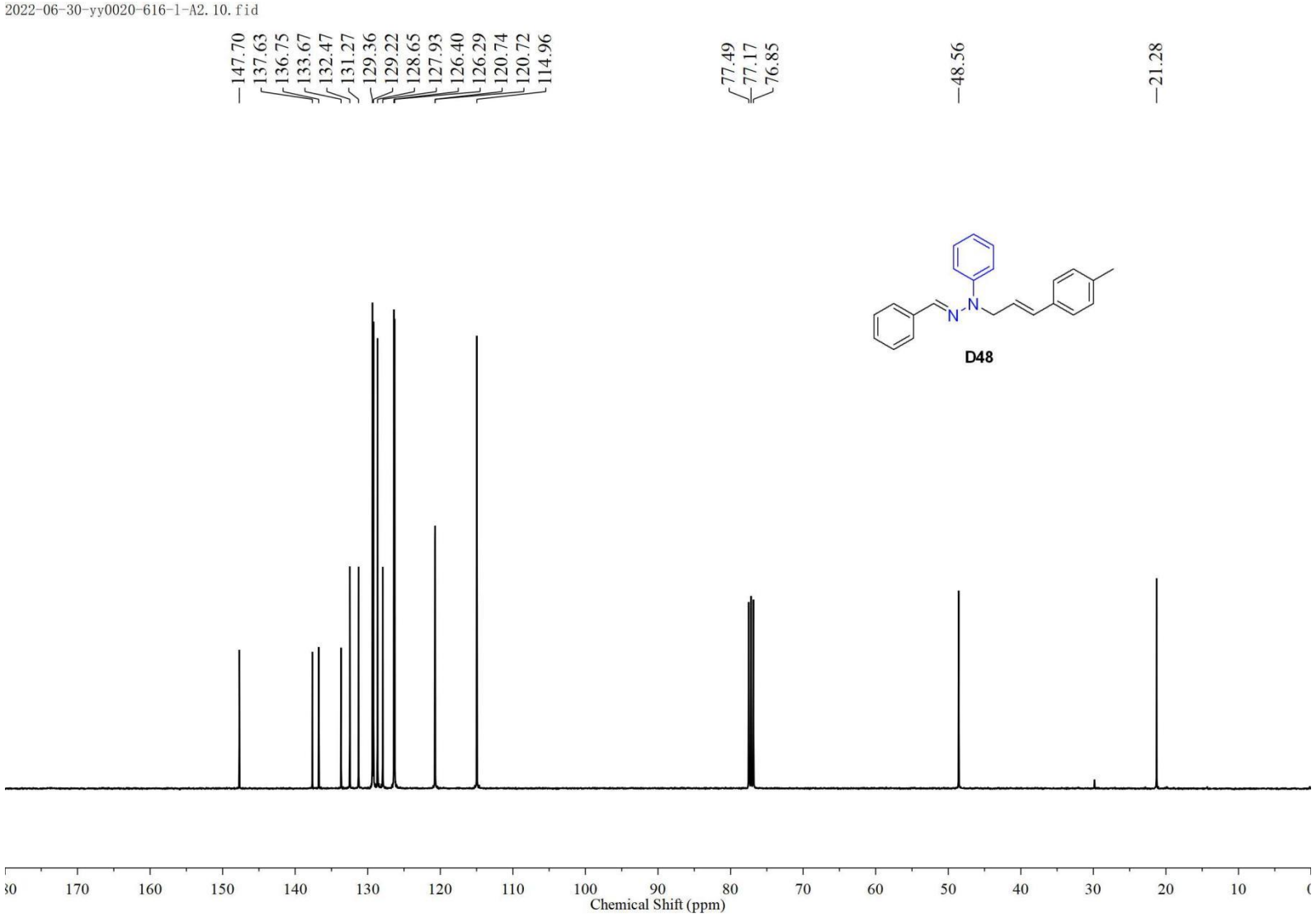
137.75
136.98
130.80
129.36
128.56
128.37
127.41
126.60
126.31
125.31
125.24
77.37
77.05
76.73
65.67
50.63
31.28
25.92

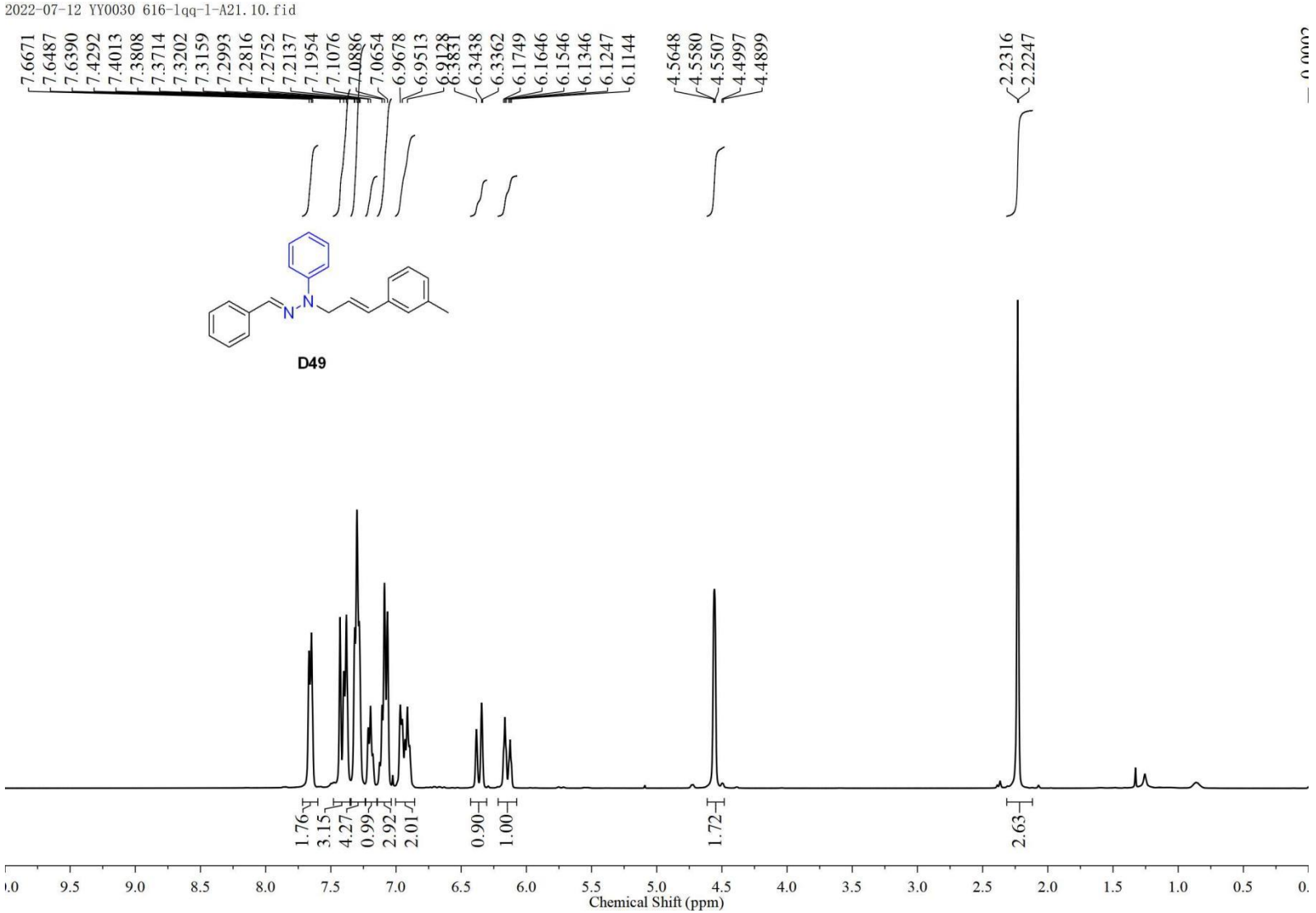


D47



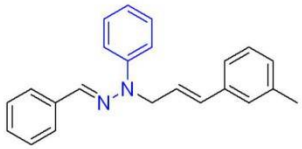

2022-07-01-yy0020-616-1-a2.10.fid
7.6826
7.6787
7.6738
7.6648
7.6613
7.6586
7.6533
7.4697
7.4180
7.4147
7.4003
7.3957
7.3927
7.3464
7.3321
7.3274
7.3139
7.3091
7.2922
7.2252
7.2080
7.2033
7.1929
7.1879
7.0638
7.0440
6.9500
6.9469
6.9438
6.9321
6.9288
6.9258
6.9138
6.9108
6.9078
6.4191
6.3788
6.1901
6.1799
6.1696
6.1399
4.6327
4.6278
4.6223
4.6173
2.2729
D48
2.09
1.03
2.03
4.17
2.80
3.07
0.72
0.87
2.00
2.98
Chemical Shift (ppm)


2022-06-30-yy0020-616-1-A2.10.fid
147.70
137.63
136.75
133.67
132.47
131.27
129.36
129.22
128.65
127.93
126.40
126.29
120.74
120.72
114.96
77.49
77.17
76.85
48.56
21.28
D48
Chemical Shift (ppm)

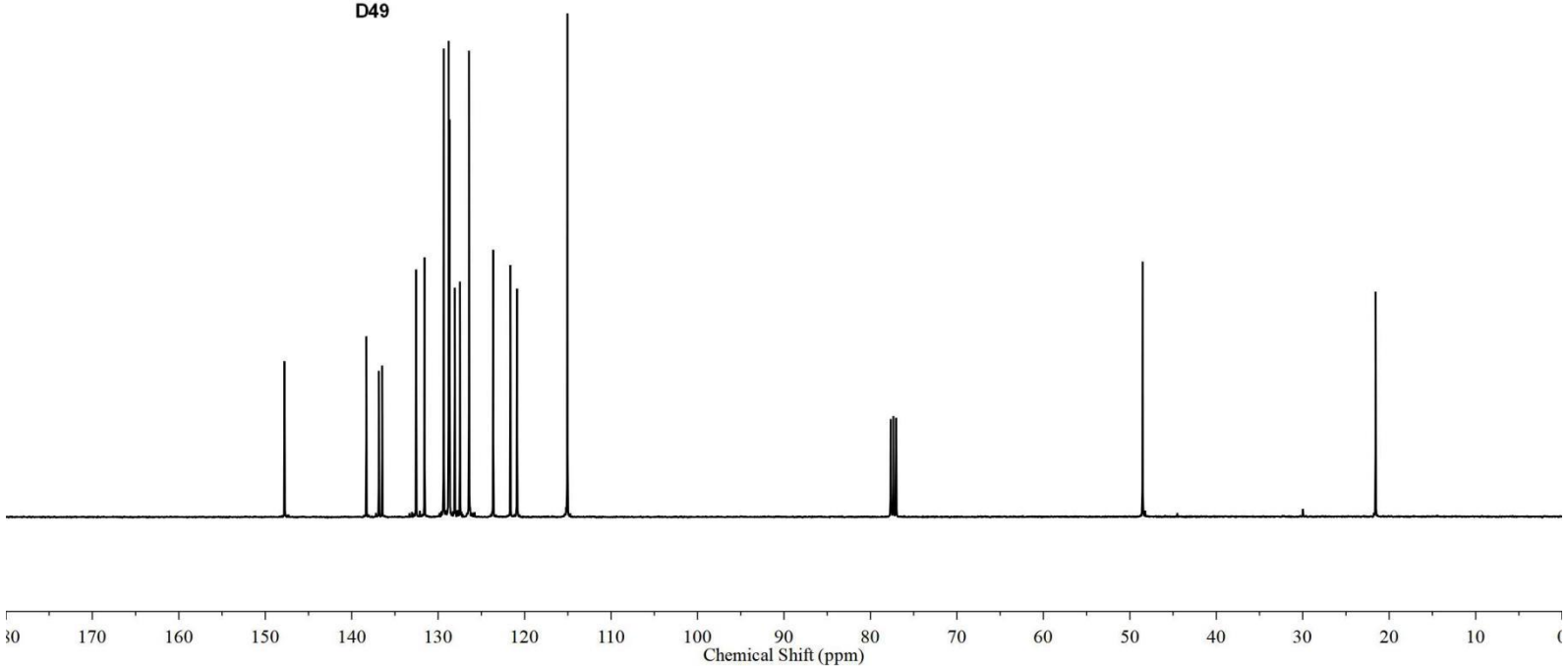

2022-07-12 YY0030 616-1qq-1-A21.10.fid
7.6671
7.6487
7.6390
7.4292
7.4013
7.3808
7.3714
7.3202
7.3159
7.2993
7.2816
7.2752
7.2137
7.1954
7.1076
7.0886
7.0654
6.9678
6.9513
6.9128
6.3831
6.3438
6.3362
6.1749
6.1646
6.1546
6.1346
6.1247
6.1144
4.5648
4.5580
4.5507
4.4997
4.4899
2.2316
2.2247
D49
1.76
3.15
4.27
0.99
2.92
2.01
0.90
1.00
1.72
2.63
Chemical Shift (ppm)

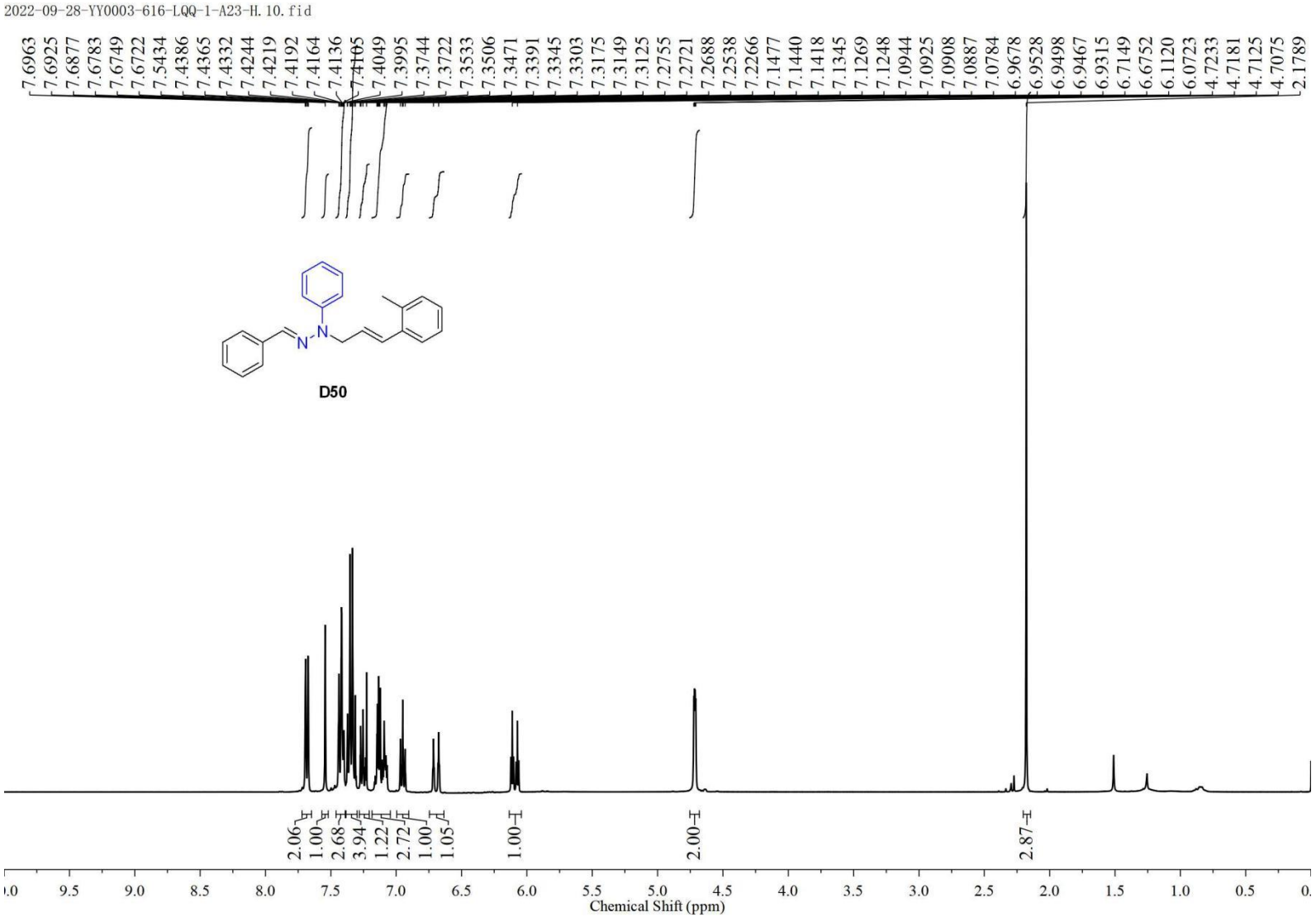
2022-07-12 YY0030 616-1qq-1-A21.11.fid

147.77
138.31
136.86
136.47
132.55
131.58
129.36
128.78
128.69
128.07
127.48
126.42
123.64
121.65
120.88
115.05
77.66
77.34
77.02
48.52
21.57

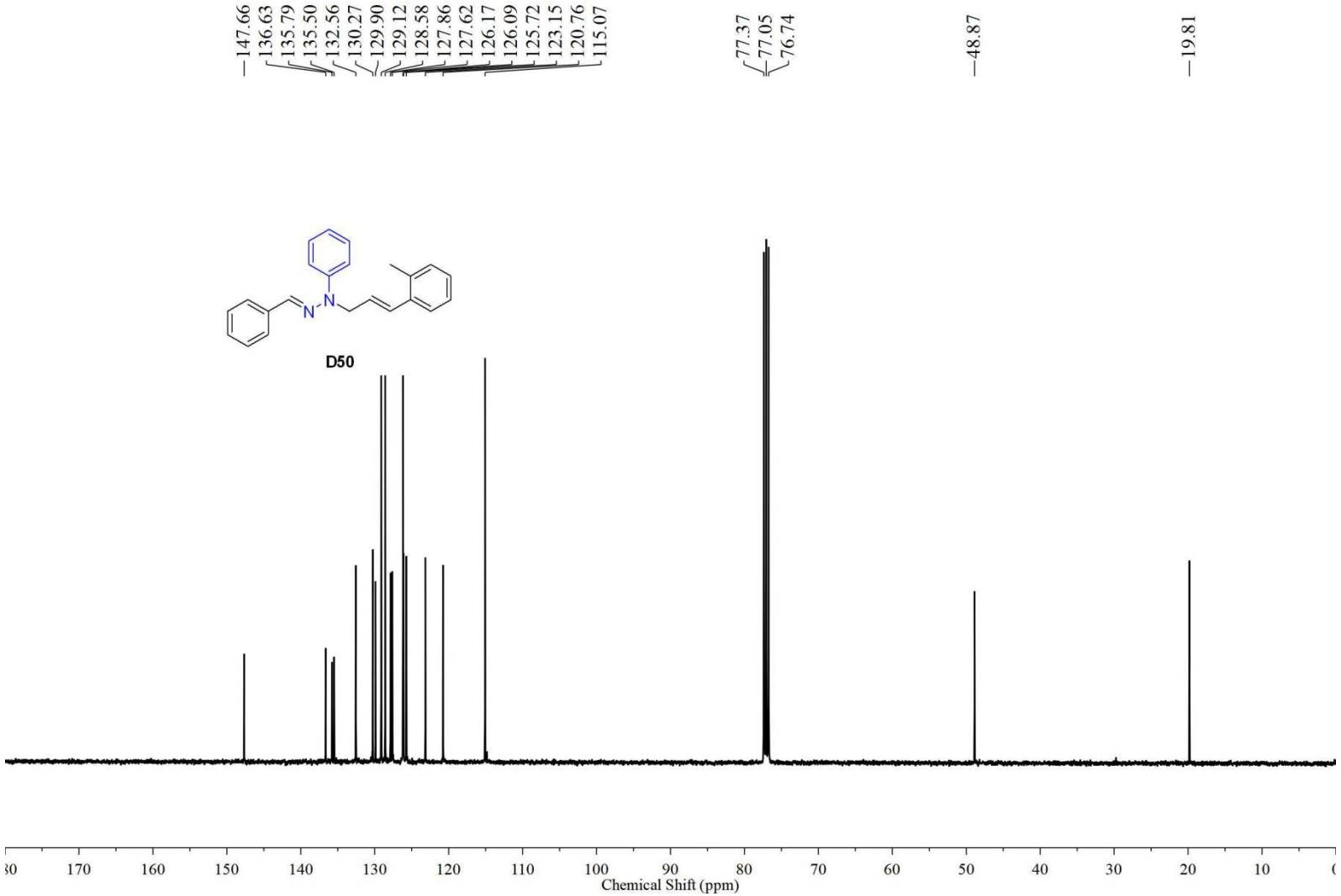


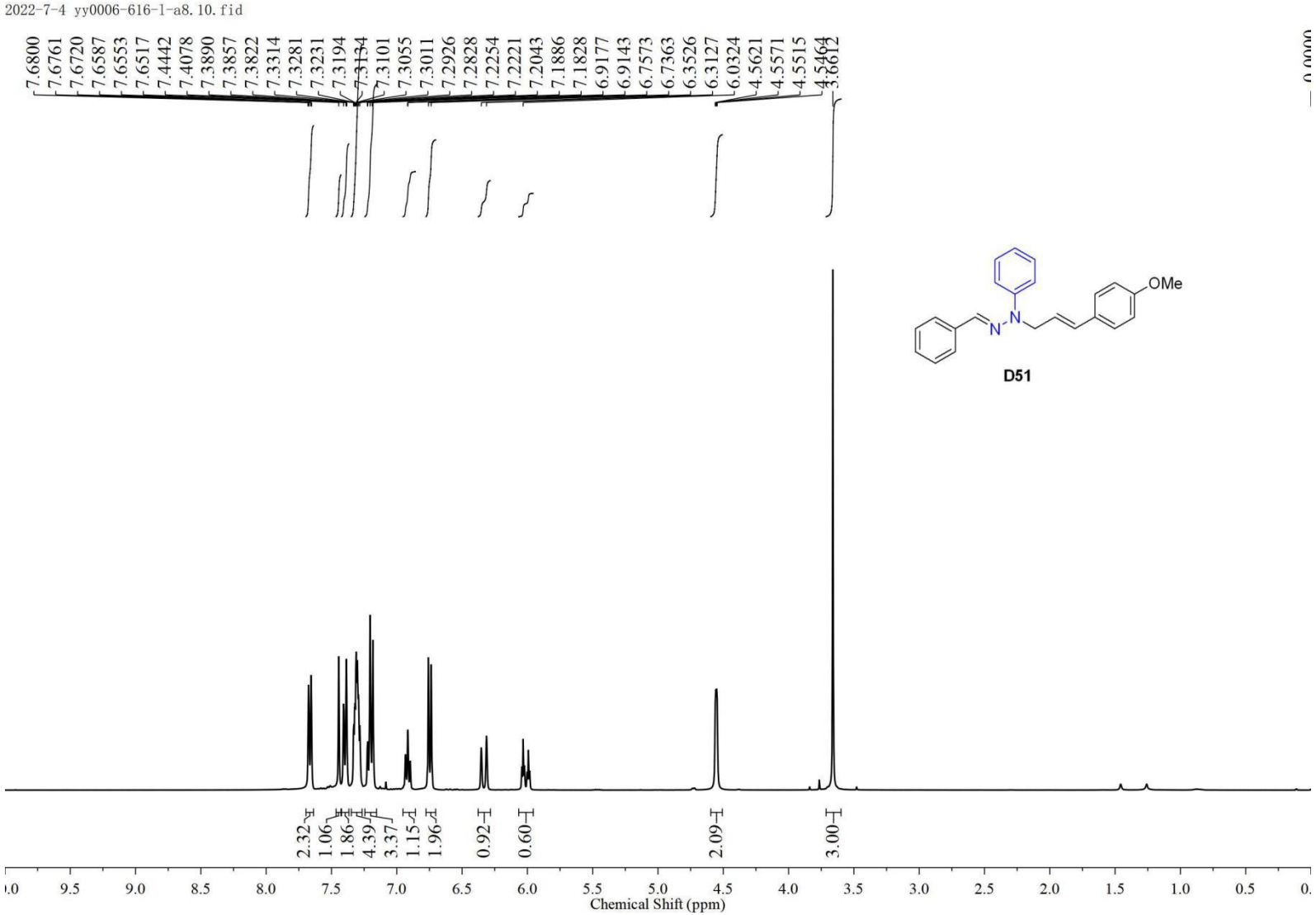
D49

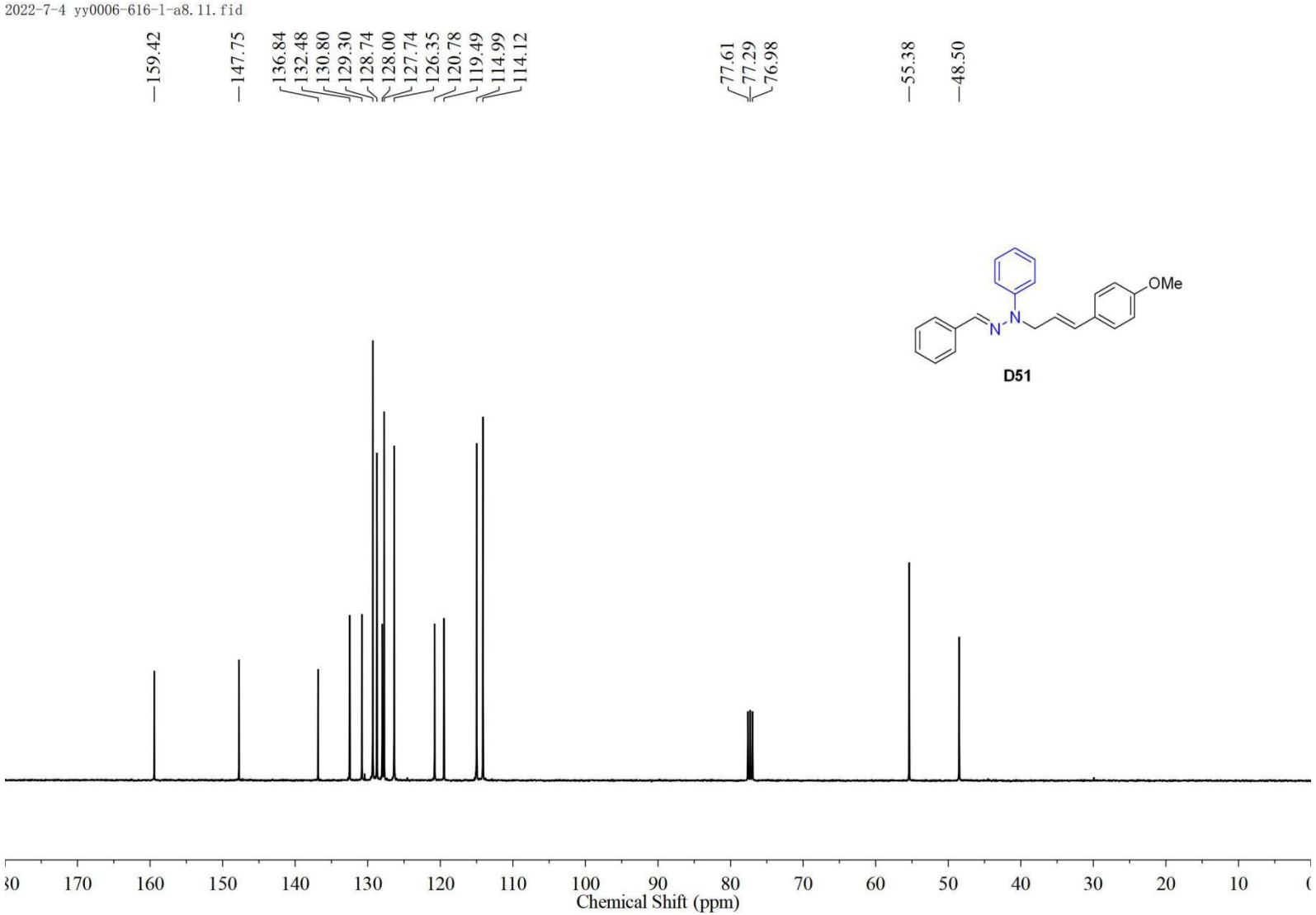


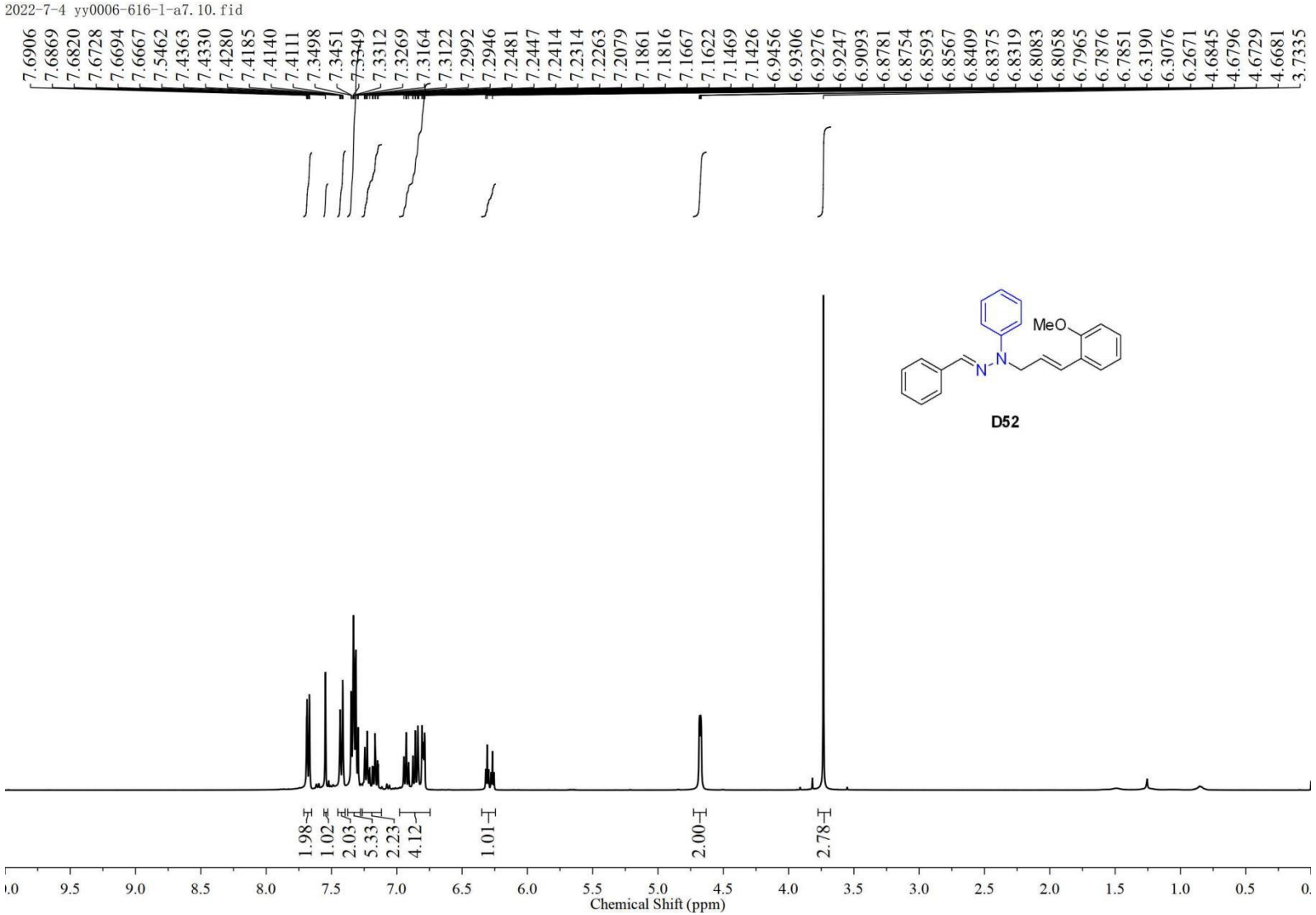

2022-09-28-YY0003-616-LQQ-1-A23-H.10.fid
7.6963
7.6925
7.6877
7.6783
7.6749
7.6722
7.5434
7.4386
7.4365
7.4332
7.4244
7.4219
7.4192
7.4164
7.4136
7.4105
7.4049
7.3995
7.3744
7.3722
7.3533
7.3506
7.3471
7.3391
7.3345
7.3303
7.3175
7.3149
7.3125
7.2755
7.2721
7.2688
7.2538
7.2266
7.1477
7.1440
7.1418
7.1345
7.1269
7.1248
7.0944
7.0925
7.0908
7.0887
7.0784
6.9678
6.9528
6.9498
6.9467
6.9315
6.7149
6.6752
6.1120
6.0723
4.7233
4.7181
4.7125
4.7075
2.1789
D50
2.06
1.00
2.68
3.94
1.22
2.72
1.00
1.05
1.00
2.00
2.87
Chemical Shift (ppm)

2022-09-27-YY0034-616-LQQ-1-A23.10.fid

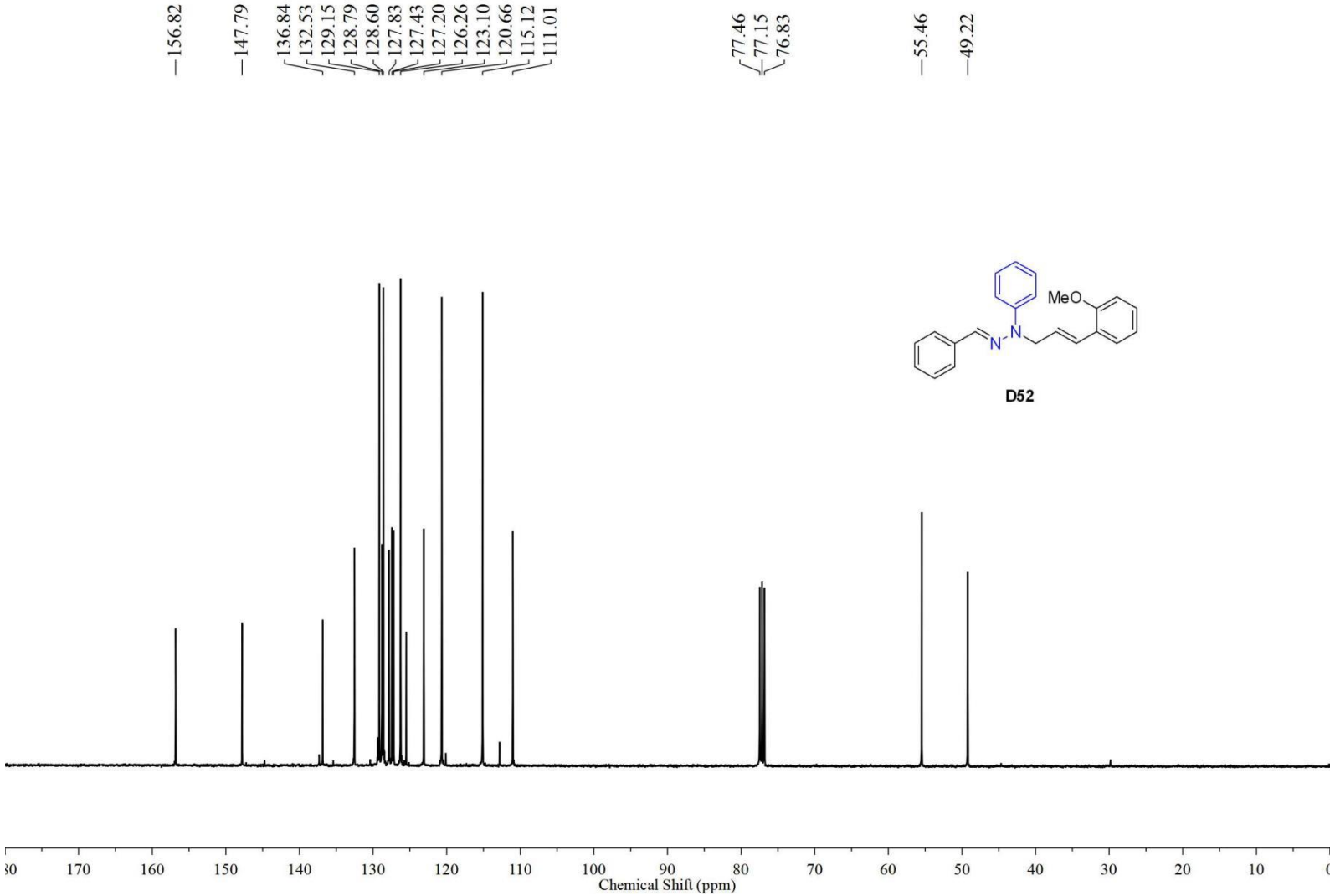


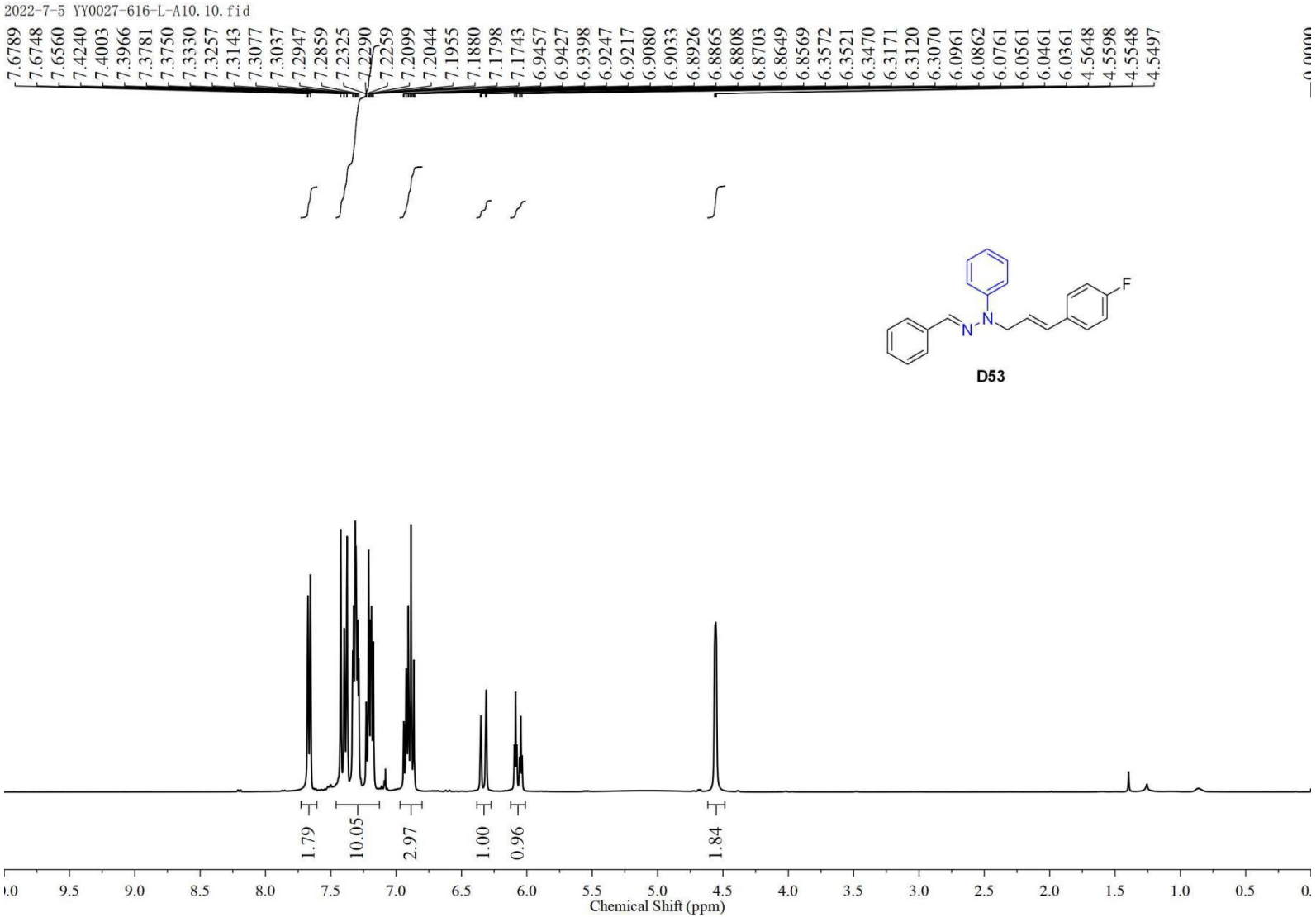

2022-7-4 yy0006-616-1-a8.10.fid
7.6800
7.6761
7.6720
7.6587
7.6553
7.6517
7.4442
7.4078
7.3890
7.3857
7.3822
7.3314
7.3281
7.3231
7.3194
7.3134
7.3101
7.3055
7.3011
7.2926
7.2828
7.2254
7.2221
7.2043
7.1886
7.1828
7.9177
6.9143
6.7573
6.7363
6.3526
6.3127
6.0324
4.5621
4.5571
4.5515
4.5464
3.6612
OMe
N
N
D51
2.32
1.06
1.86
4.39
3.37
1.15
1.96
0.92
0.60
2.09
3.00
Chemical Shift (ppm)


2022-7-4 yy0006-616-1-a8.11.fid
159.42
147.75
136.84
132.48
130.80
129.30
128.74
128.00
127.74
126.35
120.78
119.49
114.99
114.12
77.61
77.29
76.98
55.38
48.50
OMe
N
N
D51
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-7-4 yy0006-616-1-a7.10.fid
7.6906
7.6869
7.6820
7.6728
7.6694
7.6667
7.5462
7.4363
7.4330
7.4280
7.4185
7.4140
7.4111
7.3498
7.3451
7.3349
7.3312
7.3269
7.3164
7.3122
7.2992
7.2946
7.2481
7.2447
7.2414
7.2314
7.2263
7.2079
7.1861
7.1816
7.1667
7.1622
7.1469
7.1426
6.9456
6.9306
6.9276
6.9247
6.9093
6.8781
6.8754
6.8593
6.8567
6.8409
6.8375
6.8319
6.8083
6.8058
6.7965
6.7876
6.7851
6.3190
6.3076
6.2671
4.6845
4.6796
4.6729
4.6681
3.7335
MeO
N
N
D52
1.98
1.02
2.03
5.33
2.23
4.12
1.01
2.00
2.78
Chemical Shift (ppm)

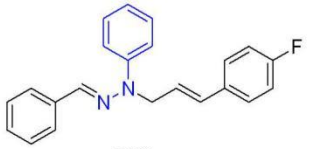
2022-7-4 yy0006-616-1-a7.11.fid



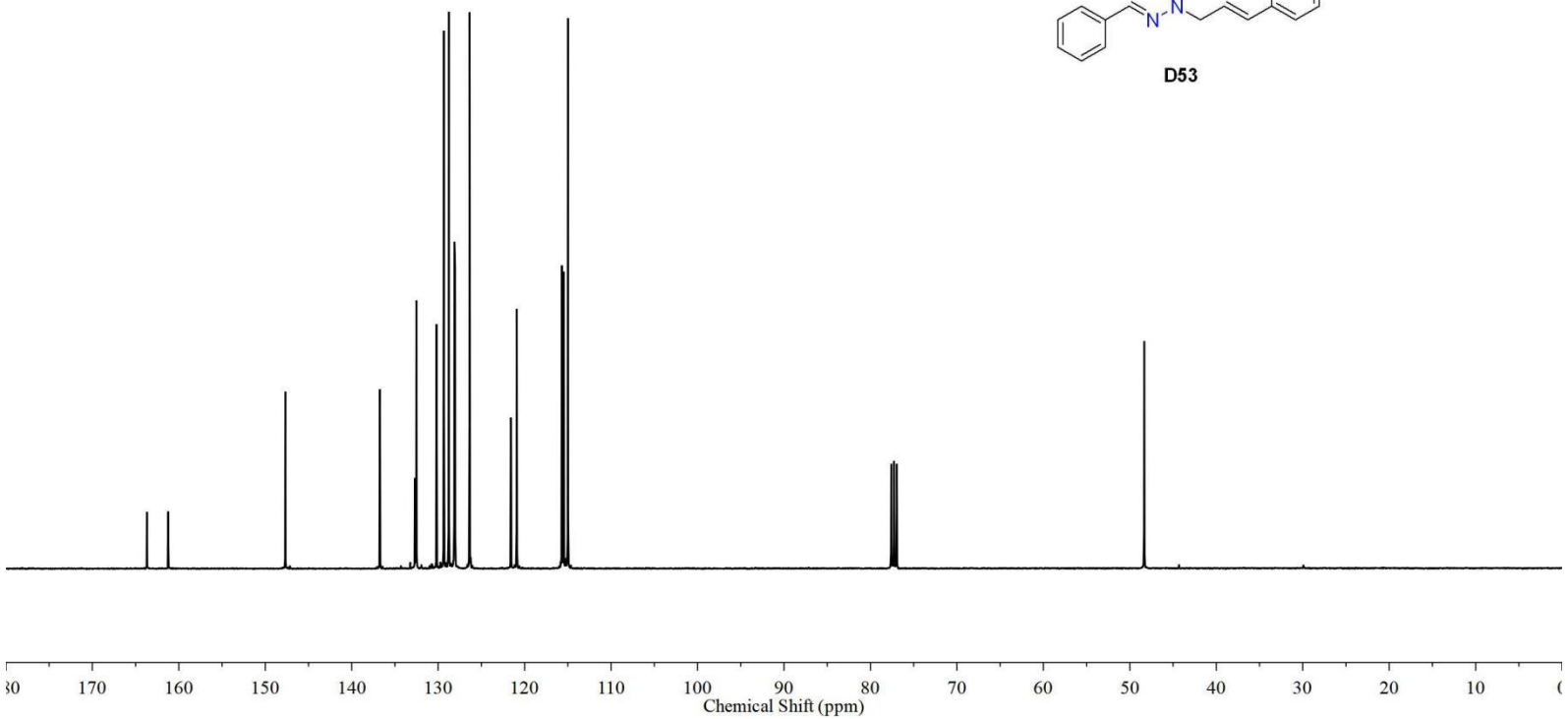

2022-7-5 YY0027-616-L-A10.10.fid
7.6789
7.6748
7.6560
7.4240
7.4003
7.3966
7.3781
7.3750
7.3330
7.3257
7.3143
7.3077
7.3037
7.2947
7.2859
7.2325
7.2290
7.2259
7.2099
7.2044
7.1955
7.1880
7.1798
7.1743
6.9457
6.9427
6.9398
6.9247
6.9217
6.9080
6.9033
6.8926
6.8865
6.8808
6.8703
6.8649
6.8569
6.3572
6.3521
6.3470
6.3171
6.3120
6.3070
6.0961
6.0862
6.0761
6.0561
6.0461
6.0361
4.5648
4.5598
4.5548
4.5497
F
N
N
D53
1.79
10.05
2.97
1.00
0.96
1.84
Chemical Shift (ppm)

2022-7-5 YY0027-616-L-A10.11.fid

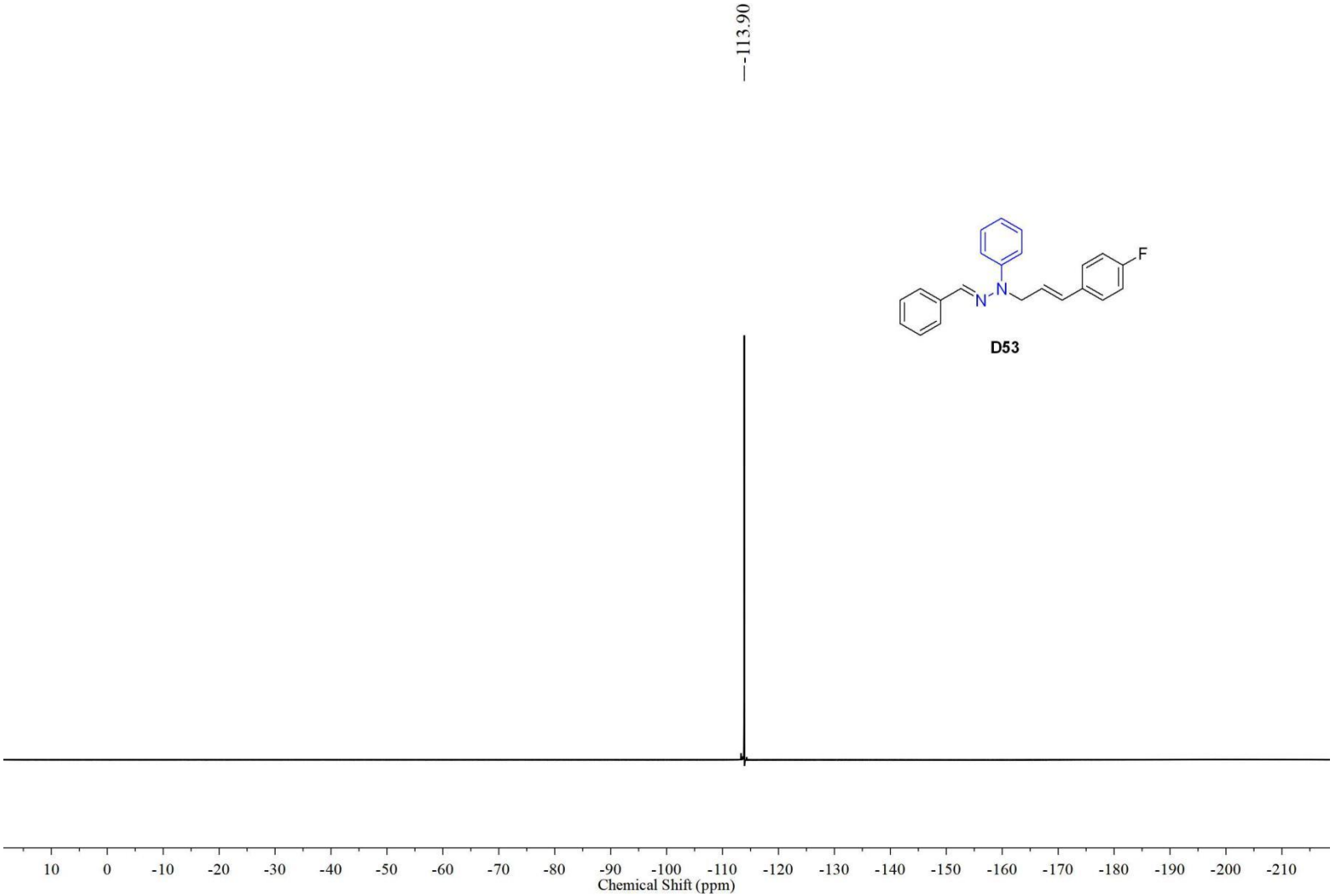
163.68
161.23
147.67
136.74
132.69
132.66
132.52
130.19
129.34
128.76
128.12
128.10
128.04
126.37
121.59
121.57
120.91
115.70
115.48
114.99
77.59
77.27
76.96
48.33

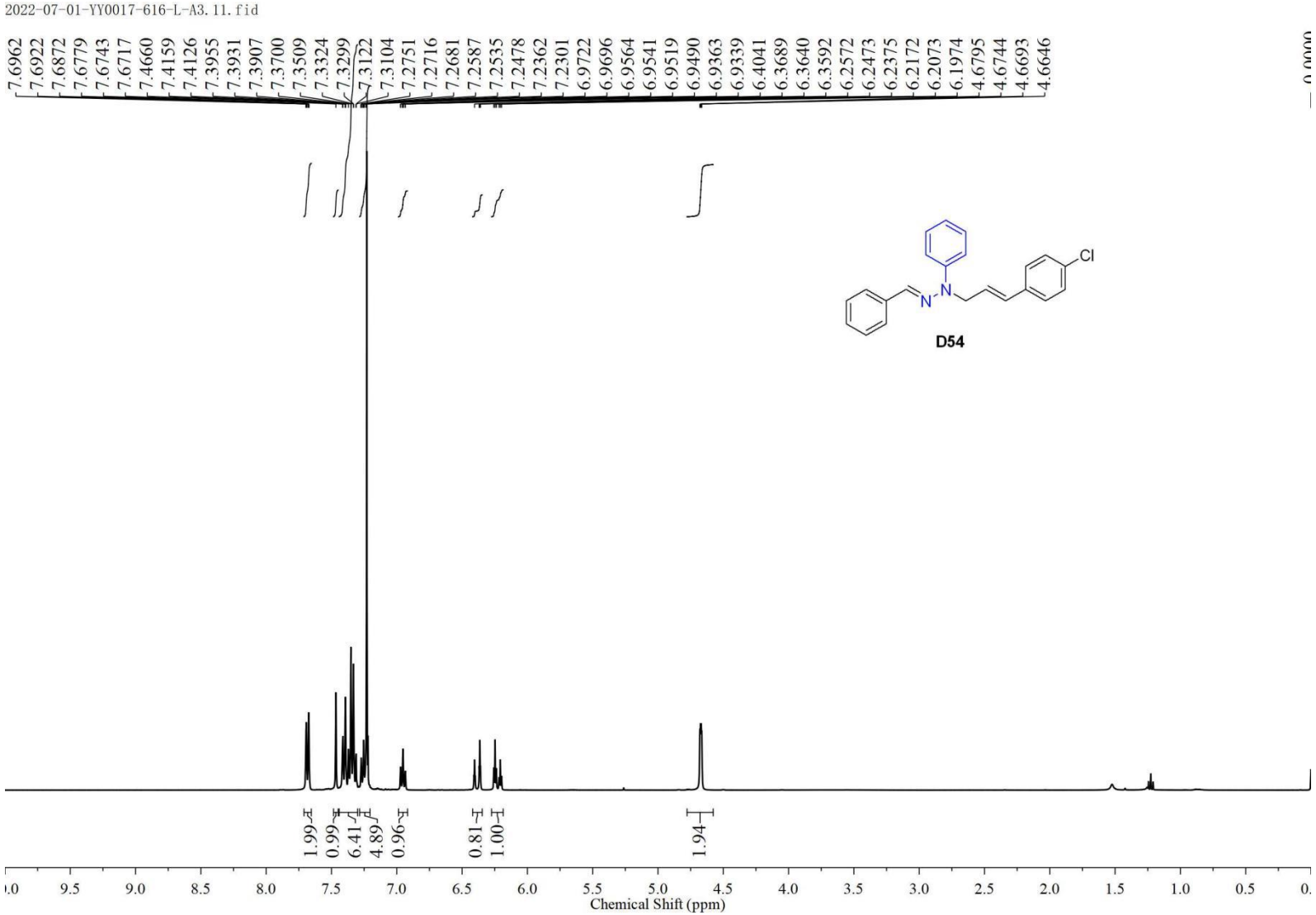


D53

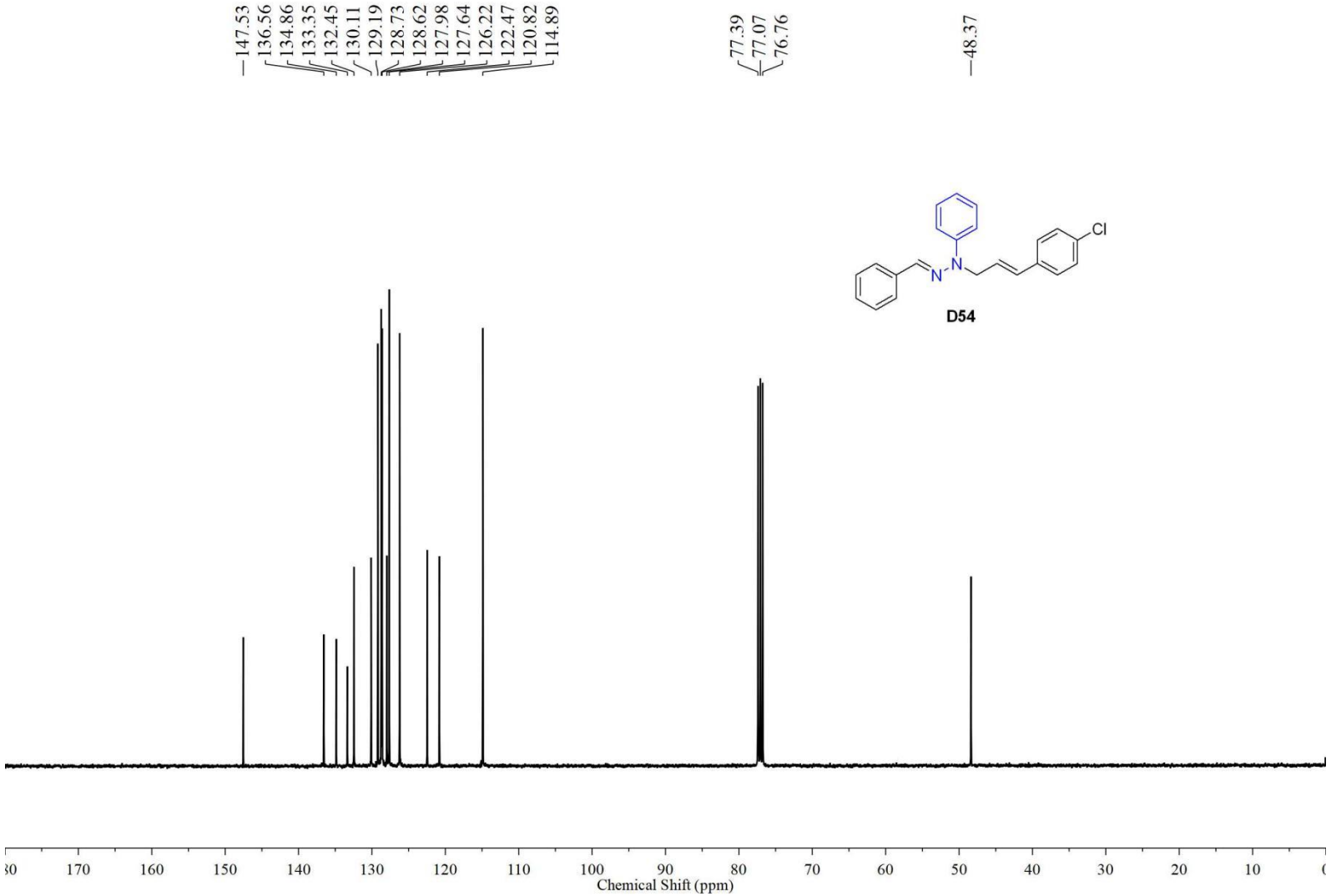


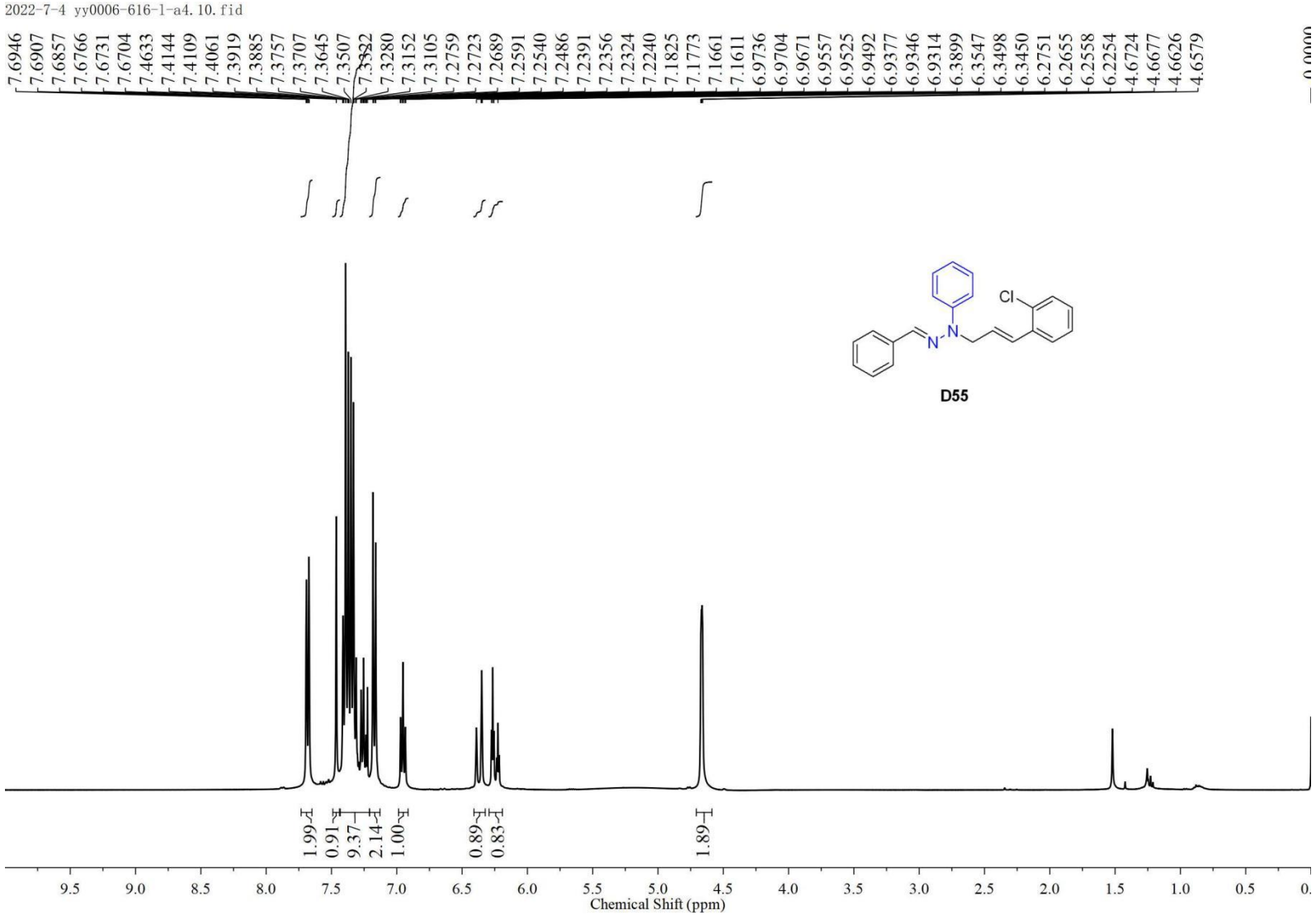
2022-7-5 YY0027-616-L-A10.12.fid



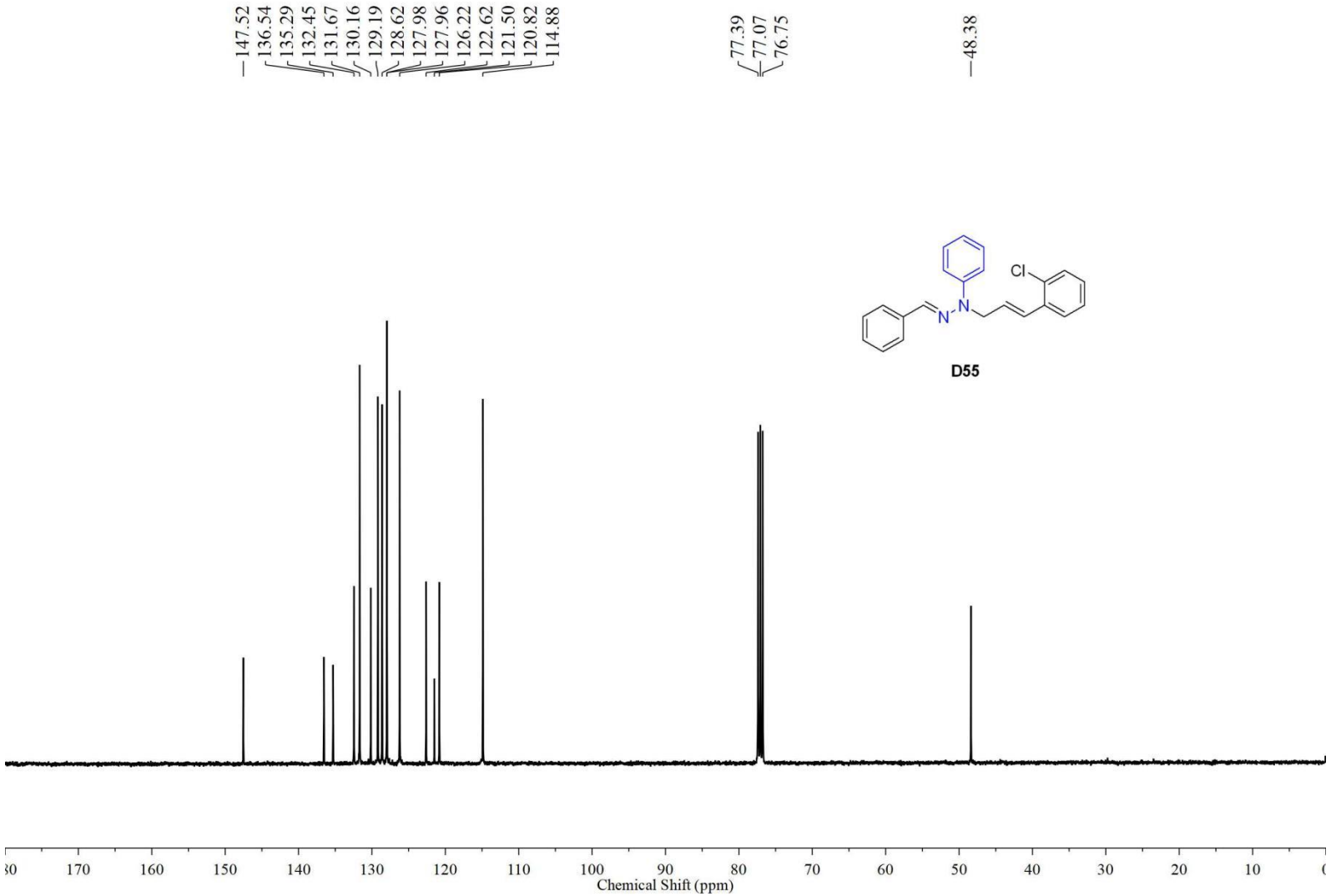

2022-07-01-YY0017-616-L-A3.11.fid
7.6962
7.6922
7.6872
7.6779
7.6743
7.6717
7.4660
7.4159
7.4126
7.3955
7.3931
7.3907
7.3700
7.3509
7.3324
7.3299
7.3122
7.3104
7.2751
7.2716
7.2681
7.2587
7.2535
7.2478
7.2362
7.2301
6.9722
6.9696
6.9564
6.9541
6.9519
6.9490
6.9363
6.9339
6.4041
6.3689
6.3640
6.3592
6.2572
6.2473
6.2375
6.2172
6.2073
6.1974
4.6795
4.6744
4.6693
4.6646
Cl
N
N
D54
1.99
0.99
6.41
4.89
0.96
0.81
1.00
1.94
Chemical Shift (ppm)

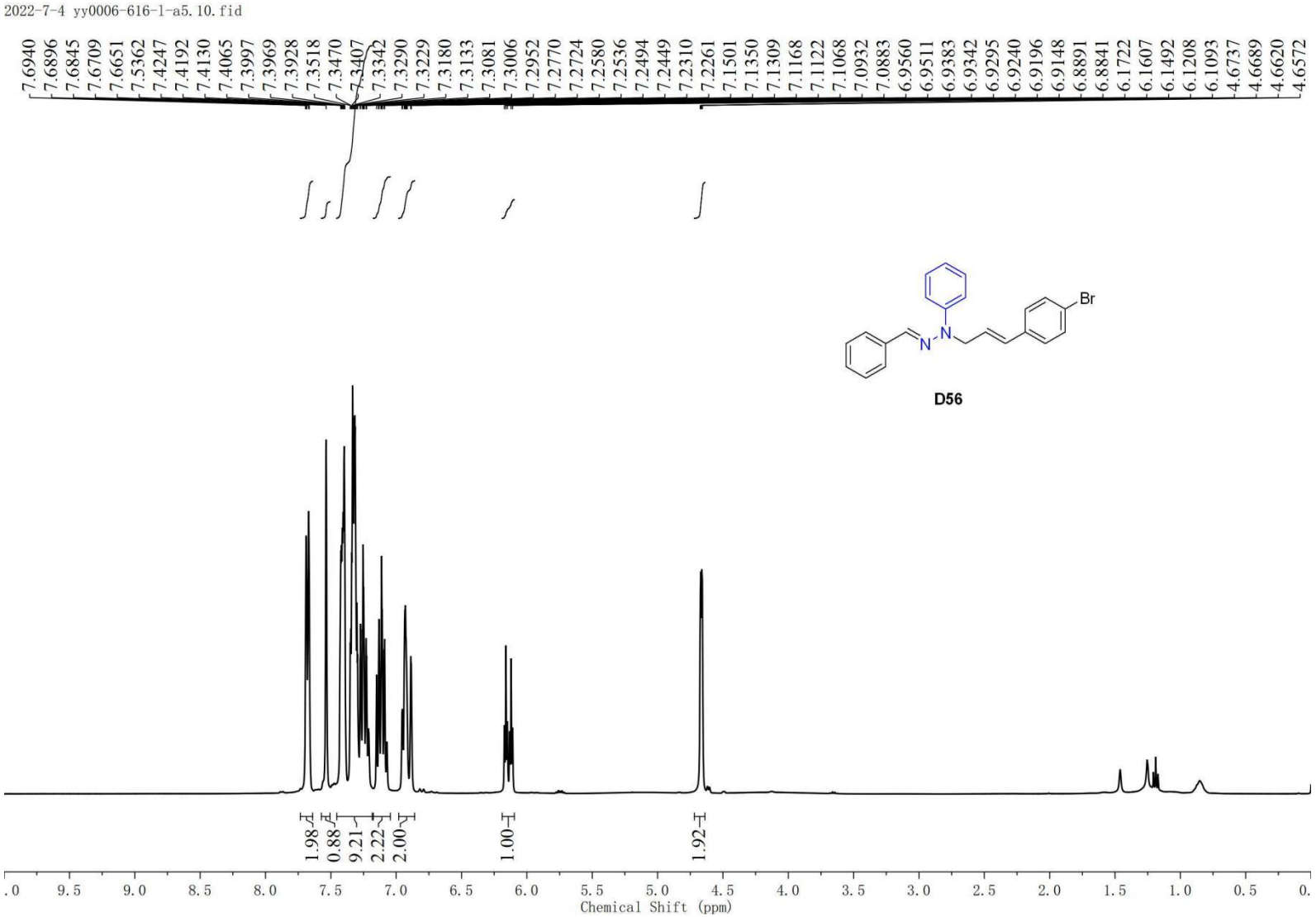
2022-07-01-YY0017-616-L-A3.10.fid

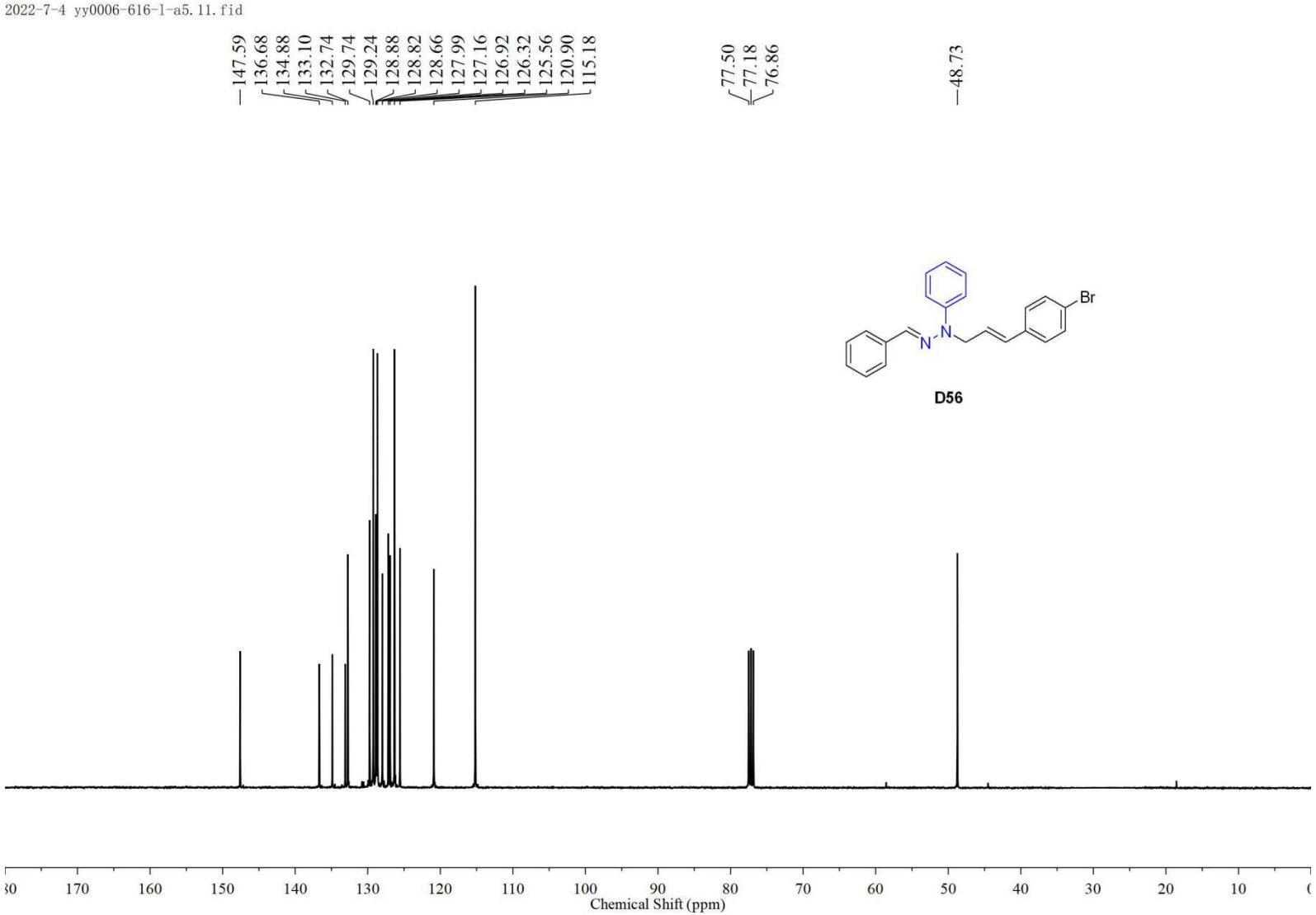


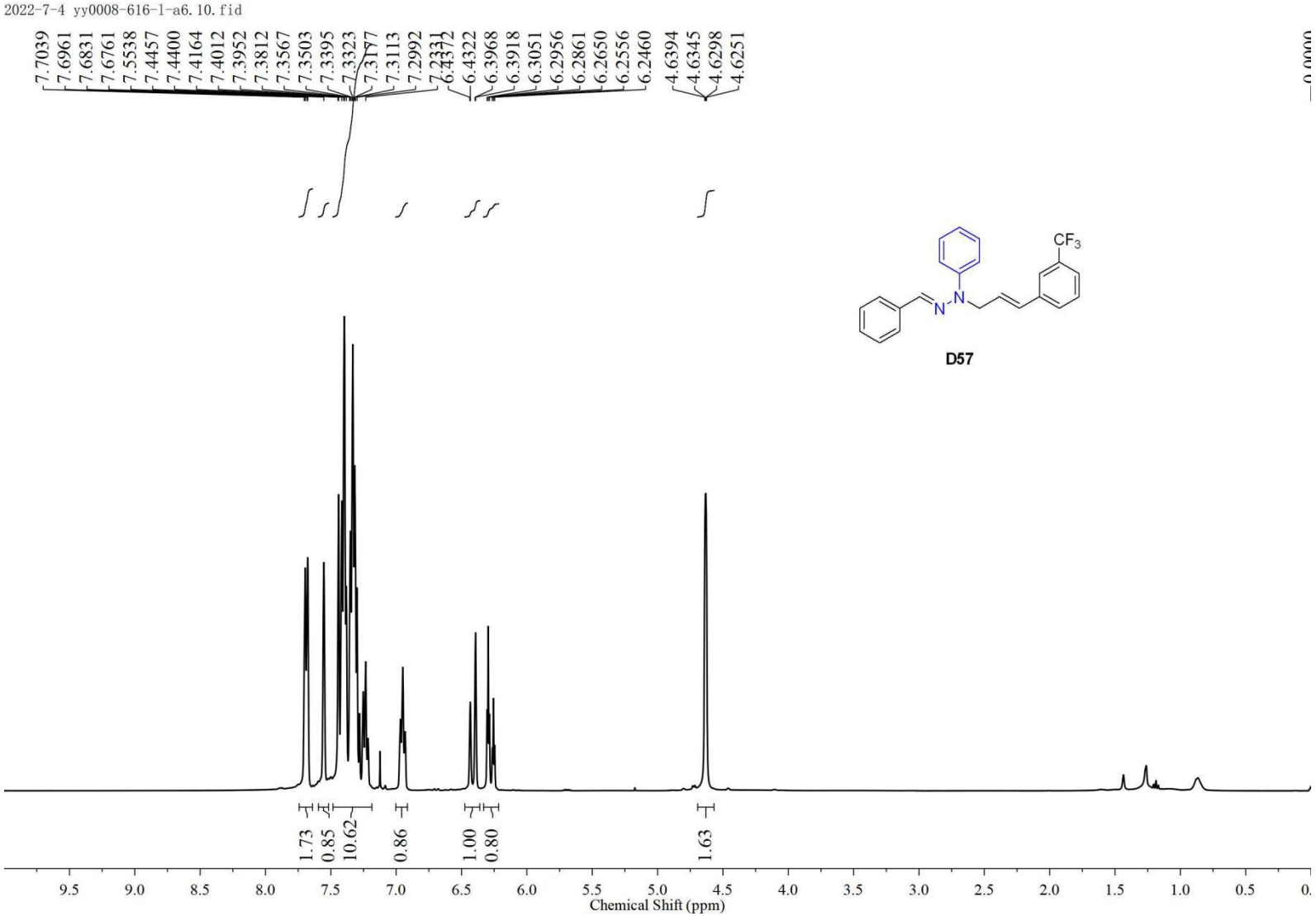

2022-7-4 yy0006-616-1-a4.10.fid
7.6946
7.6907
7.6857
7.6766
7.6731
7.6704
7.4633
7.4144
7.4109
7.4061
7.3919
7.3885
7.3757
7.3707
7.3645
7.3507
7.3332
7.3280
7.3152
7.3105
7.2759
7.2723
7.2689
7.2591
7.2540
7.2486
7.2391
7.2356
7.2324
7.2240
7.1825
7.1773
7.1661
7.1611
6.9736
6.9704
6.9671
6.9557
6.9525
6.9492
6.9377
6.9346
6.9314
6.3899
6.3547
6.3498
6.3450
6.2751
6.2655
6.2558
6.2254
4.6724
4.6677
4.6626
4.6579
Cl
N
N
D55
1.99
0.91
9.37
2.14
1.00
0.89
0.83
1.89
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

2022-7-4 yy0006-616-1-a4.11.fid




2022-7-4 yy0006-616-1-a5.10.fid
7.6940
7.6896
7.6845
7.6709
7.6651
7.5362
7.4247
7.4192
7.4130
7.4065
7.3997
7.3969
7.3928
7.3518
7.3470
7.3407
7.3342
7.3290
7.3229
7.3180
7.3133
7.3081
7.3006
7.2952
7.2770
7.2724
7.2580
7.2536
7.2494
7.2449
7.2310
7.2261
7.1501
7.1350
7.1309
7.1168
7.1122
7.1068
7.0932
7.0883
6.9560
6.9511
6.9383
6.9342
6.9295
6.9240
6.9196
6.9148
6.8891
6.8841
6.1722
6.1607
6.1492
6.1208
6.1093
4.6737
4.6689
4.6620
4.6572
Br
N
N
D56
1.98
0.88
9.21
2.22
2.00
1.00
1.92
Chemical Shift (ppm)

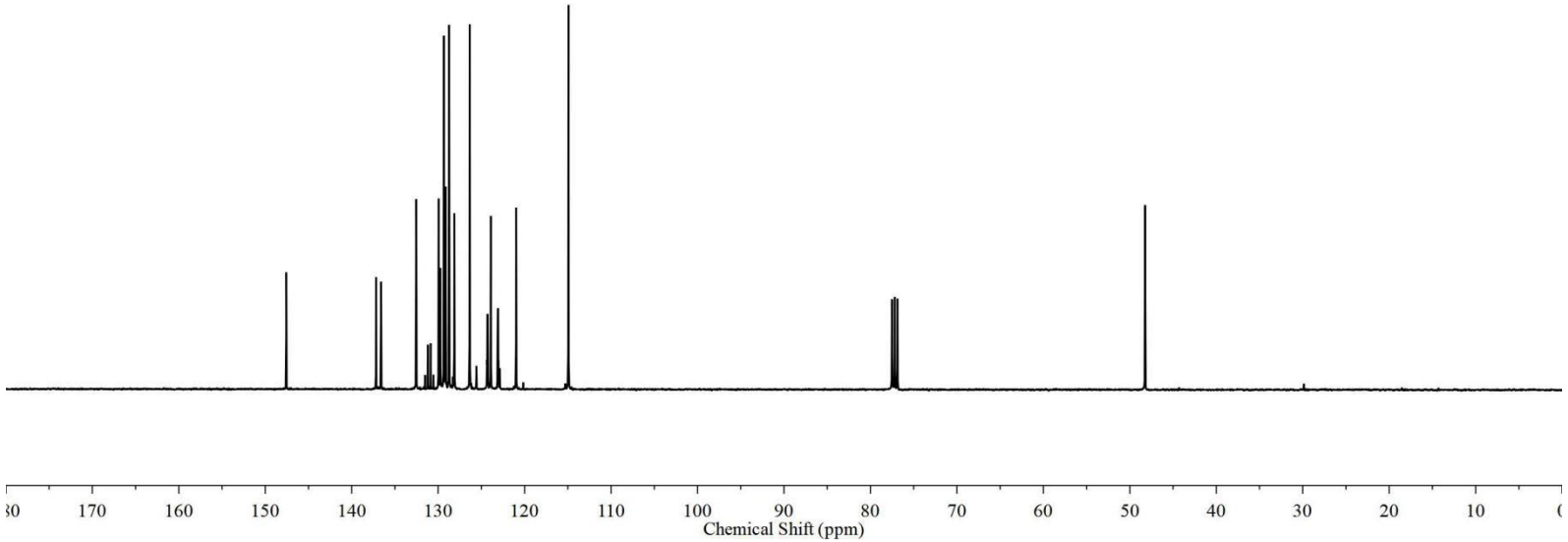

2022-7-4 yy0006-616-1-a5.11.fid
147.59
136.68
134.88
133.10
132.74
129.74
129.24
128.88
128.82
128.66
127.99
127.16
126.92
126.32
125.56
120.90
115.18
77.50
77.18
76.86
48.73
Br
N
N
D56
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-7-4 yy0008-616-1-a6.10.fid
7.7039
7.6961
7.6831
7.6761
7.5538
7.4457
7.4400
7.4164
7.4012
7.3952
7.3812
7.3567
7.3503
7.3395
7.3323
7.3177
7.3113
7.2992
6.4372
6.4322
6.3968
6.3918
6.3051
6.2956
6.2861
6.2650
6.2556
6.2460
4.6394
4.6345
4.6298
4.6251
CF3
N
N
D57
1.73
0.85
10.62
0.86
1.00
0.80
1.63
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

2022-7-4 yy0008-616-1-a6.11.fid

147.57
137.18
136.61
132.54
129.95
129.76
129.34
129.14
128.74
128.13
126.35
124.35
124.31
124.27
124.23
123.91
123.14
123.10
123.06
123.03
120.98
114.93
77.51
77.19
76.87
48.23

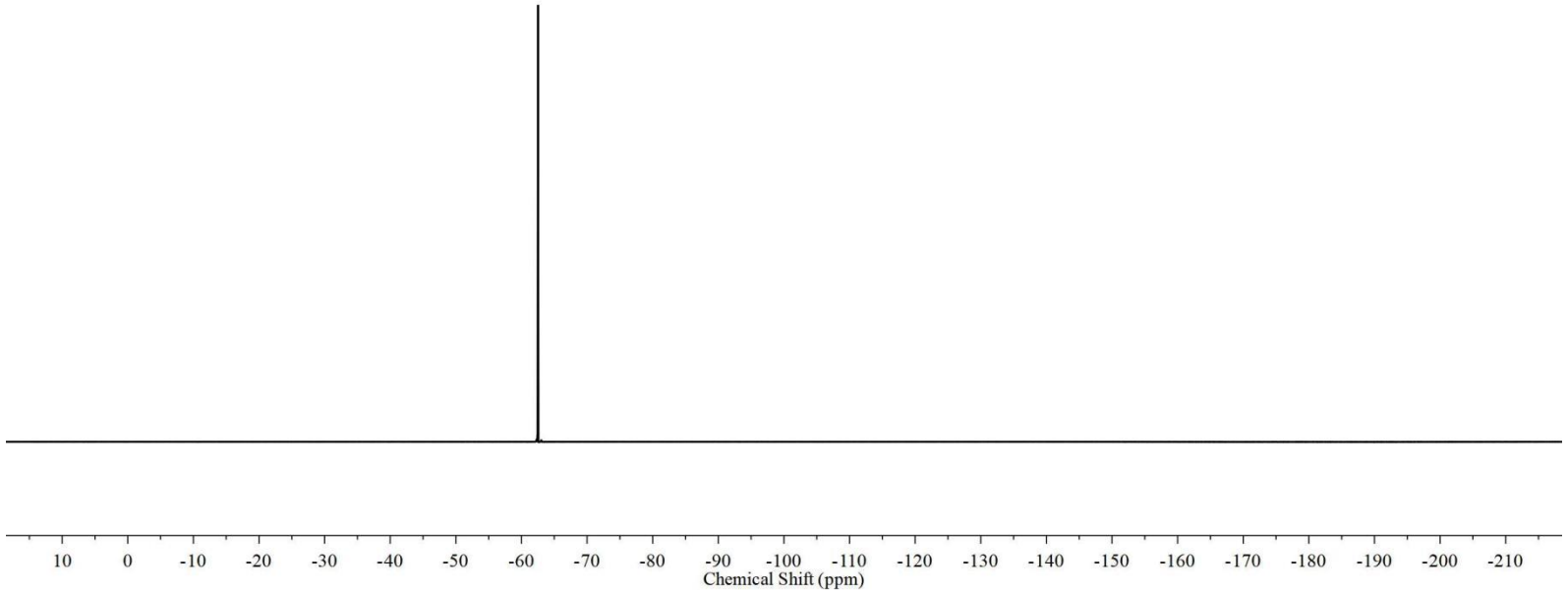
D57

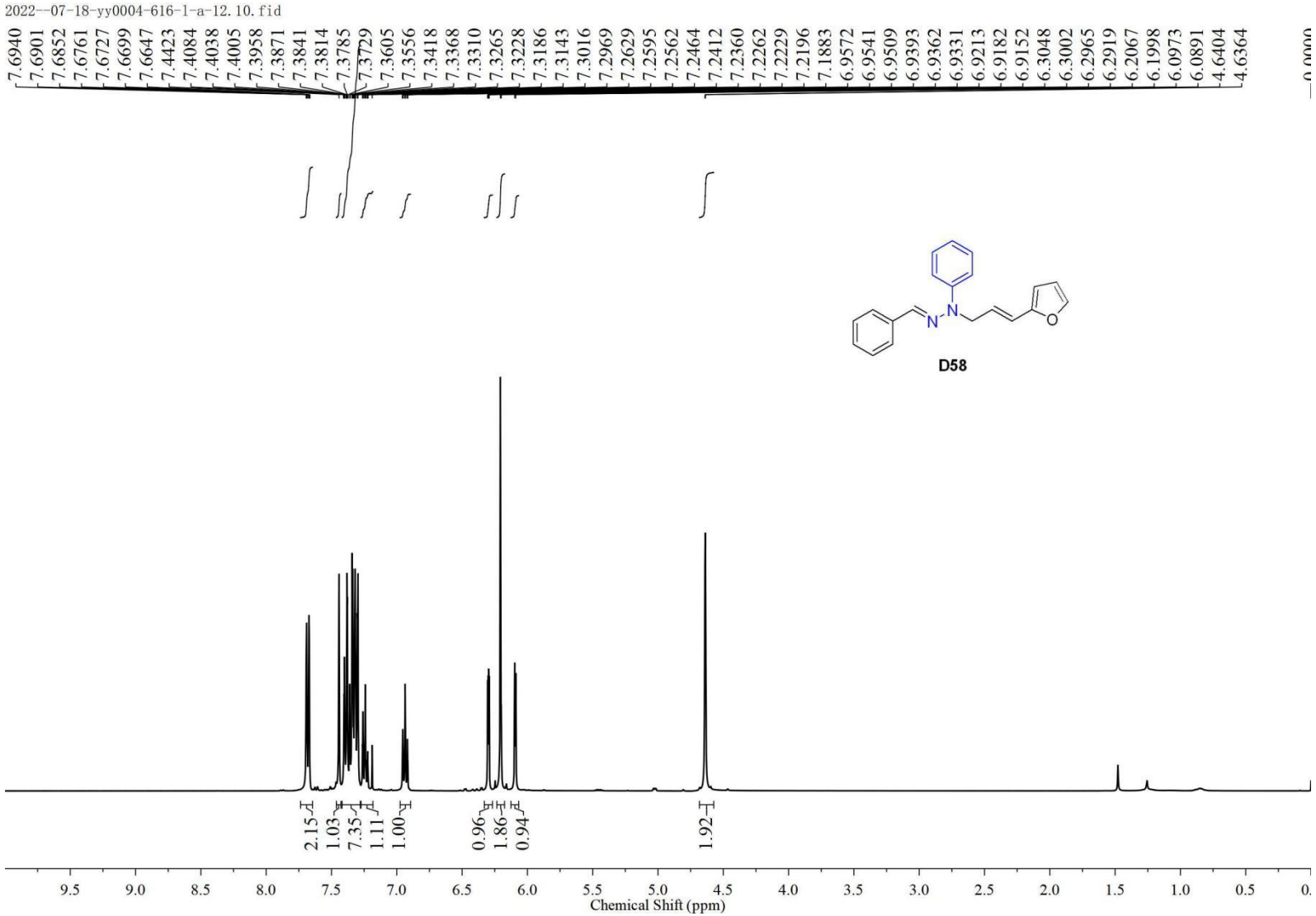


2022-7-4 yy0008-616-1-a6.12.fid

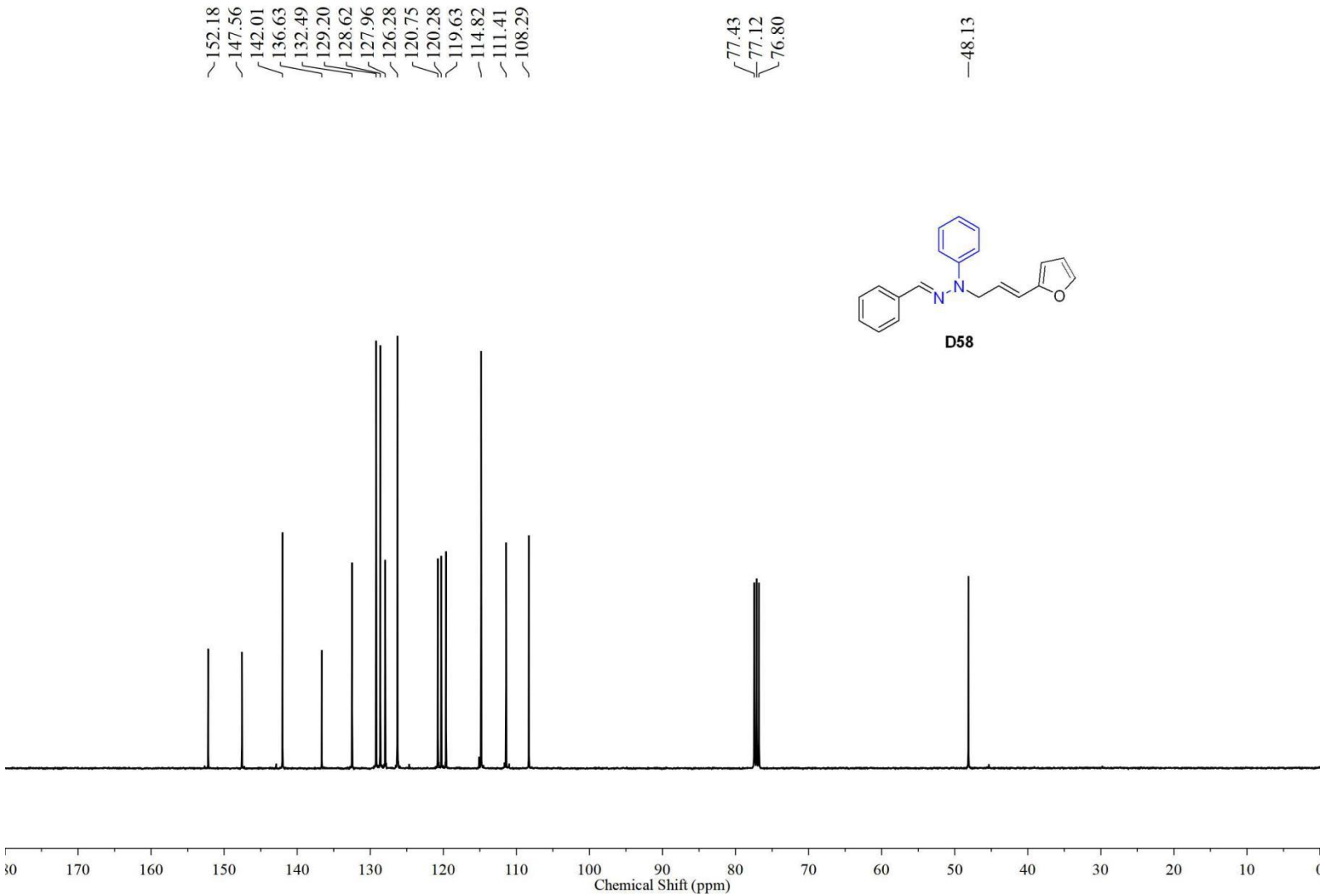
-62.53

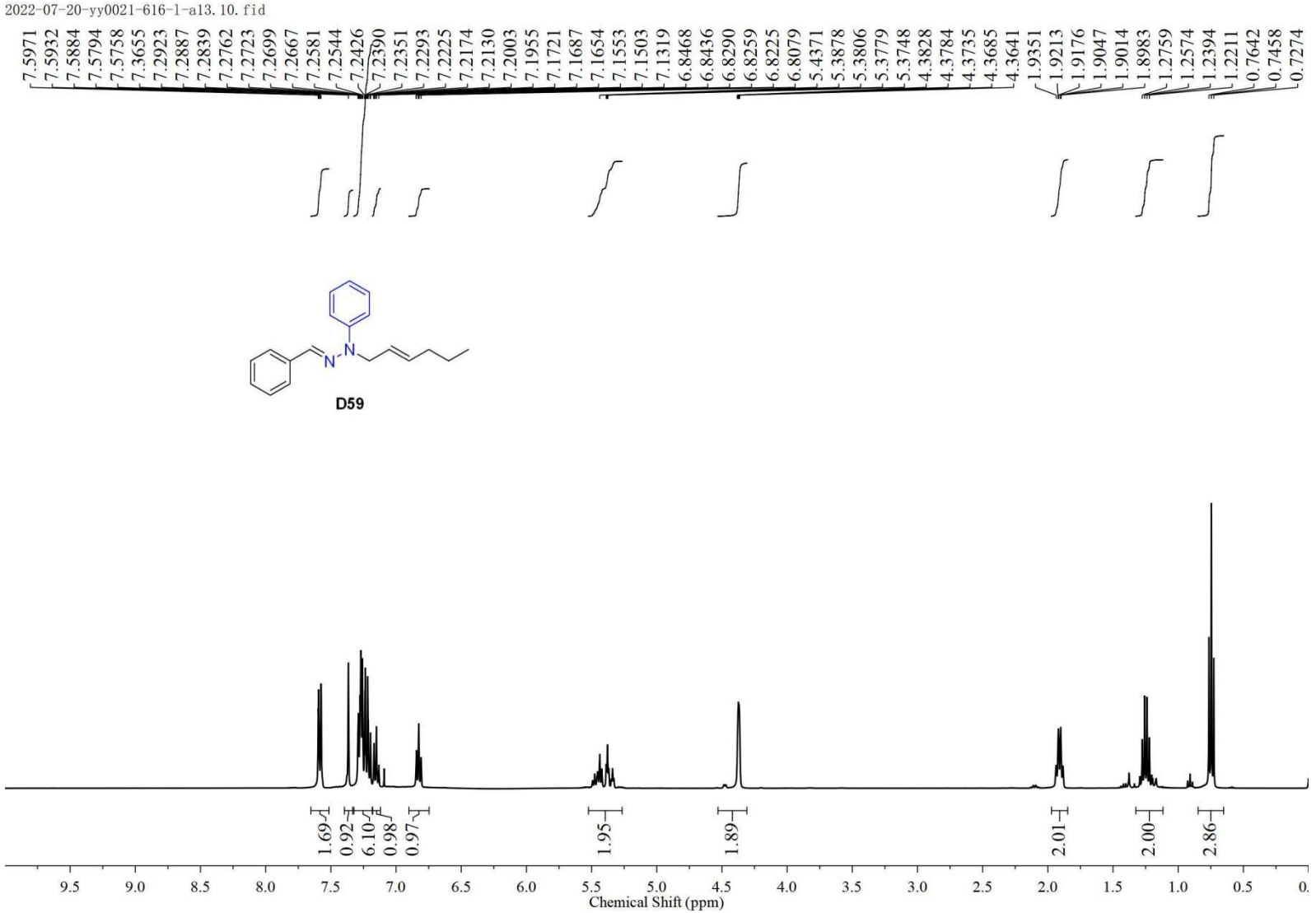
D57



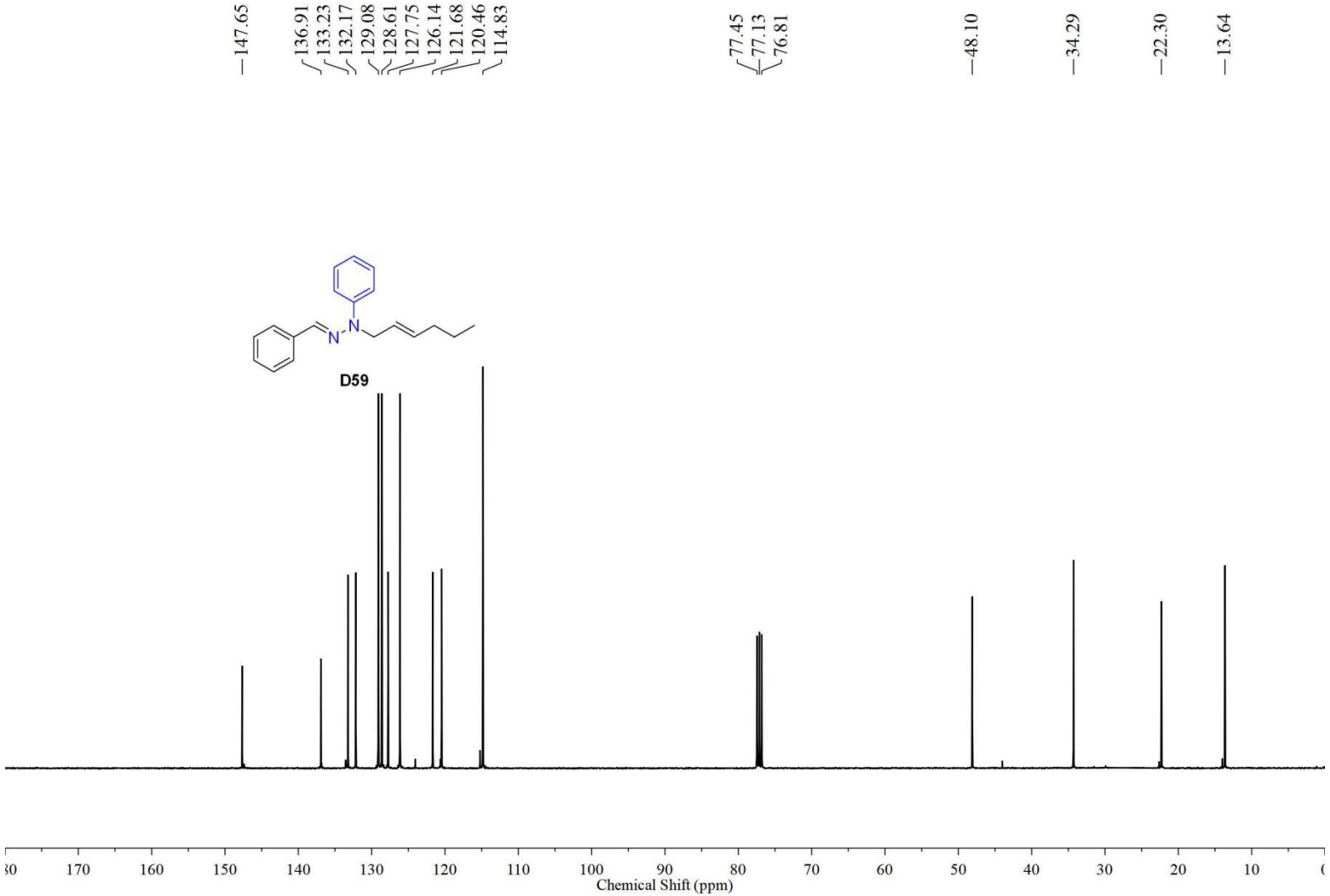

2022--07-18-yy0004-616-1-a-12.10.fid
7.6940
7.6901
7.6852
7.6761
7.6727
7.6699
7.6647
7.4423
7.4084
7.4038
7.4005
7.3958
7.3871
7.3841
7.3814
7.3785
7.3729
7.3605
7.3556
7.3418
7.3368
7.3310
7.3265
7.3228
7.3186
7.3143
7.3016
7.2969
7.2629
7.2595
7.2562
7.2464
7.2412
7.2360
7.2262
7.2229
7.2196
7.1883
6.9572
6.9541
6.9509
6.9393
6.9362
6.9331
6.9213
6.9182
6.9152
6.3048
6.3002
6.2965
6.2919
6.2067
6.1998
6.0973
6.0891
4.6404
4.6364
0.0000
D58
2.15
1.03
7.35
1.11
1.00
0.96
1.86
0.94
1.92
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

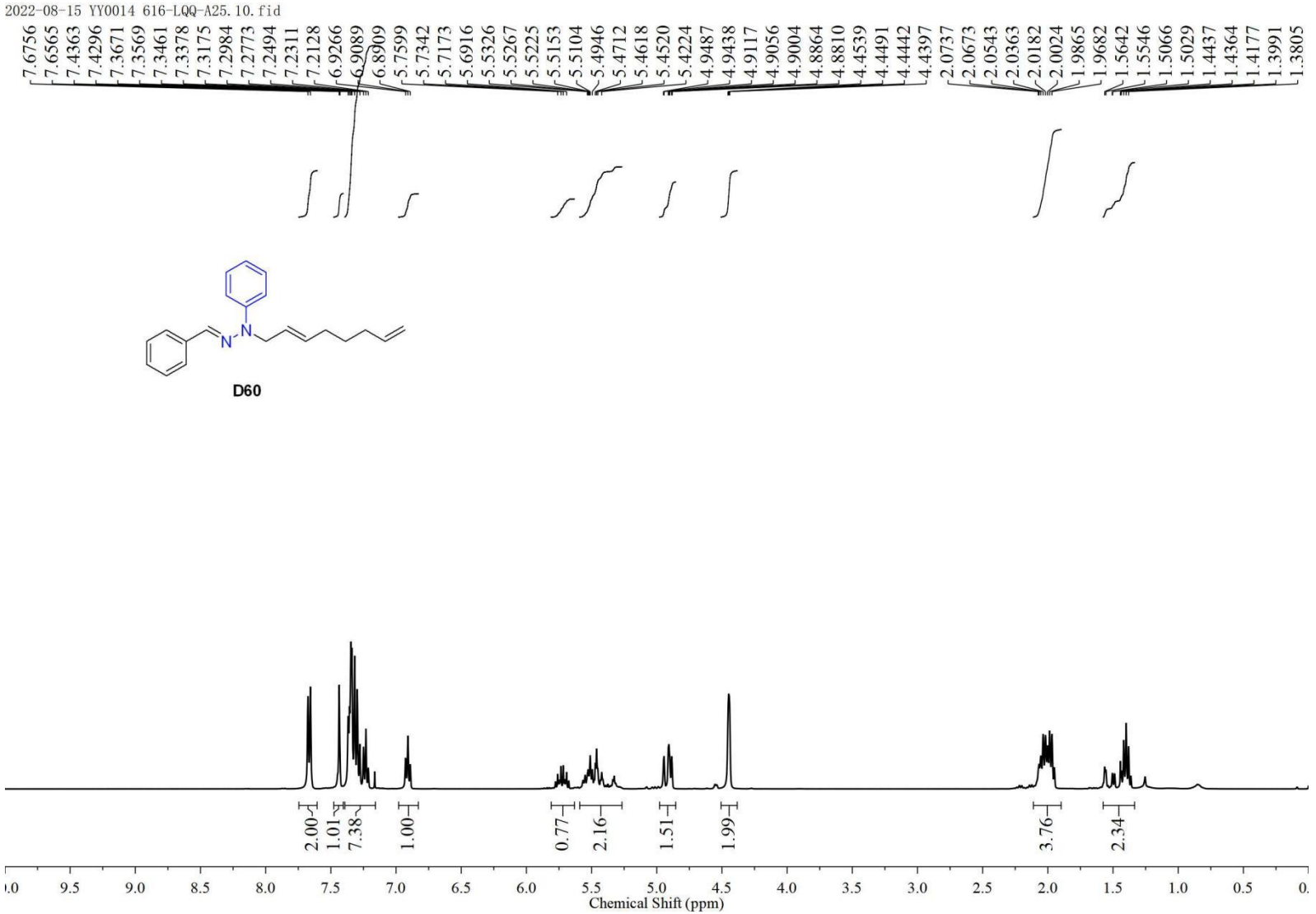
2022-07-19-YY0059-616-L-A12.10.fid




2022-07-20-yy0021-616-1-a13.10.fid
7.5971
7.5932
7.5884
7.5794
7.5758
7.3655
7.2923
7.2887
7.2839
7.2762
7.2723
7.2699
7.2667
7.2581
7.2544
7.2426
7.2390
7.2351
7.2293
7.2225
7.2174
7.2130
7.2003
7.1955
7.1721
7.1687
7.1654
7.1553
7.1503
7.1319
6.8468
6.8436
6.8290
6.8259
6.8225
6.8079
5.4371
5.3878
5.3806
5.3779
5.3748
4.3828
4.3784
4.3735
4.3685
4.3641
1.9351
1.9213
1.9176
1.9047
1.9014
1.8983
1.2759
1.2574
1.2394
1.2211
0.7642
0.7458
0.7274
D59
1.69
0.92
6.10
0.98
0.97
1.95
1.89
2.01
2.00
2.86
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
Chemical Shift (ppm)

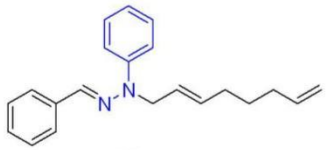
2022-07-21-yy0026-616-1-a12.10.fid



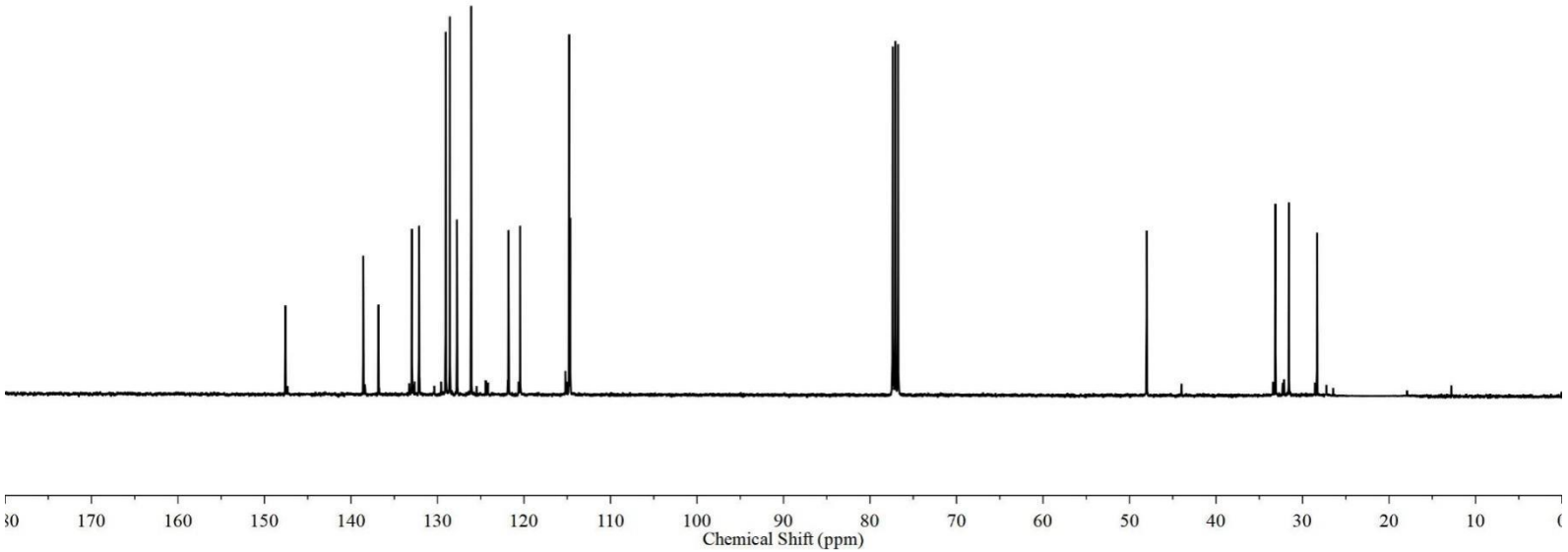

2022-08-15 YY0014 616-LQQ-A25.10.fid
7.6756
7.6565
7.4363
7.4296
7.3671
7.3569
7.3461
7.3378
7.3175
7.2984
7.2773
7.2494
7.2311
7.2128
6.9266
6.9089
6.8909
5.7599
5.7342
5.7173
5.6916
5.5326
5.5267
5.5225
5.5153
5.5104
5.4946
5.4712
5.4618
5.4520
5.4224
4.9487
4.9438
4.9117
4.9056
4.9004
4.8864
4.8810
4.4539
4.4491
4.4442
4.4397
2.0737
2.0673
2.0543
2.0363
2.0182
2.0024
1.9865
1.9682
1.5642
1.5546
1.5066
1.5029
1.4437
1.4364
1.4177
1.3991
1.3805
N
N
D60
2.00
1.01
7.38
1.00
0.77
2.16
1.51
1.99
3.76
2.34
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

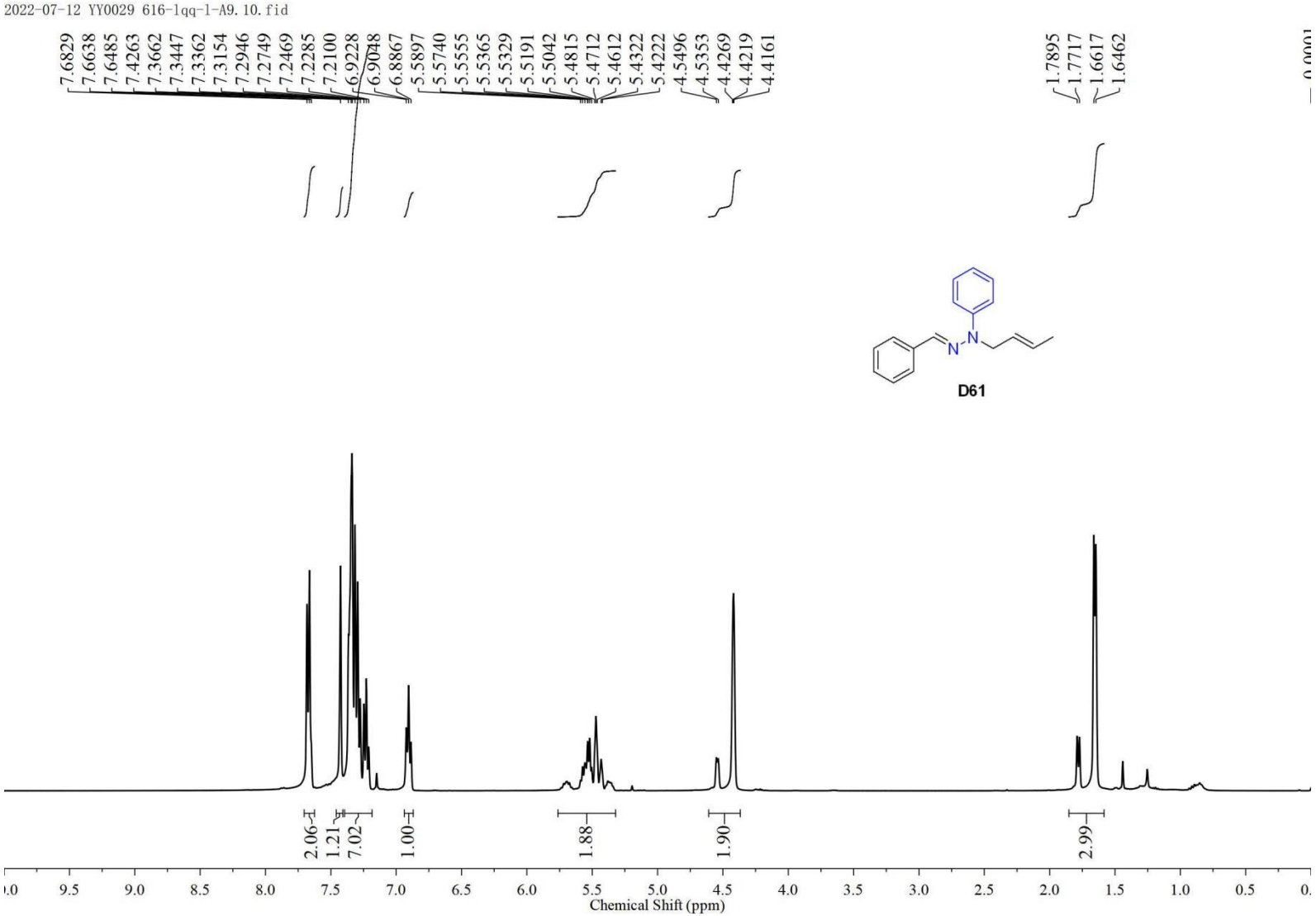
2022-10-17-YY0002--616-L-1.10.fid

147.58
138.57
136.82
132.96
132.13
129.05
128.58
127.74
126.10
121.79
120.45
114.78
114.65
77.39
77.07
76.75
48.01
33.14
31.58
28.32



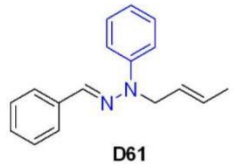
D60



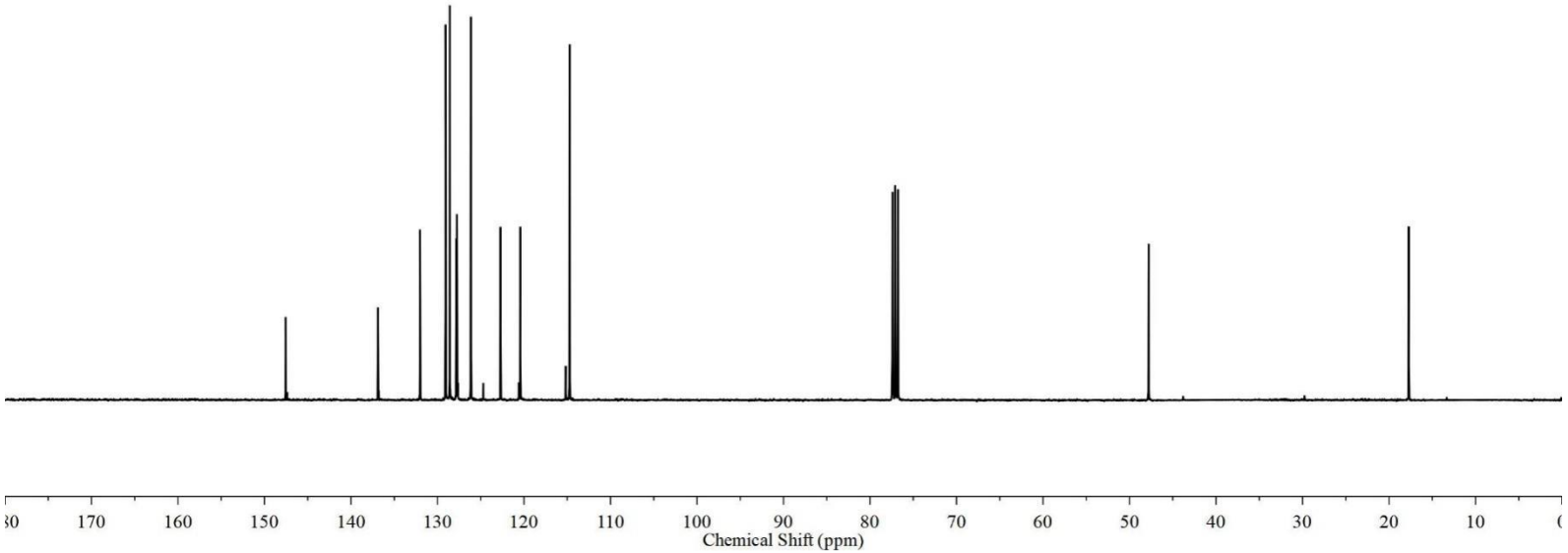

2022-07-12 YY0029 616-1qq-1-A9.10.fid
7.6829
7.6638
7.6485
7.4263
7.3662
7.3447
7.3362
7.3154
7.2946
7.2749
7.2469
7.2285
7.2100
6.9228
6.9048
6.8867
5.5897
5.5740
5.5555
5.5365
5.5329
5.5191
5.5042
5.4815
5.4712
5.4612
5.4322
5.4222
4.5496
4.5353
4.4269
4.4219
4.4161
1.7895
1.7717
1.6617
1.6462
D61
2.06
1.21
7.02
1.00
1.88
1.90
2.99
Chemical Shift (ppm)

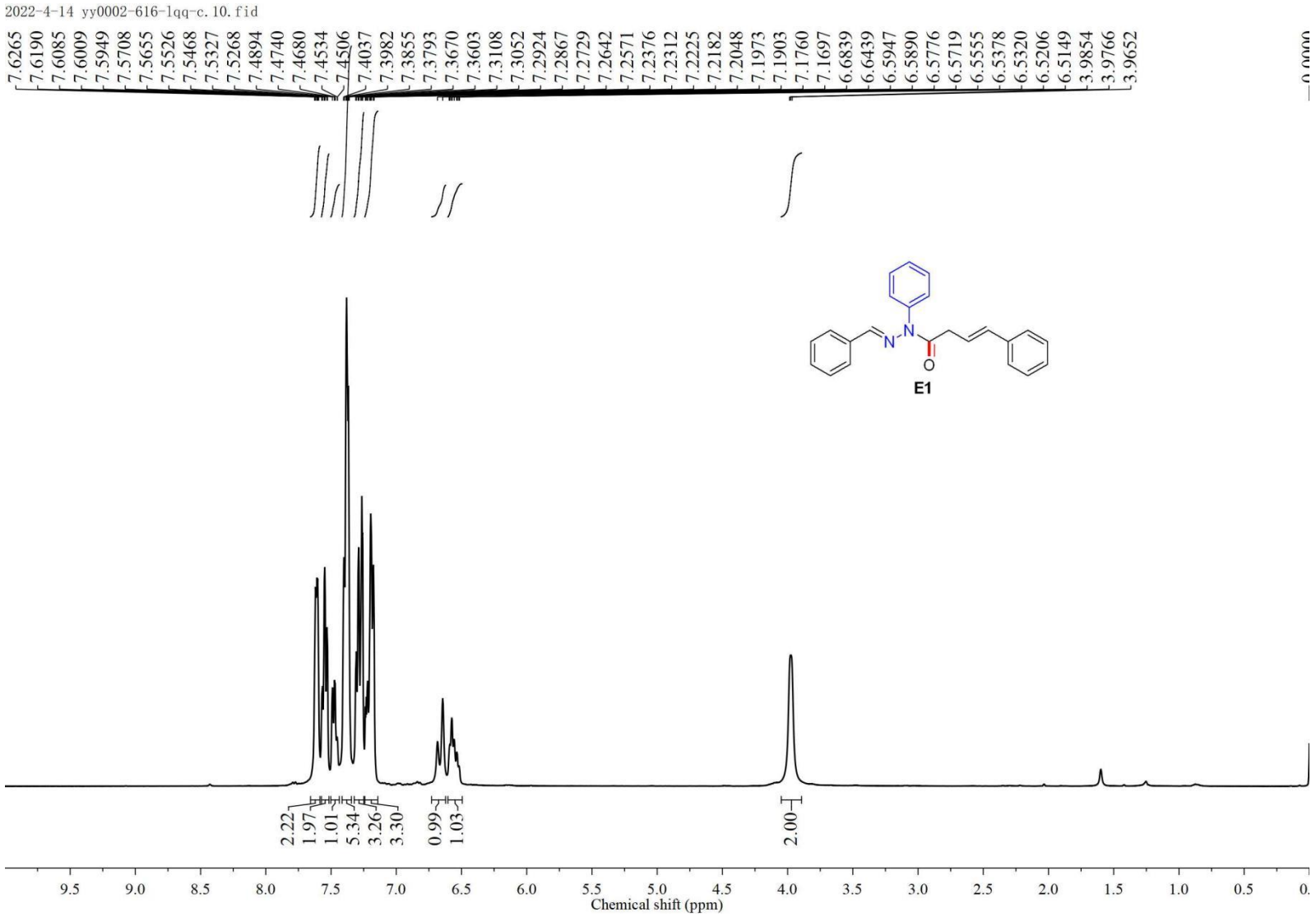
2022-07-14 YY0037 616-1qq-1-A12.11.fid

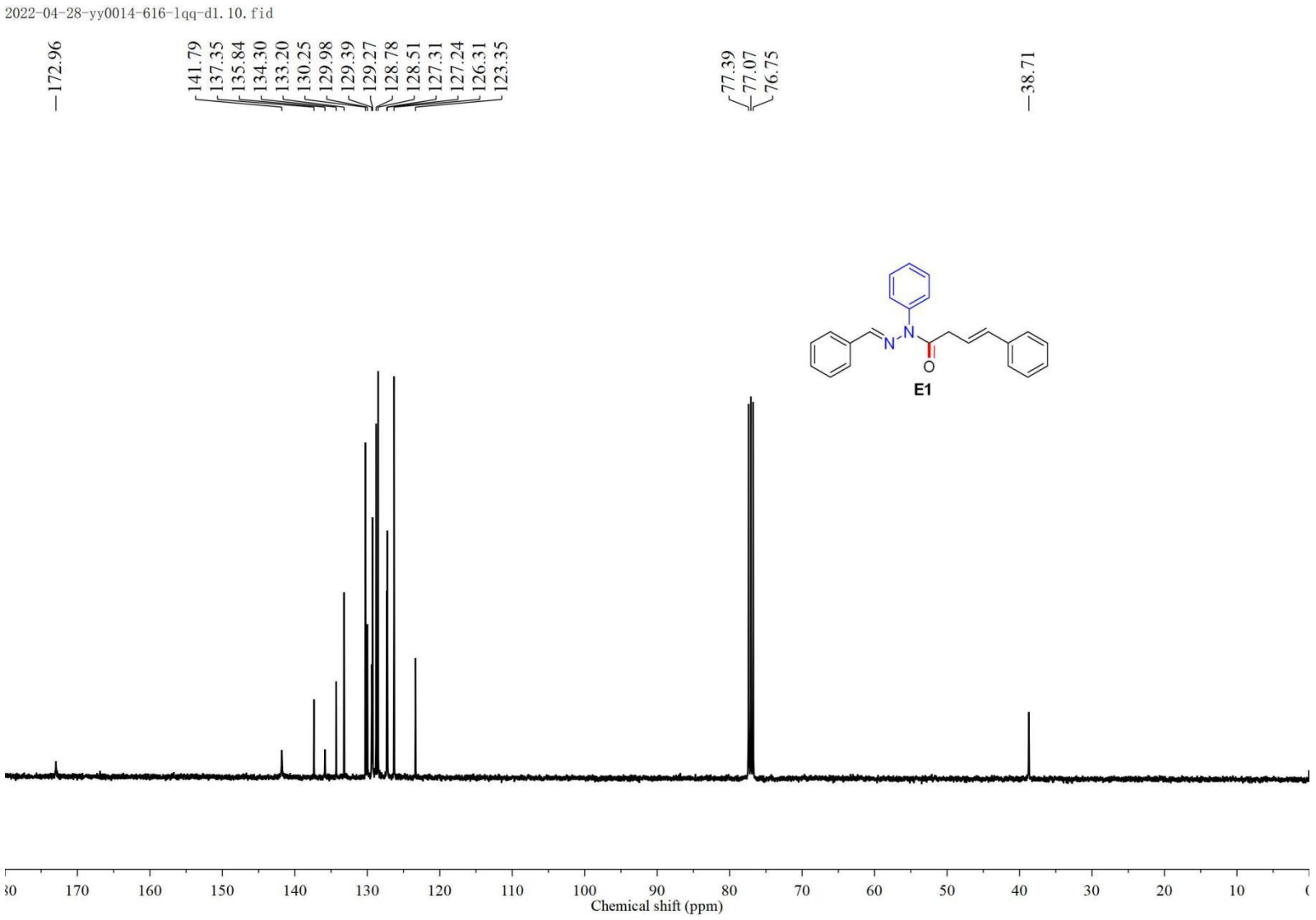
147.55
136.88
132.01
129.06
128.58
127.83
127.74
126.14
126.12
122.71
120.42
114.73
77.40
77.09
76.77
47.80
17.72

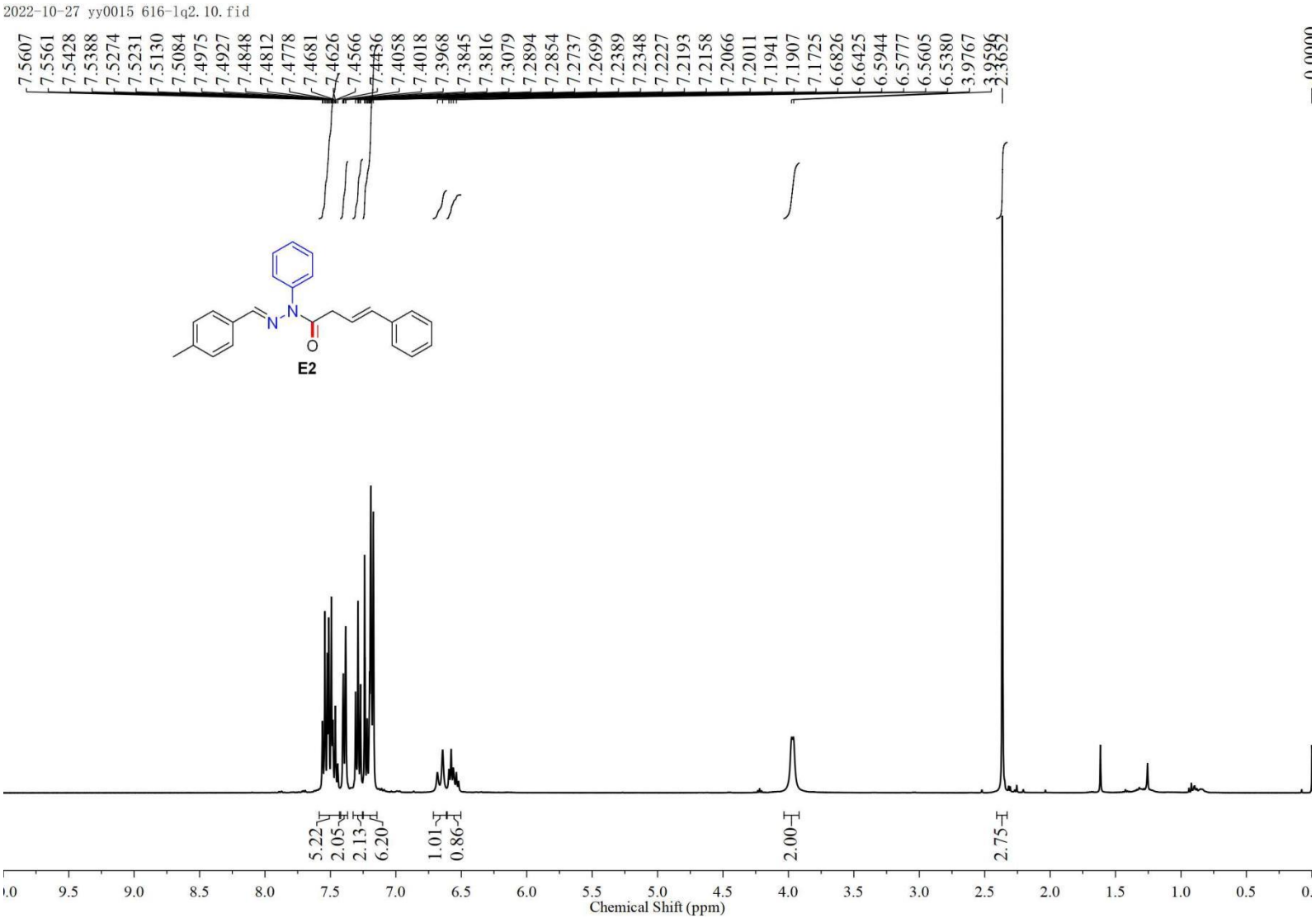


D61



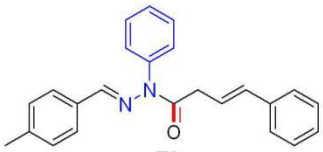

2022-4-14 yy0002-616-lqq-c.10.fid
7.6265
7.6190
7.6085
7.6009
7.5949
7.5708
7.5655
7.5526
7.5468
7.5327
7.5268
7.4894
7.4740
7.4680
7.4534
7.4506
7.4037
7.3982
7.3855
7.3793
7.3670
7.3603
7.3108
7.3052
7.2924
7.2867
7.2729
7.2642
7.2571
7.2376
7.2312
7.2225
7.2182
7.2048
7.1973
7.1903
7.1760
7.1697
6.6839
6.6439
6.5947
6.5890
6.5776
6.5719
6.5555
6.5378
6.5320
6.5206
6.5149
3.9854
3.9766
3.9652
N
N
O
E1
2.22
1.97
1.01
5.34
3.26
3.30
0.99
1.03
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical shift (ppm)


2022-04-28-yy0014-616-lqq-d1.10.fid
172.96
141.79
137.35
135.84
134.30
133.20
130.25
129.98
129.39
129.27
128.78
128.51
127.31
127.24
126.31
123.35
77.39
77.07
76.75
38.71
N
N
O
E1
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical shift (ppm)

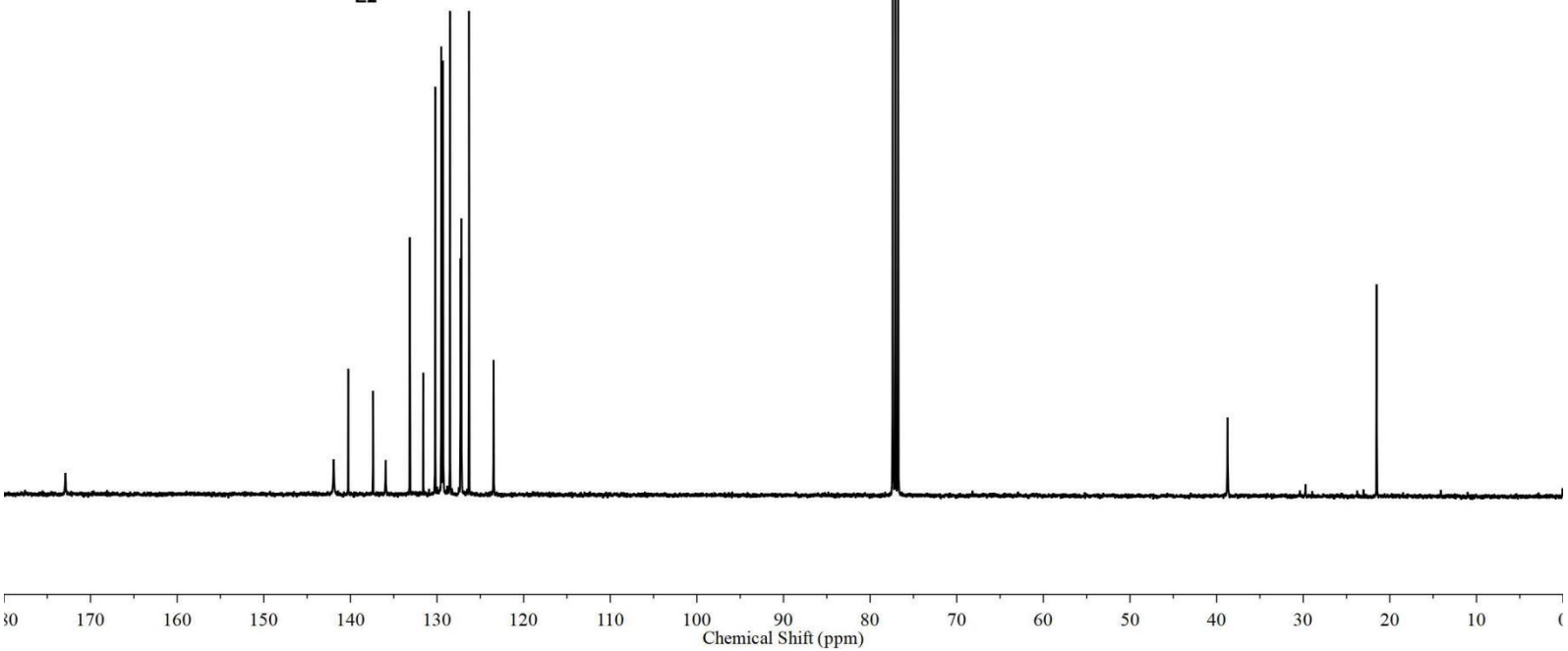

2022-10-27 yy0015 616-lq2.10.fid
7.5607
7.5561
7.5428
7.5388
7.5274
7.5231
7.5130
7.5084
7.4975
7.4927
7.4848
7.4812
7.4778
7.4681
7.4626
7.4566
7.4436
7.4058
7.4018
7.3968
7.3845
7.3816
7.3079
7.2894
7.2854
7.2737
7.2699
7.2389
7.2348
7.2227
7.2193
7.2158
7.2066
7.2011
7.1941
7.1907
7.1725
6.6826
6.6425
6.5944
6.5777
6.5605
6.5380
3.9767
3.9596
3.3652
2.3652
N
N
O
E2
5.22
2.05
2.13
6.20
1.01
0.86
2.00
2.75
Chemical Shift (ppm)

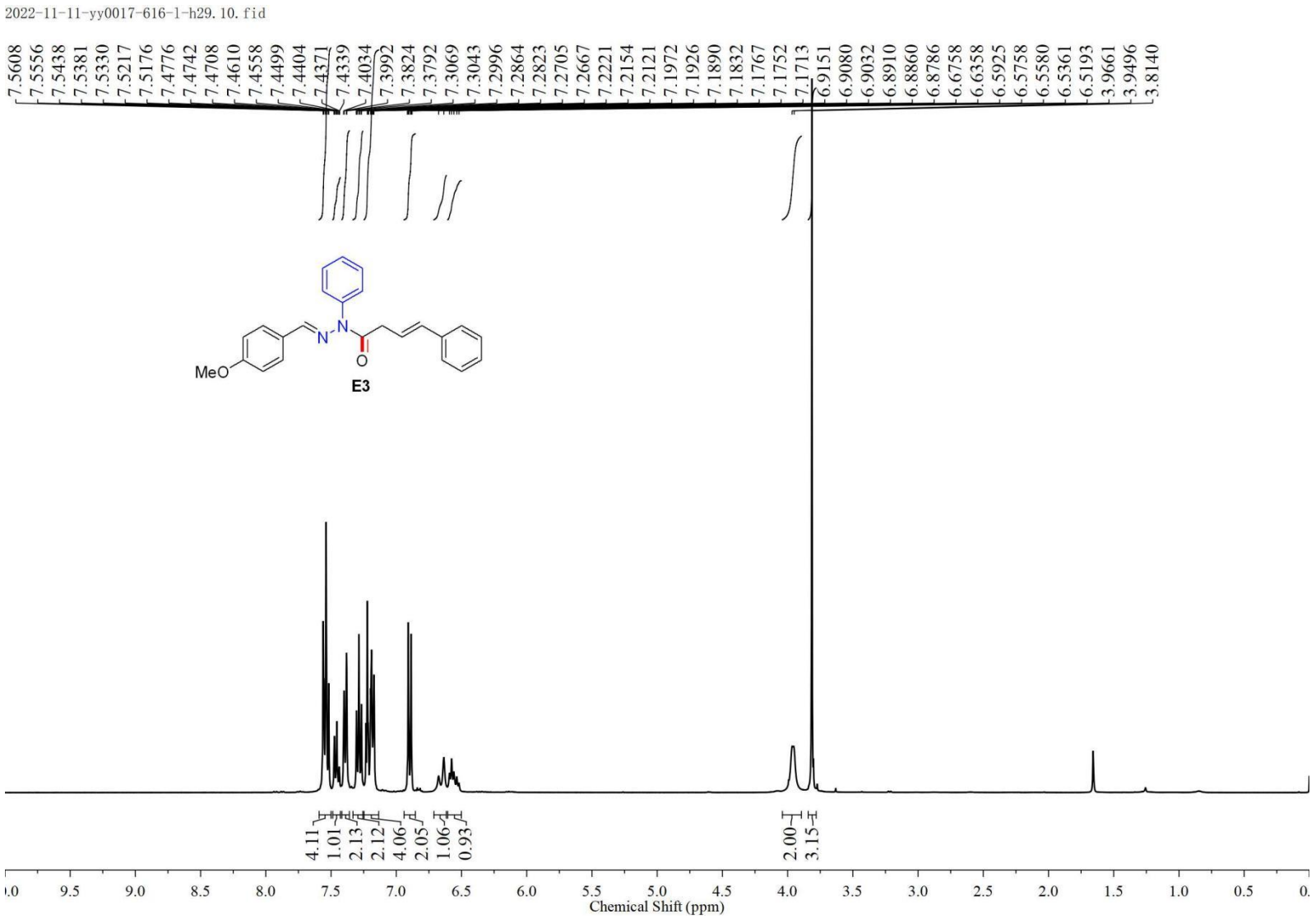
2022-10-28 yy0003 616-lqq-6.10.fid

172.90
141.93
140.25
137.39
135.93
133.14
131.59
130.21
129.51
129.31
128.50
127.29
127.20
126.31
123.47
77.40
77.08
76.76
38.73
21.52



E2




2022-11-11-yy0017-616-1-h29.10.fid
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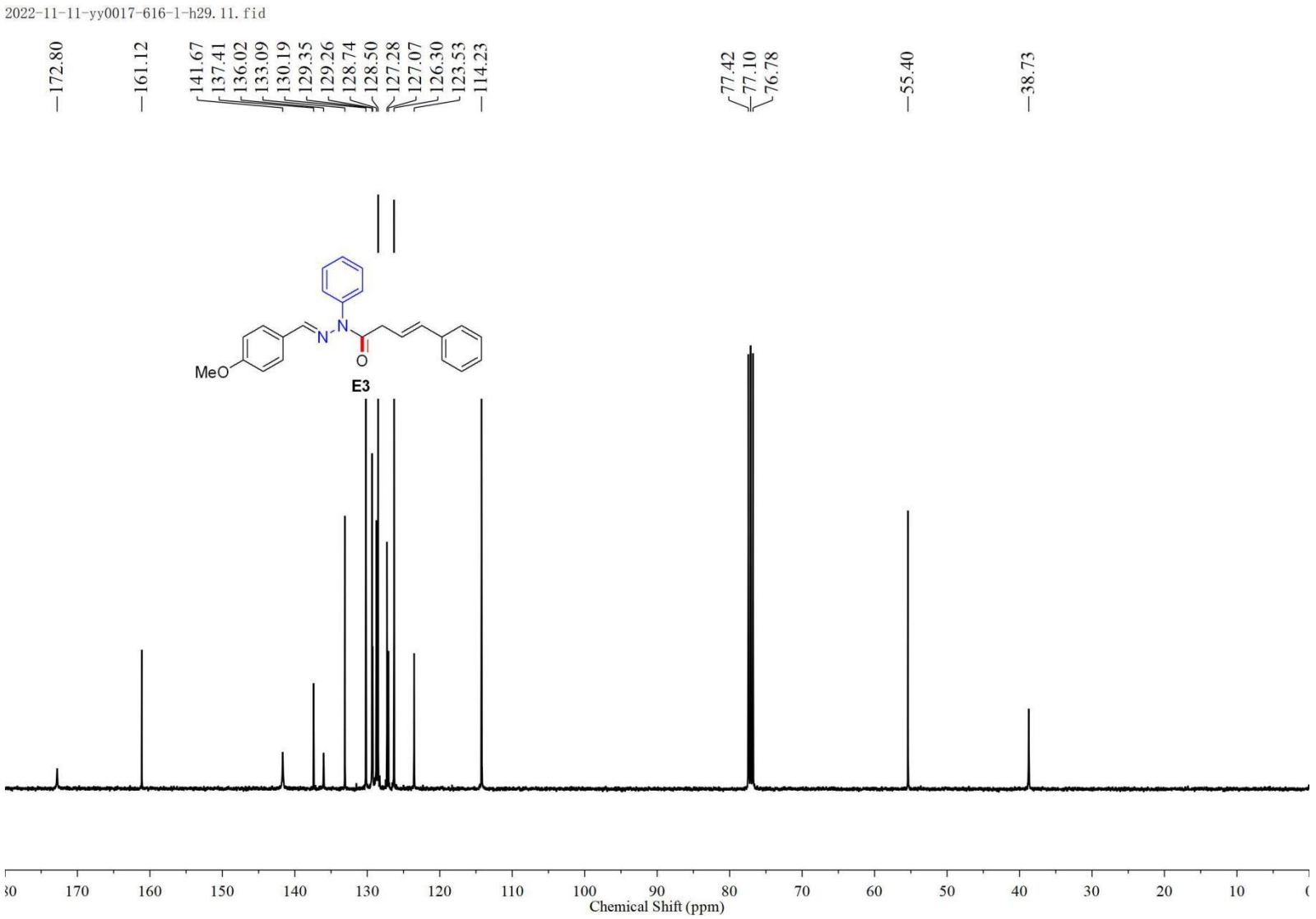
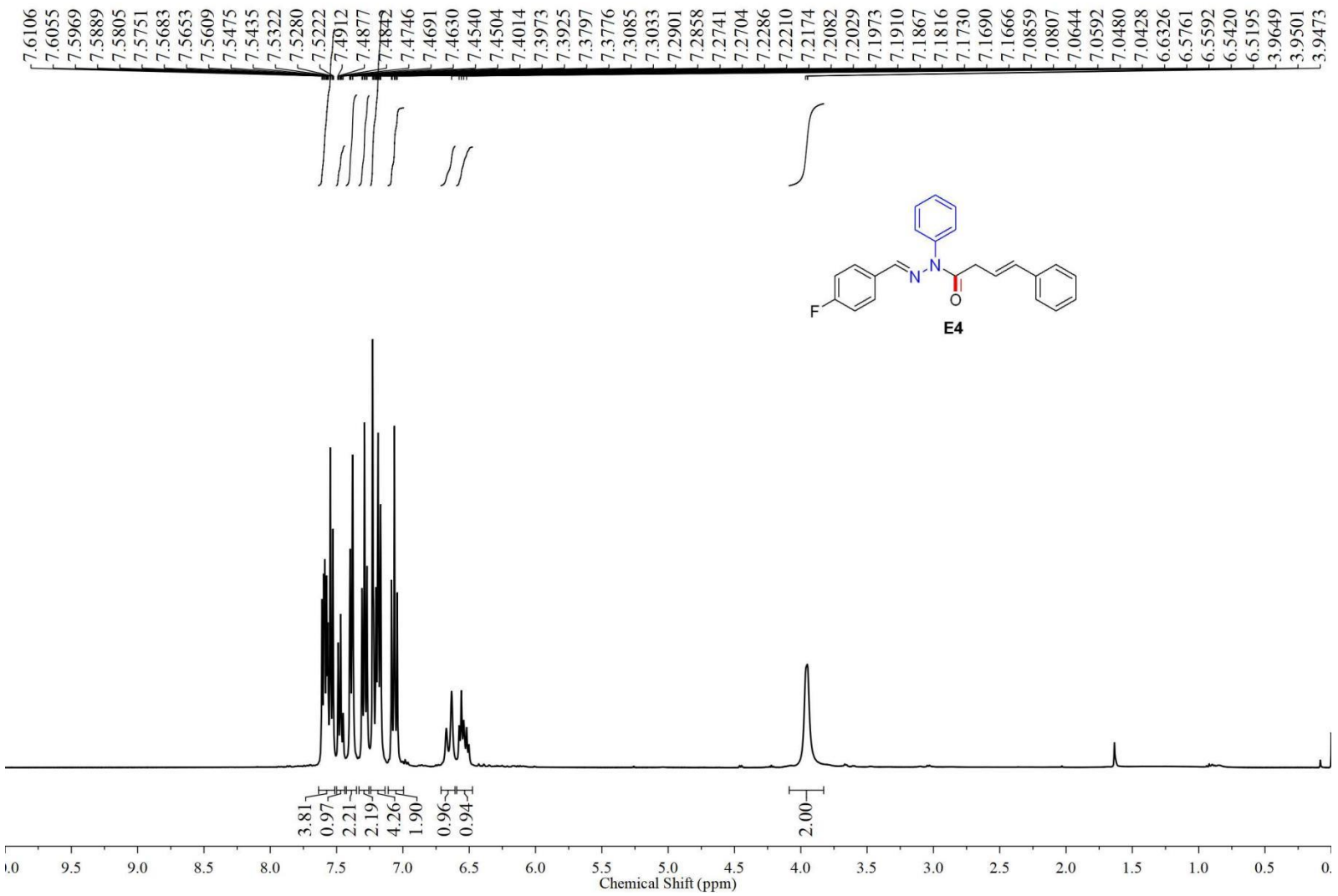
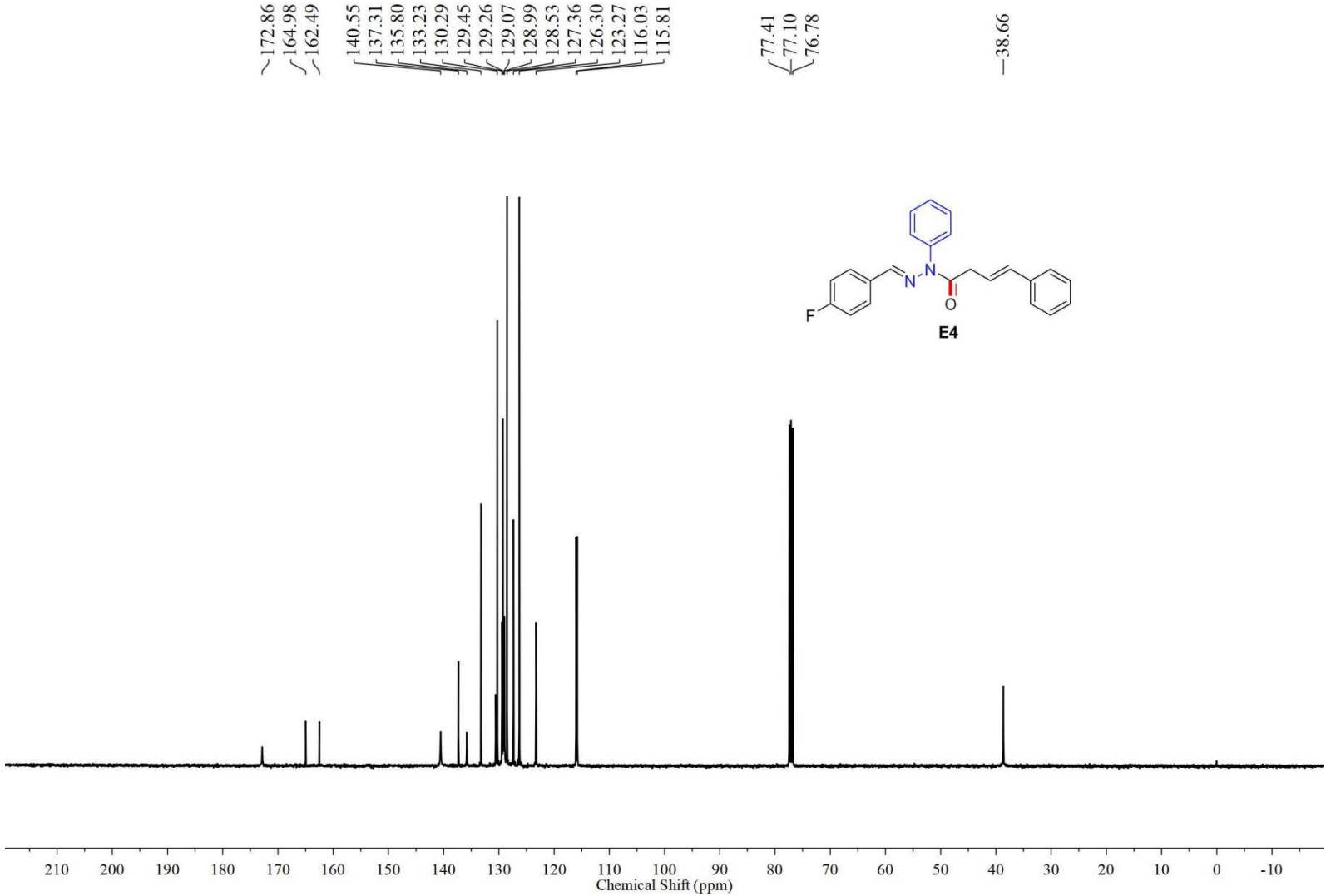
7.5438
7.5381
7.5330
7.5217
7.5176
7.4776
7.4742
7.4708
7.4610
7.4558
7.4499
7.4404
7.4371
7.4339
7.4034
7.3992
7.3824
7.3792
7.3069
7.3043
7.2996
7.2864
7.2823
7.2705
7.2667
7.2221
7.2154
7.2121
7.1972
7.1926
7.1890
7.1832
7.1767
7.1752
7.1713
6.9151
6.9080
6.9032
6.8910
6.8860
6.8786
6.6758
6.6358
6.5925
6.5758
6.5580
6.5361
6.5193
3.9661
3.9496
3.8140
MeO
N
N
O
E3
4.11
1.01
2.13
2.12
4.06
2.05
1.06
0.93
2.00
3.15
Chemical Shift (ppm)


2022-11-11-yy0017-616-1-h29.11.fid
172.80
161.12
141.67
137.41
136.02
133.09
130.19
129.35
129.26
128.74
128.50
127.28
127.07
126.30
123.53
114.23
77.42
77.10
76.78
55.40
38.73
MeO
N
N
O
E3
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

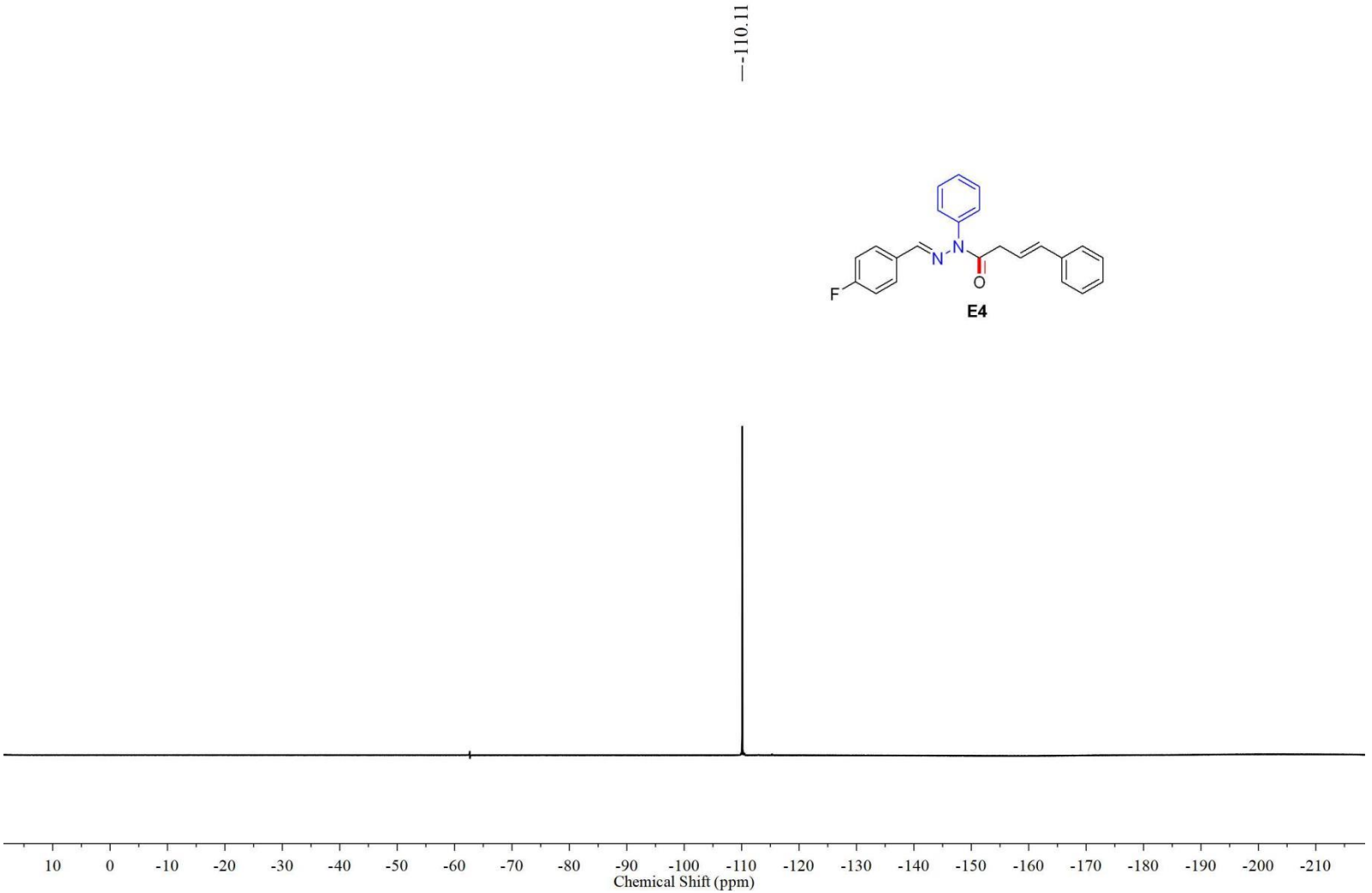
2022-11-09-yy0020-616-h30.10.fid

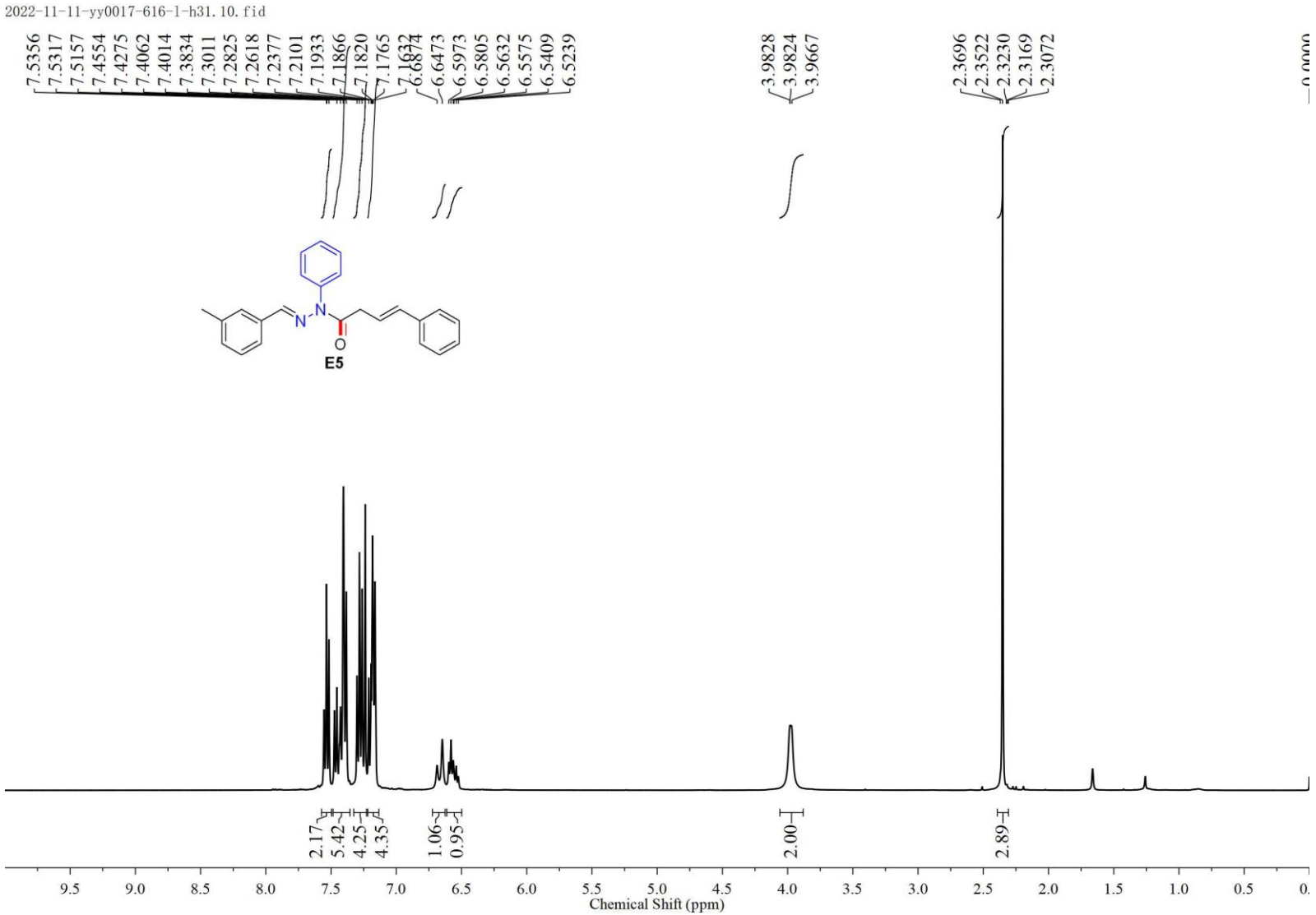


2022-11-10-yy0019-616-h30.10.fid



2022-11-10-yy0019-616-h30.11.fid




2022-11-11-yy0017-616-1-h31.10.fid
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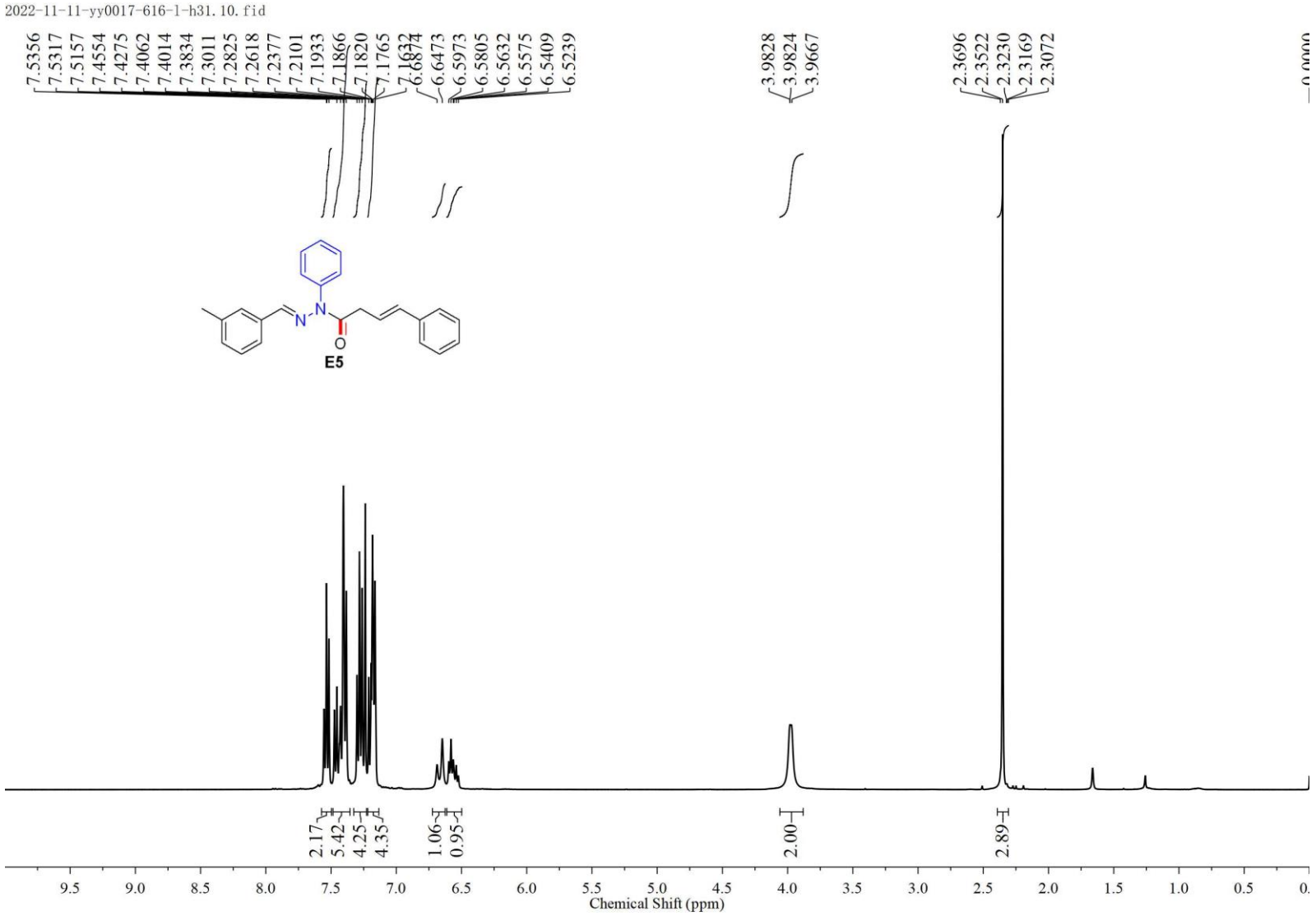
7.5157
7.4554
7.4275
7.4062
7.4014
7.3834
7.3011
7.2825
7.2618
7.2377
7.2101
7.1933
7.1866
7.1820
7.1765
7.1632
6.6874
6.6473
6.5973
6.5805
6.5632
6.5575
6.5409
6.5239
3.9828
3.9824
3.9667
2.3696
2.3522
2.3230
2.3169
2.3072
0.0000
E5
2.17
5.42
4.25
4.35
1.06
0.95
2.00
2.89
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)


2022-11-11-yy0017-616-1-h31.10.fid
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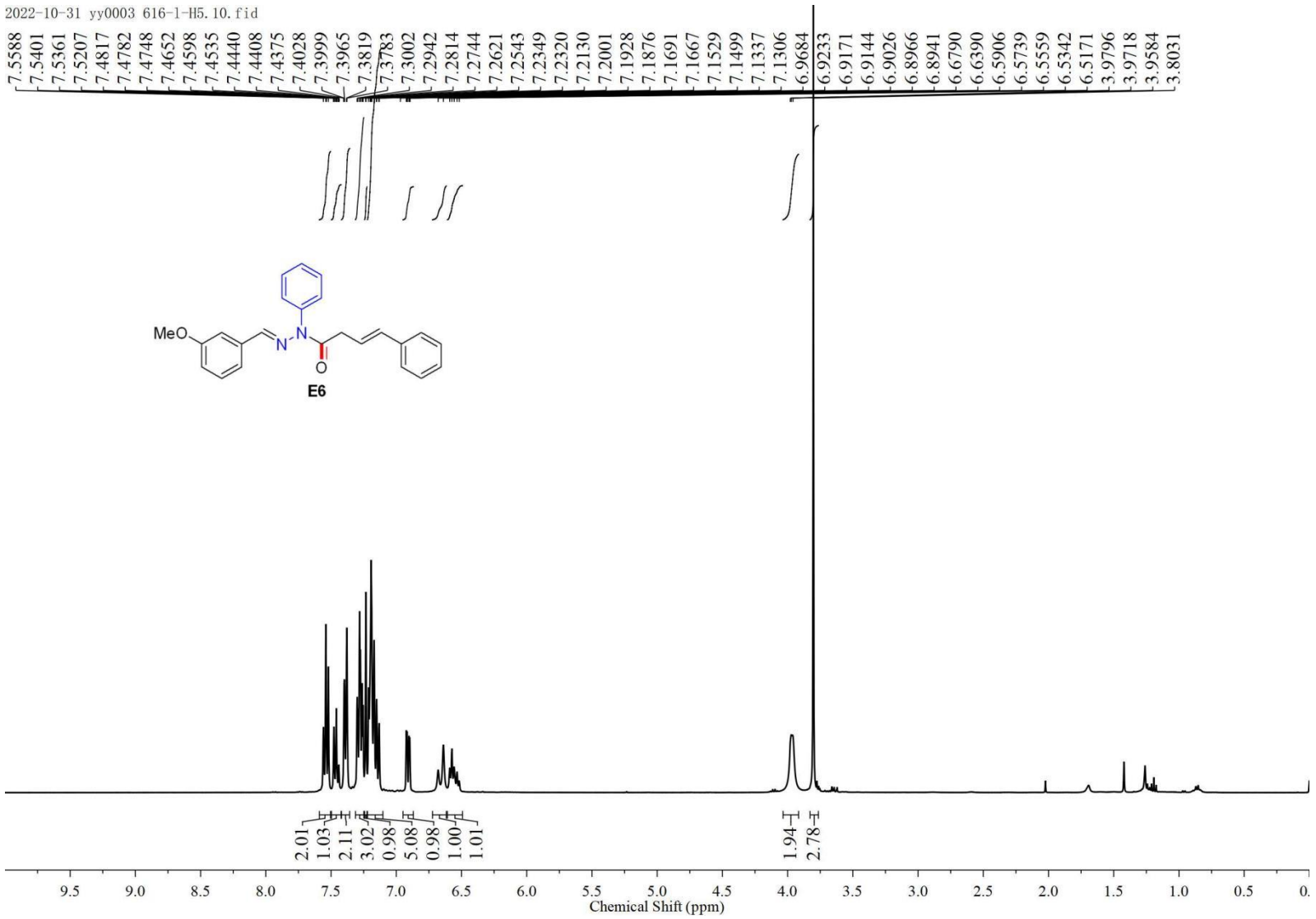
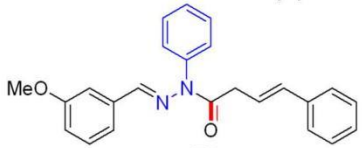
7.5157
7.4554
7.4275
7.4062
7.4014
7.3834
7.3011
7.2825
7.2618
7.2377
7.2101
7.1933
7.1866
7.1820
7.1765
6.6874
6.6473
6.5973
6.5805
6.5632
6.5575
6.5409
6.5239
3.9828
3.9824
3.9667
2.3696
2.3522
2.3230
2.3169
2.3072
0.0000
N
N
O
E5
2.17
5.42
4.25
4.35
1.06
0.95
2.00
2.89
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

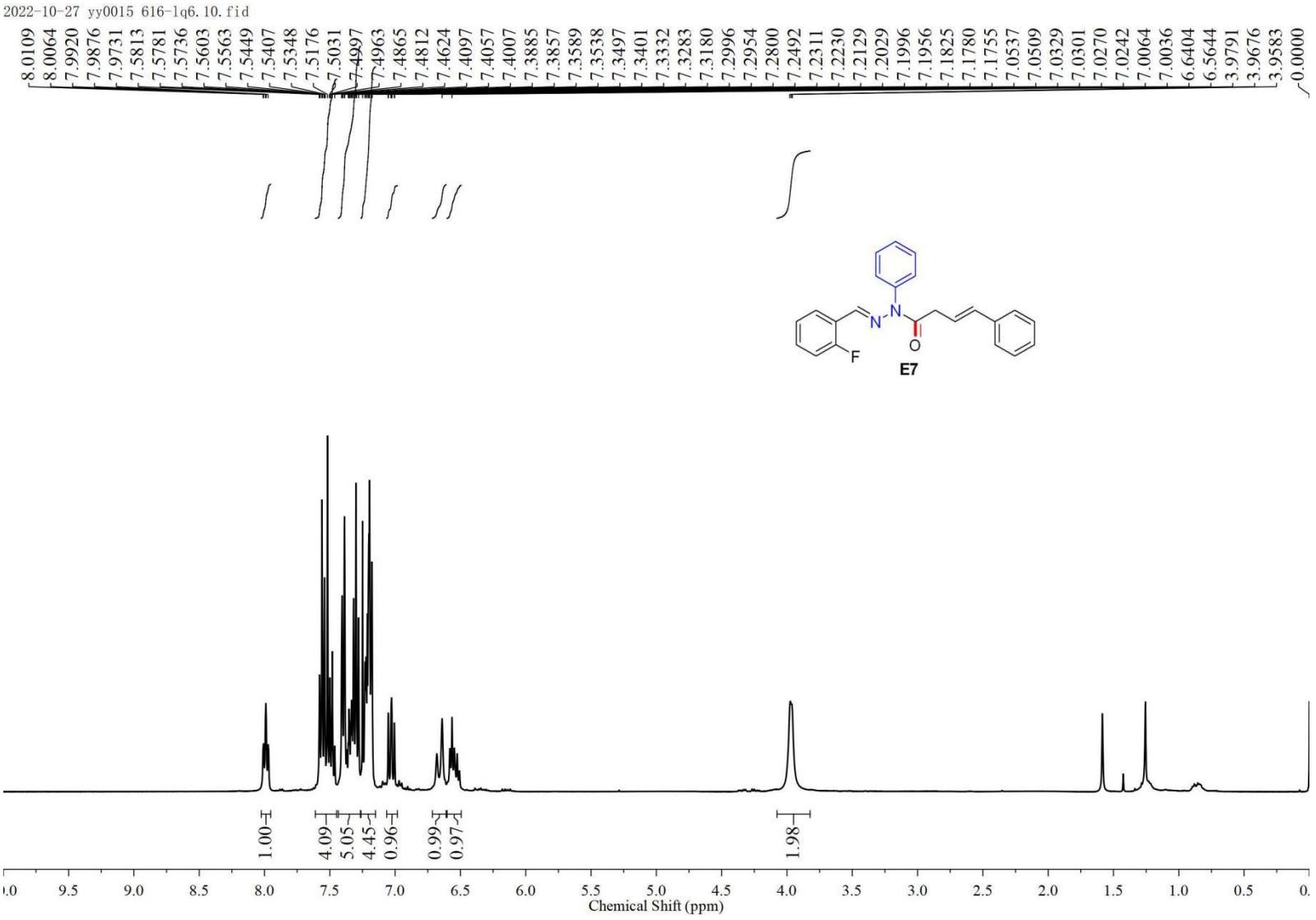

2022-10-31 yy0003 616-1-H5.10.fid
7.5588
7.5401
7.5361
7.5207
7.4817
7.4782
7.4748
7.4652
7.4598
7.4535
7.4440
7.4408
7.4375
7.4028
7.3999
7.3965
7.3819
7.3783
7.3002
7.2942
7.2814
7.2744
7.2621
7.2543
7.2349
7.2320
7.2130
7.2001
7.1928
7.1876
7.1691
7.1667
7.1529
7.1499
7.1337
7.1306
6.9684
6.9233
6.9171
6.9144
6.9026
6.8966
6.8941
6.6790
6.6390
6.5906
6.5739
6.5559
6.5342
6.5171
3.9796
3.9718
3.9584
3.8031
MeO
N
N
O
E6
2.01
1.03
2.11
3.02
0.98
5.08
0.98
1.00
1.01
1.94
2.78
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

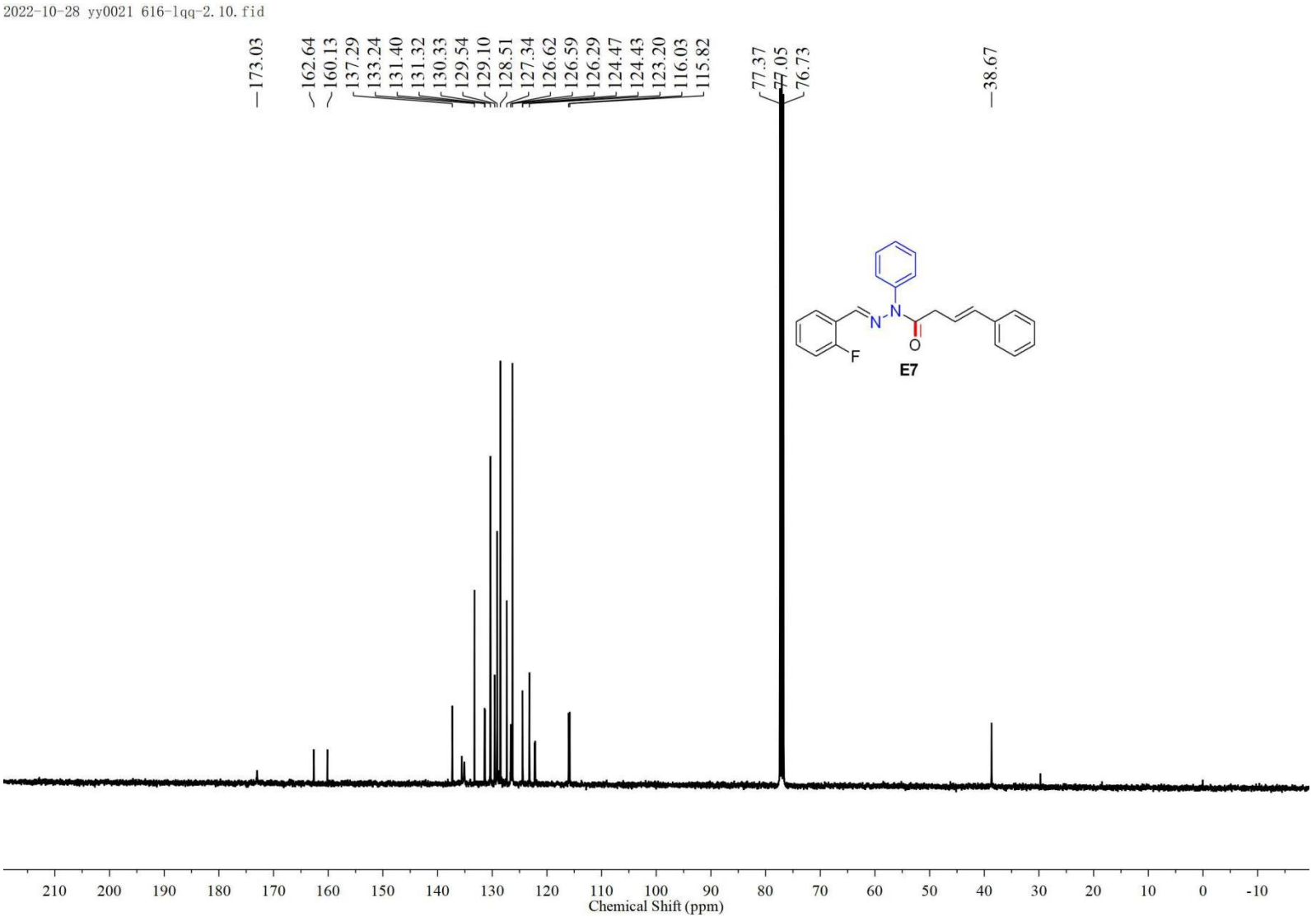
2022-11-1 yy0019-616-lqq-5.10.fid

172.94
159.97
141.68
137.37
135.89
135.72
133.24
130.28
129.83
129.42
129.28
128.54
127.36
126.33
123.36
120.24
115.98
111.79
77.48
77.17
76.85
55.35
38.73

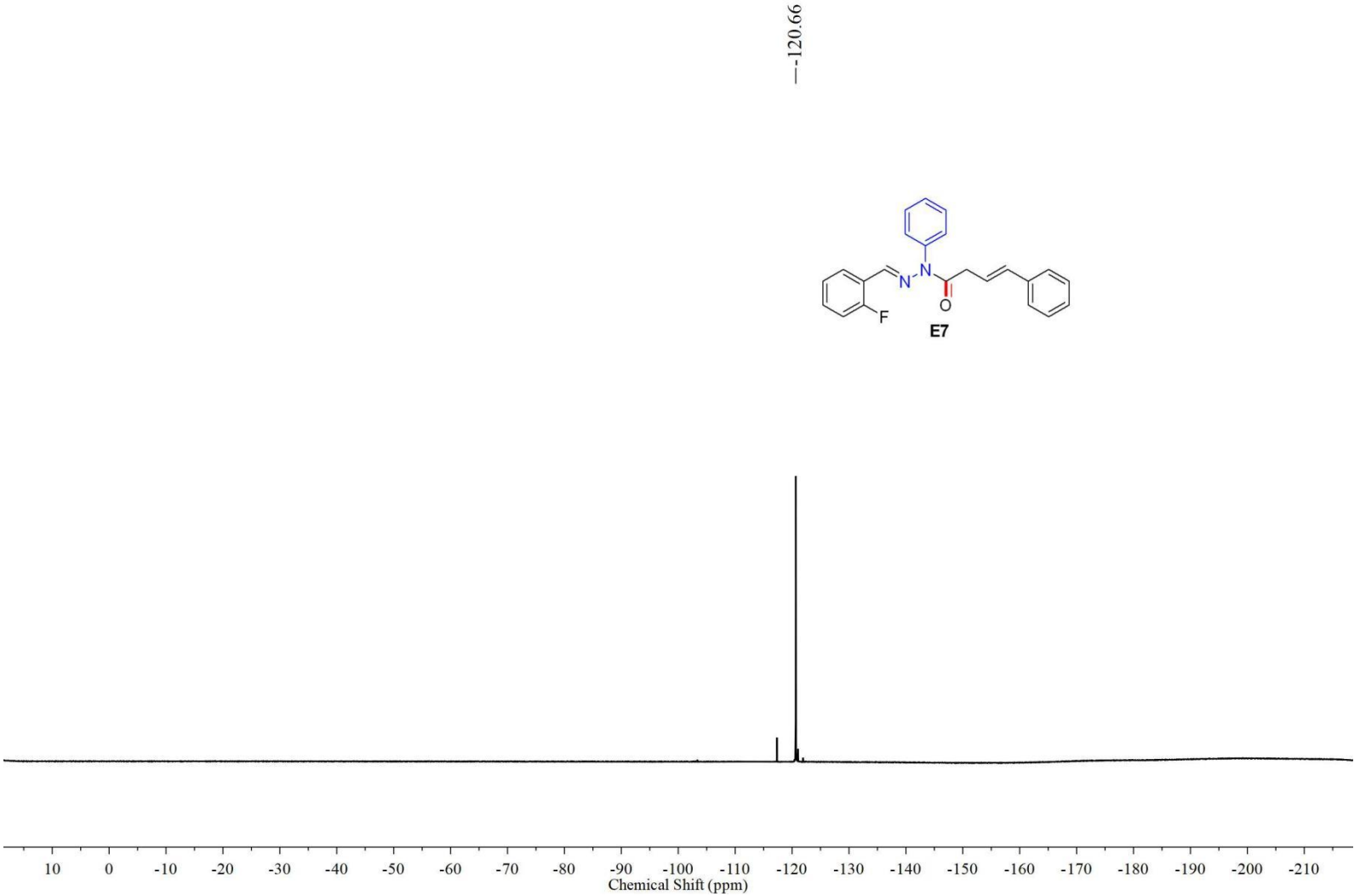


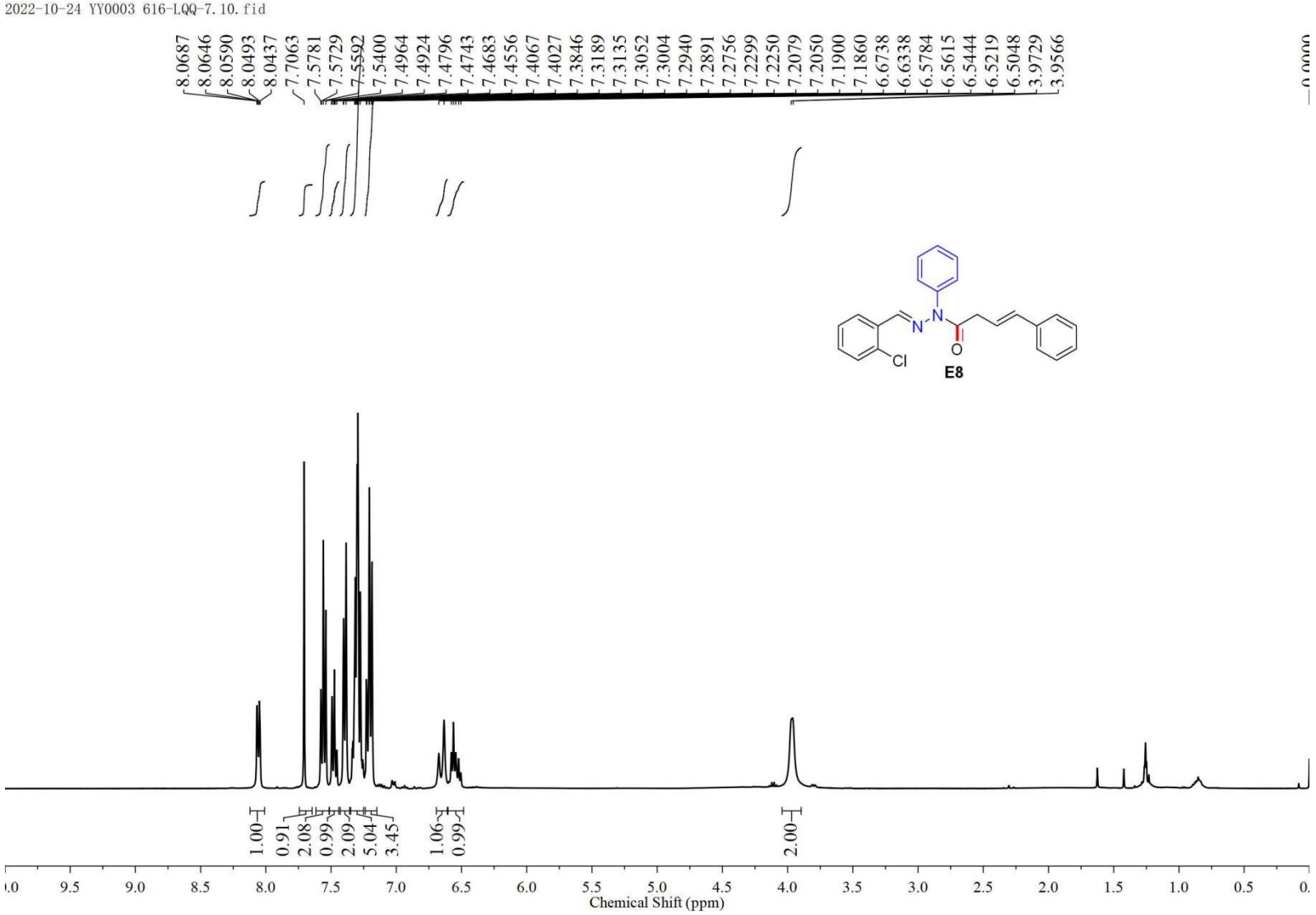
E6

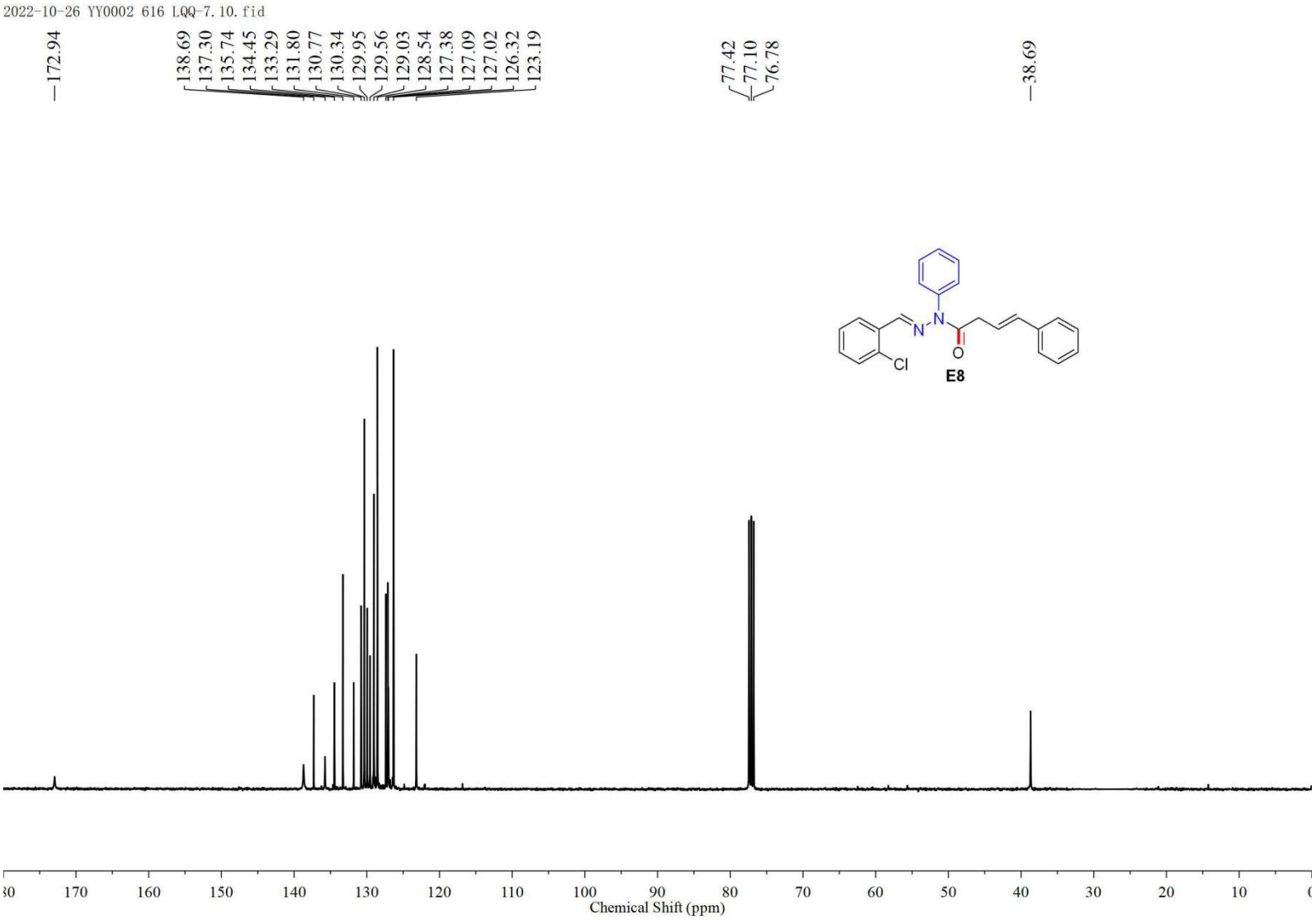

2022-10-27 yy0015 616-lq6.10.fid
8.0109
8.0064
7.9920
7.9876
7.9731
7.5813
7.5781
7.5736
7.5603
7.5563
7.5449
7.5407
7.5348
7.5176
7.5031
7.4997
7.4963
7.4865
7.4812
7.4624
7.4097
7.4057
7.4007
7.3885
7.3857
7.3589
7.3538
7.3497
7.3401
7.3332
7.3283
7.3180
7.2996
7.2954
7.2800
7.2492
7.2311
7.2230
7.2129
7.2029
7.1996
7.1956
7.1825
7.1780
7.1755
7.0537
7.0509
7.0329
7.0301
7.0270
7.0242
7.0064
7.0036
6.6404
6.5644
3.9791
3.9676
3.9583
0.0000
N
N
O
F
E7
1.00
4.09
5.05
4.45
0.96
0.99
0.97
1.98
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

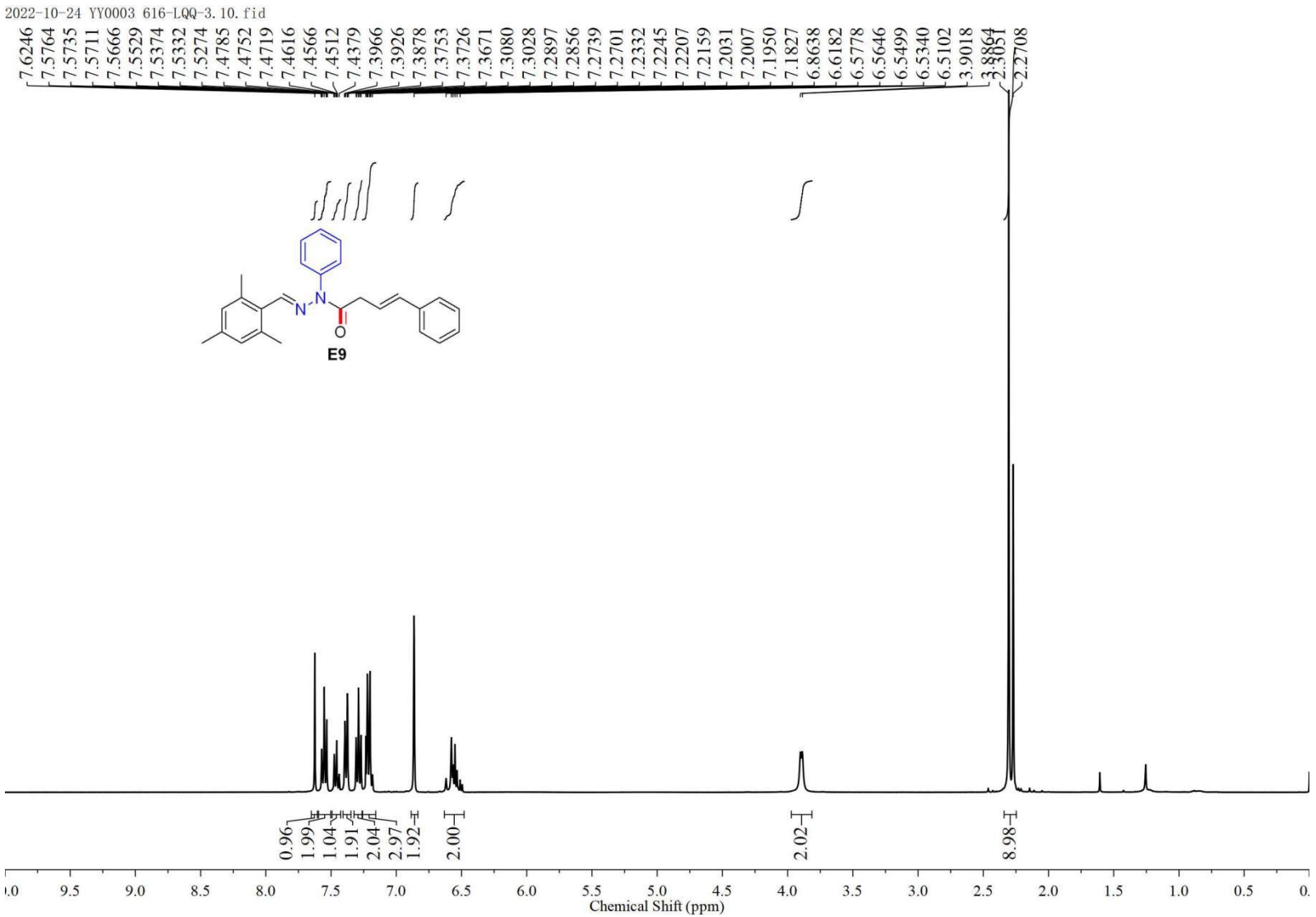

2022-10-28 yy0021 616-lqq-2.10.fid
173.03
162.64
160.13
137.29
133.24
131.40
131.32
130.33
129.54
129.10
128.51
127.34
126.62
126.59
126.29
124.47
124.43
123.20
116.03
115.82
77.37
77.05
76.73
38.67
N
N
O
F
E7
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
Chemical Shift (ppm)

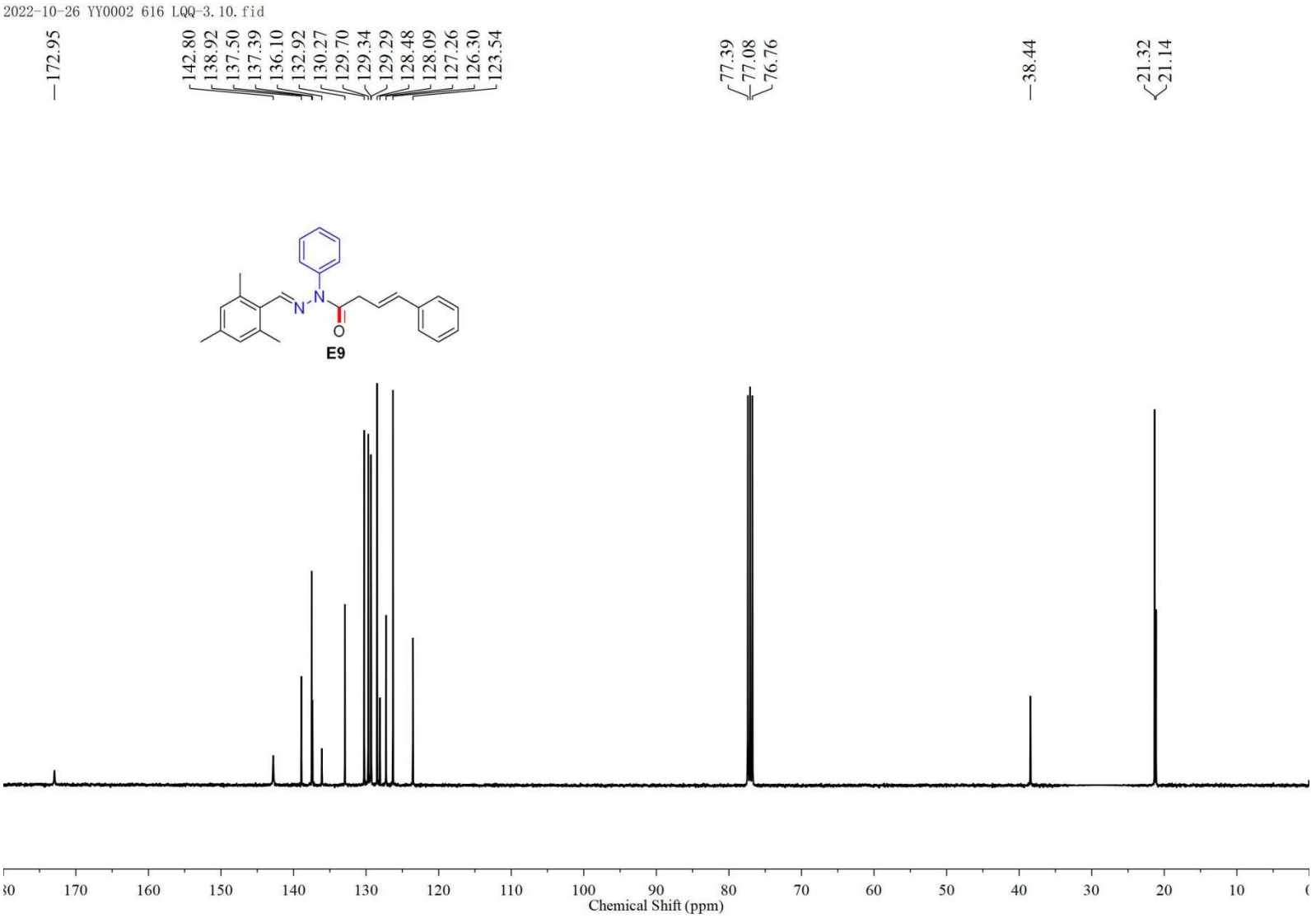
2022-10-31 yy0020 616-1-H6.10.fid

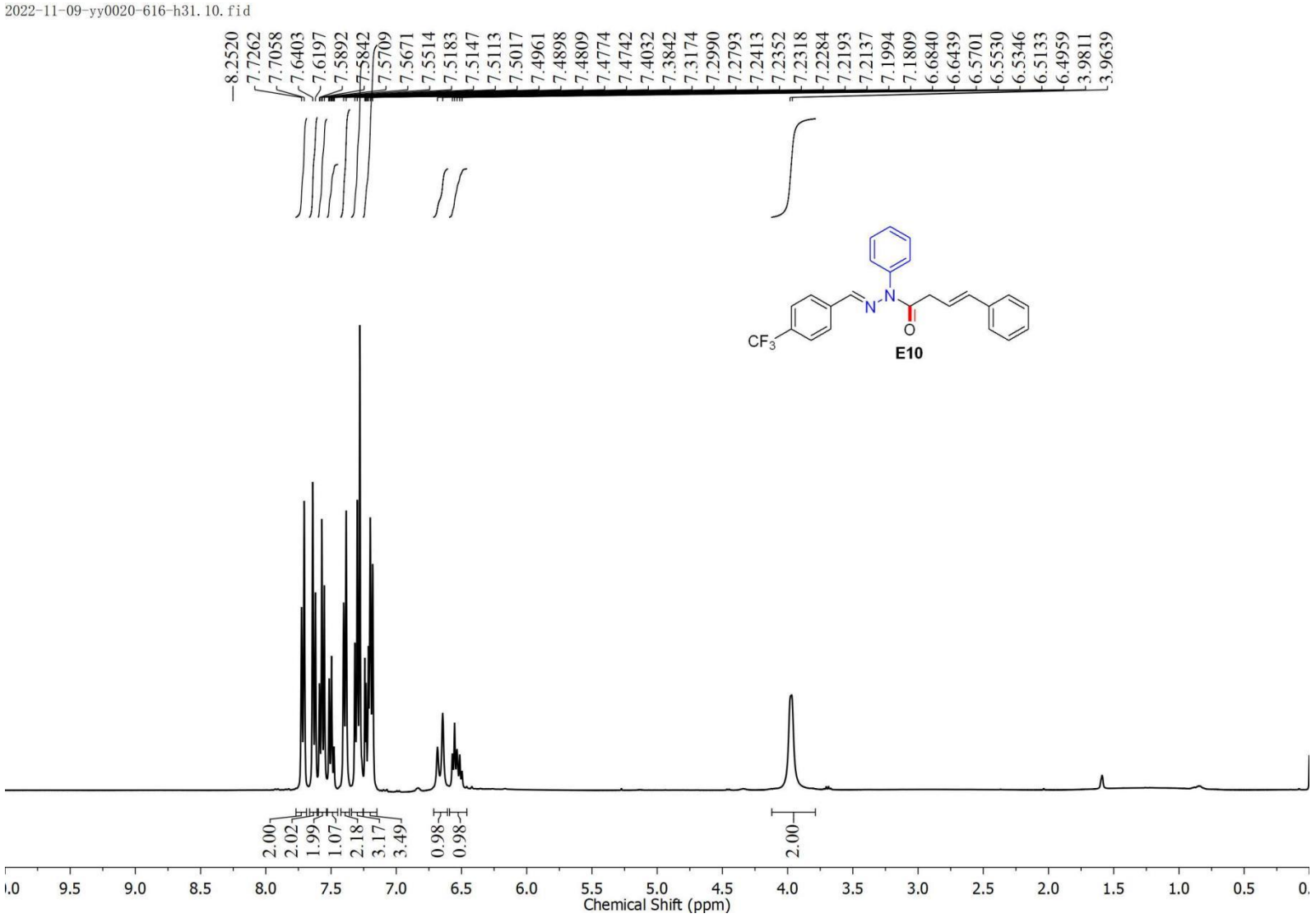



2022-10-24 YY0003 616-LQQ-7.10.fid
8.0687
8.0646
8.0590
8.0493
8.0437
7.7063
7.5781
7.5729
7.5592
7.5400
7.4964
7.4924
7.4796
7.4743
7.4683
7.4556
7.4067
7.4027
7.3846
7.3189
7.3135
7.3052
7.3004
7.2940
7.2891
7.2756
7.2299
7.2250
7.2079
7.2050
7.1900
7.1860
6.6738
6.6338
6.5784
6.5615
6.5444
6.5219
6.5048
3.9729
3.9566
N
N
O
Cl
E8
1.00
0.91
2.08
0.99
2.09
5.04
3.45
1.06
0.99
2.00
Chemical Shift (ppm)


2022-10-26 YY0002 616 LQQ-7.10.fid
172.94
138.69
137.30
135.74
134.45
133.29
131.80
130.77
130.34
129.95
129.56
129.03
128.54
127.38
127.09
127.02
126.32
123.19
77.42
77.10
76.78
38.69
N
N
O
Cl
E8
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

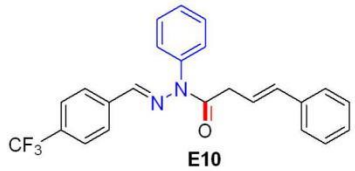

2022-10-24 YY0003 616-LQQ-3.10.fid
7.6246
7.5764
7.5735
7.5711
7.5666
7.5529
7.5374
7.5332
7.5274
7.4785
7.4752
7.4719
7.4616
7.4566
7.4512
7.4379
7.3966
7.3926
7.3878
7.3753
7.3726
7.3671
7.3080
7.3028
7.2897
7.2856
7.2739
7.2701
7.2332
7.2245
7.2207
7.2159
7.2031
7.2007
7.1950
7.1827
6.8638
6.6182
6.5778
6.5646
6.5499
6.5340
6.5102
3.9018
3.8864
3.8051
2.2708
N
N
O
E9
0.96
1.99
1.04
1.91
2.04
2.97
1.92
2.00
2.02
8.98
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)


2022-10-26 YY0002 616 LQQ-3.10.fid
172.95
142.80
138.92
137.50
137.39
136.10
132.92
130.27
129.70
129.34
129.29
128.48
128.09
127.26
126.30
123.54
77.39
77.08
76.76
38.44
21.32
21.14
E9
Chemical Shift (ppm)

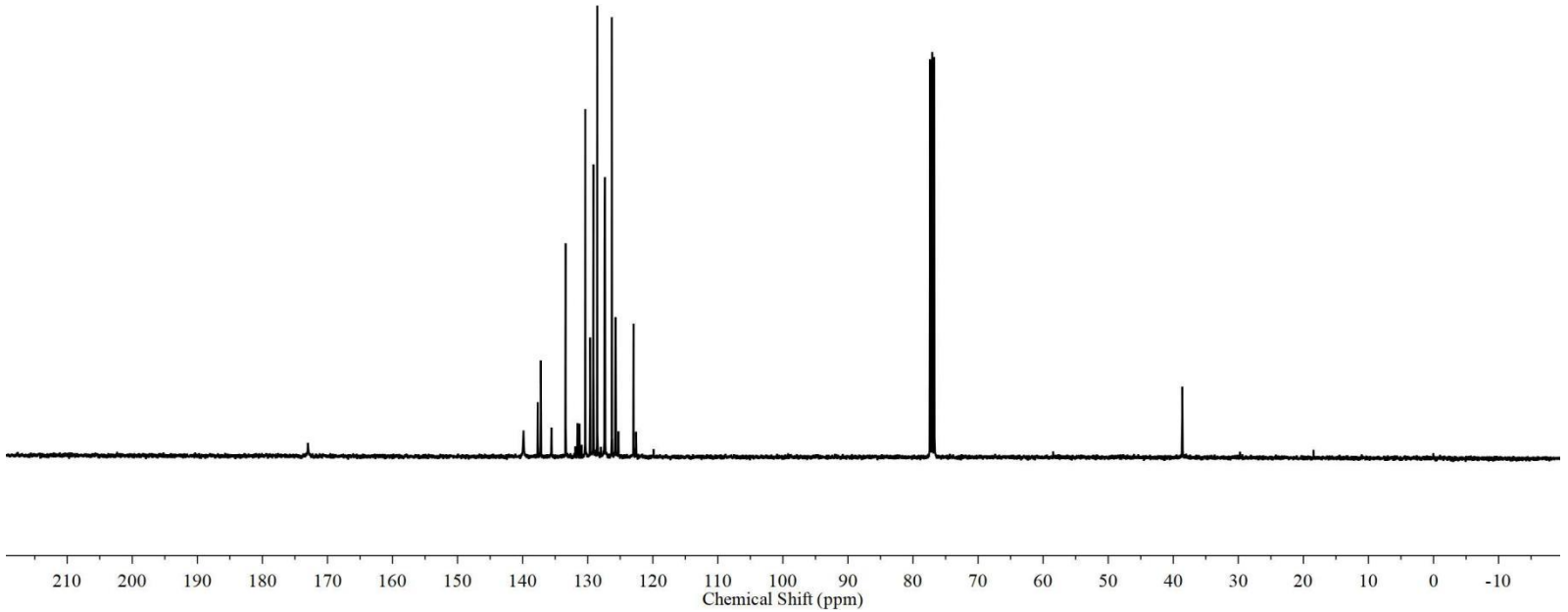

2022-11-09-yy0020-616-h31.10.fid
8.2520
7.7262
7.7058
7.6403
7.6197
7.5892
7.5842
7.5709
7.5671
7.5514
7.5183
7.5147
7.5113
7.5017
7.4961
7.4898
7.4809
7.4774
7.4742
7.4032
7.3842
7.3174
7.2990
7.2793
7.2413
7.2352
7.2318
7.2284
7.2193
7.2137
7.1994
7.1809
6.6840
6.6439
6.5701
6.5530
6.5346
6.5133
6.4959
3.9811
3.9639
CF3
N
N
O
E10
2.00
2.02
1.99
1.07
2.18
3.17
3.49
0.98
0.98
2.00
Chemical Shift (ppm)

2022-11-10-yy0019-616-h31.10.fid

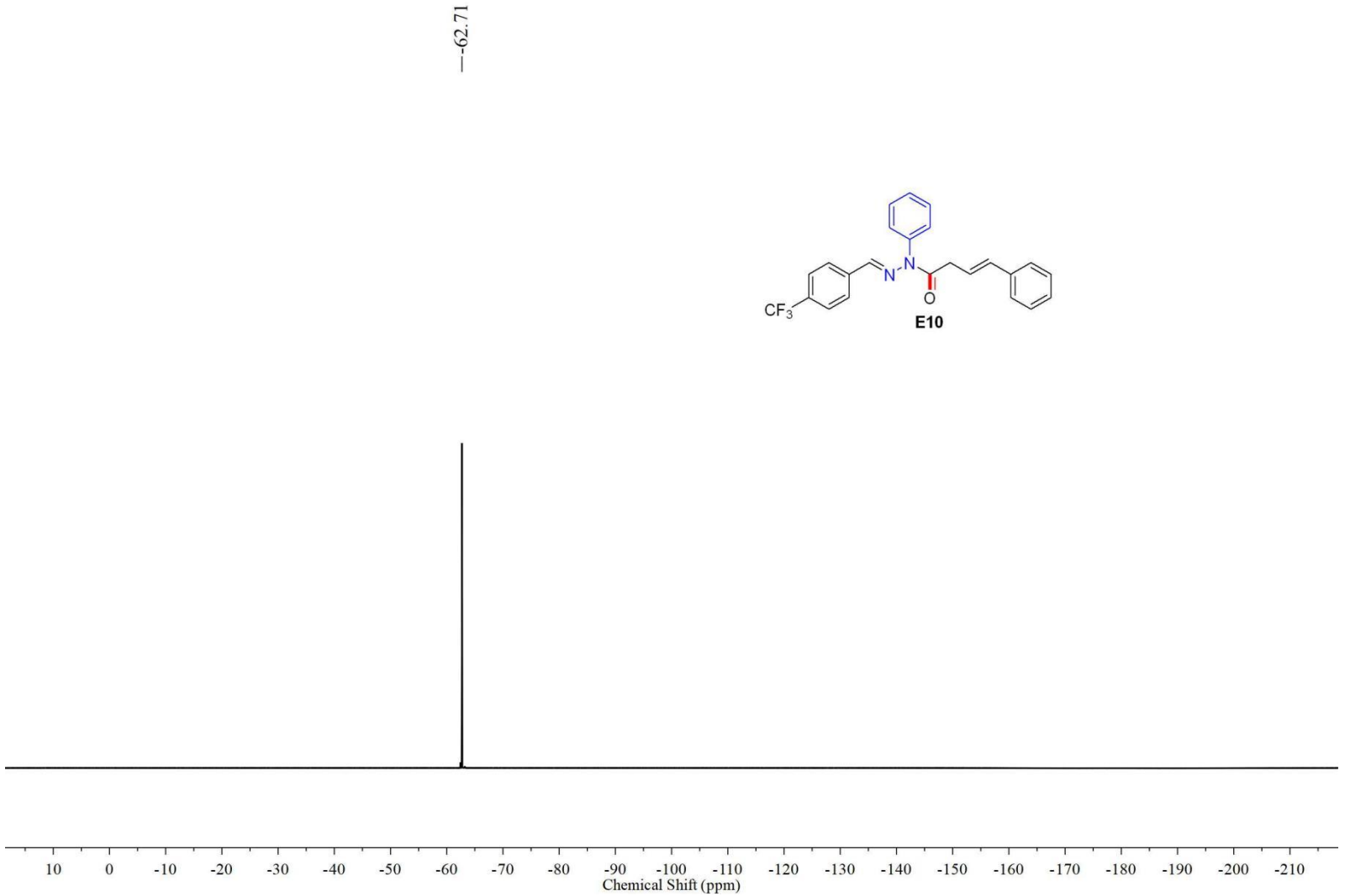
172.98
139.87
137.68
137.21
135.58
133.40
130.38
129.63
129.13
128.54
127.42
127.35
126.29
125.74
125.70
122.96
77.38
77.06
76.74
38.61

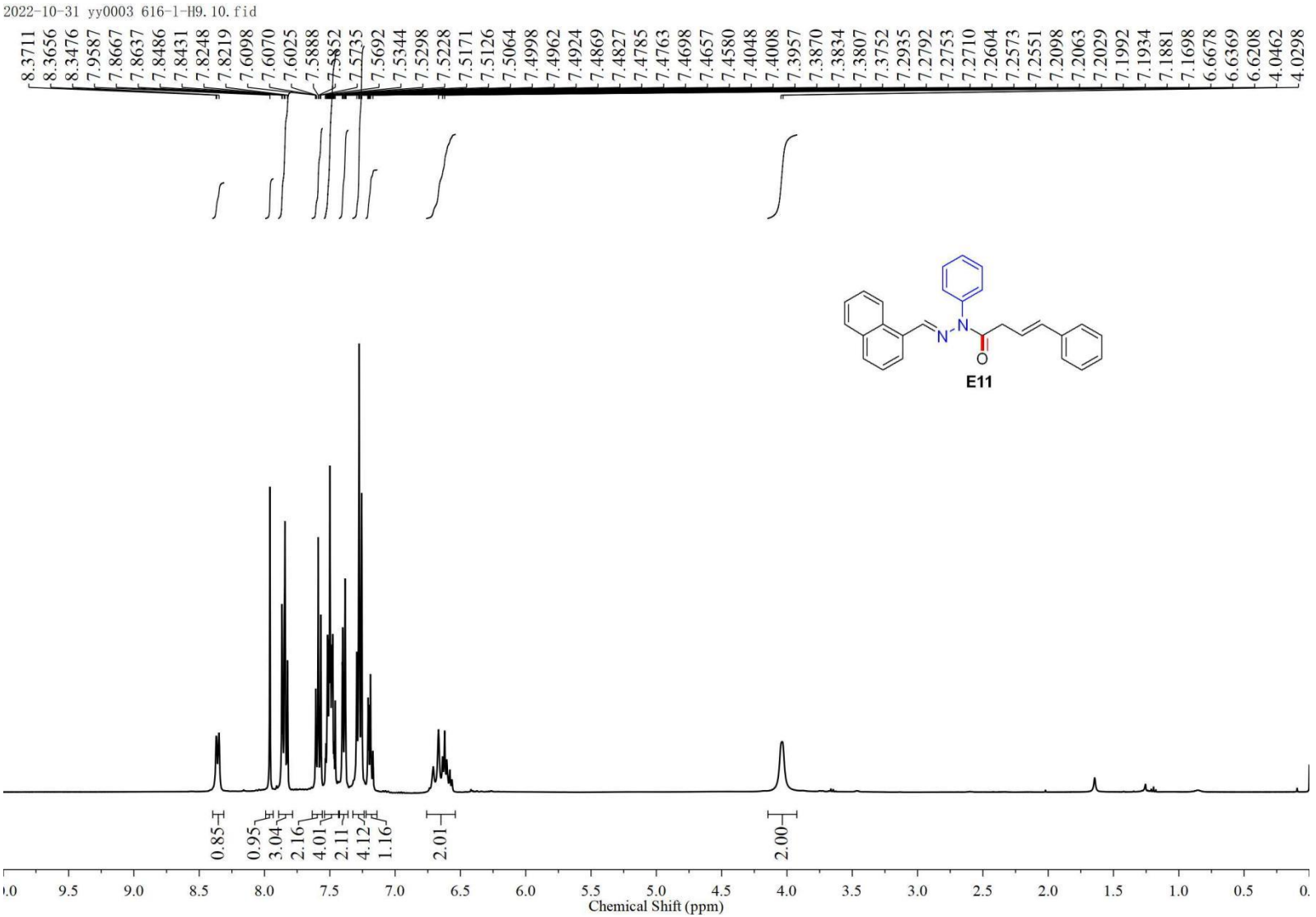


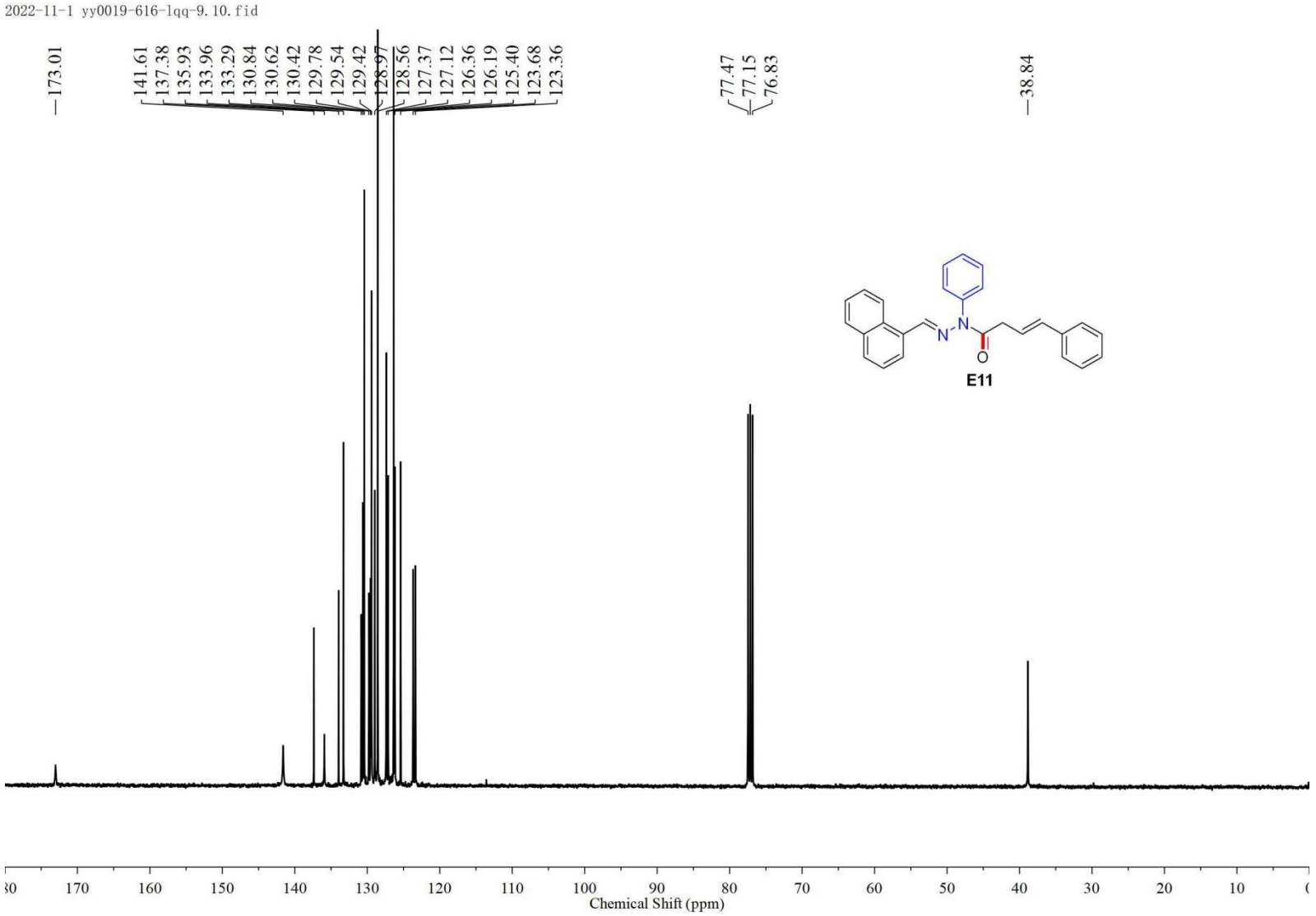
E10

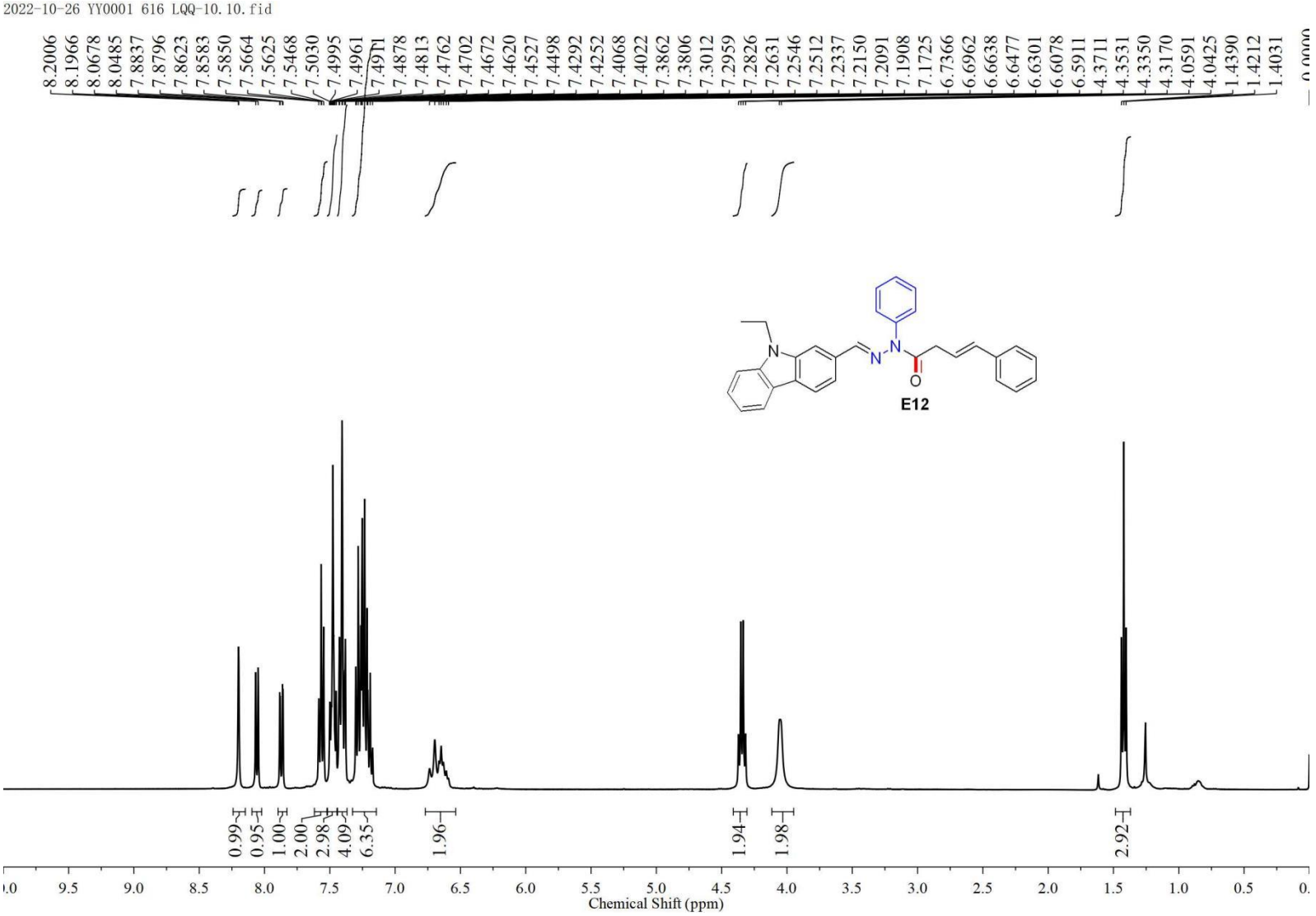


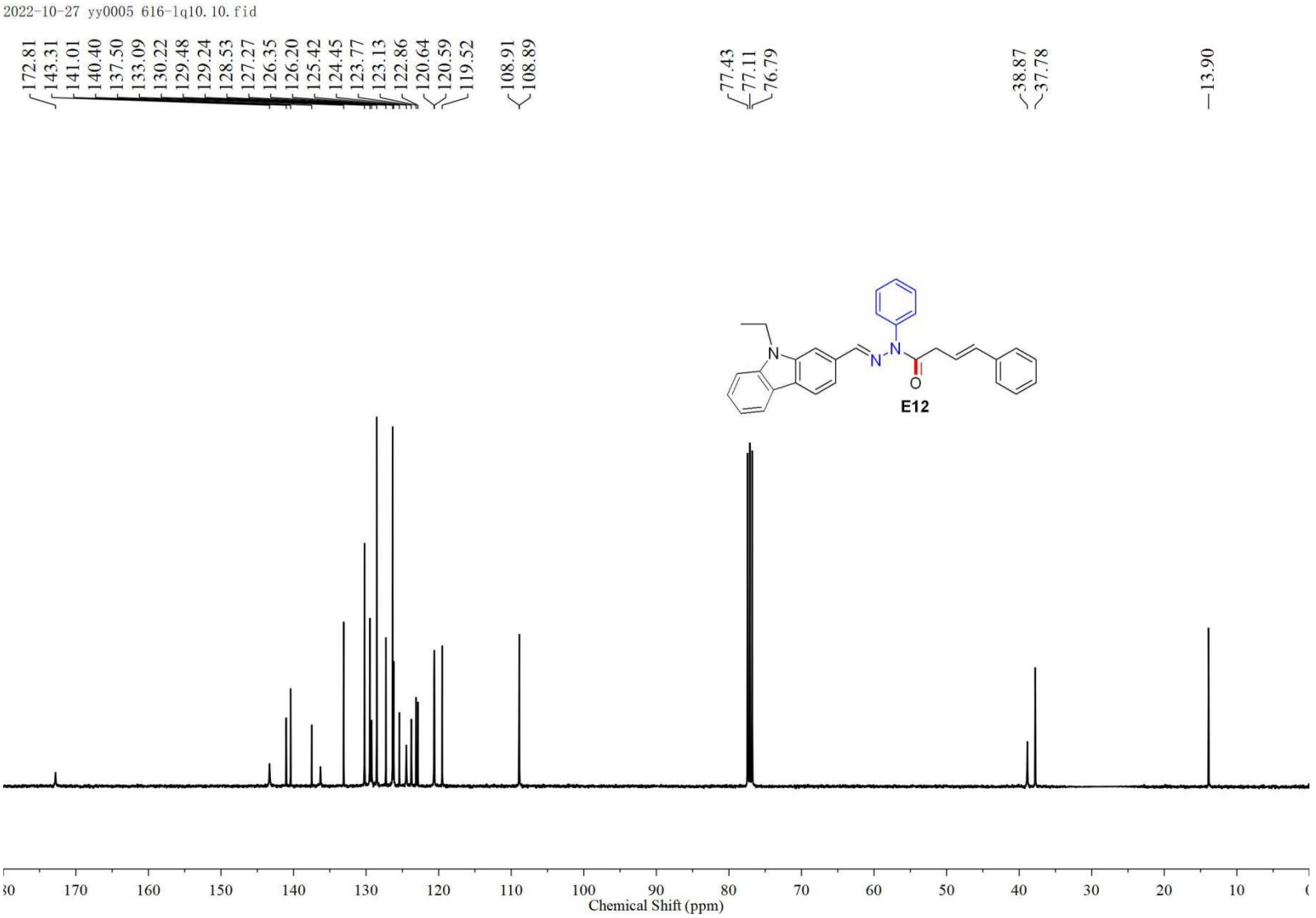
2022-11-10-yy0019-616-h31.11.fid

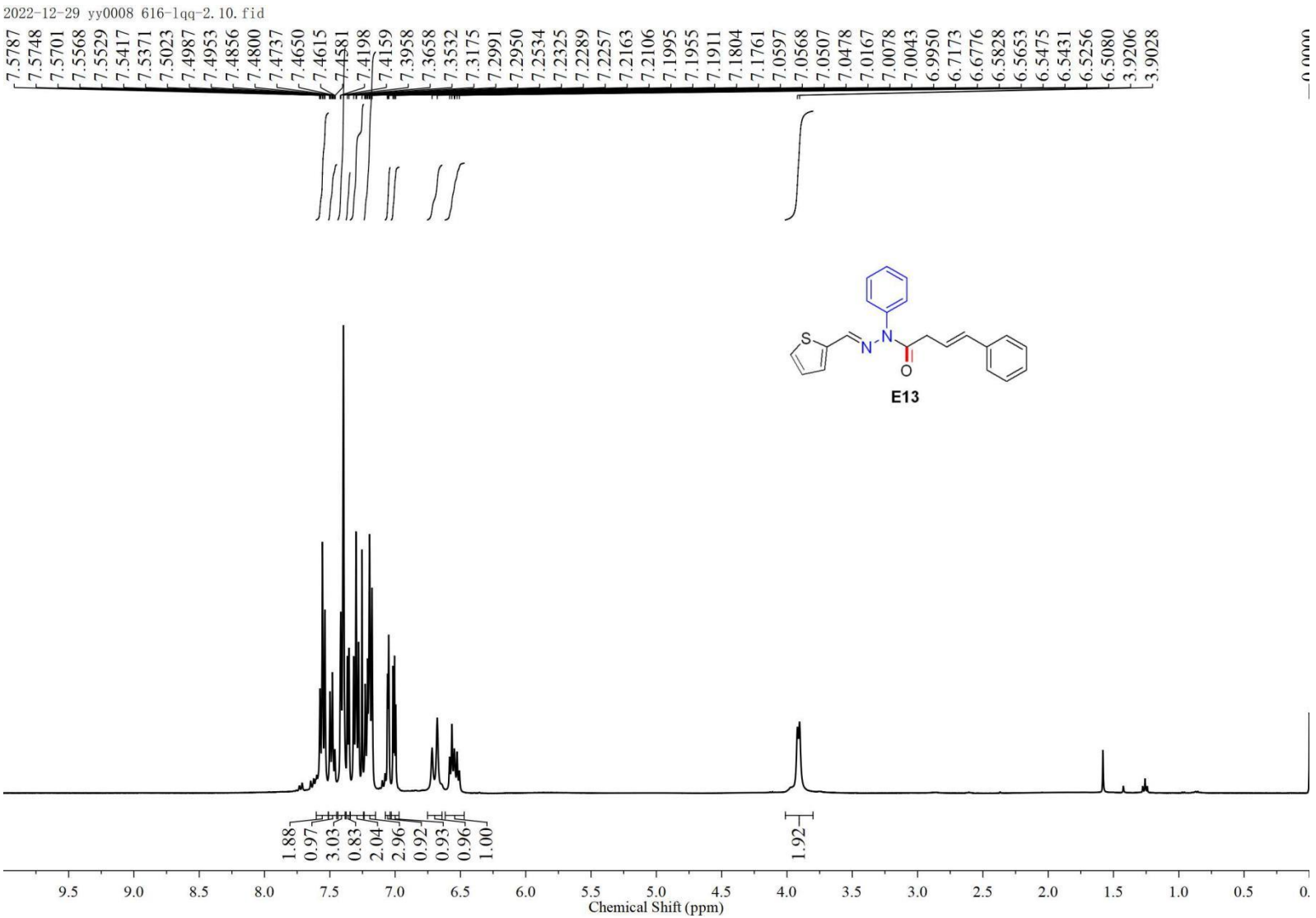


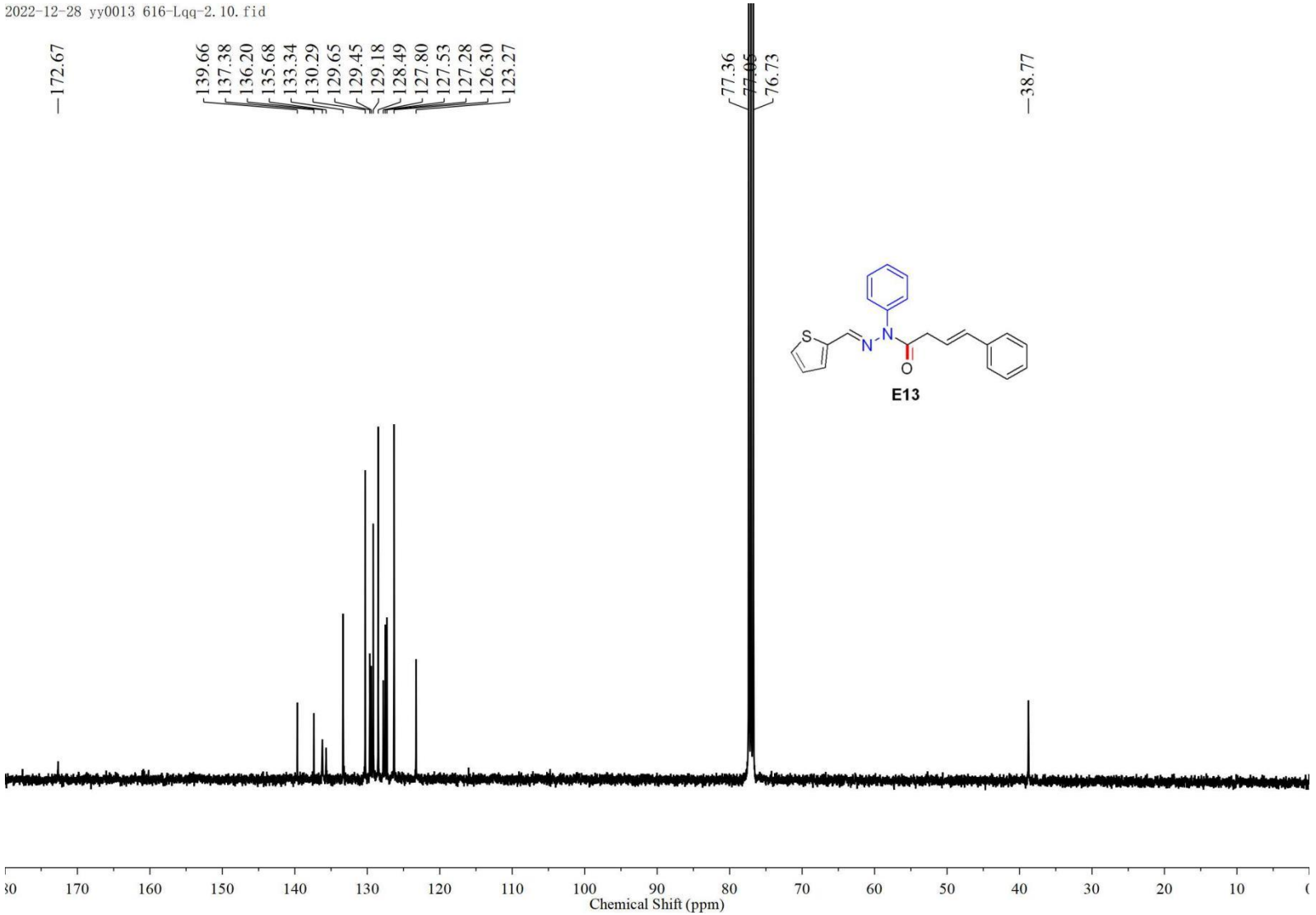

2022-10-31 yy0003 616-1-H9.10.fid
8.3711
8.3656
8.3476
7.9587
7.8667
7.8637
7.8486
7.8431
7.8248
7.8219
7.6098
7.6070
7.6025
7.5888
7.5852
7.5735
7.5692
7.5344
7.5298
7.5228
7.5171
7.5126
7.5064
7.4998
7.4962
7.4924
7.4869
7.4827
7.4785
7.4763
7.4698
7.4657
7.4580
7.4048
7.4008
7.3957
7.3870
7.3834
7.3807
7.3752
7.2935
7.2792
7.2753
7.2710
7.2604
7.2573
7.2551
7.2098
7.2063
7.2029
7.1992
7.1934
7.1881
7.1698
6.6678
6.6369
6.6208
4.0462
4.0298
N
N
O
E11
0.85
0.95
3.04
2.16
4.01
2.11
4.12
1.16
2.01
2.00
Chemical Shift (ppm)

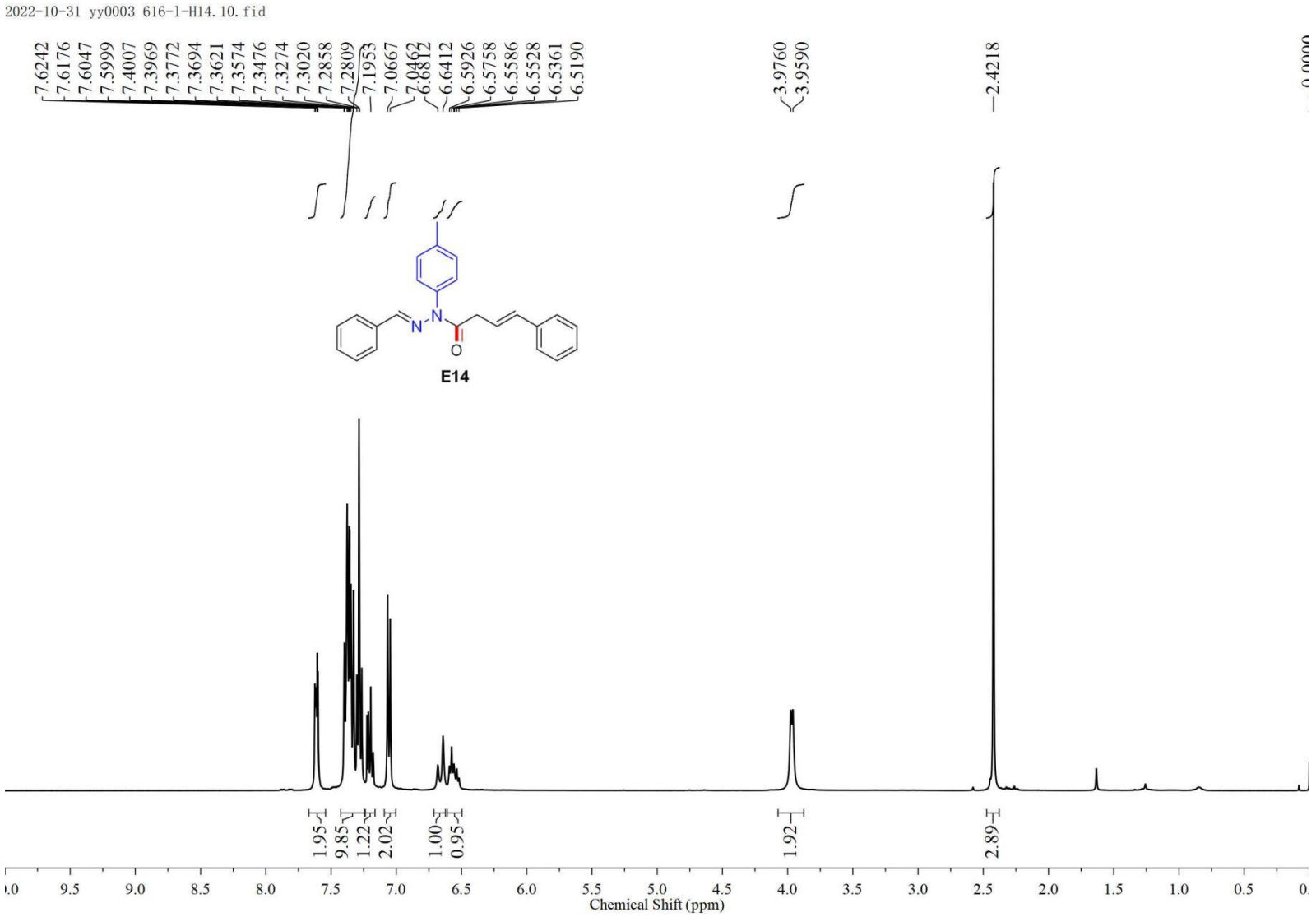

2022-11-1 yy0019-616-lqq-9.10.fid
173.01
141.61
137.38
135.93
133.96
133.29
130.84
130.62
130.42
129.78
129.54
129.42
128.97
128.56
127.37
127.12
126.36
126.19
125.40
123.68
123.36
77.47
77.15
76.83
38.84
E11
Chemical Shift (ppm)


2022-10-26 YY0001 616 LQQ-10.10.fid
8.2006
8.1966
8.0678
8.0485
7.8837
7.8796
7.8623
7.8583
7.5850
7.5664
7.5625
7.5468
7.5030
7.4995
7.4961
7.4911
7.4878
7.4813
7.4762
7.4702
7.4672
7.4620
7.4527
7.4498
7.4292
7.4252
7.4068
7.4022
7.3862
7.3806
7.3012
7.2959
7.2826
7.2631
7.2546
7.2512
7.2337
7.2150
7.2091
7.1908
7.1725
6.7366
6.6962
6.6638
6.6477
6.6301
6.6078
6.5911
4.3711
4.3531
4.3350
4.3170
4.0591
4.0425
1.4390
1.4212
1.4031
E12
0.99
0.95
1.00
2.00
2.98
4.09
6.35
1.96
1.94
1.98
2.92
Chemical Shift (ppm)

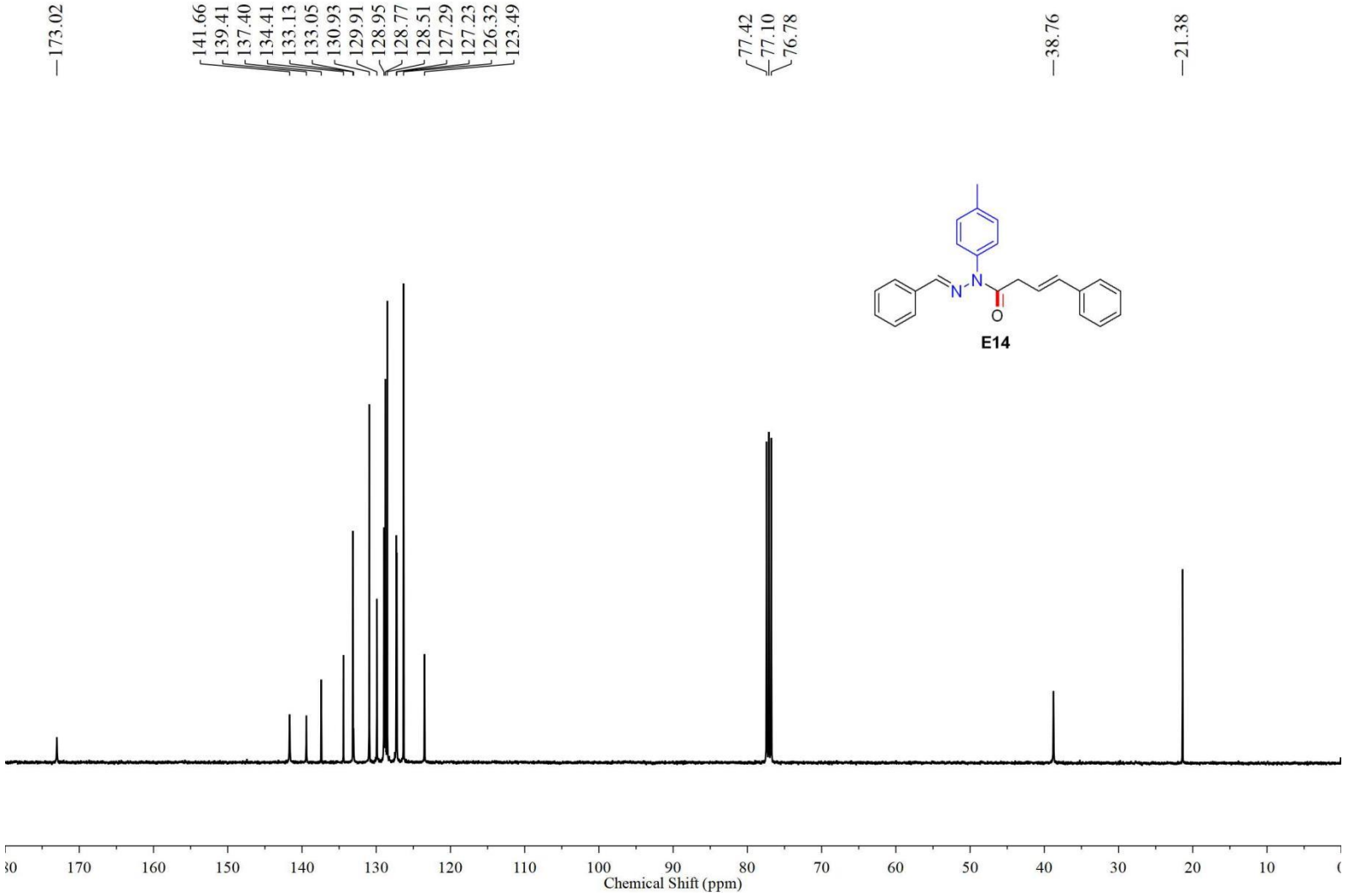

2022-10-27 yy0005 616-lq10.10.fid
172.81
143.31
141.01
140.40
137.50
133.09
130.22
129.48
129.24
128.53
127.27
126.35
126.20
125.42
124.45
123.77
123.13
122.86
120.64
120.59
119.52
108.91
108.89
77.43
77.11
76.79
38.87
37.78
13.90
E12
Chemical Shift (ppm)

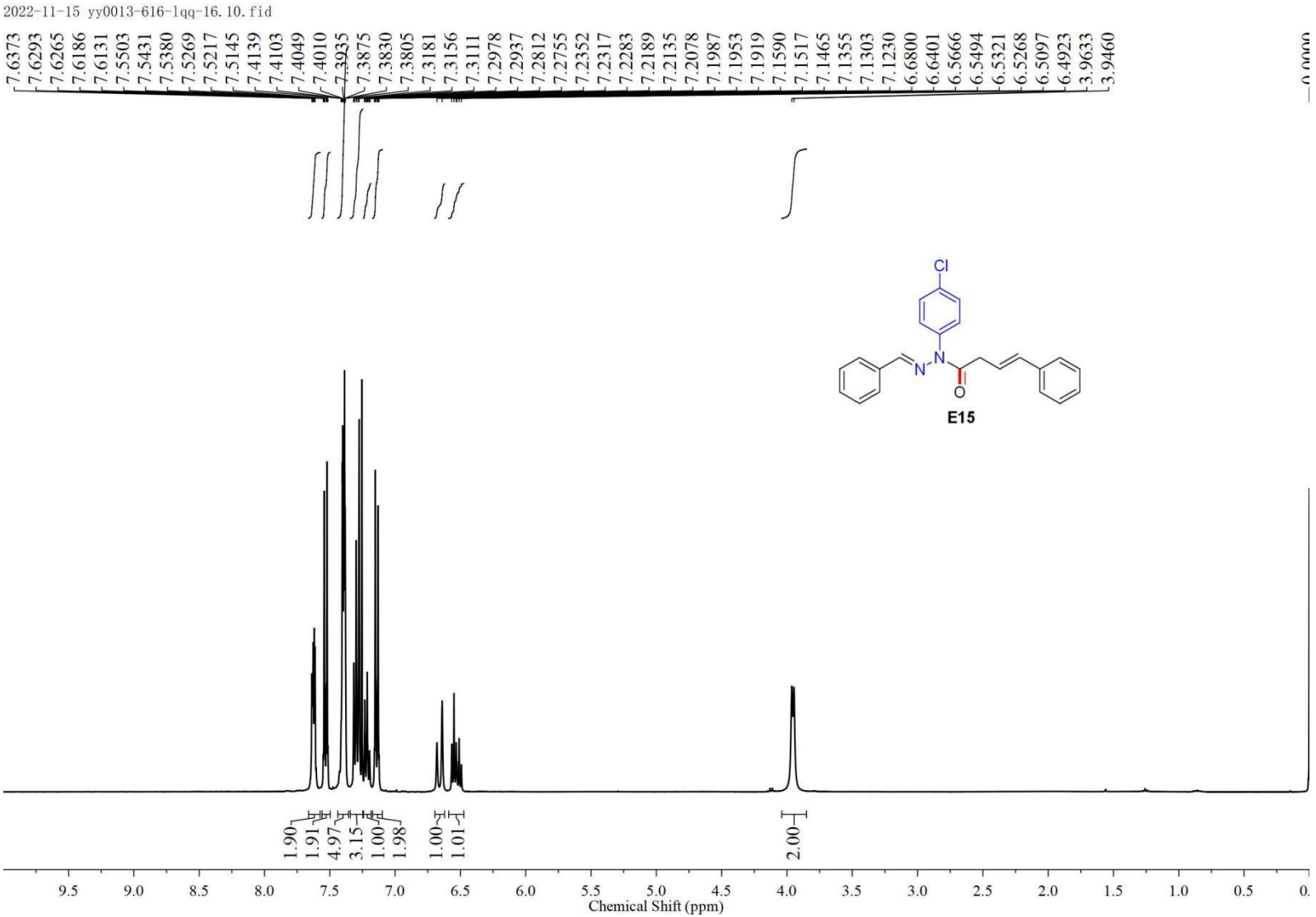

2022-12-29 yy0008 616-lqq-2.10.fid
7.5787
7.5748
7.5701
7.5568
7.5529
7.5417
7.5371
7.5023
7.4987
7.4953
7.4856
7.4800
7.4737
7.4650
7.4615
7.4581
7.4198
7.4159
7.3958
7.3658
7.3532
7.3175
7.2991
7.2950
7.2534
7.2325
7.2289
7.2257
7.2163
7.2106
7.1995
7.1955
7.1911
7.1804
7.1761
7.0597
7.0568
7.0507
7.0478
7.0167
7.0078
7.0043
6.9950
6.7173
6.6776
6.5828
6.5653
6.5475
6.5431
6.5256
6.5080
3.9206
3.9028
S
N
N
O
E13
1.88
0.97
3.03
0.83
2.04
2.96
0.92
0.93
0.96
1.00
1.92
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

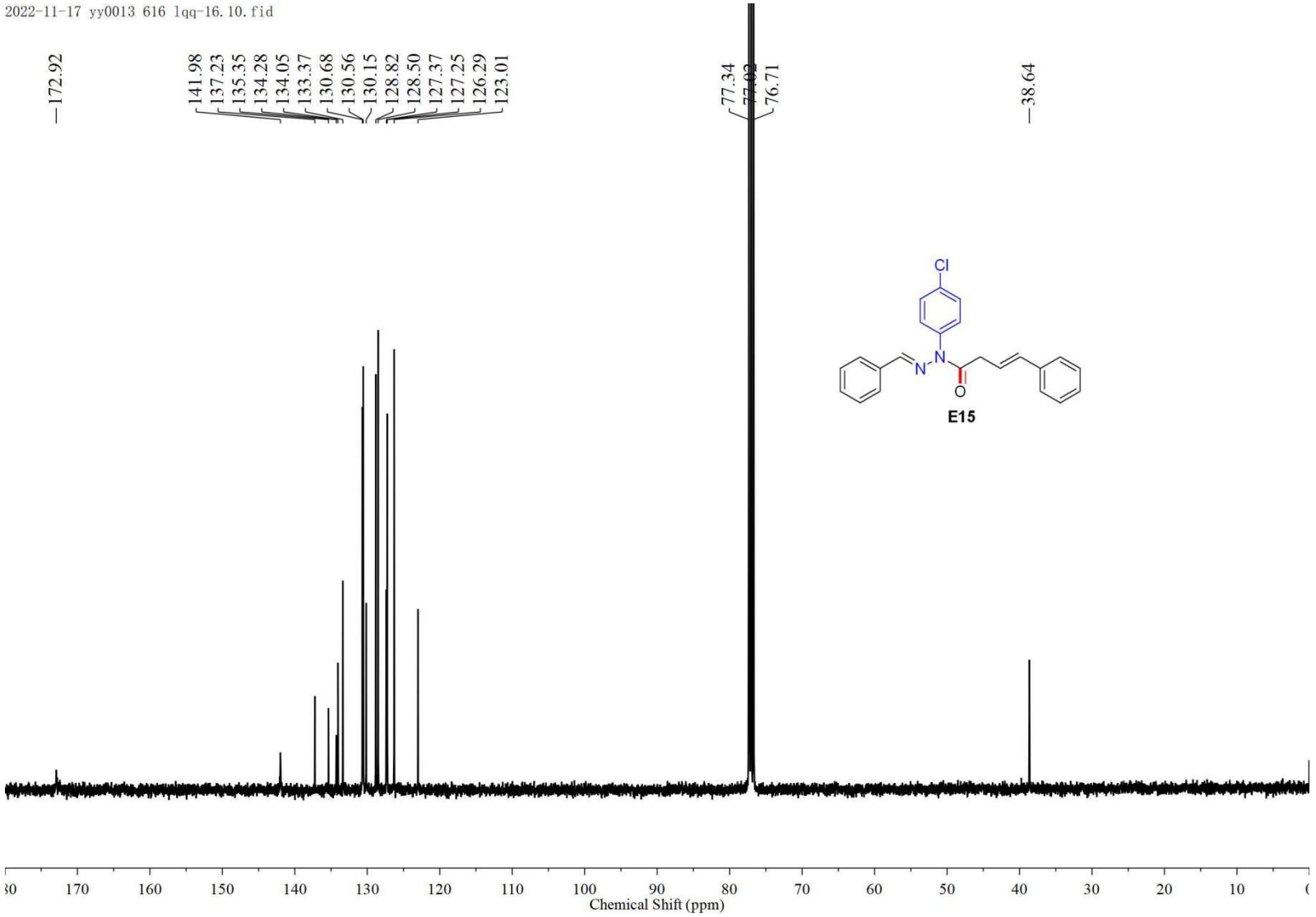

2022-12-28 yy0013 616-Lqq-2.10.fid
172.67
139.66
137.38
136.20
135.68
133.34
130.29
129.65
129.45
129.18
128.49
127.80
127.53
127.28
126.30
123.27
77.36
77.05
76.73
38.77
S
N
N
O
E13
Chemical Shift (ppm)

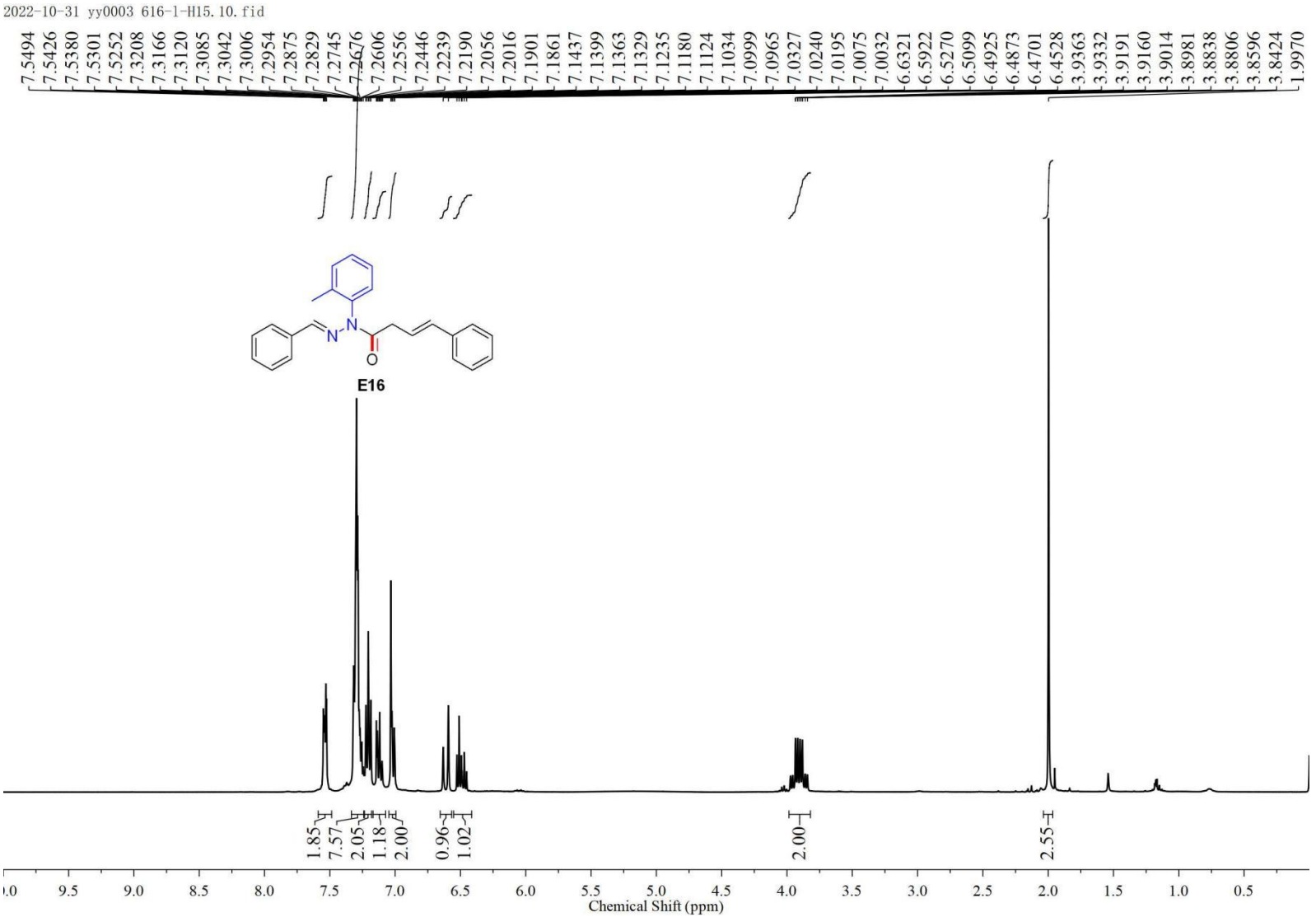

2022-10-31 yy0003 616-1-H14.10.fid
7.6242
7.6176
7.6047
7.5999
7.4007
7.3969
7.3772
7.3694
7.3621
7.3574
7.3476
7.3274
7.3020
7.2858
7.2809
7.1953
7.0667
7.0462
6.6412
6.5926
6.5758
6.5586
6.5528
6.5361
6.5190
3.9760
3.9590
2.4218
0.0000
N
N
O
E14
1.95
9.85
1.22
2.02
1.00
0.95
1.92
2.89
Chemical Shift (ppm)

2022-11-1 yy0019-616-lqq-14.10.fid



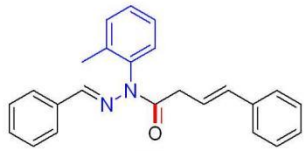

2022-11-15 yy0013-616-lqq-16.10.fid
7.6373
7.6293
7.6265
7.6186
7.6131
7.5503
7.5431
7.5380
7.5269
7.5217
7.5145
7.4139
7.4103
7.4049
7.4010
7.3935
7.3875
7.3830
7.3805
7.3181
7.3156
7.3111
7.2978
7.2937
7.2812
7.2755
7.2352
7.2317
7.2283
7.2189
7.2135
7.2078
7.1987
7.1953
7.1919
7.1590
7.1517
7.1465
7.1355
7.1303
7.1230
6.6800
6.6401
6.5666
6.5494
6.5321
6.5268
6.5097
6.4923
3.9633
3.9460
Cl
N
N
O
E15
1.90
1.91
4.97
3.15
1.00
1.98
1.00
1.01
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)


2022-11-17 yy0013 616 lqq-16.10.fid
172.92
141.98
137.23
135.35
134.28
134.05
133.37
130.68
130.56
130.15
128.82
128.50
127.37
127.25
126.29
123.01
77.34
77.02
76.71
38.64
Cl
N
N
O
E15
Chemical Shift (ppm)

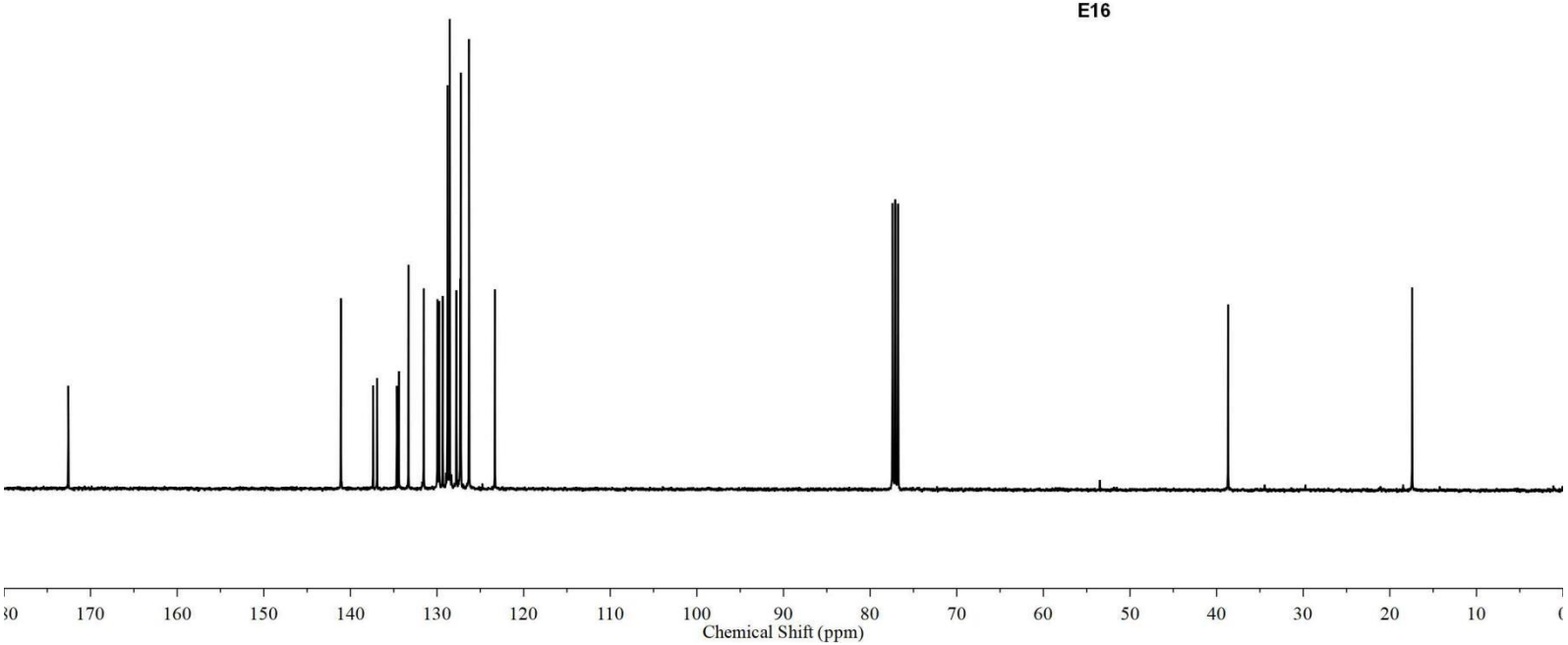

2022-10-31 yy0003 616-1-H15.10.fid
7.5494
7.5426
7.5380
7.5301
7.5252
7.3208
7.3166
7.3120
7.3085
7.3042
7.3006
7.2954
7.2875
7.2829
7.2745
7.2676
7.2606
7.2556
7.2446
7.2239
7.2190
7.2056
7.2016
7.1901
7.1861
7.1437
7.1399
7.1363
7.1329
7.1235
7.1180
7.1124
7.1034
7.0999
7.0965
7.0327
7.0240
7.0195
7.0075
7.0032
6.6321
6.5922
6.5270
6.5099
6.4925
6.4873
6.4701
6.4528
3.9363
3.9332
3.9191
3.9160
3.9014
3.8981
3.8838
3.8806
3.8596
3.8424
1.9970
N
N
O
E16
1.85
7.57
2.05
1.18
2.00
0.96
1.02
2.00
2.55
Chemical Shift (ppm)

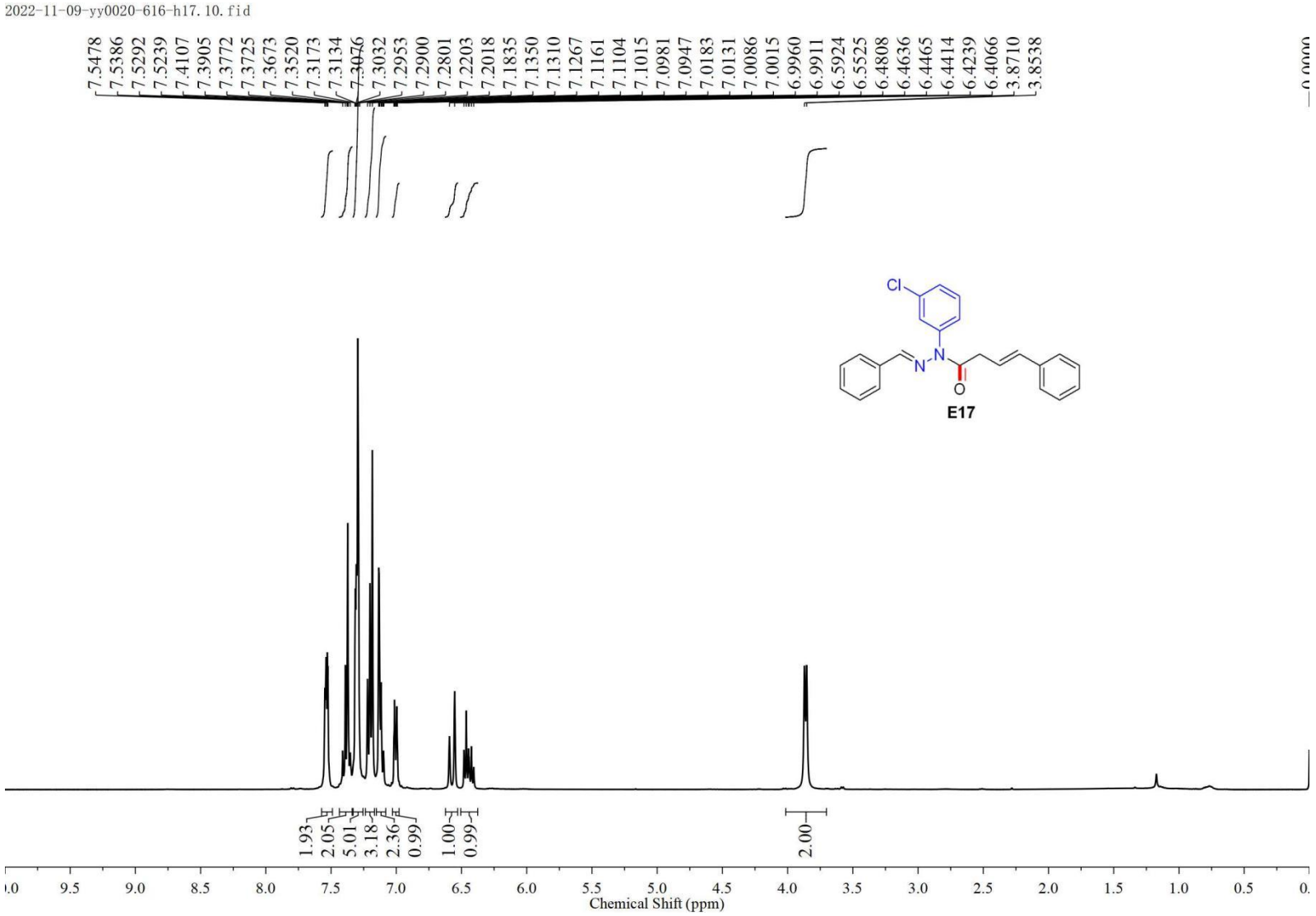
2022-11-1 yy0019-616-lqq-15.10.fid

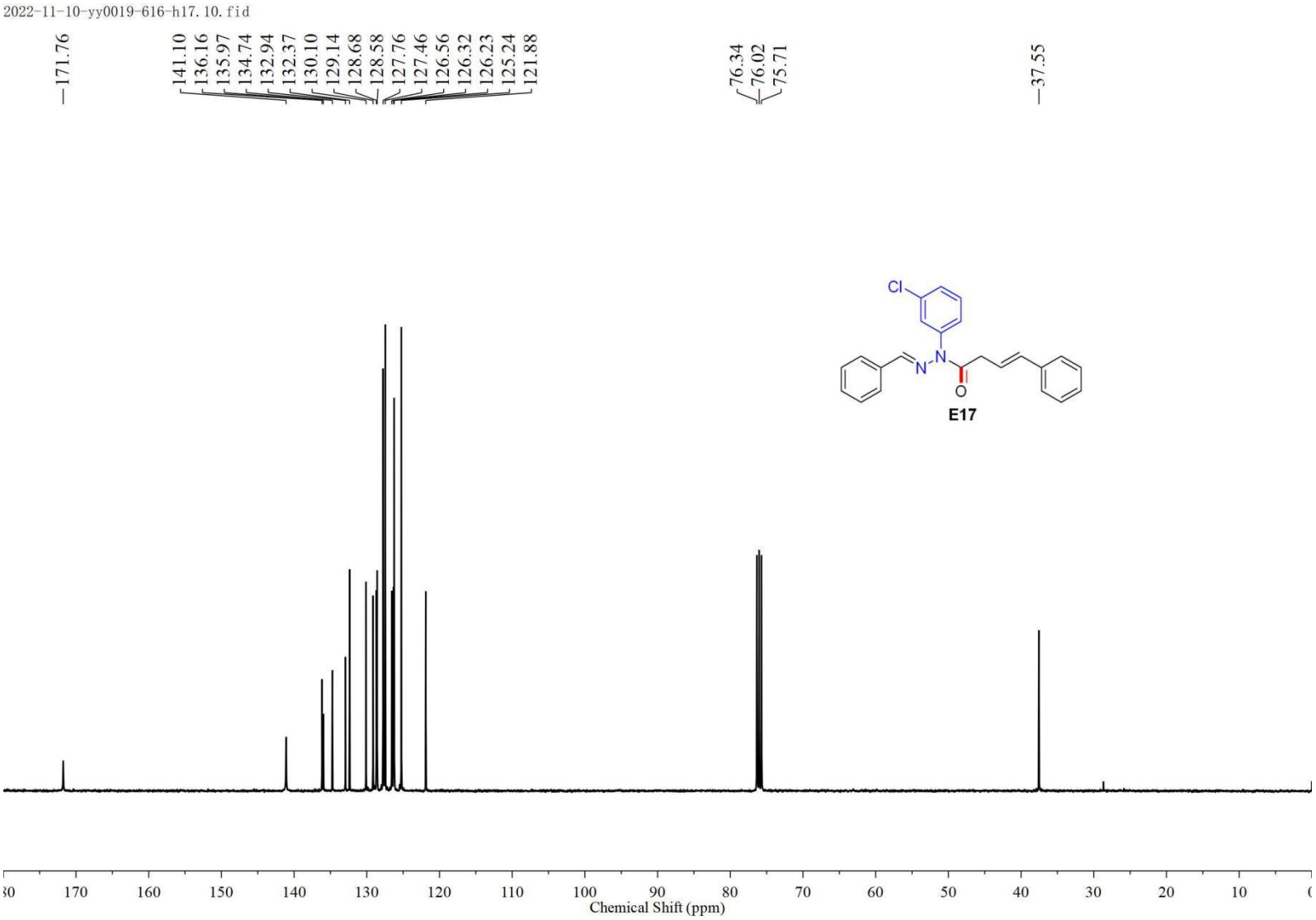
172.57
141.09
137.38
136.92
134.64
134.40
133.30
131.54
129.96
129.76
129.35
128.79
128.53
127.76
127.32
127.25
126.31
123.32
77.41
77.09
76.78
38.67
17.42

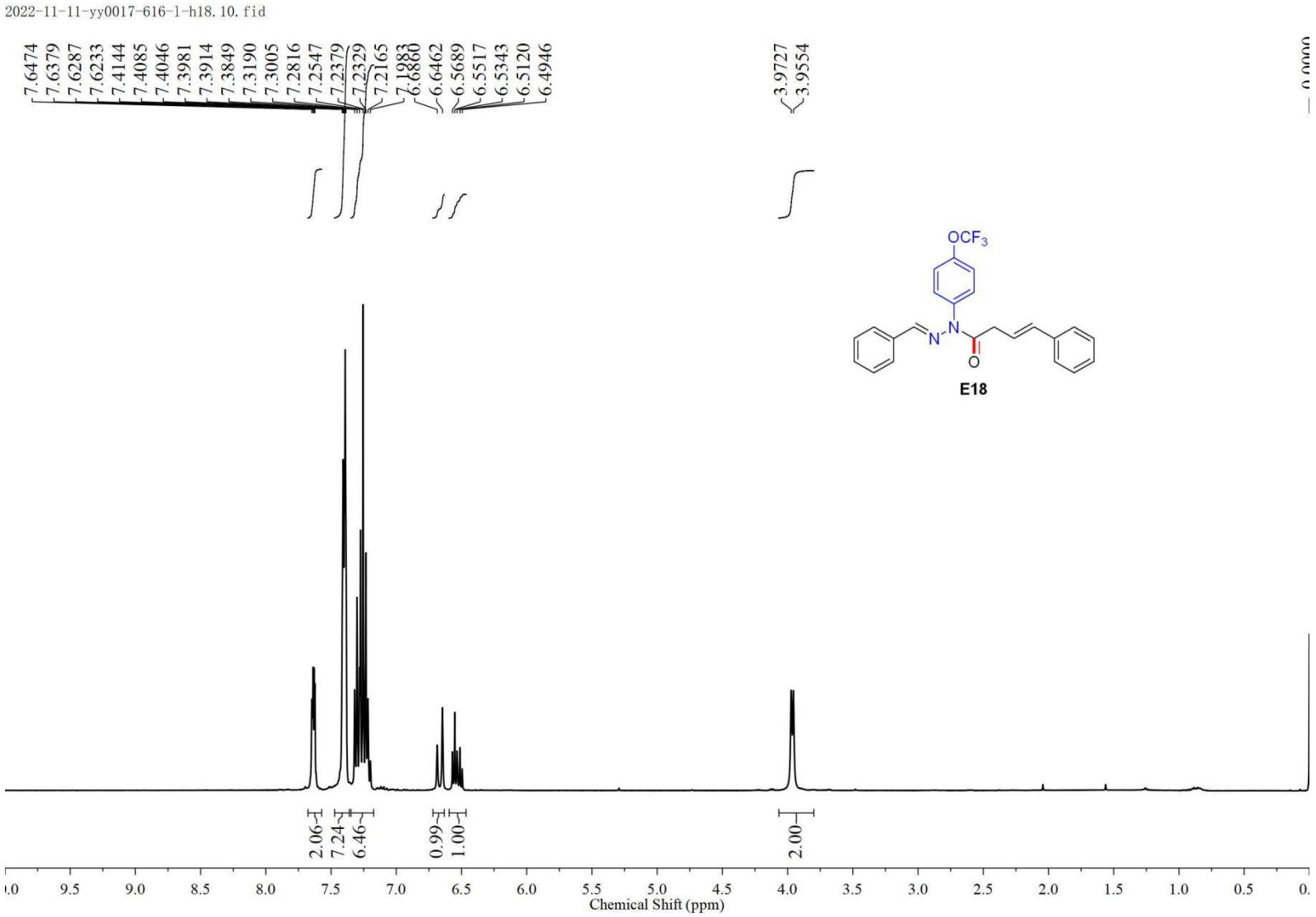


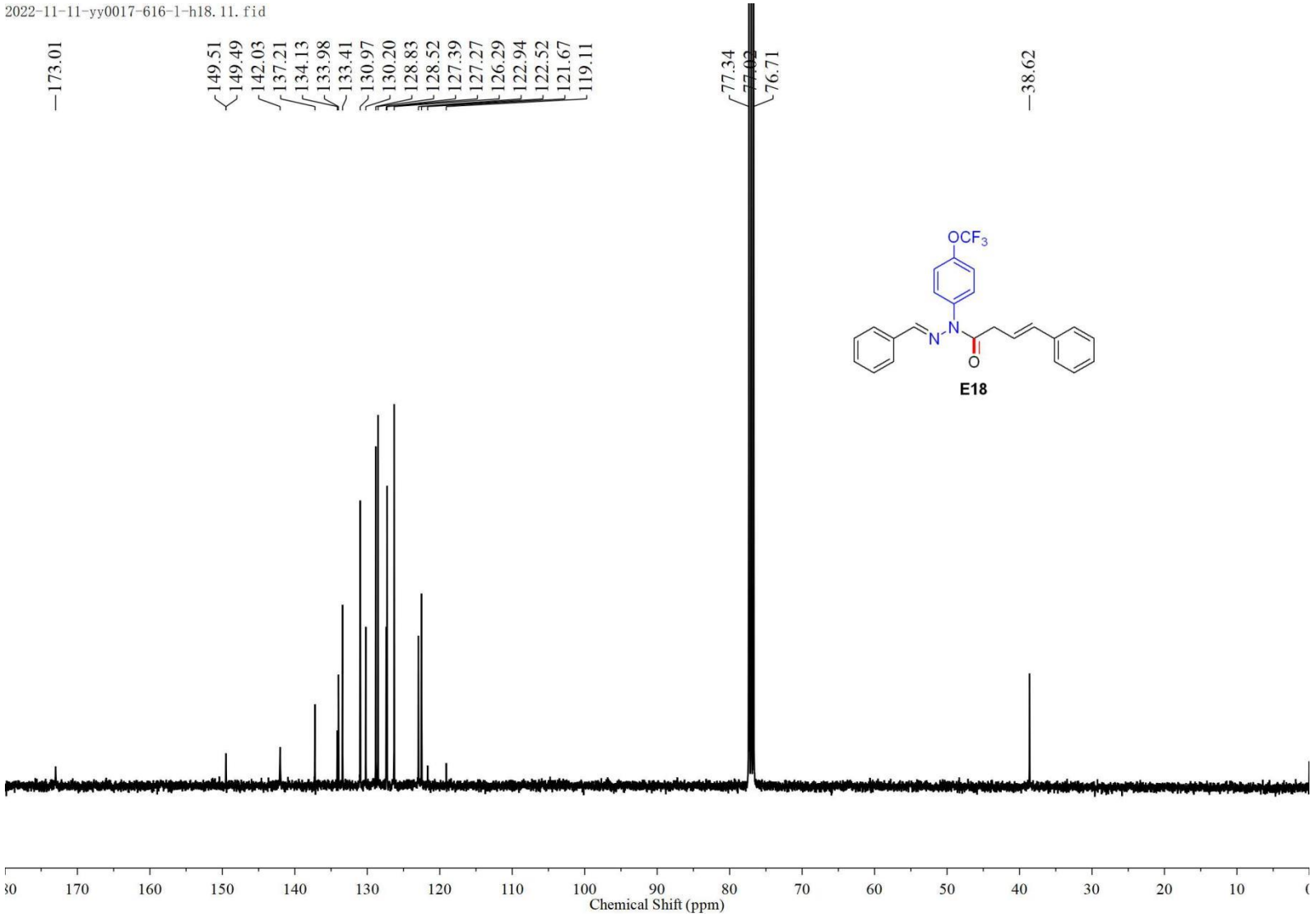
E16



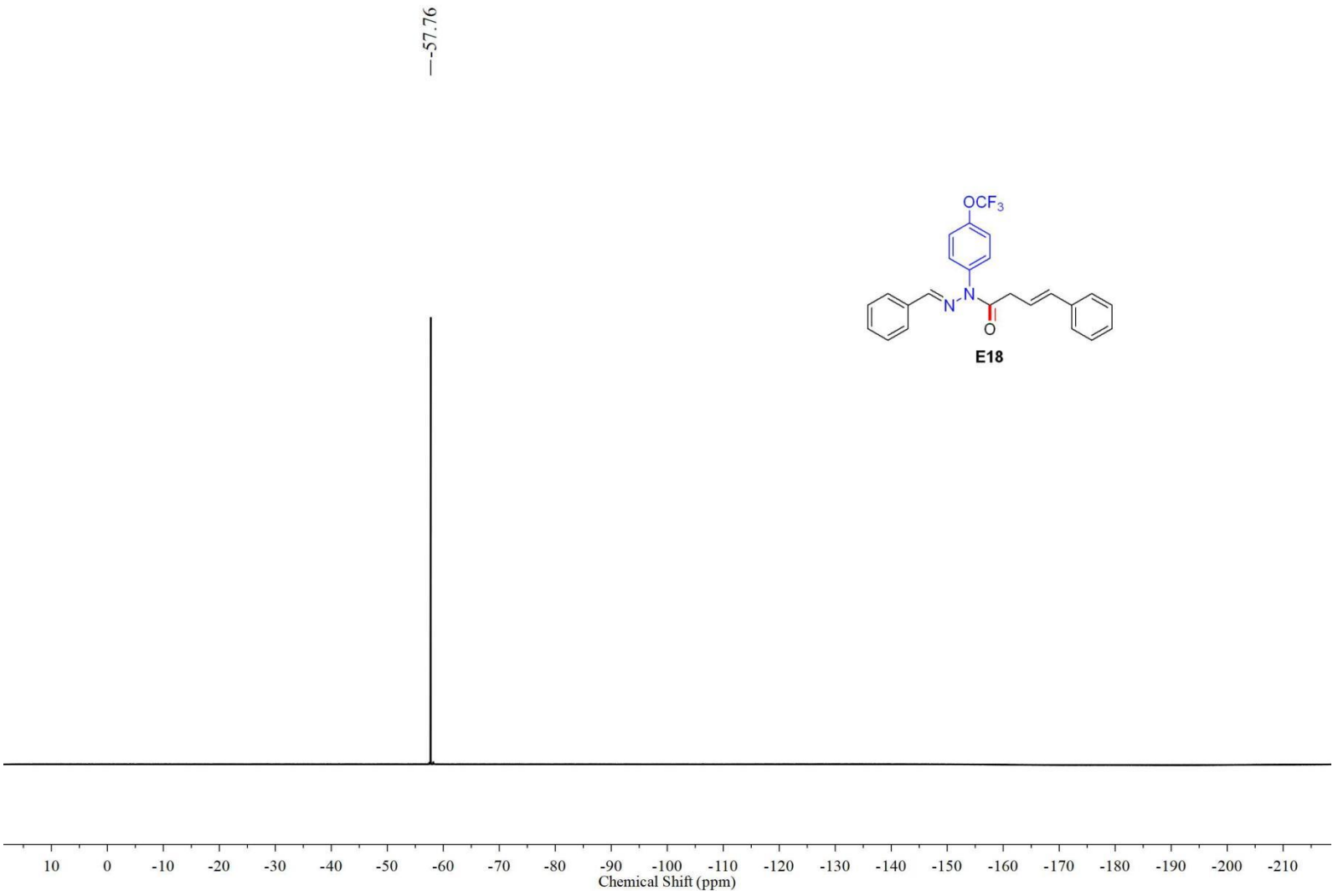

2022-11-09-yy0020-616-h17.10.fid
7.5478
7.5386
7.5292
7.5239
7.4107
7.3905
7.3772
7.3725
7.3673
7.3520
7.3173
7.3134
7.3076
7.3032
7.2953
7.2900
7.2801
7.2203
7.2018
7.1835
7.1350
7.1310
7.1267
7.1161
7.1104
7.1015
7.0981
7.0947
7.0183
7.0131
7.0086
7.0015
6.9960
6.9911
6.5924
6.5525
6.4808
6.4636
6.4465
6.4414
6.4239
6.4066
3.8710
3.8538
Cl
N
N
O
E17
1.93
2.05
5.01
3.18
2.36
0.99
1.00
0.99
2.00
Chemical Shift (ppm)


2022-11-10-yy0019-616-h17.10.fid
171.76
141.10
136.16
135.97
134.74
132.94
132.37
130.10
129.14
128.68
128.58
127.76
127.46
126.56
126.32
126.23
125.24
121.88
76.34
76.02
75.71
37.55
Cl
N
N
O
E17
Chemical Shift (ppm)

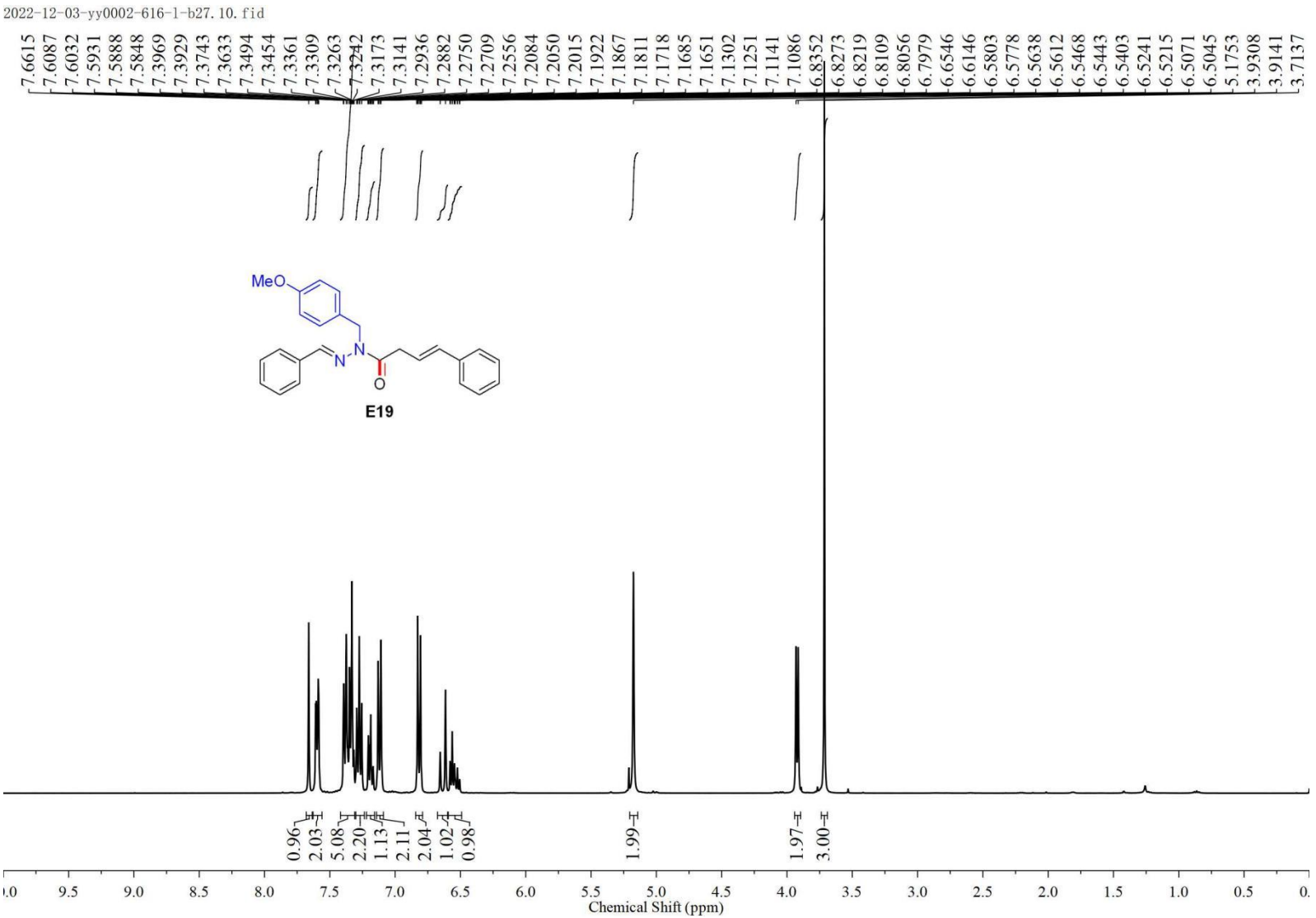

2022-11-11-yy0017-616-1-h18.10.fid
7.6474
7.6379
7.6287
7.6233
7.4144
7.4085
7.4046
7.3981
7.3914
7.3849
7.3190
7.3005
7.2816
7.2547
7.2379
7.2329
7.2165
7.1983
7.1880
6.6462
6.5689
6.5517
6.5343
6.5120
6.4946
3.9727
3.9554
OCF3
N
N
O
E18
2.06
7.24
6.46
0.99
1.00
2.00
Chemical Shift (ppm)

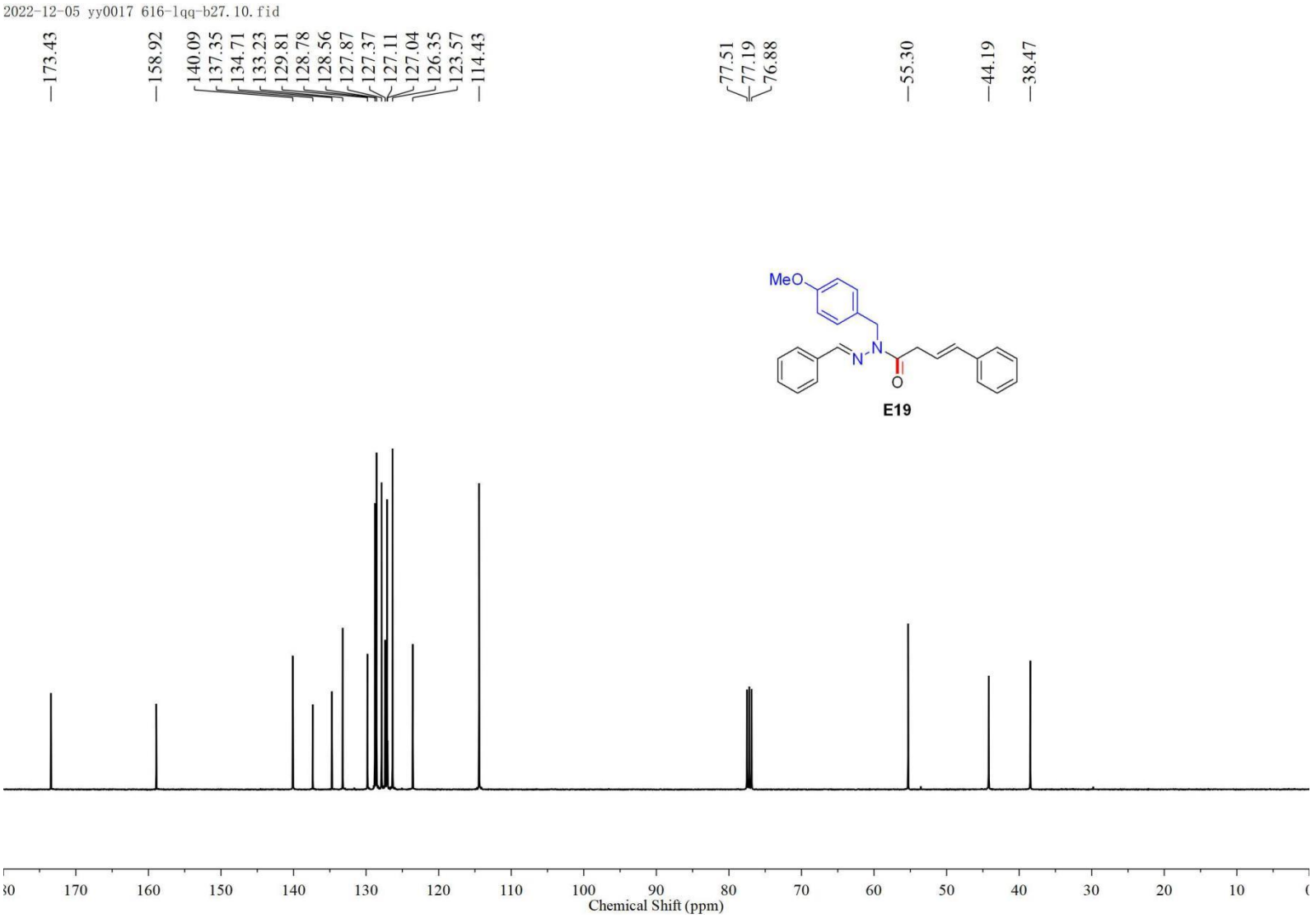

2022-11-11-yy0017-616-1-h18.11.fid
173.01
149.51
149.49
142.03
137.21
134.13
133.98
133.41
130.97
130.20
128.83
128.52
127.39
127.27
126.29
122.94
122.52
121.67
119.11
77.34
77.03
76.71
38.62
OCF3
N
N
O
E18
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

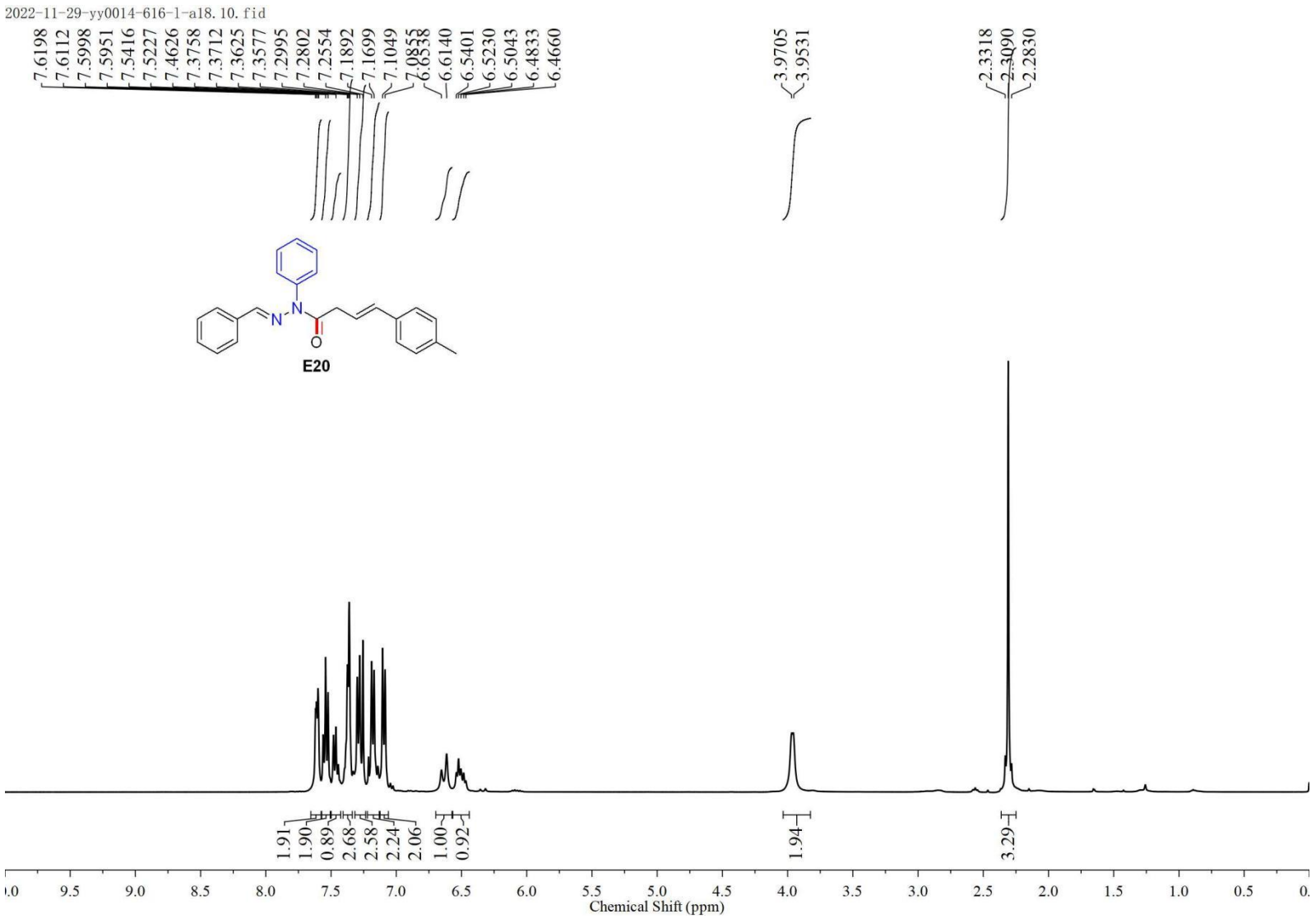
2022-11-17 yy616 lqq-f(bu).10.fid

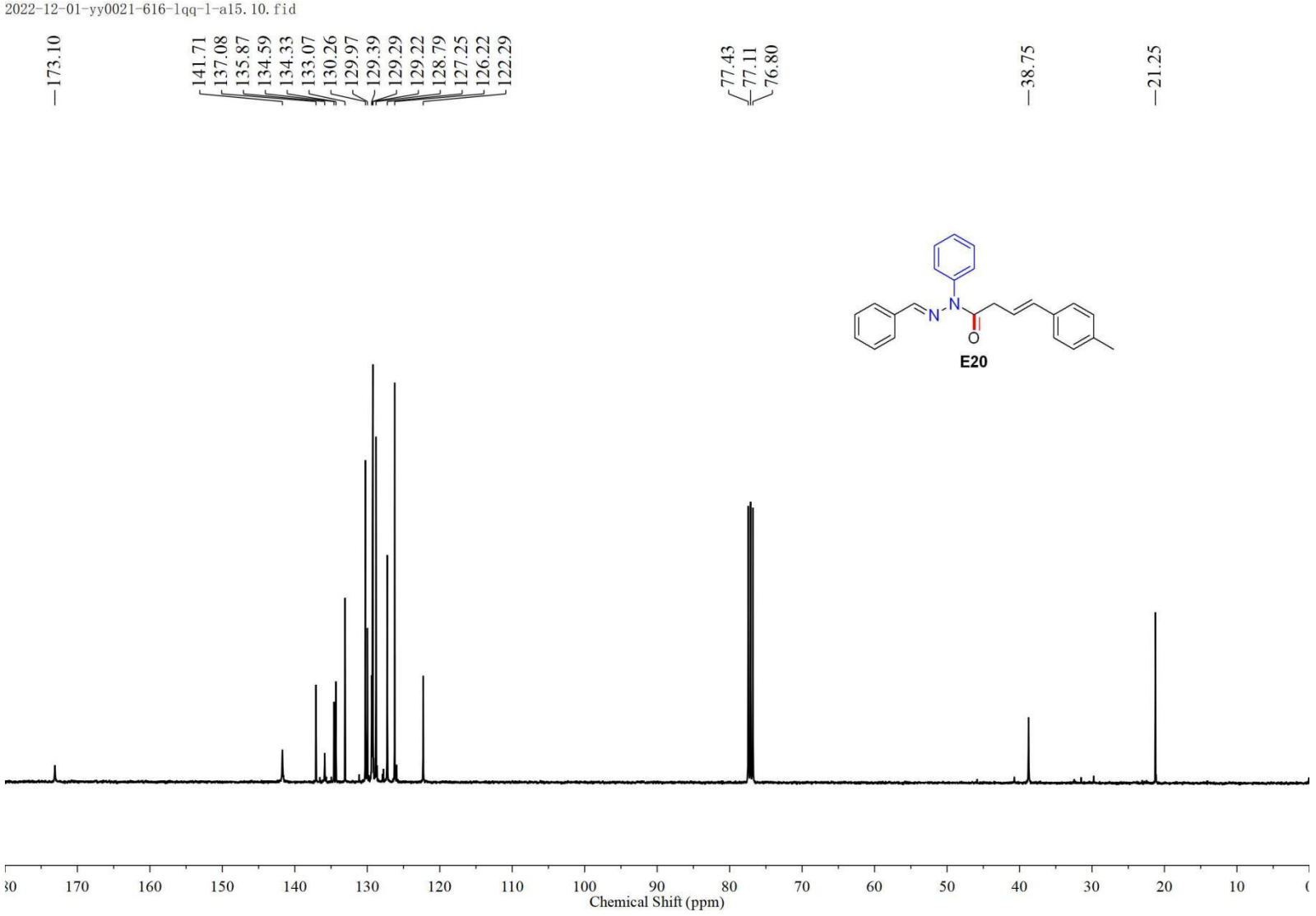


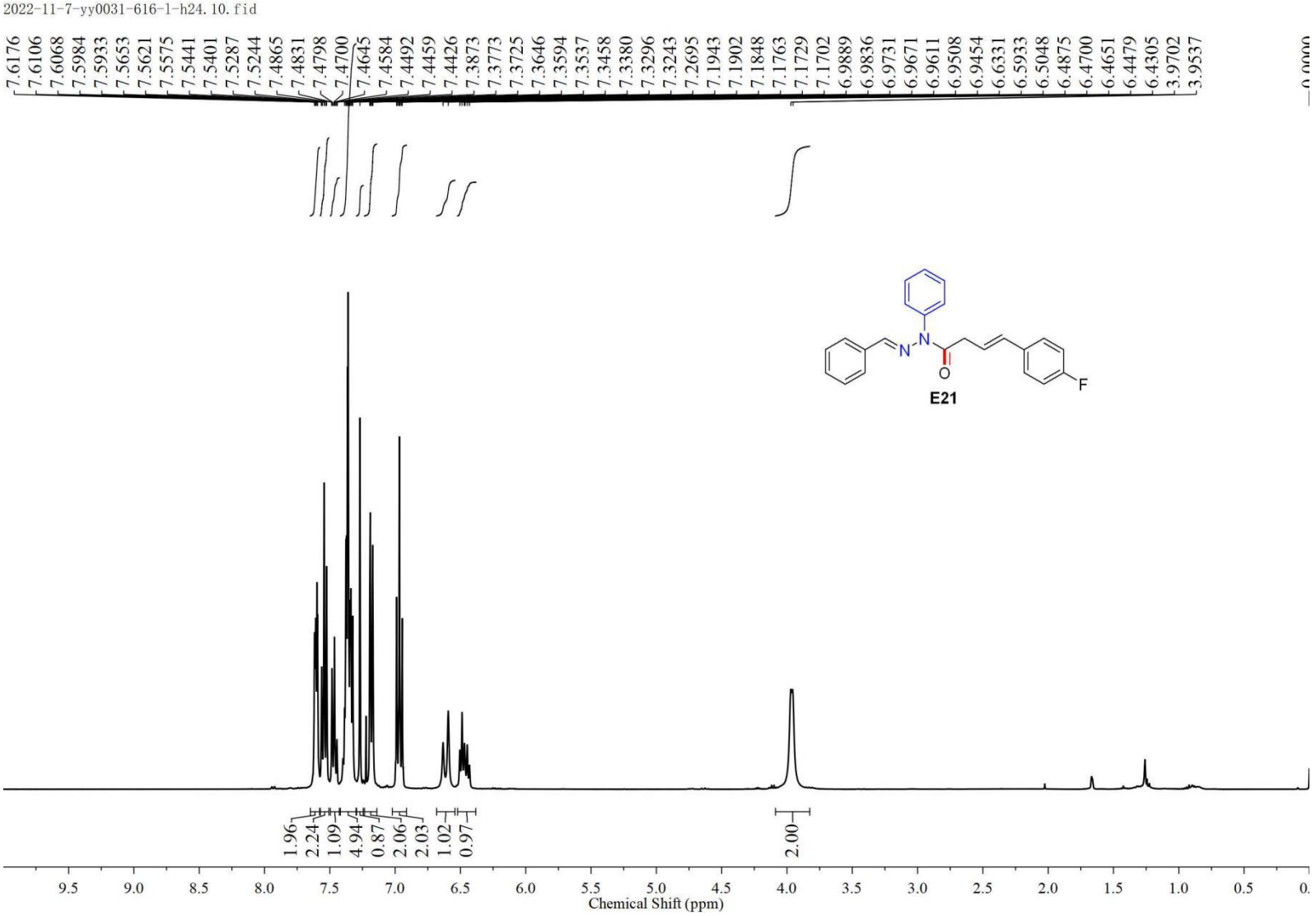
E18


2022-12-03-yy0002-616-1-b27.10.fid
7.6615
7.6087
7.6032
7.5931
7.5888
7.5848
7.3969
7.3929
7.3743
7.3633
7.3494
7.3454
7.3361
7.3309
7.3263
7.3242
7.3173
7.3141
7.2936
7.2882
7.2750
7.2709
7.2556
7.2084
7.2050
7.2015
7.1922
7.1867
7.1811
7.1718
7.1685
7.1651
7.1302
7.1251
7.1141
7.1086
6.8352
6.8273
6.8219
6.8109
6.8056
6.7979
6.6546
6.6146
6.5803
6.5778
6.5638
6.5612
6.5468
6.5443
6.5403
6.5241
6.5215
6.5071
6.5045
5.1753
3.9308
3.9141
3.7137
MeO
N
N
O
E19
0.96
2.03
5.08
2.20
1.13
2.11
2.04
1.02
0.98
1.99
1.97
3.00
Chemical Shift (ppm)


2022-12-05 yy0017 616-lqq-b27.10.fid
173.43
158.92
140.09
137.35
134.71
133.23
129.81
128.78
128.56
127.87
127.37
127.11
127.04
126.35
123.57
114.43
77.51
77.19
76.88
55.30
44.19
38.47
MeO
N
N
O
E19
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

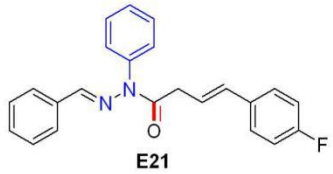

2022-11-29-yy0014-616-1-a18.10.fid
7.6198
7.6112
7.5998
7.5951
7.5416
7.5227
7.4626
7.3758
7.3712
7.3625
7.3577
7.2995
7.2802
7.2554
7.1892
7.1699
7.1049
7.0855
7.0538
6.6140
6.5401
6.5230
6.5043
6.4833
6.4660
3.9705
3.9531
2.3318
2.3090
2.2830
E20
1.91
1.90
0.89
2.68
2.58
2.24
2.06
1.00
0.92
1.94
3.29
Chemical Shift (ppm)


2022-12-01-yy0021-616-lqq-l-a15.10.fid
173.10
141.71
137.08
135.87
134.59
134.33
133.07
130.26
129.97
129.39
129.29
129.22
128.79
127.25
126.22
122.29
77.43
77.11
76.80
38.75
21.25
N
N
O
E20
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-11-7-yy0031-616-l-h24.10.fid
7.6176
7.6106
7.6068
7.5984
7.5933
7.5653
7.5621
7.5575
7.5441
7.5401
7.5287
7.5244
7.4865
7.4831
7.4798
7.4700
7.4645
7.4584
7.4492
7.4459
7.4426
7.3873
7.3773
7.3725
7.3646
7.3594
7.3537
7.3458
7.3380
7.3296
7.3243
7.2695
7.1943
7.1902
7.1848
7.1763
7.1729
7.1702
6.9889
6.9836
6.9731
6.9671
6.9611
6.9508
6.9454
6.6331
6.5933
6.5048
6.4875
6.4700
6.4651
6.4479
6.4305
3.9702
3.9537
E21
1.96
2.24
1.09
4.94
0.87
2.06
2.03
1.02
0.97
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

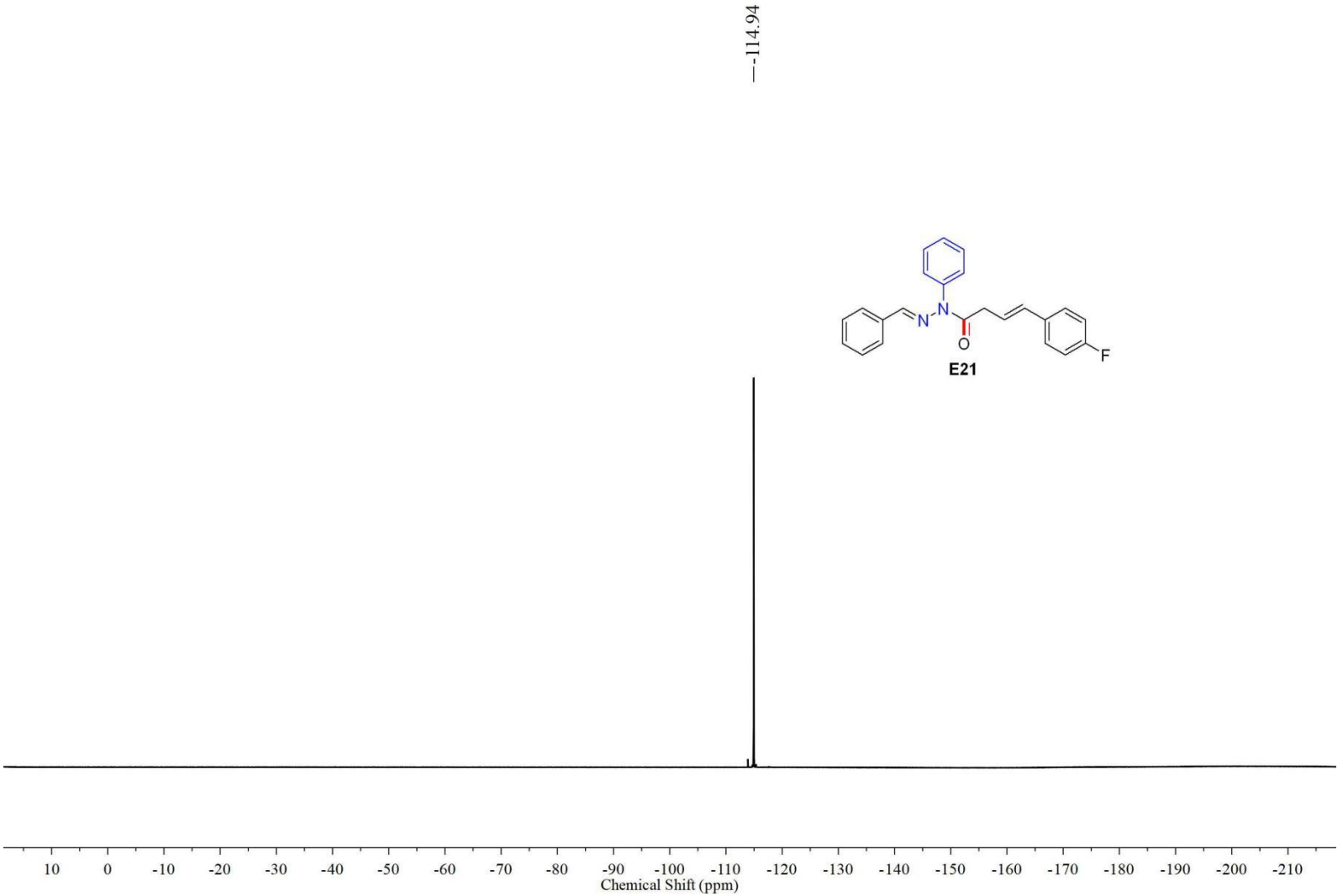
2022-11-7-yy0031-616-1-h24.11.fid

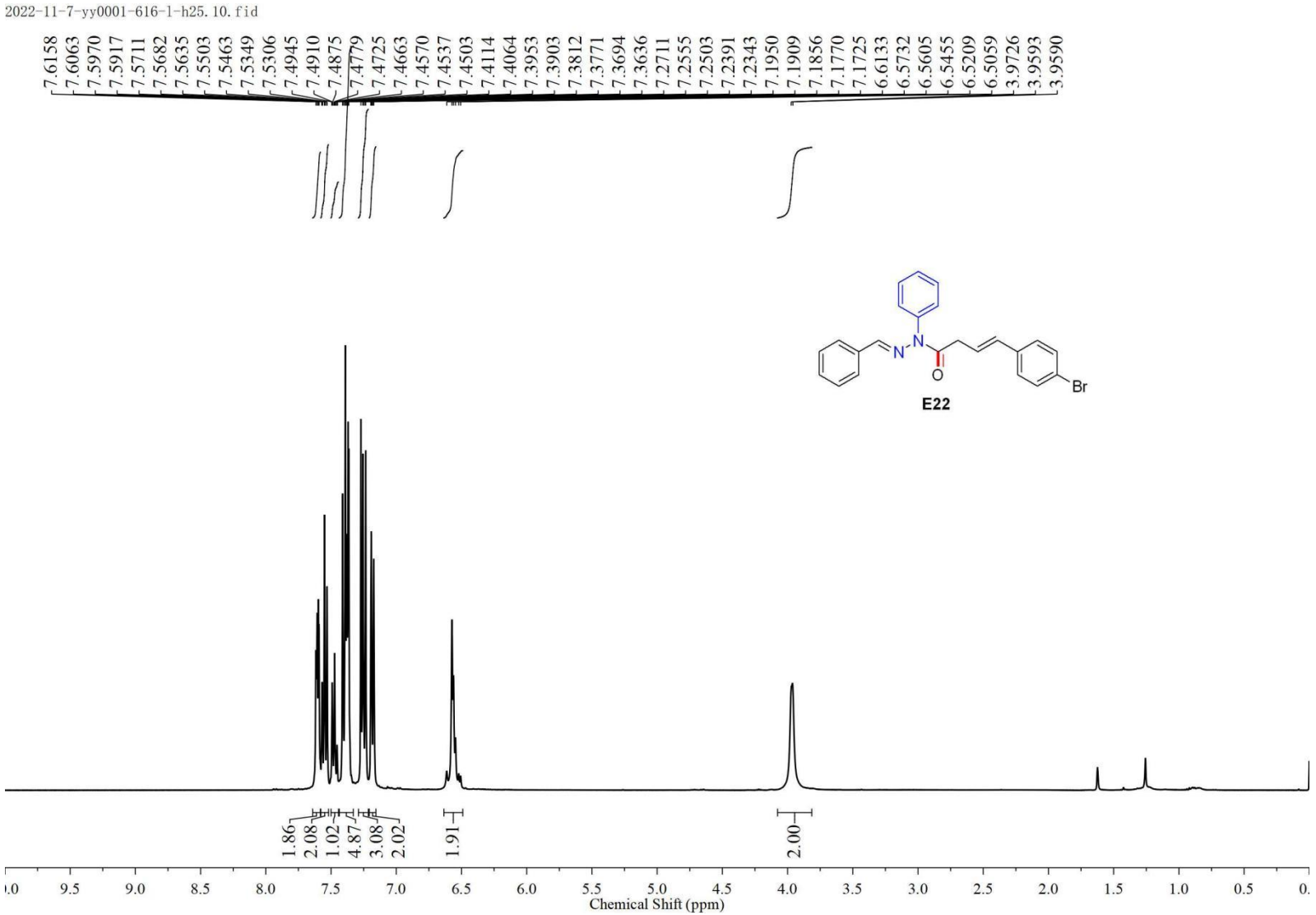
172.88
163.40
160.95
141.88
135.84
134.29
133.56
133.53
132.02
130.27
130.03
129.42
129.27
128.80
127.82
127.75
127.25
123.15
123.12
115.50
115.28
77.44
77.12
76.81
38.56

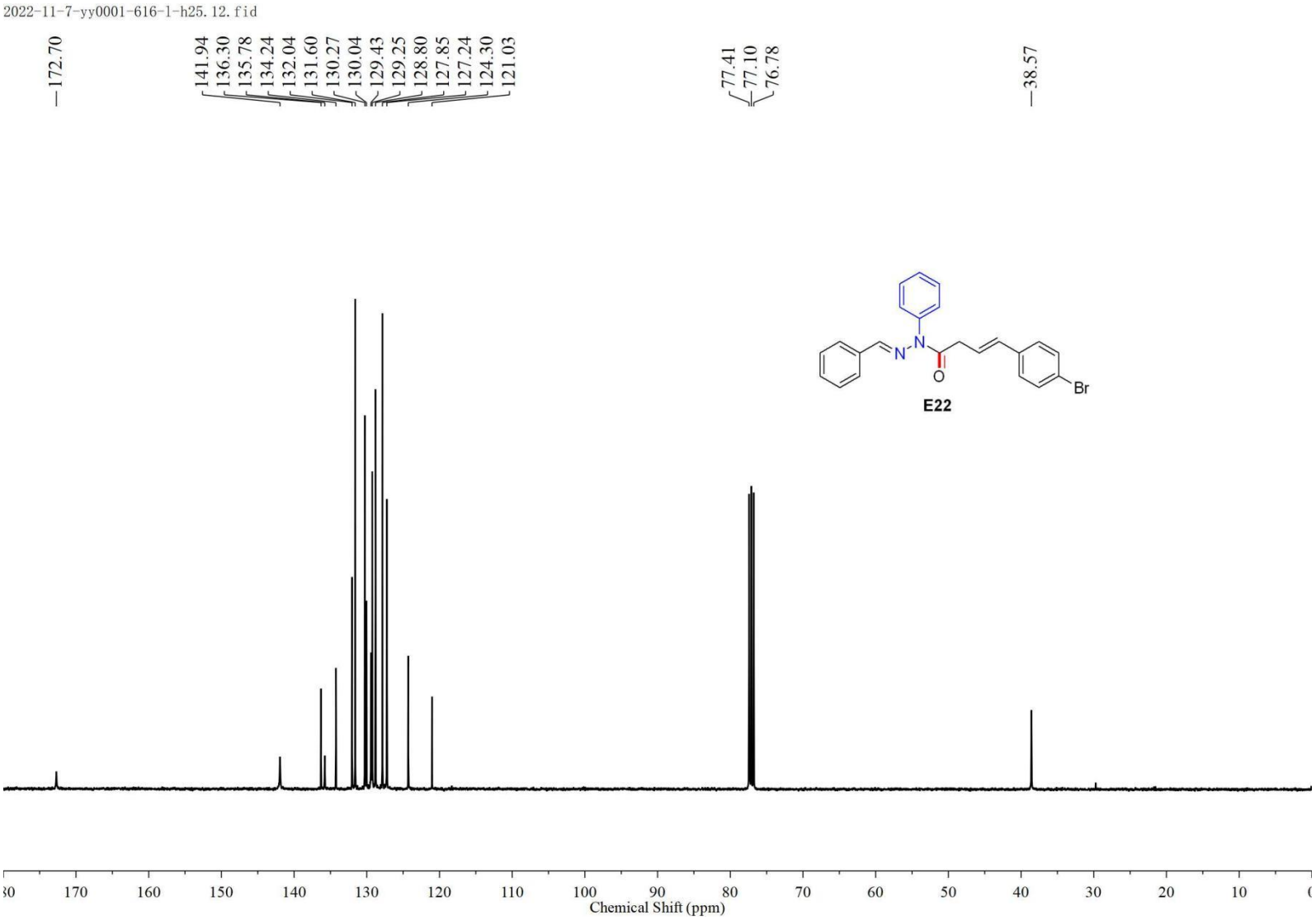


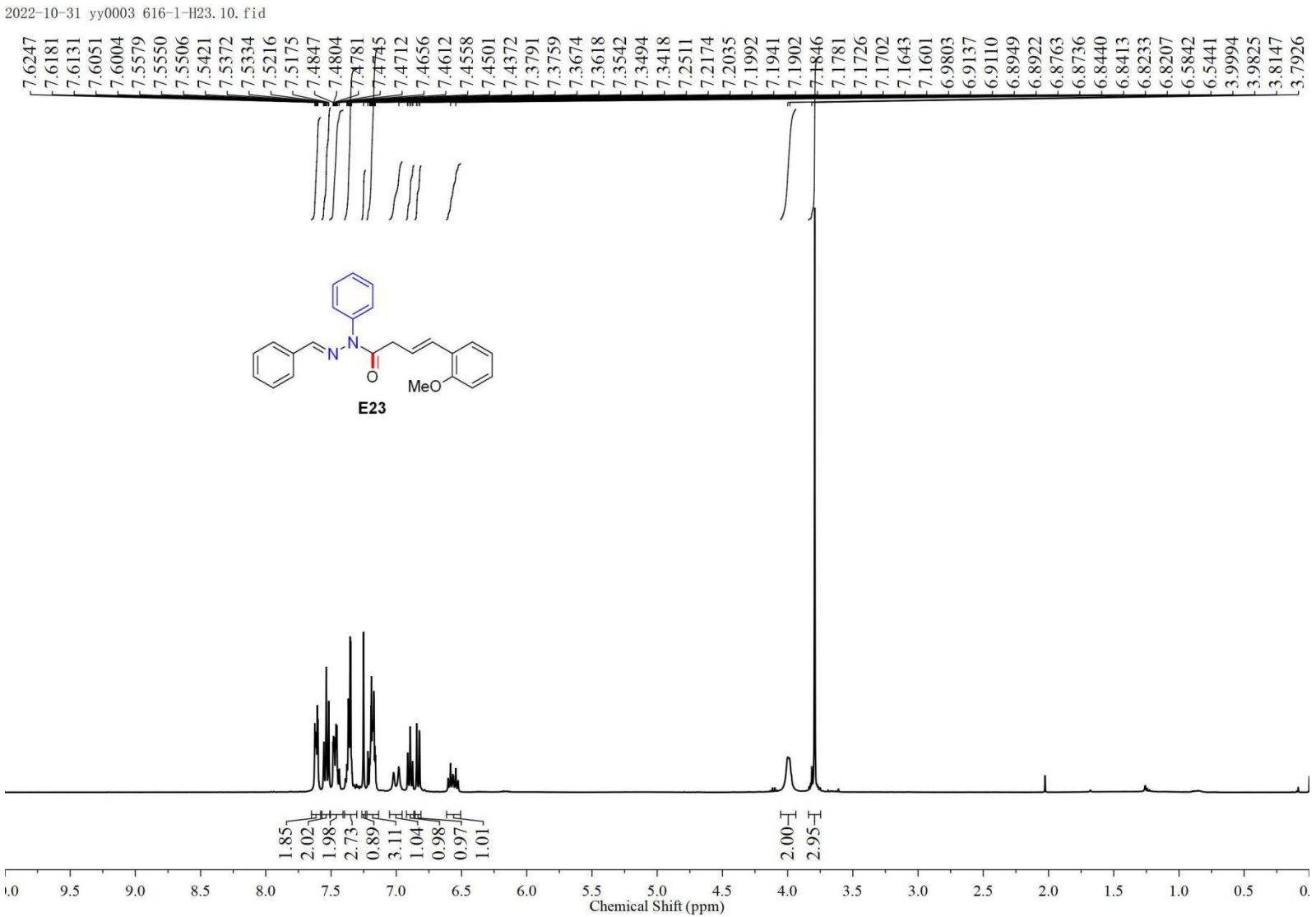
E21

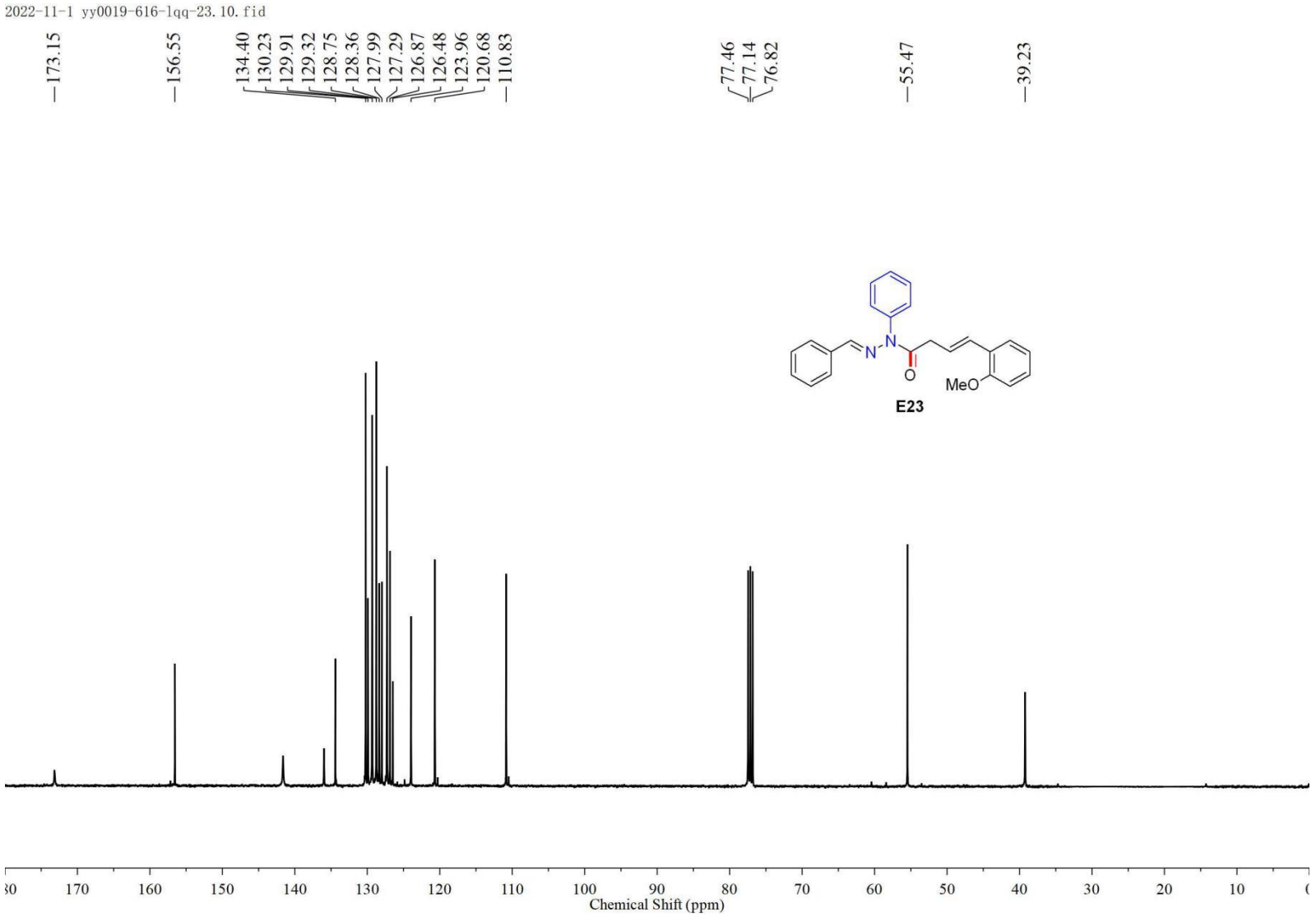
2022-11-7-yy0031-616-1-h24.12.fid

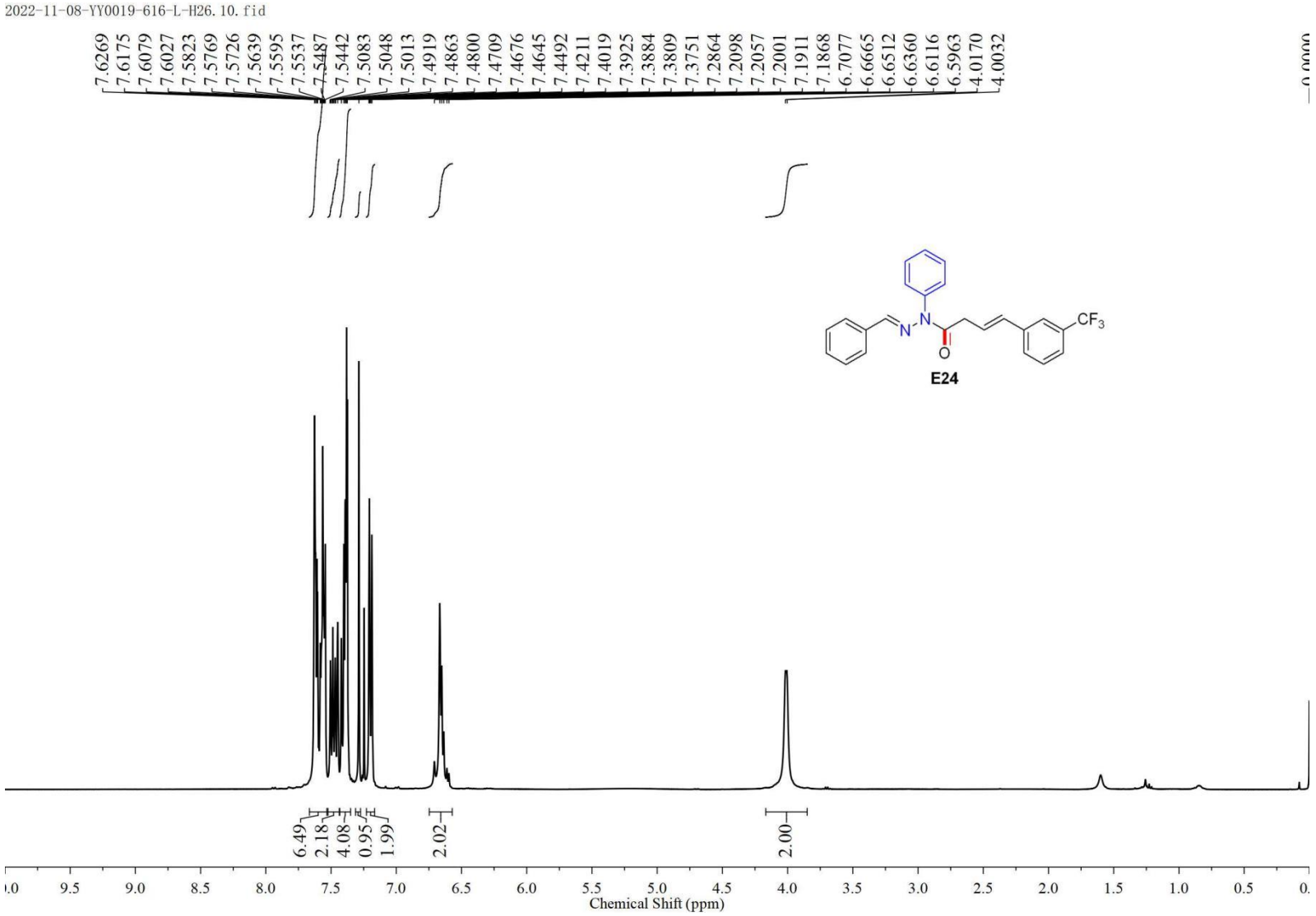



2022-11-7-yy0001-616-l-h25.10.fid
7.6158
7.6063
7.5970
7.5917
7.5711
7.5682
7.5635
7.5503
7.5463
7.5349
7.5306
7.4945
7.4910
7.4875
7.4779
7.4725
7.4663
7.4570
7.4537
7.4503
7.4114
7.4064
7.3953
7.3903
7.3812
7.3771
7.3694
7.3636
7.2711
7.2555
7.2503
7.2391
7.2343
7.1950
7.1909
7.1856
7.1770
7.1725
6.6133
6.5732
6.5605
6.5455
6.5209
6.5059
3.9726
3.9593
3.9590
N
N
O
Br
E22
1.86
2.08
1.02
4.87
3.08
2.02
1.91
2.00
Chemical Shift (ppm)

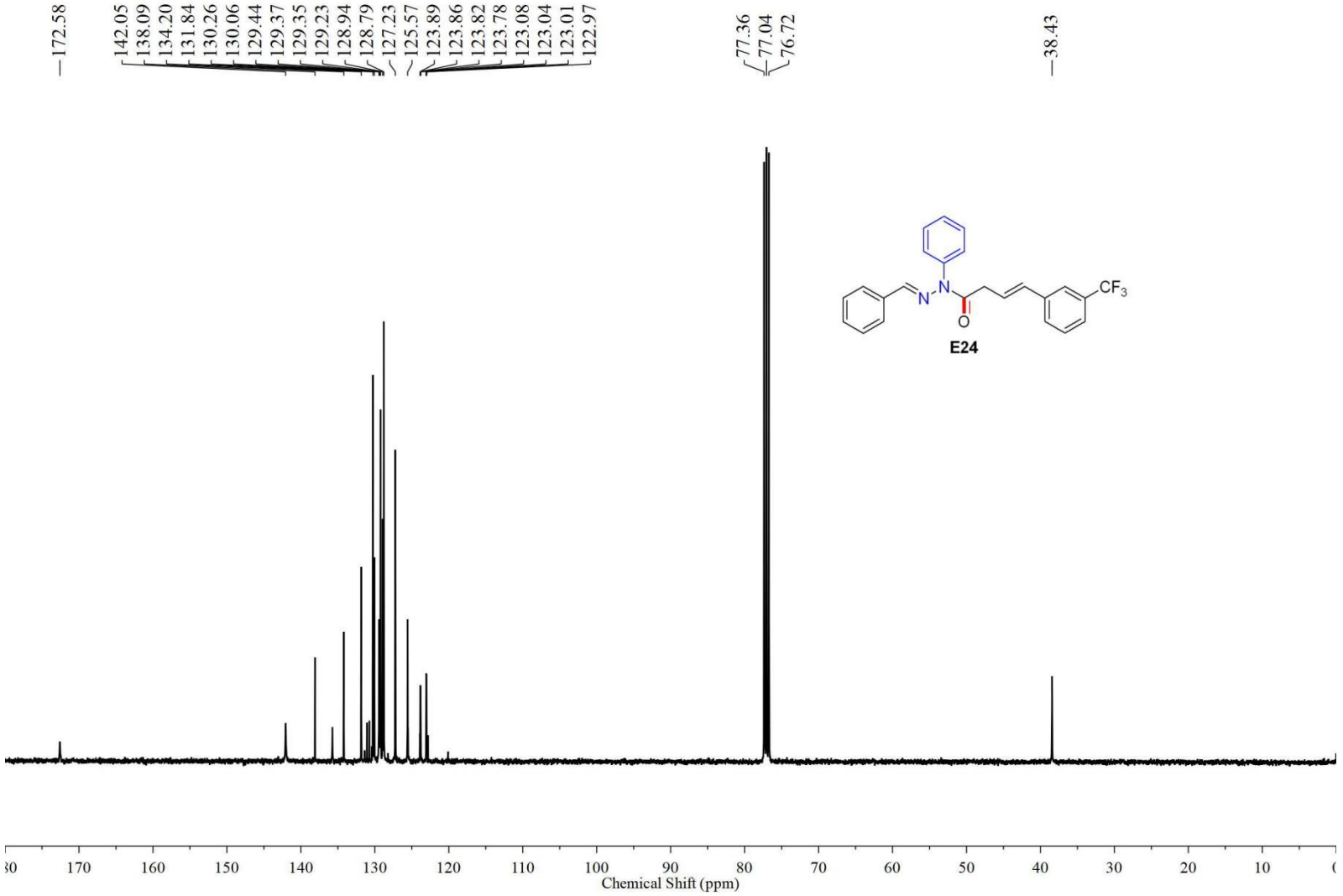

2022-11-7-yy0001-616-1-h25.12.fid
172.70
141.94
136.30
135.78
134.24
132.04
131.60
130.27
130.04
129.43
129.25
128.80
127.85
127.24
124.30
121.03
77.41
77.10
76.78
38.57
N
N
O
Br
E22
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)


2022-10-31 yy0003 616-1-H23.10.fid
7.6247
7.6181
7.6131
7.6051
7.6004
7.5579
7.5550
7.5506
7.5421
7.5372
7.5334
7.5216
7.5175
7.4847
7.4804
7.4781
7.4745
7.4712
7.4656
7.4612
7.4558
7.4501
7.4372
7.3791
7.3759
7.3674
7.3618
7.3542
7.3494
7.3418
7.2511
7.2174
7.2035
7.1992
7.1941
7.1902
7.1846
7.1781
7.1726
7.1702
7.1643
7.1601
6.9803
6.9137
6.9110
6.8949
6.8922
6.8763
6.8736
6.8440
6.8413
6.8233
6.8207
6.5842
6.5441
3.9994
3.9825
3.8147
3.7926
N
N
O
MeO
E23
1.85
2.02
1.98
2.73
0.89
3.11
1.04
0.98
0.97
1.01
2.00
2.95
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

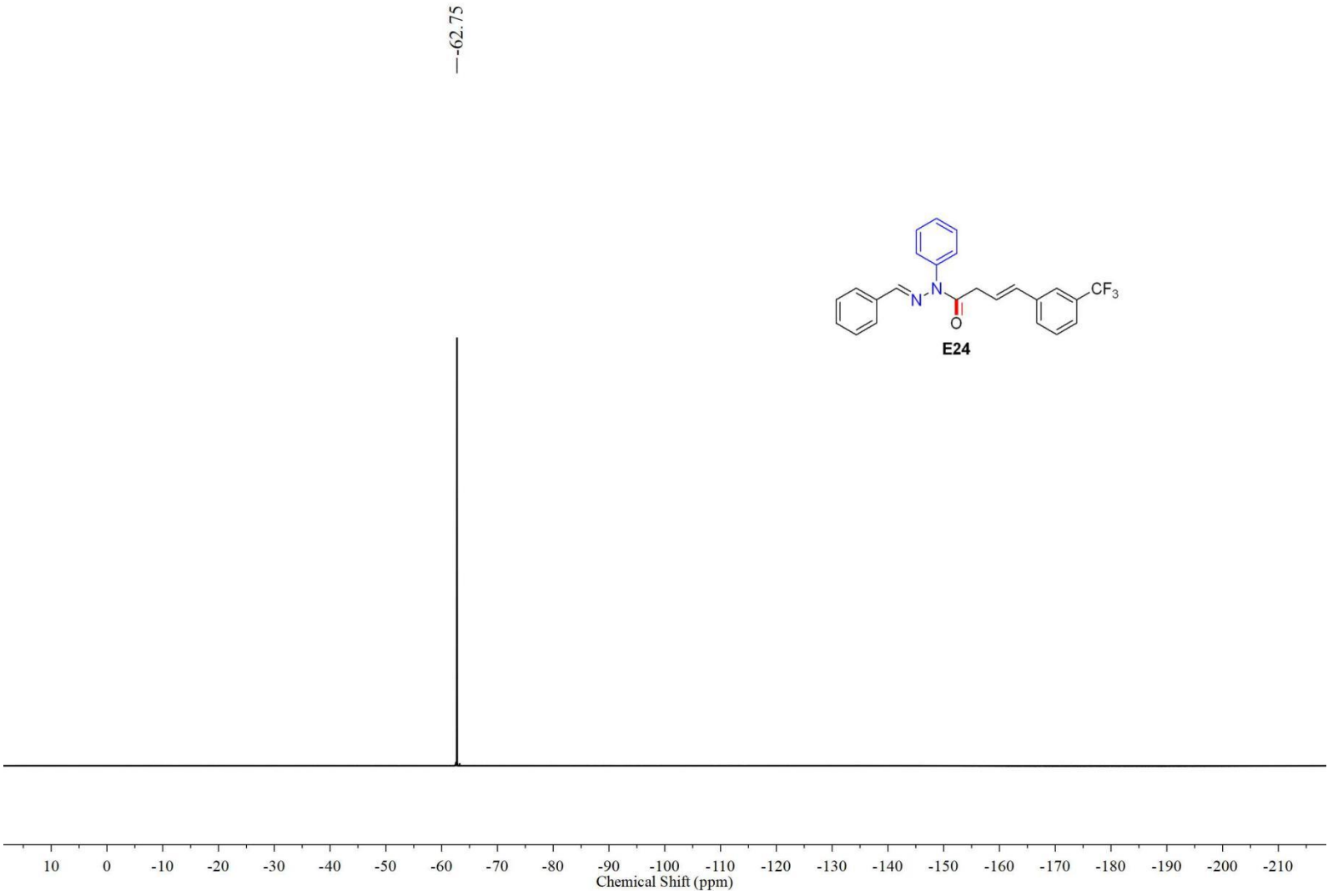

2022-11-1 yy0019-616-lqq-23.10.fid
173.15
156.55
134.40
130.23
129.91
129.32
128.75
128.36
127.99
127.29
126.87
126.48
123.96
120.68
110.83
77.46
77.14
76.82
55.47
39.23
N
N
O
MeO
E23
Chemical Shift (ppm)


2022-11-08-YY0019-616-L-H26.10.fid
7.6269
7.6175
7.6079
7.6027
7.5823
7.5769
7.5726
7.5639
7.5595
7.5537
7.5487
7.5442
7.5083
7.5048
7.5013
7.4919
7.4863
7.4800
7.4709
7.4676
7.4645
7.4492
7.4211
7.4019
7.3925
7.3884
7.3809
7.3751
7.2864
7.2098
7.2057
7.2001
7.1911
7.1868
7.7077
6.6665
6.6512
6.6360
6.6116
6.5963
4.0170
4.0032
CF3
N
N
O
E24
6.49
2.18
4.08
0.95
1.99
2.02
2.00
Chemical Shift (ppm)

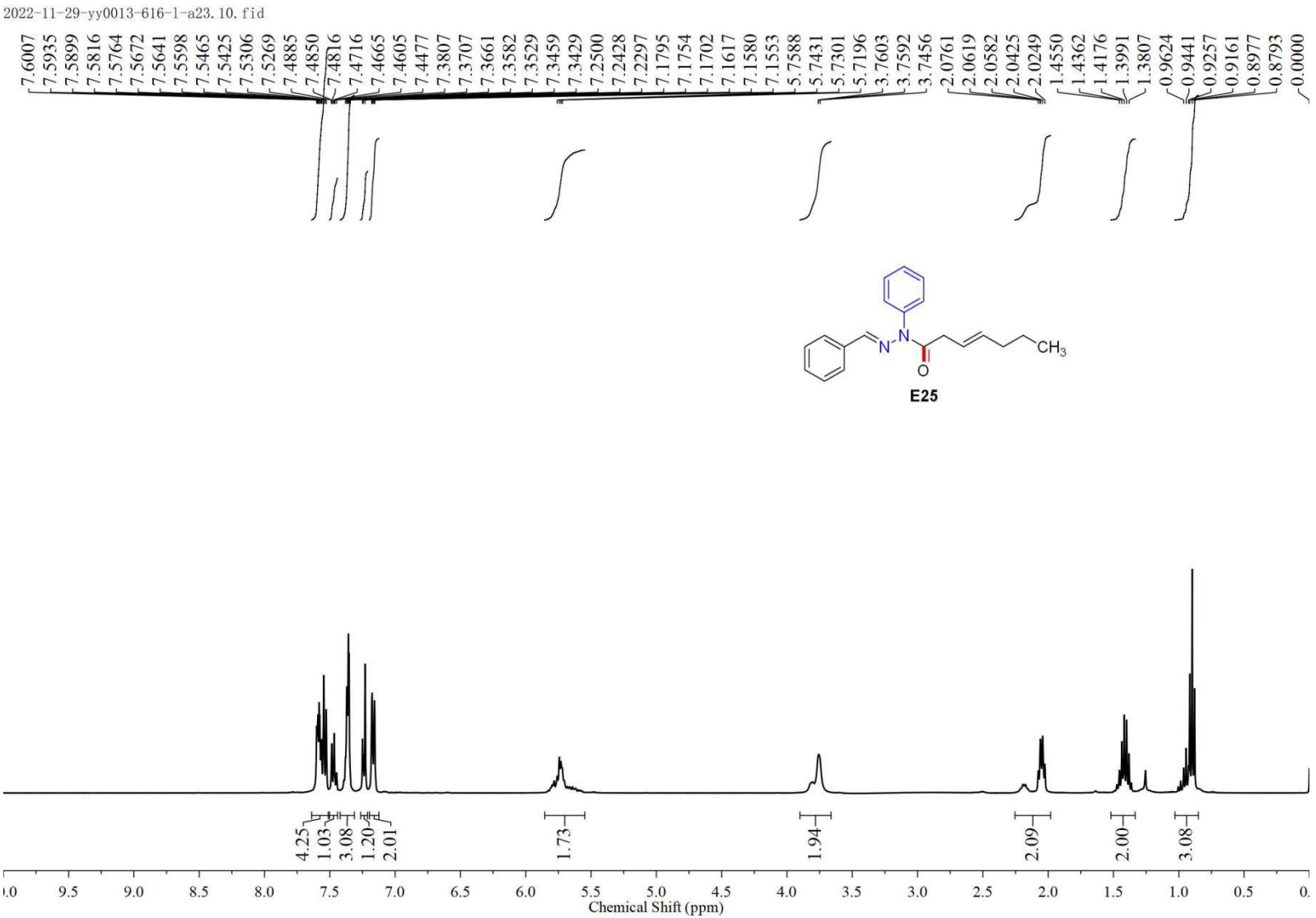
2022-11-08-YY0019-616-L-H26.11.fid



2022-11-08-YY0019-616-L-H26.12.fid

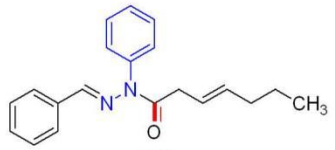


E24

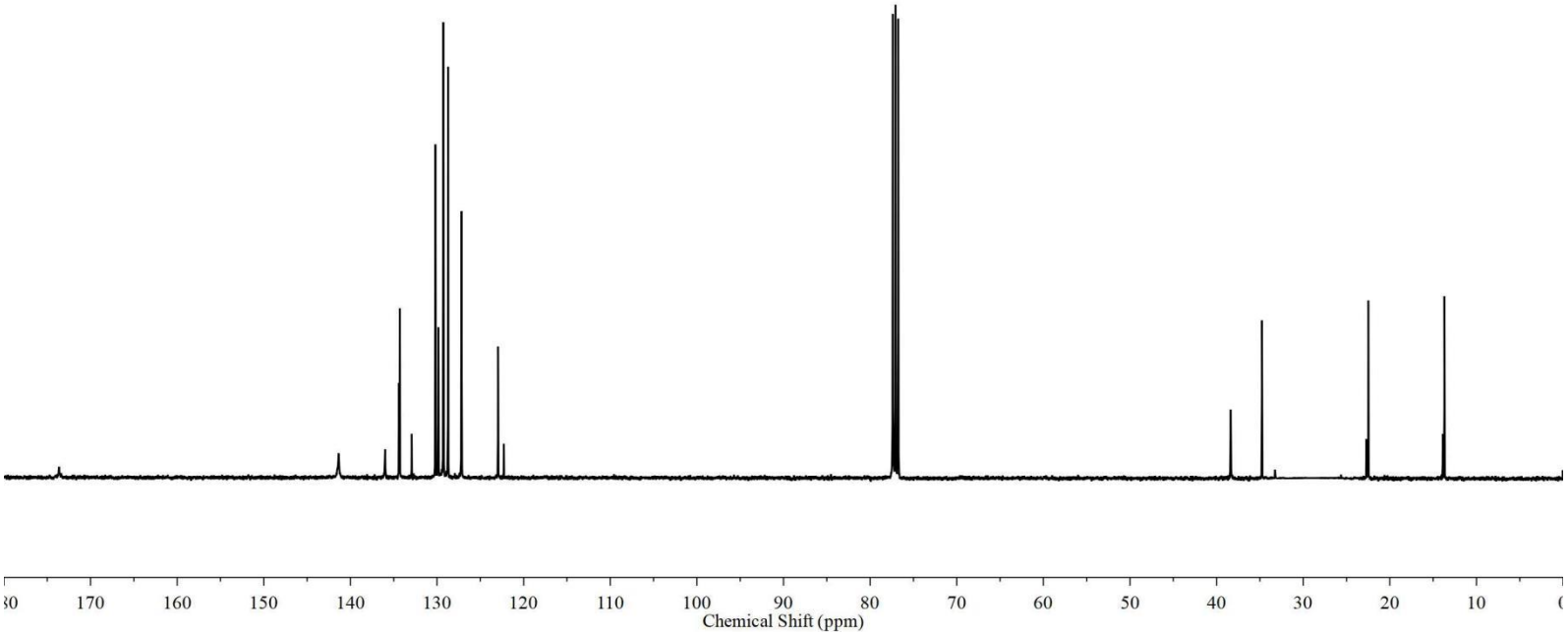

2022-11-29-yy0013-616-1-a23.10.fid
7.6007
7.5935
7.5899
7.5816
7.5764
7.5672
7.5641
7.5598
7.5465
7.5425
7.5306
7.5269
7.4885
7.4850
7.4816
7.4716
7.4665
7.4605
7.4477
7.3807
7.3707
7.3661
7.3582
7.3529
7.3459
7.3429
7.2500
7.2428
7.2297
7.1795
7.1754
7.1702
7.1617
7.1580
7.1553
5.7588
5.7431
5.7301
5.7196
3.7603
3.7592
3.7456
2.0761
2.0619
2.0582
2.0425
2.0249
1.4550
1.4362
1.4176
1.3991
1.3807
0.9624
0.9441
0.9257
0.9161
0.8977
0.8793
0.0000
N
N
O
CH3
E25
4.25
1.03
3.08
1.20
2.01
1.73
1.94
2.09
2.00
3.08
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Chemical Shift (ppm)

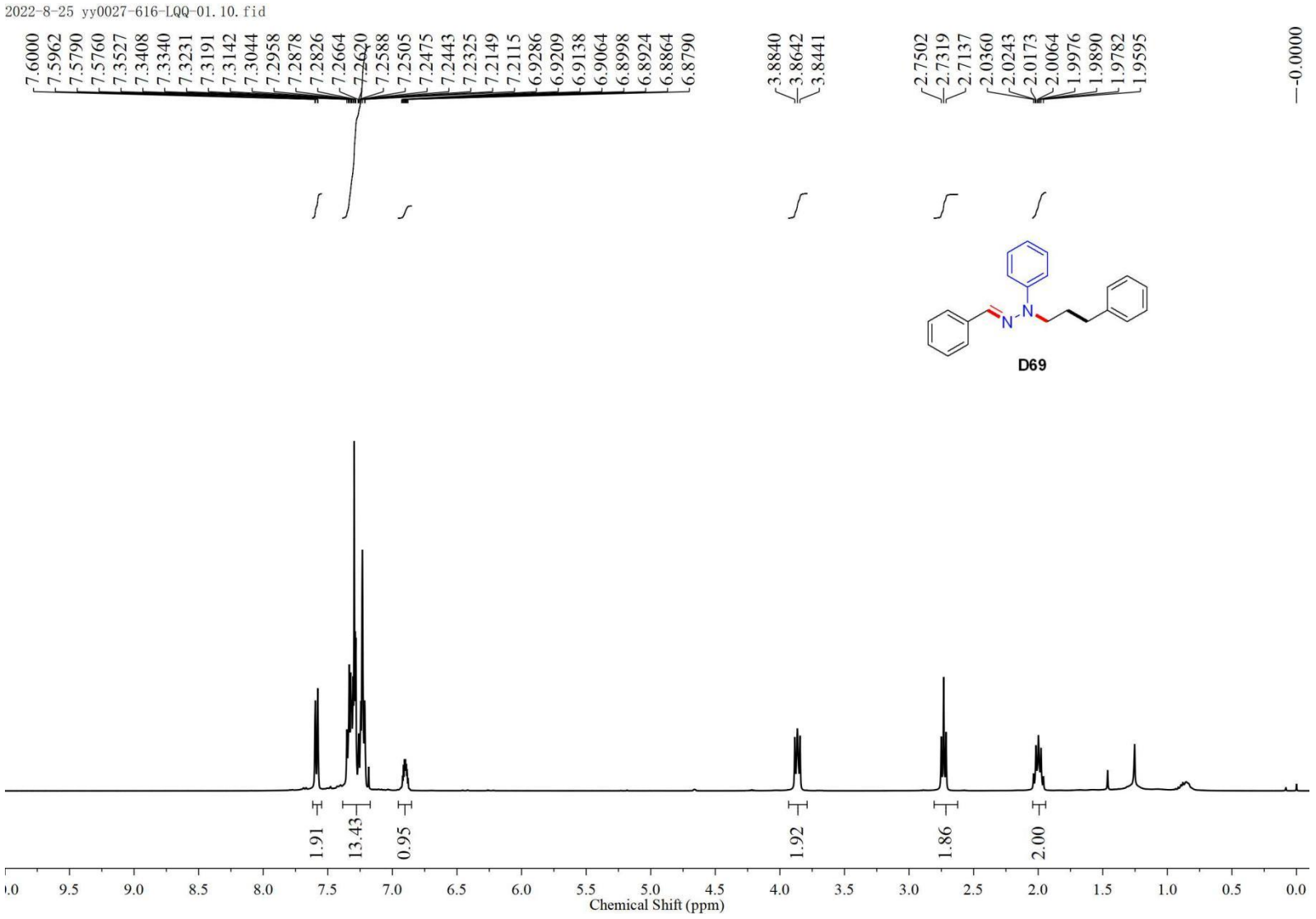
2022-11-29-yy0013-616-1-a23.11.fid

173.66
141.36
135.99
134.35
132.92
130.18
129.84
129.27
128.72
127.18
122.95
122.29
77.39
77.07
76.75
38.37
34.76
22.71
22.48
13.88
13.70



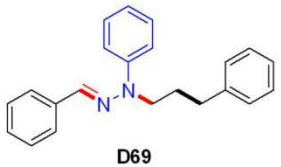
E25



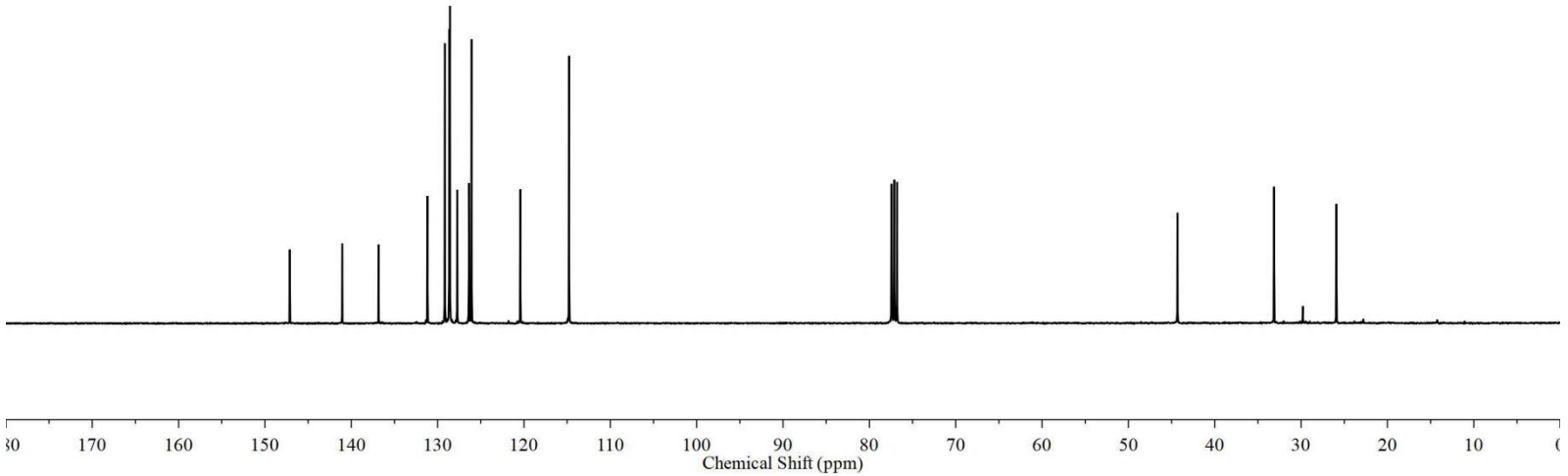

2022-8-25 yy0027-616-LQQ-01.10.fid
7.6000
7.5962
7.5790
7.5760
7.3527
7.3408
7.3340
7.3231
7.3191
7.3142
7.3044
7.2958
7.2878
7.2826
7.2664
7.2620
7.2588
7.2505
7.2475
7.2443
7.2325
7.2149
7.2115
6.9286
6.9209
6.9138
6.9064
6.8998
6.8924
6.8864
6.8790
3.8840
3.8642
3.8441
2.7502
2.7319
2.7137
2.0360
2.0243
2.0173
2.0064
1.9976
1.9890
1.9782
1.9595
-0.0000
D69
1.91
13.43
0.95
1.92
1.86
2.00
Chemical Shift (ppm)

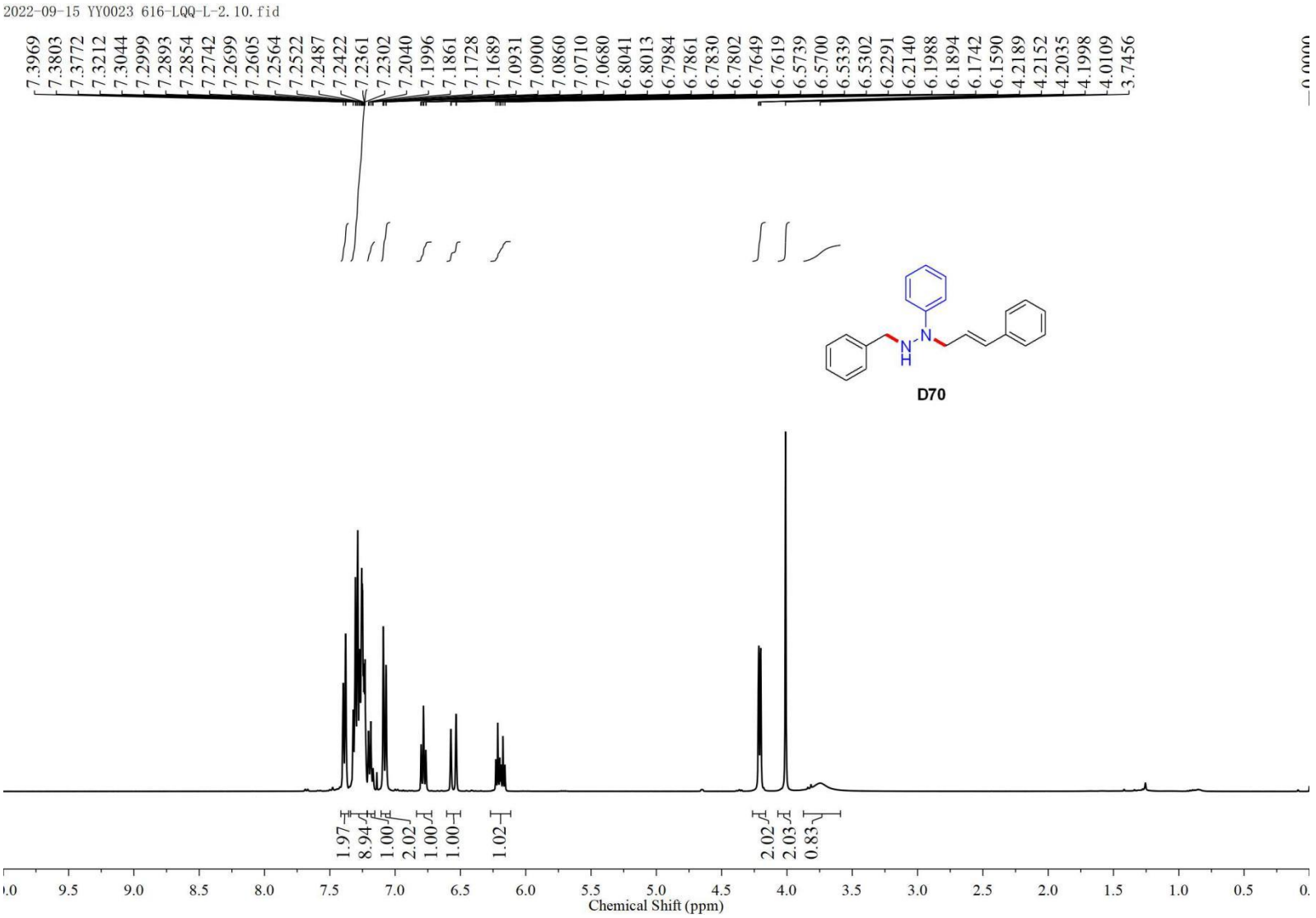
2022-08-26 YY0018 616-LQQ-01.10.fid

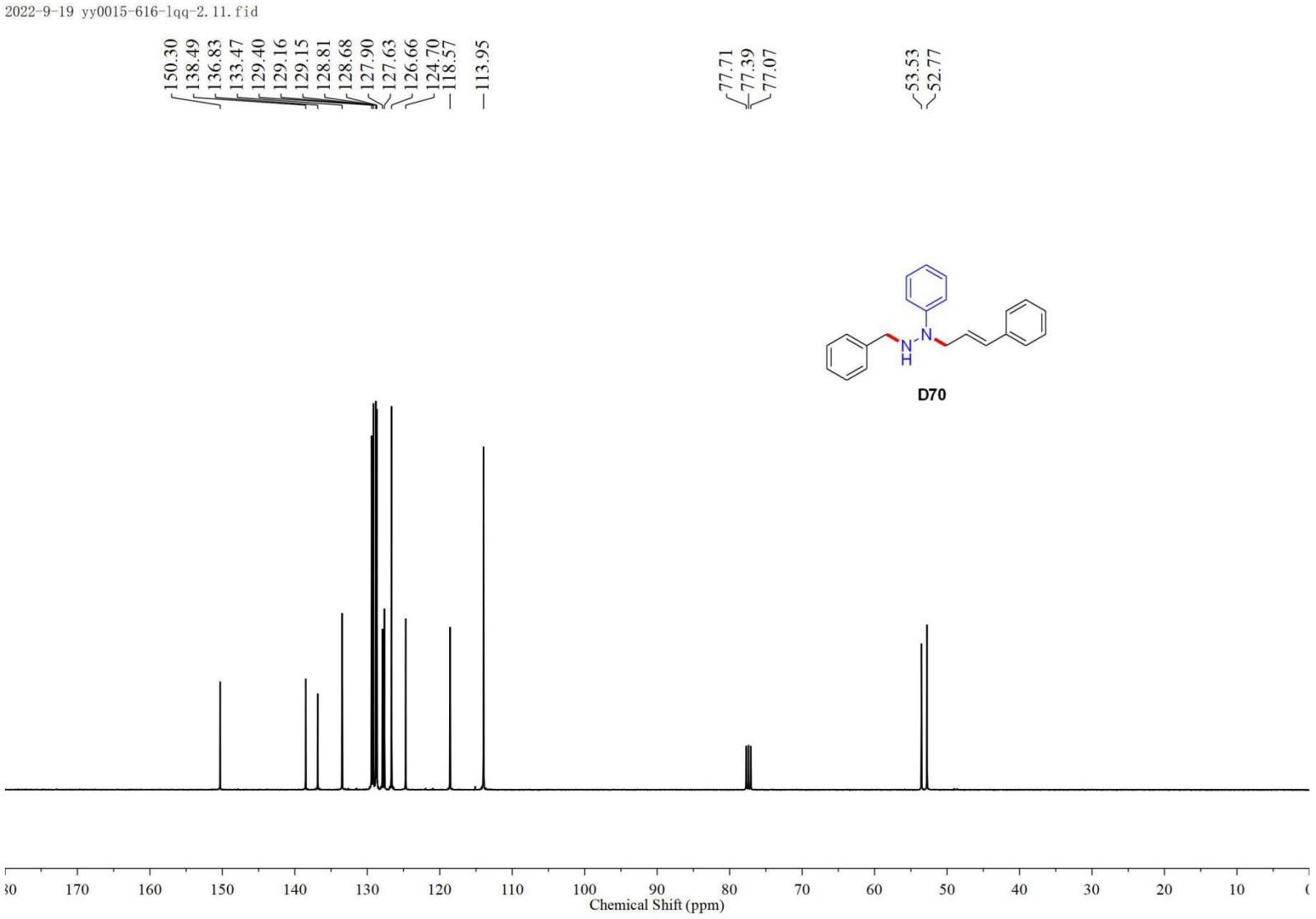
147.12
141.05
136.84
131.18
129.17
128.66
128.60
128.57
127.73
126.37
126.07
120.42
114.78
77.44
77.12
76.80
44.32
33.13
25.92

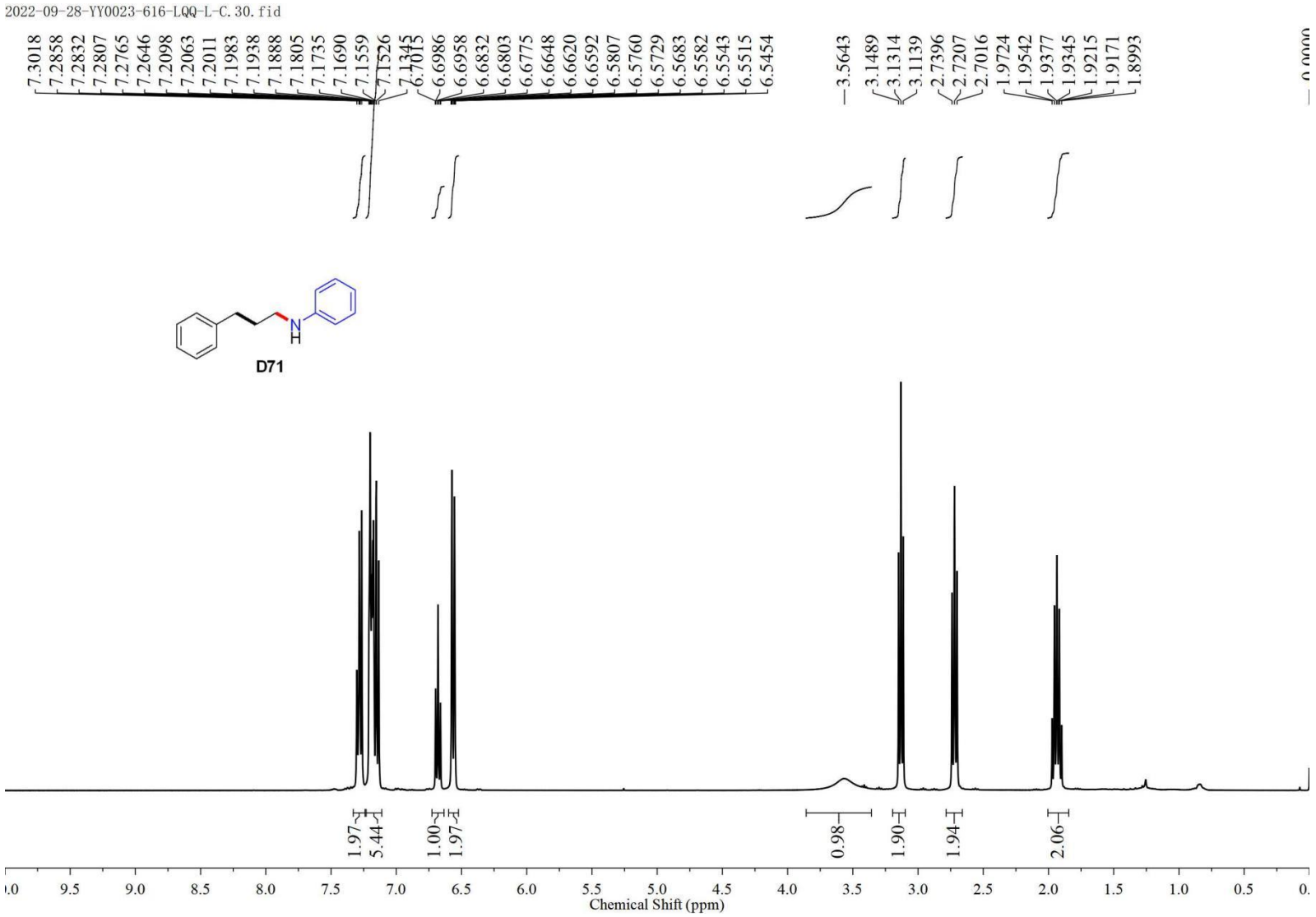


D69



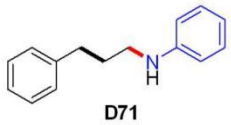

2022-09-15 YY0023 616-LQQ-L-2.10.fid
7.3969
7.3803
7.3772
7.3212
7.3044
7.2999
7.2893
7.2854
7.2742
7.2699
7.2605
7.2564
7.2522
7.2487
7.2422
7.2361
7.2302
7.2040
7.1996
7.1861
7.1728
7.1689
7.0931
7.0900
7.0860
7.0710
7.0680
6.8041
6.8013
6.7984
6.7861
6.7830
6.7802
6.7649
6.7619
6.5739
6.5700
6.5339
6.5302
6.2291
6.2140
6.1988
6.1894
6.1742
6.1590
4.2189
4.2152
4.2035
4.1998
4.0109
3.7456
D70
1.97
8.94
1.00
2.02
1.00
1.00
1.02
2.02
2.03
0.83
Chemical Shift (ppm)


2022-9-19 yy0015-616-lqq-2.11.fid
150.30
138.49
136.83
133.47
129.40
129.16
129.15
128.81
128.68
127.90
127.63
126.66
124.70
118.57
113.95
77.71
77.39
77.07
53.53
52.77
D70
Chemical Shift (ppm)

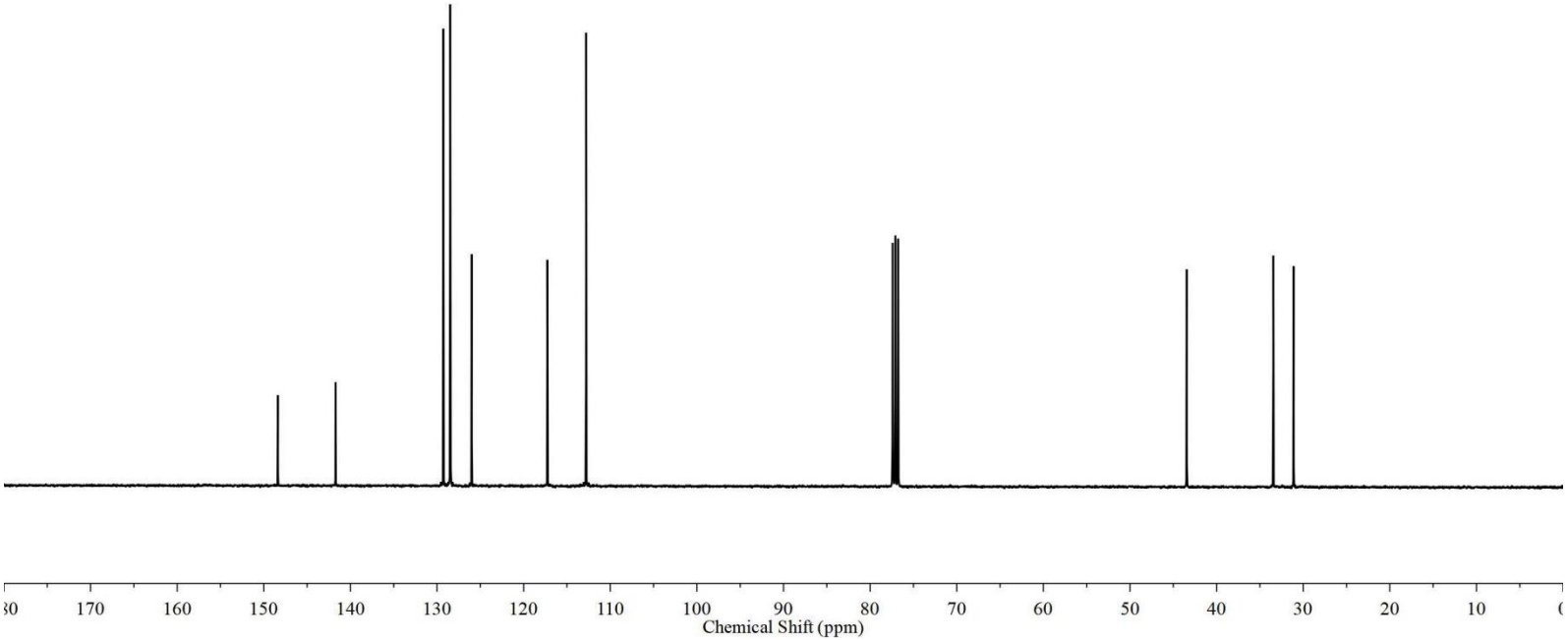

2022-09-28-YY0023-616-LQQ-L-C.30.fid
7.3018
7.2858
7.2832
7.2807
7.2765
7.2646
7.2098
7.2063
7.2011
7.1983
7.1938
7.1888
7.1805
7.1735
7.1690
7.1559
7.1526
7.1345
7.1015
6.6986
6.6958
6.6832
6.6803
6.6775
6.6648
6.6620
6.6592
6.5807
6.5760
6.5729
6.5683
6.5582
6.5543
6.5515
6.5454
3.5643
3.1489
3.1314
3.1139
2.7396
2.7207
2.7016
1.9724
1.9542
1.9377
1.9345
1.9215
1.9171
1.8993
0.0000
N
H
D71
1.97
5.44
1.00
1.97
0.98
1.90
1.94
2.06
Chemical Shift (ppm)

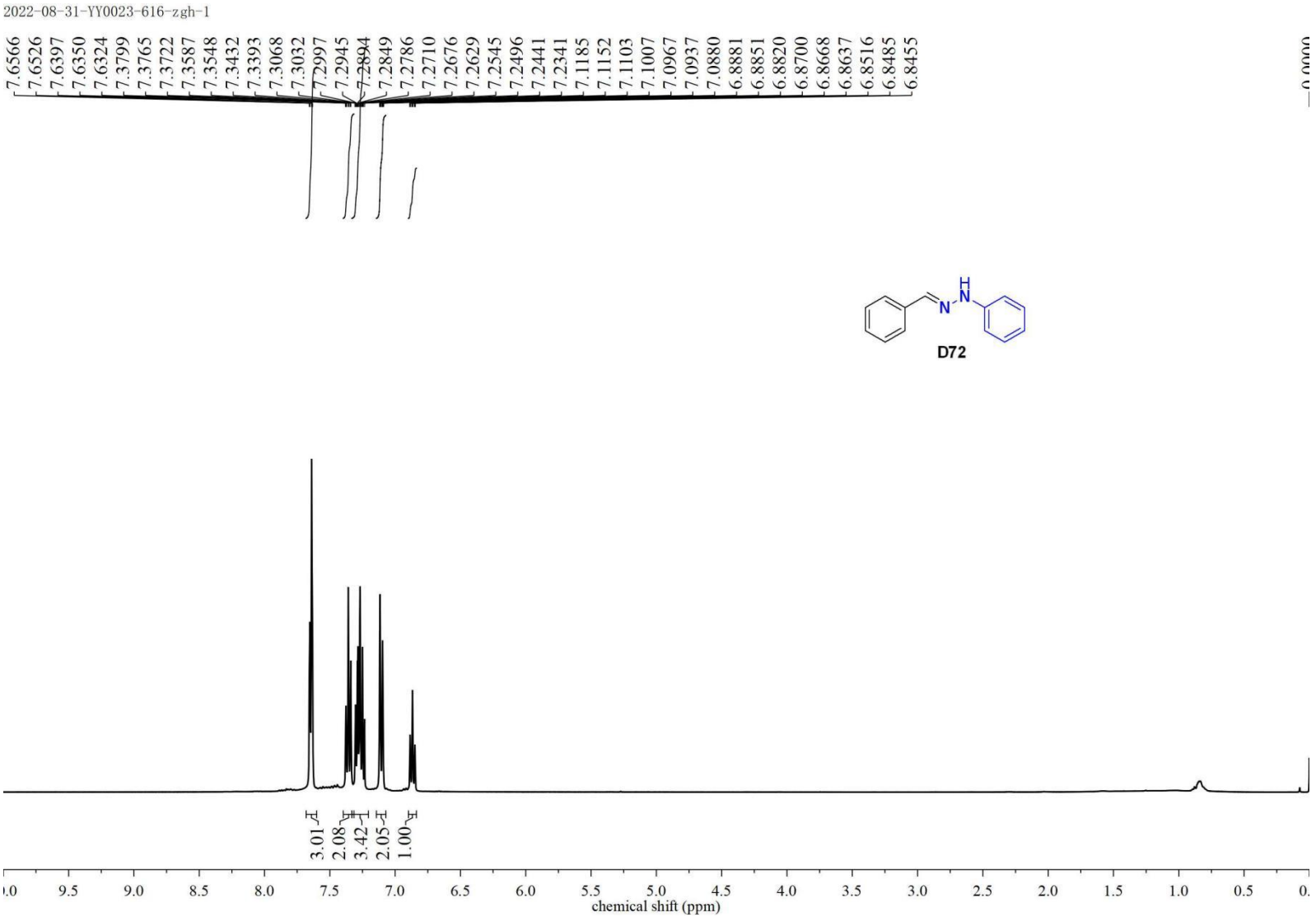
2022-09-28-YY0023-616-LQQ-L-C.31.fid

148.38
141.71
129.27
128.48
128.45
126.00
117.26
112.79
77.40
77.08
76.77
43.45
33.45
31.11



D71

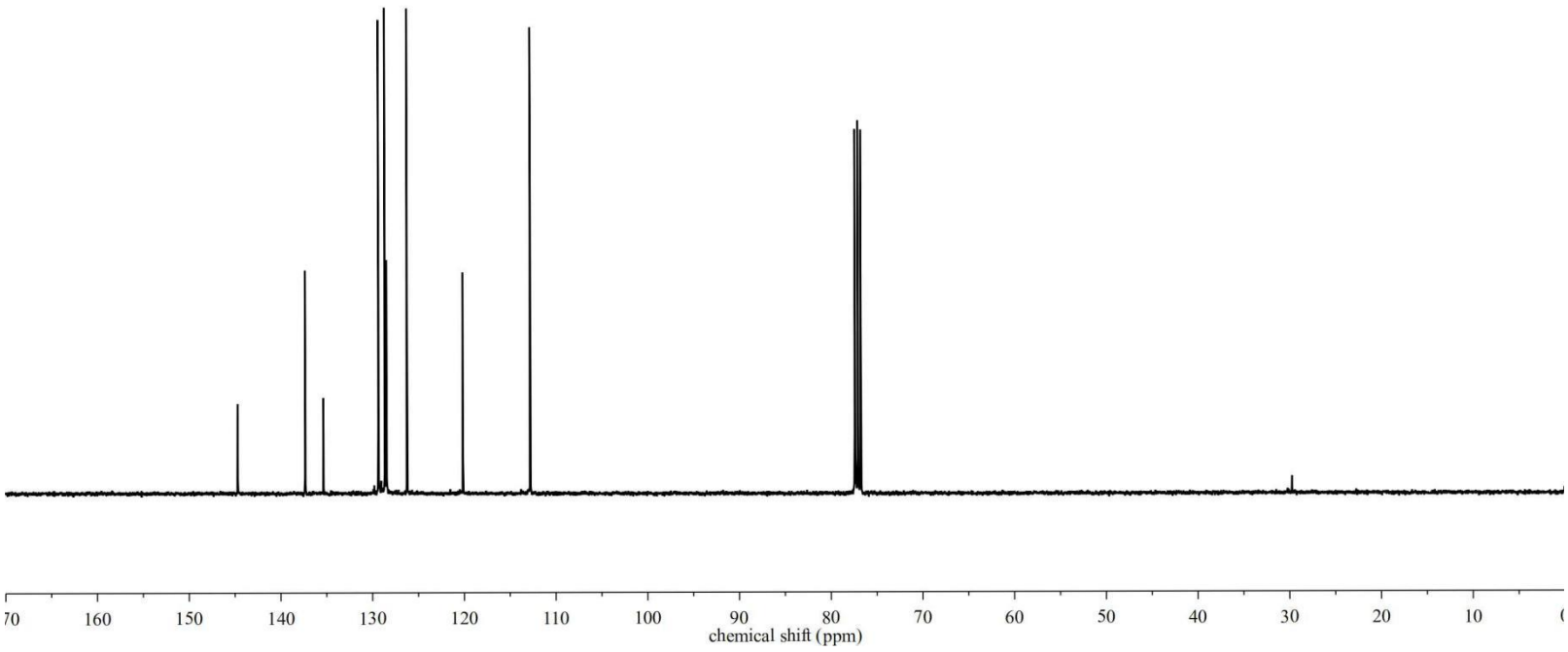


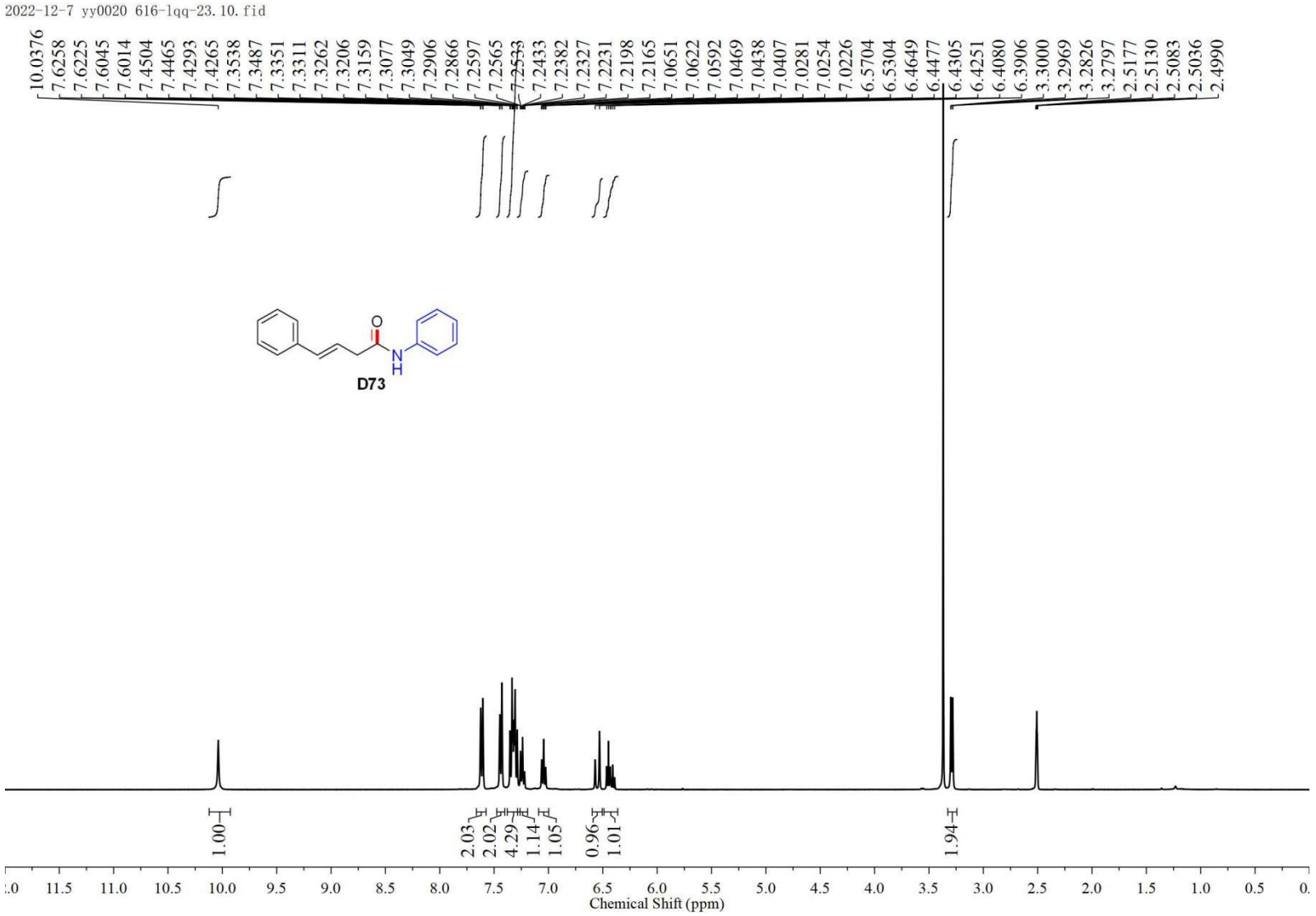

2022-08-31-YY0023-616-zgh-1
7.6566
7.6526
7.6397
7.6350
7.6324
7.3799
7.3765
7.3722
7.3587
7.3548
7.3432
7.3393
7.3068
7.3032
7.2997
7.2945
7.2894
7.2849
7.2786
7.2710
7.2676
7.2629
7.2545
7.2496
7.2441
7.2341
7.1185
7.1152
7.1103
7.1007
7.0967
7.0937
7.0880
6.8881
6.8851
6.8820
6.8700
6.8668
6.8637
6.8516
6.8485
6.8455
D72
3.01
2.08
3.42
2.05
1.00
chemical shift (ppm)

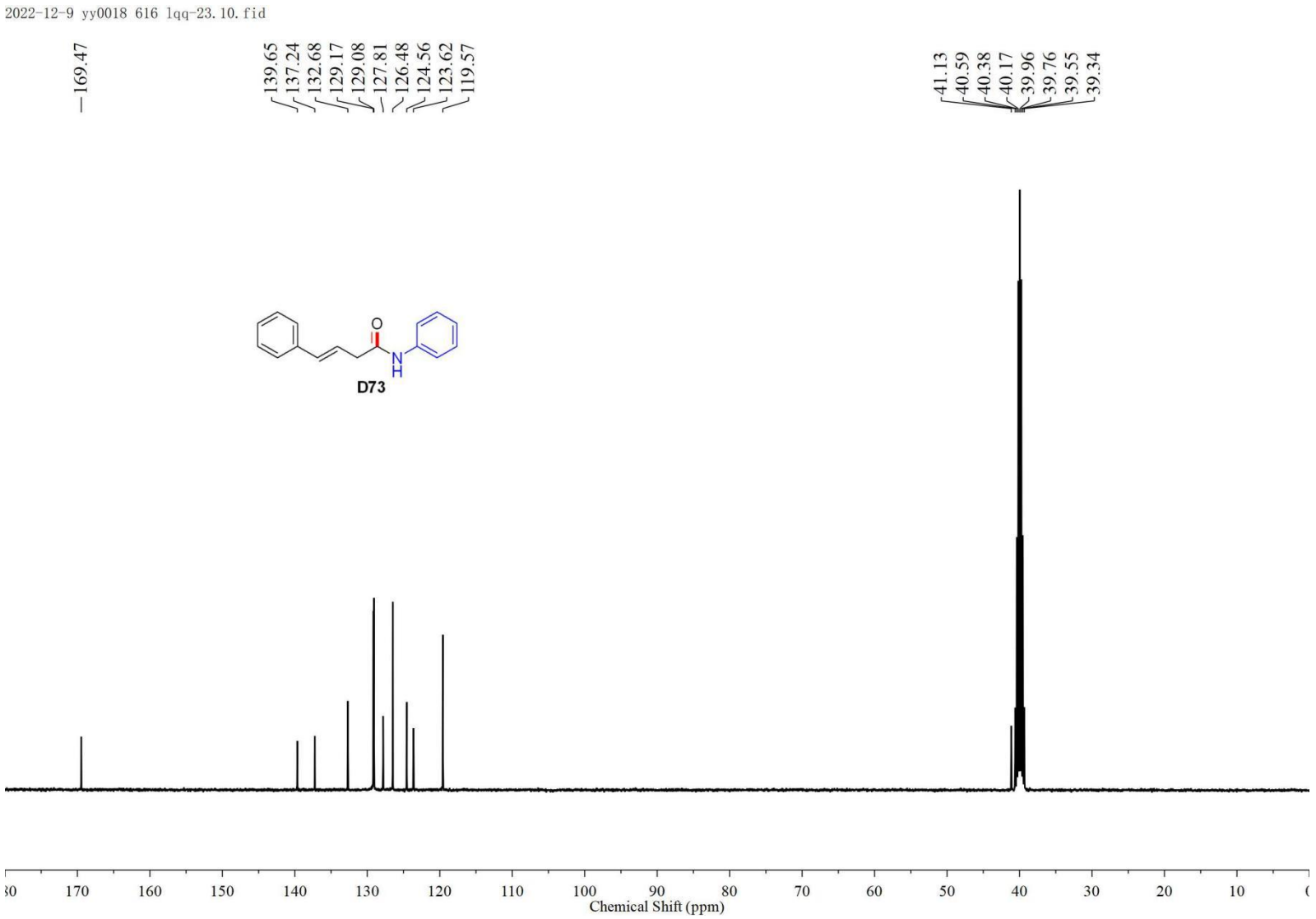
2022-08-31-YY0023-616-zgh-1

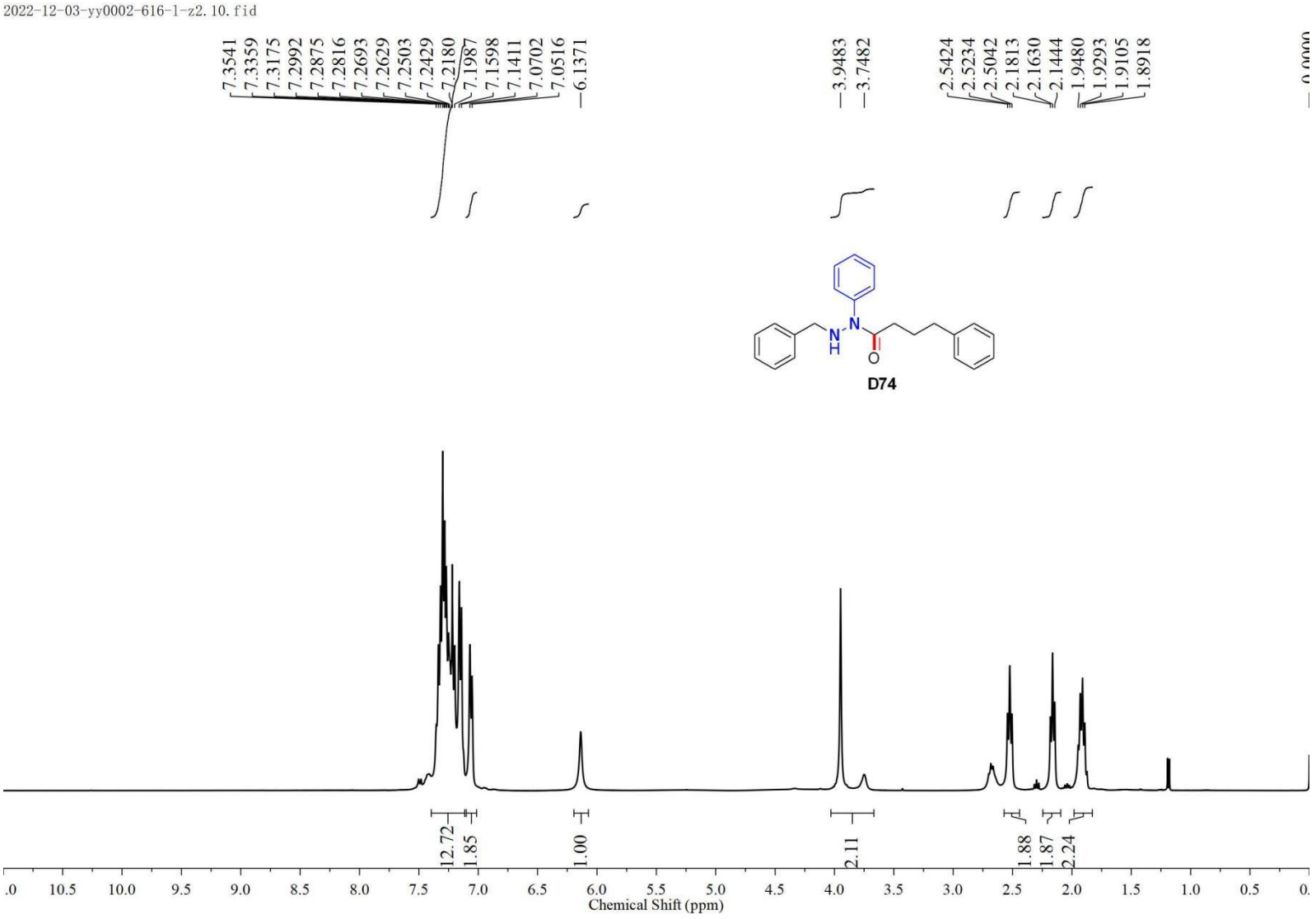
144.69
137.32
135.34
129.34
128.63
128.45
126.22
120.13
112.79
77.38
77.06
76.74

D72



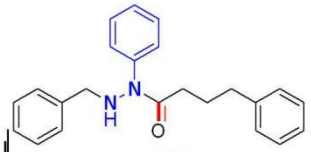

2022-12-7 yy0020 616-lqq-23.10.fid
10.0376
7.6258
7.6225
7.6045
7.6014
7.4504
7.4465
7.4293
7.4265
7.3538
7.3487
7.3351
7.3311
7.3262
7.3206
7.3159
7.3077
7.3049
7.2906
7.2866
7.2597
7.2565
7.2533
7.2433
7.2382
7.2327
7.2231
7.2198
7.2165
7.0651
7.0622
7.0592
7.0469
7.0438
7.0407
7.0281
7.0254
7.0226
6.5704
6.5304
6.4649
6.4477
6.4305
6.4251
6.4080
6.3906
3.3000
3.2969
3.2826
3.2797
2.5177
2.5130
2.5083
2.5036
2.4990
O
N
H
D73
1.00
2.03
2.02
4.29
1.14
1.05
0.96
1.01
1.94
Chemical Shift (ppm)


2022-12-9 yy0018 616 lqq-23.10.fid
169.47
139.65
137.24
132.68
129.17
129.08
127.81
126.48
124.56
123.62
119.57
41.13
40.59
40.38
40.17
39.96
39.76
39.55
39.34
O
N
H
D73
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Chemical Shift (ppm)

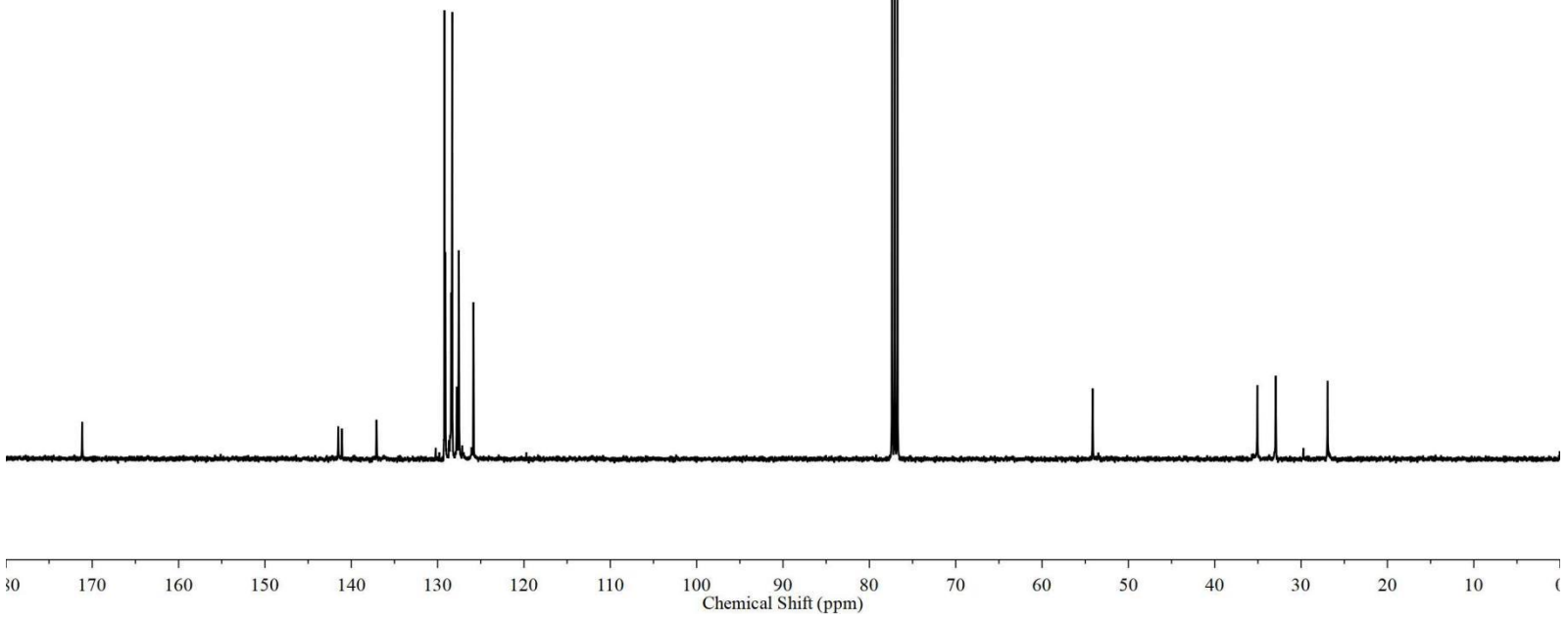

2022-12-03-yy0002-616-1-z2.10.fid
7.3541
7.3359
7.3175
7.2992
7.2875
7.2816
7.2693
7.2629
7.2503
7.2429
7.2180
7.1987
7.1598
7.1411
7.0702
7.0516
6.1371
3.9483
3.7482
2.5424
2.5234
2.5042
2.1813
2.1630
2.1444
1.9480
1.9293
1.9105
1.8918
D74
12.72
1.85
1.00
2.11
1.88
1.87
2.24
Chemical Shift (ppm)

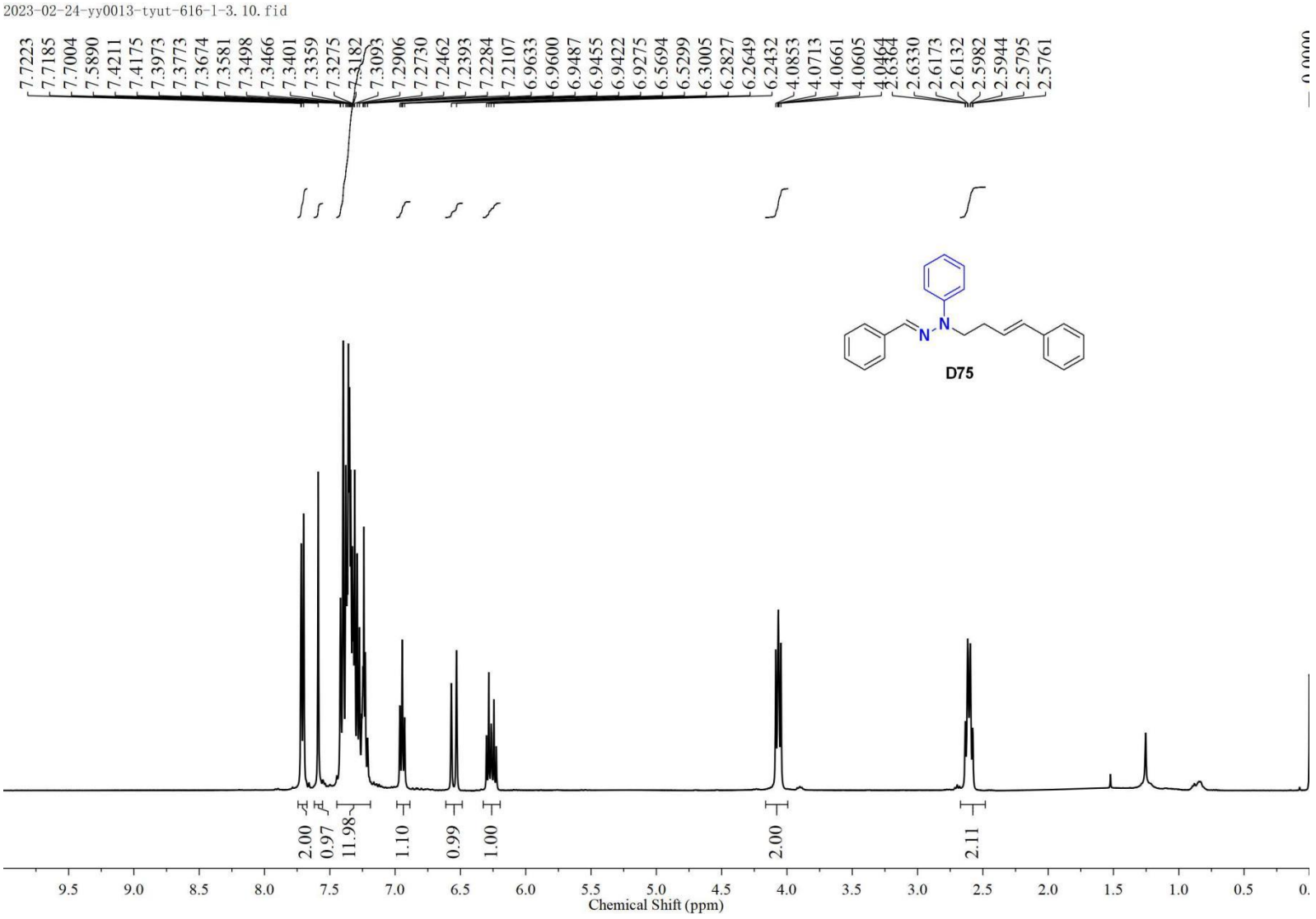
2023-01-10-yy0014-616-lq-1.10.fid

171.17
141.51
141.09
137.07
129.20
129.11
128.41
128.35
128.31
127.79
127.55
125.85
77.38
77.07
76.75
54.15
35.07
32.94
26.93



D74

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7.7004
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7.3581
7.3498
7.3466
7.3401
7.3359
7.3275
7.3182
7.3093
7.2906
7.2730
7.2462
7.2393
7.2284
7.2107
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6.9600
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6.9455
6.9422
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6.5694
6.5299
6.3005
6.2827
6.2649
6.2432
4.0853
4.0713
4.0661
4.0605
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4.0364
2.6330
2.6173
2.6132
2.5982
2.5944
2.5795
2.5761
D75
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0.97
11.98
1.10
0.99
1.00
2.00
2.11
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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4.0
3.5
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2.0
1.5
1.0
0.5
Chemical Shift (ppm)

2023-02-25 YY0007 616-LQQ-L-3-01.10.fid